

# **T-21 OPERATORS MANUAL**

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# **SECTION 1 INTRODUCTION**

## **1.1 INTRODUCTION**

The T-21 is a mountable data entry terminal capable of accessing up to 31 axes of Emerson Positioning Drives. The T-21 is designed to operate with the FX, DX 520 and 525 product lines. The T-21 has four function keys which can be programmed to perform pre-determined data programming functions.

The T-21 has 2 serial ports (A and B). Ninety-eight programming functions can be programmed into the T-21 via the serial port A. The T-21 in turn, communicates with the drive via the Serial Port B allowing the operator to change drive parameters or monitor the present condition of the drive.

The standard T-21 is used solely to monitor and change data. It is not intended to be used to initiate motion or change the configuration of the positioning servo drive.

The T-21 comes with special software which provides an easy way to setup and program the T-21 function keys. The question and answer format this software uses assists the operator when setting up and programming the T-21 Data Entry Terminal to monitoring the positioning drive functions without an extensive knowledge of programming.

### **1.1.1 PACKING LIST**

- 1.T-21 Data Entry Terminal
- 2.Disk with T-21 software (T21.EXE)
- 3.This manual

If any of the items listed above are missing or damaged, contact Emerson EMC customer service at 1-800-474-8833.

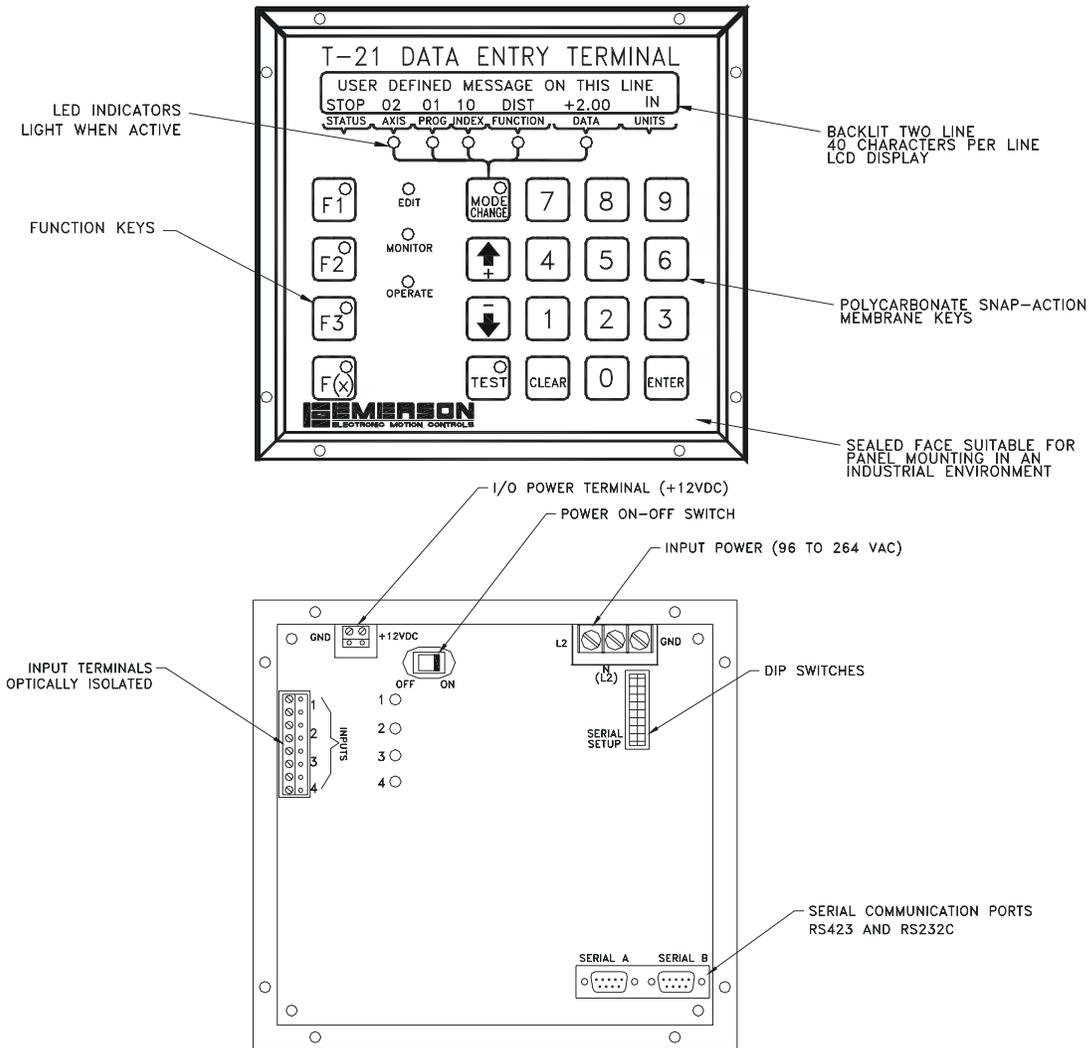
Free T21.EXE and PCX software updates can be obtained from Emerson EMC BBS:  
Phone # (612)-474-8835

# SECTION 2 INSTALLATION AND WIRING

## 2.1 INSTALLATION AND CONNECTIONS

The following installation requirements, methods and procedures are provided to ensure reliable and trouble free installation and operation of your T-21 Data Entry Terminal.

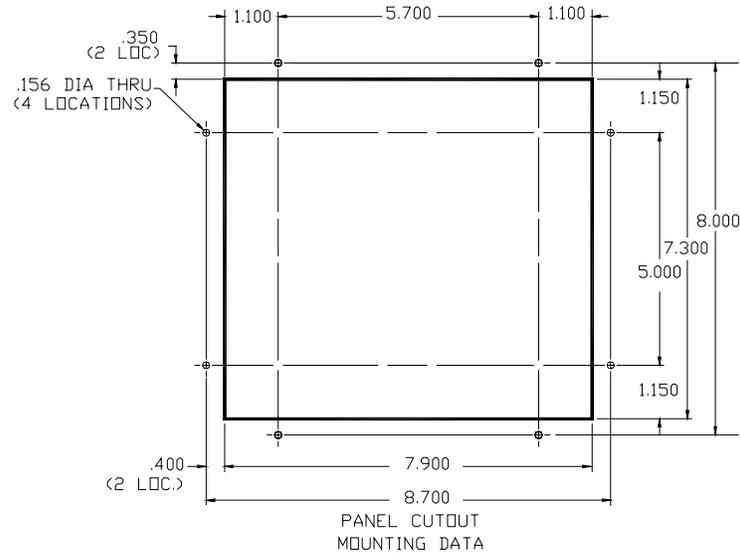
### 2.1.1 PANEL LAYOUT



**Figure 2-1** Panel Layout

## 2.1.2 MOUNTING

The T-21 is designed to be "through panel" mounted in a metal NEMA type 12 enclosure.



**Figure 2-2** Through Panel Mounting Cut-Out

### 2.1.2.1 SELECTING AN ENCLOSURE

The T-21 is designed for the industrial environment however, no sophisticated electronic system can tolerate certain atmospheric contaminants such as moisture, oils, conductive dust, chemical contaminants and metallic particles. Therefore, if the T-21 is going to be subjected to type of environment it must be provided with proper ventilation and filtering.

## 2.1.3 AC POWER CONNECTIONS

The T-21 is designed to operate between 96 & 264 VAC, 50 to 60 Hz @ 1 Amp max.

## 2.1.4 GROUNDING

The enclosure, T-21 and the drive grounds should be a common single point that ultimately is a continuous electrical path to earth ground. The following example illustrates the ideal grounding arrangement of the AC power.

