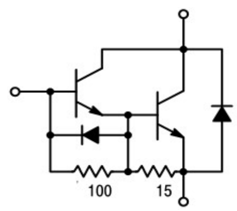
NPN SILICON POWER DARLINGTON TRANSISTOR MJ10005

400 VOLTS 20 AMPERE 175 WATTS

TO-3
Metal Can Package
RoHS compliant

TO-3



General Description

The MJ10005 Darlington transistor is designed for high–voltage, high–speed, power switching in inductive circuits where fall time is critical. It is particularly suited for line operated switchmode applications

FEATURES:

1. Fast Turn–Off Times
   - 40 ns Inductive Fall Time @25º C (Typ)
   - 650 ns Inductive Storage Time @ 25º C (Typ)
   - Operating Temperature Range –65 to +200º C
2. 100º C Performance Specified for: _
   - Reversed Biased SOA with Inductive Loads
   - Switching Times with Inductive Loads
   - Saturation Voltages
   - Leakage Currents

APPLICATION:

1. Switching Regulators
2. Inverters
3. Solenoid and Relay Drivers
4. Motor Controls
5. Deflection Circuits

ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	400	Vdc
Collector–Emitter Voltage	V_{CEX}	450	Vdc
Collector–Emitter Voltage	V_{CEV}	500	Vdc
Emitter Base Voltage	V_{EB}	8.0	Vdc
Collector Current — Continuous — Peak (1)	I_C I_{CM}	20 30	Adc
Base Current — Continuous — Peak (1)	I_B I_{BM}	2.5 5.0	Adc
Total Power Dissipation @ T_C = 25°C @ T_C = 100°C Derate above 25°C	P_D	175 100 1.0	Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	R_{JC}	1.0	°C/W
Maximum Lead Temperature for Soldering Purposes 1/8 from Case for 5 Seconds	T_L	275	°C

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.

ELECTRICAL CHARACTERISTICS at T_a = 25 °C

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (Table 1) (I_C = 250 mA, I_B = 0, V_{clamp} = Rated V_{CEO})	$V_{CEO(sus)}$	400	—	—	Vdc
Collector Emitter Sustaining Voltage (Table 1, Figure 12) (I_C = 2.0 A, V_{clamp} = Rated V_{CEX}, T_C = 100°C) (I_C = 10 A, V_{clamp} = Rated V_{CEX}, T_C = 100°C)	$V_{CEX(sus)}$	 450 325	 — —	 — —	Vdc
Collector Cutoff Current (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc) (V_{CEV} = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)	I_{CEV}	 — —	 — —	 0.25 5.0	mAdc
Collector Cutoff Current (V_{CE} = Rated V_{CEV}, R_{BE} = 50 , T_C = 100°C)	I_{CER}	—	—	5.0	mAdc
Emitter Cutoff Current (V_{EB} = 2.0 Vdc, I_C = 0)	I_{EBO}	—	—	175	mAdc
SECOND BREAKDOWN					
Second Breakdown Collector Current with base forward biased	$I_{S/b}$	See Figure 11			
ON CHARACTERISTICS (2)					
DC Current Gain (I_C = 5.0 Adc, V_{CE} = 5.0 Vdc) (I_C = 10 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	 50 40	 — —	 600 400	—
Collector Emitter Saturation Voltage (I_C = 10 Adc, I_B = 400 mAdc) (I_C = 20 Adc, I_B = 2.0 Adc) (I_C = 10 Adc, I_B = 400 mAdc, T_C = 100°C)	$V_{CE(sat)}$	 — — —	 — — —	 1.9 3.0 2.0	Vdc
Base Emitter Saturation Voltage (I_C = 10 Adc, I_B = 400 mAdc) (I_C = 10 Adc, I_B = 400 mAdc, T_C = 100°C)	$V_{BE(sat)}$	 — —	 — —	 2.5 2.5	Vdc
Diode Forward Voltage (1) (I_F = 10 Adc)	V_f	—	3.0	5.0	Vdc
DYNAMIC CHARACTERISTICS					
Small–Signal Current Gain (I_C = 1.0 Adc, V_{CE} = 10 Vdc, f_{test} = 1.0 MHz)	h_{fe}	10	—	—	—
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f_{test} = 100 kHz)	C_{ob}	100	—	325	pF

