

10255-CAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	5.16	74.18	19.71	3.98	65.0	± 9.6 %
		Y	5.30	74.47	20.22		65.0	
		Z	4.70	75.20	20.10		65.0	
10256-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	2.82	65.41	11.62	3.98	65.0	± 9.6 %
		Y	3.39	67.80	13.73		65.0	
		Z	1.43	60.37	6.45		65.0	
10257-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	2.81	65.08	11.37	3.98	65.0	± 9.6 %
		Y	3.37	67.35	13.43		65.0	
		Z	1.43	60.21	6.25		65.0	
10258-CAA	LTE-TDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	2.65	67.44	13.38	3.98	65.0	± 9.6 %
		Y	3.19	70.14	15.47		65.0	
		Z	1.40	61.72	8.16		65.0	
10259-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	4.28	71.17	17.42	3.98	65.0	± 9.6 %
		Y	4.53	72.03	18.38		65.0	
		Z	3.28	68.98	14.98		65.0	
10260-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	4.32	71.00	17.35	3.98	65.0	± 9.6 %
		Y	4.58	71.85	18.31		65.0	
		Z	3.30	68.72	14.83		65.0	
10261-CAB	LTE-TDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	4.60	75.09	19.17	3.98	65.0	± 9.6 %
		Y	4.90	76.17	20.19		65.0	
		Z	3.83	74.43	17.98		65.0	
10262-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	4.83	72.90	19.32	3.98	65.0	± 9.6 %
		Y	4.99	73.31	19.95		65.0	
		Z	4.22	72.78	18.54		65.0	
10263-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	4.70	71.27	18.26	3.98	65.0	± 9.6 %
		Y	4.88	71.67	18.88		65.0	
		Z	3.86	70.18	16.92		65.0	
10264-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.11	76.15	20.20	3.98	65.0	± 9.6 %
		Y	5.32	76.78	20.92		65.0	
		Z	4.65	77.32	20.40		65.0	
10265-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	4.98	71.27	18.71	3.98	65.0	± 9.6 %
		Y	5.12	71.52	19.17		65.0	
		Z	4.30	70.79	18.21		65.0	
10266-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	5.32	72.21	19.49	3.98	65.0	± 9.6 %
		Y	5.45	72.39	19.92		65.0	
		Z	4.69	72.11	19.19		65.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	5.36	74.67	19.71	3.98	65.0	± 9.6 %
		Y	5.53	75.07	20.25		65.0	
		Z	4.91	75.84	20.32		65.0	
10268-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	5.65	71.50	19.26	3.98	65.0	± 9.6 %
		Y	5.78	71.64	19.62		65.0	
		Z	5.00	71.24	19.08		65.0	
10269-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	5.66	71.18	19.17	3.98	65.0	± 9.6 %
		Y	5.77	71.29	19.52		65.0	
		Z	5.05	71.01	18.99		65.0	
10270-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	5.52	72.92	19.16	3.98	65.0	± 9.6 %
		Y	5.66	73.16	19.58		65.0	
		Z	5.08	73.78	19.71		65.0	

10303-AAA	IEEE 802.16e WiMAX (31:15, 5ms, 10MHz, 64QAM, PUSC)	X	4.69	65.08	17.81	4.96	50.0	± 9.6 %
		Y	4.86	65.07	17.83		50.0	
		Z	4.28	65.64	17.34		50.0	
10304-AAA	IEEE 802.16e WiMAX (29:18, 5ms, 10MHz, 64QAM, PUSC)	X	4.52	65.07	17.38	4.17	50.0	± 9.6 %
		Y	4.68	64.98	17.34		50.0	
		Z	4.13	65.73	17.00		50.0	
10305-AAA	IEEE 802.16e WiMAX (31:15, 10ms, 10MHz, 64QAM, PUSC, 15 symbols)	X	4.03	66.10	18.90	6.02	35.0	± 9.6 %
		Y	4.21	66.22	19.08		35.0	
		Z	3.65	66.53	17.54		35.0	
10306-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 64QAM, PUSC, 18 symbols)	X	4.40	65.40	18.61	6.02	35.0	± 9.6 %
		Y	4.58	65.52	18.78		35.0	
		Z	4.00	66.02	17.76		35.0	
10307-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, PUSC, 18 symbols)	X	4.29	65.50	18.56	6.02	35.0	± 9.6 %
		Y	4.47	65.67	18.74		35.0	
		Z	3.89	65.97	17.63		35.0	
10308-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, PUSC)	X	4.26	65.67	18.69	6.02	35.0	± 9.6 %
		Y	4.43	65.81	18.85		35.0	
		Z	3.87	66.17	17.78		35.0	
10309-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, 16QAM, AMC 2x3, 18 symbols)	X	4.44	65.57	18.74	6.02	35.0	± 9.6 %
		Y	4.63	65.74	18.92		35.0	
		Z	4.01	66.04	17.84		35.0	
10310-AAA	IEEE 802.16e WiMAX (29:18, 10ms, 10MHz, QPSK, AMC 2x3, 18 symbols)	X	4.35	65.44	18.58	6.02	35.0	± 9.6 %
		Y	4.52	65.57	18.74		35.0	
		Z	3.96	66.10	17.79		35.0	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	3.38	70.80	17.36	0.00	150.0	± 9.6 %
		Y	3.17	69.01	16.40		150.0	
		Z	3.03	70.70	17.35		150.0	
10313-AAA	iDEN 1:3	X	2.17	67.28	13.10	6.99	70.0	± 9.6 %
		Y	2.46	69.39	14.63		70.0	
		Z	2.34	70.28	14.80		70.0	
10314-AAA	iDEN 1:6	X	3.10	72.02	17.74	10.00	30.0	± 9.6 %
		Y	3.63	75.49	19.88		30.0	
		Z	5.66	83.35	22.39		30.0	
10315-AAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	1.10	64.76	16.13	0.17	150.0	± 9.6 %
		Y	1.07	63.46	15.15		150.0	
		Z	1.10	65.43	16.17		150.0	
10316-AAB	IEEE 802.11g WiFi 2.4 GHz (ERP-OFDM, 6 Mbps, 96pc duty cycle)	X	4.55	66.83	16.41	0.17	150.0	± 9.6 %
		Y	4.60	66.52	16.30		150.0	
		Z	4.22	67.27	16.31		150.0	
10317-AAB	IEEE 802.11a WiFi 5 GHz (OFDM, 6 Mbps, 96pc duty cycle)	X	4.55	66.83	16.41	0.17	150.0	± 9.6 %
		Y	4.60	66.52	16.30		150.0	
		Z	4.22	67.27	16.31		150.0	
10400-AAC	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	4.69	67.34	16.57	0.00	150.0	± 9.6 %
		Y	4.74	66.94	16.37		150.0	
		Z	4.27	67.58	16.41		150.0	
10401-AAC	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	5.39	67.42	16.67	0.00	150.0	± 9.6 %
		Y	5.47	67.20	16.57		150.0	
		Z	4.99	67.35	16.44		150.0	

