

ES3DV3- SN:3335

July 26, 2018

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth (mm) <sup>D</sup>	Unc (k=2)
750	41.9	0.89	6.67	6.67	6.67	0.80	1.15	± 12.0 %
835	41.5	0.90	6.46	6.46	6.46	0.80	1.16	± 12.0 %
900	41.5	0.97	6.31	6.31	6.31	0.80	1.18	± 12.0 %
1750	40.1	1.37	5.53	5.53	5.53	0.42	1.60	± 12.0 %
1900	40.0	1.40	5.29	5.29	5.29	0.53	1.50	± 12.0 %
2100	39.8	1.49	5.34	5.34	5.34	0.80	1.17	± 12.0 %
2300	39.5	1.67	5.01	5.01	5.01	0.79	1.18	± 12.0 %
2450	39.2	1.80	4.71	4.71	4.71	0.80	1.30	± 12.0 %
2600	39.0	1.96	4.59	4.59	4.59	0.80	1.26	± 12.0 %
3500	37.9	2.91	4.41	4.41	4.41	0.60	1.30	± 13.1 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

ES3DV3- SN:3335

July 26, 2018

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unc (k=2)
750	55.5	0.96	6.54	6.54	6.54	0.80	1.16	± 12.0 %
835	55.2	0.97	6.34	6.34	6.34	0.80	1.18	± 12.0 %
900	55.0	1.05	6.19	6.19	6.19	0.59	1.37	± 12.0 %
1750	53.4	1.49	5.09	5.09	5.09	0.46	1.65	± 12.0 %
1900	53.3	1.52	4.97	4.97	4.97	0.74	1.30	± 12.0 %
2100	53.2	1.62	5.06	5.06	5.06	0.79	1.28	± 12.0 %
2300	52.9	1.81	4.75	4.75	4.75	0.77	1.30	± 12.0 %
2450	52.7	1.95	4.62	4.62	4.62	0.80	1.25	± 12.0 %
2600	52.5	2.16	4.49	4.49	4.49	0.80	1.20	± 12.0 %
3500	51.3	3.31	4.04	4.04	4.04	0.80	1.30	± 13.1 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

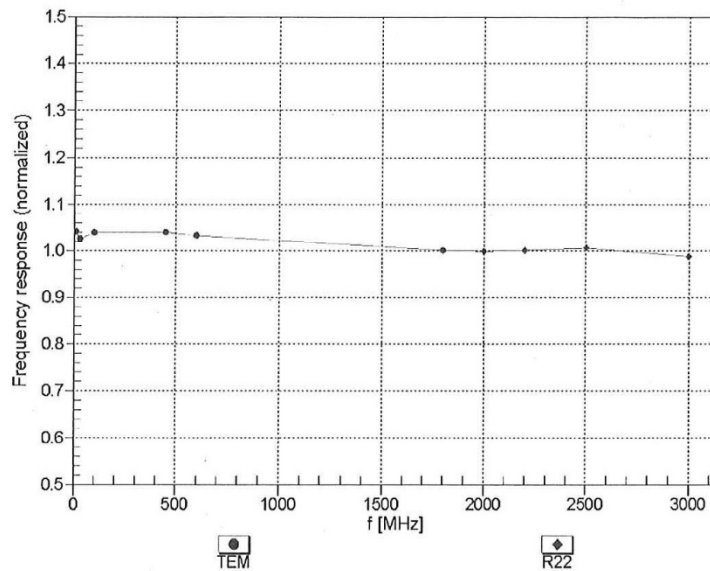
<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

ES3DV3-SN:3335

July 26, 2018

### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



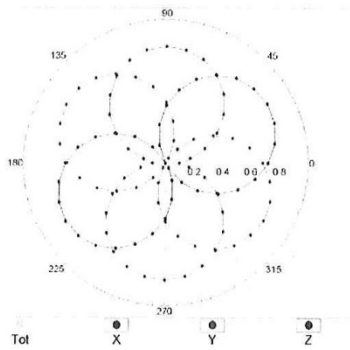
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

