ProHelp tm

Production Monitoring System

Installation Instructions
and Wiring Diagrams

MANUAL # 710-0001

Revision - E

28 NOV 88

MATTEC Corporation

ATTENTION

The information contained within this manual is critical to the proper installation of the MATTEC ProHelp System. Please review this manual completely **BEFORE** starting your installation. Resolve any questions immediately with the MATTEC Customer Service Department.

Phone (513) 683 - 1802

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1 OVERVIEW

1.1 GENERAL

Your company just purchased a plant wide production monitoring system to monitor the cycle time performance and process performance of various machines within your plant.

You, as the maintenance manager, have responsibility for the installation of this system. This system has been purchased from Mattec Corporation of Cincinnati, Ohio.

Mattec Corporation will supply all the advice you need to make this installation as simple as possible. Mattec would also like to assure that you don't get stuck with a project without knowing anything about it. BE SURE TO READ THIS ENTIRE OVERVIEW AND THE REST OF THIS INSTALLATION MANUAL BEFORE YOU ATTEMPT TO DO ANYTHING. The fifteen minutes required to scan this manual will give you a good understanding of the responsibilities that you are expected to uphold for this installation. It will also help you realize how simple an installation task you are about to experience.

1.2 WHAT THE BOSS PURCHASED

Your boss has purchased a very simple Compaq or compatible computer system which has software programs that physically monitor selected machines in your plant. The machines are monitored to assure that they are running within the proper cycle times that the sales department quoted your jobs.

If the cycle times of the machines deviate from allowable standard, alarm displays are shown on the CRT's that are hooked into the computers.

Your boss may also want to monitor the physical temperatures and pressures on certain machines. This computer system has the ability to do that. Physical thermocouples and load cells are interfaced into black boxes that are mounted at each press. These black boxes then communicate back to the computer system via overhead cables. If the temperatures or pressures deviate from allowable standards, alarm displays are shown at the computer.

The computer system is a Compaq Deskpro 386 personal computer or compatible. If the boss needed more speed for his system he purchased the model 386-20. Regardless, the installation effort is the same.

The boss may also have purchased additional color CRT's that can be mounted throughout the plant so that other people such as the foreman, the quality control engineers, and the maintenance department can see what's going on in the plant at any given time. These remote CRT's are interfaced into the central computer system via a simple cabling that is run overhead. Your purchase order will identify whether these additional CRT's were bought.

Believe it or not, this computer system has enough software intelligence to monitor up to ninety-six machines continuously throughout the day. The Mattec engineers were pretty ingenuous in this effort such that a low cost computer can do all of the physical monitoring, cycle by cycle, of every machine every second of the day. In order to accommodate such a high number of machines, the Mattec engineers developed little microprocessor based "black boxes" that actually mount on every machine that will be interfaced into the computer system. These little black boxes are approximately six inches by nine inches by six inches. The engineers call these black boxes machine interface units, or for simplicity just plain old MIU.

1.3 HOW DO I INSTALL IT

Every machine in the plant needs to have an MIU attached to it if that machine is going to be tied into the central computer. The MIU is very simple. Mattec will supply you with an angle bracket and bolts so that the MIU can be mounted at any convenient location on the machine and near the operator. Typically, the MIUs are mounted on the electrical panel of the machine or at the front operator station. Basic wiring between the machine and the MIU is 115 VAC power and the cycle start signal. Both the power and the cycle start signal are brought from the machine's electrical panel onto the terminal strips located within the MIU.

Now, you and I both know what a forklift driver can do to an unprotected cable. That's right! You've had the same experiences. So, when you wire the AC power and the cycle start signal from the electrical panel to the MIU, you should put the cable in conduit. The length of the conduit is determined by where you physically locate the MIU on the machine.

By this time, you have asked yourself how do these crazy little MIU black boxes hook up to the computer. Well, the answer is still very simple. You run one standardized cable that is about a quarter inch diameter from the computer room to the very first machine. Then you loop this cable, we call it a daisy chain, to twelve machines in a row. If you have more than twelve machines, then you run a separate cable from the computer out to the next group of twelve machines, and loop it from one to the next. The inner connections between the individual machine loops are made on terminal strips within the MIU black box.

In most applications, this overhead cable does not need to be run in conduit. You can just string it or tie wrap it to your various support beams in the plant. But you must take caution as to how you run this overhead cable. Computer systems don't like electrical interference from 440 volt machine power lines, or RF interference from heater ovens and sonic welders. There are a couple of other no-no's that are explained in detail later on in this manual.

One basic assumption that you and the boss need to decide is, where you are going to put the computer. The computer 11 device that requires no more is a small device that requires no more than a 2 ft.x 5 ft. area of desk top. With the computer comes a small printer that the daily production reports will be printed on. This printer can also sit on top of the desk. So, your first step is to decide where the computer is going to be physically located, and then you can determine how much overhead cable you need to purchase in order to install that cable between the computer room and your machines.

You, the maintenance manager, are responsible for purchasing this overhead cable. It's a standard Belden cable that can be purchased at almost any electrical supply house in town. The cost of this cable is approximately $500 per thousand feet. It contains three twisted pairs of shielded wire. The specification number of this cable is detailed in another section of this manual.

So far, you have learned that:

- the boss has purchased a computer system that has a CRT and a printer.
- the boss has purchased some microprocessor black boxes that mount to each machine in your plant.
- that you are responsible for mounting the black boxes at the boxes at the machine.
- that you are responsible for running and connecting the overhead cables from the computer's location to each black box in a daisy chain fashion.
- that you are also responsible for wiring the black box to the AC power source and the cycle start signal of each machine.

There is only one last thing that you need to know about the installation, and that is where the remote CRT units will be placed. Check your order. If your boss bought additional CRT units, you need to know who's going to be using them. Once you determine the location, you then have the responsibility of running an overhead cable line between each CRT directly to the computer. The physical cable is the same type you ran between the computer and the individual machines. For technical details, just read the following sections.

2 GRAPHIC OVERVIEW

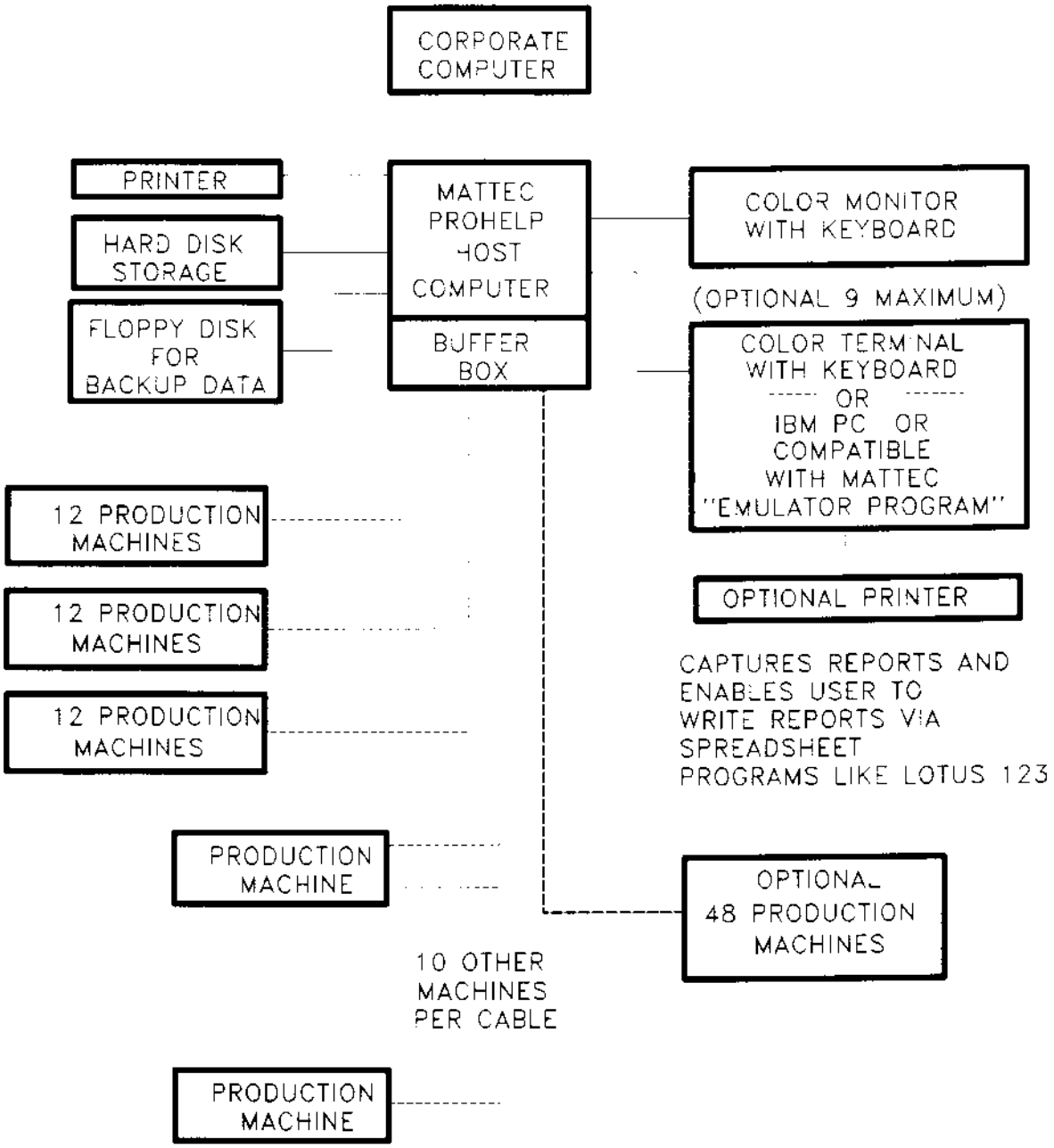


Figure 2 - GRAPHIC OVERVIEW

3 MACHINE INTERFACE UNITS

3.1 GENERAL DEFINITION

The machine interface units come in several different types. These types are explained below for your review. Each MIU has a model number that defines what type it is. The individual wiring for MIU Level 1, Level 2, and Level 3 is the same. The wiring between the molding machine and the MIU is identical. The wiring between the computer and the MIU is identical.

The wiring for MIU Level 0, the 4 in 1 box, is different from the other three. This MIU handles cycle start signals from four machines at a time. A separate page within this manual shows you how to wire the MIU Level 0.

