



GRIDTRAK PROJECT SYNCHROPHASOR MEASURING SYSTEM

01/07/2011
Rev A.2

APPENDIX F - BILL OF MATERIALS

Label	Unit Qty	Bag Qty	Description
C20 CAPACITOR - 470 uF, 25V 1 each	1	3	Voltage Regulator Input
C21 CAPACITOR - 22 uF, 25V 1 each	1	3	Voltage Regulator Output
C17 CAPACITOR – 10 uF, 25V 1 each	1	3	Voltage Reference
C1 to C16 CAPACITOR – 0.1 uF, 25V 9 each	9	27	Bypass Capacitors
D3, D4, D5, D6 DIODE – 1N4001, 50V 1A 4 each	4	12	Rectifier Diodes
D7, D8 SCHOTTKY DIODE - 1N5819 2 each	2	6	Barrier Diodes
D1, D2 DIODE – N914 2 each	2	6	Signal Diodes
R1 RESISTOR - 10k ohm 1 each	1	3	Reset Switch 10k ohm Resistor
R2, R11 RESISTOR - 1k ohm 2 each	2	6	Reset Switch and Power LED Resistors
R5 to R10 RESISTOR, 3.9k ohm, 1% 6 each	6	18	Voltage Divider Resistors
R3, R12, R13 RESISTOR, 4.7k ohm 3 each	3	9	Pull-up Resistors
R4 RESISTOR, 330 ohm 1 each	1	3	Activity LED Load Resistor
U4 VOLTAGE REGULATOR – LM7805 1 each	1	3	5V Positive Voltage Regulator
U7 VOLTAGE REFERENCE, 2.5V – MCP1525 1 each	1	3	2.5V Voltage Reference
X1 OSC OSCILLATOR - 12.000 MHz 1 each	1	3	12.000 MHz Clock Oscillator



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LED1 LED - BLUE 1 each	1	3	Activity LED 1 each for PCB	
LED3 LED – GREEN 1 each	1	3	Power LED 1 each for PCB	
U1 MCU - dsPIC30F3013 Micro Controller 1 each	1	3	Micro Controller	
U1 SOCKET – 28 PINS 1 each	1	3	Micro Controller Socket	
U6 MAX232A – RS232 Transceiver 1 each	1	3	MAX232A RS232 Transceiver	
U6 Socket SOCKET – 18 PINS 1 each	1	3	MAX232 RS232 Transceiver 18 Pins Socket	
U2 and X1 Sockets SOCKET - 8 PINS 2 each	2	6	U2 Op Amp Socket X1 Oscillator Socket (Optional)	
SW1 TACTILE SWITCH – Reset 1 each	1	3	Reset Switch	
SIP Header Pins SIPx40 – Headers 1 each	1	3	SIP Header Pin Stock 40 pins per strip (38 required per PCB)	
U2 OPERATIONAL AMPLIFIER - MCP6292 1 each	1	3	Dual Operational Amplifier	
Battery Cable 9V BATTERY CABLE 1 each	1	3	Backup Battery Cable	
U4 Heat Sink HEAT SINK - T220 1 each	1	3	Voltage Regulator Heat Sink	
DPDT Mini Slide Switch CASE - Battery Switch 1 each	1	3	Battery Backup Enable Switch	
AC Transformer Jack CASE – 2.1 mm Power Jack 1 each	1	3	AC Transformer Case Jack 2.1 mm Power Jack	
DB9F Connector CASE – RS232 1 each	1	3	DB9F Connector	
DB Connector Screws SCREW, NUT, LOCK WASHER - 4-40 2 each	2	6	DB9 Case Screws, Nuts, and Lock Washers Optional Washers	



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J6 Connector and Cable CONNECTOR and CABLE pair 1 each	1	3	Connector and Cable for Battery	
J7 Connector and Cable CONNECTOR and CABLE pair 1 each	1	3	Connector and Cable for VAC	
Jumpers JUMPER – 2 Pin Shunt 3 each	3	9	Jumpers	
PCB Mounting Screws SCREW - #4 x 3/8" 4 each	4	12	PCB Mounting Screws #4-3/8" or #4-1/4"	
F-F Wires WIRE - Header to Case Wires 7 each	7	21	Female Jumper Wires for PCB-Case Connections	
Case	1	3	Serpac Case	
ICD2/3 Cable	1	1	Device Programmer Interface Cable for ICD3 or ICD2	



APPENDIX G - PCB ASSEMBLY NOTES

ASSEMBLY TIPS

* Add components from shortest in height off the PCB to tallest.

1. PCB PREPARATION FOR CASE MOUNTING

[Approximately 30 minutes]

A. Mount the PC Board in the case. Use a roto-tool or rat tail file to grind a radius in the board edge to allow screw clearance. There are small crescent etchings on the PCB marking where the radius clearance may be needed.

B. For a case bottom reset pin hole: mount the PC Board in the case and use the center hole in the Reset Button SW1 as a drill guide to drill a hole in the case bottom. Enlarge the case hole if desired.

