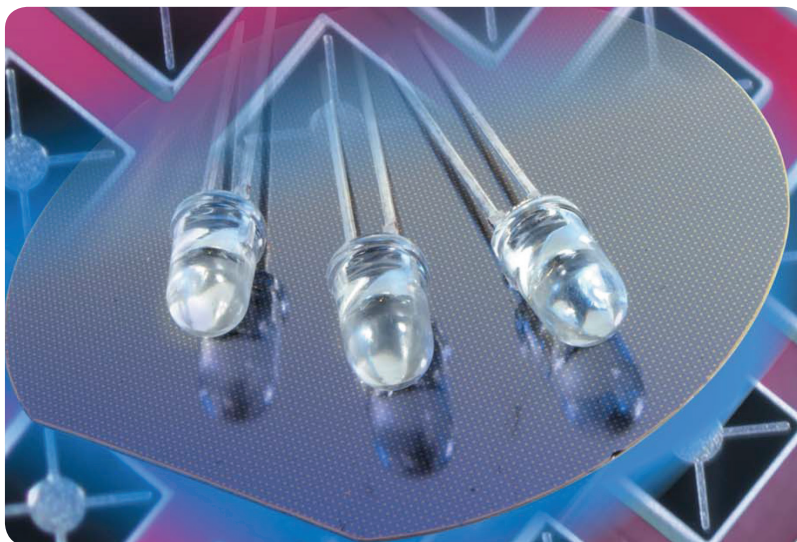


## The Aging of Infrared Emitter Components



### INTRODUCTION

Over its lifetime, an infrared emitter gradually loses its radiant power. This type of aging or degradation has three main causes:

- Mechanical stress deforms the crystal structure, causing loss of efficiency
- Delamination occurs between epoxy and chip, causing loss of optical coupling
- Thermal stress inflicts damage on the crystal structure

The rate of device aging is determined by:

- Chip technology: GaAlAs Double Hetero (DH), bulk, and surface emitter technologies result in lower rates, while GaAlAs and GaAs technologies result in higher rates of aging
- Package technology: metal can and chip on board (COB) packaging technologies result in lower rates, and epoxy packaging technologies result in higher rates of aging

Chip size: The smaller the chip, the higher the current density. A higher current density results in faster aging.

### RESOURCES

- Infrared Emitter Selector Guide: <http://www.vishay.com/doc?49495>
- Optoelectronics Portfolio: <http://www.vishay.com/optoelectronics/>
- For technical questions, contact [emittertechsupport@vishay.com](mailto:emittertechsupport@vishay.com)





## DEVICE AGING AND DEVICE SELECTION

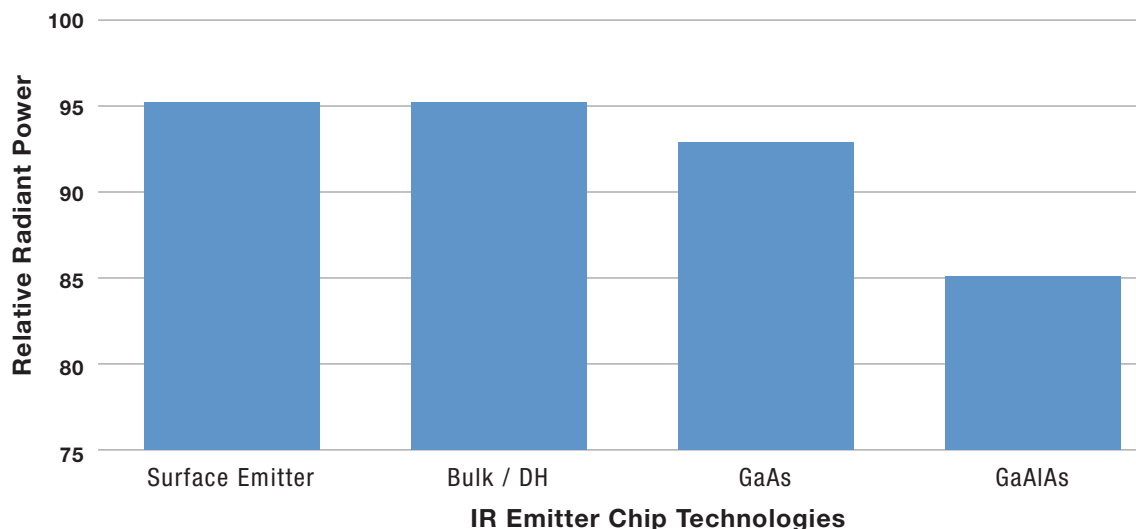
Degradation rate is an important feature to consider when selecting an emitter. State-of-the-art chip technologies and high quality standards in the assembly process are essential to maintain a low degradation rate. Aging behavior varies, moreover, for the various infrared chip technologies. For example, DH, bulk, and surface emitter chips age slowly even when used in applications with high duty cycles and are thus best suited for long-term DC mode applications. GaAlAs and GaAs chips typically degrade more depending on their usage. This combined with their inherent outstanding radiant power makes them ideal for remote control (RC) applications, which of course have extremely low duty cycles. In the typical RC system in fact, the expected useful lifetime of the GaAlAs/GaAs emitter chips averages 10 or more years.

