MODUL DIGITAL

PRAKTIKUM

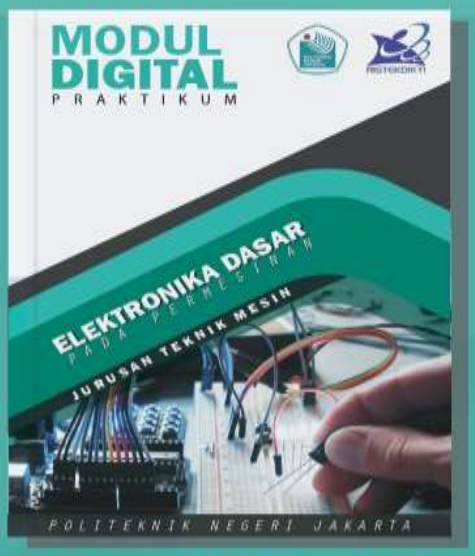
2019

ELEKTRONIKA DASAR

PADA PERMESINAN

JURUSAN TEKNIK MESIN

MODUL
DIGITAL
PRAKTIKUM



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MODUL DIGITAL

PRAKTIKUM

BAB III

2019

KARAKTERISTIK DAN APLIKASI DIODA

IDENTIFIKASI KARAKTERISTIK DOIDA DAN APLIKASINYA SEBAGAI REGULATOR TEGANGAN LISTRIK

JURUSAN TEKNIK MESIN

POLITEKNIK NEGERI JAKARTA

BAB III

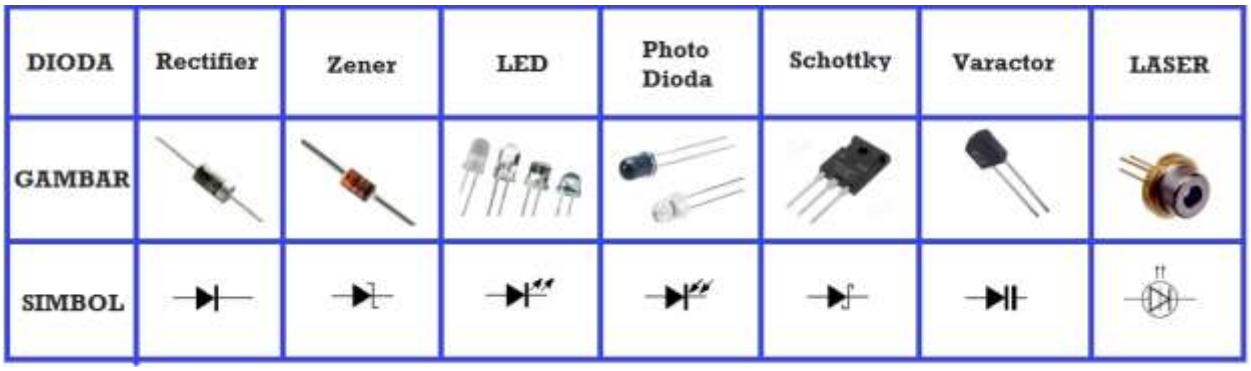
KARAKTERISTIK DAN APLIKASI DIODA

3.1 TUJUAN

Pada akhir sesi, mahasiswa akan dapat mengidentifikasi karakteristik Dioda dan aplikasinya sebagai regulator tegangan listrik.

3.2 TEORI PENGANTAR

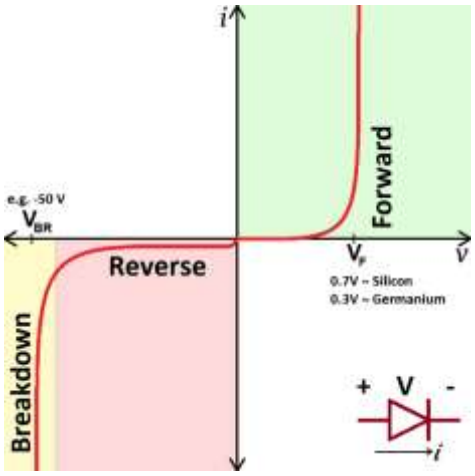
Dioda merupakan piranti semikonduktor dengan bahan tipe-n yangmenyediakanelektron-elektron bebas dan bahan tipe-p yang disatukan (P-N junction). Dioda pada umumnya memiliki potensial barrier sekitar 0,7V untuk bahan silicon (Si) dan 0,3V untuk bahan germanium (Ge). Berikut beberapa jenis dioda.



