

# Application Note – Bizcom ESP1000/1100 and ESP604 Interface with Teledesign Systems TS2000 Radio Modem for Utility Applications

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This paper describes the interface of the Bizcom 220 MHz radios with the Teledesign Systems TS2000 radio modem for use with utility applications requiring transparent RS232 data communications over radio. The pin for pin connection and configuration of settings of the radio and modem is covered.

## Physical Connection of the Bizcom 220 MHz Radios and TS2000 Radio Modem

The TS2000 radio modem comes with a radio interface pigtail to connect to the radio. The cable pinouts and color code is listed in the below figures. Figure 1 below describes the pin for pin connection required between the ESP1000/1100 base station and the TS2000 Radio Modem.

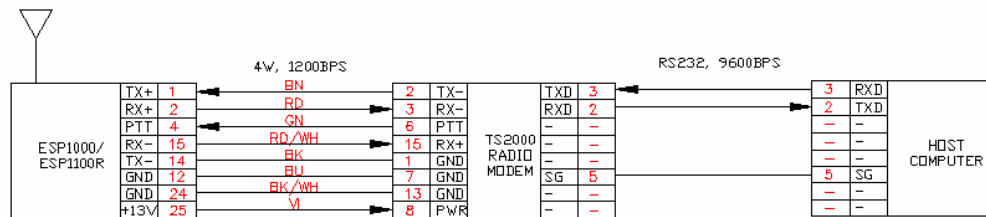


Figure 1 – ESP1000/1100 and TS2000 Interconnection

Figure 2 describes the pin for pin connection required between the ESP604 mobile radio and the TS2000 Radio Modem.

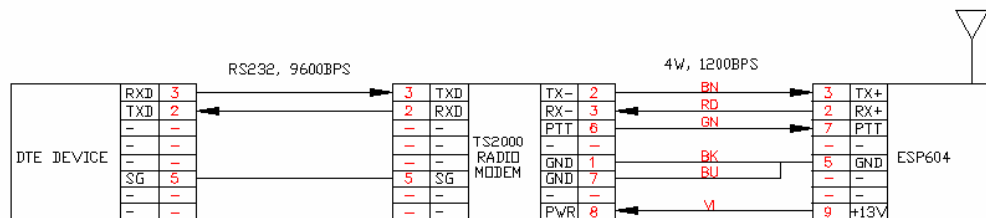


Figure 2 – ESP604 and TS2000 Interconnection

## Programming SEA Repeaters for Wideband Data Mode

Follow the following procedure for putting the ESP1000/1100 into Wideband mode. Step 5 sets the half-second automatic turnoff code transmissions to a 15 minute interval. Since the ESP604 does not have a high stability oscillator the base updates the mobile radio frequency tracking memories at regular intervals. When this is set to fifteen minutes, it causes a 500ms interruption in the data every fifteen minutes. If the host computer polls the remote device during this 500ms interruption it will have errors. This is a relatively small amount of errors. If this amount is unacceptable to the end user, then this system is not suitable for use with their application. The turnoff code can be turned off but the mobiles drift off frequency and don't realign themselves causing the mobile to not function. Also, the CWID code is turned off because the FCC doesn't require the CWID code to be transmitted when the channel is used for data only. This prevents additional errors from occurring once every thirty minutes. Enabling the local mic/speaker at the base station in step 7, allows the use of the mic/speaker on the base to communicate to the mobile during the initial path setup.

### Step 1. Determine RF Channel Numbers

Transmit channel #'s correspond to frequencies on channel table.

### Step 2. Access Setup/Program Mode:

- A. Rotate Local Volume control clockwise to activate alphanumeric display and LEDs.
- B. Press [#] key to enter Setup Mode. Display reads "DM=".
- C. Press [9][3][#] to enter Program Mode. Display reads "PM=".

Note: If a mistake is made while in a program function press [\*] to exit the program function before pressing [#].

### Step 3. Program Frequencies:

- A. Press [1][#]. Display reads the current receive channel # or the default "RX=377".
- B. Enter the desired 3 digit receive channel number.
- C. Press [#]. Wait until the display reads "PM=".
- D. Press [2][#]. Display reads the current transmit channel # or the default "TX=000".
- E. Enter the desired 3 digit transmit channel number.
- F. Press [#]. Wait until the display reads "PM=".

