Electronic Supplementary Material (ESI) for Chemical Science.

Supporting information

Cobalt-Electrocatalytic C–H Hydroxyalkylation of *N*-Heteroarenes with Trifluoromethyl Ketones

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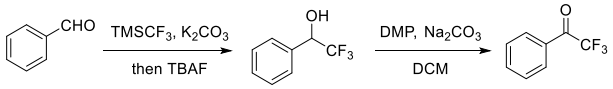
1.General Information

Unless otherwise stated, all glassware was oven dried. All solvents were distilled from appropriate drying agents prior to use. All reagents were used as received from commercial suppliers unless otherwise indicated. Reactions were monitored using Thin Layer Chromatography (TLC) carried out on Merck silica gel plates (60F-254) using UV light as the visualizing agent. Flash column chromatography was performed using silica gel 60 (200-300 mesh). HRMS data were recorded on ThermoFisher LTQ Orbitrap XL. All ^{1}H NMR, ^{13}C NMR, ^{19}F NMR spectra were recorded on Bruker DRX-600 and AMX-400 instruments. Chemical shifts were given in parts per million (ppm, δ), referenced to the solvent peak of $CDCl_3$, defined at δ = 7.26 (^{1}H NMR), defined at δ = 77.16 (^{13}C NMR). Coupling constants were quoted in Hz (*J*). ^{1}H NMR Spectroscopy splitting patterns were designated as singlet (s), doublet (d), triplet (t), quartet (q). Splitting patterns that could not be interpreted or easily visualized were designated as multiplet (m) or broad (br).

2. Synthesis of Trifluoromethyl Ketone

The substrates **1a-1u** were purchased from commercial suppliers. The trifluoromethyl ketones are known compounds[1-6] and were prepared according to the literature[1].



K_2CO_3 (7 mg, 0.05 mmol, 1 mol%) was added at room temperature to a DMF (5 mL) solution of the appropriate aromatic aldehyde (5 mmol, 1.0 equiv) and $TMSCF_3$ (0.98 mL, 6.5 mmol, 1.3 equiv), and the solution was stirred for approximately 4 h at room temperature. Then the reaction mixture was cooled to 0 °C in an ice bath and TBAF (1 M in THF, 5 mL, 5 mmol, 1 equiv) were added. The ice bath was removed and the reaction mixture was stirred at room temperature for 1 h. Finally, the mixture was extracted with ethyl acetate (30 mL × 3). The organic phase was washed with brine and then dried over anhydrous Na_2SO_4. After filtration and evaporation under vacuum, the residue was subjected to silica gel column chromatography using hexane/ethyl acetate as eluent to give trifluoromethyl alcohols.

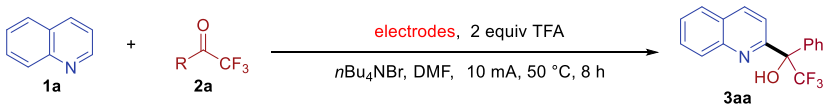
To a solution of the alcohol (5 mmol, 1 equiv) in DCM (30 mL), was added DMP (Dess-Martin Periodinane) (7.5 g, 17.5 mmol, 3.5 equiv) and Na_2CO_3 (2.1g, 20 mmol, 4 equiv). The solution was stirred at room temperature for 3 h. Then water was added and the obtained suspension was stirred for an additional hour, the mixture was extracted with DCM (30 mL × 3). The organic phase was washed with brine and then dried over anhydrous Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography to afford the desired product.

3. Optimization Tables and Substrates Characterization

3.1 Optimization Tables

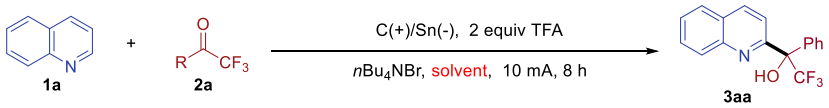
All optimization reactions were carried out on 0.20 mmol scale. The crude reaction mixture was isolated by column chromatography.

Table S1 Screening of the electrodes



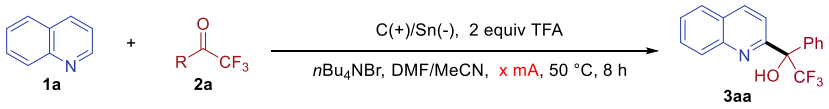
entry	electrodes	yield
1	**C(+)/Sn(-)**	**46%**
2	C(+)/Al(-)	24%
3	C(+)/Ni(-)	0%
4	Zn(+)/Sn(-)	0%

Table S2 Screening of the solvent



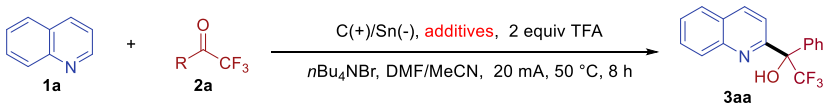
entry	solvent	yield
1	DMF	46%
2	DCM	trace
3	DMSO	15%
4	MeCN	29%
5	HFIP	0%
6	Toluene	0%
7	**DMF/MeCN(7/1)**	**51%**

Table S3 Screening of the current



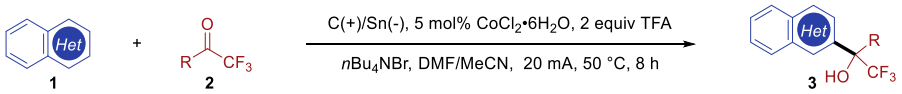
entry	current	yield
1	I = 5 mA	NR
2	I = 10 mA	51%
3	**I = 20 mA**	**61%**

Table S4 Screening of additives



entry	additives (5 mol%)	yield
1	**$CoCl_2·6H_2O$**	**81%**
2	SmI_2	54%
3	$CoBr_2$	69%
4	$Co(OAc)_3$	54%
5	$InCl_3$	46%
6	$CuCl_2$	0%

3.2 Typical Experimental Procedure



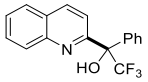
A three necked round bottom flask (10 mL) with a stir bar was charged, TBAB (197.4 mg, 0.6 mmol, 2 eq), $CoCl_2 \cdot 6H_2O$ (3.6 mg, 0.015 mmol, 5 mol%), quinoline **1** (0.3 mmol), trifluoromethyl ketones **2** (0.6 mmol, 2 eq), TFA (45 μL, 0.6 mmol, 2 eq), DMF (3.5 mL), and MeCN (0.5 mL). The flask was equipped with graphite plate (10 mm x 10 mm x 2 mm) as the anode and Sn plate (10 mm x 10 mm x 1 mm) as the cathode. The mixture was electrolyzed at a constant current of 20 mA at 50 ℃ in an oil bath for 8 h. After the reaction was finished, the resulting mixture was extracted with EtOAc (20 mL × 3). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography on silica gel to afford the desired product.

Graphical Guide for Setting Up the 0.3 mmol Scale Electrochemical Device

Figure S1 Left: electrodes. Right: flask charged with all reagents.

3.3 Characterization Data

2,2,2-Trifluoro-1-phenyl-1-(quinolin-2-yl)ethan-1-ol (3a)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

69.1 mg, 76%, white solid.

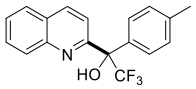
R_f = 0.3 (5% PE in EA).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.4 Hz, 1H), 8.17 (d, *J* = 8.2 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.80 (t, *J* = 7.7 Hz, 1H), 7.71 (d, *J* = 7.4 Hz, 2H), 7.63 (t, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 8.6 Hz, 1H), 7.44 – 7.33 (m, 3H).

^{19}F NMR (377 MHz, $CDCl_3$) δ -73.88.

These data are in accordance with the literature.[7]

2,2,2-Trifluoro-1-(quinolin-2-yl)-1-(p-tolyl)ethan-1-ol (3b)



2,2,2-trifluoro-1-(p-tolyl)ethan-1-one (115.2 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

79 mg, 83%, white solid.

R_f = 0.35 (5% PE in EA).

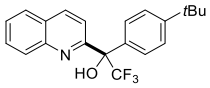
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 – 8.17 (m, 2H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.83 – 7.77 (m, 1H), 7.65 – 7.61 (m, 3H), 7.61 – 7.56 (m, 1H), 7.48 (s, 1H), 7.22 (d, *J* = 8.2 Hz, 1H), 2.36 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 155.0, 145.3, 138.7, 137.9, 135.3, 130.6, 129.3, 129.0, 128.0, 127.8, 127.7, 127.1, 125.3 (q, *J* = 283.1 Hz), 119.8, 78.1 (q, *J* = 28.8 Hz), 21.1.

^{19}F NMR (377 MHz, $CDCl_3$) δ -73.90.

HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1100.

1-(4-(*tert*-Butyl)phenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3c)



1-(4-(*tert*-butyl)phenyl)-2,2,2-trifluoroethan-1-one (140.9 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

84 mg, 78%, white solid.

R_f = 0.35 (5% PE in EA).

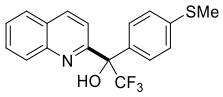
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.6 Hz, 1H), 8.17 (d, *J* = 8.5 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.83 – 7.77 (m, 1H), 7.62 (m, 3H), 7.59 (d, *J* = 8.6 Hz, 1H), 7.43 (s, 1H), 7.41 – 7.38 (m, 2H), 1.30 (s, 9H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.1, 151.7, 145.4, 137.9, 135.2, 130.6, 129.0, 128.1, 127.8, 127.7, 126.9, 125.6, 125.3 (q, *J* = 286.4 Hz), 119.9, 78.1 (q, *J* = 28.8 Hz), 34.7, 31.3.

^{19}F NMR (565 MHz, $CDCl_3$) δ -73.97.

HRMS (ESI) *m/z* calculated for $C_{21}H_{21}F_3NO^+$ $[M+H]^+$ 360.1570, found 360.1570.

2,2,2-Trifluoro-1-(4-(methylthio)phenyl)-1-(quinolin-2-yl)ethan-1-ol (3d)



2,2,2-trifluoro-1-(4-(methylthio)phenyl)ethan-1-one (140.9 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

72.3 mg, 69%, white solid.

R_f = 0.2 (5% PE in EA).

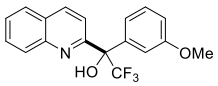
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.6 Hz, 1H), 8.16 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.83 – 7.77 (m, 1H), 7.65 – 7.59 (m, 3H), 7.55 (d, *J* = 8.6 Hz, 1H), 7.45 (s, 1H), 7.25 (d, *J* = 8.6 Hz, 2H), 2.46 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.7, 145.4, 139.7, 138.0, 134.8, 130.7, 129.0, 128.1, 127.8, 127.67, 127.66, 126.2, 125.2 (q, *J* = 286.4 Hz), 119.7, 77.9 (q, *J* = 28.9 Hz), 15.5.

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.00.

HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NOS^+$ $[M+H]^+$ 350.0821, found 350.0820.

2,2,2-Trifluoro-1-(3-methoxyphenyl)-1-(quinolin-2-yl)ethan-1-ol (3e)



2,2,2-trifluoro-1-(3-methoxyphenyl)ethan-1-one (125 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

73.9 mg, 74%, white solid.

R_f = 0.4 (10% PE in EA).

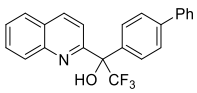
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.6 Hz, 1H), 8.16 (d, *J* = 8.5 Hz, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.79 (t, *J* = 7.7 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 2H), 7.50 (s, 1H), 7.35 – 7.30 (m, 3H), 6.91 (d, *J* = 7.0 Hz, 1H), 3.79 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 159.8, 154.7, 145.3, 139.7, 138.0, 130.6, 129.7, 129.0, 128.1, 127.8, 127.7, 125.2 (d, *J* = 286.1 Hz), 119.7, 119.4, 114.1, 113.4, 78.1 (q, *J* = 28.6 Hz), 55.4.

^{19}F NMR (565 MHz, $CDCl_3$) δ -73.84.

HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO_2^+$ $[M+H]^+$ 334.1049, found 334.1049.

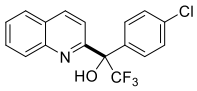
1-([1,1'-Biphenyl]-4-yl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3f)



1-([1,1'-biphenyl]-4-yl)-2,2,2-trifluoroethan-1-one (153.2 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

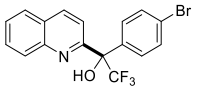
66 mg, 58%, white solid.
R_f = 0.3 (10% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.5 Hz, 1H), 8.21 (d, *J* = 8.2 Hz, 1H), 7.88 (d, *J* = 8.1 Hz, 1H), 7.86 – 7.80 (m, 3H), 7.67 – 7.63 (m, 4H), 7.62 (d, *J* = 7.6 Hz, 2H), 7.58 (s, 1H), 7.47 (t, *J* = 7.6 Hz, 2H), 7.39 (t, *J* = 7.3 Hz, 1H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.7, 145.4, 141.6, 140.4, 138.0, 137.2, 130.7, 129.0, 128.9, 128.1, 127.8, 127.73, 127.69, 127.3, 127.2, 125.3 (q, *J* = 286.5 Hz), 119.8, 78.1 (q, *J* = 28.8 Hz).
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.79.
HRMS (ESI) *m/z* calculated for $C_{23}H_{17}F_3NO^+$ $[M+H]^+$ 380.1257, found 380.1254.

1-(4-Chlorophenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3g)



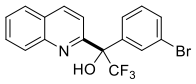
1-(4-chlorophenyl)-2,2,2-trifluoroethan-1-one (127.7 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.
55.7 mg, 55%, colorless oil.
R_f = 0.2 (5% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.6 Hz, 1H), 8.16 (d, *J* = 8.5 Hz, 1H), 7.87 (d, *J* = 8.1 Hz, 1H), 7.81 (ddd, *J* = 8.4, 7.0, 1.3 Hz, 1H), 7.68 – 7.62 (m, 3H), 7.53 (d, *J* = 8.6 Hz, 1H), 7.48 (s, 1H), 7.39 – 7.34 (m, 2H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.3, 145.4, 138.2, 136.8, 135.0, 130.8, 129.0, 128.9, 128.8, 128.1, 128.0, 127.7, 125.0 (q, *J* = 286.1 Hz), 119.6, 77.8 (q, *J* = 29.2 Hz).
^{19}F NMR (565 MHz, $CDCl_3$) δ -74.09.
HRMS (ESI) *m/z* calculated for $C_{17}H_{12}ClF_3NO^+$ $[M+H]^+$ 338.0554, found 338.0554.

1-(4-Bromophenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3h)



1-(4-bromophenyl)-2,2,2-trifluoroethan-1-one (127.7 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.
69.9 mg, 61%, colorless oil.
R_f = 0.3 (5% PE in EA).
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.6 Hz, 1H), 8.16 (d, *J* = 8.5 Hz, 1H), 7.88 (d, *J* = 8.1 Hz, 1H), 7.81 (t, *J* = 7.7 Hz, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.58 (d, *J* = 8.2 Hz, 2H), 7.52 (t, *J* = 6.8 Hz, 3H), 7.46 (s, 1H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 154.2, 145.4, 138.2, 137.3, 131.8, 130.8, 129.0, 128.1, 128.0, 127.7, 125.0 (q, *J* = 286.1 Hz), 123.2, 119.57, 119.56, 77.9 (q, *J* = 29.1 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -74.11.
HRMS (ESI) *m/z* calculated for $C_{17}H_{12}BrF_3NO^+$ $[M+H]^+$ 382.0049, found 382.0049.

1-(3-Bromophenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3i)



1-(3-bromophenyl)-2,2,2-trifluoroethan-1-one (154.9 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

63 mg, 55%, colorless oil.

R_f = 0.3 (5% PE in EA).

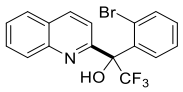
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.6 Hz, 1H), 8.16 (d, *J* = 8.5 Hz, 1H), 7.90 – 7.84 (m, 2H), 7.81 (t, *J* = 7.7 Hz, 1H), 7.69 (d, *J* = 8.0 Hz, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.57 (d, *J* = 8.6 Hz, 1H), 7.52 (s, 1H), 7.51 – 7.47 (m, 1H), 7.27 (t, *J* = 8.0 Hz, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.0, 145.4, 140.4, 138.3, 132.0, 130.8, 130.5, 130.2, 129.0, 128.1, 128.0, 127.7, 125.8, 124.9 (q, *J* = 286.0 Hz), 122.9, 119.5, 77.8 (q, *J* = 29.2 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.01.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}BrF_3NO^+$ $[M+H]^+$ 382.0049, found 382.0057.

1-(2-Bromophenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3j)



1-(2-bromophenyl)-2,2,2-trifluoroethan-1-one (154.9 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

35 mg, 30%, colorless oil.

R_f = 0.3 (5% PE in EA).

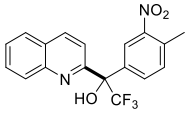
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.5 Hz, 1H), 8.14 (d, *J* = 8.5 Hz, 1H), 7.97 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.1 Hz, 1H), 7.85 – 7.80 (m, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.57 (dd, *J* = 7.9, 0.9 Hz, 1H), 7.47 – 7.43 (m, 1H), 7.26 – 7.23 (m, 2H), 7.12 (d, *J* = 8.5 Hz, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.3, 145.5, 137.9, 136.4, 135.8, 130.6, 130.4, 129.81, 129.78, 129.2, 128.1, 127.8, 127.2, 124.9 (q, *J* = 231.3 Hz), 124.2, 119.9, 79.8 (q, *J* = 28.0 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -72.55.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}BrF_3NO^+$ $[M+H]^+$ 382.0049, found 382.0049.

2,2,2-trifluoro-1-(4-methyl-3-nitrophenyl)-1-(quinolin-2-yl)ethan-1-ol (3k)



2,2,2-trifluoro-1-(4-methyl-3-nitrophenyl)ethan-1-one (142.7 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

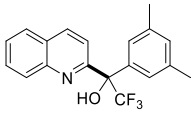
30 mg, 26%, yellow oil.

R_f = 0.3 (20% PE in EA).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.33 (d, *J* = 1.4 Hz, 1H), 8.28 (d, *J* = 8.6 Hz, 1H), 8.19 (d, *J* = 8.5 Hz, 1H), 7.92 – 7.88 (m, 2H), 7.86 – 7.82 (m, 1H), 7.69 – 7.64 (m, 1H), 7.60 (d, *J* = 8.6 Hz, 1H), 7.38 (d, *J* = 8.2 Hz, 1H), 2.59 (s, 3H).

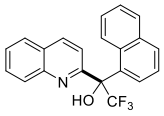
^{13}C NMR (150 MHz, $CDCl_3$) δ 153.4, 149.4, 145.5, 138.6, 137.8, 134.3, 133.2, 131.57, 131.56, 131.0, 129.0, 128.2, 127.8, 124.8 (q, *J* = 286.5 Hz), 123.8, 119.2, 77.9 (q, *J* = 29.2 Hz), 20.3.
^{19}F NMR (565 MHz, $CDCl_3$) δ -74.44.
HRMS (ESI) *m/z* calculated for $C_{18}H_{14}F_3N_2O_3^+$ $[M+H]^+$ 363.0951, found 363.0956.

1-(3,5-Dimethylphenyl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3l)



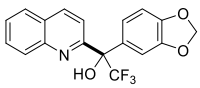
1-(3,5-dimethylphenyl)-2,2,2-trifluoroethan-1-one (123.8 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.
64.6 mg, 65%, colorless oil.
R_f = 0.4 (5% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.0 Hz, 1H), 8.18 (d, *J* = 7.4 Hz, 1H), 7.86 (d, *J* = 8.1 Hz, 1H), 7.80 (t, *J* = 7.7 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 7.58 (d, *J* = 8.6 Hz, 1H), 7.45 (s, 1H), 7.32 (s, 2H), 7.00 (s, 1H), 2.33 (s, 6H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 155.1, 145.4, 138.2, 138.1, 137.9, 130.6, 130.5, 129.0, 128.1, 127.8, 127.7, 125.3 (q, *J* = 286.0 Hz), 124.9, 119.9, 78.2 (q, *J* = 28.6 Hz), 21.6.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.66.
HRMS (ESI) *m/z* calculated for $C_{19}H_{17}F_3NO^+$ $[M+H]^+$ 332.1257, found 332.1257.

2,2,2-Trifluoro-1-(naphthalen-1-yl)-1-(quinolin-2-yl)ethan-1-ol (3m)



2,2,2-trifluoro-1-(naphthalen-1-yl)ethan-1-one (137.3 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.
44.5 mg, 42%, white solid.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (d, *J* = 8.5 Hz, 1H), 8.11 (d, *J* = 7.1 Hz, 1H), 7.98 (d, *J* = 8.5 Hz, 1H), 7.92 (d, *J* = 8.2 Hz, 1H), 7.86 (t, *J* = 7.7 Hz, 1H), 7.81 (s, 1H), 7.80 – 7.77 (m, 2H), 7.63 (t, *J* = 7.5 Hz, 1H), 7.57 (t, *J* = 7.9 Hz, 1H), 7.34 – 7.28 (m, 2H), 7.16 – 7.06 (m, 2H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 156.1, 145.7, 138.0, 135.1, 131.7, 130.7, 130.6, 129.2, 129.1, 128.0, 127.83, 127.78, 126.5, 126.2, 126.0, 125.5, 125.1 (q, *J* = 262.2 Hz), 124.5, 120.1, 80.3 (q, *J* = 27.2 Hz).
^{19}F NMR (377 MHz, $CDCl_3$) δ -72.70.
HRMS (ESI) *m/z* calculated for $C_{21}H_{15}F_3NO^+$ $[M+H]^+$ 354.1100, found 354.1104.

1-(Benzo[*d*][1,3]dioxol-5-yl)-2,2,2-trifluoro-1-(quinolin-2-yl)ethan-1-ol (3n)



1-(benzo[*d*][1,3]dioxol-5-yl)-2,2,2-trifluoroethan-1-one (133.5 mg, 0.6 mmol) and quinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

52 mg, 50%, yellow oil.

R_f = 0.4 (10% PE in EA).

