Diagnosing and resolving DSM issues

Introduction

This page intends to be a central resource for information on diagnosing faults with DSM external sounder modules, aimed at DSM owners.

Why have we written this page?

DSM problems can be difficult to deal with. There are a number of contributing factors to this, including the below:

- *Verbal descriptions of the problem are usually hard to make a diagnosis from. It is difficult to make a clear verbal description of what you see on a sounder screen.*
- *Problems often only occur whilst at sea, and are often hard to replicate dockside when a technical dealer is on-board.*
- *Early DSM manufacturing and software issues, although now resolved, are still commonly blamed and tend to mask the real issue*
- *Many issues are intermittent*
- *There are many possible causes for relatively few possible symptoms, so it is easy to mistakenly assign the wrong cause to a particular problem.*

How to use this guide

Please ensure that you read the section First: know the problem! before you go any further. This explains the general classes of problem we see with DSMs: it is absolutely crucial to know what kind of fault is being experienced, before you can move forward with a diagnosis and solution.

Once you know what kind of problem you're faced with, that will significantly narrow down the range of diagnostics and remedial measures that are appropriate and allow you to resolve the problem more surely and more quickly.

Throughout this page, optional sections containing additional information are in *italics*, whilst sections which you should definitely read are non-italic. Please read all non-italic sections.

First: know the problem!

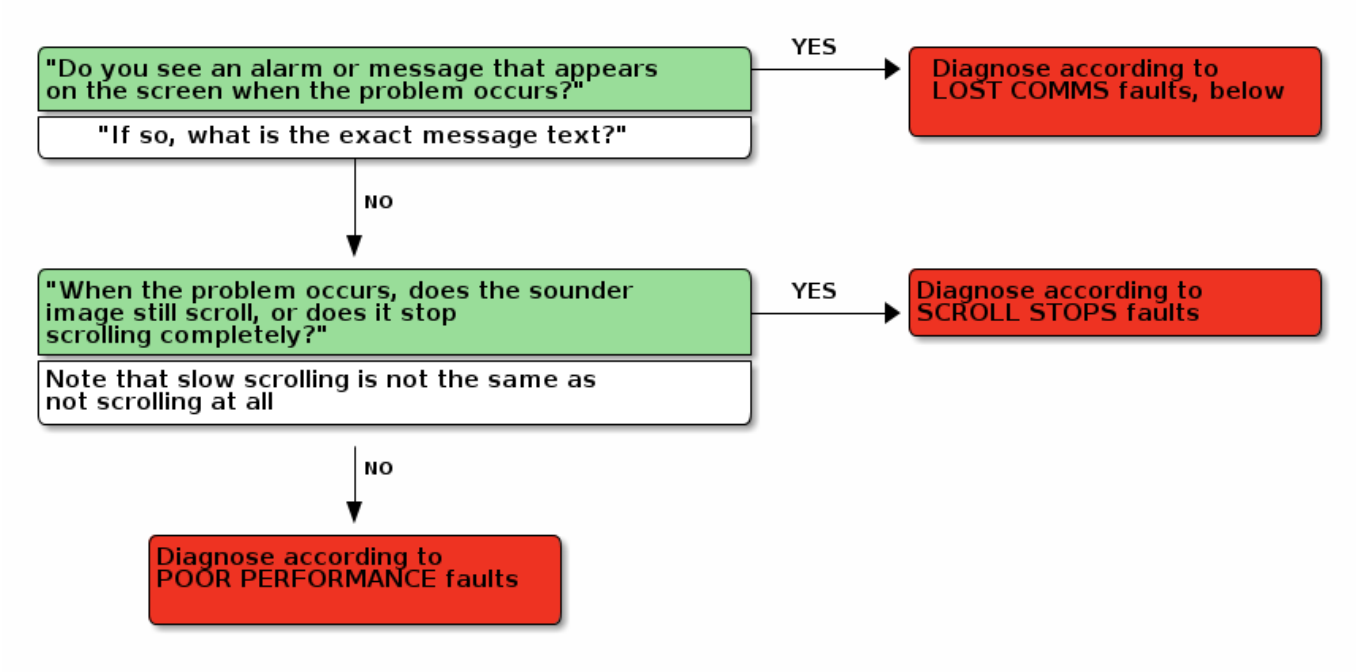
Issues with DSMs fall into three categories, and it is critical to accurately diagnosing the problem that we can narrow down which of these three categories the particular problem in question belongs to.

