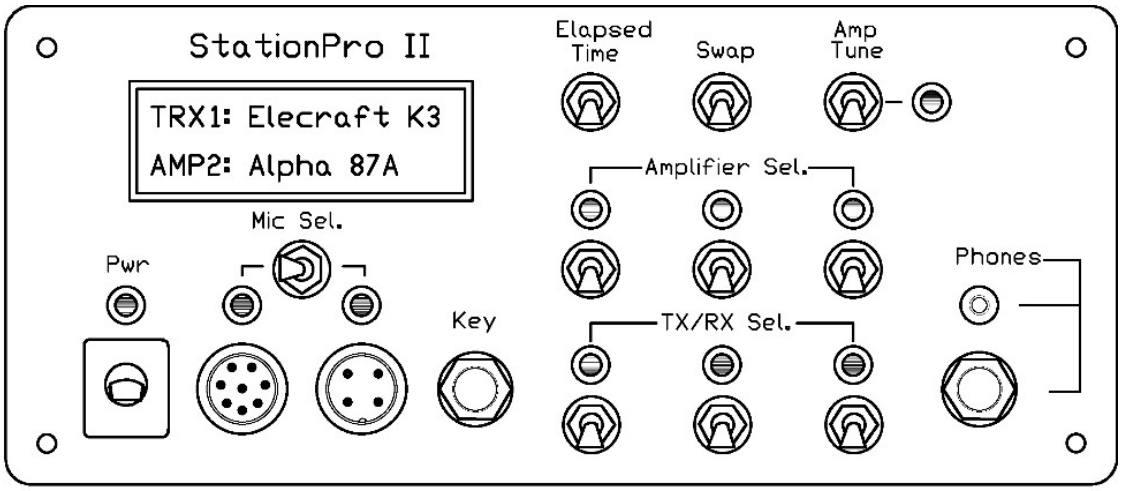
Assembly Instructions SP-II Upgrade Kit



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Contents

Upgrading your SP-I to an SP-II merely involves wiring a new front panel/circuit board assembly and assembling a microcontroller circuit board. You should reuse the jacks from your old SP-I front panel (microphone, headphone, and key jacks), but do not try to reuse the power switch (it cannot be non-destructively removed.) You will also need to remove the jumpers previously installed on your main printed ciruit board at J101-J106, as well as the cover plate over the unused holes on the controller's rear panel. A few unused hardware items supplied with your SP-I will also be needed for the upgrade.

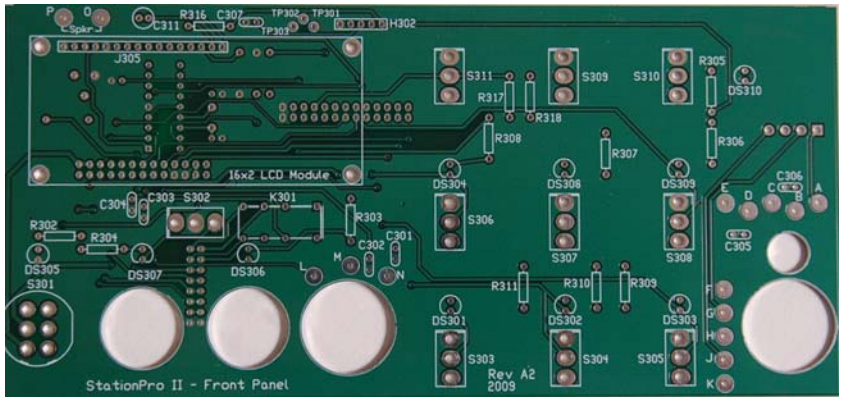
I . Front Panel Assembly

Please read through these instructions and then identify the front panel circuit board. Referring to the parts listing shown below, collect all of the components. (Additional information about each component is in **Appendix B: SP-II Parts List**, at the end of the **StationPro II Operating and Assembly Manual**. Also, photos of most components are shown in the step-by-step directions that follow.) Note that components mount on both the front and rear sides of the front panel circuit board, as indicated by the white silkscreened legends. Also note that Header H302 is unused, even though its outline is shown on the circuit board

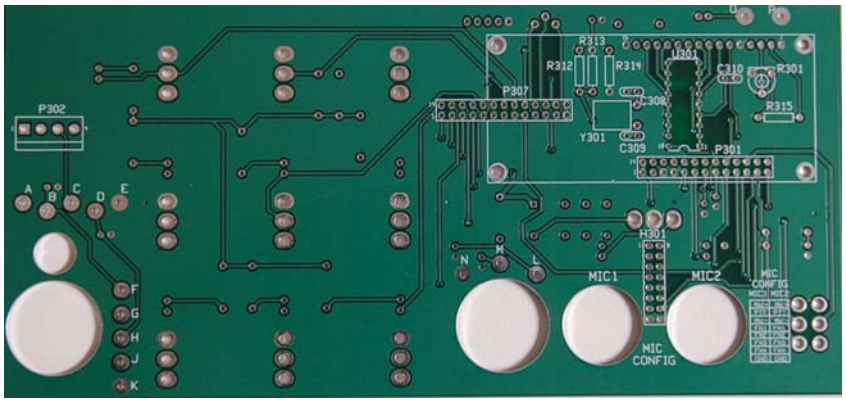
SPII Front Panel Parts List

IC socket	18 pin	DIP 18 pin IC socket
C301-C307	1000 pF	Capacitor, 50V, epoxy-dipped ceramic, qty 7
C308, C309	47 pF	Capacitor, 50V, epoxy-dipped ceramic, qty 2
C310	0.1 µF	Capacitor, 50V, epoxy dipped ceramic, qty 1
C311	1 µF	Capacitor, electrolytic, 50V, qty 1
DS301-DS304, DS308, DS309	LED	LED, Green, qty 6
DS306-DS307	LED	LED, Yellow, qty 2
DS305, DS310	LED	LED, Red,, qty 2
--	LED bezels	LED mounting clips, qty 10
J301	Key Jack	1/4 in. Stereo NO Phone Jack, qty 1
J302	Phone Jack	1/4 in. Stereo NO/NC Phone Jack, qty 1
J303	Phone Jack	3.5 mm Stereo NO/NC Phone Jack, qty 1
P305	Header	40 pin, 0.100 male, breakaway header, qty 1
K301	Relay	P&B/Tyco V23105, DPDT 12VDC, qty 1
P301, P307	Header	Molex, 26-pin (2x13), 0.100 male header, qty 2

