# Thermal Data for Avago Optocouplers

## Application Note 1087

### Introduction

This document contains steady state thermal models for optocouplers based on empirical data and theoretical extrapolation.

Seven thermal models have been chosen to suit the type of optocoupler:

- Thermal Model-A for a hermetic-package optocoupler
- Thermal Model-B for a single-channel plastic-package optocoupler
- Thermal Model-C for a single-channel HCPL-3700/60 optocoupler with input buffer circuit
- Thermal Model-D for a dual-channel plastic-package optocoupler
- Thermal Model-E for a Single-Channel Optocoupler with input buffer circuit
- Thermal Model-F for a single channel SO-5 plastic-package optocoupler
- Thermal Model-G for a dual channel SO-16 plastic-package optocoupler
- Thermal Model-H for a Quad channel SO-16 plastic-package optocoupler
- Thermal Model-I for a dual-channel bi-directional SO-8 plastic-package optocoupler

The thermal data in each of these models allows the user to calculate the approximate junction temperatures at various nodes in the optocoupler. The actual semiconductor junction temperatures may vary based upon the heat flows from the surrounding components on the printed circuit board. Each of the models assumes that the optocoupler is either soldered to a printed circuit board (PCB) or placed in a socket, which is soldered on a PCB. The PCB is further assumed to be in still air. In models that define the optocoupler case to be a node, the case-to-ambient thermal resistance will depend on the board design and the placement of the optocoupler. The package case temperature is measured at the center of the package bottom.

The data presented in each of these models is approximate and is meant to be an indicator, not a specification. To ensure reliability, the semiconductor junction temperatures in plastic-package optocouplers must not exceed 125 °C, and in hermetic-package optocouplers it must not exceed 175 °C unless otherwise specified.

All thermal data in this document are taken from testing on Avago Technologies devices. They are not transferable to other manufacturers' part types.

**Table 1. Optocoupler Thermal Model Index.**

| Part Number | Thermal Model Type | Comments |
|---|---|---|
| 4N45/6 | Model-B | Approximates 6N138 data |
| 4N55 | Model-A | |
| 6N134 | Model-A | |
| 6N135/6/7/8/9 | Model-B | |
| 6N140 | Model-A | |
| ACSL-6210 | Model-I | |
| ACSL-6300 | Model-H | Approximates ACSL-6400 data, omit LED4 and IC5 |
| ACSL-6310 | Model-H | Approximates ACSL-6400 data, omit LED1 and IC8 |
| ACSL-6400/6410/6420 | Model-H | |
| HCNW135/6/7, HCNW4502/3, HCNW2601/11 | Model-B | |
| HCNW138/9, HCNW4562 | Model-B | Approximates HCNW135 data |
| HCNW2201/4504/4506 | Model-B | Approximates HCNW2601 data |
| HCPL-0452/3, -0500/1, -050L | Model-B | |
| HCPL-0201/11, -0454, -0466, -0600/01/11, -0708, -060L | Model-B | Approximates HCPL-0600 data |
| HCPL-0700/1, 070L | Model-B | |
| HCPL-0530/1/4, -0630/1, -0730/1, -053L, -063L, -073L | Model-D | Approximates HCPL-0738 data |
| HCPL-0370 | Model-E | |
| HCPL-0738 | Model-D | |
| HCPL-1930/1 | Model-A | |
| HCPL-2200/01/02/11/12/19 | Model-B | |
| HCPL-2231/2 | Model-D | Approximates HCPL-2430 data |
| HCPL-2300 | Model-B | Approximates HCPL-2601 data |
| HCPL-2400/11 | Model-B | |
| HCPL-2430 | Model-D | |
| HCPL-2502/3, -250L | Model-B | Approximates 6N135 data |
| HCPL-2530/1/3, -253L | Model-D | Approximates HCPL-2430 data |
| HCPL-2601/11/12, -260L | Model-B | Approximates 6N137 data |
| HCPL-2630/1, -2730/1, -263L, -273L | Model-D | Approximates HCPL-2430 data |
| HCPL-3000, 3100/1 | | Refer to Application Note 1058 |
| HCPL-3120/3150/3180 | | Refer to HCPL-3120/3150/3180 data sheet |
| HCPL-314J | Model-G | Approximates HCPL-315J data |
| HCPL-315J | Model-G | |
| HCPL-316J | | Refer to HCPL-316J data sheets |
| HCPL-3700/3760 | Model-C | |
| HCPL-4100/4200 | Model-C | Approximates HCPL-3700 data |
| HCPL-4502/3/4/6 | Model-B | Approximates 6N135 data |
| HCPL-4534 | Model-D | Approximates HCPL-2430 data |
| HCPL-4562 | Model-B | Approximates 6N135 data |
| HCPL-4661 | Model-D | Approximates HCPL-2430 data |
| HCPL-4701 | Model-B | Approximates 6N138 data |
| HCPL-4731 | Model-D | Approximates HCPL-2430 data |
| HCPL-52XX, -54XX, -55XX, -56XX, -57XX, -62XX, -64XX, -65XX | Model-A | |
| HCPL-7100/01 | Model-E | |
| HCPL-7710, -7720, -7721, -7723 | Model-E | Approximates HCPL-7100 data |
| HCPL-0710, -0720, -0721, -0723 | Model-E | Approximates HCPL-0370 data |
| HCPL-7601/7611 | Model-B | Approximates 6N137 data |
| HCPL-7800/40, -7510/20, | Model-C | Approximates HCPL-3700 data |
| HCPL-7860/786J | | Refer to HCPL-7860/786J data sheet |
| HSSR-7110 | | Refer to HSSR-7110 data sheet |
| HCPL-M600/601/611 | Model-F | |
| HCPL-M452/3/4/6, -M700/701 | Model-F | Approximates HCPL-M600/601/611 data |

## Thermal Model-A for a Hermetic-Package Optocoupler

### Definitions

$\theta_{E-C}$: Thermal resistance from emitter (input LED) junction to package case.

