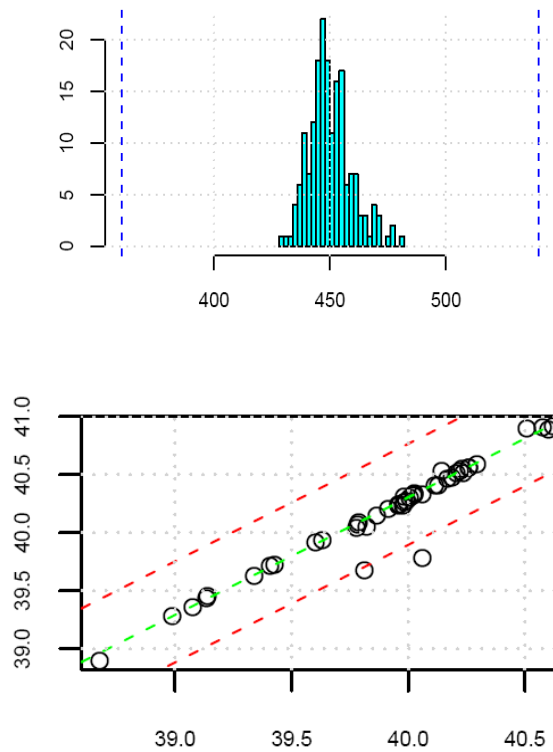


An Introduction to RADAR

What is RADAR?

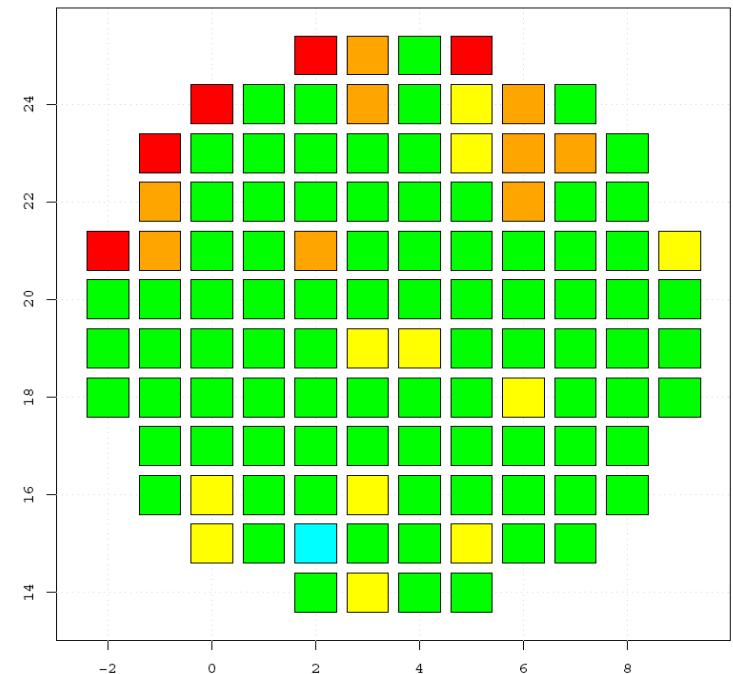
...Yet another ATE STDF data analysis toolkit, but **THIS ONE IS OPEN SOURCE!!!**

R-based
ATE
Data
Analysis
Resources



LOT:TEST SUBLOT: WAFER:09 YIELD: 76.8 percent

■	sbin 1:	86 (76.8%)	PASS of 112 die
■	sbin 4:	11 (9.8%)	DELAY
■	sbin 3:	9 (8.0%)	FUNC
■	sbin 10:	5 (4.5%)	CONT
■	sbin 11:	1 (0.9%)	POWER



Topics covered in this slide presentation:

==For the basic user ==

- * What is R? Why R? Who uses R?
- * What is RADAR?
- * An introductory tutorial – part 1
ConvertStd, SplitWafer, Wafermap, PlotRtdf, ConvertCSV
- * Some Useful Things To Know...
- * Installing RADAR

== For the more advanced user ==

- * RTDF description
- * An introductory tutorial – part 2 – using the R console
- * Looking at some of the existing RADAR scripts
- * Some of many R learning resources
- * Test Conditions

What is R?

...R is a statistical computing package.

