Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Au(I)-Catalyzed Hydrogen Bond-Directed Tandem Strategy to Indeno-chromen-4-one and Indeno-quinolin-4-one Derivatives

Chongguo Jiang,[a,b] Zhiling Xiong,[a,b] Shengfei Jin,[a,b] Peng Gao,[a,b] Yingzhan Tang,[a,b] Yanshi Wang,[a,b] Chuan Du,[a,b] Xiaoyu Wang,[a,b] Yang Liu,[a] Bin Lin,[a,b] and Yongxiang Liu,[a,b] Maosheng Cheng*[a,b]*

[a] Key Laboratory of Structure-Based Drug Design and Discovery (Shenyang Pharmaceutical University), Ministry of Education Shenyang 110016, P. R. China

[b] Institute of Drug Research in Medicine Capital of China Benxi, 117000, P. R. China

Email: yongxiang.liu@syphu.edu.cn; mscheng@syphu.edu.cn.

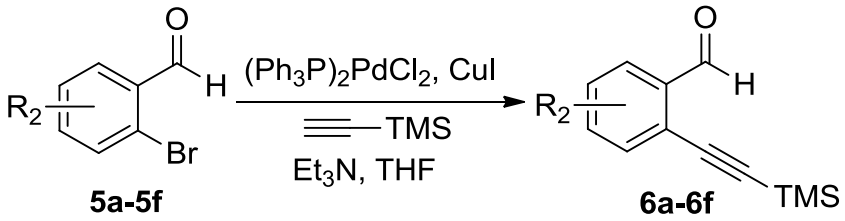
Contents

1. General Information

Unless otherwise noted, reagents were obtained commercially and used without further purification. Tetrahydrofuran (THF) was distilled from sodium under a nitrogen atmosphere. Dichloromethane (DCM) was distilled from calcium hydride under a nitrogen atmosphere. TLC analysis of reaction mixtures was performed on Dynamicadsorbents silica gel F-254 TLC plates. Flash chromatography was carried out on Zeoprep 60 (200-300 mesh) silica gel. ^{1}H and ^{13}C NMR spectra were recorded with Bruker Avance-III 600 spectrometers and referenced to $CDCl_3$ and DMSO-d_6. HR-ESI-MS was recorded on a Bruker micro-TOFQ-Q instrument. IR spectra were recorded on a Bruker IFS 55 spectrometer. Melting points (Mp) were tested on Thomas Hoover capillary melting point apparatus.

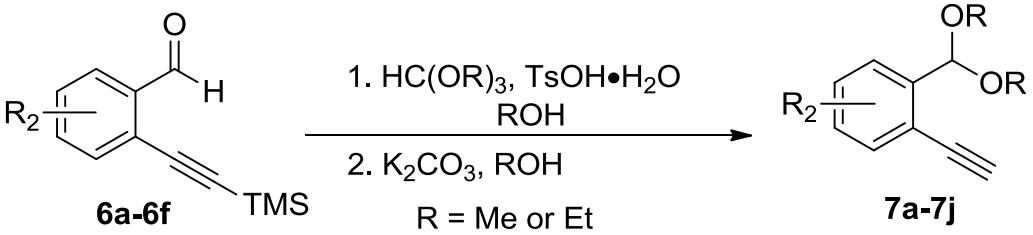
2. General Procedures for the Preparation of Substrates 1a-1y, 3a-3m and Characterization Data

2.1 General Procedures for the Preparation of 2-Alknyl Benzaldehydes 6a-6f



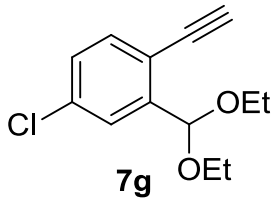
To a mixture of 2-bromobenzaldehyde **5a-5f** (10.0 mmol), $(Ph_3P)_2PdCl_2$ (0.2 mmol, 140 mg) and CuI (0.1 mmol, 19 mg) was added degassed THF (50 mL) under nitrogen atmosphere. Then ethynyl trimethylsilane (20.0 mmol, 2.8 mL) and Et_3N (20.0 mmol, 2.8 mL) were added by syringe under nitrogen atmosphere. The solution was stirred at 50 ℃ for 12 hours till the consumption of the starting material. The reaction mixture was filtrated through Celite after cooling to room temperature. The crude materials were purified by a flash column chromatography on silica gel to afford the products **6a-6f**.[S1, S2]

2.2 General Procedures for the Preparation of Acetals 7a-7j and Characterization Data



The substrates **6a-6f** (1 mmol) were dissolved in MeOH or EtOH (5 mL) before $HC(OMe)_3$ (2 mmol, 212 mg) or $HC(OEt)_3$ (2 mmol, 296 mg) and TsOH $\cdot H_2O$ (0.01 mmol, 2 mg) were added. The mixture was stirred at room temperature for 5 hours till TLC showed the consumption of the starting material. K_2CO_3 (5 mmol, 691 mg) was added to the solution and the resulting mixture was stirred at room temperature for 5 hours till TLC showed the starting materials were completely consumed. The reaction mixture was filtrated through Celite. The filtrate was concentrated and purified by a flash column chromatography on silica gel to afford the products **7a-7j**. [S1, S2]

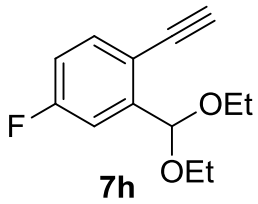
4-Chloro-2-(diethoxymethyl)-1-ethynylbenzene (7g)



7g

Yellow oil in 90% yield (EtOAc/petroleum ether = 1:100): ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.63 (d, *J* = 2.2 Hz, 1H), 7.40 (d, *J* = 8.2 Hz, 1H), 7.23 (dd, *J* = 8.2, 2.2 Hz, 1H), 5.75 (s, 1H), 3.66 (dq, *J* = 9.4, 7.1 Hz, 2H), 3.56 (dq, *J* = 9.4, 7.1 Hz, 2H), 3.34 (s, 1H), 1.23 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 143.21, 135.15, 134.11, 128.50, 126.78, 119.35, 99.67, 82.67, 80.33, 62.52, 15.22; IR (thin film, cm^{-1}) 3425, 3299, 2977, 2922, 2107, 1737, 1593, 1474, 1402, 1384, 1371, 1259, 1108, 1060, 897, 825, 655, 619, 561; HRMS (ESI): *m/z* Calcd. for $C_{13}H_{15}ClO_2Na$ $[M+Na]^+$ 261.0653, Found 261.0633.

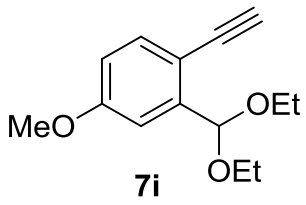
2-(Diethoxymethyl)-1-ethynyl-4-fluorobenzene (7h)



7h

Yellow oil in 89% yield (EtOAc/petroleum ether = 1:100): ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.46 (dd, *J* = 8.5, 5.5 Hz, 1H), 7.35 (dd, *J* = 9.5, 2.7 Hz, 1H), 6.95 (td, *J* = 8.3, 2.7 Hz, 1H), 5.76 (s, 1H), 3.67 (dq, *J* = 9.2, 7.1 Hz, 2H), 3.57 (dq, *J* = 9.3, 7.1 Hz, 2H), 3.27 (s, 1H), 1.23 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 162.87 (d, *J* = 249.0 Hz), 144.35 (d, *J* = 7.5 Hz), 134.83 (d, *J* = 9.0 Hz), 116.89 (d, *J* = 4.5 Hz), 115.55 (d, *J* = 22.5 Hz), 113.78 (d, *J* = 24.0 Hz), 99.70 (d, *J* = 1.5 Hz), 81.48 (d, *J* = 1.5 Hz), 80.38, 62.56, 15.20; IR (thin film, cm^{-1}) 3432, 3304, 2978, 2929, 2881, 2108, 1607, 1488, 1270, 1156, 1061, 893, 826, 704, 655, 618, 426; HRMS (ESI): *m/z* Calcd. for $C_{13}H_{15}FO_2Na$ $[M+Na]^+$ 245.0948, Found 245.0948.

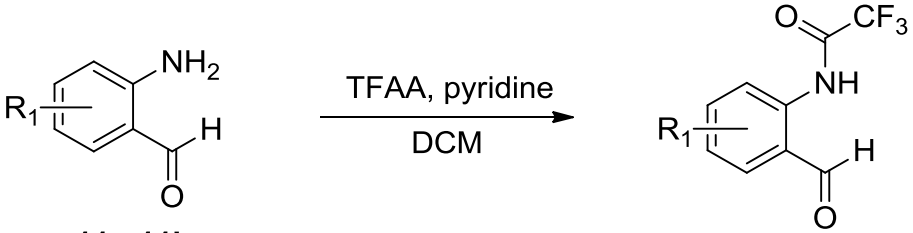
2-(Diethoxymethyl)-1-ethynyl-4-methoxybenzene (7i)



7i

Yellow oil in 90% yield (EtOAc/petroleum ether = 1:100); ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.5 Hz, 1H), 7.18 (d, *J* = 2.7 Hz, 1H), 6.80 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.78 (s, 1H), 3.82 (s, 3H), 3.70 (dq, *J* = 9.4, 7.1 Hz, 2H), 3.58 (dq, *J* = 9.4, 7.1 Hz, 2H), 3.22 (s, 1H), 1.24 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 160.21, 143.28, 134.35, 114.66, 113.07, 111.21, 100.39, 81.42, 80.27, 62.75, 55.47, 15.30; IR (thin film, cm^{-1}) 3432, 3284, 2976, 2929, 2103, 1609, 1493, 1465, 1372, 1296, 1236, 1165, 1061, 894, 824, 691, 648; HRMS (ESI): *m/z* Calcd. for $C_{14}H_{18}O_3Na$ $[M+Na]^+$ 257.1148, Found 257.1150.

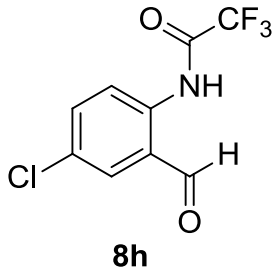
2.3 General Procedures for the Preparation of 8h-8i and Characterization Data



11a-11b **8h-8i**

To a solution of *o*-aminobenzaldehyde (1.0 mmol) in anhydrous CH_2Cl_2 (5 mL) was added TFAA (0.2 mL, 1.4 mmol), followed by dropwise addition of anhydrous pyridine (0.16 mL, 2 mmol) at 0 ℃. The reaction mixture was warmed to rt and stirred for 5 hours. 1 M HCl (5 mL) was added to the reaction mixture, the aqueous phase was extracted with CH_2Cl_2 (10 mL). The combined organic layer was washed with 1 M HCl (10 mL) and brine (10 mL), dried over anhydrous Na_2SO_4, filtered through Celite. The filtrate was concentrated and purified by a flash column chromatography on silica gel to afford the products **8h** and **8i**[S3].

N-(4-Chloro-2-formylphenyl)-2,2,2-trifluoroacetamide (8h)

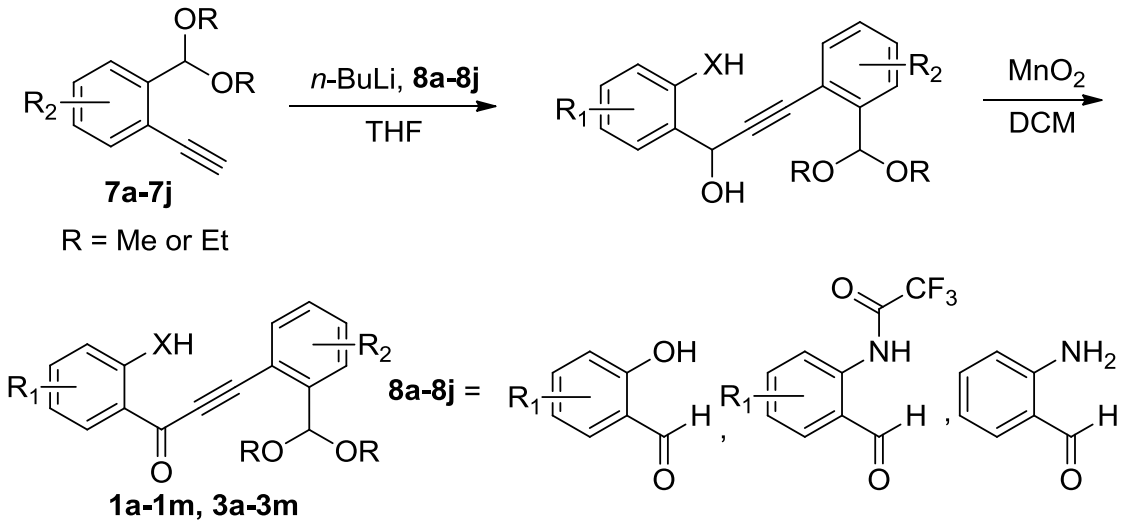


8h

White solid in 86% yield (EtOAc/petroleum ether = 1:20): Mp 63.5–64.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.05 (s, 1H), 9.92 (s, 1H), 8.66 (d, *J* = 8.9 Hz, 1H), 7.75 (d, *J* = 2.5 Hz, 1H), 7.66 (dd, *J* = 8.9, 2.5 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 194.51, 155.91 (q, *J* = 37.5 Hz), 136.72, 136.29, 135.40, 130.82, 123.74, 122.14, 115.55 (q, *J* = 286.5 Hz); IR (thin film, cm^{-1}) 3432, 2923, 2853, 1731, 1674, 1611, 1535, 1384, 1280, 1191, 1154, 913, 887, 729, 517; HRMS (ESI): *m/z* Calcd. for

$C_9H_6ClF_3NO_2$ $[M+H]^+$ 252.0034, Found 252.0033.

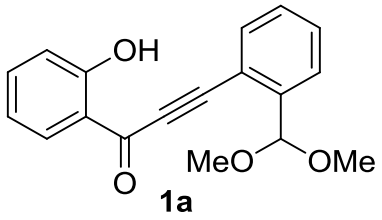
2.4 General Procedure for the Preparation of 1a-1m, 3a-3m and Characterization Data



To a stirring solution of **7a-7j** (2.1 mmol) in THF (11 mL) was added a solution of *n*-BuLi (1.0 M in THF, 2.1 mL) dropwise at –78 ℃ under nitrogen atmosphere. The reaction was stirred for 1 hour at –78 ℃ followed by the addition of **8a-8j** (1 mmol) dropwise. After stirring at –78 ℃ for 1 hour, the solution was warmed to 0 ℃ for another 1 hour. The reaction mixture was quenched by the addition of a saturated aqueous solution of NH_4Cl. The aqueous phase was extracted with ethyl acetate. The combined organic portions were washed with H_2O, saturated aqueous solution of NaCl, dried over anhydrous Na_2SO_4, filtered and reduced *in vacuo*.

To a solution of the residue obtained above in DCM (11 mL) was added activated MnO_2 (5.0 mmol, 434 mg). The mixture was stirred at room temperature overnight. The reaction mixture was filtrated through Celite. The filtrate was concentrated and purified by a flash column chromatography on silica gel to afford the products **1a-1m, 3a-3m**.

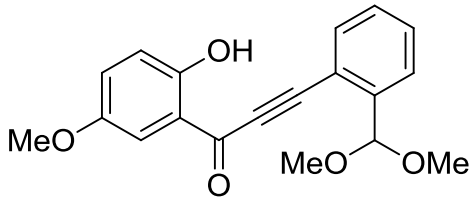
3-(2-(Dimethoxymethyl)phenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1a)



Yellow solid in 60% yield (EtOAc/petroleum ether = 1:80): Mp 32.1–34.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.74 (s, 1H), 8.25 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.74 – 7.68 (m, 2H), 7.56 – 7.50 (m, 2H), 7.41 (td, *J* = 7.6, 1.2 Hz, 1H), 7.00 (t, *J* = 7.7 Hz, 2H), 5.73 (s, 1H), 3.43 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.36, 162.92, 141.77, 137.28, 134.23, 133.37, 131.08, 128.84, 127.05, 121.11, 119.56, 118.64, 118.19, 102.05, 93.50, 90.01, 54.01; IR (thin film, cm^{-1}) 3427, 3064, 2930, 2830, 2202, 1622, 1481, 1448, 1356, 1339, 1308, 1251, 1203, 1153, 1112, 1085, 1049, 1012, 984, 759,

690, 628; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{16}O_4Na$ $[M+Na]^+$ 319.0941, Found 319.0937.

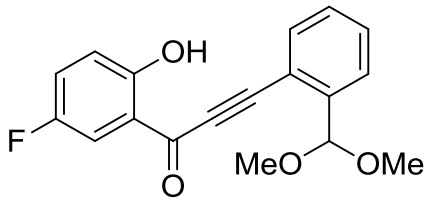
3-(2-(Dimethoxymethyl)phenyl)-1-(2-hydroxy-5-methoxyphenyl)prop-2-yn-1-one (1b)



1b

Yellow oil in 68% yield (EtOAc/petroleum ether = 1:80); ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.47 (s, 1H), 7.72 (dd, *J* = 9.9, 3.6 Hz, 2H), 7.70 (d, *J* = 3.1 Hz, 1H), 7.53 (td, *J* = 7.6, 1.1 Hz, 1H), 7.41 (td, *J* = 7.6, 1.2 Hz, 1H), 7.17 (dd, *J* = 9.1, 3.1 Hz, 1H), 6.95 (d, *J* = 9.1 Hz, 1H), 5.79 (s, 1H), 3.88 (s, 3H), 3.37 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.94, 157.74, 152.46, 141.54, 134.57, 131.06, 128.88, 127.21, 126.28, 120.53, 119.28, 118.62, 114.44, 101.36, 93.42, 90.17, 56.13, 53.34; IR (thin film, cm^{-1}) 3427, 2929, 2199, 1592, 1484, 1358, 1253, 1173, 1053, 984, 832, 772; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{18}O_5Na$ $[M+Na]^+$ 349.1046, Found 349.1036.

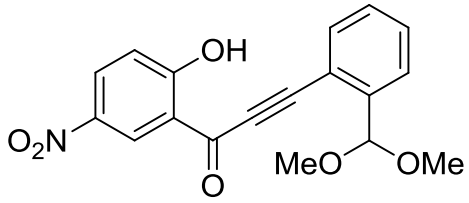
3-(2-(Dimethoxymethyl)phenyl)-1-(5-fluoro-2-hydroxyphenyl)prop-2-yn-1-one (1c)



1c

Yellow oil in 61% yield (EtOAc/petroleum ether = 1:80); ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.49 (s, 1H), 8.02 (dd, *J* = 8.7, 3.1 Hz, 1H), 7.73 (d, *J* = 7.6 Hz, 1H), 7.70 (d, *J* = 7.8 Hz, 1H), 7.54 (td, *J* = 7.7, 0.9 Hz, 1H), 7.42 (td, *J* = 7.6, 1.0 Hz, 1H), 7.29 – 7.25 (m, 1H), 6.97 (dd, *J* = 9.1, 4.3 Hz, 1H), 5.72 (s, 1H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.46 (d, *J* = 3.0 Hz), 159.08, 155.38 (d, *J* = 238.5 Hz), 141.91, 134.56, 131.28, 128.89, 127.32, 124.93 (d, *J* = 22.5 Hz), 120.78 (d, *J* = 6.0 Hz), 119.54 (d, *J* = 4.5 Hz), 118.22, 117.96 (d, *J* = 24.0 Hz), 101.93, 94.27, 89.72, 77.37, 77.16, 76.95, 53.72.; IR (thin film, cm^{-1}) 3439, 2925, 2200, 1602, 1482, 1349, 1249, 1199, 1164, 1085, 1049, 985, 830, 790, 775, 762, 734, 692, 637, 542; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}FO_4Na$ $[M+Na]^+$ 337.0847, Found 337.0853.

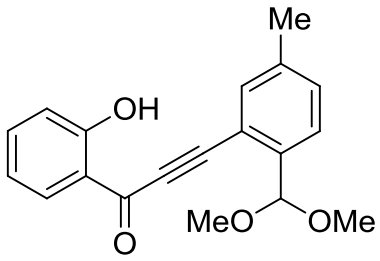
3-(2-(Dimethoxymethyl)phenyl)-1-(2-hydroxy-5-nitrophenyl)prop-2-yn-1-one (1d)



1d

Yellow solid in 69% yield (EtOAc/petroleum ether = 1:80): Mp 85.1-87.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.39 (s, 1H), 9.20 (d, *J* = 2.7 Hz, 1H), 8.39 (dd, *J* = 9.2, 2.7 Hz, 1H), 7.78 (d, *J* = 7.6 Hz, 1H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.57 (t, *J* = 7.5 Hz, 1H), 7.44 (t, *J* = 7.5 Hz, 1H), 7.12 (d, *J* = 9.2 Hz, 1H), 5.83 (s, 1H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.38, 167.29, 142.44, 140.39, 135.01, 131.78, 131.60, 129.63, 128.94, 127.47, 120.02, 119.43, 117.67, 101.30, 96.50, 89.30, 53.39; IR (thin film, cm^{-1}) 3437, 2938, 2197, 1627, 1608, 1475, 1359, 1344, 1329, 1179, 1052, 1012, 984, 910, 857, 800, 760, 636; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}NO_6Na$ $[M+Na]^+$ 364.0792, Found 364.0789.

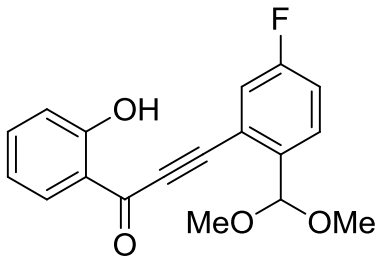
3-(2-(Dimethoxymethyl)-5-methylphenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1e)



1e

Yellow solid in 58% yield (EtOAc/petroleum ether = 1:80): Mp 71.8–73.5 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.75 (s, 1H), 8.24 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.57 (d, *J* = 8.0 Hz, 1H), 7.55 – 7.51 (m, 2H), 7.33 (d, *J* = 7.9 Hz, 1H), 7.00 (t, *J* = 7.7 Hz, 2H), 5.70 (s, 1H), 3.41 (s, 6H), 2.39 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.42, 162.93, 139.00, 138.87, 137.24, 134.65, 133.40, 132.04, 127.02, 121.16, 119.56, 118.44, 118.19, 102.08, 93.93, 89.73, 53.96, 21.05; IR (thin film, cm^{-1}) 3444, 2928, 2853, 2831, 2200, 1621, 1595, 1484, 1384, 1364, 1337, 1239, 1211, 1192, 1147, 1094, 1053, 1029, 821, 764, 739, 688; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{18}O_4Na$ $[M+Na]^+$ 333.1097, Found 333.1103.

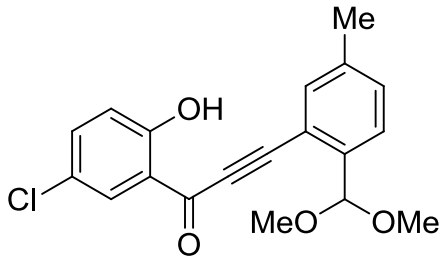
3-(2-(Dimethoxymethyl)-5-fluorophenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1f)



1f

Yellow solid in 54% yield (EtOAc/petroleum ether = 1:80): Mp 59.6-60.5 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.64 (s, 1H), 8.20 (d, *J* = 8.2 Hz, 1H), 7.68 (dd, *J* = 8.6, 5.7 Hz, 1H), 7.54 (t, *J* = 7.7 Hz, 1H), 7.39 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.22 (td, *J* = 8.4, 2.5 Hz, 1H), 7.05 – 6.96 (m, 2H), 5.69 (s, 1H), 3.41 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.01, 162.95, 162.11 (d, *J* = 247.5 Hz), 137.92 (d, *J* = 3.0 Hz), 137.50, 133.28, 129.18 (d, *J* = 7.5 Hz), 120.98, 120.58, 120.39 (d, *J* = 12.0 Hz), 119.65, 118.40 (d, *J* = 12.0 Hz), 118.24 (d, *J* = 4.5 Hz), 101.45, 91.44 (d, *J* = 3.0 Hz), 90.18, 53.92; IR (thin film, cm^{-1}) 3445, 2920, 2206, 1625, 1596, 1481, 1339, 1241, 1201, 1152, 1050, 877, 827, 733, 686, 631, 529; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}FO_4Na$ $[M+Na]^+$ 337.0847, Found 337.0856.

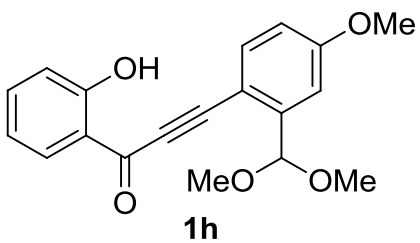
1-(5-Chloro-2-hydroxyphenyl)-3-(2-(dimethoxymethyl)-5-methylphenyl)prop-2-yn-1-one (1g)



1g

Yellow solid in 53% yield (EtOAc/petroleum ether = 1:80): Mp 129.4–130.7 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.68 (s, 1H), 8.32 (d, *J* = 2.6 Hz, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.54 (s, 1H), 7.47 (dd, *J* = 8.9, 2.6 Hz, 1H), 7.34 (d, *J* = 7.3 Hz, 1H), 6.96 (d, *J* = 8.9 Hz, 1H), 5.71 (s, 1H), 3.41 (s, 6H), 2.39 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.49, 161.34, 139.21, 138.93, 137.08, 135.01, 132.40, 132.26, 127.28, 124.42, 121.81, 119.83, 117.98, 101.71, 95.00, 89.44, 53.52, 21.04; IR (thin film, cm^{-1}) 3427, 2958, 2936, 2899, 2837, 2206, 1629, 1593, 1474, 1403, 1362, 1333, 1201, 1096, 1053, 1030, 981, 906, 842, 819, 783, 741, 646, 531; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{17}ClO_4Na$ $[M+Na]^+$ 367.0708, Found 367.0709.

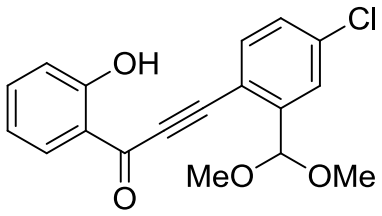
3-(2-(Dimethoxymethyl)-4-methoxyphenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1h)



1h

Yellow solid in 64% yield (EtOAc/petroleum ether = 1:80): Mp 71.1–73.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.82 (s, 1H), 8.23 (dd, *J* = 8.0, 1.4 Hz, 1H), 7.66 (d, *J* = 8.5 Hz, 1H), 7.54 – 7.50 (m, 1H), 7.23 (d, *J* = 2.6 Hz, 1H), 6.99 (t, *J* = 7.8 Hz, 2H), 6.92 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.71 (s, 1H), 3.89 (s, 3H), 3.44 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.45, 162.89, 162.17, 144.32, 137.05, 136.25, 133.30, 121.18, 119.48, 118.19, 115.09, 112.41, 110.43, 101.99, 94.81, 89.94, 55.77, 54.23; IR (thin film, cm^{-1}) 3060, 2985, 2941, 2838, 2580, 2183, 1590, 1560, 1481, 1447, 1429, 1358, 1337, 1301, 1277, 1235, 1196, 1050, 1007, 885, 811, 756, 612, 526; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{18}O_5Na$ $[M+Na]^+$ 349.1046, Found 349.1050.

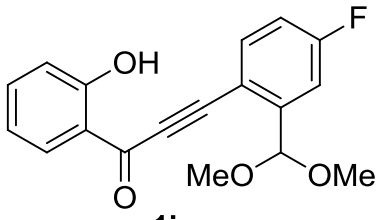
3-(4-Chloro-2-(dimethoxymethyl)phenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1i)



1i

Yellow solid in 56% yield (EtOAc/petroleum ether = 1:80): Mp 68.6–70.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.68 (s, 1H), 8.21 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.71 (d, *J* = 2.1 Hz, 1H), 7.64 (d, *J* = 8.2 Hz, 1H), 7.56 – 7.51 (m, 1H), 7.39 (dd, *J* = 8.2, 2.2 Hz, 1H), 7.04 – 6.96 (m, 2H), 5.69 (s, 1H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.16, 162.98, 143.58, 137.73, 137.45, 135.32, 133.31, 129.22, 127.77, 121.06, 119.64, 118.28, 117.08, 101.21, 92.17, 90.64, 53.95; IR (thin film, cm^{-1}) 3443, 2925, 2853, 2202, 1619, 1588, 1479, 1452, 1384, 1355, 1339, 1206, 1189, 1105, 1053, 1012, 880, 818, 800, 758; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}ClO_4$ $[M+H]^+$ 331.0732, Found 331.0732.

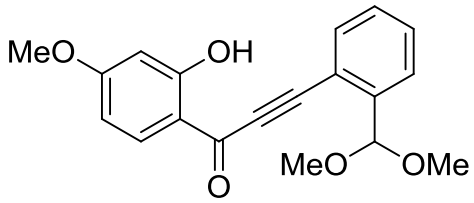
3-(2-(Dimethoxymethyl)-4-fluorophenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1j)



1j

Yellow solid in 65% yield (EtOAc/petroleum ether = 1:80): Mp 133.3–134.7 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.70 (s, 1H), 8.22 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.71 (dd, *J* = 8.5, 5.4 Hz, 1H), 7.55 – 7.51 (m, 1H), 7.43 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.10 (td, *J* = 8.2, 2.7 Hz, 1H), 7.02 – 6.96 (m, 2H), 5.71 (s, 1H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.22, 164.19 (d, *J* = 164.2 Hz), 162.93, 145.13 (d, *J* = 7.5 Hz), 137.34, 136.43 (d, *J* = 9.0 Hz), 133.27, 121.04, 119.58, 118.23, 116.31 (d, *J* = 22.5 Hz), 114.99 (d, *J* = 24.0 Hz), 114.64 (d, *J* = 3.0 Hz), 101.09 (d, *J* = 12.0 Hz), 92.44, 89.90 (d, *J* = 1.5 Hz), 53.91; IR (thin film, cm^{-1}) 3443, 2922, 2852, 2201, 1649, 1621, 1594, 1478, 1384, 1259, 1183, 1150, 1112, 1048, 1011, 875, 761, 726, 614, 527; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{12}FO_3$ $[M+H]^+$ 315.1027, Found 315.1036.

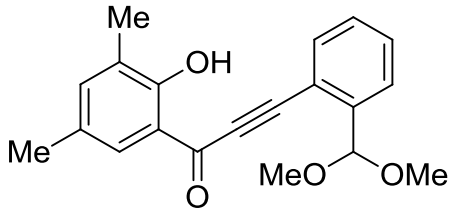
3-(2-(Dimethoxymethyl)phenyl)-1-(2-hydroxy-4-methoxyphenyl)prop-2-yn-1-one (1k)



1k

Yellow solid in 62% yield (EtOAc/petroleum ether = 1:80): Mp 75.8–77.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.22 (s, 1H), 8.12 (d, *J* = 8.9 Hz, 1H), 7.71 – 7.67 (m, 2H), 7.51 (t, *J* = 7.6 Hz, 1H), 7.40 (td, *J* = 7.6, 0.9 Hz, 1H), 6.53 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.44 (d, *J* = 2.4 Hz, 1H), 5.72 (s, 1H), 3.87 (s, 3H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.42, 167.18, 165.89, 141.59, 135.05, 134.07, 130.86, 128.83, 126.99, 118.96, 115.66, 108.65, 102.13, 100.70, 92.66, 90.01, 55.90, 54.09; IR (thin film, cm^{-1}) 3441, 2922, 2852, 2202, 1632, 1588, 1507, 1448, 1384, 1354, 1269, 1126, 1114, 1052, 763, 683, 611; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{18}O_5Na$ $[M+Na]^+$ 349.1046, Found 349.1038.

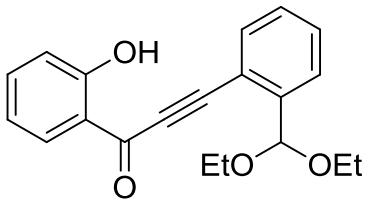
3-(2-(Dimethoxymethyl)phenyl)-1-(2-hydroxy-3,5-dimethylphenyl)prop-2-yn-1-one (1l)



1l

Yellow solid in 61% yield (EtOAc/petroleum ether = 1:80): Mp 59.3–61.3 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.85 (s, 1H), 7.93 (d, *J* = 0.7 Hz, 1H), 7.72 (dd, *J* = 2.5, 0.8 Hz, 1H), 7.70 (dd, *J* = 2.8, 0.8 Hz, 1H), 7.52 (td, *J* = 7.7, 1.1 Hz, 1H), 7.41 (td, *J* = 7.6, 1.2 Hz, 1H), 7.23 (d, *J* = 0.5 Hz, 1H), 5.79 (s, 1H), 3.41 (s, 6H), 2.33 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.46, 159.43, 141.65, 139.45, 134.25, 130.92, 130.56, 128.84, 128.11, 127.07, 126.95, 120.22, 118.90, 101.71, 92.86, 90.43, 53.68, 20.43, 15.39; IR (thin film, cm^{-1}) 3427, 2956, 2921, 2854, 2203, 1622, 1588, 1469, 1383, 1356, 1294, 1253, 1221, 1095, 1051, 976, 783, 752, 612; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{20}O_4Na$ $[M+Na]^+$ 347.1254, Found 347.1253.

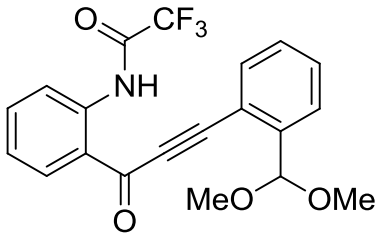
3-(2-(Diethoxymethyl)phenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1m)



1m

Yellow solid in 55% yield (EtOAc/petroleum ether = 1:80): Mp 59.3–61.5 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.74 (s, 1H), 8.28 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.77 – 7.67 (m, 2H), 7.56 – 7.50 (m, 2H), 7.39 (td, *J* = 7.6, 1.1 Hz, 1H), 7.03 – 6.96 (m, 2H), 5.84 (s, 1H), 3.72 (dq, *J* = 9.3, 7.1 Hz, 2H), 3.62 (dq, *J* = 9.3, 7.0 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.42, 162.92, 142.90, 137.30, 134.14, 133.51, 131.23, 128.69, 126.97, 121.14, 119.52, 118.59, 118.20, 100.31, 93.75, 89.98, 62.57, 15.34; IR (thin film, cm^{-1}) 3406, 3070, 3051, 2971, 2928, 2891, 2202, 1624, 1592, 1487, 1443, 1360, 1341, 1309, 1249, 1155, 1058, 1012, 799, 764, 748, 689, 630, 528; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{20}O_4Na$ $[M+Na]^+$ 347.1254, Found 347.1264.

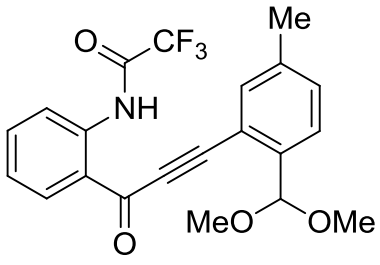
N-(2-(3-(2-(Dimethoxymethyl)phenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3a)



3a

Yellow solid in 52% yield (EtOAc/petroleum ether = 1:70): Mp 83.6–84.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.68 (s, 1H), 8.72 (dd, *J* = 8.4, 0.6 Hz, 1H), 8.62 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.71 (tdd, *J* = 6.3, 5.3, 1.3 Hz, 3H), 7.54 (td, *J* = 7.7, 1.2 Hz, 1H), 7.42 (td, *J* = 7.6, 1.2 Hz, 1H), 7.39 – 7.36 (m, 1H), 5.72 (s, 1H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.23, 155.88 (q, *J* = 37.5 Hz), 141.96, 139.25, 136.36, 135.21, 134.45, 131.35, 128.93, 127.27, 124.99, 123.39, 120.82, 118.34, 115.76 (d, *J* = 286.5 Hz), 101.93, 93.79, 90.90, 53.87; IR (thin film, cm^{-1}) 3440, 3120, 2919, 2850, 2198, 1741, 1616, 1597, 1530, 1451, 1322, 1273, 1198, 1155, 1116, 1056, 1013, 903, 758, 634, 511; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{16}F_3NO_4Na$ $[M+Na]^+$ 414.0924, Found 414.0920.

N-(2-(3-(2-(Dimethoxymethyl)-5-methylphenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3b)

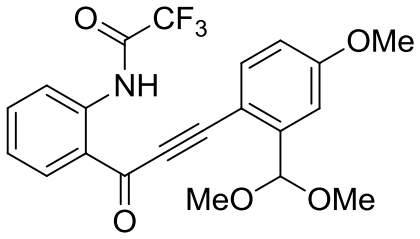


3b

Yellow solid in 56% yield (EtOAc/petroleum ether = 1:70): Mp 121.4–123.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.70 (s, 1H), 8.72 (d, *J* = 7.9 Hz, 1H), 8.61 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.73 – 7.68 (m, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.54 (s, 1H), 7.40 – 7.36 (m, 1H), 7.35 (d, *J* = 8.0 Hz, 1H), 5.69 (s, 1H), 3.40 (s, 6H), 2.40 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.25, 155.89 (q, *J* = 37.5 Hz), 139.25, 139.17, 138.97, 136.30, 135.21, 134.85, 132.28, 127.22, 124.99, 123.43, 120.82, 118.13, 115.77 (d, *J* = 286.5 Hz), 101.95, 94.21, 90.62, 53.80, 21.06; IR (thin film, cm^{-1}) 3434, 3113, 2920,

2851, 2197, 1739, 1618, 1599, 1534, 1453, 1324, 1278, 1239, 1192, 1157, 1117, 1093, 1054, HRMS (ESI): *m/z* Calcd. for $C_{21}H_{18}F_3NO_4Na$ $[M+Na]^+$ 428.1080, Found 428.1098.

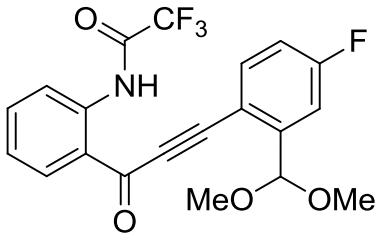
_N_-(2-(3-(2-(Dimethoxymethyl)-4-methoxyphenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3c)



3c

Yellow solid in 54% yield (EtOAc/petroleum ether = 1:70): Mp 116.4–117.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.76 (s, 1H), 8.70 (d, *J* = 7.9 Hz, 1H), 8.60 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.73 – 7.63 (m, 2H), 7.39 – 7.33 (m, 1H), 7.23 (d, *J* = 2.6 Hz, 1H), 6.92 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.70 (s, 1H), 3.89 (s, 3H), 3.43 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.16, 162.34, 155.78 (q, *J* = 37.5 Hz), 144.50, 139.13, 136.49, 136.01, 135.01, 124.89, 123.45, 120.71, 115.76 (d, *J* = 286.5 Hz), 114.98, 112.71, 109.97, 101.71, 95.21, 90.97, 55.73, 53.92; IR (thin film, cm^{-1}) 3429, 2920, 2850, 2192, 1729, 1592, 1534, 1452, 1384, 1279, 1236, 1168, 1118, 1062, 1012, 903, 872, 781, 760, 619, 531; HRMS (ESI): *m/z* Calcd. for $C_{21}H_{18}F_3NO_5Na$ $[M+Na]^+$ 444.1029, Found 444.1025.

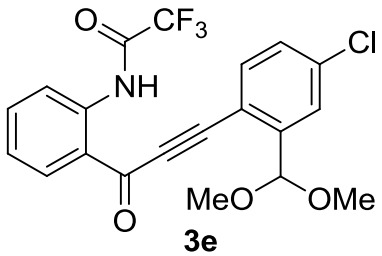
_N_-(2-(3-(2-(Dimethoxymethyl)-4-fluorophenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3d)



3d

Yellow solid in 57% yield (EtOAc/petroleum ether = 1:70): Mp 126.1–127.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.65 (s, 1H), 8.74 – 8.70 (m, 1H), 8.58 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.71 (td, *J* = 8.5, 3.4 Hz, 2H), 7.44 (dd, *J* = 9.4, 2.7 Hz, 1H), 7.39 – 7.35 (m, 1H), 7.12 (td, *J* = 8.2, 2.7 Hz, 1H), 5.70 (s, 1H), 3.41 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.10, 164.36 (d, *J* = 254.0 Hz), 155.89 (dd, *J* = 37.5 Hz, 75.2 Hz), 145.36 (d, *J* = 7.5 Hz), 139.28, 136.67 (d, *J* = 8.9 Hz), 136.42, 135.12, 124.99, 123.32, 120.87, 116.42 (d, *J* = 22.5 Hz), 115.75 (d, *J* = 288.0 Hz), 115.24 (d, *J* = 23.9 Hz), 114.36 (d, *J* = 3.5 Hz), 100.95 (d, *J* = 0.9 Hz), 92.74, 90.8 (d, *J* = 1.2 Hz), 53.77; IR (thin film, cm^{-1}) 3429, 2919, 2851, 2196, 1741, 1617, 1597, 1534, 1452, 1384, 1275, 1224, 1154, 1118, 1056, 1015, 882, 758, 618, 515; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{15}F_4NO_4Na$ $[M+Na]^+$ 432.0829, Found 432.0828.

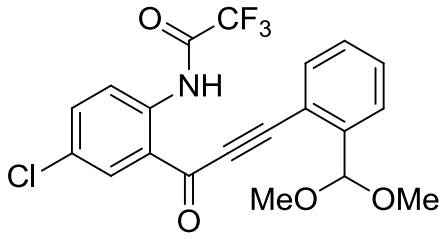
_N_-(2-(3-(4-Chloro-2-(dimethoxymethyl)phenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3e)



3e

Yellow solid in 59% yield (EtOAc/petroleum ether = 1:70): Mp 149.3– 150.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.62 (s, 1H), 8.74 – 8.70 (m, 1H), 8.57 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.74 – 7.69 (m, 2H), 7.65 (d, *J* = 8.2 Hz, 1H), 7.42 – 7.35 (m, 2H), 5.68 (s, 1H), 3.41 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.02, 155.89 (q, *J* = 37.5 Hz), 143.74, 139.28, 138.01, 136.49, 135.49, 135.14, 129.27, 127.95, 125.01, 123.29, 120.87, 116.75, 115.74 (d, *J* = 286.5 Hz), 101.04, 92.41, 91.49, 53.77; IR (thin film, cm^{-1}) 3430, 2920, 2851, 2204, 1734, 1630, 1597, 1525, 1465, 1323, 1280, 1191, 1158, 1132, 1117, 1055, 1018, 906, 761, 618, 516; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{15}ClF_3NO_4Na$ $[M+Na]^+$ 448.0534, Found 448.0527.

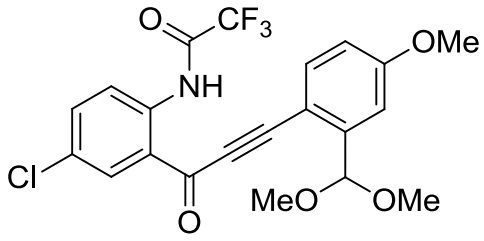
N-(4-Chloro-2-(3-(2-(dimethoxymethyl)phenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3f)



3f

Yellow solid in 53% yield (EtOAc/petroleum ether = 1:70): Mp 126.6–127.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.57 (s, 1H), 8.68 (dd, *J* = 5.7, 3.1 Hz, 2H), 7.72 (t, *J* = 6.9 Hz, 2H), 7.64 (dd, *J* = 9.0, 2.4 Hz, 1H), 7.57 – 7.53 (m, 1H), 7.45 – 7.40 (m, 1H), 5.73 (s, 1H), 3.41 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.14, 155.84 (q, *J* = 37.5 Hz), 142.15, 137.62, 136.00, 134.88, 134.60, 131.58, 130.51, 128.97, 127.52, 124.63, 122.21, 117.88, 115.66 (d, *J* = 288.0 Hz), 101.46, 94.76, 90.64, 53.34; IR (thin film, cm^{-1}) 3422, 2910, 2861, 1621, 1581, 1526, 1465, 1382, 1339, 1278, 1121, 881, 769, 620, 518; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{15}ClF_3NO_4Na$ $[M+Na]^+$ 448.0534, Found 448.0537.

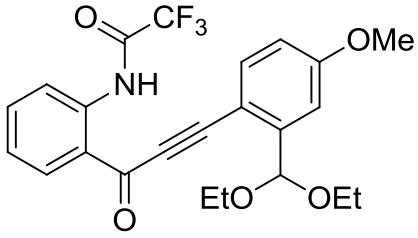
N-(4-Chloro-2-(3-(2-(dimethoxymethyl)-4-methoxyphenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3g)



3g

Yellow solid in 56% yield (EtOAc/petroleum ether = 1:70): Mp 152.9–153.8 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.67 (s, 1H), 8.68 (t, *J* = 5.3 Hz, 2H), 7.68 (d, *J* = 8.5 Hz, 1H), 7.63 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.25 (d, *J* = 2.6 Hz, 1H), 6.93 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.72 (s, 1H), 3.90 (s, 3H), 3.42 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.06, 162.56, 155.84 (q, *J* = 37.5 Hz), 144.75, 137.56, 136.99, 135.70, 134.46, 130.42, 124.77, 122.18, 115.69 (d, *J* = 288.0 Hz), 114.96, 113.12, 109.56, 101.22, 96.34, 90.88, 55.81, 53.44; IR (thin film, cm^{-1}) 3434, 3081, 2959, 2920, 2851, 2180, 1730, 1594, 1526, 1435, 1384, 1280, 1230, 1193, 1157, 1091, 1062, 1013, 989, 884, 848, 738, 617; HRMS (ESI): *m/z* Calcd. for $C_{21}H_{17}ClF_3NO_5Na$ $[M+Na]^+$ 478.0640, Found 478.0641.

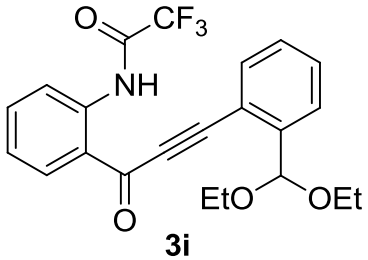
N-(2-(3-(2-(Diethoxymethyl)-4-methoxyphenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3h)



3h

Yellow solid in 58% yield (EtOAc/petroleum ether = 1:70): Mp 96.8–97.7 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.78 (s, 1H), 8.70 (d, *J* = 8.3 Hz, 1H), 8.64 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.71 – 7.67 (m, 1H), 7.65 (d, *J* = 8.5 Hz, 1H), 7.37 – 7.33 (m, 1H), 7.28 (d, *J* = 2.6 Hz, 1H), 6.91 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.80 (s, 1H), 3.89 (s, 3H), 3.76 – 3.68 (m, 2H), 3.67 – 3.59 (m, 2H), 1.26 (t, *J* = 7.0 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.21, 162.46, 155.85 (q, *J* = 37.5 Hz), 145.63, 139.16, 136.45, 136.05, 135.16, 124.85, 123.51, 120.76, 115.82 (d, *J* = 274.5 Hz), 114.80, 112.67, 110.00, 100.05, 95.41, 90.98, 62.54, 55.75, 15.35; IR (thin film, cm^{-1}) 3424, 3087, 2974, 2920, 2850, 2190, 1734, 1596, 1534, 1455, 1384, 1303, 1280, 1230, 1195, 1164, 1120, 1054, 1030, 1010, 890, 808, 761, 617; HRMS (ESI): *m/z* Calcd. for $C_{23}H_{22}F_3NO_5Na$ $[M+Na]^+$ 427.1342, Found 472.1346.

N-(2-(3-(2-(Diethoxymethyl)phenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3i)

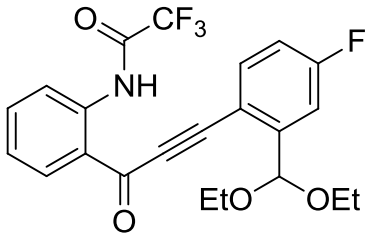


3i

Yellow solid in 56% yield (EtOAc/petroleum ether = 1:70): Mp 104.1–105.4 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.69 (s, 1H), 8.72 (d, *J* = 8.4 Hz, 1H), 8.67 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.73 – 7.68 (m, 2H), 7.54 (td, *J* = 7.7, 0.8 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.36 (t, *J* = 7.6 Hz, 1H), 5.83 (s, 1H), 3.75 – 3.66 (m, 2H), 3.65 – 3.57 (m, 2H), 1.25 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.26, 155.89 (q, *J* = 37.5 Hz), 143.05, 139.25, 136.34, 135.36, 134.38, 131.44, 128.75, 127.18, 124.93, 123.42, 120.81, 118.29, 115.77 (d, *J* = 286.5 Hz), 100.18, 94.00, 90.88, 62.33, 15.35; IR (thin film, cm^{-1}) 3435, 2920, 2851, 2199, 1736, 1623, 1597, 1534, 1453, 1384,

1278, 1160, 1120, 1056, 764, 619; HRMS (ESI): *m/z* Calcd. for $C_{22}H_{20}F_3NO_4Na$ $[M+Na]^+$ 442.1237, Found 442.1253.

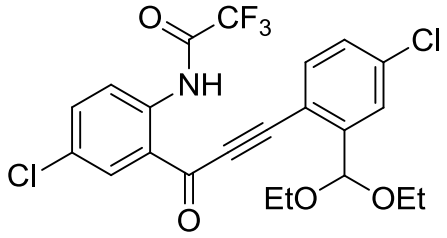
N-(2-(3-(2-(Diethoxymethyl)-4-fluorophenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3j)



3j

Yellow solid in 59% yield (EtOAc/petroleum ether = 1:70): Mp 141.7–143.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.66 (s, 1H), 8.71 (d, *J* = 8.4 Hz, 1H), 8.64 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.71 (dd, *J* = 8.4, 5.7 Hz, 2H), 7.48 (dd, *J* = 9.4, 2.6 Hz, 1H), 7.38 – 7.34 (m, 1H), 7.10 (td, *J* = 8.2, 2.7 Hz, 1H), 5.81 (s, 1H), 3.72 – 3.59 (m, 4H), 1.26 (t, *J* = 7.0 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.11, 164.5 (d, *J* = 255.0 Hz), 155.86 (dd, *J* = 37.5, 75.0 Hz), 146.45 (d, *J* = 7.5 Hz), 139.24, 136.60 (d, *J* = 7.5 Hz), 136.38, 135.25, 124.93, 123.33, 120.81, 116.22 (d, *J* = 22.5 Hz), 115.75 (d, *J* = 286.5 Hz), 115.07 (d, *J* = 24.0 Hz), 114.27 (d, *J* = 1.5 Hz), 99.26 (d, *J* = 0.75 Hz), 92.93, 90.78 (d, *J* = 1.2 Hz), 62.29, 15.30; IR (thin film, cm^{-1}) 3432, 3081, 2979, 2920, 2200, 1731, 1599, 1535, 1453, 1277, 1219, 1158, 1053, 1012, 892, 838, 761, 619; HRMS (ESI): *m/z* Calcd. for $C_{22}H_{19}F_4NO_4Na$ $[M+Na]^+$ 460.1142, Found 460.1141.

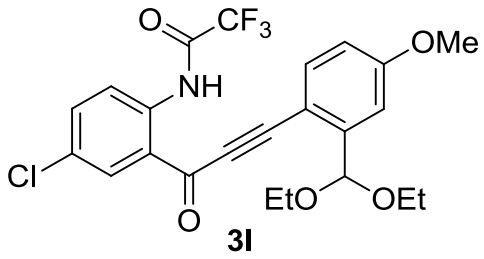
N-(4-Chloro-2-(3-(4-chloro-2-(diethoxymethyl)phenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3k)



3k

Yellow solid in 57% yield (EtOAc/petroleum ether = 1:70): Mp 102.7–104.4 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.55 (s, 1H), 8.69 (t, *J* = 5.6 Hz, 2H), 7.76 (d, *J* = 2.2 Hz, 1H), 7.66 (d, *J* = 2.5 Hz, 1H), 7.65 (d, *J* = 1.9 Hz, 1H), 7.40 (dd, *J* = 8.2, 2.2 Hz, 1H), 5.82 (s, 1H), 3.71 – 3.60 (m, 4H), 1.26 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 179.95, 155.85 (q, *J* = 37.5 Hz), 145.15, 138.44, 137.67, 136.15, 135.96, 134.45, 130.56, 129.15, 128.06, 124.53, 122.27, 116.26, 115.66 (d, *J* = 286.5 Hz), 98.94, 93.64, 91.28, 61.91, 15.30; IR (thin film, cm^{-1}) 3435, 3078, 2978, 2920, 2851, 2199, 1735, 1622, 1597, 1532, 1452, 1277, 1209, 1159, 1120, 1056, 1015, 904, 765, 731, 683, 633; HRMS (ESI): *m/z* Calcd. for $C_{22}H_{18}Cl_2F_3NO_4Na$ $[M+Na]^+$ 510.0457, Found 510.0462.

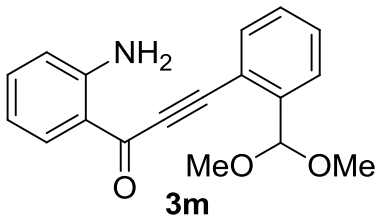
N-(4-Chloro-2-(3-(2-(diethoxymethyl)-4-methoxyphenyl)propioloyl)phenyl)-2,2,2-trifluoroacetamide (3l)



3l

Yellow solid in 52% yield (EtOAc/petroleum ether = 1:70): Mp 118.7–119.5 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.70 (s, 1H), 8.69 (dd, *J* = 7.5, 5.7 Hz, 2H), 7.68 (d, *J* = 8.5 Hz, 1H), 7.63 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.29 (d, *J* = 2.6 Hz, 1H), 6.92 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.83 (s, 1H), 3.90 (s, 3H), 3.75 – 3.61 (m, 4H), 1.25 (t, *J* = 7.1 Hz, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.04, 162.70, 155.83 (q, *J* = 37.5 Hz), 145.98, 137.57, 137.05, 135.71, 134.36, 130.43, 124.75, 122.20, 115.70 (d, *J* = 286.5 Hz), 114.71, 113.07, 109.53, 99.63, 96.68, 90.98, 62.14, 55.79, 15.34; IR (thin film, cm^{-1}) 3428, 2920, 2851, 2191, 1723, 1619, 1593, 1524, 1460, 1433, 1384, 1303, 1280, 1227, 1191, 1159, 1128, 1057, 618; HRMS (ESI): *m/z* Calcd. for $C_{23}H_{21}ClF_3NO_5Na$ $[M+Na]^+$ 506.0953, Found 506.0942.

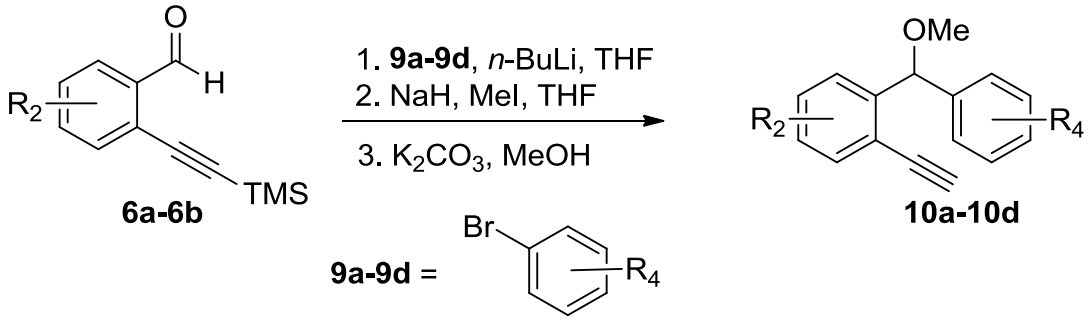
1-(2-Aminophenyl)-3-(2-(dimethoxymethyl)phenyl)prop-2-yn-1-one (3m)



3m

Yellow oil in 78% yield (EtOAc/petroleum ether = 1:10); ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.68 (dd, *J* = 3.2, 0.7 Hz, 1H), 7.67 (dd, *J* = 3.4, 0.8 Hz, 1H), 7.48 (td, *J* = 7.7, 1.1 Hz, 1H), 7.38 (td, *J* = 7.6, 1.2 Hz, 1H), 7.34 – 7.30 (m, 1H), 6.75 – 6.70 (m, 1H), 6.67 (d, *J* = 8.3 Hz, 1H), 6.39 (s, 2H), 5.74 (s, 1H), 3.43 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 179.51, 151.23, 141.37, 135.47, 134.75, 133.78, 130.40, 128.74, 126.70, 119.58, 119.15, 116.86, 116.27, 102.40, 91.53, 89.74, 54.34; IR (thin film, cm^{-1}) 3448, 3344, 2932, 2830, 2199, 1620, 1582, 1541, 1478, 1447, 1303, 1256, 1213, 1159, 1115, 1052, 1003, 750, 691, 626, 525; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{17}NO_3Na$ $[M+Na]^+$ 318.1101, Found 318.1096.

2.5 General Procedure for the Preparation of 10a-10d and Characterization Data



6a-6b **10a-10d**

9a-9d =

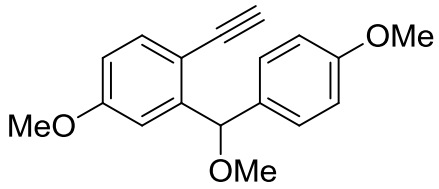
To a stirring solution of **9a**-**9d** (1 mmol) in THF (5 mL) was added a solution of *n*-BuLi

(1.0 M in THF, 1.0 mL) dropwise at –78 ℃ under nitrogen atmosphere. After stirring for 1 hour, the solution was added **6a-6b** (1.0 mmol) dropwise at –78 ℃. After stirring at –78 ℃ for another 1 hour, the solution was warmed to 0 ℃ for 1 hour. The reaction mixture was quenched by addition of a saturated aqueous solution of NH_4Cl. The aqueous phase was extracted with ethyl acetate. The combined organic portions were washed with H_2O, saturated aqueous solution of NaCl, dried over anhydrous Na_2SO_4, filtered and reduced *in vacuo*.

To a solution of the residue obtained above in THF (5 mL) was added NaH (60% dispersion in mineral oil, 1.2 mmol, 48 mg) at 0 ℃ and the resulting mixture was stirred for 1 hour at room temperature before MeI (2.0 mmol, 284 mg) was added. After TLC showed the starting material was completely consumed, the reaction mixture was filtrated through Celite and the filtrate was concentrated *in vacuo*.

The residue obtained above was resolved in MeOH (5 mL) and anhydrous K_2CO_3 (5 mmol, 691 mg) was added to the solution. Desilylation was conducted at room temperature for 5 hours till TLC showed the starting material was completely consumed. The reaction mixture was filtrated through Celite. The filtrate was concentrated and purified by a flash column chromatography on silica gel to afford the products **10a-10d**. [S4]

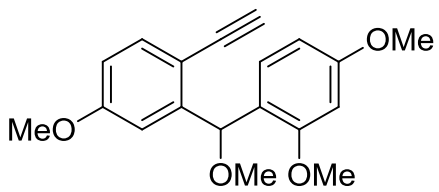
1-Ethynyl-4-methoxy-2-(methoxy(4-methoxyphenyl)methyl)benzene (10b)



10b

White solid in 48% yield (EtOAc/petroleum ether = 1:50): Mp 94.8–95.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.43 (d, *J* = 8.5 Hz, 1H), 7.36 (d, *J* = 8.5 Hz, 2H), 7.11 (d, *J* = 2.7 Hz, 1H), 6.86 (d, *J* = 8.8 Hz, 2H), 6.76 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.74 (s, 1H), 3.81 (s, 3H), 3.78 (s, 3H), 3.40 (s, 3H), 3.27 (s, 1H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 160.49, 159.04, 146.77, 134.42, 133.55, 128.33, 113.74, 113.27, 113.03, 111.23, 82.09, 81.98, 80.86, 57.09, 55.40, 55.27; IR (thin film, cm^{-1}) 3443, 3262, 2931, 2837, 2819, 2100, 2033, 1607, 1512, 1486, 1293, 1232, 1105, 1077, 1033, 969, 861, 832, 792, 680, 567, 541; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{19}O_3$ $[M+H]^+$ 283.1329, Found 283.1374.

2-((2,4-Dimethoxyphenyl)(methoxy)methyl)-1-ethynyl-4-methoxybenzene (10c)

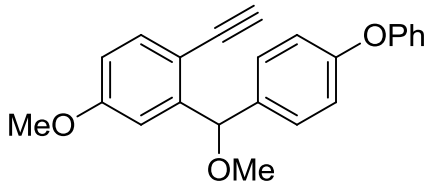


10c

Colorless oil in 40% yield (EtOAc/petroleum ether = 1:50); ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.41 (d,

J = 8.5 Hz, 1H), 7.15 (d, *J* = 8.2 Hz, 1H), 6.98 (d, *J* = 2.7 Hz, 1H), 6.74 (dd, *J* = 8.5, 2.7 Hz, 1H), 6.47 – 6.42 (m, 2H), 6.01 (s, 1H), 3.79 (s, 3H), 3.79 (s, 3H), 3.78 (s, 3H), 3.41 (s, 3H), 3.15 (s, 1H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 160.48, 160.15, 158.60, 146.38, 134.37, 128.58, 122.01, 113.93, 112.86, 112.60, 104.23, 98.61, 81.98, 80.03, 76.75, 57.51, 55.61, 55.45, 55.43; IR (thin film, cm^{-1}) 3436, 3281, 2999, 2932, 2836, 2101, 1609, 1504, 1464, 1296, 1208, 1158, 1117, 1081, 1036, 966, 826, 640, 617; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{20}O_4Na$ $[M+Na]^+$ 335.1254, Found 335.1254.

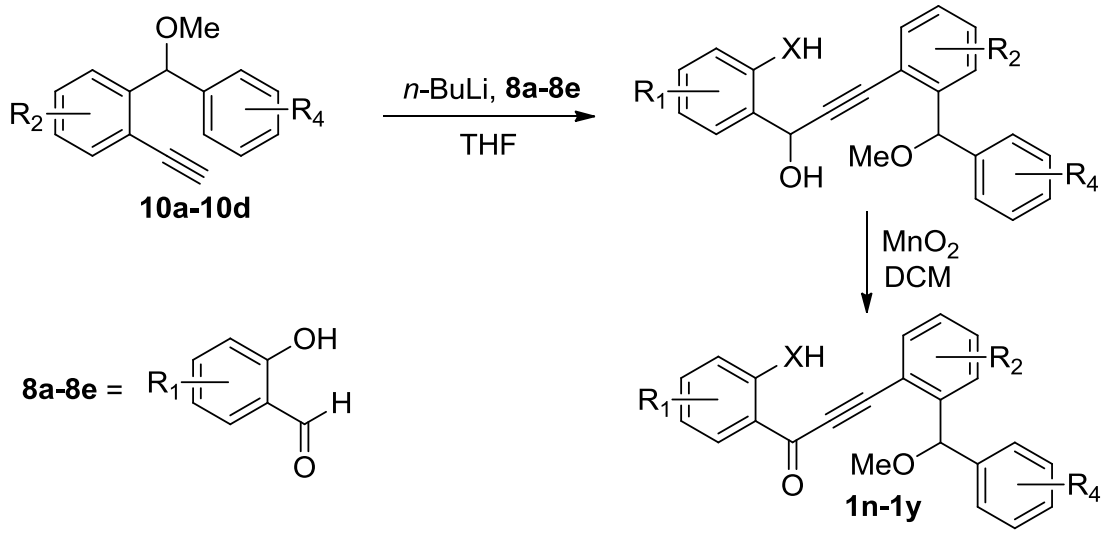
1-Ethynyl-4-methoxy-2-(methoxy(4-phenoxyphenyl)methyl)benzene (10d)



10d

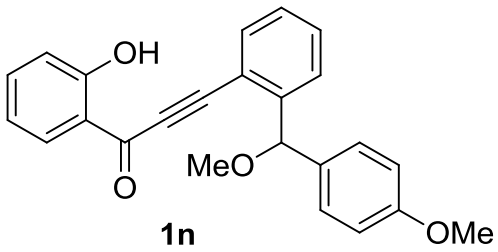
Colorless oil in 41% yield (EtOAc/petroleum ether = 1:50); ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.43 (d, *J* = 8.5 Hz, 1H), 7.38 (d, *J* = 8.7 Hz, 2H), 7.33 – 7.29 (m, 2H), 7.11 – 7.07 (m, 2H), 6.99 (d, *J* = 8.0 Hz, 2H), 6.94 (d, *J* = 8.6 Hz, 2H), 6.77 (dd, *J* = 8.5, 2.7 Hz, 1H), 5.77 (s, 1H), 3.82 (s, 3H), 3.41 (s, 3H), 3.26 (s, 1H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 160.60, 157.26, 156.72, 146.50, 136.34, 134.52, 129.83, 128.51, 123.38, 119.09, 118.68, 113.46, 113.19, 111.35, 82.09, 81.93, 80.96, 57.26, 55.51; IR (thin film, cm^{-1}) 3429, 3283, 2921, 2823, 2184, 2101, 1664, 1606, 1589, 1487, 1296, 1232, 1164, 1099, 1036, 871, 752, 692, 618, 531; HRMS (ESI): *m/z* Calcd. for $C_{23}H_{21}O_3$ $[M+H]^+$ 345.1485, Found 345.1490.

2.6 General Procedures for the Preparation of 1n-1y and Characterization Data



The experiment procedures for the preparation of **1n-1y** were the same with those of **3a-3m**.

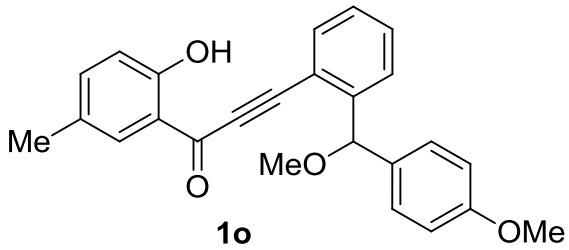
1-(2-Hydroxyphenyl)-3-(2-(methoxy(4-methoxyphenyl)methyl)phenyl)prop-2-yn-1-one (1n)



1n

Yellow solid in 54% yield (EtOAc/petroleum ether = 1:70): Mp 86.5–88.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.76 (s, 1H), 7.97 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.67 (d, *J* = 8.0 Hz, 2H), 7.56 – 7.50 (m, 2H), 7.36 – 7.31 (m, 3H), 7.01 (d, *J* = 8.4 Hz, 1H), 6.93 (t, *J* = 7.5 Hz, 1H), 6.85 (d, *J* = 8.7 Hz, 2H), 5.75 (s, 1H), 3.77 (s, 3H), 3.42 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.22, 162.96, 159.34, 146.44, 137.30, 134.01, 133.15, 132.81, 131.69, 128.83, 127.64, 126.67, 120.92, 119.53, 118.47, 118.27, 114.00, 94.24, 90.50, 82.56, 57.30, 55.36; IR (thin film, cm^{-1}) 3424, 2922, 2850, 2186, 1623, 1589, 1511, 1479, 1347, 1303, 1232, 1174, 1152, 1101, 1083, 1035, 1013, 842, 800, 760, 620; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{20}O_4Na$ $[M+Na]^+$ 395.1254, Found 395.1257.

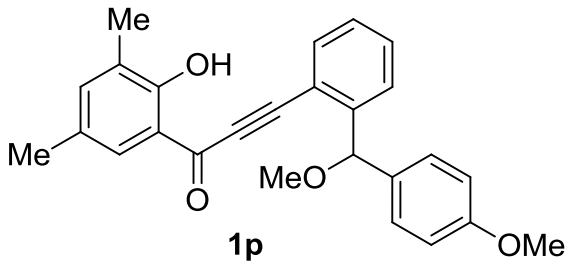
1-(2-Hydroxy-5-methylphenyl)-3-(2-(methoxy(4-methoxyphenyl)methyl)phenyl) prop-2-yn-1-one (1o)



1o

Yellow solid in 50% yield (EtOAc/petroleum ether = 1:70): Mp 70.6–71.7 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.60 (s, 1H), 7.82 (d, *J* = 1.5 Hz, 1H), 7.67 (dd, *J* = 7.7, 1.2 Hz, 2H), 7.56 – 7.50 (m, 1H), 7.37 – 7.33 (m, 4H), 6.92 (d, *J* = 8.5 Hz, 1H), 6.87 – 6.81 (m, 2H), 5.77 (s, 1H), 3.76 (s, 3H), 3.42 (s, 3H), 2.29 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.13, 161.00, 159.30, 146.53, 138.50, 133.90, 133.86, 132.88, 132.63, 131.64, 128.76, 128.65, 127.64, 126.64, 120.57, 118.55, 118.09, 114.00, 94.06, 90.55, 82.51, 57.24, 55.34, 20.56; IR (thin film, cm^{-1}) 3432, 2921, 2851, 2195, 1631, 1600, 1481, 1464, 1447, 1384, 1344, 1247, 1172, 1036, 1020, 780, 621, 535; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{22}O_4Na$ $[M+Na]^+$ 409.1410, Found 409.1417.

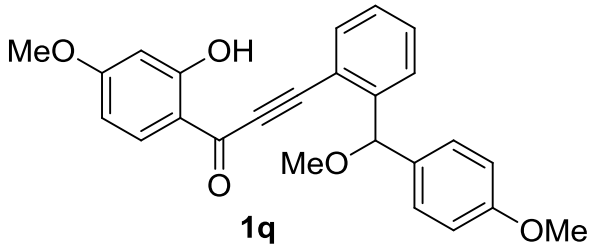
1-(2-Hydroxy-3,5-dimethylphenyl)-3-(2-(methoxy(4-methoxyphenyl)methyl) phenyl)prop-2-yn-1-one (1p)



1p

Yellow solid in 59% yield (EtOAc/petroleum ether = 1:70): Mp 115.5–117.3 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.89 (s, 1H), 7.69 – 7.64 (m, 3H), 7.52 (td, *J* = 7.8, 1.1 Hz, 1H), 7.37 – 7.30 (m, 3H), 7.23 (d, *J* = 0.6 Hz, 1H), 6.86 – 6.82 (m, 2H), 5.78 (s, 1H), 3.76 (s, 3H), 3.42 (s, 3H), 2.27 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.27, 159.52, 159.28, 146.50, 139.49, 133.86, 132.93, 131.55, 130.17, 128.64, 128.01, 127.61, 127.13, 126.58, 119.96, 118.67, 113.99, 93.76, 90.78, 82.49, 57.24, 55.34, 20.56, 15.40; IR (thin film, cm^{-1}) 3427, 2921, 2851, 2193, 1604, 1574, 1464, 1433, 1383, 1357, 1303, 1271, 1244, 1221, 1174, 1082, 836, 790, 619, 591, 564; HRMS (ESI): *m/z* Calcd. for $C_{26}H_{25}O_4$ $[M+H]^+$ 401.1747, Found 401.1749.

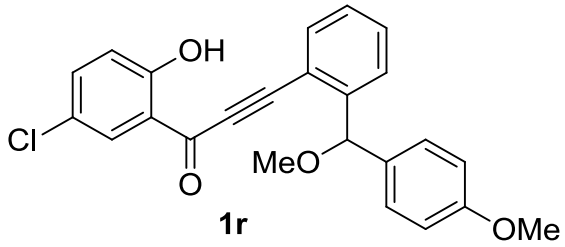
1-(2-Hydroxy-4-methoxyphenyl)-3-(2-(methoxy(4-methoxyphenyl)methyl) phenyl)prop-2-yn-1-one (1q)



1q

Yellow solid in 58% yield (EtOAc/petroleum ether = 1:70): Mp 79.4–81.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.23 (d, *J* = 1.4 Hz, 1H), 7.82 (d, *J* = 8.7 Hz, 1H), 7.65 (t, *J* = 7.2 Hz, 2H), 7.51 (t, *J* = 7.7 Hz, 1H), 7.36 – 7.29 (m, 3H), 6.85 (d, *J* = 8.7 Hz, 2H), 6.47 – 6.43 (m, 2H), 5.74 (s, 1H), 3.87 (s, 3H), 3.77 (s, 3H), 3.41 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.27, 167.15, 165.90, 159.33, 146.33, 146.18, 134.82, 133.85, 132.90, 131.42, 128.83, 127.60, 126.60, 118.77, 115.44, 113.99, 108.62, 100.74, 93.38, 90.46, 82.55, 57.32, 55.89, 55.37; IR (thin film, cm^{-1}) 3426, 2920, 2851, 2202, 1631, 1584, 1510, 1462, 1359, 1269, 1230, 1123, 1082, 1032, 1011, 958, 801, 760, 620, 582, 553, 523; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{22}O_5Na$ $[M+Na]^+$ 425.1359, Found 425.1367.

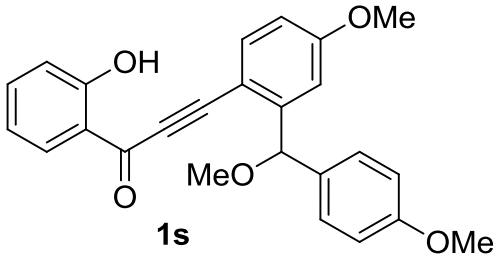
1-(5-Chloro-2-hydroxyphenyl)-3-(2-(methoxy(4-methoxyphenyl)methyl)phenyl) prop-2-yn-1-one (1r)



1r

Yellow solid in 55% yield (EtOAc/petroleum ether = 1:70): Mp 123.3–125.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.68 (s, 1H), 8.04 (d, *J* = 2.6 Hz, 1H), 7.70 – 7.65 (m, 2H), 7.57 – 7.53 (m, 1H), 7.47 (dd, *J* = 8.9, 2.6 Hz, 1H), 7.37 – 7.31 (m, 3H), 6.98 (d, *J* = 8.9 Hz, 1H), 6.87 – 6.82 (m, 2H), 5.72 (s, 1H), 3.76 (s, 3H), 3.43 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.16, 161.43, 159.36, 146.74, 137.15, 134.27, 132.66, 131.96, 131.91, 128.74, 127.72, 126.81, 124.26, 121.44, 120.03, 118.01, 114.02, 95.37, 90.07, 82.68, 57.28, 55.34; IR (thin film, cm^{-1}) 3422, 2946, 2931, 2824, 1993, 1632, 1578, 1463, 1379, 1347, 1292, 1211, 1090, 1053, 968, 778, 732, 611; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{20}ClO_4$ $[M+H]^+$ 407.1045, Found 407.1038.

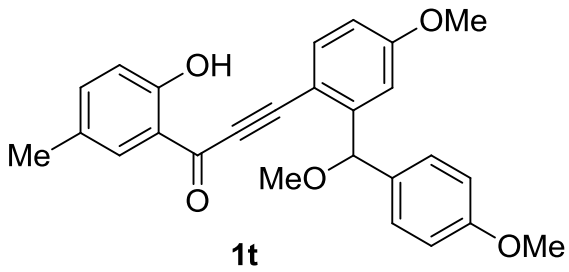
1-(2-Hydroxyphenyl)-3-(4-methoxy-2-(methoxy(4-methoxyphenyl)methyl)phenyl) prop-2-yn-1-one (1s)



1s

Yellow solid in 53% yield (EtOAc/petroleum ether = 1:70): Mp 91.3–92.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.85 (s, 1H), 7.97 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.61 (d, *J* = 8.5 Hz, 1H), 7.53 – 7.49 (m, 1H), 7.37 – 7.33 (m, 2H), 7.22 (d, *J* = 2.6 Hz, 1H), 7.00 (dd, *J* = 8.3, 0.5 Hz, 1H), 6.94 – 6.89 (m, 1H), 6.85 (dt, *J* = 4.8, 2.2 Hz, 3H), 5.73 (s, 1H), 3.88 (s, 3H), 3.77 (s, 3H), 3.42 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.29, 162.90, 162.65, 159.38, 149.07, 137.03, 136.12, 133.04, 132.71, 128.82, 120.97, 119.43, 118.24, 114.00, 113.78, 111.97, 110.26, 95.57, 90.52, 82.46, 57.33, 55.72, 55.38; IR (thin film, cm^{-1}) 3425, 2922, 2851, 2187, 1623, 1590, 1511, 1479, 1384, 1346, 1303, 1250, 1232, 1174, 1152, 1101, 1083, 1035, 1012, 843, 799, 759, 620; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{22}O_5Na$ $[M+Na]^+$ 425.1359, Found 425.1359.

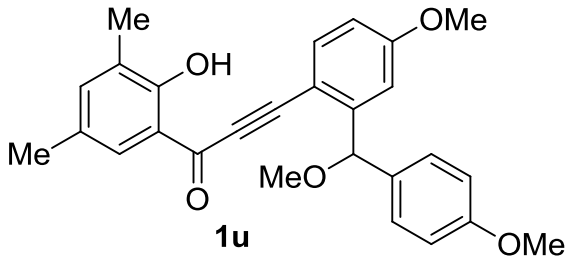
1-(2-Hydroxy-5-methylphenyl)-3-(4-methoxy-2-(methoxy(4-methoxyphenyl) methyl)phenyl)prop-2-yn-1-one (1t)



1t

Yellow solid in 58% yield (EtOAc/petroleum ether = 1:70): Mp 95.3–97.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.69 (s, 1H), 7.82 (d, *J* = 1.0 Hz, 1H), 7.61 (d, *J* = 8.5 Hz, 1H), 7.36 (d, *J* = 8.7 Hz, 2H), 7.32 (dd, *J* = 8.5, 1.9 Hz, 1H), 7.21 (d, *J* = 2.5 Hz, 1H), 6.91 (d, *J* = 8.5 Hz, 1H), 6.87 – 6.82 (m, 3H), 5.76 (s, 1H), 3.88 (s, 3H), 3.76 (s, 3H), 3.43 (s, 3H), 2.29 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.19, 162.59, 160.91, 159.32, 149.16, 138.20, 136.00, 132.78, 132.55, 128.61, 120.60, 118.04, 114.00, 113.82, 111.89, 110.34, 95.37, 90.53, 82.41, 57.25, 55.70, 55.35, 20.58; IR (thin film, cm^{-1}) 3426, 2920, 2851, 2186, 1627, 1608, 1511, 1461, 1384, 1348, 1300, 1246, 1173, 1108, 1035, 836, 800, 780, 620, 537; HRMS (ESI): *m/z* Calcd. for $C_{26}H_{24}O_5Na$ $[M+Na]^+$ 439.1516, Found 439.1517.

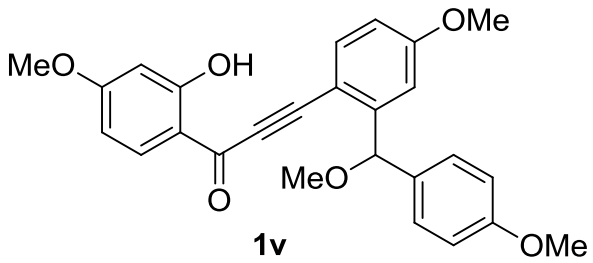
1-(2-Hydroxy-3,5-dimethylphenyl)-3-(4-methoxy-2-(methoxy(4-methoxyphenyl) methyl)phenyl) prop-2-yn-1-one (1u)



1u

Yellow solid in 57% yield (EtOAc/petroleum ether = 1:70): Mp 115.6–117.4 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.98 (s, 1H), 7.68 (s, 1H), 7.61 (d, *J* = 8.5 Hz, 1H), 7.36 (d, *J* = 8.7 Hz, 2H), 7.20 (d, *J* = 2.7 Hz, 2H), 6.86 – 6.82 (m, 3H), 5.76 (s, 1H), 3.87 (s, 3H), 3.76 (s, 3H), 3.42 (s, 3H), 2.26 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.35, 162.52, 159.43, 159.31, 149.10, 139.20, 135.95, 132.83, 130.10, 128.60, 127.87, 127.06, 119.99, 114.00, 113.81, 111.83, 110.47, 95.04, 90.73, 82.39, 57.25, 55.69, 55.35, 20.58, 15.41; IR (thin film, cm^{-1}) 3427, 2920, 2851, 2193, 1604, 1574, 1510, 1487, 1464, 1432, 1383, 1357, 1303, 1271, 1245, 1221, 1174, 1082, 1035, 836, 789, 591, 564; HRMS (ESI): *m/z* Calcd. for $C_{27}H_{26}O_5Na$ $[M+Na]^+$ 453.1672, Found 453.1671.

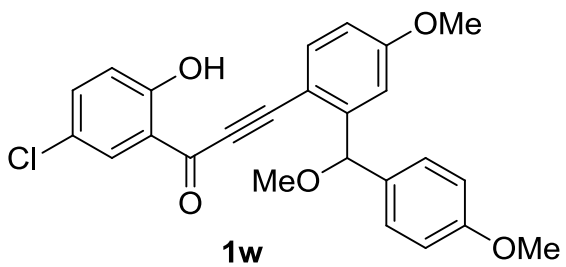
1-(2-Hydroxy-4-methoxyphenyl)-3-(4-methoxy-2-(methoxy(4-methoxyphenyl) methyl)phenyl) prop-2-yn-1-one (1v)



1v

Yellow solid in 55% yield (EtOAc/petroleum ether = 1:70): Mp 92.6–94.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.32 (s, 1H), 7.83 (d, *J* = 8.8 Hz, 1H), 7.59 (d, *J* = 8.5 Hz, 1H), 7.35 (d, *J* = 8.7 Hz, 2H), 7.20 (d, *J* = 2.6 Hz, 1H), 6.85 (dq, *J* = 8.1, 2.7 Hz, 3H), 6.44 (dt, *J* = 5.7, 2.4 Hz, 2H), 5.72 (s, 1H), 3.87 (s, 3H), 3.86 (s, 3H), 3.77 (s, 3H), 3.42 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 180.41, 166.91, 165.77, 162.39, 159.34, 148.71, 135.87, 134.68, 132.77, 128.79, 115.42, 113.97, 113.69, 111.89, 110.54, 108.45, 100.71, 94.57, 90.28, 82.44, 57.31, 55.84, 55.67, 55.36; IR (thin film, cm^{-1}) 3425, 2921, 2850, 2194, 1605, 1584, 1510, 1361, 1280, 1232, 1111, 1085, 1036, 1012, 845, 829, 813, 620, 528; HRMS (ESI): *m/z* Calcd. for $C_{26}H_{24}O_6Na$ $[M+Na]^+$ 455.1465, Found 455.1468.

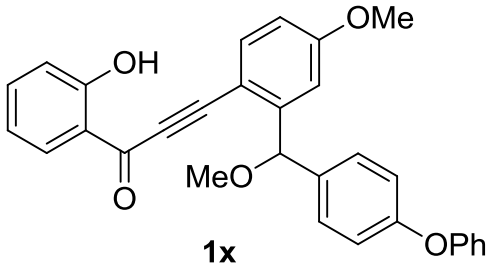
1-(5-Chloro-2-hydroxyphenyl)-3-(4-methoxy-2-(methoxy(4-methoxyphenyl) methyl)phenyl)prop-2-yn-1-one (1w)



1w

Yellow solid in 57% yield (EtOAc/petroleum ether = 1:70): Mp 124.4–125.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.78 (s, 1H), 8.03 (d, *J* = 2.6 Hz, 1H), 7.63 (d, *J* = 8.5 Hz, 1H), 7.45 (dd, *J* = 8.9, 2.6 Hz, 1H), 7.37 – 7.33 (m, 2H), 7.23 (d, *J* = 2.6 Hz, 1H), 6.96 (d, *J* = 8.9 Hz, 1H), 6.88 – 6.83 (m, 3H), 5.70 (s, 1H), 3.89 (s, 3H), 3.76 (s, 3H), 3.44 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 181.16, 162.88, 161.36, 159.39, 149.42, 136.85, 136.46, 132.55, 131.84, 128.76, 124.13, 121.50, 119.98, 114.03, 113.80, 112.18, 109.74, 96.86, 90.25, 82.57, 57.30, 55.74, 55.35; IR (thin film, cm^{-1}) 3429, 2921, 2851, 2187, 1624, 1587, 1511, 1466, 1352, 1304, 1250, 1228, 1187, 1091, 1035, 1014, 836, 646, 537; HRMS (ESI): *m/z* Calcd. for $C_{27}H_{21}ClO_5$ $[M+H]^+$ 460.1072, Found 460.1080.

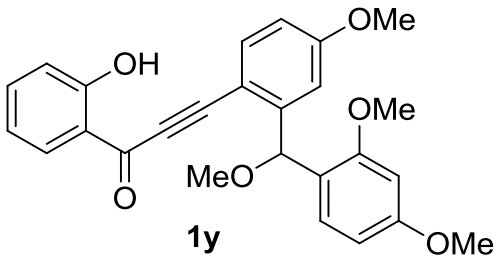
1-(2-Hydroxyphenyl)-3-(4-methoxy-2-(methoxy(4-phenoxyphenyl)methyl) phenyl)prop-2-yn-1-one (1x)



1x

Yellow oil in 60% yield (EtOAc/petroleum ether = 1:80); ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.82 (s, 1H), 7.98 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.64 (d, *J* = 8.5 Hz, 1H), 7.54 – 7.48 (m, 1H), 7.39 (d, *J* = 8.7 Hz, 2H), 7.30 (t, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 2.6 Hz, 1H), 7.09 (t, *J* = 7.4 Hz, 1H), 7.02 – 6.90 (m, 6H), 6.88 (dd, *J* = 8.5, 2.6 Hz, 1H), 5.77 (s, 1H), 3.89 (s, 3H), 3.45 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.22, 162.91, 162.68, 157.15, 157.02, 148.68, 137.07, 136.16, 135.36, 132.96, 129.87, 128.93, 123.55, 120.93, 119.44, 119.23, 118.72, 118.28, 113.87, 112.12, 110.36, 95.39, 90.53, 82.37, 57.46, 55.73; IR (thin film, cm^{-1}) 3439, 2929, 2850, 2184, 1629, 1463, 1384, 1130, 878, 619; HRMS (ESI): *m/z* Calcd. for $C_{30}H_{24}O_5Na$ $[M+Na]^+$ 487.1516, Found 487.1498.

3-(2-((2,4-Dimethoxyphenyl)(methoxy)methyl)-4-methoxyphenyl)-1-(2-hydroxyphenyl)prop-2-yn-1-one (1y)

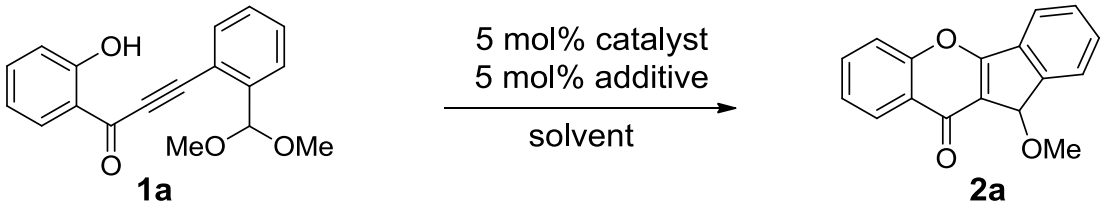


1y

Yellow oil in 56% yield (EtOAc/petroleum ether = 1:50); ^{1}H NMR (600 MHz, $CDCl_3$) δ 11.89 (s, 1H), 8.02 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.62 (d, *J* = 8.5 Hz, 1H), 7.49 (t, *J* = 7.0 Hz, 1H), 7.18 (d, *J* = 8.5 Hz, 1H), 7.10 (d, *J* = 2.6 Hz, 1H), 6.98 (d, *J* = 7.9 Hz, 1H), 6.91 (t, *J* = 7.1 Hz, 1H), 6.84 (dd, *J* = 8.5, 2.6 Hz, 1H), 6.46 (dd, *J* = 8.5, 2.4 Hz, 1H), 6.42 (d, *J* = 2.3 Hz, 1H), 6.09 (s, 1H), 3.85 (s, 3H), 3.78 (s, 3H), 3.70 (s, 3H), 3.44 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 182.43, 162.84, 162.19, 160.70, 158.41, 148.33, 136.86, 135.95, 133.16, 128.38, 121.50, 121.05, 119.35, 118.10, 113.43, 113.20, 111.10, 104.34, 98.54, 95.88, 89.66, 76.85, 57.57, 55.58, 55.48, 55.43; IR (thin film, cm^{-1}) 3425, 3000, 2934, 2837, 2184, 1593, 1503, 1464, 1342, 1299, 1206, 1153, 1082, 1036, 1012, 825,

794, 757, 690, 619, 530; HRMS (ESI): *m/z* Calcd. for $C_{26}H_{24}O_6Na$ $[M+Na]^+$ 455.1465, Found 455.1467.

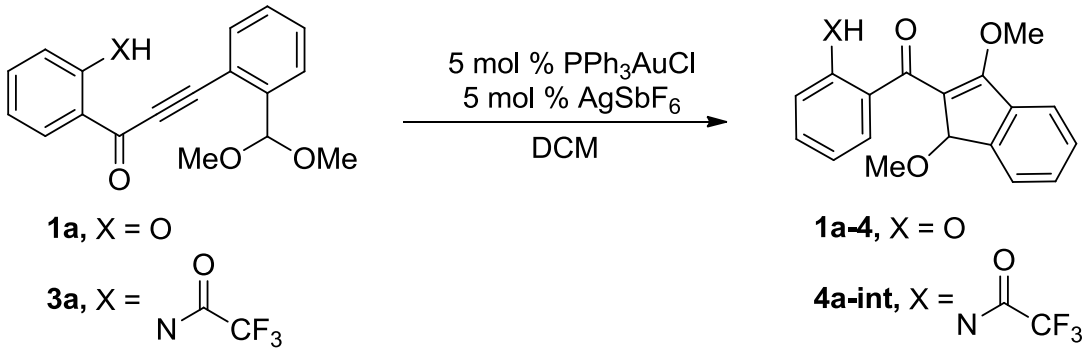
3. Screening of the Reaction Conditions[a]



Entry	catalyst	additive	solvent	yield (%)[b]
1	$Ph_3PAuNTf_2$	-	toluene	58
2	Ph_3PAuCl	-	toluene	0
3	Ph_3PAuCl	$AgBF_4$	toluene	30
4	Ph_3PAuCl	$AgSbF_6$	toluene	45
5	Ph_3PAuCl	$AgBF_4$+4 Å MS	toluene	30
6	Ph_3PAuCl	$AgSbF_6$+4 Å MS	toluene	90
7	$Ph_3PAuNTf_2$	4 Å MS	toluene	80
8	Ph_3PAuCl	$AgSbF_6$+4 Å MS	DCM	93
9	Ph_3PAuCl	$AgSbF_6$+4 Å MS	DCE	91
10	Ph_3PAuCl	$AgSbF_6$+4 Å MS	THF	0
11	TfOH	-	DCM	0
12	$AgSbF_6$	-	DCM	0

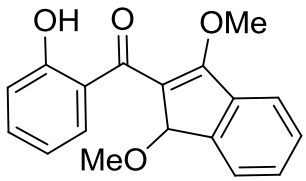
Note: [a] The reactions were conducted on 0.1 mmol scale at room temperature; [b] Yield of isolated product.