$\theta_{D-C}$: Thermal resistance from detector (output IC) junction to package case.

$\theta_{C-A}$: Thermal resistance from package case to ambient. The value $\theta_{C-A}$ depends on the heat flows from surrounding components, and can be estimated to be in the range of 70 °C/W to 210 °C/W (see Note 5).

Package Case Temperature: Measured at center of package bottom, with no forced air. Ambient Temperature: Measured approximately 15 cm above the package.

### Description

This thermal model assumes that an 8- or 16-pin dual-in-line package hermetic optocoupler is inserted into an IC socket, which is soldered into a 7.5 cm x 7.5 cm printed circuit board (PCB). The PCB is suspended in still air.

Thermal resistance values shown in the above figure can be used for calculating the temperatures at each node for a given operating condition. The thermal resistance between the LED and other internal nodes is very large in comparison with the terms shown in the figure, and is omitted for simplicity

For optocouplers that have more than one channel, the same values for $\theta_{E-C}$ and $\theta_{D-C}$ can be assumed to be in parallel, as shown by the dotted lines, for each of the additional LED and detector. Again, the direct thermal resistance between any two LEDs, any two detectors, or an LED and a detector is very large in comparison to $\theta_{E-C}$ and $\theta_{D-C}$, and may be omitted.

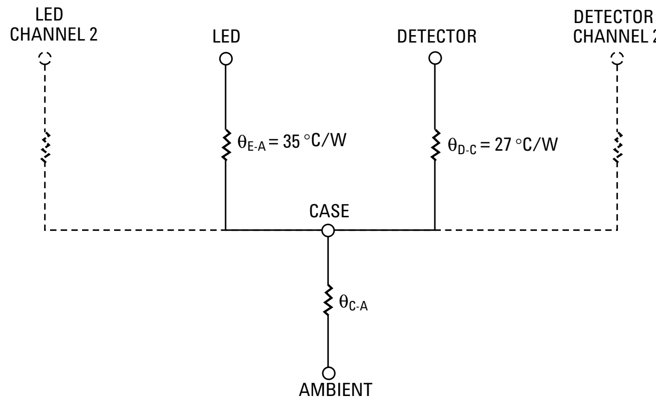



**Figure 1. Thermal Model-A Diagram**

Notes:

1. Above model is applicable for HCPL-52XX, -54XX, -55XX, -56XX, -57XX, -62XX, 64XX, -65XX, -66XX, -67XX; 4N55; 6N134; and 6N140.
2. For HSSR-7100/1 thermal model, refer to its data sheet.
3. HCPL-193X and HCPL-576X have an input buffer IC. The above model may be used for these optocouplers with an assumption that the Input Buffer IC and LED are a common node. The thermal resistance of this common node to case is approximately 35 °C/W.
4. Maximum Junction Temperature for HSSR-7110/1: 150 °C; for all other hermetic optocouplers: 175 °C.
5. The thermal data in this model assumes the optocoupler is inserted into a socket. Thermal resistance $\theta_{C-A}$ is likely to be lower when the optocoupler is soldered to a printed circuit board.

## Thermal Model-B for a Single-Channel Plastic-Package Optocoupler

### Definitions

$\theta_1$: Thermal resistance from LED junction to ambient

$\theta_2$: Thermal resistance from LED to detector (output IC)

$\theta_3$: Thermal resistance from detector (output IC) junction to ambient

Ambient Temperature: Measured approximately 1.25 cm above the optocoupler, with no forced air.

### Description

This thermal model assumes that an 8-pin single-channel plastic package optocoupler is soldered into an 8.5 cm x 8.1 cm printed circuit board (PCB). The temperature at the LED and Detector junctions of the optocoupler can be calculated using the equations below.

$\Delta T_{EA} = A_{11}P_E + A_{12}P_D$

$\Delta T_{DA} = A_{21}P_E + A_{22}P_D$

where:

$\Delta T_{EA}$ = Temperature difference between ambient and LED

$\Delta T_{DA}$ = Temperature difference between ambient and detector

$P_E$ = Power dissipation from LED

$P_D$ = Power dissipation from detector

$A_{11}$, $A_{12}$, $A_{21}$, $A_{22}$ thermal coefficients (units in °C/W) are functions of the thermal resistance $\theta_1$, $\theta_2$, $\theta_3$ (See Note 2).