SWITCHING CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Resistive Load (Table 1)						
Delay Time	(V_{CC} = 250 Vdc, I_C = 10 A, I_{B1} = 400 mA, $V_{BE(off)}$ = 5.0 Vdc, t_p = 50 s, Duty Cycle ≤ 2%).	t_d	—	0.12	0.2	s
Rise Time		t_r	—	0.2	0.6	s
Storage Time		t_s	—	0.6	1.5	s
Fall Time		t_f	—	0.15	0.5	s
Inductive Load Clamped (Table 1)						
Storage Time	(I_C = 10 A(pk), V_{clamp} = Rated V_{CEX}, I_{B1} = 400 mA, $V_{BE(off)}$ = 5.0 Vdc, T_C = 100°C)	t_{sv}	—	1.0	2.5	s
Crossover Time		t_c	—	0.4	1.5	s
Storage Time	(I_C = 10 A(pk), V_{clamp} = Rated V_{CEX}, I_{B1} = 400 mA, $V_{BE(off)}$ = 5.0 Vdc, T_C = 25°C)	t_{sv}	—	0.65	—	s
Crossover Time		t_c	—	0.2	—	s

(1) The internal Collector–to–Emitter diode can eliminate the need for an external diode to clamp inductive loads.
Tests have shown that the Forward Recovery Voltage (V_f) of this diode is comparable to that of typical fast recovery rectifiers.
(2) Pulse Test: PW = 300 s, Duty Cycle ≤ 2%.

