TABLE OF CONTENTS

CHAPTER 6 INFRARED

CHAPTER 7 O2 AND NO

CHAPTER 8 RPM

CHAPTER 9 PARTS

CHAPTER 10 THEROMCOUPLE

CHAPTER 11 PRINTERS

APPENDIX A SOFTWARE PAGE FLOW

INTRODUCTION

GENERAL

The MT-3505 Emission Analyzer is a highly versatile test instrument used to test exhaust gases. When used with other tools and equipment, the analyzer can also be used to detect and locate ignition, fuel, exhaust, emission control, and engine service problems.

When exhaust gas concentrations are within limits specified by the vehicle manufacture or the local, state or federal government, it is generally assumed that the fuel, ignition, and emission control systems are functioning properly. If exhaust gas concentrations exceed those specified limits, repairs or adjustments are probably needed.

Most customer complaints are attributed to a specific function of the MT-3505 not operating properly. Therefore, the Service Manual is divided into Chapters that provide Theory of Operation, Service Calibration Page Usage (when applicable), Calibration (when applicable) and troubleshooting for the various functions of the Tester.

NOTE: *If the Table of Contents does not list a calibration procedure, service calibration usage notes, etc... this indicates that there is no procedure applicable to that function.*

Most Theory of Operation is written around the Functional Block Diagram. All Signals and Circuitry that are referred to will be all capitalized. (i.e. BUS INTERFACE LOGIC).

Printed Circuit Boards may be called PCB's, CCA (Circuit Card Assemblies) or just Boards.

IMPORTANT GUIDELINES FOR SERVICING

A. ALWAYS verify that the power supply is operating within the specified tolerance (at CPU) before replacing any Circuit Boards!!

B. Verify that the connectors on the boards are fully seated and that the boards are fully seated in their respective backplane. In addition, verify that a connector keying pin has not come loose and lodged between pins, thereby inhibiting proper mating.

C. NEVER remove boards or disconnect a connector with power on!

D. Make sure that you completely understand what the Tester is suppose to do (you cannot fix it if it's not broken). Refer to the Operator's Manual, application notes and the flow diagrams for this type of information.

E. CONSULT the Service Bulletin Binder to see if this problem was identified earlier and instructions provided on how to correct it.

F. Use Wrist Static Straps when handling the circuit boards; use Anti-Static Bags and Cartons when transporting the circuit boards.

LOGIC LEVEL DESIGNATIONS

Throughout this manual the terms "high" and "low" are used. Unless otherwise noted, the "high" refers to a TTL logic high level (5V) and a "low" refers to a TTL logic low level (0V).

Signals that are active low or active on the falling edge are designated with an asterisk (*) following the signal name, i.e. TRACK 00*, STROBE*. Typically the text will differentiate between a level sensitive or edge sensitive signal.

A Functional block may use either an asterisk following the signal name (PUMP ON*) or a bar over the signal's name (PUMP ON) to indicate that the signal is active low or on the falling edge.

OPEN COLLECTOR OUTPUTS

Some of the outputs are open collector, meaning that a pull-up resistor is used to "pull- up" the signal to Vcc. Usually the pull-up resistor is at the signal's destination board. The Open Collector outputs are designated on the diagrams with an O.C. marking at the edge connector. The FST should keep in mind the fact that open collector drive may be used. A broken wire between the source board and the destination board will cause the source board to appear to be defective (the signal will not be pulled-up, thus it will appear that the source board is not outputting a signal).

HANDLING OF MOS IC AND OTHER STATIC SENSITIVE DEVICES

A majority of integrated circuits are high impedance devices. This characteristic makes them susceptible to damage by electrostatic charges. Large electrostatic charges can build up in low humidity environments which if discharged through IC terminals, may permanently damage the device.

To eliminate needless failures, use the following techniques when handling any circuit board, integrated circuit chip or any other static sensitive device:

1. Do not remove the printed circuit board from the static protection packaging until it is ready for use.

2. Never remove or insert boards under power.

3. The correct procedure for removal of a Board from card rack or main equipment is as follows:
   a. Equipment on which the repair is performed must be grounded.
   b. Wear wrist strap and connect wrist strap to equipment or any available nearest ground (wrist strap ground cord is included in field service kit).
   c. Always grasp the Board from two opposite edges using the forefingers.
   d. Place removed Board on grounded static dissipative mat (part of field service kit) when troubleshooting or upgrading software.

4. When inserting Boards into a card rack or into main equipment:
   a. Remove Board from original packaging on static dissipative material. Save all packaging for possible reuse if required to ship defective Board.
   b. Install Boards into unit using rules 3A, 3B, and 3C.
   c. Package defective Boards into a shielded bag and then return in a reusable container.

5. Package IC chips or any other static sensitive device in conductive foam or an equivalent static dissipative material which provides adequate static and physical protection.

6. Avoid any unnecessary contact with internal circuits.

7. Avoid setting Board's on static prone insulating surfaces such as paper, glass, rubber, and plastic.

8. Beware of friction generated static when:
   a. Wearing silk or nylon garments.
   b. Walking on carpets.
   c. Scuffing rubber sole shoes.

NOTE: *Relative humidity has a direct bearing on the magnitude of possible static charge buildup; the lower the relative humidity, the higher the charge and vice versa.*

BASIC ASSEMBLY DESCRIPTIONS

The Computer Power Supply Assembly converts primary AC power into the required DC output voltage necessary to operate the CPU, along with all of its associated circuitry. For a more in-depth explanation, refer to Chapter 1.

The 286 CPU Board is the brain, used to control and process all the information collected by the MT-3505. Such functions include, but are not limited to; the pneumatics, speaker, peripheral ports, keypad, Infrared Bench, and Monitor. It also contains ROM memory used for the system's BIOS (Basic Input Output System used to standardize software calls to hardware devices). For a more in-depth explanation, refer to Chapter 2.

The Connector Board contains the serial and parallel ports used by the various external peripherals. There are no active components on the Connector board. It simply provides a medium to interface to external peripherals, all interpretation of this data is done by the CPU Board. For a more in-depth explanation, refer to Chapter 2.

The Keypad is used to allow the operator to input information into the computer. It is a "Smart Keyboard" in that it scans the keys continuously, interrupting the CPU to communicate what and when a key is pressed. For a more in-depth explanation, refer to Chapter 3.

The monitor (which includes the monitor board) interprets the signals sent from the CPU board. This enables the production of monochrome quality text and high-resolution graphic displays on the VDU. For a more in-depth explanation, refer to Chapter 4.

The Infrared Bench is an Andros 6241 digital automotive bench, which utilizes a single-beam NDIR (nondispersive infrared) measurement technology to provide fully corrected HC, CO, and CQgas concentrations. These concentrations are then transferred to the CPU Board. For a more in-depth explanation, refer to Chapter 6.

The NO and O2 measurements are performed by cells located on the rear of the analyzer. These cells produce a voltage in the presence of Nitric Oxide and Oxygen respectively. This voltage is then processed by the Andros Bench. For a more in-depth explanation, refer to Chapter 7.

CHAPTER 1
AC/DC DISTRIBUTION

⚠ WARNING!

DANGEROUS HIGH VOLTAGES
ARE PRESENT IN THIS EQUIPMENT

Always use the “One Hand Rule” (keep one hand in a pocket or behind your back) when working with AC voltages. Always verify that the Analyzer is “OFF” using the Power Switch on the side of the tester. It is also important to ensure the AC power cord is unplugged from the outlet before removing wires from the MT-3505’s power supply board.

AC DISTRIBUTION

REFER TO DRAWING 1-1 PAGE 1-5

AC Power enters the unit via the power cord. The power cord plugs into the combination Input Filter / Fuse Assembly on one end, and the wall outlet on the other end. Both the AC Hot line and the AC Neutral line are filtered through the Input Filter portion of the Input Filter / Fuse Assembly. On the output side of the Input Filter portion of the Input Filter / Fuse Assembly, the AC Neutral line is routed directly to Pin 3 of P1, on the Power Supply Board. The AC Hot line is jumped to the Fuse Assembly portion of the Input Filter / Fuse Assembly, where it runs though a 2A fast blow fuse. After the AC Hot line has passed through the 2A fast blow fuse, it is routed to the S1 power switch. From the S1 power switch, the AC Hot line is routed to Pin 5 of P1, on the Power Supply Board. The AC Ground line is routed to the ground post on the Chassis sheet metal.

DC DISTRIBUTION

REFER TO DRAWING 1-2 PAGE 1-7

The DC Distribution portion of this manual has been broken into two sections, since the MT-3505 can be run on a 12 Volt DC supply. The first portion deals with the 12 volt DC supply that will be use to power the MT-3505. The second portion deals with the DC voltages that are generated by the Power Supply.

12 VOLT INPUT SUPPLY

REFER TO DRAWING 1-1, PAGE 1-5

Since the MT-3505 can be run on a 12 Volt DC supply instead of the AC supply, there is a second power supply Leadset. The DC leadset connects to a 12 Volt DC supply and provides 12 volts DC across Pin 2 and 3 of the 3 pin 12 Volt input power connector, located on the back panel of the analyzer. The 12 Volt DC return line runs directly from Pin 3 of the 12 Volt DC input connector to the Male spade lug marked ST1 on the Power Supply Board. The 12 Volt DC line is routed first to the 15 Amp Circuit Breaker, located on the back panel of the MT-3505. From the Circuit Breaker, the 12 Volt DC line is routed to the 32V 20 Amp fuse (F1) located above the Input Filter / Fuse Assembly on the inside of the back panel. From the 20 Amp fuse, the 12 Volts DC is routed to the MT-3505’s Power Switch, then to the Male spade lug ST3 on the Power Supply Board.

INTERNAL DC POWER SUPPLY ROUTING (beyond the power supply)

Whether the input to the MT-3505’s power supply is a DC or AC voltage, the power supply provides many DC voltages out at connector P2 to the CPU Board J4. The next page has a list of power supply voltages and where they are routed to, from the CPU board.

DC VOLTAGE REFERENCE CHART

DC VOLTAGE SIGNAL	FROM J4 of CPU PIN NUMBER	DESTINATION	
GND	1	J9 pin 1,2,19,20 J12 pin 1 J13 pin 1 J14 pin 3 J23 pin 3 J28 pin 15,16 33,35,37,39	Monitor Keyboard Bench Bench Speaker Connector Bd.
VCC +5V	2	J13 pin 2 J23 pin 4	Bench Speaker
PGNDS	3	J13 pin 3	Bench
+15 HPS	4	J13 pin 4	Bench
+15 HP	5	J13 pin 5 J21 pin 2 J22 pin 2 J11 pin 1	Bench Solenoid 1 Solenoid 2 Fan
+15V	6	J13 pin 6	Bench
AGND	7	J13 pin 7	Bench
-15V	8	J13 pin 8	Bench
PGND	9	J13 pin 9 J11 pin 2	Bench Fan

CHECKOUT / CALIBRATION

There are no power supply adjustments. Therefore there is no need for a calibration procedure. To verify that proper DC Voltages are present, refer to drawing 1-2 on page 1-7.

TROUBLESHOOTING

Whenever troubleshooting any problem, always ensure the power supply is generating the correct voltages.

Whenever troubleshooting power problems ensure the following:

- **110 Volts AC is present at P1, across pins 3 and 5 on the power supply board.**

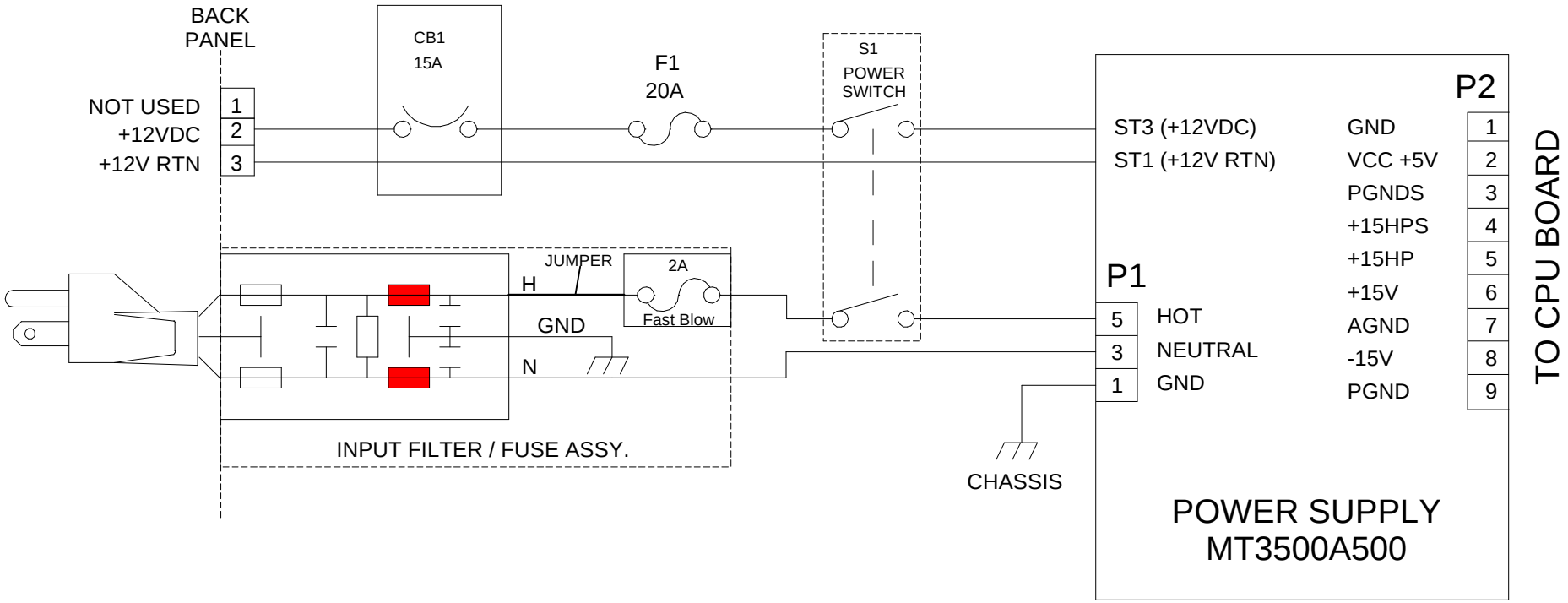
or

- **12 Volts DC is present across ST1 and ST3 on the power supply board.**

- **all DC supplies are present at P2 on the power supply board.**

COMPLAINT	CORRECTIVE ACTION
I. UNIT WILL NOT POWER UP FROM AC SOURCE.	Unplug the unit from the AC wall outlet and plug the unit into the DC Source. Does the unit power up now? • Check DC Power Supply Voltages. Refer to Page 1-2. • Check AC Power to the Power Supply Board, Connector P1. • Check the 2 amp fast blow fuse. If blown, replace fuse and recheck voltages. • Check the Input Filter / Fuse Assembly. If no AC voltage is getting through it replace Input Filter / Fuse Assembly. • Check AC wall Outlet, and check power cable.
II. UNIT WILL NOT POWER UP FROM DC SOURCE.	Unplug the unit from the DC Source and plug the unit into the AC wall outlet. Does the unit power up? • Check DC Power Supply Voltages. Refer to Page 1-2. • Check DC Power to the Power Supply Board. Connector ST1 to ST3 should read 12 volts. • Check the 20 amp fuse. If blown, replace fuse. • Check Circuit Breaker. • Check DC Source.
III. PUMP WILL NOT RUN.	Ensure that you are in a mode in which the pump should run. • Verify ≅ 15 VAC from J18 pins 1 to 2. • Verify ≅ 15 VAC from J18 pins 2 to 3. If all voltages are OK replace vacuum pump. Replace CPU Board.
IV. FAN WILL NOT RUN.	The fan should be running whenever the unit is powered up. If not check the following. • Verify 12 Volts across pins 1 and 2 on connector J11. If present, replace FAN. • Verify all voltages at connector J4. If present, replace CPU Board. • Replace Power Supply.

NOTES:



SUN ELECTRIC CORPORATION
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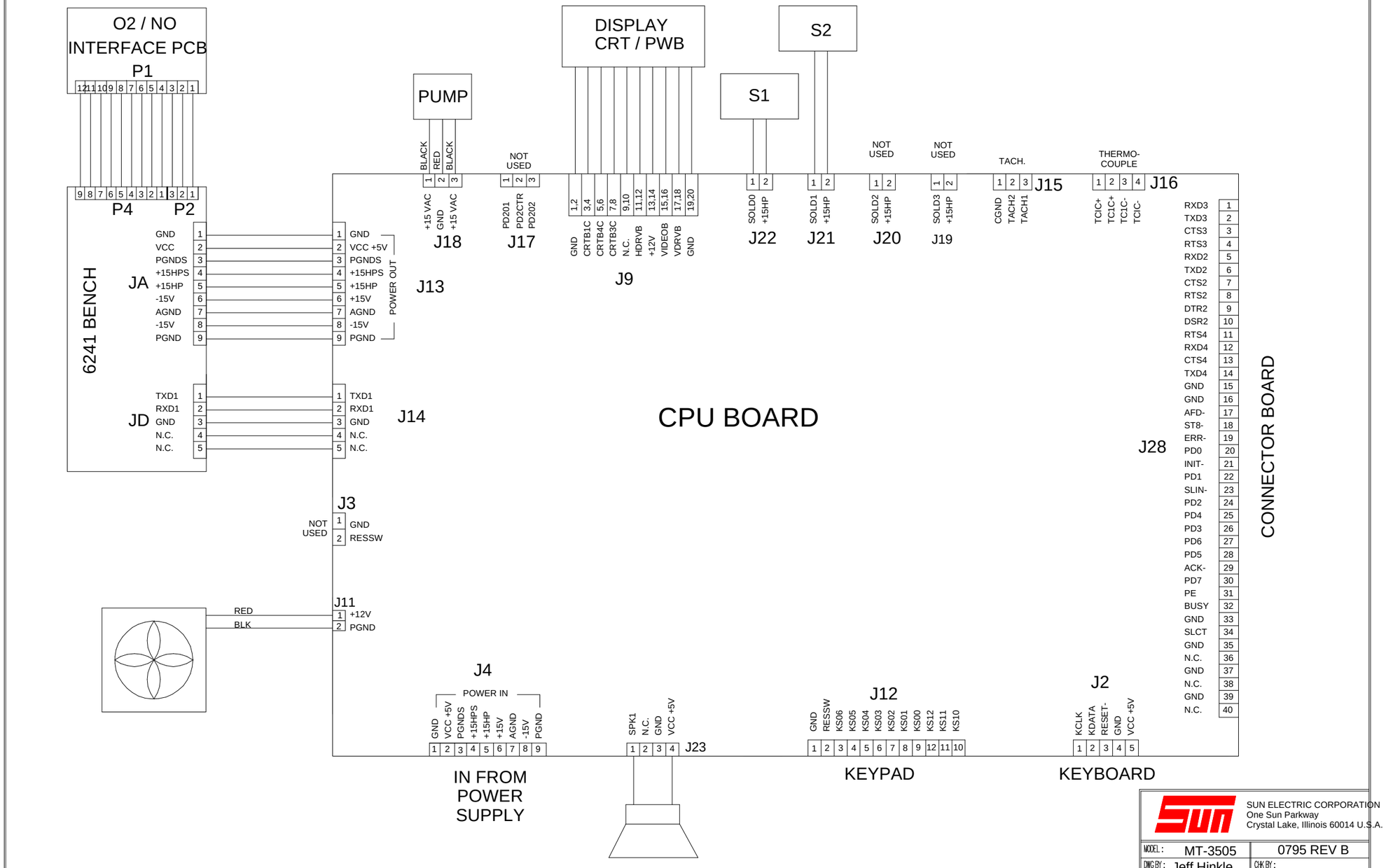
MODEL: MT-3505	0795 REV B
DWG BY: Jeff Hinkle	CHK BY:

TITLE: AC DISTRIBUTION

DWG: 1-1	PAGE: 1-5

NOTES:



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MODEL: MT-3505	0795 REV B
DWG BY: Jeff Hinkle	CHK BY:

TITLE: DC DISTRIBUTION

DWG: 1-2	PAGE: 1-7

NOTES:

CHAPTER 2
COMPUTER

THEORY OF OPERATION

The heart of the MT-3505 is a ROM based, 80286 Microprocessor driven, CPU Board specifically designed for the needs of this analyzer. It is mounted on the bottom chassis of the MT-3505, below the Andros Infrared Bench. All the Functions of the MT-3505 are routed through this Board. Below is a discussion of individual circuits and their functions.

CMOS RAM BATTERY BACKUP

The CMOS RAM (Random Access Memory) is Battery Backed up by the 3.6 volt, 110 milliamp Ni-Cad (Nickel Cadmium) Battery. It supplies power to the CMOS RAM when the power switch is in the "0" OFF position. This allows special setups (waveforms, Letterhead, Communication ports, Date and Time) to be stored when the power is turned off. If this battery was to fail or become weak, some if not all of the above setups would be erased.

SPEAKER

The speaker is run by the System Controller Chip (U41, 82C235). The speaker signal is output on J23 pin 1, and +5 volts (VCC) powers the speaker on J23 pin 4.

KEYPAD

The Keypad is controlled by the Keyboard controller (U7, 80C51SL-BG). Keypad Sense and Activate lines are transmitted via connector J12 pins 3 through 12. Pins 1 and 2 of that same connector are the Software Reset Lines for the Central Processing Unit. For further details and a functional block diagram of the Keypad circuitry, please refer to Chapter 3 of this manual.

TILT CIRCUIT

The angle of operation of the MT-3505 is 0° to 30°, measured from the front of the analyzer to the back of the analyzer, horizontally. If the front of the MT-3505 is tilted more than approximately 30° higher than the back, the mercury switch (SW1) on the CPU board will short between contacts 1 and 2. This Switch is being monitored by the Keyboard Controller. When the switch is shorted the keyboard controller tells the system controller that the analyzer has been tilted. At that point, an error beep will sound. This indicates an error has occurred and the message "**ANGLE TOO STEEP, LEVEL ANALYZER**" will be displayed.

FAN

The fan is powered by the +15HP volt supply from the power supply assembly Before the +15HP volt supply reaches the fan it goes though a 24 ohm 5 watt sand block resistor. Sending the +15HP volt line through the resistor before it gets to the fan cuts down the effective current to the fan. Connector J11 pin 1 on the CPU board is the fan power. Pin 2 of J11 is the ground for the fan.

VIDEO

Video signals to the monitor are generated on the CPU board by the Video chip (U3, W86855). Video Display RAM is also stored on the CPU board on Integrated Circuit chips U2 and U3 (53C464). The Front panel Brightness pot is also located on the CPU board. For an in-depth description of the Video circuitry, please refer to Chapter 4 of this manual.

SERIAL AND PARALLEL I / O PORTS

All the controlling components (drivers, controllers) are located on the CPU Board. U55 and U56 (16C462) are the Serial / Parallel controllers. Each chip controls two serial ports and one parallel port. J28 on the CPU board is the connector through which all the data is transferred to the connector board. The connector board, mounted on the back panel, has all the serial and parallel connectors to hook up a serial printer, parallel printer, or MT-2500 Scanner. For a detailed block diagram of the Serial / Parallel I/O circuit please refer to drawing 21, page 2-5.

PUMP

The pump is powered by a 60 volt center tapped AC supply, which is generated on the CPU board. When the software has determined, by operator input, that the pump should be turned on. 30 volts AC is supplied across pins 1 and 2, and pins 2 and 3 of connector J18 on the CPU board. This turns the pump on.

SOLENOIDS

The two solenoids contained in the MT-3505 are both controlled by circuitry on the CPU Board. Part of one of the Serial / Parallel Controller chips on the CPU board is used as the controlling device to turn the solenoids on and off. Solenoid 1 is controlled via connector J22, and Solenoid 2 is controlled via connector J21, on the CPU Board. Pin 2, on both connectors is +15 volt HP supply and pin 1 is the controlling signal. In order for the solenoids to be energized the controlling circuitry must provide a ground path for the +15 volt HP supply.

TACHOMETER

The entire tachometer circuitry is located on the CPU Board. From the back panel '**TACH**' connector the RPM signal is routed, via a wiring harness, to J15 on the CPU Board. On the CPU Board, the RPM signal is processed, digitized and sent to the Central Processing Unit Chip. From there, the signal is sent to the video circuitry and displayed on the Monitor. For a detailed description of the Tachometer circuit and a functional block diagram, please refer to Chapter 8 of this manual.