**Table 2. Thermal Model-B Coefficient Data (units in °C/W).**

| Part Number | $A_{11}$ | $A_{12}$, $A_{21}$ | $A_{22}$ |
|---|---|---|---|
| 6N135/6, HCPL-4503 | 323 | 154 | 225 |
| HCNW135/6, HCNW4502/3 | 220 | 61 | 166 |
| HCPL-0500/1, HCPL-0452/3 | 409 | 201 | 295 |
| HCNW137, HCNW2601/11 | 219 | 51 | 139 |
| HCPL-0600/01/11 | 455 | 216 | 308 |
| HCPL-0700/1 | 396 | 193 | 290 |
| HCPL-2200/01/02/11/12 | 304 | 149 | 216 |
| HCPL-2400/11 | 337 | 139 | 215 |

Notes:

1. Maximum junction temperature for above parts: 125 °C.
2. $A_{11} = \theta_1 \,||\, (\theta_2 + \theta_3)$; $A_{12} = A_{21} = (\theta_1 \theta_2) / (\theta_1 + \theta_2 + \theta_3)$; $A_{22} = \theta_3 \,||\, (\theta_2 + \theta_3)$.

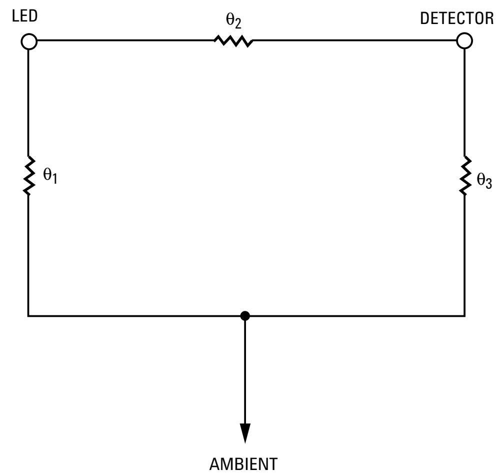



**Figure 2. Thermal Model-B Diagram**

## Thermal Model-C for HCPL-3700/60 Optocoupler with Input Buffer Circuit

### Definitions

θ1: Thermal resistance from LED/input-buffer IC junctions to ambient

θ2: Thermal resistance from detector IC junction to ambient

Ambient Temperature: Measured approximately 1.25 cm above package, with no forced air.

### Description

Thermal resistance values shown in the above figure can be used for calculating the temperatures at each node for a given operating condition. For simplification, the LED and the Input Buffer IC are assumed to be at the same node.

Furthermore, the thermal resistance between the LED and detector are very large in comparison with the terms shown in the figure, and are omitted for simplicity.

$\Delta T_{EA} = \theta_1 P_E$

$\Delta T_{DA} = \theta_2 P_D$

where:

$\Delta T_{EA}$ = Temperature difference between ambient and LED

$\Delta T_{DA}$ = Temperature difference between ambient and detector

$P_E$ = Power dissipation from LED

$P_D$ = Power dissipation from detector

Note:

1 Maximum junction temperature for above part: 125 °C.

2. Please refer to Thermal Model-E that is simulated with three dies.

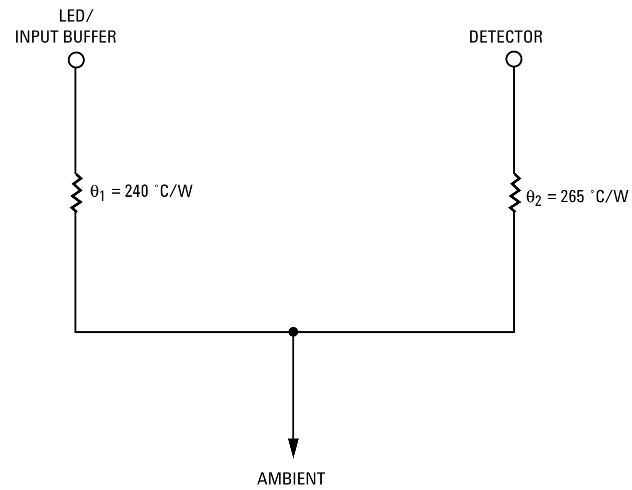



**Figure 3. Thermal Model-C Diagram**

## Thermal Model-D for a Dual-Channel Plastic-Package Optocoupler

### Definitions

$\theta_1$, $\theta_2$, $\theta_3$, $\theta_4$, $\theta_5$, $\theta_6$, $\theta_7$, $\theta_8$, $\theta_9$, $\theta_{10}$: Thermal resistances between nodes as shown in Figure 4.

Ambient Temperature: Measured approximately 1.25 cm above the optocoupler HCPLl-2430 with no forced air and 2.54cm around the optocoupler HCPL-0738 with no forced air.

### Description

HCPL-2430 thermal model assumes that an 8-pin dual-channel plastic package optocoupler is soldered into an 8.5 cm x 8.1 cm printed circuit board (PCB). HCPL-0738 thermal model assumes that a SO-8 plastic package optocoupler is soldered into a 7.62 cm x 7.62 cm low K board. These optocouplers are hybrid devices with four die: two LEDs and two detectors. The temperature at the LED and the detector of the optocoupler can be calculated by using the equations below.

