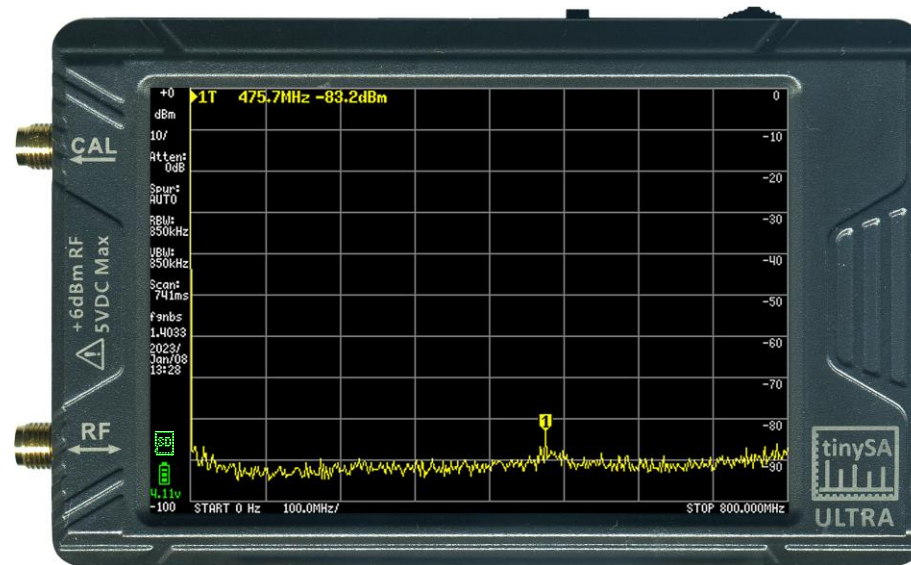


TinySA Ultra Menu-Tree Chart



TinySA Ultra showing default startup display

PURPOSE

- The purpose of this document is to provide the TinySA Ultra user a quick reference guide for the menu tree structure and menu selections of the TinySA Ultra device.
- It is a work-in-progress and will reflect changes in the menu structure, features, selections, etc. as firmware updates necessitate.
- It is beyond the scope of this document to serve as an operational manual or comprehensive technical reference for the TinySA Ultra. That information can be found on the official TinySA® wiki website <https://www.tinysa.org/wiki/>.

DESCRIPTION AND NOTES

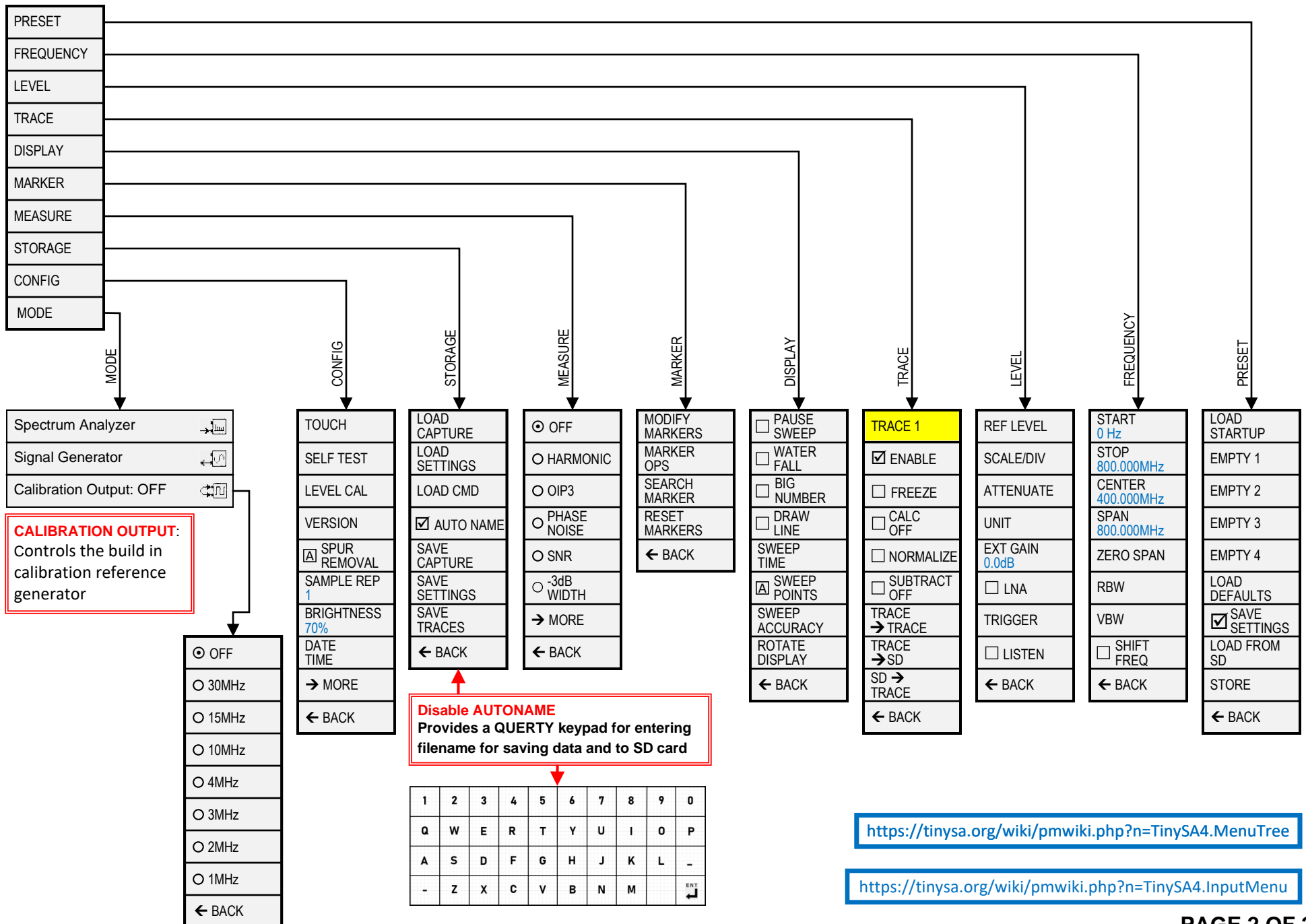
As with most software driven menu devices, the TinySA Ultra has a TOP LEVEL (a.k.a., MAIN MENU) and branches down to sub menu levels for each of the top level selection buttons. This document is organized so that each menu level and its submenu(s) and/or other functions such as a keypad is represented on a separate page. As room permits, more than one level of submenus may appear on a single page. Default settings are shown in this document unless otherwise stated.

Firmware version archive can be found at <http://athome.kaashoek.com/tinySA4/>. For the official online discussion group go to <https://groups.io/g/tinysa/>. This document is based on the firmware version shown below.

Originally created by David Massey (WD4OWA@gmail.com) and then updated by Kurt Poulsen (kurt@hamcom.dk), this drawing is released to the public domain for non-commercial/non-profit use. Original drawing created and updated using Microsoft Visio Professional 2019 and then converted to a standard PDF file for universal computer and printer compatibility. Both the Visio and PDF files are made available.

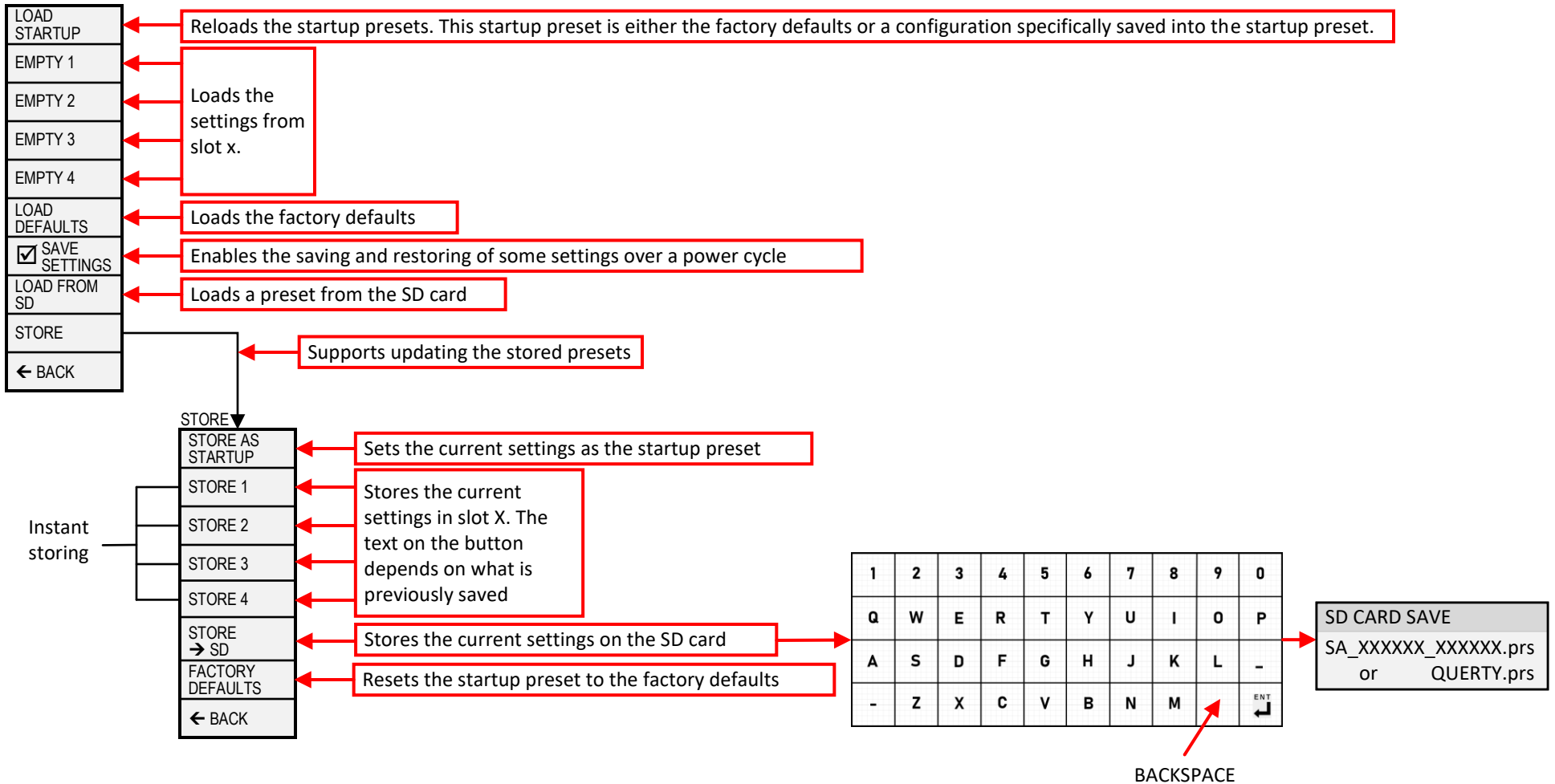
Drawing base on Firmware version: v1.4-49.
See last page for document revision history.

