

Managerial Design Review

DDR Action Items

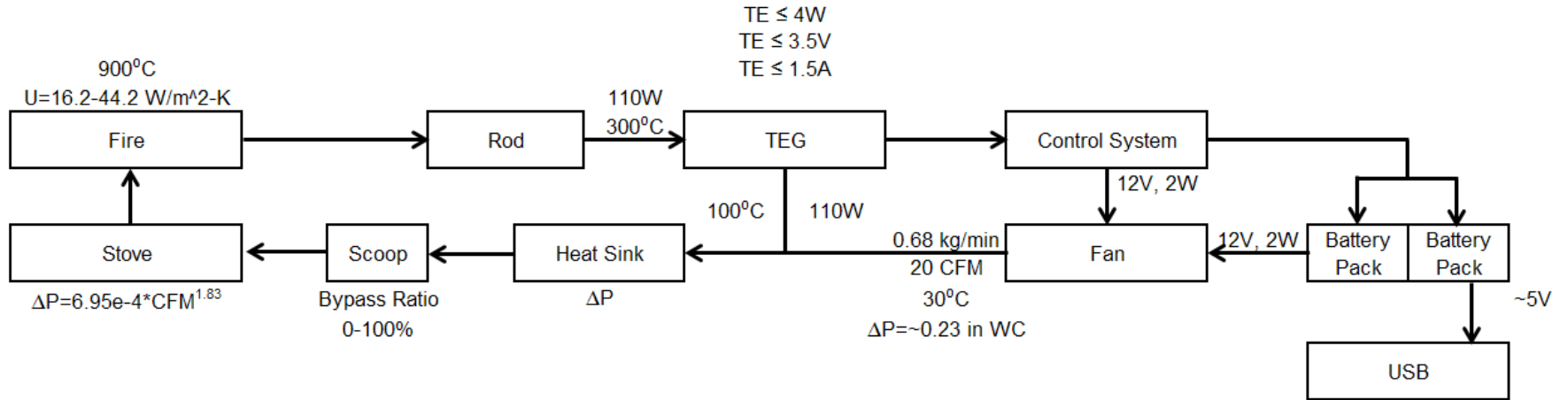
Item #	Action	Owner	Status	Comments
1	For ES #3 Unit price, specify material cost only	Jared	Done	
2	For ES #9 Battery size, Ah vs. Wh? If Ah specify voltage	Fahad	Done	
3	For ES #6 Product life span, how will we test this?	Brad	Done	Thermal life cycle analysis, battery and fan life estimations
4	Update energy flow diagram with flow through heat sink	Brad	Done	
5	Bump schedule forward. When are parts in house?	Jared	Done	
6	Calculate pumping wattage for fan	Jared		
7	Battery life cycle chart	Fahad		
8	Reconsider fan battery sizing (Can we use one for fan?)	Tom	Done	2 batteries will be used
9	Consider convective loss out of rod	Brad		
10	Order enough components for 4 systems	Tom	Done	
11	Put more realistic resistance into switching simulations	Tom	Done	
12	Integrate charging and switching circuit schematic	Tom	Done	
13	Peak power considerations - Anything other than resistor bank?	Tom	Done	No
14	Look into operating temps of thermal pastes	Jeff	Done	
15	Add battery holder to BOM	Tom	Done	
16	Add subsystem costs to BOM	Jared	Done	
17	Specify what equipment will be needed for specific tests	Jared	Done	Will occur Week 1 of MSD II when more detailed test plans are written
18	Consider modifying stove to match P11461's proposed design	Jared	Done	Will not modify

