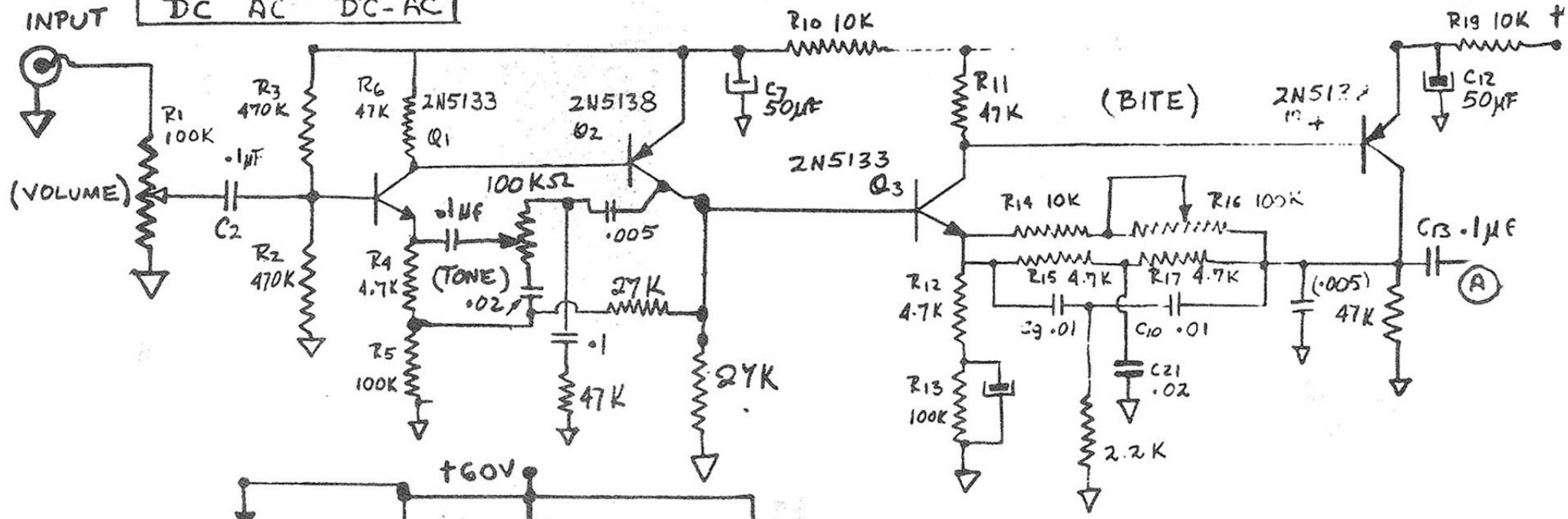
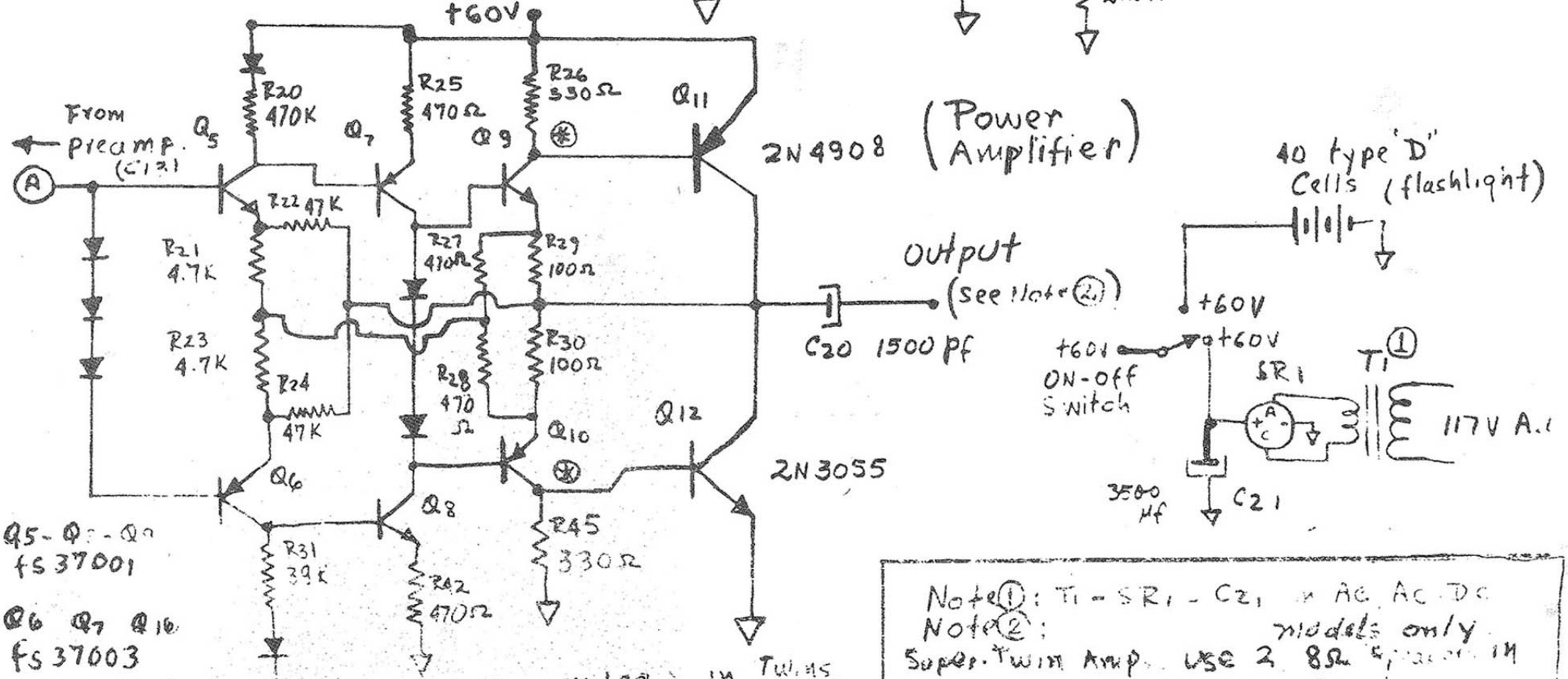
Electro-Harmonix - N.Y.
Freedom Amplifier 6/17
DC AC DC-AC

