

Waterfall Pro — User Guide

Thetis SDR (openHPSDR transceiver software) — Yurij-eu2av modification package, v2.10.3.16 · July 2026
Covers: 16-bit float pipeline, Stage-9 GPU FFT waterfall, Auto Overlap, Noise Floor Pro, GPU/CPU modes

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Introduction

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This build of Thetis ships a completely reworked waterfall subsystem. The goal was to reach — and in several places exceed — the display quality of SDR Console while keeping the CPU load low enough for real-time operation, and to make PureSignal (PS-A) robust in daily on-air use. Everything in this guide applies to version **2.10.3.16** and later.

What is new compared to the classic Thetis waterfall

Area	Before	Now
Color pipeline	8-bit palette bitmap, visible banding	16-bit float pipeline (65536 levels), HDR tone mapping, dithering — banding eliminated
FFT engine	WDSP/CPU spectrum only, limited sizes	Stage-9 GPU FFT on the graphics card, sizes 1024–262144, with automatic level calibration to the CPU reference
Overlap	Fixed percent; scroll speed halves with every FFT doubling; auto	Auto Overlap : mathematically exact constant row rate — identical scroll speed at every FFT

	mode pinned incorrectly at high refresh rates	size and frame rate
Noise floor	Manual thresholds per band	Noise Floor Pro (Average / Percentile) + Auto Threshold that tracks the measured floor while keeping your manual palette shape
Image quality	One fixed palette mapping	Quality levels (Classic / Vivid / Sharp / Ultra), palette resolution, S-curve, gamma, dither (Bayer 8×8), temporal filtering, Zoom Adaptive
PureSignal	Correction drop-outs, slow first calibration, comb artifacts after cold start, engine reset on any feedback transient	Cold-start guard, correction hold on transient resets, invalidation on retune (± 10 kHz), bucket collection across VOX gaps, auto-attenuate hysteresis
Mode / Render logic	Render combo silently switched between CPU and GPU paths	Pipeline is chosen only by GPU Acceleration → Mode; the Render list shows only the tiers valid for that pipeline

i Where things are: most settings live in [Setup → Display → Waterfall](#) and [Setup → Display → General](#). FFT engine & detector settings for each receiver are on [Setup → Display → RX 1 / RX 2](#).