## APPLICATIONS

- Data Transmission
- IrDC
- Photo Interrupter
- IR Curtain
- Encoder
- DC Mode
- Remote Control
- Low Duty Cycle
- Burst Mode
- Pulse Mode
- Keyless Entry

## TYPICAL DEGRADATION OF RADIANT POWER AFTER 4000 h OPERATION

Comparison of Major IR Emitter Chip Technologies Assembled Using T-1 3/4" Plastic Package



### PACKAGE FORMS


**TABLE 1: CHARACTERISTICS DATA OF IRED CHIPS**

| TECHNOLOGY      | TYPICAL CHIP DATA      |                  |                      |          | TYPICAL DEVICE | TYPICAL DEVICE DATA    |                    |                    |                     |
|-----------------|------------------------|------------------|----------------------|----------|----------------|------------------------|--------------------|--------------------|---------------------|
|                 | $\Phi_e$ at 0.1 A (mW) | $\lambda_p$ (nm) | $\Delta\lambda$ (nm) | POLARITY |                | $\Phi_e$ at 0.1 A (mW) | $V_F$ at 0.1 A (V) | $V_F$ at 1.0 A (V) | $t_r$ at 0.1 A (ns) |
| GaAs            | 7.7                    | 950              | 50                   | p up     | TSUS540.       | 20                     | 1.3                | 2.1                | 800                 |
| GaAlAs          | 12.8                   | 875              | 80                   | n up     | TSHA550.       | 27                     | 1.5                | 3.4                | 600                 |
| GaAlAs (DH)     | 20                     | 890              | 40                   | p up     | TSHF5410       | 45                     | 1.5                | 2.3                | 30                  |
| GaAlAs (DH)     | 26                     | 870              | 40                   | p up     | TSFF5410       | 50                     | 1.5                | 2.3                | 15                  |
| Bulk Emitter    | 21                     | 940              | 30                   | p up     | VSLB3940       | 40                     | 1.35               | 2.1                | 15                  |
| GaAlAs MQW      | 22                     | 940              | 30                   | p up     | TSAL6200       | 40                     | 1.35               | 2.2                | 15                  |
| Surface Emitter | 30                     | 850              | 25                   | n up     | VSLY5850       | 55                     | 1.65               | 2.9                | 10                  |



## OPTOELECTRONICS

## Infrared Emitters

## CHIP TECHNOLOGY, DEVICES AND DEDICATED APPLICATION

| Technology                               | DH                                   | GaAs              | GaAlAs               | Bulk Emitter (*)  | Surface Emitter   |
|------------------------------------------|--------------------------------------|-------------------|----------------------|-------------------|-------------------|
| Performance @ Test Condition IF = 100 mA |                                      |                   |                      |                   |                   |
| Typ. 4000 h-Degradation                  | -5%                                  | -7%               | -15%                 | -5%               | -5%               |
| Radiant Power                            | 45 mW                                | 15 mW             | 25 mW                | 40 mW             | 55 mW             |
| Cut-off Frequency                        | 12 MHz                               | 450 kHz           | 600 kHz              | 23 MHz            | 35 MHz            |
| Rise/Fall Time tr, tf                    | 30 ns                                | 800 ns            | 600 ns               | 15 ns             | 10 ns             |
| Wavelength                               | 830 ... 890 nm                       | 950 nm            | 870 nm               | 940 nm            | 850 nm / 940 nm   |
| Product Series                           |                                      |                   |                      |                   |                   |
| Package Forms                            |                                      |                   |                      |                   |                   |
| T1                                       | -                                    | TSUS4xxx          | TSHA4400             | VSLB3940          | VSLY3850          |
| T1 3/4                                   | TSHF5xxx /<br>TSFF5xxx /<br>TSHG5xxx | TSUS5xxx          | TSHA5xxx             | VSLB3940          | VSLY5850          |
| Side View / SMD                          | TSSF4500                             | TSKS5400          | -                    | VSMB2940SLX01     | VSMY2853SL        |
| Dome SMD                                 | VSMF289x /<br>VSMG2xxx               | -                 | -                    | VSMB2020X01       | VSMY2850          |
| PLCC-2                                   | VSMF3710 /<br>VSMF4710 /<br>VSMG3700 | VSMS3700          | -                    | VSMB3940          | VSMY3850          |
| 0805                                     | -                                    | -                 | -                    | VSMB1940          | VSMY1850          |
| Metal Can                                | -                                    | TSTS7xxx          | TSTA7xxx             | -                 | -                 |
| APPLICATIONS                             | High Reliability                     | High Reliability  | Standard Application | High Reliability  | High Reliability  |
|                                          | Data Transmission                    | Photo Interrupter | Keyless Entry        | Data Transmission | Data Transmission |
|                                          | IrDC                                 | IR Curtain        | Low Duty Cycle       | IrDC              | IrDC              |
|                                          | Encoder                              | Encoder           | Burst Mode           | Encoder           | Encoder           |
|                                          | DC Mode                              | DC Mode           | Pulse Mode           | DC Mode           | DC Mode           |

