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ENCODER MIKE™ CONTROLLER

MODEL 18011

Please read these instructions completely before operating this equipment. If there are any questions or problems regarding the use of this equipment, please contact: ORIEL INSTRUMENTS - or - the representative from whom this equipment was purchased.

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WARRANTY AND RETURNS

I. INTRODUCTION

The Model 18011 Encoder Mike™ Controller drives and controls up to three Oriel Encoder Mikes™ or Motor Mikes™. The unit relies on feedback of the motor back EMF and the encoder pulses to provide tightly regulated speed control and position information. Microprocessor controlled deceleration ramps and unidirectional completion of steps ensures excellent repeatability.

There are two ways of operating this controller.

1. As a stand-alone instrument. The push buttons on the controller command the Encoder Mikes™. We call this **local** operation.

2. Remote operation is possible using the RS 232C (V24) interface. There are two types of **remote** operation.

   a. Using a terminal (or computer with terminal program). This allows remote operation of the 18011, essentially replacing the keyboard of the 18011 with the keyboard of the terminal or computer. Using a terminal can simplify development of a program for the RS 232C interface.

   b. Using a computer program to command the 18011 to follow a series of steps. This mode of control allows execution of application specific sequences of commands.

I.1 CONNECTING ENCODER MIKE™

Each Encoder Mike™ is connected to the Oriel Encoder Mike™ Controller by a six conductor ribbon cable. (These ribbon cables are included with the Encoder Mike™). They are to be plugged into M1, M2 and M3 located on the rear of the Oriel 18011 Controller.

I.2 ADAPTING THE UNIT FOR DIFFERENT LINE VOLTAGES

The units will be supplied with the appropriate voltage (USA 110V, otherwise 220V/240V). Should it be necessary to change the value, please proceed as follows:

1. Unplug the unit from the mains.

2. Open the unit (4 screws on the bottom). (See page 14)

3. Put the switch on the transformer into the appropriate position (220V/110V).

4. Close the unit.

5. Exchange primary fuse - correct values are:

Fuses: Slow blow, T type 5 x 20 mm

110V 315 mA
220V 200 mA

Please check that the unit is unplugged before any changes are carried out.

I.3 NOMENCLATURE

Through this manual we have a specific meaning for some terms (jargon). Here we define some of those to help clarify the remainder of the manual.

Encoder Mike™ and Motor Mike™ are motorized **actuators**. They push or drive mechanisms such as translators. When the spindle of the actuator is moving out, we say it is moving in the **up** direction.

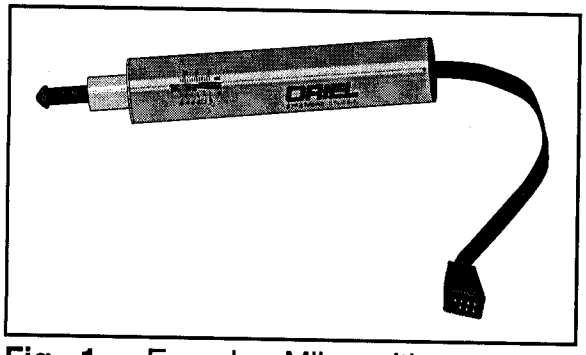


Fig. 1 - Encoder Mike with extended spindle, i.e. in an up position.

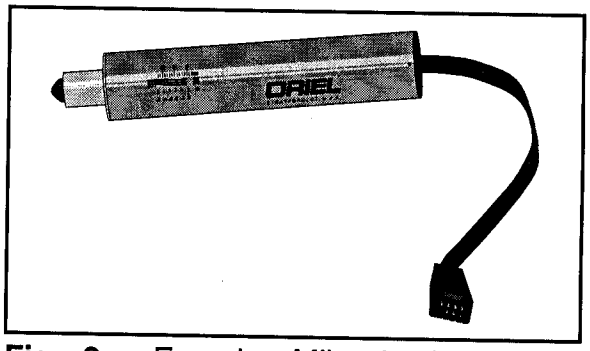


Fig. 2 - Encoder Mike in fully down position, i.e. spindle retracted.

When the spindle of the actuator is moving back into the body of the device, the actuator is moving in the **down** direction. We also refer to spindle positions as **low** and **high** corresponding to a retracted screw and an extended screw.

A **step** is movement of a preset distance. As long as the distance and velocity parameters remain unchanged, the **step** command will cause the actuator to move the required distance at the preset velocity.

To **jog** is to make small movements, usually in an attempt to approach a target or maximize or minimize some position dependent parameter. With this controller the resolution, how small a distance you can jog, depends on the velocity setting and how long you press the **jog** key. The lower the velocity setting, the smaller the jogged distance for the same duration of key press. To a lesser degree the resolution also depends on the loading on the actuator.

All actuators and mechanisms exhibit some amount of **backlash**. If you command an actuator to move in one direction, then stop and move in the reverse direction, there will be some "lost motion" as the device reverses. This is due to gear meshes having some play and at the submicron level to the elasticity of all materials. A driven shaft or gear is compressed in the direction of motor drive. As you reverse the drive the gear mesh reverses, and the shaft unwinds and is compressed in the other direction. The motor and any encoder on the motor shaft senses that motion has taken place, while there is no forward drive on the actuator. Encoder Mikes™ have a specified maximum backlash of 6 microns. Usually it is less than this and, more important, it is repeatable. This controller has a **backlash compensation feature.** When finishing a step movement in the up (from low to high) direction, the actuator approaches the target unidirectionally. When finishing a step movement in the down direction, the actuator is driven 15 microns beyond the target, reverses and then returns to the target. This ensures that stepping from x_1 to x_2 and back to x_1, re-positions the actuator exactly at x_1.

Two positions can be displayed for the actuator, **abs** and **rel**. Zero for both can be chosen to match your application. Since the Encoder Mikes™ have no absolute zero other than the mechanical end of travel stops, the use of "abs" for "absolute" is meant to indicate that this is the more fundamental range. You can set the zero of this range close to, but at least 15 μm above the mechanical stop of a fully retracted (**down**) actuator, or you can set it to match some zero position for your equipment. (Remember the 15 μm backlash compensation when choosing the **abs** zero.) The 18011 Controller will stop the actuator at this abs zero when executing any command. If the actuator stops unexpectedly then check the **abs** reading.

Rel position is convenient for many applications and zero can be reset freely as the **abs** position allows recall of the position on the **abs** range.

II. CONTROLLER PUSH BUTTONS AND DISPLAYS

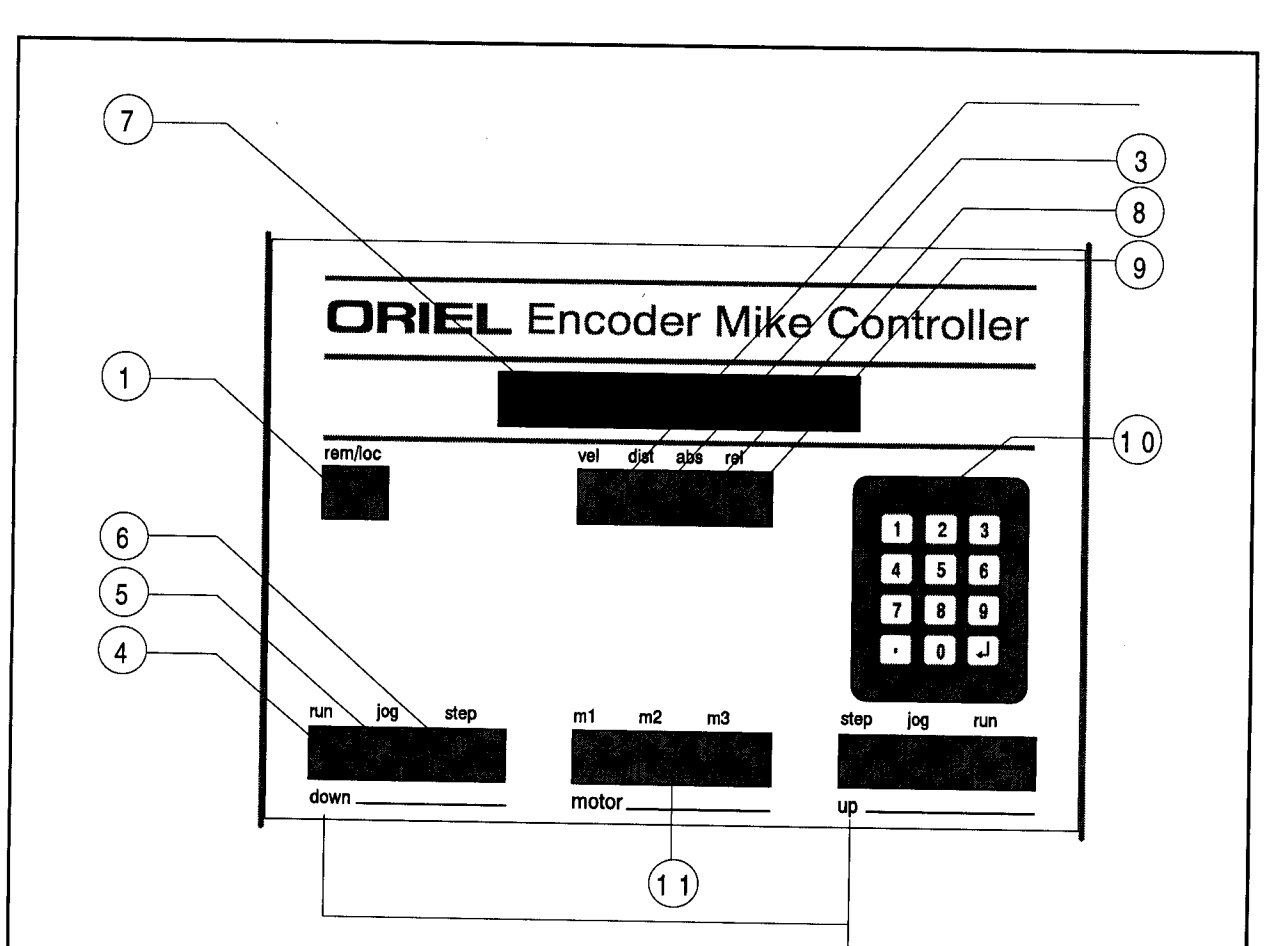


Fig. 3 - Front Panel Buttons and Display

II.1 LOCAL/REMOTE

LED out: The controller is in **local** mode ie. the key board is operative. Press button to enter **remote** mode.

