Technitron
T2050 Weld Control

Description and Instructions

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WELDING TECHNOLOGY CORPORATION

150 East St. Charles Road
Carol Stream, IL 60188 U.S.A.
Voice: (800) 323-2903
(630) 462-8250
Fax: (630) 462-8259

24775 Crestview Court
Farmington Hills, MI 48335 U.S.A.
Voice: (248) 477-3900
Fax: (248) 477-8897

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The Technitron T2050 Control 1

About the Technitron T2050 Weld Control

The Technitron T2050 weld control is a state-of-the-art microprocessor-based, fixed sequence weld control. It provides the ability to upslope, downslope, postheat and apply pulsation. The fast and powerful Motorola MC68HCZ1 (16-bit processor with DSP math capability) enables the T2050 to weld accurately and reliably in constant-current mode. This means that when programming your weld in terms of secondary (or primary) A., that the programmed current is passed through your work piece, regardless of dirt, oil, or changes in your secondary circuit.

Weld current is measured either on the primary of the weld transformer using a CT pickup, or the secondary side of the transformer using a toroid pickup coil. In addition to this feature, you can still weld using the traditional percent of available current mode with AVC (Automatic Voltage Compensation). AVC programs all currents as a percentage of available current. The control compensates for changes in your primary voltage to provide consistent weld quality.

Up to 60 unique weld schedules are stored in nonvolatile memory. You may "chain" schedules together for a long string of uninterrupted welding operations, and / or chain in an interrupted, then re-initiated, "successive" set of welds.

Inputs and Outputs

The control has seven inputs and six outputs. The functions assigned to the I/O may be controlled by DIP switches or via downloading from a personal computer through the RS-485 Network port TS1.

Inputs

The inputs are

- FS1 – Initiate sequence 1 or Binary Pilot 1
- FS2 – Initiate sequence 2 or Binary Pilot 2
- FS3 – Initiate sequence 3 or Binary Pilot 4
- FS4 – Initiate sequence selected with the Data Entry Panel or Binary Pilot 8
- ESTOP – Emergency stop
- WELD – External weld / no weld and
- PS / SS – (Second Stage or Pressure Switch) or (Second Stage or Reset Steppers).

Outputs

The outputs are

- VALVE1 – Solenoid Valve 1 or Binary Output 1
- VALVE2 – Solenoid Valve 2 or Binary Output 2
- VALVE3 – Solenoid Valve 3 or Binary Output 4
- VALVE4 – Solenoid Valve 4 or Binary Output 8 or Stepper end
- WCOMP – Weld Complete
- FAULT– Fault or Fault NOT

All solenoid valve outputs are protected by a pilot safety relay (K7). K7 prevents possible unexpected gun closure due to failed output modules. Relay K7 is "latched" in sequence by the output of one of the valve outputs. Refer to the I/O hookup print at the back of this manual.

T2050 Controller Board Layout 2

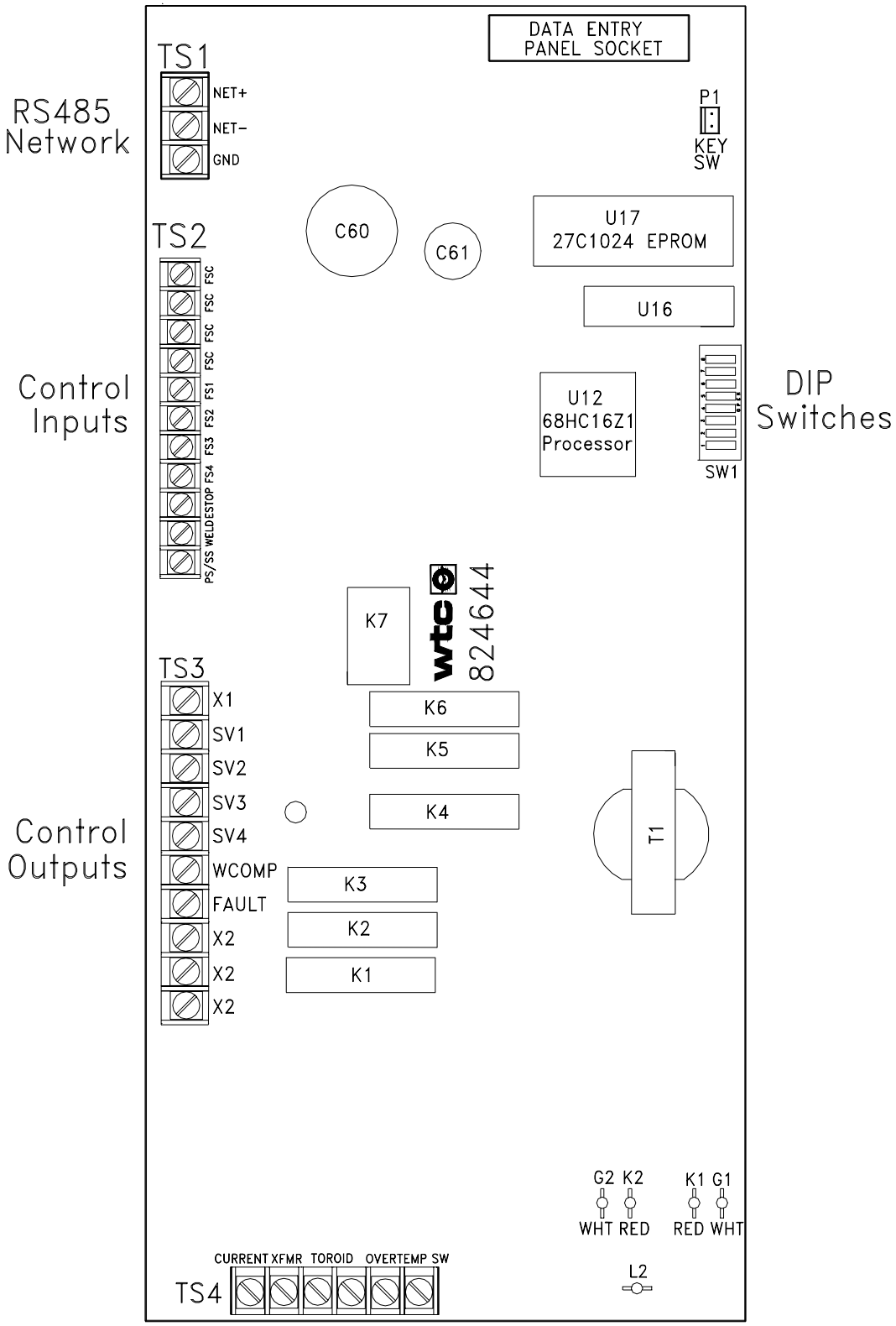
Major Features of the Controller Board

Figure 1 on page 2-4 illustrates the Controller board (p / n 824644) used in the T2050 control.

Principal features to note are the following connectors, DIP switches and hardware I / O points:

- **TS1 – RS-485 Connections:** Terminal strip TS1 has the positive, negative and ground terminals required for network communications using the RS-485 standard.
- **TS2 – Control Inputs:** Terminal strip TS2 is used to attach the seven defined hardware user input points.
- **TS3 – Control Outputs:** Terminal strip TS3 includes the six defined hardware user output points.
- **TS4:** Terminal strip TS4 has the terminals to accept the CT (current transformer), toroid and OVERTEMP sensor inputs.
- **Data Entry Panel Socket:** This socket connects the power and data transmit / receive signals necessary to operate the Data Entry Panel (DEP).
- **K7:** This is the Pilot Safety Relay.
- **P1 – KEY SW:** This jumper is a substitute for an external key switch.
- **SW1:** Switch 1 is eight DIP (dual in-line package) switches used to configure features of the timer.

Figure 1T 2050 Controller Board Layout



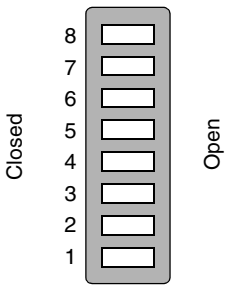
DIP Switches 3

Feature Configuration Switches

The T2050 has two sets of feature configuration switches. They appear in two different forms:

- The first form is considered a virtual set of switches and are located in the EPROM U17 at address $0206 and $0208. The setting of the virtual switches may affect the features of the DIP switches SW1. A control running firmware version V1.01 will display **77** at power-up. In V1.01, the feature choices of SW1 are listed in Figure 2 below.
- The second set of switches are DIP (dual in-line package) switches. These are on the controller PC board at SW1.

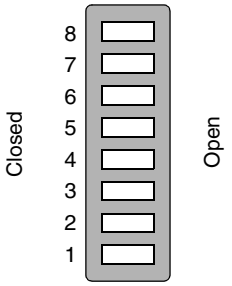
Figure 2 DIP Switches V1.01 Display = **77**



C = ACCESS YELLOW CONFIG	0 = ACCESS YELLOW DENIED
C = BINARY VALVES	0 = DISCRETE VALVES
C = DISPLAY SCHEDULE	0 = DISPLAY LAST CURRENT
C = HYPERSIL WELD TRANS.	0 = STACKED IRON WELD TRANS.
C = RESET FAULT BY PILOT	0 = FAULT NOT RESET BY PILOT
C = PRESSURE SWITCH	0 = SECOND STAGE
C = BINARY INITIATION	0 = DISCRETE INITIATION
C = CONSTANT CURRENT	0 = AVC MODE WELD

A control running firmware version V1.01A will display **79** at power-up. Figure 3 on page 3-6 lists in V1.01A the feature choices of SW1. The difference is switch #3, when closed the PS/SS input will reset all stepper programs. Therefore, Pressure Switch mode is not available in V1.01A.

Figure 3 DIP Switches V1.01A
Display = **79**



C = ACCESS YELLOW CONFIG	0 = ACCESS YELLOW DENIED
C = BINARY VALVES	0 = DISCRETE VALVES
C = DISPLAY SCHEDULE	0 = DISPLAY LAST CURRENT
C = HYPERSIL WELD TRANS.	0 = STACKED IRON WELD TRANS.
C = RESET FAULT BY PILOT	0 = FAULT NOT RESET BY PILOT
C = PS/SS RESETS STEPPER	0 = SECOND STAGE
C = BINARY INITIATION	0 = DISCRETE INITIATION
C = CONSTANT CURRENT	0 = AVC MODE WELD

Anyone skilled in EPROM reproduction can configure the features of any T2050 by applying the features of the ***virtual*** switches listed on the next page.

T2050 V1.00 and V1.01 Switch Options at EPROM Location $0208

(DIP switch or Network download control of firmware V1.00 features) (normal)=set in firmware V1.01 displaying **77**.

EPROM Location $0208=$00 (Normal):

Hardware SW1 Switch is **Enabled**
Option Flag at EPROM $0206 is **Enabled**
Host "SW1H" Downloadable Parameter is **Disabled**
Host "OPTFLGH" Downloadable Parameter is **Disabled**

EPROM Location $0208=$01:

Hardware SW1 Switch is **Disabled** (SW1 may be removed)
Option Flag at Eprom $0206 is **Disabled**
Host "SW1H" Downloadable Parameter is **Enabled** (Host control of SW1)
Host "OPTFLGH" Downloadable Parameter is **Enabled** (Host control of Option)

Option Flag

(EPROM Location $0206 or SYSPAR.OPTFLGH)

Bit	Description
$80	(Reserved for future option)
$40	(Reserved for future option)
$20	(Reserved for future option)
$10	(Reserved for future option)
$08	**Invert Fault Output:**
(normal)>0	= Fault Output is ON when Fault is present
1	= Fault Output is OFF when Fault is present
$04	**Valves:**
(normal)>0	= Normal 4-Bit Binary Valves
1	= Use 3-Bit Binary Valves, Valve4=Stepper End Output
$02	**Define SW3 operation:**
(normal)>0	= SW3 OPEN = Use PS/SS Input for Second Stage Input SW3 CLOSED = USE PS/SS Input for Pressure Switch
1	= SW3 OPEN = USE PS/SS Input for Second Stage Input SW3 CLOSED = USE PS/SS Input to Reset Steppers
$01	**Software Line Clock Filter:**
0	= Disable Software Line Clock IIR Filter
(normal)>1	= Enable Software Line Clock IIR Filter

If you change a location listed above from (normal), **you MUST document your changes**. At a MINIMUM, mark this manual wherever necessary. Technitron recommends RoboNet download control of SW1 and removing the switch from the board. With SW1 removed, accidental changes cannot be made and the state of the switches will be stored in the PC. If the features are unknown and SW1 is removed, they may be uploaded from a T2050 and thereby recorded in the PC.

SW1 is located on the right side of the upper edge of the T2050 Controller Board #824644 (see Figure 1 on page 2-4 and Figure 2 on page 3-5). Proper switch settings are CRITICAL to satisfactory operation of the control. Be sure to study and understand these functions thoroughly.

DIP 1: Constant Current or AVC

CLOSED = CC (Constant Current)
OPEN = AVC (Automatic Voltage Compensation).