TinySA Ultra **TOP** Menu Chart



TinySA Ultra PRESET Menu Chart

Preset Load



TinySA Ultra **FREQUENCY** Menu Chart

Sets everything related to the frequencies to scan

START
0 Hz
STOP
800.000MHz
CENTER
400.000MHz
SPAN
800.000MHz
ZERO SPAN
RBW
VBW
<input type="checkbox"/> SHIFT FREQ
← BACK

Actual start frequency

7	8	9	G
4	5	6	M
1	2	3	K
0	.	←	x1

START Actual start frequency

VBW

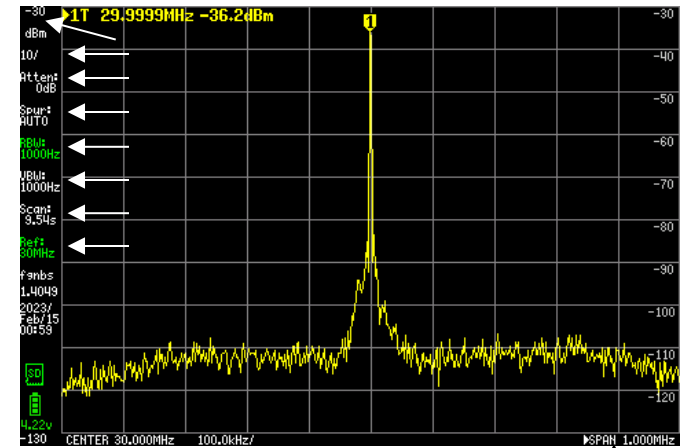
<input checked="" type="radio"/> AUTO
<input type="radio"/> 0.01 RBW
<input type="radio"/> 0.03 RBW
<input type="radio"/> 0.10 RBW
<input type="radio"/> 0.33 RBW
<input type="radio"/> 1.00 RBW
← BACK

RBW

<input checked="" type="radio"/> AUTO
<input type="radio"/> 200Hz
<input type="radio"/> 1KHz
<input type="radio"/> 3KHz
<input type="radio"/> 10KHz
<input type="radio"/> 30KHz
<input type="radio"/> 100KHz
<input type="radio"/> 300KHz
<input type="radio"/> 600KHz
<input type="radio"/> 850KHz
← BACK

7	8	9	G
4	5	6	M
1	2	3	K
0	.	←	x1

START/STOP/CENTER/SPAN
FREQ 0Hz to 12.072GHz if
ULTRA enabled else 800MHz

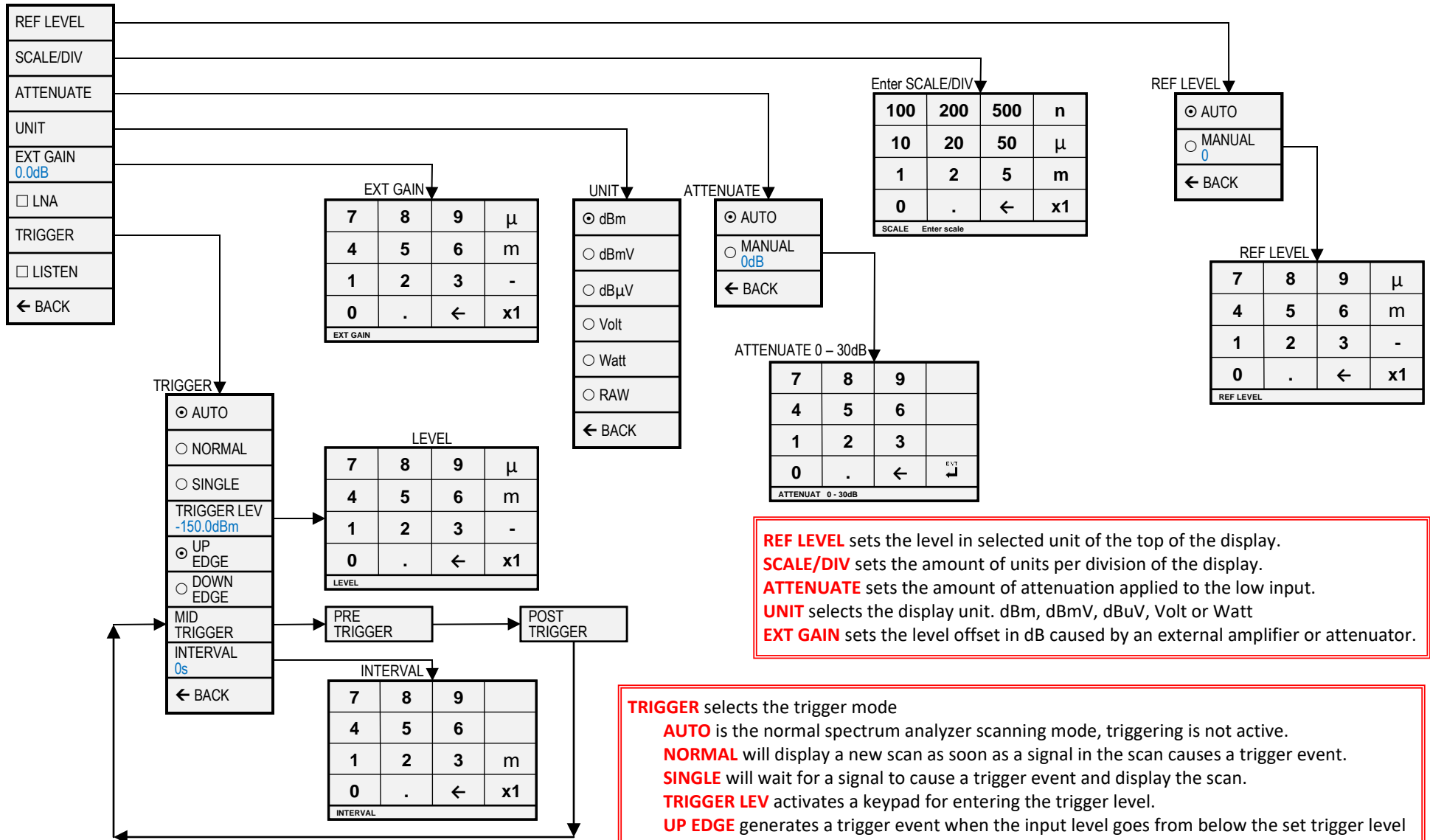


Select either CENTER or SPAN for changing value with Jog Wheel
Other function also accessible as marked with white arrows

- START** sets the scanning to start/stop mode and sets the start frequency
- STOP** sets the scanning to start/stop mode and sets the stop frequency
- CENTER** sets the scanning to center/span mode and sets the center frequency
- SPAN** sets the scanning to center/span mode and sets the frequency span
- ZERO SPAN** sets the scanning to center/span mode, sets the span to 0Hz and sets the center frequency
- RBW** sets the resolution bandwidth. Keep in mind a low RBW may increase scanning time substantially.
- VBW** sets the VBW as fraction of the RBW or to automatic.
- SHIFT FREQ:** Used in combination with up/down converters & allows entering the actual START or CENTER frequency before the up/down conversion.

TinySA Ultra **LEVEL** Menu Chart

Sets everything related to the level of the signals being measured

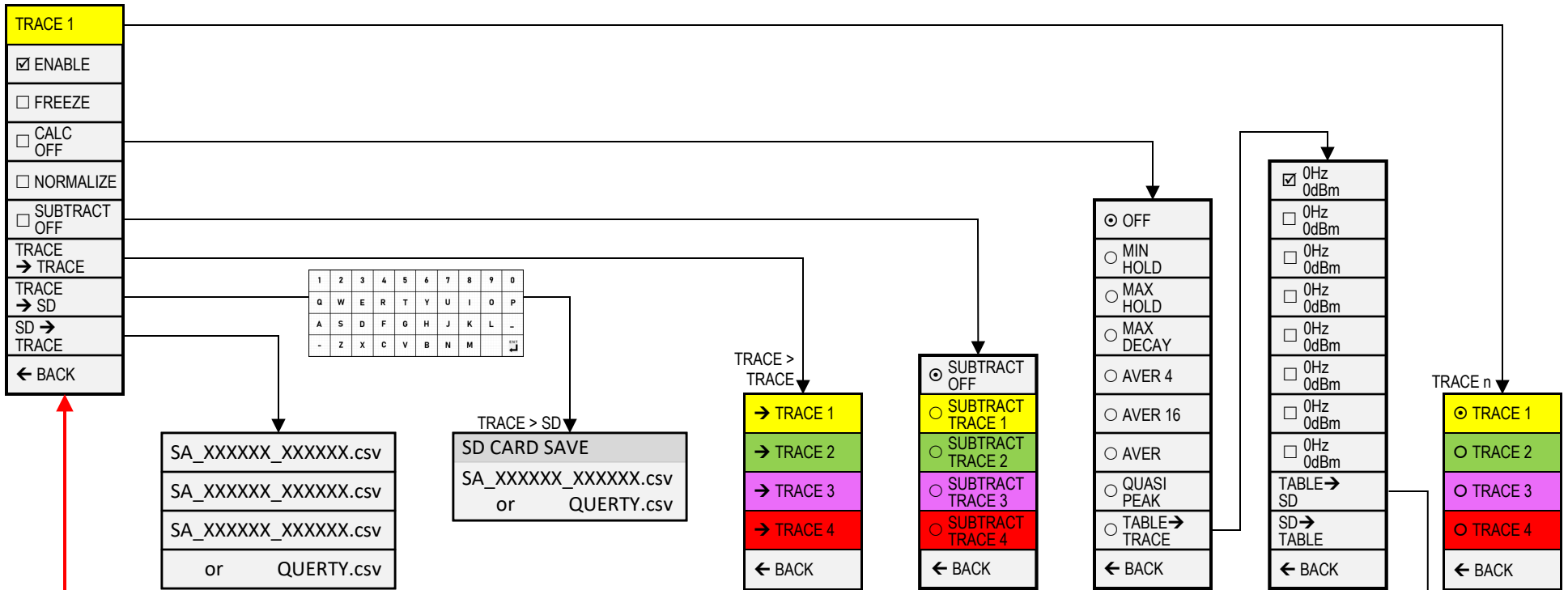


REF LEVEL sets the level in selected unit of the top of the display.
SCALE/DIV sets the amount of units per division of the display.
ATTENUATE sets the amount of attenuation applied to the low input.
UNIT selects the display unit. dBm, dBmV, dBuV, Volt or Watt
EXT GAIN sets the level offset in dB caused by an external amplifier or attenuator.

TRIGGER selects the trigger mode
AUTO is the normal spectrum analyzer scanning mode, triggering is not active.
NORMAL will display a new scan as soon as a signal in the scan causes a trigger event.
SINGLE will wait for a signal to cause a trigger event and display the scan.
TRIGGER LEV activates a keypad for entering the trigger level.
UP EDGE generates a trigger event when the input level goes from below the set trigger level to above the set trigger level
DOWN EDGE generates a trigger event when the input level goes from above the set trigger level to below the set trigger level
PRE | MID | POST TRIGGER is a three value toggle setting allowing to place the trigger position at the start, middle or end of the scan.
LISTEN puts the TinySA in Listen mode at the frequency of the current active marker.

