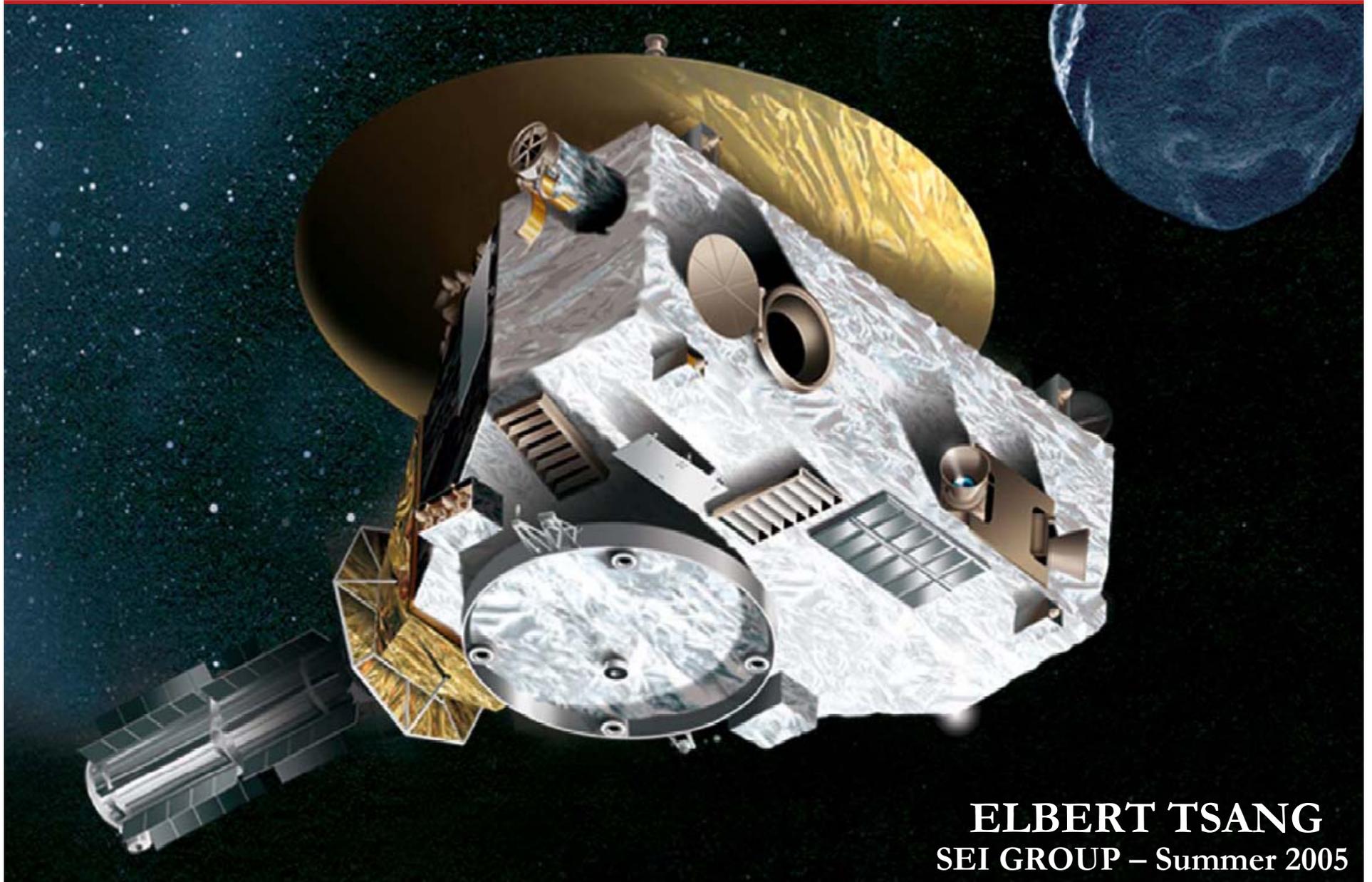




NEW HORIZONS



ELBERT TSANG
SEI GROUP – Summer 2005



NH OPERATIONS SIMULATOR



- Spacecraft hardware simulator
 - Contains real S/C computers
 - Receives real S/C codes and commands
- Motivation behind this project
 - Enhancing an existing simulator (i.e. NHOPS) for autonomy testing
- Parts needed for NHOPS
 - Oscillator Switch
 - RF Switch
 - TWTA
 - SP3T Switch
 - Transfer Switch



