Online Electronics

Achieving the Peak of EM Detection

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Agenda

- Challenge
- Background
- Project Requirements
- Test Set up
- Testing & Results
- Discussion
- Recommendations

The Challenge – EM Tx Performance

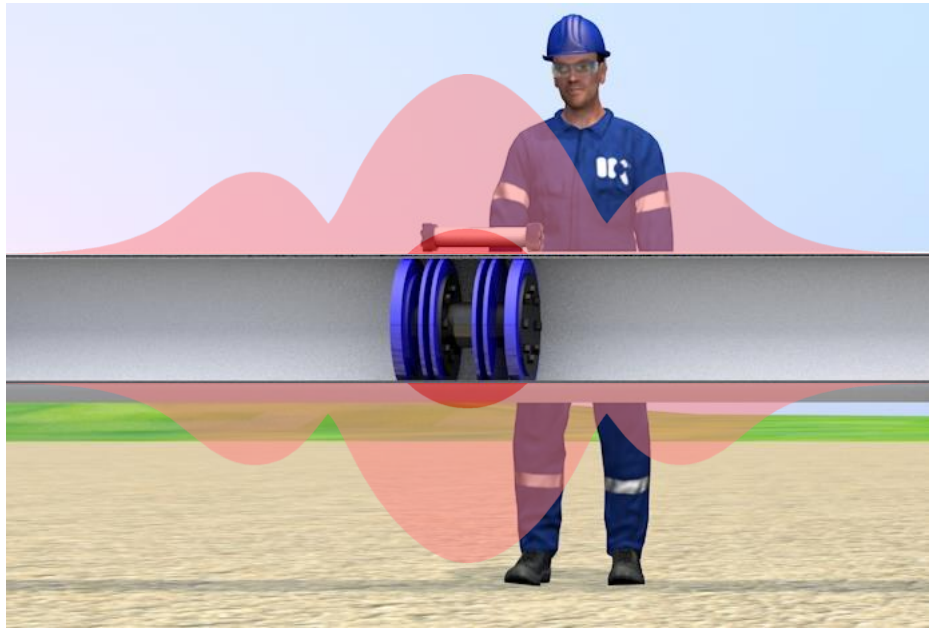
Performance figures are NOT comparable

- Signal voltage @ 1m with ref antenna
- Distance in Air EM can be detected
- EM Power
- ETC

Client comparing Apples with Oranges?????

Question?

"Is there any logic in specifying an EM transmitter's performance by distance through air?"



Background - EM Transmitter

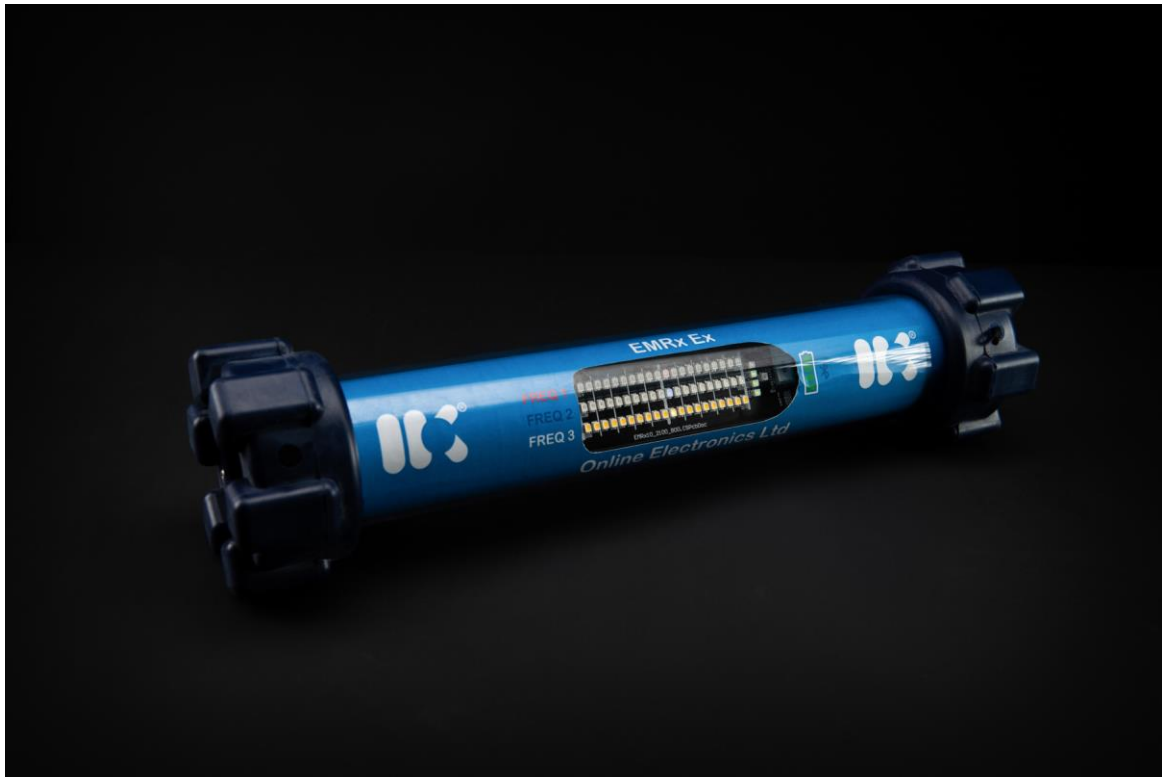
- Frequencies 10Hz to 30Hz
- Suitable for Pipe Sizes 6” to 48” up to ~40mm WT
- Self-Regulation to ensure the signal strength is constant over the battery lifetime
- Client Configurable using Bluetooth®
- Endcap activation options
- Enhanced reliability
- Tested for 20G shock and extended periods of vibration
- ATEX certification for IIC gas group inc Hydrogen

