

# DESK TOP and WALL MOUNT STATION INTERCONNECT BOARD 188D5418G

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# 1 DESCRIPTION

The Interconnect Board 188D5418G1 enables you to integrate the JAGUAR™ and Orion™ mobile radio into a Desktop or Wall Mount Station. The Interconnect Board provides connections to the station power supply, station speaker, control panel, station fan, external options terminal board, the optional Keypad/Frequency Select board, the Tone Remote Interface Board, and the Clock VU Meter board. Four jumpers on the board to provide correct routing of signals.

When the radio and options are connected, the following functions are available.

- Audio Switching
- Local and Remote Keying
- Channel Guard Monitor
- Volume Adjustment
- Frequency Selection
- Intercom
- Remote ON/OFF Control

The interconnect board is supplied with jacks for connecting to:

- External Options (J200)
- Desk Top Mic (J201)
- Radio (J202, J215)
- Clock/VU Module, Optional (J203)
- Remote Interface Option (J204, J205)
- Power Supply, or Standby Power Transfer Option (J206)
- Keypad/Freq, Select Board, Option (J207, J208)
- Data Options (J209, J210)
- Station Speaker/Power LED (J211)
- Station Fan (J212)
- Station Fan Test (J213)
- VU Meter Enable (J214)
- JAGUAR/Orion RS485 Devices (J216)
- Radio Type Configuration Jumpers (J217-J220)

## CREDITS

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## 2 CIRCUIT ANALYSIS

### 2.1 TRANSMIT AUDIO PATH

The desktop microphone audio modulates the radio transmitter. The audio is received as **DESK TOP MIC HI** on J201-2. The audio is then routed to the External Option Connector J200-2 and returns to the Interconnect Board on J200-3 as **SW DESK TOP MIC HI** (as shown in Figure 1). This allows an external device to break the microphone audio path. A zero ohm resistor, R207, connects the **DESK TOP MIC HI** to the **SW DESK TOP MIC HI** line when an external device is not used to break the microphone audio path.

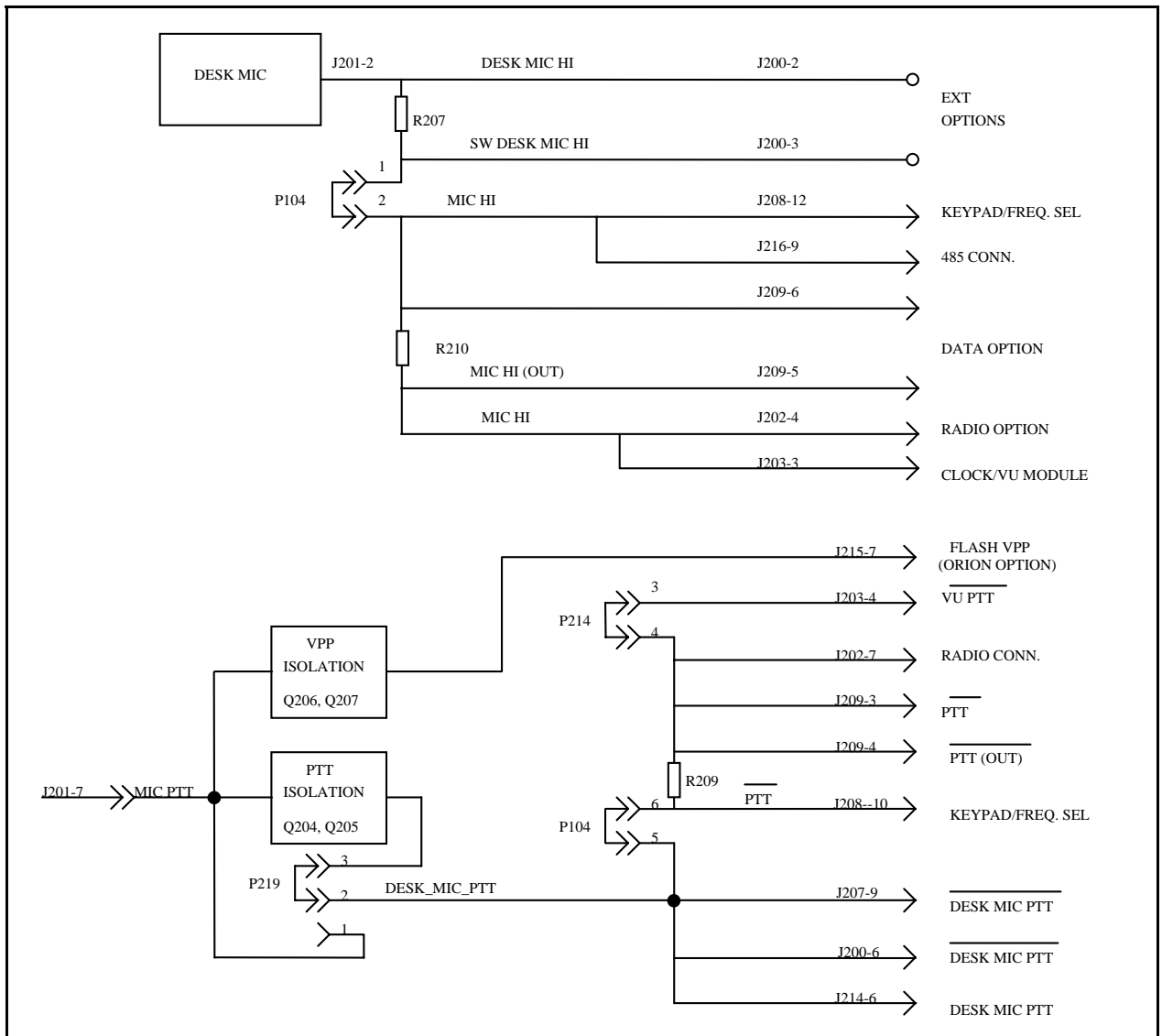


Figure 1: MIC HTT and PTT Routing

The **SW DESK MIC HI** audio is then routed to the Remote Interface Board connector J204-1. If a Remote Interface Board (optional) is present, the transmit audio from the Remote Board is summed with

the microphone audio and returns to the Interconnect Board as **MIC HI** via connector J204-2. When the Remote Interface Board is not used, the **DESK MIC HI** is connected to **MIC HI** by a jumper on P104-1 and 2.



