

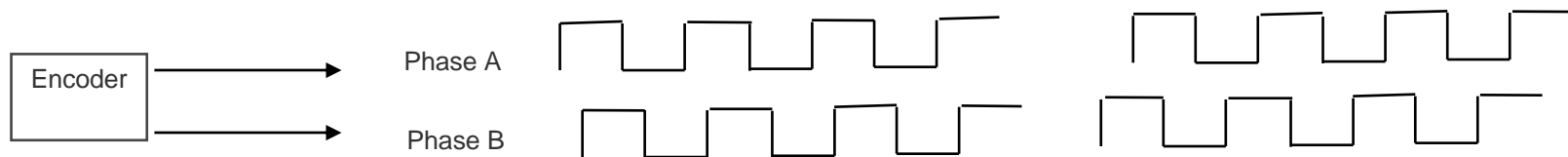


# 11015 MS2

## MPLAB<sup>®</sup> Simulators Advanced Stimulus Additional Examples

# Using Clock tab for Grey Code Encoder stimulus

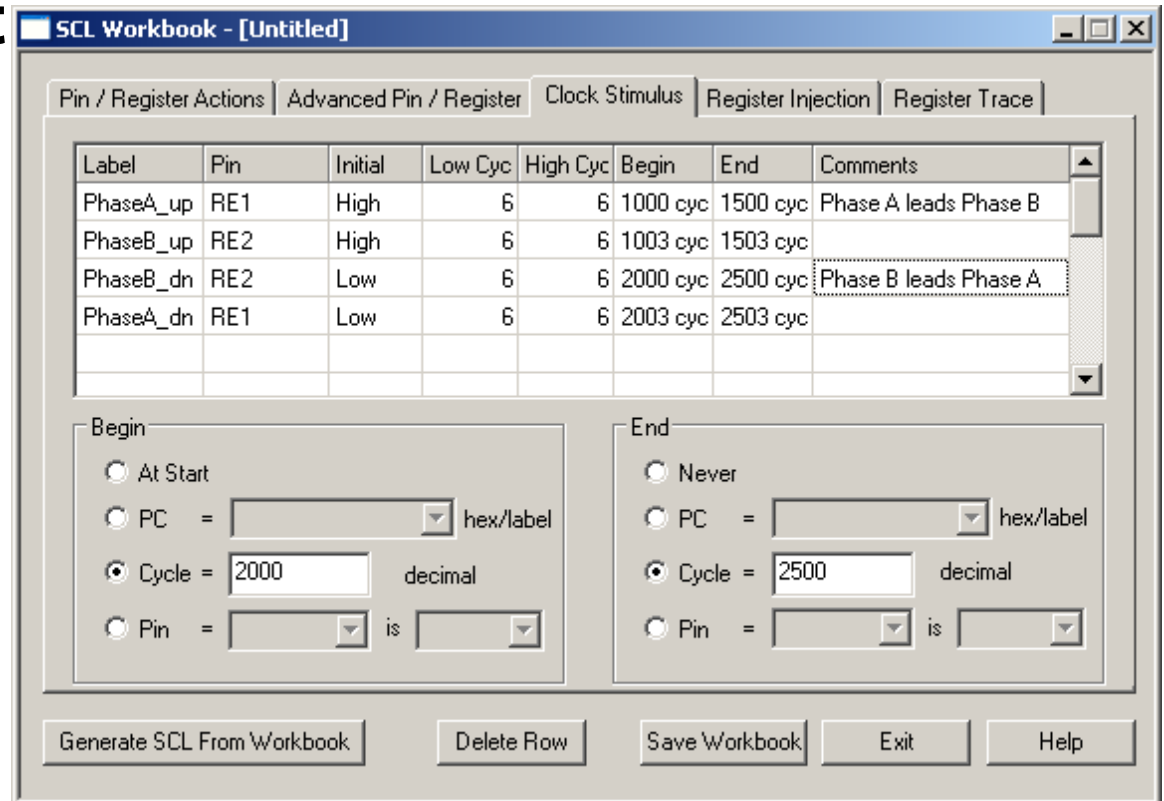
- **Grey code encoder has 2 pulse trains, one out of phase with the other. When turning in one direction the phase A leads phase B. In the opposite direction phase B will lead phase A.**



- **A goes high when B is low = Clockwise**  
**A goes high when B is high = Anti-Clockwise**

