050-1496-00

M36789, S42994

## Q314/Q414 REPLACEMENT

For the following TEKTRONIX® oscilloscopes:

212 Serial Numbers B010100 - B079999
214 Serial Numbers B010100 - B089999

N-Channel Field Effect Transistor (FET), pn 151-1057-00, replaces P-Channel FET, pn 151-1072-00, which has been discontinued by the manufacturer. Extensive circuit changes are required to use the new transistor for Q314 or Q414.

NOTE

If the serial number of the oscilloscope is greater than those listed above, or if this kit has been previously installed, disregard the instructions and use pn 151-1057-00 as a direct replacement.



2-AUG-1989
Supersedes: 25-MAR-1983

KIT PARTS LIST:

| Ckt. No. | Quantity | Part Number | Description |
|---|---|---|---|
| DS320 or DS420 | 1 ea | 150-1000-00 | LED: Red, 40mA max |
| Q314 or Q414 | 1 ea | 151-1057-00 | FET: N-channel, Si, dual |
| CR313 or CR413 | 1 ea | 152-0246-00 | Diode, Si: 40V, 200mA |
| R315 or R417 | 1 ea | 311-0622-00 | Resistor, var: 100Ω, 10%, 0.5W |
| R322 or R422 | 1 ea | 315-0512-00 | Resistor, film: 5.1kΩ, 5%, 0.25W |
| R314 or R414 | 1 ea | 321-0164-00 | Resistor, film: 499Ω, 1%, 0.125W |
| R317 or R415 | 1 ea | 321-0168-00 | Resistor, film: 549Ω, 1%, 0.125W |
| R316, R318 or R416, R418 | 2 ea | 321-0776-03 | Resistor, film: 3.501kΩ, 0.25%, 0.125W |
| | 1 ea | Label: 050-kit | |

THE FOLLOWING INSTRUCTIONS ARE DIVIDED INTO FOUR SECTIONS:

SECTION A - Oscilloscope Disassembly.

SECTION B - Q314 REPLACEMENT.

SECTION C - Q414 REPLACEMENT.

SECTION D - Oscilloscope Reassembly.

## WARNING

*Potentially dangerous high voltages exist inside this instrument when it is operating. Disconnect the instrument from the power line and* ***turn it off*** *(disconnecting the instrument from the power line* ***does not*** *turn it off) before removing the cabinet halves.*

*The following instructions are for use by qualified service personnel only. To avoid personal injury, do not perform any of the following procedure unless you are qualified to do so.*

SECTION A. OSCILLOSCOPE DISASSEMBLY:

( ) 1. Unwrap the probe leads and power cord from the rear of the instrument.

( ) 2. Place the instrument upside down on the work surface.

NOTE

*Since the circuit board assembly is not fastened to the cabinet except by a close fit around the crt flange, be careful when performing the following steps to avoid dropping the assembly.*

( ) 3. Remove the two screws and neck-strap spacers located under the crt bezel.

( ) 4. Remove the nylon screw from the center of the bottom cabinet.

( ) 5. Loosen, but do not remove the two screws located at the rear of the bottom cabinet. The screws are located in the probe storage area.

( ) 6. While holding the crt in place, lift the bottom cabinet up and away from the instrument using a gentle rocking motion. Set the rear panel compartment cover and bottom cabinet aside.

NOTE

*To facilitate reassembly of the instrument, note the routing of the probe leads and power cord inside the instrument cabinet.*

( ) 7. Carefully lift the instrument out of the top cabinet.

( ) 8. Carefully lift the Power Supply circuit board and the two battery sets straight up; then lay them next to the instrument.

( ) 9. Remove the side panel control knobs. Removal of the VOLTS/DIV and SEC/DIV knobs may require the use of a small flat-bladed screwdriver to pry them loose.

( ) 10. Remove the mounting screws securing the side panel to the Input circuit board and remove the side panel.

( ) 11. Disconnect the Input circuit board from the rest of the instrument.

( ) 12. Remove the attenuator shields from both sides of the circuit board.