ES3DV3- SN:3335

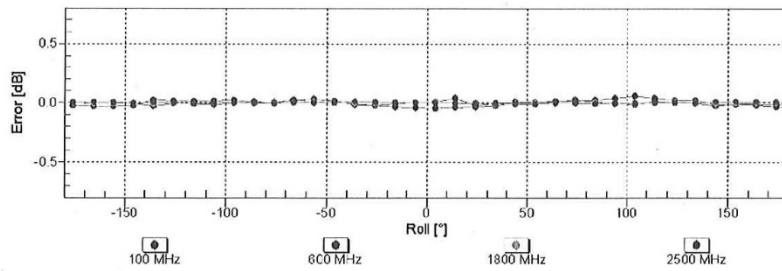
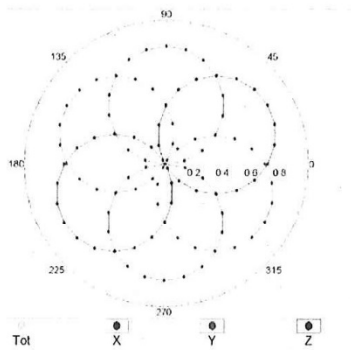
July 26, 2018

### Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz,TEM



f=1800 MHz,R22

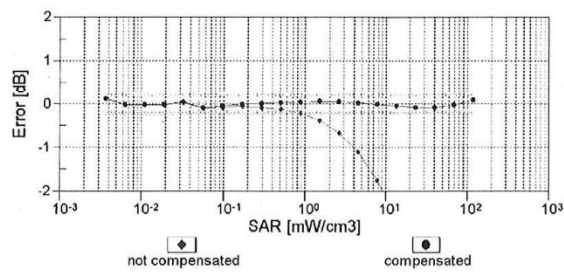
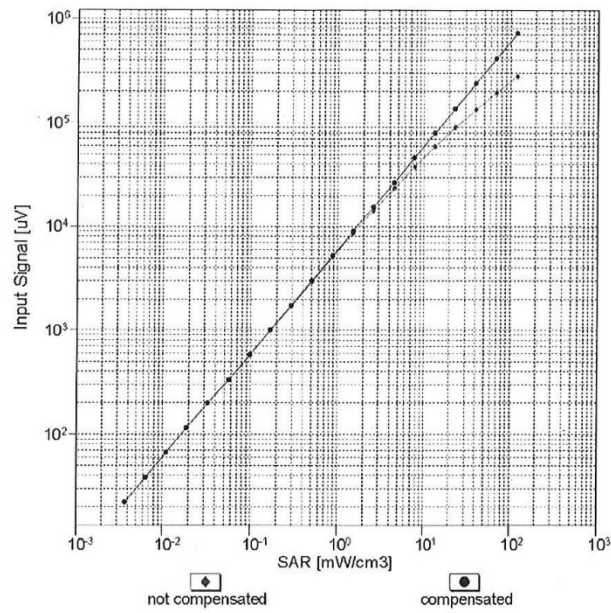


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

ES3DV3- SN:3335

July 26, 2018

### Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f<sub>eval</sub>= 1900 MHz)

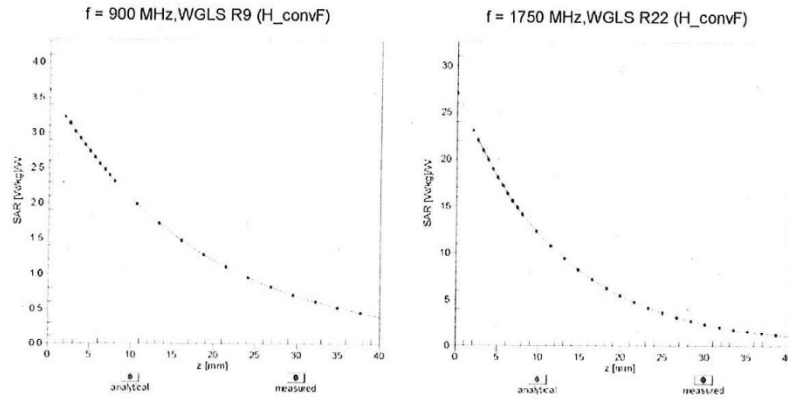


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3- SN:3335

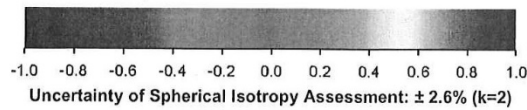
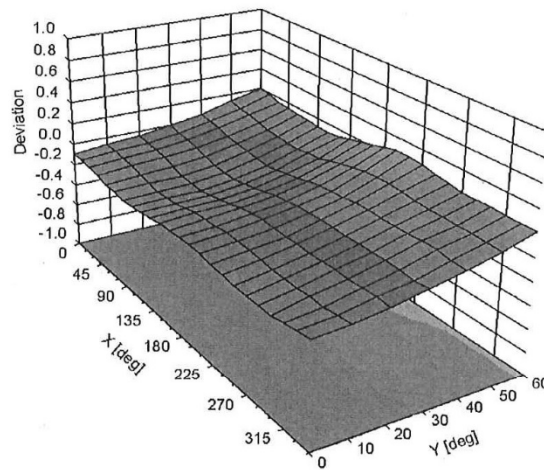
July 26, 2018

