MC-20A-1 DC Buss Monitor and Control

13.8 VDC at 30 Amps

MC-20A-1 DC Buss Monitor and Control
Schematic
Assembly Drawings
Specifications
Operation

MC-20A-1 DC Buss Monitor and Control

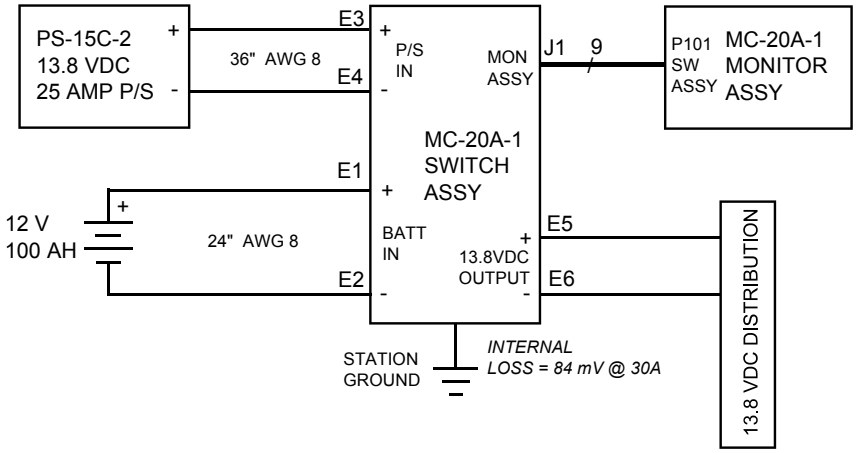
Applications

- Designed specifically for use in an unattended 13.8 VDC battery back-up power system providing float charging of a secondary battery and fault protection for connected equipment. Intended to be used with the PS-15C power supply charger series, or equivalent and a 100 Ah lead-acid battery.
- Provides remote monitor and control functions:
  Input Voltage
  Buss Voltage
  Buss Current
  Buss Status
  Buss ON/OFF Switch
- Fused battery and power supply inputs - able to withstand 1000 Amp fault current.
- Surge and RFI/EMI protection included.
- Earth ground connection for station grounding provided.
- Low voltage disconnect to protect battery from damaging discharge levels.
- Over voltage disconnect (Not Crow-Bar) to protect equipment - note battery protection is limited to fuse protection of excessive current.

Specifications

Parameter	Value	Notes
Operating Voltage	13.80 VDC	Nominal
Over Voltage Shut down	15.00 VDC	+/- 0.25 VDC
Under Voltage Disconnect	10.25 VDC	+/- 0.25 VDC
Output Current	30 Amps	Continuous Buss Current
Peak Output Current	50 Amps	< 60% duty cycle
Max Output Current	55 Amps	Fuse limited
Max Fault Condition Current	1000 Amps	< 100 mS
Internal Voltage Drop	< 250 mV	30 Amp Output Current

MC-20A-1 DC Monitor and Control



Applications.

The above application provides 30 Amp continuous current to a station distribution system from a 100 Ah Marine type deep cycle lead-acid battery. Float charging from an external PS-15C type 25 Amp power supply allows 100% duty cycle below 25 Amps (except for deep recovery period after a battery discharge event). 30 Amp load current can be supplied at 70% or less duty cycle and intermittent currents to 50 Amps can be supplied, but should be kept to short durations.

Cautions.

1. Limit initial charge current to the battery manufacturer's specification. This may require limiting the 25 Amp P/S output.
2. Do not parallel batteries with this application.
3. Adhere to wiring information for battery, power supply and load connections to and from the MC-20A as follows:

Interconnect Wiring Requirements			
Connection	Wire Length	Wire Size	Notes
Battery	20" to 32"	AWG 8	Fault condition limited
Power Supply	24" to 42"	AWG 8	
Load	12" to 48"	AWG 8	Recommended to minimize voltage drop to distribution
If other wire sizes and/or lengths are used, ensure the fault current is limited to < 1000 Amps based on the internal battery resistance plus 3.0 mΩ internal resistance of the MC-20A plus the interconnecting wiring resistance.			

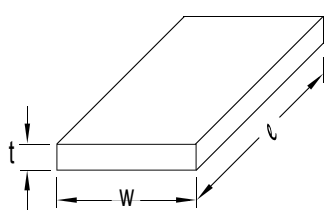
Wire and Conductor Resistance T = 25 °C	
Wire Type	Resistance
AWG 8	0.7 mΩ per foot
AWG 4	0.27 mΩ per foot

Resistance of flat copper conductor.

