Philips Semiconductors

Data sheet	
status	Preliminary specification
date of issue	December 1990

BRY39
Programmable unijunction transistor

DESCRIPTION

A planar pnpn trigger device in a TO-72 metal envelope, intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shapers, etc.

PINNING

Anode gate (ag) connected to case.

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate
4	anode

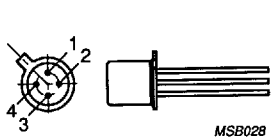
ACCESSORIES

56246 (distance disc).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
I_A	anode current	DC value up to T_{amb} = 25 °C	–	175	mA
T_j	operating junction temperature		–	150	°C
$I_{(P)}$	peak point current	V_S = 10 V R_G = 10 kΩ	–	0.2	µA

PIN CONFIGURATION



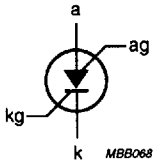


Fig.1 Simplified outline and symbol.

Programmable unijunction transistor

BRY39

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{GA}	gate-anode voltage		–	70	V
I_A	anode current	average value up to T_{amb} = 25 °C	–	175	mA
I_{ARM}	repetitive peak anode current	t_p = 10 µs δ = 0.01	–	2.5	A
I_{ASM}	non-repetitive peak anode current	t_p = 10 µs T_j = 150 °C	–	3	A
dI_A/dt	rate of rise of anode current	up to I_A = 2.5 A	–	20	A/µs
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	275	mW
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	150	°C
T_{amb}	ambient operating temperature range		–65	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient in free air	450	K/W

EXPLANATION OF SYMBOLS

For application of the BRY39 as a programmable unijunction transistor, only the anode gate is used. To simplify the symbols, the term gate, instead of anode gate, will be used (see Fig.2).

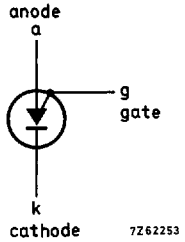


Fig.2 Explanation of symbols.

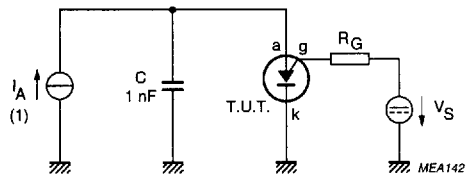
Programmable unijunction transistor

BRY39

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{(P)}$	peak point current (see Figs 3 and 8)	V_S = 10 V R_G = 10 kΩ	–	–	0.2	µA
		V_S = 10 V R_G = 100 kΩ	–	–	0.06	µA
$I_{(V)}$	valley point current (see Figs 3 and 8)	V_S = 10 V R_G = 10 kΩ	–	–	2	µA
		V_S = 10 V R_G = 100 kΩ	–	–	1	µA
V_{offset}	offset voltage (for V_P and V_S, see Fig.8)	typical curve I_A = 0	–	V_P–V_S	–	V
I_{GAO}	gate-anode leakage current	I_K = 0 V_{GA} = 70 V	–	–	10	nA
I_{GKS}	gate-cathode leakage current	V_{AK} = 0 V_{KG} = 70 V	–	–	100	nA
V_{AK}	anode-cathode voltage	I_A = 100 mA	–	–	1.4	V
V_{OM}	peak output voltage (see Figs 9 and 10)	V_{AA} = 20 V C = 10 nF	6	–	–	V
t_r	rise time (see Fig.10)	V_{AA} = 20 V C = 10 nF	–	–	80	ns



(1) Controllable current source.

Fig.3 Test circuit for peak and valley point currents.

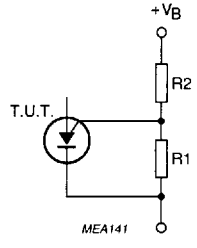


Fig.4 BRY39 with 'program' resistors R1 and R2.

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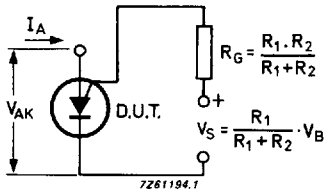

Fig.5 Equivalent test circuit for characteristics testing.

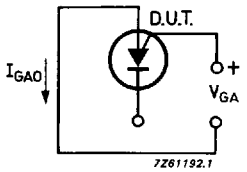

Fig.6 Equivalent test circuit for gate-anode leakage current.

