References

[1] F. Ulaby, R.K. Moore, A.K. Fung, “Microwave Remote Sensing. Active and Passive”, Vol I: Microwave Remote Sensing Fundamentals and Radiometry, Addison-Wesley Publishing Company, 1981.

[2] N. Skou, Microwave Radiometer Systems: Design and Analysis, Artech House, 1981, p.121.

[3] R. Villarino, L. Enrique, A. Camps, I. Corbella and S. Blanch, “Design, implementation and test of the UPC L-band AUtomatic RAdiometer,” Open Symposium on Propagation and Remote Sensing URSI- F 2002, Garmisch-Partenkirchen, Germany, February 2002.

[4] N. Skou, Microwave Radiometer Systems: Design and Analysis, Artech House, 1981, p. 83

[5] A. Sumpsi, “Design, implementation and test of a Doppler delay-radiometer,” Final Project, ETSETB Polytechnic University of Catalonia, March 2003.

[6] X. Corominas, “Disseny i implementació d’un radiòmetre polarimètric en banda L: circuits de RF i detecció,” Final Project, ETSETB Polytechnic University of Catalonia, January 2001.

[7] I. Corbella and J. Bará. “A New Structure of Coupled Transmission Line Filters.” 30th Europen Microwave Conference EuMC. Paris 2-6 October 2000. Volume 2 pages 60-62.

[8] I. Sanz, “Diseño de VCO para aplicaciones MVDS,” Final Project, ETSETB Polytechnic University of Catalonia, 2001.

[9] J. Farré, N. Pizarro, “Optimització de circuits per a un radiometre de banda L,” Final Project, ETSETB Polytechnic University of Catalonia, January 2002

[10] J. Capdevila, “Design and Implementation of an X-band Polarimetric Radiometer,” Final Project, ETSETB Polytechnic University of Catalonia, January 1998.

[11] S. Franco, Design With Operational Amplifiers and Analog Integrated Circuits, McGraw-Hill International Editions, USA, 1988 , pp.372.

[12] F.J. Monzón, “Implementación de un correlador digital de alta velocidad en PLD”, Final Project, Polytechnic University of Catalonia, July 1998.

[13] R. Villarino, “Manual del experimento del radiómetro LAURA,” Internal publication, Polytechnic University of Catalonia, July 2002.

[14] R.Villarino,“ Radiómetro polarimétrico en Banda X: diseño de las antenas, control de temperatura y estructura mecánica,” Final Project, ETSETB Polytechnic University of Catalonia, January 2000.

[15] L. Enrique, “Manual de software del radiómetro LAURA,” Internal publication, Polytechnic University of Catalonia, July 2002.Internal Publication.

[16] UNESCO technical papers in marine science. Background papers and supporting data on the Practical Salinity Scale, 1978. Num 37, p141-144.

[17] D. Weaire, S. Hutzler, "The Physics of Foams", Clarendon press, Oxford 1999. Reich, W., 1982, A radio continuum survey of the northern sky at 1420 MHz – Part I, Astron- Astrophys. Suppl. Ser., 48, 219-297.

[18] P. Reich, and W. Reich, 1986, A radio continuum survey of the northern sky at 1420 MHz – Part I, Astron- Astrophys. Suppl. Ser., 63, 205-292.

[19] A. Camps, I. Corbella, J. Font, J. Etcheto, V. Caselles, and A. Weill, "WISE 2000 and 2001: Campaign Description And Executive Summary", *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA, pp. 17-26, France, 4-6 Nov 2002.

[20] A. Camps, R. Villarino, L. Enrique, M. Vall-llossera, J. Miranda, I. Corbella, "Sea Surface Emissivity At L-Band: Derived Dependence With Incidence And Azimuth Angles", *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA, pp. 105-106, France, 4-6 Nov 2002.

[21] A. Camps, et al. "Wind and Salinity Experiment 2000, Experiment Plan", May 2000.

[22] A. Camps, et al. "Wind and Salinity Experiment 2001, Experiment Plan", October 2001.

[23] "WInd and Salinity Experiment 2000, Data Acquisition Report, Version 1.0", May 2001

[24] J. Guo, L. Tsang, W. Asher, K.-H. Ding and C.-T. Chen, " Applications of dense media radiative transfer theory for passive microwave remote sensing of foam covered ocean", IEEE Transactions Geoscience and Remote Sensing, Vol. 39, No. 5, pp. 1019-1027, May 2001.

[25] N. Reul, N, and B. Chapron, " Effects of foam on the emissivity of the sea surface at L-band, WP 1300 Report, ESA contract Nº 15165/01/NL/SF April 2001.