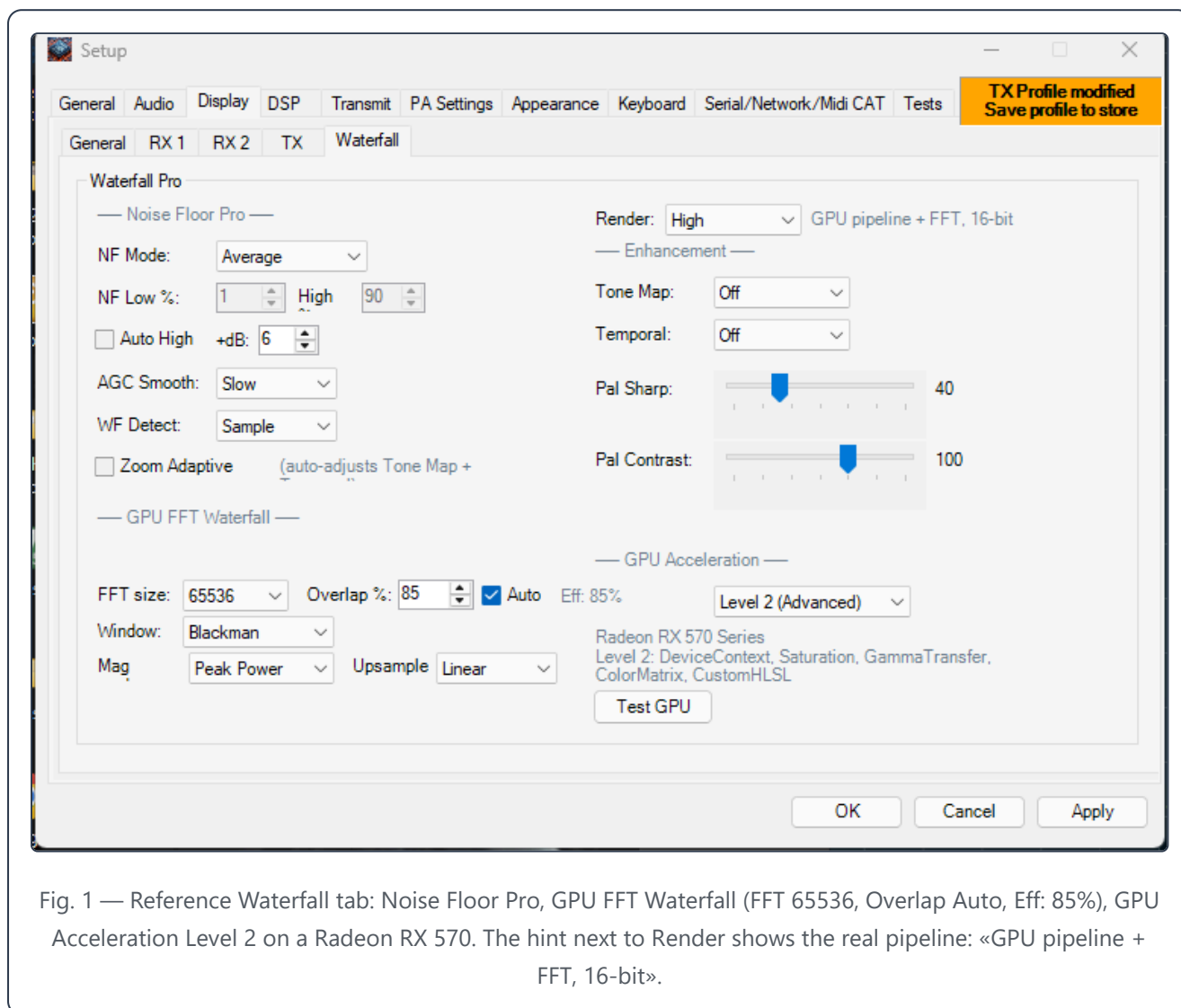
1. Quick Start

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The following configuration is the author's reference setup (the same one shown in the figures of this guide). It targets the 192 kHz panadapter span and gives a smooth, detailed picture on a mid-range GPU (Radeon RX 570 class or better):

Setting	Where	Recommended value
GPU Acceleration → Mode	Display → Waterfall	Level 2 (Advanced) — or <i>Auto</i> to let Thetis decide
Render	Display → Waterfall	High (GPU pipeline + FFT)
Color Depth	Display → General (DirectX group)	16-bit Float
FFT size	Display → Waterfall	65536 (131072 on strong GPUs)
Overlap %	Display → Waterfall	Auto checked (Eff: ≈ 90 – 95%)
Window	Display → Waterfall	Blackman or Nuttall

Mag (magnitude mode)	Display → Waterfall	Peak Power
Quality / Gamma / Depth	Display → General (DirectX group)	Vivid · 0.70–1.00 · 16-bit Float
Resampling	Display → General (Waterfall group)	Quality



Minimal path to a good picture: set Mode = Level 2 (or Auto), Depth = 16-bit Float, Render = High, enable Overlap → Auto. Everything else can stay at defaults and be tuned later.

Do NOT enable Auto Threshold yet. First set the waterfall offset (Low/High levels on the RX 1 tab) to approximately the values shown in Fig. 2 — only then enable Auto Threshold. See [Section 6](#) for the exact procedure.

2. Display Settings

2.1 GPU Acceleration (Mode) CORE

The **Mode** combo (Display → Waterfall → GPU Acceleration) is the **only** switch between the CPU and GPU pipelines. Everything downstream (Render list, GPU FFT rows, the native I/Q tap) follows it.

Mode	Pipeline	Use when
Auto	Detected automatically	Default; Thetis enables GPU when the hardware/driver supports it, CPU otherwise.
Level 0 (CPU)	CPU only	Old GPUs, driver problems, or when you want zero GPU load. GPU FFT and the I/Q tap are fully disengaged.
Level 1 (Basic)	GPU, built-in D2D effects	Integrated GPUs that support Direct2D effects but not custom compute shaders.
Level 2 (Advanced)	GPU, built-in effects + custom HLSL compute	Discrete GPUs (Radeon RX 570+, GTX 1050+). Required for the Stage-9 GPU FFT waterfall.

The info label under the combo shows the detected GPU, its capability level and the active state (*ACTIVE ✓ / INACTIVE / Pending...*). The **Test GPU** button shows the same details in a dialog (device context, built-in effects, custom shader support).

i Requirements for Level 2: Direct3D 11 with compute-shader support. The GPU FFT pipeline pre-allocates buffers for FFT 262144 and display width 8192 (~ few tens of MB VRAM). If Level 2 is requested but custom shaders are unavailable, Thetis shows a notice and falls back to Level 1.

2.2 Color Depth (8-bit / 16-bit Float)

The Depth selector (Display → General → DirectX Display Settings) chooses the pixel format of the waterfall surface and of the whole post-processing chain:

Depth	Levels	Effect
8-bit	256	Classic Thetis look; on smooth noise you can see banding (steps between adjacent colors).
16-bit Float	65536	Banding eliminated, HDR tone mapping (Reinhard/ACES) and accurate dither become meaningful. This is the recommended mode for the GPU pipeline.

- Switching depth works **without restarting Thetis** — the swap chain and pipeline are rebuilt on the fly.
- A subtle DXGI quirk was fixed in this build: starting Thetis *with* 16-bit already saved no longer lifts the mid-tones (washed-out background); the swap chain now always keeps the sRGB

attribute, including on a cold start.

- 16-bit costs slightly more GPU memory bandwidth; on RX 570-class cards it is free in practice.