3.2 MIU LEVEL 0

This machine interface unit handles cycle counts and downtime from four machines at a time. The cycle count signal is brought back from each of the four machines into this black box. One source of AC power is needed for this box. All downtime is recorded into the unknown category. There is no downtime selector switch with this MIU. Typically, this MIU is used to monitor auxiliary operations or high speed operations which have no operator intervention.

3.3 MIU LEVEL 1

This MIU counts cycle times and downtime for one machine. There is a ten position machine status switch and a ten position HELP call switch. Alarm lights (LED)s are provided to signal the operator when the machine is running outside the standard conditions. This MIU requires AC power and the cycle start signal to be brought from the machine into this box.

3.4 MIU LEVEL 2

This MIU does everything that MIU Level 1 does, plus it has the capability for the operator to manually enter scrapped part quantities and reasons. Operators may also log-in and log-out at the machine in order to have their performance tracked. A keypad is provided in which code numbers are entered via the operator and sent to the computer. The computer then displays the appropriate data on a sixteen character alpha numeric display. The AC power and the cycle start signals are brought from the machine into this box.

3.5 MIU LEVEL 3

This MIU provides all the capabilities of Level 2, plus it has the capability of monitoring six physical temperatures or pressures. An actual thermocouple on the

machine or a pressure load cell on the machine is monitored. The leads from the sensors are brought back into the MIU. The MIU converts the analog signal of the sensors into a digital value, compares the digital value to the job specification values, and then determines whether the machine is operating within conditions. Typically, mold temperature, hydraulic oil temperature, injection pressure, and hold pressure are monitored. The AC power and the cycle start signals are brought from the machine into this box.

Sensors must be purchased separately for use with this MIU. Any combination of thermocouple or pressure transducers may be used. Different machines may have a different combination of sensors. Some machines may have sensors mounted on them and other machines may not. It is allowable to mix and match the different types of MIUs within the same system.

See the MIU Subsystems Manual, Mattec P/N #710-0003, Revision B or greater, for additional information on analog sensors, installation, and calibration.

4 MIU WIRING CONFIGURATION

Before any overhead cable is dropped to the machines within the daisy chain loop, please determine the order in which you want the machines to be displayed on the "real-time" screen at the CRT's.

You will have to determine the order of display, then divide the list from top to bottom into channels that contain 12 or less machines. If you have 48 machines or less in the system, then you are free to assign up to 4 channels. If you have more than 48 machines, then you are free to assign up to 8 channels. Channel 1 will display the first 12 MIUs, while channel 2 will display the next 12 MIUs, etc.

Each channel does not have to be fully populated with 12 MIUs before going to the next channel. Any amount from 1 to 12 may be on any channel. The MIUs on each channel are individually addressable, so the order in which the daisy chain is connected in a specific channel is not critical.

For example, on channel 1, the cable could run from the computer to machine #1, to machine #3, to machine #2, to machine #4, etc. With the proper MIU addressing, they could be displayed as #1,#2,#3,#4, etc. You can re-arrange the display order of MIUs within a channel, but you cannot re-arrange the channel order. See figure 9.4 for an example.

So be sure to determine the order in which you want the machines to be displayed on the real-time screen before you drop the overhead cable wires to the MIUs.

The cable that is run between the computer and the individual MIUs is either Belden #8777 (or equivalent) or Belden #9730 (or equivalent). See figure 9.4 for the definition of which cable to use. This is a three twisted pair shielded cable that is commonly purchased from any good electrical supply house in town.

Complete conduit coverage is required in high EMI or RF noise environments.

5 CRT TERMINAL WIRING

The additional color CRT terminals or remote PC emulators that are interfaced into the Mattec computer are done so by the same Belden cable that you use for machine interface units.

Each CRT must have one cable run between the computer and the CRT.

The Mattec service engineer will physically connect the cables to the computer and CRT terminals. All you have to do is drop the cable to the appropriate location.

All systems require that short haul modems be installed at both ends of this line. They are supplied with the CRT terminal purchase, but must be purchased in pairs with each remote PC emulator connection. Note that each short haul modem requires a 115 VAC outlet to be plugged into for power.

If you intend to do the connection wiring, please see the installation instructions for details.

6 CYCLE START SIGNAL

The cycle start signal, or the equivalent to this signal, is brought from the machine being monitored into the MIU at terminal T2 location I0. This signal must be of certain duration and of certain composition.

The signal must indicate that an actual part is being produced and is usually comprised of 2 or more logical conditions. A commonly used set of conditions is Single/Auto mode operation and injection start. With this signal, the cycles that occur during purging and setup (while in manual mode) do not register. (See the attached wiring diagram for definition of cycle start signal.) Mattec provides "arc suppressors" which you will mount across the signal lines in order to filter electrical spikes.

AC Power (115 VAC, 1/2 AMP) must be brought from each machine's electrical panel into the MIU. Some filtering of noise from the AC line occurs in the MIU circuitry. Most machines can provide a relatively clean AC power source for the MIU. If you have a bad grounding or noise situation on the machine, that must be fixed before proper operation can be achieved.

7 OUTPUT SIGNAL ALARMS

Each machine interface unit has the capability of exciting solid state modules which will drive output alarms. Such a driver can be wired to a bell or a light at the machine in order to signal the foreman or operator that something has gone wrong.

These output alarm contacts are optionally priced and may not be included in your order. Please check your purchase order to determine this.

The attached pages show you how to wire the output alarms for either an AC contact output or a DC contact output.

You must provide the alarm light, bell, or whatever that these output drivers are going to excite. The output load rating is specified in the installation instructions.

8 ANALOG SENSOR WIRING

Individual sensors from the machine such as temperature thermocouples and pressure load cells can be monitored by an MIU Level 3. The physical wiring diagrams on how to install these sensors at the MIU are contained in the MIU Subsystems Manual, Mattec P/N #710-0003, Revision B or greater. The actual MIU timing diagram as to when the sensor is physically read is shown in Figure 9.9 .

See the MIU Subsystems Manual, Mattec P/N #710-0003, Revision B or greater, for additional information on analog sensors, installation, and calibration.

8.1 OTHER MIU OPTIONS

The other options that are available on the MIUs are covered in the MIU Subsystems Manual, Mattec P/N #710-0003, Revision B or greater. For additional information on analog sensors, installation, calibration, auxiliary digital inputs, operator warning lights, serial inputs, and "Help Call" light boxes see the above manual.

9 INSTALLATION INSTRUCTIONS STEPS

9.1 STEP 1- LOCATIONS

Determine the mounting locations for all MIU stations. Each station must be located in an area as vibration free as possible and within easy reach of the machine operator. If possible, and if machine vibration permits, mount the MIU on the on the operator station or on the electronic panel.

Caution: Do not mount the MIU on or around plastics machinery platens.

9.2 STEP 2- DISTANCES

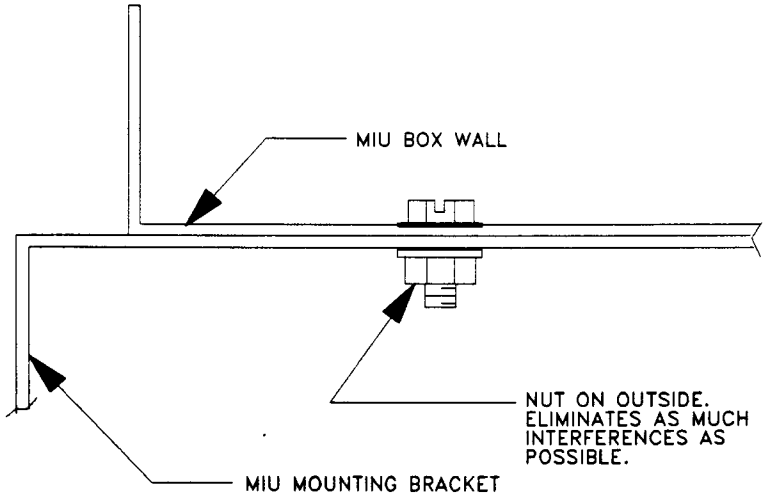
Determine the distance that the communications cable needs to run from the computer to the first machine. Determine the distance that the cable needs to run in the loop to loop daisy chain fashion from the first machine to the last machine in that channel run.

Important: You do not need to fill all twelve daisy chain positions in each cable run. You may leave room for growth.

Now, determine how many cable runs you need for the machines. Determine the length of cable runs needed for the extra CRT's. Go buy the cable now and get it strung overhead as soon as possible.

9.3 STEP 3- MOUNTING

If the operator is to enter scrap part data via the MIU, it is recommended that it be within easy reach of the operator. Mount the MIU stations using the pre-drilled MIU mount bracket and the 1/4-20 bolts, lock washers, and nuts provided. Any configuration is acceptable with the exception that the bolts should pass outwardly through the box as shown below, and should be securely tightened. Use all the mounting holes necessary to insure a rigid mount.



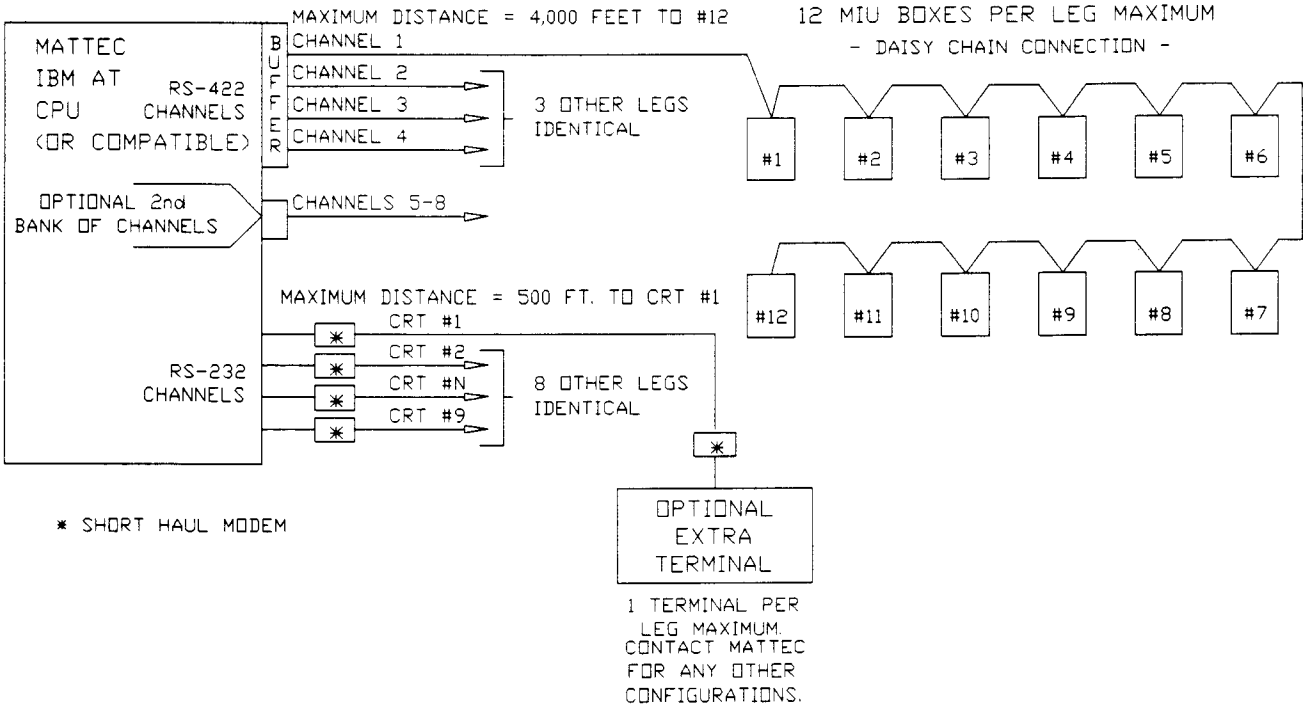
- o Place nut and lockwasher on outside of shell.
- o Eliminate as much internal interference as possible.