EMTx range

Background - EMRx Receiver

- Multifrequency EM receiver.
- 3 configurable LED bargraphs
  - Displays 3 received signals
  - Frequencies between 10Hz and 30Hz
- Modern Digital Signal Processing (DSP)
  - Enhanced sensitivity and noise immunity
- Bluetooth link
  - RS485 for subsea version
  - Windows & Android apps
  - Advanced functionality
- Magnetic Sensor

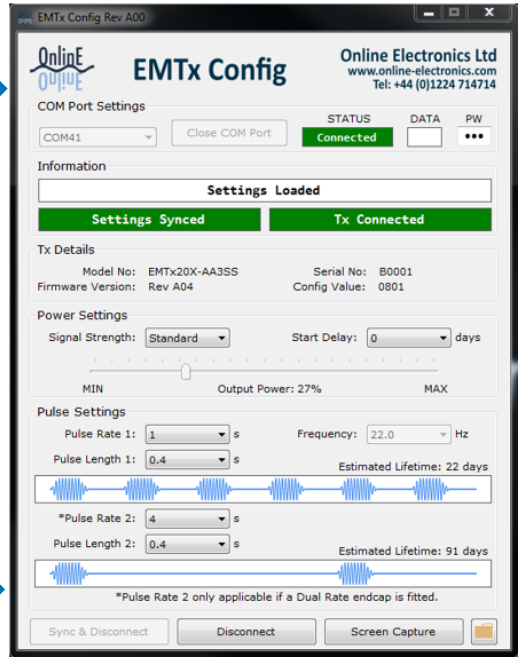
- ATEX IECEx certified (Launched this week)



EMRx Ex receiver

Electromagnetic (EM) Pig Tracking System

17Hz
5 second Pulse Rate
EM Transmitter



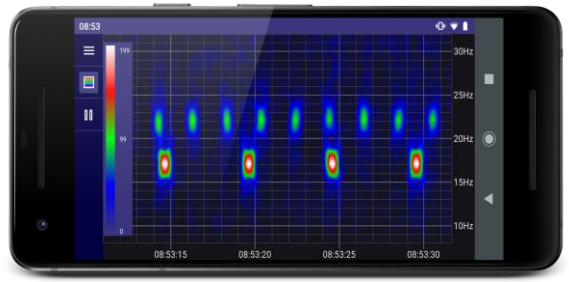
Bluetooth™

22Hz
2 second Pulse Rate
EM Transmitter

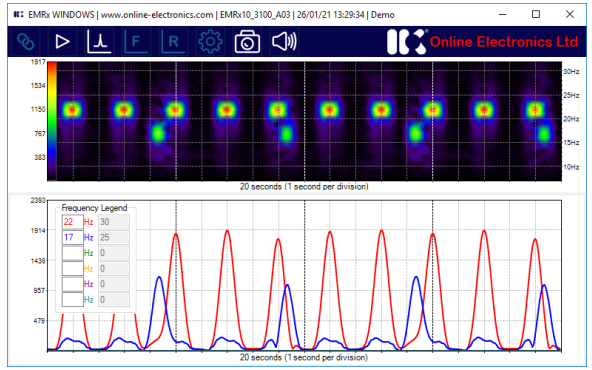
EM Signal

Standalone
EM Receiver

Bluetooth™



ANDROID

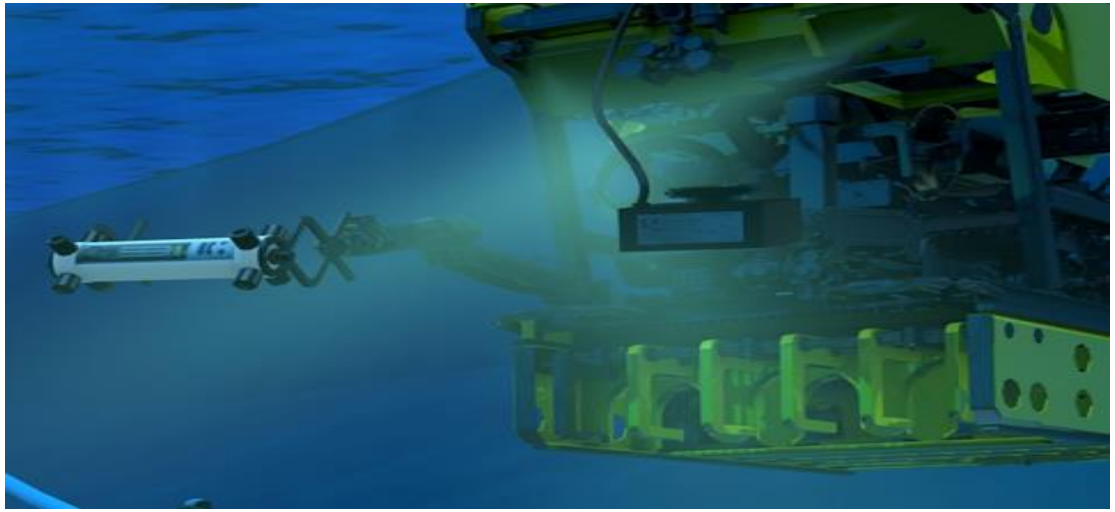


EM Receiver applications
(optional)

Project Requirements

- Subsea Pre-commissioning
- 16” and 20” pipelines
- ROV Operations
- EMRx Subsea
- Confirm Detection Envelope

