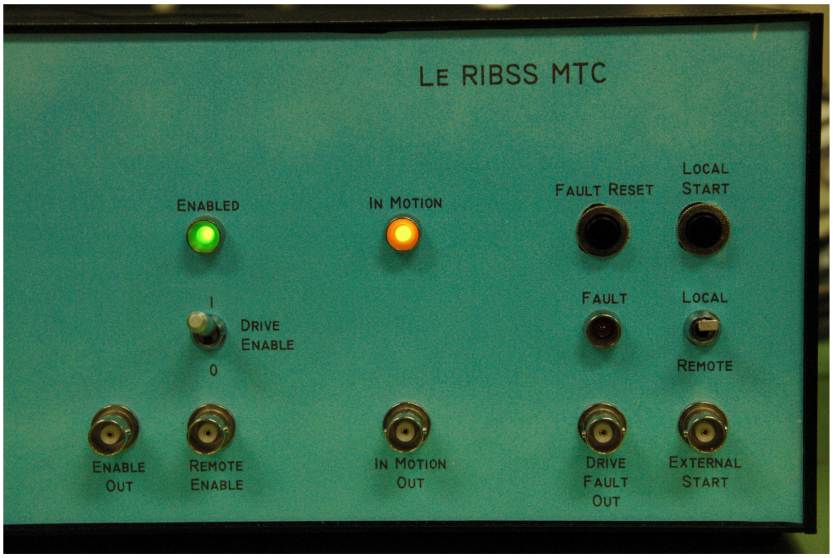
LeRIBSS MTC MANUAL

Issue #1

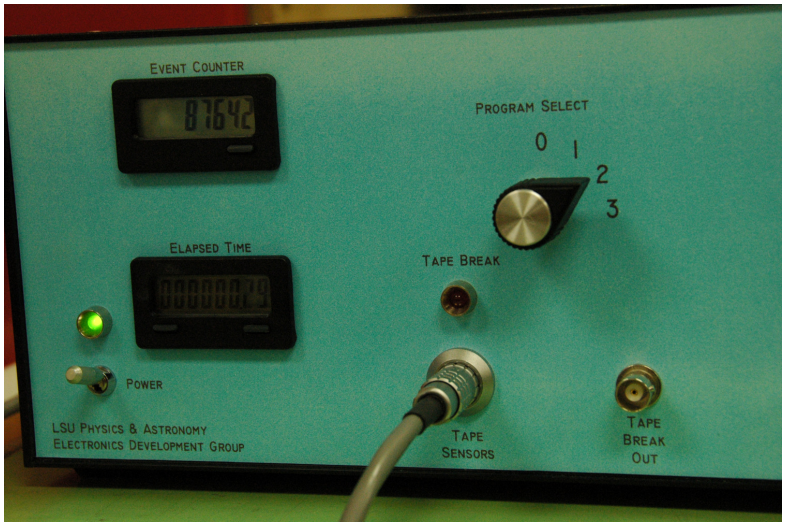
March, 2008

Contents:

MTC Control Unit



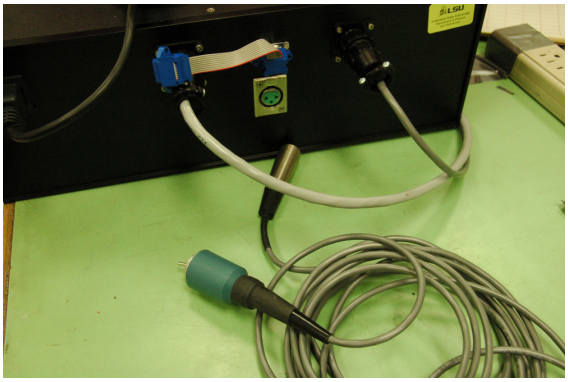
Most of the labeling is self-explanatory. The unit is operated in the *local mode* when installing new tape and testing the system. Then, the *local start* initiates the program. When in the *remote mode*, an *external start* will initiate the program. The drive fault occurs when the motor is unable to turn properly, i.e. the tape is "jammed". The *in motion out* can be connected to an oscilloscope to measure the move time. The *remote enable* and *remote out* connections are not really necessary, but are provided (just in case) for some possible unusual situation.



The *event counter* counts the number of moves. It resets to zero when the power is off. The *elapsed time* represents the time since the last move. The *program select* switch has

4 positions, each of which represents a different "move" sequence. The "move" programs are accessed by the laptop computer. This is explained in the next section. Once these programs are set, the laptop is no longer needed. The laptop's only function is to alter the programs denoted by 0, 1, 2, and 4. The *tape sensor* connection goes to the back of the MTC. If the tape breaks, the tape break light is lighted and the drive motor is disabled until the tape is fixed or the *tape sensor* disable connector is installed. This is shown in the photo below. This "plug" is also needed whenever the aluminized mylar tape is used since it is semitransparent and the tape-break diodes will be energized. In that case, however, it is not possible to know when/if the tape breaks. Since the "Black Watch" tape will be used almost exclusively, this plug will not be used very often, except occasionally for testing purposes.

