

RM3182A

ARINC 429 Differential Line Driver

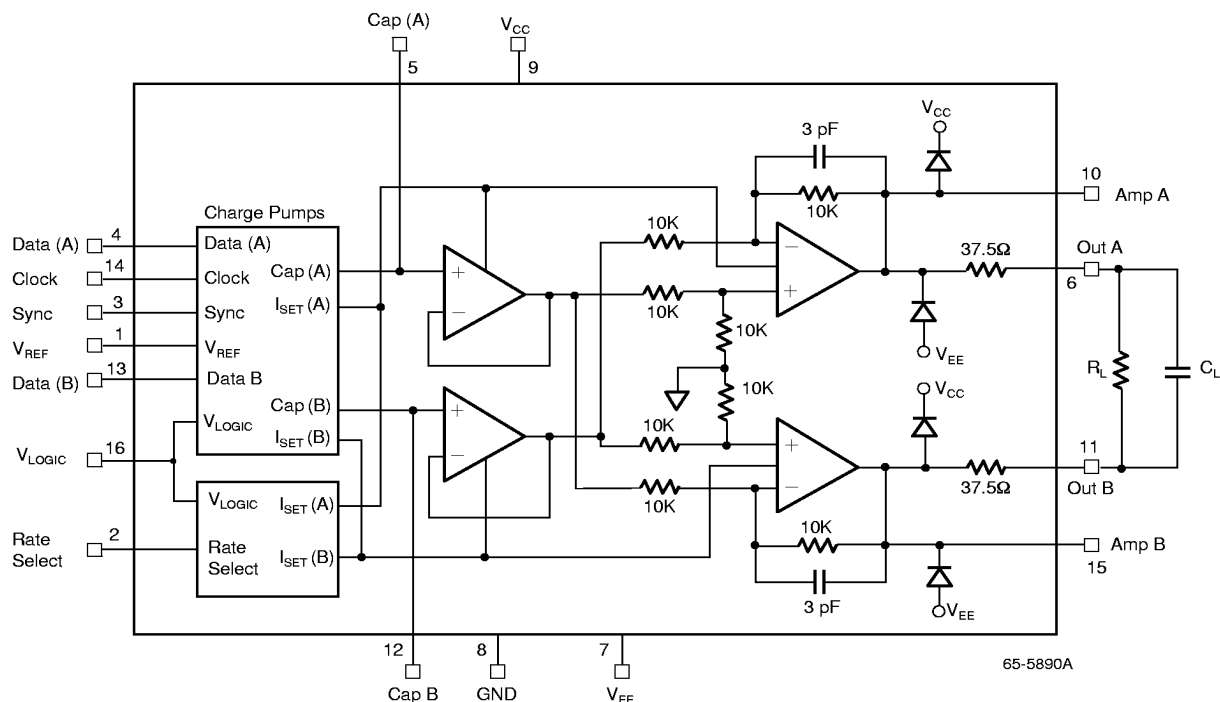
Features

- Adjustable rise and fall times
- Low supply current
- Capable of driving 30 nF || 400Ω
- Digitally selectable 12.5 or 100 kbit/sec data rate
- Adjustable output voltages swing
- Output overvoltage protected
- Short circuit protected
- TTL and CMOS compatible inputs
- MIL-STD-883B screening available
- Available in 16-lead ceramic sidebrazed DIP and 28-Terminal LCC

Description

The RM3182A is a complete differential line driver IC. When Data A = Data B or Sync or Clock Signal is low, the driver forces the output to a Voltage Null level ($0V \pm 250\text{ mV}$). Designed to address the ARINC 429 standard, the RM3182A has output rise and fall times that can be adjusted by the selection of an external capacitor (C_A or C_B) and an output voltage range adjustable through an externally applied V_{REF} signal. All logic inputs and sync control inputs are TTL/CMOS compatible. The device is constructed on a monolithic IC using a junction-isolated bipolar process. Sputtered SiCr resistors in the internal bias circuitry provide for stable bias currents and a tighter tolerance of output impedance. The RM3182A is available in 16-lead ceramic sidebrazed DIP, 28-Terminal LCC and can be ordered with MIL-STD-883B high reliability screening.

Block Diagram



Note: Pin numbers are for the DIP package.