4. Procedures for the Preparation of 1a-4 and 4a-int and Characterization Data



The gold catalyst was generated in a round bottom flask by addition of PPh_3AuCl (0.01 mmol, 5 mg), $AgSbF_6$ (0.01 mmol, 4 mg), activated 4 Å molecular sieves (20 mg) and dry CH_2Cl_2 (5 mL) under nitrogen atmosphere at room temperature. The mixture was stirred for 30 minutes before the solution of **1a** or **3a** (0.2 mmol) in dry CH_2Cl_2 (5 mL) was added via a syringe. The mixture was stirred for 7 minutes for **1a** or 1 hour for **3a** at room temperature, the solvent was removed *in vacuo*. The residue was purified by a flash column chromatography on silica gel to afford the intermediate **1a-4** or **4a-int**.

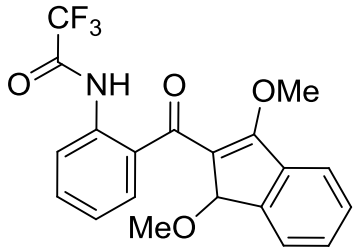
(1,3-Dimethoxy-1H-inden-2-yl)(2-hydroxyphenyl)methanone (1a-4)



1a-4

White solid in 90% yield (EtOAc/petroleum ether = 1:60): Mp 158.1–160.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.27 (s, 1H), 7.82 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.53 – 7.47 (m, 3H), 7.41 (dd, *J* = 5.4, 2.7 Hz, 2H), 5.71 (s, 1H), 3.81 (s, 3H), 3.13 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 198.86, 162.32, 161.18, 141.45, 138.14, 136.48, 132.46, 129.10, 129.06, 124.19, 121.76, 120.62, 119.08, 118.40, 115.00, 83.19, 60.96, 53.10; IR (thin film, cm^{-1}) 3425, 2921, 2851, 1621, 1588, 1572, 1481, 1441, 1378, 1240, 1151, 1073, 962, 762, 739, 643, 611; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{16}O_4Na$ $[M+Na]^+$ 319.0941, Found 319.0959.

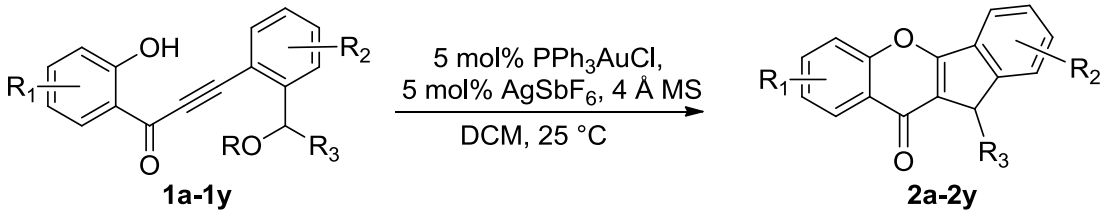
***N*-(2-(1,3-Dimethoxy-1H-indene-2-carbonyl)phenyl)-2,2,2-trifluoroacetamide (4a-int)**



4a-int

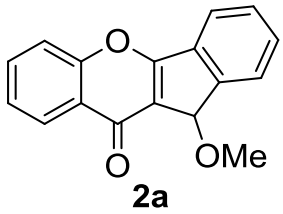
Yellow oil in 83% yield (EtOAc/petroleum ether = 1:10); ^{1}H NMR (600 MHz, $CDCl_3$) δ 12.42 (s, 1H), 8.66 (d, *J* = 8.3 Hz, 1H), 7.98 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.67 – 7.62 (m, 1H), 7.55 – 7.51 (m, 2H), 7.45 – 7.42 (m, 2H), 7.31 – 7.27 (m, 1H), 5.66 (s, 1H), 3.83 (s, 3H), 3.12 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 196.59, 163.73, 156.07, 155.82, 155.57, 155.32, 141.93, 137.77, 137.56, 134.83, 133.11, 129.76, 129.31, 125.98, 124.80, 124.41, 121.40, 121.22, 116.81, 116.47, 114.90, 82.94, 61.44, 53.34; IR (thin film, cm^{-1}) 3444, 2922, 2852, 1732, 1627, 1525, 1439, 1384, 1282, 1249, 1153, 1116, 1075, 733, 619; HRMS (ESI): *m/z* Calcd. for $C_{20}H_{16}F_3NO_4Na$ $[M+Na]^+$ 414.0924, Found 414.0924.

5. General Procedures for the Preparation of Indeno-chromen-4-ones (2a-2y) and Characterization Data



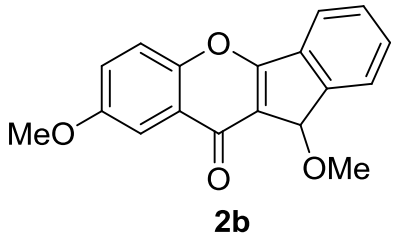
The gold catalyst was generated in a round bottom flask by addition of PPh_3AuCl (0.01 mmol, 5 mg), $AgSbF_6$ (0.01 mmol, 4 mg), activated 4 Å molecular sieves (20 mg) and dry CH_2Cl_2 (5 mL) under nitrogen atmosphere. The mixture was stirred for 30 min before the substrates **1a-1y** (0.2 mmol) in dry CH_2Cl_2 (5 mL) were added via a syringe. The mixture was stirred at room temperature, after the consumption of the starting material. The solvent was removed in vacuo and the residue was purified by a flash column chromatography on silica gel to afford the products **2a-2y**.

11-Methoxyindeno[1,2-b]chromen-10(11H)-one (2a)



White solid in 93% yield (EtOAc/petroleum ether = 1:8): Mp 158.1–160.2 ℃; ^{1}H NMR (600 MHz, DMSO-d_6) δ 8.14 (d, J = 7.8 Hz, 1H), 7.87 – 7.73 (m, 3H), 7.69 (d, J = 7.2 Hz, 1H), 7.62 – 7.57 (m, 2H), 7.54 (t, J = 7.6 Hz, 1H), 5.58 (s, 1H), 3.31 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.17, 165.41, 155.61, 144.01, 133.91, 133.10, 131.51, 129.58, 125.95, 125.44, 125.39, 124.85, 120.71, 120.09, 118.55, 78.07, 54.87; IR (thin film, cm^{-1}) 3432, 2924, 2852, 1646, 1624, 1556, 1480, 1463, 1431, 1109, 1080, 760, 738; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{12}O_3Na$ $[M+Na]^+$ 287.0679, Found 287.0683.

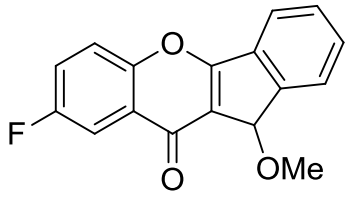
8,11-Dimethoxyindeno[1,2-b]chromen-10(11H)-one (2b)



White solid in 95% yield (EtOAc/petroleum ether = 1:8): Mp 129.3-130.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.75 (d, J = 7.4 Hz, 1H), 7.71 (d, J = 3.1 Hz, 1H), 7.69 (d, J = 7.3 Hz, 1H), 7.55 – 7.52

(m, 2H), 7.49 (t, *J* = 7.3 Hz, 1H), 7.29 – 7.26 (m, 1H), 5.64 (s, 1H), 3.92 (s, 3H), 3.45 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.53, 166.35, 157.44, 150.98, 144.33, 133.99, 131.47, 129.50, 126.37, 125.64, 123.00, 120.91, 119.82, 119.60, 106.01, 78.67, 56.10, 55.55; IR (thin film, cm^{-1}) 3433, 2933, 2833, 1652, 1561, 1479, 1414, 1348, 1277, 1196, 1110, 1024, 955, 932, 821, 763, 729, 591, 563; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}O_4Na$ $[M+Na]^+$ 317.0784, Found 317.0778.

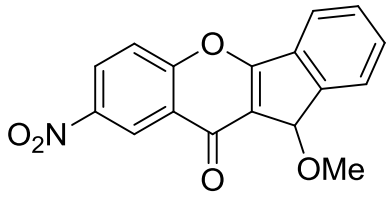
8-Fluoro-11-methoxyindeno[1,2-b]chromen-10(11H)-one (2c)



2c

White solid in 91% yield (EtOAc/petroleum ether = 1:8): Mp 149.2-150.5 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.97 (dd, *J* = 8.3, 3.1 Hz, 1H), 7.76 (d, *J* = 7.4 Hz, 1H), 7.69 (d, *J* = 7.4 Hz, 1H), 7.61 (dd, *J* = 9.1, 4.1 Hz, 1H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.52 (d, *J* = 7.7 Hz, 1H), 7.45 – 7.38 (m, 1H), 5.63 (s, 1H), 3.47 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.72 (d, *J* = 1.5 Hz), 166.78, 160.05 (d, *J* = 246.0 Hz), 152.41 (d, *J* = 1.5 Hz), 144.39, 133.63, 131.79, 129.61, 127.10 (d, *J* = 6.0 Hz), 125.71, 121.34 (d, *J* = 25.2 Hz), 121.06, 120.25 (d, *J* = 7.5 Hz), 120.2(d, *J* = 1.5 Hz), 111.59 (d, *J* = 24.0 Hz), 78.70, 55.85; IR (thin film, cm^{-1}) 3437, 3057, 2911, 1647, 1560, 1471, 1418, 1249, 1180, 1110, 1073, 926, 866, 831, 766, 732, 668, 577, 556; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{11}FO_3Na$ $[M+Na]^+$ 305.0584, Found 305.0590.

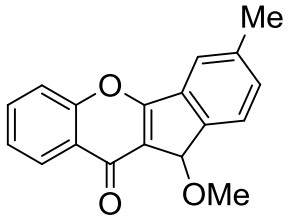
11-Methoxy-8-nitroindeno[1,2-b]chromen-10(11H)-one (2d)



2d

White solid in 97% yield (EtOAc/petroleum ether = 1:8): Mp 198.1-199.3 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 9.16 (d, *J* = 2.8 Hz, 1H), 8.51 (dd, *J* = 9.1, 2.8 Hz, 1H), 7.80 – 7.40 (m, 2H), 7.71 (d, *J* = 7.4 Hz, 1H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.53 (t, *J* = 7.5 Hz, 1H), 5.61 (s, 1H), 3.50 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 172.67, 166.97, 159.04, 145.28, 144.40, 132.86, 132.30, 129.80, 127.80, 126.03, 125.81, 122.98, 121.24, 121.22, 119.99, 78.73, 56.25; IR (thin film, cm^{-1}) 3433, 2925, 1651, 1621, 1534, 1446, 1347, 1245, 1117, 1083, 961, 838, 766, 734, 693, 574; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{11}NO_5Na$ $[M+Na]^+$ 332.0529, Found 332.0536.

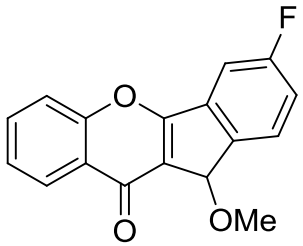
11-Methoxy-3-methylindeno[1,2-b]chromen-10(11H)-one (2e)



2e

White solid in 89% yield (EtOAc/petroleum ether = 1:8): Mp 157.2–159.3 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.34 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.72 – 7.66 (m, 1H), 7.60 – 7.58 (m, 2H), 7.57 (d, *J* = 7.6 Hz, 1H), 7.47 – 7.44 (m, 1H), 7.35 (d, *J* = 7.6 Hz, 1H), 5.61 (s, 1H), 3.44 (s, 3H), 2.47 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.65, 166.60, 156.30, 141.55, 139.71, 134.11, 133.35, 132.38, 126.47, 125.71, 125.69, 125.39, 121.48, 120.77, 118.25, 78.45, 55.43, 21.64; IR (thin film, cm^{-1}) 3427, 2924, 2853, 1645, 1609, 1456, 1384, 1222, 1072, 810, 761; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}O_3Na$ $[M+Na]^+$ 301.0835, Found 301.0830.

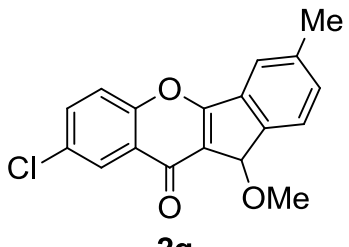
3-Fluoro-11-methoxyindeno[1,2-b]chromen-10(11H)-one (2f)



2f

White solid in 93% yield (EtOAc/petroleum ether = 1:8): Mp 165.5-167.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.33 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.75 – 7.68 (m, 1H), 7.64 (dd, *J* = 8.2, 4.7 Hz, 1H), 7.60 (dd, *J* = 8.4, 0.7 Hz, 1H), 7.49 – 7.45 (m, 2H), 7.25 – 7.19 (m, 1H), 5.59 (s, 1H), 3.48 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.57, 165.09 (d, *J* = 3.0 Hz), 163.75 (d, *J* = 247.5 Hz), 156.21, 139.76 (d, *J* = 3.0 Hz), 135.90 (d, *J* = 9.0 Hz), 133.66, 129.36 (d, *J* = 12.0 Hz), 127.07 (d, *J* = 9.0 Hz), 126.49, 125.94, 125.57, 122.09, 118.24 (d, *J* = 22.5 Hz), 108.40 (d, *J* = 24.0 Hz), 78.24, 55.88; IR (thin film, cm^{-1}) 3439, 2921, 1648, 1607, 1455, 1419, 1195, 1108, 1071, 929, 873, 765; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{11}FO_3Na$ $[M+Na]^+$ 305.0584, Found 305.0576.

8-Chloro-11-methoxy-3-methylindeno[1,2-b]chromen-10(11H)-one (2g)

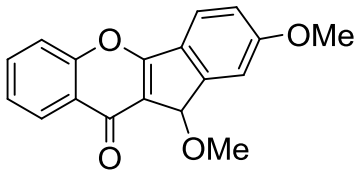


2g

White solid in 92% yield (EtOAc/petroleum ether = 1:8): Mp 131.7–133.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.30 (d, *J* = 2.6 Hz, 1H), 7.63 (dd, *J* = 8.8, 2.6 Hz, 1H), 7.58 (d, *J* = 7.4 Hz, 2H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.37 (d, *J* = 8.0 Hz, 1H), 5.60 (s, 1H), 3.44 (s, 3H), 2.48 (s, 3H); ^{13}C NMR (150

MHz, $CDCl_3$) δ 173.32, 166.86, 154.62, 141.60, 139.86, 133.76, 133.48, 132.69, 131.76, 126.81, 126.00, 125.49, 121.57, 120.81, 119.89, 78.43, 55.59, 21.66; IR (thin film, cm^{-1}) 3424, 2997, 2922, 2852, 2352, 1648, 1603, 1551, 1442, 1397, 1249, 1165, 1124, 1072, 927, 816, 688, 675, 566, 545; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{13}ClO_3Na$ $[M+Na]^+$ 335.0445, Found 3350443.

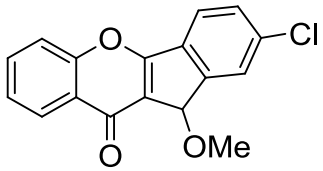
2,11-Dimethoxyindeno[1,2-b]chromen-10(11H)-one (2h)



2h

White solid in 90% yield (EtOAc/petroleum ether = 1:8): Mp 132.5–134.4 ℃; ^1H NMR (600 MHz, $CDCl_3$) δ 8.34 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.71 – 7.64 (m, 2H), 7.58 (d, *J* = 8.3 Hz, 1H), 7.49 – 7.43 (m, 1H), 7.24 (d, *J* = 2.1 Hz, 1H), 7.02 (dd, *J* = 8.4, 2.3 Hz, 1H), 5.61 (s, 1H), 3.92 (s, 3H), 3.45 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.21, 166.85, 163.30, 156.25, 147.17, 133.16, 126.44, 126.19, 125.67, 125.61, 122.22, 119.11, 118.15, 115.81, 111.22, 78.49, 55.93, 55.45; IR (thin film, cm^{-1}) 3437, 2925, 2852, 2357, 1644, 1620, 1553, 1460, 1429, 1384, 1295, 1272, 1239, 1139, 1116, 1076, 1026, 764, 689; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}O_4Na$ $[M+Na]^+$ 317.0784, Found 317.0780.

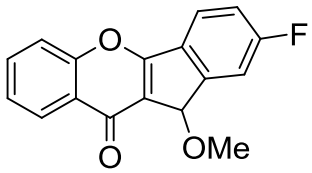
2-Chloro-11-methoxyindeno[1,2-b]chromen-10(11H)-one (2i)



2i

White solid in 90% yield (EtOAc/petroleum ether = 1:8): Mp 169.4–171.2 ℃; ^1H NMR (600 MHz, $CDCl_3$) δ 8.34 (dd, *J* = 7.9, 1.5 Hz, 1H), 7.73 – 7.69 (m, 3H), 7.60 (d, *J* = 8.2 Hz, 1H), 7.51 – 7.46 (m, 2H), 5.61 (s, 1H), 3.51 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.57, 165.43, 156.27, 146.19, 138.01, 133.62, 132.37, 129.94, 126.52, 126.38, 125.94, 125.57, 121.92, 120.87, 118.30, 78.59, 56.21; IR (thin film, cm^{-1}) 3440, 2923, 2853, 1646, 1552, 1461, 1430, 1384, 1121, 1086, 759; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{11}ClO_3Na$ $[M+Na]^+$ 321.0289, Found 321.0292.

2-Fluoro-11-methoxyindeno[1,2-b]chromen-10(11H)-one (2j)

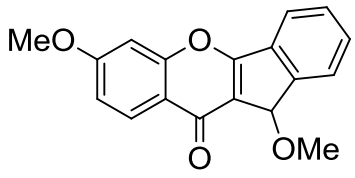


2j

White solid in 92% yield (EtOAc/petroleum ether = 1:8): Mp 153.5–154.8 ℃; ^1H NMR (600 MHz, $CDCl_3$) δ 8.34 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.75 (dd, *J* = 8.3, 4.8 Hz, 1H), 7.73 – 7.68 (m, 1H), 7.60

(d, *J* = 7.9 Hz, 1H), 7.50 – 7.45 (m, 1H), 7.41 (dd, *J* = 8.0, 2.2 Hz, 1H), 7.21 (td, *J* = 8.6, 2.3 Hz, 1H), 5.61 (s, 1H), 3.50 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.37, 165.62, 165.39 (d, *J* = 251.9 Hz), 156.27, 147.43 (d, *J* = 7.5 Hz), 134.32 (d, *J* = 13.5 Hz), 133.52, 129.39 (d, *J* = 12.0 Hz), 126.54, 125.91, 125.51, 122.54 (d, *J* = 9.3 Hz), 118.26, 116.88 (d, *J* = 22.5 Hz), 113.84 (d, *J* = 22.5 Hz), 78.50 (d, *J* = 1.8 Hz), 56.06; IR (thin film, cm^{-1}) 3427, 2921, 2851, 1651, 1627, 1600, 1460, 1438, 1264, 1226, 1110, 1062, 763, 688; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{11}FO_3Na$ $[M+Na]^+$ 305.0584, Found 305.0581.

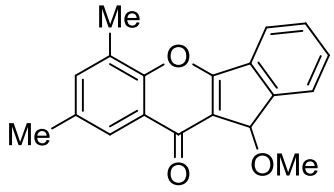
7,11-Dimethoxyindeno[1,2-b]chromen-10(11H)-one (2k)



2k

White solid in 92% yield (EtOAc/petroleum ether = 1:8): Mp 137.2–139.8 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.27 – 8.21 (m, 1H), 7.73 (d, *J* = 7.2 Hz, 1H), 7.68 (d, *J* = 7.2 Hz, 1H), 7.53 (td, *J* = 7.4, 1.2 Hz, 1H), 7.51 – 7.47 (m, 1H), 7.02 (dd, *J* = 4.7, 2.4 Hz, 2H), 5.61 (s, 1H), 3.94 (s, 3H), 3.47 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.36, 166.06, 163.93, 158.00, 144.28, 134.04, 131.26, 129.44, 127.72, 125.62, 120.70, 120.54, 119.40, 114.38, 101.14, 78.75, 56.01, 55.72; IR (thin film, cm^{-1}) 3430, 2923, 2856, 1643, 1630, 1559, 1470, 1462, 1434, 1102, 1060, 762, 734; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}O_4$ $[M+H]^+$ 295.0965, Found 295.0968.

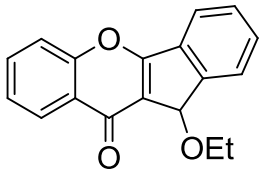
11-Methoxy-6,8-dimethylindeno[1,2-b]chromen-10(11H)-one (2l)



2l

White solid in 90% yield (EtOAc/petroleum ether = 1:8): Mp 172.1–173.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.77 (d, *J* = 7.3 Hz, 1H), 7.70 (d, *J* = 7.3 Hz, 1H), 7.55 (t, *J* = 7.3 Hz, 1H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.35 (s, 1H), 5.66 (s, 1H), 3.44 (s, 3H), 2.58 (s, 3H), 2.44 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 175.18, 166.03, 153.03, 144.43, 135.81, 135.17, 134.28, 131.39, 129.44, 127.36, 125.68, 125.28, 123.60, 120.78, 120.15, 78.73, 55.48, 21.07, 15.68; IR (thin film, cm^{-1}) 3421, 2921, 2851, 2827, 1639, 1608, 1564, 1470, 1442, 1382, 1264, 1191, 1109, 1083, 767, 741, 728, 580; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{16}O_3Na$ $[M+Na]^+$ 315.0992, Found 315.0992.

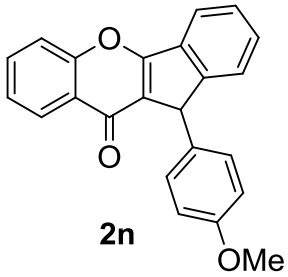
11-Ethoxyindeno[1,2-b]chromen-10(11H)-one (2m)



2m

White solid in 85% yield (EtOAc/petroleum ether = 1:8): Mp 121.1– 121.9 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.34 (d, *J* = 7.8 Hz, 1H), 7.77 (d, *J* = 7.4 Hz, 1H), 7.70 (dd, *J* = 7.0, 4.0 Hz, 2H), 7.61 (d, *J* = 8.3 Hz, 1H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 1H), 7.47 (t, *J* = 7.5 Hz, 1H), 5.65 (s, 1H), 3.87 (dq, *J* = 14.1, 7.1 Hz, 1H), 3.80 (dq, *J* = 14.2, 7.0 Hz, 1H), 1.27 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.75, 166.36, 156.32, 145.08, 133.79, 133.38, 131.56, 129.40, 126.48, 125.77, 125.73, 125.65, 121.45, 120.93, 118.30, 77.84, 64.59, 15.85; IR (thin film, cm^{-1}) 3423, 3058, 2969, 2925, 2856, 1645, 1609, 1555, 1483, 1464, 1429, 1104, 1077, 758; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}O_3Na$ $[M+Na]^+$ 301.0835, Found 301.0836.

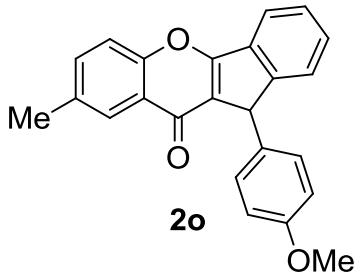
11-(4-Methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2n)



2n

White solid in 97% yield (EtOAc/petroleum ether = 1:6): Mp 182.1–184.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.90 – 7.88 (m, 1H), 7.71 – 7.67 (m, 1H), 7.66 – 7.63 (m, 1H), 7.50 – 7.47 (m, 2H), 7.44 – 7.41 (m, 2H), 7.16 – 7.12 (m, 2H), 6.83 – 6.79 (m, 2H), 5.13 (s, 1H), 3.76 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.52, 164.87, 158.86, 156.49, 149.38, 134.53, 133.14, 130.97, 129.54, 129.11, 127.92, 126.36, 125.73, 125.70, 125.35, 124.76, 120.93, 118.27, 114.27, 55.33, 49.50; IR (thin film, cm^{-1}) 3430, 2920, 2851, 1643, 1622, 1462, 1434, 1384, 1248, 1140, 762, 619; HRMS (ESI): *m/z* Calcd. for $C_{23}H_{16}O_3Na$ $[M+Na]^+$ 363.0992, Found 363.0991.

11-(4-Methoxyphenyl)-8-methylindeno[1,2-b]chromen-10(11H)-one (2o)

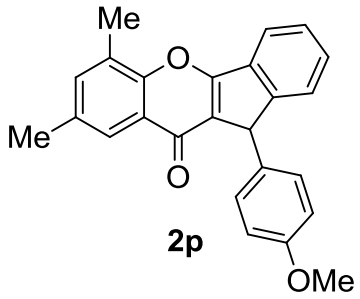


2o

White solid in 97% yield (EtOAc/petroleum ether = 1:6): Mp 199.2–200.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.04 (d, *J* = 1.1 Hz, 1H), 7.88 – 7.86 (m, 1H), 7.54 (d, *J* = 8.5 Hz, 1H), 7.50 – 7.46 (m, 3H), 7.42 – 7.40 (m, 1H), 7.15 – 7.11 (m, 2H), 6.82 – 6.78 (m, 2H), 5.12 (s, 1H), 3.75 (s, 3H), 2.46 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.64, 164.82, 158.82, 154.75, 149.36, 135.28, 134.60,

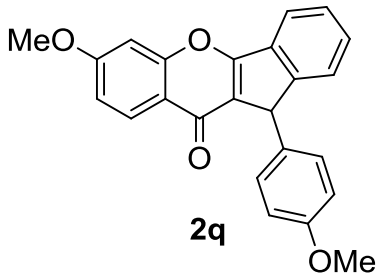
134.28, 130.87, 129.68, 129.07, 127.87, 125.79, 125.66, 125.36, 124.59, 120.88, 118.00, 114.25, 55.34, 49.44, 21.11; IR (thin film, cm^{-1}) 3433, 2922, 2851, 1642, 1615, 1556, 1511, 1478, 1451, 1408, 1299, 1274, 1249, 1226, 1177, 1149, 1097, 1034, 826, 574, 547; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{19}O_3$ $[M+H]^+$ 355.1329, Found 355.1343.

11-(4-Methoxyphenyl)-6,8-dimethylindeno[1,2-b]chromen-10(11H)-one (2p)



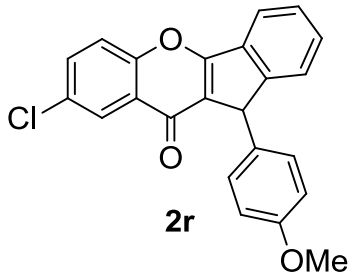
White solid in 98% yield (EtOAc/petroleum ether = 1:6): Mp 201.2–203.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.88 (dd, *J* = 6.3, 2.0 Hz, 2H), 7.50 – 7.45 (m, 2H), 7.42 (d, *J* = 6.6 Hz, 1H), 7.34 (s, 1H), 7.13 (d, *J* = 8.7 Hz, 2H), 6.79 (d, *J* = 8.7 Hz, 2H), 5.12 (s, 1H), 3.75 (s, 3H), 2.62 (s, 3H), 2.41 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.96, 164.49, 158.81, 153.16, 149.36, 135.50, 134.77, 134.66, 130.80, 129.75, 129.06, 127.82, 127.29, 125.68, 125.29, 124.34, 123.44, 120.73, 114.25, 55.34, 49.43, 21.06, 15.74; IR (thin film, cm^{-1}) 3431, 2920, 2851, 1639, 1609, 1510, 1469, 1437, 1384, 1248, 1177, 1156, 1102, 1035, 765, 694, 618, 545, 504; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{21}O_3$ $[M+H]^+$ 369.1485, Found 369.1482.

7-Methoxy-11-(4-methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2q)



White solid in 96% yield (EtOAc/petroleum ether = 1:6): Mp 188.5–190.6 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.8 Hz, 1H), 7.84 (dd, *J* = 6.4, 1.7 Hz, 1H), 7.50 – 7.44 (m, 2H), 7.40 (d, *J* = 6.9 Hz, 1H), 7.13 (t, *J* = 5.8 Hz, 2H), 7.06 (d, *J* = 2.3 Hz, 1H), 6.98 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.82 – 6.78 (m, 2H), 5.09 (s, 1H), 3.94 (s, 3H), 3.75 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.20, 164.46, 163.74, 158.82, 158.16, 149.22, 134.62, 130.66, 129.65, 129.09, 127.83, 127.60, 125.66, 124.65, 120.64, 119.52, 114.25, 114.07, 101.04, 55.98, 55.33, 49.44; IR (thin film, cm^{-1}) 3429, 2920, 2851, 1640, 1625, 1611, 1440, 1384, 1244, 1161, 838, 761, 618; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{18}O_4Na$ $[M+Na]^+$ 303.1097, Found 303.1098.

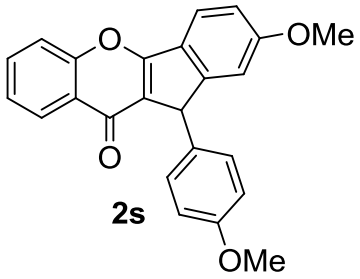
8-Chloro-11-(4-methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2r)



2r

White solid in 99% yield (EtOAc/petroleum ether = 1:6): Mp 202.2–203.8 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.21 (d, *J* = 2.4 Hz, 1H), 7.87 (dd, *J* = 5.8, 2.8 Hz, 1H), 7.63 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.60 (d, *J* = 8.8 Hz, 1H), 7.51 – 7.48 (m, 2H), 7.43 – 7.41 (m, 1H), 7.12 (d, *J* = 8.7 Hz, 2H), 6.81 (d, *J* = 8.7 Hz, 2H), 5.12 (s, 1H), 3.76 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.18, 165.14, 158.94, 154.79, 149.39, 134.14, 133.25, 131.33, 131.27, 129.17, 129.08, 128.03, 126.78, 125.84, 125.76, 124.71, 121.01, 119.92, 114.31, 55.34, 49.48; IR (thin film, cm^{-1}) 3429, 2920, 2851, 1644, 1619, 1552, 1510, 1462, 1442, 1384, 1252, 1119, 821, 772, 700, 619; HRMS (ESI): *m/z* Calcd. for $C_{23}H_{15}ClO_3Na$ $[M+Na]^+$ 397.0602, Found 397.0615.

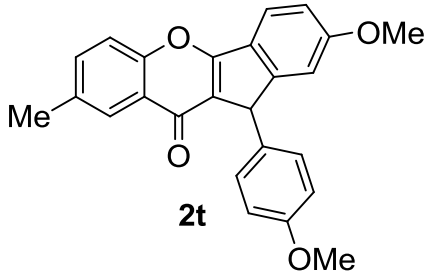
2-Methoxy-11-(4-methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2s)



2s

White solid in 97% yield (EtOAc/petroleum ether = 1:6): Mp 194.1–195.1 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.78 (d, *J* = 8.4 Hz, 1H), 7.69 – 7.64 (m, 1H), 7.61 (d, *J* = 7.9 Hz, 1H), 7.43 – 7.37 (m, 1H), 7.14 (d, *J* = 8.7 Hz, 2H), 7.02 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.92 (d, *J* = 2.0 Hz, 1H), 6.82 (s, 1H), 6.80 (s, 1H), 5.07 (s, 1H), 3.83 (s, 3H), 3.76 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.95, 165.12, 162.73, 158.84, 156.39, 152.00, 132.85, 129.91, 129.16, 127.03, 126.30, 125.68, 125.25, 123.44, 122.07, 118.11, 114.77, 114.29, 110.88, 55.80, 55.35, 49.44; IR (thin film, cm^{-1}) 3435, 3006, 2920, 2837, 1646, 1621, 1551, 1511, 1461, 1433, 1298, 1278, 1251, 1235, 1177, 1152, 1100, 1030, 831, 766, 688, 592, 574, 542; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{19}O_4$ $[M+H]^+$ 371.1278, Found 371.1294.

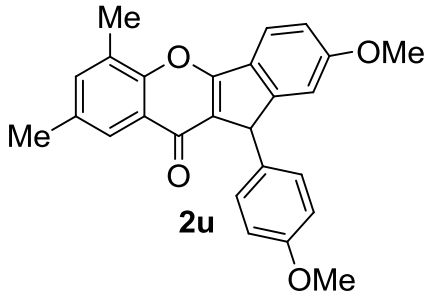
2-Methoxy-11-(4-methoxyphenyl)-8-methylindeno[1,2-b]chromen-10(11H)-one (2t)



2t

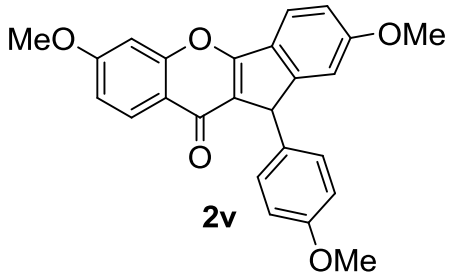
White solid in 98% yield (EtOAc/petroleum ether = 1:6): Mp 196.4–198.4 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.03 (d, *J* = 1.0 Hz, 1H), 7.77 (d, *J* = 8.4 Hz, 1H), 7.48 (dt, *J* = 8.5, 5.3 Hz, 2H), 7.16 – 7.12 (m, 2H), 7.01 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.92 (d, *J* = 2.0 Hz, 1H), 6.82 – 6.79 (m, 2H), 5.07 (s, 1H), 3.82 (s, 3H), 3.76 (s, 3H), 2.45 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.06, 165.05, 162.63, 158.80, 154.63, 151.95, 135.12, 133.96, 130.03, 129.11, 127.10, 125.76, 125.31, 123.28, 122.00, 117.83, 114.68, 114.27, 110.86, 55.78, 55.35, 49.38, 21.10; IR (thin film, cm^{-1}) 3434, 2920, 2850, 1641, 1613, 1511, 1449, 1276, 1249, 1176, 1150, 1098, 1033, 821, 591, 574, 548; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{21}O_4$ $[M+H]^+$ 385.1434, Found 385.1435.

2-Methoxy-11-(4-methoxyphenyl)-6,8-dimethylindeno[1,2-b]chromen-10(11H)-one (2u)



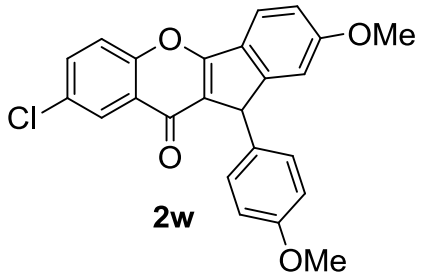
White solid in 95% yield (EtOAc/petroleum ether = 1:6): Mp 141.6–142.8 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.87 (s, 1H), 7.77 (d, *J* = 8.4 Hz, 1H), 7.31 (s, 1H), 7.14 (d, *J* = 8.6 Hz, 2H), 7.01 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.92 (d, *J* = 1.8 Hz, 1H), 6.80 (d, *J* = 8.6 Hz, 2H), 5.06 (s, 1H), 3.82 (s, 3H), 3.75 (s, 3H), 2.59 (s, 3H), 2.40 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 174.38, 164.74, 162.59, 158.78, 153.03, 151.95, 135.22, 134.51, 130.09, 129.11, 127.27, 127.10, 125.21, 123.41, 123.03, 121.85, 114.69, 114.26, 110.83, 55.79, 55.35, 49.37, 21.05, 15.73; IR (thin film, cm^{-1}) 3431, 2921, 2851, 1641, 1605, 1511, 1451, 1279, 1251, 1230, 1176, 1159, 1098, 1031, 824, 724, 578, 542; HRMS (ESI): *m/z* Calcd. for $C_{26}H_{23}O_4$ $[M+H]^+$ 399.1591, Found 399.1590.

2,7-Dimethoxy-11-(4-methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2v)



White solid in 96% yield (EtOAc/petroleum ether = 1:6): Mp 199.8–201.7 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.8 Hz, 1H), 7.74 (d, *J* = 8.4 Hz, 1H), 7.14 (d, *J* = 8.6 Hz, 2H), 7.05 – 6.96 (m, 3H), 6.92 (d, *J* = 1.9 Hz, 1H), 6.81 (d, *J* = 8.6 Hz, 2H), 5.05 (s, 1H), 3.94 (s, 3H), 3.82 (s, 3H), 3.76 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.68, 164.72, 163.52, 162.47, 158.78, 158.00, 151.79, 129.99, 129.13, 127.51, 127.11, 123.24, 121.73, 119.40, 114.60, 114.25, 113.84, 110.89, 100.99, 55.94, 55.76, 55.32, 49.36; IR (thin film, cm^{-1}) 3431, 2920, 2850, 1643, 1622, 1511, 1448, 1280, 1246, 1169, 1095, 1029, 835, 685; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{21}O_5$ $[M+H]^+$ 401.1384, Found 401.1382.

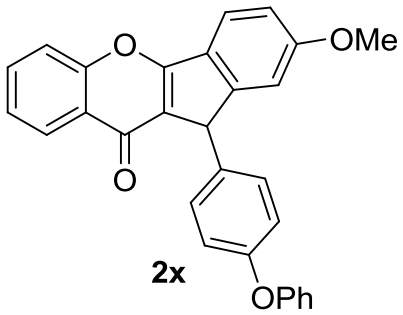
8-Chloro-2-methoxy-11-(4-methoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2w)



2w

White solid in 94% yield (EtOAc/petroleum ether = 1:6): Mp 187.5–188.3 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.19 (d, *J* = 2.5 Hz, 1H), 7.77 (d, *J* = 8.4 Hz, 1H), 7.60 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.56 (d, *J* = 8.9 Hz, 1H), 7.12 (d, *J* = 8.7 Hz, 2H), 7.02 (dd, *J* = 8.5, 2.2 Hz, 1H), 6.92 (d, *J* = 1.9 Hz, 1H), 6.81 (d, *J* = 8.7 Hz, 2H), 5.06 (s, 1H), 3.83 (s, 3H), 3.76 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 172.58, 165.37, 162.96, 158.92, 154.68, 152.06, 132.93, 131.19, 129.55, 129.12, 126.78, 126.61, 125.80, 123.37, 122.18, 119.74, 114.94, 114.33, 110.89, 55.82, 55.35, 49.41; IR (thin film, cm^{-1}) 3432, 2920, 2850, 1646, 1617, 1548, 1511, 1450, 1251, 1179, 1148, 1098, 1031, 824, 685, 546; HRMS (ESI): *m/z* Calcd. for $C_{24}H_{17}ClO_4Na$ $[M+Na]^+$ 427.0707, Found 427.0698.

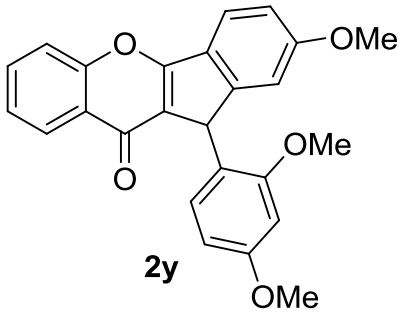
2-Methoxy-11-(4-phenoxyphenyl)indeno[1,2-b]chromen-10(11H)-one (2x)



2x

White solid in 97% yield (EtOAc/petroleum ether = 1:5): Mp 161.2–162.2 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.79 (d, *J* = 8.4 Hz, 1H), 7.69 – 7.65 (m, 1H), 7.63 – 7.60 (m, 1H), 7.44 – 7.39 (m, 1H), 7.30 (dd, *J* = 8.5, 7.5 Hz, 2H), 7.19 (d, *J* = 8.6 Hz, 2H), 7.07 (t, *J* = 7.4 Hz, 1H), 7.04 – 7.00 (m, 2H), 7.00 (s, 1H), 6.94 (d, *J* = 2.0 Hz, 1H), 6.91 (d, *J* = 8.6 Hz, 2H), 5.10 (s, 1H), 3.84 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.91, 165.22, 162.73, 157.19, 156.48, 156.35, 151.66, 132.91, 132.70, 129.78, 126.95, 126.23, 125.61, 125.30, 123.32, 123.14, 122.13, 119.16, 119.01, 118.13, 114.65, 111.04, 55.80, 49.42; IR (thin film, cm^{-1}) 3428, 2920, 2851, 1643, 1618, 1460, 1384, 1276, 1238, 1131, 878, 750, 619; HRMS (ESI): *m/z* Calcd. for $C_{29}H_{21}O_4$ $[M+H]^+$ 433.1434, Found 433.1432.

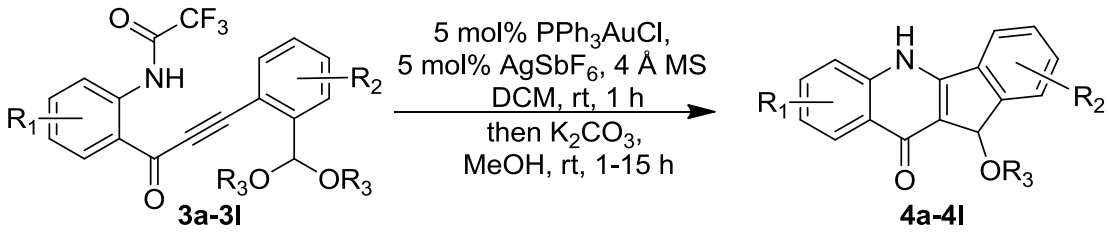
11-(2,4-Dimethoxyphenyl)-2-methoxyindeno[1,2-b]chromen-10(11H)-one (2y)



2y

White solid in 98% yield (EtOAc/petroleum ether = 1:5): Mp 205.1–206.8 ℃; ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.28 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 1H), 7.70 – 7.64 (m, 1H), 7.62 (d, *J* = 8.2 Hz, 1H), 7.46 – 7.38 (m, *J* = 1H), 7.04 (s, 1H), 6.97 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.67 (s, 1H), 6.57 (s, 1H), 6.29 (d, *J* = 8.0 Hz, 1H), 5.56 (s, 1H), 3.94 (s, 3H), 3.81 (s, 3H), 3.75 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 173.81, 165.52, 162.53, 160.00, 158.61, 156.39, 152.77, 132.73, 126.69, 126.35, 125.59, 125.14, 122.73, 121.85, 118.58, 118.10, 114.08, 110.83, 104.80, 99.52, 55.90, 55.65, 55.41; IR (thin film, cm^{-1}) 3435, 2920, 2851, 1642, 1619, 1461, 1446, 1433, 1384, 1133, 879, 837, 766, 619; HRMS (ESI): *m/z* Calcd. for $C_{25}H_{21}O_5$ $[M+H]^+$ 401.1384, Found 401.1391.

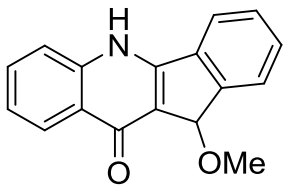
6. General Procedures for the Preparation of Indeno-quinolin-4-ones (4a-4l) and Characterization Data



3a-3l **4a-4l**

The gold catalyst was generated in a round bottom flask by addition of PPh_3AuCl (0.01 mmol, 5 mg), $AgSbF_6$ (0.01 mmol, 4 mg), activated 4 Å molecular sieves (20 mg) and dry CH_2Cl_2 (5 mL) under nitrogen atmosphere. The mixture was stirred for 30 min before the substrates **3a-3l** (0.2 mmol) in dry CH_2Cl_2 (5 mL) were added via a syringe. The mixture was stirred for 1 h at room temperature before the addition of MeOH (0.5 mL) and K_2CO_3 (2 mmol, 276 mg). The mixture was stirred at room temperature till the consumption of the starting material. The mixture was filtered through filter paper, and washed with MeOH for three times. The combined filtrates were removed in vacuo, and the residue was purified by a flash column chromatography on silica gel to afford the products **4a-4l**.

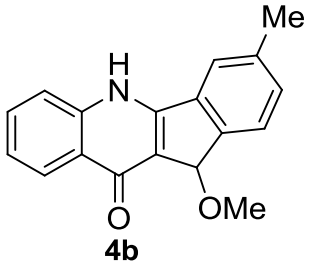
11-Methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4a)



4a

White solid in 65% yield (MeOH/DCM = 1:130): Mp 333.4–335.2 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.47 (s, 1H), 8.20 (d, J = 8.0 Hz, 1H), 8.05 (d, J = 7.0 Hz, 1H), 7.70 (d, J = 3.7 Hz, 2H), 7.66 (d, J = 6.9 Hz, 1H), 7.60 – 7.52 (m, 2H), 7.38 (dt, J = 8.0, 4.0 Hz, 1H), 5.55 (s, 1H), 3.25 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.47, 150.48, 145.10, 140.08, 134.58, 131.64, 130.51, 129.13, 126.78, 125.41, 125.26, 123.52, 121.24, 118.48, 118.00, 79.05, 54.27; IR (thin film, cm^{-1}) 3426, 2920, 2851, 1632, 1464, 1384, 1131, 879, 619; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{13}NO_2Na$ $[M+Na]^+$ 286.0838, Found 286.0844.

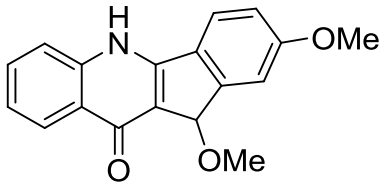
11-Methoxy-3-methyl-5H-indeno[1,2-b]quinolin-10(11H)-one (4b)



4b

White solid in 73% yield (MeOH/DCM = 1:130): Mp 338.0–339.2 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 8.20 (d, J = 6.1 Hz, 1H), 7.97 – 7.80 (m, 1H), 7.75 – 7.65 (m, 1H), 7.60 (t, J = 7.1 Hz, 1H), 7.51 – 7.40 (m, 1H), 7.33 – 7.25 (m, 2H), 5.52 (s, 1H), 3.24 – 3.10 (m, 3H), 2.43 – 2.33 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 172.65, 172.58, 145.39, 142.19, 139.86, 138.26, 130.49, 130.40, 129.50, 127.45, 127.31, 125.90, 124.98, 124.95, 122.60, 122.54, 121.59, 120.99, 117.35, 117.34, 116.87, 116.86, 78.91, 78.73, 53.74, 53.43, 21.34, 21.10; IR (thin film, cm^{-1}) 3425, 2920, 2851, 1632, 1577, 1509, 1469, 1384, 1123, 879, 811, 768, 619; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}NO_2Na$ $[M+Na]^+$ 300.0995, Found 300.0993.

2,11-Dimethoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4c)

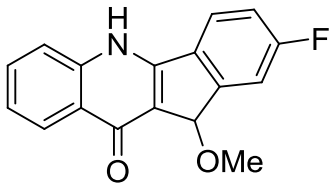


4c

White solid in 66% yield (MeOH/DCM = 1:100): Mp 294.4–295.6 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.42 – 12.33 (m, 1H), 8.18 (t, J = 7.5 Hz, 1H), 7.95 (d, J = 8.3 Hz, 1H), 7.68 – 7.62 (m, 2H), 7.41 – 7.30 (m, 1H), 7.19 (s, 1H), 7.13 – 7.04 (m, 1H), 5.51 – 5.46 (m, 1H), 3.86 (s, 3H), 3.27 – 3.19 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.31, 172.94, 161.81, 160.24, 150.81, 147.60, 139.99, 136.85, 131.59, 131.36, 126.80, 126.60, 126.19, 125.26, 125.20, 123.49, 123.33,

122.45, 118.27, 116.94, 116.30, 114.85, 111.15, 106.42, 78.83, 78.44, 55.64, 55.54, 54.03, 53.87; IR (thin film, cm^{-1}) 3426, 2920, 2851, 1631, 1576, 1469, 1384, 1120, 879, 619; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}NO_3Na$ $[M+Na]^+$ 316.0944, Found 316.0949.

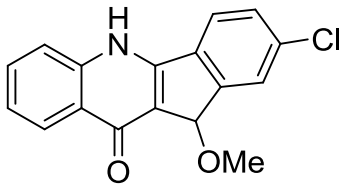
2-Fluoro-11-methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4d)



4d

White solid in 51% yield (MeOH/DCM = 1:130): Mp 352.2–352.7 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.52 (s, 1H), 8.19 (dd, *J* = 7.8, 3.1 Hz, 1H), 8.10 – 7.85 (m, 1H), 7.73 – 7.59 (m, 3H), 7.44 – 7.33 (m, 2H), 5.55 – 5.51 (m, 1H), 3.28 – 3.24 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ173.40, 173.19, 164.90 (d, *J* = 247.5 Hz), 162.70 (d, *J* = 243.0 Hz), 149.77 (d, *J* = 4.5 Hz), 148.24 (d, *J* = 9.0 Hz), 140.93 (d, *J* = 1.5 Hz), 140.14 (d, *J* = 1.5 Hz), 136.97, 136.89, 132.05 (d, *J* = 3.0 Hz), 131.70 (d, *J* = 21.0 Hz), 128.77 (d, *J* = 10.5 Hz), 127.07 (d, *J* = 9.0 Hz), 126.66 (d, *J* = 28.5 Hz), 125.24 (d, *J* = 6.0 Hz), 123.65, 123.57, 123.16, 123.10, 118.62 (d, *J* = 16.5 Hz), 118.04 (d, *J* = 1.5 Hz), 117.03, 116.88, 116.30, 116.14, 113.20, 113.05, 108.65, 108.49, 78.76, 78.46, 54.43, 54.28; IR (thin film, cm^{-1}) 3424, 2920, 2851, 1631, 1577, 1470, 1384, 1133, 879, 774, 619; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{13}FNO_2Na$ $[M+Na]^+$ 305.0822, Found 305.0842.

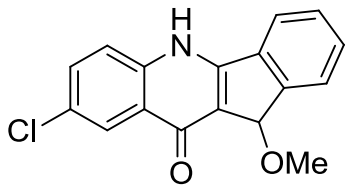
2-Chloro-11-methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4e)



4e

White solid in 56% yield (MeOH/DCM = 1:130): Mp 336.1–336.9 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.53 – 12.42 (m, 1H), 8.19 (d, *J* = 8.1 Hz, 1H), 8.04 (d, *J* = 8.1 Hz, 1H), 7.73 – 7.63 (m, 4H), 7.40 – 7.35 (m, 1H), 5.56 – 5.53 (m, 1H), 3.29 – 3.24 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.52, 173.43, 149.38, 149.03, 147.31, 143.74, 140.01, 139.96, 136.65, 135.30, 133.67, 133.46, 131.87, 131.77, 130.00, 129.31, 126.96, 126.74, 126.68, 125.61, 125.27, 125.24, 123.70, 123.64, 122.78, 121.32, 118.87, 118.53, 118.50, 118.17, 78.84, 78.65, 54.62, 54.44; IR (thin film, cm^{-1}) 3425, 2920, 2851, 1629, 1579, 1524, 1467, 1384, 1338, 1272, 1128, 879, 764, 619, 516; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{12}ClNO_2Na$ $[M+Na]^+$ 320.0448, Found 320.0452.

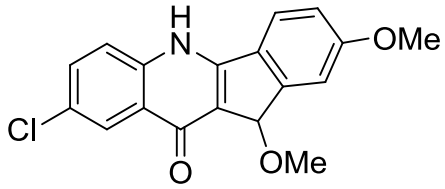
8-Chloro-11-methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4f)



4f

White solid in 54% yield (MeOH/DCM = 1:130): Mp 335.4–336.6 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.65 (s, 1H), 8.11 (s, 1H), 8.03 (d, J = 6.8 Hz, 1H), 7.73 (s, 2H), 7.66 (d, J = 6.5 Hz, 1H), 7.60 – 7.54 (m, 2H), 5.55 (s, 1H), 3.25 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 172.11, 150.91, 145.11, 138.72, 134.25, 131.67, 130.77, 129.23, 128.19, 127.90, 125.48, 124.24, 121.35, 120.87, 118.28, 78.99, 54.39; IR (thin film, cm^{-1}) 3425, 3081, 1920, 2851, 1635, 1573, 1508, 1468, 1384, 1160, 767, 703, 626, 582, 555; HRMS (ESI): *m/z* Calcd. for $C_{17}H_{12}ClNO_2Na$ $[M+Na]^+$ 320.0449, Found 320.0440.

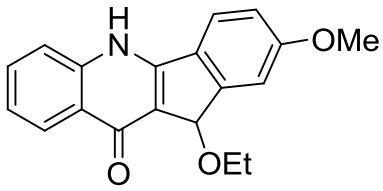
8-Chloro-2,11-dimethoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4g)



4g

White solid in 50% yield (MeOH/DCM = 1:100): Mp 326.5–328.2 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.59 – 12.46 (m, 1H), 8.08 (d, J = 5.9 Hz, 1H), 7.73 – 7.48 (m, 4H), 7.14 – 7.04 (m, 1H), 5.50 – 5.42 (m, 1H), 3.86 (s, 3H), 3.25 – 3.15 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 171.93, 171.52, 161.99, 160.25, 151.17, 150.71, 138.59, 136.86, 131.62, 131.36, 128.16, 127.99, 127.90, 127.74, 126.42, 126.26, 124.24, 124.19, 122.56, 122.52, 120.75, 120.58, 117.21, 116.58, 114.99, 111.14, 106.43, 78.75, 78.38, 55.67, 55.57, 54.16, 54.00; IR (thin film, cm^{-1}) 3428, 2920, 2851, 1628, 1572, 1514, 1467, 1384, 1243, 1119, 879, 822, 685, 620, 541; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}ClNO_3Na$ $[M+Na]^+$ 350.0554, Found 350.0554.

11-Ethoxy-2-methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4h)

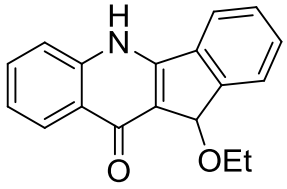


4h

White solid in 87% yield (MeOH/DCM = 1:100): Mp 286.6–287.1 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.41 – 12.31 (m, 1H), 8.18 (t, J = 8.3 Hz, 1H), 7.74 – 7.62 (m, 3H), 7.53 (d, J = 8.2 Hz, 1H), 7.36 (dt, J = 7.9, 4.5 Hz, 1H), 7.14 – 7.04 (m, 1H), 5.52 – 5.46 (m, 1H), 3.86 (d, J = 3.4 Hz, 3H), 3.64 – 3.53 (m, 2H), 1.12 – 1.05 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.33, 160.18, 150.14, 139.95, 137.60, 135.84, 131.62, 126.83, 126.20, 125.30, 123.47, 119.80, 118.39, 116.32, 106.35, 77.47, 62.25, 55.57, 15.70; IR (thin film, cm^{-1}) 3424, 3262, 3066, 2922, 2851, 1631,

1573, 1503, 1470, 1341, 1241, 1109, 1067, 1029, 878, 815, 767, 697, 681; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{17}NO_3Na$ $[M+Na]^+$ 330.1101, Found 330.1109.

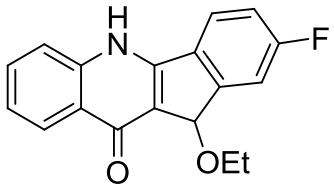
11-Ethoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4i)



4i

White solid in 51% yield (MeOH/DCM = 1:130): Mp 324.5–325.1 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.44 (s, 1H), 8.19 (d, *J* = 8.0 Hz, 1H), 8.04 (d, *J* = 6.7 Hz, 1H), 7.69 (d, *J* = 3.6 Hz, 2H), 7.65 (d, *J* = 6.6 Hz, 1H), 7.58 – 7.51 (m, 2H), 7.37 (dt, *J* = 8.0, 3.9 Hz, 1H), 5.56 (s, 1H), 3.64 (q, *J* = 6.9 Hz, 2H), 1.10 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.44, 150.27, 145.76, 140.04, 134.37, 131.59, 130.46, 128.99, 126.78, 125.38, 125.25, 123.46, 121.15, 118.87, 118.44, 78.03, 62.65, 15.69; IR (thin film, cm^{-1}) 3429, 3068, 2920, 2851, 1630, 1575, 1508, 1470, 1384, 1116, 761, 619; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{15}NO_2Na$ $[M+Na]^+$ 300.0995, Found 300.0999.

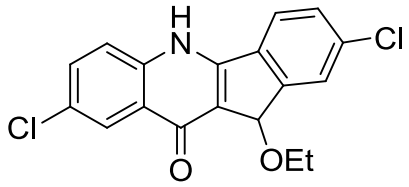
11-Ethoxy-2-fluoro-5H-indeno[1,2-b]quinolin-10(11H)-one (4j)



4j

White solid in 48% yield (MeOH/DCM = 1:130): Mp 318.8–319.5 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.50 – 12.40 (m, 1H), 8.18 (dd, *J* = 7.0, 2.5 Hz, 1H), 8.08 – 7.81 (m, 1H), 7.78 – 7.62 (m, 3H), 7.43 – 7.33 (m, 2H), 5.57 – 5.50 (m, 1H), 3.70 – 3.57 (m, 2H), 1.14 – 1.06 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 173.46, 173.21, 164.06 (d, *J* = 192.0 Hz), 162.43 (d, *J* = 189.0 Hz), 149.03 (d, *J* = 3.0 Hz), 148.90 (d, *J* = 9.0 Hz), 141.60 (d, *J* = 1.5 Hz), 139.94 (d, *J* = 7.5 Hz), 136.58, 136.52, 131.71 (d, *J* = 24.0 Hz), 130.62 (d, *J* = 1.5 Hz), 127.03 (d, *J* = 9.0 Hz), 126.68 (d, *J* = 27.0 Hz), 125.85 (d, *J* = 57.0 Hz), 125.27 (d, *J* = 7.5 Hz), 123.61, 123.51, 123.06, 123.00, 118.96 (d, *J* = 1.5 Hz), 118.43 (d, *J* = 9.0 Hz), 117.02, 116.87, 116.18, 116.02, 113.13, 112.98, 108.52, 108.36, 77.75, 77.45, 62.88, 62.73, 15.65, 15.63; IR (thin film, cm^{-1}) 3426, 3071, 2921, 2851, 1633, 1632, 1574, 1508, 1470, 1341, 1109, 764, 696; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}FNO_2Na$ $[M+Na]^+$ 318.0901, Found 318.0901.

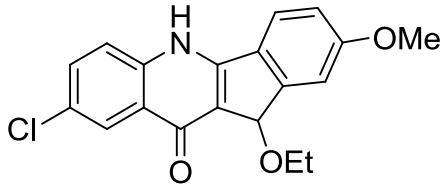
2,8-Dichloro-11-ethoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4k)



4k

White solid in 52% yield (MeOH/DCM = 1:130): Mp 318.7–319.2 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.64 – 12.51 (m, 1H), 8.08 – 7.94 (m, 2H), 7.69 (dd, J = 8.7, 2.4 Hz, 1H), 7.67 – 7.60 (m, 3H), 5.54 – 5.48 (m, 1H), 3.69 – 3.54 (m, 2H), 1.11 – 1.03 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 172.13, 172.05, 149.54, 149.18, 147.89, 144.35, 138.59, 138.53, 136.08, 135.48, 133.58, 132.91, 131.80, 131.71, 130.18, 129.26, 128.29, 127.82, 126.95, 125.57, 124.23, 124.21, 122.80, 121.30, 120.82, 120.79, 119.93, 119.27, 77.73, 77.55, 63.22, 62.97, 15.62, 15.52; IR (thin film, cm^{-1}) 3427, 3064, 2920, 2851, 1632, 1574, 1506, 1470, 1384, 1114, 758, 618, 581; HRMS (ESI): *m/z* Calcd. for $C_{18}H_{14}ClNO_2Na$ $[M+Na]^+$ 334.0605; Found 334.0617.

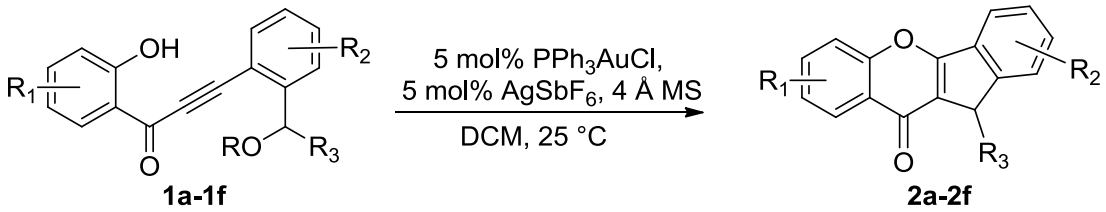
8-Chloro-11-ethoxy-2-methoxy-5H-indeno[1,2-b]quinolin-10(11H)-one (4l)



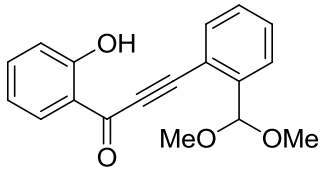
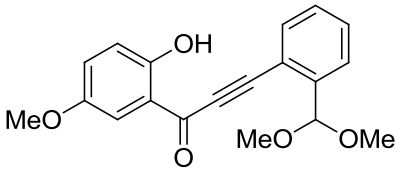
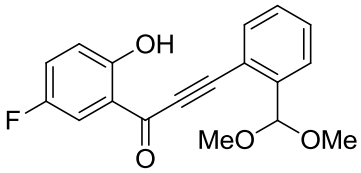
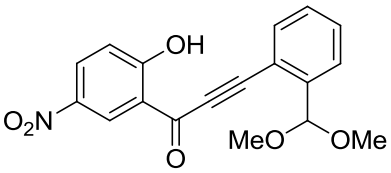
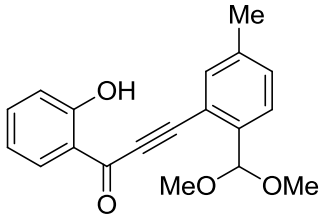
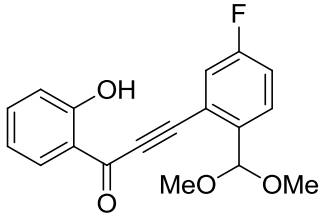
4l

White solid in 61% yield (MeOH/DCM = 1:100): Mp 335.7–336.9 ℃ (decomposed); ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.58 – 12.46 (m, 1H), 8.09 (d, J = 7.1 Hz, 1H), 7.74 – 7.64 (m, 2H), 7.62 (d, J = 6.0 Hz, 1H), 7.53 (d, J = 7.6 Hz, 1H), 7.15 – 7.04 (m, 1H), 5.52 – 5.44 (m, 1H), 3.87 (s, 3H), 3.64 – 3.52 (m, 2H), 1.12 – 1.02 (m, 3H); ^{13}C NMR (150 MHz, DMSO-d_6) δ 171.92, 171.51, 161.95, 160.16, 150.94, 150.50, 138.55, 137.57, 131.57, 131.31, 128.09, 127.91, 127.89, 127.76, 126.25, 126.20, 124.25, 124.20, 122.54, 122.50, 120.74, 120.70, 118.09, 116.57, 114.98, 114.75, 111.20, 111.12, 106.42, 106.33, 77.74, 77.38, 62.50, 62.35, 55.66, 55.56, 15.72, 15.66; IR (thin film, cm^{-1}) 3425, 2920, 2851, 1618, 1573, 1506, 1469, 1241, 1148, 1121, 880, 768, 643, 619; HRMS (ESI): *m/z* Calcd. for $C_{19}H_{16}ClNO_3Na$ $[M+Na]^+$ 364.0711, Found 364.0715.

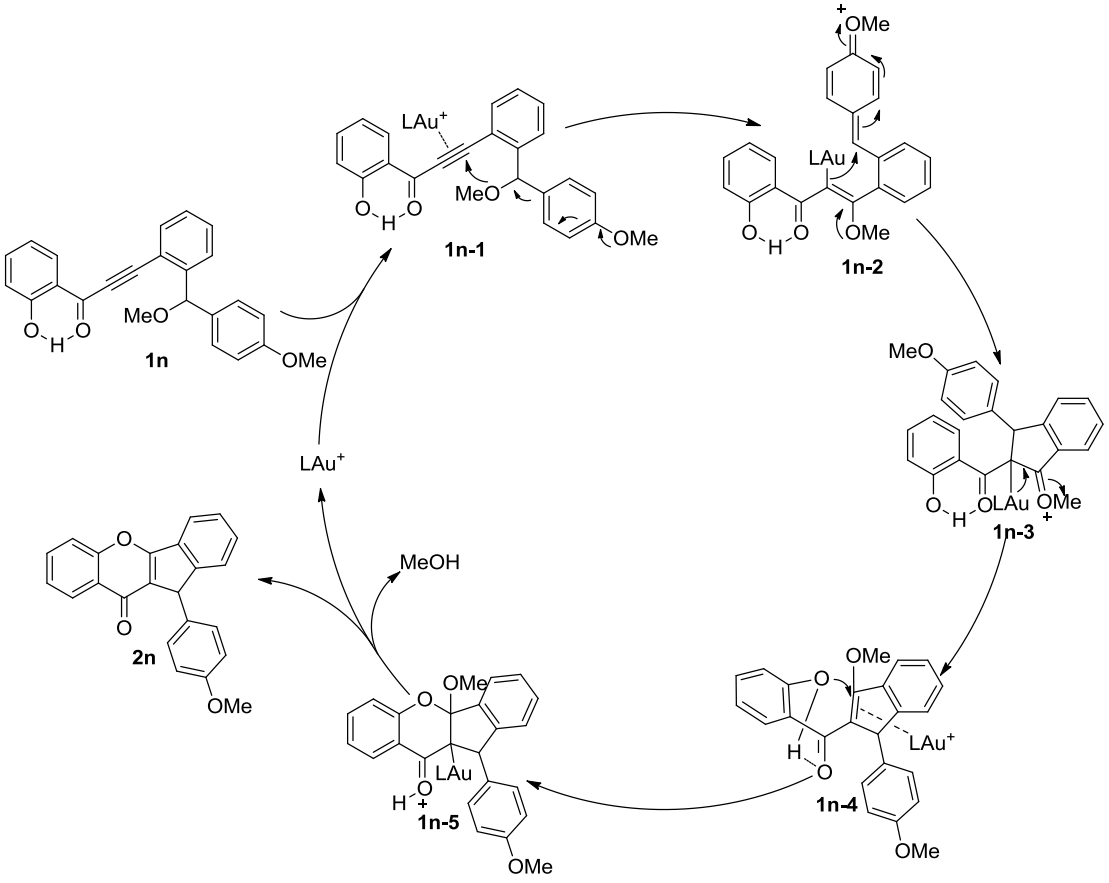
7. The Reaction Time Determination



1a-1f **2a-2f**

substrate	structure	time of 50% conversion (min)	time of 100% conversion (min)
1a		20	60
1b		10	40
1c		15	90
1d		2	5
1e		15	50
1f		50	120

8. The Proposed Mechanism for *p*-Methoxylbenzyl Ether-type Substrates



9. References

[S1] Zi, W, F. D. Toste, *J. Am. Chem. Soc*. **2013**, *135*, 12600–12603.

[S2] L. Sun, Y. Zhu, P. Lu, Y. Wang, *Org. Lett*. **2013**, *15*, 5894–5897.

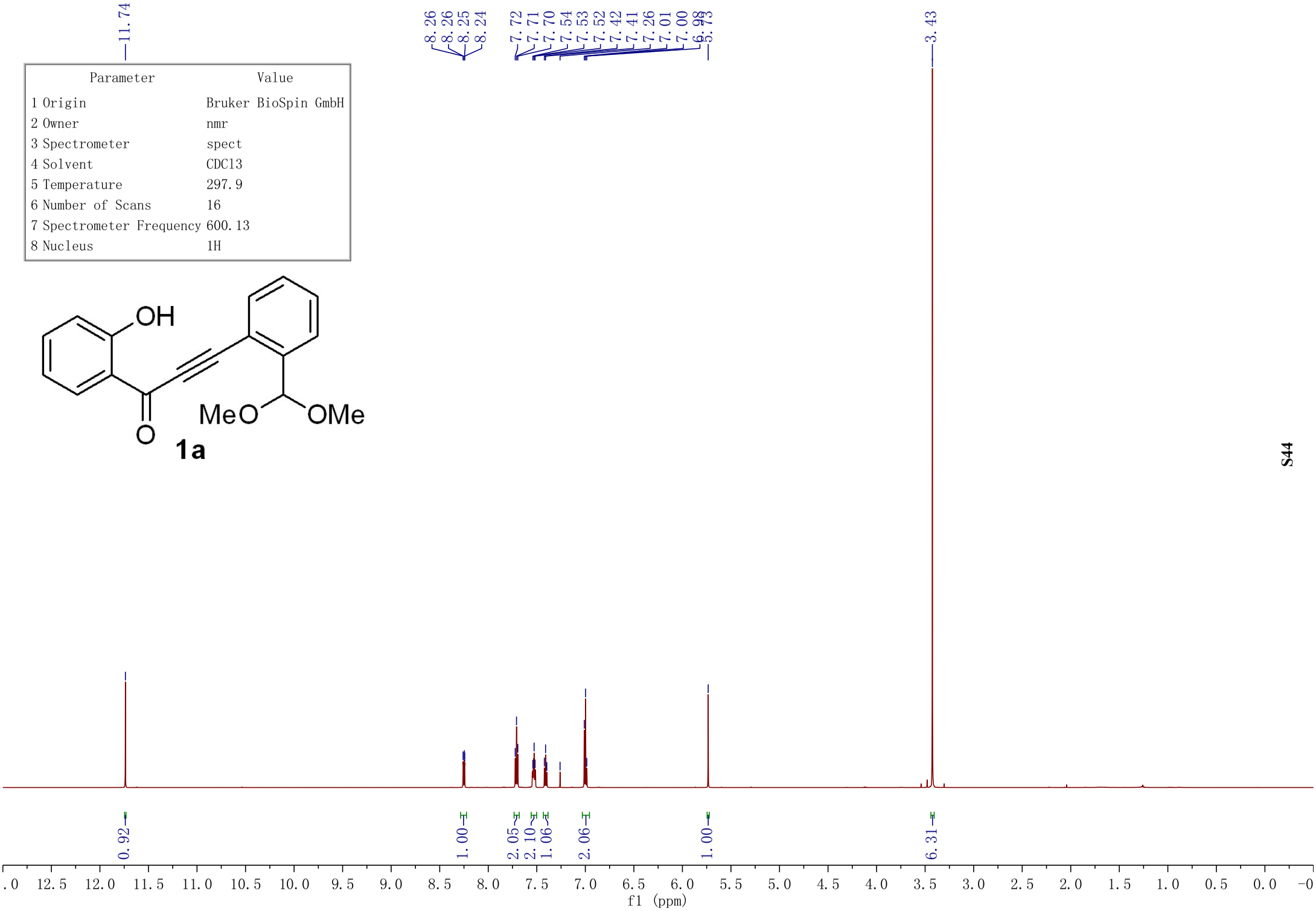
[S3] Y. Zhao, D. Li, L. Zhao, J. Zhao, *Synthesis* **2011**, *6*, 873–880.

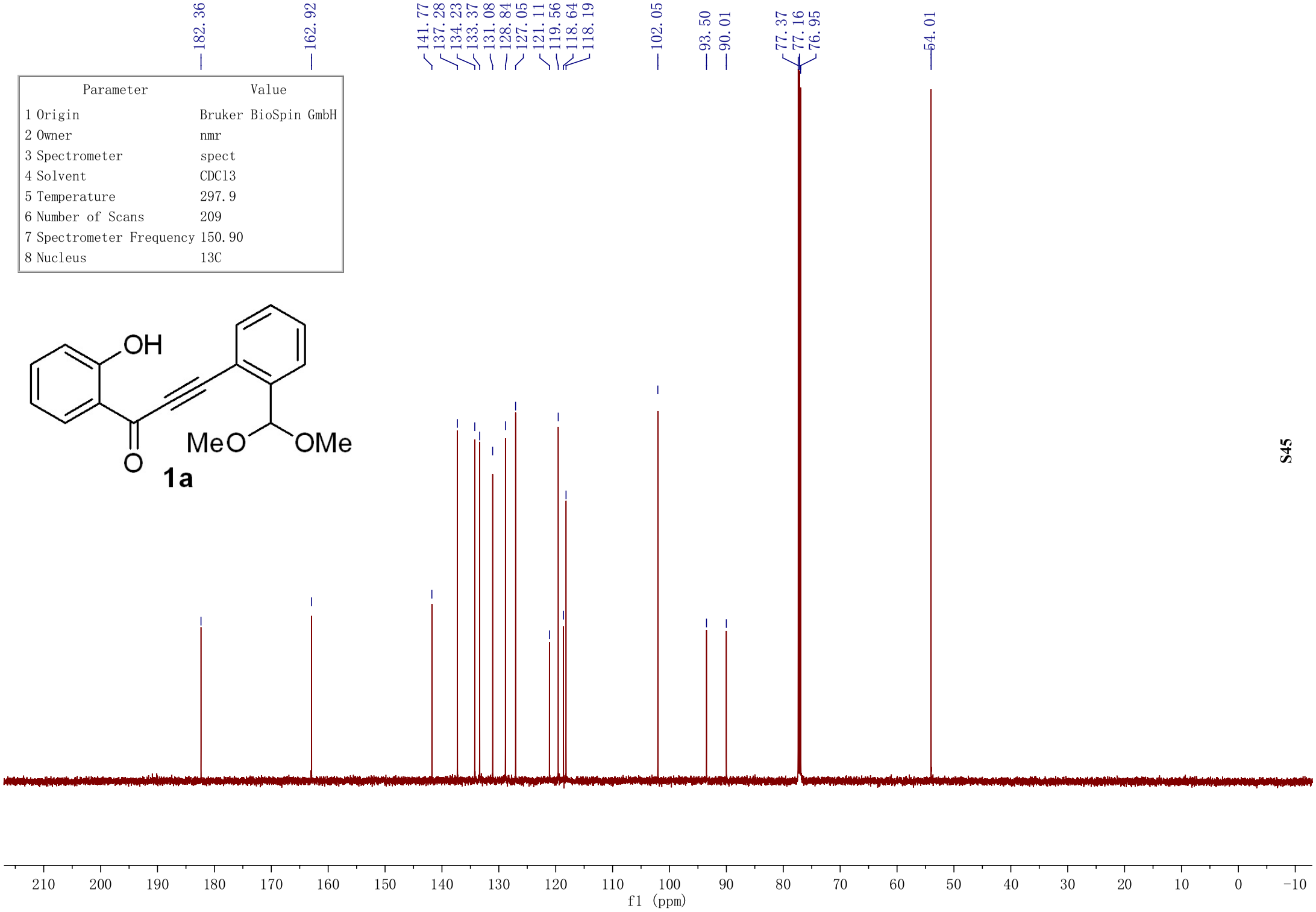
[S4] S. K. Pawar, C. -D. Wang, S. Bhunia, A. M. Jadhav, R. -S. Liu, *Angew. Chem*. **2013**, *125*, 7707–7711; *Angew. Chem. Int. Ed.* **2013**, *52*, 7559−7563.

10. NMR Spectra

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

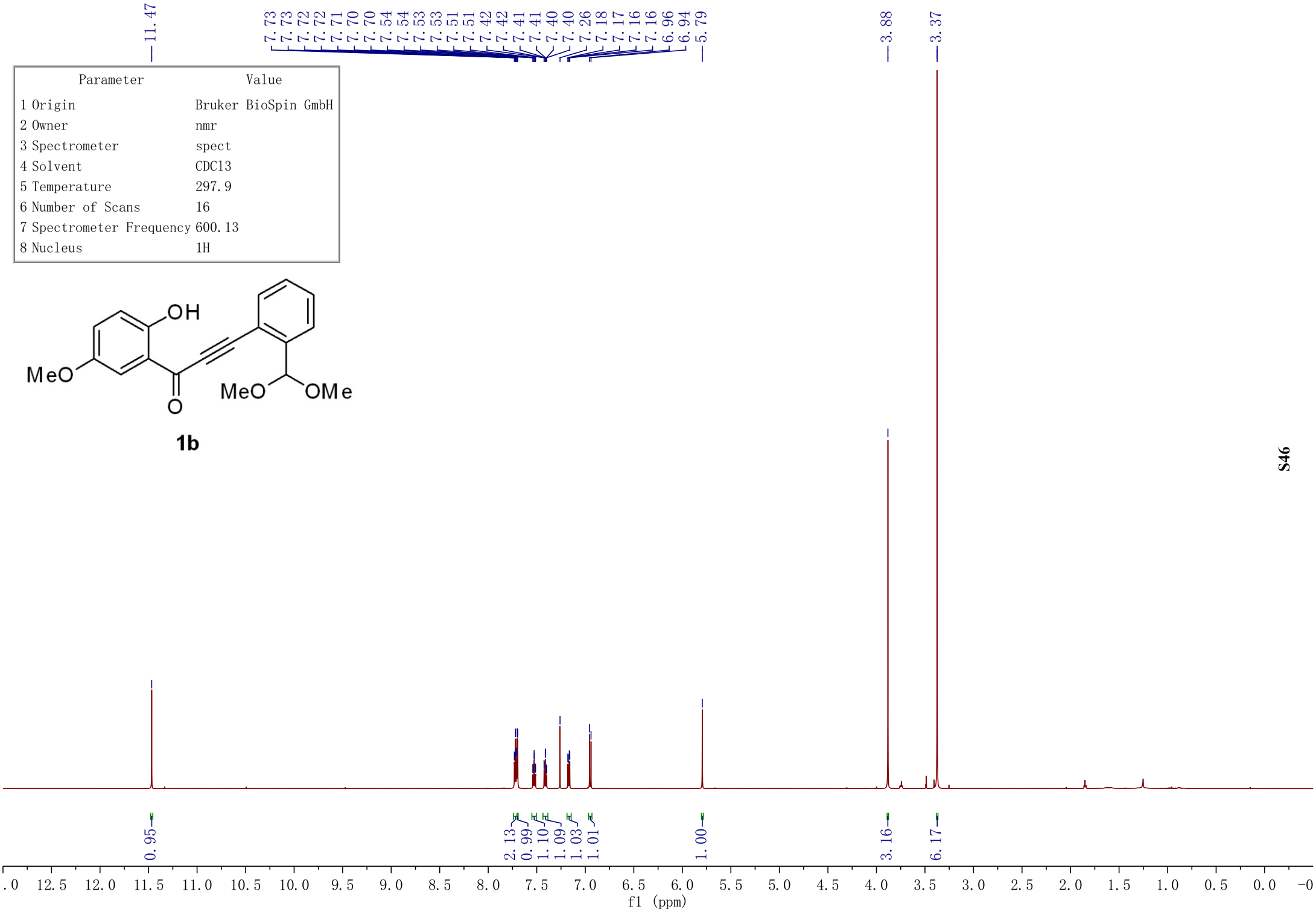
1a

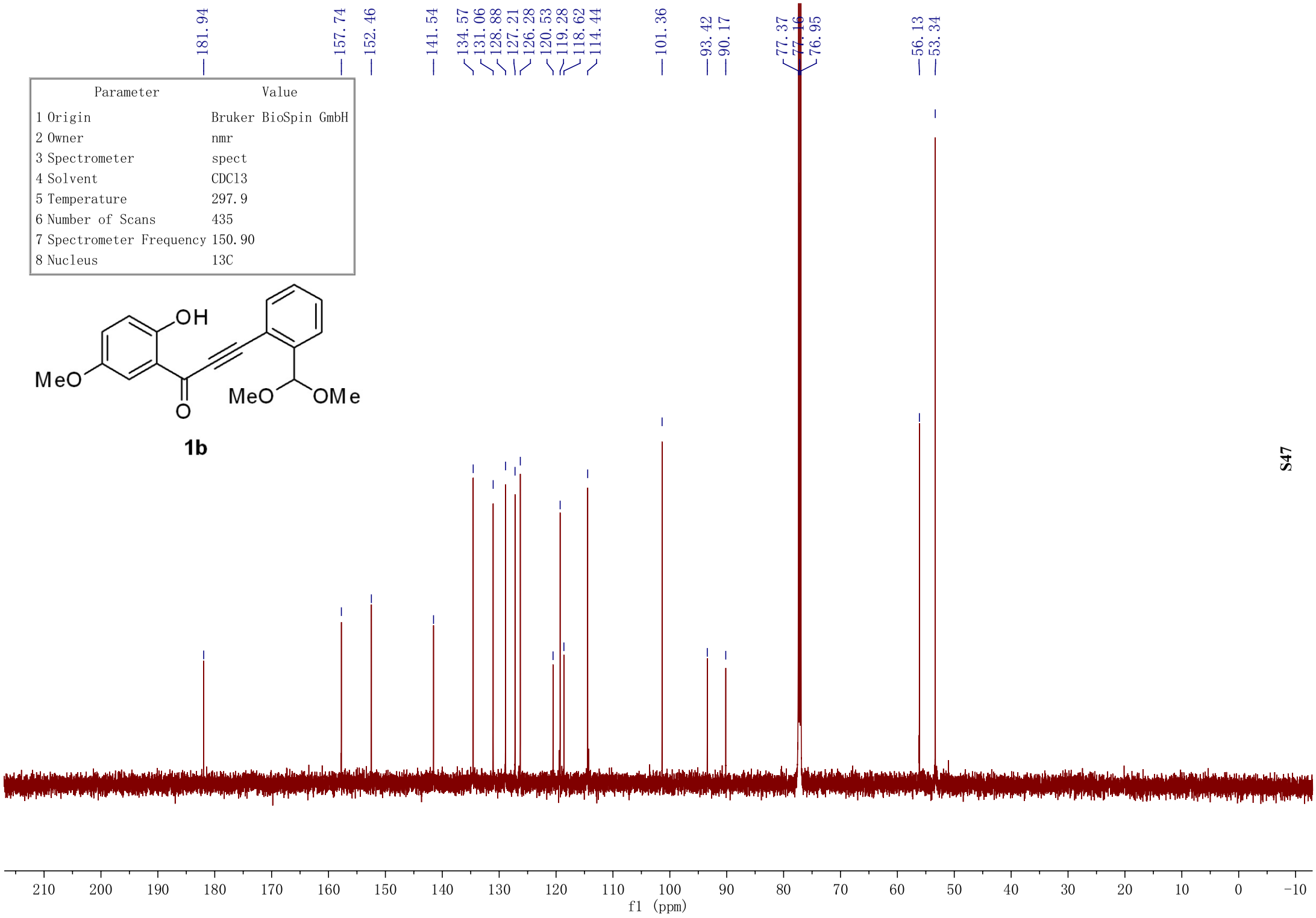



182.36
162.92
141.77
137.28
134.23
133.37
131.08
128.84
127.05
121.11
119.56
118.64
118.19
102.05
93.50
90.01
77.37
77.16
76.95
54.01
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 209
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
O
MeO
OMe
1a
S45
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

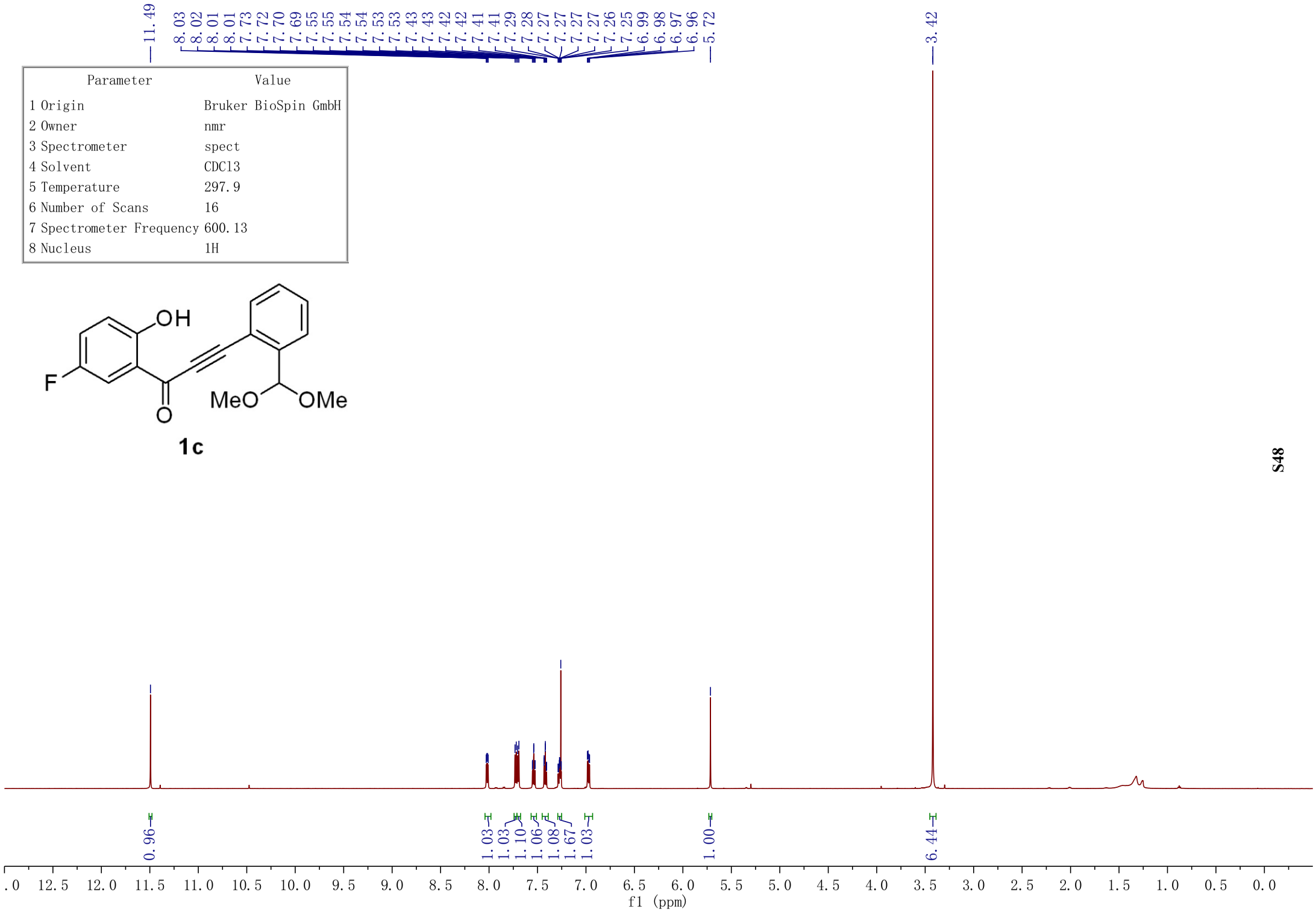
1b

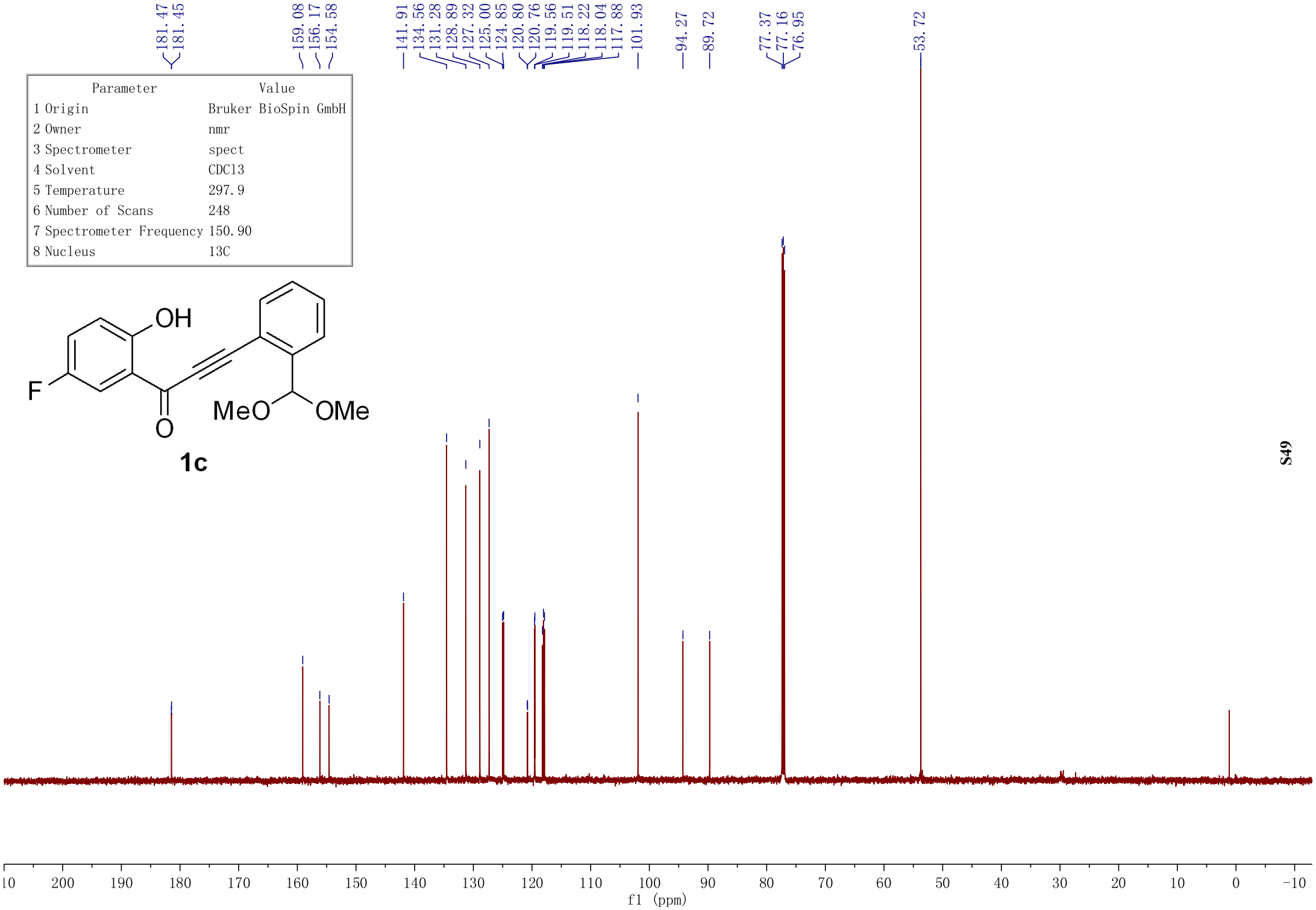



181.94
157.74
152.46
141.54
134.57
131.06
128.88
127.21
126.28
120.53
119.28
118.62
114.44
101.36
93.42
90.17
77.37
77.16
76.95
56.13
53.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 435
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
MeO
O
MeO
OMe
1b
S47
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