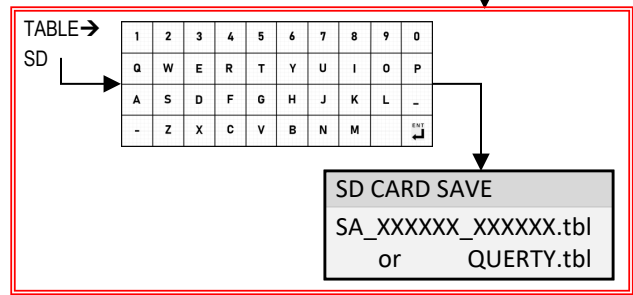
TinySA Ultra TRACE Menu Chart

Selects a trace and controls various aspects of how the trace is displayed



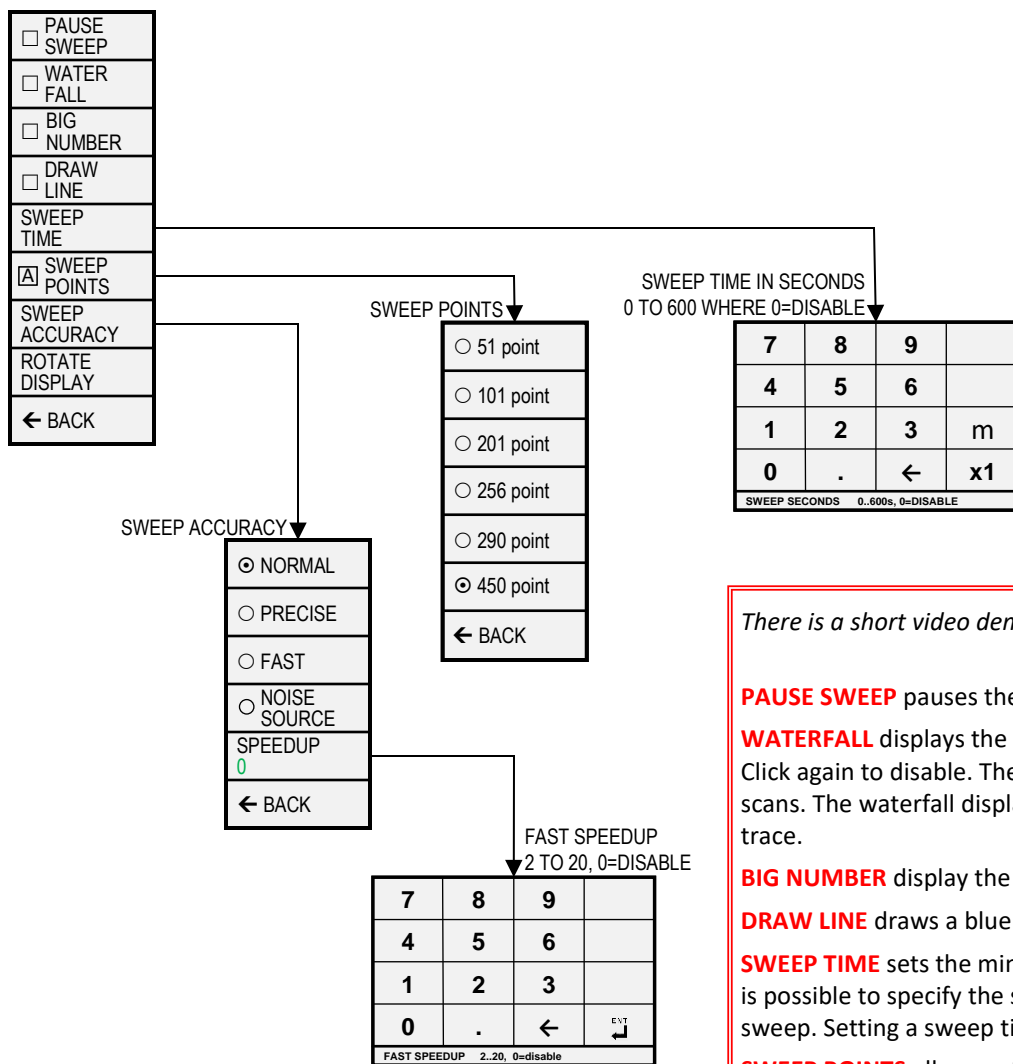
Disable AUTONAME
As shown on PAGE 2 provides a QUERTY on screen keypad for entering filenames for saving to SD card

- TRACE n** selects which trace to control
- ENABLE** dis/en-ables a trace display
- FREEZE** freezes the trace displayed
- CALC** state selects various calculation options over time such as averaging, max hold and display the current CALC state.
 - OFF** disables any calculation
 - MIN HOLD** sets the display to hold the minimum value measured.
 - MAX HOLD** sets the display to hold the maximum value measured.
 - MAX DECAY** sets the display to hold the maximum value measured for a certain amount of scans.
 - AVER 4** sets the amount of running averaging to 4.
 - AVER 16** sets the amount of running averaging to 16.
 - AVER** continuous averaging of sweeps.
 - QUASI PEAK** sets the quasi peak hold mode
 - TABLE->TRACE** supports the definition of a static trace
- NORMALIZE** will normalize the trace.
- SUBTRACT** selects a trace to subtract from the current trace
- TRACE->TRACE** copies the current trace data to another trace
- TRACE->SD** copies the current trace data to SD
- SD->TRACE** reads a trace from SD and stores into a frozen trace.



TinySA Ultra **DISPLAY** Menu Chart

Controls various aspects of how the display



There is a short video demonstrating the display menu at https://www.youtube.com/watch?v=DlnEVAvS_I4

PAUSE SWEEP pauses the scanning

WATERFALL displays the power level over time in a waterfall map. A second click enlarges the waterfall. Click again to disable. The waterfall moves per scan and displays the last 40 (small mode) or 80 (large mode) scans. The waterfall displays the first active trace without calculation or, if not available, the first active trace.

BIG NUMBER display the value of marker 1 as a big number below the scan

DRAW LINE draws a blue horizontal line at the entered level, click again to remove the line.

SWEEP TIME sets the minimum time for a complete sweep in seconds. Using the 'm' button on the keypad it is possible to specify the sweep time in milliseconds. Setting the sweep time to zero enables the fastest sweep. Setting a sweep time below the fastest sweep time has no impact.

SWEEP POINTS allows setting the number of sweep points to 51, 101, 145 or the default of 290. Reducing the sweep points will only lead to a reduction of sweep time if the RBW using the reduced number of sweep points is below 600kHz.

SWEEP ACCURACY menu contains various settings on how to sweep the selected frequency or time span.

ROTATE DISPLAY rotates the display 180 degrees

BACK returns to the input menu

TinySA Ultra **MARKER** Menu Chart

Controls the markers on the display

The active marker is indicated with a triangle before the number and a T after the number for tracking

MODIFY MARKERS
MARKER OPS
SEARCH MARKER
RESET MARKERS
← BACK

SEARCH MARKER

PEAK SEARCH
MIN ← LEFT
MIN → RIGHT
MAX ← LEFT
MAX → RIGHT
ENTER FREQUENCY
<input checked="" type="checkbox"/> TRACKING
PEAK 5
← BACK

MARKER OPS

→ START
→ STOP
→ CENTER
→ SPAN
→ REF LEVEL
← BACK

MODIFY MARKERS

MARKER 1
<input type="checkbox"/> DELTA 1
<input type="checkbox"/> NOISE
<input checked="" type="checkbox"/> TRACKING
TRACE 1
<input type="checkbox"/> TRACE AVERAGE
SEARCH
DELETE
← BACK

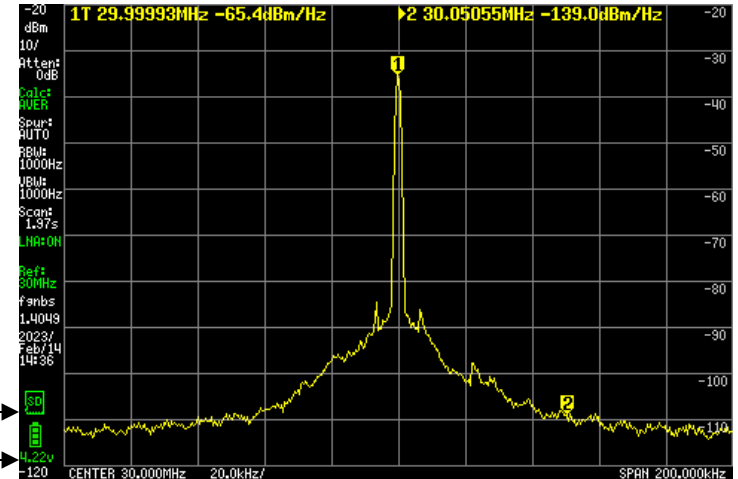
7	8	9	G
4	5	6	M
1	2	3	K
0	.	←	x1

MARKER FREQ

NOISE LEVEL 2 TO 20 dB

7	8	9	
4	5	6	
1	2	3	
0	.	←	ENT

NOISE LEVEL 2..20 dB



The internal 30MHz signal measured with MARKER 1 as TRACKING and NOISE MARKER 2 at +50KHz as NOISE Levels are normalized to 1Hz RBW Noise 73.6dB below carrier

Markers are used to display the value of signals. Up to 8 markers can be shown and linked to up to 4 traces.

MODIFY MARKER allows selecting a marker and shows a submenu to modify the MARKER TYPE or to delete the marker.

MARKER OPS allows setting the frequency display range based on the active marker by jog wheel

SEARCH MARKER allows positioning a non-tracking marker on signal maximum or minimum. This can also be done using the jog button or by dragging the marker.

ENTER FREQUENCY of marker

PEAK n sets the minimum amount of dB above the noise floor of a tracking marker.

