

Observing with the 3-bit samplers

A how-to guide



Michael P. Rupen

Project Scientist for the WIDAR Correlator



Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array



Using the OPT

Use webtest!

- <https://webtest.aoc.nrao.edu/opt/>
- You can transfer stuff from production but it's a pain

RCT: 3-bit resource

NRAO Instrument Configuration Management Tool - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://webtest.aoc.nrao.edu/rct/MyCatalogs.jsf

Most Visited WIDAR PTC Links ASG WIDAR DRAO Docs http://10.80.99.11/ http://10.80.99.12/ Operators' Screens Wideband VLA spec...

File Edit Catalog Management System Help

NRAO > User Portal > Observation Preparation | Sources | Instrument Configurations Hello, Michael P. Rupen Exit

Notice: you are currently connected to the test version of the RCT.

INSTRUMENT CONFIGURATIONS IN 'BASIC 3-BIT CATALOG' (14)

Select All | None Show: 25 | 50 | 100 | 200

		Name	Band	Back End	T _{int}	AC BW BD BW	AC Freq BD Freq	Comments
<input type="checkbox"/>		Ku AC3 + BD8 4sec	Ku	WIDAR / RSRO	4	4.096GHz 1.024GHz	14.0GHz 14.0GHz	
<input type="checkbox"/>		Ku AC8 + BD3 4sec	Ku	WIDAR / RSRO	4	1.024GHz 4.096GHz	14.0GHz 14.0GHz	
<input type="checkbox"/>		Ku AC3 + BD8 2sec	Ku	WIDAR / RSRO	2	4.096GHz 1.024GHz	14.0GHz 14.0GHz	
<input type="checkbox"/>		K 24 GHz AC3BD3	K	WIDAR / RSRO	4	4.096GHz 4.096GHz	24.0GHz 24.0GHz	
<input type="checkbox"/>		K 25 GHz AC3BD3	K	WIDAR / RSRO	4	4.096GHz 4.096GHz	25.0GHz 25.0GHz	
<input type="checkbox"/>		Ka 34 GHz AC3BD3	Ka	WIDAR / RSRO	4	4.096GHz 4.096GHz	34.0GHz 34.0GHz	
<input type="checkbox"/>		Q 41.5GHz AC3BD3	Q	WIDAR / RSRO	4	4.096GHz 4.096GHz	41.5GHz 41.5GHz	
<input type="checkbox"/>		Ku3 wide	Ku	WIDAR / RSRO	2	4.096GHz 4.096GHz	13.0GHz 17.096GHz	
<input type="checkbox"/>		K3 wide	K	WIDAR / RSRO	2	4.096GHz 4.096GHz	23.048GHz 19.024GHz	
<input type="checkbox"/>		Ka3 wide	Ka	WIDAR / RSRO	2	4.096GHz 4.096GHz	35.0GHz 27.524GHz	
<input type="checkbox"/>		Q3 wide	Q	WIDAR / RSRO	2	4.096GHz 4.096GHz	46.0GHz 41.024GHz	
<input type="checkbox"/>		K 25 GHz AC3+BD8	K	WIDAR / RSRO	2	4.096GHz 1.024GHz	25.0GHz 25.0GHz	
<input type="checkbox"/>		Ka 34 GHz AC3+BD8	Ka	WIDAR / RSRO	2	4.096GHz 1.024GHz	34.0GHz 34.0GHz	
<input type="checkbox"/>		Q 41.5GHz AC3+BD8	Q	WIDAR / RSRO	2	4.096GHz 1.024GHz	41.5GHz 41.5GHz	

Find: model2 Previous Next Highlight all Match case



RCT: 3-bit resource



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Address bar: <https://webtest.aoc.nrao.edu/rct/MyCatalogs.jsf>

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Left Sidebar:

- NRAO Defaults
 - Basic 3-bit Catalog
 - Overlapping: 3-bit+8-bit
 - Overlapping: 3-bit ABCD
 - Spread out: 3-bit
 - old NRAO Defaults
 - Autosave: Personal Catalog
 - Lines_RRL_Lband
 - Personal Catalog
 - Basics
 - OSRO mode tests
 - Novae
 - RSRO basics
 - 3-bit
 - For Others
 - RSRO Tests
 - Crazed MPR setups

