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U.S. Extended Continental Shelf Cruise to Map Gaps in Kela and Karin Ridges, Johnston Atoll, Equatorial Pacific Ocean

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CRUISE REPORT

RV *Kilo Moana*

U.S. Extended Continental Shelf Cruise to Map Gaps in Kela and Karin Ridges, Johnston Atoll, Equatorial Pacific Ocean

CRUISE KM14-17

August 9, to August 22, 2014

Papeete, Tahiti to Honolulu, HI

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University of New Hampshire
Durham, NH 03824

September 1, 2014

UNH-CCOM/JHC Technical Report 14-001

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Introduction

The objectives for cruise KM14-17 are to map the bathymetry of two gaps in two submarine ridges in the vicinity of Johnston Atoll. One ridge gap occurs along the informally named Keli Ridge (Hein et al., 2005) south of Johnston Atoll and the other ridge gap occurs north of Johnston Atoll that separates Sculpin Ridge (also informally called Karin Ridge) and Horizon Ridge, all in the central equatorial Pacific (Fig. 1). The cruise took advantage of a scheduled dead-head transit from Papeete, Tahiti to Honolulu, Hawai'i that could be extended for 5 days to include the planned mapping. The mapping is in support of the U.S. (Extended Continental Shelf (ECS) Task Force. These areas were identified by the ECS Central Pacific Integrated Regional Team as having the potential for an ECS. The Center for Coastal and Ocean Mapping/Joint Hydrographic Center (CCOM/JHC) of the University of New Hampshire was directed by the U.S. Congress, through funding to the U.S. National Oceanic and Atmospheric Administration (NOAA) to conduct these bathymetry surveys and archive the resultant data.

Just south of Johnston Atoll, Keli Ridge has a ~24 km wide gap (Fig. 2) along its WNW-ESE extent. The predicted bathymetry of Smith and Sandwell (1997, v. 15.1) determines the gap has a maximum depth of 5093 m) compared to abyssal depths of 5592 m to the south of the ridge and 5190 m to the north. The water depths of the predicted bathymetry of Smith and Sandwell (1997) are based on satellite altimetry and may not be accurate to ±100+ m. More significantly, the 1850 m/pixel grid spacing of the predicted bathymetry does not resolve details of features such as archipelagic aprons that may actually span across such a gap. Consequently, multibeam bathymetry is needed to investigate the details of the gap.

A similar situation occurs to the north of Johnston Atoll between the northern nose of Sculpin Ridge and Horizon Ridge (Fig. 2). The gap from Smith and Sandwell predicted bathymetry has a water depth of 5015 m whereas abyssal depths to the southwest are 5275 m and to the northeast are 5171m. This gap is only 11 km wide and, again, the predicted bathymetry does not resolve any archipelagic aprons.

Because the mapping took advantage of a transit of the RV *Kilo Moana* from Papeete, Tahiti to Honolulu, Hawai'i that the University of Hawai'i had scheduled for August 2014, the amount of time available for the ECS mapping was restricted by the schedule for cruises before and after the transit leg. NOAA contracted through NSF-UNOLS (National Science Foundation University National Oceanographic Laboratory System) with the University of Hawai'i to use their 186-ft, 3060-ton RV *Kilo Moana* (Fig. 3), a SWATH (small water area twin hull) vessel with a hull-mounted Kongsberg EM122 MBES as well as a Knudsen CHIRP 3260 3.5-kHz chirp sub-bottom profiler and a Bell BGM-3 gravimeter.

The UNH chief scientist was responsible for organizing and conducting the cruise, as well as collecting and processing the bathymetry, acoustic-backscatter and chirp sub-bottom data aboard ship. The University of Hawai'i was responsible for the post-cruise processing of the gravity data.

The cruise began with a 9 day transit that crossed the Line Islands ridge to a point south of Keli Ridge. A full patch test, including a calibration of the XBT system with an XCTD cast, was performed on the transit. The next 2.5 days consisted of mapping two ridge gaps;

one on Keli Ridge and the other at the northern terminus of Sculpin (Karin) Ridge and the Line Islands ridge. The cruise ended with a three day transit to Honolulu, HI. The cruise mapped a total of 97,250 km^2 in 13.5 survey days and collected 6275 line km of MBES lines with an average speed of 11.6 knts. A summary of the cruises is given in Table 1.

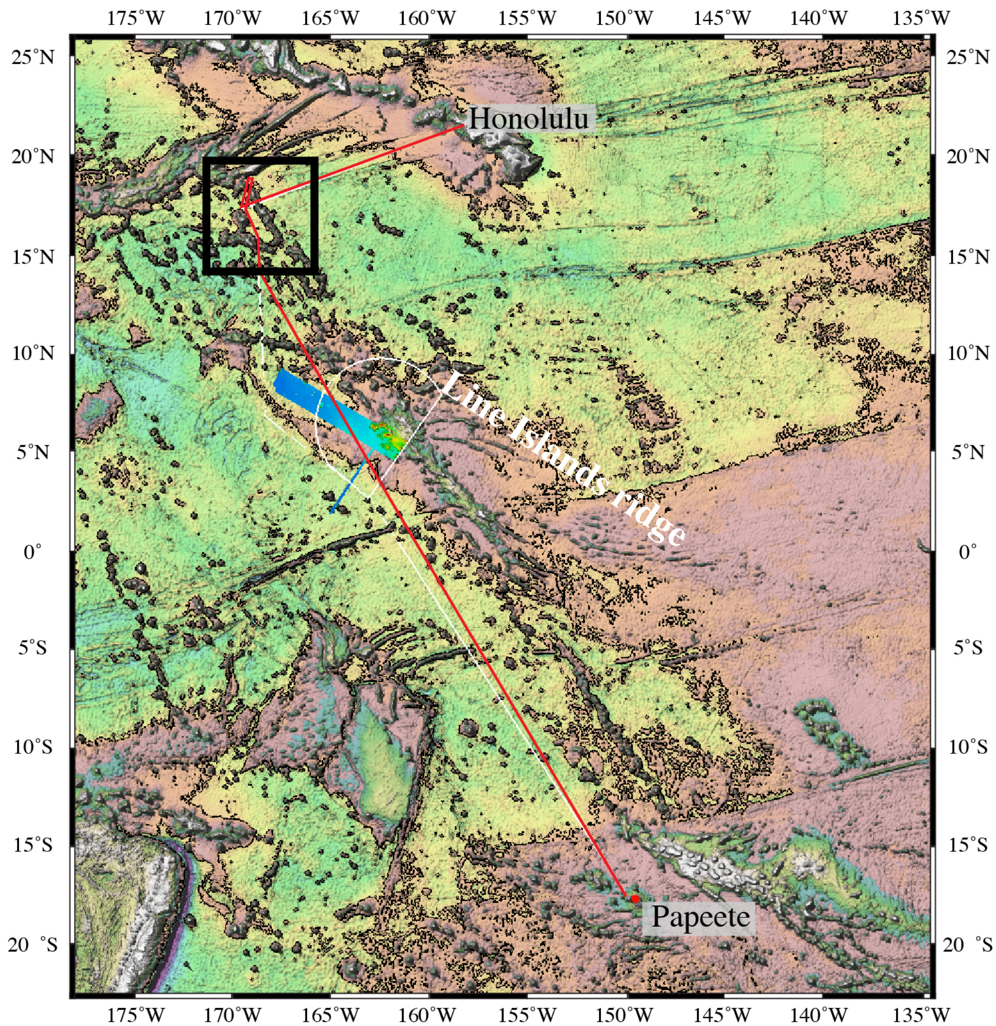


Figure 1. Cruise track overview (red line) and areas of interest; (A) southern platform flank of the northern Line Islands ridge and (B) Keli and Sculpin Ridge gaps. White polygon is U.S. EEZ.

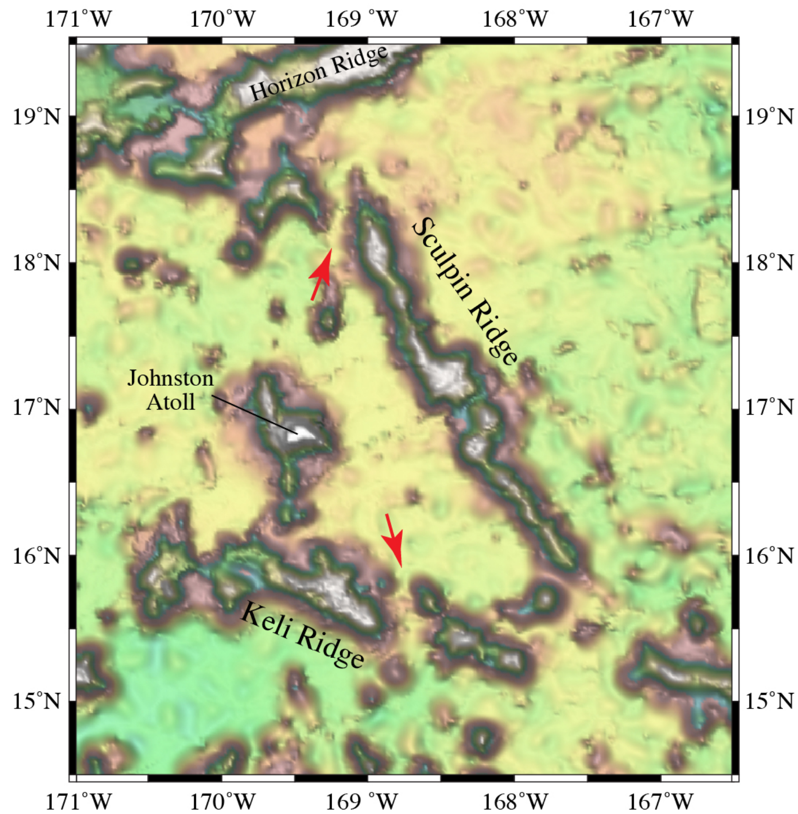


Figure 2. Overview of Keli and Sculpin Ridge gaps (red arrows).

Table 1. Cruise Statistics

Julian dates	JD221 to JD234
Dates	August 9 to August 22, 2014
Weather delays	0 days
Total non-mapping days (transits)	11 days
Total mapping days	2 days
Total area mapped	97,250 km^2 (41,481 mi^2)
Total line kilometers	6275 km (3387 nmi)
Beginning draft	7.01 m
Ending draft	7.13 m
Average ship speed for survey	11.5 kts

Figure 3. RV *Kilo Moana*.

The Multibeam Echosounder System and Associated Systems

The hull-mounted Kongsberg Maritime EM122 MBES system aboard RV *Kilo Moana* is a 12-kHz multibeam echosounder that transmits a 1˚ wide (fore-aft) acoustic pulse and then generates 432-2˚ receive apertures ("beams") over a 150˚ swath. The system can automatically adjust the pointing angles of the receive beams to maximize the achievable coverage or a maximum aperture can be defined by the operator. The transmit cycle can be rapidly duplicated to provide two swaths per ping, each transmitted with a small along-track offset that compensates for water depths and ship speed to generate a constant sounding spacing in the along-track direction. This mode can provide as many as 864 soundings per transmit cycle swath (432 soundings per swath) in the high-density dual-swath mode. With more than one sounding generated per beam in the high-density mode, the horizontal resolution is increased and is almost constant over the entire swath when run in the equidistant mode. In addition, the receive beams can be steered as much as 10° forward or aft to reduce the effects of specular reflection at nadir and near-nadir angles.

The EM122 uses both continuous wave (CW) and frequency modulation (FM) pulses with pulse compression on reception to increase the signal-to-noise ratio. The transmit pulse is split into several independently steered sectors to compensate for vessel yaw. The system is pitch, yaw and roll stabilized to compensate for vehicle motion during transmission. Kongsberg Maritime states that, at the 10-ms pulse length used during this survey (deep mode), the system is capable of depth accuracies of 0.3 to 0.5% of water depth. The Konsberg Maritime EM122 Product Description should be consulted for the full details of the MBES system. The installed software versions used on the Seafloor Information System (SIS) and the transmit-receive unit (TRU) systems are given in Table 2.

Table 2. Kongsberg software version numbers.

System	Software Version
Seafloor Information System	3.6.4, build 4.1.3 120702
TRU CPU	1.2.8, 120702
TRU DDS	3.5.4 120124
TRU BSP Master	2.2.3 090702
TRU BSP Slave	2.2.3 090702
TRU RX version	Feb. 18 2010 Rev. 1.11
TRU TX LC version	June 17 2008 Rev. 1.11

A hull-mounted Applied Microsystems Ltd Smart SV&T sound-speed sensor (SN 4844) was used to measure the sound speed at the MBES array for accurate beam forming. The sensor was calibrated at the factory in January 2010. Beam forming during this cruise used the high-density equidistant mode with FM enabled and Automatic mode in deep water. For receive beams at near-normal incidence, the depth values are determined by center-of-gravity amplitude detection, but for most of the beams, the depth is determined by split-beam phase detection. The spacing of individual sounding is approximately every 50 m, regardless of survey speed.

An Applanix POS/MV model 320 version 4 inertial motion unit (IMU) (with TrueHeave) was interfaced to a C&C Technologies, Inc. CNAV model 3050 provided differential corrections that provided position fixes with an accuracy of ~0.5 m. The IMU provides roll, pitch and yaw at accuracies of better than 0.1˚ at 1 Hz. The MBES system can incorporate transmit beam steering up to ±10˚ from vertical, roll compensation up to ±10˚ and can perform yaw corrections as well. All horizontal positions were georeferenced to the WGS84 ellipsoid and vertical referencing was to instantaneous sea level.

The Kongsberg Maritime EM122 is capable of simultaneously collecting full time-series acoustic backscatter that is co-registered with each bathymetric sounding. The full time-series backscatter is a time series of acoustic-backscatter values across each beam footprint on the seafloor. If the received amplitudes are properly calibrated to the outgoing signal strength, receiver gains, spherical spreading, and attenuation, then the corrected backscatter should provide clues as to the composition of the surficial seafloor. However, the interpreter must be cautious because the 12-kHz acoustic signal undoubtedly penetrates the seafloor to an unknown, but significant (meters) depth, thereby generating a received signal that is a function of some unknown combination of acoustic impedance, seafloor roughness and volume reverberation.

The derived sound-speed profiles from numerous XBT casts (see Appendix 3) were used to raytrace each MBES receive signal to the seafloor and back to the receiver to compensate for the refraction effects within the water column.

The University of Hawai'i (UH) assigned the cruise designator *KM14-19* to the cruise. All raw MBES files were initially labeled with a unique Kongsberg file designator but the files were renamed to JohnstonAtoll_line_X, where X is a consecutive line number starting with 1 (see Appendix 1). Transit lines were given line numbers suffixed with "tran" and patch test lines were prefixed with "patch. The renaming of MBES and Knudsen lines was done so that the individual lines would be unequivocally identified with the cruise.

Water-column sound-speed profiles were routinely collected every 6 hrs during the cruise as well as anytime the sound speed measured at the transducers differed by 1.0 m/s from the value at the transducer depth from the XBT-derived sound speed. Sound speeds were calculated from measurements of water temperature vs depth using Sippican Deep Blue expendable bathythermographs (XBTs) and processed by SVPeditor. SVPeditor uses local salinity profiles from the World Ocean Atlas together with the XBT temperature measurements to derive sound speed for each XBT cast. Deep Blue XBTs have a 760-m maximum depth of measurement and the profiles were extended to 12,000 m to provide a profile throughout the water column for the MBES software. A Sippican-Lockheed XCTD was used to calibrate the XBTs during the patch test. The two temperature sensors (serial no. 2013 and 2700), the conductivity sensor (serial no. 3326) and pressure sensor (serial number 92859) were last calibrated by Sea Bird Electronics on June 17, 2009. Derived sound-speed profiles derived from the two systems (XCTD vs XBT) from data collected during the patch test were compared between the systems to calibrate the XBT (Fig. 4).