THERMOCOUPLE

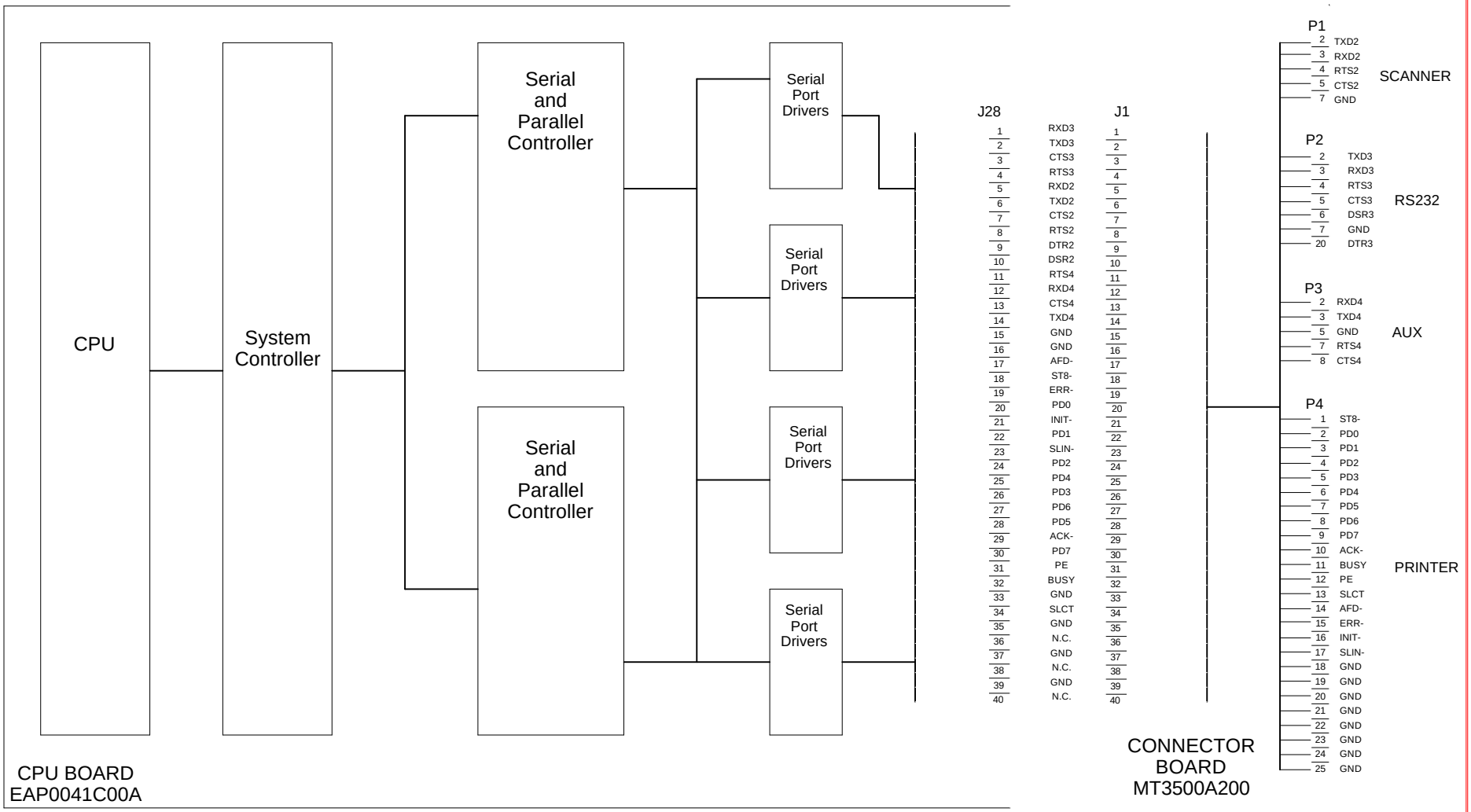
As with the Tachometer circuitry, the entire Thermocouple circuitry is also located on the CPU Board. From the back panel "**TEMP**" connector, the Temperature signal is routed, via a wiring harness, to J16 on the CPU Board. On the CPU Board, the Temperature signal is processed, digitized and sent to the Central Processing Unit Chip. From there, the signal is sent to the video circuitry and displayed on the Monitor. For a detailed description of the Thermocouple circuit and functional block diagram, please refer to Chapter 12 of this manual.

TROUBLESHOOTING

COMPLAINT	CORRECTIVE ACTION
I. ANALYZER CONTINUES TO LOOSE SETUP PARAMETERS OR STORED WAVEFORMS.	Ensure that the CMOS Battery is reading 3.6 Volts DC across its terminals. • If not, replace CPU Board. Refer to Drawing 2-1, ensure that all voltages are present at the CPU Board connector J4. • If not, replace Power Supply.
II. SPEAKER NEVER BEEPS.	Enter the Analyzer Setup menu through the Options Menu and ensure that the beeper option is turned on. • Toggle Beeper Option to ON by pressing **<F4>**. Place the black lead of the Digital Multimeter to Chassis Ground (Sheet Metal), place the red lead to J23 pin 4. The Digital Multimeter should read 5 volts. • If not, Check DC Voltage supplies on connector J4. • If DC Voltage is present at J4 replace CPU Board. • If DC voltage is not present, refer to chapter 1.
III. NO RESPONSE FROM ANY KEYS ON THE KEYPAD.	Ensure that connector J12 on the CPU Board is seated properly and that the connector is not moved over one pin. Press **<RESET>,** does the analyzer reset? • If yes, keyboard controller is fine, Replace Keypad. • If no, replace CPU Board.
IV. "ANALYZER TOO STEEP, LEVEL ANALYZER" MESSAGE ALWAYS DISPLAYED.	Ensure that the front of the analyzer is less than 30° above the rear of the analyzer. • If not, Take the proper steps necessary to level the analyzer such that the front of the analyzer is closer to the same height as the rear of the analyzer. With a Digital Multimeter measure the resistance between pins 1 and 2 of SW1 on the CPU Board. • If the contacts are shorted and the analyzer is level, Replace CPU Board.

COMPLAINT	CORRECTIVE ACTION

V. SOLENOIDS WILL NOT ENERGIZE.	Enter the second page of the Service Menu through the Options Menu. In this mode you can toggle the solenoids on and off.
	
	Place the Digital Multimeters Red lead to J22 pin 1 and the Black lead to J22 pin 2. Press **<F2>** to toggle solenoid 1 to the ZERO Mode. The Digital Multimeter should read 12 volts±3 volts.
	
	• If yes, replace Solenoid.
	• If not, Check Power Supply Voltages on J4.
	  • If Voltages are OK, replace CPU Board.
	  • If not, refer to chapter 1.
	
	Place the Digital Multimeters Red lead to J21 pin 1 and the Black lead to J21 pin 2. Press **<F3>** to toggle solenoid 2 to the CAL Mode. The Digital Multimeter should read 12 volts±3 volts. Follow the steps above for Troubleshooting.



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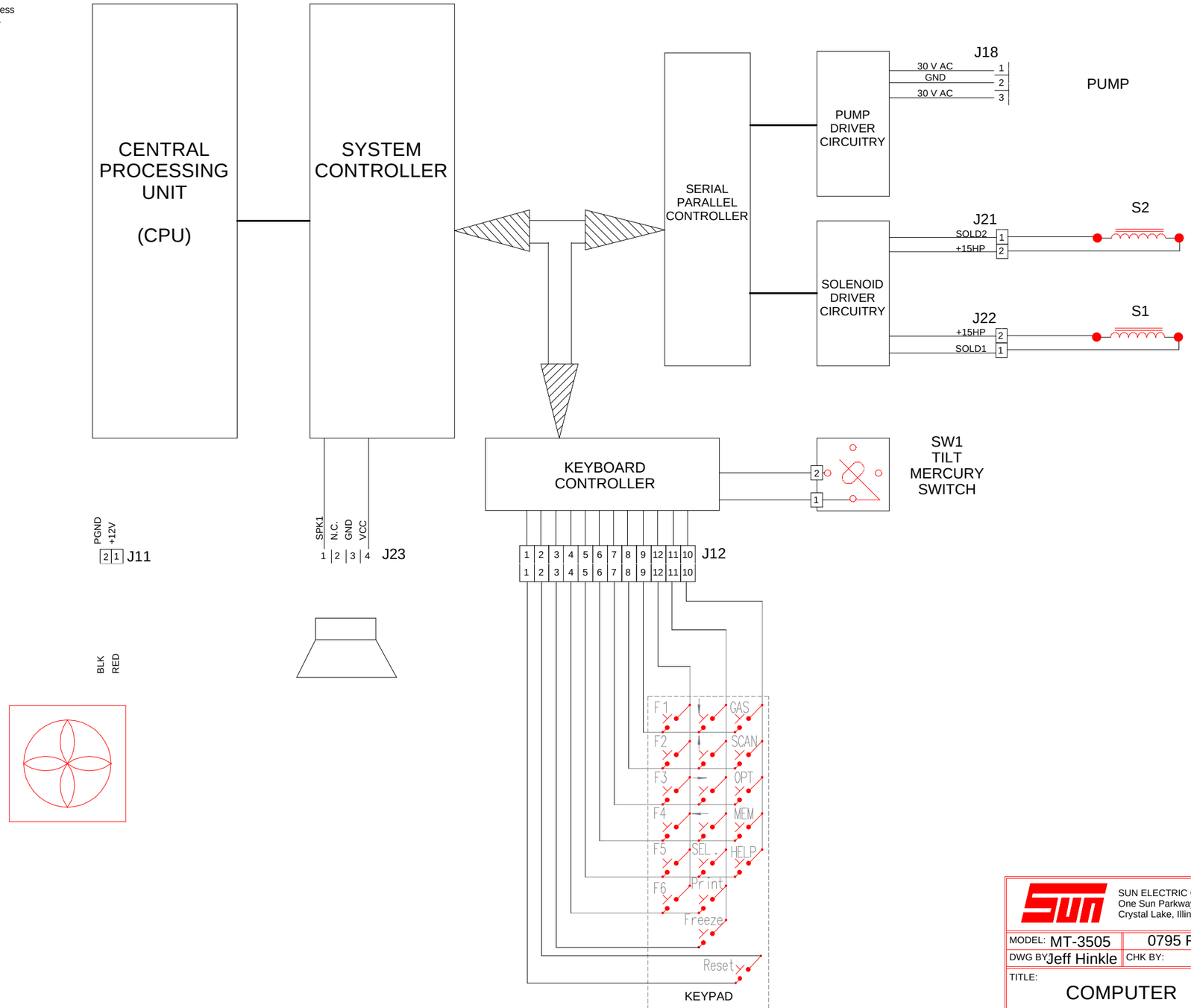
MODEL: MT-3505	0795 REV B
DWG BY: Jeff Hinkle	CHK BY:
TITLE: I/O SERIAL AND PARALLEL	
DWG: 2-1	PAGE: 2-5

NOTES:



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MODEL: MT-3505	0795 REV B
DWG BY: Jeff Hinkle	CHK BY:
TITLE: COMPUTER	
DWG: 2-2	PAGE: 2-7

NOTES:

CHAPTER 3
KEYPAD

THEORY OF OPERATION

The keypad is the operator's interface to the MT-3505's computer. It is the only device that the operator has to control the MT-3505. The keypad is a 19 button keypad. It is configured in a 3 x 7 matrix, with seven active lines and 3 sense lines. With these lines the keyboard controller determines which of the keys are pressed. This information is then sent to the system controller via control lines. The key press is then executed by the CPU. For a functional block diagram of the keyboard, refer to figure 3-1 below.

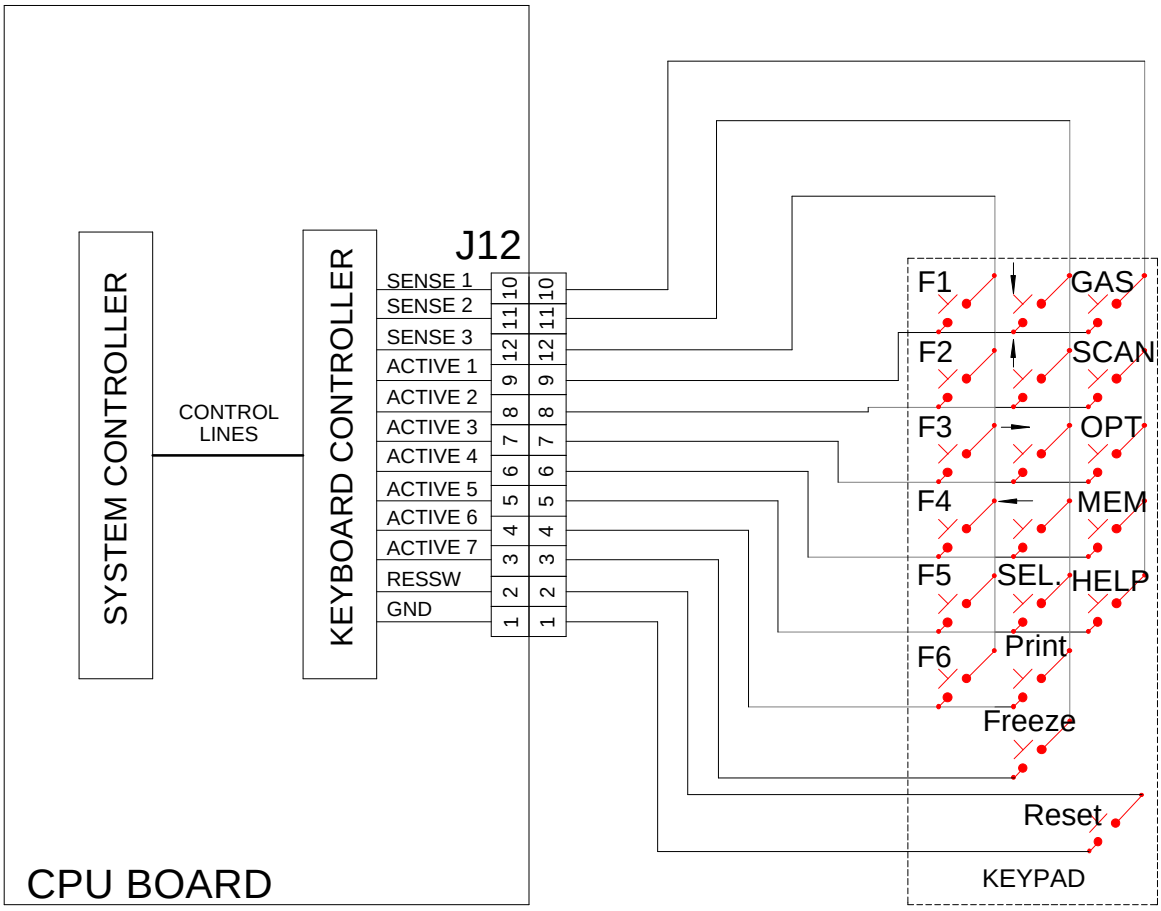


Figure 1
Keypad Connections

TROUBLESHOOTING

COMPLAINT	CORRECTIVE ACTION
I. PRESSING RESET DOES NOT RESET THE ANALYZER	Remove keyboard connector J12 from the CPU Board. Place the DMM red and black leads to P12 pins 1 and 2. Press **<RESET>**. • If DMM indicates continuity, replace CPU Board. • If DMM indicates open, replace Keypad.
II. ONE	

CHAPTER 4

VIDEO

THEORY OF OPERATION

The MT-3505's display is a 9" diagonal Cathode Ray Tube. The CPU Board is responsible for generating the signals that need to be sent to the Monitor. The Monochrome Video Graphics Adapter generates three signals that are sent to the monitor. The three signals are; Video, Vertical Sync, and Horizontal Sync. The Video RAM receives characters in digital form. Each character position is independently capable of displaying characters in inverse video, blinking, or both. Below is a Block Diagram of the Video Circuitry.

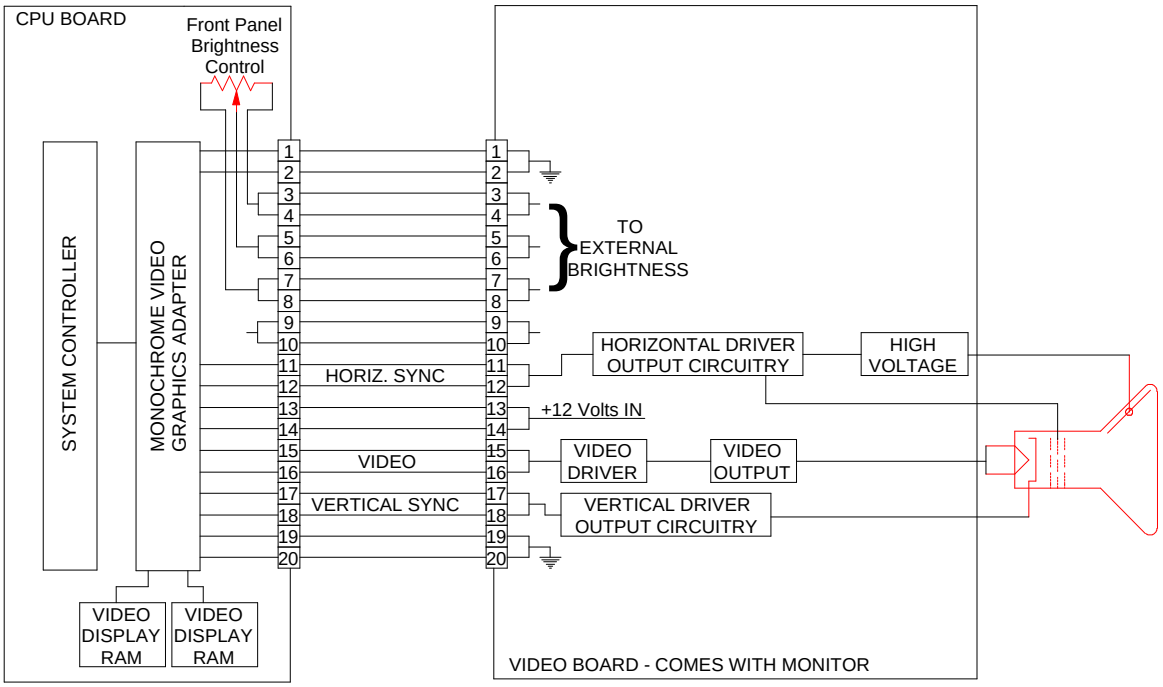


FIGURE 4-1

TROUBLESHOOTING

Not available at time of publication.

NOTES:

CHAPTER 5

PNEUMATICS

GENERAL

The pneumatic system associated with the MT-3505 is controlled by two solenoid valves, which are in turn controlled via solenoid drivers on the Main CPU Board. These solenoid valves operate in four different modes. They are 1) Zero Mode, 2) Gas Calibration Mode, 3) Leak Test Modes, and 4) Sample Mode. A detailed description of each follows.

ZERO MODE

DRAWING 5-1 PAGE 5-3

To maintain the high accuracy of the MT-3505 the analyzer must continually be zeroed. This can be done manually by turning on the Auto Zero function (F3) in the Gas Analyzer Mode, or by pressing **<F4> Manual Zero** in the Gas Analyzer Mode. During the Zero Mode clean air is drawn in from the "Zero" port on the back of the analyzer and into the manifold. The clean air is then drawn through the normally closed port of S1, through the common port and to the pump. From the pump the clean air is pushed through the Bench, the NO_x and O_2 manifold, and out the port to the atmosphere. It is important to note that the vacuum pump is also aspirating moisture from the primary filter bowl at this time as is consistent with any time the pump is running. Therefore, if for any reason solenoid S1 does not fully energize, gases from the filter assembly would be pulled in.

GAS CALIBRATION MODE

DRAWING 5-2 PAGE 5-5

To maintain the accuracy of the MT-3505 gas readings, the analyzer may need to be periodically calibrated. To determine if a Gas Calibration needs to be performed the operator should consult the User's Manual. During a Gas Calibration the pump is off, or not running, and solenoid S2 is energized. Gas from the pressurized calibration gas bottle flows in through the back panel "Cal" port. From the "Cal" port the calibration gas is forced through a restrictor which is internally molded into the manifold. The gas then travels through S2 (which is energized), the Bench, and finally through the NO_x and O_2 manifold where it is pushed out to the atmosphere. As with all pneumatic modes it is important to note any residual flow in case there is a pneumatic related problem with the analyzer. The only residual flow in the Gas Calibration Mode would be from the Manifold block to the check valve on the exhaust side of the Vacuum pump. If for any reason this check valve fails open, the Calibration Gas from the gas bottle will also flow into the pump, diluting the gas getting to the bench, possibly causing a Gas Calibration Failure "Cal Failed".

LEAK TEST MODES

To ensure the sample system is leak free a Leak Test should be performed every week. A leak test should also be performed after every probe change, filter service, or any other servicing of the pneumatic system. In the MT-3505 the Leak Test consists of two modes. The first mode is Leak Test A Mode, which is more symbolically named the Pull Down Mode, because it pulls the entire inlet side of the vacuum pump into a vacuum. The second mode is Leak Test B Mode, or more symbolically named Vacuum Decay Mode, because it monitors the vacuum decay of the Leak Test Mode A. A more detailed explanation for both modes are described on the next page.

LEAK TEST A*(PULL DOWN)* MODE DRAWING 5-3 PAGE 5-7

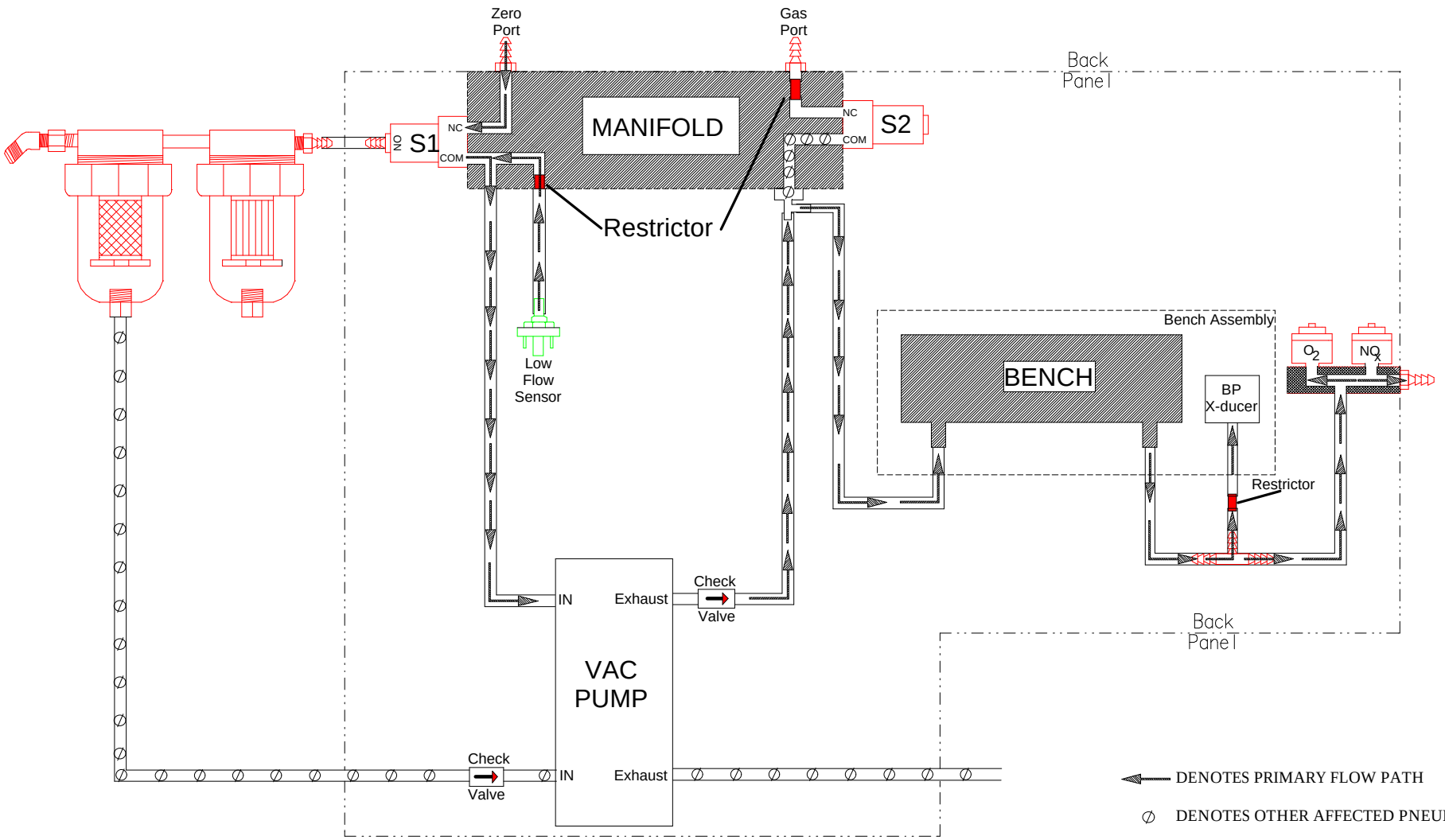
During the Leak Test A Mode the operator must place a Leak Test Cap on the end of the exhaust probe. The pump then draws a vacuum on the exhaust probe, filtering system, the low flow switch, and all tubing on the input side of the sampling system. During this portion of the Leak Test the low flow sensor threshold is changed to allow the unit to accurately measure the vacuum draw. Once the proper amount of vacuum is sensed, the pump shuts off and the analyzer proceeds to the Leak Test B Mode.