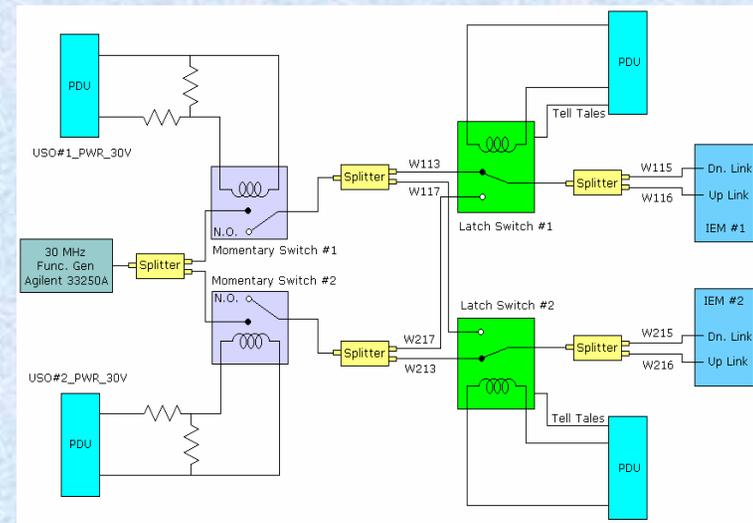
BRINGING IDEAS TO REALITY



- Transcribing ideas from brain onto paper
- Transcribing ideas from paper onto the computer



