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SERVICE MANUAL SUPPLEMENT
THEORY GUIDE
KODAK RP *X-OMAT* PROCESSOR, MODEL M7B

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ELECTRICAL THEORY OF OPERATION

CIRCUIT DESCRIPTION

See the Schematic Diagram

Dryer Temperature Control, Main Drive and Water Saver Solenoids.

- Power Supply Circuit

Actuating CIRCUIT BREAKERS CB1 and CB3 supplies 120 V ac to TRANSFORMER T1. This voltage is stepped down to 18 V ac and rectified to 20 V dc by full wave DIODES CR23 AND CR24. The rectified 20 V dc is regulated to 12 V dc by VOLTAGE REGULATOR U1. The regulated 12 V dc turns on CR9 LED and provides power to the standby control circuit, SOLID-STATE RELAY U1 and RELAY K1. — 1E,1F; 2E&G; 3E,4G; 3E,10B

- Standby Control Circuit:

The Standby Control Circuit has two timers:

1. • Three-minute (adjustable) film clear timer.
2. • Eight-minute (fixed) standby timer.

Three-Minute Film Clear Timer

A three-minute LATCH U15 defines the state of the timer. If U15 pin 4 is hi and the latch is set, then the three-minute timer is counting and CR4 LED is on. If U15, pin 4 is lo and the latch reset, then the three-minute timer is off and CR4 LED is off. — 7D; 8E; 7D,8E

The three-minute LATCH is reset (CR4 is off) by OR gate U6, pin 3. U6, pin 3 is controlled by the power-up pulse U6, pin 2 or by COUNTER U10, pin 12. — 7D

The film clear timer is adjusted by POTENTIOMETER R1, which in turn, adjusts the rate of clock 2 pulses from OSCILLATOR U2, pin 9. COUNTER U10 counts these clock 2 pulses (2048 pulses), then pin 12 of U2 goes hi. Either the power-up pulse from OR GATE U7, pin 5, or STANDBY RESET SWITCH S6 or the FILM DETECTOR SWITCHES S4/S5 will reset COUNTER U10 with a hi at pin 11. This inhibits the counter, and a lo allows the counter to count the clock 2 pulses. Actuating STANDBY RESET SWITCH S6 or the FILM DETECTOR SWITCHES S4/S5 provides a lo to pin 2 of OPTICAL ISOLATOR U4. This, in turn, lights CR6 LED. Pin 5 of U4 goes lo. This lo satisfies OR gate U7 with a hi at pin 4. This hi holds COUNTER U10, pin 11 in the reset mode or "not counting" mode. Releasing the STANDBY RESET SWITCH S6 or FILM DETECTOR SWITCH S4/S5 reverses the above description with LED CR4 on. — 6B; 7D; 6D,5E; 5E,5F; 7D; 5E,5F; 5C; 5C; 7D; 5E; 8D

TRANSISTOR Q2 is now turned on by the three-minute timer circuit; U7 and pins 11 and 12 are hi. The collector of Q2 goes lo, LED CR2 is on and RELAY K1 is energized by the STANDBY OVERRIDE SWITCH S8 in the normal mode. The BLOWER MOTOR B2, DRIVE MOTOR B1, and WATER SAVER SOLENOID L1 are on. With STANDBY OVERRIDE SWITCH S8 in the override mode, RELAY K1 is always energized, thereby overriding the printed circuit board, PCB 100. — 9D; 10B,10D; 11B; 10B

Eight-Minute Standby Timer

The eight-minute timer cannot be on if the three-minute timer is on; that is, turning on the three-minute timer turns off the eight-minute timer. Once the three-minute timer has timed out, then the eight-minute timer will start to count *if* the DRYER THERMOSTAT S3 is not calling for heat but is at operating temperature. — 4B