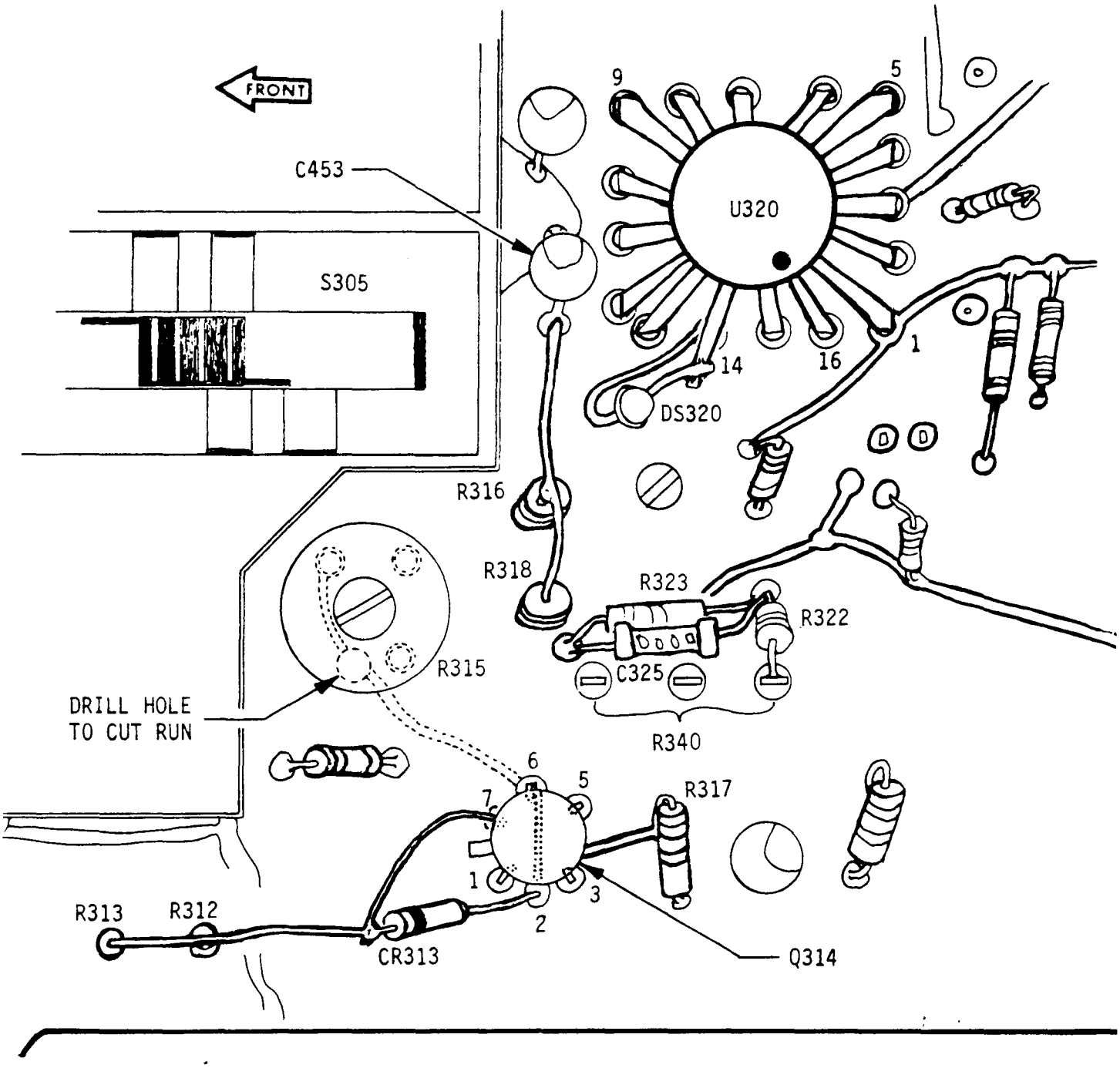


Fig. 1. Partial View - Front (Component Side) of Input Circuit Board. (Installation of Q314)

SECTION B. Q314 REPLACEMENT:

## CAUTION

*Be sure to position the parts installed in this procedure so they will not contact the attenuator shields.*

**Make the Following changes on the front (component side) of the input circuit board. Refer to figures 1 and 2 while performing steps B-1 through B-21.**

( ) 1. Remove R315.

( ) 2. Cut the inner-layer run connecting the front terminal of R315 to Pin 6 (drain) of Q314 by drilling a 1/32-inch diameter hole through the circuit board (and the run) in front of the terminal of R315 closest to Q314. Hold the circuit board to the light to locate the run.

