International
IOR Rectifier

AN-1049

Application Note

iMOTION™

Plug N Drive™ Storage and Assembly overview

Integrated Power Module for Appliance Motor Drive

Introduction

This document provides note on items that require care when using Plun N Drive power modules. This document covers standard usage notes.

Special usage notes, which only a certain power module has, may be indicated by another data. Be careful of this point.

1. Storage and Transportation

- Store the PlugNDriveTM module products in locations that are not subject to direct sunlight, and that are only subject to minimal changes in temperature and humidity. Note that condensation may be a problem in locations that are subject to large temperature changes.
- Recommended storage conditions:
  Temperature: 5 to 30°C
  Relative humidity: 40 to 70%
- Do not allow the PlugNDriveTM module devices to be exposed to corrosive gasses, including but not limited to gasses containing sulfur, chlorine, or ammonia compounds.
- Store the PlugNDriveTM module in locations with the minimum dust and dirt levels possible.
- Store cartons holding the PlugNDriveTM module in the indicated direction, i.e. according to the "This Side Up" marking.
- Do not stack cartons containing the PlugNDriveTM module excessively. Applying unnatural forces or excessive loads to the packing can result in bent lead-frames or destruction of the product itself.
- Do not throw or drop cartons containing the PlugNDriveTM module. (the PlugNDriveTM module must be handled as fragile merchandise.)
- Do not allow water to get onto cartons containing the PlugNDriveTM module. (PlugNDriveTM modules must be handled as susceptible to water damage.)
- Inspect products that have been stored for one year or longer for rusting, degradation of lead frame soldering characteristics, and other problems before use.

2. Inspection and Testing

- Note that the PlugNDriveTM module may be destroyed, exploded, bummed or suffer a reduction in their operating lifetime, if excessive stresses are applied during testing of the PlugNDriveTM module electrical characteristics during inspection procedures.
- When inspection and testing, be careful of the following item.

3 Test Jigs

- Verify that the test jigs using in inspections result in measurements being performed within the test conditions listed in the specifications document for the device.
- Verify that there are no incorrect connections or wiring on the printed circuit boards used as test jigs.
- Verify that the values of all external components are correct and that all capacitors are connected with the correct polarity.
- We recommend the use of sockets with partitions to insertion with the lead positions shifted.
- We recommend the use of power supplies with built-in current limiting functions to prevent destruction of the test jig by incorrect settings or devices that are defective from the start.
- For the PlugNDriveTM module that requires multiple supply voltages, unless specified otherwise all supply voltages must be applied with identical timings, i.e. at the same time.
- Verify that no abnormal pulses are generated when switches in the power supplies, test and measurement equipment and testing are switched.
- Discharge all capacitors in the test jig printed circuit boards after completing a test, especially power supply related capacitors.

4. Power-up

- Verify that there are no input signals with excessive levels.
- Verify that the PlugNDriveTM module lead frames have not been bent and that packages have not been cracked due to abuse such as being dropped or thrown.
- Insert and remove the PlugNDriveTM module with the power supply turned off.
- Do not insert the PlugNDriveTM module into sockets back wards.
- Verify that parasitic oscillations are not occurring in the PlugNDriveTM module.
- Do not test pins unnecessarily when the power supply is turned on.

- The PlugNDriveTM module substrate temperature must not exceed the maximum temperature allowed by the absolute maximum ratings during testing.
- In particular, use a heat sink if the supply voltages must be applied for extended periods.
- Observe all specified stipulations regarding test times. (See the specifications document for the individual product.)
- Note that certain items in the electrical characteristics depend on the device temperature.
- Unless specified otherwise, rated values apply/ when the substrate temperature (Tc) is 25°C during testing.

5. Electrostatic Discharge

- The PlugNDriveTM module includes CMOS, MOSFET and other semiconductor devices. Since these devices are easily damaged by ESD, take the following static reduction measures when handling these products.
- Cover the work area with a conductive mat.
- Employees should wear grounded wrist straps. To prevent shocks, a resistor of about IM.Q should be inserted in the grounding cord near the wrist strap.
- All items that will actually contact the PlugNDriveTM module must be grounded. This includes physical plant equipment, test equipment, and soldering irons.
- If grounding is not possible, use ionized air blowers and other techniques to reduce static buildup in the work area.
- Use conductive materials that do not easily accumulate static charges for all cases, storage units, and racks that will hold the PlugNDriveTM module.