**NOTE**

When no Remote interface Board is used, a jumper block, P104, is plugged into J204.

P104 JUMPER BLOCK CONNECTIONS	
Pin 1 to Pin 2	(SW DESK MIC HI to MIC HI)
Pin 3 to Pin 4	(DESK MIC LO to MIC LO)
Pin 5 to Pin 6	(DESK MIC PTT to PTT)
Pin 7 to Pin 8	(SW SPKR HI to STA SPKR HI)
Pin 9 to Pin 10	(SPKR LO to STA SPKR LO)

The **MIC HI** signal is also routed to the Keypad/Frequency Select Board on J208-12 and to the JAGUAR/Orion RS-485 connector at J216-9. This allows an external RS-485 device to provide the transmit audio. The **MIC HI** signal is also routed to the data device connector on J209-6 and returned from the data device at J209-5. This allows a data device to break the microphone audio path. A zero ohm resistor R210 connects J209-5 to J209-6 when a data device is not used or when a data device does not break the microphone audio path.

The **MIC HI** signal from the data device is routed to the radio through J202-4 and to the Clock/VU Meter through J203-3.

The desktop microphone supplied with the equipment requires a DC bias voltage. This voltage is generated inside the radio. External devices breaking the microphone path must provide DC continuity between the radio connector (J202-4) and the desktop microphone connector (J201-2) when not active to connect an equivalent microphone bias circuit to the desktop microphone connector.



**NOTE**

There are no active devices or frequency response shaping components in the microphone lines on the Interconnect Board. The return for the microphone lines, **MIC LO**, is not switched. It is common to all connectors that have a microphone input.

## 2.2 PTT PATH

The ground closure, **PTT**, from the desktop microphone is routed to the Interconnect Board as **DESK\_MIC\_PTT** through J201-7 and is labeled **MIC PTT**. Refer to Figure 1.

**MIC PTT** is routed to the **PTT** isolation circuit consisting of two NPN buffer transistors Q204 and Q205. These transistors keep the 12V P-P voltage on the **PTT** line during flashing and personality programming isolated from the +5V PTT line. The **MIC PTT** is routed through Q204 and Q205 and returned as **DESK\_MIC\_PTT** through jumper P219-2 and 3.

The **DESK\_MIC\_PTT** signal is then routed to the External Option connector at J200-6, the Keypad/Frequency Select Board connector at J207-9, the Remote Interface Board connector at J204-5, and to the **VU PTT** jumper field at J214-6. The radio may be keyed with an external device by grounding J200-6. However, it cannot break the **PTT** line. The radio may be keyed with an external device by grounding J200-6. However, it cannot break the **PTT** line. The Keypad/Frequency Select Board uses the **DESK\_MIC\_PTT** signal to recognize when a local transmission is in progress. Connecting the **VU PTT** line to **DESK\_MIC\_PTT** on the J214 jumper field will only enable the VU meter on local transmissions. Jumper definitions for J214 are identified below.

JACK	JUMPER	DESCRIPTION
J214	1 & 2	VUPTT - GND
J214	3 & 4	VUPTT - PTT
J214	5 & 6	VUPTT – DESK MIC PTT

The PTT path is then routed to the Remote Interface Board connector as **DESK\_MIC\_PTT** on J204-5 and returned from the Remote Interface Board connector as **PTT** on J204-6. Remote PTT will be summed into the **PTT** path if there is a remote option. If there is no remote option, **DESK\_MIC\_PTT** will be tied to **PTT** by a jumper from P104-5 and 6. The **PTT** signal is also brought to Keypad/Frequency Select Board at J207-9. The **PTT** signal is then routed to the Data Option connector at J209-4. It is received at J209-3. This allows a data device to break the **PTT** path. If a data option is not used or if a data option does not break the **PTT** path, then a zero ohm resistor R209 is used to connect J209-3 and 4 together to complete the **PTT** path to the radio.

The radio is keyed by its **PTT** line through J202-7. It will transmit when this line is low. The line is also routed to the **VU PTT** via a jumper on J214-4 and 5. When selected, the VU meter is enabled on all transmissions. The radio also contains a 5 volt pull-up resistor. External devices keying the radio should do so with an open collector transistor or by a mechanical closure to ground.

### 2.3 RECEIVE AUDIO PATH

Speaker audio is passed from the radio to the Interconnect Board over three lines: **SPKR LO**, **SPKR HI**, and **SW SPKR HI**. All three lines have DC blocking capacitors. The radios have floating DC coupled push-pull speaker lines. The blocking capacitors allow external devices greater versatility when using the radio's balanced outputs. See Figure 2.

