



# Logic Gate Optocouplers

## Reliability Data Sheet

**Agilent**  
**HCPL-2200/2201/2202**  
**HCPL-2211/2212**  
**HCPL-2219**  
**HCPL-2231/2232**

### Description

The reliability data shown includes Agilent Technologies reliability test data from the past three years on this product family. All of these products use the same LEDs, similar IC, and the same packaging materials, processes, stress conditions and testing. The data in Table 1 and Table 2 reflect actual test data for devices on a per channel basis. Before stress, all devices are preconditioned using a solder reflow process (260°C, 5 sec 2X) and 20 temperature cycles (-55°C to +125°C, 15 mins dwell, 5 mins

transfer). These data are taken from testing on Agilent Technologies devices using internal Agilent process, material specifications, design standards, and statistical process controls. **THEY ARE NOT TRANSFERABLE TO OTHER MANUFACTURERS' SIMILAR PART TYPES.**

### Operating Life Test

For valid system reliability calculations it is necessary to adjust for the time when the system is not in operation. Note that if you are using MIL-HDBK-217 for predict-

ing component reliability, the results may not be comparable to those given in Table 2 due to different conditions and factors that have been accounted for in MIL-HDBK-217. For example, it is unlikely that your application will exercise all available channels at full rated power with the LED(s) always ON as Agilent Technologies testing does. Thus, your application total power and duty cycle must be carefully considered when comparing Table 2 to predictions using MIL-HDBK-217.

**Table 1. Demonstrated Operating Life Test Performance**

| <b>Stress Test Condition</b>   | <b>Total Devices Tested</b> | <b>Total Device Hours</b> | <b>Number of Failed Units</b> | <b>Demonstrated MTTF (hr) @ T<sub>A</sub> = +125°C</b> | <b>Demonstrated FITs @ T<sub>A</sub> = +125°C</b> |
|--|-----------------------------|---------------------------|-------------------------------|--|---|
| T <sub>A</sub> = +125°C<br>V <sub>CC</sub> = 20.0 V<br>I <sub>in</sub> = 20 mA<br>I <sub>out</sub> = 16 mA | 180                         | 180,000                   | 0                             | > 180,000  | < 5,555   |

### Definition of Failure

Inability to switch, i.e., “functional failure”, is the definition of failure in this data sheet. Specifically, failure occurs when the device fails to switch ON with 2 times the minimum recommended drive current (but not exceeding the max. rating) or fails to switch OFF when there is no input current.

### Failure Rate Projections

The demonstrated point mean time to failure (MTTF) is measured at the absolute maximum stress condition. The failure rate projections in Table 2 use the Arrhenius acceleration relationship, where a 0.43eV activation energy is used as in the hybrid section of MIL-HDBK-217.

### Application Information

The data of Tables 1 and 2 were obtained on devices with high temperature operating life duration up to 1000 hours. An exponential (random) failure distribution is assumed, expressed in units of FIT (failures per billion device hours) are only defined in the random failure portion of the reliability curve.



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**Table 2. Reliability Projections (per channel) for Devices Listed in Title**

| Ambient Temperature (°C) | Junction Temperature (°C) | Typical (60% Confidence) |                                | 90% Confidence |                                |
|--------------------------|---------------------------|--------------------------|--------------------------------|----------------|--------------------------------|
|                          |                           | MTTF (hr/fail)           | FITs (fail/10 <sup>9</sup> hr) | MTTF (hr/fail) | FITs (fail/10 <sup>9</sup> hr) |
| 125                      | 140                       | 197,000                  | 5,083                          | 133,000        | 7,528                          |
| 120                      | 135                       | 228,000                  | 4,388                          | 154,000        | 6,492                          |
| 110                      | 125                       | 309,000                  | 3,233                          | 209,000        | 4,774                          |
| 100                      | 115                       | 426,000                  | 2,345                          | 289,000        | 3,456                          |
| 90                       | 105                       | 598,000                  | 1,672                          | 407,000        | 2,459                          |
| 80                       | 95                        | 854,000                  | 1,171                          | 582,000        | 1,718                          |
| 70                       | 85                        | 1,245,000                | 803                            | 850,000        | 1,176                          |
| 60                       | 75                        | 1,853,000                | 540                            | 1,269,000      | 788                            |
| 50                       | 65                        | 2,826,000                | 354                            | 1,940,000      | 516                            |
| 40                       | 55                        | 4,420,000                | 226                            | 3,042,000      | 329                            |
| 30                       | 45                        | 7,110,000                | 141                            | 4,909,000      | 204                            |
| 25                       | 40                        | 9,122,000                | 110                            | 6,307,000      | 159                            |

**Table 3. Mechanical Tests** (Testing done on a constructional basis)

| Test Name            | MIL-STD-883  | Test Conditions  | Units Tested | Units Failed |
|----------------------|--------------|--|--------------|--------------|
| Temperature Cycle    | 1010 Cond. B | -55 to 125°C, Transfer = 5 mins;<br>Dwell = 15 mins; 1000 cycles | 160          | 0            |
| Mechanical Shock     | 2002 Cond. B | 2 blows each axis,<br>1500 G, 0.5 ms pulse                       | 139          | 0            |
| Mechanical Vibration | 2007 Cond. A | 20 G, 20 - 2000 Hz,<br>4 min/cycle, 4 times/axis                 | 139          | 0            |
| Terminal Strength    | 2004         | 2 lb. tension,<br>8 oz. lead bend stress                         | 150          | 0            |
| Solderability        | 2003         | Sn60 Pb40 Solder<br>Temperature = 260°C (5 sec, 2X)              | 397          | 0            |
| Physical Dimensions  | 2009         | Device profile @ 10X   | 220          | 0            |

**Table 4. Environmental Testing**

| Test Name               | MIL-STD-883     | Test Conditions   | Units Tested | Units Failed |
|-------------------------|-----------------|---|--------------|--------------|
| Temp. and Humidity Bias | N/A             | T <sub>A</sub> = 85°C, RH = 85%<br>See Table 1 for bias condition.<br>Time = 1000 hours | 80           | 0            |
| Un-Biased Pressure Pot  | N/A             | T <sub>A</sub> = 121°C, RH = 100%<br>Time = 96 hours                                    | 400          | 0            |
| Salt Atmosphere         | 1009<br>Cond. A | T <sub>A</sub> = 35°C Mist  | 80           | 0            |
| Resistance to Solvents  | 2015            | 3 one-min. immersion.<br>Brush after solvent.   | 80           | 0            |

**Table 5. Basic Material Properties**

| Material Property                          | Test Result            |
|--|------------------------|
| Mold Compound Flammability Classification  | UL 94V-0               |
| Mold Compound Oxygen Index                 | 32%                    |
| Mold Compound Glass Transition Temperature | T <sub>g</sub> = 160°C |
| Mold Compound Hydrolizable Chlorine        | < 30 ppm               |

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