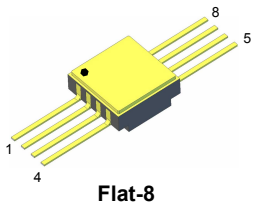
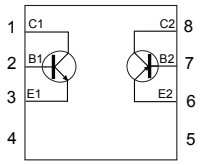
Hi-Rel NPN and PNP complementary transistors 60 V, 0.8 A



Flat-8



Flat-8

Pin 4 and pin 5
are connected together to the seal ring and lid

Features

Polarity	$V_{(BR)CEO}$	IC (max.)	h_{FE} (1)
NPN	60 V	0.8 A	160
PNP	-60	-0.8 A	160

1. *at IC = 1 A and V_{CE} = 2 V*

- 100 krad (Si) low dose rate
- Temperature range: -65 °C to 200 °C
- Linear gain characteristics
- ESCC qualified: 5207/009 specification

Description

2ST3360 is a dual complementary NPN and PNP bipolar transistor housed in Flat-8 hermetic package and specifically designed for aerospace applications.

Developed from ST's rad'hard high current density technology, it ensures high switching and best in class radiation hardness performances.

Suitable for power MOSFET driver applications, it is qualified in the ESCC system as per 5207/009 specification.

STPOWER

Product status link
2ST3360

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		NPN	PNP	
V_{CBO}	Collector-base voltage (I_E = 0)	60	-60	V
V_{CEO}	Collector-emitter voltage (I_B = 0)	60	-60	V
V_{EBO}	Emitter-base voltage (I_C = 0)	6	-6	V
I_C	Collector current	0.8	-0.8	A
I_{CM}	Collector peak current (t_P < 5 ms)	4	-4	A
I_B	Base current	0.2	-0.2	A
I_{BM}	Base peak current (t_P < 5 ms)	0.4	-0.4	A
P_{TOT}	Total dissipation at T_{amb} ≤ 25 °C	1.4(1)		W
		0.8(2)		
	Total dissipation at T_c ≤ 25 °C	7(1)		W
		5(2)		
T_{STG}	Storage temperature range	-65 to 200		°C
T_J	Operating junction temperature range			°C

1. *Both sections.*
2. *One section.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	125(1)	°C/W
		180(2)	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	25(1)	
		35(2)	

1. *Both sections.*
2. *One section.*

2 Electrical characteristics

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

Table 3. Electrical characteristics for NPN

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector-base cut-off current (I_E = 0)	V_{CB} = 60 V		-	100	nA
		V_{CB} = 60 V, T_a = 150 °C		-	10	µA
I_{EBO}	Emitter-base cut-off current (I_C = 0)	V_{EB} = 6 V		-	100	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = 100 µA	60	-		V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	60	-		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage	I_E = 10 µA	6	-		V
$V_{BE(on)}$	Base-emitter on voltage	V_{CE} = 2 V, I_C = 100 mA	600		720	mV
$V_{CE(sat)}$ (1)	Collector-emitter saturation voltage	I_C = 0.8 A, I_B = 40 mA		-	160	mV
		I_C = 2 A I_B = 100 mA		-	380	mV
h_{FE} (1)	DC current gain	I_C = 100 mA, V_{CE} = 2 V	100	-		
		I_C = 100 mA, V_{CE} = 2 V, T_a = -55 °C	40			
		I_C = 1 A, V_{CE} = 2 V	160		400	
t_{on}	Turn on-time	V_{CC} = 10 V, I_C = 0.8 A, I_{bon} = 80 mA, I_{boff} = -80 mA(2)		-	175	ns
t_{off}	Turn off-time				2.5	µs
C_{OBO}	Output capacitance	V_{CB} = 10 V, I_E = 0 A, f = 1 MHz		-	45	pF

1. *Pulse test: pulse duration ≤ 300 µs, duty cycle ≤ 2%.*
2. *Resistive load*

Table 4. Electrical characteristics for PNP

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector-base cut-off current (I_E = 0)	V_{CB} = 60 V		-	100	nA
		V_{CB} = 60 V, T_a = 150 °C		-	10	µA
I_{EBO}	Emitter-base cut-off current (I_C = 0)	V_{EB} = 6 V		-	100	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = 100 µA	60	-		V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	60	-		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage	I_E = 10 µA	6	-		V
$V_{BE(on)}$	Base-emitter on voltage	V_{CE} = 2 V, I_C = 100 mA	600		720	mV
$V_{CE(sat)}$ (1)	Collector-emitter saturation voltage	I_C = 0.8 A, I_B = 40 mA		-	180	mV
		I_C = 2 A I_B = 100 mA		-	440	mV
h_{FE} (1)	DC current gain	I_C = 100 mA, V_{CE} = 2 V	100	-		
		I_C = 100 mA, V_{CE} = 2 V, T_a = -55 °C	40			
		I_C = 1 A, V_{CE} = 2 V	160		400	
t_{on}	Turn on-time	V_{CC} = 10 V, I_C = 0.8 A, I_{bon} = 80 mA, I_{boff} = -80 mA(2)		-	150	ns
t_{off}	Turn off-time				1	µs
C_{OBO}	Output capacitance	V_{CB} = 10 V, I_E = 0 A, f = 1 MHz		-	60	pF