Figure 9.3 - MIU MOUNTING

9.4 STEP 4- WIRING PATH

Determine the path of wiring for each of the daisy chained MIU communications channels in your system. Up to 12 MIUs can be linked to the system on one channel. Up to 4 channels can be installed in a 48 MIU or less system. Eight channels can be installed in an optionally priced 96 MIU system.

Figure 9.4 shows an overview of the overhead cable wiring in a daisy chain loop from machine to machine.



MIU CABLE FOR RS-422 CHANNELS

- o Use Belden #8777 for distances up to 2,000 ft.
- o Use Belden #9730 for distances up to 4,000 ft.
- o Using 1/2" liquid-tit conduit for two #8777 cables is a tight fit. For ease in pulling, 3/4" conduit should be used.
- o For two #9730 cables, 3/4" conduit must be used.

SERIAL CABLE FOR RS-232 CHANNELS

- o Use Belden #8777 for distances up to 500 ft.

Figure 9.4 - OVERVIEW OF CABLE WIRING

9.5 STEP 5- SIGNAL CABLE WIRING.

Install the overhead cable to each MIU and any conduit that is to be used. Conduit is not required in most cases; however, its use is recommended. When used, a minimum of 2 Belden 8777 or 9730 cables. Note: Power and communications must be in a separate conduit or duct.

Conduit is necessary for protecting all cable located within 10 feet of height off the floor. Complete conduit coverage is required in high EMI or RFI noise environments.

Figure 9.5.1 shows a close up of the overhead cable wiring between MIUs.

Connect the signal conduit to the right side of the MIU shell when possible. Route the signal cables along the bottom of the shell and over to T4 and T5, and connect. Keep excess wire inside the shell to a minimum.

Figure 9.5.2 shows the detailed MIU terminal block wiring assignments for the daisy chain hookup.

9.5.1 CABLE WIRING BETWEEN MIUs

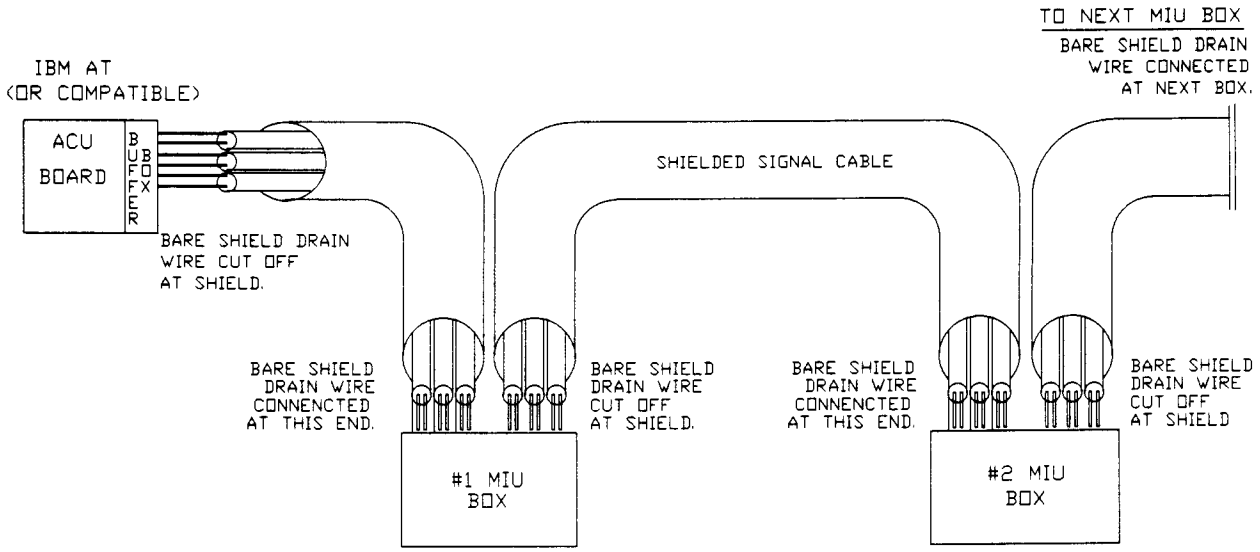
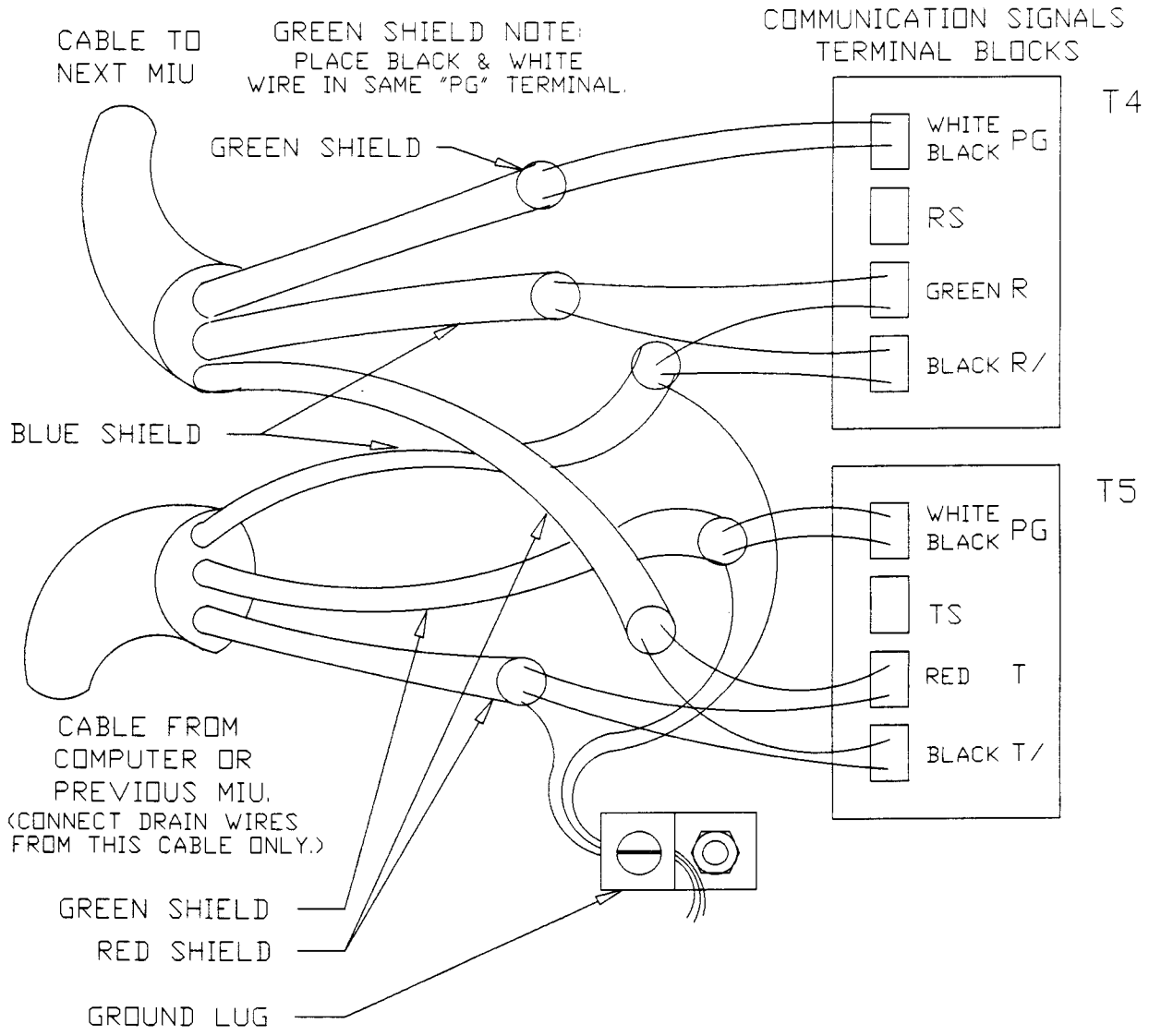


Figure 9.5.1 - CABLE WIRING BETWEEN MIUs

9.5.2 MIU WIRING ASSIGNMENTS



- o Keep protective gray vinyl jacket stripped back to a minimum from terminal blocks.
- o Keep foil shield stripped back to a maximum of 2.0 inches.
- o Tape foil shield ends to keep them from unravelling (per shield).
- o Do not connect the bare wire from the shields of cable going to next MIU. Tape the cut wires and stripped foil to keep them from shorting to other cable.
- o This type of connection is called a "Daisy Chain".

Figure 9.5.2 - MIU WIRING ASSIGNMENTS

9.6 STEP 6- POWER AND CYCLE SIGNAL WIRING

Determine the path on the machine of wiring for the 115 VAC power source and the machine cycle signals for each MIU. 115 VAC must be supplied to each MIU from an electrically clean and reliable source and provide a minimum of 1/2 amp of power.

Install the power and cycle signal conduit to the left hand side of the MIU shell when possible. Pull the wires to the shell. Route the power and cycle signal wires over the top edge of the terminal board and connect them to T1, T2, and T3 terminal blocks. Keep excess wire inside the shell to a minimum.

Figure 9.6.1 shows the hookup of the machine signals and AC power to the MIU terminal block.

