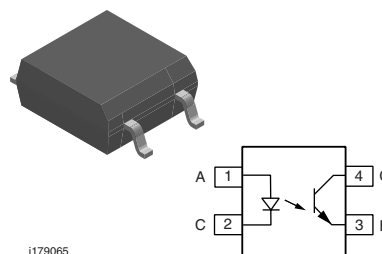


## Optocoupler, Phototransistor Output, SOP-4, Mini-Flat Package, 110 °C Rated

### Features

- Operating temperature from - 55 °C to + 110 °C
- SOP (Small Outline Package)
- Isolation Test Voltage, 3750 V<sub>RMS</sub> (1.0 s)
- High Collector-Emitter Breakdown Voltage, V<sub>CEO</sub> = 70 V
- Low Saturation Voltage
- Fast Switching Times
- Temperature Stable
- Low Coupling Capacitance
- End-Stackable, 0.100" (2.54 mm) Spacing
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



### Agency Approvals

- UL File #E52744 System Code U
- CUL - File No. E52744, equivalent to CSA bulletin 5A
- DIN EN 60747-5-2(VDE0884) Available with Option 1

### Applications

- High density mounting or space sensitive PCBs
- PLCs
- Telecommunication

### Description

The 110 °C rated SFH1690AT/BT/CT/ABT family has a GaAs infrared emitting diode emitter, which is optically coupled to a silicon planar phototransistor detec-

tor, and is incorporated in a 4 pin 100 mil lead pitch miniflat package. It features a high current transfer ratio, low coupling capacitance, and high isolation voltage.

The coupling devices are designed for signal transmission between two electrically separated circuits. The SFH1690 series is available only on tape and reel. There are 2000 parts per reel. Marking for SFH1690AT is SFH690A; SFH1690BT is SFH690B; SFH1690CT is SFH690C; SFH1690ABT will be marked as SFH1690A or SFH1690B.

### Order Information

| Part       | Remarks                |
|------------|------------------------|
| SFH1690ABT | CTR 50 - 300 %, SOP-4  |
| SFH1690AT  | CTR 50 - 150 %, SOP-4  |
| SFH1690BT  | CTR 100 - 300 %, SOP-4 |
| SFH1690CT  | CTR 100 - 200 %, SOP-4 |

For additional information on the available options refer to Option Information.

## Absolute Maximum Ratings

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

Stresses in excess of the absolute Maximum Ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute Maximum Rating for extended periods of the time can adversely affect reliability.

## Input

| Parameter                                  | Test condition                   | Symbol     | Value | Unit                   |
|--------------------------------------------|----------------------------------|------------|-------|------------------------|
| DC Forward current                         |                                  | $I_F$      | 50    | mA                     |
| Reverse voltage                            |                                  | $V_R$      | 6.0   | V                      |
| Surge forward current                      | $t_p \leq 10\text{ }\mu\text{s}$ | $I_{FSM}$  | 2.5   | A                      |
| Power dissipation                          |                                  | $P_{diss}$ | 80    | mW                     |
| Derate linearly from 25 $^{\circ}\text{C}$ |                                  |            | 0.7   | mW/ $^{\circ}\text{C}$ |

## Output

| Parameter                                  | Test condition           | Symbol     | Value | Unit                   |
|--------------------------------------------|--------------------------|------------|-------|------------------------|
| Collector-emitter voltage                  |                          | $V_{CE}$   | 70    | V                      |
| Emitter-collector voltage                  |                          | $V_{EC}$   | 7.0   | V                      |
| Collector current                          |                          | $I_C$      | 50    | mA                     |
|                                            | $t_p \leq 1.0\text{ ms}$ | $I_C$      | 100   | mW                     |
| Power dissipation                          |                          | $P_{diss}$ | 150   | mW                     |
| Derate linearly from 25 $^{\circ}\text{C}$ |                          |            | 1.5   | mW/ $^{\circ}\text{C}$ |

