## Q935, Q946, Q947, OR Q9070 REPLACEMENT

### (Q933, Q935, Q940 OR Q942 in 2213 and 2215 instruments)

For the following TEKTRONIX® instruments:

| | | |
|---|---|---|
| 2213* | Serial Numbers | B020100 - Up |
| 2213 Opt. 48 | Serial Numbers | B010100 - Up |
| 2213A | Serial Numbers | B010100 - B029677 |
| 2215* | Serial Numbers | B022000 - Up |
| 2215 Opt. 48 | Serial Numbers | B010100 - Up |
| 2215A | Serial Numbers | B010100 - Up |
| 2235 | Serial Numbers | B010100 - B041675 |
| 2236 | Serial Numbers | B019720 - B028884 |

This kit provides parts and instructions to replace the SCR, FET, and inverter transistors. Because failure of any one of these components may cause excess stress to the others, replacement of all components is recommended.

The new silicon control rectifier has improved current characteristics and the new inverter transistors, have improved saturation characteristics. Use of the new field effect transistor, which has a higher voltage rating, requires changing the value of R908.

This replacement kit also incorporates the following reliability improvements.

1. The circuit location for VR901 and R900 are switched to prevent excess stress to VR901.
2. The values of R945 and R949 are changed to ensure the power supply shuts down if Q939, the inverter transistors, or the +8.6V, -8.6V or +5V supplies are shorted.
3. A diode-resistor network is added between the emitters of Q946/Q947 and the gate of Q935 to ensure power supply shutdown if an overvoltage occurs.

NOTE

If the instrument serial number is greater than those listed above or if this kit has been previously installed, disregard the instructions and use the new SCR, FET, and inverter transistors as direct replacements. Parts Replacement Kit, pn 050-2240-XX, is available to replace Q935, Q946, Q947, or Q9070 in 2236 instruments with serial numbers below B019720.

* This kit may be used on 2213 instruments below serial number B020100 and 2215 instruments below serial number B022000 if Option 48 has been installed. Option 48 instruments have a new Power Supply (with the Preregulator board mounted above the Main board) which was installed via a modification kit (040-1119-XX or 040-1120-XX).

## CAUTION

### STATIC SENSITIVE DEVICES

Static discharge can damage any semiconductor component in this instrument. Static voltages of 1kV to 30kV are common in unprotected environments.

### TO AVOID DAMAGE, OBSERVE THE FOLLOWING:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a wrist-strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of retaining a static-charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only approved, anti-static type, desoldering tools.

KIT PARTS LIST:

| Ckt. Number | Quantity | Part Number | Description |
|---|---|---|---|
| A1CR948/R948 | 1 ea | 119-3511-00 | Diode-resistor network<br>1N4148 and 10ohm 1/4w resistor in series, cathode of diode away from resistor. |
| A1W934 | 1 ea | 131-0566-00 | Bus, conductor: Dummy resistor |
| A1Q935* | 1 ea | 151-0565-00 | Thyrister, SCR: 8A, 200V, sens gate, TO-220<br>Substitute with S4010LS2TP |
| A1Q946*<br>A1Q947* | 2 ea | 151-0852-00 | Transistor: NPN, 50V, 150mA, 200mW, Inverter<br>Substitute with TIP41C |
| A1Q9070* | 1 ea | 151-1245-00 | Transistor: MOSEFET, N-Channel, TO-220<br>Substitute with IRFBC40LCPBF |
| A1R945 | 1 ea | 301-0202-00 | Resistor, fxd, film: 2kΩ, 5%, 0.5W |
| A6R900 | 1 ea | 301-0474-00 | Resistor, fxd, film: 470kΩ, 5%, 0.5W |
| A6VR901 | 1 ea | 307-0456-00 | Resistor, volt sens: 250vac, 20W<br>Substitute with V250LA20AP |
| A1R949 | 1 ea | 308-0755-00 | Resistor, fxd, ww: 0.75Ω, 5%, 2W |
| A1R908 | 1 ea | 315-0222-00 | Resistor, fxd, film: 2.2kΩ, 5%, 0.25W |
| | 1 ea | ----- ----- | Label: 050-kit |

* A1Q935, A1Q946, A1Q947 and A1Q9070 are designated A18Q935, A10Q940, A10Q942 and A18Q933, respectively, in 2213 and 2215 instruments.

INSTALLATION INSTRUCTIONS:

THE FOLLOWING INSTRUCTIONS ARE DIVIDED INTO TWO SECTIONS.

SECTION A applies to 2213 and 2215 instruments.

SECTION B applies to 2213A, 2215A, 2235, and 2236 instruments.