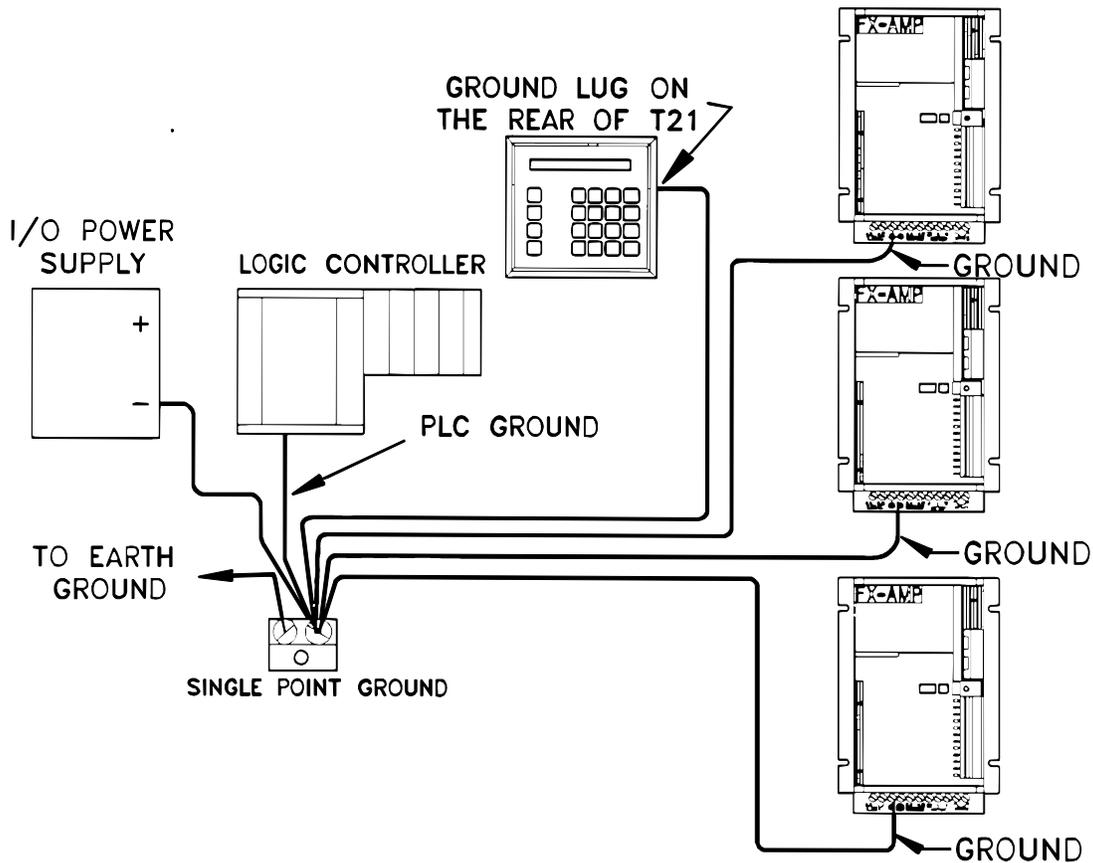


Figure 2-3 Ideal Grounding Illustration

**Note:** These ground wires should not be shared with other equipment. Also insure that metal to metal contact is made between the ground lug and the cabinet back.

## 2.1.5 SERIAL COMMUNICATION SETUP

The serial communications setup dip switches are located on the top right hand of the back cover. The following is a description of the function of each switch.

Switches 1, 2 and 3 are decoded to determine the baud rate.

<u>SWITCH</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>BAUD RATE (CPS)</u>
	0	0	0	110
	1	0	0	300
	0	1	0	1200
	1	1	0	2400
	0	0	1	4800
	1	0	1	9600
	0	1	1	19200

**1 = ON      0 = OFF**

The other serial parameters are fixed values.

Parity: even

Stopbits: 1 bit

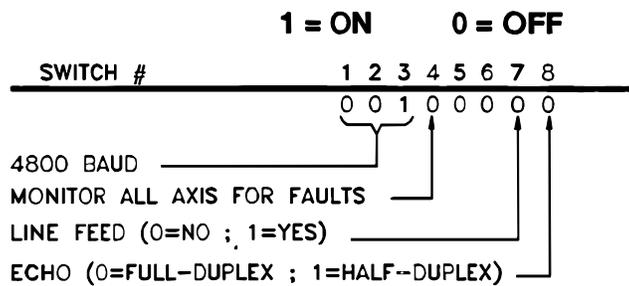
Character: 7 bits

No hand shaking

### 2.1.5.1 T-21 DEFAULT SETTINGS

The T-21 as shipped will have the DIP switch set as follows.

1 = ON 0 = OFF

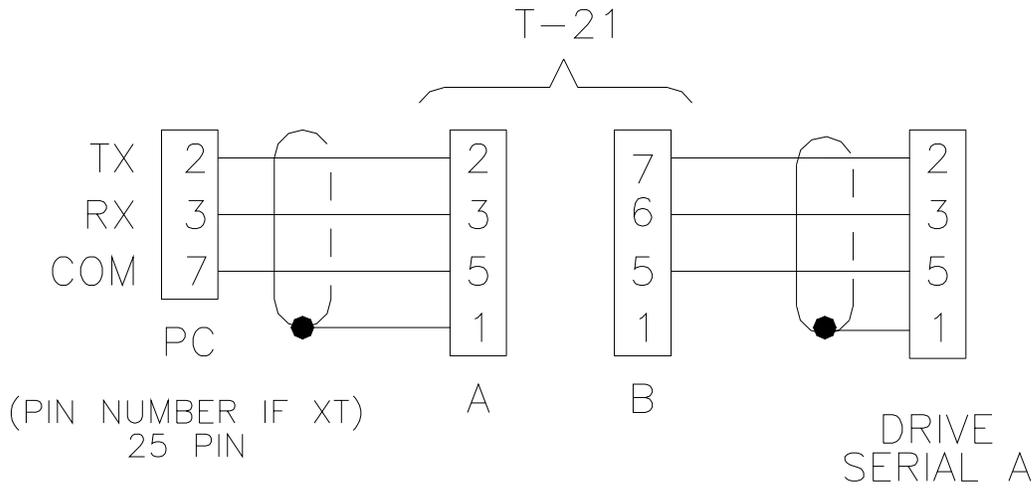


**Figure 2-4** Default Settings

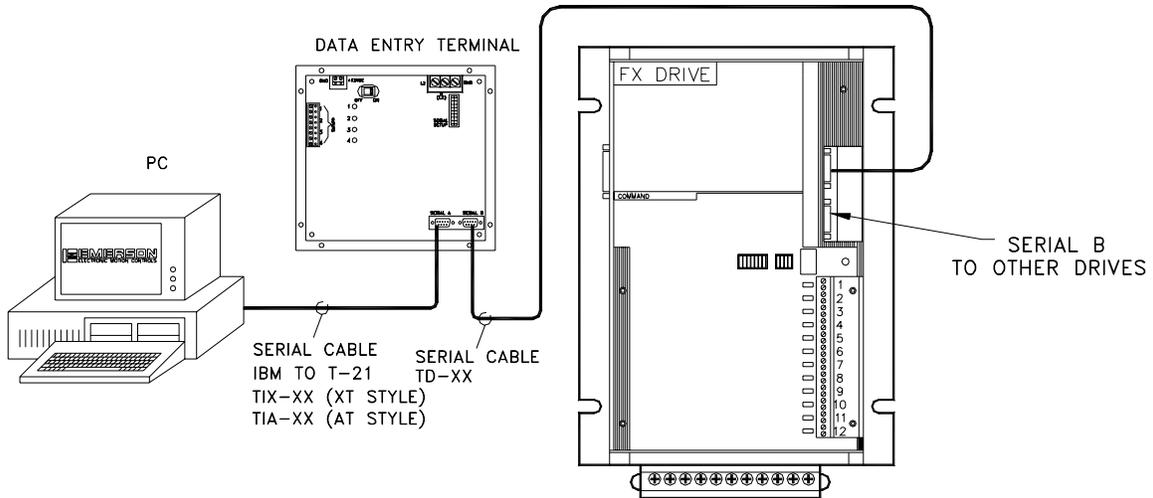
**Note:** For a description of Full-Duplex and Half-Duplex see paragraph A.1.2.

For the T-21 to communicate with an FX, DX, 520 or 525 positioning drive, Each drive must have the same serial communication setup as the T-21. If there is more than one drive connected to the T-21, each positioning drive must have a unique axis identifier. See the "Positioning Drive" manual section on "Setting Up the Serial Interface Switches and Protocol".

## 2.1.6 SERIAL COMMUNICATION CONNECTIONS



**Figure 2-5** T-21 To Drive Connections



**Figure 2-6** Serial Communication Setup

## 2.2 SERIAL COMMUNICATION TROUBLESHOOTING

If at power up this message appears:

NO AXIS PRESENT, PRESS TEST KEY FOR TEST MENU.

This indicates that communications with the positioning drive have not been established. In this case, the following should be checked.

1. Ensure that the serial cable is hooked up correctly and securely. Check the labels on the cable. Serial cable connections must be secured with screws at both ends to ensure reliable serial communications.
2. Verify that each axis (if multi axis system) has a unique axis identifier, 1-9, and A-V.
3. Verify dip switch settings, (check baud rate). The baud rate of the drive must be the same as the baud rate of the T-21.

If the communication problem still exists after checking the items listed above, it could be that the T-21, drive or cable or PC is malfunctioning.

As the T-21 continues to check for axes, it will automatically go into the monitor mode when the serial link is established.

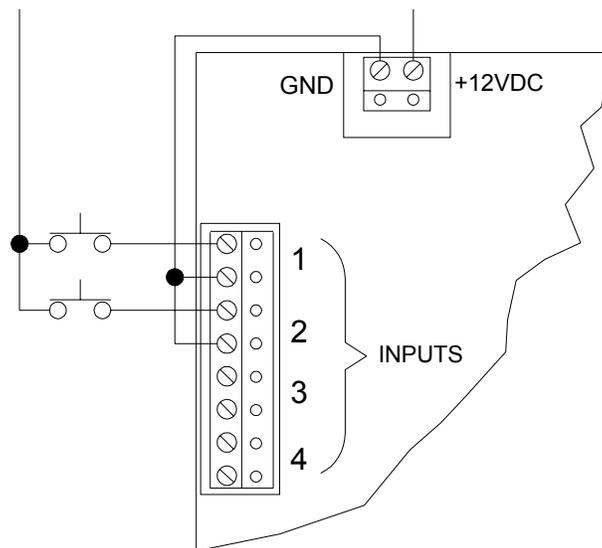
The baud rate of the T-21 can be changed as explained under "Serial Communications Setup" on page . After setting the dipswitches, press the ENTER key. This will cause the T-21 to be configured with the new baud rate.

**Note:If the baud rate on the drive is changed, the T-21 does not have to be reset. When changing the baud rate on the T-21, go into the TEST mode menu, option #4. This will cause the T-21 to stop sending commands to the drive.**

## 2.3 DIGITAL INPUTS

The T-21 is equipped with 4 inputs which are optically isolated for +10 to +30 VDC operation. Each input has two screw terminals associated with it to provide for either sinking or sourcing operation. An LED indicator will light when the associated input is on. The voltage source for the optical inputs may be supplied by the on-board isolated power supply. An example of activating the inputs is shown. This power supply terminals are located on the rear of the T-21 panel.