[26] A. Guissard, "Atmospheric instability above the ocean and implications for scatterometry", submitted for publication December 2001.

[27] L.A. Klein and C.T. Swift, "An Improved Model for the Dielectric Constant of Sea Water at Microwave Frequencies", IEEE Journal of Oceanic Engineering, OE-Vol 2, No 1, pp 104-111, 1977.

[28] J. P. Hollinger, "Passive microwave measurements of sea surface roughness," *IEEE Trans. Geosci. Electron.*, vol. GE-9, no. 3, pp. 165–169, 1971.

[29] F. Ulaby, R. Moore, A. Fung "Microwave Remote Sensing: Active and Passive- Volume III: Active Microwave Sensing of the Ocean". Artech House, 1986, pp. 1653.

[30] C.T. Swift, "Microwave Radiometer Measurements of the Cape Cod Canal", Radio Science, Vol. 9, No. 7, pp 641-653, 1974.

[31] S.H. Yueh, “Modeling of Wind Direction Signals in Polarimetric Sea Surface Brightness Temperatures”, IEEE Transactions on Geoscience and Remote Sensing, Vol. 35, No 6, November 1997.

[32] M. Vall-llossera, J. Miranda, A. Camps, and R. Villarino, “Sea Surface Emissivity Modelling at L-band: An Inter-comparison Study”, *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA, pp. 143-153, France, 4-6 Nov 2002.

[33] T. Elfouhaily, B. Chapron, K. Katsaros, and D. Vandermark, “A Unified Directional Spectrum for Long and Short Wind-driven Waves,” *Journal of Geophysical Research*, Vol. 102, pp. 15781-15796, 1997.

[34] S.L. Durden, and J. F. Vesecky, “A Physical Radar Cross-Section Model for aWind-Driven Sea with Swell,” *IEEE Journal Of Oceanic Engineering*, Vol. OE-10, pp. 445-451, 1985.

[35] A. Camps, and S.C. Reising, “A Model for Wind Direction Signature in the Stokes Emission Vector of the Ocean Surface at Microwave Frequencies”, Microwave and Optical Technology Letters, Vol. 29(6), pp. 426-432, June 2001.

[36] R. Villarino, A. Camps, M. Vall-llossera, J. Miranda, and J. Arenas, “Sea foam and sea state effects on the instantaneous brightness temperatures at L-band”, *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA, pp. 95-103, France, 4-6 Nov 2002.

[37] F. Ulaby, R.K. Moore, A.K. Fung, “Microwave Remote Sensing. Active and Passive”, Vol III, Artech House, 1986.

[38] E.C. Monahan, and I. Muircheartaigh, “Whitecaps and the passive remote sensing of the ocean surface”, Int. J. Remote Sensing, Vol. 7, No. 5, pp. 627-642, 1986.

[39] E.C. Monahan, and M. Lu, “Acoustically Relevant Bubble Assemblages and Their Dependence on Meteorological Parameters”, IEEE Journal Of Oceanic Engineering, Vol. 15, No. 4, October 1990.

[40] E.C. Monahan, “Whitecap coverage as a monitorable indication of the rate of bubble injection into oceanic mixed layer. Sea Surface Sound”, Dordrecht, the Netherlands: Kluwer academic Publisher, 1988.

[41] E.C. Monahan, “Occurrence and evolution of acoustically relevant subsurface bubble plumes and their associated, remotely monitorable, surface whitecaps. Natural Physical Sources of underwater sounds: Sea Surface Sound (2)”, Dordrecht, the Netherlands: Kluwer academic Publisher, 1993.

[42] I.V. Cherny and V. Y. Raizer, Passive Microwave Remote Sensing of Oceans. Wiley-Praxis Series in Remote Sensing, 1998. 193 pages.

[43] G.S. Bordonskiy, I. B. Vasil'kova, N. N. V. V. M. Veselov, Y. A. Militskiy, V. G. Mirovskiy, V. N. Nkitin, V. Y. Raizer, Y. B. Khapin, Y. A. Sharkov, and V. S. Etkin, “Spectral characteristics of the

emissivity of foam formations," Izvestiya, Atmospheric and Oceanic Physics, vol. 14, no. 6, pp. 464-469, 1978.

[44] E.C. Monahan and D. K. Woolf, "Comments on variations of whitecap coverage with windstress and water temperature," J. Phys. Oceanogr., vol. 19, pp. 706-709, 1989.

[45] C. Reising, K. A. Horgan and M. A. Aziz, "Passive polarimetric Remote Sensing of the Ocean Surface: The Effect of Surface Roughness and Whitecaps",URSI General Assembly '02 Maastrict, Netherlands, August 2002.