Rev. 1.0.0

Functional Description

The device contains three main functional blocks. The first block is a digital section used to decode the ARINC Clock, Synchronization, and Data inputs as shown in Block Dia-

gram. This block takes these inputs and channels the data to the charge pump circuits. The logical relationship for these pins is presented in Table 1.

Table 1. I/O Truth Table

Sync	Clock	Data A	Data B	Out A	Out B	Comments
X	L	X	X	0V	0V	Null
L	X	X	X	0V	0V	Null
H	H	L	L	0V	0V	Null
H	H	L	H	-VREF	+VREF	Low
H	H	H	L	+VREF	-VREF	High
H	H	H	H	0V	0V	Null

The second functional block is a charge pump circuit that is used to control the output waveform and its timing characteristics. This is achieved through charging and discharging a capacitor with a known current. The capacitor is user selectable, and is connected between CA or CB pins and ground. A rate select pin (digital input) enables to set the rise and fall

time. If this pin is tied to ground, the device functions in the high rate. This mode is recommended if the user does not have an application requiring data rate switching. In the table below, recommended capacitor values are given for each possible data combination.

Table 2. Rate Select Pin Truth Table

Rate Select	CA CB (pF)	10% to 90% Rise/Fall time (μ S)	Data Rate (Kbits/sec)	Comments
Logic 0	56	1.5	100	High Rate
Logic 1	56	10	12-14.5	Low Rate
Logic 0	390	10	12-14.5	Low Rate
Logic 1	390	N/A	N/A	Not Used

The last functional block of the device consists of a voltage follower and a high power output differential amplifier. The voltage follower buffers the signals presented at the charge caps and presents the mirrored signal to the difference amplifier to drive the ARINC line. Two different outputs are available from the differential amplifiers: Amp A, Amp B, and Out A, Out B. The outputs Amp A and Amp B are the direct outputs of the power amplifier. The outputs Out A and Out B include 37.5 Ω series resistors added to minimize bus

reflections by matching the power amplifier's output impedance to the cable's impedance of 75 Ω . Amp A and Amp B may be used to customize the output impedance of the device. These outputs can also be used to enhance the device's drive capability. For example, driving the standard 30 nF || 400 Ω load defined in the ARINC specifications (see output drive capability and capacitive loads for more details). All outputs are protected from voltage spikes with diodes connected between the output pins and the supply lines.

Output Drive Capability and Capacitive Loads

The Traditional Approach

The RM3182A is capable of driving a high capacitive/resistive load. If complete ARINC compliance is required then Out A and Out B pins are recommended to maintain the output impedance. In this configuration, driving the full ARINC load of $30\text{nF} \parallel 400\Omega$ the output characteristic takes on the transfer function of a low pass filter due to the internal 37.5Ω resistor, the line resistance and the capacitance associated with the cable. This will result in a lower rise/fall time of the device. Equation 1.1 relates the output voltage at Out A and Out B to the voltage at the power amplifier's output. Output A is taken for this example:

$$1.1 \quad \text{Out A} = \frac{\text{AmpA } Z_L/2}{(Z_L/2) + R_{\text{OUT}}}$$

Where: $R_{\text{OUT}} = 37.5\Omega$ and $Z_L = R_L \parallel C_L$

The output as a function of frequency is given by equation 1.2.

$$1.2 \quad A_{\text{OUT}}(j\omega) = \text{Amp A}(j\omega) \left[\frac{R_L}{R_L + 2R_{\text{OUT}}(1 + j\omega C_L R_L)} \right]$$

Using equation 1.2, a time constant can be determined for the given application which is shown in equation 1.3.

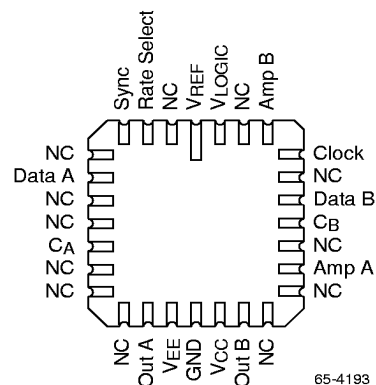
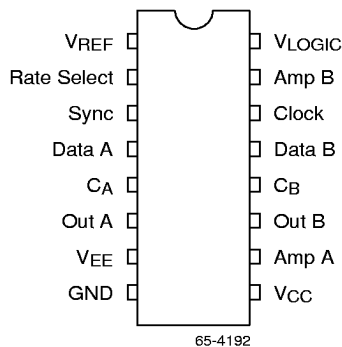
$$1.3 \quad \tau = (R_{\text{OUT}} \parallel R_L) C_L$$

