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Widex Testing Tools

User Manual

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1 Introduction

In 2008, the IRAM backend group built a new wide band correlator, called WideX. Many computer programs were written to validate this new and complex hardware. This document is the user manual for these softwares.

2 Installation

All the programs are installed in `/home/introot/wcorrel/bin`
So it is a good idea to add this directory to your environment variable PATH.

No need to remember program names because all start with a common prefix: `correl-`
Therefore, type `correl-` in a UNIX shell and then press the TAB key to display the list of program names that start with this prefix.

3 Correl-manager

Correl-manager is the supervisor program that:

- Initialize the optical link.
- Load real-time modules.
- Execute correl-control and correl-server programs.

Features:

- Protection against concurrent executions: the program checks and insures that only one instance of correl-manager, correl-control and correl-server are running.
- Autocleaning: subprocesses and modules are cleaned when exiting.
- Signals are caught to insure that cleaning is always done.

If you try run simultaneously two instances of correl-manager, the 2nd instance detects the 1st one and kills it before starting.

Correl-manager must be started before the other programs; otherwise they abort (Segmentation Fault).

3.1 Syntax

Usage:

`correl-manager` *[options]*

Options:

-v	Display version information
-h, -?	Display help
-c=arg	Pass 'arg' to correl-control. Can be used several times.

-s=arg Pass 'arg' to correl-server. Can be used several times.

Refer to correl-control and correl-server syntax to know the options you can pass with –c and –s.

3.2 Examples

Display correl-control and correl-server help

```
$ correl-manager -c=-h -s=-h
Start correl-manager
Start RTAI
Widex Correlator Server
Network interface for the correlator control process
Usage: correl-server [options]
Options:
  -v        Display version information
  -h, -?    Display help

Widex Control Software
Control the widex correlator (acquisition and data processing)
Usage: correl-control [options]
Options:
  -s        Simulation mode

  -r        Raw processing (to debug readout board) [DEFAULT]
  -c        Chip processing (to debug chip)
  -a        Astro processing (for observing)

  -v        Display version information
  -h, -?    Display help
  -m        Manual readings (for debugging)

Mon Jun 9 10:40:44 2008:correl-manager: signal 2
Stop RTAI
Stop correl-manager
$
```

Start a debug chip session. Correl-control should be started with chip processing.

```
$ correl-manager -c=-c
Start correl-manager
Start RTAI
TcpServer is listening on port 2100
Settings:
        simulated      = 0
        autoReading    = 1
        processingMode = Chip
Read control register
Write current time
Start at Mon Jun 9 10:48:34 2008
```

4 Correl-control

Correl-control controls the correlator hardware.
Features:

- Real-time engine: Data acquisition and processing timings are guaranteed.
- Built-in simulator: All the programs can be developed/tested now, even if the correlator hardware is not available yet.
- Modular design: it is very easy to add new data processors or new simulation patterns.

This program cannot be executed directly. It must be run by correl-manager.

4.1 Syntax

Usage:

`correl-control` *[options]*

Options:

-s	Simulation mode
-m	Manual reading (for debugging)
-r	Raw processing (to debug readout board) [DEFAULT]
-c	Chip processing (to debug chip)
-a	Astro processing (for observing)
-v	Display version information
-h, -?	Display help

Notes

- The program stops if the correlator hardware is not present at the startup. In this case, select the simulation mode to run the program.
- You can modify the processing mode (raw, chip, astro) during execution (for example with correl-client).
- Data are automatically acquired and processed at 32 Hz, but for debbuging purpose you can enable *Manual reading*. In this mode correl-control waits for a *readCorrelation* command (for example from correl-client) to acquire and process data.

5 Correl-server

Correl-server is the gateway for correl-control.

Features:

- Centralize requests from clients to correl-control.
- Send back answers from correl-control to clients.
- Fair scheduler: requests are sequentially executed in the arrival order, and no client can block the others.

This program cannot be executed directly. It must be run by correl-manager.
The program prints also useful information about timing on the standard output.

5.1 Syntax

Usage:

correl-server [options]

Options:

-v	Display version information
-h, -?	Display help

5.2 Example

If *correl-server* receives a *readTime* request, the following lines appear on screen.

```
Incoming connection
Connection from 127.0.0.1:53904
Request: readTime
processRequest takes 1661 usec
Answer: readTime time =  0x3ba3 (04:14:27)
End of connection
Exiting thread 0x0805d1e0
exit rtai::Thread [cortcp]
```

6 Correl-client

Correl-client is a tool to send arbitrary commands to correl-control via correl-server.