	See the Schematic Diagram
If the dryer is not at the set temperature, then the eight-minute timer waits until the DRYER THERMOSTAT S3 is up to temperature and *only* then does the eight-minute timer begin to count.	4B
If DRYER THERMOSTAT S3 is calling for heat *before four seconds are counted,* then the eight-minute timer will reset itself and again wait until the DRYER THERMOSTAT S3 is satisfied.	4B 4B
Once the eight-minute timer counts out, COUNTER U11 waits for the DRYER THERMOSTAT S3 to close, bring the dryer up to temperature, then open and start another eight-minute cycle.	7B
The DRYER THERMOSTAT S3 controls SOLID-STATE RELAY U1 as follows: When the DRYER THERMOSTAT S3 closes, the output of OPTICAL ISOLATOR U3, goes lo, INVERTER U16, pin 14 goes hi, and gate U17, pin 8 is enabled because the three-minute timer is counting. U17, pin 9 goes hi and produces a lo at U17, pin 10. INVERTER U16, pin 2 goes hi, turns on TRANSITOR Q1 which energizes SOLID-STATE RELAY U1.	4B 4B,11E 4B,5B 7B 8D 9F,10E

Replenishment Control

- Power Supply Circuit

Actuating CIRCUIT BREAKERS CB1 and CB3 supplies 120 V ac to TRANSFORMER T1. This voltage is stepped down to 18 V ac and rectified to 20 V dc by full-wave DIODES CR23 and CR24. The rectified 20 V dc is regulated to 12 V dc by VOLTAGE REGULATOR U1. The regulated 12 V dc turns the CR9 LED on and provides power to the standby control circuit, BUZZER DS1 and RELAY K3.	1D,1E 2D,2F 3E 6C,7A

- Standby Control Circuit

The REPLENISHER PUMP B4 operates continuously when film is present in the FILM DETECTOR SWITCH ASSEMBLY S4/S5 and for an additional three seconds after the film leaves the detector assembly. The replenisher pump also operates by depressing and holding the STANDBY RESET SWITCH S6; releasing this switch turns off the pump.	7B 4E 4B
The BUZZER DS1 operates everytime that the STANDBY RESET SWITCH S6 is depressed, and it buzzes for one second, three seconds after the film leaves the FILM DETECTOR SWITCH ASSEMBLY S4/S5.	6C,4B
Film in the FILM DETECTOR SWITCHES S4/S5 causes OPTICAL ISOLATOR U5 pin 5 to go lo. This causes the three-second latch U15, pin 11 to go hi which passes through U12, pins 6 and 4. This turns on TRANSISTOR Q3, thereby, energizing RELAY K3 and REPLENISHER PUMP B4.	4E,4D 6B 7A,7B
A lo from OPTICAL ISOLATOR U5, pin 5 holds DECADE COUNTER U9, pin 15 hi. When the film leaves the FILM DETECTOR SWITCHES S4/S5, the DECADE COUNTER pin 15 counts the one-second pulses that are present. After a count of three pulses, the output of U9, pin 7 goes hi for one second and energizes the BUZZER DS1. This one-second pulse resets the three-second latch U15, pin 11 which goes lo and deenergizes RELAY K3. The power-up pulse from U6, pin 4 is used to reset the three-second latch when the processor is turned on.	5D 4E 5D 7C 5C,7A 5B

