FAIRCHILD
A Schlumberger Company

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137

T-29-23

NPN Small Signal General Purpose Amplifiers

- **P_D ... 625 mW @ T_A = 25° C**
- **V_{CEO} ... 25 V (Min) (PN/FTSO5135)**
- **h_{FE} ... 50-600 @ 10 mA (PN/FTSO5135), 20-400 @ 150 mA (PN/FTSO5136/7)**
- **f_T ... 40 MHz (Min)**
- **Complements ... PN5142, PN5143**

PACKAGE

PN5135	TO-92
PN5136	TO-92
PN5137	TO-92
FTSO5135	TO-236AA/AB
FTSO5136	TO-236AA/AB
FTSO5137	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	PN	FTSO
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents		**5135**	**5136/7**
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 V	20 V
V_{CBO}	Collector to Base Voltage	30 V	30 V
V_{CES}	Collector to Emitter Voltage	30 V	30 V
V_{EBO}	Emitter to Base Voltage	4.0 V	3.0 V
I_C	Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5135 MIN	5135 MAX	5136 MIN	5136 MAX	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage	30		30		V	I_C = 100 μA, V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30		30		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		3.0		V	I_E = 10 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		10		100	nA μA	V_{EB} = 2.0 V, I_C = 0 V_{EB} = 4.0 V, I_C = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T145.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137

T-29-23

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5135 MIN	5135 MAX	5136 MIN	5136 MAX	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current	300			100	nA	V_{CB} = 15 V, I_E = 0
						nA	V_{CB} = 20 V, I_E = 0
			10			μA	V_{CB} = 15 V, I_E = 0 T_A = 65° C
					10	μA	V_{CB} = 20 V, I_E = 0, T_A = 65° C
h_{FE}	DC Pulse Current Gain (Note 5)	50	600				I_C = 10 mA, V_{CE} = 10 V
		15					I_C = 2.0 mA, V_{CE} = 1.0 V
				20	400		I_C = 150 mA, V_{CE} = 1.0 V
				20			I_C = 30 mA, V_{CE} = 1.0 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	25		20		V	I_C = 1.0 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		1.0			V	I_C = 100 mA, I_B = 10 mA
					0.25	V	I_C = 150 mA, I_B = 15 mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.0			V	I_C = 100 mA, V_{CE} = 10 V
					1.1	V	I_C = 150 mA, V_{CE} = 1.0 V
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.0			V	I_C = 100 mA, I_B = 10 V
					1.1	V	I_C = 150 mA, I_B = 15 V
C_{cb}	Collector to Base Capacitance		25		35	pF	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz
C_{eb}	Emitter to Base Capacitance				85	pF	V_{EB} = 0.5 V, I_C = 0, f = 1.0 MHz
$\|h_{fe}\|$	Magnitude of Common Emitter Small Signal Current Gain	2.0	15				I_C = 30 mA, V_{CE} = 10 V, f = 20 MHz
				2.0	20		I_C = 50 mA, V_{CE} = 5.0 V, f = 20 MHz

SYMBOL	CHARACTERISTIC	5137 MIN	5137 MAX	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage	30		V	I_C = 100 μA, V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		V	I_E = 10 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		100	nA	V_{EB} = 2.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = 20 V, I_E = 0
			10	μA	V_{CB} = 20 V, I_E = 0, T_A = 65° C
h_{FE}	DC Pulse Current Gain (Note 5)	20	400		I_C = 150 mA, V_{CE} = 1.0 V
		20			I_C = 30 mA, V_{CE} = 1.0 V

PN5135/FTSO5135
PN5136/FTSO5136
PN5137/FTSO5137

T-29-23

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	5137 MIN	5137 MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	20		V	I_C = 1.0 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		0.25	V	I_C = 150 mA, I_B = 15 mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		1.1	V	I_C = 150 mA, V_{CE} = 1.0 V
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		1.1	V	I_C = 150 mA, I_B = 15 V
C_{cb}	Collector to Base Capacitance		35	pF	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz
C_{eb}	Emitter to Base Capacitance		85	pF	V_{BE} = 0.5 V, I_C = 0, f = 1.0 MHz
$\|h_{fe}\|$	Magnitude of Common Emitter Small Signal Current Gain	2.0	20		I_C = 50 mA, V_{CE} = 5.0 V, f = 20 MHz

FAIRCHILD
A Schlumberger Company

PN5138/FTSO5138

PNP Low Level Amplifier

T-29-23

- h_{FE} ... 50 (Min) @ 100 μA & 10 mA
- V_{CEO} ... -30 V (Min)

PACKAGE

PN5138	TO-92
FTSO5138	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	PN	FTSO
Total Dissipation at		
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO} Collector to Emitter Voltage	−30 V
V_{CBO} Collector to Base Voltage	−30 V
V_{EBO} Emitter to Base Voltage	−5.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	−30		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		V	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		50 3.0	nA μA	V_{CB} = −20 V, I_E = 0 V_{CB} = −20 V, I_E = 0, T_A = 65° C
h_{FE}	DC Current Gain	50 50	800		I_C = 100 μA, V_{CE} = −10 V I_C = 1.0 mA, V_{CE} = −10 V
h_{FE}	DC Pulse Current Gain (Note 5)	50			I_C = 10 mA, V_{CE} = −10 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	−30		V	I_C = 10 mA (pulsed), I_B = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T219.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5138/FTSO5138