The three categories are:

1. DSM CONNECTION LOST / NO DATA SOURCE alarms
2. Sounder image stops scrolling (without an alarm)
3. Performance problems (still scrolling, no alarms but picture not as expected)

The first step to solving a sounder issue is getting a clear description as to the nature of the fault. Commonly-used phrases such as 'locks up', 'freezes' *or* 'just doesn't work' *are unfortunately of little practical use, because no two people mean quite the same things when they say them.*

The questions that we would recommend asking are:



DSM CONNECTION LOST

Causes	Applies to	Background and diagnostics	Remedies
Sounder power supply fluctuations	All	See Power Supplies below	See Power Supplies below

Causes	Applies to	Background and diagnostics	Remedies
DSM power cable contact intermittent	DSM30/300	An issue has been discovered with the DSM's 3-pin power cable in which the two wipers in the cable connector can splay over time, leading to a poor contact with the pin in the DSM's socket. The CP450C, although using an almost-identical 3-pin cable, has had an improved design of plug with 4 wipers per pin rather than 2 since first release.	This improved cable was introduced to the DSM30 and DSM300G from early October 2012 (DSM300G start serial 1020001.) The new power cable is available as a spare under part number A80025, and **should be installed as a matter of course on all DSM systems with Lost Comms problems.**
DSM I/O PCB contact onto Sonar PCB	DSM30/300	Early (Mexican-built) DSMs had build quality that was lower than in current models. This could exhibit as a poor contact between the input-output circuit board and the main Sonar board.	Return the DSM to Raymarine Service for investigation and repair or replacement
DSM I/O PCB solder quality	DSM30/300	As above, build quality was lower in early DSMs and this has long since been resolved in Production	Return the DSM to Raymarine Service for investigation and repair or replacement
Older DSM software	DSM30/300	All DSM software prior to v4.20 has known weaknesses in handling error-conditions and error-recovery in SeatalkHS communications These older versions will not handle gracefully any of the [very likely] minor interruptions in SeatalkHS that can happen in the marine environment	Update DSM software to v4.20 App, v5.18 Bootloader (as supplied with v4.11 App software)
Kinked, stretched or twisted SeatalkHS cables	All products using SeatalkHS cables	SeatalkHS cables are not robust, and are prone to faults if stretched, twisted or put through a tight bend radius during installation or through improper support. Look for white marks on the strain-evident grey cable sheath.	Replace any suspect cables; this is not covered by Raymarine warranty, since these are installation faults.
SeatalkHS cross-over couplers	Any system using a coupler	Cross-over couplers are known to occasionally suffer from intermittent connections.	Ensure that cables are securely supported with inward pressure towards the cross-over, to minimise the possibility of movement on the SeatalkHS connection in the coupler. If all other parts of the system have been eliminated as causes, replace the coupler.
SeatalkHS network switch connector play	Any system using a switch	As with couplers, it is known that we can suffer intermittent connections into the Switch	Secure all cables with positive inward pressure on the connection into the switch, so that the cable enters the switch parallel to the PCB (no lateral pressure) and that there is no scope for movement of the RJ45 connector

Causes	Applies to	Background and diagnostics	Remedies
E-series Classic internal PCB connections	Systems using E-series Classic MFDs	Earlier E-series Classic MFDs (E80, E120, not E120W) could be prone to poor contacts between two internal circuit boards. This was resolved in Production as soon as it was discovered, but if you have an affected display then this can cause intermittent SeatalkHS comms and DSM Connection Lost alarms.	If you have more than one E-series in the network, typically you'll see unexpected E-series reboots, 'Data Master not available' alarms, and in particular 'DSM Connection Lost' alarms ON ONE DISPLAY ONLY. If you see alarms on only a single display, return that display to Raymarine Service to be reworked.

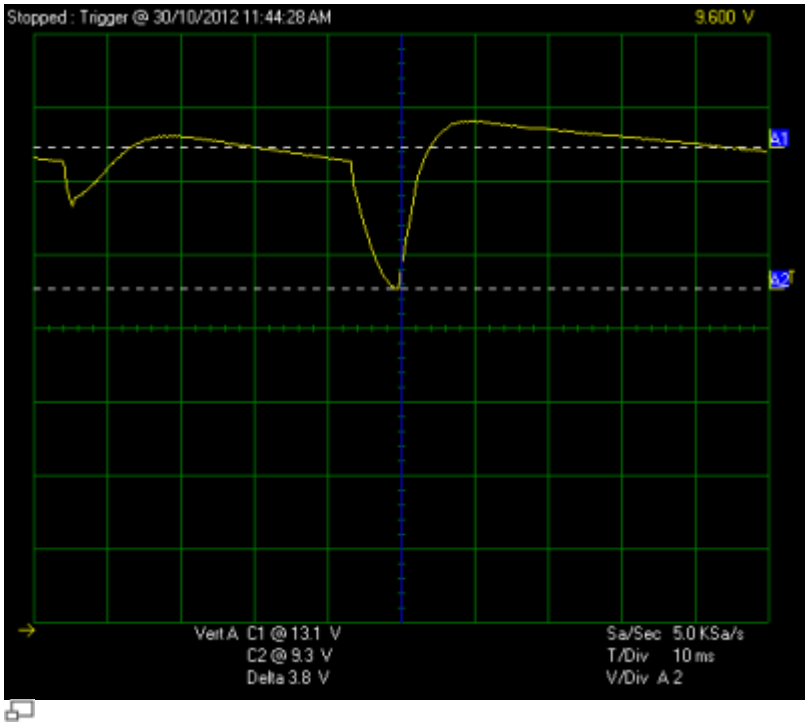
Power supplies

Raymarine sounders do not draw power continuously. Most of the time, a DSM300 will draw 1A - 1.5A at 12V, but when its internal reservoir capacitors become depleted it will draw considerably more than this for a brief period (milliseconds) in order to recharge. This charge cycle can draw 8A or more.

