Regulatating Pulse Width Modulator

Description

The SG1524B is a pulse width modulator for switching power supplies that features improved performance over industry standards like the SG1524. A direct pin-for-pin replacement for the earlier device, it combines advanced processing techniques and circuit design to provide improved reference accuracy, and extended common mode range at the error amplifier and current limit inputs. A DC-coupled flip-flop eliminates triggering and glitch problems, and a PWM data latch prevents edge oscillations.

The circuit incorporates true digital shutdown for high speed response, while an undervoltage lockout circuit prevents spurious outputs when the supply voltage is too low for stable operation. Full double-pulse suppression logic insures alternating output pulses when the Shutdown pin is used for pulse-by-pulse current limiting.

The SG1524B is specified for operation over the full military ambient temperature range of -55°C to 125°C. The SG2524B is characterized for the industrial range of -25°C to 85°C, and the SG3524B is designed for the commercial range of 0°C to 70°C.

Features

- 7V to 40V Operation
- 5V Reference Trimmed to ±1%
- 100Hz to 400kHz Oscillator Range
- Excellent External Sync Capability
- Dual 100 mA Output Transistors
- Wide Current Limit Common Mode Range
- DC-Coupled Toggle Flip-flop
- PWM Data Latch
- Undervoltage Lockout
- Full Double-pulse Suppression Logic
- 60V Output Collectors

High Reliability Features - SG1524B

- Available to MIL-STD-883, ¶1.2.1
- MSC-AMS level "S" Processing Available
- Available to DSCC
  - Standard Microcircuit Drawing (SMD)

Block Diagram

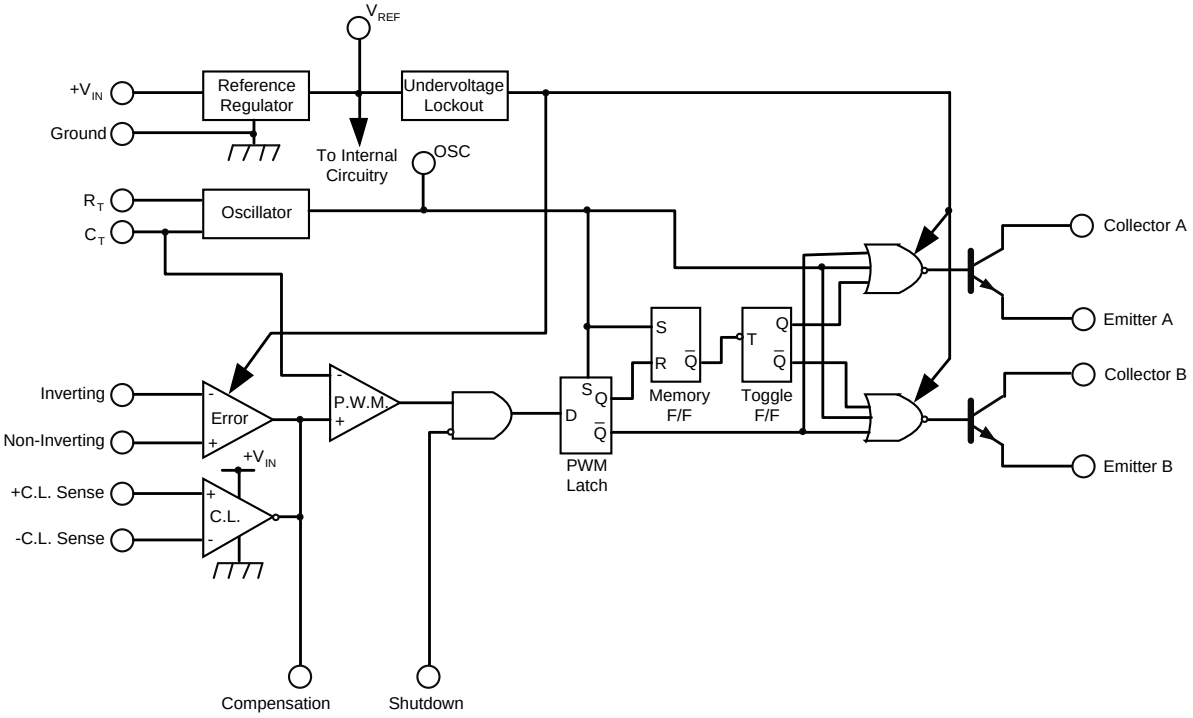
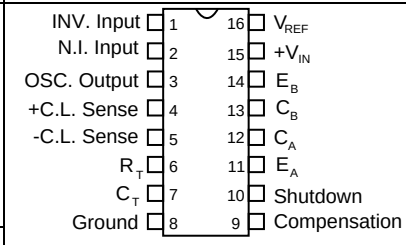
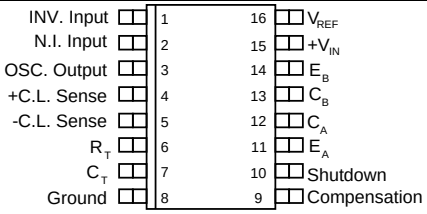
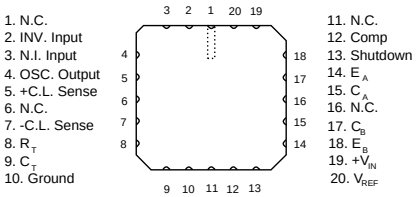


