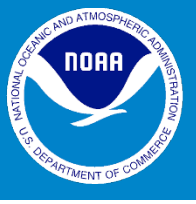

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2018 EK Calibration Report

NOAA Ship *Okeanos Explorer*

EX-18-02

Gulf of Mexico Mapping and Emerging Technology Demonstration Cruise

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Introduction

Calibration of the Simrad EK60 echosounders on NOAA Ship *Okeanos Explorer* took place March 2018 in the Gulf of Mexico during cruise EX-18-02. Four frequencies (18, 70, 120 and 200 kilohertz (kHz)) were calibrated at the pulse length of 1.024 milliseconds (ms) and maximum power for each frequency. The 18 and 70 kHz were calibrated at the additional pulse lengths of 4.096 ms and 2.048 ms, respectively. Additionally, two Wide Band Transceivers (WBTs) on loan from the University of New Hampshire (UNH) were calibrated at requested UNH settings. As they were the property of UNH, they will not be detailed in this report. The 38 kHz frequency was not successfully calibrated as it was not able to detect the sphere at the known target strength. Further updates from the ship indicate that the 38 kHz transducer might be damaged and all data produced by this sonar in 2018 should be considered in light of this.

Location and Conditions

- The ship was located in the north-central Gulf of Mexico at coordinates 29° 36 N, 87° 24 W.
- The vessel was drifting in waters deeper than 50 meters.
- A conductivity, temperature, depth (CTD) cast was performed before commencing calibration to obtain the required water properties necessary for calibration including the temperature and salinity at the depth of the sphere.
- Average speed of sound at the calibration depth (15 meters) for the 70, 120, and 200 kHz transducers was 1527.6 meters per second.
- At 15 meters the average temperature was 21.6 °C and average salinity was 36 psu (practical salinity unit).
- Average speed of sound at the calibration depth (28 meters) for the 18 kHz transducer was 1529.01 meters per second.
- At 28 meters the average temperature was 22.1 °C and average salinity was 36 psu.

Calibration Parameters

- All frequencies were calibrated with a pulse length of 1.024 ms. The 18 and 70 kHz were calibrated at the additional pulse lengths of 4.096 ms and 2.048 ms, respectively.
- Ping rate was 1 ping/second.
- Power was set to maximum for each frequency.
- See Table 1 of this document for a complete list of parameters used during calibration.

Table 1. List of relevant parameters and initial settings used during the 2018 calibration of the Simrad EK60 echosounders. For more information, see Appendix 1 containing the channel tab for each frequency calibrated.

Frequency (kHz)	18	18	70	70	120	200
GPT model	GPT	GPT	GPT	GPT	GPT	GPT
EK80 software version	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0
Transducer model	ES18	ES18	ES70-7C	ES70-7C	ES120-7C	ES200-7C
Transducer serial number	2097	2097	343	343	1256	596
Transducer draft setting (m)	4.42	4.42	4.42	4.42	4.42	4.42
Transmit power (W)	2000	2000	750	750	250	150
Pulse length (ms)	4.096	1.024	2.048	1.024	1.024	1.024
Two-way beam angle (dB)	–17.0	-17.0	–20.70	–20.70	–20.70	–20.70
Transducer peak gain (dB)	23.0	22.4	27.0	27.0	27.0	27.0
Sa correction (dB)	0.00	0.00	0.00	0.00	0.00	0.00
Absorption coefficient (dB/km)	0.001947	0.001947	0.022875	0.022875	0.049569	0.082906
Speed of sound (m/s)	1529.01	1529.01	1527.61	1527.61	1527.61	1527.61
3 dB beamwidth (º) alongship/athwartship	11.00/11.00	12.05/11.70	6.79/6.51	7.00/7.00	7.00/7.00	7.00/7.00
Angle offset (º) alongship/athwartship	0.00/0.00	0.41/-0.08	-0.03/-0.28	0.00/0.00	0.00/0.00	0.00/0.00

Calibration Procedure

To minimize the time and setup required, we used one sphere (38.1 millimeter tungsten carbide sphere) for all frequencies except for the 18 kHz which used a 64 millimeter copper sphere.

Calibration was performed using Simrad's EK80 calibration software and custom software from the NOAA Northeast Fisheries Science Center (NEFSC) to control the downriggers. For detailed setup of the downriggers and other calibration information, contact the authors for the EK60/EK80 Calibration Standard Operating Procedures Manual. For the pod setup calibration, the sphere was suspended about 5 meters (15 feet) below the swivels and a five pound lead fishing weight, for stability, was suspended about 3 meters (10 feet) below the sphere. For the 18 kHz calibration, the sphere was suspended about 10 meters (30 feet) below the swivels and a five pound lead fishing weight, for stability, was suspended about 15 meters (45 feet) below the sphere.

The three calibration lines were joined using typical calibration procedures (lowering a rope under the bow with the port side calibration line attached to the end of it and retrieving the rope from the starboard side once passed under the keel). For the 18 kHz calibration, the reciprocal was used with the line being attached to the starboard side and pulling up on the port side. Prior to deployment the sphere was soaked in a soapy water solution to break surface tension. The sphere was then lowered to a depth of approximately 15 meters and 28 meters from the surface of the water for the pod and 18 kHz calibration, respectively, which is a range of about 10 meters and 13 meters from the transducers. This depth was achieved by having 80 feet of line out of each downrigger for the pod. For the 18 kHz calibration, the line out count was 100 feet at the water line for each downrigger. See Appendix 7 for the X, Y, and Z offset locations of each of the transducers on the hull.

Calibration Results

Beam Coverage: For each frequency we initially positioned the sphere in the center of the beam (on-axis) and recorded for several minutes. We then moved the sphere throughout the beam to achieve adequate coverage in each quadrant. We had very good coverage for all frequencies and root mean square (RMS) error values below the recommended 0.4 threshold (per Simrad recommendations) aside from the 38 kHz. See Appendix 5 for beam coverage and error values of each of the calibrated frequencies. See Appendix 3 for the total number of sphere detections in the beam for each frequency calibrated. See Appendix 6 for a complete list of the .raw files and .xml files recorded during calibration.

Table 2. Target strength (TS) values of the spheres used during calibration based on the values calculated in the Simrad EK80 calibration software using the CTD provided temperature and salinity.

Frequency (kHz)	64 mm diameter copper sphere TS (dB)	38.1 mm diameter tungsten carbide sphere TS (dB)
18	-34.37	N/A
38	N/A	-42.43
70	N/A	-41.46
120	N/A	-39.49
200	N/A	-39.25

Table 3. 2018 calibration results. During 2018, the 38 kHz system was not successfully calibrated. See Appendix 4 for the screenshots detailing the results from the 2018 calibration.

18 kHz: Pulse length: 4.096 ms	**March 2018**
Transducer peak gain (dB)	20.54
Sa correction (dB)	-0.47
Beamwidth (º) alongship/athwartship	12.05/11.70
Beam offset (º) alongship/athwartship	0.41/-0.08
RMS deviation (dB)	0.35
18 kHz: Pulse length: 1.024 ms	**March 2018**
Transducer peak gain (dB)	20.09
Sa correction (dB)	-0.68
Beamwidth (º) alongship/athwartship	11.64/11.84
Beam offset (º) alongship/athwartship	0.12/0.14
RMS deviation (dB)	0.37
70 kHz: Pulse length: 2.048 ms	**March 2018**
Transducer peak gain (dB)	26.76
Sa correction (dB)	-0.34
Beamwidth (º) alongship/athwartship	6.50/6.60
Beam offset (º) alongship/athwartship	0.05/0.36
RMS deviation (dB)	0.16
70 kHz: Pulse length: 1.024 ms	**March 2018**
Transducer peak gain (dB)	26.65
Sa correction (dB)	-0.36
Beamwidth (º) alongship/athwartship	6.79/6.51
Beam offset (º) alongship/athwartship	-0.03/-0.28
RMS deviation (dB)	0.38
120 kHz: Pulse length: 1.024 ms	**March 2018**
Transducer peak gain (dB)	26.25
Sa correction (dB)	-0.38
Beamwidth (º) alongship/athwartship	6.49/6.75
Beam offset (º) alongship/athwartship	-0.10/0.09
RMS deviation (dB)	0.22
200 kHz: Pulse length: 1.024 ms	**March 2018**
Transducer peak gain (dB)	26.34
Sa correction (dB)	-0.36
Beamwidth (º) alongship/athwartship	6.76/6.88
Beam offset (º) alongship/athwartship	0.04/0.13
RMS deviation (dB)	0.23

Appendix 1 - Channel Results

18 kHz: 4.096 ms

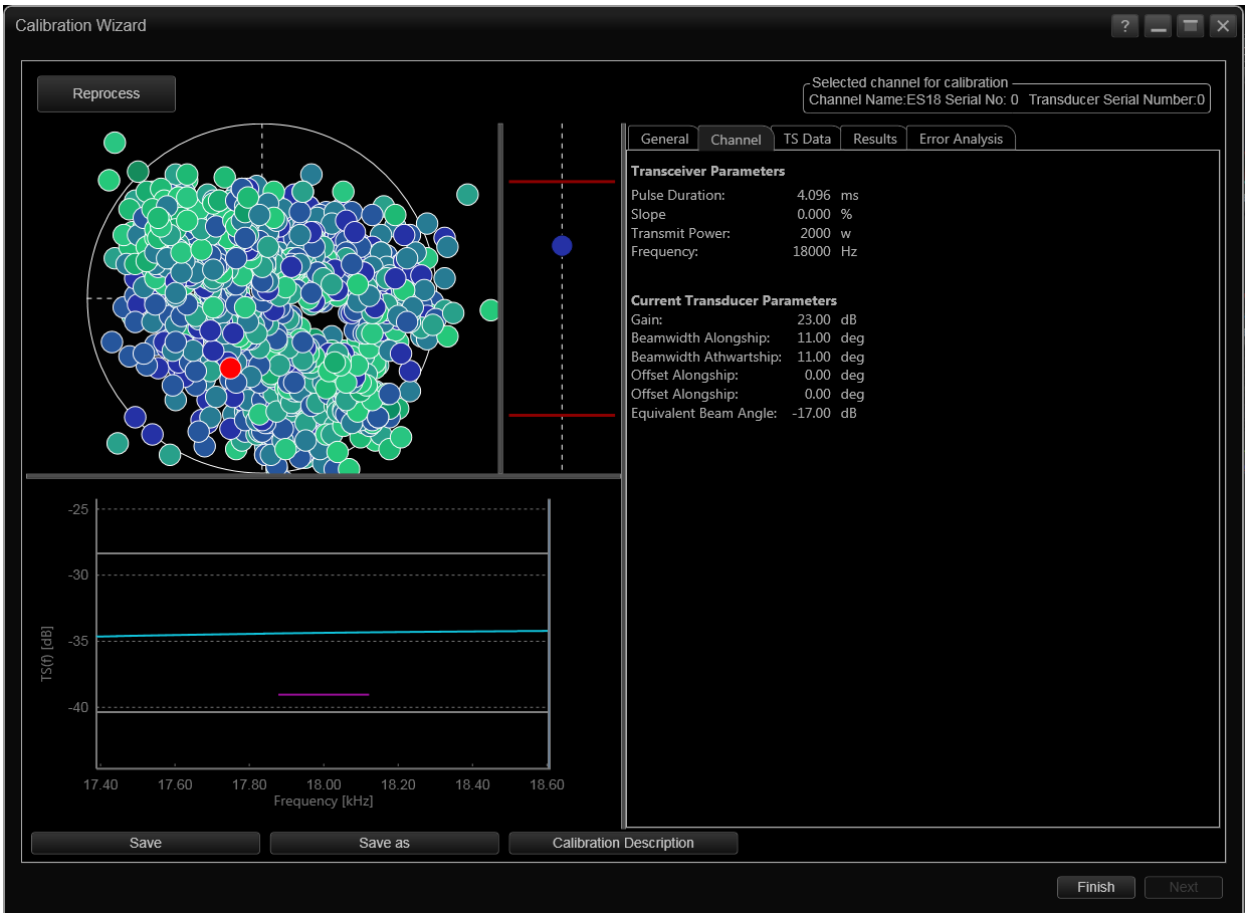

Figure 1. Screenshot of EK80 Calibration Wizard. Channel results for 18 kHz calibration at 4.096 ms.

18 kHz: 1.024 ms

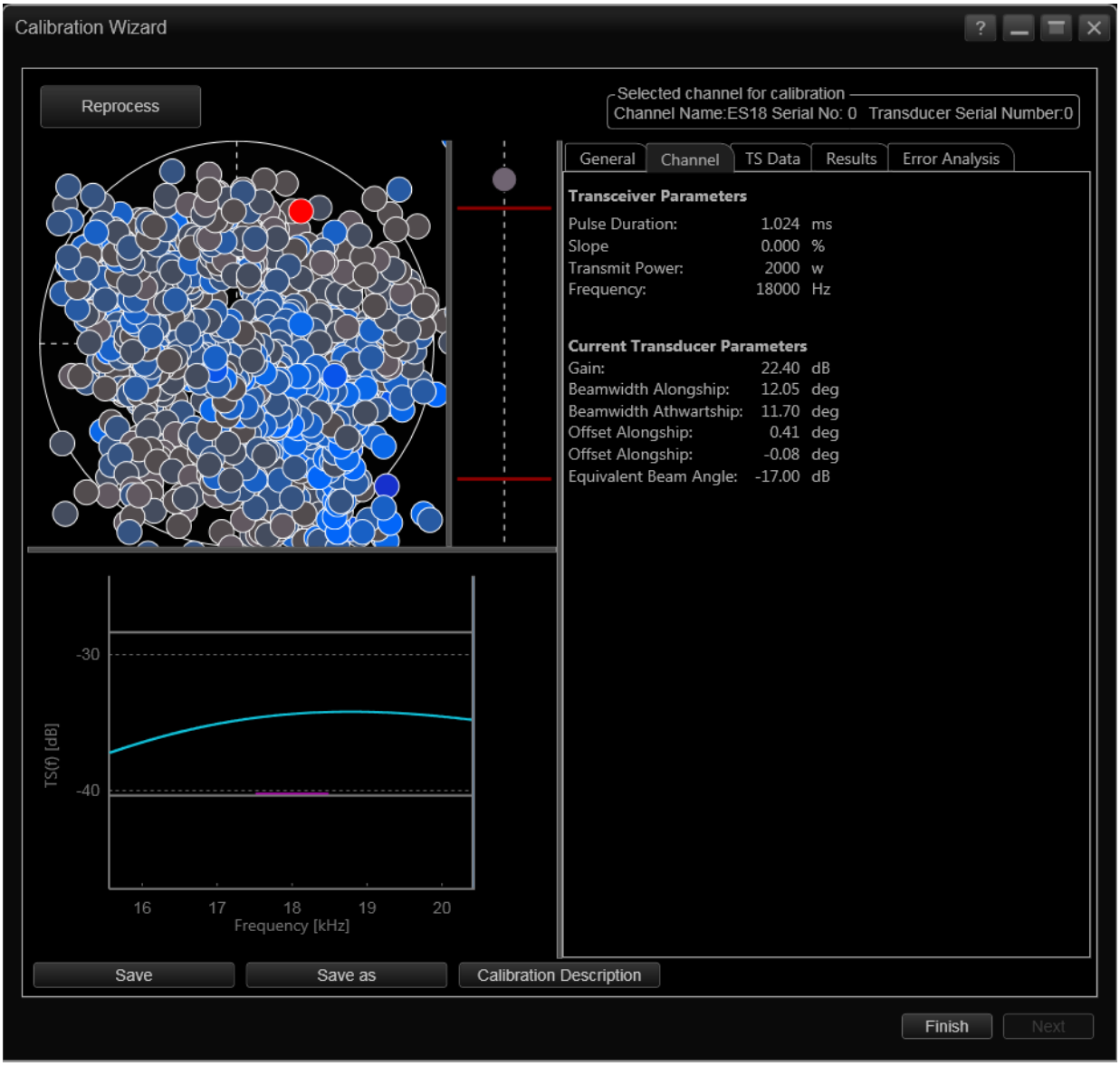

Figure 2. Screenshot of EK80 Calibration Wizard. Channel results for 18 kHz calibration at 1.024 ms.