$R = \rho (\ell / A)$ ℓ = length, A = area both in same units as constant used, where

$\rho = 1.724\ \Omega\text{-cm} \times 10^{-6}$ or $0.6787\ \Omega\text{-in} \times 10^{-6}$

$A = t \times w$



Operation

The Monitor assembly measures the input voltage (battery and power supply), DC Buss voltage and DC Buss current. Input voltage is measured at the battery input so that when F1 and F2 are good the measured voltage will be equal to the power supply voltage (nominally 13.8 VDC) unless in the initial charge of a deeply discharged battery.

In the case where either fuse is blown the voltage will be that of the battery and will typically be between 10.5 VDC and 13.0 VDC depending upon the load current and charge level of the battery.

If the DC Buss voltage is 0 VDC when the input is > 12.25 VDC, then F2 is blown or if less than ~ 13.6 VDC when the AC power supply is on, then F1 is blown.

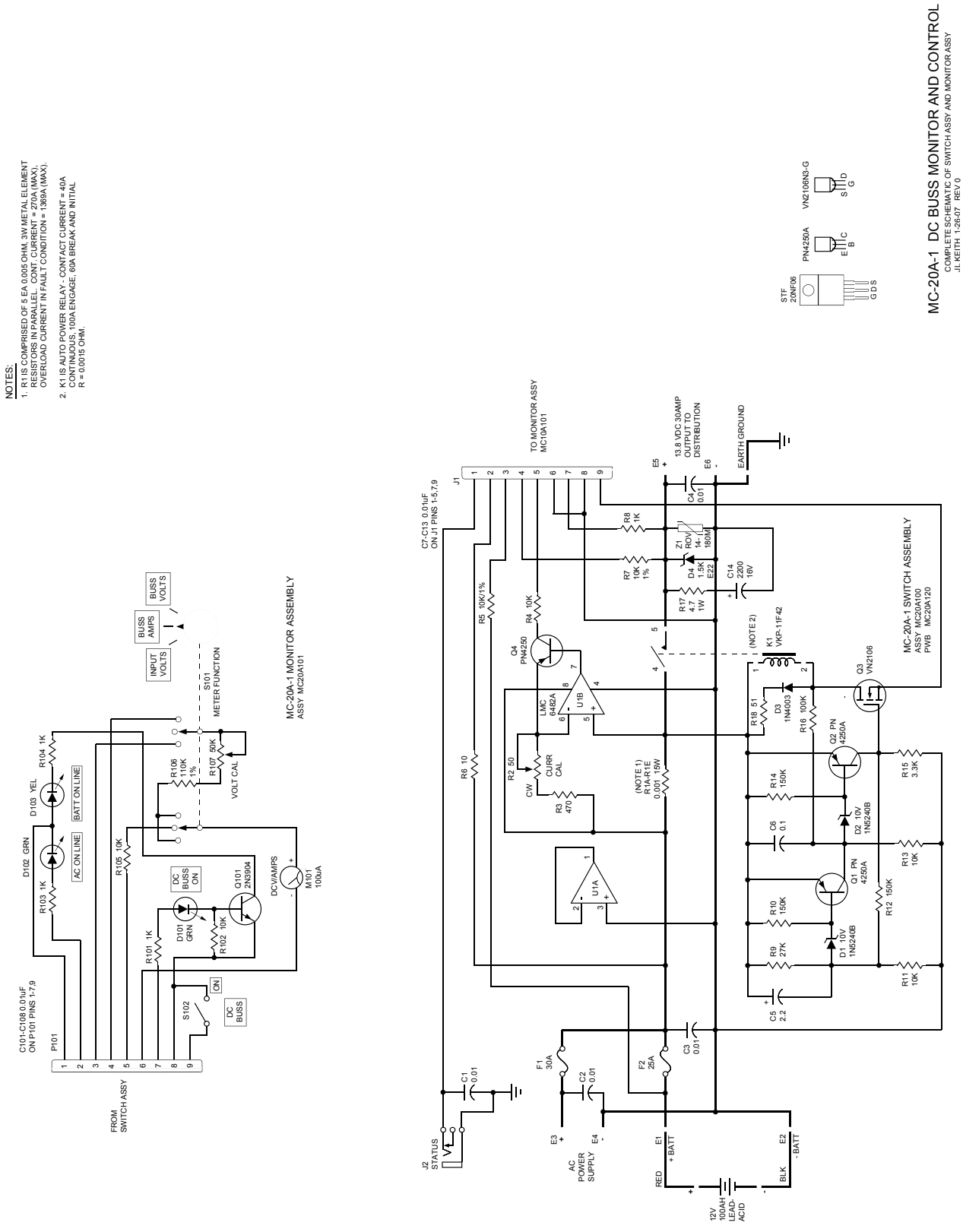
When AC power is lost, both input and DC Buss voltage will drop as the battery discharges to ~ 10.25 VDC at which point the DC output Buss will be disconnected. "INPUT VOLTAGE" will still show the battery voltage.