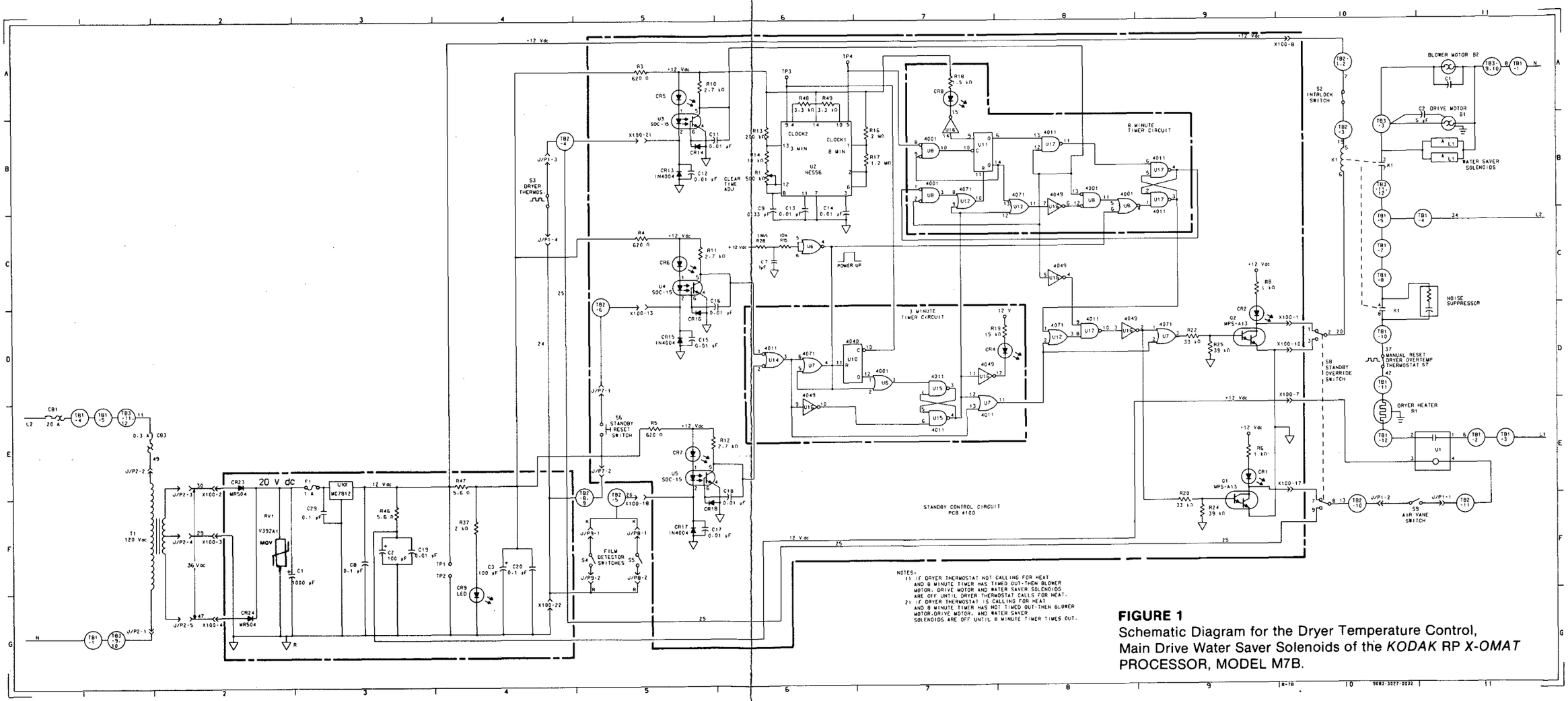

FIGURE 1
Schematic Diagram for the Dryer Temperature Control, Main Drive Water Saver Solenoids of the *KODAK* RP *X-OMAT* PROCESSOR, MODEL M7B.