Tip: the hint next to Render on the Waterfall tab always shows the real pipeline and depth, e.g. «GPU pipeline + FFT, 16-bit». If it says 8-bit while you saved 16-bit — reopen the tab (the hint is refreshed after the color depth is applied).

2.3 FFT Size (1024 – 262144)

FFT size sets the **frequency resolution** of the GPU waterfall row. Bin width at the 192 kHz span:

FFT size	Bin width @192k	Window time @192k	Typical use
1024	187.5 Hz	5.3 ms	Fastest response, coarse detail
16384	11.7 Hz	85 ms	Light systems
65536	2.93 Hz	341 ms	Default / sweet spot
131072	1.47 Hz	683 ms	Fine detail, strong GPU
262144	0.73 Hz	1.37 s	Maximum resolution, strong GPU

- Larger FFT = finer frequency detail, but a longer window to fill (the first row appears after one full window — this «honest wait» is normal) and more GPU work per row.
- With **Auto Overlap** the scroll speed no longer depends on the size — only the detail changes. That is the main reason 131072/262144 became practical.
- On RX 570 the comfortable daily maximum is 131072 at 95% overlap; 262144 works but each window takes ~1.4 s to fill and the GPU has less headroom.



Note: FFT size for the GPU waterfall is set on the Waterfall tab. The classic WDSP spectrum FFT (RX 1 tab, up to 131072, see Fig. 2) is a separate engine — the GPU path replaces the row source at Render = High.

2.4 Overlap / Auto Overlap NEW FORMULA

Overlap defines how much consecutive FFT windows share. It controls the **row rate** (scroll speed) and the smoothness of fast signals.

Manual mode

- Overlap % → $\text{step} = N \times (1 - \text{overlap})$ new samples per row. Row rate = F_s / step .
- Spinner step is now **1%** (was 5%) for precise tuning.
- Keep in mind: with a fixed percent the scroll speed **halves with every FFT doubling** (85% on 65536 $\approx$ 19.5 rows/s, on 131072 $\approx$ 9.8 rows/s at 192 kHz).

Auto Overlap (recommended)

Auto mode targets a **constant row rate** and derives the overlap from it:

```
R*   = min( fps / updatePeriod , 30 )    // target rows per second
step = round( Fs / R* )                  // samples between rows
overlap = 1 - step / N                   // derived, capped at 95%
```

- `fps / updatePeriod` is the row-timer ceiling, so the FFT hop logic and the display timer can no longer starve each other (this is what caused stutter at 60 Hz and the pinned 95% at 165 Hz in the old heuristic).
- 30 rows/s is the validated comfort ceiling; 95% is the stability cap for large FFTs on modest GPUs.
- Result at 192 kHz: **90.2% @65536, 95% @131072, 95% @262144** — the *Eff:* label next to the Auto checkbox shows the actual value. Scroll speed is identical at every FFT size and frame rate.



How to choose: leave Auto on. If you want to compare — manual 85–90% at 60 Hz gives the same ballpark on 65536; at 131072+ manual 95% is the stable maximum.

2.5 Render (quality tiers) UX FIXED

The Render combo no longer switches pipelines by itself — it shows **only the tiers that are valid for the pipeline selected in Mode**:

Mode	Render list	Meaning
GPU (Level 1/2, Auto+GPU)	High	GPU renderer + Stage-9 GPU FFT rows (16-bit pipeline)
CPU (Level 0, Auto no-GPU)	Low / Medium	CPU bitmap path; Medium = Linear interpolation, Low = Nearest-Neighbor

- The hint next to the combo always names the real pipeline (e.g. «*GPU pipeline + FFT, 16-bit*», «*CPU pipeline, 8-bit, Linear*»).
- Earlier, Medium/Low silently dropped to the CPU renderer in GPU mode (looked like a bug), and High in CPU mode silently fell back to Medium. Both cases are gone.

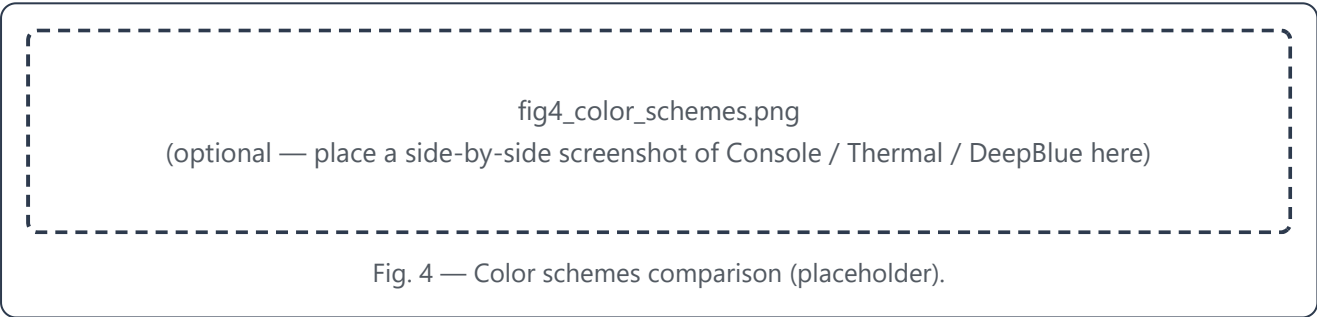
3. Color Schemes

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The color scheme is selected on the RX 1 / RX 2 tabs (Palette combo). The GPU pipeline supports the dynamic-LUT schemes directly; legacy hard-coded schemes run on the CPU path.