10427-AAA	IEEE 802.11n (HT Greenfield, 150 Mbps, 64-QAM)	X	5.36	67.59	16.76	0.00	150.0	± 9.6 %
		Y	5.43	67.35	16.64		150.0	
		Z	4.96	67.56	16.58		150.0	
10430-AAA	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1)	X	4.52	72.63	19.14	0.00	150.0	± 9.6 %
		Y	4.35	71.05	18.45		150.0	
		Z	5.24	77.71	20.13		150.0	
10431-AAA	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1)	X	4.23	67.74	16.59	0.00	150.0	± 9.6 %
		Y	4.26	67.17	16.32		150.0	
		Z	3.83	68.36	16.30		150.0	
10432-AAA	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1)	X	4.52	67.50	16.62	0.00	150.0	± 9.6 %
		Y	4.56	67.04	16.39		150.0	
		Z	4.14	68.01	16.49		150.0	
10433-AAA	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1)	X	4.77	67.42	16.66	0.00	150.0	± 9.6 %
		Y	4.81	67.02	16.46		150.0	
		Z	4.39	67.81	16.57		150.0	
10434-AAA	W-CDMA (BS Test Model 1, 64 DPCH)	X	4.77	73.99	19.28	0.00	150.0	± 9.6 %
		Y	4.47	71.99	18.45		150.0	
		Z	5.68	79.05	19.83		150.0	
10435-AAA	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	57.32	270.58	6.41	2.23	80.0	± 9.6 %
		Y	0.79	60.00	2.71		80.0	
		Z	0.00	60.00	0.00		80.0	
10447-AAA	LTE-FDD (OFDMA, 5 MHz, E-TM 3.1, Clipping 44%)	X	3.56	68.03	16.00	0.00	150.0	± 9.6 %
		Y	3.55	67.20	15.65		150.0	
		Z	3.02	67.99	14.69		150.0	
10448-AAA	LTE-FDD (OFDMA, 10 MHz, E-TM 3.1, Clipping 44%)	X	4.08	67.53	16.47	0.00	150.0	± 9.6 %
		Y	4.10	66.95	16.18		150.0	
		Z	3.71	68.19	16.21		150.0	
10449-AAA	LTE-FDD (OFDMA, 15 MHz, E-TM 3.1, Clipping 44%)	X	4.34	67.35	16.54	0.00	150.0	± 9.6 %
		Y	4.37	66.87	16.29		150.0	
		Z	4.01	67.87	16.42		150.0	
10450-AAA	LTE-FDD (OFDMA, 20 MHz, E-TM 3.1, Clipping 44%)	X	4.54	67.21	16.54	0.00	150.0	± 9.6 %
		Y	4.57	66.78	16.31		150.0	
		Z	4.22	67.62	16.45		150.0	
10451-AAA	W-CDMA (BS Test Model 1, 64 DPCH, Clipping 44%)	X	3.46	68.28	15.62	0.00	150.0	± 9.6 %
		Y	3.44	67.39	15.28		150.0	
		Z	2.67	66.96	13.39		150.0	
10456-AAA	IEEE 802.11ac WiFi (160MHz, 64-QAM, 99pc duty cycle)	X	6.22	68.09	16.88	0.00	150.0	± 9.6 %
		Y	6.28	67.88	16.79		150.0	
		Z	6.27	69.14	17.28		150.0	
10457-AAA	UMTS-FDD (DC-HSDPA)	X	3.81	65.67	16.25	0.00	150.0	± 9.6 %
		Y	3.82	65.24	16.02		150.0	
		Z	3.66	66.44	16.23		150.0	
10458-AAA	CDMA2000 (1xEV-DO, Rev. B, 2 carriers)	X	3.24	67.44	14.88	0.00	150.0	± 9.6 %
		Y	3.26	66.69	14.66		150.0	
		Z	2.09	63.76	10.84		150.0	
10459-AAA	CDMA2000 (1xEV-DO, Rev. B, 3 carriers)	X	4.33	65.63	15.82	0.00	150.0	± 9.6 %
		Y	4.37	65.04	15.64		150.0	
		Z	3.46	64.49	13.53		150.0	

