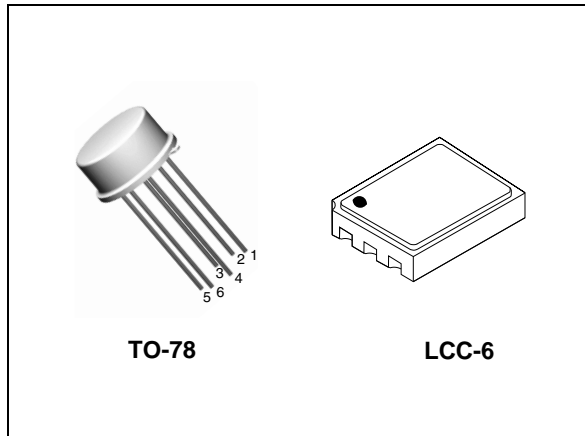


Hi-Rel PNP dual matched bipolar transistor 60 V, 0.05 A

Datasheet - production data

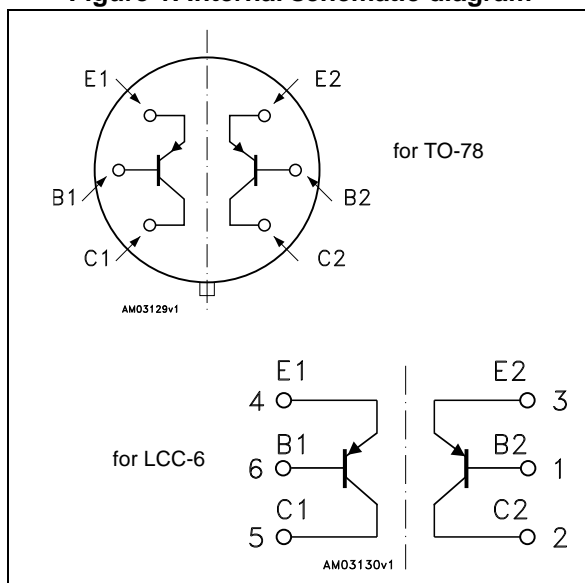


Features

BV_{CEO}	60 V
I_C (max)	0.05 A
H_{FE} at 10 V - 150 mA	> 150
Operating temperature range	-65°C to +200°C

- Hi-Rel PNP dual matched bipolar transistor
- Linear gain characteristics
- ESCC qualified
- European preferred part list - EPPL
- Radiation level: lot specific total dose contact marketing for specified level

Figure 1. Internal schematic diagram



Description

The 2N3810HR is a silicon planar epitaxial PNP transistor in TO-78 and LCC-6 packages. It is specifically designed for aerospace Hi-Rel applications and ESCC qualified according to the 5207-005 specification. In case of conflict between this datasheet and ESCC detailed specification, the latter prevails.

Table 1. Device summary

Device	Qualification system	Agency specification	Package	Radiation level	EPPL
SOC3810HRx	ESCC Flight	5207/005	LCC-6	-	Yes
2N3810HRx	ESCC Flight	5207/005	TO-78	-	-

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base voltage ($I_E = 0$)	-60	V
V_{CEO}	Collector-emitter voltage ($I_B = 0$)	-60	V
V_{EBO}	Emitter-base voltage ($I_C = 0$)	-5	V
I_C	Collector current	-50	mA
P_{TOT}	Total dissipation at $T_{amb} \leq 25\text{ °C}$		
	for TO-78 ⁽¹⁾	0.5	W
	for TO-78 ⁽²⁾	0.6	W
	for LCC-6 ⁽¹⁾⁽³⁾	0.6	W
	for LCC-6 ⁽²⁾⁽³⁾	1.2	W
	Total dissipation at $T_C \leq 25\text{ °C}$		
for TO-78 ⁽¹⁾	0.5	W	
for TO-78 ⁽²⁾	0.6	W	
T_{STG}	Storage temperature	-65 to 200	°C
T_J	Max. operating junction temperature	200	°C

