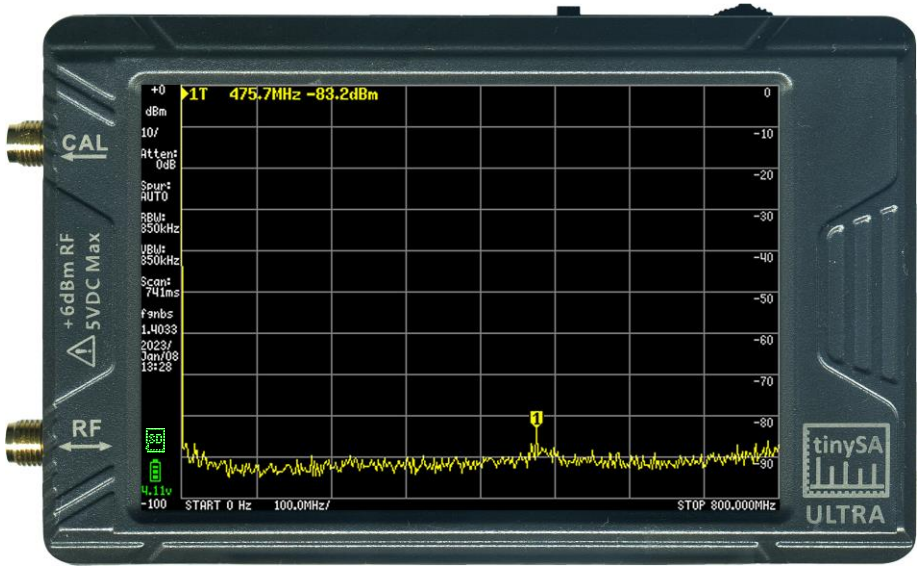
TinySA Ultra Menu-Tree Chart



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/.

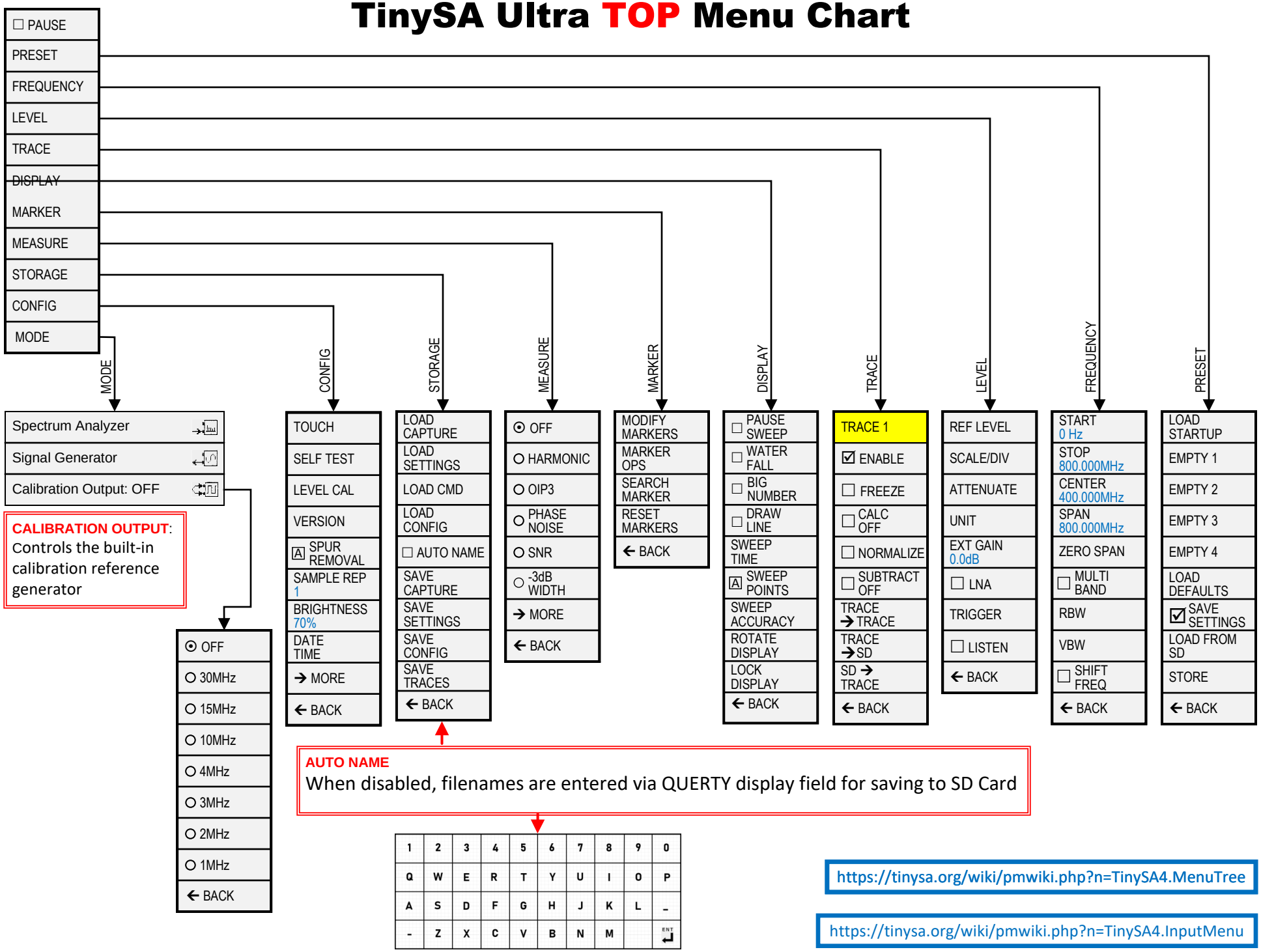
DESCRIPTION AND NOTES

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.

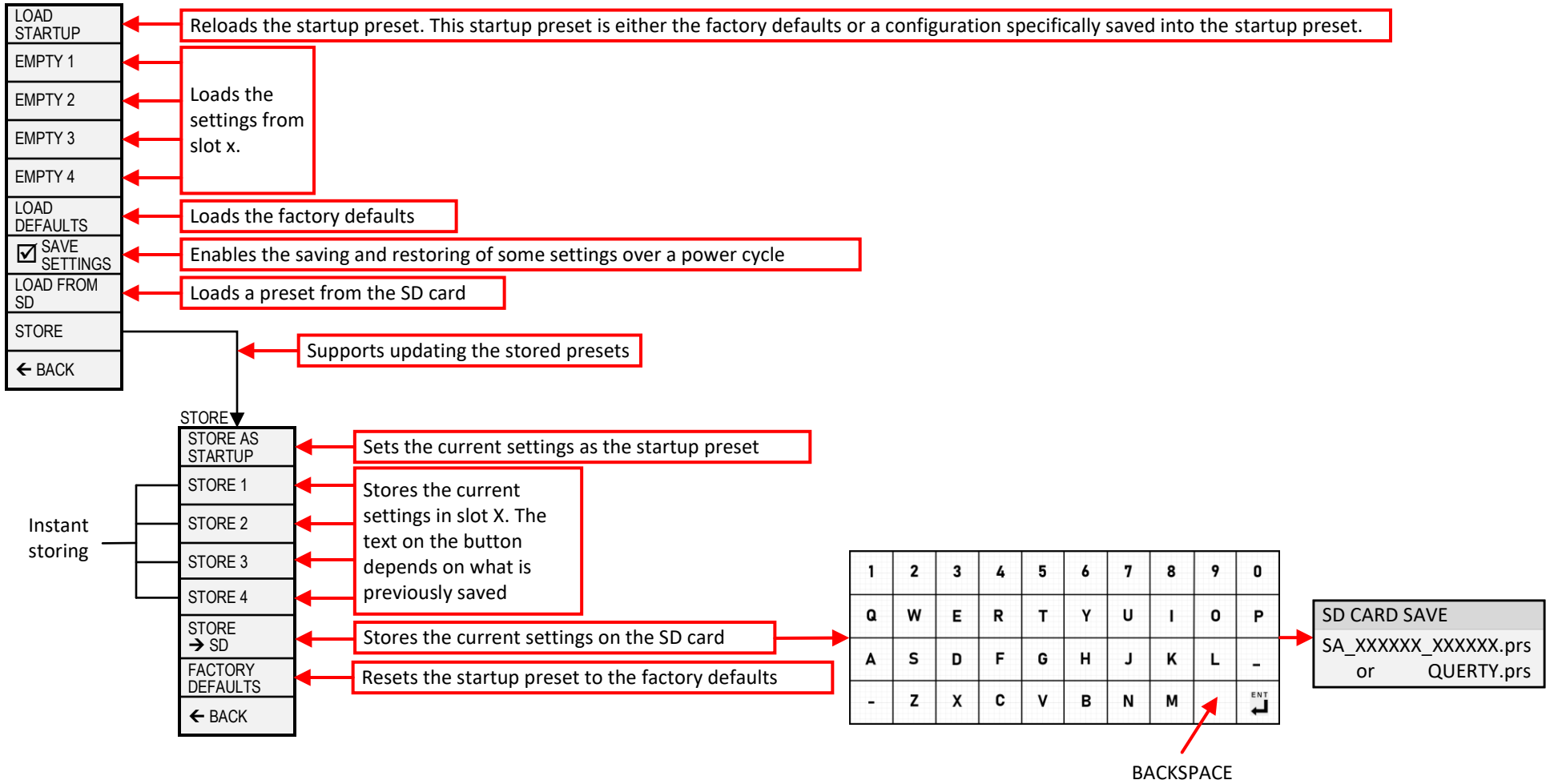
Drawing based on Firmware version: v1.4-104
See last page for document revision history.

TinySA Ultra TOP Menu Chart



TinySA Ultra PRESET Menu Chart

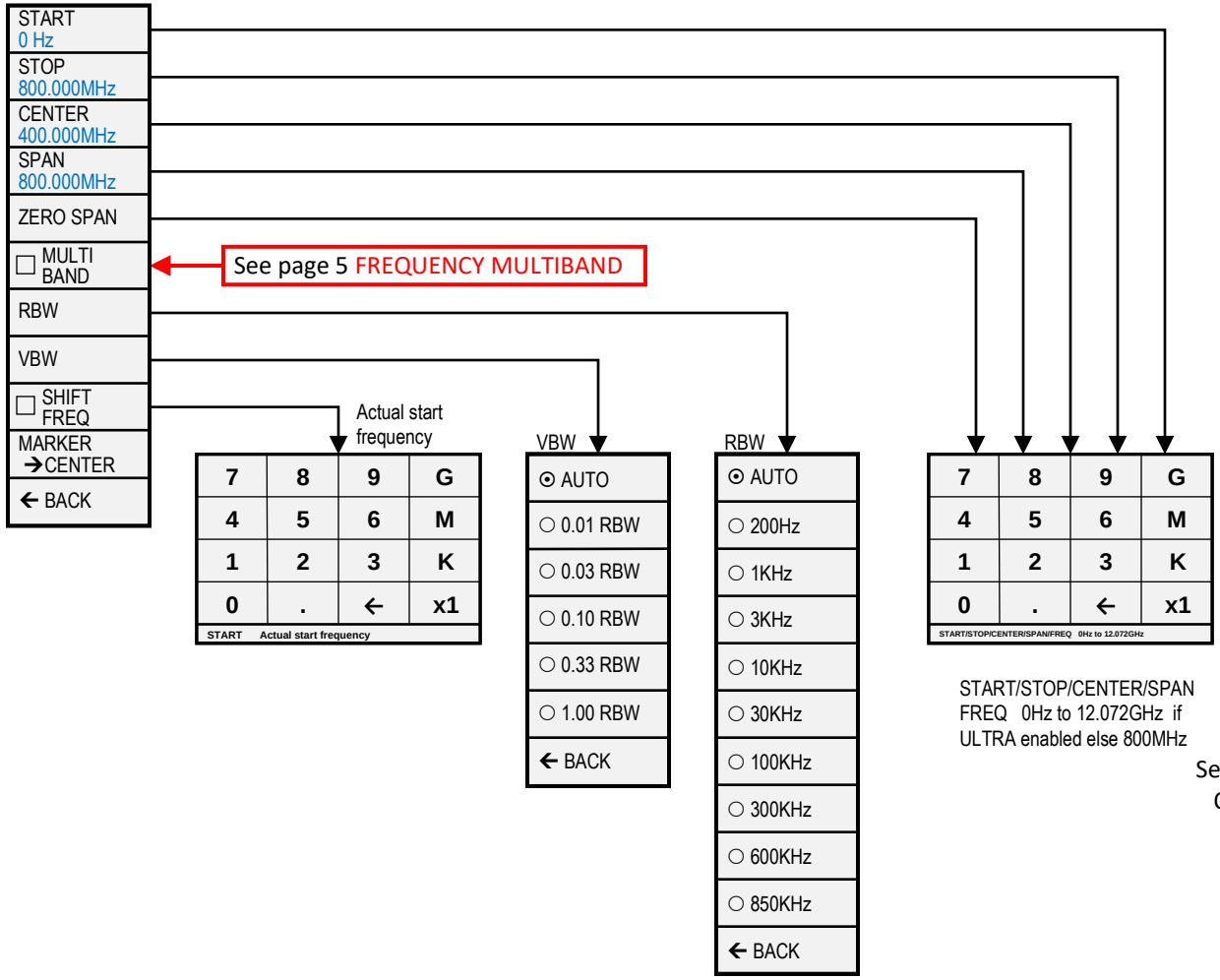
Preset Load



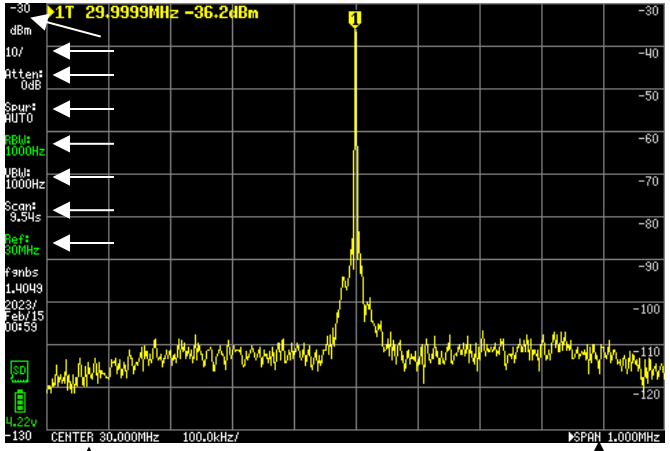
If the saved preset contained a stored trace this will also be restored