LED on: **Remote** mode. The controller will not react to any other button but **loc/rem** as long as the LED is on. Press the button to enter local mode.

II.2 VELOCITY

LED out: Push button to change or check the velocity.

LED on:

a. Display shows the actual speed at which the selected encoder mike will run or the speed being selected during entry. The motor selected is marked by a lighted LED on the corresponding motor selection button (No. 11).

b. To change velocity, enter the new velocity via the keyboard (No. 10) using the following format:

From	To	Resolution	Entry Format
0.5 μm/s	4.99 μm/s	0.01 μm/s	x.xx
5.0 μm/s	49.9 μm/s	0.1 μm/s	x.x or xx.x
50.0 μm/s	200.0 μm/s	1.0 μm/s	xx or xxx

IMPORTANT:

You must press (enter) ↵ on the keyboard to transfer the entered value to the processor.

If you enter other formats or speeds outside of the range specified above, the controller will ignore these and use the closest permitted value. The display will indicate this by either not accepting the entry or automatically jumping to the closest value.

Example:

entry 250 μm/s : motor will run at 200 μm/s

entry 0.1 μm/s : motor will run at 0.5 μm/s

entry 15.58 μm/s : motor will run at 15.5 μm/s

(the "8" is ignored)

II.3 DISTANCE

LED out: This button controls the step size for the **step** commands. Push button to change or check the current value.

LED on:

a. The display shows the distance (in μm) which the selected. Encoder Mike™ will move if you press the **step** button (No. 6). The motor selected is marked by a lighted LED on the corresponding motor selection button (No. 11).

b. To change the step distance, enter new value via the keyboard (No. 9) and complete the entry by pushing ←.

The following entry formats are permitted:

x.x
xx.x
xxx.x

The resolution is 0.1 μm, the largest possible travel 999.9 μm. If no decimal point is entered, the controller will automatically add .0 to the entry, once ← has been pressed.

c. No negative distances can be entered. Use **step down** for negative travel.

IMPORTANT:

After selecting a step distance and starting motion by pressing **step** (No. 6) the motor can be stopped while traveling by pressing the **run** (No. 4)button. When restarting it with the **step** button it will not complete the first interrupted distance, but run for the full selected distance, i.e., when using **step** the present position is always considered to be in the starting position.

II.4 RUN

LED out: The Encoder Mike™ is not running. Press the button to start the selected Encoder Mike™.

LED on: The Encoder Mike™ runs at preselected speed (see 2.2 Velocity), either in the **up** or **down** direction.

The Encoder Mike™ will run until switched off by pressing the same button again, or unit it reaches an internal or external physical stop. This causes **overload**.

The Encoder Mike™ is then switched off automatically by an overload protector.

This condition is indicated by a flashing LED in the **run** button.

To restart, press **run** or **jog** for the opposite direction. If this does not help, select a higher speed and try again. (The selection of a higher speed will help to overcome the effect of excessive friction that may be present at the end of the actuator range of travel.)

If this does not help, either check for a mechanical blockage of either actuator or the object driven by the actuator.

Monitoring

The lighted LED in the run button is the indicator/monitor for a running actuator. To monitor whether an Encoder Mike™ actually runs or not, you can also press **rel** (No. 9) or **abs** (No. 8). The display will then read out the changing position of your Encoder Mike™. Since the position is derived from the encoder signal in the Encoder Mike™, it will change only if the actuator is moving.

II.5 JOG

The actuator will run either in the **up** or **down** direction as long as the button is depressed.

Overload

If during the **jog** operation the LED in the **run** button just beside the **jog** button starts blinking, you have reached the end of travel and/or encountered a mechanical obstacle which has forced the motor to a stop and caused the overload protection to turn it off. To end this condition press **run** or **jog** for the opposite direction. If, at very slow speeds, this does not end the overload condition, there is an overload condition in the opposite direction caused either by excessive friction (to overcome this select a higher speed and try again) or there is a mechanical obstacle which must first be removed.

Use of jog

Jog is especially useful for approaching a specific position or peaking a signal. It is advisable to select a slow speed and switch the display to **abs** or **rel** so that it reads out position. When repeatedly approaching the same position this should always happen from the same side (i.e., from "below" or "above") since the Encoder Mikes can have several microns play on direction reversal. The 18011 does not compensate for the backlash when you use the **jog** function. Please note that using this function can cause loss of positioned information (for repeating positions reached prior to use of the **jog** function).

II.6 STEP

The actuator will run up or down for a specific distance which has been entered using the **dist** key and the keyboard (see 2.3: Distance). The distance can be selected in 100 nm increments.

Overshoot

To eliminate the play of gearbox and spindle, and any additional mechanical system, the desired position is always approached from the low (spindle retracted) side. This causes a 15 μm overshoot when using **step down** followed by a motor reverse and a slow movement back to the correct position.

Speed, Starting Movement

The actuator in the Encoder Mike™ is not capable of infinite acceleration, so a certain time, depending on load and selected speed, is required to come up to speed on start up. There will always be a "speed ramp" as the motor attempts to drive the actuator at the selected speed. In cases of small steps at high speeds, (i.e., 5 μm at 200 μm/s) the actuator will not reach the selected speed before finishing the required motion (5 μm).

Completing a Step

To avoid overshooting the position, the controller starts to reduce the actuator speed before completing the motion. When moving up the actuator, the speed reduction is as follows:

Speed	Reduction to 10 μm/s at ...before target	Reduction to 0.5 μm/s at 1 μm before target
1 - 9.99	-	√
10.0 - 19.9 μm/s	50 μm	√
20.0 - 49.9 μm/s	100 μm	√
50.0 - 99.9 μm/s	140 μm	√
100.0 - 200.0 μm/s	1000 μm	√

Zero Position

Upon reaching the zero position defined for abs the actuator will stop automatically. This feature can be used in lieu of a travel limiting switch. Approaching abs position zero from the low side, the actuator will slow down and stop at zero. Approaching from the high side it will overshoot and go to zero from the low side.

Because of this overshoot and the fact that Encoder Mikes™ exhibit high friction near the end of their travel due to production tolerances, we recommend setting the zero point for abs at least 50 microns away from the end of travel of the Encoder Mike™.

Stopping During step

The motor can be stopped while traveling in the **step** mode by pressing the **run** (2.4) button. When restarting with the **step** button the motor will not complete the first interrupted distance but start all over again and run for the full distance.

II.7 POSITION READOUT

Activated by buttons **rel** (No. 9) or **abs** (No. 8). A lighted LED in the button indicates which of the two is displayed. Both systems count all the time, whether displayed or not. Both systems are counting parallel using the encoder signals from the Encoder Mike™.

When the actuator changes direction, the position readout includes an error due to the lost motion of the gearbox and lead screw of the Encoder Mike™. To avoid this, always approach your target position from the same side (see II.6 Overshoot). Backlash compensation will remove this error as discussed on Page 2.

II.8 REL POSITION

This position is displayed when the LED in the **rel** button is lit. The zero point can be arbitrarily defined by pressing "0" on the keyboard while the **rel** position is displayed. The display indicates negative positions by a minus sign.

II.9 ABS POSITION

Absolute position is displayed if the LED in the **abs** button is lighted. The zero point can be set arbitrarily. To avoid accidental setting of zero for **abs**, the zero button on the keyboard must be depressed and held down for more than one second while **abs** is activated. The Encoder Mike™ stops when it comes to position zero (see II.6 Zero Position).

II.10 KEYBOARD

Used to enter values for velocity and distance and to set zero points for the **rel** and **abs** position ranges.

* in the lower left is the decimal point.

↤ in the lower right is the ↤ key.

