

# Millett Hybrid MiniMAX - Design/Layout by Colin Toole

Last revised: 1/10/2014  
BOM by Tom Blanchard

PART ID	DESCRIPTION	QTY	SOURCE	PART NO	EACH	TOTAL	SOURCE	PART NO	EACH	TOTAL
<b>BASIC MILLETT</b>										
RA1L/R	5K Ohm Trim Pot	2	Mouser	<a href="#">72-T93YA-5K</a>	\$1.85	\$ 3.70	DigiKey	<a href="#">490-2888-ND</a>	\$ 1.51	\$ 3.02
RA2L/R, RA4L/R	1K ohm	4	Mouser	<a href="#">71-RN55D-F-1.0K</a>	\$0.08	\$ 0.32	DigiKey	<a href="#">CMF1.00KHFCT-ND</a>	\$ 0.17	\$ 0.49
RA7L/R	1M ohm	2	Mouser	<a href="#">71-RN55D-F-1.0M</a>	\$0.08	\$ 0.16	DigiKey	<a href="#">CMF1.00MHFCT-ND</a>	\$ 0.17	\$ 0.49
CA2L/R*	1000uF 16V Nichicon MUSE ES	2	<a href="#">Beezar.com</a>	<a href="#">ES-1000-16</a>	\$1.75	\$ 3.50	<a href="#">Beezar.com</a>	<a href="#">ES-1000-16</a>	\$ 1.75	\$ 6.13
CA4L/R, CA5L/R	1000-1800uF 35V Electrolytic (18mm dia. max, 15mm leads max)	4	Mouser	<a href="#">647-UPW1V182MHD</a>	\$1.44	\$ 5.76	DigiKey	<a href="#">P12410-ND</a>	\$ 1.36	\$ 5.44
CA3L/R, CA6L/R, CA9L/R	0.22uF Film Cap 15mm leads	6	Mouser	<a href="#">505-M10.22/250/10</a>	\$1.11	\$ 6.66	DigiKey	<a href="#">P3224-ND</a>	\$ 1.28	\$ 7.68
CA8L/R*	0.33uf 200V Sonicap Gen II	2	<a href="#">Beezar.com</a>	Sonicap Gen II	\$4.00	\$ 8.00	<a href="#">Beezar.com</a>	Sonicap Gen II	\$ 4.00	\$ 8.00
CA7L/R*	470uF 35V Electrolytic* (16mm dia. Max)	2	<a href="#">Beezar.com</a>	<a href="#">ES-470-35</a>	\$2.00	\$ 4.00	<a href="#">Beezar.com</a>	<a href="#">ES-470-35</a>	\$ 2.00	\$ 4.00
<b>CCS:</b>										
QA1L/R, QA2L/R	2N5087 PNP small signal	4	Mouser	<a href="#">512-2N5087_J18Z</a>	\$0.08	\$ 0.32	DigiKey	<a href="#">2N5087-ND</a>	\$ 0.19	\$ 0.76
RA8L/R	1.13K ohm		Mouser	<a href="#">71-RN55D1131F</a>	\$0.16	\$ -	DigiKey	<a href="#">CMF1.13KHFCT-ND</a>	\$ 0.17	\$ -
RA9L/R	11.3K ohm		Mouser	<a href="#">71-RN55D-F-11.3K</a>	\$0.16	\$ -	DigiKey	<a href="#">CMF11.3KHFCT-ND</a>	\$ 0.17	\$ -
<b>Optional selection:</b>	<b>results in CCS current of 0.565 ma</b>									
RA8L/R	1.15K ohm	2	Mouser	<a href="#">71-RN55D1151F</a>	\$0.08	\$ 0.16	DigiKey	<a href="#">CMF1.00KHFCT-ND</a>	\$ 0.17	\$ 0.34
RA9L/R	11.5K ohm	2	Mouser	<a href="#">71-RN55D1152F</a>	\$0.08	\$ 0.16	DigiKey	<a href="#">CMF10.0KHFCT-ND</a>	\$ 0.17	\$ 0.34
<b>MISC:</b>										
R1	10 ohm, 1W resistor	1	Mouser	<a href="#">282-10-RC</a>	\$0.19	\$ 0.19	DigiKey	<a href="#">10W-2-ND</a>	\$ 0.18	\$ 0.18
RA5C/L/R (RLED's)	2K ohm 1W	3	Mouser	<a href="#">594-5073NW2K000J</a>	\$0.16	\$ 0.48				
	2K ohm 1/2W (alternate)		Mouser	<a href="#">293-2K-RC</a>	\$0.09	\$ -	DigiKey	<a href="#">2.0KH-ND</a>	\$ 0.26	\$ 0.78