70 kHz: 2.048 ms

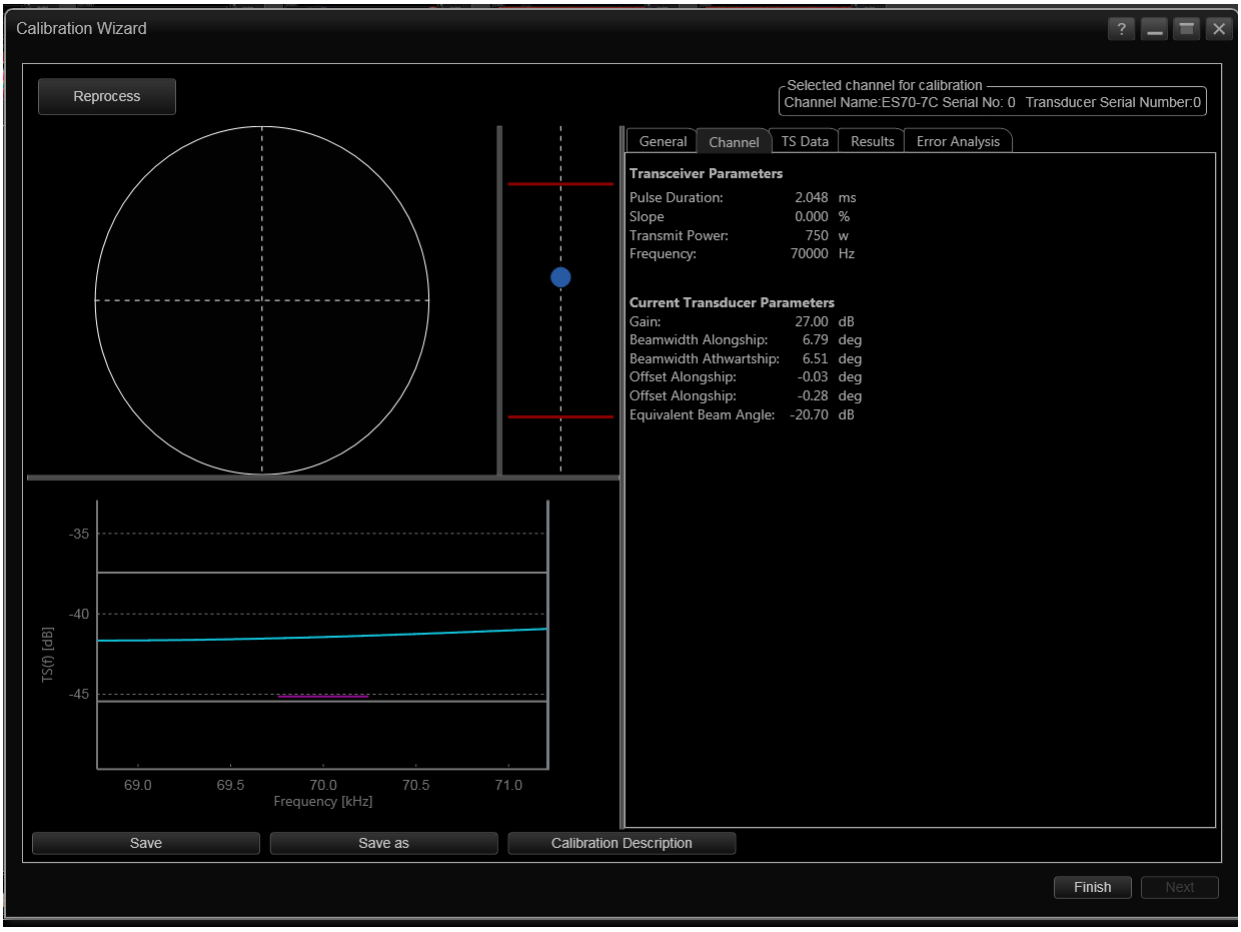

Figure 3. Screenshot of EK80 Calibration Wizard. Channel results for 70 kHz calibration at 2.048 ms.

70 kHz: 1.024 ms

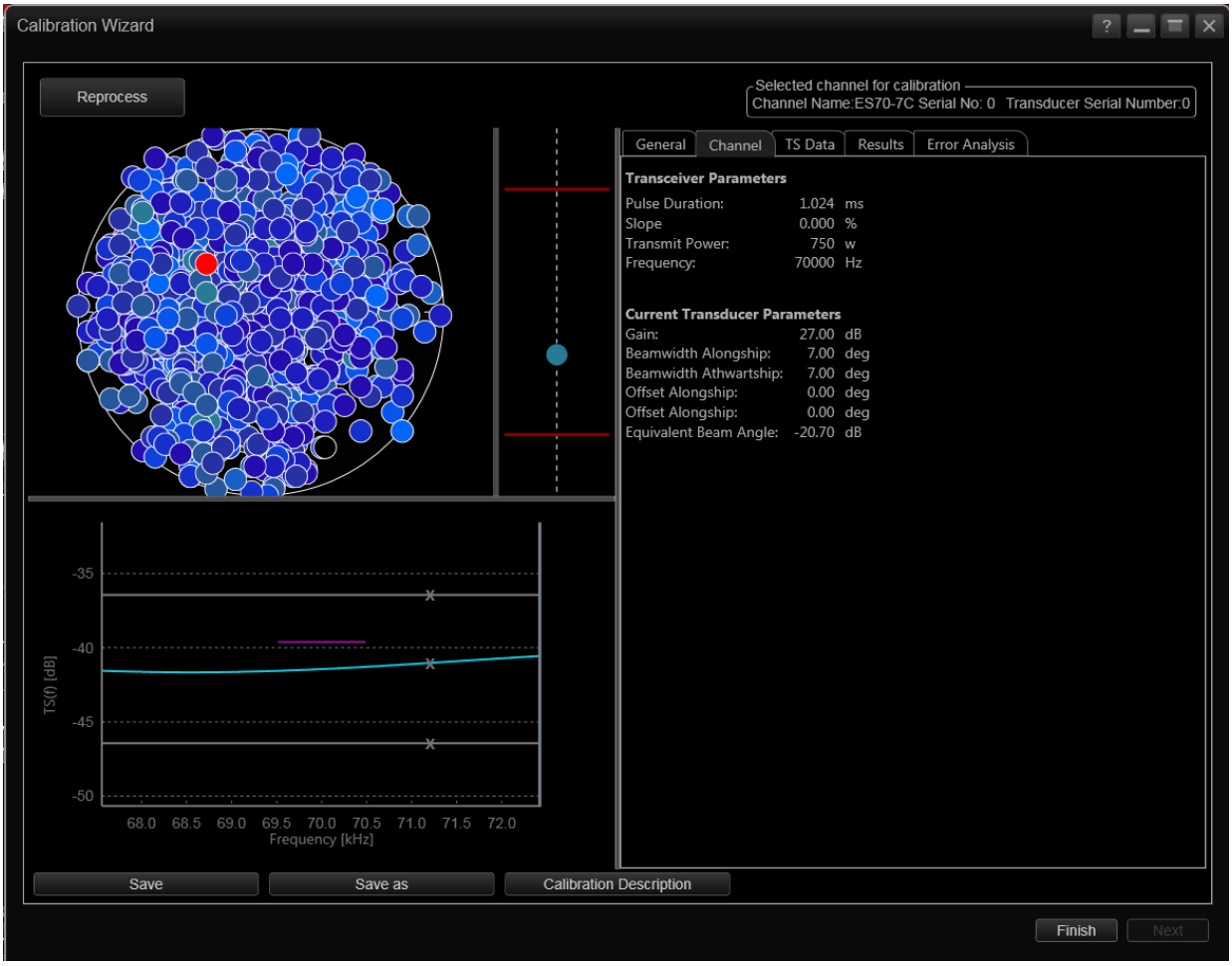

Figure 4. Screenshot of EK80 Calibration Wizard. Channel results for 70 kHz calibration at 1.024 ms.

120 kHz: 1.024 ms

This calibration was conducted but the “Channel” screengrab is unavailable. The results are tabulated in Table 1 in the body of this report. This can be reproduced by replaying the file in the EK Calibration Wizard if desired.

200 kHz: 1.024 ms

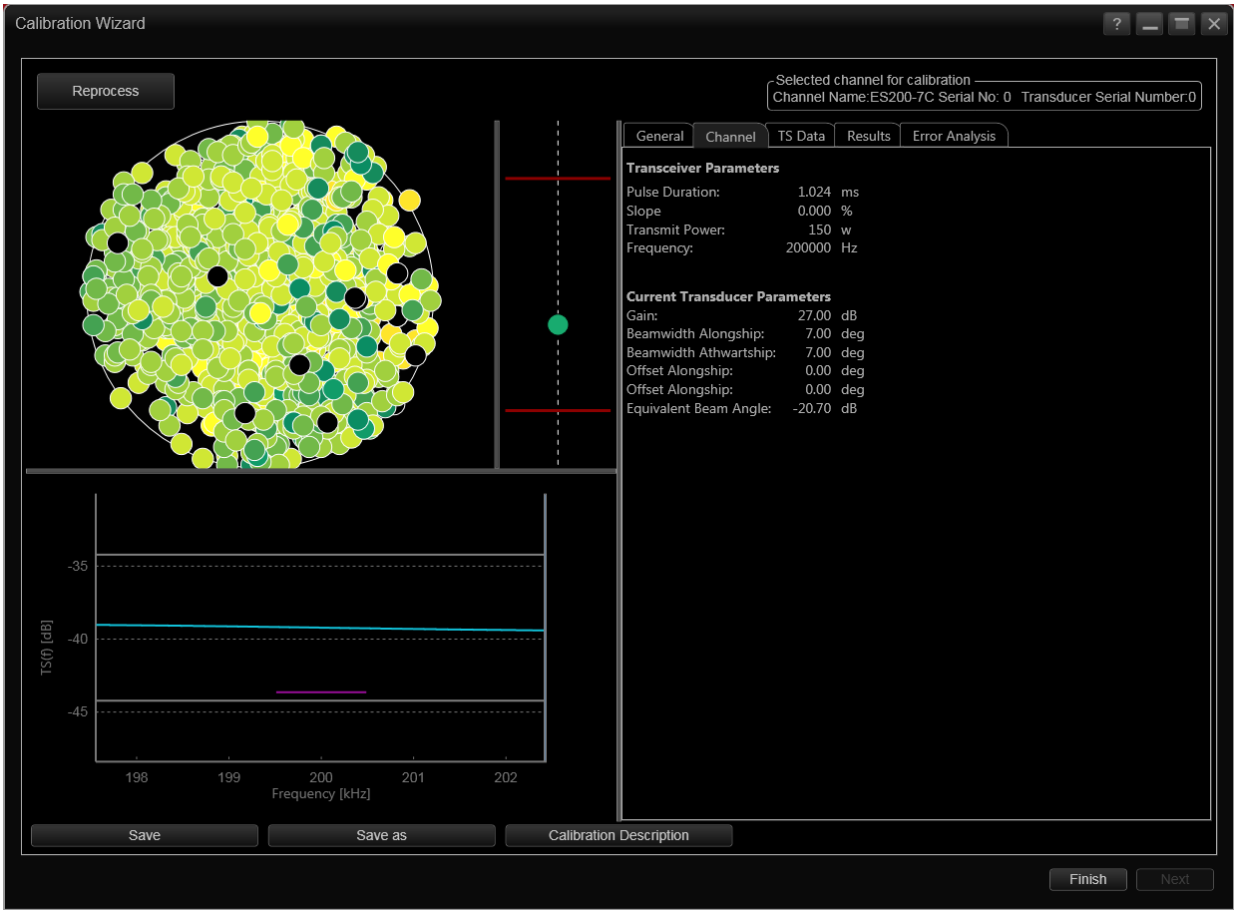

Figure 5. Screenshot of EK80 Calibration Wizard. Channel results for 200 kHz calibration at 1.024 ms.

Appendix 2 - General Results

18 kHz: 4.096 ms

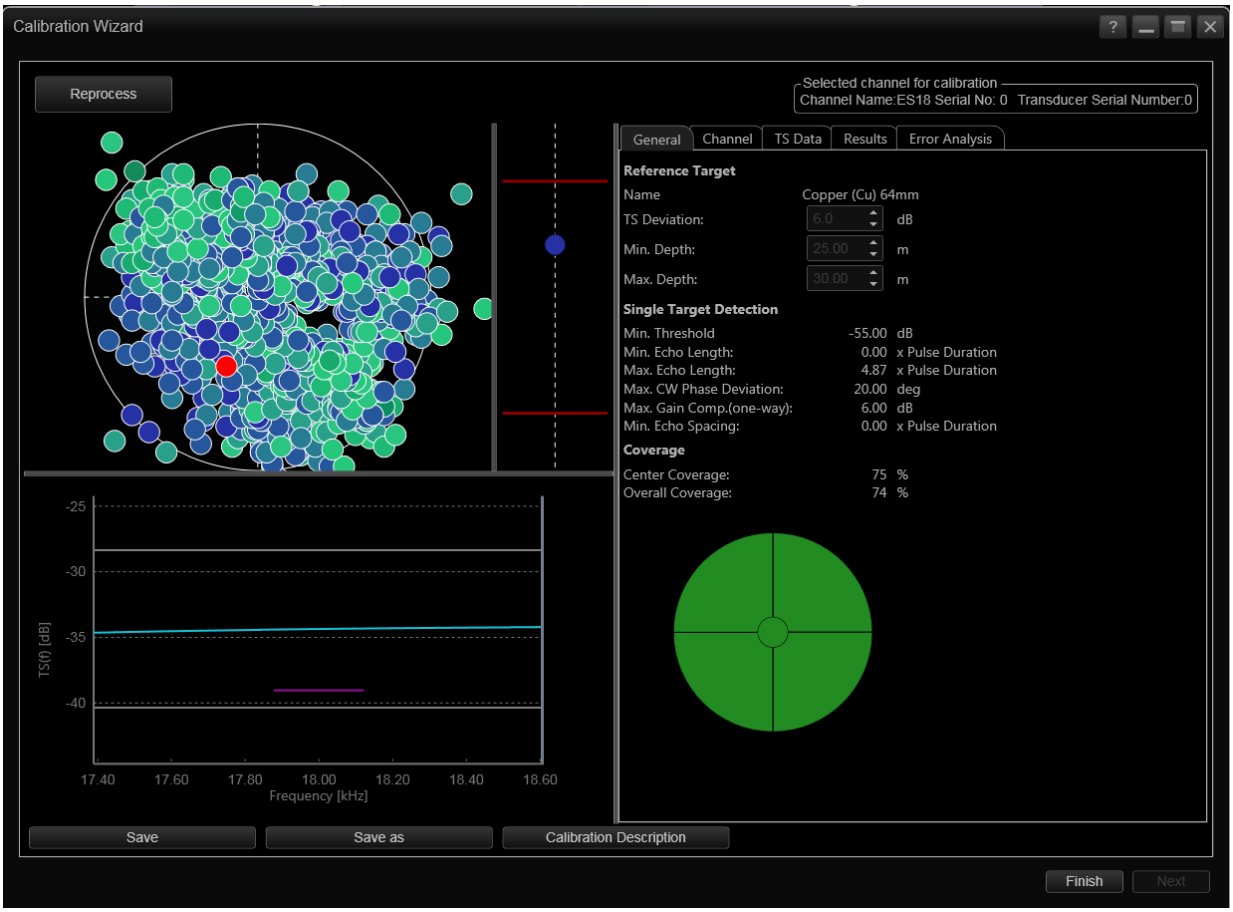

Figure 6. Screenshot of EK80 Calibration Wizard. General results for 18 kHz calibration at 4.096 ms.