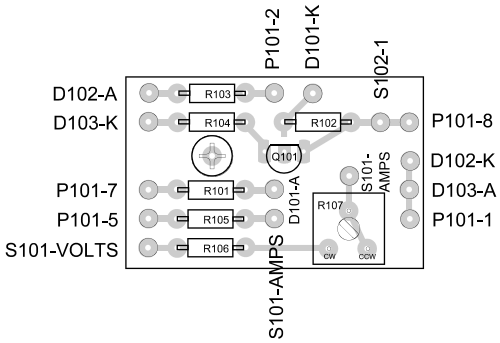
The "STATUS" LEDs will show the battery is on line until an under voltage disconnect occurs. When AC power is restored, "AC ON LINE" will light regardless of DC Buss on/off status. The "STATUS INPUT" must be provided by the AC power supply independent of its' output voltage. When AC power is on, the line must be < 100Ω to ground (power supply negative terminal) and when AC power is off, the line must be < 100Ω to +13.8 VDC output terminal.

The DC Buss On/Off switch on the monitor assembly is remotely connected to the Switch Assembly via the 9 pin submin D connector and enables the power relay to operate under the control of the voltage monitor circuit.

If the MC-20A is used without a battery and a fault occurs that pulls the AC power supply below 10.25 VDC (low voltage drop out point) power cycling will occur as the load and the MC-20A alternately connect and disconnect. If operation without a battery is intended, a jumper should be connected across D2 in the Switch Assembly to disconnect the under voltage detector, thus eliminating this mode of operation.