When closed (CC mode), all current values are programmed in actual current (A). For example, entering 9.50 as the value for **Weld Cur**, the control will pass 9,500 A. through the gun during the Weld function. (This is regardless of the amount of metal in the throat of the gun or metal stack-up, but provided the welding transformer can deliver the requested current.) DO NOT use constant current mode initially. Run AVC mode ***first***.

If open (AVC mode), all welding current is in terms of the percent of available current. If programming 50% for **Weld Cur**, the control will deliver 50% of the maximum current that the welding transformer and its secondary can deliver. The AVC feature automatically adjusts the percent of available current so that weld quality is consistent, regardless of voltage fluctuations on the welding bus. Refer to Chapter 7, "Faults and Messages", *Compensation Fault* before making your first weld, and use AVC mode ***first***.

DIP 2: Binary Inputs ON/OFF

CLOSED = binary schedule initiation
OPEN = discrete schedule initiation.

If DIP 2 is in the closed position, then schedules 1 – 15 are selected by placing a binary combination on inputs FS1 – FS4. The first four inputs are, in order,

- **FS1:** Binary Pilot 1
- **FS2:** Binary Pilot 2
- **FS3:** Binary Pilot 4
- **FS4:** Binary Pilot 8

To choose which schedule to run, add up the appropriate binary pilot numbers to get the desired schedule. For example, to run schedule 3, energize BINARY PILOT 1 and BINARY PILOT 2 at the same time. To run schedule 4, energize only BINARY PILOT 4. To run schedule 5, energize BINARY PILOT 1 and BINARY PILOT 4 at the same time.

If DIP 2 is open, then energizing FS1 will run schedule 1. FS2 will run schedule 2. FS3 will run schedule 3. FS4 runs the schedule selected on the Data Entry Panel. To select a schedule, press ↓ underneath the Sequence column of the DEP until the center row LED light is next to the Schedule instruction. Press the **DATA** ↑ and ↓ keys to change the numeric display value until you reach the desired schedule number (1 – 60).

DIP 3: Pressure Switch or Second Stage with V1.01

CLOSED = Pressure switch
OPEN = Second stage.

If running V1.01 firmware and DIP 3 is in the closed (PRESSURE SWITCH) position, the schedule will execute the SQUEEZE DELAY and SQUEEZE instructions, then wait until the PS/SS input is made before executing any more instructions. After the sequence is initiated, the pilot may be removed and the sequence will still run to completion. If the pressure switch is not made after five seconds, the message **P_S** will be displayed on the DEP's numeric display.

If DIP 3 is open (second stage position), the schedule will execute the SQUEEZE DELAY and SQUEEZE instructions, then wait until the PS/SS input is made before executing any more instructions. The guns will open and the sequence will stop if the pilot is removed before the PS/SS input is made. If the pressure switch is not made after five seconds, the message **S_S** will be displayed on the data entry panel numeric display.

DIP 3: Pressure switch or Second Stage with V1.01A (Option flag $02 set=1)

CLOSED = Reset Steppers
OPEN = Second stage.

If running V1.01A and DIP 3 is closed (Reset Steppers position) and the control is in program mode, when input PS/SS it true, the stepper programs will be reset. The display will read **RES**, indicating the stepper programs are all reset.

If DIP 3 is in the open (second stage) position, the schedule will execute the SQUEEZE DELAY and SQUEEZE instructions, then wait until the PS/SS input is made before executing any more instructions.The guns will open and the sequence will stop if the pilot is removed before the PS/SS input is made. If the pressure switch is not made after five seconds, the message **S_S** will be displayed on the DEP's numeric display.

DIP 4: Reset Fault by Pilot YES/NO

CLOSED = Reset faults by pilot
OPEN = Do not reset fault by pilot.

If DIP 4 is closed (reset faults by pilot), all faults will be cleared when a new pilot is applied. If the stepper has ended and not been reset, the STEPPER END fault will re-appear with the next weld. If DIP 4 is open (do not clear faults with pilot) the control will not initiate until all faults (except Compensation faults) have been cleared at the DEP.

DIP 5: Anti-Saturation ON/OFF

CLOSED = 87-degree delayed firing and automatic bleed down enabled.
OPEN = 87-degree delayed firing and automatic bleed down disabled.

When using Hypersil weld transformers, it is ***essential*** to use delayed firing and automatic bleed-down to avoid saturation. Saturation is characterized by a "grunting" noise coming from the transformer. This noise is the sound of the transformer magnetically tearing itself apart, which will eventually destroy it. When a transformer saturates, less total current passes through the part. This results in bad welds.

By contrast, stacked-iron transformers are very forgiving and difficult to saturate. If full welding power is needed without delay (as in a 1- or 2-cycle weld), then turn delayed firing (anti-saturation) OFF. When seam welding, Hypersil transformers are typically not used, and anti-saturation and automatic bleed down are disabled.

DIP 6: Display Schedule or Last Current

CLOSED = Display schedule
OPEN = Display last current.

When DIP 6 is in the closed position and a schedule is initiated, the SCHEDULE LED will light and the schedule number running will appear on the numeric display.

If DIP 6 is open, the last average half-cycle RMS Weld current or the average half-cycle sum of Weld + Cool + Impulses programmed, will appear on the numeric display.

DIP 7: Binary Valves ON/OFF

CLOSED = Binary valves on
OPEN = Binary valves off.

When DIP 7 is **closed**, the four valves will output a 0 – 15 binary number. If Option flag bit $04 is set = 1, then the output will be 0 – 7 binary number with the fourth output indicating Stepper Program end. Use this feature with a binary pressure valve, or when more than one output must be turned on at the same time for machine control. When using binary valves, only one stepper program is available. This assumes that you are using one gun with different pressures.

If DIP 7 is **open**, the valves function sequentially. Programming a number 1 – 4 (or 3 if flag bit $04 is set = 1) will turn on a valve output 1 – 4 (or 3).

DIP 8: One Time Config ON/OFF

CLOSED = access to the one time configuration items on the DEP is enabled.
OPEN = access to the one time config items on the DEP is disabled.

One-time configuration items are the items on the DEP in the yellow area of the **Config** column. These items are the weld transformer Turns Ratio, AVC set point, Program Lockout, Network ID, Cal Line Voltage and Cal CURRENT of the Data Entry Panel. Access to these instructions is restricted because once they are set up, ***they should never be changed***. Cal Line Voltage and Cal Current values are set at the factory and ***should* NOT *be changed***. If they are changed, your control may not operate properly until properly re-calibrated. A special keystroke sequence is needed to change calibration values so they are not changed accidentally.

Hooking Up the T2050 4

Hook-up Procedure

Hooking up the T2050 is simple.Follow these steps:

1. Connect cooling water to the hose fittings provided through the bottom of the control enclosure.
2. Ensure that the flow rate of cooling water flow be **AT LEAST 1.2 gal/min**.
3. Connect the L1, L2 line power cables and the H1, H2 weld transformer cables to the labeled copper bars provided in the enclosure.
4. Referring to the I/O hookup schematic located at the back of this manual, connect the inputs and outputs as required.
5. If Emergency Stop, Weld and/or PS/SS are not used, jumper the inputs to FSC. Review DIP switch settings and voltage tap connections of T1 for your application.

WARNING!

NEVER apply 120VAC to FSC, as it will destroy the control.

6. Make sure the cabinet has a good earth ground according to NEC standards. ALWAYS close the enclosure door and latch it tightly before applying power, especially on the initial application of power.

Hints: Begin the initial start-up in AVC mode (SW1-1 set **open**). Set the tap on the weld transformer so good welds are made at the midrange of the percent of available current (40 – 80%). Enter the proper transformer Turns Ratio. Before going to Constant Current mode, check the measurement of current (SW1-6 **open**).

Check at various percentages, making sure the control does not go over range at high percentages. A control in over range will "top out", displaying a value and then beome unable to display any higher values. Record the tap setting, turns ratio and good weld current value. Then in CC mode (SW1-1 closed), requesting the same current observed in AVC mode will result in that current maintained ***constantly***.

The Data Entry Panel (DEP) 5

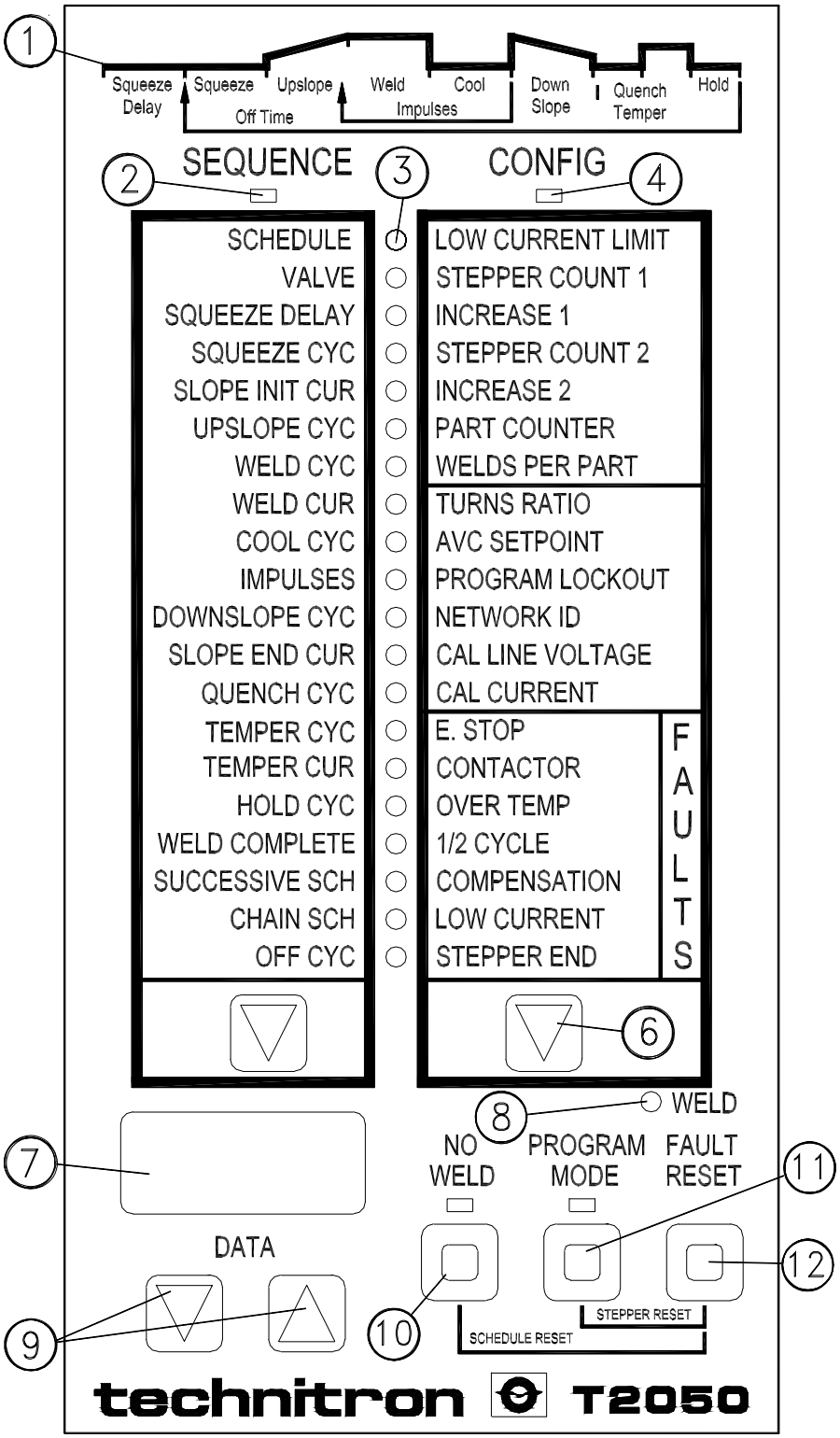
Overview of the DEP

Figure 4 on page 5-16 illustrates the overlay of the Data Entry Panel (DEP). This is WTC p/n **811695** or **811990**.

As an overview, these are the important features of the DEP:

1. Weld sequence diagram
2. **Sequence** column LED
3. **Instruction** indicator LED
4. **Config** column LED
5. **Sequence instruction** selector button
6. **Config instruction** selector button
7. Numeric display
8. **WELD** light
9. **DATA** ↑ and ↓ buttons
10. **NO WELD** button
11. **PROGRAM MODE** button
12. **FAULT RESET** button

Figure 4 DEP Overlay (WTC #811695 or 811990)



Details of the DEP's Features

Figure 4 on page 5-16 shows the T2050 DEP (Data Entry Panel) overlay. To aid in learning the DEP, all features are numbered and defined below:

1. Weld sequence diagram

The diagram shows the flow of sequence instructions as they execute.

2. Sequence column LED

This LED (Light Emitting Diode) lights to show that the **Sequence** column is active. Numbers displayed in the numeric display (7) are sequence instruction values.