10477-AAA	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	0.78	60.00	6.46	3.23	80.0	± 9.6 %
		Y	0.87	60.00	7.92		80.0	
		Z	1.90	63.97	6.26		80.0	
10478-AAA	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	0.83	60.00	5.93	3.23	80.0	± 9.6 %
		Y	0.89	60.00	7.41		80.0	
		Z	33.67	201.87	0.27		80.0	
10479-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	1.07	60.00	4.57	1.99	80.0	± 9.6 %
		Y	0.89	60.00	6.00		80.0	
		Z	0.00	60.00	0.00		80.0	
10480-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	2.45	59.65	3.32	1.99	80.0	± 9.6 %
		Y	1.23	60.00	5.25		80.0	
		Z	0.00	60.00	0.00		80.0	
10481-AAA	LTE-TDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	13.18	60.14	2.72	1.99	80.0	± 9.6 %
		Y	1.31	60.00	4.99		80.0	
		Z	0.00	60.00	0.00		80.0	
10482-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	1.51	64.28	11.90	1.99	80.0	± 9.6 %
		Y	1.84	66.25	13.46		80.0	
		Z	0.79	60.00	7.19		80.0	
10483-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	1.60	61.74	9.91	1.99	80.0	± 9.6 %
		Y	2.13	64.49	12.08		80.0	
		Z	1.06	60.00	6.05		80.0	
10484-AAA	LTE-TDD (SC-FDMA, 50% RB, 3 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	1.61	61.58	9.86	1.99	80.0	± 9.6 %
		Y	2.12	64.17	11.95		80.0	
		Z	1.08	60.00	6.08		80.0	
10485-AAA	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	2.18	68.63	15.15	1.99	80.0	± 9.6 %
		Y	2.38	69.42	15.98		80.0	
		Z	1.34	64.80	11.82		80.0	
10486-AAA	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	2.16	65.10	13.12	1.99	80.0	± 9.6 %
		Y	2.39	66.04	14.08		80.0	
		Z	1.12	60.00	8.43		80.0	
10487-AAA	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	2.18	64.86	13.01	1.99	80.0	± 9.6 %
		Y	2.42	65.78	13.96		80.0	
		Z	1.16	60.00	8.41		80.0	
10488-AAA	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	2.77	69.96	16.82	1.99	80.0	± 9.6 %
		Y	2.88	70.03	17.14		80.0	
		Z	2.48	71.15	16.98		80.0	
10489-AAA	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	2.81	67.04	15.68	1.99	80.0	± 9.6 %
		Y	2.91	67.09	16.01		80.0	
		Z	2.46	67.45	15.03		80.0	
10490-AAA	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	2.90	66.96	15.68	1.99	80.0	± 9.6 %
		Y	3.01	67.00	16.01		80.0	
		Z	2.50	67.18	14.90		80.0	
10491-AAA	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	3.08	69.02	16.72	1.99	80.0	± 9.6 %
		Y	3.19	69.01	16.94		80.0	
		Z	2.74	69.79	17.01		80.0	
10492-AAA	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	3.22	66.78	16.04	1.99	80.0	± 9.6 %
		Y	3.31	66.75	16.26		80.0	
		Z	2.87	67.35	15.87		80.0	