Features:

- Interactive command line.
- Command name completion: type the beginning of the command name, and then press TAB to complete it.
- History: use arrow up and down to navigate in the command history.
- On-line help: type *help command*, to display help about *command*.

6.1 Syntax

Usage:

correl-client[options]

Options:

-v	Display version information
-h, -?	Display help

6.2 Examples

Execute commands

```
correl-client> readTime
Send request:
        Request: readTime
Status:
        Answer: readTime time =  0x1565 (01:31:17)

correl-client> writeControl 0x1234
Send request:
        Request: writeControl control =  0x1234
Status:
        Answer: writeControl
```

On-line help

```
correl-client> help
Help about help
Syntax:
        help action
Print help about action

Available actions:
  help                  readAttenuator
  readControl           readCorrelation
  readDelay             readMaintenance
  readStatus            readTime
  readTotalPower        setApodizationMode
  setClippingMode       setCorrelationMode
  setProcessingMode     setSimulationMode
  writeAttenuator       writeControl
  writeDelay            writeTime

correl-client> help setProcessingMode
Help about setProcessingMode
Syntax:
        setProcessingMode N
with N:
0 => RawCopy
1 => Chip
2 => Astro

correl-client> help writeTime
Help about writeTime
Syntax:
        writeTime T
T is specified in seconds
```

Correl-client can also be used to execute command file (with standard input redirection)
You can insert comment with a #

```
$ cat ./command.txt
# This is a comment. Comment starts with a dash (#)
```

```
readTime

$ correl-client < command.txt
Hit Ctrl+D to exit
correl-client> # This is a comment. Comment starts with a dash (#)
correl-client> readTime
Send request:
        Request: readTime
Status:
        Answer: readTime time =  0x1446 (01:26:30)
correl-client> $
```

7 Correl-client-repeat.py

Correl-client-repeat.py is a small python script to execute a command file with correl-client forever. With this program you can stress correlator hardware and software to check stability.

7.1 Syntax

Usage:

correl-client-repeat.py commandFile

8 Correl-dump

Correl-dump is a command line tool to dump the content of the correlator shared memory.

8.1 Syntax

Usage:

correl-dump [options]

Options:

-r[=baseline,offset,length]	Dump raw data
-c[=chipNum,offset,length]	Dump chip data
-s[=baseline,offset,length]	Dump Spectra data
-v	Display version information
-h, -?	Display help

Obviously, there are raw (resp. chip, spectra) data to display, only if correl-control is runing in raw (resp. chip, astro) processing mode.

8.2 Examples

Dump common settings

```
$ correl-dump
----------------------------------
Dump Common
----------------------------------
Date    : Tue Jun 10 08:52:07 2008
Hostname: wcorrel0

integrationDuration: 32
simulated: 1
simulationMode: Constant
autoReading : 1
processingMode : RawCopy
apodizationMode: None
clippingMode: None


Data Header:
time = 000f96ef (08h:52m:07s,15)
bias = 0x5968 (22888) ; status = 0x0000  ;
temp_L = 0x0000 (-273.00 degC) ;  temp_R = 0x0000 (-273.00 degC)
temp_RO = 0x0000 (-273.00 degC)
totalPower =  0   0   0   0   0   0   0   0

End of dump
```

Display 10 raw channels for baseline #2, starting from offset 8

```
$ correl-dump -r=2,8,10
----------------------------------
Dump Common
----------------------------------
Date    : Tue Jun 10 10:51:56 2008
Hostname: wcorrel0

integrationDuration: 32
simulated: 1
simulationMode: Constant
autoReading : 1
processingMode : RawCopy
apodizationMode: None
clippingMode: None

Data Header:
time = 00134bba (10h:58m:37s,26)
bias = 0x5968 (22888) ; status = 0x0000  ;
temp_L = 0x0000 (-273.00 degC) ;  temp_R = 0x0000 (-273.00 degC)
temp_RO = 0x0000 (-273.00 degC)
totalPower =  0   0   0   0   0   0   0   0

-----------------------------------------------------------------------
Dump Raw                           Offset                 Word
BaseLine Channel Board           Hex:       Dec:        Hex:     Dec:
-----------------------------------------------------------------------
 2(1,3)        0     8       0x010010      65552      0x0001        1
 2(1,3)        0     9       0x010012      65554      0x0001        1
```

```
 2(1,3)        0    10       0x010014      65556      0x0001        1
 2(1,3)        0    11       0x010016      65558      0x0001        1
 2(1,3)        0    12       0x010018      65560      0x0001        1
 2(1,3)        0    13       0x01001a      65562      0x0001        1
 2(1,3)        0    14       0x01001c      65564      0x0001        1
 2(1,3)        0    15       0x01001e      65566      0x0001        1
 2(1,3)        1     0       0x010020      65568      0x0001        1
 2(1,3)        1     1       0x010022      65570      0x0001        1
-------------------------------------------------------------------------
End of dump
```