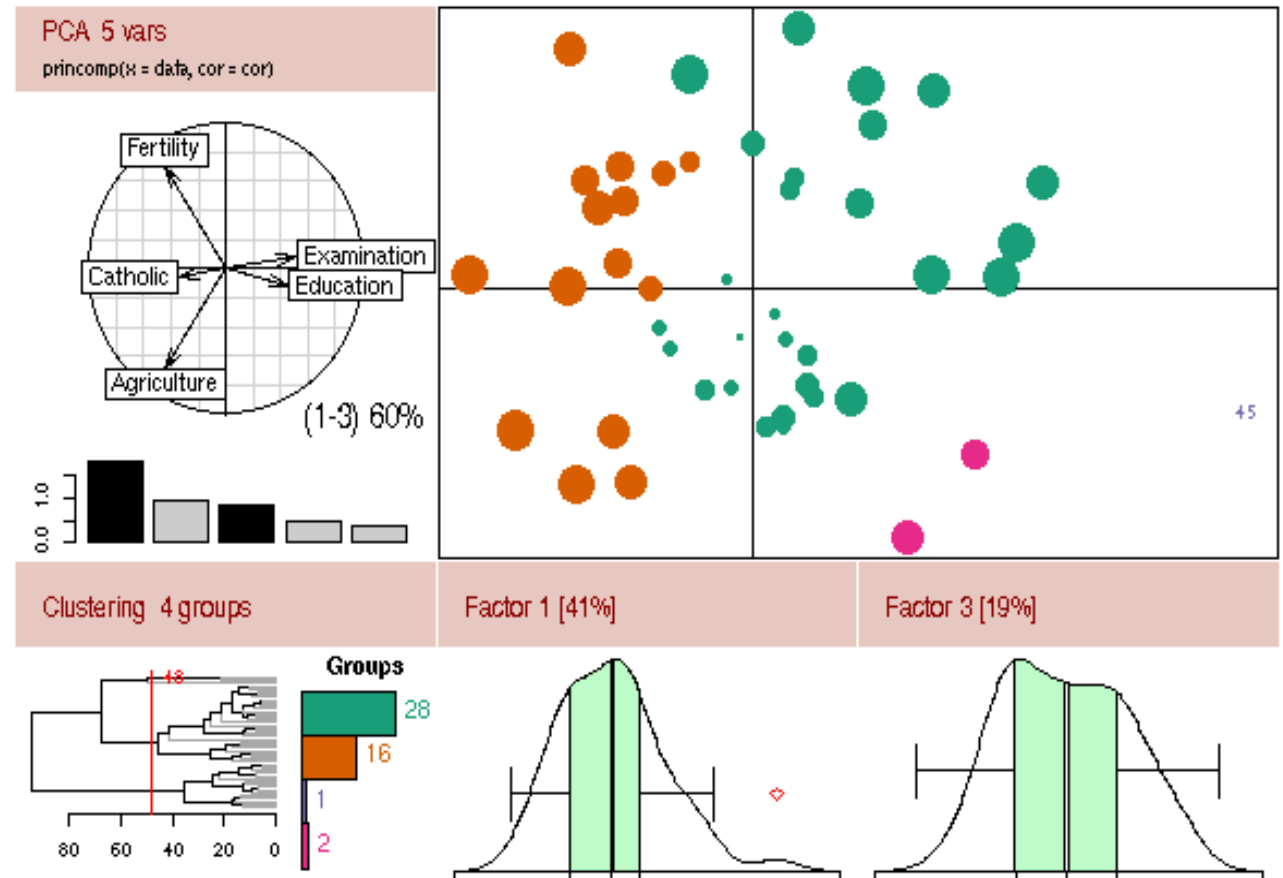


Other packages you may have encountered:

RS/1
Matlab and Octave
S-plus
O-Matrix
Scilab
Ox

Where to find R?

<http://www.r-project.org/>



Why R?

...Cost

R is open source. Some other packages can cost into the thousands to tens of thousands for licenses.

...Performance

**In benchmark exercises between various packages, R proved to be among the fastest.
(www.sciviews.org/benchmark)**

...Platform support

R is available in Linux, Mac, Windows, UNIX versions, and many others

...Language features

- R is primarily a statistics language, so it already has an extensive set of statistical commands.**
- It has many plotting/graphing functions and allows an extensive amount of customizing of various plot parameters.**
- It has support for parsing binary and ascii files.**
- It has Tcl/Tk support for GUI generation**
- Interactive command line**
- Interpretive language, so no compiling**

Who uses R?

R is used in many post-graduate statistics and statistics related courses as well as in various industries and the medical science field. R has a strong international community with an estimated 1 million users globally.