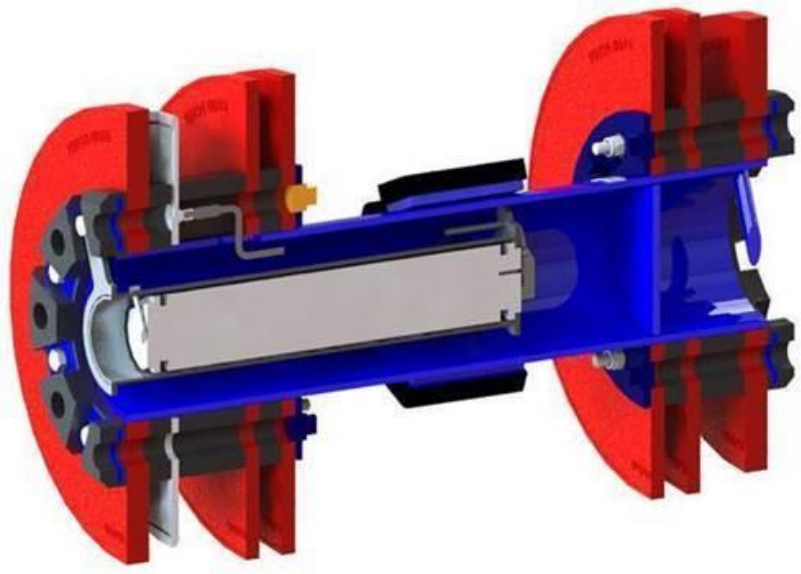
Pipe Size	Wall Thickness
16” (406.4mm)	20.62mm
16” (406.4mm)	30.17mm
20” (508mm)	23.83mm
20” (508mm)	36.44mm



EMRx Subsea

Test Set Up

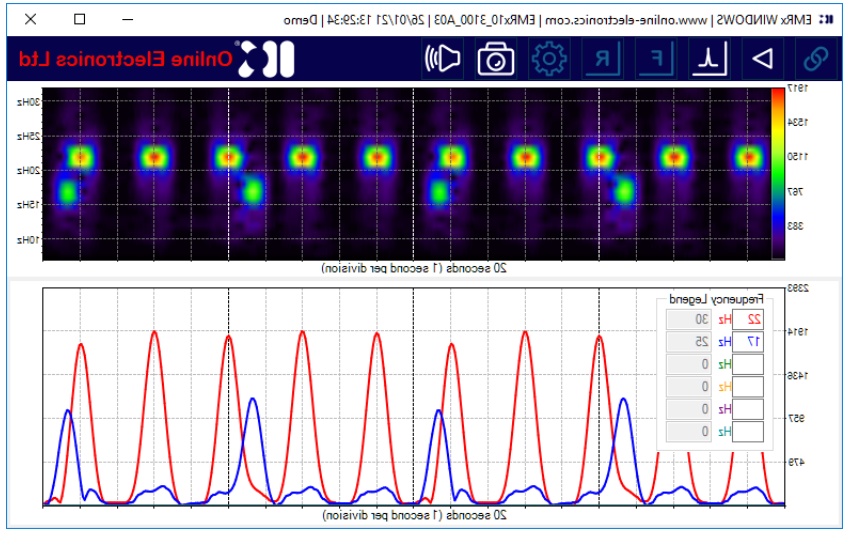
- Pipe: 608mm OD, 35mm WT, 10.5m long
- Transmitter: 3015X
- Receiver: EMRx 10
- Mounted on Wheeled platform “Skateboard”
- Pig configuration