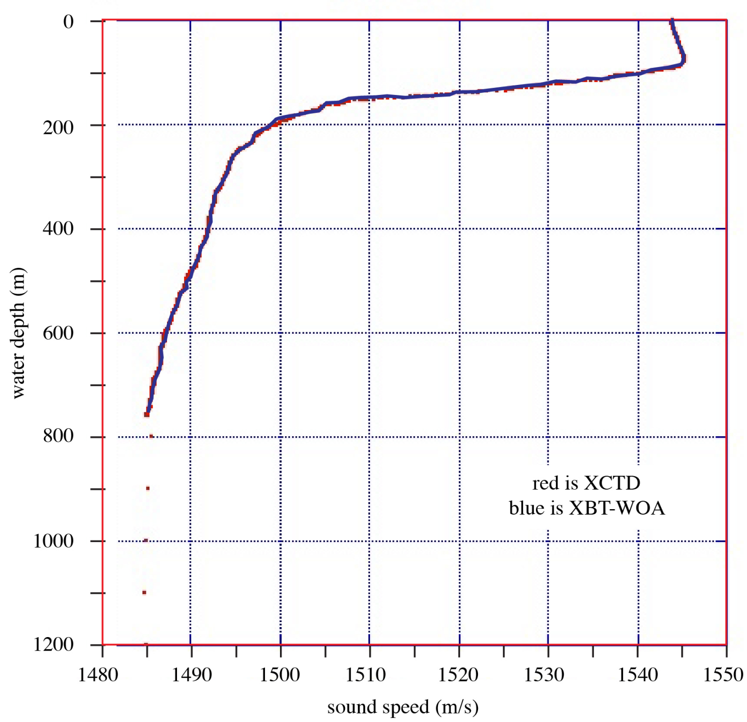


Figure 4. Comparison of sound speeds calculated from XCTD (red) and XBT (blue).

A full patch test was not conducted until mid-way through the cruise because of the uncertainty of the ship speed and the constrained time schedule for the cruise. However, after 6 days of steaming with an average speed of 12 knts, we realized we had the time to conduct a full patch test to ensure that the sensor offsets were correct. Tables 2 and 3 show the sensor offsets used for the survey.

Table 3. Initial system sensor offsets

	Location Offsets			Angular Offsets		
Sensor	**Forward**	**Stbd**	**Down**	**Roll**	**Pitch**	**Heading**
POS 1	0.00	0.00	0.00	–	–	–
POS 2	0.00	0.00	0.00	–	–	–
POS 3	0.00	0.00	0.00	–	–	–
Tx tdr	-3.27	-0.053	0.803	-0.064	0.024	0.026
Rx tdr	1.156	-1.225	0.804	-0.092	0.044	0.046
Attitude 1	0.00	0.00	0.00	0.09	0.00	0.00
Attitude 2	0.00	0.00	0.00	0.00	0.00	0.00

Departure draft….7.01 m bow   Final draft….7.01 m

Table 4. Offset corrections determined by Patch Test

Offset	Value
roll	-0.03˚
pitch	-0.2
yaw	0
latency	0

Ancillary Systems

Knudsen CHIRP 3260 subbottom profiler

A CHIRP 3260 subbottom profiler was deployed throughout the cruise. The system is a hull-mounted 3.5-kHz system that produces an FM signal with a 1-kHz bandwidth. The system has adjustable pulse lengths, power and gain settings allowing it to acquire good bottom detection and subbottom resolution to about 50 m subbottom. The digital data were recorded in SEG-Y format and processed with Chesapeake Technologies, Inc. SonarWeb software. SEG-Y line names were synchronized with the MBES line names (Appendix 2) so that they correspond with one another. The Knudsen system was synchronized with the EM122 MBES so that it did not interfere with the multibeam data.

Bell gravity meter

A Bell BGM-3 gravimeter was run on a hands-off basis, not to interfere with the MBES operations. A land tie was made at Papeete, Tahiti before the cruise and at Honolulu at the end of the cruise (see Appendix 5). Post-cruise processing of the gravity data will be done by the University of Hawai'i geophysics group.

MBES Data Processing

The raw multibeam bathymetry and acoustic backscatter data were processed aboard ship using the University of New Brunswick's SwathEd software suite, version 20140429.

Each Kongsberg .all file was collected by the onboard Kongsberg SIS data-acquisition system. Once a line was completed, the .all file was copied to a server that could be accessed by the UNH computer via the shipboard network. Each .all file was renamed from the Kongsberg-generated file name to *JohnstonAtoll_line_x.all* (see Appendix 1). The line numbers commenced with JohnstonAtoll_line_tran1 for the transit to the map area and then commenced to JohnstonAtoll_line_XX when the target mapping began. Each .all file is composed of individual data packets of beam bathymetry (range and angle), beam average and full time-series acoustic backscatter, navigation, parameters, sound-speed profiles, orientation and sound speed at the transducer. The first step in the processing separates each of these data packets into the individual files.

The second step in the processing plots the navigation file so that any bad fixes can be flagged. Once this step is completed, the validated navigation is merged with the bathymetry and acoustic backscatter files.

The third step involves editing (flagging) individual soundings that appear to be fliers, bad points, multipaths, etc. The entire file of soundings is viewed and edited in a sequence of steps through the file. Once the bathymetry file has been edited, the valid individual soundings are gridded into subarea DTM maps and the co-registered valid acoustic backscatter full beam time series is assembled into a file and gridded into subarea mosaics.

The area covered by the entire cruise was subdivided into 35 subarea bathymetry maps (Fig. 5). Each subarea map was designed to maximize the spatial resolution allowed by the mapped water depths within the area.

The Areas

The main physiographic feature in this area of the Central Pacific is the northern extent of the Line Islands, sometimes referred to as the Line Islands chain in the scientific literature, but there are very few actual islands on the feature in the section mapped. In fact, only Johnston Atoll, Kingman Reef and Palmyra Atoll rise above sea level within the area of U.S. ECS interest. However, there are several submarine ridges in the area, some of which trend NW-SW whereas others trend E-W. The general region is located in the central equatorial Pacific Ocean about midway between Tahiti and Honolulu, HI (Fig. 1).

The area mapped during this transit leg was restricted by the time allotted to map two small areas; a gap in Keli Ridge and the northern nose of Karin (Sculpin) Ridge.

Morphologically, the entire Line Islands ridge extends >4000 km from the Tuamotu chain in the south to the Mid Pacific Mountains in the north with widely spaced, isolated seamounts and ridges. Winterer (1976) subdivided the Line Islands ridge into a Northern, Central and Island Province, each with its distinct gross morphology. The main ridge has a remarkably consistent trend of 147˚-327˚ throughout its length, a feature that has generated widely differing interpretations of its origin (Morgan, 1972; Clague and Jarrard, 1973; Winterer et al., 1973; Jackson and Schlanger, 1976; Natland, 1976; Schlanger et al, 1976; Crough and Jarrard, 1981; Davis et al., 2002). Some authors, Morgan (1972) and summarized in Natland (1976), interpret the Line Islands ridge as a hotspot trace with a younging to the south. Other authors, summarized in Davis et al. (2002), interpret the ridge as a huge buildup of volcanics that was constructed during two periods (86 to 81 Myr and 73 to 68 Myr) within a zone of lithospheric extension along pre-existing areas of weakness.

The Line Islands ridge is composed of submarine volcanoes with a large range of chemistries, sizes and shapes (Davis, et al., 2002). The area of interest is the northern portion of the Line Islands ridge, an area dominated by a huge broad ridge structure, as opposed to a chain of seamounts, composed of isolated and amalgamated seamount peaks that rises ~1500 m above the adjacent seafloor. This 170-km-long main ridge is ~225 km wide in the north and narrows to ~50 km wide in the south (out of the survey area) before it eventually disappears. Two chains of seamounts form the eastern and western margins of the main ridge summit and are separated by ~40 km in the south and ~100 km in the north of the survey area. Water depths of the main ridge range from 2000 to 3000 m with isolated seamounts that rise to depth of less than 1000 m.

Northern Line Islands Ridge

The setting and geology of the Line Islands ridge is discussed in the 2009 cruise report for the Kingman Reef-Palmyra Atoll section of the ridge (Gardner and Calder, 2010). The Kingman-Palmyra region spans the boundary of the southern part of Winterer's Central Province and northern part of his Line Islands Province. The ridge sits above a broad platform that abruptly rises about 1000 m above local abyssal depths (Fig. 5). The extent of the platform is unknown because there has not been systematic mapping in the Line Islands ridge area using modern MBES mapping systems, other than the 2009 ECS cruise. The platform has never been sampled, although it is a good assumption that it is composed of basalt flows similar to the composition of the Line Islands ridge proper.

The existing multibeam tracks in the area cross the platform and ridge and provide a suggestion of the breadth of the platform (Fig. 6). However, perhaps a better evaluation of the breadth of the platform is determined by slicing the satellite bathymetry with an opaque plane that hides the seafloor at depths deeper than the plane (Fig. 7).

The restricted time schedule allowed only a single SE-NW line (Fig. 5) in the area on the transit to Keli Ridge so line was chosen to map the slope of the platform with the hope of collecting a swath wide enough to capture both the basin as well as a narrow section of the upper surface of the platform, thus defining the bathymetric expression of the platform margin along the southern margin of the platform.

Keli Ridge

Keli Ridge, informally named by Koschinsky et al., (1997), is a prominent cross-trend (Winterer, 1976) that intersects the Line Islands ridge at an angle of 47˚ (Fig. 8). Sculpin Ridge (Fig. 8) is the northern extension of the Line Islands ridge in this region. Keli Ridge is a volcanic edifice that has been dated 72 to 67 Ma (Davis, et al., 2002). Keli Ridge is ~680 km long and rises 4000 m above the abyssal seafloor. The ridge has three breaks or gaps, two of which reach regional abyssal depths of 5500 m but the third gap is only 4700 m deep, 800 m shallower than the regional abyssal depths. These water depths are measured on the satellite bathymetry of Smith and Sandwell (1997 v. 15.1) and may be in error by hundreds of meters.

Sculpin (Karin) Ridge

The ~740-km-long Sculpin Ridge lies on the trend of the Line Islands ridge and the northern extent abruptly ends about 75 km from Horizon Guyot on Horizon ridge (Fig. 9).

Sculpin ridge has only one 36 km gap along its length. The ridge rises ~4000 m from the abyssal seafloor to within about 1500 m of the sea surface. The ridge is volcanic edifice composed of basalts that date from 86 to 81 Ma (Schlanger et al., 1984; Davis, et al., 2002). Davis et al. (2002) argue that the ages of the basalts from Sculpin Ridge are not an extension of an age-progressive trend of a hot spot; rather, they argue that the Sculpin Ridge basalts occurred during an episode of extensive volcanism that lasted ~5 Myr. The ages of the basalts from Sculpin Ridge contrast with the 99.6 Ma age of the basalts from Horizon ridge (Winterer, 1973), demonstrating that the two ridges are not related to the same magmatic events.

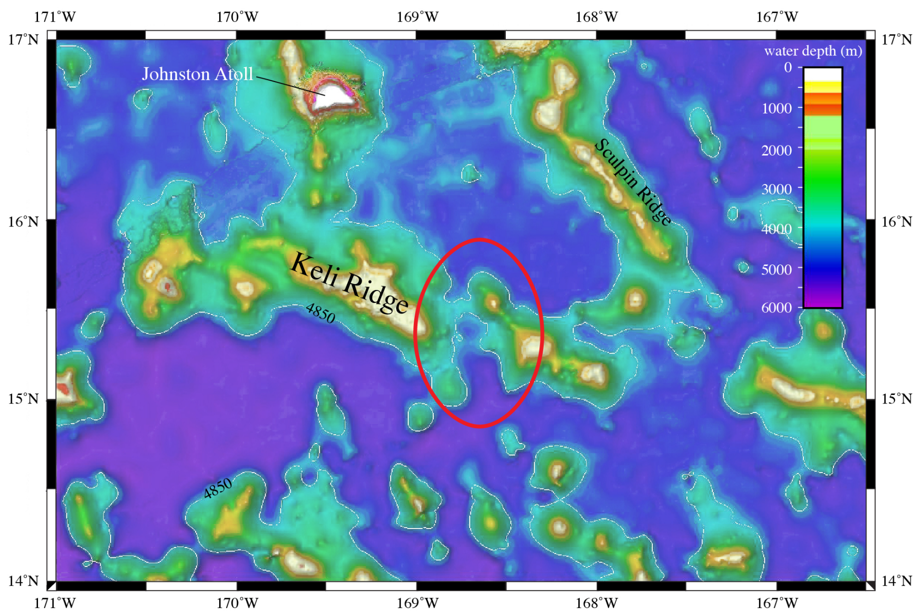


Figure 8. Bathymetry of Keli Ridge and vicinity. Gap of interest is circled in red. Isobath is 4850 m.

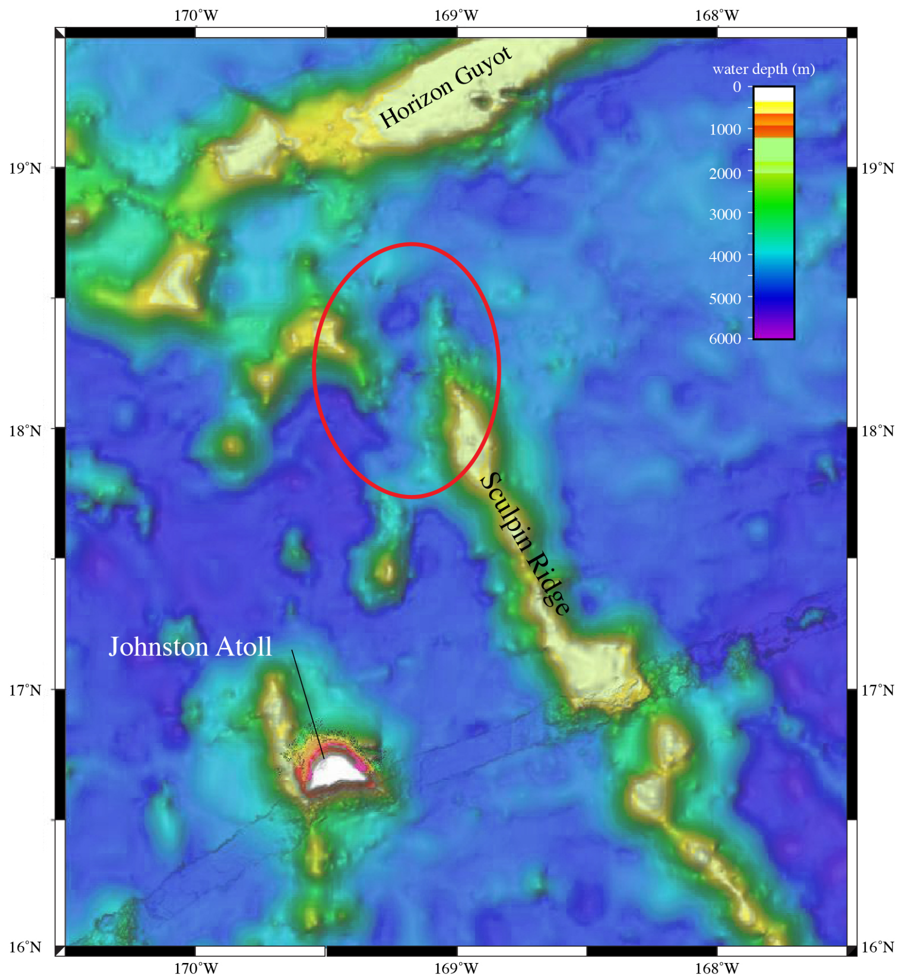


Figure 9. Bathymetry of Sculpin Ridge and vicinity. Gap of interest is circled in red. Isobath is 4850 m.

Daily Log

JD 221 (Saturday, August 9, 2014)

A Bist Test (*KM14-17 at dock at Papeete_09Aug14*) was run at the dock prior to departure from Papeete, Tahiti. All tests passed. We departed Papeete, Tahiti at 1015 L (2115 UTC) and headed on a course of 328˚ for WP1 at 14.9642108˚N/168.6588972˚W. We experimented with swath angles of ±70˚ and ±65˚ and found that ±65˚ gives the best coverage without all the ragged outer beams. However, this provided a swath width of only 3.0 x water depth in Deep mode FM enabled in water depths of 3800 m.

JD 222 (Sunday, August 10, 2014)

Continued to map en route to WP1. Weather and sea conditions were ideal. The crew began needle-gunning in mid morning. They tested a "rust buster" machine that resembles a snowblower that uses chains. This thing causes a lot of noise in the water column and we lost some signal. After some tests, we asked the Mate to stop using the "rust buster" machine, but we allowed the continued use of the needle guns. The needle guns generate some noise on the EM122 but not enough noise to greatly affect the bottom detection. The needle-gunning ceased in the mid afternoon and some of the noise was reduced. Much of the noise we see on the EM122 is the result of having three generators running to ensure a transit speed of 12+ knts.

