The Constituents of Semiconductor Components

Responsible electronic component and equipment manufacturers are already preparing for the time when the lifespan of their products comes to an end by scrutinizing the materials incorporated and their future recylcability. Recycling laws have already come into force in Germany ("Kreislauf-Wirtschaftsgesetz") and guidelines for electronic scrap are in preparation.

The aim is a suitable waste disposal program and – as a preventative measure – a reduction in the content of hazardous damaging materials in such components. In order to conform to this procedure, detailed information about the materials and their quantities is needed.

This overview answers questions put forward by customers as to the constituents and their function in the most important of Vishay Telefunken's semiconductor products. Special significance is given to so-called "Hazardous Substances". It demonstrates that Vishay Telefunken products under normal operating conditions do not expose the applier or environment to any hazard. However, most products nevertheless contain small but necessary quantities of "Hazardous Substances" which can – if not treated correctly or through accidents – be released on a small scale into the environment.

The present information was produced with the greatest possible care. Any suggestions for improvement of this brochure are welcome.

Definitions

Vishay Telefunken offers a wide range of semiconductor components including transistors, diodes and opto-electronic components. These have been manufactured in various standard packages.

On the following pages, these packages are listed together with their materials shown in weight percentages. In order to limit the number of tables, all components whose structure and composition are the same have been compiled in families. In many cases, different lead frames together with chips of different sizes may be used for the one package. This usually means that there may be slight differences in the quantities of the declared material. The weight percent is, however, valid for a representative sample of the relevant family. In order to sensibly reduce the number and quantities of materials contained in the respective components, quantities smaller than 0.1% by weight have been stated in the following list as **traces**. This is the case unless lower limits are forced by law, e.g., cadmium < 75 ppm and PCDD as well as PCDF (known as dioxin) < 2 ppb. In the lists themselves, details of content and composition are separated into the individual parts of the semiconductor component. The most important of these are:

Active element: The active element is either a silicon chip or for optoelectronic components a chip containing combinations of Ga (Al) (As, P). These are doped with very small amounts of boron, arsenic, phosphorus, zinc and germanium etc. The metallisation consists of thin layers of aluminium, gold or titanium. The chips are generally bonded to the lead frame with a silver epoxy and have gold or aluminium wires bonded to the lead frame.

Lead frame: For electrical connection, a metal lead frame made from alloys such as FeNi (42) or CuFe (2) and partly or totally plated with silver is commonly used. The metal alloys contain traces of silver, zinc and phosphorus. Part of the lead frame is also coated with tin/ lead.

Case: The semiconductor chip is protected from the environment by a case of glass, plastic or metal.

The glass is composed of oxides of silicon and lead together with boron and aluminium.

Plastic cases are composed of an epoxy resin filled with up to 70% by weight of quartz particles. Antimony trioxide and brominated epoxy resin (no TBA) are added as flame retardents. Antimony and bromine amount to about 1.6 and 1.0% respectively.

In use: In use, it is the content of hazardous substances which is of importance. In Germany, there are a series of lists which give the materials which are potentially hazardous to people and the environment, for example:

Appendix II and IV of the "Hazardous Materials Regulations", the TRGS 900 ("MAK-Wert-Liste") and the "Catalog of Materials Hazardous to the Water Supply". These lists, however, are only partially consistent.

The names used are often different for materials with the same chemical composition. Furthermore, the use of trivial and trade names often adds to the confusion.

Vishay Telefunken therefore for their descriptions use that proposed by the Zentralverband Elektrotechnik und Elektronikindustrie e.V. (ZVEI; Central Association of Electrical Engineering and Electronic Industry) for the harmonization of the nomenclature of hazardous substances.

Statements are made on the safety precautions to be used during storage and disposal by mechanical, chemical and thermal means of the more important chemicals (so-called "Leitchemikalien"). These are listed in the tables in the order of their potential

risk.Their effect upon people and the environment are also listed and any special precautions emphasized.