3D model of test pig

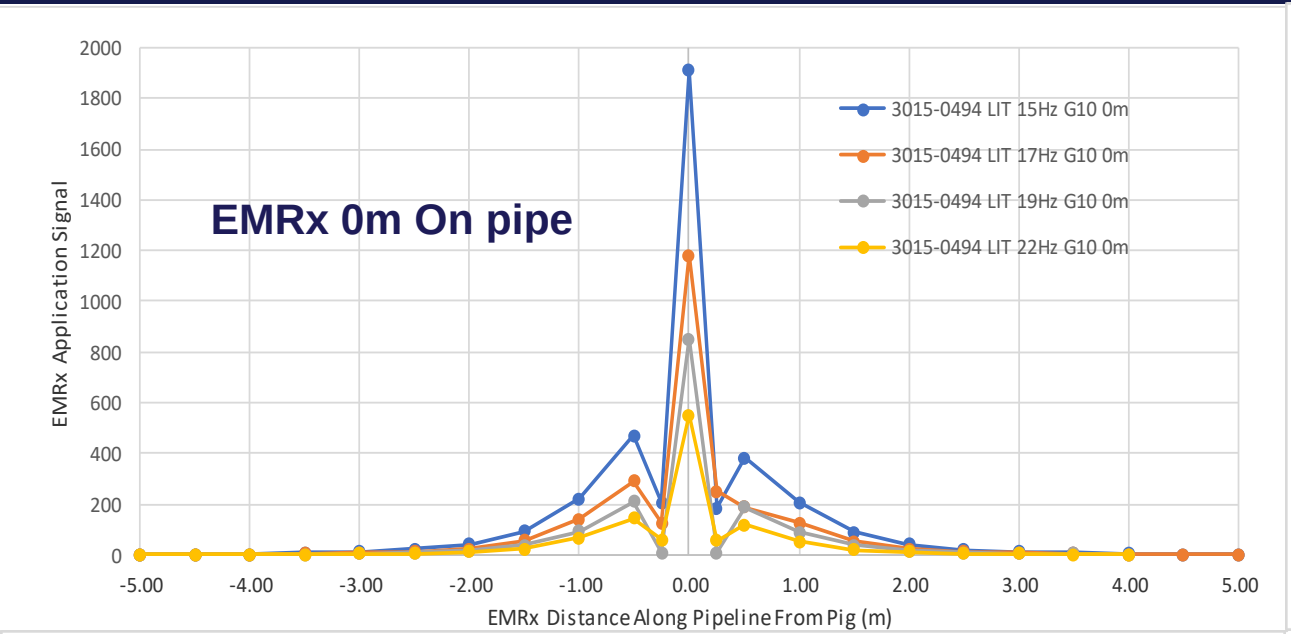
Testing & Results

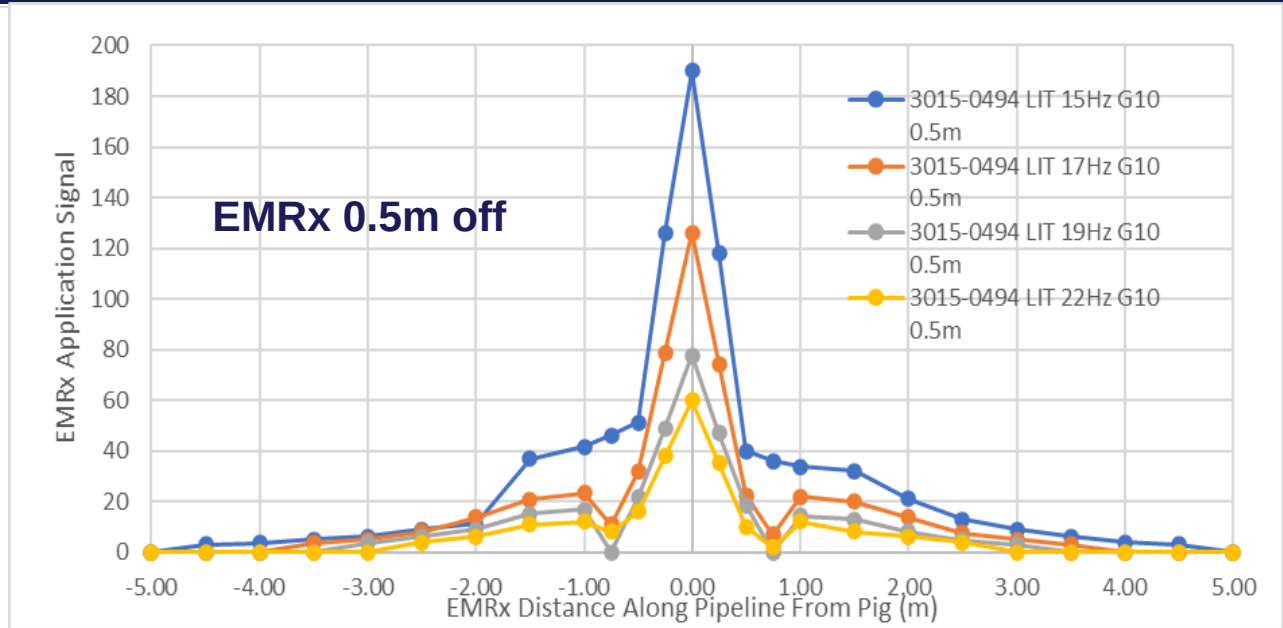
- EM Tx set to 4 different frequencies: 15Hz, 17Hz, 19Hz, 22Hz.
- ROV Cradle various configurations
- Magnets 4 positions
- Break Wire Gauge Plate (BWGP) various configurations