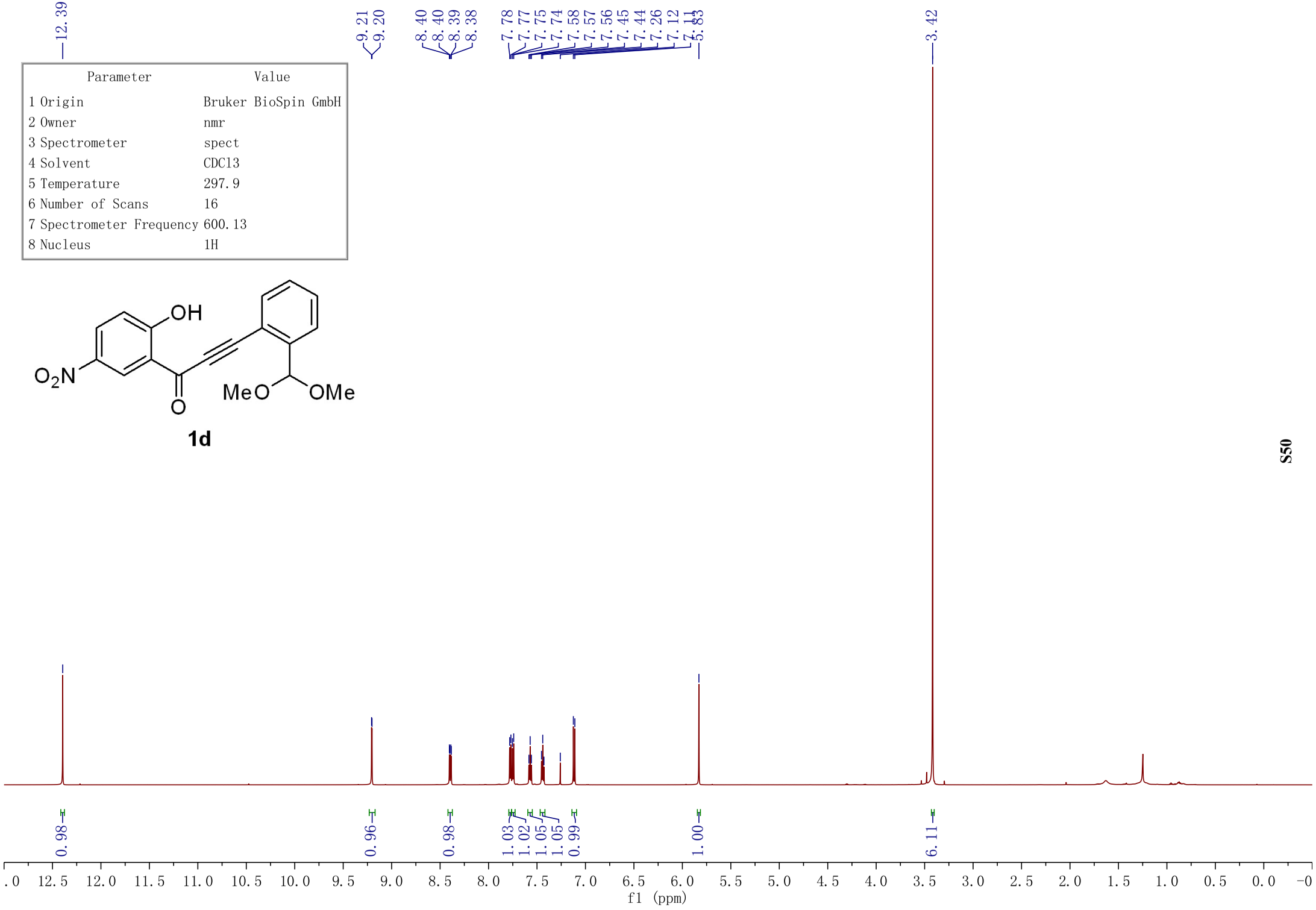
1c

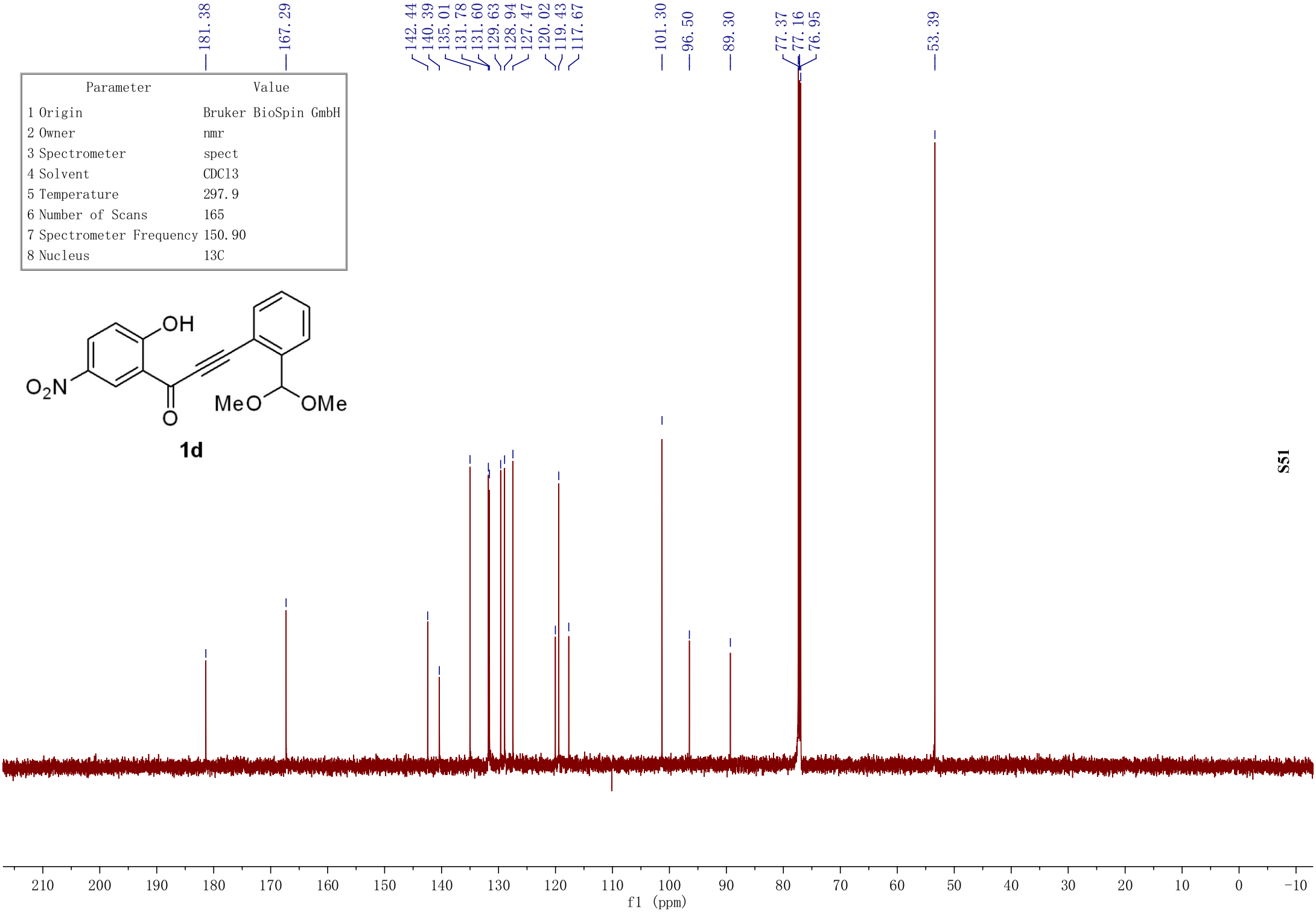



181.47
181.45
159.08
156.17
154.58
141.91
134.56
131.28
128.89
127.32
125.00
124.85
120.80
120.76
119.56
119.51
118.22
118.04
117.88
101.93
94.27
89.72
77.37
77.16
76.95
53.72
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 248
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
F
O
MeO
OMe
1c
S49
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

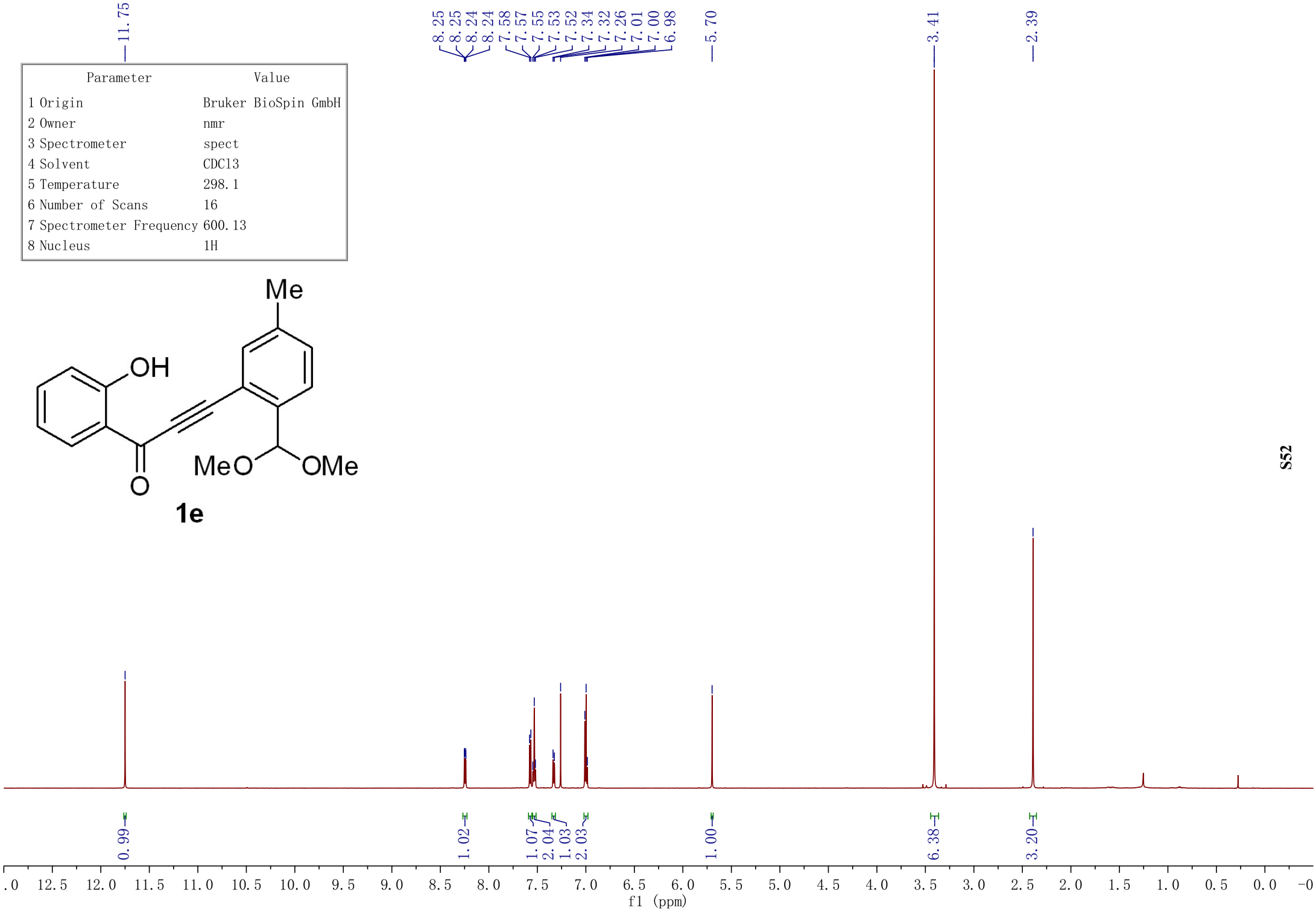
1d

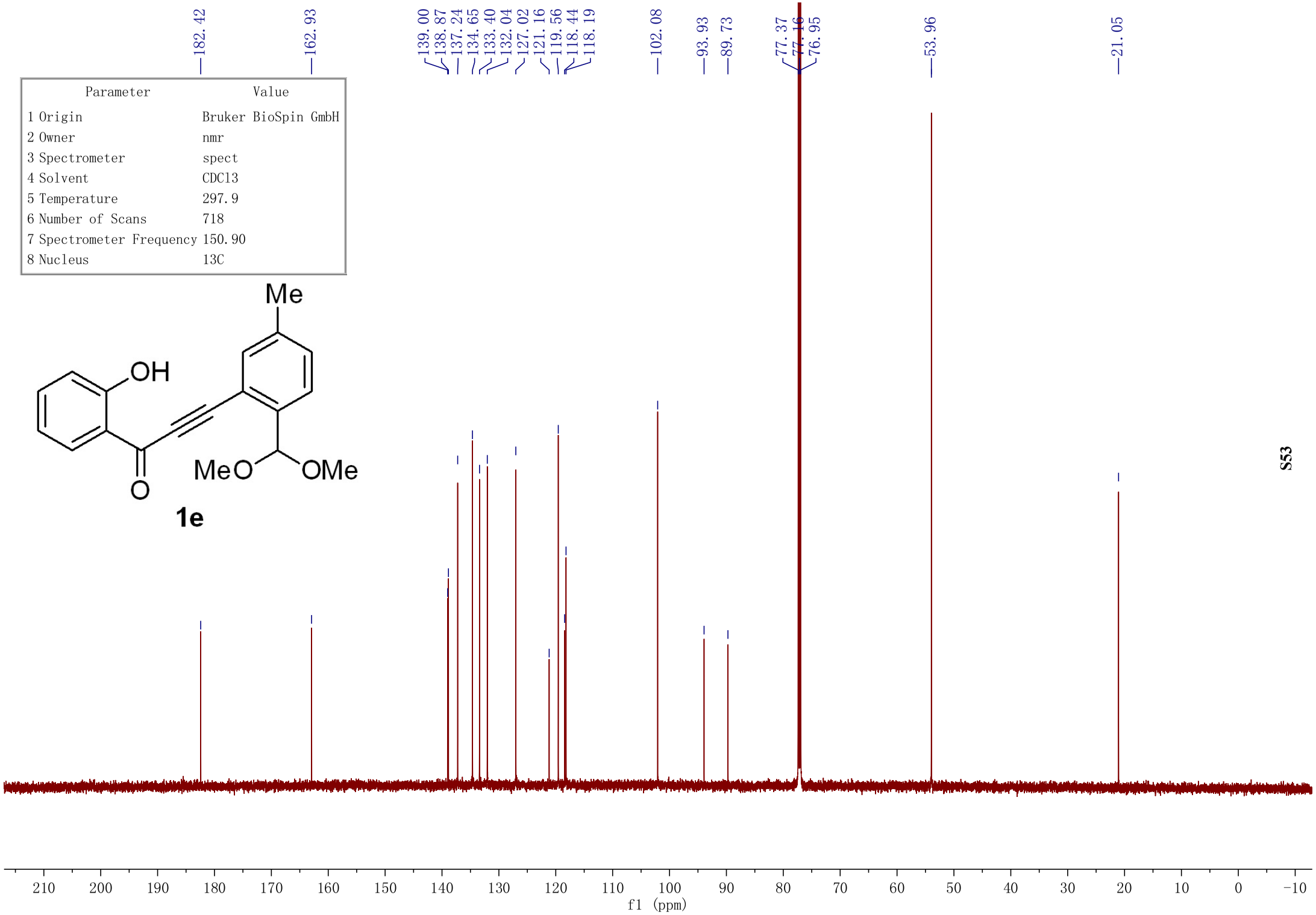



181.38
167.29
142.44
140.39
135.01
131.78
131.60
129.63
128.94
127.47
120.02
119.43
117.67
101.30
96.50
89.30
77.37
77.16
76.95
53.39
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 165
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
O2N
O
MeO
OMe
1d
S51
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	298.1
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

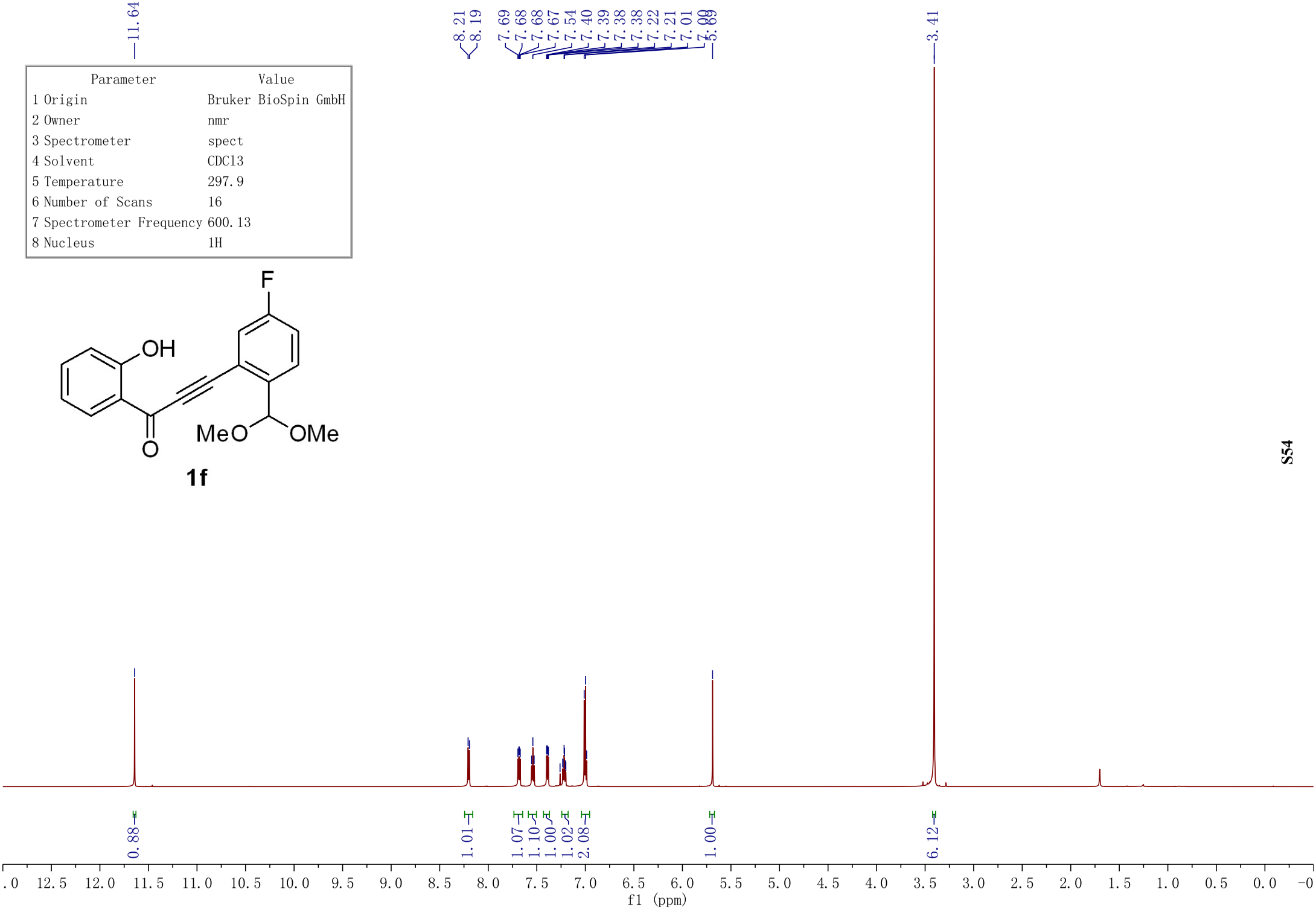
1e

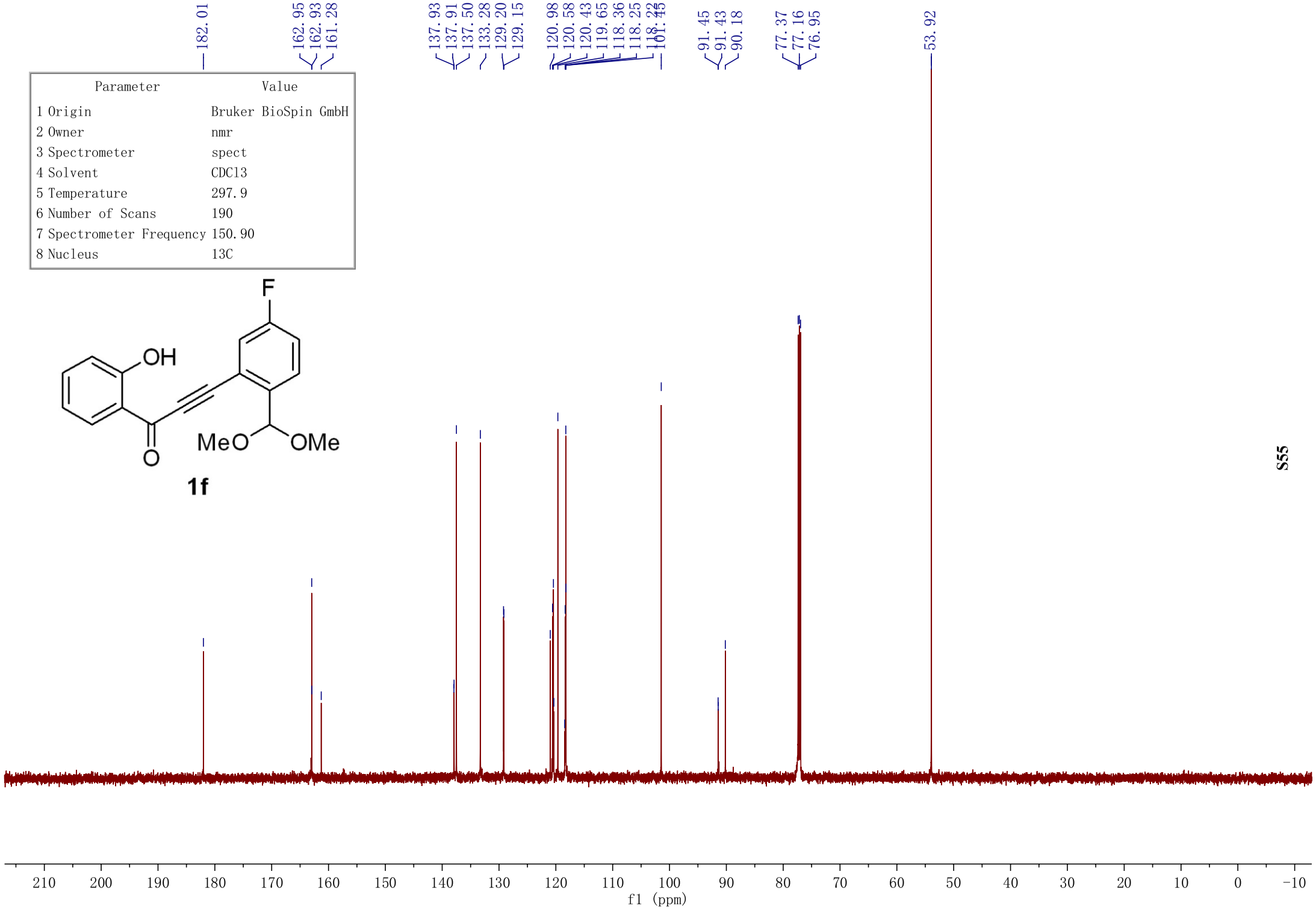


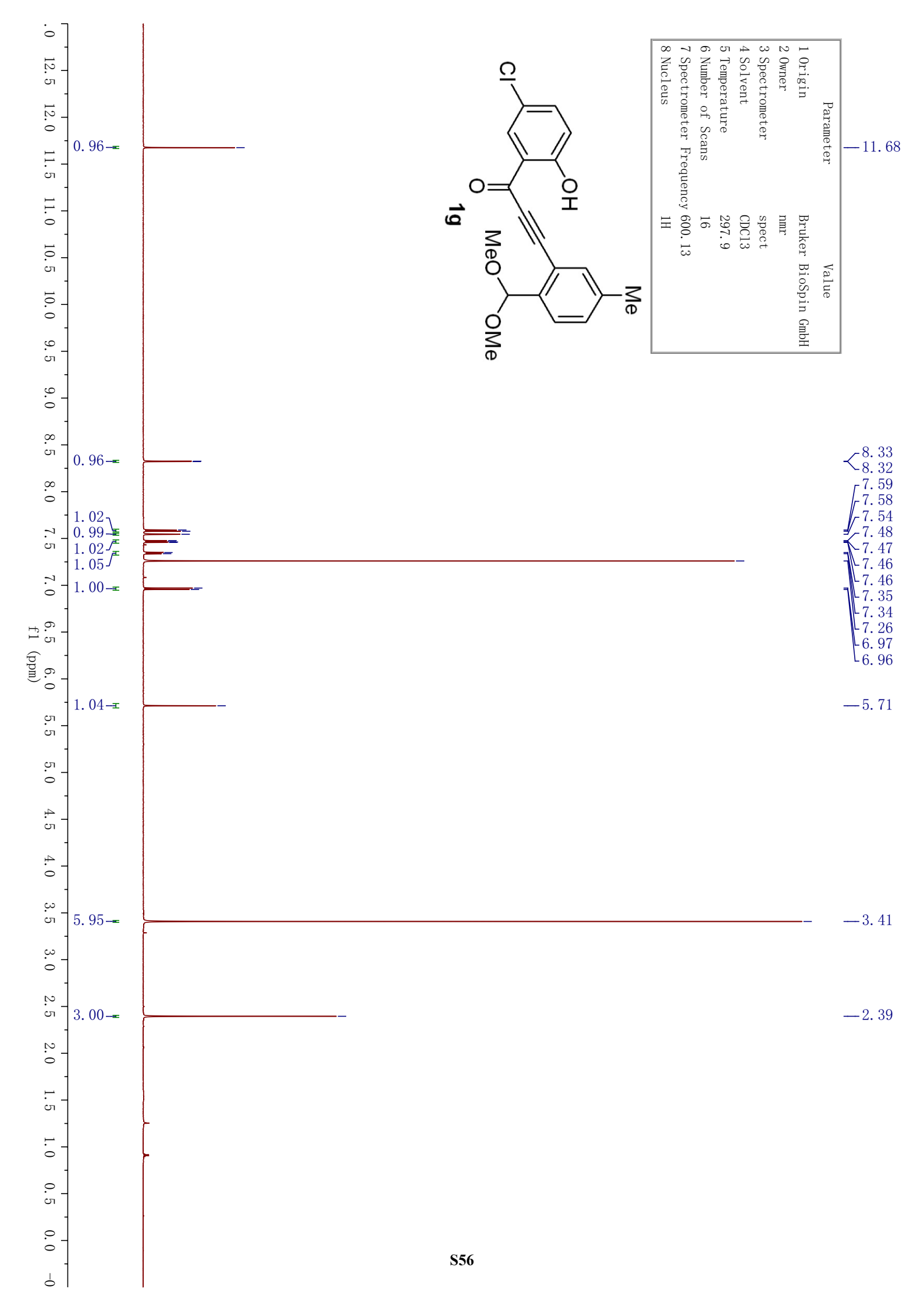

182.42
162.93
139.00
138.87
137.24
134.65
133.40
132.04
127.02
121.16
119.56
118.44
118.19
102.08
93.93
89.73
77.37
77.16
76.95
53.96
21.05
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 718
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
OH
MeO
OMe
O
1e
S53
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

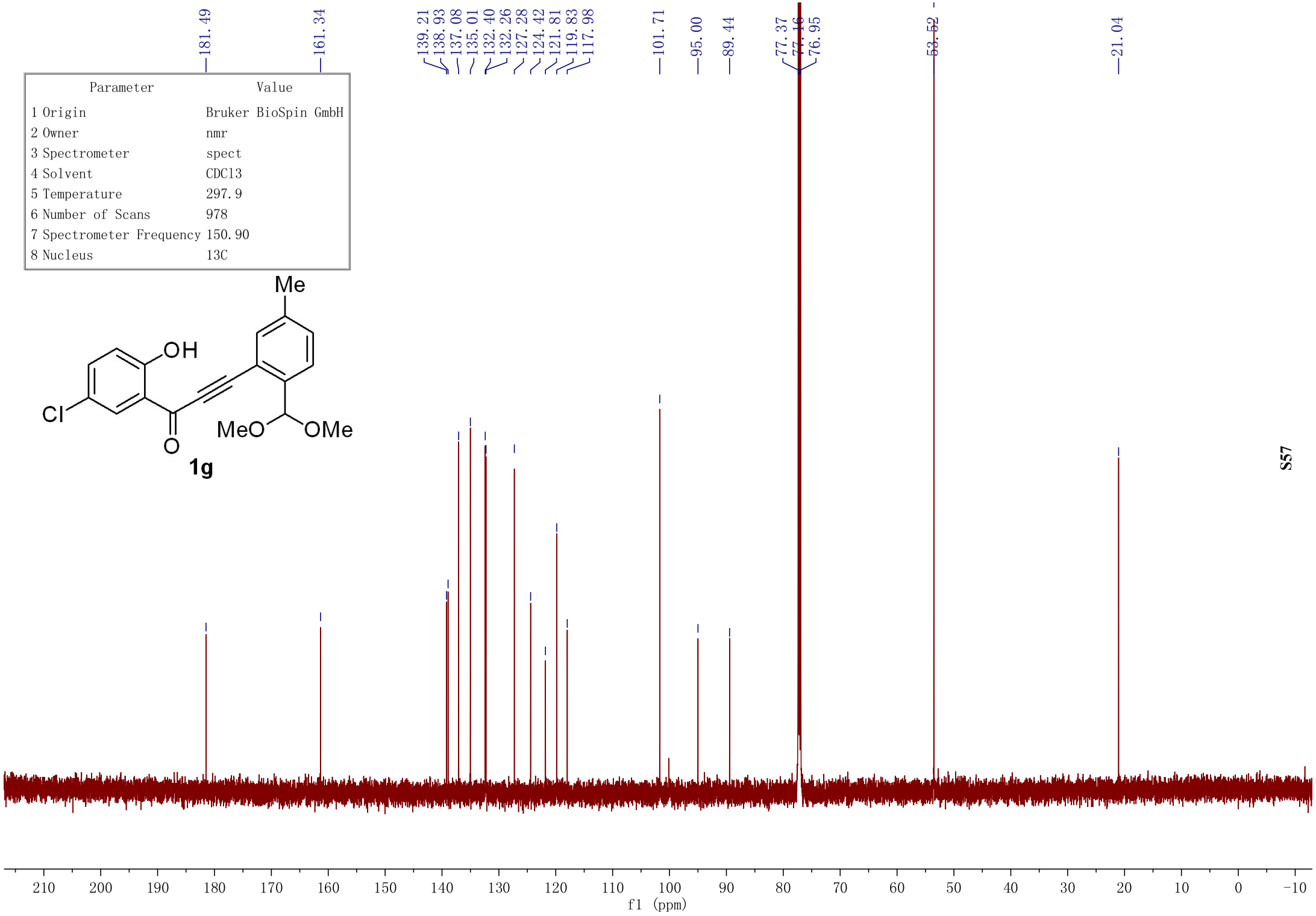
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

1f



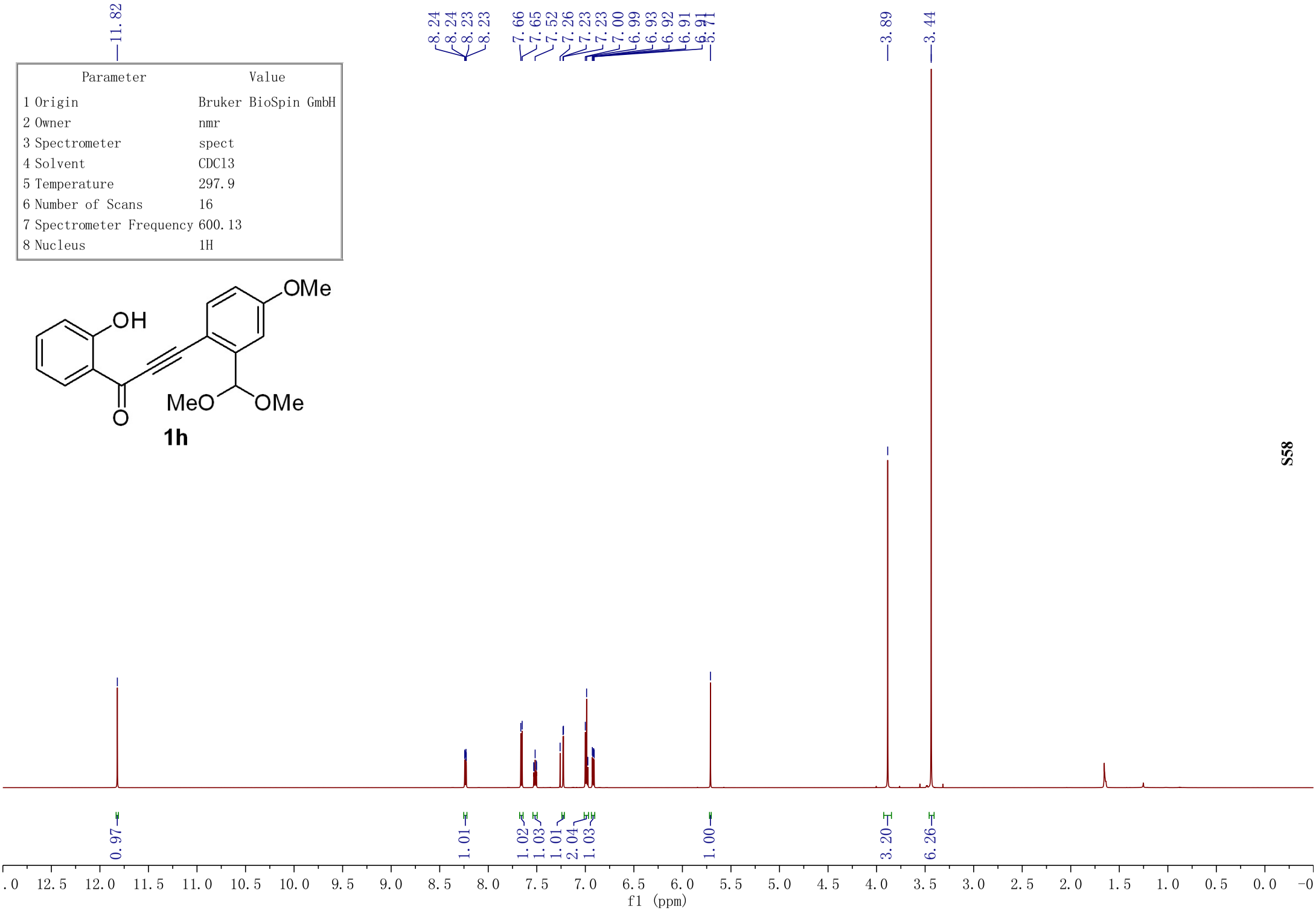

182.01
162.95
162.93
161.28
137.93
137.91
137.50
133.28
129.20
129.15
120.98
120.58
120.43
119.65
118.36
118.25
118.22
101.45
91.45
91.43
90.18
77.37
77.16
76.95
53.92
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 190
7 Spectrometer Frequency 150.90
8 Nucleus 13C
F
OH
MeO
OMe
O
1f
S55
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

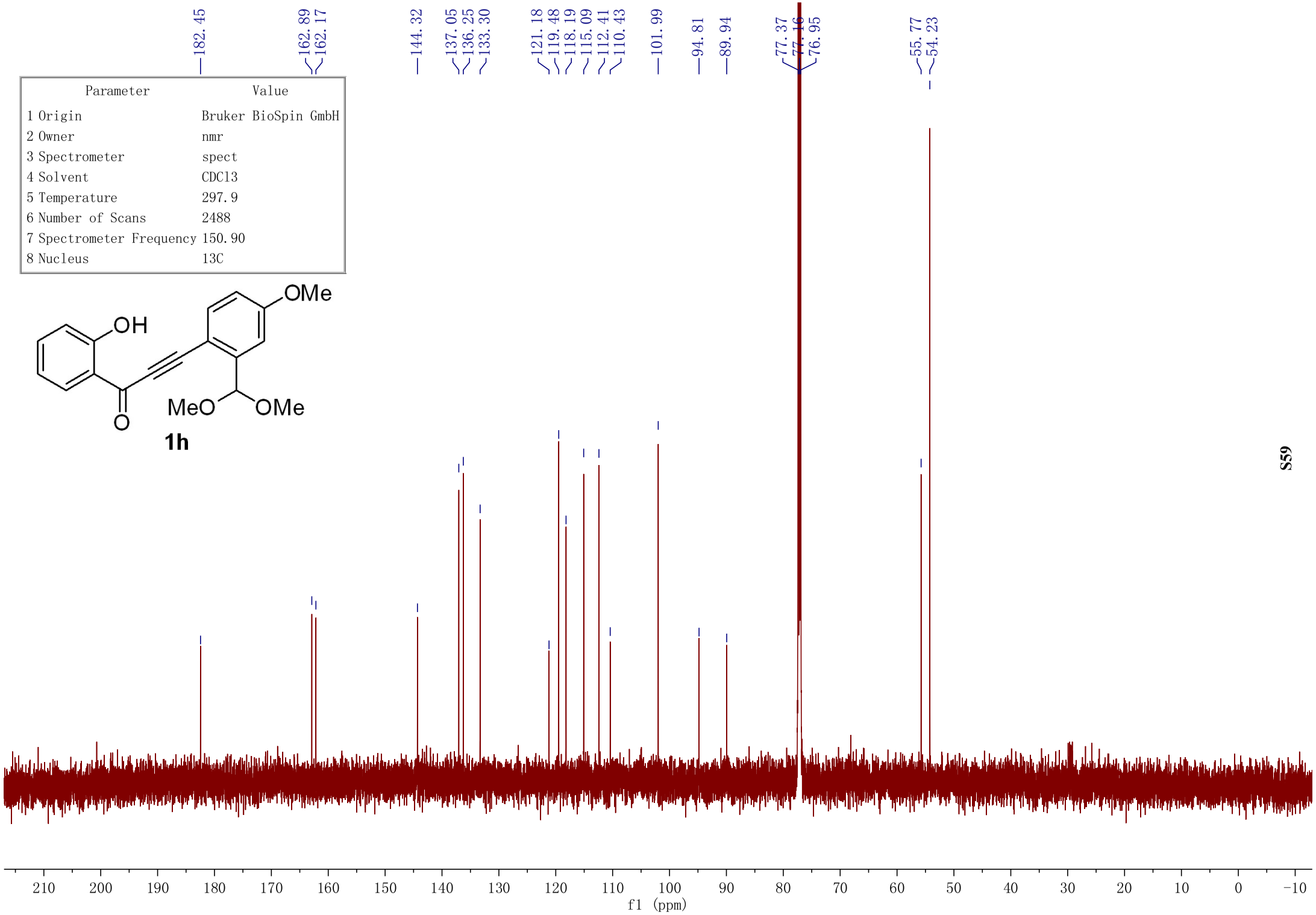

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
OH
O
MeO
OMe
Me
1g
0.96
0.96
1.02
0.99
1.02
1.05
1.00
1.04
5.95
3.00
11.68
8.33
8.32
7.59
7.58
7.54
7.48
7.47
7.46
7.46
7.35
7.34
7.26
6.97
6.96
5.71
3.41
2.39
f1 (ppm)


181.49
161.34
139.21
138.93
137.08
135.01
132.40
132.26
127.28
124.42
121.81
119.83
117.98
101.71
95.00
89.44
77.37
77.16
76.95
53.52
21.04
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 978
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
OH
Cl
O
MeO
OMe
1g
S57
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

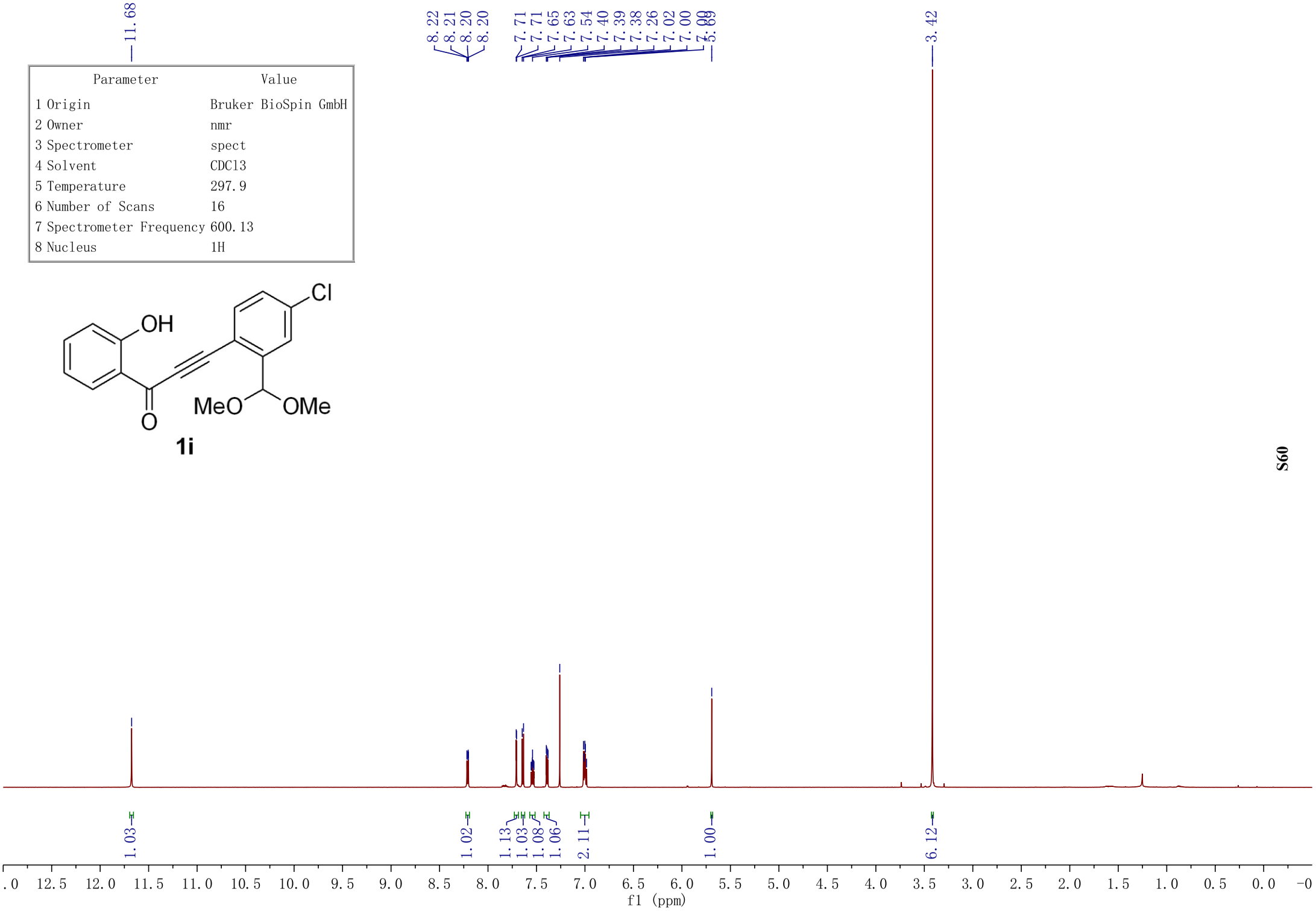
1h

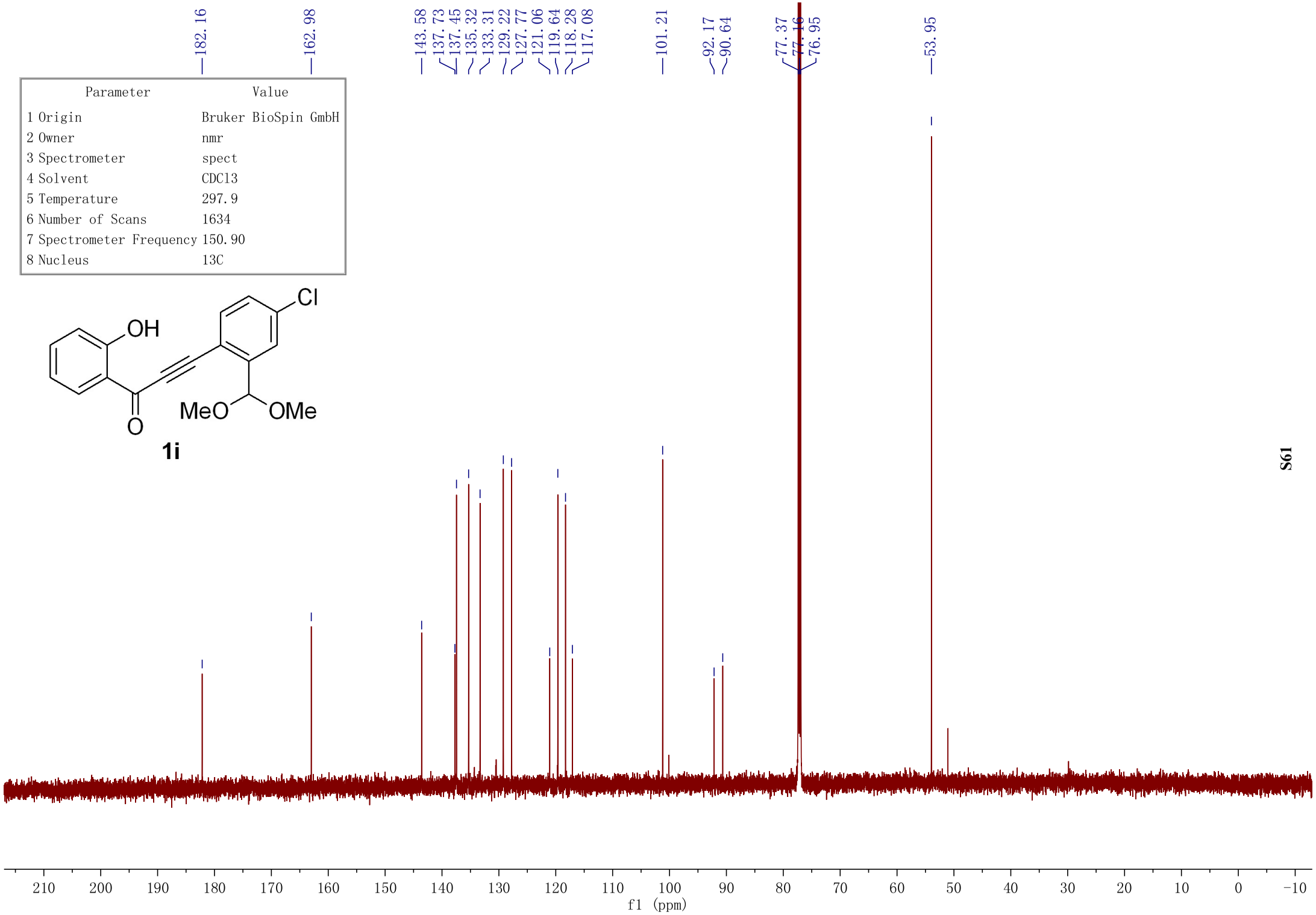



182.45
162.89
162.17
144.32
137.05
136.25
133.30
121.18
119.48
118.19
115.09
112.41
110.43
101.99
94.81
89.94
77.37
77.16
76.95
55.77
54.23
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 2488
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OMe
OH
MeO
OMe
O
1h
S59
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

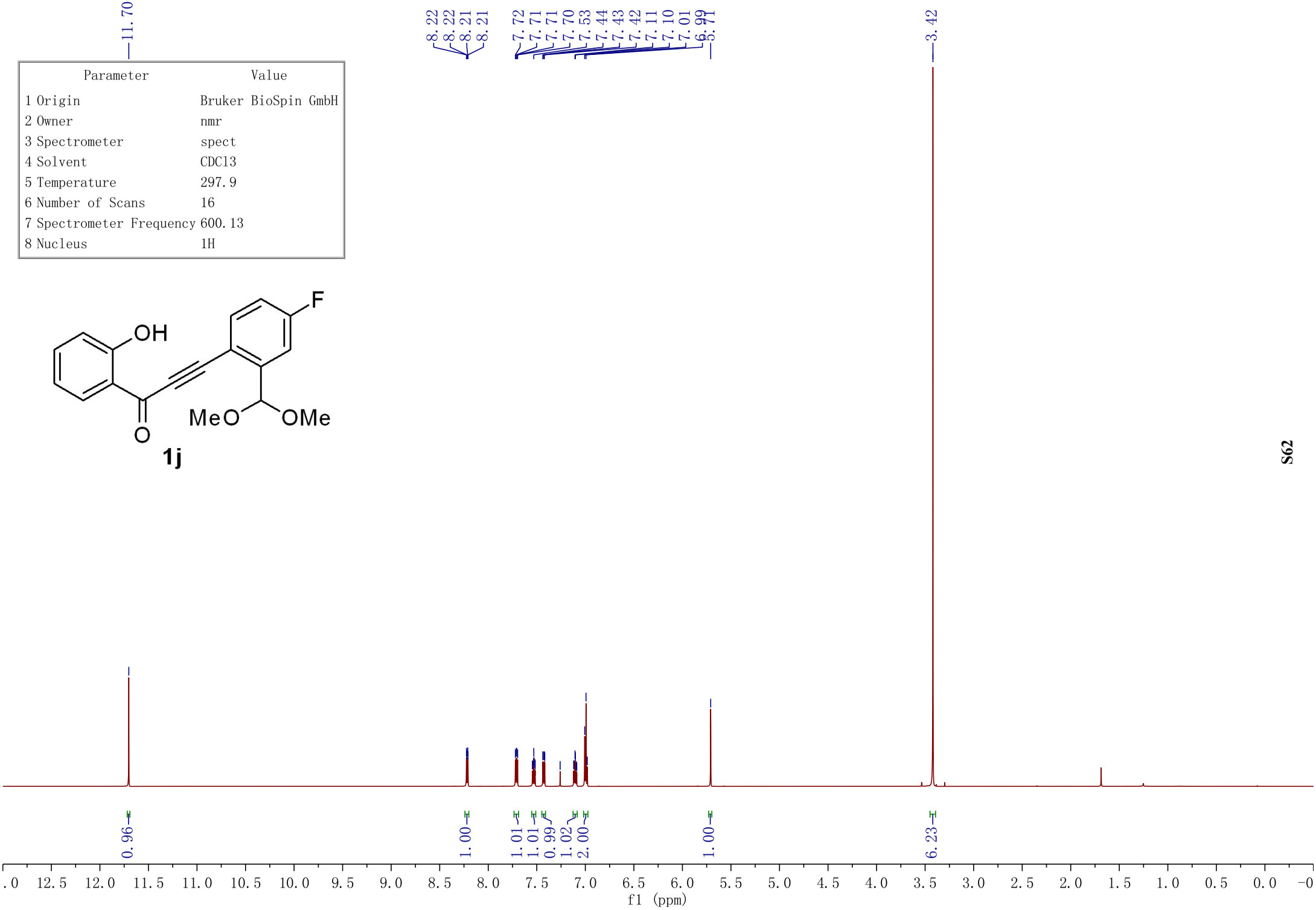
1i

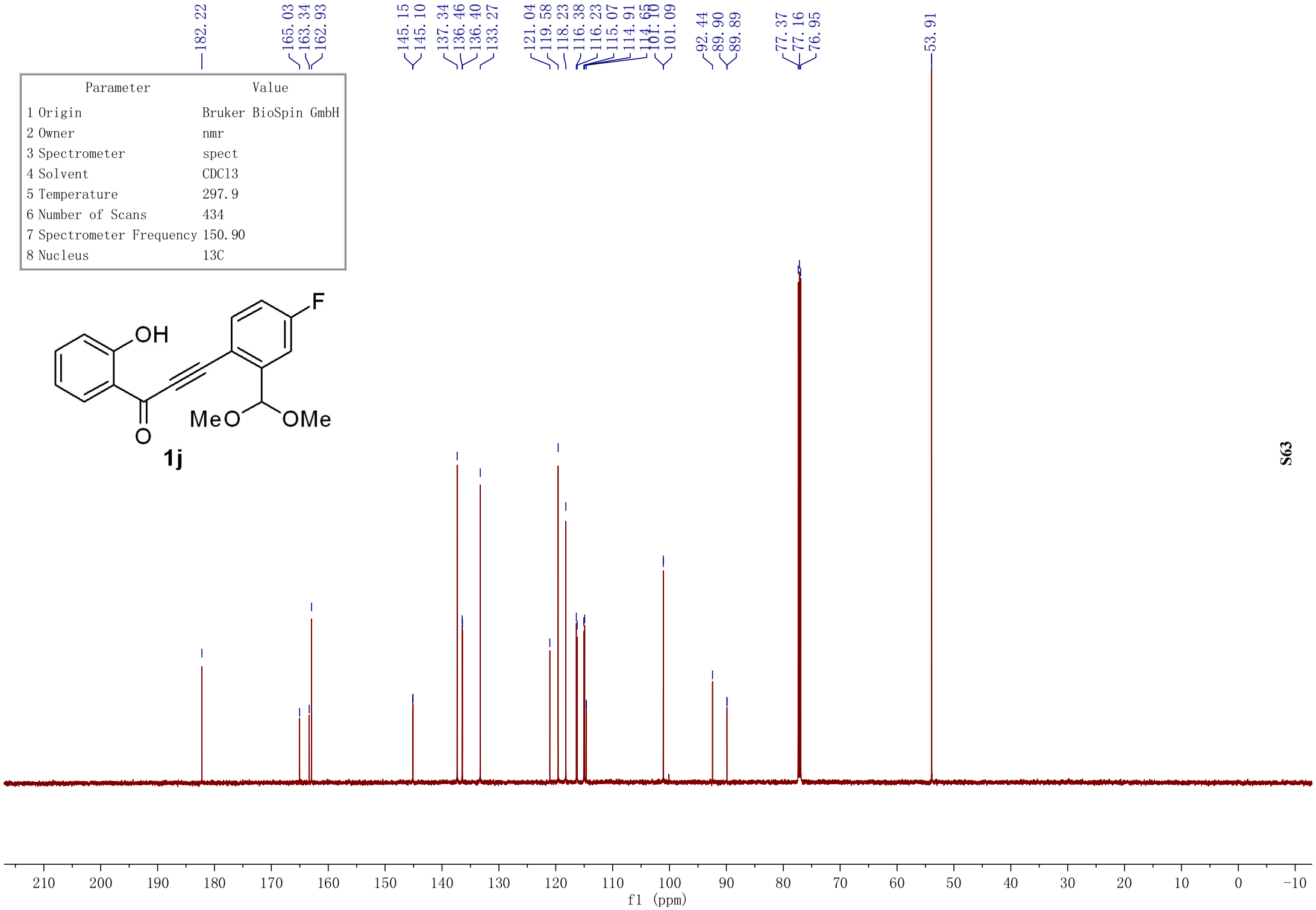


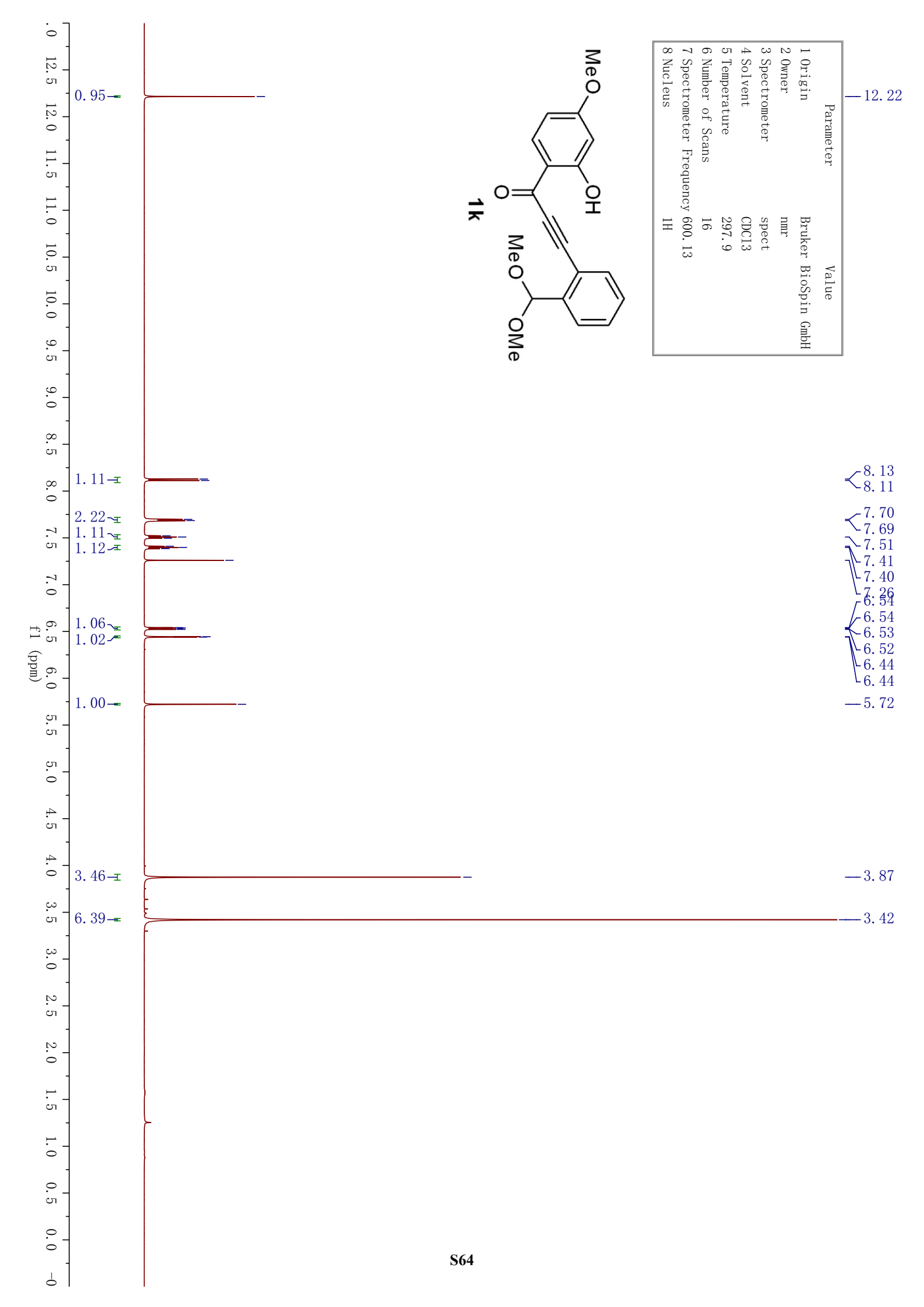

182.16
162.98
143.58
137.73
137.45
135.32
133.31
129.22
127.77
121.06
119.64
118.28
117.08
101.21
92.17
90.64
77.37
77.16
76.95
53.95
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 1634
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
Cl
MeO
OMe
O
1i
S61
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

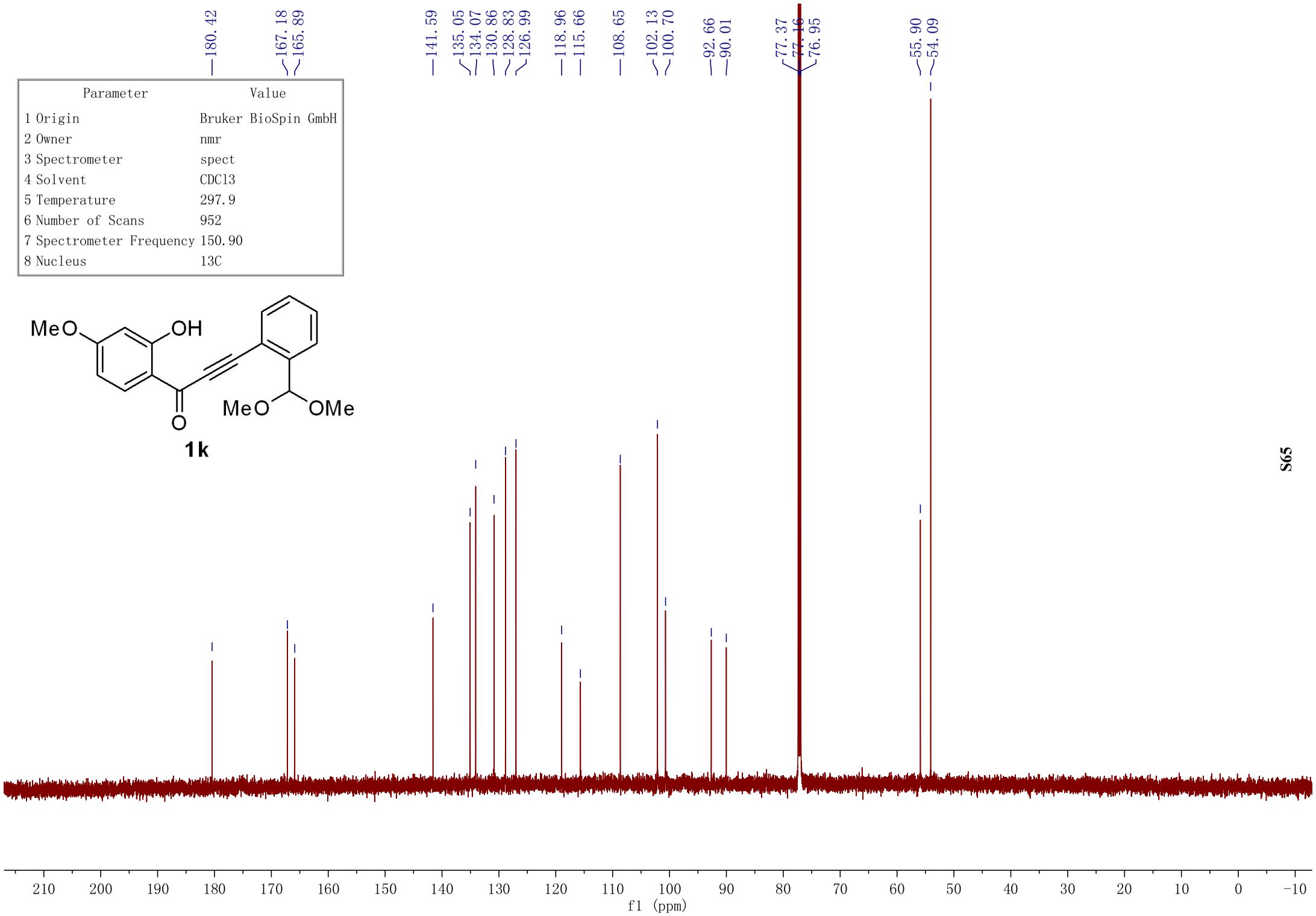
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

1j

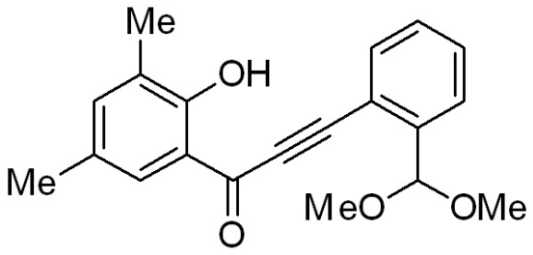



182.22
165.03
163.34
162.93
145.15
145.10
137.34
136.46
136.40
133.27
121.04
119.58
118.23
116.38
116.23
115.07
114.91
101.10
101.09
92.44
89.90
89.89
77.37
77.16
76.95
53.91
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 434
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
F
MeO
OMe
O
1j
S63
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

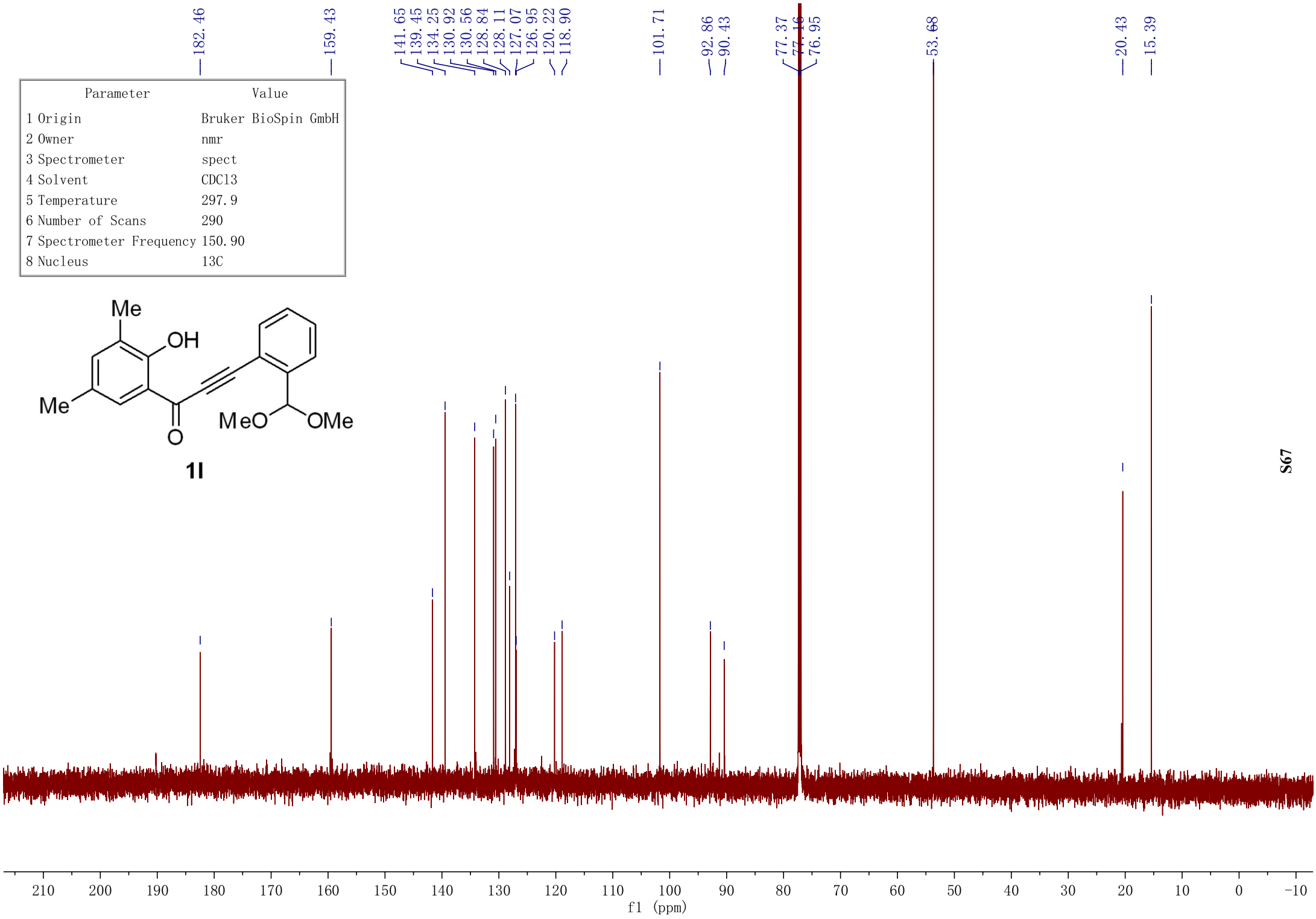

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
MeO
OH
O
MeO
OMe
1k
0.95
1.11
2.22
1.11
1.12
1.06
1.02
1.00
3.46
6.39
12.22
8.13
8.11
7.70
7.69
7.51
7.41
7.40
7.26
6.54
6.54
6.53
6.52
6.44
6.44
5.72
3.87
3.42
f1 (ppm)


180.42
167.18
165.89
141.59
135.05
134.07
130.86
128.83
126.99
118.96
115.66
108.65
102.13
100.70
92.66
90.01
77.37
77.16
76.95
55.90
54.09
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 952
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
OH
O
MeO
OMe
1k
S65
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

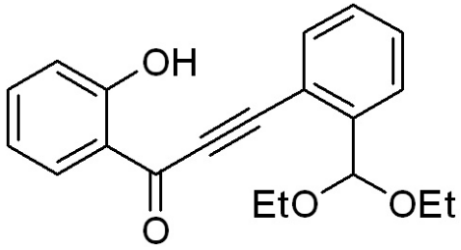
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



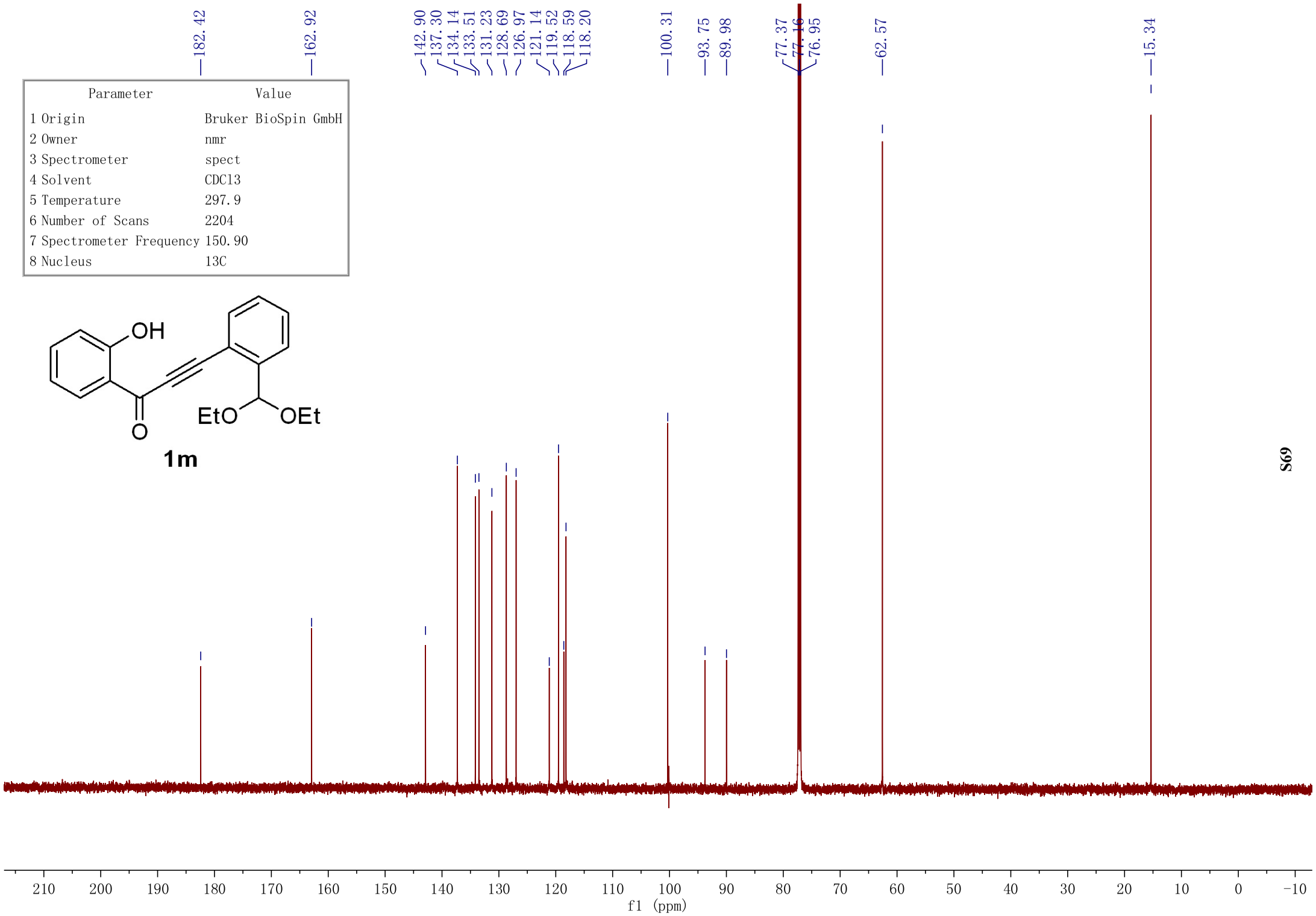
1l

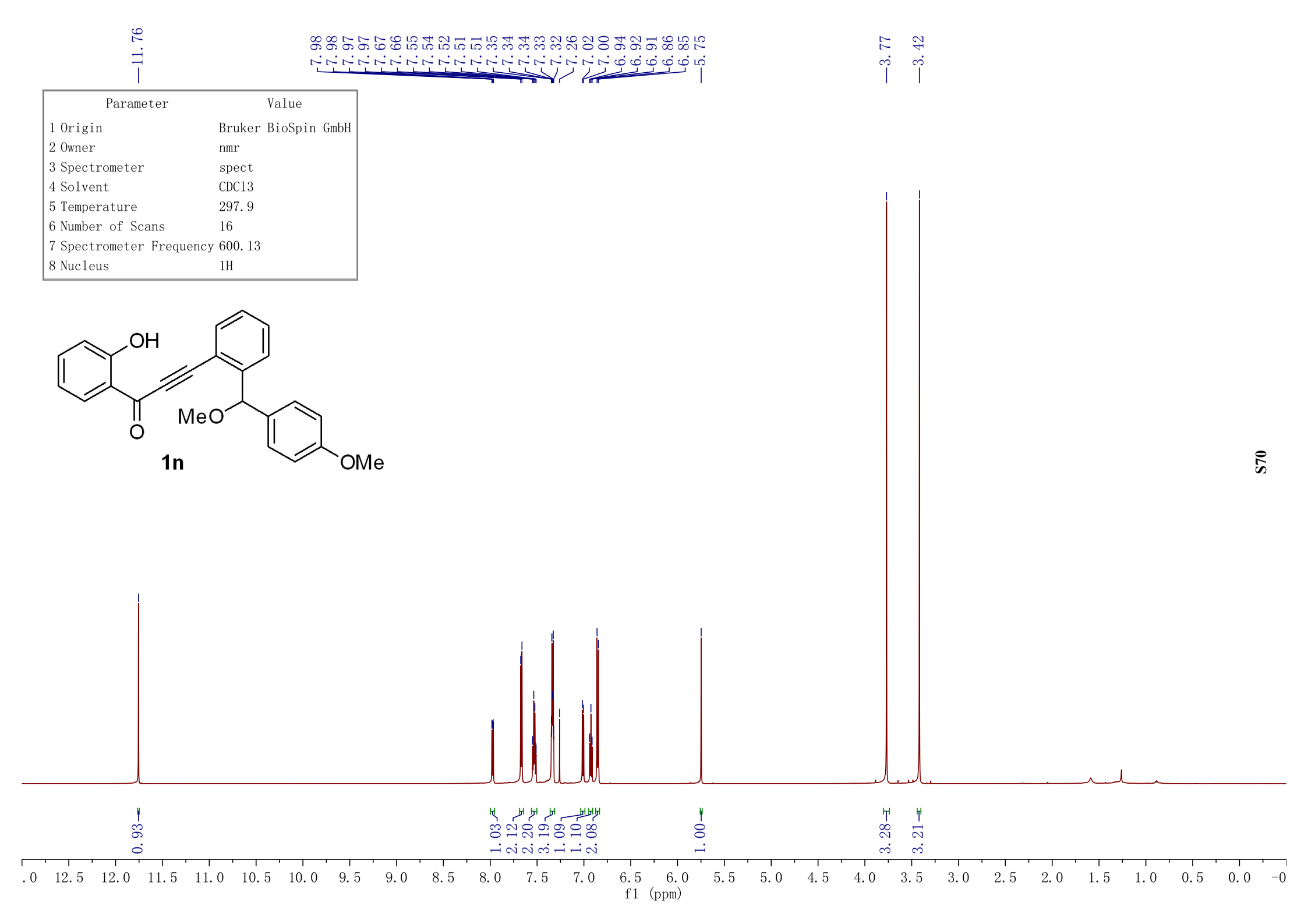

182.46
159.43
141.65
139.45
134.25
130.92
130.56
128.84
128.11
127.07
126.95
120.22
118.90
101.71
92.86
90.43
77.37
77.16
76.95
53.68
20.43
15.39
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 290
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
OH
Me
O
MeO
OMe
1l
S67
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

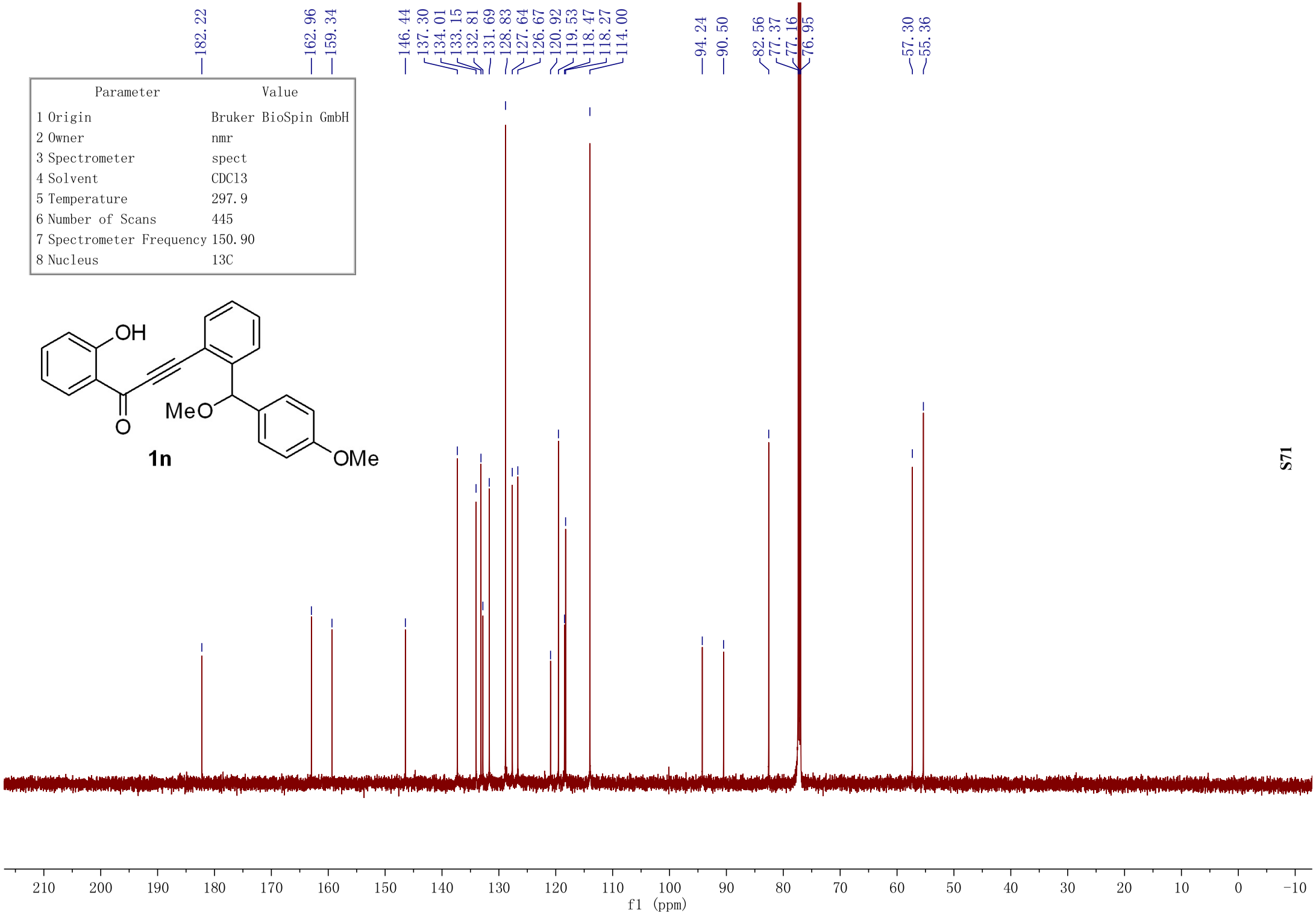
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	298.0
6 Number of Scans	3369
7 Spectrometer Frequency	150.90
8 Nucleus	13C

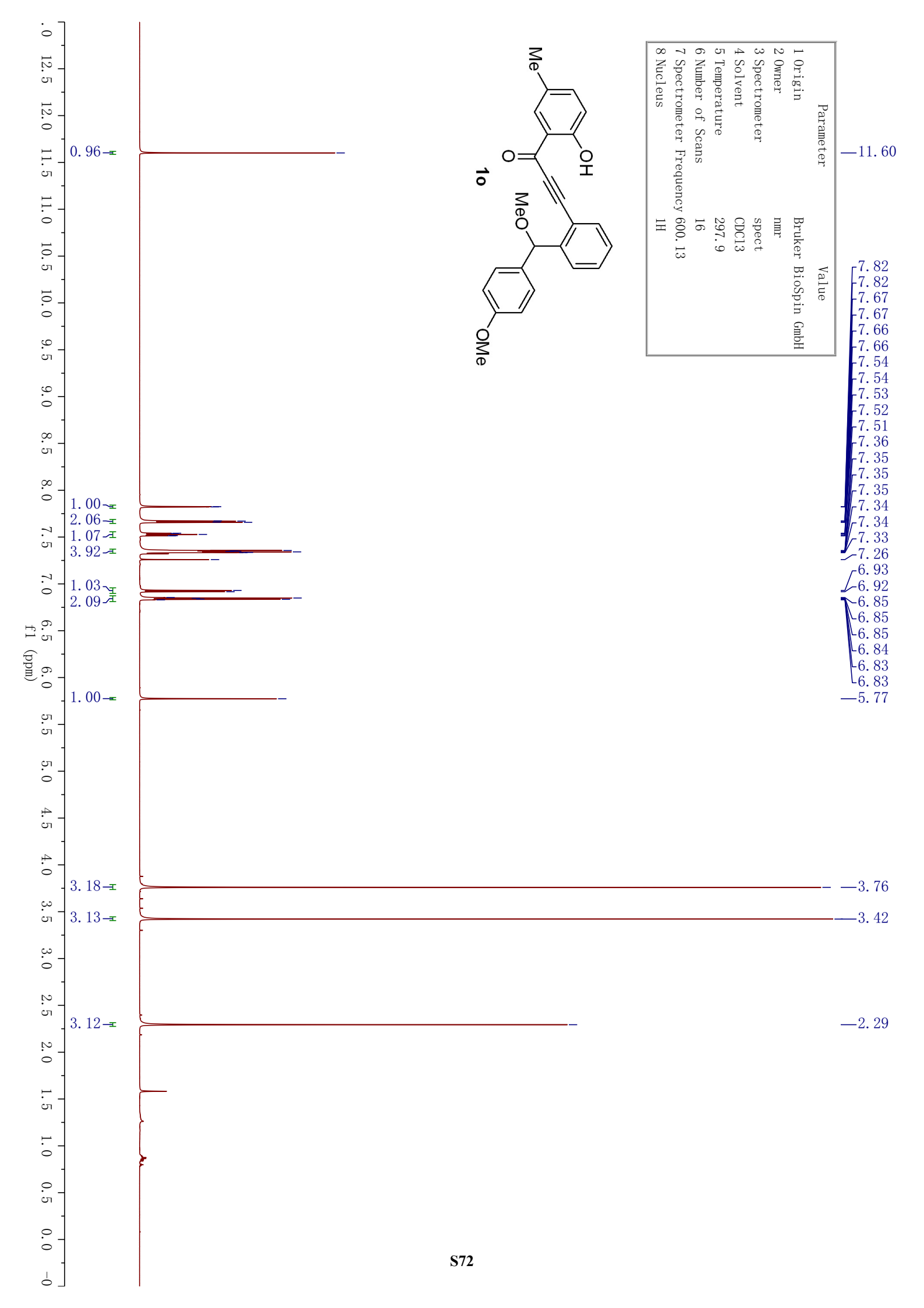


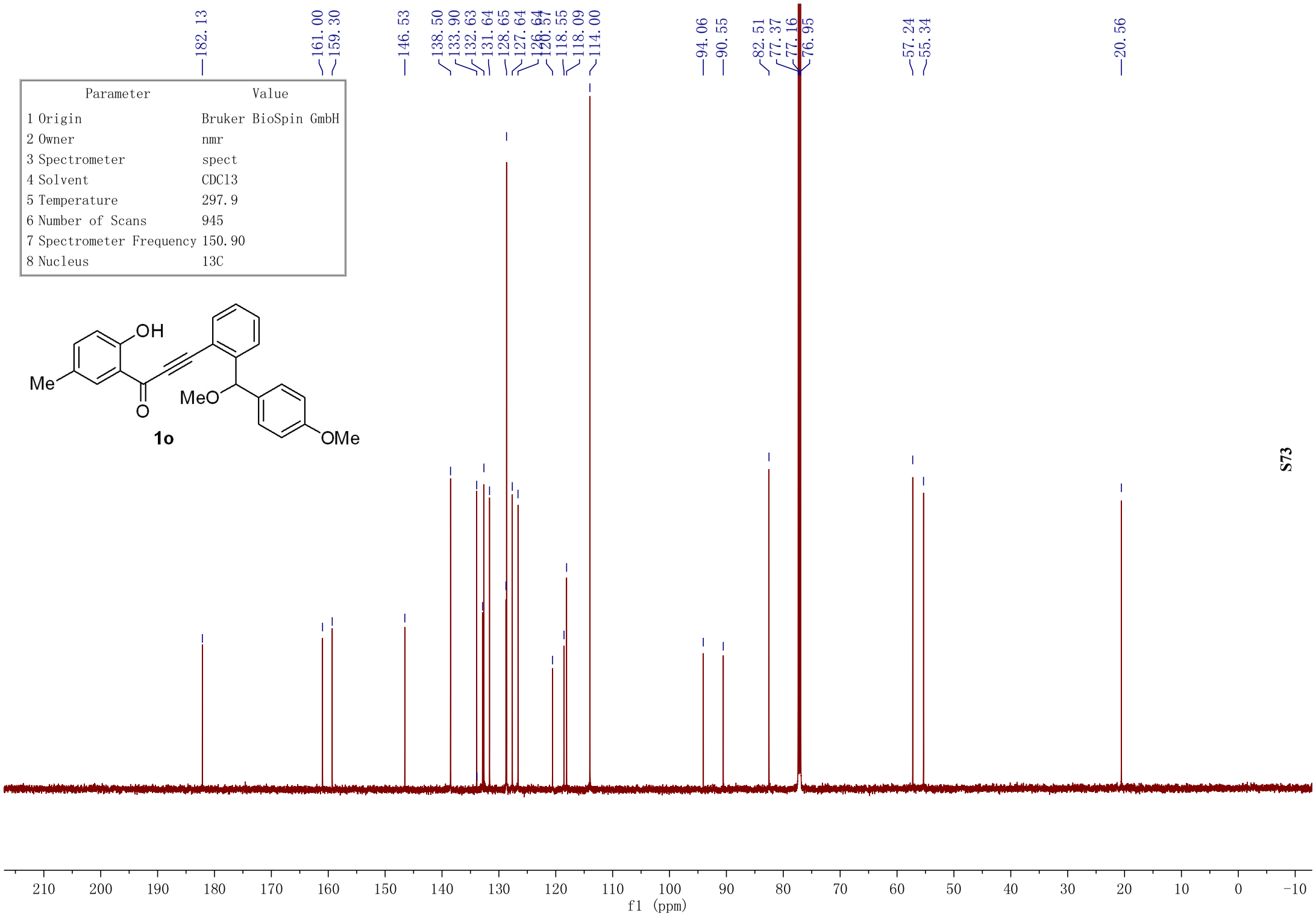
1m

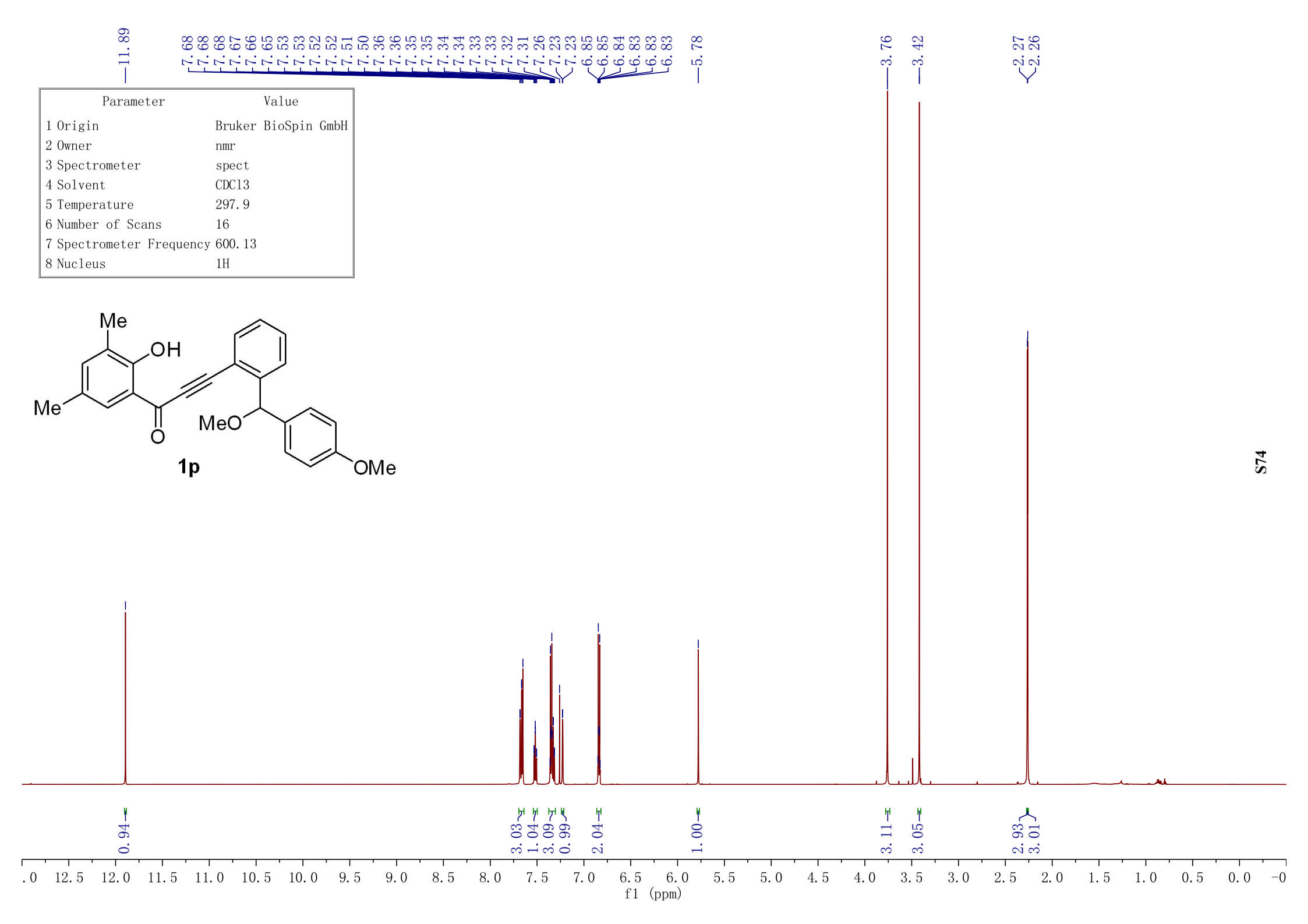

182.42
162.92
142.90
137.30
134.14
133.51
131.23
128.69
126.97
121.14
119.52
118.59
118.20
100.31
93.75
89.98
77.37
77.16
76.95
62.57
15.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 2204
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
O
EtO
OEt
1m
S69
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


