UNITRODE

UC1855A/B
UC2855A/B
UC3855A/B

High Performance Power Factor Preregulator

FEATURES

- Controls Boost PWM to Near Unity Power Factor
- Fixed Frequency Average Current Mode Control Minimizes Line Current Distortion
- Built-in Active Snubber (ZVT) allows Operation to 500kHz, improved EMI and Efficiency
- Inductor Current Synthesizer allows Single Current Transformer Current Sense for Improved Efficiency and Noise Margin
- Accurate Analog Multiplier with Line Compensator allows for Universal Input Voltage Operation
- High Bandwidth (5MHz), Low Offset Current Amplifier
- Overvoltage and Overcurrent protection
- Two UVLO Threshold Options
- 150µA Startup Supply Current Typical
- Precision 1% 7.5V Reference

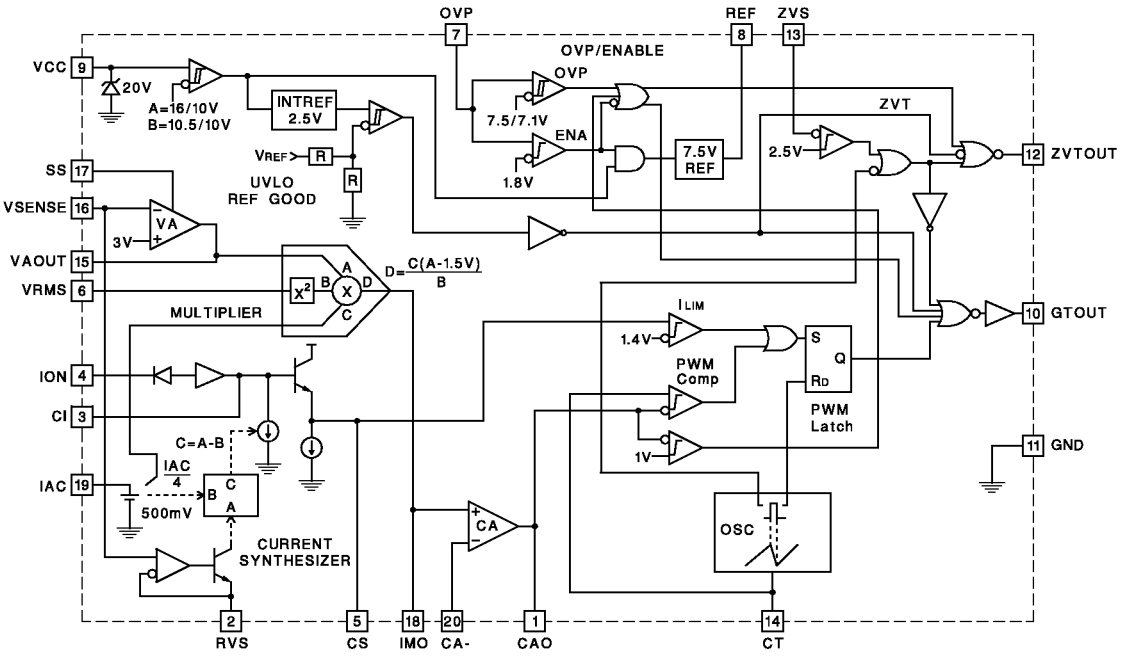
DESCRIPTION

The UC1855A/B provides all the control features necessary for high power, high frequency PFC boost converters. The average current mode control method allows for stable, low distortion AC line current programming without the need for slope compensation. In addition, the UC1855 utilizes an active snubbing or ZVT (Zero Voltage Transition technique) to dramatically reduce diode recovery and MOSFET turn-on losses, resulting in lower EMI emissions and higher efficiency. Boost converter switching frequencies up to 500kHz are now realizable, requiring only an additional small MOSFET, diode, and inductor to resonantly soft switch the boost diode and switch. Average current sensing can be employed using a simple resistive shunt or a current sense transformer. Using the current sense transformer method, the internal current synthesizer circuit buffers the inductor current during the switch on-time, and reconstructs the inductor current during the switch off-time. Improved signal to noise ratio and negligible current sensing losses make this an attractive solution for higher power applications.

The UC1855A/B also features a single quadrant multiplier, squarer, and divider circuit which provides the programming signal for the current loop. The internal multiplier current limit reduces output power during low line conditions. An overvoltage protection circuit disables both controller outputs in the event of a boost output OV condition.

Low startup supply current, UVLO with hysteresis, a 1% 7.5V reference, voltage amplifier with softstart, input supply voltage clamp, enable comparator, and overcurrent comparator complete the list of features. Available packages include: 20 pin N, DW, Q, J, and L.

BLOCK DIAGRAM



License Patent from Pioneer Magnetics. Pin numbers refer to DIL-20 J or N packages.

UDG-94001-2

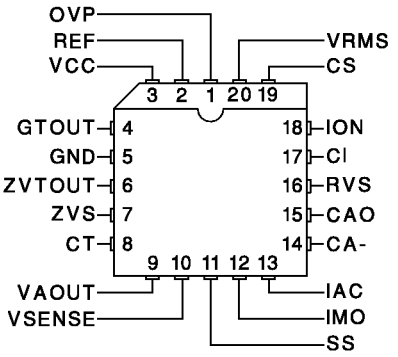
ABSOLUTE MAXIMUM RATINGS

Supply Voltage VCC . . . . . Internally Limited
VCC Supply Clamp Current 20mA
PFC Gate Driver Current (continuous) . . . . . ± 0.5A
PFC Gate Driver Current (peak) . . . . . ± 1.5A
ZVT Drive Current (continuous) . . . . . ± 0.25A
ZVT Drive Current (peak) . . . . . ± 0.75A
Input Current (IAC, RT, RVA) 5mA
Analog Inputs (except Peak Limit) . . . . . –0.3 to 10V
Peak Limit Input . . . . . –0.3 to 6.5V
Softstart Sinking Current 1.5mA
Storage Temperature . . . . . –65°C to +150°C
Junction Temperature . . . . . –55°C to +150°C
Lead Temperature (Soldering, 10 sec.) . . . . . +300°C

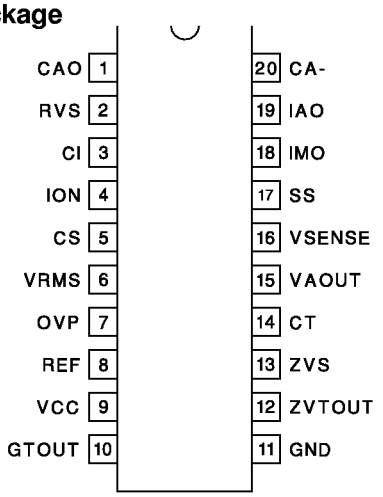
Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages. All voltages are referenced to GND.