1. *Pulse test: pulse duration ≤ 300 µs, duty cycle ≤ 2%.*
2. *Resistive load*

For PNP type, voltage and current values are negative.

2.1 Test circuits

Figure 1. **Resistive load switching for NPN**

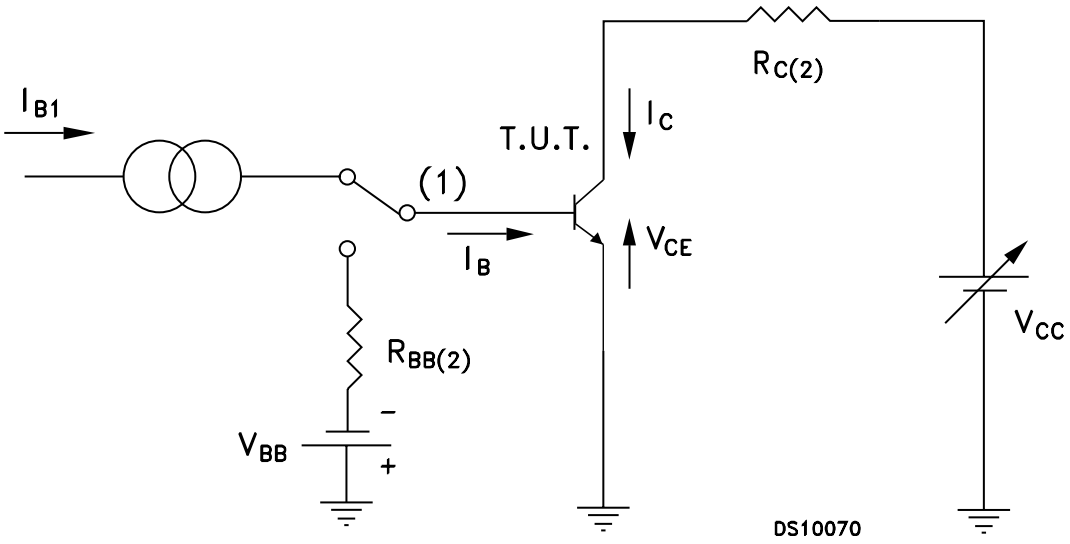
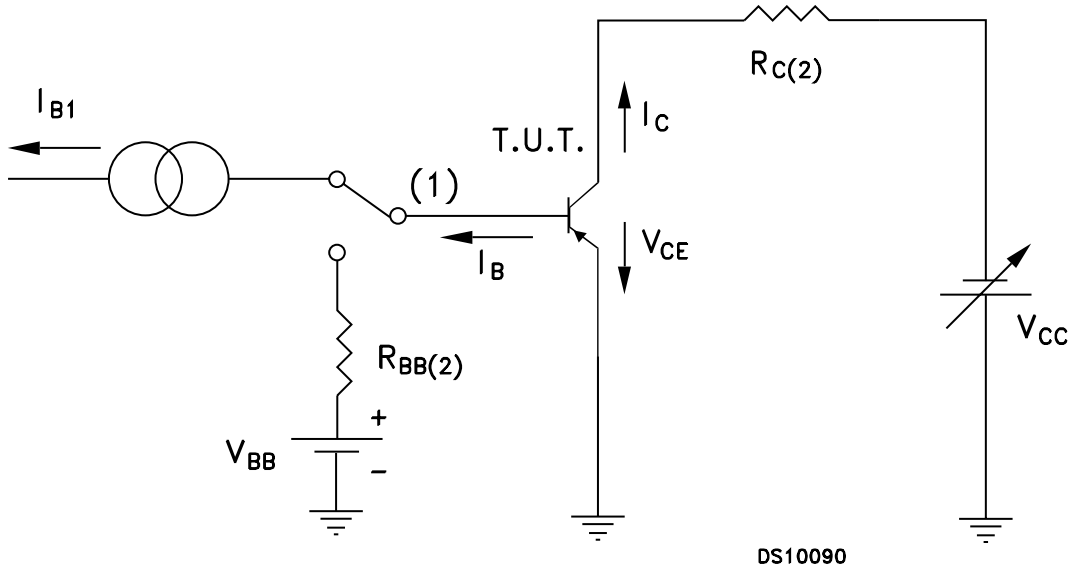


Figure 2. **Resistive load switching for PNP**



3 Radiation hardness assurance

The products guaranteed in radiation within the ESCC system fully comply with the ESCC 5207/009 and ESCC 22900 specifications.