Figure 9.6.2 shows the wiring of AC "cycle start" signals to the MIU.

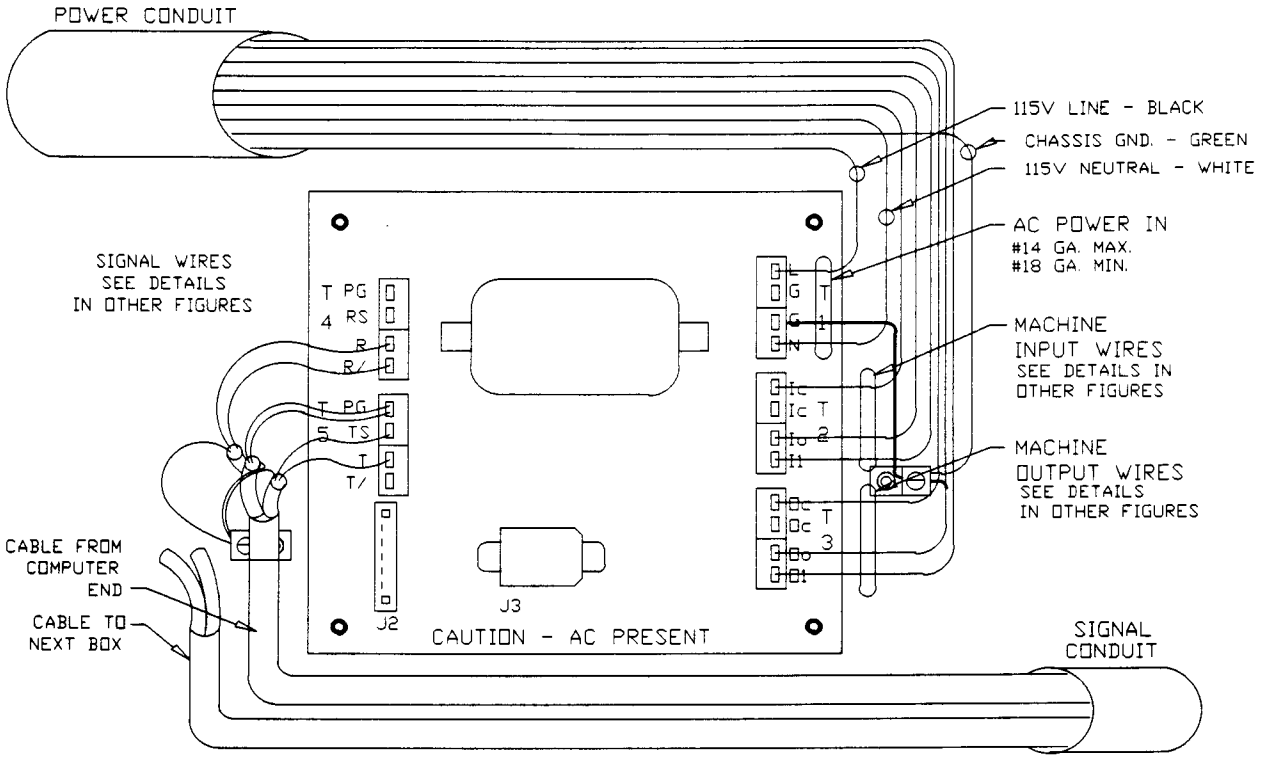
Figure 9.6.3 shows the timing diagram of the cycle start signal.

Figure 9.6.4 shows the wiring of DC "cycle start" signals to the MIU.

Figure 9.6.5 shows the wiring of AC output alarm contacts from the MIU to external alarms.

Figure 9.6.6 shows the wiring of DC output alarm contacts from the MIU to external alarms.

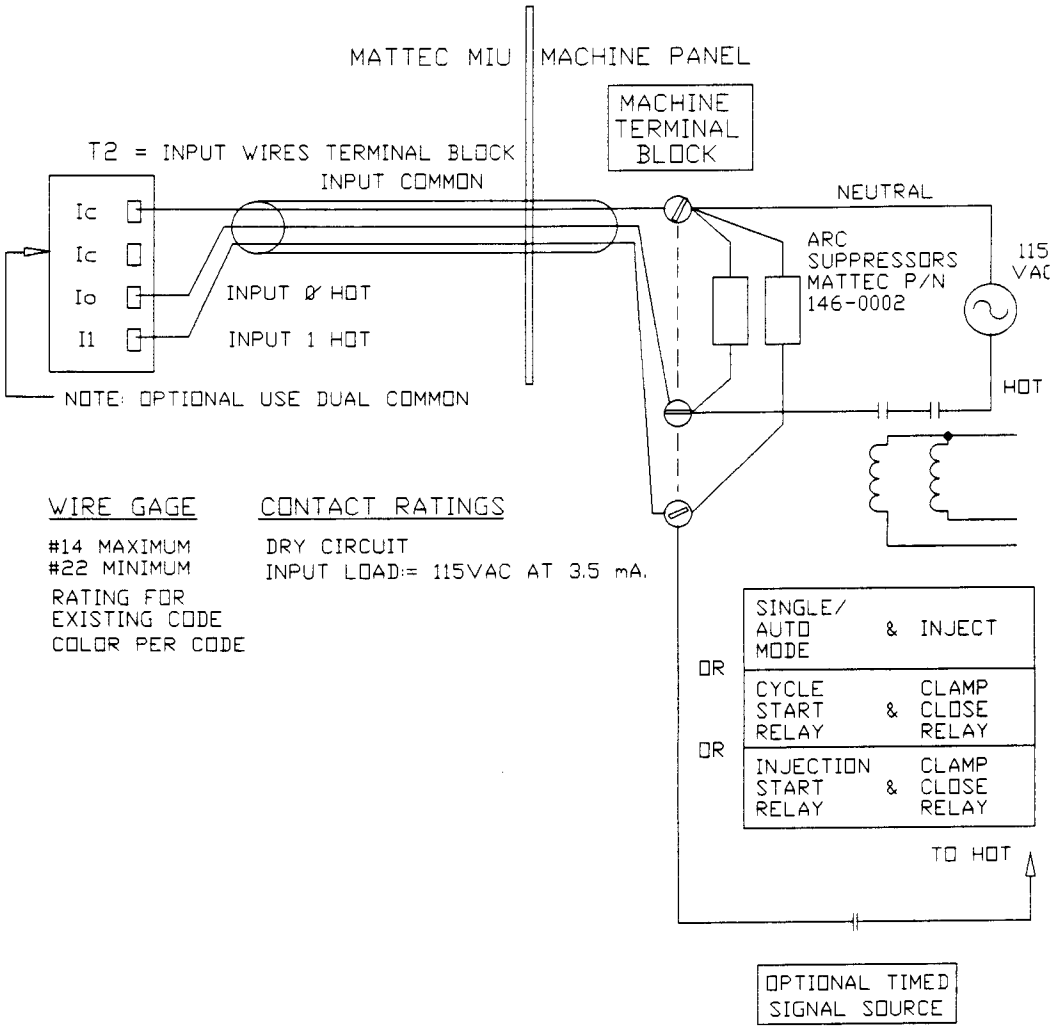
9.6.1 WIRING OF OVERHEAD CABLE



- **Knock-outs on the MIU shell are designed for 3/4" liquid-tite conduit fittings. (i.e.- 1-1/16" openings)**
- **Run computer signal cable in a separate liquid-tite conduit.**

Figure 9.6.1 - WIRING OF OVERHEAD CABLE

9.6.2 WIRING OF AC CYCLE



- o **Machine signal combinations brought into "Input 0 hot" should represent valid parts made per cycle.**
- o **A signal brought into "Input 1 hot" represents an optional timed signal.**