P302	Header	Molex 4-pin 0.156” PCB connector w/locking clip, qty 1
LCD	16x2 LCD	Microtips 16x2 LCD
R301	5 KΩ trimpot	carbon trimmer potentiometer
R302-R304	2.2 KΩ	Resistor, 5% carbon film 1/4W (red-red-red), qty 3
R305-R311	1000 Ω	Resistor, 5% carbon film 1/4W (brown-black-red), qty 7
R312	22 KΩ	Resistor, 5% carbon film 1/4W (red-red-orange), qty 1
R313	220 KΩ	Resistor, 5% carbon film 1/4W (red-red-yellow), qty 1
R314	4.7 KΩ	Resistor, 5% carbon film 1/4W (yellow-violet-orange), qty 1
R315, R317, R318	10 KΩ	Resistor, 5% carbon film 1/4W (brown-black-orange), qty 3
R316	10 Ω	Resistor, 5% carbon film 1/4W (brown-black-black), qty 1
S301	Switch	Plastic DPDT paddle, qty 1
S302	Switch	Min. toggle, flat lever SPDT, qty 1
S303-S311	Switch	Min. toggle, flat lever SPDT mom. action, qty 9
Y301	Ceram. Res.	480 KHz ceramic resonator
U301	IC	PIC16C54 custom pre-programmed IC
----	connectors	8 pin mic jacks, qty 2
----	hardware	threaded standoff, round alum., 2-56 x 1/4,” qty 4
----	hardware	2-56 x 3/16” machine screws, qty 8



Front Panel Circuit Board –Front View



Front Panel Circuit Board – Rear View

(1) Install the following 1/4 Watt metal film resistors and the 5 KΩ trimpot onto the circuit board. Note that some resistors mount on the rear side of the board, as indicated on the silkscreening. Make certain the resistor bodies lie flat against the board before soldering and align all the resistor color codes in the same direction.

R302-R304	2.2 KΩ (red-red-red)
R305-R311	1000 Ω (brown-black-red)
R312	22 KΩ (red-red-orange)
R313	220 KΩ (red-red-yellow)
R314	4.7 KΩ (yellow-violet-red)
R315,R317,R318	10 KΩ (brown-black-orange)
R316	10 Ω (brown-black-black)
R301	5 KΩ Trimpot

(2) Install the following ten blue epoxy-dipped capacitors and one electrolytic capacitor onto the circuit board. Make sure you install the capacitors on the front or rear side, as indicated by the silkscreening, and that you observe the polarity of the electolytic capacitor.

C301-C307	1000 pF (marked 102 – blue epoxy-dipped)
C308, C309	47 pF (marked 470 – blue epoxy-dipped)
C310	0.1 µF (marked 104 – blue epoxy-dipped)
C311	1.0 µF electrolytic (observe polarity when installing)

(3) Install the 480 kHz ceramic resonator Y301 on the rear side of the circuit board. Bend the two tabs down, as shown below, so the resonator lies flat against the outline on the circuit board.

(4) Install relay K301 on the front side of the board. Make certain the relay body lies flat against the board. *Hint: solder diagonally opposite pins first, so you can readjust the relay body if necessary.*

(5) Install the 18 pin DIP IC socket at U301 on the rear side of the circuit board. Make sure the notch on the socket is aligned with the notch on the silkscreening. Do not plug in the IC yet.

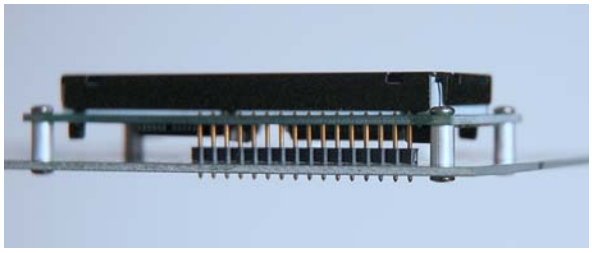
(6) Install two 26-pin headers at P301, P307 and the 4-pin 0.156" PCB connector w/locking clip at P302 on the *rear* side of the circuit board. *Hint: solder the end pins first*

to secure the headers. Then, after you're certain the headers are seated against the board, with the pins perpendicular to the board, solder the remaining pins.

(7) Mount the LCD to the front panel, as follows: (Note: the rectangular cutout on the front panel is sized for the recommended Microtips NC-S16205DFYSAY display. If other brands of LCDs are used, it may be necessary to file slightly the cutout opening.)

(a) Slide a 16-pin 0.100" header into position J305 on the *front* side of the circuit board, but do not solder it yet. (Clip the 16 pins off of a 40 pin breakaway header using wire cutters.)

(b) As shown below, *loosely* mount the LCD onto the top side of the circuit board using a 1/4" x 2-56 threaded standoff and two 2-56 x 3/16" screws at each of the four mounting holes. The top of the J305 header pins should fit into the mating holes on the LCD. Do not solder the pins yet. (You want the screws to be loose enough so you can center the LCD in its front panel cutout in a subsequent step.



The LCD display mounts on four 1/4" threaded standoffs with 2-56 x 3/16" screws and connects to the circuit board with the 16 pin header. Be sure to solder both ends of each header pin.

(8) Remove all hardware from the nine momentary action toggle switches and discard the flat washers. Finger tighten one of the nuts against each switch body and then temporarily secure each toggle switch to the front panel. The lockwashers should be behind the panel, and the front panel nuts should also be only finger-tight. IMPORTANT: make certain the bat handles are pointing upward on all the switches, so that the handles are pressed down to actuate the switch.

(9) In the same way, temporarily mount the SPDT miniature snap-action toggle switch S302 to the front panel. The switch mounts sideways, in either direction.

(10) DO NOT attach the plastic DPDT AC power switch to the front panel. It will be installed later.

(11) Temporarily attach the circuit board to the front panel, adjusting the switches as necessary to make sure their pins fit into the mating holes on the circuit board, and that the LCD fits into the square cutout on the front panel. Use the slight bit of wiggle room on the LCD mounting screws to center the LCD into its cutout. When you are certain the switch bodies are snug against the circuit board, and that the LCD is flush with the front of the panel, and after you have double-checked that no switches are mounted upside down, then solder all the switch pins to the circuit board. Now tighten the LCD mounting screws on the rear side of the printed circuit board

(12) Detach the front panel from the circuit board, taking care not to lose the outer nut and lockwasher from each switch. *Hint: note that the nuts on S302 are slightly smaller than the nuts on the momentary action switches, so don't get them mixed up.* Now tighten the top screws on the LCD spacers and solder all the pins on both ends of J305 (32 solder connections in total).

(13) Mount the plastic DPDT AC power switch S301 on the front panel (it goes either way). The nut should be finger tight. Now set the front panel aside.

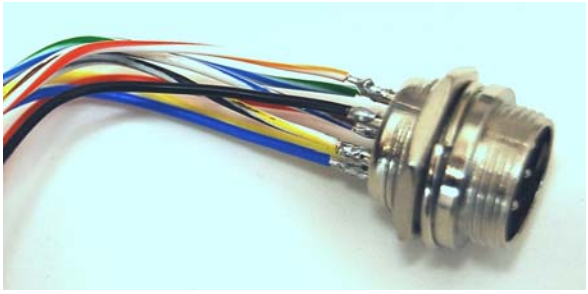
AC Power Switch S301

(14) Identify all the jacks that mount on the front panel: two microphone jacks, the 1/4 in. key jack (J301), the 1/4 in. headphone jack (J302), and the 3.5mm headphone jack (J303). As illustrated below, bend the solder lugs out flat on the key jack, so that they won't touch the printed circuit board when installed. Don't mix up the two 1/4 in. jacks; the J302 jack has a black plastic shell.