Figure 5 · Block Diagram

Connection Diagrams and Ordering Information

Ambient Temperature	Type	Package	Part Number	Packaging Type	Connection Diagram
55°C to 125°C	J	16-PIN Ceramic Dual Inline Package	SG1524BJ SG1524BJ-883B SG1524BJ-DESC	CERDIP	
-25°C to 85°C	N	16-PIN Dual Inline Plastic Package	SG2524BN	PDIP	N Package: RoHS Compliant / Pb-free Transition DC: 0503 N Package: RoHS / Pb-free 100% Matte Tin Lead Finish
0°C to 70°C			SG3524BN		
-25°C to 85°C	DW	16-PIN Small Outline Wide Body Package	SG2524BDW	SOWB	
0°C to 70°C			SG3524BDW		DW Package: RoHS Compliant / Pb-free Transition DC: 0516 DW Package: RoHS / Pb-free 100% Matte Tin Lead Finish
-55°C to 125°C	L	20-Pin Ceramic Leadless Chip Carrier	SG1524BL-883B SG1524BL	CLCC	

Note:

1. *Contact factory for DESC product availability.*
2. *All packages are viewed from the top.*
3. *Hermetic Packages J, & L use Sn63/ Pb37 hot solder lead finish, contact factory for availability of RoHS versions*
4. *Available in Tape & Reel. Append the letters "TR" to the part number. (i.e. SG3524BDW-TR)*

Absolute Maximum Ratings

Parameter	Value	Units
Input Voltage, ($+V_{IN}$)	42	V
Collector Voltage	60	V
Logic Inputs	-0.3 to 5.5	V
Current Limit Sense Inputs	-0.3 to V_{IN}	V
Output Current (Each transistor)	200	mA
Reference Load Current	50	mA
Oscillator Charging Current	5	mA
Operating Junction Temperature		
Hermetic (J, L Packages)	150	°C
Plastic (N, DW Packages)	150	°C
Storage Temperature Range	-65 to 150	°C
Lead Temperature (Soldering, 10 seconds)	300	°C
RoHS Peak Package Solder Reflow Temp. (40 sec. max. exp.)	260 (+0, -5)	°C
Note: *1. Values beyond which damage may occur*		

Thermal Data

Parameter	Value	Units
J Package		
Thermal Resistance-Junction to Case, θ_{JC}	30	°C/W
Thermal Resistance-Junction to Ambient, θ_{JA}	80	°C/W
N Package		
Thermal Resistance-Junction to Case, θ_{JC}	40	°C/W
Thermal Resistance-Junction to Ambient, θ_{JA}	65	°C/W
DW Package		
Thermal Resistance-Junction to Case, θ_{JC}	40	°C/W
Thermal Resistance-Junction to Ambient, θ_{JA}	95	°C/W
L Package		
Thermal Resistance-Junction to Case, θ_{JC}	35	°C/W
Thermal Resistance-Junction to Ambient, θ_{JA}	120	°C/W

Note:

1. *Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.*
2. *The above numbers for θ_{JC} are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The θ_{JA} numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.*

Recommended Operating Conditions[1]

Parameter	Value	Units
Input Voltage (+V_{IN})	7 to 40	V
Collector Voltage	0 to 60	V
Error Amp Common Mode Range	2.3 to V_{REF}	V
Current Limit Sense Common Mode Range	0 to V_{IN} - 2.5V	V
Output Current (Each transistor)	0 to 100	mA
Reference Load Current	0 to 20	mA
Oscillator Charging Current	25 to 1.8	µA / mA
Oscillator Frequency Range	100 to 400	Hz / kHz
Oscillator Timing Resistor (R_T)	2 to 150	kΩ
Oscillator Timing Capacitor (C_T)	1 to 0.1	nF / µF
Operating Ambient Temperature Range		
SG1524B	-55 to 125	°C
SG2524B	-25 to 85	°C
SG3524B	0 to 70	°C

Note: *1. Range over which the device is functional.*

Electrical Characteristics

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1524B with -55°C ≤ T_A ≤ 125°C, SG2524B with -25°C ≤ T_A ≤ 85°C, SG3524B with 0°C ≤ T_A ≤ 70°C, and +V_{IN} = 20V. Low duty cycle pulse testing techniques are used that maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Test Conditions	SG1524B/2524B			SG3524B			Units
		Min.	Typ.	Max	Min.	Typ.	Max	
Reference Section[1]								
Output Voltage	T_J = 25°C	4.95	5.00	5.05	4.90	5.00	5.10	V
Line Regulation	V_{IN} = 7V to 40V		3	20		3	30	mV
Load Regulation	I_L = 0 to 20mA		5	30		5	50	mV
Temperature Stability[5]	Over Operating Temperature Range		15	50		15	50	mV
Total Output Voltage Range	Over Line, Load and Temperature	4.90		5.10	4.80		5.20	V
Short Circuit Current	V_{REF} = 0V	25	50	120	25	50	120	mA
Undervoltage Lockout Section								
Threshold Voltage		4.3	4.5	4.7	4.2	4.5	4.9	V

Notes:
1. *I_L = 0mA*
2. *F_{OSC} = 45 kHz (R_T = 2700 Ω, C_T = .01µF)*
3. *V_{CM} = 2.3V to V_{REF}*
4. *V_{CM} = 0V to 17.5V*
5. *These parameters, although guaranteed over the recommended operating conditions, are not tested in production.*

Electrical Characteristics (continued)

Parameter	Test Conditions	SG1524B/2524B			SG3524B			Units
		Min.	Typ.	Max	Min.	Typ.	Max	
Oscillator Section[2]								
Initial Accuracy	T_J = 25°C	42	45	48	40	45	50	kHz
Voltage Stability	V_{IN} = 7V to 40V		0.1	1		0.1	1	%
Temperature Stability[5]	Over Operating Range		1	2		1	2	%
Minimum Frequency[5]	R_T = 150kΩ, C_T = 0.1µF		50	140		50	120	Hz
Maximum Frequency	R_T = 2 kΩ, C_T = 470pF	400	600		400	600		kHz
Sawtooth Peak Voltage	V_{IN} = 40V		3.5	3.9		3.5	3.9	V
Sawtooth Valley Voltage	V_{IN} = 7V	0.6	1		0.6	1		V
Clock Amplitude		3.0	4.0		3.0	4.0		V
Clock Pulse Width		0.2	0.5	1.2	0.2	0.5	1.2	µs
Error Amplifier Section[3]								
Input Offset Voltage	R_S ≤ 2kΩ		0.5	5		2	10	mV
Input Bias Current			1	5		1	10	µA
Input Offset Current				1			1	µA
DC Open Loop Gain	R_L ≥ 10MΩ	60	78		60	78		dB
Output Low Level	I_{SINK} = 100µA; $V_{PIN\ 1}$ - $V_{PIN\ 2}$ ≥ 150mV		0.2	0.5		0.2	0.5	V
Output High Level	I_{SOURCE} = 100µA; $V_{PIN\ 2}$ - $V_{PIN\ 1}$ ≥ 150mV	3.8	4.2		3.8	4.2		V
Common Mode Rejection	V_{CM} = 2.3V to V_{REF}	70	90		70	90		dB
Supply Voltage Rejection	V_{IN} = 7V to 40V	76	100		76	100		dB
Gain-Bandwidth Product[5]	T_J = 25°C	1	2		1	2		MHz
P.W.M. Comparator[2]								
Minimum Duty Cycle	V_{COMP} = 0.5V			0			0	%
Maximum Duty Cycle	V_{COMP} = 3.9V	45	49		45	49		%
Current Limit Amplifier Section[4]								
Sense Voltage		180	200	220	170	200	230	mV
Input Bias Current			-3	-10		-3	-10	µA