Engineering Specifications

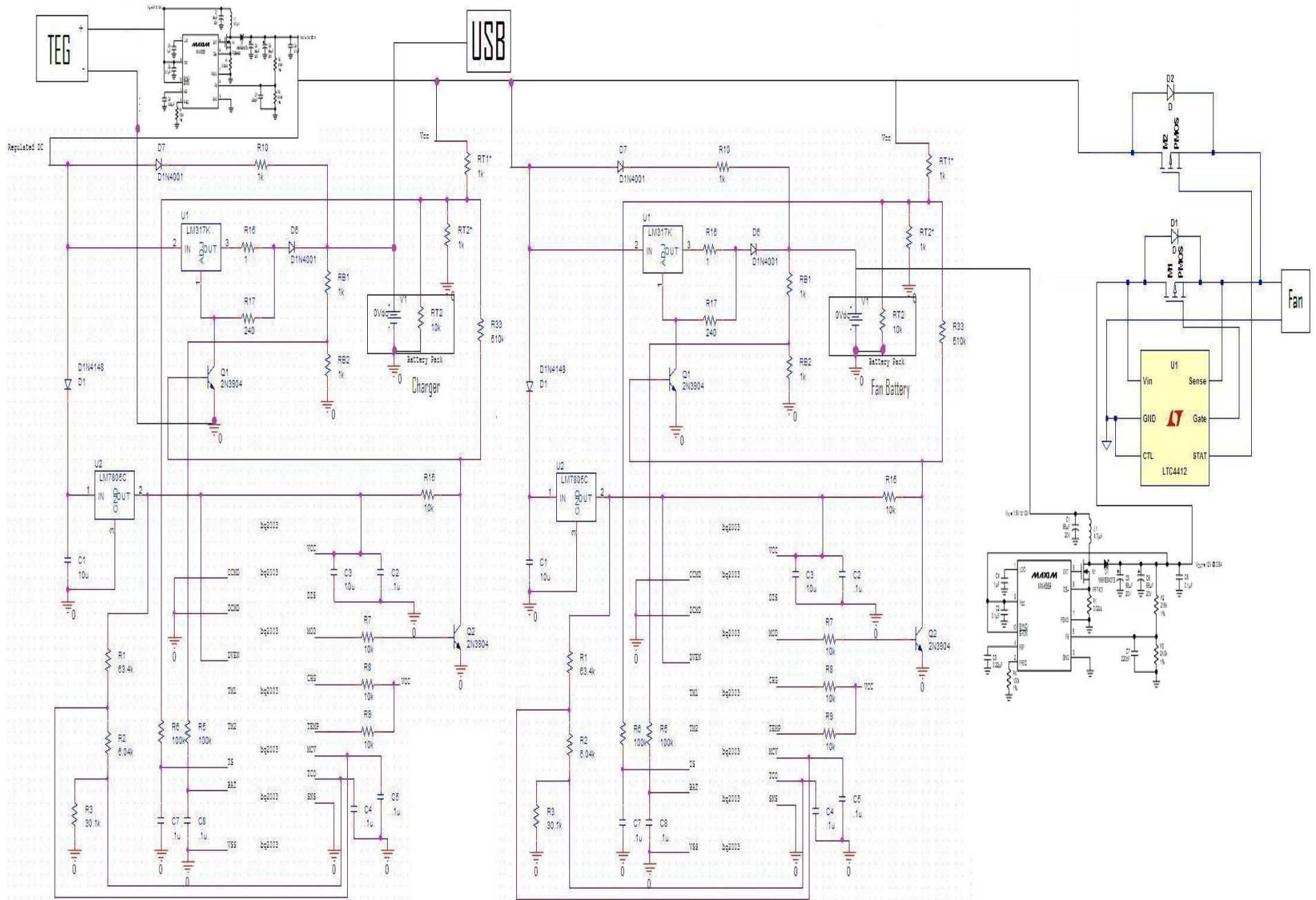
Spec	Description	Importance	Relates to CN	Units	Marginal	Target	Comments/Status
1	Flow rate of air into stove	9	1,6,13	kg/min	0.3-0.7	0.2-0.8	
2	Flow control settings	3	6,13	#	2	3	Evenly distributed across the flow range
3	Unit price	9	3	\$	27.5	12.5	Material cost
4	Coupling time with no tools	1	2,7,12	min	10	5	
5	Removal time with no tools	1	2,7,12,15	min	10	5	
6	Product life span	3	4, 9	years	3	5	Assume 2 hr/use and 3 uses/day
7	Replaceable component life span	3	4, 9	years	1	2	Rod, Fan, Battery
8	Aux charging	3	11,16	Wh		4	Being able to charge ~2 cell phones throughout the day
9	Battery size	3	11,13,16	Ah	1.5-3	2	Energy required for 5 product startup cycles/Provide 2Ah @ 1.2V per battery cell
10	Weight	1	7,8,12,15	kg	<2.5	<2	
11	Volume	1	7,8,12,15	cm ³	3000	1000	
12	Time to reach peak performance	1	13,16	min	15	10	Within 90% of SS assuming charcoal ignites instantly
13	User actions during operational cycle	3	6,7,13	#	6	4	
14	User actions to protect system	3	5,7	#	1	0	
15	Maximum temperature inside enclosure	3	1,4,9,14	°C	60	50	
16	Maximum external temperature of housing	3	7,8,14	°C	54	45	
17	Maximum temperature of hot side of TEG	9	9,16	°C	275	300	