JD 223 (Monday, August 11, 2014)

Continued on transit toward Kingman Palmyra. Conditions ideal for mapping. We were thwarted from running a series of short quality-control lines (not a Patch Test) because of the lack of a relatively flat seafloor. Hopefully, we can accomplish this prior to reaching Keli Ridge. Our 1200 XBT indicated an unusual tail at about 700 m depth. We dropped a second XBT, which showed a more typical temperature profile. We applied the second profile for sound speed correction, with satisfactory results.

One needle-gunner worked on forward starboard hull and two worked on the fantail between the hulls in the mid morning that caused almost complete loss of Knudsen subbottom data (Fig. 10). However, only ragged outer beams were seen on the MBES so we allowed the maintenance to continue. The needle gunning stopped for lunch and the data immediately improved. Needle gunning commenced after lunch and again we saw some degradation in the Knudsen data but not too much in the MBES data.

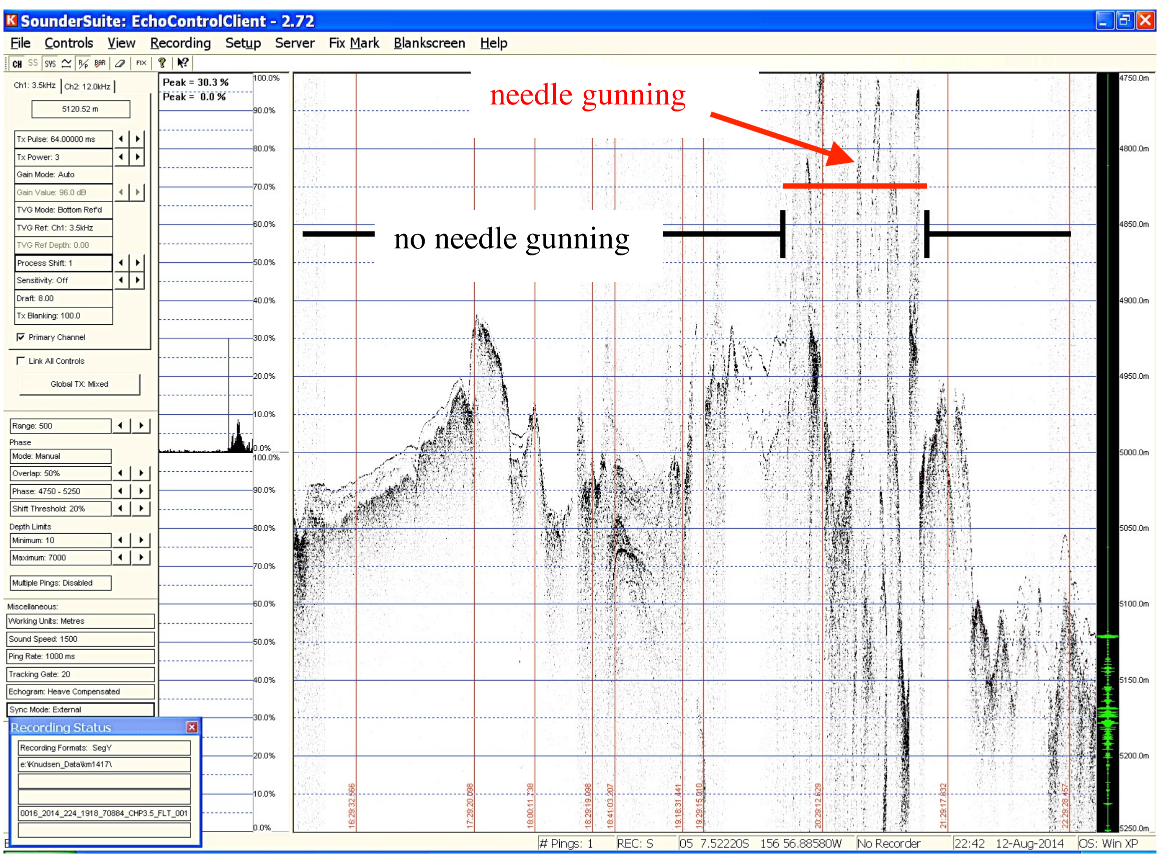


Figure 10. Affects on Knudsen subbottom data of needle gunning on starboard hull

JD 224 (Tuesday, August 12, 2014)

Continued on transit toward Kingman Palmyra; conditions ideal for mapping. At 1044 UTC the ship reduced speed to 4.5 knts and deployed an ARGO float at latitude 7°00.000’S, longitude 155°50.745’W. At 1650 UTC the ship slowed to 5 knts and deployed a Global Drifter Program drifter at latitude 6°00.000’S 156°26.000’W.

At 1840 UTC the ship abruptly stopped and veered off the line. We stopped logging the MBES and Knudsen. The problem was a failure of some computer control in the propulsion system. Repairs were made and we were underway again at 1909 UTC. We had the ship circle around and resume the transit line at a position about 5 minutes prior to the failure position. Logging resumed on the MBES and Knudsen at 1918 UTC.

Needle gunning commenced from 1015 L (2015 UTC) until 1115 L (start of lunch) and affected the Knudsen but not the MBES. Slowed to 5 knts to deploy an Argo float at ~1315L (2315 UTC).

Ship slowed to 5 knts for about 15 minutes to launch a Argo buoy.

JD 225 (Wednesday, August 13, 2014)

At ~0242 UTC, se started seeing no bottom detection at nadir. Then, about 10 minutes later, we started seeing dropouts on both starboard and port sides of the EM122 data (red arrows on Fig. 11). Then, for about 5 minutes, there was a complete loss of bottom detection (blue arrow on Fig. 11). The dropouts correlate to sector boundaries. The engineers were asked if any equipment was recently turned on but none had been. The dropouts became persistent for the next hour so we conferred with the UH Senior Tech and decided to stop pinging, run a BIST test and reboot SIS. Pinging was stopped at 0706 UTC.

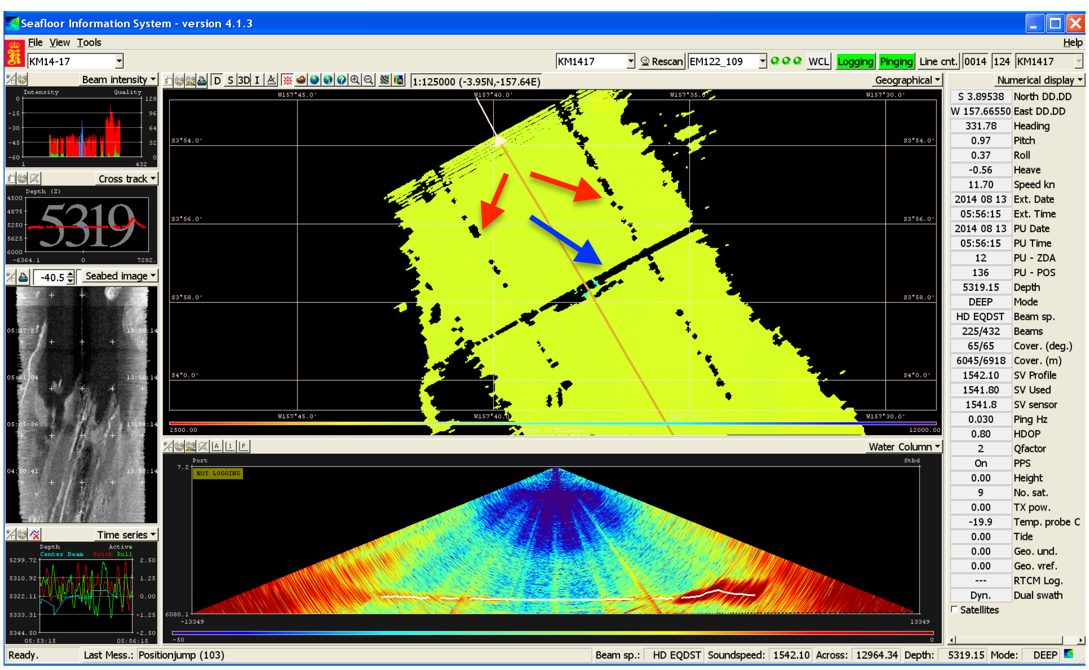


Figure 11. SIS view of no bottom detection (blue arrow) and dropouts (red arrows)

The BIST test was all good. The system was put back into FM mode and the array was changed to ±60˚ to see if the dropout tracks would continue to follow the sector boundaries. The starboard dropouts did not appear but the port dropouts continued to occur. After processing the file with all the dropouts, it was apparent that SIS is flagging data as bad and creating the dropouts. The data dropouts were unflagged and the DTM did not suffer the dropouts. However, overall the data became much noisier once the dropouts started to appear. There is a correlation of dropouts occurring in areas of sediment rather than bare basalt. Also, it appears to help eliminate dropouts by not tilting the array and keeping the tilt at 0.0˚. At 1118 UTC slowed to 4 knts and deployed Argo float and Global drifter at latitude 2° 59.954' S longitude 158° 11.185' W.

Increased beam coverage to 65/65 at1327 UTC based on greatly improved seafloor returns in area of higher backscatter intensity. At about 1335 UTC we mapped a seamount on the port side of the swath with an estimated least depth of 3964 m in general depths of about 5100 m (Fig 12.). At 1452 UTC the swath coverage was reduced to 60/60 again, in area of weaker seafloor returns.

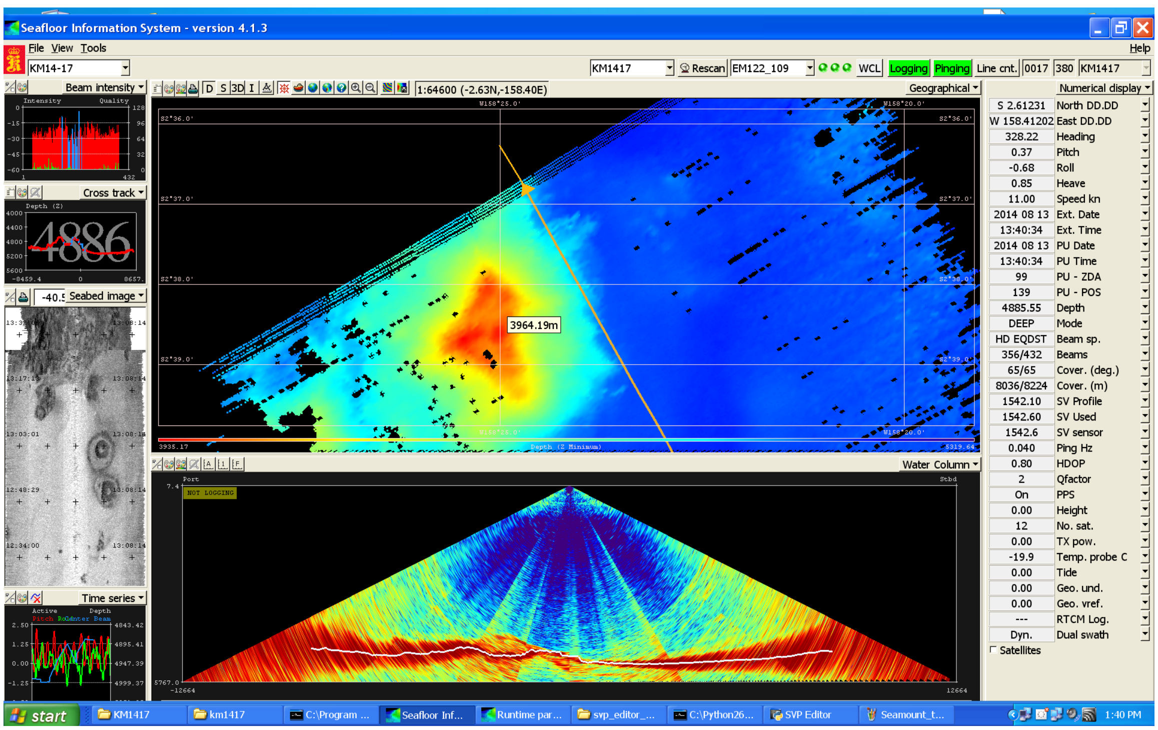


Figure 12. Seamount with preliminary least depth shown.

An unannounced steering drill occurred at 2230 UTC that caused the ship to veer off course several degrees and then back on course by 2245 UTC. The ship slowed to 4 knts at 2325 UTC to deploy an Argo float.

JD 226 (Thursday, August 14, 2014)

Continuing to map en route to Keli Ridge. The ship slowed to 4 knt to deploy an Argo float at 1115 UTC. From about 1300 to 1330 UTC we noted the presence of small (~0.02% of depth) motion artifacts in the swath. These artifacts diminished after this period. No obvious source of the artifacts was identified. Reduced speed to 4 knts again and deployed another Argo float at 1645 UTC at 02° N latitude. At about 1950 UTC the ship started their rust-buster deck grinder on the fantail. The Knudsen subbottom data are unaffected, the EM122 data are somewhat noisier and the swath width is somewhat reduced, but we still appear to be getting adequate seafloor returns and acceptable data quality.

The ship slowed to 5 knts at 2207 UTC to launch an Argo float. We were back up to 11 knots at 2214 UTC.

Knudsen line JohnstonAtoll_Line_24tran.sgy shows the abrupt SW-facing of the base of the Line Islands platform that rises 900+ m above abyssal depths (Fig. 13).

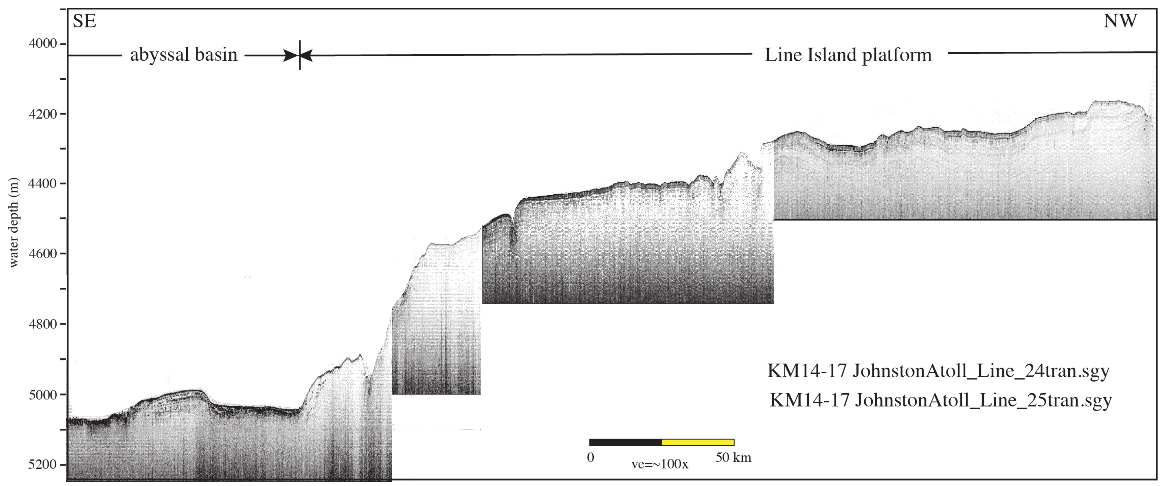


Figure 13. Chirp 3.5-kHz profile across the SW base of the Line Islands platform.

Ship slowed to 5 knts at 0442 UTC to launch an Argo float. Speed was back to 12 knts by 0450 UTC.