# Using Clock tab for Grey Code Encoder stimulus

- Encoder 64 counts/rev. At 300 RPM (5 RPS) we get 320 pulses per second. This is a 3125 us pulse so we will use 3us.
- At 20 MHZ we get 0.2us Instruction cycle
- Pulse width of 6 cycles = 1.2us period for each half of a full wave. (2.4us pulse)



SCL Workbook - [Untitled]

Pin / Register Actions | Advanced Pin / Register | **Clock Stimulus** | Register Injection | Register Trace

Label	Pin	Initial	Low Cyc	High Cyc	Begin	End	Comments
PhaseA_up	RE1	High	6	6	1000 cyc	1500 cyc	Phase A leads Phase B
PhaseB_up	RE2	High	6	6	1003 cyc	1503 cyc	
PhaseB_dn	RE2	Low	6	6	2000 cyc	2500 cyc	Phase B leads Phase A
PhaseA_dn	RE1	Low	6	6	2003 cyc	2503 cyc	

Begin

At Start

PC =  hex/label

Cycle =  decimal

Pin =  is

End

Never

PC =  hex/label

Cycle =  decimal

Pin =  is

Generate SCL From Workbook | Delete Row | Save Workbook | Exit | Help



# Low power wake up

- On startup under the simulator all input pins are at a zero level state. To initialize the low power wakeup pin we need to set this early to a high state.

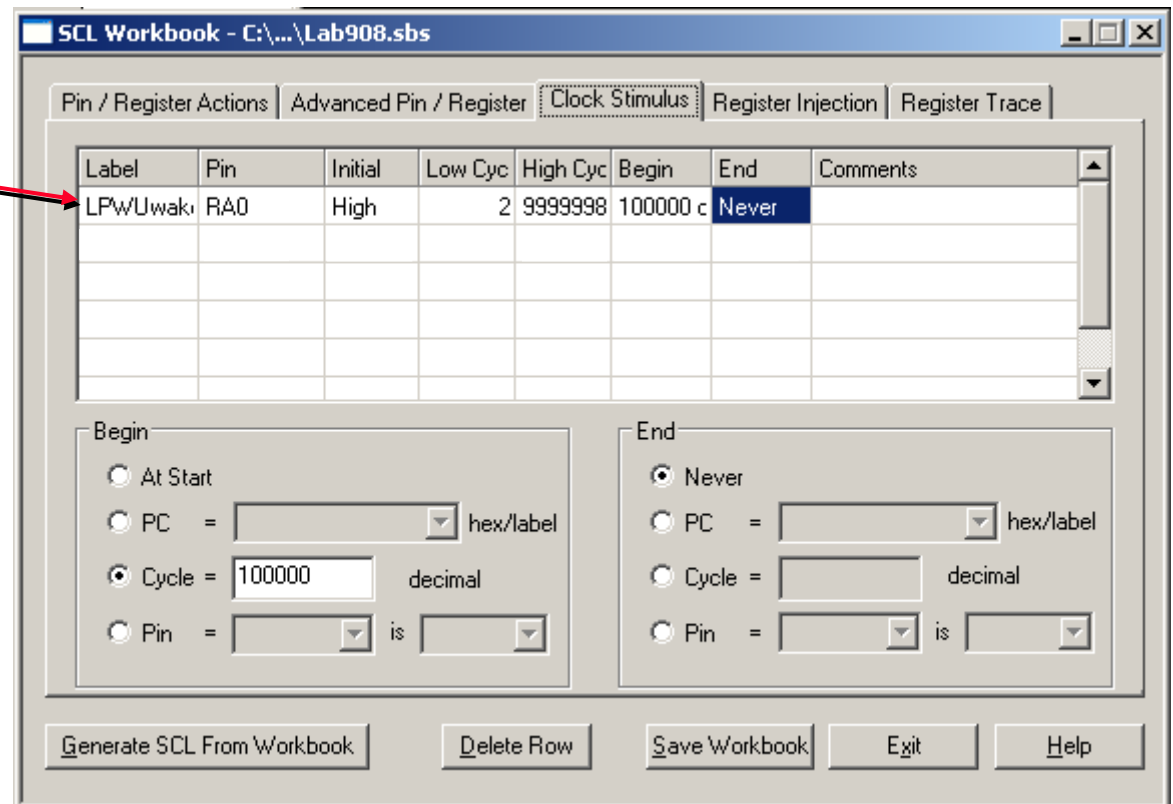
We will do this by using simple Pin/Register stimulus to set RA0 at 50 ic.