Oscillator Switch Before



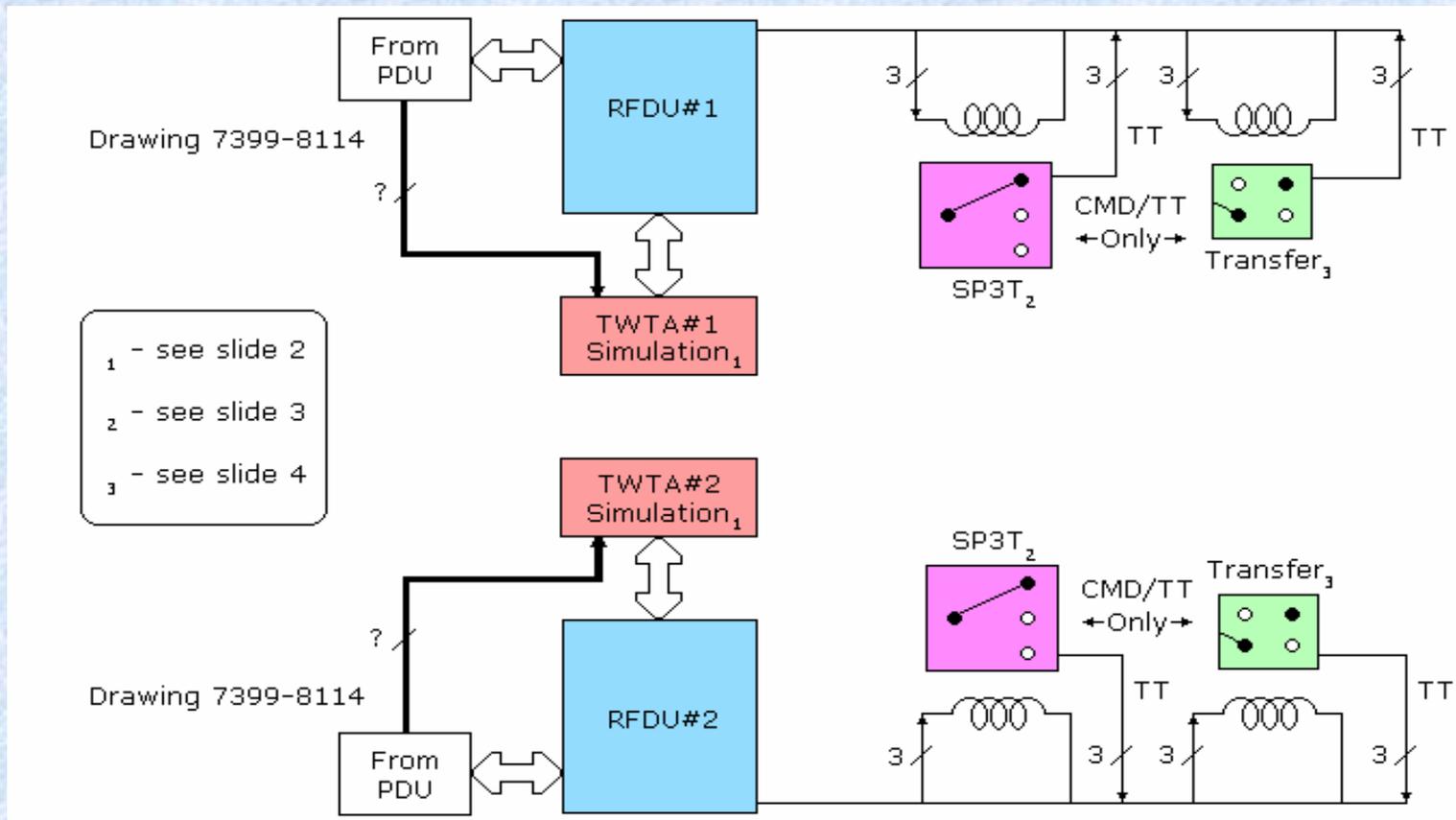
Oscillator Switch After



BLOCK DIAGRAMS



- RF Switch Simulator
 - Simulates a piece of the spacecraft
 - Checks if commands are working properly