TinySA Ultra FREQUENCY Menu Chart

Sets everything related to the frequencies to scan



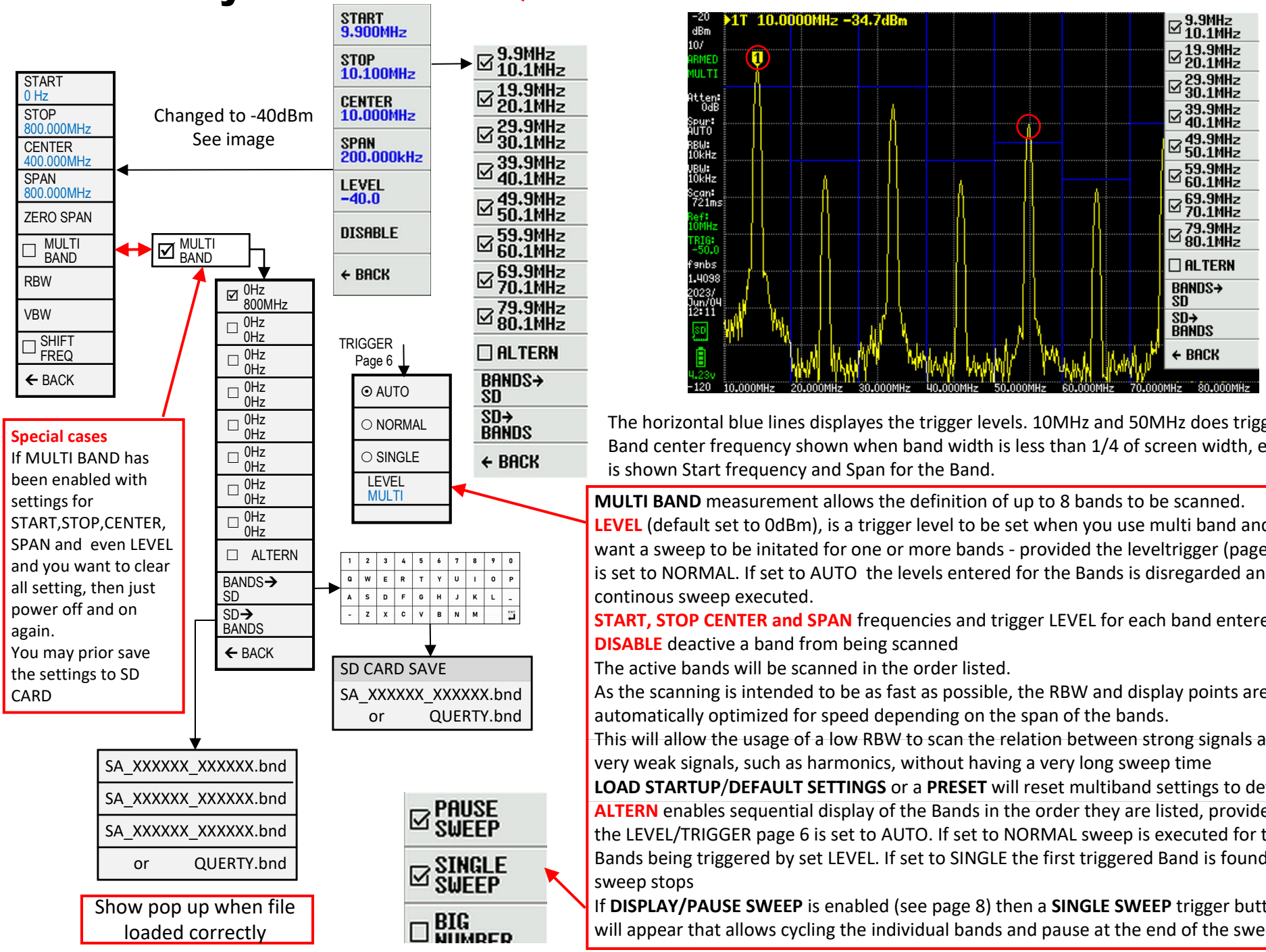
START/STOP/CENTER/SPAN FREQ 0Hz to 12.072GHz if ULTRA enabled else 800MHz



Select either CENTER or SPAN for changing value with Jog Wheel
Other functions also accessable 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 a 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.
MARKER→CENTER: Bring the marker to center of display

TinySA Ultra FREQUENCY-MULTI BAND Menu Chart



Special cases
If MULTI BAND has been enabled with settings for START,STOP,CENTER, SPAN and even LEVEL and you want to clear all setting, then just power off and on again.
You may prior save the settings to SD CARD

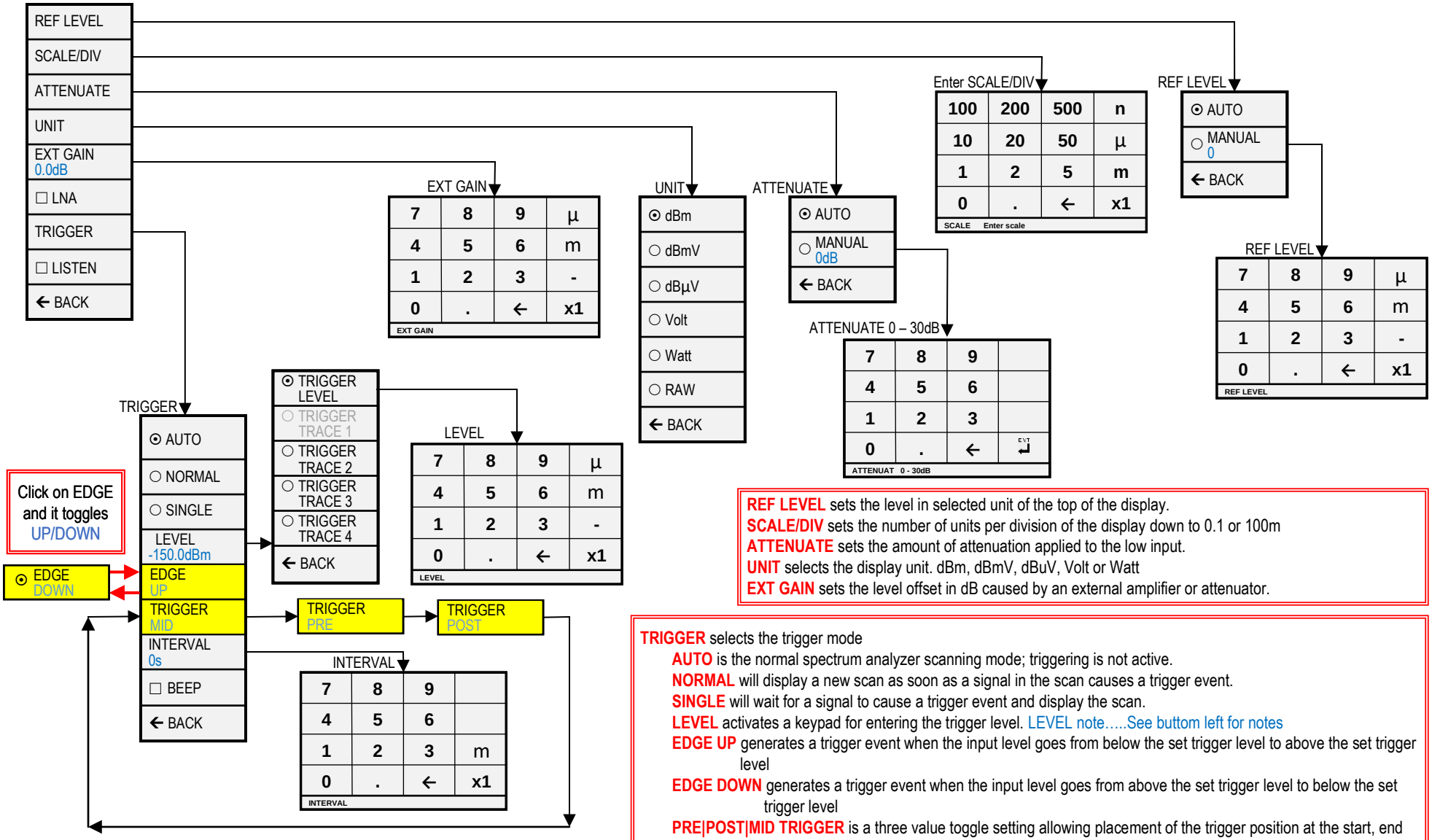
Show pop up when file loaded correctly

The horizontal blue lines displayes the trigger levels. 10MHz and 50MHz does trigger Band center frequency shown when band width is less than 1/4 of screen width, else is shown Start frequency and Span for the Band.

MULTI BAND measurement allows the definition of up to 8 bands to be scanned.
LEVEL (default set to 0dBm), is a trigger level to be set when you use multi band and want a sweep to be initated for one or more bands - provided the leveltrigger (page 6) is set to NORMAL. If set to AUTO the levels entered for the Bands is disregarded and continous sweep executed.
START, STOP CENTER and SPAN frequencies and trigger LEVEL for each band entered.
DISABLE deactive a band from being scanned
The active bands will be scanned in the order listed.
As the scanning is intended to be as fast as possible, the RBW and display points are automatically optimized for speed depending on the span of the bands.
This will allow the usage of a low RBW to scan the relation between strong signals and very weak signals, such as harmonics, without having a very long sweep time
LOAD STARTUP/DEFAULT SETTINGS or a **PRESET** will reset multiband settings to default
ALTERN enables sequential display of the Bands in the order they are listed, provided the LEVEL/TRIGGER page 6 is set to AUTO. If set to NORMAL sweep is executed for those Bands being triggered by set LEVEL. If set to SINGLE the first triggered Band is found and sweep stops
If **DISPLAY/PAUSE SWEEP** is enabled (see page 8) then a **SINGLE SWEEP** trigger button will appear that allows cycling the individual bands and pause at the end of the sweep.

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 number of units per division of the display down to 0.1 or 100m
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.
- **LEVEL** activates a keypad for entering the trigger level. LEVEL note…..See buttom left for notes
- **EDGE UP** generates a trigger event when the input level goes from below the set trigger level to above the set trigger level
- **EDGE DOWN** generates a trigger event when the input level goes from above the set trigger level to below the set trigger level
- **PRE|POST|MID TRIGGER** is a three value toggle setting allowing placement of the trigger position at the start, end or middle of the scan.