The back of the drive unit contains the connections to the drive motor, to the computer and a connector to temporarily attach the remote "start/stop" switch. This switch is used only during tape loading procedures. It must be removed when that operation is completed.



MTC Control Unit Definitions, Information, and Specifications

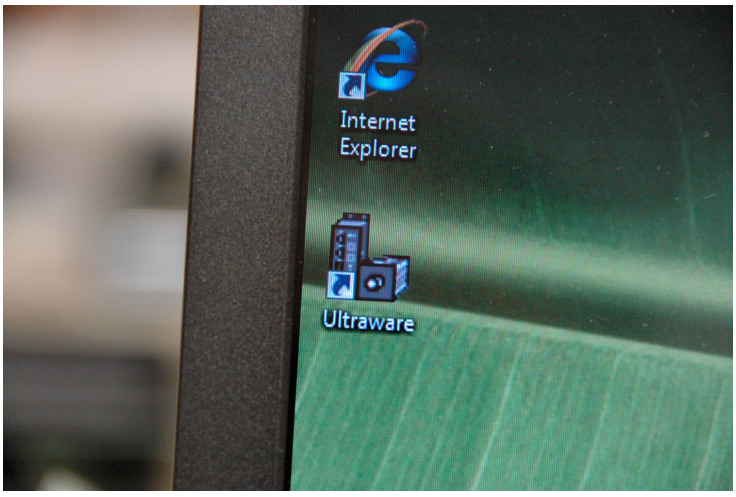
This table is also contained on the enclosed CD titled *Front_Panel*

Front Panel		
Event Counter	Counter	Counts the number of tape moves. Resets on power off.
Elapsed Time	Timer	Counts the time between moves. Resets when a move begins and restarts after the move.
Program select	Rotary Switch	Selects which Index to execute in the Ultraware software. Program 0 = index 1 Program 1 = index 2 Program 2 = index 4 Program 4 = index 8 Drive must be disabled and re-enabled after changing programs for the new selection to take affect.
Tape Break	Red LED	Indicates that one of the tape sensors has been tripped and the drive is disabled.
Tape Sensor	Input 4 Pin Lemo	Connection to the tape sensors. If not connected, a broken tape fault will disable the drive
Tape Break Out	Output BNC	5 volt TTL High when broken tape fault is present, low otherwise.
Enable	Amber LED	Indicates that the drive is enabled.
Drive Enable	Toggle Switch	When the Local/Remote switch is in the Local position, Drive Enable switch enables and disables the drive. When the Local/Remote switch is in Remote position, this switch has no function.
Enable Out	Output BNC	5 volt TTL signal. High when drive is enabled, low otherwise.
Remote Enable	Input BNC	Input that remotely enables the drive when the Remote/Local switch is in the Remote position. High to enable.
In Motion	Amber LED	Indicates that the motor is in motion.
In Motion Out	Output BNC	5 volt TTL signal. High when drive is in motion, low otherwise
Fault Reset	Push Button	Clears Faults associated with the motor and drive. Will not clear a broken tape fault.

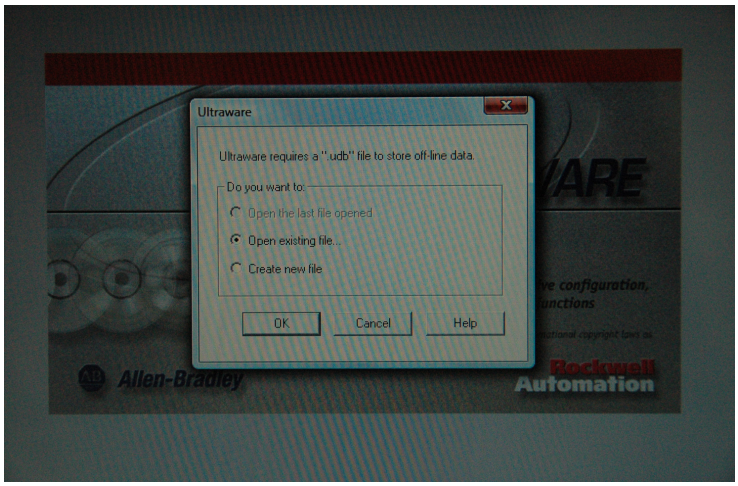
Drive Fault Out	Output BNC	5 volt TTL signal. High when a Drive fault is present (does not indicate broken tape faults).
Local Start	Push Button	When the Local/Remote Switch is in the Local position, Local Start switch starts the index corresponding to the program select switch. When the Local/Remote switch is in the Remote position, the button has no function.
Local/Remote	Toggle Switch	When in Local, Enable and Start commands are controlled by the front Panel. When in Remote, control is via the Remote Enable and External Start BNC's.
External Start	Input BNC	Input that remotely starts the index corresponding to the program select switch when the Local/Remote switch is in the Remote position. Min 2 msec positive TTL pulse.