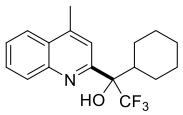
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.6 Hz, 1H), 8.15 (d, *J* = 8.5 Hz, 1H), 7.87 (d, *J* = 8.1 Hz, 1H), 7.80 (t, *J* = 7.7 Hz, 1H), 7.62 (t, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 8.6 Hz, 1H), 7.41 (s, 1H), 7.20 (d, *J* = 8.3 Hz, 1H), 7.14 (s, 1H), 6.80 (d, *J* = 8.3 Hz, 1H), 5.95 (d, *J* = 6.2 Hz, 2H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.9, 148.1, 148.0, 145.4, 138.0, 132.0, 130.7, 129.0, 128.1, 127.9, 127.7, 125.1 (q, *J* = 286.1 Hz), 120.98, 120.97, 119.7, 108.2, 101.5, 78.0 (q, *J* = 28.3 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.03.

HRMS (ESI) *m/z* calculated for $C_{18}H_{13}F_3NO_3^+$ $[M+H]^+$ 348.0842, found 348.0840.

1-Cyclohexyl-2,2,2-trifluoro-1-(4-methylquinolin-2-yl)ethan-1-ol (3o)



1-cyclohexyl-2,2,2-trifluoroethan-1-one (110.3 mg, 0.6 mmol) and 4-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.

59.2 mg, 61%, yellow oil.

R_f = 0.3 (5% PE in EA).

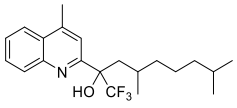
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.11 (d, *J* = 8.3 Hz, 1H), 8.03 (d, *J* = 8.3 Hz, 1H), 7.80 – 7.73 (m, 1H), 7.65 – 7.60 (m, 1H), 7.42 (s, 1H), 6.72 (s, 1H), 2.78 (s, 3H), 2.28 – 2.19 (m, 1H), 2.19 – 2.11 (m, 1H), 1.88 – 1.82 (m, 1H), 1.65 – 1.57 (m, 2H), 1.56 – 1.48 (m, 1H), 1.35 – 1.28 (m, 1H), 1.20 – 1.09 (m, 3H), 0.86 – 0.73 (m, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.1, 146.8, 145.2, 130.1, 129.5, 128.0, 127.2, 125.9 (q, *J* = 288.0 Hz), 124.0, 118.3, 79.0 (q, *J* = 26.9 Hz), 42.8, 26.7, 26.3, 26.0, 19.4.

^{19}F NMR (565 MHz, $CDCl_3$) δ -72.26.

HRMS (ESI) *m/z* calculated for $C_{18}H_{21}F_3NO^+$ $[M+H]^+$ 324.1570, found 324.1567.

1,1,1-Trifluoro-4,8-dimethyl-2-(4-methylquinolin-2-yl)nonan-2-ol (3p)



1,1,1-trifluoro-4,8-dimethylnonan-2-one (137.3 mg, 0.6 mmol) and 4-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.

58.4 mg, 53%, yellow oil.

R_f = 0.5 (5% PE in EA).

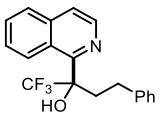
The diastereomeric ratio was 1/1 (Isomer A : Isomer B) as determined by ^{1}H NMR

analysis.
HRMS (ESI) *m/z* calculated for $C_{21}H_{29}F_3NO^+$ $[M+H]^+$ 368.2196, found 368.2197.

Isomer A
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.4 Hz, 1H), 8.03 (d, *J* = 8.3 Hz, 1H), 7.76 (t, *J* = 7.6 Hz, 1H), 7.63(t, *J* = 5.7 Hz,1H), 7.48 (s, 1H), 6.84 (s, 1H), 2.77 (s, 3H), 2.35 (dd, *J* = 14.5, 5.1 Hz, 1H), 2.10 (dd, *J* = 14.5, 8.0 Hz, 1H), 1.59 (dd, *J* = 12.3, 5.7 Hz, 1H), 1.33 – 1.27 (m, 3H), 1.11 – 1.05 (m, 4H), 0.98 (d, *J* = 6.6 Hz, 3H), 0.83 (d, *J* = 2.6 Hz, 3H), 0.73 (d, *J* = 6.6 Hz, 3H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.6, 146.4, 145.4, 130.1, 129.6, 128.0, 127.4, 125.8 (q, *J* = 286.6 Hz), 123.9, 119.2, 77.3 (q, *J* = 27.5 Hz), 40.0, 39.1, 38.4, 28.3, 27.8, 24.4, 22.8, 22.6, 21.5, 19.2.
^{19}F NMR (565 MHz, $CDCl_3$) δ -79.06.

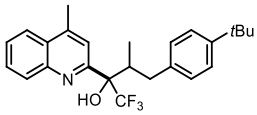
Isomer B
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.4 Hz, 1H), 8.03 (d, *J* = 8.3 Hz, 1H), 7.76 (t, *J* = 7.6 Hz, 1H), 7.63(t, *J* = 5.7 Hz, 1H), 7.45 (s, 1H), 6.78 (s, 1H), 2.77 (s, 3H), 2.27 (dd, *J* = 14.5, 3.6 Hz, 1H), 2.04 (dd, *J* = 14.4, 7.0 Hz, 1H), 1.46 – 1.41 (m, 1H), 1.21 – 1.14 (m, 3H), 0.93 – 0.85 (m, 4H), 0.82 (d, *J* = 2.6 Hz, 3H), 0.76 (d, *J* = 6.6 Hz, 3H), 0.50 (d, *J* = 6.7 Hz, 3H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.2, 146.3, 145.4, 130.0, 129.5, 127.9, 127.3, 125.7 (q, *J* = 286.5 Hz), 123.9, 119.2, 76.8 (q, *J* = 27.9 Hz), 39.2, 38.9, 38.3, 27.9, 27.8, 24.3, 22.61, 22.55, 20.9, 19.2.
^{19}F NMR (565 MHz, $CDCl_3$) δ -79.19.

1,1,1-Trifluoro-2-(isoquinolin-1-yl)-4-phenylbutan-2-ol (3q)



1,1,1-trifluoro-4-phenylbutan-2-one (123.8 mg, 0.6 mmol) and isoquinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.
31.8 mg, 32%, yellow oil.
R_f = 0.5 (5% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.55 (d, *J* = 5.5 Hz, 1H), 8.48 (d, *J* = 8.7 Hz, 1H), 7.96 (d, *J* = 8.2 Hz, 1H), 7.82 – 7.76 (m, 3H), 7.72 (ddd, *J* = 8.3, 6.9, 1.2 Hz, 1H), 7.18 (t, *J* = 7.5 Hz, 2H), 7.11 (t, *J* = 7.3 Hz, 1H), 7.00 (d, *J* = 7.2 Hz, 2H), 3.04 – 2.88 (m, 1H), 2.75 – 2.65 (m, 2H), 2.02 – 1.93 (m, 1H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 152.9, 141.2, 139.0, 137.9, 130.7, 128.5, 128.4, 128.3, 126.3, 126.1, 125.94, 125.91, 123.8 (q, *J* = 297.3 Hz), 123.6, 77.9 (q, *J* = 29.0 Hz), 36.6, 29.2.
^{19}F NMR (565 MHz, $CDCl_3$) δ -77.08.
HRMS (ESI) *m/z* calculated for $C_{19}H_{17}F_3NO^+$ $[M+H]^+$ 332.1257, found 332.1257.

4-(4-(*tert*-Butyl)phenyl)-1,1,1-trifluoro-3-methyl-2-(4-methylquinolin-2-yl)butan-2-ol (3r)



4-(4-(*tert*-butyl)phenyl)-1,1,1-trifluoro-3-methylbutan-2-one (166.7 mg, 0.6 mmol) and 4-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.

71.1mg, 57%, yellow oil.

R_f = 0.3 (5% PE in EA).

The diastereomeric ratio was 1.2/1 (Isomer A : Isomer B) as determined by ^{1}H NMR analysis.

HRMS (ESI) *m/z* calculated for $C_{25}H_{29}F_3NO^+$ $[M+H]^+$ 416.2196, found 416.2189.

Isomer A

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.4 Hz, 1H), 8.04 (d, *J* = 8.3 Hz, 1H), 7.81 – 7.76 (m, 1H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.45 (s, 1H), 7.34 (d, *J* = 8.2 Hz, 1H), 7.19 (d, *J* = 8.2 Hz, 1H), 7.16 (d, *J* = 8.2 Hz, 1H), 6.88 – 6.83 (m, 2H), 2.77 (s, 3H), 2.76 – 2.64 (m, 2H), 2.53 (dd, *J* = 13.4, 11.5 Hz, 1H), 1.33 (s, 9H), 0.48 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.1, 148.9, 146.9, 145.2, 137.8, 130.2, 129.6, 129.1, 128.1, 127.3, 125.9 (q, *J* = 286.3 Hz), 125.3, 124.0, 118.4, 79.1 (q, *J* = 27.6 Hz), 40.0, 36.5, 34.5, 31.6, 19.4, 13.1.

^{19}F NMR (565 MHz, $CDCl_3$) δ -72.01.

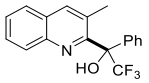
Isomer B

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.4 Hz, 1H), 8.03 (d, *J* = 7.9 Hz, 1H), 7.81 – 7.76 (m, 1H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.50 (s, 1H), 7.34 (d, *J* = 8.2 Hz, 1H), 7.19 (d, *J* = 8.2 Hz, 1H), 7.16 (d, *J* = 8.2 Hz, 1H), 6.88 – 6.83 (m, 2H), 2.79 (s, 3H), 2.76 – 2.64 (m, 2H), 2.27 (dd, *J* = 14.0, 10.2 Hz, 1H), 1.31 (d, *J* = 6.6 Hz, 3H), 1.26 (s, 9H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.1, 148.8, 147.0, 145.2, 137.2, 130.2, 129.5, 128.7, 128.1, 127.4, 125.7 (q, *J* = 286.1 Hz), 125.1, 124.0, 118.3, 79.0 (q, *J* = 27.1 Hz) 40.4, 36.3, 34.4, 31.5, 19.4, 14.0.

^{19}F NMR (565 MHz, $CDCl_3$) δ -72.66.

2,2,2-Trifluoro-1-(3-methylquinolin-2-yl)-1-phenylethan-1-ol (3s)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 3-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.

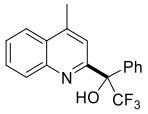
27.6 mg, 70%, yellow oil.

R_f = 0.4 (10% PE in EA).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.25 (s, 1H), 8.17 (d, *J* = 8.4 Hz, 1H), 7.96 (s, 1H), 7.80 (d, *J* = 8.1 Hz, 1H), 7.76 (t, *J* = 7.7 Hz, 1H), 7.61 (t, *J* = 7.5 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.39 – 7.32 (m, 3H), 1.94 (s, 3H).

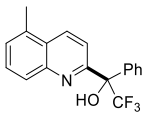
^{13}C NMR (150 MHz, $CDCl_3$) δ 153.7, 143.4, 140.5, 138.3, 130.5, 129.8, 128.8, 128.7, 128.6, 128.0, 127.88, 127.87, 126.7, 125.5 (q, *J* = 286.9 Hz), 78.7 (q, *J* = 28.5 Hz), 19.8.
^{19}F NMR (565 MHz, $CDCl_3$) δ -74.08.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1097.

2,2,2-Trifluoro-1-(4-methylquinolin-2-yl)-1-phenylethan-1-ol (3t)



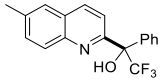
2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 4-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.
66.6 mg, 70%, colorless oil.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.2 Hz, 1H), 8.02 – 7.98 (m, 1H), 7.81 – 7.76 (m, 1H), 7.73 (d, *J* = 7.8 Hz, 2H), 7.66 – 7.62 (m, 1H), 7.58 (s, 1H), 7.42 – 7.39 (m, 3H), 7.38 – 7.35 (m, 1H), 2.70 (s, 3H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.3, 145.7, 138.3, 134.9, 134.5, 130.4, 128.8, 128.6, 128.2, 127.5 127.23, 127.22, 125.3 (q, *J* = 286.2 Hz), 119.4, 78.1 (q, *J* = 28.9 Hz), 18.8.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.92.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1100.

2,2,2-Trifluoro-1-(5-methylquinolin-2-yl)-1-phenylethan-1-ol (3u)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 5-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.
64.7 mg, 68%, colorless oil.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.36 (d, *J* = 8.8 Hz, 1H), 8.02 (d, *J* = 8.5 Hz, 1H), 7.74 (d, *J* = 7.8 Hz, 2H), 7.68 (t, *J* = 7.8 Hz, 1H), 7.59 (d, *J* = 8.8 Hz, 1H), 7.53 (s, 1H), 7.43 (d, *J* = 7.0 Hz, 1H), 7.40 (t, *J* = 7.4 Hz, 2H), 7.38 – 7.34 (m, 1H), 2.68 (s, 3H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.3, 145.7, 138.3, 134.9, 134.5, 130.4, 128.8, 128.6, 128.2, 127.5, 127.23, 127.22, 125.3 (q, *J* = 287.1 Hz), 119.4, 78.1 (q, *J* = 28.9 Hz), 18.8.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.97.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1100.

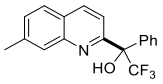
2,2,2-Trifluoro-1-(6-methylquinolin-2-yl)-1-phenylethan-1-ol (3v)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 6-methylquinoline (43.8 mg, 0.3

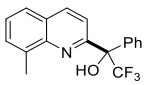
mmol) was used to afford the desired product.
71.4 mg, 75%, colorless oil.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.7 Hz, 1H), 8.05 (d, *J* = 8.7 Hz, 1H), 7.71 (d, *J* = 7.4 Hz, 2H), 7.65 – 7.60 (m, 2H), 7.51 (d, *J* = 8.7 Hz, 2H), 7.42 – 7.32 (m, 3H), 2.56 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 153.9, 143.9, 138.4, 138.0, 137.3, 132.9, 128.7, 128.64, 128.62, 128.1, 127.2, 126.5, 125.3 (q, *J* = 286.2 Hz), 119.8, 78.1 (q, *J* = 29.0 Hz), 21.8.
^{19}F NMR (377 MHz, $CDCl_3$) δ -73.92.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1110.

2,2,2-Trifluoro-1-(7-methylquinolin-2-yl)-1-phenylethan-1-ol (3w)



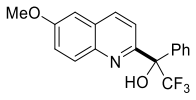
2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 7-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.
61.8 mg, 65%, colorless oil.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.4 Hz, 1H), 7.96 (s, 1H), 7.75 (d, *J* = 8.2 Hz, 1H), 7.70 (d, *J* = 7.3 Hz, 2H), 7.52 (s, 1H), 7.47 (dd, *J* = 15.3, 8.4 Hz, 2H), 7.41 – 7.31 (m, 3H), 2.60 (s, 3H).
^{13}C NMR (150 MHz, $CDCl_3$) δ 154.7, 145.6, 141.2, 138.4, 137.6, 136.5, 130.1, 128.7, 128.6, 128.0, 127.3, 127.2, 125.3 (q, *J* = 285.2 Hz), 119.0, 78.1 (q, *J* = 29.0 Hz), 22.0.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.91.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1100.

2,2,2-Trifluoro-1-(8-methylquinolin-2-yl)-1-phenylethan-1-ol (3x)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 8-methylquinoline (43.8 mg, 0.3 mmol) was used to afford the desired product.
46.6 mg, 49%, colorless oil.
R_f = 0.4 (10% PE in EA).
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.18 (d, *J* = 8.6 Hz, 1H), 7.75 (d, *J* = 7.8 Hz, 2H), 7.71 (d, *J* = 8.1 Hz, 1H), 7.65 (d, *J* = 7.0 Hz, 1H), 7.62 (s, 1H), 7.58 (d, *J* = 8.6 Hz, 1H), 7.54 – 7.49 (m, 1H), 7.44 – 7.39 (m, 2H), 7.39 – 7.35 (m, 1H), 2.89 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$) δ 157.5, 146.6, 144.5, 139.7, 139.1, 129.5, 128.8, 128.6, 128.2, 128.0, 127.6, 126.5, 125.3, 125.0 (q, *J* = 287.9 Hz), 82.6 (q, *J* = 27.8 Hz), 18.5.
^{19}F NMR (565 MHz, $CDCl_3$) δ -73.92.
HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO^+$ $[M+H]^+$ 318.1100, found 318.1095.

2,2,2-Trifluoro-1-(6-methoxyquinolin-2-yl)-1-phenylethan-1-ol (3y)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 6-methoxyquinolin (48.7 mg, 0.3 mmol) was used to afford the desired product.

63 mg, 63%, white solid.

R_f = 0.25 (10% PE in EA).

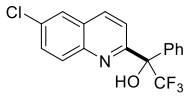
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.7 Hz, 1H), 8.05 (d, *J* = 9.3 Hz, 1H), 7.71 (d, *J* = 7.7 Hz, 2H), 7.50 (d, *J* = 8.6 Hz, 1H), 7.46 – 7.42 (m, 2H), 7.41 – 7.32 (m, 3H), 7.10 (d, *J* = 2.7 Hz, 1H), 3.93 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ158.8, 152.2, 141.4, 138.4, 136.6, 130.4, 129.3, 128.7, 128.6, 127.2, 125.2 (q, *J* = 285.5 Hz), 123.4, 120.1, 105.1, 80.1 (q, *J* = 28.8 Hz), 55.8.

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.00.

HRMS (ESI) *m/z* calculated for $C_{18}H_{15}F_3NO_2^+$ $[M+H]^+$ 334.1049, found 334.1049.

1-(6-Chloroquinolin-2-yl)-2,2,2-trifluoro-1-phenylethan-1-ol (3z)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 6-methoxyquinolin (50.1 mg, 0.3 mmol) was used to afford the desired product.

56 mg, 56%, yellow oil.

R_f = 0.3 (10% PE in EA).

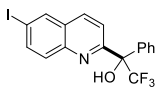
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.09 (d, *J* = 9.0 Hz, 1H), 8.07 (d, *J* = 8.6 Hz, 1H), 7.82 (m, 1H), 7.72 (d, *J* = 8.4 Hz, 3H), 7.58 (d, *J* = 8.7 Hz, 1H), 7.43 – 7.35 (m, 3H), 7.28 (s, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.3, 143.7, 137.9, 137.0, 133.7, 131.6, 130.6, 128.9, 128.7, 128.6, 127.2, 126.3, 125.1 (q, *J* = 286.3 Hz), 120.9, 78.2 (q, *J* = 28.9 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -73.81.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}ClF_3NO^+$ $[M+H]^+$ 338.0554, found 338.0555.

2,2,2-Trifluoro-1-(6-iodoquinolin-2-yl)-1-phenylethan-1-ol (3aa)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 6-iodoquinolin (78.1 mg, 0.3 mmol) was used to afford the desired product.

78.5 mg, 61%, white solid.

R_f = 0.3 (10% PE in EA).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.4 Hz, 1H), 7.90 (d, *J* = 7.8 Hz, 1H), 7.84-7.81 (m, 3H), 7.79 (t, *J* = 7.5 Hz, 1H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.70 (d, *J* = 8.3 Hz, 1H), 7.65 (m, 1H), 7.45 (t, *J* =

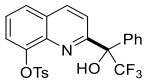
7.6 Hz, 2H), 7.40 (t, *J* = 7.2 Hz, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 153.4, 143.7, 138.4, 137.7, 134.0, 130.3, 129.0, 128.6, 127.6, 126.3 125.3 (q, *J* = 286.4 Hz), 124.6, 124.1, 120.6, 78.4 (q, *J* = 28.7 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.34.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}IF_3NO^+$ $[M+H]^+$ 429.9910, found 429.9905.

2-(2,2,2-Trifluoro-1-hydroxy-1-phenylethyl)quinolin-8-yl 4-methylbenzenesulfonate (3ab)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and quinolin-8-yl 4-methylbenzenesulfonate (91.6 mg, 0.3 mmol) was used to afford the desired product.

65.3 mg, 46%, yellow oil.

R_f = 0.5 (20% PE in EA).

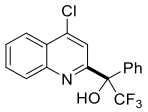
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.6 Hz, 1H), 7.89 – 7.77 (m, 4H), 7.68 – 7.58 (m, 3H), 7.54 (d, *J* = 8.6 Hz, 1H), 7.42 – 7.33 (m, 3H), 7.27 (t, *J* = 7.0 Hz, 2H), 6.90 (s, 1H), 2.39 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.6, 145.7, 145.2, 138.6, 137.9, 137.9, 133.1, 130.1, 129.3, 128.9, 128.7, 128.2, 127.6, 127.2, 126.7, 125.0 (q, *J* = 286.8 Hz), 124.3, 120.8, 78.4 (q, *J* = 29.7 Hz), 21.7.

^{19}F NMR (377 MHz, $CDCl_3$) δ -71.79.

HRMS (ESI) *m/z* calculated for $C_{24}H_{19}F_3NO_4S^+$ $[M+H]^+$ 474.0981, found 474.0980.

1-(4-Chloroquinolin-2-yl)-2,2,2-trifluoro-1-phenylethan-1-ol (3ac)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 4-chloroquinoline (48.7 mg, 0.3 mmol) was used to afford the desired product.

47.6 mg, 47%, yellow oil.

R_f = 0.3 (10% PE in EA).

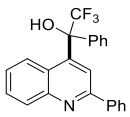
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.4 Hz, 1H), 8.19 (d, *J* = 8.5 Hz, 1H), 7.86 (t, *J* = 7.6 Hz, 1H), 7.74 – 7.69 (m, 3H), 7.62 (s, 1H), 7.44 – 7.36 (m, 3H), 7.21 (s, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.0, 146.0, 144.5, 137.6, 131.6, 129.5, 129.0, 128.8, 127.15, 127.14, 126.3, 125.1 (q, *J* = 286.3 Hz), 124.4, 120.0, 78.2 (q, *J* = 28.9 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -73.81.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}ClF_3NO^+$ $[M+H]^+$ 338.0554, found 338.0560.

2,2,2-Trifluoro-1-phenyl-1-(2-phenylquinolin-4-yl)ethan-1-ol (3ad)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 2-phenylquinoline (61.5 mg, 0.3 mmol) was used to afford the desired product.

78.5 mg, 69%, white solid.

R_f = 0.3 (5% PE in EA).