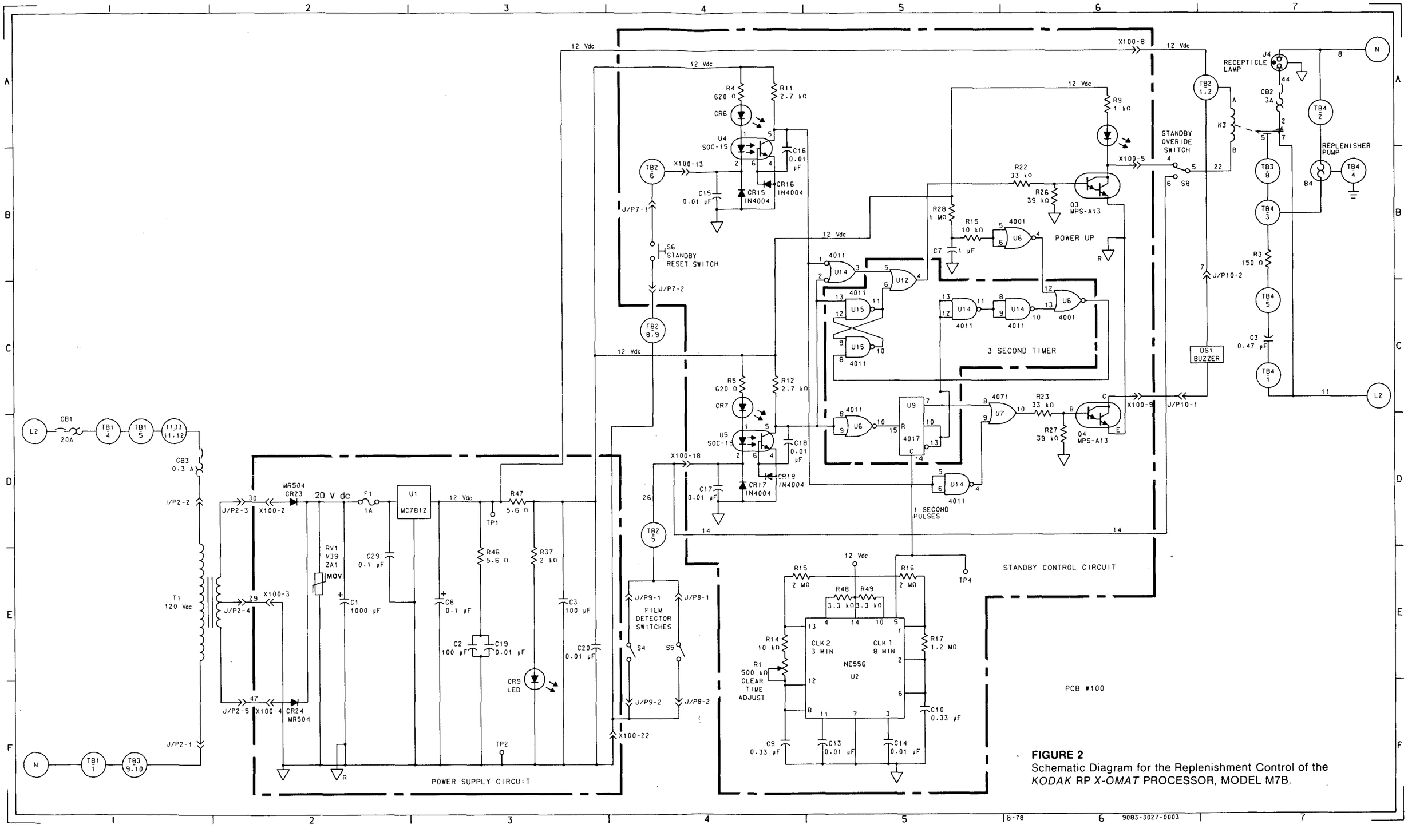

FIGURE 2
Schematic Diagram for the Replenishment Control of the *KODAK* RP *X-OMAT* PROCESSOR, MODEL M7B.

Developer Temperature Control

See the Schematic Diagram

- Power Supply Circuit

Actuating CIRCUIT BREAKERS CB1 and CB3 supplies 120 V ac to TRANSFORMER T1. The voltage is then stepped down to 18 V ac and rectified to 20 V dc by full-wave DIODES CR23 and CR24. The rectified 20 V dc is regulated to 12 V dc by VOLTAGE REGULATOR U1. The regulated 12 V dc turns on the CR9 LED and provides power to the solution presence/-overtemperature circuit, developer temperature control circuit, RELAY K2 and SOLID-STATE RELAY U2.

1C,1D,1E
2D,2F
2D
5B,5D

- Developer Temperature Control Circuit

Voltage divider network RESISTORS R30, R31 and R2 provide the reference voltage to pin 2 of VOLTAGE COMPARATOR U13. The desired developer temperature is set by adjusting POTENTIOMETER R2. Another Voltage divider network, consisting of RESISTOR R29 and THERMISTOR RT-1, provides a voltage to pin 3 of U13. This voltage is dependent on the temperature of the solution.

4D,4E,4F
4E
4F
4D,4E

If the voltage at U13, pin 3 is greater than the voltage at U13, pin 2, the solution is below the set temperature and the output at U13, pin 1 is hi. TRANSISTOR Q5 (NPN Darlington) is turned on; the collector goes lo and turns on LED CR10 and SOLID-STATE RELAY U2.