II.11 MOTOR SELECTION

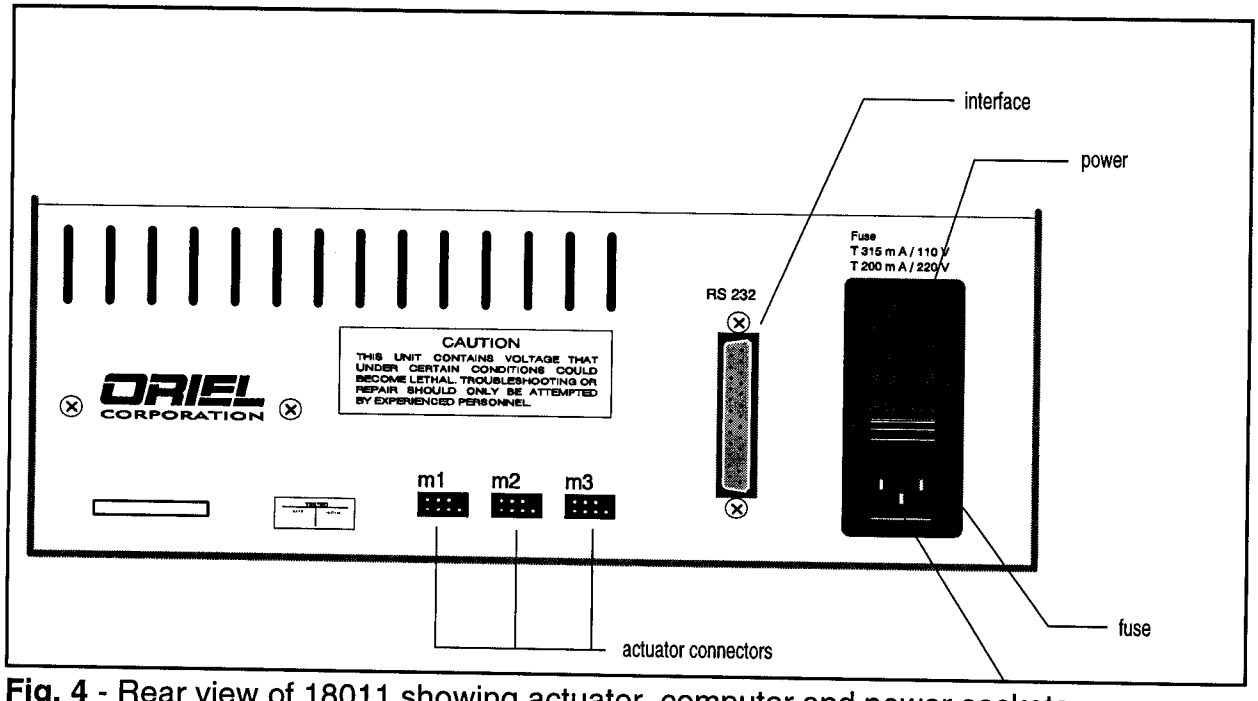


Fig. 4 - Rear view of 18011 showing actuator, computer and power sockets.

The controller has 3 output sockets for Encoder Mikes™. The sockets on the rear of the 18011 are marked M1, M2 and M3. Any of the connected Encoder Mikes™ can be activated by pressing the corresponding M1, M2 or M3 button. A lighted LED indicates which of the three sockets is active. Note that if there is no Encoder Mike™ attached to the selected socket, operation of the Controller will result in a display of the overload signal.

Retention of Parameters

Each output has its own memory to store operating parameters, i.e. position, velocity and distance. If, for example, M3 is selected after M1 had been operating, M3 will operate on its own parameters while parameters of M1 are saved in its memory for later use. The data in these memories is retained if the controller is disconnected from the line or in case of power failure.

Changeover Between Connected Encoder Mikes™

Actuator selection should not be attempted while a connected actuator is operating. If however a new actuator is accidentally selected while the old one is still executing a command, the new actuator cannot be used until the old one has come to a stop.

The controller will interpret a change in Encoder Mike™ selection during operation of a Encoder Mike™ as a "stop" command and interrupt whatever is in process. The controller will continue updating the position memory until the Encoder Mike™ has come to a complete stop and then switch over to the new Encoder Mike™.

II.12 USING THE CONTROLLER TO OPERATE MOTOR MIKES™

The controller is able to operate Motor Mikes™ at a reduced performance as described below:

1. There will be no position readout due to the absence of encoder signals.

2. The "step" function is inactive (no encoder signal!) ("distance" can be entered but will not be used).

3. "Velocity" will readout the value entered, but this will not be the actual speed (due to absence of encoder signals). The velocity entered will control the speed, but the actual speed can vary up to 15% from the value entered due to the variations in the electrical characteristics of the Motor Mike™. Since there are no encoder signals, the controller cannot use the encoder pulses to calibrate the back EMF signal of the actuator.

III. TROUBLESHOOTING

The Encoder Mike™ controller will only perform if the system, including the Encoder Mike™, cable and driven mechanical assembly is operating properly. Apparent problems with the unit come from several sources.

III.1 OVERLOADING OF THE ACTUATOR

The actuator can be overloaded if the axial load is more than 5 kg or if a non axial or off center load is applied. High loading can come from the driven mechanical assembly itself, including spring loading, or from the contact between the actuator and driven mechanics. We strongly recommend using a spherical tipped actuator driving on a hardened flat. A spherical bearing surface on the load should be carefully centered on a flat tipped actuator to avoid additional frictional loading.

If the Encoder Mike™ becomes overloaded, a "windup effect" results. The mechanism becomes wound up in driving and after the controller executes a step for example, and stops, the mechanism unwinds and the resultant encoder pulses can cause the display to move back a few tenths of a micron.

III.2 ELECTRICAL PROBLEMS

** If the 18011 fails to operate an Encoder Mike™ satisfactorily, the trouble could be in the 18011, the cabling or the Encoder Mike™. If the unit is "dead", i.e. the LEDs and display do not operate, first check the fuse. If the fuse is ok, then call Oriel for advise. *We do not recommend attempting to repair a "dead" unit in the field. You should return the unit to Oriel for repair.* See page 2 for replacement fuse types.

** If an Encoder Mike™ is not working and is not overloaded, try connecting it to a different channel. If it still fails to operate, then first suspect the Encoder Mike™ or the connecting cable. Check the cable for continuity.

** If the Encoder Mike™ is working but the repeatability is not as specified, then the problem may be noise pickup by the connecting cable. Specious pulses may be counted as Encoder pulses. Apply standard shielding techniques so that the display for a static actuator does not change. See page 17, section IV.3 for troubleshooting the computer interface.

IV. REMOTE OPERATION

IV.1 GENERAL INFORMATION

In addition to front panel operation, the 18011 Controller can be operated from a remote station. This station can be either a computer or a terminal. The computer or terminal must be capable of RS-232 operation.

On the rear of the 18011 Controller is a 25 pin connector. You need a cable to connect this socket to the RS-232 connector on your computer or terminal. The cable type is determined by the computer or terminal used. (See pages 17 and 19 for more information on cabling. Once the proper electrical connection has been made between the 18011 Controller and the computer or terminal, the computer or terminal must be set up for the correct data parameters. The data parameters for the computer or terminal must match the parameters for the 18011 Controller. The factory setting for the 18011 controller are:

4800 baud
8 data bits/word
1 stop bit
no parity

The only data parameter that can be changed on the 18011 Controller is the baud rate. To change the baud rate you must open the Controller.

Opening The Controller To Change The Baud Rate

Turn the 18011 Controller off and disconnect the power cable. Turn the 18011 face down on a soft mat or a cloth, so that the rear is facing away from you. Locate and remove the four machine screws holding the bottom cover. Refer to Figure 5. You can now remove the cover by pulling upward. Refer to Figure 6 and locate the baud rate select pins. The baud rate options are tabulated in Figure 6. Move the small jumper block to the pins for the new baud rate and reassemble.