T-29-23

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		−0.3	V	I_C = 10 mA, I_B = 0.5 mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage (Note 5)		−1.0	V	I_C = 10 mA, V_{CE} = −10 V
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		−1.0	V	I_C = 10 mA, I_B = 0.5 mA
C_{cb}	Collector to Base Capacitance		7.0	pF	V_{CB} = −5.0 V, I_E = 0, f = 1.0 MHz
C_{eb}	Emitter to Base Capacitance		30	pF	V_{EB} = −5.0 V, I_C = 0, f = 1.0 MHz
h_{fe}	High Frequency Current Gain	1.5			I_C = 0.5 mA, V_{CE} = −5.0 V, f = 20 MHz
h_{fe}	Small Signal Current Gain	40	1000		I_C = 1.0 mA, V_{CE} = −10 V, f = 1.0 kHz

FAIRCHILD
A Schlumberger Company

PN5139/FTSO5139

PNP Small Signal General Purpose Amplifier & Switch

T-29-23

- V_{CEO} ... **-20 V (Min)**
- h_{FE} ... **40 (Min) @ 10 mA**
- f_T ... **300 MHz (Min)**
- C_{cb} ... **5.0 pF (Max) @ -10 V**

PACKAGE

PN5139	TO-92
FTSO5139	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-55° C to 150° C
Operating Junction Temperature	150° C

Power Dissipation (Notes 2 & 3)

	PN	FTSO
Total Dissipation at 25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents

V_{CEO}	Collector to Emitter Voltage (Note 4)	-20 V
V_{CBO}	Collector to Base Voltage	-20 V
V_{EBO}	Emitter to Base Voltage	-5.0 V
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	-20		V	I_C = 100 μA, I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	-20		V	I_C = 100 μA, V_{EB} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		V	I_E = 100 μA, I_C = 0
I_{CES}	Collector Reverse Current		50 25	nA μA	V_{CE} = -15 V, V_{EB} = 0 V_{CE} = -15 V, V_{EB} = 0, T_A = 65°C
h_{FE}	DC Current Gain	30 40			I_C = 100 μA, V_{CE} = -10 V I_C = 1.0 mA, V_{CE} = -10 V
h_{FE}	DC Pulse Current Gain (Note 5)	40 15			I_C = 10 mA, V_{CE} = -1.0 V I_C = 50 mA, V_{CE} = -10 V

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 150° C and (TO-92) junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T215.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

PN5139/FTSO5139

T-29-23

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		−0.15	V	I_C = 1.0 mA, I_B = 0.1 mA
$V_{CE(sat)}$	Pulsed Collector to Emitter Saturation Voltage (Note 5)		−0.20 −0.5	V V	I_C = 10 mA, I_B = 1.0 mA I_C = 50 mA, I_B = 5.0 mA
$V_{BE(sat)}$	Pulsed Base to Emitter Saturation Voltage (Note 5)	−0.7 −0.75	−1.0 −1.25	V V	I_C = 10 mA, I_B = 1.0 mA I_C = 50 mA, I_B = 5.0 mA
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 5)	−20		V	I_C = 10 mA (pulsed), I_B = 0
C_{cb}	Collector to Base Capacitance		5.0	pF	V_{CB} = −10 V, I_E = 0, f = 1.0 MHz
C_{eb}	Emitter to Base Capacitance		8.0	pF	V_{EB} = −0.5 V, I_C = 0, f = 1.0 MHz
$\|h_{fe}\|$	Magnitude of Small Signal Current Gain	3.0			I_C = 10 mA, V_{CE} = −20 V, f = 100 MHz
t_{on}	Turn On Time (test circuit no. 407)		50	ns	$I_C \approx$ 50 mA, $I_{B1} \approx$ 5.0 mA
t_{off}	Turn Off Time (test circuit no. 407)		200	ns	$I_C \approx$ 50 mA, $I_{B1} \approx$ 5.0 mA, $I_{B2} \approx$ −5.0 mA

FAIRCHILD
A Schlumberger Company

1N456/457/458/459 T-01-09
FDLL456/457/458/459
1N456A/457A/458A/459A
FDLL456A/457A/458A/459A
Low Leakage Diodes

- I_R...25 nA (MAX) @ WIV
- C...6.0 pf (MAX)

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	−65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (From 25°C)	3.33 mW/°C

Maximum Voltage and Currents		1N456/A	1N457/A	1N458/A	1N459/A
WIV	Working Inverse Voltage	25 V	60 V	125 V	175 V
I_O	Average Rectified Current				200 mA
I_F	Continuous Forward Current				500 mA
i_f	Peak Repetitive Forward Current				600 mA
$i_{f(surge)}$	Peak Forward Surge Current				
	Pulse Width = 1 μs				4.0 A
	Pulse Width = 1 s				1.0 A