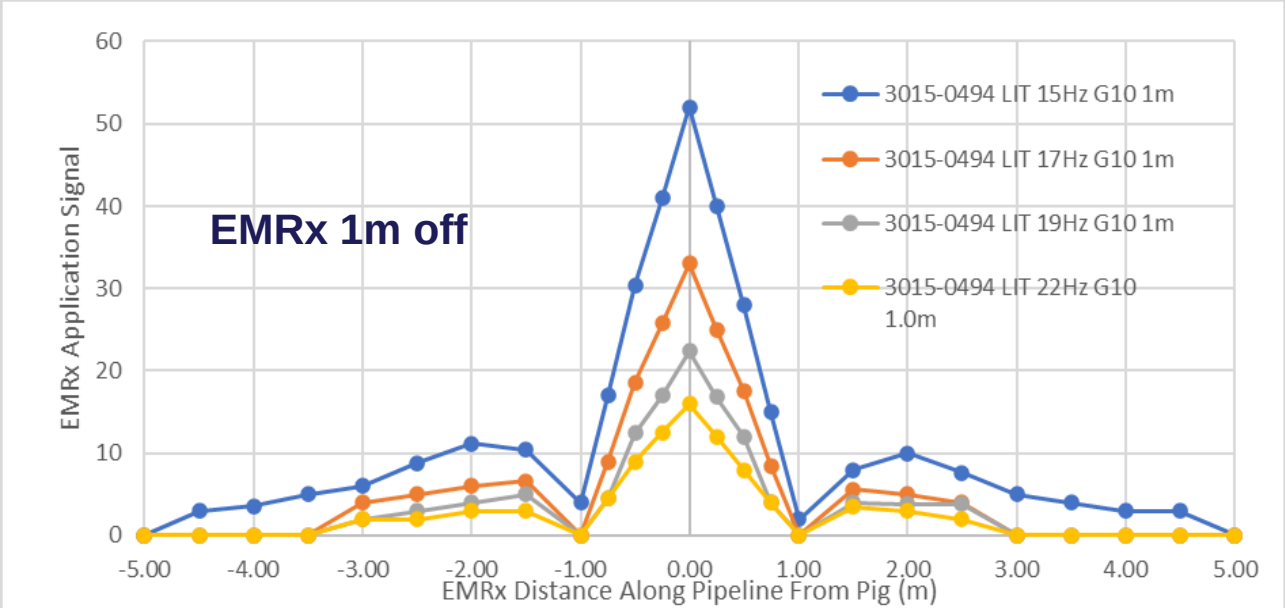


EMRx positioned 1m from pipe centre

4 different frequencies: 15Hz, 17Hz, 19Hz, 22Hz

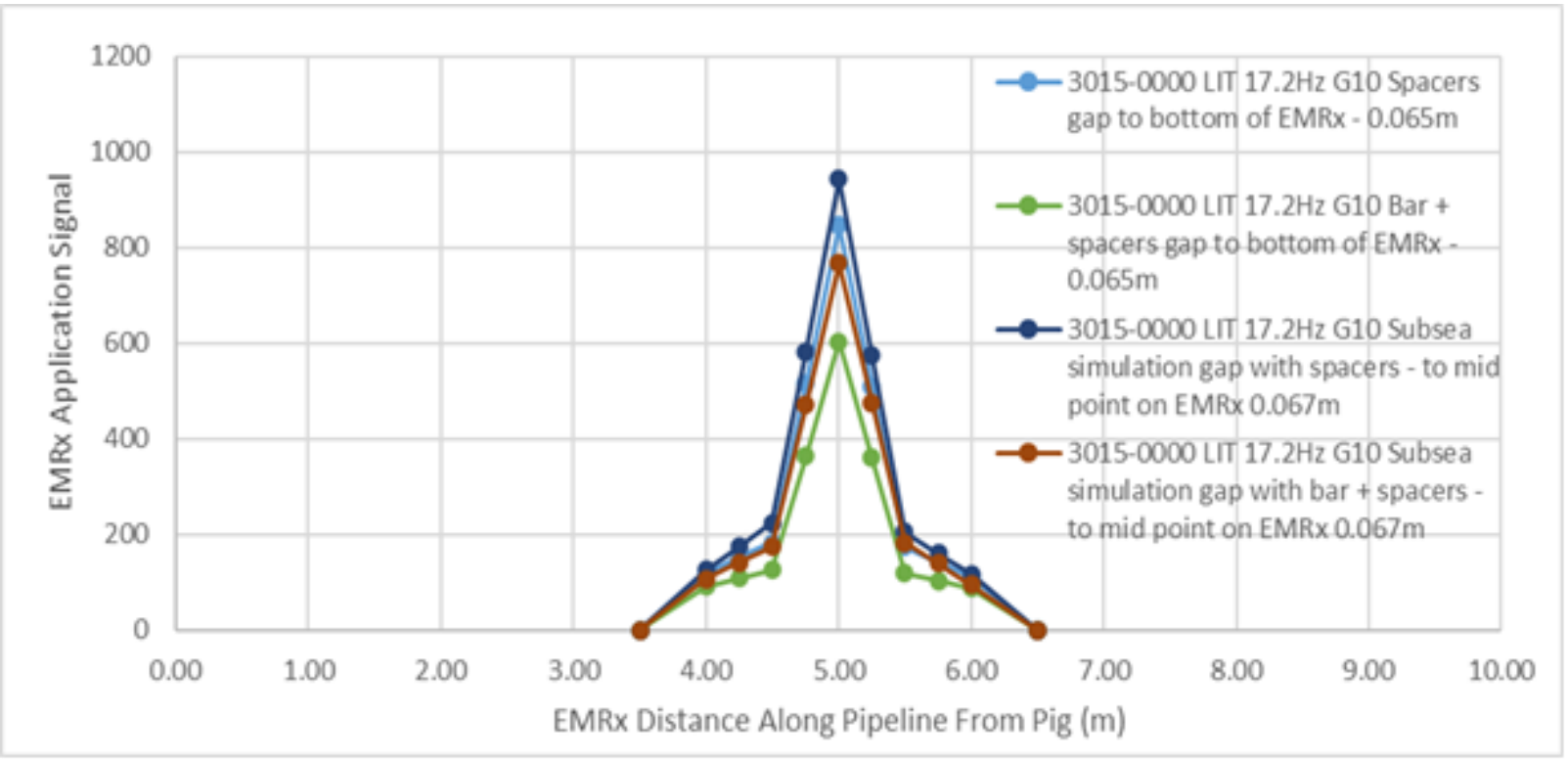






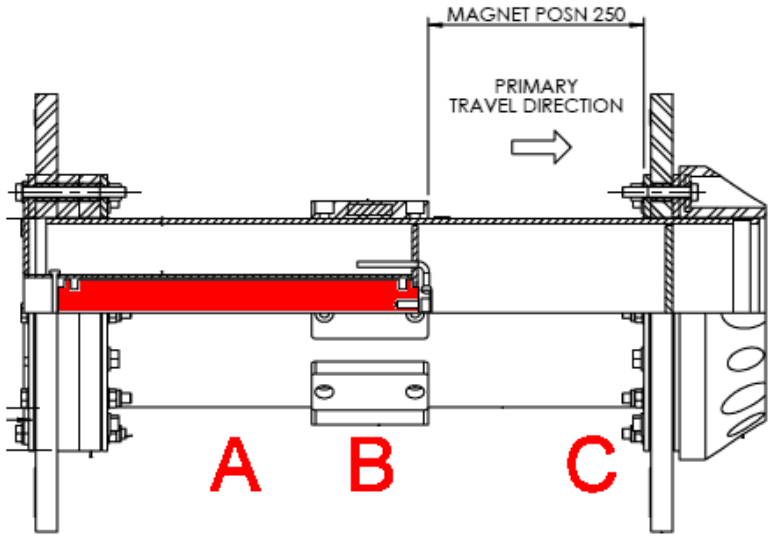
- Received Signal increases approx 50% for each Frequency step down
- Same for all distances from the pipe