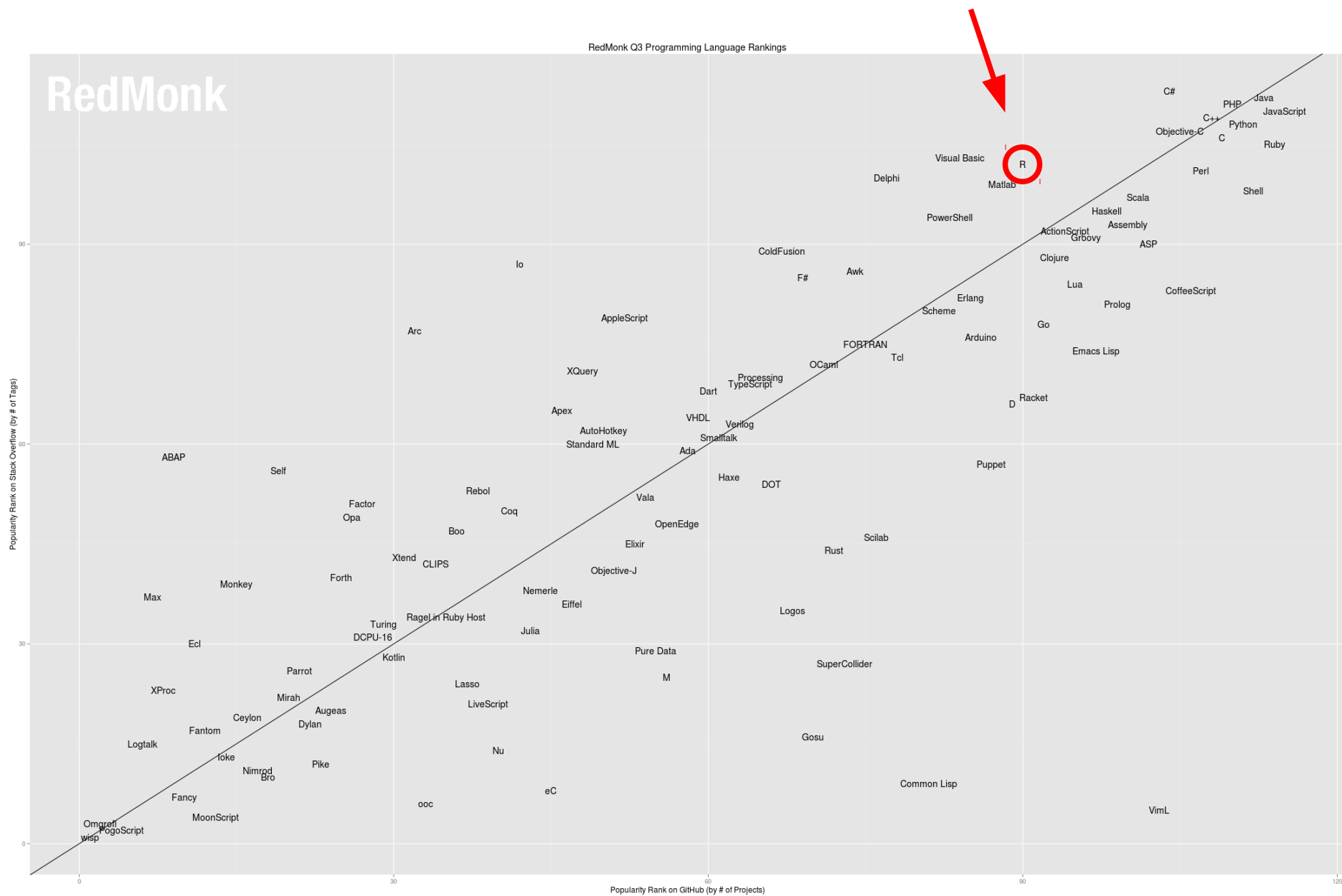
A few of the supporting institutions...

**Department of Biostatistics, Johns Hopkins University
MPI for Demographic Research, Rostock, Germany
Norwegian Institute of Marine Research, Bergen, Norway
School of Economics and Finance, Victoria University of Wellington,
New Zealand
ViaLactia Biosciences (NZ) Ltd, Auckland, New Zealand**

Some Canadian specific users...

**John Fox, Department of Sociology, McMaster University
John Nash, Telfer School of Management, University of Ottawa
Paul Gilbert, Bank of Canada
BC Cancer Agency, Vancouver, Canada
TERRA Lab, University of Regina - Department of Geography, Canada**

RedMonk Q3 Programming Language Ratings – June 2013



What is RADAR?

