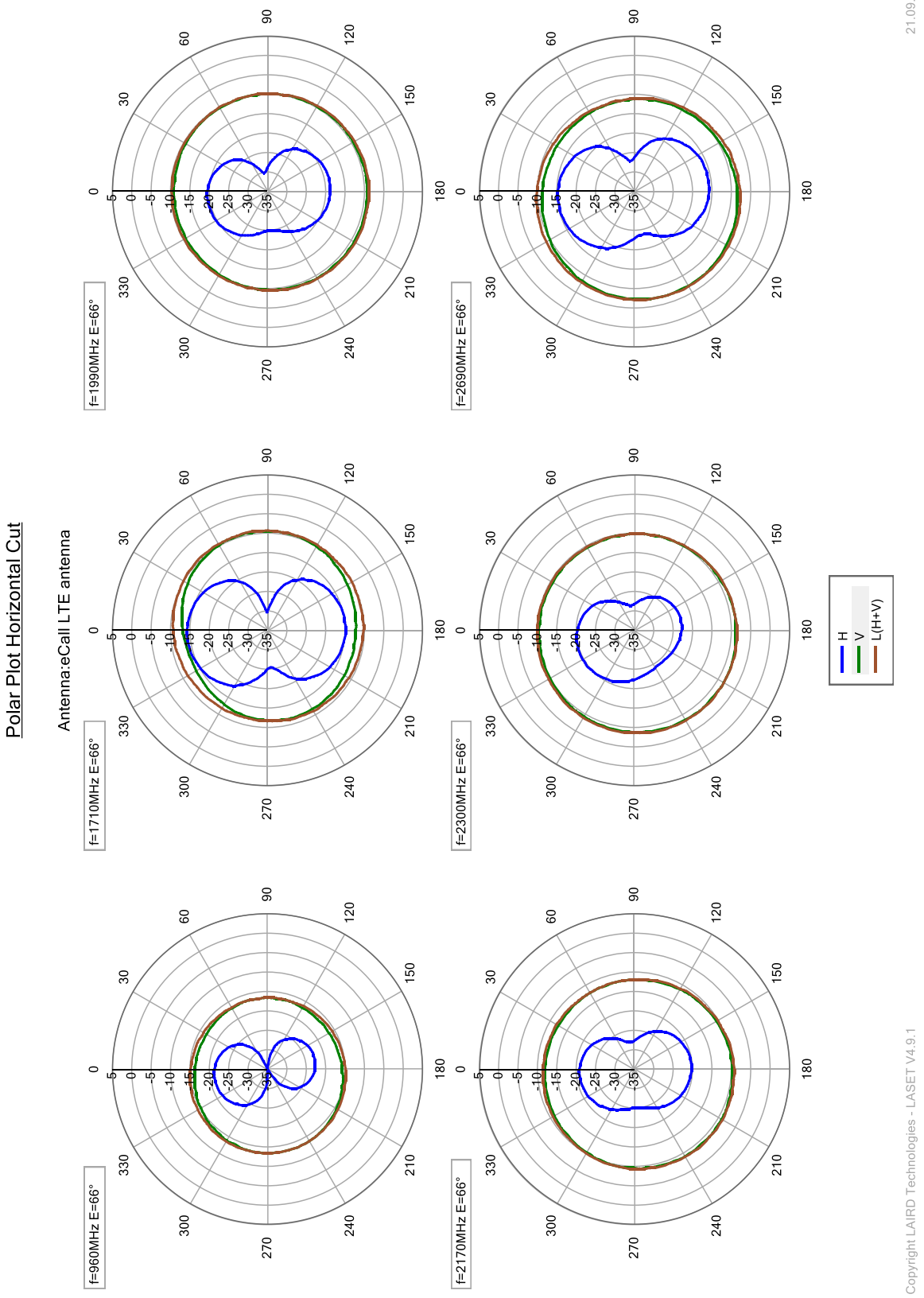


Figure 12 - eCall LTE antenna, Polar Plot Horizontal Cut, E=66°

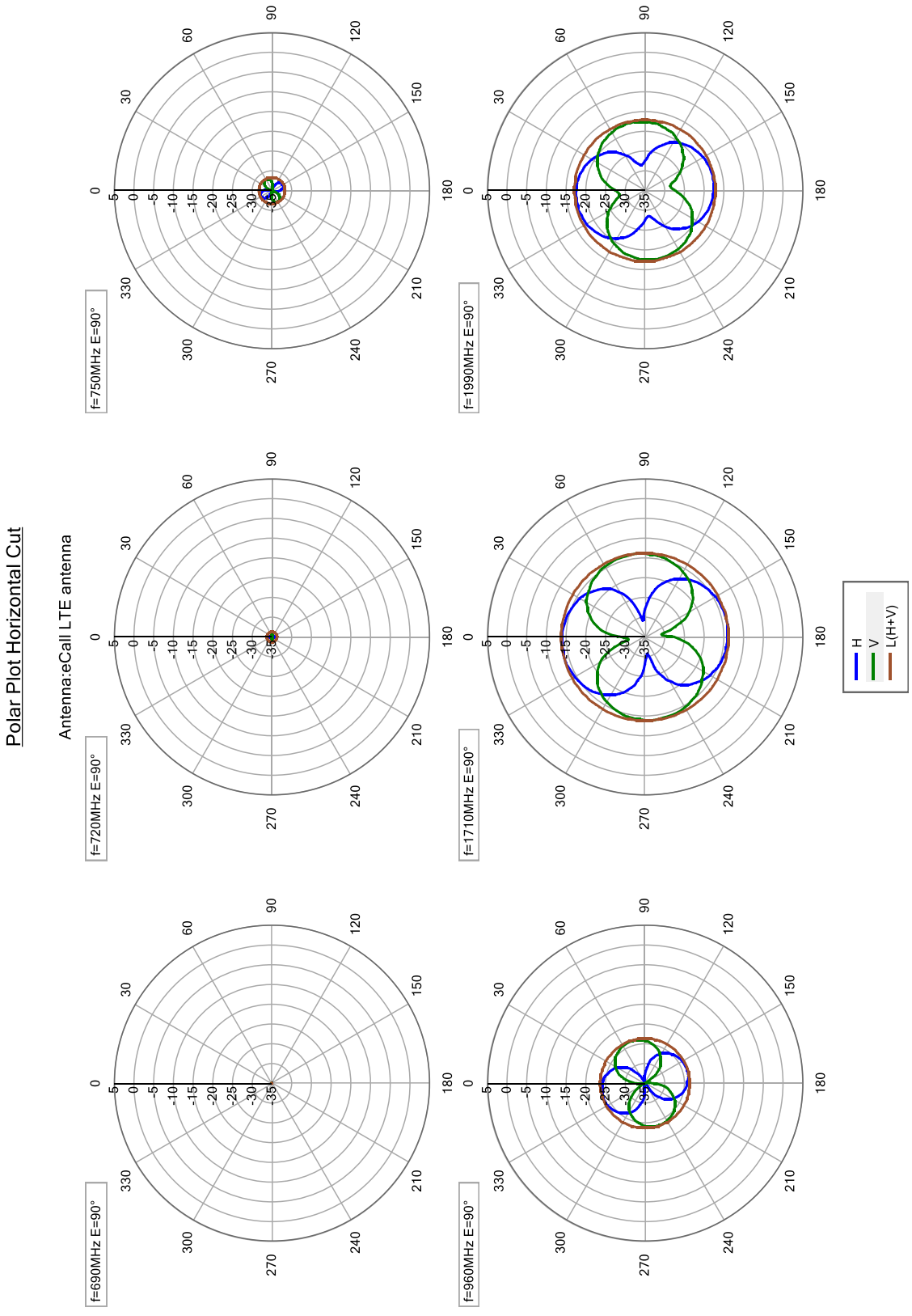


Figure 13 - eCall LTE antenna, Polar Plot Horizontal Cut, E=90°

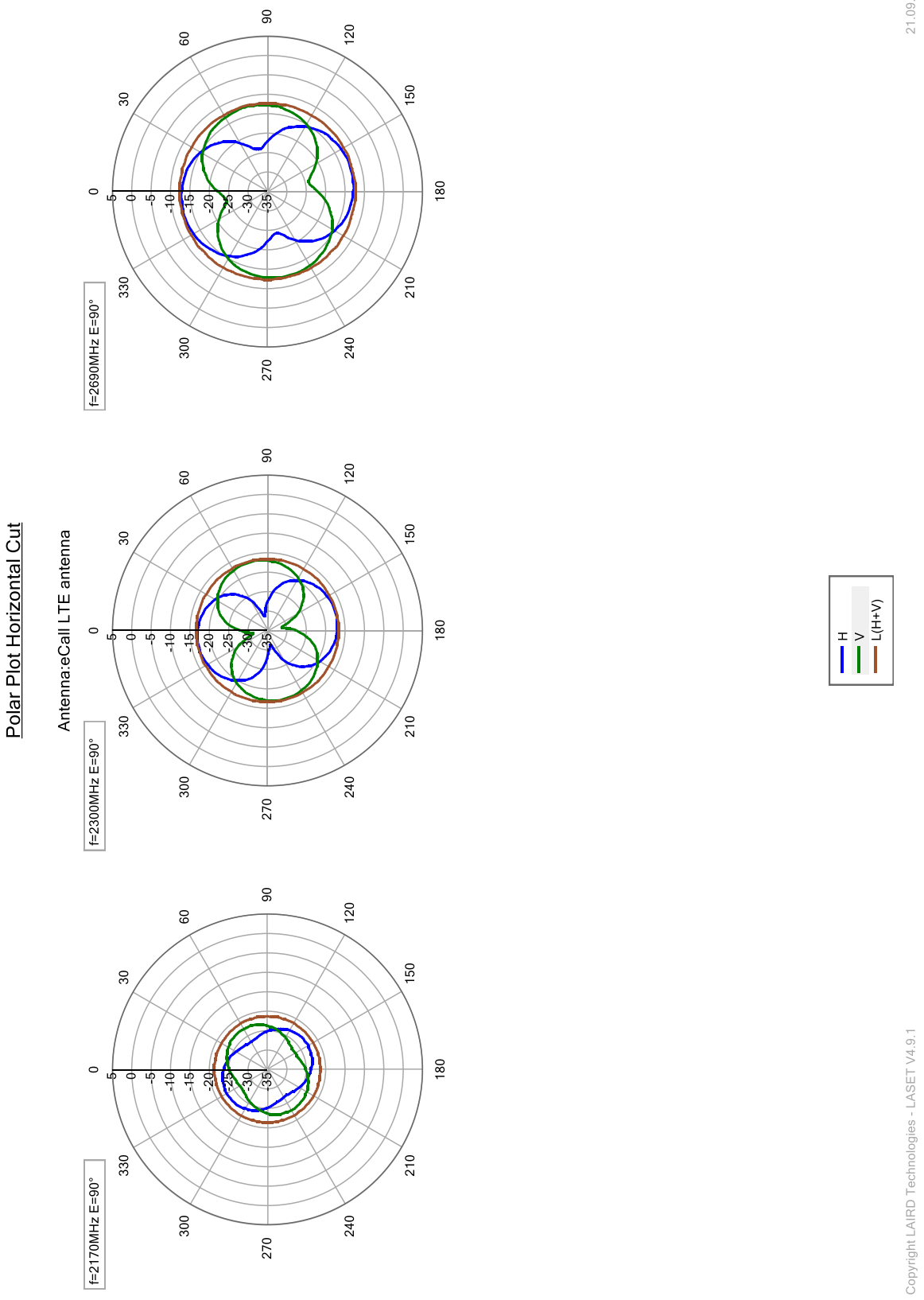


Figure 14 - eCall LTE antenna, Polar Plot Horizontal Cut, E=90°

Polar Plot Vertical Cut

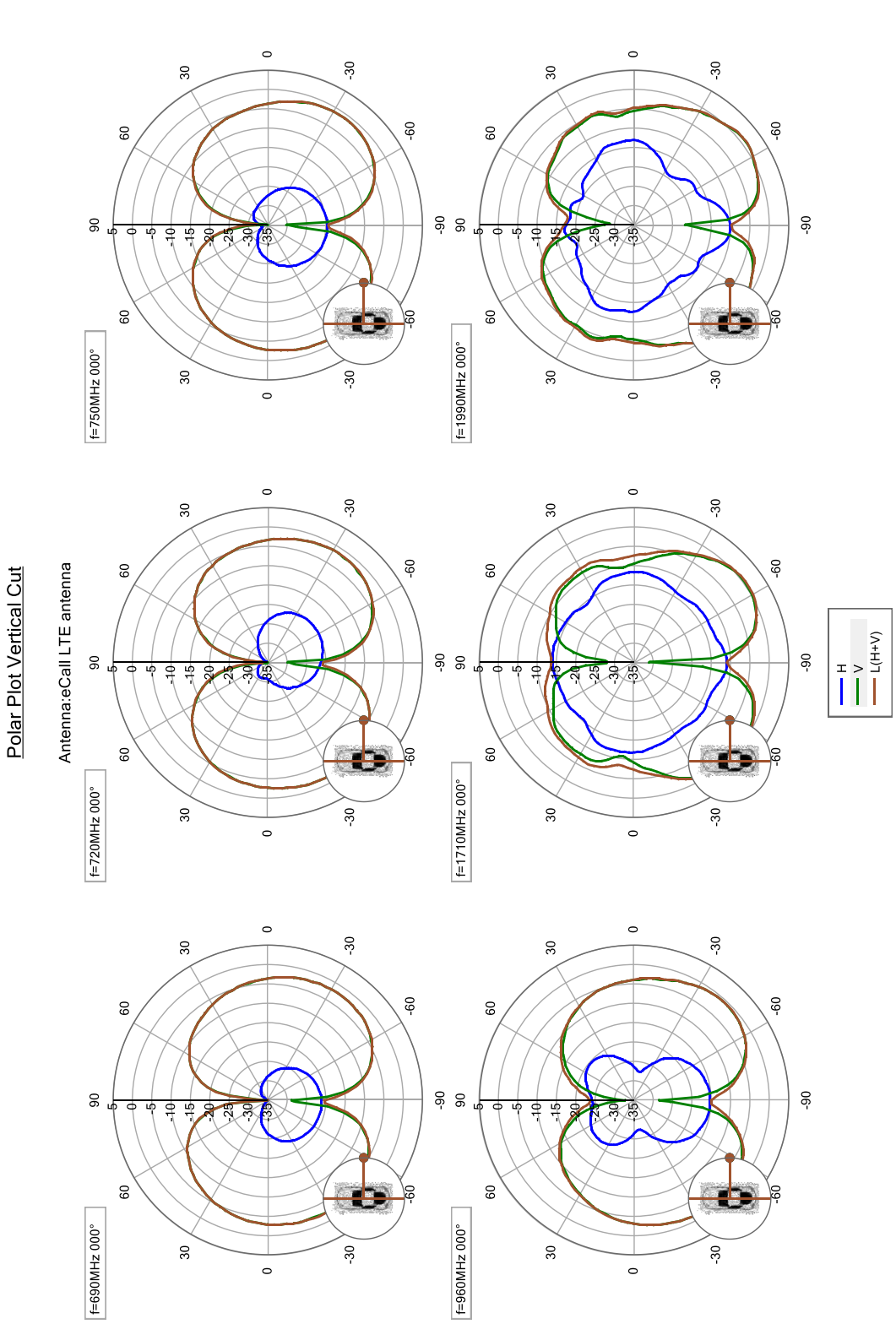