ESCC radiation assurance

Each product lot is tested according to the ESCC basic specification 22900.

ST goes beyond the ESCC specification by performing the following procedure:

- Test of 11 pieces by wafer, 5 biased at least 80% of $V_{(BR)CEO}$, 5 unbiased and 1 kept for reference.
- Irradiation at 0.1 rad (Si)/s
- Acceptance criteria of each individual wafer if as 100 krad guaranteed if all 10 samples comply with the post radiation electrical characteristics.
- Delivery together with the parts of the radiation verification test (RVT) report of the particular wafer used to manufacture the products. This RVT includes the value of each parameter at 30, 50, 70 and 100 krad (Si) and after 24 hour annealing at room temperature and after an additional 168 hour annealing at 100°C.

Table 5. Radiation summary

Radiation test	100 krad ESCC
Wafer test	Each
Part tested	5 biased + 5 unbiased
Dose rate	0.1 rad/s
Acceptance	ESCC 22900

Table 6. ESCC5207/009 post radiation electrical characteristics for NPN

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{CBO}	Collector cut-off current (I_E=0)	V_{CB}= 60 V		-	200	nA
I_{EBO}	Emitter cut-off current (I_C= 0)	V_{EB} = 6 V		-	200	nA
$V_{BE(on)}$	VBE(on) Base-emitter on voltage	V_{CE} = 2 V, I_C = 100 mA	600		828	mV
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E= 0)	I_C=100 µA	60	-		V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	60	-		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C= 0)	I_E = 10 µA	6	-		V
$V_{CE(sat)}$(1)	Collector-emitter saturation voltage	I_C=0.8 A, I_B = 40 mA		-	184	mV
		I_C= 2 A, I_B = 100 mA		-	437	
h_{FE}(1)	DC current gain	I_C= 100 mA, V_{CE}= 2 V	[50](2)	-		
		I_C= 1 A, V_{CE}= 2 V	[80](2)	-	400	

1. *Pulsed duration = 300 µs, duty cycle ≥ 2 %*
2. *The post-irradiation gain calculation of [h_{FE}], made using h_{FE} measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019*

Table 7. ESCC5207/009 post radiation electrical characteristics for PNP

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{CBO}	Collector cut-off current (I_E=0)	V_{CB}= 60 V		-	200	nA
I_{EBO}	Emitter cut-off current (I_C= 0)	V_{EB} = 6 V		-	200	nA
$V_{BE(on)}$	Base-emitter on voltage	V_{CE} = 2 V, I_C = 100 mA	600		828	mV
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E= 0)	I_C= 100 µA	60	-		V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	60	-		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C= 0)	I_E = 10 µA	6	-		V
$V_{CE(sat)}$[1]	Collector-emitter saturation voltage	I_C=0.8 A, I_B = 40 mA		-	207	mV
		I_C= 2 A, I_B = 100 mA		-	506	
h_{FE}[1]	DC current gain	I_C= 100 mA, V_{CE}= 2 V	[50][2]	-		
		I_C= 1 A, V_{CE}= 2 V	[80][2]	-	400	

1. *Pulsed duration = 300 µs, duty cycle ≥ 2 %*
2. *The post-irradiation gain calculation of [h_{FE}], made using h_{FE} measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019*