A screenshot of the "SCL Workbook" software window. The title bar reads "SCL Workbook - C:\...\Lab908.sbs". The window has several tabs: "Pin / Register Actions", "Advanced Pin / Register", "Clock Stimulus", "Register Injection", and "Register Trace". The "Pin / Register Actions" tab is active. Below the tabs, there are controls for "Time Units" (set to "cyc") and a "Repeat after" checkbox (unchecked) with a value of "1" in a text box. A table with two columns, "Time (dec)" and "PORTA (hex)", is shown. The first row contains the values "50" and "01". A red arrow points from the text "50 ic." in the previous block to the "50" in the table. Below the table is a button that says "Click here to Add Signals". At the bottom of the window, there are five buttons: "Generate SCL From Workbook", "Delete Row", "Save Workbook", "Exit", and "Help".

Time (dec)	PORTA (hex)
50	01

# Low power wake up

- Now to set the Low power wake up. We need to make RA0 go low as if the level to the pin dropped. Use Clock stimulus to set a clock on RA0. Begin at cycle = 100,000. Initial high, low for 2 and high for 9,999,998. End set at default Never. Under simulation this will wake the process about every 4 seconds.





# SPI input

- You can either clock the data in using the firmware (your own code) and driving an output pin. Here we use 1 clock per 8 or 16 bit data
- Or provide a clock as in this example as if it was an external clock. To use your code to clock data eliminate the SPI clock step.
- The data is injected using a file which is attached to the SSPBUF, SFR with trigger on Demand and RAW format.
- RC3 is pulsed 20 cycles low 5 cycles high only when RC2 is high.