Gambar 3. 1 Jenis-Jenis Dioda
sumber :https://1.bp.blogspot.com/-zArtlAYb9F0/W6dFjS1H4LI/AAAAAAAABic/fJJUkcCFwIYORRwSUSTzyGQnxb4PI18DACEwYBhgL/s1600/dioda.png

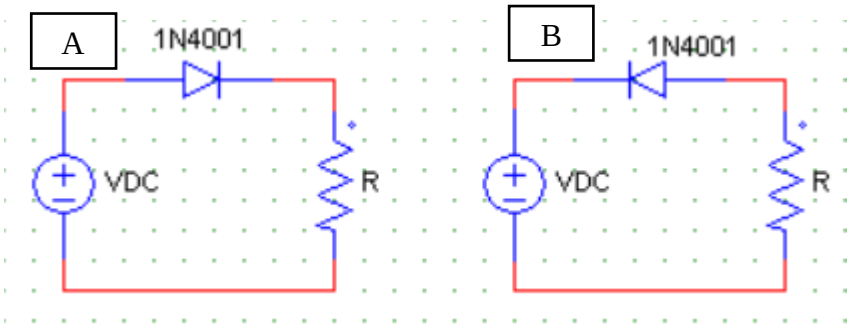
Karakteristik Dioda

Dioda memiliki daerah kerja seperti yang digambarkan pada grafik berikut.



Gambar 3. 2 Daerah Kerja Dioda
sumber :https://nulis-ilmu.com/karakteristik-dioda/

Dioda akan mengalirkan arus setelah tegangan luar melewati potensial barrier, kemudian arus maju akan menjadi besar (**Forward Bias)**. Saat arus maju terlalu besar maka dioda akan rusak karena disipasi daya terlalu besar. Jika pada arah balik (**Reverse Bias**) tegangan yang terlalu tinggi akan menimbulkan kedadalan (breakdown) listrik pada dioda. Pada tegangan reverse yang besar, arus reverse mengalir besar sekali dan saat itu disebut tegangan break down.



Gambar 3. 3(A) Forward Bias ; (B) Reverse Bias

Dioda Zener sebagai Regulator

Dioda pada umumnya dipakai pada kondisi forward bias, tetapi pada diode zener memanfaatkan kondisi reverse bias. Dioda zener digunakan sebagai regulator tegangan. Dioperasikan pada daerah reverse atau dengan kata lain memanfaatkan tegangan dadalnya atau tegangan zenernya (Vz). Nilai dari Vz berbeda-beda, tergantung pada tipe diodanya. Rentang nilai tersebut biasanya 3,3V, 5,1 V, 7,1V, dan 11,1V.

3.3 ALAT DAN BAHAN PRAKTIKUM

1. Multimeter
2. Protoboard
3. Resistor 200Ω, 220Ω, 470Ω dan 1kΩ
4. Kabel penghubung
5. Sumber tegangan DC
6. Dioda 1N4001
7. Dioda Zener tipe 2,7V, 4,7V, 6,2V

3.4 METODE PRAKTIKUM

1. Karakteristik Dioda

a. Buatlah rangkaian sesuai dengan Gambar 3. 3 (A) pada protoboard.

b. Berikanlah tegangan DC dengan nilai antara 0 – 1 V dan 1-5V.

c. Gunakanlah Resistor 1kΩ.

d. Ukurlah arus di masing-masing dioda dan catat hasilnya.

e. Buatlah rangkaian sesuai dengan Gambar 3. 3(B) pada protoboard.

f. Ulangi langkah b s/d d.