**Note:** This supply is intended to be used only by the T-21 inputs. The maximum current available is 200 mA.



**Figure 2-7** Digital Inputs

The Data Entry Panel has two "assigned" inputs, input #1 and input #2.

**Input #1 = Setup-lock.** If off, it prevents the operator from getting into the Edit Mode of the function keys. The operator must know the password if input #1 is off. If input #1 is on, the password is bypassed.

The password can also be bypassed if the password for that function has been set to zero (0). (Also see serial command "PW" on page ).

**Input #2 = Zero position display.** If toggled, it will set the displayed position on the T-21 to 0 (when in monitor mode). However, the displayed position of the drive (as monitored with PCX) is not affected.

## 2.4 POWER UP

When the power switch is turned on the operate LED will illuminate, and give the following message on the display:

**EMERSON EMC T-21 DATA ENTRY PANEL  
401048-00 A.11/10/94**

The T-21 begins checking for any axes that are attached to it. While the T-21 is checking for axes, the Monitor and Operate LED's will illuminate, and the following message will be displayed.

**PLEASE WAIT: CHECKING FOR AXES**

If the following display comes up, see the Serial Communication Troubleshooting section of this manual.

**NO AXIS PRESENT, PRESS TEST KEY FOR TEST MENU**

**Note:**The above message will always appear if no axis is connected to the T-21.

If there are no serial problems, all axes numbers that are connected will be displayed.

**AXES PRESENT: 1,2, ETC.**

After displaying the axes numbers the T-21 will automatically go into the monitor mode.

If "AXES PRESENT:" appears, but no axis number is shown, then the drive has no axis number assigned to it. This is okay if only one drive is attached.

### 2.4.1 ERROR MESSAGES

Following is an explanation of various ERROR MESSAGES which could appear on the T-21 display.

#### **Battery in ram tested bad**

This message will come up when any write attempt to the battery RAM failed. This will happen only at power up. This message appears for only 5 seconds. Should this message ever appear, the battery RAM chip should be replaced. The battery RAMs expected life is 10 years. If the battery should fail, call the EMERSON EMC Customer Service Department for instructions for how to return the T-21 for battery RAM replacement.

**Non Volatile memory has been accidentally  
changed! Clear memory - Fault code X**

## **ERROR MESSAGES (Continued)**

When this message appears the CPU has found some indication that the function area in memory has changed. This could be caused by transient voltage fluctuation beyond the specified range of 96 to 264VAC single phase. The function setup should be verified and if needed, reprogrammed. This message will remain until a key is pressed.

**Note: When this message appears, the T-21 will automatically clear the memory where the T-21 parameters are stored. The user function passwords will be reset to the default values.**

### **Serial err**

If a serial error occurs, the T-21 will display the following message. The first line of the display shows the command which was being executed when the serial error occurred. The second line shows the "Type" of serial error that has occurred

Serial Err During Command <command>  
"Error Type Code (X)"

Serial Error types: 1 = Didn't Receive Echo in 2 Seconds  
2 = Received Bad Echo  
3 = Didn't Receive Response in 2 seconds  
4 = Received Bad Response

A serial error can occur for many reasons. However, a common cause of serial errors are bad cable connections and/or faulty cables. If a serial error has been caused by a disconnected serial cable (or a bad connector), the serial cable must be reconnected. When the serial cable has been properly reconnected, the T-21 will automatically re-establish communications with the drive.

If a serial error is caused by incorrect data sent to the positioning drive, (or an invalid axis ID) the operator can "Clear" the error by pressing the "Clear" key. This will cause the T-21 to return to the monitor mode menu after checking for new axes on line.

In the monitor mode, the T-21 is continuously querying the drive. Should there be any error during one of these queries one or more of these error messages will be written to the display. As soon as the drive comes back with a correct answer the error messages will disappear. During normal operation these messages should not appear. If they do happen the system should be checked for proper power grounding and shielding.



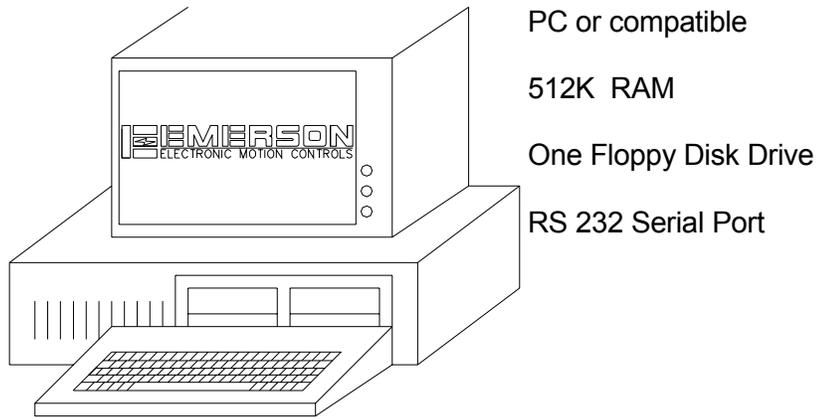
## SECTION 3 SETUP AND PROGRAMMING

### 3.1 OVERVIEW

This section of the manual introduces the hardware and software requirements for setting up and programming a T-21 Data Entry Panel using the special T-21 software provided with the T-21.

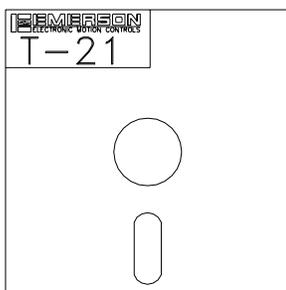
#### 3.1.1 HARDWARE REQUIREMENTS

The T-21 Software will run on any IBM PC or compatible PC with a minimum of 512K bytes of free RAM, one floppy disk drive and a RS232 or a RS423 serial interface port. The serial interface port is the communication connection to set up and program the T-21. The T-21 software requires a minimum of 100K of available storage space (Hard Disk Memory) if you intend to run from a hard disk drive.

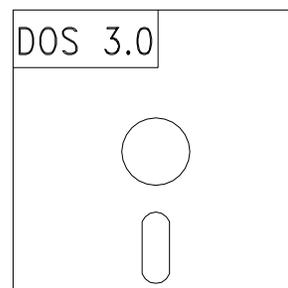


#### 3.1.2 SOFTWARE REQUIREMENTS

The T21.EXE software is supplied on a floppy diskette with this manual. The floppy diskette does not include DOS (Disk Operating System). The DOS version required by T21.EXE is 3.0 or greater. As with any software, a backup copy of the T-21 diskette should be made before starting.



T-21 Software Disk



DOS Version 3.0 Or Later

## SOFTWARE REQUIREMENTS (continued)

Certain file options within the software requires the use of the DOS files COMMAND.COM and PRINT.COM. The operator should ensure that a path is available to these files. This can be accomplished by appropriate use of the DOS "PATH" command or including the COMMAND.COM and PRINT.COM files in the same directory as T21.EXE.

The T-21 software is used to set up and program a T-21 Data Entry Panel from a personal computer. After the set up and programming is complete, the PC can be disconnected and the user information remains in the T-21's non-volatile memory.

**Note:** Once the T21.exe program has been loaded into the memory of the PC, the T-21 diskette is no longer required to be in the disk drive.

## 3.2 T-21 MENU OPTIONS

There are 9 menu options available from the main menu screen, F1 through F9. To select an option, position the cursor over that option using the up/down arrow keys and press the enter key.

Setups can be changed by placing the cursor over the desired data. This data can be changed by either typing a new number or by pressing the +/- keys. (The proper key entries are indicated in brackets). When the desired data is shown it can be entered by pressing the ENTER key.

```
PRESS ESC KEY --- TO EXIT TO DOS
H KEY --- TO GET HELP

COMMUNICATION WORKING? NO

T-21 MENU UER 6.0 1/13/1994

SELECT
F1 -- TEST COMMUNICATION WITH T-21
F2 -- SETUP T-21 FUNCTIONS
F3 -- PRINT LISTING OF T-21 FUNCTIONS
F4 -- CHANGE SERIAL PARAMETERS
F5 -- TERMINAL MODE
F6 -- SAVE ALL FUNCTIONS OF T-21 ON DISK
F7 -- DOWNLOAD A DISK FILE TO THE T-21
F8 -- SETUP FUNCTIONS OF A FILE
F9 -- SETUP NON FUNCTION PARAMETERS
```

Figure 3-4 Establishing Communications

### 3.2.1 OPTION F1 - TEST COMMUNICATIONS WITH T-21

The F1 option will establish communications between the T-21 and the PC. To establish communications, position the cursor over the F1 option by using the up/down arrow keys, then press enter.

When communications have been established a message on the top portion of the screen will read: "COMMUNICATION WORKING? YES". If communications have failed between the T-21 and the PC the message on the top portion of the screen will read: "COMMUNICATION WORKING? NO".

If communications have failed check the following items

1. Serial cable and connectors between the T-21 and PC.
2. Verify the COM port and baud rate setup using the F4 option.
3. Serial cable connectors must be secured with screws at both ends to ensure a reliable serial communication.