Why is this significant?

1. If the charge cycle coincides with other intermittent power supply loads (the head, fridge compressor, bow thruster, bilge pump etc.) then this can result in a momentary dip in system voltage which would not be easily predictable and would not show up in distribution-panel voltage and current readout. This dip could be enough to brown-out the DSM's CPU.
2. The charge cycle is very brief. Any voltage dip caused by the extra power supply load will likely not be detectable via a standard multimeter; only an oscilloscope is likely to be able to detect it (see 'scope image below.)
3. The charge cycle will occur at unpredictable intervals, and the amount of current drawn will also be unpredictable and variable
4. Measuring power supply unloaded, or when the DSM has a good bottom lock, will not show power conditions which accurately reflect what happens under adverse conditions, since charge cycles will be deeper and more frequent when the DSM is switching transmit power and pulse length after a loss of bottom lock

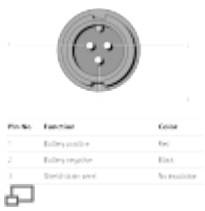
This means that it is much harder to rule out power supply as the cause of the issue than might first appear.



Two DSM300 charge cycles. Taken on a large, new, 24V powerboat, with engines running and batteries at 27V, that was using a DSM30 powered via a 25A 24-12V convertor from a reputable brand. Voltage scale: 2V/div, Time scale: 10ms/div.

When measured with a good-quality digital multimeter, the power supply appeared stable at 13.7V, and under normal circumstances one would dismiss power supply as the cause of the issue. Note the duration of the supply dips (<20ms) and depth (~9V!).

DSM 'scope probe connections



DSM power connector pinout

In order to verify a DSM's power supply, it is therefore necessary to test the DSM's power supply

whilst the system is under load. Ideally this should be done by an experienced Raymarine Service Dealer, using a portable oscilloscope connected to the internal power supply connections whilst the DSM is in use. **Do not** attempt to access the internals of the DSM yourself, since dangerous high voltages are present inside.

You can, however, make you own tests to try to verify whether power supply may be at fault: if the system tends to sound the 'DSM Connection Lost' alarm most frequently when under heavier load, power supply is likely to be the cause. In order to load the system power supply and make sure that the DSM has to recharge frequently:

- **Whilst at sea** motor at high speed, reverse or turn continuous tight circles (running over your own wake) in order to force the DSM to lose bottom-lock
- **If dockside**, set to manual 100% power and make frequent, large range changes. Note that dockside testing is less effective than a seatrial, so you should expect larger voltage drops on-water than you see dockside.

In summary - power supply should always be considered as a potential cause of the problem, regardless of battery voltage.

Stops scrolling

Symptoms

The sounder image stops scrolling with no user input and no error message (appears the same as if *Ping Enable* is set to Off.)

May be apparent from power up, intermittent or occur during use and exist until the next power-cycle.

Causes, diagnostics and remedies

Causes	Applies to	Background and diagnostics	Remedies
Intermittent communications	DSM30/300 with v4.20 software only	See communications. If this is the case, you should also see **4 amber flashes** on the DSM.	See communications

Causes	Applies to	Background and diagnostics	Remedies
Transducer Sense-line interrupted	All sounders	All Raymarine sounders use a sense resistor and/or Transducer ID (XID) IC in order to confirm that a transducer is present before pinging. This is for safety reasons, to ensure that we cannot put >1000Vp-p on exposed terminals. It also avoids sounder damage from pinging into open-circuit. To test, measure the resistance on the transducer's sense pair (e.g. pins 4-5 on the DSM30/300 connector, pins 5-6 on the A-series connector, and look at the DSM's diagnostic LED. You should see 0hms for 600W transducers and first-generation P48 transducers, ~2k7ohms for 1kW transducers, ~9kOhms for newer-style (post-Atom MFDs) P48 transducers and ~18kOhms for a single-band CP450C transducer. You will likely see 1 amber flash on the DSM if this is cause of the fault. If the transducer resistance checks ok then you can assume the fault is likely in the sounder	Check the build standard of the DSM.
XID incorrect	DSM400	Some DSM400 R-series transducers (R209/299/309/399) transducers reached the field with an incompatible XID programmed in on. If one of these is connected to a DSM400, it will act as if there is no transducer present: show 'Virtual 600W' in the *Configure Preset Frequencies* menu, and not ping/scroll.	Short-term workaround: disconnect the orange Transducer ID wire, use the rotary switches to manually set frequency and power. However, this will reduce performance so the permanent solution should be to replace the transducer.

Performance problems

Sounder performance is a function of the relationship between the signal and noise levels. High noise will cripple a sounder's performance just as surely as a weak signal, and there are many causes for both which are often a result of a DSM or transducer fault.