Programming the MTC Control Unit

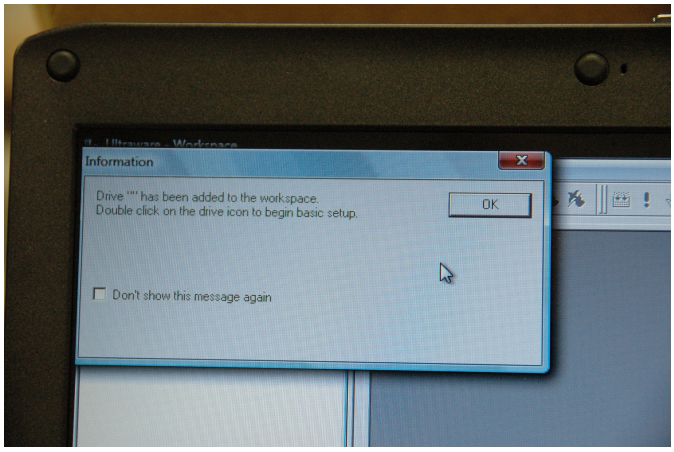
Attach the laptop to the drive unit using the USB to RS232 cable. Initialize the Allen-Bradley *Ultraware* program.



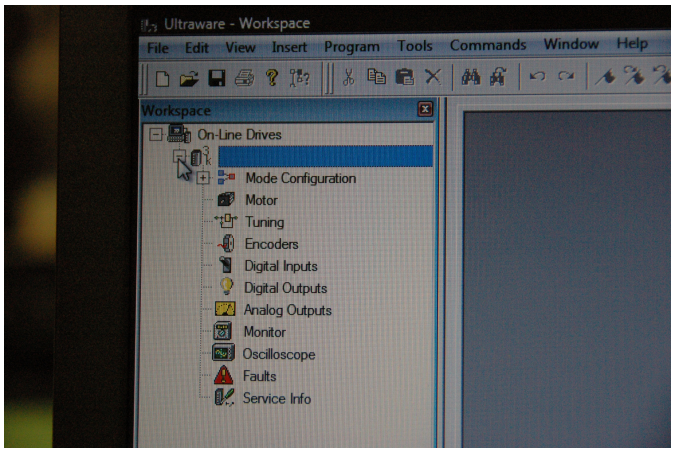
“Cancel”



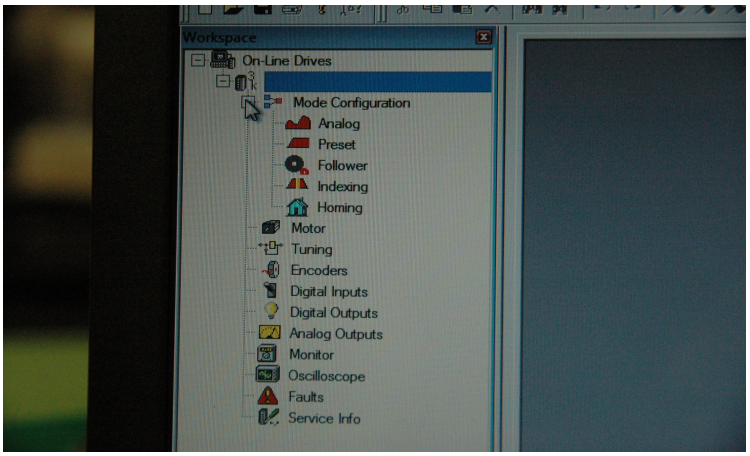
“OK”