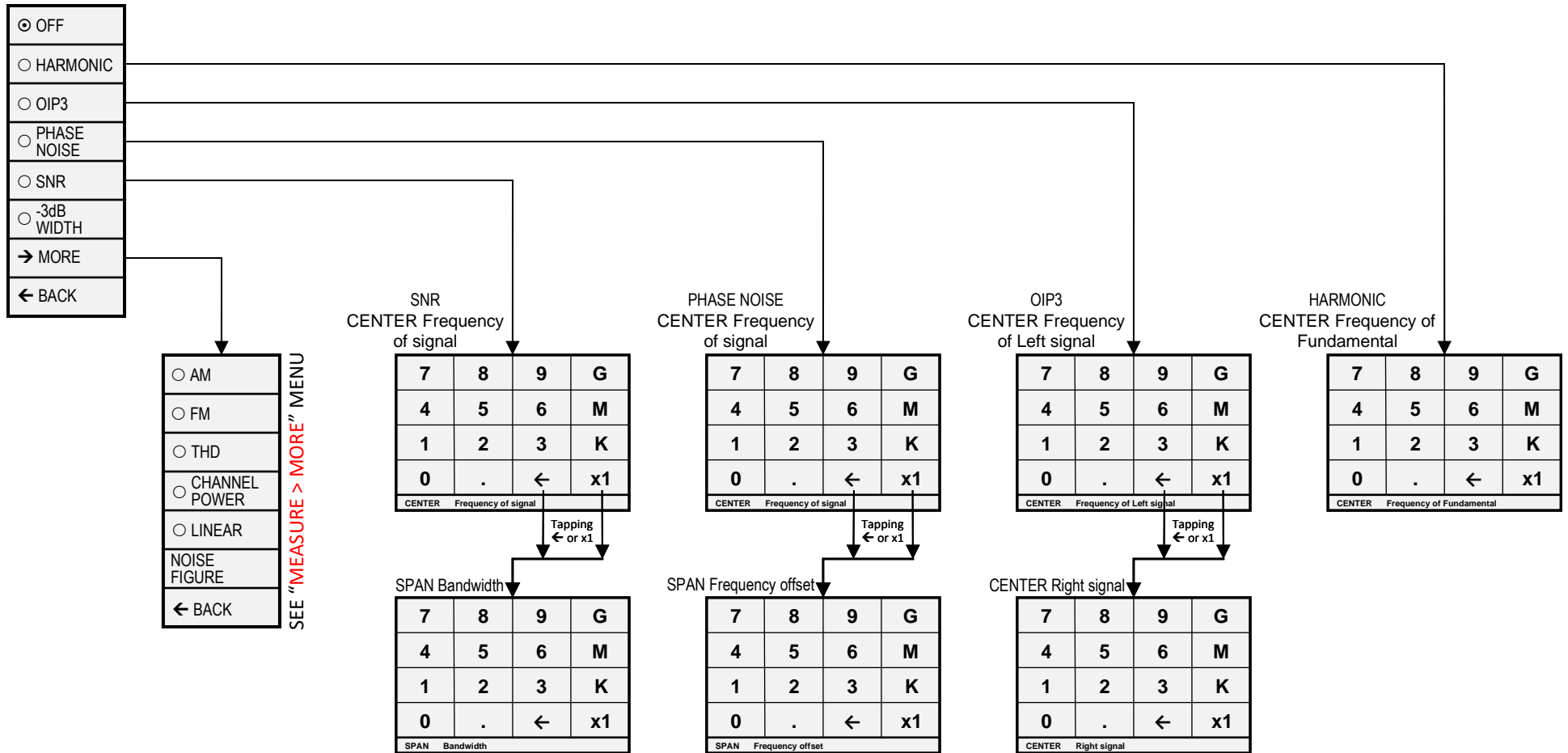
RESET MARKERS resets all markers to the default state

BACK returns to the input menu

Marker 1 is by default enabled and has the TRACKING attribute and is thus automatically positioned at the largest signal in the scan. The active marker can be moved with the jog switch. Any marker can be moved by dragging the marker to a new position. The active marker can also be selected by touching the related marker info at the top of the screen.

TinySA Ultra **MEASURE** Menu Chart

The measurement menu provides quick presets and data entering for certain type of measurements.



OFF switches of any measurement related setting and behavior and returns the TinySA to regular operation

HARMONIC switches to a marker configuration for measuring the level of harmonics of a signal

OIP3 switches to a marker configuration for measuring the Output IP3 level of a signal

PHASE NOISE switches to a marker configuration for measuring phase noise of a signal

SNR set three markers, a tracking marker and two delta markers at the specified distance to the tracking marker

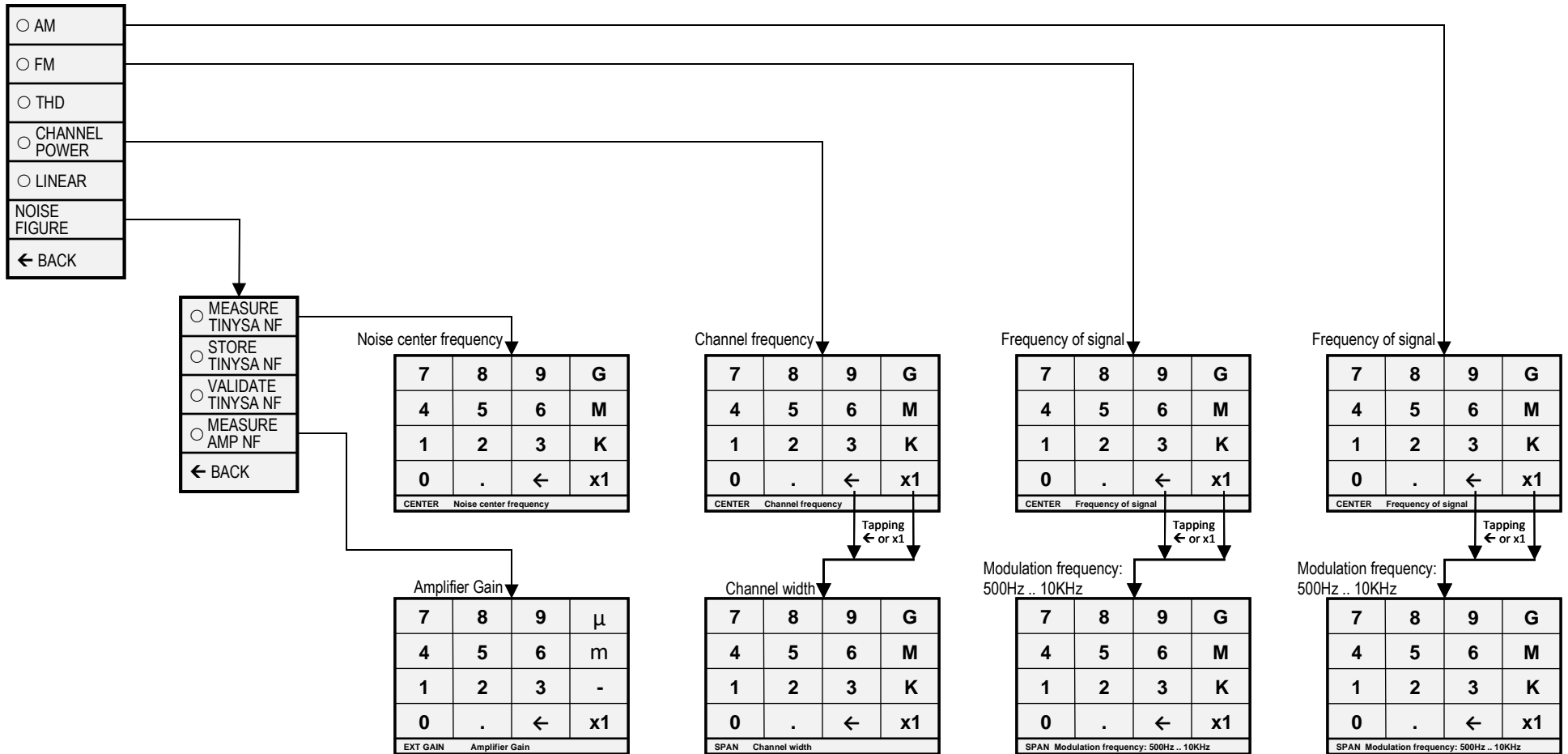
-3dB WIDTH sets three markers, a tracking marker and two delta markers at the -3dB levels versus the tracking marker and the delta frequency of the two delta markers is calculated

MORE moves to the second measure menu

BACK moves back to the input menu

TinySA Ultra **MEASURE > MORE** Menu Chart

Second Measurement Menu



AM sets various settings to optimize observations of an AM modulated signal. WARNING: For best performance keep level of AM input signal minus attenuation below -45dBm.

FM sets various settings to optimize observations of an FM modulated signal

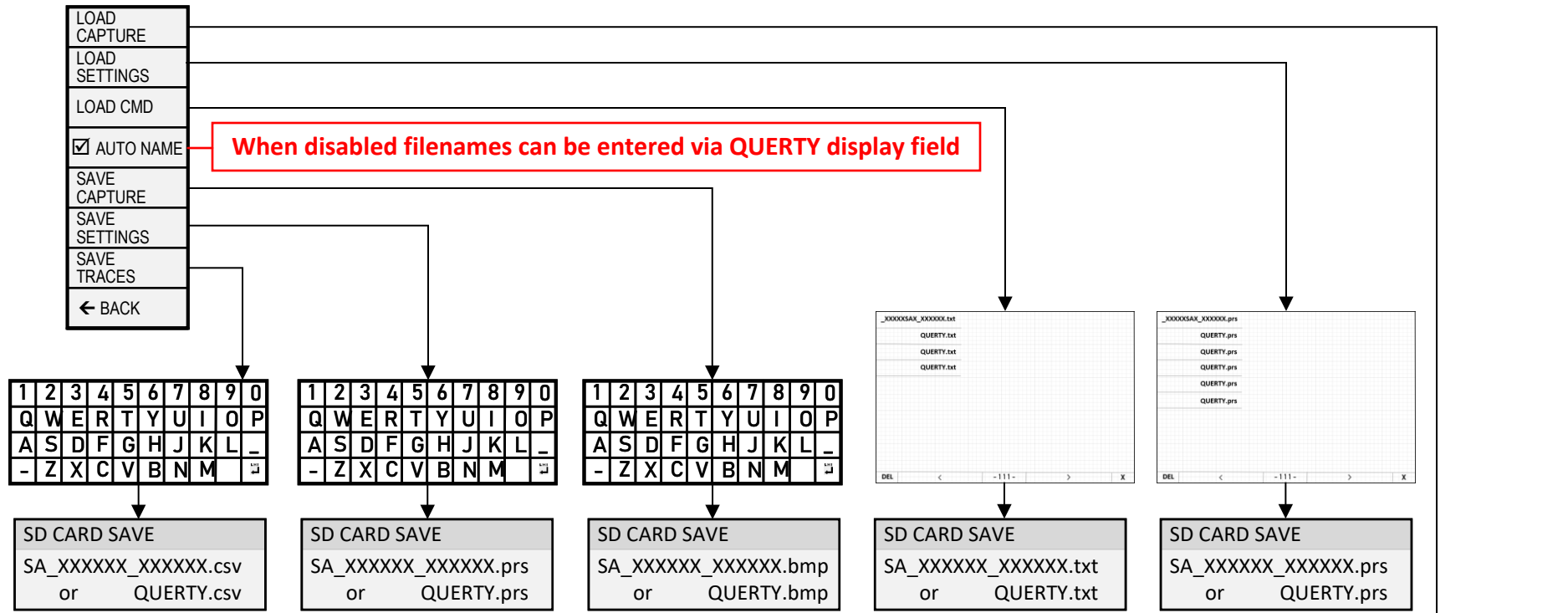
THD enables the measurement of the THD defined as the percentage of energy in the harmonics versus the energy in the fundamental. The tracking marker is assumed to be at the fundamental and all harmonics in the scan are included.

CHANNEL POWER sets the channel frequency and width and enables the measurement of the absolute and percentage of power in the specified channel and the channels at the frequencies above and below the specified channel.

LINEAR steps the internal attenuator through all attenuation levels and draws a green line showing the measured maximum level for each attenuation setting. This allows to check the linearity of the internal attenuation.

BACK moves back to the first MEASURE menu

TinySA Ultra STORAGE Menu Chart



When disabled filenames can be entered via QUERTY display field

SAVE TRACES the active trace saved to SD card as a *.csv file with either an automatic generated file name or user defined via the QUERTY on screen key field

SAVE SETTINGS the present settings are saved to SD card as a *.prs file with either an automatic generated file name or user defined via the QUERTY on screen key field

SAVE CAPTURE the active or frozen display saved to SD card as a *.bmp file with either an automatic generated file name or user defined via the QUERTY on screen key field

AUTONAME enables automatic naming of saved files using date and time. Eksempe SA_230209_112237-bmp

LOAD CMD a *.txt file containing a command sequence is executed. From a terminal program issue the command **help** and the available commands are listed. It requires some knowledge about what commands can be issued.