3. Instruction indicator LED

This LED lights next to the currently-active instruction. The active column (either the welding Sequence or the control's Configuration) is indicated by the **Sequence** column LED (2) or the **Config** column LED (4).

4. Config column LED

The LED lights to show that the **Config** column is active. Numbers shown in the numeric display (7) are configuration instruction values.

5. Sequence instruction selector button

When pressed, the **Sequence** column LED (2) will light. The instruction indicator LED (3) will move down the column one instruction every time the button is pressed.

6. Config instruction selector button

When pressed, the **Config** column LED (4) will light. The instruction indicator LED (3) will move down the column one instruction every time the button is pressed.

7. Numeric display

The display shows programmed values, weld currents, control faults and status conditions.

8. Weld light

The weld light will turn on when the control is making a attempt to pass weld current. This includes Upslope, Downslope, Weld and Temper currents.

9. DATA ↑ and ↓ buttons

Press these buttons to change values displayed in the numeric display (7). If the control must be in Program mode to change a value, the letters **LOC** (short for *locked*) will appear when these buttons are pressed.

10. NO WELD button

When pressed, the control will toggle into and out of No Weld mode. In No Weld Mode, the control will run through a sequence normally, but will NOT pass weld current. This is useful for testing tooling without actually welding.

11. Program mode button

No sequence or config instructions can be changed unless the control is in Program mode. In this mode, the control will NOT run. If you try to change sequence or configuration items when not in Program mode, the letters **LOC** appear in the numeric display.

12. FAULT RESET button

This button resets the fault currently displayed on the numeric display. It may be necessary to press this button more than once to clear multiple faults.

Programming the T2050 6

Fixed-Sequence Programming

The T2050 is a ***fixed-sequence*** control. This means that it executes all program instructions in order, and it executes all instructions. If you do not wish to use a function or instruction (such as steppers), you must program it to a value of **0**.

Two types of instructions can be entered with the Data Entry Panel (DEP).

- The first type is a ***Sequence instruction***. Sequence instructions control valves and weld heats when the control is initiated. All sequence instructions are located in the left-hand column of the DEP.
- The second type of instruction is called a ***Configuration instruction***. A Configuration instruction controls global functions that are common to more than one schedule or weld heat. All configuration instructions are located in the right-hand column of the DEP.

To select an instruction to program, press the ↓ key directly under the instruction's column on the DEP (Figure 4 on page 5-16, Items 5, 6). The LED directly above the column will light to indicate which column is active (Figure 4 on page 5-16, Items 2, 4). The instruction indicator LEDs in the center of the data entry panel (Figure 4 on page 5-16, item 3) shows which instruction you are currently editing. Repeatedly pressing the ↓ key under a column moves the instruction indicator LED down the column, allowing you to edit new instructions. The numeric display shows the value of the item you are editing.

Weld Schedule Overview

When a schedule is initiated, the instruction indicator LEDs on the DEP (Figure 4 on page 5-16, item 3) will cycle down the list of instructions. This shows which item is currently being executed.

1. The first instruction to execute is SQUEEZE DELAY. SQUEEZE DELAY will turn on the valve programmed for that schedule, and then pause for the number of line cycles programmed. SQUEEZE DELAY only executes the first time through a repeated schedule. It is available to give a weld gun time for the initial long stroke typical of a repeated schedule operation. To turn off SQUEEZE DELAY, enter a value of **0**.

2. Next, the SQUEEZE instruction executes. Squeeze will energize the valve output (if it was not already turned on by the SQUEEZE DELAY function). This function pauses for the programmed number of line cycles so that the gun has time to close and build pressure. To turn off SQUEEZE, enter **0**.

3. After SQUEEZE, the UPSLOPE TIME is executed. UPSLOPE starts at Slope Initial Current value and slopes up to the Weld Current value over the UPSLOPE time in line cycles programmed in the instruction. Turn off UPSLOPE by entering a value of **0**.

4. Next, the weld is made using the parameters entered for Weld Cycles and Weld Current. To turn off WELD, enter **0** for Weld Cyc. Weld current (but not weld time) may also be turned off and on by pressing the **NO WELD** key, or opening and closing the WELD input. The control is in No weld mode (no current) when the **NO WELD** LED is on.

5. COOL TIME then pauses for the number of line cycles programmed in the sequence with no heat. To turn off COOL TIME, program **0** in the instruction.

6. Now, IMPULSES will cause a branch back to WELD TIME if Pulses is programmed greater than **1**. If Weld Pulses is set to **999**, the control will enter Seamer Mode and continue to weld - pulse until the pilot is removed. If Cool time is programmed to **0**, the seam will be continuous.

Caution:

The only way to stop 998 or other large number of programmed pulses before completion is to turn off the EMERGENCY STOP input. A mis-programmed number might result in very hot weld electrodes!

7. When all impulses are complete, DOWNSLOPE TIME is executed. Downsope starts at the Welds Current value and slopes down to the Slope End current value over the Downslope time in line cycles. Turn off Downslope Time by entering a value of **0**.

8. Next, TEMPER (a post-heating) may be applied to the weld nugget by using the parameters entered for Temper Cycles and Temper Current. Use TEMPER to slow the cooling of the nugget and help prevent cracks in the weld. To turn off TEMPER, enter **0** cycles.

9. Then, HOLD TIME will pause in sequence, guns closed, for the programmed time. This gives the weld nugget time to fully solidify.

10. The welding process is now complete. All that remains is to de-energize the valve and release the work piece. The valve will be de-energized by one of two of the three remaining functions, SUCCESSIVE or OFF. CHAIN SCH will not de-energize the valve. As soon as the valve is de-energized, WELD COMPLETE (if programmed **non-zero**) will energize the WCOMP output for the number of line cycles specified. **Note:** The WCOMP output will not be issued until the valve is off and Off Cyc is programmed **0** (i. e. single mode, non-repeat), or SUCCESSIVE is programmed **non-zero**.

11. After the weld process is complete, the SUCCESSIVE SCH instruction (if programmed non-zero) will turn off any valve that was previously selected and wait for the pilot to be removed. If the pilot for the same schedule is re-applied, a branch to the VALVE instruction of the schedule that is programmed in SUCCESSIVE SCH will occur. If a different schedule is re-applied, the active sequence is ended and the "new" schedule is started. SUCCESSIVE SCH is used to make a series of different welds on a single part. SUCCESSIVE SCH allows up to 60 different weld schedules using the same pilot.

    A string of successive schedules may be ended in any of three ways:

    1. End normally by programming the last weld schedule's SUCCESSIVE instruction **0**.

    2. Apply a pilot that calls a different schedule outside the successive program.

    3. Abort the successive sequence of schedules in progress by this procedure:

        a. Press and release the **PROGRAM** key until the **Sequence** and **Config** column LEDs are both OFF.

        b. Press and hold the **FAULT RESET** key.

c. Press and release the **NO WELD** key.

d. Release the **FAULT RESET** key.

e. "**SCH**" will be displayed for 2 seconds and the successive schedules will be aborted.

If Successive schedules was programmed **0**, then the CHAIN SCHED instruction (if programmed **non-zero**) will cause a "branch" to the VALVE instruction of the schedule that is programmed. Chaining schedules is used to control multiple guns, clamps and other solenoids in uninterrupted cascade fashion.

The four different valves may be controlled by using a different BINARY VALVE output pattern at the VALVE instruction of each new schedule of a chain. After the output of a binary valve pattern, program **0** in the WELD functions and / or obtain proper delay timing in the SQUEEZE or HOLD function. All 60 sequences are available for Successive or Chain Schedule use.

To avoid endless loops, a schedule may be programmed only once in a successive chain of events. Successive (interrupted) and Chaining (non-interrupted) may be mixed to provide the desired control pattern. Binary valves may be used as many times as necessary in both. Use Figure 4 to assign up to 4 functions to the SV outputs. The table will help select the proper binary number for each schedule in a chain. Choose the valve output pattern necessary and mark the schedule number in the table for that step. Fore more information, refer to"Binary Valve / Function Table" on page 9-47.

A critical issue that must be addressed when chaining is safety relay K7. The relay contacts prevent outputting unless a schedule has been piloted (i. e., hands on the pilot). K7 is first energized by the pilot and then "latched" in by a SV valve output. If binary 0 is output during a chain, the latch will be lost and K7 will open valves SV1 – 4 for the remaining events. Use jumpers JW1, JW2 and JW3 to jumper the K7 safety contacts. Consider removing this safety feature VERY CAREFULLY, or not at all.

Caution:

Safety relay K7 may be disabled for automated tooling through JW1 – JW3. NEVER disable K7 for hand-operated machinery where a shorted output module could result in a hand being pinched in a weld gun. Chain schedules may be dangerous in hand-held gun applications. Other safety devices must be employed if K7 is disabled. Otherwise, injury is possible.

Binary Valve/Function Table

FUNCTION		Clamp	Electrodes		
Schedule & Valve #		SV1	SV2	SV3	SV4
Sch. # 5	# 0	OFF	OFF	OFF	OFF
Sch. # 1 & 3	# 1	ON	OFF	OFF	OFF
Sch. #	# 2	OFF	ON	OFF	OFF
Sch. # 2 & 4	# 3	ON	ON	OFF	OFF
Sch. #	# 4	OFF	OFF	ON	OFF
Sch. #	# 5	ON	OFF	ON	OFF
Sch. #	# 6	OFF	ON	ON	OFF
Sch. #	# 7	ON	ON	ON	OFF
Sch. #	# 8	OFF	OFF	OFF	ON
Sch. #	# 9	ON	OFF	OFF	ON
Sch. #	# 10	OFF	ON	OFF	ON
Sch. #	# 11	ON	ON	OFF	ON
Sch. #	# 12	OFF	OFF	ON	ON
Sch. #	# 13	ON	OFF	ON	ON
Sch. #	# 14	OFF	ON	ON	ON
Sch. #	# 15	ON	ON	ON	ON

Lastly, if SUCCESSIVE, CHAIN and OFF TIME are programmed **0**, all valve outputs will be turned off and the sequence will end. Only if OFF TIME is set to **0** will the WELD COMPLETE output be energized for its programmed number of line cycles. If a new pilot is received before the WELD COMPLETE output time is over, it will be truncated. The control will NOT sequence again unless the pilot input is removed and re-applied. If the pilot is still applied, "**PIL**" will be displayed. If OFF is programmed **non-zero** and the pilot signal is still applied, the control will turn off the valve, wait the programmed number of cycles, then repeat the sequence starting at the Squeeze instruction of the schedule applied. In repeat mode, the WELD COMPLETE instruction will never be outputted.

Changing Programmed Values

You can only edit values (except for the SCHEDULE instruction) when the control is in Program Mode. If you purchased the optional keyswitch, the control CANNOT be placed in Program Mode unless the switch is turned to the "Unlock" position.

To place the control in Program Mode, press the **PROGRAM MODE** button on the DEP. The **PROGRAM MODE** LED will light to indicate that you have changed modes. To exit Program Mode, press the **PROGRAM MODE** button again. The LED will turn off.

When the center LED next to a **Sequence** or **Config** item is on (Figure 4 on page 5-16, item 3), the value for that item appears in the numeric display. Edit the value by pressing the **DATA** ↑ and ↓ keys located below the numeric display.

Clearing Memory

Clearing memory requires a special procedure.

WARNING!

Performing this operation will ERASE ALL USER PROGRAM AND SETUP DATA! All configurable parameters are set to their default values. Calibration data is NOT erased.

To clear memory, follow these steps:

1. Enable "One time" Configuration by closing switch SW1–8.
2. Make sure the **Sequence** and **Config** LEDs are both OFF and the control is in Program Mode. Press and release the **PROGRAM MODE** key until only the **PROGRAM MODE** LED stays on.
3. Press and hold the **FAULT RESET** key.
4. Press and hold the **DATA** ↑ key.
5. Press and release the **SCHEDULE** ↓ key.
6. Release the **FAULT RESET** and **DATA** ↑ keys.

7. The display will show "**CLr**" for 2 seconds and all programmable data will be set to the default values.
8. Restore the setting of switch SW1–8 to OFF.

Sequence Instruction Definitions

Schedule

Schedule selects which weld schedule is being programmed when in Program Mode. In Run mode, if DIP switch SW1–2 is open (Discrete Initiation), and input FS4 is energized, the schedule number entered here will run. The data range is 1 – 60.

Valve

Valve selects which of the four VALVE outputs will turn on when the schedule is initiated. If DIP switch SW1–7 is closed (BINARY VALVE outputs) then the four valve outputs will turn on in a binary pattern representing a number from 0 to 15 (see “Binary Valve / Function Table” on page 6-23). If SW1–7 is open (Discrete valves) programming a valve number 0 – 4 will turn on output 1 – 4, respectively.

Squeeze Delay

Squeeze Delay pauses to give the electrodes time to close initially. In a Repeat Mode schedule (Off = non-zero), the SQUEEZE DELAY time is executed the first time through the schedule. All subsequent times, the SQUEEZE DELAY is ignored. SQUEEZE DELAY is used to accommodate the initial long stroke of a hand-held weld gun which then does not open all the way between the repeated weld spots. The data range is 0 – 99 cycles.