Figure 15 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=0°

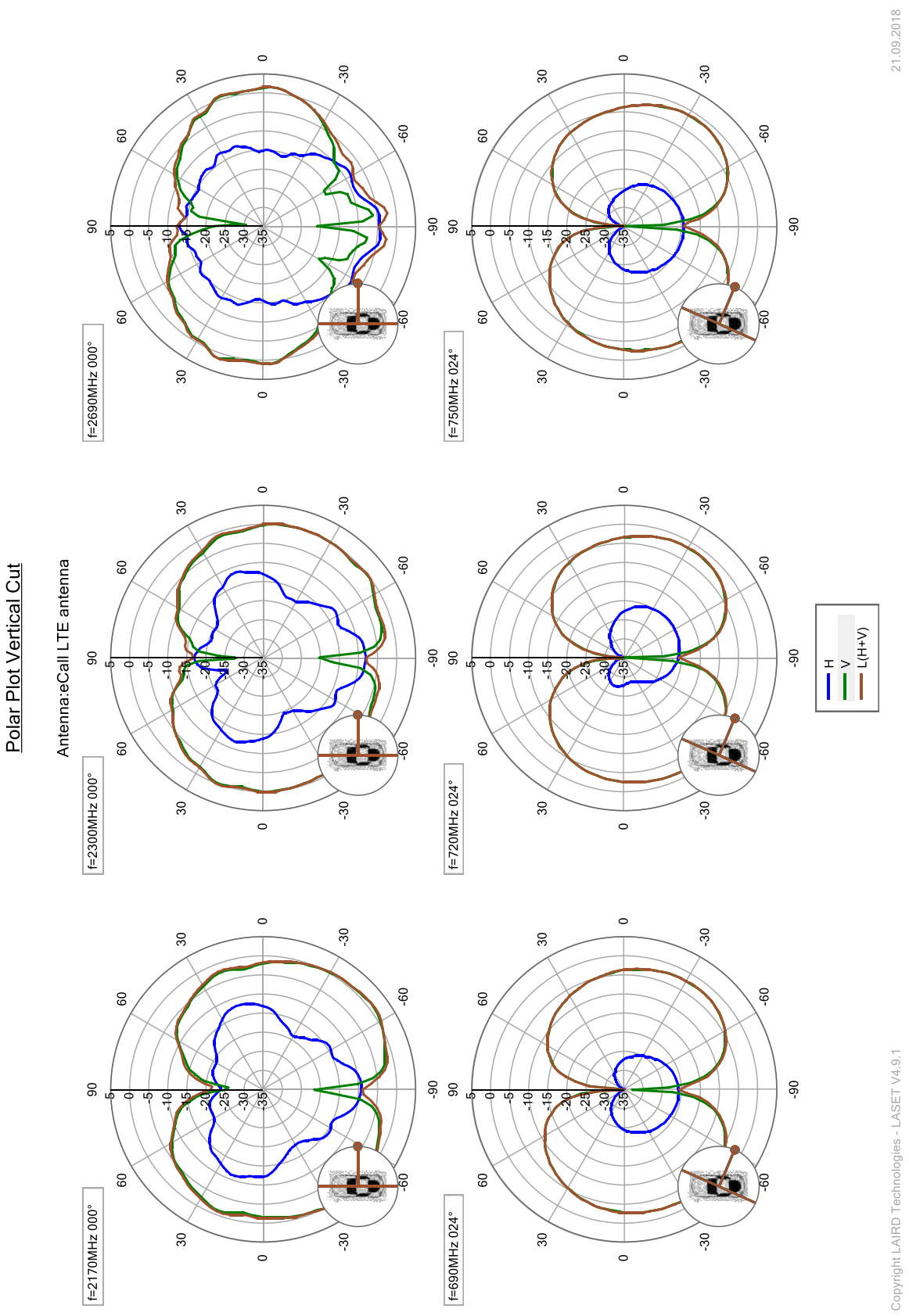


Figure 16 - eCall LTE antenna, Polar Plot Vertical Cut

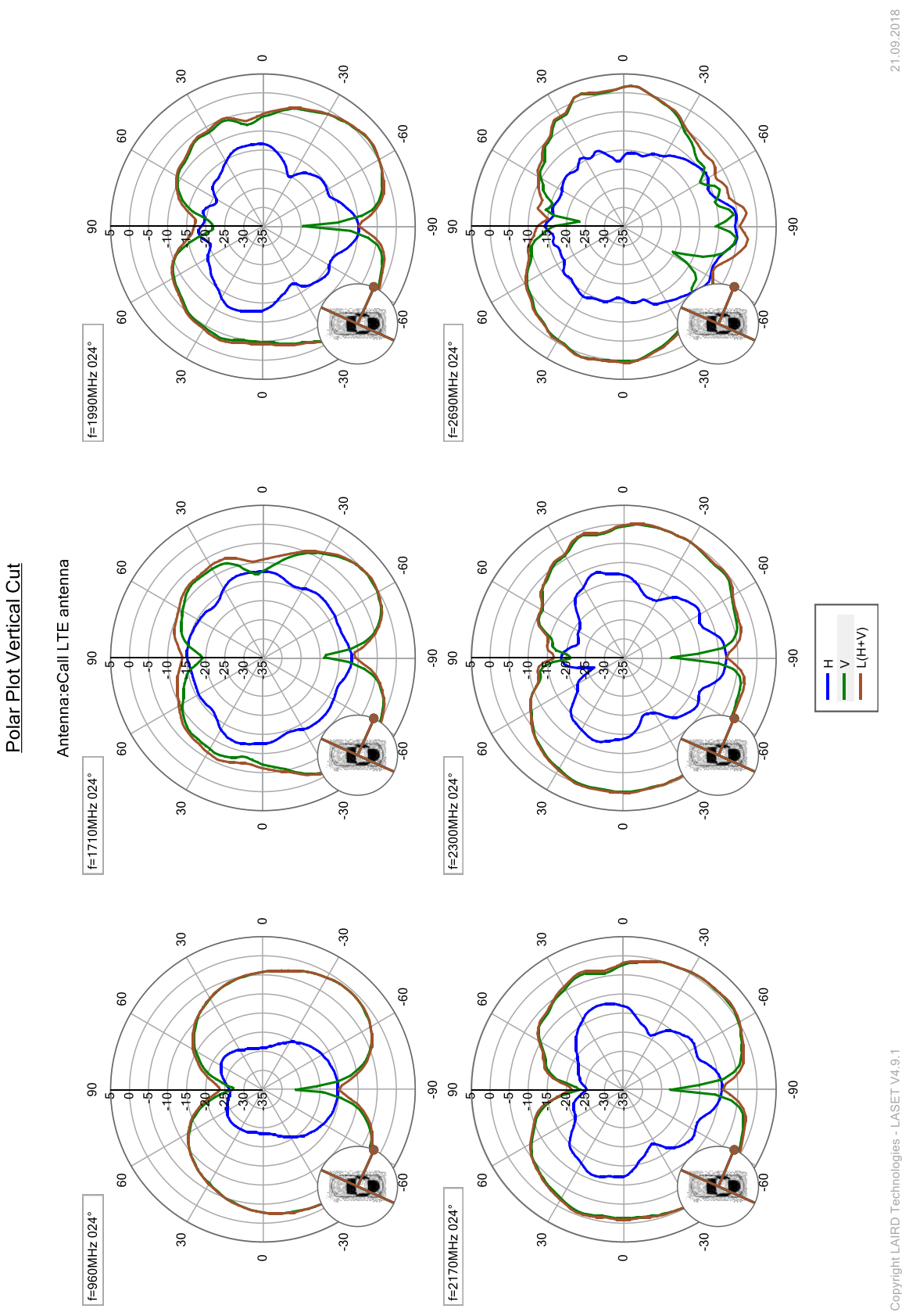


Figure 17 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=24°

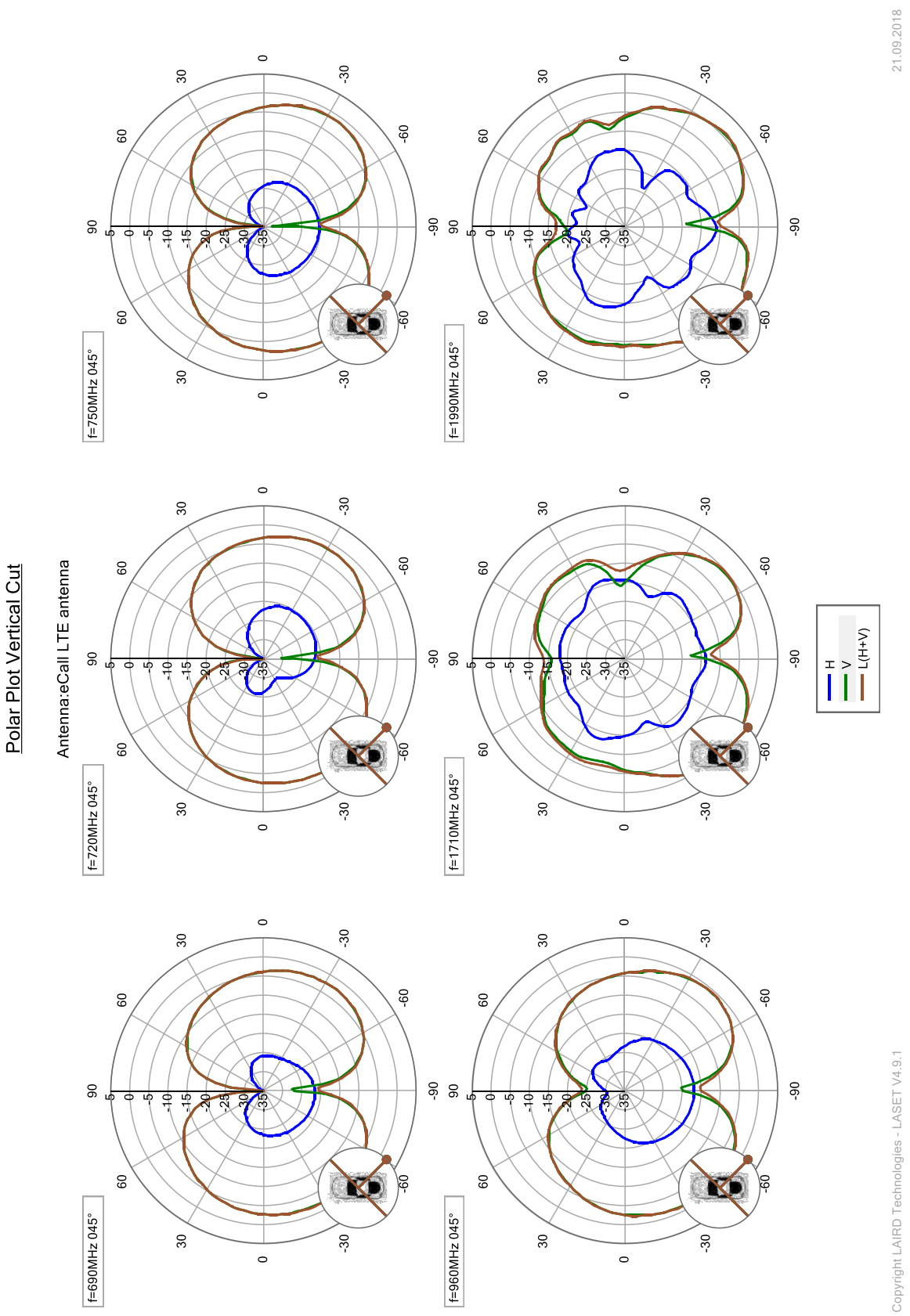


Figure 18 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=45°

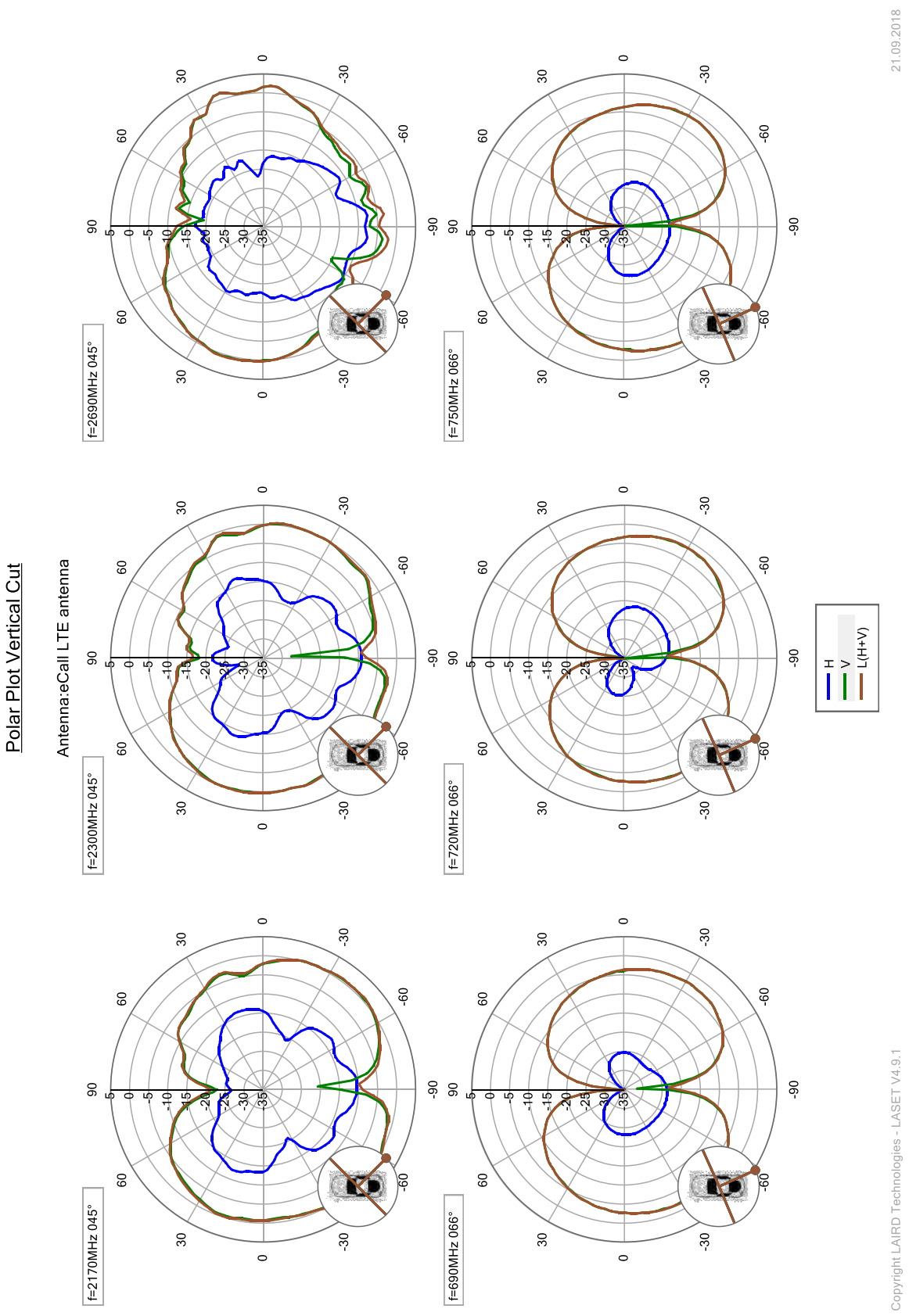