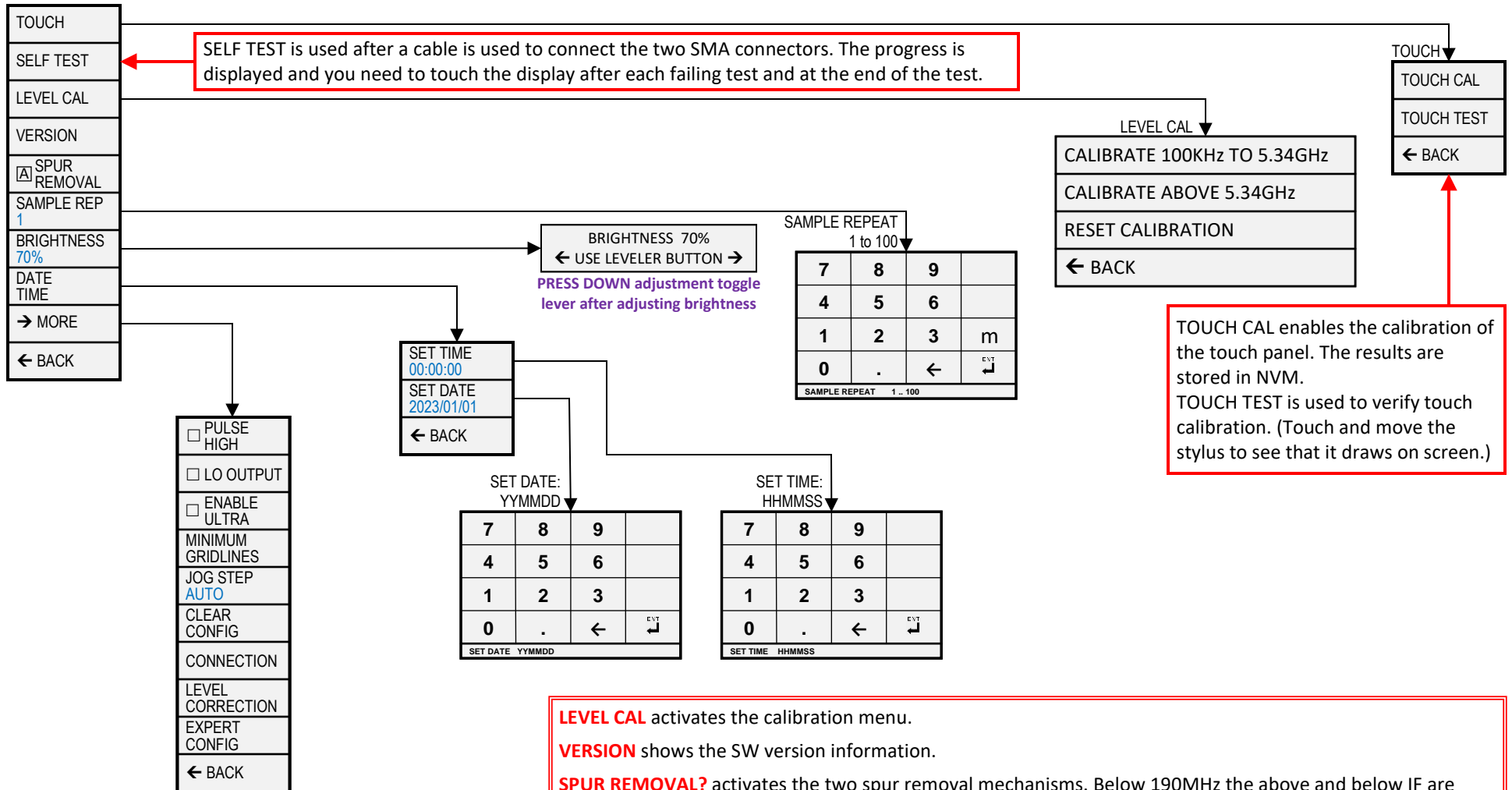
LOAD SETTINGS The saved settings can be loaded from the listing displayed

LOAD CAPTURE RACE All the saved screen images listed can be loaded. Click with the mouse on right side of screen for scrolling forward and a mouse click on the left side for scrolling backward. Click on the center of the screen for reverting to normal mode

NOTE for the file listing screen... Click with the mouse on DEL button left and it turns RED and when clicking on one of the files it will be deleted.
Click on X at button right and the file listing page is terminated.

TinySA Ultra **CONFIG** Menu Chart

The configuration menu can be used to update various settings and to test or calibrate the TinySA



TinySA Ultra **CONFIG > MORE** Menu Chart

- PULSE HIGH
- LO OUTPUT
- ENABLE ULTRA
- MINIMUM GRIDLINES
- JOG STEP **AUTO**
- CLEAR CONFIG
- CONNECTION
- LEVEL CORRECTION
- EXPERT CONFIG
- ← BACK

Ultra unlock code: <https://tinysa.org/wiki/pmwiki.php?n=TinySA4.Ultra>

7	8	9	
4	5	6	
1	2	3	
0	.	←	EXT ↵
CODE Ultra unlock code			

Enter minimum horizontal grid divisions

7	8	9	
4	5	6	
1	2	3	
0	.	←	EXT ↵
MINIMUM GRIDLINE Enter minimum horizontal grid divisions			

JOG STEP 0=AUTO

7	8	9	G
4	5	6	M
1	2	3	K
0	.	←	x1
JOG STEP 0 = AUTO			

CLEAR CONFIG UNLOCK CODE

7	8	9	
4	5	6	
1	2	3	
0	.	←	EXT ↵
CODE Clear unlock code → 1234			

- PROGRESS BAR
- DIRECT MODE
- LINEAR AVERAGING
- HARMONIC
- FREQ CORR 0
- NF **5.0dB**
- DUMP FIRMWARE
- INTERNALS
- ← BACK

- INPUT LEVEL
- OUTPUT LEVEL
- IN CURVE
- IN LNA CURVE
- IN ULTRA CURVE
- IN ULTRA LNA CURVE
- OUT CURVE
- OUT DIR CURVE
- OUT ADF CURVE
- OUT MIXER CURVE
- ← BACK

CONNECTION

- USB
- SERIAL
- SERIAL SPEED
- ← BACK

- 30MHz LEVEL
- 1GHz LEVEL
- 1.2GHz LEVEL
- ← BACK

ACTUAL POWER
Enter actual level under marker

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1
ACTUAL POWER Enter actual level under marker			

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1
LEVEL Enter actual input level			

- 30.000kHz +4.7dB
- 100.000kHz +1.1dB
- 200.000kHz -0.8dB
- 600.000kHz -2.5dB
- 5.000MHz -4.0dB
- 10.000MHz -4.0dB
- 110.000MHz -4.6dB
- MORE
- ← BACK

Enter actual output level

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1
LEVEL Level of 10MHz output			

LEVEL CORRECTION contains many menu items and tables for selection of frequency calibration points, both for the different in and out curves, quite impossible to show on this single page. The example is for 10MHz IN CURVE. For further information how to perform LEVEL CORRECTION go to page 19

ADVANCES CALIBRATION

TinySA Ultra **CONFIG > MORE > EXPERT CONFIG** Menu Chart

Allows the setting of various internal parameters. Do not change anything unless you know what you are doing.

<input checked="" type="checkbox"/> PROGRESS BAR
<input checked="" type="checkbox"/> DIRECT MODE
<input checked="" type="checkbox"/> LINEAR AVERAGING
HARMONIC
FREQ CORR 0
NF 5.0dB
DUMP FIRMWARE
INTERNALS
← BACK

Internals access code

7	8	9	
4	5	6	
1	2	3	
0	.	←	EXT ↓
CODE Internals access code			

Enter TinySA noise figure

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1
NOISE FIGURE Enter TinySA noise figure			

Enter ppb correction

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1
PPB Enter ppb correction			

HARMONIC

<input type="checkbox"/> OFF
<input type="checkbox"/> 2
<input checked="" type="checkbox"/> 3
<input type="checkbox"/> 4
<input type="checkbox"/> 5
← BACK

Enter a descriptive name for the firmware if STORAGE/AUTO NAME is disabled

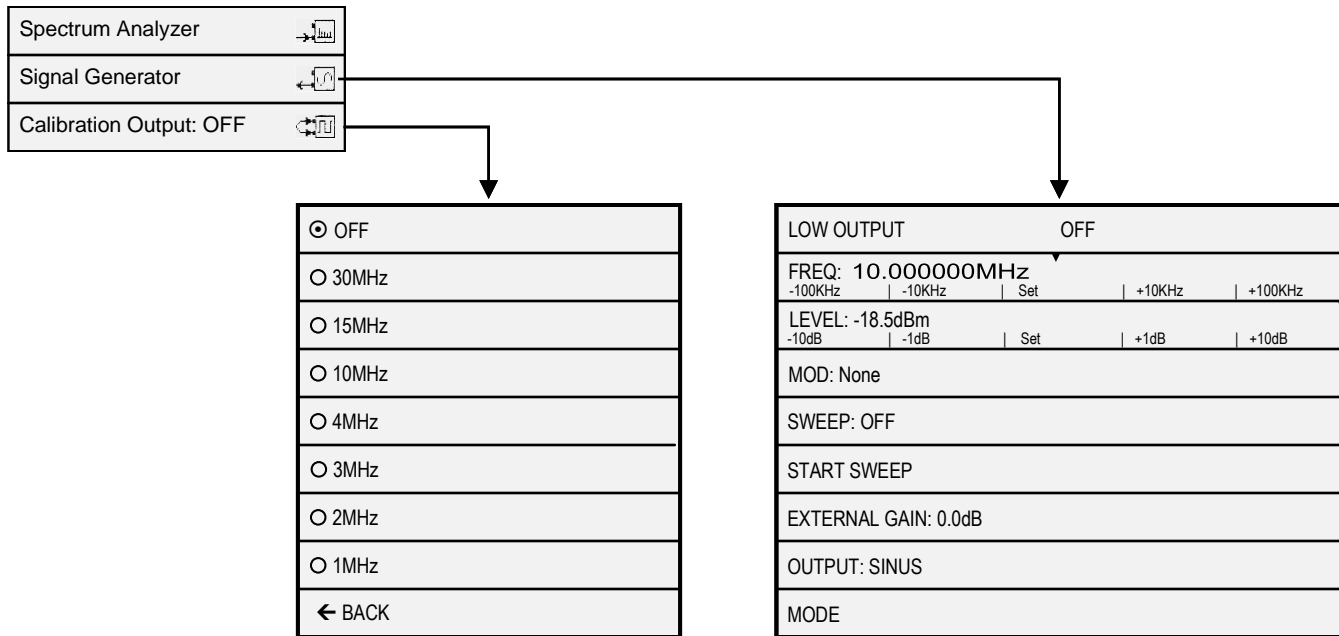
1	2	3	4	5	6	7	8	9	0
Q	W	E	R	T	Y	U	I	O	P
A	S	D	F	G	H	J	K	L	-
-	Z	X	C	V	B	N	M		EXT ↓