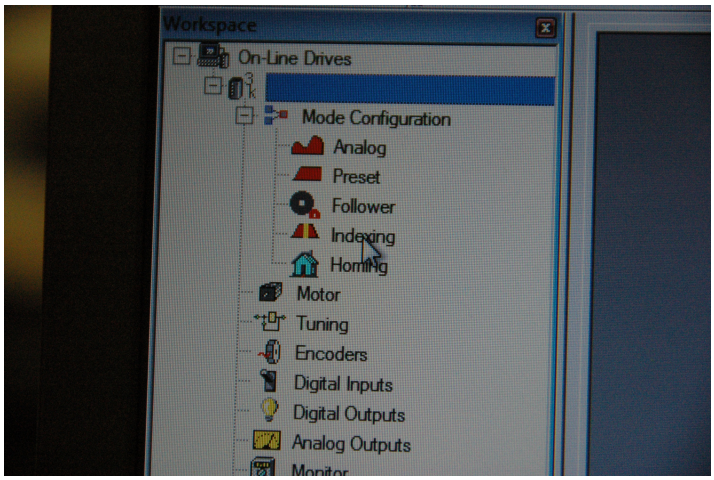
Open

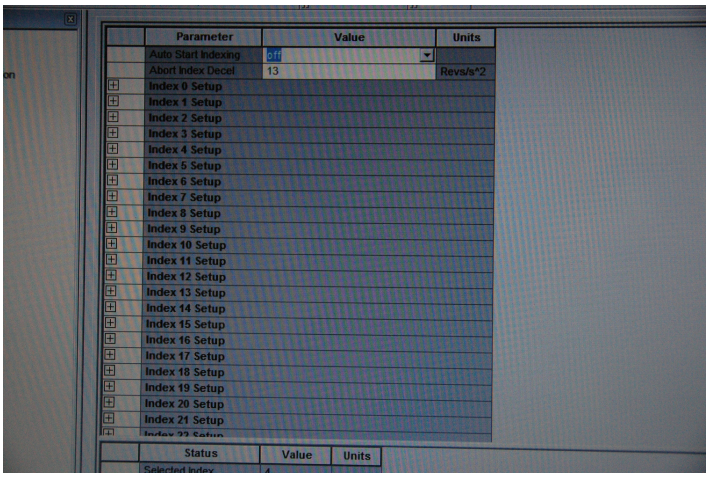


Open Mode Configuration



Open Indexing





There are 64 different index slots. While they can all be used in programmatic ways, only four (4) are "loaded" into the control unit. These are index numbers 1, 2, 4, and 8. The correspondence between index number and program number is:

$$\textbf{Index \# = } 2^{\textbf{program \#}}$$

Thus Index 1 = Program 0
Index 2 = Program 1
Index 4 = Program 2
Index 8 = Program 3

Program Parameters

Mode: Incremental

Distance: Units are in counts.

1.98×10^{-3} cm/count
7.80×10^{-4} in/count

505 counts/cm
1282 counts/in

7692 counts = 6.0 inches
15385 counts = 12.0 inches
23077 counts = 18.0 inches

Batch Count: 1

Dwell: The time between moves.
Units in milliseconds.

Velocity: The speed after acceleration is over.
Units in RPM.

Note: For short moves this essentially plays no role for the accelerations and decelerations used here because there is no "flat" spot on the curve (see below).

Acceleration: Units Rev/s^2

The Tension Device was designed for a maximum acceleration of 200 rev/s^2. Accelerations above this value can be used when the moves are longer than 12 inches (a rough number) or with the tension device disabled (remove spring and let rest on bottom), but then the registration of the tape is not accurate. This would be OK for the "take-away" mode. If accelerations greater than 200 rev/s^2 are used in the "move and count" mode, then the "thicker" pressure block must be utilized . Examples of these various settings are given below.

Deceleration: Units Rev/s^2

The Tension Device was designed for a maximum deceleration of 200 rev/s^2. Decelerations above this value can be used when the moves are longer than 12 inches (a rough number) or with the tension device disabled (remove spring and let rest on bottom), but then the registration of the tape is not accurate. This would be OK for the "take-away" mode.

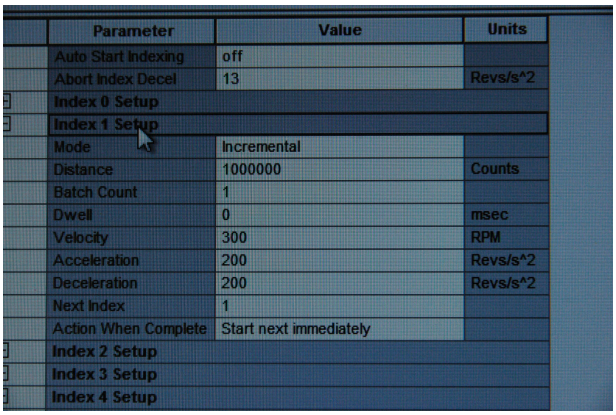
Next Index: Sends the program to the specified index number.

Action When Complete: Tells program what to do next.

Initial Setup

Index #1 (Program 0)

The settings are shown below. This is the set-up for the tape-loading procedure.

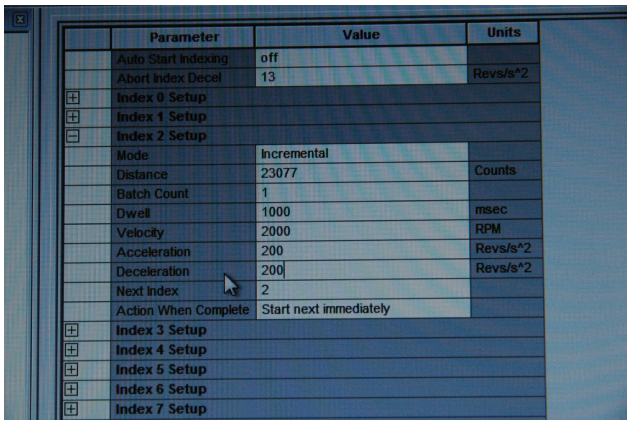


Parameter	Value	Units
Auto Start Indexing	off	
Abort Index Decel	13	Revs/s^2
Index 0 Setup		
Index 1 Setup		
Mode	Incremental	
Distance	1000000	Counts
Batch Count	1	
Dwell	0	msec
Velocity	300	RPM
Acceleration	200	Revs/s^2
Deceleration	200	Revs/s^2
Next Index	1	
Action When Complete	Start next immediately	
Index 2 Setup		
Index 3 Setup		
Index 4 Setup		