Notes:
1. *I_L = 0mA*
2. *F_{OSC} = 45kHz (R_T = 2700 Ω, C_T = .01µF)*
3. *V_{CM} = 2.3V to V_{REF}*
4. *V_{CM} = 0V to 17.5V*
5. *These parameters, although guaranteed over the recommended operating conditions, are not tested in production.*

Parameter	Test Conditions	SG1524B/2524B			SG3524B			Units
		Min.	Typ.	Max	Min.	Typ.	Max	
Shutdown Input Section								
HIGH Input Voltage		2.0			2.0			V
HIGH Input Current	$V_{SHUTDOWN}$ = 5V		0.1	1		0.1	1	mA
LOW Input Voltage				0.6			0.6	V
Output Section (Each transistor)								
Collector Leakage Current	V_{CE} = 60V			50			50	µA
Collector Saturation Voltage	I_C = 10mA I_C = 100mA		0.2 1.0	0.4 2.0		0.2 1.0	0.4 2.0	V V
Emitter Output Voltage	I_E = 10mA I_E = 100mA	17.5 17	19 18		17.5 17	19 18		V V
Emitter Voltage Rise Time[5]	R_E = 2kΩ, T_A = 25°C		0.2	0.5		0.2	0.5	µs
Collector Voltage Fall Time	R_C = 2kΩ, T_A = 25°C		0.1	0.2		0.1	0.2	µs
Power Consumption								
Standby Current	V_{IN} = 40V, $V_{SHUTDOWN}$ = 2.0 V		5	12		5	12	mA

Notes:

1. *I_L = 0mA*
2. *F_{OSC} = 45kHz (R_T = 2700Ω, C_T = .01µF)*
3. *V_{CM} = 2.3V to V_{REF}*
4. *V_{CM} = 0V to 17.5V*
5. *These parameters, although guaranteed over the recommended operating conditions, are not tested in production.*

Characteristic Curves

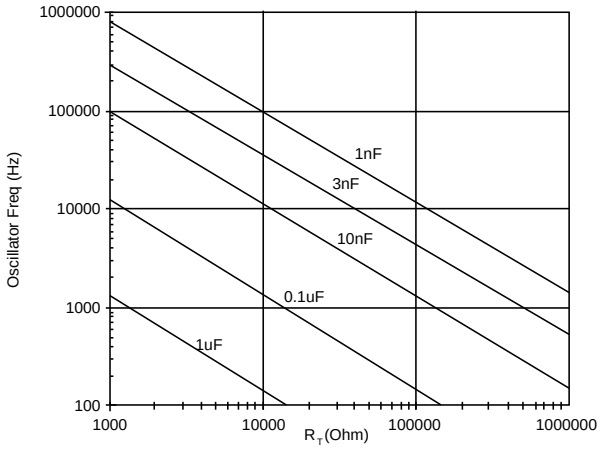


Figure 2 · Oscillator Frequency vs. Timing Resistor and Capacitor V_{IN} = 20V, T_A = 25°C

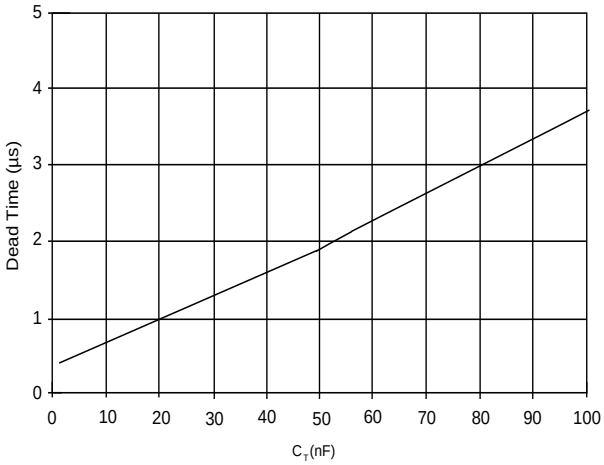


Figure 3 · SG1524B Dead Times vs. Timing Capacitance (R_T = 2.7kΩ) V_{IN} = 20V, T_A = 25°C