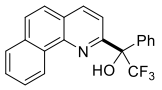
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.29 (s, 1H), 8.21 (d, *J* = 7.5 Hz, 2H), 8.18 (d, *J* = 7.9 Hz, 1H), 7.86 (d, *J* = 8.6 Hz, 1H), 7.63 – 7.55 (m, 3H), 7.54 – 7.49 (m, 3H), 7.39 – 7.32 (m, 3H), 7.28 – 7.21 (m, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 156.3, 149.8, 143.2, 139.1, 137.3, 130.7, 129.8, 129.2, 129.04, 129.01, 128.4, 127.6, 127.3, 126.7, 126.2, 124.9 (q, *J* = 286.1 Hz), 124.0, 117.5, 80.3 (q, *J* = 27.5 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.16.

HRMS (ESI) *m/z* calculated for $C_{23}H_{17}F_3NO^+$ $[M+H]^+$ 380.1257, found 380.1257.

1-(Benzo[*h*]quinolin-2-yl)-2,2,2-trifluoro-1-phenylethan-1-ol (3ae)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and benzo[*h*]quinoline (54.8 mg, 0.3 mmol) was used to afford the desired product.

75.2 mg, 71%, white solid.

R_f = 0.4 (5% PE in EA).

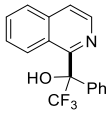
^{1}H NMR (600 MHz, $CDCl_3$) δ 9.28 (d, *J* = 8.1 Hz, 1H), 8.17 (d, *J* = 8.4 Hz, 1H), 7.90 (d, *J* = 7.8 Hz, 1H), 7.85 – 7.77 (m, 4H), 7.76 – 7.69 (m, 2H), 7.65 (m, 1H), 7.64 (s, 1H), 7.47 – 7.43 (m, 2H), 7.42 – 7.37 (m, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 153.4, 143.7, 138.4, 137.7, 134.0, 130.3, 129.0, 128.9, 128.8, 128.6, 128.2, 127.6, 127.3, 126.4, 125.3 (q, *J* = 286.3 Hz), 124.6, 124.1, 120.6, 78.4 (q, *J* = 28.7 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.00.

HRMS (ESI) *m/z* calculated for $C_{21}H_{15}F_3NO^+$ $[M+H]^+$ 354.1100, found 354.1097.

2,2,2-Trifluoro-1-(isoquinolin-1-yl)-1-phenylethan-1-ol (3af)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and isoquinoline (39.5 mg, 0.3 mmol) was used to afford the desired product.

50 mg, 55%, white solid.

R_f = 0.4 (5% PE in EA).

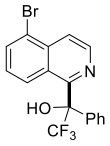
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.59 (d, *J* = 5.6 Hz, 1H), 8.17 (s, 1H), 7.86 (d, *J* = 8.2 Hz, 1H), 7.81 (d, *J* = 5.6 Hz, 1H), 7.73 (d, *J* = 8.7 Hz, 1H), 7.60 (t, *J* = 7.5 Hz, 1H), 7.50 (m, 2H), 7.38 – 7.35 (m, 3H), 7.35 – 7.30 (m, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.0, 139.5, 138.6, 138.0, 130.4, 128.8, 128.7, 127.7, 127.6, 127.5, 127.2, 125.9, 125.4 (q, *J* = 287.3 Hz), 123.7, 79.0 (q, *J* = 28.8 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -71.32.

These data are in accordance with the literature.[7]

1-(5-Bromoisoquinolin-1-yl)-2,2,2-trifluoro-1-phenylethan-1-ol (3ag)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 5-bromoisoquinoline (63.7 mg, 0.3 mmol) was used to afford the desired product.

58.8 mg, 60%, yellow oil.

R_f = 0.4 (5% PE in EA).

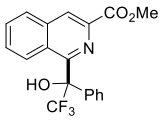
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.72 (d, *J* = 5.9 Hz, 1H), 8.12 (d, *J* = 5.9 Hz, 1H), 8.00 (d, *J* = 8.7 Hz, 1H), 7.83 (d, *J* = 7.2 Hz, 1H), 7.51 – 7.45 (m, 2H), 7.34 – 7.29 (m, 3H), 7.14 (dd, *J* = 8.5, 7.6 Hz, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 158.3, 141.3, 140.1, 136.4, 133.6, 128.7, 128.1, 127.5, 127.3, 127.1, 126.8, 124.6 (q, *J* = 287.9 Hz), 122.4, 120.7, 83.7 (q, *J* = 26.6 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -73.89.

HRMS (ESI) *m/z* calculated for $C_{17}H_{12}BrF_3NO^+$ $[M+H]^+$ 382.0049, found 382.0060.

Methyl 1-(2,2,2-trifluoro-1-hydroxy-1-phenylethyl)isoquinoline-3-carboxylate (3ah)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and methyl isoquinoline-3-carboxylate (57.3 mg, 0.3 mmol) was used to afford the desired product.

50.9 mg, 47%, yellow oil.

R_f = 0.5 (20% PE in EA).

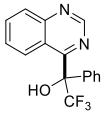
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.68 (s, 1H), 8.00 (d, *J* = 8.2 Hz, 1H), 7.75 (d, *J* = 8.7 Hz, 1H), 7.68 (t, *J* = 7.6 Hz, 1H), 7.49 – 7.42 (m, 3H), 7.39 – 7.31 (m, 3H), 4.07 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 154.5, 139.0, 137.9, 137.6, 131.2, 129.8, 129.1, 128.9, 128.6 127.7, 127.5, 127.3, 126.7 ,125.2 (q, *J* = 287.9 Hz), 79.2 (q, *J* = 28.9 Hz), 53.0.

^{19}F NMR (377 MHz, $CDCl_3$) δ -71.20.

HRMS (ESI) *m/z* calculated for $C_{19}H_{15}F_3NO_3^+$ $[M+H]^+$ 362.0999, found 362.0996.

2,2,2-Trifluoro-1-phenyl-1-(quinazolin-4-yl)ethan-1-ol (3ai)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and quinazoline (39.9 mg, 0.3 mmol) was used to afford the desired product.

33.8 mg, 37%, yellow oil.

R_f = 0.4 (10% PE in EA).

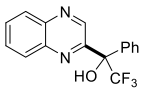
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.41 (s, 1H), 8.04 (d, *J* = 8.4 Hz, 1H), 7.88 (d, *J* = 8.6 Hz, 1H), 7.76 (dd, *J* = 11.3, 4.0 Hz, 1H), 7.49 – 7.44 (m, 2H), 7.39 – 7.29 (m, 4H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.7, 152.7, 151.5, 138.8, 133.4, 129.5, 128.9, 128.2, 127.3, 127.1, 127.0, 124.0 (q, *J* = 288.1 Hz), 122.4, 83.0 (q, *J* = 27.2 Hz).

^{19}F NMR (377 MHz, $CDCl_3$) δ -72.52.

HRMS (ESI) *m/z* calculated for $C_{16}H_{12}F_3N_2O^+$ $[M+H]^+$ 305.0896, found 305.0901.

2,2,2-Trifluoro-1-phenyl-1-(quinoxalin-2-yl)ethan-1-ol (3ag)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and quinoxaline (39.9 mg, 0.3 mmol) was used to afford the desired product.

43.8 mg, 48%, yellow oil.

R_f = 0.4 (20% PE in EA).

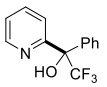
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.90 (s, 1H), 8.20 – 8.16 (m, 1H), 8.15 – 8.11 (m, 1H), 7.83 – 7.78 (m, 2H), 7.51 – 7.47 (m, 2H), 7.38 – 7.34 (m, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 154.6, 145.3, 141.4, 140.3, 138.7, 130.7, 130.6, 130.0, 129.3, 129.0, 128.3, 127.7, 124.7 (q, *J* = 287.4 Hz), 82.1 (q, *J* = 28.4 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -72.37.

HRMS (ESI) *m/z* calculated for $C_{16}H_{12}F_3N_2O^+$ $[M+H]^+$ 305.0896, found 305.0900.

2,2,2-trifluoro-1-phenyl-1-(pyridin-2-yl)ethan-1-ol (3ak)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and pyridine (24 mg, 0.3 mmol) was used to afford the desired product.

36.5 mg, 54%, yellow oil.

R_f = 0.2 (10% PE in EA).

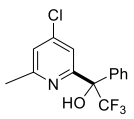
^{1}H NMR (600 MHz, $CDCl_3$) δ 8.60 (d, *J* = 4.9 Hz, 1H), 7.74 (td, *J* = 7.8, 1.7 Hz, 1H), 7.67 (d, *J* = 7.6 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 1H), 7.42 – 7.31 (m, 4H), 7.04 (s, 1H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 155.0, 147.3, 138.4, 137.6, 128.7, 128.6, 127.1, 127.09, 125.1 (q, *J* = 286.0 Hz), 124.1, 123.1, 77.8 (q, *J* = 28.8 Hz).

^{19}F NMR (565 MHz, $CDCl_3$) δ -75.24.

These data are in accordance with the literature.[7]

1-(4-chloro-6-methylpyridin-2-yl)-2,2,2-trifluoro-1-phenylethan-1-ol (3al)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 4-chloro-2-methylpyridine (78.1 mg, 0.3 mmol) was used to afford the desired product.

R_f = 0.4 (20% PE in EA).

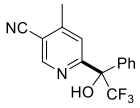
^{1}H NMR (600 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.7 Hz, 2H), 7.46 – 7.36 (m, 3H), 7.33 (s, 1H), 7.22 (s, 1H), 6.99 (s, 1H), 2.60 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 158.1, 155.8, 145.7, 137.9, 128.9, 128.66, 127.0, 126.9, 124.9 (q, *J* = 286.2 Hz), 124.1, 120.5, 120.5, 77.6 (d, *J* = 28.8 Hz), 23.9.

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.60.

HRMS (ESI) *m/z* calculated for $C_{14}H_{12}ClF_3NO^+$ $[M+H]^+$ 302.0554, found 302.0560.

4-methyl-6-(2,2,2-trifluoro-1-hydroxy-1-phenylethyl)nicotinonitrile (3am)



2,2,2-trifluoro-1-phenylethan-1-one (106.6 mg, 0.6 mmol) and 4-methylnicotinonitrile (36 mg, 0.3 mmol) was used to afford the desired product.

30.7 mg, 36%, yellow oil.

R_f = 0.3 (20% PE in EA).

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.78 (s, 1H), 7.63 (t, *J* = 9.0 Hz, 2H), 7.44 (s, 1H), 7.42 – 7.35 (m, 3H), 6.44 (s, 1H), 2.55 (s, 3H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 158.7, 152.7, 150.5, 137.2, 129.1, 128.8, 126.9,124.7 (q, *J* = 286.4 Hz), 124.1, 115.2, 111.5, 78.2 (q, *J* = 29.1 Hz), 20.6.

^{19}F NMR (565 MHz, $CDCl_3$) δ -74.23.

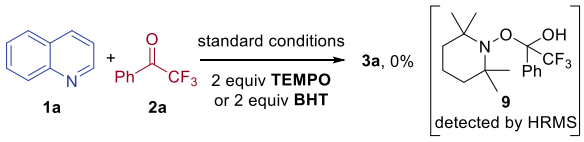
HRMS (ESI) *m/z* calculated for $C_{15}H_{12}F_3N_2O^+$ $[M+H]^+$ 293.0896, found 293.0904.

3.4 Unsuccessful Substrates

Scheme S1. Unsuccessful substrates

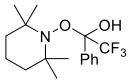
4. Mechanism Studies

4.1 Control Experiments



Under standard reaction conditions, TEMPO (0.6 mmol, 2 eq) or BHT (0.6 mmol, 2 eq) was added as an additional additive, no target product was observed. The ketal radical intermediate **8** was determined by HRMS.

2,2,2-trifluoro-1-phenyl-1-((2,2,6,6-tetramethylpiperidin-1-yl)oxy)ethan-1-ol (8)



HRMS (ESI) *m/z* calculated for $C_{17}H_{24}F_3NNaO_2^+$ $[M+Na]^+$ 354.1651, found 354.1645.

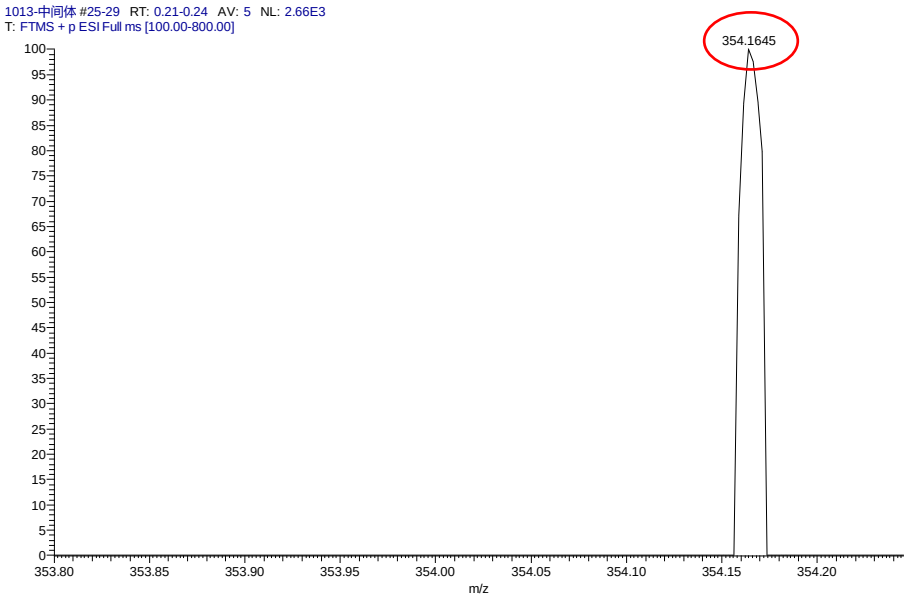
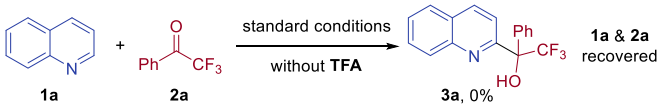
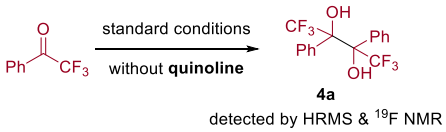


Figure S2 The HRMS spectra of compound **8**



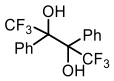
A three necked round bottom flask (10 mL) with a stir bar was charged, TBAB (197.4 mg, 0.6 mmol, 2 eq), $CoCl_2 \cdot 6H_2O$ (3.6 mg, 0.015 mmol, 5 mol%), quinoline **1a** (39.5 mg, 0.3 mmol), trifluoromethyl ketones **2a** (106.6 mg, 0.6 mmol, 2 eq), DMF (3.5 mL), and MeCN (0.5 mL). The flask was equipped with graphite plate (10 mm x 10 mm x 2 mm) as the anode and Sn plate (10 mm x 10 mm x 1 mm) as the cathode. The mixture was electrolyzed at a constant current of 20 mA at

50 ℃ in an oil bath for 8 h. After the reaction was finished, the resulting mixture was extracted with EtOAc (20 mL × 3). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography to afford **1a** and **2a**.



A three necked round bottom flask (10 mL) with a stir bar was charged, TBAB (197.4 mg, 0.6 mmol, 2 eq), $CoCl_2 \cdot 6H_2O$ (3.6 mg, 0.015 mmol, 5 mol%), TFA (45 μL, 0.6 mmol, 2 eq), trifluoromethyl ketones **2a** (106.6 mg, 0.6 mmol, 2 eq), DMF (3.5 mL), and MeCN (0.5 mL). The flask was equipped with graphite plate (10 mm x 10 mm x 2 mm) as the anode and Sn plate (10 mm x 10 mm x 1 mm) as the cathode. The mixture was electrolyzed at a constant current of 20 mA at 50 ℃ in an oil bath for 8 h. The radical coupling product **4a** was determined by HRMS and ^{19}F NMR.

1,1,1,4,4,4-Hexafluoro-2,3-diphenylbutane-2,3-diol (4a)



HRMS (ESI) *m/z* calculated for $C_{16}H_{12}F_6NaO_2^+$ $[M+Na]^+$ 373.0634, found 373.0620.

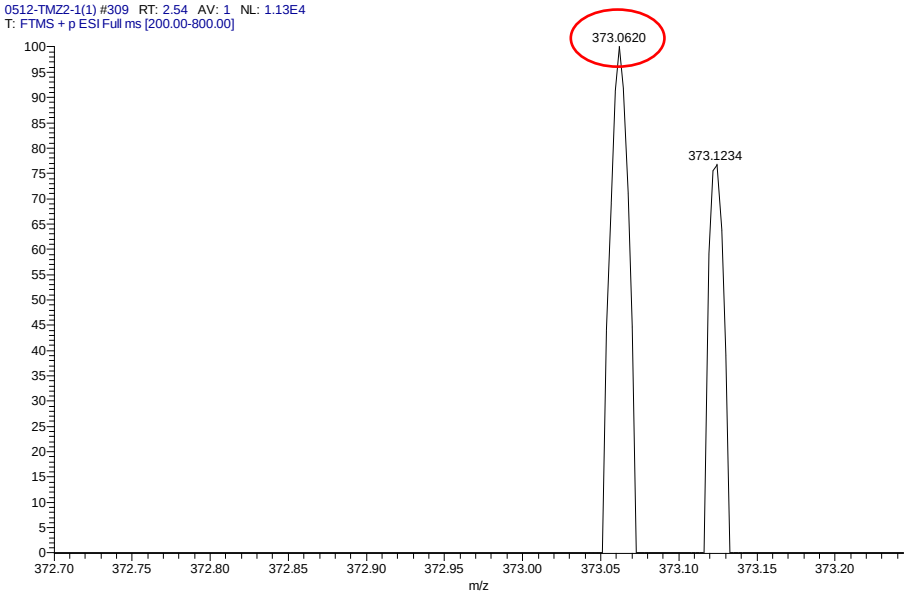


Figure S3 The HRMS spectra of compound **4a**

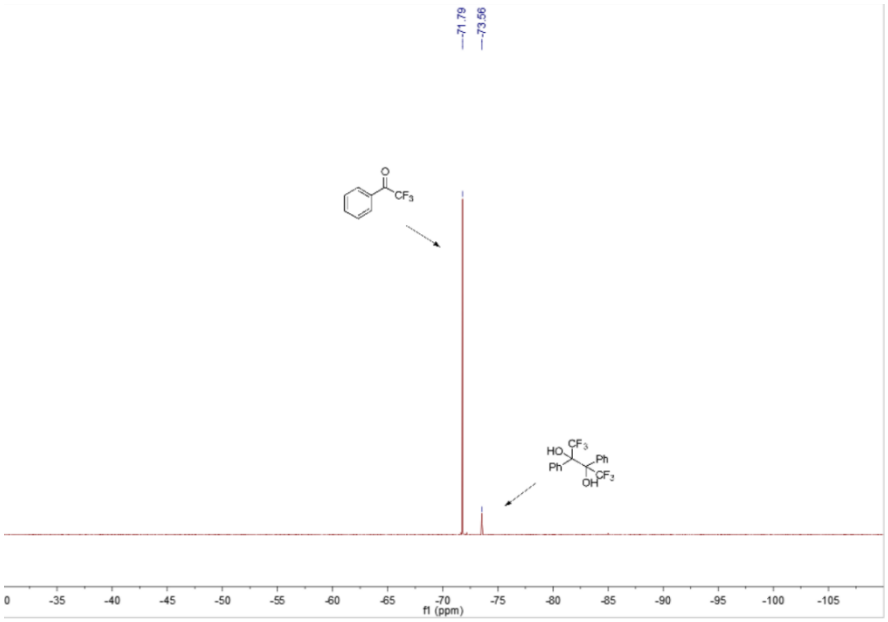
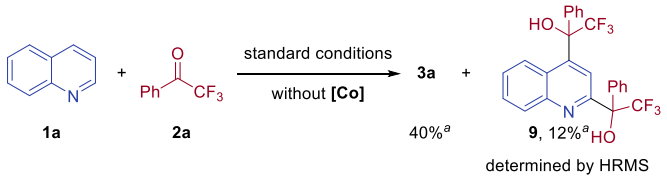


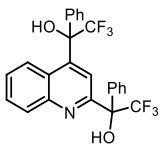
Figure S4 The ^{19}F NMR spectra of compound **4a**

The ^{19}F NMR data is in accordance with the literature.[8-9]



A three necked round bottom flask (10 mL) with a stir bar was charged, TBAB (197.4 mg, 0.6 mmol, 2 eq), quinoline **1a** (0.3 mmol), trifluoromethyl ketones **2a** (0.6 mmol, 2 eq), TFA (45 μL, 0.6 mmol, 2 eq), DMF (3.5 mL), and MeCN (0.5 mL). The flask was equipped with graphite plate (10 mm x 10 mm x 2 mm) as the anode and Sn plate (10 mm x 10 mm x 1 mm) as the cathode. The mixture was electrolyzed at a constant current of 20 mA at 50 ℃ in an oil bath for 8 h. The yields of **3aa** and **8** were determined by ^{19}F NMR analysis using (trifluoromethyl)benzene as an internal standard. The resulting mixture was analyzed by HRMS, and **9** could be detected.

1,1'-(Quinoline-2,4-diyl)bis(2,2,2-trifluoro-1-phenylethan-1-ol) (9)



HRMS (ESI) *m/z* calculated for $C_{25}H_{18}F_6NO_2^+$ $[M+H]^+$ 478.1236, found 478.1236.

