

MAINTENANCE MANUAL  
FOR  
POWER MODULE  
19D902589G2

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DESCRIPTION

The Power Module 19D902589G2 contains switching power supplies for the +12 and -12 volt supplies, and a switching power supply for the +5 volt digital supply. The outputs of the +12 volt and -12 volt supplies are regulated to provide +5 volt and -5 volt outputs. A filtered A+ output is also provided.

The Power Module is powered from the 13.8 volt Station Power Supply output. Power is distributed to the T/R Shelf modules through the Backplane Board.

Due to the high current switching components, both EMI and RFI shielding are provided by a zinc diecast cover.

FILTERED A+	at	1550 mA
REGULATED +12V	at	350 mA
REGULATED -12V	at	150 mA
REGULATED -5V	at	40 mA
ANALOG +5V	at	40 mA
DIGITAL +5V	at	1000 mA

FILTERED A+

Filtered A+ is generated by coupling the input voltage (A+) through an LC filter network consisting of C8, C9, C18 and L4. The filter network filters out any low frequency hum and isolates the audio circuits from the noise on A+. Coil L6 is used to keep digital noise from getting back onto A+.

CIRCUIT ANALYSIS

The Power Module connects to 96-pin DIN connector J9 on the Backplane Board. The Power Module provides all operating voltages for the T/R Shelf, and operates from the station power supply A+. The Power Module is designed to operate over an input voltage range of 10.8 to 16.2 volts, and provides the following outputs:

REGULATED +12V

The regulated +12 volts supply consists of two sections; a switching regulator and a 12 volt linear regulator. If the input voltage is below 13.6 volts, the step-up switching regulator increases the voltage level before the voltage is applied to the linear regulator.

The step-up switching regulator U5, is built around a Motorola MC34063 regulator. This IC is a switching power supply building block with an internal reference, comparators, switch transistors, current limiting, and start-up circuitry. Capacitor C12 controls the maximum ON time, and the value is selected to reduce ripple.

Resistor R16 is used for current limiting. The regulator's filter section consists of L1, D2 and C19. Resistor R7 and R8 sense the regulator output voltage by forming a voltage divider on the regulator's sense pin. Resistor R2 biases a transistor inside the regulator. Capacitor C14 makes sure the regulator can pull its instantaneous load. A high frequency filter formed by FL1 and C6 reduces output noise.

Finally, the 13.6 volt power is regulated down to 12 volts by the linear regulator U2 (LM7812). The linear regulator also controls some of the ripple that comes out of the switching supply.

When the input voltage is above fourteen volts the sense voltage to the switching regulator is above the IC's turn on level. This keeps the switching transistor off. The switching regulator is effectively out of the circuit. The input voltage goes through L1, D2 and FL1 to regulator U2 (LM7812). Regulator U2 will hold the input to 12 volts.

## **REGULATED -12V**

The -12 volt regulator U6, starts with another MC34063 regulator wired as a voltage inverting switcher. Resistor R17 provides the current sense. Parts L3, D3 and C17 provide the filtering. The voltage is set with R9 and R10. Note that the voltage on the divider is 1.25 volts above (-13.6 volts) the output voltage. The switching frequency is set with C10.

The output voltage on the switching regulator U1, is about -13.6 volts. It is brought up to -12 volts by a linear regulator U8 (LM7912). U8 also reduces ripple from the switching supply.

## **REGULATED -5V**

The -5 volt supply is generated by further regulating the -12 volt supply to -5 volts using regulator U1 (LM79L05). Capacitors C1, C16 and C20 provide filtering. D4, a Schottky diode, is used to limit any positive excursion of the supply during power-up. This helps prevent some CMOS parts from latching up.

## **ANALOG +5V**

This is low current regulated +5 volt supply. It is generated by further regulating the +12 volt supply by an LM78L05 (U7) regulator. Capacitors C21 and C22 provide filtering.

## **DIGITAL +5V**

This supply is the main power for the station's logic. The heart of the system is U4, and MC34063 switching regulator in a step down configuration. R15 provides a current limit. U4 has an internal temperature compensated reference, a voltage comparator that controls a variable duty oscillator, and a transistor switch. Capacitor C11 controls the maximum ON time, and the value is selected to reduce ripple.

