



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

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.

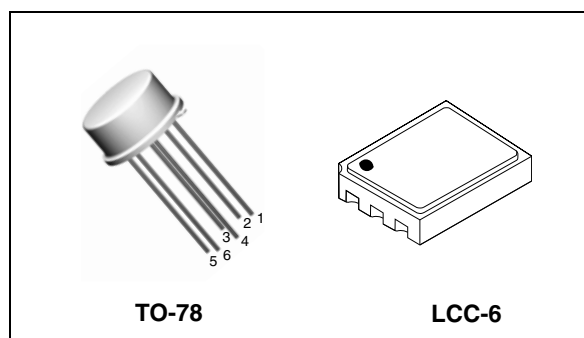


Figure 1. Internal schematic diagram

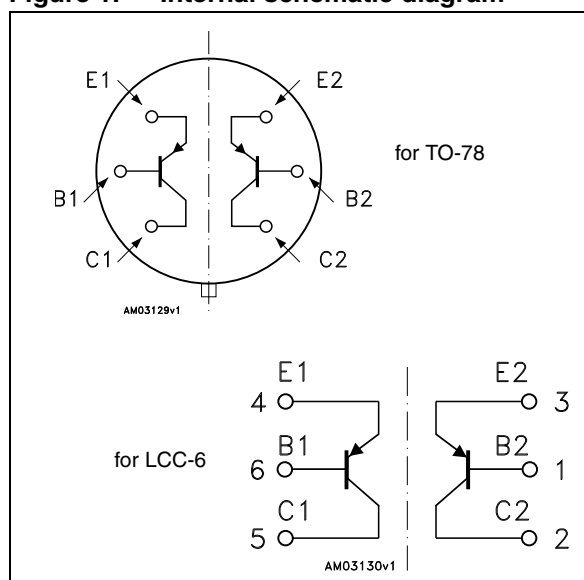


Table 1. Device summary

Order codes	Packages	Lead finish	Marking	Type	EPPL	Packaging
2N3810HR	TO-78	Gold Solder Dip	520700501 520700502	ESCC Flight		Strip pack
2N3810T1	TO-78	Gold	2N3810T1	Engineering model		Strip pack
SOC3810	LCC-6	Gold	SOC3810	Engineering model		Waffle pack
SOC3810HRB	LCC-6	Gold Solder Dip	520700507 520700509	ESCC Flight	Yes	Waffle pack

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 $T_{amb} \leq 25^\circ\text{C}$ for 2N3810HR ⁽¹⁾	0.5	W
	for 2N3810HR ⁽²⁾	0.6	W
	for SOC3810HRB ^{(1) (3)}	0.6	W
	for SOC3810HRB ^{(2) (3)}	1.2	W
	Total dissipation at $T_c \leq 25^\circ\text{C}$ for 2N3810HR ⁽¹⁾	0.5	W
	for 2N3810HR ⁽²⁾	0.6	W
T_{STG}	Storage temperature	-65 to 200	$^\circ\text{C}$
T_J	Max. operating junction temperature	200	$^\circ\text{C}$

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 $^\circ\text{C/W}$
	Thermal resistance junction-case ⁽²⁾	max	292 $^\circ\text{C/W}$
R_{thJA}	Thermal resistance junction-ambient ⁽¹⁾	max	350 $^\circ\text{C/W}$
	Thermal resistance junction-ambient ⁽²⁾	max	292 $^\circ\text{C/W}$

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 $^\circ\text{C/W}$
	Thermal resistance junction-ambient ⁽²⁾⁽³⁾	max	146 $^\circ\text{C/W}$