Notes: The following information has been prepared to be as exact and reliable as possible.

The manufacture of semiconductor components is, however, subject to regular change without special notification.

The publication of this brochure excludes any responsibility resulting from its use.

Explanation of Abbreviations

While the information on weight percent is believed correct, discrepancies depending upon component type may be possible.

1) Material information etc. Material listed as "Material Hazardous in Production"

2) S: Trace material < 0.1% by weight;
Cd < 75 ppm; concerning Cd see ***)
PCDD and PCDF < 2 ppb

*) Dioxin content – lies below agreed limits

**) No. 85 "Rules for Hazardous Materials", to be replaced as soon as a technically suitable alternative material is available

***) Traces of cadmium can only be found in lead frames made of copper

CMT: Material containing carcinogens, mutagens or terratogens

Tox: Material is toxic or very toxic

S Material with allergy producing characteristics

HAL Halogen containing material

WKG Material hazardous to the water supply

L Storage, suitable for disposal

D Disposable

M Mechanical disposal

N Chemical disposal

T Thermal disposal

H Handling

Ozone Depleting Substances

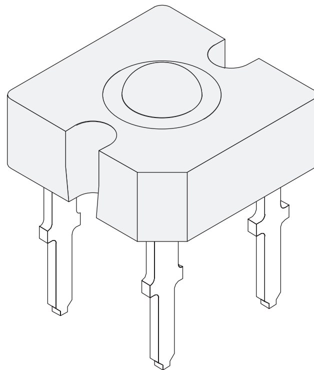
The use of Ozone Depleting Substances has been totally eliminated by Vishay Telefunken and by doing so meets the legal requirements as defined in the following documents.

1. The "Montreal Protocol" together with the "London Amendments" Appendix A, B, and the "List of Transitional Substances"
2. "Clean Air Act", Amendments 1990, "Environmental Protection Agency" (EPA), USA, Class I and II – Ozone Depleting Substances
3. "European Council Resolution" number 88/540/EEC and 91/690/eec Appendix A, B and C (Transitional Substances)

Vishay Telefunken guarantees that its components do not contain and are manufactured without the use of Ozone Depleting Substances.

The Constituents of Package Forms

Package form 1:



Total weight 280 mg

Epoxy resin (49%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame Cu (50%)
92% copper
2% iron
2% silver
4% SnPb
Traces of
Ni, Zn, P, Cd***)

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP, GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

Silver epoxy (< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Silicone (< 1%)
90.9% resin
9.1% hardener

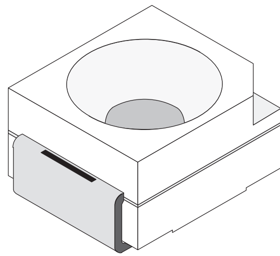
YAG-Phosphor (< 0.1%)
Y 25%
Gd 44.3%
Al_2, O_3, 30.7
Traces of Ce

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 2:



Total weight 30 mg

Epoxy resin (10.0%)
50% resin
50% hardener

Reflector (47.8%)
66.7%amodel
33.3%glass fibre

Lead frame (42.0%)
95% copper
2% iron
2% Silver
1% SnPb
Traces of
Ni, Zn, P, Cd***)

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP, GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

IR chip (0.17%)
50% gallium
50% arsenic
Traces of
Al, Au, Zn, Ge, Ti

Detector chip (0.2%)
99% silicon
Traces of
Ag, Al, Au, Sb, Ti, SiO_2

Silver epoxy (< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

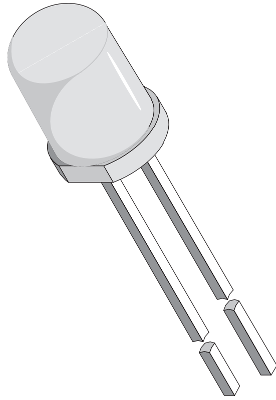
YAG-Phosphor
(< 0.1%)
Y 25%
Gd 44.3%
Al_2, O_3, 30.7
Traces of Ce