Figure 9.6.2 - WIRING OF AC CYCLE

9.6.3 MACHINE'S CYCLE START SIGNAL

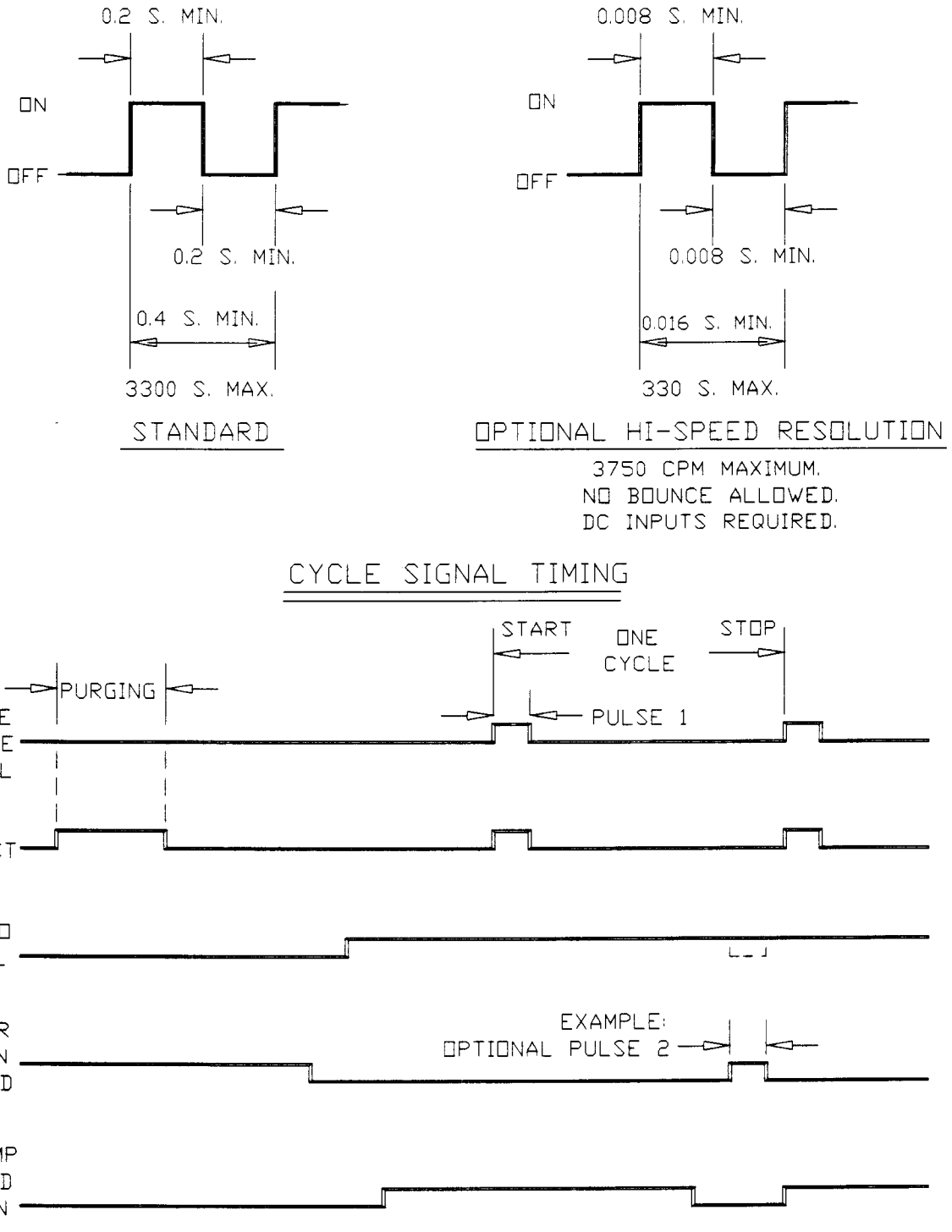
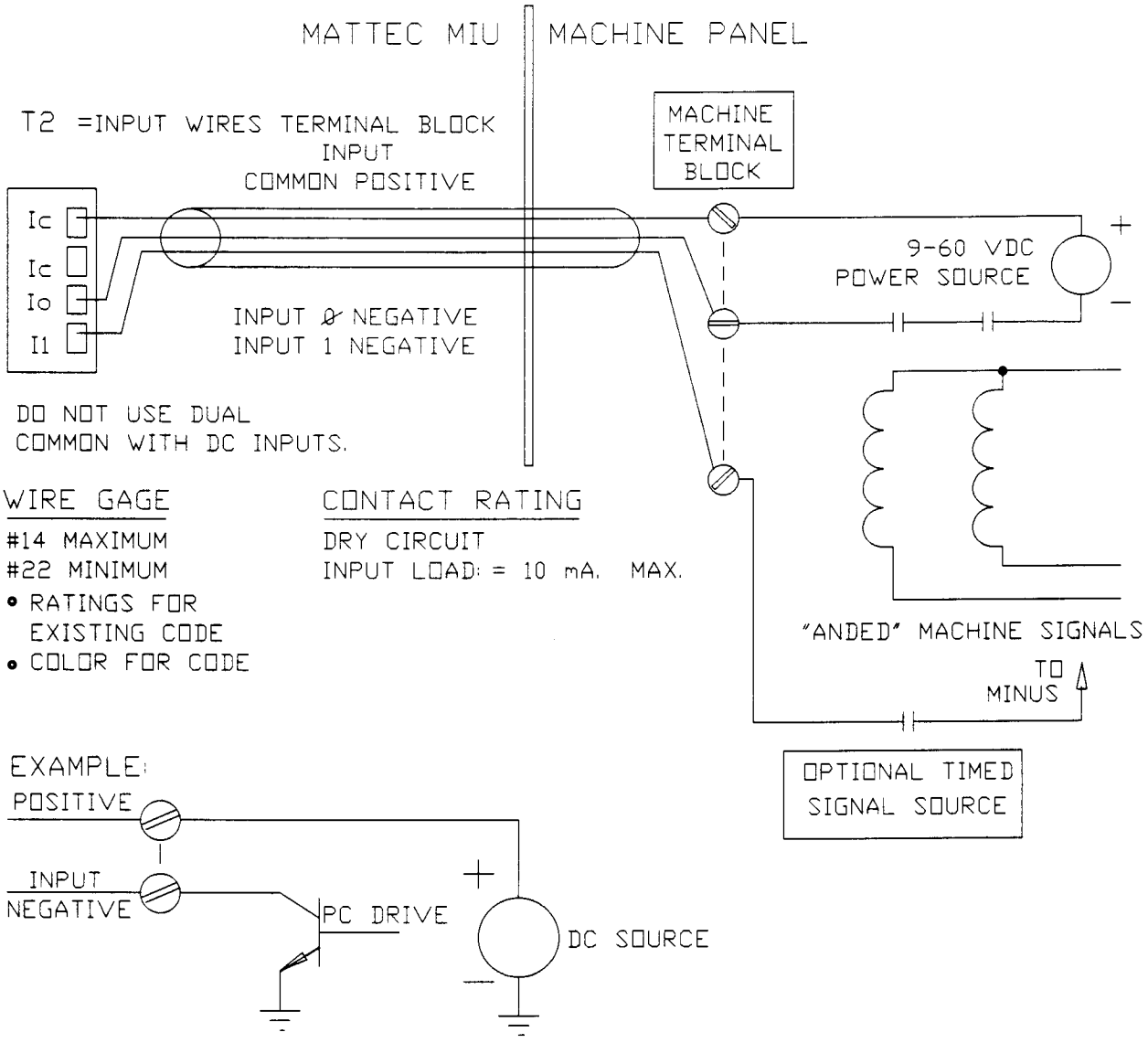


Figure 9.6.3 - MACHINE'S CYCLE START SIGNAL

9.6.4 OPTIONAL WIRING OF DC CYCLE



- o **Machine signal combinations are "ANDED" and brought into "Input 0 negative". This should represent valid parts made per cycle.**
- o **Signal brought into "Input 1 negative" represents an optional timed signal.**
- o **If a signal on either input is derived from a programmable controller, an open collector driver output can be used. (As shown above.)**

Figure 9.6.4 - OPTIONAL WIRING OF DC CYCLE

9.6.5 OPTIONAL WIRING AC OUTPUT ALARMS

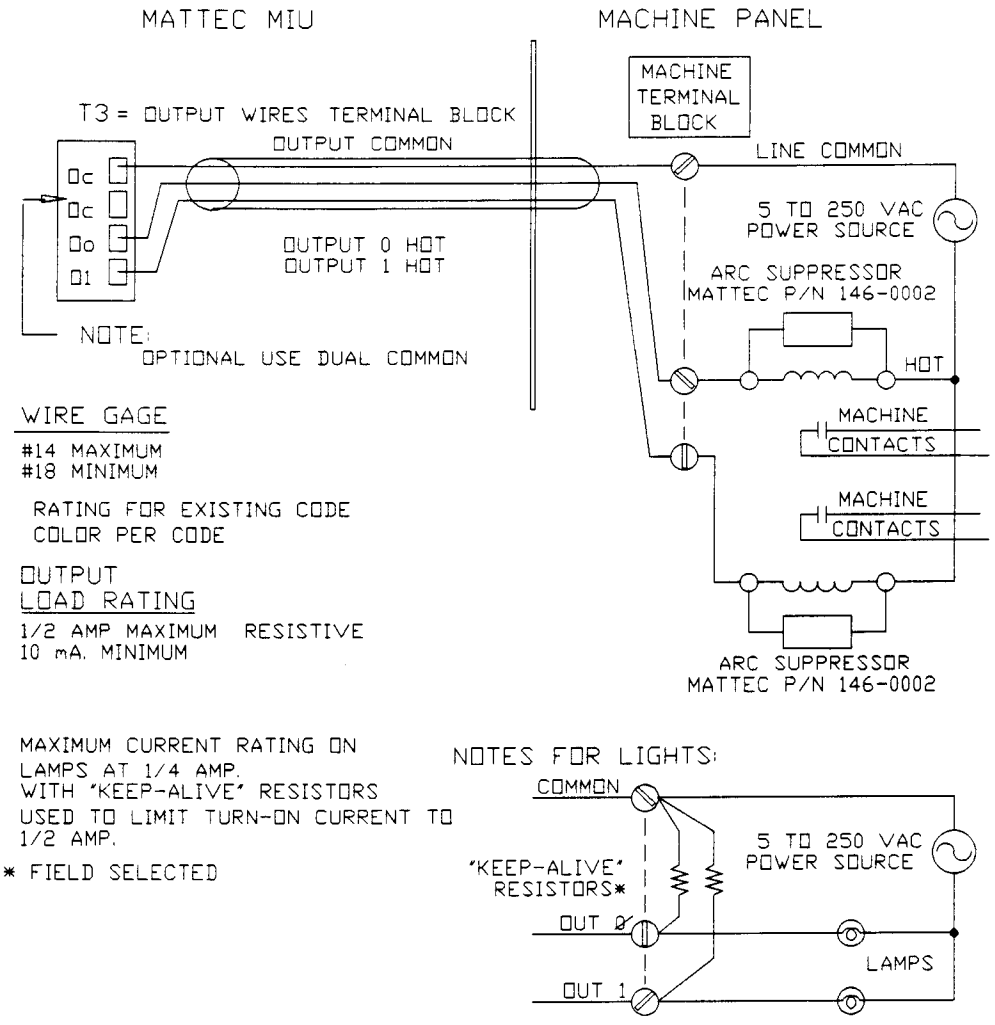
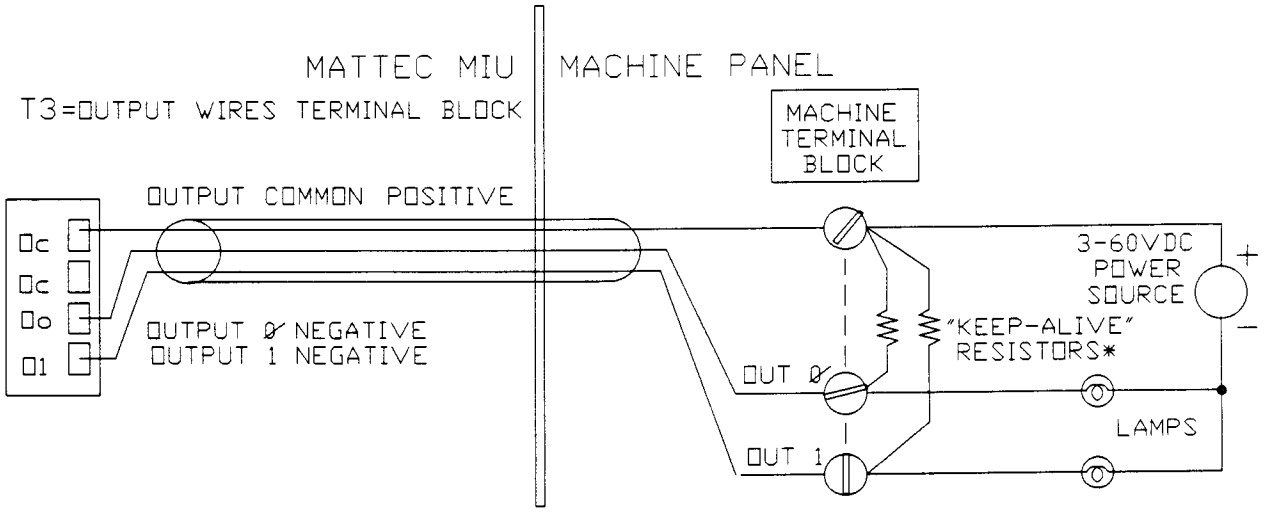


Figure 9.6.5 - OPTIONAL WIRING AC OUTPUT ALARMS

9.6.6 OPTIONAL WIRING DC OUTPUT ALARMS



WIRE GAGE

#14 MAXIMUM
#22 MINIMUM

RATINGS FOR EXISTING CODE

COLOR PER CODE

OUTPUT LOAD RATING

1/2 AMP MAXIMUM RESISTIVE

MAXIMUM CURRENT RATING ON LAMPS AT 1/4 AMP, WITH "KEEP-ALIVE" RESISTORS USED TO LIMIT TURN-ON CURRENT TO 1/2 AMP.