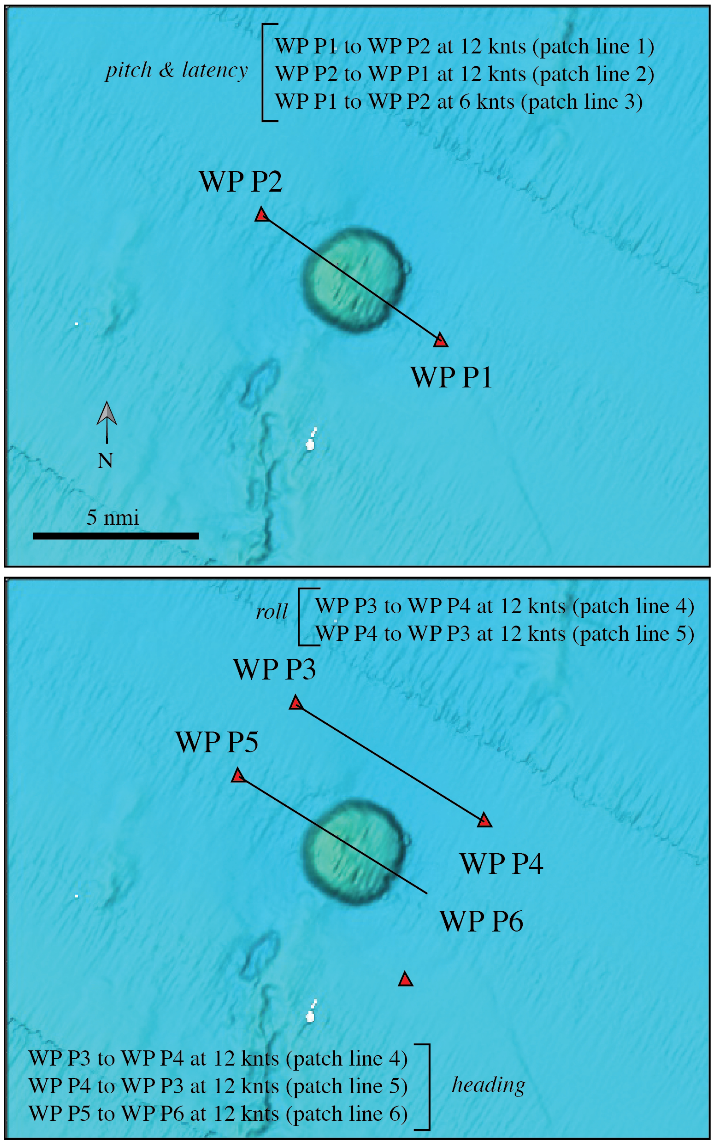
JD 227 (Friday, August 15, 2014)

Ship slowed to 5 knts at 0937 UTC to launch an Argo float and was back to 12 knts by 0942 UTC.

At about 1451 UTC, SIS crashed. Restarted SIS at 1452 UTC. The SIS started a new file, but the line count did not increment, so there are now two SIS line 25s, although with distinct file names based on starting time. At 1500 Z ship had slowed to 4 kt and deployed an ARGO float and resumed speed.

Started a full patch test (Fig. 14) at 1720 UTC. An XCTD was cast just prior to the first patch test line (Line_patch1). Secured the Knudsen subbottom profiler for the duration of the patch test.

allow 5 minutes of run-in before crossing start waypoint
turn after 5 minutes of passing through end waypoint



WP P1: 6°28.2930'N 163°42.3347'W
WP P2: 6°32.9206'N 163°46.2866'W
WP P3: 6°34.9224'N 163°42.3347'W
WP P4: 6°31.9066'N 163°39.9689'W
WP P5: 6°29.7165'N 163°48.7916'W
WP P6: 6°26.5636'N 163°43.6131'W

Figure 14. Patch test plan

The patch test was completed by 2357 UTC. We came about and resumed the transit to Keli Ridge with Line 28tran. This transit line took us across several lines collected on cruise KM1009 (Gardner and Calder, 2010) and three cross-check analyses were conducted between the 2010 surface and Line 26tran, 27tran and 28tran (Appendix 7).

JD 228 (Saturday, August 16, 2014)

The Knudsen Chirp 3260 Subbottom profiler was restarted at 0000 UTC. SIS was rebooted at 0013 UTC after a pitch offset of -0.2˚ was subtracted from IMU offset from the results of the patch test. The new pitch offset is -0.15. The ship slowed to 4 kt and deployed an ARGO float at 1133 UTC, latitude 08° 24 N, 164° 49 W, then resumed speed to ~12 kt. At 2035 UTC we increased the Knudsen subbottom profiler range to 1000 m because of the increased seafloor relief.

JD 229 (Sunday, August 17, 2014)

Continued the transit to the Keli Ridge gap. All systems operating normally. Ship slowed to 5 knts at 0822 UTC to launch an Argo float. Speed resumed to 12 knts by 0830 UTC.

JD 230 (Monday, August 18, 2014)

Continued the transit to the Keli Ridge gap. All systems operating normally. Conditions perfect for mapping. Waypoint 2 was reached at 0336 UTC and the course was changed from 331˚ to 352˚. The port generator was secured and the ship decreased speed to ~8.5 knts and the MBES swath was increased to ±65˚. Lines 140818/Line 36 and 37 takes us right down the middle of the Keli Ridge gap (Figs. 2 and 15).

After completion of the Keli Ridge gap line, resumed the transit toward Karin Ridge, continuing to map along a course of 339° while remaining at approximately 9 kt.

JD 231 (Tuesday, August 19, 2014)

Mapped the first line through the Karin Ridge gap. All systems operating normally and conditions continue perfect for mapping. Turning off the port generator and running on only two starboard generators slowed the ship to ~8.5 knts and the reduced noise from the port generator produced an increased swath width to 3.6 x water depth and less noise in the MBES data.

Mapping of the Karin Ridge gap (Figs. 2 and 16) was completed at 1756 UTC. We turned to the NW so to position the transit line to Honolulu to cross Karin Ridge gap lines L42 and L46 for cross-check analyses. At 1909 UTC, we came onto a course of about 072° to cross the two Karin Ridge lines and commence our transit to Honolulu. At 2132 UTC the ship increased speed to transit speed, bringing additional engines on line. We will continue to map along the transit.

Cross-check analyses of Line 50tran against grid of Lines 42 and 46 showed a precision of 1.7 % of water depth at 2σ (Appendix 7). The surprisingly large value is a function of very flappy outer beams, even at ±60˚ swath, only two starboard generators and 8 knt speed. A third generator was put online and the ship speed was increased to 11.5 knts at 2145 UTC for the transit to Honolulu.

JD 232 (Wednesday, August 20, 2014)

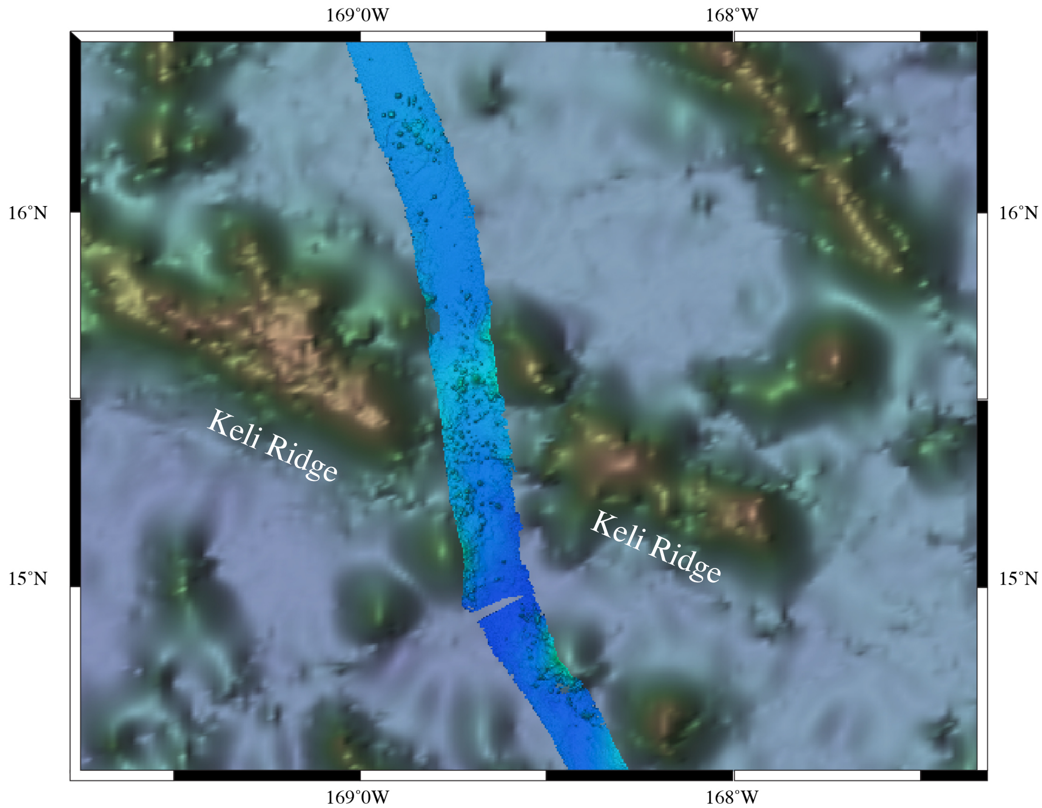
All systems operating normally and conditions continue perfect for mapping.

JD 233 (Thursday, August 21, 2014)

All systems operating normally and conditions continue perfect for mapping.

JD 234 (Friday, August 22, 2014)k

Stopped logging subbottom and multibeam at 0944 UTC. Arrived at sea buoy at 0700 L and were tied up at the UH Marine Facilities dock at 0800 L.



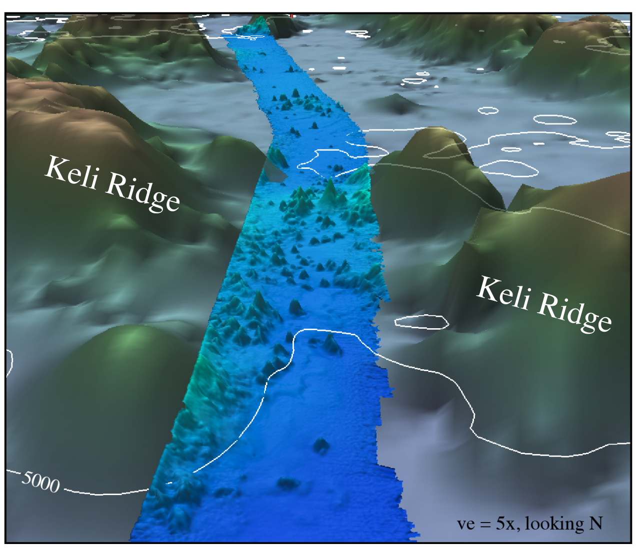


Figure 15. (upper) Map view of MBES bathymetry gap through the Keli Ridge gap. Background bathymetry from Smith and Sandwell v. 15.1 (1997). (bottom) Perspective view of MBES bathymetry through Keli Ridge gap. The 5000 m isobaths is shown in white.

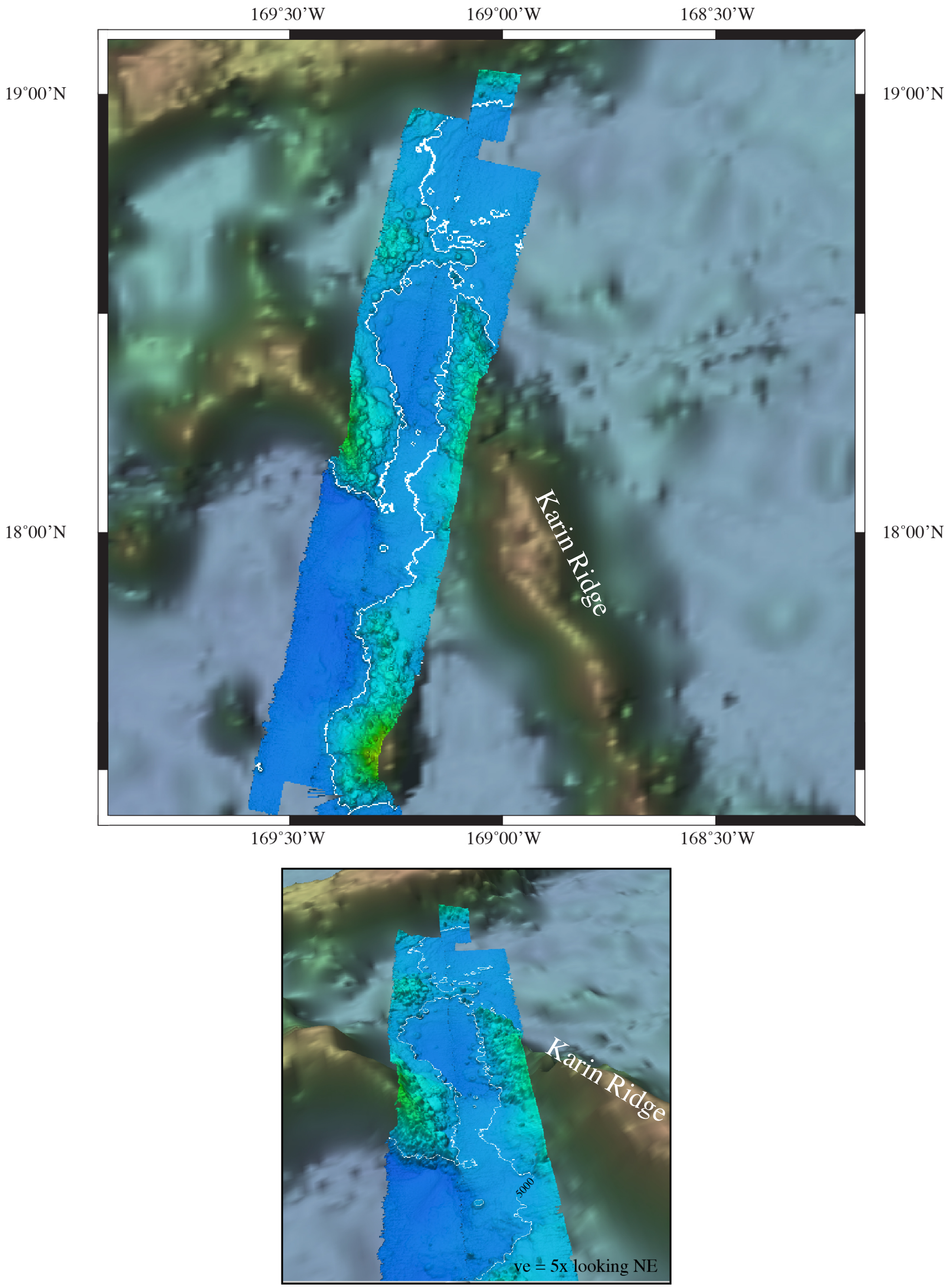


Figure 16. (upper) Map view of MBES bathymetry gap through the Karin Ridge gap. Background bathymetry from Smith and Sandwell v. 15.1 (1997). (bottom) Perspective view of MBES bathymetry through Karin Ridge gap. The 5000 m isobaths is shown in white.