CONNECTION DIAGRAMS

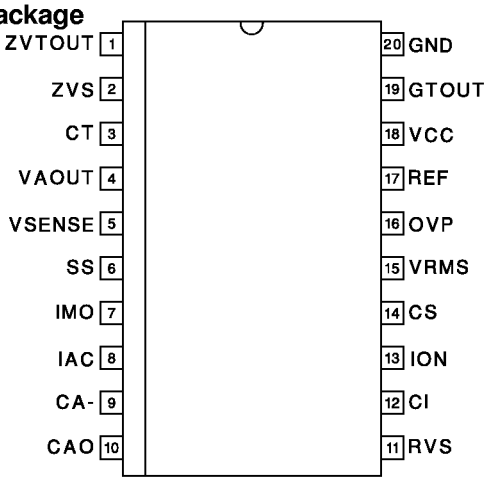
PLCC-20 & LCC-20 (Top View)
Q or L Package



DIL–20 (Top View)
J or N Package



SOIC-20 (Top View)
DW Package



ELECTRICAL CHARACTERISTICS: Unless otherwise specified: VCC = 18V, R_T = 15k, RVS = 23k, CT = 470pF, CI = 150pF, VRMS = 1.5V, IAC = 100µA, I_{SENSE} = 0V, CA_{OUT} = 4V, VAOUT= 3.5V, VSENSE = 3V. T_A = T_J. T_A = –55°C to 125°C (UC1855A/B), –40°C to 85°C (UC2855A/B), 0°C to 70°C (UC3855A/B).

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Overall					
Supply Current, OFF	CAO, VAOUT = 0V, VCC = UVLO –0.3V		150	500	µA
Supply Current, OPERATING			17	25	mA
VCC Turn-On Threshold	UC1855A		15.5	17.5	V
VCCTurn-Off Threshold	UC1855A,B	9	10		V
VCC Turn-On Threshold	UC1855B		10.5	10.8	V
VCC Clamp	I(VCC) = $I_{CC(on)}$ + 5mA	18	20	22	V
Voltage Amplifier					
Input Voltage		2.9		3.1	V
VSENSE Bias Current		–500	25	500	nA
Open Loop Gain	V_{OUT} = 2 to 5V	65	80		dB
V_{OUT} High	I_{LOAD} = –300µA	5.75	6	6.25	V
V_{OUT} Low	I_{LOAD} = 300µA		0.3	0.5	V
Output Short Circuit Current	V_{OUT} = 0V		0.6	3	mA

ELECTRICAL CHARACTERISTICS: Unless otherwise specified: VCC = 18V, R_T = 15k, RVS = 23k, CT = 470pF, CI = 150pF, VRMS = 1.5V, IAC = 100µA, I_{SENSE} = 0V, CA_{OUT} = 4V, VAOUT= 3.5V, VSENSE = 3V. T_A = T_J. T_A = –55°C to 125°C (UC1855A/B), –40°C to 85°C (UC2855A/B), 0°C to 70°C (UC3855A/B).

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Current Amplifier					
Input Offset Voltage	V_{CM} = – 2.5V	–4		4	mV
Input Bias Current (Sense)	V_{CM} = 2.5V	–500		500	nA
Open Loop Gain	V_{CM} = 2.5V, VOUT = 2 to 6V	80	110		dB
VOUT High	I_{LOAD} = –500µA		6		V
VOUT Low	I_{LOAD} = 500µA		0.3	0.5	V
Output Short Circuit Current	V_{OUT} = 0V		1	3	mA
Common Mode Range		–0.3		5	V
Gain Bandwidth Product	F_{IN} = 100kHz, 10mV, P–P, T_A = 25°C	2.5	5		MHz
Reference					
Output Voltage	I_{REF} = 0mA, T_A = 25°C	7.388	7.5	7.613	V
	I_{REF} = 0mA	7.313	7.5	7.688	V
Load Regulation	I_{REF} = 1 to 10 mA	–15		15	mV
Line Regulation	VCC = 15 to 35V	–10		10	mV
Short Circuit Current	REF = 0V	20	45	65	mA
Oscillator					
Initial Accuracy	T_A = 25°C	170	200	230	kHz
Voltage Stability	V_{CC} = 12 to 18V		1		%
Total Variation	Line, Temp.	160		240	kHz
Ramp Amplitude (P–P)		4.9		5.9	V
Ramp Valley Voltage		1.1		1.6	V
Enable/OVP/Current Limit					
Enable Threshold			1.8	2.2	V
OVP Threshold			7.5	7.66	V
OVP Hysteresis		200	400	600	mV
OVP Propagation Delay			200		ns
OVP Input Bias Current	V= 7.5V		1	10	µA
PKLIMIT Threshold		1.25	1.5	1.75	V
PKLIMIT Input Current	$V_{PKLIMIT}$ = 1.5V		100		µA
PKLIMIT Prop. Delay			100		ns
Multiplier					
Output Current - IAC Limited	IAC = 100µA, VRMS = 1V	–235	–205	–175	µA
Output Current - Zero	IAC = 0µA	–2	–0.2	2	µA
Output Current - Power Limited	VRMS = 1.5V, VAOUT = 5.5V	–250	–209	–160	µA
Output Current	VRMS = 1.5V, VAOUT = 2V		–26		µA
	VRMS = 1.5V VAOUT = 5V		–190		µA
	VRMS = 5V, VAOUT = 2V		–3		µA
	VRMS = 5V, VAOUT = 5V		–17		µA
Gain Constant	Refer to Note 1	–0.95	–0.85	–0.75	1/V
Gate Driver Output					
Output High Voltage	I_{OUT} = –200mA, VCC = 15V	12	12.8		V
Output Low Voltage	I_{OUT} = 200mA		1	2.2	V
Output Low Voltage	I_{OUT} = 10mA		300	500	mV
Output Low (UVLO)	I_{OUT} = 50mA, VCC = 0V		0.9	1.5	V
Output RISE/FALL Time	CLOAD = 1nF		35		ns
Output Peak Current	CLOAD = 10nF		1.5		A

ELECTRICAL CHARACTERISTICS: Unless otherwise specified: VCC = 18V, R_T = 15k, RVS = 23k, CT = 470pF, CI = 150pF, VRMS = 1.5V, IAC = 100µA, I_{SENSE} = 0V, CA_{OUT} = 4V, VAOUT= 3.5V, VSENSE = 3V. T_A = T_J. T_A = –55°C to 125°C (UC1855A/B), –40°C to 85°C (UC2855A/B), 0°C to 70°C (UC3855A/B).