C. Remove the PCB from the case mounting to complete the PCB assembly

2. SOLDER IN THE SOCKETS

[Approximately 30 minutes]

U2 – 8 Pin Socket

X1 – 8 Pin Socket; Only Pins 1,4,5, and 8 are used. Trim off Pins 2,3, 6, and 7.

U6 – 18 Pin Socket

U1 – 28 Pin Socket

3. SOLDER IN THE PIN HEADERS

[Approximately 30 minutes]

J1 x 6

J2 x 2

J3 x 2

J4 x 3

J5 x 3

J8 x 3

J9 x 3

J10 x 10

J11 x 3

J30 x 3

CLK x 1 - Do this one last to prevent pushing it through when hot

4. SOLDER IN THE BYPASS CAPACITORS

[Approximately 30 minutes]

5. SOLDER IN THE DIODES

[Approximately 30 minutes]

6. SOLDER IN THE RESISTORS

[Approximately 60 minutes]

7. SOLDER IN THE VAC AND BATTERY CONNECTORS

[Approximately 15 minutes]

8. SOLDER IN THE LEDs

[Approximately 15 minutes]



9. SOLDER IN THE ELECTROLYTIC CAPACITORS

[Approximately 15 minutes]

C17 - 10uF

C21 - 22uF

C20 – 470uf

10. SOLDER IN THE VOLTAGE REFERENCE AND VOLTAGE REGULATOR

[Approximately 15 minutes]

Trim the Voltage Regulator Heat Sink fins to clear the bypass jumper, J3.

Install Jumpers J3, J5, J11

Install the Voltage Regulator Heat Sink.

11. AC-AC TRANSFORMER CONNECTOR AND CABLE SUB ASSEMBLY

[Approximately 30 minutes]

Solder the 2.1mm case connector to the power cable that connects to J7

12. POWER SUPPLY AND VOLTAGE REFERENCE VERIFICATION TEST

[Approximately 15 minutes]

Connect the VAC transformer and test the +5 VDC and +2.5 VDC on the J30 pins. If you get these values and no smoking components, then you are ready to install the oscillator and ICs!

13. INSTALL THE ICs

[Approximately 15 minutes]

U1 – dsPIC30F3013 Micro Controller

U2 – MCP6292 Operational Amplifier

U6 – MAX232A* or MAX242A**

* Note: The MAX232A has 16 pins and the socket is 18 pins. When using a MAX232A, insert the IC with the MAX232A Pin #1 in the 18 pin socket's Pin #2 position. With a MAX232 installed, the socket pins #1 and #18 are empty.

** Note: The GridTrak PMU design includes support for the MAX242 to enable resetting the RS232 transceiver if this is required for improved interfacing with GPS devices.

14. FINAL ASSEMBLY POWER CHECK

[Approximately 15 minutes]

Connect the AC-AC Transformer and test the +5 VDC and +2.5 VDC on the J30 pins.

16. CASE MACHINING

[Approximately 120 minutes]

Remove the PCB from the case.

Cut holes in the case for the 2.1mm VAC Transformer Jack and the DB9 RS232 connector. Make sure to position the hole locations to allow clearance for the inside case posts. I personally think that cutting the hole for the DB9 RS232 connector is the most challenging task of the sensor assembly!

17. ASSEMBLE THE TRANSFORMER POWER SUPPLY CONNECTION

[Approximately 15 minutes]

Trim the Connector Plug Wire Leads from the J7 to the 2.1mm VAC Transformer Jack to a convenient length and solder them to the Jack. This is an AC connection so only wire up the Jack's inside pin and spring contact. Do not connect the panel ground outside of the Jack to the wiring. Mount the Jack in the case. Do not run the wires near the voltage regulator heat sink.



18. ASSEMBLE THE DB9 RS232 CONNECTION

[Approximately 30 minutes]

If the DB9 Connector is going to be mounted close to the RS232 pin headers, then cut 2 of the 7" blue F-F jumper wires in half and solder the cut ends into the DB9 Connector's # 2, 3, and 5 solder cups.

Mount the DB9 Connector in the case using the 4-40 screw posts, lock washers, and nuts.

19. MOUNT THE RESET BUTTON

[Approximately 15 minutes]

Mounting the Reset Button on the top of the board is better for open case testing or operation of the sensor. Mounting the Reset Button on the bottom of the board enables it to be clicked through the pin-hole in the bottom of the case. There also is a Reset connector next to SW1 that can be used to wire up an external Reset Switch.

During normal power up and operation, the sensor does not require the Reset Button.

The Reset Button has spring formed legs. It can be inserted into the PCB and will stay in place with soldering for testing purposes if you have not decided on top or bottom placement or want to try both before permanent soldering the button in place.

19. MOUNT THE PCB IN THE CASE

[Approximately 15 minutes]

Mount the PCB in the case.

Connect the Transformer Jack assembly's plug to J7.

Connect the RS232 wires to the RS232-1 header pins.

Wire from DB9 # 5 connects to RS232-1 Header Pin #1

Wire from DB9 # 3 connects to RS232-1 Header Pin #2

Wire from DB9 # 2 connects to RS232-1 Header Pin #3

20. THE PMU IS NOW READY FOR USE

[Approximately 30 minutes]

Put your tools away and clean up the mess you made!