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Table 5. Cruise Personnel

Capt. Jay Chavez	Ship's Master
Dr. James V. Gardner	UNH Chief Scientist
Mr. Andrew A. Armstrong	UNH Co-Chief Scientist
Dr. Brian R. Calder	UNH Scientist
Dr. Giuseppe Masetti	UNH Scientist
Mr. Evan Robertson	NOAA/NGDC Data Manager
Ms. Kelly Nifong	UNH Watchstander
Mr. Justin Smith.	UH Lead Technician
Mr. Trevor Young	UH Technician

Appendix 1. Conversion table of Kongsberg SIS-assigned .all file names to UNH file names by Julian Day

JD	Data Folder	Kongsberg file name KM122.all	UNH file name .all	Notes
221	**140809**	**0000_20140809_204412**	**JohnstonAtoll_Line_1tran**	**Depart from Papeete**
222	**140810**	**0001_20140810_000015**	**JohnstonAtoll_Line_2tran**	**Transit to KP**
		0002_20140810_060010	JohnstonAtoll_Line_3tran	Transit to KP
		0003_20140810_120057	JohnstonAtoll_Line_4tran	Transit to KP
		0004_20140810_180011	JohnstonAtoll_Line_5tran	Transit to KP
223	**140811**	**0005_20140811_000020**	**JohnstonAtoll_Line_6tran**	**Transit to KP**
		0006_20140811_060016	JohnstonAtoll_Line_7tran	Transit to KP
		0007_20140811_120003	JohnstonAtoll_Line_8tran	Transit to KP
		0008_20140811_1800452	JohnstonAtoll_Line_9tran	Transit to KP
224	**140812**	**0009_20140812_000020**	**JohnstonAtoll_Line_10tran**	**Transit to KP**
		0010_20140812_000020	JohnstonAtoll_Line_11tran	Transit to KP
		0011_20140812_120544	JohnstonAtoll_Line_12tran	Transit to KP
		0012_20140812_180008	JohnstonAtoll_Line_13tran	engine problem
		0013_20140812_191828	JohnstonAtoll_Line_14tran	Transit to KP
225	**140813**	**0014_20140813_000021**	**JohnstonAtoll_Line_15tran**	**Transit to KP**
		0015_20140813_060345	JohnstonAtoll_Line_16tran	stopped line for dropouts
		0016_20140813_072738	JohnstonAtoll_Line_17tran	Transit to KP
		0017_20140813_120016	JohnstonAtoll_Line_18tran	Transit to KP
		0018_20140813_180006	JohnstonAtoll_Line_19tran	Transit to KP
226	**140814**	**0019_20140814_000331**	**JohnstonAtoll_Line_20tran**	**Transit to KP**
		0020_20140814_060010	JohnstonAtoll_Line_21tran	Transit to KP
		0021_20140814_121953	JohnstonAtoll_Line_22tran	Transit to KP
		0022_20140814_180016	JohnstonAtoll_Line_23tran	Transit to KP
227	**140815**	**0023_20140815_000012**	**JohnstonAtoll_Line_24tran**	**Transit to KP**
		0024_20140815_060010	JohnstonAtoll_Line_25tran	Transit to KP
		0025_20140815_120004	JohnstonAtoll_Line_26tran	Transit to KP
		0025_20140815_145205	JohnstonAtoll_Line_27tran	Transit to KP
		0026_20140815_174812	JohnstonAtoll_Line_patch1	pitch patch test
		0027_20140815_183634	JohnstonAtoll_Line_patch2	pitch patch test
		0028_20140815_193301	JohnstonAtoll_Line_patch3	timing patch test
		0029_20140815_210919	JohnstonAtoll_Line_patch4	roll patch test
		0030_20140815_215554	JohnstonAtoll_Line_patch5	yaw patch test
		0031_20140815_230251	JohnstonAtoll_Line_patch6	yaw patch test
		No line 0032		
228	**140816**	0033_20140816_001937	JohnstonAtoll_Line_28tran	Transit to Keli
		0034_20140816_060002	JohnstonAtoll_Line_29tran	Transit to Keli
		0035_20140816_120014	JohnstonAtoll_Line_30tran	Transit to Keli
		0036_20140816_180012	JohnstonAtoll_Line_31tran	Transit to Keli

Appendix 1 continued

JD	Data Folder	Kongsberg file name KM122.all	UNH file name .all	Notes
229	**140817**	**0037_20140817_000007**	**JohnstonAtoll_Line_32tran**	**Transit to Keli**
		0038_20140817_060011	JohnstonAtoll_Line_33tran	Transit to Keli
		0039_20140817_120021	JohnstonAtoll_Line_34tran	Transit to Keli
		0040_20140817_180009	JohnstonAtoll_Line_35tran	Transit to Keli
230	**140818**	**0041_20140818_000003**	**JohnstonAtoll_Line_36**	**Approach to Keli**
		0042_20140818_013529	JohnstonAtoll_Line_37	Keli Ridge gap
		0043_20140818_060008	JohnstonAtoll_Line_38	Keli Ridge gap
		0044_20140818_082207	JohnstonAtoll_Line_39	Keli to Karin
		0045_20140818_120011	JohnstonAtoll_Line_40	Keli to Karin
		0046_20140818_180014	JohnstonAtoll_Line_41	Keli to Karin
		0047_20140818_181541	JohnstonAtoll_Line_42	Karin Ridge gap
231	**140819**	**0048_20140819_000006**	**JohnstonAtoll_Line_43**	**Karin Ridge gap**
		no line 0049	**–**	
		0050_20140819_052131	**JohnstonAtoll_Line_44**	**turn**
		0051_20140819_063427	JohnstonAtoll_Line_45	Karin Ridge gap
		0052_20140819_120132	JohnstonAtoll_Line_46	Karin Ridge gap
		0053_20140819_175543	JohnstonAtoll_Line_47	turn
		0054_20140819_180242	JohnstonAtoll_Line_48	turn
		0055_20140819_183410	JohnstonAtoll_Line_49tran	transit to cross line
		0056_20140819_190901	JohnstonAtoll_Line_50tran	cross line
		0057_20140819_213253	JohnstonAtoll_Line_51tran	transit to Honolulu
232	**140820**	**0058_20140820_000009**	**JohnstonAtoll_Line_52tran**	**transit to Honolulu**
		0059_20140820_060018	JohnstonAtoll_Line_53tran	transit to Honolulu
		0060_20140820_120212	JohnstonAtoll_Line_54tran	transit to Honolulu
		0061_20140820_180016	JohnstonAtoll_Line_55tran	transit to Honolulu
				transit to Honolulu
233	**140821**	0062_20140821_000013	JohnstonAtoll_Line_56tran	transit to Honolulu
		0063_20140821_060013	JohnstonAtoll_Line_57tran	transit to Honolulu
		0064_20140821_120018	JohnstonAtoll_Line_58tran	transit to Honolulu
		0065_20140821_180004	JohnstonAtoll_Line_59tran	transit to Honolulu
234	**140822**	**0066_20140822_000007**	**JohnstonAtoll_Line_60tran**	**transit to Honolulu**
		0067_20140822_060003	JohnstonAtoll_Line_61tran	transit to Honolulu
		END OF CRUISE	**END OF CRUISE**	

Appendix 2. Conversion table of Knudsen-assigned .sgy file names to UNH file names by Julian Day

JD	Data Folder	Knudsen file name .sgy	UNH file name .sgy	Notes
221	**140809**	**0002_2014_221_2250_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_1tran**	**firing up**
222	**140810**	**0003_2014_222_0006_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_2atran**	**fiddling**
		0003_2014_222_0051_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_2btran	Rough bathy
		0003_2014_222_0134_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_2ctran	line too short
		0003_2014_222_0149_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_2dtran	Rough bathy
		0003_2014_222_0224_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_2etran	Rough bathy
		0004_2014_222_0415_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_3atran	Rough bathy
		0004_2014_222_0438_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_3btran	Rough bathy
		0004_2014_222_0517_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_3ctran	line too short
		0004_2014_222_0521_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_3dtran	Rough bathy
		0005_2014_222_0601_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4atran	Rough bathy
		0005_2014_222_0617_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4btran	Rough bathy
		0005_2014_222_0753_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4ctran	Rough bathy
		0005_2014_222_0829_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4dtran	Rough bathy
		0005_2014_222_0856_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4etran	line too short
		0005_2014_222_0909_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_4ftran	Rough bathy
		0006_2014_222_1201_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_5tran	Rough bathy
		0007_2014_222_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_6tran	Rough bathy
223	**140811**	**0008_2014_223_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_7tran**	**Rough bathy**
		0009_2014_223_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_8tran	Rough bathy
		0010_2014_223_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_9tran	Rough bathy
		0011_2014_223_1804_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_10tran	Rough bathy
224	**140812**	**0012_2014_224_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_11tran**	**Rough bathy**
		0013_2014_224_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_12tran	Rough bathy
		0011_2014_223_1804_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_10tran	Rough bathy

Appendix 2 continued

224	**140812**	**0012_2014_224_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_11tran**	**Rough bathy**
		0013_2014_224_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_12tran	Rough bathy
		0014_2014_224_1205_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_13tran	Rough bathy
		0015_2014_224_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_14tran	Engine problem
		0016_2014_224_1918_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_15tran	Rough bathy
225	**140813**	**0017_2014_225_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_16tran**	**Rough bathy**
		0018_2014_225_0603_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_17tran	Rough bathy
		0019_2014_225_0625_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_18tran	Rough bathy
		0020_2014_225_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_19tran	Rough bathy
		0021_2014_225_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_20tran	Rough bathy
226	**140814**	**0022_2014_226_0003_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_21tran**	**Rough bathy**
		0023_2014_226_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_22tran	Rough bathy
		0024_2014_226_1219_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_23tran	Approach KP platform
		0025_2014_226_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_24tran	Base of KP platform
227	**140815**	**0026_2014_227_0000_70884_CHP3.5_FLT_001.sgy**	**JohnstonAtoll_Line_25tran**	**on KP platform**
		0027_2014_227_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_26tran	on KP platform
		0028_2014_227_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_27tran	on KP platform
		0029_2014_227_1502_784_CHP3.5_FLT_001	JohnstonAtoll_Line_28tran	on KP platform
228	**140816**	**0030_2014_228_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_29tran**	**on KP platform**
		0031_2014_228_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_30tran	to Keli Ridge
		0032_2014_228_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_31tran	to Keli Ridge
		0033_2014_228_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_32tran	to Keli Ridge
		0033_2014_228_2035_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_32atran	Range change
229	**140817**	**0034_2014_229_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_33tran**	**to Keli Ridge**
		0035_2014_229_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_34tran	to Keli Ridge
		0036_2014_229_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_35tran	to Keli Ridge
		0037_2014_229_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_36tran	to Keli Ridge

Appendix 2 continued

JD	Data Folder	Knudsen file name .sgy	UNH file name .sgy	Notes
230	**14818**	**0038_2014_230_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_37**	**Keli Ridge gap**
		0039_2014_230_0135_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_38	Keli Ridge gap
		0040_2014_230_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_39	Keli Ridge gap
		0041_2014_230_0821_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_40	to Karin Ridge
		0042_2014_230_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_41	to Karin Ridge
		0043_2014_230_1800_70884_CHP3.5_FLT_00y	JohnstonAtoll_Line_42	to Karin Ridge
		0044_2014_230_1815_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_43	Karin Ridge gap
231	**140819**	**0045_2014_231_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_44**	**Karin Ridge gap**
		0046_2014_231_0521_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_45	turn
		0047_2014_231_0634_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_46	Karin Ridge gap
		0048_2014_231_1201_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_47	Karin Ridge gap
		0049_2014_231_1755_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_48	turn
		0050_2014_231_1802_70884_CHP3.5_FLT_001.sgy	JohnstonAtoll_Line_48a	turn
		0051_2014_231_1834_70884_CHP3.5_FLT_001.sgy	JohnstonAtoll_Line_49tran	transit to cross line
		0052_2014_231_1909_70884_CHP3.5_FLT_001.sgy	JohnstonAtoll_Line_50tran	cross line
		0053_2014_231_2132_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_51tran	transit to Honolulu
232	**140820**	**0054_2014_232_0000_70884_CHP3.5_FLT_001.sgy**	**JohnstonAtoll_Line_52tran**	**transit to Honolulu**
		0055_2014_232_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_53tran	transit to Honolulu
		0056_2014_232_1202_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_54tran	transit to Honolulu
		0057_2014_232_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_55tran	transit to Honolulu
233	**140821**	**0058_2014_233_0000_70884_CHP3.5_FLT_001**	**JohnstonAtoll_Line_56tran**	**transit to Honolulu**
		0059_2014_233_0600_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_57tran	transit to Honolulu
		0060_2014_233_1200_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_58tran	transit to Honolulu
		0061_2014_233_1800_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_59tran	transit to Honolulu
				transit to Honolulu

Appendix 2 continued

JD	Data Folder	Knudsen file name .sgy	UNH file name .sgy	Notes
234	140822	0062_2014_234_0000_70884_CHP3.5_FLT_001	JohnstonAtoll_Line_60tran	transit to Honolulu
		0063_2014_234_0600_70884_CHP3.5_FLT_0001	JohnstonAtoll_Line_61tran	transit to Honolulu
		END OF CRUISE	END OF CRUISE	

Appendix 3. Location of XBT/XCTD casts

XBT number	Longitude	Latitude	Serial Number	TYPE
00870	-149.98015	-15.8916S	01096837	Deep Blue
00872	-150.57467	-15.08959	01096836	Deep Blue
00873	-151.18996	-14.87374	01096835	Deep Blue
00874	-151.57539	-14.232141	01096834	Deep Blue
00875	-151.80006	-13.853121	01096841	Deep Blue
00876	-152.43620	-12.794125	0109640	Deep Blue
00878	-153.05407	-11.738731	01096839	Deep Blue
00879	-153.64736	-10.740542	01096838	bad data
00880	-153.66153	-10.712840	01096845	Deep Blue
00881	-154.23966	-9.730500	01096844	Deep Blue
00882	-154.78898	-8.727920	01096843	Deep Blue
00884	-155.39753	-7.758220	01096842	Deep Blue
00885	-155.98174	-6.769938	01160610	Deep Blue
00878	-156.55340	-5.795042	01160612	Deep Blue
00889	-157.07749	-4.899462	01160613	Deep Blue
00891	-157.69295	-3.849224	01160607	Deep Blue
00892	-157.81066	-3.649478	01160608	Deep Blue
00893	-157.89090	-3.504372	01160609	Deep Blue
00894	-158.08501	-3.175788	01160602	Deep Blue
00895	-158.25719	-2.882418	01160569	Deep Blue
00896	-158.60990	-2.277082	01160573	Deep Blue
00898	-158.93212	-1.725182	01160604	Deep Blue
00899	-159.41364	-0.894782	01160605	Deep Blue
00900	-159.99407	0.098950	01160577	Deep Blue
00901	-160.47992	0.927382	01160576	Deep Blue
09002	-161.24637	2.243398	01160575	Deep Blue
00904	-161.89459	3.356500	01160574	Deep Blue
00905	-162.50753	4.397357	01160672	Deep Blue
00906	-163.158447	5.525798	01160568	Deep Blue
00907	-163.666471	6.412378	13093585	XCTD
00908	-163.758936	6.534218	01160571	Deep Blue
00909	-163.767708	6.544418	01160570	Deep Blue
00910	-163.748535	6.524680	01160567	Deep Blue
00911	-164.310059	7.502433	01160566	Deep Blue
00913	-164.403809	7.224227	01160662	Deep Blue
00914	-164.580989	7.970157	01160663	Deep Blue
00915	-164.870345	8.343658	01160668	Deep Blue
00916	-165.479036	9.525966	01160669	Deep Blue
00917	-166.070410	10.546122	01160664	Deep Blue
00918	-166.685938	11.601801	01160665	Deep Blue
00919	-167.280600	12.620951	01160667	Deep Blue
00920	-167.882650	13.646857	01160666	Deep Blue
00905	-162.50753	4.397357	01160672	Deep Blue

Appendix 3. Location of XBT/XCTD casts continued

XBT number	Longitude	Latitude	Serial Number	TYPE
00921	-168.503971	14.702476	01160670	Deep Blue
00922	-168.754850	15.625747	01160673	Deep Blue
00923	-169.013704	16.519503	01160671	Deep Blue
00925	-169.343392	17.379022	01160550	Deep Blue
00926	–	–	–	bad
00927	–	–	–	bad
00928	-169.140234	18.252871	01160553	Deep Blue
00929				bad
00930	-169.105078	18.985270	01160547	Deep Blue
00931	-169.300130	18.218038	01160548	Deep Blue
00932	-169.494238	17.417010	01160549	Deep Blue
00933	-168.733138	17.787296	01160545	Deep Blue
00934	-167.617656	18.147681	01160544	Deep Blue
00935	-166.460417	18.520034	01160543	Deep Blue
00936	-165.268229	18.902274	01160542	Deep Blue
00937	-164.110059	19.274734	01160650	Deep Blue
00938	-162.974235	19.635872	01160651	Deep Blue
00939	-161.789583	20.014138	01160652	Deep Blue
00940	-160.650672	20.375704	01160654	Deep Blue
00941	-159.828239	20.635948	01160653	Deep Blue
00942	-159.016894	20.5362964	01160655	Deep Blue
End of cruise		***End of cruise***		***End of cruise***

Appendix 4. Cruise Calendar

August 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	JD221 9 depart Papeete, begin transit 1015L
JD222 10 transit toward Kingman-Palmyra	JD223 11 transit toward Kingman-Palmyra	JD224 12 transit toward Kingman-Palmyra	JD225 13 transit toward Kingman-Palmyra	JD226 14 patch test off Kingman-Palmyra	JD227 15 transit toward Keli Ridge	JD228 16 transit toward Keli Ridge
JD229 17 Keli Ridge gap	JD230 18 Karin Ridge gap	JD231 19 Karin Ridge gap & transit to Honolulu	JD232 20 transit to Honolulu	JD233 21 transit to Honolulu	JD234 22 arrive Honolulu 0900 L	23
24	25	26	27	28	29	30
31						

Appendix 5. Gravity land-tie Data

Gravity Land-Tie Report Papeete, Tahiti

Date:____09 August 2014_________________
Base Station Code:___PPT J7912____
Port:____Papeete, Tahiti/Society Islands__________
Cruise: KM14-17
Gravity Base Station Location (lat/lon): 17˚ 34.02' S / 149˚ 32.82' W
Gravity Base Station Altitude: 357 meters above sea level
Gravity Base Station Description: Laboratoire du Geophysique - PAMATAI

Time (UTC)	Reading	Height above sea level
JD 221 00:48:28	1847.07	357 m
JD 221 00:50:30	1847.12	357 m
JD 221 00:51:19	1847.13	357 m
Average Measurement	**1847.1**	

Base station value (mGal) 978 643.64 ± 0.4

Date:____08 August 2014_________________
Ship Location (Port, Pier, etc.): Papeete Tahiti/Society Islands, Gare du Marche
Land Meter ID (Serial No.): LaCoste Romberg, s/n G-1
Ship's Meter ID (Serial Number): BGM-3, s/n 219

Location	Time (UTC)	Portable Meter Reading	Ships Meter Pulse Count
Outbound Pier Measurement			
First pier measurement	JD 220 22:09:45	1903.32	24668
Second pier measurement	JD 220 22:11:42	1903.55	24658
Third pier measurement	JD 220 22:12:40	1903.63	24670
Average pier measurement		**1903.5**	**24665**
Inbound Pier Measurement			
First pier measurement	JD 220 22:09:45	1898.62	24683
Second pier measurement	JD 220 22:11:42	1898.72	24680
Third pier measurement	JD 220 22:12:40	1898.76	24695
Average pier measurement		**1898.7**	**24686**

Comments: Gravimeter installed on ship‘s main deck.