Importance Scale: 1 – Low Importance, 3 – Moderate Importance, 9 – High Importance

Energy Flow Diagram



Full Electrical Schematic



Bill of Materials
 Team: P11462
 Revision: 2

Item	Part Description	Supplier	Part #	Quantity	Prototype		Lead Time	Owner	Status	Comments	
					Unit Price	Total Price					
1	Beam Material (0.5x2.75x36 1018CRS)	McMaster	8910K701	1	\$52.06	\$52.06	2 weeks	Jeff			
2	Heat Sink	Heatsink USA	E004	1	\$16.33	\$16.33	2 weeks	Brad			
3	6-32 Cap Screw (1 in. long) (Pack of 50)	McMaster	90128A153	1	\$10.20	\$10.20	2 weeks	Brad			
4	Thermal Blanket (24" x 25" x 1/8")	Cotronics Corp	370-1	0	\$79.95	\$0.00	4 weeks	Jared			
5	18 gauge sheet metal (2ft. X 3ft)	SMC Metal		2	\$26.00	\$52.00	1 weeks	Brad			
6	Fan	Allied Electronics	997-0881	2	\$4.20	\$8.40	2 weeks	Jared			
7	Thermal Paste	AOS Technologies	52039 (XT-3)	1	\$90.00	\$90.00	3 weeks	Jeff			
8	Stainless Steel Washers (Per 100)	McMaster	90313A101	1	\$6.60	\$6.60	2 weeks	Brad			
9	1/4 in. diameter rod (5 in. long)	McMaster	1327K115	1	\$3.68	\$3.68	2 weeks	Brad			
10	Control Knob	McMaster	6094K88	1	\$2.36	\$2.36	2 weeks	Brad			
11	Cotter Pin (pack of 100)	McMaster	98335A034	1	\$5.17	\$5.17	2 weeks	Brad			
12	Spring - 1.25 in. long - 5.22 lb/in. (pack 12)	McMaster	9657K155	1	\$6.58	\$6.58	2 weeks	Brad			
13	4-40 Cap Screw (.25 in. long) (Pack of 50)	McMaster	91306A311	1	\$8.10	\$8.10	2 weeks	Brad			
					Mechanical Sub Cost	\$261.48					