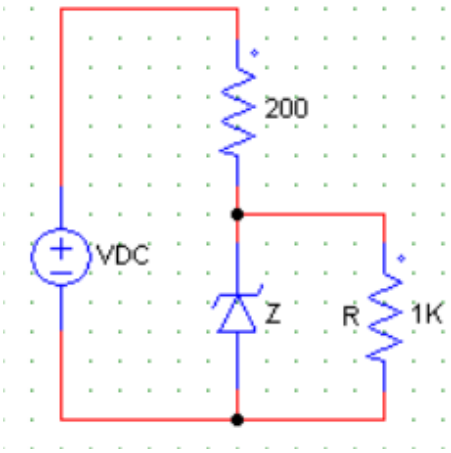
Tabel 3. 1 Hasil Pengukuran Karakteristik Dioda

VDC (volt)	I (Forward Bias) (mA)	I (Reverse Bias) (mA)
0		
0,1		
0,2		
0,3		
0,4		
0,5		
0,6		
0,7		
0,8		
0,9		
1		
2		
3		
4		
5		

g. Buatlah grafik berdasarkan data dari Tabel 3. 1di atas.

2. Dioda Zener

a. Buatlah rangkaian sesuai denganGambar 3. 4 berikut pada protoboard.



Gambar 3. 4 Rangkaian Dioda Zener

b. Berikanlah tegangan DC dengan nilai antara 0-12V.

c. Gunakanlah Resistor 200Ω dan 1kΩ.

d. Gunakanlah dioda zener 2,7V.

e. Ukurlah tegangan pada R dan arus yang mengalir pada dioda zener, kemudian catat hasilnya seperti pada Tabel 3. 2.

f. Ulangi langkah b s/d e dengan mengubah tipe dioda zener 4,7V.

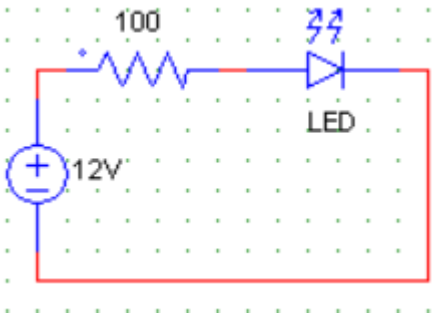
g. Ulangi langkah b s/d d dengan mengubah tipe dioda zener 6,2V.

Tabel 3. 2 Hasil Pengukuran Rangkaian Dioda Zener

VDC (volt)	Tipe 2,7V		Tipe 4,7V		Tipe 6,2V	
	V_R	I	V_R	I	V_R	I
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

3.5 EVALUASI

1. Jika diketahui sebuah rangkaian sebagai berikut.



   a. Ukurlah nilai V_R dan amati nyala lampu LED, kemudian catat hasilnya!
   b. Gantilah resistor dengan nilai 220 Ω, 470 Ω, dan 1k Ω.
   c. Lakukan langkah a secara berulang.
   d. Ubahlah polaritas sumber tegangan, kembali lakukan langkah a dan b.
   e. Bandingkanlah hasilnya dan berikan penjelasan!

DAFTAR PUSTAKA

Albert, M., & David, B. 2015. Electronic Principles. McGraw-Hill Education. New York.

Modul Praktikum Listrik dan Elektronika. 2012. Jurusan Teknik Mesin. Politeknik Negeri Jakarta.

Modul Praktikum Elektronika Dasar. 2014. FKIP, Universitas Sriwijaya.