11.76
7.98
7.98
7.97
7.97
7.67
7.66
7.55
7.54
7.52
7.51
7.51
7.35
7.34
7.34
7.33
7.32
7.26
7.02
7.00
6.94
6.92
6.91
6.86
6.85
5.75
3.77
3.42
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
OH
O
MeO
OMe
1n
S70
0.93
1.03
2.12
2.20
3.19
1.09
1.10
2.08
1.00
3.28
3.21
f1 (ppm)


182.22
162.96
159.34
146.44
137.30
134.01
133.15
132.81
131.69
128.83
127.64
126.67
120.92
119.53
118.47
118.27
114.00
94.24
90.50
82.56
77.37
77.16
76.95
57.30
55.36
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 445
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
O
MeO
OMe
1n
S71
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
OH
O
MeO
OMe
1o
11.60
7.82
7.82
7.67
7.67
7.66
7.66
7.54
7.54
7.53
7.52
7.51
7.36
7.35
7.35
7.35
7.34
7.34
7.33
7.26
6.93
6.92
6.85
6.85
6.85
6.84
6.83
6.83
5.77
3.76
3.42
2.29
0.96
1.00
2.06
1.07
3.92
1.03
2.09
1.00
3.18
3.13
3.12
f1 (ppm)


182.13
161.00
159.30
146.53
138.50
133.90
132.63
131.64
128.65
127.64
126.64
126.57
120.37
118.55
118.09
114.00
94.06
90.55
82.51
77.37
77.16
76.95
57.24
55.34
20.56
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 945
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
Me
O
MeO
OMe
1o
S73
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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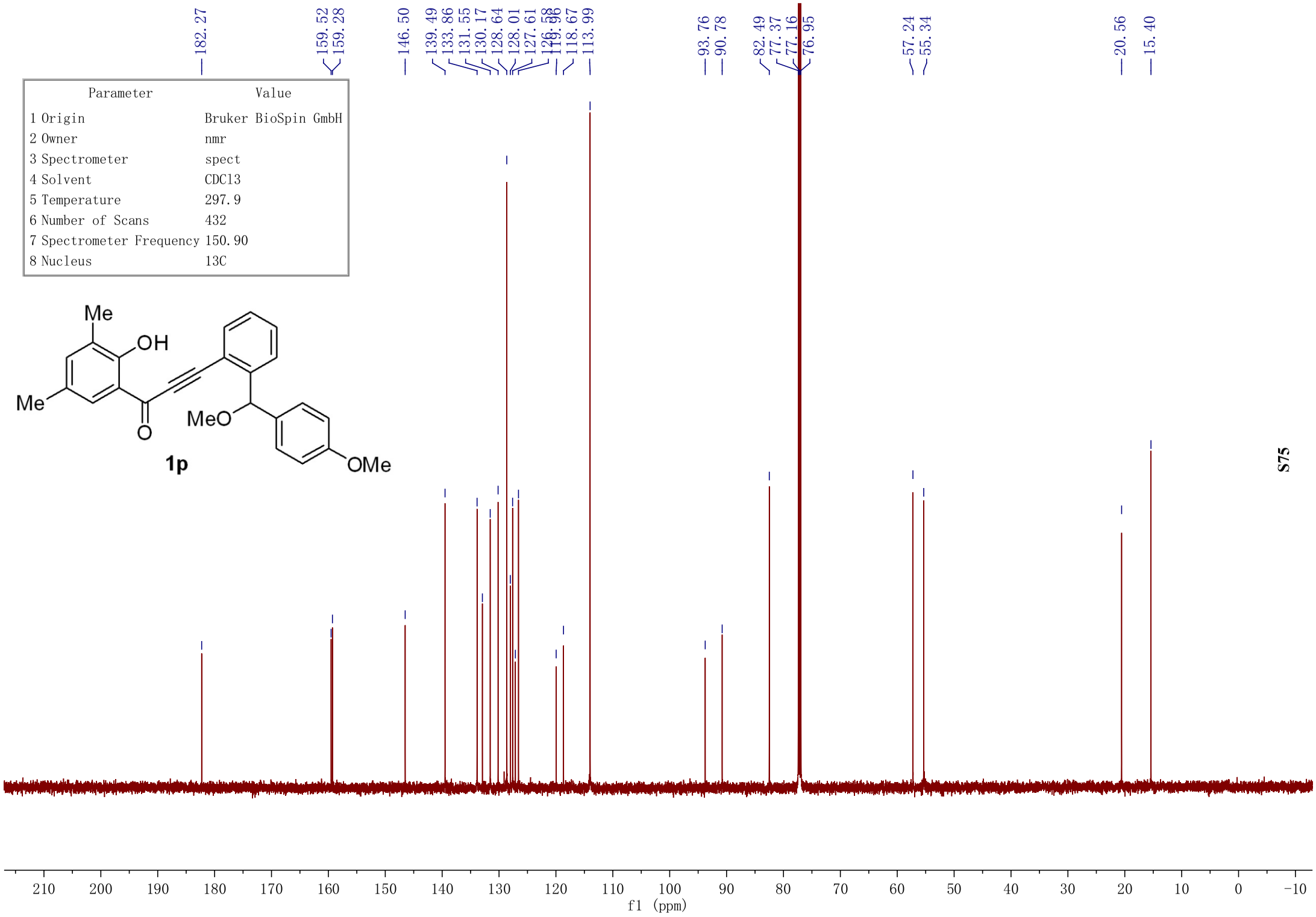
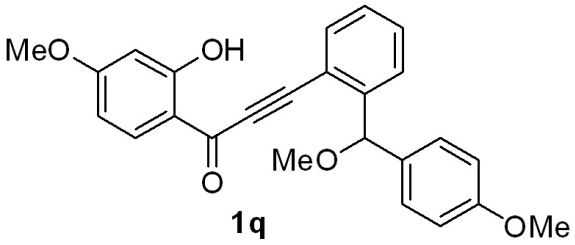
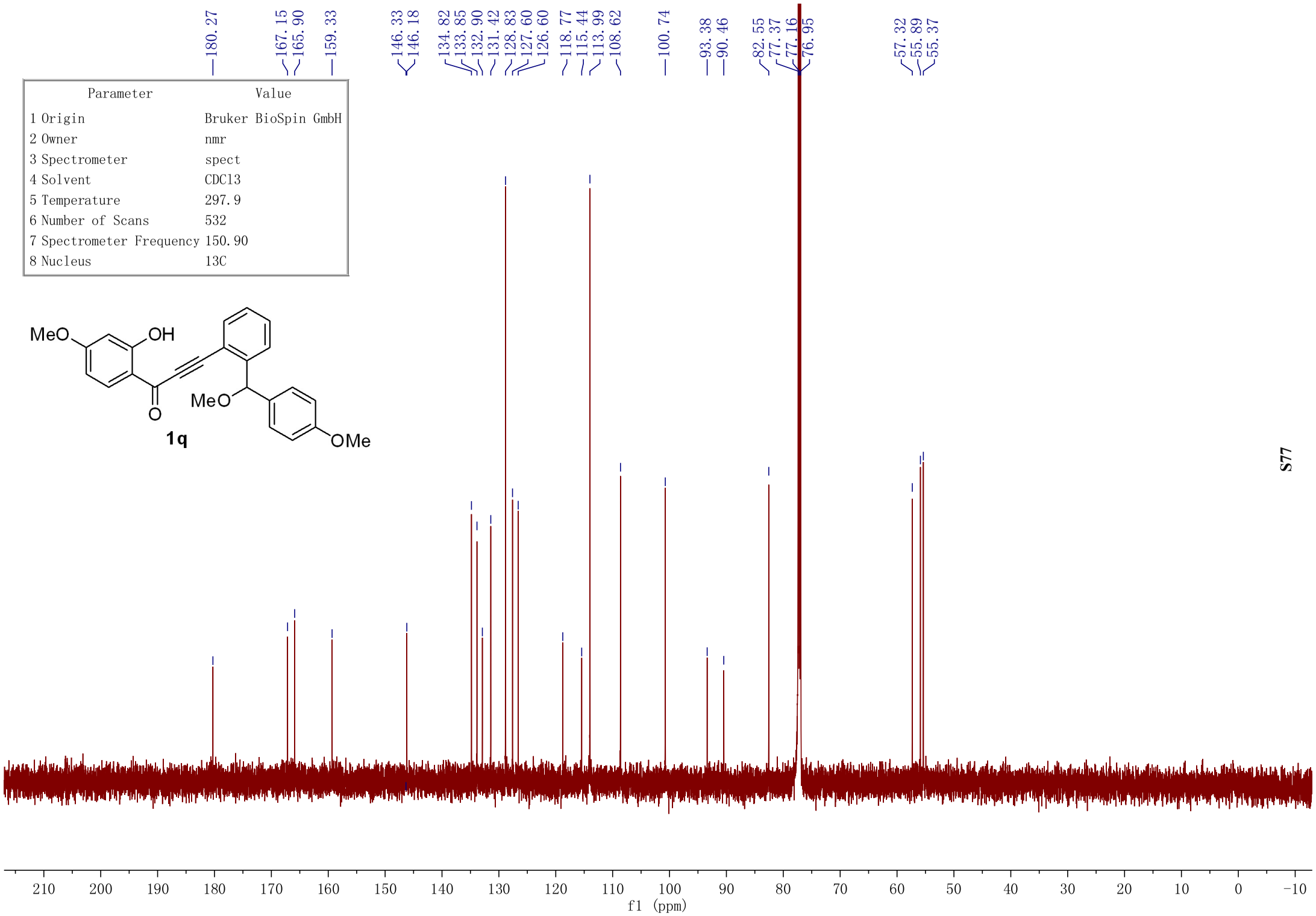
7.65
7.53
7.53
7.52
7.52
7.51
7.50
7.36
7.36
7.35
7.35
7.34
7.34
7.33
7.33
7.32
7.31
7.26
7.23
7.23
6.85
6.85
6.84
6.83
6.83
6.83
5.78
3.76
3.42
2.27
2.26
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
OH
Me
O
MeO
OMe
1p
S74
0.94
3.03
1.04
3.09
0.99
2.04
1.00
3.11
3.05
2.93
3.01
f1 (ppm)


182.27
159.52
159.28
146.50
139.49
133.86
131.55
130.17
128.64
128.01
127.61
118.67
113.99
93.76
90.78
82.49
77.37
77.16
76.95
57.24
55.34
20.56
15.40
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 432
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
OH
Me
O
MeO
OMe
1p
S75
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

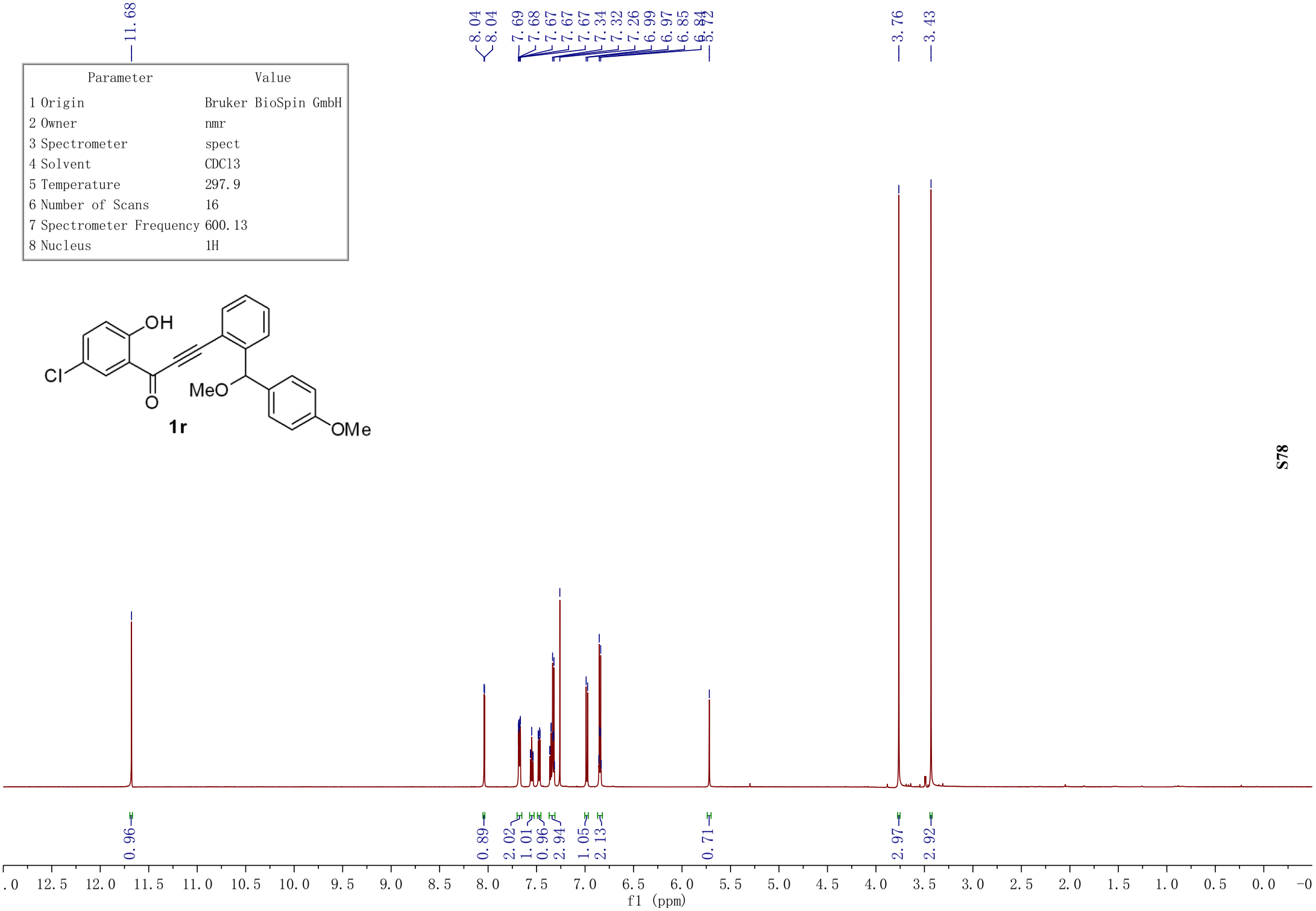


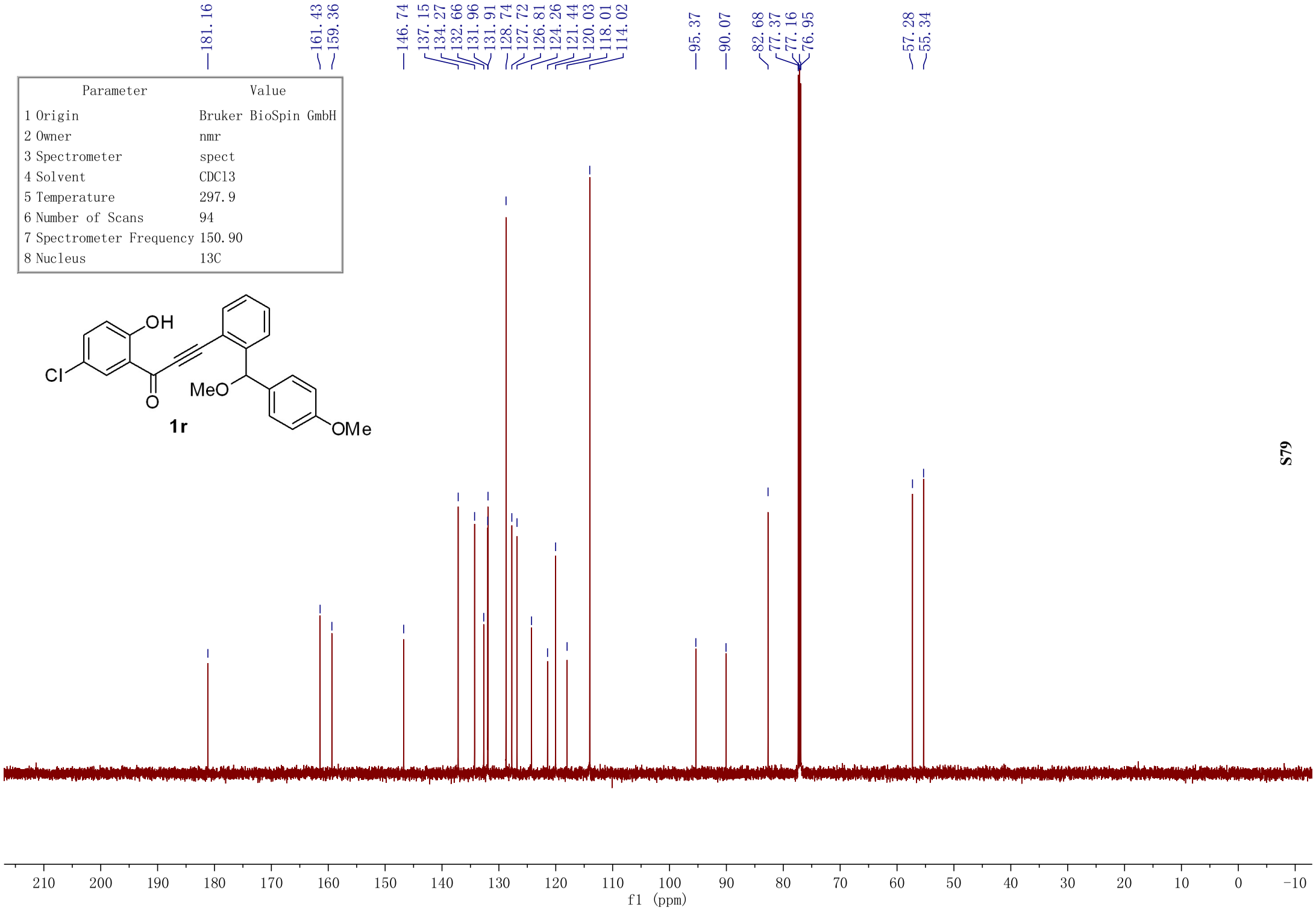
1q


180.27
167.15
165.90
159.33
146.33
146.18
134.82
133.85
132.90
131.42
128.83
127.60
126.60
118.77
115.44
113.99
108.62
100.74
93.38
90.46
82.55
77.37
77.16
76.95
57.32
55.89
55.37
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 532
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
OH
MeO
O
OMe
1q
S77
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

1r

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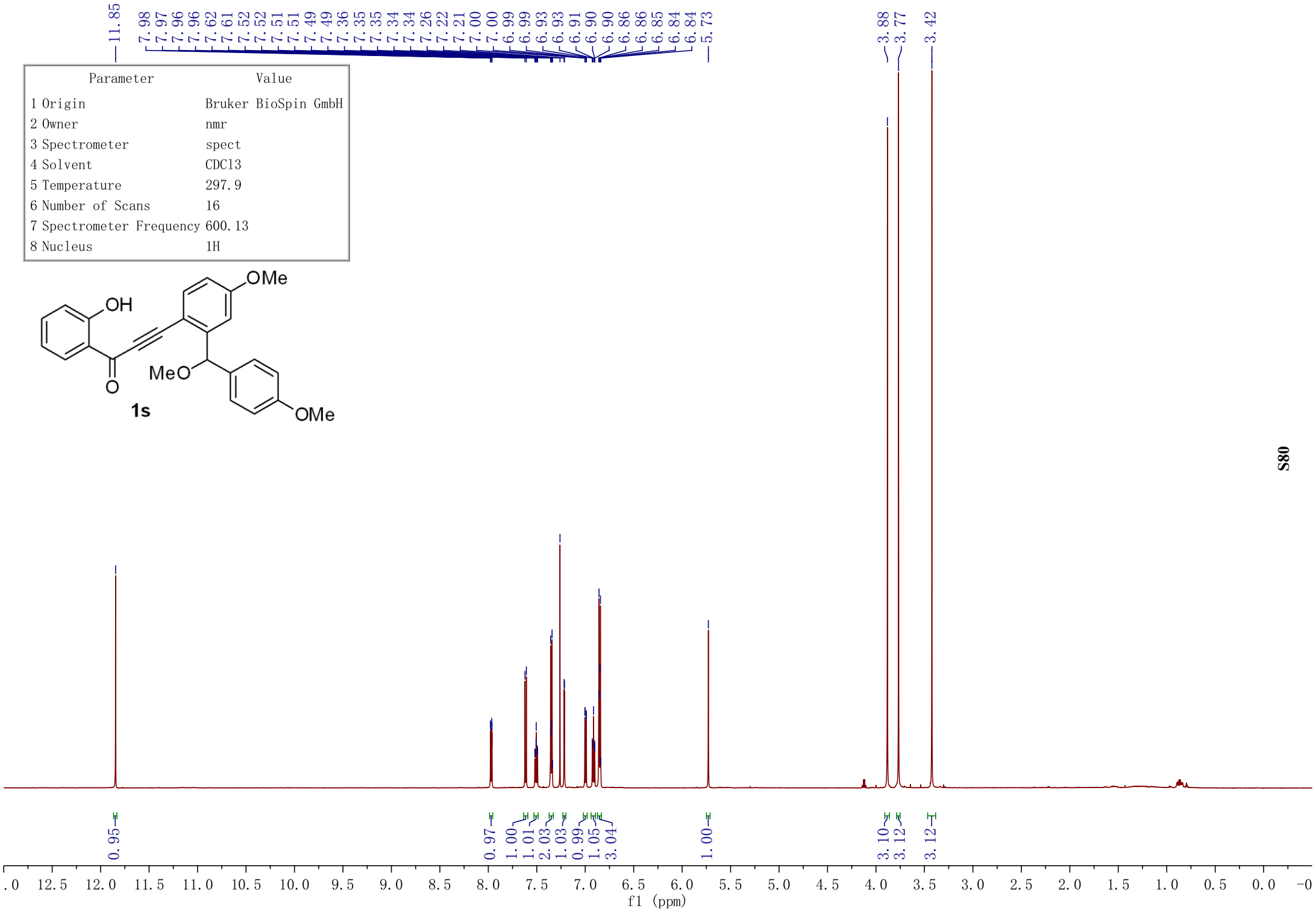
161.43
159.36
146.74
137.15
134.27
132.66
131.96
131.91
128.74
127.72
126.81
124.26
121.44
120.03
118.01
114.02
95.37
90.07
82.68
77.37
77.16
76.95
57.28
55.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 94
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
Cl
O
MeO
OMe
1r
S79
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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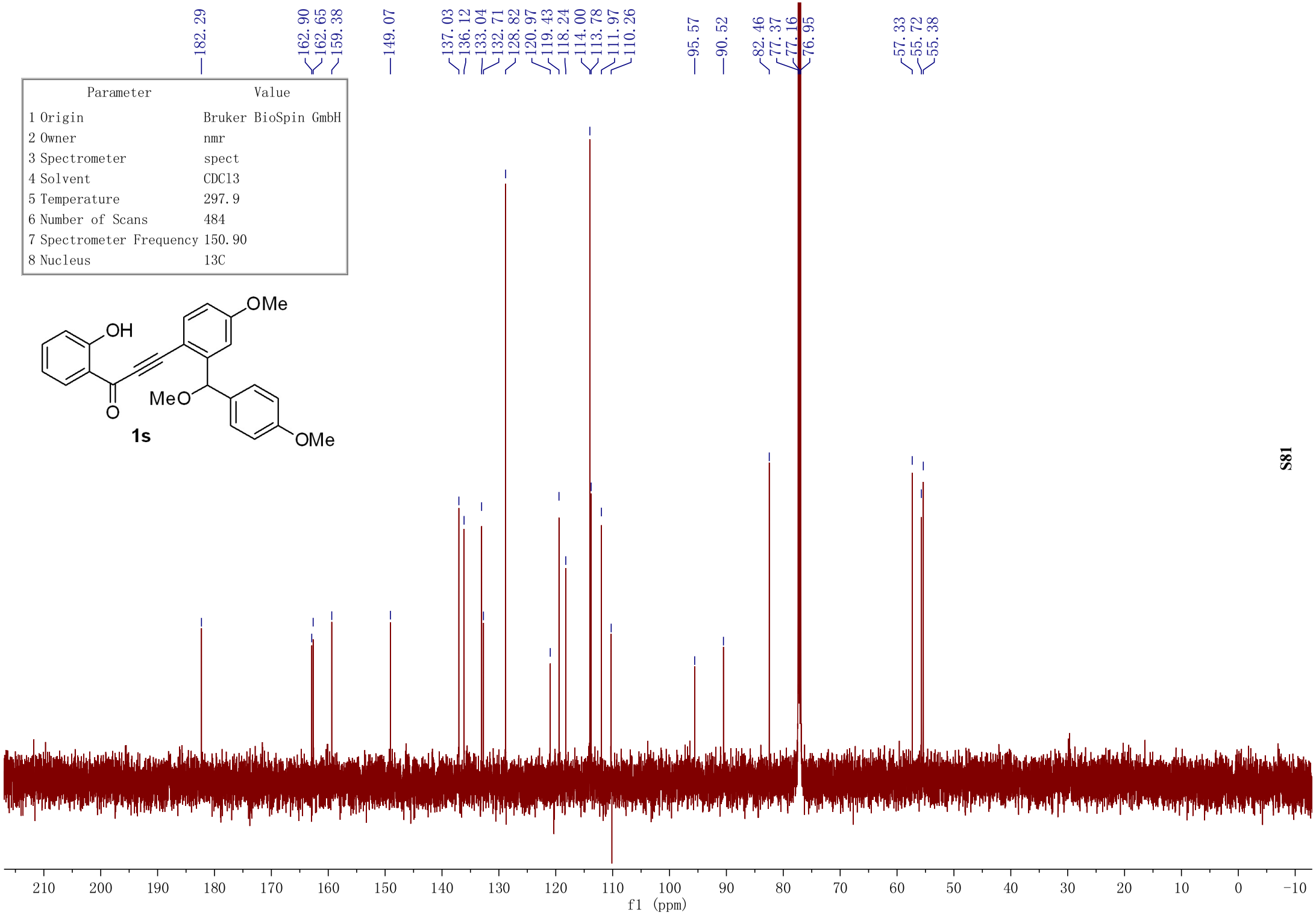
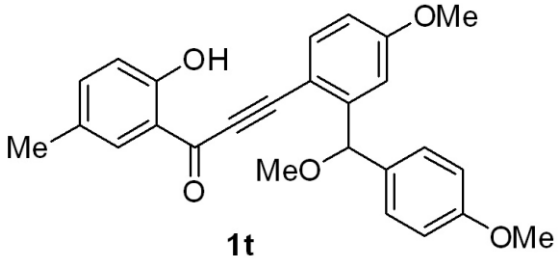
7.98
7.97
7.96
7.96
7.62
7.61
7.52
7.52
7.51
7.51
7.49
7.49
7.36
7.35
7.35
7.34
7.34
7.26
7.22
7.21
7.00
7.00
6.99
6.99
6.93
6.93
6.91
6.90
6.90
6.86
6.86
6.85
6.84
6.84
5.73
3.88
3.77
3.42
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
OMe
OH
MeO
O
1s
OMe
S80
0.95
0.97
1.00
1.01
2.03
1.03
0.99
1.05
3.04
1.00
3.10
3.12
3.12
f1 (ppm)


182.29
162.90
162.65
159.38
149.07
137.03
136.12
133.04
132.71
128.82
120.97
119.43
118.24
114.00
113.78
111.97
110.26
95.57
90.52
82.46
77.37
77.16
76.95
57.33
55.72
55.38
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 484
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
OMe
MeO
O
OMe
1s
S81
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



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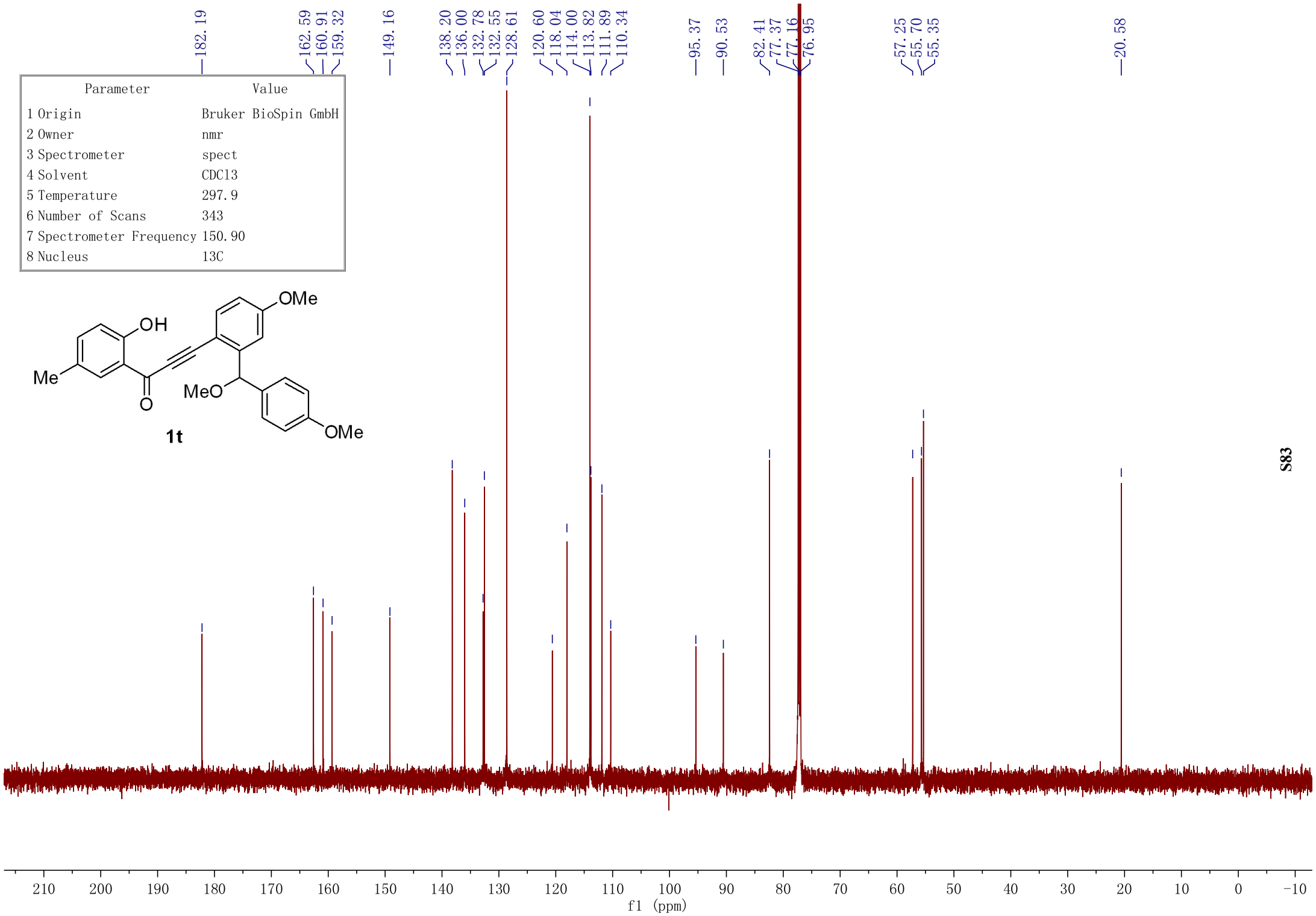
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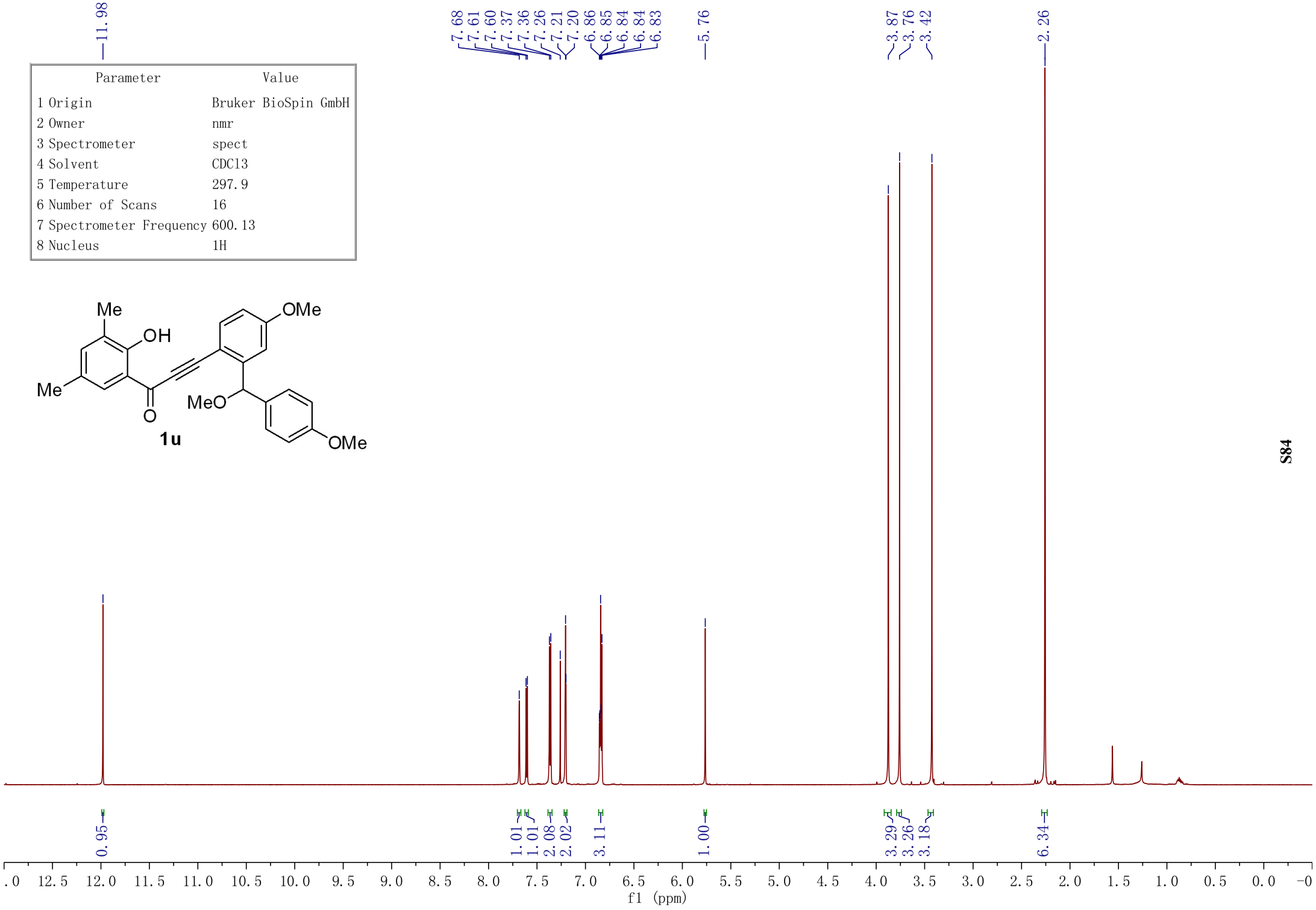
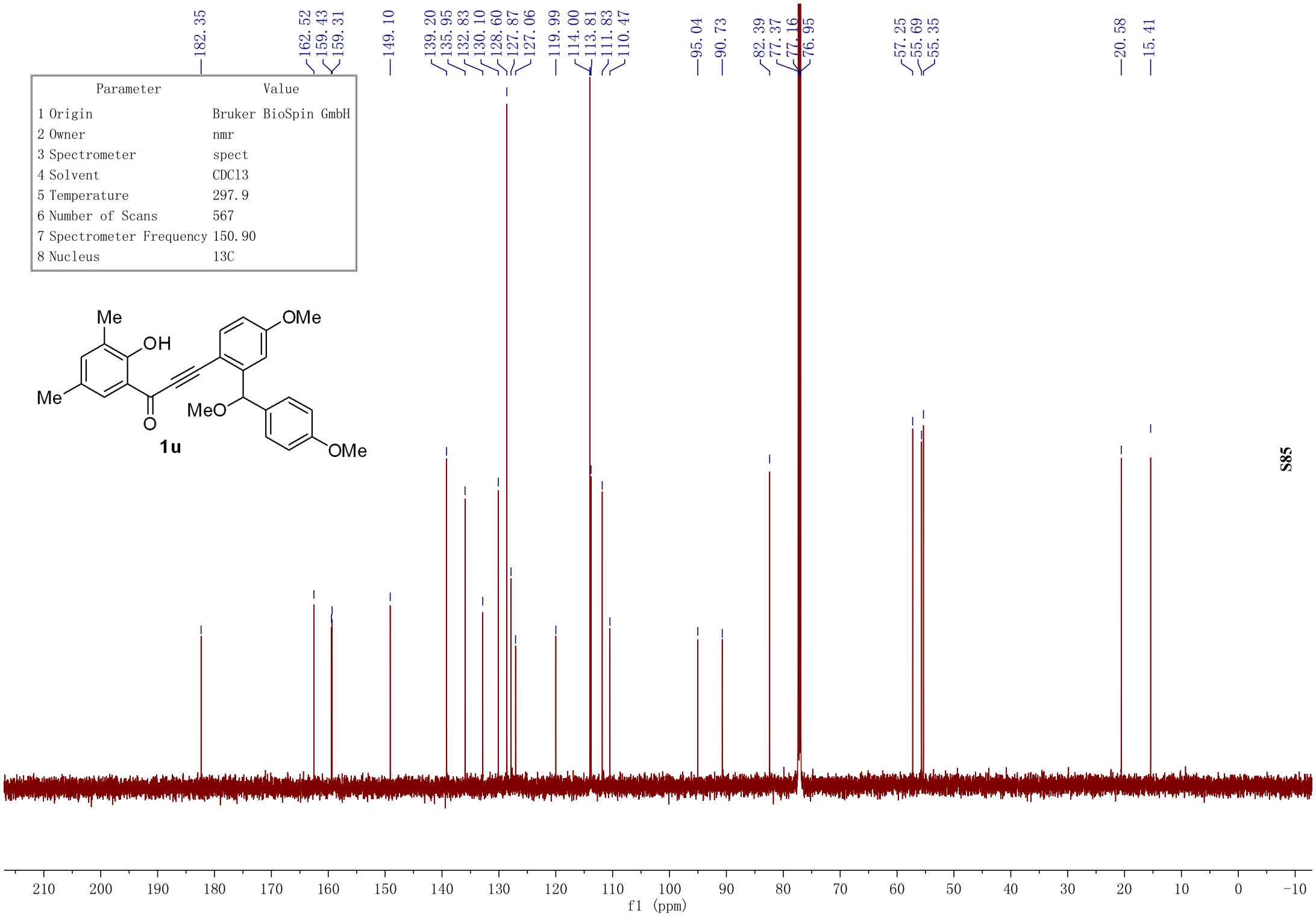
160.91
159.32
149.16
138.20
136.00
132.78
132.55
128.61
120.60
118.04
114.00
113.82
111.89
110.34
95.37
90.53
82.41
77.37
77.16
76.95
57.25
55.70
55.35
20.58
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 343
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OMe
OH
Me
MeO
O
OMe
1t
S83
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

1u

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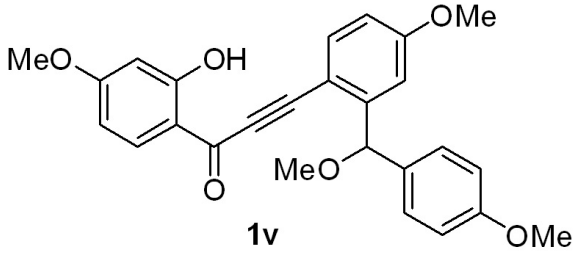
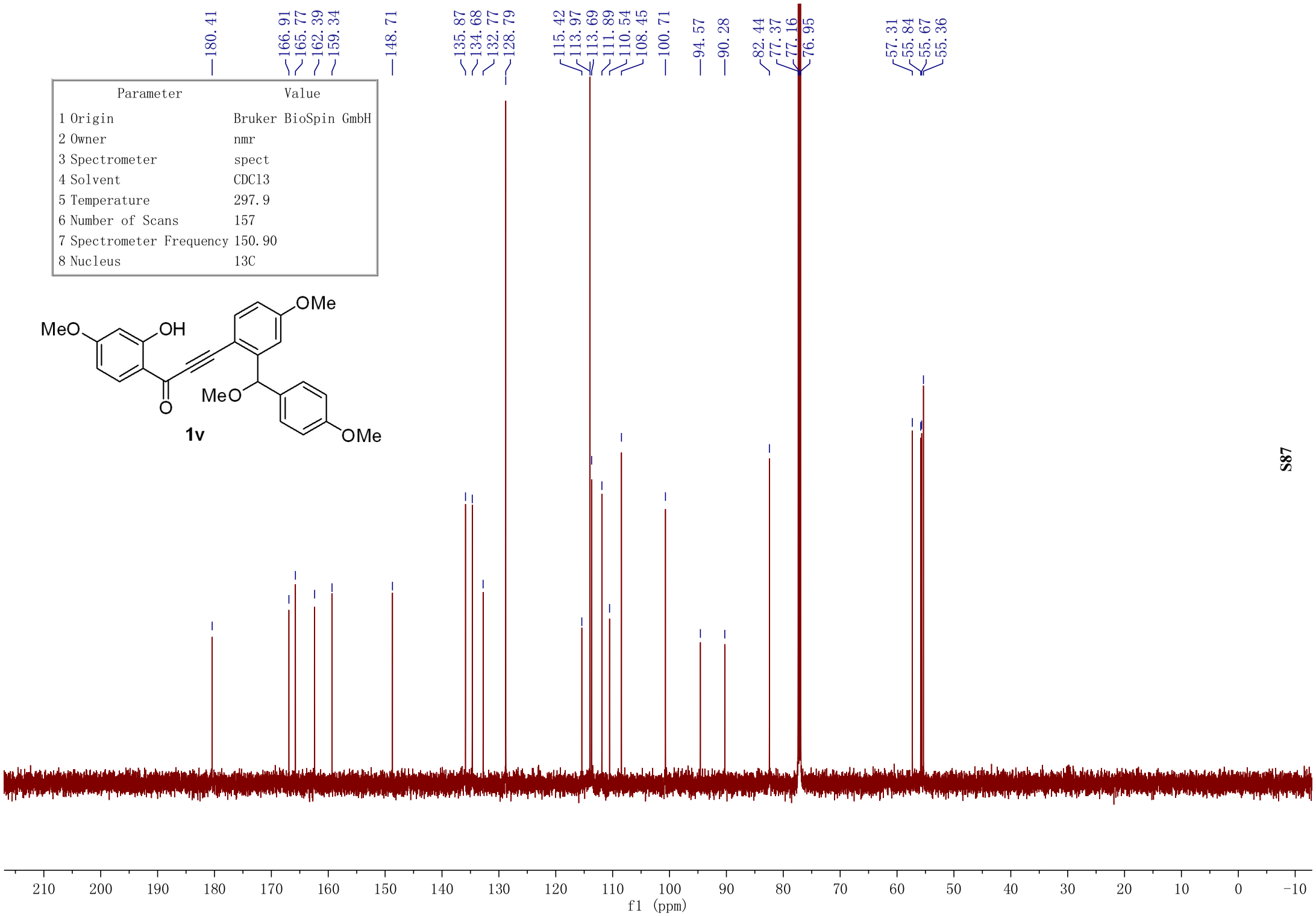
162.52
159.43
159.31
149.10
139.20
135.95
132.83
130.10
128.60
127.87
127.06
119.99
114.00
113.81
111.83
110.47
95.04
90.73
82.39
77.37
77.16
76.95
57.25
55.69
55.35
20.58
15.41
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 567
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
OH
Me
O
MeO
OMe
OMe
1u
S85
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



1v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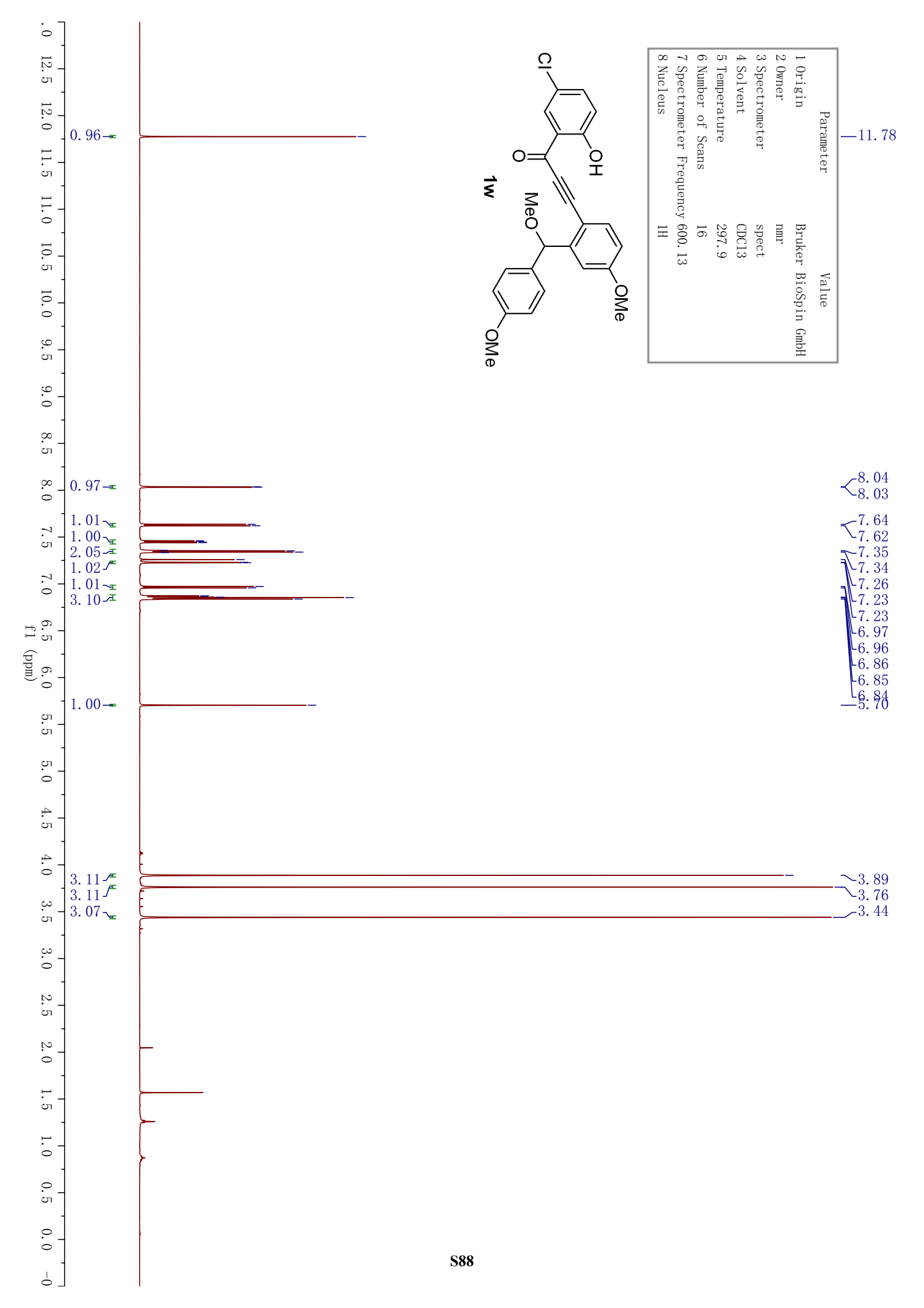
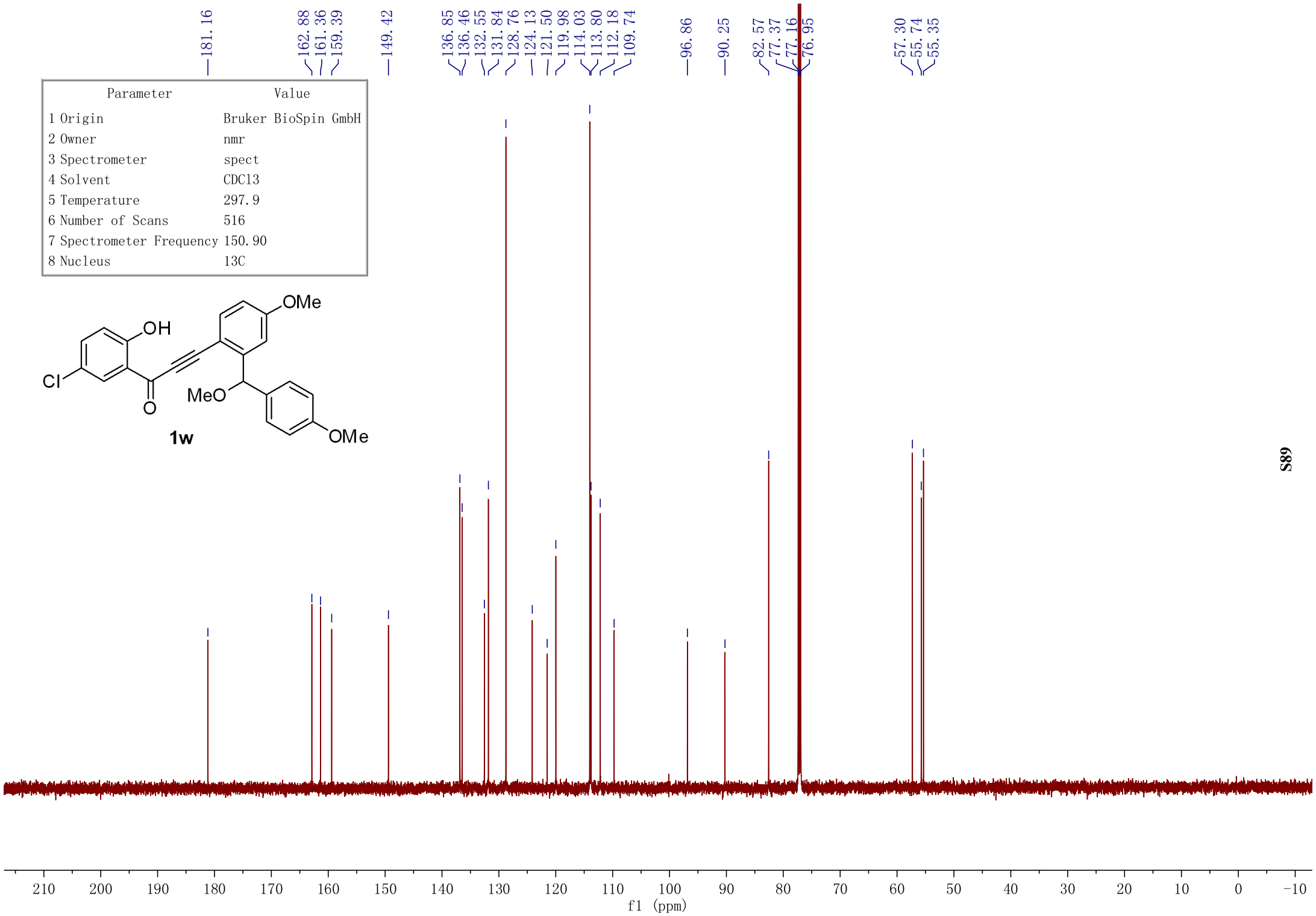
166.91
165.77
162.39
159.34
148.71
135.87
134.68
132.77
128.79
115.42
113.97
113.69
111.89
110.54
108.45
100.71
94.57
90.28
82.44
77.37
77.16
76.95
57.31
55.84
55.67
55.36
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 157
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
OH
OMe
MeO
O
OMe
1v
S87
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
OH
O
MeO
OMe
OMe
1w
11.78
8.04
8.03
7.64
7.62
7.35
7.34
7.26
7.23
7.23
6.97
6.96
6.86
6.85
6.84
5.70
3.89
3.76
3.44
0.96
0.97
1.01
1.00
2.05
1.02
1.01
3.10
1.00
3.11
3.11
3.07
f1 (ppm)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161.36
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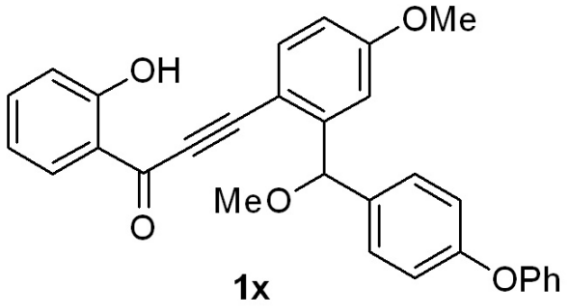
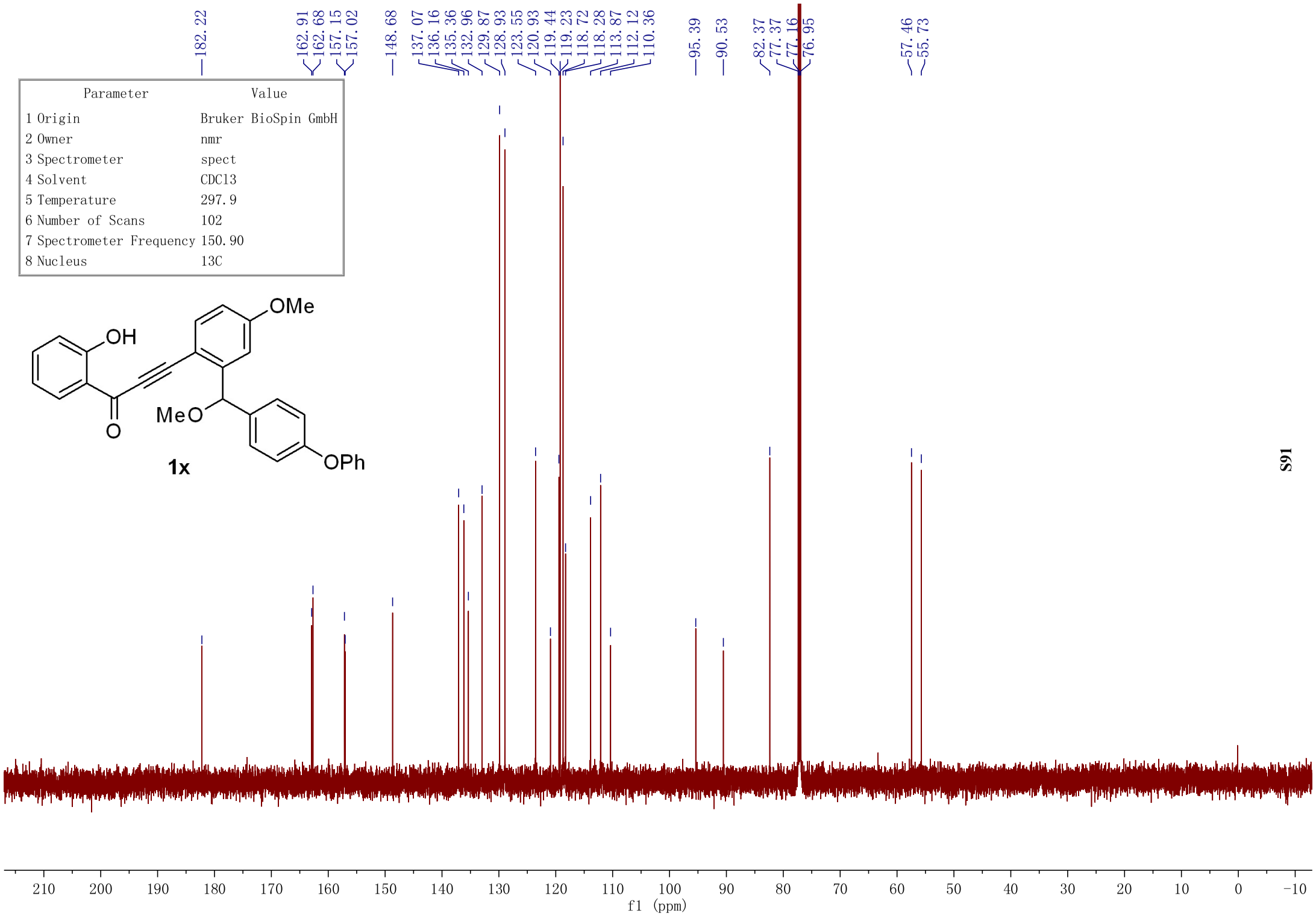
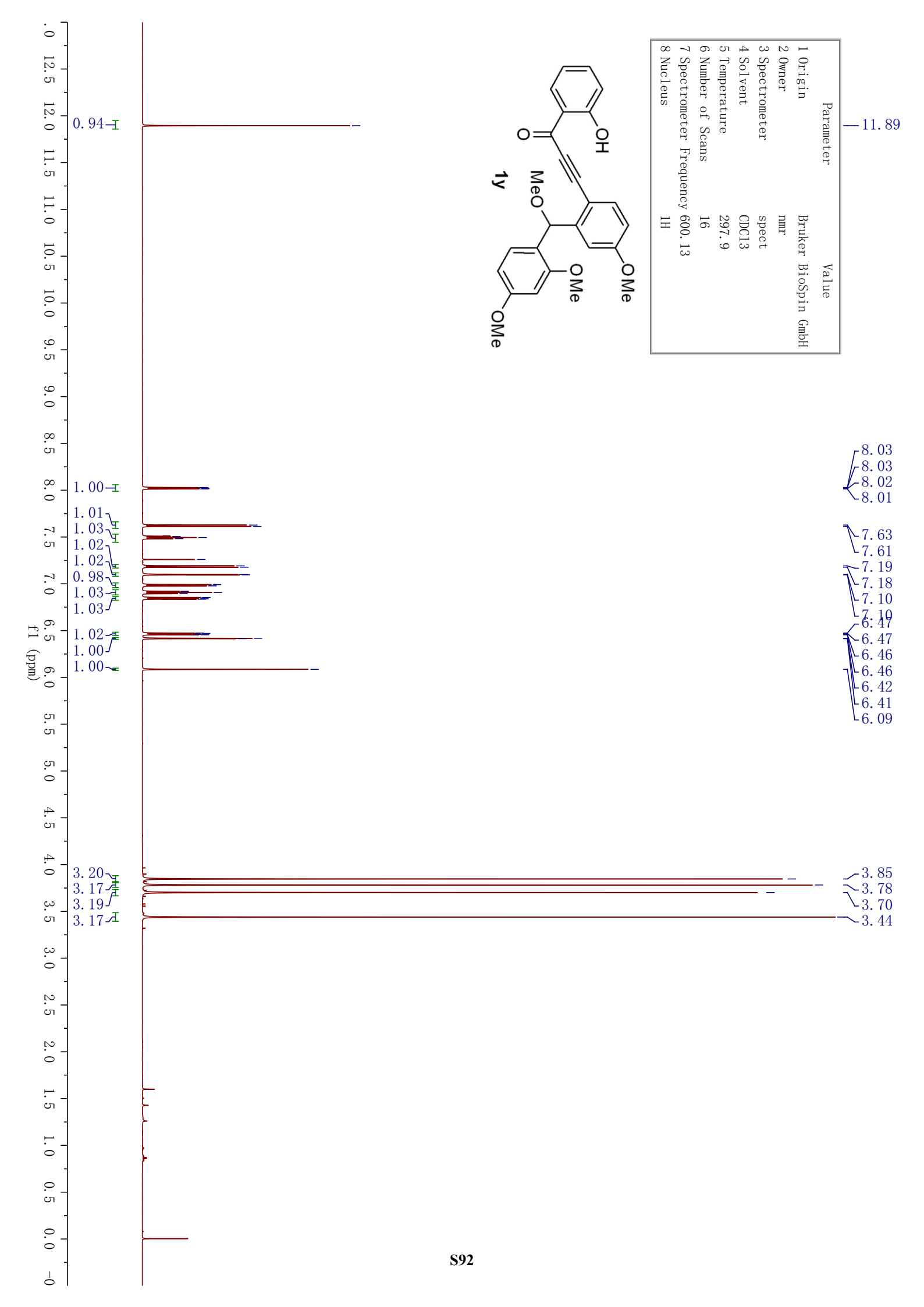
149.42
136.85
136.46
132.55
131.84
128.76
124.13
121.50
119.98
114.03
113.80
112.18
109.74
96.86
90.25
82.57
77.37
77.16
76.95
57.30
55.74
55.35
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 516
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OMe
OH
Cl
MeO
O
OMe
1w
S89
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

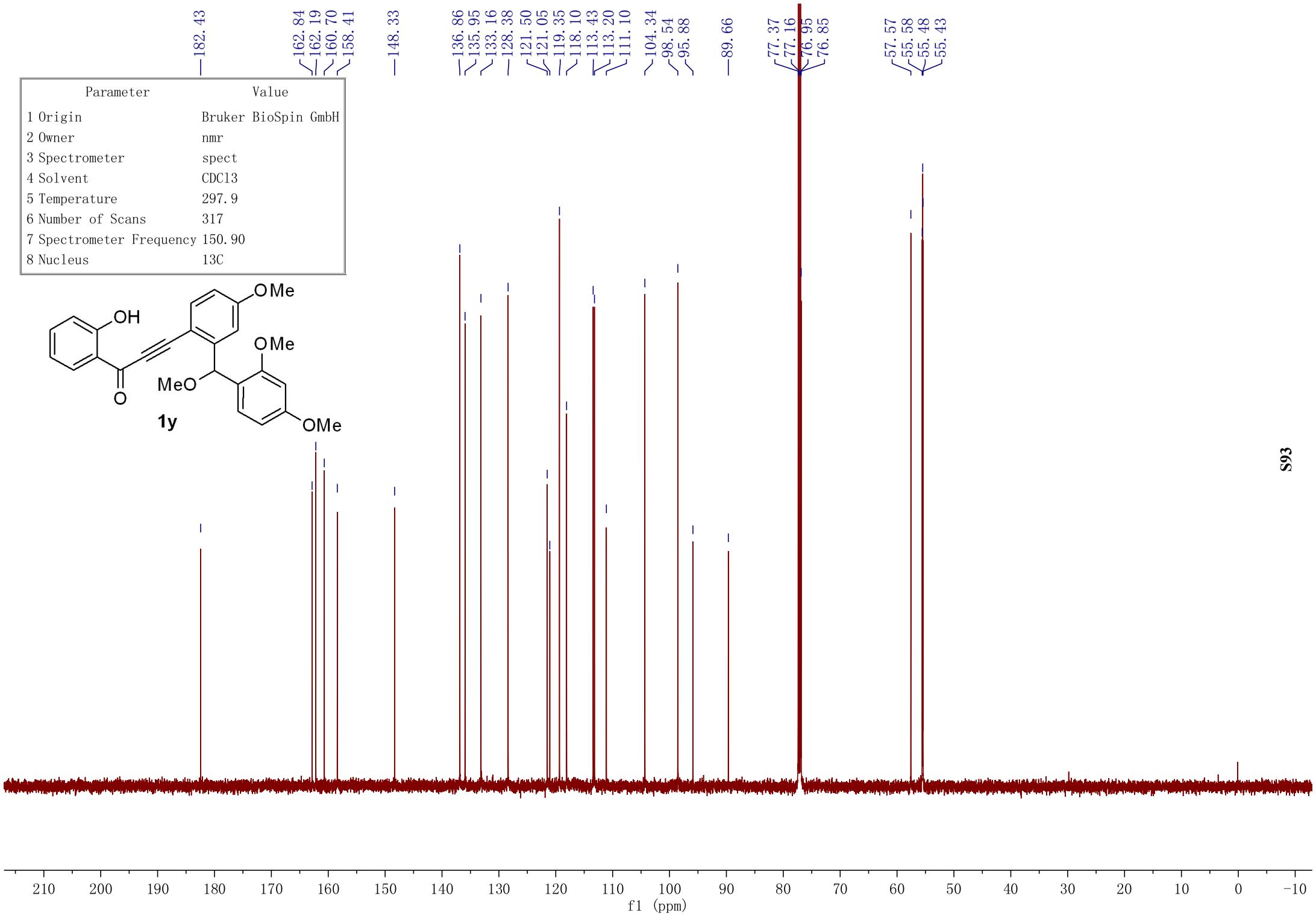
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



1x


182.22
162.91
162.68
157.15
157.02
148.68
137.07
136.16
135.36
132.96
129.87
128.93
123.55
120.93
119.44
119.23
118.72
118.28
113.87
112.12
110.36
95.39
90.53
82.37
77.37
77.16
76.95
57.46
55.73
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 102
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OMe
OH
MeO
O
OPh
1x
S91
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
OH
O
MeO
OMe
OMe
OMe
1y
11.89
8.03
8.03
8.02
8.01
7.63
7.61
7.19
7.18
7.10
6.47
6.47
6.46
6.46
6.42
6.41
6.09
3.85
3.78
3.70
3.44
0.94
1.00
1.01
1.03
1.02
1.02
0.98
1.03
1.03
1.02
1.00
1.00
3.20
3.17
3.19
3.17
f1 (ppm)


182.43
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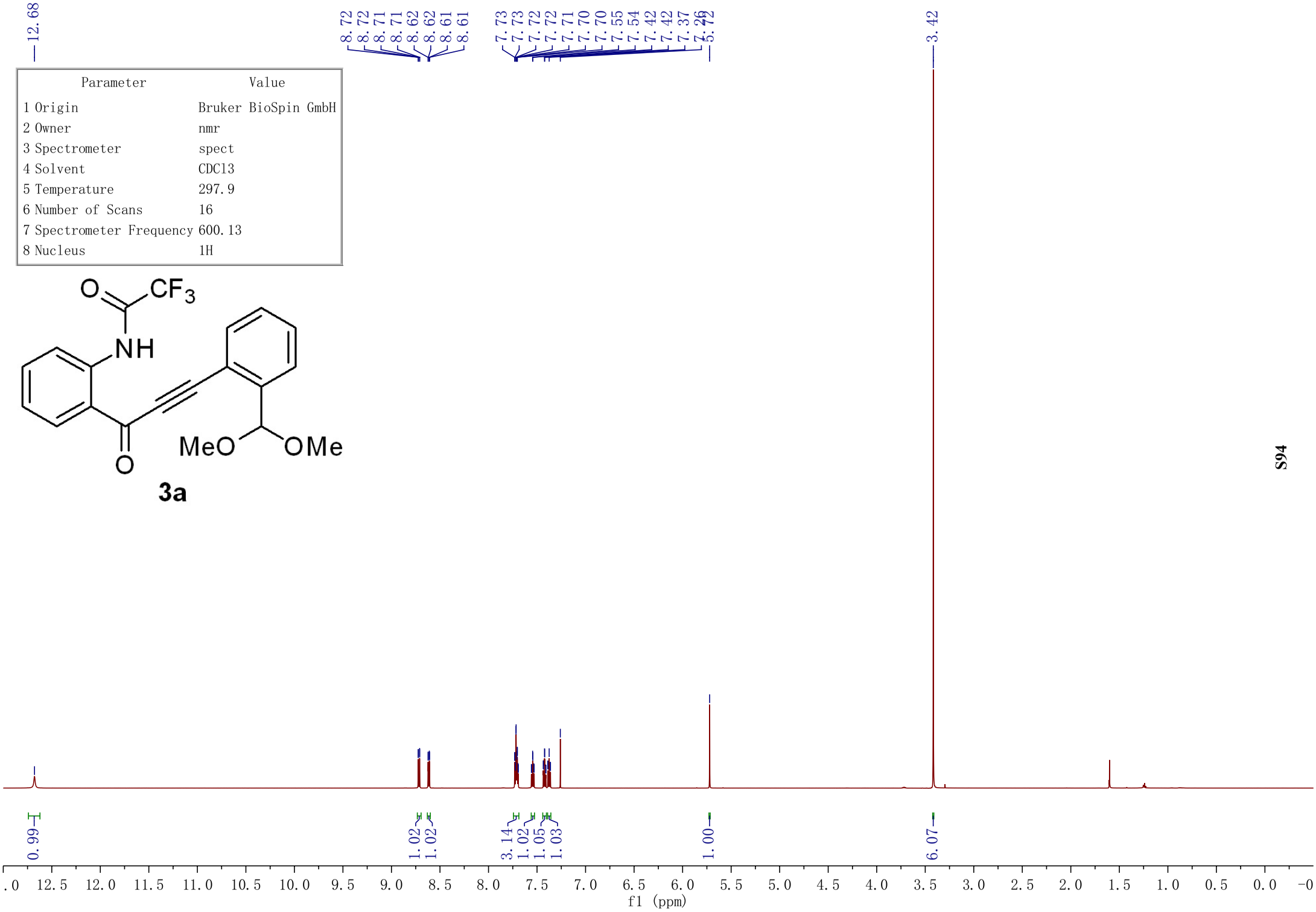
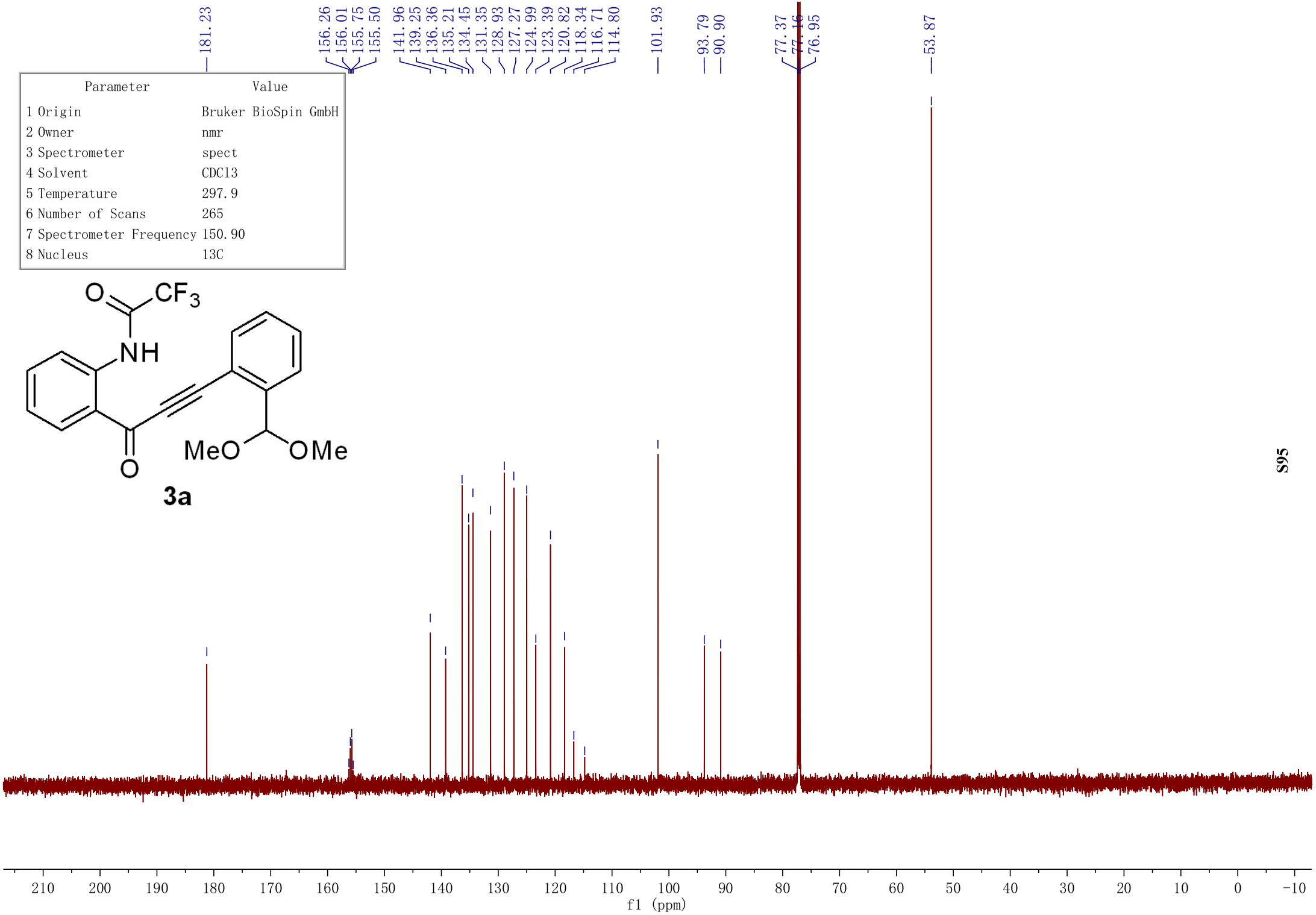
162.19
160.70
158.41
148.33
136.86
135.95
133.16
128.38
121.50
121.05
119.35
118.10
113.43
113.20
111.10
104.34
98.54
95.88
89.66
77.37
77.16
76.95
76.85
57.57
55.58
55.48
55.43
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 317
7 Spectrometer Frequency 150.90
8 Nucleus 13C
OH
OMe
OMe
MeO
O
OMe
1y
S93
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


12.68
8.72
8.72
8.71
8.71
8.62
8.62
8.61
8.61
7.73
7.73
7.72
7.72
7.71
7.70
7.70
7.55
7.54
7.42
7.42
7.37
7.26
7.12
3.42
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
O
CF3
NH
MeO
OMe
O
3a
S94
0.99
1.02
1.02
3.14
1.02
1.05
1.03
1.00
6.07
f1 (ppm)


181.23
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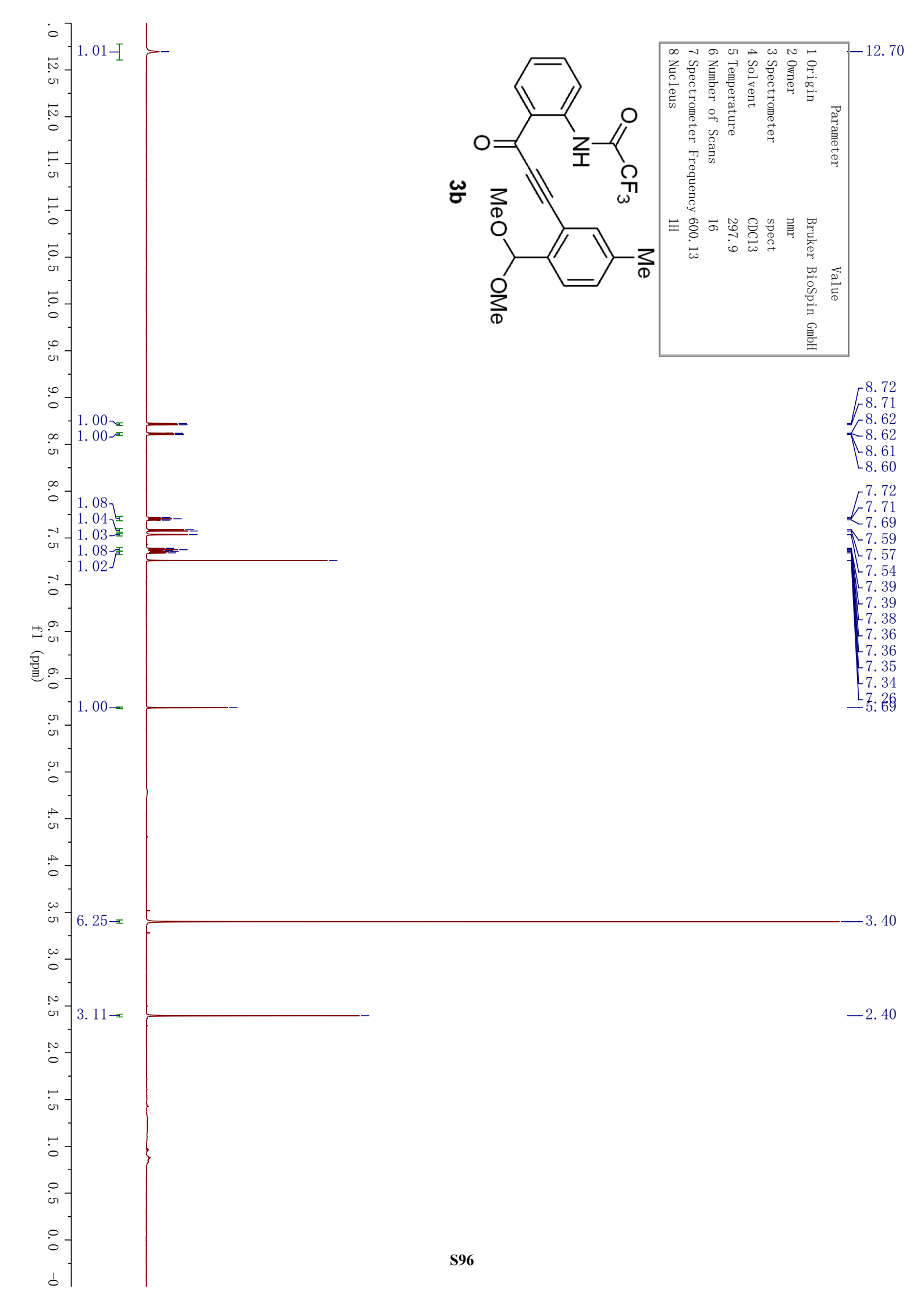
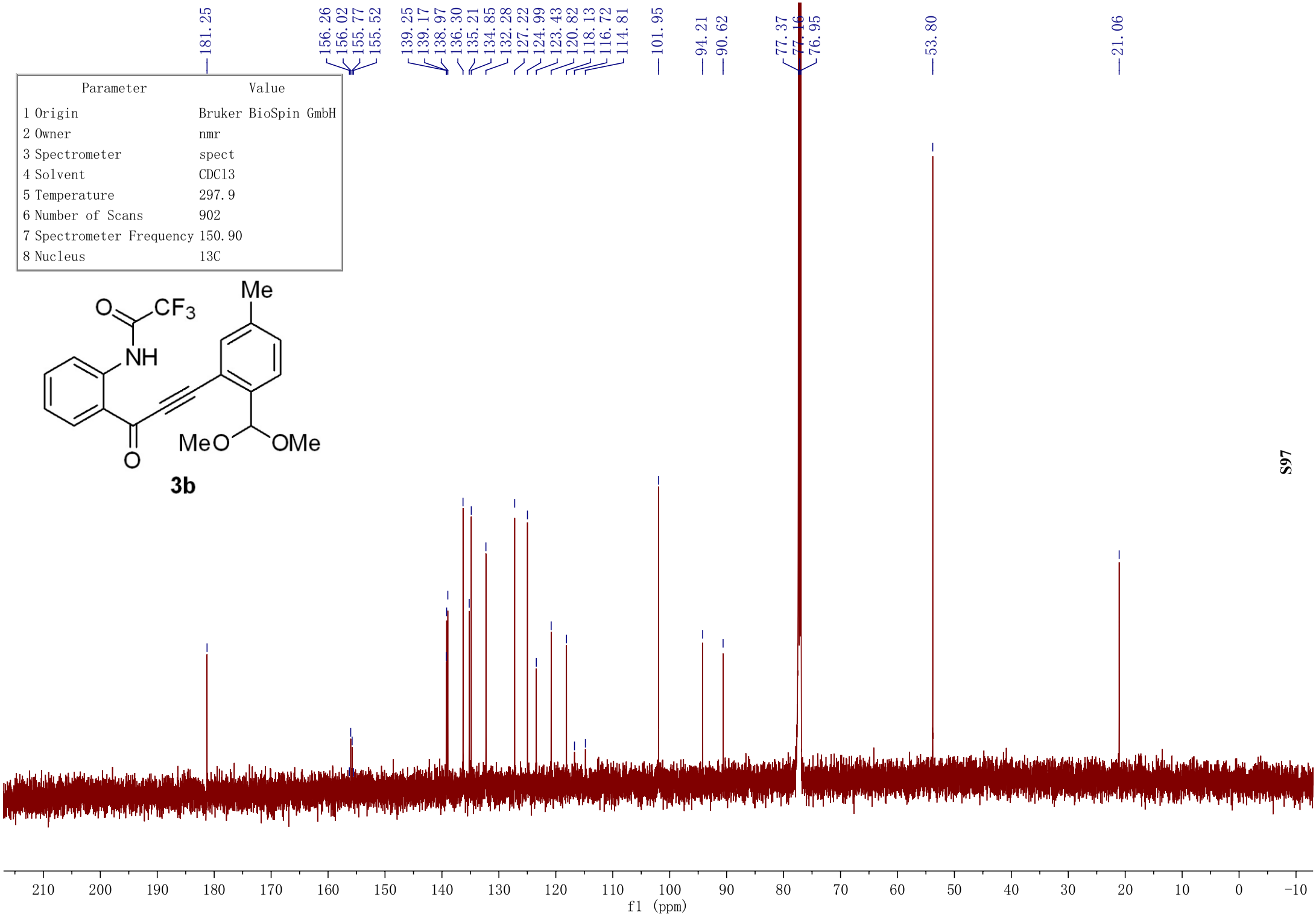
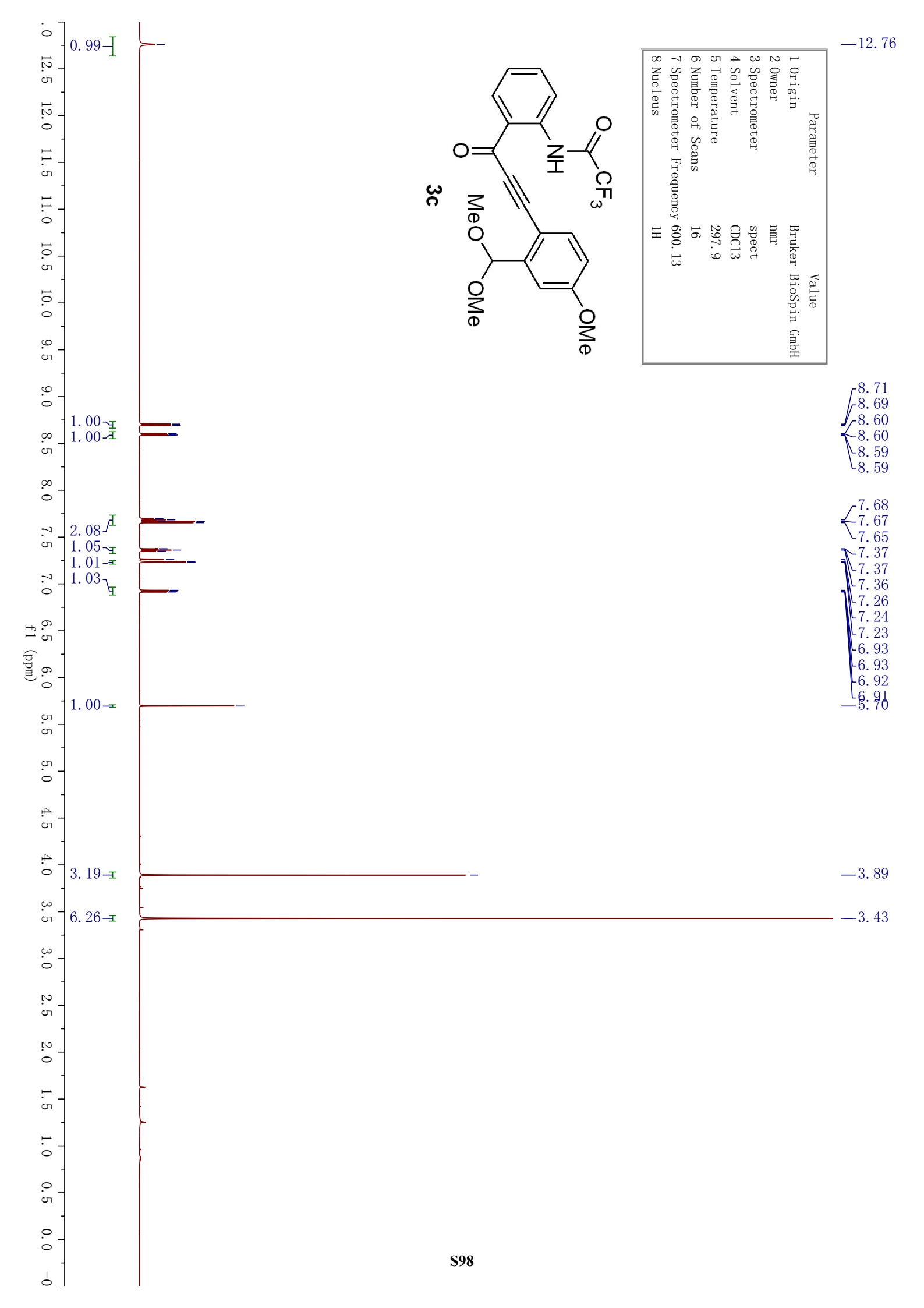
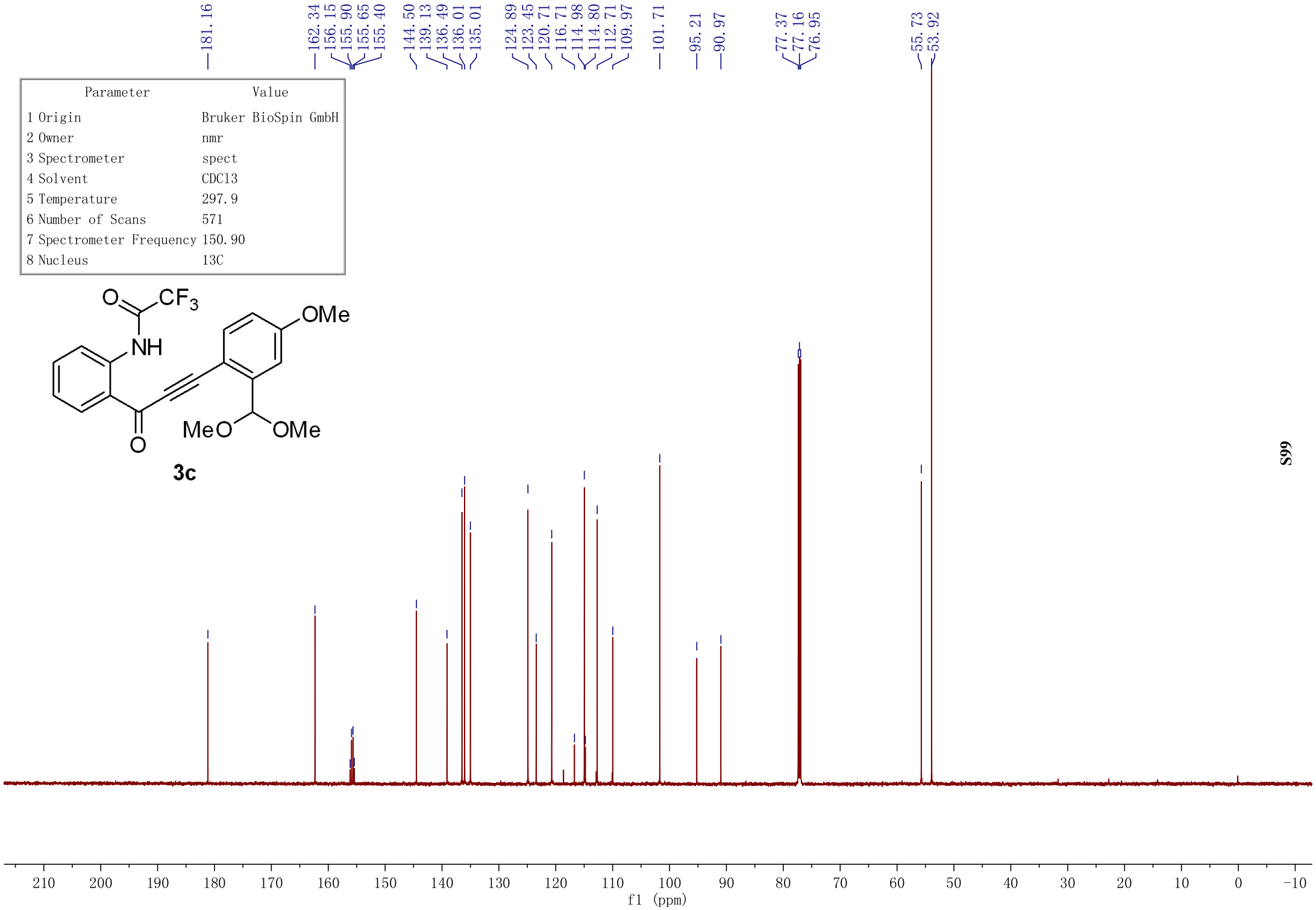
155.75
155.50
141.96
139.25
136.36
135.21
134.45
131.35
128.93
127.27
124.99
123.39
120.82
118.34
116.71
114.80
101.93
93.79
90.90
77.37
77.16
76.95
53.87
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 265
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
O
MeO
OMe
3a
S95
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
3b
NH
O
CF3
MeO
OMe
Me
12.70
8.72
8.71
8.62
8.62
8.61
8.60
7.72
7.71
7.69
7.59
7.57
7.54
7.39
7.39
7.38
7.36
7.36
7.35
7.34
7.26
5.69
3.40
2.40
1.01
1.00
1.00
1.08
1.04
1.03
1.08
1.02
1.00
6.25
3.11
f1 (ppm)