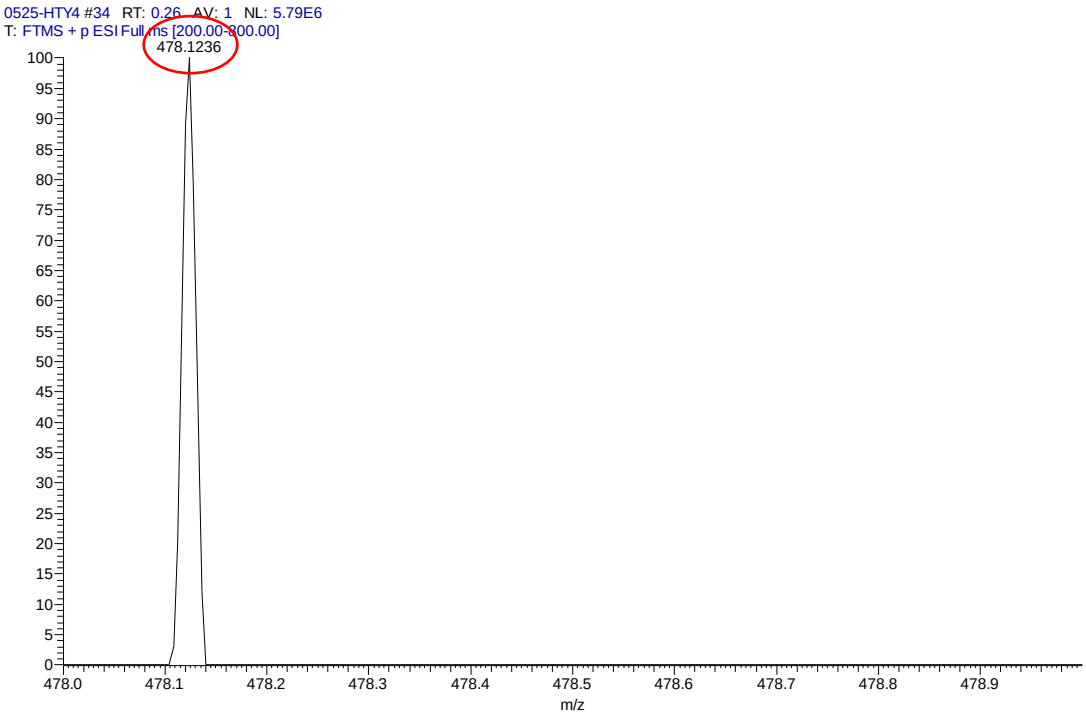


Figure S5 The HRMS spectra of compound **9**

4.2 Cyclic Voltammetry Studies

Cyclic Voltammentry was recorded with glassy carbon working electrode, platinum wire counter electrode and Ag/AgCl reference electrode on CHI660E station. Scan rate: 100 mV/s.

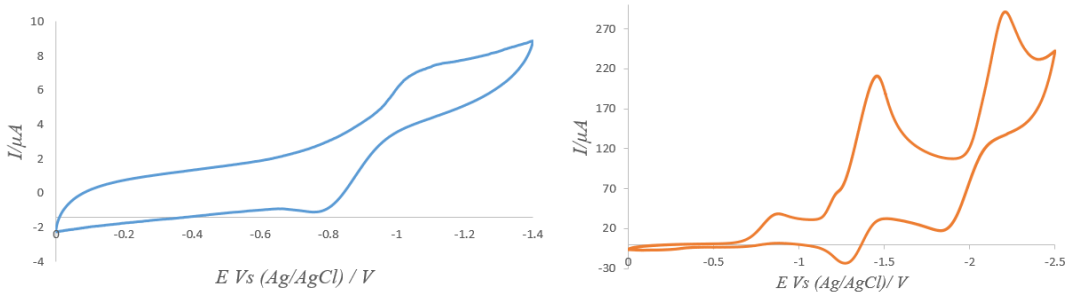


Figure S6 CVs of a 0.01 M solution of $CoCl_2{\cdot}6H_2O$ (blue trace) or 0.1 M **2a** (orange trace) with 0.1 M nBu$_4$NBr at 100 mV/s in the mixture of DMF/MeCN (3.5 mL/0.5 mL). A reduction peak (E = -1.02 V) was assigned to the reduction of Co(II) to Co(I). Ketone **2a** displayed two distinct reductions at E = -1.48 V and -2.1 V for ketones. These results indicates that the reduction of cobalt(II) should occur first.

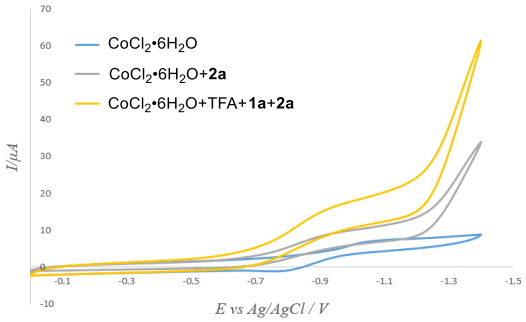


Figure S7 CVs of a 0.1 M solution of $CoCl_2{\cdot}6H_2O$ (blue trace), the mixture of 0.1 M **2a** and 0.01 M $CoCl_2{\cdot}6H_2O$ (gray trace), the mixture of 0.1 M **2a**, 0.1 M TFA, 0.1 M **1a** and 0.01 M $CoCl_2{\cdot}6H_2O$ (yellow trace) with 0.1 M nBu$_4$NBr at 100 mV/s in the mixture of DMF/MeCN (3.5 mL/0.5 mL).

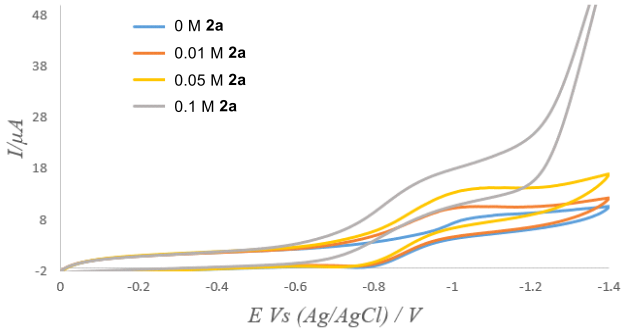


Figure S8 CVs of a 0.01 M solution of $CoCl_2 \cdot 6H_2O$, 0.1 M TFA and 0.1 M **1a** with 0.1 M *n*Bu_4NBr at 100 mV/s in the mixture of DMF/MeCN (3.5 mL/0.5 mL) and vary concentrations of **2a**.

An increasing catalyst current from cobalt as a function of the ketone concentration and the lack of a corresponding oxidation peak suggest that a PCET process might take place between cobalt and **2a** at the cathode.

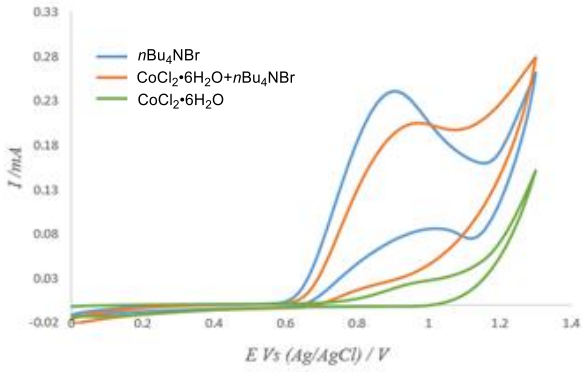


Figure S9 CVs of a 0.01 M solution of $CoCl_2 \cdot 6H_2O$ (green trace) or 0.1 M *n*Bu_4NBr (blue trace) or their mixture (orange trace) with 0.1 M Et_4NPF_6 at 100 mV/s in the mixture of DMF/MeCN (3.5 mL/0.5 mL).

The oxidation of *n*Bu_4NBr (E = +0.84 V) would be preferred at the anode compared with $CoCl_2 \cdot 6H_2O$ (E = +0.96 V).

5. References

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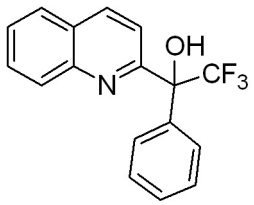
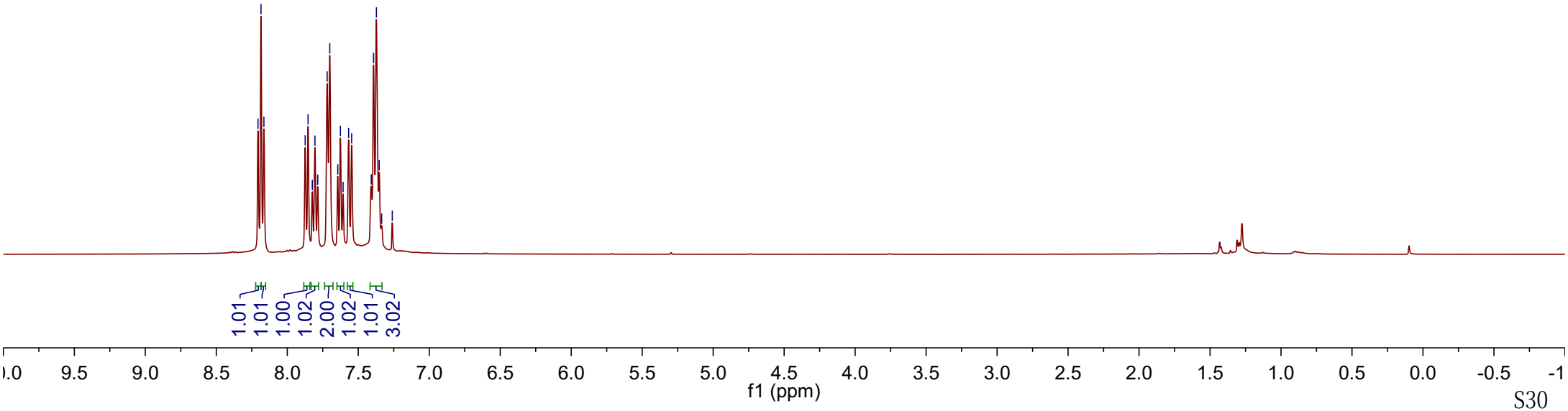
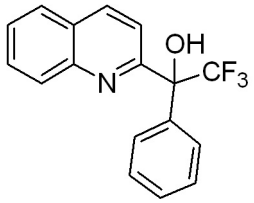
6. NMR Spectra



3a

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	400

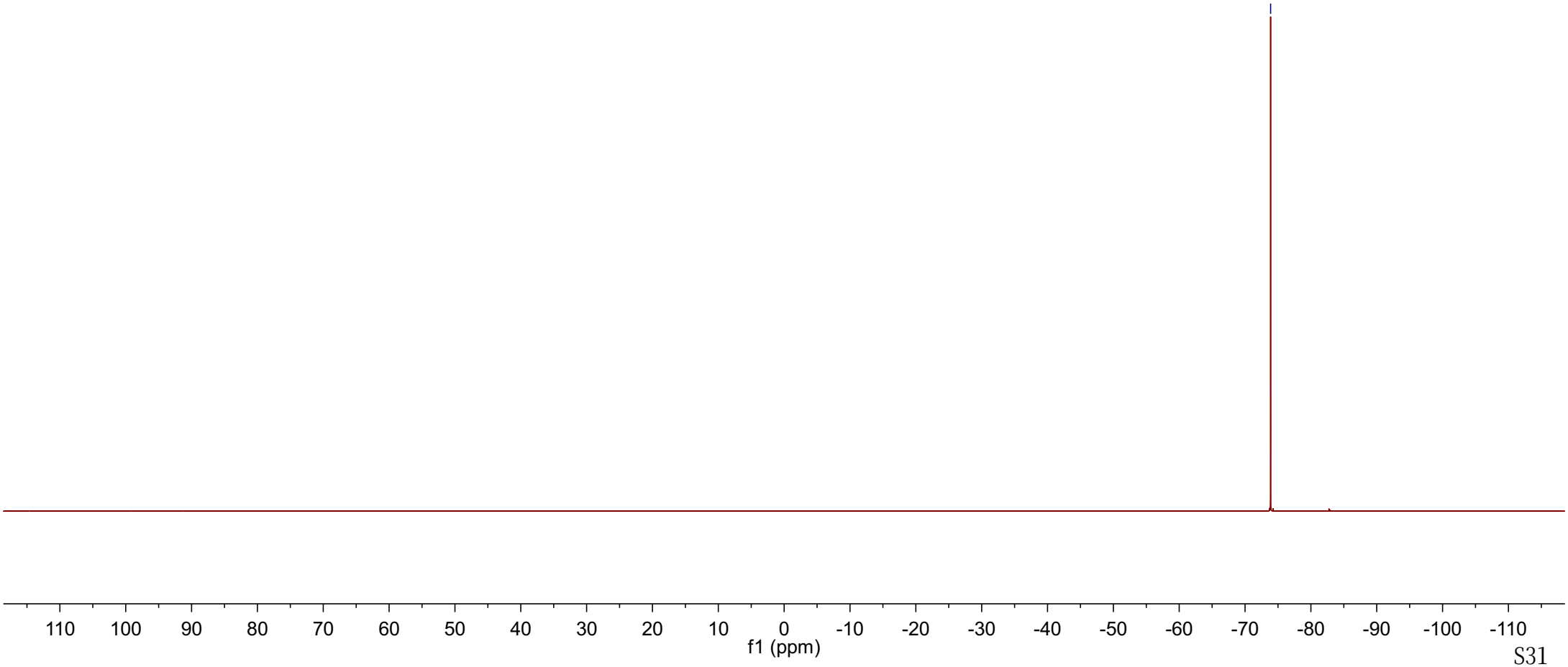


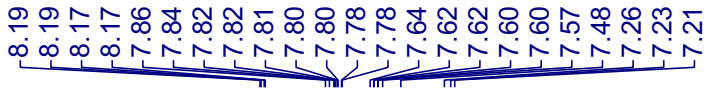


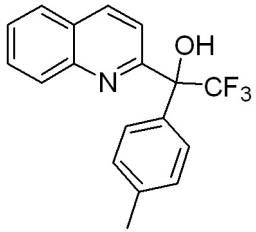
3a

-73.88

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

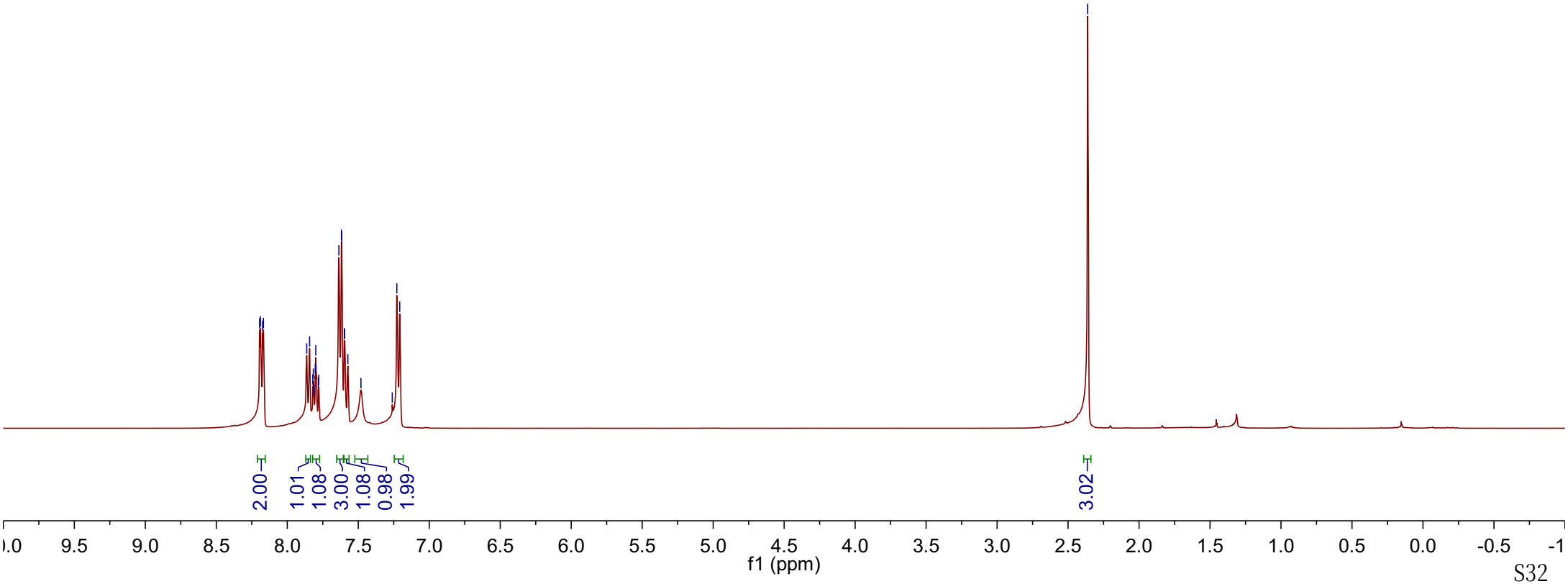


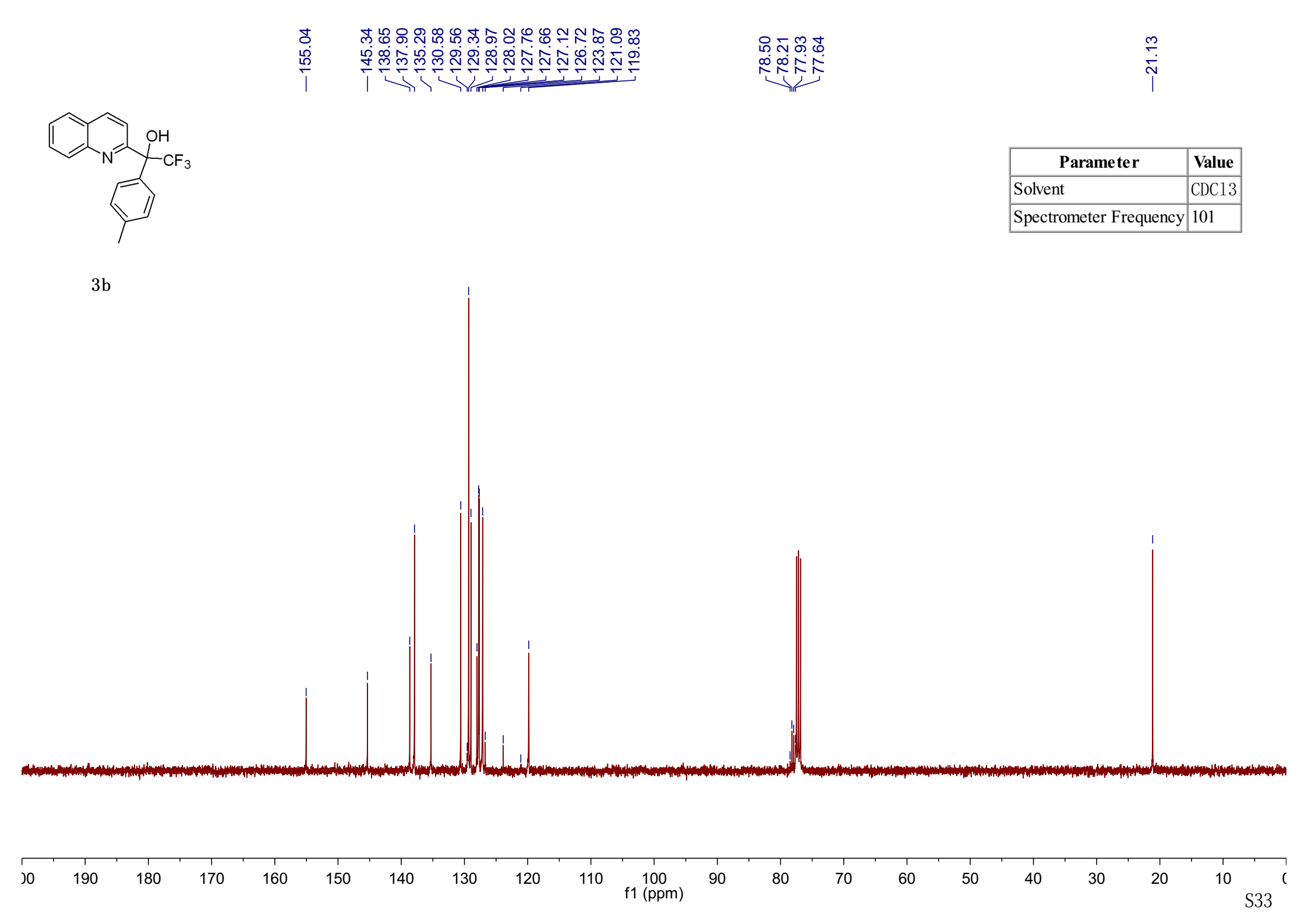




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	400

3b

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145.34
138.65
137.90
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130.58
129.56
129.34
128.97
128.02
127.76
127.66
127.12
126.72
123.87
121.09
119.83
78.50
78.21
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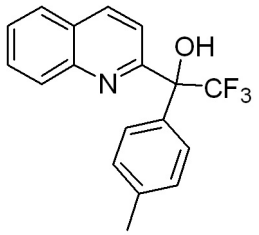
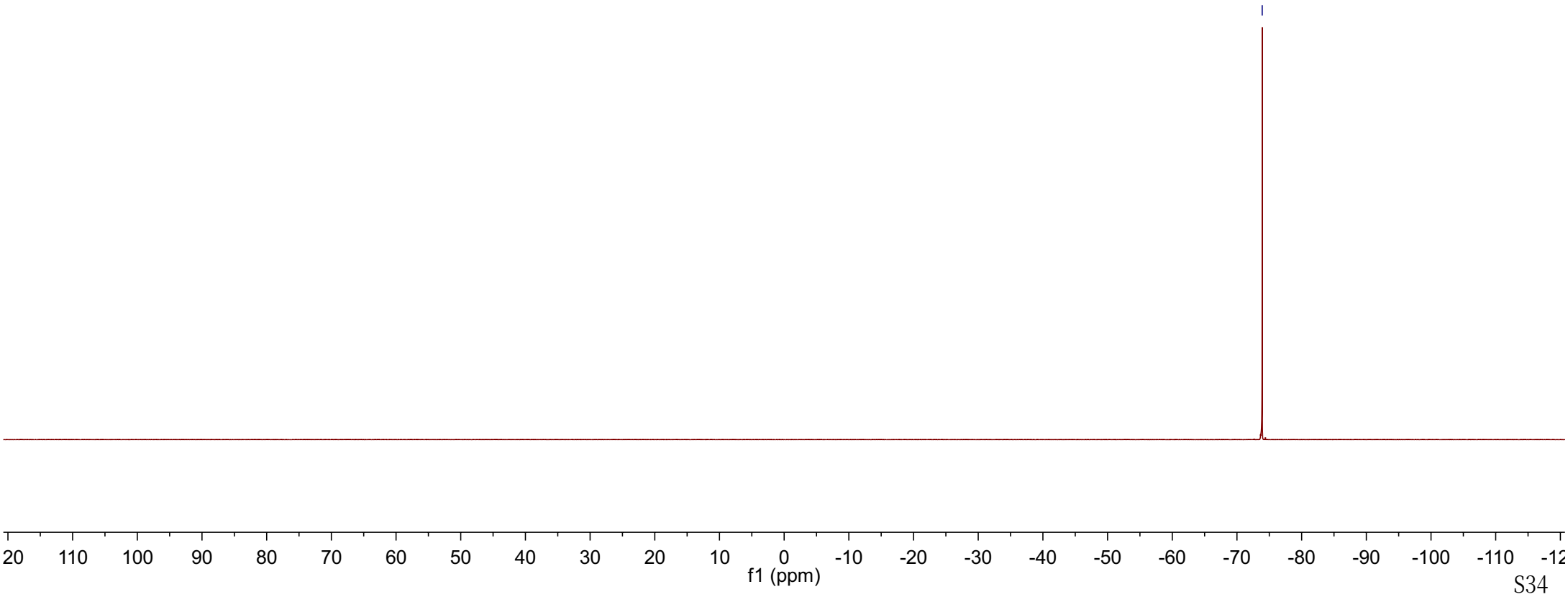
21.13
OH
N
CF3
3b
Parameter
Value
Solvent
CDC13
Spectrometer Frequency
101
f1 (ppm)