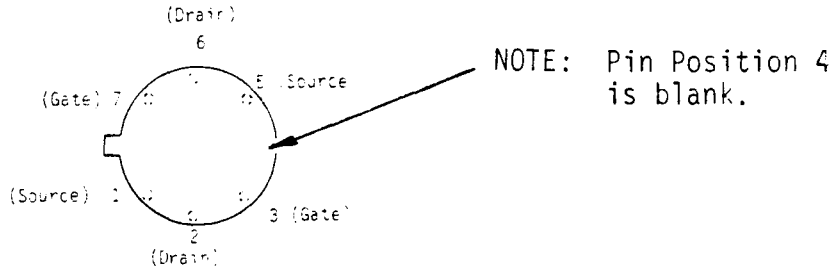


Fig. 2. **Q314 Pin Identification (Top View)**

( ) 3. Use an ohmmeter to check that the run has been cut.

( ) 4. Remove Q314.

( ) 5. Remove CR313.

( ) 6. Bend pin 7 of the new Q314, the dual FET from the kit, straight out.

( ) 7. Bend pin 2 of the new Q314 over to touch pin 6. Solder the two pins together and cut off the excess of pin 2.

( ) 8. Cut the remaining pins (1, 3, 5, and 6) of Q314 to 0.25-inch long and insert in the appropriate pin sockets.

( ) 9. Solder pin 7 (extended lead) of Q314 to the junction of R312 and R313.

( ) 10. Solder the cathode (banded) lead of the new CR313, the black-bodied diode from the kit, to the junction of R312, R313, and pin 7 of Q314.