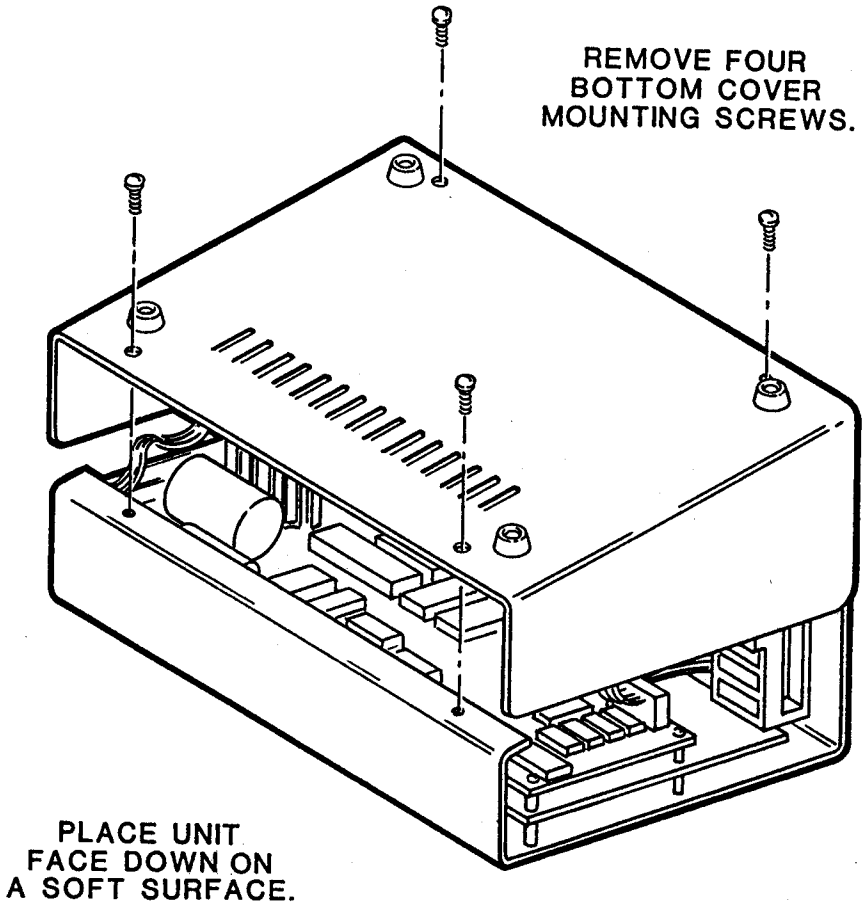


Fig. 5 - Opening the 18011 to change the Baud Rate

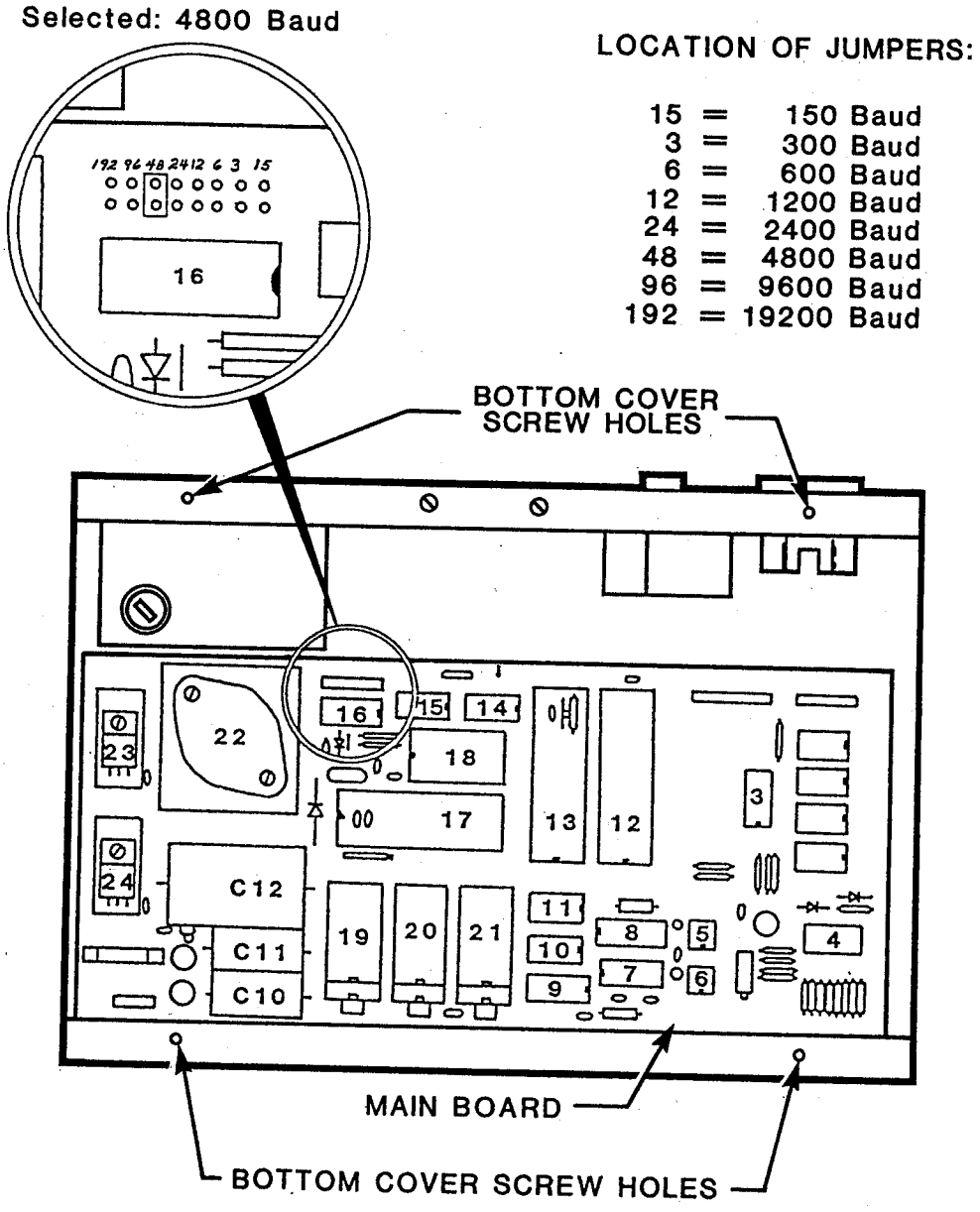


Fig. 6 - Location of the Baud Rate Jumper Switches

IV.2 REMOTE COMMAND SUMMARY

The remote commands can be broken down into 3 types, **single character, multi-character,** and **inquiries. Single character** commands are **L, R, <,>,** and **S. Multi-character** commands include; **C, G, M, T,** and **V.** We call these multi-character because you need a number or additional character to complete the command. **Inquiries** are **A, I, P,** and **Z.**

Single Character Commands:

"**L**" - <local> switches the interface to the front panel. The message "OFF LINE" is sent to the computer or terminal.

"**R**" - <remote> switches the interface to the computer or terminal and locks out the front panel. The message "ON LINE" is sent to the computer or terminal.

"**<**" - <run down> same function as the run down key on the front panel. Only the S command will terminate this function.

"**>**" - <run up> same function as the run up key on the front panel. Only the S command will terminate this function.

"**S**" - <stop> stops active actuator immediately.

Multi Character Commands:

"**CX**" where X = "A" or "R" - <clear register X>. This command will zero the value in the corresponding position register. "**CA**" will clear the absolute register and "**CR**" will clear the relative register.

"**GX <ret>**" where X is in the range +/- 999999 - <go to absolute position X>. This command moves the actuator to the specified absolute position.

"**MX <ret>**" where X = 1, 2, or 3 - <Select actuator X >. This command activates actuator 1, 2, or 3. This command is disabled when the selected actuator is moving.

"**TX <ret>**" where X is in the range +/- 999999 - <travel a distance of X μm>. This command moves the actuator a distance specified by X.

"**VX <ret>**" where X is in the range 0.5 to 200 μm/s -<velocity X>. This command set the velocity of the selected actuator.

Inquiries

"A" - <report absolute position>. This command will cause the 18011 Controller to report the value in the absolute register.

"I" - <report information>. This command will cause the 18011 to produce a multi-line report on the velocity, the absolute position register, the relative position register, the actuator selected, and its status.

"P" - <report relative position>. This command will cause the 18011 Controller to report the value in the relative register.

"Z" - <report status>. This command will cause the 18011 Controller to send a character from a to e which corresponds to the operating conditions of the actuator selected. See below:

STATUS CHARACTER	CONDITION
a	Motor Stopped - conditions normal
b	Run Down - actuator running reverse
c	Run Up - actuator running forward
d	Overload Down - actuator stopped by a limit while running in the reverse direction
e	Overload Up - actuator stopped by a limit while running in the forward direction

IV.3 SETUP and OPERATION

For remote operation you must connect the 18011 Controller to an RS-232 compatible terminal or computer port. Before connection is made it is a good idea to review the operations manual supplied with the terminal or computer.

There are only three connections that have to be made between the 18011 and the terminal or computer, input (RxD), output (TxD), and signal common. There are no other connections supported by the 18011 Controller. Some terminals and computers require additional support signals. You should identify these and supply them, making whatever connections are necessary. BelowPage 18 has a list of data cables and manufacturers that work for most computers and terminals.

TERMINALS -		Data Cable Model #	MANUFACTURER
		-----------WY-50	EYN250
M/M	BB	PNM301A & CS25MM-5	LC
TVI920		EYN250 M/M	BB
		PNM301A & CS25MM-5	LC

COMPUTERS	Data Cable Model #	MANUFACTURER
IBM PC/XT compatible	EYN250 M/F	BB
	PNM301A & CS25MF-5	LC
IBM PC/AT compatible	ENY250 M/F & AT Adapter	BB
	CMZ6-IBM & PNM301A	LC
APPLE - MAC	TL-IC047A & EYN250 M/M	BB

Note;

BB = Black Box Corp.
P.O. Box 12800
Pittsburgh Pa. 15241

LC = L - Com
1755 Osgood St.
No. Andover Ma. 01845

In applications where it is important to use a manufactured data cable the following drawings may be of use.