LED1	Center LED, 3mm, 4000 mcd - Color Change	1	<a href="#">Beezar.com</a>	<a href="#">BzrLED-RGB</a>	\$0.75	\$ 0.75	<a href="#">Beezar.com</a>	<a href="#">BzrLED-RGB</a>	\$ 0.75	\$ 0.75
LEDL/R	Tube LED's, 3mm SuperBrite, 4000 mcd	2	<a href="#">Beezar.com</a>	Varies	\$0.25	\$ 0.50	<a href="#">Beezar.com</a>	Varies	\$ 0.25	\$ 0.50
POT	50K AUDIO TAPER POT	1	<a href="#">Beezar.com</a>	ALPS RK27	\$16.00	\$ 16.00	<a href="#">Beezar.com</a>	ALPS RK27	\$ 16.00	\$ 16.00
VTL/R	TUBES	2	<a href="#">Beezar.com</a>	12AE6/A (gain of 14)	\$5.00	\$ 10.00	<a href="#">Beezar.com</a>	12AE6, 12AE6A	\$ 5.00	\$ 10.00
		2	<a href="#">Beezar.com</a>	12FK6 (gain of 7)	\$5.00	\$ 10.00	<a href="#">Beezar.com</a>	12FK6	\$ 5.00	\$ 10.00
			<a href="#">Beezar.com</a>	12FM6 (gain of 10)	\$8.00	\$ -	<a href="#">Beezar.com</a>	12FM6	\$ 8.00	\$ -
SOCKET	7-PIN MINI TUBE SOCKET	2	<a href="#">Beezar.com</a>	GZC7-Y-G	\$2.00	\$ 4.00	<a href="#">Beezar.com</a>	GZC7-Y-G	\$ 2.00	\$ 4.00
Terminal Block 3pos	5mm (or 5.08mm)	2	Mouser	<a href="#">571-2828363</a>	\$1.12	\$ 2.24	DigiKey	<a href="#">ED1931-ND</a>	\$ 1.30	\$ 2.60
1/4" Stereo Jack	Neutrik NMJ6HCD2	1	Mouser	<a href="#">550-22302</a>	\$2.10	\$ 2.10	<a href="#">Beezar.com</a>	Neutrik NMJ6HCD2	\$ 2.10	\$ 2.10
Tip Jacks	Emerson	3	Mouser	<a href="#">530-105-0602-1</a>	\$1.82	\$ 5.46	DigiKey	<a href="#">J106-ND</a>	\$ 1.54	\$ 4.62
RCA Jacks	Philmore MTG12	1	<a href="#">Beezar.com</a>	MTG-12, BL + RD	\$6.00	\$ 6.00	<a href="#">Beezar.com</a>	MTG-12, BL + RD	\$ 6.00	\$ 6.00
Fuse Clips, PCB mount	5x20 fuse clip, 0.2" horiz. lead spacing	2	Mouser	<a href="#">534-3519</a>	\$0.13	\$ 0.26	DigiKey	<a href="#">486-1173-ND</a>	\$ 0.15	\$ 0.30
Fuse	5x20mm - 1A slo-blo optional, your choice	1	Mouser	<a href="#">576-0218001.HXP</a>	\$0.61	\$ 0.61	DigiKey	<a href="#">F2419-ND</a>	\$ 1.00	\$ 1.00
PCB	Circuit Board	1	<a href="#">Beezar.com</a>	MiniMAX PCB	\$15.00	\$ 15.00	<a href="#">Beezar.com</a>	MiniMAX PCB	\$ 15.00	\$ 15.00
<b>POWER SUPPLY</b>										
RR1	120 ohm 1/4W	1	Mouser	<a href="#">71-RN55D-F-121</a>	\$0.08	\$ 0.08	DigiKey	<a href="#">CMF121HFCT-ND</a>	\$ 0.17	\$ 0.49
RR2	2K ohm 1/2W	1	Mouser	<a href="#">71-RN60D-F-2K/R</a>	\$0.09	\$ 0.09	DigiKey	<a href="#">P2.0KW-1BK-ND</a>	\$ 0.23	\$ 0.23
RR3	1K ohm trimmer pot	1	Mouser	<a href="#">72-T93YA-1K</a>	\$1.85	\$ 1.85	DigiKey	<a href="#">490-2874-ND</a>	\$ 1.51	\$ 1.51

PF1	Polyfuse, resettable radial 0.5A 72V	1	Mouser	<a href="#">650-RXEF050</a>	\$0.38	\$ 0.38	DigiKey	<a href="#">RXEF050-ND</a>	\$ 0.32	\$ 0.32
CR1A, CR1B	1000uF 50V Electrolytic (18mm dia max)	2	Mouser	<a href="#">647-UPW1H102MHD</a>	\$1.46	\$ 2.92	DigiKey	<a href="#">P12393-ND</a>	\$ 1.39	\$ 2.78