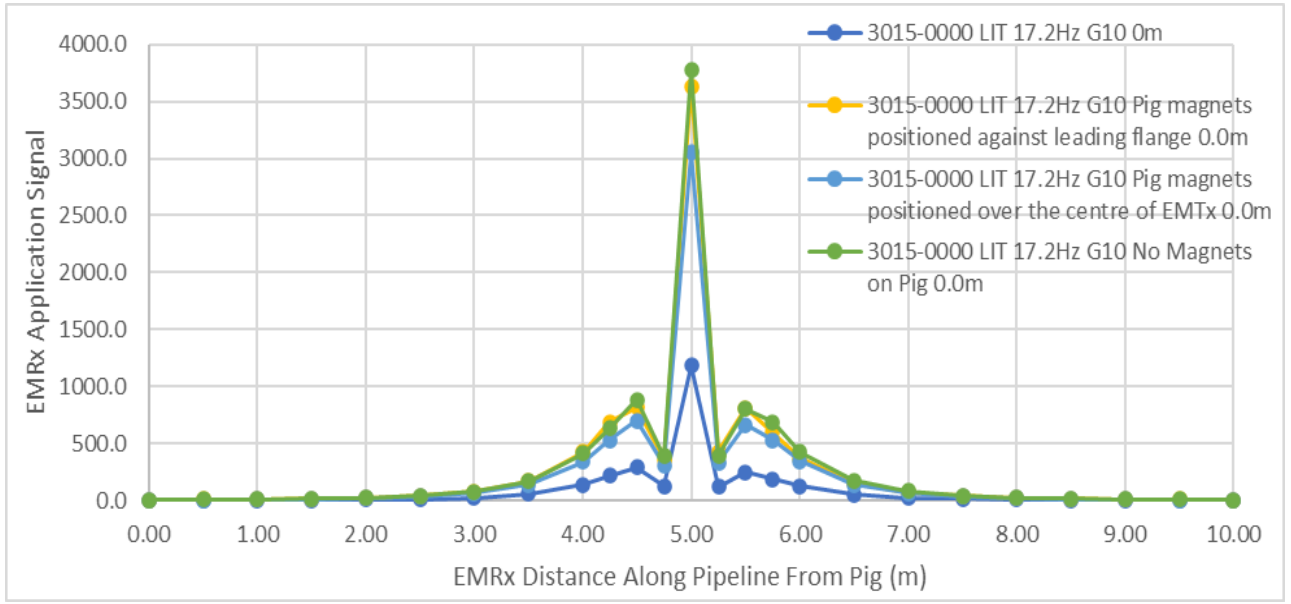
ROV Cradle Testing



- ROV Cradle – sizeable impact
- Separation Increase of 65mm – less 30%
- Add carbon steel plate – less 30%
- Minimise separation and remove all material below EMRx

Magnet Testing





Magnets have a considerable effect on the signal strength of the EMTx.

A. Signal strength improved drastically

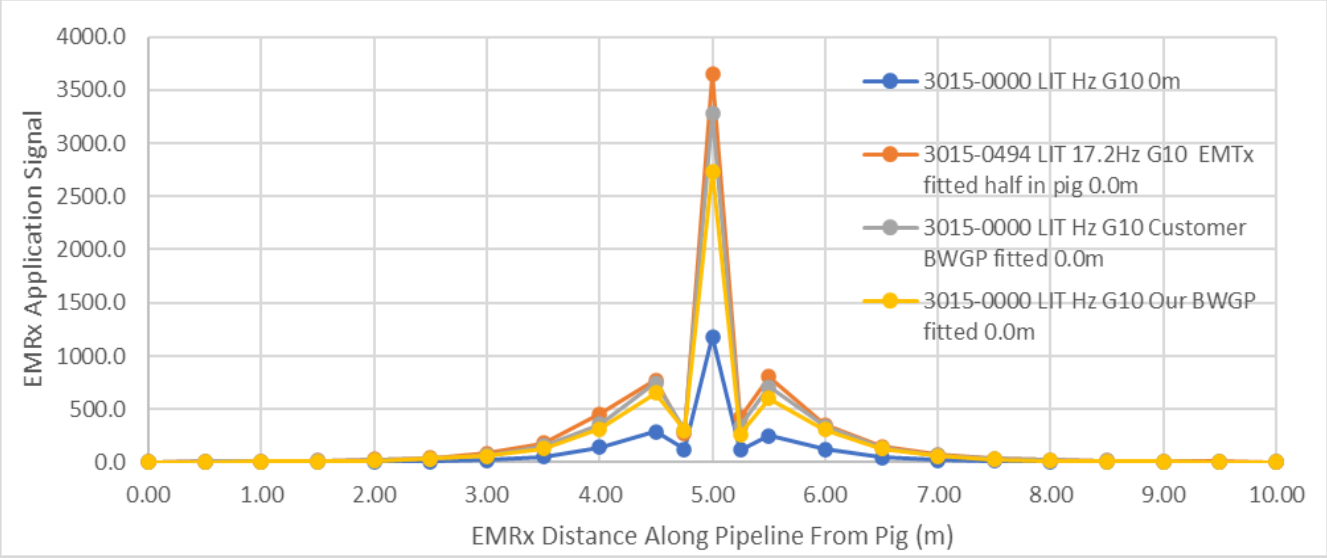
B. Weakest signal strength

C. Slight improvement over A

D. Small increase over C with NO magnets

BWGP Testing

- 50% of the EMTx protruding from the pig body.
- 6mm Aluminium BWGP – 10% less signal
- 8mm Aluminium BWGP – 25% less signal



Detection Envelope

Step size too big
If step size is larger than the detectable envelope width, you can miss the pig entirely.

