

# Automotive H-Bridge Driver

## Thermal Addendum

### Introduction

This thermal addendum is provided as a supplement to the MC33186 technical datasheet. The addendum provides thermal performance information that may be critical in the design and development of system applications. All electrical, application, and packaging information is provided in the datasheet.

### Package and Thermal Considerations

The MC33186 is offered in a 20 terminal HSOP exposed pad, single die package. There is a single heat source (P), a single junction temperature (T<sub>J</sub>), and thermal resistance (R<sub>θJA</sub>).

$$\{ T_J \} = [ R_{\theta JA} ] \cdot \{ P \}$$

The stated values are solely for a thermal performance comparison of one package to another in a standardized environment. This methodology is not meant to and will not predict the performance of a package in an application-specific environment. Stated values were obtained by measurement and simulation according to the standards listed below.

### Standards

Table 1. Thermal Performance Comparison

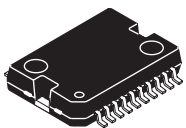
Thermal Resistance	[°C/W]
R <sub>θJA</sub> <sup>(1), (2)</sup>	29
R <sub>θJB</sub> <sup>(2), (3)</sup>	9.0
R <sub>θJA</sub> <sup>(1), (4)</sup>	69
R <sub>θJC</sub> <sup>(5)</sup>	2.0

Notes:

1. Per JEDEC JESD51-2 at natural convection, still air condition.
2. 2s2p thermal test board per JEDEC JESD51-5 and JESD51-7.
3. Per JEDEC JESD51-8, with the board temperature on the center trace near the center lead.
4. Single layer thermal test board per JEDEC JESD51-3 and JESD51-5.
5. Thermal resistance between the die junction and the exposed pad surface; cold plate attached to the package bottom side, remaining surfaces insulated.