Main Content:

Return to 'Overlapping: 3-bit+8-bit'

ID	Name	Telescope	Band	Correlator	Editor	Download
378898	Ka 34-GHz AC3+BD8	EVLA	Ka (26.5GHz - 40.0GHz) 1-dB range: 26.0GHz - 40.0GHz 3-dB range: 25.0GHz - 41.0GHz	WIDAR	RSRO	Download VCI

BASEBAND TUNING

	NAME	BITS	CENTER SKY FREQUENCY	BANDWIDTH	SKY RANGE	SIDEBAND
<input type="radio"/>	A0/C0	8				
<input checked="" type="radio"/>	A1/C1	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower
<input type="radio"/>	A2/C2	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower
<input checked="" type="radio"/>	B0/D0	8	34.0GHz	1.024GHz	33.488GHz - 34.512GHz	Upper
<input type="radio"/>	B1/D1	3				
<input type="radio"/>	B2/D2	3				

Center frequency of this baseband/IF

INTEGRATION TIME: 2.0 s

DATA RATE: 14.8070 Mbytes/s (53.3053 Gbytes/hour)

CONFIGURATION SUMMARY

Total RL RDs Used: 40 Total RL RDs Available: 64

Find: model2 Previous Next Highlight all Match case

RCT: 3-bit resource



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File Edit Catalog Management System Help

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Notice: you are currently connected to the test version of the RCT.

Return to 'Overlapping: 3-bit ABCD'

ID	Name	Telescope	Band	Correlator	Editor	Download
377052	Ka 34 GHz AC3BD3	EVLA	Ka (26.5GHz - 40.0GHz) 1-dB range: 26.0GHz - 40.0GHz 3-dB range: 25.0GHz - 41.0GHz	WIDAR	RSRO	Download VCI

BASEBAND TUNING

	NAME	BITS	CENTER SKY FREQUENCY	BANDWIDTH	SKY RANGE	SIDEBAND
<input type="radio"/>	A0/C0	8				
<input checked="" type="radio"/>	A1/C1	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower
<input type="radio"/>	A2/C2	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower
<input type="radio"/>	B0/D0	8				
<input checked="" type="radio"/>	B1/D1	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower
<input type="radio"/>	B2/D2	3	34.0GHz	2.048GHz	32.976GHz - 35.024GHz	Lower

INTEGRATION TIME 4.0 s

DATA RATE 11.8456 Mbytes/s (42.6443 Gbytes/hour)

CONFIGURATION SUMMARY

Total RL RDe Used: 64 Total RL RDe Available: 64

Find: model2 Previous Next Highlight all Match case

RCT: 3-bit resource



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 - Overlapping: 3-bit+8-bit
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 - Spread out: 3-bit
 - old NRAO Defaults
- Autosave: Personal Catalog
- Lines_RRL_Lband
- Personal Catalog

Catalog Id: 230073

[Return to 'Spread out: 3-bit'](#)

Name	Telescope	Band	Correlator	Download
Ka3 wide	EVLA	Ka (26.5GHz - 40.0GHz) 1-dB range: 26.0GHz - 40.0GHz 3-dB range: 25.0GHz - 41.0GHz	WIDAR	Download VCI

BASEBAND TUNING

	NAME	BITS	CENTER SKY FREQUENCY	BANDWIDTH	SKY RANGE	SIDEBAND
<input type="radio"/>	A0/C0	8				
<input checked="" type="radio"/>	A1/C1	3	35.0GHz	2.048GHz	33.976GHz - 36.024GHz	Lower
<input checked="" type="radio"/>	A2/C2	3	37.048GHz	2.048GHz	36.024GHz - 38.072GHz	Lower
<input type="radio"/>	B0/D0	8				
<input checked="" type="radio"/>	B1/D1	3	27.524GHz	2.048GHz	26.5GHz - 28.548GHz	Upper
<input checked="" type="radio"/>	B2/D2	3	29.572GHz	2.048GHz	28.548GHz - 30.596GHz	Upper

INTEGRATION TIME 2S
DATA RATE 23.6913 Mbytes/s (85.2886 Gbytes/hour)