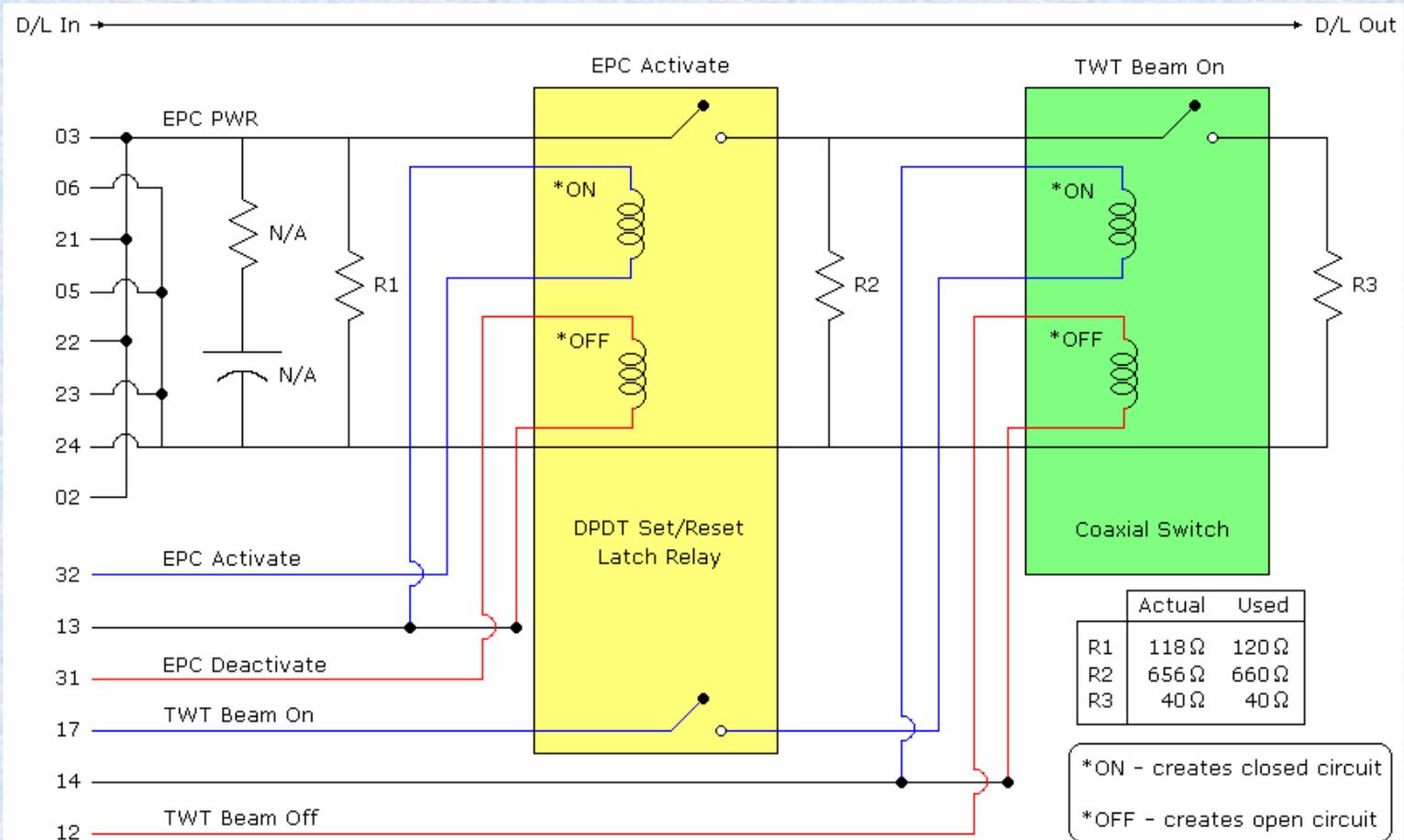




BLOCK DIAGRAMS



- TWTA Simulator
 - Simulates EPC and TWTA power circuitry

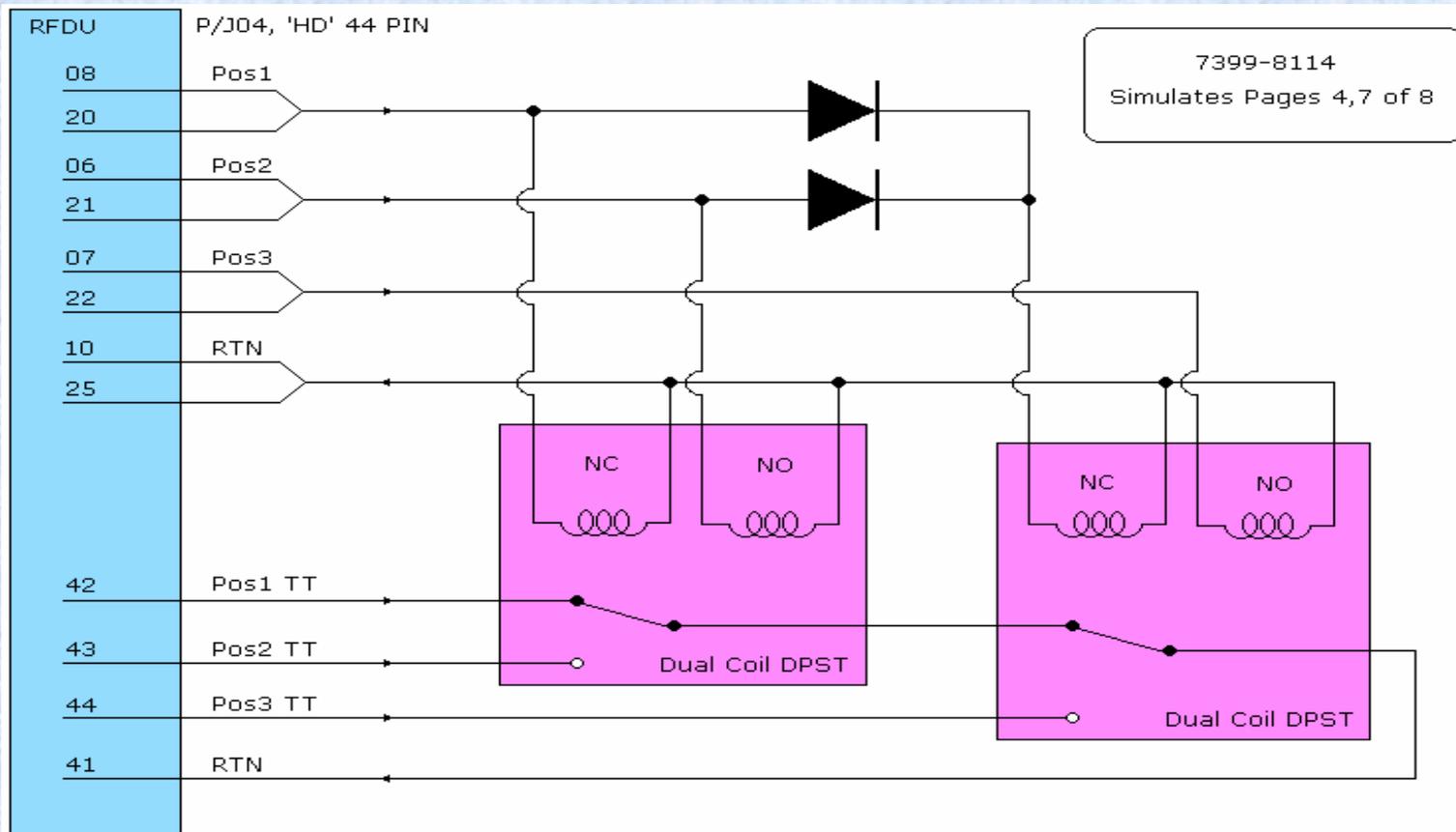




BLOCK DIAGRAMS



- SP3T Switch Simulator
 - Simulates Tell Tales to determine which antenna is being used (i.e. High Gain, Medium Gain or Low Gain)