## Coupler

| Parameter                                           | Test condition                                                         | Symbol    | Value         | Unit               |
|-----------------------------------------------------|------------------------------------------------------------------------|-----------|---------------|--------------------|
| Isolation test voltage between emitter and detector | $t = 1.0\text{ s}$                                                     | $V_{ISO}$ | 3750          | $V_{RMS}$          |
| Operating temperature range                         |                                                                        | $T_{amb}$ | - 55 to + 110 | $^{\circ}\text{C}$ |
| Storage temperature range                           |                                                                        | $T_{stg}$ | - 55 to + 150 | $^{\circ}\text{C}$ |
| Soldering temperature                               | max. 10 s Dip soldering distance to seating plane $\geq 1.5\text{ mm}$ | $T_{sld}$ | 260           | $^{\circ}\text{C}$ |

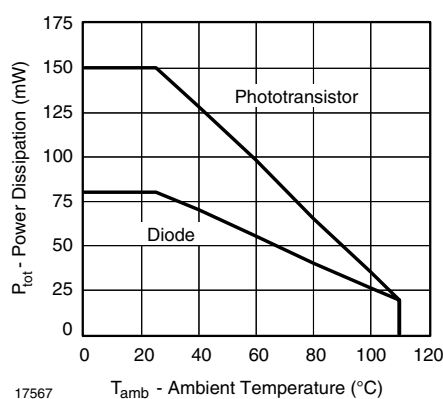


Figure 1. Permissible Power Dissipation vs. Temperature



## Electrical Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

## Input

| Parameter       | Test condition                              | Symbol | Min | Typ. | Max | Unit          |
|-----------------|---------------------------------------------|--------|-----|------|-----|---------------|
| Forward voltage | $I_F = 5\text{ mA}$                         | $V_F$  |     | 1.15 | 1.4 | V             |
| Reverse current | $V_R = 6.0\text{ V}$                        | $I_R$  |     | 0.01 | 10  | $\mu\text{A}$ |
| Capacitance     | $V_R = 0.0\text{ V}$ , $f = 1.0\text{ MHz}$ | $C_I$  |     | 14   |     | pF            |

## Output

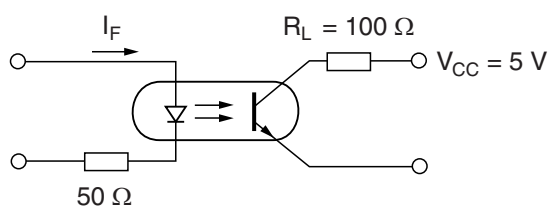
| Parameter                            | Test condition                                 | Symbol      | Min | Typ. | Max  | Unit |
|--------------------------------------|------------------------------------------------|-------------|-----|------|------|------|
| Collector-emitter leakage current    | $V_{CE} = 20\text{ V}$                         | $I_{CEO}$   |     |      | 100  | nA   |
| Collector-emitter breakdown voltage  | $I_C = 100\text{ }\mu\text{A}$                 | $BV_{CEO}$  | 70  |      |      | V    |
| Emitter-collector breakdown voltage  | $I_E = -10\text{ }\mu\text{A}$                 | $BV_{ECO}$  | 70  |      |      | V    |
| Collector-emitter saturation voltage | $I_F = 10\text{ mA}$ , $I_C = 2.5\text{ mA}$   | $V_{CEsat}$ |     | 0.25 | 0.40 | V    |
| Collector-emitter capacitance        | $V_{CE} = 5.0\text{ V}$ , $f = 1.0\text{ MHz}$ | $C_{CE}$    |     | 2.8  |      | pF   |

## Coupler

| Parameter                  | Test condition                                  | Part       | Symbol   | Min | Typ. | Max | Unit |
|----------------------------|-------------------------------------------------|------------|----------|-----|------|-----|------|
| $I_C/I_F$                  | $I_F = 5.0\text{ mA}$ , $V_{CE} = 5.0\text{ V}$ | SFH1690ABT | CTR      | 50  |      | 300 | %    |
|                            |                                                 | SFH1690AT  | CTR      | 50  |      | 150 | %    |
|                            |                                                 | SFH1690BT  | CTR      | 100 |      | 300 | %    |
|                            |                                                 | SFH1690CT  | CTR      | 100 |      | 200 | %    |
| Coupling capacitance       | $f = 1.0\text{ MHz}$                            |            | $C_C$    |     | 0.3  |     | pF   |
| Capacitance (input-output) |                                                 |            | $C_{IO}$ |     | 0.5  |     | pF   |

