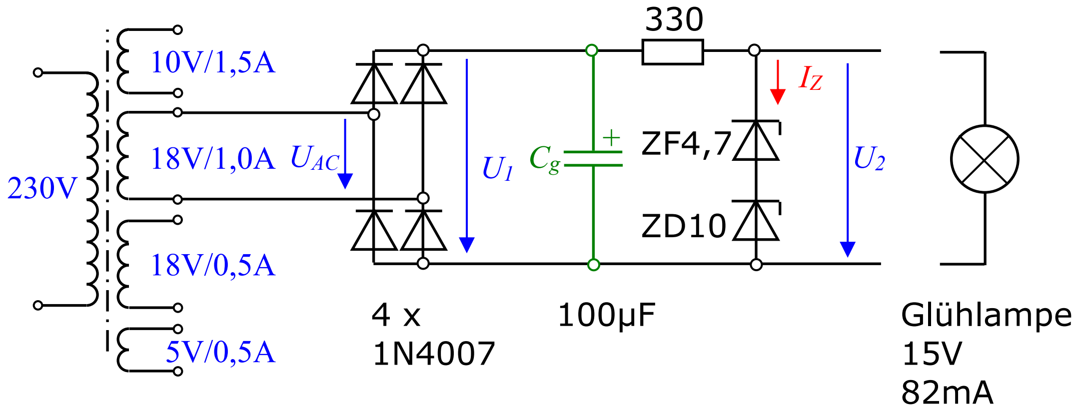
Stabilisierung einer Gleichspannung

Messung 1:

Stabilisierung mit Z-Diode



Berechnung des maximalen Diodenstromes $I_{Z\max} = \dfrac{P_{tot}}{U_Z} = \dfrac{500\,mW}{15V} = \dfrac{0{,}5W}{15V} = 0{,}033\,A$ *(der gewählte Wert muss darunter liegen!)*

Berechnung des minimalen Diodenstromes $I_{Z\min} = I_{Z\max} \cdot 0{,}1 = 0{,}0033\,A$ *(10% von I_{zmax})*

Berechnung des Vorwiderstandes $R_V = \dfrac{U_1 - U_Z}{I_Z} = \dfrac{20{,}1V - 16V}{15\,mA} = \dfrac{4{,}1V}{0{,}015\,A} = 273{,}3{,}\Omega$

(gewählt $R_V = 330\Omega$)

Philips Semiconductors **Product specification**

Voltage regulator diodes **BZX55 series**

FEATURES

- Total power dissipation: max. 500 mW
- Tolerance series: ±5%
- Working voltage range: nom. 2.4 to 75 V (E24 range)
- Non-repetitive peak reverse power dissipation: max. 40 W.

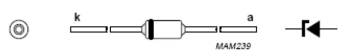
APPLICATIONS

- Low voltage stabilizers or voltage references.

DESCRIPTION

Low-power voltage regulator diodes in hermetically sealed leaded glass SOD27 (DO-35) packages.

The diodes are available in the normalized E24 ±5% tolerance range. The series consists of 37 types with nominal working voltages from 2.4 to 75 V (BZX55-C2V4 to BZX55-C75).



The diodes are type branded.

Fig.1 Simplified outline (SOD27; DO-35) and symbol.