Left to right: J303, J302, J301, 8-pin Mic

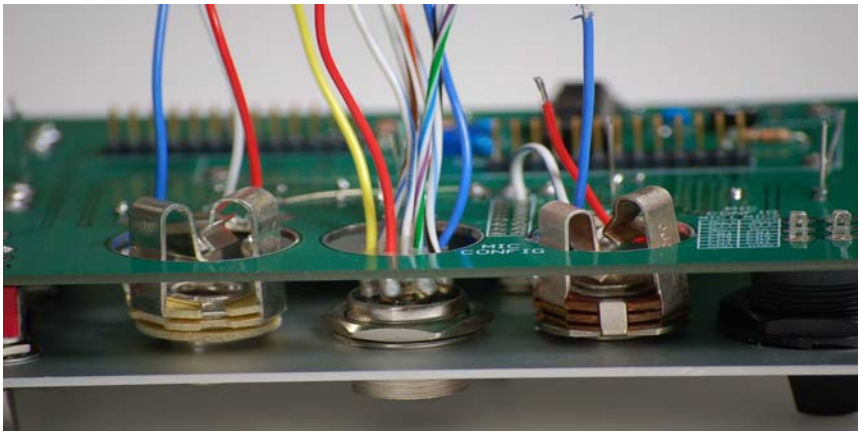
Bend the solder lugs on the key jack (J301) out flat, so they won't touch the front panel printed circuit board. If you're installing your own mic jacks with exposed solder lugs, bend them out flat too.

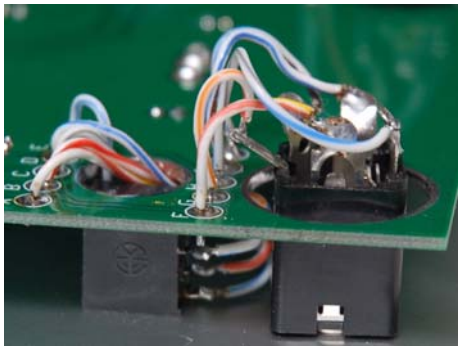
(15) Solder a 5 inch length of hookup wire (approximately) to each pin on all jacks. (You will trim to size, later.) Important: when you solder the wires to the black 1/4 in. headphone jack (J302), orient the wires so they emerge from the side of each terminal rather than straight out the back. (See second photo on next page.) This will increase the rear clearance for this jack, which is tight when the front panel is installed in the cabinet. *Hint: a small length of sleeving or heat-shrink tubing slipped over each pin of multipin mic jacks will make a neat-looking job (not shown in below photo. This would also be a good time to read FAQ No. 11 about hookup wire on the W8ZR StationPro website.)*



Different wire colors make it easy to keep track of microphone jack pin numbers.

(16) Loosely attach all the jacks to the front panel and then secure the printed circuit board to the front panel with the toggle switch hardware. If necessary, adjust the AC power switch so that its pins fit into their mating circuit board holes. As before, there should be a nut and lockwasher *behind* the panel for each of the miniature toggle switches. Feed all the jack wires though the access holes in the circuit board, as shown in the following two photos.





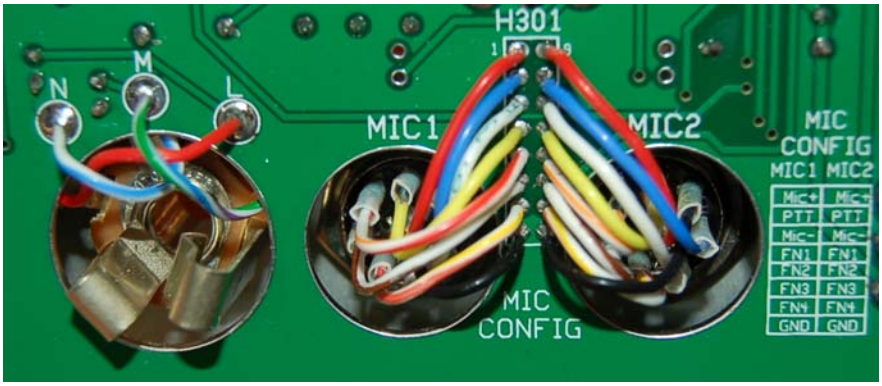
Detail showing wires from jacks threaded through the access holes on the front panel printed circuit board. Be sure none of the wires interferes with the jacks' operation

(17) Make sure none of the jack wiring interferes with the insertion of plugs. If you have provided your own 1/4" or 3/16" microphone jacks, be certain that their tabs do not touch the rim of the circuit board holes. You will need to insert a plug into the jacks to verify adequate clearance, since the plugs bend the tabs out slightly. If any tabs touch the hole rims, then file the hole rim with a small needle file to provide clearance. (No filing will be necessary if you use the supplied 8-pin mic jacks, or other jacks that fit the 0.625" front panel holes.)

(18) Rotate the jacks so that their wires are oriented adjacent to the matching lettered pads on the circuit board. The indent on 8-pin microphone jacks should face downward, and the washer should be *behind* the panel. Flat washers on 1/4 in. jacks go in *front* of the panel. There are no washers on the 3.5 mm headphone jack. Note that the clearance behind the black plastic 1/4 in. headphone jack will be tight once the front panel is installed, so do not use a second nut behind the panel on the jack. Now tighten all the jacks to the front panel, and also tighten the plastic nut on the AC power switch. Take care not to scratch the panel.

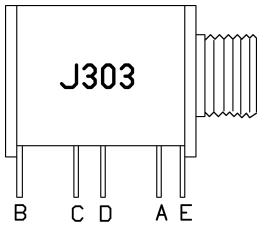
(19) Solder the pins on the plastic AC power switch S301 to the circuit board.

(20) Trim the wires from the headphone jacks (J302 and J303) and key jack (J301) to size (no longer than necessary), tin their ends, and then solder them to their mating pads on the circuit board (see photo, drawings and tables, below). If you prefer, you can route the wires from the 3.5 mm phone jack (J303) around the edge of the circuit board, rather than through the access hole. IMPORTANT: double-check to make sure you have identified all the wires correctly.



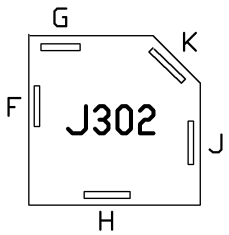
Trim the wires to size (keep them as short as practical) and solder each to its mating pad on the circuit board. Instructions for wiring the microphone jacks in this photo are given in Step (21), below.