181.25
156.26
156.02
155.77
155.52
139.25
139.17
138.97
136.30
135.21
134.85
132.28
127.22
124.99
123.43
120.82
118.13
116.72
114.81
101.95
94.21
90.62
77.37
77.16
76.95
53.80
21.06
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 902
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
Me
MeO
OMe
O
3b
S97
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
3c
NH
O
CF3
MeO
OMe
OMe
12.76
8.71
8.69
8.60
8.60
8.59
8.59
7.68
7.67
7.65
7.37
7.37
7.36
7.26
7.24
7.23
6.93
6.93
6.92
6.91
5.70
3.89
3.43
0.99
1.00
1.00
2.08
1.05
1.01
1.03
1.00
3.19
6.26
f1 (ppm)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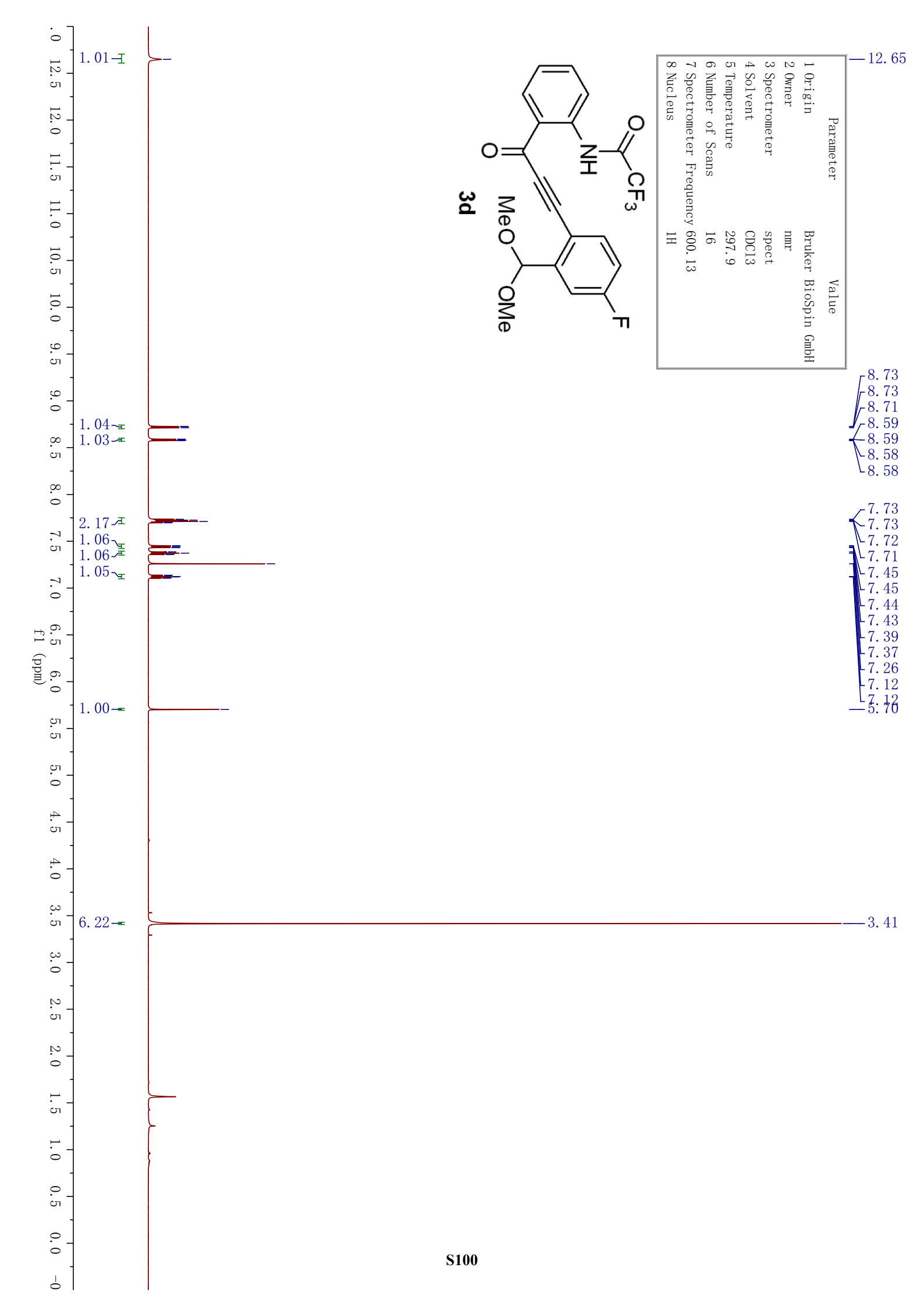
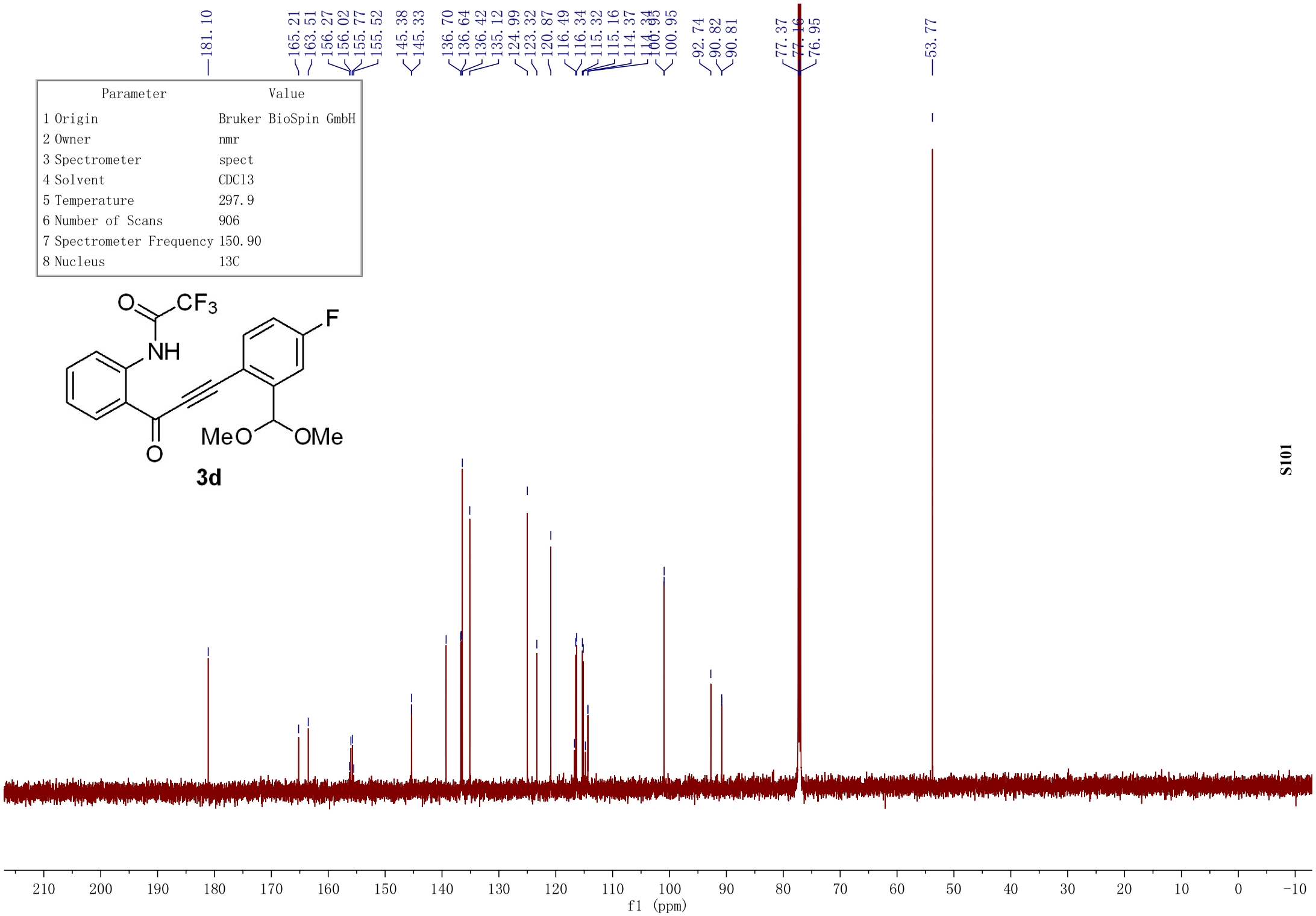
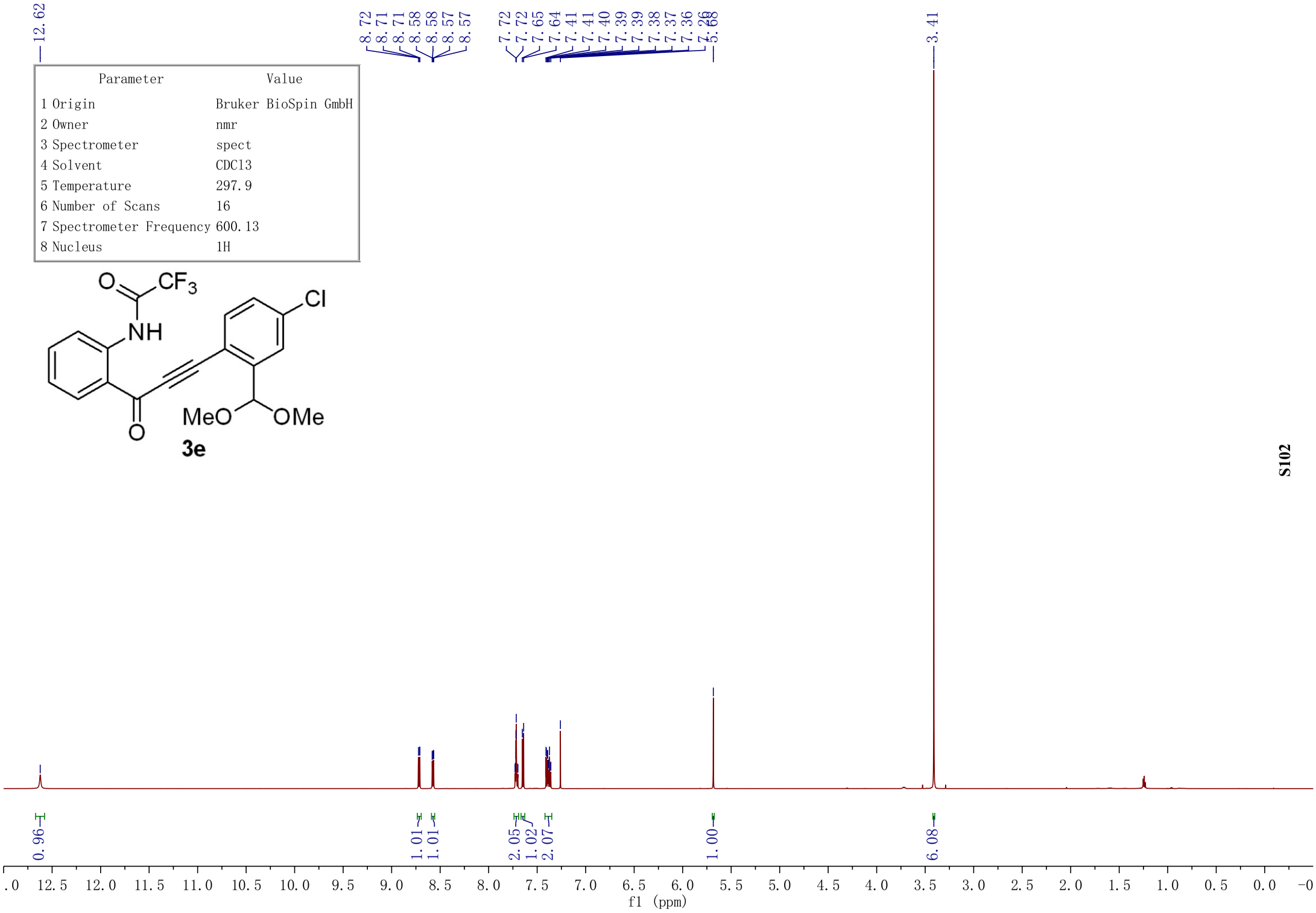
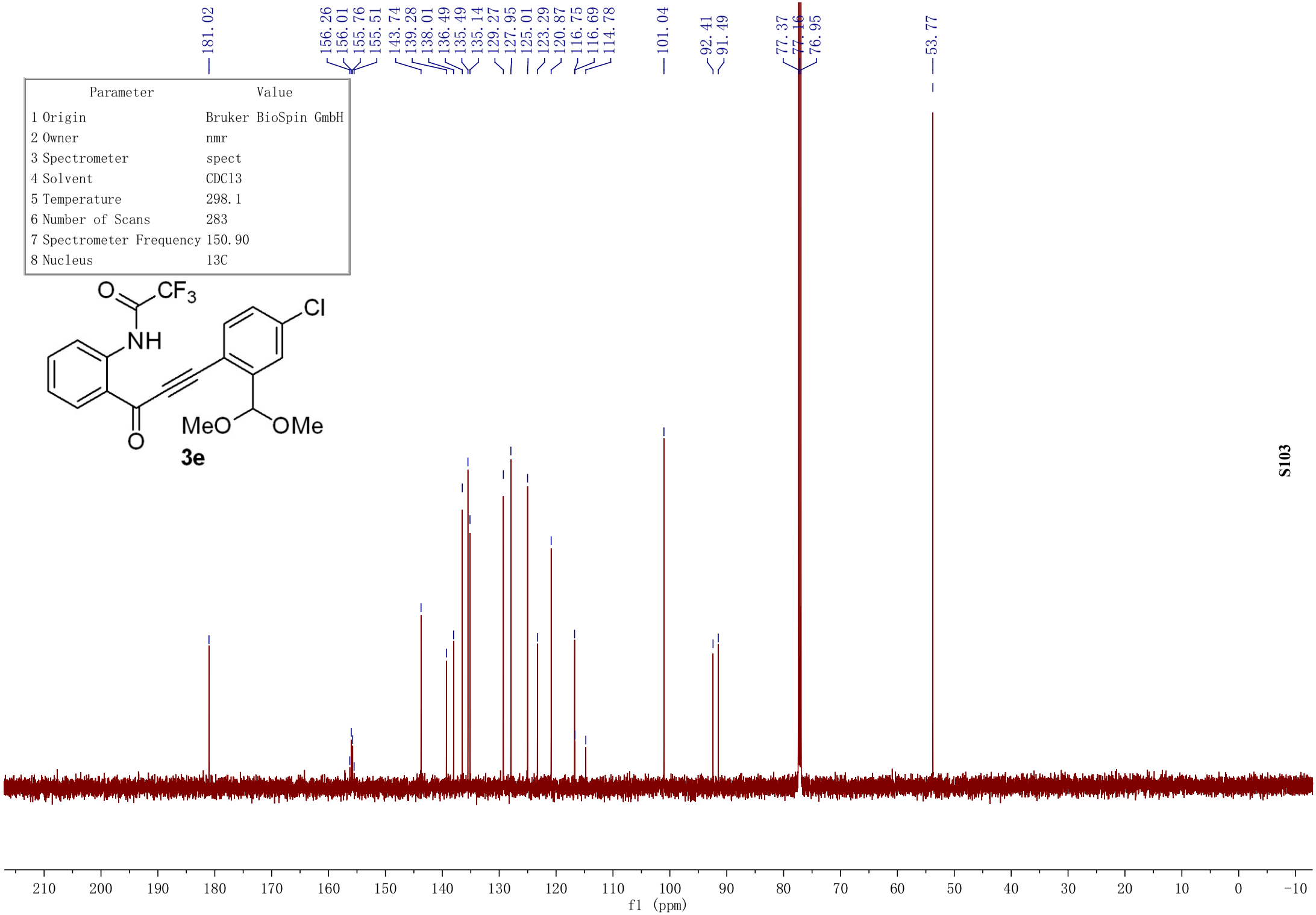
162.34
156.15
155.90
155.65
155.40
144.50
139.13
136.49
136.01
135.01
124.89
123.45
120.71
116.71
114.98
114.80
112.71
109.97
101.71
95.21
90.97
77.37
77.16
76.95
55.73
53.92
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 571
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
OMe
MeO
OMe
O
3c
S99
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
3d
NH
O
CF3
MeO
OMe
F
12.65
8.73
8.73
8.71
8.59
8.59
8.58
8.58
7.73
7.73
7.72
7.71
7.45
7.45
7.44
7.43
7.39
7.37
7.26
7.12
7.12
5.70
3.41
1.01
1.04
1.03
2.17
1.06
1.06
1.05
1.00
6.22
f1 (ppm)

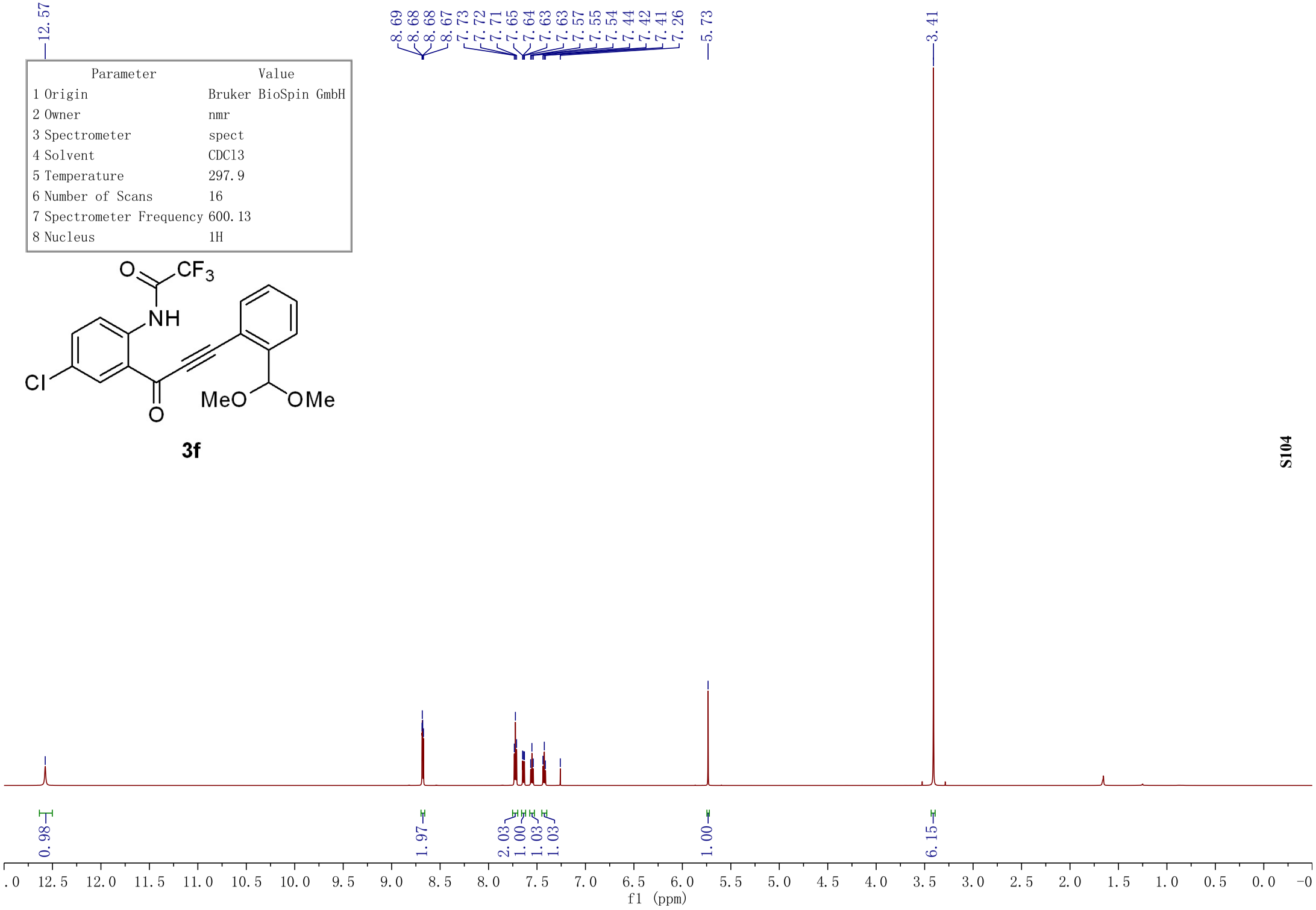

181.10
165.21
163.51
156.27
156.02
155.77
155.52
145.38
145.33
136.70
136.64
136.42
135.12
124.99
123.32
120.87
116.49
116.34
115.32
115.16
114.37
100.95
92.74
90.82
90.81
77.37
77.16
76.95
53.77
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDC13
5 Temperature 297.9
6 Number of Scans 906
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
F
MeO
OMe
O
3d
S101
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

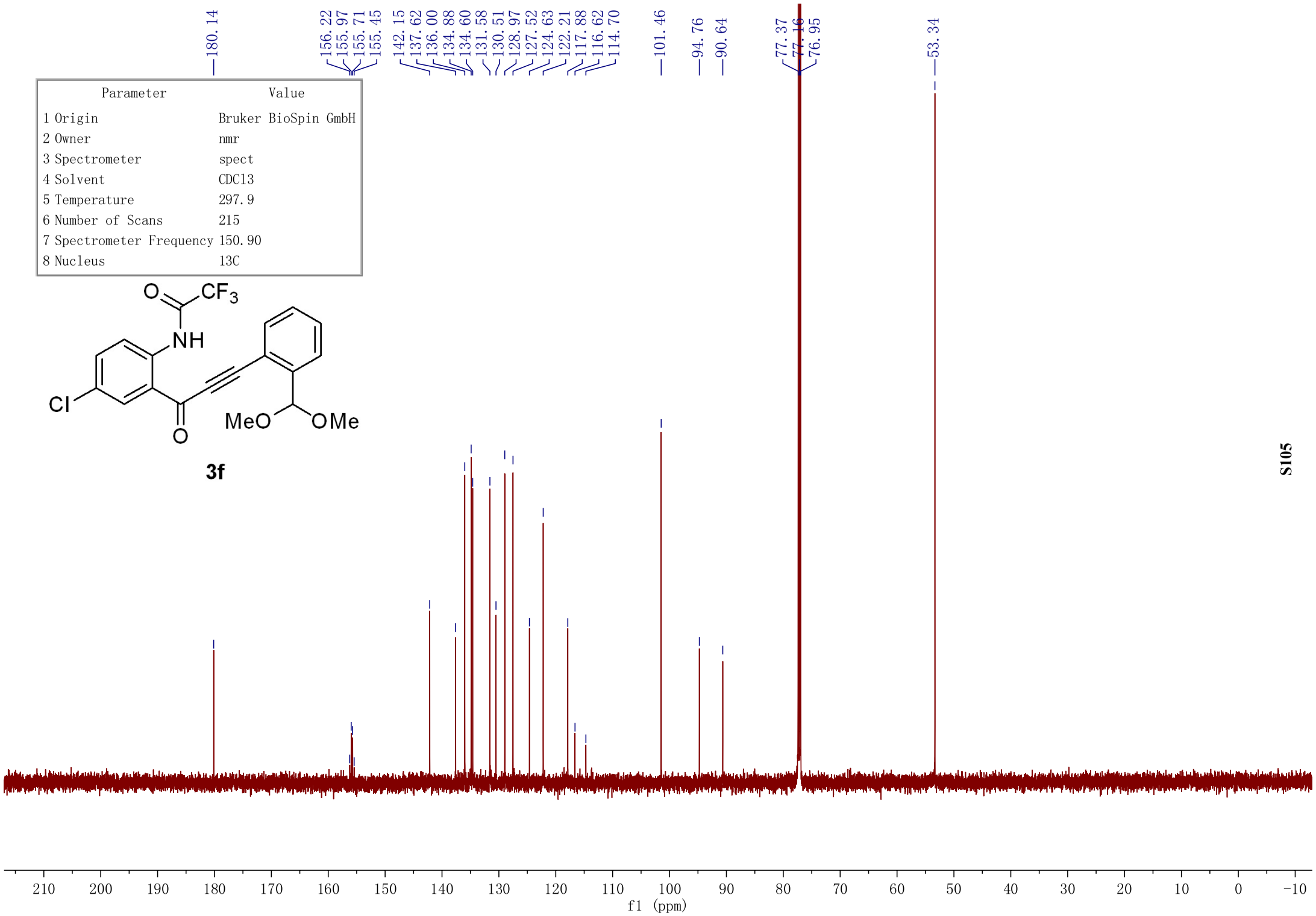

12.62
8.72
8.71
8.71
8.58
8.58
8.57
8.57
7.72
7.72
7.65
7.64
7.41
7.41
7.40
7.39
7.39
7.38
7.37
7.36
7.26
5.68
3.41
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
O
CF3
NH
Cl
MeO
OMe
O
3e
S102
0.96
1.01
1.01
2.05
1.02
2.07
1.00
6.08
f1 (ppm)


181.02
156.26
156.01
155.76
155.51
143.74
139.28
138.01
136.49
135.49
135.14
129.27
127.95
125.01
123.29
120.87
116.75
116.69
114.78
101.04
92.41
91.49
77.37
77.16
76.95
53.77
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 283
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
Cl
MeO
OMe
O
3e
S103
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

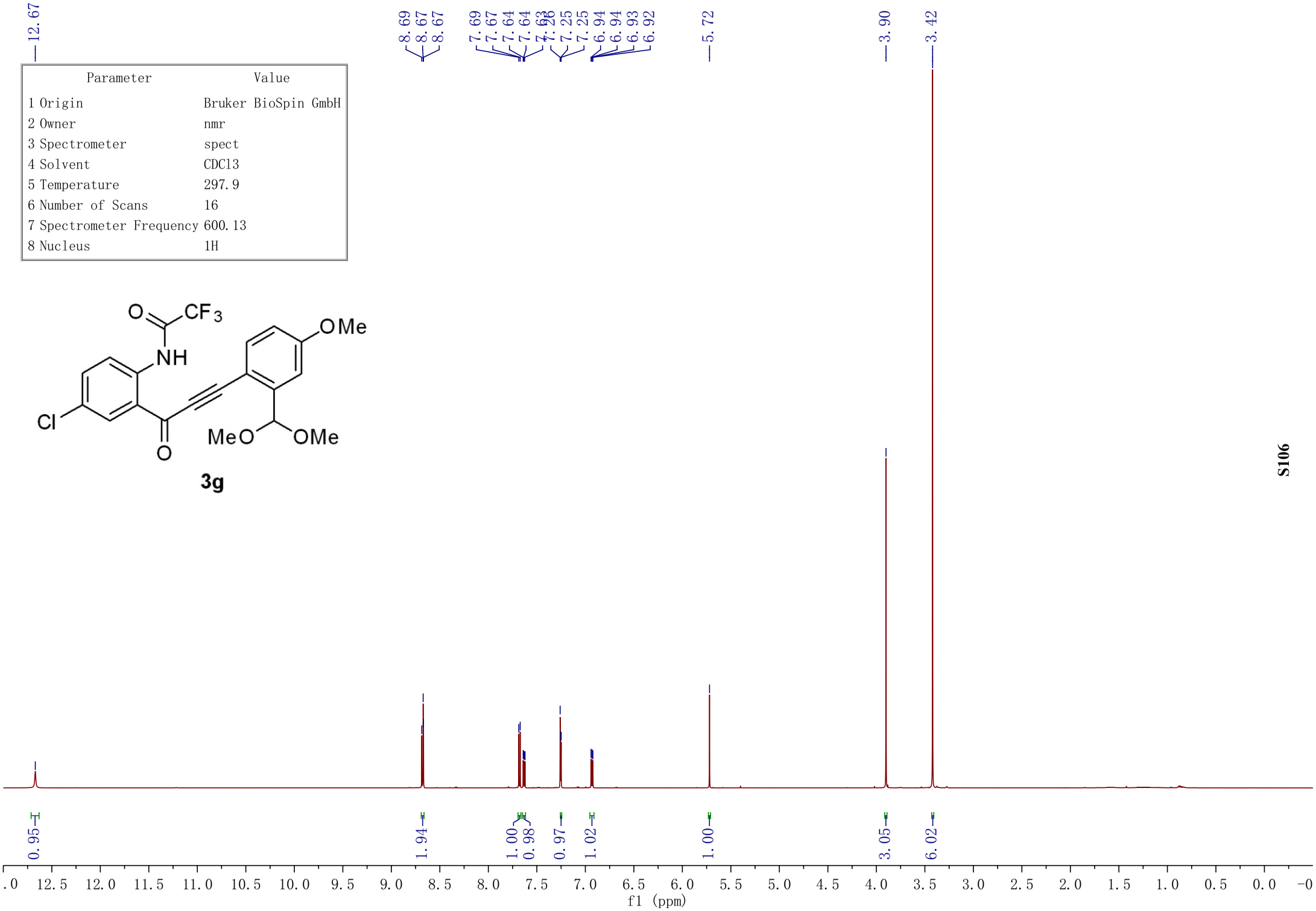
3f

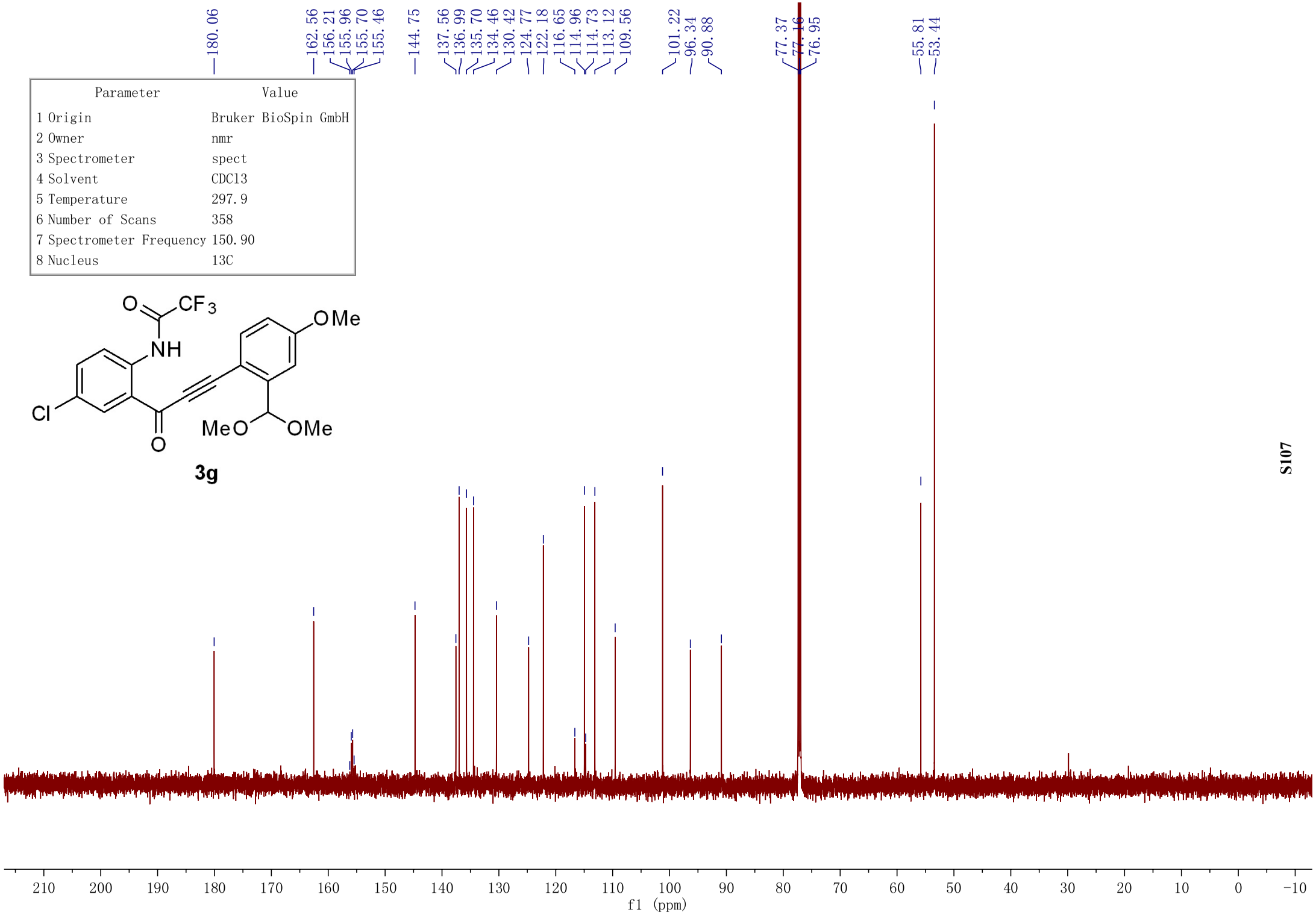


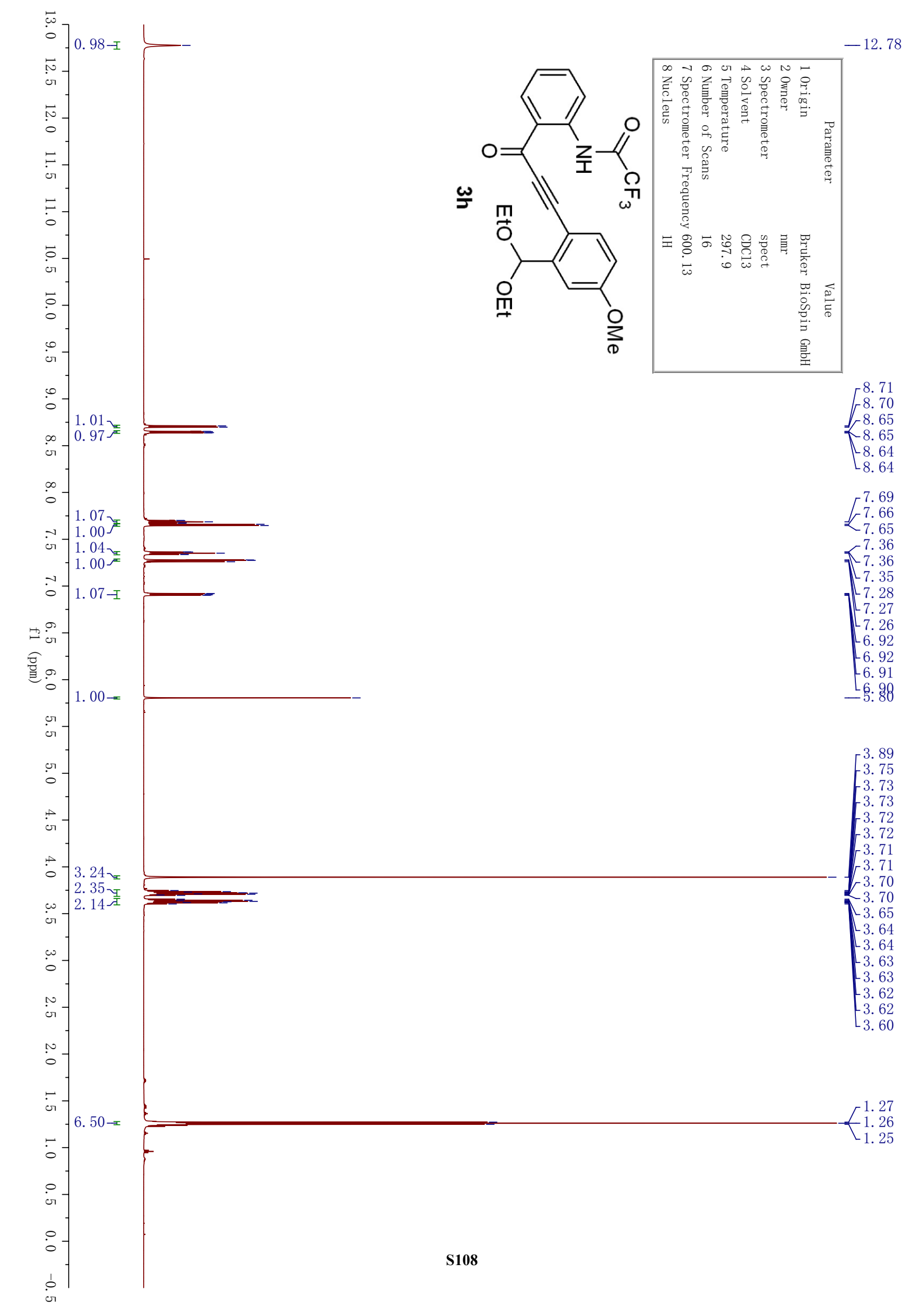

180.14
156.22
155.97
155.71
155.45
142.15
137.62
136.00
134.88
134.60
131.58
130.51
128.97
127.52
124.63
122.21
117.88
116.62
114.70
101.46
94.76
90.64
77.37
77.16
76.95
53.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 215
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
Cl
O
MeO
OMe
3f
S105
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

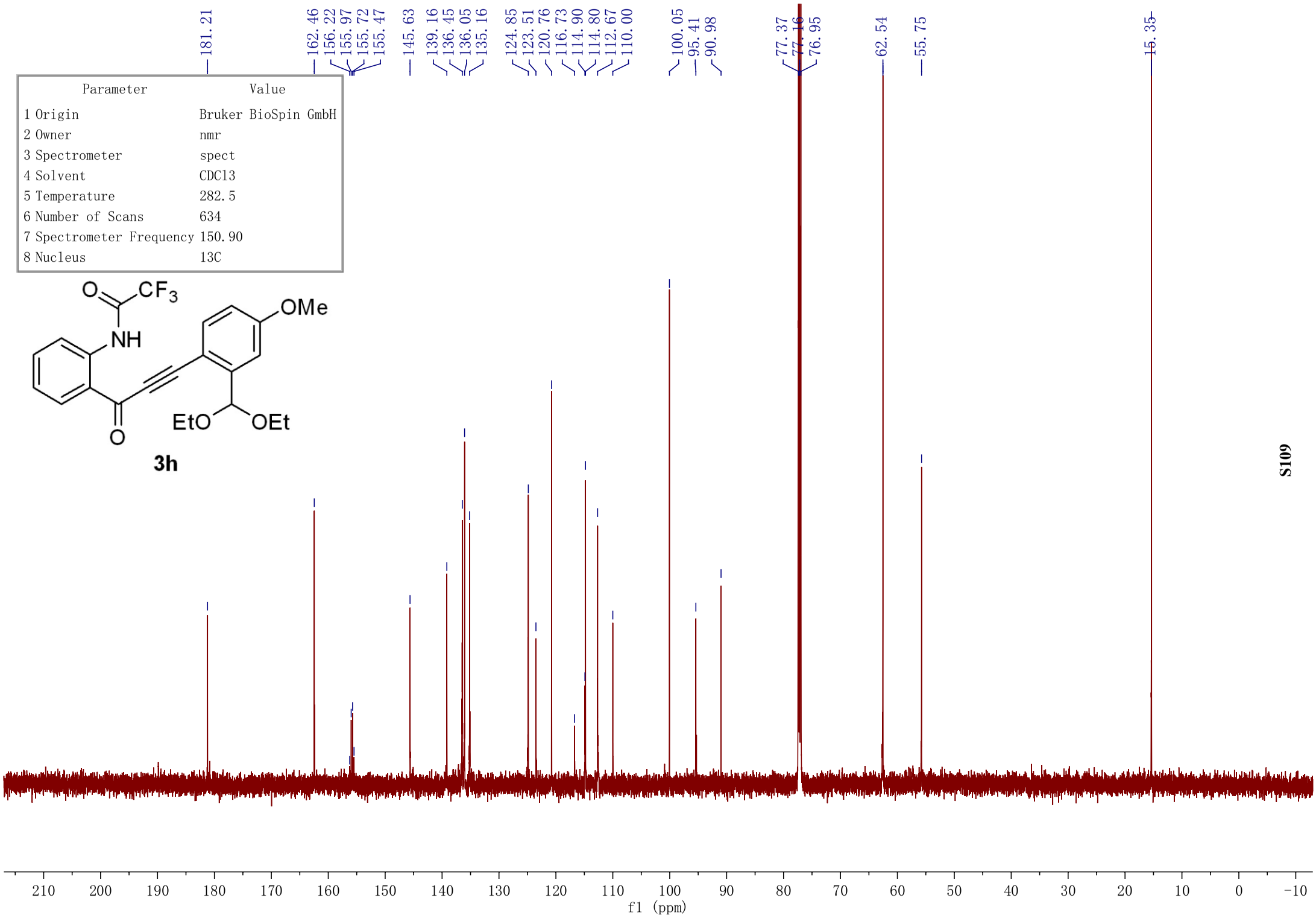
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

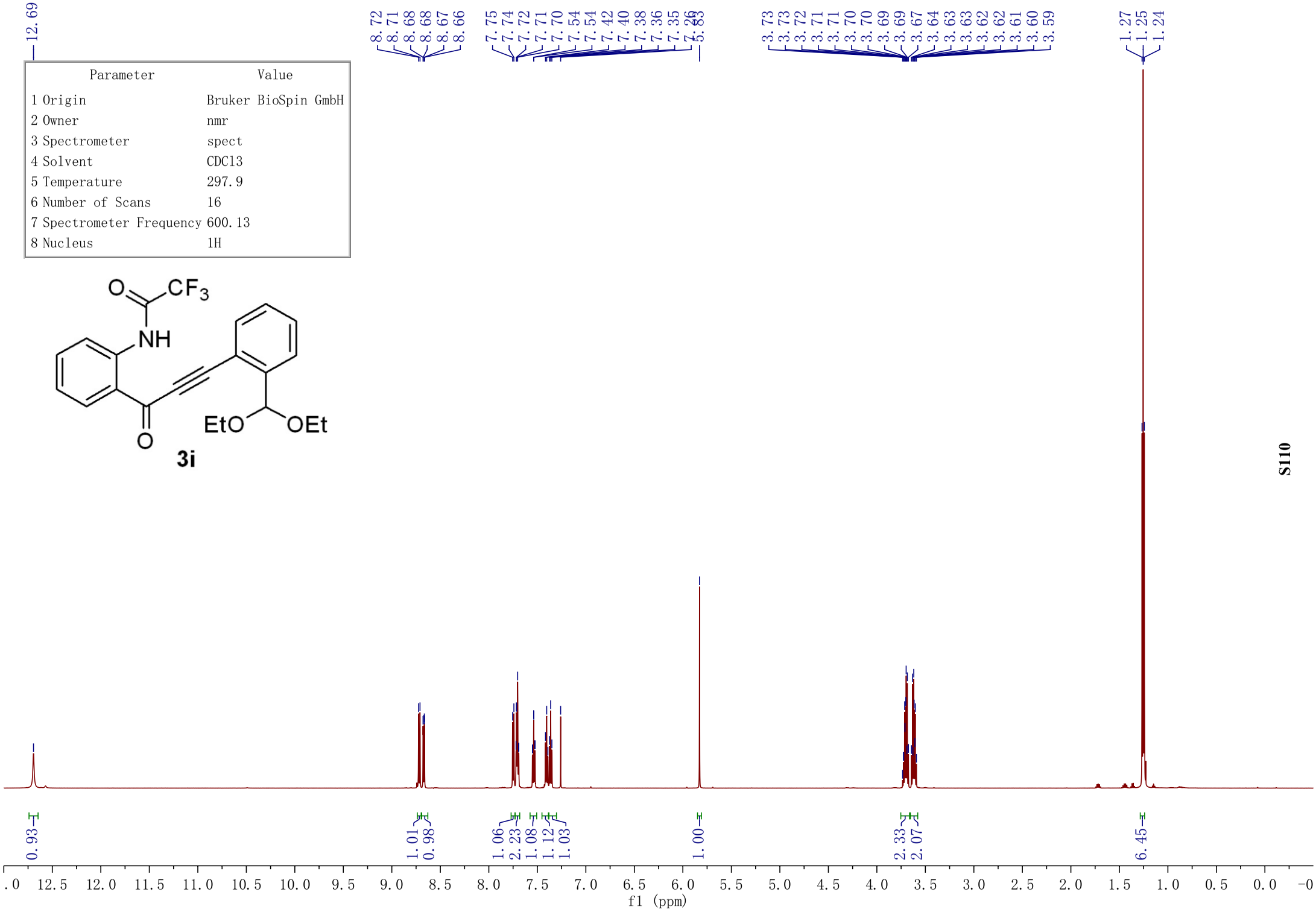
3g

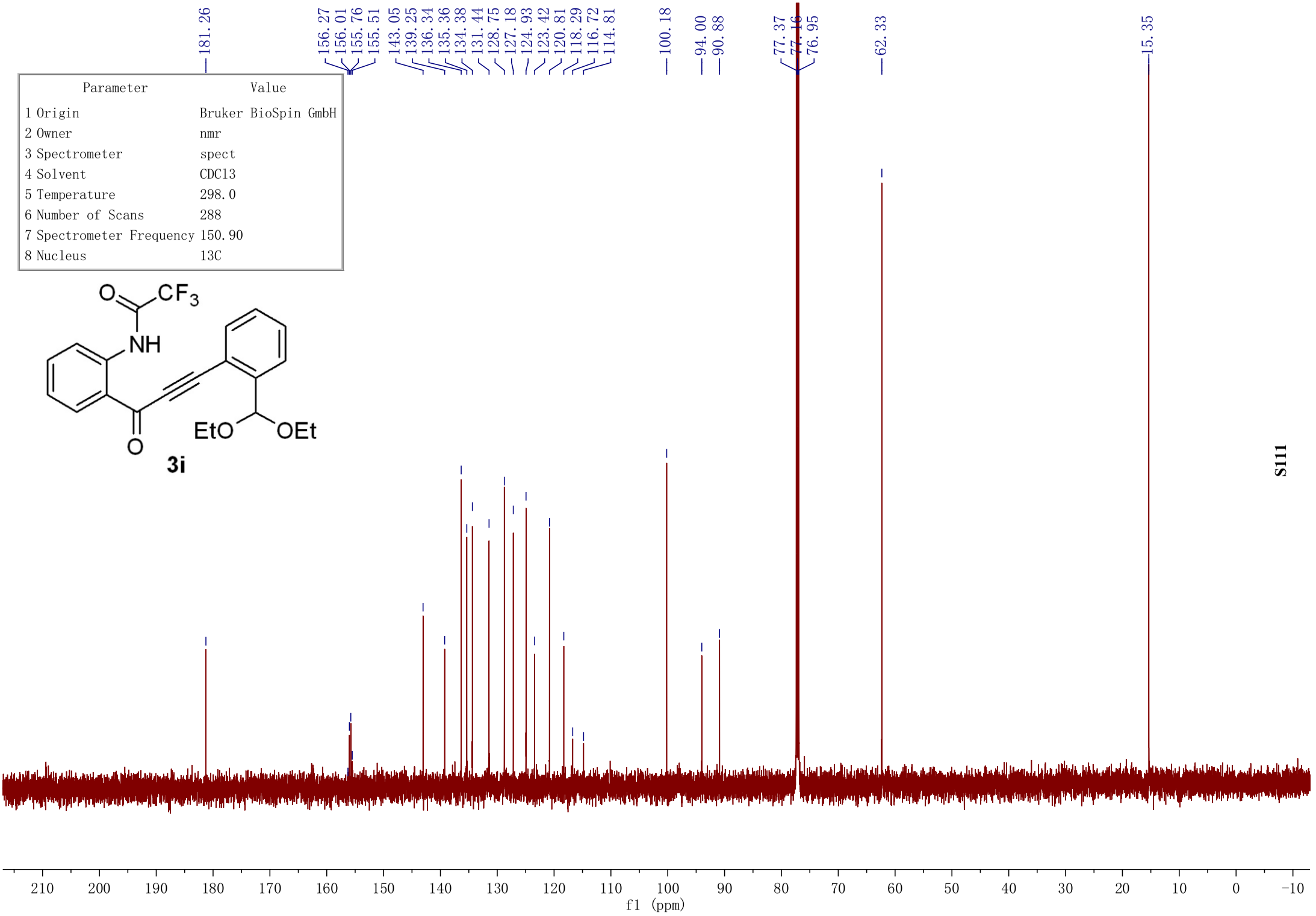


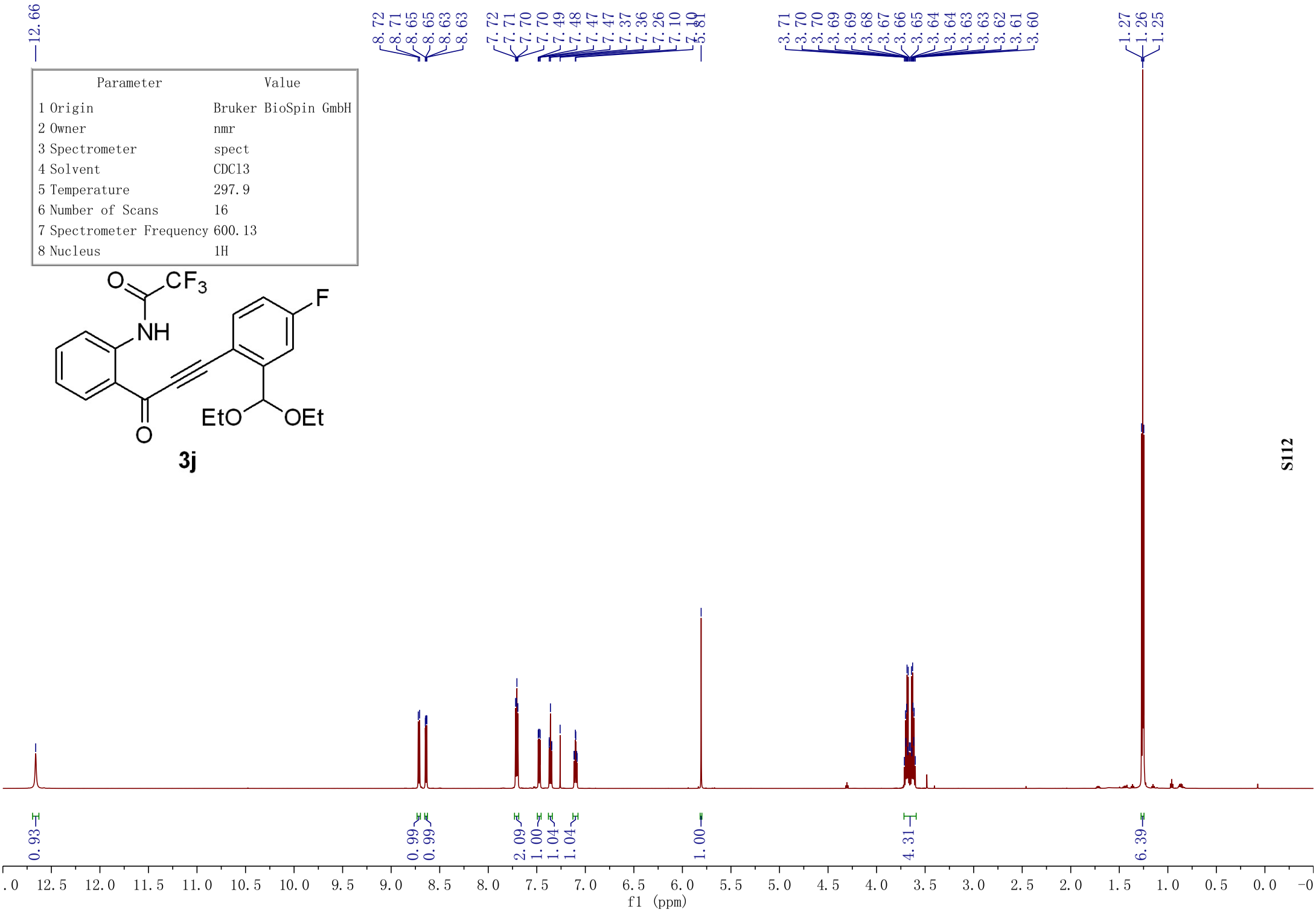

180.06
162.56
156.21
155.96
155.70
155.46
144.75
137.56
136.99
135.70
134.46
130.42
124.77
122.18
116.65
114.96
114.73
113.12
109.56
101.22
96.34
90.88
77.37
77.16
76.95
55.81
53.44
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 358
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
OMe
Cl
MeO
OMe
O
3g
S107
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

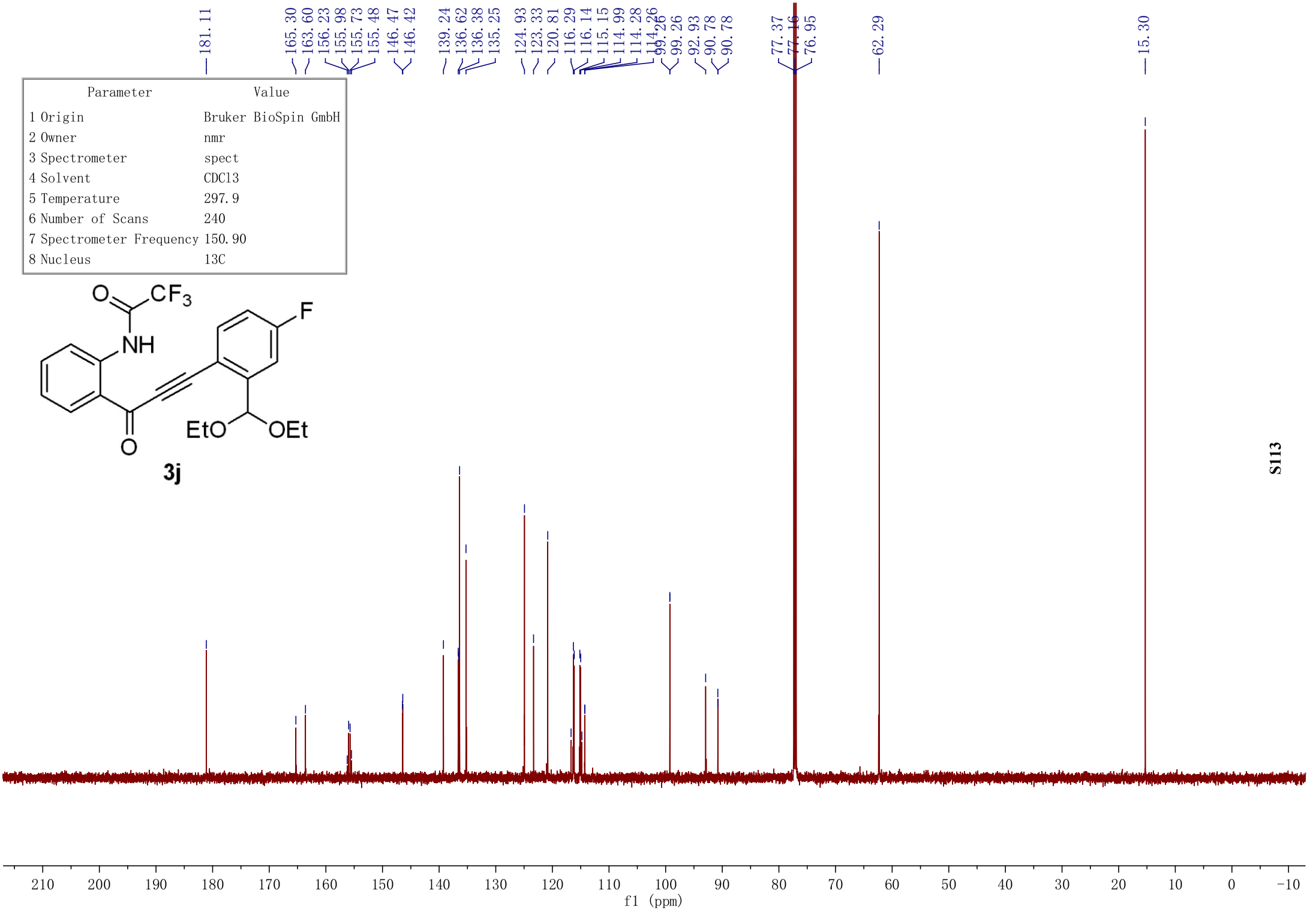

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
3h
NH
O
CF3
EtO
OEt
OMe
12.78
8.71
8.70
8.65
8.65
8.64
8.64
7.69
7.66
7.65
7.36
7.36
7.35
7.28
7.27
7.26
6.92
6.92
6.91
6.90
5.80
3.89
3.75
3.73
3.73
3.72
3.72
3.71
3.71
3.70
3.70
3.65
3.64
3.64
3.63
3.63
3.62
3.62
3.60
1.27
1.26
1.25
0.98
1.01
0.97
1.07
1.00
1.04
1.00
1.07
1.00
3.24
2.35
2.14
6.50
f1 (ppm)


181.21
162.46
156.22
155.97
155.72
155.47
145.63
139.16
136.45
136.05
135.16
124.85
123.51
120.76
116.73
114.90
114.80
112.67
110.00
100.05
95.41
90.98
77.37
77.16
76.95
62.54
55.75
15.35
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 282.5
6 Number of Scans 634
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
OMe
EtO
OEt
O
3h
S109
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

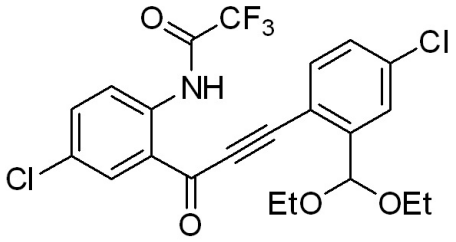

12.69
8.72 8.71 8.68 8.68 8.67 8.66
7.75 7.74 7.72 7.71 7.70 7.54 7.54 7.42 7.40 7.38 7.36 7.35 7.26 7.83
3.73 3.73 3.72 3.71 3.71 3.70 3.70 3.69 3.69 3.67 3.64 3.63 3.63 3.62 3.62 3.61 3.60 3.59
1.27 1.25 1.24
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
O CF3
NH
O
EtO OEt
3i
S110
0.93 1.01 0.98 1.06 2.23 1.08 1.12 1.03 1.00 2.33 2.07 6.45
f1 (ppm)


181.26
156.27
156.01
155.76
155.51
143.05
139.25
136.34
135.36
134.38
131.44
128.75
127.18
124.93
123.42
120.81
118.29
116.72
114.81
100.18
94.00
90.88
77.37
77.16
76.95
62.33
15.35
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.0
6 Number of Scans 288
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
EtO
OEt
O
3i
S111
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


12.66
8.72
8.71
8.65
8.65
8.63
8.63
7.72
7.71
7.70
7.70
7.49
7.48
7.47
7.47
7.37
7.36
7.26
7.10
7.10
5.81
3.71
3.70
3.70
3.69
3.69
3.68
3.67
3.66
3.65
3.64
3.64
3.63
3.63
3.62
3.61
3.60
1.27
1.26
1.25
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
O
CF3
NH
F
EtO
OEt
O
3j
S112
0.93
0.99
0.99
2.09
1.00
1.04
1.04
1.00
4.31
6.39
f1 (ppm)

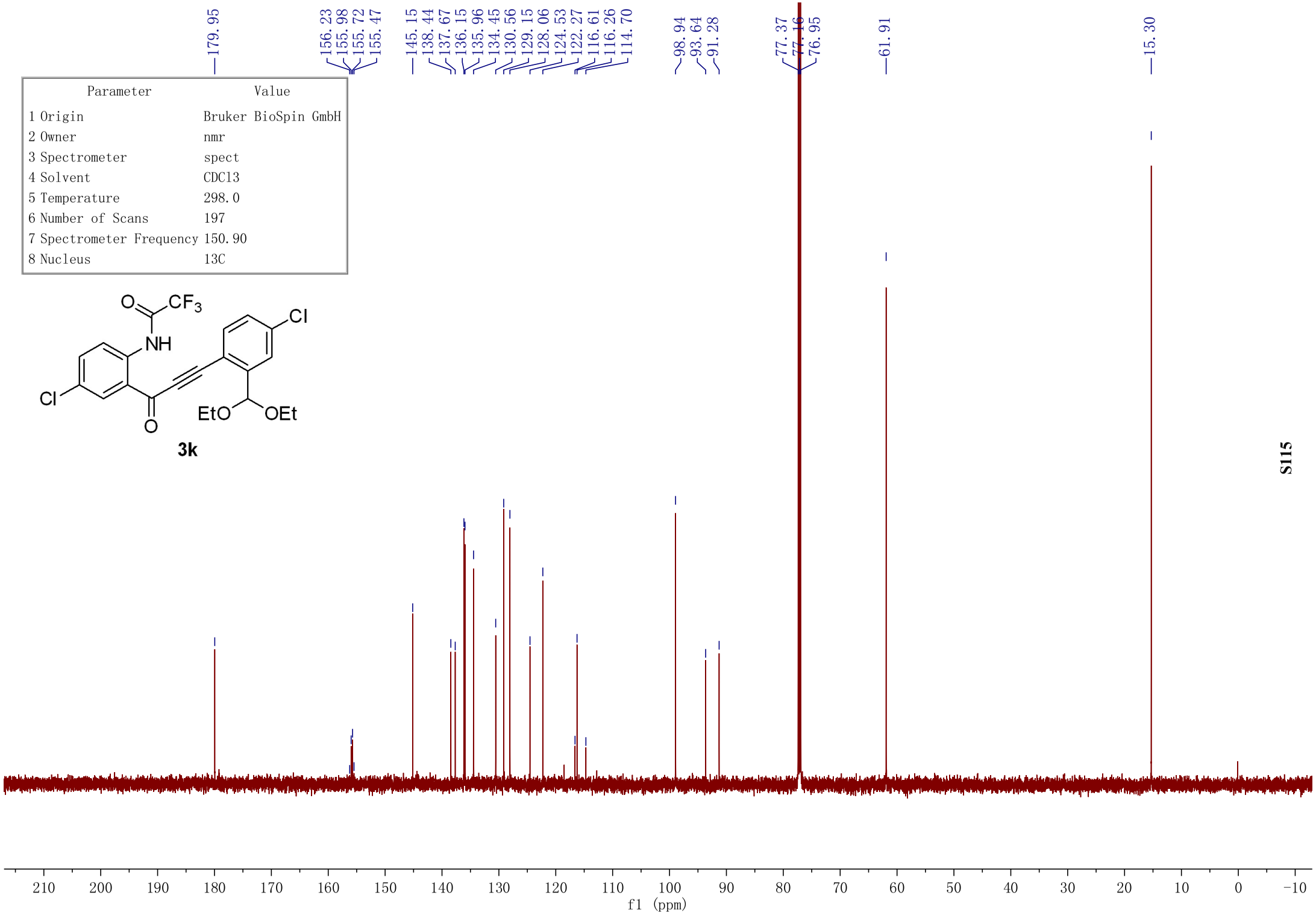

181.11
165.30
163.60
156.23
155.98
155.73
155.48
146.47
146.42
139.24
136.62
136.38
135.25
124.93
123.33
120.81
116.29
116.14
115.15
114.99
114.28
114.26
99.26
99.26
92.93
90.78
90.78
77.37
77.16
76.95
62.29
15.30
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 240
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
F
EtO
OEt
O
3j
S113
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

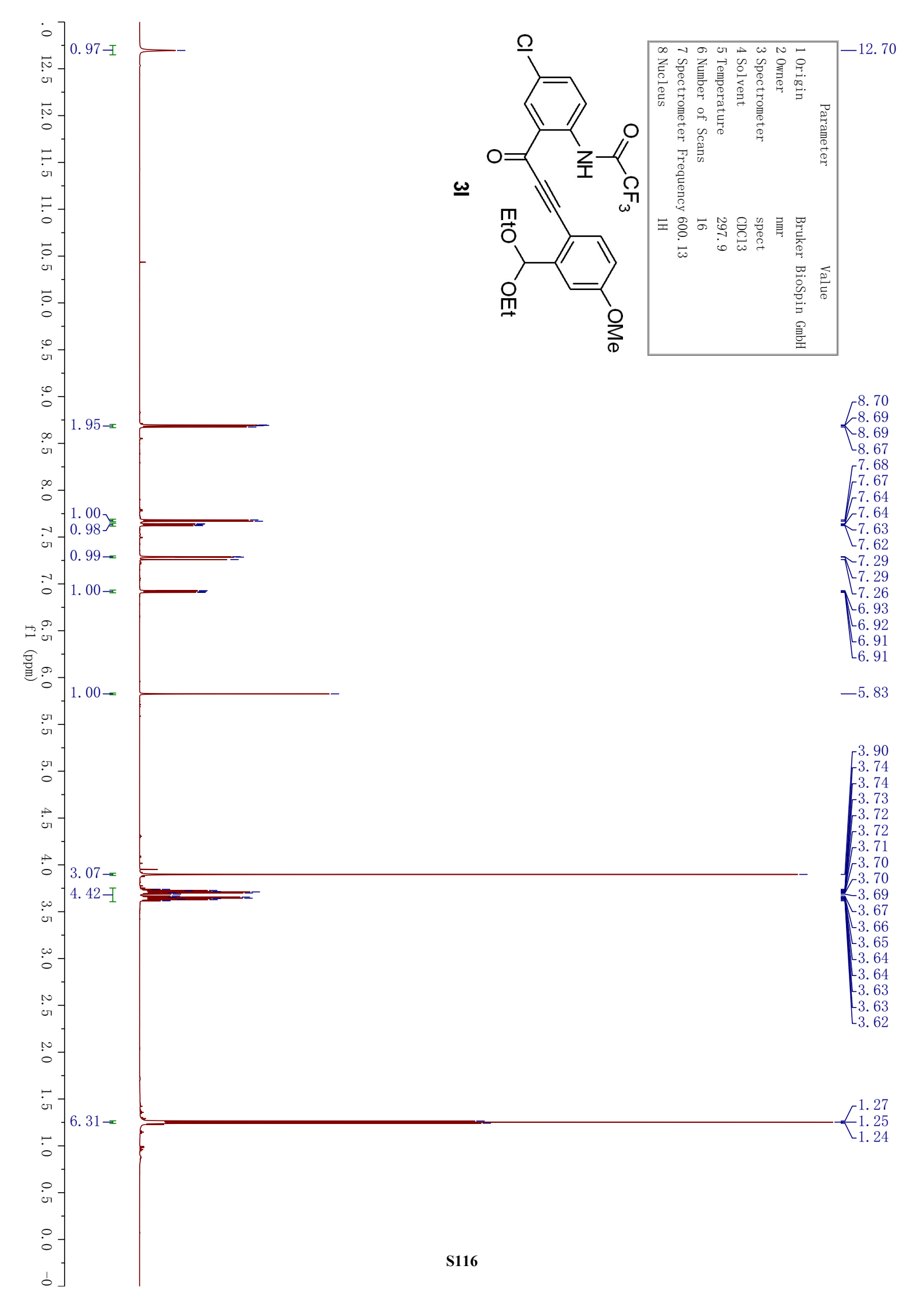
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDC13
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

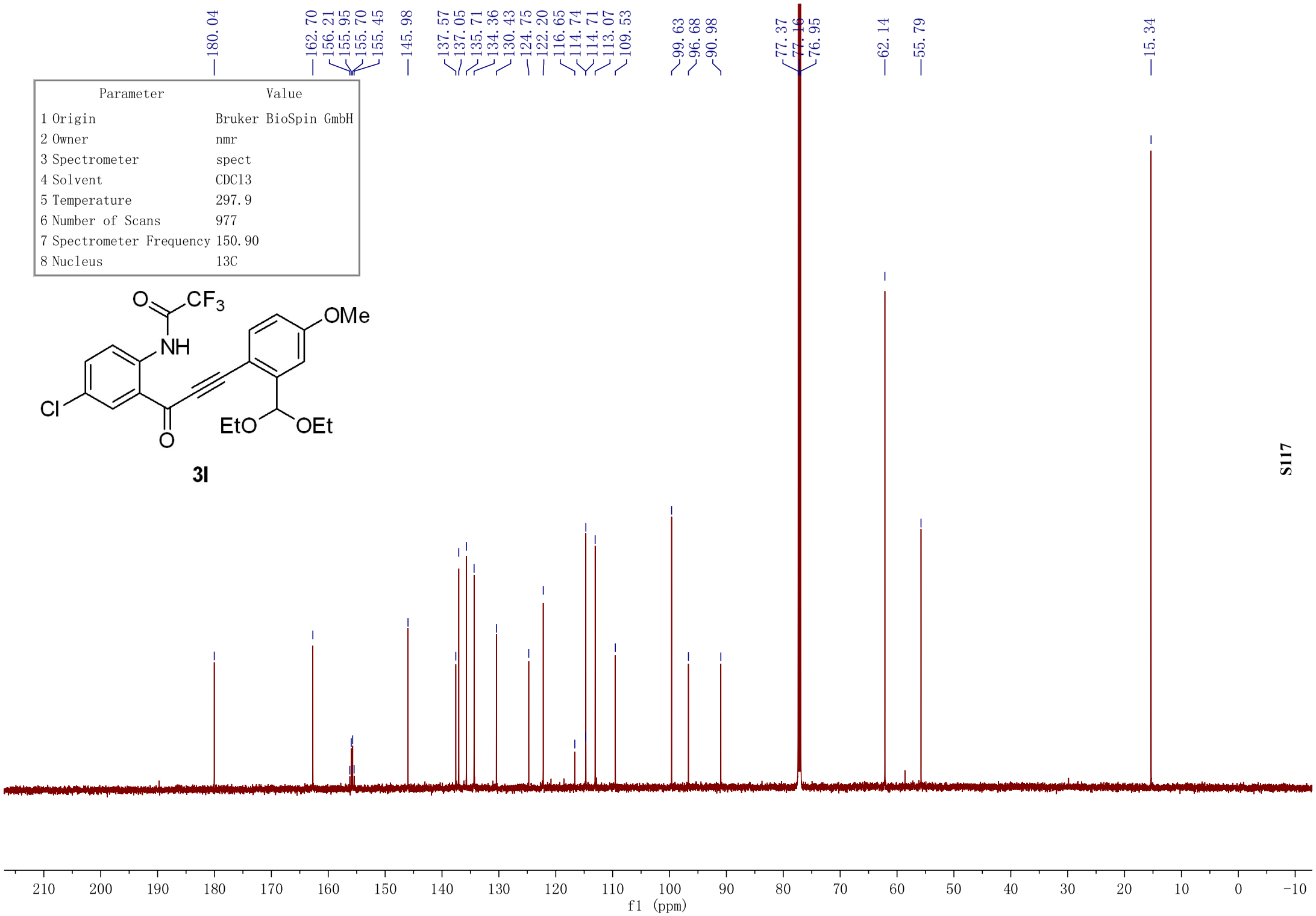


3k

f1 (ppm)


179.95
156.23
155.98
155.72
155.47
145.15
138.44
137.67
136.15
135.96
134.45
130.56
129.15
128.06
124.53
122.27
116.61
116.26
114.70
98.94
93.64
91.28
77.37
77.16
76.95
61.91
15.30
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.0
6 Number of Scans 197
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
Cl
Cl
EtO
OEt
O
3k
S115
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
3l
Cl
NH
O
CF3
EtO
OEt
OMe
12.70
8.70
8.69
8.69
8.67
7.68
7.67
7.64
7.64
7.63
7.62
7.29
7.29
7.26
6.93
6.92
6.91
6.91
5.83
3.90
3.74
3.74
3.73
3.72
3.72
3.71
3.70
3.70
3.69
3.67
3.66
3.65
3.64
3.64
3.63
3.63
3.62
1.27
1.25
1.24
0.97
1.95
1.00
0.98
0.99
1.00
1.00
3.07
4.42
6.31
f1 (ppm)


180.04
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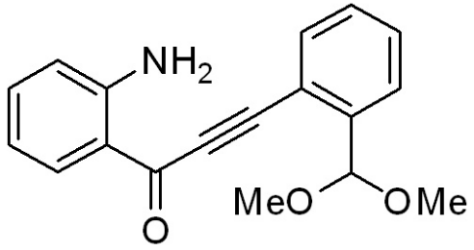
156.21
155.95
155.70
155.45
145.98
137.57
137.05
135.71
134.36
130.43
124.75
122.20
116.65
114.74
114.71
113.07
109.53
99.63
96.68
90.98
77.37
77.16
76.95
62.14
55.79
15.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 977
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
CF3
NH
OMe
Cl
O
EtO
OEt
3l
S117
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

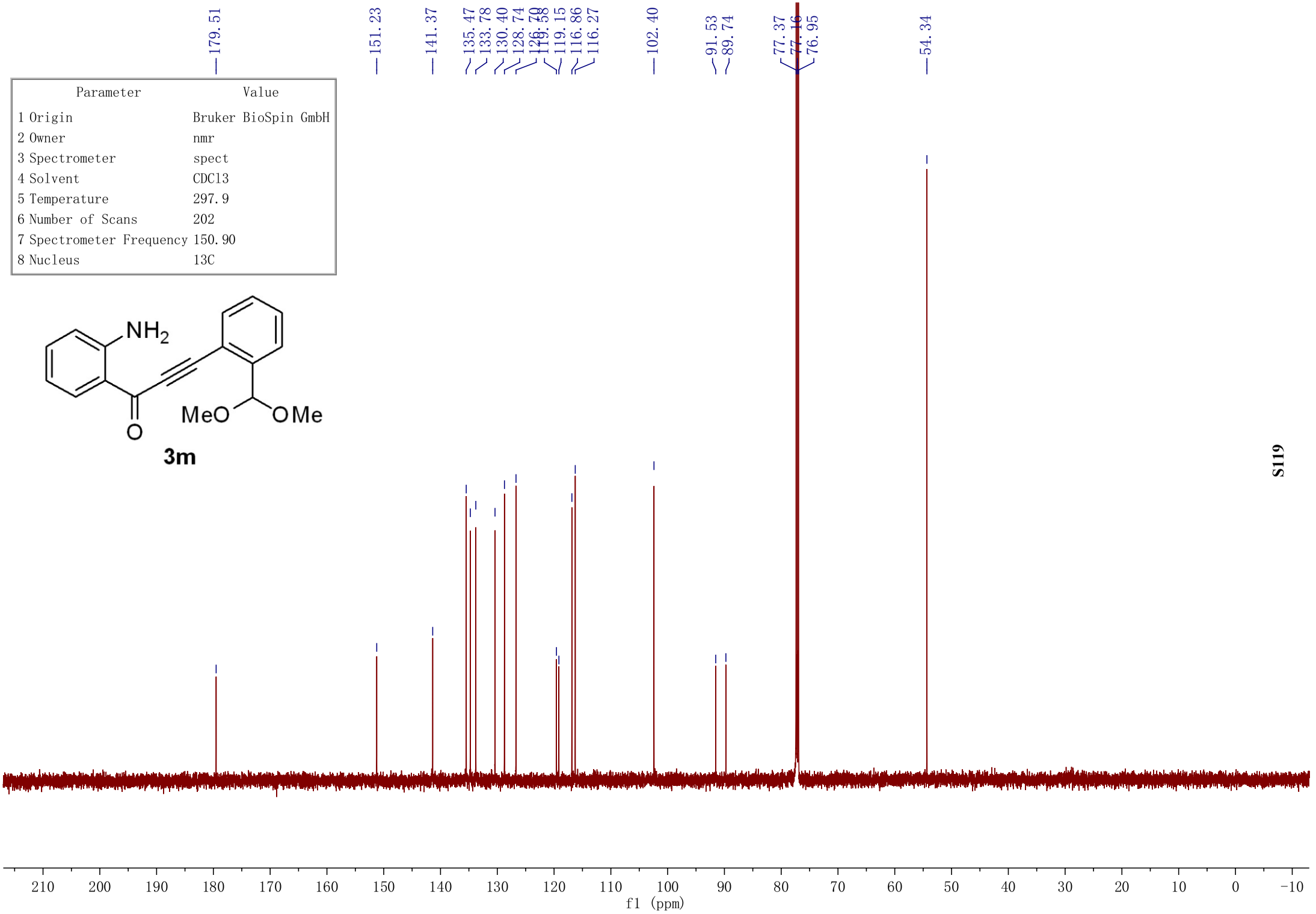
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

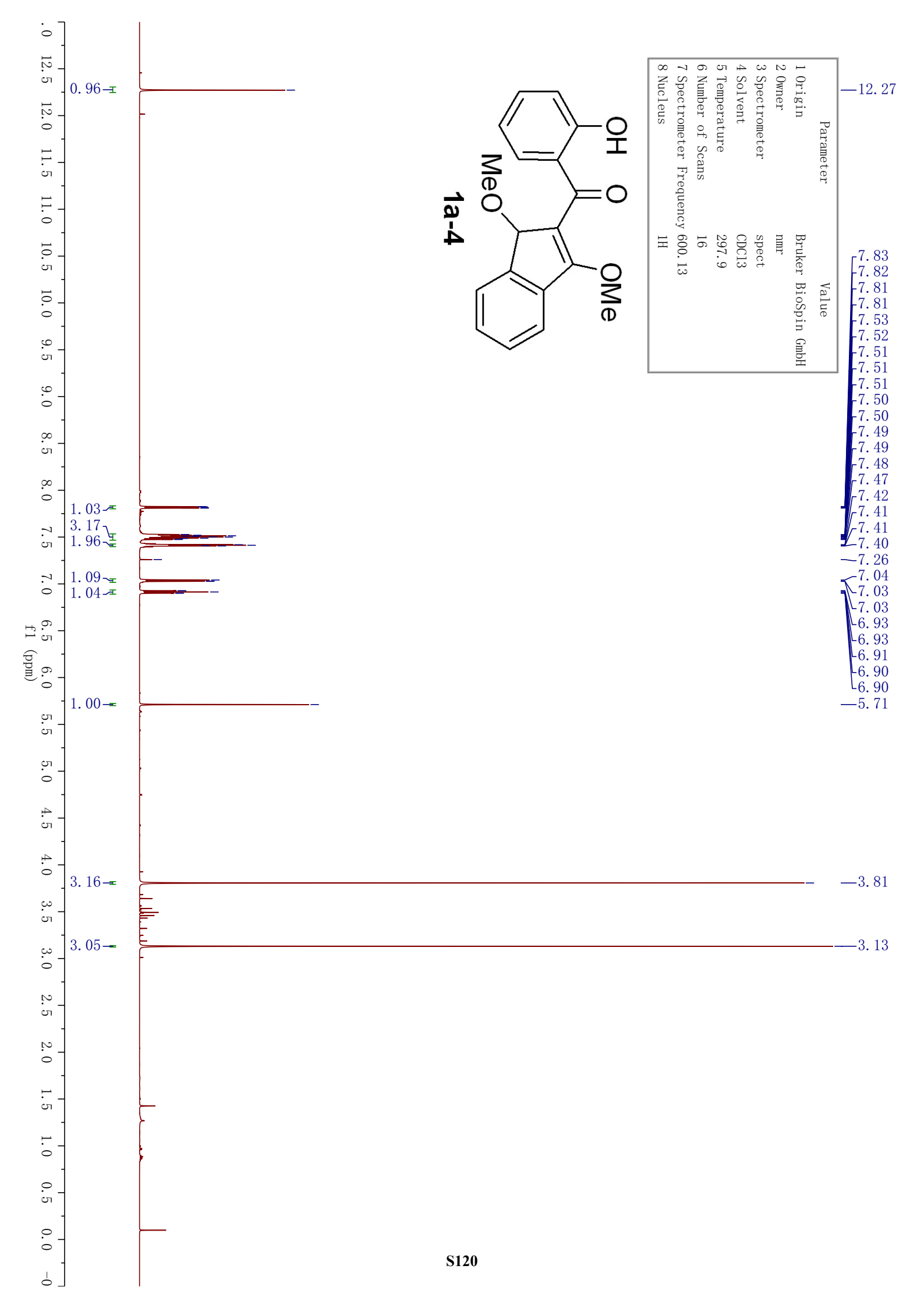


3m

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	202
7 Spectrometer Frequency	150.90
8 Nucleus	13C

3m



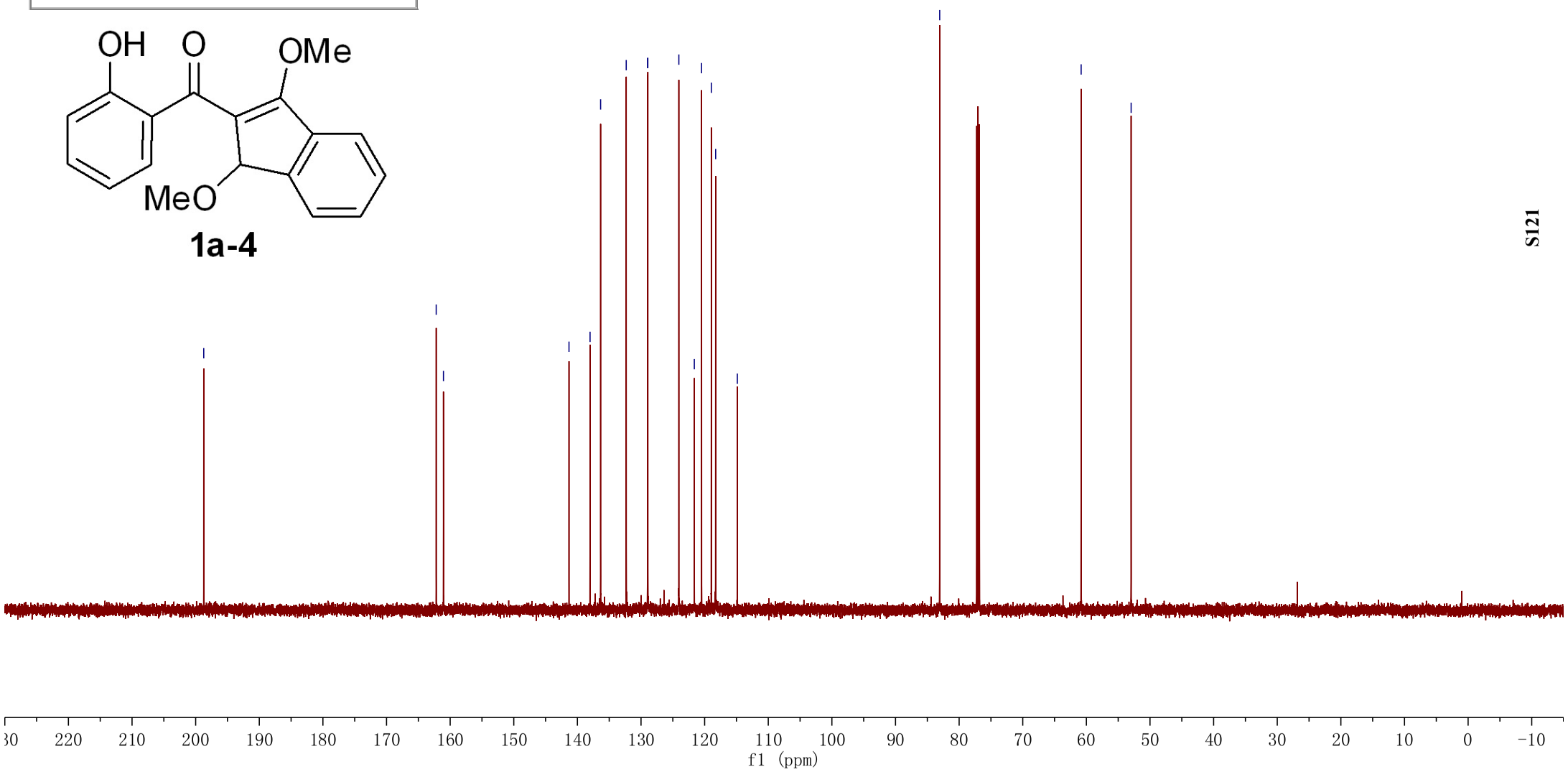

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
OH O
MeO OMe
1a-4
12.27
7.83 7.82 7.81 7.81 7.53 7.52 7.51 7.51 7.51 7.50 7.50 7.49 7.49 7.48 7.47 7.42 7.41 7.41 7.40
7.26
7.04 7.03 7.03 6.93 6.93 6.91 6.90 6.90
5.71
3.81
3.13
0.96
1.03
3.17
1.96
1.09
1.04
1.00
3.16
3.05
f1 (ppm)

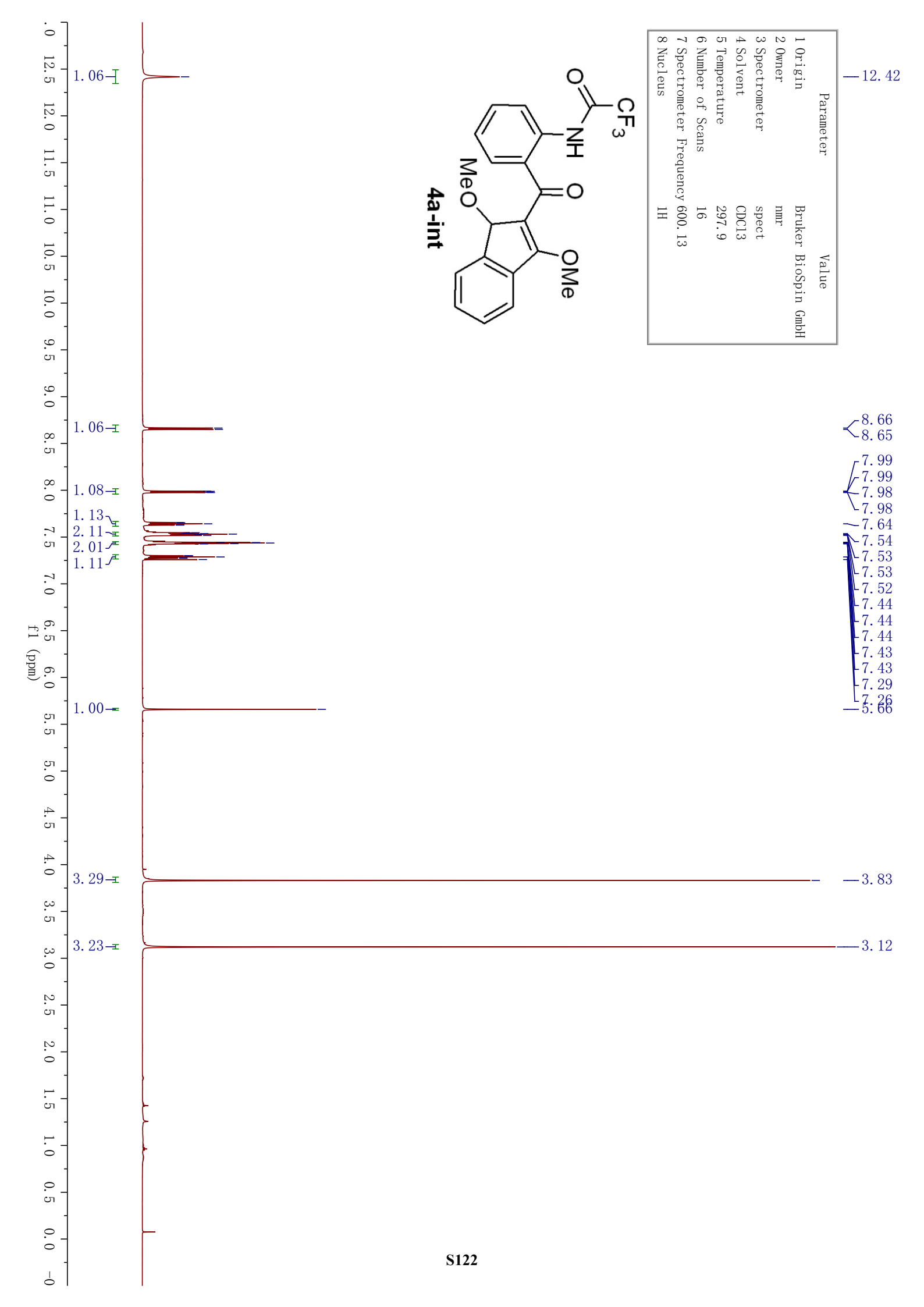
198.73
162.19
161.05
141.32
138.01
136.35
132.32
128.97
128.93
124.05
121.62
120.49
118.95
118.27
114.86
83.05
60.82
52.96

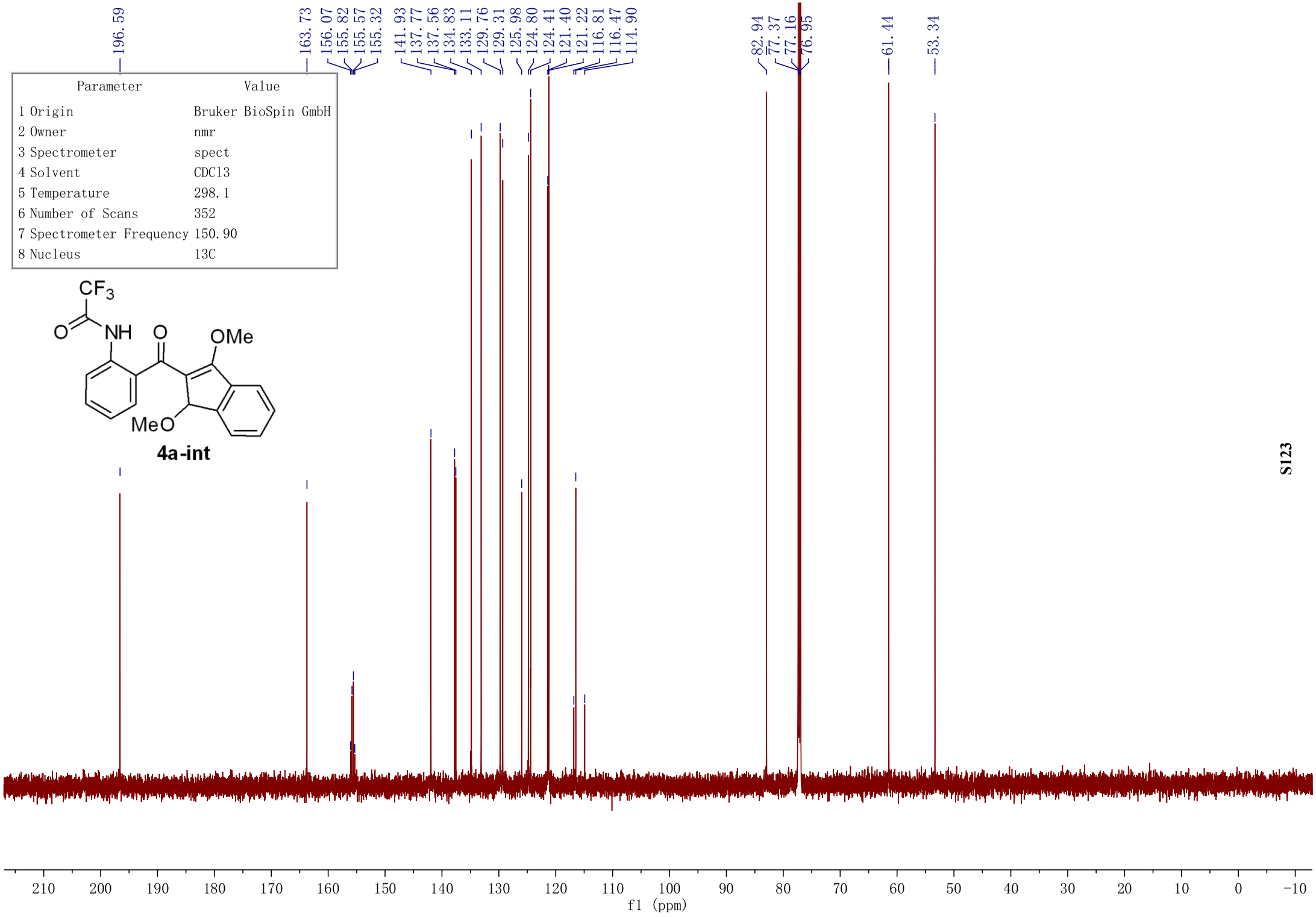
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	1021
7 Spectrometer Frequency	150.90
8 Nucleus	13C