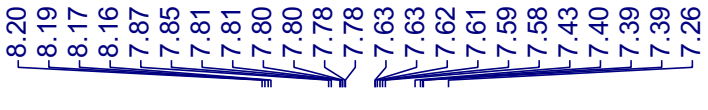


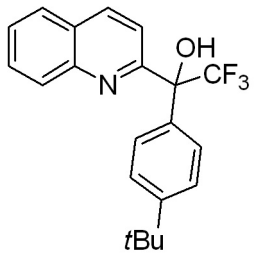
3b

-73.90

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	377

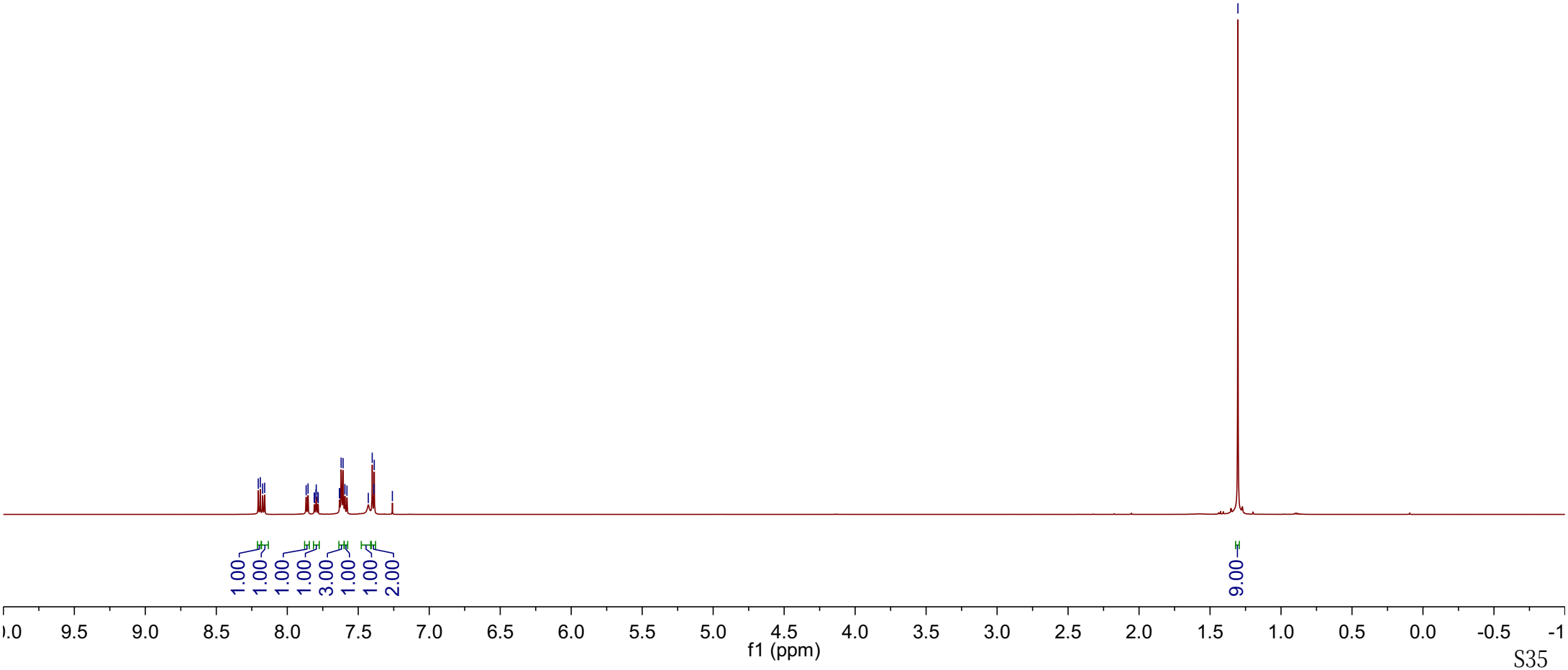


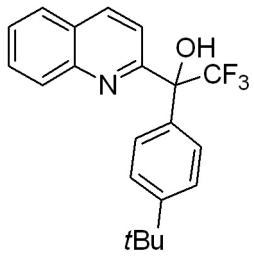




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3c

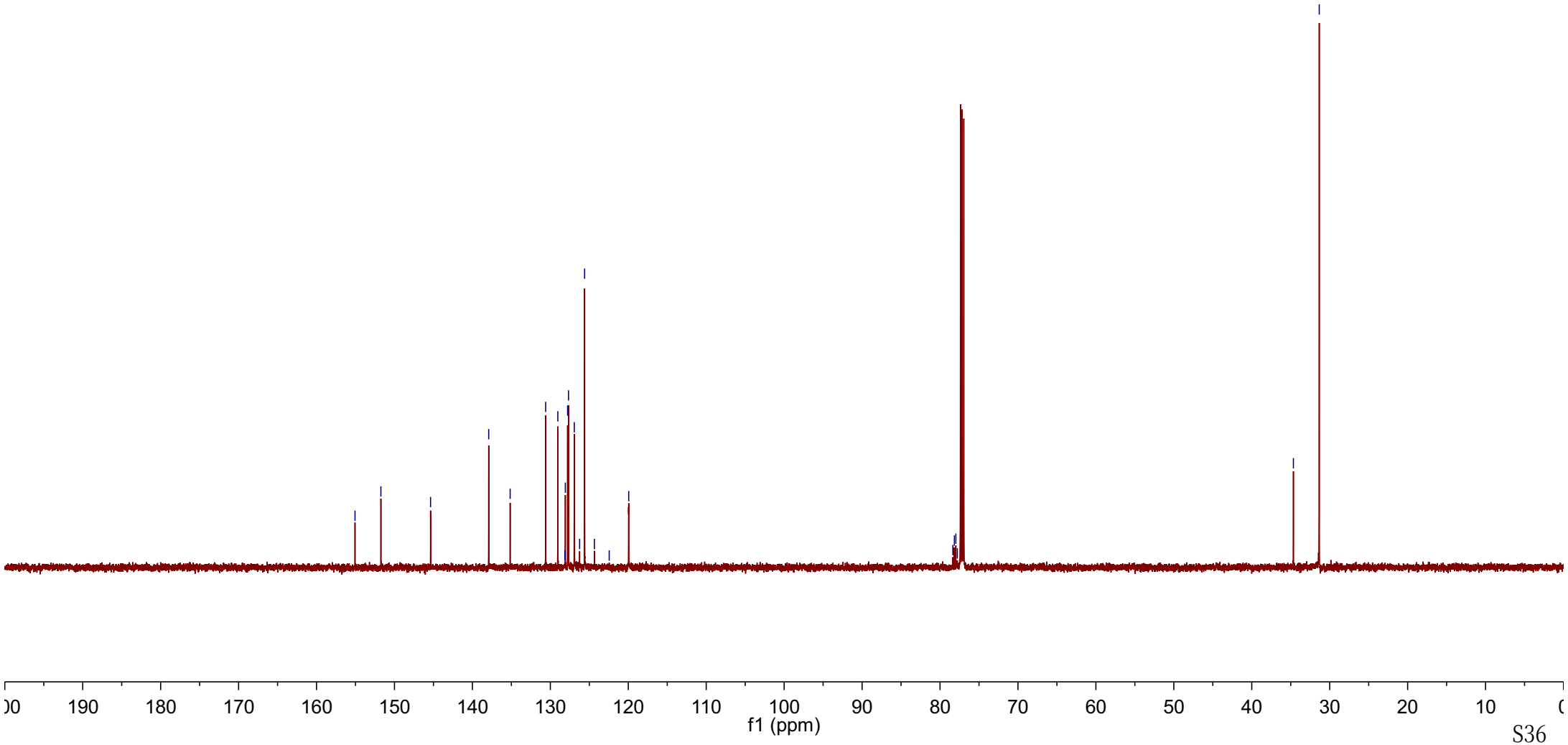


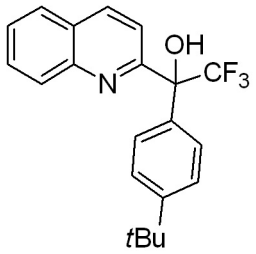


155.06
151.74
145.37
137.91
135.16
130.60
129.04
128.14
128.08
127.78
127.67
126.93
126.24
125.60
124.35
122.45
119.94
78.35
78.16
77.97
77.78
34.66
31.34

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

3c

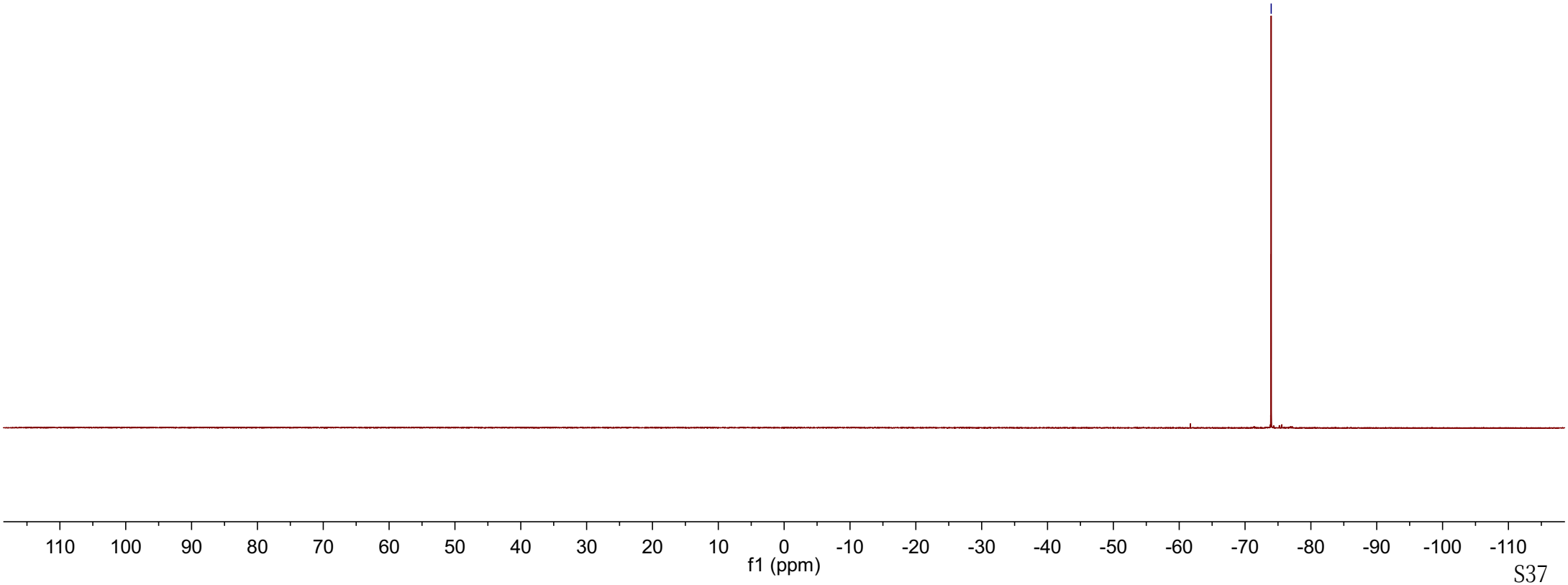


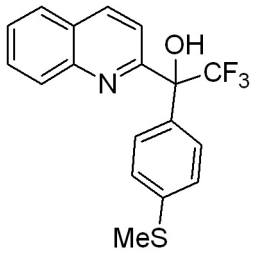


3c

-73.97

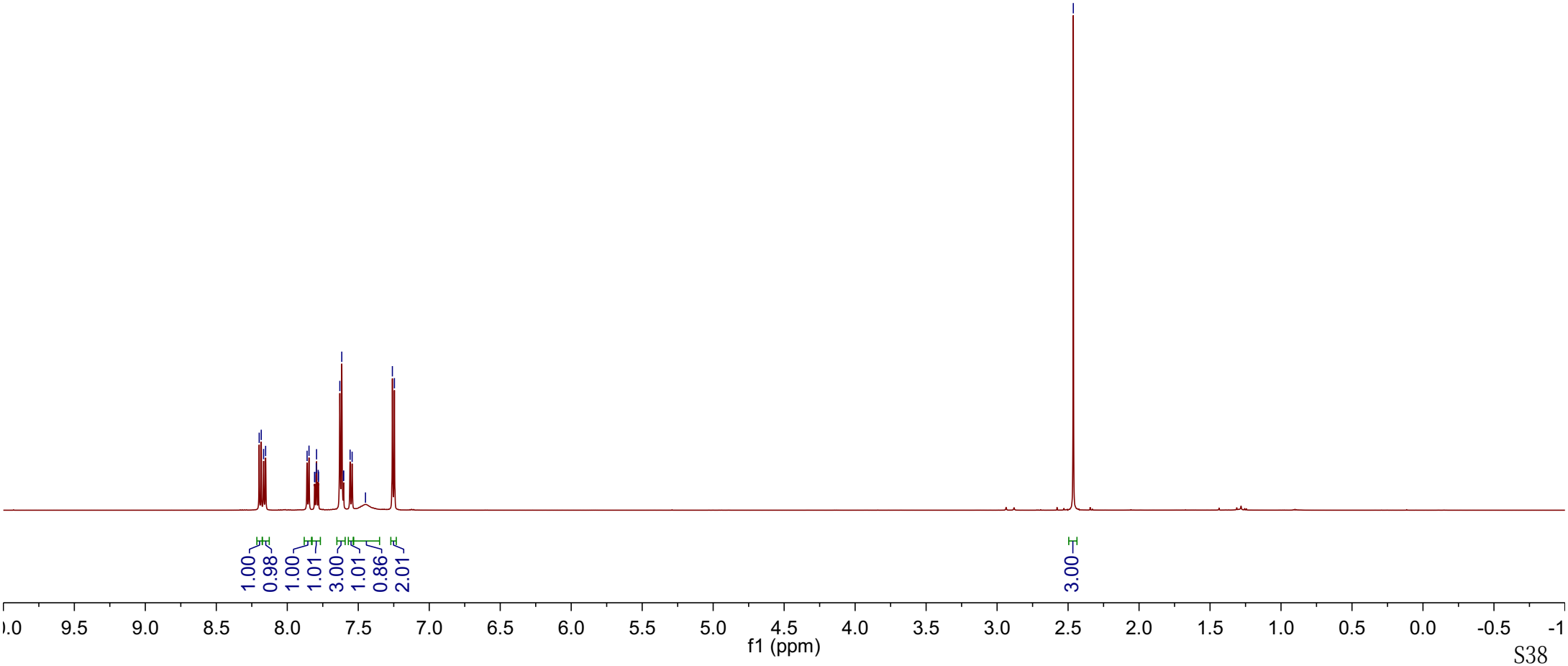
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