Typical Characteristic Curves

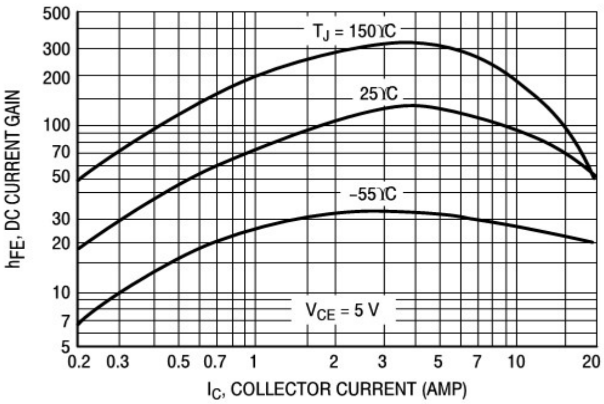


Figure 1. DC Current Gain

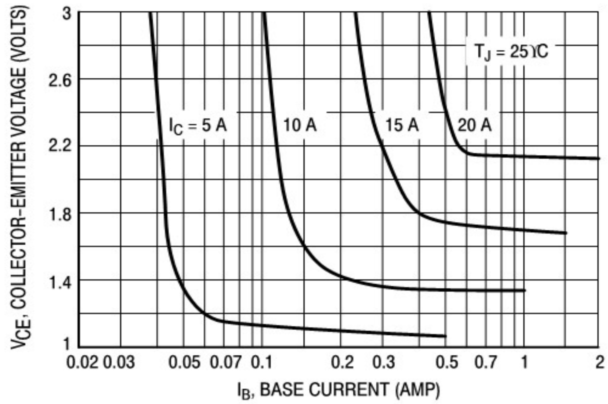


Figure 2. Collector Saturation Region

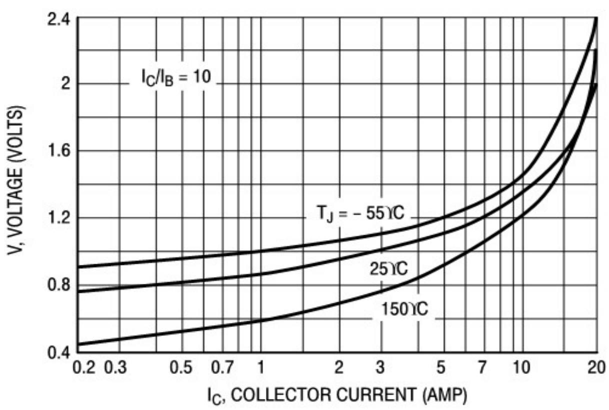


Figure 3. Collector−Emitter Saturation Voltage

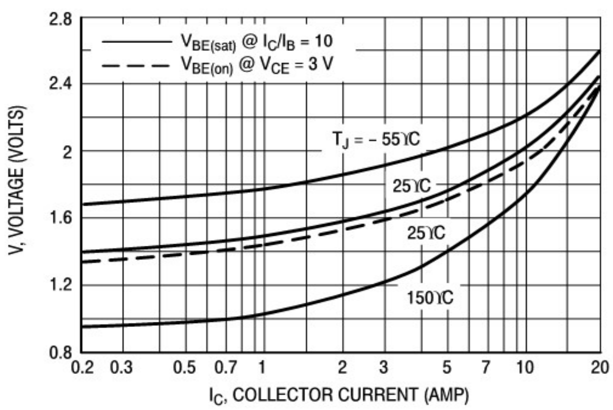


Figure 4. Base−Emitter Voltage

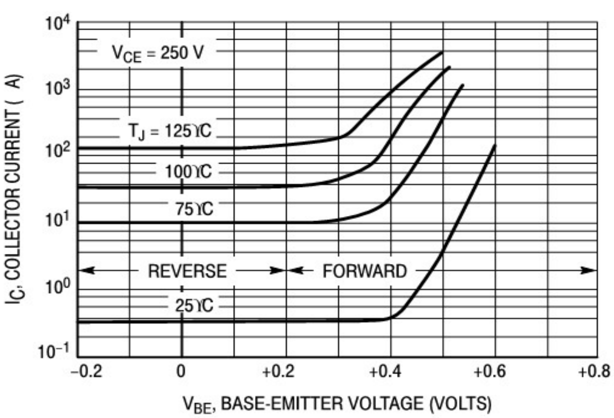


Figure 5. Collector Cutoff Region

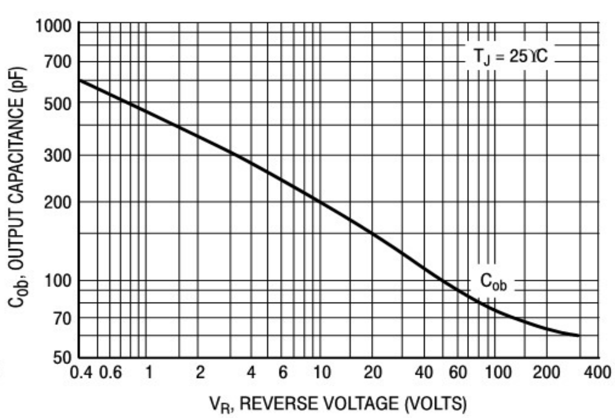


Figure 6. Output Capacitance

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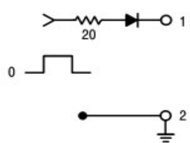
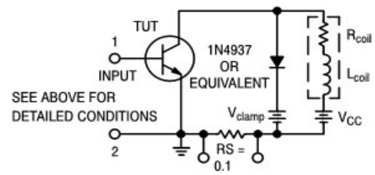
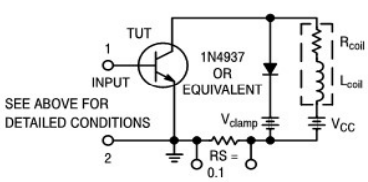
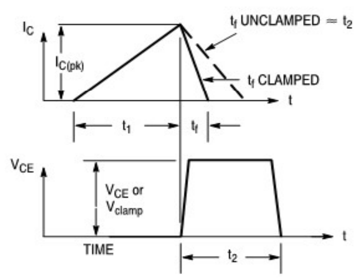
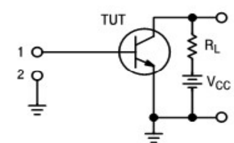
Table 1. Test Conditions for Dynamic Performance

<table>
<tr><th></th><th>$V_{CEO(sus)}$</th><th>$V_{CEX(sus)}$ AND INDUCTIVE SWITCHING</th><th>RESISTIVE SWITCHING</th></tr>
<tr><td>INPUT CONDITIONS</td><td>

PW Varied to Attain
I_C = 250 mA</td><td colspan="2">INDUCTIVE TEST CIRCUIT

</td></tr>
<tr><td>CIRCUIT VALUES</td><td>L_{coil} = 10 mH, V_{CC} = 10 V
R_{coil} = 0.7
V_{clamp} = $V_{CEO(sus)}$</td><td>L_{coil} = 180 H
R_{coil} = 0.05
V_{CC} = 20 V
V_{clamp} = Rated V_{CEX} Value</td><td>V_{CC} = 250 V
R_L = 25
Pulse Width = 50 s</td></tr>
<tr><td>TEST CIRCUITS</td><td colspan="2">INDUCTIVE TEST CIRCUIT