Some of the symptoms and fault descriptions that are used include:

- Depth digits reading -.– and flashing
- Surface clutter but no bottom return
- 'Bottom search' mode cycling through 3 different pulse-widths and ping-rates (Inverted 'city skyline' profile stretching down from top edge of sounder view)
- Very cluttered image
- Performance worse at speed
- Performance worse when turning boat in one direction

- Intermittent gaps in bottom return
- Intermittent vertical stripes overlaying expected sounder image
- Herringbone patterns on sounder image
- etc., etc. (everyone describes these problems differently)

Diagnosing (and solving) a sounder performance issue involves removing as much of the sounder's automatic control as possible and assessing in as objective (comparable, numerical) a way as possible, and comparing to values from equivalent known-good systems.

In Auto mode, you cannot diagnose either Noise or Aeration issues. This is because in Auto gain mode the sounder will work hard to hide clutter from the user, and in doing so will hide the true cause of the poor performance. More explicitly, in Auto mode a noise/interference issue will be almost indistinguishable from an aeration/turbulence issue.

As already mentioned, aside from a product fault, there are three principal external causes for poor DSM performance:

- Aeration (anything that causes air across the face of the transducer)
- Interference (any noise signal)
- Water conditions (anything in the water column apart from the fish and bottom structure you're interested in)

These are described below.

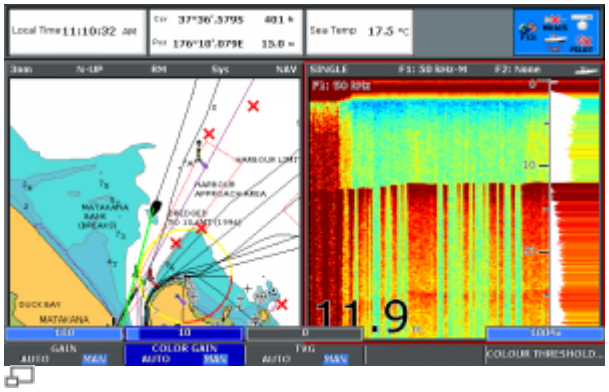
Aeration

Causes including:

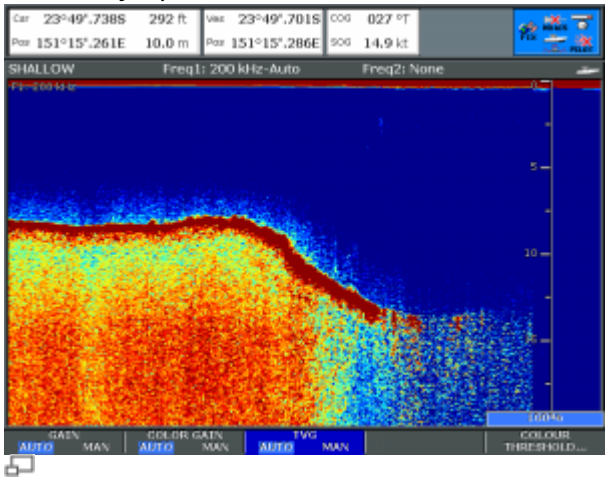
- Cavitation off any hull feature or fitting (chines, engine intakes, steps, etc., etc.)
- Poor transducer installation (e.g. no fairing block, transducer not straight and flush in fairing block, yellow blank plug missing from fairing anti-rotation bolt hole)
- prop wash (typically transom transducers)
- planing-hull boundary layer (all planing hulls create a boundary layer of aerated water that thickens as weight or speed increases)
- other-vessel or own-vessel wakes (esp. when trolling in busy fishing grounds)
- wave action
- leaking in-hull transducer wet-box

can all cause air to intervene between the bottom and the transducer face.

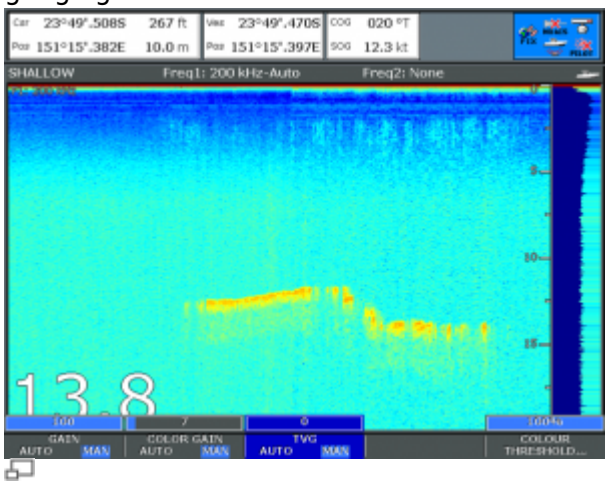
Air attenuates the two-way sound propogation, so causes an interruption in the sounder image.



Classic symptoms of aeration



A DSM300 in Auto on a Luhrs 31 IPS, as speed increases. Note how unhelpful Auto is in gauging the cause of the fault.