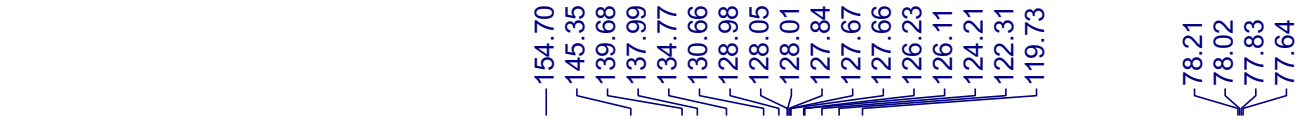


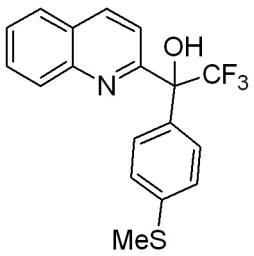


3d

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

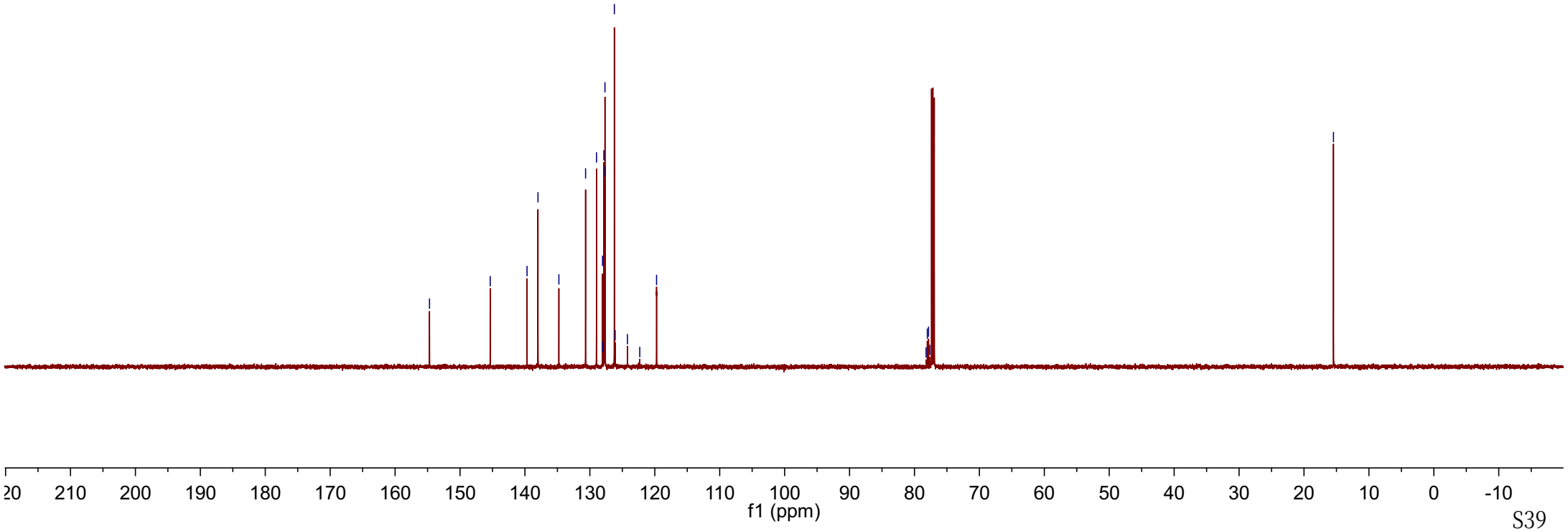


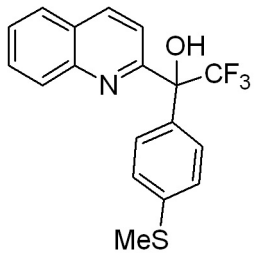




3d

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

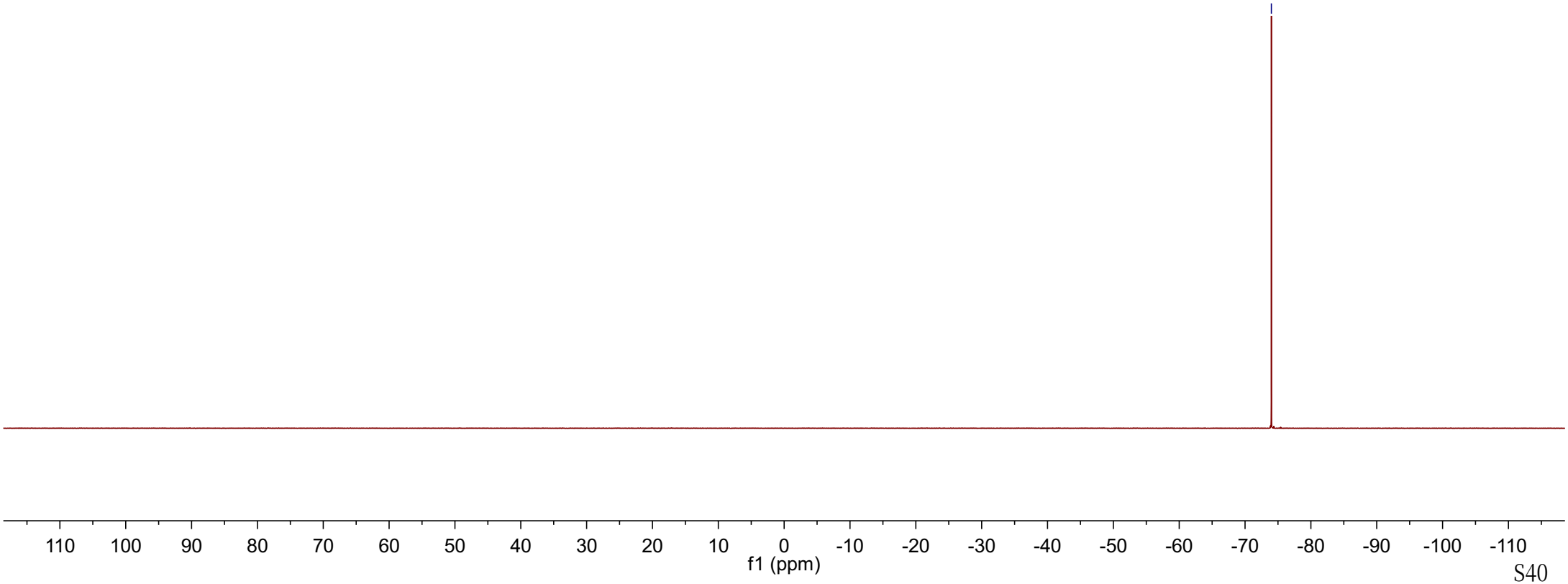


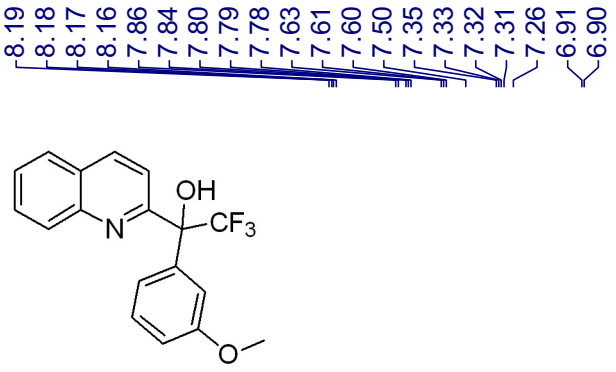


3d

-74.00

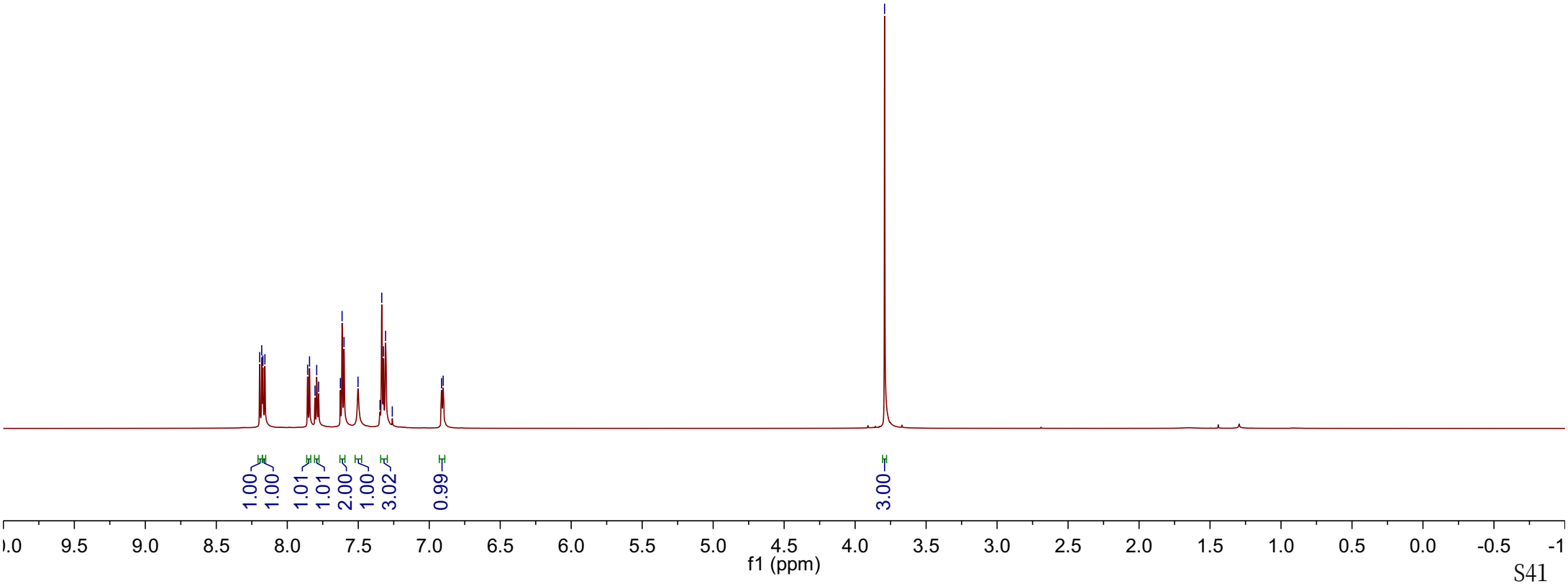
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

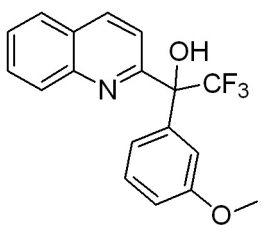




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3e

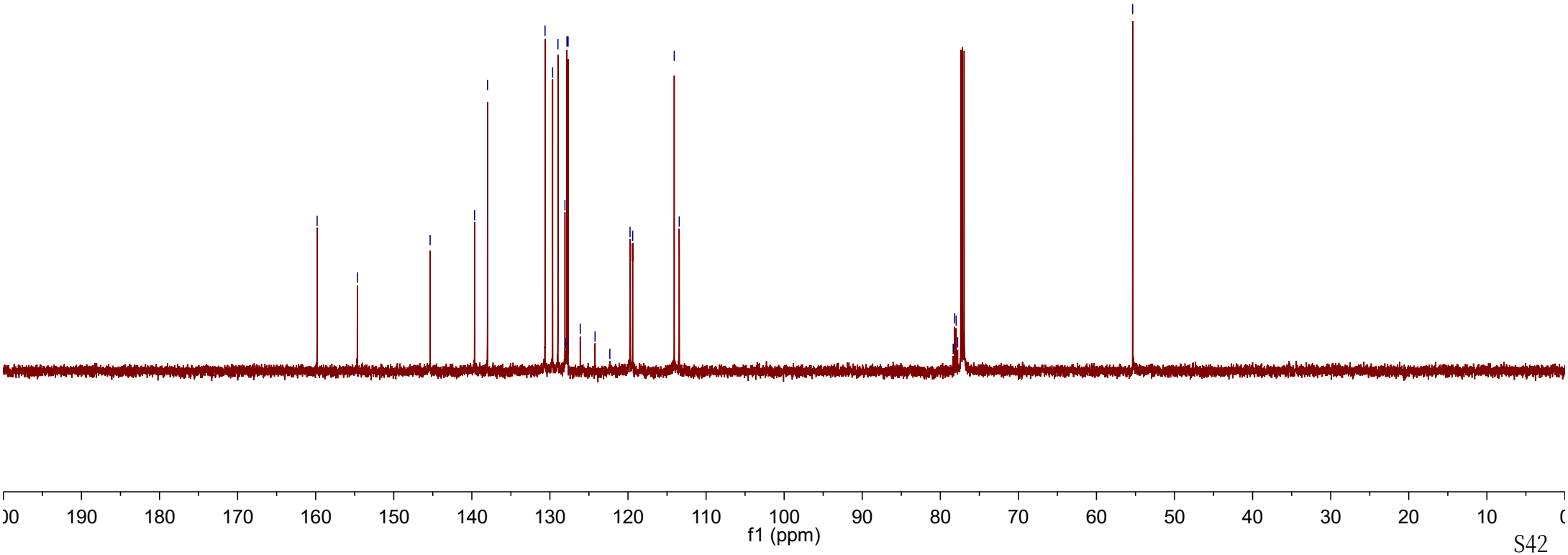


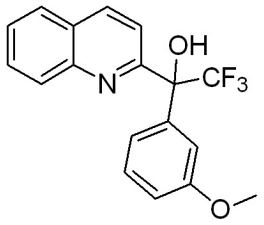


3e

159.81
154.66
145.34
139.65
137.99
130.62
129.65
128.97
128.07
128.01
127.82
127.67
126.11
124.22
122.32
119.73
119.40
114.08
113.44
78.35
78.16
77.97
77.78
55.36

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

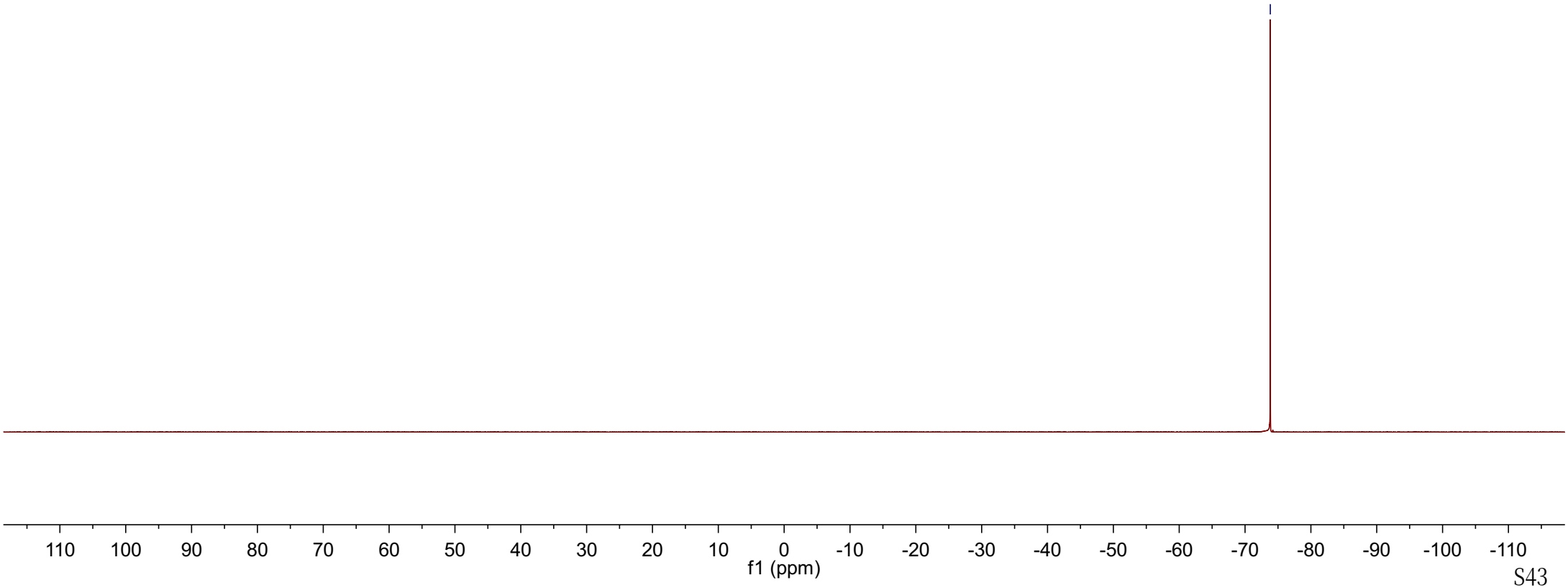




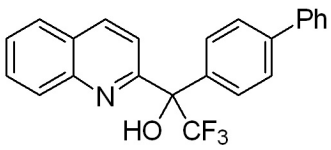
3e

-73.84

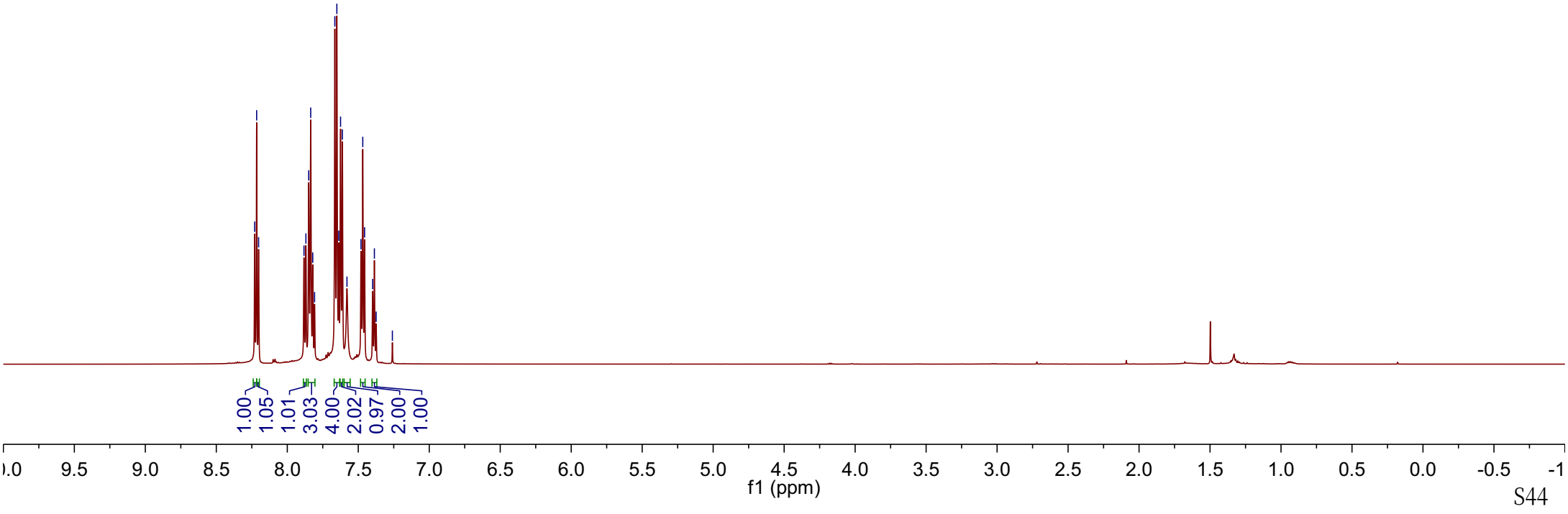
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

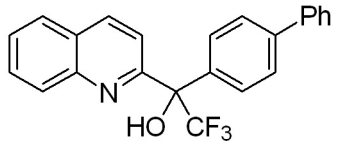


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



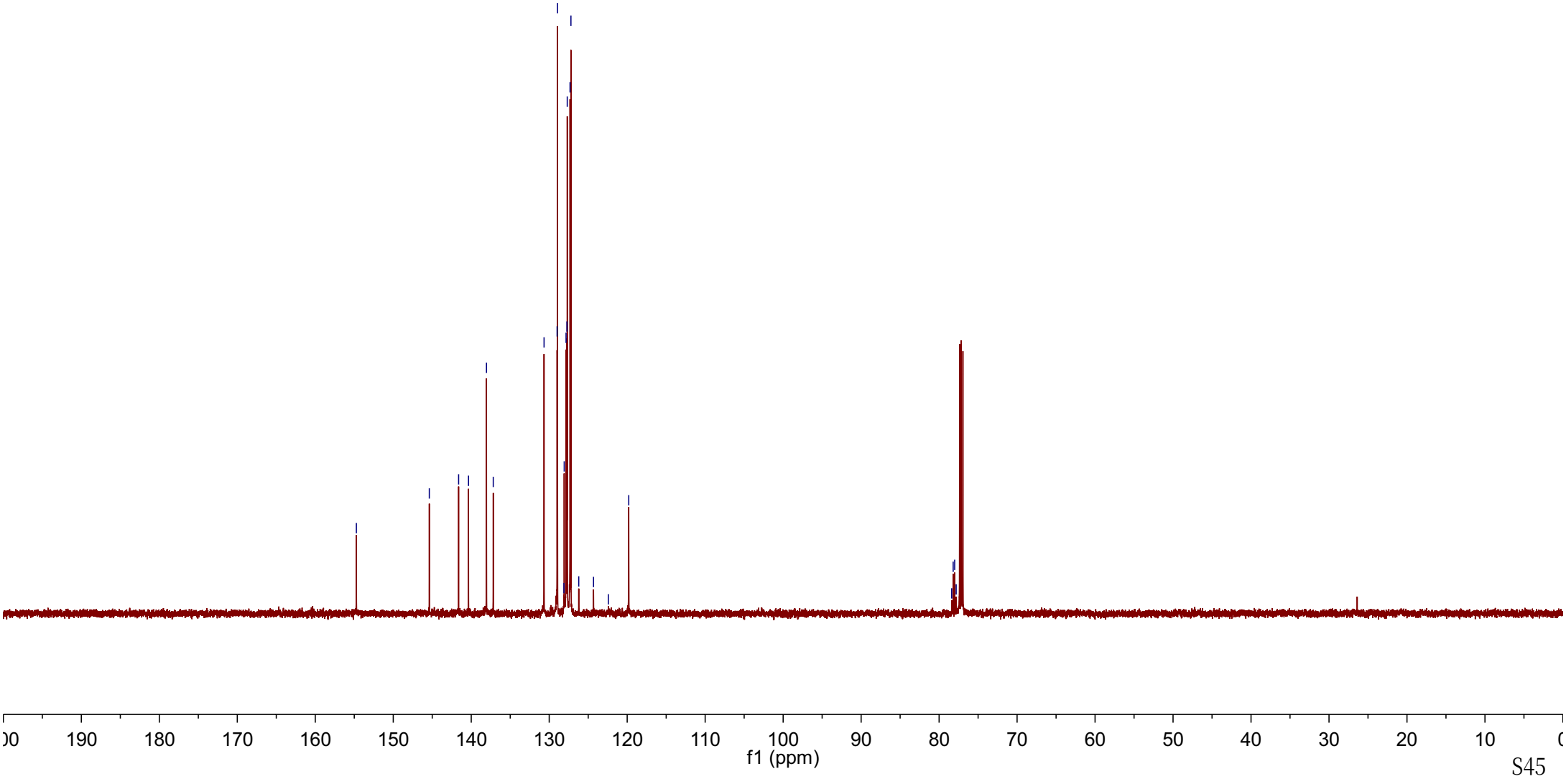
3f

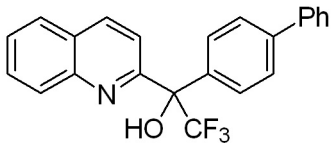




3f

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

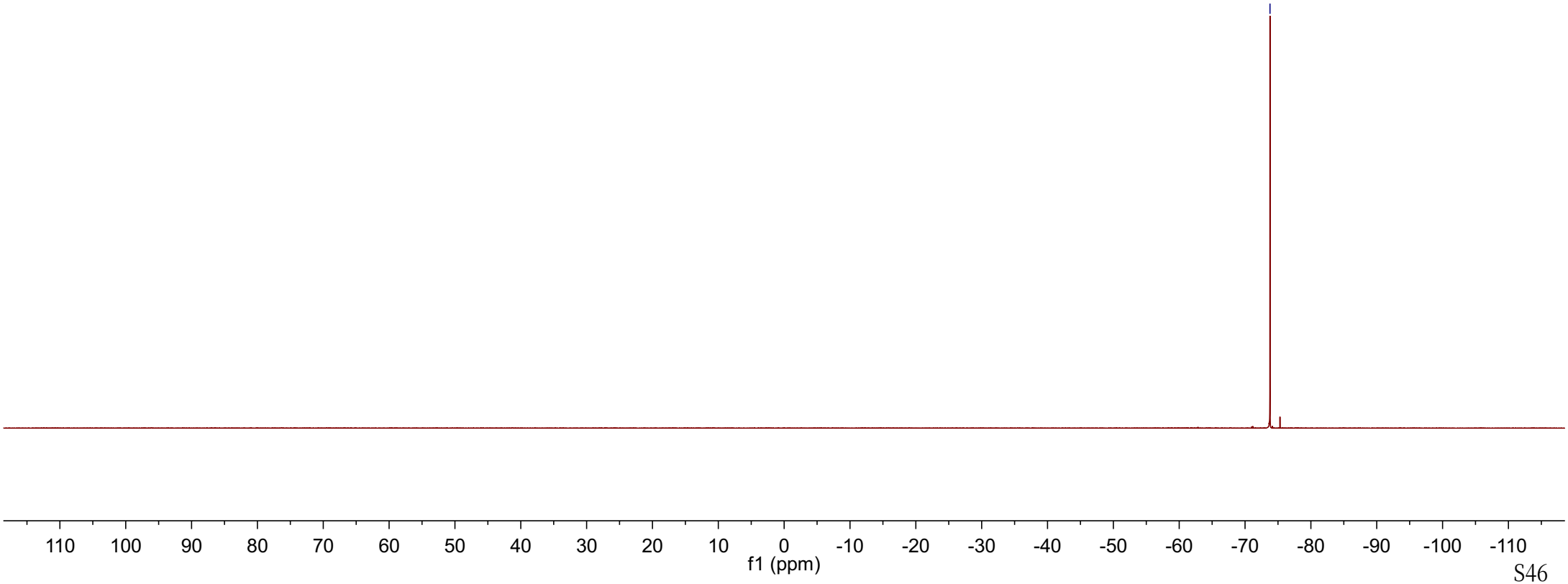


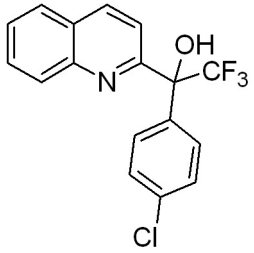


3f

-73.79

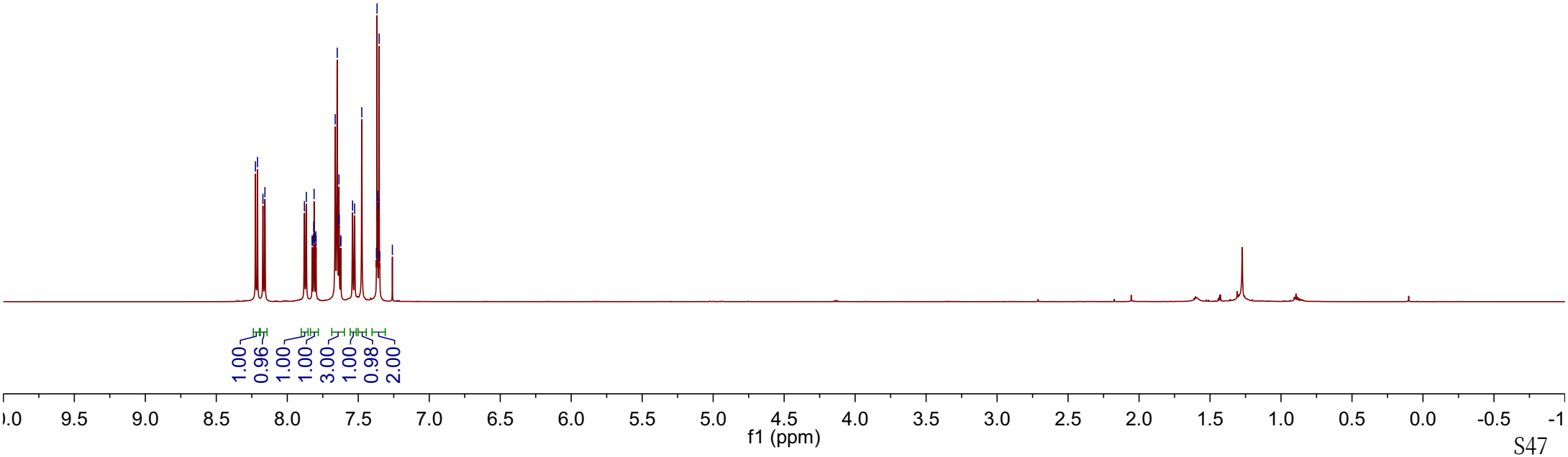
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