### Step 4. Select Base Station mode:

- A. Press [7][#]. Display reads the current mode or the default "CONVENTL".
- B. Press [0] until display reads "BASESTN".

### Step 5. Select Conventional/Base Station AREA and HOME:

- A. Press [#]. Display reads the current area or the default "AREA=0".
- B. Press [0].
- C. Press [#]. Display reads "HOME=01".
- D. Press [01]
- E. Press [#]. Display reads "TOCRT=15".
- F. Press [0] until the display reads "TOCRT=15", which is a 15 minute interval between half-second automatic turnoff code transmissions. (Updates the mobile radio frequency tracking memories.)
- G. Press [#]. Display reads "TOTE=N".
- H. Press [0] so display reads "TOTE=N", which disables the transmit time-out timer.
- I. Press [#]. Display reads "PM=".

### Step 6. Program Conventional Morse code station identification:

- A. Press [8][2][#]. Display reads the current FCC callsign or the default "CALLSIGN".
- B. After 3 seconds the display will read as follows:

1		=		X	/	A	B
---	--	---	--	---	---	---	---

Where the first digit "1" is the first character in the FCC Callsign.

X is the current value of the first digit and A and B are the two digit ASCII code that represents the first character in the callsign. In data mode the CWID will be disabled

- C. Press [3][2] in the first character for AB to turn the CWID off.
- D. Press [#] to scroll through the remaining digits of the ID. Display reads "PM=".

### Step 7. Enable Local Mic/Spkr for Voice

- A. Press [0][9][#]. Display reads the current mode or default of "LCLTXOFF".
- B. Press [0] until the display reads "LCLTXON".
- C. Press [#]. Display reads the current DTL ID type or default of "PRESETID".
- D. Press [0] until the display reads "PRESETID".
- E. Press [#]. Display will read the current pre-set DTL ID: "PSID=XXX" where "XXX" is the current DTL ID.
- F. Press [0][0][2] to make the microphone ID of the repeater be 002.
- G. Press [#].

### Step 8. Exit Setup Mode:

- A. Press [9][9][#] to exit Setup Mode.
- B. Display reads "MBSO XXX" and shows the time remaining (XXX=seconds) before the MBSO oven is fully warmed up. When the MBSO timer reaches zero, display reads "ESP1X00" and the repeater switches from standby to repeat operation.

## Programming the ESP604 for Wideband Data

When programming the ESP604 setup your sites that will be data only base stations with one channel per base station site. Also, ensure that the ESP604 mobile has an AFSK data board installed. In the configuration setup ensure that the settings are set like the following:

The screenshot shows the 'ESP600 Radio Configuration' window for a configuration named 'FranklinRTU'. The window is divided into several sections:

- Configuration Name:** FranklinRTU
- Serial Number:** No radio found
- Date Saved:** (Empty field)
- Options Enabled:**
  - Range Light
  - Ringback
  - Channel Hold
  - Ignition Sense
  - Courtesy Tone
  - Volume Set Tone
  - MIC Gain: Default 3, set to 3
  - Transmit Timeout: 8 min
  - TX Inh Timeout: .5 sec
  - Ignition Delay: 0 min
- Scan Defaults:**
  - Scan Enable
  - Interval Scan
  - Scan list:  1  2  3  4
  - Interval Delay: 5 sec
  - Resume Delay: 5 sec
  - Revert Weight: 3
  - Revert Type: Fixed
- Coverage Area:** EA67
- Data Type:** 6 - Ext HS Modem
- Buttons:** Write to Radio (F7), Service (F6), Edit Modes (F5), Set Defaults (F8), Save Changes (F9), Close (F12)

Once this is done the four modes of the mobile will have to be edited. The following is an example of what the modes will look like:

The screenshot shows the 'Edit Modes FranklinRTU' window for Mode 1. The window is divided into several sections:

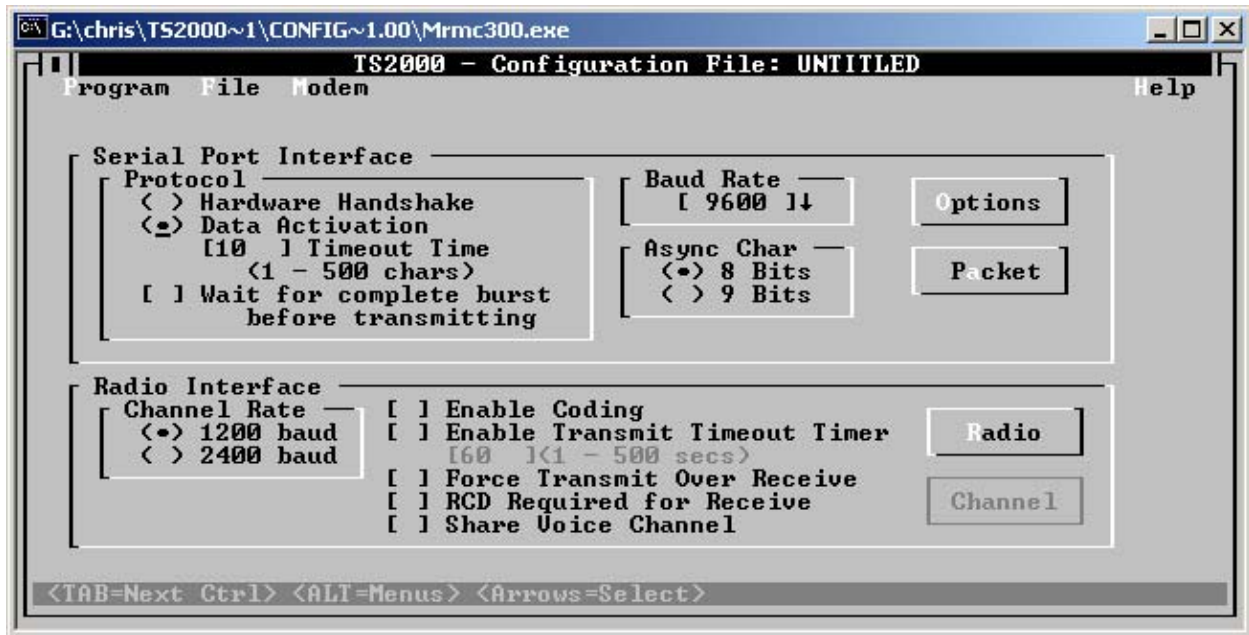
- Mode:** 1
- Type:** Conventional
- Site:** Franklin SCADA Base
- Home Repeater:** 1
- Option Settings:**
  - Talk Around
  - Busy Channel Lockout
  - Interconnect
- Radio ID's:**