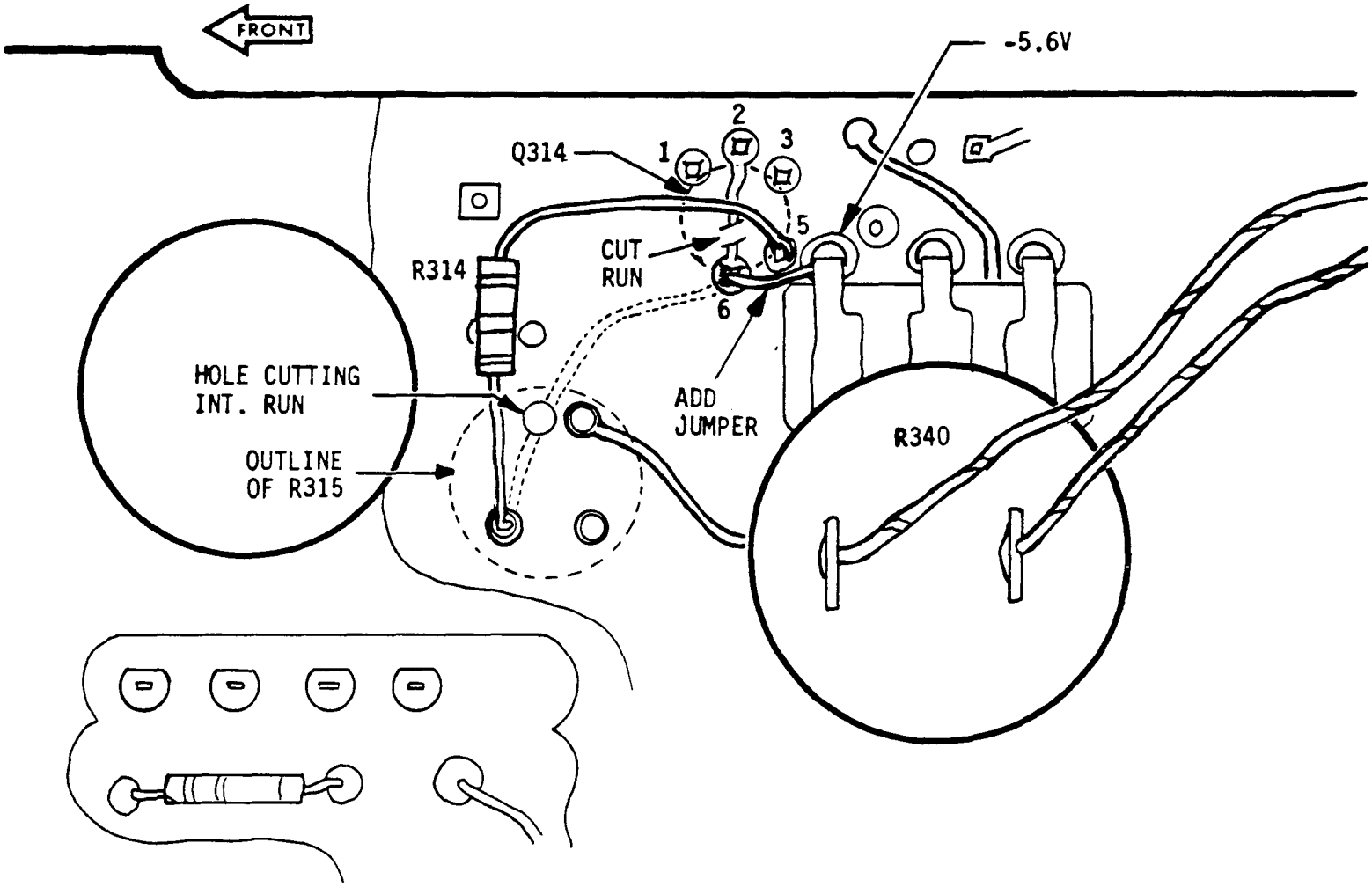


Fig. 3. Partial View - Back (Solder Side) of Input Circuit Board.
(Installation of Q314)

( ) 11. Solder the anode lead of CR313 to the empty pin socket (pin 2) of Q314.

( ) 12. Remove R316 (20kΩ) and R318 (20kΩ).

( ) 13. Trim both leads of the new R316 (one of the 3.501kΩ resistors from the kit) to 1/16-inch in length and solder one lead to the solder pad from which the original R316 was removed.

( ) 14. Trim one lead of the new R318 (the other 3.501kΩ resistor from the kit) to 1/16-inch in length. Solder this lead to the solder pad from which the original R318 was removed.

( ) 15. Trim the other lead of R318 to 5/8-inch in length. Bend it over parallel with the circuit board, then down to the closest (-5.6V) lead of C453, a 4.7μF tantalum capacitor. Solder this lead to the unconnected end of R316 and to C453 as shown in Fig. 1.

( ) 16. Unplug pin 14 of U320 from its socket and bend it straight out.

( ) 17. Solder the cathode (green dot) lead of DS320, the LED from the kit, to the socket from which pin 14 of U320 was removed.

( ) 18. Solder the anode lead of DS320 to the extended pin 14 lead of U320.

( ) 19. Replace variable resistor R315 (500Ω) with the 100Ω variable resistor from the kit.

( ) 20. Replace R317 (270Ω) with the 549Ω 0.125W resistor from the kit.

( ) 21. Add R322, the 5.1kΩ 0.25W resistor from the kit, between the rear (-5.6V) terminal of R340 and the rear junction of R323 and C323.

**Make the following changes on the back (solder side) of the Input circuit board. Refer to Fig. 3.**

( ) 22. Cut the run between pins 2 and 6 of Q314.

( ) 23. Add R314, the 499Ω resistor from the kit, between the front terminal of varialble resistor R315 and Pin 5 (source) of Q314.

( ) 24. Solder a jumper wire between the front (+5.6V) terminal of R340 and pin 6 (drain) socket of Q314.