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		●			●	Lead plating	0.1			●	●	●	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 3:



Total weight (5 mm) 310 mg

Epoxy resin (58%)
50% resin
50% hardener

Lead frame (42 %)
93% iron
2% copper
2% silver
3% SnPb
Traces of
Ni, Zn, P, Cd ***)

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP, GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

IR chip (0.1%)
50% gallium
50% arsenic
Traces of
Al, Au, Zn, Ge, Ti

Silicone (< 1%)
90.9% resin
9.1% hardener

Silver epoxy (< 0.1%)
80% silver
10% resin
10% hardener

Bond wire (< 0.1%)
99.99% gold
Traces of BE, Mg

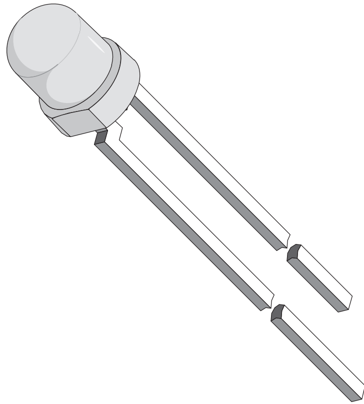
YAG-Phosphor (< 0.1%)
Y 25%
Gd 44.3%
Al_2, O_3, 30.7
Traces of Ce

Significant Materials for Disposal

No.	Material and/or Group [1]	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in [2] Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 4:



Total weight (3mm)132 mg

Epoxy resin (25%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame (75%)
96% copper
2% iron
2% silver
Traces of Ni, Zn, P, Cd***)

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP, GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

Resistor chip
(< 0.1%)
99% silicon
Traces of
Ag, Al, Au, Sb, Ti, B

Silver epoxy
(< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

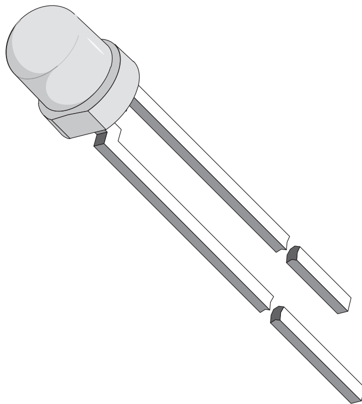
Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 5:



Total weight (3mm) 130 mg

Epoxy resin (30%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame (70%)
90% iron
4% copper
2% silver
4% SnPb
Traces of
Ni, Zn, P, Cd***)

Silver epoxy (< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP, GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

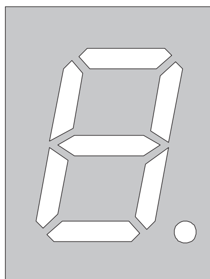
IR chip (0.1%)
50% gallium
50% arsenic
Traces of
Al, Au, Zn, Ge, Ti

Detector chip (< 0.1%)
99% silicon
Traces of
Ag, Al, Au, Sb, Ti, SiO_2

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Package form 6:



Case	Weight/ mg
7 mm	700
10 mm	1150
13 mm	2090

Epoxy resin (42.9%)
44.0%resin
48.0%hardener
8.0% diffuser

Reflector (39.8%)
73.0%Pocan
27.0%TiO_2

Lead frame (17.3%)
98.8%copper
1.2% iron
Traces of
Ni, Ag, Zn, Cd ***)

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP,
GaN, InGaN, AlIn-GaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

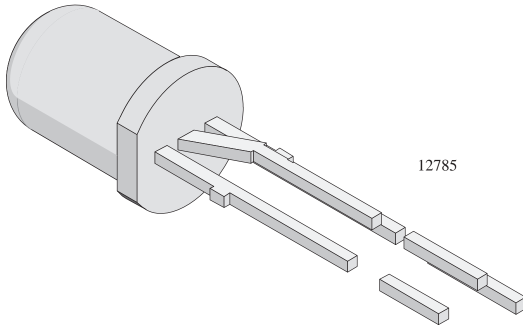
Silver epoxy
(< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Arsenic	•	•			•	Chip	Traces			•	•	•	
2	Epoxy resin						Mold	43.0					•	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 7:



Total weight 400 mg

Epoxy resin (50%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame (50%)
96% copper
2% iron
2% silver
Traces of Ni, Zn, P, Cd***)

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

Silver epoxy
(< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs,
GaP,
GaN, InGaN, AlIn-GaP
Substrates: (50%)
GaP, GaAlAs, GaAs,
SiC
Traces of
Au, Zn, Ge, Ti

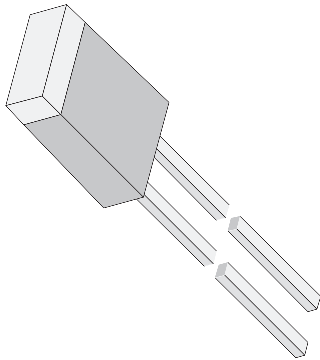
Detector chip
(< 0.1%)
99% silicon
Traces of
Ag, Al, Ni, Ti, V

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Note: *), **), ***), 1), 2), CMT, T etc.: see 'Explanation of Abbreviations', page 2

Package form 8:



approx. weight 300 mg

Epoxy resin (60%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame (40%)
96% copper
2% iron
2% silver
Traces of Ni, Zn, P, Cd***)

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

Detector chip (< 0.1%)
99% silicon
Traces of
Ag, Al, Ni, Ti, V

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs, GaP,
GaN, InGaN, AlInGaP
Substrates: (50%)
GaP, GaAlAs, GaAs, SiC
Traces of
Au, Zn, Ge, Ti

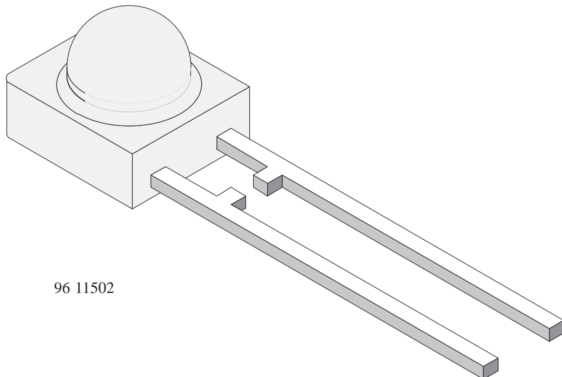
Silver epoxy (< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		●			●	Lead plating	0.1			●	●	●	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2

Package form 9:



Total weight 122 mg

Epoxy resin (60%)
50% resin
50% hardener
Traces of Fe, C, Cl

Lead frame (40%)
96% copper
2% iron
2% silver
Traces of Ni, Zn, P, Cd***)

Bond wire (< 0.1%)
99.99% gold
Traces of Be, Mg

Detector chip
(< 0.1%)
99% silicon
Traces of
Ag, Al, Ni, Ti, V

LED chip (< 0.1%)
Active Layers: (50%)
GaAsP, GaAlAs,
GaP,
GaN, InGaN, AlIn-
GaP
Substrates: (50%)
GaP, GaAlAs, GaAs,
SiC
Traces of
Au, Zn, Ge, Ti

Silver epoxy
(< 0.1%)
80% silver
10% resin
10% hardener
Traces of Cl, Na, K

Significant Materials for Disposal

No.	Material and/or Group 1)	CMT	TOX	S	HAL	WGK	Available in the Compound Used for	Part in 2) Weight Percent	L	D	M	N	T	H
1	Lead and lead compounds		•			•	Lead plating	0.1			•	•	•	

Note: *), **), ***), 1), 2), CMT, T etc.: see ‘Explanation of Abbreviations’, page 2