6. Circuit Design

- Electrical Circuit Design
- The absolute maximum ratings must not be exceeded, even briefly or during a transient state. In this case, the PlugNDriveTM module may be destroyed, exploded, burned or suffer a reduction in their operating lifetime.
- Note that the sample application circuit provided in the specification documents, are intended as samples for reference purposes only. In particular, their operation is not guaranteed. Always verify the operation of PlugNDriveTM module in an end product unit.
- Although surface preparation is applied to the back surface of the PlugNDriveTM module substrate, the insulation characteristics of that preparation may be degraded by scratches or peeling, and is not guaranteed in such cases. In end products in which the PlugNDriveTM module substrate is at the circuit ground potential, this means that the circuit ground may be inadvertently connected to the end product chassis through the substrate and heat sink. This can result in noise or even destruction, burst and burn of the device. During design, connect the PlugNDriveTM module substrate to the chassis and carefully check the noise level and other characteristics.
- Output pins that are not shown connected internally in the equivalent circuit should not be used as intermediate pins for any connections. Some of these pins are connected to internal circuits that are used for testing during the manufacturing process. Pins listed as NC "no connection" pins, can be source of oscillation or other problems if not handled as specified in the documentation for the product itself.
- Provide a supply voltage that remains within the stipulated range for all operating states of the PlugNDriveTM module, from idling (quiescent) through maximum output.
- Adopt extremely conservative de-rating policies (e.g. load reduction) in end products that require especially high reliability.
- Keep the following additional points in mind when designing application circuits.
- Fluctuations in the supply voltage (ripple)
- The temperature characteristics and sample-to-sample variations in the external components used, including ICs, resistors, capacitors, and coils.

- Variations in input signals and loads .The application of abnormal pulses, including times when switches are turned on or off Overload states (excessive input levels, excessive output). Sample-to-sample variations in the operating regions of the protective circuits.

- Ambient temperature (Always design end products so that there is adequate air flow in the area around the module.)

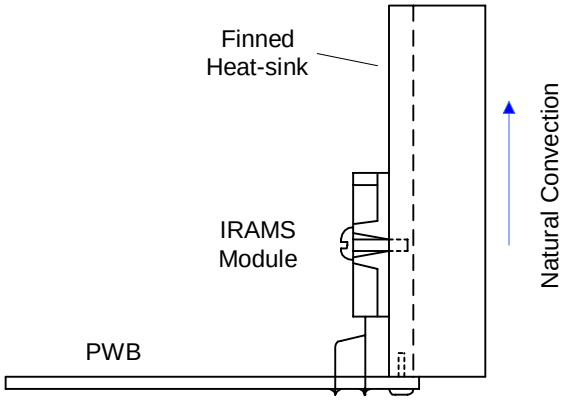


Figure 1: Straight Pin Mounting

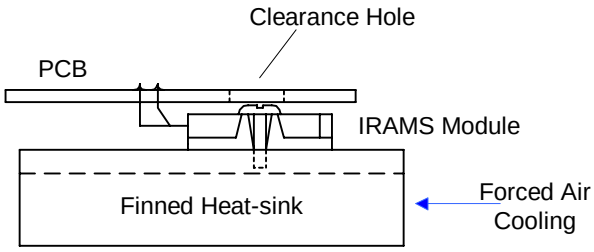


Figure 2: 90° Lead-Form Mounting

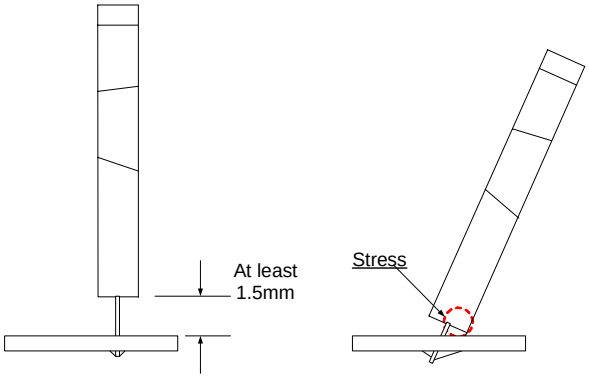
- Verify operation in cases where the power supply is turned on and off an excessively large number of times, and cases where the protective functions operate and are cleared an excessively large number of times.

7. Printed Circuit Board Layout Design

- Design in which the printed circuit board and the heat sink are both mounted to the chassis independently, use a mechanical design that does not result in stresses being applied to the PlugNDriveTM module lead frame.

- For the PlugNDriveTM module in which there is no stop on the lead frame, always maintain a separation of at least 1.5mm between the PlugNDriveTM module case and the printed circuit board. In particular, avoid mounting techniques in which the PlugNDriveTM module case directly contacts the printed circuit board.

- Do not mount the PlugNDriveTM module with a tilted orientation. This can result in stress being applied to the lead-frame and the PlugNDriveTM module substrate could short out lines on the printed circuit board.



- Since the use of sockets to mount the PlugNDriveTM module can result in poor contact with the PlugNDriveTM module leads, we strongly recommend making direct connections to PCB.

- PlugNDriveTM module package material is fire retarding.

8. Mounting

Mounting on a Heat Sink

- If a heat sink is used, insufficiently secure or inappropriate mounting can lead to a failure of the heat sink to dissipate heat adequately. This can lead to an inability of the device to provide its inherent performance, a serious reduction in reliability, or even destruction, burst and burn of the device due to thermal runaway.
The following general points should be observed when mounting the PlugNDriveTM on a heat-sink.