Buku Penuntun Praktikum Elektronika 1. 2018. FMIPA, Universitas Indonesia

LAMPIRAN

1. Datasheet 1N4001 Rectifier Diodes
2. Datasheet 1N4728 Zener Diodes

1N4001 - 1N4007

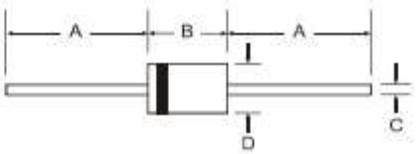
1.0A RECTIFIER

Features

- Diffused Junction
- High Current Capability and Low Forward Voltage Drop
- Surge Overload Rating to 30A Peak
- Low Reverse Leakage Current
- **Lead Free Finish, RoHS Compliant (Note 3)**

Mechanical Data

- Case: DO-41
- Case Material: Molded Plastic. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminals: Finish - Bright Tin. Plated Leads Solderable per MIL-STD-202, Method 208
- Polarity: Cathode Band
- Mounting Position: Any
- Ordering Information: See Page 2
- Marking: Type Number
- Weight: 0.30 grams (approximate)



Dim	DO-41 Plastic	
	Min	Max
A	25.40	—
B	4.06	5.21
C	0.71	0.864
D	2.00	2.72
All Dimensions in mm		

Maximum Ratings and Electrical Characteristics @T_A = 25°C unless otherwise specified

Single phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current (Note 1) @ T_A = 75°C	I_O	1.0							A
Non-Repetitive Peak Forward Surge Current 8.3ms single half sine-wave superimposed on rated load	I_{FSM}	30							A
Forward Voltage @ I_F = 1.0A	V_{FM}	1.0							V
Peak Reverse Current @T_A = 25°C at Rated DC Blocking Voltage @ T_A = 100°C	I_{RM}	5.0 50							μA
Typical Junction Capacitance (Note 2)	C_j	15				8			pF
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	100							K/W
Maximum DC Blocking Voltage Temperature	T_A	+150							°C
Operating and Storage Temperature Range	T_J, T_{STG}	-65 to +150							°C

Notes:
1. Leads maintained at ambient temperature at a distance of 9.5mm from the case.
2. Measured at 1.0 MHz and applied reverse voltage of 4.0V DC.
3. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied, see EU Directive 2002/95/EC Annex Notes.