Note that the distance is just set for a "long" move (1,000,000 counts or 780 inches) and then the "next index" sends it back to the "top" and the "Action When Completed" tells it to send it back immediately. The "dwell" is set to zero so there is no time between. The net result is a continuous move of the tape.

Index #2 (Program #1)

This is the setup for a move of 18 inches or 46 cm (distance = 23,077 counts) with one second between moves (Dwell = 1000 ms). Velocity will have an effect here. This will be discussed below. The setup below is well within the design parameters, and results in a move time of 238 ms.



Parameter	Value	Units
Auto Start Indexing	off	
Abort Index Decel	13	Revs/s^2
Index 0 Setup		
Index 1 Setup		
Index 2 Setup		
Mode	Incremental	
Distance	23077	Counts
Batch Count	1	
Dwell	1000	msec
Velocity	2000	RPM
Acceleration	200	Revs/s^2
Deceleration	200	Revs/s^2
Next Index	2	
Action When Complete	Start next immediately	
Index 3 Setup		
Index 4 Setup		
Index 5 Setup		
Index 6 Setup		
Index 7 Setup		

However, this is a "longer" move and as stated above, longer moves can

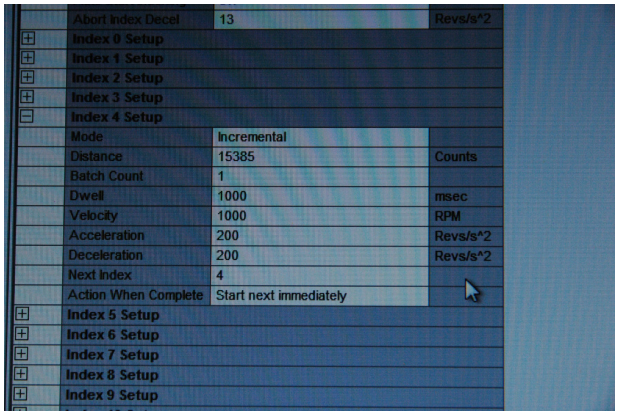
sustain greater accelerations and decelerations. Keeping all else constant, one can get the following move times:

Velocity (RPM)	acceleration (rev/s^2)	deceleration (rev/s^2)	move time (ms)
2000	200	200	238
2000	300	300	198
2000	400	400	168
3000	500	500	150

The precision of the location of the "activity spot" becomes less with the greater accelerations. It is recommended that the "thicker" pressure block be utilized above 200 rev/s^2 if precision on the "spot" is required.

Index #4 (Program #2)

This is the setup for a move of 12 inches or 30 cm (distance = 15,385 counts) with one second between moves (Dwell = 1000 ms). The setup below is within the design parameters, and results in a move time of 198 ms.



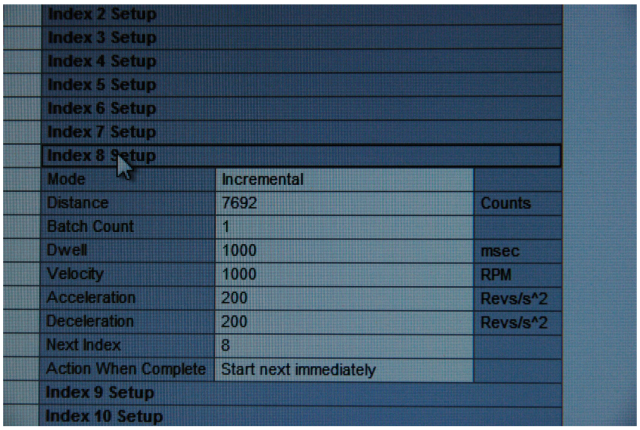
Keeping all else constant, one can get the following move times:

Velocity (RPM)	acceleration (rev/s^2)	deceleration (rev/s^2)	move time (ms)
1000	200	200	198
2000	300	300	158
2000	400	400	138

The precision of the location of the "activity spot" becomes less with the greater accelerations. It is recommended that the "thicker" pressure block be utilized above 200 rev/s^2 if precision on the "spot" is required.