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid

Error ( $\phi$ ,  $\theta$ ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  (k=2)

ES3DV3- SN:3335

July 26, 2018

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	64
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

ES3DV3- SN:3335

July 26, 2018

**Appendix: Modulation Calibration Parameters**

UID	Communication System Name		A dB	B dB $\sqrt{\mu}$ V	C	D dB	VR mV	Max Unc <sup>E</sup> (k=2)
0	CW	X	0.00	0.00	1.00	0.00	184.9	± 3.3 %
		Y	0.00	0.00	1.00		192.8	
		Z	0.00	0.00	1.00		196.3	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	8.34	78.65	19.34	10.00	25.0	± 9.6 %
		Y	9.04	80.63	19.00		25.0	
		Z	7.65	78.11	17.73		25.0	
10011- CAB	UMTS-FDD (WCDMA)	X	0.99	66.44	14.46	0.00	150.0	± 9.6 %
		Y	1.09	68.74	15.88		150.0	
		Z	0.92	65.74	13.86		150.0	
10012- CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	1.27	64.65	15.36	0.41	150.0	± 9.6 %
		Y	1.29	65.49	16.05		150.0	
		Z	1.22	64.32	15.05		150.0	
10013- CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	5.20	67.14	17.31	1.46	150.0	± 9.6 %
		Y	5.08	67.32	17.42		150.0	
		Z	5.01	67.11	17.24		150.0	
10021- DAC	GSM-FDD (TDMA, GMSK)	X	14.10	88.78	24.73	9.39	50.0	± 9.6 %
		Y	37.99	105.34	28.69		50.0	
		Z	49.13	108.86	29.29		50.0	
10023- DAC	GPRS-FDD (TDMA, GMSK, TN 0)	X	13.33	87.64	24.38	9.57	50.0	± 9.6 %
		Y	30.51	101.73	27.71		50.0	
		Z	36.22	103.97	28.00		50.0	
10024- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	34.93	103.76	27.60	6.56	60.0	± 9.6 %
		Y	100.00	117.61	29.94		60.0	
		Z	100.00	116.34	29.19		60.0	
10025- DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	X	13.34	92.13	34.16	12.57	50.0	± 9.6 %
		Y	22.27	112.33	42.76		50.0	
		Z	17.48	104.83	39.77		50.0	
10026- DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	14.98	94.12	31.90	9.56	60.0	± 9.6 %
		Y	24.18	109.22	37.64		60.0	
		Z	19.51	103.82	35.66		60.0	
10027- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	100.00	118.24	29.93	4.80	80.0	± 9.6 %
		Y	100.00	116.45	28.50		80.0	
		Z	100.00	114.73	27.57		80.0	
10028- DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	100.00	117.64	28.76	3.55	100.0	± 9.6 %
		Y	100.00	116.52	27.73		100.0	
		Z	100.00	114.13	26.52		100.0	
10029- DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	11.50	89.16	29.09	7.80	80.0	± 9.6 %
		Y	14.92	97.96	32.77		80.0	
		Z	12.49	93.74	31.09		80.0	
10030- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	75.35	114.16	29.33	5.30	70.0	± 9.6 %
		Y	100.00	116.01	28.63		70.0	
		Z	100.00	114.43	27.75		70.0	
10031- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	100.00	116.99	26.80	1.88	100.0	± 9.6 %
		Y	100.00	116.80	26.31		100.0	
		Z	100.00	111.90	24.05		100.0	