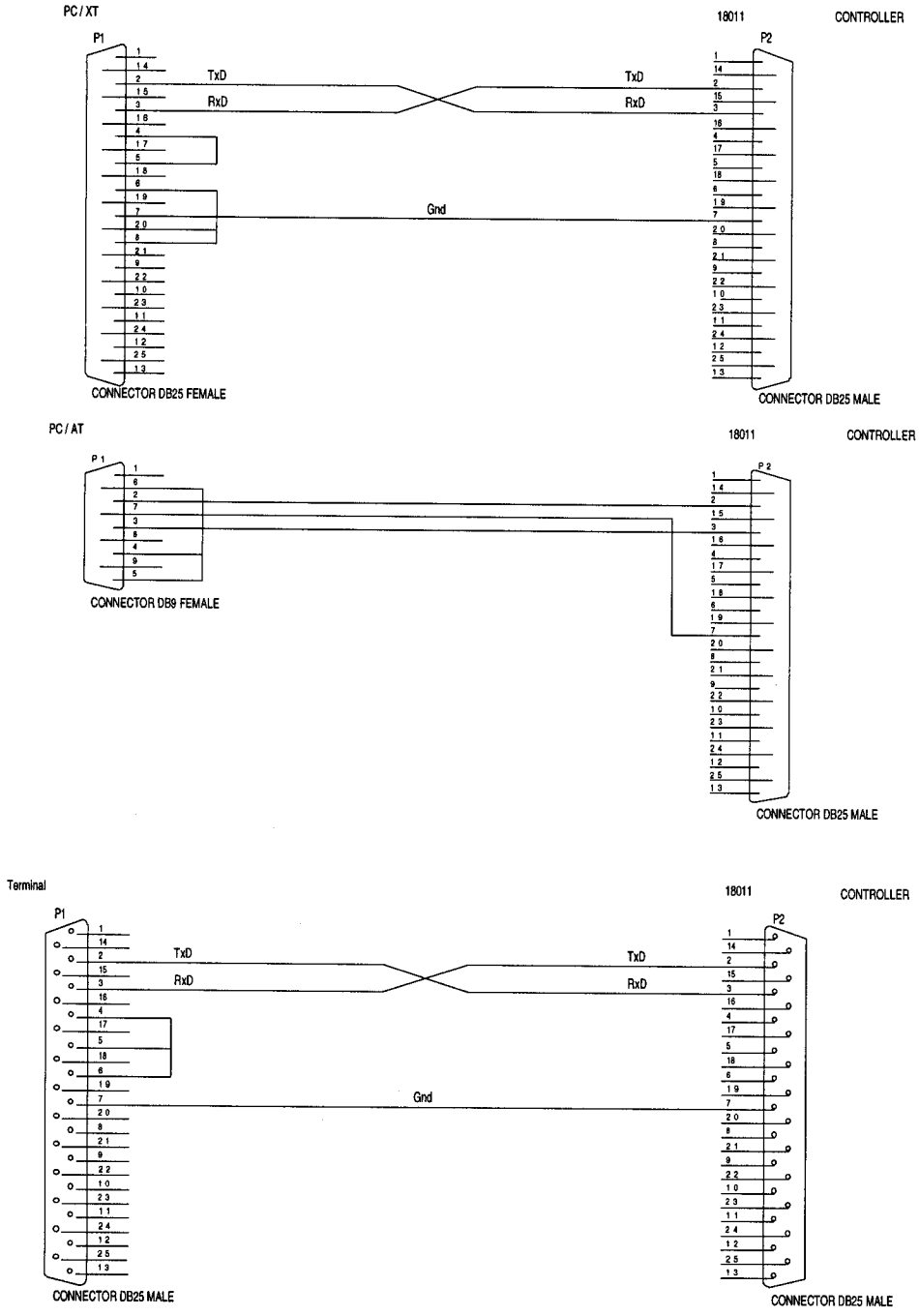


Fig. 5 - Cable Drawings

Only three wires are required for remote operation of the 18011 controller. TxD (pin 2), the data output from the 18011 Controller. This pin is normally connected to the data input (RxD) of the computer or terminal. RxD (pin 3) is the data input to the 18011 Controller; this pin is normally connected to the data output (TxD) of the computer or terminal. The signal common (pin 7) is connected to the signal common of the computer or terminal. Sometimes the computer or terminal requires additional signals for proper operation (handshake signals). These signals can be present at the RS-232 connector of the computer or terminal. Check your computer user manual for these connections.

IV.4 COMPUTER OPERATION - SOFTWARE

The computer can be operated in two modes, terminal mode and controller or application specific mode. In terminal mode the computer emulates a terminal.
Because there are many terminal or modem emulation programs available for most computers, it is not generally practical to write a terminal emulation program. These programs are usually inexpensive and have useful options such as serial port debugging, data buffering and disk file generation.

When you want the computer to control the 18011 for a specific application, you must write an appropriate computer program. Developing an application specific program involves many considerations, such as speed of operation, type of language, and types of utilities. We recommend that you operate the 18011 using a terminal emulation program before trying complete computer control. This verifies the connections and protocol.

IV.5 TROUBLESHOOTING FOR REMOTE OPERATION

Troubleshooting involves three areas; electrical, data format, and software. A troubleshooting flow chart has been provided at the end of this section.

Electrical

Start by testing for proper RS-232 port operation. This is accomplished by connecting TxD and RxD together at the computer. Load up and run a terminal emulation program. The characters that are typed should be echoed to the screen. If no characters appear on the screen then the computer or emulator is not operating properly, some terminal emulators also have diagnostics to help in locating the problem.

If everything is working properly, then remove the shorting connection at the computer. Next connect the data cable to the RS-232 connector on the computer and connect TxD to RxD at the other end of the data cable. Load and run the terminal emulation program. If the characters typed are echoed correctly to the screen then the data cable is working correctly.

Data Format

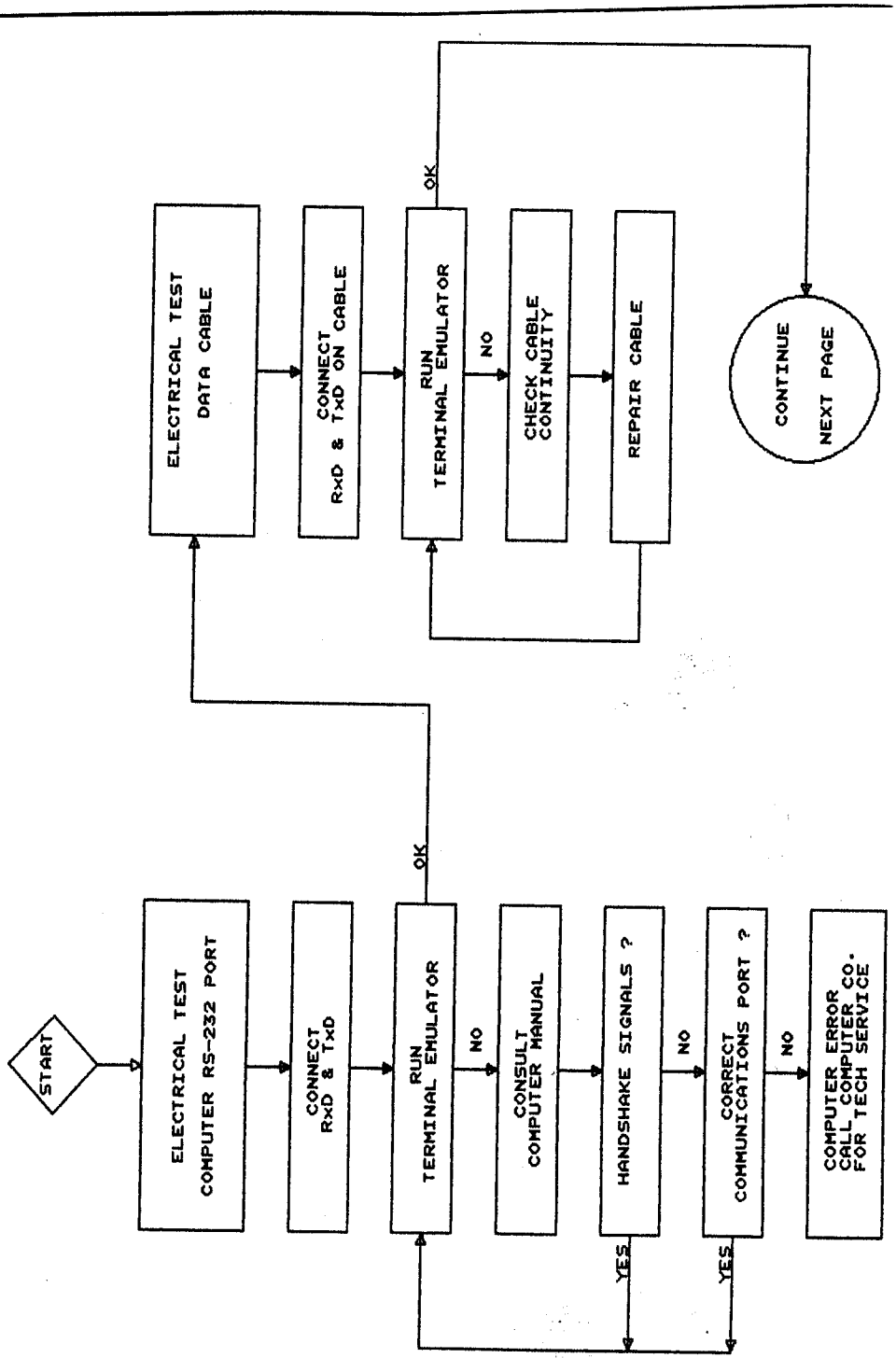
The terminal emulator should be configured for, 8 bits/character, 1 stop bit, no parity, and 4800 baud. The characters should be sent out as lower case.