RADAR is a package of scripts written in R that can

- process ATE (Automated Test Equipment) data in STDF (Standard Test Data Format) or various other ATE specific formats**
- provide various common data manipulations like removing devices or individual results**
- generate histograms, xy plots, statistics tables, wafer maps, and guardbands**

These scripts are run in the R console, or alternatively can be executed using the TkRADAR GUI (Graphical User Interface).

An Introductory Tutorial – Part 1

...turn off buffered output... Misc -> buffered output

NOTE: stdf file from: <http://www.ge.infn.it/ATLAS/Electronics/home.html>

USE GUI to convert stdf file into R friendly format (rtdf), generate histograms, wafermaps, and spreadsheet output.

- ConvertStdF (also look at .summary file)*
- PlotRtdf (also look at statistics .csv file, search pdf for testname, histo vs norm)*
- WaferMap (do parametric as well as soft bin)*
- ConvertCSV*

- PlotRtdf – normal probability plots*
- ControlCharts*

- FilterByBinning*

Commands can also be typed in via the console, or run as a batch/script.

In “R”, function parameters can have default values or can be explicitly referenced, or implicitly by order

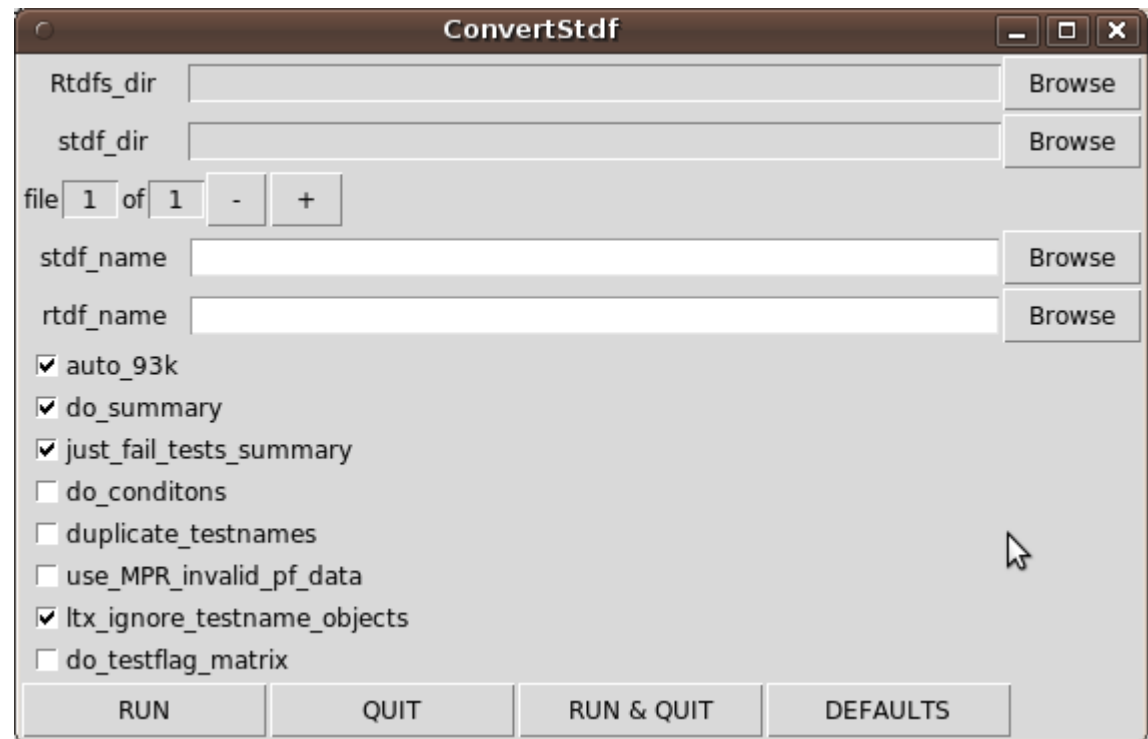
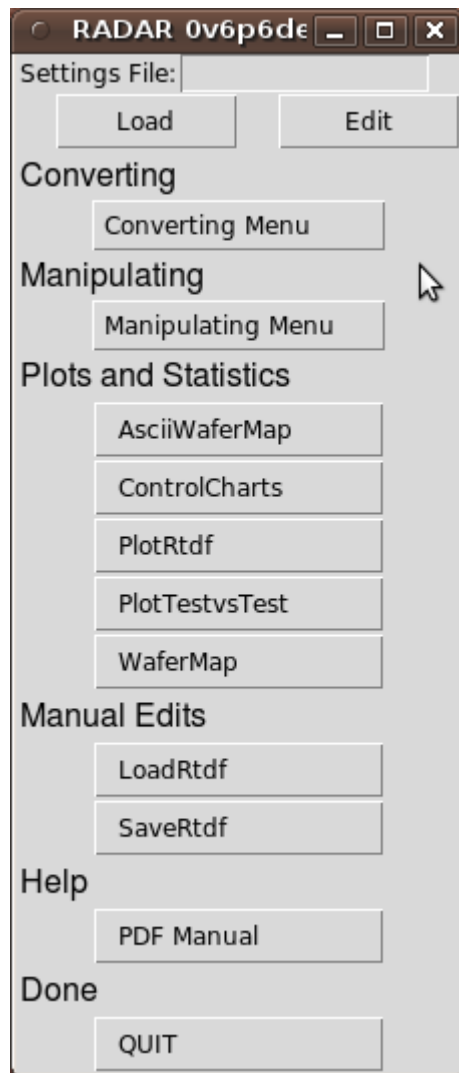
ConvertStdF(stdf_name = "a595.stdF.gz", rtdf_name = "a595.rtdf")