So, for the maximum loading condition of $30\text{nF} \parallel 400\Omega$ the resulting time constant is $1.9 \mu\text{s}$. This shows that with a maximum load, the output waveform is greatly affected by the low pass filter combination of the $R_{\text{OUT}} \parallel R_L$ resistor and the load capacitance.

A New Option: Amp A/Amp B

The RM3182A also provides the user the option of connecting the data line directly to the power output amplifiers thus bypassing the internal 37.5Ω resistance of the device and matching the line more precisely. For example, using a 1% 37.5Ω resistor allows better control of the output impedance. By applying the load directly to the power amplifiers output pins, the resulting waveform is virtually unchanged when driving other loads. There may be applications where these pins present a more desirable result. For instance, if the line that the chip is driving is short, then the parasitic components of the line can be neglected, and power amplifier can be tied directly to the lines. This option can be utilized to achieve a greater noise immunity through bypassing the internal resistors.

Pin Assignments



Absolute Maximum Ratings

Parameter	Min.	Max.	Units
Supply Voltage (VCC to VEE)		+36	V
VLOGIC Theshold Voltage		+7	V
VREF Voltage		+VCC	V
Logic Input Voltage	-0.3	VLOGIC + 0.3	V
Storage Temperature Range	-65	+150	°C
Operating Temperature Range	-55	+125	°C
Junction Temperature	-55	+175	°C
Lead Soldering Temperature (60 sec.)		+300	°C

Thermal Characteristics

(Still air, soldered into PC board)

Parameter	16-Lead Sidebrazed DIP	28-Terminal LCC
Maximum Junction Temperature	+175°C	+175°C
Thermal Resistance, θ_{JC}	70°C/W	60°C/W
Thermal Resistance, θ_{JA}	28°C/W ⁽¹⁾	25°C/W
For T _A > 50°C Derate at	14.3 mW/°C	13.3 mW/°C

Electrical Characteristics

(VCC = +15V, VEE = -15V, VREF = +5V, VLOGIC = +5V, Rate Select = 0V, RL = Open Circuit, CL = 0 pF, and -55°C < T_A < +125°C)

Symbol	Parameters	Test Conditions	Min.	Typ.	Max.	Units
ICC	Positive Supply Current	Data Rate = 0 to 100 Kbits/sec	4.0	5.7	6.9	mA
IEE	Negative Supply Current	Data Rate = 0 to 100 Kbits/sec	4.0	4.9	6.9	mA
ILOGIC	VLOGIC Supply Current	Data Rate = 0 to 100 Kbits/sec	150	214	300	μA
IREF	VREF Supply Current	Data Rate = 0 to 100 Kbits/sec	-500	-294	-100	μA
VIH	Input Logic Level High	Dependent on VLOGIC	2.0		Vlogic	V
VIL	Input Logic Level Low				0.5	V
VOH	Output Voltage High	With Respect to Ground	4.75	5.0	5.25	V
VOL	Output Voltage Low	With Respect to Ground	-5.25	-5.0	-4.75	V
VNULL	Output Voltage Null	Both Data Inputs = Logic 0	-250	0	+250	mV
IiH	Input Current High	VIN = 2.0V			1	μA
IiL	Input Current Low	VIN = 0.5V	-645	-161	-50	nA
CI ¹	Input Capacitance				15	pF
ISC	Output Short Circuit Current	AOUT and/or BOUT shorted line to line or to GND	100	133	156	mA
ISCVCC	VCC Short Circuit Current	AOUT and/or BOUT shorted line to line or to GND		140	165	mA
ISCVEE	VEE Short Circuit Current	AOUT and/or BOUT shorted line to line or to GND		140	165	mA

Note:

1. Guaranteed by design.

Typical Power Dissipation Characteristics

($V_{CC} = +15V$, $V_{EE} = -15V$, $V_{REF} = +5V$, $T_A = +25^\circ C$, $C_A = C_B = 56pF$)