SD CARD SAVE
SA_XXXXXX_XXXXXX.bin
or QUERTY.bin

PROGRESS BAR controls the display of the green progress bar when scanning is slow.
DIRECT MODE enables a special mode for
LINEAR AVERAGING
HARMONIC Default 3, other settings for experimental use.
FREQ CORR sets the correction to be applied to measured or output frequencies in parts per billion
NF allows entering the noise figure of the TinySA Ultra
DUMP FIRMWARE to SD card as *.bin file
INTERNALS supports setting some internal parameters. *Do not use unless being instructed to do so.*
AGC enables/disables the build in Automatic Gain Control.
LNA enables/disables the build in Low Noise Amplifier.
BPF enables measurement of the performance of the internal Band Pass Filter.
BELOW IF switches the LO to below the IF when measuring below 190MHz.
IF FREQ allows entering the IF frequency used in low mode.
DECAY sets the decay speed of the quasi peak measurement
ATTACK sets the attack speed of the quasi peak measurement
SCAN SPEED allows setting the speed of scanning.
MIXER DRIVE sets the LO input to the mixer

TinySA Ultra **MODE** Menu Chart

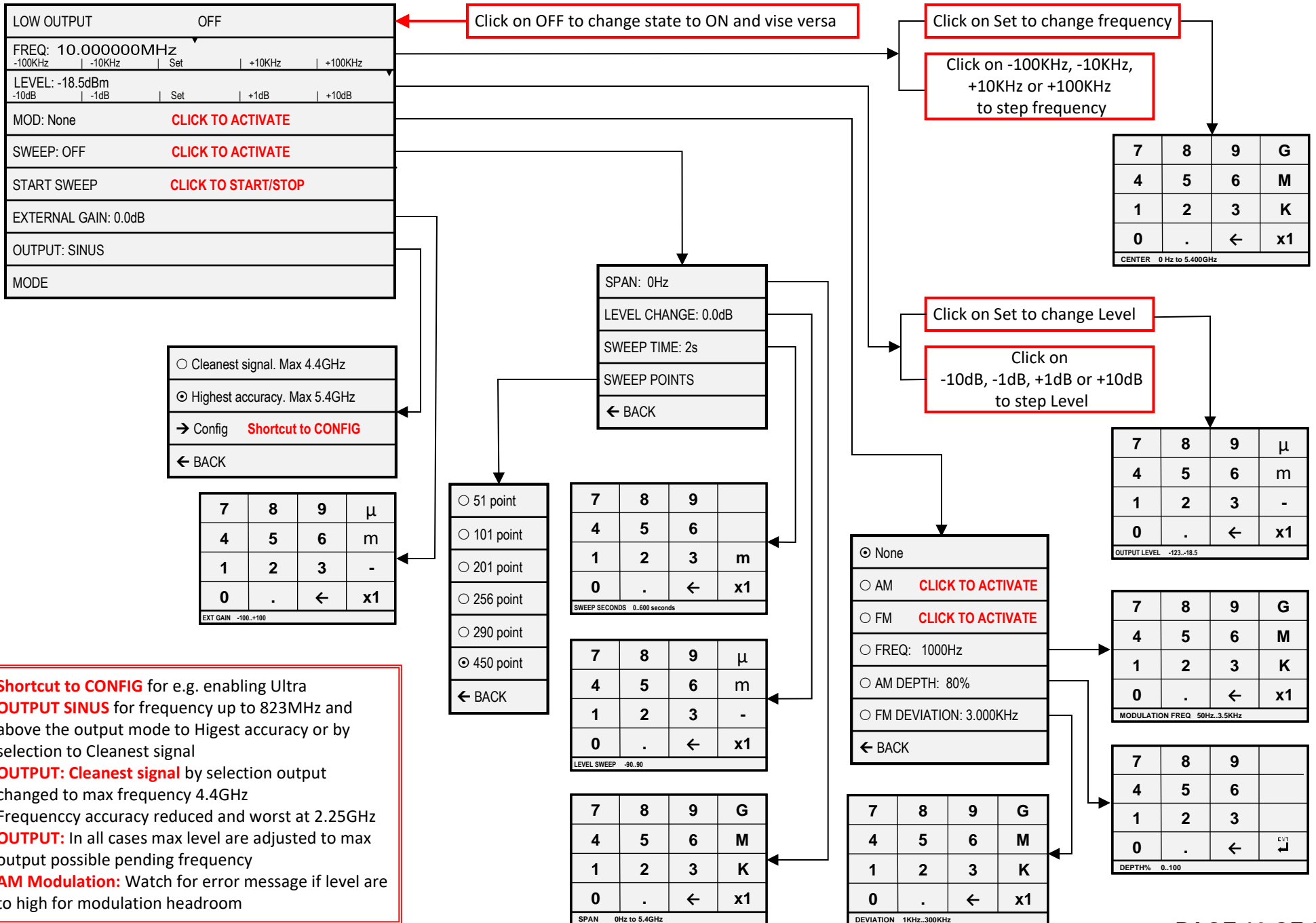
Activates the mode switching menu



See PAGE 16 for detailed description

SPECTRUM ANALYZER activates the spectrum analyzer using the RF port for input
SIGNAL GENERATOR activates the signal generator using the RF port for output
CALIBRATION OUTPUT controls the build in calibration reference generator using the CAL port for output.

TinySA Ultra **MODE > SIGNAL GENERATOR** Menu Chart



TinySA Ultra Calibration System-1 Menu Chart

WARNING !!! DO NOT MODIFY ANYTHING AS DESCRIBED IN THE FOLLOWING PAGES EXCEPT YOU ARE KNOWING WHAT YOU ARE DOING

The TinySA ULTRA firmware contain a very complex Calibration System with a number of pre-defined leveloffset parameters in addition to 6 input correction tables and 4 output correction tables.

Before doing the CONFIG/LEVEL CAL perform a CONFIG/MORE/CLEAR CONFIG to remove any remains form earlier calibrations

The automatic calibration for CONFIG/LEVEL CAL below 5.34GHz, modifies a number of the predefined leveloffset parameters to compensate for hardware variation from unit to unit and utilizes the build in 30MHz reference signal, when the two SMA adaptors are connected via a short low loss cable.

CONFIG/LEVEL CAL above 5.34GHz modifies the single pre-defined "leveloffset harmonic 10.5" parameter, also to compensate for said hardware unit to unit variation, but requires an external 5.34GHz test signal. However this single predefined leveloffset are pretty close to the ideal value so only if accurate SA measurements above 5.34GHz is required, this above 5.34GHz calibration is needed.

Via the supplied USB cable all the data can be studies by using a simple PC terminal program such as KITTY from <https://www.fosshub.com/KiTTY.html>

Below is shown the predefined leveloffset parameters before and after a complete automatic CONFIG/LEVEL CAL below and above 5.34GHz

In principle that is all to be done, as the in and out correction tables embedded in the firmware provides very good accuracy for all TinySA ULTRA units.

When entering the terminal command **leveloffset** all the leveloffset parameters are shown

The two CONFIG/LEVEL CAL functions modifies these parameters as shown in red below

After upgrade to Firmware
v1.4-49 and CLEAR CONFIG

```
ch> leveloffset
leveloffset low 0.0
leveloffset low output 0.0
leveloffset switch 0.0
leveloffset receive_switch 0.0
leveloffset out_switch 0.0
leveloffset Ina 0.0
leveloffset harmonic 10.5
leveloffset shift1 0.5
leveloffset shift2 3.0
leveloffset shift3 0.0
leveloffset drive1 0.0
leveloffset drive2 -1.5
leveloffset drive3 -0.5
leveloffset direct 30.0
leveloffset direct_Ina 0.0
leveloffset ultra 0.0
leveloffset ultra_Ina 0.0
leveloffset adf 0.0
leveloffset direct output 0.0
```

After CONFIG/LEVEL CAL
below 5.34GHz

```
ch> leveloffset
leveloffset low -0.1
leveloffset low output 0.0
leveloffset switch 0.0
leveloffset receive_switch -1.3
leveloffset out_switch 0.0
leveloffset Ina 0.3
leveloffset harmonic 10.5
leveloffset shift1 -0.8
leveloffset shift2 0.6
leveloffset shift3 -0.6
leveloffset drive1 0.0
leveloffset drive2 -0.9
leveloffset drive3 -0.4
leveloffset direct 28.9
leveloffset direct_Ina 31.4
leveloffset ultra -0.4
leveloffset ultra_Ina 0.2
leveloffset adf 0.0
leveloffset direct output 0.0
```

After CONFIG/LEVEL CAL
above 5.34GHz

```
ch> leveloffset
leveloffset low -0.1
leveloffset low output 0.0
leveloffset switch 0.0
leveloffset receive_switch -1.3
leveloffset out_switch 0.0
leveloffset Ina 0.3
leveloffset harmonic 9.6
leveloffset shift1 -0.8
leveloffset shift2 0.6
leveloffset shift3 -0.6
leveloffset drive1 0.0
leveloffset drive2 -0.9
leveloffset drive3 -0.4
leveloffset direct 28.9
leveloffset direct_Ina 31.4
leveloffset ultra -0.4
leveloffset ultra_Ina 0.2
leveloffset adf 0.0
leveloffset direct output 0.0
```

TinySA Ultra Calibration System-2 Menu Chart

The 6 input correction tables with 20 frequency level corrections entries are displayed when entering a terminal command with the name as shown above the listings

correction low

```
correction low 0 10000 12.2
correction low 1 50000 7.6
correction low 2 200000 4.5
correction low 3 400000 2.2
correction low 4 900000 0.4
correction low 5 20000000 -0.4
correction low 6 30000000 0.0
correction low 7 100000000 -0.8
correction low 8 160000000 -0.4
correction low 9 230000000 0.5
correction low 10 290000000 0.3
correction low 11 400000000 1.0
correction low 12 520000000 0.1
correction low 13 600000000 0.5
correction low 14 660000000 0.4
correction low 15 740000000 1.5
correction low 16 790000000 3.0
correction low 17 810000000 4.7
correction low 18 820000000 6.3
correction low 19 830000000 8.7
```

Range 0 to 830MHz
Normalized to 30MHz

correction direct

```
correction direct 0 140000000 5.1
correction direct 1 150000000 4.2
correction direct 2 160000000 2.4
correction direct 3 180000000 0.0
correction direct 4 280000000 -8.3
correction direct 5 300000000 -9.6
correction direct 6 380000000 -13.6
correction direct 7 390000000 -14.1
correction direct 8 410000000 -15.1
correction direct 9 430000000 -15.7
correction direct 10 490000000 -18.4
correction direct 11 520000000 -19.3
correction direct 12 560000000 -21.1
correction direct 13 830000000 -28.8
correction direct 14 840000000 -29.4
correction direct 15 860000000 -28.5
correction direct 16 870000000 -29.4
correction direct 17 960000000 -27.8
correction direct 18 1040000000 -26.2
correction direct 19 1130000000 -23.7
```