Scheme	Character	Notes
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Console 256	SDR-Console-style blue→cyan→yellow→red ramp	Best general readability, the reference scheme used in this guide's figures.
Thermal 256	«Thermal imager» black→red→yellow→white	Strong visual punch for pileups and weak-signal hunting.
DeepBlue 256	Deep blue gradient	Low eye strain in dark shacks.
Enhanced / SPECTRAN / legacy	Classic Thetis schemes	CPU path (fixed palettes).
Custom	User gradient from the database	Edited per-band; the GPU path uploads your LUT as-is. If no gradient is saved for the band, the row is skipped (no black overwrite) until a valid one exists.



4. Quality Levels & S-Curve

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The **Quality** combo (Display → General → DirectX Display Settings) selects the built-in post-processing preset applied in the float pipeline:

Level	Processing	Character
Classic	none	Pure mapping, neutral look.
Vivid	+30% saturation boost	Richer colors, signals pop out of the noise.
Sharp	Vivid + contrast boost	Crisper traces, slightly harsher noise texture.
Ultra	Maximum quality + Bayer 8×8 dither	Smoothest gradients; best on 16-bit. Costs a little GPU time.

The S-curve

Palette sharpness (**Pal Sharp** slider on the Waterfall tab) applies an S-shaped transfer curve to the normalized signal before mapping it to the palette. Increasing it compresses mid-tones and stretches the low/high ends:

- Low values (0–30) — soft, film-like image;
- Medium (40–60) — the author's default zone, good balance;
- High (70+) — «posterized» look, strong signals dominate; useful in contests.

Pal Contrast (default 100) scales the palette span after the S-curve. Both sliders work in real time and in both pipelines.

5. Advanced Image Settings

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5.1 Palette resolution

The palette LUT is generated with 256 steps by default. Higher resolutions are available for the Custom scheme workflow (smoother hand-tuned gradients). The built-in 256-step schemes are already optimal; do not raise the LUT size expecting more colors — it only affects Custom gradients.

5.2 Dithering (Bayer 8×8)

The **Dither** checkbox (DirectX group) adds an ordered Bayer 8×8 dither in the float pipeline. On 16-bit output it is nearly invisible and removes the last traces of quantization on smooth noise. Included automatically in the **Ultra** quality preset.

5.3 Gamma curve (0.50 – 2.00)

Gamma (DirectX group, author reference 0.70) reshapes the signal-to-palette transfer:

- **< 1.0** — lifts the low end: weak signals and the noise floor structure become visible (the author's 0.70 setting, good for 192 kHz wide spans);
- **= 1.0** — linear;
- **> 1.0** — compresses the low end: quiet background, only strong signals visible (contest/DX style).



Practical recipe: for weak-signal work — Gamma 0.6–0.8, Quality Vivid/Sharp, Auto Threshold on. For pileups — Gamma 1.2–1.5, Quality Classic, thresholds manual.

6. Noise Floor Pro & Auto Threshold

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Noise Floor Pro (Waterfall tab, top-left) measures the noise floor from the spectrum and drives the waterfall thresholds automatically:

Control	Meaning
NF Mode	Average — mean of the lower spectrum; Percentile — percentile-based floor, more robust in crowded bands.
NF Low % / High	The percentile window used for floor estimation.
Auto High +dB	Lets the <i>upper</i> threshold track the floor too (offset in dB above it).
AGC Smooth	Smoothing speed of the floor estimate (Slow recommended — no pumping on strong signals).
WF Detect	Sample / Peak / Average — how the per-bin value for the floor estimate is taken.

Auto Threshold — read this before enabling

Auto Threshold (Display → General → Waterfall group) makes **both** thresholds follow the measured noise floor *while keeping your manual palette shape*: the span between your Low and High levels becomes the fixed dynamic range, and the pair of thresholds slides up/down with the band noise. **Fine** (dB) shifts the whole pair.



Important — set the offset FIRST, enable SECOND.

1. With Auto Threshold **OFF**, set the waterfall offset on the RX 1 tab (**Low Level / High Level**) to approximately the reference values from Fig. 2: **Low $\approx$ -145 dBm, High $\approx$ -100 dBm** ($\approx$ 45 dB span). Adjust to taste on a quiet band so the noise floor sits in the blue zone.

2. Only then enable **Auto Threshold**.

If you tune the offset *while Auto Threshold is enabled*, the thresholds keep moving with the noise floor and the manual range/offset you enter is applied against a shifting reference — the result is an **incorrect**, drifting palette. Set first, then enable.