ConvertStdF("a595.stdF.gz")

An Introductory Tutorial – Part 1 continued

#TkRadar() **# start the GUI (Graphical User Interface)**

click on the Converting Menu → ConvertStdF button to bring up the ConvertStdF Gui



***# this visually shows you all the options for the script as well
as gives you a pointy-clicky way of setting the various
options...***

A closer look at PlotRtdf output:

Histogram

6000002 DISTORT_125MHZ

LL=-150.00 UL=-35.00 dBm

revB_dutcard3_corr_26oct_v2.Rdata

Mean = -42.487

Cpklo = 17.31

Cpkhi = 1.21

SDev = 2.070

Lo4sd = -50.77

Hi4sd = -34.20

Count = 46

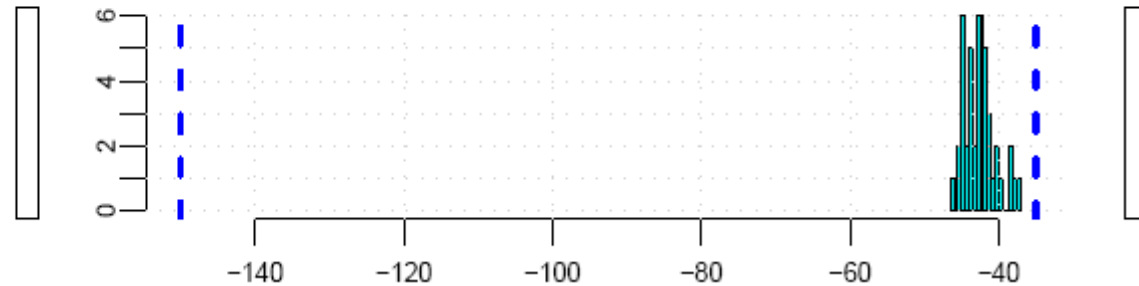
Lo6sd = -54.91

Hi6sd = -30.06

Off the plot = 0

Min = -46.206

Max = -37.171



XY plot

revB_dutcard4_corr_26oct_v2.Rdata

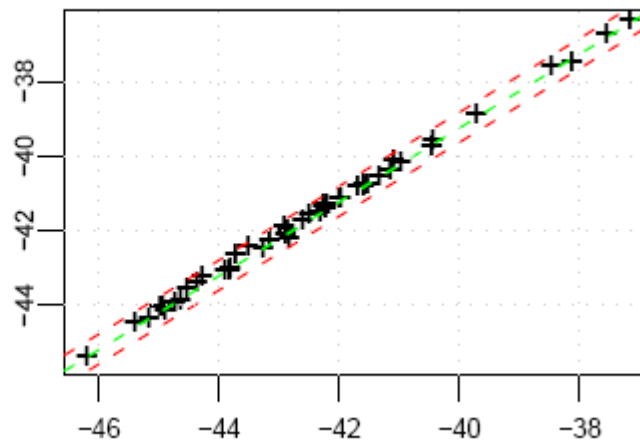
Slope = 0.991

Yint = 0.411

UL_yint = 0.832

LL_yint = 0.027








R = 1.00

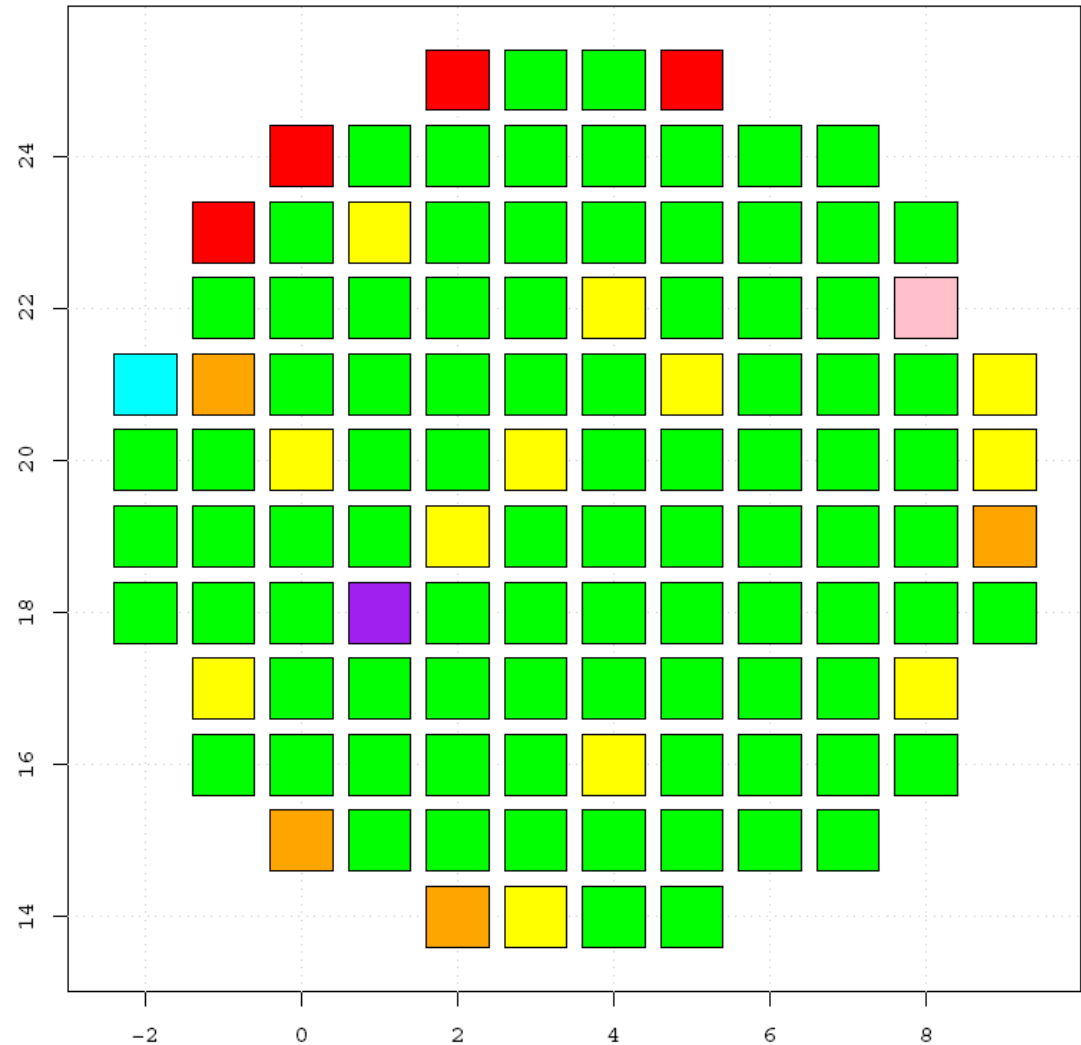


A closer look at WaferMap Output

type = "sbin":