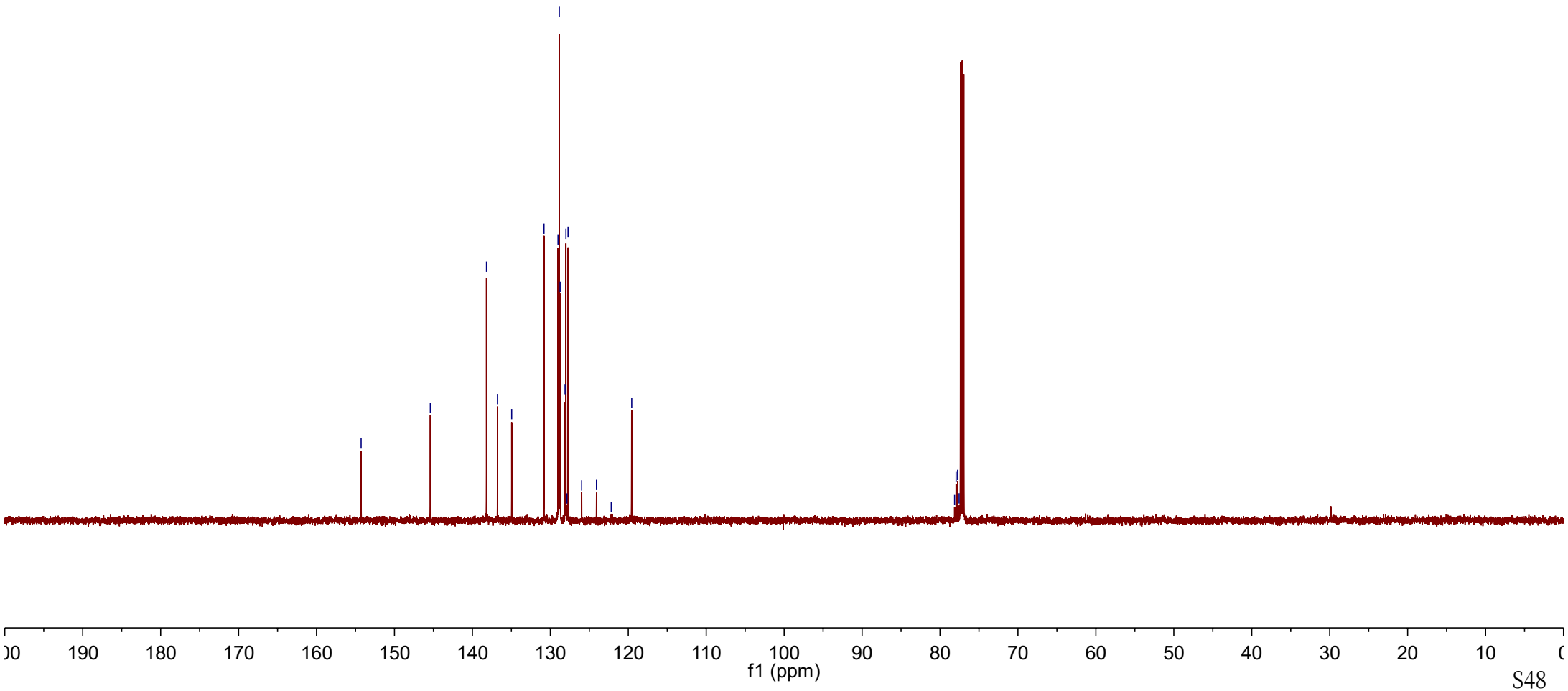
3g

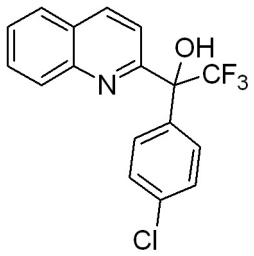
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

3g

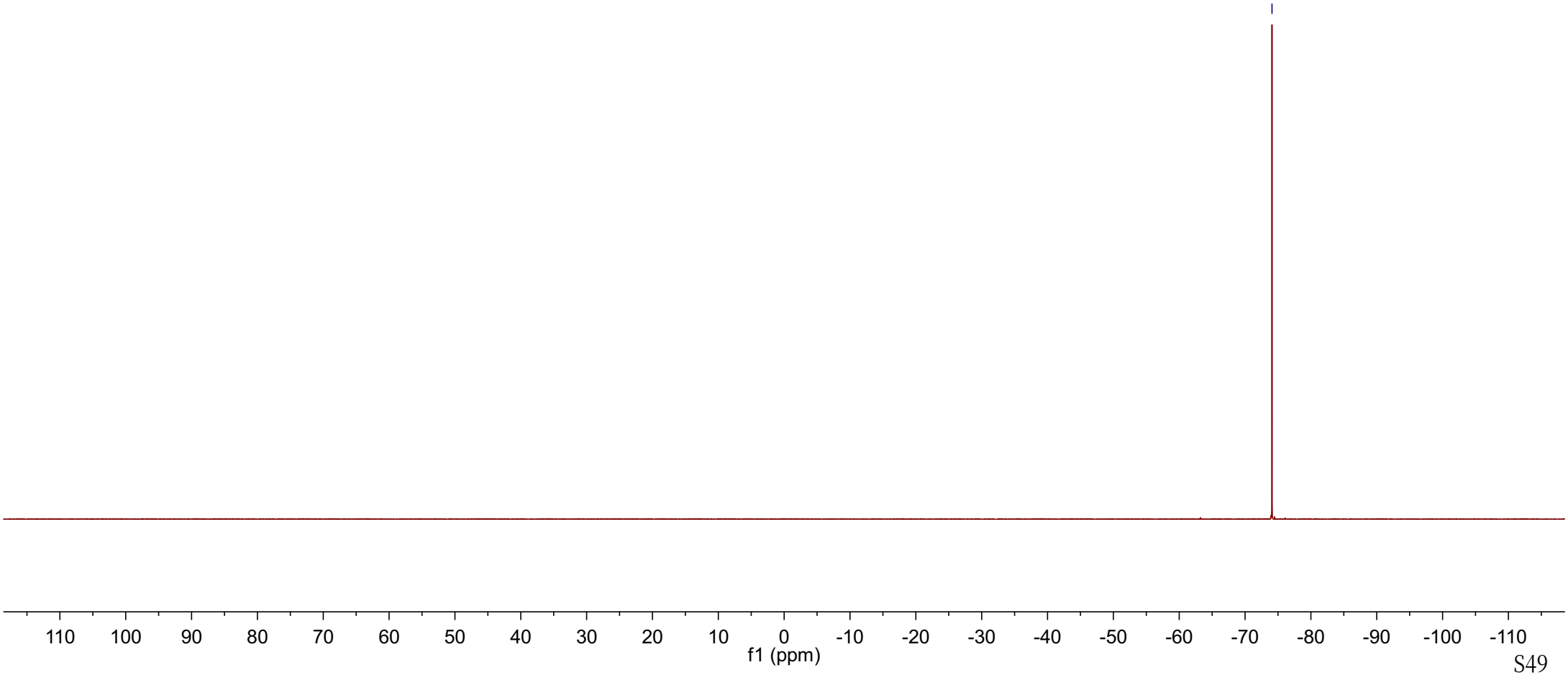


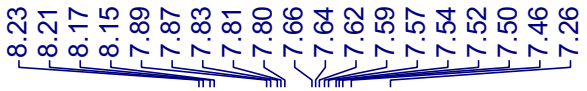


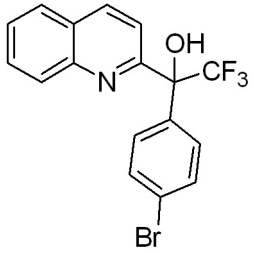
3g

-74.09

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

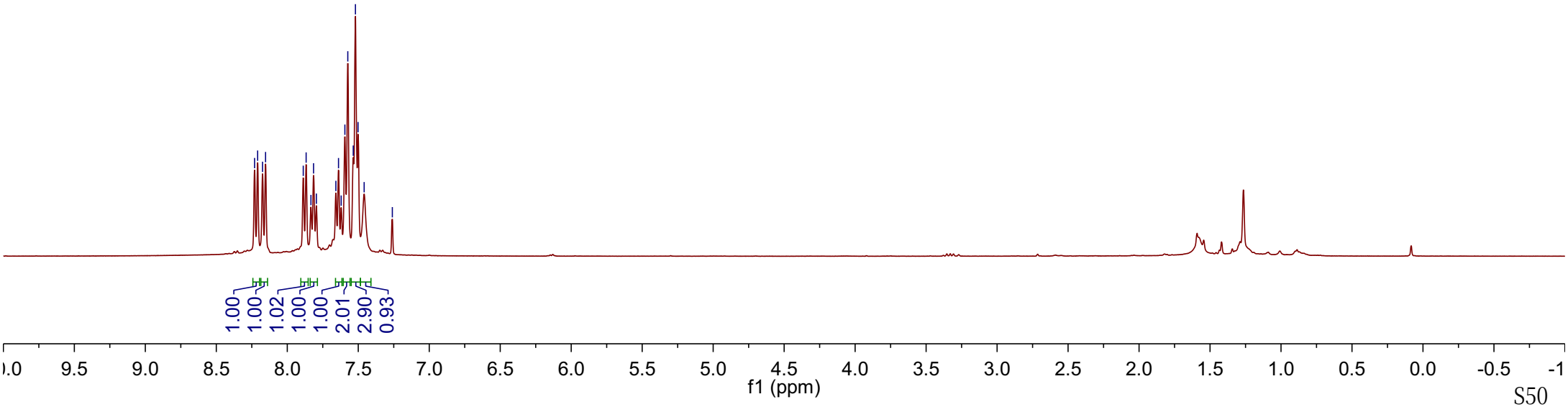






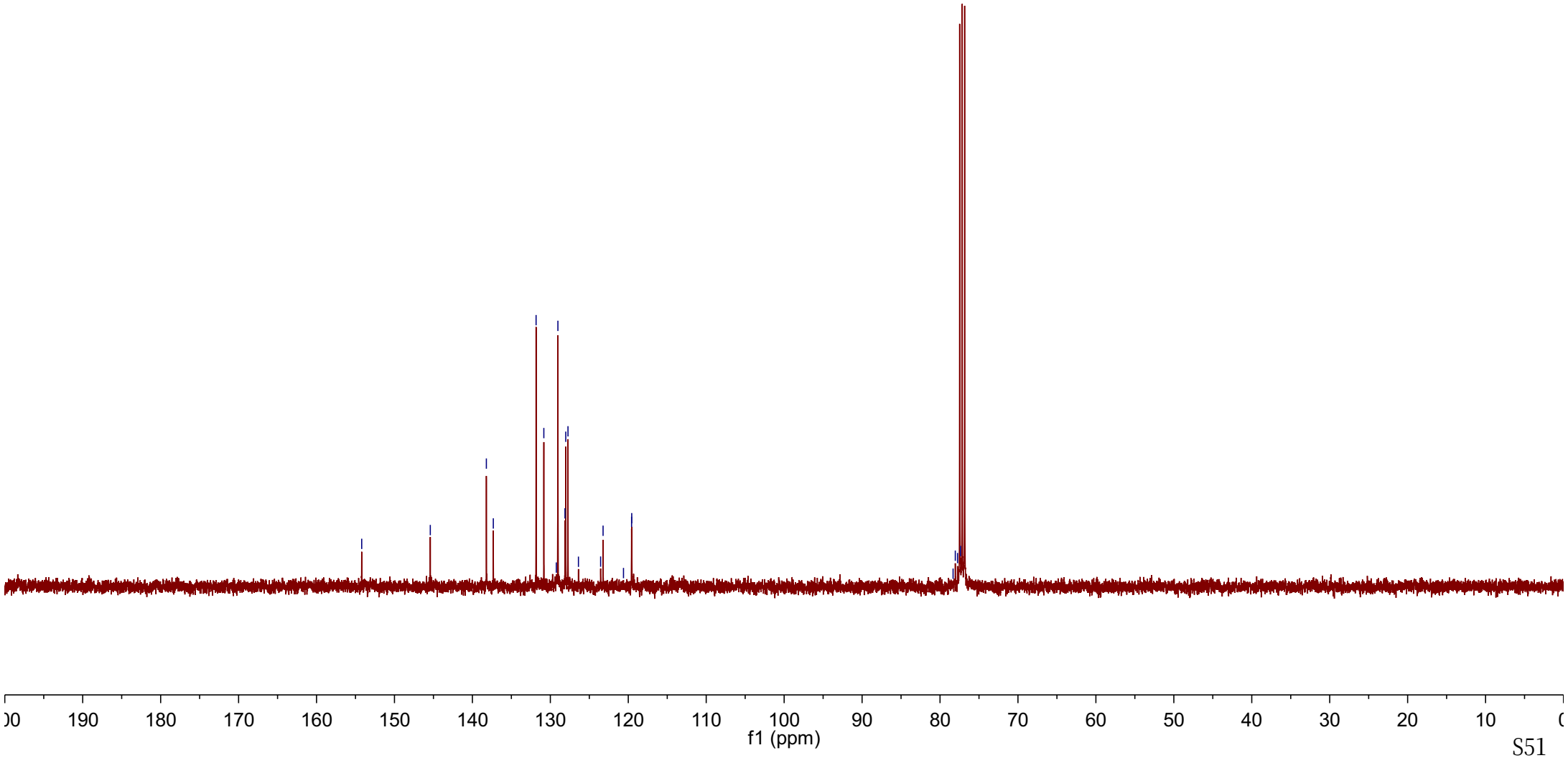
3h

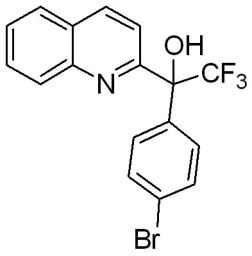
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	400



Parameter	Value
Solvent	CDC13
Spectrometer Frequency	100

3h

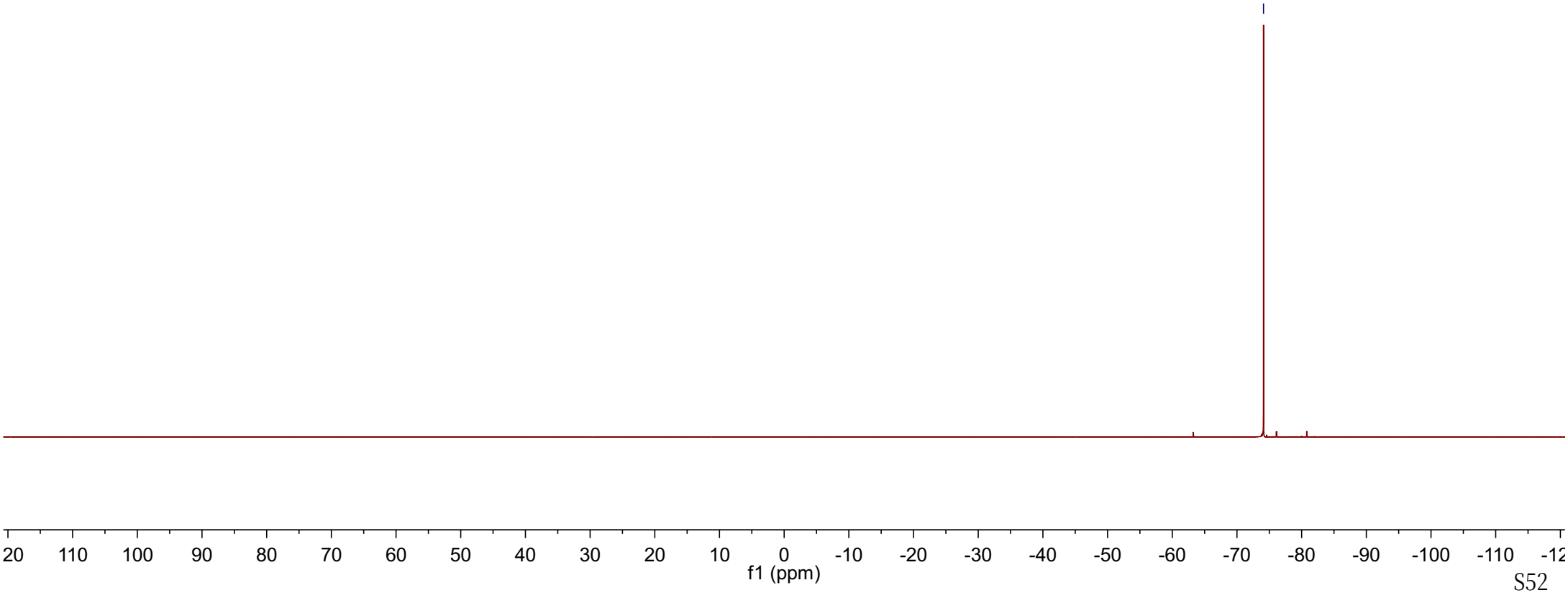




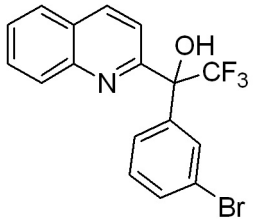
3h

-74.11

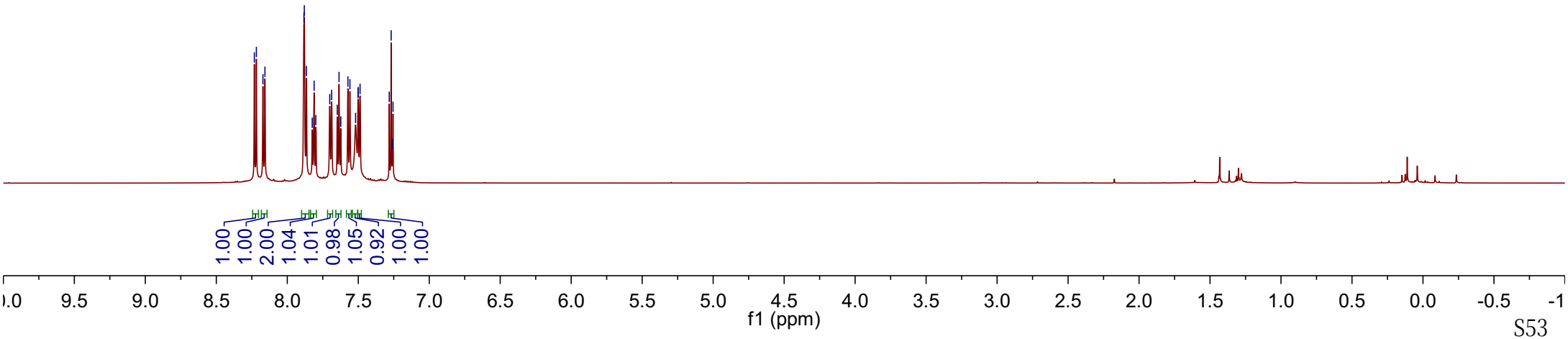
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	377

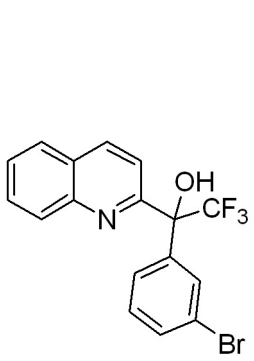


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



3i

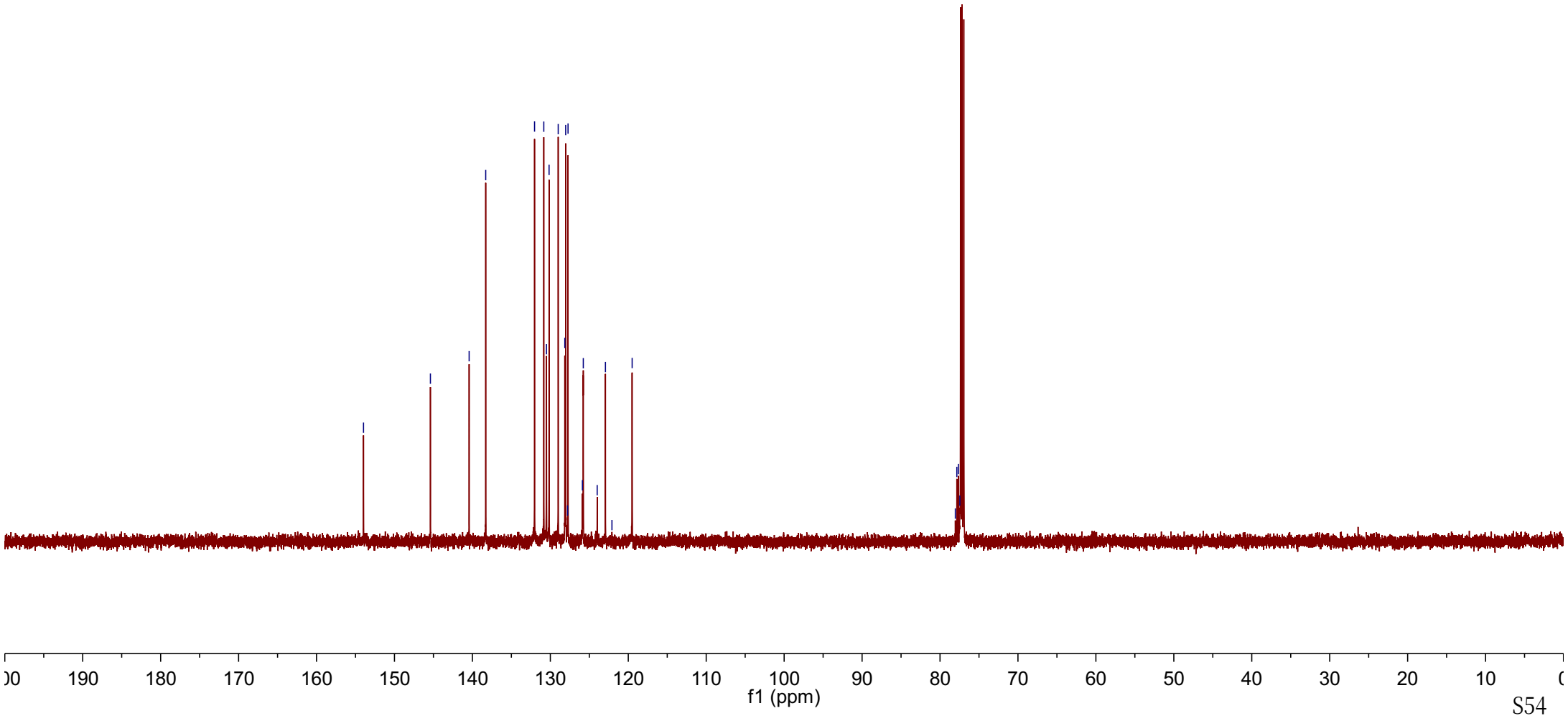


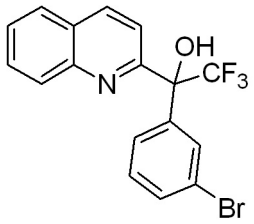


3i

153.97
145.39
140.42
138.29
132.03
130.84
130.50
130.16
128.99
128.14
128.03
127.78
127.73
125.89
125.77
123.99
122.93
122.10
119.50
78.04
77.84
77.65
77.46