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
ZVT					
Reset Threshold		2.3	2.6	2.9	V
Input Bias Current	V = 2.5V, V_{CT} = 0		6	20	µA
Propagation Delay	Measured at ZVTOUT		100		ns
Maximum Pulse Width			400		ns
Output High Voltage	I_{OUT} = –100mA, V_{CC} = 15V	12	12.8		V
Output Low Voltage	I_{OUT} = 100mA		1	2.2	V
	I_{OUT} = 10mA		300	900	mV
Output Low (UVLO)	I_{OUT} = 50mA, V_{CC} = 0V		0.9	1.5	V
Output RISE/FALL Time	C_{LOAD} = 1nF		35		ns
Output Peak Current	C_{LOAD} = 10nF		0.75		A
Current Synthesizer					
I_{ON} to CS Offset	VION = 0V		30	50	mV
CI Discharge Current	IAC = 50µA	105	118	140	µA
	IAC = 500µA		5		µA
IAC Offset Voltage		0.3	0.65	1.1	V
ION Buffer Slew Rate			10		V/µs
ION Input Bias Current	V_{ION} = 2V		2	15	µA
RVS Output Voltage	23k from RVS to GND	2.87	3	3.13	V

Note 1: Gain constant (K) $= \frac{IAC \bullet (VA_{OUT} - 1.5V)}{(V_{RMS}{}^2 \bullet IMO)}$ *at* V_{RMS} *= 1.5V,* VA_{OUT} *= 5.5V.*

PIN DESCRIPTIONS

CA–: This is the inverting input to the current amplifier. Connect the required compensation components between this pin and CAOUT. The common mode operating range for this input is between –0.3V and 5V.

CAO: This is the output of the wide bandwidth current amplifier and one of the inputs to the PWM duty cycle comparator. The output signal generated by this amplifier commands the PWM to force the correct input current. The output can swing from 0.1V to 7.5V.

CI: The level shifted current sense signal is impressed upon a capacitor connected between this pin and GND. The buffered current sense transformer signal charges the capacitor when the boost switch is on. When the switch is off, the current synthesizer discharges the capacitor at a rate proportional to the dI/dt of the boost inductor current. In this way, the discharge current is approximately equal to

$$\frac{3V}{RRVS} - \frac{IAC}{4}.$$

Discharging the CI capacitor in this fashion, a "reconstructed" version of the inductor current is generated using only one current sense transformer.

CS: The reconstructed inductor current waveform generated on the CI pin is level shifted down a diode drop to this pin. Connect the current amplifier input resistor between CS and the inverting input of the current amplifier. The waveform on this pin is compared to the multiplier output waveform through the average current sensing current amplifier. The input to the peak current limiting comparator is also connected to this pin. A voltage level greater than 1.5 volts on this pin will trip the comparator and disable the gate driver output.

CT: A capacitor from CT to GND sets the PWM oscillator frequency according to the following equation:

$$f \approx \frac{1}{11200 \bullet CT}.$$

Use a high quality ceramic capacitor with low ESL and ESR for best results. A minimum CT value of 200pF insures good accuracy and less susceptibility to circuit layout parasitics. The oscillator and PWM are designed to provide practical operation to 500kHz.

GND: All voltages are measured with respect to this pin. All bypass and timing capacitors connected to GND should have leads as short and direct as possible.

PIN DESCRIPTIONS (cont.)

GTOUT: The output of the PWM is a 1.5A peak totem pole MOSFET gate driver on GTOUT. A series resistor between GTOUT and the MOSFET gate of at least 10 ohms should be used to limit the overshoot on GTOUT. In addition, a low V_F Schottky diode should be connected between GTOUT and GND to limit undershoot and possible erratic operation.

IAC: This is a current input to the multiplier. The current into this pin should correspond to the instantaneous value of the rectified AC input line voltage. This is accomplished by connecting a resistor directly between IAC and the rectified input line voltage. The nominal 650mV level present on IAC negates the need for any additional compensating resistors to accommodate for the zero crossings of the line. A current equal to one fourth of the IAC current forms one of the inductor current synthesizer inputs.

IMO: This is the output of the multiplier, and the noninverting input of the current amplifier. Since this output is a current, connect a resistor between this pin and ground equal in value to the input resistor of the current amplifier. The common mode operating range for this pin is –0.3V to 5V.

ION: This pin is the current sensing input. It should be connected to the secondary side output of a current sensing transformer whose primary winding is in series with the boost switch. The resultant signal applied to this input is buffered and level shifted up a diode to the CI capacitor on the CI pin. The ION buffer has a source only output. Discharge of the CI cap is enabled through the current synthesizer circuitry. The current sense transformer termination resistor should be designed to obtain a 1V input signal amplitude at peak switch current.

OVP: This pin senses the boost output voltage through a voltage divider. The enable comparator input is TTL compatible and can be used as a remote shutdown port. A voltage level below 1.8V, disables V_{REF}, oscillator, and the PWM circuitry via the enable comparator. Between 1.8V and V_{REF} (7.5V) the UC1855 is enabled. Voltage levels above 7.5V will set the PWM latch via the hysteretic OVP comparator and disable both ZVTOUT and GTOUT until the OVP level has decayed by the nominal hysteresis of 400mV. If the voltage divider is designed to initiate an OVP fault at 5% of OV, the internal hysteresis enables normal operation again when the output voltage has reached its nominal regulation level. Both the OVP and enable comparators have direct logical connections to the PWM output and exhibit typical propagation delays of 200ns.

REF: REF is the output of the precision reference. The output is capable of supplying 25mA to peripheral circuitry and is internally short circuit current limited. REF is disabled and low whenever VCC is below the UVLO threshold, and when OVP is below 1.8V. A REF "GOOD" comparator senses REF and disables the stage until REF has attained approximately 90% of its nominal value. Bypass REF to GND with a 0.1µF or larger ceramic capacitor for best stability.

RVS: The nominal 3V signal present on the VSENSE pin is buffered and brought out to the RVS pin. A current proportional to the output voltage is generated by connecting a resistor between this pin and GND. This current forms the second input to the current synthesizer.