Squeeze

Squeeze is the amount of time required to close electrodes and achieve full tip pressure. If the SQUEEZE DELAY instruction is programmed, the Squeeze time is added to the Squeeze Delay time the first time through a repeated schedule. After that, only the Squeeze time is used. The data range is 0 – 99 line cycles.

Slope Initial Current

Upslope current (a weld area preheat or "cleaning" function) will range from the value programmed in this location up to the Weld Current value over the Upslope time in line cycles. The data range for this instruction is 20% – 99% in AVC Mode (SW1–1 open) or 0 – 65.5 kA. in Constant Current mode (SW1–1 closed). The control will accept a value larger then the Weld Current value, but will not deliver a current greater then the Weld current during the Upslope Time. Therefore the UPSLOPE function will be up only or possibly flat, but never down to Weld.

Upslope Cycles The upslope current will range from the Initial Current up to the Weld Current over the Upslope Time. The timing range is 0 – 99 cycles. For example, if your Weld Cur is set to 60% of available current, and Upslope Time is set to 5 cycles, then upslope weld will start at the Initial Current value (or 60% if programmed higher) and ramp up to 60% of available current over the 5 cycles of time.

Weld Cycles The duration of the weld current in line cycles. The range is 0 – 99 cycles.

Weld Cur The amount of current passed during Weld Cy. Program this current in terms of primary or secondary A. if SW1–1 is closed, or percent available current if SW1–1 is open. Current ranges are 20% – 99% in AVC mode or 0 – 65.5 kA. in Constant Current mode. In CC mode, the display starts at **0** to **999A**, then shifts from **999A** to **1.0** kA. and continues to **65.5** kA.

Cool time ***Cool time*** is the duration of time in line cycles during which no weld current is passed; therefore, the weld nugget begins to cool. The range for this instruction is 0 – 99 cycles.

Impulses The number of times the schedule loops back to the WELD CY instruction before the schedule moves on to HOLD CY. The range for this instruction is 1 – 999. If set to **1**, the sequence will not loop back to the WELD instruction, resulting in only one pulse of weld / cool. If set to **2**, the control will loop back once for 2 weld / cool pulses. Impulses are used to weld multi-layer or very thick material by controlling the time the heat is applied. If Impulses are set to **999**, the control will enter Seamer or Roll Spot mode and deliver weld / cool pulses until the pilot is removed.

Downslope Cycles The Downslope current will range from Weld Current to the Slope End Current over the Downslope Cycle time. The timing range is 0 – 99 cycles. For example, if Weld Cur is set to 60% of available current, and Downslope time is set to 5 cycles, then downslope weld will start at the Weld Current value of 60% and ramp down to the Slope End current (or 60% if it is programmed higher) over the 5 cycles of time. Use Downslope to slow down the cooling of the nugget, to prevent cracking and brittle weld spots.

Slope End Current Downslope current will range from the Weld current value over the Downslope time in line cycles, to the value programmed in this location. The data range for this instruction is 20% – 99% in AVC Mode or 0 – 65.5 kA. in Constant Current mode. The control will accept a value larger then the Weld Current value, but will not deliver a current greater then the Weld current during the Downslope time. Therefore, the DOWNSLOPE function will be down only or possibly flat, but never up to the Slope End current.

Temper Cyc This is tge duration of the temper current in line cycles. The range is 0 – 99 cycles. Temper serves to control the cooling of the nugget, thereby preventing cracking and brittle weld spots.

Temper Cur The amount of current passed during Temper time. Program this current in primary or secondary A. if SW1–1 is closed, or percent available current if SW1–1 is open. Current ranges are 20% – 99% in AVC mode or 0 – 65.5 kA. in Constant Current mode. In CC mode, the display starts at **0** to **999** A., then shifts from **999A** to **1.0** kA and continues to **65.5** kA.

Hold Cyc The number of line cycles the control will pause for the weld nugget to solidify before continuing the sequence. The range for this instruction is 0 – 99 cycles.

Weld Complete ***Weld Complete*** energizes the WCOMP output for the number of line cycles programmed. **Note:** The WCOMP output will not be issued until the valve is turned off and Off Cyc must be programmed to **0** (i. e., single mode, non-repeat only) or Successive is programmed non **0**. For more details see “Weld Schedule Overview” on page 6-20 and read HOLD through OFF functions.

Successive Sch If programmed **non-zero** (1 – 60), the control will turn off any valve that was previously selected, issue a WELD COMPLETE if programmed **non-zero**, and wait for the pilot to be removed. If the pilot for the same schedule is re-applied, a branch to the VALVE instruction of the schedule that is programmed in Successive Sch will occur. If a different schedule is re-applied, the active sequence ends and the "new" schedule is started. Use successive schedules to make a series of different welds on a single part using the same pilot successively. If Successive Sch is programmed **non-zero**, the CHAIN SCHEDULES and OFF functions below will not be accessible.

Chain Sch If the number programmed is **non-zero** (1 – 60), the control will "branch" to the VALVE instruction of the sequence number that is entered. The OFF TIME instruction below will not be accessible and is ignored until the last schedule in the chain executes. Also, the WELD COMPLETE output is not energized until the last schedule in the chain is executed and its Off time is **0**. If the OFF TIME is non-zero in the last weld schedule, WELD COMPLETE will not be issued and the control will repeat the entire chain of weld schedules. A schedule CANNOT be chained to itself, and can be used only once in a chain. See “Weld Schedule Overview” on page 6-20 and *Chain Schedules* for more details.

Off Cyc If Off time is 0, the SV VALVE outputs are turned off and the sequence ends. After the valves are off, the WCOMP output is energized for the time programmed in WELD COMPLETE. If the OFF Time is greater than **0**, the control is in Repeat mode. In Repeat mode, OFF Time turns off all VALVE outputs and pauses for the number of line cycles entered. When the delay is over, if the PILOT input is still on, the sequence will repeat starting with the SQUEEZE instruction. WELD COMPLETE will not occur in Repeat mode. Use Repeat mode in hand gun operation where the operator may pull and hold the weld gun trigger, moving the gun around as the electrodes automatically open, re-close and weld. The range of this instruction is 0 – 99 cycles.

Configuration Item Definitions

Low Current Limit This is a programmable low current limit that is compared to the WELD function current (and COOL, if programmed) after a weld is made. If the Weld current is less than the low limit, then the LOW CURRENT fault is set. Low Current Limits are separately programmable in each weld schedule. The data range is 0 – 65.5 kA. To turn off Low Current Limit, set the value to **0**. Low Current Limit defaults to **0**.

Stepper Count 1 Four programmable 2-step stepper programs are available. One program is assigned for each of the 4 valves. Stepper Count 1 is the Step 1 stepper count for the Valve selected in the **Sequence** column. If operating binary valves (SW1–7 closed), there is only one stepper, the same stepper for all valves. The count range is 0 – 65.5 k welds. The display starts at **0** – **999**, then shifts to **1.0** – **65.5K**.

ALL 4 stepper programs are reset when the **FAULT RESET** and **PROGRAM MODE** buttons are pressed at the same time. If running V1.00A firmware, SW1–3 is closed and PS/SS is true.

Powering down the control resets all steppers. When using steppers, either do not turn off the control, or change your tips when the power is cycled.

Stepper Count 1 This is the Step 1 stepper count for the valve selected in the **Sequence** column. To disable the steppers, program **0** in Stepper Count 1 and Stepper Count 2.

Increase 1 ***Increase 1*** is the percentage that the current will increase over the course of Stepper Count 1. The range for this instruction is 80% – 199%.

Stepper Count 2

This is the Step 2 stepper count for the valve selected in the **Sequence** column. Program **0** in Stepper Count 1 and Stepper Count 2 to disable the steppers.

Increase 2

Increase 2 is the percentage that the current will increase over the course of Stepper Count 2. The range for this instruction is 80% – 199%.

Parts Counter

In Program mode, this location allows a part counter value to be entered. In Run mode, the actual part count (or the parts made) is displayed. When the actual parts made equals the value programmed, the FAULT output will turn on, the display will indicate "**P_C**" and the pilot will be inhibited. The fault and actual parts count will be reset in Run mode by going to CONFIG (LED on), ↓ to **PART COUNTER** (LED on) and with the actual count displayed, press **FAULT RESET**. If "**P_C**" appears when pressing **FAULT RESET**, the fault (not the actual part count) will be reset. This permits one more parts to be made and counted before the P_C fault re-appears.

Welds Per Parts

In Program mode, this location lets you program a "welds-per-part" value. In Run mode, the location will display the actual welds-per-part value. Normally, every weld is counted as a weld per part; when the actual welds per part equals the programmed value, Part Counter will be incremented. In Successive schedules operation, welds per part are counted for the "same pilot applied" and will not advance the Parts Counter until the completion of a full successive operation. Aborting or resetting a Successive operation will also reset the welds per part counter.

Turns Ratio

This is the weld transformer's turns ratio. The proper ratio must be entered for secondary current readout and control of constant secondary current. If set to **0**, a toroid coil will be used to read, display and control secondary current. Otherwise, the primary current x Turns Ratio is used.

If setting the Turns Ratio to **1**, the control will display and control primary current. If the turns ratio is incorrect, the control will probably run into the compensation limits trying to deliver an unattainable value.

Caution:

Changing the transformer tap changes the turns ratio. The range for this instruction is 0 – 200. For a value less than 100, the decimal point is used (i. e.. 51.2). Find the ratio on the transformer tag, or by dividing the secondary voltage into the primary voltage rating of the transformer. If the transformer ratings cannot be found, apply a low voltage to the primary, read the secondary and divide.

Small offsets between the calibrated value and the delivered value in constant current may be nullified by adjusting the tenths digit of Turns Ratio.

AVC Setpoint

AVC Setpoint is the voltage value that the Automatic Voltage Control algorithm pivots on. If set to **0**, the AVC system is turned off. If the control is in constant current mode, the LED next to **AVC Setpoint** on the DEP will not light. The AVC algorithm is not used in Constant Current mode.

Program Lockout

Program Lockout is in several levels. To change the lockout level, first close SW1–8 and in Program mode, choose a new level. The new lockout level will be secured ONLY by reopening SW1–8. After reopening SW1–8, when attempting to change a lockout item, access is denied and "**LOC**" is displayed. Regardless of the chosen lockout level, the operator can always select and display any schedule data or select a schedule to run in Discrete pilot mode. The lockout definitions are

- Level 4: Full access.
- Level 3: Full access except for certain restricted Config items.
- Level 2: Full access except for all Config. items.
- Level 1: Access ONLY to the WELD function
- Level 0: No access.

Network ID

This is the unique address of the weld control on a RS-485 networked system. The range is 0 – 64, where 0 is off line.

Cal Line Voltage

Line Voltage calibration allows the user to enter a measured line voltage value. The range for this instruction is 0 – 999 VAC. A new value will be accepted ONLY when you

1. Exit Cal Line Voltage or Program mode, and
2. Answer the "**?**" (question, accept this new value?) by pressing the **FAULT RESET** key. By pressing any other key, the control will not scale itself to the new voltage value.

Cal Current

This is a current calibration entered in A. or kA. (A. x 1,000). The range for this instruction is 0 – 999 A., then shifts to 1.00 –65.5 kA. Appearance of the decimal point indicates the shift to kA. A new value is accepted ONLY when you

1. Exit Cal Current or exit Program mode, and
2. Answer the "**?**" (question, accept this new value?) by pressing the Fault Reset key. By pressing any other key, the control will not scale itself to the new current value. See Chapter 8, "Re-calibrating the T2050" for more details.

Faults and Messages 7

Fault LEDs on the Data Entry Panel

When a fault listed on the DEP occurs, the LED next to the fault will blink on and off. This distinguishes the fault condition from a sequence instruction in the other column. One fault is displayed at a time, so that the proper message can be shown on the numeric display. Clearing a fault displays the next fault (if any). To clear faults, press the **FAULT RESET** button.

EMERGENCY STOP This indicates that the ESTOP input has been de-energized. The sequence is halted and the VALVE output is removed. The display will flash "**E_S**," for Emergency Stop. Emergency stop is monitored through U10.

CONTACTOR Fault This indicates the voltage that should be developed across a SCR contactor that is off is missing. It means that the SCR is shorted, or the line voltage is disconnected. The contactor off voltage is checked before the valve is energized, to prevent the tips from closing energized. It is also checked during normal sequence operation. The display will flash "**C_F**," for Contactor Fault. The voltage is monitored by op amps U5, U22 and U6.

OVER TEMP Fault This fault indicates that the over-temperature switch on the SCR is open. The display will flash "**O_F**," for Over temperature Fault. The over-temperature switch is monitored with +40 VDC through U10.

1/2 CYCLE Fault This indicates that the SCR failed to fire on time for three consecutive half-cycles of the same polarity. The display will flash "**H_F**" for Half cycle Fault. The feedback voltage is monitored by op amps U5, U22 and U6.