CR2	1uF 63V Box cap	1	Mouser	<a href="#">75-MKT1817510064</a>	\$1.50	\$ 1.50	DigiKey	<a href="#">478-3367-ND</a>	\$ 0.45	\$ 0.45
CR3A, CR3B, CR3C, CR3D	100pf C0G Axial Ceramic	4	Mouser	<a href="#">581-SA102A101JAR</a>	\$0.11	\$ 0.44	DigiKey	<a href="#">478-3141-1-ND</a>	\$ 0.19	\$ 0.76
	100pF NPO Ceramic Disc (alternate)		Mouser	<a href="#">140-50N5-101J-RC</a>	\$0.08	\$ -	DigiKey	<a href="#">399-4199-ND</a>	\$ 0.28	\$ -
CR4	82uf 35V Electrolytic (6.3mm dia max)	1	Mouser	<a href="#">647-UPW1V820MED</a>	\$0.26	\$ 0.26	DigiKey	<a href="#">399-3579-ND</a>	\$ 1.50	\$ 1.50
DR1A, DR1B, DR1C, DR1D	Schottky MBR360, 60V 3A Rectifier - AXIAL	4	Mouser	<a href="#">863-MBR360RLG</a>	\$0.42	\$ 1.68	DigiKey	<a href="#">MBR360-ND</a>	\$ 0.64	\$ 2.56
DR2, DR3	1N4002	2	Mouser	<a href="#">512-1N4002</a>	\$0.07	\$ 0.14	DigiKey	<a href="#">1N4002/54GICT-ND</a>	\$ 0.69	\$ 1.38
VREG	LM317T	1	Mouser	<a href="#">511-LM317T</a>	\$0.70	\$ 0.70	DigiKey	<a href="#">LM317TFS-ND</a>	\$ 0.48	\$ 0.48
Heat Sink	Wakefield #647-10ABP (1"h.)	1	Mouser	<a href="#">567-647-10ABP</a>	\$2.90	\$ 2.90	DigiKey	<a href="#">345-1031-ND</a>	\$ 1.66	\$ 1.66
Heat Sink Kit w Shldr Wshr	for LM317 Voltage Regulator	1	<a href="#">Beezar.com</a>	<a href="#">HiSkKit-1</a>	\$1.50	\$ 1.50	<a href="#">Beezar.com</a>	<a href="#">HiSkKit-1</a>	\$ 1.25	\$ 1.25
Walwart	24VAC, 750-1000ma Walwart	1	Mouser	<a href="#">553-WAU24-750</a>	\$16.40	\$ 16.40	DigiKey	----	\$ 16.40	\$ 16.40
Power Socket	2.1mm Insulated Socket (must be isolated from case)	1	Mouser	<a href="#">163-4302-E</a>	\$1.92	\$ 1.92	DigiKey	<a href="#">CP-011A-ND</a>	\$ 1.49	\$ 1.49
SPST Switch	Red Pushbutton w/round body & thread	1	Mouser	<a href="#">10PP422</a>	\$4.96	\$ 4.96	Radio Shack	<a href="#">275-1565</a>	\$ 2.99	\$ 2.99
	Red Pushbutton w/square body & thread		Mouser	<a href="#">10PP432</a>	\$2.80	\$ -				
Knob	Silver, Solid Aluminum, 30mm dia	1	ebay/Partspipe		\$5.99	\$ 5.99	ebay/Partspipe		\$ 5.99	\$ 5.99
<b>RELAY-DELAY</b>										
RM1	3.32K ohm	1	Mouser	<a href="#">71-RN55D-F-3.32K</a>	\$0.08	\$ 0.08	DigiKey	<a href="#">CMF3.32KHFACT-ND</a>	\$ 0.17	\$ 0.49
RM2	1M ohm	1	Mouser	<a href="#">71-RN55D-F-1.0M</a>	\$0.08	\$ 0.08	DigiKey	<a href="#">CMF1.00MHFACT-ND</a>	\$ 0.17	\$ 0.49
CM1	47uF, 25V Electrolytic	1	Mouser	<a href="#">140-HTRL25V47-RC</a>	\$0.08	\$ 0.08	DigiKey	<a href="#">493-1300-ND</a>	\$ 0.14	\$ 0.14
CM3	470uF 16V Electrolytic (10mm dia. Max)	1	Mouser	<a href="#">140-HTRL16V470-RC</a>	\$0.17	\$ 0.17	DigiKey	<a href="#">493-1286-ND</a>	\$ 0.29	\$ 0.29
DM1	1N5242B Zener	1	Mouser	<a href="#">78-1N5242B</a>	\$0.06	\$ 0.06	DigiKey	<a href="#">1N5242B-TPCT-ND</a>	\$ 0.75	\$ 0.75