Software

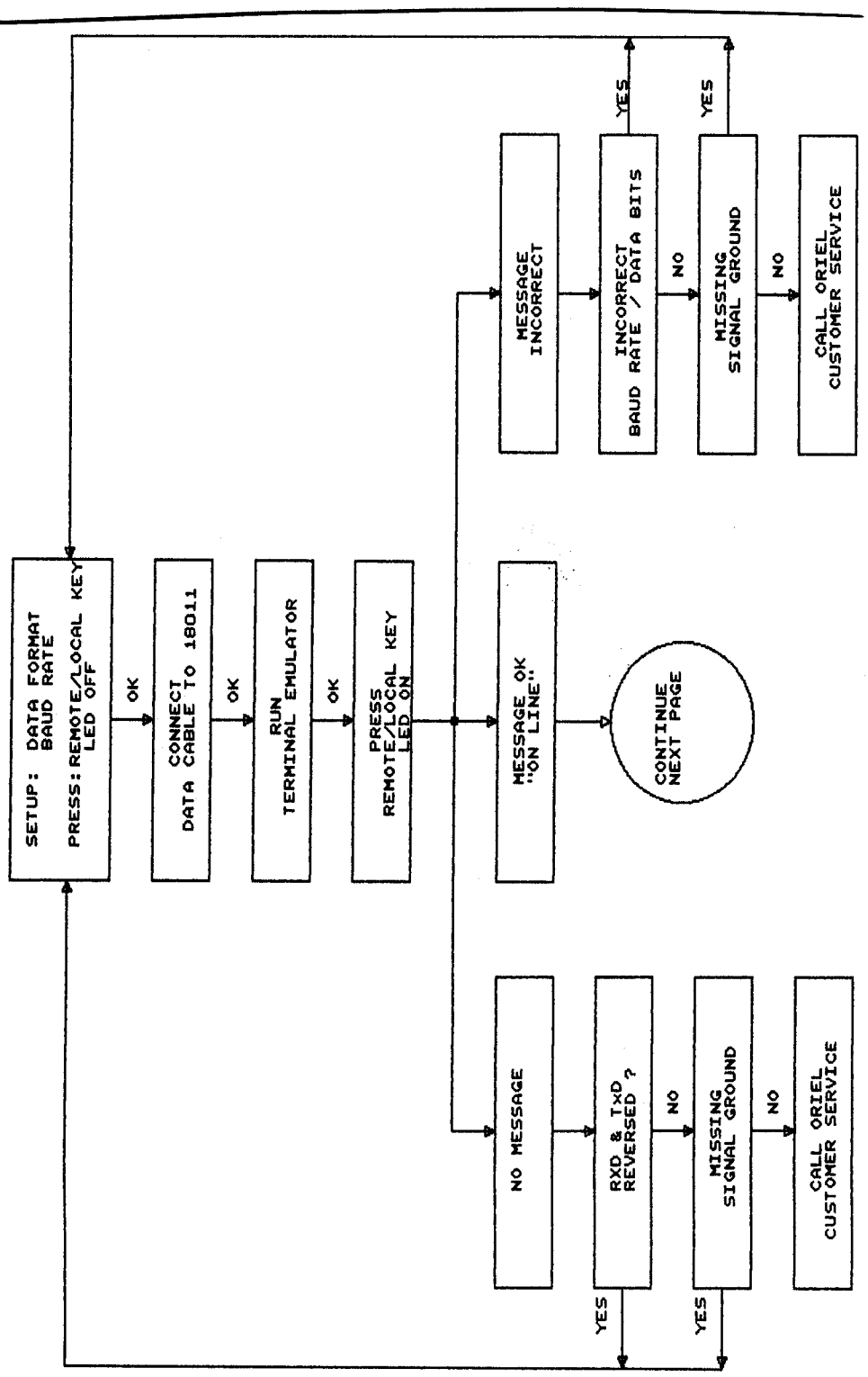
It is generally advisable to emulate the specific application manually before switching to complete computer control. One way to do this is to run the 18011 application using a terminal or a computer running a terminal emulation program. Manually enter the 18011 commands and observe the responses, this will help in application program development.

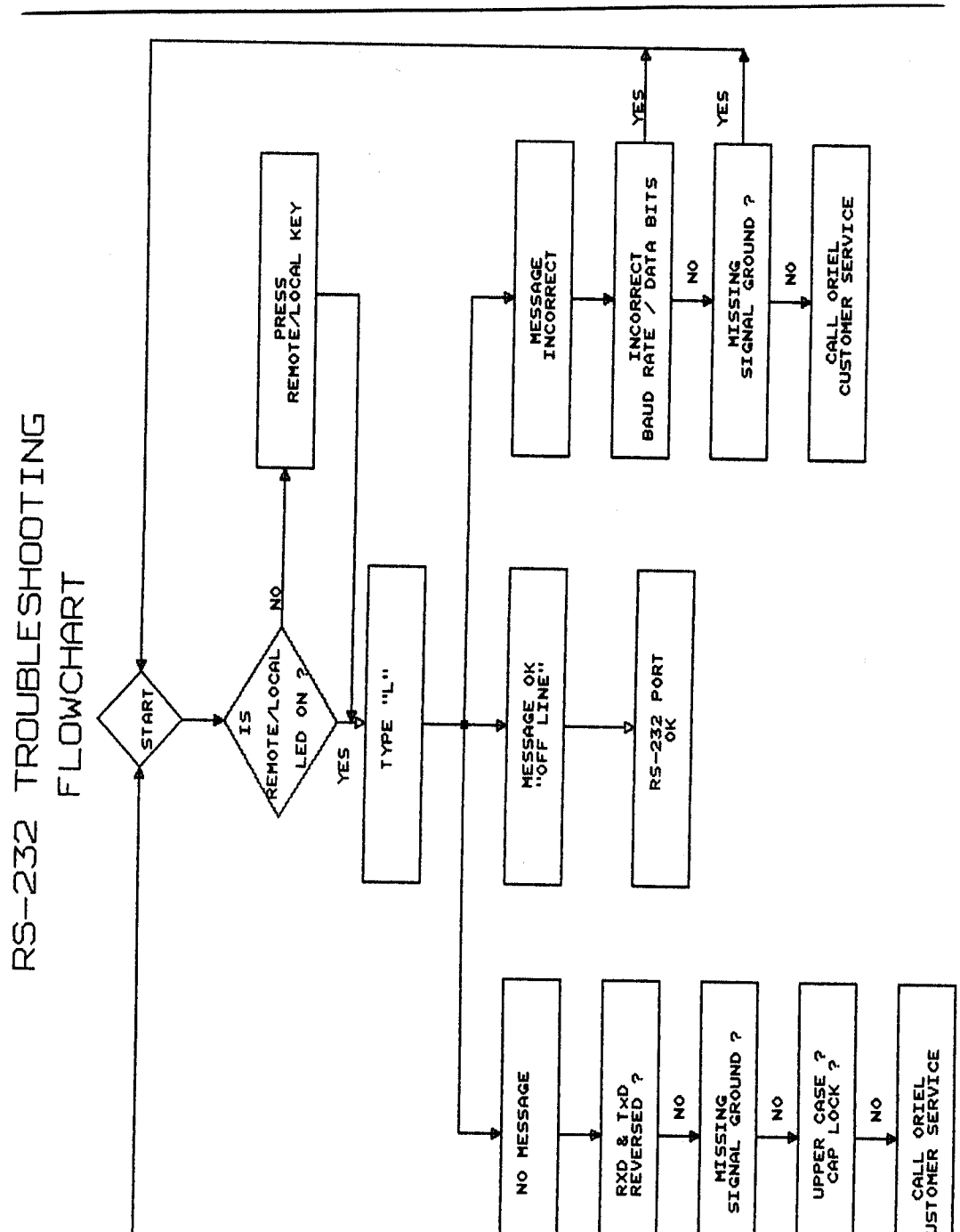
It is possible to develop an application program that requires responses from the 18011 controller. A program that requires "feedback" is generally more responsive but can be more complex and harder to troubleshoot (debug) if there is a problem. Another way to develop a program is to send out commands, then delay for a period until the command is completed. After this delay the next command is sent to the controller. This method results in a much less complex program, but it usually operates slower.