VAO: This is the output of the voltage amplifier. At a given input RMS voltage, the voltage on this pin will vary directly with the output load. The output swing is limited from approximately 100mV to 6V. Voltage levels below 1.5V on this pin will inhibit the multiplier output.

VCC: Positive supply rail for the IC. Bypass this pin to GND with a 1µF low ESL, ESR ceramic capacitor. This pin is internally clamped to 20V. Current into this clamp should be limited to less than 10mA. The UC1855A has a 15.5V (nominal) turn on threshold with 6 volts of hysteresis while the UC1855B turns on at 10.5V with 500mV of hysteresis.

VRMS: This pin is the feedforward line voltage compensation input to the multiplier. A voltage on VRMS proportional to the AC input RMS voltage commands the multiplier to alter the current command signal by $1/VRMS^2$ to maintain a constant power balance. The input to VRMS is generally derived from a two pole low pass filter/voltage divider connected to the rectified AC input voltage. This feature allows universal input supply voltage operation and faster response to input line fluctuations for the PFC boost preregulator. For most designs, a voltage level of 1.5V on this pin should correspond to low line, and 4.7V for high line. The input range for this pin extends from 0 to 5.5V.

VSENSE: This pin is the inverting input of the voltage amplifier and serves as the output voltage feedback point for the PFC boost converter. It senses the output voltage through a voltage divider which produces a nominal 3V. The voltage loop compensation is normally connected between this pin and VAO. The VSENSE pin must be above 1.5V at 25°C, (1.9V at –55°C) for the current synthesizer to work properly.

PIN DESCRIPTIONS (cont.)

ZVS: This pin senses when the drain voltage of the main MOSFET switch has reached approximately zero volts, and resets the ZVT latch via the ZVT comparator. A minimum and maximum ZVTOUT pulse width are programmable from this pin. To directly sense the ≈400V drain voltage of the main switch, a blocking diode is connected between ZVS and the high voltage drain. When the drain reaches 0V, the level on ZVS is ≈0.7V which is below the 2.6V ZVT comparator threshold. The maximum ZVTOUT pulse width is approximately equal to the oscillator blanking period time.

For more information see Unitrode Applications Note U-153.

ZVTOUT: The output of the ZVT block is a 750mA peak totem pole MOSFET gate driver on ZVTOUT. Since the ZVT MOSFET switch is typically 3X smaller than the main switch, less peak current is required from this output. Like GTOUT, a series gate resistor and Schottky diode to GND are recommended. This pin may also be used as a high current synchronization output driver.