SECTION A (2213 and 2215):

**WARNING**

*Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure the power switch is in the off position. Then, disconnect the instrument from the power source. Disassembly should only be attempted by qualified service personnel.*

( ) 1. Remove the instrument wrap-around cabinet.

( ) 2. Remove the screw used to secure the plastic power supply shield to the solder side of the Main circuit board and set the shield aside.

( ) 3. Remove the metal power supply shield from the component side of the Main circuit board as follows:

( ) a. Remove the screw used to secure the lower right front corner of the power supply shield to the Main circuit board. The screw is accessible from the solder side of the Main circuit board.

( ) b. Remove the three screws used to secure the power supply shield to the rear chassis (two located along the left rear edge of the shield and one located in the upper right rear corner of the shield).

( ) c. Remove the screw used to secure the upper right front corner of the power supply shield.

( ) d. Remove the screw used to secure the support bracket to the top left front corner of the power supply shield and rotate the support bracket away from the shield.

( ) e. Remove the screw used to secure the Preregulator circuit board assembly to the upper left corner of the power supply shield.

( ) f. Carefully lift the power supply shield up and out of the chassis by removing the right rear corner first.

( ) 4. Remove the Preregulator circuit board assembly as follows:

( ) a. Remove the two screws used to secure the Preregulator circuit board mounting brackets (one near the top center of the rear chassis and one on the right side near the rear corner of the chassis).

( ) b. Remove the securing screw that is acccessible through the hole in the plastic shield located on top of the Preregulator circuit board.

( ) c. Disconnect the four wire connectors (P801, P802, P803, and P804) from the Preregulator circuit board noting their locations for reference during installation.

( ) 5. On the A10 Main circuit board, replace Q940 and Q942 with the new components included in this kit. Refer to the parts list on page 3 for circuit and part number information.

**Make the following changes on the A18 Preregulator circuit board.**

( ) 6. Replace Q933 and Q935 with the new components included in this kit. Refer to the parts list on page 3 for circuit and part number information.

( ) 7. Replace R934, a 3Ω 3W resistor located adjacent to Q933, with the dummy resistor (W934) included in this kit.

( ) 8. Install the Preregulator circuit board assembly and the two power supply shields, by performing the reverse of the procedure described in steps 2 through 4.

( ) 9. Refer to the Performance Check Procedure in the Instruction Manual and verify performance.

( ) 10. Remove the protective backing from the 050-kit label, included in this kit, and place the label on a clean, flat surface of the rear panel.

( ) 11. Correct the Replaceable Electrical Parts list in the Instruction Manual with the information provided in the parts list of this kit.

SECTION B (2213A, 2215A, 2235, and 2236):

**WARNING**

*Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure the power switch is in the off position. Then, disconnect the instrument from the power source. Disassembly should only be attempted by qualified service personnel.*

( ) 1. Remove the instrument wrap-around cabinet.

( ) 2. Remove the screw used to secure the plastic power supply shield to the solder side of the Main circuit board and set the shield aside.

( ) 3. For 2236 instruments only, lift the CTM circuit board up to the service position and secure the board latch into the chassis side rail.

( ) 4. Remove the metal power supply shield from the component side of the Main circuit board as follows:

( ) a. Remove the screw used to secure the lower right front corner of the power supply shield to the Main circuit board. The screw is accessible from the solder side of the Main circuit board.

( ) b. Remove the three screws used to secure the power supply shield to the rear chassis (two located along the left rear edge of the shield and one located in the upper right rear corner of the shield).

( ) c. Remove the crt anode lead from the anode clip on the side of the power supply shield.

( ) d. Remove the screw used to secure the upper right front corner of the power supply shield.

( ) e. Carefully lift the power supply shield up and out of the chassis by removing the right rear corner first.

Make the following changes on the A1 Main circuit board.

( ) 5. Replace Q935, Q946, Q947, and Q9070 with the new components included in this kit. Q946, Q947 and Q9070 are located on the nearby metal shield. Refer to the parts list on page 3 for circuit and part number information.

( ) 6. Check the value of R934. If R934 is a 3Ω 3W resistor, replace it with the dummy resistor (W934) included in this kit.

( ) 7. Replace R908, a 3kΩ 0.25W resistor, with the 2.2kΩ resistor included in this kit.

**Perform step 8 only on 2235 instruments below serial number B011700. The 2213A, 2215A and 2236 instruments already have the correct resistor.**

( ) 8. Remove CR945 and replace R945, a 6.2kΩ 0.5W resistor, with the 2kΩ resistor included in this kit.