10508-AAA	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	3.32	66.86	16.16	1.99	80.0	± 9.6 %
		Y	3.42	66.85	16.36		80.0	
		Z	2.98	67.37	16.12		80.0	
10509-AAA	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	3.68	69.24	16.73	1.99	80.0	± 9.6 %
		Y	3.78	69.24	16.91		80.0	
		Z	3.32	69.83	17.17		80.0	
10510-AAA	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	3.73	67.00	16.35	1.99	80.0	± 9.6 %
		Y	3.83	66.99	16.53		80.0	
		Z	3.35	67.19	16.38		80.0	
10511-AAA	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	3.79	66.81	16.32	1.99	80.0	± 9.6 %
		Y	3.89	66.78	16.49		80.0	
		Z	3.43	67.07	16.35		80.0	
10512-AAA	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	3.77	70.46	17.03	1.99	80.0	± 9.6 %
		Y	3.88	70.51	17.24		80.0	
		Z	3.40	70.93	17.48		80.0	
10513-AAA	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM, UL Subframe=2,3,4,7,8,9)	X	3.61	67.18	16.41	1.99	80.0	± 9.6 %
		Y	3.70	67.20	16.59		80.0	
		Z	3.25	67.26	16.45		80.0	
10514-AAA	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM, UL Subframe=2,3,4,7,8,9)	X	3.65	66.85	16.34	1.99	80.0	± 9.6 %
		Y	3.74	66.85	16.51		80.0	
		Z	3.31	66.98	16.36		80.0	
10515-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps, 99pc duty cycle)	X	1.02	64.71	16.08	0.00	150.0	± 9.6 %
		Y	0.98	63.16	14.86		150.0	
		Z	1.03	65.43	16.11		150.0	
10516-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps, 99pc duty cycle)	X	1.29	86.24	25.12	0.00	150.0	± 9.6 %
		Y	0.63	70.74	17.66		150.0	
		Z	1.19	85.17	24.72		150.0	
10517-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps, 99pc duty cycle)	X	0.93	68.14	17.61	0.00	150.0	± 9.6 %
		Y	0.84	65.15	15.53		150.0	
		Z	0.92	68.69	17.62		150.0	
10518-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 99pc duty cycle)	X	4.54	67.12	16.52	0.00	150.0	± 9.6 %
		Y	4.57	66.69	16.30		150.0	
		Z	4.22	67.67	16.46		150.0	
10519-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 99pc duty cycle)	X	4.71	67.32	16.61	0.00	150.0	± 9.6 %
		Y	4.76	66.92	16.42		150.0	
		Z	4.34	67.78	16.52		150.0	
10520-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 99pc duty cycle)	X	4.57	67.30	16.55	0.00	150.0	± 9.6 %
		Y	4.61	66.89	16.34		150.0	
		Z	4.20	67.72	16.45		150.0	
10521-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 99pc duty cycle)	X	4.50	67.30	16.54	0.00	150.0	± 9.6 %
		Y	4.54	66.88	16.32		150.0	
		Z	4.14	67.64	16.41		150.0	
10522-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 99pc duty cycle)	X	4.56	67.41	16.64	0.00	150.0	± 9.6 %
		Y	4.60	66.97	16.41		150.0	
		Z	4.15	67.65	16.44		150.0	

10541-AAA	IEEE 802.11ac WiFi (40MHz, MCS7, 99pc duty cycle)	X	5.12	66.72	16.34	0.00	150.0	± 9.6 %
		Y	5.16	66.39	16.17		150.0	
		Z	4.78	66.87	16.25		150.0	
10542-AAA	IEEE 802.11ac WiFi (40MHz, MCS8, 99pc duty cycle)	X	5.28	66.78	16.38	0.00	150.0	± 9.6 %
		Y	5.32	66.46	16.22		150.0	
		Z	4.91	66.91	16.28		150.0	
10543-AAA	IEEE 802.11ac WiFi (40MHz, MCS9, 99pc duty cycle)	X	5.34	66.79	16.41	0.00	150.0	± 9.6 %
		Y	5.40	66.51	16.26		150.0	
		Z	4.97	66.96	16.34		150.0	
10544-AAA	IEEE 802.11ac WiFi (80MHz, MCS0, 99pc duty cycle)	X	5.46	66.81	16.30	0.00	150.0	± 9.6 %
		Y	5.49	66.49	16.14		150.0	
		Z	5.17	66.85	16.18		150.0	
10545-AAA	IEEE 802.11ac WiFi (80MHz, MCS1, 99pc duty cycle)	X	5.64	67.22	16.45	0.00	150.0	± 9.6 %
		Y	5.69	66.95	16.31		150.0	
		Z	5.29	67.18	16.32		150.0	
10546-AAA	IEEE 802.11ac WiFi (80MHz, MCS2, 99pc duty cycle)	X	5.51	66.99	16.35	0.00	150.0	± 9.6 %
		Y	5.56	66.71	16.21		150.0	
		Z	5.18	66.93	16.20		150.0	
10547-AAA	IEEE 802.11ac WiFi (80MHz, MCS3, 99pc duty cycle)	X	5.58	67.04	16.37	0.00	150.0	± 9.6 %
		Y	5.63	66.75	16.22		150.0	
		Z	5.28	67.14	16.30		150.0	
10548-AAA	IEEE 802.11ac WiFi (80MHz, MCS4, 99pc duty cycle)	X	5.80	67.87	16.76	0.00	150.0	± 9.6 %
		Y	5.92	67.81	16.72		150.0	
		Z	5.30	67.37	16.40		150.0	
10550-AAA	IEEE 802.11ac WiFi (80MHz, MCS6, 99pc duty cycle)	X	5.54	67.04	16.39	0.00	150.0	± 9.6 %
		Y	5.58	66.74	16.23		150.0	
		Z	5.26	67.23	16.36		150.0	
10551-AAA	IEEE 802.11ac WiFi (80MHz, MCS7, 99pc duty cycle)	X	5.54	67.06	16.36	0.00	150.0	± 9.6 %
		Y	5.59	66.77	16.21		150.0	
		Z	5.16	66.87	16.15		150.0	
10552-AAA	IEEE 802.11ac WiFi (80MHz, MCS8, 99pc duty cycle)	X	5.47	66.89	16.28	0.00	150.0	± 9.6 %
		Y	5.50	66.56	16.11		150.0	
		Z	5.18	67.02	16.22		150.0	
10553-AAA	IEEE 802.11ac WiFi (80MHz, MCS9, 99pc duty cycle)	X	5.54	66.89	16.31	0.00	150.0	± 9.6 %
		Y	5.58	66.59	16.16		150.0	
		Z	5.21	66.91	16.19		150.0	
10554-AAA	IEEE 1602.11ac WiFi (160MHz, MCS0, 99pc duty cycle)	X	5.87	67.14	16.36	0.00	150.0	± 9.6 %
		Y	5.90	66.86	16.23		150.0	
		Z	5.59	67.09	16.22		150.0	
10555-AAA	IEEE 1602.11ac WiFi (160MHz, MCS1, 99pc duty cycle)	X	5.99	67.43	16.48	0.00	150.0	± 9.6 %
		Y	6.03	67.18	16.36		150.0	
		Z	5.65	67.23	16.28		150.0	
10556-AAA	IEEE 1602.11ac WiFi (160MHz, MCS2, 99pc duty cycle)	X	6.01	67.48	16.51	0.00	150.0	± 9.6 %
		Y	6.05	67.22	16.38		150.0	
		Z	5.70	67.38	16.34		150.0	
10557-AAA	IEEE 1602.11ac WiFi (160MHz, MCS3, 99pc duty cycle)	X	5.97	67.37	16.47	0.00	150.0	± 9.6 %
		Y	6.02	67.12	16.35		150.0	
		Z	5.66	67.27	16.30		150.0	