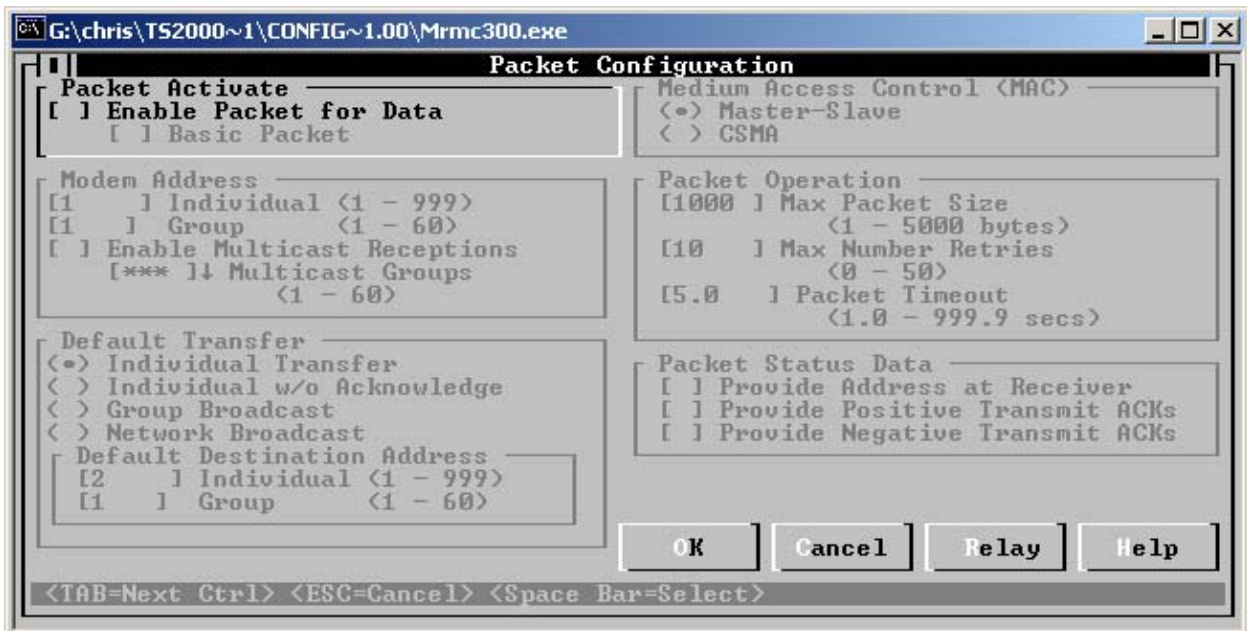
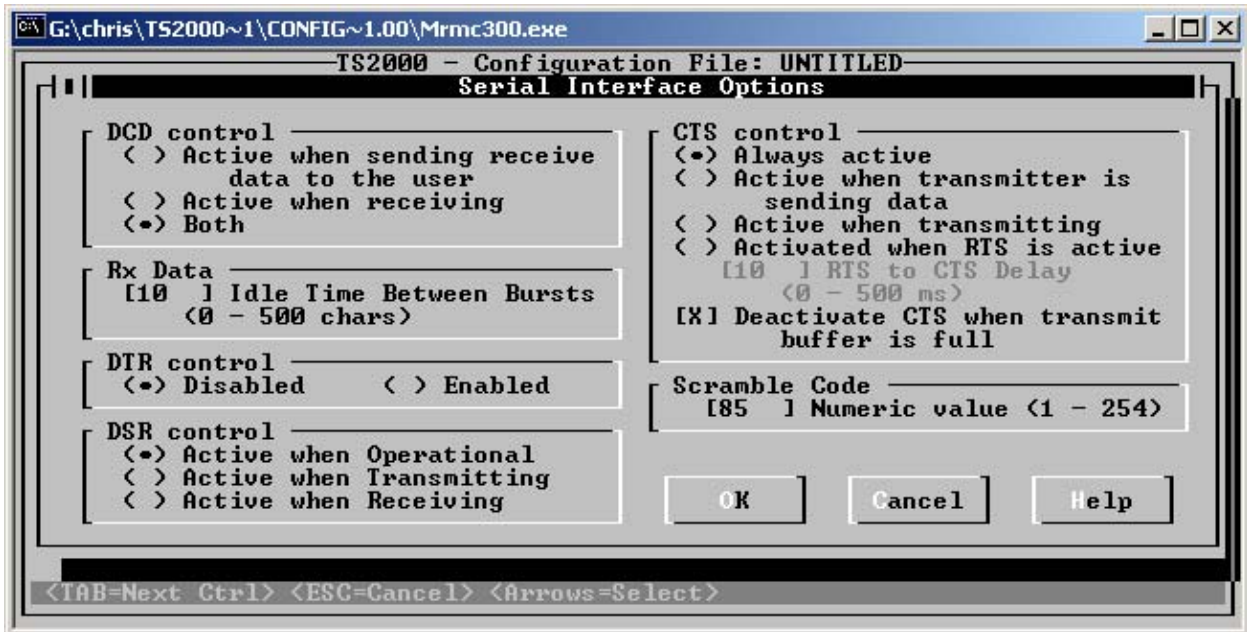
	Start	End	Call LED	Transpond	Horn Honk
Tx ID	0				
Rx ID	0		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Priority Rx ID	0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Block Rx ID	0	0	<input type="checkbox"/>		<input type="checkbox"/>
Tx Inhibit	0	0			
Data Tx ID	1				
Data Rx ID	1		<input type="checkbox"/>		<input type="checkbox"/>
- Buttons:** Set Defaults (F8), Save Changes (F9), Close (F12)