1	Thermoelectric	China	TEP1-1264-1.5	1	\$8.00	\$8.00	6 weeks	Tom			
2	Rechargeable AA Ni-MH Battery (4 pack)	Zeikos (Amazon.com)	ZE-4AA	2	\$2.49	\$4.98	2 weeks	Fahad			
3	Low Loss Power Path Controller	Linear Technology	LTC4412ES6#TR	1	\$1.93	\$1.93	3 weeks	Tom			
4	P channel MOSFET	Digikey	FDN306P	2	\$0.55	\$1.10	2 weeks	Tom			
5	Diode	Allied Electronics	1N914	2	\$0.01	\$0.03	2 weeks	Tom			
6	Capacitor 10µF 50V electrolytic	Rubycon	50YK10M5X11	2	\$0.04	\$0.08	2 weeks	Fahad		C1	
7	Capacitor 0.1µF ceramic	Vetco	SMDCAP-CER0603-0.1UF50V	10	\$0.49	\$4.90	2 weeks	Fahad		C2, C4, C5, C7, C8	
8	Capacitor 10µF 7V electrolytic	West Florida Components	RE175PD	2	\$0.10	\$0.20	2 weeks	Fahad		C3	
9	Diode	Tayda	1N4148	2	\$0.01	\$0.02	2 weeks	Fahad		D1	
10	HLMP 4700 red LED			4		\$0.00	2 weeks	Fahad		D2, D3	
11	Diode	Allied Electronics	1N5400	2	\$0.09	\$0.17	2 weeks	Fahad		D6	
12	Diode	Allied Electronics	1N4001	2	\$0.08	\$0.16	2 weeks	Fahad		D7	
13	NPN General Purpose Amplifier	Talon Electronics	2N3904	4	\$0.09	\$0.36	2 weeks	Fahad		Q2, Q3	
14	Resistor 63.4KΩ	Galco Industrial Electronics	RN55D6342F	2	\$0.06	\$0.12	2 weeks	Fahad		R1	
15	Resistor 6.04KΩ	Galco Industrial Electronics	RN55D6041F	2	\$0.06	\$0.12	2 weeks	Fahad		R2	
16	Resistor 30.1KΩ	Galco Industrial Electronics	RN55D3012F	2	\$0.26	\$0.52	2 weeks	Fahad		R3	
17	Resistor 100KΩ (Qty 10)	Tayda	100K OHM 1/4W 5%	1	\$0.10	\$0.10	2 weeks	Fahad		R5, R6	
18	Resistor 10KΩ (Qty 10)	Tayda	10K OHM 1/4W 5%	1	\$0.10	\$0.10	2 weeks	Fahad		R7, R15	
19	Resistor 1.0KΩ	Jameco Electronics	CF 1/2W102JRC	2	\$3.00	\$6.00	2 weeks	Fahad		R8, R9	
20	Resistor 2KΩ	Galco Industrial Electronics	2W-68K-5%-MO	2	\$0.07	\$0.14	2 weeks	Fahad		R10	
21	Resistor 1Ω (Qty 10)	Tayda	1 OHM 1/4W 5%	1	\$0.10	\$0.10	2 weeks	Fahad		R16	
22	Resistor 240Ω (Qty 10)	Tayda	240 OHM 1/4W 5%	1	\$0.10	\$0.10	2 weeks	Fahad		R17	
23	Resistor 510 KΩ (Qty 10)	Tayda	510K OHM 1/4W 5%	1	\$0.10	\$0.10	2 weeks	Fahad		R33	
24	Resistor 562 KΩ	Newark	26R4203	2	\$0.03	\$0.06	2 weeks	Fahad		RB1	
25	Resistor 187 KΩ	Digikey	01P3731	2	\$0.05	\$0.10	2 weeks	Fahad		RB2	
26	Thermistor	Digikey	NTCLE100E3103JB0	2	\$0.42	\$0.84	2 weeks	Fahad		RT	
27	Resistor 3.65KΩ (Qty 100)	Jameco Electronics	MFR-25FRF-3K57	1	\$0.90	\$0.90	2 weeks	Fahad		RT1	
28	Resistor 2.8KΩ	Galco Industrial Electronics	RN55D2671F	2	\$0.06	\$0.12	2 weeks	Fahad		RT2	
29	Fast Charge IC(price only in quantity of 1k)	Texas Instruments	bq2003	2		\$0.00	3 weeks	Fahad		U1	
30	Voltage Regulator	Tayda	LM317T	2	\$0.21	\$0.42	2 weeks	Fahad		U2	
31	Voltage Regulator	Newark	72K8848	2	\$0.16	\$0.33	2 weeks	Fahad		U3	
32	USB	Firefold	USB-EXT-1-IVY	1	\$1.29	\$1.29					
33	1 AA Battery Holder	Electronix	34-256-1	1	\$0.59	\$0.59	2 weeks				
34	3 AA Battery Holder	Electronix	34-250-3	1	\$0.79	\$0.79	2 weeks				
35	Manual Switch for Fan Turnon	Parts Express	060-542	1	\$0.98	\$0.98					
36	Capacitor 0.1µF	Vetco	SMDCAP-CER0603-0.1UF50V	4	\$0.49	\$1.96	2 weeks	Tom			
37	Capacitor 22µF	Vetco	SMDCAP-CER1206-22UF6.3V	2	\$0.59	\$1.18	2 weeks	Tom			
38	Capacitor 68µF 10V	Mouser Electronics	647-UPJ1A680MDD1AQ	6	\$0.06	\$0.36	2 weeks	Tom			
39	Capacitor 220pF	Newark	97K4334	2	\$0.02	\$0.03	2 weeks	Tom			
40	Resistor 0.02Ω	Newark	08N2213	2	\$0.47	\$0.94	2 weeks	Tom			
41	Resistor 218KΩ (Can be made with previous resistors)			2		\$0.00		Tom			
42	Resistor 24.9KΩ	Newark	94C5000	2	\$0.04	\$0.09	2 weeks	Tom			
43	Inductor 4.7µH (Qty 10)	Jameco Electronics	78F4R7J-VP	1	\$0.50	\$0.50	2 weeks	Tom			
44	Single N Channel Logic Level MOSFET (FDS6680)	Newark	96K9885	2	\$1.42	\$2.84	3 weeks	Tom			
45	Schottky Power Rectifier	West Florida Components	MBRS340T3	2	\$0.36	\$0.72	2 weeks	Tom			
46	Boost DC-DC Converter	Maxim	MAX668	2		\$0.00	2 weeks	Tom			
47	Resistor 100KΩ (Added into Previous QTY #18)							Tom			
					Electrical Sub Cost	\$44.36					