RS-232 TROUBLESHOOTING FLOWCHART



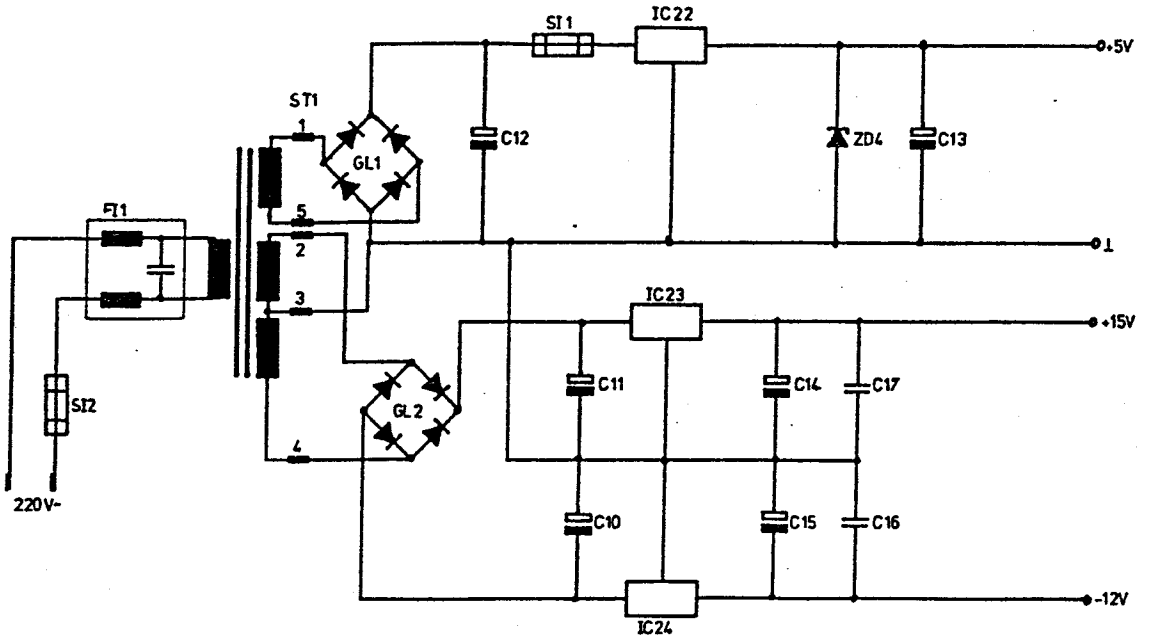
RS-232 TROUBLESHOOTING FLOWCHART



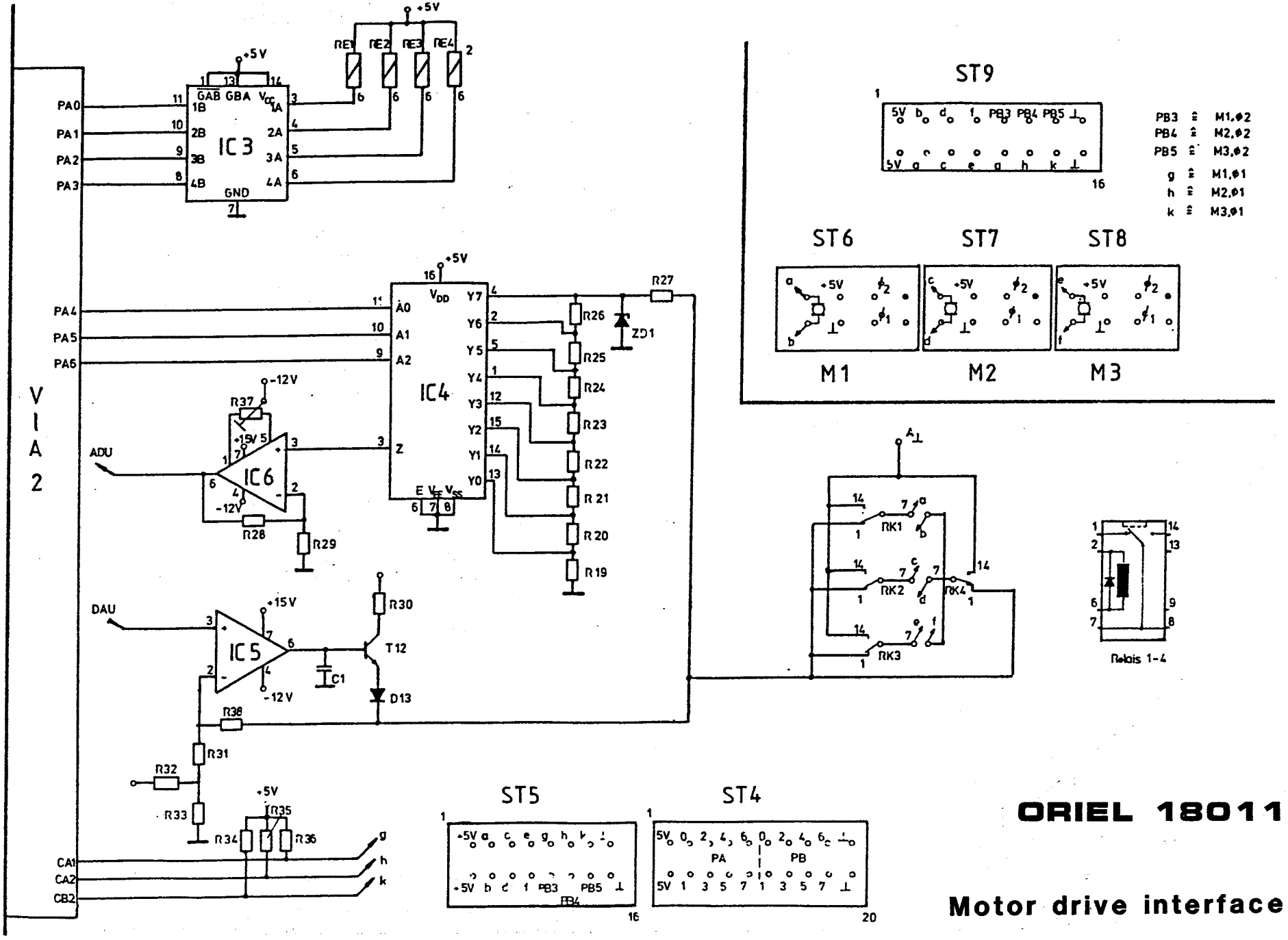

RS-232 TROUBLESHOOTING
FLOWCHART
START
IS REMOTE/LOCAL LED ON ?
NO
PRESS REMOTE/LOCAL KEY
YES
TYPE "L"
MESSAGE INCORRECT
YES
INCORRECT BAUD RATE / DATA BITS
NO
MISSING SIGNAL GROUND ?
YES
NO
CALL ORIEL CUSTOMER SERVICE
MESSAGE OK "OFF LINE"
RS-232 PORT OK
NO MESSAGE
RXD & TXD REVERSED ?
YES
NO
MISSING SIGNAL GROUND ?
YES
NO
UPPER CASE ? CAP LOCK ?
YES
NO
CALL ORIEL CUSTOMER SERVICE

V. DRAWINGS

In the event of problems, this unit should be returned to Oriel for repair. Failure of the unit may originate in the hardware or software. Schematics are provided for a general understanding of the design only.

