Application Note #3

PTC Computer Interfacing

Adapting The PTC Model III For Use With the Chubb Computer Interface System

CAPABILITES OVERVIEW

This application note describes the adaptation of the PTC Model III Turntable Indexing System for use with the Chubb Universal Computer Interface System (UCIS). Adaptation of the PTC to the UCIS will permit automatic control of the turntable indexing function from the computer console.

In addition to controlling the indexing function, the interface will permit the computer to also monitor the PTC Controller's operational status, including identification of a manually initiated emergency stop condition and determination of when the index operation is complete.

LIMITATIONS

The Chubb Interface will permit full automatic operation of the turntable under control of your computer. However, there are two limitations related to system programming and re-indexing:

1. Programming of the system (i.e., the learning of the track locations) must be done conventionally using the PTC Track Selector Module.
2. Re-indexing (i.e., re-orientation of the turntable), if needed, must be done conventionally using the PTC Track Selector Module.

REQUISITES

PTC Model III System Familiarity. You should be familiar with the general programming and operation of the PTC Model III using either the standard Pushbutton Track Selector or the new Chubb/Universal Track Selector. In particular, familiarity with the function and operation of the RUN/STOP button, HEAD/TAIL switch, and individual TRACK_SELECT buttons is necessary. Please review the applicable PTC User's Manual if you are not familiar with these functions.

Chubb System Familiarity. To accomplish the interface, you should be familiar with the Chubb system architecture including the general theory of operation of the digital output and input cards. Complete details on the Chubb system can be found in the following books by Dr. Bruce A. Chubb, MMR:

- Build Your Own Universal Computer Interface, Second Edition, McGraw Hill, ©1997, $34.95
- The Railroader's C/MRI Applications Handbook, Rev 1.1, JLC Enterprises, ©1998, $36

Both of these publications are available directly from JLC Enterprises, P.O. Box 88187, Grand Rapids, MI, 49518.

HARDWARE REQUIREMENTS

Refer to Figure 1, *Hardware Connection Block Diagram*, for additional explanation of the recommended hardware configuration and interconnection.

Chubb System Hardware Configuration.

(A) Digital Outputs: You will need a digital output card with the following outputs available for interfacing:

- One output per track you would like to index
- One output for driving the HEAD_TAIL switch to select the turnbridge head or tail end
- One output for driving the RUN_STOP switch, to initiate bridge movement and optionally excute emergency stops.

Example: If you have 6 tracks you want to index, you will need an output card with 8 outputs available (6 + 1 + 1 = 8).

The digital outputs will be used to "pull down" signals normally pulled high by the PTC (logic "1" at +5V nominal); therefore, the digital cards outputs should be configured as current sinking.

(B) Digital Inputs: The PTC can be operated without providing feedback to your computer system, but at a minimum, one input to read the status of the Track Selector HEAD_TAIL switch is highly recommended (further explaination of this is detailed below). Two additional optional inputs, if available, can also be utilized:

- One input for reading the index status signal (IN_STAT), a signal which indicates whether the bridge is currently at an indexed position or not.
- One input for reading the PTC Status LED signal (ES_STAT), a normally low (logic "0") signal that indicates if the PTC Controller is in a emergency stop condition.

◆**Tip:** The IN_STAT and ES_STAT outputs from the Track Selector are already provided with active pullup resistors. It not recommended to install pull up resistors or filtering capacitors on the C/MRI Digital Input Card.

PTC Model III Hardware Configuration.

(A) Track Selector Modules: The PTC Model III will be used in it's standard configuration, with either the standard Pushbutton Track Selector or the new Chubb/Universal Track Selector ("CTS"). Use of the Chubb/Universal Track Selector is recommended. While the general theory of operation is the same for both selectors, these instructions will assume you are using the Chubb/Universal Track Selector.