OUTPUT WAVEFORMS


t_1 Adjusted to Obtain I_C
$t_1 \approx \frac{L_{coil}\,(I_{Cpk})}{V_{CC}}$
$t_2 \approx \frac{L_{coil}\,(I_{Cpk})}{V_{Clamp}}$
Test Equipment
Scope — Tektronix
475 or Equivalent</td><td>RESISTIVE TEST CIRCUIT

</td></tr>
</table>

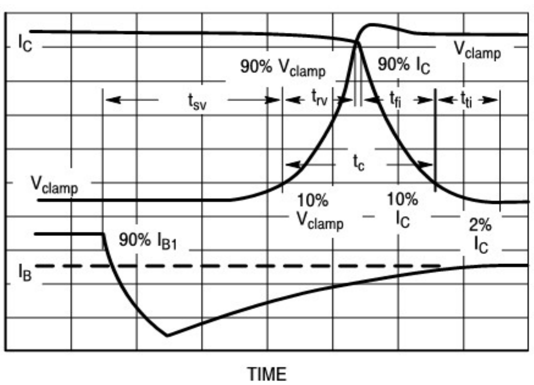


Figure 7. Inductive Switching Measurements

Typical Characteristic Curves

RESISTIVE SWITCHING PERFORMANCE

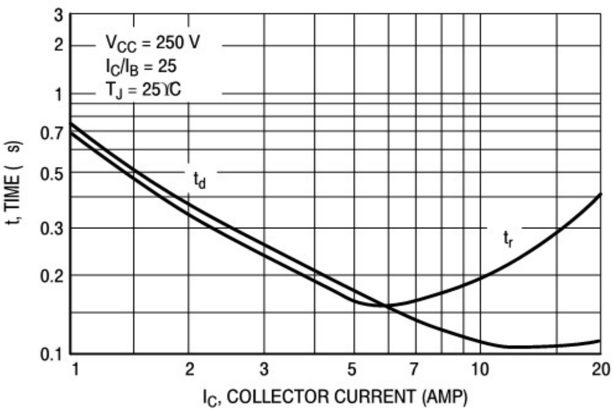


Figure 8. Turn–On Time

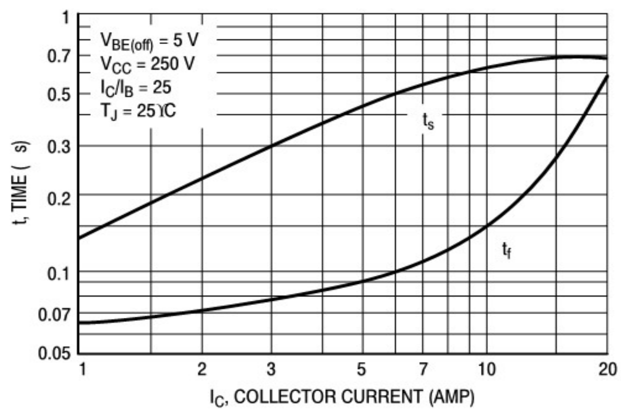


Figure 9. Turn–Off Time