(Preamplifier)





Note (1): T1 - SR1 - C21 in AC, AC-DC models only
Note (2): Super-Twin Amp. use 2 8Ω speakers in Push-Pull amps use 4 or 8Ω speakers

New Jersey Semi-Conductor Products, Inc.

20 STERN AVE.
SPRINGFIELD, NEW JERSEY 07081
U.S.A.

TELEPHONE: (973) 376-2922
(212) 227-6005
FAX: (973) 376-8960

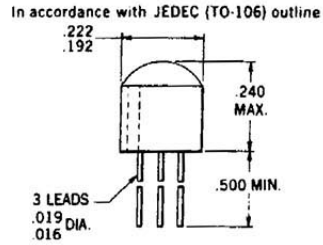
2N5138

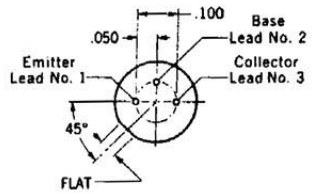
PNP LOW LEVEL AMPLIFIER

DIFFUSED SILICON PLANAR II TRANSISTOR

- **LOW NOISE FIGURE . . . . 0.7 dB (TYP) AT f = 1 kHz**
- **HIGH CURRENT GAIN . . . h_{FE} = 100 (TYP) AT I_C = 100 μA**
- **HIGH BREAKDOWN . . . . . LV_{CEO} = 30 V (MIN)**
- **EXCELLENT BETA LINEARITY FROM 1 μA TO 50 mA**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline





NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperatures	−55° to +125°C
Operating Junction Temperatures	+125°C
Lead Temperature (Soldering, 10 second time limit)	+260°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	0.5 Watt
at 25°C Ambient Temperature	0.2 Watt