Data Rate (Kbits/sec)	Load	Rate Select	Positive Supply Current	Negative Supply Current	Pin V _{LOGIC} Supply Current	Total Power Dissipation
0 - 100	Open Circuit	Logic 1,0	5.7 mA	4.9 mA	214 μA	160 mW
12.5 - 14	Full Load ¹	Logic 1	19.6 mA	22.7 mA	200 μA	655 mW
100	Full Load ¹	Logic 0	39.1 mA	38.4 mA	200 μA	1165 mW

Note:

1. $R_L = 400\Omega$, $C_L = 0.03 \mu F$ (see Block Diagram).

Typical Performance Characteristics

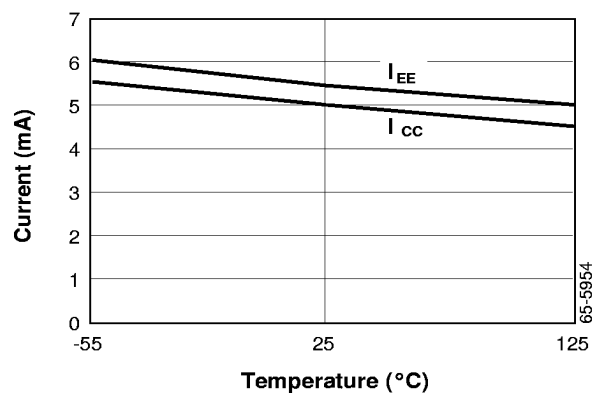


Figure 1. Supply Current vs. Temperature
($C_L = 0 \text{ pF}$, $R_L = \text{Open Circuit}$)

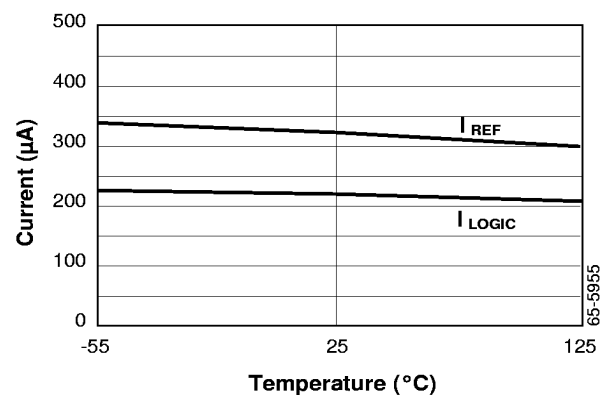


Figure 2. I_{REF} , I_{LOGIC} vs. Temperature

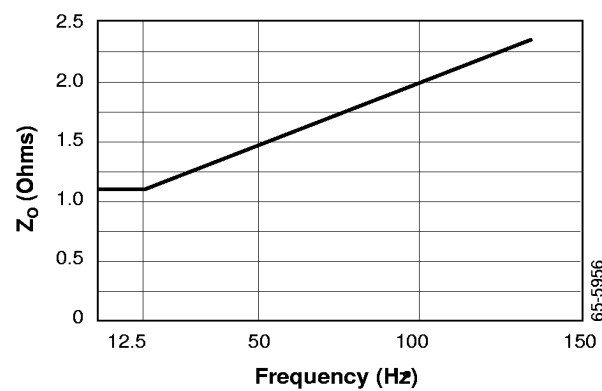


Figure 3. AmpA, AmpB Output Impedance Typical

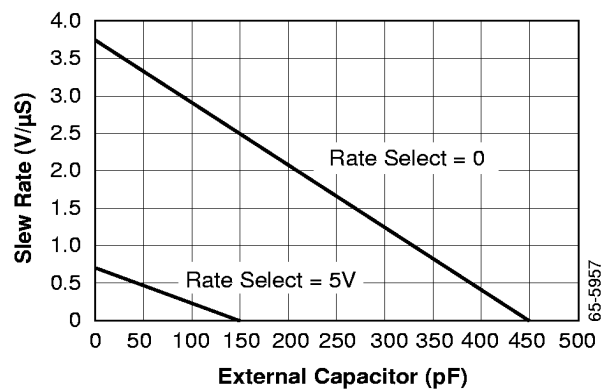


Figure 4. Slew Rate vs. C_A , C_B

Applications

Heat Sinking /Air Flow and Short Circuit Protection

The user application will determine if and how much heat sinking/air flow will be required for the RM3182A. Consideration must be given to ambient temperature, load conditions and output voltage swing. In addition, power consumption increases with increased operating frequency. Use the numbers given in the Thermal Characteristics Table to determine that the maximum allowable junction temperature of 175°C is not exceeded.