18 kHz: 1.024 ms

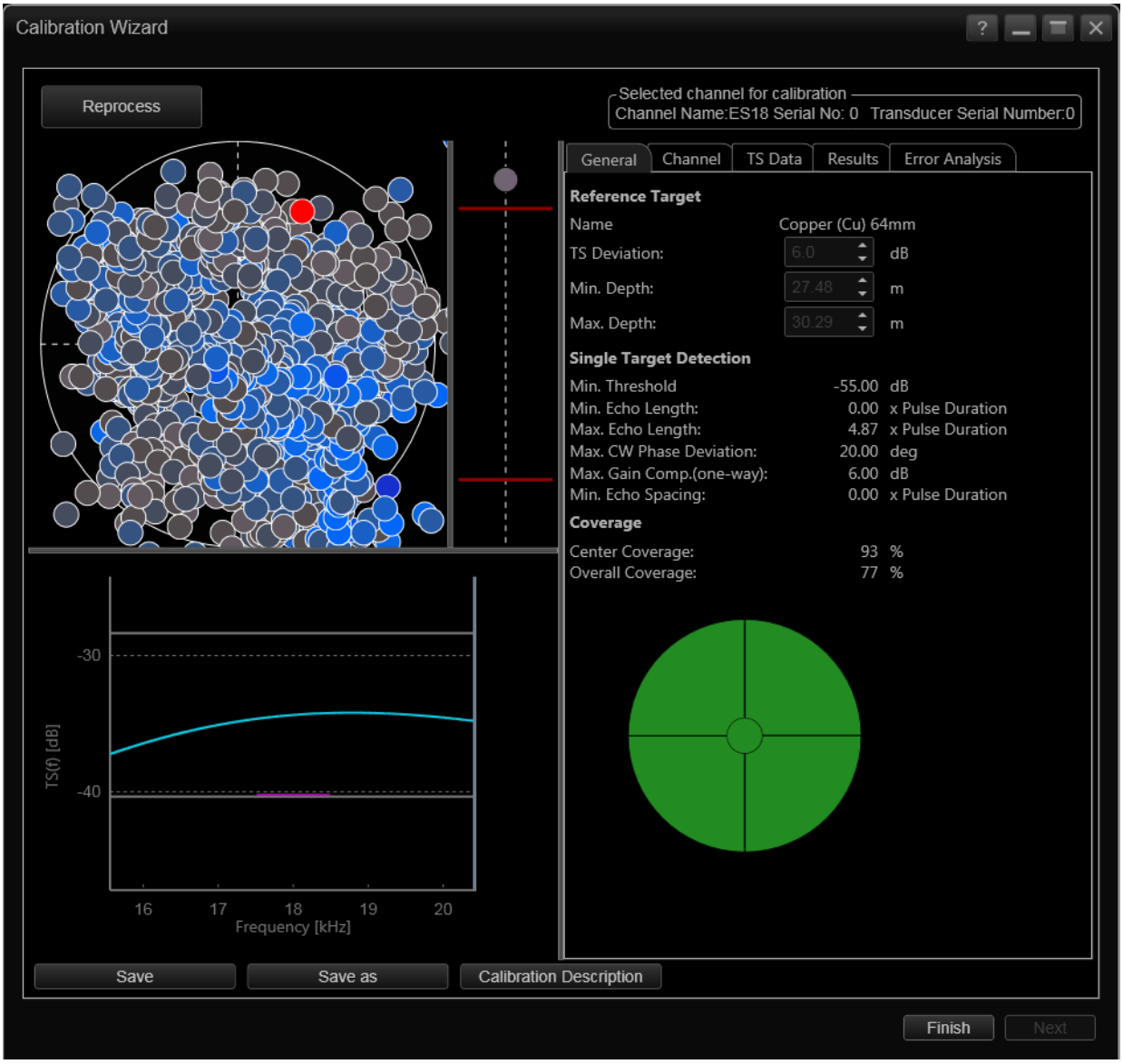

Figure 7. Screenshot of EK80 Calibration Wizard. General results for 18 kHz calibration at 1.024 ms.

70 kHz: 2.048 ms

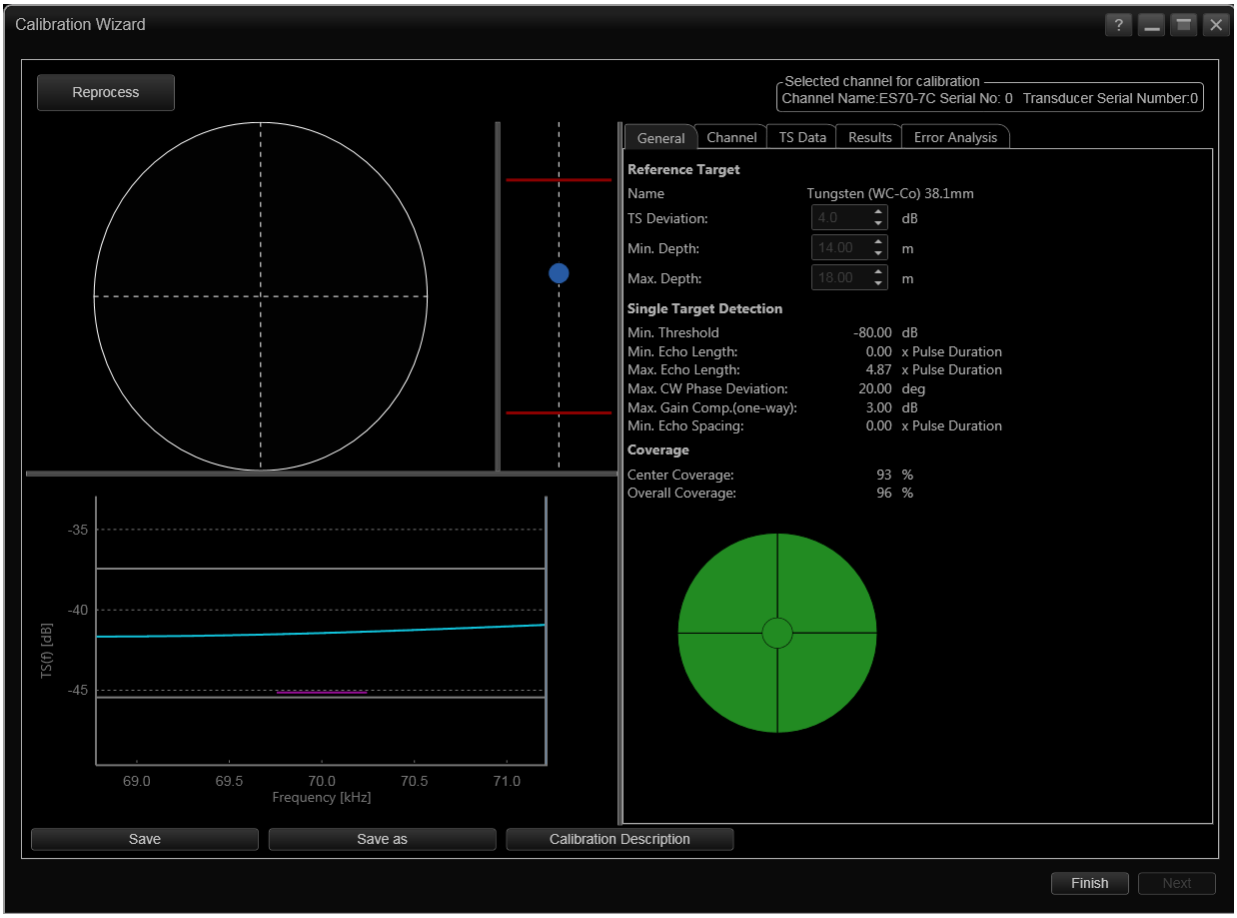

Figure 8. Screenshot of EK80 Calibration Wizard. General results for 70 kHz calibration at 2.048 ms.

70 kHz: 1.024 ms

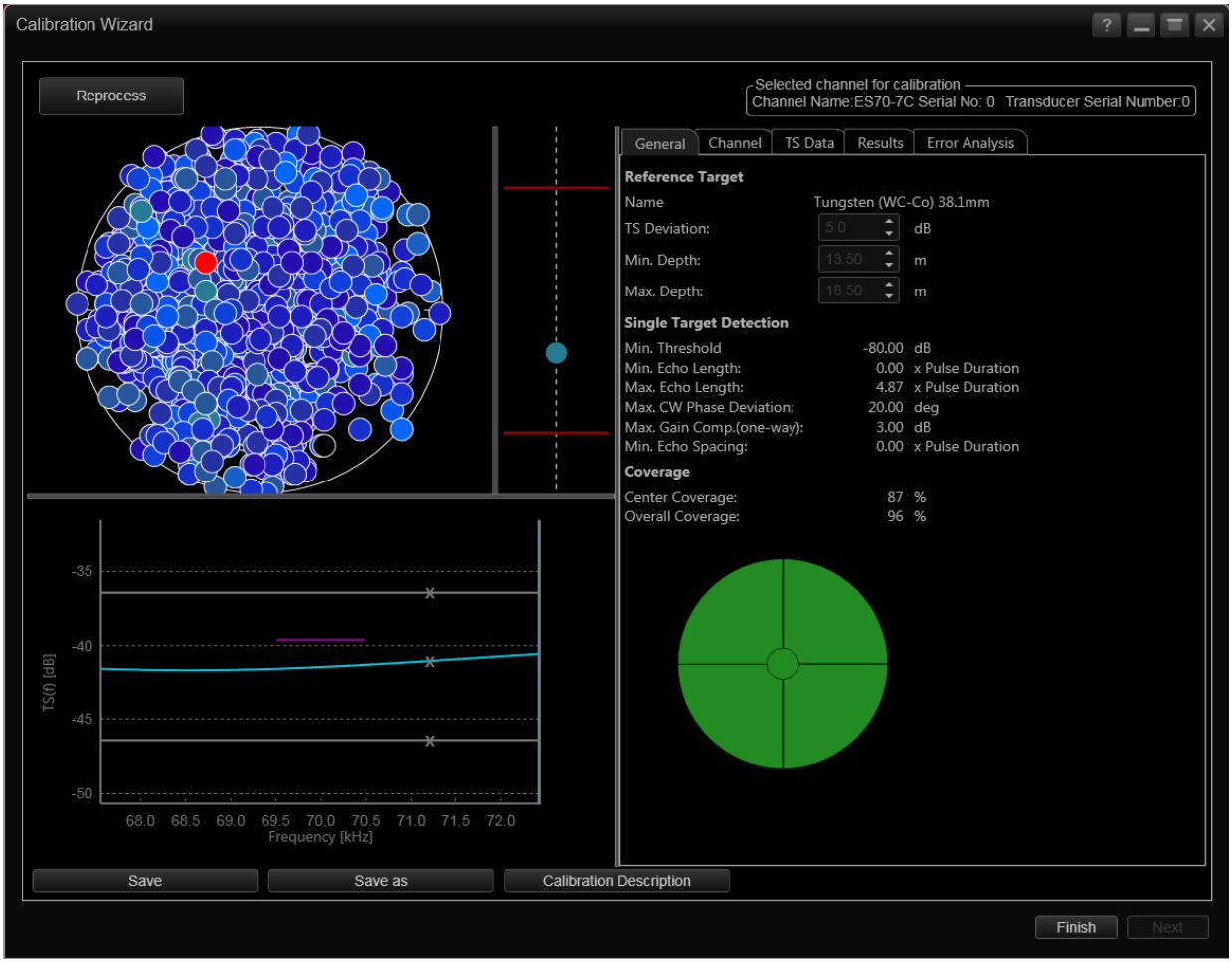

Figure 9. Screenshot of EK80 Calibration Wizard. General results for 70 kHz calibration at 1.024 ms.

120 kHz: 1.024 ms

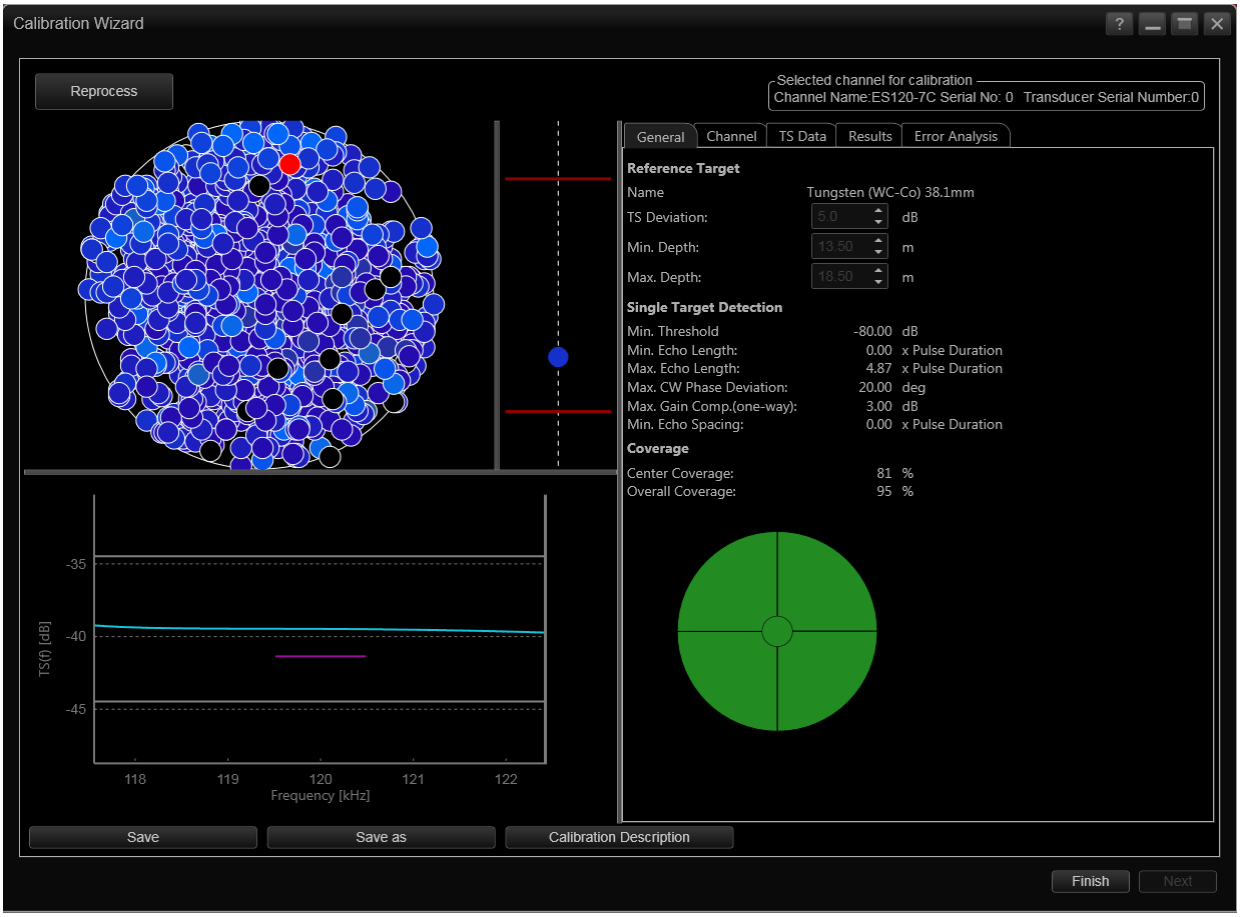

Figure 10. Screenshot of EK80 Calibration Wizard. General results for 120 kHz calibration at 1.024 ms.