$\Delta T_{E1A} = A_{11}P_{E1} + A_{12}P_{E2} + A_{13}P_{D1} + A_{14}P_{D2}$

$\Delta T_{E2A} = A_{21}P_{E1} + A_{22}P_{E2} + A_{23}P_{D1} + A_{24}P_{D2}$

$\Delta T_{D1A} = A_{31}P_{E1} + A_{32}P_{E2} + A_{33}P_{D1} + A_{34}P_{D2}$

$\Delta T_{D2A} = A_{41}P_{E1} + A_{42}P_{E2} + A_{43}P_{D1} + A_{44}P_{D2}$

where:

$\Delta T_{E1A}$ = Temperature difference between ambient and LED 1

$\Delta T_{E2A}$ = Temperature difference between ambient and LED 2

$\Delta T_{D1A}$ = Temperature difference between ambient and detector 1

$\Delta T_{D2A}$ = Temperature difference between ambient and detector 2

$P_{E1}$ = Power dissipation from LED 1;

$P_{E2}$ = Power dissipation from LED 2;

$P_{D1}$ = Power dissipation from detector 1;

$P_{D2}$ = Power dissipation from detector 2

$A_{XY}$ thermal coefficient (units in °C/W) is a function of thermal resistances $\theta_1$ through $\theta_{10}$.

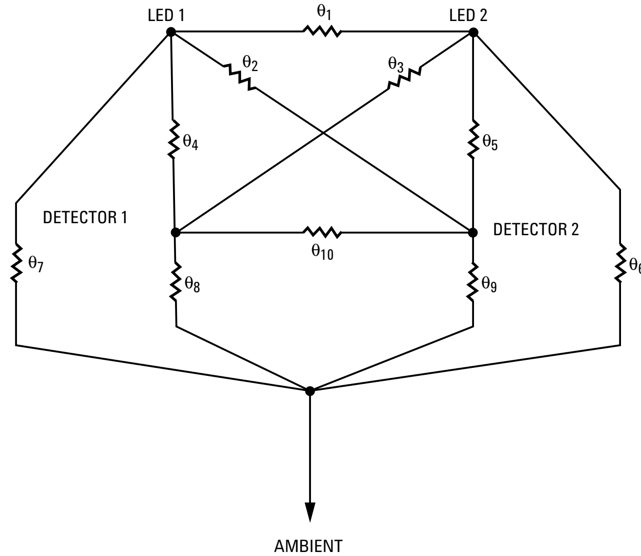



Figure 4. Thermal Model-D Diagram

**Table 3. Thermal Model-D Coefficient Data (units in °C/W).**

| Part Number | $A_{11}$, $A_{22}$ | $A_{12}$, $A_{21}$ | $A_{13}$, $A_{31}$ | $A_{14}$, $A_{41}$ | $A_{23}$, $A_{32}$ | $A_{24}$, $A_{42}$ | $A_{33}$, $A_{44}$ | $A_{34}$, $A_{43}$ |
|---|---|---|---|---|---|---|---|---|
| HCPL-2430 | 308 | 92 | 101 | 91 | 91 | 101 | 162 | 112 |
| HCPL-0738 | 383 | 188 | 179 | 196 | 193 | 178 | 249 | 200 |

Note: Maximum junction temperature for above part: 125 °C.

## Thermal Model-E for a Single-Channel Optocoupler with Input Buffer Circuit

### Definitions

$\theta_1$, $\theta_2$, $\theta_3$, $\theta_4$, $\theta_5$, $\theta_6$: Thermal resistances between nodes as shown in Figure 5.

Ambient Temperature: Measured approximately 1.25 cm above the optocoupler HCPL-7100/01 with no forced air and 2.54cm around the optocoupler HCPL-0370 with no forced air.

### Description

HCPL-7100/1 thermal model assumes that the optocoupler is soldered into an 8.5 cm x 8.1 cm printed circuit board (PCB). HCPL-0370 thermal model assumes that the optocoupler is soldered into a 7.62 cm x 7.62 cm low K board. These couplers are hybrid devices with three die: an input IC that drives the LED, an LED, and the detector IC. The temperature at the input IC, LED, and detector of this optocoupler can be calculated be using the equations below.

$$\Delta T_{IA} = A_{11}P_I + A_{12}P_E + A_{13}P_D$$

$$\Delta T_{EA} = A_{21}P_I + A_{22}P_E + A_{23}P_D$$

$$\Delta T_{DA} = A_{31}P_I + A_{32}P_E + A_{33}P_D$$

where:

$\Delta T_{IA}$ = Temperature difference between ambient and input IC

$\Delta T_{EA}$ = Temperature difference between ambient and LED

$\Delta T_{DA}$ =Temperature difference between ambient and detector

$P_I$ = Power dissipation from input IC (Typical: 25 mW)

$P_E$ = Power dissipation from LED (Typical: 10 mW when input Logic Low; less than 0.01 mW when input Logic High)

$P_D$ = Power dissipation from detector (Typical 30 mW)

$A_{11}$ through $A_{33}$ thermal coefficients (units in °C/W) are functions of thermal resistances $\theta_1$, $\theta_2$, $\theta_3$, $\theta_4$, $\theta_5$, $\theta_6$.