1. One section.
2. Both sections.
3. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

Table 3. Thermal data for through-hole package

Symbol	Parameter	Value	Unit	
R_{thJC}	Thermal resistance junction-case ⁽¹⁾	max	350	°C/W
	Thermal resistance junction-case ⁽²⁾	max	292	°C/W
R_{thJA}	Thermal resistance junction-ambient ⁽¹⁾	max	350	°C/W
	Thermal resistance junction-ambient ⁽²⁾	max	292	°C/W

1. One section.
2. Both sections.

Table 4. Thermal data for SMD package

Symbol	Parameter	Value	Unit	
R_{thJA}	Thermal resistance junction-ambient ⁽¹⁾⁽³⁾	max	292	°C/W
	Thermal resistance junction-ambient ⁽²⁾⁽³⁾	max	146	°C/W

1. One section.
2. Both sections.
3. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

2 Electrical characteristics

$T_{\text{case}} = 25\text{ °C}$ unless otherwise specified.

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector-base cut-off current ($I_{\text{E}} = 0$)	$V_{\text{CB}} = -50\text{ V}$ $V_{\text{CB}} = -50\text{ V}$ $T_{\text{C}} = 150\text{ °C}$		-	-10 -10	μA ∞A
I_{EBO}	Emitter-base cut-off current ($I_{\text{C}} = 0$)	$V_{\text{EB}} = -4\text{ V}$		-	-20	μA
$V_{(\text{BR})\text{CBO}}$	Collector-base breakdown voltage ($I_{\text{E}} = 0$)	$I_{\text{C}} = -10\ \infty\text{A}$	-60	-		V
$V_{(\text{BR})\text{CEO}}^{(1)}$	Collector-emitter breakdown voltage ($I_{\text{B}} = 0$)	$I_{\text{C}} = -10\text{ mA}$	-60	-		V
$V_{(\text{BR})\text{EBO}}$	Emitter-base breakdown voltage ($I_{\text{C}} = 0$)	$I_{\text{E}} = -10\ \infty\text{A}$	-5	-		V
$V_{\text{CE}(\text{sat})}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = -100\ \mu\text{A}$ $I_{\text{B}} = -10\ \mu\text{A}$ $I_{\text{C}} = -1\text{ mA}$ $I_{\text{B}} = -100\ \mu\text{A}$		-	-0.2 -0.25	V V
$V_{\text{BE}(\text{sat})}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = -100\ \mu\text{A}$ $I_{\text{B}} = -10\ \mu\text{A}$ $I_{\text{C}} = -1\text{ mA}$ $I_{\text{B}} = -100\ \mu\text{A}$		-	-0.7 -0.8	V V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = -10\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -500\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -1\text{ mA}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\text{ mA}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $T_{\text{amb}} = -55\text{ °C}$	100 150 150 150 125	-	450 450 450	
$h_{\text{FE}2-1} / h_{\text{FE}2-2}$	DC current ratio comparison	$I_{\text{C}} = -100\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$	0.91	-	1.1	
$h_{\text{FE}2-1} / h_{\text{FE}2-2}$	DC current ratio comparison	$I_{\text{C}} = -100\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $T_{\text{amb}} = -55\text{ °C to } +125\text{ °C}$	0.85	-	1.18	
$\Delta V_{\text{BE}1} - V_{\text{BE}2} $	Base-emitter voltage differential	$V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\ \mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\text{ mA}$		-	5 3 5	mV mV mV
$\Delta V_{\text{BE}1} - V_{\text{BE}2} $	Base-emitter voltage differential	$V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\ \mu\text{A}$ $T_{\text{amb}} = -55\text{ °C to } +25\text{ °C}$ $T_{\text{amb}} = +25\text{ °C to } +125\text{ °C}$		-	0.8 1	mV mV
I_{LK}	Leakage current between active devices	$V = -50\text{ V to } E_2, B_2, C_2$ $V = 0\text{ V to } E_1, B_1, C_1$		-	-5	μA