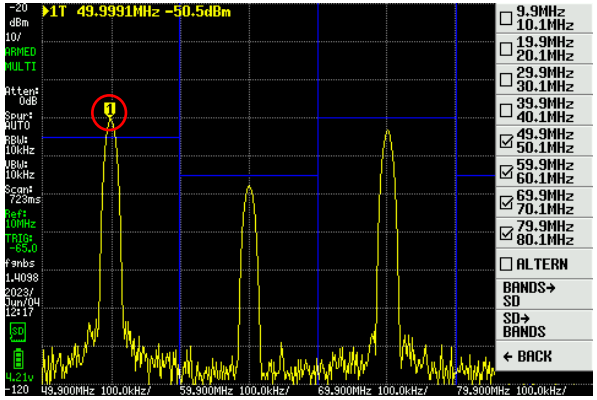
INTERVAL sets the repetition rate of certain events. When active, a sweep is always started at a multiple of the repetition rate. If the sweep takes longer than one interval, the start of the next sweep is delayed till the next interval start time. Consider any sweep started at a precise time interval defined by the value entered in the INTERVAL field. If a sweep takes less than one interval, the start of next sweep is also delayed to the interval start time.
BEEP for every trigger event a beep sound is heard via the 3.5mm jack audio output

If FREQUENCY/MULTI BAND (page 5) is enabled then the LEVEL field is shown as **LEVEL MULTI** and you cannot enter any levels, as controlled by MULTI BAND

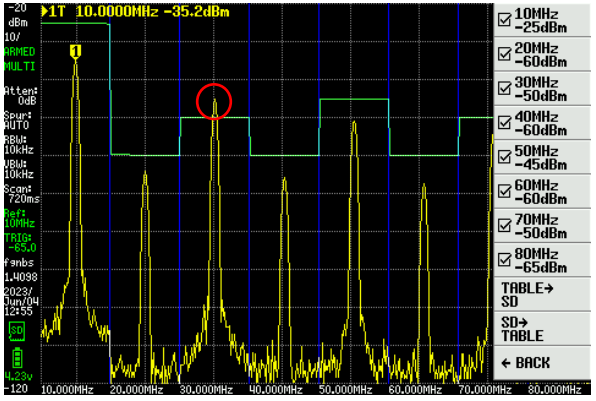
As an alternative you may define a trigger trace 2, 3 or 4 then shown as **LEVEL TRACE 2** and taking control over the MULTI BAND trigger levels if enabled

Once trigger is set to LEVEL the trigger trace is released

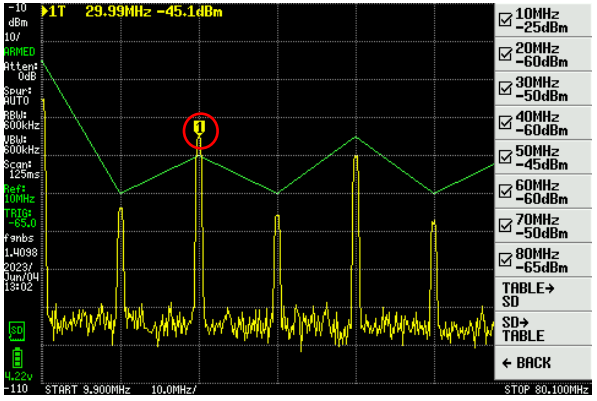
TinySA Ultra TRIGGER EXAMPLES Menu Chart



FREQUENVY/MULTI BAND enabled and LEVEL/TRIGGER set to NORMAL. Trigger levels entered and displayed as horizontal blue lines. Triggering at 50MHz
Band width larger than ¼ of Span then Start and Band Span shown

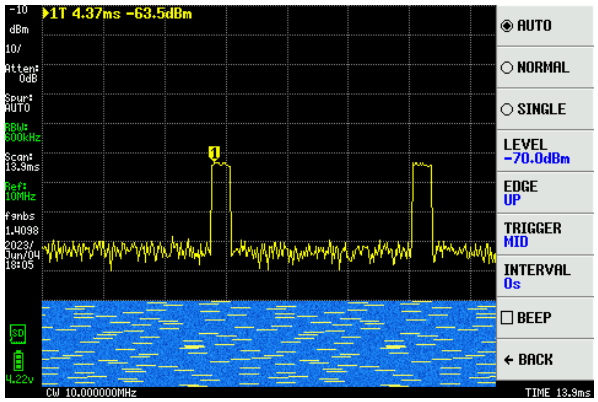


FREQUENCY/MULTI BAND still enabled and LEVEL/TRACE 2/ TRIGGER TRACE 2 enabled.
Trigger levels entered simular to MULTI BAND LEVELS (now not in force) and displayed as horizontal green lines. Triggering at 30MHz.

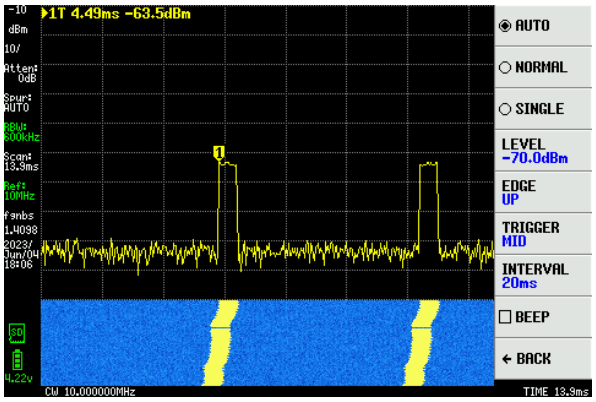


FREQUENCY/MULTI BAND disabled so normal scan and LEVEL/ TRACE 2/TRIGGER TRACE 2 enabled.
Trigger levels same as center image and start and stop frequencies the same as well.Triggering at 30MHz

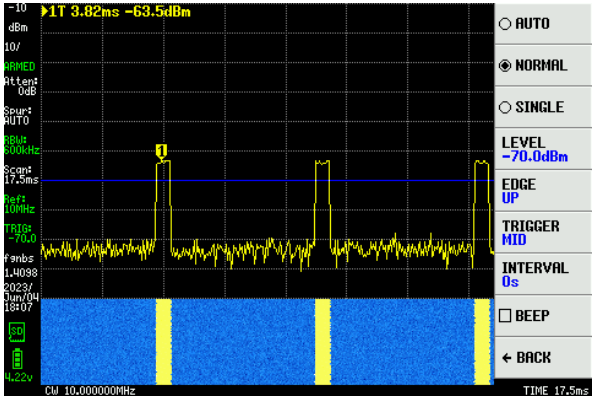
THE INTERVAL TRIGGER FUNCTION



The condition for above settings is:
Frequency set to 10MHz and 0 span.
Trigger set to AUTO and INTERVAL set to 0
Input signal is 10MHz pulse modulated wirth squarewave pulses, being on/off modulated with 200Hz
No Trigger level entered, so the burst jumps all over the screen without any sync. Sweep time 13.9ms for RBW 600KHz.
The DISPLAY/WATERFALL shows the unsyncronized sweep



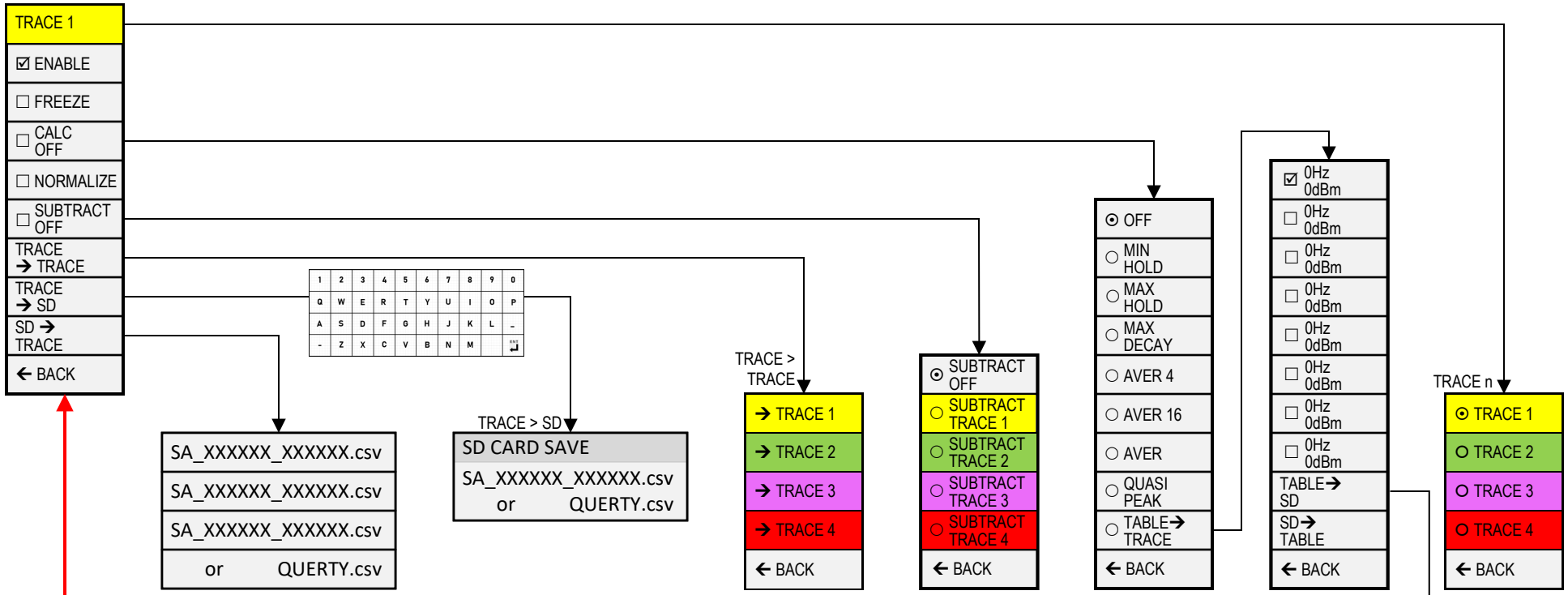
Now the INTERVAL set to 20mS and as seen the sweep time stays unchanged at 13.9ms, and the burst stays almost stable on screen as being started every 20ms. It may drift slowly to either side pending the accuracy of 200Hz modulation and the internal trigger clock of the TinySA ULTRA
This function requires you know the repetition rate for the input signal and enabling the DISPLAY/WATERFALL can further be used to study the signal you examine



For a stable signal, like the used test signal then NORMAL trigger LEVEL (here -70dBm) creates steady positioned burst with a scan time 17.5ms.
Use of INTERVAL sweep might be an advantage to find 50Hz burst hidden in noise
The maximum interval you can use is 141ms

TinySA Ultra TRACE Menu Chart

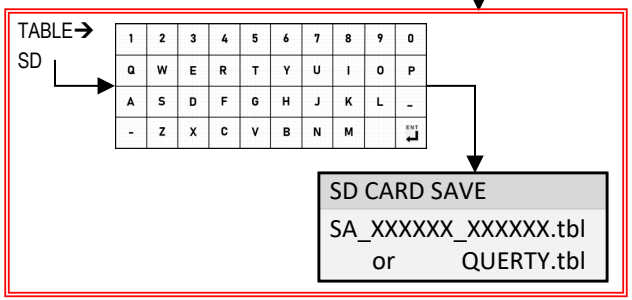
Selects a trace and controls various aspects of how the trace is displayed



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

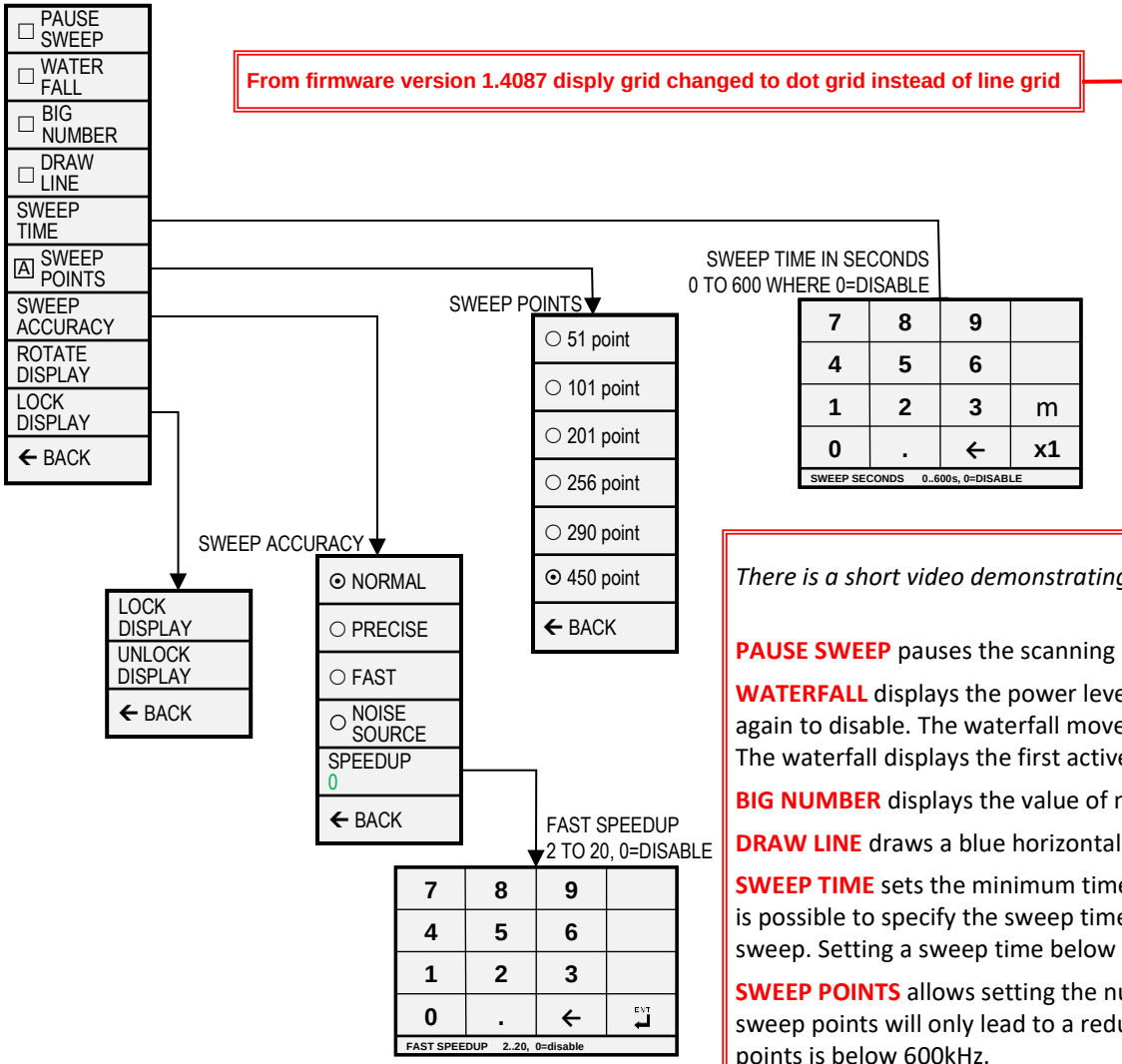
TRACE n selects which trace to control
ENABLE dis/en-ables a trace display
FREEZE freezes the trace displayed
CALC state selects various calculation options over time such as averaging, max hold and display the current CALC state.
- **OFF** disables any calculation
- **MIN HOLD** sets the display to 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 Selected number 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