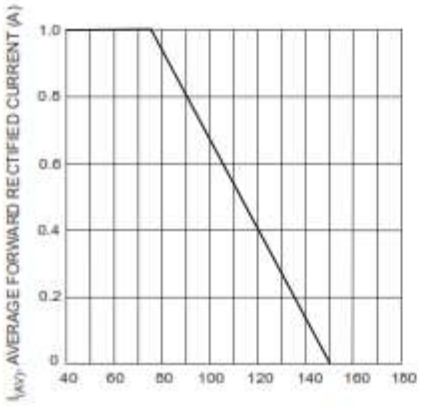


Fig. 1 Forward Current Derating Curve

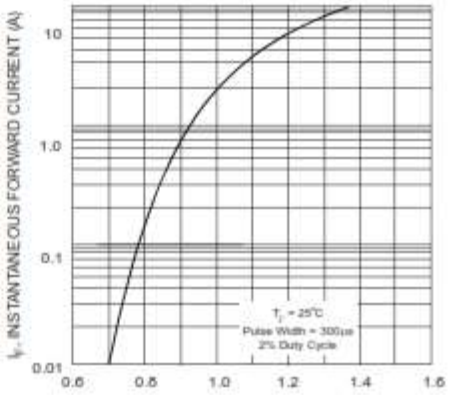


Fig. 2 Typical Forward Characteristics

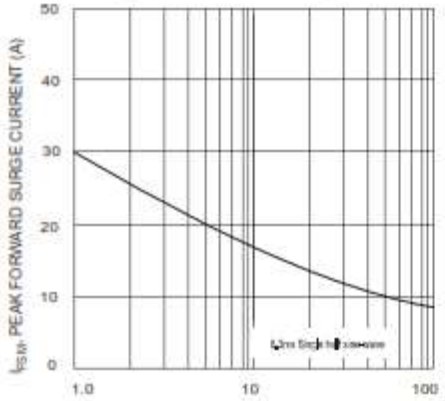


Fig. 3 Max Non-Repetitive Peak Fwd Surge Current

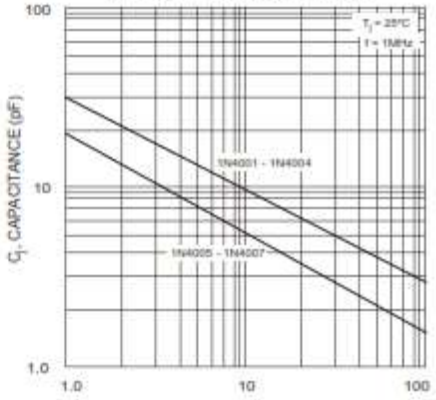


Fig. 4 Typical Junction Capacitance

Ordering Information (Note 4)

Device	Packaging	Shipping
1N4001-B	DO-41 Plastic	1K/Bulk
1N4001-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4002-B	DO-41 Plastic	1K/Bulk
1N4002-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4003-B	DO-41 Plastic	1K/Bulk
1N4003-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4004-B	DO-41 Plastic	1K/Bulk
1N4004-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4005-B	DO-41 Plastic	1K/Bulk
1N4005-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4006-B	DO-41 Plastic	1K/Bulk
1N4006-T	DO-41 Plastic	5K/Tape & Reel, 13-inch
1N4007-B	DO-41 Plastic	1K/Bulk
1N4007-T	DO-41 Plastic	5K/Tape & Reel, 13-inch

Notes: 4. For packaging details, visit our website at http://www.diodes.com/datasheets/ap02006.pdf.

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Zener Diodes

Features

- Silicon Planar Power Zener Diodes
- For use in stabilizing and clipping circuits with high power rating
- Standard Zener voltage tolerance is ± 5 %
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

Applications

- Voltage stabilization

Mechanical Data

Case: DO-41 Glass case

Weight: approx. 310 mg

Packaging Codes/Options:

TR / 5 k per 13" reel, 25 k/box

TAP / 5 k per Ammo pack (52 mm tape), 25 k/box

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

Parameter	Test condition	Symbol	Value	Unit
Power dissipation		P_{tot}	1.3[1]	W
Z-current		I_Z	P_V/V_Z	mA

[1] Valid provided that leads at a distance of 4 mm from case are kept at ambient temperature.

Thermal Characteristics

T_{amb} = 25 °C, unless otherwise specified

Parameter	Test condition	Symbol	Value	Unit
Thermal resistance junction to ambient air		R_{thJA}	110[1]	K/W
Junction temperature		T_j	175	°C
Storage temperature range		T_{stg}	- 65 to + 175	°C

[1] Valid provided that leads at a distance of 4 mm from case are kept at ambient temperature.

Electrical Characteristics

T_{amb} = 25 °C, unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Forward voltage	I_F = 200 mA	V_F			1.2	V