Outputs Out A and Out B are short circuit protected by the internal 37.5Ω back termination resistors. During a short circuit of the output to either power supply or ground, the device must be able to dissipate the generated heat. For example, if the output is shorted to ground and $V_{CC} = +15V$, the device must dissipate $15V \times 0.165A = 2.5W$. An appropriate heat sink is required in this situation.

Note that the Amp A and Amp B outputs are not short circuit protected. Shorting these pins to either power supply or ground will cause failure of the device. An added external resistor will protect the circuit by limiting the current.

Power Supply Considerations

Three power supplies are required to operate the RM3182A in a typical ARINC 429 bus application: +15V for VCC, -15V for VEE, and +5V for both VREF and VLOGIC. The differential output swing of the RM3182A is equal to 2 x VREF. Using +5V gives a differential output swing of 10V. If a different output voltage swing is required, an additional power supply is needed to set VLOGIC.

Each power supply pin should be decoupled to ground using a high quality 10 μF tantalum capacitor. This is especially true when driving a large capacitive or resistive loads. The decoupling capacitors should be located as close to the device pins as possible to eliminate the wiring inductance.

Typical ARINC 429 Application

Figure 5 shows typical switching waveform for the RM3182A in any configuration.

Figure 6 depicts connections for a ARINC 429 high speed bus driver application. This circuit shows the complete configuration for a 100 Kbits/sec, 10V differential output swing using the terminated output pins.

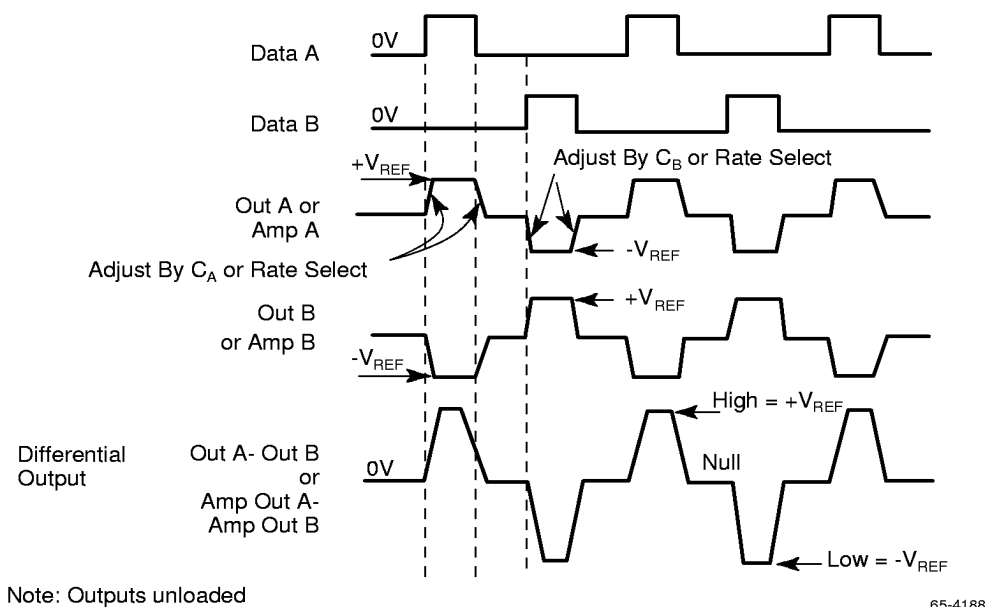
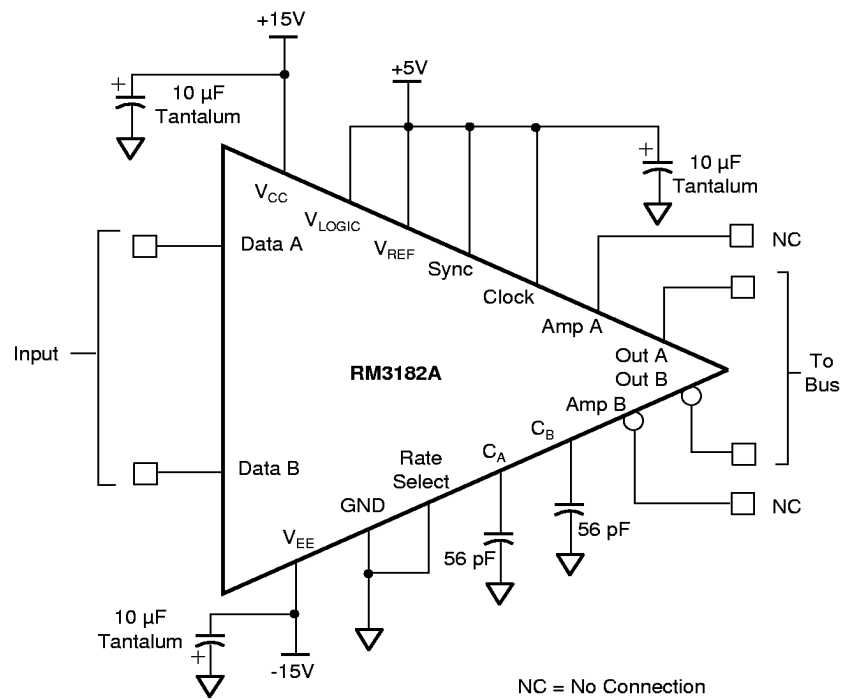