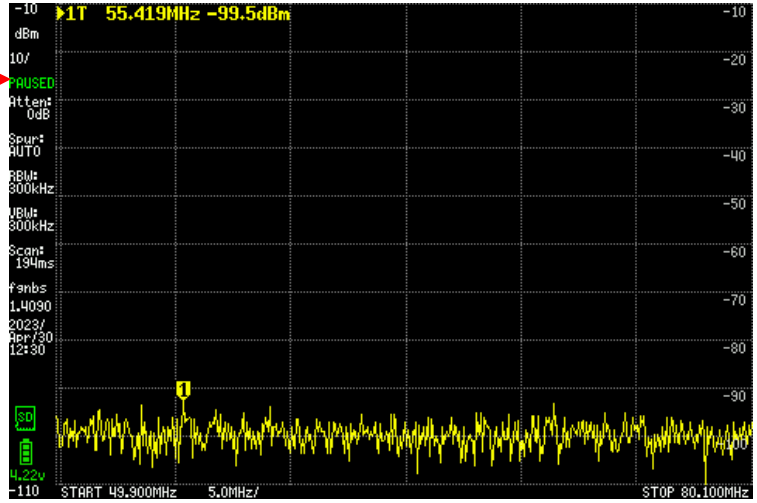
NORMALIZE will normalize the trace.
SUBTRACT selects a trace to subtract from the current trace
TRACE->TRACE copies the current trace data to another trace
TRACE -> SD copies the current trace data to SD
SD->TRACE reads a trace from SD and stores into a frozen trace.



TinySA Ultra DISPLAY Menu Chart

Controls various aspects of the display





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

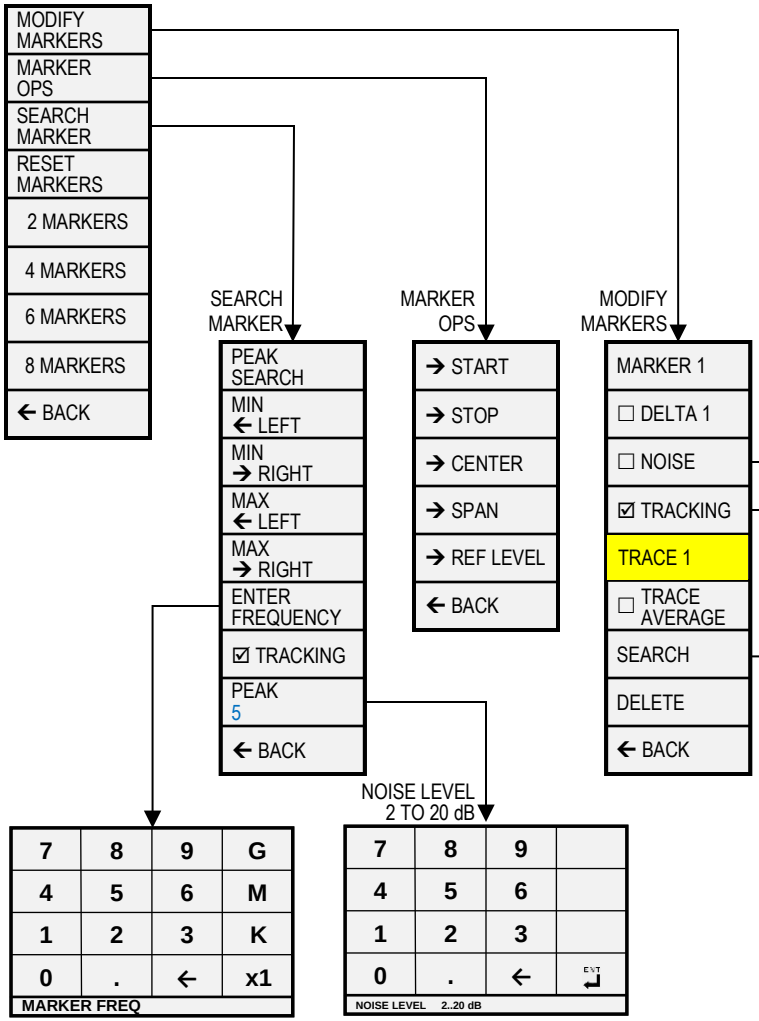
ROTATE DISPLAY rotates the display 180 degrees

LOCK DISPLAY when selected no selections on the touchscreen are possible. To unlock press the rockerswitch and move down to UNLOCK DISPLAY by twice operate the rockerswitch to the right, then press down. Alternative power off and on again

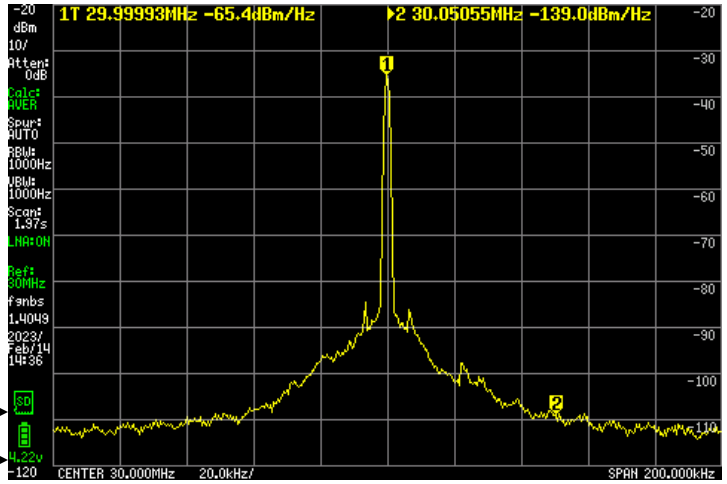
BACK returns to the input menu

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



Jump to SEARCH MARKER

The internal 30MHz signal meaured 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

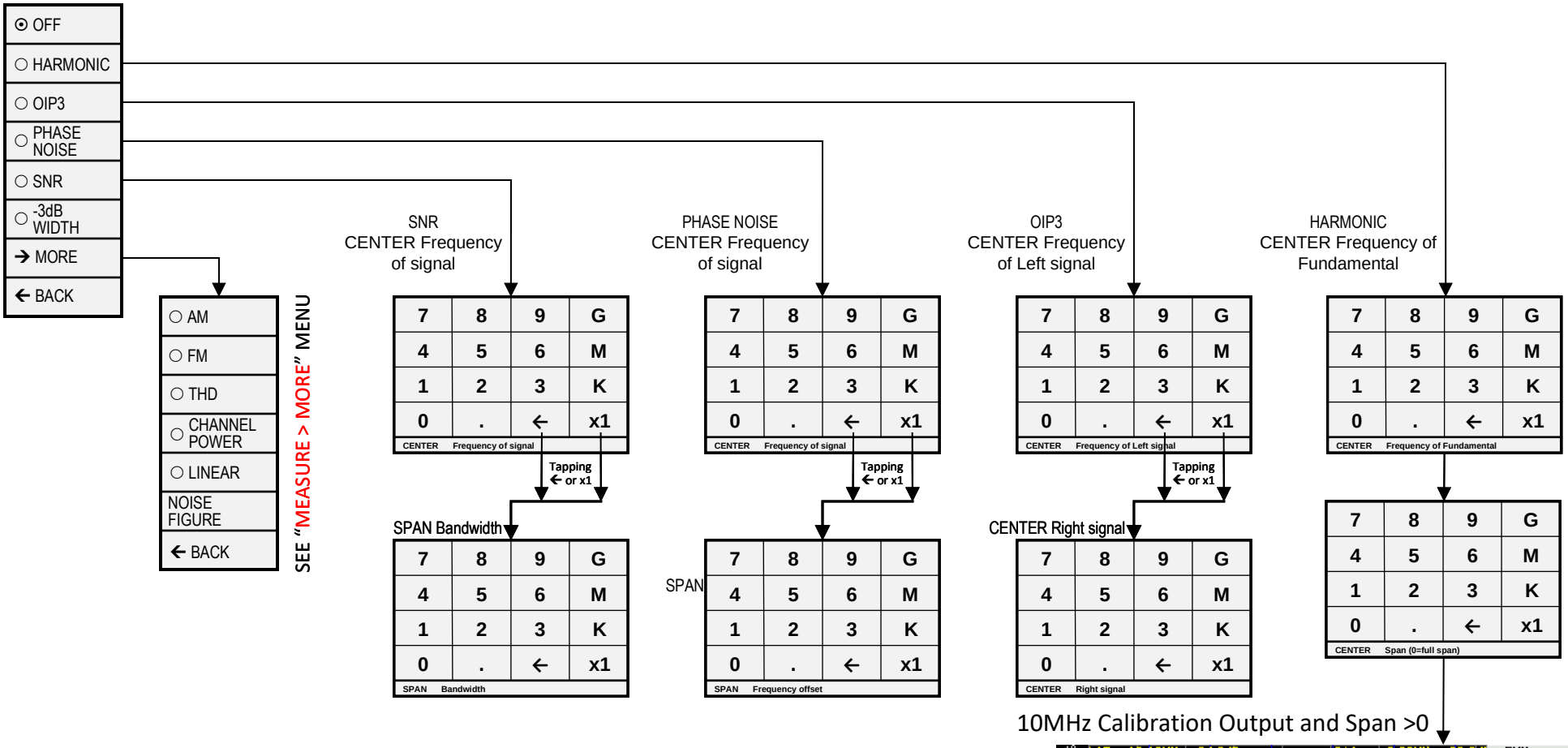
2, 4, 6 or 8 MARKERS Enables a fixed numbers of tracking markers. To use 1 marker select RESET MARKERS

BACK returns to the input menu

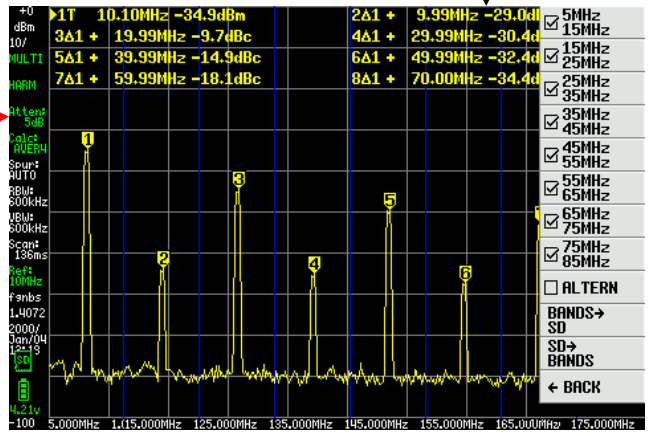
Marker 1 is by default enabled and has the TRACKING attribute and is thus automatically positioned at the largest signal in the scan. The active marker can be moved with the jog switch. Any marker can be moved by dragging the marker to a new position. The active marker can also be selected by touching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



10MHz Calibration Output and Span >0



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

HARMONIC switches to a Delta marker configuration for measuring the level of harmonics of a signal if Span=0 For Span>0 activates MULTI BAND with the requested Span per harmonic.