[46] M.A. Donelan, and Pierson, W. J., "Bragg-scattering and equilibrium ranges in wind-generated waves, with application to scatterometry ", *J. Geophys. Res.,* 1985.

[47] C. Craeye, Sobieski, P.W., and Bliven, L.F., "Scattering by artificial wind and rain roughened water surfaces at oblique incidences", Int. J. Remote Sensing, Vol 18, No 10, pp 2241-2246, 1997.

[48] W. Reich, 1982, A radio continuum survey of the northern sky at 1420 MHz – Part I, Astron-Astrophys. Suppl. Ser., 48, 219-297.

[49] J. Arenas, "Determinación de parámetros de la espuma del mar con aplicaciones en teledetección," Final Project, EUPBL Polytechnic University of Catalonia, September 2001.

[50] J. Miranda, M. Vall-llossera, R. Villarino, A. Camps, "Sea state and rain effects in the sea surface emissivity at L-Band", *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA SP 525, pp. 17-26, France, 4-6 Nov 2002.

[51] J. Miranda, M. Vall-llossera, R. Villarino, A. Camps, "Sea state and rain effects in the sea surface emissivity at L-Band", *Proceedings of the First Results Workshop on WISE/LOSAC/EuroSTARSS Campaigns*, ESA SP 525, pp. 17-26, France, 4-6 Nov 2002.

Publications

Journal Papers.

1. Camps A., J.Font, J. Etchetto, V. Caselles, A. Weill, I. Corbella, M. Vall-llossera, N. Duffo, F. Torres, R. Villarino, L. Enrique, A. Julià, C. Gabarró, J. Boutin, E. Rubio, S.C. Reising, P. Wursteisein, M. Berger, M. Martín-Neira. "Sea Surface Emissivity Observations at L-band: First Results of the Wind and Salinity Experiment WISE 2000". IEEE Transactions on Geoscience and Remote Sensing, Vol 40, No 10, October 2002, pp 2117-2130.

2. A. Camps, J. Font, M. Vall-llossera, C. Gabarró, I. Corbella, N. Duffo, F. Torres, S. Blanch, A. Aguasca, R. Villarino, L. Enrique, J. Miranda, J. Arenas, A. Julià, J. Etcheto, V. Caselles, A. Weill, J. Boutin, S. Contardo, R. Niclós, R. Rivas, S.C.Reising, P. Wursteisen, M. Berger, and M. Martín-Neira, "The *WISE* 2000 and 2001 campaigns in support of the SMOS Mission: Sea Surface L-Band Brightness Temperature Observations And Their Application to Multi-Angular Salinity Retrieval". IEEE Transactions on Geoscencie Remote Sensing, Vol 42 No 4, April 2004, pp 804 a 823.

3. Camps, A., I. Corbella, M. Vall-llossera, N. Duffo, F. Torres, R. Villarino, L. Enrique , F. Julbé, J. Font, A. Julià, C. Gabarró, J. Etchetto, J. Boutin, A. Weill, V. Caselles, E. Rubio, P. Wursteisein, M. Martín-Neira. "L-band Sea Surface Emissivity: Preliminary Results of The WISE-2000 Campaign And its Application to Salinity Retrieval in The SMOS Mission". Radio Science Volumen: 38, No. 4, 8071, 10.1029/2002RS002629, June 2003.

4. A. Camps, M. Vall.llossera, R. Villarino, R. Rodríguez, R. Sabia, A. Monerris, I. Corbella, N. Duffo, F. Torres, "Foam –covered and rain-roughned sea surface emissivity at L-band: Results from the FROG 2003 experiment ". 8th specialist meeting on microwave radiometry and remote sensing applications, Rome, February 2004, IEEE Transactions on Geoscencie Remote Sensing, special issue submitted for publication.

Conferences and workshop proceedings.

5. Camps A., I. Corbella, M. Vall-llossera, R. Villarino, L. Enrique, J. Font, A. Julià, C. Gabarró, J. Etchetto, J. Boutin, A. Weill, F. Torres, N. Duffo, R. Niclós, V. Caselles, P. Wursteinsen y M. Martín-Neira." Sea Surface Emissivity Observations at L-band: First Preliminary Results of the Wind and Salinity Experiment WISE 2000". International Geoscience ad Remote Science Symposium, IGARSS '01, Sydney (Australia), July 2001.