FOR RELAY EXAMPLES, SEE AC OUTPUTS.

Figure 9.6.6 - OPTIONAL WIRING DC OUTPUT ALARMS

9.7 STEP 7- MIU LEVEL 0 WIRING

Machines that use Level 0 MIUs need a cycle start signal to be run from each machine to the MIU. Only one machine of the four needs to provide AC power to the MIU.

Note that the order of the cycle signal wiring to the MIU has an effect on the order that the machine is displayed on the CRT.

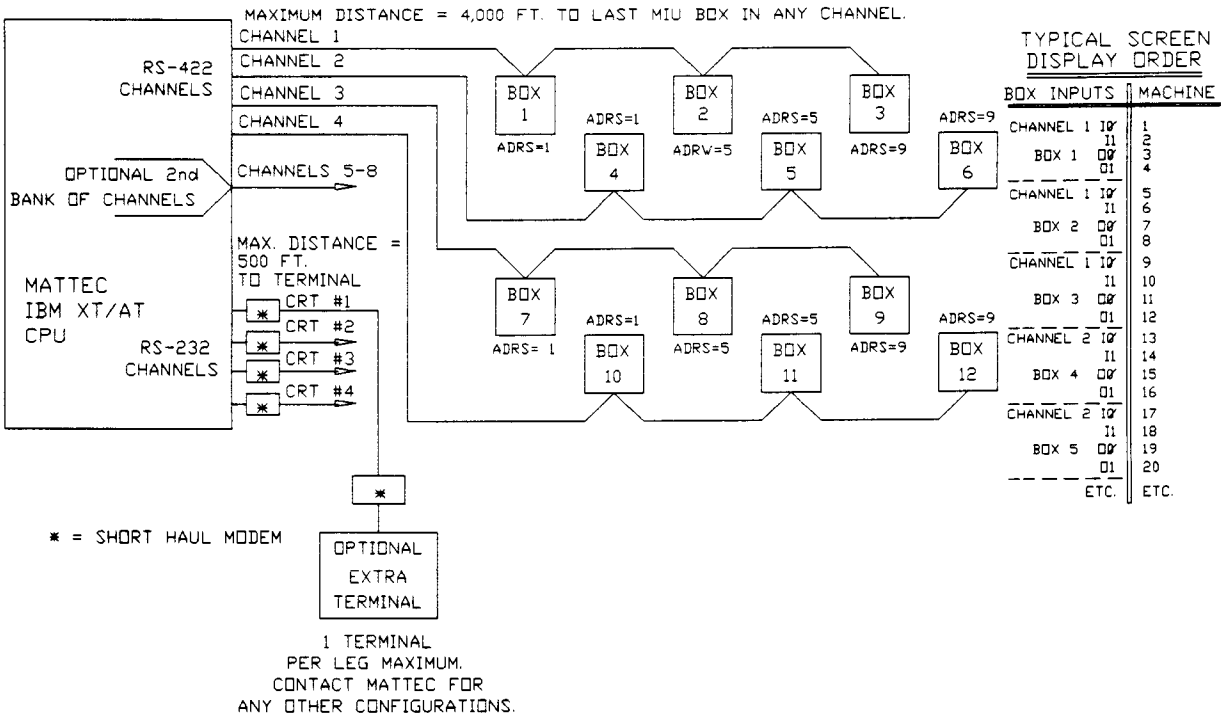
Also note the a Level 0 MIU uses 4 of the 12 available slots on the daisy chain loop from the computer.

Figure 9.7.1 shows the order that the machines will be displayed on the CRT's when using Level 0 MIUs.

Figure 9.7.2 shows the wiring for interfacing 4 cycle start signals to Level 0 MIUs when multiple 115 VAC sources are used to provide the signals.

Figure 9.7.3 shows how to provide AC power and cycle start signals to a Level 0 MIUs when a single 115 VAC source is used to provide the signals.

9.7.1 ORDER OF MACHINE DISPLAY ON THE CRT'S



- All the notes and cable information in Figure 9.4 apply to this section also.