Index #8 (Program #3)

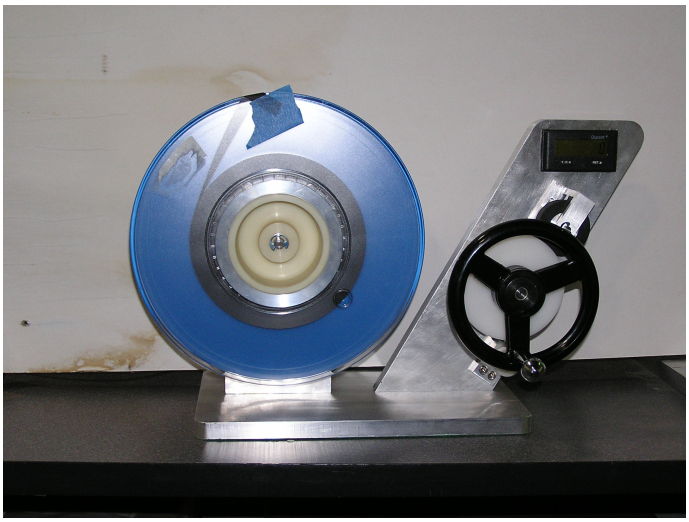
This is the setup for a move of 6 inches or 15 cm (distance = 7,692 counts) with one second between moves (Dwell = 1000 ms). Velocity will not have an effect here. The setup below is results in a move time of 138 ms.



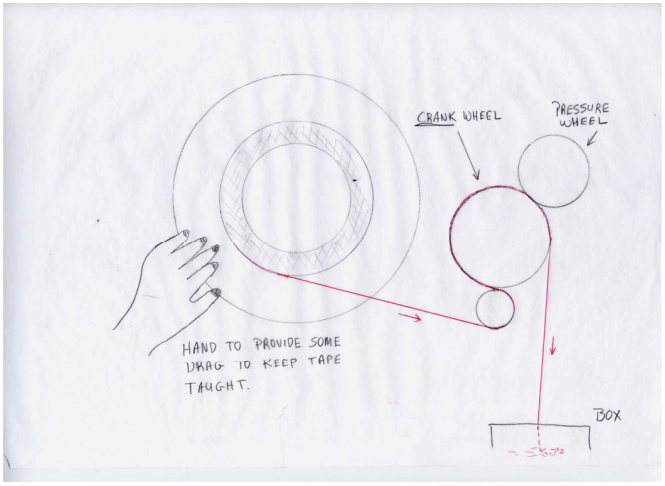
Keeping all else constant, one can get the following move times:

Velocity (RPM)	acceleration (rev/s^2)	deceleration (rev/s^2)	move time (ms)
1000	200	200	138
	Remove Spring in Tension Device for the following setups		
1000	300	300	112
2000	400	400	98
2000	500	500	86
3000	800	800	68

Measuring out tape



Install a reel of tape on the spool mount. Thread the tape through the unit as shown in the figure below.



Let the leader hang into a clean cardboard box. Set the counter to zero and start cranking tape into the box. The counter records in 0.01 units per foot. Thus one foot is 100 units. 300 feet would be 30,000 on the counter. Measure out 300 feet of tape, cut it, and tape the end to the outside of the cardboard box fore easy retrieval.

Comment on length of tape:

> Long moves, on the order of 2 feet or more, pack into the cassette in such a way that 400 to 500 feet of tape could be used. For the short moves required at HRIBF, however, the packing is such that a smaller amount of tape is called for. To be safe, limit the amount of *Black Watch* tape to approximately 300 feet. If other tapes are used, then one should determine the maximum length empirically.

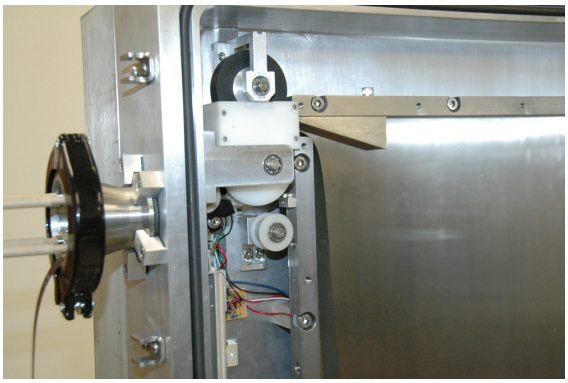
Loading Tape

1. Using the tape measuring device, measure out 300 feet of tape and spool it carefully into a clean cardboard box. Be sure to Scotch-tape the "end" of the tape to the side of the box so that it does not get lost in the "pile" of tape.

2. Remove the cover from the tape cassette. It is fastened with 24 8-32 vented screws. Vented screws are not necessary in this application since venting is provided on the side, but they are preferred .