3.5 mm Headphone Jack Pads (J303)



A	Tip
B	Tip (norm. closed contact)
C	Ring
D	Ring (norm. closed contact
E	Common (ground)

1/4" Headphone Jack Pads (J302)



F	Tip
G	Tip (norm. closed contact)
H	Ring
J	Ring (norm. closed contact)
K	Common (ground)

Key/Paddle Pads J301 (no drawing shown)

L	Tip (dot)
M	Ring (dash)
N	Common (ground)

(21) Microphone Jack Wiring: The microphone wiring table silkscreened onto the rear of the circuit board corresponds to the sixteen pads that are centered between the two microphone access holes. Although some microphones have numerous features (UP, DOWN, etc.), at a minimum all have at least three conductors: an audio output wire (Mic+), a PTT wire; and a ground (shield) wire. If a microphone jack has a separate "Mic Gnd" or "Mic-" wire, then connect it to the Mic- pad and not to GND.

Note that there are four rows of pads labeled FN1-FN4 on the silkscreened table. These pads, along with the Mic- pads, differ from the Mic+ and PTT pads because both pads in each row, FN1 for example, are jumpered together on the circuit board. You can assign the other microphone wires (e.g., UP, DOWN, +V, etc.) to FN1-4, in any order you like, but be sure to assign the corresponding wires on each microphone to the same pads. In other words, if you assign FAST to FN1 for Microphone 1, then you should also assign FAST to FN1 for Microphone 2. The following table shows recommended pad assignments for common 8-pin microphone pinouts used in contemporary transceivers.

IMPORTANT: if you do not use any of the FN1-4 rows, then jumper an unused pad on that row to the GND pad. However, if a pad, such as FN4, is used only on one microphone but not on the other, then do NOT ground the unused FN4 pad. Now trim the wires from each microphone jack to size, tin the ends, and solder each wire to its pad, according to the table. Be especially careful to avoid short circuits from loose wire strands or solder bridges on the Mic+ pads (Pin nos. 1,9) and PTT pads (Pin nos. 2,10).

Common 8-pin DIN Microphone Wiring Table

	--------Mic Connector Pin No.----------				
Pad Label	Elecraft	Yaesu	Ten-Tec	Icom	Kenwood
MIC+(Audio Out)	1	8	8	1	1
PTT	2	6	6	5	2
MIC- (MIC GND)	7	7	7	7	7
FN1 (FAST)	5	4	--	--	--
FN2 (DOWN)	4	3	--	--	3
FN3 (+V)	6	2	2	2	5
FN4 (UP)	3	1	--	3	4
GND	8	5	5	6	8

(22) Once you have soldered all the wires from the front panel jacks to their mating circuit board pads, then carefully inspect your work to make sure there are no short circuits, solder bridges, or unsoldered connections.

(23) Slide six green LEDs through the front panel LED cutout holes so that their leads pass into the mating holes on the circuit board marked DS301, DS302, DS303, DS304, DS308, and DS309. Do not solder the LEDS yet. IMPORTANT: The flat side of the LEDS (the short lead) goes down, as shown on the silkscreened legend.

(24) Similarly, insert two yellow LEDs into DS306 and DS307. Do not solder the LEDs, and be sure the flat side is down.

(25) Insert two red LEDs into DS305 and DS310 (flat side down). Do not solder the LEDs

(26) Snap the LED plastic mounting bezels into their holes on the front panel, taking care not to let any of the LEDs slip out of their circuit board pads.

(27) Slide the body of the LEDs into the back of the LED bezels until they click into place. Use a small flat-blade screwdriver to nudge the LEDs into the bezels. Once you have verified that each LED is seated in its bezel, and that each bezel is pushed flat against the panel, solder all the LEDs to the circuit board. *Hint: if you have trouble getting the LEDs to snap into the bezels, try bending the plastic tabs on the bezels out slightly, using a small-blade screwdriver.*

(28) Plug the PIC16C54 preprogrammed IC into the 18-pin IC socket at U301. Wear a grounded wrist strap or touch a grounded surface to avoid damaging U301 with static electricity. IMPORTANT: Be sure to align the notch on U301 with the silkscreened notch on the circuit board. Make sure none of the IC pins are bent and that all fit into the mating holes in the socket. *Hint: bend the pins on U301 inward slightly by pressing the IC pins against a flat surface. This will make the IC easier to install.*

(29) Clean the flux from the rear of the circuit board with isopropyl alcohol and Q-tips and then inspect each solder connection using a magnifying glass. Pay particular attention to the grounds on the LEDs and switches; make sure solder has flowed onto the circuit board groundplane and isn't beading up on the pad.

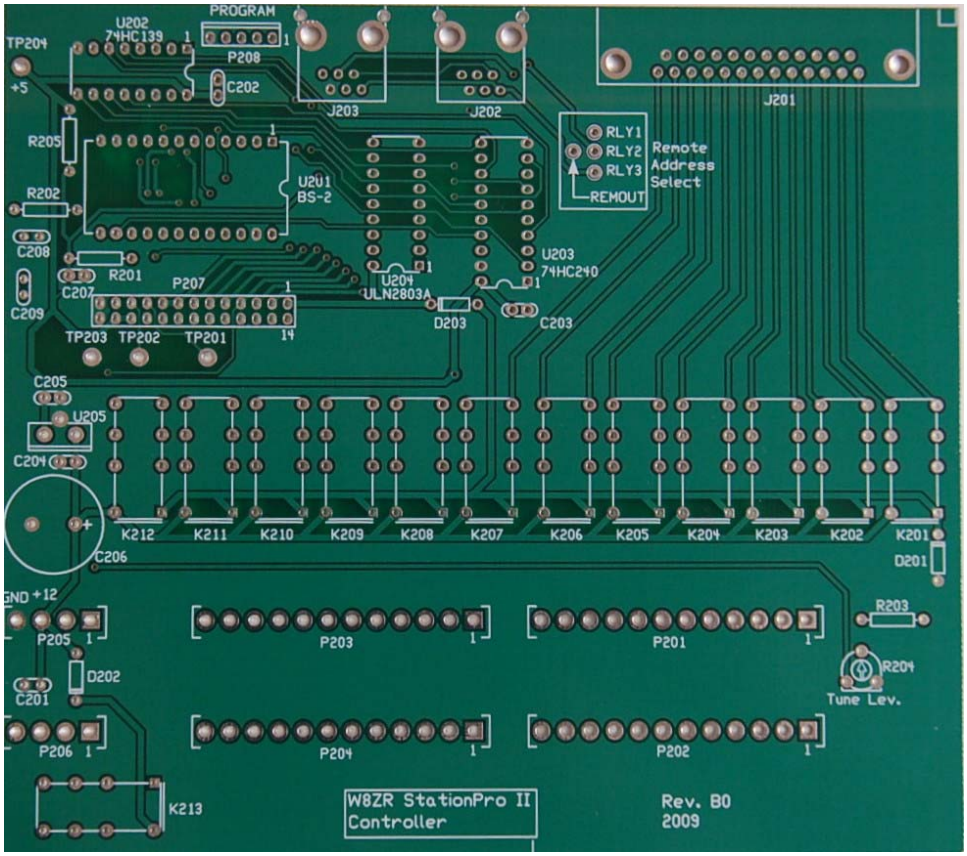
(30) Set aside the completed front panel assembly. Note that Header H302 is unused, and that no wires are soldered yet to the two speaker holes labeled "O" and "P" in the upper left of the board.