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 from the tracking marker

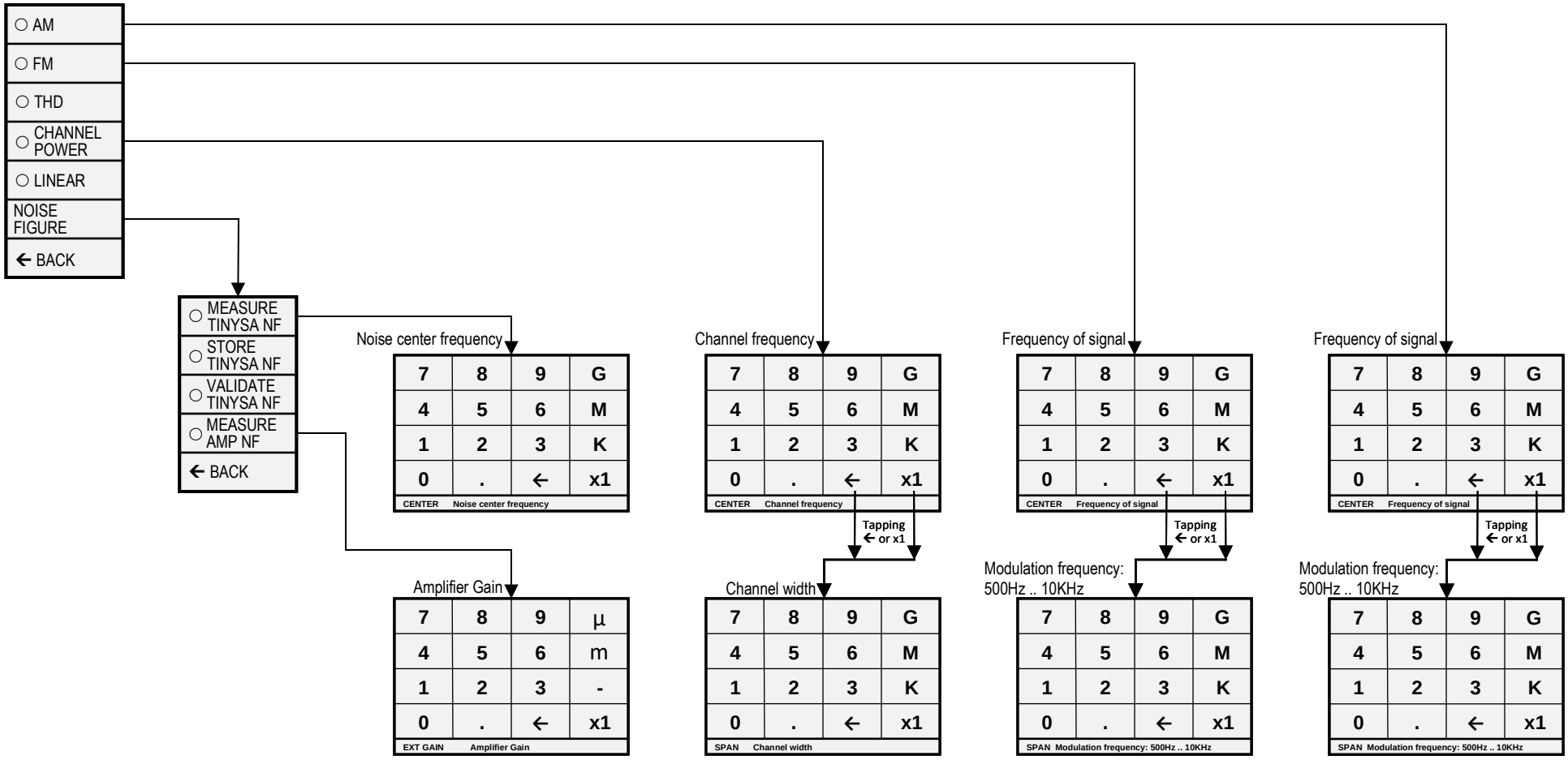
-3dB WIDTH sets three markers, a tracking marker and two delta markers at the -3dB levels with respect to the tracking marker and the delta frequency of the two delta markers is calculated

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 amplitude 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 frequency modulated signal

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

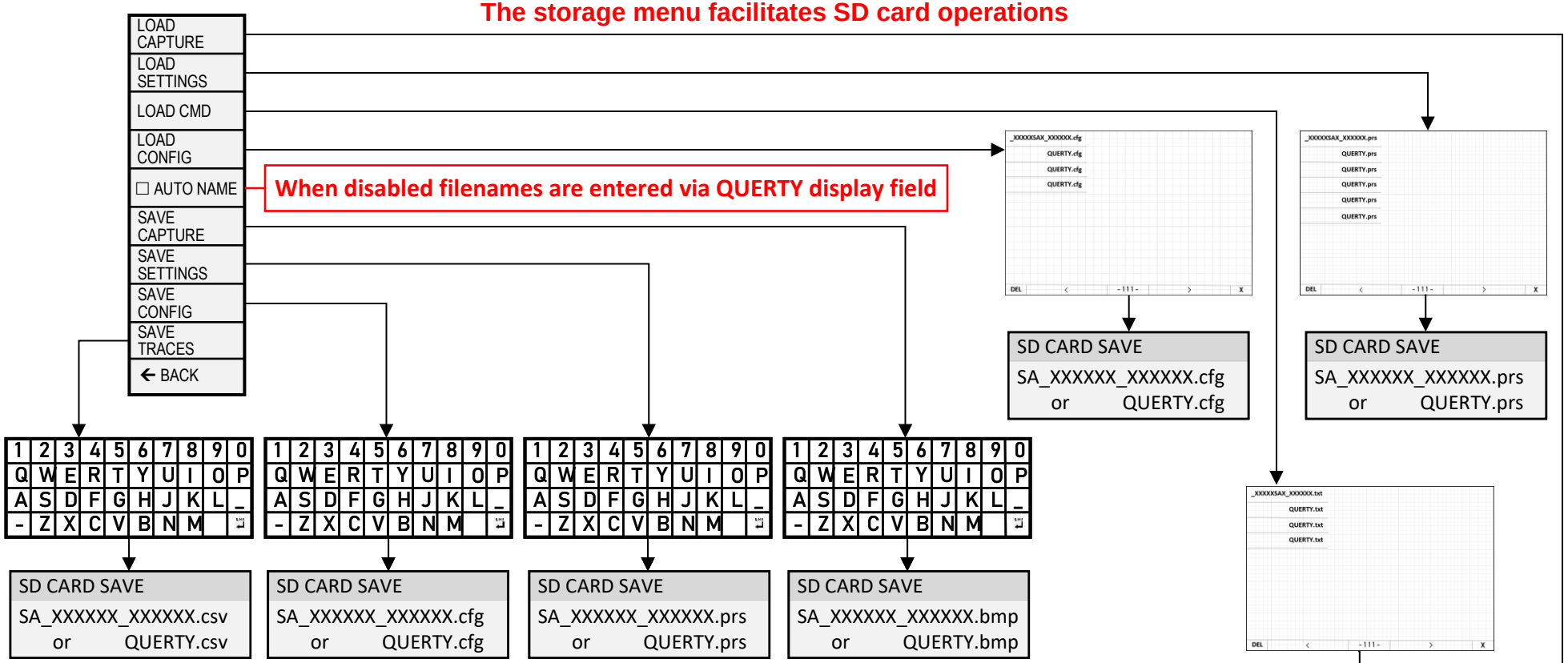
CHANNEL POWER sets the channel frequency and width and enables the measurement of the absolute and percentage of power in the specified channel and the channels at the frequencies above and below the specified channel.

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 checkIng of the linearity of the internal attenuation.

BACK moves back to the first MEASURE menu

TinySA Ultra STORAGE Menu Chart

The storage menu facilitates SD card operations



LOAD CAPTURE 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

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

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 CONFIG a saved *.cfg file can be loaded from SD card. All correction tables are included

AUTONAME enables automatic naming of saved files to SD card using date and time. Example: SA_230209_112237-bmp
Is disabled after a CONFIG/MORE/CLEAR CONFIG

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

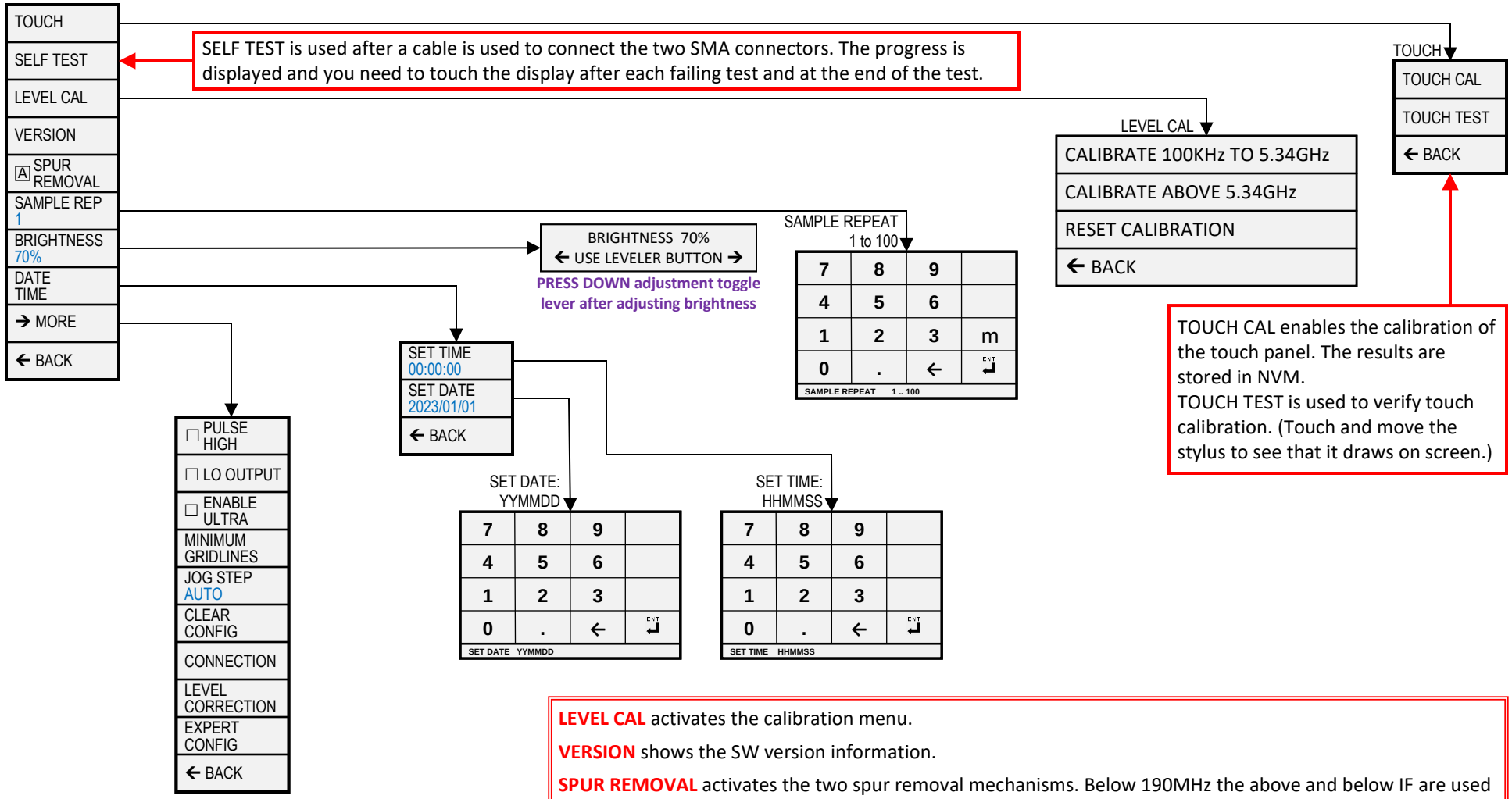
SAVE CONFIG the present configuration can be saved to SD Card. All correction tables are included

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

NOTE for all the LOAD command file listing screens… Click with the mouse on DEL bottom left and it turns RED and when clicking on one of the files it will be deleted. Click on X at bottom 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



LEVEL CAL activates the calibration menu.

VERSION shows the SW version information.

SPUR REMOVAL activates the two spur removal mechanisms. Below 190MHz the above and below IF are used to identify spurs and above 190MHZ the IF is shifted.

SAMPLE REP sets the amount of samples to take at a frequency. Minimum is 1, maximum is not defined but a large number will make the scan very slow. Increasing the sample repeat helps to average out noise.