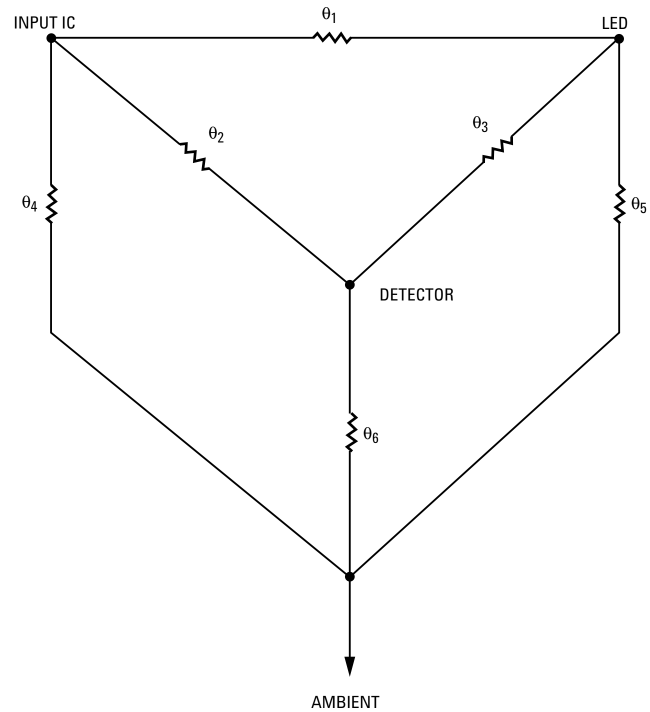



**Figure 5. Thermal Model-E Diagram**

**Table 4. Thermal Model-E Coefficient Data (units in °C/W).**

| Part Number | $A_{11}$ | $A_{12}$ | $A_{13}$ | $A_{21}$ | $A_{22}$ | $A_{23}$ | $A_{31}$ | $A_{32}$ | $A_{33}$ |
|---|---|---|---|---|---|---|---|---|---|
| HCPL-7100/1 | 206 | 133 | 103 | 133 | 299 | 115 | 103 | 115 | 193 |
| HCPL-0370 | 240 | 191 | 141 | 205 | 328 | 167 | 165 | 173 | 255 |

Note: Maximum junction temperature for above part: 125 °C.

## Thermal Model-F for a Single-Channel SO-5 Plastic-Package Optocoupler

### Definitions

$\theta_1$: Thermal resistance from LED junction to ambient

$\theta_2$: Thermal resistance from LED to detector (output IC)

$\theta_3$: Thermal resistance from detector (output IC) junction to ambient

Ambient Temperature: Measured approximately 2.54 cm around the optocoupler with no forced air.

### Description

This thermal model assumes that a 5-pin single-channel plastic package optocoupler is soldered into a 7.62 cm x 7.62 cm low K printed circuit board (PCB). The temperature at the LED and Detector junctions of the optocoupler can be calculated using the equations below.

$$\Delta T_{EA} = A_{11}P_E + A_{12}P_D$$

$$\Delta T_{DA} = A_{21}P_E + A_{22}P_D$$

where:

$\Delta T_{EA}$ = Temperature difference between ambient and LED

$\Delta T_{DA}$ = Temperature difference between ambient and detector

$P_E$ = Power dissipation from LED

$P_D$ = Power dissipation from detector

$A_{11}$, $A_{12}$, $A_{21}$, $A_{22}$ thermal coefficients (units in °C/W) are functions of the thermal resistances $\theta_1$, $\theta_2$, $\theta_3$ (See Note 2).

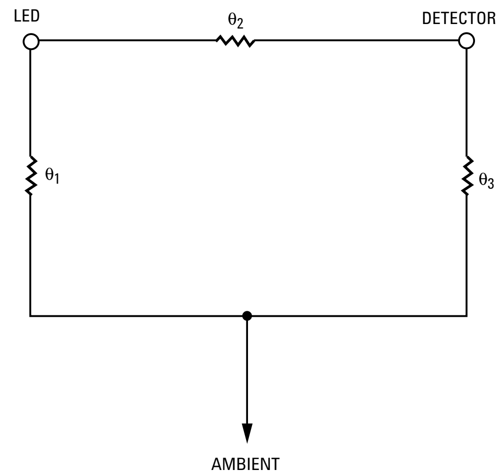



**Figure 6. Thermal Model-F Diagram**

**Table 5. Thermal Model-F Coefficient Data (units in °C/W).**

| Part Number | $A_{11}$ | $A_{12}$, $A_{21}$ | $A_{22}$ |
|---|---|---|---|
| HCPL-M601/M611 | 399 | 223 | 282 |

Notes:
1. Maximum junction temperature for above parts: 125 °C.
2. $A_{11} = \theta_1 \,||\, (\theta_2 + \theta_3)$; $A_{12} = A_{21} = (\theta_1 \theta_2) / (\theta_1 + \theta_2 + \theta_3)$; $A_{22} = \theta_3 \,||\, (\theta_2 + \theta_3)$.

## Thermal Model-G for a Dual-Channel SO-16 Plastic-Package Optocoupler

### Definitions

$\theta_1$, $\theta_2$, $\theta_3$, $\theta_4$, $\theta_5$, $\theta_6$, $\theta_7$, $\theta_8$, $\theta_9$, $\theta_{10}$: Thermal resistances between nodes as shown in Figure 7.

Ambient Temperature: Measured 1.25 cm above the optocoupler with no forced air.

### Description

This thermal model assumes that a 16-pin dual-channel plastic package optocoupler is soldered into an 8.5 cm x 8.1 cm printed circuit board. These optocouplers are hybrid devices with four die: two LEDs and two detectors. The temperature at the LED and the detector of the optocoupler can be calculated by using the equations below.