LOT:TEST SUBLOT: WAFER:03 YIELD: 79.5 percent

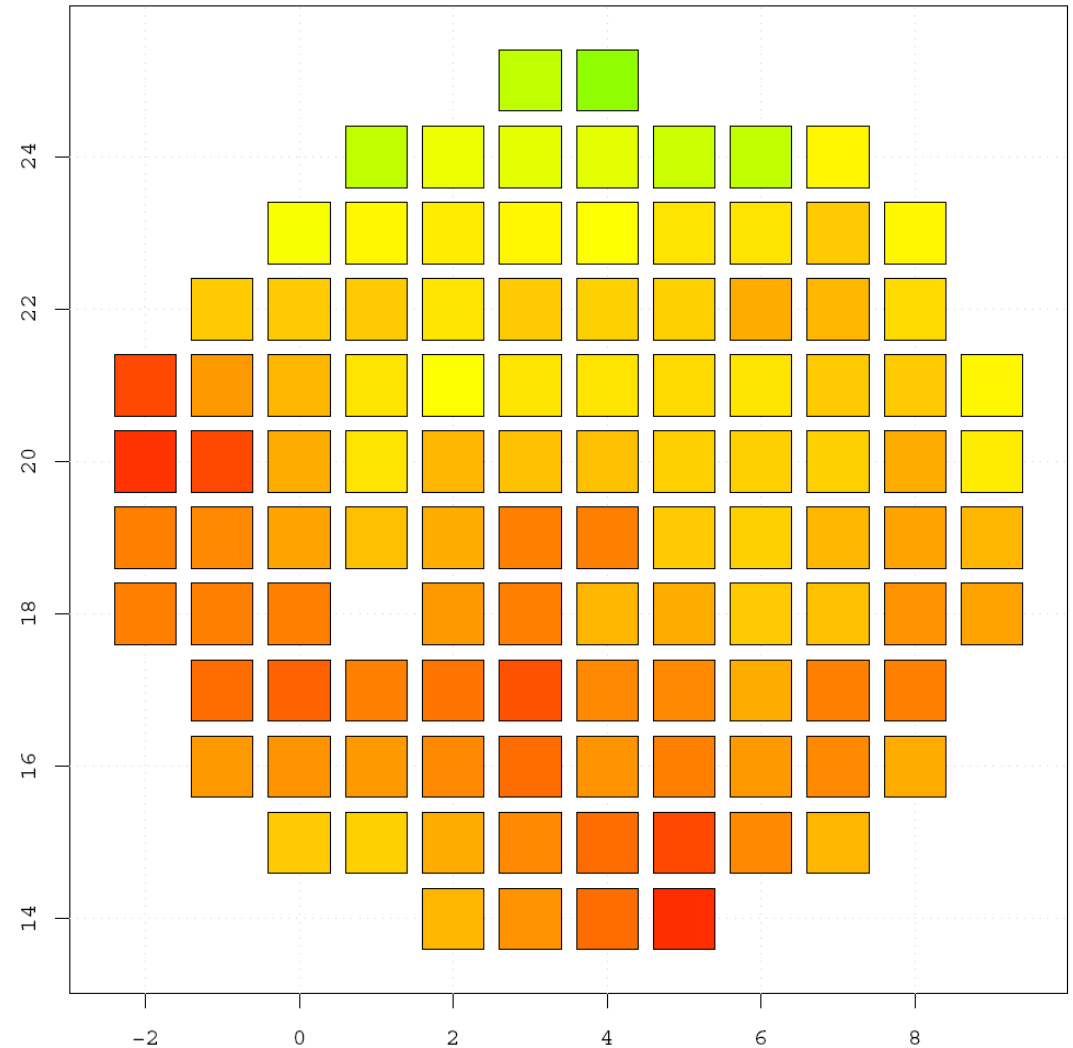
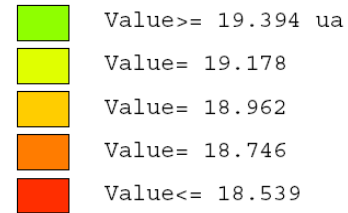
	sbin 1:	89 (79.5%)	PASS of 112 die
	sbin 4:	12 (10.7%)	DELAY
	sbin 3:	4 (3.6%)	FUNC
	sbin 10:	4 (3.6%)	CONT
	sbin 8:	1 (0.9%)	VIN
	sbin 9:	1 (0.9%)	VOUT
	sbin 11:	1 (0.9%)	POWER



A closer look at WaferMap Output type = "parameter":

LOT:TEST SUBLOT: WAFER:03 YIELD: 79.5 percent

Parameter: IIH_TSTEN



Some Useful Things To Know...

...about RADAR

- stdf files can be .gz compressed

...about the TkRadar GUI

- detachable menus
- multiple file selection
- settings files
- PDF help documentation
- TkRadar.log file

... about R

- up arrow/down arrow --- for command recall
- q() --- quitting your R session
- getwd() setwd() --- where are we? also Rgui directory control
- help(plot) --- getting help on built-in functions
- html search --- more help help.start()
- history()

Installing RADAR

See the PDF help documentation!

Install R

Install RADAR (Windows)

Create RADAR folder

Download RADAR package to this folder, unzip

Copy .Rprofile file from package subfolder to RADAR folder

Edit .Rprofile file to reflect location of package

Edit R desktop shortcut to look in RADAR folder

What is RTDF?