II. Microcontroller Circuit Board Assembly

Identify the microcontroller circuit board, pictured below, and collect all of the components in the following list. (Refer to the master parts list in the SP-II Operating and Assembly Manual for additional details about each component.) Note that all components will install on the *top* side of the circuit board, except for the the headers at P201-P204 and P205-P206. These headers will be inserted into their mating connectors on the main circuit board before soldering, in order to ensure correct alignment

Microcontroller Circuit Board Components

IC socket	24 pin	24 pin IC socket, qty 1
C201-C205	0.1µF	Capacitor, 50V blue ceramic, (marked 104) qty 5
C206	4700 µF	Capacitor, 16V electrolytic, qty 1
C207	1000 pF	Capacitor, 50V, blue ceramic (marked 102) qty 1
C208, C209	.01 µF	Capacitor, 50V, blue ceramic (marked 103) qty 2
D201- D203	1N4005	1A/600 PIV diode, qty 3
J201	Connector	D-Sub 25 pin male, R/A PCB mount, qty 1
J202, J203	Connector	RJ25 6 pin PCB side-entry, shielded, qty 2
K201 –K213	Relay	P&B/Tyco V23105, DPDT 12 VDC, qty 13
P201-P204	Header	Molex 0.156" 12 pin header, qty 4
P205, P206	Header	Molex 0.156" 4 pin header, qty 2
P207	Header	Molex, 26 pin (2x13) 0.100" male header, qty 1
P208	Header	Molex 5 pin, 0.100", friction lock
R201	1000 Ω	Resistor, 1/4W (brown-black-red), qty 1
R202	100 KΩ	Resistor, 1/4W (brown-black-yellow), qty 1
R203, R205	10 KΩ	Resistor, 1/4W (brown-black-orange), qty 2
R204	10 KΩ	carbon trimmer potentiometer, qty 1
U201	BS2-IC	Parallax Basic Stamp model BS2-IC
U202	74HC139	IC, dual 4-to-2 line decoder, 16 pin, qty 1
U203	74HC240	IC, octal bus buffer, 20 pin, qty 1
U204	ULN2803A	IC, darlington 8 NPN array, 18 pin, qty 1
U205	7805	IC, +5V voltage regulator TO-220 3 pin, qty 1



Microcontroller Circuit Board – Top View

(1) Install all of the 1/4 watt resistors, making sure the resistor bodies are flat against the circuit board and that color codes are aligned in the same direction:

R201	1 KΩ	(brown-black-red)
R202	100 KΩ	(brown-black-yellow)
R203, R205	10 KΩ	(brown-black-orange)

(2) Install a 10 KΩ trimpot at R204.

(3) Install blue epoxy-dipped ceramic capacitors as follows:

C201–C205	0.1 µF / 50V	(marked 104)
C207	1000 pF/50V	(marked 102)
C208, C209	0.01 µF/50V	(marked 103)

(4) Install a 4700 µF/16V electrolytic capacitor at C206. Be sure to observe the polarity of the capacitor. The "+" pad is marked on the silkscreening, whereas the "-" side is marked on the capacitor.

(5) Install 1N4005 diodes at D201-D203. Make sure the diodes bands are oriented as shown on the silkscreened legends.

(6) Install a 24 pin IC socket at U201. Make certain the socket orientation aligns with the notch on the silkscreened legend.

(7) Install the thirteen relays K201-K213. Begin by soldering two opposing pins on each relay so you can make sure the relay bodies are flat against the circuit board. Then solder the remaining pins.

Be certain not to miss any pins when you solder the thirteen relays to the circuit board

(8) Install a 26 pin (2x13 pin) header at P207. Solder diagonally opposite pins first, to make sure the header is flush against the board, and check to make sure you have no solder bridges between pins.

Be especially careful to avoid solder bridges between the closely spaced pins on the 26 pin header

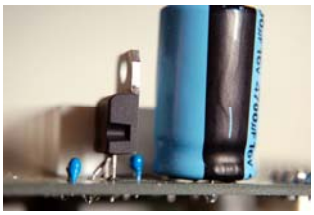
(9) Install the 0.100" Molex 5 pin header with locking clip at P208. Orient the header so that it matches the outline on the silkscreened legend.

(10) Install connectors J201 (25 pin) and J202, J203 (6 pin) along the rear of the circuit board. Check that these connectors lie flush against the circuit board before you solder the pins. The spacing between pins is very close, so inspect your work to make certain there are no solder bridges. Don't forget to solder the ground plane pins, using extra heat if necessary.

(11) Install integrated circuits as listed below. Wear a grounded wrist strap or touch a grounded surface to avoid damaging the ICs with static electricity. Be sure to align the notch on the ICs with the silkscreened notch on the circuit board. Before you solder the pins, make sure none of them is bent and that all fit into the holes on the circuit board. *Hint: bend the pins on the ICs inward slightly by pressing the IC pins against a flat surface. This will make the ICs easier to install.*

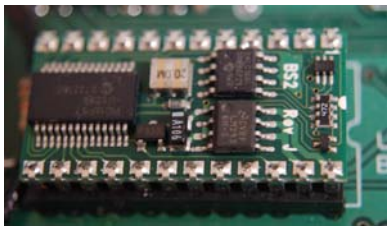
U202	74HC139
U203	74HC240
U204	ULN2803A

(12) Install the 7805 5-Volt regulator at U205. Bend the leads on the 7805 to align with the pads on the circuit board. The body of the IC should sit about 1/4" above the circuit board.



The 7805 voltage regulator is vertically mounted and sits about 1/4" above the circuit board.

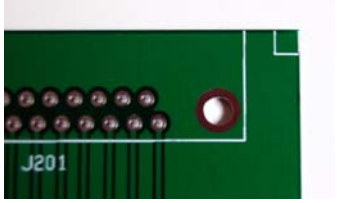
(13) Plug the Basic Stamp BS2-IC into the socket previously installed at U201. (Wear a wrist strap or touch a ground while you handle this component.) Make certain the BS2-IC is aligned with the notch on the silkscreened legend, and verify that all 24 pins are properly seated into the socket. Take your time nursing the BS2-IC into its socket and do not apply excessive pressure. It helps to rock the BS2-IC back and forth slightly while you insert it.



Verify that its pins are straight before inserting the BS2-IC into its socket.The white dot on the front of the BS2-IC must be aligned with the notch on the silkscreening.

(14) Clean the flux from the bottom of the circuit board with isopropyl alcohol and Q-tips and then inspect each solder joint using a magnifying glass. Look especially closely at the multipin connectors along the rear edge of the circuit board, the 26 pin header, and the pins on the ICs.

(15) With a pair of wire cutters, cut a 1/8" notch at the *right rear corner* of the circuit board. Note that the outline of the notch is silkscreened on the board. The notch allows the circuit board to clear the side bracket on the enclosure.