$\Delta T_{E1A} = A_{11}P_{E1} + A_{12}P_{E2} + A_{13}P_{D1} + A_{14}P_{D2}$

$\Delta T_{E2A} = A_{21}P_{E1} + A_{22}P_{E2} + A_{23}P_{D1} + A_{24}P_{D2}$

$\Delta T_{D1A} = A_{31}P_{E1} + A_{32}P_{E2} + A_{33}P_{D1} + A_{34}P_{D2}$

$\Delta T_{D2A} = A_{41}P_{E1} + A_{42}P_{E2} + A_{43}P_{D1} + A_{44}P_{D2}$

Where:

$\Delta T_{E1A}$ = Temperature difference between ambient and LED 1

$\Delta T_{E2A}$ = Temperature difference between ambient and LED 2

$\Delta T_{D1A}$ = Temperature difference between ambient and detector 1

$\Delta T_{D2A}$ = Temperature difference between ambient and detector 2

$P_{E1}$ = Power dissipation from LED 1;

$P_{E2}$ = Power dissipation from LED 2;

$P_{D1}$ = Power dissipation from detector 1;

$P_{D2}$ = Power dissipation from detector 2

$A_{XY}$ thermal coefficient (units in °C/W) is a function of thermal resistances $\theta_1$ through $\theta_{10}$.

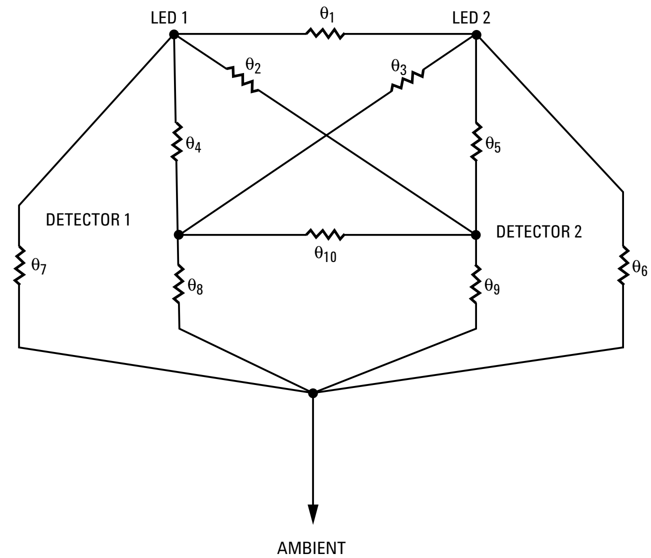


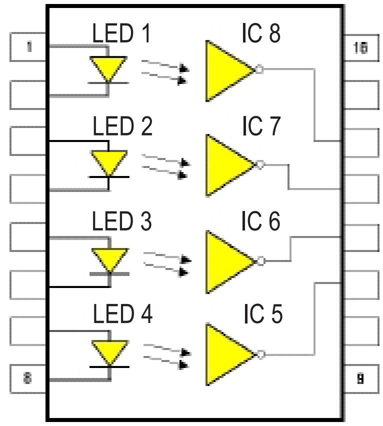

**Figure 7. Thermal Model-G Diagram**

**Table 6. Thermal Model-D Coefficient Data (units in °C/W).**

| Part Number | $A_{11}$, $A_{22}$ | $A_{12}$, $A_{21}$ | $A_{13}$, $A_{31}$ | $A_{14}$, $A_{41}$ | $A_{23}$, $A_{32}$ | $A_{24}$, $A_{42}$ | $A_{33}$, $A_{44}$ | $A_{34}$, $A_{43}$ |
|---|---|---|---|---|---|---|---|---|
| HCPL-315J | 198 | 64 | 62 | 83 | 90 | 64 | 137 | 69 |

Note: Maximum junction temperature for above part: 125 °C.

## Thermal Model-H for a Quad Channel SOIC-16 Plastic-Package Optocoupler




### Definitions

$A_{11}$, $A_{12}$, $A_{13}$, $A_{14}$, $A_{15}$, $A_{16}$, $A_{17}$, $A_{18}$, $A_{21}$, $A_{22}$, $A_{23}$, $A_{24}$, $A_{25}$, $A_{26}$, $A_{27}$, $A_{28}$, $A_{31}$, $A_{32}$, $A_{33}$, $A_{34}$, $A_{35}$, $A_{36}$, $A_{37}$, $A_{38}$, $A_{41}$, $A_{42}$, $A_{43}$, $A_{44}$, $A_{45}$, $A_{46}$, $A_{47}$, $A_{48}$, $A_{51}$, $A_{52}$, $A_{53}$, $A_{54}$, $A_{55}$, $A_{56}$, $A_{57}$, $A_{58}$, $A_{61}$, $A_{62}$, $A_{63}$, $A_{64}$, $A_{65}$, $A_{66}$, $A_{67}$, $A_{68}$, $A_{71}$, $A_{72}$, $A_{73}$, $A_{74}$, $A_{75}$, $A_{76}$, $A_{77}$, $A_{78}$, $A_{81}$, $A_{82}$, $A_{83}$, $A_{84}$, $A_{85}$, $A_{86}$, $A_{87}$, $A_{88}$ :Thermal Coefficients (in °C/W) as a function of Thermal Resistances between nodes.