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
h_{fe}	Small signal current gain	$V_{CE} = -5\text{ V}$ $I_C = -10\text{ mA}$ $f = 1\text{ kHz}$	125	-		
h_{fe}	Small signal current gain	$V_{CE} = -10\text{ V}$ $I_C = -10\text{ mA}$ $f = 1\text{ kHz}$	150	-	600	
f_T	Transition frequency	$I_C = -1\text{ mA}$ $V_{CE} = -5\text{ V}$	80	-	500	MHz
C_{obo}	Output capacitance ($I_E = 0$)	$V_{CB} = -5\text{ V}$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$		-	6	$\pi\Phi$
C_{ibo}	Input capacitance ($I_C = 0$)	$V_{EB} = -0.5\text{ V}$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$		-	15	$\pi\Phi$
h_{ie}	Input impedance	$I_C = -1\text{ mA}$ $V_{CE} = -10\text{ V}$ $f = 1\text{ kHz}$	3	-	30	$\kappa\Omega$
NF	Noise figure	$V_{CE} = -5\text{ V}$ $I_C = -200\text{ }\mu\text{A}$ $R_S = 2\text{ k}\Omega$ $f = 100\text{ Hz}$		-	7	δB
NF	Noise figure	$V_{CE} = -5\text{ V}$ $I_C = -200\text{ }\mu\text{A}$ $R_S = 2\text{ k}\Omega$ $f = 1\text{ kHz}$		-	3	δB
NF	Noise figure	$V_{CE} = -5\text{ V}$ $I_C = -200\text{ }\mu\text{A}$ $R_S = 2\text{ k}\Omega$ Bandwidth = 10 Hz to 15.7 kHz		-	3.5	δB

1. Pulsed duration = 300 μs , duty cycle $\leq 1.5\%$

2.1 Electrical characteristics (curves)

Figure 2. h_{FE} @ $V_{CE} = 5\text{ V}$

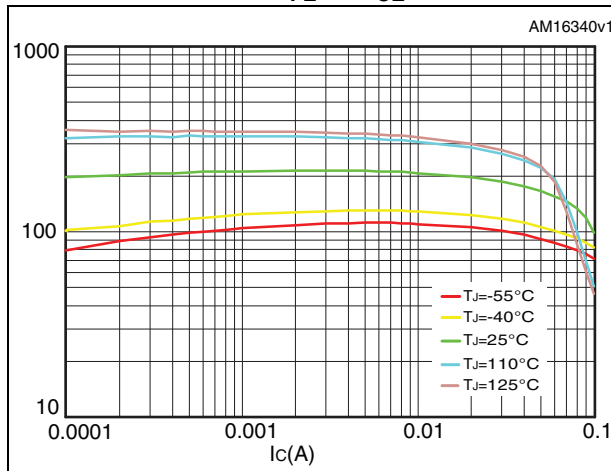


Figure 3. $V_{CE(sat)}$ @ $h_{FE} = 10$

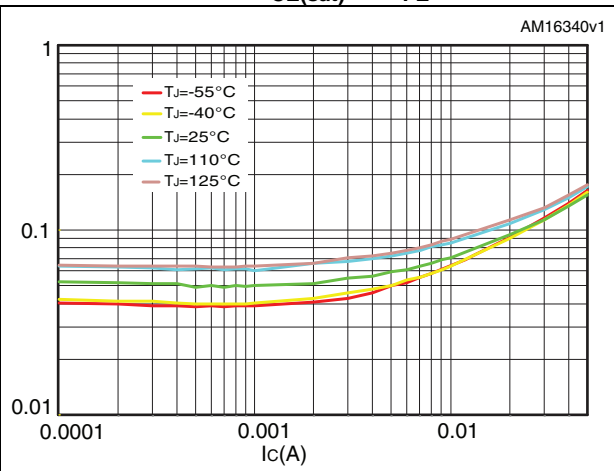
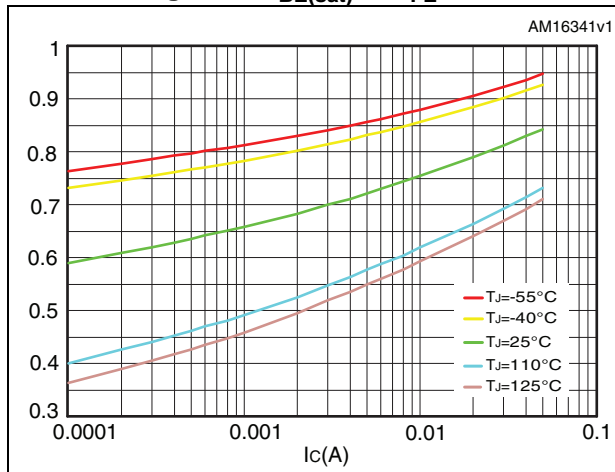


Figure 4. $V_{BE(sat)}$ @ $h_{FE} = 10$ 

3 Package mechanical data

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.