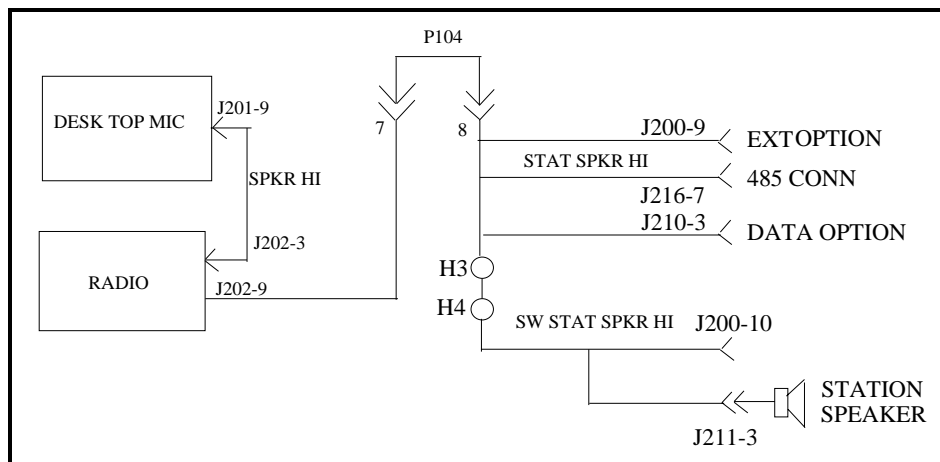


Figure 2: Station Speaker Routing

**SPKR HI** from the radio is routed to the Interconnect Board through connector J202-3 and applied to the desktop microphone connector at J201-9. Its purpose is to drive a low power handset or headset speaker referenced to A-. The complementary **SPKR LO** line is not brought to the microphone connector.

**SPKR LO** from the radio is routed to the Interconnect Board through J202-2 and then to the Remote Interface Board through J204-9. It comes back from the Remote Interface Board through J204-10 as **STA\_SPKR\_LO**. If there is no remote option, then **SPKR LO** is tied to **STA\_SPKR\_LO** by a jumper on P104-9 and 10. This makes **STA\_SPKR\_LO** the floating complementary output of **SW SPKR HI**. When a Remote Interface Board is present, **SPKR LO** and **STA\_SPKR\_LO** are connected to A-. From the Remote Interface Board, **STA\_SPKR\_LO** is routed to the External Option connector on J200-8, the Data Port connector at J210-4, the desk top speaker/power LED connector at J211-4, and to the RS-485 device at J216-8.

**SW SPKR HI** from the radio is received by the Interconnect Board at J202-9 and routed to the Remote Interface Board connector at J204-7. It is returned to the Remote Interface Board as **STA\_SPKR\_HI** on J204-8. If a Remote Interface Board is not present, then **SW SPKR HI** and **STA\_SPKR\_HI** are connected by a jumper on P104-7 and 8. **STA\_SPKR\_HI** is the radio's **SW SPKR HI**. Speaker volume is controlled by the radio volume control. If a remote option is present, the radio's **SW SPKR HI** is routed to the desk top's front panel volume control and **STA\_SPKR\_HI** is the output of the audio amplifier on the Remote Interface Board. The audio amplifier is used to sum the audio from a remote into the speaker path. With this option, the speaker level out of the radio is fixed and the volume control on the radio is not used. Volume is controlled from the front panel control of the desktop station.

**STA\_SPKR\_HI** from the Remote Interface Board connector is then routed to the data connector at J210-3, the RS-485 Device connector at J216-7, and out to the External Device through connector J200-9. It is returned from the External Device as **SW STA SPKR HI** on J200-10. This allows an external device to break the speaker path. A wire run on the PC board between holes H3 and H4 on the Interconnect board connects **STA\_SPKR\_HI** to **SW STA SPKR HI**. If an external device is to break the speaker path, this run must be cut. **SW STA SPKR HI** is applied to the desk top speaker at the Station Speaker/Power Led connector at J211-4.

## 2.4 SERIAL PORT APPLICATIONS

The keypad serial and display serial of the microphone connector pass through a RS-232 converter chip (U202) before connecting to the desktop's keypad serial and display serial lines. The desktop and radio lines are at RS-232 levels. An RS-232 device can be connected to the data port without a TQ3370 box. Jumpers J217, J218 and J220 must be set to put the RS-232 converter chip in the circuit. The lines at the desktop microphone connector are TTL level lines.

Jumper J217 determines if the display serial line at the microphone connection is TTL or RS-232. Jumper J218 determines if the keypad serial line at the microphone connector is TTL or RS-232. J220 connects the radio display serial to the input of the max232 chip.

## 2.5 STATION FAN CONTROL

The Interconnect Board contains a thermistor, R212, which allows the fan to be controlled by ambient temperature. The positive side of the 12 volt DC fan is connected to A+ at J212-1. The negative side is connected to the emitter of PNP transistor Q201 at J212-2. When the station is "cool", the thermistor resistance R212 is high. This equates to a higher voltage at the junction of voltage divider R214 and R211. The voltage divider is formed by R211, R214, and thermistor R212. This holds Q202 and Q203 off, removing ground from the bottom of the voltage divider formed by R201, R202, R203, and R204.

This also keeps Q201 turned off allowing its emitter voltage to rise to A+. The lack of voltage difference across the fan terminals keeps the fan off. This state also includes hysteresis resistor R214 in the upper leg of the thermistor voltage divider.

Increasing temperature causes the resistance of the thermistor to decrease, causing the voltage at the base of Q202 to decrease. Q202 turns off when the station "overheats". This turns on Q203, grounding the lower side of the voltage divider at the base of Q201. Current now flows through these resistors. The resistors in this divider are paralleled to increase the power handling capabilities to allow adequate base drive using chip resistors. The base of Q201 is set to 6 volts. This pulls the emitter down toward 7 volts. (The remaining voltage is dissipated by the transistor, primarily through the collector which is at ground potential.) This voltage differential, now appearing across the fan's terminals, starts the fan and pulls air through the station. Turning Q203 on also moves hysteresis resistor R214 to the lower leg of the voltage divider.