(B) Software Revisions: The following software revisions must be installed in your PTC, depending on the type of track selector you are using. The software revision installed in your PTC is stamped in the lower left corner of the serial number label, found on the bottom of your PTC Controller:

- Chubb/Universal Selector: use version 7.6 or greater
- Pushbutton Selector: use version 7.4 or greater

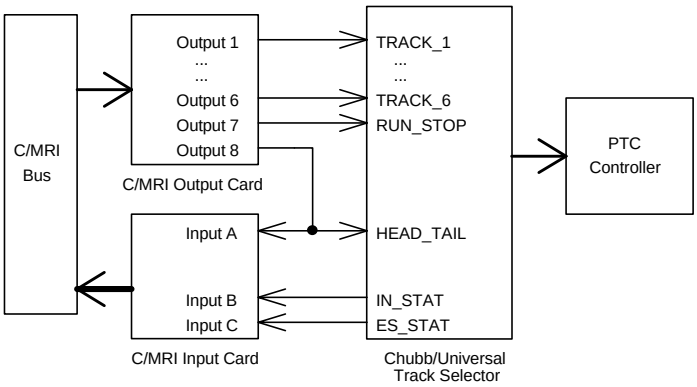


Figure 1: Hardware Connection Block Diagram
(Example shows 6 tracks being indexed)

TRACK SELECTOR THEORY OF OPERATION

PTC Track Selector. The Chubb/Universal Track Selector Module and the Standard Pushbutton Track Selector Modules are designed to be used with individual, normally open momentary pushbutton switches for indentification and selection of tracks to be indexed to. Each switch is connected to the PTC track selector module, and is "pulled up" (held to a logic "1") with an on-board resistor. Refer to Figure 2, *Track Select Switch Input Schematic.* The track selector's HEAD_TAIL and RUN_STOP switches are similarly wired with on-board pullup resistors.

During operation, the PTC scans the status of the individual track selection pushbuttons, HEAD_TAIL, and the RUN_STOP switches looking for their inputs to be pulled low to a logic "0". The PTC Controller then performs actions appropriate to the switch being activated.

By connecting the outputs of the C/MRI digital output board to the Track Selector, the C/MRI controller can emulate the normal action of the track select, HEAD_TAIL, and RUN_STOP switches by toggling them in the same sequence as would ordinarily occur if operated manually.

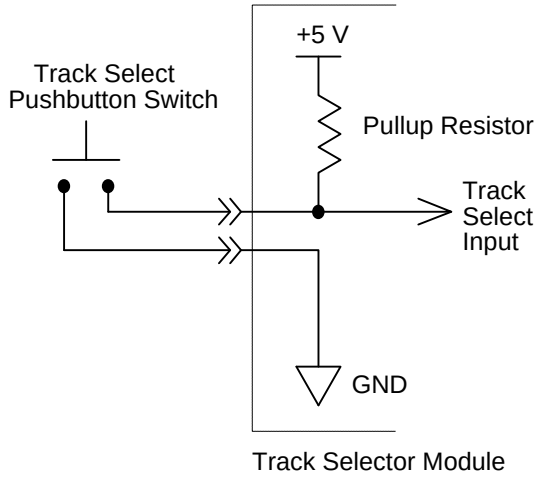


Figure 2: Track Select Switch Input Schematic

◆ **Tip:** Since the Track Select and RUN_STOP switches and C/MRI digital output boards are both "normally open" (the C/MRI digital outputs will normally be in a high impedance, or "off" state), the C/MRI digital outputs and conventional Track Select Pushbuttons can be connected *in parallel*, so that the PTC Model III can be operated using it's standard track selector controls if the C/MRI computer control is turned off or is otherwise unavailable.

◆ **Caution:** The HEAD_TAIL switch is not a momentary switch; therefore, the HEAD_TAIL switch should remain in its normally open so that it can be brought low under C/MRI program control (the "open" position for the HEAD_TAIL is the "down" position, if holding the track selector upright such that the printed circuit board text can be read left-to-right). This is why the HEAD_TAIL switch is shown being fed back to the C/MRI controller via Input A in Figure 1: the C/MRI controller can then read the state of HEAD_TAIL to confirm that it is in a logic "1" prior to attempting to control it. If the state of HEAD_TAIL is logic "0", then the C/MRI application should report an error message to the operator so that the HEAD_TAIL switch can be toggled manually before continuing with the C/MRI application.