ES3DV3- SN:3335

July 26, 2018

10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	100.00	118.35	26.21	1.17	100.0	± 9.6 %
		Y	100.00	120.25	26.65		100.0	
		Z	100.00	111.76	22.96		100.0	
10033-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	X	11.79	89.10	24.51	5.30	70.0	± 9.6 %
		Y	24.91	102.32	28.14		70.0	
		Z	19.09	97.24	26.23		70.0	
10034-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	X	5.54	82.29	20.69	1.88	100.0	± 9.6 %
		Y	9.89	91.35	23.28		100.0	
		Z	5.75	82.63	19.86		100.0	
10035-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	X	3.40	77.06	18.50	1.17	100.0	± 9.6 %
		Y	5.04	83.45	20.47		100.0	
		Z	3.15	76.09	17.20		100.0	
10036-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	X	13.31	91.29	25.30	5.30	70.0	± 9.6 %
		Y	32.79	106.98	29.50		70.0	
		Z	24.65	101.47	27.52		70.0	
10037-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	X	5.37	81.88	20.50	1.88	100.0	± 9.6 %
		Y	9.31	90.52	22.99		100.0	
		Z	5.41	81.86	19.56		100.0	
10038-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	X	3.50	77.68	18.80	1.17	100.0	± 9.6 %
		Y	5.27	84.34	20.87		100.0	
		Z	3.24	76.69	17.51		100.0	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	1.77	70.27	15.48	0.00	150.0	± 9.6 %
		Y	2.05	73.53	16.61		150.0	
		Z	1.46	68.66	13.84		150.0	
10042-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	X	20.32	94.21	24.88	7.78	50.0	± 9.6 %
		Y	100.00	116.39	29.62		50.0	
		Z	100.00	115.19	28.88		50.0	
10044-CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	X	0.01	119.53	0.13	0.00	150.0	± 9.6 %
		Y	0.00	110.04	5.34		150.0	
		Z	0.01	125.09	2.71		150.0	
10048-CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	X	10.39	80.37	23.54	13.80	25.0	± 9.6 %
		Y	13.58	87.14	24.95		25.0	
		Z	14.91	88.83	25.23		25.0	
10049-CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	X	11.40	84.04	23.52	10.79	40.0	± 9.6 %
		Y	17.07	91.91	25.14		40.0	
		Z	18.40	92.95	25.16		40.0	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	11.01	83.55	23.54	9.03	50.0	± 9.6 %
		Y	15.55	91.17	25.67		50.0	
		Z	14.95	90.28	25.07		50.0	
10058-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	9.14	85.34	27.00	6.55	100.0	± 9.6 %
		Y	10.41	90.61	29.44		100.0	
		Z	8.99	87.27	28.02		100.0	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	1.45	66.74	16.37	0.61	110.0	± 9.6 %
		Y	1.47	67.85	17.19		110.0	
		Z	1.37	66.29	16.03		110.0	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	29.79	111.16	28.52	1.30	110.0	± 9.6 %
		Y	100.00	130.93	33.39		110.0	
		Z	76.13	123.76	30.95		110.0	

ES3DV3- SN:3335

July 26, 2018

10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	7.28	89.08	24.38	2.04	110.0	± 9.6 %
		Y	15.44	103.55	29.06		110.0	
		Z	8.43	92.79	25.43		110.0	
10062-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	4.90	66.86	16.58	0.49	100.0	± 9.6 %
		Y	4.81	67.09	16.71		100.0	
		Z	4.73	66.84	16.50		100.0	
10063-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	4.95	67.03	16.73	0.72	100.0	± 9.6 %
		Y	4.85	67.24	16.85		100.0	
		Z	4.77	67.00	16.64		100.0	
10064-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	5.30	67.41	17.02	0.86	100.0	± 9.6 %
		Y	5.17	67.56	17.11		100.0	
		Z	5.08	67.31	16.90		100.0	
10065-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	5.21	67.47	17.19	1.21	100.0	± 9.6 %
		Y	5.07	67.60	17.28		100.0	
		Z	4.99	67.34	17.07		100.0	
10066-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	5.28	67.62	17.43	1.46	100.0	± 9.6 %
		Y	5.13	67.73	17.61		100.0	
		Z	5.04	67.47	17.30		100.0	
10067-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	5.61	67.78	17.89	2.04	100.0	± 9.6 %
		Y	5.45	67.92	17.99		100.0	
		Z	5.37	67.71	17.80		100.0	
10068-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	5.78	68.21	18.29	2.55	100.0	± 9.6 %
		Y	5.58	68.24	18.35		100.0	
		Z	5.48	67.98	18.14		100.0	
10069-CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	5.85	68.11	18.45	2.67	100.0	± 9.6 %
		Y	5.66	68.21	18.54		100.0	
		Z	5.57	67.98	18.34		100.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	5.36	67.41	17.71	1.99	100.0	± 9.6 %
		Y	5.23	67.56	17.81		100.0	
		Z	5.16	67.35	17.62		100.0	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	5.44	68.01	18.04	2.30	100.0	± 9.6 %
		Y	5.29	68.11	18.14		100.0	
		Z	5.21	67.87	17.94		100.0	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	5.60	68.40	18.48	2.83	100.0	± 9.6 %
		Y	5.42	68.47	18.57		100.0	
		Z	5.34	68.22	18.36		100.0	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	5.65	68.52	18.76	3.30	100.0	± 9.6 %
		Y	5.46	68.55	18.83		100.0	
		Z	5.38	68.29	18.61		100.0	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	5.85	69.11	19.30	3.82	90.0	± 9.6 %
		Y	5.60	69.02	19.32		90.0	
		Z	5.51	68.70	19.07		90.0	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	5.86	68.91	19.41	4.15	90.0	± 9.6 %
		Y	5.62	68.84	19.46		90.0	
		Z	5.54	68.56	19.22		90.0	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	5.90	69.00	19.51	4.30	90.0	± 9.6 %
		Y	5.66	68.94	19.56		90.0	
		Z	5.58	68.65	19.33		90.0	