$A_{11}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 1

$A_{12}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 2

$A_{13}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 3

$A_{14}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 4

$A_{15}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 5

$A_{16}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 6

$A_{17}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 7

$A_{18}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 8

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$A_{81}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of LED 1

$A_{82}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of LED 2

$A_{83}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of LED 3

$A_{84}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of LED 4

$A_{85}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of IC 5

$A_{86}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of IC 6

$A_{87}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of IC 7

$A_{88}$: Thermal Coefficient as a function of Thermal Resistance of IC 8 due to heating of IC 8

Ambient Temperature: Measured approximately 8.89 cm horizontally and 2.54 cm vertically below from the edge of the test board.

### Description

ACSL-6400 thermal model assumes that a 16 pin narrow body SOIC plastic package optocoupler ACSL-6400 is soldered onto a low conductivity 7.62 cm x 7.62 cm board per JESD 51-3. The quad channel optocouplers are hybrid devices with eight die: four LEDs and four ICs. The temperature at the LED and the IC of the optocoupler can be calculated by using the equations below:

$$\Delta T_{E1A} = A_{11}P_{E1} + A_{12}P_{E2} + A_{13}P_{E3} + A_{14}P_{E4} + A_{15}P_{D5} + A_{16}P_{D6} + A_{17}P_{D7} + A_{18}P_{D8}$$

$$\Delta T_{E2A} = A_{21}P_{E1} + A_{22}P_{E2} + A_{23}P_{E3} + A_{24}P_{E4} + A_{25}P_{D5} + A_{26}P_{D6} + A_{27}P_{D7} + A_{28}P_{D8}$$

$$\Delta T_{E3A} = A_{31}P_{E1} + A_{32}P_{E2} + A_{33}P_{E3} + A_{34}P_{E4} + A_{35}P_{D5} + A_{36}P_{D6} + A_{37}P_{D7} + A_{38}P_{D8}$$

$$\Delta T_{E4A} = A_{41}P_{E1} + A_{42}P_{E2} + A_{43}P_{E3} + A_{44}P_{E4} + A_{45}P_{D5} + A_{46}P_{D6} + A_{47}P_{D7} + A_{48}P_{D8}$$

$$\Delta T_{D5A} = A_{51}P_{E1} + A_{52}P_{E2} + A_{53}P_{E3} + A_{54}P_{E4} + A_{55}P_{D5} + A_{56}P_{D6} + A_{57}P_{D7} + A_{58}P_{D8}$$
$$\Delta T_{D6A} = A_{61}P_{E1} + A_{62}P_{E2} + A_{63}P_{E3} + A_{64}P_{E4} + A_{65}P_{D5} + A_{66}P_{D6} + A_{67}P_{D7} + A_{68}P_{D8}$$
$$\Delta T_{D7A} = A_{71}P_{E1} + A_{72}P_{E2} + A_{73}P_{E3} + A_{74}P_{E4} + A_{75}P_{D5} + A_{76}P_{D6} + A_{77}P_{D7} + A_{78}P_{D8}$$
$$\Delta T_{D8A} = A_{81}P_{E1} + A_{82}P_{E2} + A_{83}P_{E3} + A_{84}P_{E4} + A_{85}P_{D5} + A_{86}P_{D6} + A_{87}P_{D7} + A_{88}P_{D8}$$

where:

$\Delta T_{E1A}$ : Temperature difference between ambient and LED 1

$\Delta T_{E2A}$ : Temperature difference between ambient and LED 2

$\Delta T_{E3A}$ : Temperature difference between ambient and LED 3

$\Delta T_{E4A}$ : Temperature difference between ambient and LED 4

$\Delta T_{D5A}$ : Temperature difference between ambient and IC 5

$\Delta T_{D6A}$ : Temperature difference between ambient and IC 6

$\Delta T_{D7A}$ : Temperature difference between ambient and IC 7

$\Delta T_{D8A}$ : Temperature difference between ambient and IC 8

$P_{E1}$ = Power dissipation from LED 1

$P_{E2}$ = Power dissipation from LED 2

$P_{E3}$ = Power dissipation from LED 3

$P_{E4}$ = Power dissipation from LED 4

$P_{D5}$ = Power dissipation from IC 5

$P_{D6}$ = Power dissipation from IC 6

$P_{D7}$ = Power dissipation from IC 7

$P_{D8}$ = Power dissipation from IC 8

**Table 7. Thermal Model-H Coefficient Data (units in °C/W)**
**Part Number: ACSL-6400**

| **A11** | **A12** | **A13** | **A14** | **A15** | **A16** | **A17** | **A18** | **A21** | **A22** | **A23** | **A24** | **A25** | **A26** | **A27** | **A28** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 496 | 136 | 115 | 113 | 107 | 112 | 116 | 121 | 137 | 516 | 131 | 119 | 113 | 116 | 122 | 118 |
| **A31** | **A32** | **A33** | **A34** | **A35** | **A36** | **A37** | **A38** | **A41** | **A42** | **A43** | **A44** | **A45** | **A46** | **A47** | **A48** |
| 121 | 138 | 486 | 141 | 121 | 125 | 118 | 117 | 124 | 134 | 148 | 509 | 132 | 130 | 125 | 120 |
| **A51** | **A52** | **A53** | **A54** | **A55** | **A56** | **A57** | **A58** | **A61** | **A62** | **A63** | **A64** | **A65** | **A66** | **A67** | **A68** |
| 96 | 102 | 111 | 114 | 117 | 114 | 101 | 105 | 102 | 110 | 108 | 107 | 115 | 114 | 116 | 112 |
| **A71** | **A72** | **A73** | **A74** | **A75** | **A76** | **A77** | **A78** | **A81** | **A82** | **A83** | **A84** | **A85** | **A86** | **A87** | **A88** |
| 106 | 117 | 106 | 102 | 106 | 111 | 114 | 113 | 108 | 110 | 104 | 97 | 101 | 114 | 115 | 117 |

Note: Maximum junction temperature for above part: 125 °C.