MC-20A-1 DC Monitor and Control

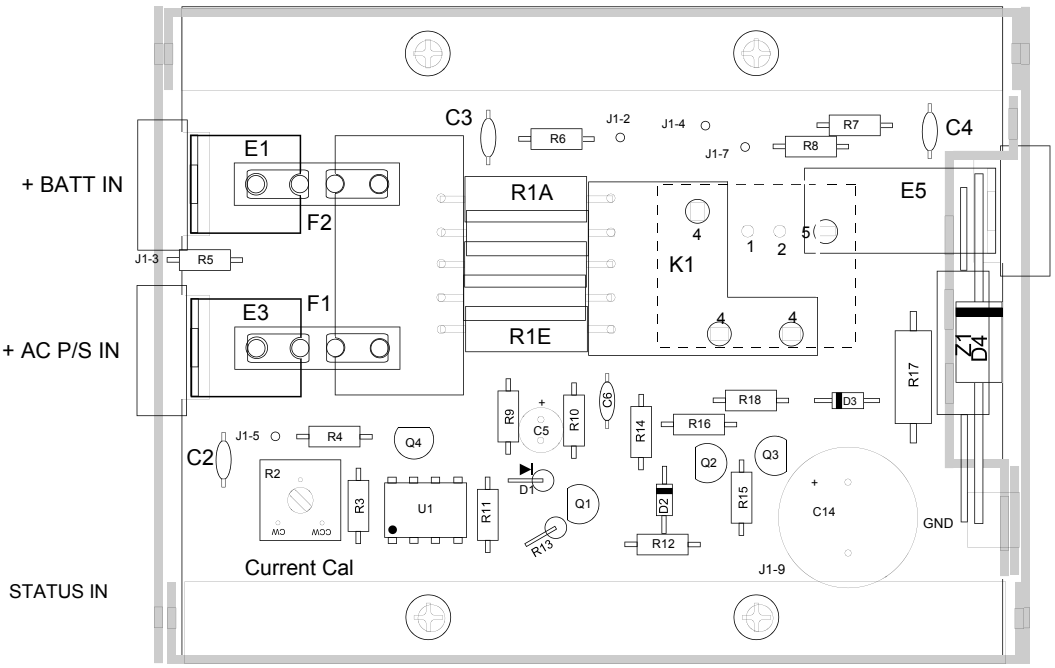




Monitor Assembly PWB

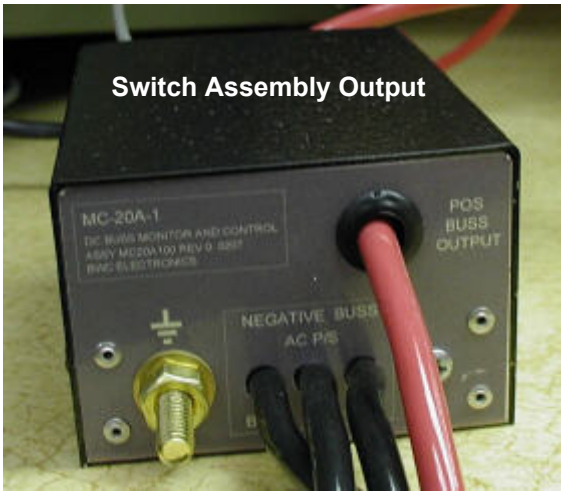
FUSE CLIPS SOLDERED TO 0.040 CU STRAPS ON BOTTOM SIDE OF PWB

RELAY TERMINALS SOLDERED TO 0.040 CU STRAPS ON BOTTOM SIDE OF PWB)