5E
5D

If there are no overtemperature conditions and solution is present, the solution presence/overtemperature circuit will energize RELAY K2. With RELAY K2 energized SOLID-STATE RELAY U2 energized, the developer heater is energized.

5B
6B,5D

With the developer at operating temperature, the resistance of THERMISTOR RT-1 has decreased in value and the voltage at pin 3 of VOLTAGE COMPARATOR U13 is lower than the voltage at pin 2 of U13. Therefore, the output of U13, pin 1 goes lo. TRANSISTOR Q5 turns off, the collector goes hi, and CR10 LED and SOLID-STATE RELAY U2 are turned off.

4E
4E
5E
5D

- Solution Presence/Overtemperature Circuit (Serial Numbers 14,579 and lower)

A probe in the thermowell detects the presence of developer and also senses the temperature of the developer. The probe contains an overtemperature switch which senses the temperature of the developer. The probe shell receives 18 V ac which is grounded through the developer to the heater shell when developer is present.

Voltage divider network RESISTORS R42 and R43 provide a fixed reference voltage to pin 5 of VOLTAGE COMPARATOR U13. When the voltage at pin 5 is greater than the voltage at pin 6, and there is a "solution present/not overtemperature" condition, the output at pin 7 is hi. TRANSISTOR Q6 (NPN Darlington) turns on; the collector goes lo, which energizes RELAY K2 and LED CR11. Under these normal conditions, RELAY K2 is *always* energized.

4B,4C
4E
5B
5B

The input to VOLTAGE COMPARATOR U13, pin 6 is provided by DIODES CR12 and CR20 to the overtemp/presence probe. These diodes also act as halfwave rectifiers when there is a "developer overtemp and / or solution no present" condition. Under normal conditions U13, pin 6 is at ground because the solution overtemp switch is closed which connects CR12 anode to ground. The solution shorts the anode of CR20 to ground through the probe shell, to the developer, then to the developer heater shell.

4B,4E

A "developer overtemp and/or solution not present" condition will remove ground from the diode which charges CAPACITOR C6, for approximately *one second,* to a voltage higher than that on VOLTAGE COMPARATOR U13, pin 5. This causes the output of VOLTAGE COMPARATOR U13, pin 7 to go lo which turns off TRANSISTOR Q6. LED CR11 goes off and RELAY K2 is deenergized.

4B
4B
4E
5B,6B

See the Schematic Diagram

The collector of Q6 goes to VOLTAGE COMPARATOR U13, pin 6 through CR21 and R40. 4B
This holds VOLTAGE COMPARATOR U13, pin 6 higher than pin 5 *even* if the "developer overtemp and/or solution no present" condition is corrected. The circuit is reset by removing power after the condition has been corrected, turning CR1 off and waiting approximately *three* seconds for CAPACITOR C6 to discharge through R41 before reapplying power. This prevents cycling of the overtemperature thermostat. 4B 4B

Solution Presence/Solution Overtemperature Circuit (Serial Numbers 14,580 and higher)

Sensing the Presence of the Developer Solution

An ANODE TUBE is located in the plumbing between the DEVELOPER THERMOWELL and the HEAT EXCHANGER in the FIXER TANK. It is supplied with 18 V ac. When developer solution is present between the ANODE TUBE and the HEATER SHELL, the 18 V ac is shorted through the solution to ground. (Ground is provided by the shell of the SOLUTION HEATER.) This connection grounds the anode of the HALF-WAVE RECTIFIER CR20 and pin 6 of VOLTAGE COMPARATOR U13.

Sensing an "OVERTEMPERATURE" Condition

An OVERTEMPERATURE condition exists when the temperature of the developer solution is higher than 125°F. A PROBE in the DEVELOPER THERMOWELL contains a SWITCH that senses the temperature of the developer solution. During normal operation, the temperature is less than 125°F and the SWITCH is closed. Both the anode of HALF-WAVE RECTIFIER CR12 and pin 6 of VOLTAGE COMPARATOR U13 are grounded. The U13, pin 6, voltage can be measured at TP9.