Step size too small
If step size is too small, will not miss the pig but taking more steps and time (£) than necessary.

Optimum step size
If step size is approximately 50% of detectable envelope width, then cannot miss the pig.

Separation from pipe surface (m)	Frequency (Hz)	Maximum Detectable width (m)	Maximum Step Size (m)
0.0m	15Hz	6.0m	3.0m
	17Hz	5.0m	2.5m
	19Hz	5.0m	2.5m
	22Hz	4.0m	2.0m
0.5m	15Hz	4.5m	2.25m
	17Hz	4.0m	2.0m
	19Hz	3.5m	1.75m
	22Hz	2.5m	1.25m
1.0m	15Hz	2.0m	1.0m
	17Hz	1.0m	0.5m
	19Hz	1.0m	0.5m
	22Hz	1.0m	0.5m

GROUP

Discussion

Changing Frequencies

- Reducing the frequency provides significant improvement.
- Proves standard 22Hz is not always the best frequency to use.
- The lower frequencies better for this pig & pipe combination. Due to the 35mm pipe, stainless EMTx housing and a carbon steel pig body.

Cradle Testing

- Reducing the distance and removing any metal from below the EMRx can provide a significant improvement.
- Optimal designed ROV cradles used to achieve these improvements.

Magnets

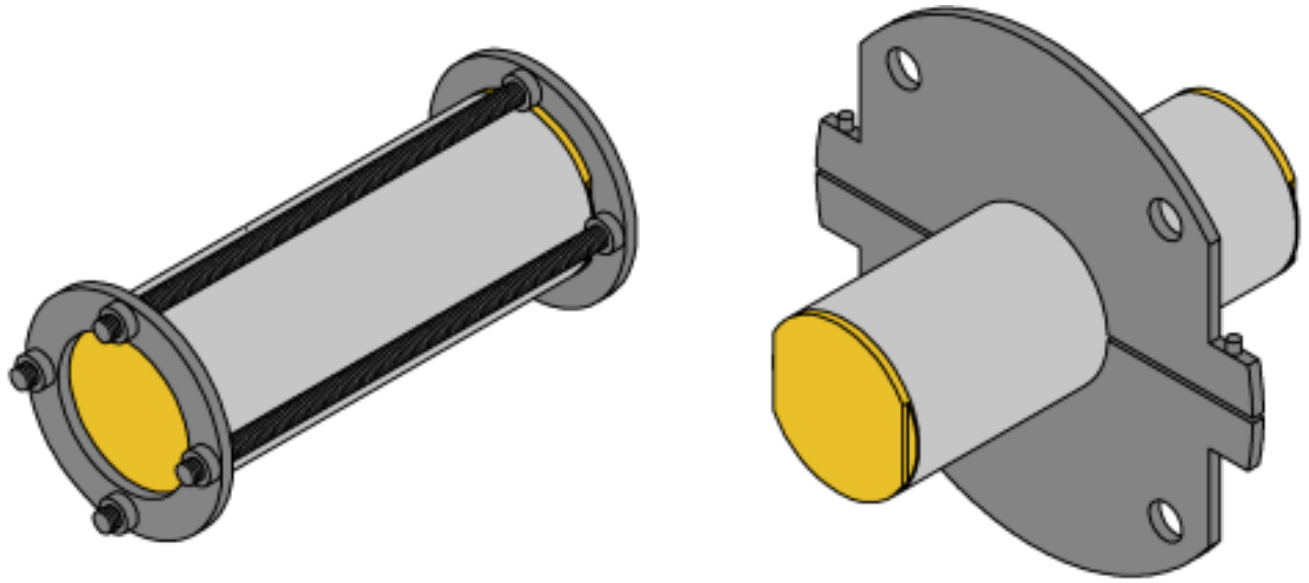
- Moving the magnets to the best position has a considerable effect on the signal strength of the EMTx.

Discussion

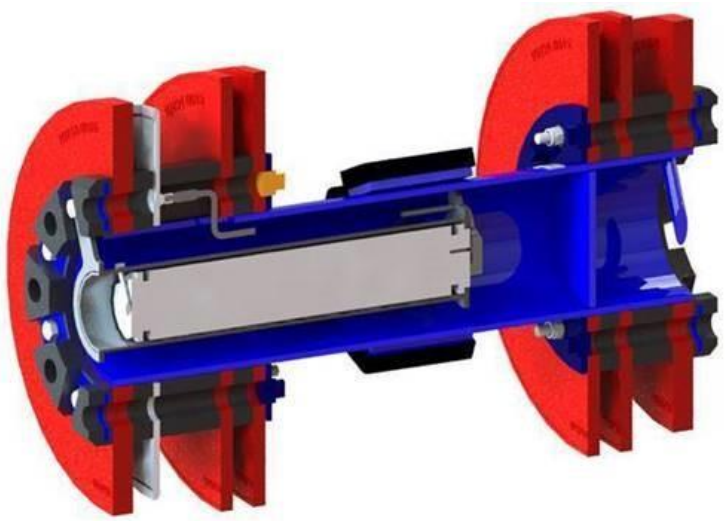
EM Tx Housing

- The transmitter is mounted inside a housing within the pig.
- This housing is a stainless steel tube which attenuates the EM signal.
- Some pigs have this housing made from carbon steel has far more attenuation.