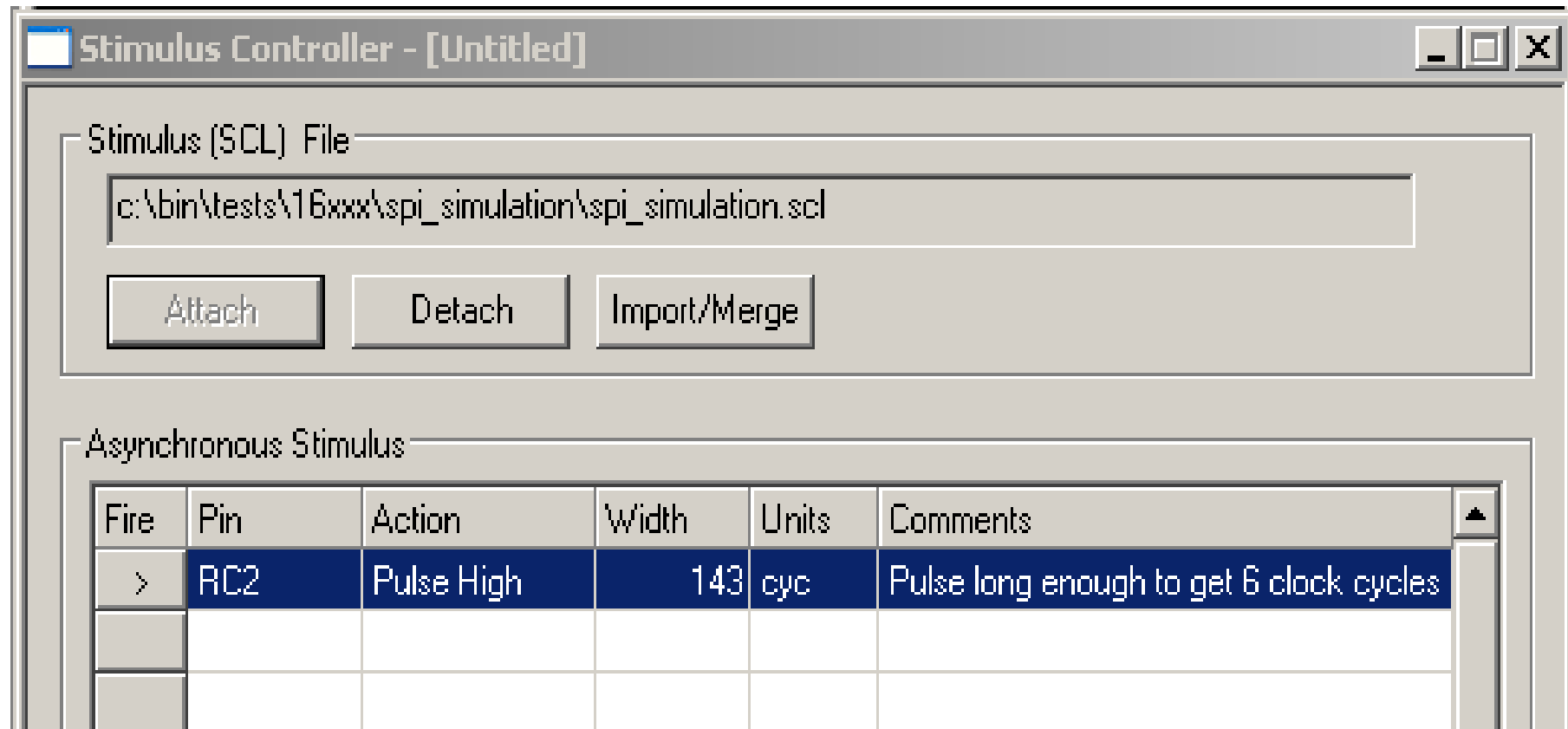


# SPI input

- **RC2 is set high using an Asynchronous pulse for 143 cycles which allows 6 low to high transitions of RC3.**
- **Each low to high transition of RC3 sets the SSPIF flag. (not quite true SPI which has 1 clock per bit)**
- **Your program should wait until the IF bit is set then read the SSPBUF (into Wreg)**
- **Clear the IF flag and loop for the next read.**
- **When you read the SSPBUF the data from the file will be injected as you read.**

# SPI input

- **Asynch Pulse to initiate a message**



Stimulus Controller - [Untitled]

Stimulus (SCL) File

c:\bin\tests\16xxx\spl\_simulation\spl\_simulation.scl

Attach Detach Import/Merge

Asynchronous Stimulus

Fire	Pin	Action	Width	Units	Comments
>	RC2	Pulse High	143	cyc	Pulse long enough to get 6 clock cycles





# SPI input

- **SPI Clock**

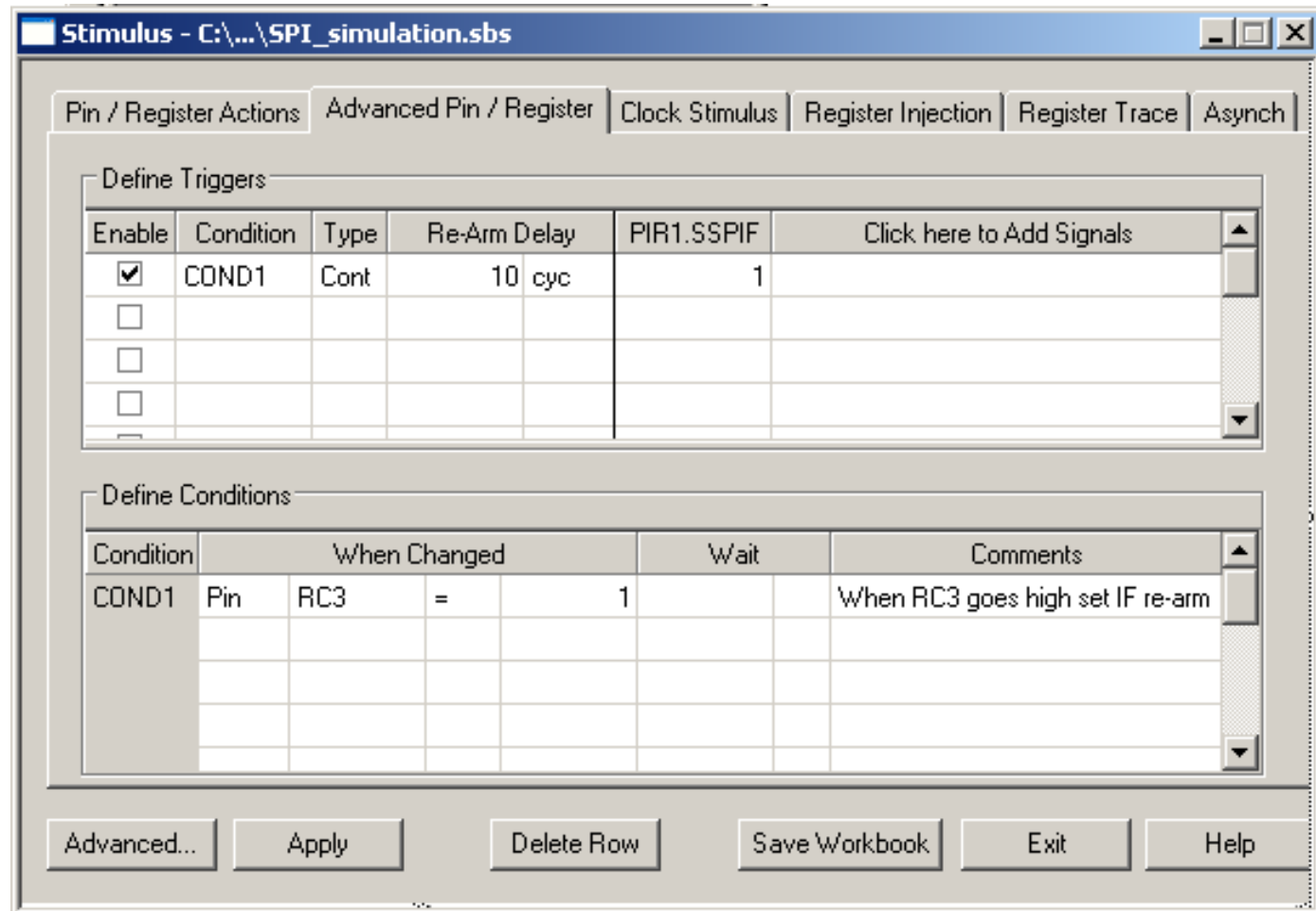
The screenshot shows the 'Stimulus' software window with the 'Clock Stimulus' tab selected. The main table contains the following data:

Label	Pin	Initial	Low Cyc	High Cyc	Begin	End	Comments
SPIClock	RC3	Low	20	5	RC2 is High	RC2 is Low	

Below the table, the 'Begin' and 'End' configuration panels are visible. In the 'Begin' panel, the 'Pin' condition is selected with 'RC2' and 'High'. In the 'End' panel, the 'Pin' condition is selected with 'RC2' and 'Low'. Buttons at the bottom include 'Advanced...', 'Apply', 'Delete Row', 'Save Workbook', 'Exit', and 'Help'.

# SPI input

- **SPI IRQ Flag set by using a conditional statement**



The screenshot shows the Stimulus software window titled "Stimulus - C:\... \SPI\_simulation.sbs". The interface includes several tabs: "Pin / Register Actions", "Advanced Pin / Register", "Clock Stimulus", "Register Injection", "Register Trace", and "Asynch".

The "Define Triggers" section contains a table with the following data:

Enable	Condition	Type	Re-Arm Delay	PIR1.SSPIF	Click here to Add Signals
<input checked="" type="checkbox"/>	COND1	Cont	10 cyc	1	
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					

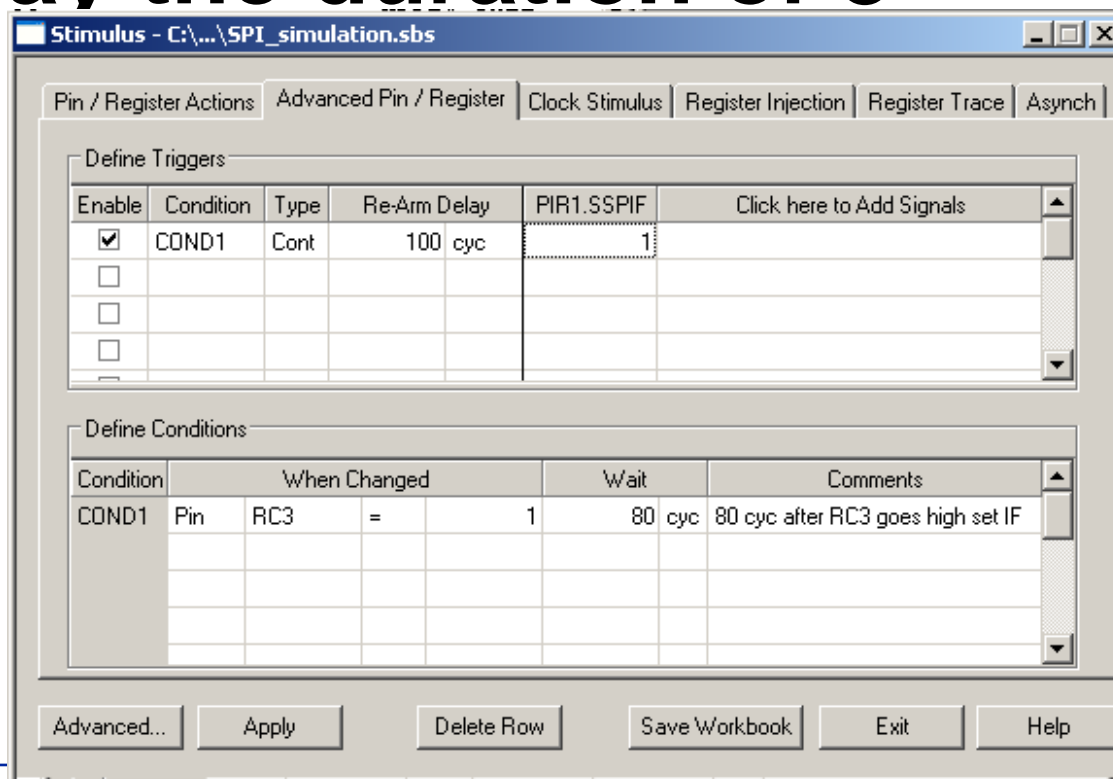
The "Define Conditions" section contains a table with the following data:

Condition	When Changed			Wait	Comments
COND1	Pin	RC3	=	1	When RC3 goes high set IF re-arm

At the bottom of the window, there are buttons for "Advanced...", "Apply", "Delete Row", "Save Workbook", "Exit", and "Help".

# SPI input

- If you wanted to clock bits and have the IF set after 8 bit clocks. You could set the wait time on COND1 to delay the duration of 8 clock cycles.
- You can then set the re-arm delay to avoid a retrigger.



The screenshot shows the Stimulus software interface for configuring a simulation. The window title is "Stimulus - C:\...\SPI\_simulation.sbs". The "Define Triggers" section contains a table with the following data:

Enable	Condition	Type	Re-Arm Delay	PIR1.SSPIF	Click here to Add Signals
<input checked="" type="checkbox"/>	COND1	Cont	100 cyc	1	
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					

The "Define Conditions" section contains a table with the following data:

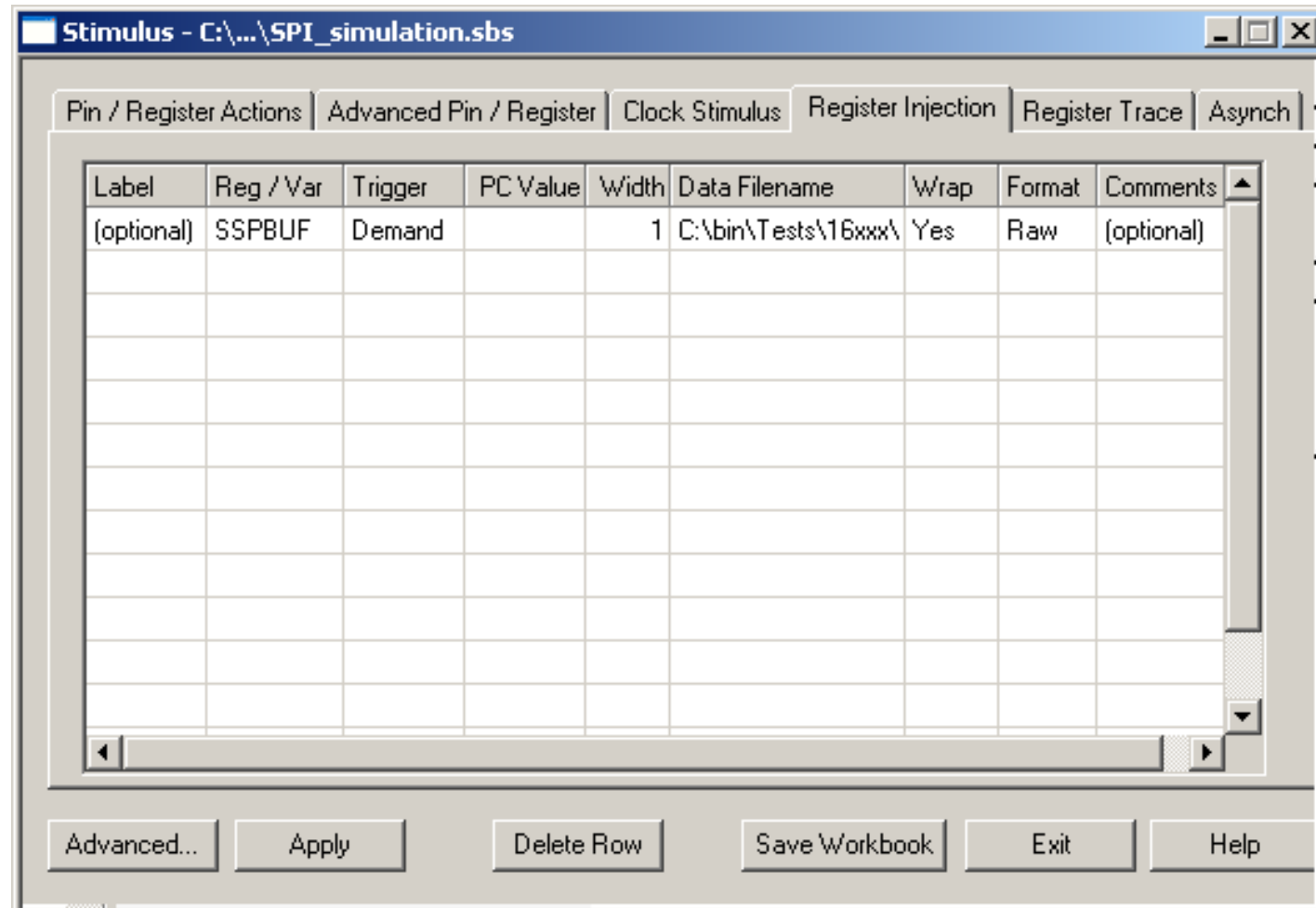
Condition	When Changed	Wait	Comments
COND1	Pin RC3 = 1	80 cyc	80 cyc after RC3 goes high set IF