Range 140 to 180MHz and 280 to 560MHz and 830 to 1130MHz
Normalized to 180MHz

correction ultra

```
correction ultra 0 30000000 0.0
correction ultra 1 70000000 0.6
correction ultra 2 98000000 1.7
correction ultra 3 144000000 4.5
correction ultra 4 159000000 4.5
correction ultra 5 190000000 3.2
correction ultra 6 281000000 4.6
correction ultra 7 334000000 6.3
correction ultra 8 339000000 5.7
correction ultra 9 393000000 7.0
correction ultra 10 423000000 8.8
correction ultra 11 430000000 7.0
correction ultra 12 434000000 8.3
correction ultra 13 481000000 11.4
correction ultra 14 507000000 11.6
correction ultra 15 511000000 13.3
correction ultra 16 530000000 12.4
correction ultra 17 551000000 12.6
correction ultra 18 585000000 15.8
correction ultra 19 600000000 15.9
```

Range fixed 30MHz and 700 to 6000MHz
Normalized to 30MHz

correction lna

```
correction lna 0 10000 11.0
correction lna 1 30000 8.5
correction lna 2 80000 6.3
correction lna 3 300000 4.5
correction lna 4 400000 3.2
correction lna 5 800000 1.0
correction lna 6 1000000 0.7
correction lna 7 10000000 0.2
correction lna 8 60000000 -0.4
correction lna 9 120000000 -0.4
correction lna 10 270000000 0.6
correction lna 11 420000000 0.7
correction lna 12 550000000 -0.1
correction lna 13 600000000 0.6
correction lna 14 680000000 0.8
correction lna 15 750000000 1.7
correction lna 16 770000000 1.8
correction lna 17 800000000 3.5
correction lna 18 820000000 5.5
correction lna 19 830000000 8.0
```

correction direct_lna

```
correction direct_lna 0 140000000 4.3
correction direct_lna 1 150000000 3.3
correction direct_lna 2 170000000 1.7
correction direct_lna 3 180000000 0.0
correction direct_lna 4 280000000 -10.1
correction direct_lna 5 300000000 -11.7
correction direct_lna 6 340000000 -13.9
correction direct_lna 7 360000000 -14.8
correction direct_lna 8 500000000 -21.0
correction direct_lna 9 560000000 -23.3
correction direct_lna 10 830000000 -30.7
correction direct_lna 11 840000000 -31.0
correction direct_lna 12 860000000 -30.8
correction direct_lna 13 870000000 -31.3
correction direct_lna 14 950000000 -30.4
correction direct_lna 15 1010000000 -29.3
correction direct_lna 16 1030000000 -28.2
correction direct_lna 17 1040000000 -28.4
correction direct_lna 18 1050000000 -28.0
correction direct_lna 19 1130000000 -25.9
```

correction ultra_lna

```
correction ultra_lna 0 30000000 0.0
correction ultra_lna 1 70000000 0.5
correction ultra_lna 2 77000000 0.5
correction ultra_lna 3 99000000 1.3
correction ultra_lna 4 123000000 3.1
correction ultra_lna 5 239000000 2.7
correction ultra_lna 6 280000000 2.7
correction ultra_lna 7 281000000 3.5
correction ultra_lna 8 315000000 4.7
correction ultra_lna 9 321000000 6.2
correction ultra_lna 10 381000000 8.5
correction ultra_lna 11 406000000 11.5
correction ultra_lna 12 418000000 13.5
correction ultra_lna 13 423000000 15.8
correction ultra_lna 14 430000000 15.8
correction ultra_lna 15 440000000 18.7
correction ultra_lna 16 449000000 19.4
correction ultra_lna 17 496000000 22.6
correction ultra_lna 18 507000000 22.8
correction ultra_lna 19 600000000 28.1
```

TinySA Ultra **CALIBRATION SYSTEM-3** Menu Chart

The 4 output correction tables with 20 frequency level corrections entries are displayed when entering a terminal command with the name as shown above the listings

correction out

Range 10KHz to 830MHz

```
correction out 0 30000 4.7
correction out 1 100000 1.1
correction out 2 200000 -0.8
correction out 3 600000 -2.5
correction out 4 5000000 -4.0
correction out 5 10000000 -4.2
correction out 6 110000000 -4.6
correction out 7 120000000 -4.7
correction out 8 240000000 -3.6
correction out 9 300000000 -3.4
correction out 10 400000000 -3.0
correction out 11 490000000 -3.5
correction out 12 650000000 -3.4
correction out 13 690000000 -3.0
correction out 14 750000000 -2.1
correction out 15 780000000 -1.1
correction out 16 800000000 0.0
correction out 17 810000000 1.0
correction out 18 823000000 2.9
correction out 19 830000000 4.9
```

correction out_direct

Range fixed 500KHz and 823 to 1130MHz

```
correction out_direct 0 500000000 -7.4
correction out_direct 1 823000000 -3.6
correction out_direct 2 830000000 -3.5
correction out_direct 3 850000000 -3.3
correction out_direct 4 860000000 -3.2
correction out_direct 5 870000000 -3.1
correction out_direct 6 880000000 -3.0
correction out_direct 7 890000000 -2.9
correction out_direct 8 900000000 -2.8
correction out_direct 9 910000000 -2.6
correction out_direct 10 920000000 -2.5
correction out_direct 11 930000000 -2.5
correction out_direct 12 1030000000 -1.1
correction out_direct 13 1040000000 -1.0
correction out_direct 14 1050000000 -0.9
correction out_direct 15 1060000000 -0.8
correction out_direct 16 1080000000 -0.4
correction out_direct 17 1100000000 -0.2
correction out_direct 18 1120000000 0.0
correction out_direct 19 1130000000 0.2
```

correction out_adf

Range fixed 500KHz and 700 to 1130MHz

```
correction out_adf 0 500000000 -1.0
correction out_adf 1 1130000000 -0.3
correction out_adf 2 1240000000 2.3
correction out_adf 3 1400000000 6.7
correction out_adf 4 1500000000 8.4
correction out_adf 5 1560000000 9.0
correction out_adf 6 1610000000 9.0
correction out_adf 7 1850000000 8.5
correction out_adf 8 1970000000 8.0
correction out_adf 9 2210000000 7.7
correction out_adf 10 2350000000 8.5
correction out_adf 11 2600000000 7.7
correction out_adf 12 2800000000 6.2
correction out_adf 13 2810000000 5.3
correction out_adf 14 2940000000 3.4
correction out_adf 15 3000000000 3.1
correction out_adf 16 3250000000 3.1
correction out_adf 17 3480000000 5.2
correction out_adf 18 3830000000 9.5
correction out_adf 19 4400000000 11.1
```

correction out_ultra

Range 10KHz to 5400MHz

```
correction out_ultra 0 823000000 -3.5
correction out_ultra 1 1130000000 -1.8
correction out_ultra 2 1390000000 0.7
correction out_ultra 3 1580000000 0.7
correction out_ultra 4 1950000000 -2.2
correction out_ultra 5 2210000000 -2.2
correction out_ultra 6 2800000000 0.8
correction out_ultra 7 2810000000 0.1
correction out_ultra 8 2980000000 -0.1
correction out_ultra 9 3100000000 0.8
correction out_ultra 10 3200000000 0.7
correction out_ultra 11 3360000000 1.9
correction out_ultra 12 3380000000 1.6
correction out_ultra 13 3600000000 2.2
correction out_ultra 14 3720000000 1.3
correction out_ultra 15 3820000000 1.6
correction out_ultra 16 3990000000 0.8
correction out_ultra 17 4220000000 1.8
correction out_ultra 18 5010000000 7.6
correction out_ultra 19 5400000000 7.3
```

The in and out correction tables are derived for a single TinySA ULTRA hardware for every mode and single decided frequency, the dB corrections is found with an accuracy below 0.5dB and in most cases even better.

Other TinySA ULTRA hardware units will eventually differ slightly, and if more than accepted, the users can edit each single corrections via the CONFIG/MORE/LEVEL CORRECTION for these 10 correction tables, except for direct and direct_ina which is only relevant for measurements without spurs near the IF frequency. So far not implemented for editing.

Despite the correction low includes frequencies up to 823MHz, this low range is limited to 800MHz and a 800MHz lowpassfilter is in action. This lowpass filter is also being used in output mode to provide sinus signal up to and below 823MHz.

If ULTRA is enabled then it takes action from 700MHz upwards

For doing any output corrections are required an accurate Spectrum Analyzer to 6GHz, if the entire frequency range needed, and only recommended if you are sure a correction is justified. For input corrections likewise an accurate signal generator is required

How to perform such corrections go to page 13 for further informantion

TinySA Ultra **ADVANCE CALIBRATION** Menu Chart

From page 12 the LEVEL CORRECTION is selected.

Before any output correction can be made the OUTPUT LEVEL/30MHz LEVEL must be performed. The TinySA ULTRA enables a -30dBm level to be measured by a Spectrum Analyzer or a selective power meter (a wideband power meter able to measure such low levels may be used for 30MHz only, but not for 1GHz and 1.2GHz due to harmonics) The measured level must be entered via the on screen keypad. For "30MHz LEVEL" the frequency as you choose but 30MHz is recommended

Check via the terminal command "leveloffset" that the "leveloffset low output" has been changed from 0.0 to a new small value Repeat the process for 1GHz and check the "leveloffset direct out" has been changed from 0.0 to a small amount.

Repeat the process for 1.2GHz and check the "leveloffset adf" has been changed from 0.0 to a small amount.

For the "INPUT LEVEL" and all the 4 "IN CURVE's", use a input of known accurate level between -35 to -25dBm from a signal generator. See the comments below

<input type="checkbox"/> PULSE HIGH
<input type="checkbox"/> LO OUTPUT
<input type="checkbox"/> ENABLE ULTRA
MINIMUM GRIDLINES
JOG STEP AUTO
CLEAR CONFIG
CONNECTION
LEVEL CORRECTION
EXPERT CONFIG
← BACK

For all "IN CURVE's" below settings are used and for "INPUT LEVEL" the same settings are recommended incl. LEVEL -35.0dBm FREQUENCY/30MHz and SPAN/1MHz FREQUENCY/RBW and VBM 10kHz LEVEL/ATTENUATE/MANUEL/5dB CONFIG/SAMPLE REP/10 Other settings left as automatic set

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

Enter actual level of 30MHz input

INPUT LEVEL
OUTPUT LEVEL
IN CURVE
IN LNA CURVE
IN ULTRA CURVE
IN ULTRA LNA CURVE
OUT CURVE
OUT DIR CURVE
OUT ADF CURVE
OUT MIXER CURVE
← BACK