1a-4

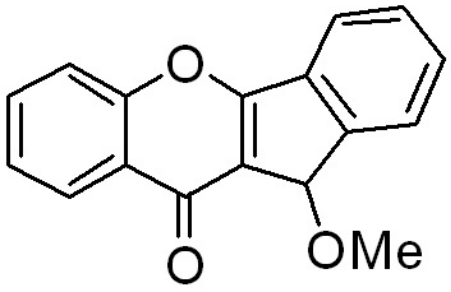
S121



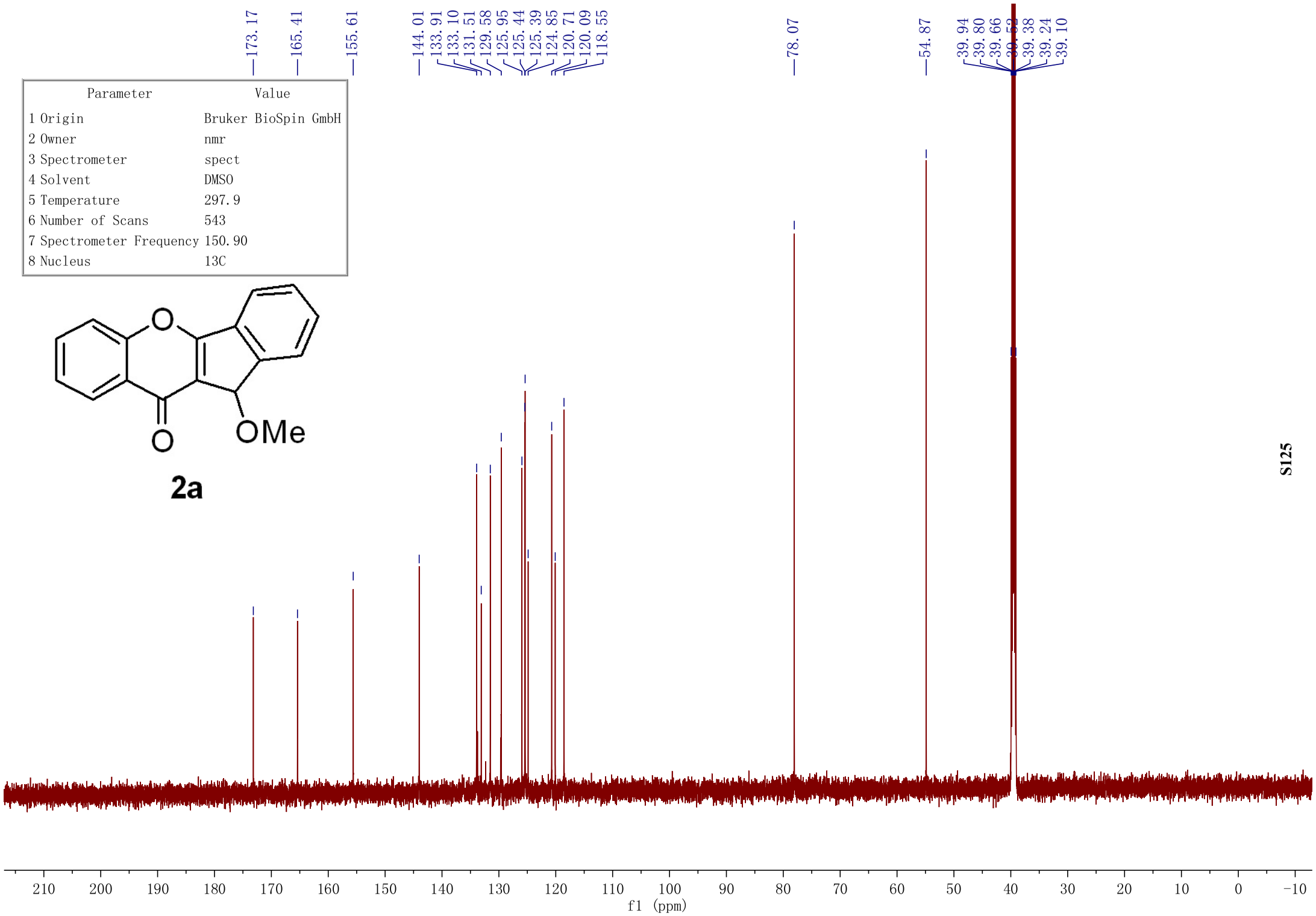

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
4a-int
MeO
OMe
NH
O
CF3
12.42
8.66
8.65
7.99
7.99
7.98
7.98
7.64
7.54
7.53
7.53
7.52
7.44
7.44
7.44
7.43
7.43
7.29
7.26
5.66
3.83
3.12
1.06
1.06
1.08
1.13
2.11
2.01
1.11
1.00
3.29
3.23
f1 (ppm)

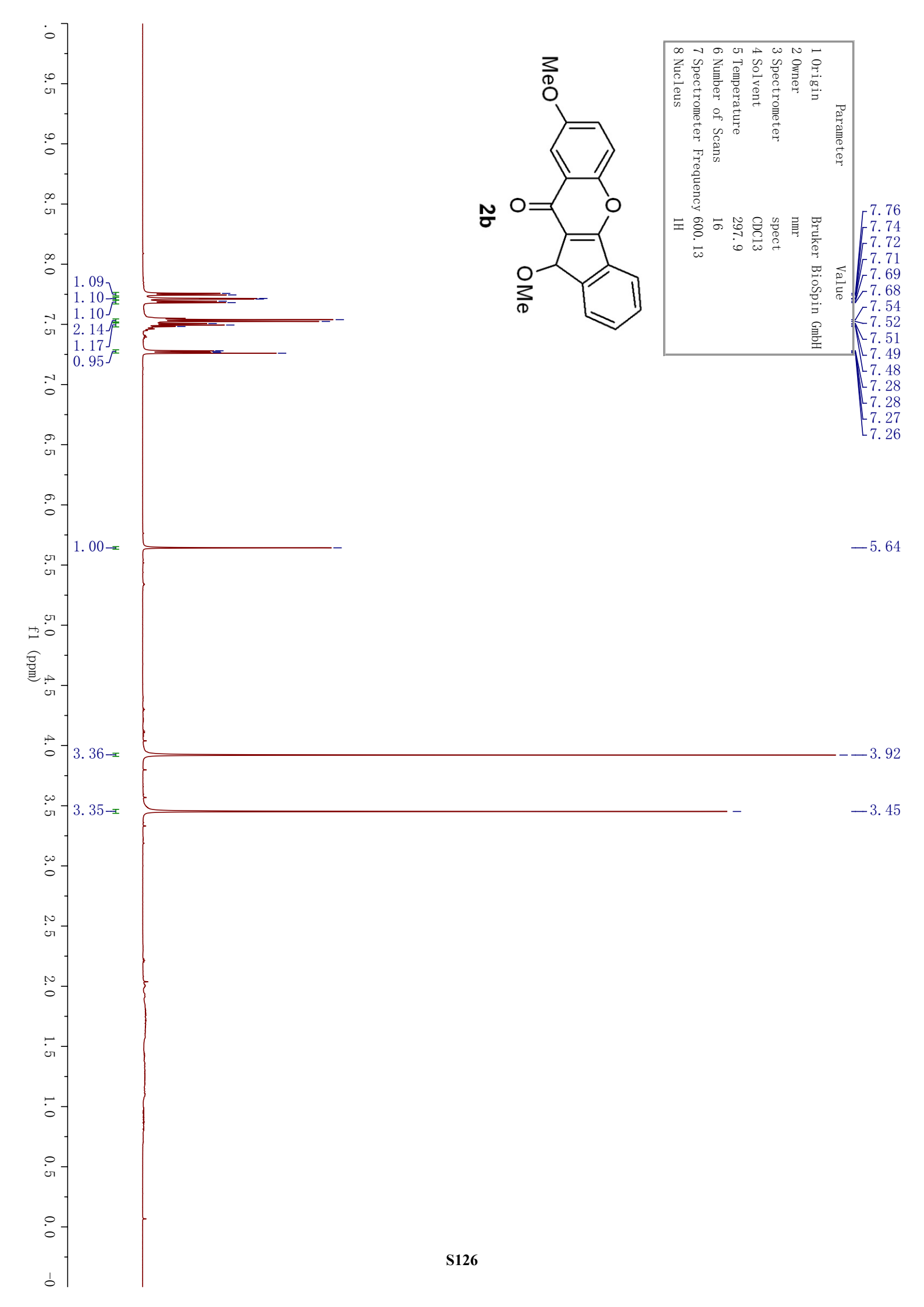

196.59
163.73
156.07
155.82
155.57
155.32
141.93
137.77
137.56
134.83
133.11
129.76
129.31
125.98
124.80
124.41
121.40
121.22
116.81
116.47
114.90
82.94
77.37
77.16
76.95
61.44
53.34
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 352
7 Spectrometer Frequency 150.90
8 Nucleus 13C
CF3
O
NH
O
OMe
MeO
4a-int
S123
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

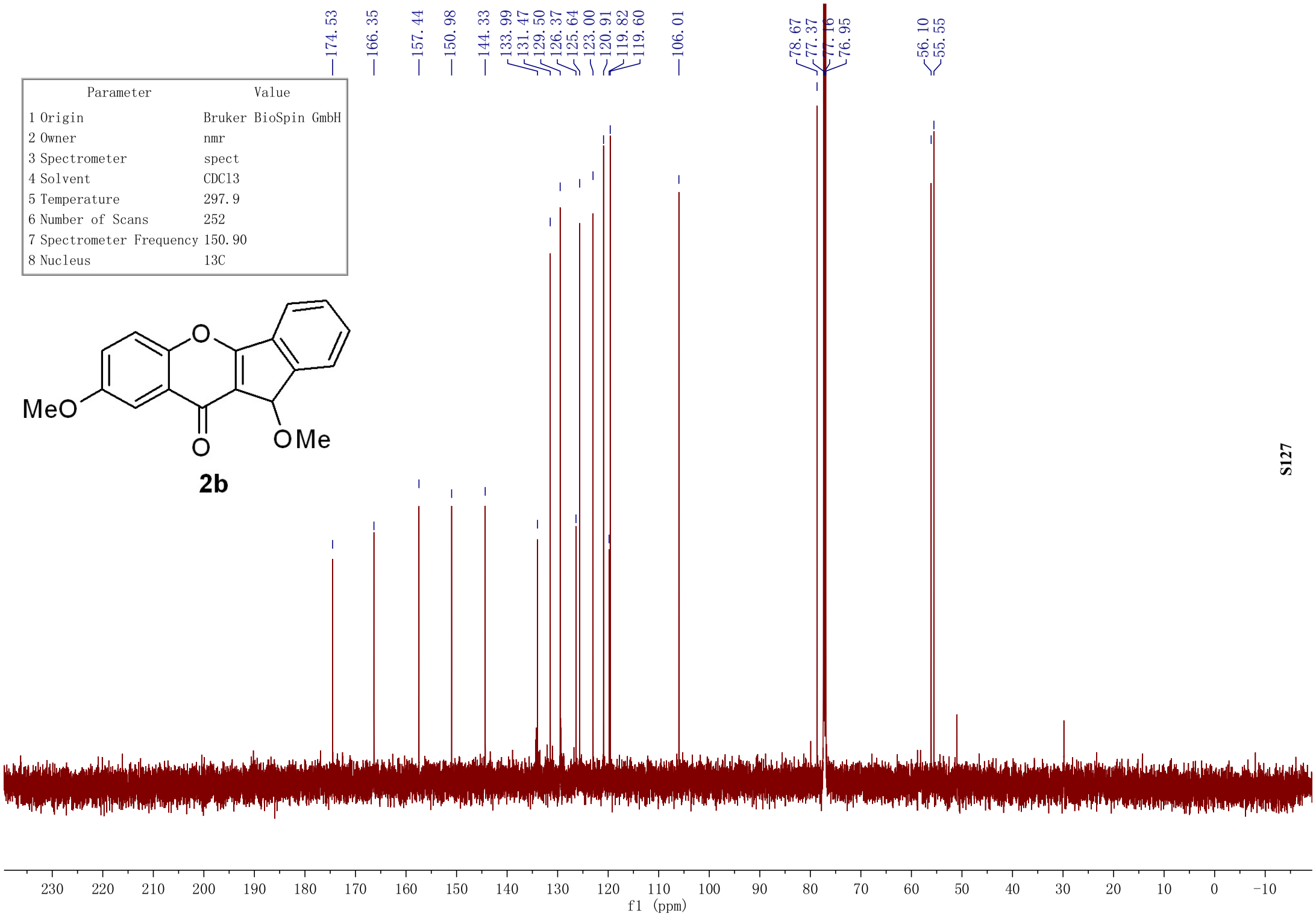
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

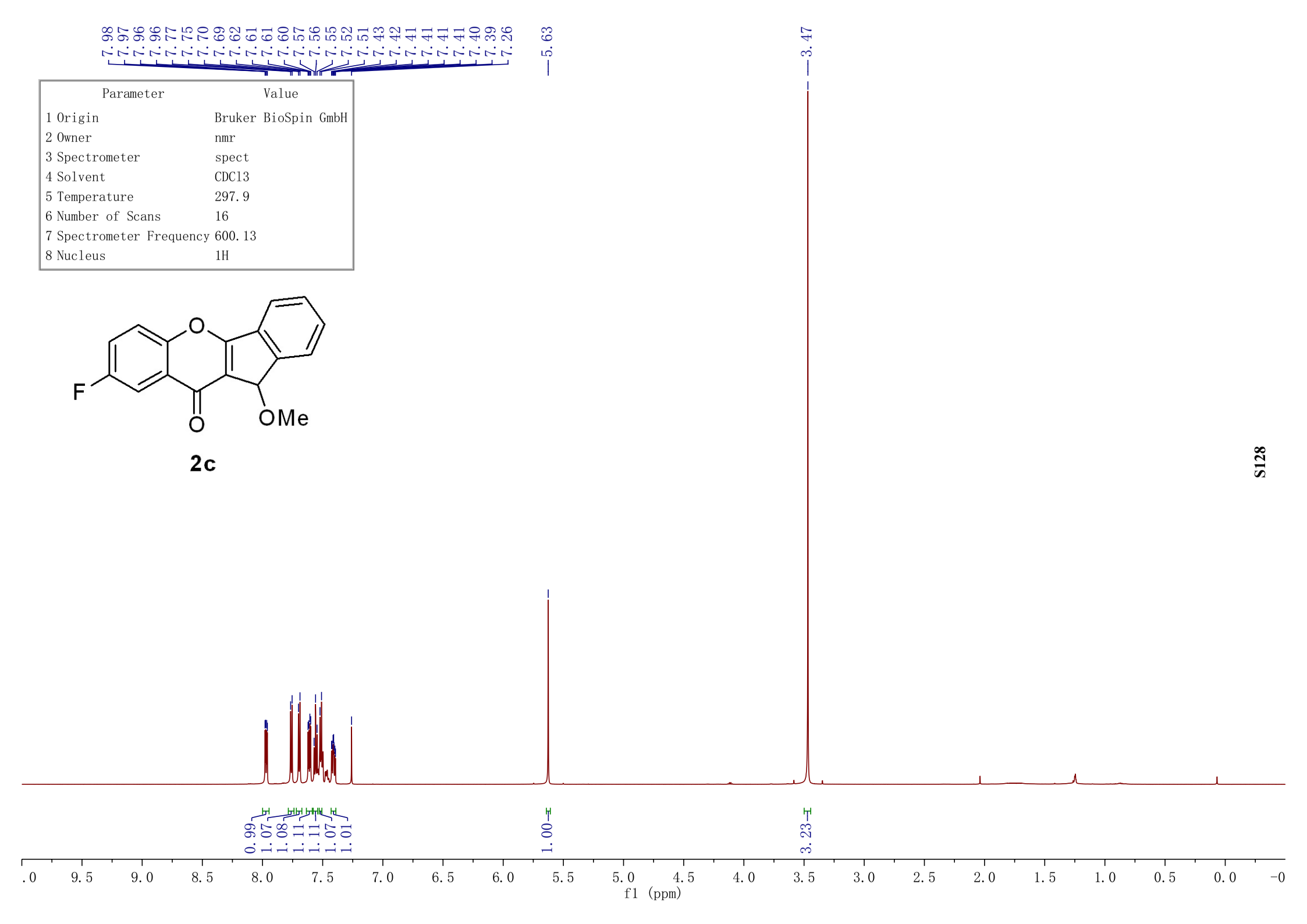


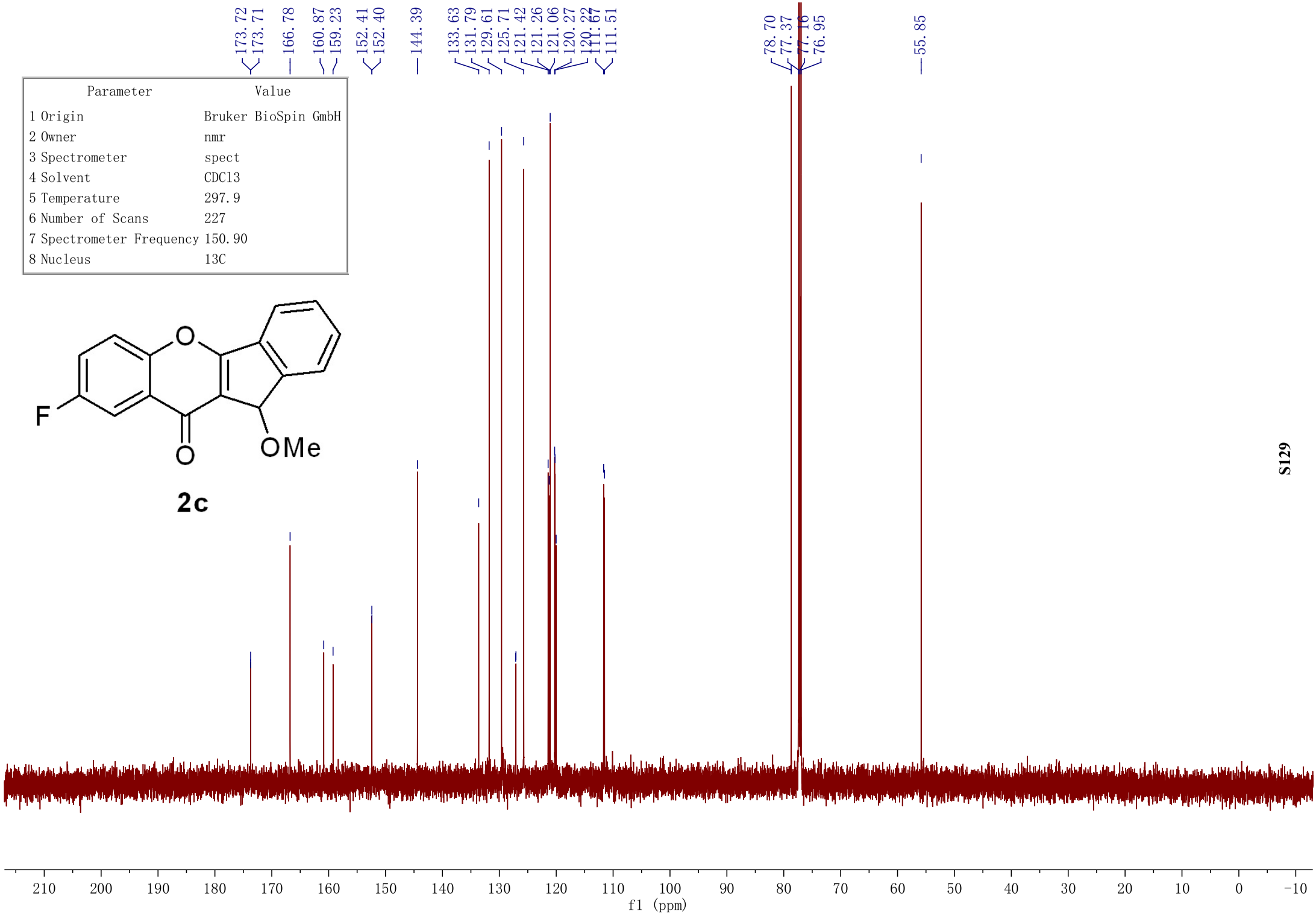
2a

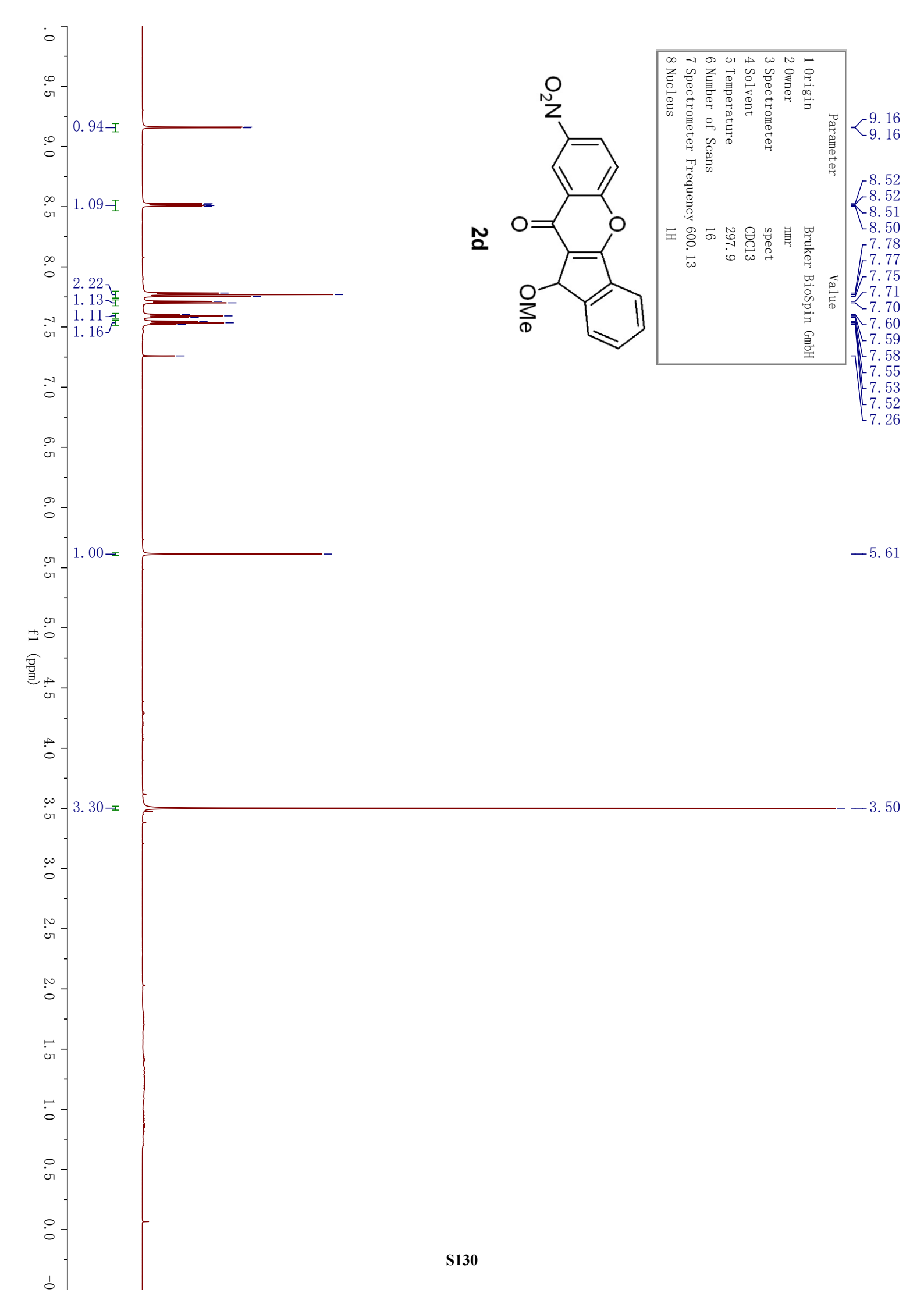

173.17
165.41
155.61
144.01
133.91
133.10
131.51
129.58
125.95
125.44
125.39
124.85
120.71
120.09
118.55
78.07
54.87
39.94
39.80
39.66
39.52
39.38
39.24
39.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 543
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
O
OMe
2a
S125
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

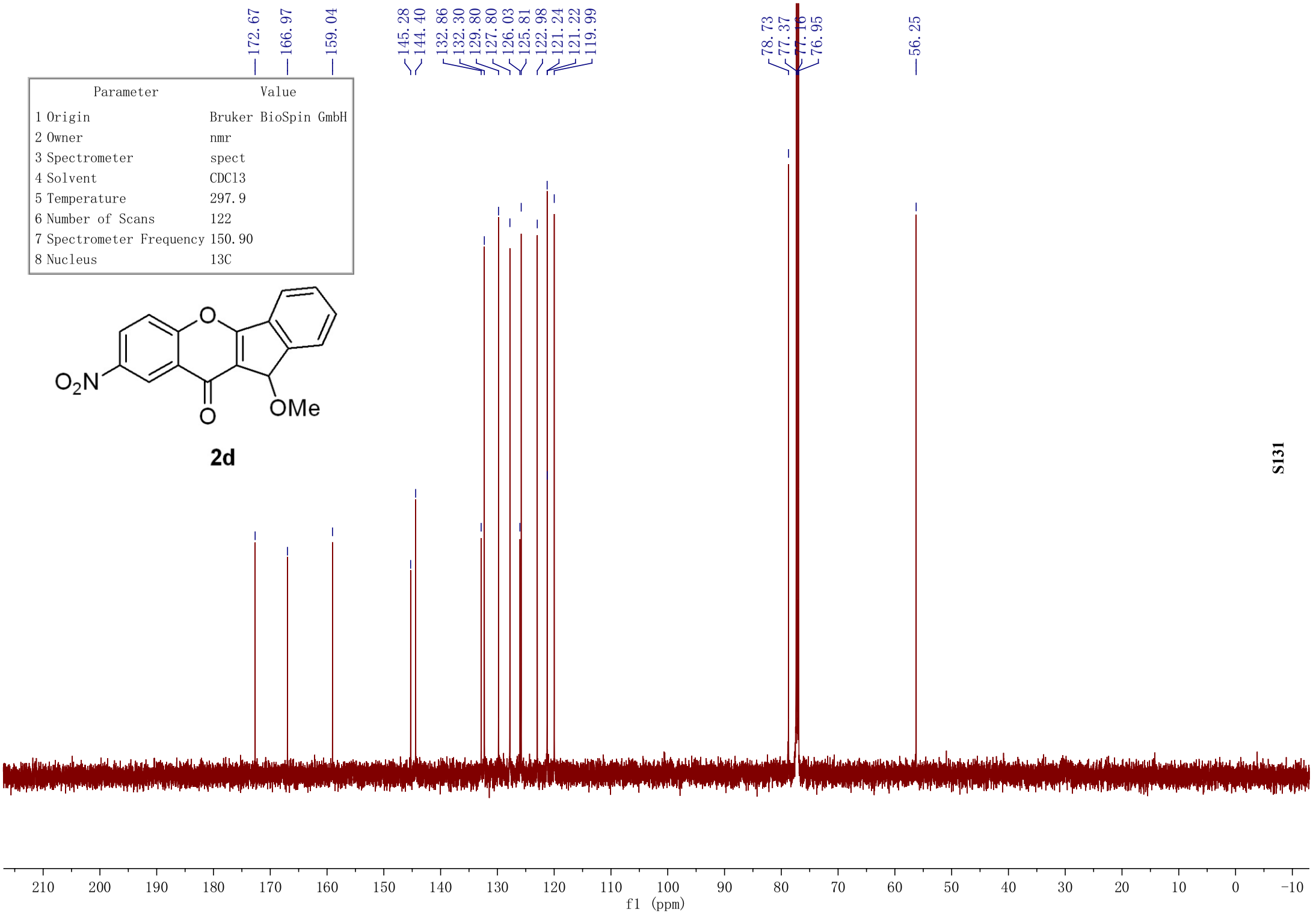

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
MeO
O
O
OMe
2b
7.76
7.74
7.72
7.71
7.69
7.68
7.54
7.52
7.51
7.49
7.48
7.28
7.28
7.27
7.26
5.64
3.92
3.45
1.09
1.10
1.10
2.14
1.17
0.95
1.00
3.36
3.35
f1 (ppm)

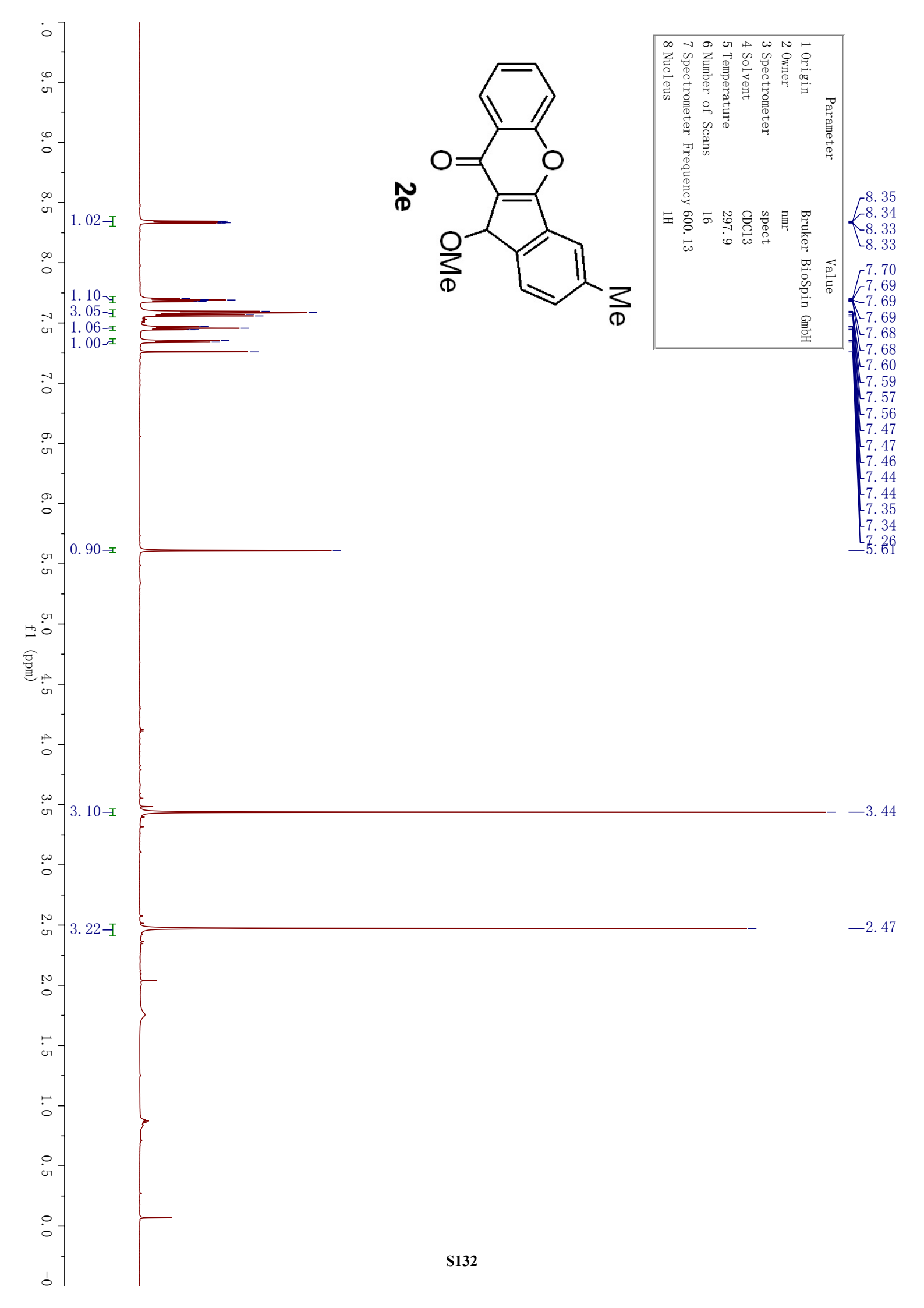

174.53
166.35
157.44
150.98
144.33
133.99
131.47
129.50
126.37
125.64
123.00
120.91
119.82
119.60
106.01
78.67
77.37
77.16
76.95
56.10
55.55
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 252
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
OMe
O
O
2b
S127
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

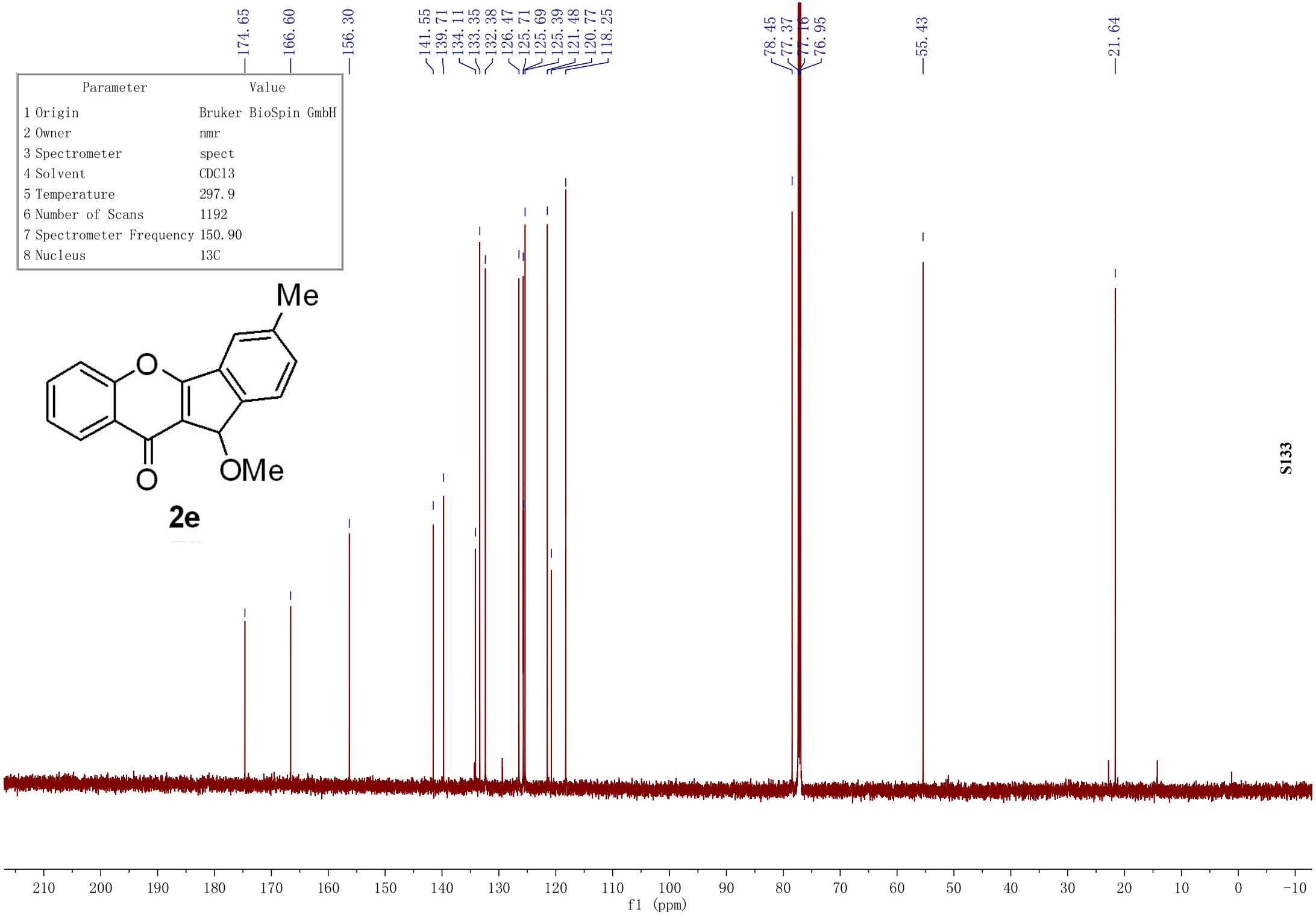

7.98
7.97
7.96
7.96
7.77
7.75
7.70
7.69
7.62
7.61
7.61
7.60
7.57
7.56
7.55
7.52
7.51
7.43
7.42
7.41
7.41
7.41
7.40
7.39
7.26
5.63
3.47
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
F
O
O
OMe
2c
S128
0.99
1.07
1.08
1.11
1.11
1.07
1.01
1.00
3.23
f1 (ppm)


173.72
173.71
166.78
160.87
159.23
152.41
152.40
144.39
133.63
131.79
129.61
125.71
121.42
121.26
121.06
120.27
120.22
111.67
111.51
78.70
77.37
77.16
76.95
55.85
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 227
7 Spectrometer Frequency 150.90
8 Nucleus 13C
F
O
O
OMe
2c
S129
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

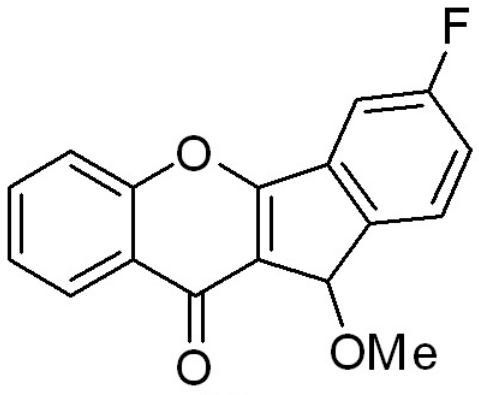

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
O2N
O
O
OMe
2d
9.16
9.16
8.52
8.52
8.51
8.50
7.78
7.77
7.75
7.71
7.70
7.60
7.59
7.58
7.55
7.53
7.52
7.26
5.61
3.50
0.94
1.09
2.22
1.13
1.11
1.16
1.00
3.30
f1 (ppm)


172.67
166.97
159.04
145.28
144.40
132.86
132.30
129.80
127.80
126.03
125.81
122.98
121.24
121.22
119.99
78.73
77.37
77.16
76.95
56.25
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 122
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O2N
O
OMe
2d
S131
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

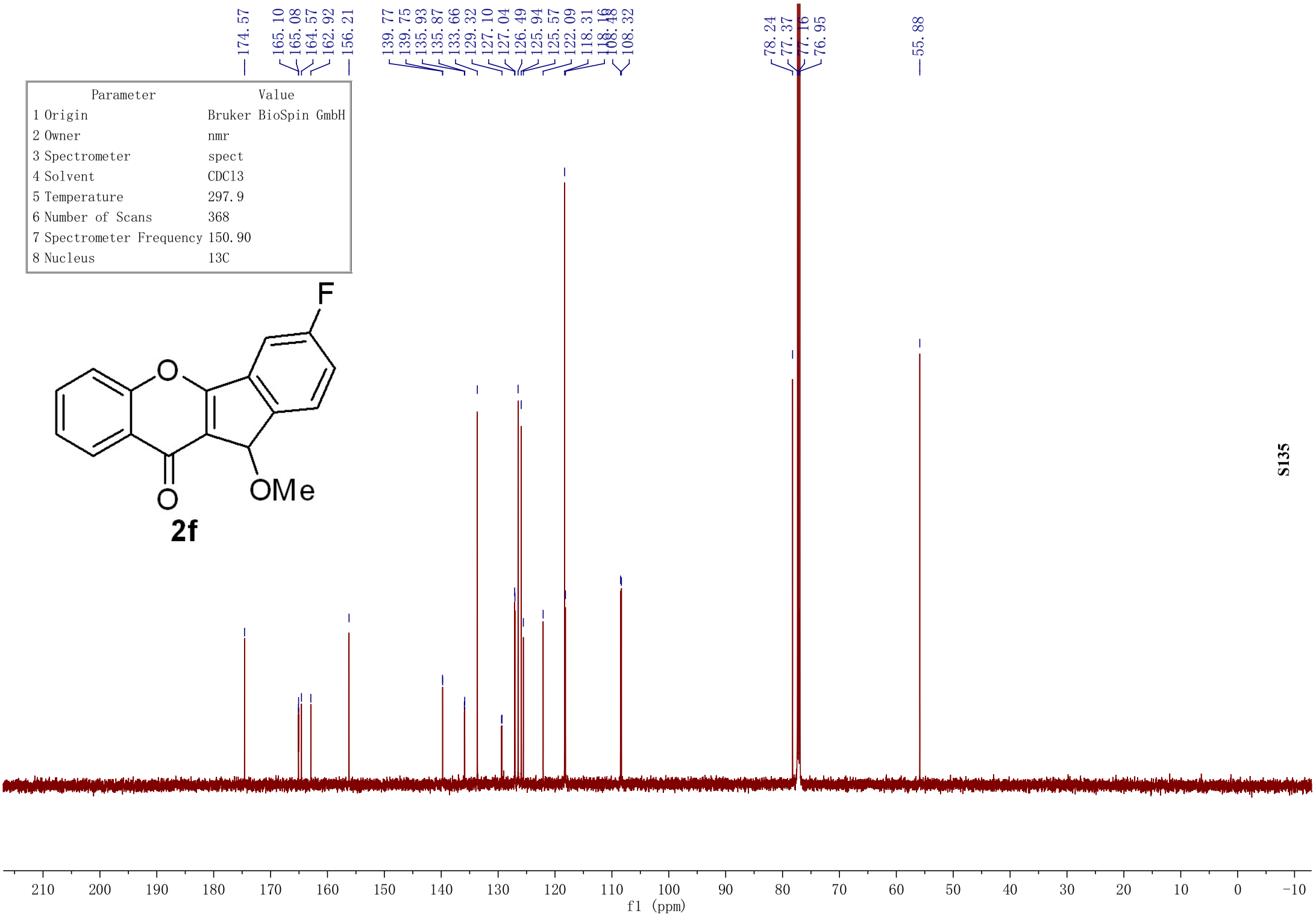

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2e
O
OMe
Me
1.02
1.10
3.05
1.06
1.00
0.90
3.10
3.22
8.35
8.34
8.33
8.33
7.70
7.69
7.69
7.69
7.68
7.68
7.60
7.59
7.57
7.56
7.47
7.47
7.46
7.44
7.44
7.44
7.35
7.34
7.26
5.61
3.44
2.47
f1 (ppm)

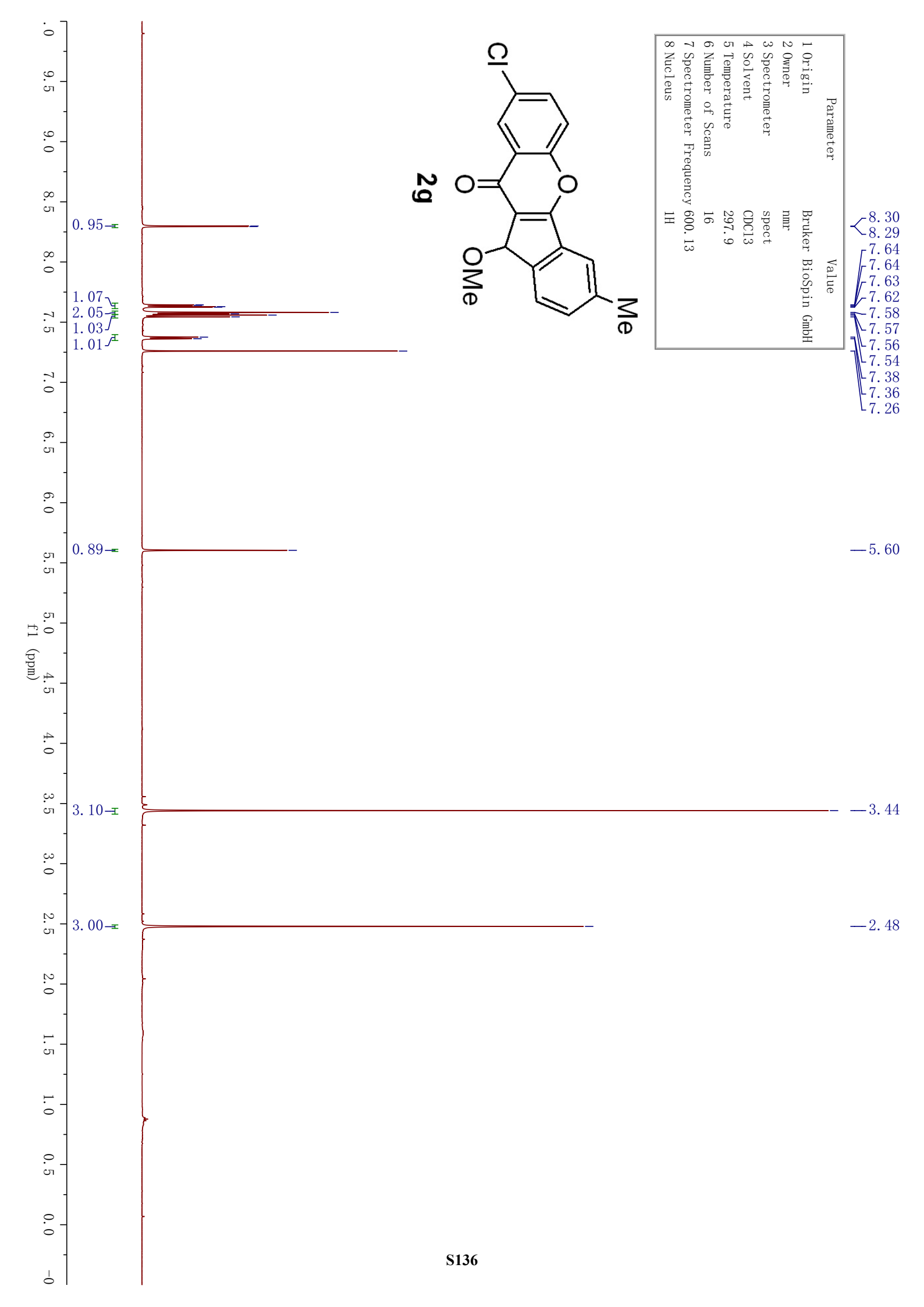

174.65
166.60
156.30
141.55
139.71
134.11
133.35
132.38
126.47
125.71
125.69
125.39
121.48
120.77
118.25
78.45
77.37
77.16
76.95
55.43
21.64
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 1192
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
O
O
OMe
2e
S133
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

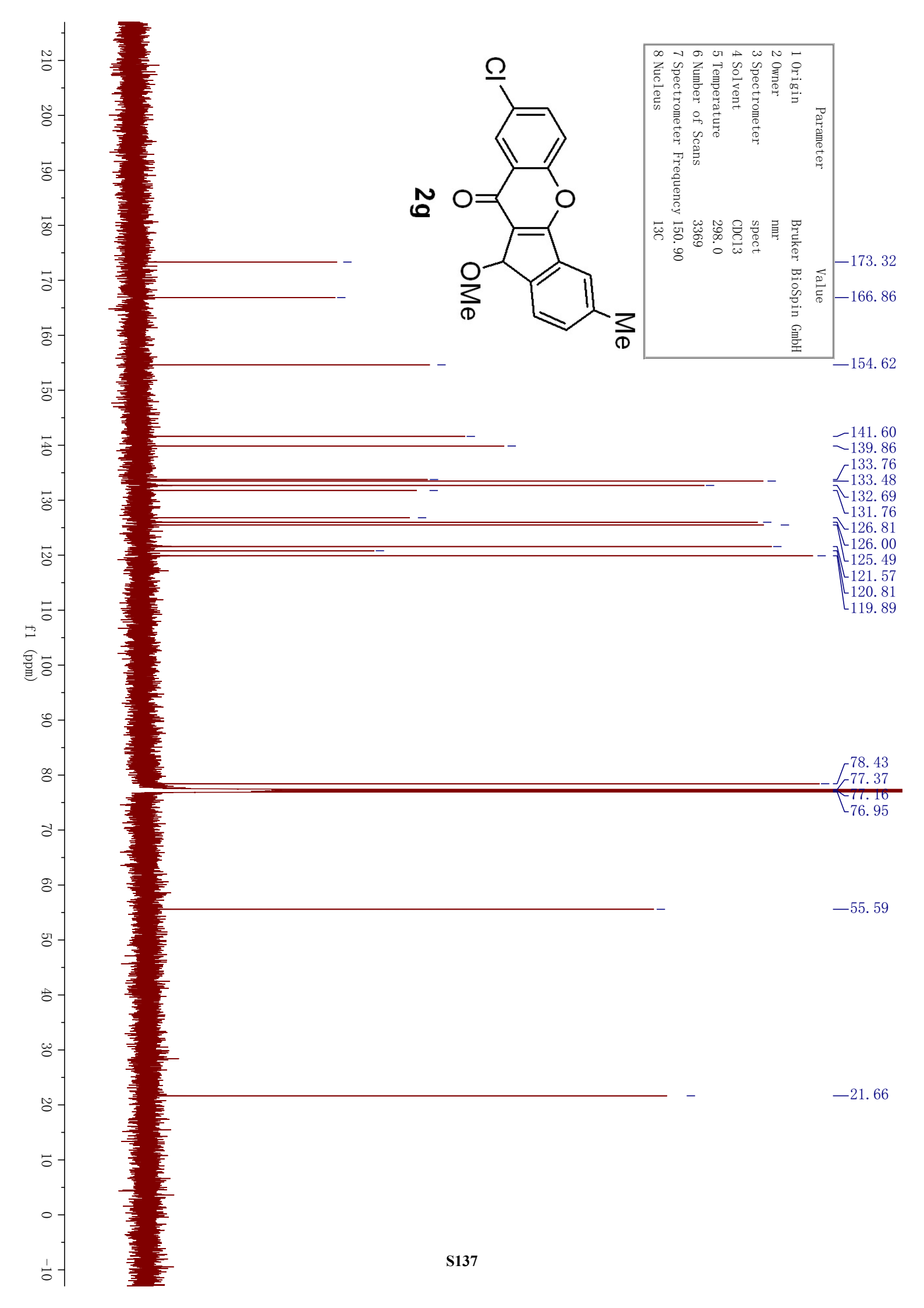
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

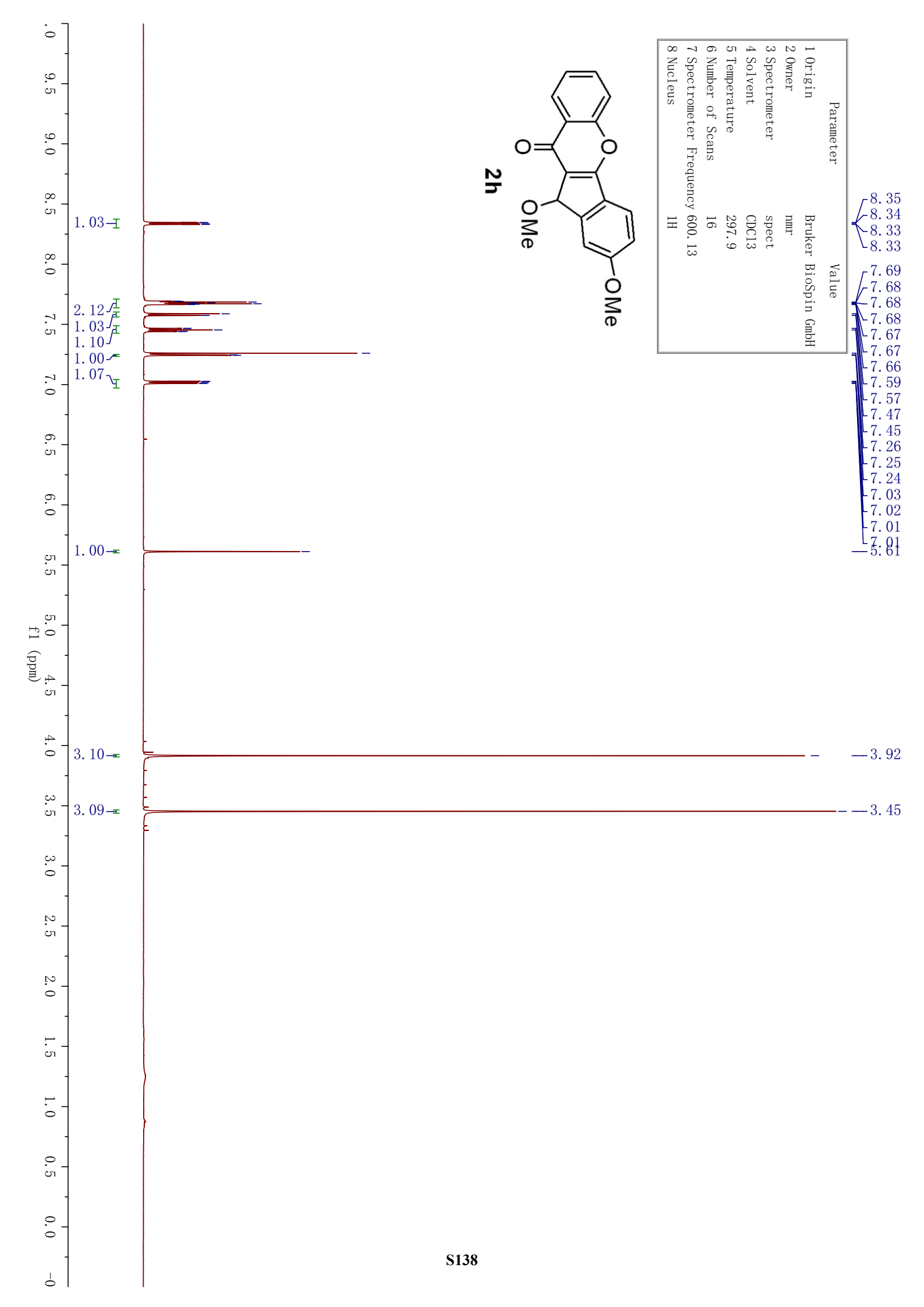


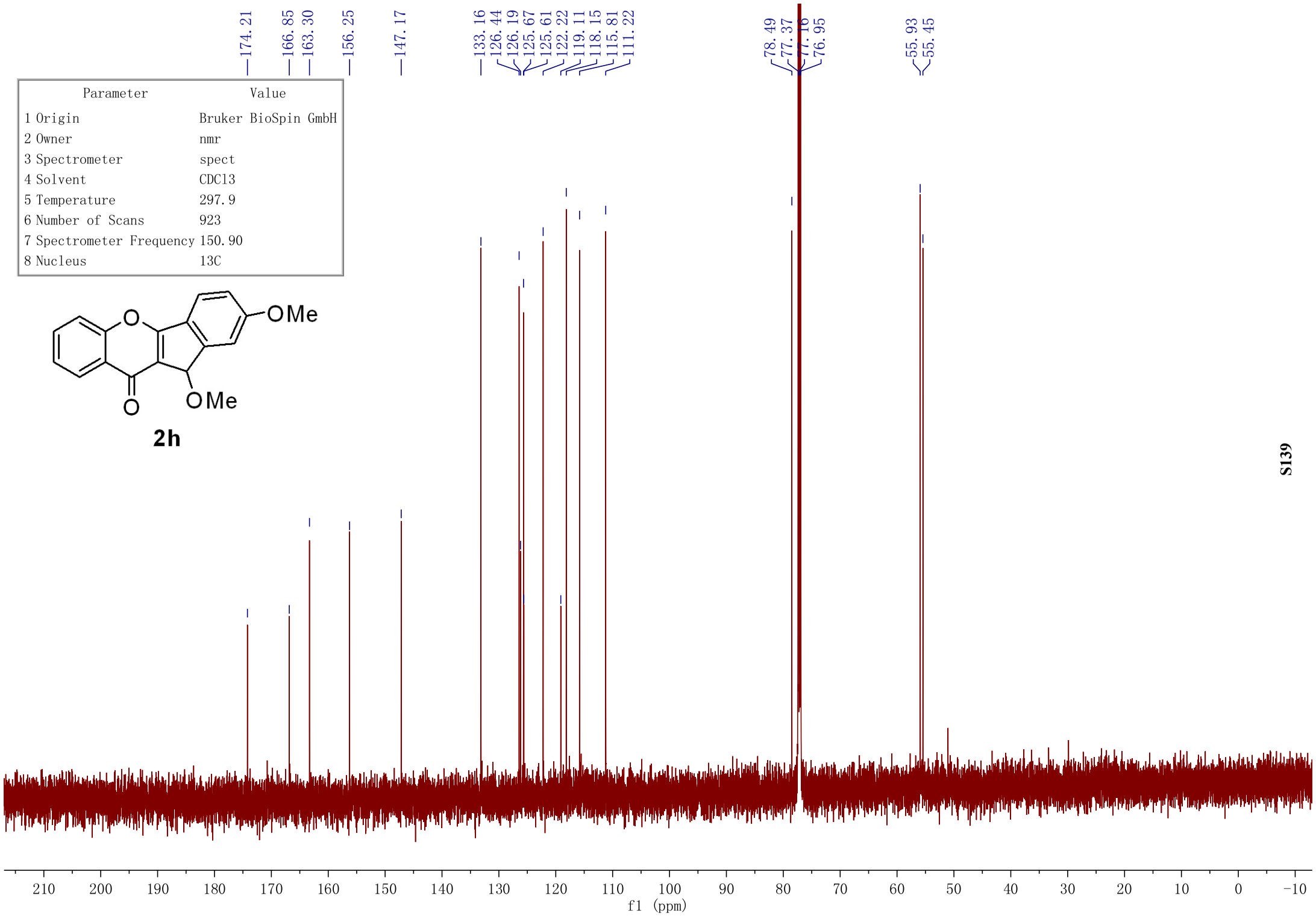
2f

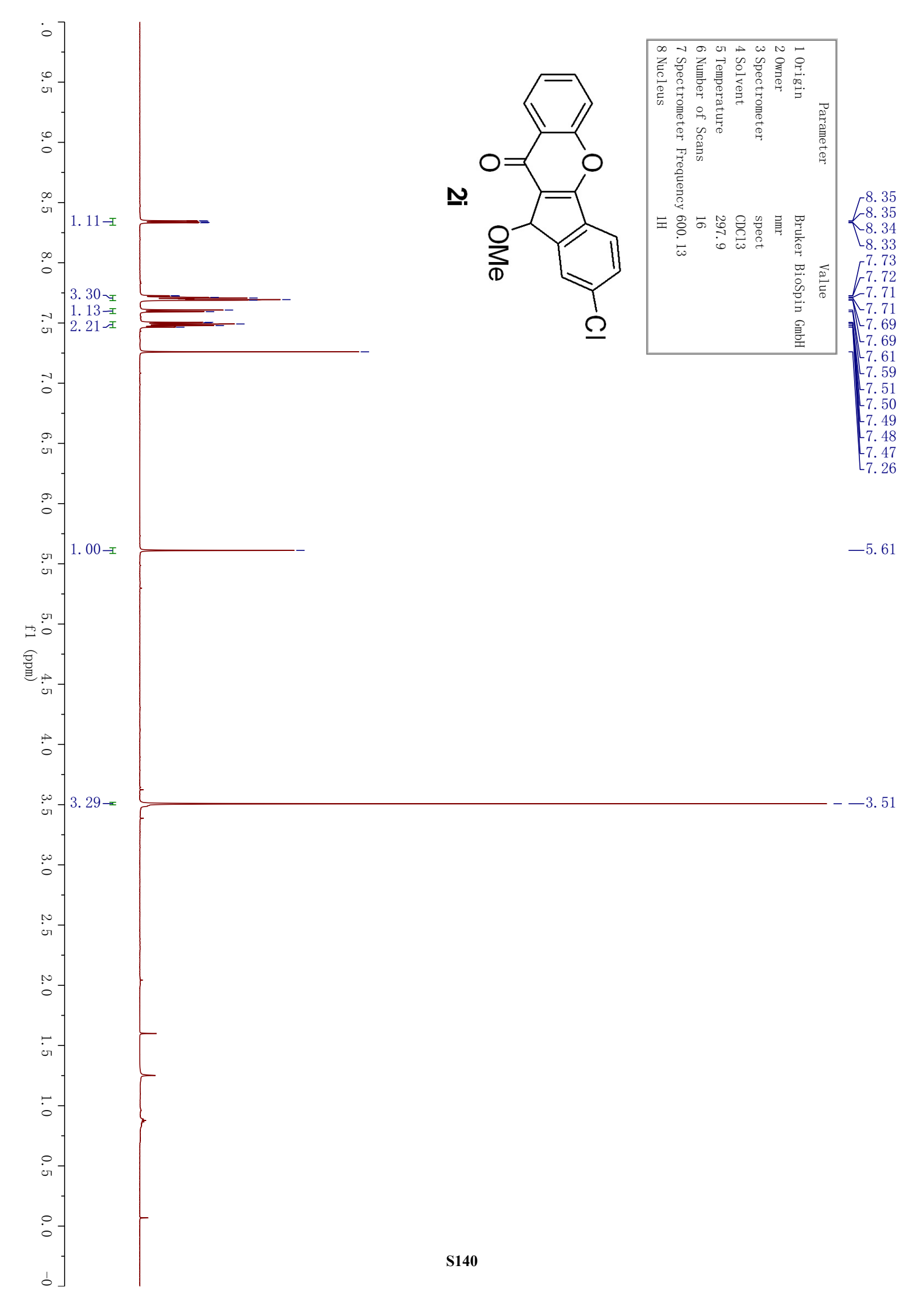

174.57
165.10
165.08
164.57
162.92
156.21
139.77
139.75
135.93
135.87
133.66
129.32
127.10
127.04
126.49
125.94
125.57
122.09
118.31
118.16
108.48
108.32
78.24
77.37
77.16
76.95
55.88
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 368
7 Spectrometer Frequency 150.90
8 Nucleus 13C
F
O
O
OMe
2f
S135
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

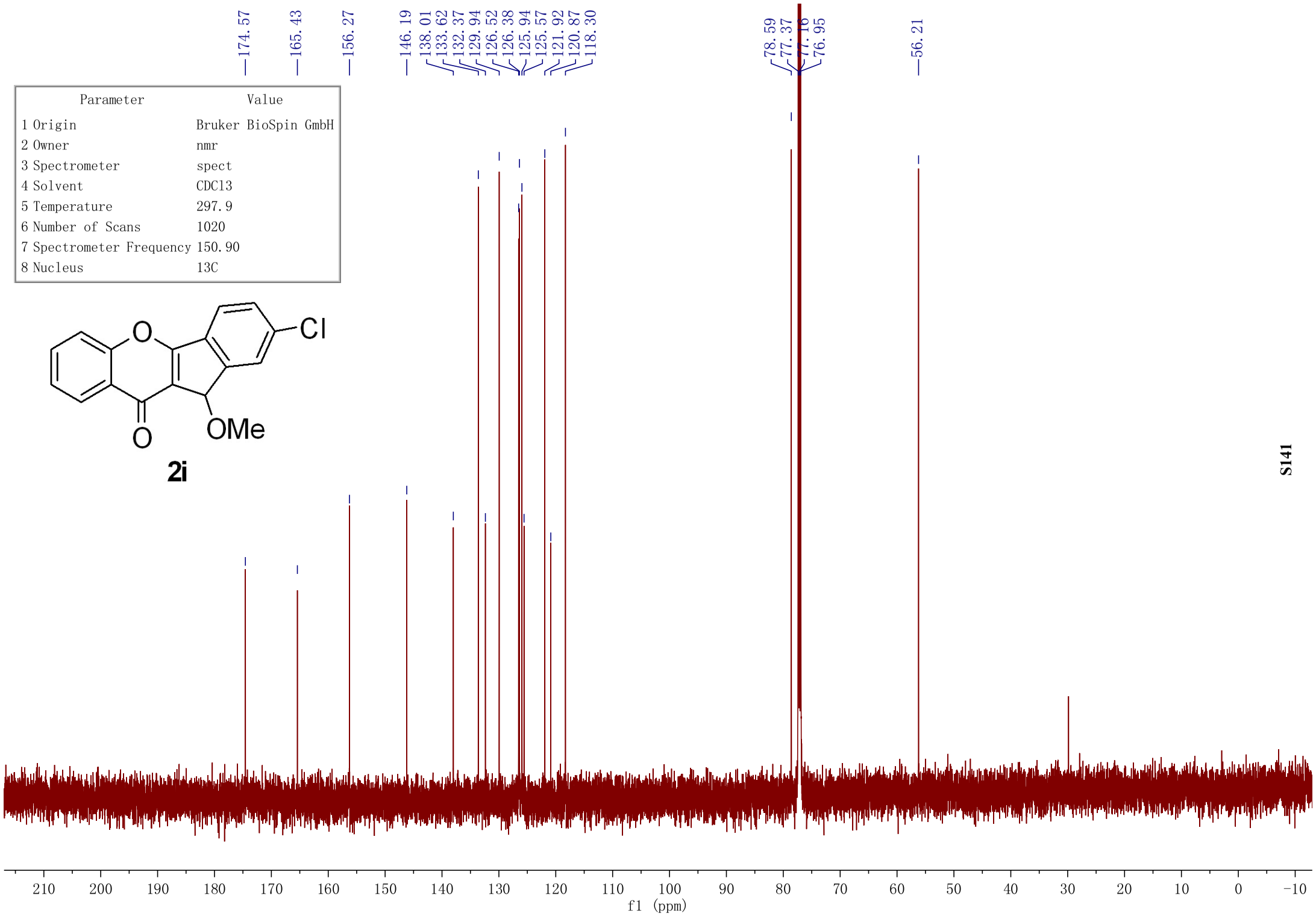

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
O
O
OMe
Me
2g
8.30
8.29
7.64
7.64
7.63
7.62
7.58
7.57
7.56
7.54
7.38
7.36
7.26
5.60
3.44
2.48
0.95
1.07
2.05
1.03
1.01
0.89
3.10
3.00
f1 (ppm)

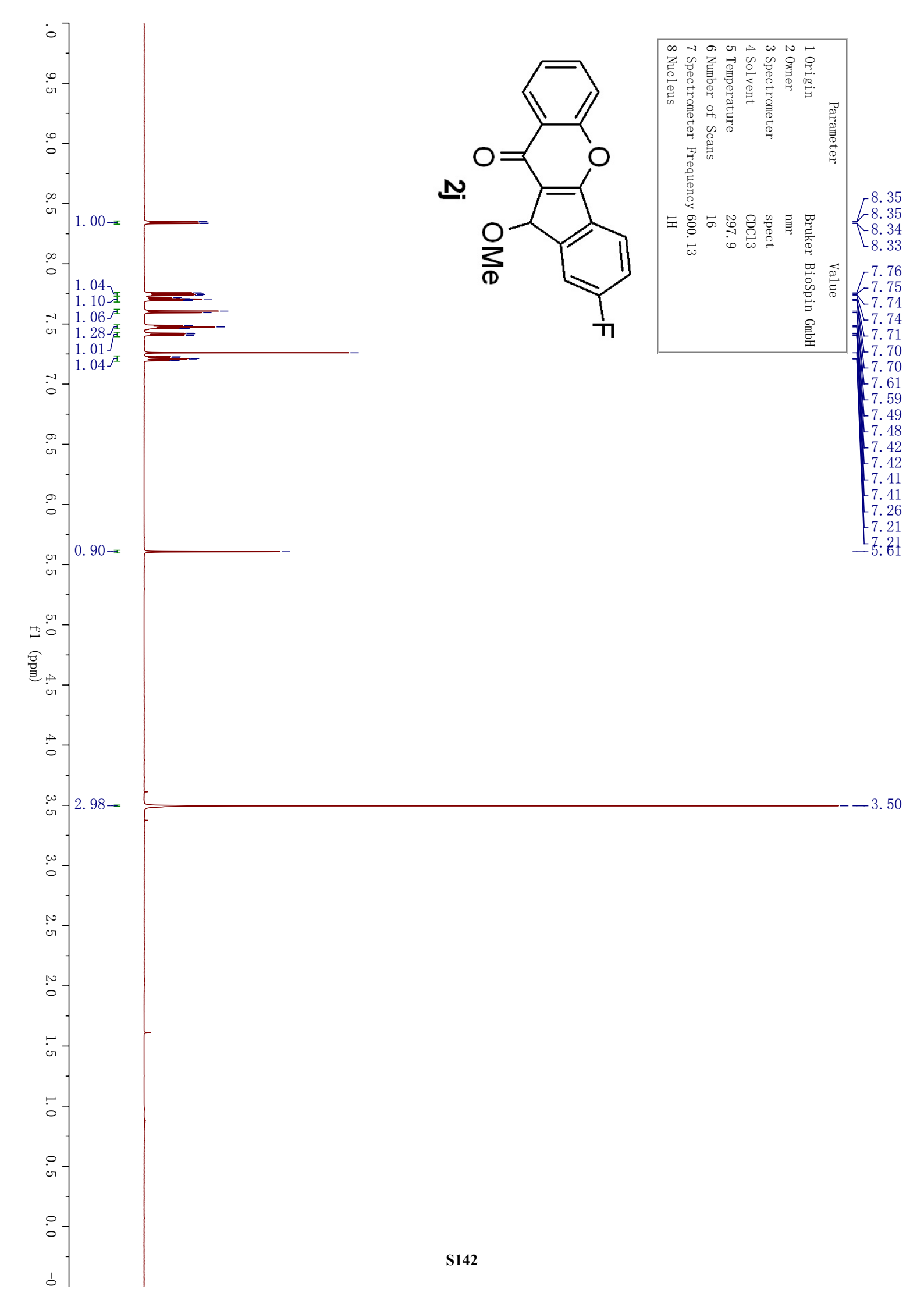

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.0
6 Number of Scans 3369
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Cl
O
O
OMe
Me
2g
173.32
166.86
154.62
141.60
139.86
133.76
133.48
132.69
131.76
126.81
126.00
125.49
121.57
120.81
119.89
78.43
77.37
77.16
76.95
55.59
21.66
f1 (ppm)

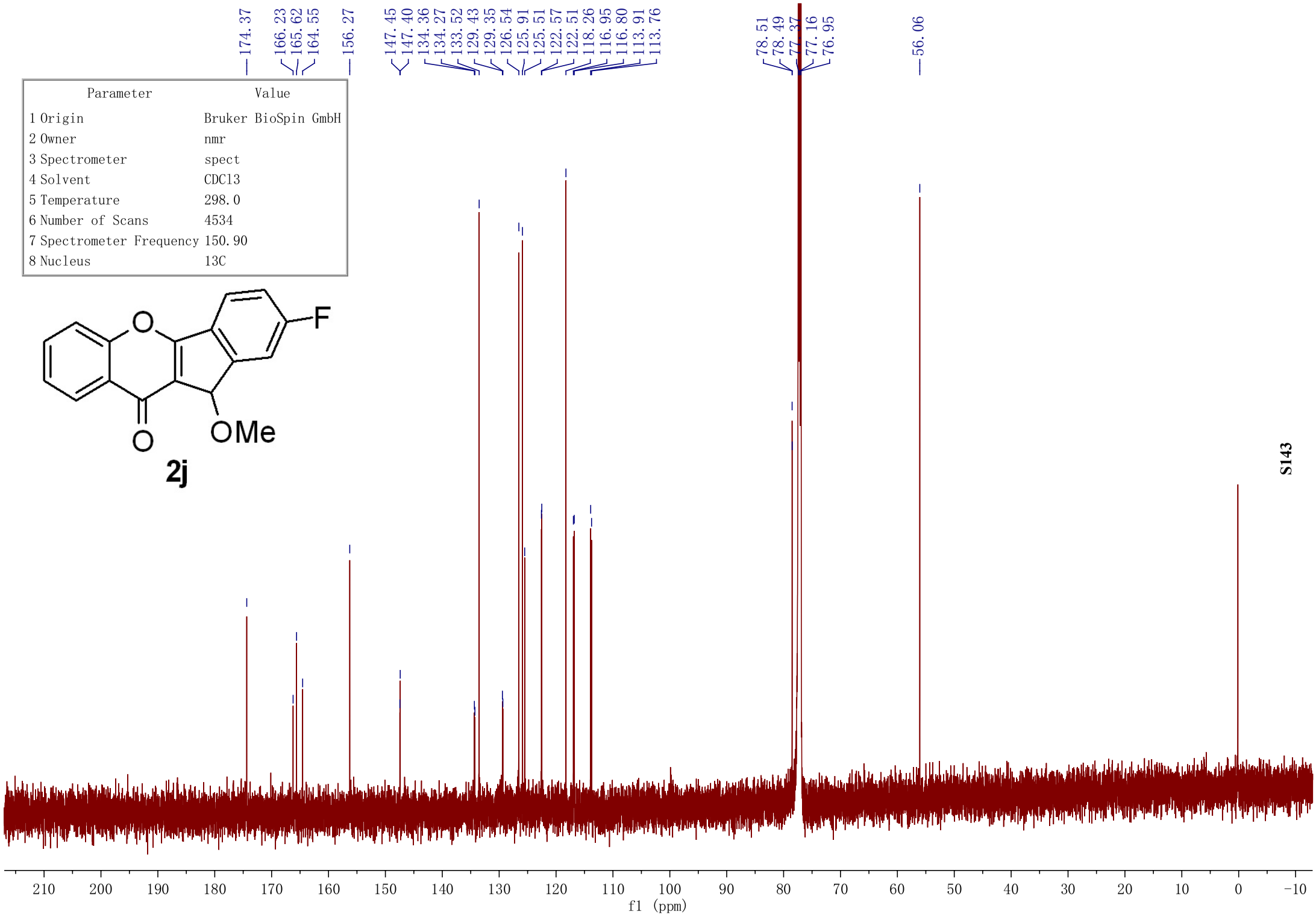

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2h
OMe
OMe
8.35
8.34
8.33
8.33
7.69
7.68
7.68
7.68
7.67
7.67
7.66
7.59
7.57
7.47
7.45
7.26
7.25
7.24
7.03
7.02
7.01
7.01
5.61
3.92
3.45
1.03
2.12
1.03
1.10
1.00
1.07
1.00
3.10
3.09
f1 (ppm)


174.21
166.85
163.30
156.25
147.17
133.16
126.44
126.19
125.67
125.61
122.22
119.11
118.15
115.81
111.22
78.49
77.37
77.16
76.95
55.93
55.45
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 923
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
O
OMe
2h
S139
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

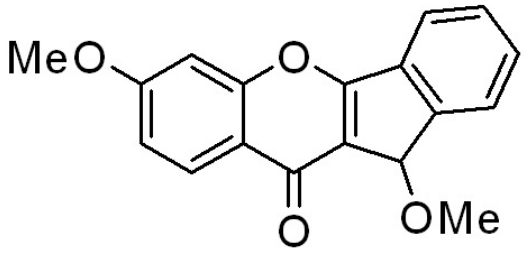

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDC13
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2i
O
O
OMe
Cl
8.35
8.35
8.34
8.33
7.73
7.72
7.71
7.71
7.69
7.69
7.61
7.59
7.51
7.50
7.49
7.48
7.47
7.26
5.61
3.51
1.11
3.30
1.13
2.21
1.00
3.29
f1 (ppm)


174.57
165.43
156.27
146.19
138.01
133.62
132.37
129.94
126.52
126.38
125.94
125.57
121.92
120.87
118.30
78.59
77.37
77.16
76.95
56.21
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 1020
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
Cl
O
OMe
2i
S141
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

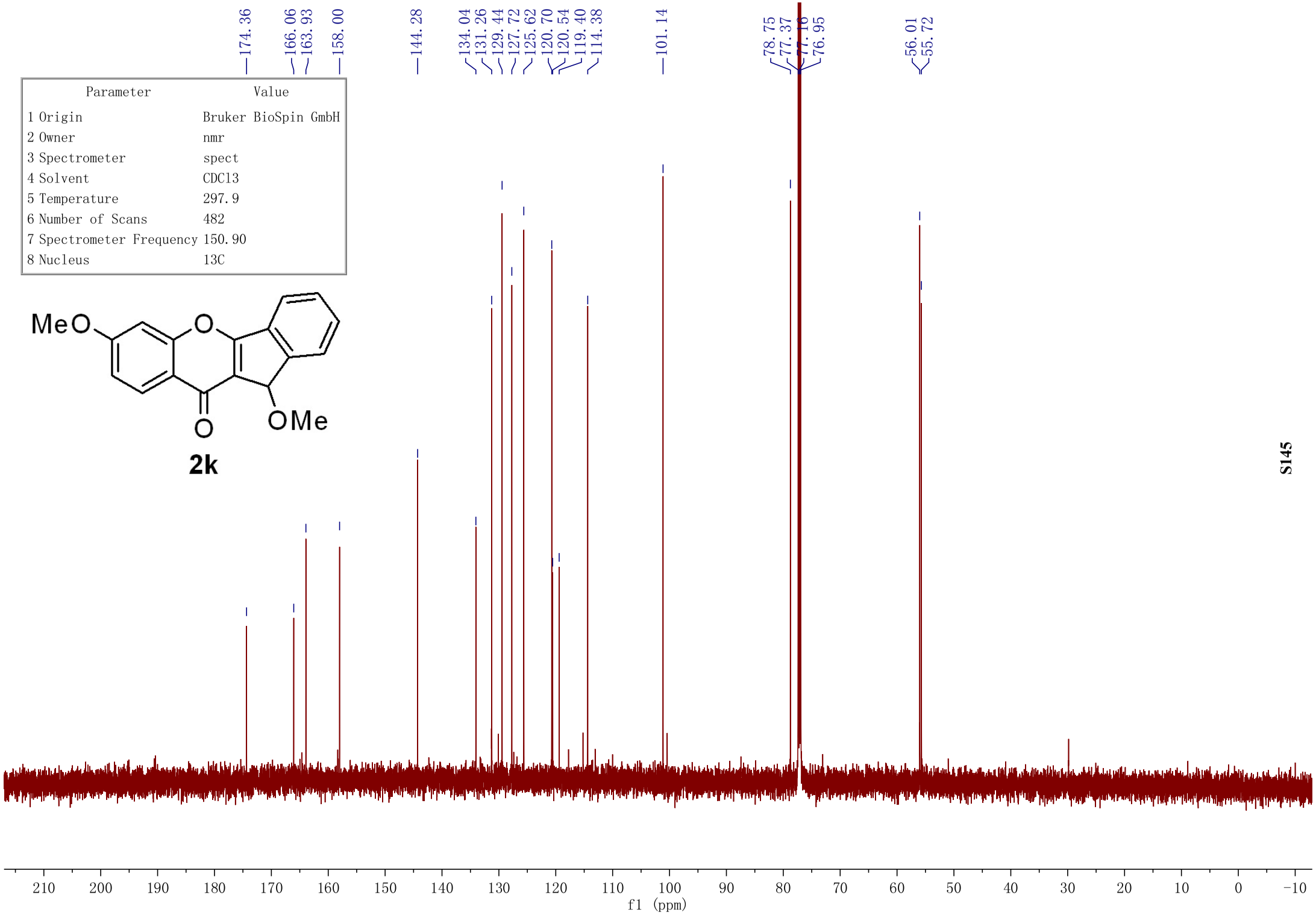

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2j
O
O
OMe
F
8.35
8.35
8.34
8.33
7.76
7.75
7.74
7.74
7.71
7.70
7.70
7.61
7.59
7.49
7.48
7.42
7.42
7.41
7.41
7.26
7.21
7.21
5.61
3.50
1.00
1.04
1.10
1.06
1.28
1.01
1.04
0.90
2.98
f1 (ppm)

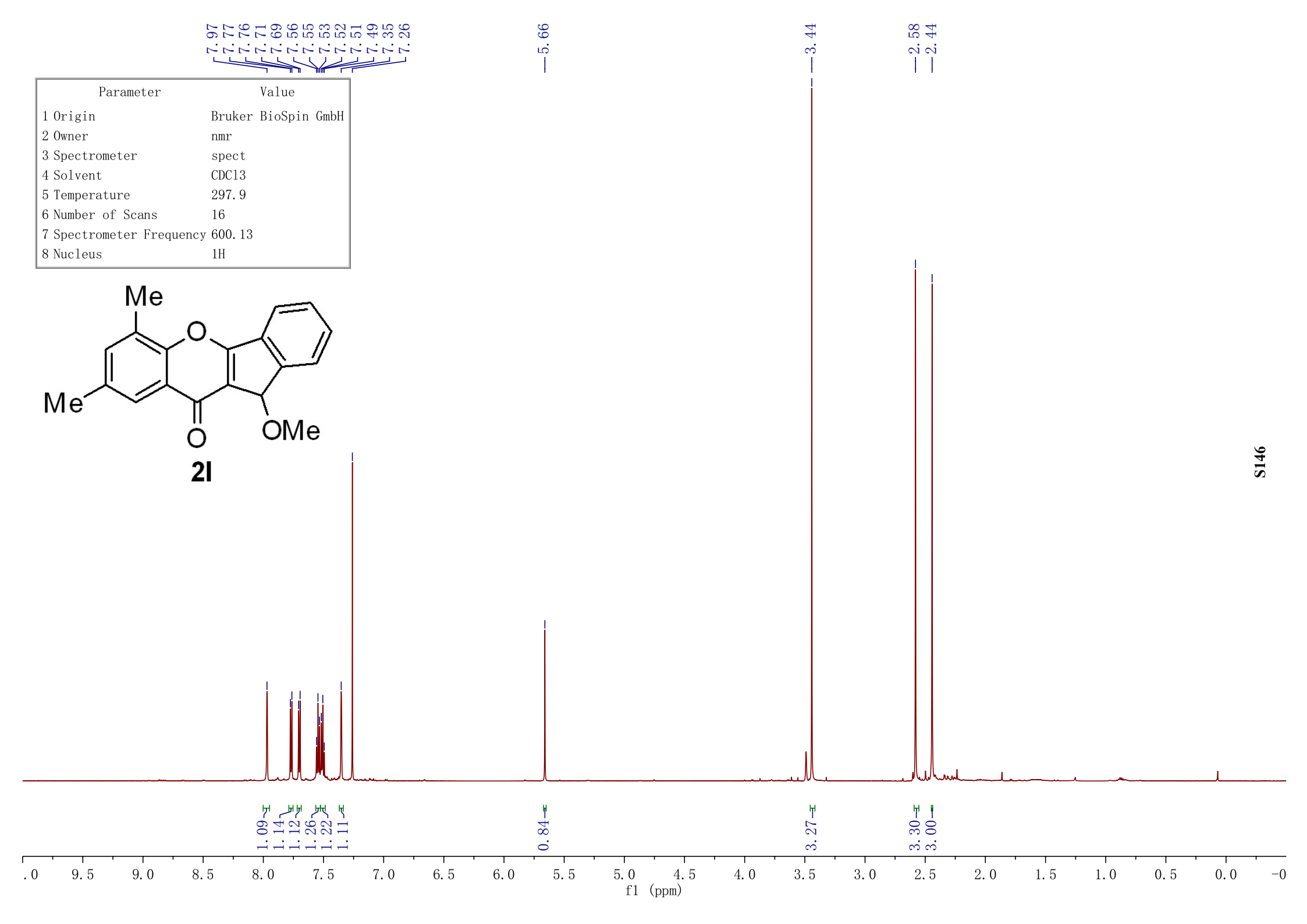

174.37
166.23
165.62
164.55
156.27
147.45
147.40
134.36
134.27
133.52
129.43
129.35
126.54
125.91
125.51
122.57
122.51
118.26
116.95
116.80
113.91
113.76
78.51
78.49
77.37
77.16
76.95
56.06
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.0
6 Number of Scans 4534
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
F
O
OMe
2j
S143
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

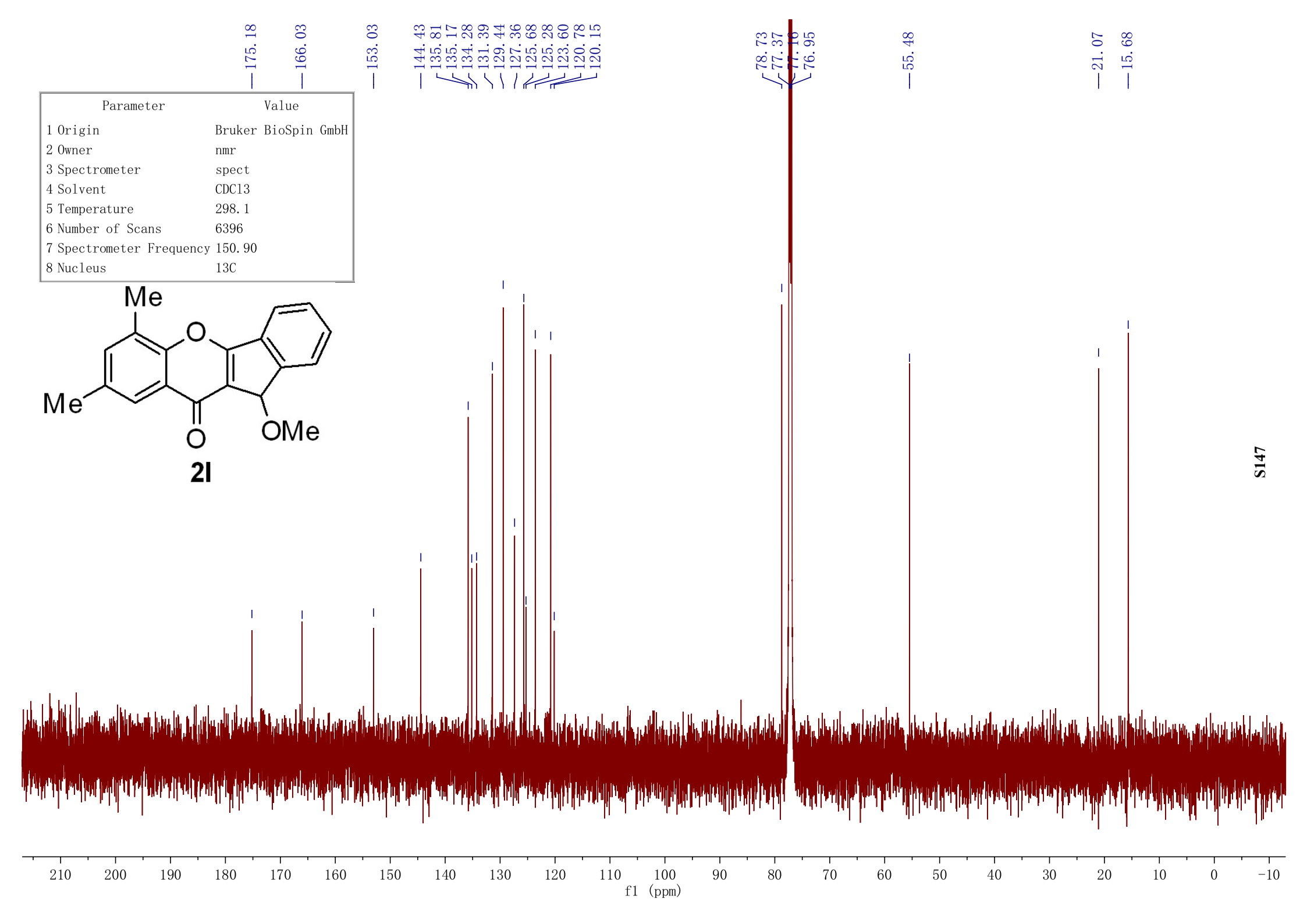
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



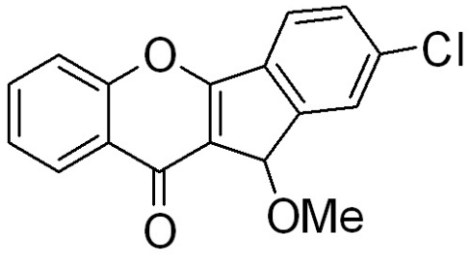
2k


174.36
166.06
163.93
158.00
144.28
134.04
131.26
129.44
127.72
125.62
120.70
120.54
119.40
114.38
101.14
78.75
77.37
77.16
76.95
56.01
55.72
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 482
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
O
O
OMe
2k
S145
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.97
7.77
7.76
7.71
7.69
7.56
7.55
7.53
7.52
7.51
7.49
7.35
7.26
5.66
3.44
2.58
2.44
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
O
Me
O
OMe
2l
S146
1.09
1.14
1.12
1.26
1.22
1.11
0.84
3.27
3.30
3.00
f1 (ppm)


175.18
166.03
153.03
144.43
135.81
135.17
134.28
131.39
129.44
127.36
125.68
125.28
123.60
120.78
120.15
78.73
77.37
77.16
76.95
55.48
21.07
15.68
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 6396
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
O
Me
O
OMe
2l
S147
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

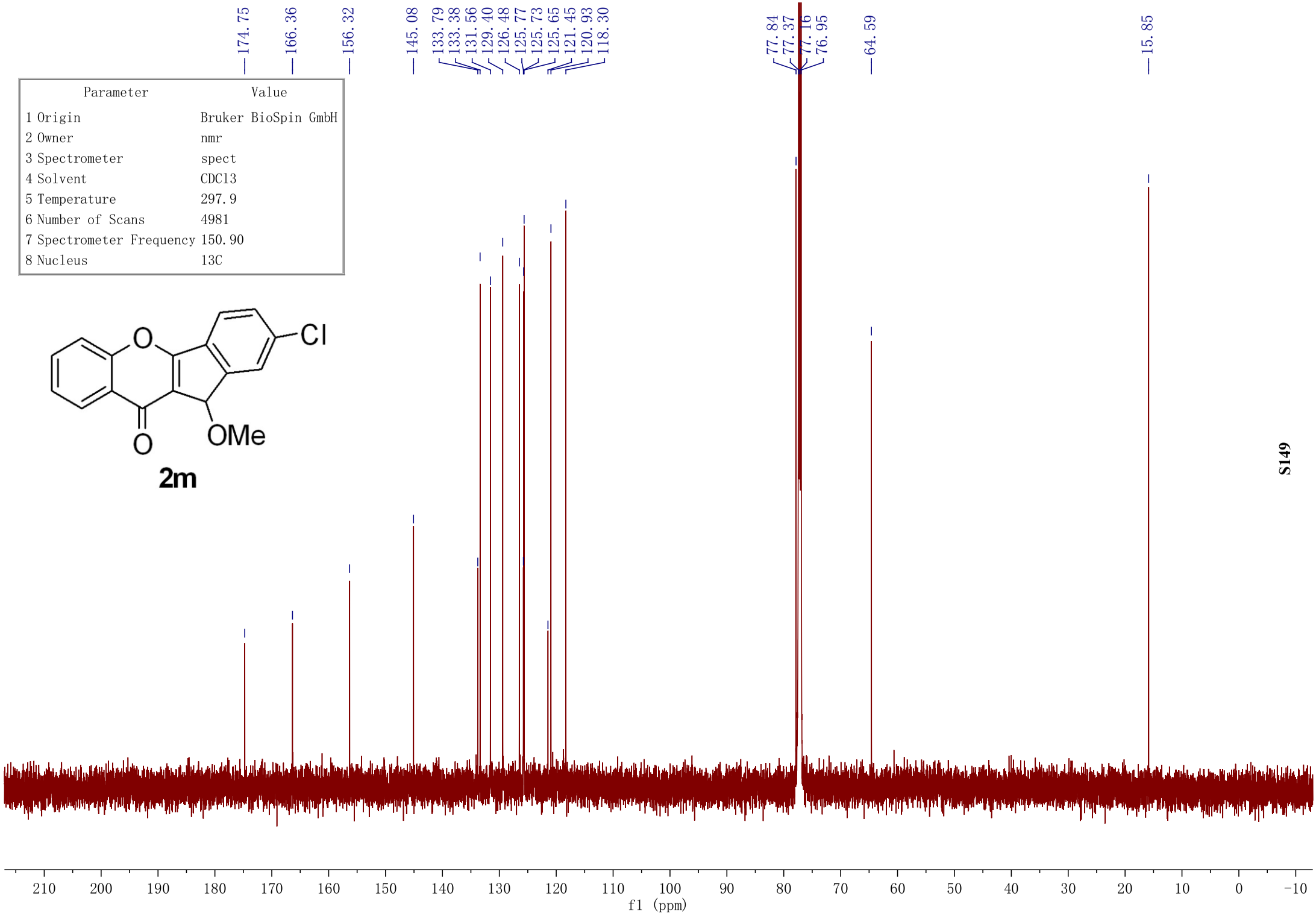
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H