LEAK TEST B*(VAC DECAY)* MODE DRAWING 5-4 PAGE 5-9

Leak Test B Mode occurs immediately following Leak Test A Mode. The only noticeable difference to an operator would be that the pump shuts off. During the Leak Test B Mode the pump shuts off trapping the vacuum drawn in the Leak Test A Mode. The computer monitors the low flow sensor to determine if the vacuum that was drawn in the Leak Test A Mode diminishes. If the Vacuum diminishes below a predetermined level a “Leak Test Failed” error message will appear. If the leak test passes the analyzer will return back to the first service screen.

SAMPLE MODE DRAWING 5-5 PAGE 5-11

The Sample Mode is used to read gases from the vehicles exhaust pipe. The exhaust gases are drawn through the exhaust probe, primary and secondary filter assemblies, solenoid S1, and into the vacuum pump. From the vacuum pump the exhaust gases are pushed through the check valve, bench, NO_x and O_2 manifold, and out the port to the atmosphere. During this mode the low flow sensor is constantly monitoring the amount of vacuum from the vacuum pump to determine if sufficient flow exists. If it doesn’t a “Low Flow” condition exists.



ZERO MODE			
COMPONENT	TYPE	STATE	ACTIVE PORT
PUMP	NA	ON	NA
S1	3-WAY	ENERGIZED	NC
S2	NC	DE-ENERGIZED	NONE

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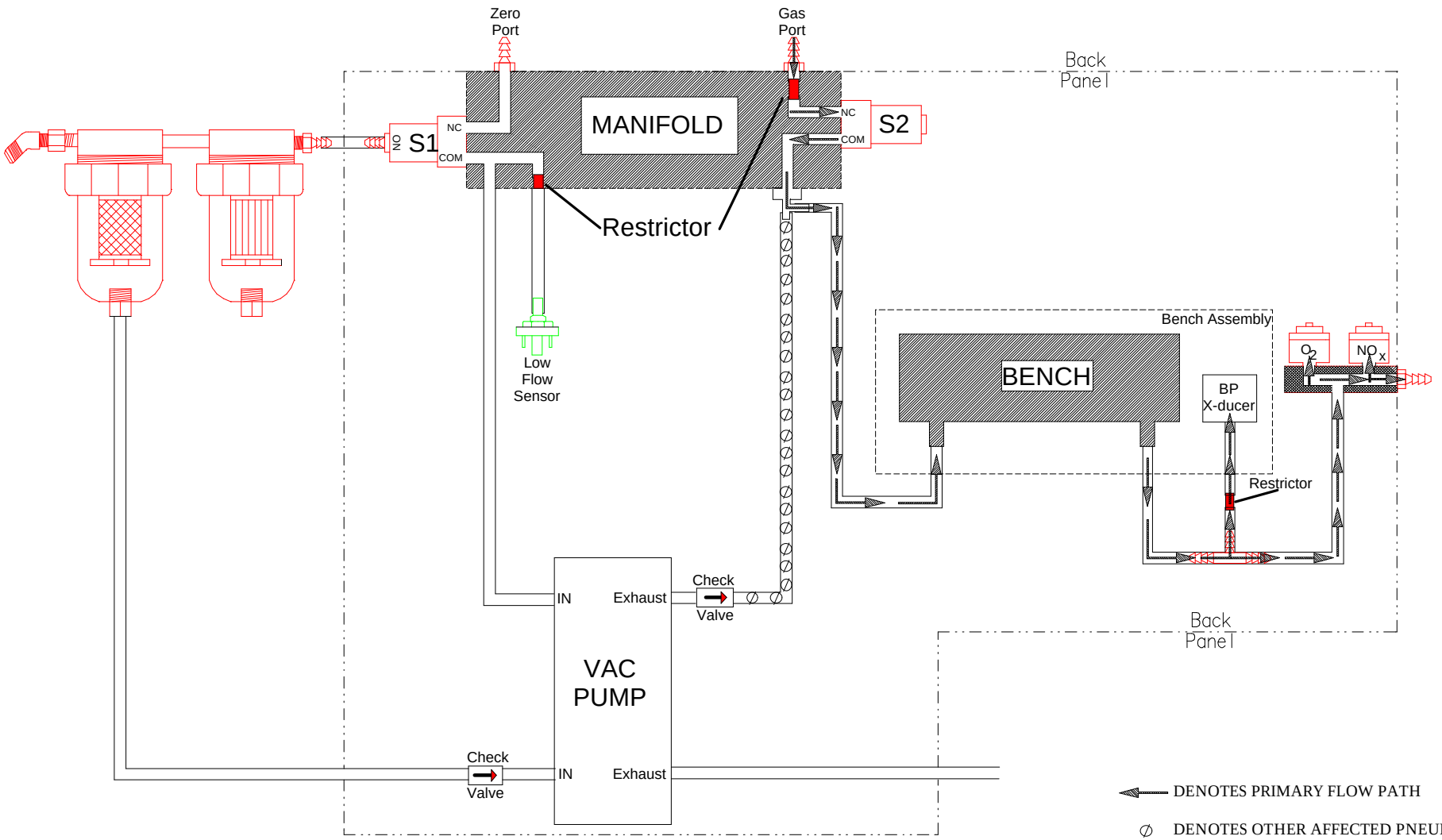
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0195 REV A
DWG BY: J. HINKLE	CHK BY:
TITLE: ZERO	
DWG: 5-1	PAGE: 5-3

NOTES:



CALIBRATION MODE

COMPONENT	TYPE	STATE	ACTIVE PORT
PUMP	NA	OFF	NA
S1	3-WAY	DE-ENERGIZED	NO
S2	NC	ENERGIZED	NC

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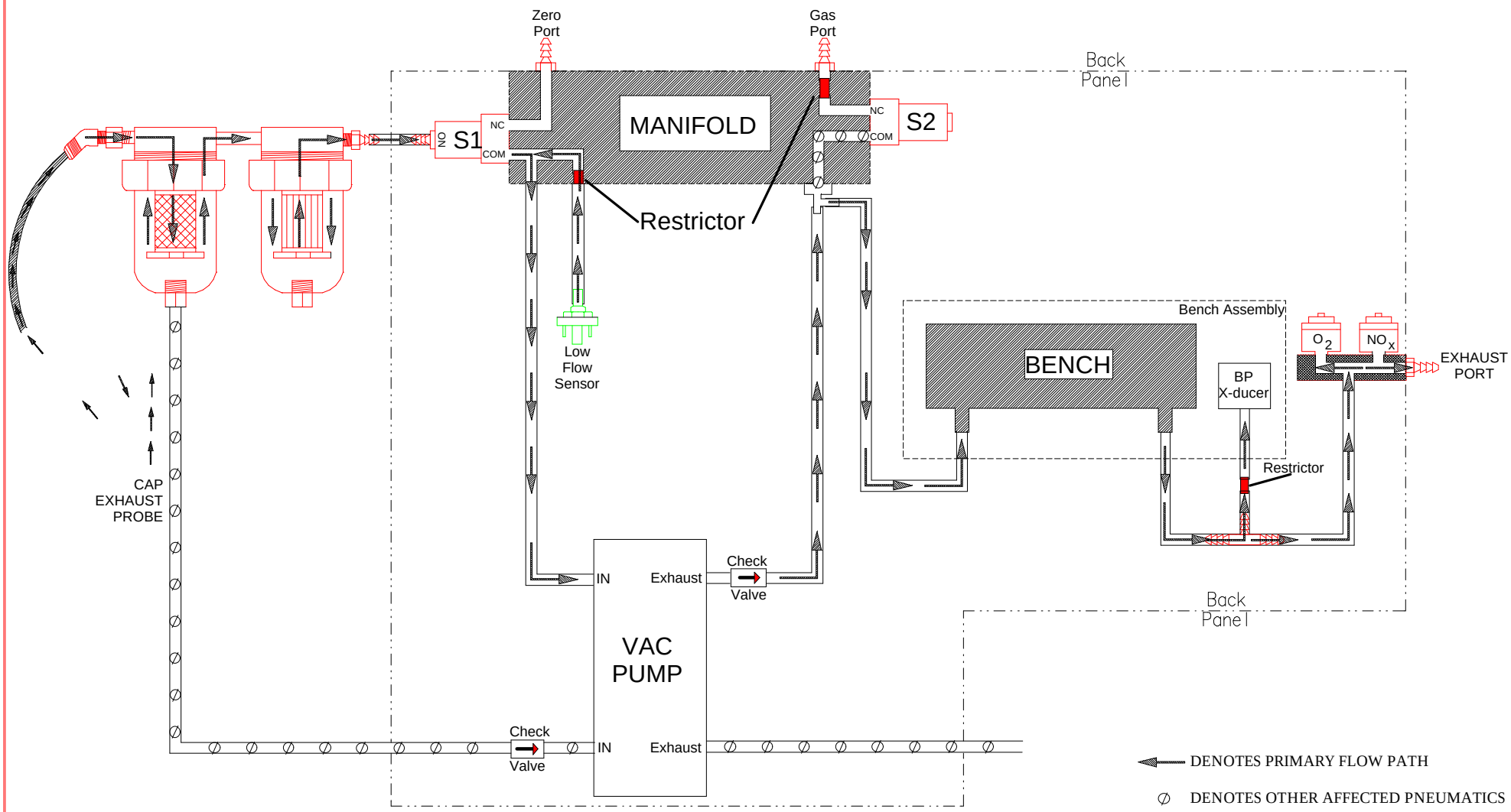
MODEL: MT-3505	0195 REV A
DWG BY: J. HINKLE	CHK BY:

TITLE: GAS CALIBRATION

DWG: 5-2	PAGE: 5-5

NOTES:



LEAK TEST "A" MODE (PULL DOWN)

COMPONENT	TYPE	STATE	ACTIVE PORT
PUMP	NA	ON	NA
S1	3-WAY	DE-ENERGIZED	NO
S2	NC	DE-ENERGIZED	NA

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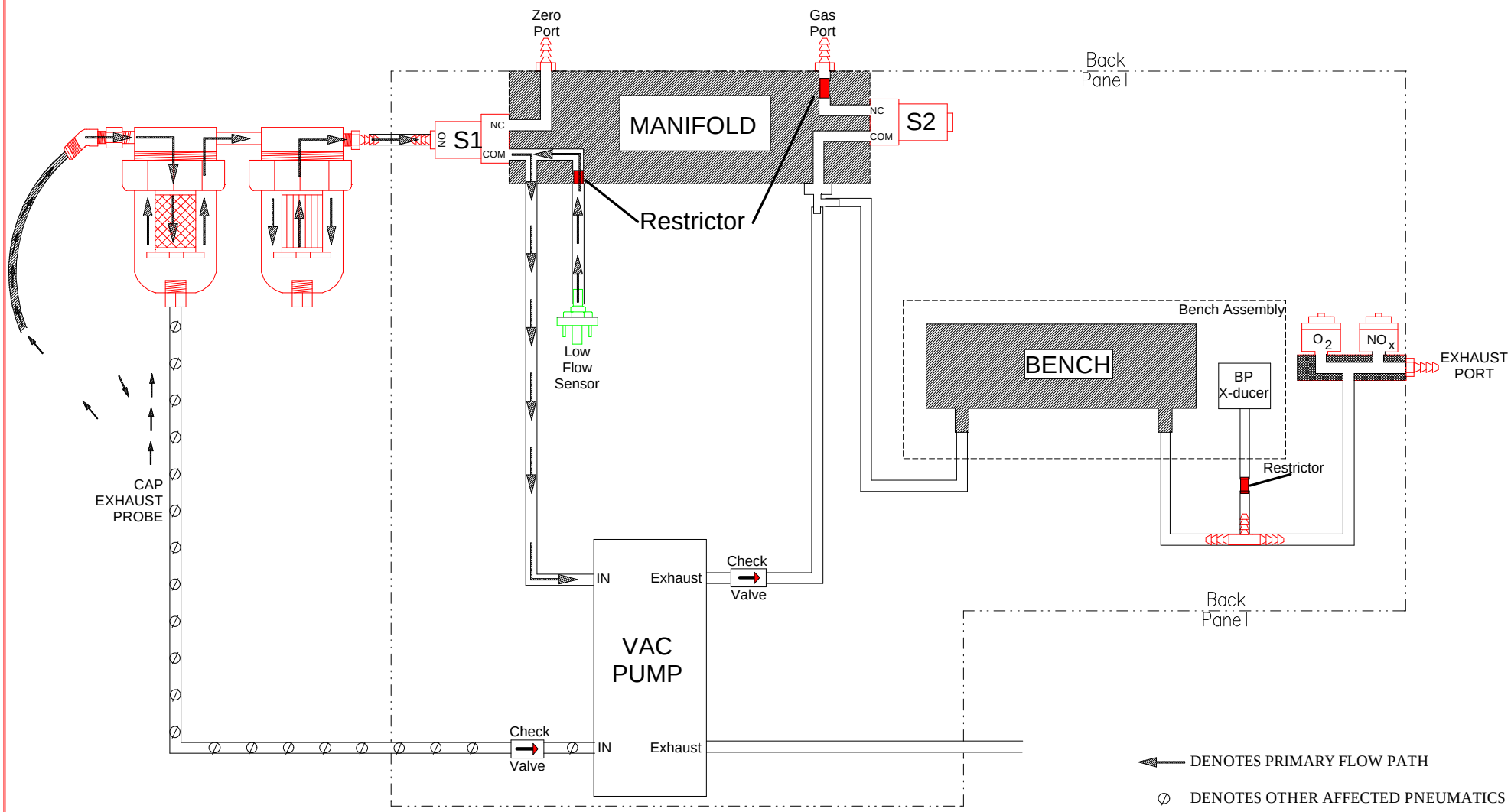
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0195 REV A
DWG BY: J. HINKLE	CHK BY:
TITLE: LEAK TEST "A" (PULL DOWN)	
DWG: 5-3	PAGE: 5-7

NOTES:



LEAK TEST "B" MODE (VAC. DECAY)

COMPONENT	TYPE	STATE	ACTIVE PORT
PUMP	NA	OFF	NA
S1	3-WAY	DE-ENERGIZED	NO
S2	NC	DE-ENERGIZED	NA

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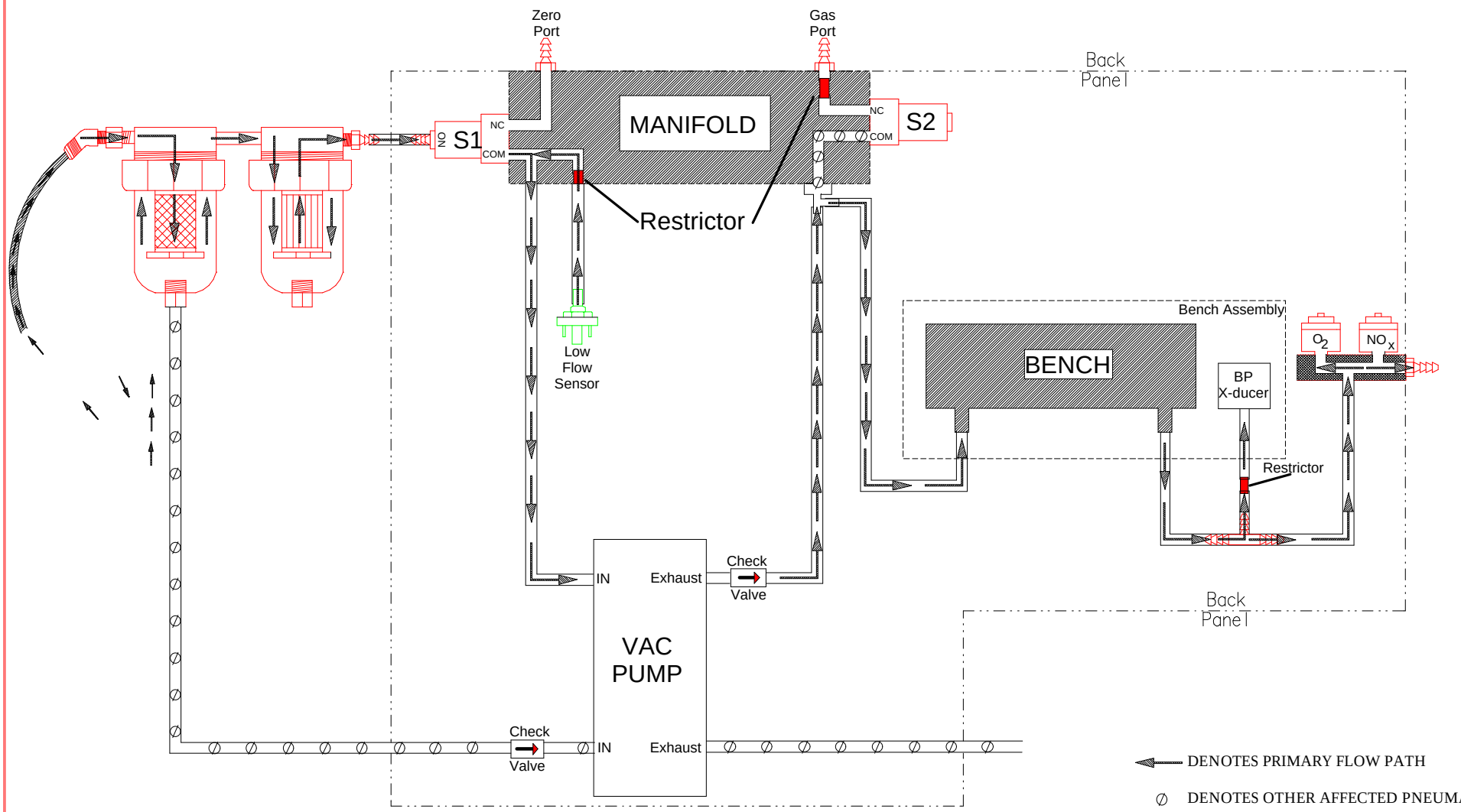
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0195 REV A
DWG BY: J. HINKLE	CHK BY:
TITLE: LEAK TEST "B" (VAC. DECAY)	
DWG: 5-4	PAGE: 5-9

NOTES:



DENOTES PRIMARY FLOW PATH

∅ DENOTES OTHER AFFECTED PNEUMATICS

SAMPLE MODE

COMPONENT	TYPE	STATE	ACTIVE PORT
PUMP	NA	ON	NA
S1	3-WAY	DE-ENERGIZED	NO
S2	NC	DE-ENERGIZED	NA

SUN ELECTRIC CORPORATION
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0195 REV A
DWG BY: J. HINKLE	CHK BY:

TITLE: SAMPLE

DWG: 5-5	PAGE: 5-11

NOTES:

CHAPTER 6

INFRARED

GENERAL

NOTE: ***The term "IR Bench" is used throughout this chapter to refer to the Andros 5 Gas Infrared Analyzer.***

There are three key components that make up the Infrared Exhaust Analyzer function. They include the CPU Board, Andros Infrared Bench, and the Pneumatics. The Analyzers' purpose is to measure the concentrations of Hydrocarbons (HC), Carbon Dioxide (CO2), Carbon Monoxide (CO), Oxygen (O2), and Nitric Oxide (NO) emitted from the exhaust of an automobile. The infrared bench is being used to measure HC, CO and CO2 concentrations. The NO and O2 readings are obtained from a NO and O2 cell mounted on the rear of the analyzer. For further information on the O2 and NO functions, please refer to chapter 7 of this manual.

INFRARED THEORY

In order to understand the purpose of the MT-3505, you must understand the basic principles of Infrared analyzing. The "IR Bench" is nothing more than a molecule counter. It counts the number of molecules of HC, CO and CO2 that pass through the bench. Each of the gases absorb a different "Infrared Frequency". This is how an infrared bench measures the concentration of each gas. The following figure and text is a breakdown of the components used in an Infrared (IR) bench.

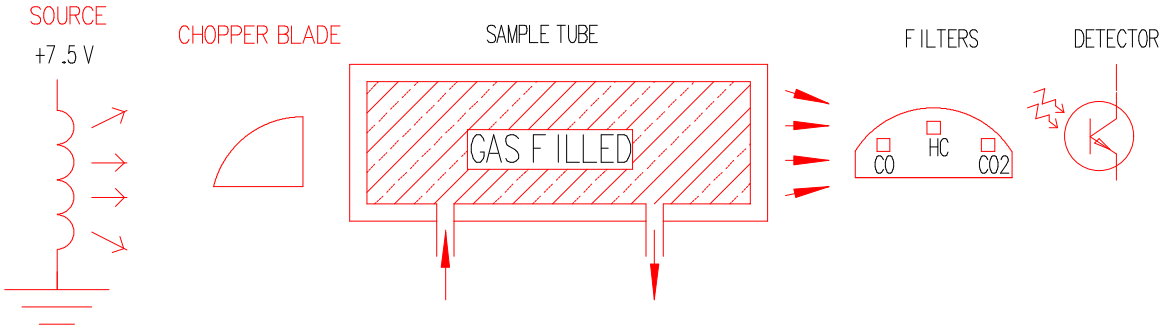


FIGURE 1
BASIC COMPONENTS OF THE IR BENCH

The **Source** is used to emit a broad band of "Infrared Light or Energy". The source is nothing more than a coil of wire with current flowing through it, just like a light bulb.

The **Chopper Blade** is used as a reference or sync pulse, to allow the hardware interface of the gas bench to determine the start of a stream of data. When the chopper blade is in front of the source it acts much as the dark pulse. This provides a reference to the computer to tell it that when the chopper blade drops a sample of the gas will be taken and sent to the computer.

The **Sample Tube** is a cylinder that gases flow in and out of. The source is located at one end of the tube, radiating infrared energy through the tube. The gases inside the sample tube absorb the infrared energy as it passes through. As the energy exits the tube, it passes through an opening that is covered by a concave material. This concave material acts as a lens and focuses the energy to a constant location.

The **Filters** are located at the end of the sample tube, opposite to the source. The energy focused by the lens passes through the filters. The filters are referred to as **Band Pass Filters** These filters will only allow the frequency for each of the gases to pass. There are 4 filters used in most 3 gas IR benches, one each for the three gases HC, CO and CO2 and a Reference filter. The 3 for the gases allow the particular frequency for each gas to pass through. The fourth filter, "Reference," allows all the frequencies, except those absorbed by the 3 gases, to pass through. This gives a known value for the source so that we can determine how much absorption occurs in the sample tube.

The **Detector** is positioned behind the filters. It receives the unabsorbed infrared energy. This unabsorbed amount is then turned into an analog voltage that is used in calculating the amount of gas inside the sample tube. The analog voltage is then processed by the Andros Bench, turned into a digital signal and sent to the CPU board. From there the CPU board processes the digital signals and displays them on the monitor.

Propane Equivalency Factor or P.E.F.

PEF is a value used in calculating the amount of Hydrocarbons contained in the calibration gas. PEF values will fall between .490-.540. The purpose of PEF is to make Propane Gas appear as Hexane Gas during calibrations. Hexane is used by the BAR (Bureau of Automotive Repair) to set standards for the Hydrocarbon's measurement. The reason Hexane was chosen is due to its molecular structure. It is in the middle of all the Hydrocarbons that are emitted from vehicles. Hexane is not practical for customer use due to its instability at different temperatures. This is why we use Propane for calibration, therefore we need a PEF value to correlate the two readings.

As mentioned earlier in the text, the bench is no more than a molecule counter. The atomic structure for Propane = C_3H_8 and Hexane = C_6H_{14}. The size of molecules found in Propane is almost exactly half the size of the molecules in Hexane. When a sample tube is filled with Propane, almost twice as much absorption will occur due to twice as many molecules contained in the tube. Remember the bench is counting the number of molecules contained in the tube. Therefore, we multiply the gas readings of Propane by the PEF amount. This makes the Propane appear the same as Hexane.

An Example of How PEF is used in Gas Calculations:

Gas Tag Value for Hydrocarbons (HC) 300ppm x PEF from the Bench .510 = 153ppm. During a Gas Calibration, using a bottle with this value, the bench should read 153ppm (parts per million).

Note: *PEF is only used in the calculation of Hydrocarbons. CO and CO2 should equal the amount on the Gas Tag during calibration*

Gas Tag Values are the values that are written on tags located on gas bottles. These values indicate the mixture of the HC (Hydrocarbons), CO (Carbon Monoxide), CO2 (Carbon Dioxide), and NO (Nitric Oxide) in the bottle. The Gas Tag Values are written in the MT-3505 software by the operator, in the Gas Calibration Screen. Each time the bench performs a calibration, it reads these values in order to know which gas it is reading and what the correct reading should be when calibrating.