Figure 19 - eCall LTE antenna, Polar Plot Vertical Cut

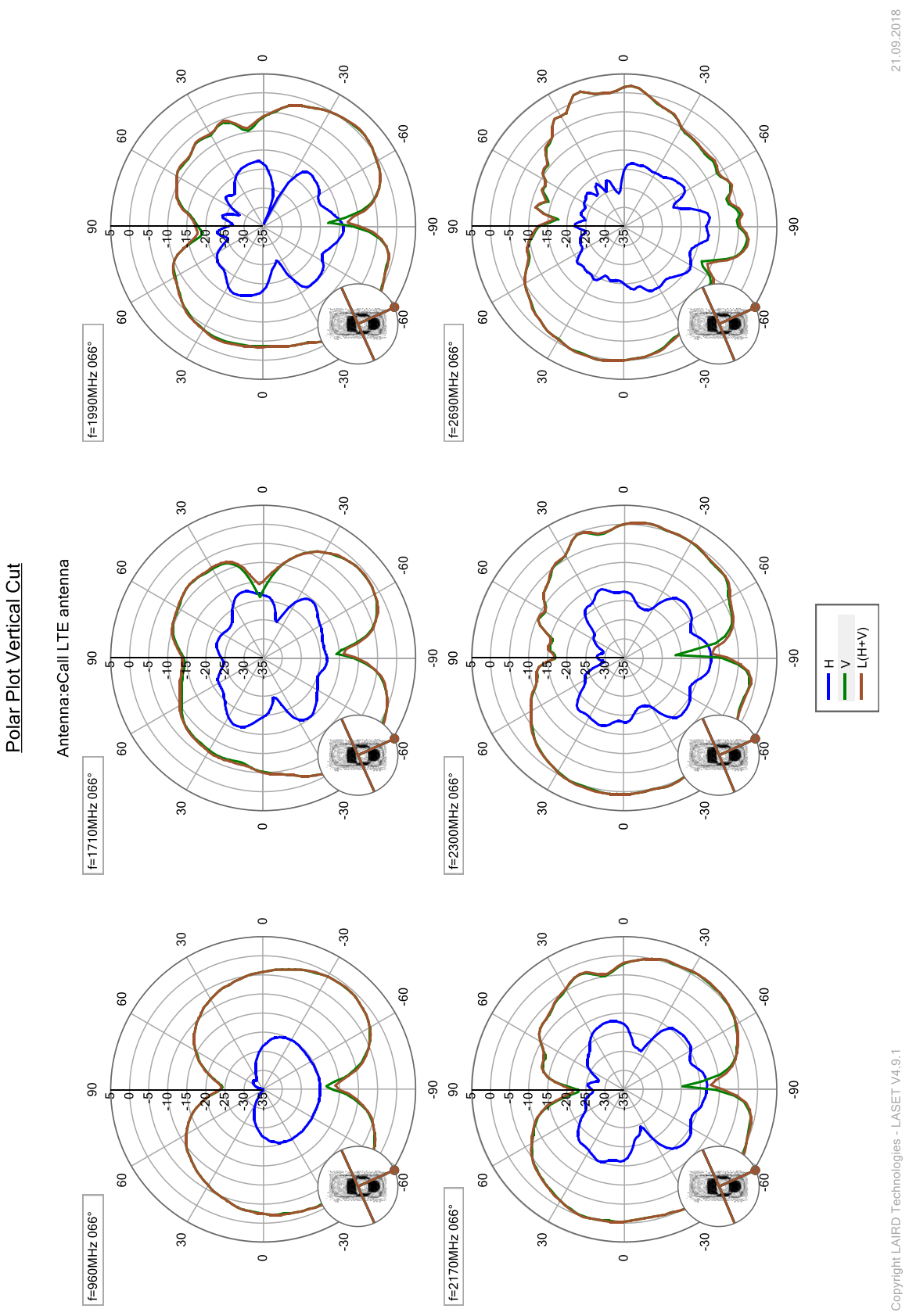


Figure 20 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=66°

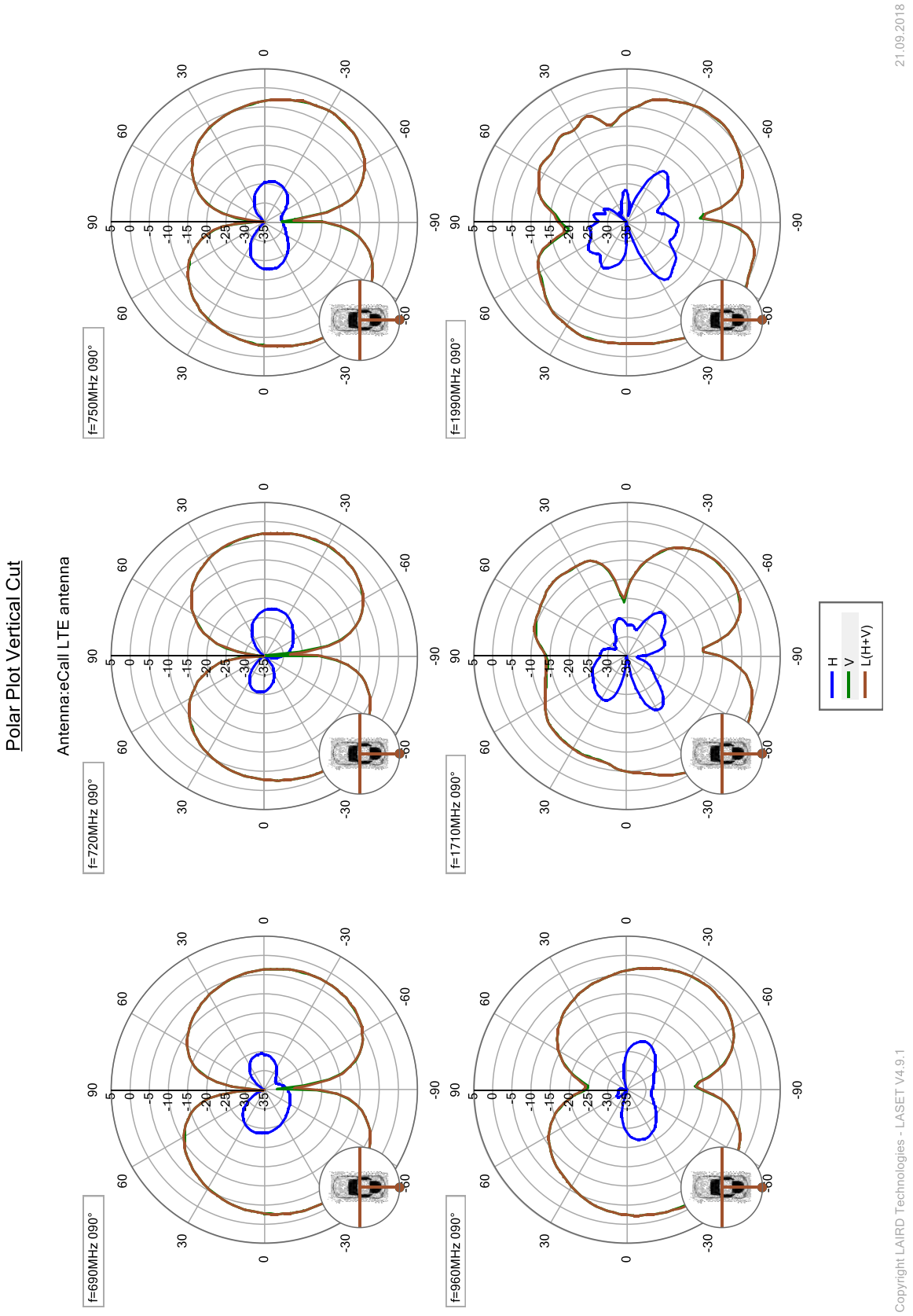


Figure 21 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=90°

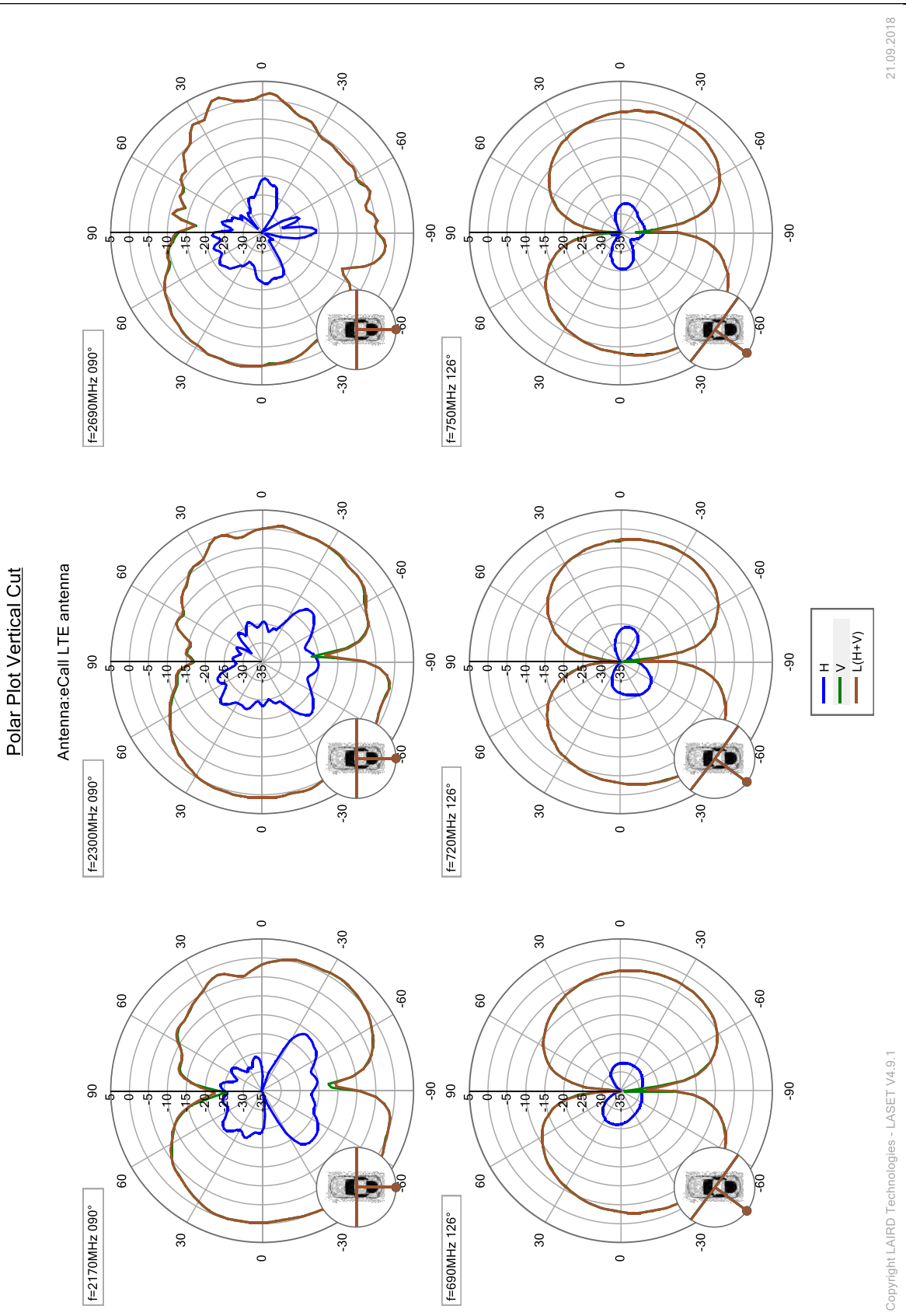


Figure 22 - eCall LTE antenna, Polar Plot Vertical Cut

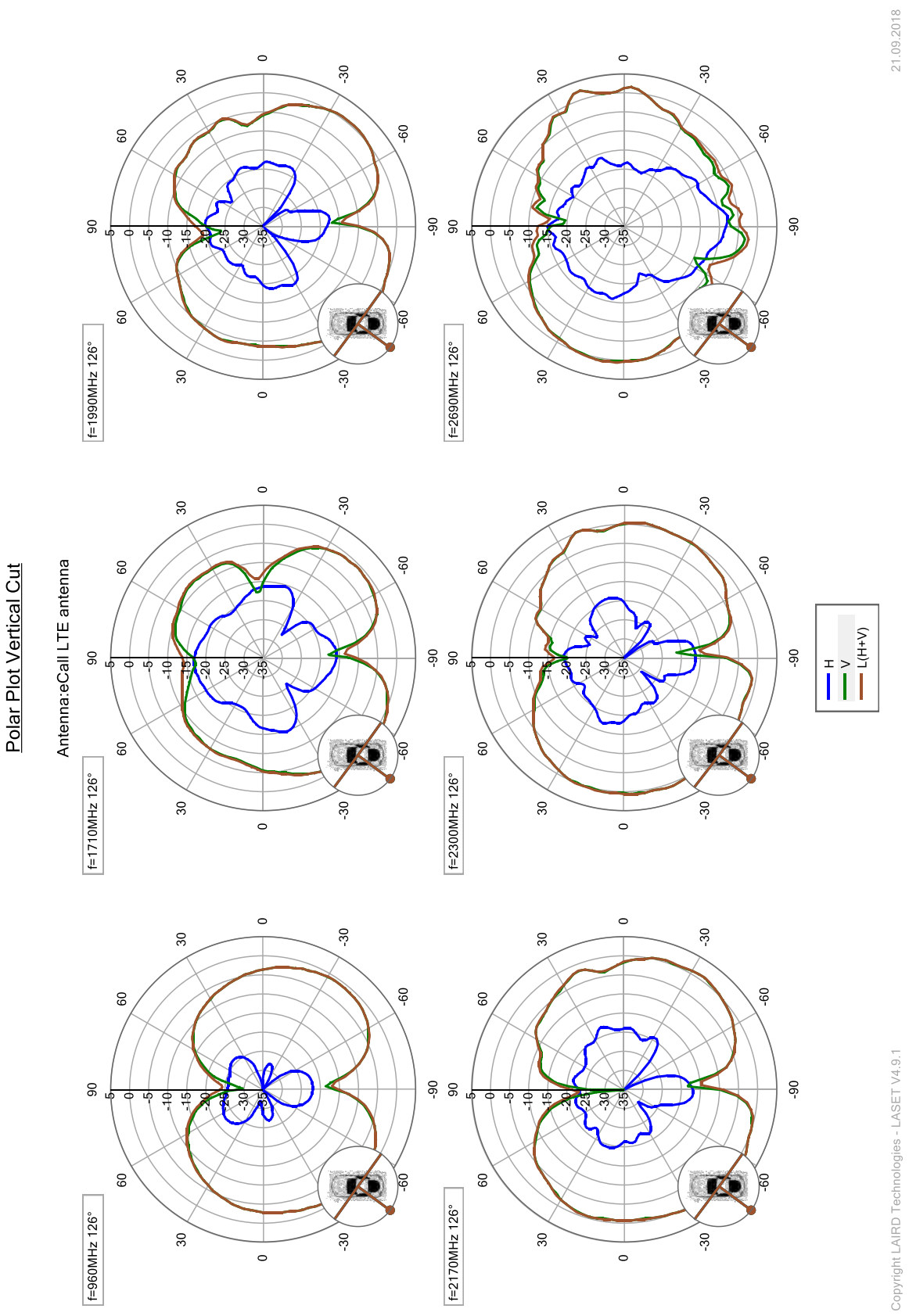