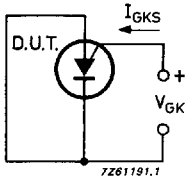

Fig.7 Equivalent test circuit for gate-cathode leakage current.

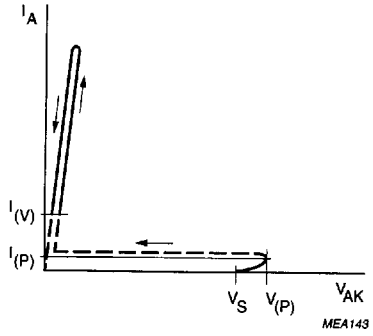

Fig.8 Offset voltage.

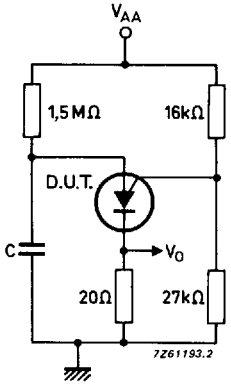

Fig.9 Test circuit for peak output voltage.

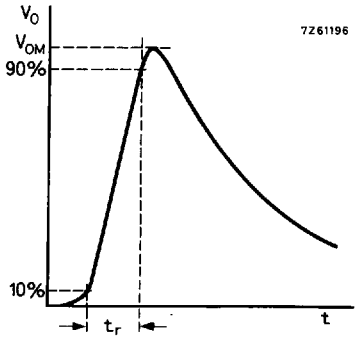

Fig.10 Peak output voltage.

Programmable unijunction transistor

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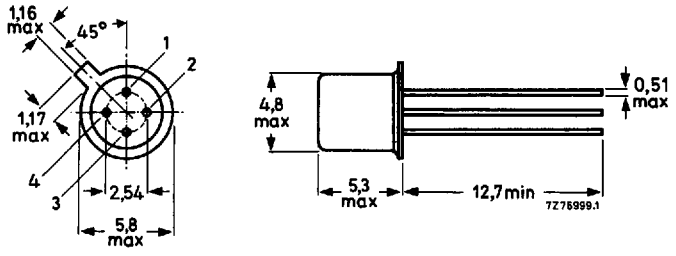
PACKAGE OUTLINE



Dimensions in mm.

Fig.11 TO-72.

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Data sheet	
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BRY39
Silicon controlled switch

DESCRIPTION

A silicon planar pnpn switch in a TO-72 metal envelope, intended for use in switching applications. It is an integrated pnp/npn transistor pair, with all electrodes accessible.

PINNING - TO-72

Collector of the npn transistor (ag, anode gate) connected to case.

PIN	DESCRIPTION
1	cathode
2	cathode gate
3	anode gate
4	anode

ACCESSORIES

56246 (distance disc).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
PNP transistor					
$-V_{EBO}$	emitter-base voltage		–	70	V
NPN transistor					
V_{CBO}	collector-base voltage		–	70	V
$-I_{ERM}$	repetitive peak emitter current		–	2.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	275	mW
T_j	operating junction temperature		–	150	°C
V_{AK}	forward on-state voltage	I_A = 50 mA I_{AG} = 0 R_{KG-K} = 10 kΩ	–	1.4	V
I_H	holding current	I_{AG} = 10 mA $-V_{BB}$ = 2 V R_{KG-K} = 10 kΩ	–	1	mA
t_{on}	turn-on time		–	0.25	µs
t_{off}	turn-off time		15	–	µs

PIN CONFIGURATION

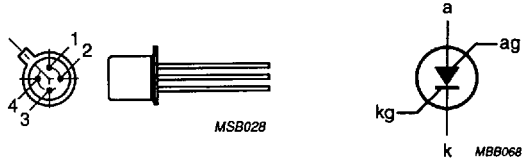

Fig.1 Simplified outline and symbol.

Silicon controlled switch BRY39

TEST CIRCUITS

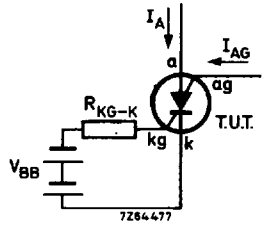

Fig.2 Equivalent test circuit for holding current.