(\*) and GaAlAs MQW

**SEMICONDUCTORS*****MOSFETs Segment*****MOSFETs**

- Low-Voltage TrenchFET® Power MOSFETs
- Medium-Voltage Power MOSFETs
- High-Voltage Planar MOSFETs
- High-Voltage Super Junction MOSFETs
- Automotive-Grade MOSFETs

**ICs**

- Power Management and Power Control ICs
- Smart Load Switches
- Analog Switches and Multiplexers

***Diodes Segment*****Rectifiers**

- Schottky Rectifiers
- Ultrafast Recovery Rectifiers
- Standard and Fast Recovery Rectifiers
- High-Power Rectifiers/Diodes
- Bridge Rectifiers

**Small-Signal Diodes**

- Schottky and Switching Diodes
- Zener Diodes
- Tuner/Capacitance Diodes
- Bandswitching Diodes
- RF PIN Diodes

**Protection Diodes**

- TVS Diodes or TRANSZORB®  
(unidirectional, bidirectional)
- ESD Protection Diodes (including arrays)

**Thyristors/SCRs**

- Phase-Control Thyristors
- Fast Thyristors

**IGBTs****Power Modules**

- Input Modules (diodes and thyristors)
- Output and Switching Modules (contain MOSFETs, IGBTs, and diodes)
- Custom Modules

***Optoelectronic Components Segment*****Infrared Emitters and Detectors****Optical Sensors****Infrared Remote Control Receivers****Optocouplers**

- Phototransistor, Photodarlington
- Linear
- Phototriac
- High-Speed
- IGBT and MOSFET Driver

**Solid-State Relays****LEDs and 7-Segment Displays****Infrared Data Transceiver Modules****Custom Products****PASSIVE COMPONENTS*****Resistors and Inductors Segment*****Film Resistors**

- Metal Film Resistors
- Thin Film Resistors
- Thick Film Resistors
- Power Thick Film Resistors
- Metal Oxide Film Resistors
- Carbon Film Resistors

**Wirewound Resistors**

- Vitreous, Cemented, and Housed Resistors
- Braking and Neutral Grounding Resistors
- Custom Load Banks

**Power Metal Strip® Resistors****Battery Management Shunts****Crowbar and Steel Blade Resistors****Thermo Fuses****Chip Fuses****Pyrotechnic Initiators/Igniters****Variable Resistors**

- Cermet Variable Resistors
- Wirewound Variable Resistors
- Conductive Plastic Variable Resistors
- Contactless Potentiometers
- Hall Effect Position Sensors
- Precision Magnetic Encoders

**Networks/Arrays****Non-Linear Resistors**

- NTC Thermistors
- PTC Thermistors
- Varistors

**Magnetics**

- Inductors
- Wireless Charging Coils
- Transformers

**Connectors*****Capacitors Segment*****Tantalum Capacitors**

- Molded Chip Tantalum Capacitors
- Molded Chip Polymer Tantalum Capacitors
- Coated Chip Tantalum Capacitors
- Solid Through-Hole Tantalum Capacitors
- Wet Tantalum Capacitors

**Ceramic Capacitors**

- Multilayer Chip Capacitors
- Multilayer Chip RF Capacitors
- Disc Capacitors

**Film Capacitors****Power Capacitors****Heavy-Current Capacitors****Aluminum Capacitors****ENYCAP™ Energy Storage Capacitors**