COMPENSATION Fault During the dynamic process of controlling weld current, the weld control tried to exceed 99% or go below 20% of available current. When this fault occurs, "**HI**" (Compensation over 99%) or "**LO**" (Compensation under 20%) will flash on the display to show the direction of the effort. It means that the control could not deliver the requested current and therefore the last spot weld may be bad. Refer to *Configuration Item Definitions*, *Turns Ratio* and AVC *Setpoint*.

Things to check are

- Is the tap on the weld transformer set to deliver a requested AVC current and make good welds, at mid range of the percent of available current (40 – 80%)? The control must have room to make corrections. The closer the control is programmed to the limits, the more likely the faults will occur. Adjust the tap or change the secondary's impedance so that good welds are made at mid-range.
- If the control is in AVC mode, is the AVC set point near the actual line voltage? Temporarily disable AVC by entering **0**. If turning off AVC corrects the problem and Step 1 is true, then re-calibrate the line voltage.
- If the control is in Constant Current mode, place it in AVC mode. Make sure Step 1 is satisfied. Then make sure the control can read current to your satisfaction. Know what the transformer turns ratio is and enter it correctly. If everything is correct, when SW1–6 is open, the display should match the reading on a secondary current meter. Return the control to Constant Current mode.

LOW CURRENT Fault

This denotes that the Low Current Limit has been exceeded. When this fault occurs, the actual current value will flash on the numeric display. The value displayed will be lower then the value programmed in Configuration Items, Cur. low limit.

STEPPER END

This indicates that one of the four stepper programs has ended. When this fault occurs, the numeric display will display "**S_1**," "**S_2**," "**S_3**" or "**S_4**" to indicate which stepper has ended. To reset the stepper program, place the control in Program mode and press the **FAULT/STEPPER RESET** button. This resets ALL four Stepper programs. If not using steppers, program **0** in both Stepper Count 1 and 2.

List of Numeric Display Messages

The following is a list of numeric display messages.

Power-up Status

X.XX Software version number on power-up, momentarily displayed.

XXX EPROM check sum, momentarily displayed after software version.

E00 Memory Fault. A data check sum error occurred in **Sequence**, or **Config** or both. Review all data, change data in ONE function in BOTH Sequence and Configuration. The fault may be cleared only after the data change is made. Restore if necessary. This error will occur the first time new firmware and / or PC board is booted up.It may be caused by switching relay or valve noise applied to the microprocessor. Always apply snubbers across all relay and valve coils. Keep relays physically and electrically away from the microprocessor and its power source T1.

Motorola HC16 Reset Status Register

E01 Test Module reset, momentarily displayed.

E02 System Reset, momentarily displayed.

E03 Loss of clock reset, momentarily displayed.

E04 *Not used.*

E05 Halt monitor reset, momentarily displayed. (HC16 was lost, probably due to bus noise.)

E06 Software watch dog reset, momentarily displayed. (HC16 was lost, probably due to bus noise.)

E07 Power up reset (*masked off, not used*).

E08 External reset (*masked off, not used*).

Control Faults

S_1	Stepper 1 program ended
S_2	Stepper 2 program ended
S_3	Stepper 3 program ended
S_4	Stepper 4 program ended
E_S	Emergency Stop
C_F	Contactor Fault
O_F	SCR Overtemp
H_F	Half Cycling Fault
ErH	Data out of range – Error High
ErL	Data out of range – Error Low
Err	System Error
LC	Line clock missing
HI	Compensation over 99%
LO	Compensation under 20%

Other Status Messages

PIL	The pilot is not clear at off single. Remove the pilot or press **RESET** (anti-repeat).
ES	Stepper reset acknowledged, momentarily displayed.
?	Accept calibration value change? (If yes, press **FAULT RESET**.)
LOC	Locked out, or not in program mode
S_S	Second Stage Open, close to latch in sequence
P_S	Pressure Switch Open, close to continue sequence
CLr	Memory has been cleared (except Calibration Data)
PrS	Program in Sequence was reset
SCH	Reset of Successive Schedules has been accomplished
P_C	The Part counter equals the counter's programmed value

Re-calibrating the T2050 8

Factory Calibration

Before shipment, your T2050 control was tested and calibrated by Technitron. It was calibrated on a 480 V line, welding at values near 140 primary and 13,000 secondary A. Voltage and currents were calibrated to the values at the time of the final test. Primary current was calibrated on 1 kA. maximum range; secondary current, on 20 kA. maximum range.

These three calibration values are stored in non-volatile memory. Therefore, re-calibration is not necessary. Re-calibration of current is necessary ONLY if making a change to the current range. Re-calibration may be (but normally is not) necessary if the firmware is changed (U7 PROM) or if the current transformer (CT) or toroid coil is replaced.

Primary Current Control

Primary current control is "turned on" by programming a transformer Turns Ratio of 1 ***or higher***. You must have a current transformer (CT) with a 0.2 ohm burden resistor across its terminals connected to TS4. Technitron normally installs the CT.

The primary current range control is by "W" jumpers W1 – W4, where

W4 on = 200 A. max @ 99% AVC Mode
W3 on = 1,000 A. max @ 99% AVC Mode (normal)
W2 on = 2,000 A. max @ 99% AVC Mode
W1 on = 3,000 A. max @ 99% VAC Mode

If the Turns Ratio readout is 1, the control will be in primary A. If the number is above 1, the readout will be primary A. multiplied by the transformer Turns Ratio entered (secondary).The maximums listed above are the values before transformer turns multiplication.

Secondary Current Control

Secondary current read out and control are "turned on" by programming a Turns Ratio of **0**. You must have a toroid coil connected to TS4. The toroid coil is considered optional and is not normally installed. The secondary current range is controlled by a combination of "W" jumpers W5 – W6, where

W5	W6	Maximum A. @ 99% AVC Mode
ON	ON	20 kA. (normal)
OFF	ON	26 kA.
ON	OFF	60 kA.

About the Calibration Process

The CAL CURRENT process forces the control to display the current value you think the value should be, for the last weld made. This process may be done for line voltage, primary and secondary current. After this calibration, the readout should match your instrumentation (whether it is correct or not).

Improper or no calibration will not affect the control's ability to deliver a percent of available current in AVC mode.The numerical current readout and Constant Current control is relative to the perception of the user. The control does not "care" what that value is, or what it means. The T2050 delivers (if it can) in constant current the value request based on the RMS current of the last weld and the value you told the control it was.

The greatest concern is that the current NOT exceed the maximum level permitted by the W jumpers installed. The working current level should be in the middle, or somewhat mid-lower portion, of the range chosen. If the working current is near the maximum, the percent of available current requested must also be near maximum. If the value is near the maximum and the percent of available current reported by the control is low, the peak current for that RMS value is probably in over range.

The computer units which represent the peak A. were at maximum, jammed at the largest number during the peak of the current crest wave form. To correct this computer unit "clipping" problem, choose the next higher current range, re-welding and re-calibrating with the W jumper installed in the new range.

Caution:

NEVER attempt to calibrate primary or secondary current in Constant Current mode. Always check for the proper current range first, by delivering at 99% in AVC mode and measuring the current. NEVER switch to Constant Current mode without first checking the control's ability to accurately report current at 20%, 50% and 99% AVC current.

Remember: If any range jumper is changed the control is NOT calibrated in the new range. If the jumper is returned to the original calibrated position, the control is still NOT calibrated. Calibrated current values reside in two memory locations, one for primary and one for secondary. The control does not "know" or remember where the range jumpers are located.

Primary Current Calibration Procedure

To calibrate primary current, follow this procedure:

1. Choose a primary current range (W1 – W4) that cannot be exceeded at a 99% available current weld.
2. Turn off power and set SW1–1 to be OPEN (AVC Mode).
3. Program a simple weld schedule:

   SQUEEZE 20 CY
   WELD TIME 15 CY (TURNS RATIO = 1)
   WELD CUR 99%
   HOLD 10 CY
   OFF 0 CY

4. Set all other functions off (set to **0**), EXCEPT Impulses and Turns Ratio = **1**.
5. Make a weld, with or without work. Measure the secondary current with a secondary current meter such as Technitron's WS10, blanking the first 3 cycles in the measurement on the WS10. (First = 4, last = 15 on the WS10 or WS25.)

6. Divide the secondary current reading by the Turns Ratio of the weld transformer. The result is the primary current value. Are you sure you have the proper ratio? Does your transformer have taps?

7. The control must be in Program mode and the **CONFIG** and **CAL CURRENT** LEDs lit. With the **DATA** keys, enter the primary current value.

8. Press the **CONFIG** ↓ key. "**?**" will be displayed. Press **FAULT RESET**.

9. Re-weld at different currents to confirm that the primary current readings now match your secondary current meter. (Primary x Turns Ratio = Secondary.) If not satisfied, re-calibrate now, to make sure the numbers match.

10. If Constant Current mode will be used, or you want to see secondary current displayed, program the Turns Ratio used in Step 5. To correct slight offsets between the current displayed and your secondary meter, change the Turns Ratio tenths value.

Hint: If your transformer has taps, now is the time to determine what the transformer turns ratio is for each tap. If you change taps, you MUST program the new value. **DO NOT RE-CALIBRATE.** Instead, program the proper Turns Ratio.

Secondary Current Calibration Procedure

To calibrate secondary current, follow this procedure:

1. Choose a secondary current range (W5 and W6) that cannot be exceeded at a 99% available current weld.

2. Turn off power and set SW1–1 to be OPEN (AVC Mode).

3. Program a simple weld schedule:

```
SQUEEZE 20 CY
WELD TIME  15 CY (TURNS RATIO = 0)
WELD CUR 60%
HOLD  10 CY
OFF 0 CY
```

4. Turn all other functions OFF (set to **0**), except Impulses = **1** and Turns Ratio = **0**.

5. Make a weld, with or without work. Measure the secondary current with a secondary current meter such as Technitron's WS10, blanking the first 3 cycles in the measurement on the WS10. (First = 4, last = 15 on the WS10 or WS25.)
6. The control must be in Program mode and the **CONFIG** and **CAL CURRENT** LEDs lit. With the **DATA** keys, enter the WS10 secondary current value.
7. Press the **CONFIG** ↓ key. "**?**" will be displayed. Press the **FAULT RESET** key.
8. Re-weld at different currents to confirm that the secondary current readings now match your secondary meter. Explore and record the range of current the system is able to deliver without incurring HI or LO compensation faults.

Voltage Calibration Procedure

To calibrate voltage, follow this procedure:

1. Measure and record the line voltage.
2. The control must be in Program mode and the **CONFIG** and **CAL LINE VOLTAGE** LEDs lit. With the **DATA** keys, enter the line voltage value.
3. Press the **CONFIG** ↓ key. "**?**" will be displayed. Press the **FAULT RESET** key.

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Application Example 9

Example of a Successive Welding Application

A part has two different spot welds made successively. The first weld is made, the part is rotated and pieces are added to the part for the second weld. Before each weld, a clamp is used to gauge and hold the part precisely before the electrodes are engaged.

After the second spot weld, the gauging clamp must fully retract before a part stripper ejects the part into a box. Each box holds 25 parts. The clamp is assigned to SV1, gun valve to SV2 and the part stripper to WCOMP. SW2-7 must be closed for binary valve operation. Refer to “Binary Valve/Function Table” on page 9-47.

The procedure for programming this example follows:

Assign Schedule #1

4. Assign Schedule #1 to clamp and align the parts before making the first spot weld:

```
SCHEDULE=1
VALVE=1                 ;Energize the gauging clamp SV1
SQUEEZE DELAY=0         ;N/A
SQUEEZE=40              ;Give the clamp time to align the
                         parts
UPSLOPE=0               ;N/A
WELD CYC=0              ;N/A
WELD CUR=20%            ;N/A
COOL=0                  ;N/A
IMPULSES=1              ;N/A
DOWNSLOPE CYC=0         ;N/A
SLOPE END CUR=20        ;N/A
QUENCH CYC=0            ;N/A
```

TEMPER CYC=0	;N/A
TEMPER CUR=0	;N/A
HOLD CYC=10	;N/A
WELD COMPLETE=0	;N/A
SUCCESSIVE SCH=0	;N/A
CHAIN SCH=2	;The part is now clamped go to Schedule #2 and make the first weld
OFF CYC=0	;N/A the sequence jumped to Schedule #2.

Configuration Parameters

LOW CURRENT = Your values. Remember: There is a value for each schedule (Schedules #2 and #4 weld).

STEPPER COUNT1 = Your choice. (There is only one stepper in binary valve mode.)

INCREASE 1 = Your choice. (There is only one stepper in binary valve mode.)

STEPPER COUNT2 = Your choice. (There is only one stepper in binary valve mode.)

INCREASE 2 = Your choice. (There is only one stepper in binary valve mode.)

PARTS COUNTER=25 After 25 parts are made, initiation will be blocked. The operator replaces the box.

WELDS PER PART=2 The operator resets the parts counter, and welding can resume. There are two welds per part.