Barometric Pressure

Barometric Pressure is Atmospheric pressure measured in inches of mercury. With different pressures, the bench will indicate different gas readings, due to the density of the molecules in the sample tube. To ensure correct readings, the Gas Tag Values are compensated, depending on the Barometric pressure reading taken at Calibration. Every time a calibration is performed, the barometric pressure is read from the transducer located on the IR Bench. The pressure is used in a calculation with the Gas Tag Values. The values are changed and written to the bench, to compensate for the pressure. This procedure is performed at the beginning of each Gas Calibration.

WARM UP

The MT-3505 will allow the operator to read gases during the warm up period. It is important to note that, if gases are being read during this period they are still drifting and may not be accurate. During a "Cold Start" the IR source temperature stabilizes long before the filter/detector assemble (which has a much higher thermal mass) reaches final temperature. This can take up to 14 minutes under worst case conditions. During a "hot restart" (caused by a front panel reset) the filter/detector assembly's thermal mass allows it to regain final temperature very quickly. The IR Source, however, may take one to two minutes to regain the temperature it lost and retrace its steps through the software sequenced startup routine.

CALIBRATION

Calibration should be performed at a minimum interval of at least every 30 days to maintain accuracy. To determine if a calibration should be performed before the 30 day interval either follow the procedure below or consult the operators manual.

NOTE: ***The following procedure assumes that a quad blend gas with 2000 ppm Nitric Oxide (NO), 1200 ppm Propane (HC), 4.0% Carbon Monoxide (CO), and 12.0% Carbon Dioxide (CO2) is used.***

1. Turn the analyzer on and let the analyzer Warm-up for a minimum of 30 minutes.

2. Press **<OPTION MENU>**. The Option Screen is displayed.

3. Press "**SERVICE**", **<F6>**. The Service Screen is displayed.

4. Press "**GAS CAL**", **<F1>**. The Gas Calibration Screen is displayed.

5. Compare the Tag Values displayed, to the Tag Values on the gas bottle. Press "**CHANGE TAG VALUE**", **<F1>** and change the analyzer tag values to match the concentration on the calibration gas bottle if required.

6. Press "**CHANGE TAG VALUE**", **<F1>** again. Selected tag values are saved.

NOTE: ***Calibration gas concentrations are checked against the tag values that display on the screen before calibration is performed. When calibration gas concentrations do not equal at least 50% of the tag value, calibration is not allowed and "CAL FAILED" is displayed. This prevents calibration that would result in decreased accuracy.***

7. Connect the hose from the gas bottle regulator assembly to the "**CAL**" port on the back panel of the analyzer.

8. Open the valve on the calibration gas bottle. Ensure the bottle pressure is at least 25 psi. Replace the bottle if the pressure is less than 25 psi.

9. Adjust the output regulator until 5-10 psi is indicated on the output pressure gauge.

10. Press "**CALIBRATE**", **<F2>**.

NOTE: ***You will not execute the last line of the message "PRESS CONTINUE WHEN READY". At this point in the procedure you are checking the calibration, not actually performing a calibration.***

11. Wait approximately 60 seconds, or until the readings stabilize.

12. Press **<FREEZE>**. Data on the screen freezes.

    NOTE: ***After 5 minutes the analyzer will automatically revert back to the Service Screen.***

13. Close the valve on the calibration bottle.

14. Compare the values in the "**Analyzer Data**" Column on the screen, with those in Table 6-1.

GAS	ALLOWABLE RANGE
CO_2	11.6% - 12.4%
CO	3.85% - 4.15%
NO_X	1940 ppm - 2060 ppm
HC	±60 ppm of (Gas Tag Value X PEF)

FIGURE 6-1
ALLOWABLE CALIBRATION CHECK RANGES

15. If all readings are within the allowable ranges, calibration is not necessary. Disconnect the calibration gas hose then press "**RETURN**", **<F6>**, the "Service Screen" is displayed.

16. If any of the readings are not within the allowable range, continue with the next step to calibrate the analyzer.

17. Press **<FREEZE>**, to unfreeze the gas calibration screen.

NOTE: ***If the analyzer reverted back to the Service Screen, Press "GAS CAL", <F1>, then "CALIBRATE", <F2>.***

18. Re-open the valve on the calibration gas bottle.

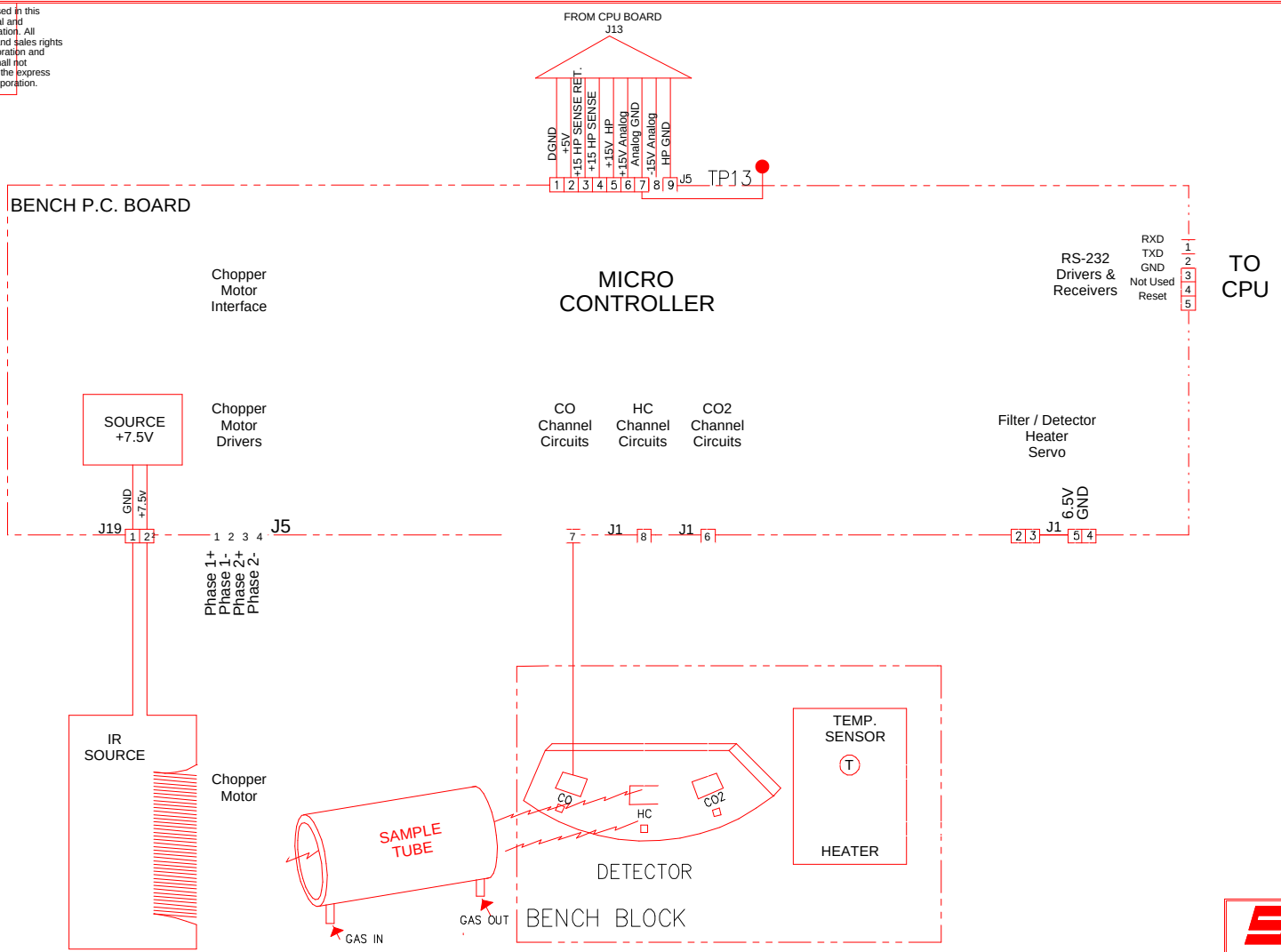
19. Verify that the output pressure is still 5-10 psi.

20. Press "**CONTINUE**", **<F1>**. Calibration will begin by automatically zeroing.

21. "**CALIBRATION PASSED**" will be displayed when the calibration is successful.

22. Close the valve on the calibration gas bottle, and remove the hose from the "**CAL**" port.

23. Press "**RETURN**", **<F6>**.



PIEZO RESONATOR
OPTICAL BENCH

SUN ELECTRIC CORPORATION
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0195 REV A
DWG BY: Jeff Hinkle	CHK BY:
TITLE: INFRARED	
DWG: 6-1	PAGE: 6-5

NOTES:

CHAPTER 7

O_2 AND NO

NITRIC OXIDE (NO)

THEORY OF OPERATION

The NO Sensor Assembly has a finite lifetime, and is designed to be end user replaceable. The NO cell requires a bias voltage applied to it at all times. During shipment this voltage is supplied by the 3 volt Lithium Battery which is permanently mounted on top of the NO cell. This battery has a lifetime of 180 days from the date of manufacture. If the NO cell is not installed into a analyzer within this 180 days, the NO cell will become inoperative.

When the cell is placed in the analyzer the 6 volt rechargeable sealed Lead Acid battery takes over, and supplies power to the NO cell. When the analyzer is powered up, the rechargeable sealed Lead Acid Battery is being recharged. It takes approximately 12 hours of power up time, over the period of a month, to keep the rechargeable lead acid battery charged.

The NO Cell is mounted on the back panel of the MT-3505 under the O_2 / NO cover. The NO content of the exhaust sample, from the engine under test, is measured by flowing a small amount of the exhaust sample over the NO Cell. The cell outputs a DC voltage when exposed to NO. Typically the voltage is 4.4VDC±0.22 volts when exposed to the atmosphere. As the concentration of NO increases the DC voltage drops. When full scale NO (4000ppm) is reached, the DC voltage should be 2.0 Volts DC±1.0 Volt DC. Zero and span calibration of the NO sensor is required periodically to accommodate the unit-to-unit and unit-over-time differences in the NO Cell output.

The O_2 / NO Interface Board contains the circuits that support the NO Cell and preamplify its output. This output is then sent to the Andros Bench. The O_2 / NO interface board also passes on the O_2 sensor output to the Andros Bench. For a block diagram of the O_2 and NO circuitry, refer to drawing 7-1, page 7-3.

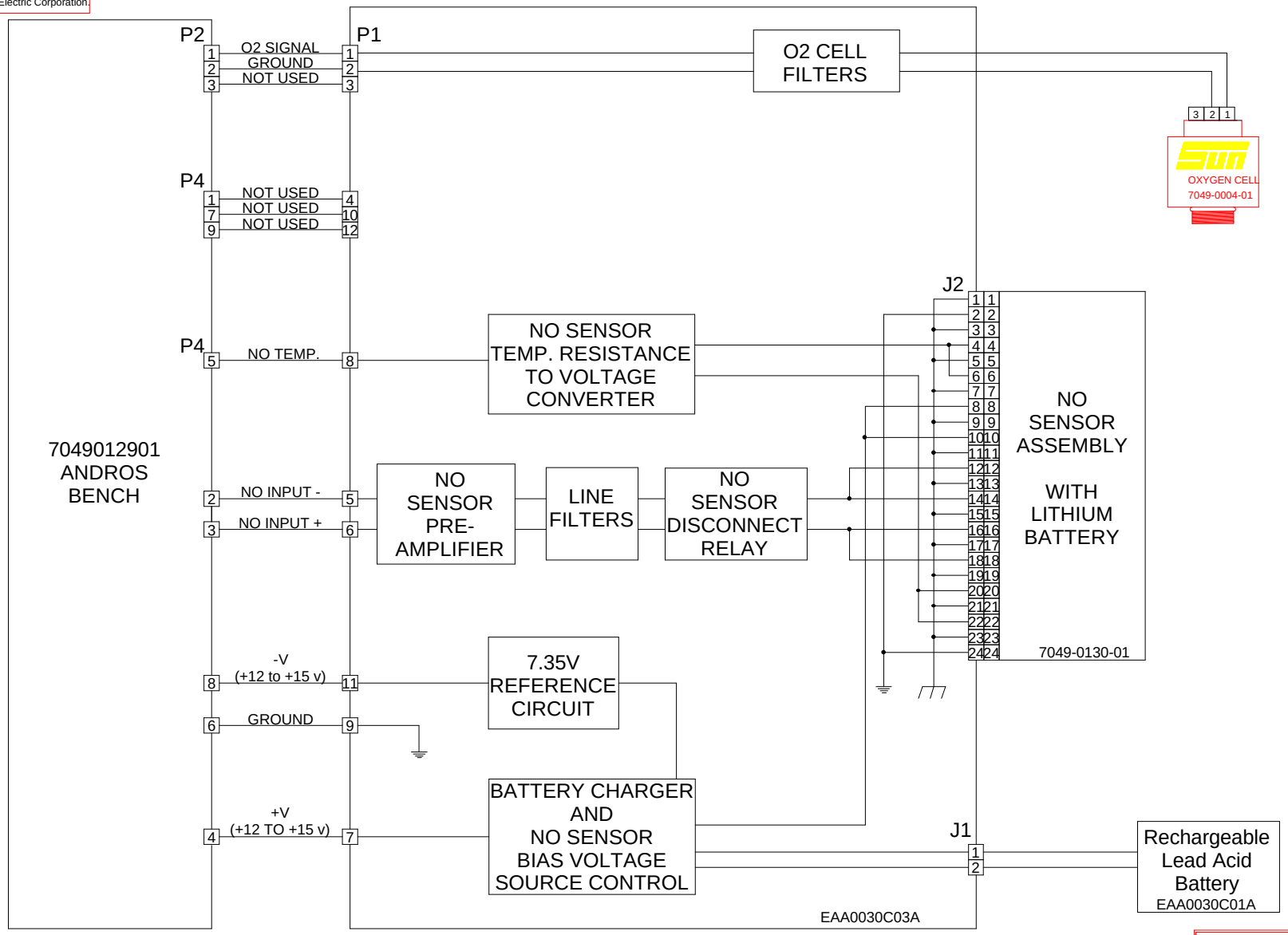
OXYGEN (O_2)

THEORY OF OPERATION

The O_2 content of the exhaust sample, from the engine under test, is measured by an O_2 Cell. The cell outputs a DC voltage in the millivolts range when exposed to atmospheric oxygen. Typically the voltage is -11 millivolts +/-3 millivolts when exposed to atmospheric oxygen (20.8%) at sea level. As the oxygen content of the exhaust sample decreases, the cell's DC output voltage decreases. The output of the O_2 Cell is very stable throughout its life. At the end of a O_2 Cell life, the output will begin to ramp up as much as 40 millivolts. Therefore, if the output is consistently out of specification, replacement is recommended.

The O_2 Cell output is routed to the O_2 / NO Interface Board at J2 pin 1 (signal voltage) and J2 pin 2 (ground). The input and ground signals then go through a filter and are output on pins 1 and 2 of J1 respectively. From there, the O_2 signal is routed to the Andros Bench for processing.

NOTES:



SUN ELECTRIC CORPORATIC
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.

MODEL: MT-3505	0195 REV A
DWG BY: Jeff Hinkle	CHK BY:

TITLE: NO / O2 INTERFACE

DWG: 7-1	PAGE: 7-3

NOTES:

CHAPTER 8

RPM

GENERAL

The MT-3505's RPM circuitry consists of an Inductive Trigger Pickup (MT60A08A) with cable, and an RPM Adapter Cable (MT350090), on the outside of the analyzer. On the back panel of the analyzer is the "TACH" connector, with the internal RPM harness attached to it. The internal RPM wiring harness attaches to the CPU Board, which has the engine sync processor and counter timer circuitry on it.

THEORY OF OPERATION

When the spark plug in an automobile fires, it has current flowing through its spark plug wire. The inductor coil in the trigger pickup assembly senses this current. The inductor produces a positive and negative going signal. These two signals are sent through pins 3 and 5 of the TACH cables to the back of the analyzer. These two signals are routed from the back panel "TACH" connector to pins 2 and 3 of connector J15, on the CPU Board. On the CPU Board, the signals are run through a comparator, where they are compared and the single output signal is sent to the engine sync processor. From the engine sync processor, the signal is sent to a counter timer where the signal is changed to a digital signal and processed by the system controller.

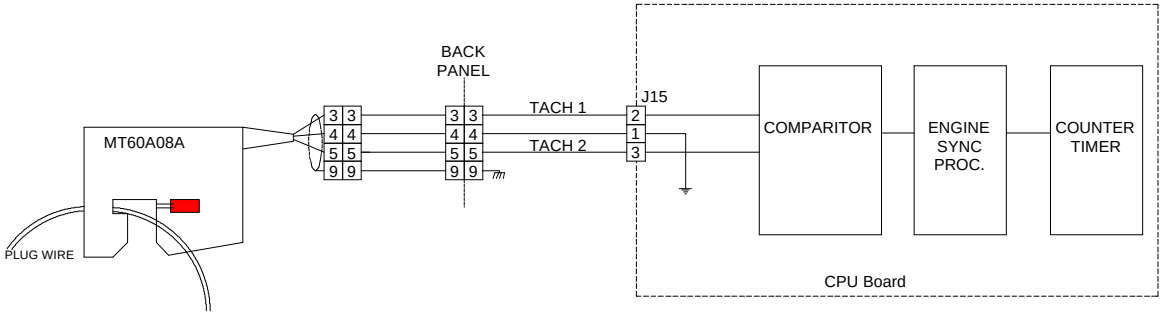


Figure 1
RPM CIRCUITRY

NOTES:

CHAPTER 9

PARTS

GENERAL

This chapter contains parts considered replaceable during field service. It includes assemblies, subassemblies and piece parts.

NOTE: ***The following is a breakdown description for the MT3505 serial numbers.***

Serial Number Location Back Panel bottom left hand corner on the Serial Plate.

Example 1194A0102

11 Month Manufactured
94 Year Manufactured
A Serial Revision
0102 Number of Unit Off Production Line

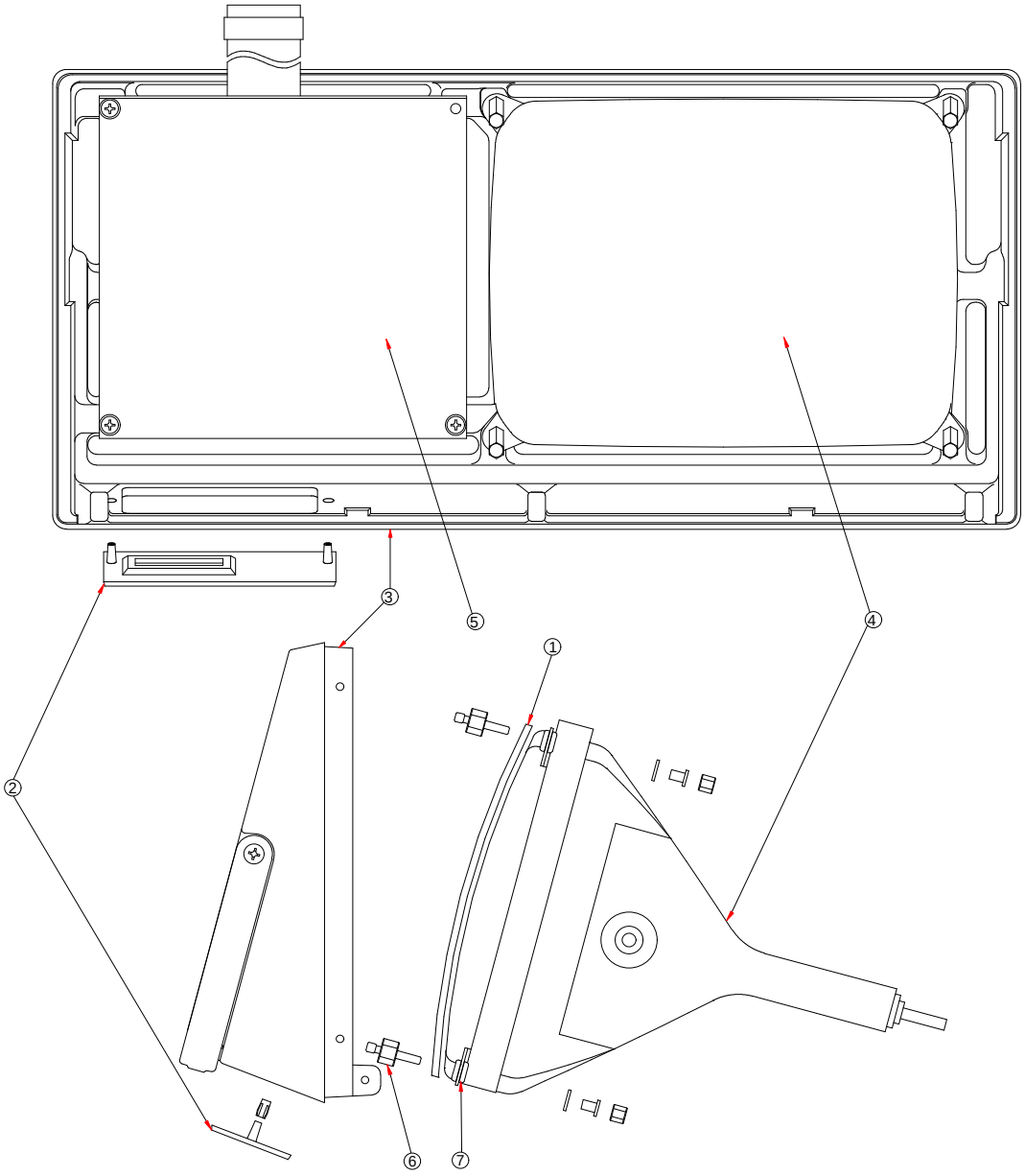
Example A95030102

A Serial Revision
95 Year Manufactured
03 Week Manufactured
0102 Number of Unit Off Production Line

PARTS BY PICTORIAL

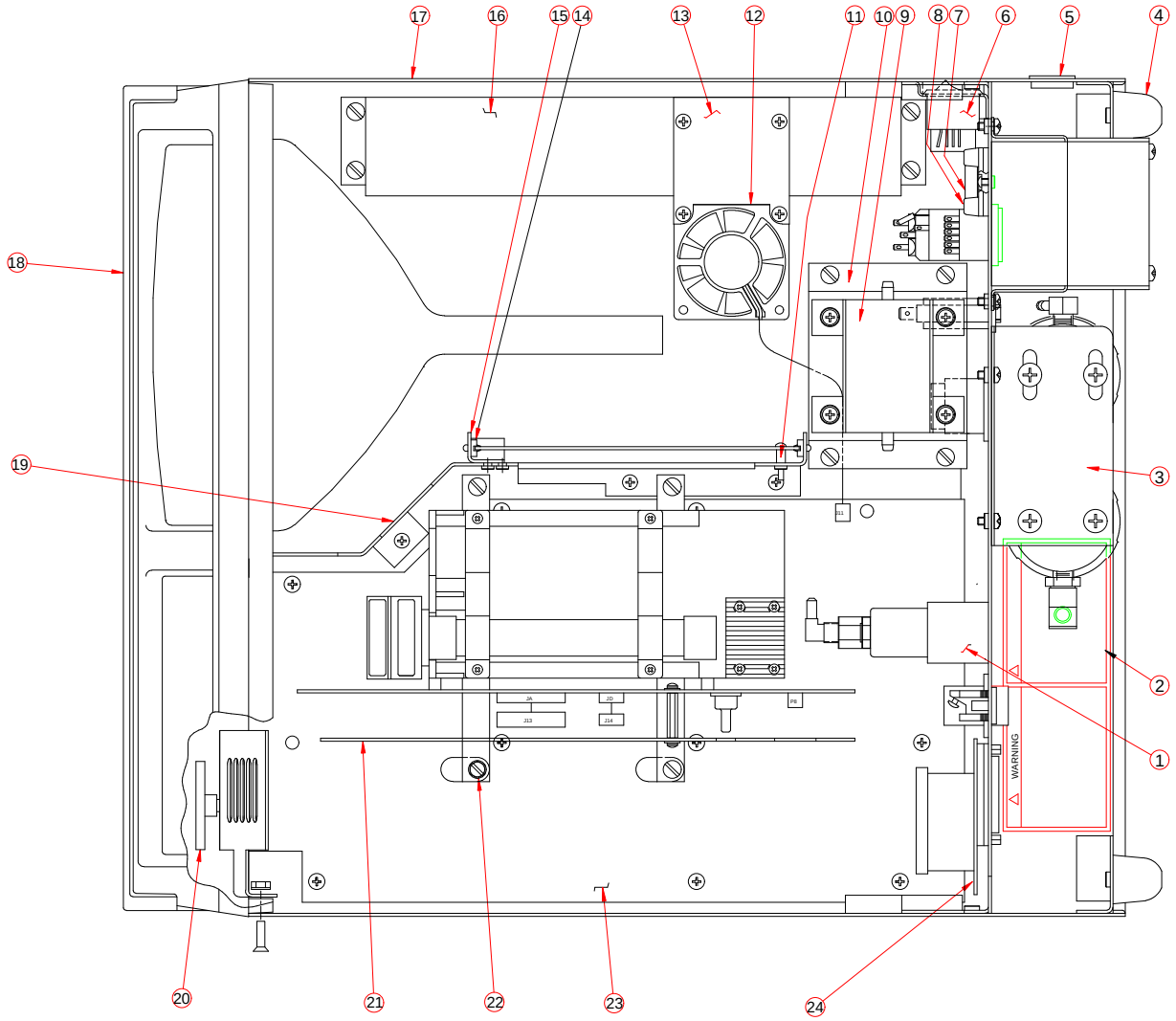
The following section is a list of parts in pictorial form.