Figure 9.7.1 - ORDER OF MACHINE DISPLAY

9.7.2 CYCLE SIGNAL POWER FROM EACH MACHINE

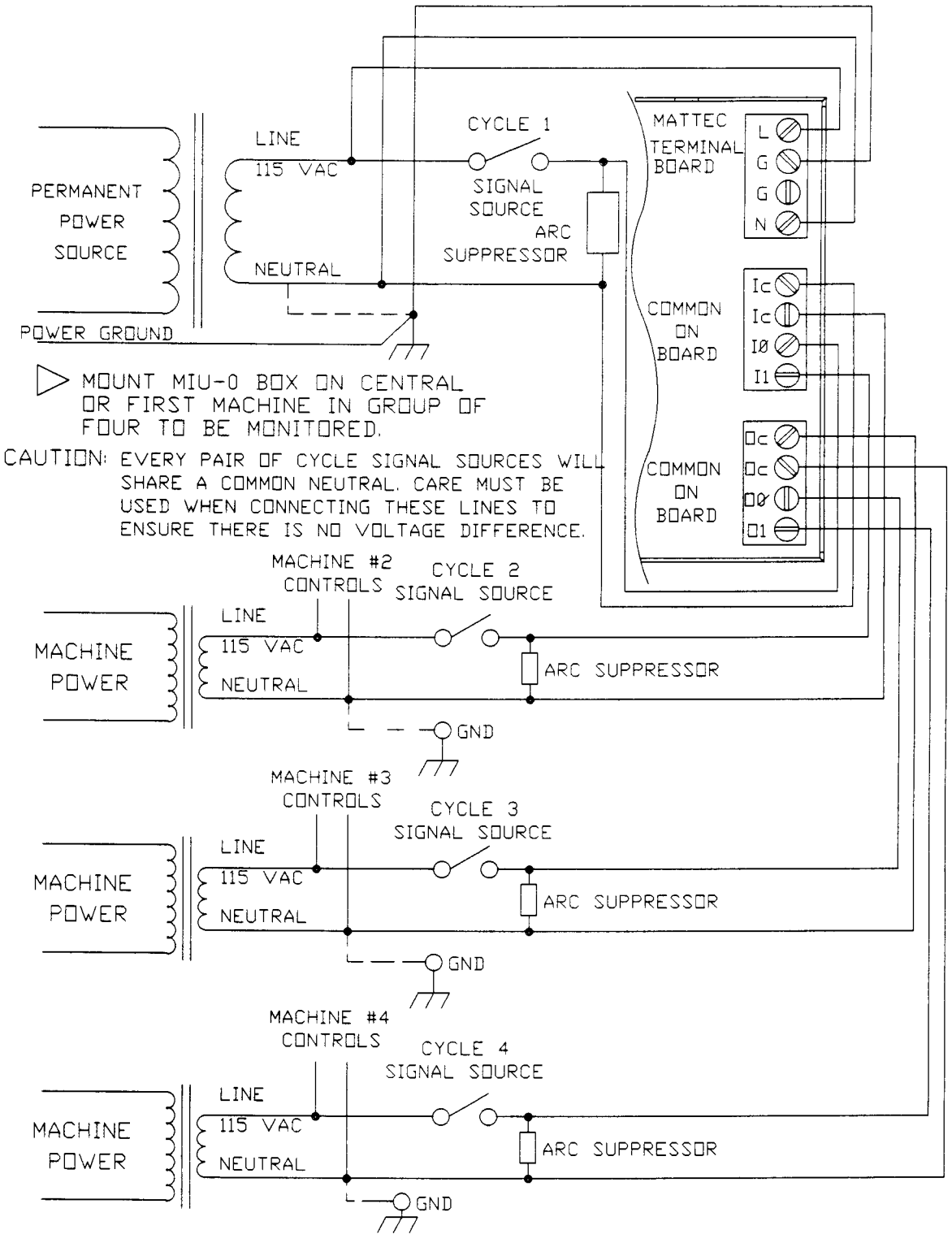


Figure 9.7.2 - CYCLE SIGNAL FROM EACH MACHINE

9.7.3 CENTRAL SOURCE OF POWER

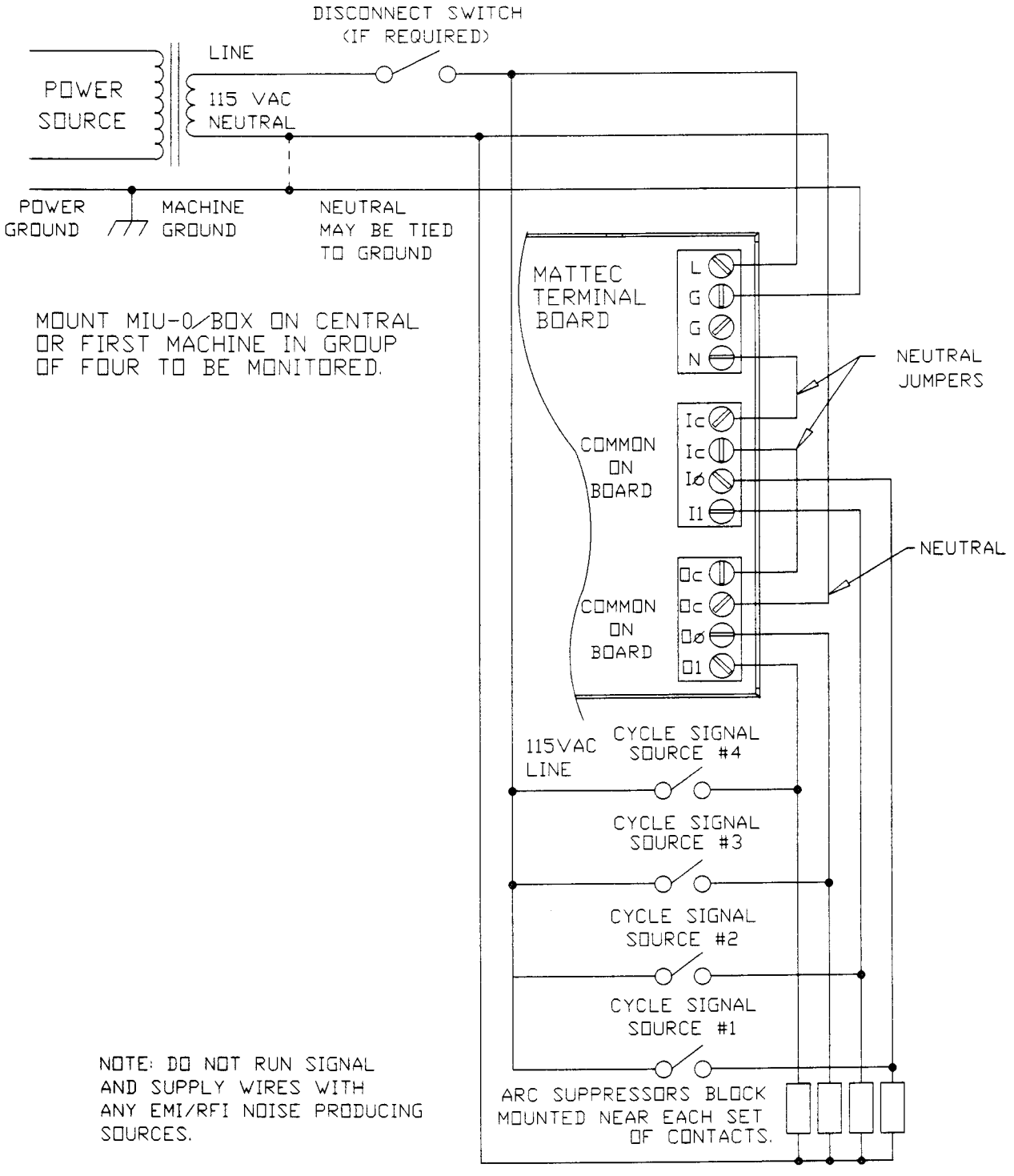


Figure 9.7.3 - CENTRAL SOURCE OF POWER

9.8 STEP 8- CRT TERMINAL/PC EMULATOR WIRING

Determine the location where the CRT terminals/PC Emulators will be placed. Provide a clean 115 VAC power source for terminal and short haul modem. Line Surge Suppression equipment is helpful in providing clean 115 VAC.

Run the overhead cable from the computer to each CRT terminal location. The cable is the same Belden cable used for the machines.

Each CRT terminal has a short haul modem that attaches to it and to the overhead cable. Mattec provides this modem to you with the cable that attaches it to the CRT terminal.

Figure 9.8 shows the terminal block connections for the wiring to the short haul modems.

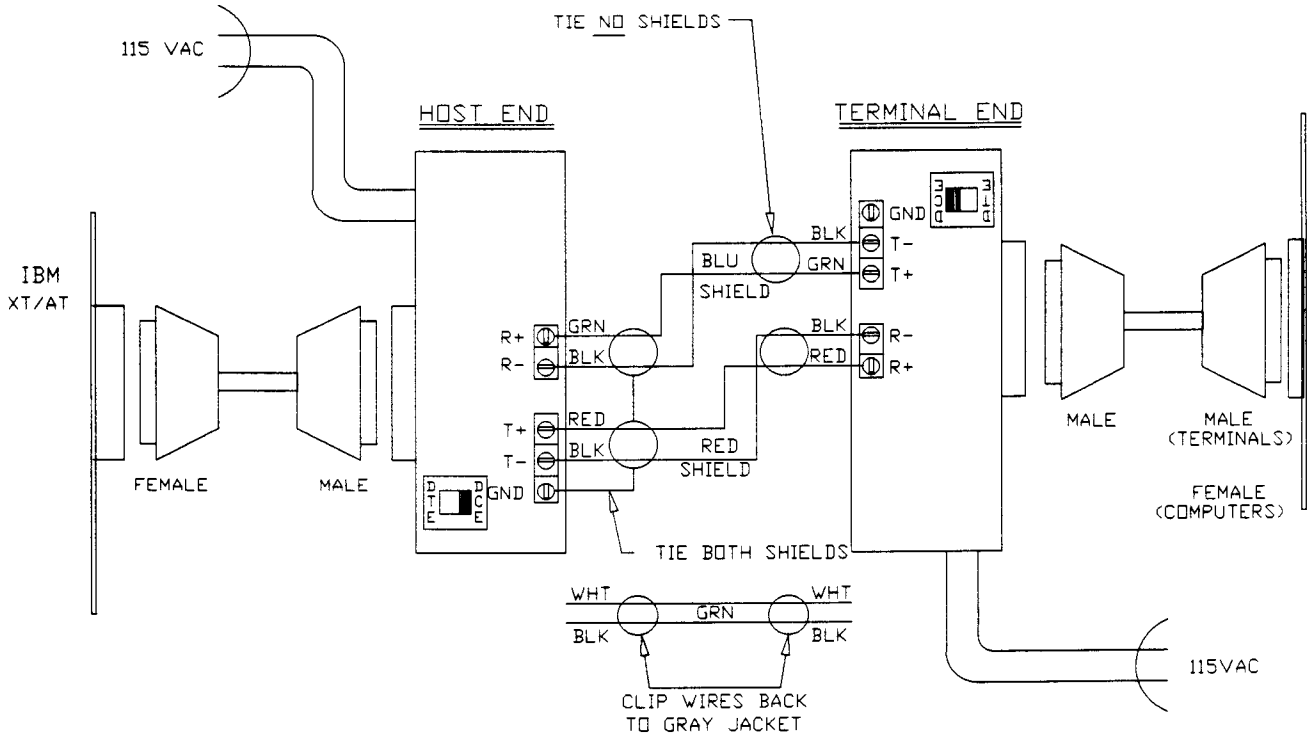


Figure 9.8 - CRT WIRING USING SHORT HAUL MODEMS

9.9 STEP 9- ADDITIONAL DIGITAL INPUTS

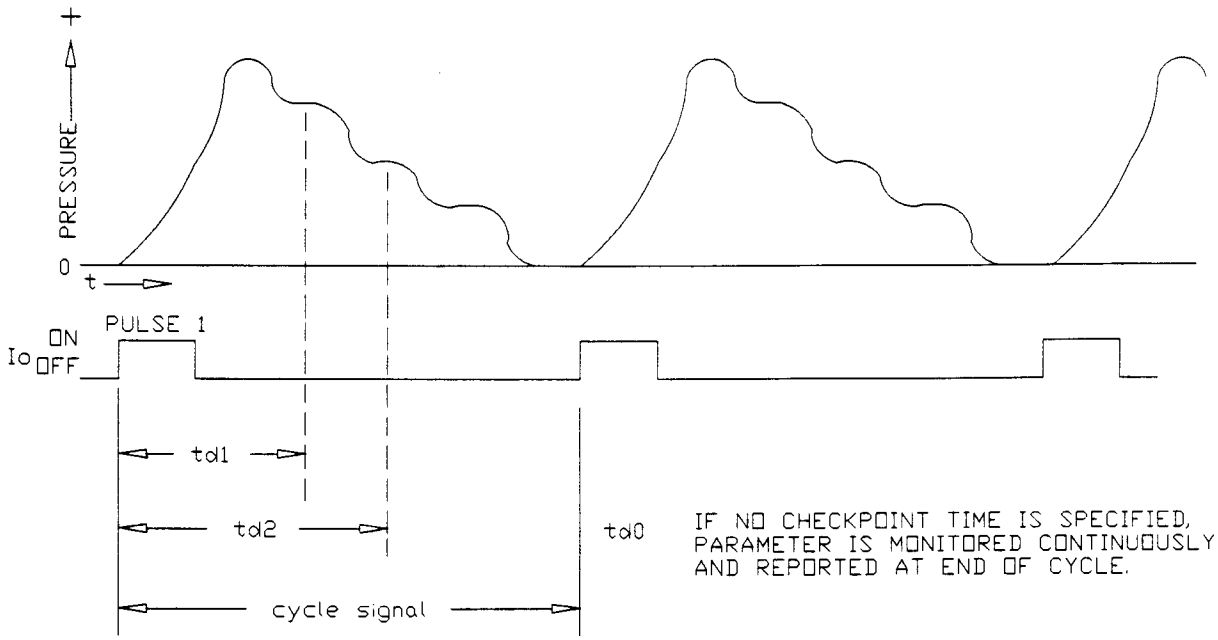
Extra digital inputs are available with the MIU Level 1, 2, and 3. The second input is optional and makes available for monitoring a general timing parameter. Gate open, mold open etc. are examples of signals that are of interest, and that can be monitored in addition to the standard cycle start signal.

For MIU Level 3, optional multiple additional inputs can be used to tell the MIU software when to start reading an analog sensor and when to stop reading an analog sensor. See the MIU Subsystems Manual, Mattec P/N #710-0003, Revision B or greater, for additional information on analog sensors, installation, and calibration.

If these digital signals are not used with MIU Level 3, the MIU reads each analog signal at the beginning of the cycle or within some fixed time delay after the start of cycle. This time delay is unique for each sensor and for each machine. It is specified in the job data file in the computer.