**33186DH**

**20-TERMINAL HSOP-EP**



**DH1 SUFFIX**  
**VW1 SUFFIX (PB-FREE)**  
**98ASH70273A**  
**20-TERMINAL HSOP-EP**

**Note** For package dimensions, refer to the 33186 data sheet.

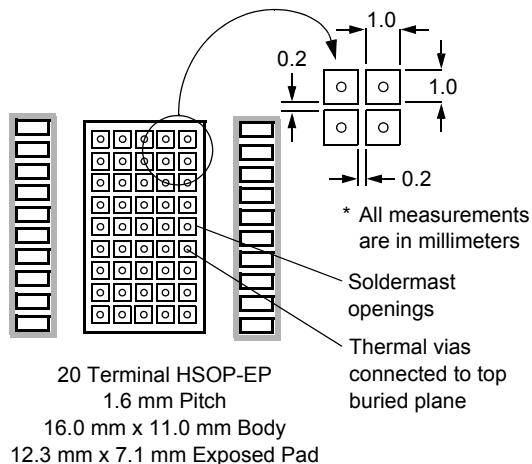
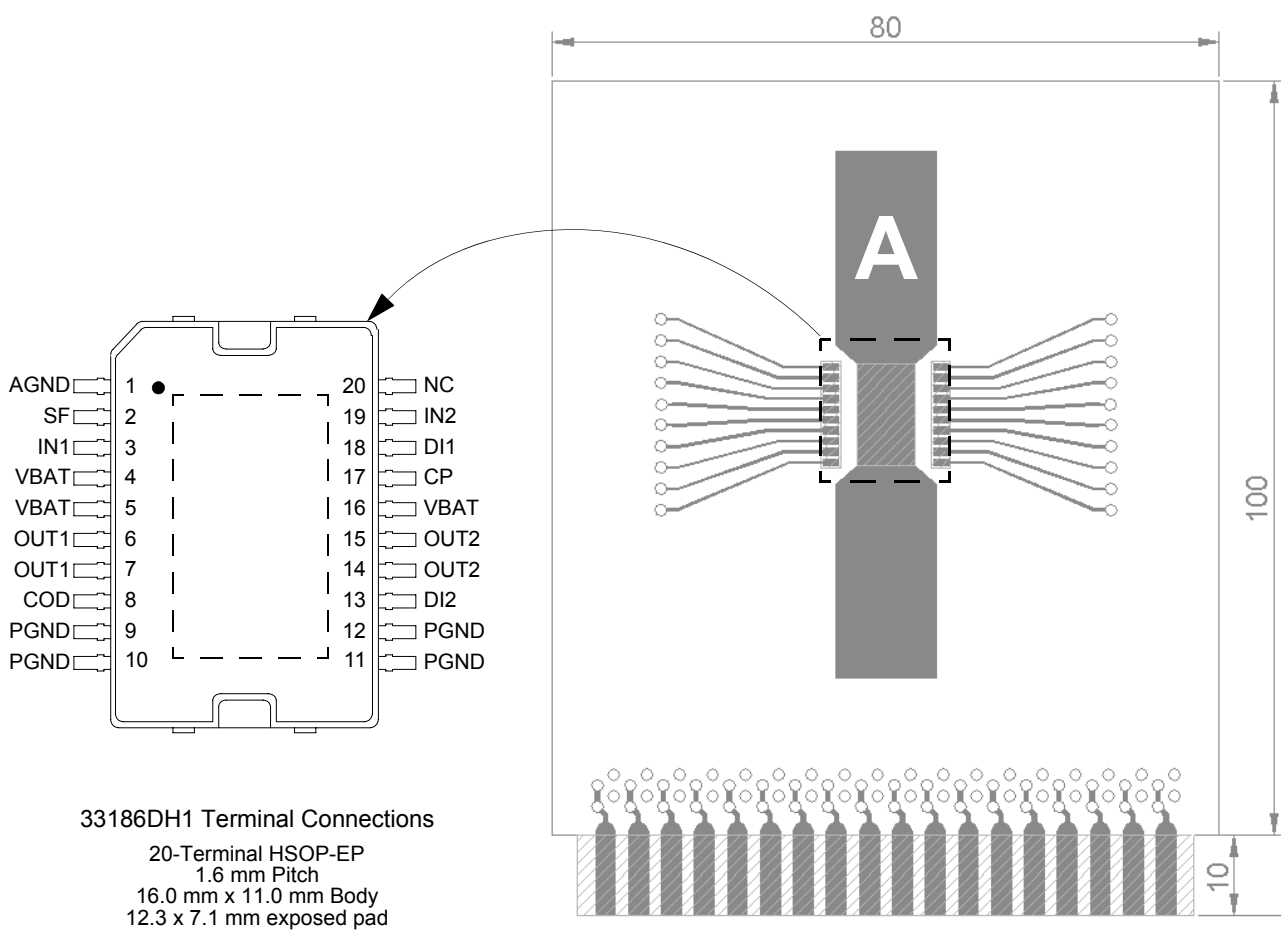


Figure 1. Thermal Land Pattern for Direct Thermal Attachment According to JESD51-5



**33186DH1 Terminal Connections**  
 20-Terminal HSOP-EP  
 1.6 mm Pitch  
 16.0 mm x 11.0 mm Body  
 12.3 x 7.1 mm exposed pad

**Figure 2. Thermal Test Board**

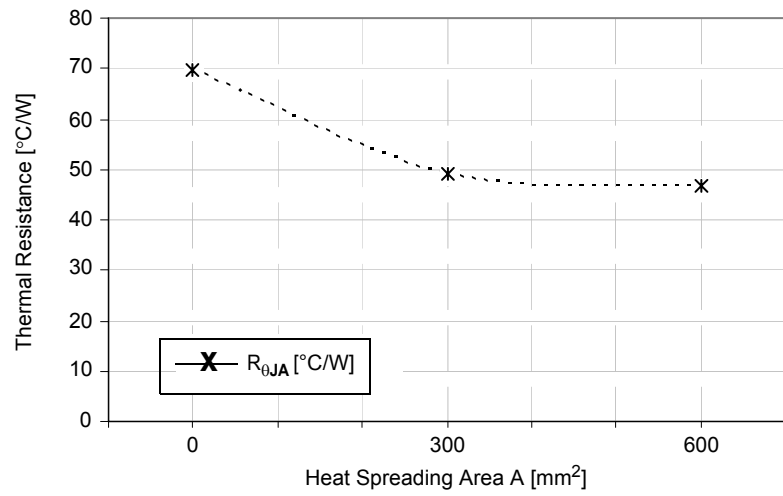
**Device on Thermal Test Board**

- Material:** Single layer printed circuit board  
FR4, 1.6 mm thickness  
Cu traces, 0.07 mm thickness
- Outline:** 80 mm x 100 mm board area,  
including edge connector for  
thermal testing
- Area A:** Cu heat-spreading areas on board  
surface
- Ambient Conditions:** Natural convection, still air