## Switching Characteristics

| Parameter     | Test condition                                                            | Symbol    | Min | Typ. | Max | Unit          |
|---------------|---------------------------------------------------------------------------|-----------|-----|------|-----|---------------|
| Rise time     | $I_C = 2.0 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ ,<br>$R_L = 100 \Omega$ | $t_r$     |     | 3.0  |     | $\mu\text{s}$ |
| Fall time     | $I_C = 2.0 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ ,<br>$R_L = 100 \Omega$ | $t_f$     |     | 4.0  |     | $\mu\text{s}$ |
| Turn-on time  | $I_C = 2.0 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ ,<br>$R_L = 100 \Omega$ | $t_{on}$  |     | 5.0  |     | $\mu\text{s}$ |
| Turn-off time | $I_C = 2.0 \text{ mA}$ , $V_{CC} = 5.0 \text{ V}$ ,<br>$R_L = 100 \Omega$ | $t_{off}$ |     | 3.0  |     | $\mu\text{s}$ |



isfh690at\_01

Figure 2. Switching Operation (without Saturation)

## Safety and Insulation Ratings

As per IEC60747-5-2 §7.4.3.8.1, this optocoupler is suitable for 'safe electrical insulation' only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

| Parameter                                                                                               | Test condition                                        | Symbol     | Min        | Typ.      | Max            | Unit     |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------|------------|-----------|----------------|----------|
| Climatic Classification<br>(according to IEC 68 part 1)                                                 |                                                       |            |            | 55/110/21 |                |          |
| Polution Degree<br>(DIN VDE 0109)                                                                       |                                                       |            |            | 2.0       |                | mm       |
| Comparative tracking index per<br>DIN IEC112/VDE 0303 part 1,<br>group IIIa per DIN VDE 6110<br>175 399 |                                                       |            | 175        |           | 399            |          |
| $V_{IOTM}$                                                                                              |                                                       | $V_{IOTM}$ | 6000       |           |                | V        |
| $V_{IORM}$                                                                                              |                                                       | $V_{IORM}$ | 707        |           |                | V        |
| Isolation resistance                                                                                    | $V_{IO} = 500 \text{ V}$ , $T_{amb} = 25 \text{ °C}$  | $R_{IO}$   |            |           | $\geq 10^{12}$ | $\Omega$ |
|                                                                                                         | $V_{IO} = 500 \text{ V}$ , $T_{amb} = 100 \text{ °C}$ | $R_{IO}$   |            |           | $\geq 10^{11}$ | $\Omega$ |
| $P_{SO}$                                                                                                |                                                       |            |            |           | 350            | mW       |
| $I_{SI}$                                                                                                |                                                       |            |            |           | 150            | mA       |
| $T_{SI}$                                                                                                |                                                       |            |            |           | 165            | °C       |
| Creeepage                                                                                               |                                                       |            | 5.0        |           |                | mm       |
| Clearance                                                                                               |                                                       |            | 5.0        |           |                | mm       |
| Insulation thickness between<br>emitter and detector                                                    |                                                       |            | $\geq 0.4$ |           |                | mm       |