FRONT BEZEL VIEW



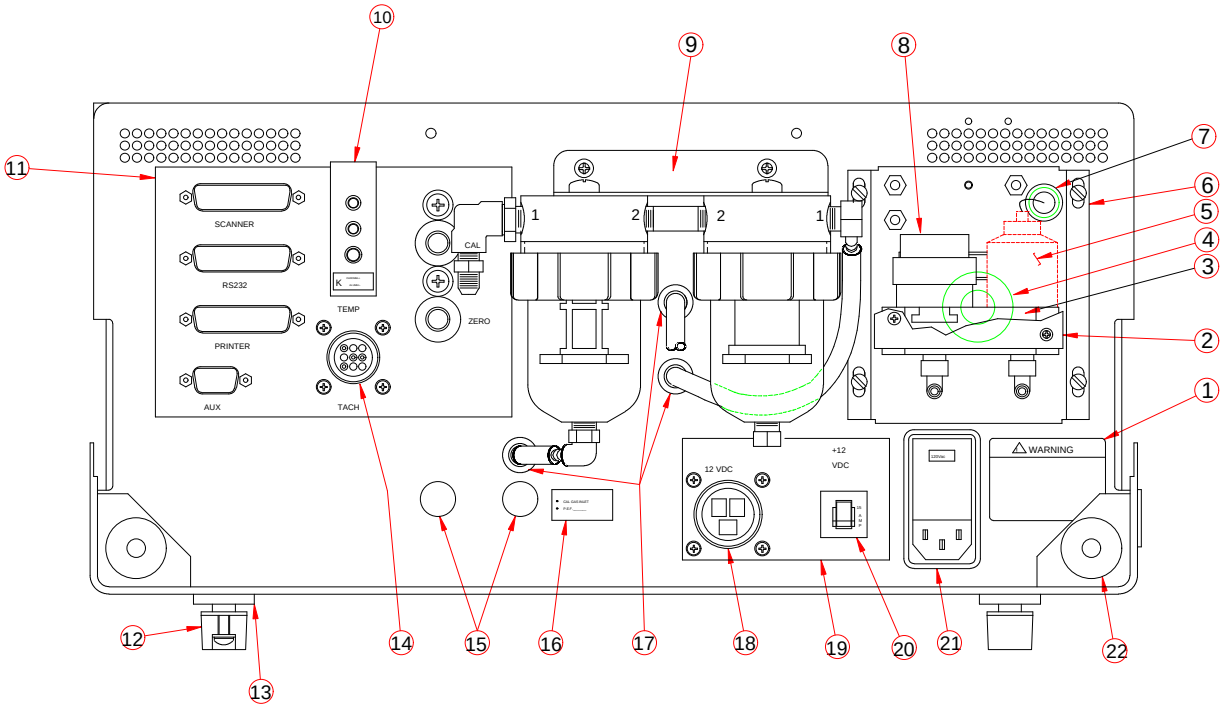
ITEM	DESCRIPTION	PART NUMBER	ITEM	DESCRIPTION	PART NUMBER
1	Gasket, CRT	MT16651013	4	Monitor	MT3500320
2	Escutcheon	MT3500301	5	Keyboard	MT3500A330
3	Bezel w/ Handle	MT3500310	6	Standoff	15061
			7	Grommet	85216

INSIDE VIEW



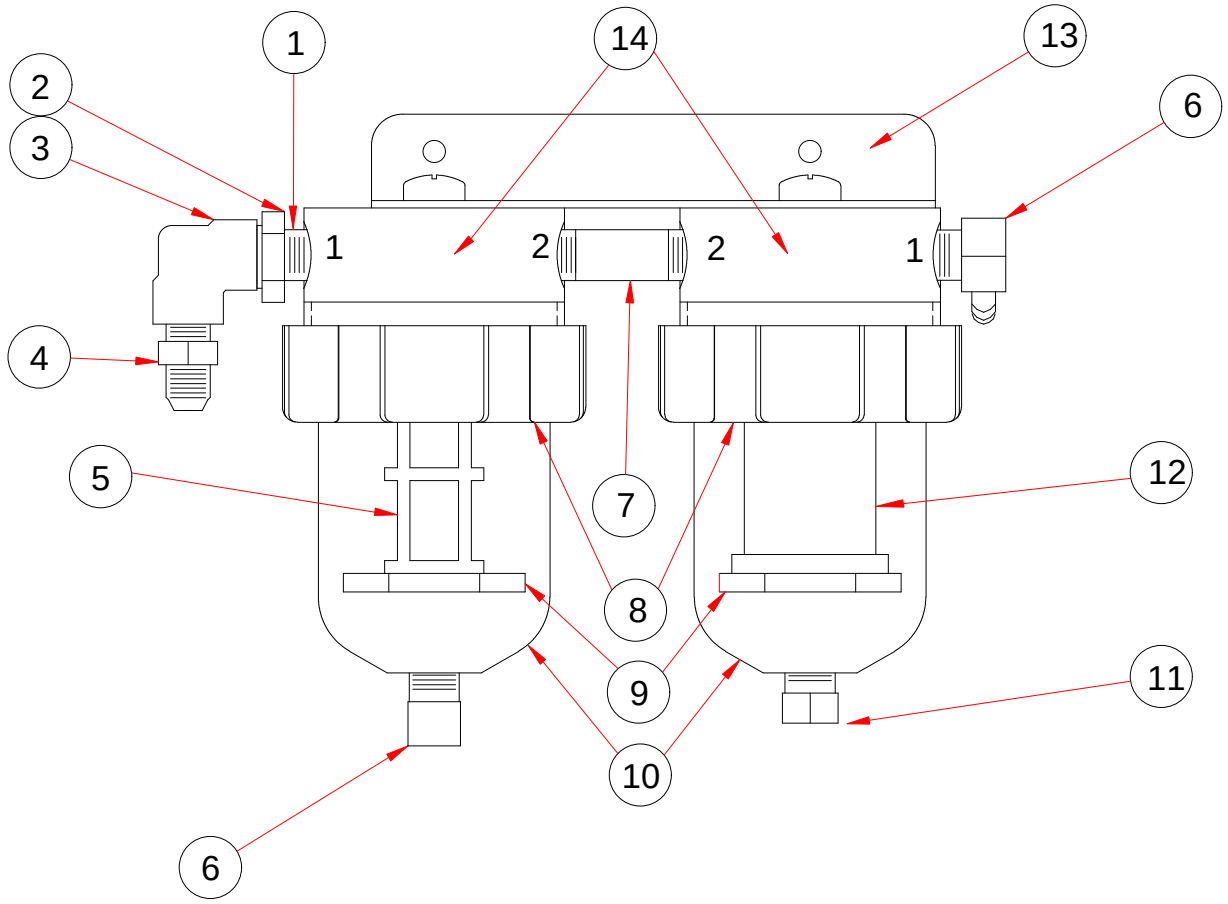
ITEM	DESCRIPTION	PART NUMBER	ITEM	DESCRIPTION	PART NUMBER
1	Manifold Ass. Solenoid	24437	13	Bracket, Fan	MT3500A7
2	Label, English / French	MT3000A37A	14	Guide, Circuit Card	22066
3	Filter Assembly	See Page 9-5	15	Bracket, Monitor	MT3500A6
4	Bumper, Rubber	8518	16	Power Supply Assy.	MT3500A500
5	Grommet, Blk Plastic	85716	17	Chassis Subassembly	MT3500A600B
6	Switch On / Off	28658	18	Bezel, w/handle	MT3500310
7	Fuse, 20A, 32V	210551	19	Shield, Monitor	MT3500A340
8	Fuse Holder	210951	20	Knob	86330
9	Pump, Sample	MT3500A21	21	Bench	7049012901
10	Bracket, Pump	MT3500A25	22	Standoff	15861
11	Spacer	04010354	23	Board, Main CPU	EAP0041C00A
12	Fan	MT3500A60	24	Board, Connector	MT3500A200

BACK PANEL VIEW



ITEM	DESCRIPTION	PART NUMBER	ITEM	DESCRIPTION	PART NUMBER
1	Label, Warning	MT16704A	12	Bumper, Rubber	84918
2	Cover, NO and O_2	EASP0034C00A	13	Foot	MT3500A8
3	Manifold Block NO O_2	EAA0031C02A	14	Harness, Internal Tach	MT3500A10
4	Channel, NO and O_2	07200002	15	Plug, Black Plastic	13740031
5	O_2 Sensor	7049000401	16	Label, Warning	MT35004
6	Plate, NO and O_2	EASP033C00A	17	Grommet, Blk Plastic	85816
7	Grommet	05010003	18	Harness, Internal DC	MT3500A50
8	NO Cell	7049013001	19	Label	MT35005
9	Filter Assembly	See Page 9-5	20	Breaker, Circuit	28851
10	Conn, Thermocouple	214348	21	Filter, AC Line	210751
11	Label, RS232, Printer.	MT35002	22	Bumper, Rubber	8518

FILTER ASSEMBLY



ITEM	DESCRIPTION	PART NUMBER	ITEM	DESCRIPTION	PART NUMBER
1	Fitting, Brass Nipple	0647030101	8	Nut, Filter Bowl	0301094801
2	Nut, Brass Seal	0647030201	9	Nut, Filter Retaining	0301094601
3	Fitting, Brass Elbow	0647030301	10	Bowl, Filter	0301094701
4	Fitting, Male Brass	113380	11	Plug, Filter	06470138
5	Element, Primary Filter	0301094401	12	Element, Sec. Filter	0301094501
6	Fitting, Brass Elbow	113680	13	Bracket, Filter	MT3500A9
7	Fitting, Brass Nipple	113480	14	Head, Filter	0301094201

PARTS IN ALPHABETICAL ORDER

DESCRIPTION	PART NUMBER	COMMENTS
Adapter, Inductive Pickup	MT350090	From Back Panel to Inductive Pickup Harness
AntiDilution Exhaust Probe	MT310019	
Battery, External NO Cell	EAA0030C01A	Below NO, O_2 Interface Bd.
Bench	7049012901	Andros, 5 Gas
Bezel, w/ handle	MT3500310	Front Panel Bezel with handle
Board, Connector	MT3500A200	Contains 6049D0039901 Ribbon Cable
Board, Main CPU	EAP0041C00A	With Speaker and Speaker Bracket
Board, NO, O_2 Interface	EAA0030C03A	Behind NO and O_2 Cell
Bowl, Filter	0301094701	Primary and Secondary
Bracket, Bench Support	MT3500A410	Sheet Metal
Bracket, CRT Board	MT3500A6	Sheet Metal
Bracket, Fan	MT3500A7	Sheet Metal
Bracket, Filter Mounting	MT3500A9	Sheet Metal
Bracket, Pump Support	MT3500A25	Sheet Metal
Bracket, Speaker	MT3500A125	Sheet Metal
Breaker, Circuit	28851	15 Amp
Bumper, Rubber	8518	Back of Analyzer
Bumper, Rubber	84918	Bottom of Analyzer
Cable, 20 Pin Ribbon	6047D0149901	From Monitor PCB to Main PCB J9
Cable, 5 Pin Ribbon	6057D0049901	From IR Bench to Main PCB J14
Cable, 9 Pin Ribbon	6058D0049901	From IR Bench to Main PCB J13
Cable, 9 Pin Ribbon	6058D0169901	From Power Supply P2 to Main PCB J4
Cable, O_2 and NO Cell	EAA0030C02A	From
Cap, Needle Adapter	MT310033	For Leak Check
Cap, Sample Probe	MT310032	For Leak Check
Case, Top	MT3500A700	Sheet Metal
Channel, O_2 and NO	07200002	
Chassis, Subassembly	MT3500A600B	Back and Bottom Sheet Metal Panels For Case
Clamp, Cable	25857	Gray Plastic Wiring Harness Hold Down
Clamp, Hose	11582	Internal Tubing Clamp
Connector, Thermocouple	214348	Back Panel Thermocouple Connector
Cord, Power	62421	
Cover, O_2 and NO Cell	EASP034C00A	Sheet Metal Cover Over Both Sensors
CRT	MT3500326	
Element, Primary Filter	0301094401	75 Micron Filter
Element, Secondary Filter	0301094501	8 Micron Filter
Escutcheon	MT3500301	Black Plate around Monitor Brightness Control
Fan	MT3500A60	
Filter, AC Line	210751	Input Filter / Fuse Assembly
Filter, Assembly	EAA0031C01A	Complete Pri. & Sec. Filter Assembly
Fitting, Brass Elbow	0647030301	90° Elbow to Exhaust Sample Hose
Fitting, Brass Elbow	113680	90° Elbow off Secondary Filter Housing and Bottom of Primary Filter Bowl
Fitting, Brass Nipple	113480	Between Primary and Secondary Filter
Fitting, Brass Nipple	0647030101	Between Primary Filter and 90° adapter
Fitting, Male Brass	113380	Primary Filter Housing to 90° adapter
Fitting, Plastic	15680	For Back Panel Gas Calibration Port
Fitting, Plastic Tee	06470102	
Foot	MT3500A8	Bottom Rubber Bumper Screws into it
Fuse	07390040	1 Amp, Slo Blo
Fuse	27551	1 Amp, 250 Volt for 240 Volt Testers
Fuse	210351	2 Amp, 250 Volt Fast Blow (AC input Connector)
Fuse	210551	20 Amp, 32 Volt
Fuse Holder	210951	Holds 20A Fuse Above Power in Conn.
Gasket, CRT	MT16651013	Gasket around front of CRT
Grommet	05010003	O_2 Harness runs through this on Manifold Sheet Metal

Grommet	85216	4 attached to corners of CRT
Grommet, Black Plastic	85716	Side of unit by Power Switch (qty 1)
Grommet, Black Plastic	85816	On Back Panel (qty 4)
Grommet, Strip	51441	On CRT sheet metal for Power Supply Wiring Harness
Guide, Circuit Card	22066	
Handle, Sample Probe	MT310047	Without Flexible Probe Tip
Harness, Internal AC	MT3500A40	With AC Power Line Filter
Harness, Internal DC	MT3500A50	Includes Back Panel Conn. & Harnesses
Harness, Internal Tach.	MT3500A10	Back Panel Tach Connector and Internal Harness
Harness, Int. Thermocouple	6105G004ADED	1 wire Internal Thermocouple Harness
Harness, Int. Thermocouple	6031C0099901	2 wire Internal Thermocouple Harness
Head, Filter	0301094201	Primary and Secondary Filter
Hose Assembly, Exhaust	MT310017	Exhaust Hose, Handle, and Flexible Probe
Hose, Exhaust	MT310020	25 Feet Replacement Sample Hose (No Probe)
Keyboard, Subassembly	MT3500A330	
Knob	86330	Brightness Adjustment Knob
Label	MT35002	Scanner, RS232, Printer, etc...
Label	MT35005	DC / AC Power Connector
Label, Line Cord Fuse	810262	On AC Power Cord Connector
Label, Model	EAL0062C00A	MT3505 Front Panel Adhesive Label
Label, Warning	EAL0061C00A	Exhaust Probe Warning Label on Handle
Label, Warning	MT16704A	Electrical Shock Label next to AC Power Input Conn.
Label, Warning	MT3000A37A	English / French Electrical Shock Label
Label, Warning	MT35003A	Warning on top of Filter Assembly
Label, Warning	MT35004	Warning below Tach. input connector
Leadset, DC Power	MT3000210A	
Manifold Assembly, Solenoid	24437	Might Break This Down into smaller Part
Manifold Block, O_2 and NO	EAA0031C02A	
Monitor	MT3500320	Monitor and Monitor Bd. (mounted on Monitor Shield)
NO Cell	7049013001	
Nut, Brass Seal	0647030201	Between Primary Filter Bowl and 90° Adapter
Nut, Filter Bowl	0301094801	Primary and Secondary Filter Bowl Nut
Nut, Filter Element Retaining	0301094601	Primary and Secondary Element Retaining Nut
ORing, Filter	0301094301	Primary and Secondary Filter Bowls
O_2 Sensor	7049000401	
Pickup, Trigger	MT60A08A	Inductive Trigger Pickup with Cable
Plate, O_2 and NO Mounting	EASP033C00A	Sheet Metal
Plug, Black Plastic	13740031	2 Plugs Below Cal and Zero Ports on Back Panel
Plug, Filter	06470138	Bottom of Secondary Filter Bowl
Power Supply Assembly	MT3500A500	Sheet Metal and Board
Probe, Exhaust	MT310018	Flexible Sample Hose with Probe Tip
Pump, Sample	MT3500A21	
Restrictor	12779	In Pneumatics going to Barometric Pressure Transducer
Shield, Monitor	MT3500A340	
Spacer	04010354	Holds CRT PCB to Sheet Metal
Speaker	MT3500A110	with wiring harness
Standoff, Bench	15861	
Standoff, CRT	15061	4 between Bezel and Monitor
Standoff, NO/O_2 Interface Bd.	0429003802	Between Interface Bd. and Sheet Metal
Strip, Optional AC Power	EAW0029C00A	To Plug In Optional Accessories (printer...)
Switch, On / OFF	28658	
Valve, Check	12981	

PARTS IN NUMERICAL ORDER

PART NUMBER	DESCRIPTION	COMMENTS
EAA0030C01A	Battery, External NO Cell	Below NO, O_2 Interface Bd.
EAA0030C02A	Cable, O_2 and NO Cell	From
EAA0030C03A	Board, NO, O_2 Interface	Behind NO and O_2 Cell
EAA0031C01A	Filter, Assembly	Complete Pri. & Sec. Filter Assembly
EAA0031C02A	Manifold Block, O_2 and NO	
EAL0061C00A	Label, Warning	Exhaust Probe Warning Label on Handle
EAL0062C00A	Label, Model	MT3505 Front Panel Adhesive Label
EAP0041C00A	Board, Main CPU	With Speaker and Speaker Bracket
EASP033C00A	Plate, O_2 and NO Mounting	Sheet Metal
EASP034C00A	Cover, O_2 and NO Cell	Sheet Metal Cover Over Both Sensors
EAW0029C00A	Strip, Optional AC Power	To Plug In Optional Accessories (printer...)
MT16651013	Gasket, CRT	Gasket around front of CRT
MT16704A	Label, Warning	Electrical Shock Label next to AC Power Input Conn.
MT3000210A	Leadset, DC Power	
MT3000A37A	Label, Warning	English / French Electrical Shock Label
MT310012	Screen, Water Filter	
MT310013	Screen, Gas Filter	
MT310017	Hose Assembly, Exhaust	Exhaust Hose, Handle, and Flexible Probe
MT310018	Probe, Exhaust	Flexible Sample Hose with Probe Tip
MT310019	AntiDilution Exhaust Probe	
MT310020	Hose, Exhaust	25 Feet Replacement Sample Hose (No Probe)
MT310032	Cap, Sample Probe	For Leak Check
MT310033	Cap, Needle Adapter	For Leak Check
MT310047	Handle, Sample Probe	Without Flexible Probe Tip
MT35002	Label	Scanner, RS232, Printer, etc...
MT3500301	Escutcheon	Black Plate around Monitor Brightness Control
MT3500320	Monitor	Monitor and Monitor Bd. (mounted on Monitor Shield)
MT3500326	CRT	
MT35003A	Label, Warning	Warning on top of Filter Assembly
MT35004	Label, Warning	Warning below Tach. input connector
MT35005	Label	DC / AC Power Connector
MT350090	Adapter, Inductive Pickup	From Back Panel to Inductive Pickup Harness
MT3500310	Bezel, w/ handle	Front Panel Bezel with handle
MT3500A10	Harness, Internal Tach.	Back Panel Tach Connector and Internal Harness
MT3500A110	Speaker	with wiring harness
MT3500A125	Bracket, Speaker	Sheet Metal
MT3500A200	Board, Connector	Contains 6049D0039901 Ribbon Cable
MT3500A21	Pump, Sample	
MT3500A25	Bracket, Pump Support	Sheet Metal
MT3500A330	Keyboard, Subassembly	
MT3500A340	Shield, Monitor	
MT3500A40	Harness, Internal AC	With AC Power Line Filter
MT3500A410	Bracket, Bench Support	Sheet Metal
MT3500A50	Harness, Internal DC	Includes Back Panel Conn. & Harnesses
MT3500A500	Power Supply Assembly	Sheet Metal and Board
MT3500A6	Bracket, CRT Board	Sheet Metal
MT3500A60	Fan	
MT3500A600B	Chassis, Subassembly	Back and Bottom Sheet Metal Panels For Case
MT3500A7	Bracket, Fan	Sheet Metal
MT3500A700	Case, Top	Sheet Metal
MT3500A8	Foot	Bottom Rubber Bumper Screws into it
MT3500A9	Bracket, Filter Mounting	Sheet Metal
MT60A08A	Pickup, Trigger	Inductive Trigger Pickup with Cable
6031C0099901	Harness, Int. Thermocouple	2 wire Internal Thermocouple Harness
6047D0149901	Cable, 20 Pin Ribbon	From Monitor PCB to Main PCB J9
6057D0049901	Cable, 5 Pin Ribbon	From IR Bench to Main PCB J14

6058D0049901	Cable, 9 Pin Ribbon	From IR Bench to Main PCB J13
6058D0169901	Cable, 9 Pin Ribbon	From Power Supply P2 to Main PCB J4
6105G004ADED	Harness, Int. Thermocouple	1 wire Internal Thermocouple Harness
8518	Bumper, Rubber	Back of Analyzer
11582	Clamp, Hose	Internal Tubing Clamp
12779	Restrictor	In Pneumatics going to Barometric Pressure Transducer
12981	Valve, Check	
15061	Standoff, CRT	4 between Bezel and Monitor
15680	Fitting, Plastic	For Back Panel Gas Calibration Port
15861	Standoff, Bench	
214348	Connector, Thermocouple	Back Panel Thermocouple Connector
22066	Guide, Circuit Card	
24437	Manifold Assembly, Solenoid	Might Break This Down into smaller Part
25857	Clamp, Cable	Gray Plastic Wiring Harness Hold Down
27551	Fuse	1 Amp, 250 Volt for 240 Volt Testers
28658	Switch, On / OFF	
28851	Breaker, Circuit	15 Amp
51441	Grommet, Strip	On CRT sheet metal for Power Supply Wiring Harness
62421	Cord, Power	
84918	Bumper, Rubber	Bottom of Analyzer
85216	Grommet	4 attached to corners of CRT
85716	Grommet, Black Plastic	Side of unit by Power Switch (qty 1)
85816	Grommet, Black Plastic	On Back Panel (qty 4)
86330	Knob	Brightness Adjustment Knob
113380	Fitting, Male Brass	Primary Filter Housing to 90º adapter
113480	Fitting, Brass Nipple	Between Primary and Secondary Filter
113680	Fitting, Brass Elbow	90° Elbow off Secondary Filter Housing and Bottom of Primary Filter Bowl
210351	Fuse	2 Amp, 250 Volt Fast Blow (AC input Connector)
210551	Fuse	20 Amp, 32 Volt
210751	Filter, AC Line	Input Filter / Fuse Assembly
210951	Fuse Holder	Holds 20A Fuse Above Power in Conn.
810262	Label, Line Cord Fuse	On AC Power Cord Connector
04010354	Spacer	Holds CRT PCB to Sheet Metal
05010003	Grommet	O_2 Harness runs through this on Manifold Sheet Metal
06470102	Fitting, Plastic Tee	
06470138	Plug, Filter	Bottom of Secondary Filter Bowl
07200002	Channel, O_2 and NO	
07390040	Fuse	1 Amp, Slo Blo
13740031	Plug, Black Plastic	2 Plugs Below Cal and Zero Ports on Back Panel
0301094201	Head, Filter	Primary and Secondary Filter
0301094301	ORing, Filter	Primary and Secondary Filter Bowls
0301094401	Element, Primary Filter	75 Micron Filter
0301094501	Element, Secondary Filter	8 Micron Filter
0301094601	Nut, Filter Element Retaining	Primary and Secondary Element Retaining Nut
0301094701	Bowl, Filter	Primary and Secondary
0301094801	Nut, Filter Bowl	Primary and Secondary Filter Bowl Nut
0429003802	Standoff, NO/O_2 Interface Bd.	Between Interface Bd. and Sheet Metal
0647030101	Fitting, Brass Nipple	Between Primary Filter and 90º adapter
0647030201	Nut, Brass Seal	Between Primary Filter Bowl and 90º Adapter
0647030301	Fitting, Brass Elbow	90° Elbow to Exhaust Sample Hose
7049000401	O_2 Sensor	
7049012901	Bench	Andros, 5 Gas
7049013001	NO Cell	

NOTES:

CHAPTER 10

THERMOCOUPLE

GENERAL

The Thermocouple (or Temperature) function is optional on all MT-3505s. The Thermocouple circuitry consists of a Temperature Probe (MT3500A800) on the outside of the analyzer. On the back panel of the analyzer is the “TEMP” connector, with the internal thermocouple harness attached to it. The internal thermocouple wiring harness attaches to the CPU Board, which has the engine sync processor and counter timer circuitry on it.