9 Correl-debugchip

Correl-debugchip is an advanced graphical tool to debug correlator chips.
Features:

- Display correlation function of any chip.
- Run automatic checking to find damaged chips.

When the program starts it displays the main window:

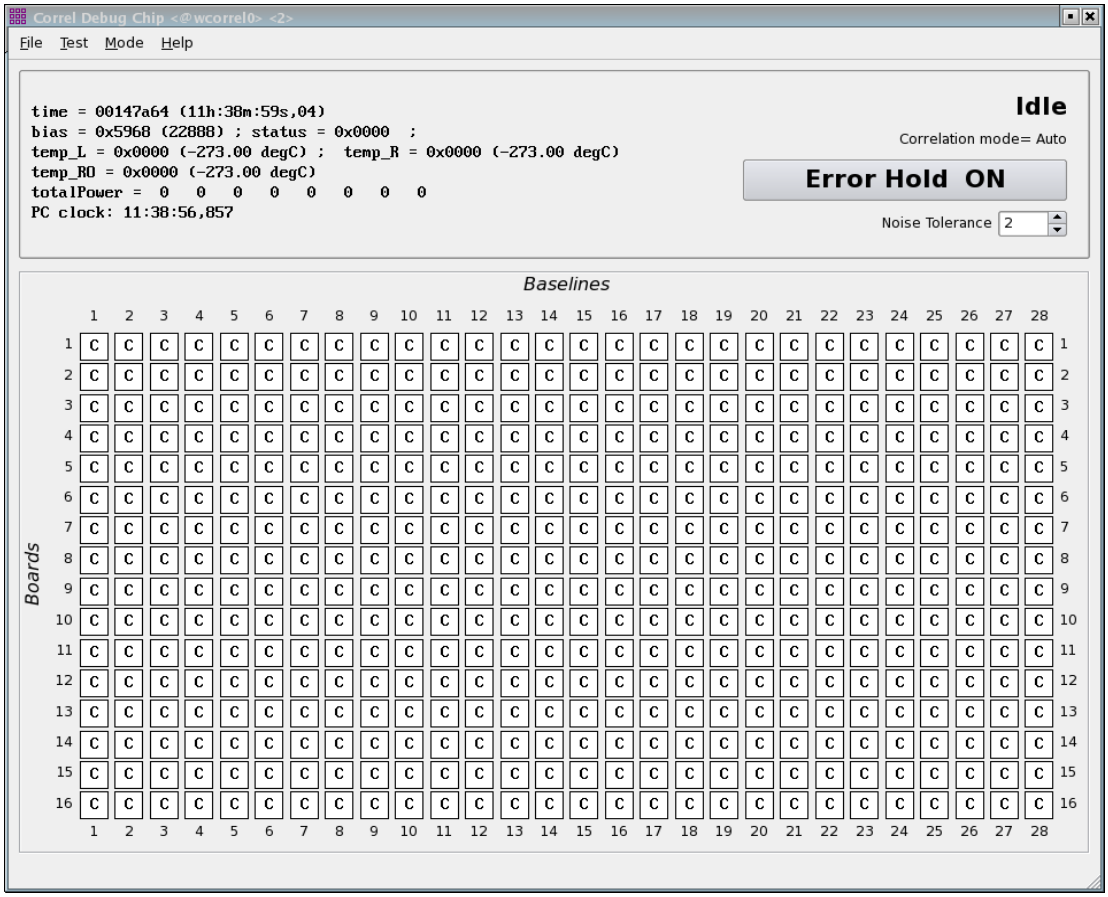


Figure 1: DebugChip Main Window

9.1 User Interface description

9.1.1 Correlator information

In the top left corner, correlator information is displayed.
This area is refreshed several times per seconds.