6. Camps A., I. Corbella, M. Vall-llossera, R. Villarino, L. Enrique, , F. Julbé, J. Font, A. Julià, C. Gabarró, J. Etchetto, J. Boutin, A. Weill, N. Duffo, F. Torres, V. Caselles, E. Rubio, P. Wursteinsein y M. Martín-Neira. " L-band sea surface emissivity: preliminary results of The WISE 2000 campaign and its application to salinity setrieval in the SMOS mission". Microrad '01 conference. Boulder (Colorado), USA, November 2001.

7. Villarino R., L. Enrique, A. Camps, I. Corbella y S. Blanch. "Design, implementation and test of the UPC L-band AUtomatic RAdiometer". Open Symposium on Propagation and Remote Sensing URSI- F 2002, Garmisch-Partenkirchen, February 2002.

8. Camps A., I. Corbella, M. Vall-llossera, F. Torres, N. Duffo, R. Villarino, L. Enrique, J. Miranda, J. Arenas, J. Font, A. Julià, C. Gabarró, J. Etchetto, J. Boutin, S. Contardo, A. Weill, R. Niclós, V. Caselles, P. Wursteisen, M. Berger y M. Martín-Neira. "Wind Effects on the Sea Surface Emissivity at L-band: Preliminary Results of WISE 2000 and 2001". Open Symposium on Propagation and Remote Sensing URSI- F 2002, Garmisch-Partenkirchen, February 2002.

9. Camps A., J. Font, J. Etchetto, A. Weill, V. Caselles, I. Corbella, M. Vall-llossera, F. Torres, N. Duffo, R. Villarino, L. Enrique, J. Miranda, A. Julià, C. Gabarró, J. Boutin, R. Niclós, P. Wursteisein, M. Berger y M. Martín-Neira. "L-band Sea Surface Emissivity Radiometric Observations under High Winds: Preliminary Results of the Wind ad Salinity Experiment WISE-2001". International Geoscience ad Remote Sensing Symposium, IGARSS '02. Toronto (Canada), June 2002.

10. Camps A., J. Font, J. Etchetto, ,V. Caselles, I. Corbella, M. Vall-llossera, F. Torres, N. Duffo, R. Villarino, L. Enrique, J. Miranda, J. Arenas, A. Julià, C. Gabarró, J. Boutin, S. Contardo, A. Weill, R. Niclós, R. Rivas, S.C. Reising, P. Wursteisen, M. Berger y M. Martín-Neira. "Sea Surface Radiometric Observations At L-band: Wind Speed Sensitivity Derived From WISE 2000 and 2001". Proceedings of the URSI General Assembly (CD-ROM). Maastrich, The Netherlands, August 2002.

11. R. Villarino, A. Camps, M. Vall-llossera, J. Miranda, J. Arenas, "Sea Foam And Sea State Effects On The Instantaneous Brightness Temperatures At L-Band". EuroSTARRS, WISE and LOSAC, ESA Publications Division (ISBN 92-9092-835-2), pp (95 a 103), November 2002.

12. A. Camps, R. Villarino, L. Enrique, M. Vall-llossera, J. Miranda, I. Corbella, "Sea Surface Emissivity at L-Band: Derived Dependence with Incidence and Aziumth Angles". EuroSTARRS, WISE and LOSAC, ESA Publications Division (ISBN 92-9092-835-2), pp (105 a 116), November 2002.

13. M. Vall-llossera, J. Miranda, A. Camps, R. Villarino, "Sea Surface Emissivity Modelling at L-Band: An Inter-Comparison Study". EuroSTARRS, WISE and LOSAC, ESA Publications Division (ISBN 92-9092-835-2), pp (143 a 153), November 2002.

14. J. Miranda, M. Vall-llossera, R. Villarino, A. Camps, "Sea State and Rain Effects on Sea Surface Emissivity at L-Band". EuroSTARRS, WISE and LOSAC, ESA Publications Division (ISBN 92-9092-835-2), pp (155 a 162), November 2002.

15. A. Camps, M. Vall-llossera, R. Villarino, J. Miranda, F. Fulbé, B. Vallespín, "Sea Surface Retrieval in the SMOS Configuration: Simulation Performance Study". EuroSTARRS, WISE and LOSAC, ESA Publications Division (ISBN 92-9092-835-2), pp (173 a 180), November 2002.

16. J. Miranda, M. Vall-llossera, A. Camps, R. Villarino, "Estimation of Sea Surface Spectrum Under Non-Stationary Conditions". International Geoscience and Remote Sensing Symposium IGARSS 2003. Proceedings of the International Geoscience and Remote Sensing Symposium IGARSS 2003 (CD-ROM), Tolouse France, July 2003.