Figure 5. Switching Waveforms



65-5891A

Figure 6. ARINC 429 Bus Driver Applications (100 kb/s Mode)

Notes:

Notes:

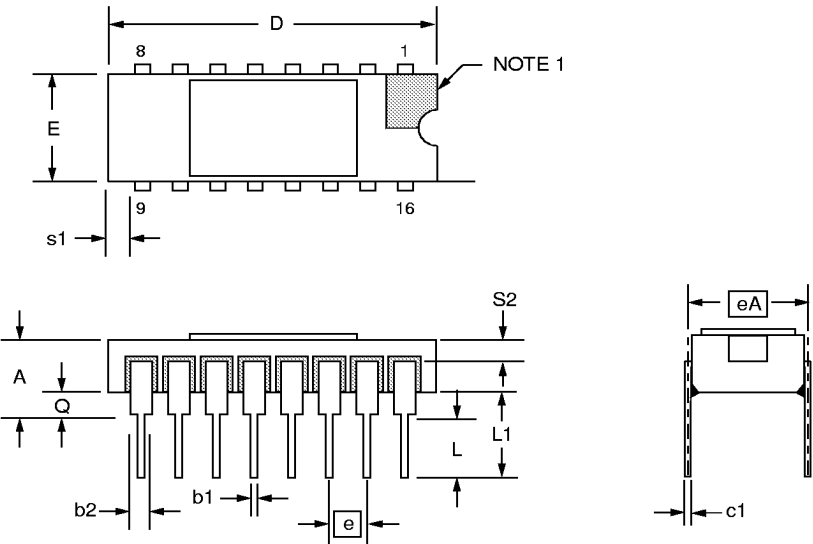
Mechanical Dimensions

16-Lead SideBrazed Ceramic DIP

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	—	.200	—	5.08	
b1	.014	.023	.36	.58	7
b2	.045	.065	1.14	1.65	2
c1	.008	.015	.20	.38	7
D	—	.860	—	21.84	
E	.280	.310	7.11	7.87	
e	.100 BSC		2.54 BSC		4, 8
eA	.300 BSC		7.62 BSC		6
L	.125	.200	3.18	5.08	
L1	.140	—	3.56	—	
Q	.015	.070	.38	1.78	3
s1	.005	—	.13	—	5
s2	.005	—	.13	—	

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 pin one identification mark.
2. The minimum limit for dimension "b2" may be .023 (.58mm) for leads number 1, 8, 9 and 16 only.
3. Dimension "Q" shall be measured from the seating plane to the base plane.
4. The basic pin spacing is .100 (2.54mm) between centerlines. Each pin centerline shall be located within $\pm .010$ (.25mm) of its exact longitudinal position relative to pins 1 and 16.
5. Applies to all four corners (leads number 1, 8, 9, and 16).
6. "eA" shall be measured at the centerline of the leads.
7. All leads – Increase maximum limit by .003 (.08mm) measured at the center of the flat, when lead finish applied.
8. Fourteen spaces.