Figure 23 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=126°

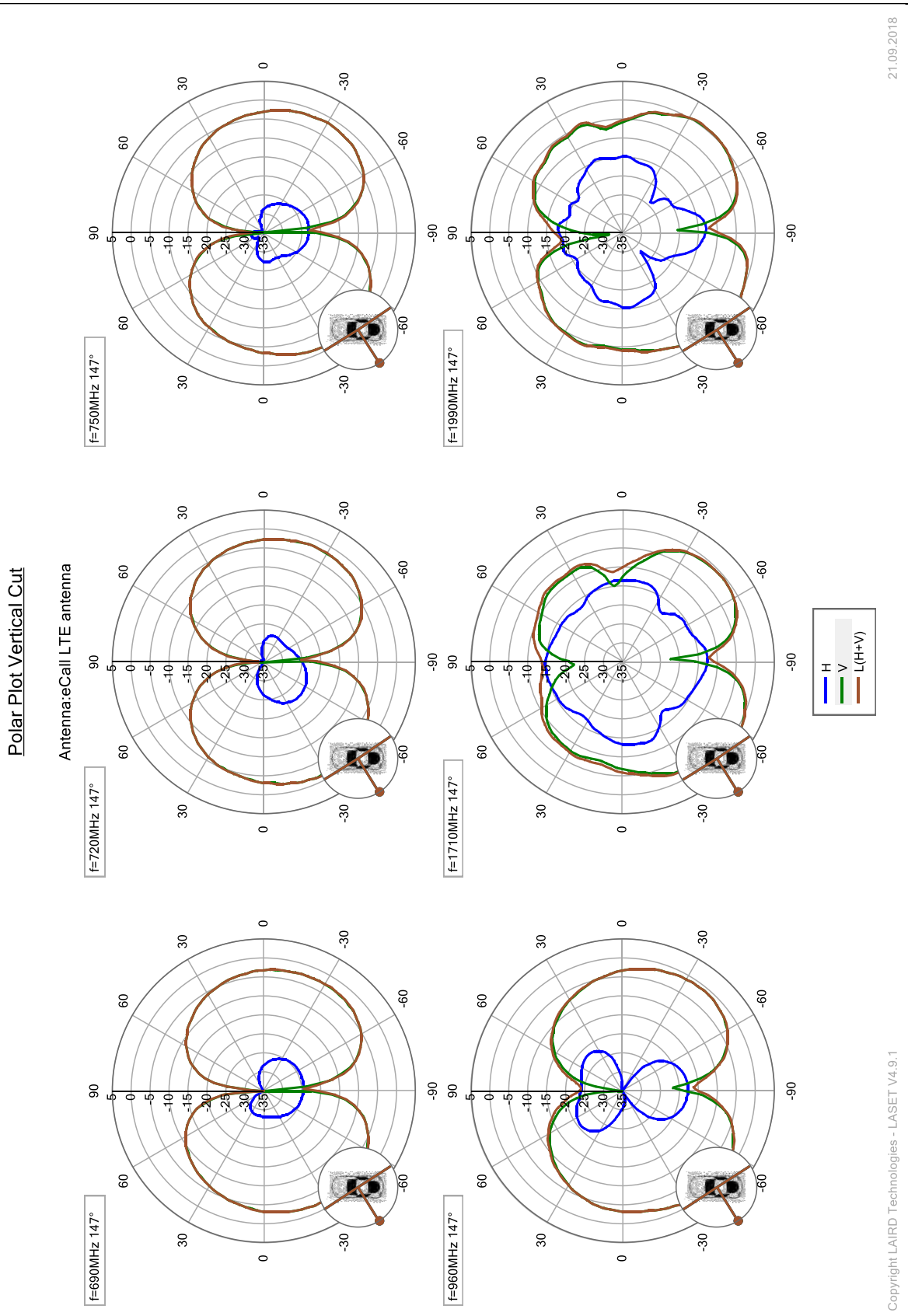


Figure 24 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=147°

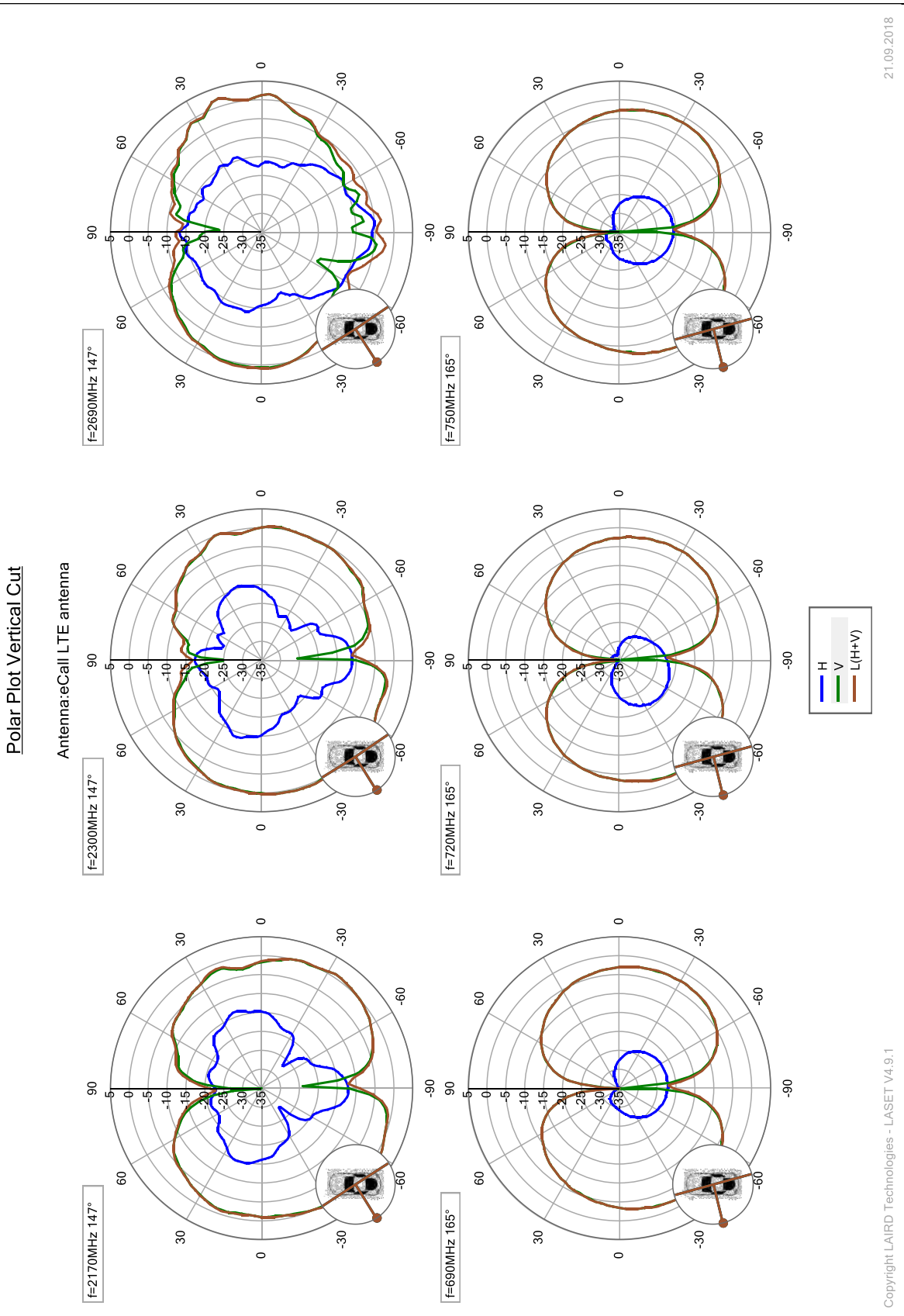


Figure 25 - eCall LTE antenna, Polar Plot Vertical Cut

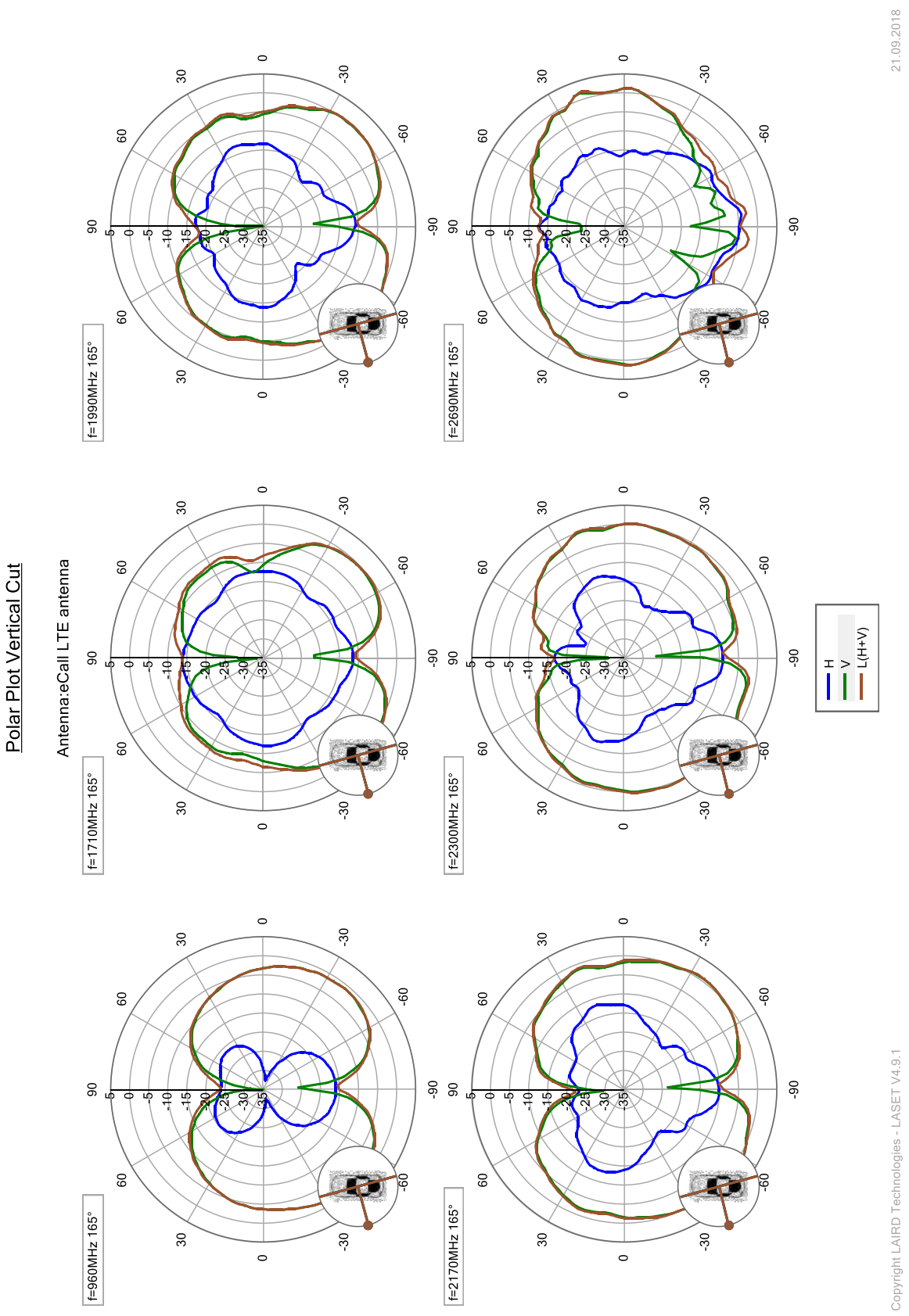


Figure 26 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=165°