Verify the following points related to the heat sink:

a. There must be no burrs on aluminum or copper heat sinks.

b. Screw holes must be countersunk.

c. There must be no unevenness in the heat sink
d. Surface in contact with the module.
e. There must be no oxidation nor stain or burls on the heat sink surface

- To improve the thermal conductivity, apply silicone grease to the contact surface between the PlugNDriveTM module and heatsink. Spread an even layer of silicone grease with a thickness of between 0.2 and 0.4 mm over the PlugNDriveTM module substrate surface.

- To prevent a loss of heat dissipation effect due to warping of the substrate, tighten down the mounting screws gradually and sequentially while maintaining a left/right balance in pressure applied.

9. Recommended tightening torque:

- (For packages that use M3 screws) 0.8 to 1.0 Nm

- If a thermally conductive silicone rubber sheet such as Fuji poly's Sercon is used, note that a torque higher than the set torque may be applied due to the elasticity of the sheet and other factors.

- If an insulating sheet is used, use a sheet somewhat larger than the PlugNDriveTM module substrate should be used, and it should be aligned accurately when attached. Generally speaking, insulating sheets are used in the following cases.

- When the ability to withstand primary and secondary voltages is required to achieve required safety standard.

- When PlugNDriveTM module must be insulated from the heat sink.

- When measures to reduce noise or other problems are required.

10. Screw tTightening for SIP Module to Heatsink

Assumptions

- Interface pad attached to the heatsink face extending to the edge of the module and located for the fixing holes.

- M3 fixing screws used in conjunction with Belleville washer and flat washer

- Fixing tool has capability for torque setting.

Tightening Process

- Align module with the fixing holes.

- Insert screw A with washers to touch only position (finger tight).

- Insert screw B with washers to 0.3N-m.

- Tighten screw A to final torque. Not exceeding 0.9N-m

- Tighten screw B to final torque. Not exceeding 0.9N-m

11. Mounting on a Printed Circuit Board

- Do not apply excessive tensile stresses the lead frame in the axial direction.

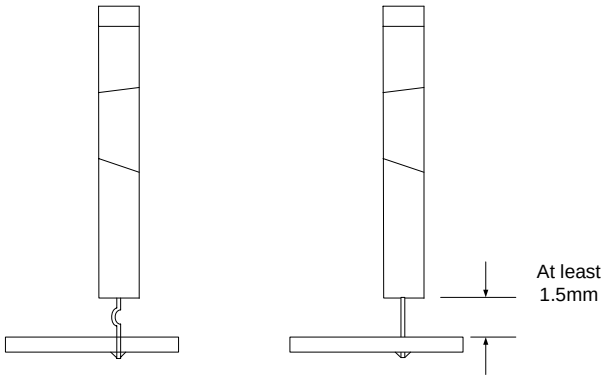
- Do not allow the lead frame to be bent repeatedly in the same place.

- Do not insert the PlugNDriveTM module into printed circuit board with an incorrect orientation, i.e. be sure to prevent reverse insertion. PlugNDriveTM modules may be destroyed, exploded, burned or suffer a reduction in their operating lifetime by this mistaking.

- Align the lead frame with the holes in the printed circuit board and do not use excessive force when inserting the pins into the printed circuit board. To avoid bending the lead frames, do not try to force pins into the printed circuit board unreasonably.

12. Notes on soldering

- Since heat that results in temperatures in excess of the maximum storage temperature allowed by the maximum ratings is applied to the lead frame during soldering, soldering should be performed as quickly as possible.
  a. Solder with bath techniques: 260°C: ±5°C, no more than 10 seconds: ±1 second
  b. Soldering iron: 350°C: ± 0°C, no more than 3 seconds: ±0.5 second
- Observe the above limits when removing the PlugNDriveTM module from printed circuit boards. We recommend using a vacuum solder removing tool.
- Only use grounded solder baths and soldering irons.
- Limitations on the lead frame solder immersion position:
  - Lead frames that include a stop: Up to the position of the stop.
  - Lead frames with no stop: Up to a point 1.5mm from the PlugNDriveTM module itself.



Leadframe with stop Leadframe without stop

* If flux is used, 'avoid chlorine based products and use a rosin-based flux.
* The body of PlugNDriveTM modules have a structure that is unable to withstand the thermal stresses associated with flow soldering in which the module is hit by solder spray, IR re-flow soldering, air re-flow soldering, and vapor phase re-flow soldering.
* Do not use these techniques with these modules.
* Always inspect products after soldering to verify solder quality.

Cleaning:

* PlugNDriveTM modules have a structure that is unable to withstand cleaning.
* As a basic policy, do not clean indepe PlugNDrive module or printed circuit boards on which PlugNDrive module is mounted.

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