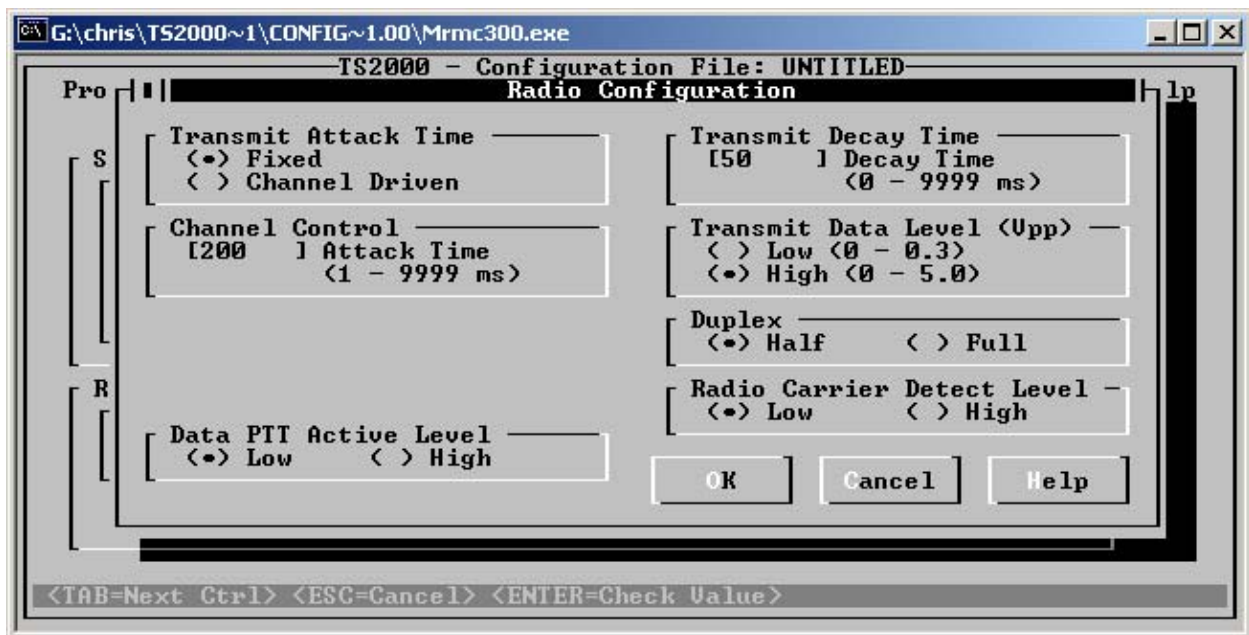
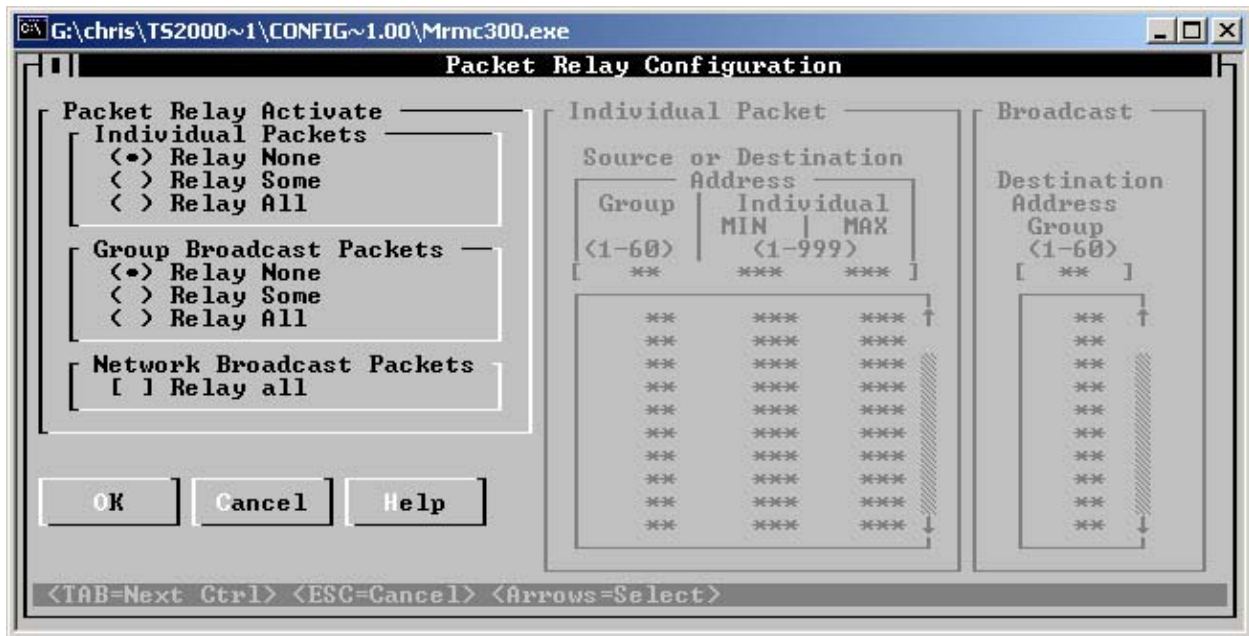
If all of the modes are configured to look this way then the radio will function no matter what mode the radio is placed. If one of the modes is set with a TxID and RxID instead of Data Tx ID and Data Rx ID then that mode can be used to communicate to personnel at the base station for alignment and testing purposes.