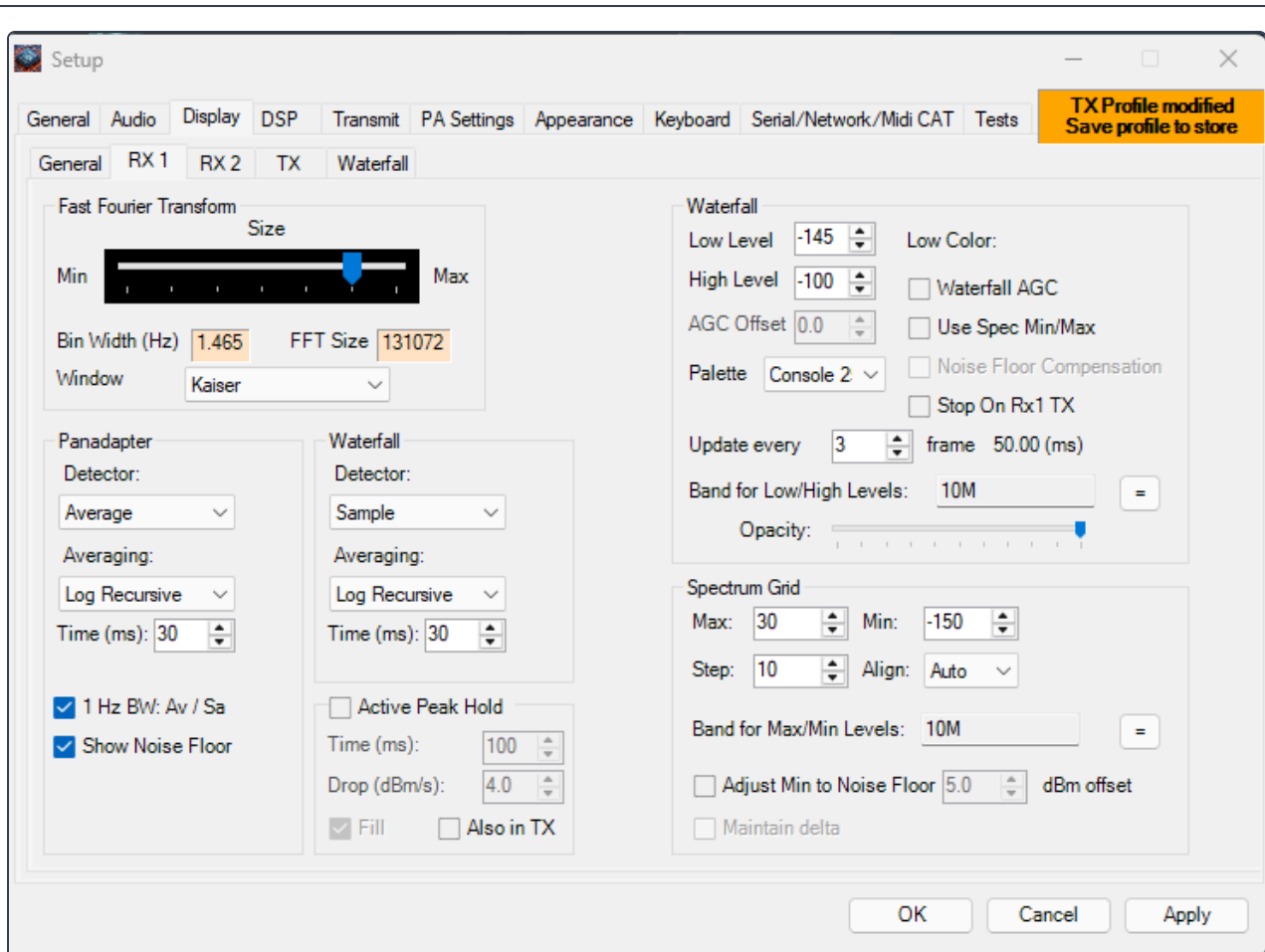


Fig. 2 — RX 1 tab: FFT engine (131072, Kaiser, bin width 1.465 Hz), detectors, and the waterfall offset — reference values Low Level -145, High Level -100 (≈ 45 dB span), Update every 3 frames (50 ms), Palette Console 2. Set approximately these offsets BEFORE enabling Auto Threshold.