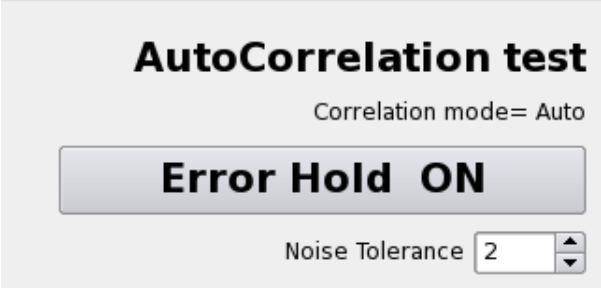
```
time = 00146741 (11h:36m:26s,01)
bias = 0x5968 (22888) ; status = 0x0000  ;
temp_L = 0x0000 (-273.00 degC) ;  temp_R = 0x0000
temp_RO = 0x0000 (-273.00 degC)
totalPower =  0   0   0   0   0   0   0   0
PC clock: 11:36:23,339
```

The computer clock is also displayed to monitor time derivation.

9.1.2 Mode information

In the top right corner, mode information is displayed.

This area is refreshed several times per seconds.



The 1st line displays the current test.
You can switch to another test with the menu *Test*.

The 2nd line displays the current correlation mode.
You can switch to another mode with the menu *Mode*.

The 3rd line displays the error holding policy.
Indeed this line is a button, and you can click on it to switch on/off error holding.

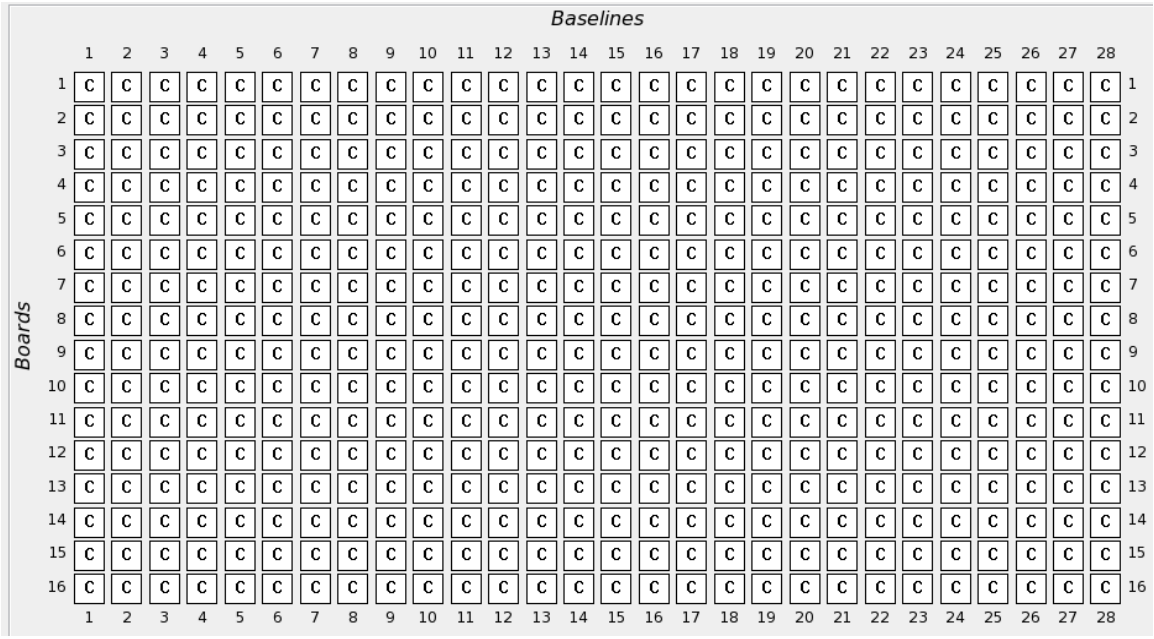
When Error Hold is ON, error status is not cleared between tests running. It is useful to catch sporadic errors. It is the quickest mode, because it requires less graphic operations on the screen.

When Error Hold is OFF, error status on chip is cleared before each test running.
It is useful when tuning fine timing. It is the slowest mode, because it requires more graphic operations on the screen.

The 4th line displays the noise tolerance
The value is specified in channel raw unit. It is used when comparing chips together.

9.1.3 Chip Matrix

At the bottom, a matrix represents the correlator chips.