## Thermal Model-I for a Dual-Channel Bi-Directional SOIC-8 Plastic-Package Optocoupler

### Definitions

$A_{11}$, $A_{12}$, $A_{13}$, $A_{14}$, $A_{21}$, $A_{22}$, $A_{23}$, $A_{24}$, $A_{31}$, $A_{32}$, $A_{33}$, $A_{34}$, $A_{41}$, $A_{42}$, $A_{43}$, $A_{44}$: Thermal Coefficients (in °C/W) as a function of Thermal Resistances between nodes.

$A_{11}$: Thermal Coefficient as a function of Thermal Resistance of LED 2 due to heating of LED 2

$A_{12}$: Thermal Coefficient as a function of Thermal Resistance of LED 2 due to heating of IC 1

$A_{13}$: Thermal Coefficient as a function of Thermal Resistance of LED 2 due to heating of LED 1

$A_{14}$: Thermal Coefficient as a function of Thermal Resistance of LED 2 due to heating of IC 2

$A_{21}$: Thermal Coefficient as a function of Thermal Resistance of IC 1 due to heating of LED 2

$A_{22}$: Thermal Coefficient as a function of Thermal Resistance of IC 1 due to heating of IC 1

$A_{23}$: Thermal Coefficient as a function of Thermal Resistance of IC 1 due to heating of LED 1

$A_{24}$: Thermal Coefficient as a function of Thermal Resistance of IC 1 due to heating of IC 2

$A_{31}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 2

$A_{32}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 1

$A_{33}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of LED 1

$A_{34}$: Thermal Coefficient as a function of Thermal Resistance of LED 1 due to heating of IC 2

$A_{41}$: Thermal Coefficient as a function of Thermal Resistance of IC 2 due to heating of LED 2

$A_{42}$: Thermal Coefficient as a function of Thermal Resistance of IC 2 due to heating of IC 1

$A_{43}$: Thermal Coefficient as a function of Thermal Resistance of IC 2 due to heating of LED 1

$A_{44}$: Thermal Coefficient as a function of Thermal Resistance of IC 2 due to heating of IC 2

Ambient Temperature: approximately 8.89 cm horizontally and 2.54 cm vertically below from the edge of the test board.

### Description

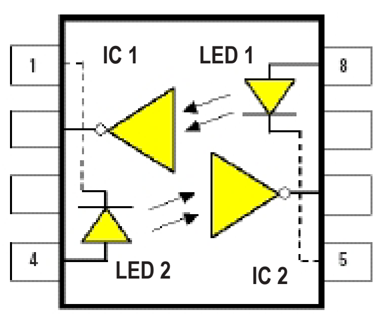
ACSL-6210 thermal model assumes that an 8 pin narrow body dual-channel bi-directional plastic package optocoupler is soldered onto a low conductivity 7.62 cm x 7.62 cm board per JESD 51-3. These optocouplers are hybrid devices with four die: two LEDs and two ICs. The temperature at the LED and the IC of the optocoupler can be calculated by using the equations below:

$\Delta T_{E2A} = A_{11}P_{E2} + A_{12}P_{D1} + A_{13}P_{E1} + A_{14}P_{D2}$

$\Delta T_{D1A} = A_{21}P_{E1} + A_{22}P_{D2} + A_{23}P_{E2} + A_{24}P_{D1}$

$\Delta T_{E1A} = A_{31}P_{E1} + A_{32}P_{D2} + A_{33}P_{E2} + A_{34}P_{D1}$

$\Delta T_{D2A} = A_{41}P_{E1} + A_{42}P_{D2} + A_{43}P_{E2} + A_{44}P_{D1}$




where:

$\Delta T_{E2A}$ : Temperature difference between ambient and LED 2

$\Delta T_{D1A}$ : Temperature difference between ambient and IC 1

$\Delta T_{E1A}$ : Temperature difference between ambient and LED 1

$\Delta T_{D2A}$ : Temperature difference between ambient and IC 2

$P_{E2}$ = Power dissipation from LED 2

$P_{D1}$ = Power dissipation from IC 1

$P_{E1}$ = Power dissipation from LED 1

$P_{D2}$ = Power dissipation from IC 2

**Table 8. Thermal Model-I Coefficient Data (units in °C/W)**
**Part Number: ACSL-6210**

| A11 | A12 | A13 | A14 | A21 | A22 | A23 | A24 | A31 | A32 | A33 | A34 | A41 | A42 | A43 | A44 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 560 | 120 | 121 | 184 | 117 | 209 | 179 | 109 | 117 | 186 | 526 | 116 | 166 | 100 | 106 | 203 |

Note: Maximum junction temperature for above part: 125 °C.

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**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