Legend	
	Ready to order
	Know what needs to be done and have XX hrs of work
	Do not know all info and estimate time is XX hrs.

Sub Cost	\$305.84
Tax	
Total Cost	\$305.84

MSD II Schedule

ID	Task Name	Duration	Start	Finish	Mar 6, '11	Mar 13, '11	Mar 20, '11	Mar 27, '11	Apr 3, '11	Apr 10, '11	Apr 17, '11	Apr 24, '11	May 1, '11	May 8, '11	May 15, '11
					M	T	S	W	S	T	F	M	T	S	W
1	MSD 2 Timeline	55 days	Mon 3/7/11	Fri 5/20/11											
2	Week 1	5 days	Mon 3/7/11	Fri 3/11/11											
3	Assume sheet metal, fan, and TE	5 days	Mon 3/7/11	Fri 3/11/11											
4	Cut Heat Sink to Size	5 days	Mon 3/7/11	Fri 3/11/11											
5	Machine Heat Sink TE cavity	5 days	Mon 3/7/11	Fri 3/11/11											
6	Modify stove	5 days	Mon 3/7/11	Fri 3/11/11											
7	Research PCB layout sources & prices	5 days	Mon 3/7/11	Fri 3/11/11											
8	Cardboard mock-up of housing	5 days	Mon 3/7/11	Fri 3/11/11											
9	Write test plans	5 days	Mon 3/7/11	Fri 3/11/11											
10	Week 2	5 days	Mon 3/14/11	Fri 3/18/11											
11	Assume electrical part, beam arrival	5 days	Mon 3/14/11	Fri 3/18/11											
12	Breadboard switching circuit	5 days	Mon 3/14/11	Fri 3/18/11											
13	Breadboard charging circuit	5 days	Mon 3/14/11	Fri 3/18/11											
14	Test switching circuit	5 days	Mon 3/14/11	Fri 3/18/11											
15	Fabricate sheet metal housing	5 days	Mon 3/14/11	Fri 3/18/11											
16	Machine fan brackets	5 days	Mon 3/14/11	Fri 3/18/11											
17	Heat sink thermal testing	5 days	Mon 3/14/11	Fri 3/18/11											
18	Fabricate bypass scoop	5 days	Mon 3/14/11	Fri 3/18/11											
19	Research PCB layout sources & prices	5 days	Mon 3/14/11	Fri 3/18/11											
20	Week 3	5 days	Mon 3/21/11	Fri 3/25/11											
21	Test charging circuit	5 days	Mon 3/21/11	Fri 3/25/11											
22	Assemble housing, fan, scoop	5 days	Mon 3/21/11	Fri 3/25/11											
23	Test flow rate	5 days	Mon 3/21/11	Fri 3/25/11											
24	Test bypass operation	5 days	Mon 3/21/11	Fri 3/25/11											
25	Rod thermal testing	5 days	Mon 3/21/11	Fri 3/25/11											
26	Research PCB layout sources & prices	5 days	Mon 3/21/11	Fri 3/25/11											
27	Week 4	5 days	Mon 3/28/11	Fri 4/1/11											
28	Integrate thermal unit and housing	5 days	Mon 3/28/11	Fri 4/1/11											
29	Test temps	5 days	Mon 3/28/11	Fri 4/1/11											
30	Test electrical output	5 days	Mon 3/28/11	Fri 4/1/11											
31	Test controllability	5 days	Mon 3/28/11	Fri 4/1/11											
32	Merge electrical systems	5 days	Mon 3/28/11	Fri 4/1/11											
33	Test total electrical system	5 days	Mon 3/28/11	Fri 4/1/11											
34	Order PCB	5 days	Mon 3/28/11	Fri 4/1/11											
35	Week 5	5 days	Mon 4/4/11	Fri 4/8/11											
36	Integrate all systems	5 days	Mon 4/4/11	Fri 4/8/11											
37	Test overall system	5 days	Mon 4/4/11	Fri 4/8/11											
38	Life cycle calculation	5 days	Mon 4/4/11	Fri 4/8/11											
39	Week 6	5 days	Mon 4/11/11	Fri 4/15/11											
40	Test variations (charcoal level, air temp, etc.)	5 days	Mon 4/11/11	Fri 4/15/11											
41	ES Verification	5 days	Mon 4/11/11	Fri 4/15/11											
42	Tweak design based on tests	5 days	Mon 4/11/11	Fri 4/15/11											
43	Write paper	5 days	Mon 4/11/11	Fri 4/15/11											
44	Keep EDGE up-to-date	5 days	Mon 4/11/11	Fri 4/15/11											
45	Week 7	5 days	Mon 4/18/11	Fri 4/22/11											
46	Write paper	5 days	Mon 4/18/11	Fri 4/22/11											
47	Create poster	5 days	Mon 4/18/11	Fri 4/22/11											
48	Machine electrical housing	5 days	Mon 4/18/11	Fri 4/22/11											
49	Attach electrical components	5 days	Mon 4/18/11	Fri 4/22/11											
50	Refine packaging	5 days	Mon 4/18/11	Fri 4/22/11											
51	Work on 10,000 unit BOM	5 days	Mon 4/18/11	Fri 4/22/11											
52	Write plan to apply to P11461 stove	5 days	Mon 4/18/11	Fri 4/22/11											
53	Week 8	5 days	Mon 4/25/11	Fri 4/29/11											
54	Write paper	5 days	Mon 4/25/11	Fri 4/29/11											
55	Create poster	5 days	Mon 4/25/11	Fri 4/29/11											
56	Write plan to apply to P11461 stove	5 days	Mon 4/25/11	Fri 4/29/11											
57	Work on 10,000 unit BOM	5 days	Mon 4/25/11	Fri 4/29/11											
58	Week 9	5 days	Mon 5/2/11	Fri 5/6/11											
59	Write paper	5 days	Mon 5/2/11	Fri 5/6/11											
60	Create poster	5 days	Mon 5/2/11	Fri 5/6/11											
61	Write plan to apply to P11461 stove	5 days	Mon 5/2/11	Fri 5/6/11											
62	Work on 10,000 unit BOM	5 days	Mon 5/2/11	Fri 5/6/11											
63	Imagine RIT	1 day	Sat 5/7/11	Sat 5/7/11											
64	Week 10	5 days	Mon 5/9/11	Fri 5/13/11											
65	Finalize everything	5 days	Mon 5/9/11	Fri 5/13/11											
66	Final presentation	5 days	Mon 5/9/11	Fri 5/13/11											
67	Week 11	5 days	Mon 5/16/11	Fri 5/20/11											
68	Final management review	5 days	Mon 5/16/11	Fri 5/20/11											