The airflow cools the station, thereby increasing the resistance of the thermistor. Because R214 is now in parallel with the thermistor, the temperature must drop below the fan's turn on threshold point before the voltage is sufficient to turn Q202 on. With Q202 "on" Q203 is turned off, thus turning off the fan. Turning Q203 off also moves R214 to the upper leg of the divider, resetting the fan's turn on temperature. This hysteresis action keeps the fan from "chattering" on and off.

### **2.5.1 Fan Test**

Test the fan by applying ground to pin J213-1. This will turn the fan on regardless of temperature. For more demanding applications it may be desirable to run the fan continuously. This can easily be done by placing a shorting plug across J213-1 and 2. In more extreme temperature situations, it may be desirable to run the fan continuously at the full A+ voltage. This can be done by shorting pins two and three of Q201. This will greatly increase airflow and also fan noise.

### 3 PROGRAMMING

Personality programming, flash memory programming and cryptographic keyloading are done from the station microphone connector through the radio serial port.

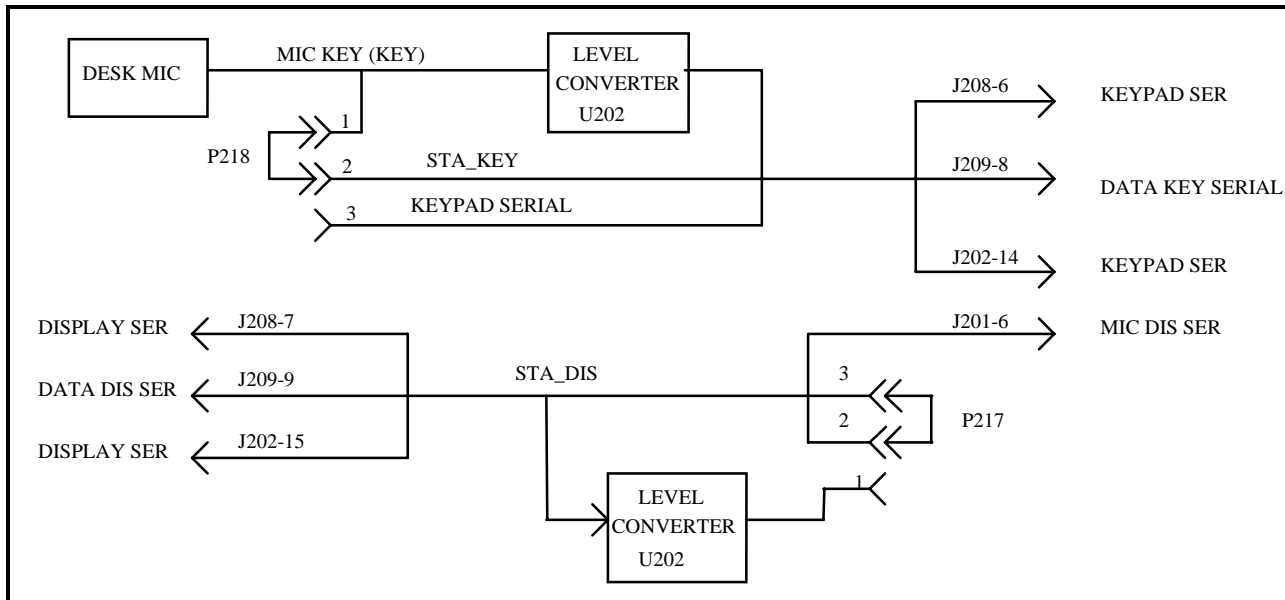
#### 3.1 PROGRAMMING REQUIREMENTS AND LEVELS

The radios have different programming requirements. JAGUAR and Orion radios have a true RS-232 serial port, which requires only that the VPP flash voltage be on a dedicated pin.

**JAGUAR/Orion:**

- PTT line resides at +5 volts when inactive.
- two RS-232 lines (handshake) are provided for use on the data port.

In general, these voltage level differences are reconciled on the Interconnect Board. This provides commonalty and allows the same programming and keyloader cables to be used for either application. They do not change with the radio being used. See Figure 3.



**Figure 3: Program Data Routing**

The TTL level data is received by the microphone connector at J201-5. It is then routed to the TTL input on RS-232 converter chip U202-10 and to J218-1. The RS-232 output of U202-7 is routed to J218-3. The position of jumper plug P218 determines whether TTL levels from the microphone connector or RS-232 levels from converter IC U202 are passed on. A Jumper on J218-2 and 3 provides RS-232 levels for the JAGUAR and Orion stations. This signal is labeled **STA\_KEY**.

**STA\_KEY** is routed to the Keypad/Frequency Select Board at J208-6 and relabeled **KEYPAD SERIAL**. It is also routed to J202-14 on the radio connector and through a 470 ohm resistor (R229) to the data port at J209-8. The resistor reduces the conflict between a device connected to the data options jack on the rear of the station and a programming or keyloader cable on the front microphone connector.



The Display Serial Data **DISPLAY SER** is received from the station radio at radio connector J202-15, from the Keypad/Frequency Select Board at J208-7, or from a data device connected to J209-9 through a 470 ohm resistor. As with **KEYPAD SERIAL**, the resistor reduces the conflicts between the front and rear connectors. The **DISPLAY SER** may be TTL or RS-232 depending on the radio. Once on the Interconnect Board, **DISPLAY SER** is routed through **STA\_DIS** pin to jumper P217-1 and to the input of RS-232 converter chip U202-13. The TTL output at U202-12 is connected to J217-3. Center pin, J217-2, is routed through the **DIS** pin to the Display serial output of the microphone connector at J201-6.