TURNS RATIO = Weld transformer Turns Ratio.

AVC SETPOINT = A value near line voltage.

Assign Schedule #2

5. Assign Schedule #2 to make the first spot weld:

SCHEDULE=2	
VALVE=3	;The clamp is still on (SV1) add SV2, and energize the gun valve (SV1+SV2=3).
SQUEEZE DELAY=0	;N/A
SQUEEZE=40	;Give the electrodes time to close and build pressure, the clamp is still energized.
UPSLOPE=0	;N/A
WELD CYC=8	;Weld time
WELD CUR=65%	;Pass 65% available current
COOL=0	;N/A
IMPULSES=1	;N/A
DOWNSLOPE CYC=0	;N/A
SLOPE END CUR=20	;N/A
QUENCH CYC=0	;N/A
TEMPER CYC=0	;N/A
TEMPER CUR=0	;N/A
HOLD CYC=10	;N/A
WELD COMPLETE=0	;N/A
SUCCESSIVE SCH=3	;Turn both valves off and wait for another initiation. On re-initiation, go to Schedule #3.
CHAIN SCH=0	;N/A (The sequence jumped to Schedule #3.)
OFF CYC=0	;N/A

Assign Schedule #3

6. Assign Schedule #3 to re-clamp the parts with SV1 before the second spot weld is made:

SCHEDULE=3	
VALVE=1	;Energize the gauging clamp SV1.
SQUEEZE DELAY=0	;N/A
SQUEEZE=40	;Give the clamp time to clamp and align the parts.
UPSLOPE=0	;N/A
WELD CYC=0	;N/A
WELD CUR=20%	;N/A
COOL=0	;N/A
IMPULSES=1	;N/A
DOWNSLOPE CYC=0	;N/A
SLOPE END CUR=20	;N/A
QUENCH CYC=0	;N/A
TEMPER CYC=0	;N/A
TEMPER CUR=0	;N/A
HOLD CYC=10	;N/A
WELD COMPLETE=0	;N/A
SUCCESSIVE SCH=0	;N/A
CHAIN SCH=4	;The part is now clamped, Go to Schedule #4. Make the second weld.
OFF CYC=0	;N/A. The sequence jumped to Schedule #4.

Assign Schedule #4

7. Assign Schedule #4 to make the second weld:

SCHEDULE=4	
VALVE=3	;The clamp is still on (SV1). Add SV2 and energize the gun valve (SV1+SV2=3).
SQUEEZE DELAY=0	;N/A
SQUEEZE=40	;Give the electrodes time to close and build pressure. The clamp is still energized.
UPSLOPE=0	;N/A
WELD CYC=5	;Weld for 5 cycles
WELD CUR=65%	;Pass 65% of available current.
COOL=2	;65% current for 10 cycles is too much for this application. Cool it!
IMPULSES=2	;Three layers of metal need plenty of heat applied slowly. Go back and WELD again.
DOWNSLOPE CYC=5	;Try cooling the spot slowly, to prevent cracking.
SLOPE END CUR=20	;N/A
QUENCH CYC=0	;N/A
TEMPER CYC=0	;N/A
TEMPER CUR=0	;N/A
HOLD CYC=10	;N/A
WELD COMPLETE=0	;N/A
SUCCESSIVE SCH=0	;N/A
CHAIN SCH=5	;Jump to Schedule #5 to eject the part.
OFF CYC=0	;N/A the sequence jumped to Schedule #5.

Assign Schedule #5

Assign Schedule #5 to release and eject the part:

SCHEDULE=5	
VALVE=0	;Turn off the clamp and gun before the clamp is energized.
SQUEEZE DELAY=0	;N/A
SQUEEZE=40	;Give the clamp and electrodes time to open before ejection.
UPSLOPE=0	;N/A
WELD CYC=0	;N/A
WELD CUR=65%	;N/A
COOL=0	;N/A
IMPULSES=1	;N/A
DOWNSLOPE CYC=0	;N/A
SLOPE END CUR=20	;N/A
QUENCH CYC=0	;N/A
TEMPER CYC=0	;N/A
TEMPER CUR=0	;N/A
HOLD CYC=10	;N/A
WELD COMPLETE=30	;Energize the ejector for a half-second to eject the part. Use the WCOMP output.
SUCCESSIVE SCH=0	;N/A
CHAIN SCH=0	;NA
OFF CYC=0	;Off Single turns off all valves.

This completes the operation.

Binary Valve/Function Table

FUNCTION		Clamp	Electrodes		
Schedule & Valve #		**SV1**	**SV2**	**SV3**	**SV4**
Sch. # 5	# 0	OFF	OFF	OFF	OFF
Sch. # 1 & 3	# 1	ON	OFF	OFF	OFF
Sch. #	# 2	OFF	ON	OFF	OFF
Sch. # 2 & 4	# 3	ON	ON	OFF	OFF
Sch. #	# 4	OFF	OFF	ON	OFF
Sch. #	# 5	ON	OFF	ON	OFF
Sch. #	# 6	OFF	ON	ON	OFF
Sch. #	# 7	ON	ON	ON	OFF
Sch. #	# 8	OFF	OFF	OFF	ON
Sch. #	# 9	ON	OFF	OFF	ON
Sch. #	# 10	OFF	ON	OFF	ON
Sch. #	# 11	ON	ON	OFF	ON
Sch. #	# 12	OFF	OFF	ON	ON
Sch. #	# 13	ON	OFF	ON	ON
Sch. #	# 14	OFF	ON	ON	ON
Sch. #	# 15	ON	ON	ON	ON

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Appendix A: Schematics

This section contains the required T2050 weld control schematics. As listed by drawing number, they are

503-5-2050-01	I/O Hookup for T2050
824644 [1 of 2]	Series 2050 Weld Control
824644 [2 of 2]	Series 2050 Weld Control
473-0-0426-01 [Sheet 1 of 2]	Model 2050 Data Entry Panel
473-0-0426-01 [Sheet 2 of 2]	Model 2050 Data Entry Panel

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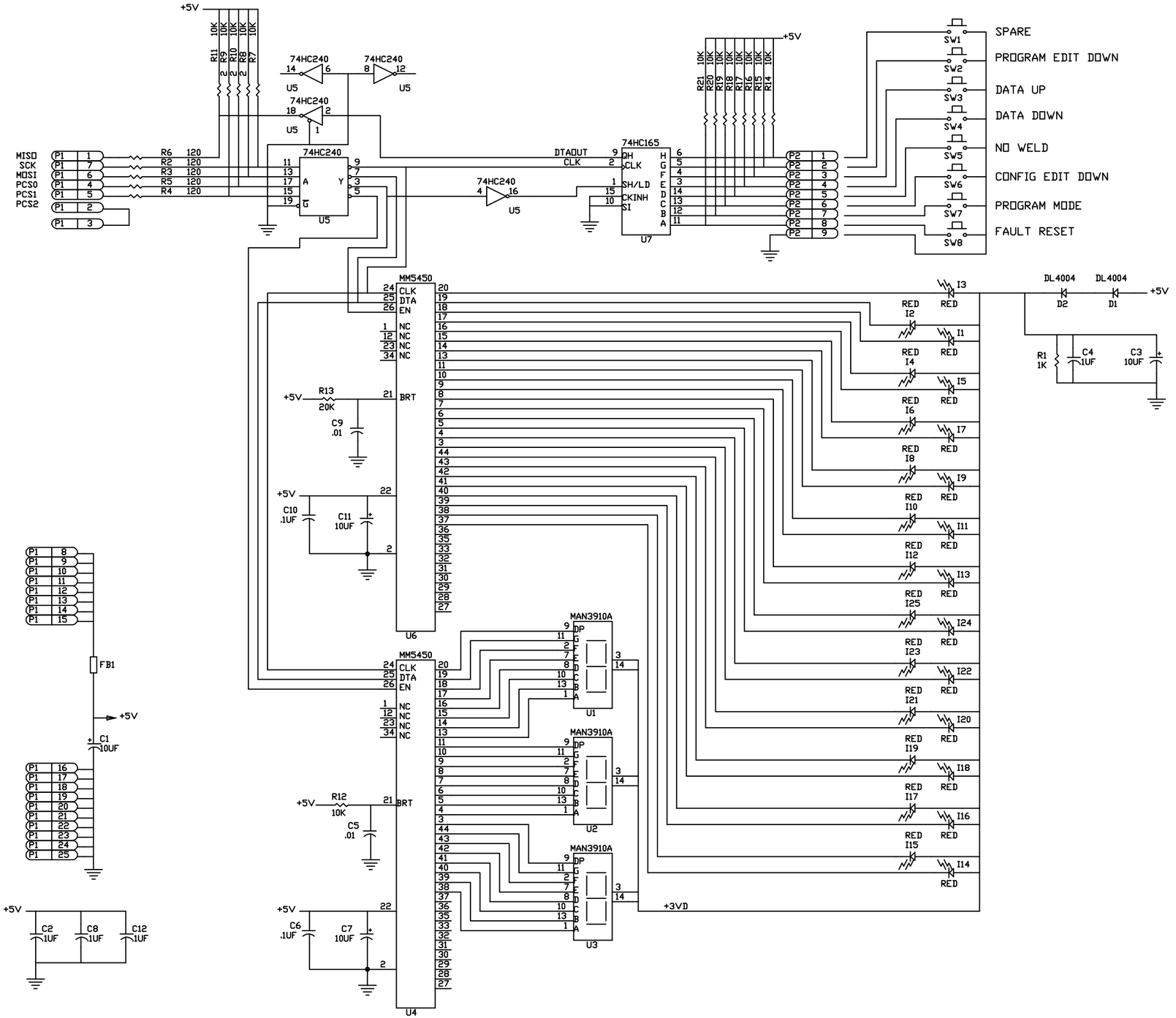

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A	11-28-00	CHANGE LOGO ALL PAGES	15988	JML	

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DR.N. wwd
DATE: 9-18-97
CH.K.D
DATE:

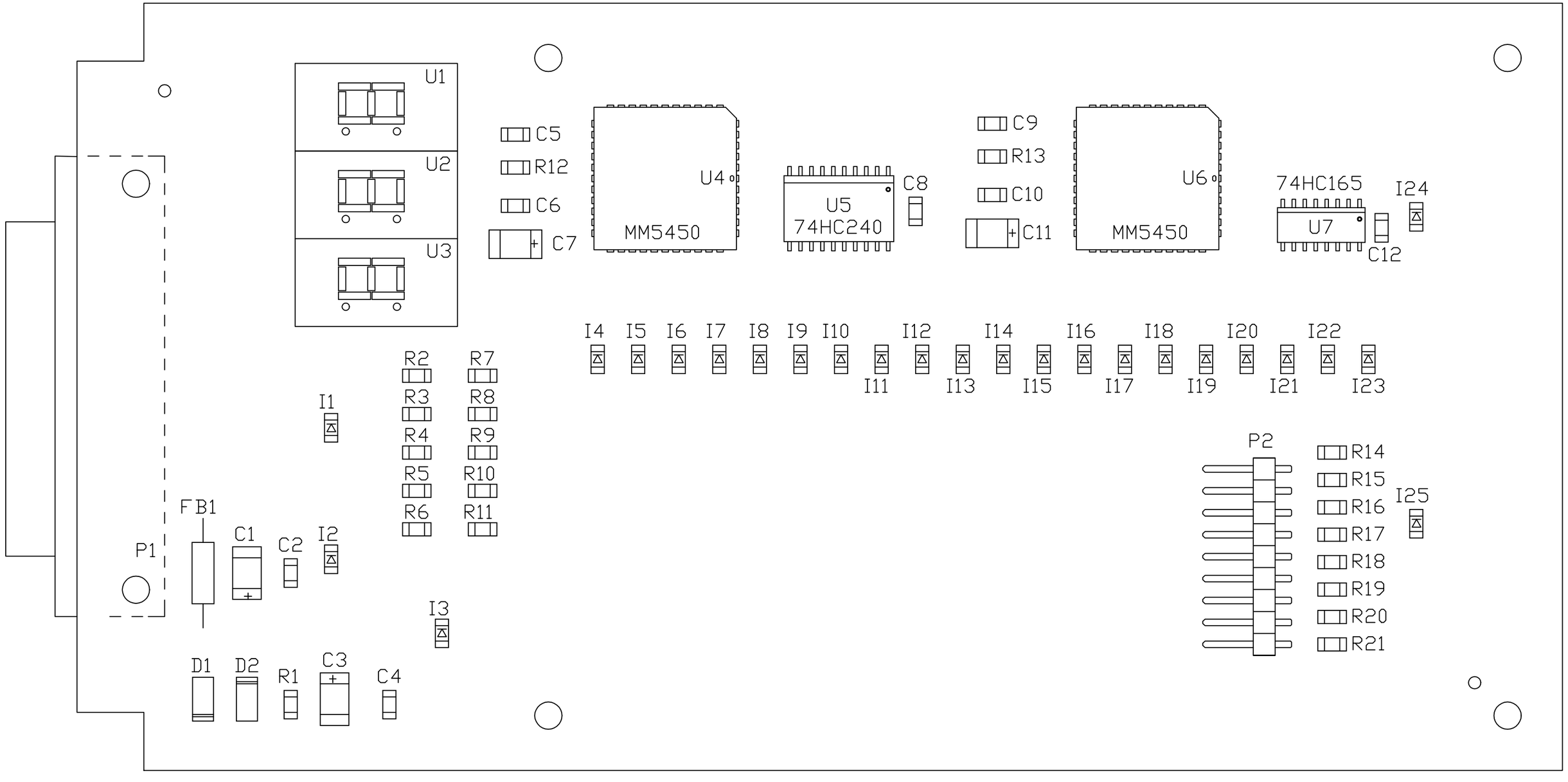
MODEL 2050
DATA ENTRY PANEL

wtc

TB# 845036 R. B
DO NOT SCALE DWG
DO NOT SCALE DWG
SHEET 1 OF 2

DRAWING NO. 473-0-0426-01

REV. A



REV	DATE	DISCRIPTION	ECA	BY	APPRV
A	11-28-00	CHANGE LOGO ALL PAGES	15988	JML	

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DR.N.
DATE:
CH.K.D
DATE:

MODEL 2050
DATA ENTRY PANEL

wtc

TB# 845036 R. B
DO NOT SCALE DWG
DO NOT SCALE DWG
SHEET 2 OF 2

DRAWING NO. 473-0-0426-01

REV. A

U12

68HC16Z1

C1	3/19/01	R54 WAS 2 WATTS
SYM.	DATE	REVISION

wtc

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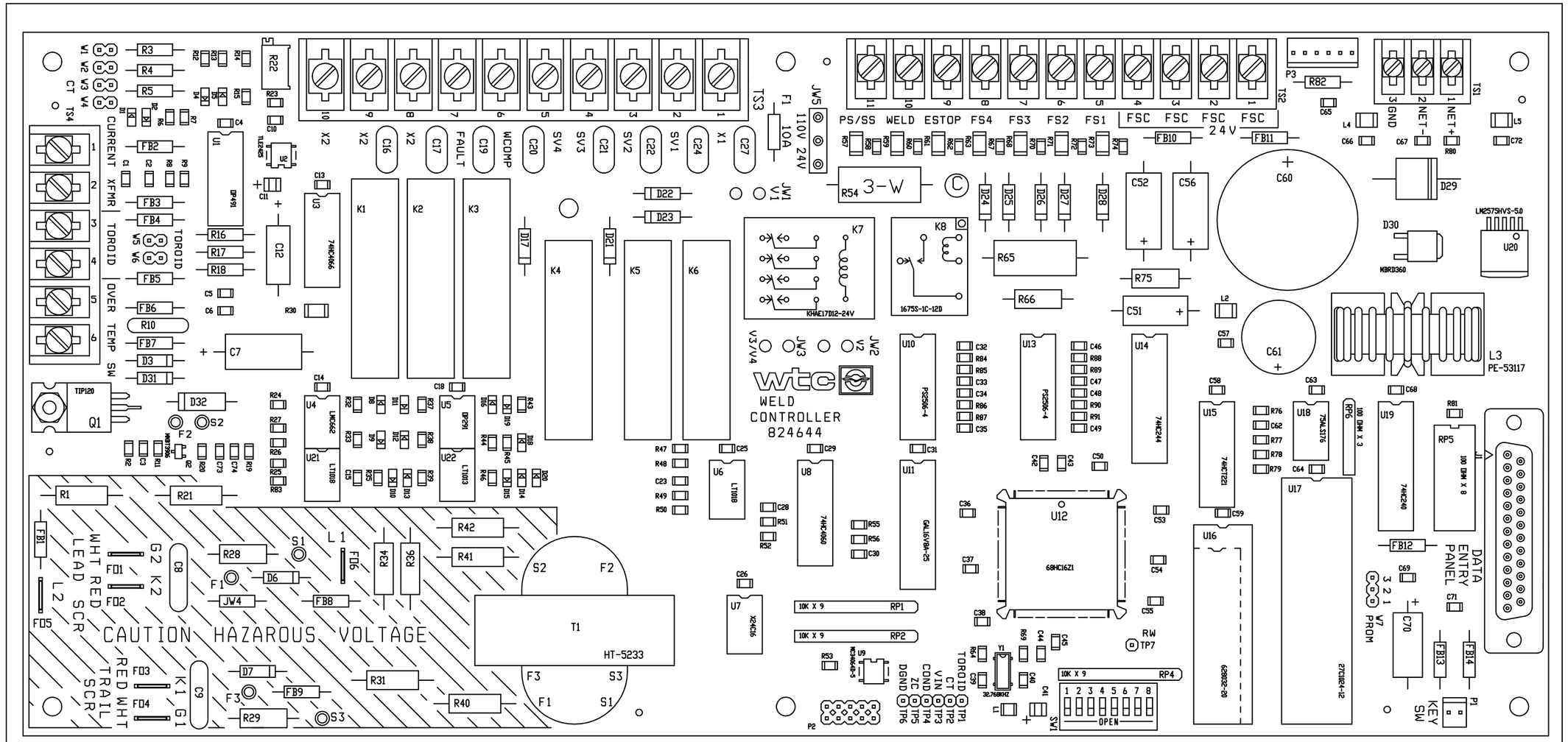
Description

Series 2050
Weld Control

Drawn	Checked	Scale
1-May-00	ERK	None

Drawing Size (D) | Sheet 1 of 2

Dwg./ Part No. 824644 Rev. Proto



SYM.	DATE	REVISION	BY
C1	3/19/01	R54 WAS 2 WATTS	16127

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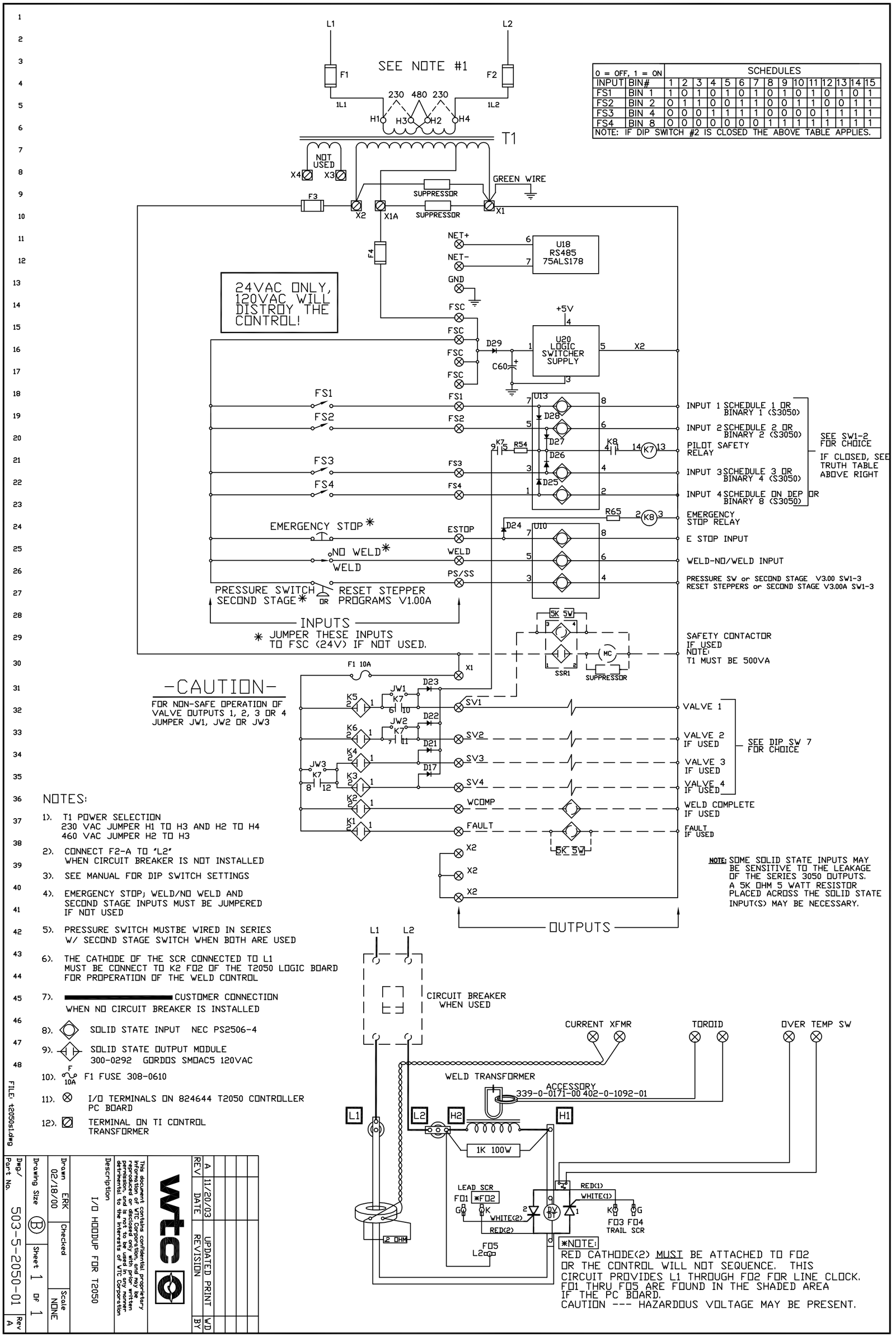
Description
Series 2050
Weld Control

Drawn	Checked	Scale
1-May-00	ERK	None

Drawing Size (C) Sheet 2 of 2

Dwg/ Part No. 824644 Rev. Proto



0 = OFF, 1 = ON		SCHEDULES														
INPUT	BIN#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FS1	BIN 1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
FS2	BIN 2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
FS3	BIN 4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
FS4	BIN 8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

NOTE: IF DIP SWITCH #2 IS CLOSED THE ABOVE TABLE APPLIES.

NOTES:

1). T1 POWER SELECTION
230 VAC JUMPER H1 TO H3 AND H2 TO H4
460 VAC JUMPER H2 TO H3

2). CONNECT F2-A TO 'L2'
WHEN CIRCUIT BREAKER IS NOT INSTALLED

3). SEE MANUAL FOR DIP SWITCH SETTINGS

4). EMERGENCY STOP; WELD/NO WELD AND SECOND STAGE INPUTS MUST BE JUMPERED IF NOT USED

5). PRESSURE SWITCH MUSTBE WIRED IN SERIES W/ SECOND STAGE SWITCH WHEN BOTH ARE USED

6). THE CATHODE OF THE SCR CONNECTED TO L1 MUST BE CONNECT TO K2 FD2 OF THE T2050 LOGIC BOARD FOR PROPERATION OF THE WELD CONTROL

7). ▬▬▬ CUSTOMER CONNECTION WHEN NO CIRCUIT BREAKER IS INSTALLED

8). ◇ SOLID STATE INPUT NEC PS2506-4

9). ◇ SOLID STATE OUTPUT MODULE 300-0292 GORDOS SMOAC5 120VAC

10). F 10A F1 FUSE 308-0610

11). ⊗ I/O TERMINALS ON 824644 T2050 CONTROLLER PC BOARD

12). ▨ TERMINAL ON TI CONTROL TRANSFORMER

FILE: t2050sldwg

Dwg./ Part No.	Drawing Size	Drawn	Checked	Scale
503-5-2050-01 Rev A	B	ERK 02/18/00		NONE