### 3.2.2 OPTION F2- SETUP T-21 FUNCTIONS

This option will show the present setup of the function keys (1 through 98) and allows these setups to be changed.

```
FUNCTION NUMBER <01 - 98> ----- 01
FUNCTION ENABLED <Y/N> ----- Y
DATA TO BE CHANGED <+/-> ----- INDEX DISTANCE
UNITS <UP TO 3 CHARACTERS> ----- ST
INDEX/PROGRAM NUMBER <0 - 255> ----- 000
AXIS ID <1 - 9, A - U, 0 = NONE> ----- 1
DATA HIGH LIMIT <N or +/-XXXXXXXX> --- N
DATA LOW LIMIT <N or +/-XXXXXXXX> --- N

MESSAGE

>>> TO EXIT PRESS ESC KEY <<<
>>> TO CHANGE SETUPS, USE UP DOWN CURSOR KEYS, THEN TYPE DATA <<<
>>> TO ENTER CHANGED DATA, PRESS ENTER KEY <<<
```

Figure 3-5 Function Setup Screen

Note: Communication must be working to activate this option.

## 3.2.2.1 DESCRIPTIONS OF FUNCTION SETUP PARAMETERS

### **FUNCTION NUMBER**

When option F2 is opened it will default to function number 1. To see other functions type the function number desired, then press ENTER.

### **FUNCTION ENABLED**

A function must be enabled before it can be set up using the T21.EXE program or accessed by the T-21. Also, when using the F3 (print list) option, the T-21 will only print those functions that are enabled.

### **DATA TO BE CHANGED**

This parameter is used to select the drive parameter that you wish to change with this function. Below is a list of drive parameters you can select from. Use the (+/-) keys to advance to the drive parameters then press the enter key to select.

\*USER DEFINED  
INDEX DISTANCE  
INDEX ACCEL TIME  
INDEX DECEL TIME  
INDEX VELOCITY  
INDEX DWELL TIME  
INDEX FEED VELOCITY  
INDEX COUNT  
TIMED OUTPUT  
DEFAULT INDEX NUMBER  
LIMIT DISTANCE  
JOG VELOCITY FAST  
PROGRAM COUNT  
DEFAULT PROGRAM NUMBER  
JOG VELOCITY SLOW  
FLYING SHEAR COUNT

### **\*USER DEFINED**

The user defined parameter is unique because it allows you to select a serial command to be assigned to a function. When setting up a user defined function you will need to enter a "Command Type". The possible serial commands and command types are listed in appendix B, paragraph .

### **UNITS**

You may enter three letters that represent the distance or position units of your system.

Examples:  
IN for Inches  
GAL for Gallons  
MTR for Meters

### **INDEX/PROGRAM NUMBER**

This parameter determines the program or index number that is to be affected by the function being setup.

### **AXIS ID**

This parameter selects the axis # in a multi-axis system that this function will pertain to. If the system is a single axis system, enter zero.

### **HIGH/LOW LIMITS**

This parameter limits the maximum and minimum value that can be entered for a function. For example: If you set the high limit to be 50.00 and the low limit to be 25.00 the valued entered must be within these two values.

### **PASSWORD**

This command sets the password which allows the operator access to a function. For no password enter zero (0). Each function can have its own independent password.

### **EDIT MESSAGE**

To edit a message for line 1 of the T-21, the cursor must be brought into the message frame. With the cursor in this frame a message of up to 40 characters (including spaces) can be typed. The DELETE, BACKSPACE, and RIGHT/LEFT/HOME/END cursor keys will work in this frame.

The INSERT key will toggle the Insert Mode. With INSERT off, key entries will write over the old message. With insert on, key entries will be inserted moving the text to the right. The ENTER key will enter the message as it appears in the message frame.

## **3.2.3 OPTION F3 - PRINT LISTING OF T-21 FUNCTION**

To obtain a listing of all programmed function keys select this option. A printer must be connected to the PC. The T-21 will print only those functions that are enabled.

## **3.2.4 OPTION F4 - CHANGE SERIAL PARAMETERS**

This option lets the user change the baud rate and the communications channel (1 or 2). All other serial parameters are fixed:

Parity:even  
Stopbits: 1 bit  
Character:7 bits  
No hand shaking

### **3.2.5 OPTION F5 - TERMINAL MODE**

When selected, this option makes the PC act like a terminal. This allows communication with almost any serial device. This mode is useful for troubleshooting, or if desired, to program the T-21 with serial commands as explained under "Programming In Terminal Mode" on page . The help (F6) function will explain more of its operation.

#### **CAUTION**

**Programming should be done entirely with the T21.EXE software or through terminal mode ASCII serial commands - BUT NEVER BOTH. If both programming methods are used there is a chance that not all the parameters entered through terminal mode will be transferred to the T21.EXE software. This may lead to unpredictable behavior of the drive.**

### **3.2.6 OPTION F6 - SAVE FUNCTIONS TO A DISK**

This option creates a disk file of all functions of the T-21. This option is only available when communication between the PC and the T-21 have been established. All 98 functions of a T-21 will be uploaded whether programmed or not and stored on a disk. Functions that have not been programmed will be uploaded with default values.

Note:Only functions that are "Enabled" will be loaded.

### **3.2.7 OPTION F7 - DOWNLOAD TO THE T-21**

This option downloads a disk file to a T-21. Thus the serial link must be working to allow this option. Only programmed functions will be downloaded.

### **3.2.8 OPTION F8 - OFF LINE SETUP**

This option lets the operator change or program T-21 functions of a disk file. This can be done on a PC without being linked to a T-21.

The operator will first be prompted to enter a disk drive letter. The T-21 then searches this drive for all T-21 function files and displays them. The operator can now enter a file name from this list to edit an existing one or enter a new one to create a brand new file. This file is then edited like a T-21. It can be downloaded to a T-21 using the F7 option.

### **3.2.9 OPTION F9 - SETUP NON-FUNCTION PARAMETERS**

This option lets the operator change or program non-function parameters of the T-21. You will be prompted whether this is done on the T-21 or on a disk file.

## SECTION 4 OPERATING MODES

### 4.1 MODE CHANGE KEY

Depressing the MODE CHANGE key will allow the operator to toggle between the "Axis" field and the "Function" field. The LED will be on under the word Axis or Function, showing the operator which part of the display is being changed.

By depressing the (+) or (-) key allows the operator to change axis or the function that is being displayed.

The functions that can be displayed are position (POS), velocity (VEL), dwell (DWL) or count (CNT).

To exit MODE CHANGE press the CLEAR key and the LED on the MODE CHANGE key will go out. The T-21 has three modes of operation, Monitor, Edit, and Test.

### 4.2 MONITOR MODE

While in monitor mode, the Monitor and Operate LED's will be illuminated and the display will be as shown below.



**Figure 4-1**

In monitor mode the status, last index, position, velocity, dwell or count will be continuously updated for the current axis that is displayed.

#### 4.2.1 STATUS FIELD

<u>DISPLAY</u>	<u>EXPLANATION</u>
ECTRL	Drive is controlled by its I/O
SCTRL	Drive is controlled via the serial interface
INDEXING	Drive is indexing
HOME	Drive is homing
PROG	Drive is running a PROGRAM
JOG	Drive is running JOG
TR_LIM	Drive is in HOME-LOCK
CALIBR	Drive is in calibration mode
WT_EXT	Drive is waiting for an input
WT_RES	Drive is waiting for RESUME input
FAULT	Drive is FAULTED
*BUSY*	T-21 is busy with PCX or other Serial Channel A usage.

## **STATUS FIELD (Continued)**

When the "Busy" message appears in the status field, the T-21 will stop sending data to the drive via serial port B. During this time, the T-21 will be receiving data from the PC via serial port A. This data can be a command that was sent to the T-21 or to the Drive. If the command was sent to the drive, the T-21 will act like a switchboard, passing the data to the drive. If the command was meant for the T-21, the T-21 will execute the command.

As soon as the T-21 has completed processing the data received via serial port A, the "Busy" message will disappear. The T-21 will then return to monitoring the drive via serial port B.

All axes are continuously monitored for faults by the T-21 (if dipswitch #4 is OFF), regardless of which axis is the "current" axis. In the event of a fault, the top line of the T-21 display will show which axis has faulted. To get more information regarding the type of fault, press the TEST key. The T-21 will then display an information menu. Press "+" or "-" to review another axis. Press the "CLEAR" key twice to go back to the monitor mode.

As soon as the faulted axis has been reset, the first line of the T-21 display will automatically clear.

To disable the monitoring of all axes except the current axis, set dipswitch #4 of the Serial Setup dipswitches to "ON". This allows faster monitoring of the presently displayed axis.

### **4.2.2 AXIS FIELD**

The number displayed in the "Axis" field is the axis ID of the Drive currently being monitored. If this field is blank, the Drive being monitored does not have an axis ID and is a single axis system. In a multi axis system, the "Mode Change" key can be used to toggle between "Axes" field and the "Functions" field. If axis field is selected, the (+) or (-) key will allow the operator to scroll through the "Axis" and select the "Axis" to be monitored.

To exit MODE CHANGE press the CLEAR key and the LED on the MODE CHANGE key will go out and the new axis and/or function will be displayed.

### **4.2.3 INDEX FIELD**

This field displays the current index in operation for the selected axis.

## 4.2.4 FUNCTION FIELD

This field displays the type of data that is being monitored and displayed in the "Data" field. The "Mode Change" key can be used to toggle between "Axes" field and the "Functions" field. If the function field is selected, the (+) or (-) key will allow the user to scroll through the "Function" to be displayed for the current axis. Listed below are the function "data type" descriptions.