The same Luhrs 31 at higher speeds, in Manual Gain. Note the very weak bottom return, and apparently low noise level though it is hard to tell since the customer took this screenshot on CG=8 so is not directly comparable with other screenshots. This is very characteristic of aeration problems

Symptoms

In Auto: Vertical stripes of missing sounder data (plain background colour)

In Manual: Vertical stripes where the background noise level (see below) remains the same but where any real returns in the water column (e.g. bottom) become severely attentuated or disappear completely.

In both cases you'd tend to see the stripes getting wider and closer together as boatspeed increases or sea conditions worsen until they are dominant and may fill the complete width of the screen.

Solution

Depends on the cause. Generally involves:

- moving the transducer
- switching to a faired through-hull version instead of low-profile, in-hull or transom

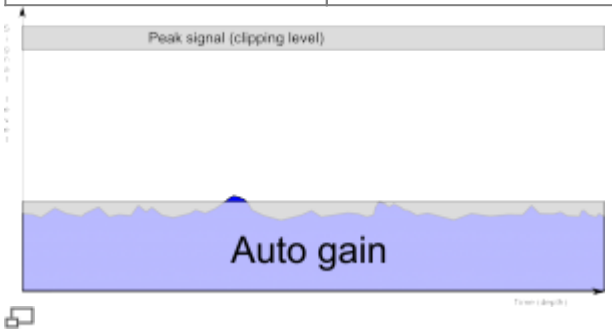
However on some boats there is no solution, because of limitations of:

- trailerability
- suitable transducer installation points due to internal hull fittings and layout
- hull design
- customer speed expectations
- noise sources within the hull
- hull external fittings

Noise and interference

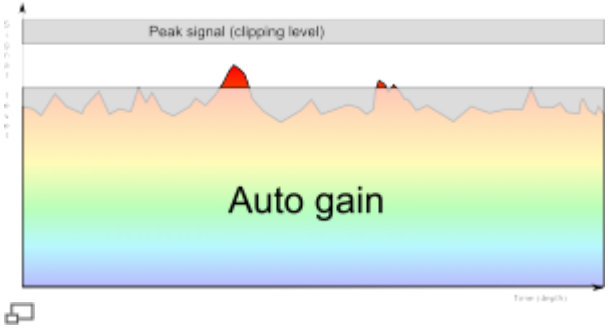
This can be both more difficult to both identify and solve than aeration. Interference can be both acoustic (the transducer is a microphone, remember) or electrical, and can both come from the boat or from outside. Generally electrical noise will come from own-vessel, of course.

Example causes of different noise sources		
	Acoustic	**Electrical**
Intermittent/periodic	Pumps, Steering, Autopilot, other sounders	Pumps, refrigerators, Autopilots, power steering
Speed-related	Hull resonance, water turbulence, engine, props, prop glands	Engine electrics
Constant	Ocean	Boat systems (e.g. invertors)

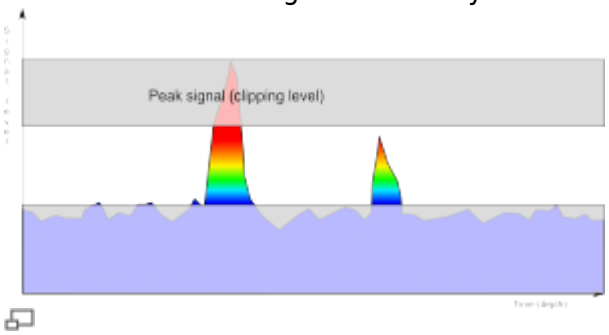


A cartoon view of Auto Gain handling a low signal level with low background noise. Note that the 'real' signal is only just above the

noise, and that this is likely to only intermittently display on-screen.



A cartoon view of Auto Gain handling a high signal level with high background noise. Note that to hide the noise, the DSM drops gain such that the 'real' signal will hardly show.



By comparison, this image shows approximately how the sounder will handle an 'ideal' situation, with strong signals and comparatively low noise levels.

As you can see from the diagrammatic views, in Auto Gain the sounder will adjust Gain, Colour Gain and TVG in order to try to hide any clutter and if the desired signals are only a little stronger, will hide these too.

So, it follows that for good sounder performance, a low background noise level is essential.

Measuring background noise

1. Range out to maximum depth
2. Use:

```
Gain    = 100
CG  = 10
```

1. Using **A-scope Mode 2**, increase CG until the strongest peaks start to clip near the bottom of the A-scope, then note the CG value required

- Do NOT test in the marina – this is an inherently noisy location and you will see a far higher background noise level than expected, because you will be seeing echoes of your own ping from the marina walls and other boats, other electrical, mechanical and hydraulic gear in all the other boats in the marina, and any other sounders that have been left powered up on other boats.
- It is important to range out to maximum depth, and measure noise at the bottom of the A-scope.