Main deck height above pier: **Outbound 3.759m** (12.33 ft), **Inbound 3.454m** (11.33 ft)
Pier‘s height above sea surface: **Outbound 0.330m** (1.08 ft), **Inbound 0.457m** (1.50 ft)
Main deck above sea surface: **Outbound 4.089m** (13.42 ft), **Inbound 3.91m** (12.83 ft)

Reading taken at the edge of the pier, in line with the third bollard from the Southwest corner of the pier closest to Gare du Marche (see Fig. 16).

Pier station location: 17˚ 32.276’S / 149˚ 45.673’W
Operator: Justin Smith and David Hashisaka

Figure 16. Location of pier land-tie gravity station at Papeete, Tahiti.

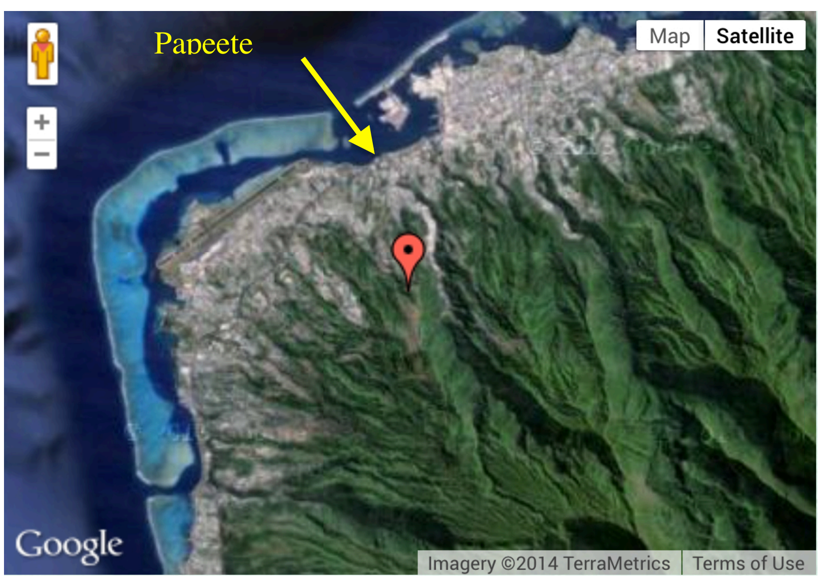


Figure 17. Location and proximity of gravity benchmark in Pamatai to Papeete, Tahiti.

GRAVITY BASE STATION

LATITUDE	STATION DESIGNATION PAPEETE
LONGITUDE	
ELEVATION METERS	COUNTRY/STATE Society Islands/Tahiti

REFERENCE CODE NUMBERS	
ACIC 2080-2	
IGB 37579A	
NHO 10.12	

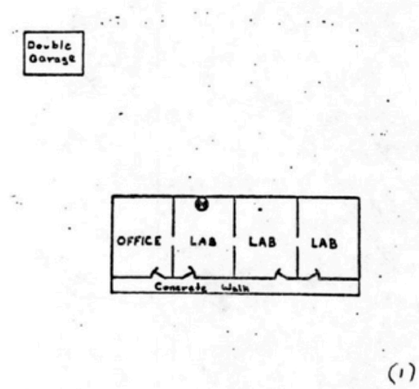
ADOPTED GRAVITY VALUE

g = 978 643.64 mgals

ESTIMATED ACCURACY	DATE MONTH/YEAR
± 0.4 mgals	9/70

DESCRIPTION AND/OR SKETCH

Pamatai Observatory--Station is located in second room from left when facing observatory, and is at center of back wall. (1)



REFERENCE SOURCE

(1) 02632

ACIC HQ FORM FEB 69 0-415

459

Figure 18. Gravity Base Station specifics, Pamatai Observatory, Tahiti.

Figure 19. Gravity Base Station Land-Tie photo, Pamatai Observatory, Tahiti.

Figure 20. Old lab building's cement pad, Pamatai Observatory, Tahiti

Appendix 6. Kongsberg EM122 BIST Test Results

BIST test at Papeete Harbor dock on August 9, 2014 just prior to departure

Saved: 2014.08.09 18:58:10

Sounder Type: 122, Serial no.: 109
Date Time Ser. No. BIST Result

2014.08.09 18:41:34.296 109 0 OK

Number of BSP67B boards: 2
BSP 1 Master 2.2.3 090702 4.3 070913 4.3 070913
BSP 1 Slave 2.2.3 090702 6.0 080902
BSP 1 RXI FPGA 3.6 080821
BSP 1 DSP FPGA A 4.0 070531
BSP 1 DSP FPGA B 4.0 070531
BSP 1 DSP FPGA C 4.0 070531
BSP 1 DSP FPGA D 4.0 070531
BSP 1 PCI TO SLAVE A1 FIFO: ok
BSP 1 PCI TO SLAVE A2 FIFO: ok
BSP 1 PCI TO SLAVE A3 FIFO: ok
BSP 1 PCI TO SLAVE B1 FIFO: ok
BSP 1 PCI TO SLAVE B2 FIFO: ok
BSP 1 PCI TO SLAVE B3 FIFO: ok
BSP 1 PCI TO SLAVE C1 FIFO: ok
BSP 1 PCI TO SLAVE C2 FIFO: ok
BSP 1 PCI TO SLAVE C3 FIFO: ok
BSP 1 PCI TO SLAVE D1 FIFO: ok
BSP 1 PCI TO SLAVE D2 FIFO: ok
BSP 1 PCI TO SLAVE D3 FIFO: ok
BSP 1 PCI TO MASTER A HPI: ok
BSP 1 PCI TO MASTER B HPI: ok
BSP 1 PCI TO MASTER C HPI: ok
BSP 1 PCI TO MASTER D HPI: ok
BSP 1 PCI TO SLAVE A1 HPI: ok
BSP 1 PCI TO SLAVE A2 HPI: ok
BSP 1 PCI TO SLAVE A3 HPI: ok
BSP 1 PCI TO SLAVE B1 HPI: ok
BSP 1 PCI TO SLAVE B2 HPI: ok
BSP 1 PCI TO SLAVE B3 HPI: ok
BSP 1 PCI TO SLAVE C1 HPI: ok
BSP 1 PCI TO SLAVE C2 HPI: ok
BSP 1 PCI TO SLAVE C3 HPI: ok
BSP 1 PCI TO SLAVE D1 HPI: ok
BSP 1 PCI TO SLAVE D2 HPI: ok
BSP 1 PCI TO SLAVE D3 HPI: ok
BSP 2 Master 2.2.3 090702 4.3 070913 4.3 070913
BSP 2 Slave 2.2.3 090702 6.0 080902
BSP 2 RXI FPGA 3.6 080821
BSP 2 DSP FPGA A 4.0 070531
BSP 2 DSP FPGA B 4.0 070531
BSP 2 DSP FPGA C 4.0 070531
BSP 2 DSP FPGA D 4.0 070531
BSP 2 PCI TO SLAVE A1 FIFO: ok
BSP 2 PCI TO SLAVE A2 FIFO: ok
BSP 2 PCI TO SLAVE A3 FIFO: ok

BSP 2 PCI TO SLAVE B1 FIFO: ok
BSP 2 PCI TO SLAVE B2 FIFO: ok
BSP 2 PCI TO SLAVE B3 FIFO: ok
BSP 2 PCI TO SLAVE C1 FIFO: ok
BSP 2 PCI TO SLAVE C2 FIFO: ok
BSP 2 PCI TO SLAVE C3 FIFO: ok
BSP 2 PCI TO SLAVE D1 FIFO: ok
BSP 2 PCI TO SLAVE D2 FIFO: ok
BSP 2 PCI TO SLAVE D3 FIFO: ok
BSP 2 PCI TO MASTER A HPI: ok
BSP 2 PCI TO MASTER B HPI: ok
BSP 2 PCI TO MASTER C HPI: ok
BSP 2 PCI TO MASTER D HPI: ok
BSP 2 PCI TO SLAVE A1 HPI: ok
BSP 2 PCI TO SLAVE A2 HPI: ok
BSP 2 PCI TO SLAVE A3 HPI: ok
BSP 2 PCI TO SLAVE B1 HPI: ok
BSP 2 PCI TO SLAVE B2 HPI: ok
BSP 2 PCI TO SLAVE B3 HPI: ok
BSP 2 PCI TO SLAVE C1 HPI: ok
BSP 2 PCI TO SLAVE C2 HPI: ok
BSP 2 PCI TO SLAVE C3 HPI: ok
BSP 2 PCI TO SLAVE D1 HPI: ok
BSP 2 PCI TO SLAVE D2 HPI: ok
BSP 2 PCI TO SLAVE D3 HPI: ok

Summary:
BSP 1: OK
BSP 2: OK

2014.08.09 18:41:35.780 109 1 OK

High Voltage Br. 1

TX36 Spec: 108.0 - 132.0
0-1 119.7
0-2 119.7
0-3 120.1
0-4 120.1
0-5 120.5
0-6 120.9
0-7 120.9
0-8 120.5
0-9 120.1
0-10 120.5
0-11 120.5
0-12 120.5
0-13 120.1
0-14 120.5
0-15 119.3
0-16 120.5
0-17 120.5
0-18 120.1
0-19 120.1

0-20 120.5
0-21 120.1
0-22 120.1
0-23 120.1
0-24 120.1

High Voltage Br. 2

TX36   Spec: 108.0 - 132.0
0-1   119.7
0-2   122.6
0-3   119.7
0-4   120.1
0-5   120.9
0-6   120.9
0-7   120.5
0-8   120.5
0-9   119.7
0-10   120.5
0-11 120.9
0-12 120.5
0-13 119.7
0-14 120.5
0-15 118.9
0-16 119.7
0-17 119.7
0-18 120.9
0-19 120.5
0-20 121.3
0-21 120.5
0-22 120.1
0-23 120.1
0-24 120.5

Input voltage 12V

TX36   Spec: 11.0 - 13.0
0-1   11.9
0-2   11.9
0-3   12.0
0-4   11.9
0-5   11.9
0-6   12.0
0-7   12.0
0-8   12.0
0-9   11.9
0-10   11.9
0-11   11.9
0-12   12.0
0-13   11.9
0-14   11.9
0-15   11.9
0-16   11.8
0-17   11.9
0-18   12.0
0-19   11.9

0-20   12.0
0-21   11.9
0-22   11.9
0-23   11.9
0-24   11.9

Digital 3.3V

TX36   Spec: 2.8 - 3.5
0-1   3.3
0-2   3.3
0-3   3.3
0-4   3.3
0-5   3.3
0-6   3.3
0-7   3.3
0-8   3.3
0-9   3.3
0-10   3.3
0-11   3.3
0-12   3.3
0-13   3.3
0-14   3.3
0-15   3.3
0-16   3.3
0-17   3.3
0-18   3.3
0-19   3.3
0-20   3.3
0-21   3.3
0-22   3.3
0-23   3.3
0-24   3.3

Digital 2.5V

TX36   Spec: 2.4 - 2.6
0-1   2.5
0-2   2.5
0-3   2.5
0-4   2.5
0-5   2.5
0-6   2.5
0-7   2.5
0-8   2.5
0-9   2.5
0-10   2.5
0-11   2.5
0-12   2.5
0-13   2.5
0-14   2.5
0-15   2.5
0-16   2.5
0-17   2.5
0-18   2.5
0-19   2.5

0-20   2.5
0-21   2.5
0-22   2.5
0-23   2.5
0-24   2.5

Digital 1.5V

TX36   Spec: 1.4 - 1.6
0-1   1.5
0-2   1.5
0-3   1.5
0-4   1.5
0-5   1.5
0-6   1.5
0-7   1.5
0-8   1.5
0-9   1.5
0-10   1.5
0-11   1.5
0-12   1.5
0-13   1.5
0-14   1.5
0-15   1.5
0-16   1.5
0-17   1.5
0-18   1.5
0-19   1.5
0-20   1.5
0-21   1.5
0-22   1.5
0-23   1.5
0-24   1.5

Temperature

TX36   Spec: 15.0 - 75.0
0-1   33.2
0-2   33.6
0-3   32.4
0-4   31.6
0-5   32.4
0-6   32.8
0-7   32.8
0-8   30.8
0-9   32.8
0-10   32.0
0-11   31.2
0-12   30.8
0-13   31.6
0-14   32.0
0-15   33.2
0-16   31.6
0-17   33.2
0-18   34.0
0-19   33.6

0-20 34.0
0-21 34.0
0-22 32.4
0-23 33.6
0-24 33.6

Input Current 12V

TX36 Spec: 0.3 - 1.5
0-1 0.6
0-2 0.6
0-3 0.6
0-4 0.5
0-5 0.5
0-6 0.5
0-7 0.6
0-8 0.5
0-9 0.5
0-10 0.5
0-11 0.5
0-12 0.5
0-13 0.5
0-14 0.5
0-15 0.6
0-16 0.5
0-17 0.5
0-18 0.5
0-19 0.5
0-20 0.5
0-21 0.5
0-22 0.5
0-23 0.5
0-24 0.5

TX36 power test passed

IO TX PPC Embedded PPC Download
2.11 1.14 Mar 5 2007/1.07 May 7 2013/1.11

TX36 unique firmware test OK

2014.08.09 18:41:36.047 109 2 OK

Input voltage 12V

RX32 Spec: 11.0 - 13.0
7-1 11.8
7-2 11.7

Input voltage 6V

RX32 Spec: 5.0 - 7.0
7-1 5.7
7-2 5.7

Digital 3.3V

RX32   Spec: 2.8 - 3.5
7-1   3.3
7-2   3.3

Digital 2.5V

RX32   Spec: 2.4 - 2.6
7-1   2.5
7-2   2.5

Digital 1.5V

RX32   Spec: 1.4 - 1.6
7-1   1.5
7-2   1.5

Temperature

RX32   Spec: 15.0 - 75.0
7-1   31.0
7-2   33.0

Input Current 12V

RX32   Spec: 0.4 - 1.5
7-1   0.6
7-2   0.6

Input Current 6V

RX32   Spec: 2.4 - 3.3
7-1   2.9
7-2   2.7

RX32   power test passed

IO   RX   MB Embedded   PPC Embedded   PPC Download
1.12 1.14 May 5 2006/1.06 May 5 2006/1.07 Feb 18 2010/1.11

RX32 unique firmware test OK

2014.08.09 18:41:36.113 109   3   OK

High Voltage Br. 1

TX36   Spec: 108.0 - 132.0
0-1   119.7
0-2   119.7
0-3   120.1
0-4   119.7
0-5   120.5