PACKAGES

1N456	DO-35
1N457	DO-35
1N458	DO-35
1N459	DO-35
1N456A	DO-35
1N457A	DO-35
1N458A	DO-35
1N459A	DO-35
FDLL456	LL-34
FDLL457	LL-34
FDLL458	LL-34
FDLL459	LL-34
FDLL456A	LL-34
FDLL457A	LL-34
FDLL458A	LL-34
FDLL459A	LL-34

If you need this device in the SOT package, an electical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage 1N456A/7A/8A/9A			1.0	V	I_F = 100 mA
		1N456		1.0	V	I_F = 40 mA
		1N457		1.0	V	I_F = 20 mA
		1N458		1.0	V	I_F = 7 mA
		1N459		1.0	V	I_F = 3 mA
I_R	Reverse Current			25	nA	V_R = Rated WIV
				5.0	μA	V_R = Rated WIV, T_A = 150°C
BV	Breakdown Voltage	1N456/A	30		V	I_R = 100 μA
		1N457/A	70		V	I_R = 100 μA
		1N458/A	150		V	I_R = 100 μA
		1N459/A	200		V	I_R = 100 μA
C	Capacitance			6.0	pF	V_R = 0, f = 1 MHz

NOTES:
1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2.

FAIRCHILD
A Schlumberger Company

1N461A/462A/463A
FDLL461A/462A/463A

General Purpose High Conductance Diodes

T-01-09

- V_F . . . 1.0 V (MAX) @ 100 mA
- I_R . . . 500 nA (MAX) @ WIV

PACKAGES

1N461A	DO-35
1N462A	DO-35
1N463A	DO-35
FDLL461A	LL-34
FDLL462A	LL-34
FDLL463A	LL-34

If you need this device in the SOT package, an electical equivalent is available. See FDSO1500 family.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	−65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents		**IN461A**	**IN462A**	**IN463A**	**IN464A**
WIV	Working Inverse Voltage	25 V	60 V	175 V	125 V
I_O	Average Rectified Current	200 mA	200 mA	200 mA	200 mA
I_F	Continuous Forward Current	500 mA	500 mA	500 mA	500 mA
i_f	Peak Repetitive Forward Current	600 mA	600 mA	600 mA	600 mA
$i_{f(surge)}$	Peak Forward Surge Current				
	Pulse Width = 1 s	1.0 A	1.0 A	1.0 A	1.0 A
	Pulse Width = 1 μs	4.0 A	4.0 A	4.0 A	4.0 A

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.0	V	I_f = 100 mA
I_R	Reverse Current			500	nA	V_R = Rated WIV
				30	μA	V_R = Rated WIV, T_A = 150°C
BV	Breakdown Voltage	IN461A	30		V	I_R = 100 μA
		IN462A	70		V	I_R = 100 μA
		IN463A	200		V	I_R = 100 μA
		IN464A	150		V	I_R = 100 μA

NOTES:
1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2.

FAIRCHILD
A Schlumberger Company

1N482B/483B/484B/485B
FDLL482B/483B/484B/485B

General Purpose Low Leakage Diodes

T-01-09

- V_F...1.0 V (MAX) @ 100 mA
- I_R...25 nA (MAX) @ WIV

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature Range	−65°C to +200°C
Maximum Junction Operating Temperature	+175°C
Lead Temperature (from 25°C)	+260°C

Power Dissipation (Note 2)

Maximum Total Power Dissipation at 25°C Ambient	500 mW
Linear Power Derating Factor (from 25°C)	3.33 mW/°C

Maximum Voltage and Currents		IN482B	IN483B	IN484B	IN485B	IN486B
WIV	Working Inverse Voltage	36 V	70 V	130 V	180 V	225 V
I_O	Average Rectified Current					200 mA
I_F	Continuous Forward Current					500 mA
i_f	Peak Repetitive Forward Current					600 mA
$i_{f(surge)}$	Peak Forward Surge Current					
	Pulse Width = 1 s					1.0
	Pulse Width = 1 μs					4.0

PACKAGES

1N482B	DO-35
1N483B	DO-35
1N484B	DO-35
1N485B	DO-35
FDLL482B	LL-34
FDLL483B	LL-34
FDLL484B	LL-34
FDLL485B	LL-34

If you need this device in the SOT package, an electical equivalent is available. See FDSO1500 family.

ELECTRICAL CHARACTERISTICS (25°C Ambient Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC		MIN	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.0	V	I_F = 100 mA
I_R	Reverse Current	1N482B – 1N485B		25	nA	V_R = Rated WIV
				5.0	μA	V_R = Rated WIV, T_A = 150°C
		1N486B		50	nA	V_R = 225 V
				10	μA	V_R = 225 V, T_A = 150°C
BV	Breakdown Voltage	1N482B	40		V	I_R = 100 μA
		1N483B	80		V	I_R = 100 μA
		1N484B	150		V	I_R = 100 μA
		1N485B	200		V	I_R = 100 μA
		1N486B	250		V	I_R = 100 μA

NOTES:
1. These ratings are limiting values above which the serviceability of the diode may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty-cycle operation.
3. For product family characteristic curves, refer to Chapter 4, D2.