Maximum Voltages and Current

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

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

		2N5138					
SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
NF	**Narrow Band Noise Figure (f = 1.0 kHz)** (Note 6)		0.7		**dB**	I_C = **20 μA**	V_{CE} = **−5.0 V**
NF	**Wide Band Noise Figure** (Note 7)		1.0		**dB**	I_C = **20 μA**	V_{CE} = **−5.0 V**
NF	Narrow Band Noise Figure (f = 1.0 kHz) (Note 8)		0.8		dB	I_C = 250 μA	V_{CE} = −5.0 V
h_{FE}	**DC Current Gain**	50	100	800		I_C = **100 μA**	V_{CE} = **−10 V**
h_{FE}	DC Current Gain	50	110			I_C = 1.0 mA	V_{CE} = −10 V
h_{FE}	**DC Pulse Current Gain** (Note 5)	50	120			I_C = **10 mA**	V_{CE} = −10 V
BV_{CBO}	Collector to Base Breakdown Voltage	−30			Volts	I_C = 100 μA	I_E = 0
V_{CEO}**(sust)**	**Collector to Emitter Sustaining Voltage** (Notes 4 and 5)	−30			**Volts**	I_C = **10 mA (pulsed)**	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			Volts	I_C = 0	I_E = 100 μA
I_{CBO}	**Collector Cutoff Current**			10	nA	I_E = **0**	V_{CB} = **−20 V**
I_{CBO}(65°C)	Collector Cutoff Current			3.0	μA	I_E = 0	V_{CB} = −20 V
V_{CE}(sat)	Pulsed Collector Saturation Voltage (Note 5)			−0.3	Volts	I_C = 10 mA	I_B = 0.5 mA
V_{BE}(sat)	Pulsed Base Saturation Voltage (Note 5)			−1.0	Volts	I_C = 10 mA	I_B = 0.5 mA
V_{BE}(on)	Pulsed Base to Emitter "On" Voltage (Note 5)		−0.74	−1.0	Volts	I_C = 10 mA	V_{CE} = −10 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	40		1000		I_C = 1.0 mA	V_{CE} = −10 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	1.5				I_C = 0.5 mA	V_{CE} = −5.0 V
C_{cb}	Collector to Base Capacitance			7.0	pF	I_E = 0	V_{CB} = −5.0 V
C_{eb}	Emitter to Base Capacitance			30	pF	I_C = 0	V_{EB} = −0.5 V

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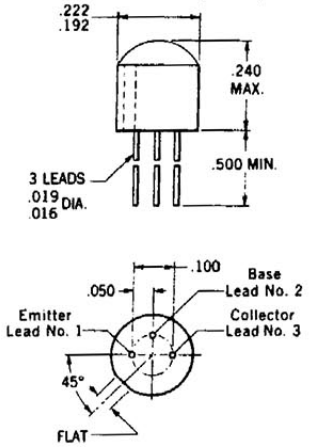
2N5133

- **LOW NOISE - -NF = 1.5 dB (TYP) @ 1.0 kHz**
- **HIGH GAIN - - h_{FE} = 60 (MIN), 220 (TYP) @ 1.0 mA**
  h_{FE} = 50 (TYP) @ 50 μA
- **BREAKDOWN VOLTAGE - - LV_{CEO} = 18 VOLTS (MIN)**

PHYSICAL DIMENSIONS
In accordance with JEDEC (TO-106) outline



NOTES: All dimensions in inches
All leads electrically isolated from case
Package weight is 0.31 gram. Package is electrically non-conductive material