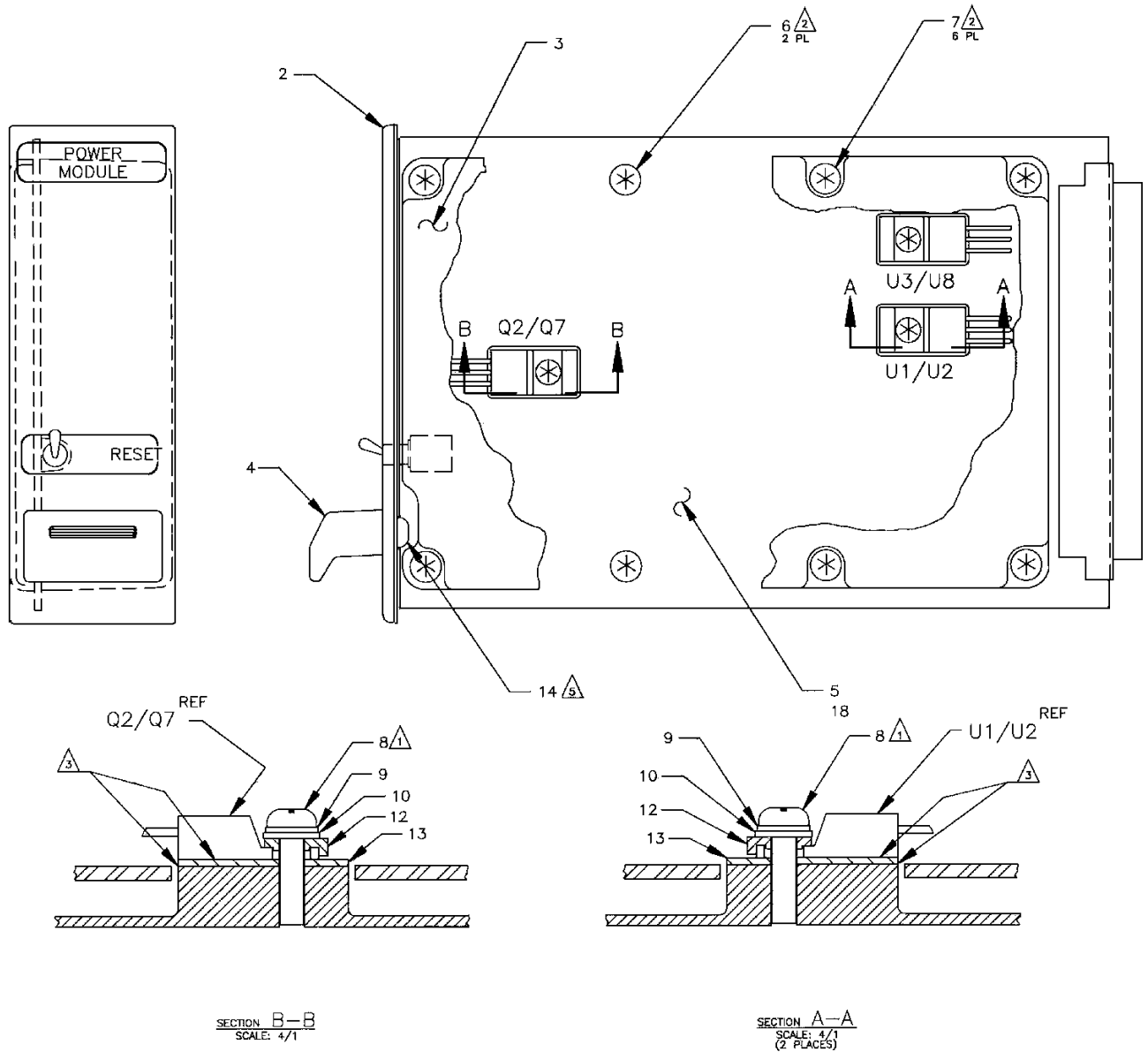
An external power FET switch, Q2, is used because the current requirements exceed the chip's internal switch capabilities. Resistor R1 provides a pull-up on the open collector nature of the internal switch. Filtering is provided by D1, L2, C2 and C3. The voltage is set by R5 and R6. It is purposely set on the high side to allow for the drop through the filter formed by L5 and C23.