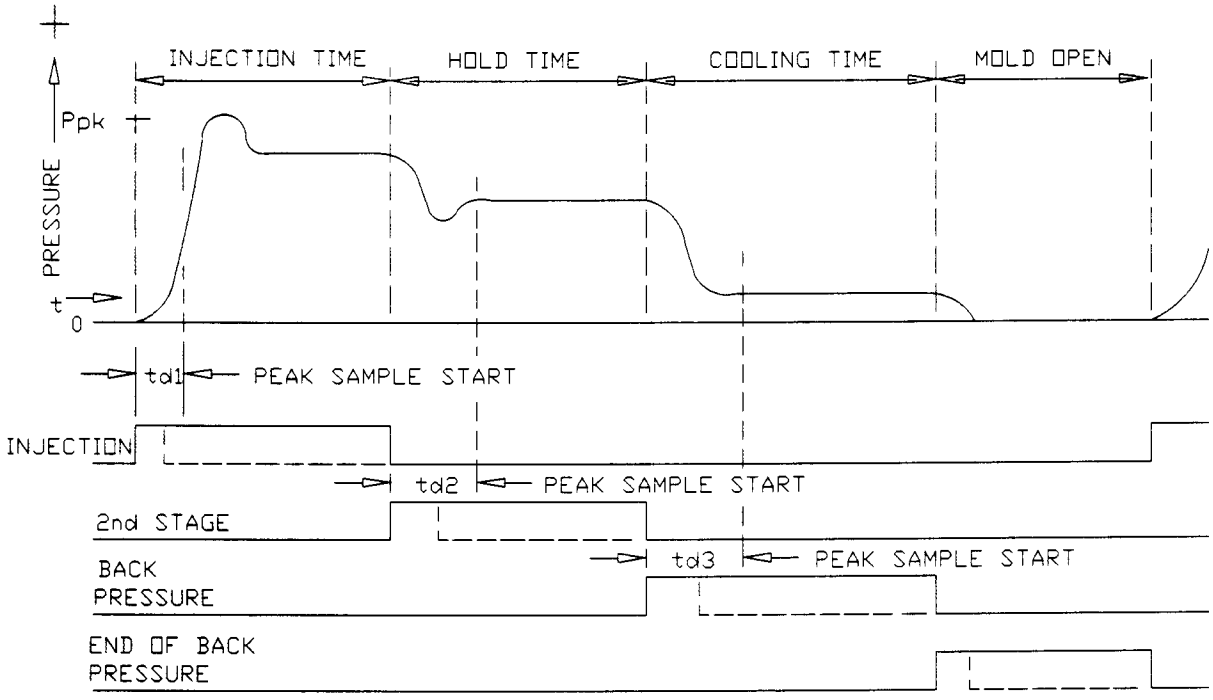
NOTE: Most installations do not require these extra digital inputs. Only the purist does.

Figure 9.9 shows this timing sequence.



MIU-3 OPERATION

ANALOG MONITORING WITH TIME DELAY SPECIFIED IN JOB DESCRIPTOR FILE.



MIU-3+ OPERATION

Figure 9.9 - ANALOG MONITORING WITH SEPARATE DIGITAL SIGNALS

9.10 STEP 10- COMPUTER COMMUNICATION CABLE SIGNAL PLUG

The communication signal cable wires must be terminated at the computer end with the 25 pin D plug terminal board supplied with this ProHelp system. Run the communication signal cable(s) behind the computer, and leave plenty of slack in the cable just in case the computer may be moved to a different location in this area.

Take the buffer box supplied with the system and place it next to the computer system. See Figure 9.10.1 for approximate location and pictorial of cabling. Attach the interface cable supplied with the unit to the 25 pin D connector on the front of the buffer box. Attach the other end of the interface cable to the Mattec ACU II board's 25 pin D connector installed in slot 1 at the rear of the computer system. This connector should be the end vertical one in the I/O card area. Insure the cable clamp screws at both ends of this cable are screwed down securely.

Do not plug the buffer box into the AC outlet until the communications wiring has been checked out. (Preferably by a Mattec Service employee.)

Cut and strip the wires of the cable as shown in Figure 9.10.2.

Connect the wires to the terminal blocks as shown in Figure 9.10.3.
Insure the connections are correct before proceeding. Ty-wrap the cable(s) to the strain relief plate on the terminal board.

Now plug the terminal board into the back of the buffer box on the rear 25 pin D connector. Seat the plug firmly into the connector. Using the two #4 screws supplied, screw each one into the holes on the 25 pin D plug to secure it to its mating connector on the buffer box. Insure the screws are tight to prevent any plug movement.

Leave some slack on this cable at the back of the buffer box so the wires will not have a tendency to pull out or break from the weight of the cable. It is a good idea to anchor the cable(s) with a cable clamp, or a ty-wrap to the desk or table that the computer and buffer box sits on.

9.10.1 BUFFER BOX LOCATION

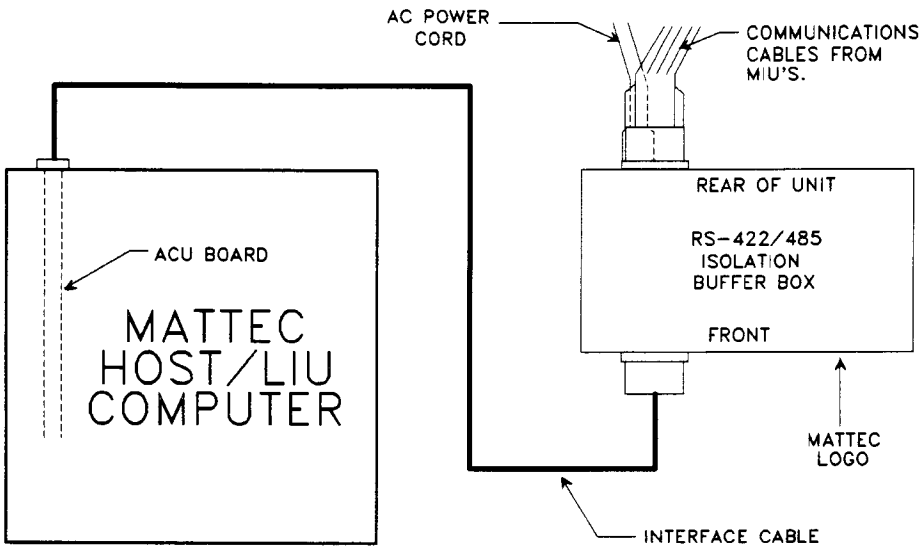
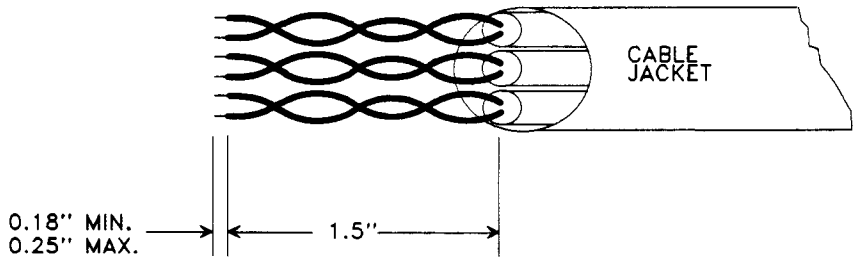


Figure 9.10.1 - BUFFER BOX LOCATION

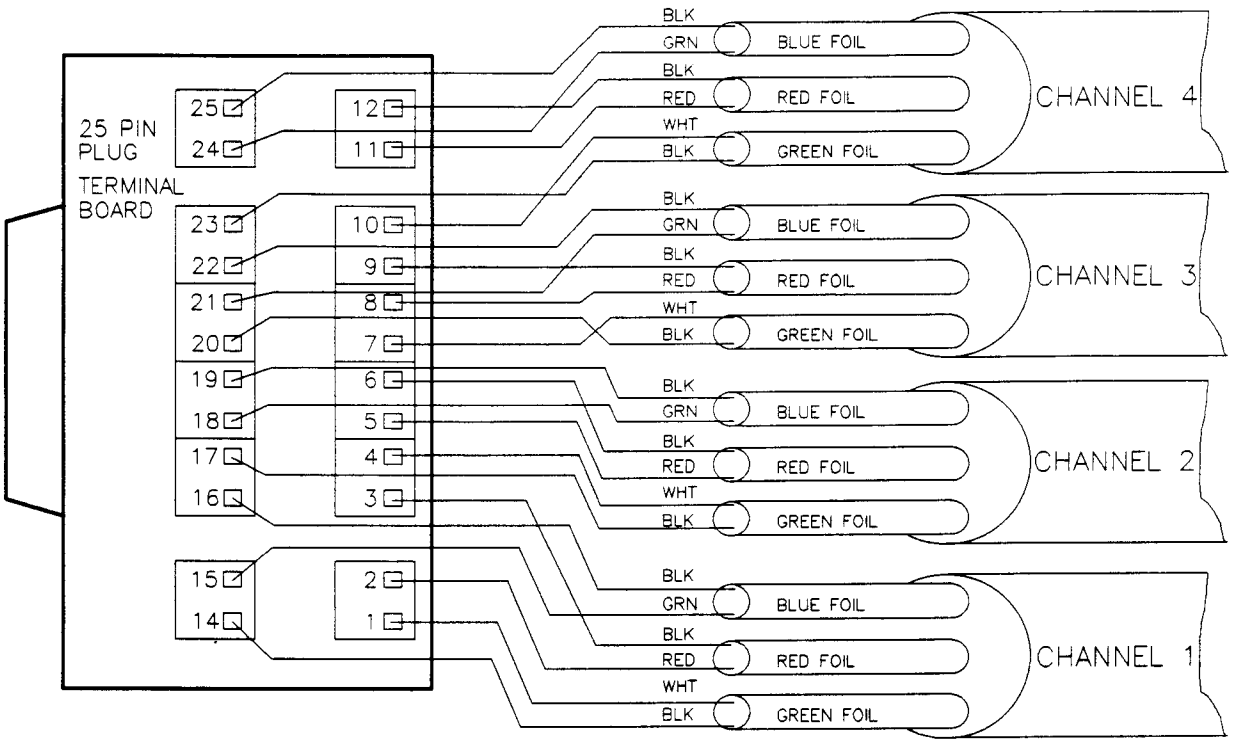
9.10.2 WIRE STRIPPING DETAIL - COMPUTER CABLE



- REMOVE FOIL SHIELDING BACK TO CABLE JACKET.
- KEEP INDIVIDUAL PAIRS TWISTED TOGETHER.
- STRIP AS SHOWN.
- CUT THE 3 SHIELD DRAIN WIRES OFF AT THE CABLE JACKET AND BLACK TAPE.

Fig. 9.10.2 - COMPUTER CABLE WIRE STRIPPING DETAIL

9.10.3 TERMINAL BLOCK DETAIL - COMPUTER SIGNAL



- LOOSEN TERMINAL SCREWS ONE AT A TIME.
- LOOSEN SCREW ALL THE WAY (CCW).
- INSERT APPROPRIATE COMMUNICATION CABLE WIRE INTO TERMINAL.
- RE-TIGHTEN SCREW, INSURING INSULATION OF WIRE IS NOT PINCHED IN CONNECTION.
- GENTLY PULL ON WIRE TO INSURE A GOOD ELECTRICAL CONNECTION IS MADE.
- CONTINUE UNTIL ALL CONNECTIONS ARE COMPLETED.

Fig. 9.10.3 - COMPUTER SIGNAL TERMINAL BLOCK DETAIL