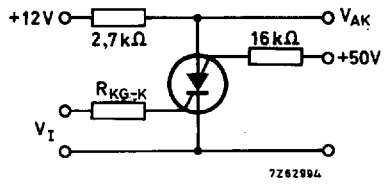

Fig.3 Test circuit for turn-on time.

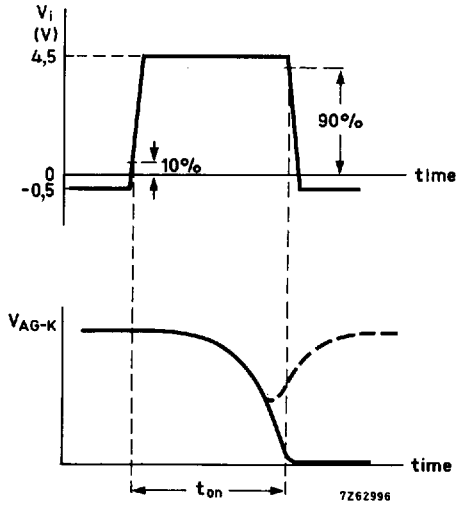

Fig.4 Pulse duration increased until dashed curve disappears.

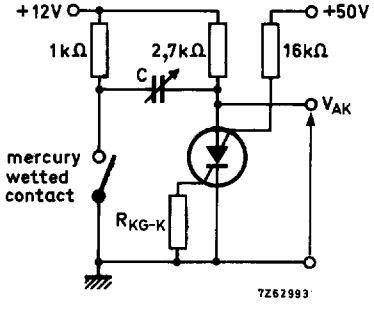

Fig.5 Test circuit for turn-off time.

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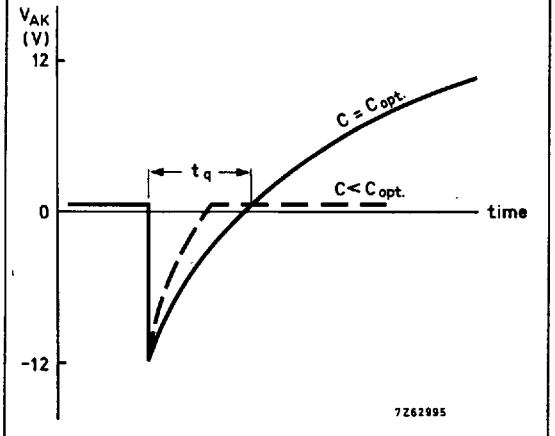

Fig.6 Capacitance increased until C = C_{opt} dashed curve disappears.

Silicon controlled switch

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LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	pnp		–	–70	V
	npn		–	70	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 kΩ			
	pnp		–	–	
	npn		–	70	V
V_{CEO}	collector-emitter voltage	open base			
	pnp		–	–70	V
	npn		–	–	
V_{EBO}	emitter-base voltage	open collector			
	pnp		–	–70	V
	npn		–	5	V
I_C	collector current (note 1)	DC value			
	pnp		–	–	
	npn		–	175	mA
I_{CM}	collector current (note 2)	peak value			
	pnp		–	–	
	npn		–	175	mA
I_E	emitter current	DC value			
	pnp		–	175	mA
	npn		–	–175	mA
I_{ERM}	repetitive peak emitter current	t_p = 10 µs δ = 0.01			
	pnp		–	2.5	A
	npn		–	–2.5	A
P_{tot}	total power dissipation	up to T_{amb} = 25 °C	–	275	mW
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	150	°C
T_{amb}	ambient operating temperature range		–65	150	°C

Notes

1. Provided the I_E rating is not exceeded.
2. During switch-on, the device can withstand the discharge of a capacitor of maximum value of 500 pF. This capacitor is charged when the transistor is in cut-off condition, with a collector supply voltage of 160 V and a series resistance of 100 kΩ.