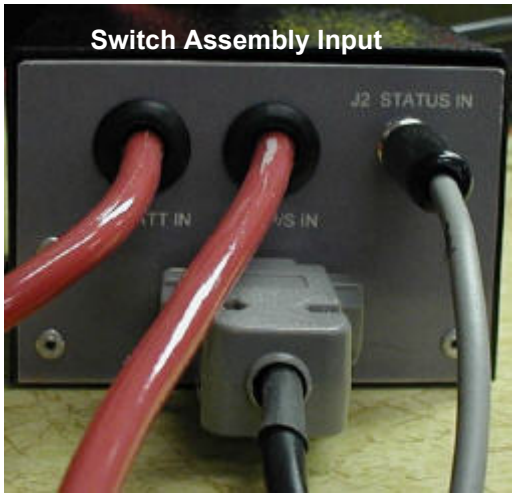
Switch Assembly PWB

MC-20A-1 DC Monitor and Control



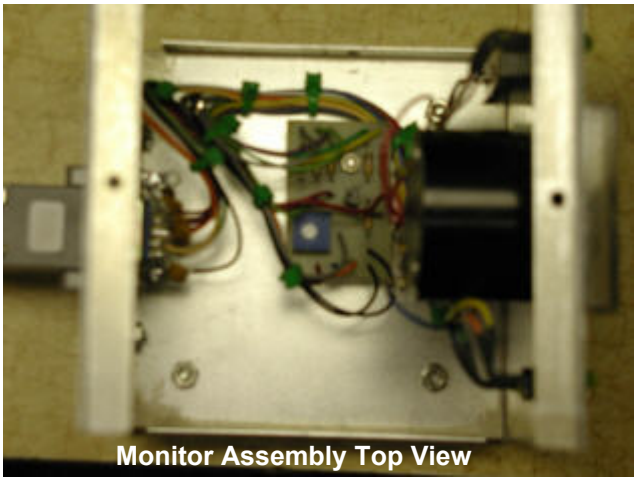
Switch Assembly Output

Monitor Assembly Front



Switch Assembly Input

Monitor Assembly Rear Panel


Monitor Assembly Top View

Switch Assembly Top View

Supplier is Mouser unless otherwise noted. Mous = Mouser, Digi = Digi-Key

Material List

MC-20A-1 MC20A100 Switch Assembly

Qty	Designator	Value/Type	Description	Part Number	Sup-plier
11	C1-4,7-13	0.01uF, 50V	Ceramic disk Z5U	140-50Z2-103M-RC	
1	C5	2.2uF, 25V	Aluminum	647-UVR1H2R2MDD	
1	C6	0.1uF, 50V	MLC Ceramic	80-C320C104K5R5TA	
1	C14	4700uF, 16V	Aluminum	140-XRL16V4700	
2	D1,2	1N5240B	10V, 0.5 W	512-1N5240B	
1	D3	1N4007	1A, 1KV Silicon rect	821-1N4007	
1	D4	1.5KE22	18V, 1.5KW TVS	576-1.5KE22	
1	F1	ATO-30	30A ATO Blade fuse	576-0257030.PXPV	
1	F2	ATO-25	25A ATO Blade fuse	576-0257025.PXV	
1	J1	9C SUB-D recpt	9 Pin submin D conn	156-1309	
1	J2	3.5mm Open Ckt	Chassis mtg jack	16PJ135	
1	K1	VKP-11F42	12V, 40A SPST Relay	655-VKP-11F42	
3	Q1,2,4	PN4250A	Small signal PNP	512-PN4250A	
1	Q3	VN2106N3-G	60V, 1W, N-Ch FET	689-VN2106N3-G	
5	R1	0.005 Ω, 3 W, 5%	Metal element	66-LOB3R005JLF	
1	R2	50 Ω, 0.25 W, 5%	3/8" Cermet variable	652-3386F-1-500LF	
1	R3	470, 0.25 W, 5%	Carbon Film	291-470-RC	
3	R4,11,13	10K, 0.25 W, 5%	Carbon Film	291-10K-RC	
2	R5,7	10K, 0.25 W, 1%	Metal Film	271-10K-RC	
1	R6	10, 0.25 W, 5%	Carbon Film	291-10-RC	
1	R8	1K, 0.25W, 5%	Carbon Film	291-1K-RC	
1	R9	27K, 0.25 W, 5%	Carbon Film	291-27K-RC	
3	R10,12,14	150K, 0.25 W, 5%	Carbon Film	291-150K-RC	
1	R15	3.3K, 0.25 W, 5%	Carbon Film	291-3.3K-RC	
1	R16	62K, 0.25 W, 5%	Carbon Film	291-62K-RC	
1	R17	4.7 Ω, 1 W, 5%	Carbon Film	294-4.7-RC	
1	R18	51, 0.25 W, 5%	Carbon Film	291-51-RC	
1	U1	LMC 6482A	Dual FET Op Amp	LMC6482AIN-ND	Dig
1	Z1	ROV14-180M	18V MOV	650-ROV14-180M	

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Material List

MC-20A-1 MC20A101 Monitor Assembly

Qty	Designator	Value/Type	Description	Part Number	Sup-plier
7	C101-107	0.01uF, 50V	Ceramic disk Z5U	140-50Z2-103M-RC	
2	D101,102	WP7113SGD	GRN DIFF LED	604-WP7113SGD	
1	D103	WP7113SYD	YEL DIFF LED	604-WP7113SYD	
1	M101	100uA, 4.7K	Panel meter		
1	P101	9C SUB-D recpt	9 Pin submin D conn	156-1209	
1	Q101	2N3904	Small Sig NPN	863-2N3904G	
3	R101,103, 104	1K, 0.25W, 5%	Carbon Film	291-1K-RC	
2	R102, 105	10K, 0.25 W, 5%	Carbon Film	291-10K-RC	
1	R106	110K, 0.25 W, 1%	Metal Film	271-110K-RC	
1	R107	50K, 0.25 W, 5%	3/8" Cermet variable	652-3386F-1-503LF	
1	S101	2P, 3POS	Rotary Switch	105-SR2512F-43NS	
1	S102	SPST	Mini Rocker Sw	642-FMC12A220	

Test Notes

Measurements, calibration and notes on my prototype tested 2-13-07.

Load Test with Battery connected			
Time	Buss Voltage (VDC)	Relay coil Temperature (°C)	Notes
10:32	12.80	-	Battery at approximately 90% charge initially
10:33	11.18	-	20 Amp Load Current
10:46	11.10	-	
10:53	11.20	54.4	
11:14	11.12	54.7	41 Minutes at 20 Amp Load
11:15	11.90		Remove Load after 14 Ah drain
11:17	12.06		
16:20		57.5	Coil temperature after 5 hours no-load coil-on
Coil = 93 Ω @ 13.8 V = 148 mA and P_D = 2.05 W for 15.9 °C / W temperature rise Contact drop at 30A = 27 mV for 0.9 mΩ contact resistance producing another 0.81 W			

Disconnect and Reconnect Voltages			
Low Voltage		Over Voltage	
Disconnect	Reconnect	Disconnect	Reconnect
10.46	11.40	14.88	13.92

Input to Output Voltage Drop				
Load Current (Amps)	Input Voltage (VDC)	Output Voltage (VDC)	Voltage Drop (VDC)	Resistance (Ω)
0	13.80	13.80	0	-
10	13.80	13.73	0.07	0.007
20	13.48	13.32	0.16	0.008

ATO Auto Blade Fuses				
Style	Size (A)	Resistance (Ohms)	Voltage Drop (mV)	P_D @ Rated Current (W)
Maxi	40	0.0016	64	2.56
Std	30	0.0024	72	2.16
Std	25	0.0027	67.5	1.69

NOTES:

Additional testing needs to be done - the voltage drop measurements where not made differentially and appear to be higher than design calculations indicate they should be. Suspect measurement error that could be corrected by differential measurement.