LIMITING VALUES

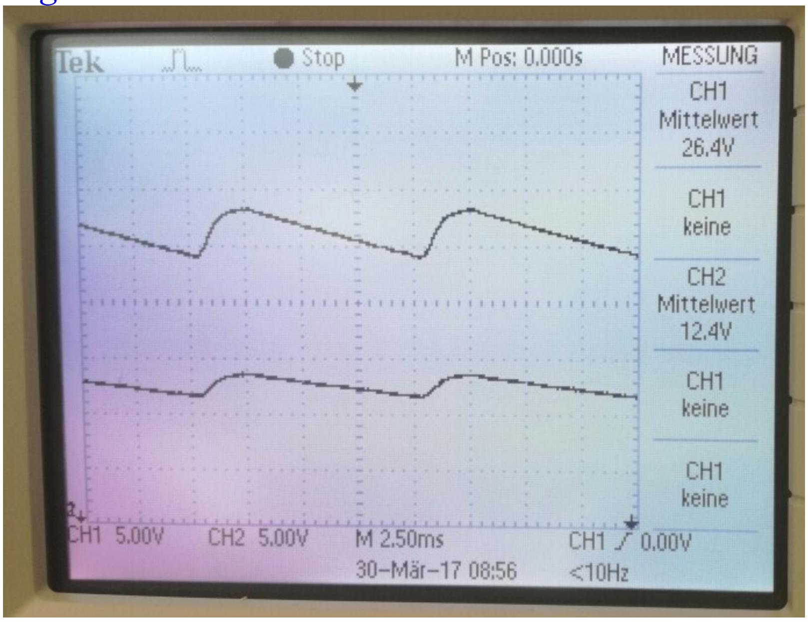
In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_F	continuous forward current		–	250	mA
I_{ZSM}	non-repetitive peak reverse current	t_p = 100 µs; square wave; T_j = 25 °C prior to surge	see Table "Per type"		
P_{tot}	total power dissipation	T_{amb} = 50 °C; note 1	–	400	mW
		T_{amb} = 50 °C; note 2	–	500	mW
P_{ZSM}	non-repetitive peak reverse power dissipation	t_p = 100 µs; square wave; T_j = 25 °C prior to surge	–	40	W
		t_p = 8.3 ms; square wave; $T_j \leq$ 150 °C prior to surge	–	30	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C

Notes

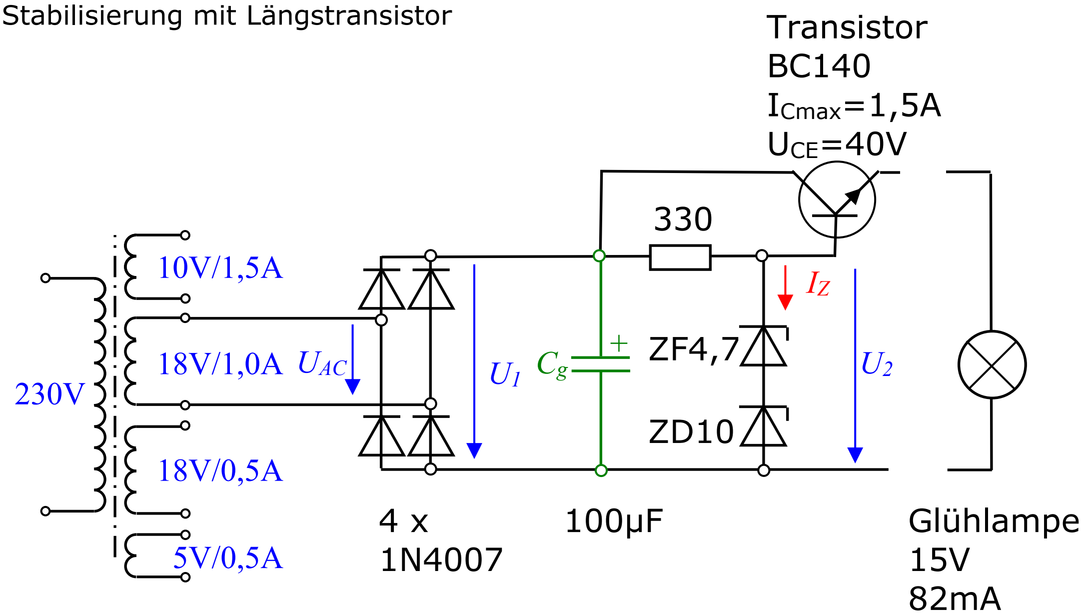
1. Device mounted on a printed circuit-board without metallization pad; lead length max.
2. Tie-point temperature ≤ 50 °C; lead length 8 mm.

Ergebnis:



Messung 2:

Stabilisierung mit Längstransistor



Philips Semiconductors **Product specification**

NPN medium power transistors **BC140; BC141**

FEATURES

- High current (max. 1 A)
- Low voltage (max. 60 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

NPN medium power transistor in a TO-39 metal package.
PNP complements: BC160 and BC161.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector, connected to case