PTC Controller Status. In addition to simulating the action of the pushbuttons, the Chubb/Universal Track Selector also supports reading back of the PTC's status via the IN_STAT and ES_STAT pins. Refer to Table 1, *PTC Status Outputs,* for a summary of PTC operating states:

- **IN_STAT (Index Status):** This pin is a logic "1" whenever the turntable is stopped at an indexed location. In other words, when the bridge *is in motion,* or is stopped in *between* tracks (for example, during an emergency stop situation), the IN_STAT signal will be a logic "0". By monitoring the status of the IN_STAT pin after initiating an index operation, the C/MRI application can determine when the index operation is complete and the turntable has arrived at the desired location. **Power-On Note:** When the PTC Controller is going through it's power-on self test bridge "wag", the IS_STAT signal will be a logic "0". It will become a logic "1" after the self test wag is completed. Therefore, your C/MRI application should wait until IS_STAT becomes a logic "1" before beginning operation.
- **ES_STAT (Emergency Stop Status):** This pin is normally a logic "0", and only goes to a logic "1" state in the event of an emergency stop situation. The emergency stop would typically be initiated manually by an operator near the turntable pushing the Track Selector RUN_STOP switch during a bridge index operation. By reading the status if the ES_STAT pin, the C/MRI application can produce an error message to the C/MRI operator console informing him or her of the emergency condition.

◆**Tip:** The C/MRI application can optionally support an emergency stop from the console by toggling the RUN_STOP switch during an index operation. In this case, the ES_STAT pin will also go low to acknowledge the emergency stop request. The ES_STAT pin will remain low until the RUN_STOP is toggled again, cancelling the emergency stop condition.

IN_STAT	ES_STAT	PTC Controller Status
"0"	"0"	The turntable bridge is in motion, in the process of executing a normal index operation.
"0"	"1"	Bridge is in between indexed locations, and motion is **stopped** in response to an "emergency stop" command from the Track Selector or C/MRI application (if supported).
"1"	"0"	Bridge stopped and indexed at valid track location. **This the normal state when the bridge is at an indexed location and is waiting for a new index command.**
"1"	"1"	*(Intermediate PTC state, ignore)*

Table 1: PTC Status Outputs

◆ **Caution:** The RUN_STOP and HEAD_TAIL are CMOS TTL logic level compatible inputs; do not use logic signals greater than +5V (nominal) on these inputs.

◆ **Note:** The IN_STAT and ES_STAT signals are outputs, being driven by a CMOS TTL level compatible output driver. The output current drive characteristics of these pins are as follows :

IN_STAT, ES_STAT

Output Current, Logic Low (V_{out}=0.4V)	4.0 mA
Output Current, Logic High (V_{out}=4.0V)	-0.5 mA

C/MRI SOFTWARE APPLICATION OVERVIEW

Conventional Operation. Conventional operation of the PTC using the standard Track Selector is straight forward: the operator pushes a track selector pushbutton corresponding to the track desired, then pushes the RUN_STOP switch to confirm the track selection and initiate the indexing operation.

C/MRI Operation. To simulate the same operation, the C/MRI application must execute the same sequence of events. This means the toggling of the desired digital output (a track selection), followed by a toggling of the RUN_STOP digital output. In addition, as mentioned earlier, the C/MRI application must also check for:

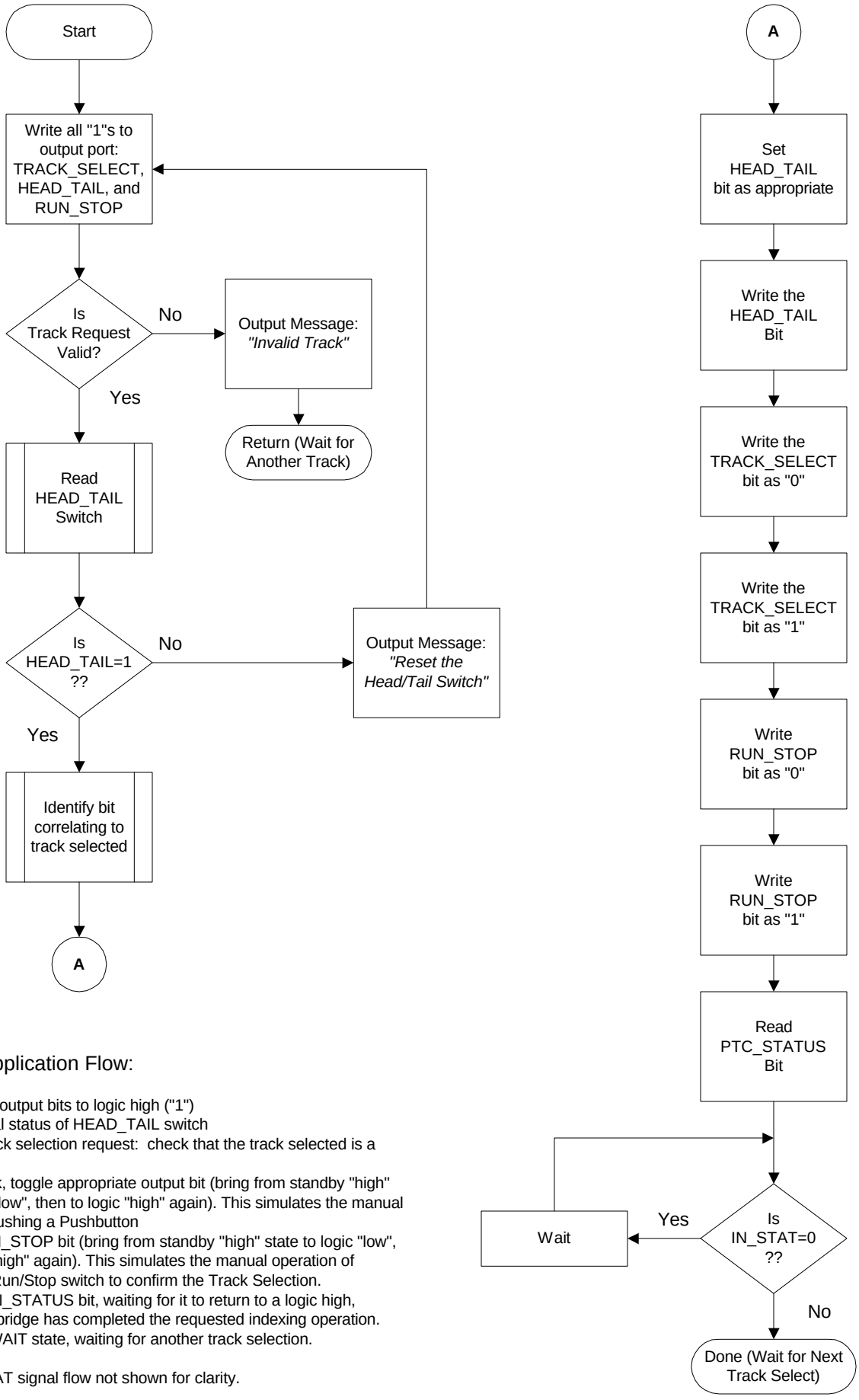
1. The state of the HEAD_TAIL switch to confirm that it is in a controllable (logic "1") condition;
2. The state of the IN_STAT bit to determine when the index move is complete, and (optionally)
3. The C/MRI application can optionally monitor the state of the ES_STAT bit to detect any emergency stop condition initiated by an operator at the Track Selector.

C/MRI APPLICATION PROGRAM

Since many software implementations of the C/MRI interface are possible, only an overview of the application routine in the form of "psuedo code" will be provided here. Authoring of the desired routine is left to the reader. In addition to the notes contained here, refer to Figure 3, *C/MRI Application Flowchart,* for additional insight into the application.

The following represents the logical operation of an implementation that drives the PTC Controller, including monitoring of the IN_STAT and ES_STAT bits. In this example, the PTC is controlling 6 tracks. The application assumes it has been invoked with the desired track in a variable called TRACK and the desired end of the bridge stored in a variable called BR_END. *Note:* Program comments are bracketed with the "{" and "}" symbols.