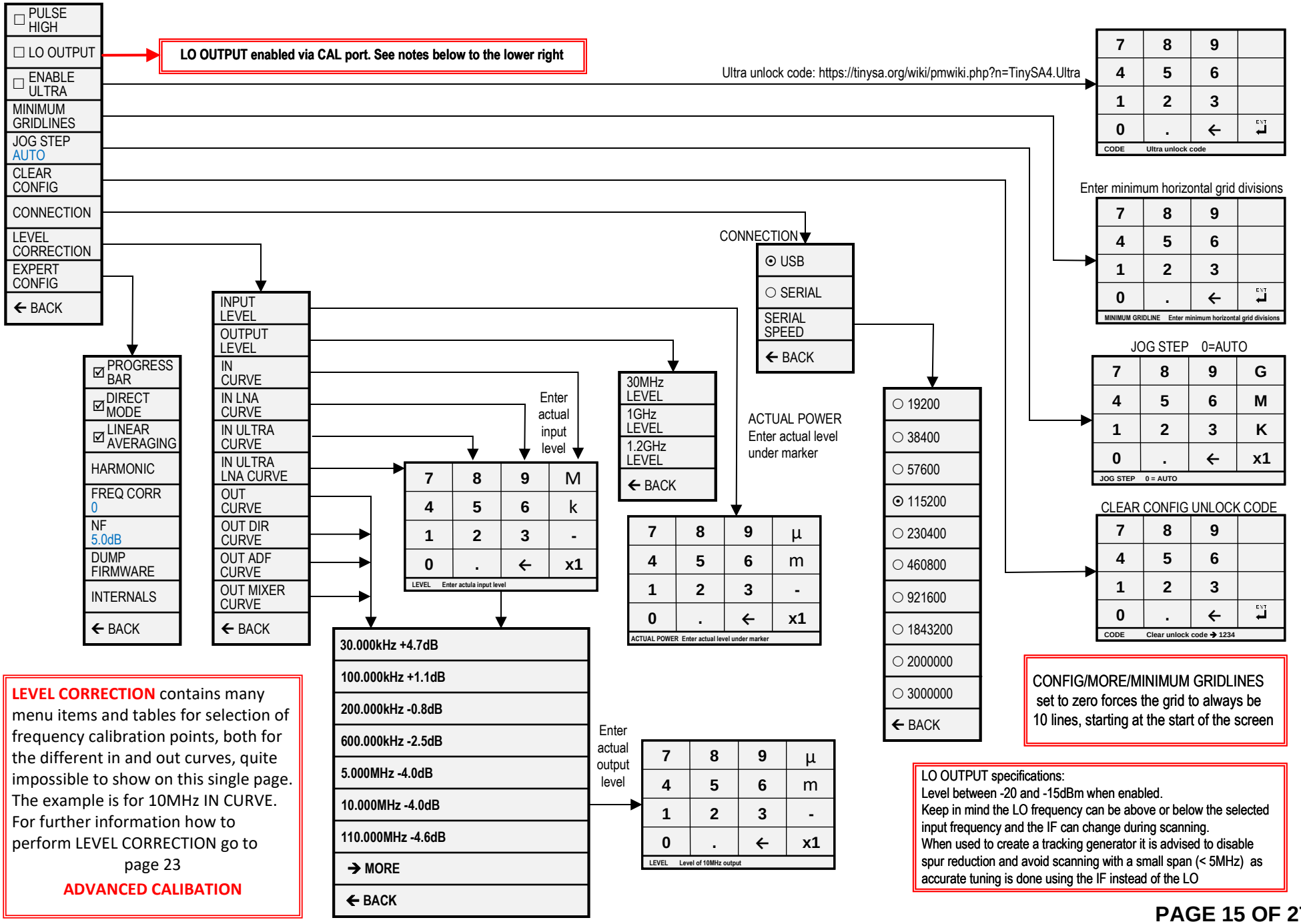
BRIGHTNESS allows setting the brightness of the screen using the leveler button.

DATE TIME activates the menu for setting Date and Time. (The battery provides power to store the Date and Time, once set.)

MORE activates the next configuration menu

BACK moves back to the previous CONFIG menu.

TinySA Ultra CONFIG > MORE Menu Chart



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 23

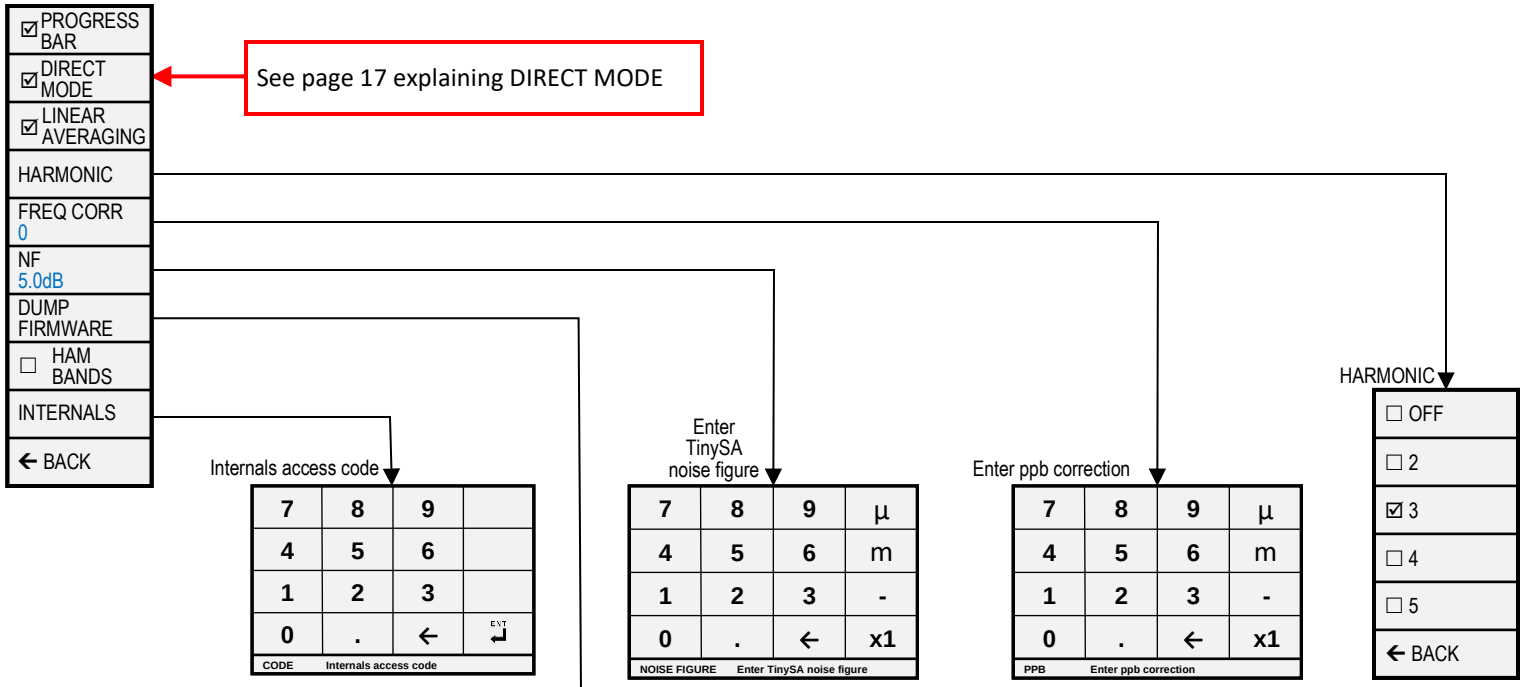
ADVANCED CALIBATION

CONFIG/MORE/MINIMUM GRIDLINES set to zero forces the grid to always be 10 lines, starting at the start of the screen

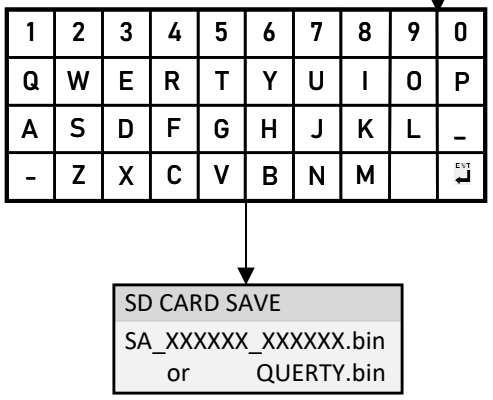
LO OUTPUT specifications:
Level between -20 and -15dBm when enabled.
Keep in mind the LO frequency can be above or below the selected input frequency and the IF can change during scanning.
When used to create a tracking generator it is advised to disable spur reduction and avoid scanning with a small span (< 5MHz) as accurate tuning is done using the IF instead of the LO

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.

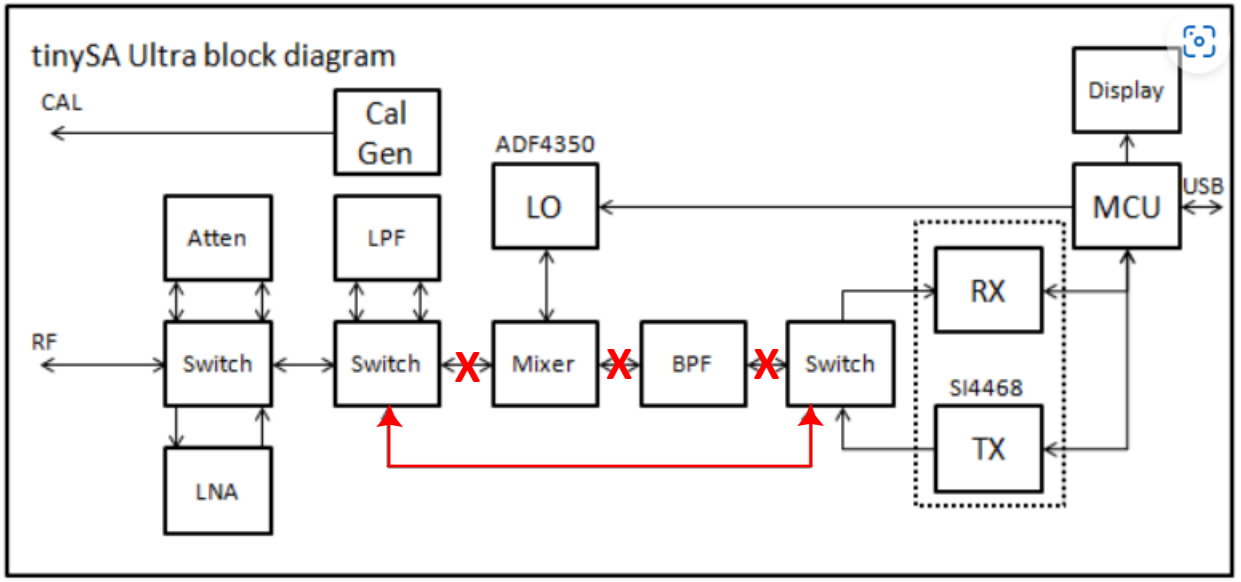


Enter a desriptive name for the firmware
if STORAGE/AUTO NAME is disabled



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
HAM BANDS Enable display of Ham Bands. Presently Region2. User editing to other regions planned
Colour can be edited via USB via terminal command by issuing e.g. color 24 0x5050F0
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 CONFIG > MORE > ....DIRECT MODE Menu Chart



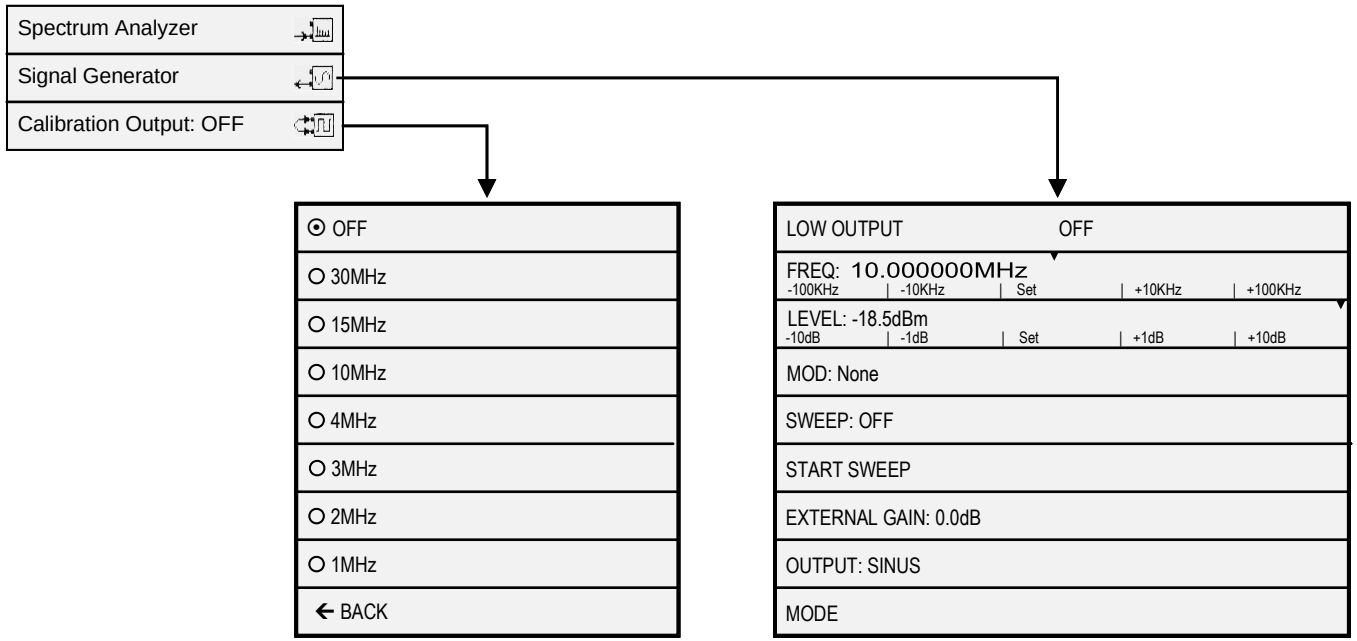
In DIRECT mode the 2nd and 3rd switch in above picture https://tinysa.org/wiki/pmwiki.php?n=TinySA4.TechnicalDescription are set to bypass the mixer and BPF so the SI4468 is connected to the RF connector via the attenuator/LNA switch.
This allows the input and output of al frequency ranges directly supported by the SI4468
Most important is the 830MHz to 1130MHz range

DIRECT input mode is selected when CONFIG/MORE/EXPERT CONFIG/DIRECT MODE is enabled (is not enabled by default) and the selected frequency is between DSTART and DSTOP in the INTERNALS menu, these are default set to 965MHz and 985MHz

Direct mode is also selected in output mode when the output frequencies are between 830MHz and 1130MHz but not controlled by the CONFIG/MORE/EXPERT CONFIG/DIRECT MODE settings but by the signal generator function.