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	nA μA
I_{EBO}	Emitter-base cut-off current ($I_{\text{C}} = 0$)	$V_{\text{EB}} = -4\text{ V}$		-	-20	nA
$V_{(\text{BR})\text{CBO}}$	Collector-base breakdown voltage ($I_{\text{E}} = 0$)	$I_{\text{C}} = -10\text{ }\mu\text{A}$	-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 ($I_{\text{C}} = 0$)	$I_{\text{E}} = -10\text{ }\mu\text{A}$	-5	-		V
$V_{\text{CE(sat)}}^{(1)}$	Collector-emitter saturation voltage	$I_{\text{C}} = -100\text{ }\mu\text{A}$ $I_{\text{B}} = -10\text{ }\mu\text{A}$ $I_{\text{C}} = -1\text{ mA}$ $I_{\text{B}} = -100\text{ }\mu\text{A}$		-	-0.2 -0.25	V V
$V_{\text{BE(sat)}}^{(1)}$	Base-emitter saturation voltage	$I_{\text{C}} = -100\text{ }\mu\text{A}$ $I_{\text{B}} = -10\text{ }\mu\text{A}$ $I_{\text{C}} = -1\text{ mA}$ $I_{\text{B}} = -100\text{ }\mu\text{A}$		-	-0.7 -0.8	V V
$h_{\text{FE}}^{(1)}$	DC current gain	$I_{\text{C}} = -10\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -500\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -1\text{ mA}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\text{ mA}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $T_{\text{amb}} = -55\text{ °C}$	100 150 150 150 125 60	-	450 450 450	
$h_{\text{FE2-1}} / h_{\text{FE2-2}}$	DC current ratio comparison	$I_{\text{C}} = -100\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$	0.91	-	1.1	
$h_{\text{FE2-1}} / h_{\text{FE2-2}}$	DC current ratio comparison	$I_{\text{C}} = -100\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $T_{\text{amb}} = -55\text{ °C to } +125\text{ °C}$	0.85	-	1.18	
$\Delta \left \begin{matrix} V_{\text{BE1}} \\ V_{\text{BE2}} \end{matrix} \right $	Base-emitter voltage differential	$V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\text{ }\mu\text{A}$ $V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -10\text{ mA}$		-	5 3 5	mV mV mV
$\Delta \left \begin{matrix} V_{\text{BE1}} \\ V_{\text{BE2}} \end{matrix} \right $	Base-emitter voltage differential	$V_{\text{CE}} = -5\text{ V}$ $I_{\text{C}} = -100\text{ }\mu\text{A}$ $T_{\text{amb}} = -55\text{ °C to } +25\text{ °C}$ $T_{\text{amb}} = +25\text{ °C to } +125\text{ °C}$		-	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	pF
C_{ibo}	Input capacitance ($I_C = 0$)	$V_{EB} = -0.5\text{ V}$ $100\text{ kHz} \leq f \leq 1\text{ MHz}$		-	15	pF
h_{ie}	Input impedance	$I_C = -1\text{ mA}$ $V_{CE} = -10\text{ V}$ $f = 1\text{ kHz}$	3	-	30	k Ω
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	dB
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	dB
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	dB

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

2.1 Electrical characteristics (curves)

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

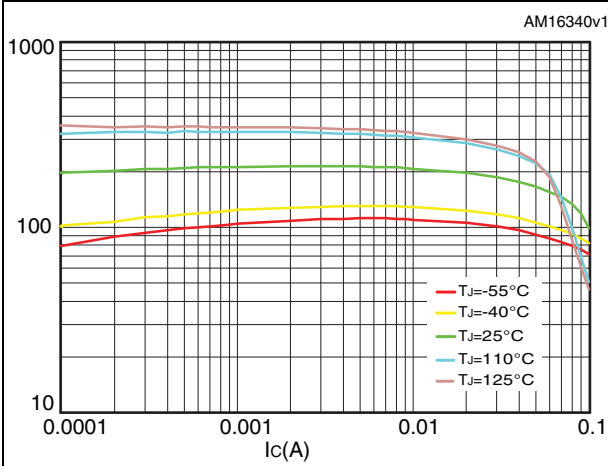


Figure 3. $V_{CE(sat)}$ @ $h_{FE} = 10$

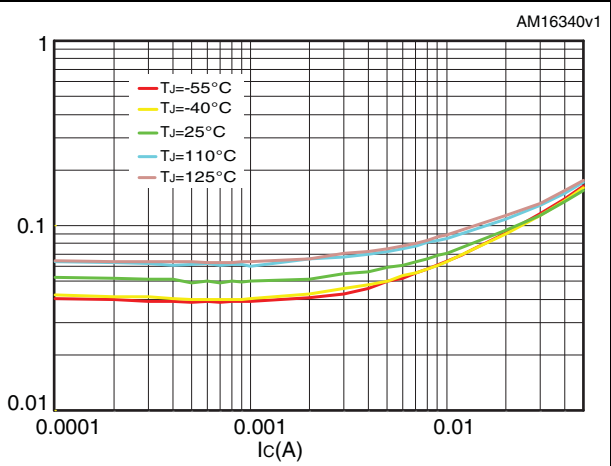
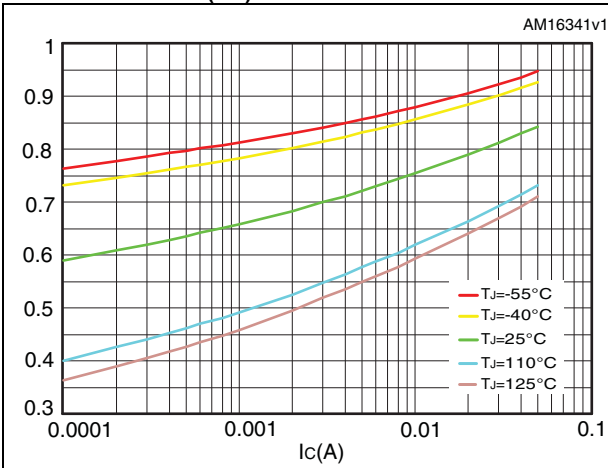