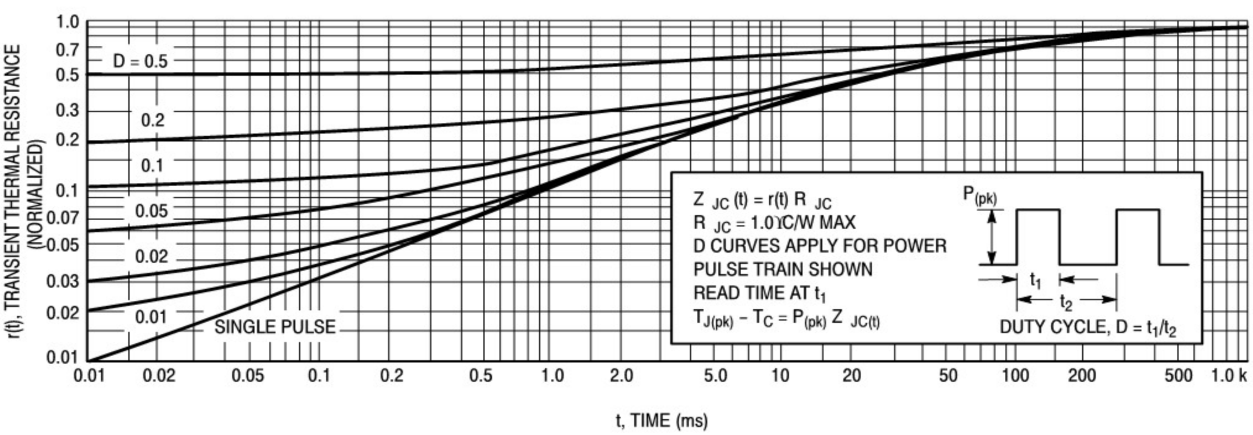


Figure 10. Thermal Response

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Typical Characteristic Curves

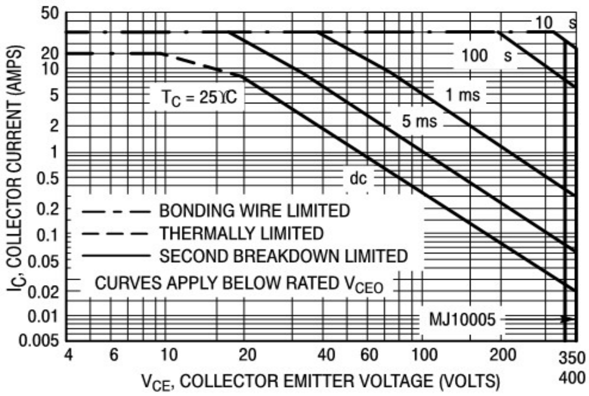

Figure 11. Forward Bias Safe Operating Area

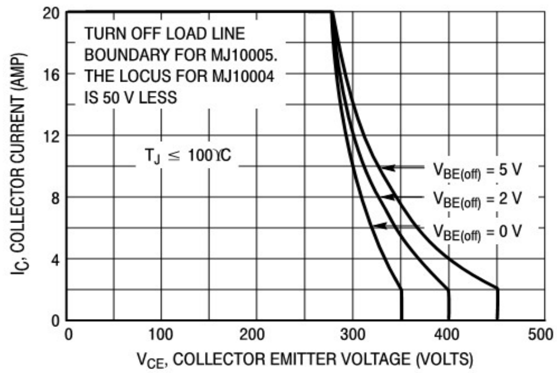

Figure 12. Reverse Bias Switching Safe Operating Area

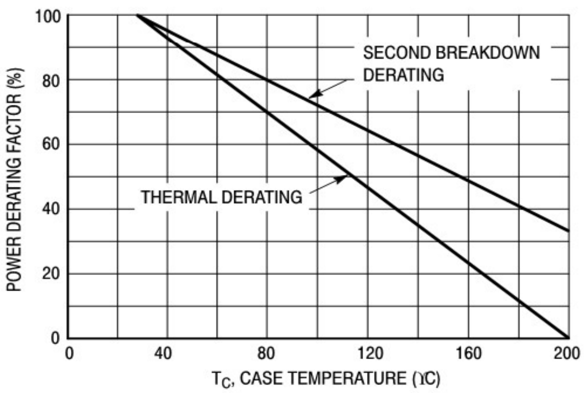

Figure 13. Power Derating

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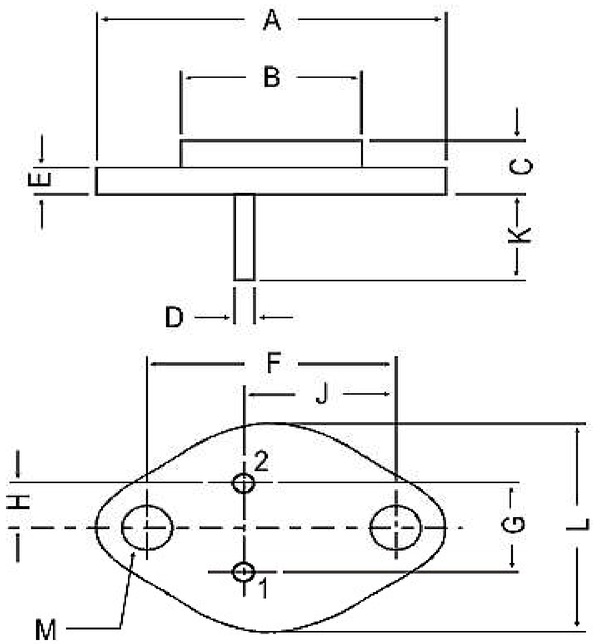
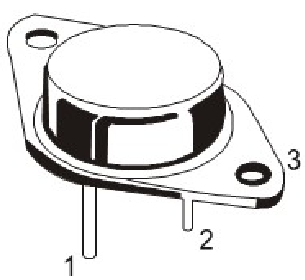
Package Details