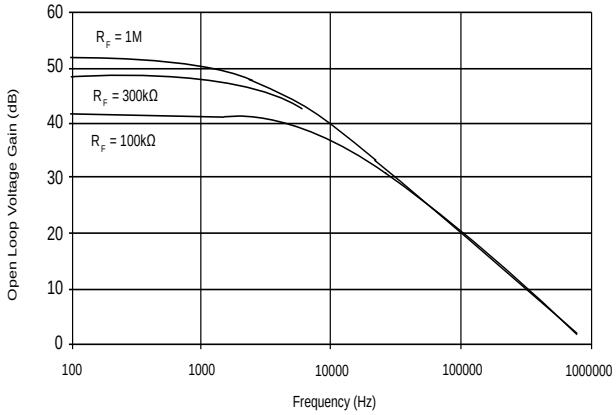
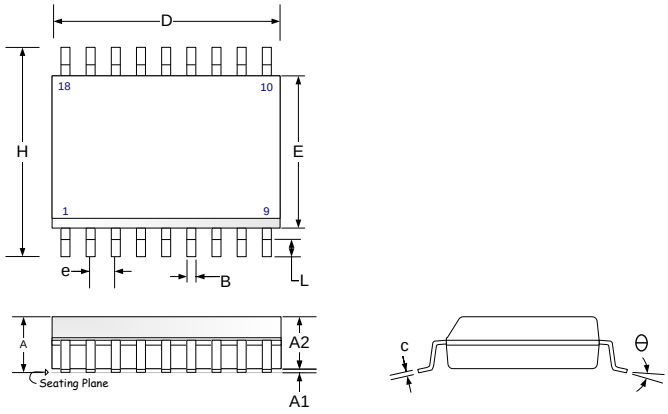


Figure 4 · SG1524B Error Amp Voltage Gain vs. Freq Over R_F ; V_{IN} = 20V, T_A = 25°C

Package Outline Dimensions

Controlling dimensions are in inches, metric equivalents are shown for general information.



Dim	MILLIMETERS		INCHES	
	MIN	**MAX**	**MIN**	**MAX**
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.52	0.049	0.060
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.007	0.010
D	9.78	10.01	0.385	0.394
E	5.79	6.20	0.228	0.244
e	1.27 BSC		0.050 BSC	
H	3.81	4.01	0.150	0.158
L	0.40	1.27	0.016	0.050
Θ	0	8	0	8
*LC		0.10		0.004

*Lead coplanarity

Note:

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006”) on any side. Lead dimension shall not include solder coverage.