## **RESET SWITCH**

The system reset switch is mounted on the power module. It is a momentary closure to ground. Provision for a pull-up resistor to 5 volts (R3) is also provided.



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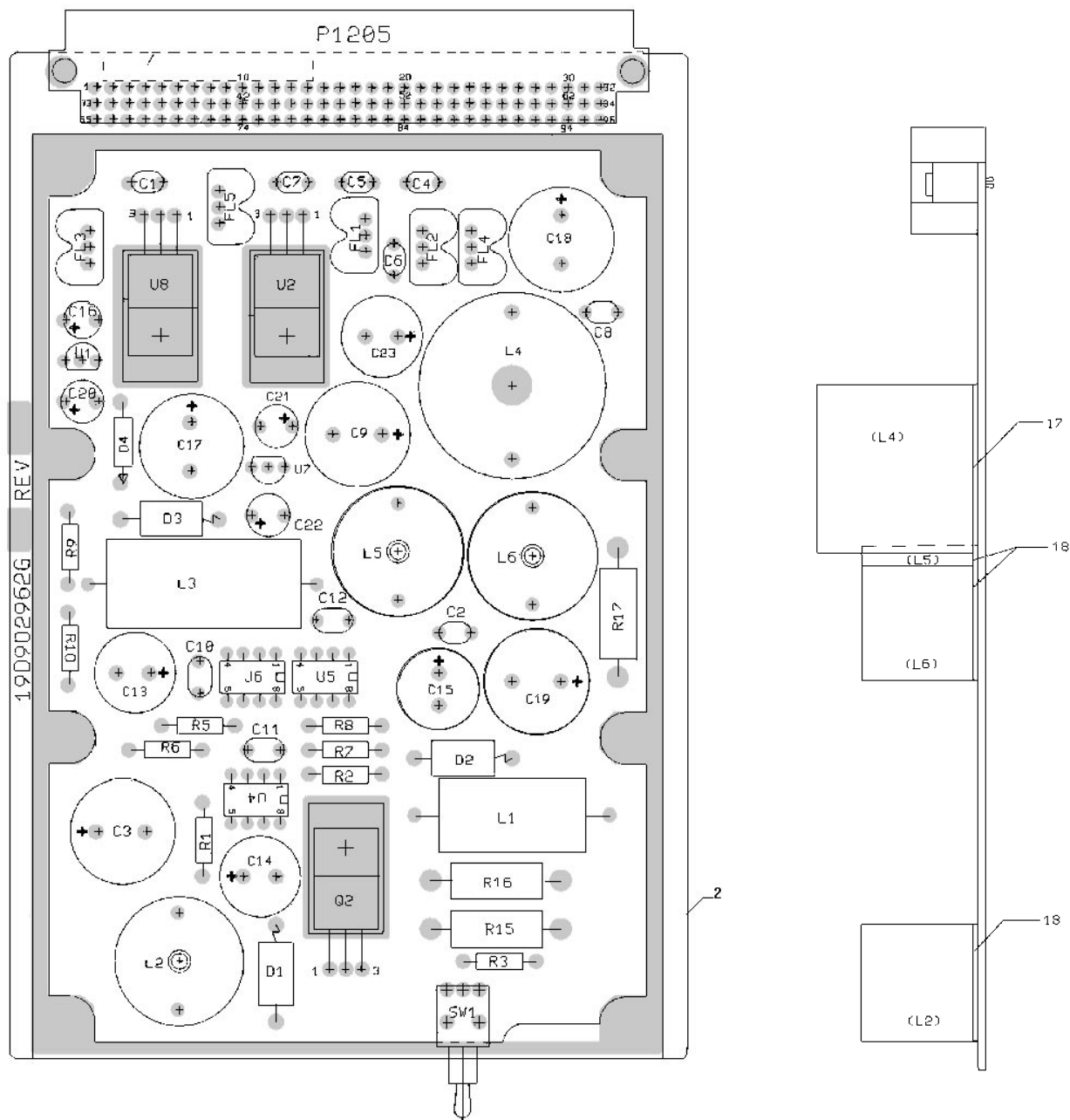
NOTES:

- 1** TORQUE SCREW, ITEM 8 TO  $2.5 \pm 0.5$  INCH POUNDS.
- 2** TORQUE SCREWS, ITEMS 6 & 7 TO  $15.5 \pm 1.3$  in.-lbs.
- 3** APPLY INSULATOR, ITEM 13, TO CONTACT FACES.
- 5** TORQUE SCREW, ITEM 14 TO  $20 \pm 1.3$  in.-lbs.

**POWER MODULE**  
19D902589G2

(19D902589, Sh. 1, Rev. 5)

## COMPONENT SIDE



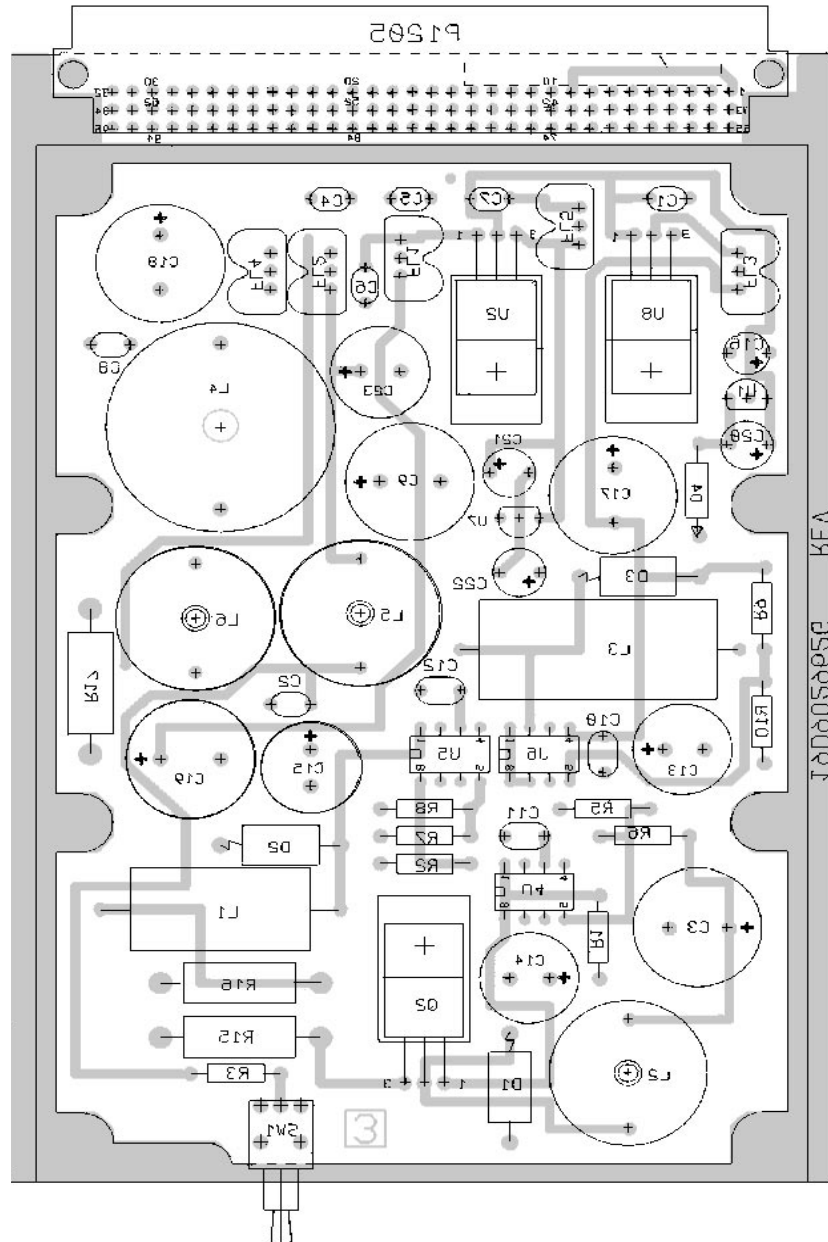
(19D902962, Sh. 1, Rev. 3)  
 (19D902961, Component Side, Rev. 3)