DM2	1N4148	1	Mouser	<a href="#">78-1N4148</a>	\$0.04	\$ 0.04	DigiKey	<a href="#">1N4148FS-ND</a>	\$ 0.07	\$ 0.07
QM1	BD139	1	Mouser	<a href="#">512-BD1396STU</a>	\$0.54	\$ 0.54	DigiKey	<a href="#">BD13916STU-ND</a>	\$ 0.42	\$ 0.42
QM2	MPSA14	1	Mouser	<a href="#">512-MPSA14</a>	\$0.50	\$ 0.50	DigiKey	<a href="#">MPSA14-ND</a>	\$ 0.29	\$ 0.29
G6A	Omron 12V DPDT Relay G6A-234P	1	Mouser	<a href="#">653-G6A-234P-DC12</a>	\$8.06	\$ 8.06	DigiKey	<a href="#">Z106-ND</a>	\$ 6.08	\$ 6.08
<b>BJT Diamond Buffer</b>										
RB1L/R	1K ohm	2	Mouser	<a href="#">71-RN55D-F-1.0K</a>	\$0.08	\$ 0.16	DigiKey	<a href="#">CMF1.00KHFACT-ND</a>	\$ 0.17	\$ 0.34
RB6L/R, RB7L/R	220 ohm	4	Mouser	<a href="#">71-RN55D-F-221</a>	\$0.08	\$ 0.32	DigiKey	<a href="#">CMF221HFCT-ND</a>	\$ 0.17	\$ 0.68
RB2L/R, RB3L/R	10 ohm	4	Mouser	<a href="#">71-RN55D-F-10.2</a>	\$0.10	\$ 0.40	DigiKey	<a href="#">CMF10.2HFCT-ND</a>	\$ 0.17	\$ 0.68
RB10L/R, RB11L/R	2.2 ohm 2W Metal Film	4	Mouser	<a href="#">594-5083NW2R200J</a>	\$0.32	\$ 1.28	DigiKey	<a href="#">P2.2W-2BK-ND</a>	\$ 0.28	\$ 0.98
RB12L/R	2K ohm Trimmer Pot - different value	2	Mouser	<a href="#">72-T93YA-2K</a>	\$1.85	\$ 3.70	DigiKey	<a href="#">490-2880-ND</a>	\$ 1.51	\$ 3.02
RB4L/R, RB5L/R, RB13L/R	100 ohm	6	Mouser	<a href="#">71-RN55D-F-100</a>	\$0.08	\$ 0.48	DigiKey	<a href="#">CMF100HFCT-ND</a>	\$ 0.17	\$ 1.02
RB8L/R, RB9L/R	NOT USED - for MOSFET ONLY - jumper out									
RB14L/R	jumper	2	-		\$0.00	\$ -	-		\$ -	\$ -
	Kiwame 10R (alternate)	2	<a href="#">Beezar.com</a>	<a href="#">KOA/Kiwame 10R 2W</a>	\$1.00	\$ 2.00	<a href="#">Beezar.com</a>	<a href="#">KOA/Kiwame 10R 2W</a>	\$ 1.00	\$ 2.00
QB1L/R	PN4392 Matched for current	1	<a href="#">Beezar.com</a>	<a href="#">PN4392pr</a>	\$2.50	\$ 2.50	DigiKey	<a href="#">PN4392FS-ND</a>	\$ 0.60	\$ 0.60
QB2L/R, QB4L/R, QB6L/R	2N5087 PNP small signal	6	Mouser	<a href="#">512-2N5087 J18Z</a>	\$0.11	-	DigiKey	<a href="#">2N5087-ND</a>	\$ 0.19	\$ 1.14
QB3L/R, QB5L/R, QB7L/R	2N5088 NPN small signal	6	Mouser	<a href="#">512-2N5088TA</a>	\$0.07	-	DigiKey	<a href="#">2N5088BU-ND</a>	\$ 0.18	\$ 1.08
	Matched Small Transistors (preferred alternate)	1	<a href="#">Beezar.com</a>	<a href="#">Matched Transistors</a>	\$2.50	\$ 2.50	<a href="#">Beezar.com</a>	<a href="#">Matched Transistors</a>	\$ 2.50	\$ 2.50

QB8L/R	MJE243 NPN power transistor		Mouser	<a href="#">863-MJE243G</a>	\$0.76	\$ -	DigiKey	<a href="#">MJE243GOS-ND</a>	\$ 0.73	\$ -
(default option)	BD137 NPN power transistor	2	Mouser	<a href="#">512-BD13716STU</a>	\$0.42	\$ 0.84	DigiKey	non-stock	\$ 0.73	\$ 1.46