10575-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps, 90pc duty cycle)	X	4.59	66.71	16.49	0.46	130.0	± 9.6 %
		Y	4.65	66.43	16.40		130.0	
		Z	4.25	67.13	16.37		130.0	
10576-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 9 Mbps, 90pc duty cycle)	X	4.62	66.90	16.57	0.46	130.0	± 9.6 %
		Y	4.68	66.60	16.47		130.0	
		Z	4.29	67.42	16.51		130.0	
10577-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 12 Mbps, 90pc duty cycle)	X	4.81	67.17	16.74	0.46	130.0	± 9.6 %
		Y	4.88	66.90	16.64		130.0	
		Z	4.43	67.61	16.64		130.0	
10578-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 18 Mbps, 90pc duty cycle)	X	4.71	67.35	16.86	0.46	130.0	± 9.6 %
		Y	4.78	67.06	16.75		130.0	
		Z	4.36	67.83	16.81		130.0	
10579-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 24 Mbps, 90pc duty cycle)	X	4.46	66.55	16.10	0.46	130.0	± 9.6 %
		Y	4.54	66.31	16.03		130.0	
		Z	4.06	66.71	15.86		130.0	
10580-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 36 Mbps, 90pc duty cycle)	X	4.51	66.60	16.13	0.46	130.0	± 9.6 %
		Y	4.58	66.35	16.05		130.0	
		Z	4.06	66.63	15.80		130.0	
10581-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 48 Mbps, 90pc duty cycle)	X	4.61	67.39	16.80	0.46	130.0	± 9.6 %
		Y	4.67	67.08	16.68		130.0	
		Z	4.29	67.98	16.83		130.0	
10582-AAA	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps, 90pc duty cycle)	X	4.40	66.30	15.88	0.46	130.0	± 9.6 %
		Y	4.48	66.07	15.82		130.0	
		Z	3.97	66.40	15.59		130.0	
10583-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps, 90pc duty cycle)	X	4.59	66.71	16.49	0.46	130.0	± 9.6 %
		Y	4.65	66.43	16.40		130.0	
		Z	4.25	67.13	16.37		130.0	
10584-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps, 90pc duty cycle)	X	4.62	66.90	16.57	0.46	130.0	± 9.6 %
		Y	4.68	66.60	16.47		130.0	
		Z	4.29	67.42	16.51		130.0	
10585-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps, 90pc duty cycle)	X	4.81	67.17	16.74	0.46	130.0	± 9.6 %
		Y	4.88	66.90	16.64		130.0	
		Z	4.43	67.61	16.64		130.0	
10586-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps, 90pc duty cycle)	X	4.71	67.35	16.86	0.46	130.0	± 9.6 %
		Y	4.78	67.06	16.75		130.0	
		Z	4.36	67.83	16.81		130.0	
10587-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps, 90pc duty cycle)	X	4.46	66.55	16.10	0.46	130.0	± 9.6 %
		Y	4.54	66.31	16.03		130.0	
		Z	4.06	66.71	15.86		130.0	
10588-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps, 90pc duty cycle)	X	4.51	66.60	16.13	0.46	130.0	± 9.6 %
		Y	4.58	66.35	16.05		130.0	
		Z	4.06	66.63	15.80		130.0	
10589-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps, 90pc duty cycle)	X	4.61	67.39	16.80	0.46	130.0	± 9.6 %
		Y	4.67	67.08	16.68		130.0	
		Z	4.29	67.98	16.83		130.0	
10590-AAA	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps, 90pc duty cycle)	X	4.40	66.30	15.88	0.46	130.0	± 9.6 %
		Y	4.48	66.07	15.82		130.0	
		Z	3.97	66.40	15.59		130.0	