Buttons at the bottom of the window include: Advanced..., Apply, Delete Row, Save Workbook, Exit, and Help.



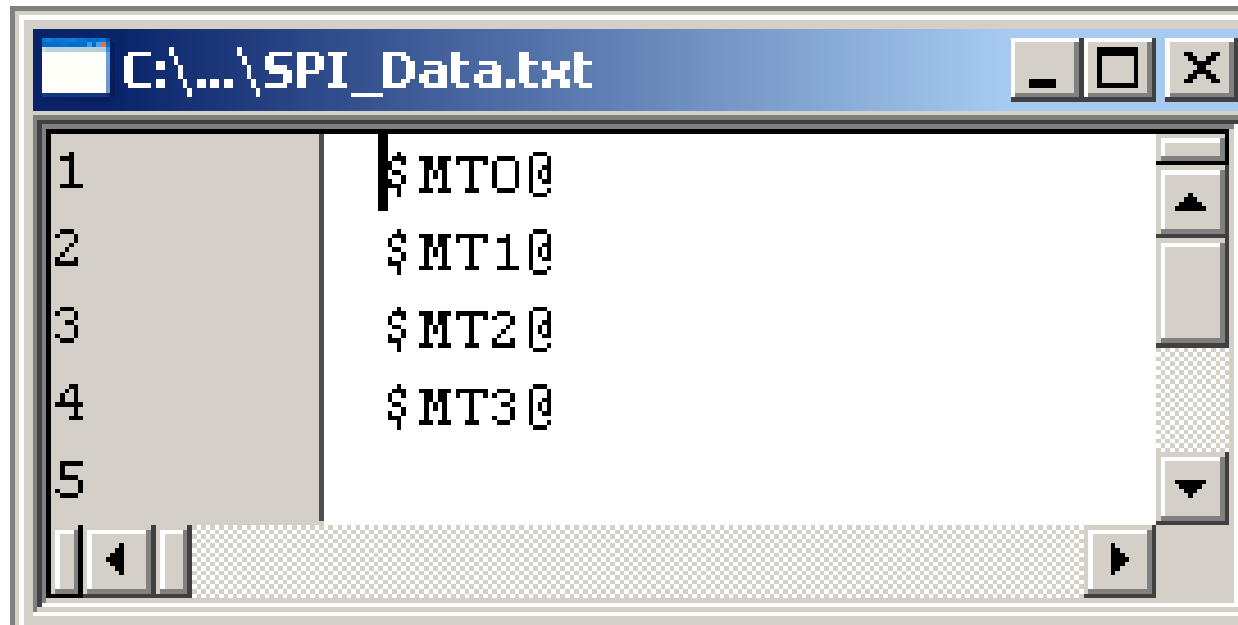
# SPI input

- SPI Data file injection



# SPI input

- **SSPBUF Data**  
1 character is read on each IRQIF  
The string is 5 characters plus CRLF