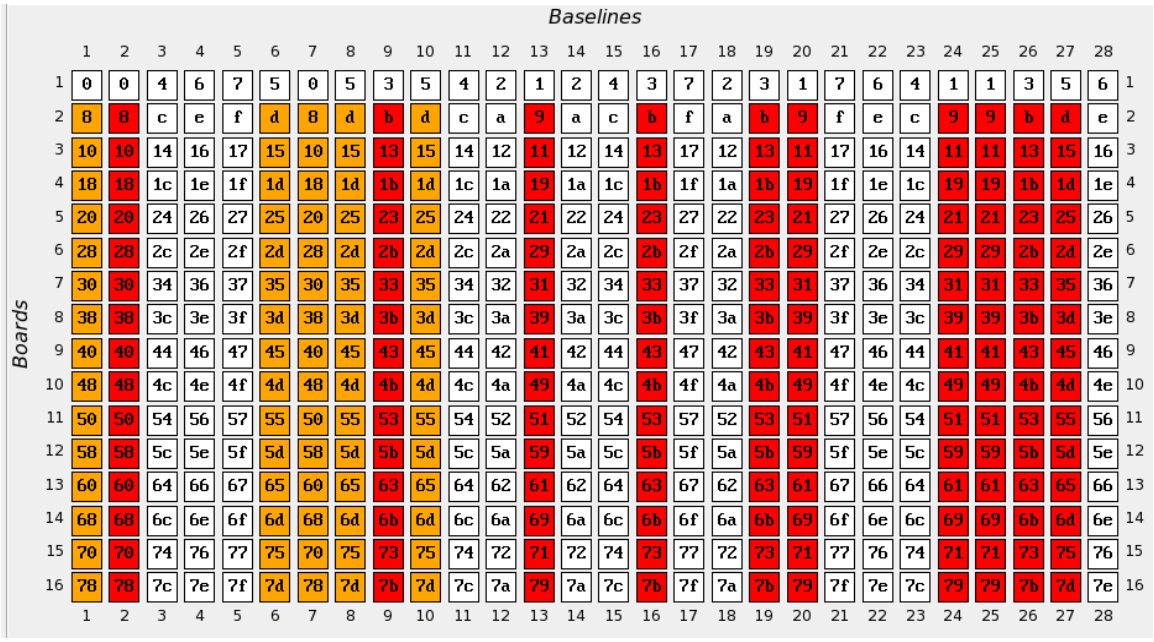


You can get information on each individual chip by moving (without clicking) the mouse cursor on the chip. Double click on the chip to display its content in another window.

9.2 Tests

With the *Test* menu, you can select a test to run on the chips.
If you want to run no test, select the *Idle* test (which does nothing)

The test is executed several times per seconds and its results are displayed on the chip matrix with colors.



9.2.1 Result interpretations

Group numbers
For some tests, chips are labeled with a group number. All chips in a same group number are expected to deliver the same value (modulo noise). So the group members are compared together, and the algorithm finds the members that differ from the group majority.

Background colors
- White: OK
- Orange: WARNING
- Red: ERROR

Example:
On the screenshot above, on the 2nd board, there is a problem in the #8 chip group. The problem is probably located on the 2nd baseline. (i.e. 2nd chip)

9.2.2 Test Listing

Idle
This test does nothing. It is the default mode. It does not modify the current correlation mode.

Static test p=0
Switch the correlator to the static0 correlation mode. In this mode all channels of all chips are expected to be equal to 0.
This test accepts no noise margin. Values are expected to be exact.

Static test p=6
Switch the correlator to the static6 correlation mode. In this mode all channels of all chips are expected to be equal to a magic value (about 25000), which depends only from the integration time.
This test accepts no noise margin. Values are expected to be exact.

Autocorrelation test
Switch the correlator to the autocorrelation mode. According to the correlator card wiring table, some chips do the same job in this mode. Chips doing the same jobs are put in a same group. These chips are expected to deliver the same values. Therefore the test compares chips together to check if they match.
This test accepts a noise margin.

Compare board
Keep the current correlation mode, and compare boards (per baseline) together.
This test accepts a noise margin.

Compare baseline
Keep the current correlation mode, and compare baseline (on same board) together.
This test accepts a noise margin.

9.3 Modes

With the *Mode* menu, you can switch to any correlation mode.

9.3.1 Mode Listing

See *Correlator_Asic.pdf* from Philippe Chavatte, to understand how correlation modes work.