0-6 120.9
0-7 120.9
0-8 120.5
0-9 120.1
0-10 120.5
0-11 120.5
0-12 120.5
0-13 120.1
0-14 120.5
0-15 118.8
0-16 120.5
0-17 120.5
0-18 120.1
0-19 120.1
0-20 120.5
0-21 120.1
0-22 120.1
0-23 120.1
0-24 120.5

High Voltage Br. 2

TX36 Spec: 108.0 - 132.0
0-1 119.7
0-2 122.6
0-3 119.7
0-4 120.1
0-5 120.9
0-6 120.9
0-7 120.5
0-8 120.9
0-9 119.7
0-10 120.5
0-11 120.9
0-12 120.5
0-13 119.7
0-14 120.5
0-15 118.9
0-16 119.7
0-17 119.7
0-18 120.9
0-19 120.5
0-20 121.3
0-21 120.5
0-22 120.1
0-23 120.1
0-24 120.5

Input voltage 12V

TX36 Spec: 11.0 - 13.0
0-1 11.9
0-2 11.9
0-3 12.0
0-4 11.9
0-5 11.9

0-6 12.0
0-7 12.0
0-8 12.0
0-9 11.9
0-10 11.9
0-11 11.9
0-12 12.0
0-13 11.9
0-14 11.9
0-15 11.9
0-16 11.8
0-17 11.9
0-18 12.0
0-19 11.9
0-20 12.0
0-21 11.9
0-22 11.9
0-23 11.9
0-24 11.9

RX32 Spec: 11.0 - 13.0
7-1 11.8
7-2 11.7

Input voltage 6V

RX32 Spec: 5.0 - 7.0
7-1 5.7
7-2 5.7

TRU power test passed

2014.08.09 18:41:36.230 109 4 OK

EM 122 High Voltage Ramp Test
Test Voltage:20.00 Measured Voltage: 18.00 PASSED
Test Voltage:60.00 Measured Voltage: 59.00 PASSED
Test Voltage:100.00 Measured Voltage: 100.00 PASSED
Test Voltage:120.00 Measured Voltage: 120.00 PASSED
Test Voltage:80.00 Measured Voltage: 85.00 PASSED
Test Voltage:40.00 Measured Voltage: 45.00 PASSED

6 of 6 tests OK

2014.08.09 18:44:00.320 109 5 OK

BSP 1 RXI TO RAW FIFO: ok
BSP 2 RXI TO RAW FIFO: ok

2014.08.09 18:44:04.770 109 6 OK

Receiver impedance limits [350.0 700.0] ohm

Board	1	2	3	4
1:	566.1	510.1		
2:	570.6	550.7		
3:	566.3	560.8		
4:	570.6	569.2		
5:	574.2	574.0		
6:	549.0	580.2		
7:	560.9	584.0		
8:	572.0	579.0		
9:	531.4	494.5		
10:	541.8	559.2		
11:	572.8	546.2		
12:	562.6	550.4		
13:	539.9	582.7		
14:	589.6	535.9		
15:	528.5	572.9		
16:	563.9	574.6		
17:	515.7	561.8		
18:	518.6	572.4		
19:	574.5	579.8		
20:	577.7	587.1		
21:	575.2	525.3		
22:	533.1	587.3		
23:	570.3	586.4		
24:	571.1	554.3		
25:	546.4	578.7		
26:	584.4	594.8		
27:	575.7	503.5		
28:	555.6	560.1		
29:	563.0	518.6		
30:	513.2	574.0		
31:	552.2	614.7		
32:	556.5	551.7		

Receiver Phase limits [-20.0 20.0] deg

Board	1	2	3	4
1:	-0.7	4.1		
2:	-1.4	0.3		
3:	-1.3	-0.2		
4:	-1.3	-0.7		
5:	-0.8	-1.6		
6:	0.1	-1.1		
7:	-0.5	-1.4		
8:	-1.2	-2.1		
9:	2.0	5.0		
10:	0.7	-0.2		
11:	-1.0	0.9		
12:	-0.1	0.1		
13:	1.7	-1.2		
14:	-2.4	2.2		
15:	2.9	-0.7		
16:	-0.8	-1.0		
17:	4.2	0.3		
18:	3.5	-1.2		

19: -1.4   -1.4
20: -1.9   -2.7
21: -1.6   3.4
22:   2.2   -2.3
23: -0.9   -1.8
24: -1.4   1.0
25:   1.2   -1.8
26: -2.2   -2.3
27: -0.8   4.6
28:   0.0   -0.1
29: -0.5   4.3
30:   3.3   -0.4
31:   0.8   -3.6
32: -0.4   1.6
Rx Channels test passed

2014.08.09 18:44:36.271 109 7 OK

Tx Channels test passed

2014.08.09 18:47:16.262 109 8 OK

RX NOISE LEVEL

Board No: 1 2

0:	69.5	67.5	dB
1:	67.6	67.5	dB
2:	68.3	68.0	dB
3:	68.2	67.4	dB
4:	69.2	67.6	dB
5:	68.1	67.9	dB
6:	69.0	67.2	dB
7:	67.8	67.0	dB
8:	69.4	68.5	dB
9:	68.5	68.3	dB
10:	65.0	68.7	dB
11:	68.2	67.6	dB
12:	69.6	67.7	dB
13:	68.4	67.4	dB
14:	68.7	67.8	dB
15:	67.9	67.2	dB
16:	69.1	68.4	dB
17:	68.6	68.1	dB
18:	69.2	68.7	dB
19:	68.9	68.2	dB
20:	68.6	68.6	dB
21:	68.3	68.5	dB
22:	68.9	68.8	dB
23:	67.3	67.3	dB
24:	68.7	69.2	dB
25:	68.3	67.7	dB

26:	69.3	67.8	dB
27:	68.4	67.5	dB
28:	68.8	68.4	dB
29:	68.5	68.2	dB
30:	68.6	68.1	dB
31:	67.8	68.0	dB

Maximum noise at Board 1 Channel 12 Level: 69.6 dB

Broadband noise test

Average noise at Board 1 68.5 dB OK
Average noise at Board 2 68.0 dB OK

2014.08.09 18:47:22.196 109 9 OK

RX NOISE SPECTRUM

Board No:	1	2	
10.0 kHz:	66.4	65.8	dB
10.2 kHz:	66.7	67.1	dB
10.3 kHz:	69.2	69.2	dB
10.4 kHz:	69.3	69.2	dB
10.6 kHz:	70.0	70.5	dB
10.7 kHz:	70.2	69.8	dB
10.9 kHz:	70.2	71.4	dB
11.0 kHz:	69.9	71.3	dB
11.2 kHz:	70.2	70.5	dB
11.3 kHz:	70.1	70.1	dB
11.4 kHz:	69.5	70.6	dB
11.6 kHz:	70.4	71.0	dB
11.7 kHz:	70.2	70.1	dB
11.9 kHz:	69.4	70.6	dB
12.0 kHz:	69.8	69.4	dB
12.1 kHz:	69.0	69.6	dB
12.3 kHz:	68.6	68.8	dB
12.4 kHz:	68.6	69.0	dB
12.6 kHz:	67.6	68.6	dB
12.7 kHz:	68.6	68.6	dB
12.9 kHz:	67.8	67.9	dB
13.0 kHz:	67.4	67.9	dB

Maximum noise at Board 2 Frequency 10.9 kHz Level: 71.4 dB

Spectral noise test

Average noise at Board 1 69.2 dB OK
Average noise at Board 2 69.6 dB OK

2014.08.09 18:47:28.129 109 10 OK

CPU: KOM CP6011
Clock 1795 MHz
Die   42 oC (peak: 45 oC @ 2014-08-09 - 18:39:15)
Board 44 oC (peak: 45 oC @ 2014-08-09 - 18:39:52)
Core 1.33 V
3V3   3.28 V
12V   11.85 V
-12V -12.04 V
BATT 3.49 V
Primary network: 157.237.14.60:0xffff0000
Secondary network: 192.168.1.1:0xffffff00

2014.08.09 18:47:28.196 109   15   OK

EM 122

BSP67B Master: 2.2.3 090702
BSP67B Slave: 2.2.3 090702
CPU: 1.3.2 140129
DDS: 3.5.9 130926
DSV: 3.1.6 130104
RX32 version : Feb 18 2010 Rev 1.11
TX36 LC version : May 7 2013 Rev 1.11
VxWorks 5.5.1 Build 1.2/2-IX0100 May 16 2007, 11:31:17

End of Papeete Harbor pier BIST Test

BIST test during transit at 11 knts

Saved: 2014.08.13 07:16:48
Sounder Type: 122, Serial no.: 109

Date   Time   Ser. No.   BIST   Result

2014.08.13 07:10:07.800 109   0   OK

Number of BSP67B boards: 2
BSP 1 Master 2.2.3 090702 4.3 070913 4.3 070913
BSP 1 Slave 2.2.3 090702 6.0 080902
BSP 1 RXI FPGA 3.6 080821
BSP 1 DSP FPGA A 4.0 070531
BSP 1 DSP FPGA B 4.0 070531
BSP 1 DSP FPGA C 4.0 070531
BSP 1 DSP FPGA D 4.0 070531
BSP 1 PCI TO SLAVE A1 FIFO: ok
BSP 1 PCI TO SLAVE A2 FIFO: ok

BSP 1 PCI TO SLAVE A3 FIFO: ok
BSP 1 PCI TO SLAVE B1 FIFO: ok
BSP 1 PCI TO SLAVE B2 FIFO: ok
BSP 1 PCI TO SLAVE B3 FIFO: ok
BSP 1 PCI TO SLAVE C1 FIFO: ok
BSP 1 PCI TO SLAVE C2 FIFO: ok
BSP 1 PCI TO SLAVE C3 FIFO: ok
BSP 1 PCI TO SLAVE D1 FIFO: ok
BSP 1 PCI TO SLAVE D2 FIFO: ok
BSP 1 PCI TO SLAVE D3 FIFO: ok
BSP 1 PCI TO MASTER A HPI: ok
BSP 1 PCI TO MASTER B HPI: ok
BSP 1 PCI TO MASTER C HPI: ok
BSP 1 PCI TO MASTER D HPI: ok
BSP 1 PCI TO SLAVE A1 HPI: ok
BSP 1 PCI TO SLAVE A2 HPI: ok
BSP 1 PCI TO SLAVE A3 HPI: ok
BSP 1 PCI TO SLAVE B1 HPI: ok
BSP 1 PCI TO SLAVE B2 HPI: ok
BSP 1 PCI TO SLAVE B3 HPI: ok
BSP 1 PCI TO SLAVE C1 HPI: ok
BSP 1 PCI TO SLAVE C2 HPI: ok
BSP 1 PCI TO SLAVE C3 HPI: ok
BSP 1 PCI TO SLAVE D1 HPI: ok
BSP 1 PCI TO SLAVE D2 HPI: ok
BSP 1 PCI TO SLAVE D3 HPI: ok
BSP 2 Master 2.2.3 090702 4.3 070913 4.3 070913
BSP 2 Slave 2.2.3 090702 6.0 080902
BSP 2 RXI FPGA 3.6 080821
BSP 2 DSP FPGA A 4.0 070531
BSP 2 DSP FPGA B 4.0 070531
BSP 2 DSP FPGA C 4.0 070531
BSP 2 DSP FPGA D 4.0 070531
BSP 2 PCI TO SLAVE A1 FIFO: ok
BSP 2 PCI TO SLAVE A2 FIFO: ok
BSP 2 PCI TO SLAVE A3 FIFO: ok
BSP 2 PCI TO SLAVE B1 FIFO: ok
BSP 2 PCI TO SLAVE B2 FIFO: ok
BSP 2 PCI TO SLAVE B3 FIFO: ok
BSP 2 PCI TO SLAVE C1 FIFO: ok
BSP 2 PCI TO SLAVE C2 FIFO: ok
BSP 2 PCI TO SLAVE C3 FIFO: ok
BSP 2 PCI TO SLAVE D1 FIFO: ok
BSP 2 PCI TO SLAVE D2 FIFO: ok
BSP 2 PCI TO SLAVE D3 FIFO: ok
BSP 2 PCI TO MASTER A HPI: ok

BSP 2 PCI TO MASTER B HPI: ok
BSP 2 PCI TO MASTER C HPI: ok
BSP 2 PCI TO MASTER D HPI: ok
BSP 2 PCI TO SLAVE A1 HPI: ok
BSP 2 PCI TO SLAVE A2 HPI: ok
BSP 2 PCI TO SLAVE A3 HPI: ok
BSP 2 PCI TO SLAVE B1 HPI: ok
BSP 2 PCI TO SLAVE B2 HPI: ok
BSP 2 PCI TO SLAVE B3 HPI: ok
BSP 2 PCI TO SLAVE C1 HPI: ok
BSP 2 PCI TO SLAVE C2 HPI: ok
BSP 2 PCI TO SLAVE C3 HPI: ok
BSP 2 PCI TO SLAVE D1 HPI: ok
BSP 2 PCI TO SLAVE D2 HPI: ok
BSP 2 PCI TO SLAVE D3 HPI: ok

Summary:
BSP 1: OK
BSP 2: OK

2014.08.13 07:10:09.284 109 1 OK

High Voltage Br. 1

TX36 Spec: 108.0 - 132.0
0-1 121.7
0-2 121.7
0-3 122.1
0-4 121.7
0-5 122.6
0-6 123.0
0-7 123.0
0-8 122.6
0-9 122.1
0-10 122.1
0-11 122.6
0-12 122.6
0-13 122.1
0-14 122.6
0-15 120.9
0-16 122.6
0-17 122.6
0-18 122.1
0-19 122.1

0-20 122.6
0-21 122.1
0-22 122.1
0-23 122.1
0-24 122.1

High Voltage Br. 2

TX36   Spec: 108.0 - 132.0
0-1   121.7
0-2   125.0
0-3   121.7
0-4   122.2
0-5   122.6
0-6   123.0
0-7   122.6
0-8   122.6
0-9   121.7
0-10   122.6
0-11 123.0
0-12 122.6
0-13 121.7
0-14 122.6
0-15 120.9
0-16 121.7
0-17 121.7
0-18 123.0
0-19 122.6
0-20 123.4
0-21 122.6
0-22 122.2
0-23 122.2
0-24 122.6

Input voltage 12V

TX36   Spec: 11.0 - 13.0
0-1   11.9
0-2   11.9
0-3   12.0
0-4   11.9
0-5   11.9
0-6   12.0
0-7   12.0
0-8   12.0
0-9   11.9

0-10 11.9
0-11 11.9
0-12 12.0
0-13 11.9
0-14 11.9
0-15 11.9
0-16 11.8
0-17 11.9
0-18 12.0
0-19 11.9
0-20 12.0
0-21 11.9
0-22 11.9
0-23 11.9
0-24 11.9

Digital 3.3V

TX36 Spec: 2.8 - 3.5
0-1 3.3
0-2 3.3
0-3 3.3
0-4 3.3
0-5 3.3
0-6 3.3
0-7 3.3
0-8 3.3
0-9 3.3
0-10 3.3
0-11 3.3
0-12 3.3
0-13 3.3
0-14 3.3
0-15 3.3
0-16 3.3
0-17 3.3
0-18 3.3
0-19 3.3
0-20 3.3
0-21 3.3
0-22 3.3
0-23 3.3
0-24 3.3

Digital 2.5V

TX36   Spec: 2.4 - 2.6
0-1   2.5
0-2   2.5
0-3   2.5
0-4   2.5
0-5   2.5
0-6   2.5
0-7   2.5
0-8   2.5
0-9   2.5
0-10   2.5
0-11   2.5
0-12   2.5
0-13   2.5
0-14   2.5
0-15   2.5
0-16   2.5
0-17   2.5
0-18   2.5
0-19   2.5
0-20   2.5
0-21   2.5
0-22   2.5
0-23   2.5
0-24   2.5

Digital 1.5V

TX36   Spec: 1.4 - 1.6
0-1   1.5
0-2   1.5
0-3   1.5
0-4   1.5
0-5   1.5
0-6   1.5
0-7   1.5
0-8   1.5
0-9   1.5
0-10   1.5
0-11   1.5
0-12   1.5
0-13   1.5
0-14   1.5
0-15   1.5
0-16   1.5
0-17   1.5