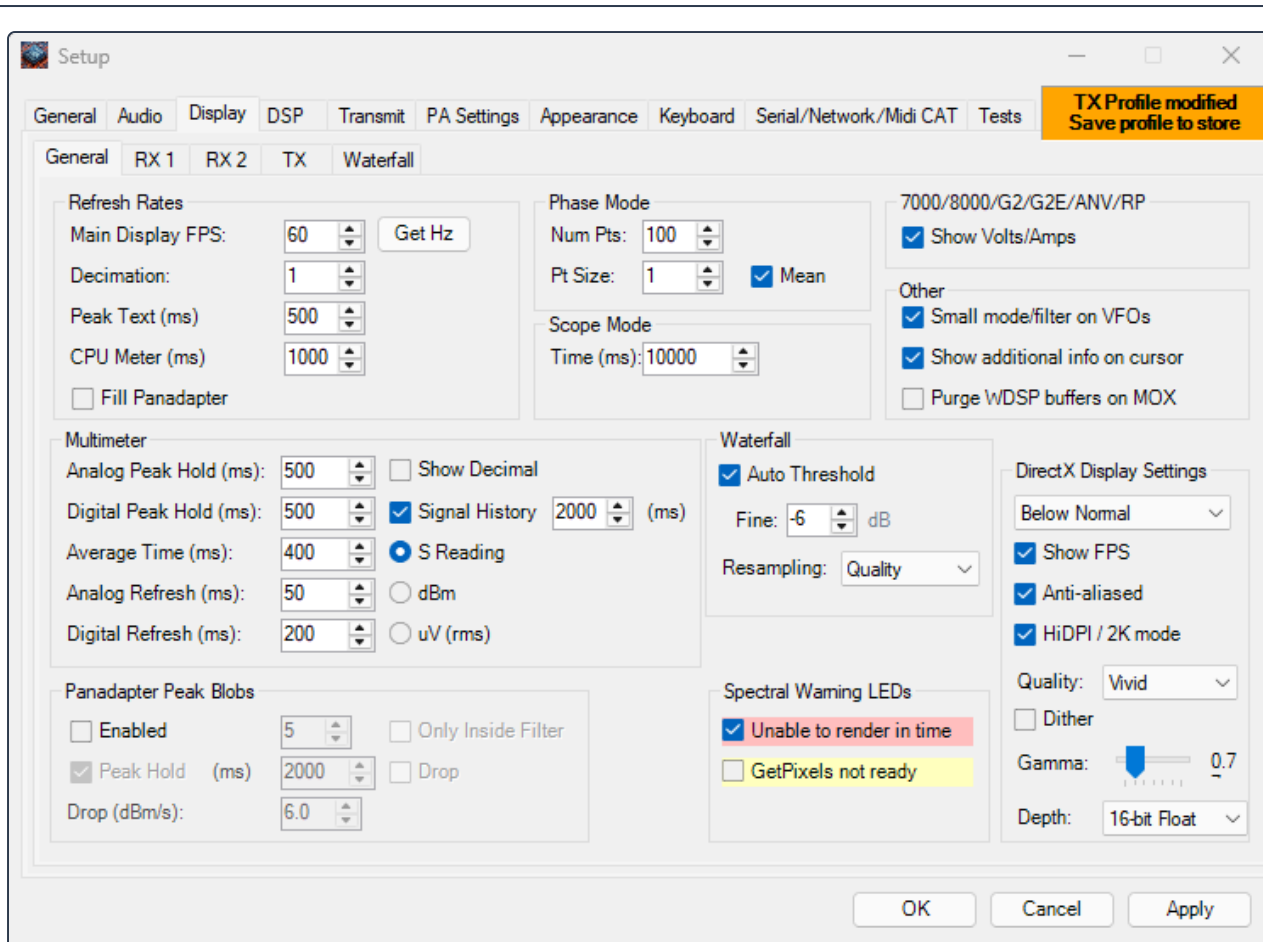


Fig. 3 — Display → General: the Waterfall group (Auto Threshold + Fine dB, Resampling) next to DirectX Display Settings (Quality Vivid, Gamma 0.70, HiDPI mode, Depth 16-bit Float), refresh rates and multimeter settings used for this guide.

7. Tone Mapping

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Tone Map (Waterfall tab → Enhancement) applies HDR compression in the float pipeline. It matters when the scene has extreme dynamic range — e.g. an S9+60 dB broadcast station next to the noise floor:

Mode	Effect	Use when
Off	No compression	Default; normal bands.
Reinhard	Classic HDR curve, compresses highlights smoothly	Very strong local stations clipping the palette while you still want floor detail.
ACES Filmic	Film-style curve, more natural highlight roll-off	Same situations as Reinhard, with a slightly «photographic» look.

Note: Tone Map needs the 16-bit float pipeline to show its full effect (in 8-bit the compression happens after quantization, so the benefit is small). **Zoom Adaptive** (next sections) can switch

Tone Map automatically.

8. Temporal Filtering

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Temporal (Waterfall tab → Enhancement) is a **motion-aware EMA** (exponential moving average) over consecutive waterfall rows:

- Noise, being uncorrelated row-to-row, is smoothed away;
- Real signals (carriers, bursts) move or persist and are **preserved** — the filter adapts its strength per bin based on detected motion (EMA alpha 0.15 / 0.30 / 0.45 with a motion threshold in the signal domain).
- Light (0.15) — gentle noise reduction, no visible lag;
- Medium (0.30) — visible smoothing, good for monitoring;
- Strong (0.45) — heavy smoothing for static bands; fast sweepers may leave a short trail.