<u>Function</u>	<u>"Data Types"</u>
-----------------	---------------------

Pos:	This will display the current position of the selected axis.
------	--

Vel:	This will display the current velocity of the selected axis.
------	--

Dwl:	This will display the dwell of the current index of the selected axis.
------	--

Cnt:	This will display the index count of the current index on the selected axis.
------	--

## 4.2.5 DATA FIELD

This field displays the value read from the drive for the Function Field "Data Type"

**NOTE: If the field function is "Pos", then the value on the data field can be either "Commanded Position" or "Feedback Position" depending on how the T-21 was setup (see Position Display Command on page ). The default setting is "Feedback Position."**

## 4.2.6 UNITS FIELD

This field is used to display the "Unit" for the function currently shown on the display. If the "Cnt" (Count) function is selected the units field will be blank. The units displayed in monitor mode, are the units read from the drive.

## 4.3 EDIT MODE

### 4.3.1 FUNCTION KEY EDIT

The main feature of the T-21 Data Entry Terminal are the programmable function keys. Functions 1-3 are selected by pressing F1-F3 keys. All functions (1-98) can be selected by pressing the F(X) key and then entering the number of the desired function.

To have access to these functions, input #1, of the digital I/O, must be active. If input #1 is not active an access code must be entered. The function must have been pre-programmed and the T-21 must have recorded at least one drive axes at power up. The serial link between the T-21 and the drive must still be active. Also, an incorrect axis identifier will not allow the function to work. Until the "Data Fields" have been programmed, they will display the default values.

**Table 4-1** Default Data Value

DATA FIELD	VALUE
Units and Message	Spaces
Index/Program #	0
Axis ID	0
Data High Limit	21747483547
Data Low Limit	-2147483648

#### 4.3.1.1 HOW TO USE THE FUNCTION KEYS

Each function key must have been previously programmed before it can be used. See "Programming The T-21" in section 3.

For example: If you wish to change the distance on index number 1, on axis #1, program the function key F1 accordingly. Press the F1 key and the T-21 is ready to accept new distance inputs for axis #1. Function keys can only be selected from the Monitor Mode.

When a function key is pressed, the T-21 checks the number 1 digital input. If this input is active then the function is instantly available for changing drive parameters. If this input is not active then the T-21 will ask for the access code. The operator must enter a 4 digit access code to be allowed to continue. This feature protects the machine from unauthorized tampering. The default access code is 2216. After pressing the F1 key, the display looks like this:



**Figure 4-2**

Function keys F(1) to F(3) will allow you to edit only one parameter each. In it is the distance of index #1 on axis ID #1. The cursor will flash at the first digit in the data field. Type the numbers desired. When the last digit is reached the cursor will return to the first digit. The sign can be changed any time by pressing the + or - keys. When the desired data is attained press "ENTER", which will cause the new data to be sent to the drive.

If the drive accepted the input the T-21 will return to monitor mode. If the new data was not accepted the function will not exit to allow you to input new data. Pressing the CLEAR key will exit to the monitor mode without changing the data. For example: If the you tries to enter data that is out of range an OVER LIMIT or UNDER LIMIT message will appear on the display. At this time the operator can hit any key to return to the "Edit Mode".

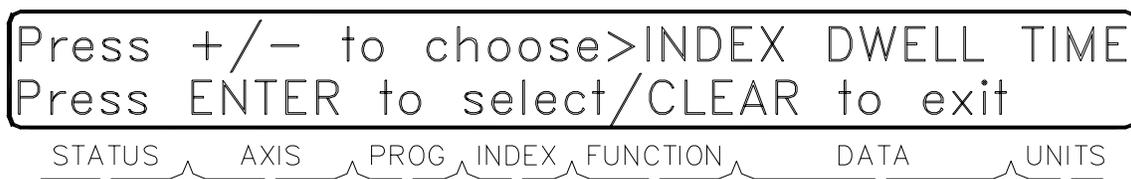
### 4.3.1.2 FUNCTION 99

The difference between Function 99 and functions 1 through 98, is that Function 99 allows the operator access to all of the parameters which can be accessed through the programmable function keys, using only one access code.

To access function 99, press the F(x) key. The T-21 will then prompt the operator to **"ENTER NUMBER OF FUNCTION DESIRED:XX"**, press 99 then "ENTER". After function 99 has been selected, the four digit access code (1751) for function 99 must be entered.

The next step is to choose the parameter that is to be changed. By pressing the + or - keys you can scroll through the available parameters (see page for list of parameters) After a parameter has been selected you must enter a 3 digit index or program number as required (some functions do not require an index or program number). All leading zeros must be entered, for example: to select index #1, enter 001.

**Note: There are 256 indexes available (0 through 255), and 100 programs (0 through 99)**



**Figure 4-3**

Data pertaining to the parameter selected can now be modified. Pressing the ENTER key will send the modified data to the drive. To return to "Monitor Mode" press the CLEAR key.

### 4.3.1.3 FUNCTION 00

Function 00 will clear the portion of memory where the T-21 user parameters (functions 1 through 98) are stored, and set the "user function" access code to its default of 2216. Function 00 will also clear the "user defined" message which appears on the first line of the display when in monitor mode.

**Note:**The user defined message can be defined using the "Q" serial command

To utilize function 00, press the F(x) key, then enter 00, followed by pressing the ENTER key. The T-21 will then prompt the operator for the access code which is 1232. After the access code has been entered, the following message will appear:

```

This will erase all user functions!!!
Continue? (Yes = 1, No = 2) 2

```

STATUS      AXIS      PROG      INDEX      FUNCTION      DATA      UNITS

**Note:**The T-21 memory can also be cleared by using the C9 or CM serial command.

## 4.4 TEST MODE

The TEST key must be pressed twice to get into the Test Menus. There are 2 Test Menus, Test 1 and Test 2. The TEST key when pressed, will bring up the Test 1 menu.

### 4.4.1 TEST MENU 1:

1 = MEM      2 = KEYS      3 = SER      4 = DIPSW  
5 = LEDS      6 = DISPL      7 = INP      8 = TEST2

**Note:**Depressing the CLEAR key will allow the T-21 to exit the Test Menu.

#### Descriptions of test functions (Test Menu 1)

##### 1 - Memory

Depressing the number (1) key will test the RAM memory of the T-21. The display will show the percentage of memory that has been tested.

When the memory test is 100% complete, press the "CLEAR" key. The T-21 will display the following message:

**TESTED RAM (0d000-0ffff)  
Press the CLEAR key to exit.**

## **2 - Keys**

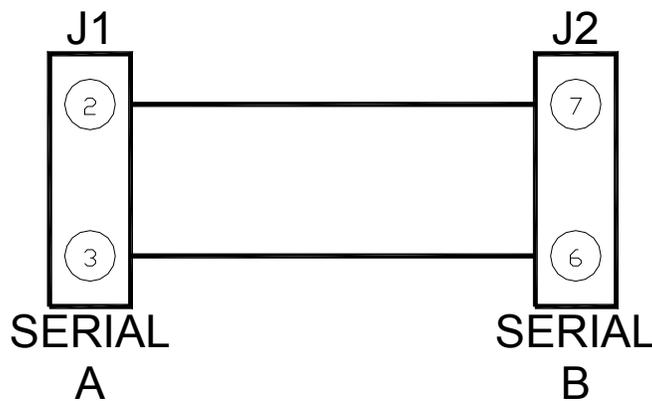
Test 2 is used to test all the keys on the T-21. Pressing the number (2) key enables test 2 and displays the following:

**TEST KEY PAD:  
PRESS ANY KEY TO TEST. CLEAR TO EXIT.**

To test the key pad, simply press the key to be tested and the T-21 will display the character of the key pressed. Pressing the CLEAR will return you to the TEST Menu.

## **3 - Serial Ports**

This test is used to test the serial ports on the T-21 (COM A and COM B). RX and TX of both ports must be connected to each other (RXA to TXB, RXB to TXA).



**Figure 4-5**

When test 3 is selected from the test menu, the following message will appear in the T-21 display:

**TEST SERIAL COM PORTS A AND B:  
CONNECT A & B TOGETHER, THEN PRESS ENTER**

At this time the operator must connect serial ports A & B together (as shown in ), then press the "ENTER" key to begin the test. Internally, a character is sent from serial B, and received at serial A. If the operation is successful, the character that was received at serial A is compared with the one that was sent from serial B. A character is then sent from serial A to serial B where a comparison is made.

During this Operation 4 different errors can occur. The type of error will be displayed on the second line of the T-21 display. The 4 types of errors are listed below:

- 1.Character sent from B, not received at A.
- 2.Bad character received at A.
- 3.Character sent from A, not received at B.
- 4.Bad character received at B.

If any of the errors occur during the test, press the "CLEAR" key to return to the "Test" menu.

#### **4 - DIP Switch**

Test 4 is used to test the DIP switches on the back of the T-21 Pressing the number (4) key will give the following display:

```
DIP_SWITCH STATUS      1 2 3 4 5 6 7 8
BAUD RATE 48000 0 1 0 1 1 1 0
```

**0 = Switch Off**  
**1 = Switch On**

Toggleing any DIP switch will toggle that switch on the display. To exit this test mode, press the CLEAR key

#### **5 - LEDs**

Test 5 is used to test all the LEDs on the front of the T21. Pressing the number (5) key from the test menu will start testing the LEDs and display the LED being tested. The LEDs will continue to cycle on one at a time (each LED will flash 5 times) until the CLEAR key is pressed.