TinySA Ultra MODE Menu Chart

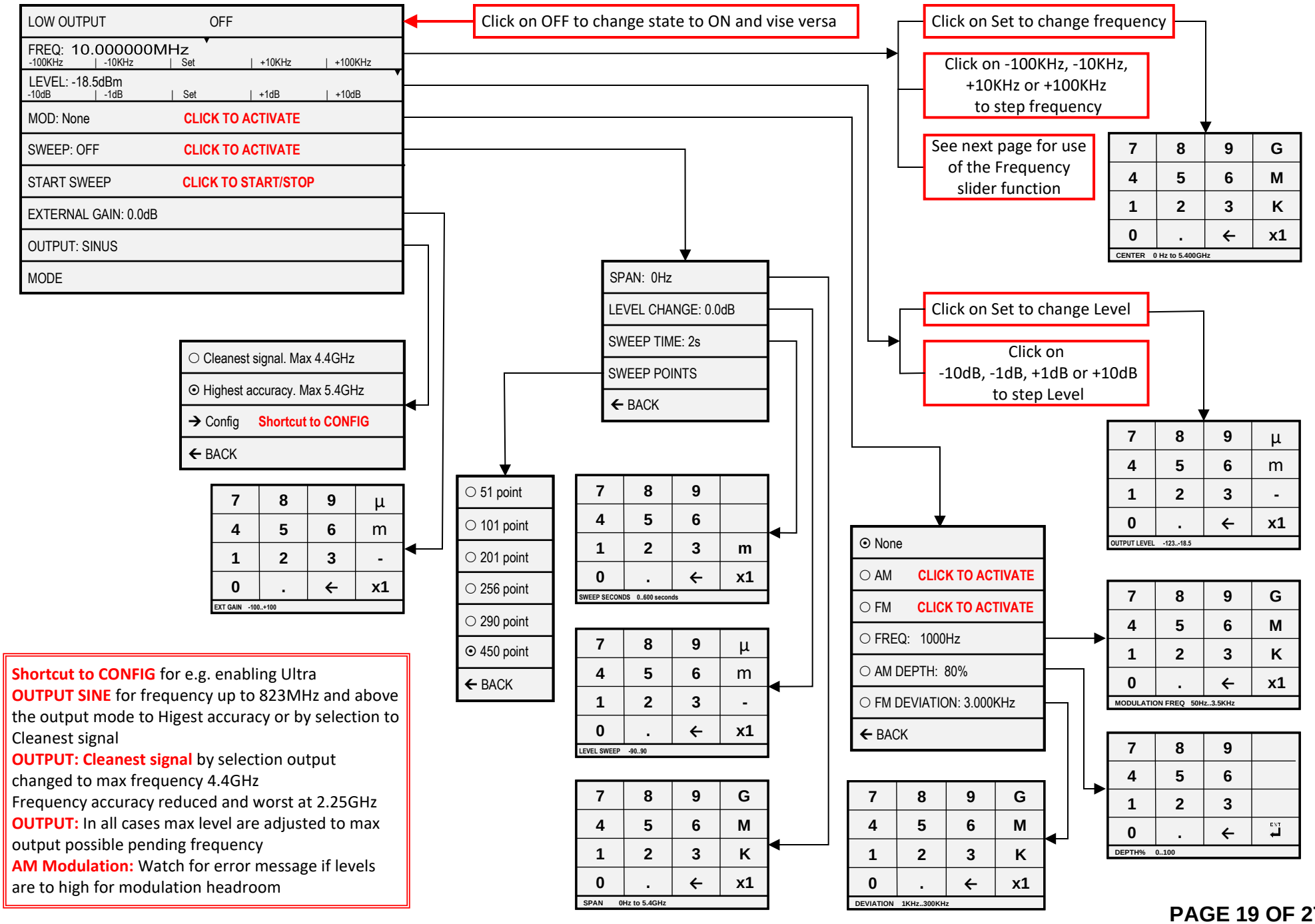
Activates the mode switching menu



See PAGE 19 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 built-in calibration reference generator using the CAL port for output.

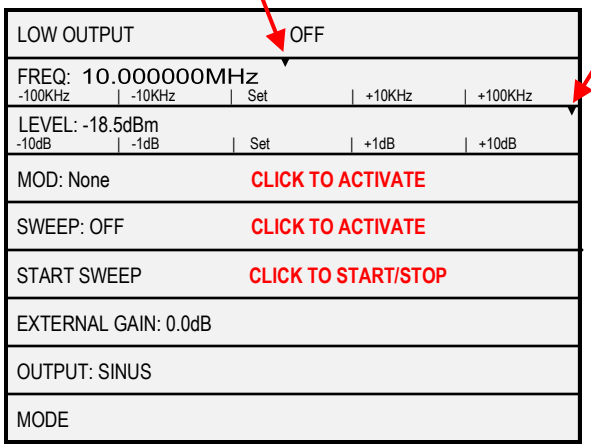
TinySA Ultra MODE > SIGNAL GENERATOR Menu Chart



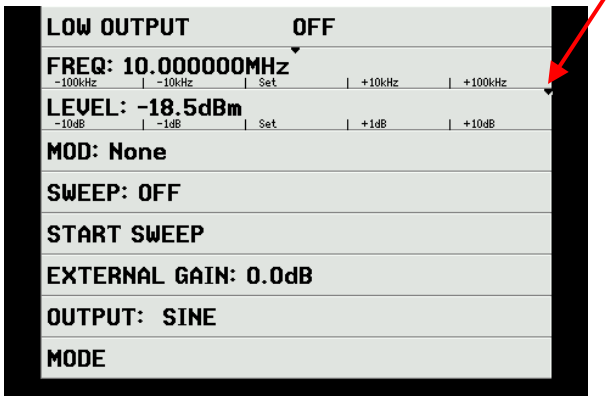
Shortcut to CONFIG for e.g. enabling Ultra
OUTPUT SINE for frequency up to 823MHz and above the output mode to Higest accuracy or by selection to Cleanest signal
OUTPUT: Cleanest signal by selection output changed to max frequency 4.4GHz
Frequency accuracy reduced and worst at 2.25GHz
OUTPUT: In all cases max level are adjusted to max output possible pending frequency
AM Modulation: Watch for error message if levels are to high for modulation headroom

TinySA Ultra MODE > SIGNAL GENERATOR SLIDERS Menu Chart

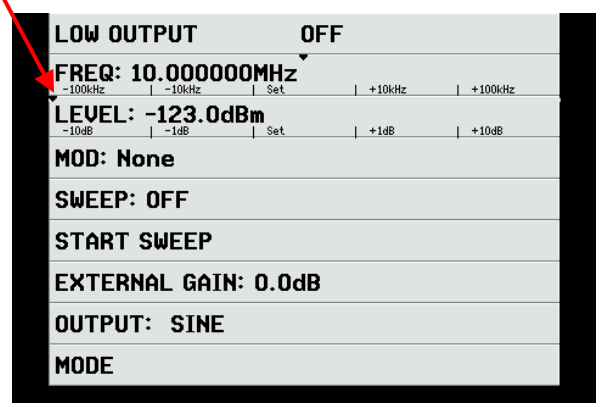
Remark the small triangular **FREQ** slider icon



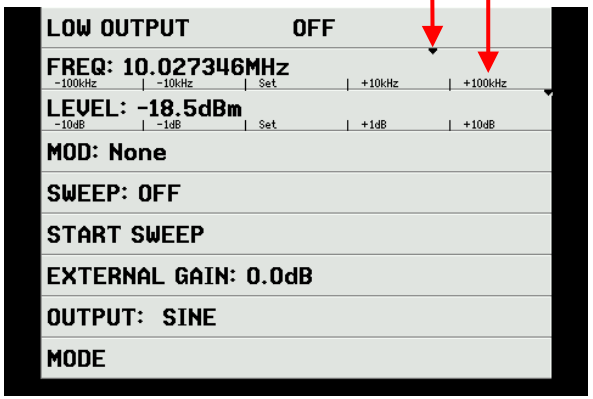
Remark the small triangular **LEVEL** slider icon
Select and drag it with a stylus



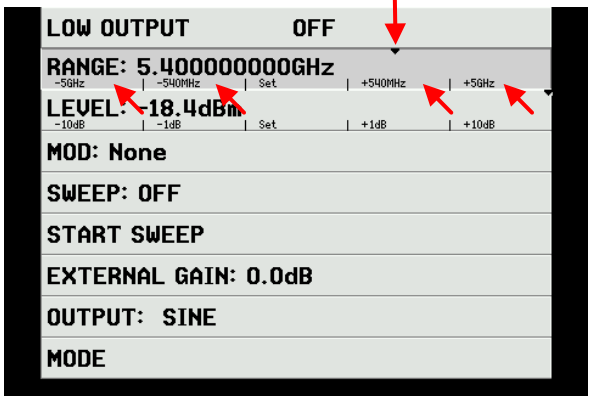
The Level slider set the LOW OUTPUT LEVEL from max available for the FREQ selected by Set to 0 and to -123dBm



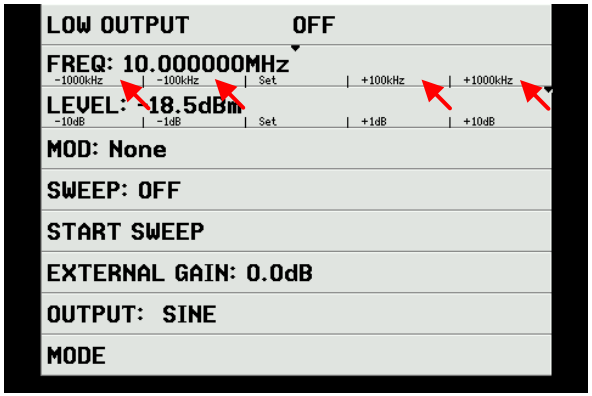
By dragging the frequency slider with a stylus any frequency can be set within the span of 100KHz



The RANGE of the frequency span can be changed by holding down, with a stilus, one of the 4 up down buttons, until with greyed background. Slide with the stylus to change the Span ranging from 100Hz to 5.4GHz.
The up down buttons changes accordingly



The RANGE of the frequency span changed to 1MHz, in below screen copy, such that the FREQ slider with the stylus can set frequencies from 9.5MHz to 10.5MHz:
The up down buttons will step the frequencies in -100KHz, -1MHz. +100KHz and 1MHz steps



TinySA Ultra Calibration System-1 Menu Chart

WARNING !!! DO NOT MODIFY ANYTHING AS DESCRIBED IN THE FOLLOWING PAGES UNLESS YOU KNOW 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 correection tables.
Before doing the CONFIG/LEVEL CAL perform a CONFIG/MORE/CLEAR CONFIG to remove any remains from 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 is 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 lna 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_lna 0.0
leveloffset ultra 0.0
leveloffset ultra_lna 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 lna 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_lna 31.4
leveloffset ultra -0.4
leveloffset ultra_lna 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 lna 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_lna 31.4
leveloffset ultra -0.4
leveloffset ultra_lna 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

Range 0 to 830MHz Normalized to 30MHz

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
```

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
```

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

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
```

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
```