200 kHz: 1.024 ms

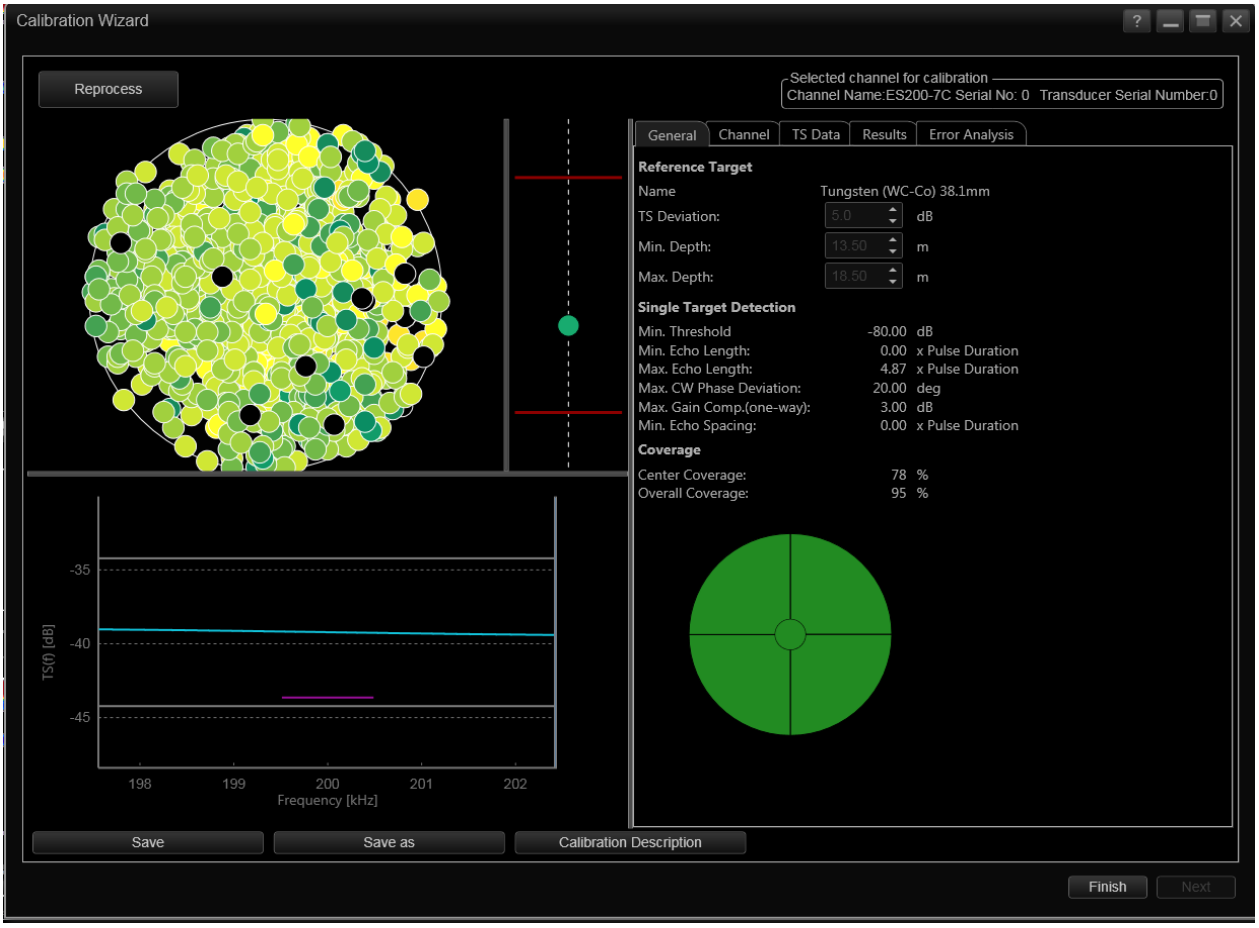

Figure 11. Screenshot of EK80 Calibration Wizard. General results for 200 kHz calibration at 1.024 ms.

Appendix 3 - TS Results

18 kHz: 4.096 ms

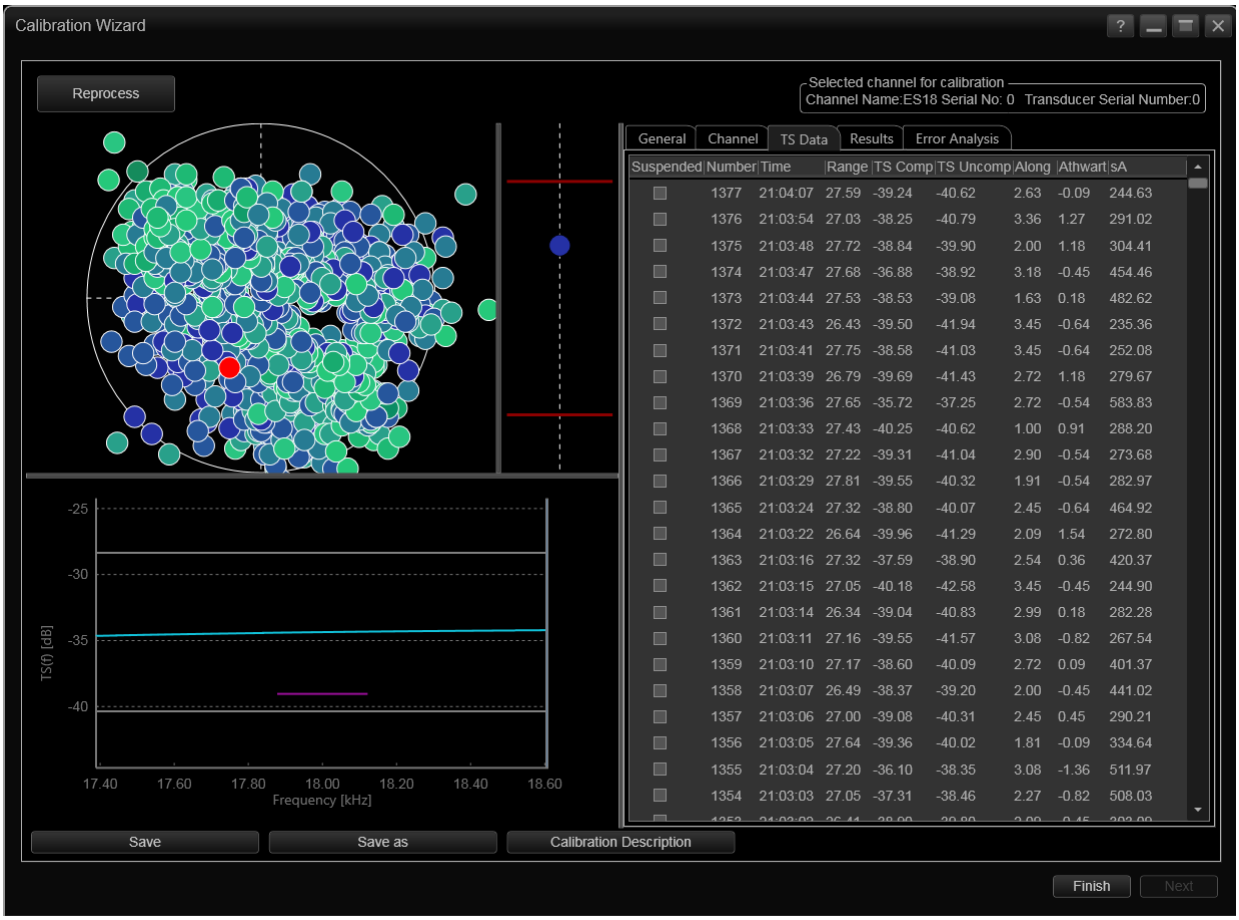

Figure 12. Screenshot of EK80 Calibration Wizard. Target strength results for 18 kHz calibration at 4.096 ms.

18 kHz: 1.024 ms

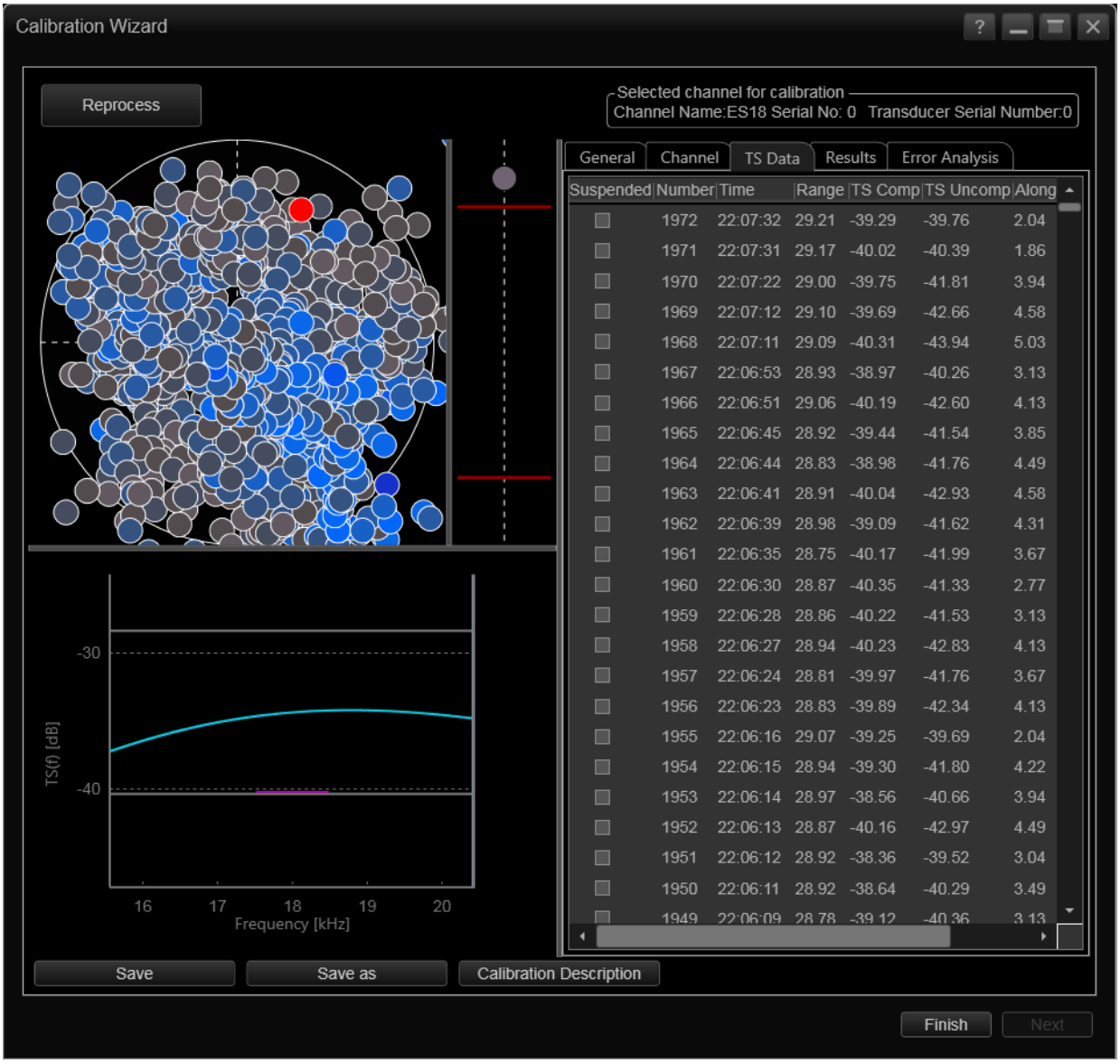

Figure 13. Screenshot of EK80 Calibration Wizard. Target strength results for 18 kHz calibration at 1.024 ms.

70 kHz: 2.048 ms

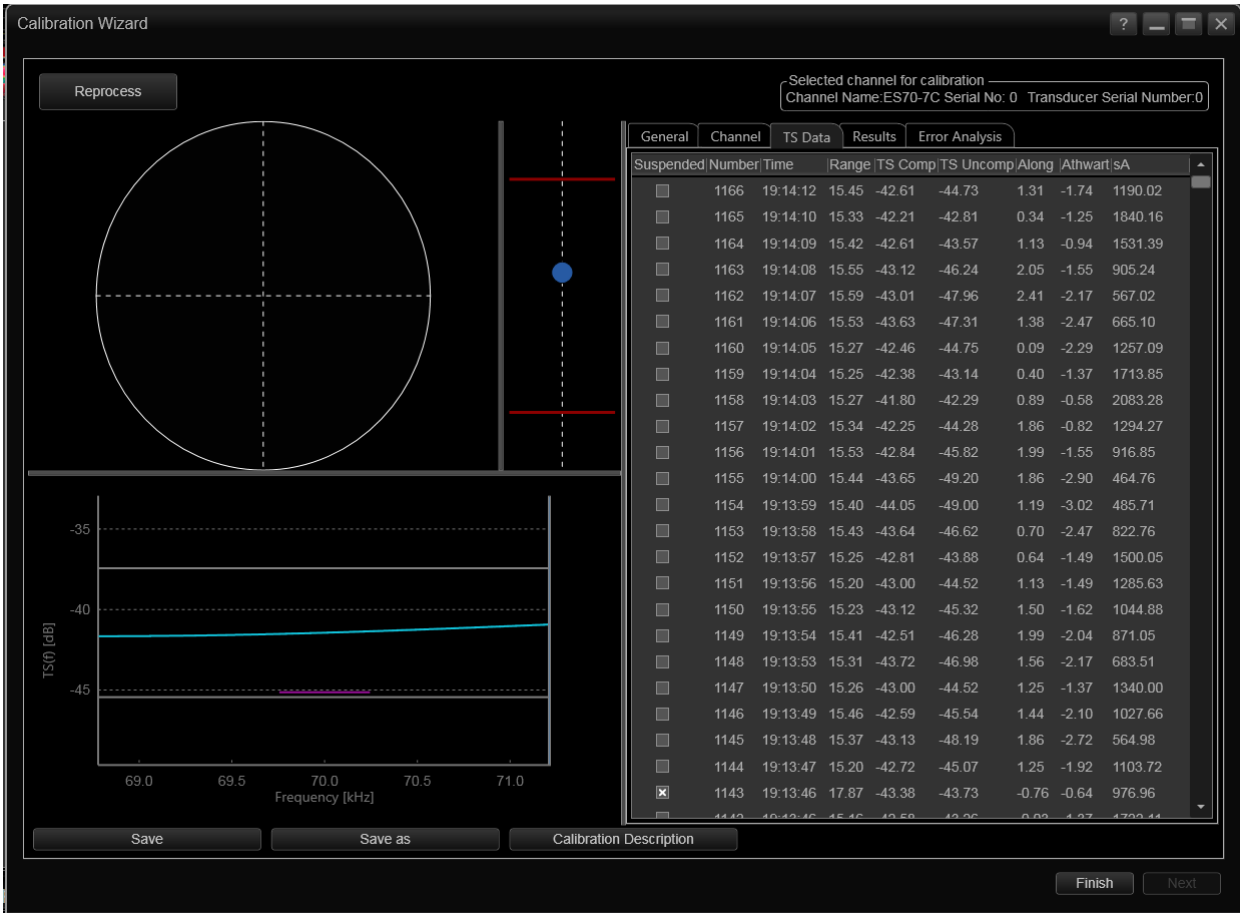

Figure 14. Screenshot of EK80 Calibration Wizard. Target strength results for 70 kHz calibration at 2.048 ms.