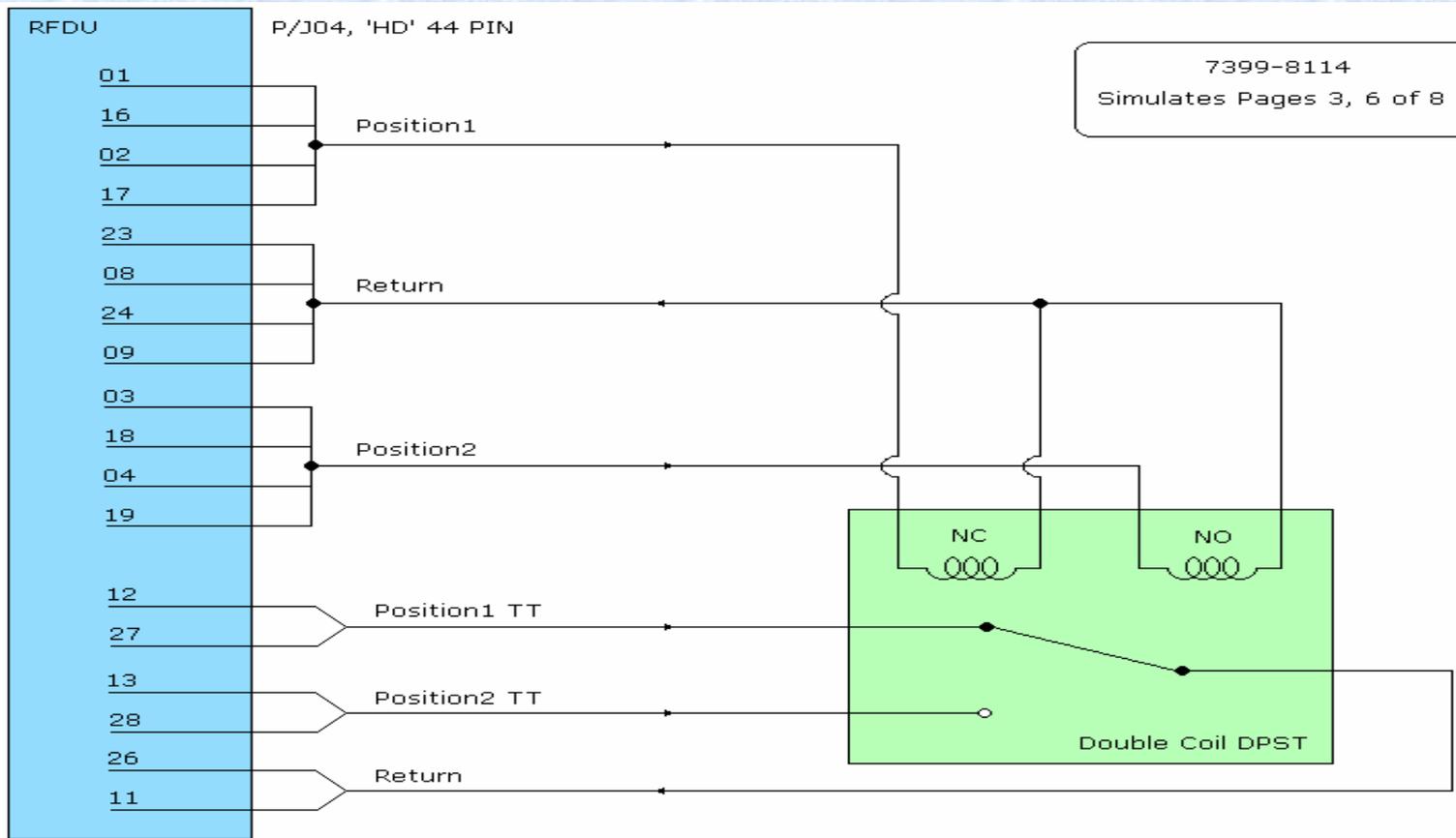




BLOCK DIAGRAMS



- Transfer Switch Simulator
 - Simulates Tell Tales to determine which Low Gain Antenna is being used (i.e. Forward or Aft)