THERMAL RESISTANCE

SYMBOL	PARAMETER	MAX.	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient in free air	450	K/W

Silicon controlled switch BRY39

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Individual npn transistor						
I_{CER}	collector cut-off current	V_{CE} = 70 V R_{BE} = 10 kΩ	–	–	100	nA
		V_{CE} = 70 V R_{BE} = 10 kΩ T_j = 150 °C	–	–	10	μA
I_{EBO}	emitter cut-off current	V_{EB} = 5 V I_C = 0 T_j = 150 °C	–	–	10	μA
V_{CEsat}	collector-emitter saturation voltage	I_C = 10 mA I_B = 1 mA	–	–	500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA I_B = 1 mA	–	–	900	mV
h_{FE}	DC current gain	I_C = 10 mA V_{CE} = 2 V	50	–	–	
f_T	transition frequency	I_C = 10 mA V_{CE} = 2 V f = 100 MHz	–	170	–	MHz
C_c	collector capacitance	$I_E = I_e$ = 0 V_{CB} = 20 V	–	–	5	pF
C_e	emitter capacitance	$I_E = I_e$ = 0 V_{EB} = 1 V	–	–	25	pF
Individual pnp transistor						
$-I_{CEO}$	collector cut-off current	$-V_{CE}$ = 70 V I_B = 0 T_j = 150 °C	–	–	10	μA
$-I_{EBO}$	emitter cut-off current	$-V_{EB}$ = 70 V I_C = 0 T_j = 150 °C	–	–	10	μA
h_{FE}	DC current gain	I_E = 1 mA V_{CB} = 0	–	5	–	
Combined device						
V_{AK}	forward on-state voltage	R_{KG-K} = 10 kΩ I_A = 50 mA I_{AG} = 0	–	–	1.4	V
		R_{KG-K} = 10 kΩ I_A = 50 mA I_{AG} = 0 T_j = −55 °C	–	–	1.9	V
		R_{KG-K} = 10 kΩ I_A = 1 mA I_{AG} = 10 mA	–	–	1.2	V

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_H	holding current (see Fig.2)	R_{KG-K} = 10 kΩ I_{AG} = 10 mA $-V_{BB}$ = 2 V	–	–	1	mA
Switching times						
t_{on}	turn-on time	V_{KG-K} = −0.5 to 4.5 V R_{KG-K} = 1 kΩ	–	–	0.25	µs
		V_{KG-K} = −0.5 to 4.5 V R_{KG-K} = 10 kΩ	–	–	1.5	µs
t_{off}	turn-off time	R_{KG-K} = 10 kΩ	–	15	–	µs

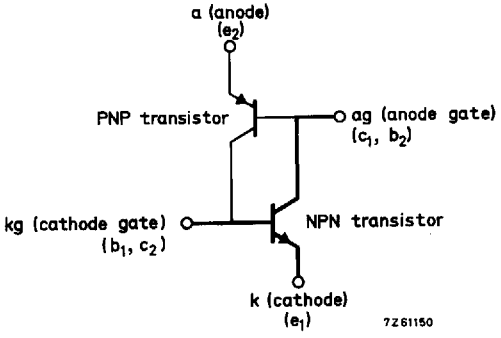


Fig.7 Two transistor equivalent circuit.

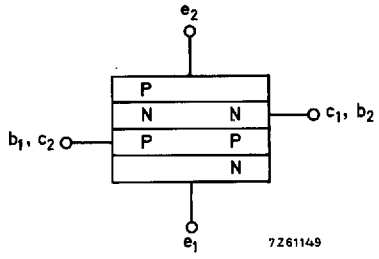


Fig.8 PNPN silicon controlled switch structure.

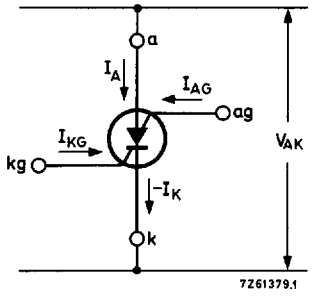
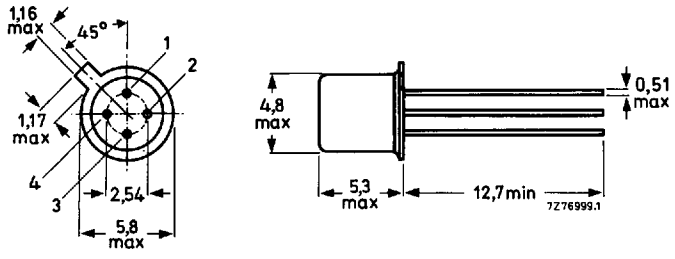


Fig.9 Silicon controlled switch symbol.

Silicon controlled switch BRY39

PACKAGE OUTLINE



Dimensions in mm.

Fig.10 TO-72.