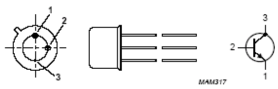
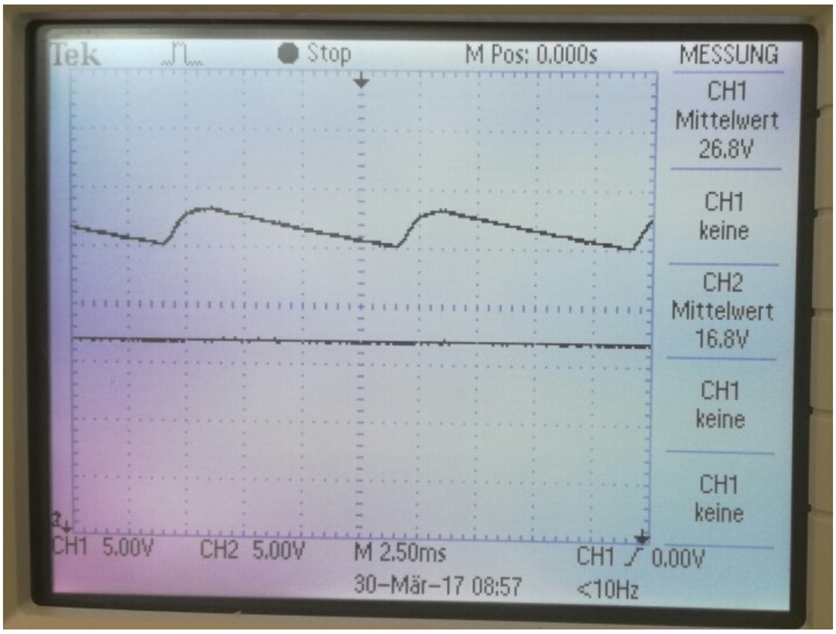


Fig.1 Simplified outline (TO-39) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BC140		–	–	80	V
	BC141		–	–	100	V
V_{CEO}	collector-emitter voltage	open base				
	BC140		–	–	40	V
	BC141		–	–	60	V
I_{CM}	peak collector current		–	–	1.5	A
P_{tot}	total power dissipation	$T_{case} \leq 45$ °C	–	–	3.7	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V				
	BC140-10; BC141-10		63	100	160	
	BC140-16; BC141-16		100	160	250	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz	50	–	–	MHz

Ergebnis



Berechnung der Schaltung

1) Gleichrichterberechnung

$$\hat{U} = \sqrt{2} \cdot U_{eff} = 1{,}4 \cdot 18V = 25{,}2\text{V}$$

Die gewünschte Gleichspannung soll 15V betragen. $\leftarrow U_2$
Das heißt: Die Brummspannung darf maximal $U_{Br} = \hat{U} - U_2$ sein.

$$U_{Br} = \hat{U} - U_2 = 25{,}2V - 15V = 10{,}2V$$

Damit haben wir aber keine Reserven mehr, deshalb wählen wir für die Eingangsspannung

$$U_1 = \hat{U} - \frac{U_{Br}}{2} = 25{,}2V - 5{,}1V = 20{,}1V$$

2) Berechnung der Zenerdioden-Stabilisierung

$$U_Z = 0{,}7V + U_2 = 0{,}7V + 15V \approx 16V$$

$$I_{Z\max} = \frac{P_{tot}}{U_Z} = \frac{500\,mW}{15V} = \frac{0{,}5W}{15V} = 0{,}033\,A$$ *(der gewählte Wert muss darunter liegen!)*

$$R_V = \frac{U_1 - U_Z}{I_Z} = \frac{20{,}1V - 16V}{30\,mA} = \frac{4{,}1V}{0{,}03\,A} = 136{,}7\Omega$$ *(gewählt R_V = 150Ω)*

3) Berechnung des Glättungskondensators

$$C = \frac{I_L}{U_{Br}} \cdot 1{,}8 = \frac{1500\,mA}{5V} \cdot 1{,}8 = 540\,\mu F$$ $I_L \mathrel{\hat{=}} I_{C\max}$

(gewählt C_g = 470µF)

4) Berechnung der Belastung

$$R_{L\min} = \frac{U_2}{I_{c\max}} = \frac{15V}{1{,}5A} = 10\Omega$$

$$P_V = U_2 \cdot I_L = 15V \cdot 1{,}5A = 22{,}5W$$

5) Berechnung des Transistors

$$I_B = \frac{I_C}{B} = \frac{1{,}5A}{100} = 15mA$$

$$U_{1\max} = \frac{P_{TOT} + P_L}{I_L} = \frac{3{,}7W + 15V \cdot 0{,}5A}{0{,}5A} = 22{,}4V\ .$$

$$I_{1\max} = \frac{P_{TOT}}{U_1 - U_2} = \frac{3{,}7W}{20{,}1V - 15V} = 0{,}73A$$