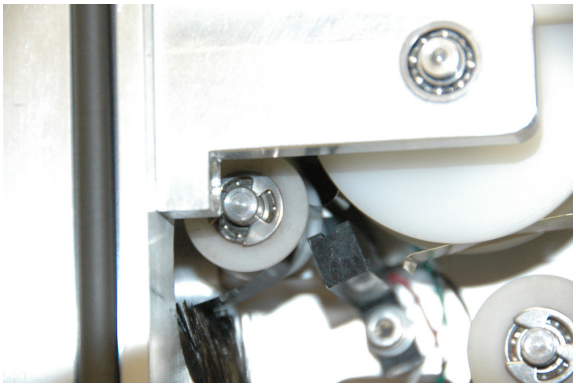
3. Remove the PEEK block that puts tension on the rubber pressure wheel. The "standard" PEEK block is 0.4695 inches thick. This is set for the *Black Watch* tape. For high accelerations, use the thicker block. Two other blocks are provided if/when thicker tape is utilized.

4. Cut off an 8 foot piece of tape from the spool and begin to thread it from the inside of the cassette into the drive mechanism.



5. Use the rubber pressure wheel (PEEK block removed) to help you catch and pull the tape into the mechanism. NOTE: This is the only time you can reverse the direction of the tape when the pressure wheel is engaged. You can use the PEEK block to support the pressure wheel off the drive wheel if you want to push/pull the tape in either direction.

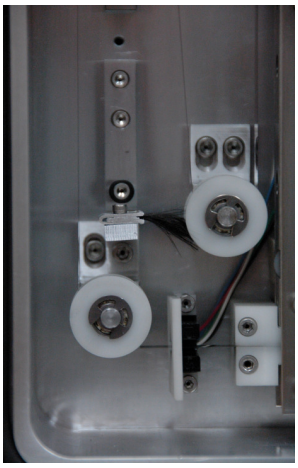
6. Thread the tape around the small drive wheel and out of the box. This may require the use of a small tool since there is little room. A small wooden stick about the thickness of a thick toothpick would work best.



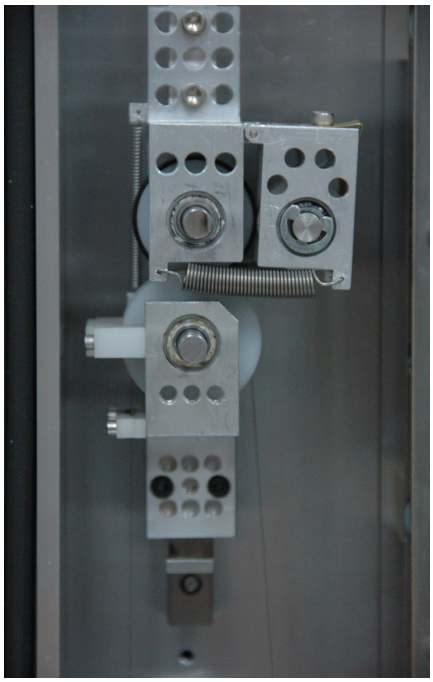
7. Holding the pressure wheel up off the drive wheel (use Peek block) pull out enough tape so that the tape "leader"
can reach the box containing the 300 feet of tape.

8. Attach the leader to the tape in the box. Attach it so that the metallic side of the tape will "see" the beam. Scotch tape will work here. You can overlap the tapes with the tape, but be sure to trim the edges to make the width ½ inch.

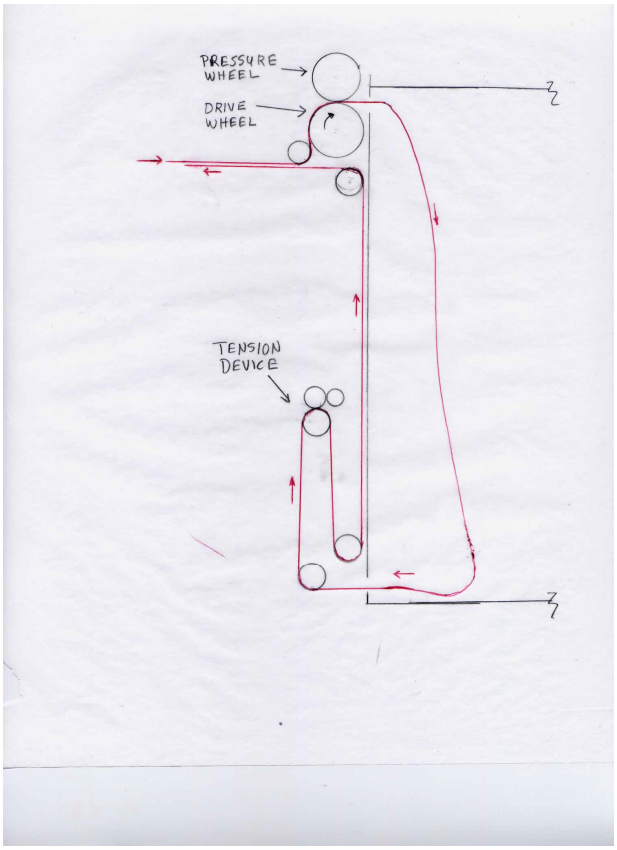
9. Pull the fresh tape into the tape cassette box and start to thread it out of the box at the bottom of the box.