Figure 5 · DW 16-Pin SOWB Package Dimensions

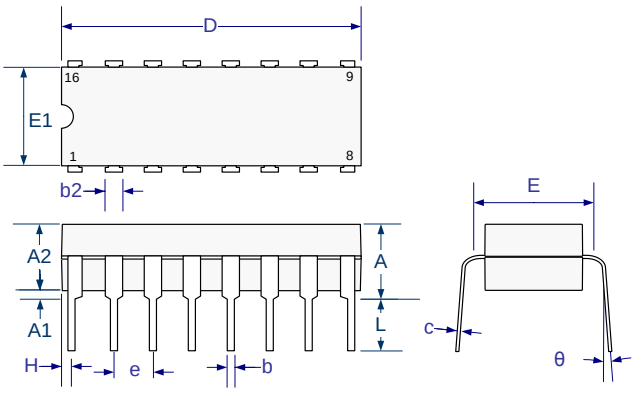


Figure 6 ·

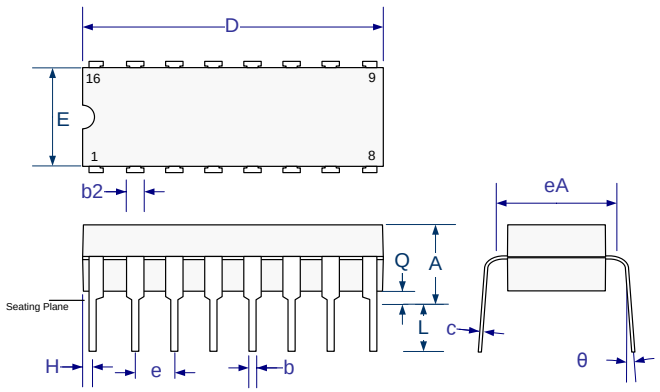
Dim	MILLIMETERS		INCHES	
	MIN	**MAX**	**MIN**	**MAX**
A	-	5.08	-	0.200
A1	0.38	0.51	0.015	0.040
A2	3.30 Typ.		0.130 Typ.	
b	0.38	0.51	0.015	0.020
b2	0.76	1.52	0.030	0.060
c	0.20	0.38	0.008	0.015
D	18.54	20.57	0.730	0.810
~~e~~	2.54 BSC		0.100 BSC	
E1	6.10	6.60	0.240	0.260
E	7.62 BSC		0.300 BSC	
L	3.05		0.120	
θ	-	15°	-	15°

Note:

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006”) on any side. Lead dimension shall not include solder coverage.

Figure 6 · N 16-Pin Plastic Dual Inline Package Dimensions

Package Outline Dimensions

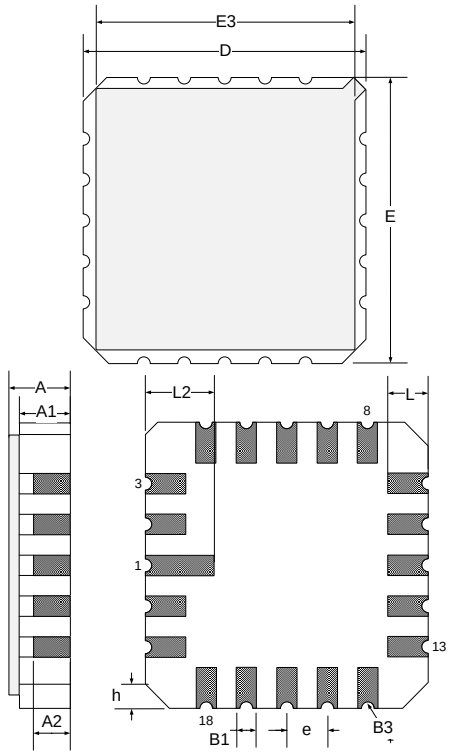


Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A		5.08		0.200
b	0.38	0.51	0.015	0.020
b2	1.04	1.65	0.045	0.065
c	0.20	0.38	0.008	0.015
D	19.30	19.94	0.760	0.785
E	5.59	7.11	0.220	0.280
e	2.54 BSC		0.100 BSC	
eA	7.37	7.87	0.290	0.310
H	0.63	1.78	0.025	0.070
L	3.18	5.08	0.125	0.200
α	-	15°	-	15°
Q	0.51	1.02	0.020	0.040

Note:

Dimensions do not include protrusions; these shall not exceed 0.155mm (.006") on any side. Lead dimension shall not include solder coverage.

Figure 7 · J 16-Pin Ceramic Dual Inline Package Dimensions



Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
D/E	8.64	9.14	0.340	0.360
E3	-	8.128	-	0.320
e	1.270 BSC		0.050 BSC	
B1	0.635 TYP		0.025 TYP	
L	1.02	1.52	0.040	0.060
A	1.626	2.286	0.064	0.090
h	1.016 TYP		0.040 TYP	
A1	1.372	1.68	0.054	0.066
A2	-	1.168	-	0.046
L2	1.91	2.41	0.075	0.95
B3	0.203R		0.008R	

Note:

All exposed metalized area shall be gold plated 60 micro-inch minimum thickness over nickel plated unless otherwise specified in purchase order.

Figure 8 · L 20-Pin Ceramic Leadless Chip Carrier (LCC) Package Outline Dimensions

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