## Typical Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

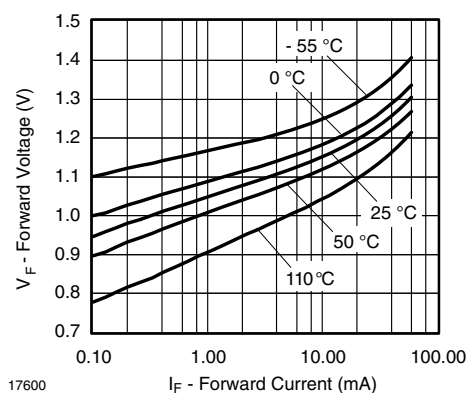


Figure 3. Forward Voltage vs. Forward Current

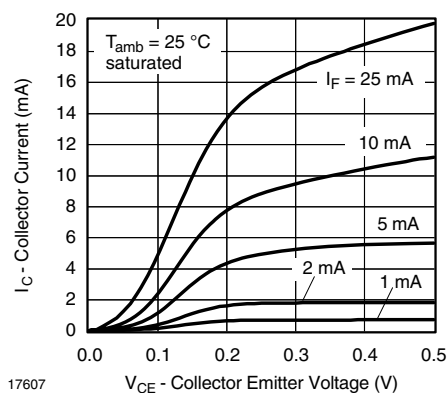


Figure 6. Collector Current vs. Collector Emitter Voltage

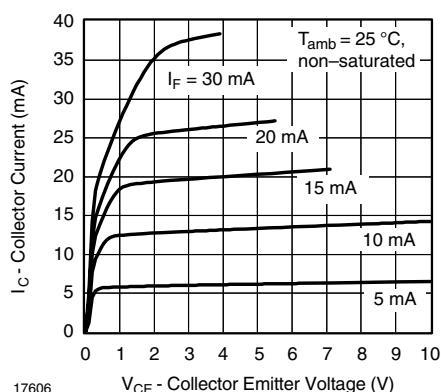


Figure 4. Collector Current vs. Collector Emitter Voltage

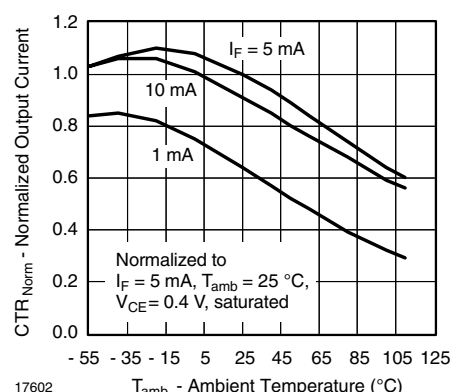


Figure 7. Normalized Current Transfer Ratio vs. Ambient Temperature

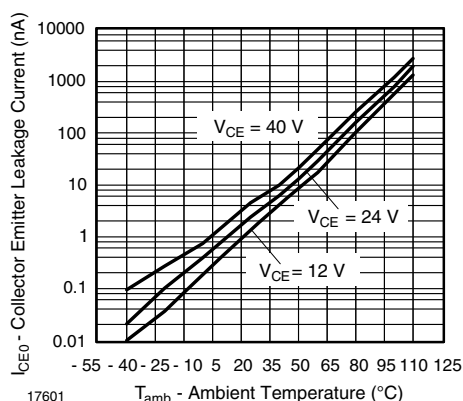


Figure 5. Collector-Emitter Dark Current vs. Ambient Temperature

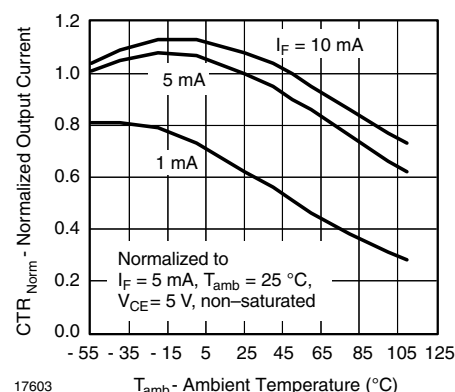


Figure 8. Normalized Current Transfer Ratio vs. Ambient Temperature

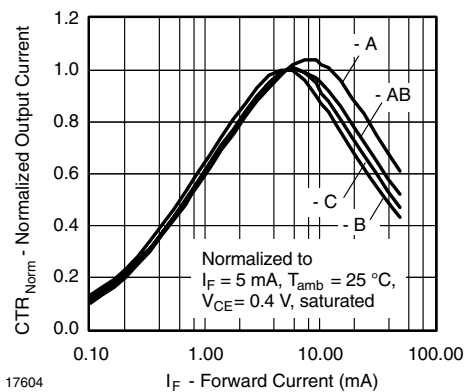