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

correction ultra

```
correction ultra 0 30000000 0.0
correction ultra 1 700000000 0.6
correction ultra 2 980000000 1.7
correction ultra 3 1440000000 4.5
correction ultra 4 1590000000 4.5
correction ultra 5 1900000000 3.2
correction ultra 6 2810000000 4.6
correction ultra 7 3340000000 6.3
correction ultra 8 3390000000 5.7
correction ultra 9 3930000000 7.0
correction ultra 10 4230000000 8.8
correction ultra 11 4300000000 7.0
correction ultra 12 4340000000 8.3
correction ultra 13 4810000000 11.4
correction ultra 14 5070000000 11.6
correction ultra 15 5110000000 13.3
correction ultra 16 5300000000 12.4
correction ultra 17 5510000000 12.6
correction ultra 18 5850000000 15.8
correction ultra 19 6000000000 15.9
```

correction ultra_lna

```
correction ultra_lna 0 30000000 0.0
correction ultra_lna 1 700000000 0.5
correction ultra_lna 2 770000000 0.5
correction ultra_lna 3 990000000 1.3
correction ultra_lna 4 1230000000 3.1
correction ultra_lna 5 2390000000 2.7
correction ultra_lna 6 2800000000 2.7
correction ultra_lna 7 2810000000 3.5
correction ultra_lna 8 3150000000 4.7
correction ultra_lna 9 3210000000 6.2
correction ultra_lna 10 3810000000 8.5
correction ultra_lna 11 4060000000 11.5
correction ultra_lna 12 4180000000 13.5
correction ultra_lna 13 4230000000 15.8
correction ultra_lna 14 4300000000 15.8
correction ultra_lna 15 4400000000 18.7
correction ultra_lna 16 4490000000 19.4
correction ultra_lna 17 4960000000 22.6
correction ultra_lna 18 5070000000 22.8
correction ultra_lna 19 6000000000 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
```

corrrection 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 corrrection 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_lna 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 corrrections likewise an accurate signal generator is required

How to perform such corrections go to page 15 for further informantion

TinySA Ultra ADVANCED CALIBRATION Menu Chart

From page 14 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

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

For all "IN CURVEs"the settings below are used and for "INPUT LEVEL" the same settings are recommended, incl. LEVEL= -35.0dBm, FREQUENCY=30MHz, SPAN=1MHz, RBW and VBW=10KHz, LEVEL/ATTENUATE/MANUAL=5dB, CONFIG/SAMPLE REP=10
Other settings left as automatically 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

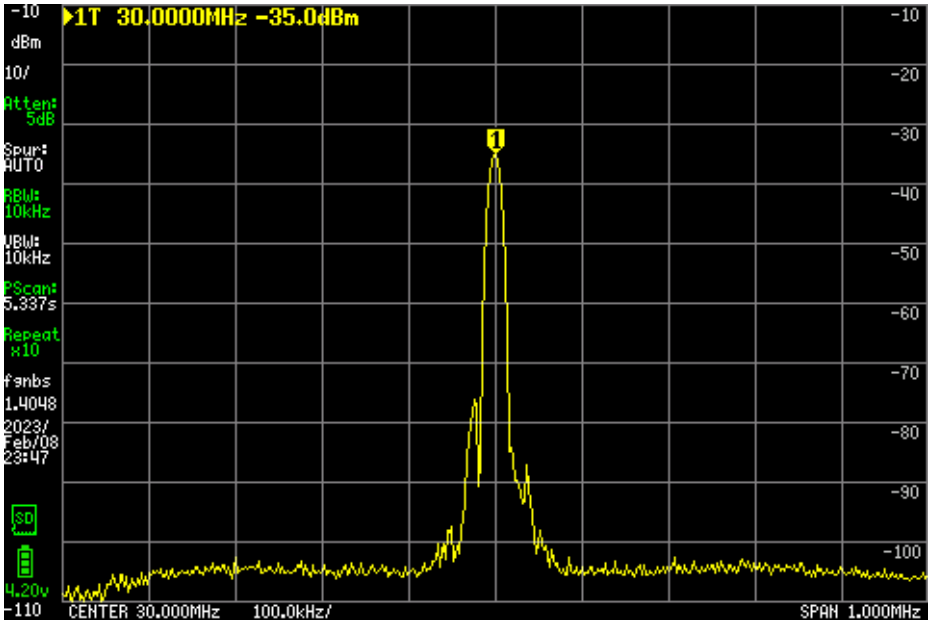
Enter actual level of 30MHz output

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 CRTL 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

P

TinySA Ultra ADVANCE CALIBRATION-IN Menu Chart

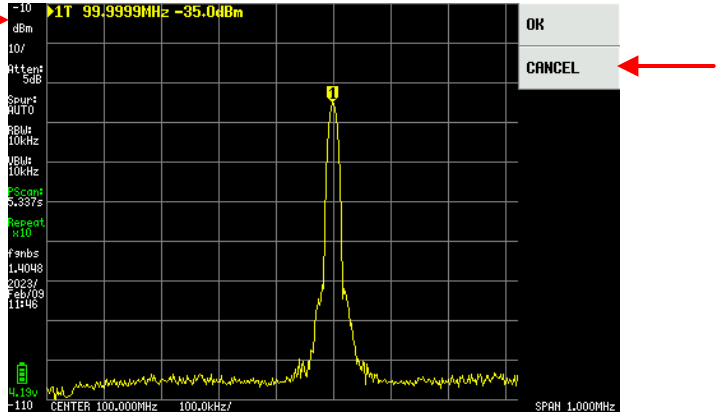
For all the 4 IN CURVEs you must provide from a signal generator an accurate input signal of known level between -35 to -25dBm. Recommended level to use is the same as for the ”INPUT LEVEL” calibration page 21 which was -35dBm.
First step in example below is to enter the level -35dBm by means of the 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 is needed and thus CANCEL selected followed by BACK a couple of times.
You may edit just a single frequency or several, depending on what you need. Up tp 3GHz the levels do not deviate much from unit to unit

- 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 CURVEs consist of 3 entry fields, and reflect the data from the correction tables shown on PAGE 21. 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 CRTL 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

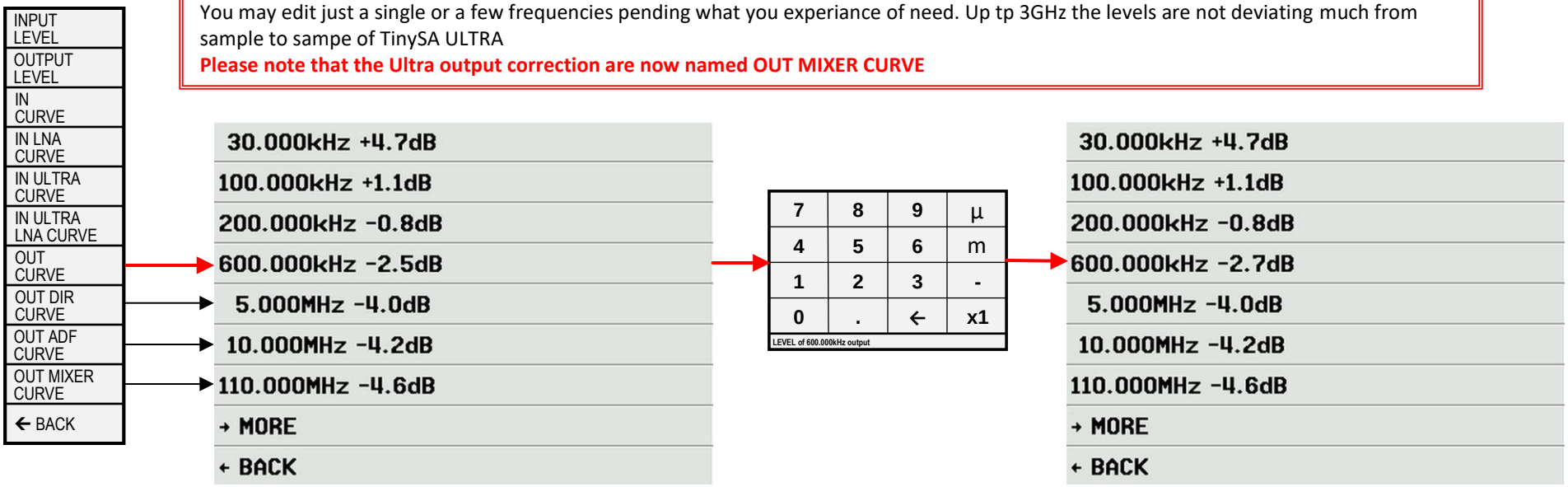
- 100.000MHz -0.8dB
- 160.000MHz -0.4dB
- 230.000MHz +0.5dB
- 290.000MHz +0.3dB
- 400.000MHz +1.0dB
- 520.000MHz +0.1dB
- 600.000MHz +0.5dB
- → MORE
- ← BACK

- 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

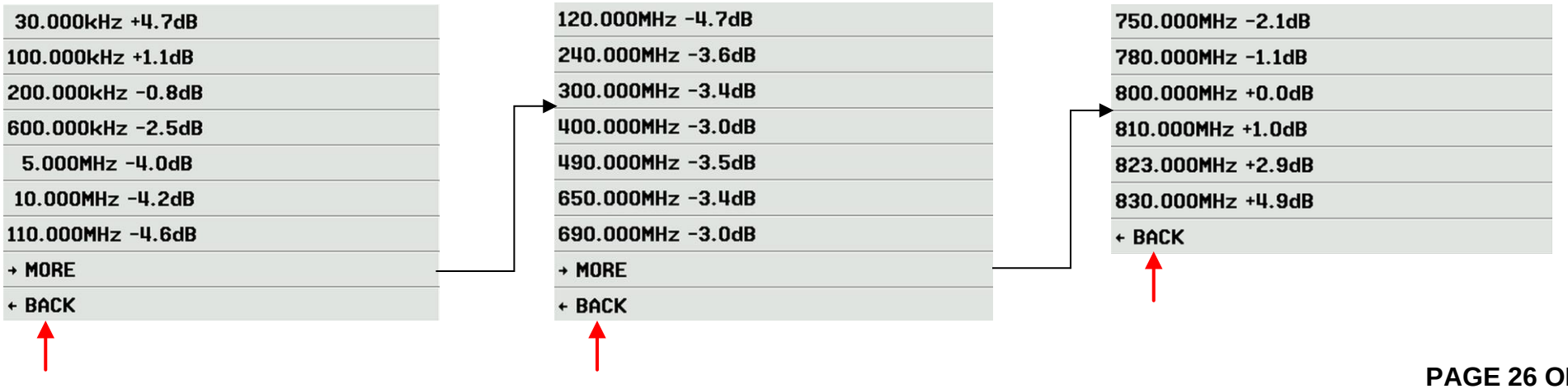
TinySA Ultra ADVANCE CALIBRATION-OUT Menu Chart

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 meaured 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 experiance of need. Up tp 3GHz the levels are not deviating much from sample to sampe of TinySA ULTRA

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



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 CRTL 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



TinySA Ultra TIPS and TRICK's Menu Chart

Besides the calibation information on page 20 to 25 the wiki pages are containing further information at the links shown below

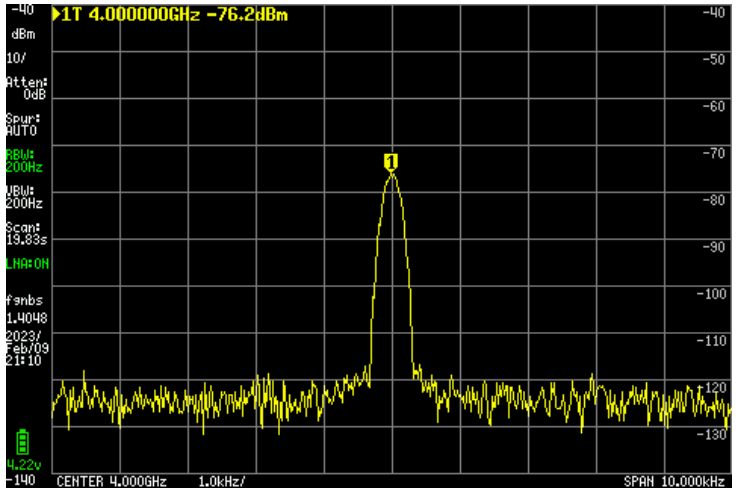
https://tinysa.org/wiki/pmwiki.php?n=TinySA4.MenuTree

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 presision 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

To get rid of ALL user settings, press the jog switch to the side during startup
Evidence this worked is the ref level number turning red
After startup do CONFIG/SAVE CONFIG and PRESET/STORE/AS STARTUP

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=i8CYCua8vqQ&t=41s

TinySA Ultra Menu-Tree Chart Revision History

DATE	DESCRIPTION
13-01-2023	INITIAL RELEASE. Based on Firmware version tinySA4_v1.4-40
16-01-2023	Added menu descriptions, additional menu levels, shrunk keypad to 80% of original size to fit more on a page, added MODE page, etc.
28-01-2023	Added MODE > Signal Generator menu page - credit to Kurt Poulsen (kurt@hamcom.dk). Added text and made text corrections.
10-02-2023	Menus updated and additional information added by Kurt as a result of firmware update to version tinySA4_v.1.4-49
23-02-2023	Final updates by Kurt with many additions over last update.
24-03-2023	Extension of Multi Band and Level by Kurt with many update and additions over last update
04-04-2023	Load and Save Config added to Storage menu by Kurt
11-04-2023	Correction to Page 2 - 6 - 9 - 13 implemented with respect to menu structure
04-06-2023	Correction to many pages for several updates since mid April 2023
20-07-2023	Update of Firmware version to v1.4-104 on page1