THEORY OF OPERATION

The Thermocouple on the outside of the analyzer produces a voltage when hooked to the analyzer. This voltage is sent to the back panel “TEMP” connector. From there the internal thermocouple wiring harness routes the signal to J16 pins 2 and 3, of the CPU Board. This voltage signal is then sent to a temperature compensation circuit, which sets a reference for the thermocouple. From there the voltage is sent to a comparator. The output of the comparator is then sent to an operational amplifier where the zero and gain calibrations can be performed. From the operational amplifier, the signal is sent to a counter timer where the signal is changed to a digital signal and processed by the system controller.

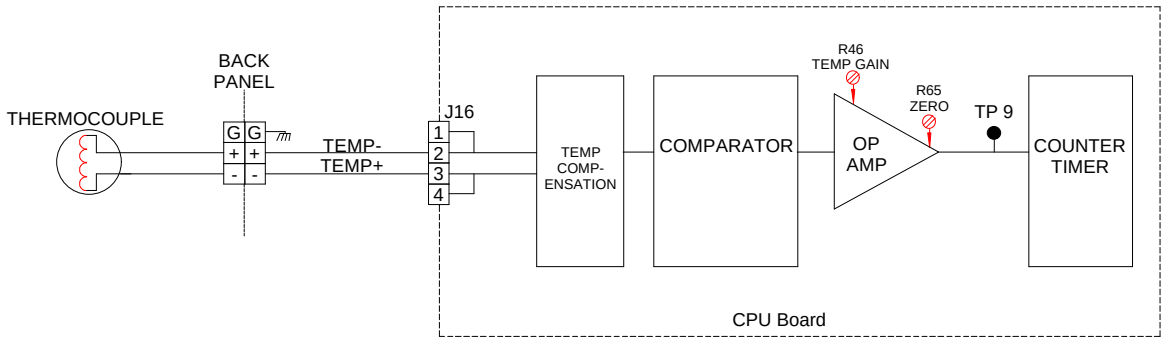


Figure 1
THERMOCOUPLE CIRCUITRY

NOTES:

CHAPTER 11

PRINTERS

GENERAL

There are two types of printers (Parallel, and Serial) that can be used in an MT-3505. In addition there are two different Parallel printers that can be used in the MT-3505. All printers are optional, and are described in detail below.

AMT PARALLEL PRINTER

The results and/or diagnostic messages of the MT-3505 are printed using the AMT-242, an 85 column, bi-directional, 24 pin, dot matrix, impact printer. When the printer is activated the print head will travel to the far right and then back to the far left of the platen to indicate initialization. The LCD window on the front panel will display "DRAFT 10 READY".

From any screen menu an operator can print the desired information by pressing **<PRINT>**. The AMT-242 prints at a rate of up to 240 cps (characters per second), and can print letter quality in any of eight available character faces (Fonts) and six character sizes (Pitch). The printer resolution is 360 x 360 dpi (dots per inch). The printer also incorporates self diagnostics which will help in isolating a specific printer component for corrective action.

USING THE SETUP MENU:

The Setup menu is a list of printer parameters organized into six categories.

1) **Operations**
2) **Print Modes**
3) **Page Settings**
4) **Communication Settings**
5) **Special Modes**
6) **Service Mode**

OPERATIONS		**PAGE SETUP**		**SPECIAL MODES**	
1) RSTOR:	None	19) LENGTH:	066	36) HEXMODE:	Off
2) SAVE:	None	20) WIDTH:	8	37) AUTO CR:	On
3) DFALT:	SUN	21) DEMAND:	Auto	38) AUTO LF:	Off
4) TEST:	None	22) BIN:	None	39) AUTO FF:	Off
PRINT MODES		23) TOP MAR:	000	40) PAPROUT:	On
5) EMUL:	MT3010	24) BOT MAR:	066	41) SLASH 0:	On
6) FNT:	Draft	25) LFT MAR:	000	42) QUIET:	Off
7) PITCH:	10	26) RGT MAR:	080	43) LF SPD:	5.0
8) LPI:	6	**COMMUNICATIONS**		44) DELAY:	3 SEC
9) ITALICS:	Off	27) DWNLOAD:	Off		
10) Off HIGH:	Off	28) INTRFCE:	Par		
11) WIDE:	Off	29) BAUD:	9600		
12) SCRIPT:	Off	30) PARITY:	None		
13) UNDLINE:	Off	31) DTA BITS:	8		
14) BLD/SHA:	Off	32) STOP BITS:	1		
15) CTR/JST:	Off	33) HNDSHAK:	DTR		
16) LANG:	PC437	34) DTR:	Low		
17) DIRCTN:	Bi-d	35) IPRIME:	Off		
18) GRFICS:	Uni				

ACCESSING THE SETUP MENU

Press **<Setup>**, to enter the Setup menu. When the Setup menu appears, the control panel acts like a one-line window over the menu. Each line contains a different parameter. Turning the Select-dial scrolls the menu up or down past the window. Each parameter is numbered so you can always tell where you are in the menu.

Beside each parameter is the current setting. Holding down **<Alt>** and turning the Select-dial cycles through the possible settings. The current setting is displayed when **<Alt>** is released.

To leave the Setup menu and redisplay the status message, press **<Setup>** again. If you display the Setup menu and do not use it for more than one minute, the status message will reappear automatically. Also, pressing any control panel button except **<Alt>** will redisplay the status message.

Change the current settings as required then save them for use at a later time. Specify the power-on defaults for the printer to use. Print the Setup menu by holding down **<Alt>** and pressing **<Status>**.

SELECTING OPERATIONS

RUNNING PRINTER SELF TEST:

To run the printer self test press and hold **<Alt>**, and press **<Test>**.

BASIC PRINTER OPERATION:

The first section of the Setup menu is basic printer operations. Selecting an operation performs a specific action. Unless otherwise specified for MT-3505 operation, the settings are identified directly behind the name of the function.

"1) RSTOR: None" Restore Printer Settings:

The first operation on the Setup menu is RSTOR. RSTOR is used to restore printer settings to the factory settings or user settings that you saved previously with the SAVE operation. When RSTOR is selected, the printer clears the data input buffer.

Selecting NONE can be used to cancel the operation; Fctry to restore the factory settings; or Usr 1 through Usr 3 to restore the settings saved under one of these names.

"2) SAVE: None" Save Printer Settings:

SAVE is used to save the current printer setting in non-volatile memory for use at a later time.

To save the current printer settings, hold down **<Alt>** and turn the Select-dial to select one of the three users names. As soon as **<Alt>** is released, the printer saves the current printer settings and assigns the user name that is selected. RSTOR is used to restore the settings that are saved; DFALT is used to make your saved settings the power-on default settings.

None is selected to cancel the operation; or Usr 1 through Usr 3 to save the current settings under one of these names.

"3) DEFALT: Fctry" Select Power-On Default Settings:

DFALT is used to select the printer settings to use as the power-on default settings. Select the factory settings or the settings were saved previously with a SAVE operation.

The printer keeps that DFALT selection in non-volatile memory so it is retained when the printer is off.

Select Fctry to use the factory settings as the power-on defaults or Usr 1 through Usr 3 to use settings saved under one of these names.

"4) TEST: None" Run Printer Test

TEST allows a variety of printer tests, including a sensor check and a memory check. If a test fails, an error message will appear.

Select None, that is always the default and does not perform any test; Sensor, that runs the sensor check; or Memory, that checks the printer memory.

SELECTING PRINT MODES:

Emulation is the most important print mode parameter and must be set to be compatible with the application program.

"5) EMUL: MT3010" Set Printer Emulation:

EMUL allows a selection for a printer emulation for the printer to use. Selecting an Emulation enables the printer to imitate other popular printers. When an emulation is selected, all current printer settings stay in effect. Selections include Epson, that causes the printer to imitate Epson LQ-570 and LQ-1070 printers; IBM, that causes the printer to imitate IBM XL24 and LEXMARK 2390/2391 printers; and MT3010, which causes the printer to imitate the Snap-on MT3010 printer. The only setting which will print properly when working with an MT-3505 is the MT3010 emulation.

"6) FNT: Draft" Set Font:

FNT is used to select a font (typestyle), such as, Roman, SanSrf, Courier, Prestige, Script, OCR-B, Orator, Draft, and HSDraft.

"7) PITCH: 10" Set Pitch:

PITCH is used to specify how many characters to print per inch. You can select 10, 12, 13, 15, 17, or 20. Select PS for proportional spacing. If the current setting is Other, then the software has set the pitch to some nonstandard value.

"8) LPI: 6" Set Number of Lines Per Inch:

LPI specifies how many lines to print per inch. You can select 3, 4, 6, 8 or 12. If the current setting is "Other", then the software has set the number of lines per inch to some other numerical value.

"9) ITALICS: Off" Turn Italics Mode On and Off:

ITALIC is used to turn the italic mode on and off.

"10) HIGH: Off" Turn Double-High Mode On and Off:

HIGH is used to turn the Double-High mode on and o**f**. In double-high mode, characters stretch downward to twice their normal height, and the LPI setting changes to three lines per inch. When the mode is turned off, the LPI settings change to six lines per inch.

"11) WIDE: Off" Turn Double-Wide Mode On and Off:

WIDE is used to turn double-wide mode on and off. In double-wide mode, characters stretch to the right twice their normal width. When the user turns on the double-wide mode, the pitch is set to half its current value. When the user turns off double-wide, the pitch is doubled to its previous value.

"12) SCRIPT: Off" Turn Super/Subscript Mode On and Off:

SCRIPT is used to turn on and off the superscript and subscript modes. In superscript mode, characters shrink to about half their normal size and print above the print line. In subscript mode, the same small characters print below the normal print line. Select Supr to turn the superscript mode on, sub to turn the subscript mode on, or Off to turn both modes off.

"13) UNDLINE: Off" Turn Underline Mode On and Off:

UNDLINE is used to turn the underline mode on and off. In underline mode, all characters and spaces are underlined.

"14) BLD/SHA: Off" Turn Bold/Shadow Modes On and Off:

BLD/SHA is used to turn on and off the bold shadow modes. In bold mode, characters are printed twice-one on top of the other-to produce bold print. In shadow mode, characters are also printed twice-once and then slightly offset to the right-to produce shadow print. Select Bld to turn the bold mode on, Sha to turn the shadow mode on, or Off to turn both modes off.

"15) CTR/JST: Off" Turn Center/Justify Modes On and Off:

CTR/JST is used to turn on and off the center and justify modes. In the center mode, the printer centers each line of text between the margins. In the justify mode, the printer expands or compresses each line of text as necessary so that it ends at the right margin. If the printer must expand a line to over twice its original length or compress a line so that characters overlap, the line prints unjustified. With both the center and justify modes, a carriage return or line feed code in the print marks the end of the line. Select Ctr to turn on the center mode, Jst to turn on the justify mode, or Off to turn both modes off.

"16) LANG: PC437" Set Language:

LANG is used to specify a language for the printer to use when printing text. When selecting any other language than USA, the printer replaces some of the standard ASCII printable characters with alternate characters that are used in a specific language. Use PC437 for the setup.

"17) DIRCTN: Bi-d" Set Text Printing Direction:

DIRCTN is used to specify whether the printer should print text in both directions or from left to right only. Printing only from left to right provides the highest possible vertical alignment, but slows down printing. Select Bi-d for bidirectional printing or Uni for left to right printing.

"18) GRFICS: Bi-d" Set Graphics Printing Direction:

GRFICS is used to specify whether the printer should print graphics in both directions or from left to right only. Printing from left to right only provides the highest possible vertical alignment, but slows down printing. You can select Bi-d for bidirectional printing or Uni for left to right printing.

SELECTING PAGE SETUP PARAMETERS:

Page Setup parameters lets you specify page size and margins.

"19) LENGTH: 066" Set Page Length:

LENGTH is used to specify the length of the paper that the user is using in 1/6-inch increments. This setting is especially important since it controls continuous-forms feeding. The user may select a number from 0 to 182. To determine the correct number to use for your paper, multiply the length of the paper in inches by 6. For example, if the paper is 11 inches long, select 66 (11 x 6 = 66).

When setting page length, the printer sets the top-of-form at the current line and clears top and bottom margins. If the length is set to 0, the printer does not keep track of lines per page.

When using single sheets, a form-feed control code ejects the page; when using pin-feed paper, a form-feed control code performs a carriage return only.

"20) WIDTH: 8.5" Set Maximum Print Width:

WIDTH is used to specify the maximum print width. If the printer receives a line that exceeds the maximum print width, the excess prints on the next line. The user may specify 8, 8.5, or 13.6 inches (13.6 only applies to wide carriage printer models, therefore it should not be selected.

"21) DEMAND: Auto" Turn Demand Document Mode On and Off:

DEMAND is used to turn demand document mode on and off. The demand document mode lets the user remove a pin-fed page without wasting the next page. When demand document mode is on, pressing **<Ready>** turns printing off and feeds the paper until the bottom edge of the last printed page is at the tear bar. You can then tear the page off. The display will show DEMND instead of PAUSE. Pressing **<Ready>** again causes one of the following actions to occur:

A) If you removed the last printed page, the paper reverse feeds to the last top-of-form, the READY message reappears, and printing continues at the point where it left off.

B) If you did not remove the last printed page, the paper reverse feeds back to its original position, the READY message reappears, and printing continues at the point where it left off.

The user can select On to turn the demand document mode on; Off, to turn the mode off; or Auto, which causes the printer to present the paper for tear-off whenever the printer idle (you don't have to press **<Ready>**). If demand document mode is on and the user does not want the paper presented for tear off, just press **<Ready>** twice.

"22) BIN: None" Select Sheetfeeder Bin:

If the user is using a sheetfeeder option. BIN lets the user select a sheetfeeder bin to feed paper from. Select None when not using a sheet feeder; Front to feed paper from the front (or only) sheet feeder bin; Back to feed paper from the back sheetfeeder bin; or Envel to feed from the envelope tray (if your printer has it installed).

"23) TOP MAR: 000" Set Top Margin: (continued)

TOP MAR is used to specify a top margin. On subsequent form feeds, paper advances to the top margin you specify. The top margin can be from 0 to 181 lines down from the top of form; however, the user can only select a line that is above the bottom margin setting.

The physical location of the top margin on the page is unaffected by subsequent changes to line spacing. If the user changes the LENGTH (page length) setting, the top margin resets to 0.

"24) BOT MAR: 066" Set Bottom Margin:

BOT MAR is used to specify a bottom margin. After printing on this line, the printer performs a form feed operation automatically; no printing occurs below the bottom margin. The bottom margin can be from 1 to 182 lines down from the top-of-form; however, the user can only select a line that is below the top margin setting.

The physical location of the bottom margin on the page is unaffected by subsequent changes to line spacing. If the user changes the LENGTH (page length) setting, the bottom margin resets to the new page length.

"25) LFT MAR: 000" Set Left Margin:

LFT MAR is used to specify a left margin. All subsequent carriage returns cause the printhead to move to the left margin.

The left margin can be from 0 to 271 character spaces to the right of the far left print position; however, the user can only select a character space that is to the left of the right margin setting.

To help the user visualize leftmargin locations as they scroll through the possible settings, the printhead moves to the displayed setting. The physical location of the left margin setting is unaffected by subsequent pitch changes.

"26) RGT MAR: 085" Set Right Margin:

RGT MAR is used to specify a right margin. When printing reaches the right margin on a line, the printer performs a carriage return/line feed and continues printing on the next line.

The right margin is also used in the center and justify modes. The right margin can be from 1 to 272 character spaces to the right of the far left print position; however, the user can only select a character space that is to the right of the left margin setting.

To help the user visualize the right margin locations as they scroll through the possible settings. the printhead moves to the displayed setting. The physical location of the right margin on the page is unaffected by subsequent pitch changes.

SPECIFYING COMMUNICATIONS PARAMETERS:

The next section on the Setup menu is Communications. The communications parameters control data communications between the printer and the host computer. Before successful communications can occur, these parameters must be set to match those of the host computer. When you change a communications setting, the printer clears the data input buffer.

"27) DWNLOAD: Off" Allocating Memory for User-Defined Characters:

DWNLOAD is used to allocate a portion of the printers memory to hold user-defined characters that are downloaded from the computer. Select ON to allocate eight kilobytes (8,191 bytes) of memory for user-defined characters or Off to allocate all of the printers memory for a data input buffer.

"28) INTRFCE: Par" Select Interface:

INTRFACE is used to select either the parallel or serial interface port for communication with the host computer. The user can select Par for parallel or Ser for serial. If the user selects serial, you must also set the BAUD, PARITY, DTA BITS, STOP BITS and HNDSHAK parameters to match the serial configuration of the host computer. If the user selects parallel, these parameters are irrelevant. For our applications Par should be selected.

"29) BAUD: 9600" Specify Baud Rate:

BAUD is used to tell the printer what serial baud rate your computer is using. Baud rate is the speed that serial data is transmitted between the computer and the printer. The user can select 150, 300, 600, 1200, 2400, 9600, 19200 or 38400. Both the computer and the printer must be set to the same baud rate which is 9600 for the MT-3505.

"30) PARITY: None" Specify Parity:

PARITY is used to tell the printer what parity method your computer is using. Parity is a technique that lets the printer check for data transmission errors.

The user must select None if the host computer does not support parity; Odd if the host computer uses odd parity; or Even if the host computer uses even parity. Both the computer and the printer must be set for the same parity method.

"31) DTA BITS: 8" Specify Number of Data Bits:

DTA BITS are used to tell the printer how many data bits your computer is sending in each byte. The user must select 7 if your computer sends 7-bit bytes, 8 if the computer sends 8-bit bytes, or 8 if the computer sends 8-bit bytes and you want the printer to ignore the most significant bit (MSB). For MT-3505 operation the printer should be set to 8.

"32) STOP BITS: 1" Specify Number of Stop Bits:

STOP BITS are used to tell the printer how many stop bits the host computer is sending in each byte. Stop bits are necessary to separate consecutive bytes in the data stream. The user must select 1 if the host computer sends one stop bit; or 2 if the host computer sends two stop bits. For the MT-3505 operation the printer should be set to 1.

"33) HNDSHAK: DTR" Specify Handshaking Method:

HNDSHAK is used to tell the printer what handshaking method the host computer is using.

Handshaking is a technique that starts and stops data transmission between the host computer and the printer. This starting and stopping is important so that neither device receives more data than it can handle at any given time.

The user can specify DTR for DTR hardware method; XON for the X-ON/X-OFF software method; ETX for the ETX/ACK software method; D/X for both the DTR and X-ON/X-OFF methods; D/E for both the DTR and ETX/ACK methods; or None for no handshaking method. Both the host computer and the printer must use the same handshaking method. For the MT-3505 set this to DTR.

"34) DTR: Low" Set DTR Signal Polarity:

DTR is used to specify the polarity of the Data Terminal Ready signal in the printer's serial interface. You can select Low for a signal that goes low to disable data transmission; or High for a signal that goes high to disable data transmission. For the MT-3505 set this to Low.

"35) IPRIME: Off" Enable and Disable IPRIME Signal:

IPRIME is used to enable and disable the IPRIME signal. When enabled, the computer can reset the printer by setting the IPRIME signal low for at least 50 microseconds. The printer remains in the reset condition until the signal returns high. You can select On to enable the IPRIME signal or Off to disable it. With most computers and software, this signal should be disabled.

SELECTING SPECIAL MODES:

The last section on the setup menu is Special Modes. These modes let the user invoke a variety of special printing features. They are as follows:

"36) HEXMODE: Off" Turn Hexadecimal Mode On and Off:

HEXMODE is used to turn the hexadecimal mode on and off. In the hexadecimal mode, the printer prints the hexadecimal and ASCII representations of every byte it receives. The printer does not interpret or execute any control sequences, nor does it print any text.

Hexadecimal mode is useful when you need to view the codes being sent from the host computer to the printer. The user can select On to turn the hexadecimal mode on or Off to turn the mode off.

"37) AUTO CR: On" Turn Auto Carriage Return Modes On and Off:

AUTO CR is used to turn the automatic carriage return mode on and off. In automatic carriage return mode, the printer performs a carriage return/line feed for each line feed code it receives. The user can select On to turn the mode on or Off to turn the mode off.

"38) AUTO LF: Off" Turn Automatic Line Feed Mode On and Off:

AUTO LF is used to turn the automatic line feed mode on and off. In the automatic line feed mode, the printer performs a carriage return/line feed for each carriage return code it receives. The user can select On to turn the mode on or Off to turn the mode off.

"39) AUTO FF: Off" Turn Automatic Form Feed Mode On and Off:

AUTO FF is used to turn the automatic form feed mode on and off. In the automatic form feed mode, the printer skips over the perforations of the pin-fed paper by setting top and bottom margins to one half inch. The user can select On to turn the mode On or Off to turn the mode off. For the automatic form feed mode to work correctly, the LENGTH parameter must be set to the correct page length.

"40) PAPROUT: On" Enable and Disable Paper Out Sensing:

PAPROUT is used to disable paper out detection by the printer's paper out sensors. Disabling paper out detection does not affect the printer's ability to load paper. The user can select On to enable the mode or Off to disable the mode.

"41) SLASH 0: On" Turn Zero Flashing On and Off:

SLASH 0 is used to turn zero flashing on and off. The user can select Off to specify that the numeral 0 be printed without a slash (0); or On to specify the numeral 0 be printed with a slash. The user's selection affects the printing of the numeral 0 in all fonts.

"42) QUIET: Off" Turn Quiet Mode On and Off:

QUIET is used to turn quiet mode on and off. In quiet mode, the print speed slows down by about 10% in all modes to decrease the amount of noise that is generated. The user can select On to turn the mode on or Off to turn the mode off.

SERVICE MENU FUNCTIONS

The Service mode settings are numbered 54 through 63. To access the Service modes enter the printer setup by pressing **<Setup>**. Once in the setup menu turn the dial clockwise until the numbers do not change. With the previous message displayed press and hold **<Pitch>**, and **<Form Feed>**, while turning the dial clockwise. This will bring up the Service Menu item number “54) ADJ.LQ10: 52”. To change to any other Service selection continue holding **<Pitch>**, and **<Form Feed>** while turning the dial clockwise. To change any of the settings release **<Pitch>**, and **<Form Feed>**. Then press and hold **<Alt>**, while turning the dial. Below are all the service modes, and there associated function.

SERVICE MODE		
54)	ADJ.LQ10:	52
55)	ADJ.HQ10:	19
56)	ADJ.DQ10:	24
57)	ADJ.DQ12:	42
58)	ADJ.DQ17:	51
59)	ADJ.DQ20:	50
60)	TEARBAR:	-24
61)	P_SNSR:	46
62)	H_SNSR:	0
63)	SET_USR:	

"54) ADJ.LQ10: 52" Letter Quality 10 Pitch Vertical Adjustment:

When printing in letter quality mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"55) ADJ.HQ10: 19" High Draft Quality 10 Pitch Vertical Adjustment:

When printing in HDraft mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"56) ADJ.DQ10: 24" Draft Quality 10 Pitch Vertical Adjustment:

When printing in Draft mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"57) ADJ.DQ12: 42" Draft Quality 12 Pitch Vertical Adjustment:

When printing in Draft mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"58) ADJ.DQ17: 51" Draft Quality 17 Pitch Vertical Adjustment:

When printing in Draft mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"59) ADJ.DQ20: 50" Draft Quality 20 Pitch Vertical Adjustment:

When printing in Draft mode, this adjustment will align the forward pass of the print head with the backwards pass of the print head. If this is not set to the proper setting, the alignment of the lines in a printout will not line up with the left or right margin.

"60) TEARBAR: -8" Tearbar:

Sets the distance from the first printed line to the paper tear bar. Aligns the perforation on the paper to the paper tear off bar.