Cross correlation
It is the natural mode for observing. Chips compute cross correlation between two antennas signals.

Auto correlation
This mode is used for testing and calibrating the interferometer.

Static test p = 0
In this mode, chip multiplier outputs deliver always 0, so all channels are equal to 0.

Static test p = 0
In this mode, chip multiplier outputs deliver always 6, so all channels are equal to a magic number (about 25000), which depends only from the integration time.

9.4 Chip Window

On the main window, double-click on a chip to display its correlation function, in a new window.

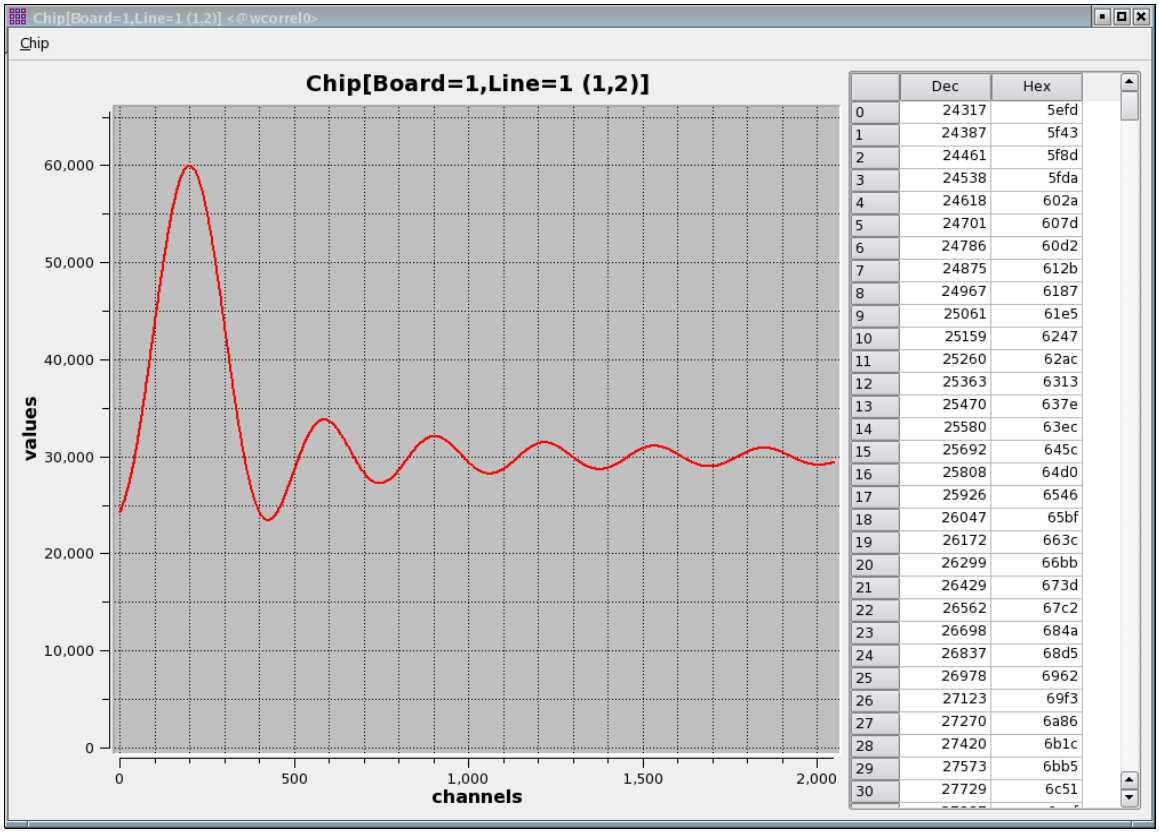


Figure 2: DebugChip Chip Window

Features:

- Automatic refresh: the window is refreshed several times per seconds.
- Automatic scaling: the scale is automatically adapted to the data.
- Multi-level zooming capability.

The individual channel values are displayed in an array on the right panel.
By default, automatic scaling is disabled. Open the *Chip* menu to enable it.

9.4.1 Chip Label

On this screenshot, we are watching the chip located on

- Board #1
- Baseline #8. This baseline is the product of antennas (6x2)

9.4.2 Zoom

The chip window supports multi-level zooms.

How to zoom:

- Draw a rectangle with the mouse left button, to define the area to zoom. You can zoom-in several times to create a zoom stack. (push a zoom)
- Use mouse middle button, to zoom out one position on the zoom stack. (pop a zoom)
- Use mouse right button to restore the original zoom base.