Figure 4. $V_{BE(sat)}$ @ $h_{FE} = 10$



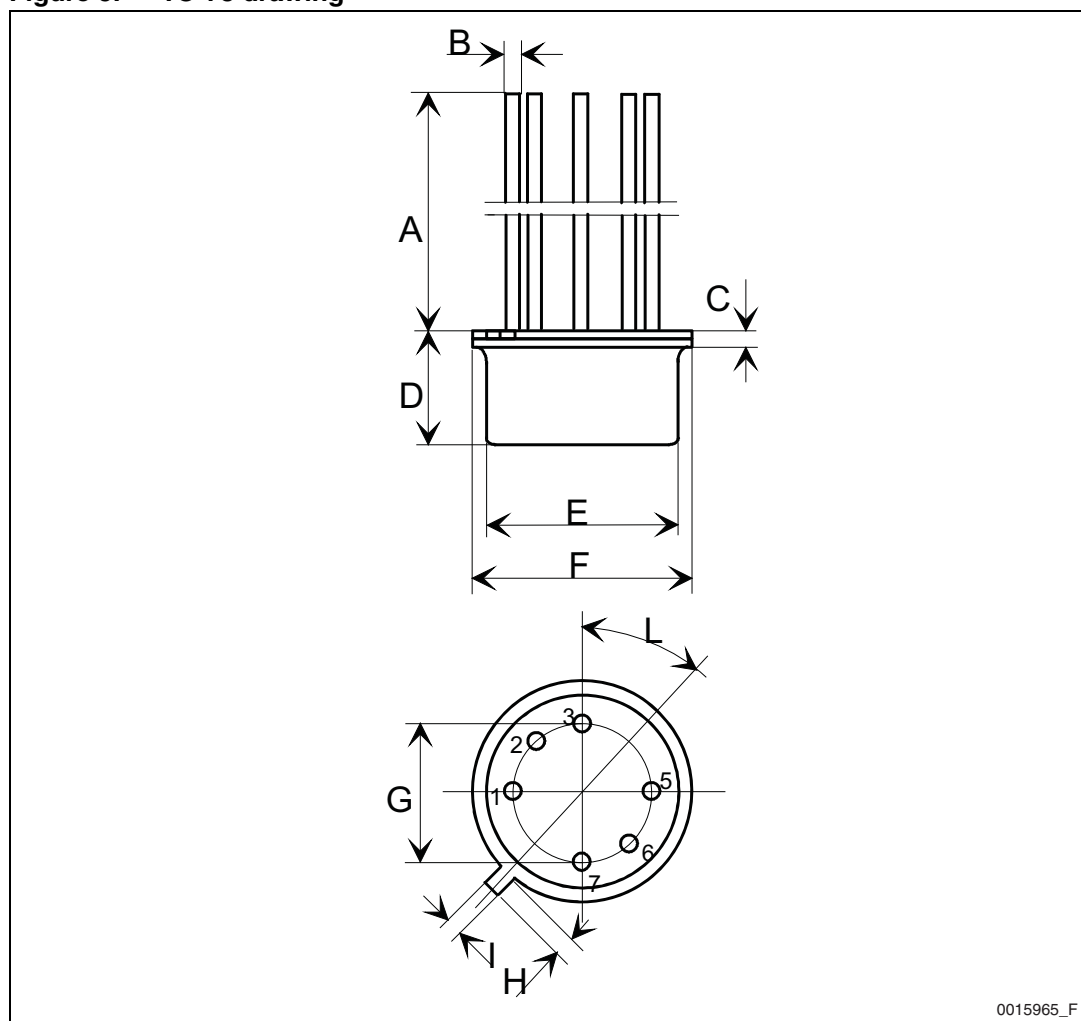
3 Package mechanical data

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.

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°			

Figure 5. TO-78 drawing

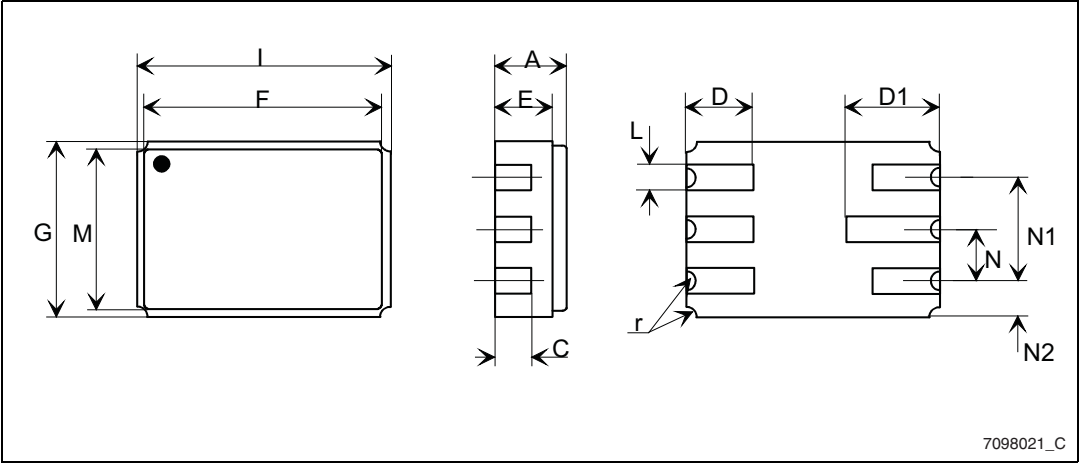


0015965_F

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

Figure 6. LCC-6 drawing



4 Revision history

Table 8. 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

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2012 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com