3.1 TO-78

Figure 5. TO-78 drawing

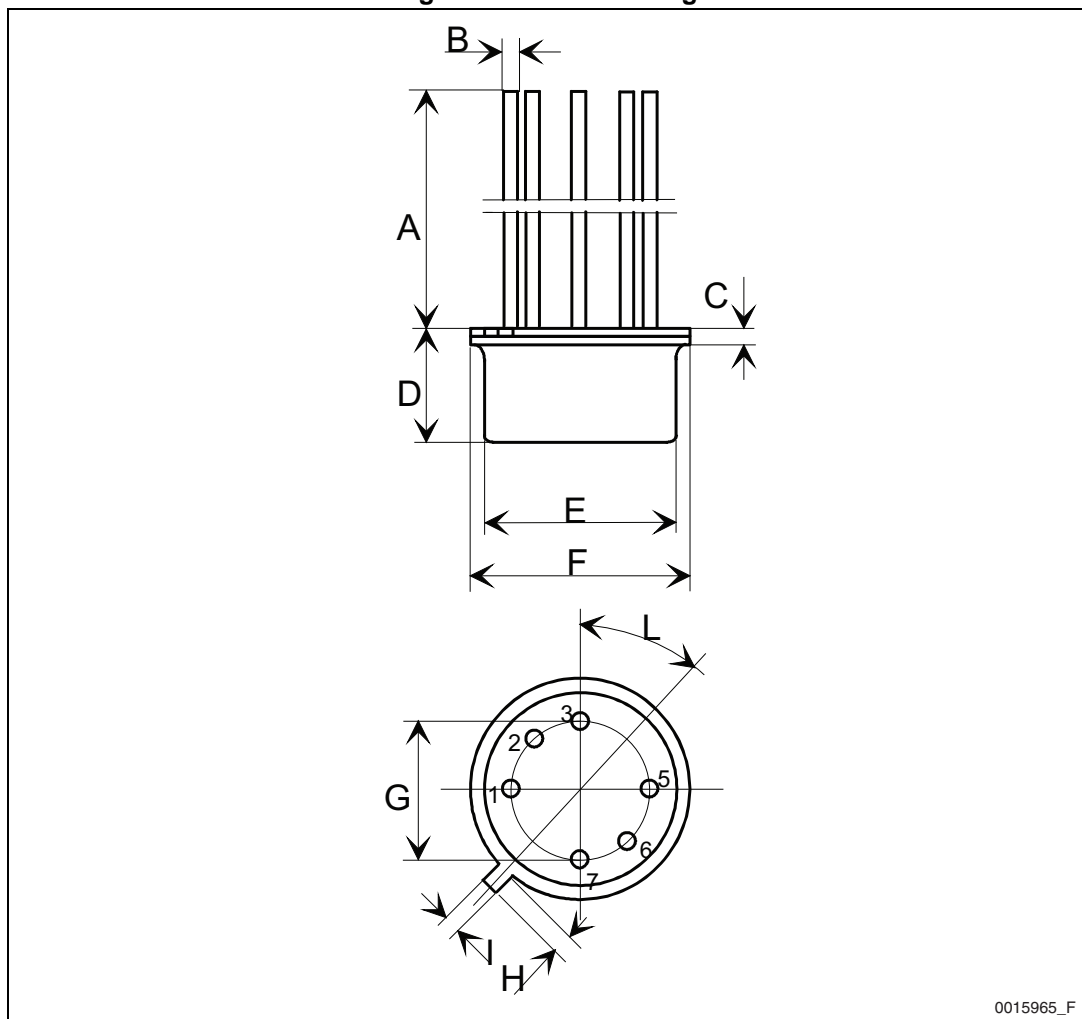


Table 6. TO-78 mechanical data

Dim.	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	12.70		13.70	0.500		0.539
B	0.40		0.47	0.016		0.019
C	0.55		0.76	0.022		0.030
D	4.26		4.57	0.168		0.180
E	8.15		8.25	0.321		0.325
F	9.05		9.25	0.356		0.364
G	4.85	5.08	5.31	0.191	0.200	0.209
H	0.71		0.85	0.028		0.034
I	0.90		1.00	0.035		0.040
L	42°		48°			

3.2 LCC-6

Figure 6. LCC-6 drawing

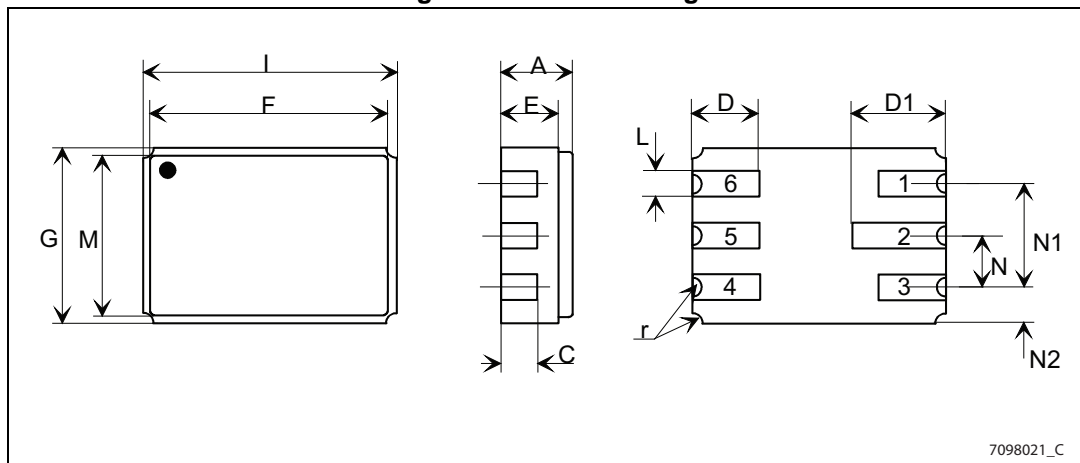


Table 7. LCC-6 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	1.53		1.96
C	0.78	0.89	0.99
D	1.52	1.65	1.78
E	12.4	1.40	1.55
F	5.77	5.84	5.92
G	4.19	4.31	4.45
I	6.10	6.22	6.35
L	0.56	0.63	0.71
M	3.86	3.94	4.01
N	1.14	1.27	1.40
N1	2.41	2.54	2.67
N2	0.64	0.89	1.14
r		0.23	
D1	2.08	2.28	2.49



4 Ordering information

Table 8. Oder codes

CPN	Agency specification	EPPL	Quality level	Radiation level	Package	Lead finish	Marking ⁽¹⁾	Packing
SOC38101	-	-	Engineering model ESCC	-	LCC-6	Gold	SOC38101	WafflePack
SOC3810HRG	5207/005/07	Yes	ESCC Flight	-	LCC-6	Gold	520700507	WafflePack
SOC3810HRT	5207/005/09	Yes	ESCC Flight	-	LCC-6	Solder Dip	520700509	WafflePack
2N3810HRG	5207/005/01	-	ESCC Flight	-	TO-78	Gold	520700501	Strip Pack
2N3810HRT	5207/005/02	-	ESCC Flight	-	TO-78	Solder Dip	520700502	Strip Pack

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

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
10-Dec-2008	1	Initial release
08-Jan-2010	2	Modified Table 1 on page 1
14-Nov-2012	3	Added: Section 2.1: Electrical characteristics (curves) Updated: Section 3: Package mechanical data
13-May-2014	4	Updated Table 1: Device summary . Added Section 4: Ordering information .

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