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures		
Operating Junction Temperature		125°C Maximum
Storage Temperature		−55°C to +125°C
Lead Temperature (Soldering, 10 second time limit)		260°C Maximum
Maximum Power Dissipation		
Total Dissipation at 25°C Case Temperature (Note 2)		0.5 Watt
at 25°C Ambient Temperature (Note 2)		0.2 Watt
Maximum Voltages and Current		
V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	18 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	**DC Current Gain**	**60**	**220**	**1000**		**I_C = 1.0 mA**	**V_{CE} = 5.0 V**
h_{FE}	**DC Current Gain**		**50**			**I_C = 50 μA**	**V_{CE} = 10 V**
h_{fe}	High Frequency Current Gain (f = 20 MHz)		1.3			I_C = 50 μA	V_{CE} = 5.0 V
h_{fe}	High Frequency Current Gain (f = 20 MHz)	2.0		20		I_C = 1.0 mA	V_{CE} = 5.0 V
NF	**Narrow Band Noise Figure (f = 1.0 kHz)**		1.5		dB	**I_C = 30 μA**	**V_{CE} = 5.0 V**
						PWR BW = 200 Hz	**R_S = 10 kΩ**
V_{CE}(sat)	Collector Saturation Voltage			0.4	Volts	I_C = 1.0 mA	I_B = 0.1 mA
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0	V_{CB} = 15 V
I_{CBO}(65°C)	Collector Cutoff Current			5.0	μA	I_E = 0	V_{CB} = 15 V
C_{cb}	Collector-Base Capacitance			5.0	pF	I_E = 0	V_{CB} = 5.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	I_C = 100 μA	I_E = 0
V_{CEO}(sust)	**Collector to Emitter Sustaining Voltage** (Notes 3 and 4)	**18**			**Volts**	**I_C = 3.0 mA**	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_E = 10 μA	I_C = 0
V_{BE}(on)	Base to Emitter On Voltage			0.75	Volts	I_C = 100 μA	V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50		1100		I_C = 1.0 mA	V_{CE} = 5.0 V

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These ratings give a maximum junction temperature of 125°C and junction to case thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C); junction to ambient thermal resistance of 500°C/Watt (derating factor of 2.0 mW/°C).
(3) Rating refers to a high-current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.
(4) Pulse Conditions: length = 300 μs; duty cycle = 1%.

https://www.ssguitar.com/index.php?topic=511.0

ryansteele
Chipper

Re: Help me understand this power amp design - please?
« **Reply #8 on:** December 01, 2014, 03:43:26 PM »

Hello.
Please forgive me resurrecting such an ancient thread. However, information on this amplifier is criminally rare, and this thread has some of the best discussion to be found. I felt it appropriate to add further information regarding the transistors used in the EH Mike Matthews Freedom Amplifier here for this reason.
This information is based on my servicing/comparing two of these amplifiers. One of these is built using transistors with the obscure EH numbering in one section, and normal labelled parts in the other. The second amp is reversed in this regard. As such, I was able to ascertain what is what for those looking to service this amp, or try their hand at building the circuit properly.

[Schematic Label]	[Schematic Part]	[Stamped (Amp 1)]	[Stamped (Amp 2)]
Q1, Q3 NPN	2N5133	FS36999	2N5133
Q2, Q4 PNP	2N5138	FS37000	2N5138
Q5, Q8, Q9 NPN	FS37001	FS37001	2N3568
Q6, Q7, Q10 PNP	FS37003	FS37003	2N4354
Q11 PNP	2N4908	2SA627	S37005
Q12 NPN	2N3055	2SC1079	S37004

Firstly, this seems to confirm the longstanding suspicion that the "FS36999" (as also used in the early Big Muff) is in fact a 2N5133 NPN.

"FS37000" - 2N5138 PNP

On to the "FS37001" and "FS37003":

"FS37001" - 2N3568 NPN.
"FS37003" - 2N4354 PNP.

"FS37004" - 2N4908/2SA627 PNP.
"FS37005" - 2N3055/2SC1079 NPN.

Free yourself from the bureaucratically dominated sources of electricity!

Hope this information is of use to someone.

When you needed a portable amp back in the 70's, you had 2 choices: the Pignose, which put out a few watts of power or you could go the EH Freedom amp route, with 55W of battery-powered goodness. It held forty D cell batteries. The Freedom amp came about around 1972, blasting it's way into the musician's consciousness with the power of 55 watts into a single 10" heavy duty CTS speaker.
Here's a series of photos taken in 1972 to advertise the new EH Freedom amplifier. While at least one of the shots was initially rejected by publishers (guess which one), all eventually appeared in magazine ads or EH literature. Featured in these ads was the famous "Miss Band-Aid",who was also available on her own 6 ft poster, and Mike Matthews in his finest 70's regalia. The African-American gentleman is unknown, but may well be EH employee Willie Magee. The slogan above sums up the Freedom amp campaign.