**POWER MODULE BOARD**  
 19D902962G1



**CAUTION**  
 OBSERVE PRECAUTIONS  
 FOR HANDLING  
 ELECTROSTATIC  
 SENSITIVE  
 DEVICES

SOLDER SIDE



(19D902962, Sh. 1, Rev. 3)  
(19D902961, Solder Side, Rev. 3)

**POWER MODULE BOARD**

19D902962G1

**POWER MODULE  
19D902589G2  
ISSUE 1**

SYMBOL	PART NUMBER	DESCRIPTION
2	19D902485P2	Chassis.
3	19D902486P2	Cover.
4	19D902555P1	Handle.
6	19D702381P506	Screw, thread forming: TORX, No. M3.5 - 0.6 x 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 x 13.
8	19A702364P208	Machine screw: TORX, Drive M2.5 - 0.45 x 8.
9	19A700032P3	Lockwasher, tooth, steel, metric: 2.5.
10	19A701312P3	Flatwasher, metric: No. 2.5MM.
11	N210P9B6	Nut, machine.
12	19A700068P1	Insulator, bushing.
13	19A705469P1	Insulator Plate, T0-220.
14	19A702381P508	Screw, thd. form: No. 3.5 - 0.6 x 8.
17	19B235310P1	Nameplate.
18	19D902962G1	Power Supply Board (see below).
<p align="center"><b>POWER SUPPLY BOARD 19D902962G1</b></p> <p align="center">— — — — CAPACITORS — — — —</p>		
C1 and C2	19A700121P106	Ceramic: 0.1 $\mu$ F $\pm$ 20%, 50 VDCW.
C3	19A701225P5	Electrolytic: 680 $\mu$ F, -10 +50%, 35 VDCW.
C4 thru C8	19A700121P106	Ceramic: 0.1 $\mu$ F $\pm$ 20%, 50 VDCW.
C9	19A701225P5	Electrolytic: 680 $\mu$ F, -10 +50%, 35 VDCW.
C10 thru C12	19A700233P3	Ceramic: 220 pF $\pm$ 20%, 50 VDCW.
C13 thru C15	19A701225P4	Electrolytic: 330 $\mu$ F, $\pm$ 10%, 25 VDCW.
C16	19A701534P8	Tantalum: 22 $\mu$ F, $\pm$ 20%, 16 VDCW.
C17 thru C19	19A701225P5	Electrolytic: 680 $\mu$ F, -10 +50%, 35 VDCW.
C20	19A701534P9	Tantalum: 47 $\mu$ F, $\pm$ 20%, 6.3 VDCW.
C21	19A701534P8	Tantalum: 47 $\mu$ F, $\pm$ 20%, 16 VDCW.
C22	19A701534P9	Tantalum: 47 $\mu$ F, $\pm$ 20%, 6.3 VDCW.
C23	19A701225P8	Electrolytic: 470 $\mu$ F, -10 +75%, 16 VDCW; sim to Sprague 5002D477-G016DGIC.
<p align="center">— — — — DIODES — — — —</p>		
D1 thru D3	19A702977P1	Diode, silicon, SCHOTTKY; sim to IN5822.
D4	19A134134P2	Rectifier, silicon; sim to Motorola 1N5818.
<p align="center">— — — — FILTERS — — — —</p>		
FL1 thru FL5	19A705217P1	Filter, EMI Suppression.