Monitoring the Presence and the Overtemperature of the Developer Solution

As previously explained, pin 6, of U13 is at ground voltage during normal operation. Pin 5 of U13 is supplied with a reference voltage of approximately 4 V dc, which can be measured at TP10. Thus, U13, pin 5, has a higher voltage than U13, pin 6, (ground) and the output at U13, pin 7, is hi. This hi energizes TRANSISTOR Q6 (NPN Darlington), and its COLLECTOR goes lo. This signal energizes RELAY K2 and LED CR11. K2 connects the DEVELOPER HEATER and the "READY" LAMP 13 to one side of the supply voltage.

Error Indications

If the LED CR11 goes off during normal operation, *one* or *both* of the following errors occurred:

1. **Solution not present between the ANODE TUBE and the HEATER SHELL.** The short through the solution will open, which breaks the ground to CR20 and to U13, pin 6.

NOTE

Developer solution has a higher electrical conductivity than water. If this error indication is provided when you are testing the processor with water, and 1/4 cup of developer solution to the water to raise its conductivity. This will correct a false error indication caused by the low conductivity of the water.

2. **OVERTEMPERATURE condition.** If the temperature of the developer solution rises above 125°F, the SWITCH inside the PROBE opens. This breaks the ground to CR12 and to U13, pin 6.

Circuit Activity After an Error Is Detected

When the ground to either CR20 or CR12 is broken — as described above — CAPACITOR C6 charges for approximately one second, and the voltage at U13, pin 6, is higher than the voltage at U13, pin 5. This condition causes the output at U13, pin 7 to go lo. This lo deenergizes TRANSISTOR Q6, and its COLLECTOR goes hi. This signal deenergizes RELAY K2 and turns off LED CR11. The "READY" LAMP 13 also goes off. The hi signal from the COLLECTOR is returned to U13, pin 6, through CR21 and R40. These components cause the voltage at U13, pin 6, to *remain* higher than the voltage at U13, pin 5, *even if the error condition has been corrected.* To reset the circuit, you must deenergize the PROCESSOR and wait for at least 3 seconds. This delay allows CAPACITOR C6 to discharge through R41. It also prevents cycling on the OVERTEMPERATURE THERMOSTAT.