10607-AAA	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	X	4.59	66.14	16.25	0.46	130.0	± 9.6 %
		Y	4.64	65.81	16.13		130.0	
		Z	4.28	66.70	16.24		130.0	
10608-AAA	IEEE 802.11ac WiFi (20MHz, MCS1, 90pc duty cycle)	X	4.76	66.53	16.41	0.46	130.0	± 9.6 %
		Y	4.83	66.22	16.29		130.0	
		Z	4.38	66.94	16.35		130.0	
10609-AAA	IEEE 802.11ac WiFi (20MHz, MCS2, 90pc duty cycle)	X	4.65	66.37	16.24	0.46	130.0	± 9.6 %
		Y	4.72	66.06	16.13		130.0	
		Z	4.28	66.77	16.16		130.0	
10610-AAA	IEEE 802.11ac WiFi (20MHz, MCS3, 90pc duty cycle)	X	4.70	66.53	16.41	0.46	130.0	± 9.6 %
		Y	4.77	66.22	16.29		130.0	
		Z	4.34	66.97	16.36		130.0	
10611-AAA	IEEE 802.11ac WiFi (20MHz, MCS4, 90pc duty cycle)	X	4.62	66.33	16.25	0.46	130.0	± 9.6 %
		Y	4.68	66.02	16.13		130.0	
		Z	4.25	66.71	16.17		130.0	
10612-AAA	IEEE 802.11ac WiFi (20MHz, MCS5, 90pc duty cycle)	X	4.62	66.48	16.29	0.46	130.0	± 9.6 %
		Y	4.69	66.17	16.17		130.0	
		Z	4.20	66.73	16.15		130.0	
10613-AAA	IEEE 802.11ac WiFi (20MHz, MCS6, 90pc duty cycle)	X	4.62	66.33	16.16	0.46	130.0	± 9.6 %
		Y	4.69	66.05	16.06		130.0	
		Z	4.21	66.55	15.99		130.0	
10614-AAA	IEEE 802.11ac WiFi (20MHz, MCS7, 90pc duty cycle)	X	4.58	66.56	16.42	0.46	130.0	± 9.6 %
		Y	4.64	66.24	16.30		130.0	
		Z	4.22	66.94	16.34		130.0	
10615-AAA	IEEE 802.11ac WiFi (20MHz, MCS8, 90pc duty cycle)	X	4.61	66.14	16.01	0.46	130.0	± 9.6 %
		Y	4.68	65.84	15.90		130.0	
		Z	4.22	66.49	15.88		130.0	
10616-AAA	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	X	5.23	66.54	16.42	0.46	130.0	± 9.6 %
		Y	5.30	66.33	16.35		130.0	
		Z	4.89	66.69	16.34		130.0	
10617-AAA	IEEE 802.11ac WiFi (40MHz, MCS1, 90pc duty cycle)	X	5.30	66.73	16.48	0.46	130.0	± 9.6 %
		Y	5.38	66.53	16.42		130.0	
		Z	4.90	66.72	16.34		130.0	
10618-AAA	IEEE 802.11ac WiFi (40MHz, MCS2, 90pc duty cycle)	X	5.19	66.76	16.51	0.46	130.0	± 9.6 %
		Y	5.26	66.51	16.42		130.0	
		Z	4.83	66.86	16.42		130.0	
10619-AAA	IEEE 802.11ac WiFi (40MHz, MCS3, 90pc duty cycle)	X	5.20	66.52	16.33	0.46	130.0	± 9.6 %
		Y	5.28	66.34	16.27		130.0	
		Z	4.87	66.72	16.28		130.0	
10620-AAA	IEEE 802.11ac WiFi (40MHz, MCS4, 90pc duty cycle)	X	5.28	66.55	16.39	0.46	130.0	± 9.6 %
		Y	5.37	66.37	16.34		130.0	
		Z	4.89	66.58	16.25		130.0	
10621-AAA	IEEE 802.11ac WiFi (40MHz, MCS5, 90pc duty cycle)	X	5.30	66.72	16.60	0.46	130.0	± 9.6 %
		Y	5.37	66.50	16.52		130.0	
		Z	4.95	66.83	16.51		130.0	
10622-AAA	IEEE 802.11ac WiFi (40MHz, MCS6, 90pc duty cycle)	X	5.31	66.89	16.68	0.46	130.0	± 9.6 %
		Y	5.39	66.68	16.61		130.0	
		Z	4.92	66.88	16.54		130.0	