70 kHz: 1.024 ms

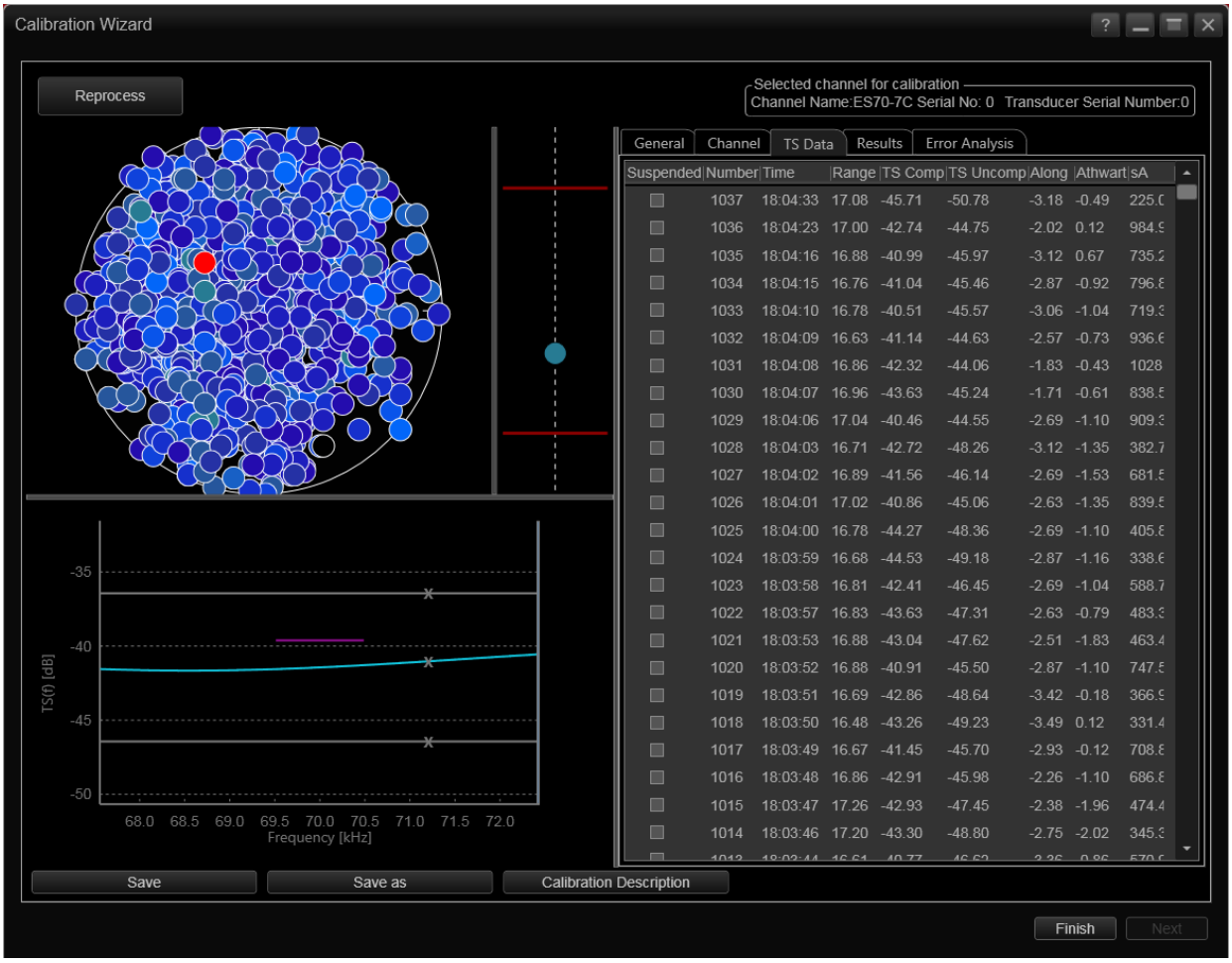

Figure 15. Screenshot of EK80 Calibration Wizard. Target strength results for 70 kHz calibration at 1.024 ms.

120 kHz: 1.024 ms

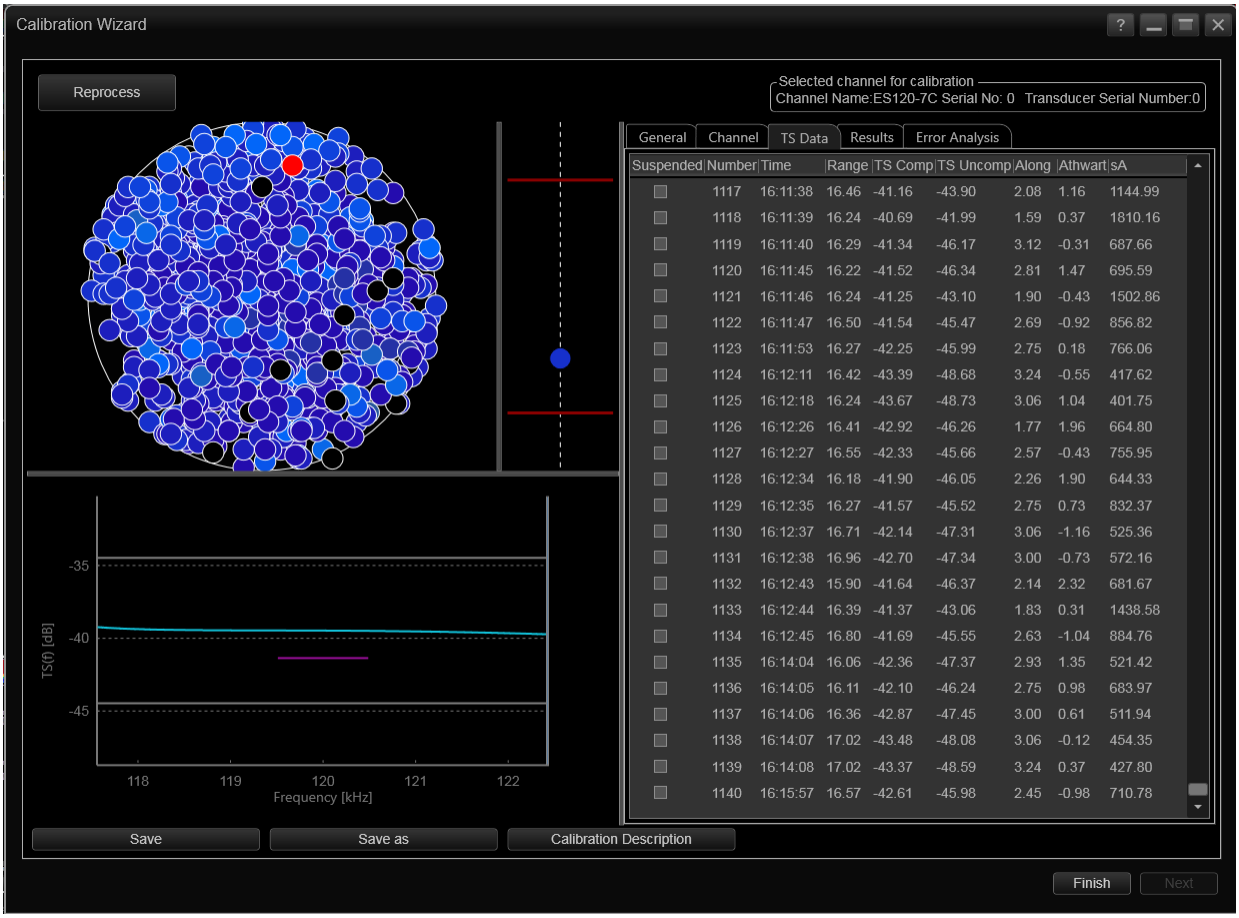

Figure 16. Screenshot of EK80 Calibration Wizard. Target strength results for 120 kHz calibration at 1.024 ms.

200 kHz: 1.024 ms

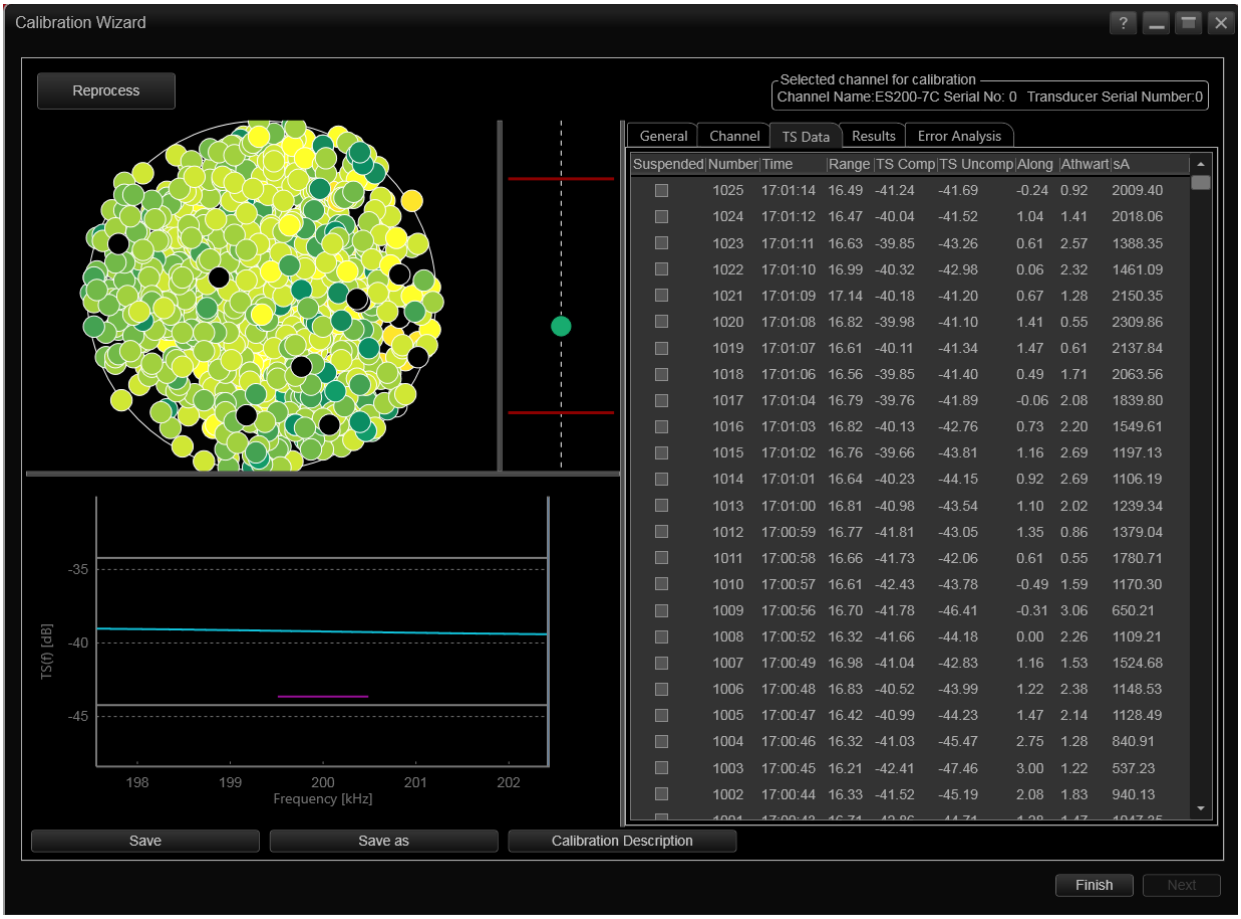

Figure 17. Screenshot of EK80 Calibration Wizard. Target strength results for 200 kHz calibration at 1.024 ms.

Appendix 4 - Results

18 kHz: 4.096 ms

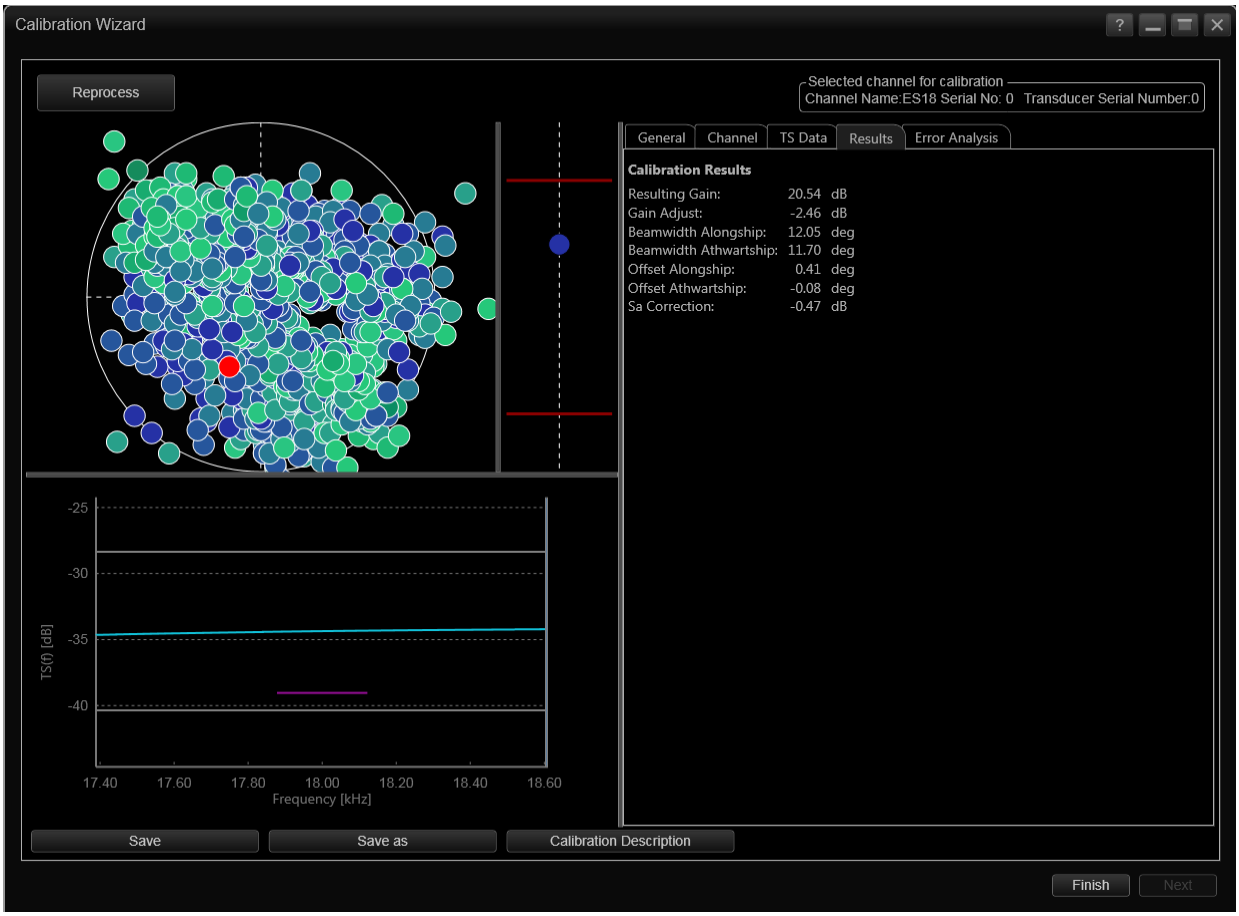

Figure 18. Screenshot of EK80 Calibration Wizard. Results for 18 kHz calibration at 4.096 ms.

18 kHz: 1.024 ms

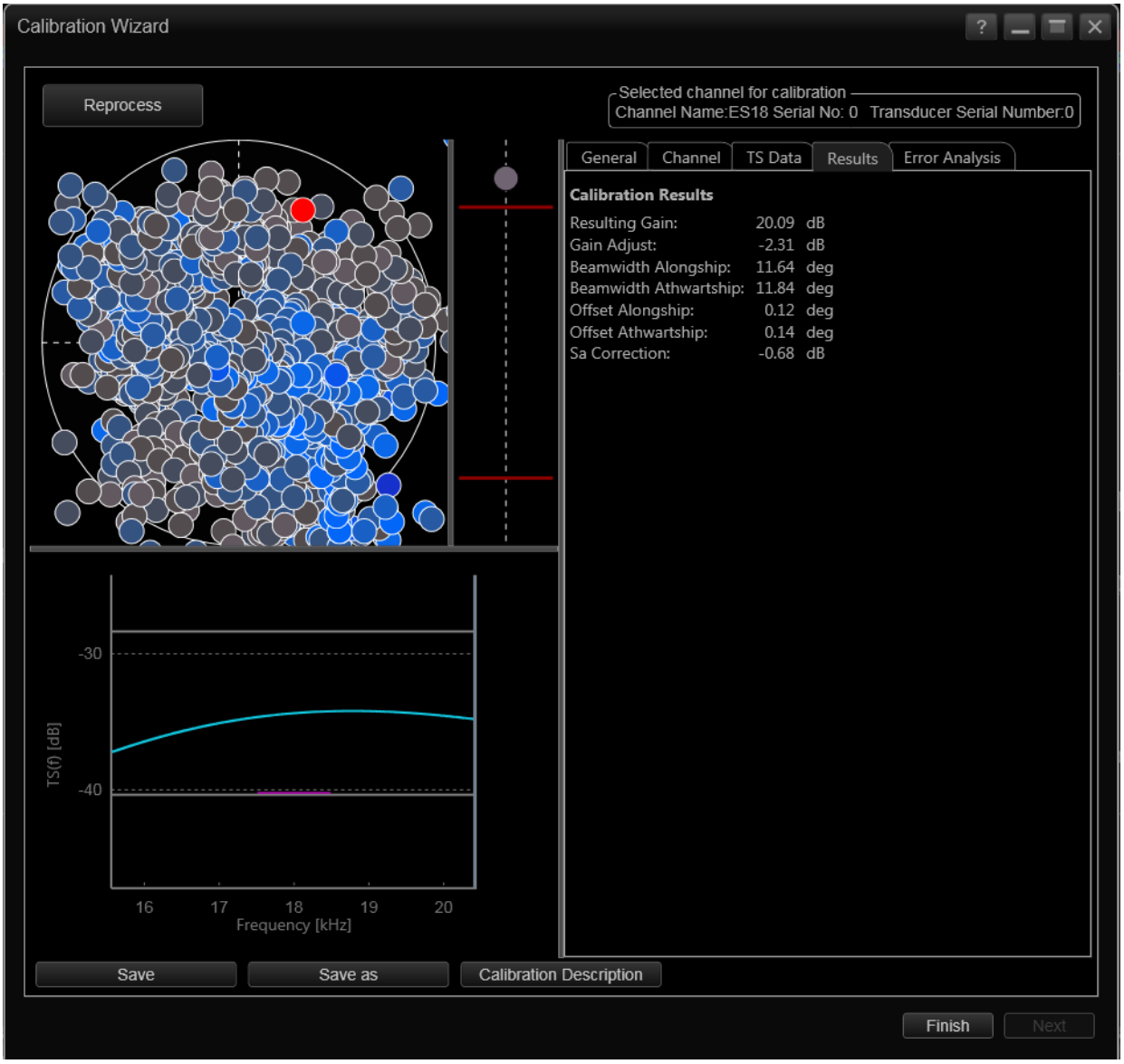

Figure 19. Screenshot of EK80 Calibration Wizard. Results for 18 kHz calibration at 1.024 ms.