### Configuration of the TS2000 Radio Modem

The TS2000 radio modem comes with software for setting up the modem. The software allows you to setup the various parameters that define the function of the modem. When using devices such as meters and remote terminal units (RTUs) that require transparent communications at 9600 bps, the only setting that has not been default is the Channel Control Attack Time which has been set to 200ms. The ESP1000/1100 base station and ESP604 mobile both use the same setup. Below are the screens of the TS2000 radio modem software that detail how the modems have been set for Hoosier Energy's meter reading and SCADA applications.







Once the radio and radio modem are connected and configured, the levels on both can be set.

### Level Setting Procedure

The first step in setting the levels is to attach a peak envelope power watt meter and load to the output of the radio and connect a computer with TS2000 configuration software to the TS2000 radio modem. In the TS2000 software in the modem diagnostics generate a low tone for the modem. This tone is at 1200Hz. With the modem attached to the radio set the modem test program to transmit a low tone only transmit test, monitor the output and adjust the transmit level potentiometer on the modem until the modem test software reads a value of 500mV peak to peak. Verify that the output of the modem with an oscilloscope and observe the signal being transmitted out of the TS2000. Check to ensure that the audio transmit level is 500mV peak to peak and that there is no distortion of the signal. Once this is done

the transmit output level to the ESP1000/1100 or ESP604 is complete. Check the reading on the watt meter and adjust the power output of the radio to the desired output. Considering the modulation is amplitude companded single side band, the RF output power of the transmitter is a direct function of the data audio input level. On the ESP1000/1100 this is done via pot R155 which adjusts the transmit output of the base station. If this is an ESP1000 with a 100W power amplifier adjust the output of the base station to 5 watts and do not use the internal test modes of the repeater. Using the internal test modes could cause excess power to be transmitted and could damage the power amplifier. On the ESP604 use a separate power utility from the ESP604 Data Manager software. The original Data Manager software adjusts the automatic level control (ALC) level with the power. Doing this could result in the radio going into a fault mode. This fault is characterized by a Boop-Beep tone being heard. This tone signifies that an ALC Fault has been detected. The radio will NOT recover from this fault without operator intervention. The power to the radio must be cycled OFF and then ON. To prevent this from happening during data use, a separate power utility has been created. This power utility adjusts the transmit power but leaves the ALC calibrated to the 20 watt threshold. Using the power utility, the transmit power should only be reduced to a level of 5 watts. If a lower power is needed, external coaxial attenuators have to be used.

When setting the receive level, the ESP1000/1100 is factory set at 500 mV peak to peak. In the ESP604 mobile the receive level is always 400 mV peak to peak. With the radio receiving a 1200 Hz audio tone at 500 mV or 400 mV peak to peak, depending on whether it is the base station or mobile, adjust the receive attenuation on the TS2000 radio modem until a reading of 600 mV peak to peak is displayed in the modem configuration software. The radio can either be communicating with a distant radio and radio modem that is transmitting a 1200 Hz tone or a service monitor that is set to modulate a received audio tone of 1200 Hz. Once the levels have been setup properly, utilize the TS2000 configuration software to check the bit error rate (BER) of the path.

### **Measuring Bit Error Rate**

When measuring bit error rate a computer running the TS2000 configuration software will need to be setup to the TS2000 radio modem on each end of the radio path. One end will have to transmit a bit error rate test and the other end will have to receive a bit error rate test. Considering the ESP604 is not a continuous duty radio, it is advisable to transmit the bit error rate test from the base station and measure the bit error rate at the mobile. While this is only one direction, the mobile cannot be transmitted for a length of time required to get an accurate bit error rate. The longer the BER test is run the more accurate the result. BER testing is further described in the TS2000 User's Manual.