QB9L/R	MJE253 PNP power transistor		Mouser	<a href="#">863-MJE253G</a>	\$0.58	\$ -	DigiKey	<a href="#">MJE253GOS-ND</a>	\$ 0.72	\$ -
(default option)	BD138 PNP power transistor	2	Mouser	<a href="#">512-BD13810STU</a>	\$0.42	\$ 0.84	DigiKey	non-stock	\$ 0.72	\$ 1.44
Special Alternates for Q8/Q9										
a	2SC3421 NPN power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SC3421</a>	\$1.50	***				
a	2SA1358 PNP power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SA1358</a>	\$1.50	***				
b	2SC3422 NPN power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SC3422</a>	\$1.75	***				
b	2SA1359 PNP power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SA1359</a>	\$1.75	***				
c	2SC2344 NPN power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SC2344</a>	\$1.25	***				
c	2SA1011 PNP power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SA1011</a>	\$1.25	***				
d	2SC2238 NPN power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SC2238</a>	\$2.00	***				
d	2SA968 PNP power transistor	2	<a href="#">Beezar.com</a>	<a href="#">2SA968</a>	\$2.00	***				
Heat Sink	Aavid #531002B02500G (1"h.)	4	Mouser	<a href="#">532-531002B25G</a>	\$1.92	\$ 7.68	DigiKey	<a href="#">HS351-ND</a>	\$ 1.19	\$ 4.76
Heat Sink Kit w/o Shldr Wshr	for Toshiba 2SC3422/2SA1359	4	<a href="#">Beezar.com</a>	<a href="#">HtSkKit-2</a>	\$1.25	\$ 5.00	<a href="#">Beezar.com</a>	<a href="#">HtSkKit-2</a>	\$ 1.25	\$ 5.00
<b>ACCESSORIES</b>										
Digital Multimeter	Centech Digital Multimeter	1	<a href="#">Beezar.com</a>	<a href="#">Centech DMM</a>	\$7.50	\$ 7.50	<a href="#">Beezar.com</a>	<a href="#">Centech DMM</a>	\$ 7.50	\$ 56.25
Trimmer Adjustment Tool	Bourns Trimpot Adjustment Tool	1	<a href="#">Beezar.com</a>	<a href="#">H-90</a>	\$2.80	\$ 2.80	<a href="#">Beezar.com</a>	<a href="#">H90-ND</a>	\$ 1.29	\$ 3.61
<b>ENCLOSURE***</b>										
PCB: approx. 5" x 6"	<a href="#">Lansing</a>		Lansing-Clear	<a href="#">DT1A60-06A1</a>	\$21.37	\$ -	Lansing-Black	<a href="#">DT1K60-06B2</a>	\$ 23.07	\$ -
	Custom Machined Beezar/Lansing MiniMAX Case	1	<a href="#">Beezar.com</a>	<a href="#">MiniMAX Case - Black</a>	\$65.00	\$ 65.00	<a href="#">Beezar.com</a>	<a href="#">MiniMAX Case - Black</a>	\$ 65.00	\$ 65.00
Center Standoff Kit	For Custom Beezar/Lansing case	1	<a href="#">Beezar.com</a>	<a href="#">Beezar Cskit</a>	\$1.50	\$ 1.50	<a href="#">Beezar.com</a>	<a href="#">Beezar Cskit</a>	\$ 1.50	\$ 1.50
				<b>TOTAL</b>		<b>\$264.15</b>		<b>TOTAL</b>		<b>\$ 314.84</b>

\* These are consensus boutique electrolytic cap positions, the selection choices are many.

\*\* These are consensus boutique film cap positions, the selection choices are many.