THERMAL BRIDGING CONSIDERATIONS

Bolts: 6-32 cap screws 1 inch long

Radius: 0.065 in. = 0.00165 m

Length: 1 in. = 0.0254 m

$$A = \pi r^2$$

$$A = \pi (.00165)^2$$

$$A = 8.55E^{-6} \text{ m}^2$$

$$R = \frac{L}{KA}$$

K=50 W/mK (Steel)

$$R = \frac{(.0254)}{(50) * (8.55E^{-6})}$$

$$R = 59.4$$

$$I = \frac{V}{R}$$

For temperature differences of 150 C (conservative) and 200 C (worst case)

$$q = \frac{150 \text{ K}}{59.4 \text{ W/K}} = 2.6 \text{ W}$$

$$q = \frac{200 \text{ K}}{59.4 \text{ W/K}} = 3.4 \text{ W}$$

CONDUCTION BEAM – CONVECTIVE HEAT LOSS CONSIDERATIONS

Convection:

$$q = KA(\Delta T)$$

For free convection:

$$K=10 \text{ W/mK}$$

$$A=.0085 \text{ m}^2$$

$$T_{\infty} = 25 \text{ C}$$

$$T_s = 300 \text{ C}$$

$$q = \left(10 \frac{\text{W}}{\text{m}^2\text{K}}\right) (0.0085 \text{ m}^2) (275\text{K})$$

$$q = 23\text{W}$$

**Insulation will be required*