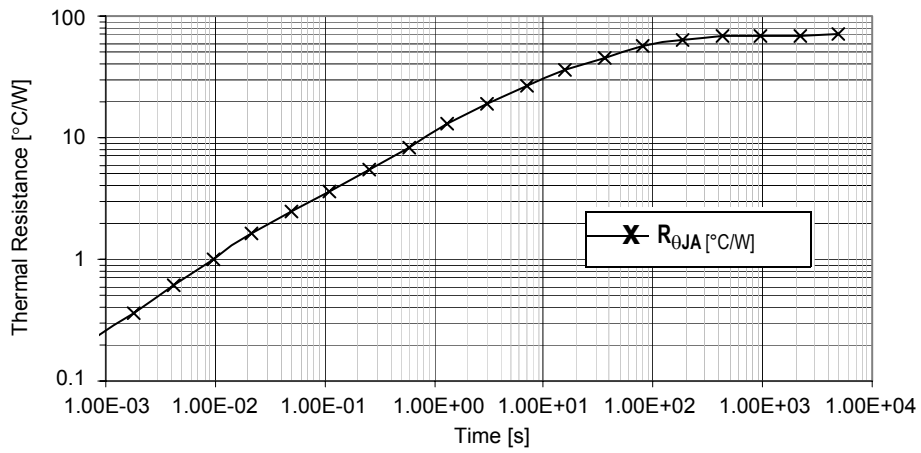
**Table 2. Thermal Resistance Performance**

A [mm <sup>2</sup> ]	R <sub>θJA</sub> [°C/W]
0	70
300	49
600	47

R<sub>θJA</sub> is the thermal resistance between die junction and ambient air.



**Figure 3. Device on Thermal Test Board  $R_{\theta JA}$**



**Figure 4. Transient Thermal Resistance  $R_{\theta JA}$   
1 W Step Response, Device on Thermal Test Board Area A = 600 (mm<sup>2</sup>)**

## How to Reach Us:

### Home Page:

[www.freescale.com](http://www.freescale.com)

### E-mail:

[support@freescale.com](mailto:support@freescale.com)

### USA/Europe or Locations Not Listed:

Freescale Semiconductor  
Technical Information Center, CH370  
1300 N. Alma School Road  
Chandler, Arizona 85224  
+1-800-521-6274 or +1-480-768-2130  
[support@freescale.com](mailto:support@freescale.com)

### Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
81829 Muenchen, Germany  
+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
[support@freescale.com](mailto:support@freescale.com)

### Japan:

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
[support.japan@freescale.com](mailto:support.japan@freescale.com)

### Asia/Pacific:

Freescale Semiconductor Hong Kong Ltd.  
Technical Information Center  
2 Dai King Street  
Tai Po Industrial Estate  
Tai Po, N.T., Hong Kong  
+800 2666 8080  
[support.asia@freescale.com](mailto:support.asia@freescale.com)

### For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center  
P.O. Box 5405  
Denver, Colorado 80217  
1-800-441-2447 or 303-675-2140  
Fax: 303-675-2150  
[LDCForFreescaleSemiconductor@hibbertgroup.com](mailto:LDCForFreescaleSemiconductor@hibbertgroup.com)

RoHS-compliant and/or Pb-free versions of Freescale products have the functionality and electrical characteristics of their non-RoHS-compliant and/or non-Pb-free counterparts. For further information, see <http://www.freescale.com> or contact your Freescale sales representative.

For information on Freescale's Environmental Products program, go to <http://www.freescale.com/epp>.

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should a Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, the Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc., 2006. All rights reserved.