RECAP



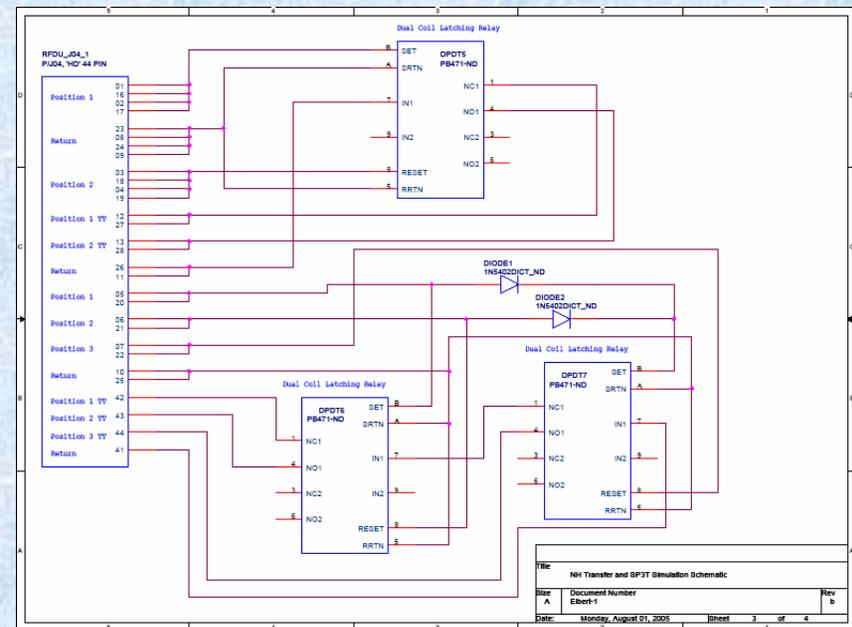
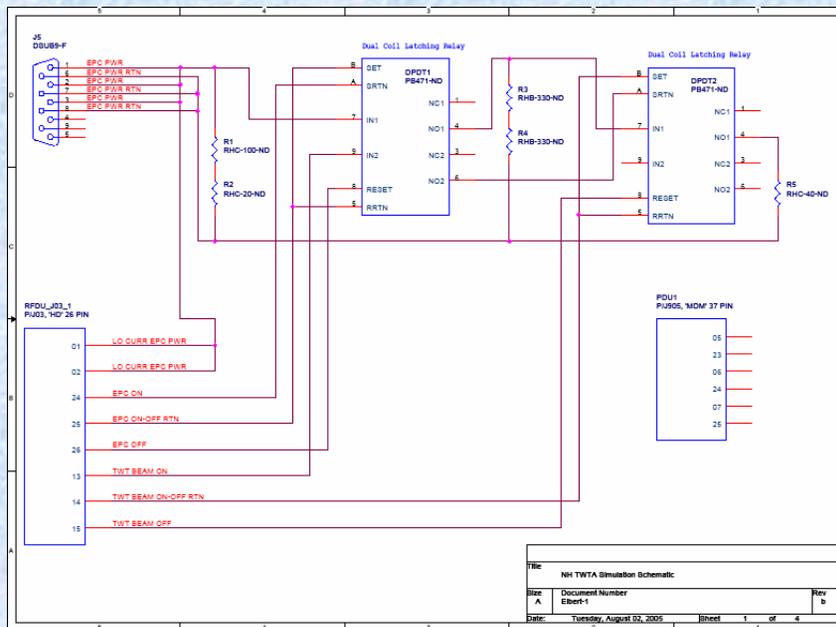
- RF Switch Simulator Block Diagram
 - Simulates a piece of the spacecraft
 - Checks if commands are working properly
- TWTA Simulator
 - Simulates EPC and TWTA power circuitry
- SP3T Switch Simulator
 - Simulates Tell Tales to determine which antenna is being used (i.e. High Gain, Medium Gain or Low Gain)
- Transfer Switch Simulator
 - Simulates Tell Tales to determine which Low Gain antenna is being used (i.e. Forward or Aft)



SCHEMATIC DRAWINGS



- Wiring diagrams ready to be physically assembled together
 - Schematic Drawing
 - Bill of Materials
 - Wire List





PRIOR TO ASSEMBLY



- Bill of Materials
 - List of components and their part numbers
- Net List
 - List of wire connections

```
NH TWTa Simulation Schematic Revised: Tuesday, August 02, 2005
Elbert-1 Revision: b
Bill Of Materials August 2,2005 15:48:02 Page1
```

Item	Quantity	Reference	Part
1	4	DIODE1,DIODE2,DIODE3, DIODE4	1N5402DICT_ND
2	10	DPDT1,DPDT2,DPDT3,DPDT4, DPDT5,DPDT6,DPDT7,DPDT8, DPDT9,DPDT10	PB471-ND
3	2	J5,J6	DSUB9-F
4	1	PDU1 P/J905, 'MDM' 37 PIN	
5	1	PDU2 P/J1001, 'MDM' 37 PIN	
6	2	RFDU_J03_1,RFDU_J03_2	P/J03, 'HD' 26 PIN
7	2	RFDU_J04_1,RFDU_J04_2	P/J04, 'HD' 44 PIN
8	2	R1,R6	RHC-100-ND
9	2	R2,R7	RHC-20-ND
10	4	R3,R4,R8,R9	RHB-330-ND
11	2	R5,R10	RHC-40-ND

```
<<< Wire List >>>
```