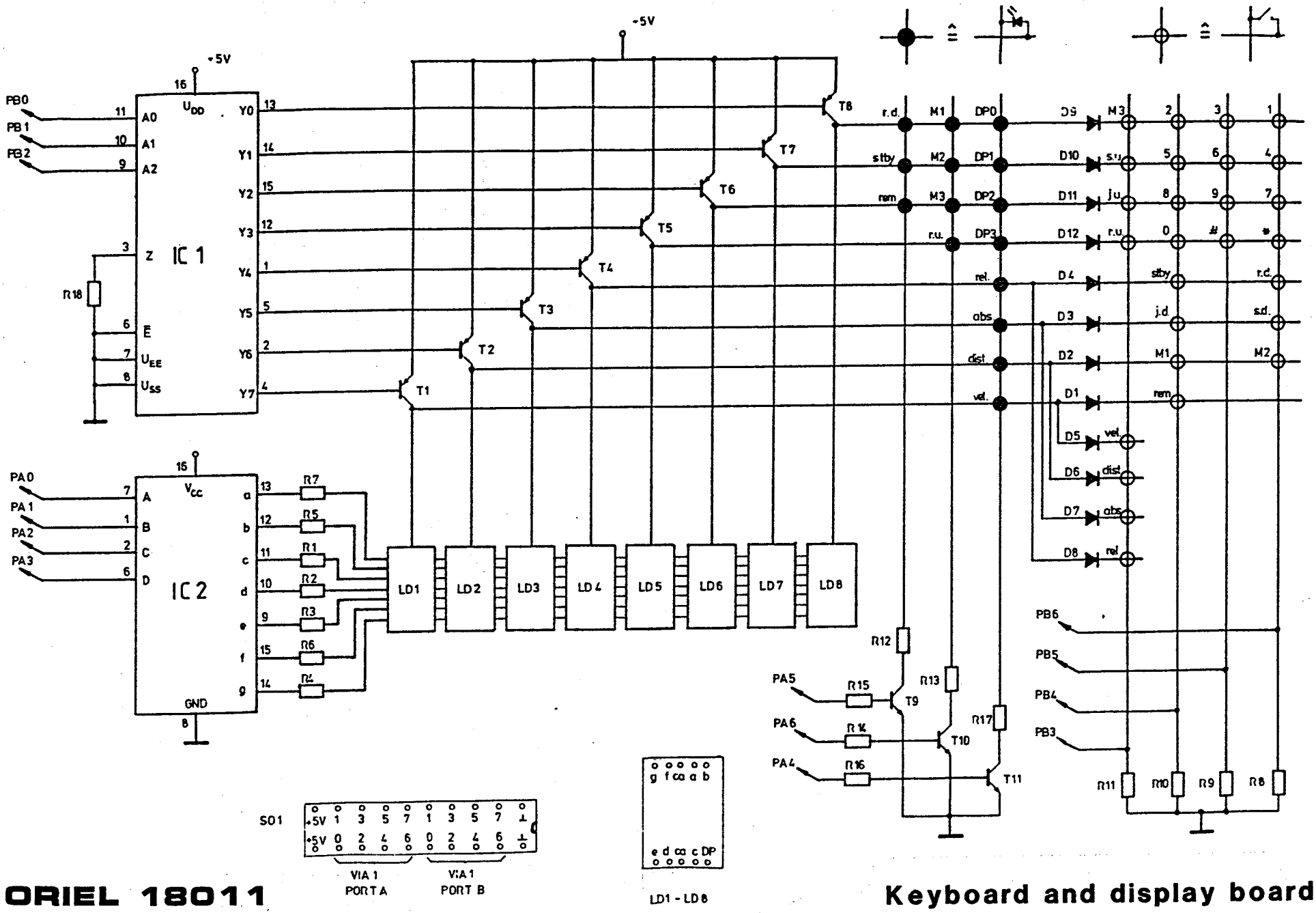


ORIEL 18011 **Power supply**



ORIEL 18011

Motor drive interface

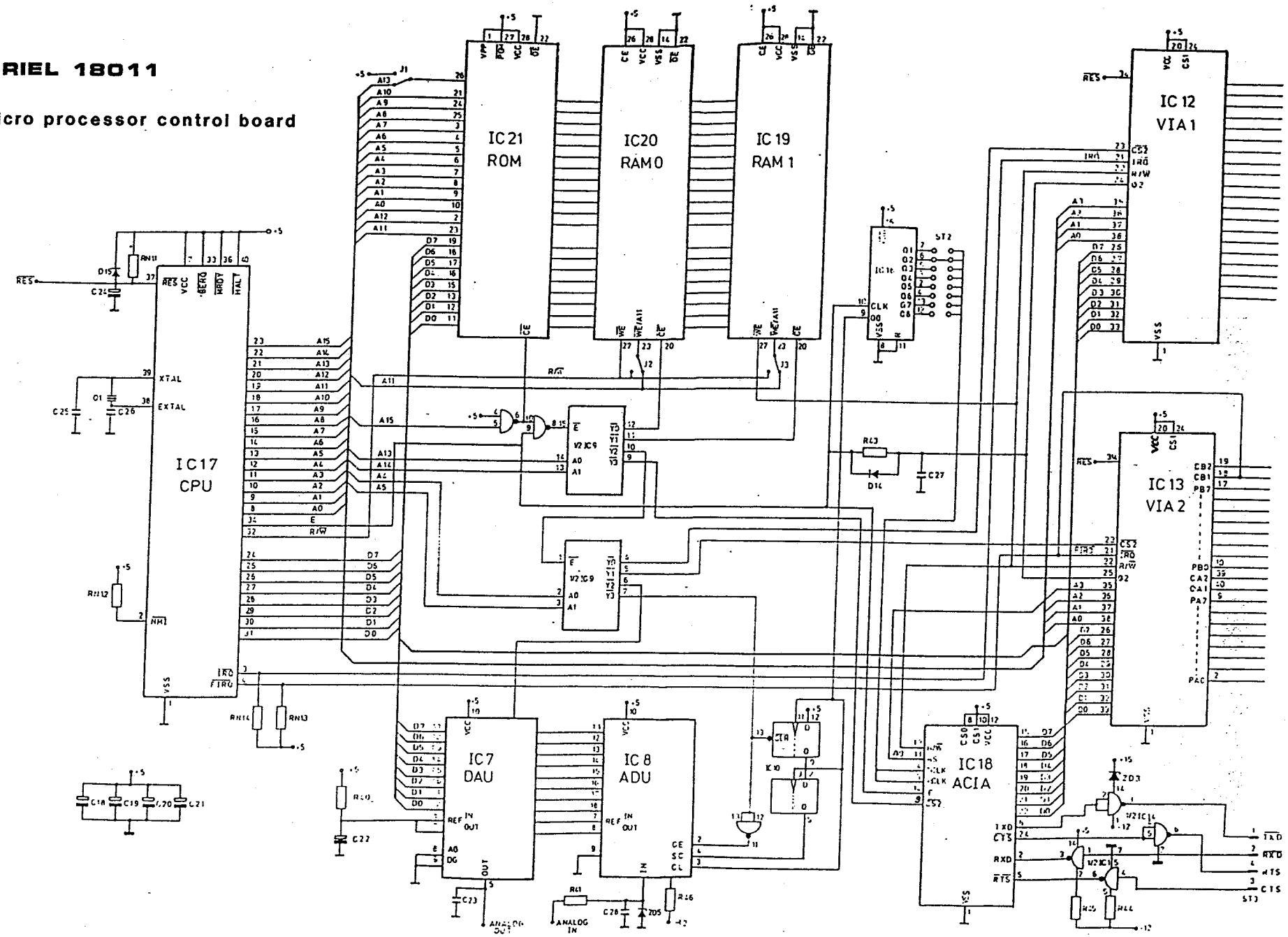


ORIEL 18011

Keyboard and display board

ORIEL 18011

Micro processor control board



WARRANTY AND RETURNS

WARRANTY

Oriel Instruments warrants that all goods described in this manual (except consumables such as lamps, bulbs, filters, ellipses, etc.) shall be free from defects in material and workmanship. Such defects must become apparent within the following period:

1. All products described here, except spare and repaired parts: one (1) year or 3000 hours of operation, whichever comes first, after delivery of the goods to buyer.

2. Spare parts: ninety (90) days after delivery of goods to buyer.

3. Repaired items: ninety (90) days after delivery of goods to buyer.

Oriel Instruments' liability under this warranty is limited to the adjustment, repair and/or replacement of the defective part(s). During the above listed warranty period, Oriel Instruments shall provide all materials to accomplish the repaired adjustment, repair or replacement. Oriel Instruments shall provide the labor required during the above listed warranty period to adjust, repair and/or replace the defective goods at no cost to the buyer ONLY IF the defective goods are returned, freight prepaid, to an Oriel Instruments designated facility.

Oriel Instruments shall be relieved of all obligations and liability under this warranty if:

1. The user operates the device with any accessory, equipment or part not specifically approved or manufactured or specified by Oriel Instruments unless buyer furnishes reasonable evidence that such installations were not a cause of the defect.

2. The goods are not operated or maintained in accordance with Oriel's instructions and specifications.

3. The goods have been repaired, altered or modified by other than Oriel authorized personnel.

4. Buyer does not return the defective goods, freight prepaid, to an Oriel repair facility within the applicable warranty period.

IT IS EXPRESSLY AGREED THAT THIS WARRANTY SHALL REPLACE ALL WARRANTIES OF FITNESS AND MERCHANTABILITY. BUYER HEREBY WAIVES ALL OTHER WARRANTIES, GUARANTIES, CONDITIONS OR LIABILITIES, EXPRESSED OR IMPLIED, ARISING BY LAW OR OTHERWISE, WHETHER OR NOT OCCASIONED BY ORIEL'S NEGLIGENCE.

This warranty shall not be extended, altered or varied except by a written document signed by both parties. If any portion of this agreement is invalidated, the remainder of the agreement shall remain in full force and effect.

CONSEQUENTIAL DAMAGES -

Oriel Instruments shall not be responsible for consequential damages resulting from misfunctions or malfunctions of the goods described in this manual. Oriel's total responsibility is limited to repairing or replacing the misfunctioning or malfunctioning goods under the terms and conditions of the above described warranty.

INSURANCE -

Persons receiving goods for demonstrations, demo loan, temporary use or in any manner in which title is not transferred from Oriel, shall assume full responsibility for any and all damage to the goods while they are in their care, custody and control. If damage occurs which is unrelated to the proper and warranted use and performance of the goods, then the recipient of the goods accepts full responsibility for restoring the goods to their condition upon original delivery, and for assuming all costs and charges.

RETURNS

Before returning equipment to Oriel for repair, please call the Customer Service Department at (203) 377-8282. Have your purchase order number available before calling Oriel. The Customer Service Representative will give you a Return Material Authorization number (RMA). Having an RMA will shorten the time required for the repair, because it ensures that your equipment will be properly processed. Write the RMA on the returned equipment's box. Equipment returned without a RMA may be rejected by the Oriel Receiving Department. Equipment returned under warranty will be returned with no charge for the repair or shipping. Oriel will notify you of the cost of repairs not covered by warranty before starting out of warranty repairs.

Please return equipment in the original (or equivalent) packaging. You will be responsible for damage incurred from inadequate packaging, if the original packaging is not used.

Include the cables, connector caps and antistatic materials sent and/or used with the equipment, so that Oriel can verify correct operation of these accessories.