10. Now pull about 2 feet of tape out of the box, but take care not to leave much tape inside the box as it may twist. Continue to thread the tape around the pulley "A" and upward to the tension device.

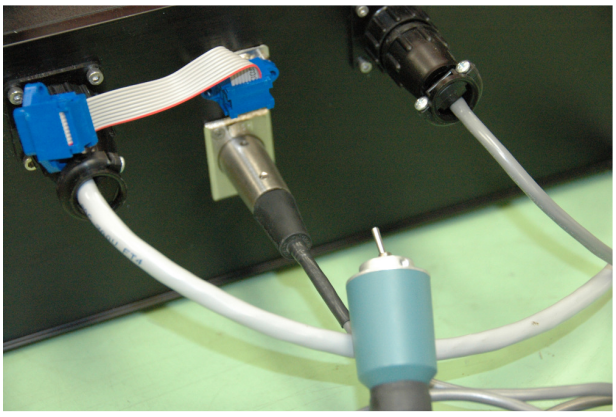


11. This part requires the most dexterity. The tape goes through the narrow slot in the "guide" and around the tension pulley. BUT, the wheel with O-ring "tires" presses on the tension pulley. These pulleys can be held apart by manually separating their axels marked "axels". It is spring loaded so it will return to its original position when released. Thread the tape back down to pulley "B", then upward and around pulley "C" and then out of the cassette. The tape path should then look like this":



12. Now, replace the cassette cover. Load the 300 feet of tape into the cassette using the following procedure:

a) Plug the remote “start/stop” switch into the back of the tape drive unit.



b) Set to program 0.

c) With a cotton glove on your left hand, hold the tape coming out of the box in your left hand and the remote start/stop switch in your right. Start the drive.

d) While your left hand guides the tape and keeps out "twists", your right hand stands ready to stop the drive if necessary.

e) Load all the tape but leave enough out to make the splice. You will splice the "end" of the tape from the box to the leader that comes out of the bottom of the KF-50 exit port.

13. Splice the tape according to the recommended procedure (see next section).

14. Take the slack out of the tape hanging out of the MTC and let it run for awhile on program 0.

15. Check the path and operation. Stop the drive and "comb" the carbon brushes so that the tape runs smoothly over a maximum of the fibers.

16. Set to program 1, 2, or 4 (the one to be used in the experiment) and watch the operation. Let it run for 5-10 minutes. If all looks OK, stop and close the door and proceed to vacuum.

Tape Splicing

The equipment items needed to make a proper splice are shown below.

NOTE: A good splice will enable you to run the entire experiment without a "tape break". A bad splice will cost a lot of time. Follow these procedures diligently.

a) Wash your hands.

b) Overlap the ends and cut through both at the same time at an angle of about 30 degrees.

c) Clean both ends with alcohol using Kim-Wipes or something similar. Wipe both ends with a clean Kim-Wipe. Take care not to touch the ends.

d) Cut two pieces of the ¾ inch wide, 0.001 inch thick aluminized mylar tape. One to 1.5 inches long is OK. Stick each on the side of the MTC (at a corner of the mylar tape which will not be used in the splice itself).

e) Place one end of the tape in the tape guide such that the 30 degree cut is centered in the gap left for the mylar tape. Place the other tape into the guide so the 30 degree cuts match up. They should not touch. You should see a "tiny" bit of space between them (a few thousands of an inch). Be SURE you have no twists in the tape and that metallic side matches metallic side.

f) Place a piece of mylar tape over them and press down. Flip the "connected" tape over and place the other piece of Mylar tape over the splice. Using the roller, roll both sides on the plexiglass "roller block".

g) Trim the edges so that the splice is ½ inch or slightly less. Be absolutely sure there are no edges "sticking out". The edges should be smooth to the touch as you run your finger over them. The curved scissors may be useful if a small snip is needed.

h) Roll both sides again on the block.

i) Using the yellow plastic handle and the plexiglass block, rub each side with the handle so that you run from the center of the splice outward toward the edge of the mylar tape. Never go backwards. You want to press the Mylar tape edge down firmly onto the MTC tape. You have 4 regions to do this procedure.

CAUTION. Hold tension on the tape when you do this. If you put a kink or crease in the tape you should start over.

Hardware Notes

The "standard" PEEK pressure block is 0.4695 inches thick. This is appropriate for the Black Watch tape and accelerations 200 rev/s2 or less when using the "move and count" mode of operation

The "standard" spring that suspends the tension device is 1.35 inches long. A variety of other sizes are provided and can be tried. The "secret" is that there should always be tension in the tape. If it is loose all the time (there often is an occasional loose move), then a spring change may solve the problem.

MTC Control Unit Electronic Schematics

The schematics are contained on the Enclosed CD as *PCB Schematic* and C*onnection_Diagram*.

The CD Contains

This Manual
The MTC Control Unit Input/Output Specifications
The MTC Control Unit Electronic Diagrams
The MTC Control Unit Electronic Connections