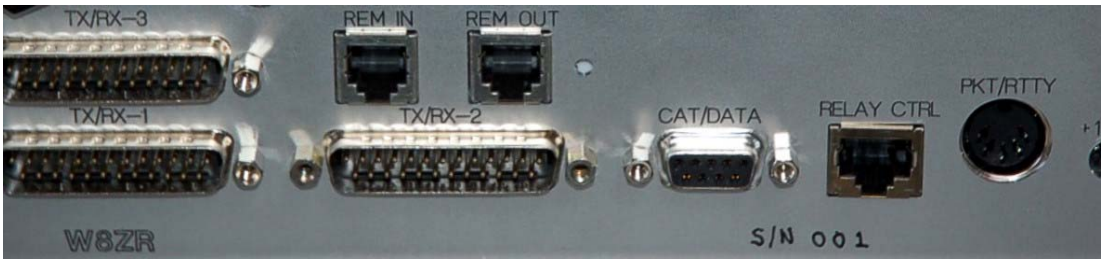
Use wire cutters to cut a 1/8 in. notch in the right rear corner of the microcontroller circuit board.

(16) With the exception of the six headers at P201–P204 and at P205–P206, which have not yet been installed, this completes assembly of the microcontroller circuit board.

III. Final Assembly of the Controller

(1) Retrieve the previously assembled main circuit board, and remove the jumpers you installed at J101–J106 when you assembled your SP-I. Now plug the 12-pin and 4-pin headers P201-P206 into the recently vacated connectors. Verify that these headers are fully seated into their connectors. Now set the microcontroller circuit board on top of the main circuit board, so that the pins on the six headers extend into their holes on the microcontroller circuit board. Do not solder the pins, yet.

(2) Carefully attach the main circuit board and microcontroller circuit board assembly to the rear panel, taking care not to let the pins on the six headers slip out of their pads. These boards attach to the rear panel with the eight jack screws that secure the three 25-pin DB25 connectors and the 9-pin DB9 connector. Before you tighten the jack screws, make sure the bodies of the 8-pin RJ-45 (RELAY/CTRL) and 6-pin RJ-25 (REM IN, REM OUT) connectors fit into their rectangular cutouts on the panel. The jack screws are rather fragile, so do not overtighten them. *Note: do not attach the rear panel circuit board to the rear panel yet.*



The main circuit board and microcontroller circuit board attach to the rear panel with the eight jack screws that secure the DB25 and DB-9 connectors.

(3) Check again to make sure that the pins on the six headers at P201–P204 and P205–P206 are still in their circuit board pads. Then solder the end pins on each header so you can make certain the header bodies are seated flat against the underside of the microcontroller circuit board. Now solder the remaining pins.

(4) As shown below, attach the left and right side enclosure brackets to the rear panel, using the 6-32 x 3/8" screws supplied with the enclosure (not with the hardware packs). Do not use any washers. Note that the lip on the side brackets will fit into the notches previously cut into the two circuit boards.

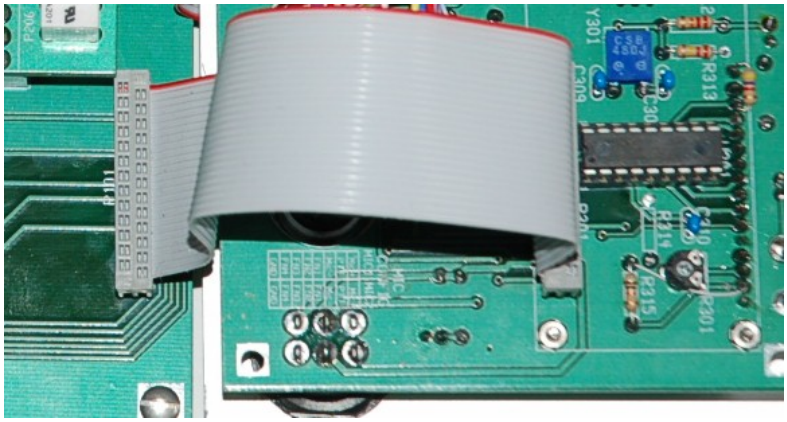
(5) In the same manner, attach the front panel assembly to the left and right side brackets. Use the four black 6-32 x 3/8" machine screws supplied with the enclosure, with no washers. NOTE: When you attach the front panel to the side brackets, inspect carefully the lugs on the back of the 1/4 in. headphone jack to make sure they don't bump into the 4-pin Molex header at P102 on the main PCB. If they do, carefully bend the interfering lugs out of the way. These lugs are brittle, so bend them slowly (to allow stresses to equalize), no more than necessary, and avoid sharp bends.

(6) Identify the curved bottom cover of the enclosure. It is the cover that has two small holes that line up with the two threaded standoffs closest to the front of the main circuit board.

(7) Press the four adhesive-backed feet supplied with the enclosure onto the underside of the bottom cover.

(8) Attach the bottom cover to the side brackets, using the black No. 10 sheet metal screws supplied with the enclosure, and secure the two threaded standoffs to the bottom cover, using 6-32 x 1/4 machine screws and No. 6 internal lockwashers. The lockwashers go underneath the screw heads. The remaining four standoffs are not attached to the bottom cover.

(9) Plug the free end of the previously installed 26-conductor ribbon cable from P101 on the main circuit board to P301 on the front panel circuit board. When properly installed, the cable should not twist. It should emerge down from the lower end of P301, as shown below. Don't forget to check the alignment of the connector with the pins on P301, to make sure the pins are not inadvertently offset.

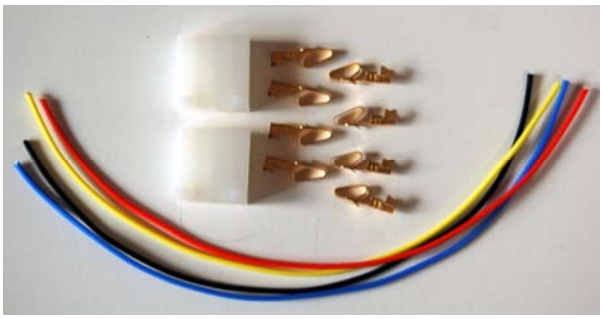


When properly installed, none of the three ribbon cables should be twisted and all should line up nicely with their mating headers

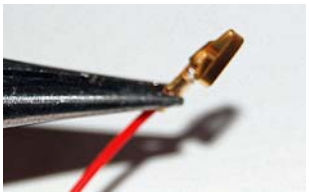
(10) Plug one end of a six inch 26-conductor ribbon cable into P207 on the microcontroller circuit board, and the other end into P307 on the front panel circuit board. The ribbon cable should point from P207 toward the front of the controller circuit board, and from P307 toward the bottom of the front panel circuit board. The cable should not twist. Check the alignment of the connectors at both headers. At this stage of the assembly, two ribbon cables should be installed fully, and the third ribbon cable (from P103) should be hanging free.