A jumper placed across J217-2 and J217-3 connects the converted RS-232 TTL output from the radio to microphone connector J201-6.

### 3.1.1 PTT Isolation Circuit

The **PTT** line on microphone connector, J201-7, is also used for the 12 volt PP flash programming voltage. A **PTT** isolation circuit consisting of Q204 and Q205 converts the multiplexed signal to a +5 volt signal, representing the isolated **PTT** signal. This signal is connected J219-3. Placing a jumper on P219 pins 2 & 3 provides **PTT** isolation. The center pin, J219-2 is labeled **DESK\_MIC\_PTT**. (**MIC\_PTT** is also connected to the VPP isolation circuit and to J219.)

JUMPER CHART	
JUMPER	JAGUAR AND ORION
P217 to J217	Pins 2&3
P218 to J218	Pins 2&3
P219 to J219	Pins 2&3
P220 to J220	Pins 2&3

### 3.1.2 VPP Isolation Circuit

The **MIC\_PTT** line from the microphone connector J201-7 is also routed to the VPP isolation circuit consisting of Q206 and Q207. The VPP signal output from Q206 keeps the normal TTL level transitions on the PTT switch off the VPP line.

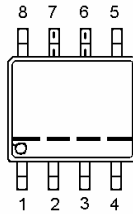
When **MIC-PTT** is connected to PNP transistor switch Q206 and to a voltage divider formed by R225 and R226, the output of Q206, VPP, is connected to the VPP line at J215-7 through the VPP pin. The voltage divider is connected to the base of NPN switching transistor Q207. Q207 turns on when the voltage on **DESK\_MIC\_PTT**, J201-7, rises above 9 volts, turning on Q206 and connecting VPP to the radio at J215-7.

### 3.1.3 5 Volt Regulator

The RS-232 converter chip U202 and the various pull-up resistors on Interconnect Board require a regulated 5 volt supply. This voltage is provided by the 78L05 regulator U201. The regulator receives **A+** (13.8 VDC) from the Power Supply through connector J206-3. Its output, **VCC**, is +5 volts at U201-1.

4 IC DATA

VOLTAGE REGULATOR  
19A704971PE,P9,11,12



PIN	FUNCTION
1	Vout
2	GROUND
3	GROUND
4	N.C.
5	N.C.
6	GROUND
7	GROUND
8	Vin

Figure 4: U201 5 Volt Regulator 19A704971P3

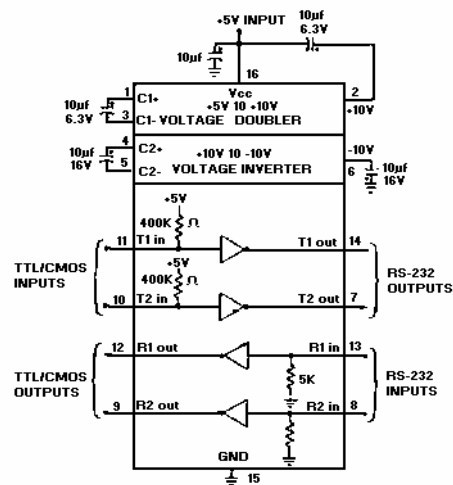
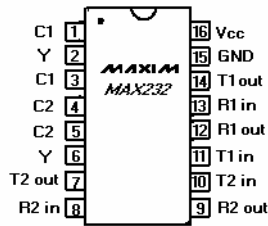


Figure 5: U202 Transmitter/Receiver RS-232 19A149446P2

## 5 REPLACEABLE PARTS

Replaceable assemblies can be ordered through M/A-COM Service Parts. Component Items listed in the following parts lists and identified with M/A-COM part numbers are available through M/A-COM Service Parts. All other components are for reference only or are considered common parts. These items can usually be obtained from your local electronic parts distributor.

To order replacement parts from the M/A-COM Service Department, call or FAX our on-line ordering system:

North America: 800-368-3277  
 FAX: 800-833-7592  
 e-mail: [customerfocus@tycoelectronics.com](mailto:customerfocus@tycoelectronics.com)

International: 434-455-9217 (Latin America, Asia Pacific)  
 434-455-9219 (Europe, MiddleEast, Canada)  
 FAX: 434-455-6685  
 e-mail: [internationalcustomerfocus@tycoelectronics.com](mailto:internationalcustomerfocus@tycoelectronics.com)

Ref	Part Number	Description
C201 thru C250	19A702061P61	Capacitor, Cer.: 100 pF 10%, 50 DCWV
C251 thru C253	344A4194P471160	Capacitor, Electrolytic: 470 F 20%, 16 DCWV; sim to United Chemicon SME
C254 thru C285	19A702061P61	Capacitor, Cer.: 100 pF 10%, 50 DCWV
C286 thru C291	19A705205P7	Capacitor, Tantalum: 10F 20%, 25 DCWV
C295	19A702052P26	Capacitor, Cer.: 0.1F 10%, 50 DCWV
<b>DIODES</b>		
D201	19A149615P1	Diode, Silicon Array; sim to Siemens BGX50A.
D202	19A700155P2	Diode, Silicon switching; sim to BAT 18
D203		
D204	19A700083P108	Diode, Silicon Zener: 13.8 Volts; sim to BZx84-C15
<b>JACKS</b>		
J200	344A3197P1	Terminal Block, 15 positions; sim to Electrovert 25.106.1553
J201	19A704852P35	Connector, PWB two part, 9 ckt; sim to Molex 22-229-2091
J202	19A704852P41	Connector, PWB two part, 15 ckt; sim to Molex 22-229-2151
J203	19A704852P30	Connector, PWB two part, 4 ckt; J206 sim to Molex 22-229-2041