30MHz LEVEL
1GHz LEVEL
1.2GHz LEVEL
← BACK

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

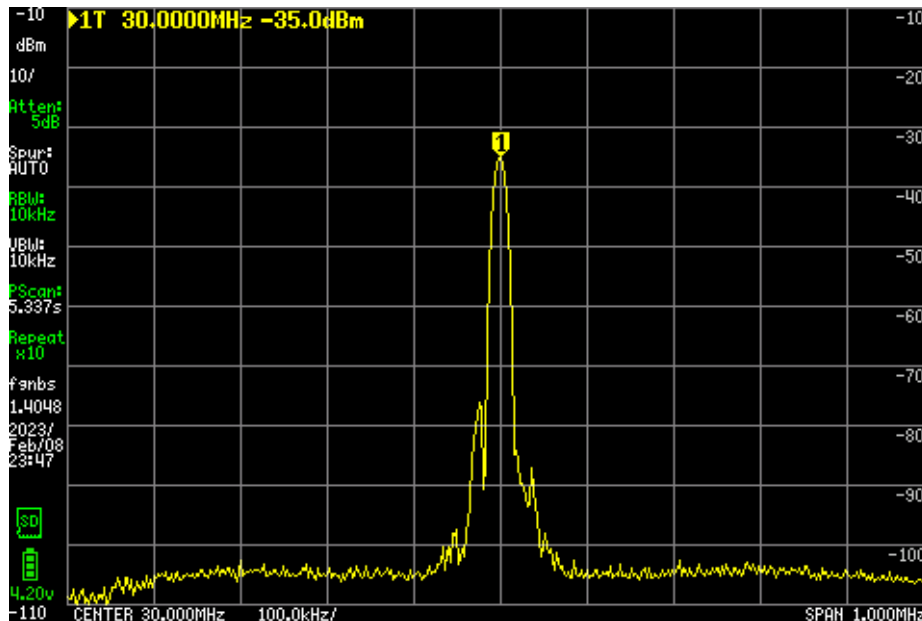
Enter actual level of 30MHz output

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

Enter actual level of 1GHz output

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

Enter actual level of 1.2GHz output



After finishing corrections execute the terminal command "saveconfig" to preserve the modifications. You may also preserve the "leveloffset" settings by in the command window mark all the leveloffset lines, chose CTRL C and open the windows notepad and paste by CTRL V followed by saving the setting to a folder with a descriptive name. You may at any time perform the reverse process to restore the just stored leveloffset settings

TinySA Ultra **ADVANCE CALIBRATION-IN** Menu Chart

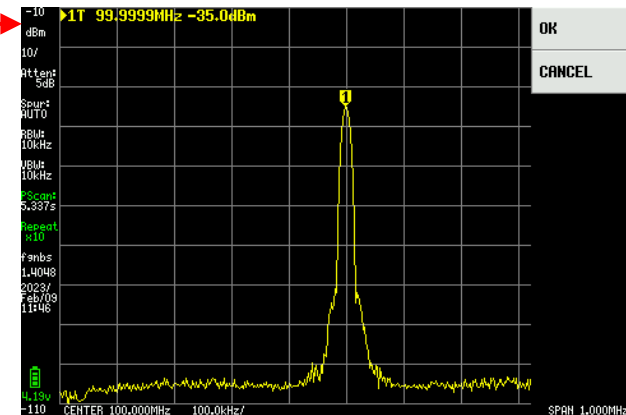
For all the 4 IN CURVE's you must provided from a signal generator an accurate input signal of known level between -35 to -25dBm. Recommended level to use is the same as for the "INPUT LEVEL" calibration page 19 which was -35dBm. First step in below example is to enter the level -35dBm by means of the on screen keypad, and then select the frequency in question for modification here being 100MHz. Now a sweep is shown and the marker level noted. If the marker level is different from the input level, then click on OK and the IN CURVE selection page is displayed again with the new level correction table value shown. In the example no correction needed and thus CANCEL selected followed by BACK a couple of times. You may edit just a single or a few frequencies pending what you experiance of need. Up tp 3GHz the levels are not deviating much from sample to sampe of TinySA ULTRA

INPUT LEVEL
OUTPUT LEVEL
IN CURVE
IN LNA CURVE
IN ULTRA CURVE
IN ULTRA LNA CURVE
OUT CURVE
OUT DIR CURVE
OUT ADF CURVE
OUT MIXER CURVE
← BACK

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

Enter actual input level

100.000MHz -0.8dB
160.000MHz -0.4dB
230.000MHz +0.5dB
290.000MHz +0.3dB
400.000MHz +1.0dB
520.000MHz +0.1dB
600.000MHz +0.5dB
+ MORE
+ BACK



All the IN CURVE's consist of 3 entry fields, and reflect the data from the correction tables shown on PAGE 17. Below shown are the 3 IN CURVE entry fields for selecting frequencies. After finishing corrections execute the terminal command "saveconfig" to preserve the modifications. You may also preserve the modified correction tables by in the command window marking all the 20 lines, chose CTRL C and open the windows notepad and paste by CTRL V followed by saving the correction new table to a folder with a descriptive name. **After a firmware update you may at any time perform the reverse process to restore the just stored correction table.**

10.000kHz +12.2dB
50.000kHz +7.6dB
200.000kHz +4.5dB
400.000kHz +2.2dB
900.000kHz +0.4dB
20.000MHz -0.4dB
30.000MHz +0.0dB
+ MORE
+ BACK

100.000MHz -0.8dB
160.000MHz -0.4dB
230.000MHz +0.5dB
290.000MHz +0.3dB
400.000MHz +1.0dB
520.000MHz +0.1dB
600.000MHz +0.5dB
+ MORE
+ BACK

660.000MHz +0.4dB
740.000MHz +1.5dB
790.000MHz +3.0dB
810.000MHz +4.7dB
820.000MHz +6.3dB
830.000MHz +8.7dB
+ BACK

TinySA Ultra **ADVANCE CALIBRATION-OUT** Menu Chart

All the 4 OUT CURVE's enables a -35dBm output level to be measured by a Spectrum Analyzer or a selective power meter (a wideband power meter able to measure such low levels may be used for 30MHz but not for frequencies at and above 823MHz due to harmonics). The measured level must be entered via the keypad. When done the OUT CURVE selection page is shown again and the new correction table value is displayed showing a change from -2.5dB to -2.7dB. You may select the frequency again and check if the correction made sense. You may edit just a single or a few frequencies pending what you experience of need. Up to 3GHz the levels are not deviating much from sample to sample of TinySA ULTRA

Please note that the Ultra output correction are now named OUT MIXER CURVE

INPUT LEVEL
OUTPUT LEVEL
IN CURVE
IN LNA CURVE
IN ULTRA CURVE
IN ULTRA LNA CURVE
OUT CURVE
OUT DIR CURVE
OUT ADF CURVE
OUT MIXER CURVE
← BACK

30.000kHz +4.7dB
100.000kHz +1.1dB
200.000kHz -0.8dB
600.000kHz -2.5dB
5.000MHz -4.0dB
10.000MHz -4.2dB
110.000MHz -4.6dB
+ MORE
← BACK

7	8	9	μ
4	5	6	m
1	2	3	-
0	.	←	x1

LEVEL of 600.000kHz output

30.000kHz +4.7dB
100.000kHz +1.1dB
200.000kHz -0.8dB
600.000kHz -2.7dB
5.000MHz -4.0dB
10.000MHz -4.2dB
110.000MHz -4.6dB
+ MORE
← BACK

All the OUT CURVE's consist of 3 entry fields and reflect the data from the correction tables shown on PAGE 17. Below shown the 3 OUT CURVE entry fields for selection frequencies. After finishing corrections execute the terminal command "saveconfig" to preserve the modifications. You may also preserve the modified correction tables by in the command window marking all the 20 lines, chose CTRL C and open the windows notepad and paste by CTRL V followed by saving the modified correction table to a folder with a descriptive name. **After a firmware update you may at any time perform the reverse process to restore the just stored new correction table**

30.000kHz +4.7dB
100.000kHz +1.1dB
200.000kHz -0.8dB
600.000kHz -2.5dB
5.000MHz -4.0dB
10.000MHz -4.2dB
110.000MHz -4.6dB
+ MORE
← BACK

120.000MHz -4.7dB
240.000MHz -3.6dB
300.000MHz -3.4dB
400.000MHz -3.0dB
490.000MHz -3.5dB
650.000MHz -3.4dB
690.000MHz -3.0dB
+ MORE
← BACK

750.000MHz -2.1dB
780.000MHz -1.1dB
800.000MHz +0.0dB
810.000MHz +1.0dB
823.000MHz +2.9dB
830.000MHz +4.9dB
+ BACK

TinySA Ultra **TIPS and TRICK's** Menu Chart

Besides the calibration information on page 16 to 21 the wiki pages are containing further information at the links shown below

<https://tinysa.org/wiki/pmwiki.php?n=TinySA4.MenuTree>

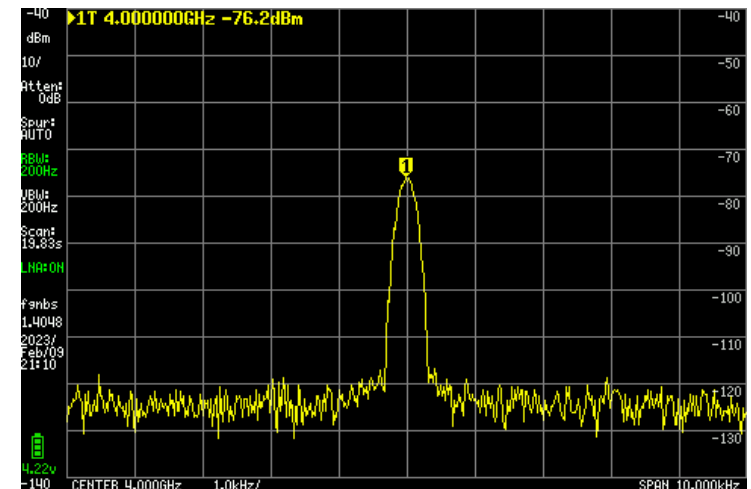
Upgrading firmware Always perform a CONFIG/MORE/CLEAR CONFIG before calibration and set CONFIG/MORE/EXPERT CONFIG/FREQ CORR if ealier found.

Prior doing a recalibration Always perform a CONFIG/MORE/CLEAR CONFIG and set CONFIG/MORE/EXPERT CONFIG/FREQ CORR (the **FREQ CORR ppb (part per billion)**) Finding the value requires a frequency standard for locking a Signal Generator or a locked frequency counter with 1 Hz resolution. Best frequency for Signal Generator is 1GHz or better 4GHz. Se below for an alternative high precision 4 GHz signal.

Place a small label on the rear of TinySA ULTRA with the found ppb value. You need it for every firmware update

A small 10MHZ GPSDO device from Leobodnar delivers squarewave signal and at 4GHz deliver signal with a level of -76dBm, when the input to TinySA ULTRA is reduced by inline SMA attenuator to about -2dBm. and LNA activated. Then finding the ppb value is easy. The value for the used TinySA ULTRA is -2100. The settings for TinySA ULTRA are SPAN 10KHz and RBW 200Hz

http://www.leobodnar.com/shop/index.php?main_page=product_info&cPath=107&products_id=301



A 17 minutes long video with hints for a new user

<https://www.youtube.com/watch?v=i8CYCua8vQ&t=41s>

TinySA Ultra Menu-Tree Chart Revision History

DATE	DESCRIPTION
1/13/2023	INITIAL RELEASE. Based on Firmware version tinySA4_v1.4-40
1/16/2023	Added menu descriptions, additional menu levels, shrunk keypad to 80% of original size to fit more on a page, added MODE page, etc.
1/28/2023	Added MODE > Signal Generator menu page - credit to Kurt Poulsen (kurt@hamcom.dk). Added text and made text corrections.
2/10/2023	Menus updated and additional information added by Kurt as a result of firmware update to version tinySA4_v.1.4-49
2/23/2023	Final updates by Kurt with many additions over last update.