Tip: Temporal pairs well with Tone Map Reinhard for broadcast-band listening, and with Quality Sharp for CW Skimmer-style views. For fast modes (FT8 hunts, SSB QSOs) keep it Off or Light.

9. Zoom Adaptive

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Zoom Adaptive (Waterfall tab, checkbox) watches the displayed span and adjusts the enhancement chain automatically:

- Wide spans (whole band) — favors overview: keeps manual enhancement off/light;
- Narrow spans (zoomed into a signal) — automatically engages Tone Map and Temporal so the zoomed view stays clean and detailed.

While Zoom Adaptive is on, the manual **Tone Map** and **Temporal** combos are disabled (they are driven by the adapter). The *Eff:* values are visible in the same area.

10. GPU FFT Waterfall (Stage 9) FLAGSHIP

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What it is

Stage 9 moves the waterfall spectrum computation from the CPU/WDSP path onto the graphics card: raw I/Q samples are tapped from ChannelMaster (lock-free ring on the DSP threads, engaged

only while the feature is on), uploaded to the GPU, transformed with a compute-shader FFT (1024–262144 points), converted to dBm and drawn by the GPU renderer.

Advantages over the CPU path

- **Resolution up to 262144 points** (0.73 Hz bins at 192 kHz) — far beyond the classic path;
- **Zero extra CPU load** — the render thread only receives finished rows; the deferred (one-call-lag) readback never stalls the UI;
- **Automatic level calibration**: the GPU rows are matched to the CPU/WDSP median (A/B calibration with EMA), so switching sources is seamless — no steps or bands;
- **Mathematically correct normalization** per magnitude mode and window (coherent gain / window power), verified across all sizes and windows to 0.02 dB.

Settings (Waterfall tab)

Control	Meaning / recommendation
FFT size	1024–262144. 65536 default; 131072 on strong GPUs. See §2.3.
Overlap % + Auto	Auto recommended (constant 30 rows/s, overlap derived). See §2.4.
Window	Hann, Hamming, Blackman, BlackmanHarris, Nuttall (default), Kaiser (+Beta 0–20). Blackman/Nuttall for best side-lobes.
Mag (mode)	Peak Amp (peak-hold amplitude), Avg Power (average power, quiet floor), Peak Power (default — peak power, good balance).
Upsample	Row interpolation to display width: Linear or Lanczos 2/3/4. Lanczos 3 = sharpest traces; Linear = fastest and the reference setting in Fig. 1.
Resampling	Quality (sinc-windowed, default) vs Fast (legacy). Living in Display → General → Waterfall group now.

How it behaves (good to know)

- The first row appears after one full FFT window accumulates («honest wait» — 0.3–1.4 s depending on size) — by design, no garbage rows are drawn.
- Rows are produced at a constant rate (Auto Overlap) and gated by the row timer (fps/updatePeriod). Both are aligned by construction — no stutter from rate conflicts.
- If the GPU readback is momentarily busy, the frame simply skips a row (like a timer miss) — the UI never blocks.
- In CPU mode (Level 0) the I/Q tap and the pipeline fully stand down — no background cost.

11. DPI Awareness (HiDPI / 2K monitors)

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On 2K/4K monitors Windows may scale the Thetis window and make the panadapter look blurry. Enable **HiDPI / 2K mode** (Display → General → DirectX group) to render at native pixels.



Requires a restart of Thetis — the flag is applied at process start (DPI awareness is per-process). The checkbox is stored in the registry, not in the options DB.

12. PureSignal (PS-A) Notes

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The PS-A engine (PureSignal adaptive pre-distortion) received a stability package in this build. It is not a waterfall feature, but it shares the display thread — and bad correction shows up *on* the waterfall as IMD combs, so it belongs in this guide:

- **Cold-start guard:** for ~6 s after power-on, calibration datasets are discarded (the TX/PA/feedback chain is settling — exactly the window that used to produce the «comb» on the noise). The first applied correction is always from a settled chain.
- **Correction hold:** transient failures (stalled collection, failed calc) no longer kill the correction — the last good curve keeps working while a fresh dataset is collected (capped, so a bad state cannot stick forever).
- **Speech/VOX collection:** amplitude buckets now survive VOX gaps — with speech the correction engages after 1–2 phrases and tracks PA heating continuously, instead of restarting on every pause.
- **Retune invalidation:** the curve is invalidated on band change or a ≥ 10 kHz jump (LF antennas are narrowband), and left alone for fine in-QSO tuning — no pumping.
- **Auto-attenuate hysteresis:** the engine no longer resets on a single out-of-range feedback reading (3 consecutive required).



Practical: with two-tone, PS-A calibrates instantly; with SSB speech, expect engagement after the first couple of phrases and continuous tracking afterwards. If the «CO» indicator blinks off frequently, check the feedback level (FB bar) before blaming the engine.