Electrical Characteristics

1N4728A...1N4764A

Partnumber	Nominal Zener Voltage[1]	Test Current	Maximum Dynamic Impedance			Maximum Reverse Leakage Current		Surge Current[3]	Maximum Regulator Current[2]
	V_Z at I_{ZT}	I_{ZT}	Z_{ZT} at I_{ZT}	Z_{ZK} at I_{ZK}	I_{ZK}	I_R	Test Voltage V_R	at T_A = 25 °C I_R	I_{ZM}
	V	mA	Ω	Ω	mA	µA	V	mA	mA
1N4728A	3.3	76	10	400	1	100	1	1380	276
1N4729A	3.6	69	10	400	1	100	1	1260	252
1N4730A	3.9	64	9	400	1	50	1	1190	234
1N4731A	4.3	58	9	400	1	10	1	1070	217
1N4732A	4.7	53	8	500	1	10	1	970	193
1N4733A	5.1	49	7	550	1	10	1	890	178
1N4734A	5.6	45	5	600	1	10	2	810	162
1N4735A	6.2	41	2	700	1	10	3	730	146
1N4736A	6.8	37	3.5	700	1	10	4	660	133
1N4737A	7.5	34	4	700	0.5	10	5	605	121
1N4738A	8.2	31	4.5	700	0.5	10	6	550	110
1N4739A	9.1	28	5	700	0.5	10	7	500	100
1N4740A	10	25	7	700	0.25	10	7.6	454	91
1N4741A	11	23	8	700	0.25	5	8.4	414	83
1N4742A	12	21	9	700	0.25	5	9.1	380	76
1N4743A	13	19	10	700	0.25	5	9.9	344	69
1N4744A	15	17	14	700	0.25	5	11.4	304	61
1N4745A	16	15.5	16	700	0.25	5	12.2	285	57
1N4746A	18	14	20	750	0.25	5	13.7	250	50
1N4747A	20	12.5	22	750	0.25	5	15.2	225	45
1N4748A	22	11.5	23	750	0.25	5	16.7	205	41
1N4749A	24	10.5	25	750	0.25	5	18.2	190	38
1N4750A	27	9.5	35	750	0.25	5	20.6	170	34
1N4751A	30	8.5	40	1000	0.25	5	22.8	150	30
1N4752A	33	7.5	45	1000	0.25	5	25.1	135	27
1N4753A	36	7	50	1000	0.25	5	27.4	125	25
1N4754A	39	6.5	60	1000	0.25	5	29.7	115	23
1N4755A	43	6	70	1500	0.25	5	32.7	110	22
1N4756A	47	5.5	80	1500	0.25	5	35.8	95	19
1N4757A	51	5	95	1500	0.25	5	38.8	90	18
1N4758A	56	4.5	110	2000	0.25	5	42.6	80	16
1N4759A	62	4	125	2000	0.25	5	47.1	70	14
1N4760A	68	3.7	150	2000	0.25	5	51.7	65	13
1N4761A	75	3.3	175	2000	0.25	5	56	60	12
1N4762A	82	3.0	200	3000	0.25	5	62.2	55	11
1N4763A	91	2.8	250	3000	0.25	5	69.2	50	10
1N4764A	100	2.5	350	3000	0.25	5	76.0	45	9

[1] Based on dc-measurement at thermal equilibrium while maintaining the lead temperature (T_L) at 30 °C + 1 °C, 9.5 mm (3/8") from the diode body.

[2] Valid provided that electrodes at a distance of 4 mm from case are kept at ambient temperature.

[3] T_P = 10 ms.

Typical Characteristics

T_{amb} = 25 °C, unless otherwise specified

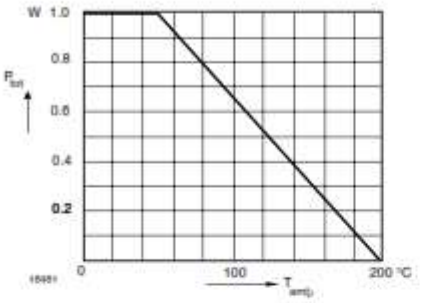
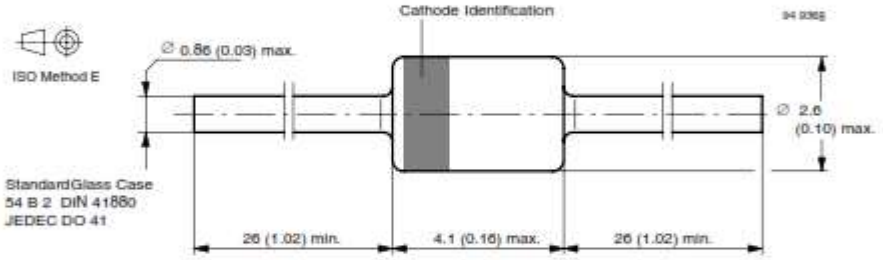


Figure 1. Admissible Power Dissipation vs. Ambient Temperature

Package Dimensions in mm (Inches)



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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.

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

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