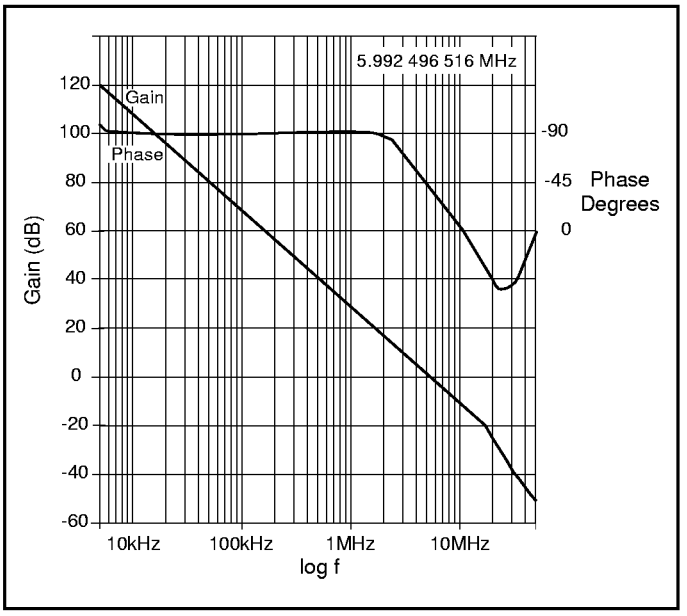


Figure 1. Current Amplifier Frequency Response

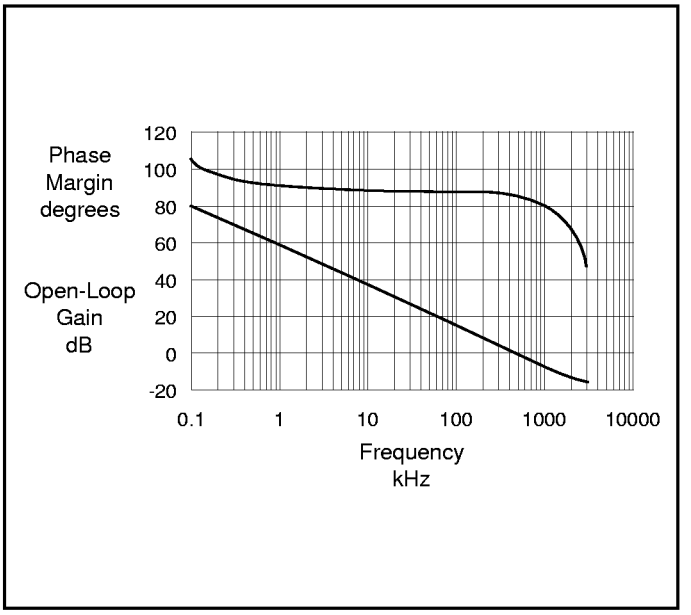


Figure 2. Voltage Amplifier Gain Phase vs Frequency

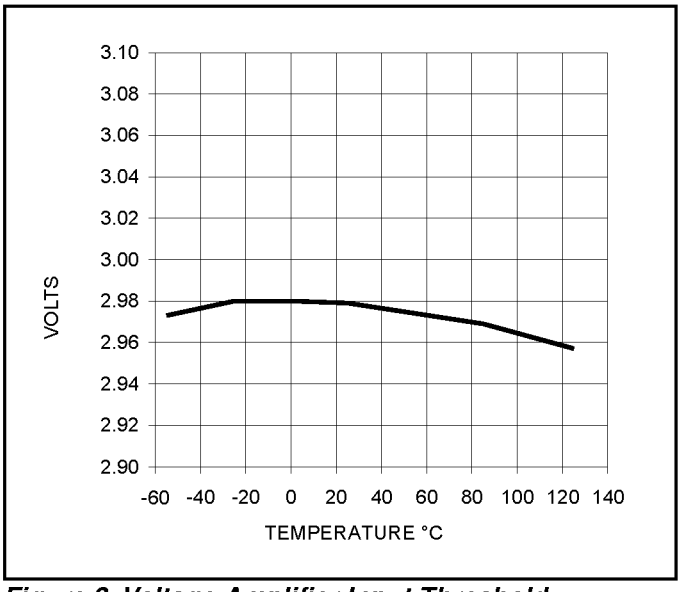


Figure 3. Voltage Amplifier Input Threshold

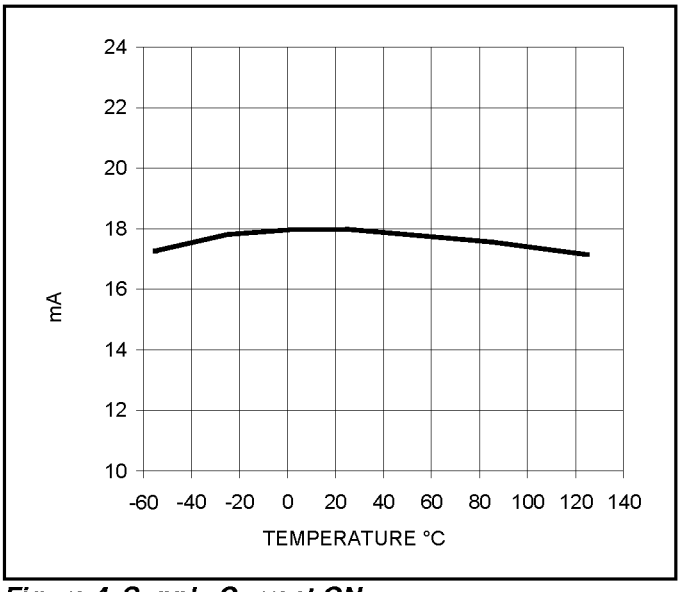


Figure 4. Supply Current ON

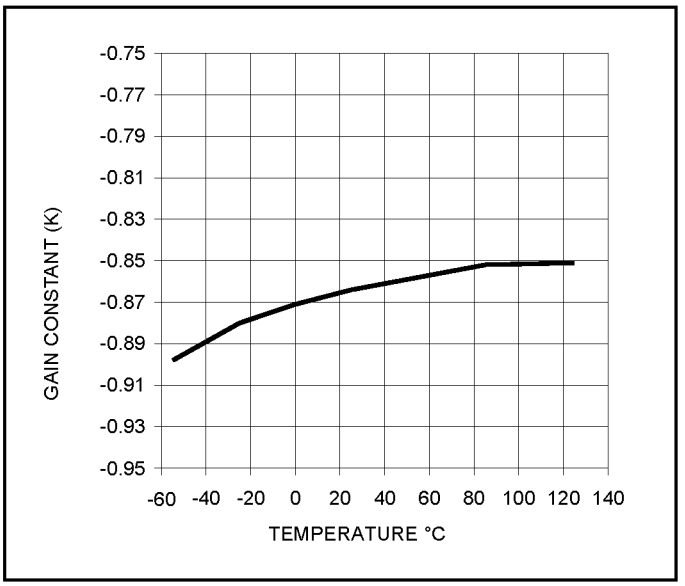


Figure 5. Multiplier Current Gain Constant

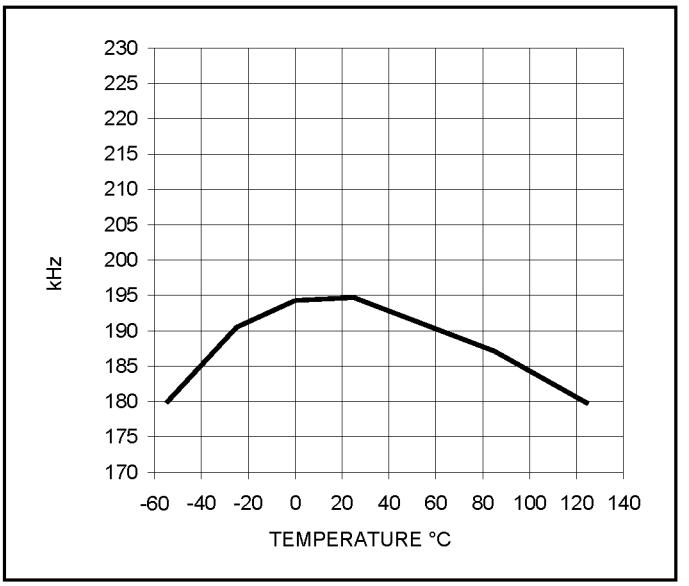


Figure 6. Oscillator Initial Accuracy

TYPICAL APPLICATION

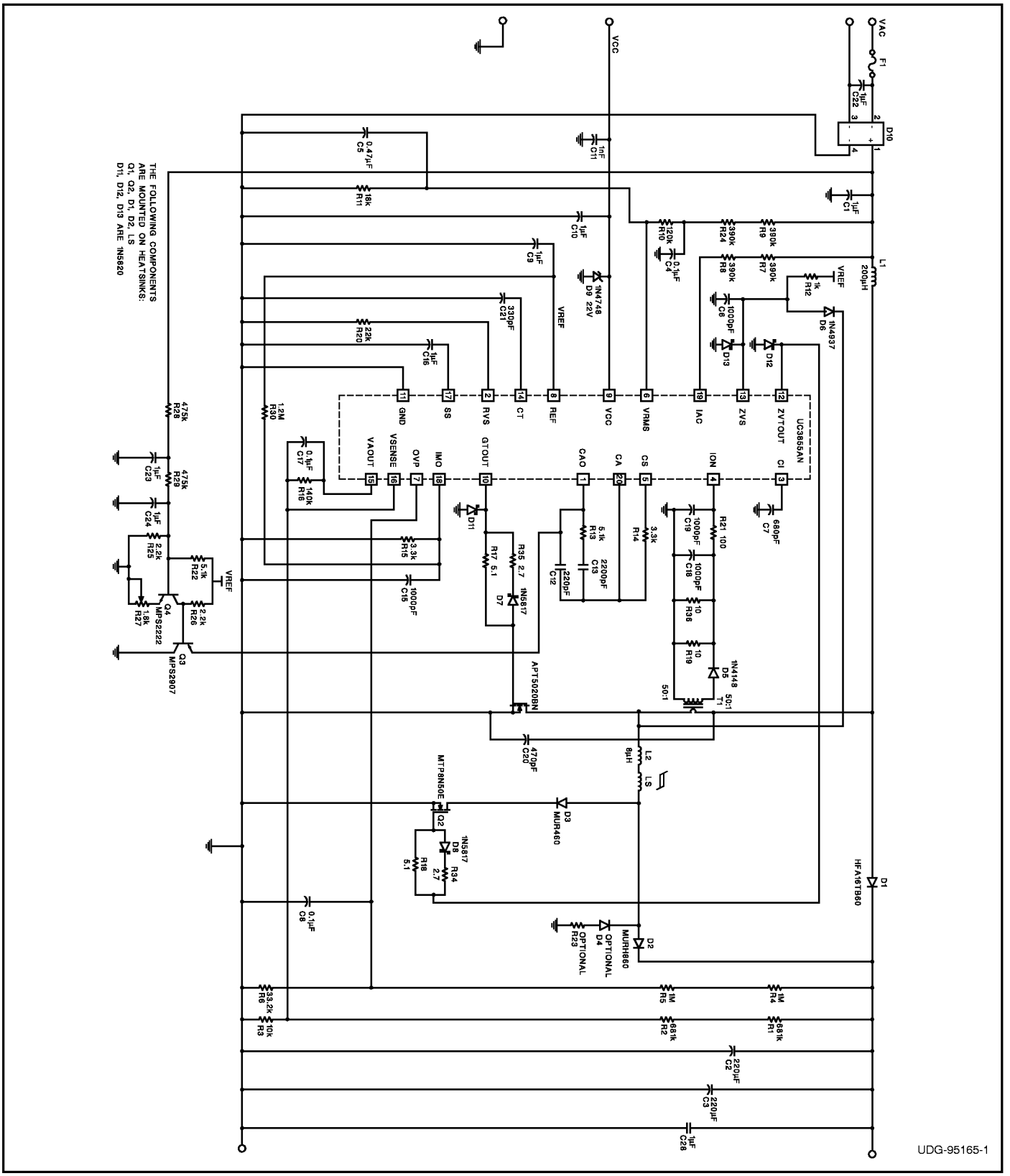


Figure 7. Typical Application

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Mechanical Drawings

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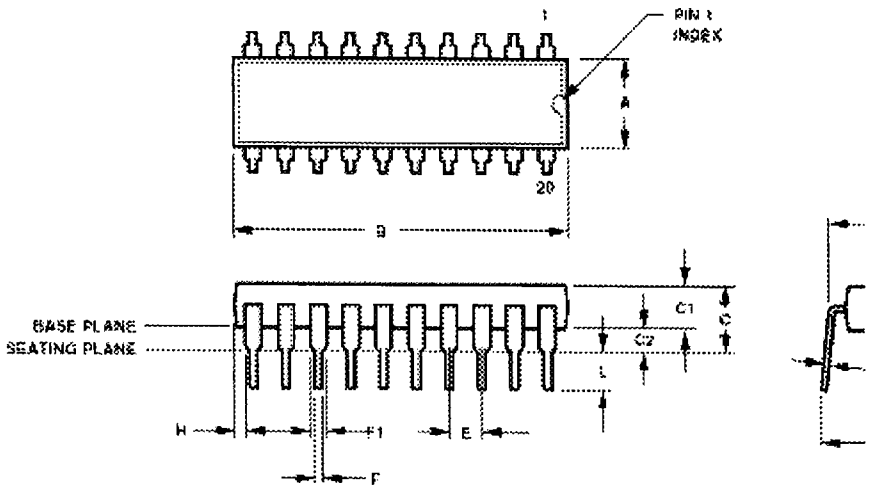
20-PIN PLASTIC DIP ~ N PACKAGE SUFFIX

DIMENSIONS					
	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	.245	.260	6.22	6.60	1
B	1.010	1.030	25.65	26.16	1
C	-	.210	-	5.33	