**Perform step 9 only on 2236 instruments in the serial number range of B019720 to B028298 inclusive. The 2213A, 2215A and 2235 instruments already have the correct resistor.**

( ) 9. Replace R949, a 0.51Ω 2W resistor, with the 0.75Ω resistor included in this kit.

**Perform step 10 only if the diode-resistor network shown in Fig. 1 is not present.**

( ) 10. Install the diode-resistor network, included in this kit, as shown in Fig. 1. Connect the cathode lead to the lead of R935 that is closest to the rear of the instrument. Connect the resistor lead of the new network to the lead of R949 that is nearest the front of the instrument. Ensure both leads of the new network make a solid mechanical connection by installing the leads into the circuit board holes with the resistor leads or by wrapping the network leads around the resistor leads before soldering.

( ) 11. If VR901, on the EMI Filter circuit board, is located adjacent to the 10Ω thermal resistor (RT901), the physical locations of VR901 and R900 will need to be swapped. A voltage sensitive resistor (VR901) and a 470kΩ resistor (R900) have been included in this kit to facilitate swapping their locations.

( ) 12. Install the two power supply shields by performing the reverse of the procedure described in steps 2 through 4.

( ) 13. Refer to the Performance Check Procedure in the Instruction Manual and verify performance.

( ) 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 rear panel.

( ) 15. Correct the Replaceable Electrical Parts list and the Power Supply, Z-Axis & CRT schematic in the Instruction Manual with the information provided in the parts list of this kit.

JLG

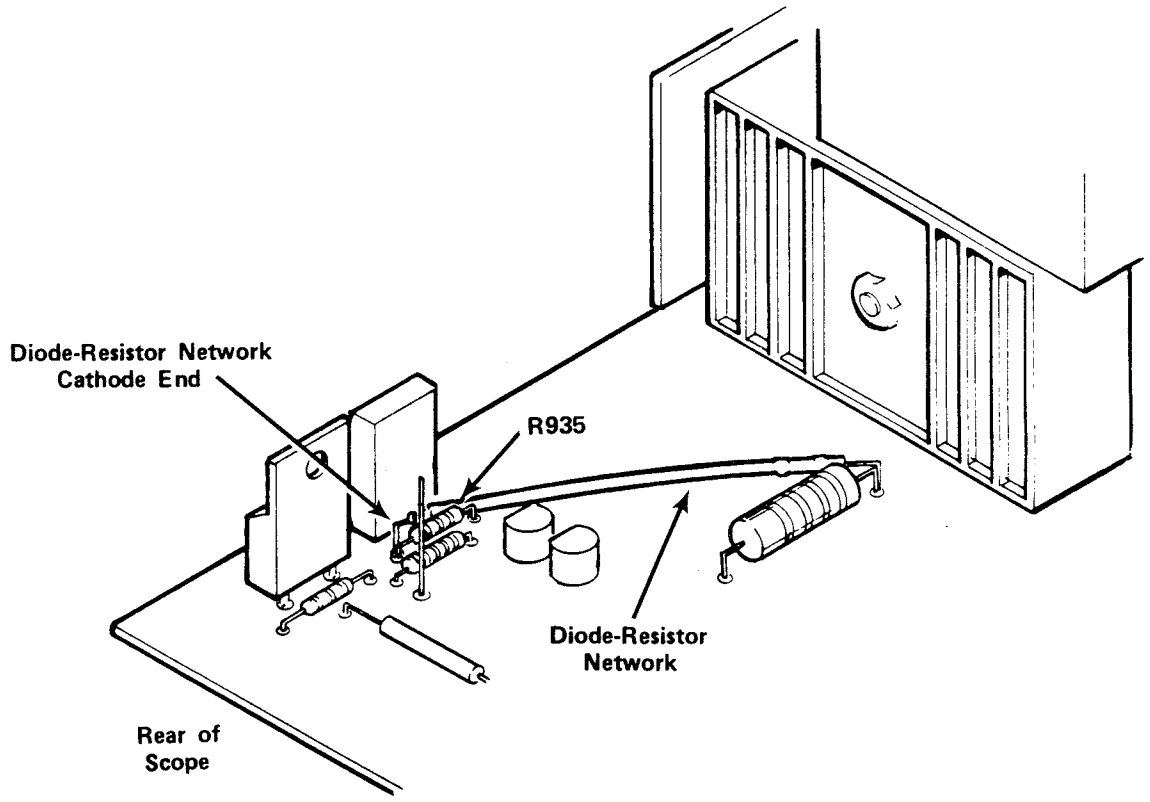


Fig. 1. Location of new diode-resistor network.