Ref	Part Number	Description
J204&J205	19A703248P18	Contact, Electrical
J206	19A704852P30	Connector, PWB two part, 4 ckt; J206 sim to Molex 22-229-2041
J207 & J208	19A703248P18	Contact, Electrical
J209	19A704852P41	Connector, PWB two part, 15 ckt; sim to Molex 22-229-2151
J211	19A704852P30	Connector, PWB two part, 4 ckt; sim to Molex 22-229-2041
J212	19A704852P28	Connector, PWB two part, 2 ckt; sim to Molex 22-229-2021
J213 & J214	19A703248P11	Contact, Electrical (Gold Plated)
J215	19A704852P40	Connector, PWB two part, 14 ckt; sim to Molex 22-229-2141
J216 thru J219	19A704852P38	Connector, PWB two part, 12 ckt; sim to Molex 22-229-2121
J220	19A703248P11	Contact, Electrical (Gold Plated)
<b>PLUGS</b>		
P214 thru P220	19A702104P2	Connector, 2 pin jumper; sim to AMP - 530153-1
<b>RESISTORS</b>		
R201 & R202	19B800607P821	Resistor, Metal film: 820 ohms 5%, 1/8 w
R203 & R204	19B800607P681	Resistor, Metal film: 680 ohms 5%, 1/8 w

## REPLACEABLE PARTS

Ref	Part Number	Description
R205 & R206	19B800607P391	Resistor, Metal film: 390 ohms 5%, 1/8 w
R207	19B800607P1	Resistor, Metal film: 0 ohms (50 milliohms max).
R208	19B800607P103	Resistor, Metal film: 10K ohms 5%, 1/8 w
R209 & R210	19B800607P1	Resistor, Metal film: 0 ohms (50 milliohms max).
R211	19B800607P154	Resistor, Metal film: 150K ohms 5%, 1/8 w
R212	19A701864P4	Resistor, Thermistor, 10K ohms 10%, NTC; sim to Midwest 2H-103
R213	19B800607P223	Resistor, Metal film: 22K ohms 5%, 1/8 w
R214	19B800607P334	Resistor, Metal film: 330K ohms 5%, 1/8 w
R215	19B800607P103	Resistor, Metal film: 10K ohms 5%, 1/8 w
R216 thru R218	19B800607P101	Resistor, Metal film: 100 ohms 5%, 1/8 w
R219	19B800607P103	Resistor, Metal film: 10K ohms 5%, 1/8 w
R220 & R221	19B800607P473	Resistor, Metal film: 47K ohms 5%, 1/8 w
R222	19B800607P472	Resistor, Metal film: 4.7K ohms 5%, 1/8 w
*R223	19B800607P223	Resistor, Metal film: 22K ohms 5%, 1/8 w.
*R224	19B800607P473	Resistor, Metal film: 47K ohms 5%, 1/8 w
*R225	19B800607P104	Resistor, Metal film: 100K ohms 5%, 1/8 w
R226	19B800607P103	Resistor, Metal film: 10K ohms 5%, 1/8 w
R227	19B800607P100	Resistor, Metal film: 10 ohms 5%, 1/8 w
R228 thru R230	19B800607P471	Resistor, Metal film: 470 ohms 5%, 1/8 w

Ref	Part Number	Description
R231	19B800607P100	Resistor, Metal film: 10 ohms 5%, 1/8 w
R232	19B800607P471	Resistor, Metal film: 470 ohms 5%, 1/8 w
<b>TRANSISTORS</b>		
Q201	19A116942P1	Transistor, Silicon, PNP; sim to Motorola 2N6490
Q202 thru Q205	19A700076P2	Transistor, Silicon, NPN; sim to Motorola MMBT39044
Q206	19A700059P2	Transistor, Silicon, PNP; sim to Motorola MMBT3906
Q207	19A700076P2	Transistor, Silicon, NPN; sim to Motorola MMBT39044
<b>INTEGRATED CIRCUITS</b>		
U201	19A704971P9	Voltage Regulator, 5 V (POS & NEG); to MC78L05ACD
U202	19A149446P2	Transmitter/ Receiver RS-232

\* Components added/deleted or changed by production changes.

## 5.1 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.

To prevent unreliable operation due to U202, J220 and P220 added.

### REV B.

To improve unit programmability at low temperatures.

R223 was 47K ohm (19B800607p473), R224 was 100K ohm (19B800607P104), R225 was 180K ohm (19B800607P184).