#### **6 - Display**

Test 6 will test every character on the display when the number (6) key is pressed. Every character that the display accepted will be displayed for each character position of the display. The display will continue to cycle through these characters until the CLEAR key is pressed.

#### **7 - Inputs**

Test 7 is used to test the four inputs of the T-21. Pressing the number (7) key will start the test and display the following:

```
TEST INPUTS:      1 2 3 4
                  0 0 0 0
```

**0 = OFF**  
**1 = ON**

Energizing any input will give an on signal for the inputs. To exit, press the CLEAR key.

#### **8 - TEST 2**

Pressing 8 will take you to Test Menu 2.

## 4.4.2 TEST MENU 2

1=CHKRAM            2=CHKPROM            3=POW-UP-CNT  
4=DRV\_ANALOG\_MONITOR      CLEAR to EXIT

Descriptions of test functions (Test Menu 2)

### 1 - CHECKSUM RAM

To perform a checksum of the function program area of the non-volatile read/write memory, press the (1) key. If this is done just after memory was cleared, the checksum should be 5138. The Checksum RAM will be displayed in decimal and hexadecimal values. When a function is changed, the Checksum RAM value will change. Press the CLEAR key to return to the TEST2 menu.

**Note:CHECKSUM RAM test can also be performed using serial command "R" (see page B-9)**

### 2 - CHECKSUM EPROM

Pressing "2" will calculate the checksum of the EPROM. This checksum must be identical to the number printed on the EPROM label, and should not change. Press the CLEAR key to return to the TEST2 menu.

**Note:CHECKSUM EPROM test can also be performed using serial command "T" (see page B-10)**

### 3 - POWER-UP-COUNT

This test will display the number of times the T-21 has been powered-up.

**Note: POWER-UP-COUNT number can also be performed using serial command "P" (see page B-9)**

### 4 - DRIVE ANALOG CHANNEL

This test operation will display the Drv-Analog-Monitor menu. This menu displays the Analog Channels that can be monitored by the T-21. To Monitor a channel, press the corresponding number key for that channel. Press the CLEAR key to return to the DRIVE\_ANALOG\_MONITOR menu.

The first line of the analog monitor screen shows percentage graduations. The second line will show a continuously updated bar graph of the analog value of the selected channel. The first character of this graph is always a sign (+/-) to indicate the polarity of the analog value. The highest reading is always saved and indicated by placing a sign (+ or - to show the peak polarity) on the screen.

## **DRIVE ANALOG CHANNELS:**

CHANNEL    0=STABILITY (not used)  
              1=VELOCITY COMMAND  
              2=ACTUAL VELOCITY (TAC)  
              3=CURRENT  
              4=ANALOG COMMAND (+/-10V)  
              5=ANALOG INPUT VIA PCM (For future use)

**NOTE: Only the drive which is presently accessed will be monitored. If more than one drive is attached and you want to monitor another drive, go back to the MONITOR mode and use the MODE CHANGE KEY to select another drive. Press the CLEAR key two times to return to the TEST2 menu.**

## **APPENDIX A T-21 SERIAL COMMUNICATIONS PROTOCOL**

### **A.1 SERIAL INTERFACE**

The T-21's serial interface sends and expects to receive, an ASCII "string" of information. A "string" is nothing more than a group of ASCII characters. Some of these characters may be meaningful to the T-21 and others may be ignored.

#### **A.1.1 THE TERMINATOR**

A "terminator" must be issued to complete the command string. The terminator serves to tell the T-21 that a complete command string has been received and that processing of that command may begin.

If the T-21 is echoing command strings no internally generated response or report will be sent until the command line terminator has been found to end the command. This keeps command strings intact as they are sent along the serial communications chain.

The terminator is an ASCII carriage return (CR). If LF has been selected (dipswitch #7 on), the T-21 will issue a <CR><LF> at the end of each response, otherwise it will issue a simple <CR>.

#### **A.1.2 ECHOING COMMANDS - FULL VS HALF DUPLEX**

Full and Half-Duplex are terms originally associated with serial communications from terminals but the theories involved can be applied to all serial communications.

**Note: In order for the T-21 to communicate with a DX Amplifier in either Full or half-Duplex mode, the dip-switch settings on each DX Amplifier must have the same "Duplex Mode" settings (see Emerson EMC Positioning Drive Manual).**

##### **A.1.2.1 HALF-DUPLEX**

"Half-duplex" refers to a terminal that internally duplicates a character being typed (or sent) to the screen without the need for the receiver to "echo" the character back to the sender.

The advantage of operating in Half-Duplex, is that a less sophisticated degree of communications is required. The sending device can operate without a receiver if only one-way communication is desired.

Example: When the T-21 and the DX Drive are operating in half-duplex, the DX Drive will echo the response only, not the command back to the screen.

**Note: Programming in Half-Duplex will cause serial communications to be received faster by the DX Amplifier.**

### **A.1.2.2 FULL-DUPLEX**

If Echo or Full-Duplex mode of operation is requested from the T-21 (based on the DIP switch settings on page ), everything sent to the DX Amplifier (or controller device) will be immediately echoed back.

In a Full-Duplex mode, no characters are internally generated from the screen. Instead, characters must be sent back to the sending device, or "echoed" in order to view the communications taking place.

The advantage to Full-Duplex is that you can find out exactly what the T-21 received by watching what it echoes. Therefore, the suggested mode of operation during start up and trouble shooting is Full-Duplex, even if Half-Duplex mode will be used eventually.

Example: When the T-21 and the DX Drive are operating in full-duplex, the DX Drive will echo the command and the response to that command back to the screen.

### **A.1.3 BACKSPACING**

The serial command processor will recognize a backspace (ASCII control "H", code 8) as an "erase" character and remove the previous character sent to it.

## A.2 PC TO T-21 TO DRIVE COMMUNICATIONS

### A.2.1 T-21 TO DRIVE

At power up the T-21 will send commands to the drive using serial port B. The drive will send an echo and a response back to serial B of the T-21. The drive response is processed by the T-21, and if the response from the drive is valid, the T-21 will display the response on the screen.

When the T-21 is monitoring a drive the PC can communicate with the drive, and also with the T-21 by sending a ^D character before it sends T-21 commands when in Terminal mode. ^D denotes CTRL D.

### A.2.2 PC TO DRIVE

A ^E character will allow serial communications between the PC and the drive only, bypassing the T-21. When sending data from a PC to serial port A of the T-21, the T-21 must decide whether the data is meant for the T-21 or the drive. If the command was sent to the drive, the command will bypass the T-21, and the data will be sent to the drive.

Any character coming into the serial B port (from the positioning drive) is automatically sent out to the serial A port. During this time, the T-21 will be receiving data from the PC via serial port A, and stop sending data to the drive via serial port B. If the command was meant for the T-21, the T-21 will execute the command (see paragraph ).

If the PC is talking to the drive while the T-21 is monitoring the drive, then this monitoring will be automatically suspended. Sending a command to the drive, via the T-21, will suspend the T-21 monitoring action until the drive has responded to that command.

As soon as the T-21 has completed processing the data received via serial port A, the "Busy" message will disappear. The T-21 will then return to monitoring the drive via serial port B.

**Note: Faster and safer serial communication from the PC to the drive can be accomplished by pressing the TEST key on the T-21. This will send the T-21 into a TEST MENU mode. In this mode, the T-21 suspends all serial communications with the drive, thus freeing up the lines from the PC to the drive. To leave the TEST MENU press the CLEAR key.**

## A.2.3 PC TO T-21

If the operator wants to send a command to the T-21, then a ^D character must be sent to the A port of the T-21.

When sending commands using T21.EXE software, it is not necessary to enter a ^D or a ^E, the T21.EXE software does this automatically. When exiting "Dumb Terminal" mode, always remember to enter a

**Note: Any time the T-21 is receiving data via serial port A, a "BUSY" message will appear in the status field of the T-21 display.**

^E = *Ctrl* + E Key                      ^D = *Ctrl* Key + D Key

## A.2.4 SERIAL RESPONSES

Serial responses are the responses from a serial command that was sent from a PC to a T-21 Data Entry Terminal. There are three basic types of serial responses: the error response, acknowledge response, and the query response.

### A.2.4.1 THE ERROR RESPONSE

Whenever the T-21 detects something wrong with a serial command that it is trying to process, it will abort and issue an error response consisting of a question mark ("T21?"). The error response could indicate that there was a serial framing error which kept the command from being received properly or that the command was not in the proper format. Most often, the serial command that was sent was incorrect. Check the serial command syntax and try the command again.

### A.2.4.2 THE ACKNOWLEDGE RESPONSE

The acknowledge response, a simple asterisk ("T21\*"), is used to let the command sender know that a valid command has been processed and accepted. In particular, it is used to signify acceptance of setup commands. This response is received after sending a setup type command.

### A.2.4.3 THE QUERY RESPONSE

A query response gives specific information asked of the T-21 by a query command. In general, the information will be preceded by identifiers that indicate what the data represents. This response is received after sending a query type command.

The T-21 converts all drive velocities (DV) to user velocities (UV). It first reads the maximum velocity (MV) and the velocity conversion factor (VC) from the drive. The drive velocity is then converted to the user velocity and displayed.