**Proceed to Section D of this procedure.**

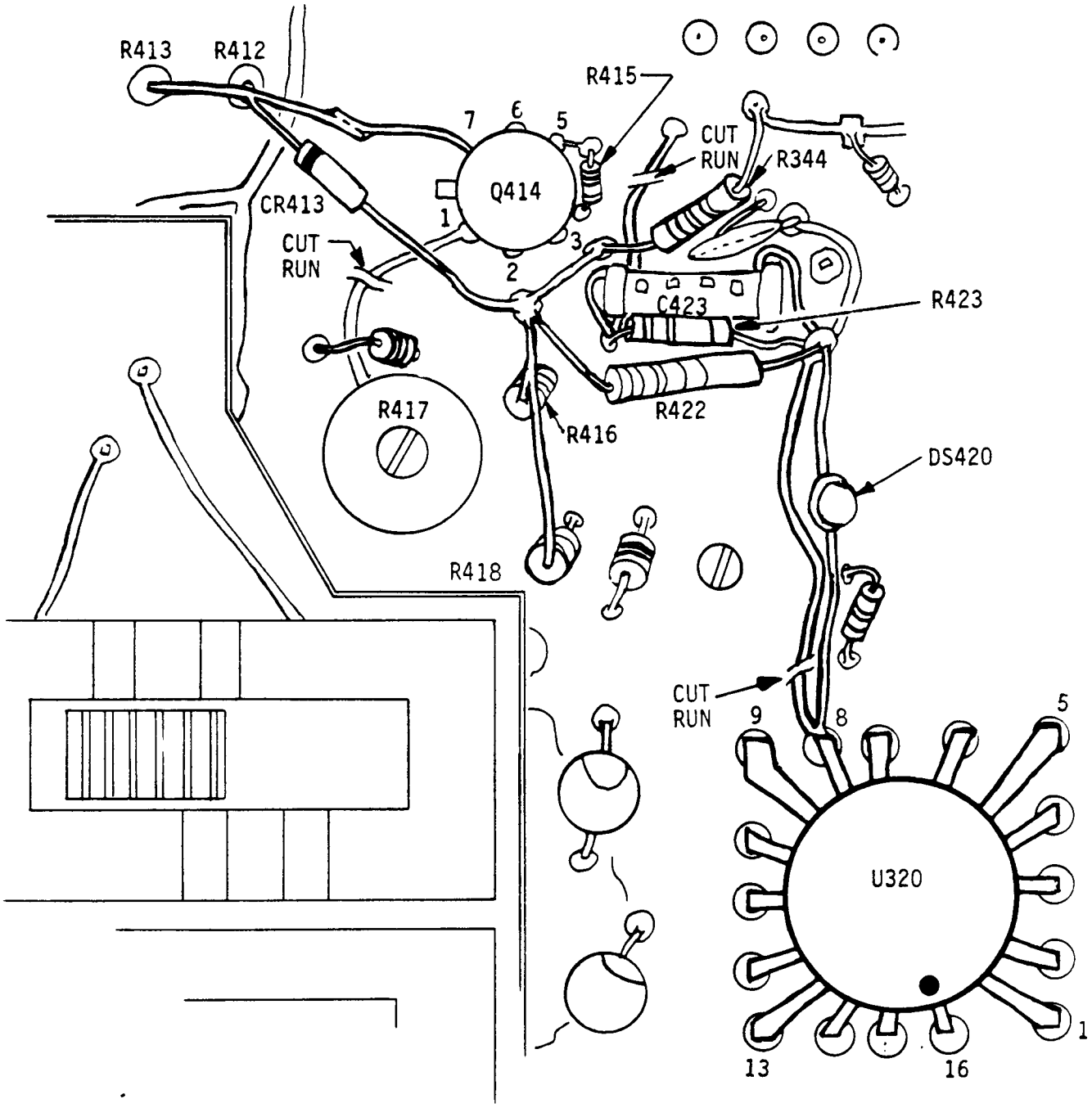


Fig. 4. Partial View - Front (Component Side) of Input Circuit Board. (Installation of Q414)

SECTION C. Q414 REPLACEMENT:

**CAUTION**

*Be sure to position the parts installed in this procedure so they will not contact the attenuator shields.*

( ) 1. Remove Q414.

( ) 2. Cut the run between variable resistor R417 and pin 1 (source) of Q414.

( ) 3. Cut the circuit board run connecting R440 (front terminal and R344.

( ) 4. Unsolder and remove the lead of R344 nearest R415 and solder it to the front terminal of R440.

( ) 5. On the back (solder side) of the circuit board, (see Fig. 6), solder a jumper between the solder pad from which R344 was unsoldered and the rear terminal (+5.6V) of variable resistor R440.

( ) 6. On the front (component side) of the circuit board, remove R416 and R418 (both 20kΩ resistors).

( ) 7. Install the new R416 and R418 (the 3.501kΩ resistors from the kit) as follows:

( ) a. Cut both leads of the new R416 to 1/8-inch in length and solder one lead to the solder pad from which the old R416 was removed.

( ) b. Cut one lead of the new R418 to 1/8-inch in length; cut the other lead to 5/8-inch in length.

( ) c. Solder the short lead to the solder pad from which the old R418 was removed; bend the other lead parallel with the circuit board and then down to be soldered to the front (-5.6V) terminal of R440.

( ) 8. Solder the new R422 (the 5.1kΩ resistor from the kit) between the rear junction of C423-R423 and the junction of R416-R418.

( ) 9. Cut the circuit board run between pin 8 of U320 and the junction of C423-R423-R422.

( ) 10. Solder the cathode lead (indicated by green dot) of the new DS420, the LED from the kit, to the junction of C423-R423-R422.

( ) 11. Solder the anode lead of DS420 to the socket for pin 8 of U320.

( ) 12. Remove the old CR413 (connected between +5.6V and the junction of R412-R413).

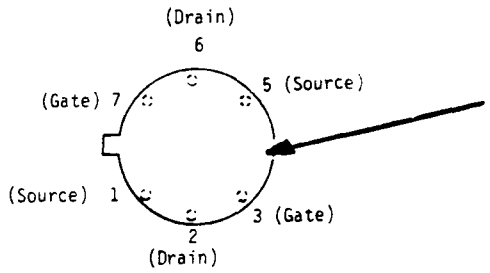


**Fig. 5. Q414 Pin Identification (Top View)**

( ) 13. Solder the cathode (banded end) lead of the new CR413 (the black-bodied diode from the kit) to the junction of R412-R413.