13. Troubleshooting

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Waterfall crawls (very slow scroll)

- **Manual overlap too low for the FFT size.** Fixed percent halves the row rate with every FFT doubling — turn on **Auto Overlap** (§2.4).

- **Update period too high** (RX 1 tab → «Update every N frames», Fig. 2). Lower it or raise FPS.
- **GPU overloaded** — drop FFT size (262144 → 131072) or quality (Ultra → Vivid).

Blank / frozen waterfall

- **First start of a large FFT** — the first row appears only after a full window (up to ~1.4 s at 262144). Wait; it is by design.
- **Render/Mode mismatch (old builds)** — in this build Render shows only valid tiers; if the picture is black after switching Mode, toggle Render once.
- **Custom scheme without a saved gradient** — rows are skipped intentionally; save a gradient for the band or pick a built-in scheme.

«Problem in DirectX Renderer!» dialog

- Known causes were fixed in this build (readback, color-depth rebuild). If you still see it, check `gpu_waterfall.log` (see below) for the last error lines and report them.

Washed-out / too bright background at 16-bit

- Was the DXGI sRGB cold-start issue — fixed. If seen on an older build, switch Depth 16→8→16 once or update to this build.

IMD «comb» on the noise after power-on (TX / PS-A)

- Fixed by the cold-start guard (§12). If it reappears, wait ~6 s after power-on before the first PS-A calibration, or toggle PS-A off/on once.

PS-A correction keeps dropping

- Should be rare now (correction hold). If frequent, check the feedback level (FB bar in the PS form) and `PSAutoAttenuate.log` (next to Thetis.exe) — it records every ATT step and engine reset.

Log files for bug reports

File	Location	Contents
<code>gpu_waterfall.log</code>	<code>%APPDATA%\OpenHPSDR\Thetis-x64\</code>	GPU pipeline init, FFT/pipeline errors, calibration stats (throttled, rotates at 2 MB)
<code>gpu_detection.log</code>	same	GPU capability detection details
<code>PSAutoAttenuate.log</code>	next to Thetis.exe	PS-A auto-attenuate steps and engine resets

Appendix A: Recommended Presets

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A.1 Weak PC / old GPU (or CPU-only)

Setting	Value
Mode	Level 0 (CPU)
Render	Medium
Depth	8-bit
FFT size	16384–65536
Overlap	Manual 85% or Auto
Quality	Classic / Vivid, no dither
Tone Map / Temporal	Off

A.2 Mid-range (GTX 1050 / RX 570 — the reference setup)

Setting	Value
Mode	Level 2 (Advanced) or Auto
Render	High
Depth	16-bit Float
FFT size	65536 (131072 for fine work)
Overlap	Auto
Window / Mag	Blackman or Nuttall / Peak Power
Quality / Gamma	Vivid · 0.70
Auto Threshold	ON — after setting offset (Low ≈ -145 , High ≈ -100) per §6

A.3 Strong GPU (RX 6600 / RTX 3060+)

Setting	Value
Mode	Level 2 (Advanced)
Render	High

Depth	16-bit Float
FFT size	131072–262144
Overlap	Auto (95% effective)
Quality	Sharp or Ultra + dither
Tone Map	Reinhard or ACES on high-dynamic-range bands
Temporal	Light (0.15) for monitoring

A.4 DXpedition / maximum quality

Setting	Value
Mode / Render / Depth	Level 2 · High · 16-bit Float
FFT size	131072
Overlap	Auto
Window / Mag	Nuttall / Peak Power
Upsample / Resampling	Lanczos 3 / Quality
Quality	Sharp, dither on
Gamma	0.8–1.0
Tone Map	Reinhard (pileups)
Auto Threshold	ON (offset set first)
Zoom Adaptive	ON if you zoom in/out a lot

Appendix B: Comparison with SDR Console

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Capability	SDR Console	Thetis (this build)
16-bit/float waterfall pipeline	✓	✓ (16-bit Float + HDR tone map)
GPU FFT spectrum	✓	✓ Stage 9, 1024–262144, auto-calibrated
Scroll speed independent of FFT size	✓	✓ Auto Overlap (constant row rate)
Palette schemes (Console/Thermal)	✓	✓ + DeepBlue + Custom LUT

Quality presets / dither	partial	✓ Classic/Vivid/Sharp/Ultra, Bayer 8×8
Noise floor tracking (Auto Threshold)	✓	✓ with manual palette shape + Fine dB
Tone mapping (HDR)	—	✓ Reinhard / ACES
Motion-aware temporal filter	—	✓ 3 levels, signal-preserving
Zoom-adaptive enhancement	—	✓
PureSignal adaptive pre-distortion	—	✓ hardened (cold guard, hold, VOX collection)

Waterfall Pro — User Guide · Thetis SDR v2.10.3.16 · Yurij-eu2av modification package, July 2026.
Sources: CHANGELOG_Yurij-eu2av_EN.md, in-code instrumentation logs. Figures: place additional screenshots (fig4_*.png ...) next to this HTML file to fill the placeholders.