70 kHz: 2.048 ms

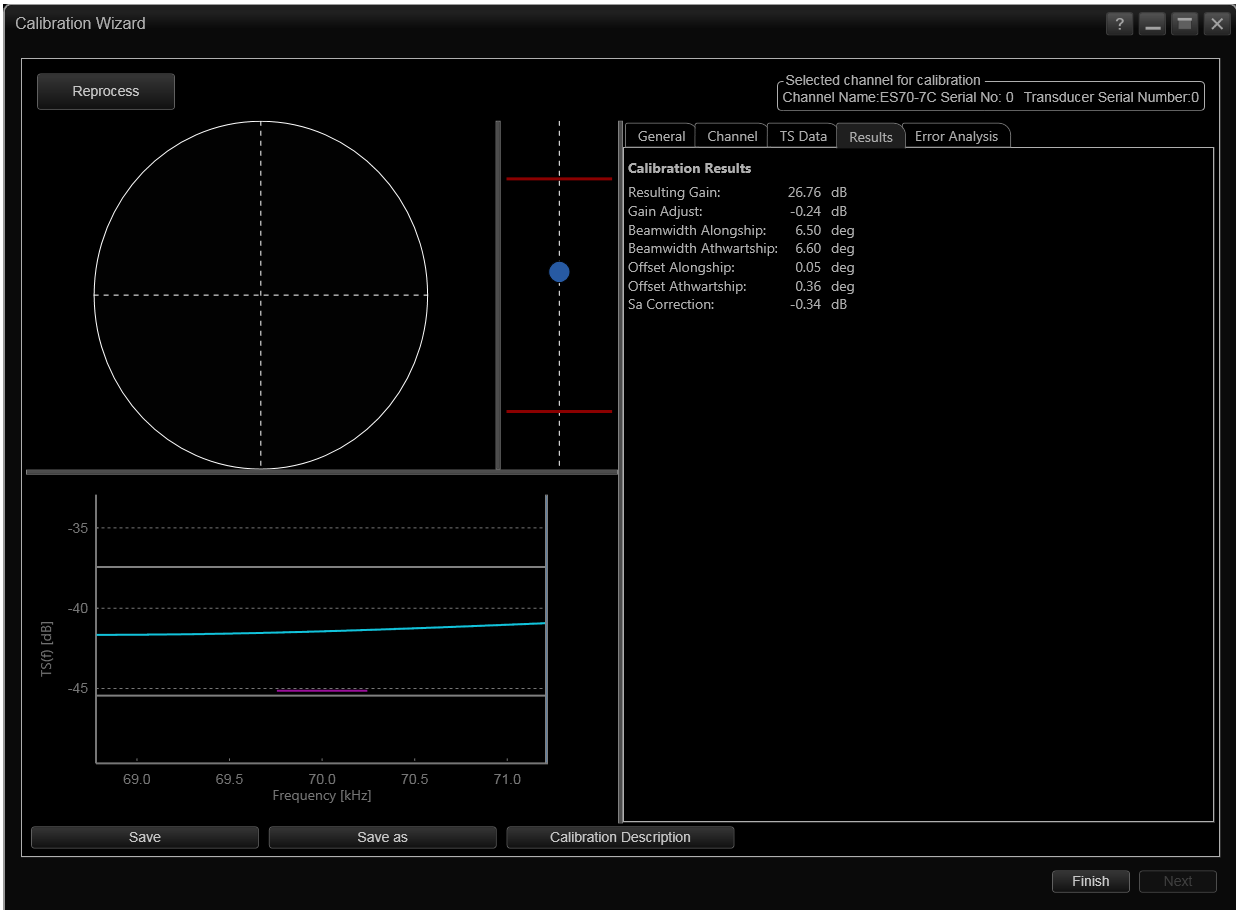

Figure 20. Screenshot of EK80 Calibration Wizard. Results for 70 kHz calibration at 2.048 ms.

70 kHz: 1.024 ms

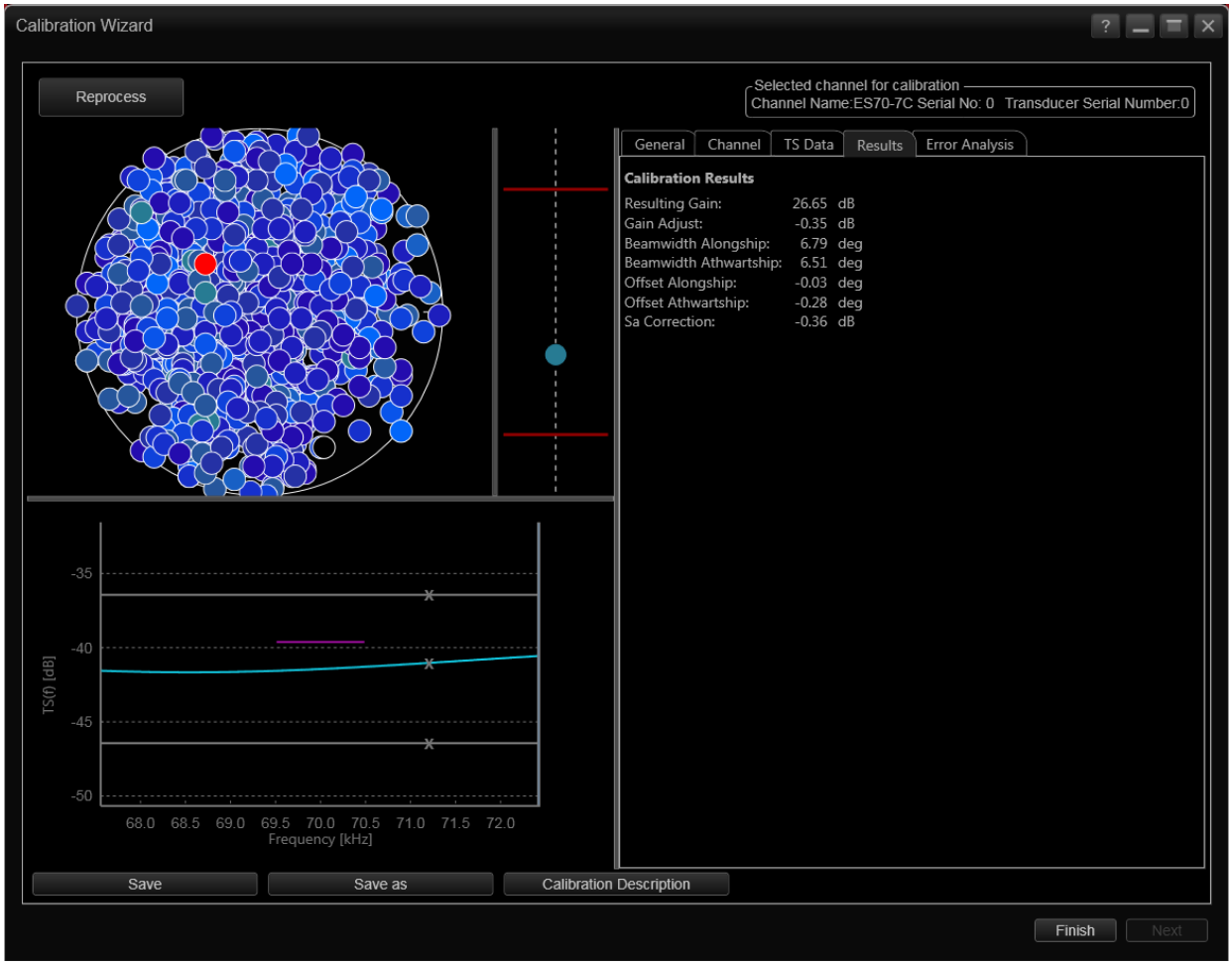

Figure 21. Screenshot of EK80 Calibration Wizard. Results for 70 kHz calibration at 1.024 ms.

120 kHz: 1.024 ms

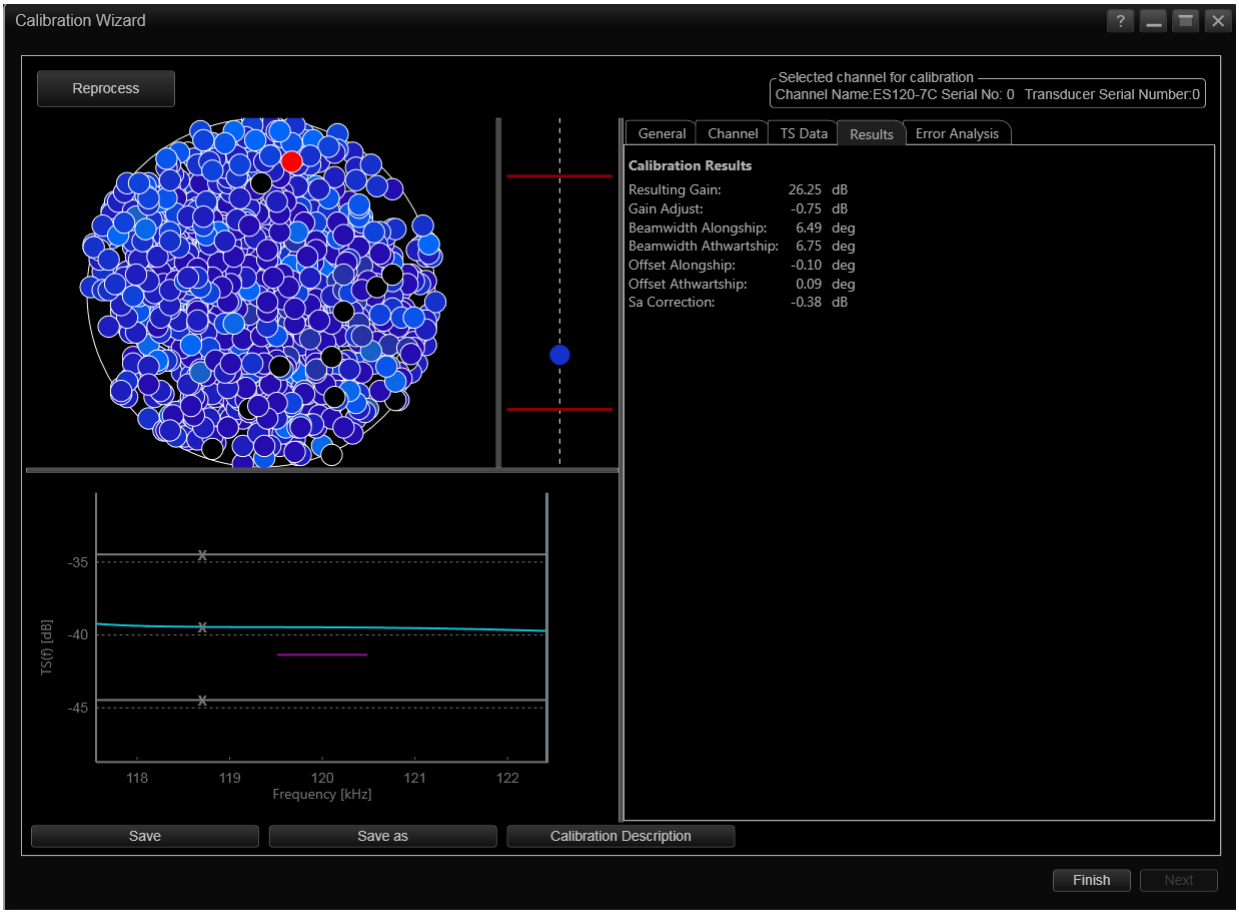

Figure 22. Screenshot of EK80 Calibration Wizard. Results for 120 kHz calibration at 1.024 ms.

200 kHz: 1.024 ms

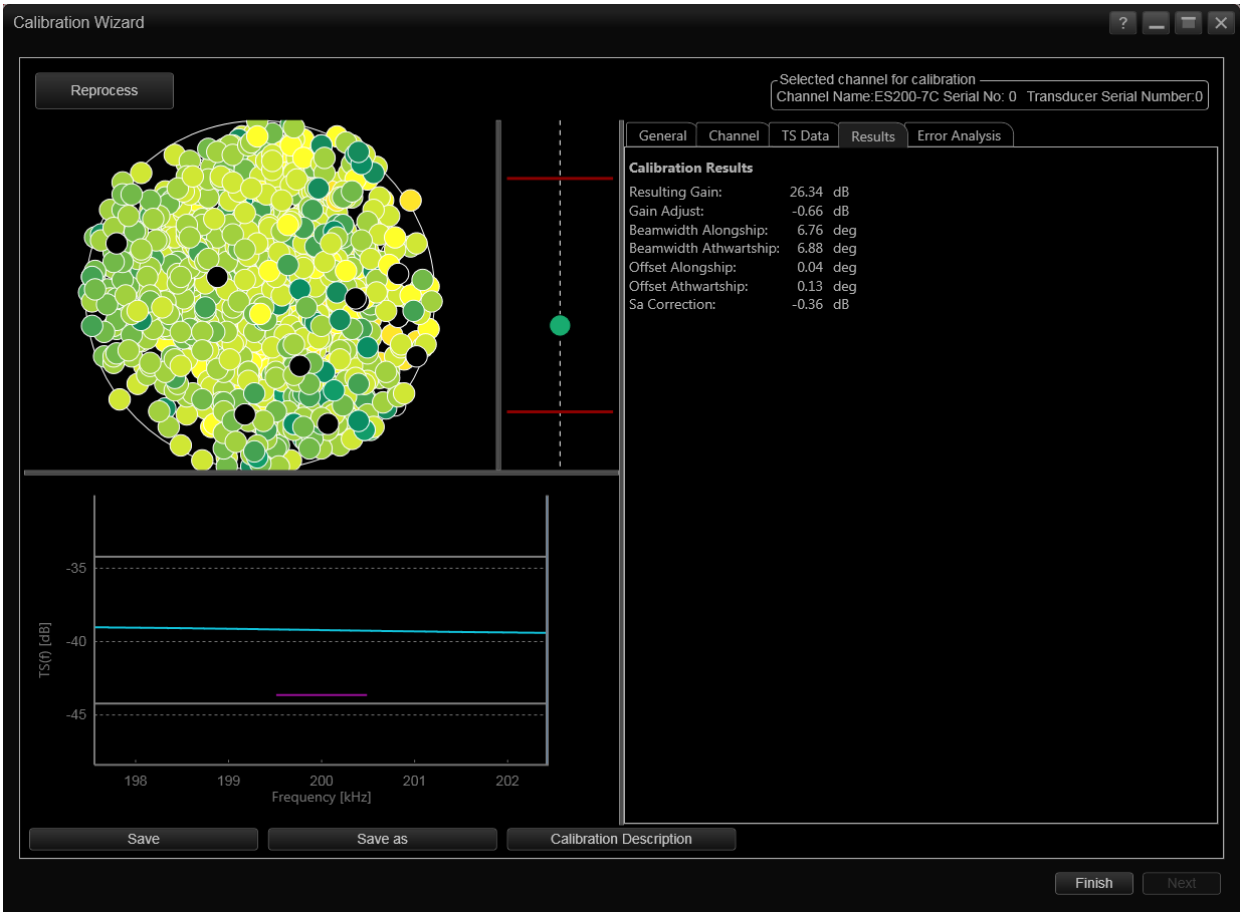

Figure 23. Screenshot of EK80 Calibration Wizard. Results for 200 kHz calibration at 1.024 ms.