( ) 14. Solder the anode lead of CR413 to the junction of R416-R418-R422.

( ) 15. Bend pin 7 (gate) of the new Q414 (the dual-FET from the kit) straight out.

( ) 16. Install the new Q414 with the locator tab toward the front.

( ) 17. Solder pin 7 of Q414 to the extended lead of R413.

( ) 18. Replace R415 (270Ω) with the 549Ω 0.125W resistor from the kit.

( ) 19. Install the new R417, the 100Ω variable resistor from the kit, in place of the original 500Ω variable resistor.

( ) 20. On the back (solder side) of the circuit board (see Fig. 6), solder the new R414 (the 499Ω resistor from the kit) between the front terminal of variable resistor R417 and the socket for pin 1 (source) of Q414.

## SECTION D. OSCILLOSCOPE REASSEMBLY:

### CAUTION

*Before replacing the attenuator shields, check that none of the components can short to the shields or to each other.*

( ) 1. Partially reasemble the oscilloscope by performing the reverse of the procedure described in steps A-9 through A-12.

( ) 2. Recalibrate the Vertical System as directed in the Calibration Section of the Instruction Manual.

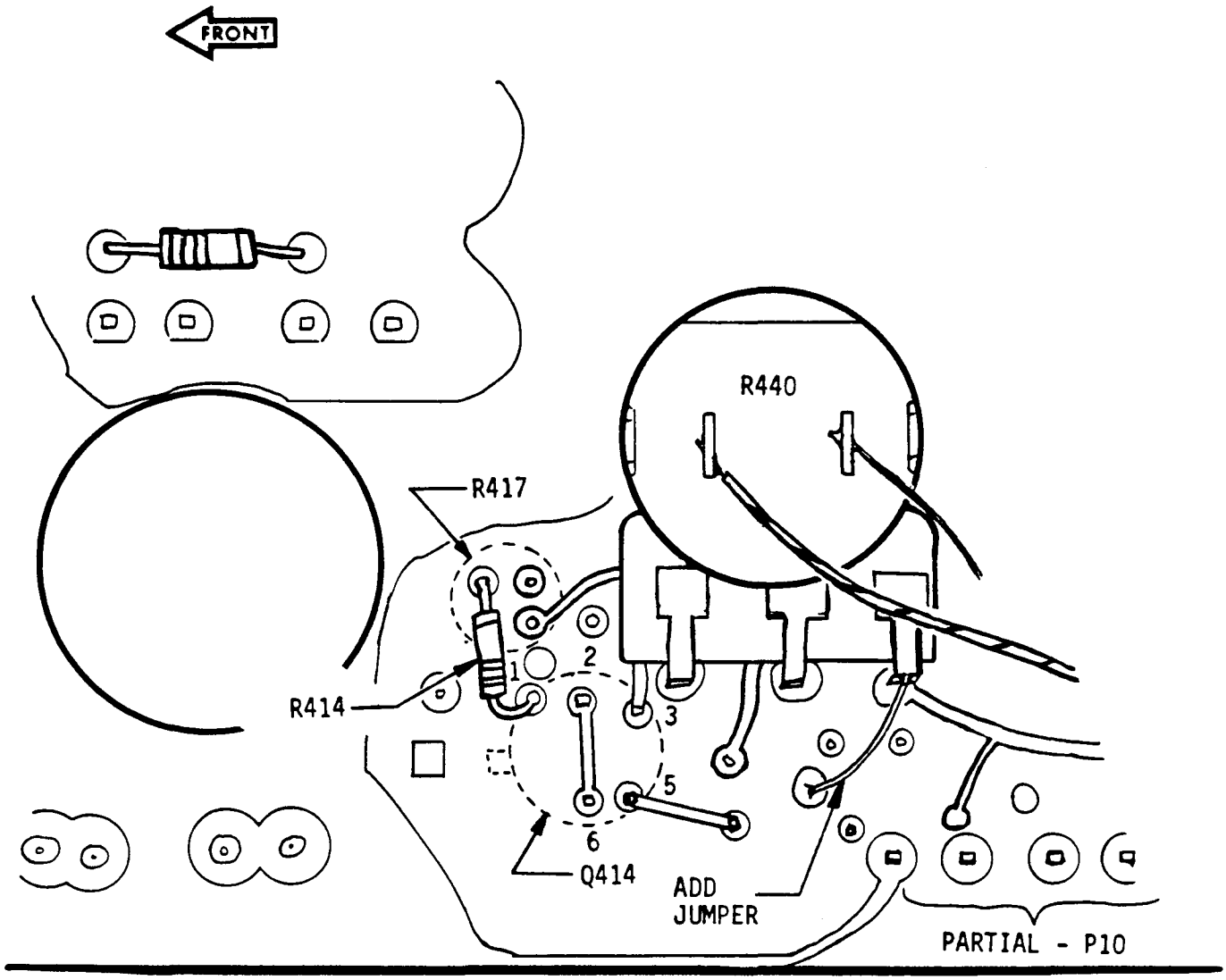


Fig. 6. Partial View - Back (Solder Side) of Input Circuit Board. (Installation of Q414)

( ) 3. Reinstall the two battery sets and the Power Supply circuit board into the instrument. Ensure the nibs on the plastic end caps of the battery sets align with the holes in the Amplifier circuit board.

( ) 4. Set the instrument (Amplifier circuit board down) into the top cabinet, ensuring the mounting holes in the circuit board fit down over the mounting nibs on the cabinet.

( ) 5. Ensure the crt filter is in place.

( ) 6. Carefully slide the front of the crt into the grooves in the cabinet.