"61) P_SNSR: 12" Page Sensor:

Sets the distance from the top of the form to the first printed line on the paper.

"62) H_SNSR: 0" Head Sensor:

Sets the spacing on the first column of the page with respect to the left perforation.

"63) SET_USR: " Set User:

Sets the printer to factory Default settings when changed to “DONE”.

ERROR MESSAGES

PRINTER MESSAGES:

When a printer message appears in the Select-dial control panel, find it in this section and perform the corrective action(s). There are five kinds of messages: operating errors, programming errors, warnings, communication errors and printer errors.

1). CORRECTING OPERATING ERRORS:

The printer can notify the user of three operator errors. When one of these errors occurs, the printer does not lose any buffered data. After the user performs the corrective action(s), printing continues where it left off.

"LOAD PAPER"

This error occurs when the printer has data to print but no paper is loaded in the printer.

"CLEAR PAPER JAM"

This error occurs when the printer detects a paper jam while ejecting the current page.

CORRECTIVE ACTION: Carefully remove the jammed paper and press the Ready button.

"PAPER ERROR"

This error occurs when the printer tries to eject a single sheet or perform a paper park operation, but continues to detect paper in the printer.

CORRECTIVE ACTION: If the paper is jammed, carefully remove the jammed paper and press the Ready button. If the user is just using a very long cut-sheet, press **<Form Feed>**. If the user is using pin-fed paper, tear off the last printed sheet and then hold down **<Alt>** and press **<Park>**. If this error occurs with no paper in the printer, one of the paper sensors is falsely detecting paper. Check for small scraps of paper caught in the front, behind or below the platen.

2). CORRECTING PROGRAMMING ERRORS:

The printer can notify the user of only one programming error.

"DOWNLOAD ERROR"

This error occurs when the computer attempts to download a font to the printer, but the user has not allocated printer memory to store the font. When a download error occurs, the printer ignores the downloaded font information and continues printing normally.

CORRECTIVE ACTION: Press **<Ready>** to stop the printing in progress. Change the download parameter setting to On. Then, restart the print job from the beginning.

3). UNDERSTANDING WARNINGS:

The printer offers three warnings to notify you of special conditions.

"CHECK TRACTR LVR"

After a paper park operation, this message appears to remind the user to move the paper select lever if the user is going to load a cut sheet into the printer. Moving this lever disengages the forms tractor and enables the cut sheet mode. If the user forgets to move this lever, a paper jam can result since both the cut sheet and pin-fed paper will feed into the printer at the same time. If the user is not going to load a cut sheet, just ignore the message. Pressing **<Ready>** or moving the paper select lever clears the message.

CORRECTIVE ACTION: If the user is going to load a cut sheet into the printer, push the paper select lever towards the back of the printer and press **<Ready>** button.

"TEST IN PROGRESS"

When the user selects a printer test on the Setup menu, this message appears to notify the user that the printer is executing the test.

"TEST UNAVAILABLE"

When the user selects the printer test on the Setup menu, this message appears to notify the user that the test is not contained on the printer and cannot be executed.

4). CORRECTING COMMUNICATION ERRORS:

The printer can notify the user of three communication errors. When a communication error occurs, printing stops and some or all of the print data is lost. After the user performs the corrective action(s), you must restart the print job from the beginning.

"FRAMING ERROR"

This error occurs when the baud rate of the printer and the host computer are not the same.

CORRECTIVE ACTION: Change the BAUD and DTA BITS settings on the Setup menu to the computer's baud rate and number of data bits. Then, press **<Ready>** button and restart the print job from the beginning.

"PARITY ERROR"

This error occurs when the printer, using the select parity method, detects a data transmission error affecting one or more data bytes.

CORRECTIVE ACTION: Change the PARITY setting on the Setup menu to the host computer's parity method. Then, press **<Ready>** to re-enable printing; then, restart the print job from the beginning.

If the printer's parity setting is correct, hold down **<Alt>** and press <Clear> to clear the data input buffer and then **<Ready>** to re-enable printing; then start the print job from the beginning. If the error occurs, reset the host computer and the printer for no parity checking and try again.

"BUFFER OVERFLOW"

This error occurs when the printer's data input buffer overflows. A buffer overflow occurs when the following condition(s) exist(s):

The printer and the host computer are not using the same handshaking method and/or the baud rate exceeds the print speed.

CORRECTIVE ACTION: Change the HNDSHAK setting on the Setup menu to the computers handshaking method. The, press **<Ready>** to re-enable printing and restart the print job from the beginning. If the computer or software program does not use handshaking, you must reduce the baud rate of the computer and printer to a rate that does not exceed the print speed.

5). CORRECTING PRINTER ERRORS:

The printer can notify the user of four printer errors. Printer errors occur when the printer is unable to continue printing due to a malfunctioning printer component.

"MEMORY ERROR"

This error occurs when the printer logic detects defective memory during a printer memory test. Memory tests occur during power up and when the user selects Memory Test on the Setup menu.

CORRECTIVE ACTION: The printer's memory must be replaced. If this message appears during the Setup menu memory test, the user may be able to clear the message and return to the Setup menu by turning the Select-dial.

"CARRIAGE ERROR"

This error occurs when the printer is unable to index the carriage at the home position due to a jammed ribbon, dirty carriage shaft, or a malfunctioning carriage home switch.

CORRECTIVE ACTION: First, try replacing the ribbon cartridge with another. If the error recurs, try cleaning the carriage shaft with a soft, dry, lint free cloth. If the error still recurs, service must be contacted for repair or replacement.

"EEROM ERROR"

This error occurs when the printer detects that its non-volatile memory is defective or does not contain the correct information.

"REPLACE BATTERY"

This error occurs when the printer's battery, which refreshes the non-volatile memory when power is off, becomes weak and is not providing reliable operation.

MT3010 SCRIBE II PARALLEL PRINTER

The results and/or diagnostic messages of the MT-3505 can also be printed using the MT3010 Scribe II parallel printer. When the printer is activated the print head will travel through its range of motion and will then stop in the center position. The power indicator will then light to show that the power is on. At that point either the Red P.E. (printer Error) light illuminates, indicating an error, or the On Line indicator will illuminate.

From any screen, pressing **<PRINT>** will print the information on the screen. The MT3010 prints at a rate of 250 cps (characters per second), and can print in near letter quality mode.

INDICATOR LIGHTS

There are four indicator lights used on the MT3010. They are : Power, On Line, Menu, and P.E. (for Printer Error or Paper Empty).

When lit, the: **POWER** light shows that the printer is ON.
P.E. light shows that an error condition exists.
MENU light shows that the printer is in the MENU MODE, which allows selection of various settings using the LF, FF, FONT, and PITCH keys (down arrow, up arrow, left arrow, and right arrow respectively).
ON LINE light shows that the printer is ON LINE.

NOTE: ***The MENU MODE settings will not change the way information from the MT-3505 is printed, since information is sent to the printer in graphics format, which is not affected by changes in font or pitch.***

NOTE: ***The printer will not print unless the On Line light is illuminated.***

SELECTING THE POWER ON CONFIGURATION MODE:

1. With the power switch OFF, hold down **<MENU>** and turn the power switch ON. "POWER ON CONFIG" is shown on the LCD to confirm this.
2. Release **<MENU>.** "PRINT OUT?" is shown, asking if you want to print out the current configuration.
3. Press Right Arrow **<PITCH>** or Left Arrow **<FONT>** to begin the printout.
4. Compare the printout to the one below. These settings should match. If not, refer to "Changing the Power On Configuration Mode Settings".

POWER-ON CONFIGURATION

ITEMS	*DATA*
1. EMULATION	TYPE1
2. CHARACTER SET	ITALIC
3. NATIONAL SET	USA
4. AUTOMATIC CR	OFF
5. AUTO LF	OFF (CR)
6. INPUT BUFFER	20kb
7. A.S.F.	OFF
8. IBM-20-COMPR.	ON
9. INTERFACE	PARALLEL
10. BAUD RATE	9600 BPS
11. PARITY	NONE
12. DATA BITS	8BITS
13. TEAR OFF	MANUAL
14. ALIGNMENT	10

CHANGING THE POWER ON CONFIGURATION MODE

If an Items setting does not match the example below, when the LCD shows “PRINTOUT” use the down arrow key to scroll through the items (in the order listed on the printout). Then use the left and right arrow keys to change the item’s setting. Continue this process for any other items that need to be changed. To exit from the Power On Configuration Mode press **<MENU>**. This saves the changes just made.

SELECTING THE MENU MODE

1. Turn the printer power ON.
2. With the printer OFF LINE, press **<MENU>**. “MENU MODE” is displayed on the LCD to confirm this.
3. Release **<MENU>**. “PRINT OUT?” is shown, asking if you want to print out the current Menu Mode settings. Press the right arrow (Pitch) or left arrow (Font) key to begin printout.
4. Compare the printout to the one below. The settings should match. If not, refer to “Changing The Menu Mode” below.

MENU MODE

ITEMS	MENU 1	MENU 2
1. FONT	DRAFT	DRAFT
2. PITCH	10CPI	10CPI
3. LINE SPACE	6LPI	6LPI
4. LEFT MARGIN	0	0
5. RIGHT MARGIN	80	80
6. PAGE LENGTH	66	66
7. TOP MARGIN	1	1
8. BOTTOM MARGIN	2	2
9. SLASHED ZERO	OFF	OFF
10. DOUBLE HIGH	OFF	OFF
11. PRINT DIRECTION	BI (NORMAL)	BI (NORMAL)
12. DEFULT MENU	1	1

CHANGING THE MENU MODE

If an Items setting does not match the example above, when the LCD shows “PRINTOUT” use the down arrow key to scroll through the items (in the order listed on the printout). Then use the left and right arrow keys to change the item’s setting. Continue this process for any other items that need to be changed. To exit from the Power On Configuration Mode press **<MENU>**. This saves the changes just made.

RUNNING THE SELF TEST

To run the printer self test, press and hold **<LF>**, while turning the printer on.

MT1670A SERIAL PRINTER

The MT1670A is a 40 column dot matrix printer that prints at a rate of eight lines per second. It is a Serial printer that hooks directly to the MT-3505's back panel "RS232" connector. A display indicates the function of the printer and four touch keys control the functions.

FRONT PANEL CONTROLS AND DISPLAY

LED DISPLAY: A dot in the center of the LED display signals the user that the printer is turned on, and that it is ready to print. If the printer becomes jammed while printing it will display the letters J, A, and M in a continual sequence.

CONTROL PANEL: The control panel has four dual-function touch keys. When the printer is turned on, all of the functions listed on the top of the keys are automatically activated, except TEST (refer to test key below). The functions on the bottom of the keys are activated by turning the printer's power switch to the "ON" position while the ID FORM key is depressed.

PAPERFEED: Advances the paper.

TEST: TEST is used to check the character set and operation of the printer. To activate the TEST function, turn the printer's power switch to "ON" while the TEST key is depressed. The printer should then print out all of the letters, numbers, and other characters available, the version of the printer's software (identified by date), the selected mode of operation (MT1665 or RS232 serial) and the RS232 baud rate (bits per second transmission speed) selected.

NOTE: ***For MT-3505 applications the mode of operation is RS232.***

ID FORM: ID FORM is used to print a customer/vehicle data form. This information includes the following fields: Customer, Vehicle/Make, Year, Odometer Reading, and Date.

PRINT: Is inactive when hooked to an MT-3505.

BACK PANEL

POWER SWITCH: Turns the printer ON and OFF.

FUSE HOLDER: Contains a 1 amp fuse and a voltage selector that is set for 120 Volt operation. For 240 Volt operation use a 3/4 amp fuse and change the voltage selector to the "240" position.

RS232 CONNECTOR: The RS232 connector is a 25 pin communication port that can be used for interconnecting the printer to the MT-3505.

BNC CONNECTOR: The BNC coaxial connector is used for connecting the printer to the Snap-on scope.

PRINTER COMPARTMENT

MODE SWITCH: The mode switch is used to set the mode of operation to use the BNC Connector, or the RS232 connector on the back panel. To use the Serial Printer in a MT-3505 the switch should be set to RS232.

NOTE: ***The position of this switch should only be altered when the power switch is OFF.***

10 POSITION SWITCH: The 10 position switch is used to select printer functions. The switches are preset at the factory with switches 1, 2, 3, 4, 8, 9, and 10 open (up) and switches 5, 6, and 7 closed (down). Dip switches 1, 2, 3, 4, and 10 are not used at the current time. Dip switch 5 is used to enable the Customer Vehicle Data Form. With this switch in the down position pressing **<ID FORM>** will print the Customer Vehicle Data Form on the paper. Dip switches 6, 7, and 8 are used to set the communication baud rate. With the dip switches set as shown below the printer is configured to print at a baud rate of 2400 baud. Dip switch 9 is used by the factory to do testing and should always be set to the Up position. To configure the dip switches for use in the MT-3505 set them according to the chart below.

SWITCH #	POSITION	DESCRIPTION
1	UP (OPEN)	NOT USED
2	UP (OPEN)	NOT USED
3	UP (OPEN)	NOT USED
4	UP (OPEN)	NOT USED
5	DOWN (CLOSED)	CUSTOMER VEHICLE DATA FORM ENABLED
6	DOWN (CLOSED)	BAUD RATE
7	DOWN (CLOSED)	BAUD RATE
8	UP (OPEN)	BAUD RATE
9	UP (OPEN)	FACTORY SERVICE TESTING
10	UP (OPEN)	NOT USED

TROUBLESHOOTING

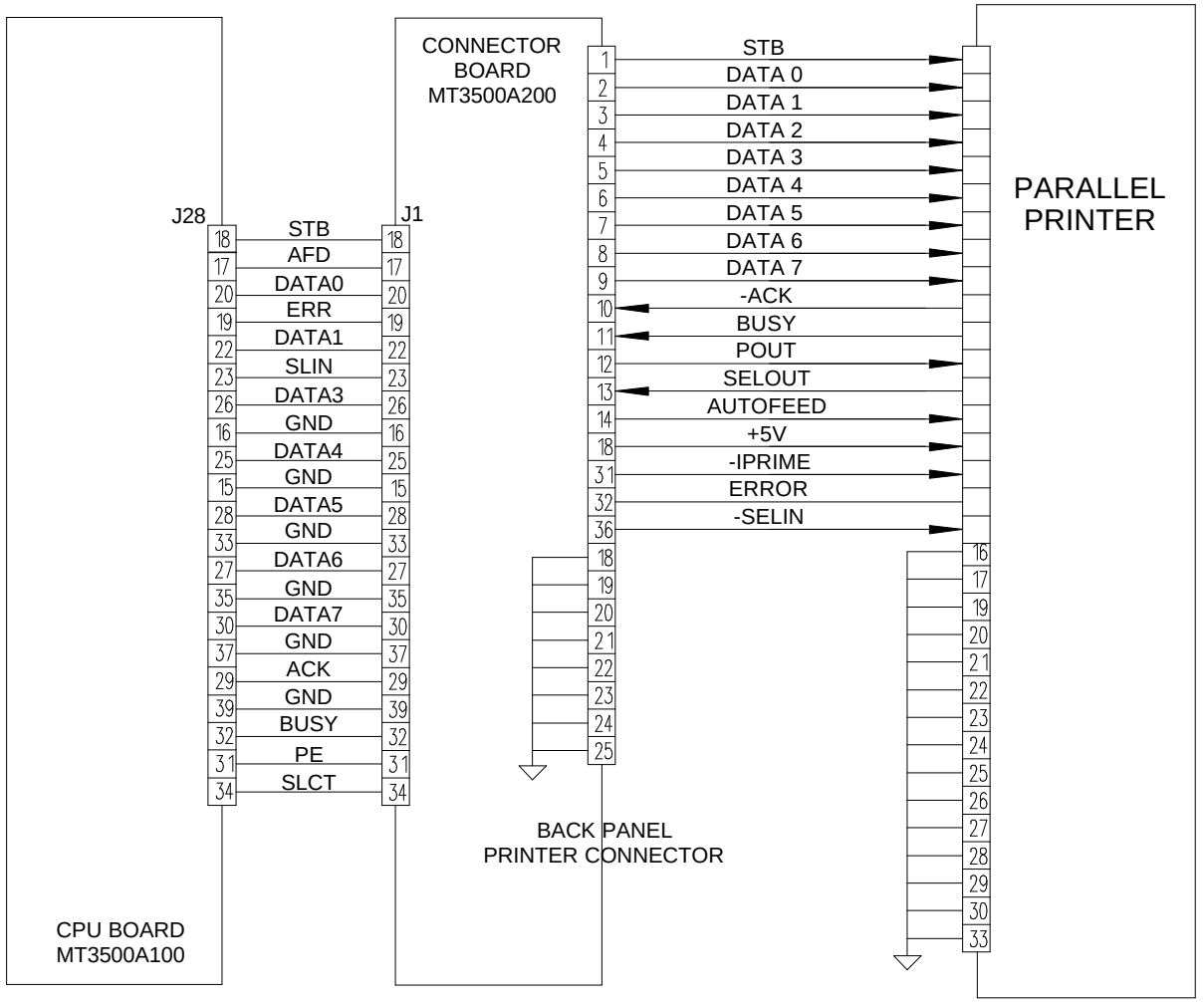
COMPLAINT	CORRECTIVE ACTION
I. Printer does not turn on.	Power cable is not plugged into power outlet. • Check power cable. Power outlet is not supplying voltage. • Check receptacle outlet for 110VAC and correct polarity. Fuse in Printer is blown. • Replace 1 amp fast blo fuse.
II. Error message appears on AMT Select-dial control panel.	Find the Error message or flashing pattern in the AMT operators manual. • Perform the corrective action.
III. Control Panel on AMT printer does not operate.	Printing is in progress. • Wait for printing to stop, or press **<READY>** to halt printing.
IV. Select dial does not move printer paper on the AMT printer.	Printer is not paused. • Press **<Ready>** and try again.
V. Self test prints, but printer does not print data sent from the analyzer.	Wrong interface settings are set. • Check host analyzer and printer configurations. Interface cable is loose, defective, or wired incorrectly. • Check interface cable. Replace if defective.
VI. Printing is too light.	Printer head gap is too wide. • Push the paper head gap lever toward the back of the analyzer. Ribbon cartridge is not fully seated in place. • Reload ribbon. Ribbon is worn. • Replace ribbon.

COMPLAINT	CORRECTIVE ACTION
VII. Printing is smearing.	Printer head gap is too narrow. • Pull paper head gap lever towards the front of the printer. Ribbon is tangled or folded. • Correct problem or replace ribbon. Small piece of paper or debris is lodged in front of printhead. • Remove obstruction.
VIII. Large portion of characters are not printing	Ribbon is tangled or folded. • Correct problem or replace ribbon.
IX. Characters are missing one or more dots.	Printer head gap is too wide. • Adjust printer paper head lever to correct problem.
X. Printer prints garbled text and paper moves erratically.	Wrong printer setup or configuration. • Ensure Printer and analyzer are set for the same emulation, and the same configuration.
XI. Paper does not feed properly.	Paper is not loaded correctly. • Check for proper installation. • Check for paper wadding or a paper jam. On 80 column printers, the tractor select lever is in the wrong position. • For single sheets push the lever towards the rear of the printer. For pin feed paper push the lever towards the front of the printer.
XII. Printing goes off the right side of the page or does not print all the way across the page on the 80 column printers	Print width setting is wrong. • Change the WIDTH setting in the SETUP menu.
XIII. Lines of text print on top of one another on an 80 column printer.	Automatic line feed mode is off. • Change AUTO LF setting on the setup menu. Paper is not taught between tractor feeder or around platen. • Reload paper.
XIV. Printer leaves blank line after every print line on the AMT printer.	Automatic line feed mode is on; it needs to be turned off. • Change AUTO LF setting in the setup menu.

COMPLAINT	CORRECTIVE ACTION
XV. Carriage does not return to the left margin before printing next line on the AMT printer.	Automatic carriage return is off; it needs to be turned on. • Change the AUTO CR setting in the setup menu.
XVI. Printer prints on pin feed perforations, on the AMT printer.	Top-of-form is set incorrectly. • Advance paper until the first print line is in front of the printhead; then hold **<Alt>**, and press **<Park>**. Then press **<Form Feed>**.

XVII. 40 column printer prints garbage.	Setup of the MT-3505 or the printer is incorrect.
	• Confirm the configuration of the dip switches in the paper compartment of the printer. Refer to this chapter for the correct settings.
	• Ensure the setup of the printer in the analyzer.
	  • Under Option Menu, Comm Setup.
	  • Printer type should be SERIAL.
	  • Printer Baud Rate should correspond to baud rate set by switches on the printer. Default is 2400 Baud.

NOTES:



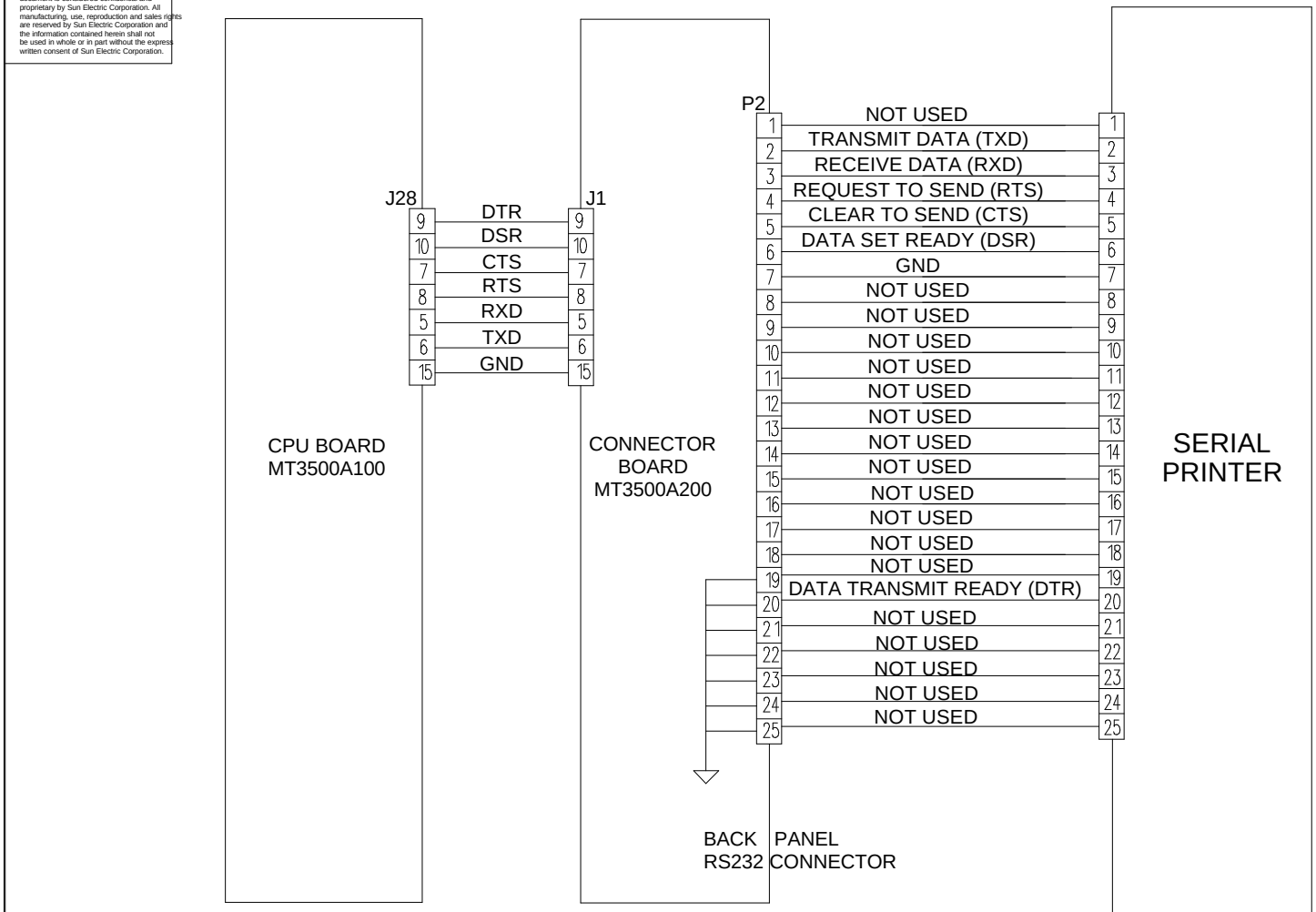
SUN ELECTRIC CORPORATION
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0395 REV A
DRG BY: J. HINKLE	CHK BY:

TITLE: PARALLEL PRINTER

DWG: 11-1	PAGE: 11-21

NOTES:



SUN ELECTRIC CORPORATION
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0395 REV A
DWG BY: J. HINKLE	CHK BY:

TITLE: SERIAL PRINTER

DWG: 11-2	PAGE: 11-23

NOTES:

CHAPTER 12

MT-2500 SNAP-ON SCANNER

GENERAL

The MT-2500 Snap-on Scanner is an optional analyzer that can be connected to and controlled by the MT-3505. This chapter is not designed to make you familiar with the MT-2500's operation, or to even allow you to troubleshoot the MT-2500. Instead it is designed to tell you how to connect the MT-2500 to the MT-3505.