SYMBOL	PART NUMBER	DESCRIPTION
L5 and L6	19A149806P1	Reactor: 100 $\mu$ H $\pm$ 10 @ 4.0 amps.
<p align="center">— — — — PLUGS — — — —</p>		
J1	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
<p align="center">— — — — TRANSISTORS — — — —</p>		
Q2	19A705325P1	MOSFET, P-Channel; sim to Seimens BUZ171. (Part of Power Module Assembly 19D902589.)
<p align="center">— — — — RESISTORS — — — —</p>		
R1	H212CRP210C	Deposited carbon: 1K ohms $\pm$ 5%, 1/4 w.
R2	H212CRP127C	Deposited carbon: 270 ohms $\pm$ 5%, 1/4 w.
R3	H212CRP310C	Deposited carbon: 10K ohms $\pm$ 5%, 1/4 w.
R5	19A701250P209	Metal Film: 1.21K ohms $\pm$ 1%, 1/4 w.
R6	19A701250P257	Metal Film: 3.83K ohms $\pm$ 1%, 1/4 w.
R7	19A701250P335	Metal Film: 22.6K ohms $\pm$ 1%, 1/4 w.
R8 and R9	19A701250P232	Metal Film: 2100 ohms $\pm$ 1%, 250 VDCW, 1/4 w.
R10	19A701250P332	Metal Film: 21K ohms $\pm$ 1%, 1/4 w.
R15	19A700050P1	Wirewound: 0.1 ohms $\pm$ 10%, 2 w.
R16	19A700050P6	Wirewound: 0.27 ohms $\pm$ 10%, 2 w.
R17	19A700050P1	Wirewound: 0.1 ohms $\pm$ 10%, 2 w.
<p align="center">— — — — SWITCHES — — — —</p>		
SW1	19A705959P4	Switch, toggle.
<p align="center">— — INTEGRATED CIRCUITS — —</p>		
U1	19A704971P5	Linear: -5 Volt Regulator; sim to MC79L05ACP.
U2	19A134717P2	Linear: -12 Volt Regulator; sim to MC7812CT. (Part of Power Module Assembly 19D902589.)
U4 thru C6	19A705941P1	Linear: DC to DC Converter; sim to MC34063.
U7	19A704971P1	Linear: +5 Volt Regulator; sim to MC78L05ACP.
U8	19A134718P2	Linear: -12 Volt Regulator; sim to uA7912U. (Part of Power Module Assembly 19D902589.)

**PRODUCTION CHANGES**

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter" which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