10639-AAA	IEEE 1602.11ac WiFi (160MHz, MCS3, 90pc duty cycle)	X	6.08	67.23	16.59	0.46	130.0	± 9.6 %
		Y	6.16	67.09	16.56		130.0	
		Z	5.76	67.12	16.43		130.0	
10640-AAA	IEEE 1602.11ac WiFi (160MHz, MCS4, 90pc duty cycle)	X	6.08	67.22	16.52	0.46	130.0	± 9.6 %
		Y	6.16	67.10	16.51		130.0	
		Z	5.68	66.86	16.24		130.0	
10641-AAA	IEEE 1602.11ac WiFi (160MHz, MCS5, 90pc duty cycle)	X	6.13	67.16	16.51	0.46	130.0	± 9.6 %
		Y	6.21	67.01	16.48		130.0	
		Z	5.78	66.97	16.31		130.0	
10642-AAA	IEEE 1602.11ac WiFi (160MHz, MCS6, 90pc duty cycle)	X	6.17	67.41	16.81	0.46	130.0	± 9.6 %
		Y	6.25	67.26	16.78		130.0	
		Z	5.83	67.26	16.63		130.0	
10643-AAA	IEEE 1602.11ac WiFi (160MHz, MCS7, 90pc duty cycle)	X	6.01	67.09	16.54	0.46	130.0	± 9.6 %
		Y	6.09	66.95	16.51		130.0	
		Z	5.66	66.87	16.31		130.0	
10644-AAA	IEEE 1602.11ac WiFi (160MHz, MCS8, 90pc duty cycle)	X	6.14	67.48	16.76	0.46	130.0	± 9.6 %
		Y	6.25	67.45	16.79		130.0	
		Z	5.71	67.04	16.42		130.0	
10645-AAA	IEEE 1602.11ac WiFi (160MHz, MCS9, 90pc duty cycle)	X	6.29	67.59	16.77	0.46	130.0	± 9.6 %
		Y	6.63	68.16	17.10		130.0	
		Z	5.86	67.19	16.46		130.0	
10646-AAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK, UL Subframe=2,7)	X	10.22	94.97	31.10	9.30	60.0	± 9.6 %
		Y	10.25	95.03	31.83		60.0	
		Z	4.56	82.30	27.51		60.0	
10647-AAA	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK, UL Subframe=2,7)	X	9.02	92.95	30.55	9.30	60.0	± 9.6 %
		Y	9.19	93.22	31.34		60.0	
		Z	4.03	80.01	26.71		60.0	
10648-AAA	CDMA2000 (1x Advanced)	X	0.82	66.63	12.52	0.00	150.0	± 9.6 %
		Y	0.72	63.85	11.13		150.0	
		Z	0.36	60.77	6.70		150.0	

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

1486

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **BTL-TW (Auden)**

Certificate No: **DAE4-1486_Aug16**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1486**

Calibration procedure(s) **QA CAL-06.v29**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **August 23, 2016**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

Calibrated by:

Name	Function	Signature
Dominique Steffen	Technician	

Approved by:

Fin Bomholt	Deputy Technical Manager
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Issued: August 23, 2016

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V , full range = -100...+300 mV

Low Range: 1LSB = 61 nV , full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.886 $\pm$ 0.02% (k=2)	403.968 $\pm$ 0.02% (k=2)	403.690 $\pm$ 0.02% (k=2)
Low Range	3.97968 $\pm$ 1.50% (k=2)	3.98952 $\pm$ 1.50% (k=2)	3.96090 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	32.0 ° $\pm$ 1 °
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199997.71	0.61	0.00
Channel X + Input	20001.24	-0.36	-0.00
Channel X - Input	-19998.21	2.58	-0.01
Channel Y + Input	199998.42	1.35	0.00
Channel Y + Input	20000.80	-0.77	-0.00
Channel Y - Input	-19997.74	3.17	-0.02
Channel Z + Input	199996.55	-0.53	-0.00
Channel Z + Input	19998.70	-2.81	-0.01
Channel Z - Input	-20000.58	0.45	-0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.48	0.14	0.01
Channel X + Input	201.87	0.16	0.08
Channel X - Input	-197.91	0.09	-0.05
Channel Y + Input	2001.44	0.13	0.01
Channel Y + Input	201.51	-0.38	-0.19
Channel Y - Input	-198.55	-0.42	0.21
Channel Z + Input	2001.24	-0.05	-0.00
Channel Z + Input	200.83	-0.96	-0.48
Channel Z - Input	-199.44	-1.26	0.64

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-0.97	-2.62
	- 200	3.49	1.64
Channel Y	200	-20.67	-20.79
	- 200	19.85	19.82
Channel Z	200	-4.52	-4.48
	- 200	2.69	2.33

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-0.96	-4.43
Channel Y	200	6.67	-	0.82
Channel Z	200	10.39	4.38	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16086	14620
Channel Y	16442	13222
Channel Z	15998	15505

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.39	-1.37	1.29	0.39
Channel Y	0.50	-0.28	1.48	0.31
Channel Z	-0.21	-1.01	1.29	0.35

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **BTL-TW (Auden)**

Certificate No: **D2450V2-973_Aug15**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 973**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 14, 2015**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: Name **Michael Weber** Function **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: August 14, 2015

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.1 $\pm$ 6 %	1.87 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.12 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω + 1.4 j Ω
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.5 Ω + 2.9 j Ω
Return Loss	- 29.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 30, 2014

DASY5 Validation Report for Head TSL

Date: 14.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 973

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.87$ S/m; $\epsilon_r = 38.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.54, 4.54, 4.54); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