THEORY OF OPERATION

The MT-2500 connects to the 25 pin "SCANNER" port on the back panel of the MT-3505. This SCANNER port is simply a 25 pin serial port which is part of the Connector Board inside the analyzer. From the Connector Board the serial information is sent from J1 pins 1, 2, 3, and 4 on the connector board, to J28 pins 1, 2, 3, and 4 on the CPU board. On the CPU board, the serial information is processed by Serial / Parallel Integrated Circuits and their associated hardware. Once the information is processed by these chips the information is sent to the system controller.

SCANNER SETUP

In order to enable the MT-3505 to recognize and control the MT-2500 the following parameters need to be set in the MT-3505 and MT-2500.

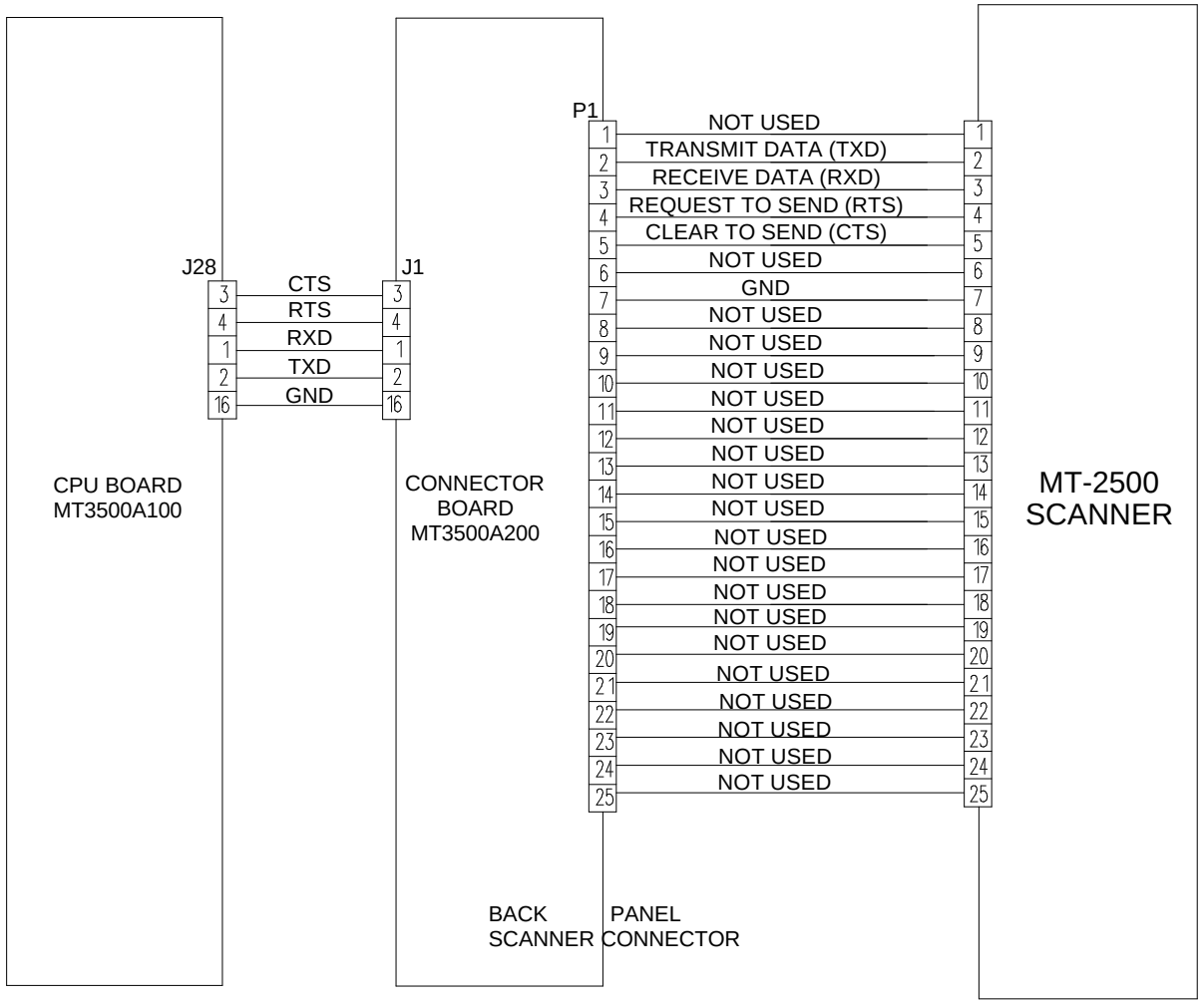
1. Turn the MT-3505 to the ON "1" position.
2. Press **<OPTION MENU>**. The analyzer proceeds to the Option Menu.
3. Press **<F5>**, "COMM SETUP". The analyzer proceeds to the Communication Setup page.
4. Press **<F1>**, "SCANNER BAUD RATE" until the box surrounds the 4800 selection.
5. Press **<F6>**, "RETURN" to return to the Option Menu.
6. Press **<GAS ANALYZER>** to proceed to the Gas Analysis page.
7. Hook the MT-2500's 25 pin Serial Cable to the MT-3505 back panel "SCANNER" port.
8. Press **<F5>**, "SPLIT SCREEN", on the MT-3505. The bottom portion of the MT-3505 screen will prompt;

SCANNER NOT DETECTED
Check: Communications cable connections
Analyzer COMM. SETUP
Scanner communications setup
Scanner power

SCANNER SETUP Cont...

NOTE: ***If you have already identified a vehicle the following steps will change it to the demo vehicle.***

9. Turn the power to the MT-2500 on.
10. Press **<Y>** on the MT-2500. If the MT-3505's display does not change to display what is showing on the MT-2500, continue to step 11. If it does correspond to the MT-2500 you are ready to use the scanner with the MT-3505.
11. Press **<Y>**, to select "DOMESTIC PRIMARY".
12. Press **<Y>**, to select "GENERAL MOTORS".
13. Press **<Y>**, to select "ENGINE AND OTHER SYSTEMS".
14. Turn the thumbwheel until "D" is displayed in the Vehicle portion of the VIN selection and press **<Y>**.
15. Turn the thumbwheel until "1" is displayed in the Make portion of the VIN selection and press **<Y>**.
16. Turn the thumbwheel until "M" is displayed in the ENGINE portion if the VIN selection and press **<Y>**.
17. Press **<Y>**, for Automatic Transmission?
18. Press **<Y>**, for Air Conditioned?
19. Press **<Y>**, to Continue.
20. Press **<Y>**, to Continue.
21. Press **<Y>**, for Engine.
22. Turn the thumbwheel until the cursor is next to "CUSTOM SETUP". Press **<Y>**.
23. Turn the thumbwheel until the cursor is next to "COMMUNICATION SETUP". Press **<Y>**.
24. Turn the thumbwheel until the cursor is next to "OTHER COMMUNICATION, 4800 BAUD". Press **<Y>**.
25. Press **<F5>**, "SPLIT SCREEN" on the MT-3505 twice. The MT-3505 should correspond to the MT-2500.



SUN ELECTRIC CORPORATION
One Sun Parkway
Crystal Lake, Illinois 60014 U.S.A.

MODEL: MT-3505	0395 REV A
DWG BY: J. HINKLE	CHK BY:

TITLE: MT-2500 SCANNER

DWG: 12-1 PAGE: 12-3

NOTES:

APPENDIX A

SOFTWARE PAGE FLOW

GENERAL

This appendix will give a breakdown of the software page flow that is used by the customer and the service technician. Directly below the “Start Up Screen” heading are five boxes. These boxes represent the green keys on the front of the keypad. All other boxes have function keys in the upper left hand corner. These “F” keys represent the “F” keys on the keypad.

SERVICE PAGE

The Service page should only be accessed by Authorized SunSERVICE personnel. To access the Service Page first enter the service menu by pressing **<OPTION MENU>**, then **<F6>**. Once in the service page press **<F5>**, then **<←>**, and then **<→>**. This will allow you to look at specific parameters of the analyzer.

NOTES:

APPENDIX B

GLOSSARY

GENERAL

The following is an appendix of common terms that may have been used throughout this manual, but are pertinent to the MT-3505 Gas Analyzer. When reading this manual please refer to this appendix for terms you are uncertain about. If you come across a term which you are unfamiliar with and do not find it in this appendix, please alert Technical Support in Crystal Lake, so they may make the proper adjustments.

AIR / FUEL RATIO A Specific quantity of air per one part of fuel, by weight, such as 14.7 pounds of air to one pound of fuel. This may be written as a ratio 14.7 to 1 or 14.7:1. The smaller the quantity of air, the richer the fuel mixture. The larger the quantity of air, the leaner the mixture.

ALPHANUMERIC A set of alphabetic and numeric characters.

AMBIENT Usually referred to in gas analyzers as ambient air. This is the air surrounding the analyzer.

ANALOG SIGNAL A continuous electrical signal representing a condition (such as temperature, or the position of a mouse). Unlike a digital signal, which is discrete, an analog signal can be any frequency or amplitude.

ASCII American Standard Code for information interchange. Set of digital codes for all alpha-numeric and control codes.

BAUD A measure of the rate at which digital data is transmitted in bits per second; typically ranges up to 57,600 baud (57.6k baud).

CRT Cathode ray tube. This is the most common form of a computer display screen. It may be a television set or a video monitor, or a slightly modified version of these display devices.

CTS Acronym for Clear To Send. This is a signal sent by the peripheral to let the computer know that it is ready to receive commands.

DOT MATRIX A means by which printed characters are formed using a matrix or pattern of small dots. The pattern is fixed and defined as so many dots wide by so many dots high. Typically patterns are 5x7, 7x9, 7x12, and so on.

DRIVER A program that provides communication between a computer and an peripheral devices such as display adapters or a mouse.

EPROM Acronym for Erasable Programmable Read-Only Memory; a type of computer memory device that can be used to store data within a computer for instant access. Can be erased by ultraviolet light and reprogrammed. A nonvolatile memory that retains programmed data even when no power is applied. See also PROM an ROM.

FEATURE KEYS These are the Gray Keys located in the center of the keypad, that are used to choose items that display on the screen. These keys include ←, ↑, →, ↓, SELECT, FREEZE, and PRINT.

FIELD The number of character spaces reserved in a data file for a specific piece of data.

FIRMWARE	A computer program or software stored permanently in PROM or ROM or Semi-permanently in an EPROM.
FUNCTION KEYS	These are the yellow keys on the keypad that are used to control analyzer operations, or functions, related to specific screens. They are located on the left side of the keypad, and on the right side of the screen. These keys are referred to as F-keys and are numbered F1 through F6. These keys are variable and depend on the screen or mode in which the analyzer is operating.
HARD-WIRED	Used to describe system components that function as a result of being soldered into the system, rather than being connected through a connector.
HARDWARE	Describes all items in a computer system that are not software: circuit boards, integrated circuits, transistors, discrete components, etc.
HERTZ	A measure of frequency or bandwidth. The same as cycles per second.
I/O	Input/Output. Refers to the paths by which information enters a computer system (input), and leaves the system (output). Some traditional input device might be a keyboard although some computer systems utilize joysticks, a mouse, touch screens, or other similar devices. The usual output devices on modern computers is a video screen, or a printer.
INTERFACE	An electronic or software device used to mate a computer and its peripherals with the outside world.
KEYPAD	A calculator-style arrangement of numeric and arithmetic keys. This is the input device that allows the operator to control the analyzer.
LAMBDA	A alternate way of expressing air / fuel ratio, where 1.0 lambda is the ideal air / fuel mixture (14.7:1). Rich mixtures are written as a value less than one (0.8), lean mixtures are written as a value greater than one (1.3).
LEAN MISFIRE	A misfire that occurs when the air/fuel mixture is too lean to support combustion.
LEAN MIXTURE	An air fuel ratio that contains more than the ideal amount of air or less than the ideal amount of fuel.
LETTERHEAD	The control information prefixed in a message text, i.e. the customers name, address, phone number.
MEGABYTE	A term used to indicate millions of bytes, 1 megabyte (1Mb) = 1,048,576 bytes or 1048 kilobytes (1000k).
MEMORY	One of the main features of a computer is its ability to store and retrieve information very quickly. There are several kinds of memory. See RAM, ROM, EPROM.
MENU KEYS	Green keys, located on the right of the keyboard, used to select one of five analyzer operation categories.
MONITOR	A computer output device designed to show alphanumeric and/or graphics data. In personal computing, the monitor is usually a TV like video screen.
NO	An abbreviation for Nitric Oxide, which is an Oxide of Nitrogen.
NO_x	An abbreviation for Oxides of Nitrogen. One of which is Nitric Oxide. Nitric Oxide is measured by the MT-3505.
PARALLEL	A method of transmitting data in which the bits comprising a character are sent at the same time.
PARALLEL PORT	The port used by peripherals to communicate with the host computer in a parallel format.
PERIPHERAL	Any device that connects to and is controlled by a computer, such as a terminal,

printer, modem, etc.

PIXEL Picture element. Refers to the smallest single screen element directly addressable by a computer. The smaller the pixel size, the more pixels to a screen, and thus the finer the graphics resolution.

PORT An Interface on a computer configured as data terminal equipment and capable of attaching a modem or other peripheral for communication with a remote data terminal.

PROM Acronym for Programmable Read-Only Memory; a permanent storage device that can be programmed by the device manufacturer, supplier, or user.

RAM Acronym for Random-Access Memory. A volatile type of temporary storage device that can be written to by the user. Any data stored in RAM can be directly retrieved simply by entering its address. Data stored in RAM is irretrievably lost when power is shut down.

RESOLUTION Refers to either the number of scanning lines on a video display terminal or the number of pixels addressable on the display screen.

RESPONSE TIME The elapsed time between the generation of the last character of a message at a terminal and the receipt of the first character of the reply. It includes terminal delay and network delay.

REVERSE VIDEO A term used to indicate, in some video terminals, the ability to display black character on a white (or green) background.

RICH MIXTURE An air / fuel mixture that contains less than an ideal amount of air or more than an ideal amount of fuel.

ROM Acronym for Read-Only Memory. A permanent data storage device that, once programmed, cannot be re-programmed. The user can only read what is in the ROM; he cannot write to it. This type of memory is non-volatile. See also EPROM and PROM.

RS-232C Interface between data terminal equipment and data communications equipment employing serial binary data interchange.

RTS Acronym for Request To Send. This is a signal sent by the host computer to determine if the peripheral is ready to receive data.

RXD Acronym for the Receive data line in serial communications.

SCAN RATE The rate at which the video beam scans the line from the top to the bottom of the screen. Higher scan rates work faster to produce sharper images.

SERIAL A type of input or output utilizing an established protocol, writing, and information format so that data is submitted one bit at a time.

SERIAL PORT An Input/Output port in a computer through which data is transmitted and received one bit at a time. In most cases in personal computers, serial data is passed through an RS232C serial interface.

STOICHIOMETRIC A term describing the ideal air / fuel ratio of 14.7:1.

TXD Acronym for the Transmitt Data line in serial communications.

ZEROING The analyzer adjusts HC, CO, CO_2, O_2, and NO to a zero point from which all readings are measured. The zeroing process uses ambient air introduced into the sample cell through the zero port on the back panel of the analyzer. Zeroing may be performed automatically or manually. The analyzer retains the zeroing data last used, except in the Warm-up and Standby modes. In these modes zeroing is always performed automatically.

NOTES:

APPENDIX C

BOARD CONFIGURATION

GENERAL

The following Appendix shows the jumper settings for the MT-3505 boards.

CPU

The CPU Board has two different configurations. One configuration is for analyzers with six PROMs on the CPU Board, the other is for a CPU Board with two PROMs. In both configurations the jumpers tell the analyzer what type and size of PROMs are being used.

	CPU BOARD (with 6 PROMs)	CPU BOARD (with 2 PROMs)
JUMPER	**POSITION**	**POSITION**
W1	2 & 3 Shorted	2 & 3 Shorted
W2	2 & 3 Shorted	2 & 3 Shorted
W3	2 & 3 Shorted	2 & 3 Shorted
W4	No Jumper	2 & 3 Shorted
W5	No Jumper	2 & 3 Shorted
W6	2 & 3 Shorted	2 & 3 Shorted
W7	2 & 3 Shorted	2 & 3 Shorted
W8	2 & 3 Shorted	2 & 3 Shorted
W9	2 & 3 Shorted	2 & 3 Shorted
W10	No Jumper	No Jumper
W11	No Jumper	No Jumper
W12	2 & 3 Shorted	2 & 3 Shorted
W13	2 & 3 Shorted	2 & 3 Shorted
W14	2 & 3 Shorted	2 & 3 Shorted
W15	2 & 3 Shorted	2 & 3 Shorted
W16	No Jumper	No Jumper
W17	No Jumper	No Jumper
W18	2 & 3 Shorted	2 & 3 Shorted

INFRARED BENCH

The Infrared Bench has two boards which have jumpers that need to be configured. During normal operation these jumpers will never need to be moved. This section has been included as a means of checking the Infrared bench to determine if a jumper may have fallen off.

MAIN BOARD	
JUMPER	**POSITION**
W1	OPEN
W2	OPEN
W3	SHORTED
W4	SHORTED
W5	OPEN
W6	OPEN
W7	OPEN
W8	OPEN
W9	SHORTED
W10	OPEN

ENHANCED O2/NO BOARD	
JUMPER	**POSITION**
W1	OPEN
W2	OPEN
W3	SHORTED
W4	OPEN
W5	OPEN
W6	OPEN

APPENDIX D

MODEL DIFFERENCES

GENERAL

At the time of publication there was only one model of the MT-3505. In the future, if different models are manufactured, this appendix will explain the differences.

NOTES:

APPENDIX E

INSTALLATION INSTRUCTIONS

GENERAL

Appendix E is reserved for the filing of Installation Instructions. When a kit is successfully installed in a analyzer, the Installation Instructions should be filled in this appendix in alpha-numerical sequence.

At the bottom of every page of an Installation Instruction is the part number, the revision level, and the date the instructions were printed. For example:**0692-2329-01 (01/26/95) REV B** is at the bottom of the page. **0692-2329-01** is the number of the Installation Instructions. **REV B**, is the revision of the Installation Instructions, and **(01/26/95)** is the date they were printed. If a subsequent instruction is done, the revision level will change to a "**C**" and a new date will be applied.

Every time you receive a new Instruction, check the REV LEVEL and update this appendix as necessary.

PART #:	DESCRIPTION:	INSTALLATION INSTRUCTION #:
MT-3505	Unit Setup	0692-2329-01 REVISION B

NOTES:

APPENDIX F

SCREEN MESSAGE PROMPTS

(INCLUDING FAULT PROMPTS)

GENERAL NORMAL MESSAGES

Normal messages are those that appear under typical operating conditions. They are either informative (explain what is happening) or instructional (tell what to do next).

Informative messages can tell the operator:
- how to enter the next function.
- an action the analyzer is performing.
- an action the analyzer will take.

Instructional messages usually tell the operator what to do after the analyzer has:
- performed an action.
- failed to perform an action.
- failed a test.

A complete listing of normal messages are as follows:

AUTO ZERO IN ONE MINUTE
- Appears in Exhaust Gas Test.
- Indicates that the Analyzer is going to perform a Zeroing procedure in one minute.
- Allows the operator to intervene, if desired, by pressing **<F3>** "**AUTO ZERO OFF**".

ANALYZER WARM-UP IN PROGRESS
- Appears in Warm-up.
- Indicates that the Analyzer is Warming Up.

CALIBRATION IN PROGRESS
- Appears during Calibration.
- Indicates that the Analyzer is in Calibration Mode and that Calibration is in progress.

CALIBRATION PASSED
- Appears at the end of a successful Calibration.

CAP EXHAUST PROBE, THEN PRESS CONTINUE
- Appears during Leak Test.
- Prompts the operator to seal the end of the Exhaust Probe.

FROZEN
- Appears when **<FREEZE>** is pressed.

HOSE/PROBE PURGE IN PROGRESS- PRESS F1 TO RESUME TEST
- Appears when Exhaust Gas Test is manually or automatically switched off.
- Indicates the Gas Sampling System is being automatically purged before the Analyzer goes into Standby.

LEAK TEST IN PROGRESS

- Appears during Leak Test.
- Indicates that a Leak Test has been initiated and is currently running.

LEAK TEST PASSED

- Appears when the Analyzer successfully passes a Leak Test.

MEMORY A

- Indicates the screen is being saved to Memory A.
- Indicates the memory column that the screen information was recalled from.

MEMORY B

- Indicates the screen is being saved to Memory B.
- Indicates the memory column that the screen information was recalled from.

NO GRAPHS SELECTED

- Appears in the Gas Analyzer Screen or split screen when no graphs are selected.
- Gas Analyzer screen message appears: "**PRESS F6, GRAPH SETUP**", then follow the on-screen instructions.
- Scanner Split screen messages appears: "**PRESS THE GREEN GAS ANALYZER KEY**"

ONLY 4 GRAPHS CAN BE SELECTED

- Appears in Graph Setup screen when more than 4 graphs are selected.

ONLY FROZEN SCREENS CAN BE SAVED IN MEMORY

- Appears when trying to save a screen that has not been frozen.

PRESS F1 TO TEST EXHAUST GAS

- Appears on the Exhaust Gas Test Screen.
- Indicates that the Analyzer is ready to test exhaust gas.

PRESS CONTINUE WHEN READY

- Prompts the operator to continue.

PRESSURIZE TO 10 PSI MAXIMUM

- Appears in Calibration.
- Promotes the operator to set the calibration gas pressure.

PRINT ABORTED

- Appears when the print is canceled.

PRINTER ERROR-PRESS HELP, THEN F3 MESSAGE HELP MENU

- Appears when the data will not print.

SCANNER NOT DETECTED

- Appears when Scanner screen is in use.
- Message Appears:
    - Check Comm. cable connections.
    - Check Analyzer Comm. Setup.
    - Check Scanner Communication Setup.
    - Check Scanner Power.

ZERO REQUIRED

- Indicates the Analyzer requires Zeroing.

ZERO IN PROGRESS

- Appears during Manual and Auto Zero.
- Indicates that Zeroing is in progress.

GENERAL FAULT MESSAGES

Fault messages inform the operator of a failure. A complete listing of possible Analyzer Fault Messages follows:

ANALYZER SUBSYSTEM FAULT-PRESS HELP, THEN F3 MESSAGE HELP MENU

- Indicates that the Analyzer has an Internal Malfunction.
- Appears whenever an Internal Malfunction occurs in the Analyzer.

ANGLE TOO STEEP. LEVEL ANALYZER. PRESS SELECT.

- Indicates the front of the Analyzer has been tilted too high (30) in relation to the back of the Analyzer.

CAL FAILED

- Appears at the end of an unsuccessful Gas Calibration.
- Message appears:
  - "Cal Gas Tag Values out of range. Change Analyzer tag values to match calibration gas concentrations."

CALIBRATION FAILURE. DEFAULT CAL VALUES NOW IN USE.

- Indicates the Analyzer has failed Calibration and the tag values in use are those from the factory.
- Message appears:
  - Press F3 Cal Reset.
  - Default Cal Values Now In Use.

FLOW RATE FAULT- PRESS HELP, THEN F3 MESSAGE HELP MENU

- Indicates that the Analyzer detects a Low Flow Condition.

NOTE: ***This message could also appear when the Sample Probe and Hose are not connected to the Analyzer and a Low Flow condition exists in the Filters or internal components.***

INVALID TIME OR DATE

- Appears on the Analyzer Setup Screen.
- Appears when an invalid time or date is entered.

LEAK TEST ABORTED

- Indicates that there is a leak in the Sampling System.
- Message Appears: "Check:
  - Probe Cap and verify it is tight.
  - Filter Bowls and Sample Hose inlet for leaks.
  - Sample Probe/Hose for damage or deterioration that could be a source of leaks.

LEAK TEST FAILED

- Appears after a failed Leak Test.
- Message Appears: "Check:
  - Probe Cap and verify it is tight.
  - Filter Bowls and Sample Hose inlet for leaks.
  - The Analyzer Pump for operation at the start of the Leak Test.

TAG VALUES OUT OF RANGE

- Appears in Calibration.
- Indicates that the value entered for the Tag Value on the Calibration Gas is invalid or unusable.

ZERO FAILURE - PRESS HELP, THEN F3 MESSAGE HELP MENU

- Appears in Zero.
- Indicates that Zeroing Failed.