17. M. Vall-llossera, J. Miranda, A. Camps, R. Villarino, N. Duffo, I. Corbella, "Inter-Comparison Study of Asymptotic Models for Sea Surface Emissivity Simulation at L-band". International Geoscience and Remote Sensing Symposium IGARSS 2003. Proceedings of the International Geoscience and Remote Sensing Symposium IGARSS 2003 (CD-ROM), Tolouse France, July 2003.

18. R. Villarino, A. Camps, M. Vall-llossera, J. Miranda, J. Arenas, "Sea Foam Effects On The Brightness Temperature At L-Band". International Geoscience and Remote Sensing Symposium IGARSS 2003. Proceedings of the International Geoscience and Remote Sensing Symposium IGARSS 2003 (CD-ROM), Tolouse France, July 2003.

19. R. Villarino, A. Camps, I. Corbella, M. Vall-llossera, N. Duffo, F. Torres, L. Enrique, J. Miranda, J. Arenas, J. Font, A. Julià, C. Gabarró, J. Echetto, J. Boutin, S. Contardo, A. Weill, E. Rubio, R.

Niclós, R. Rivas, V. Caselles, P. Wursteisein, M. Berger, and M. Martín Neira. "Sea Surface emissivity at L-band. Results of the WInd and Salinity Experiments WISE 2000 and 2001". SPIE's 10th International Symposium on Remote Sensing, Vol 5233, pp (296-307), September 2003.

20. J. Miranda, M. Vall-llossera, A. Camps, R. Villarino. "Estimation of sea surface spectrum using neural networks". SPIE's 10th International Symposium on Remote Sensing, Vol 5233, págs (108-117), September 2003.

21. R. Villarino, A. Camps, M. Vall-llossera, J. Miranda, R. Sabia, A. Monerris, R. Rodríguez, F. Campoy, J. Fernández, I. Corbella, N. Duffo, F. Torres, J. Arenas, "Sea surface emission at L-band results from the WISE/FROG field experiments ". International Geoscience and Remote Sensing Symposium IGARSS 2004, Anchorage, Alaska, September 2004. Accepted.

List of figures

List of tables

Appendix 1. Links to the devices datasheets (12/June/2004)

74HC4060 (BF frequency generator)

http://www.philipslogic.com/products/hc/pdf/74hc4060.pdf

AD767 12 bits DAC

http://www.analog.com/UploadedFiles/Data_Sheets/489657162ad767.pdf

AD536A (rms to dc converter)

http://www.chipcatalog.com/Analog/AD536A.htm

BP2G (power splitter)

http://www.minicircuits.com/dg03-114.pdf

CD4066

http://www.ee.washington.edu/stores/DataSheets/cd4000/cd4066.pdf

DS34C86T (current to voltage converter)

http://cache.national.com/ds/DS/DS34C86T.pdf

DS34C87T (voltage to current converter)

http://cache.national.com/ds/DS/DS34C87T.pdf

IL300 (optocoupler)

http://www.infineon.com/cmc_upload/0/000/008/434/IL300.pdf

INA114 (amp. de instrumentación)

http://cfa-www.harvard.edu/~thunter/datasheets/INA114.pdf

LM35

http://cache.national.com/ds/LM/LM35.pdf

MACOM's MA4CS102E (diodo detector diferencial)

http://www.macom.com/data/datasheet/MA4E2054.pdf

MAR-6 (power amplifier)

http://www.gamma.pl/technical/minicirc/monamp2.pdf

MAX238(TTL to RS232 converter)

http://pdfserv.maxim-ic.com/en/ds/MAX220-MAX249.pdf

MAX2102 (down-convert)

http://pdfserv.maxim-ic.com/en/ds/MAX2102EVKIT.pdf

MAX2640 (LNA)

http://pdfserv.maxim-ic.com/en/ds/MAX2640-MAX2641.pdf

MAX915 (comparator)

http://www.nalanda.nitc.ac.in/industry/datasheets/maxim/PDF/1217.pdf

NE5561

http://noel.feld.cvut.cz/semi/philips/acrobat/5036.pdf

NE592 (video amplifier)

http://www.oselectronics.com/downloads/ne592.pdf

OP37 (amplificador operacional)

http://www.analog.com/Analog_Root/productPage/productHome/0,2121,OP37,00.html

Pico-ADC-12 and Pico-ADC-16 (analogic to digital converter)

www.picotech.com

RSW-2-25p (switches)

http://www.minicircuits.com/dg03-216.pdf

STP11NB40

http://www.mouser.com/catalog/618/319.pdf

TS924 (operational amplifier)

http://www.jarkad.cz/katalog_listy/t/ts924.pdf

UMA1021M (Divisor programable del PLL)

http://www.semiconductors.philips.com/pip/UMA1021M.html

XR-2206

http://www.avaye.com/electronics/datasheets/timers/XR2206v103.pdf

Appendix 2. WISE (*WInd and Salinity Experiment*) 2000 and 2001 Instrumentation Technical documentation