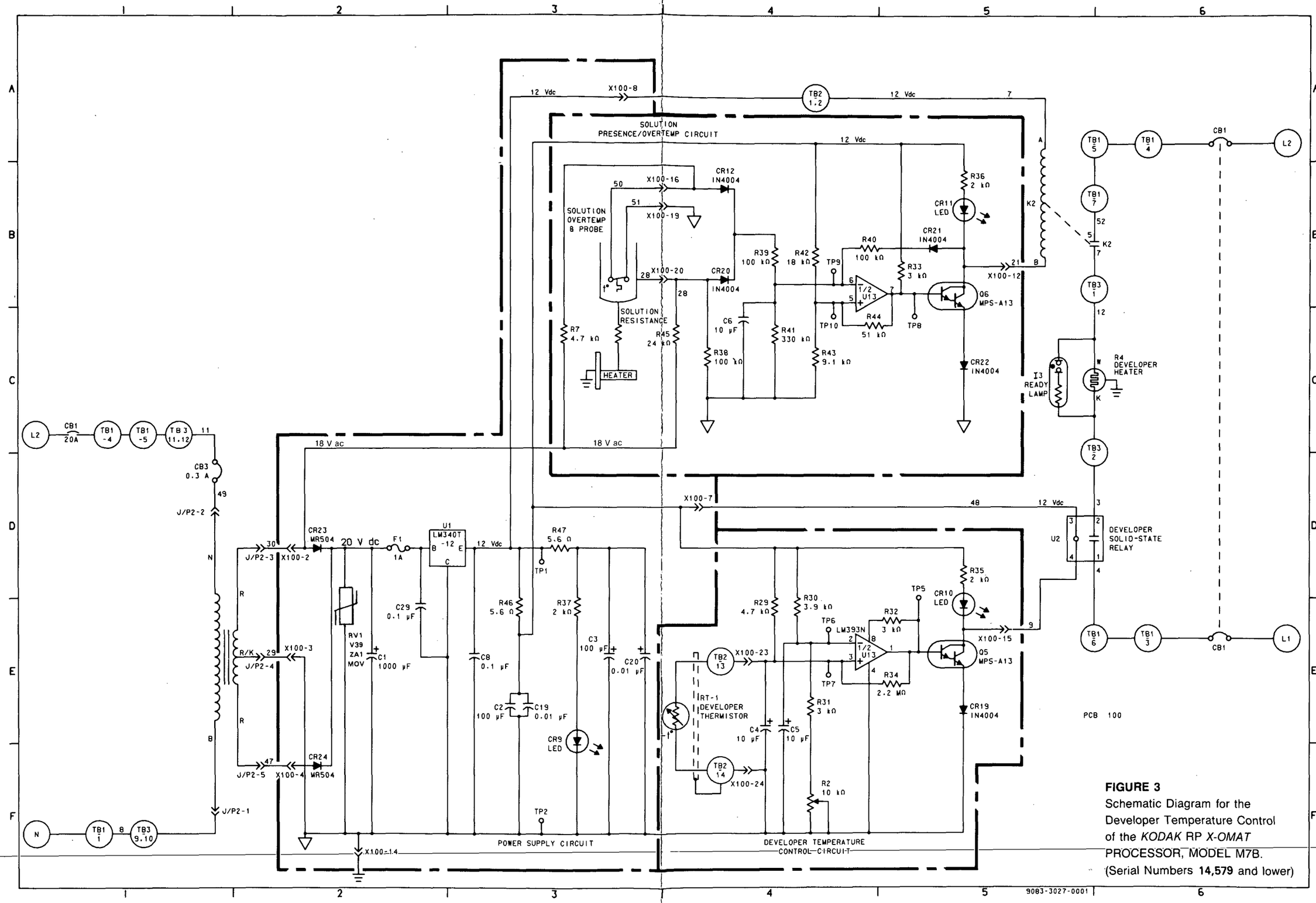

FIGURE 3
Schematic Diagram for the Developer Temperature Control of the *KODAK* RP *X-OMAT* PROCESSOR, MODEL M7B. (Serial Numbers **14,579** and lower)