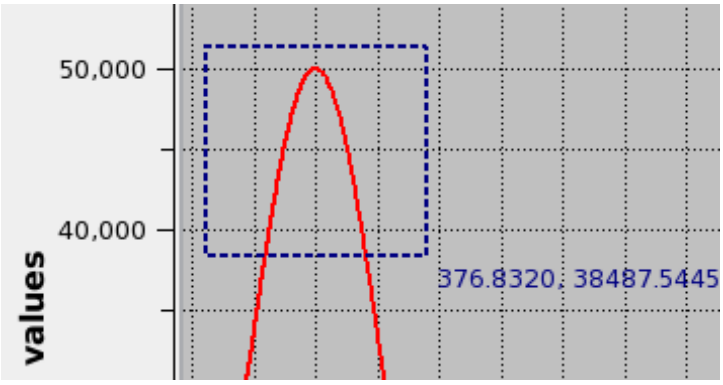


Figure 3: DebugChip zoom in action

10 Correl-register-gui

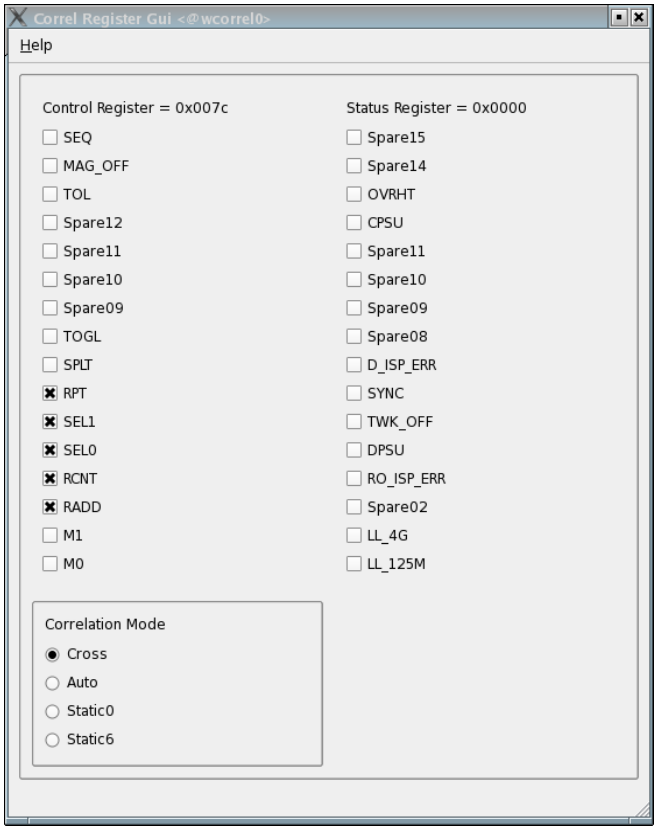
Correl-register-gui is a small graphical utility to modify/display the control register.

10.1 Syntax

Usage:

```
correl-register-gui
```

10.2 Screenshot



The window displays the current control and status registers. The value is refreshed every 500 msec.

For the control register, you can modify a bit value by clicking on it.

Obviously, you cannot modify the status register. It is a read-only value.

There are also convenient radio buttons to modify the control register at the bottom left.

11 Correl-scan-attenuator

Correl-scan-attenuator is a small program to plot the graph TotalPower(attenuation).

11.1 Syntax

Usage:

```
correl-scan-attenuator [options]
```

Options:

-v	Display version information
-h, -?	Display help

12 Correl-scan-delay

Correl-scan-delay is a small program to check the hardware delays

12.1 Syntax

Usage:

```
correl-scan-delay [options]
```

Options:

-a=antennaList	Antenna list to scan. Default value: all antennas
-t=tolerance	Tolerance for channel comparison. Default value = 4
-v	Display version information
-h, -?	Display help

13 CERN tools

The CERN RORC tools are also installed in the directory: */home/introot/wcorrel/bin*
They can be executed without special privileges.

For you information, the most useful commands are:

Name	Description
ddl_init_link	Initialize the optical link
rorc_find	Find RORC installed on the system
rorc_id	Display the RORC's firmware and hardware id words
rorc_status	Display the RORC channels status and error registers
siu_id	Display SIU firmware and hardware id words
siu_status	Send a Read and Clear SIU Status command via RORC

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