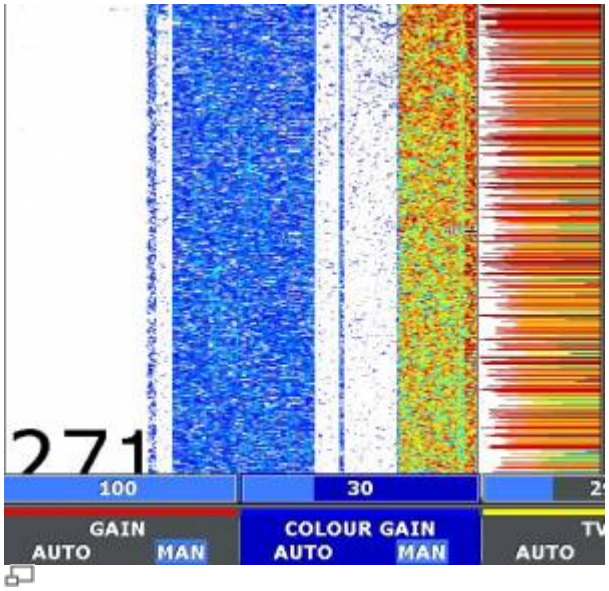
This is to ensure that what you're measuring is the background noise level (our own ping will have long since died away during the two-way travel-time of the deepest parts of the screen.)

The required CG level is an indication of the noise level: higher is better, i.e. lower background noise. Try making the same measurement at various speeds, with all boat systems powered down, etc. to get an idea of what contribution to the noise level comes from boat systems and what is the ocean. The ocean is a noisy place, and it is not possible to get a completely noise-free system in addition, the sounder has its own inherent low level of internal noise.

Good values:

200kHz: ~30

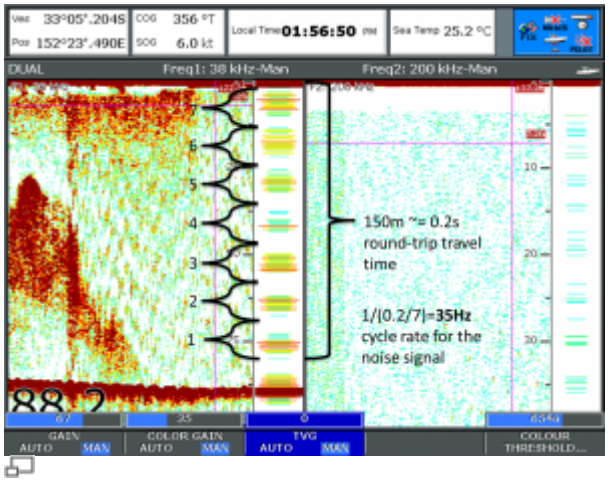
50kHz: ~40



An example of measuring the background noise level. This example shows a good range of noise signal levels (colours), which generally indicates 'natural' noise

Good information can be gained by looking at the profile of the noise in the A-scope, concentrating on repeating, pulsing or herringbone patterns, and looking at the distibution of signal levels in the A-scope profile.

- Herringbone patterns and pulsed/repetitive noise signals are NOT natural, and are driven noise signals from boat systems
- A wide spread of signal levels (colours) in the A-scope profile (as in the attached image) generally indicates natural noise: very similar signal levels indicate driven noise



Driven noise at ~38kHz (not present at 200kHz). Note the pulsing in the A-scope view.

Herringbone noise

If you have a noise signal which produces a herringbone pattern in the sounder history, and clear pulsing in the A-scope (look at a long range to see this, for slow ping-rates), then you should be able to get an idea of where this is coming from by:

- looking at which frequencies are affected (in the example attached, this is primarily 38kHz)
- work out the pulse-rate of the signal as follows:

```
r = 1/((d*2/1500)/c)
where:
d = depth in metres (which is then doubled for two-way travel time and
divided by the approx. speed of sound in salt water)
c = noise pulse repetitions within this depth
r = noise PRF in Hz
```

The attached screenshot example has works out as:

```
1/((150*2/1500)/7) = 35Hz
```

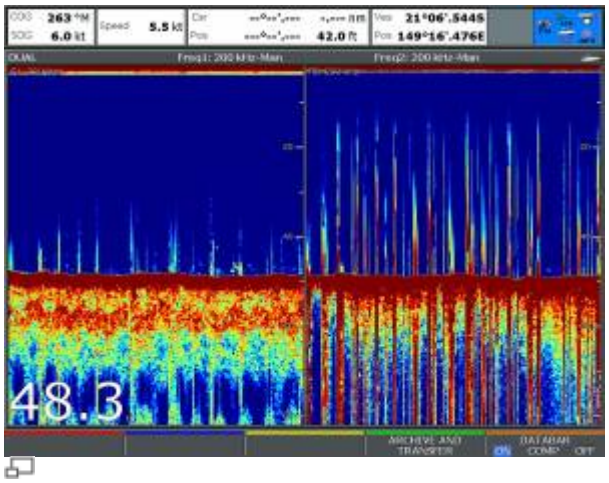
Given that the screenshot was taken at 6 knots, the source here could conceivably be engine noise (38Hz = 2100rpm.)