Figure 9. Normalized CTR vs. Forward Current

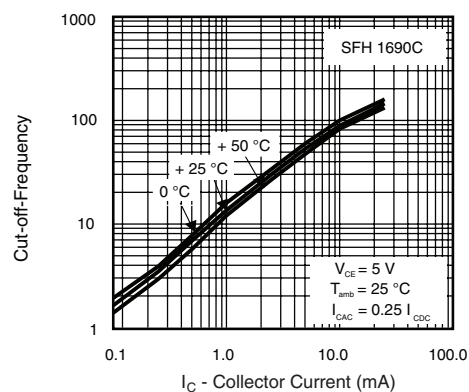


Figure 12. Cut-off-Frequency (-3 dB) vs. Collector Current

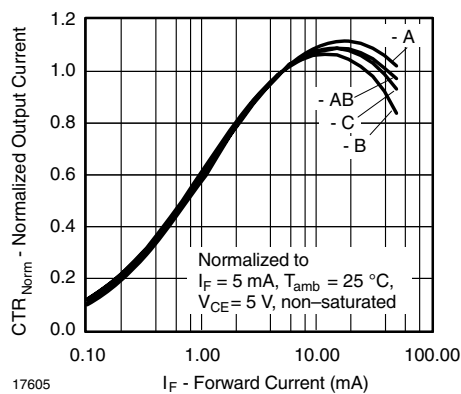


Figure 10. Normalized CTR vs. Forward Current

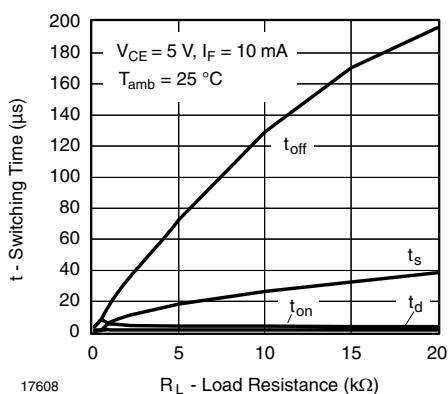
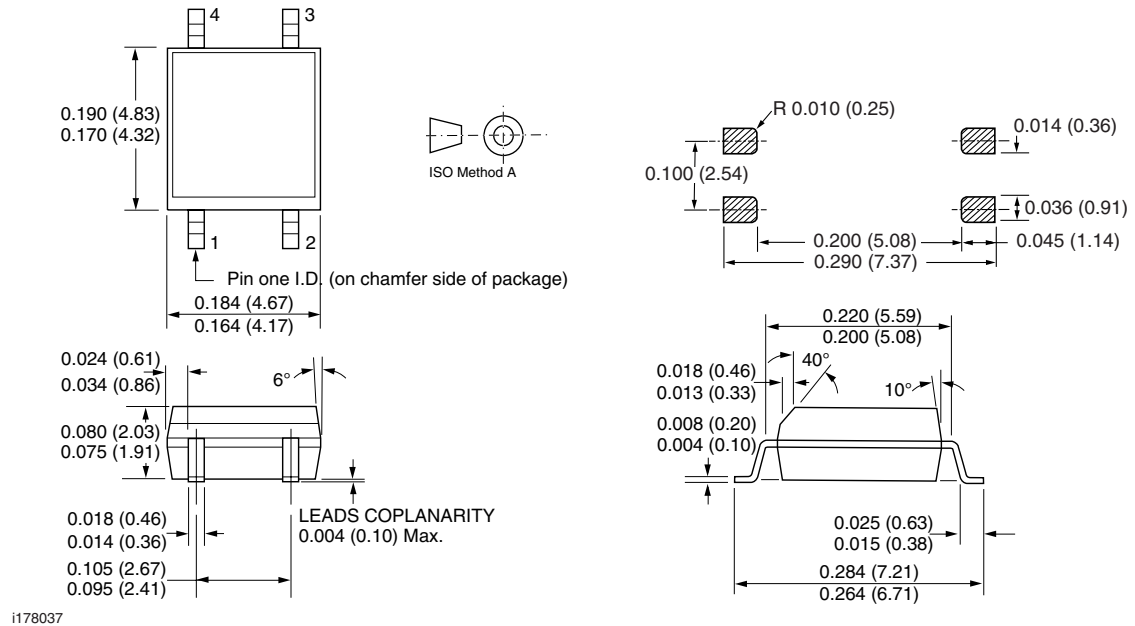


Figure 11. Switching Time vs. Load Resistance

## Package Dimensions in Inches (mm)





## Ozone Depleting Substances Policy Statement

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design  
and may do so without further notice.

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify Vishay Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany



### Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.