( ) 7. Ensure the power cord and probe leads are routed properly inside the top cabinet, then place the power cord and probe leads in their respective cabinet exit slots. Note that the metal bands (on the cables) should be inside the cabinet so that they can prevent the cables from being pulled out of the instrument.

( ) 8. Install the bottom cabinet and ensure the cabinet halves fit together completely without being forced. Ensure the mounting nibs on the inside of the bottom cabinet align with the mounting holes in the Power Supply circuit board.

( ) 9. Slide in the cord wrap spool.

( ) 10. Ensure the cabinet is properly seated all the way around and that no cables are pinched between the cabinet halves.

( ) 12. Install and lightly tighten the two metal screws and neck-strap spacers under the crt bezel and the two screws located in the probe storage area of the bottom cabinet. Install the rear panel compartment cover hinge into its respective holes and tighten the four cabinet screws.

( ) 13. Install the nylon screw in the center of the bottom cabinet. Do not overtighten.

( ) 14. Remove the protective backing from the 050-kit label, included in this kit, and place the label on a clean flat surface of the bottom cabinet to indicate installation of this kit.

( ) 15. For future reference, attach the following Manual Modification Insert to the service manual.

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# TEKTRONIX

## MANUAL MODIFICATION INSERT

**Q314/Q414 REPLACEMENT**

for

212 Serial Numbers B010100 - B079999
214 Serial Numbers B010100 - B089999

Installed in SN_____ Date_____

This modification insert is provided to supplement the manual for the above listed product(s). The information given in this insert supersedes that given in the manual.



GENERAL INFORMATION:

The new N-Channel Field Effect Transistor (FET), pn 151-1057-00, replaces the P-Channel FET, pn 151-1072-00, which has been discontinued by the manufacturer. Extensive circuit changes are required to use the new transistor for Q314 or Q414.