0-18 1.5
0-19 1.5
0-20 1.5
0-21 1.5
0-22 1.5
0-23 1.5
0-24 1.5

Temperature

TX36 Spec: 15.0 - 75.0
0-1 38.8
0-2 39.2
0-3 38.0
0-4 36.8
0-5 38.0
0-6 38.0
0-7 38.0
0-8 36.0
0-9 38.0
0-10 37.2
0-11 36.0
0-12 36.0
0-13 36.8
0-14 37.6
0-15 38.4
0-16 37.2
0-17 39.2
0-18 40.0
0-19 39.6
0-20 39.6
0-21 39.6
0-22 38.4
0-23 39.2
0-24 39.2

Input Current 12V

TX36 Spec: 0.3 - 1.5
0-1 0.6
0-2 0.6
0-3 0.6
0-4 0.5
0-5 0.5
0-6 0.5
0-7 0.6

0-8 0.5
0-9 0.5
0-10 0.5
0-11 0.5
0-12 0.5
0-13 0.5
0-14 0.6
0-15 0.6
0-16 0.5
0-17 0.6
0-18 0.5
0-19 0.5
0-20 0.5
0-21 0.5
0-22 0.5
0-23 0.6
0-24 0.5

TX36 power test passed

IO TX PPC Embedded PPC Download
2.11 1.14 Mar 5 2007/1.07 May 7 2013/1.11

TX36 unique firmware test OK

2014.08.13 07:10:09.550 109 2 OK

Input voltage 12V

RX32 Spec: 11.0 - 13.0
7-1 11.7
7-2 11.7

Input voltage 6V

RX32 Spec: 5.0 - 7.0
7-1 5.7
7-2 5.7

Digital 3.3V

RX32 Spec: 2.8 - 3.5
7-1 3.3
7-2 3.3

Digital 2.5V

RX32 Spec: 2.4 - 2.6
7-1 2.5
7-2 2.5

Digital 1.5V

RX32 Spec: 1.4 - 1.6
7-1 1.5
7-2 1.5

Temperature

RX32 Spec: 15.0 - 75.0
7-1 38.0
7-2 39.0

Input Current 12V

RX32 Spec: 0.4 - 1.5
7-1 0.6
7-2 0.6

Input Current 6V

RX32 Spec: 2.4 - 3.3
7-1 2.9
7-2 2.7

RX32 power test passed

IO RX MB Embedded PPC Embedded PPC Download
1.12 1.14 May 5 2006/1.06 May 5 2006/1.07 Feb 18 2010/1.11

RX32 unique firmware test OK

2014.08.13 07:10:09.617 109 3 OK

High Voltage Br. 1

TX36 Spec: 108.0 - 132.0
0-1 121.7

0-2 121.7
0-3 122.1
0-4 121.7
0-5 122.6
0-6 123.0
0-7 123.0
0-8 122.6
0-9 122.1
0-10 122.1
0-11 122.6
0-12 122.6
0-13 122.1
0-14 122.6
0-15 120.9
0-16 122.6
0-17 122.6
0-18 122.1
0-19 122.1
0-20 122.6
0-21 122.1
0-22 122.1
0-23 122.1
0-24 122.1

High Voltage Br. 2

TX36 Spec: 108.0 - 132.0
0-1 121.7
0-2 125.0
0-3 121.7
0-4 122.2
0-5 123.0
0-6 123.0
0-7 122.6
0-8 122.6
0-9 121.7
0-10 122.6
0-11 123.0
0-12 122.6
0-13 121.7
0-14 122.6
0-15 120.9
0-16 121.7
0-17 121.7
0-18 123.0
0-19 122.6

0-20 123.4
0-21 122.6
0-22 122.2
0-23 122.2
0-24 122.6

Input voltage 12V

TX36 Spec: 11.0 - 13.0
0-1 11.9
0-2 11.9
0-3 12.0
0-4 11.9
0-5 11.9
0-6 12.0
0-7 12.0
0-8 12.0
0-9 11.9
0-10 11.9
0-11 11.9
0-12 12.0
0-13 11.9
0-14 11.9
0-15 11.9
0-16 11.8
0-17 11.9
0-18 12.0
0-19 11.9
0-20 12.0
0-21 11.9
0-22 11.9
0-23 11.9
0-24 11.9

RX32 Spec: 11.0 - 13.0
7-1 11.8
7-2 11.7

Input voltage 6V

RX32 Spec: 5.0 - 7.0
7-1 5.7
7-2 5.7

TRU power test passed

2014.08.13 07:10:09.734 109 4 OK

EM 122 High Voltage Ramp Test
Test Voltage:20.00 Measured Voltage: 18.00 PASSED
Test Voltage:60.00 Measured Voltage: 59.00 PASSED
Test Voltage:100.00 Measured Voltage: 100.00 PASSED
Test Voltage:120.00 Measured Voltage: 120.00 PASSED
Test Voltage:80.00 Measured Voltage: 85.00 PASSED
Test Voltage:40.00 Measured Voltage: 45.00 PASSED

6 of 6 tests OK

2014.08.13 07:12:33.824 109 5 OK

BSP 1 RXI TO RAW FIFO: ok
BSP 2 RXI TO RAW FIFO: ok

2014.08.13 07:12:38.290 109 6 OK

Receiver impedance limits [350.0 700.0] ohm

Board	1	2	3	4
1:	551.9	496.8		
2:	552.7	535.3		
3:	550.1	543.2		
4:	555.1	551.6		
5:	558.9	553.6		
6:	536.8	562.1		
7:	544.2	570.3		
8:	556.8	559.9		
9:	520.5	486.4		
10:	530.8	542.1		
11:	555.9	526.4		
12:	547.2	538.9		
13:	527.9	568.5		
14:	573.8	524.2		
15:	521.0	555.1		
16:	549.9	557.6		
17:	507.3	547.5		
18:	510.6	553.2		
19:	558.4	557.4		

20:	562.4	566.9
21:	558.3	513.3
22:	525.3	570.4
23:	555.3	570.4
24:	556.6	540.4
25:	535.9	556.0
26:	567.2	573.7
27:	560.1	493.7
28:	540.4	544.4
29:	548.8	506.7
30:	506.1	559.1
31:	540.7	597.1
32:	544.5	544.8

Receiver Phase limits [-20.0 20.0] deg

Board	1	2	3	4
1:	-0.7	3.8		
2:	-1.0	0.2		
3:	-1.0	-0.1		
4:	-1.1	-0.6		
5:	-0.6	-1.1		
6:	0.0	-0.9		
7:	-0.2	-1.5		
8:	-1.0	-1.8		
9:	1.8	4.3		
10:	0.5	-0.1		
11:	-0.7	1.2		
12:	0.1	-0.3		
13:	1.6	-1.4		
14:	-2.2	1.8		
15:	2.3	-0.5		
16:	-0.8	-0.8		
17:	3.7	0.1		
18:	3.0	-1.0		
19:	-1.2	-0.9		
20:	-1.7	-2.2		
21:	-1.3	3.0		
22:	1.7	-2.2		
23:	-0.8	-1.7		
24:	-1.3	0.9		
25:	0.9	-1.2		
26:	-1.8	-1.9		
27:	-0.6	4.0		
28:	0.1	-0.1		
29:	-0.4	3.9		
30:	2.8	-0.4		

31:   0.6   -3.5
32: -0.5   0.9
Rx Channels test passed

2014.08.13 07:13:09.808 109   7   OK

Tx Channels test passed

2014.08.13 07:15:49.799 109   8   OK

RX NOISE LEVEL

Board No: 1   2

0:	63.8	57.6	dB
1:	54.8	50.0	dB
2:	60.6	60.0	dB
3:	61.1	54.6	dB
4:	51.6	47.6	dB
5:	54.6	50.5	dB
6:	51.8	55.7	dB
7:	58.5	57.3	dB
8:	58.5	53.1	dB
9:	50.4	51.9	dB
10:	62.4	56.9	dB
11:	61.5	57.8	dB
12:	51.8	50.3	dB
13:	56.3	51.8	dB
14:	51.1	54.3	dB
15:	57.6	58.4	dB
16:	60.5	55.6	dB
17:	51.8	50.8	dB
18:	62.2	58.2	dB
19:	61.3	59.5	dB
20:	51.7	50.0	dB
21:	54.4	55.0	dB
22:	51.2	58.2	dB
23:	58.5	58.0	dB
24:	56.8	58.6	dB
25:	50.9	51.8	dB
26:	59.5	59.2	dB
27:	58.2	57.8	dB

28:	51.2	54.2	dB
29:	52.2	56.1	dB
30:	55.7	59.7	dB
31:	57.8	61.8	dB

Maximum noise at Board 1 Channel 0 Level: 63.8 dB

Broadband noise test

Average noise at Board 1 58.1 dB OK
Average noise at Board 2 56.7 dB OK

2014.08.13 07:15:55.749 109 9 OK

RX NOISE SPECTRUM

Board No: 1 2

10.0 kHz:	54.7	55.7	dB
10.2 kHz:	55.7	56.3	dB
10.3 kHz:	56.1	56.1	dB
10.4 kHz:	54.5	56.8	dB
10.6 kHz:	57.9	57.5	dB
10.7 kHz:	65.2	63.9	dB
10.9 kHz:	61.6	60.4	dB
11.0 kHz:	56.8	56.2	dB
11.2 kHz:	57.2	56.0	dB
11.3 kHz:	55.9	55.8	dB
11.4 kHz:	55.9	55.9	dB
11.6 kHz:	58.2	57.9	dB
11.7 kHz:	55.7	55.5	dB
11.9 kHz:	56.1	56.8	dB
12.0 kHz:	55.9	55.8	dB
12.1 kHz:	57.5	57.0	dB
12.3 kHz:	62.5	60.9	dB
12.4 kHz:	56.9	56.3	dB
12.6 kHz:	54.7	53.4	dB
12.7 kHz:	54.7	53.9	dB
12.9 kHz:	54.1	53.6	dB
13.0 kHz:	54.2	53.5	dB

Maximum noise at Board 1 Frequency 10.7 kHz Level: 65.2 dB

Spectral noise test

Average noise at Board 1   58.1 dB   OK
Average noise at Board 2   57.5 dB   OK

2014.08.13 07:16:01.700 109   10   OK

CPU: KOM CP6011
Clock 1795 MHz
Die   47 oC (peak: 54 oC @ 2014-08-13 - 07:10:08)
Board 51 oC (peak: 52 oC @ 2014-08-13 - 07:08:49)
Core 1.31 V
3V3   3.28 V
12V   11.85 V
-12V -12.04 V
BATT 3.49 V
Primary network: 157.237.14.60:0xffff0000
Secondary network: 192.168.1.1:0xffffff00

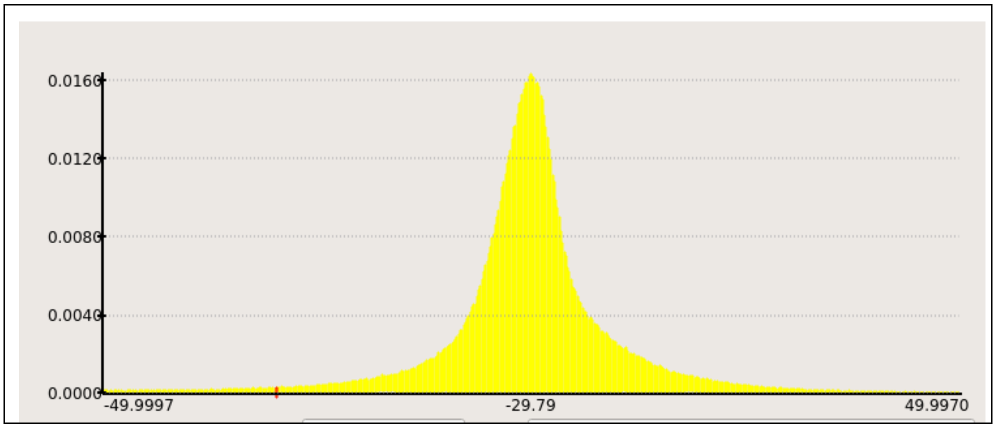
2014.08.13 07:16:01.766 109   15   OK

EM 122

BSP67B Master: 2.2.3 090702
BSP67B Slave: 2.2.3 090702
CPU: 1.3.2 140129
DDS: 3.5.9 130926
DSV: 3.1.6 130104
RX32 version : Feb 18 2010 Rev 1.11
TX36 LC version : May 7 2013 Rev 1.11
VxWorks 5.5.1 Build 1.2/2-IX0100 May 16 2007, 11:31:17

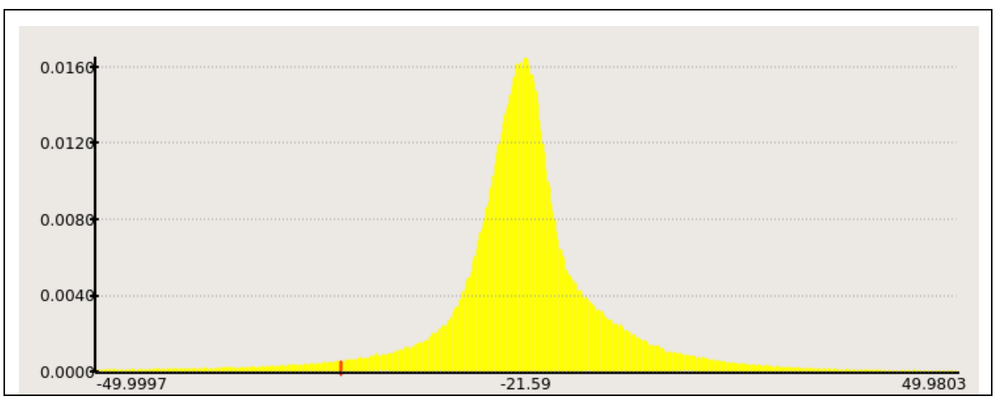
End of transit BIST Test

Appendix 7. Cross-check analyses



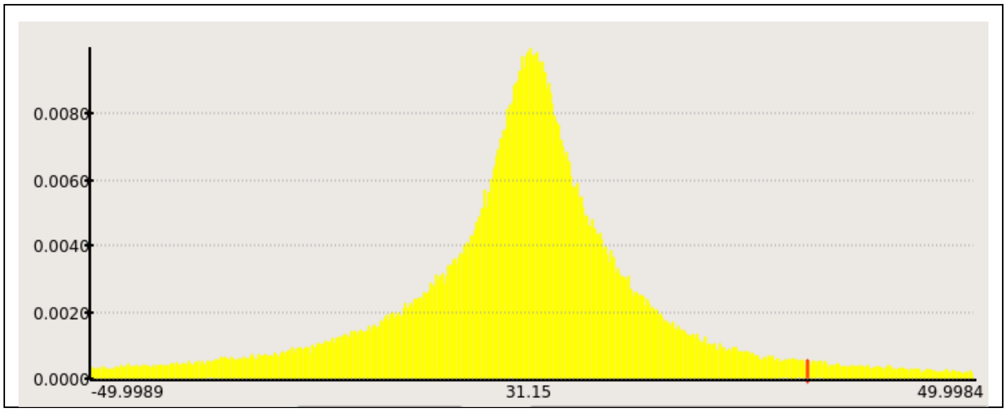
Histogram of sounding-depth differences from cross-line check of Line 26tran and 2010 KingmanPalmyra (KP) surface.

Line 26tran vs KP surface	Mean water depth	4550m
	Mean Z difference	0.25 m
	Standard deviation	20.97 m
	Number of samples	467,106
	Percent of water depth	0.47% at 2σ



Histogram of sounding-depth differences from cross-line check of Line 27tran and 2010 KingmanPalmyra (KP) surface.

Line 27tran vs KP surface	Mean water depth	4599m
	Mean Z difference	0.29 m
	Standard deviation	20.80 m
	Number of samples	487,289
	Percent of water depth	0.46% at 2σ



Histogram of sounding-depth differences from cross-line check of Line 28tran and 2010 KingmanPalmyra (KP) surface.

Line 50ran vs L42_46 surface	Mean water depth	4864 m
	Mean Z difference	5.6 m
	Standard deviation	76.7 m
	Number of samples	277,989
	Percent of water depth	1.7% at 2σ