**REV. A - Power Supply Board, 19D902962G1.**

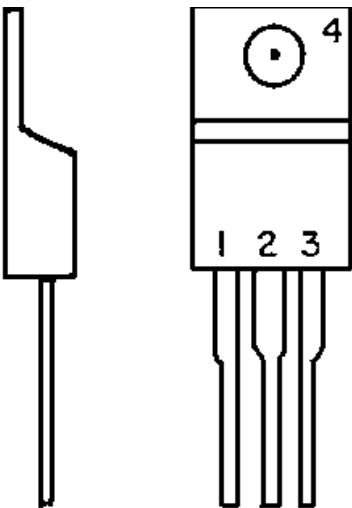
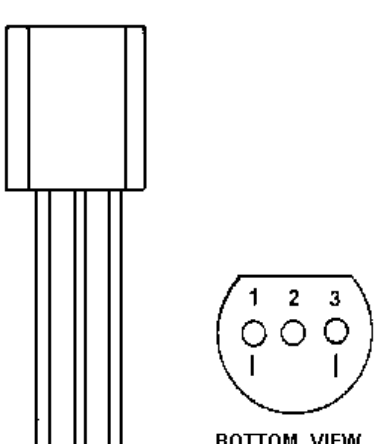
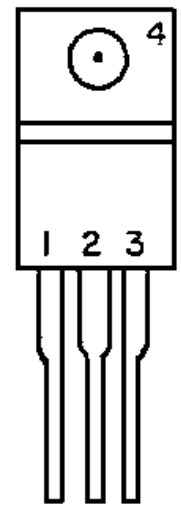
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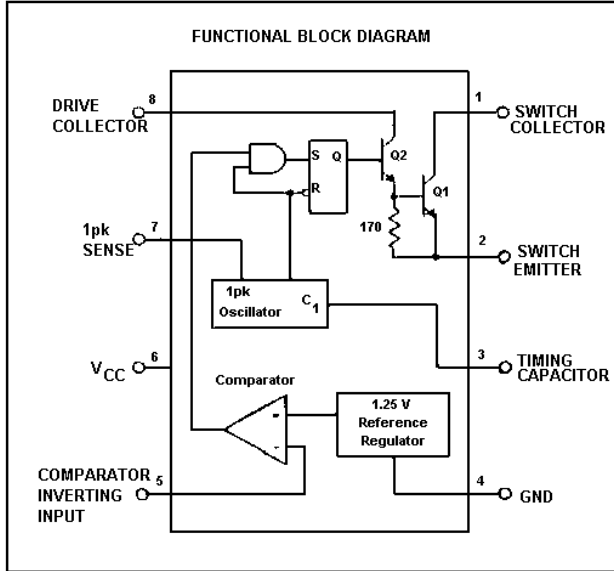
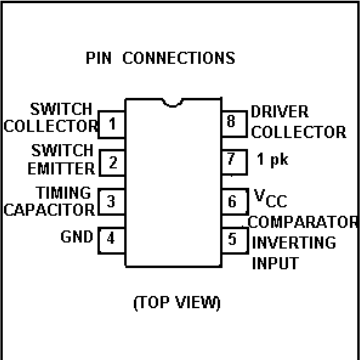
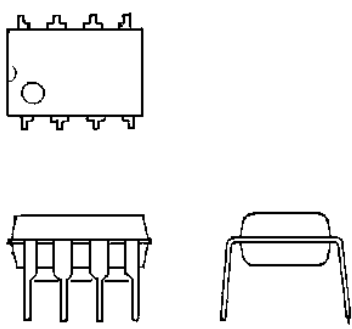
**REV. B - Power Supply Board, 19D902962G1.**

To reduce power supply noise, changed R7.  
R7 was 19A701250P332, 21k ohms.

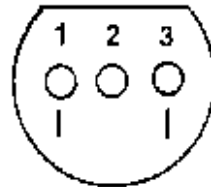
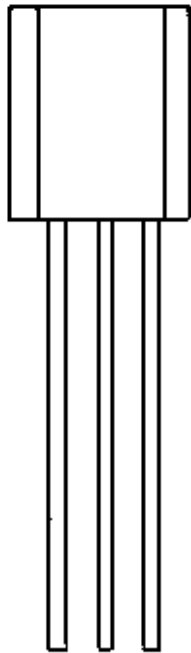
\* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



 <p>PIN 1. GATE 2. DRAIN 3. SOURCE 4. DRAIN</p> <p><b>Q2</b> <b>MOSFET</b> <b>19A705325P1</b></p>	 <p><b>U1</b> <b>-5 VOLT REGULATOR</b> <b>19A704971P5</b></p>	 <p><b>U2</b> <b>+12 VOLT REGULATOR</b> <b>19A134717P2</b></p>
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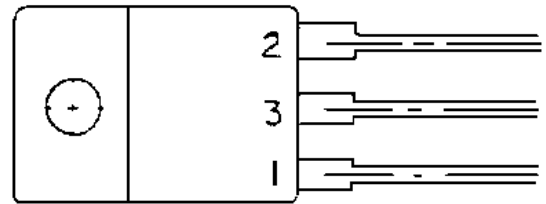
<p><b>FUNCTIONAL BLOCK DIAGRAM</b></p>  <p><b>U4, U5, U6</b> <b>DC TO DC CONVERTER</b> <b>19A705941P1</b></p>	<p><b>PIN CONNECTIONS</b></p>  <p>(TOP VIEW)</p> 
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**BOTTOM VIEW****PIN IDENTIFICATION**

PIN 1. OUTPUT  
PIN 2. GROUND  
PIN 3. INPUT

**U7**  
**+5 VOLT REGULATOR**  
**19A704971P1**



1. COMMON  
2. OUTPUT  
3. INPUT

**U8**  
**-12 VOLT REGULATOR**  
**19A13478P2**