- Sea-Bird 37-SM (MicroCAT) characteristics:

(Data provided by Sea-Bird Electronics)

The SBE 37-SM is a conductivity and temperature recorder, with internal power supply and memory for data recording. It has a RS232C serial interface and it can be programmed to give sampling rates between 10 seconds and 9.1 hours. The system uses a 24-bit A/D converter to digitise the temperature sensor voltage. The sensor is an ultra-stable aged thermistor and is referred to a VISHAY reference resistor.

PARAMETER CHARACTERISTICS

	Temperature ºC	Conductivity (S/m) *
Range	-5 to +35	0 to 7
Accuracy (1)	0.002	0.0003
Stability (2)	0.0002	0.0003
Resolution	0.0001	0.00001
Calibration (3)	+1 to 32	0 to 6

Notes:
* 1 S/m = 10 mS/cm
(1) Initial accuracy when delivered from the factory.
(2) Stability per month
(3) Range of calibration reference data.

The RMS deviation on the salinity calculation from conductivity and temperature is 0.002 psu. The time base is a TCXO of $\pm$ 5 ppm vs. temperature (in the range of –5 to +30 ºC), with a $\pm$2 ppm per year ageing, equivalent to $\pm$2.6 minutes per year. The memory capacity, expressed as number of samples, of the SBE 37-SM MicroCAT, is 410.000 samples (C and T only). For C, T and time, the capacity is 225.000 samples. At a rate of 0.5 sample per minute 410.000 samples, it means 569.4 days of operation (19 months). At the same sampling rate 225.000 samples, it means 312.5 days of operation (10.4 months). Each full power pack is capable to endure 175.000 samples (4 months).

The battery power pack is made of six 9 V lithium batteries, having a total of 6 Ah charge.

- Salinometer Guildline Autosal characteristics:

The salinometer that was used is the Model 8400B. This instrument measures the conductivity and the temperature of a sample comparing from a reference water. This reference water has a salinity of 35.0000 psu. The technical characteristics of the instrument are the following:

Accuracy	0.002 psu
Resolution	0.0002 psu
Stability on temperature	0.001ºC/day

- USONIC Ultrasonic Anemometer

Wind speed:

Range: 0-60 m/s

Resolution: 0.05 m/s

Accuracy: ±0.1 m/s (0-5 m/s)

< 1.5% (5-60 m/s)

- Wind direction:

Range: 0º-360º

Resolution: 1º

Accuracy: < ±3º

- Temperature: Range: -30º... +60º

Resolution: 0.1 ºC

Accuracy: ± 1ºC

- AANDERAA CMB 3280 Coastal Monitoring Buoy characteristics

Reference reading: 413

Sensors:

Wind Speed

Type: three-cup rotor.

Method of measurement: Average over the past measured interval

Range: 0.4 to 76 m/s

Resolution: 0.0746 m/s

Accuracy: ± 2 %

Wind Direction (Buoy orientation sensor)

Type: Direct Earth magnetic field measured by a Hall effect compass.

Method of measurement: Average over the past measured interval.

Range: 0 to 360º refereed to magnetic North

Resolution: 0.352º

Accuracy: ± 5º

Air Temperature

Type: Platinum PTC resistor in a radiation screened housing.

Method of measurement: Resistor bridge

Time constant (63 %): 6 minutes

Range: -8 to 41º C

Resolution: 0.048º C

Accuracy: ± 0.1º C

Solar Radiation

Type: Pyranometer

Range: 0 - 2000 W/m^2

Resolution: 0.4 W/m^2

Accuracy: ± 20 W/m^2

Relative Humidity Sensor

Type: Capacitive film sensor, in a radiation screened housing.

WISE 2000 Experiment Plan, v 2.0, 20/07/00 52

Method of measurement: Frequency of an oscillator capacitively tuned. Digital output.

Time constant: 1.5 minutes

Range: 0 to 100 %

Resolution: 0.1 %

Accuracy: ± 3 %

Wave Height

The significant wave height measured as the mean of the highest third of all the waves during the sampling interval.

Type: silicon accelerometer, mounted on a pendulum. Microprocessor controlled, measured each 200 ms and averaged.

Range: 0 to 10 meters (for wave periods of 3 to 8 seconds).

Accuracy: ± 10 % or ± 0.2 meters (whichever is greater).