NODE	REFERENCE	PIN #	PIN NAME	PIN TYPE	PART VALUE
[00001]	EPC PWR				
	J5	2	2	Passive	DSUB9-F
	RFDU_J03_	1	01	Passive	P/J03, 'HD' 26 PI
	J5	3	3	Passive	DSUB9-F
	RFDU_J03_	2	02	Passive	P/J03, 'HD' 26 PI
	DPDT1	7	IN1	Passive	PB471-ND
	R1	1	1	Passive	RHC-100-ND
	J5	1	1	Passive	DSUB9-F
[00002]	EPC PWR RTN				
	J5	8	8	Passive	DSUB9-F
	J5	7	7	Passive	DSUB9-F
	J5	6	6	Passive	DSUB9-F
	R5	2	2	Passive	RHC-40-ND
	R4	2	2	Passive	RHB-330-ND
	R2	2	2	Passive	RHC-20-ND
[00003]	EPC OFF				
	RFDU_J03_	5	26	Passive	P/J03, 'HD' 26 PI
	DPDT1	8	RESET	Passive	PB471-ND
[00004]	EPC ON				
	RFDU_J03_	3	24	Passive	P/J03, 'HD' 26 PI
	DPDT1	A	SRTN	Passive	PB471-ND
[00005]	TWT BEAM OFF				
	RFDU_J03_	8	15	Passive	P/J03, 'HD' 26 PI
	DPDT2	8	RESET	Passive	PB471-ND
[00006]	TWT BEAM ON-OFF RTN				
	RFDU_J03_	7	14	Passive	P/J03, 'HD' 26 PI



WHAT I DID & WHERE



- Goddard Space Flight Center
 - Attended NH I&T Daily Status Meetings
 - Monitored Ground Support Equipment (GSE) and S/C activity
 - Assisted in relocating GSE and verified electrical configurations prior to S/C power-up at Goddard Clean Room and Goddard Thermal Vacuum Chamber
 - Practiced Clean-Room protocol
- JHU Applied Physics Lab
 - Meetings with engineers on design and practicality
 - Analyzed circuits: determined resistor and power values
 - Constructed block diagrams and circuit schematics
 - Searched for circuit parts on a manufacturer's website
 - Learned powerful software tools: OrCAD Capture & Microsoft Visio



WHAT I LEARNED



- Revisions, Revisions, Revisions
 - The third time may not always be a charm...
 - Constant revision makes things better
- Deadlines are imperative
 - Work has to be done correctly and on time
 - Time management skills are key to success
- There is no I in Team
 - Everyone must work together for a common goal
 - A big group is subdivided into smaller groups; within the smaller groups, subdivisions exist as well, but all are needed to complete the task at hand



ACRONYMS LIST



- NASA
 - National Aeronautics and Space Administration
- MU-SPIN
 - Minority University-Space Interdisciplinary Network
- EPC
 - Electronic Power Controller
- PDU
 - Power Distribution Unit
- RFDU
 - Radio Frequency Diode Unit
- TWTA
 - Traveling Wave Tube Amplifier
- NH I&T
 - New Horizons Integration and Testing
- NHOPS
 - New Horizons Operations Simulator
- SEI
 - Space Department, Engineering and Technology Branch, Integration and Operations
- MOC
 - Mission Operations Center
- S/C
 - Spacecraft



NEW-ER HORIZONS



“The experience and training that I received could have only been made possible through this NASA Internship Program; for that, I am very grateful. I am confident that my exposure and involvement with the APL Space Department will lead to a path filled with unique and interesting opportunities for me in the near future.”

-- Elbert Tsang



THANK YOU ALL!



- A list of people who got me here, kept me busy, showed me around, answered my questions, and made my days enjoyable:
 - Stephanie Stockman
 - Stan Kozuch
 - Andy Good
 - Linda Butler
 - Kerri Beisser
 - Chris Hersman
 - Joe Sheehi
 - Sheila Zurvalec
 - Earleen James
 - And many more...