C1	.125	.150	3.18	3.81	
C2	.015	.055	0.38	1.40	2
D	.300	.325	7.62	8.26	3
E	.100 BSC		2.54 BSC		4
F	.014	.022	0.35	0.56	
F1	.045	.070	1.14	1.78	
F2	.008	.014	0.20	0.35	
G	.300	.400	7.62	10.16	5
H	.005	-	0.13	-	
L	.115	.160	2.92	4.06	



NOTES:

1. 'A' AND 'B' DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 IN. PER SIDE.
2. 'C2' SHALL BE MEASURED FROM THE SEATING PLANE TO THE BASE PLANE.
3. 'D' SHALL BE MEASURED WITH THE LEADS CONSTRAINED TO BE PERPENDICULAR TO THE BASE PLANE.
4. THE BASIC LEAD SPACING IS 0.100 IN. BETWEEN CENTERLINES. EACH LEAD CENTERLINE SHALL BE LOCATED WITHIN ±0.010 IN. OF ITS EXACT TRUE POSITION.
5. 'G' SHALL BE MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
6. CONTROLLING DIMENSION: INCHES. MILLIMETERS SHOWN FOR REFERENCE ONLY.

P-5

UNITRODE

Mechanical Drawings

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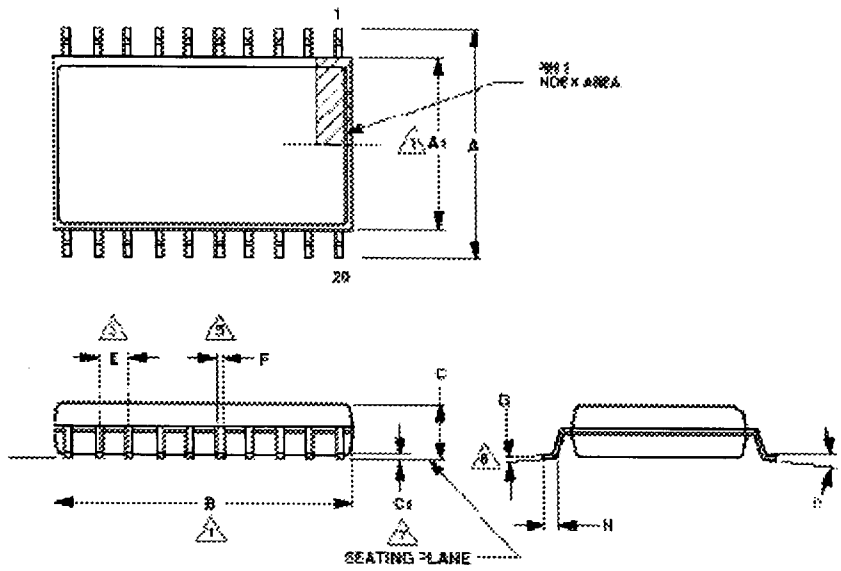
20-PIN SOIC SURFACE MOUNT~ DW PACKAGE SUFFIX