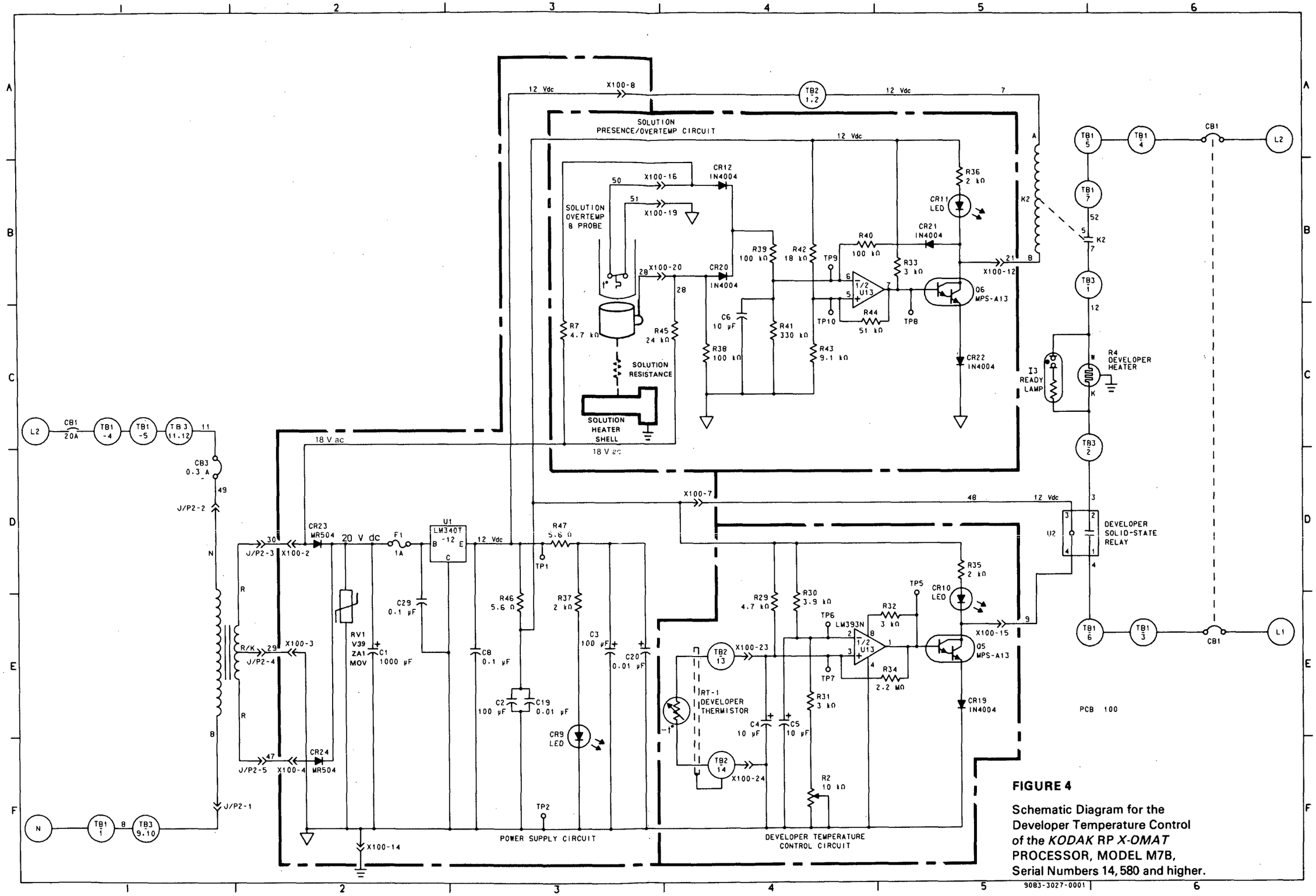

FIGURE 4

Schematic Diagram for the Developer Temperature Control of the *KODAK* RP *X-OMAT* PROCESSOR, MODEL M7B, Serial Numbers 14,580 and higher.

9083-3027-0001

NOTE:
DO NOT USE THIS DRAWING TO OBTAIN PART NUMBERS FOR ORDERING PURPOSED. USE ILLUSTRATED PARTS LIST.

DETECTOR SWITCHES
S5
S4
P8 CONNECTOR
P9 CONNECTOR
J8
J9
CABLE DET. SW.S4.S5
CABLE DET. SW.S4.S5

WD-VANE SW.
DRYER THERMO
P1
J1
CABLE DRYER

INTERLOCK SWITCH
C
NO
NC

DRYER O.T. THERMOSTAT
S7
E15

R1
DRYER HEATER
B1
DRIVE MOTOR
B4
REPLENISHER PUMP CABLE ASSY
B2
BLOWER ASSY.,DRYER
B3
RECIRC. PUMP (DEV) ASSY.
B6
RECIRC. PUMP (FIX) ASSY.

TB3
TB2
TB1
DRAIN WIRE

E16
ELECTRICAL BOX SIDE VIEW

L1
WATER SAVER SLOENOID
CABLE,WATER SAVER SOLENOID

GROUND WIRE
ANODE TUBE
DEV THERMOSTAT
DEV THERMOSTOR ASSY.
E17
BASE PLAN
DEV. HEATER
HEATER R4
THERMOWELL

C1
CAPACITOR
E2
E3
E4
E7
LUG.GND

COLOR CODE

K-BLACK -0 G-GREEN -5
N-BROWN -1 B-BLUE -6
R-RED -2 V-VIOLET-7
O-ORANGE-3 A-GRAY -8
Y-YELLOW-4 W-WHITE -9

TO INTERPRET WIRE COLOR CODE,LOCATE EXTRA WIDE WHITE SPACE. ADJACENT NARROW COLOR BAND REPRESENTS FIRST (HUNDREDS) DIGIT IN CIRCUIT NUMDER. MEDIUM WIDTH BAND.SECOND (TENS) DIGIT; WIDEST BAND, THIRD (UNITS) DIGITS.

ELECTRICAL BOX

WIRING DIAGRAM FOR THE M7B

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FIGURE 5
Wiring Diagram for the *KODAK* RP *X-OMAT* PROCESSOR, Model M7B

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