Wave Period

Type: Calculated in the same sensor with wave height.

Range: 1 to 30 seconds

Accuracy: ± 10 %

- AANDERAA RCM9 current meter:

Current speed

Type: Doppler sensor. Vector averaging at 600 pings during sampling interval.

Includes one tilt sensor for current speed and direction correction

Acoustic Frequency: 2 MHz

Beam angle: ± 1º (Main lobe)

Range: 0 to 500 cm/s

Accuracy: 2 cm/s or ± 2 % of actual speed.

Current Direction

Type: Uses the same Doppler sensor used for current speed.

Range 0 to 360º respect magnetic North.

Accuracy: ± 5º for 0 to 15º tilt of the buoy

± 7.5º for 15 – 35º tilt of the buoy

Water Temperature

Type: Platinum sensor located on the Doppler current sensor.

Range: -8 to 41º C

Accuracy: ± 0.1º C

Appendix 3. Instruments specifications

- SONY SSC-DC393

Specifications

	SSC-DC193	SSC-DC393
Image device	1/3 type Interline Transfer Super HAD CCD	1/3 type Interline Transfer Exwave HAD CCD
Picture elements (H x V)	510 x 492	768 x 494
Sensing area	1/3" format (4.8 x 3.6 mm)	
Signal system	NTSC standard	
Sync. System	INT/LL	
Horizontal resolution	330 TV lines	480 TV lines
Lens mount	CS	
Minimum illumination	0.3 lx at F1.2 (30 IRE, AGC ON, Turbo mode) 0.6 lx at F1.2 (50 IRE, AGC ON, Turbo mode) 3.0 lx at F1.2 (100 IRE, AGC ON, Turbo mode)	0.35 lx at F1.2 (30 IRE, AGC ON, Turbo mode) 0.7 lx at F1.2 (50 IRE, AGC ON, Turbo mode) 3.5 lx at F1.2 (100 IRE, AGC ON, Turbo mode)
AGC	ON/OFF switchable	
CCD IRIS	ON/OFF (switchable), 1/60 to 1/100,000 s	
White Balance (WB)	ATW	
Back-Light Compensation (BLC)	ON/OFF switchable	
S/N ratio	More than 50 dB (AGC OFF, Weight ON)	
Video out	BNC, 1.0 Vp-p, 75 Ω, sync. negative	
Operating temperature	-10°C to 50°C (14°F to 122°F)	
Storage temperature	-40°C to 60°C (-40°F to 140°F)	
Power requirements	AC 24 V ±10%, 60Hz or DC 12 V ±10%	
Power consumption	3.5 W	3.7 W
Auto iris lens	DC/video servo switchable	
Weight	13 oz (360 g)	
Dimensions (W x H x D)	2 3/8 x 2 1/4 x 4 3/4 inches (60 x 54 x 120 mm)	
Supplied accessories	Lens mount cap (1) Operating instruction (1)	

- Ademco high resolution Lens

FEATURES:	PART NUMERS – AUTO IRIS LENSES ALD02813L	ALD0412S	ALD0812S	ALD3V813S	ALD5V5018L
Image Format	3"	1/3"	1/3"	1/3"	1/3"
Focal Length	2.8mm	4mm	8mm	3-8mm	5-50mm
Iris Range	F1.3-T360	F1.2-T360	F1.2-T360	F1.3-T360	F1.8-T360
Focus Range	.1m to infinity	.1m to infinity	.1m to infinity	.3m to infinity 1m (@tele)	.3m (@wide)
Back Focus distance	8.11mm	8.62mm	8.81mm	8.07mm (in air) 11.08 (@tele)	9.70mm (@wide)
Weight	40g	40g	40g	70g	225g
Lens Mount	CS	CS	CS	CS	CS
Iris Control	4-pin DC Control	4-pin DC Control	4-pin DC Control	4-pin DC Control	4-pin DC Control
Focus Control	Manual	Manual	Manual	Manual	Manual
Iris Control cable	230mm	100mm	100mm	100mm	100mm
Dimensions (DxLxW)	32x35x44mm	32x35x44mm	32x35x44mm	41x50x48mm	54x86x54mm

- Ultrak KC550xCP

Power

• Power Source	12V DC/24V AC +/- 10% or 230VAC +/- 10%, 50 Hz +/- 1%
• Power Consumption	Max. 3.6 Watts
• Power Indicator	Green LED