Appendix 5 - Error Analysis

18 kHz: 4.096 ms

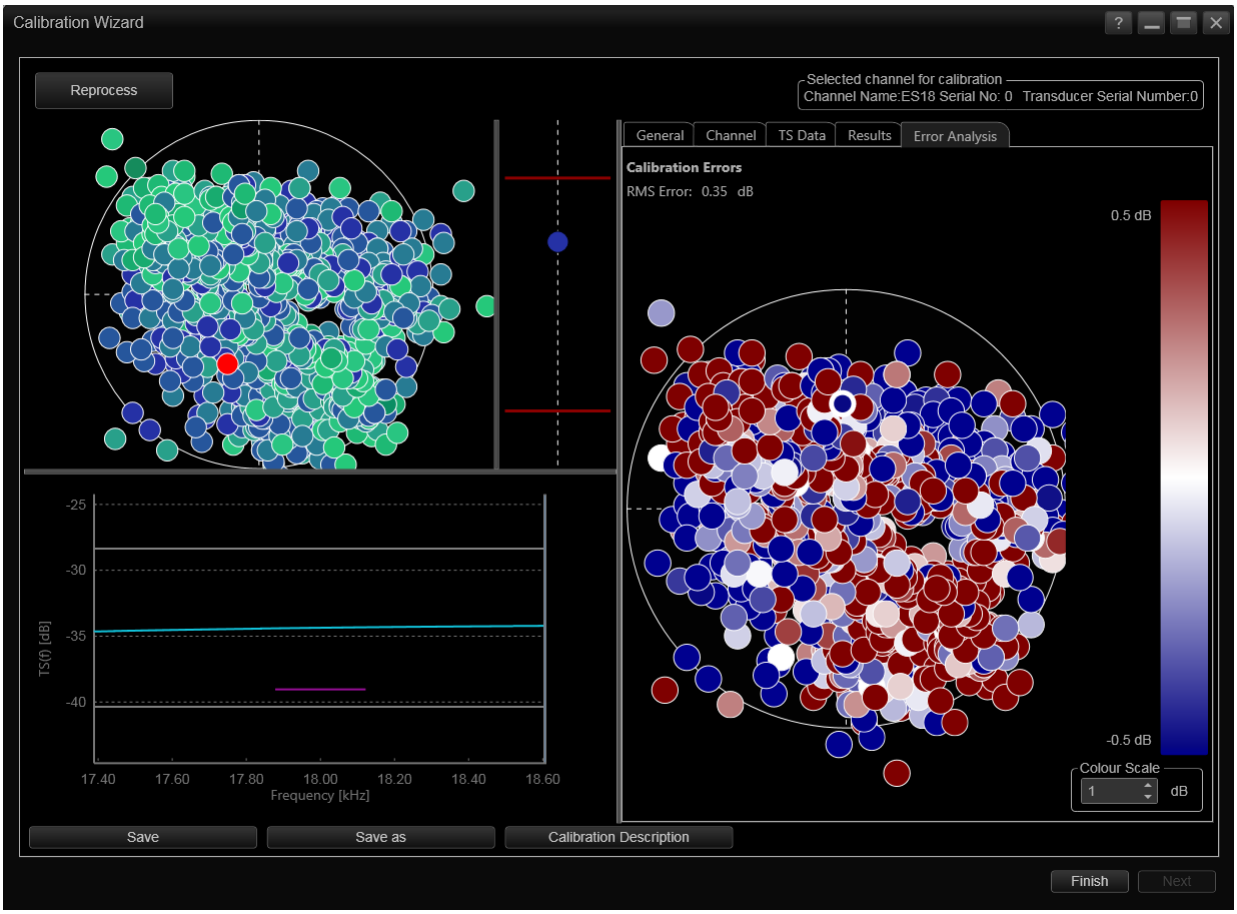

Figure 24. Screenshot of EK80 Calibration Wizard. Error analysis for 18 kHz calibration at 4.096 ms.

18 kHz: 1.024 ms

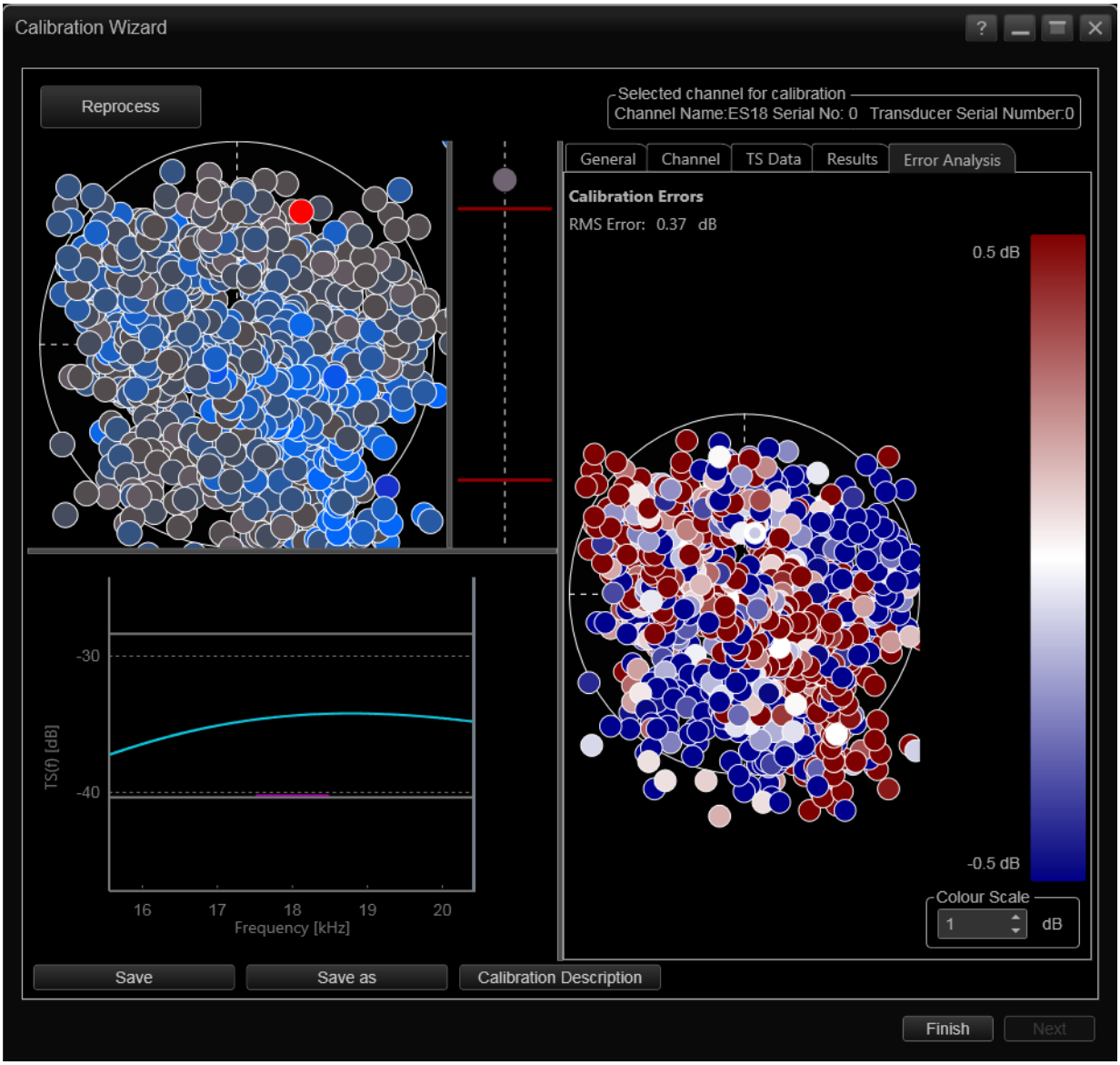

Figure 25. Screenshot of EK80 Calibration Wizard. Error analysis for 18 kHz calibration at 1.024 ms.

70 kHz: 2.048 ms

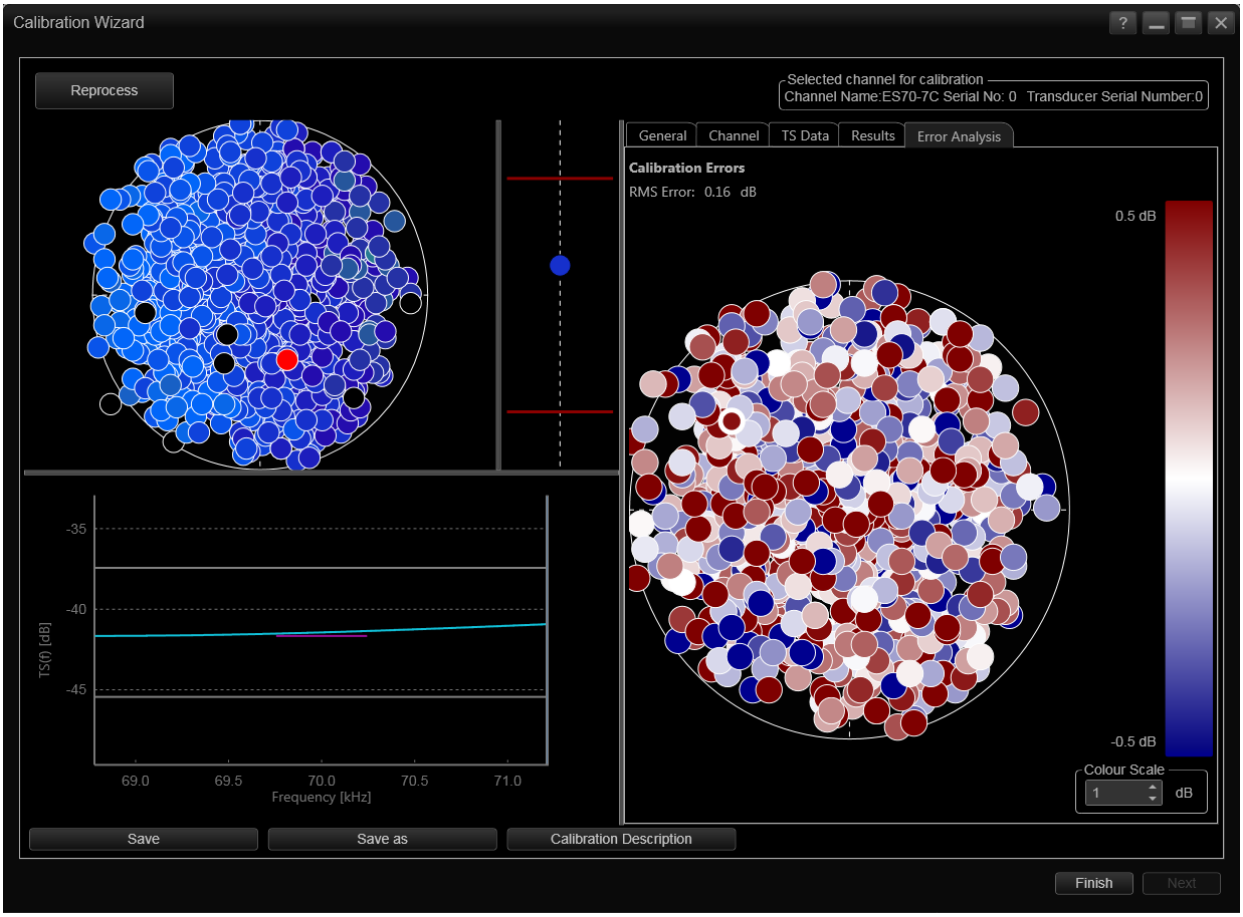

Figure 26. Screenshot of EK80 Calibration Wizard. Error analysis for 70 kHz calibration at 2.048 ms.

70 kHz: 1.024 ms

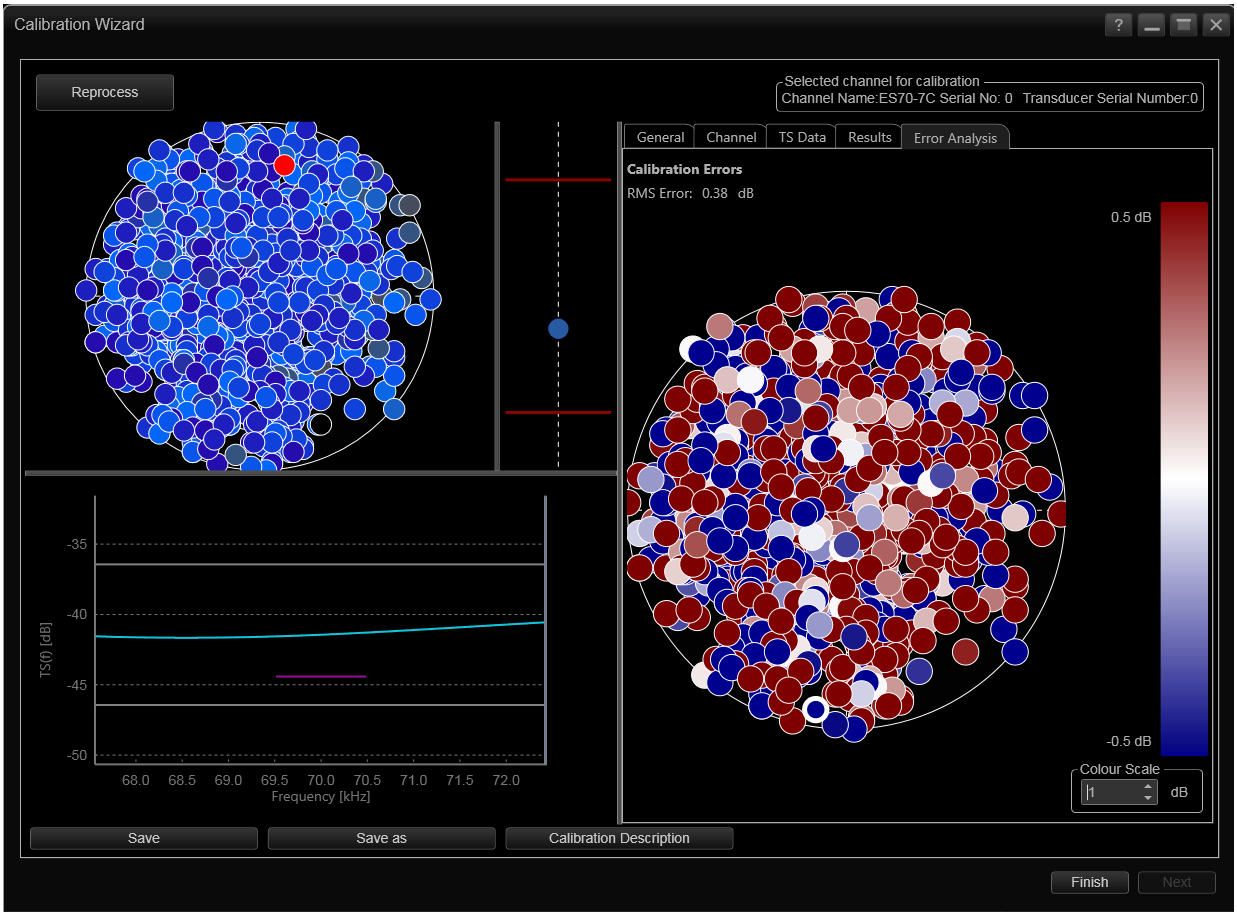

Figure 27. Screenshot of EK80 Calibration Wizard. Error analysis for 70 kHz calibration at 1.024 ms.