# 6 OUTLINE DIAGRAM

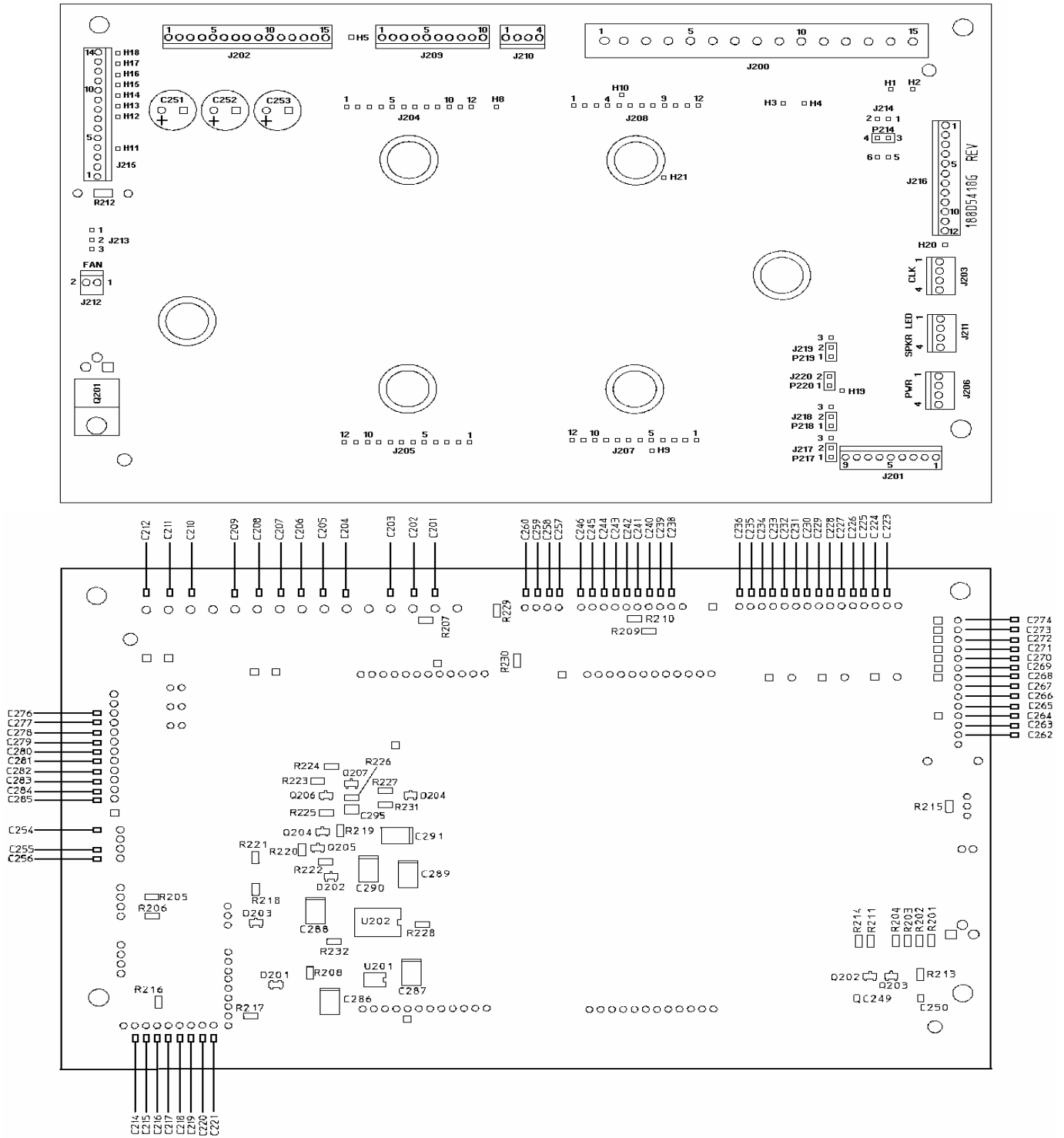


Figure 6: Interconnect Board 188D5418, Rev. 1

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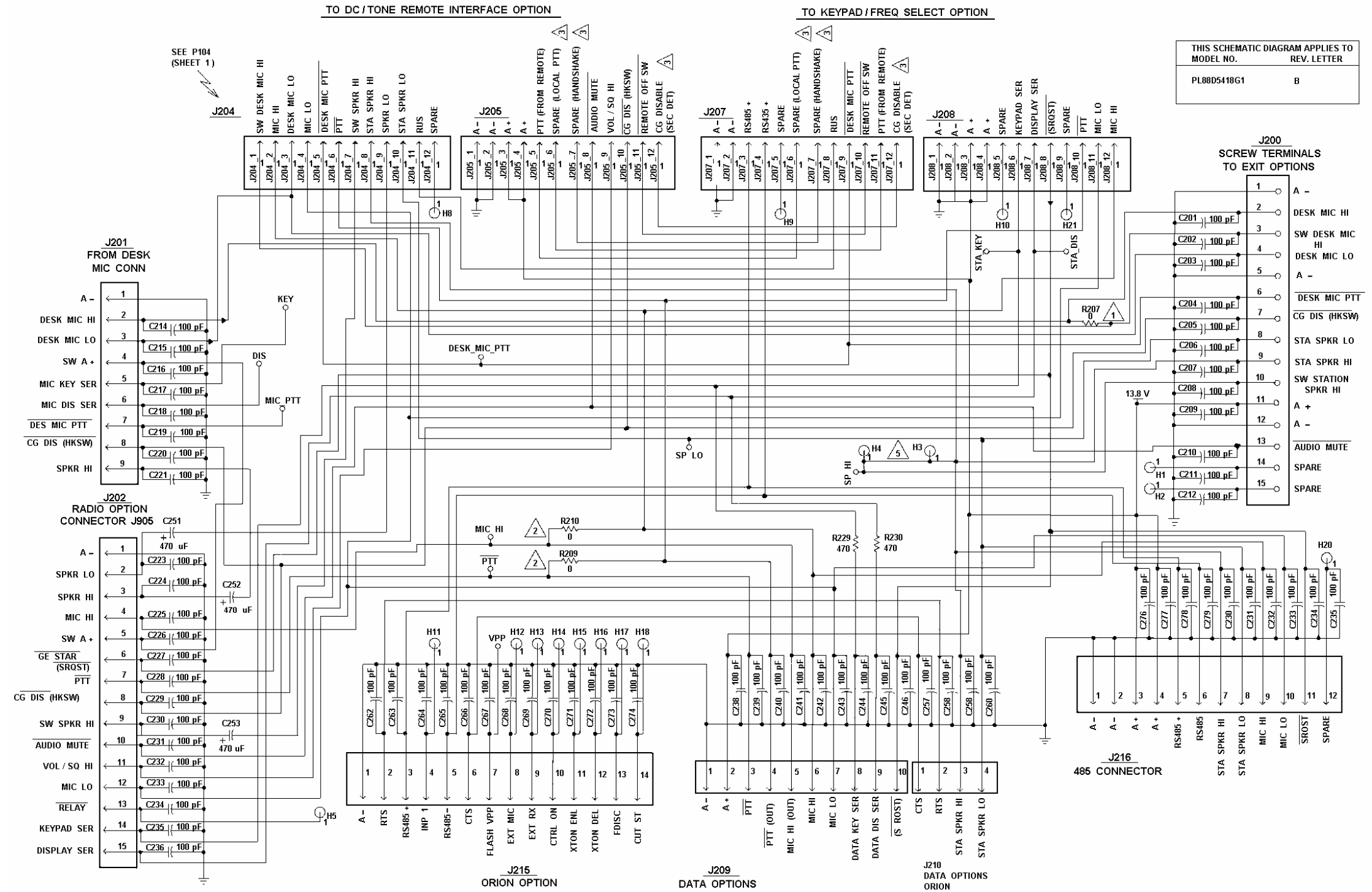
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# SCHEMATIC DIAGRAMS