- Ideally it is better to have this housing made from stainless steel or better still be open mounted, slotted or best of all made from a composite EM transparent material.



Recommendations – pig design



Tx pig body

Pig body:	Stainless Steel or EM transparent
Magnets:	Positioned away from EMTx or around its centre
Break Wire Gauge Plate:	Optimise position & thin as practicable
EM transmitter housing:	If not EM transparent then slotted or clamps
Subsea ROV cradle:	EMTx as close to pipe as possible with no steel between
OPTIMUM SOLUTION:	Transmitter can be adapted to become the pig body by fitting suitable pig discs

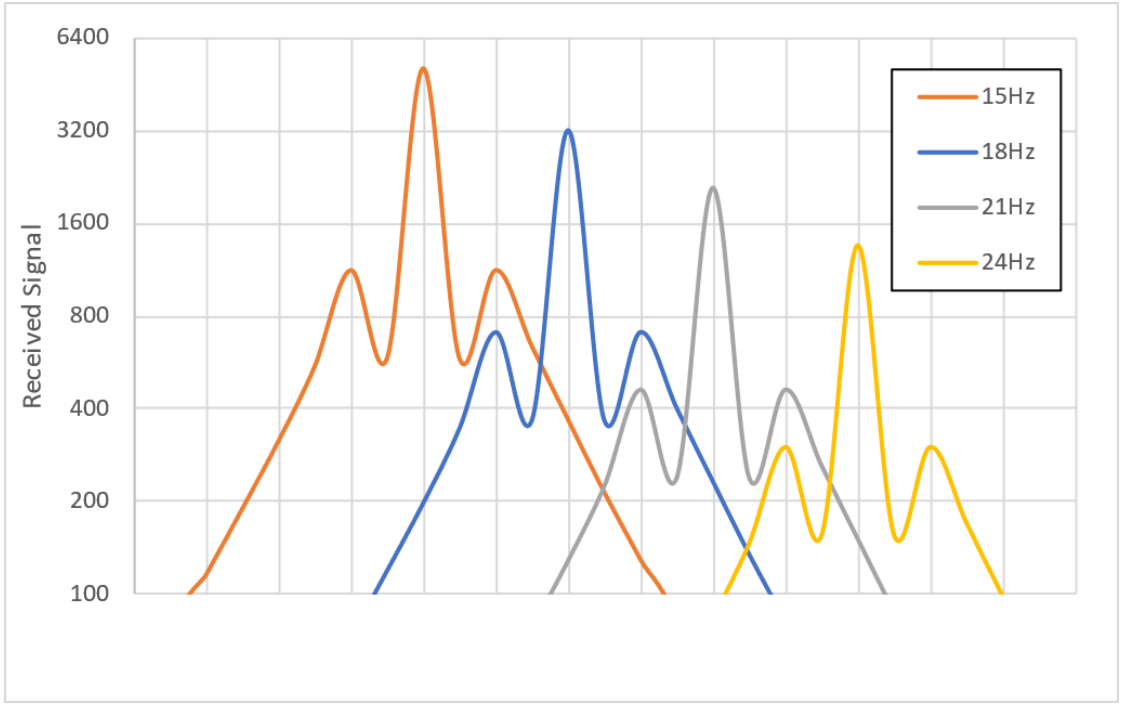
Optimal Frequency

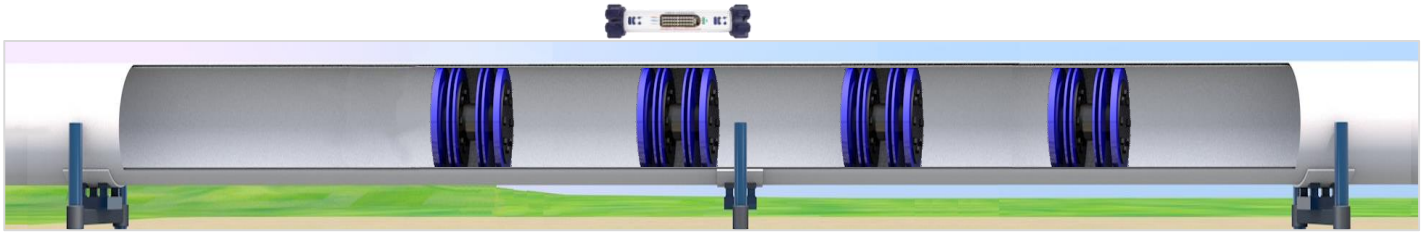
- 22Hz is **NOT** the optimal frequency for all pig detection applications

- Pipeline Variations
  - Material
  - Dimensions: OD & WT

- Many different types of pig
  - Materials
  - Configuration / Design / Size

- Operational Challenges
  - Battery Life v Power Level
  - Low flow very long runs
  - Thick Walled / Low Flow Launchers/Receivers





To Achieve the Peak of EM pig Detection

- Test the EM transmitter in as close to the actual application configuration “real life testing”, pig & pipe, as practicably possible
- Analyse the results and review the design of the pig and specification and configuration of the EM Tx
- With a few simple modifications you will be far closer to achieving the peak of EM pig detection

Answer

“Is there any logic in specifying an EM transmitter’s performance by distance through air?”

Absolutely NOT!

QUESTIONS

Thank you for your attention

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