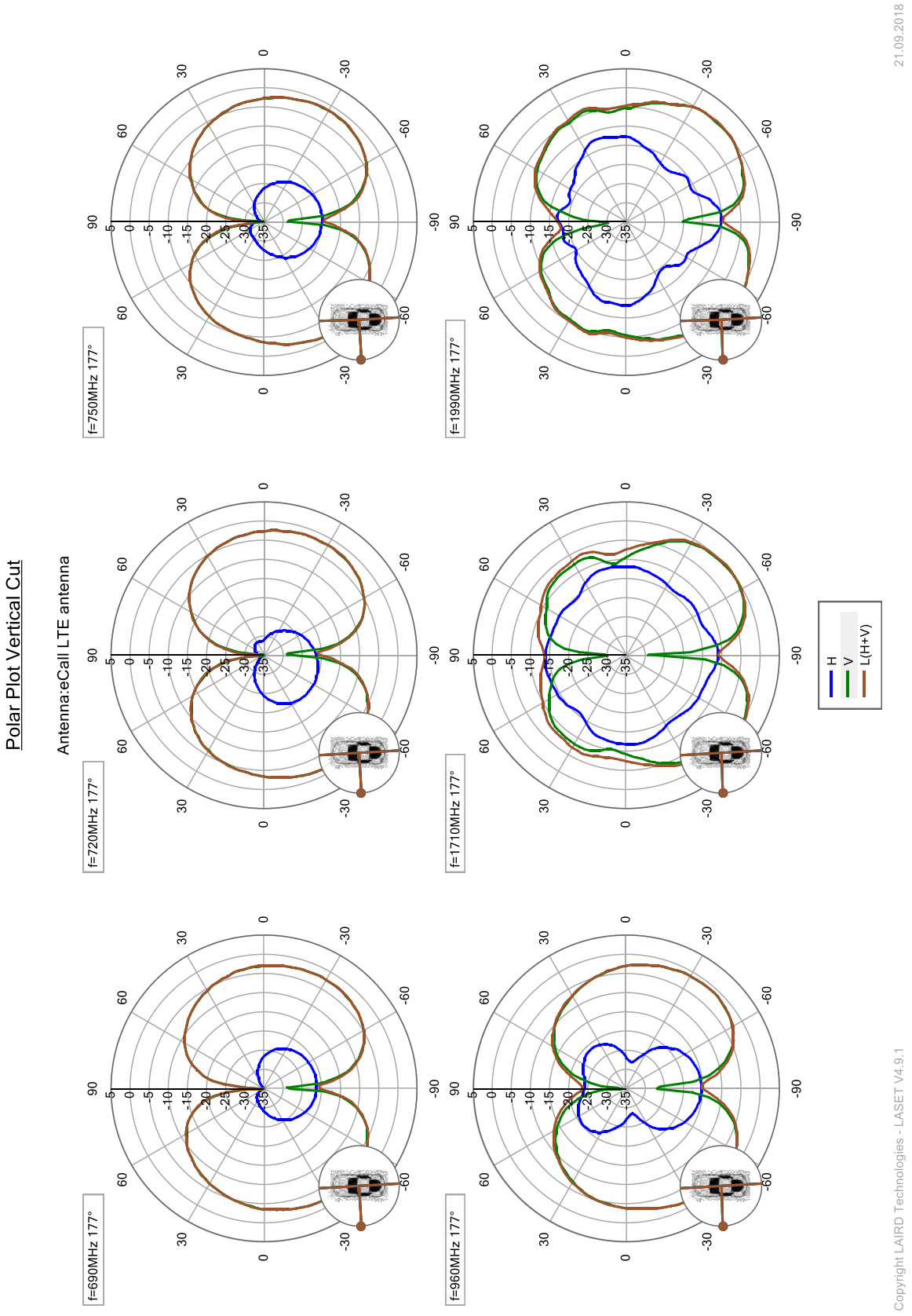


Figure 27 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=177°

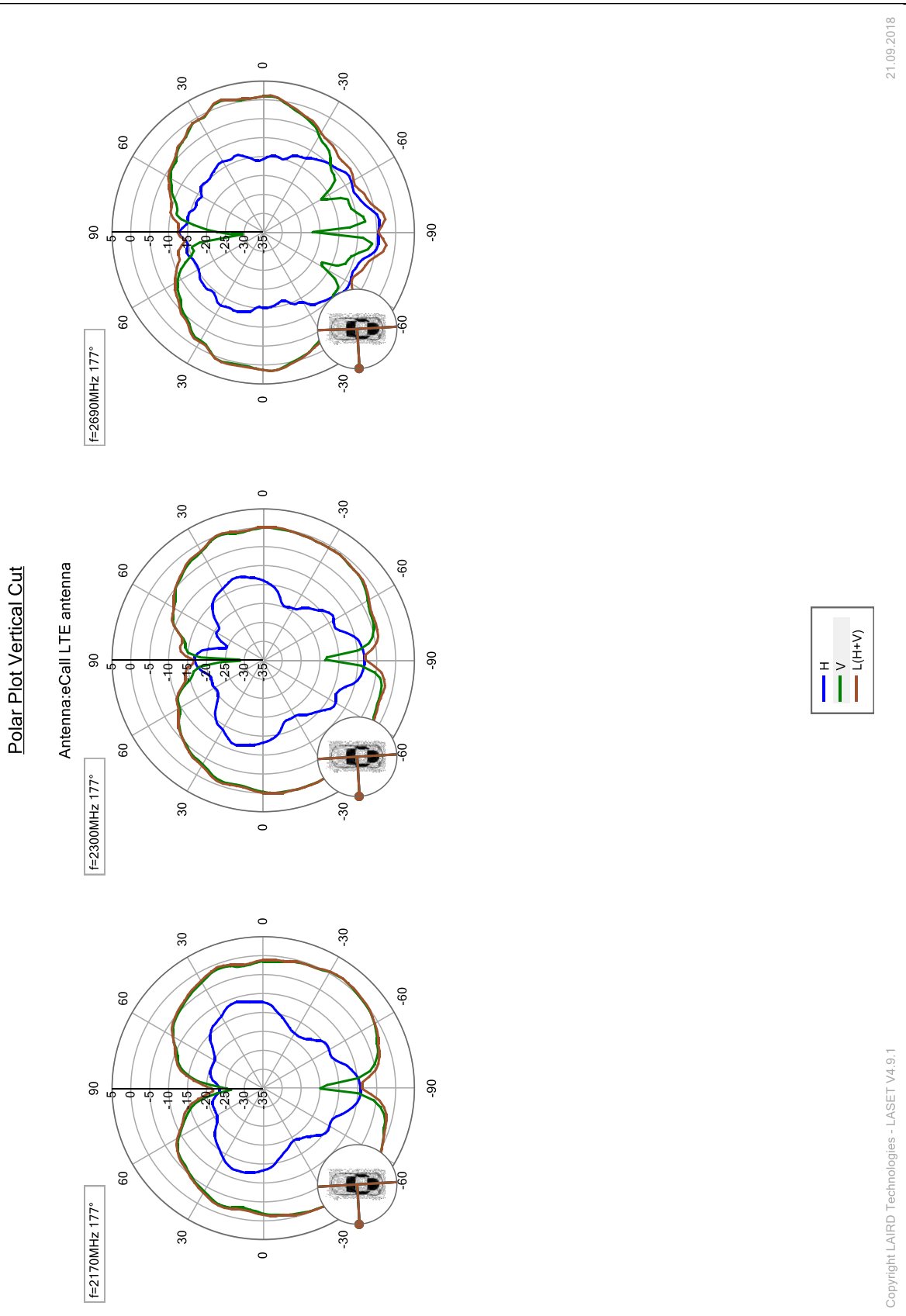


Figure 28 - eCall LTE antenna, Polar Plot Vertical Cut, Phi=177°

antenna peak values

H - overall peak			
f [MHz]	max [dB]	phi [°]	elevation [°]
2670	-3,840125144	177	-84

V - overall peak			
f [MHz]	max [dB]	phi [°]	elevation [°]
2660	2,858826177	105	18