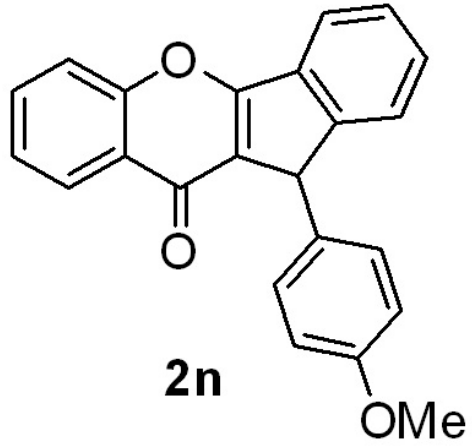
2m

S148

f1 (ppm)

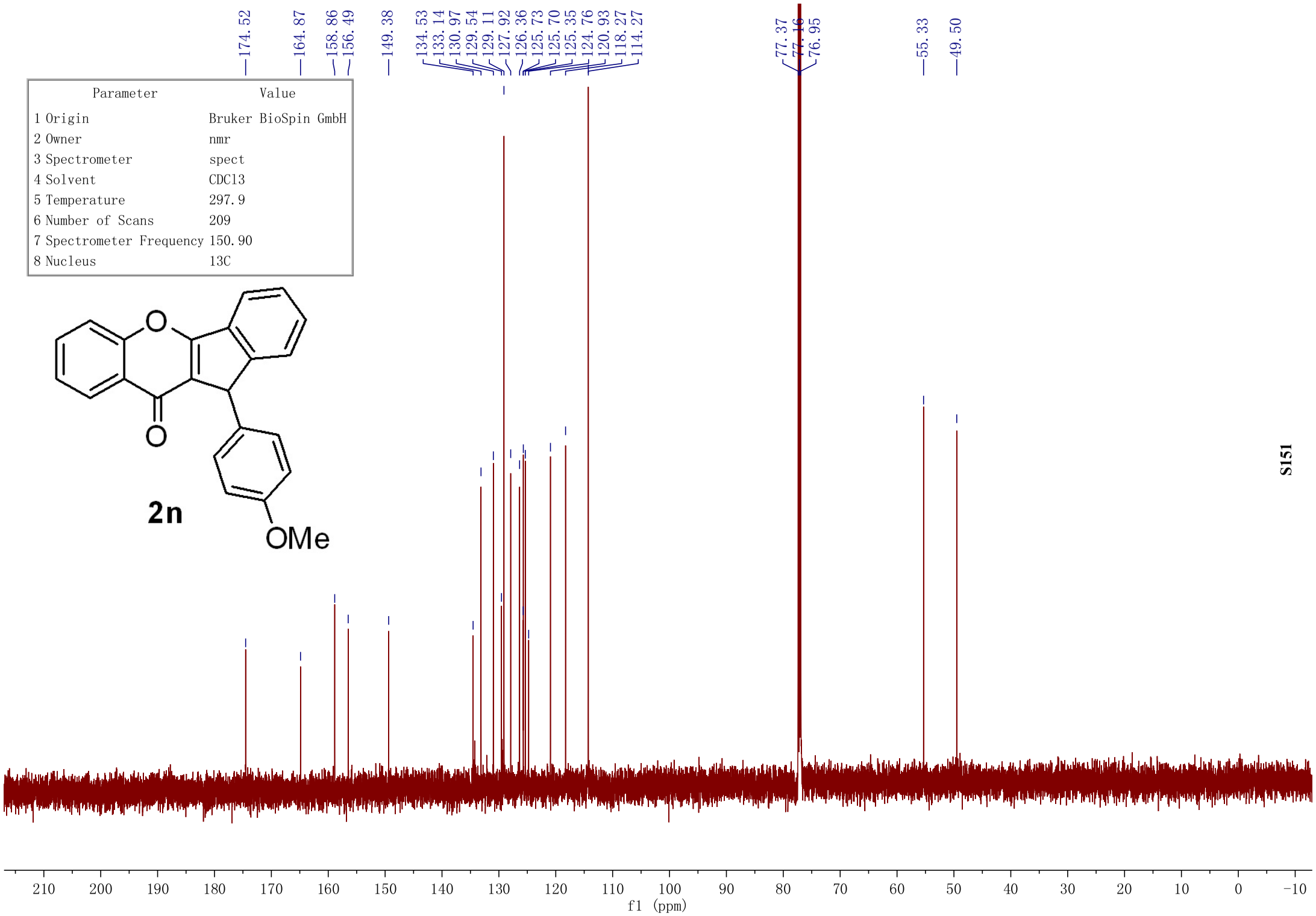

174.75
166.36
156.32
145.08
133.79
133.38
131.56
129.40
126.48
125.77
125.73
125.65
121.45
120.93
118.30
77.84
77.37
77.16
76.95
64.59
15.85
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 4981
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
Cl
O
OMe
2m
S149
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

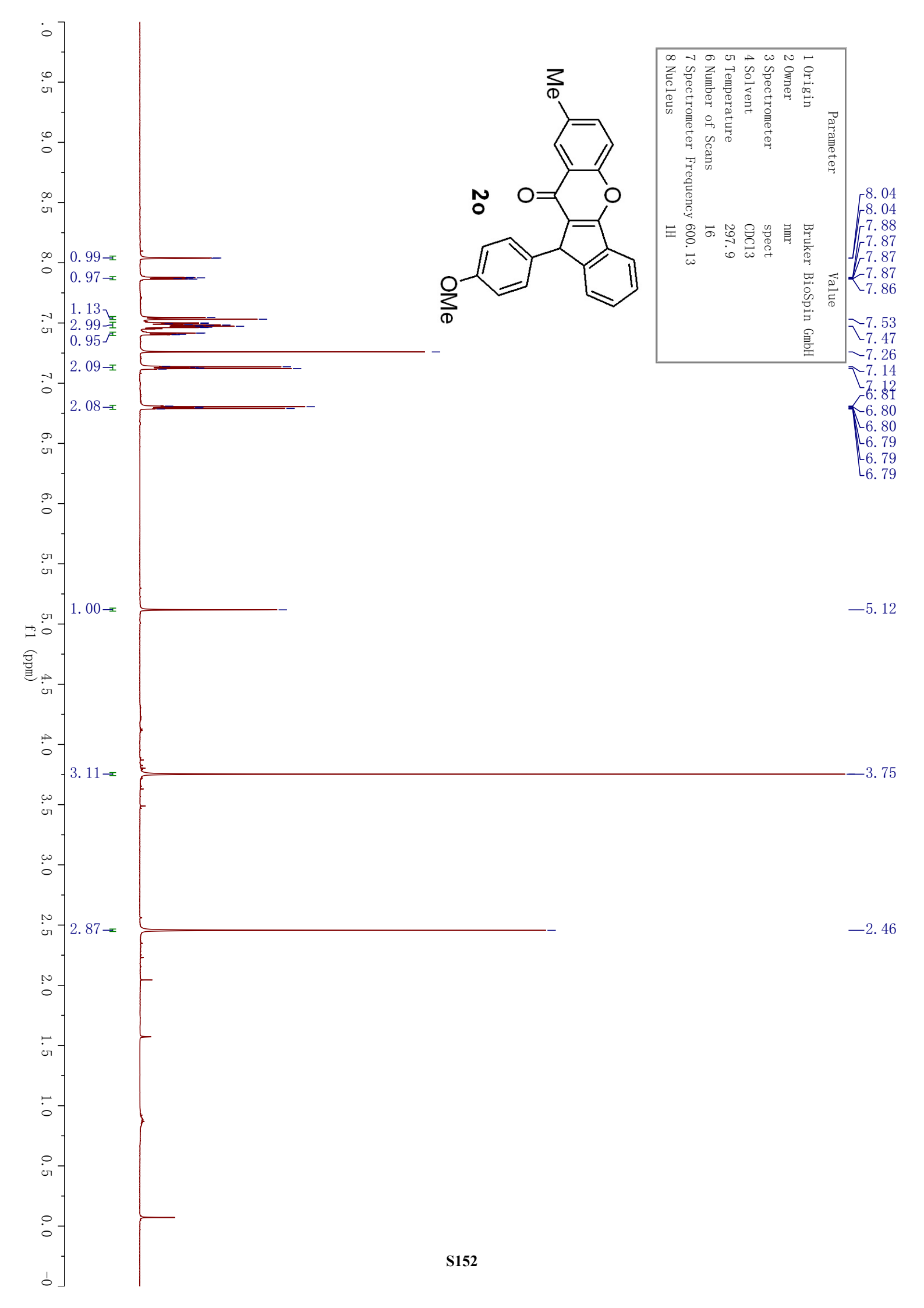
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

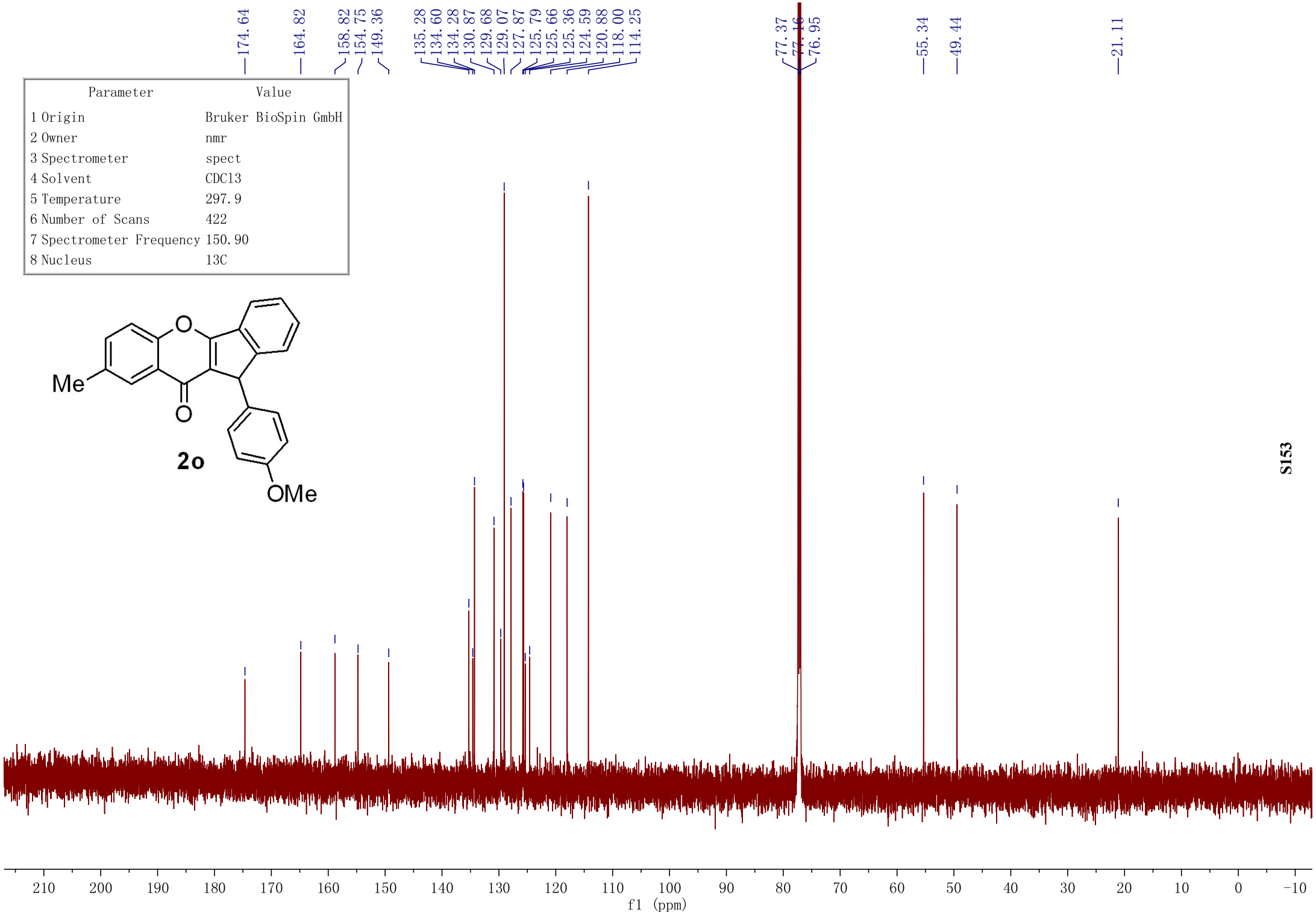


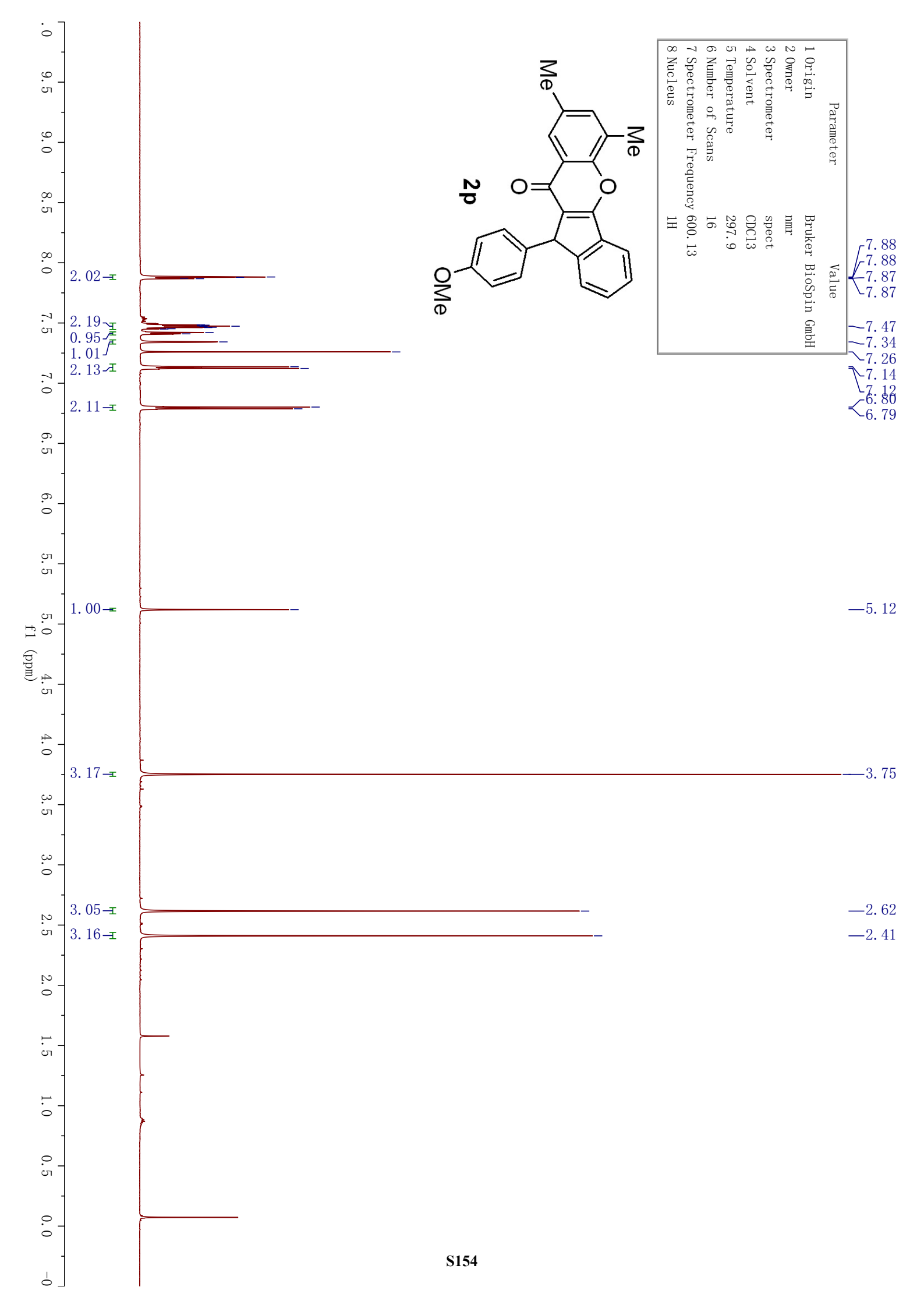
2n

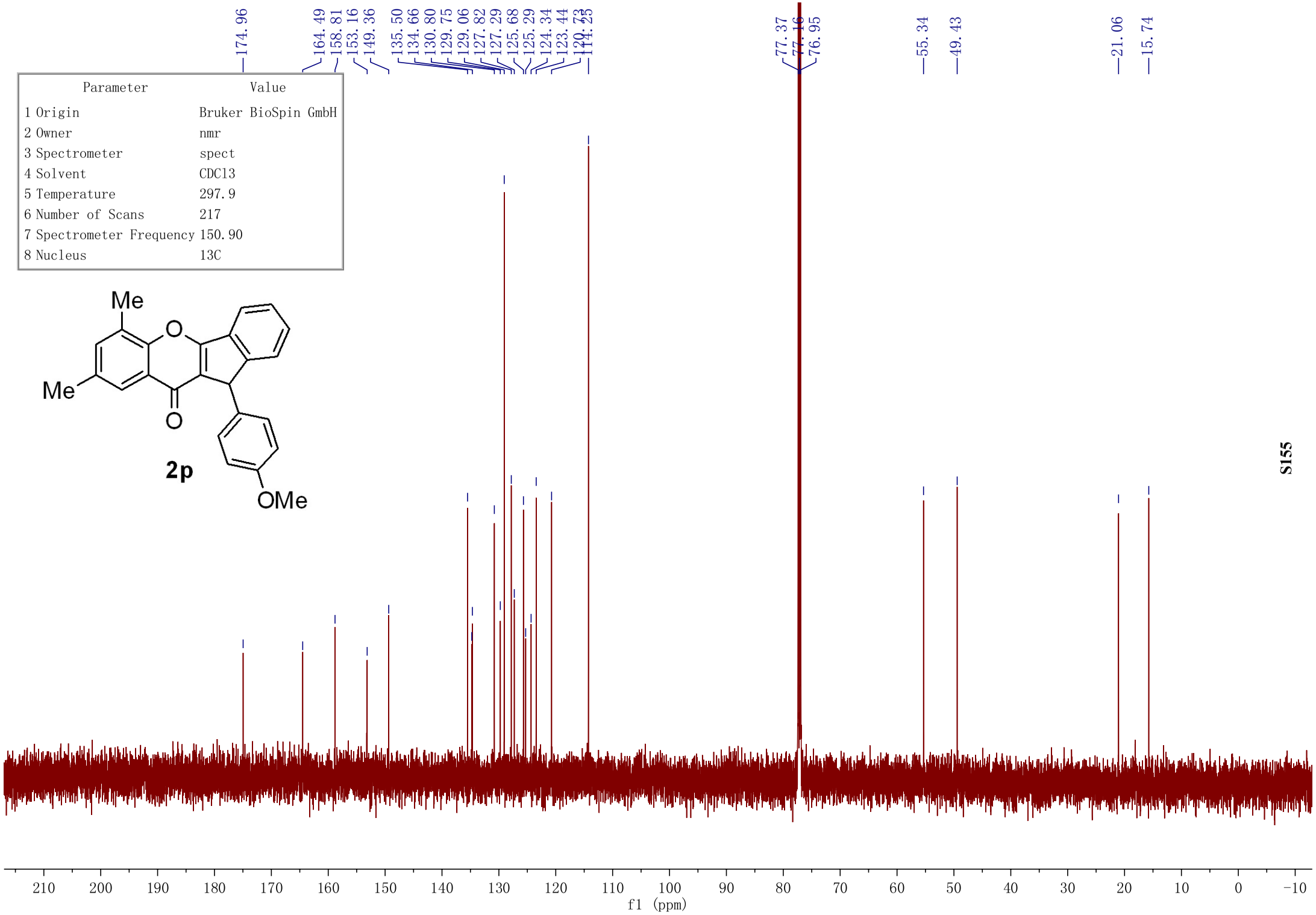
f1 (ppm)

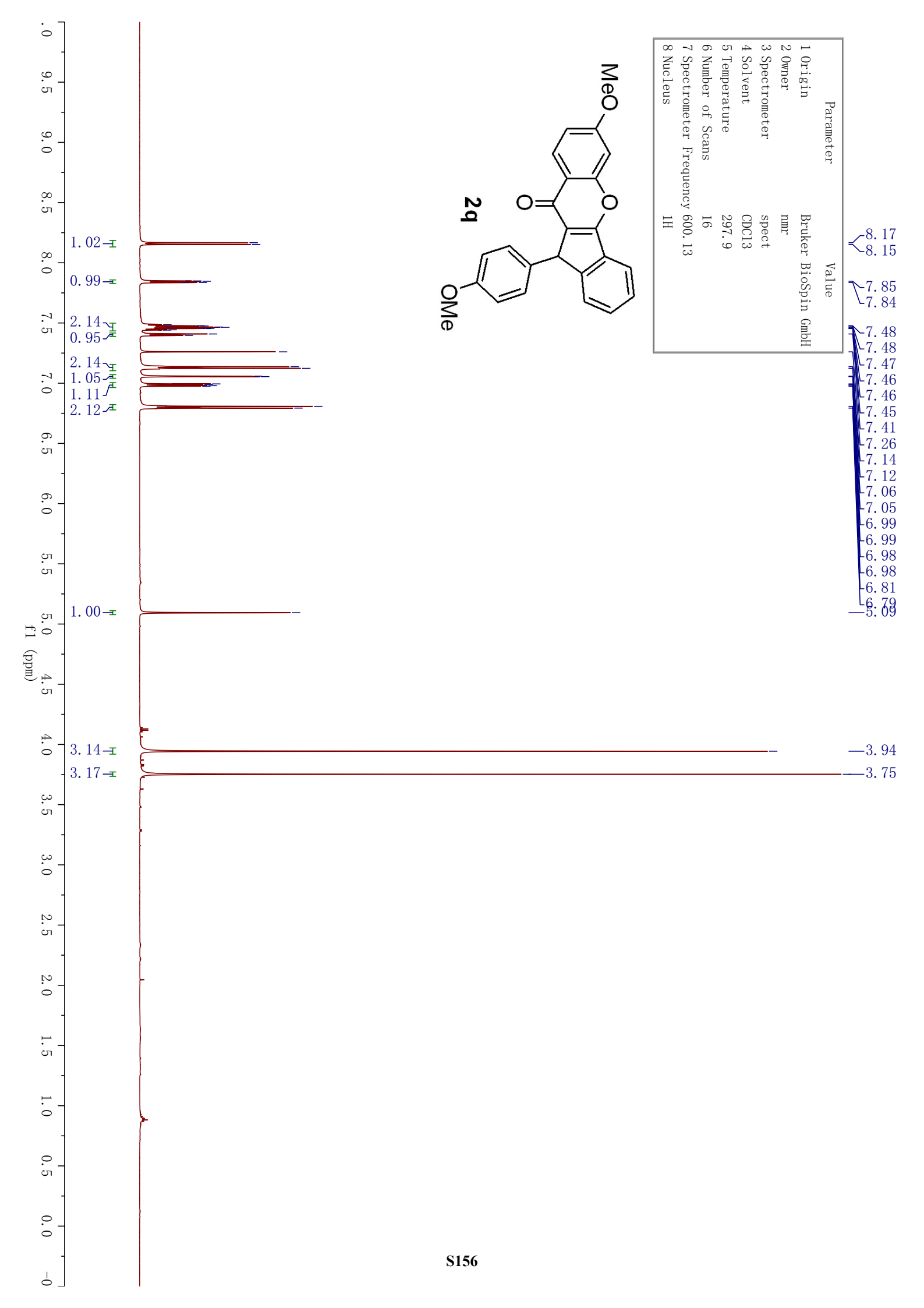

174.52
164.87
158.86
156.49
149.38
134.53
133.14
130.97
129.54
129.11
127.92
126.36
125.73
125.70
125.35
124.76
120.93
118.27
114.27
77.37
77.16
76.95
55.33
49.50
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 209
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
O
2n
OMe
S151
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

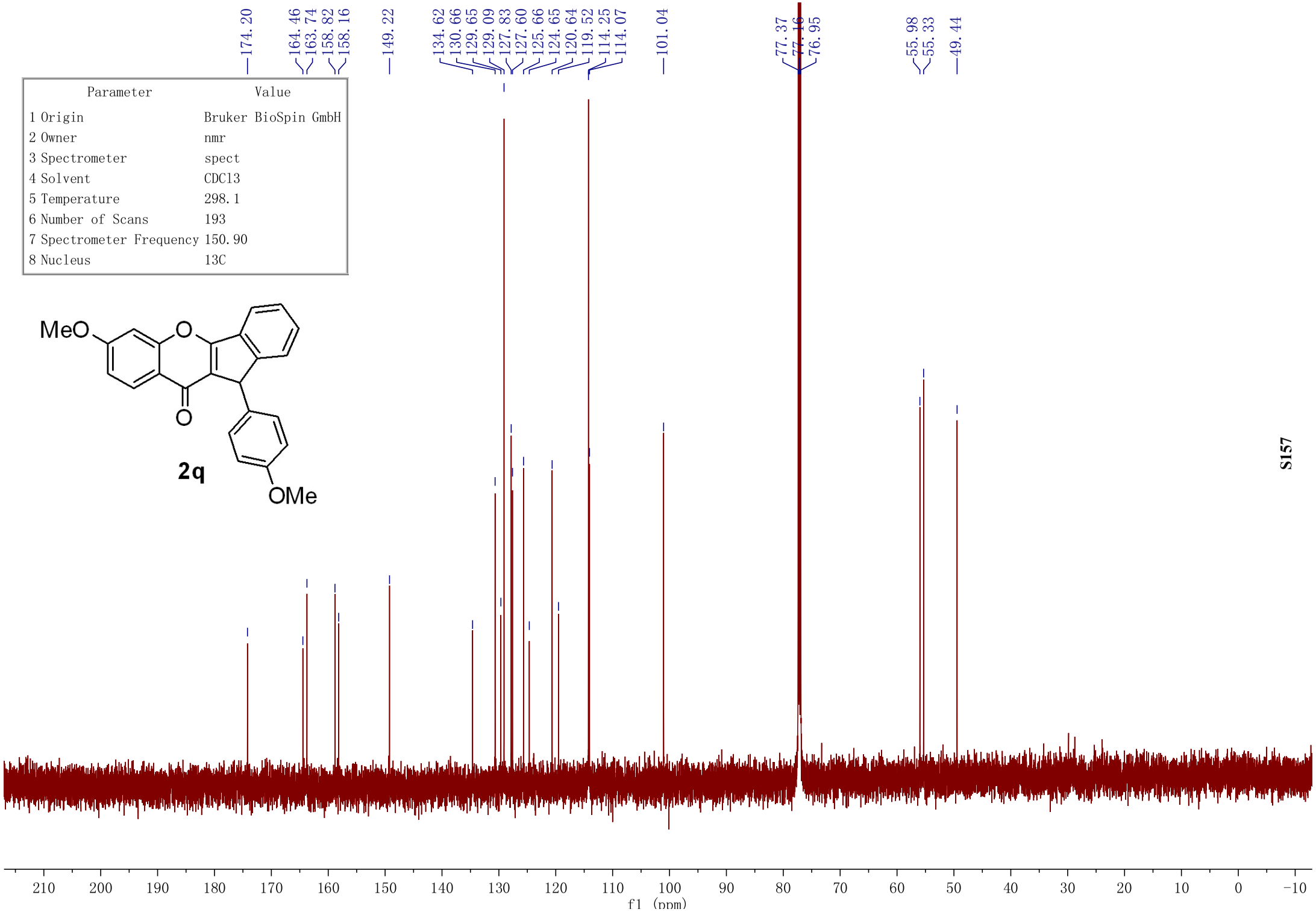

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
O
O
2o
OMe
8.04
8.04
7.88
7.87
7.87
7.87
7.86
7.53
7.47
7.26
7.14
7.12
6.81
6.80
6.80
6.79
6.79
6.79
5.12
3.75
2.46
0.99
0.97
1.13
2.99
0.95
2.09
2.08
1.00
3.11
2.87
f1 (ppm)

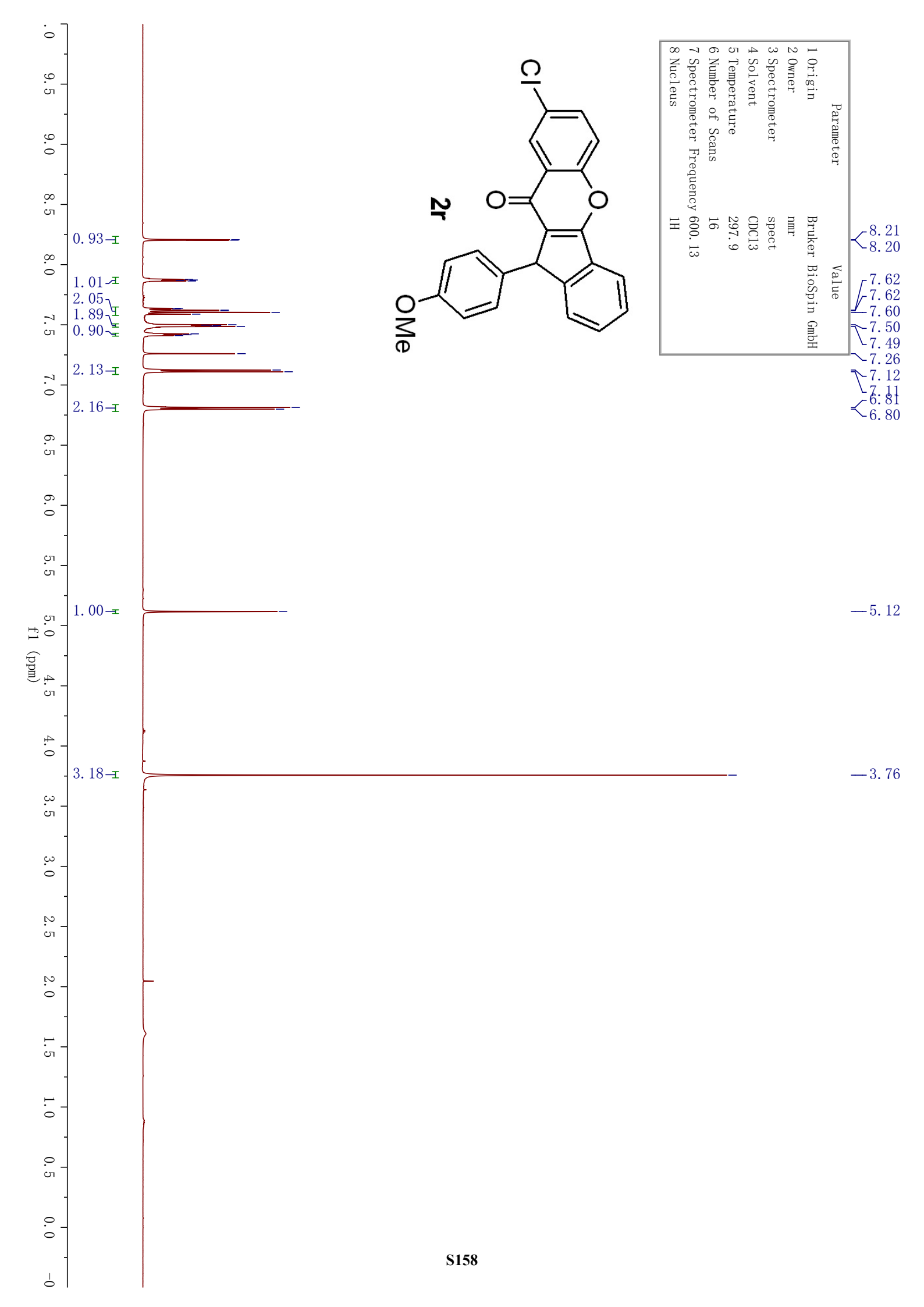

174.64
164.82
158.82
154.75
149.36
135.28
134.60
134.28
130.87
129.68
129.07
127.87
125.79
125.66
125.36
124.59
120.88
118.00
114.25
77.37
77.16
76.95
55.34
49.44
21.11
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 422
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
O
O
OMe
2o
S153
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

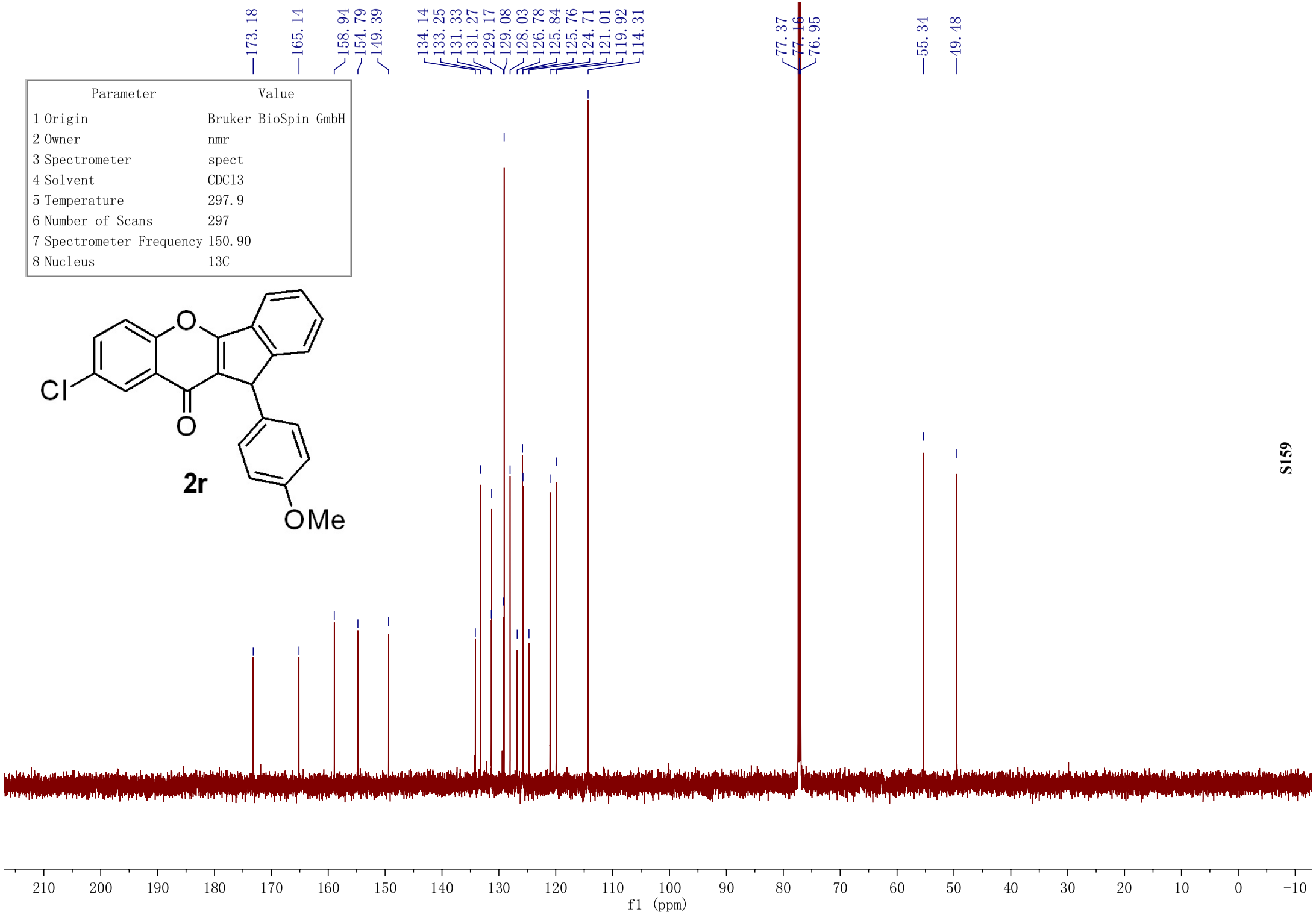

Me
Me
O
O
2p
OMe
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
7.88
7.88
7.87
7.87
7.47
7.34
7.26
7.14
7.12
6.80
6.79
5.12
3.75
2.62
2.41
2.02
2.19
0.95
1.01
2.13
2.11
1.00
3.17
3.05
3.16
f1 (ppm)

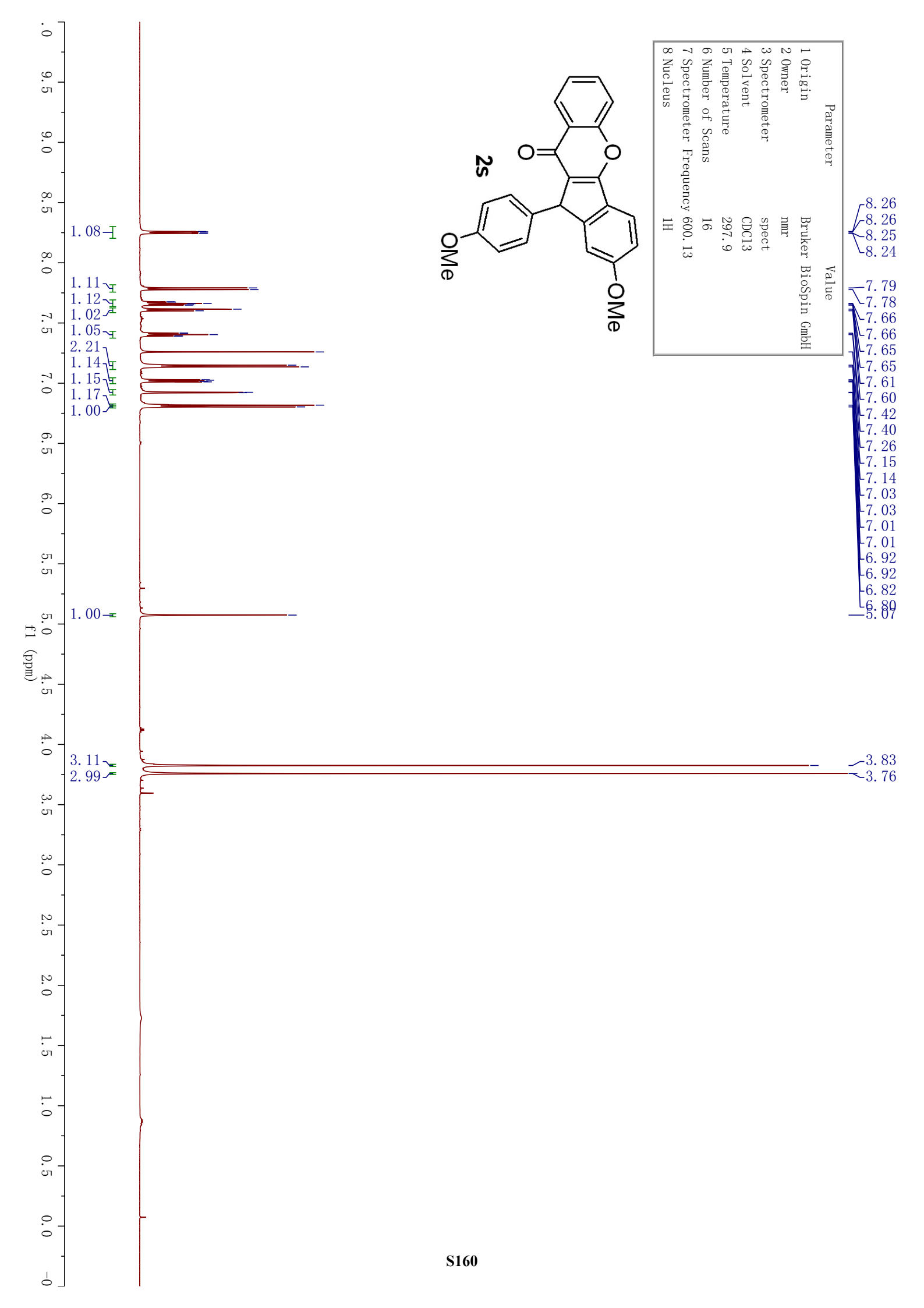

174.96
164.49
158.81
153.16
149.36
135.50
134.66
130.80
129.75
129.06
127.82
127.29
125.68
125.29
124.34
123.44
120.73
114.23
77.37
77.16
76.95
55.34
49.43
21.06
15.74
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 217
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
Me
O
O
OMe
2p
S155
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

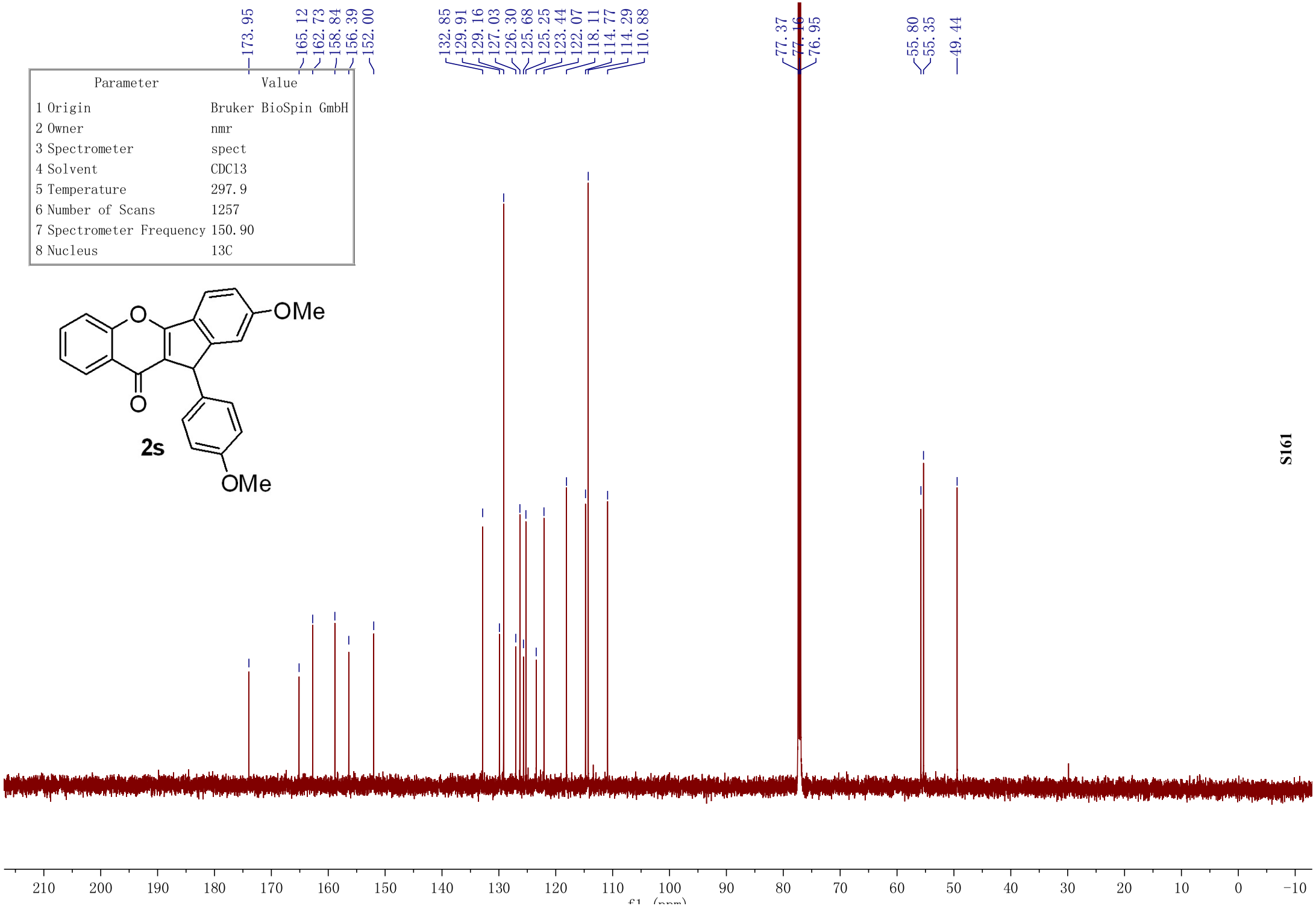

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
MeO
O
O
OMe
2q
8.17
8.15
7.85
7.84
7.48
7.48
7.47
7.46
7.46
7.45
7.41
7.26
7.14
7.12
7.06
7.05
6.99
6.99
6.98
6.98
6.81
6.79
5.09
3.94
3.75
1.02
0.99
2.14
0.95
2.14
1.05
1.11
2.12
1.00
3.14
3.17
f1 (ppm)

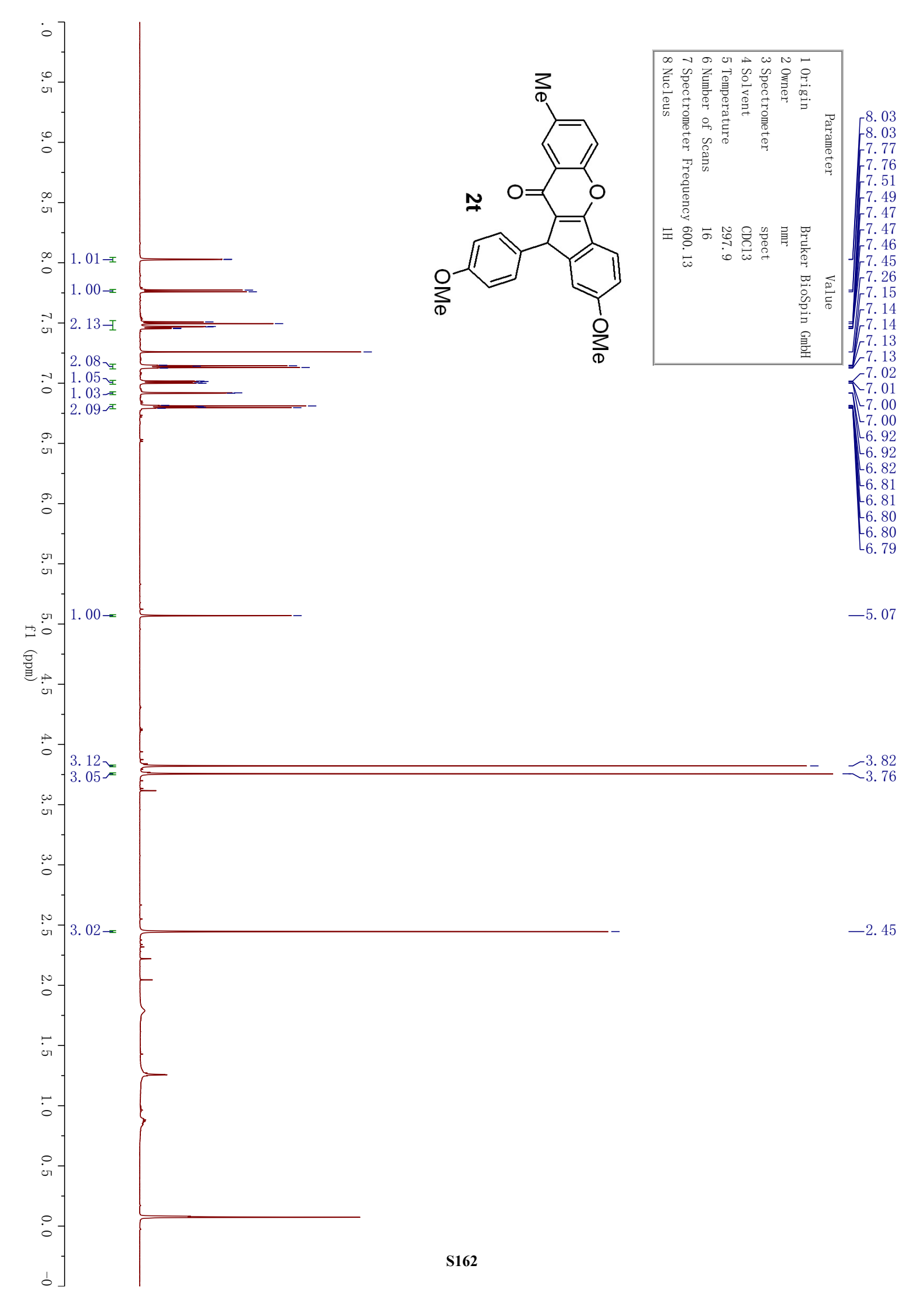

174.20
164.46
163.74
158.82
158.16
149.22
134.62
130.66
129.65
129.09
127.83
127.60
125.66
124.65
120.64
119.52
114.25
114.07
101.04
77.37
77.16
76.95
55.98
55.33
49.44
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 193
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
O
O
OMe
2q
S157
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

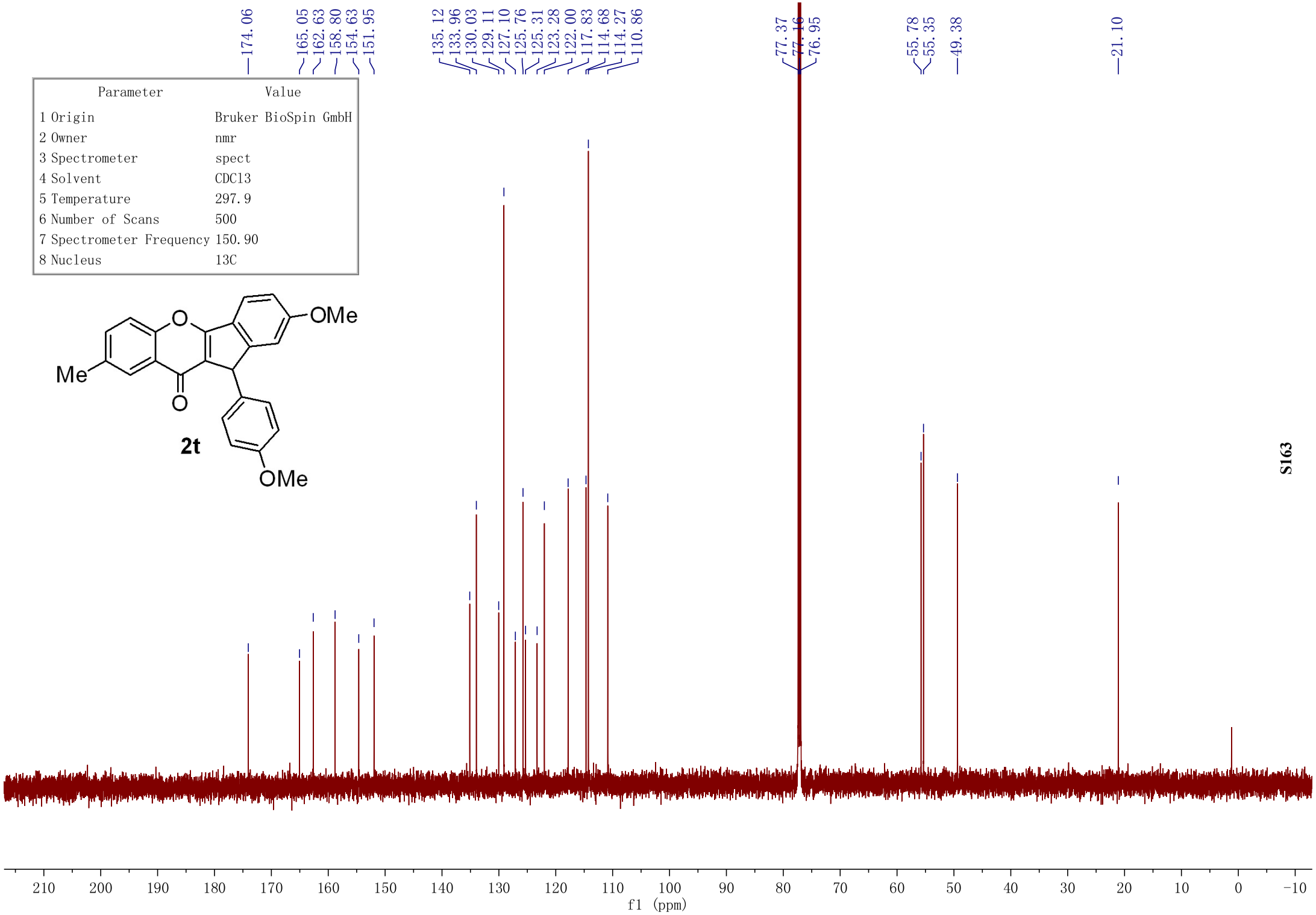

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
O
O
2r
OMe
8.21
8.20
7.62
7.62
7.60
7.50
7.49
7.26
7.12
7.11
6.81
6.80
5.12
3.76
0.93
1.01
2.05
1.89
0.90
2.13
2.16
1.00
3.18
f1 (ppm)

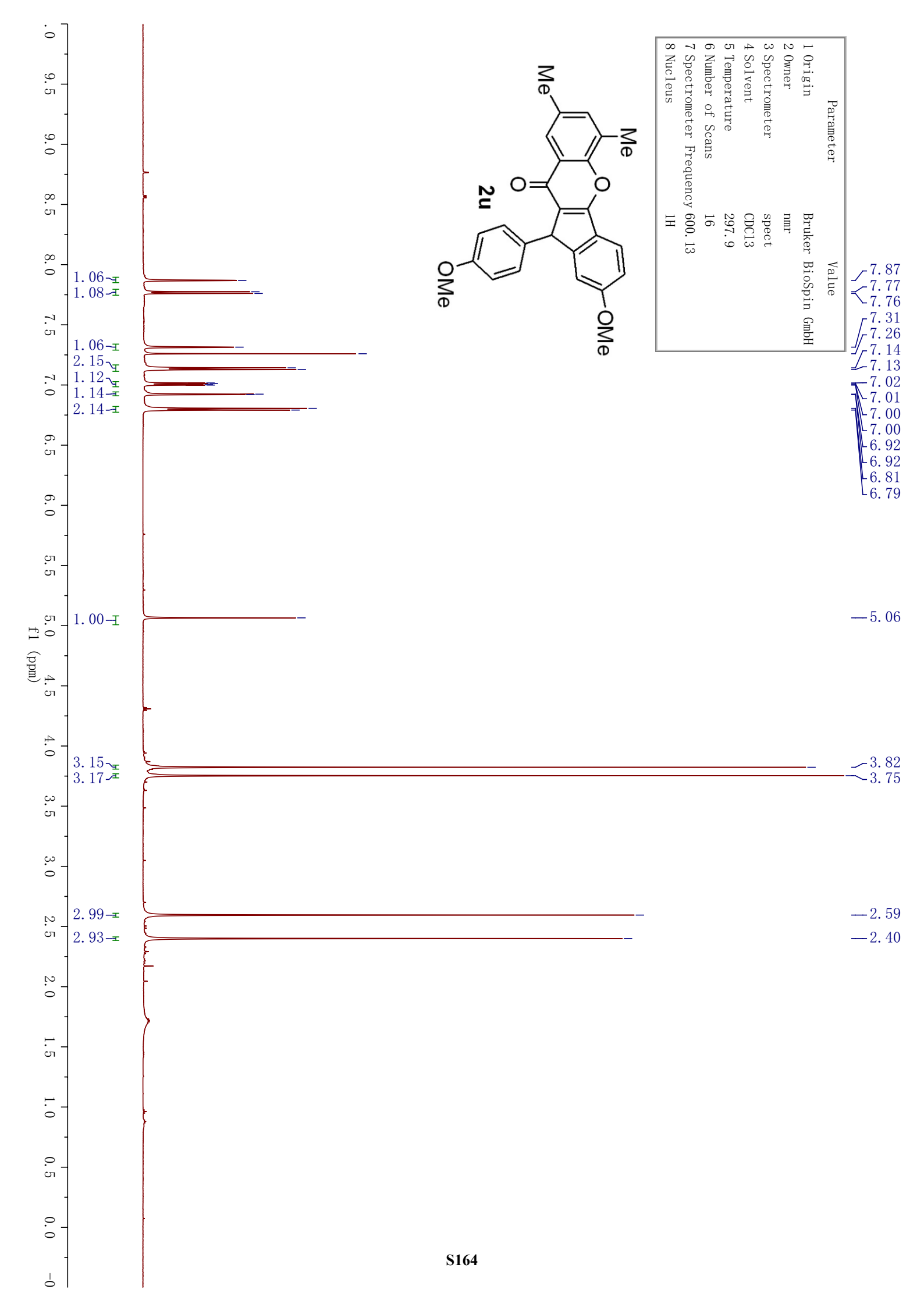

173.18
165.14
158.94
154.79
149.39
134.14
133.25
131.33
131.27
129.17
129.08
128.03
126.78
125.84
125.76
124.71
121.01
119.92
114.31
77.37
77.16
76.95
55.34
49.48
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 297
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Cl
O
O
OMe
2r
S159
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

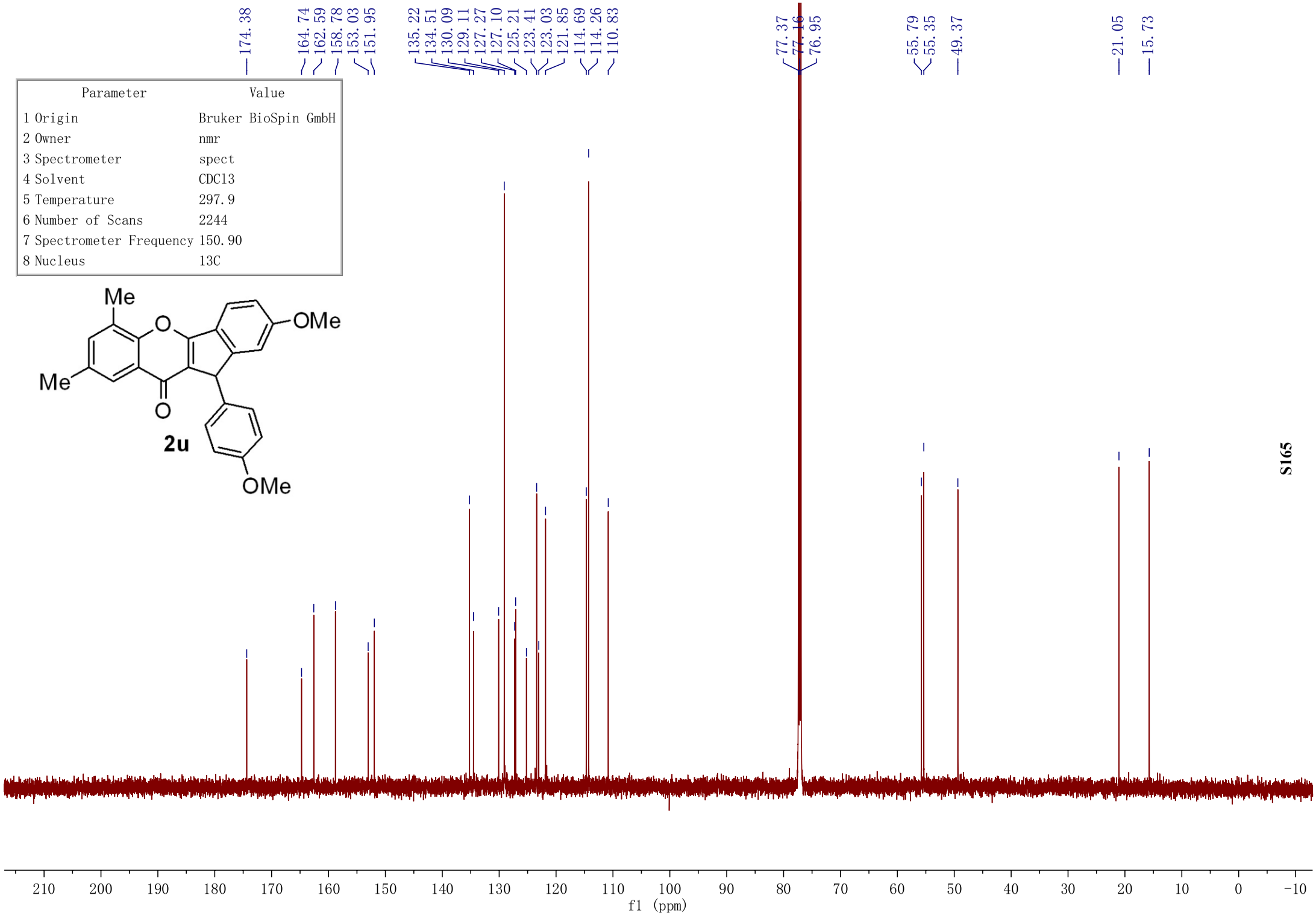

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2s
OMe
OMe
8.26
8.26
8.25
8.24
7.79
7.78
7.66
7.66
7.65
7.65
7.61
7.60
7.42
7.40
7.26
7.15
7.14
7.03
7.03
7.01
7.01
6.92
6.92
6.82
6.80
5.07
3.83
3.76
1.08
1.11
1.12
1.02
1.05
2.21
1.14
1.15
1.17
1.00
1.00
3.11
2.99
f1 (ppm)

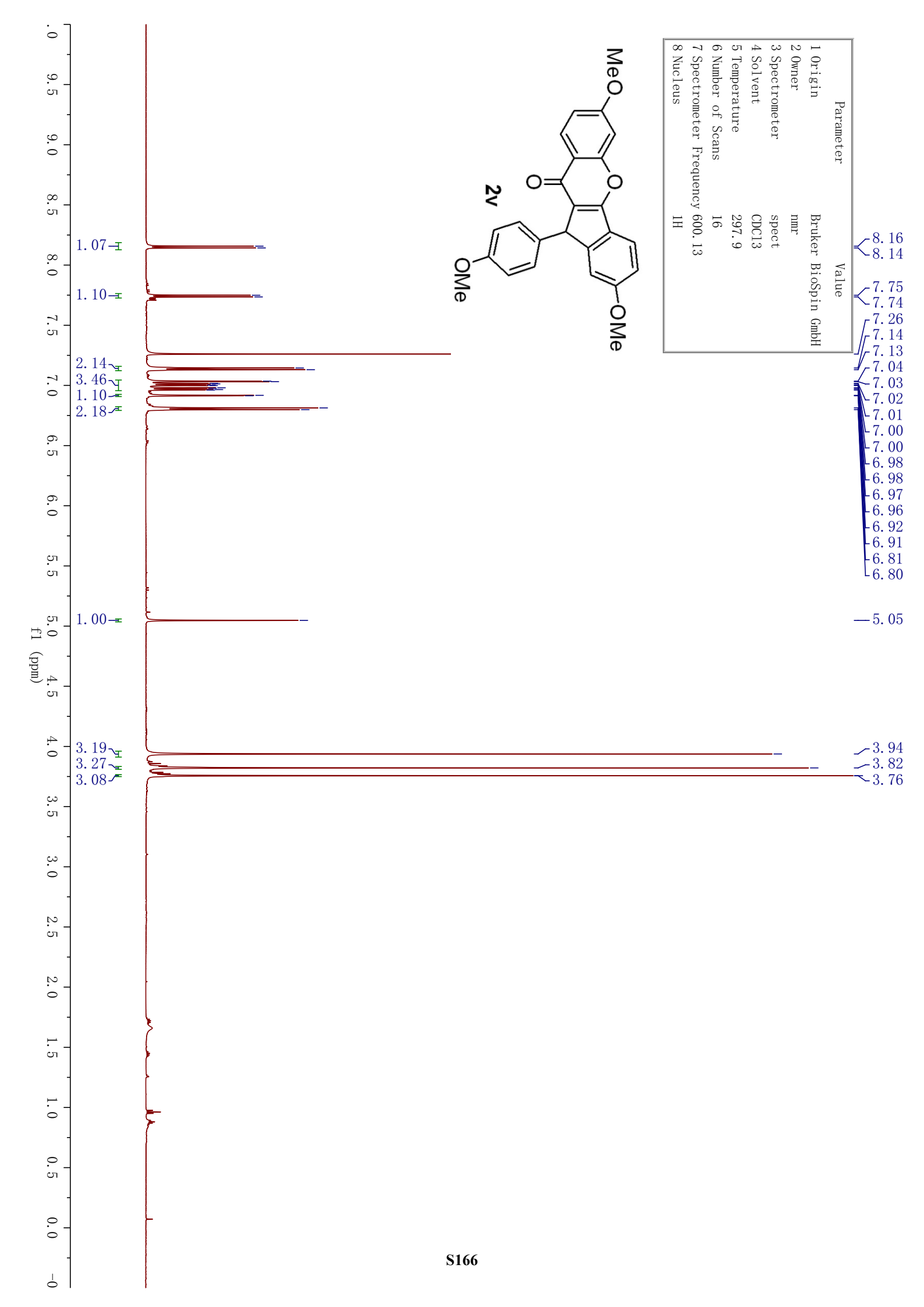

173.95
165.12
162.73
158.84
156.39
152.00
132.85
129.91
129.16
127.03
126.30
125.68
125.25
123.44
122.07
118.11
114.77
114.29
110.88
77.37
77.16
76.95
55.80
55.35
49.44
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 1257
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
O
2s
OMe
S161
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

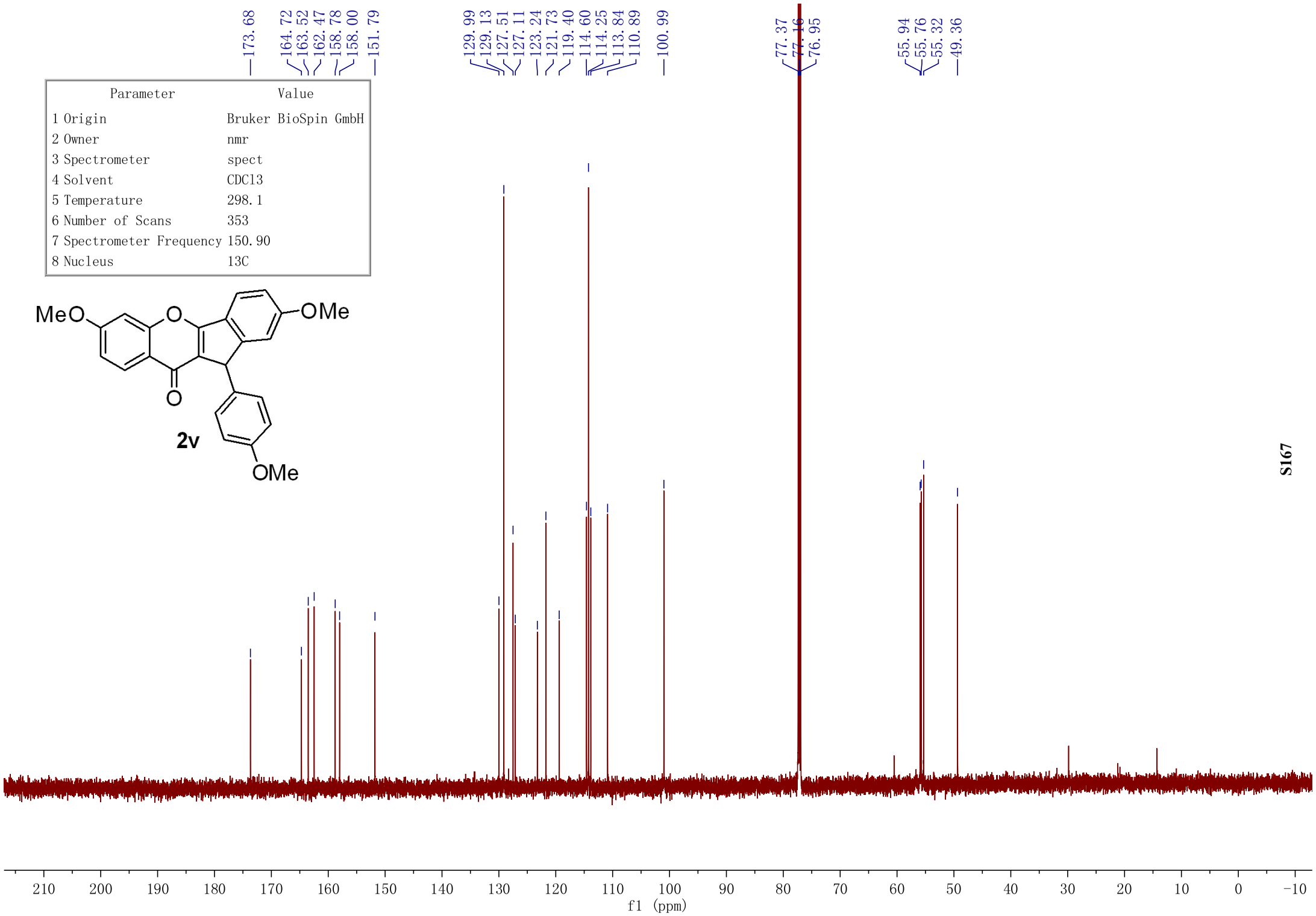

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
O
O
2t
OMe
OMe
8.03
8.03
7.77
7.76
7.51
7.49
7.47
7.47
7.46
7.45
7.26
7.15
7.14
7.14
7.13
7.13
7.02
7.01
7.00
7.00
6.92
6.92
6.82
6.81
6.81
6.80
6.80
6.79
1.01
1.00
2.13
2.08
1.05
1.03
2.09
1.00
3.12
3.05
3.02
5.07
3.82
3.76
2.45
f1 (ppm)

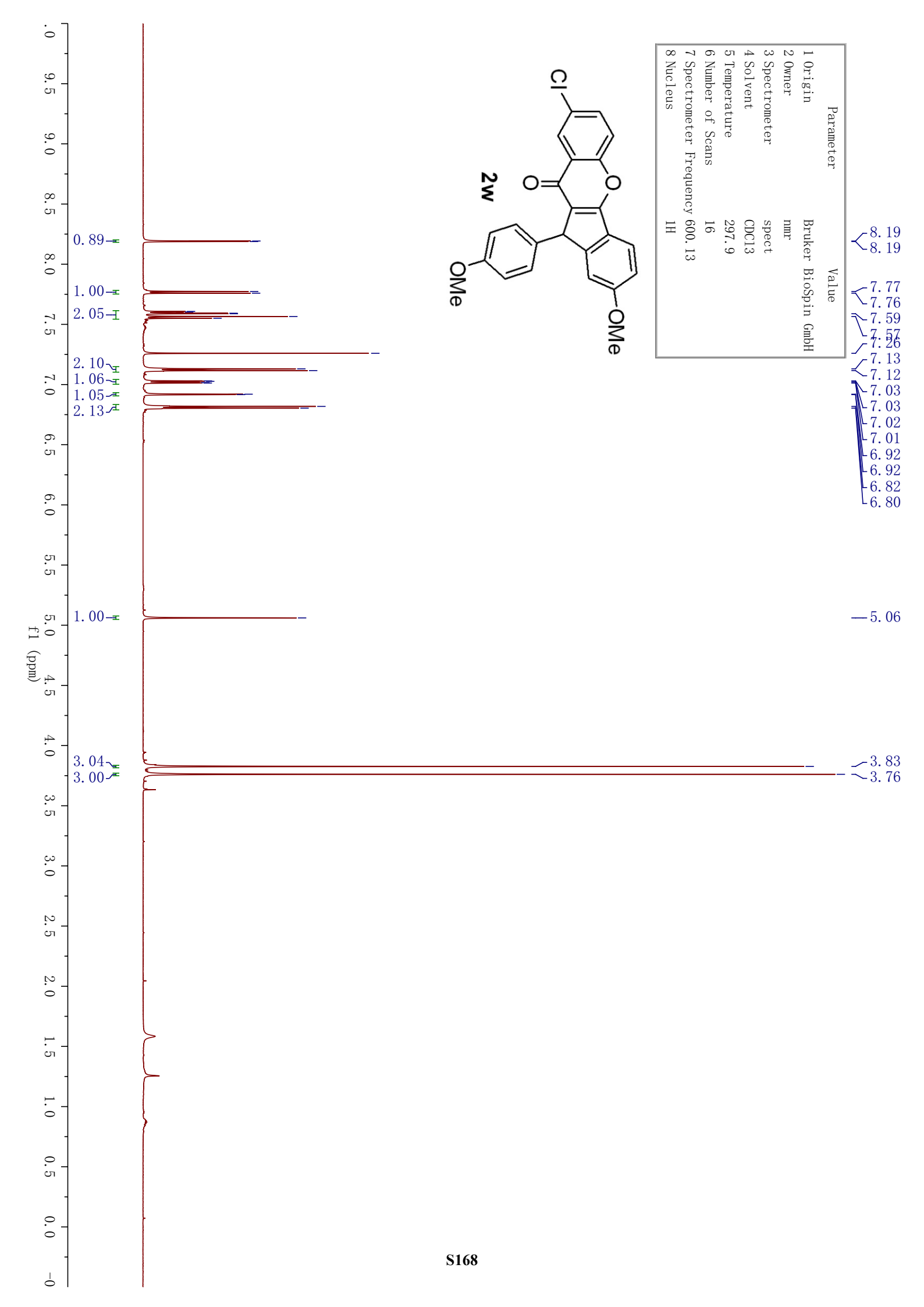

174.06
165.05
162.63
158.80
154.63
151.95
135.12
133.96
130.03
129.11
127.10
125.76
125.31
123.28
122.00
117.83
114.68
114.27
110.86
77.37
77.16
76.95
55.78
55.35
49.38
21.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 500
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
Me
O
2t
OMe
S163
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

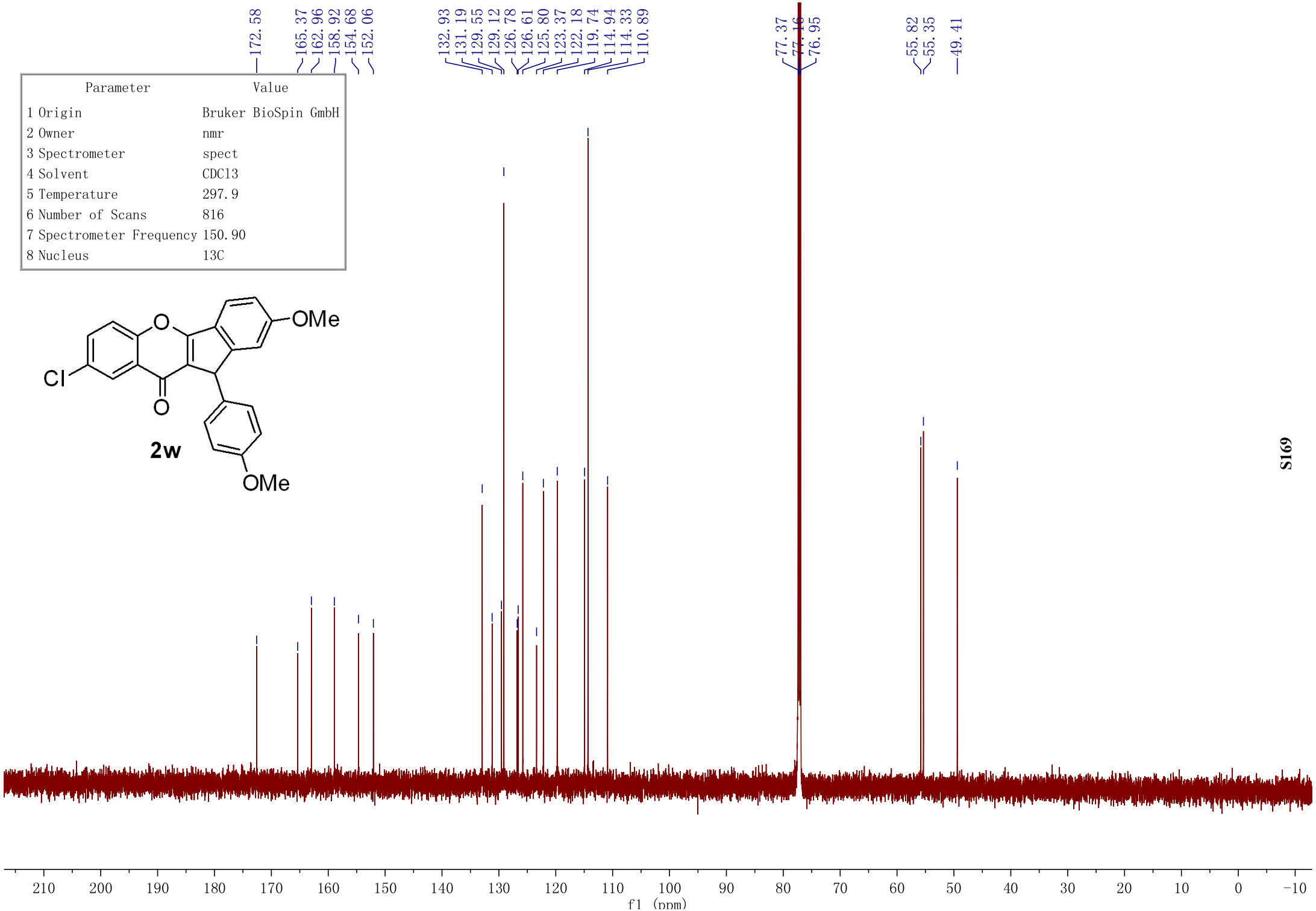

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Me
Me
O
O
2u
OMe
OMe
7.87
7.77
7.76
7.31
7.26
7.14
7.13
7.02
7.01
7.00
7.00
6.92
6.92
6.81
6.79
5.06
3.82
3.75
2.59
2.40
1.06
1.08
1.06
2.15
1.12
1.14
2.14
1.00
3.15
3.17
2.99
2.93
f1 (ppm)

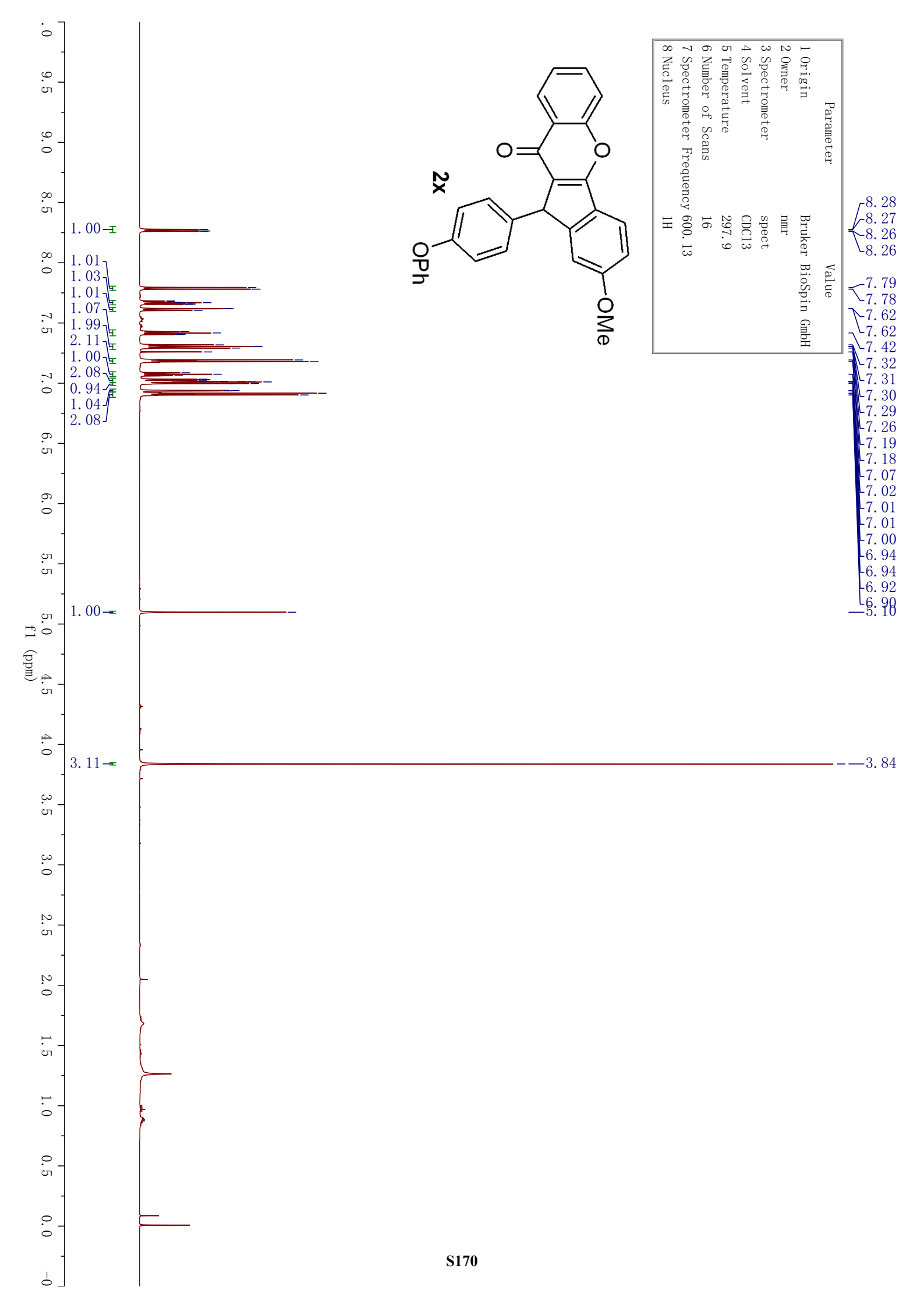

174.38
164.74
162.59
158.78
153.03
151.95
135.22
134.51
130.09
129.11
127.27
127.10
125.21
123.41
123.03
121.85
114.69
114.26
110.83
77.37
77.16
76.95
55.79
55.35
49.37
21.05
15.73
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 2244
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
O
OMe
Me
O
2u
OMe
S165
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

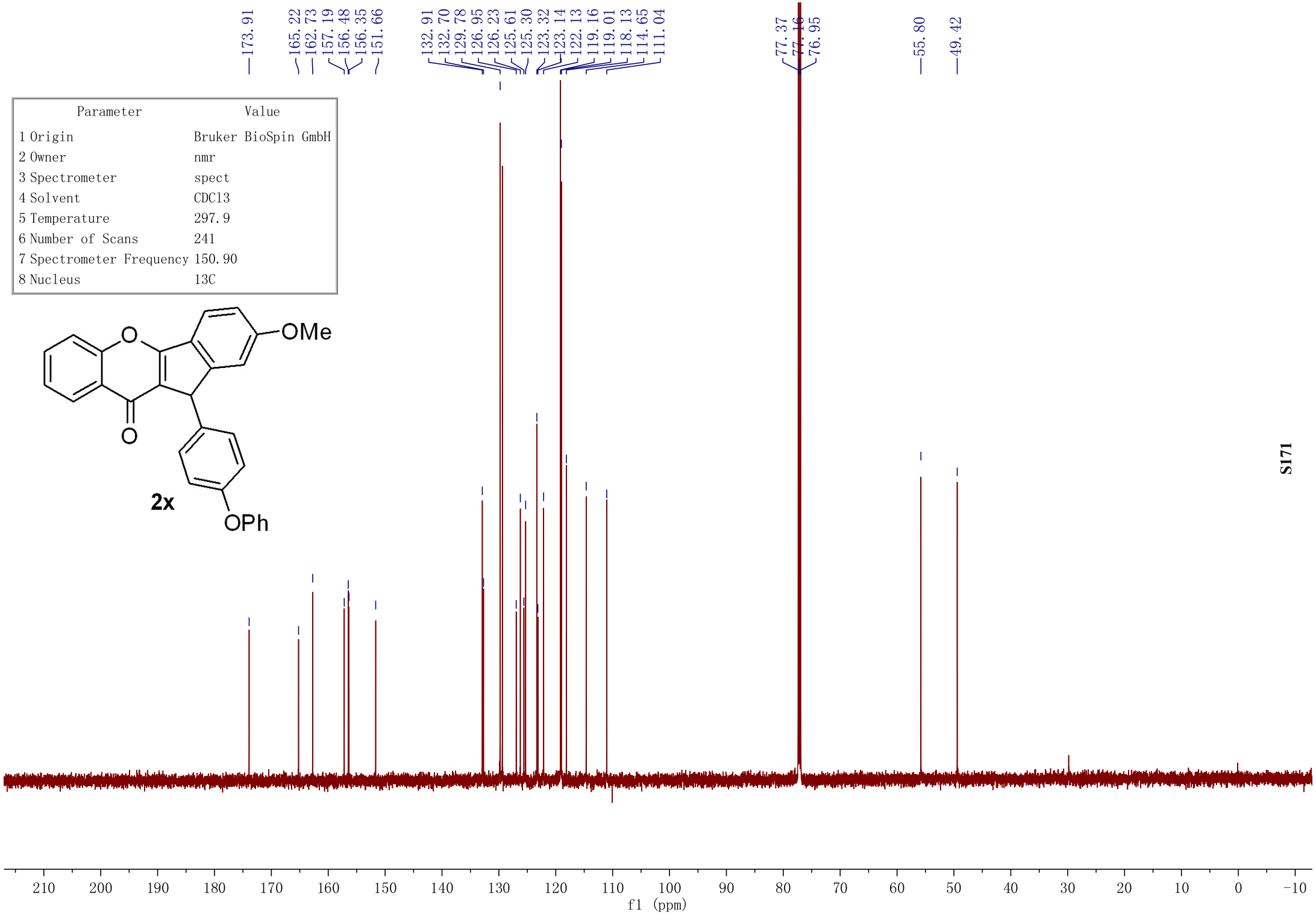

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
MeO
O
O
OMe
OMe
2v
1.07
1.10
2.14
3.46
1.10
2.18
1.00
3.19
3.27
3.08
8.16
8.14
7.75
7.74
7.26
7.14
7.13
7.04
7.03
7.02
7.01
7.00
7.00
6.98
6.98
6.97
6.96
6.92
6.91
6.81
6.80
5.05
3.94
3.82
3.76
f1 (ppm)


173.68
164.72
163.52
162.47
158.78
158.00
151.79
129.99
129.13
127.51
127.11
123.24
121.73
119.40
114.60
114.25
113.84
110.89
100.99
77.37
77.16
76.95
55.94
55.76
55.32
49.36
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 298.1
6 Number of Scans 353
7 Spectrometer Frequency 150.90
8 Nucleus 13C
MeO
O
OMe
O
OMe
2v
S167
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

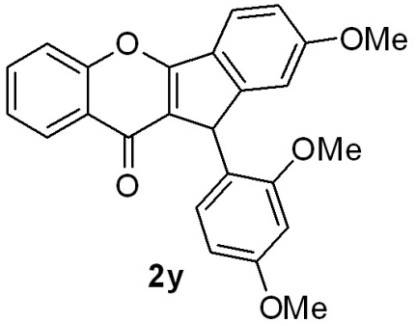

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
O
O
OMe
OMe
2w
8.19
8.19
7.77
7.76
7.59
7.57
7.26
7.13
7.12
7.03
7.03
7.02
7.01
6.92
6.92
6.82
6.80
5.06
3.83
3.76
0.89
1.00
2.05
2.10
1.06
1.05
2.13
1.00
3.04
3.00
f1 (ppm)


172.58
165.37
162.96
158.92
154.68
152.06
132.93
131.19
129.55
129.12
126.78
126.61
125.80
123.37
122.18
119.74
114.94
114.33
110.89
77.37
77.16
76.95
55.82
55.35
49.41
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 816
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
Cl
O
2w
OMe
S169
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
2x
OPh
OMe
O
O
8.28
8.27
8.26
8.26
7.79
7.78
7.62
7.62
7.42
7.32
7.31
7.30
7.29
7.26
7.19
7.18
7.07
7.02
7.01
7.01
7.00
6.94
6.94
6.92
6.90
5.10
3.84
1.00
1.01
1.03
1.01
1.07
1.99
2.11
1.00
2.08
0.94
1.04
2.08
1.00
3.11
f1 (ppm)

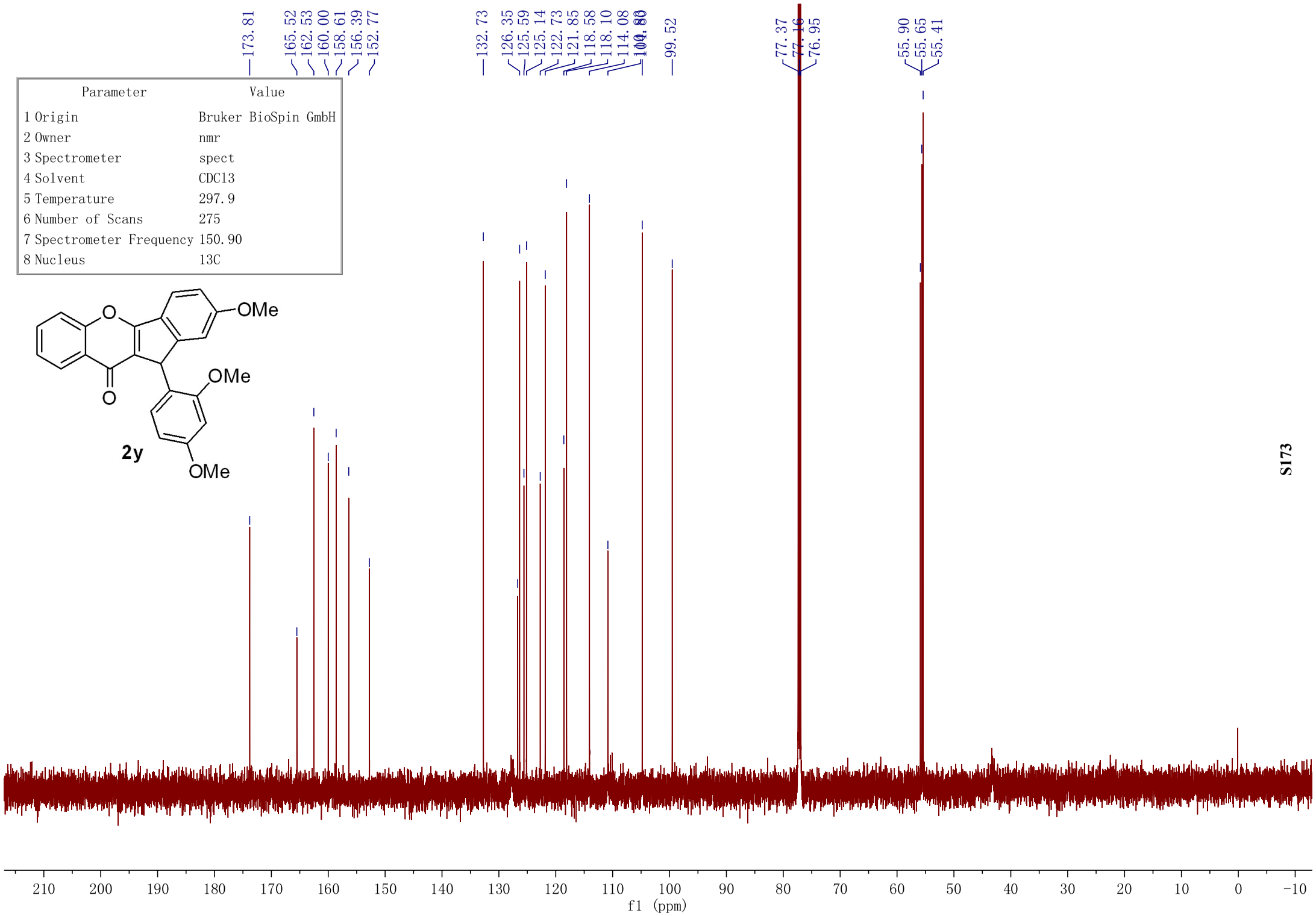

173.91
165.22
162.73
157.19
156.48
156.35
151.66
132.91
132.70
129.78
126.95
126.23
125.61
125.30
123.32
123.14
122.13
119.16
119.01
118.13
114.65
111.04
77.37
77.16
76.95
55.80
49.42
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 241
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
O
2x
OPh
S171
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