Autopilot pump noise

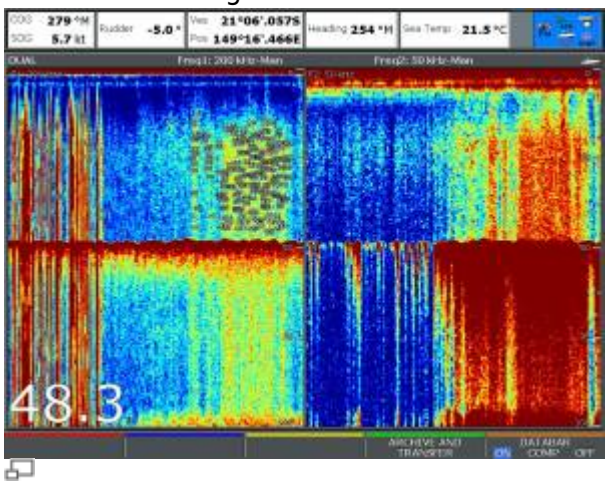
A couple of examples are attached, one on Auto and one on Manual Gain.

The most likely path for interference to get from pilot into sounder is via pilot drive current modulating the sounder's power supply. However, in this case the path was via radiated RF directly onto the transducer cable. The pilot drive unit was a Seastar DC Power Steering system auxilliary pilot pump, which according to Seastar was faulty and was clearly a major EMC fail. Seastar replaced the pump motor free of charge. Grounding the DSM and pump, fitting ferrites and re-routing transducer

cable did NOT solve the problem. This boat had a DSM400 running an R399 and a B164 and a second B164 connected to a redundant DSM300. The two B164s were installed close to the Seastar steering and were both suffering badly from the interference and unusable whilst the pilot was in control.

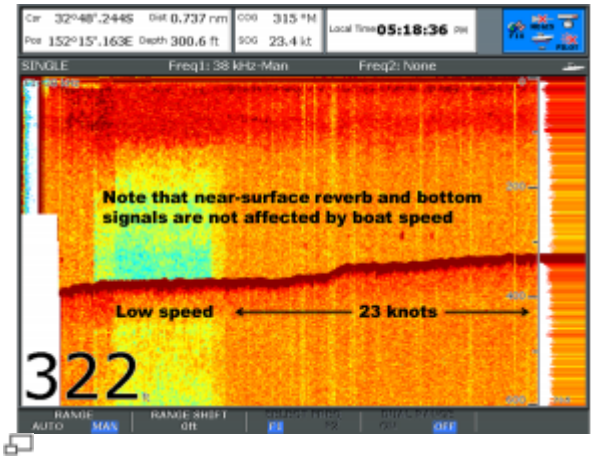


Autopilot-sourced electrical inteference on a DSM400 in Auto gain

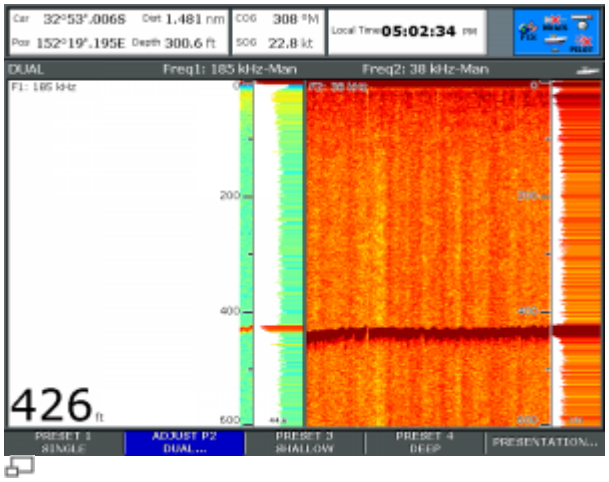


Autopilot-sourced electrical inteference on a DSM400 in Manual gain (Auto TVG)

Speed-related noise



Speed-related noise on a DSM400. Note the large variation in background noise level, with effect on the signal levels, as speed increases. This is not aeration.



Frequency-specific speed-related noise. 38kHz is badly affected, 200kHz is not.

Water conditions

Thermoclines (temperature horizons in the water column), haloclines (salinity horizons) and high densities of either bait or zooplankton will cause a degradation of sounder performance through:

- scattering/reflection/absorbtion of the sound energy which limits returns from deeper down
- a potentially strong return in the water column which can cause Auto or the user to reduce gain to remove it, also removing other returns
- 'bait school lockup' issue

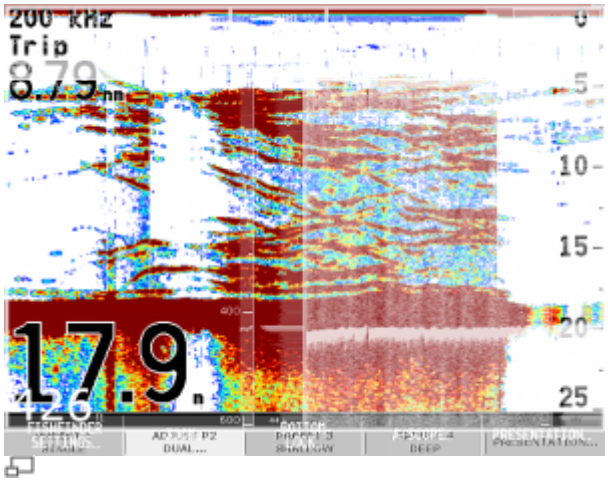
'Bait school lockup' behaviour

If you're running in Auto Gain and Auto Range, you will tend to see issues when you run over a dense bait school or similar midway in the water column, whereby:

- the sounder will change range to show the bait school at the bottom of the screen
- gain will adjust
- the bottom number will read depth to the bait school, not water depth
- when the bait school thins, the end of the bait school will be chopped off and the above symptoms will reverse

This happens because the sounder, for good safety reasons, will always treat the shallowest strong return as the bottom. This will always affect the digital depth number, and cannot be overridden, but you can control and prevent the other symptoms above:

1. Switch to Manual Range: this will force the sounder to stop changing pulsewidth and pulse-repetition frequency (PRF) when it runs over a dense bait school
2. Switch to Manual Gain and Colour Gain (you probably don't need to touch TVG now): this will prevent the sounder from changing gain controls depending on what it thinks is the bottom.

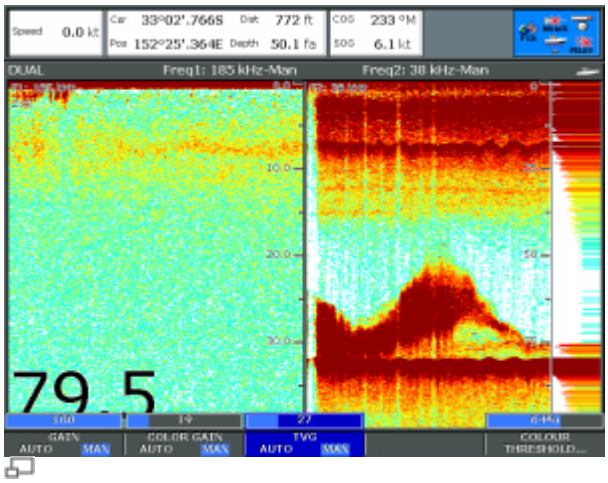


An example of bait-school lockup on A65 in all-Auto settings.

East Australian 'Reverb' issue

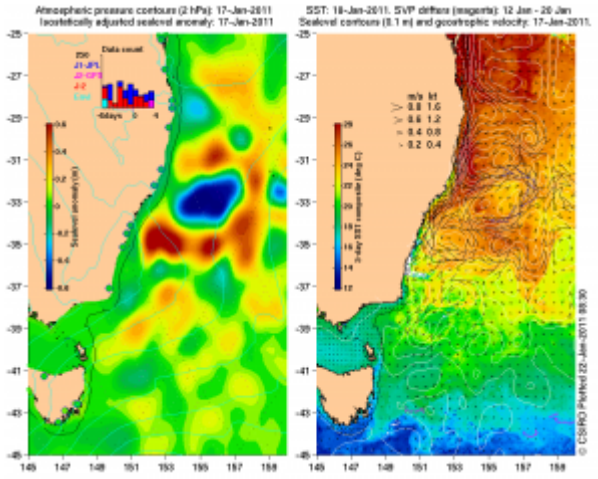
Although this has to date only been observed and reported on the Australian East Coast on DSM400s, it may occur elsewhere and is has the potential to affect some other sounder models.

As warm, nutrient-poor water from the Coral Sea flows south in the East Australian Current (of *Finding Nemo* fame), it encounters off the New South Wales coast cool, nutrient-rich water flowing off the land, mixing in kilometre-wide eddy systems (http://www.marine.csiro.au/remotesensing/oceancurrents/SE/latest.html). This mixing of warm, nutrient poor water with the nutrients coming off the land leads to large blooms of phytoplankton first, and feeding from them zooplankton. These zooplankton can be large (salps can be centrimetres long) and can occur in swarms dense enough that collectively they present an acoustic return as strong as a bait school, which is typically concentrated in the upper water layers where the sunlight penetrates.



A DSM400 off Port Stephens, NSW, showing a large bait school, almost certain marlin around/in the bait, and a very strong reverb signal in the upper water layers.

Google Earth overlay of current (ha ha) EAC data



EAC current mixing off the NSW coast, 22nd January 2011

Diagnosis

Two end-user oriented documents aimed at helping to gather screenshots in a consistent manner. These are not intended to allow the owner to diagnose their own sounder issue *per se*, but at least to allow people to gather useful screenshots or photos to allow experienced Raymarine technical support staff to be able to do so. assessing_sounder_performance-0113tg.pdf

sounder_performance_notes_0311tg.pdf

Other faults not covered above

8 amber flashes on the DSM LED

This does **not** represent an error, simply a momentary FPGA buffer under-run, is quite normal on first power-up in healthy systems, and can be safely disregarded.