Sensor Information and General

• Processing Technology	Sony DSP
• Image Sensor	1/3" interline transfer CCD(sony chip set)
• Picture Element	600(H) x 582(V)
• Chip Size	6.0mm(H) x 4.96mm(V)
• Unit Cell Size	9.8um(H) x 6.3um(V)
• Scanning System	2:1 interlace
• Scanning Frequency	15.625KHz(H), 60Hz(V)
• Sync System	Line Lock
• Vert Phase Adjust Range	0 deg. to 360 deg
• Electronic Shutter	1/60 ~ 1/100,000 sec.
• Operating Temperature / Humidity	-10°C - +50°C (14°F - 122°F) / <96% (Non-condensing)

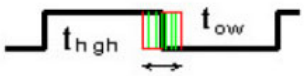
Connector and Mechanical

• Video Output	BNC Connector
• Power Input	3-pin Terminal Block or Power Cord
• AI/DC Output	4-pin mini din jack (Standard Connection)
• Lens Mount	C/CS(selected through back focus)
• Back Focus & C/CS Adjust	Built in Back Focus Cam with Thumb Wheel Adjust (Range:-1.5mm to +6.5mm)
• B/F & C/CS Lock	Phillips Tension Screw
• Mounting Hole	1/4" UNC Top and Bottom
• External Dimensions	62(W) x 54(H) x 140(D)
• Weight	290g (~10.2 oz)

Video

• Signal Format	PAL 625 Lines
• Resolution	330 TV Lines
• Minimum Illumination	0.8 Lux(F1.2)
• Video Output	1.0Vp-p, 75 ohm unbalanced
• Video Iris Output	650mV at video out 1.0 Vp-p
• S/N Ratio	46 dB (AGC Off)
• BLC Size	40% center
• Sync Level	40 IRE
• White Clip	120 IRE
• Auto/Man Shutter Control (E.S.)	Auto(On), Man(Off) (Dip Switch)
• Manual Shutter Control	1/60(1/50), 1/100(F.F.), 1/250, 1/500, 1/1000, 1/4000, 1/10,000, 1/100,000(Default 1/60)
• Auto Iris	AI/DC (Dip Switch)
• BLC	ON/OFF (Dip Switch)
• Gamma	On(0.45)/Off(1) (Dip Switch)
• AGC	On/Off (Dip Switch)
• Vert Phase Adjust	Adjustable (Tact Switch Up/Down)
• DC Iris Level Adjust	Adjustable (POT)
• White Balance	Auto (3200K ~ 8000K), 3200K, 4200K, 6300K (2 Dip Switches)

- Seika clinometer

Type	N2	N3	N4
Measuring range	±10°	±30°	±70°
Resolution	< 0.002°	< 0.005°	0.01°
Dimensions - with Mounting Ring	.976" (24.8mm) dia. X .46" (11.7mm) h 1.46" (37mm) dia. X .46" (11.7 mm) h		
Max. Non-linearity	<0.2% from measuring value!		
Transverse Sensitivity	<1% at 30° tilt		
Response time	< 0.3 Sec.		
Power Supply U_{bN} (Regulated)	5 Volt		
Min ... Max. Supply U_{bz}	3 ... 6 Volt		
Current consumption U_b=5Volt	Approx. 1mA		
Protection degree	IP65		
Operating temperature	-40 to +85°C		
Storage temperature	-45 to +90°C		
Weight (without cable and mounting ring)	Approx. .653 ounces (18.5 grams)		
Cabling	Standard: 3 highly flexible, individually shielded wires; shielding .039" (Ø 1.0mm) x 7.09" (180mm) l Optional: Shielded cable .083" (Ø2.1mm) x 19.69" (0.5m) l		
Values for analog DC output model at U_{bN}=5Volt			
Sensitivity	Approx. 12mV/°	Approx. 5mV/°	Approx. 3.2mV/°
Temperature drift of sensitivity	-0.17%/°C	< -0.12%/°C	
Temperature drift of zero	< ±0.05mV/°C	< ±0.025mV/°C	
Zero offset at Ub=5V	2.5 ±0.1 Volt - generally: 0.5Ub ±4%		
Output Impedance	10kΩ		
Values for duty cycle for digital pulse width modulated output model at U_{bN}=5Volt			
			
Sensitivity $dt_{(E)}/(t_{high}+t_{low})$	Approx. $76*10^{-3}$/°	Approx. $33*10^{-3}$/°	Approx. $20*10^{-3}$/°
Temperature drift of sensitivity	-0.17%/°C	< -0.12%/°C	
Temperature drift of zero	< $\pm 1.6*10^{-4}$ FS/°C	< $\pm 8*10^{-5}$ FS/°C	
Middle initial point t_{high}/t_{low}	1 ±4%		
Output frequency	Approx. 20Hz to approx. 1MHz (optional)		