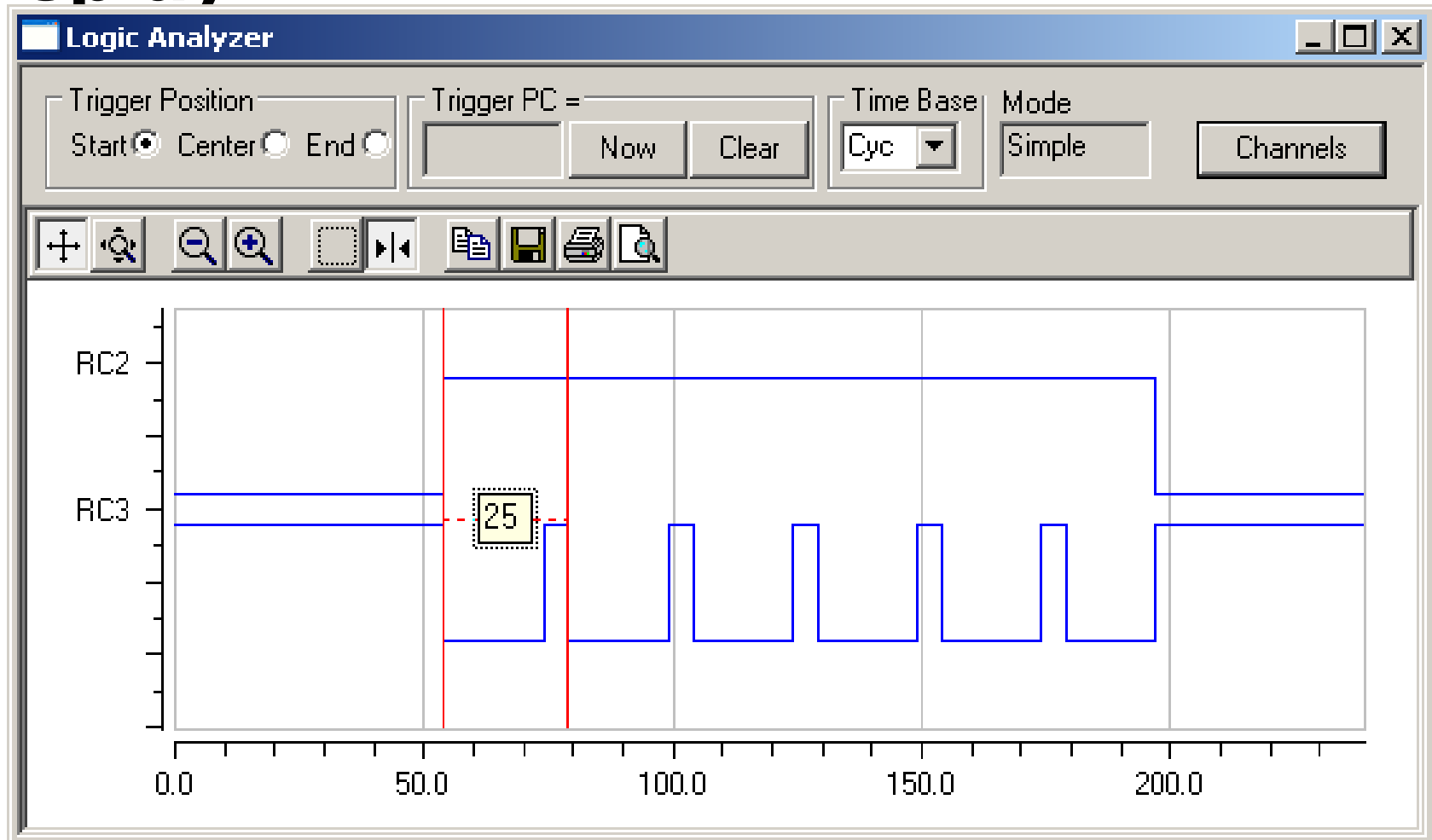


A screenshot of a text editor window titled "C:\...\SPI\_Data.txt". The window displays five lines of text, each representing a character read from the SPI buffer. The lines are numbered 1 through 5 on the left margin. The text on each line is: 1: \$MT0@, 2: \$MT1@, 3: \$MT2@, 4: \$MT3@, 5: (empty). The text is displayed in a monospaced font. The window has standard Windows-style window controls (minimize, maximize, close) in the top right corner and a scrollbar on the right side.

```
1 $MT0@
2 $MT1@
3 $MT2@
4 $MT3@
5
```

# SPI input

- **SPI Clock as seen within the Logic Display**



# SPI input

- **SPI Clock as seen within the Logic Display when using 8 clock pulses per IRQ**
- **To show the delay we set RC1 at the same time as the SSPIF flag**