L(H+V) - overall peak			
f [MHz]	max [dB]	phi [°]	elevation [°]
2660	2,89708617	114	18

H - peak values			
f [MHz]	max [dB]	phi [°]	elevation [°]
690	-20,62059528	198	-81
700	-20,44027445	201	-72
710	-19,3628196	201	-63
720	-19,57356414	15	-54
730	-19,76606214	201	-87
740	-19,31359188	201	-81
750	-19,26834376	195	-84
760	-19,39500077	12	-87
770	-19,46682092	12	-78
780	-19,11516824	198	-87
790	-18,2937926	21	-90
800	-17,53270524	18	-90
810	-17,22412272	201	-84
820	-17,77368539	18	-90
830	-17,46425524	195	-78
840	-17,85482151	18	-90
850	-16,75152268	15	-90
860	-16,52050997	12	-90
870	-16,53119688	15	-90
880	-16,34944951	15	-87
890	-15,94944349	195	-87
900	-15,44666415	195	-84
910	-15,17653369	192	-87
920	-15,76875213	195	-87
930	-15,95192102	195	-78
940	-16,14064343	195	-87
950	-15,71784409	12	-87
960	-15,09994018	9	-90
1700	-11,11907425	3	-90
1710	-10,91393825	0	-90
1720	-10,68496516	6	-90
1730	-10,76101736	9	-90
1740	-10,7134887	9	-90
1750	-10,65913602	6	-90
1760	-10,51116559	6	-90
1770	-10,77789463	186	-87
1780	-10,98773096	6	-90
1790	-11,310219	6	-90
1800	-11,35770887	6	-90
1810	-11,14477078	9	-90
1820	-10,9767238	12	-90
1830	-10,86551055	12	-90
1840	-10,69229932	9	-90
1850	-10,52714483	6	-90
1860	-10,80004266	9	-90
1870	-10,71477975	12	-90
1880	-10,60525427	15	-90
1890	-10,41309908	12	-90
1900	-10,32548927	12	-90
1910	-10,31148758	12	-90
1920	-9,814536362	195	-87
1930	-9,67508847	195	-87
1940	-9,441086769	12	-90
1950	-9,630403605	12	-90
1960	-9,816343366	12	-90
1970	-9,566939284	15	-90
1980	-10,00432382	195	-87
1990	-9,715840602	195	-87

V - peak values			
f [MHz]	max [dB]	phi [°]	elevation [°]
690	-1,699111858	291	-33
700	-1,561467115	291	-33
710	-1,167363677	297	-36
720	-1,29458705	300	-33
730	-1,047889671	294	-33
740	-1,011424172	300	-36
750	-0,929705724	300	-36
760	-0,763354066	300	-36
770	-0,774802086	297	-39
780	-0,845205532	288	-36
790	-0,891158164	288	-36
800	-0,81341246	285	-39
810	-0,528614388	288	-42
820	-0,295631263	294	-39
830	-0,31229849	297	-39
840	-0,278710165	297	-39
850	-0,377046854	294	-39
860	-0,45765472	291	-39
870	-0,499994192	288	-39
880	-0,451843493	285	-39
890	-0,402653284	285	-39
900	-0,236131786	285	-39
910	-0,056705535	291	-42
920	-0,012973276	288	-42
930	-0,176275655	291	-42
940	-0,376643862	291	-42
950	-0,445458937	294	-45
960	-0,465412206	291	-45
1700	1,441079859	285	-54
1710	1,455750285	282	-54
1720	1,504771279	282	-57
1730	1,35203838	288	-57
1740	1,238690908	291	-57
1750	1,402736293	291	-54
1760	1,588649123	288	-54
1770	1,622910465	291	-57
1780	1,770515393	288	-57
1790	1,651010447	294	-57
1800	1,60809362	297	-54
1810	1,650079112	294	-54
1820	1,58749234	297	-54
1830	1,524204599	294	-54
1840	1,705722452	300	-54
1850	1,636889966	300	-54
1860	1,350898908	309	-54
1870	1,317831134	306	-54
1880	1,401593016	312	-54
1890	1,699634757	300	-57
1900	1,601594748	309	-57
1910	1,488728481	312	-54
1920	1,396043397	312	-54
1930	1,369462275	306	-54
1940	1,49727417	300	-54
1950	1,516775815	300	-54
1960	1,500819896	309	-54
1970	1,373443491	315	-54
1980	1,282070573	309	-54
1990	1,402071663	303	-54

L(H+V) - peak values			
f [MHz]	max [dB]	phi [°]	elevation [°]
690	-1,687293	291	-33
700	-1,54981701	288	-33
710	-1,15128628	291	-36
720	-1,27582022	309	-33
730	-1,02821141	294	-33
740	-1,00051337	300	-36
750	-0,92308293	300	-36
760	-0,75807553	300	-36
770	-0,76903944	297	-39
780	-0,83095347	288	-36
790	-0,87931169	288	-36
800	-0,79604457	285	-39
810	-0,51406579	285	-42
820	-0,28829932	291	-39
830	-0,30370636	297	-39
840	-0,27460473	294	-39
850	-0,37237325	291	-39
860	-0,45141854	288	-39
870	-0,49346535	288	-39
880	-0,44025026	285	-39
890	-0,38820612	285	-39
900	-0,22190057	282	-39
910	-0,04662475	282	-39
920	-0,00573386	285	-42
930	-0,16478488	285	-42
940	-0,36590919	285	-42
950	-0,44201346	291	-45
960	-0,4624568	291	-45
1700	1,44450309	285	-54
1710	1,4577835	282	-54
1720	1,50778945	291	-57
1730	1,356213	288	-57
1740	1,24534885	294	-57
1750	1,40646725	291	-54
1760	1,59162091	288	-54
1770	1,62495481	291	-57
1780	1,7754325	300	-57
1790	1,65569879	297	-57
1800	1,61444026	297	-54
1810	1,65572998	294	-54
1820	1,59139519	294	-54
1830	1,52614573	294	-54
1840	1,70842891	300	-54
1850	1,64196494	300	-54
1860	1,35758268	312	-54
1870	1,31985987	312	-54
1880	1,40429815	312	-54
1890	1,70040561	300	-57
1900	1,60711055	309	-57
1910	1,49797689	321	-54
1920	1,40092939	315	-54
1930	1,37347203	312	-54
1940	1,50143308	306	-54
1950	1,52187777	300	-54
1960	1,50416625	309	-54
1970	1,37684947	324	-54
1980	1,28396752	309	-54
1990	1,40468207	303	-54

H - peak values				V - peak values				L(H+V) - peak values			
f [MHz]	max [dB]	phi [°]	elevation [°]	f [MHz]	max [dB]	phi [°]	elevation [°]	f [MHz]	max [dB]	phi [°]	elevation [°]
2000	-11,15362188	15	-90	2000	1,580976123	315	-54	2000	1,58686411	312	-54
2010	-10,94304283	198	-87	2010	1,590273733	312	-54	2010	1,59265109	312	-54
2020	-10,97175965	198	-87	2020	1,728156017	312	-54	2020	1,72875168	318	-54
2030	-10,82720939	15	-90	2030	1,989019847	309	-54	2030	1,99046117	309	-54
2040	-10,31631711	9	-90	2040	2,073988853	306	-54	2040	2,07820508	306	-54
2050	-10,22960971	9	-90	2050	2,308776623	297	-54	2050	2,31950392	297	-54
2060	-10,44392862	9	-90	2060	2,144138983	303	-54	2060	2,15151632	297	-54
2070	-10,61395726	12	-90	2070	1,674920656	309	-54	2070	1,68340586	300	-54
2080	-10,18725167	195	-87	2080	1,696171199	312	-54	2080	1,69719082	318	-54
2090	-10,01630968	195	-87	2090	1,981425116	309	-54	2090	1,98208084	312	-54
2100	-9,636831467	15	-90	2100	2,007533043	309	-54	2100	2,00920763	309	-54
2110	-9,49160664	15	-90	2110	1,612568685	306	-54	2110	1,61577131	306	-54
2120	-9,505385305	18	-90	2120	1,357969353	309	-54	2120	1,36331856	297	-54
2130	-9,298825262	18	-90	2130	1,464891888	303	-54	2130	1,46891145	300	-54
2140	-8,9777755	195	-87	2140	1,690392769	309	-51	2140	1,69262594	300	-51
2150	-8,927060975	15	-90	2150	1,548226106	303	-51	2150	1,54909387	303	-51
2160	-9,035266675	12	-90	2160	1,590252654	303	-54	2160	1,59326198	303	-54
2170	-8,919859054	12	-87	2170	1,73639489	300	-54	2170	1,74381641	297	-54
2180	-8,056774827	12	-90	2180	1,814460409	300	-54	2180	1,82409011	297	-54
2190	-7,620157569	12	-90	2190	1,839920228	303	-54	2190	1,84268426	303	-54
2200	-7,243390927	15	-90	2200	1,697265257	306	-54	2200	1,69737111	306	-54
2210	-7,159194374	15	-90	2210	0,956258323	300	-54	2210	0,95850336	297	-54
2220	-7,469269903	15	-90	2220	0,904388737	297	-54	2220	0,90523298	297	-54
2230	-7,553008162	15	-90	2230	1,301954028	300	-54	2230	1,30370647	294	-54
2240	-8,139750071	15	-87	2240	1,298125598	294	-54	2240	1,2991331	294	-54
2250	-8,016966497	12	-90	2250	1,085654161	297	-51	2250	1,09364554	291	-51
2260	-7,518168999	12	-90	2260	0,7007184	312	-51	2260	0,70550829	321	-51
2270	-7,499919188	15	-90	2270	0,823606165	99	-9	2270	0,826183	99	-9
2280	-7,125313942	15	-90	2280	1,404407127	96	-9	2280	1,40697512	96	-9
2290	-7,780822806	195	-87	2290	0,998368486	96	-9	2290	0,99938929	96	-9
2300	-7,858515266	15	-90	2300	0,926161348	96	-9	2300	0,93185003	93	-9
2310	-7,16981494	15	-90	2310	1,318691774	96	-9	2310	1,3190887	96	-9
2320	-6,625572839	15	-90	2320	1,386833965	90	-9	2320	1,39623216	90	-9
2330	-6,129997895	12	-90	2330	1,643875414	93	-9	2330	1,64980348	93	-9
2340	-5,916514407	12	-90	2340	2,000474161	93	-6	2340	2,0083705	93	-6
2350	-6,144160136	12	-90	2350	1,533106064	96	-6	2350	1,5984817	45	-6
2360	-5,993641974	9	-90	2360	1,62732575	108	-6	2360	1,67295896	114	-6
2370	-6,655188248	189	-87	2370	1,528434093	108	-6	2370	1,53307306	108	-6
2380	-6,521172114	9	-90	2380	1,362328343	108	-6	2380	1,37998046	108	-6
2390	-5,840266385	9	-90	2390	1,313663186	18	-9	2390	1,39188123	15	-9
2400	-5,890170357	9	-90	2400	1,505279321	12	-9	2400	1,61980333	12	-9
2410	-5,479158136	9	-90	2410	1,664704359	21	-9	2410	1,74989134	21	-9
2420	-5,826888916	9	-90	2420	1,727775041	123	-6	2420	1,76793184	18	-6
2430	-5,567184048	9	-90	2430	1,723556691	123	-6	2430	1,73817218	129	-6
2440	-5,580968298	9	-90	2440	1,849278157	123	-6	2440	1,87534165	123	-6
2450	-5,648841018	9	-90	2450	2,113139409	108	-6	2450	2,12631678	114	-6
2460	-6,099971012	186	-87	2460	1,835894351	105	-6	2460	1,84974342	105	-6
2470	-6,12254425	6	-87	2470	1,801687632	126	18	2470	1,89833753	135	18
2480	-6,371830609	6	-87	2480	1,73584334	126	18	2480	1,85242227	135	18
2490	-6,050642455	3	-90	2490	1,780254162	123	18	2490	1,85842687	132	18
2500	-5,688946888	180	-87	2500	1,961568335	123	18	2500	2,04215686	132	18
2510	-5,475442895	180	-87	2510	2,061386321	120	18	2510	2,14411994	132	18
2520	-5,484048189	183	-84	2520	2,190371721	123	18	2520	2,25222156	129	18
2530	-5,151786086	183	-87	2530	2,152273853	120	18	2530	2,2015272	132	18
2540	-5,104083133	0	-90	2540	2,093019033	126	18	2540	2,16024844	132	18
2550	-4,98091658	0	-90	2550	2,207269952	123	18	2550	2,28838228	129	18
2560	-5,365510839	180	-84	2560	2,370391332	123	18	2560	2,44136171	126	18
2570	-4,761023886	0	-90	2570	2,611129721	117	18	2570	2,66622849	126	18
2580	-4,620769385	0	-90	2580	2,763476065	117	18	2580	2,8196485	123	18
2590	-4,435326313	180	-87	2590	2,711175209	111	18	2590	2,75915138	117	18
2600	-4,609458675	180	-87	2600	2,632191849	111	18	2600	2,6773934	117	18
2610	-4,530254037	177	-87	2610	2,632068849	111	18	2610	2,66064434	117	18
2620	-4,444723803	177	-87	2620	2,529865985	114	18	2620	2,56735953	120	18
2630	-4,287687005	177	-87	2630	2,427308666	114	18	2630	2,4674403	123	18
2640	-4,231384877	177	-87	2640	2,518002903	114	18	2640	2,5643363	117	18
2650	-4,026533748	174	-87	2650	2,806953501	111	18	2650	2,84928919	117	18
2660	-3,871546579	174	-87	2660	2,858826177	105	18	2660	2,89708617	114	18
2670	-3,840125144	177	-84	2670	2,850605685	108	18	2670	2,87967146	114	18
2680	-3,979237724	177	-84	2680	2,504892131	105	18	2680	2,53028674	108	18
2690	-3,982237717	177	-84	2690	2,476298662	108	18	2690	2,50375967	108	18
2700	-3,916787856	174	-87	2700	2,466579504	105	18	2700	2,49218552	111	18