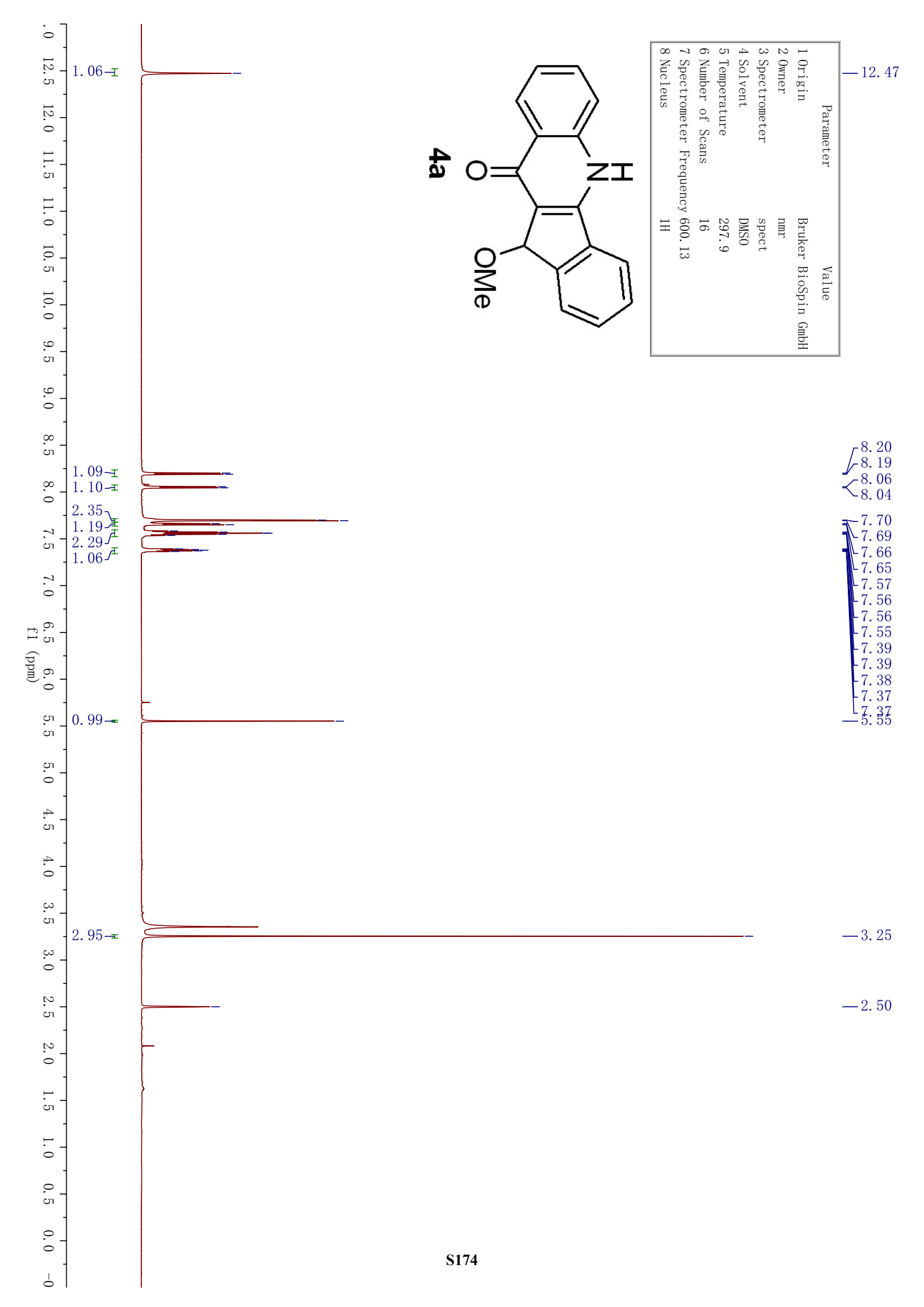
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	CDCl3
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

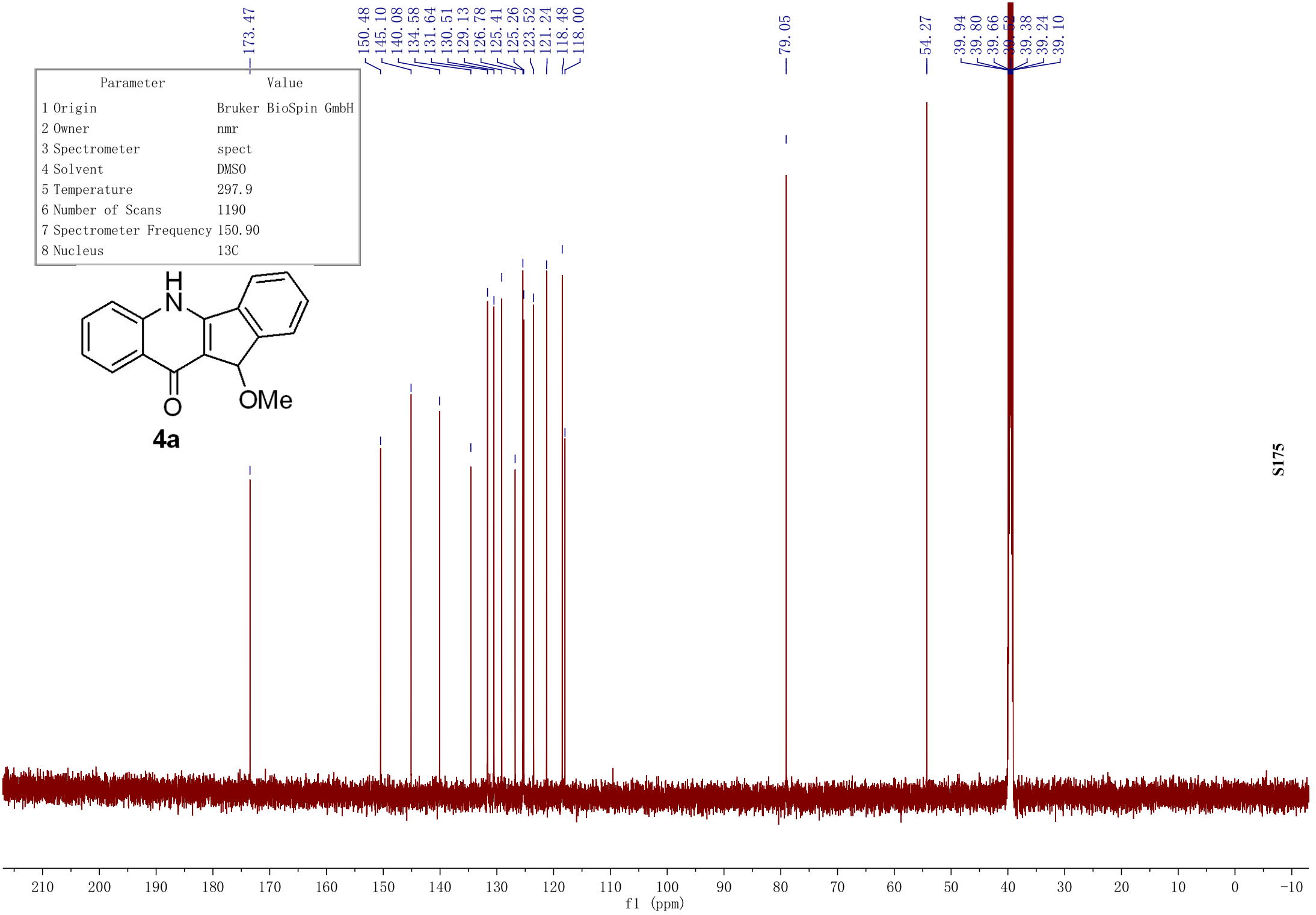


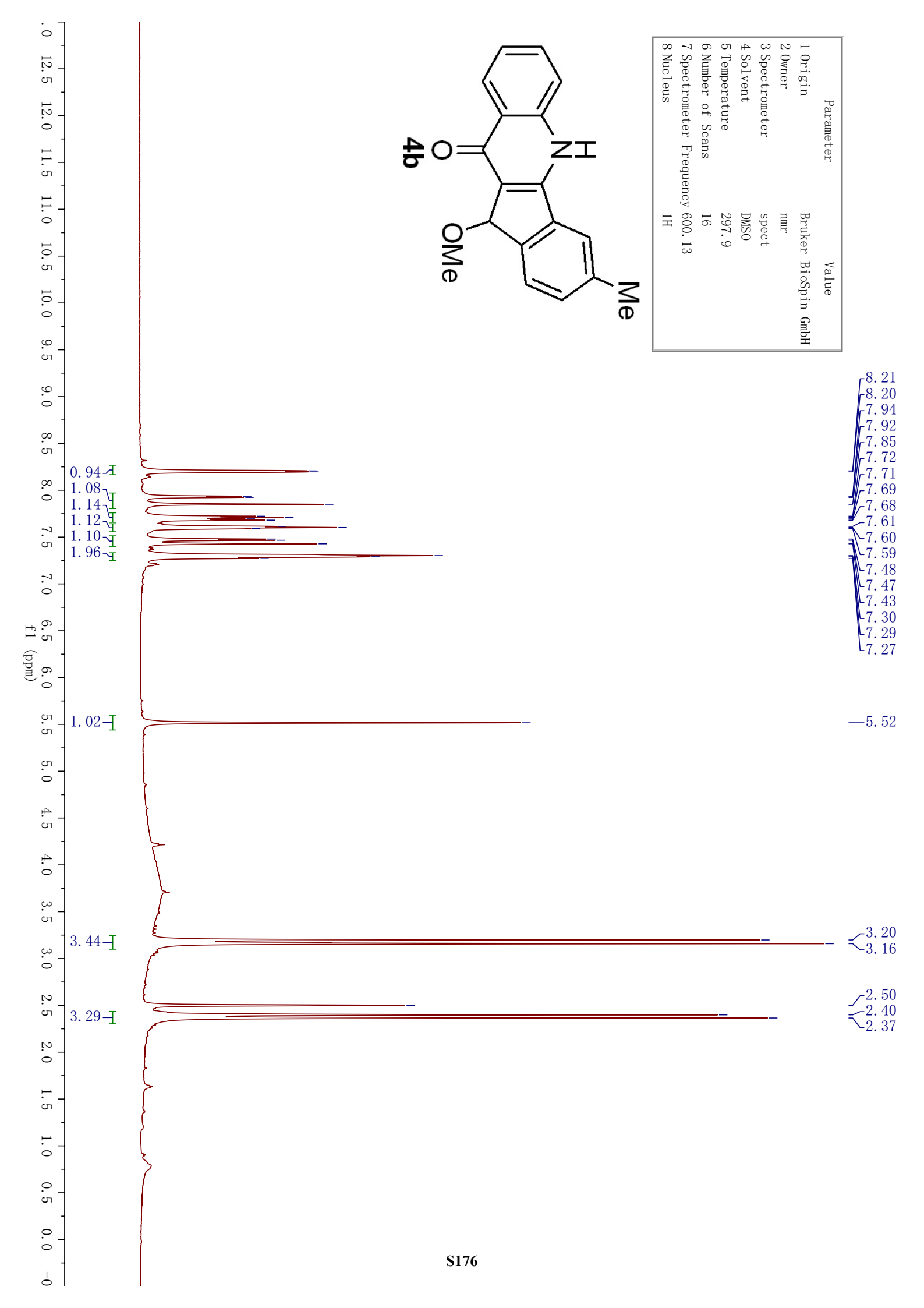
2y

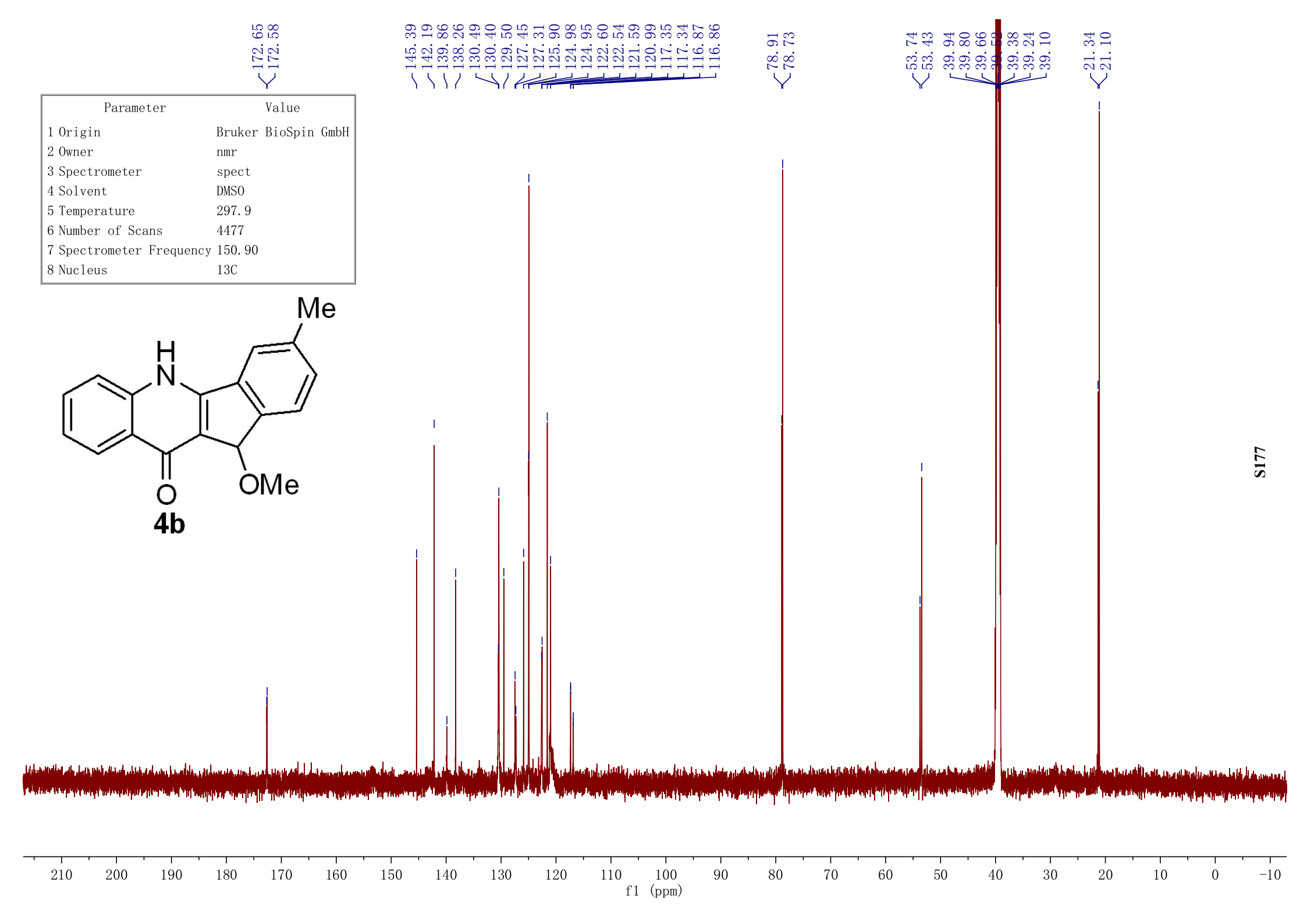
f1 (ppm)


173.81
165.52
162.53
160.00
158.61
156.39
152.77
132.73
126.35
125.59
125.14
122.73
121.85
118.58
118.10
114.08
99.52
77.37
77.16
76.95
55.90
55.65
55.41
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent CDCl3
5 Temperature 297.9
6 Number of Scans 275
7 Spectrometer Frequency 150.90
8 Nucleus 13C
O
OMe
OMe
O
OMe
2y
S173
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

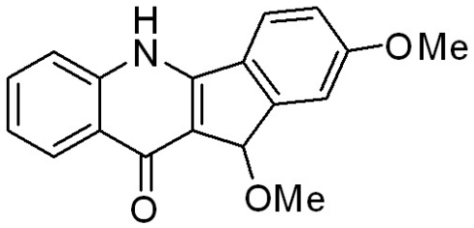

Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
4a
O
NH
OMe
12.47
8.20
8.19
8.06
8.04
7.70
7.69
7.66
7.65
7.57
7.56
7.56
7.55
7.39
7.39
7.38
7.37
7.37
5.55
3.25
2.50
1.06
1.09
1.10
2.35
1.19
2.29
1.06
0.99
2.95
f1 (ppm)


173.47
150.48
145.10
140.08
134.58
131.64
130.51
129.13
126.78
125.41
125.26
123.52
121.24
118.48
118.00
79.05
54.27
39.94
39.80
39.66
39.52
39.38
39.24
39.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 1190
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
O
OMe
4a
S175
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

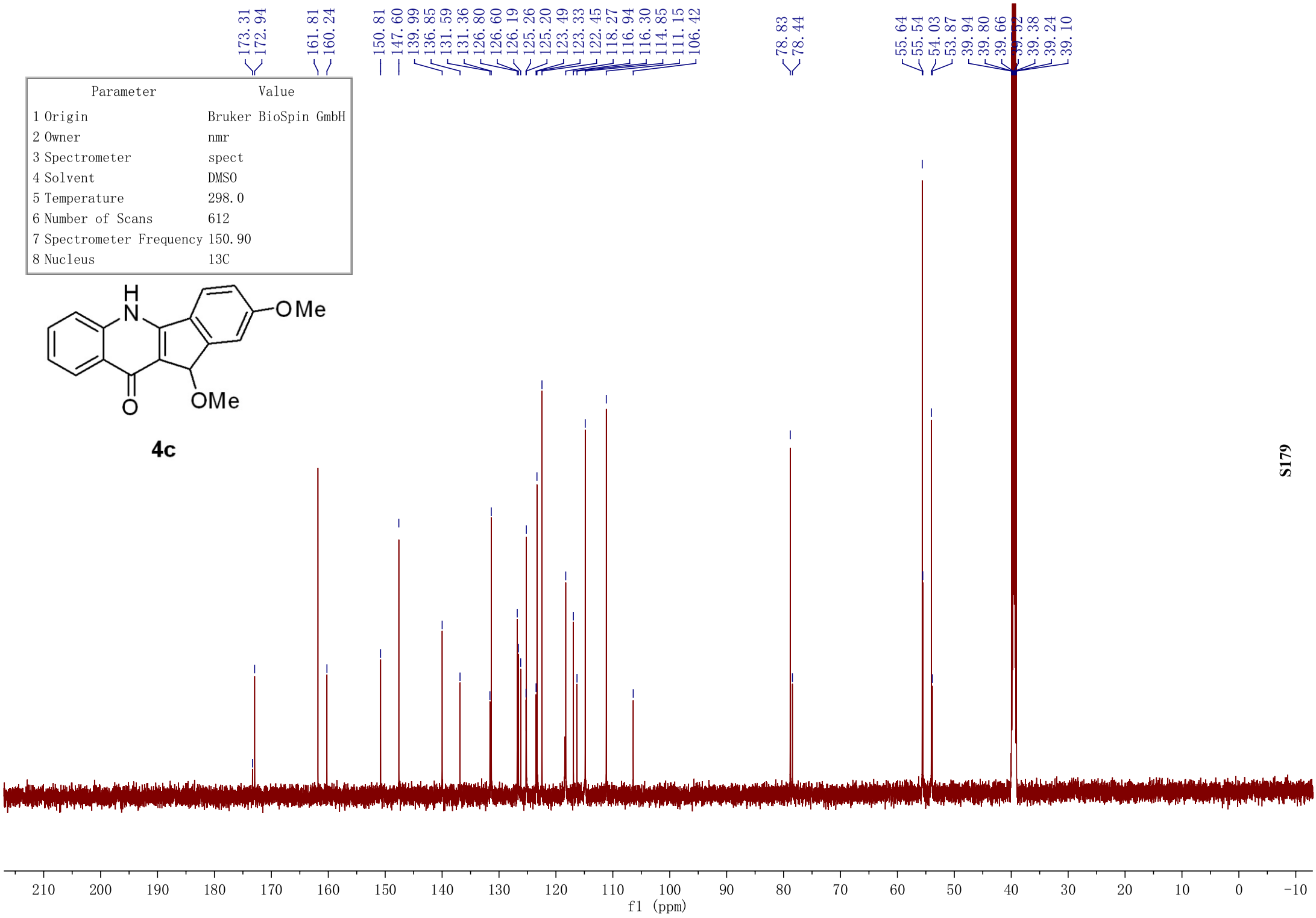

4b
O
NH
OMe
Me
Parameter
Value
1 Origin
Bruker BioSpin GmbH
2 Owner
nmr
3 Spectrometer
spect
4 Solvent
DMSO
5 Temperature
297.9
6 Number of Scans
16
7 Spectrometer Frequency 600.13
8 Nucleus
1H
8.21
8.20
7.94
7.92
7.85
7.72
7.71
7.69
7.68
7.61
7.60
7.59
7.48
7.47
7.43
7.30
7.29
7.27
5.52
3.20
3.16
2.50
2.40
2.37
0.94
1.08
1.14
1.12
1.10
1.96
1.02
3.44
3.29
f1 (ppm)

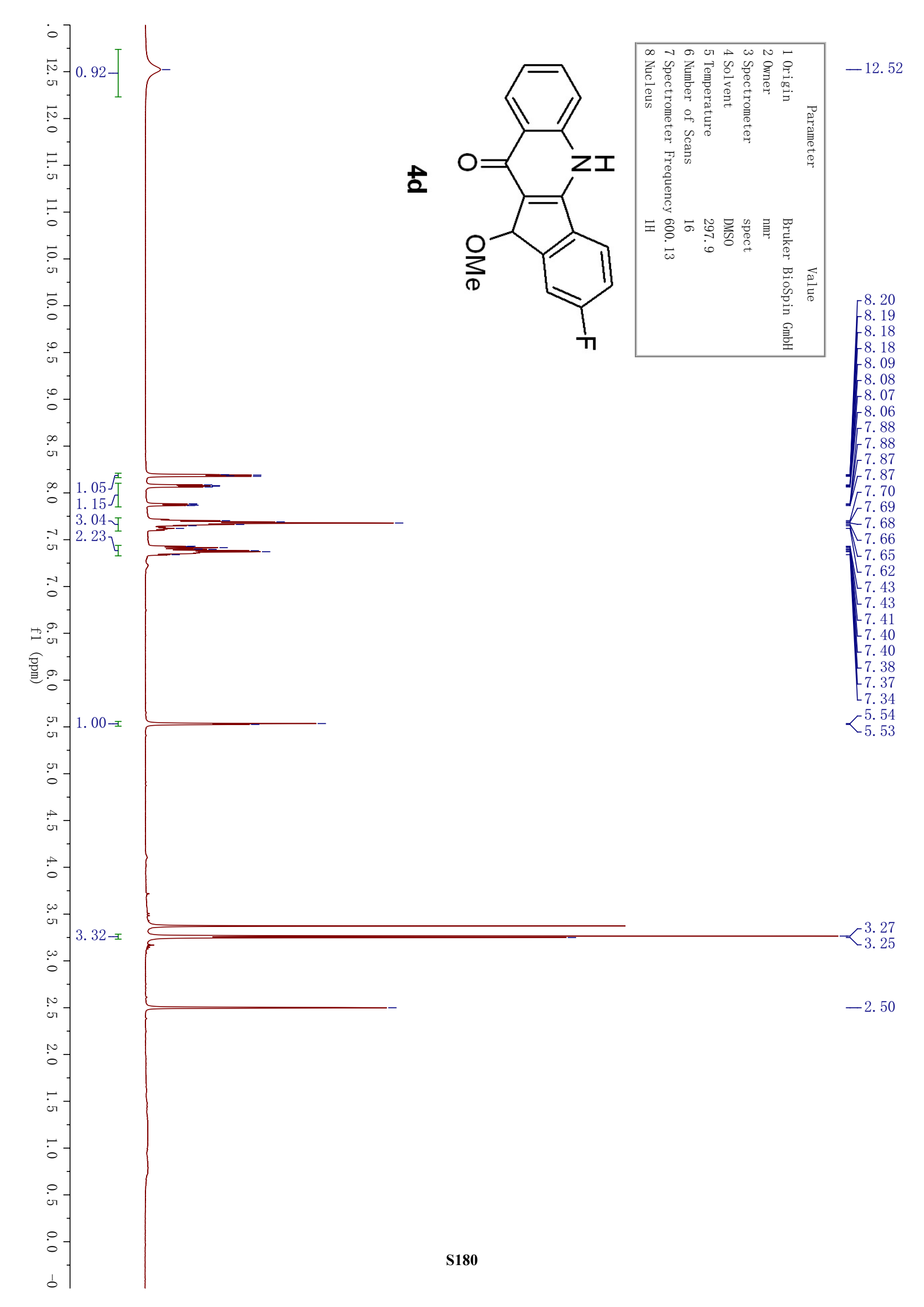

172.65
172.58
145.39
142.19
139.86
138.26
130.49
130.40
129.50
127.45
127.31
125.90
124.98
124.95
122.60
122.54
121.59
120.99
117.35
117.34
116.87
116.86
78.91
78.73
53.74
53.43
39.94
39.80
39.66
39.38
39.24
39.10
21.34
21.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 4477
7 Spectrometer Frequency 150.90
8 Nucleus 13C
Me
H
N
O
OMe
4b
S177
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

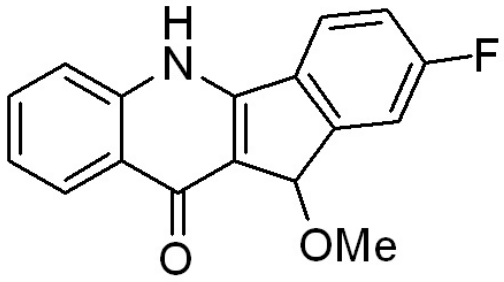


4c


173.31
172.94
161.81
160.24
150.81
147.60
139.99
136.85
131.59
131.36
126.80
126.60
126.19
125.26
125.20
123.49
123.33
122.45
118.27
116.94
116.30
114.85
111.15
106.42
78.83
78.44
55.64
55.54
54.03
53.87
39.94
39.80
39.66
39.52
39.38
39.24
39.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 298.0
6 Number of Scans 612
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
OMe
O
OMe
4c
S179
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


4d
O
NH
OMe
F
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
12.52
8.20
8.19
8.18
8.18
8.09
8.08
8.07
8.06
7.88
7.88
7.87
7.87
7.70
7.69
7.68
7.66
7.65
7.62
7.43
7.43
7.41
7.40
7.40
7.38
7.37
7.34
5.54
5.53
3.27
3.25
2.50
0.92
1.05
1.15
3.04
2.23
1.00
3.32
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	1758
7 Spectrometer Frequency	150.90
8 Nucleus	13C

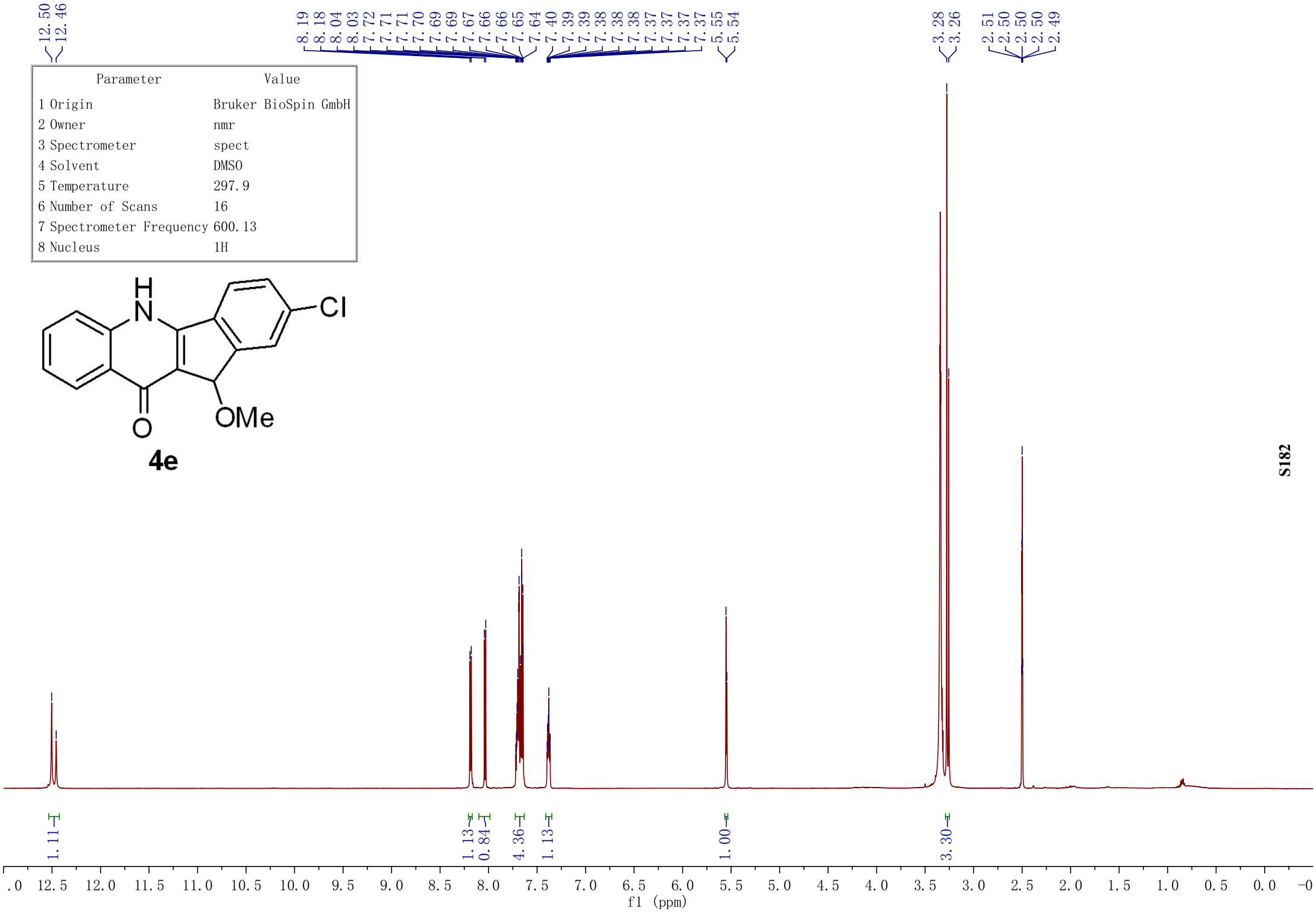


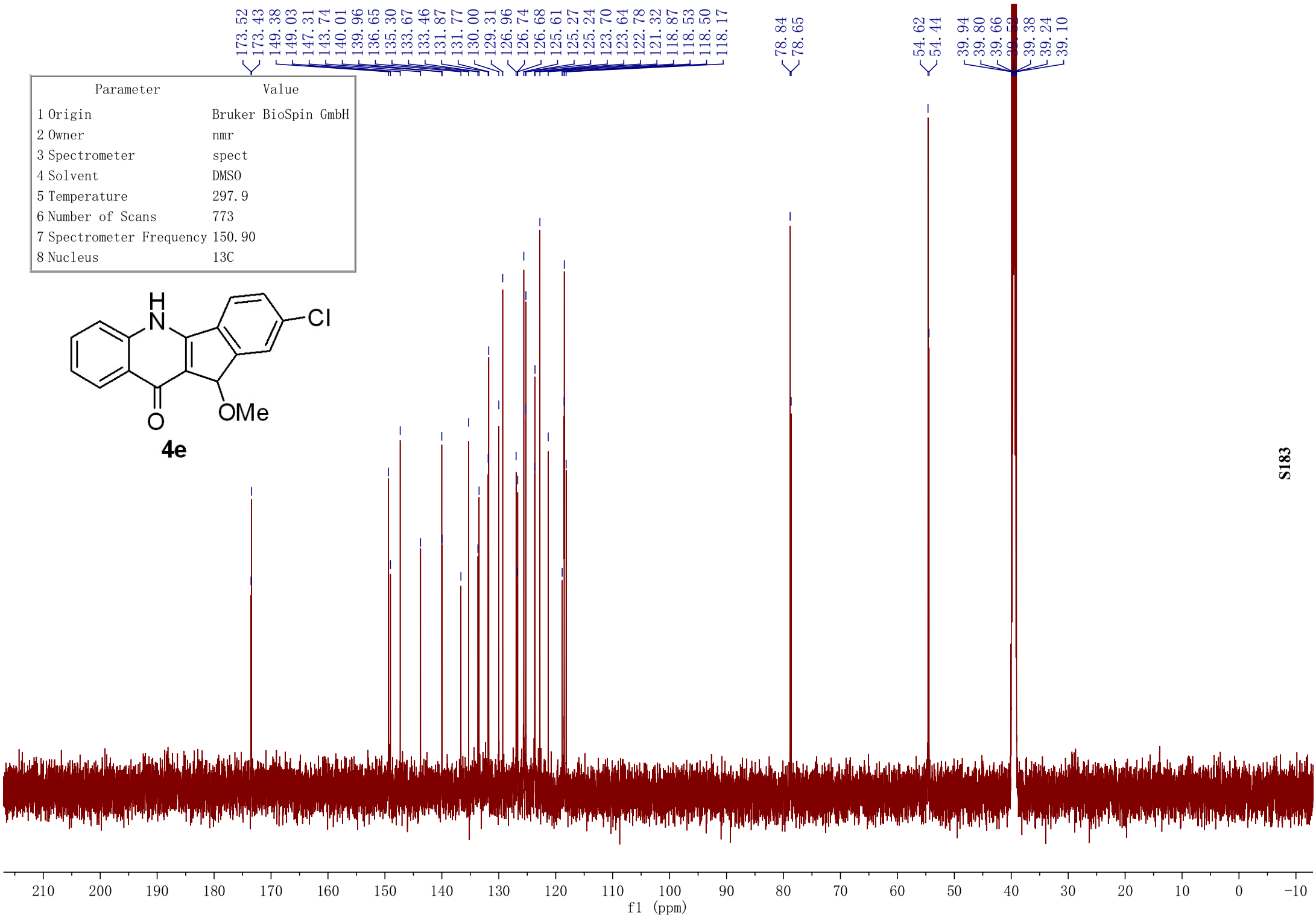
4d

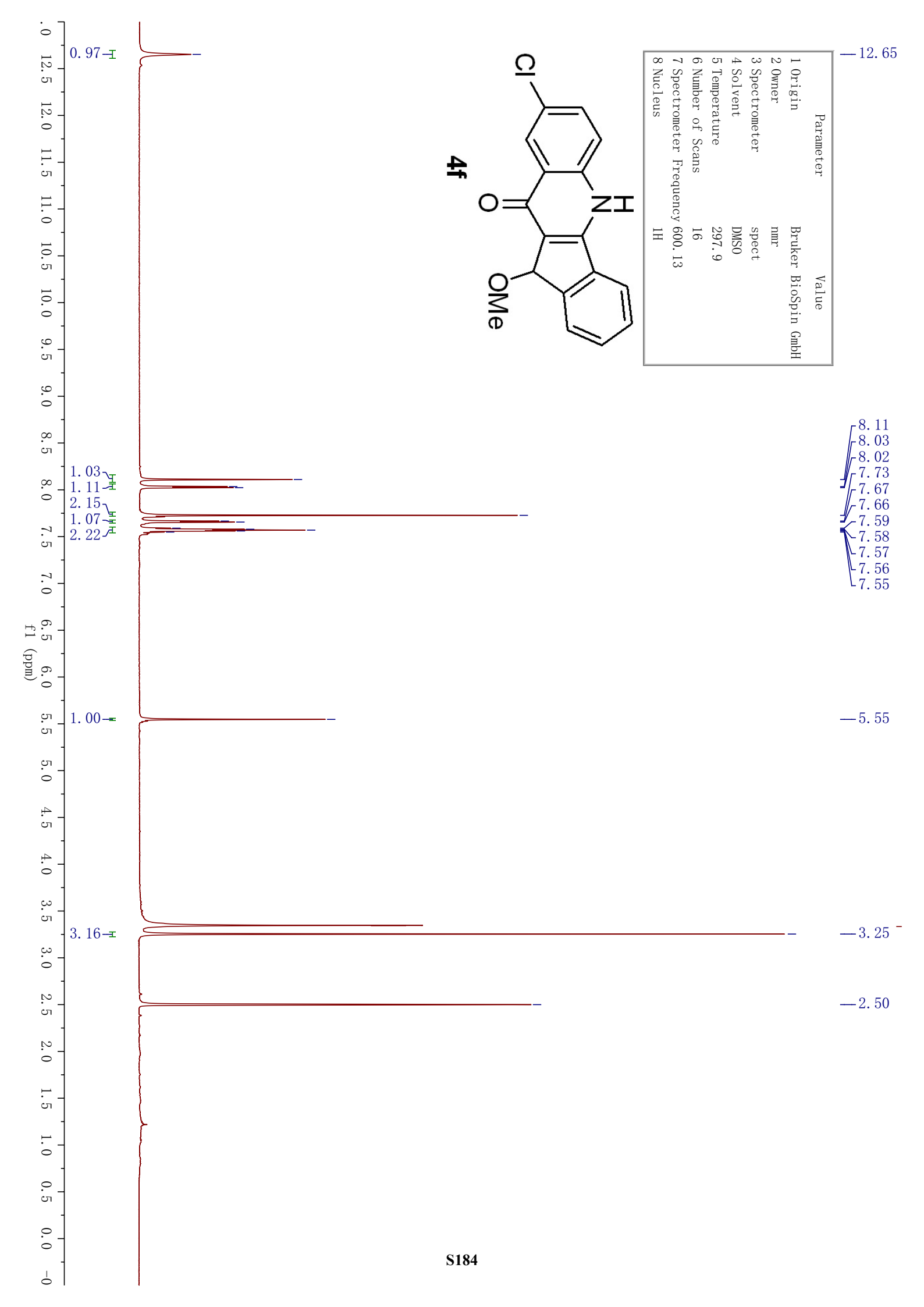
173.40 173.19 164.72 163.51 163.07 161.89 149.78 149.75 148.27 148.21 140.92 131.77 131.63 127.10 127.04 126.56 125.26 125.22 123.65 123.57 123.16 123.10 118.04 118.03 116.88 116.30 116.14 113.20 113.05 108.65 108.49 78.76 78.46 54.43 54.28 39.94 39.80 39.66 39.52 39.38 39.24 39.10

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10

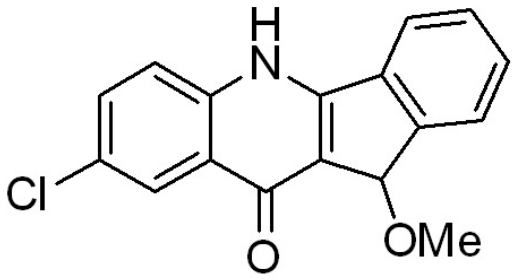
f1 (ppm)


12.50
12.46
8.19
8.18
8.04
8.03
7.72
7.71
7.71
7.70
7.69
7.69
7.67
7.66
7.66
7.65
7.64
7.40
7.39
7.39
7.38
7.38
7.38
7.37
7.37
7.37
7.37
5.55
5.54
3.28
3.26
2.51
2.50
2.50
2.50
2.49
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
H
N
Cl
O
OMe
4e
S182
1.11
1.13
0.84
4.36
1.13
1.00
3.30
f1 (ppm)


173.52
173.43
149.38
149.03
147.31
143.74
140.01
139.96
136.65
135.30
133.67
133.46
131.87
131.77
130.00
129.31
126.96
126.74
126.68
125.61
125.27
125.24
123.70
123.64
122.78
121.32
118.87
118.53
118.50
118.17
78.84
78.65
54.62
54.44
39.94
39.80
39.66
39.52
39.38
39.24
39.10
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 773
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
Cl
O
OMe
4e
S183
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
4f
Cl
O
NH
OMe
12.65
8.11
8.03
8.02
7.73
7.67
7.66
7.59
7.58
7.57
7.56
7.55
5.55
3.25
2.50
0.97
1.03
1.11
2.15
1.07
2.22
1.00
3.16
f1 (ppm)

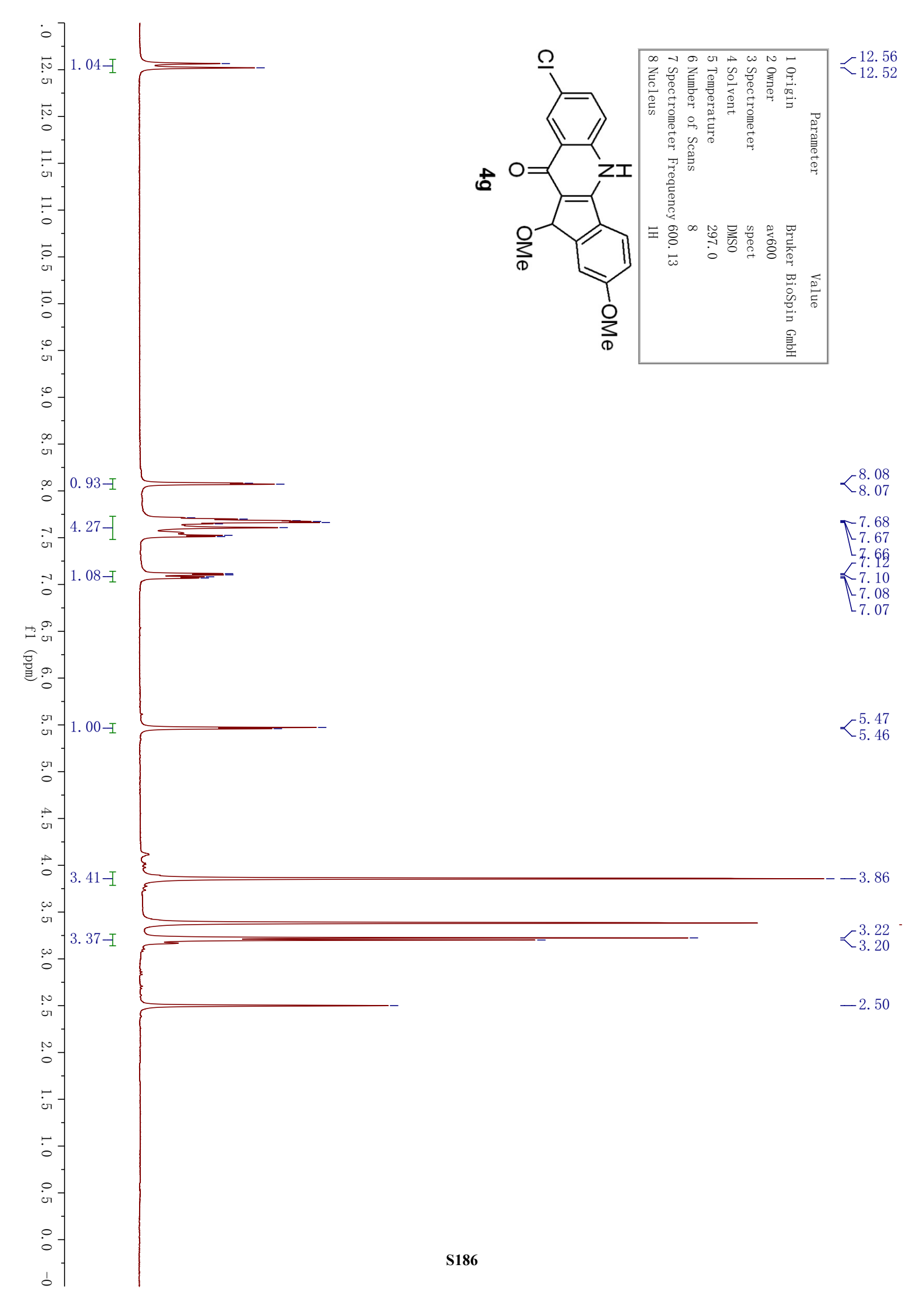
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	298.0
6 Number of Scans	2958
7 Spectrometer Frequency	150.90
8 Nucleus	13C

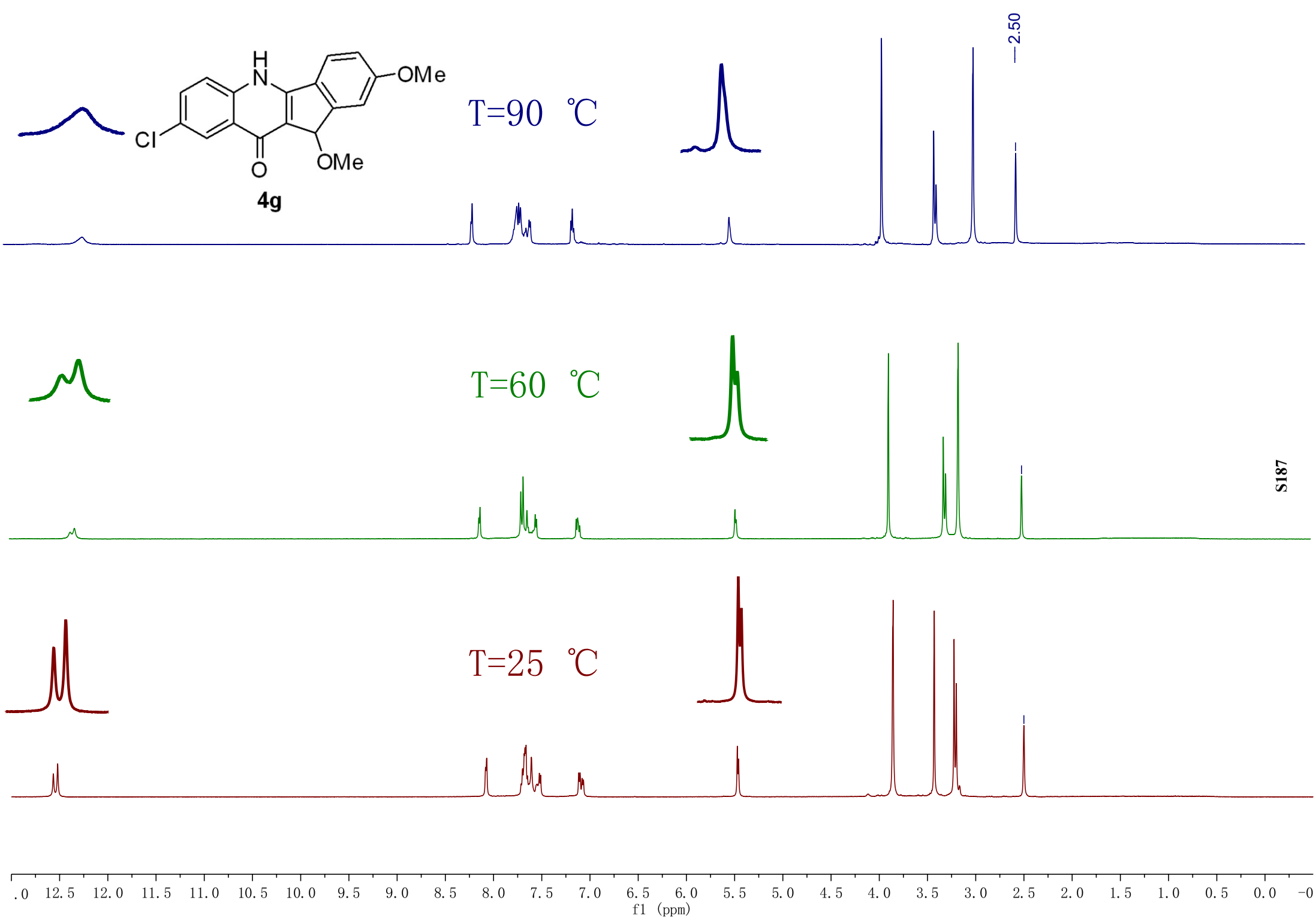


4f

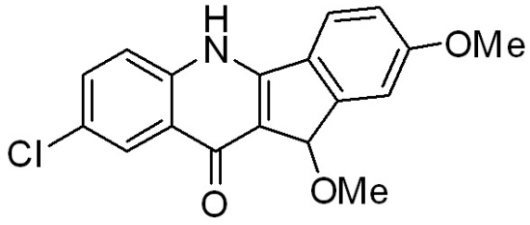
172.11
150.91
145.11
138.72
134.25
131.67
130.77
129.23
128.19
127.90
125.48
124.24
121.35
120.87
118.28
78.99
54.39
39.94
39.80
39.66
39.52
39.38
39.24
39.10

f1 (ppm)


Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner av600
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.0
6 Number of Scans 8
7 Spectrometer Frequency 600.13
8 Nucleus 1H
Cl
O
N
H
OMe
OMe
4g
12.56
12.52
8.08
8.07
7.68
7.67
7.66
7.12
7.10
7.08
7.07
5.47
5.46
3.86
3.22
3.20
2.50
1.04
0.93
4.27
1.08
1.00
3.41
3.37
f1 (ppm)


H
N
OMe
Cl
O
OMe
4g
T=90 ℃
2.50
T=60 ℃
S187
T=25 ℃
.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	698
7 Spectrometer Frequency	150.90
8 Nucleus	13C



4g

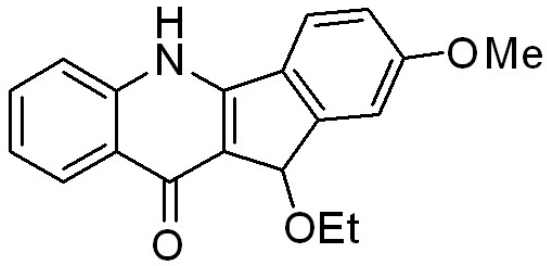
171.93, 171.52, 161.99, 160.25, 151.17, 150.71, 138.59, 136.86, 131.62, 131.36, 128.16, 127.99, 127.90, 127.74, 126.42, 126.26, 124.24, 124.19, 122.56, 122.52, 120.75, 120.58, 117.21, 116.58, 114.99, 111.14, 106.43, 78.75, 78.38, 55.67, 55.57, 54.16, 54.00, 39.94, 39.80, 39.66, 39.52, 39.38, 39.24, 39.10

S188

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

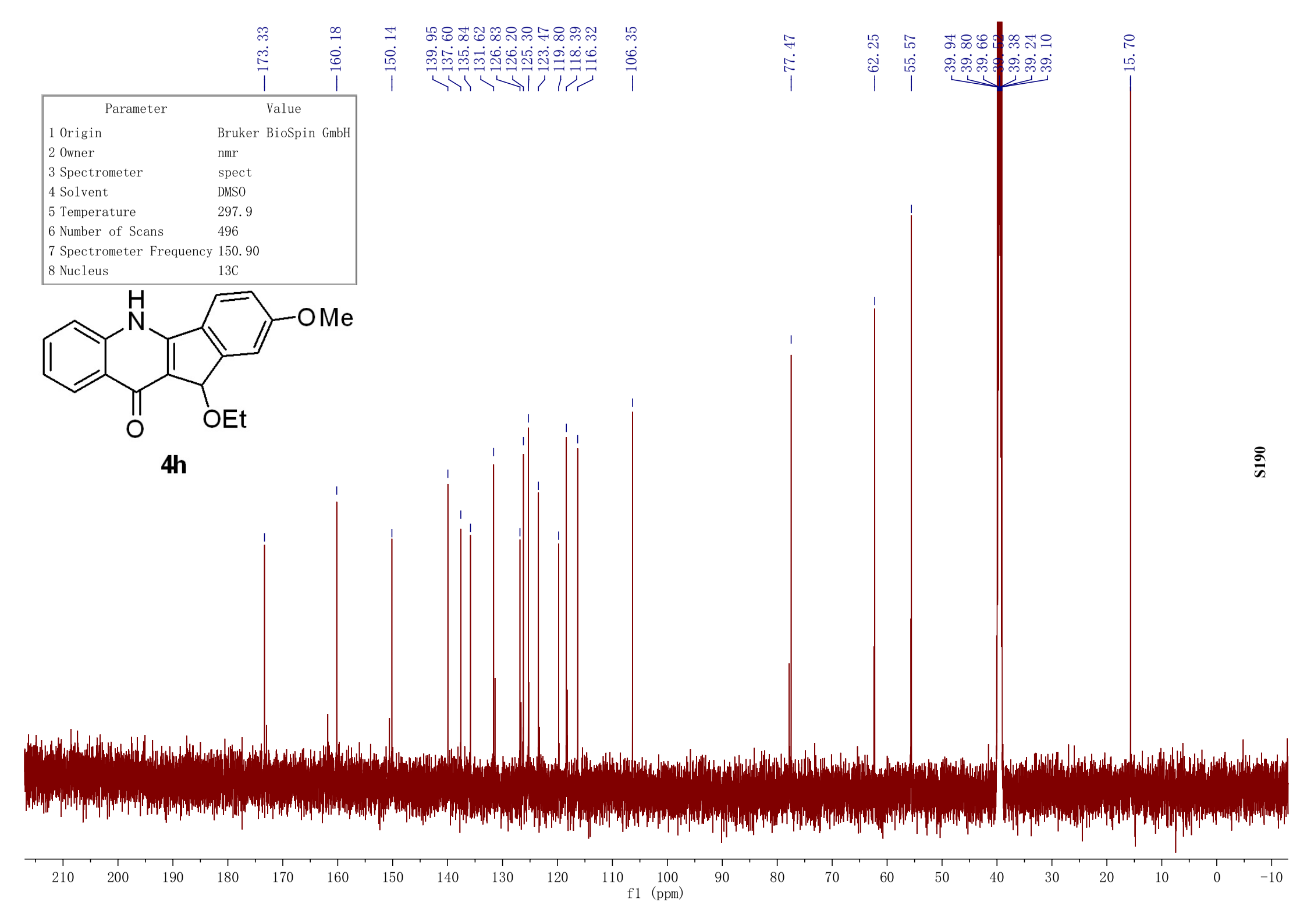
f1 (ppm)

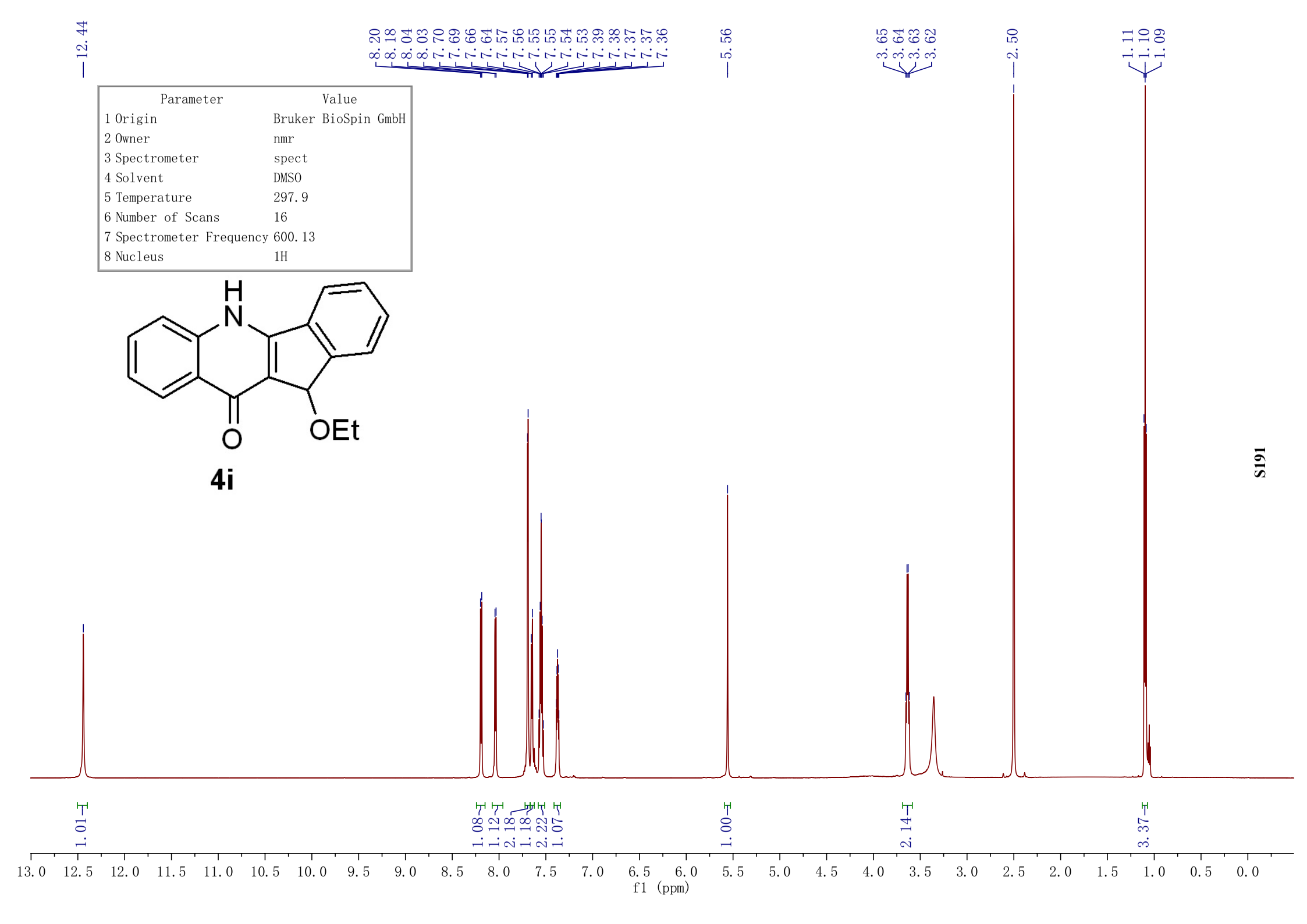
Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	16
7 Spectrometer Frequency	600.13
8 Nucleus	1H

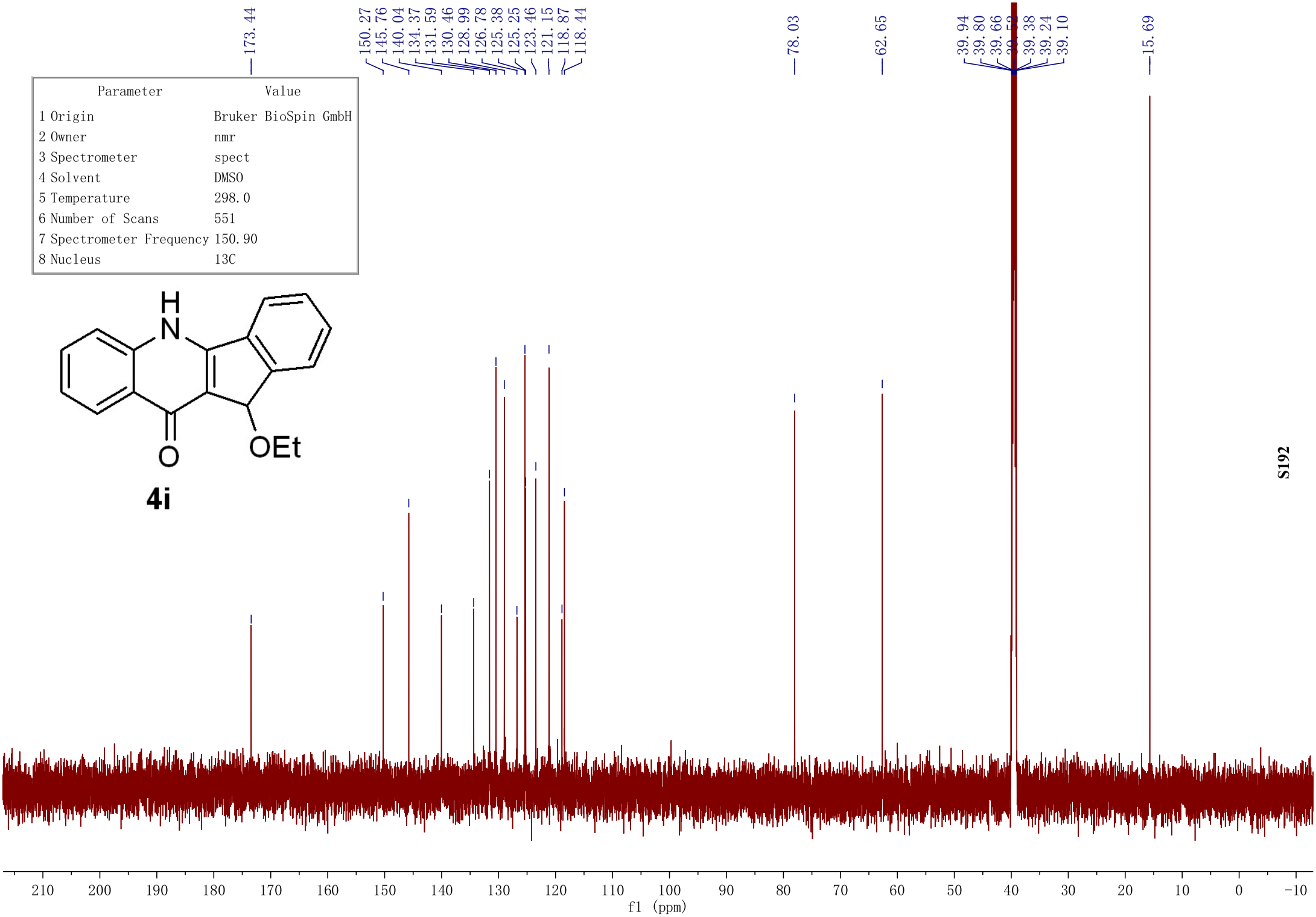


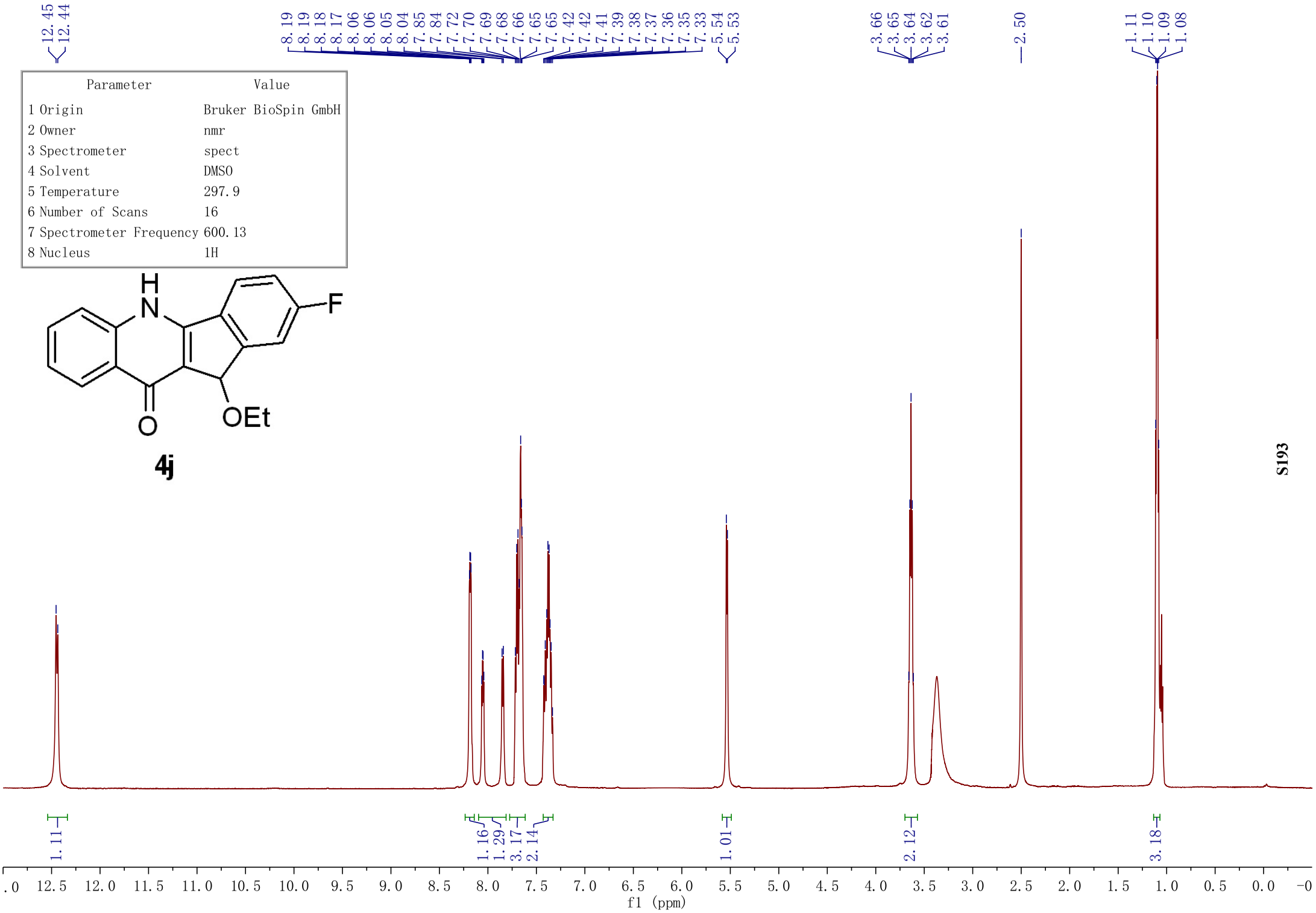
4h

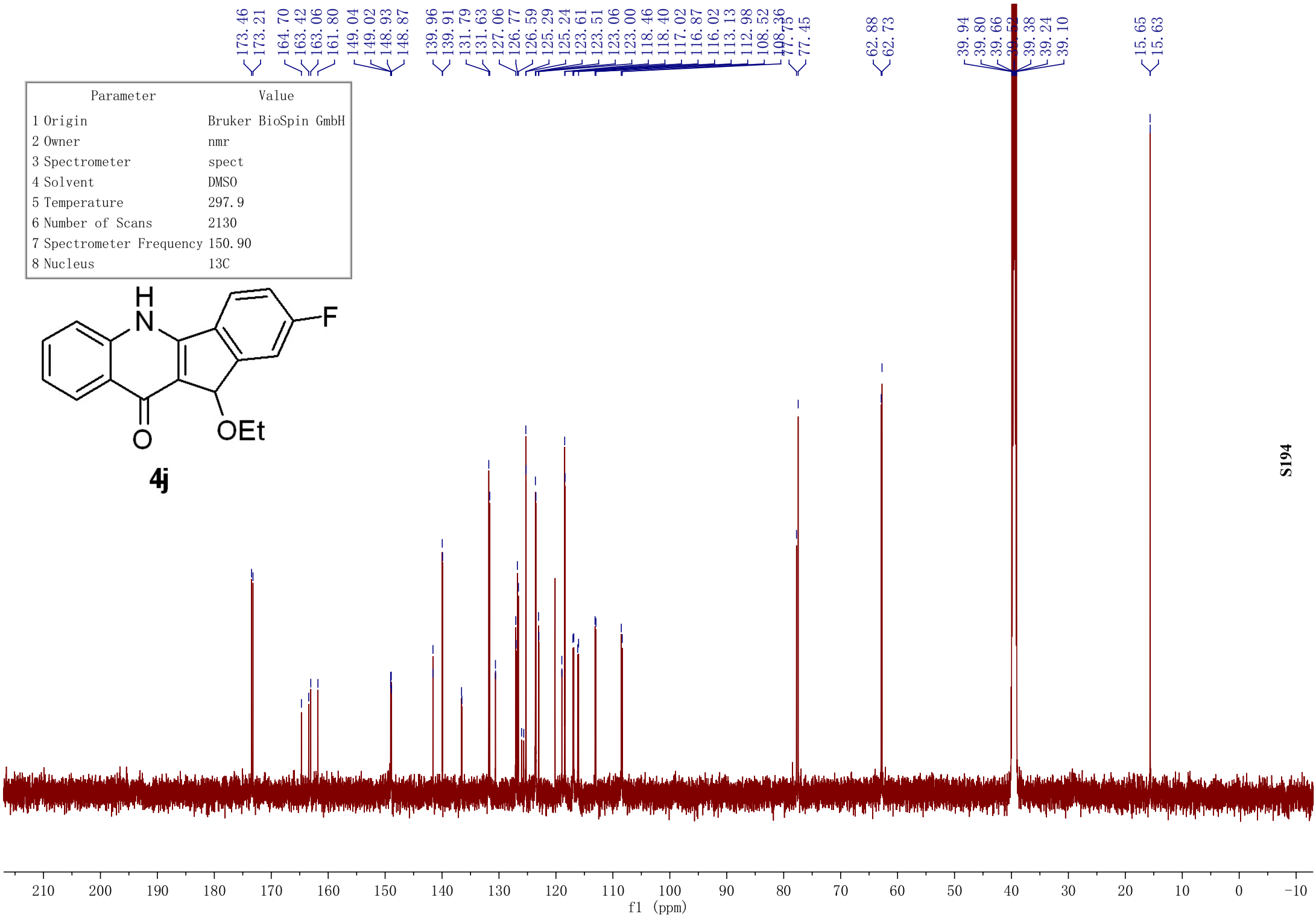
f1 (ppm)

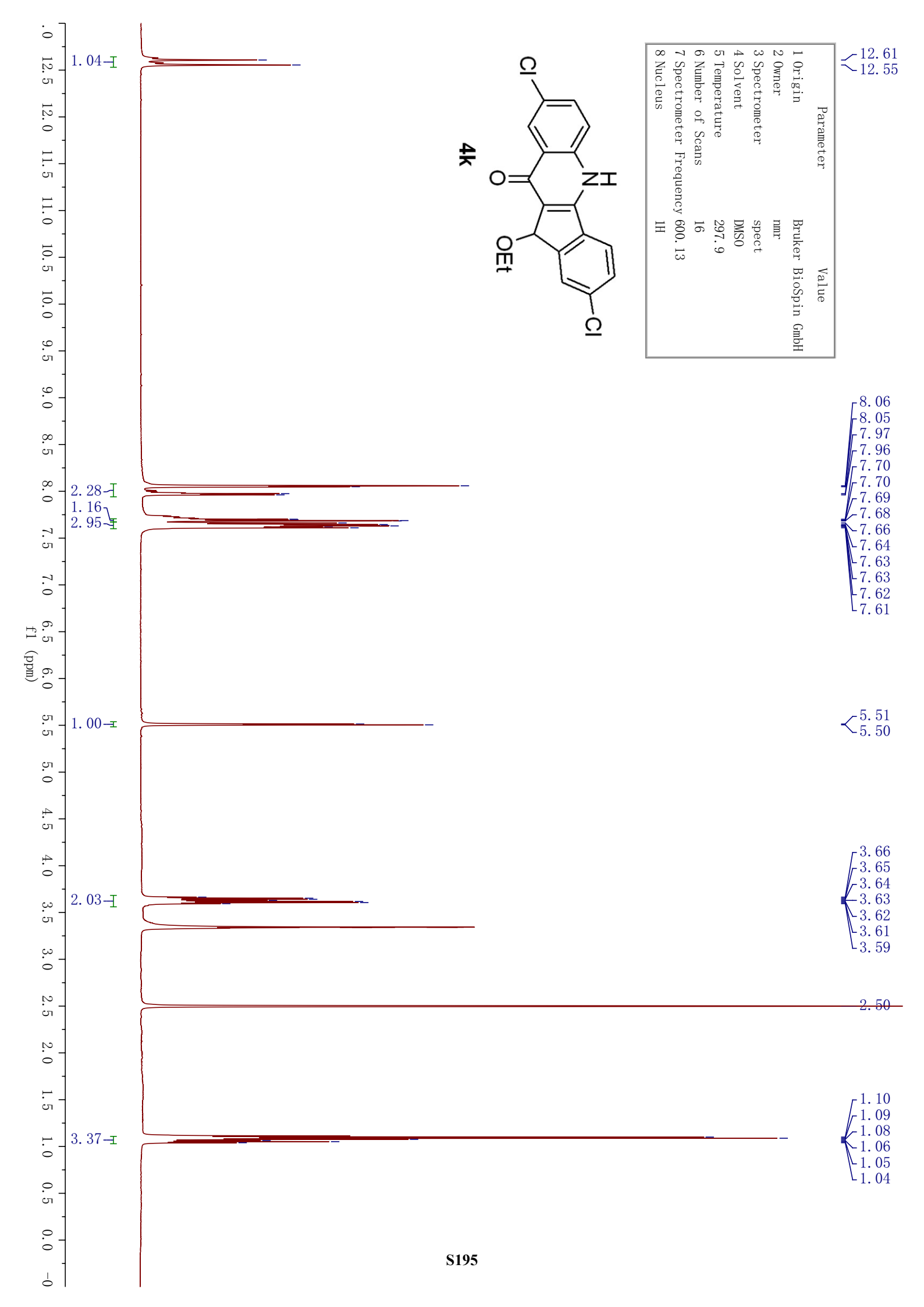

173.33
160.18
150.14
139.95
137.60
135.84
131.62
126.83
126.20
125.30
123.47
119.80
118.39
116.32
106.35
77.47
62.25
55.57
39.94
39.80
39.66
39.52
39.38
39.24
39.10
15.70
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 496
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
OMe
O
OEt
4h
S190
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


12.44
8.20
8.18
8.04
8.03
7.70
7.69
7.66
7.64
7.57
7.56
7.55
7.55
7.54
7.53
7.39
7.38
7.37
7.37
7.36
5.56
3.65
3.64
3.63
3.62
2.50
1.11
1.10
1.09
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
H
N
O
OEt
4i
S191
1.01
1.08
1.12
2.18
1.18
2.22
1.07
1.00
2.14
3.37
13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

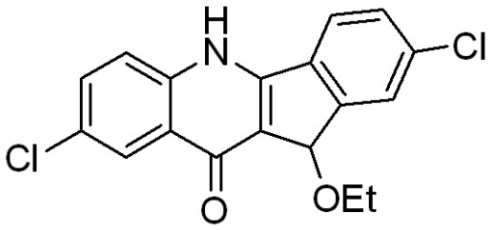

173.44
150.27
145.76
140.04
134.37
131.59
130.46
128.99
126.78
125.38
125.25
123.46
121.15
118.87
118.44
78.03
62.65
39.94
39.80
39.66
39.52
39.38
39.24
39.10
15.69
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 298.0
6 Number of Scans 551
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
O
OEt
4i
S192
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


12.45
12.44
8.19
8.19
8.18
8.17
8.06
8.06
8.05
8.04
7.85
7.84
7.72
7.70
7.69
7.68
7.66
7.65
7.65
7.42
7.42
7.41
7.39
7.38
7.37
7.36
7.35
7.33
5.54
5.53
3.66
3.65
3.64
3.62
3.61
2.50
1.11
1.10
1.09
1.08
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
H
N
F
O
OEt
4j
S193
1.11
1.16
1.29
3.17
2.14
1.01
2.12
3.18
f1 (ppm)


173.46
173.21
164.70
163.42
163.06
161.80
149.04
149.02
148.93
148.87
139.96
139.91
131.79
131.63
127.06
126.77
126.59
125.29
125.24
123.61
123.51
123.06
123.00
118.46
118.40
117.02
116.87
116.02
113.13
112.98
108.52
108.36
77.75
77.45
62.88
62.73
39.94
39.80
39.66
39.52
39.38
39.24
39.10
15.65
15.63
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 2130
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
F
O
OEt
4j
S194
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


4k
Cl
O
N
H
OEt
Cl
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
12.61
12.55
8.06
8.05
7.97
7.96
7.70
7.70
7.69
7.68
7.66
7.64
7.63
7.63
7.62
7.61
5.51
5.50
3.66
3.65
3.64
3.63
3.62
3.61
3.59
2.50
1.10
1.09
1.08
1.06
1.05
1.04
1.04
2.28
1.16
2.95
1.00
2.03
3.37
f1 (ppm)

Parameter	Value
1 Origin	Bruker BioSpin GmbH
2 Owner	nmr
3 Spectrometer	spect
4 Solvent	DMSO
5 Temperature	297.9
6 Number of Scans	1021
7 Spectrometer Frequency	150.90
8 Nucleus	13C



4k

172.13 172.05 149.54 149.18 147.89 144.35 138.59 138.53 136.08 135.48 133.58 132.91 131.80 131.71 130.18 129.26 128.29 128.24 127.82 127.78 126.95 125.57 124.23 124.21 122.80 121.30 120.82 120.79 119.93 119.27

77.73 77.55

63.22 62.97

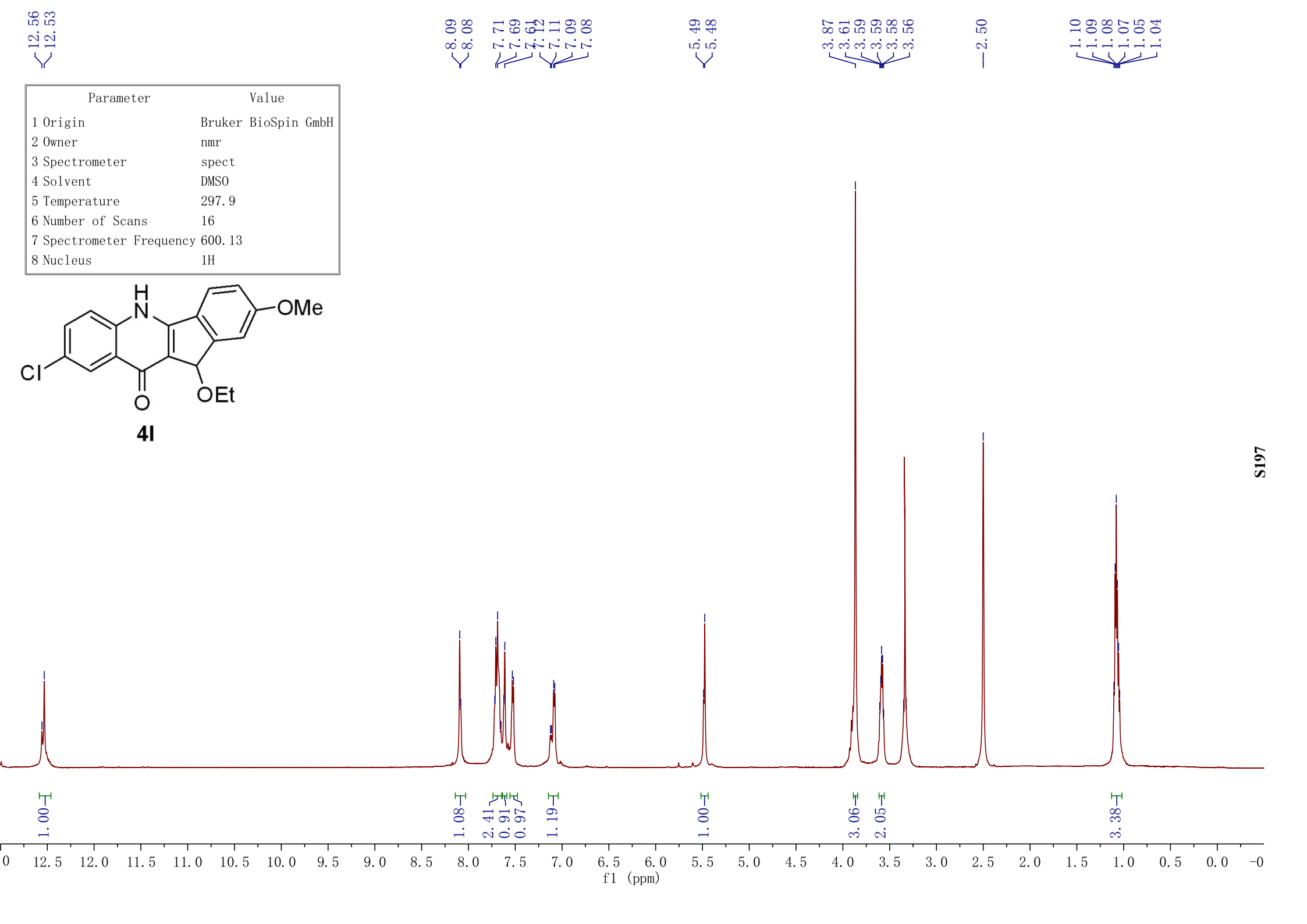
39.94 39.80 39.66 39.52 39.38 39.24 39.10

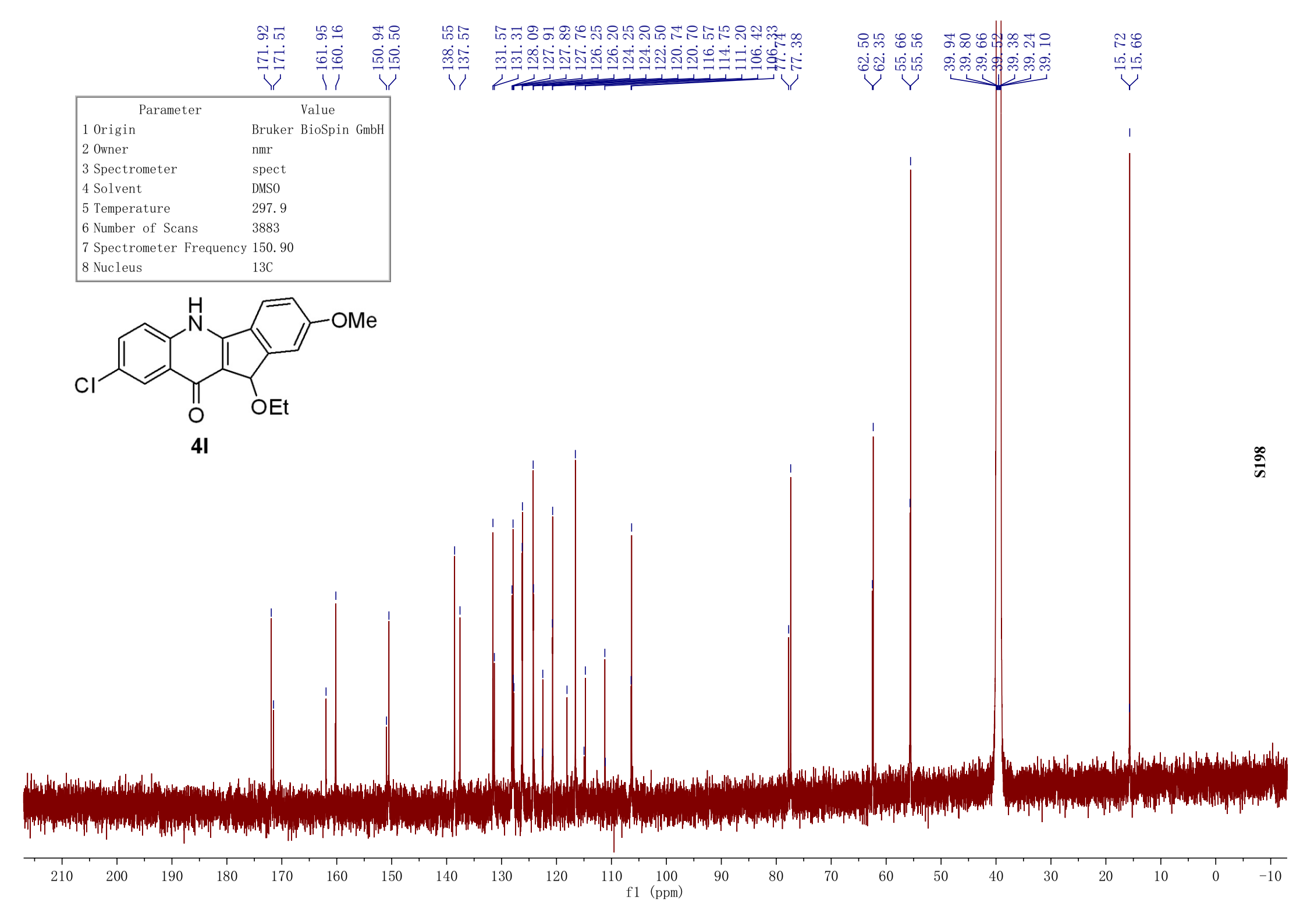
15.62 15.52

S196

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

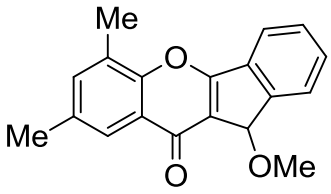
f1 (ppm)


12.56
12.53
8.09
8.08
7.71
7.69
7.61
7.12
7.11
7.09
7.08
5.49
5.48
3.87
3.61
3.59
3.59
3.58
3.56
2.50
1.10
1.09
1.08
1.07
1.05
1.04
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
H
N
OMe
Cl
O
OEt
4l
S197
1.00
1.08
2.41
0.91
0.97
1.19
1.00
3.06
2.05
3.38
f1 (ppm)

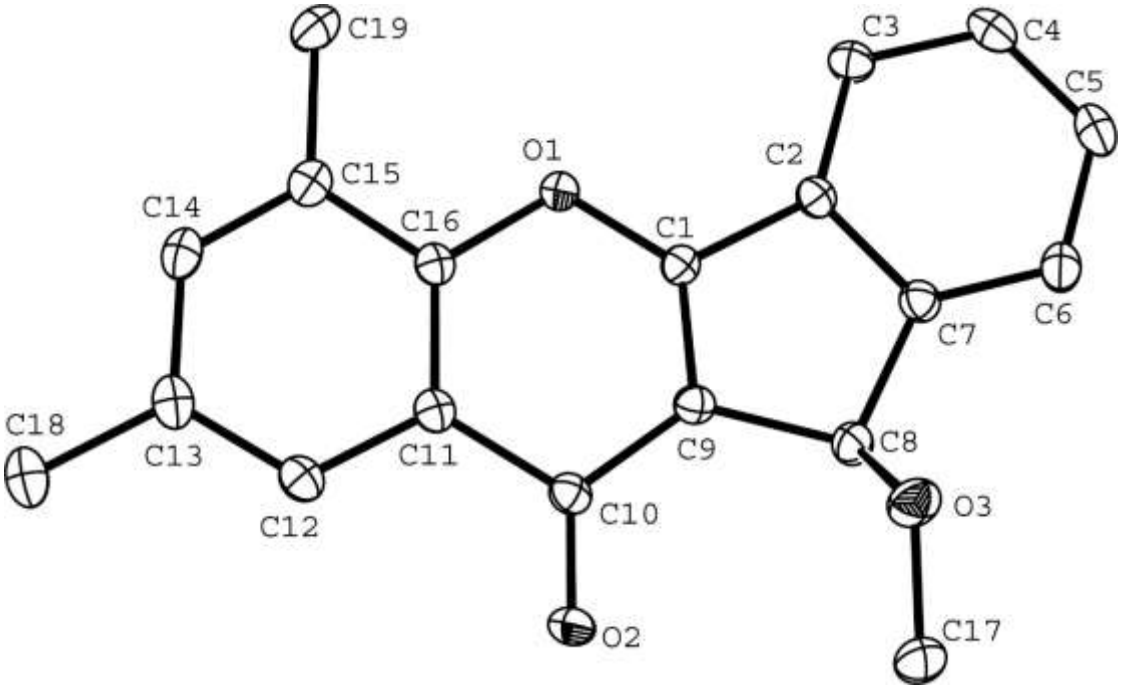

171.92
171.51
161.95
160.16
150.94
150.50
138.55
137.57
131.57
131.31
128.09
127.91
127.89
127.76
126.25
126.20
124.25
124.20
122.50
120.74
120.70
116.57
114.75
111.20
106.42
106.33
77.74
77.38
62.50
62.35
55.66
55.56
39.94
39.80
39.66
39.52
39.38
39.24
39.10
15.72
15.66
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmr
3 Spectrometer spect
4 Solvent DMSO
5 Temperature 297.9
6 Number of Scans 3883
7 Spectrometer Frequency 150.90
8 Nucleus 13C
H
N
OMe
Cl
O
OEt
4l
S198
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

11. X-Ray Crystal Structure Analyses

Identification code	exp_5651
Empirical formula	$C_{19}H_{16}O_3$
Formula weight	292.32
Temperature/K	180.01(10)
Crystal system	triclinic
Space group	P-1
a/Å	7.0903(5)
b/Å	10.2299(10)
c/Å	11.0836(10)
α/°	67.824(9)
β/°	77.107(7)
γ/°	79.532(7)
Volume/Å^3	721.45(12)
Z	2
ρ_{calc}g/cm^3	1.346
μ/mm^{-1}	0.090
F(000)	308.0
Crystal size/mm^3	0.1 × 0.1 × 0.05
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	6.578 to 52.042
Index ranges	$-7 \leq h \leq 8$, $-10 \leq k \leq 12$, $-12 \leq l \leq 13$
Reflections collected	4530
Independent reflections	2826 [R_{int} = 0.0237, R_{sigma} = 0.0459]
Data/restraints/parameters	2826/0/202
Goodness-of-fit on F^2	1.100
Final R indexes [I>=2σ (I)]	R_1 = 0.0538, wR_2 = 0.1363
Final R indexes [all data]	R_1 = 0.0736, wR_2 = 0.1531
Largest diff. peak/hole / e Å^{-3}	0.57/-0.28


Me
O
Me
O
OMe

2l


C19
C3
C4
C5
O1
C2
C15
C14
C16
C1
C6
C7
C18
C13
C11
C9
C8
O3
C12
C10
O2
C17