◆ **Caution:** While writing and testing your application, be sure that the C/MRI application does not toggle more than one PTC track select input at a time, as unreliable operation may result.



General Application Flow:

0- Initialize all output bits to logic high ("1")
1- Check initial status of HEAD_TAIL switch
2- Wait for track selection request: check that the track selected is a valid track.
3- If valid track, toggle appropriate output bit (bring from standby "high" state to logic "low", then to logic "high" again). This simulates the manual operation of pushing a Pushbutton
4-Toggle RUN_STOP bit (bring from standby "high" state to logic "low", then to logic "high" again). This simulates the manual operation of pushing the Run/Stop switch to confirm the Track Selection.
5- Read the IN_STATUS bit, waiting for it to return to a logic high, indicating the bridge has completed the requested indexing operation.
6- Return to WAIT state, waiting for another track selection.

Note: ES_STAT signal flow not shown for clarity.

Figure 3: C/MRI Application Flowchart

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File: chubb_flow.vsd, Rev 3 3/14/99

Define Variables:

Internal Variables:

TRACK	Desired track location variable
BR_END	Desired end of the bridge

Digital Card Outputs:

TSEL[1:6]	Track select outputs 1 thru 6
HD_TL	The desired end of the bridge
RN_STOP	The Run/Stop button

Digital Card Inputs:

HD_TLF	Head/Tail feedback
IN_STAT	Index status
ES_STAT	Emergency stop status

Start:

{*Check to see if the turntable is currently ready}*

```
Get IN_STAT
    If IN_STAT = 0
        Then ouput "Error: Turntable not ready"
        Go to End
```

{*Check to see if bridge Head/Tail switch is controllable; it should pull up to logic 1 if not being driven by the C/MRI}*

```
Set HD_TL = 1    {Release the C/MRI output pin}
Get HD_TLF       {Read the feedback pin}
    IF HD_TLF = 0
        Then output "Error: Reset the HEAD_TAIL switch"
        Go to End
```

{*If we have gotten here, then the HEAD_TAIL switch is controllable, so set it with desired value}*

```
Set HD_TL = BR_END
```

{*The system is now ready to execute the index move, so toggle the desired track select pin}*

```
Set TSEL [TRACK] = 0     {Toggle pin low}
Wait 2 seconds           {Make sure PTC has time to see it}
Set TSEL [TRACK] = 1     {Return pin high}
```

{*Now toggle the RUN_STOP switch output to confirm move}*

```
Set RN_STOP = 0          {Toggle pin low}
Wait 2 seconds           {Make sure PTC has time to see it}
Set RN_STOP = 1          {Return pin high}
```

{*The PTC should now begin the bridge movement; the C/MRI application should now monitor the IN_STAT and ES_STAT pins, waiting for the move to complete or the bridge to be interrupted by a push of the RUN_STOP button at the PTC Track Selector}*

Bridge_Wait_Loop:

```
Get IN_STAT
    If IN_STAT = 1
        Then output "Bridge index move complete"
            Go to End
        Else continue to Emerg_Stop_Loop
```

Emerg_Stop_Loop:

```
Get ES_STAT
    If ES_STAT = 1
        Then output "Caution! Bridge stopped by operator"
            Go to Emerg_Stop_Loop
        Else Go to Bridge_Wait_Loop
```

{*If the application gets to here, then the IN_STAT signal has gone to "0", meaning the bridge move is complete}*

End.

C/MRI OPTIONAL FEATURE

Console Emergency Stop. If desired, your application can map a console keyboard key (such as a function key) to an interrupt that sets the RUN_STOP variable to a logic "0". This will interrupt the PTC just as if the RUN_STOP button was pushed on the PTC Track Selector Module, accomplishing an emergency stop of the turntable from the C/MRI console. Note that toggling of the the RUN_STOP must be repeated to resume operation.

FOR MORE INFORMATION

Your comment and feedback on this document are valuable and are of interest to us. To forward your comments, for answers to your questions, or for more information on the **PTC Model III**, call or write New York Railway Supply Inc.

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