120 kHz: 1.024 ms

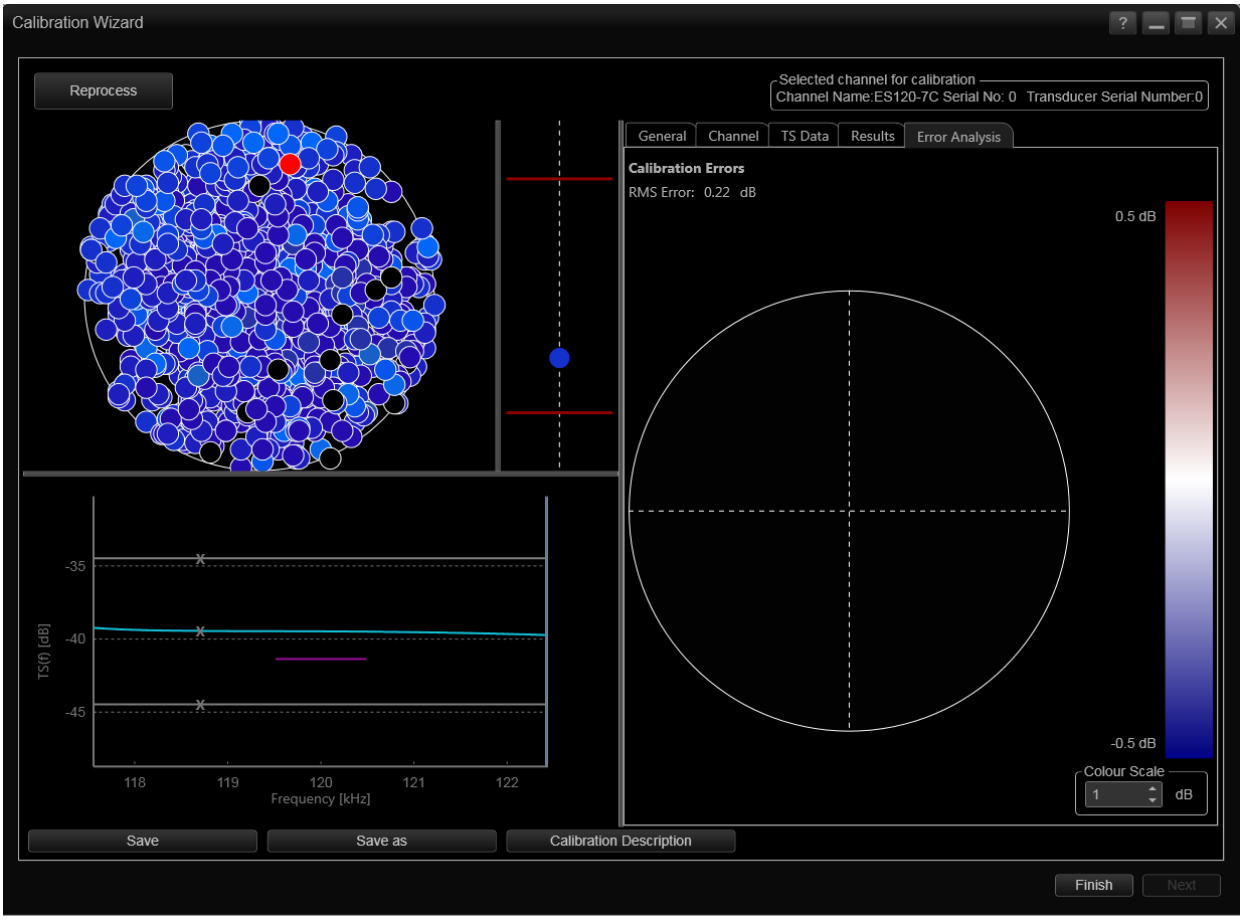

Figure 28. Screenshot of EK80 Calibration Wizard. Error analysis for 120 kHz calibration at 1.024 ms.

200 kHz: 1.024 ms

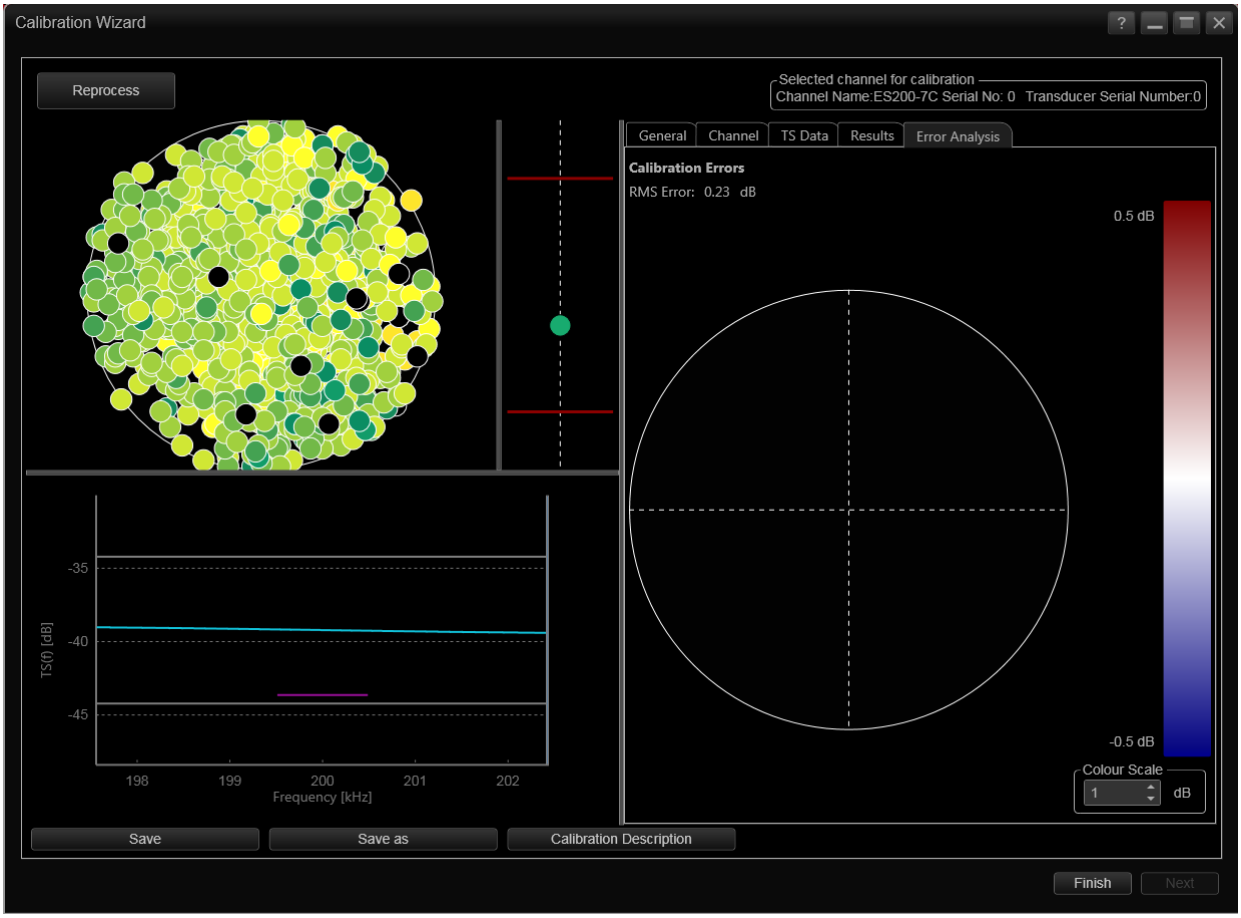

Figure 29. Screenshot of EK80 Calibration Wizard. Error analysis for 200 kHz calibration at 1.024 ms.

Appendix 6 - Detailed List of .raw and .xml Calibration Files

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
EX1802_EK60-D20180330-T154329.raw	3/30/2018	15:43:29	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T154329.raw	3/30/2018	15:43:29	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T162454.raw	3/30/2018	16:24:54	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T162454.raw	3/30/2018	16:24:54	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T162958.raw	3/30/2018	16:29:58	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T162958.raw	3/30/2018	16:29:58	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T170852.raw	3/30/2018	17:08:52	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T170852.raw	3/30/2018	17:08:52	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T174233.raw	3/30/2018	17:42:33	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T174233.raw	3/30/2018	17:42:33	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T181707.raw	3/30/2018	18:17:07	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T181707.raw	3/30/2018	18:17:07	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T184747.raw	3/30/2018	18:47:47	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T184747.raw	3/30/2018	18:47:47	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T192034.raw	3/30/2018	19:20:34	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T192034.raw	3/30/2018	19:20:34	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-	GPT	ES200-7C	Calibration

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
											7C			File
EX1802_EK60-D20180330-T193222.raw	3/30/2018	19:32:22	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T193222.raw	3/30/2018	19:32:22	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T223652.raw	3/30/2018	22:36:52	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T223652.raw	3/30/2018	22:36:52	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T224030.raw	3/30/2018	22:40:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T224030.raw	3/30/2018	22:40:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T225030.raw	3/30/2018	22:50:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T225030.raw	3/30/2018	22:50:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T230030.raw	3/30/2018	23:00:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T230030.raw	3/30/2018	23:00:30	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T231027.raw	3/30/2018	23:10:27	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT		Calibration File
EX1802_EK60-D20180330-T231027.raw	3/30/2018	23:10:27	1	GPT	ES18	GPT	ES38B	GPT	ES70-7C	WBT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180330-T232451.raw	3/30/2018	23:24:51	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T232451.raw	3/30/2018	23:24:51	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T232852.raw	3/30/2018	23:28:52	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T232852.raw	3/30/2018	23:28:52	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T233221.raw	3/30/2018	23:32:21	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T233221.raw	3/30/2018	23:32:21	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180330-T233910.raw	3/30/2018	23:39:10	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-			Calibration

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
											7C			File
EX1802_EK60-D20180330-T233910.raw	3/30/2018	23:39:10	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES200-7C			Calibration File
EX1802_EK60-D20180401-T144613.raw	4/1/2018	14:46:13	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T144613.raw	4/1/2018	14:46:13	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T145100.raw	4/1/2018	14:51:00	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T145100.raw	4/1/2018	14:51:00	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T150414.raw	4/1/2018	15:04:14	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T150414.raw	4/1/2018	15:04:14	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T151732.raw	4/1/2018	15:17:32	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T151732.raw	4/1/2018	15:17:32	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T153734.raw	4/1/2018	15:37:34	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T153734.raw	4/1/2018	15:37:34	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T155102.raw	4/1/2018	15:51:02	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T155102.raw	4/1/2018	15:51:02	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T160435.raw	4/1/2018	16:04:35	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T160435.raw	4/1/2018	16:04:35	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T161123.raw	4/1/2018	16:11:23	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T161123.raw	4/1/2018	16:11:23	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T161522.raw	4/1/2018	16:15:22	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T161522.raw	4/1/2018	16:15:22	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-	GPT	ES200-7C	Calibration

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
											7C			File
EX1802_EK60-D20180401-T162859.raw	4/1/2018	16:28:59	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T162859.raw	4/1/2018	16:28:59	1	WBT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T200840.raw	4/1/2018	20:08:40	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T200840.raw	4/1/2018	20:08:40	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T210711.raw	4/1/2018	21:07:11	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T210711.raw	4/1/2018	21:07:11	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T211139.raw	4/1/2018	21:11:39	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T211139.raw	4/1/2018	21:11:39	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T221346.raw	4/1/2018	22:13:46	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T221346.raw	4/1/2018	22:13:46	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180401-T222022.raw	4/1/2018	22:20:22	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T025903.raw	4/2/2018	2:59:03	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T031343.raw	4/2/2018	3:13:43	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T032927.raw	4/2/2018	3:29:27	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T052807.raw	4/2/2018	5:28:07	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T054643.raw	4/2/2018	5:46:43	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T074835.raw	4/2/2018	7:48:35	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T080439.raw	4/2/2018	8:04:39	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T101327.raw	4/2/2018	10:13:27	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-	GPT	ES200-7C	Calibration

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
											7C			File
EX1802_EK60-D20180402-T102939.raw	4/2/2018	10:29:39	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T144745.raw	4/2/2018	14:47:45	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T145329.raw	4/2/2018	14:53:29	0	GPT	ES18	GPT	ES38B	GPT	ES70-7C	GPT	ES120-7C	GPT	ES200-7C	Calibration File
EX1802_EK60-D20180402-T154146.raw	4/2/2018	15:41:46	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T155219.raw	4/2/2018	15:52:19	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T160002.raw	4/2/2018	16:00:02	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T160745.raw	4/2/2018	16:07:45	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T161527.raw	4/2/2018	16:15:27	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T162310.raw	4/2/2018	16:23:10	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T163052.raw	4/2/2018	16:30:52	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T163835.raw	4/2/2018	16:38:35	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T164617.raw	4/2/2018	16:46:17	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T165319.raw	4/2/2018	16:53:19	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T165452.raw	4/2/2018	16:54:52	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T165815.raw	4/2/2018	16:58:15	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T170326.raw	4/2/2018	17:03:26	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T170425.raw	4/2/2018	17:04:25	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T170633.raw	4/2/2018	17:06:33	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T171129.raw	4/2/2018	17:11:29	1	WBT	ES18									Calibration

EK file name	File Start Date UTC	File Start Time UTC	Transceiver Type(s) present in file 0 = GPT only 1 = GPT and WBT	Channel 1 GPT or WBT	Channel 1 Frequency	Channel 2 GPT or WBT	Channel 2 Frequency	Channel 3 GPT or WBT	Channel 3 Frequency	Channel 4 GPT or WBT	Channel 4 Frequency	Channel 5 GPT or WBT	Channel 5 Frequency	Comment
														File
EX1802_EK60-D20180402-T171551.raw	4/2/2018	17:15:51	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T171728.raw	4/2/2018	17:17:28	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T171909.raw	4/2/2018	17:19:09	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T172149.raw	4/2/2018	17:21:49	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T172443.raw	4/2/2018	17:24:43	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T172833.raw	4/2/2018	17:28:33	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T173037.raw	4/2/2018	17:30:37	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T173820.raw	4/2/2018	17:38:20	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T174416.raw	4/2/2018	17:44:16	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T175159.raw	4/2/2018	17:51:59	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T175941.raw	4/2/2018	17:59:41	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T180724.raw	4/2/2018	18:07:24	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T181507.raw	4/2/2018	18:15:07	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T182249.raw	4/2/2018	18:22:49	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T183032.raw	4/2/2018	18:30:32	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T183814.raw	4/2/2018	18:38:14	1	WBT	ES18									Calibration File
EX1802_EK60-D20180402-T184557.raw	4/2/2018	18:45:57	1	WBT	ES18									Calibration File

.xml file name	Date
CalibrationDataFile-D20180330-T154445-EK60-70kHz-1024.xml	3/30/2018
CalibrationDataFile-D20180330-T154445-EK60-70kHz-2048.xml	3/30/2018
CalibrationDataFile-D20180330-T154445-EK60-120kHz.xml	3/30/2018
CalibrationDataFile-D20180330-T154445-EK60-200kHz.xml	3/30/2018
CalibrationDataFile-D20180401-T200856-EK60-18kHz-4096.xml	4/01/2018
CalibrationDataFile-D20180401-T211101-EK60-18khz-1024.xml	4/01/2018

Appendix 7 - Vessel Offsets for Transducer Hull Locations

Vessel Offsets (meters)			
Transducer	X	Y	Z
EK60 (ES18)	-0.57418	1.76576	6.78192
EK80 (ES70-7C)	6.46244	3.37807	6.84786
EK60 (ES120-7C)	5.19593	3.37742	6.83574
EK60 (ES200-7C)	6.12256	3.5376	6.8436