DIMENSIONS				
	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.394	.419	10.00	10.64
A1	.292	.299	7.42	7.59
B	.504	.511	12.80	12.98
C	.097	.104	2.46	2.64
C1	.004	.011	0.10	0.28
E	.050 BSC		1.27 BSC	
F	.014	.019	0.36	0.48
G	.009	.012	0.23	0.30
H	.018	.035	0.46	0.89
θ	0°	8°	0°	8°



NOTES:

1. 'A1' AND 'B' DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 IN. PER SIDE.
2. LEADS SHALL BE COPLANAR WITHIN 0.004 IN. AT THE SEATING PLANE.
3. THE BASIC LEAD SPACING IS 0.050 IN. BETWEEN CENTERLINES. EACH LEAD CENTERLINE SHALL BE LOCATED WITHIN ±0.004 IN. OF ITS EXACT TRUE POSITION.
4. CONTROLLING DIMENSION: INCHES. MILLIMETERS SHOWN FOR REFERENCE ONLY.
5. DIMENSION 'F' DOES NOT INCLUDE DAMBAR PROTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED 'F' MAXIMUM BY MORE THAN 0.003 IN. DAMBAR CAN NOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
6. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.004 IN. AND 0.010 IN. FROM THE LEAD TIP.
7. 'C1' IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY (BASE PLANE).

UNITRODE

Mechanical Drawings

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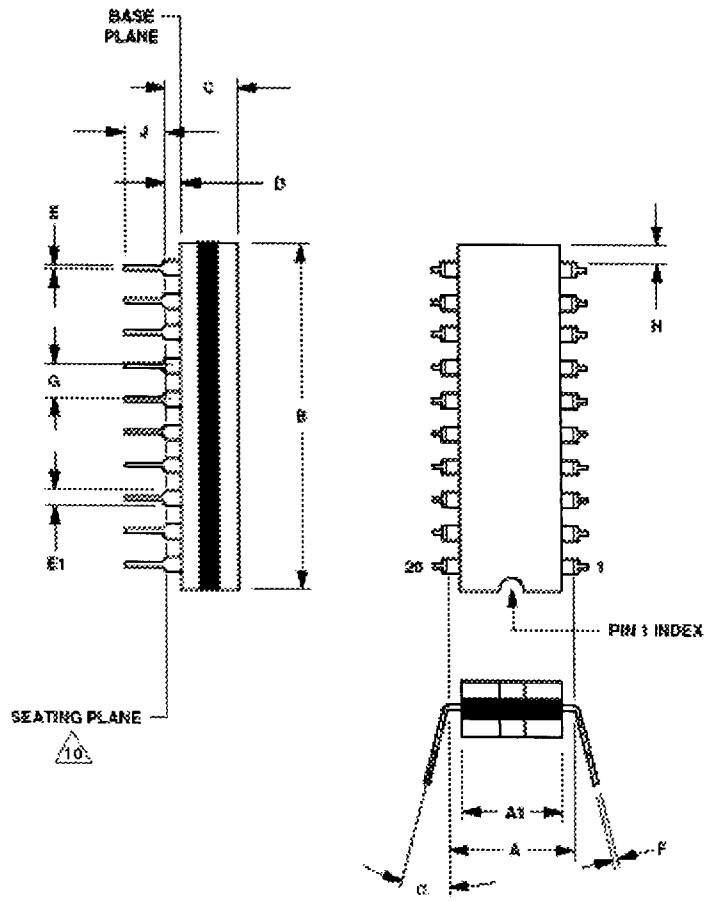
20-PIN CERAMIC DIP ~ J PACKAGE SUFFIX

DIMENSIONS					
	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.290	0.320	7.37	8.13	7
A1	0.220	0.310	5.59	7.87	4
B	-	0.840	-	21.34	4
C	-	0.200	-	5.08	
D	0.015	0.060	0.38	1.52	3
E	0.014	0.026	0.36	0.66	8
E1	0.045	0.065	1.14	1.65	2
F	0.008	0.018	0.20	0.46	8
G	0.100 BSC		2.54 BSC		5
H	0.005	-	0.13	-	6
J	0.125	0.200	3.18	5.08	
α	0°	15°	0°	15°	



NOTES:

1. INDEX AREA: A NOTCH OR A PIN ONE IDENTIFICATION MARK SHALL BE LOCATED ADJACENT TO PIN ONE. THE MANUFACTURER'S IDENTIFICATION SHALL NOT BE USED AS A PIN ONE IDENTIFICATION MARK.
2. THE MINIMUM LIMIT FOR DIMENSION 'E1' MAY BE 0.023 (0.58mm) FOR LEADS NUMBER 1, 10, 11 AND 20 ONLY.
3. DIMENSION 'D' SHALL BE MEASURED FROM THE SEATING PLANE TO THE BASE PLANE.
4. THIS DIMENSION ALLOWS FOR OFF-CENTER LID, MENISCUS AND GLASS OVERRUN.
5. THE BASIC PIN SPACING IS 0.100 (2.54mm) BETWEEN CENTERLINES. EACH PIN CENTERLINE SHALL BE LOCATED WITHIN ±0.010 (0.25mm) OF ITS EXACT TRUE POSITION.
6. APPLIES TO ALL FOUR CORNERS (LEADS NUMBER 1, 10, 11 AND 20).
7. DIMENSION 'A' SHALL BE MEASURED AT THE CENTERLINE OF THE LEADS WHEN α= 0°.
8. THE MAXIMUM LIMITS OF DIMENSIONS 'E' AND 'F' SHALL BE MEASURED AT THE CENTER OF THE FLAT WHEN SOLDER DIP IS APPLIED.