## Notes

1. Remove 0 ohm resistors R207 to switch desk mic audio.
2. Remove 0 ohm resistors R209 and R210 for data options.
3. Line names in ( ) for EDACS tone remote only.
4. Q201 is mounted to board using mounting standoff for heat sink.
5. Cut run between hole 3 and hole 4 to switch station speaker audio.



THIS SCHEMATIC DIAGRAM APPLIES TO MODEL NO.	REV. LETTER
PL88D5418G1	B

Figure 7: Interconnect Board 188D5416, Sh. 2, Rev.2

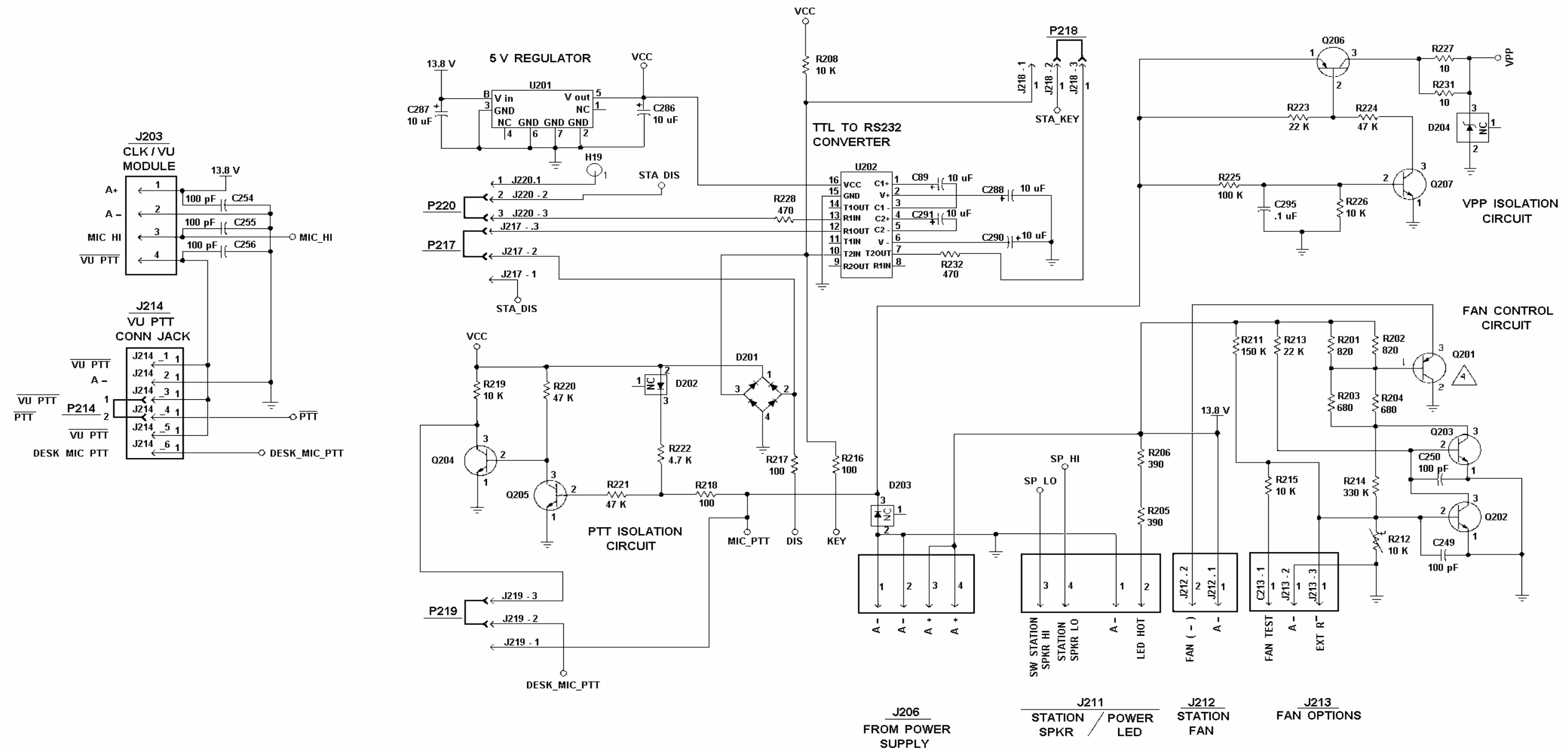


Figure 8: Interconnect Board 188D5416, Sh. 3, Rev. 2



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