Sheet 1 OF 1

Description: I/O HOOOUP FOR T2050

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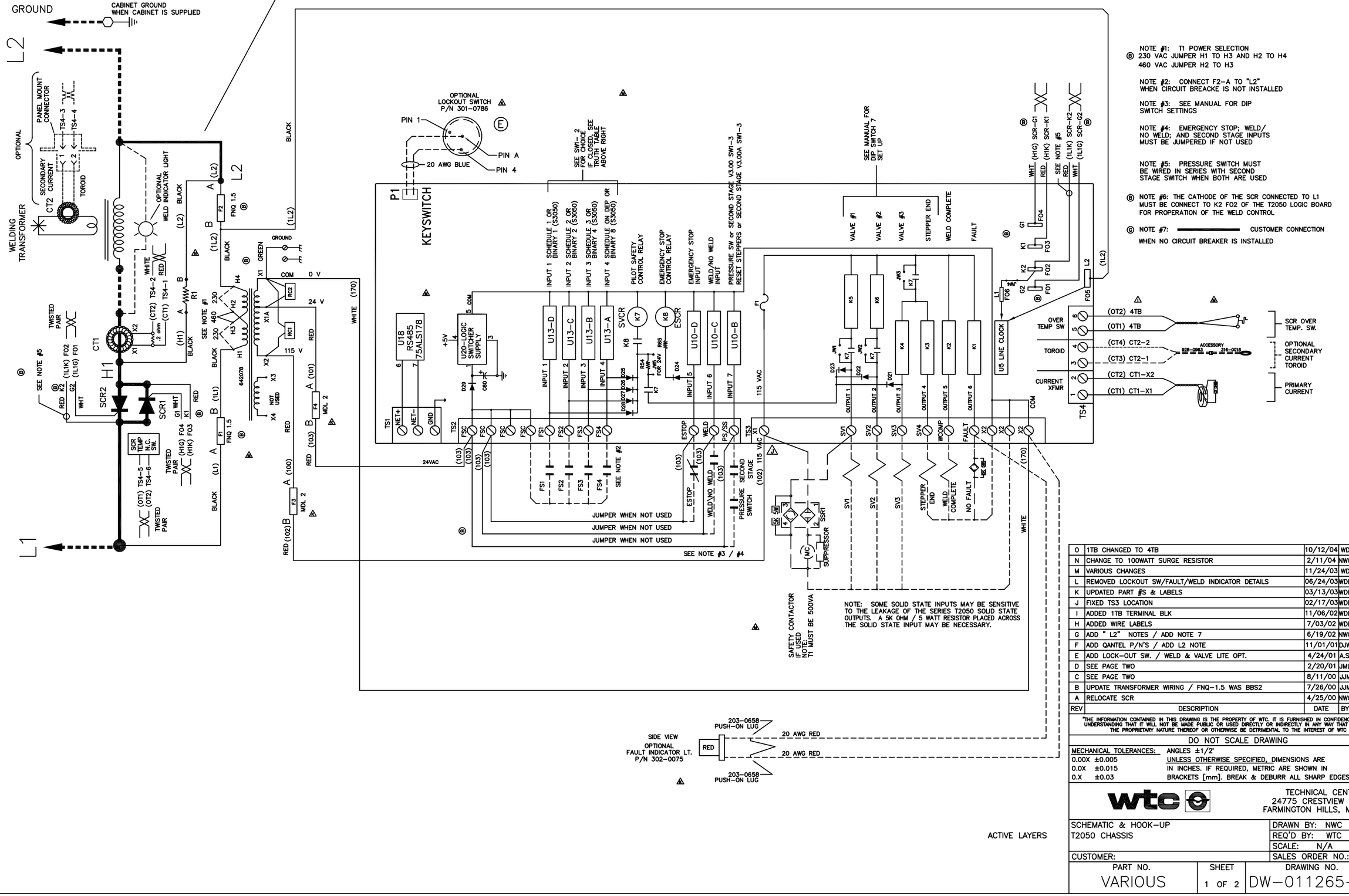
REV	DATE	REVISION	BY
A	11/20/03	UPDATED PRINT	WD

SEE NOTE TWO FOR "L2" CONNECTION



NOTE #1: T1 POWER SELECTION
Ⓑ 230 VAC JUMPER H1 TO H3 AND H2 TO H4
460 VAC JUMPER H2 TO H3

NOTE #2: CONNECT F2-A TO "L2" WHEN CIRCUIT BREACKE IS NOT INSTALLED

NOTE #3: SEE MANUAL FOR DIP SWITCH SETTINGS

NOTE #4: EMERGENCY STOP; WELD/NO WELD; AND SECOND STAGE INPUTS MUST BE JUMPERED IF NOT USED

NOTE #5: PRESSURE SWITCH MUST BE WIRED IN SERIES WITH SECOND STAGE SWITCH WHEN BOTH ARE USED

Ⓑ NOTE #6: THE CATHODE OF THE SCR CONNECTED TO L1 MUST BE CONNECT TO K2 FO2 OF THE T2050 LOGIC BOARD FOR PROPERATION OF THE WELD CONTROL

Ⓒ NOTE #7: ——— CUSTOMER CONNECTION
WHEN NO CIRCUIT BREAKER IS INSTALLED

REV	DESCRIPTION	DATE	BY	AUTHORITY	BY
O	1TB CHANGED TO 4TB	10/12/04	WD	ENG	BJ
N	CHANGE TO 100WATT SURGE RESISTOR	2/11/04	NWC		
M	VARIOUS CHANGES	11/24/03	WD	ECN#03-075	CCB
L	REMOVED LOCKOUT SW/FAULT/WELD INDICATOR DETAILS	06/24/03	WDD	ENG	ENG
K	UPDATED PART #S & LABELS	03/13/03	WDD	ENG	ENG
J	FIXED TS3 LOCATION	02/17/03	WDD	ENG	ENG
I	ADDED 1TB TERMINAL BLK	11/06/02	WDD	ENG	ENG
H	ADDED WIRE LABELS	7/03/02	WDD	ENG	ENG
G	ADD " L2" NOTES / ADD NOTE 7	6/19/02	NWC	ENG	
F	ADD QANTEL P/N'S / ADD L2 NOTE	11/01/01	DJW	ENG	CCB
E	ADD LOCK-OUT SW. / WELD & VALVE LITE OPT.	4/24/01	A.S.	ENG	KLN
D	SEE PAGE TWO	2/20/01	JML	ENG	KLN
C	SEE PAGE TWO	8/11/00	JJM	ENG	A.S.
B	UPDATE TRANSFORMER WIRING / FNQ-1.5 WAS BBS2	7/26/00	JJM	ENG	A.S.
A	RELOCATE SCR	4/25/00	NWC	ENG	A.S.

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0.00X ±0.005	UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE	
0.0X ±0.015	IN INCHES. IF REQUIRED, METRIC ARE SHOWN IN	
0.X ±0.03	BRACKETS [mm]. BREAK & DEBURR ALL SHARP EDGES.	THIRD ANGLE

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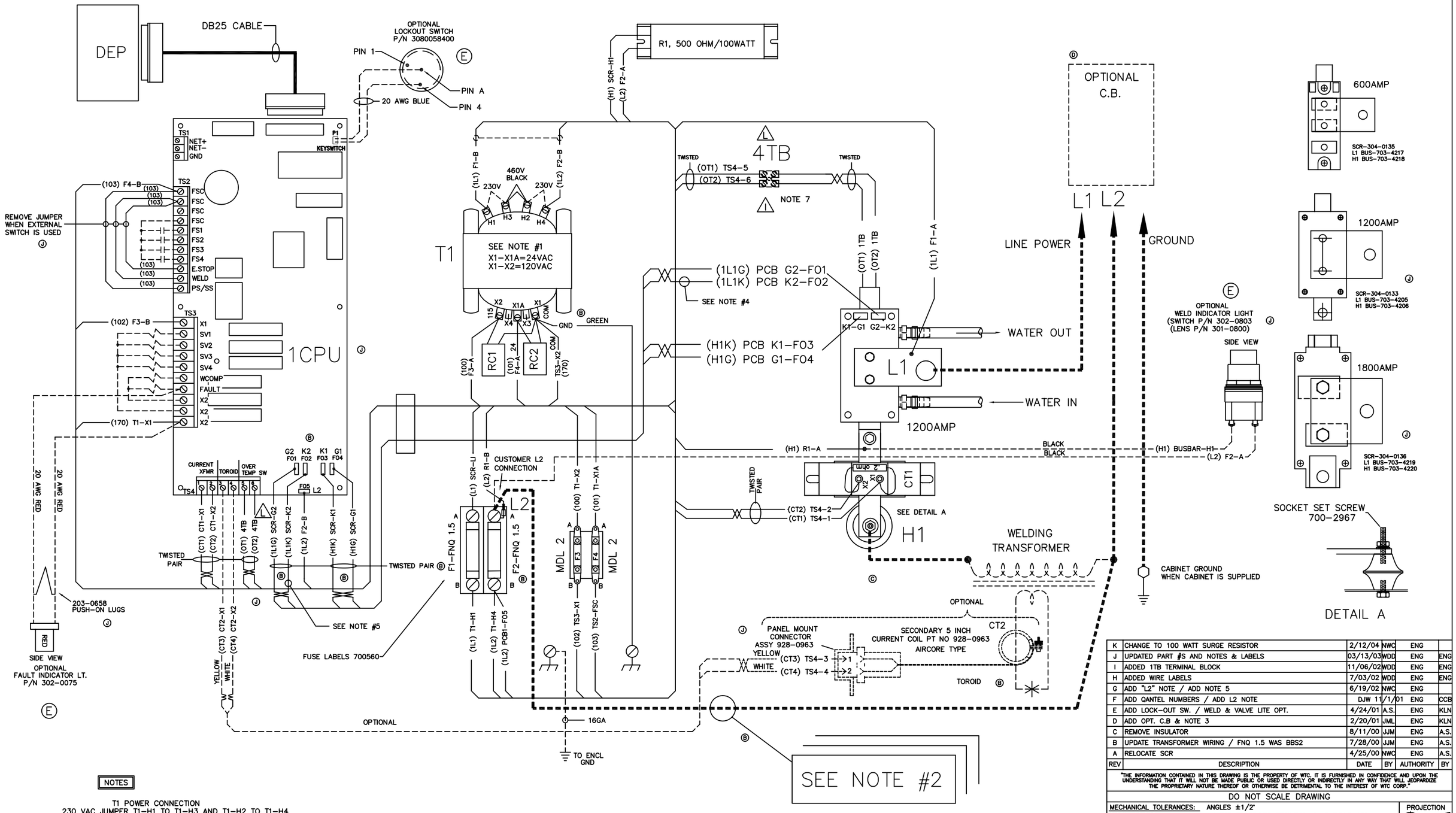
FARMINGTON HILLS, MI 48335

SCHEMATIC & HOOK-UP T2050 CHASSIS	DRAWN BY: NWC	4821/00
	REQ'D BY: WTC	
	SCALE: N/A	SIZE: B
CUSTOMER:	SALES ORDER NO.:	

PART NO.	SHEET	DRAWING NO.	REV.
VARIOUS	1 OF 2	DW-011265-01	O

ACTIVE LAYERS



NOTES

T1 POWER CONNECTION
230 VAC JUMPER T1-H1 TO T1-H3 AND T1-H2 TO T1-H4

NOTE 1.) 460 VAC JUMPER T1-H2 TO TI-H3
Ⓑ TO F2-A BEFORE CONTROL IS USED

NOTE 2.) L2 POWER MUST BE CONNECTED TO F2-A BEFORE CONTROL IS USED

NOTE 3.) ∿-∿ TWISTED WIRES

NOTE 4.) THE CATHODE OF THE SCR CONNECTED TO L1
Ⓑ MUST BE CONNECT TO K2 F02 OF THE T2050 LOGIC BOARD FOR PROPER OPERATION OF THE WELD CONTROL

NOTE 5.) ▬▬▬▬▬ CUSTOMER CONNECTIONS

NOTE 6.)

WIRE NUMBER/GAUGE CHART

WIRE NO./LABEL	COLOR/GAUGE
1 THRU 50	RESERVED FOR CUST
51 THRU 99,OT1,OT2	BLUE, 18GA ——
100 THRU 169, CT1	RED, 16GA ——
170 THRU 179, CT2	WHITE, 16GA ——
1L1, 1L2, H1, L1, L2 H1A	BLACK, 16GA ——

NOTE 7.) THERMAL SWITCH WIRED DIRECTLY TO 1CPU WHEN POSSIBLE.

ACTIVE LAYERS

REV	DESCRIPTION	DATE	BY	AUTHORITY	BY
K	CHANGE TO 100 WATT SURGE RESISTOR	2/12/04	NWC	ENG	
J	UPDATED PART #S AND NOTES & LABELS	03/13/03	WDD	ENG	ENG
I	ADDED 1TB TERMINAL BLOCK	11/06/02	WDD	ENG	ENG
H	ADDED WIRE LABELS	7/03/02	WDD	ENG	ENG
G	ADD "L2" NOTE / ADD NOTE 5	6/19/02	NWC	ENG	
F	ADD QANTEL NUMBERS / ADD L2 NOTE	DJW 11/1/01		ENG	CCB
E	ADD LOCK-OUT SW. / WELD & VALVE LITE OPT.	4/24/01	A.S.	ENG	KLN
D	ADD OPT. C.B & NOTE 3	2/20/01	JML	ENG	KLN
C	REMOVE INSULATOR	8/11/00	JJM	ENG	A.S.
B	UPDATE TRANSFORMER WIRING / FNQ 1.5 WAS BBS2	7/28/00	JJM	ENG	A.S.
A	RELOCATE SCR	4/25/00	NWC	ENG	A.S.

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0.00X ±0.005	UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE
0.0X ±0.015	IN INCHES. IF REQUIRED, METRIC ARE SHOWN IN
0.X ±0.03	BRACKETS [mm]. BREAK & DEBURR ALL SHARP EDGES.

PROJECTION: THIRD ANGLE

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FARMINGTON HILLS, MI 48335

WIRING DIAGRAM T2050 CHASSIS	DRAWN BY: NWC	4/21/00
	REQ'D BY: WTC	
	SCALE: N/A	SIZE: B
CUSTOMER:	SALES ORDER NO.:	

PART NO.	SHEET	DRAWING NO.	REV.
VARIOUS	2 OF 2	DW-011265-02	L