UNITRODE

Mechanical Drawings

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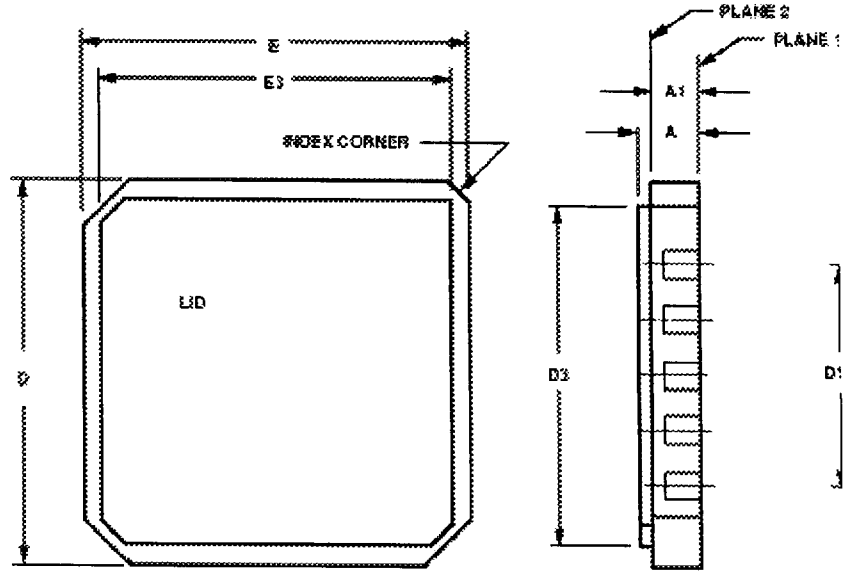
20-PIN CERAMIC LEADLESS SURFACE MOUNT ~ L PACKAGE SUFFIX

DIMENSIONS					
	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	.060	.100	1.52	2.54	6
A1	.050	.088	1.27	2.24	
B1	.022	.028	0.56	0.71	1,3
B2	.072 REF.		1.83 REF.		
B3	.006	.022	0.15	0.56	8
D/E	.342	.358	8.69	9.09	
D1/E1	.200 BSC		5.08 BSC		
D2/E2	.100 BSC		2.54 BSC		
D3/E3	-	.358	-	9.09	4
L	.045	.055	1.14	1.40	
L1	.045	.055	1.14	1.40	
L2	.075	.095	1.90	2.41	5
L3	.003	.015	0.08	0.38	
N	20		20		2
ND/NE	5		5		2
e	.050 BSC		1.27 BSC		10



NOTES:

1. A MINIMUM CLEARANCE OF 0.015 IN. (0.38mm) SHALL BE MAINTAINED BETWEEN ADJACENT TE
2. 'N' IS THE MAXIMUM QUANTITY OF TERMINAL POSITIONS. 'ND' AND 'NE' ARE THE NUMBERS OF AND 'E' RESPECTIVELY.
3. ELECTRICAL CONNECTION TERMINALS ARE REQUIRED ON PLANE 1 AND OPTIONAL ON PLANE THEY SHALL BE ELECTRICALLY CONNECTED TO OPPOSING TERMINALS ON PLANE 1.
4. A MINIMUM CLEARANCE OR 0.015 IN. (0.38mm) SHALL BE MAINTAINED BETWEEN A METAL LID TERMINALS, METALLIZED CASTELLATIONS, ETC.) THE LID SHALL NOT EXTEND BEYOND THE E
5. THE INDEX FEATURE FOR NUMBER 1 TERMINAL IDENTIFICATION, OPTIONAL ORIENTATION OR AREA DEFINED BY DIMENSIONS 'B2' AND 'L2' ON PLANE 1.
6. DIMENSION 'A' CONTROLS THE OVERALL PACKAGE THICKNESS.
7. CONTROLLING DIMENSION: INCHES. MILLIMETERS SHOWN FOR REFERENCE ONLY.
8. CASTELLATIONS ARE REQUIRED ON BOTTOM TWO LAYERS. CASTELLATIONS IN THE TOP LAYE
9. WHEN SOLDER DIP LEAD FINISH APPLIES, SOLDER BUMP HEIGHT SHALL NOT EXCEED 0.007 INC NOT EXCEED 0.006 INCHES.
10. THE BASIC TERMINAL SPACING IS 0.050 INCHES BETWEEN CENTERLINES. EACH TERMINAL CEN INCHES OF ITS EXACT TRUE POSITION.

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UNITRODE

Mechanical Drawings

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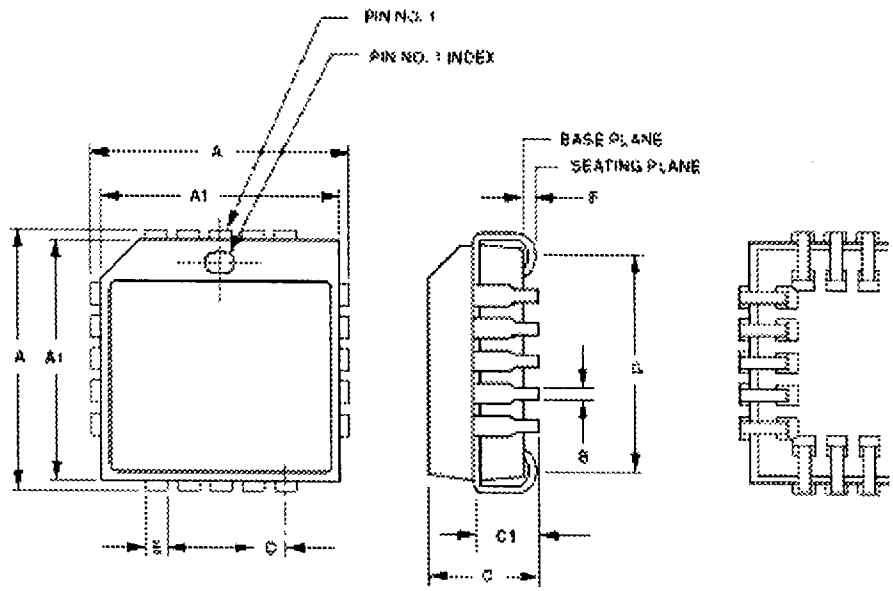
20-PIN PLASTIC PLCC SURFACE MOUNT~ Q PACKAGE SUFFIX

DIMENSIONS					
	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	.385	.395	9.78	10.03	
A1	.350	.356	8.89	9.04	1
B	.013	.021	0.33	0.53	
C	.170	.180	4.32	4.57	
C1	.100	.110	2.54	2.79	
D	.050 BSC		1.27 BSC		2
E	.026	.032	0.66	0.81	
F	.020	-	0.51	-	3, 4
G	.290	.330	7.37	8.38	



NOTES:

1. 'A1' DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 IN. PER SIDE.
2. THE BASIC LEAD SPACING IS 0.050 IN. BETWEEN CENTERLINES. EACH LEAD CENTERLINE SHALL LOCATED WITHIN ±0.004 IN. OF ITS EXACT TRUE POSITION.
3. 'F' IS MEASURED FROM THE SEATING PLANE TO THE BASE PLANE.
4. LEADS SHALL BE COPLANAR WITHIN 0.004 IN. AT THE SEATING PLANE.
5. CONTROLLING DIMENSION: INCHES. MILLIMETERS SHOWN FOR REFERENCE ONLY.