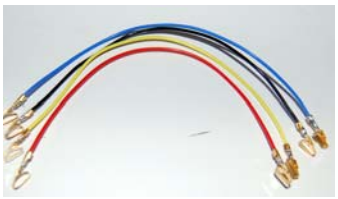
(11) Following the steps below, prepare and install a short 4-conductor cable to connect from P102 on the main circuit board to P302 on the front panel circuit board.

(a) Cut four 6 inch lengths of 22 AWG stranded hookup wire, and strip each end about 3/16 inch. If available, it will be convenient to use different color wires.



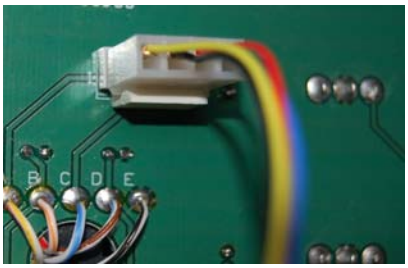
(b) As shown above, identify two 4-pin Molex 0.156” nylon connector housings (Mouser p/n 538-09-50-3041) and eight crimp terminals (Mouser p/n 538-08-50-0134). Using needle-nose pliers, crimp a terminal onto each end of the hookup wires prepared in the previous step. *(Hint: it’s a good idea also to solder the wires to the terminals. Use the smallest amount of solder necessary for a good connection.)*





(c) Snap the terminals into each connector housing. Use a small flat-bladed screwdriver to push each terminal into the housing. The terminals only insert one way and will click into place. Be sure you're inserting the terminals into their correct hole on the housing, because once installed they are difficult to remove. Important: Make sure the wires don't cross, i.e., pin 1 on one housing should mate with pin 1 on the other housing. Note that pin 1 is identified on the silkscreened legends.

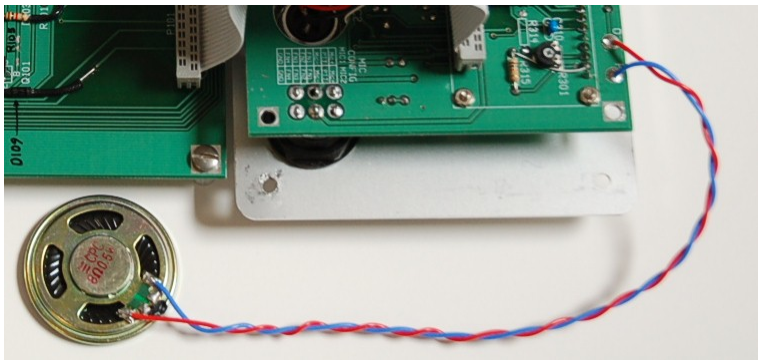
(d) Plug one end of the cable assembly into P102 on the main circuit board, and the other end into P302 on the front panel circuit board. Again, be sure not to cross the wires.



One end of the prepared cable plugs into P302 on the front panel circuit board.

(11) Identify the miniature round speaker (Mouser p/n 665-AS04508MR3R). *(Hint: a local source of small speakers is a drugstore or card shop that sells greeting cards that play songs. Remove the speaker, save the battery in your junk box, and send the card to your mother-in-law.)* Twist together two 12 inch lengths (approximately) of 22 AWG

stranded hookup wire, and strip and tin the ends about 1/4 inch. As shown below, solder one end of the twisted pair to pads "O" and "P" on the rear upper corner of the front panel circuit board, and the other end to the speaker. Either wire goes to either speaker terminal. Position the speaker on the bottom enclosure cover, underneath the main circuit board; it will be held in place by the speaker magnet. Note: If you want to try out your controller before you install a speaker, then you must temporarily solder a 1000 Ω – 2.2 KΩ resistor between pads "O" and "P" to use as a load. Otherwise your controller will exhibit erratic behavior.



The magnet in the miniature speaker holds it in place on the steel bottom cover of the StationPro II enclosure

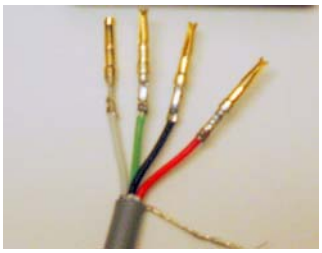
(12) Following the steps below, prepare a 4-conductor programming cable for your StationPro II. This cable will connect between a serial port on your computer and the program port P208 on the microcontroller circuit board. *Hint: If your computer does not have a serial port, you can buy a USB-to-serial adapter from Parallax, Inc. (the company that makes the Basic Stamp microcontroller) for $15. The item number is 28030 and the website is www.parallax.com*

(a) Cut a 5 ft length (approx) of 4-conductor cable. No shield is required, so you can bundle lengths of hookup wire together if you don't have 4-conductor cable. Strip each end of the cable wires by about 1/8 inch. *Hint: You can save yourself some time by purchasing a ready-made nine wire serial cable with a molded female DB-9 connector on one end. Clip off and discard the connector at the other end and then jump to step (e), below.*

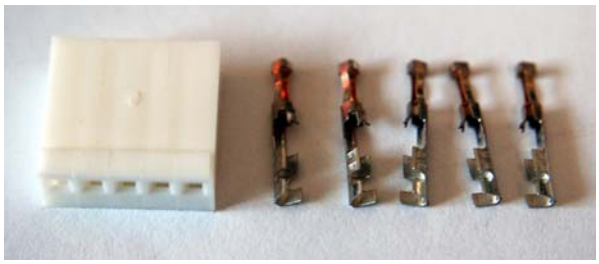
(b) Assemble the components of a 9-pin serial computer connector (Radio Shack part numbers are given below):

9-pin D-Sub female connector with crimp terminals (p/n 276-1428)
9-pin shielded D-Sub hood (p/n 276-1513 or 276-1539)

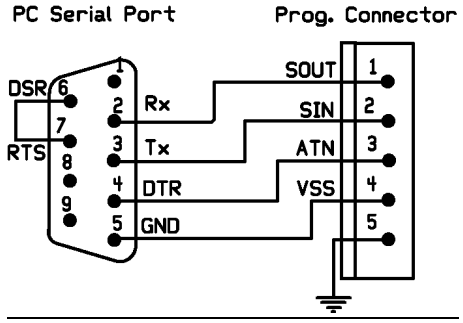
(c) Crimp and solder a terminal onto the wires at one end of the 4-conductor cable. If your cable has a shield, also attach a terminal to the shield. (Use needle-nose pliers to crimp the wires.)



(d) Crimp and solder a terminal onto each end of a 2 inch length of hookup wire. You will use this wire as a jumper in a following step.



(e) As shown above, identify one 5-pin Molex .100" nylon connector housing (Mouser p/n 538-22-01-2057) and five crimp terminals (Mouser p/n 538-08-52-0123). Crimp and solder a terminal onto the wires at the other end of your cable. (Note: if you are using a ready-made serial cable, then crimp terminals onto the wires coming from pins 2,3,4,5 of the DB-9 connector. Use an ohmmeter to verify the pin numbers. Twist and solder together the wires coming from pins 6 and 7.)



Programming Cable Wiring Diagram

(f) Install the terminals in accord with the above wiring diagram. The jumper wire you prepared in step (d) goes between pins 6 and 7 on the DB-9 connector.