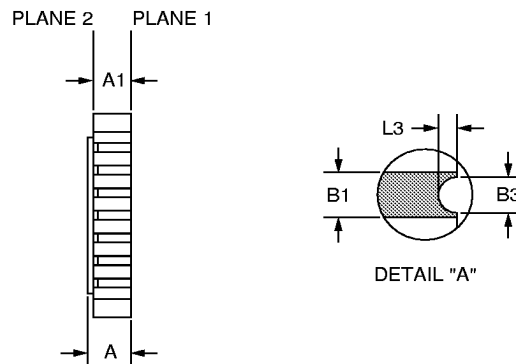
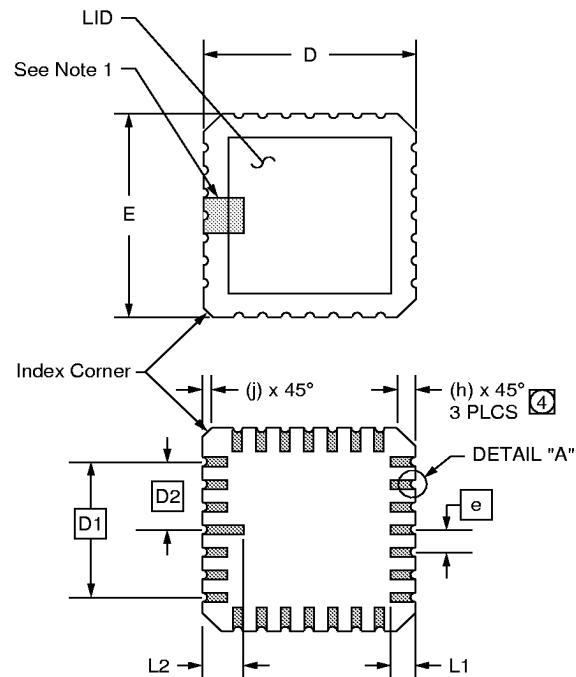
Mechanical Dimensions (continued)

28-Terminal LCC

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.060	.100	1.52	2.54	3, 6
A1	.050	.088	1.27	2.24	3, 6
B1	.022	.028	.56	.71	2
B3	.006	.022	.15	.56	2, 5
D/E	.442	.460	11.23	11.68	
D1/E1	.300 BSC		7.62 BSC		
D2/E2	.150 BSC		3.81 BSC		
e	.050 BSC		1.27 BSC		
h	.040 REF		1.02 REF		4
j	.020 REF		.51 REF		4
L1	.045	.055	1.14	1.40	
L2	.075	.095	1.91	2.41	
L3	.003	.015	.08	.38	5
ND/NE	7		7		
N	28		28		

Notes:

1. The index feature for terminal 1 identification, optical orientation or handling purposes, shall be within the shaded index areas shown on planes 1 and 2. Plane 1 terminal 1 identification may be an extension of the length of the metallized terminal which shall not be wider than the B1 dimension.
2. Unless otherwise specified, a minimum clearance of .015 inch (0.38mm) shall be maintained between all metallized features (e.g., lid, castellations, terminals, thermal pads, etc.).
3. Dimension "A" controls the overall package thickness. The maximum "A" dimension is the package height before being solder dipped.
4. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing. The index corner shall be clearly unique.
5. Dimension "B3" minimum and "L3" minimum and the appropriately derived castellation length define an unobstructed three dimensional space traversing all of the ceramic layers in which a castellation was designed. Dimension "B3" maximum and "L3" maximum define the maximum width and depth of the castellation at any point on its surface. Measurement of these dimensions may be made prior to solder dripping.
6. Chip carriers shall be constructed of a minimum of two ceramic layers.



Ordering Information

Part Number	Package	Operating Temperature Range
RM3182AS	16-Lead Sidebrazed Ceramic DIP	-55°C to +125°C
RM3182AL	28-Terminal Leadless Chip Carrier	-55°C to +125°C

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