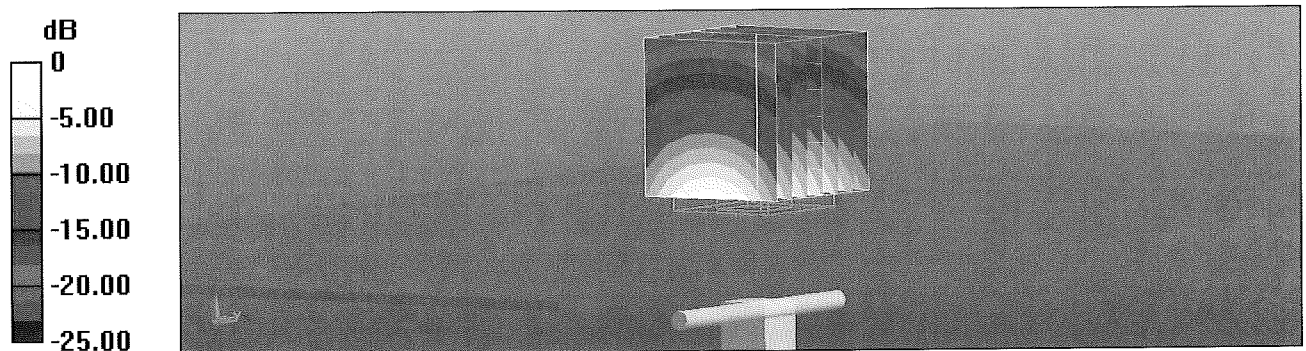
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.2 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 18.2 W/kg



0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Head TSL

14 Aug 2015 10:55:46
 [CH1] S11 1 U FS 1: 53.967 Ω 1.4414 Ω 93.635 μH 2 450.000 000 MHz

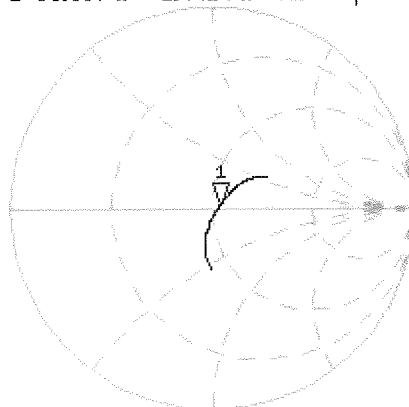
*

De1

CA

Avg
16

H1d



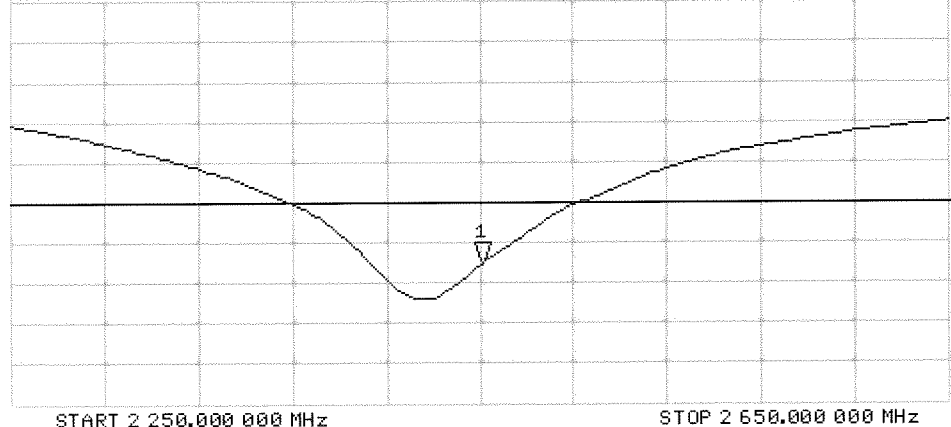
CH2 S11 LOG 5 dB/REF -20 dB 1:-27.832 dB 2 450.000 000 MHz

De1

CA

Avg
16

H1d



DASY5 Validation Report for Body TSL

Date: 14.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 973

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

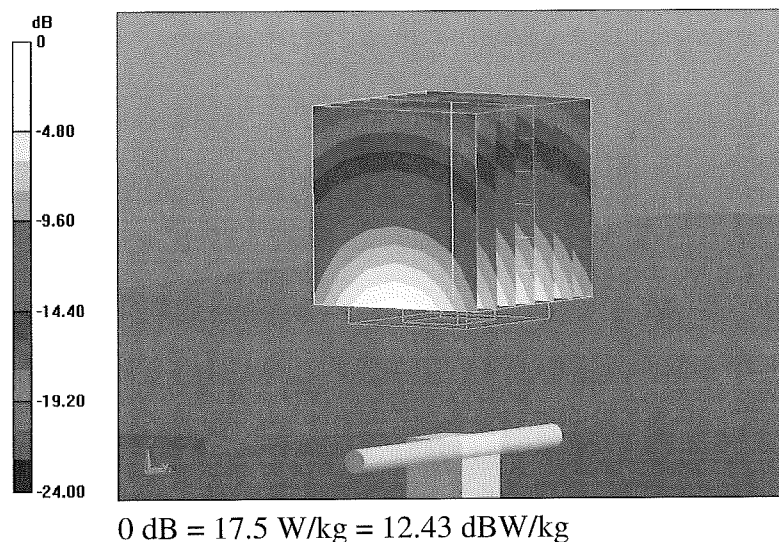
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.96 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.6 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.12 W/kg

Maximum value of SAR (measured) = 17.5 W/kg



Impedance Measurement Plot for Body TSL