...An Rdata binary file containing a set of data objects; 4 main objects plus some additional ones as needed:

LotInfoFrame
ParametersFrame
DevicesFrame
ResultsMatrix

...as needed:

WaferInfoFrame
WafersFrame
HbinInfoFrame
SbinInfoFrame
TSRFrame

**Lot
Info
Frame**

DevicesFrame
[d in length]

ParametersFrame
[p in length]

ResultsMatrix
[d x p in size]

An Introductory Tutorial – Part 2

*# Adjusting plot limits, test list, test order using alternate ParametersFrame
in PlotRtdf...*

now adjust the limits for one test and replot...

```
ConvertParameters("a595.rtdf","a595_params.txt") # make plot_ul 130 for test 210
ConvertParameters("a595_params.txt")
PlotRtdf("a595.rtdf","a595_histos_v2.pdf",param_name="a595_params.rtdf")
# alternatively, ConvertCSV
```

an example of multiple histograms per test...

```
SplitWafers("a595.rtdf")           # break out rtdf file into 3 rtdf's one per wafer
PlotRtdf(c("a595_wafer02.rtdf","a595_wafer03.rtdf","a595_wafer09.rtdf"),
        "a595_per_wafer_histos.pdf")
```

find outliers...

```
FilterByResult("a595.rtdf","report",testname="IDD2 @ 5MHz", value=60,scaler="m")
```


Introductory Tutorial – Part 2 continued

if you want to look at the rtdf structure...

clear

#rm(list=ls(all=TRUE)) # or use button Misc -> remove all objects

```
load("a595.rtdf")  
ls()
```

```
dim(ResultsMatrix)
```

```
dim(ParametersFrame)  
ParametersFrame[1,]  
ParametersFrame[4,]
```

```
dim(DevicesFrame)  
DevicesFrame[1,]
```

```
bins = as.numeric(DevicesFrame[, "soft_bin"])  
DevicesFrame[bins==11,]
```

Introductory Tutorial – Part 2 continued

*# using the rtdf format,
let's see if idd at 1.25MHz correlates with idd at 5.00MHz...*

```
ParametersFrame[5,]  
ParametersFrame[9,]  
x_1Mhz = ResultsMatrix[,5]  
y_5Mhz = ResultsMatrix[,9]  
plot(x_1Mhz,y_5Mhz)  
grid()  
help(plot)  
plot(x_1Mhz*1000.0,y_5Mhz*1000.0,xlab="Idd at 1MHz (mA)",ylab="Idd at 5MHz  
(mA)")
```

or use the RADAR script:
source("Radar.R")
PlotTestvsTest("a595.rtdf","IDD1 @ 1.25MHz","IDD1 @ 5MHz")

Looking at a RADAR script...

FilterByBinning is one of the more straightforward scripts in the Manipulating Data section...

RADAR / TkRADAR is a “body on frame” structure. Command line “frame” portion with GUI “body” on top. **FilterByBinning.R** vs. **FilterByBinningGUI.R**

Radar.R – Overall script that loads individual command line functions

TkRadar.R / TkRadarDefaultsGUI.R – Overall script that loads Tk functions

Familiarizing yourself with the R language...

R_programming_crib_sheet.txt

included in RADAR package folder

help.start()

and click on “An Introduction to R” link

or “Search Engine & Keywords” link

Various places on the web...

<http://math.illinoisstate.edu/dhkim/rstuff/rtutor.html>

<http://www.cyclismo.org/tutorial/R/>

<http://faculty.washington.edu/tlumley/Rcourse/R-fundamentals.pdf>

some examples of different graph/plot capabilities

Test Conditions

Test conditions are not explicitly handled in the STDF specification. A few different approaches have been taken at different times, but more often than not, there is usually some test system somewhere that just won't support a given approach. (some test systems have been known to either inconsistently delay DTR records, or else to put them all at the end of a device run)

One approach currently supported in RADAR uses regular MPR or PTR records, with special testnames for the converter to key on.

"CONDITION=xxxxxx"

ie. **"CONDITION=Vdda" 3.30 V** [testname, value, units of PTR record]

An alternate approach supported in RADAR uses SplitBySubstr.R to trigger on testnames. An example would be testnames with **_Vmin_** or **_Vnom_** or **_Vmax_** to indicate 3 conditions. The script would split the dataset into 3 separate datasets based on these substrings.

Visit the RADAR Web page...

To get the latest news and versions of the RADAR scripts

<http://sites.google.com/site/stdfradar>

Send an email...

To ask questions on how to do something

To provide feedback either on bugs, bug fixes, feature requests, improvements

To send STDF files [or other types of ATE generated files to add to the inventory of test cases

To submit scripts you've written to get included in the next package release

stdf.radar@gmail.com