The conversion formula is  
 **$UV = (DV)(VC) \div (MV)$**

If  $VC = MV$ , then the user velocity is equal to the drive velocity. ( $UV = DV$ ). The T-21 is capable of displaying only integers, so if the result of the conversion is a real number, the T-21 “rounded” the number to become an integer.

For example:           **if DV = 1500; VC = 3; MV = 3000**  
                          Then  **$\frac{1500 \times 3}{3000} = 1.5$**            rounded up UV = 2

When the T-21 sends data to the drive that has been converted, the drive uses the following formula:

**$DV = (UV)(MV) \div (VC)$**

The result of this formula will also be “rounded” to become a *integer*.

## APPENDIX B PROGRAMMING IN TERMINAL MODE

### B.1 T-21 SERIAL COMMANDS

There are 9 basic function setup commands for the T-21. The first character of the command string identifies each basic command. The second and/or third characters must be numbers, which is the function number. (Range is 1-98, function number 00 is illegal.)

The next character must be either an equal sign or a question mark. An equal sign designates a command to be a setup command. A question mark designates a command to be a query command. Spaces are ignored.

There are also non-function commands. Most of these are used for test purposes. Following is an explanation of each command.

Each function key can be setup with either one of 15 predefined functions, or a *User Defined* drive serial command (see list of Drive Serial Commands Manual at the end of appendix B). Several of the following commands will have different meanings if setting up a *User Defined* function.

#### **AXIS COMMAND: (A)**

The axis command sets the axis number of a function. The axis ID will be displayed in the "Axis" field, on line 2 of the display.

Syntax for setup:     A#=X  
                  for query:     A#?  
# = function number (range 1-98)  
X = axis number (must be a legal drive axis identifier, 0 = no axis number.) X can be 0 – 9 or A – V.

#### **DATA TYPE COMMAND: (B)**

The data type command sets the data type of a function. The data type will be displayed in the "Function" field, on line 2 of the display.

Syntax for setup:     B#=XX  
                  for query:     B#?  
# = function number (range 1-98)  
XX = code for data type (1-15).

## DATA TYPE COMMAND: (B) CONTINUED

Below is a list of code numbers which represent each of the data type commands available:

01=INDEX DISTANCE  
02=INDEX ACCEL TIME  
03=INDEX DECEL TIME  
04=INDEX VELOCITY  
05=INDEX DWELL TIME  
06=INDEX FEED VELOCITY  
07=INDEX COUNT  
08=TIMED OUTPUT  
09=DEFAULT INDEX TIMER  
10=LIMIT DISTANCE  
11=JOG VELOCITY FAST  
12=PROGRAM COUNT  
13=DEFAULT PROGRAM NUMBER  
14=JOG VELOCITY SLOW  
15=FLYING SHEAR COUNT

When setting up a user defined function the (B) command controls the way the data is displayed on the T-21. This parameter is referred to as the *Command Type*. See appendix B for a list of possible serial commands and their associated Command Types. The possible Command Types are listed below:

Type 1:        +/- XXXXX.XXX  
                  -decimal point read from drive  
                  -signed  
                  -with modifier  
                  -examples: positions, lengths, distances

Type 2:        XX.XXX  
                  -decimal point fix = 3  
                  -unsigned  
                  -with modifier  
                  -examples: accelerations, decelerations, delays

Type 4:        X.XXXX  
                  -velocity decimal point read from drive  
                  -unsigned  
                  -with modifier  
                  -example: velocity

Type 7:        XXXXX  
                  -no decimal point  
                  -unsigned  
                  -with modifier

Type 9:        XXX  
                  -no decimal point  
                  -unsigned  
                  -with modifier

**FUNCTION COMMAND: (F)**

The function command sets the two character drive command for the function.

Syntax for setup:    F#=XX  
                  for query:        F#?

# = function number (range 1-98)

XX = two character serial command code. Refer to Serial Commands Manual P/N 400255-00.

**Note: When using one of the 15 preset commands, F should be set to nothing.**

**INDEX NUMBER COMMAND: (I)**

This command will set the index or program number of a function. The index or program number will be displayed in the "Index" field or the "Prog" field, on line 2 of the display.

Syntax for setup:    I#=XXX  
                  for query:        I#?

# = function number (1-98)

XX X= if index number (0-255)

                 if program number (0-63)

User Defined: When using serial commands, the I setup value must be the command modifier. (See Serial Commands Manual P/N 400255-00). If there is not a command modifier, set I to 0.

Syntax for setup:    I#=XXX  
                  for query:        I#?  
                  No modifier:    I# = 0

# = function number (1-98)

XX X= command modifier

### **MESSAGE COMMAND: (M)**

This command programs the message of a function. The message appears on the first line of the display when the function is sent to the T-21.

Syntax for setup: M#=ABC  
for query: M#?

# = function number (1-99\*)

ABC = Message. Can be any ASCII character. Up to 40 characters allowed.

**Note: The message command is the only command that allows access of function #99.**

### **UNIT COMMAND: (U)**

This command sets the engineering units for the function selected. These characters will be displayed in the "Units" field, on line 2 of the display.

Syntax for setup: U#=ABC  
for query: U#?

# = function number (1-98)

ABC = any ASCII character (up to 3 characters allowed)

### **HIGH LIMIT COMMAND: (H)**

This command sets the high limit of data entered. The sign has meaning for distance data and fly shear count only.

Syntax for setup: H#= ±NUMBER  
or: H#=N  
for query: H#?

# = function number (1-98)

± = sign

NUMBER = up to 8 digit number

N = No limits (N=2147483547)

**Note: The T-21 will verify that all data sent to the drive is within range of the high and low limits. If the data being sent to the drive is within limits (high and low) the data will be sent to the drive. If the data is out of range (too high or too low) an *overlimit* or *underlimit* message will flash in the data field of the T-21 display. To clear an overlimit or underlimit message, hit any key to continue.**

### **LOW LIMIT COMMAND: (L)**

This command sets the low limit of data entered:

Syntax for setup: L#= ±NUMBER  
                  or: L#=N  
                  for query: L#?

# = function number (1-98)  
+/- = sign  
NUMBER = up to 8 digits  
N = No limit (-2147483547)

**Note: See note for high limit command on previous page.**

### **PASSWORD COMMAND: (PW)**

This command sets the password which allows the operator access to a function.

Syntax for setup: PW#=X  
                  for query: PW#?

# = function number (0-99)  
X= a four digit number (0-9999)

**Note: When PW#=0, then access to the associated function is allowed without an access code. Any value different than (0), will bring up a menu prompting the operator for an access code for that function.**

Default access code values for functions 0 – 99.

PW0 = 1232  
PW1-98 = 2216  
PW99 = 1751

**Note: PW# = 0 is equivalent to input #1 being on.**

### **DATA VALID COMMAND: (V)**

This command tells the T-21 that data for this function is valid. It is up to the programmer to make sure that this is true. The T-21 must find a "V" in the selected function in order to allow the user access from the T-21 keyboard to this function.

Syntax for setup: V#=X  
                  for query: V#?

# = function number (1-98)  
X= setup valid code (V means valid)

## B1.1 NON-FUNCTION COMMANDS

These commands are available only when in terminal mode, and cannot be accessed by T21.exe software.

### POSITION DISPLAY COMMAND (D)

This command tells the T-21 what type of position to display: Feedback position or commanded position.

Syntax for setup: D=0 or D=1  
for query: D?

The D=0 command tells the T-21 to display FEEDBACK POSITION.  
The D=1 command tells the T-21 to display COMMAND POSITION.

The position will be displayed in *Monitor Mode* when the *Pos* function has been selected. *Pos* will appear in the function field of the display and the value of either feedback position or command position will be displayed in the data field. (Default is feedback position).

### FLY SHEAR CONVERSION (N)

With this command, the external encoder pulses can be converted to units. (As inches, mm, etc.) The number entered with this command determines how many *units* equal one encoder revolution.

The following conversion formula is used:

$$\text{FLY SHEAR COUNT} = \frac{\text{EXTERNAL STEPS} * \text{UNITS/REV}}{\text{STEP/REV}}$$

The T-21 will display the value for “Fly Shear Count”. The “External Steps” data is read from the drive. This is the value that will appear on the PCX “Program” screen as data for R (RESUME). “Units/Rev” is a constant that is set using the serial command “N”. “Steps/Rev” is also a constant that is set using “N1” serial command.

**Note: Both (N) and (N1) are T-21 commands.**  
**Units per revolution (N)**

Syntax for setup: N = X  
for query: N?

X = Units/rev., range: 0-65535

The number entered (Units/Rev) determines how many units equal one encoder revolution. The decimal point is the drive’s distance must be considered. If the encoder wheel has a circumference of 12 inches and the distance decimal point is two, then you should enter: N=1200. If the decimal point is three, you should enter N=12000. Default value is N=1 for *first time* power up.

## **STEPS PER REVOLUTION (N1)**

This command allows the operator to change the external encoder steps per revolution. This value is used when making the conversion for "Fly Shear Count".

Syntax for setup: N1 = X  
for query: N1?

X = steps per revolution.  
Default at power up N1=4000

**Note: The N serial command allows N=0. When N=0, then the value for N1 will be equal with the value of N. In this case, the "External Steps" that are seen on the PCX screen will be the same as the "Fly Shear Count" on the T-21.**

## **B.2 T-21 COMMANDS**

These commands are used during check out and must be used with care.