CONFIGURATION SUMMARY

Total BI. BPs Used:	64	Total BI. BPs Available:	64
Total Data Rate:	23.69 MB/s	Total Spectral Points:	4096
Total Data Rate:	85.29 GB/h	Total Bandwidth:	8.192GHz

Warning: The data rate of this configuration, 23.7MB/s, while below the currently allowed maximum of 25.0MB/s, is greater than the suggested rate of 15.0MB/s. Rates above that value are still undergoing commissioning and may not be available until later in the configuration. [Configuration "Ka3 wide"]

Find: model2 Previous Next Highlight all Match case

RCT: 3-bit resources

- Watch for...
 - Tuning restrictions
 - RCT bugs
 - Data rates: 2sec → **23.6 MB/s, 85 GB/hr**
- “Fill subbands” is very useful for 3-bit!



RCT: 3-bit resources

- **3-bit in all basebands requires all 64 BIBPs**

RCT: 3-bit resources

- **Focus on 2013 general observing**
- 128 MHz/subband; no stacking/recirc
 - Full pol'n products: 2 MHz/channel
 - Dual p.p.: 1 MHz/channel
 - One p.p.: 0.5 MHz/channel

RCT: 3-bit resources

- High frequencies only (for now): [Ku] K
Ka Q
 - Avoid RFI
 - Band-dependent delays
 - Include Ku (not general observing) as it does not suffer from these effects, and allows observing in somewhat poorer weather



3-bit schedules

- 3-bit requires...
 - Setting attenuators & gain-slope equalizers (“set-and-remember”)
 - Setting requantizer gains

3-bit set-and-remember

- The 1st scan with a given 3-bit LO setting is used to set the attenuators & gain-slope equalizers
 - Should be at a reasonable elevation
 - Takes 4-5 minutes (conservative)
 - Done automatically by model2script – cannot (yet) be called explicitly in OPT



3-bit requantizer gain setting

- 2nd scan with given LO setting after set-and-remember, and 1st scan in ALL subsequent groups
 - There is no memory
 - Takes 90 sec – 1st 60sec will be useless

Typical 3-bit SB

- K3 setup 5mins set 3-bit attn/GSE
- X8 setup 1min set 8-bit attn
- X8 ptg 2m40s single subband RefPtg
- K3 setRQ 1m30s set 3-bit RQ
- K3 loop
 - K3cal
 - K3src



Scheduling 3-bit

- Can't use OST
- M2s by hand: Michael, Debra, Vivek, ...

Known problems

Lack of receivers

- Ku: 3 8 9 15 28
- K: none!
- Ka: 4
- Q: 8

Lost BDFs

- Sometimes no BDFs for an entire 3-bit configuration
- Actively working on this!!

Hardware issues

- Individual sampler pairs

- Ea28 B2D2
- Ea18 A2C2
- Ea21 B2D2
- Ea04
- Suckouts: ea24 B2D2, ea27 A2

Hardware issues

- Lots of one-offs
 - Not powered on
 - Manual resets
 - Unstable
- You may see sampler-dependent oddities:
 - No fringes
 - Unstable delays
 - “Lumpy bumpy” within subband/baseband