### **Conclusion**

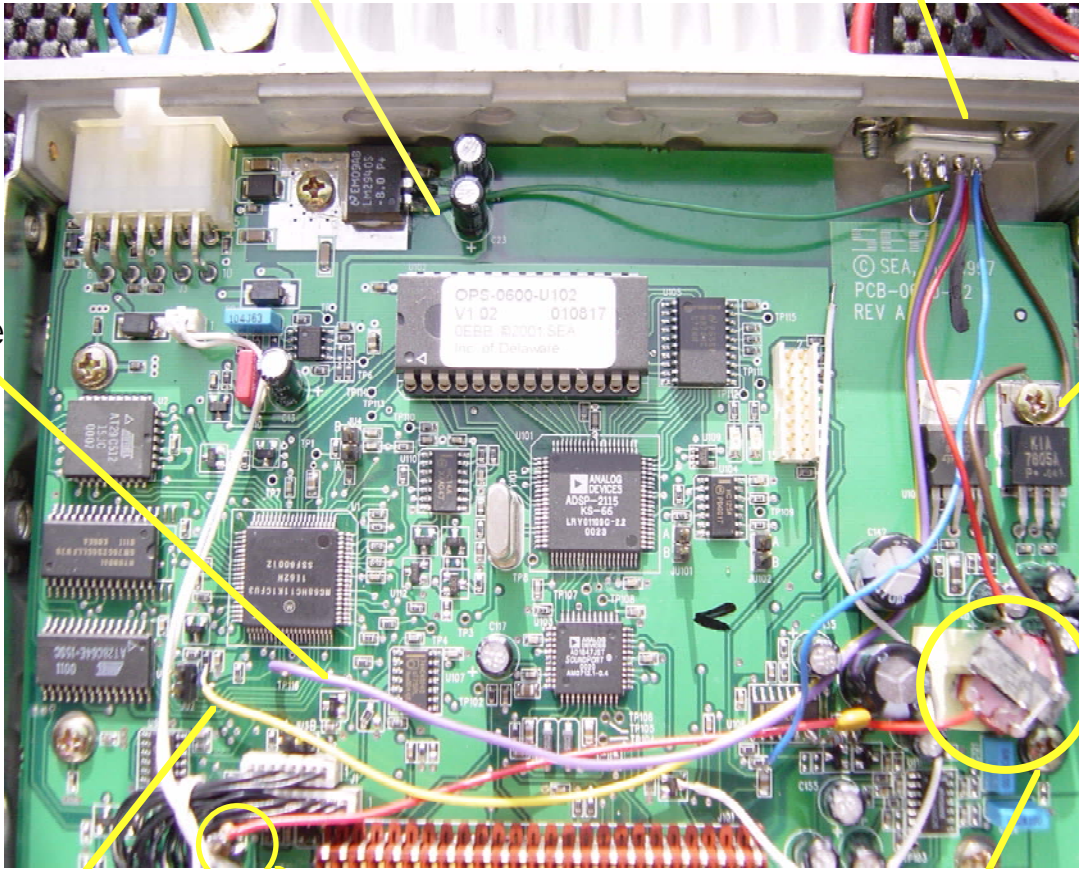
Once the radios and modems are setup and a satisfactory bit error rate is obtained, the combination will be ready for transparent data applications. While this is a data application for utilities, it can be used for other applications as well. Also, the use of the modems does not stop at transparent data. They can also be configured for packet data to enable automatic vehicle location and mobile data applications.

Switched B+, Green wire to pin 1 of regulator to Pin 3 of DB-9.

DB-9, with pins 3&5 connected together.

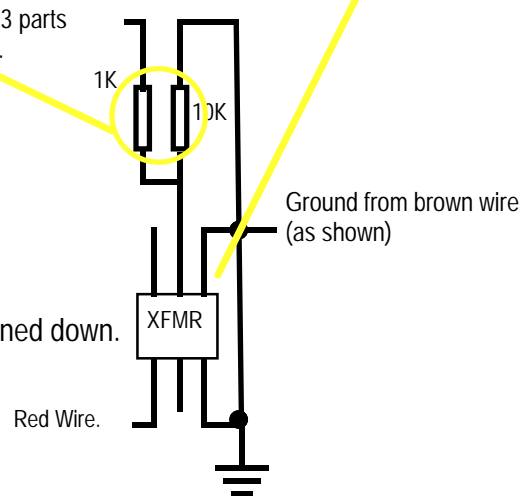
COR, Purple wire to TP116, Pin 7 of DB-9.

Ground, Brown wire screwed down, Pin 1 of DB-9.



PTT, Yellow wire to bottom of resistor right of JU2, Pin 4 DB-9.

To top of 1st resistor in row of 3 parts below J1.



Audio transformer siliconed down.

Red Wire.

Ground from brown wire (as shown)