### **CLEAR MEMORY COMMAND: (C9) OR (CM)**

This command causes the T-21 to clear the function setup area of the memory. After this the T-21 will restart. This will erase all setups! The test mode will be exited.

Syntax: C9 / CM <CR>

**Note: This command is equivalent to function 00.**

### **ID COMMAND: (E)**

This command will return the identification of the T-21 unit. The response will be in the following format:

**T21A Ver x.x            DATE, year**  
Syntax: (query only): E?

### **LED OFF COMMAND: (F)**

This command will turn all front panel LEDs off.

Syntax: F

**READ INPUTS COMMAND: (G)**

This command will return a hexadecimal number to show the status of the 4 inputs of the T-21. See the table below for input status.

Syntax (query only):            G?

**Table B-1**

<b>HEXADECIMAL NUMBER</b>	<b>INPUT #1</b>	<b>INPUT #2</b>	<b>INPUT #3</b>	<b>INPUT #4</b>
0	off	off	off	off
1	off	off	off	on
2	off	off	on	off
3	off	off	on	on
4	off	on	off	off
5	off	on	off	on
6	off	on	on	off
7	off	on	on	on
8	on	off	off	off
9	on	off	off	on
A	on	off	on	off
B	on	off	on	on
C	on	on	off	off
D	on	on	off	on
E	on	on	on	off
F	on	on	on	on

### **KEY COMMAND: (K)**

This command returns the key presently activated. The numeric and +/- keys will return the ASCII character for each key.

**Table B-2**

<b>T-21 Key</b>	<b>ASCII Character</b>
MODE CHANGE	M
CLEAR	C
ENTER	E
TEST	T
F1	(smiling face)
F2	(frowning face)
F3	♥
F(x)	♦

Syntax (query only): K?

### **LED ON COMMAND: (O)**

This command will turn all front panel LEDs off.

Syntax: F

### **POWER UP COUNT COMMAND: (P)**

This command will return or set the number of times the T-21 has been powered up.

Syntax (query only): P=?

**Note: Test menu 2, option #3 is equivalent to Power Up Count Command.**

### **RAM CHECKSUM COMMAND: (R)**

This command returns the checksum of the function setup portion of the RAM.

Syntax (query only): R?

This value displayed, will be in hexadecimal.

**Note: The same information can be obtained using the test menu by selecting option 8, then option 1.**

### **DIPSWITCH COMMAND: (S)**

This command returns the present setting of the dipswitch as a hexadecimal number.

Syntax (query only): S?

**Note: Test menu option #4 will give a more complete description regarding dipswitch status.**

### **EPROM CHECKSUM COMMAND: (T)**

This command returns the checksum of the EPROM.

Syntax (query only): T?

The value displayed will be in hexadecimal.

**Note: Test menu option #2 will give a more complete description regarding EPROM status.**

### **MESSAGE COMMAND: (Q)**

This command will print a message to the display on line 1.

Syntax: Q = MESSAGE

Where MESSAGE is any ASCII string up to 40 characters.

## B.3 DRIVE SERIAL COMMANDS

Below is an alphabetic list of serial command, command types and modifiers. If you have questions about the function of a specific command, refer to the Serial Commands Manual P/N 400255-00.

Command	Command Type	Description	Modifier	Comments
AA	2	FOLLOWER CYCLE ADJUST	None	
AL	2	ACCEL LIMIT	None	
AS	9	AUTO SERIAL REPORTING FLAGS	Index #	
AT	2	INDEX ACCEL RAMP	None	
AV	4	ANALOG COMMAND CHANNEL VELOCITY	None	
BR	9	BRIDGE INHIBIT	None	
CA	7	FOLLOWER RATIO ADJUST VEL.LIMITS	0,1	
CO	7	INDEX COUNT	Index #	
CP	1	COMMAND POSITION	0,1	
CY	9	CYCLE EDIT NUMBER COMMAND	None	
DA	2	FOLLOWER CYCLE ADJUST MAX DECEL	None	
DB	7	ANALOG DEADBAND	None	
DL	2	DECEL LIMIT	None	
DO	9	FOLLOWER DROPOUT POSITION ANGLE	None	
DS	1	INDEX DISTANCE	Index #	
DT	2	INDEX DECEL RATE	Index #	
DW	2	INDEX DWELL TIME	Index #	
EE	9	EXTERNAL ENCODER COUNTING MODE	None	
FA	2	FEED ACCEL RAMP	Index #	
FC	7	CYCLE FOLLOWER CORRECTION SPAN	None	Use CY to select the cycle to edit
FD	2	FEED DECEL RAMP	Index #	
FL	1	CYCLE FOLLOWER LENGTH/FEED SPAN	None	Use CY to select the cycle to edit
FN	9	FOLLOWER CYCLE SENSOR COUNT	None	
FO	9	CYCLE FOLLOWER OVERLAP	None	
FV	4	FEED VELOCITY	Index #	
FZ	7	CYCLE FOLLOWER SENSOR VALID ZONE	None	Use CY to select the cycle to edit
HA	2	HOME ACCEL RAMP	Home #	
HD	2	HOME DECEL RAMP	Home #	
HI	4	HOME IN VELOCITY	Home #	
HO	7	HOME OFF VELOCITY	Home #	
HP	1	HOME POSITION	Home #	
HR	4	HOME RESOLVER VELOCITY	Home #	
HT	7	HOME TYPE	Home #	

IC	7	INDEX TORQUE CURRENT FEED LIMIT	Index #	
IN	7	INDEX DEFAULT/RETURN/SLIP INDEX	0,1	
IT	7	INDEX TYPE	Index #	
JA	2	JOG ACCEL RAMP	None	
JD	2	JOG DECEL RAMP	None	
JE	9	TIME BASE FOR JOGS	0,1	
JF	4	JOG FAST	None	
JG	4	JOG	None	
JS	4	JOG SLOW	None	
JT	9	SERIAL JOG TORQUE FLAG	None	
LD	1	LIMIT DISTANCE	Index #	
LR	9	LINEAR RAMPS	None	
MA	2	MAXIMUM ACCEL/DECEL RAMP	None	
MC	9	MASTER CYCLE SENSOR COUNT	None	Use CY to select the cycle to edit
ME	7	MAXIMUM ERROR	0-3	
ML	1	MASTER CYCLE LENGTH	None	Use CY to select the cycle to edit
MS	9	MASTER SUMMATION AVERAGING CNT	None	Use CY to select the cycle to edit
MV	4	MAXIMUM VELOCITY	0-2	
MZ	7	MASTER CYCLE VALID ZONE	None	Use CY to select the cycle to edit
OD	7	PGO DELAY FROM END OF INDEX	Index #	
OT	2	PGO ON TIME(0=LEAVE ON)	Index #	
PA	9	FOLLOWER CYCLE SUMMATION AVG CNT	None	Use CY to select the cycle to edit
PC	7	EDIT PROGRAM COUNT	Prog #	
PH	7	PHASE CORRECTION	0-3	
PN	7	NEGATIVE PHASE ANGLE LIMIT	None	Use CY to select the cycle to edit
PP	7	POSITIVE PHASE ANGLE LIMIT	None	Use CY to select the cycle to edit
PR	7	PROGRAM	0,1	
PY	9	DIRECTION POLARITY	None	
RO	7	HOME RESOLVER OFFSET	Prog #	
RP	1	ROTARY ABSOLUTE POSITION	None	
SD	2	STOP DECEL RAMP	None	
SF	7	SKIP FOLLOWER SENSOR ANGLE	None	Use CY to select the cycle to edit
SL	7	SELECT LINES	0-4	
SM	7	SKIPPED MASTER SENSOR ANGLE	None	Use CY to select the cycle to edit
SP	7	SUSPEND/RESUME PROGRAM	None	
SV	4	SYNC VELOCITY	None	
TA	7	FOLLOWER PHASE TARGET ANGLE	None	

TB	7	INTERNAL TIME BASE RATIO	None	
TC	7	PHASE/TARGET ANGLE	None	Use CY to select the cycle to edit
TD	2	TRAVEL LIMIT DECEL RAMP	None	
TQ	7	TORQUE MONITOR RESET	0,1	
VC	4	VELOCITY CONVERSION NUMBER	0,1	
VE	4	INDEX VELOCITY	Index #	
VL	4	VELOCITY LIMIT	0-2	
VP0	7	VELOCITY DECIMAL POINT	0,1	
WP1	2	MAXIMUM TIME LIMIT	None	
WR	7	IN POSITION RANGE	None	
WT	2	IN POSITION TIME	None	

## APPENDIX C SPECIFICATIONS

**PROCESSOR:** 8097 16 bit microcomputer, 12 mHz, crystal

**MEMORY CAPACITY (BYTES):** 32k prom, 32k Lithium Battery Ram

**EXTERNAL I/O CAPABILITY:**

Serial Interface Port: RS423 compatible (2 ports)

Digital I/O: 4 inputs

**ENVIRONMENTAL CHARACTERISTICS:**

Operating Temp: 0° to 60° C

Relative Humidity: 0 to 95%, non-condensing

**PHYSICAL CHARACTERISTICS:**

Width: 9.3" (23.6cm)

Height: 8.6" (21.8cm)

Depth: 3.5" (8.89cm)

Weight: 6 lbs. (2.73kg)

**ELECTRICAL CHARACTERISTICS:**

Power Requirements: 96-264 VAC, 50-60 Hz, 1 A max

On Board I/O Power: +12VDC, 200 mA max

(The I/O power is intended for T-21 inputs only.)





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