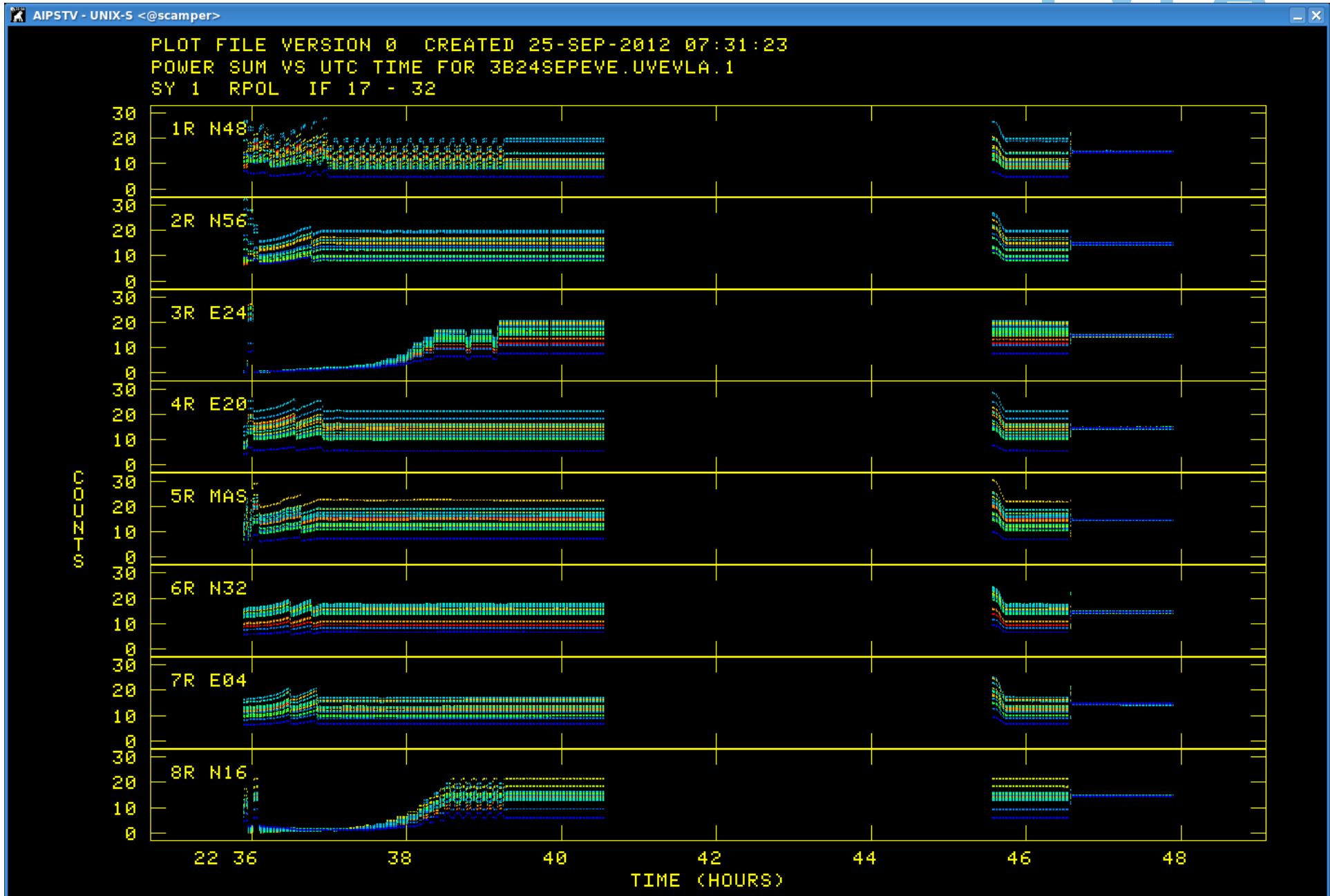


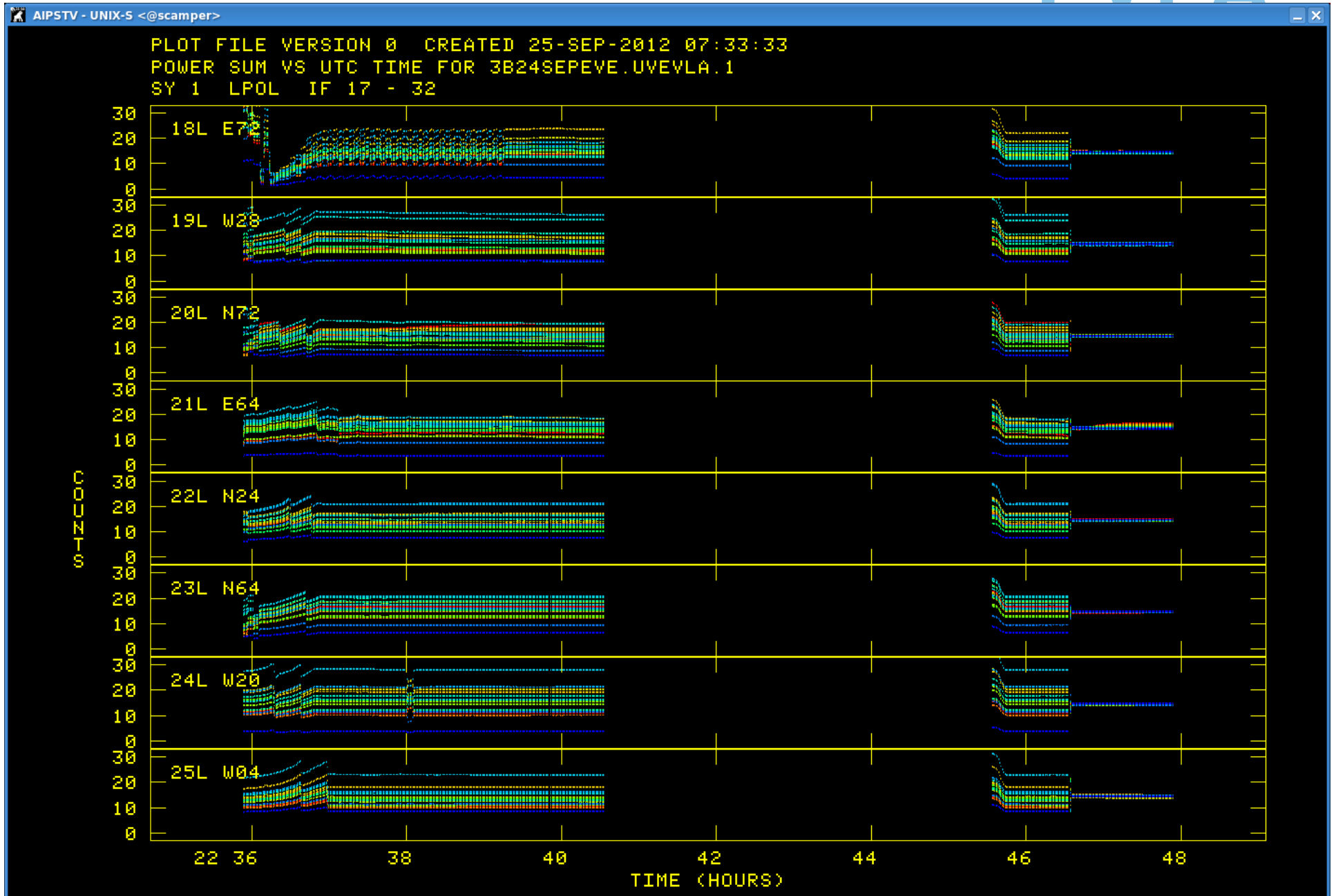
Hardware issues

- Delays
 - Sometimes not set as rapidly as 8-bit
 - Set at K-band
 - There are unexplained band-dependent delay offsets – high bands seem similar; low bands have big offsets

Post-processing

Psum is a great diagnostic





Note that...

- LOTS of data
- Overlapping basebands is very useful
 - 3-bit matches 8-bit; 3-bit matches 3-bit
- AIPS: BDF2AIPS doesn't know about basebands
 - CASA can select by baseband
- CASA/AIPS: IFs/SpWs for “overlapping” setups are:
 - A1C1 A2C2 B1D1 B2D2
 - Normally 16 subbands per 3-bit baseband; 8 per 8-bit baseband (128 MHz/subband)



We believe...

- Visibilities (correlations) are pretty linear – 5-10%?
- Pdiff are NOT linear, and should not be used
- Very little done with autocorrelations so far
- 3- bit matches 8-bit (phase, bandpass, etc.)

What is to be done

Basic tests

- Multiple tunings
- Multiple bands – Rick?
- Polarization tests (PolCal) – Dave Roberts/Steve
- Gain transfer/consistency
 - Wide range of elevations & source strengths – Vivek
 - Do we need to change GSE/attn in a run? When?
- Effects of changing GSE/attn with time



Basic tests

- Long observations
- Long-term bandpass stability
- Auto-flagging/pipelining – Hsi-Wei
 - Easy ways to find Evil Samplers (cf. Vivek's plots)
 - Birdies in a/c & flagging channels
- Use of REWAY et al.
- Spectral line survey/search – Juergen



Longer term

- Use of switched power – Rick/Vivek
- Lower bands – Lorant
- Tuning ranges – Lorant?

On-going work

- Hardware robustness
- Time required for GSE/attn setting
- Various software stuff resulting from tests (e.g., OPT, RCT, etc.)