ES3DV3- SN:3335

July 26, 2018

10081-CAB	CDMA2000 (1xRTT, RC3)	X	0.87	65.42	12.69	0.00	150.0	± 9.6 %
		Y	0.92	67.28	13.42		150.0	
		Z	0.72	64.00	11.01		150.0	
10082-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	X	2.45	64.58	9.62	4.77	80.0	± 9.6 %
		Y	1.95	63.35	8.27		80.0	
		Z	1.78	62.53	7.60		80.0	
10090-DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	34.04	103.41	27.54	6.56	60.0	± 9.6 %
		Y	100.00	117.70	30.00		60.0	
		Z	100.00	116.43	29.25		60.0	
10097-CAB	UMTS-FDD (HSDPA)	X	1.78	66.78	15.22	0.00	150.0	± 9.6 %
		Y	1.86	68.12	15.94		150.0	
		Z	1.71	66.61	14.83		150.0	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	1.74	66.72	15.17	0.00	150.0	± 9.6 %
		Y	1.82	68.10	15.91		150.0	
		Z	1.67	66.56	14.79		150.0	
10099-DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	14.93	94.01	31.86	9.56	60.0	± 9.6 %
		Y	24.04	109.03	37.58		60.0	
		Z	19.46	103.72	35.62		60.0	
10100-CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	3.18	70.09	16.29	0.00	150.0	± 9.6 %
		Y	3.26	71.07	16.92		150.0	
		Z	2.98	69.50	16.02		150.0	
10101-CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	3.33	67.56	15.77	0.00	150.0	± 9.6 %
		Y	3.32	67.99	16.09		150.0	
		Z	3.18	67.22	15.56		150.0	
10102-CAE	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	3.44	67.51	15.87	0.00	150.0	± 9.6 %
		Y	3.41	67.91	16.16		150.0	
		Z	3.29	67.20	15.67		150.0	
10103-CAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.45	77.00	20.66	3.98	65.0	± 9.6 %
		Y	8.95	79.30	21.65		65.0	
		Z	8.61	78.70	21.35		65.0	
10104-CAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	8.54	76.02	21.10	3.98	65.0	± 9.6 %
		Y	8.57	77.37	21.76		65.0	
		Z	8.26	76.73	21.40		65.0	
10105-CAF	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	7.72	74.02	20.51	3.98	65.0	± 9.6 %
		Y	7.88	75.69	21.33		65.0	
		Z	7.54	74.95	20.94		65.0	
10108-CAF	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	2.82	69.31	16.12	0.00	150.0	± 9.6 %
		Y	2.86	70.28	16.75		150.0	
		Z	2.61	68.76	15.84		150.0	
10109-CAF	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	3.00	67.31	15.68	0.00	150.0	± 9.6 %
		Y	2.98	67.82	16.01		150.0	
		Z	2.83	66.99	15.42		150.0	
10110-CAF	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	2.31	68.29	15.75	0.00	150.0	± 9.6 %
		Y	2.33	69.40	16.43		150.0	
		Z	2.11	67.80	15.39		150.0	
10111-CAF	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	2.69	67.70	15.91	0.00	150.0	± 9.6 %
		Y	2.68	68.49	16.29		150.0	
		Z	2.52	67.50	15.55		150.0	