The programming cable connects to a standard 9-pin DB-9 serial port on your computer.

IV. Programming and Checkout of the Controller

Before you can use your StationPro II, you must first program the Basic Stamp BS2-IC microcontroller. Fortunately, doing so is very easy and takes but a few minutes. ***(Note: Although I would prefer you do it yourself, as a service I will program your StationPro for you. The price is $15. Email me for instructions.)*** You begin by downloading two programs into your PC. The first is a free editor program from Parallax, Inc., and the second is the StationPro II firmware from the W8ZR StationPro website. Once these two programs are downloaded into your PC, the firmware can be transferred to the StationPro II in a few seconds Here is the step-by-step procedure.

(1) Download and install the free Basic Stamp editor into your PC from http://www.parallax.com/tabid/441/Default.aspx Choose the version of the editor for your particular operating system. Versions are available for early and late Windows operating systems and also Macintosh and Linux.

(2) Download the latest firmware version for the StationPro II from http://www.w8zr.net/stationpro/spdownload.htm The file name for the firmware has the form StnPro_code_08_11_09.bs2, where the "08_11_09" refers to the release date. Obviously you should download the latest release date. To download, right click (for Windows) the link and save the file to your hard disk. Be sure the saved file has the same file name as the original file.

(3) Open the Basic Stamp Editor. Once the Editor is open, then go to "Files" and open the StationPro II firmware file you have just downloaded. You should see the firmware program displayed on your screen. The Basic Stamp uses a form of BASIC known as P-BASIC. Note that the code has been extensively annotated, in order to facilitate changes, modifications, and hacking.

(4) The downloaded firmware has default entries for transceivers and amplifiers. These are “Transceiver 1”, “Transceiver 2”, and “Transceiver 3” for the transceivers (or receiver/transmitter pairs), and “Amplifier 1”, “Amplifier 2, and “Amplifier 3” for the linear amplifiers. You may use these default entries, but you probably will want to enter your own station equipment. To change the entries, scroll down to the second page of the program listing until you see something like the following on your computer screen:

```
'   ======================
'OWNER SUPPLIED DATA -- enter station equipment and fill out with spaces to
'make all descriptions exactly 15 characters. Note that quotation marks
'around each description are required.
      DATA @$030,  "Amplifier 1    "   'Enter AMP1 Info in quotes
      DATA @$040,  "Amplifier 2    "   'Enter AMP2 Info in quotes
      DATA @$050,  "Amplifier 3    "   'Enter AMP3 Info in quotes
      DATA @$060,  "Transceiver 1  "   'Enter TRX1 Info in quotes
      DATA @$070,  "Transceiver 2  "   'Enter TRX2 Info in quotes
      DATA @$080,  "Transceiver 3  "   'Enter TRX3 Info in quotes
```

Now enter your own station equipment on each of the six lines, between the quotation marks. There must be exactly 15 characters between the quotation marks, so that shorter descriptions must be padded out with spaces. Here is an example of a completed table:

```
      DATA @$030,  "Alpha 9500     "   'Enter AMP1 Info in quotes
      DATA @$040,  "QRO HF-2500DX  ”   'Enter AMP2 Info in quotes
      DATA @$050,  "Drake L4-B     "   'Enter AMP3 Info in quotes
      DATA @$060,  "Elecraft K3    "   'Enter TRX1 Info in quotes
      DATA @$070,  "TenTec Orion II”   'Enter TRX2 Info in quotes
      DATA @$080,  "Collins S-Line "   'Enter TRX3 Info in quotes
```

Next, scroll down to “Part II,” of the Owner Supplied Data section, which gives you the option of locking out specific amplifier/transceiver combinations. Follow the directions in the program listing, or skip this step if you do not want to lock out any amplifier selections. When you are done, press Ctrl+S to save your program. You may revise the table as many times as you want, as you change your station’s equipment.

(5) Connect a +12V DC power source to the power connector on the back panel of the StationPro II. Then plug the programming cable into P208 on the microcontroller circuit board, and connect the other end of the cable to your PC serial port. Note that pin 1 of P208 is indicated on the silkscreened legend, so don’t hook the connector backwards.

(6) Turn on the power switch on the StationPro II. The red Pwr LED should light, and also one of the yellow microphone LEDs. Other LEDs may or may not be lighted. The LCD display should be backlighted, but do not be alarmed if you do not see displayed text. Check the voltage at TP204 (on the left rear of the microcontroller circuit board), to verify that it is 4.9V– 5.1V.

(7) If all seems normal, press Ctrl+R on your keyboard to upload the firmware into your StationPro II. After a few seconds, your computer display will indicate a successful upload.

(8) Turn off the StationPro II for a few seconds and then turn it back on. You should hear the startup message "SP" in morse code, followed by a melodic beep and the sound of relays closing. Now adjust the contrast trimpot R301 on the back of the front panel circuit board until you see text on the LCD display.

Having now seen text displayed on the LCD, this is a good time to celebrate and take your spouse out to dinner.

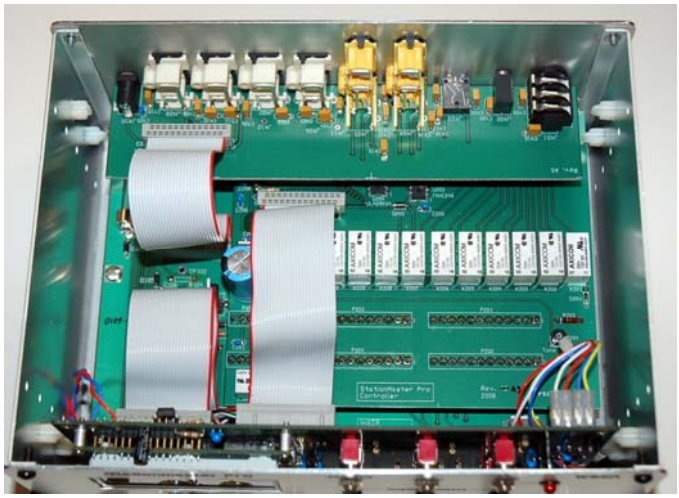
(9) Turn off the StationPro II and remove the programming cable.

(10) Mount the rear panel circuit board to the rear panel. The circuit board is attached to the panel by the hardware on the Key, Line In and Line Out jacks, and by six No. 4 x 3/8" sheet metal screws. Make certain that the RCA Phono jacks are properly centered in their holes on the panel before you tighten the sheet metal screws. Note that the black plastic washer on the key jack goes under the nut on the outside of the panel.

The rear panel circuit board attaches to the rear panel with six No. 4 x 3/8" sheet metal screws and the hardware on the jacks.

(11) Plug the free end of the ribbon cable coming from P103 on the main circuit board into P403 on the rear panel circuit board. The cable should not be twisted.

(12) Attach the top cover to the enclosure, using the black No.10 self-tapping screws supplied with the enclosure. This completes the assembly of the StationPro II control unit.



Interior view of the completed SP-II Control Unit