BT_WLAN_1 antenna

WLAN P1518 C5 10k Data Sheet

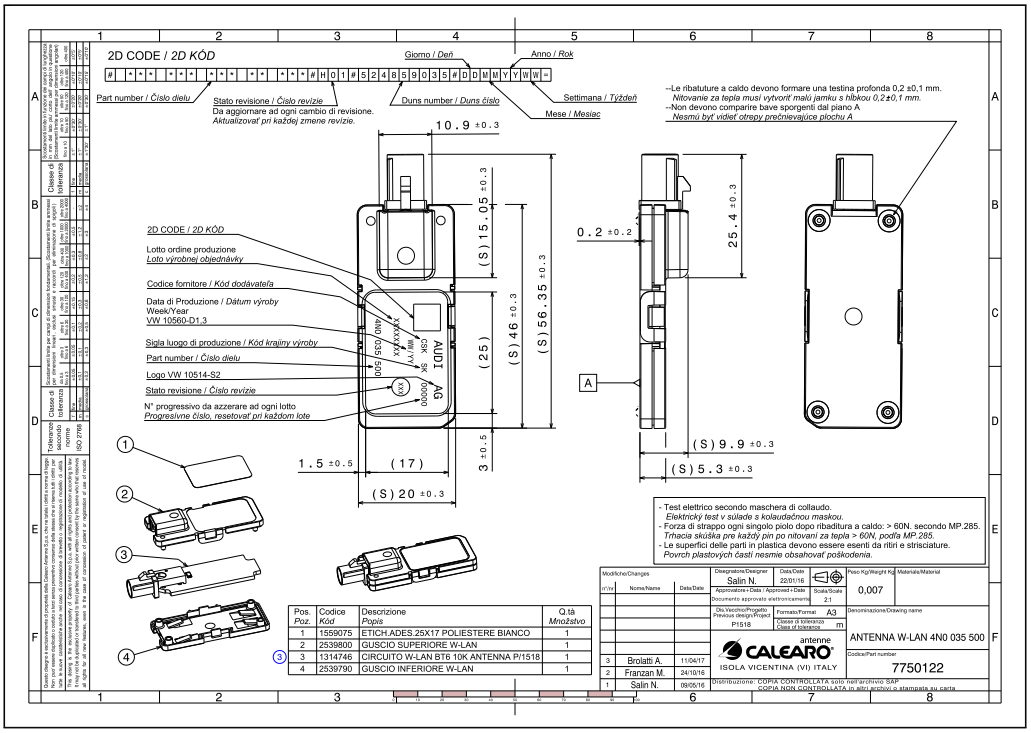
Contents

N° Rev.	Description
1	Simplifyed table in Sec. 3.3.2. Added maximum e minimum radiation level and direction in Appendix A.

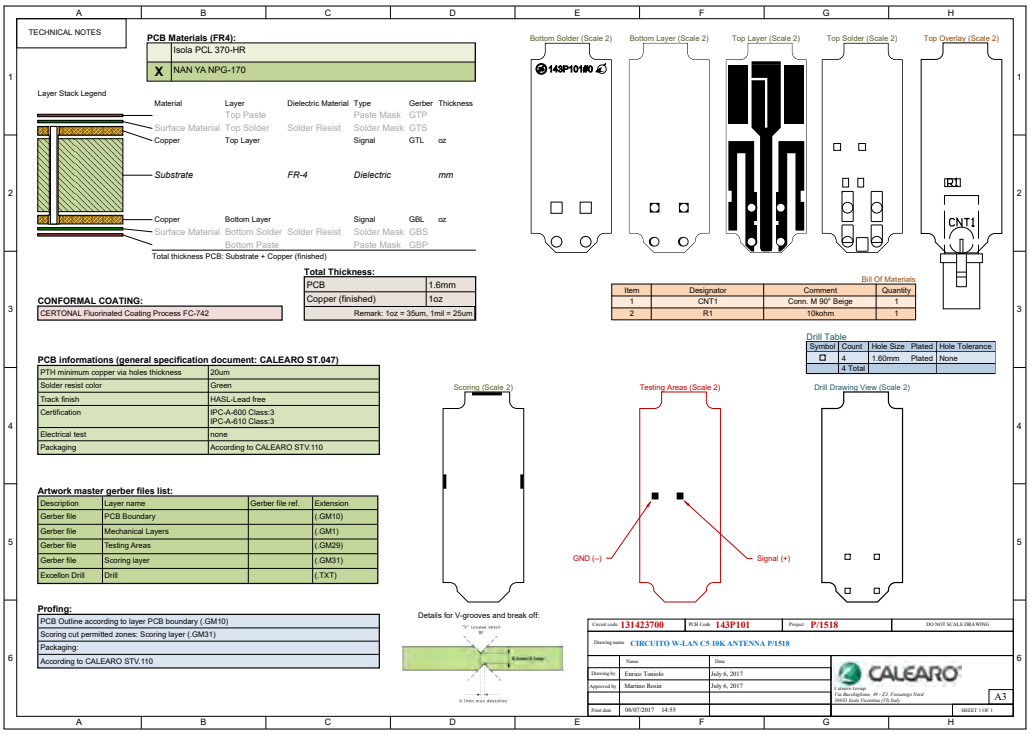
1 D.U.T.

C5

ANTENNA W-LAN 4N0 035 500 AU-VW-LAMB
DRW 7750122



CIRCUITO W-LAN C5 10K ANTENNA P/1518
DIS 131423700

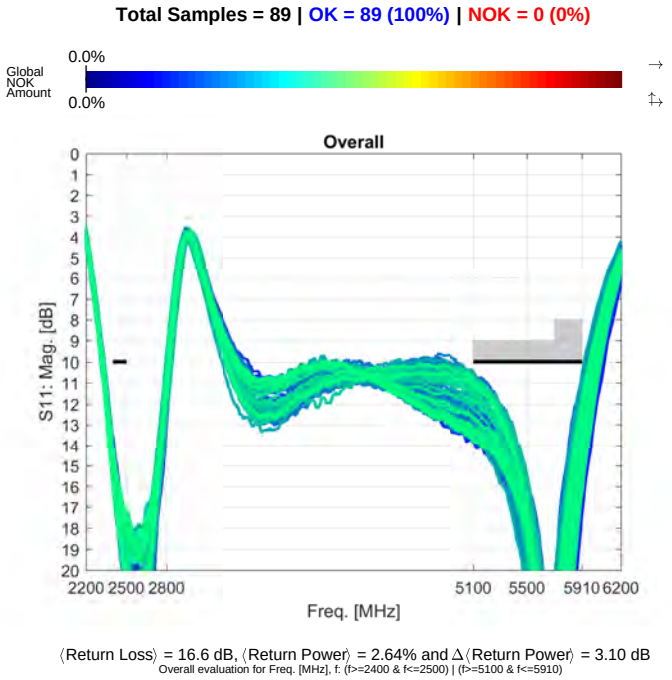


Analyzed Sample: EB159 (Cia-Nanya NPG-170) 131423700

2 Return Loss

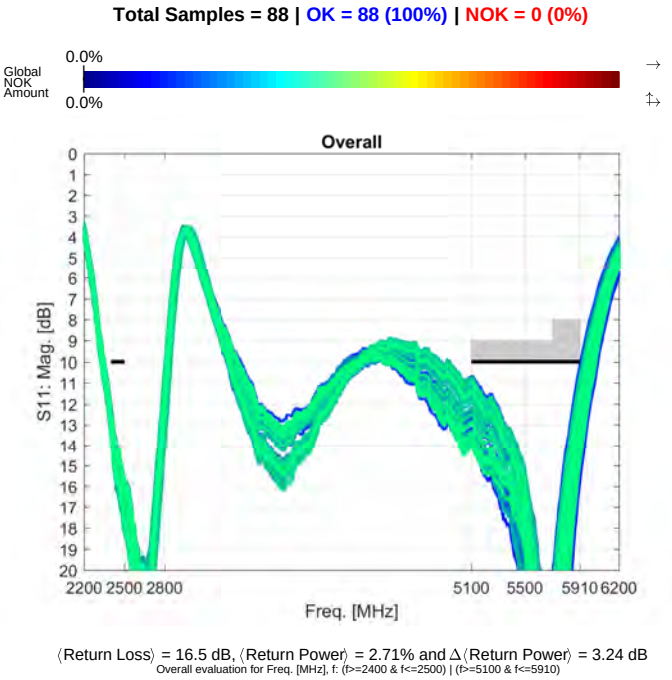
The Return Loss has been measured with the setup described according to the Calearo Test Method 'MP.315'. The characterization of about 90 C5 samples has been carried out with two different types of sma-fakra adapter:

Pomona SMB Model 72979



⟨Return Loss⟩ = 16.6 dB, ⟨Return Power⟩ = 2.64% and Δ⟨Return Power⟩ = 3.10 dB
Overall evaluation for Freq. [MHz], f: (f>=2400 & f<=2500) | (f>=5100 & f<=5910)

Rosenberger Fakra 03 K 159-S20 S3



⟨Return Loss⟩ = 16.5 dB, ⟨Return Power⟩ = 2.71% and Δ⟨Return Power⟩ = 3.24 dB
Overall evaluation for Freq. [MHz], f: (f>=2400 & f<=2500) | (f>=5100 & f<=5910)

Conclusion

The tested samples result 100 % OK: Return Loss ≥ 10 dB between 2400–2500 and 5100–5910 MHz.

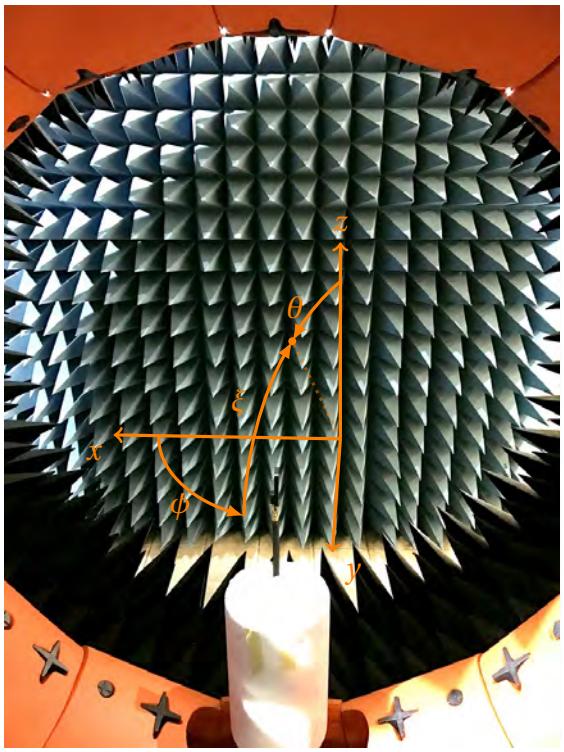
Further details can be found in I170824tone1 of 10th August, 2017 and I170721tone1 of 21st July, 2017.

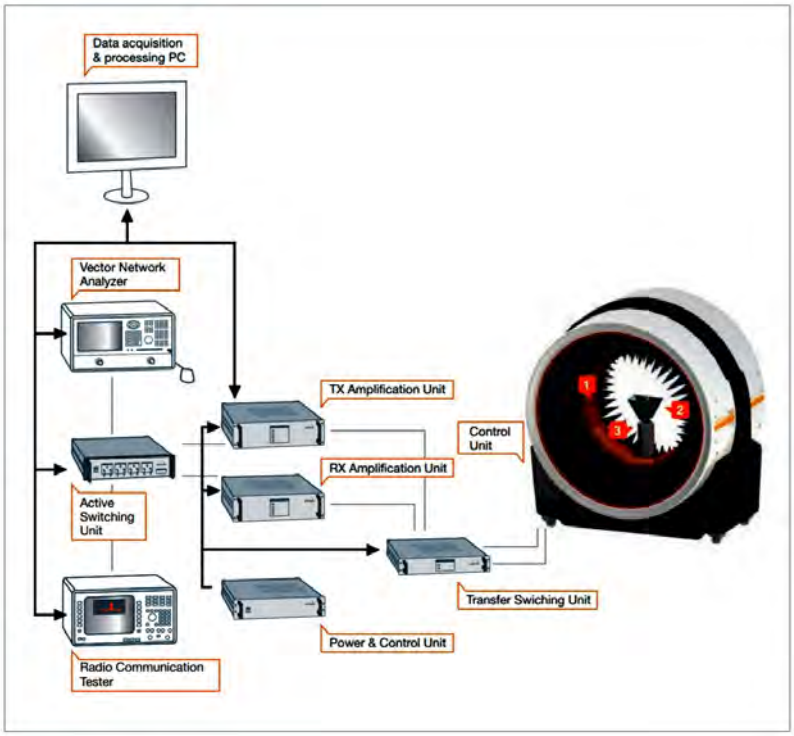
3 Radiation Pattern

3.1 Setup

The radiation pattern of the sample 'EB159' has been measured using the following setup:

StarLab / Microwave Vision Italy s.r.l. - 00040 Pomezia (RM)





Frequencies = 2350, 2360, 2370, 2380, 2390,2400, 2410, 2420, 2430, 2440, 2450, 2460,2470, 2480, 2490, 2500, 2510, 2520,2530, 2540, 2550, 4900, 5000,5100, 5200, 5300, 5400,5500, 5600, 5700,5800, 5900, 5910,6000 MHz.