4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

4.1 Flat-8 package information

Figure 3. **Flat-8 package outline**

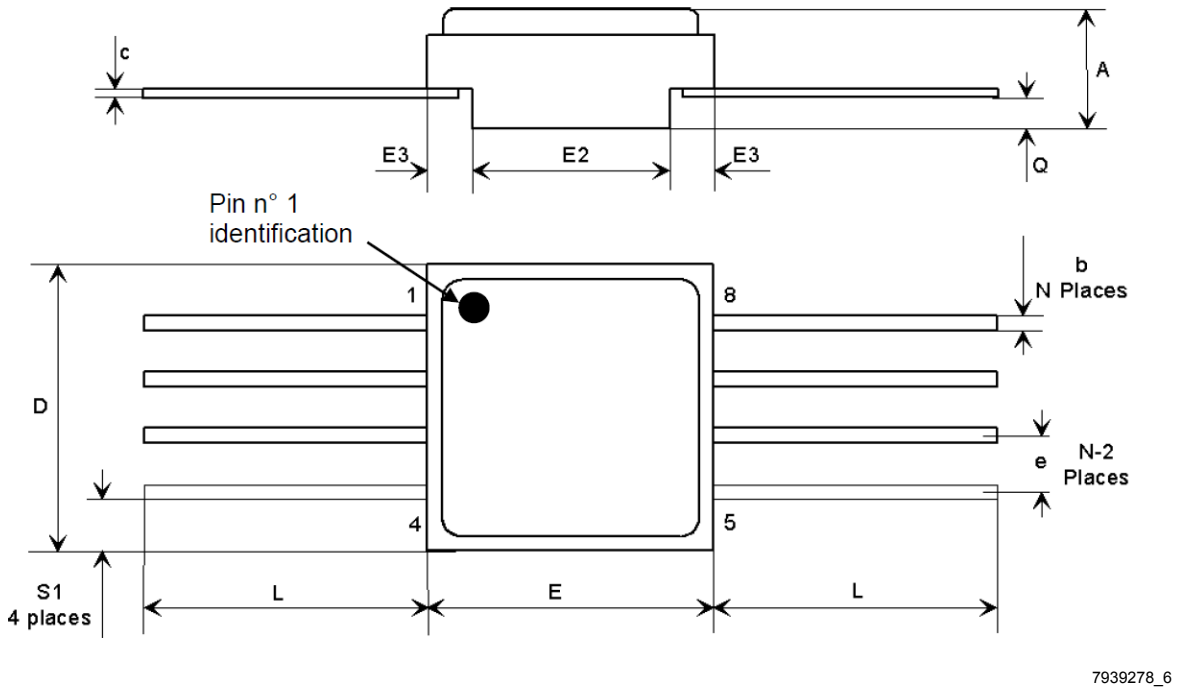


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Table 8. **Flat-8 mechanical data**

Symbol	Milimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.24	2.44	2.64	0.088	0.096	0.104
b	0.38	0.43	0.48	0.015	0.017	0.019
c	0.10	0.13	0.16	0.004	0.005	0.006
D	6.35	6.48	6.61	0.250	0.255	0.260
E	6.35	6.48	6.61	0.250	0.255	0.260
E2	4.32	4.45	4.58	0.170	0.175	0.180
E3	0.88	1.01	1.14	0.035	0.040	0.045
e		1.27			0.050	
L	6.51	-	7.38	0.256	-	0.291
Q	0.66	0.79	0.92	0.026	0.031	0.036
S1	0.92	1.12	1.32	0.036	0.044	0.052
N	08			08		

5 Ordering information

Table 9. Ordering information

Part number	Agency specification	Quality level	Radiation level	Package	Mass	Lead finish	Marking	Packing
2ST3360K1	-	Engineering model	-	Flat-8	0.4 g	Gold	2ST3360K1	Waffle pack
2ST3360RKG	5207/009/10R	ESCC flight	100 krad			Gold	520700910R	
2ST3360RKT	5207/009/11R	ESCC flight	100 krad			Solder dip	520700511R	

1. *Specific marking only. The full marking includes in addition: For the Engineering Models: ST logo, date code; country of origin (FR). For ESCC flight parts: ST logo, date code, country of origin (FR), ESA logo, serial number of the part within the assembly lot.*

Contact ST sales office for information about the specific conditions for:

- Products in die form
- Tape and reel packing

6 Other information

6.1 Traceability information

The date code in formation is structured as described in the table below.

Table 10. Date codes

Model	Date code[1]
EM	3yywwN
ESCC	yywwN

1. *yy = year, ww = week number, N = lot index in the week.*

6.2 Documentation

Each product shipment includes a set of associated documentation within the shipment box. This documentation depends on the quality level of the products, as detailed in the table below.

The documentation is provided on printed paper in a dedicated envelop.

Table 11. Default documentation provided with the parts

Quality level	Documentation
Engineering model	Certificate of conformance including: • Customer name • Customer purchase order number • ST sales order number and item • ST part number • Quantity delivered • Date code • Reference data sheet • Reference to TN1181 on engineering models • ST Rennes assembly lot ID
ESCC flight	Certificate of conformance including: • Customer name • Customer purchase order number • ST sales order number and item • ST part number • Quantity delivered • Date code • Serial numbers • Reference of the applicable ESCC Qualification maintenance lot • Reference to the ESCC detail specification • ST Rennes assembly lot ID Radiation verification test report

Revision history

Table 12. **Document revision history**

Date	Revision	Changes
08-Jan-2018	1	Initial release.
05-Mar-2019	2	Updated Section Description.

Contents

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