DIM	MIN.	MAX.
A	—	39.37
B	—	22.22
C	6.35	8.50
D	0.96	1.09
E	—	1.77
F	29.90	30.40
G	10.69	11.18
H	5.20	5.72
J	16.64	17.15
K	11.15	12.25
L	—	26.67
M	3.84	4.19

All dimensions in mm.



PIN CONFIGURATION
1. BASE
2. EMITTER
3. COLLECTOR

Packing Detail

PACKAGE	STANDARD PACK		INNER CARTON BOX		OUTER CARTON BOX		
	Details	Net Weight/Qty	Size	Qty	Size	Qty	Gr Wt
TO-3	100 pcs/pkt	1.3 kg/100 pcs	12.5" x 8" x 1.8"	0.1K	17" x 11.5" x 21"	2K	27.5 kgs

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Recommended Product Storage Environment for Discrete Semiconductor Devices

This storage environment assumes that the Diodes and transistors are packed properly inside the original packing supplied by CDIL.

- Temperature 5 °C to 30 °C
- Humidity between 40 to 70 %RH
- Air should be clean.
- Avoid harmful gas or dust.
- Avoid outdoor exposure or storage in areas subject to rain or water spraying .
- Avoid storage in areas subject to corrosive gas or dust. Product shall not be stored in areas exposed to direct sunlight.
- Avoid rapid change of temperature.
- Avoid condensation.
- Mechanical stress such as vibration and impact shall be avoided.
- The product shall not be placed directly on the floor.
- The product shall be stored on a plane area. They should not be turned upside down. They should not be placed against the wall.

Shelf Life of CDIL Products

The shelf life of products is the period from product manufacture to shipment to customers. The product can be unconditionally shipped within this period. The period is defined as 2 years.
If products are stored longer than the shelf life of 2 years the products shall be subjected to quality check as per CDIL quality procedure.
The products are further warranted for another one year after the date of shipment subject to the above conditions in CDIL original packing.

Floor Life of CDIL Products and MSL Level

When the products are opened from the original packing, the floor life will start.

For this, the following JEDEC table may be referred:

JEDEC MSL Level		
Level	**Time**	**Condition**
1	Unlimited	≤30 °C / 85% RH
2	1 Year	≤30 °C / 60% RH
2a	4 Weeks	≤30 °C / 60% RH
3	168 Hours	≤30 °C / 60% RH
4	72 Hours	≤30 °C / 60% RH
5	48 Hours	≤30 °C / 60% RH
5a	24 Hours	≤30 °C / 60% RH
6	Time on Label(TOL)	≤30 °C / 60% RH

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ISO 14001

Customer Notes

Component Disposal Instructions

1. CDIL Semiconductor Devices are RoHS compliant, customers are requested to please dispose as per prevailing Environmental Legislation of their Country.
2. In Europe, please dispose as per EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE).

Disclaimer

The product information and the selection guides facilitate selection of the CDIL's Semiconductor Device(s) best suited for application in your product(s) as per your requirement. It is recommended that you completely review our Data Sheet(s) so as to confirm that the Device(s) meet functionality parameters for your application. The information furnished in the Data Sheet and on the CDIL Web Site/CD are believed to be accurate and reliable. CDIL however, does not assume responsibility for inaccuracies or incomplete information. Furthermore, CDIL does not assume liability whatsoever, arising out of the application or use of any CDIL product; neither does it convey any license under its patent rights nor rights of others. These products are not designed for use in life saving/support appliances or systems. CDIL customers selling these products (either as individual Semiconductor Devices or incorporated in their end products), in any life saving/support appliances or systems or applications do so at their own risk and CDIL will not be responsible for any damages resulting from such sale(s).
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