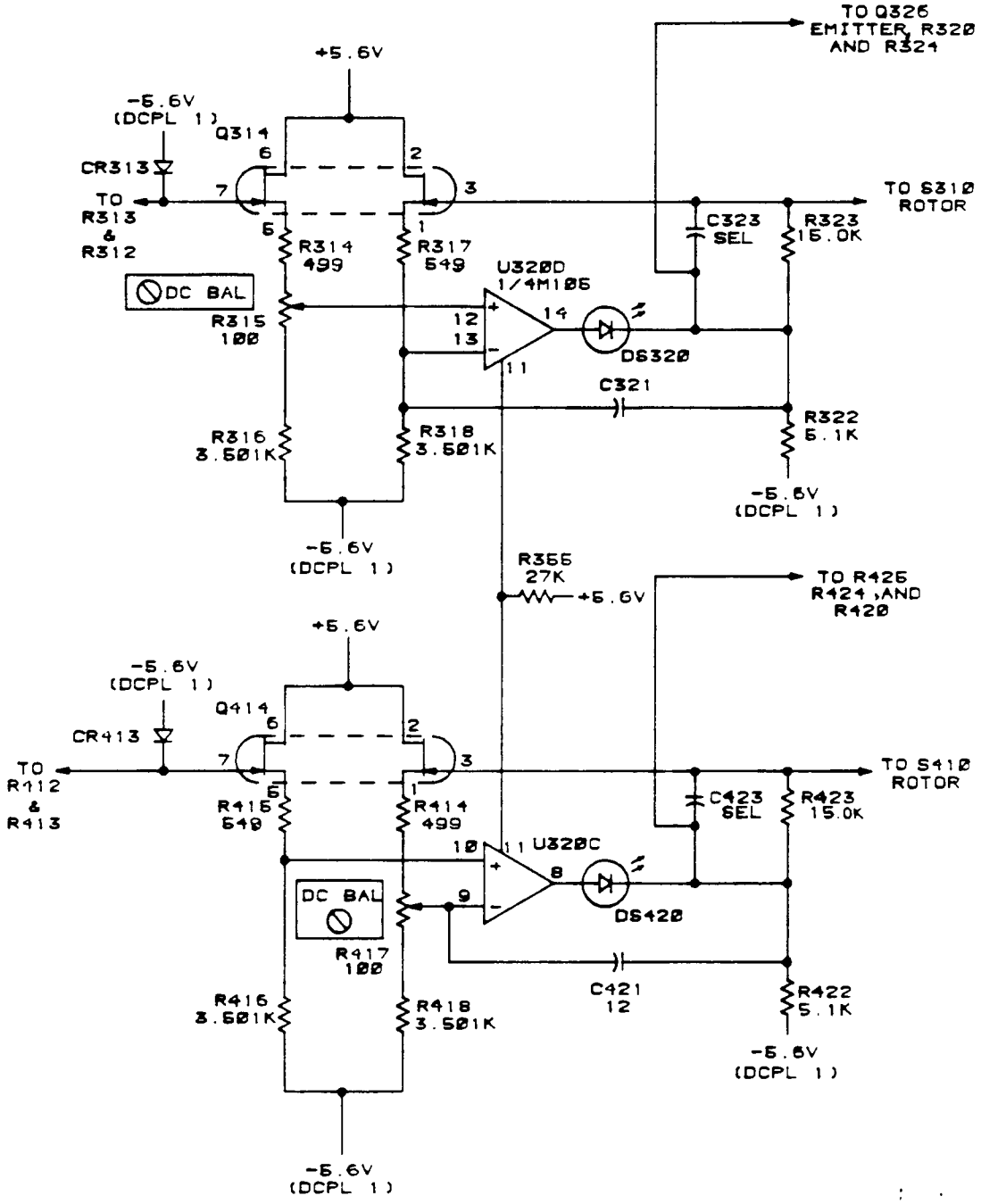
## REPLACEABLE ELECTRICAL PARTS

If Q314 was replaced:

| Ckt. No. | Part Number | Description |
|---|---|---|
| DS320 | 150-1000-00 | LED: Red, 40mA max |
| Q314 | 151-1057-00 | FET: N-channel, Si, dual |
| R314 | 321-0164-00 | Resistor, film: 499Ω, 1%, 0.125W |
| R315 | 311-0622-00 | Resistor, var: 100Ω, 10%, 0.5W |
| R316 | 321-0776-03 | Resistor, film: 3.501kΩ, 0.25%, 0.125W |
| R317 | 321-0168-00 | Resistor, film: 549Ω, 1%, 0.125W |
| R318 | 321-0776-03 | Resistor, film: 3.501kΩ, 0.25%, 0.125W |
| R322 | 315-0512-00 | Resistor, film: 5.1kΩ, 5%, 0.25W |

If Q414 was replaced:

| Ckt. No. | Part Number | Description |
|---|---|---|
| DS420 | 150-1000-00 | LED: Red, 40mA max |
| Q414 | 151-1057-00 | FET: N-channel, Si, dual |
| R414 | 321-0164-00 | Resistor, film: 499Ω, 1%, 0.125W |
| R415 | 311-0622-00 | Resistor, var: 100Ω, 10%, 0.5W |
| R416 | 321-0776-03 | Resistor, film: 3.501kΩ, 0.25%, 0.125W |
| R417 | 321-0168-00 | Resistor, film: 549Ω, 1%, 0.125W |
| R418 | 321-0776-03 | Resistor, film: 3.501kΩ, 0.25%, 0.125W |
| R422 | 315-0512-00 | Resistor, film: 5.1kΩ, 5%, 0.25W |




Partial - VERTICAL AMPLIFIER (1)