⚠ A wideband (2200–6000 MHz) reference monocone 'SMC2200' on 1 mt diameter Ground Plane has been used as reference antenna, instead of many monopoles covering the whole bands. See also `http://www.mvg-world.com/system/files/datasheet_antenna_2016_hd_monocones.pdf`

More information, about this setup, could be found in '`I160419tone1` § 5.3.4' or `http://www.mvg-world.com/products/fieldproductfamily/antenna-measurement-2/starlab`.

3.2 Definitions

POLAR PATTERN

$G(\phi,\theta,f)$ is the measured (realized) gain magnitude of the A.U.T.
expressed in dBi (referred to the isotropic antenna).
The total gain is the sum of the
Vertical and Horizontal polarized component:
$10^{G_{\text{Total}}/10} = 10^{G_{\text{VPOL}}/10} + 10^{G_{\text{HPOL}}/10}$

LINEAR AVERAGE GAIN

$$\text{AVG}(f) = 20\log_{10} \underset{\forall\phi,\,\theta\in[\theta_1,\theta_2]}{\text{mean}} 10^{G/20}$$

Global MIN-MAX

$$\text{Min}(f) = 20\log_{10} \min_{\forall\theta,\phi} 10^{G/20}, \quad \text{Max}(f) = 20\log_{10} \max_{\forall\theta,\phi} 10^{G/20}$$

Globally:

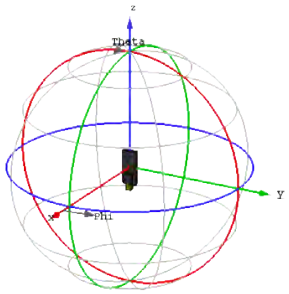
$$\text{Min} = \min_f \text{Min}(f), \quad \text{Max} = \max_f \text{Max}(f)$$

TOTAL EFFICIENCY

$$\epsilon = \frac{1}{4\pi}\int_0^{2\pi}\int_0^{\pi} 10^{G_{\text{Total}}(\theta,\phi)/10}\sin\theta\, d\theta\, d\phi$$

REFERENCE FRAME

(standalone)

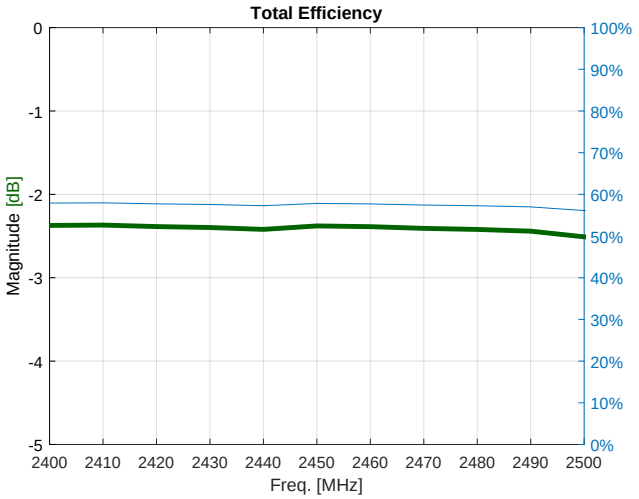


Elevation $\xi = 90^\circ - \theta$.

3.3 Results

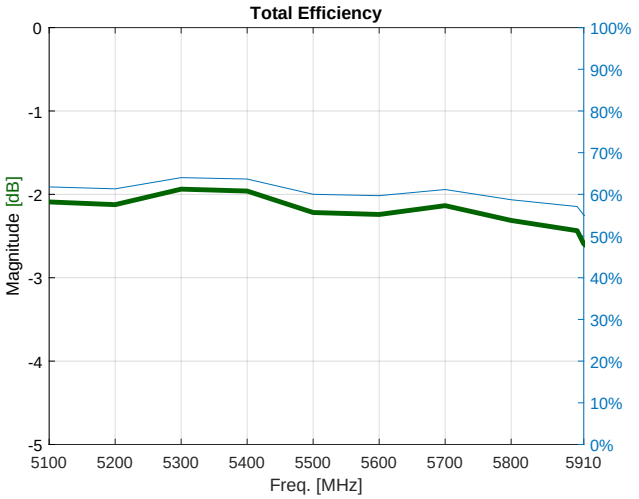
3.3.1 Total Efficiency

Lower Band



Freq. (MHz)	Total Efficiency (dB)	%
2400	−2.37	57.91
2410	−2.37	57.96
2420	−2.39	57.72
2430	−2.40	57.57
2440	−2.42	57.28
2450	−2.38	57.83
2460	−2.39	57.71
2470	−2.41	57.44
2480	−2.42	57.27
2490	−2.44	57.00
2500	−2.51	56.11
Statistics on the whole band:		
min	−2.51	56.11
mean	−2.41	57.44
max	−2.37	57.96
std	0.04	0.53

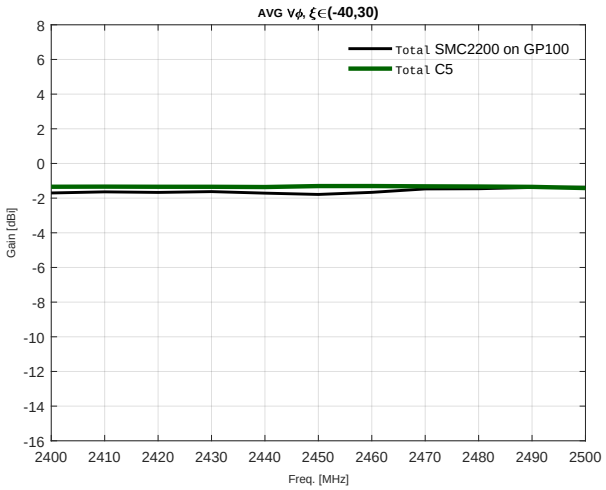
Upper Band



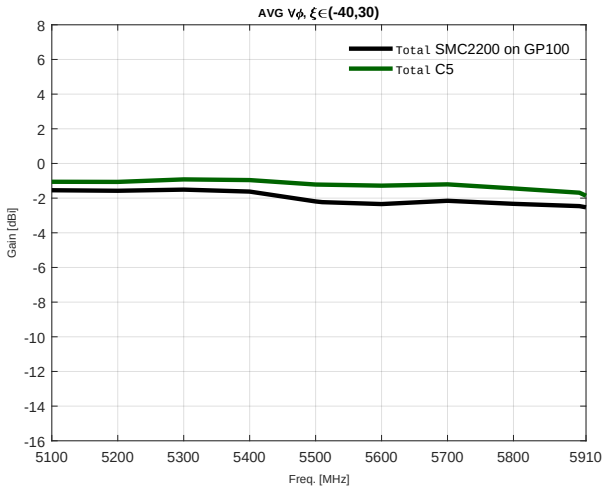
Freq. (MHz)	Total Efficiency (dB)	%
5100	−2.09	61.79
5200	−2.12	61.33
5300	−1.94	64.01
5400	−1.96	63.67
5500	−2.22	60.01
5600	−2.24	59.69
5700	−2.14	61.16
5800	−2.31	58.71
5900	−2.44	57.07
5910	−2.59	55.03
Statistics on the whole band:		
min	−2.59	55.03
mean	−2.20	60.25
max	−1.94	64.01
std	0.20	2.80

3.3.2 Linear Average Gain for $-40^\circ \leq \xi \leq 30^\circ$

Lower Band



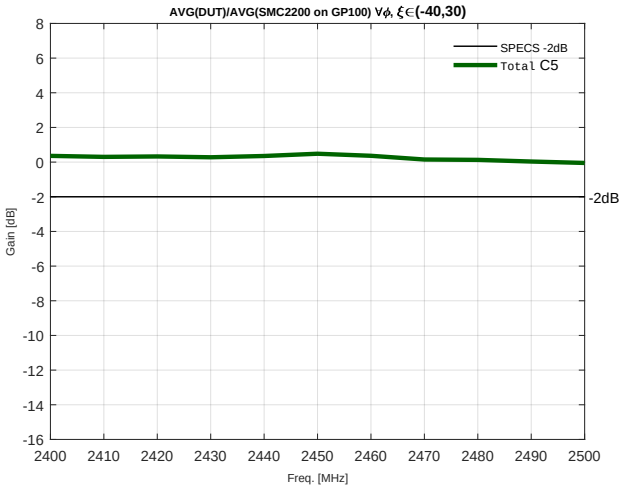
Upper Band

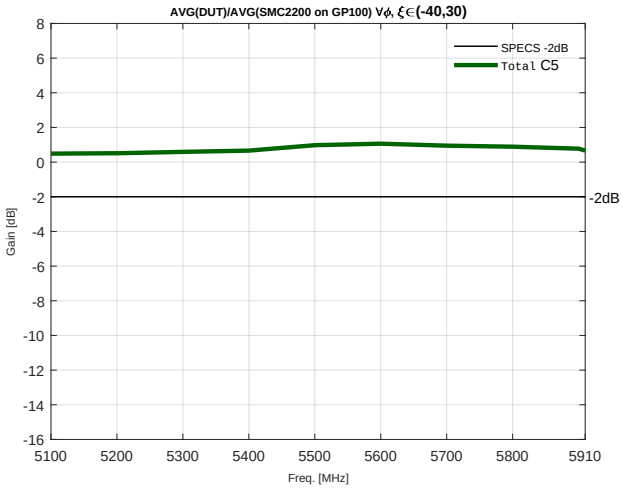


Freq. (MHz)	AVG (dBi)
2400	−1.36
2410	−1.36
2420	−1.37
2430	−1.37
2440	−1.38
2450	−1.33
2460	−1.33
2470	−1.35
2480	−1.36
2490	−1.38
2500	−1.45
Statistics on the whole band:	
min	−1.45
mean	−1.37
max	−1.33
std	0.03

Freq. (MHz)	AVG (dBi)
5100	−1.14
5200	−1.17
5300	−1.05
5400	−1.11
5500	−1.40
5600	−1.49
5700	−1.41
5800	−1.64
5900	−1.96
5910	−2.15
Statistics on the whole band:	
min	−2.15
mean	−1.45
max	−1.05
std	0.37

3.3.2.1 Comparison with Limits





Conclusion

As results from the comparison with the limits, the antenna radiation performances are compliant with specification limit of −2 dB from the reference monocone (ST.175): the minimum distance min Δ AVG = −0.05 dB > −2 dB as shown in the table below:

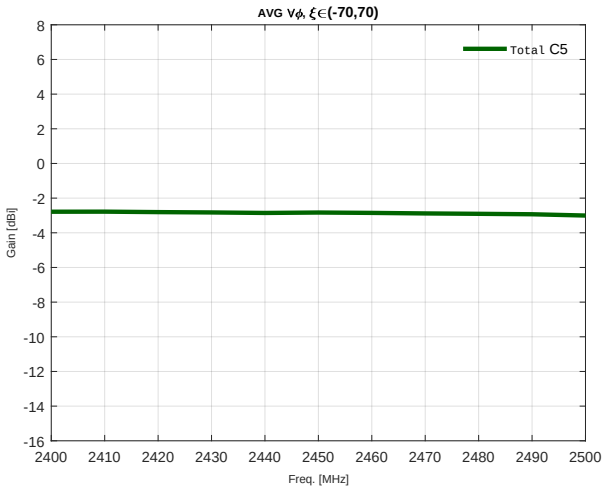
Freq. (MHz)	Δ AVG (dB)
2400	0.36
2410	0.30
2420	0.33
2430	0.28
2440	0.35
2450	0.48
2460	0.36
2470	0.15
2480	0.13
2490	0.03
2500	−0.05
Statistics on the whole band:	
min	−0.05
mean	0.25
max	0.48
std	0.16

Freq. (MHz)	Δ AVG (dB)
5100	0.49
5200	0.51
5300	0.59
5400	0.66
5500	0.98
5600	1.06
5700	0.95
5800	0.89
5900	0.77
5910	0.67
Statistics on the whole band:	
min	0.49
mean	0.76
max	1.06
std	0.20

In Sec. 3.3.3, the antenna mean performances on extended elevation (ξ) ranges will be represented, while the whole 3D polar pattern is shown for few frequencies in Sec. 3.4.

3.3.3 Linear Average Gain for $|\xi| \leq 70, 60, 50°$

Lower Band



Upper Band