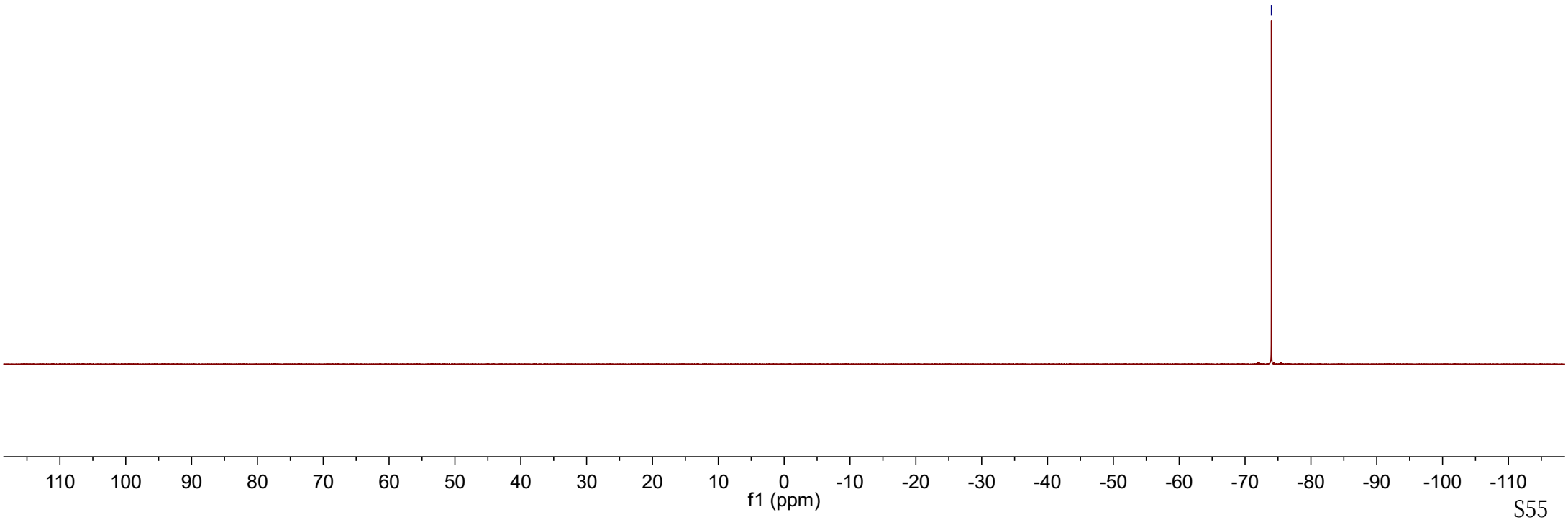
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

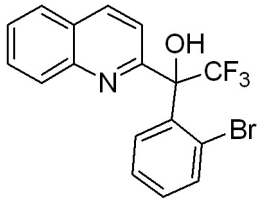




3i

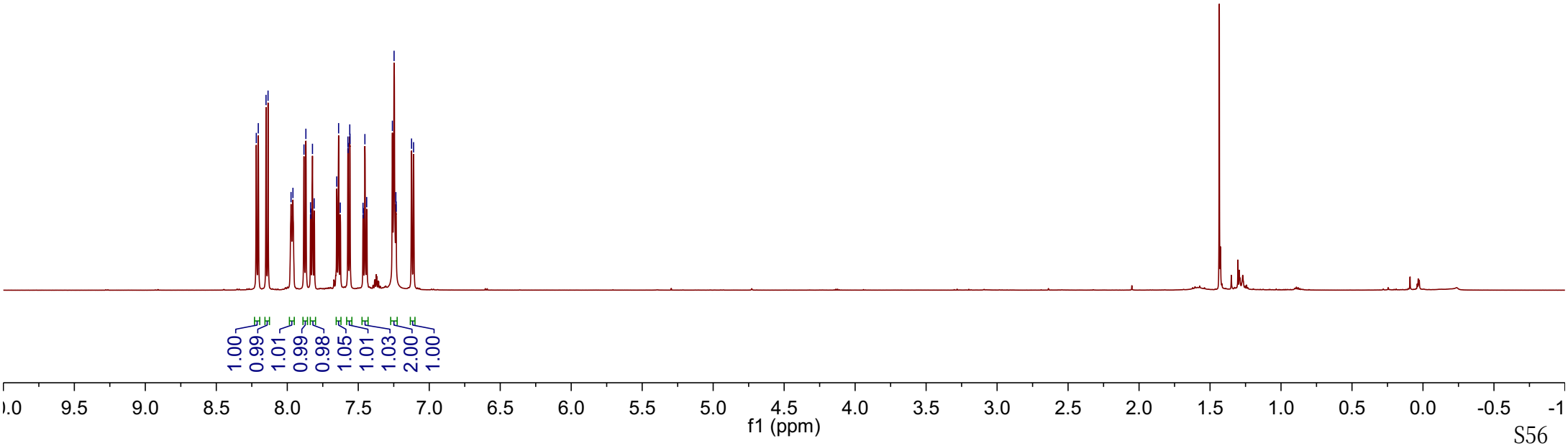
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





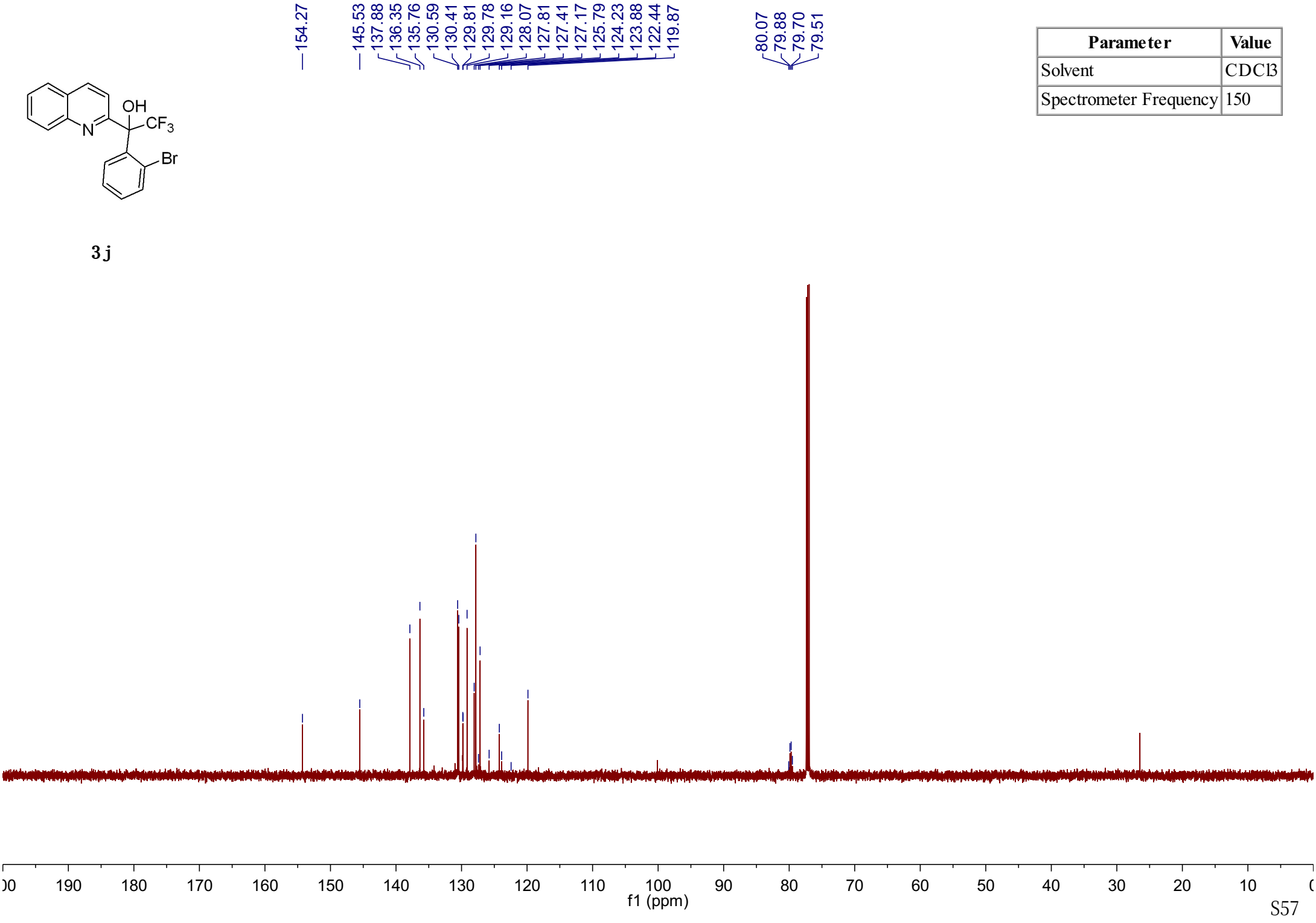
3 j

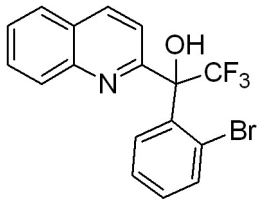
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



3j

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

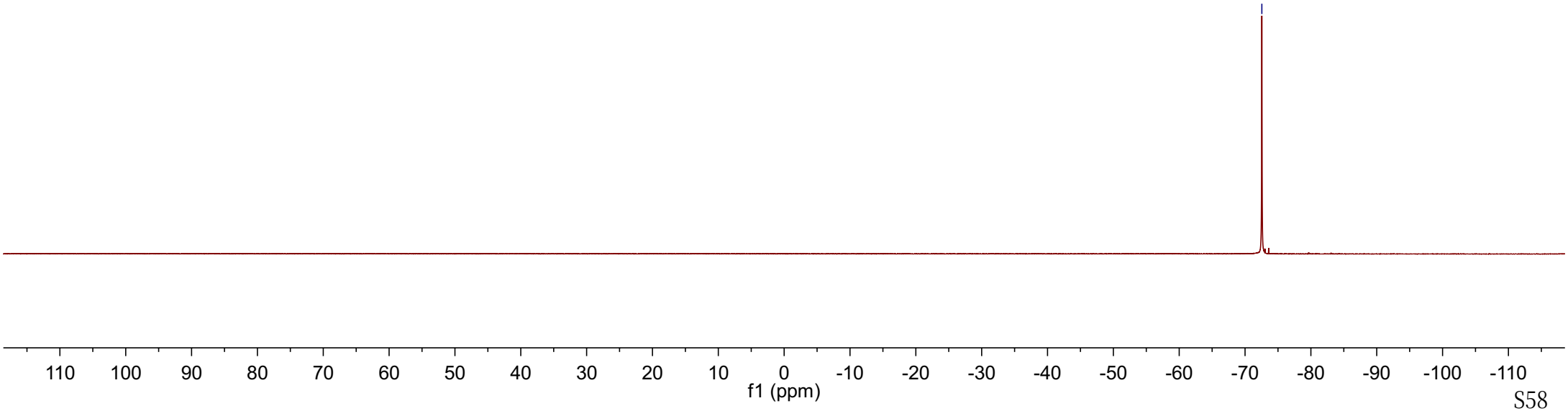


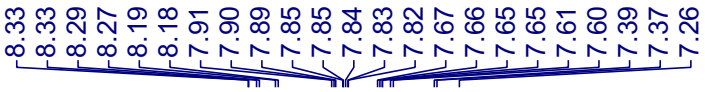


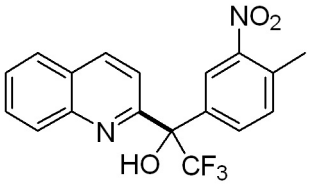
3j

-72.55

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

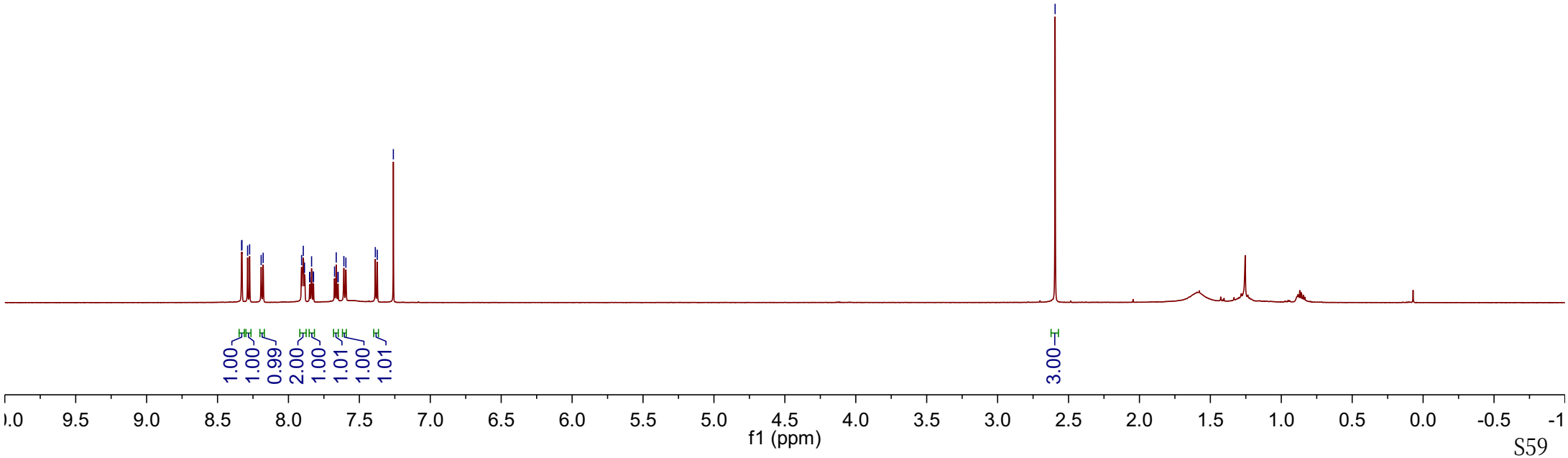


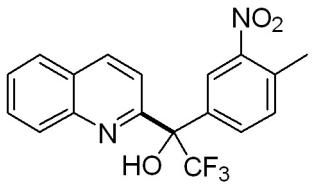




3k

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600





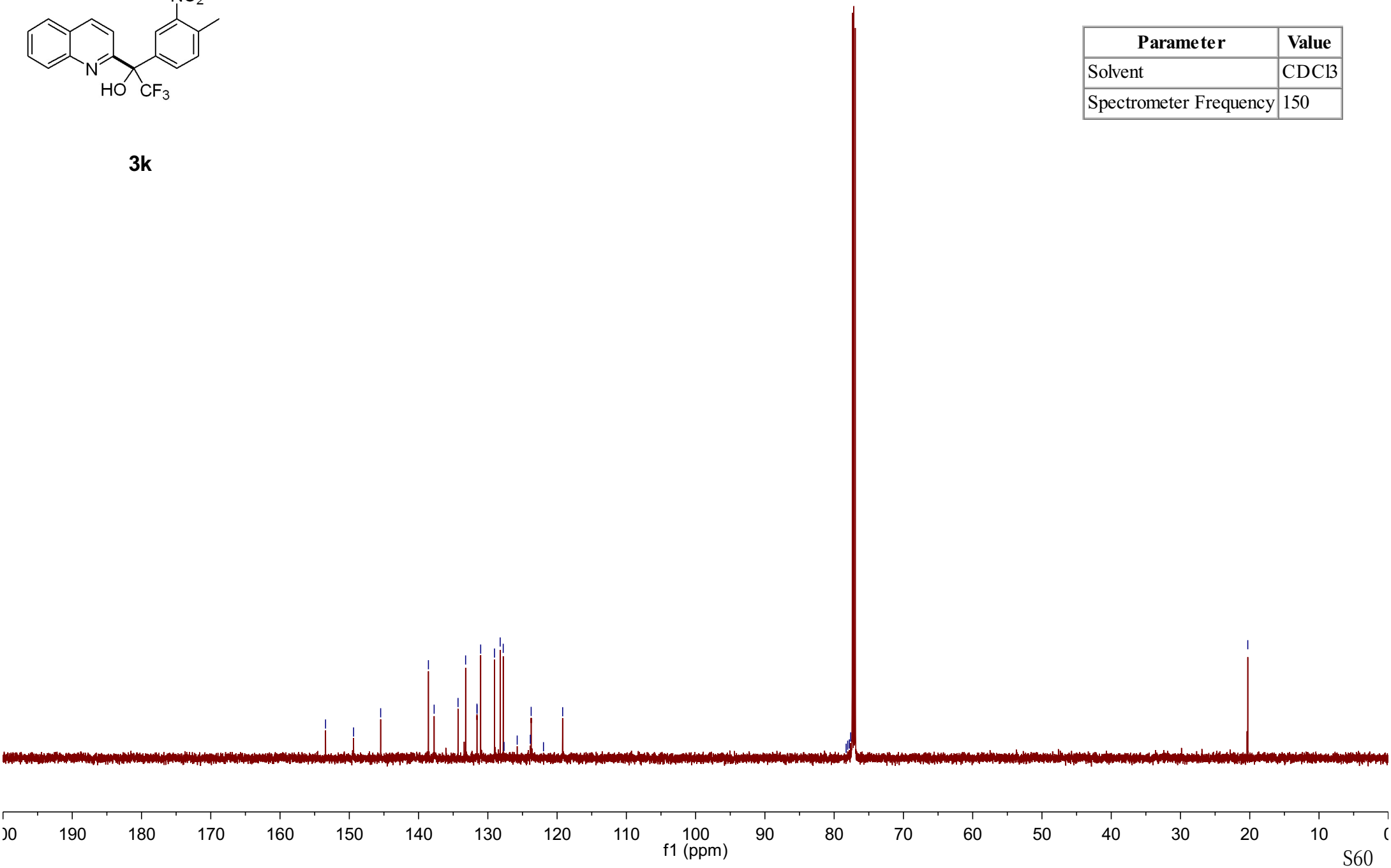
3k

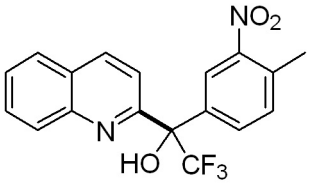
153.43
149.38
145.47
138.58
137.75
134.30
133.21
131.57
131.56
131.03
129.04
128.22
127.78
127.66
125.76
123.86
123.75
121.97
119.20

78.27
78.05
77.81
77.61

20.28

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

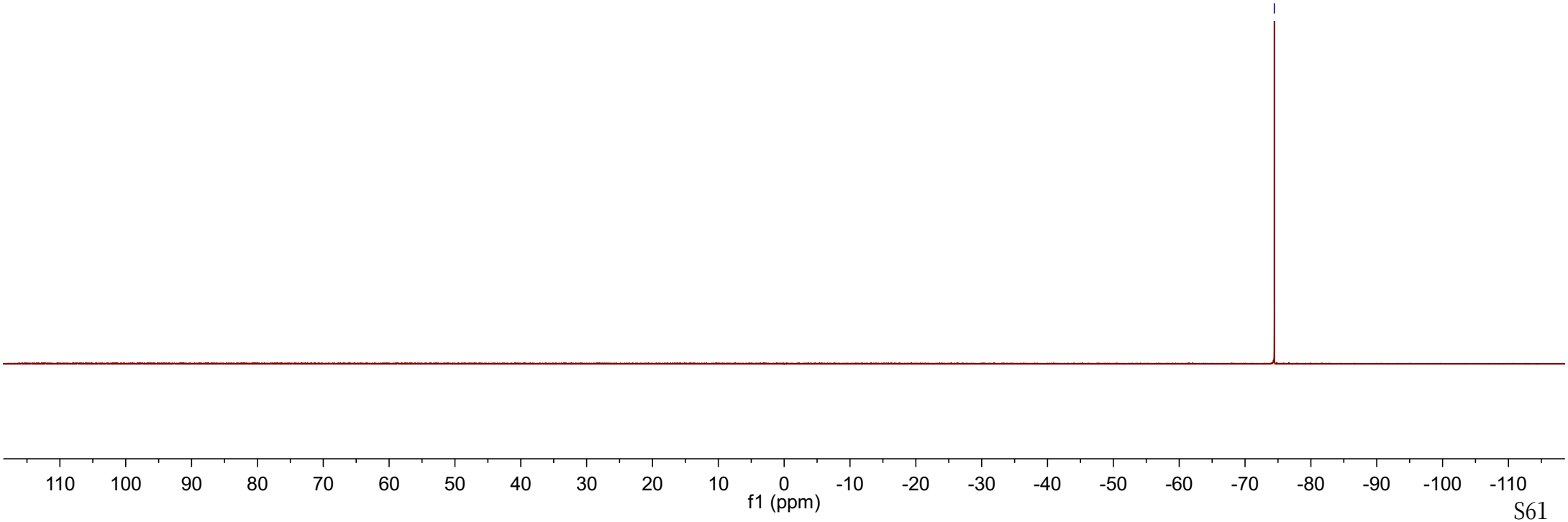


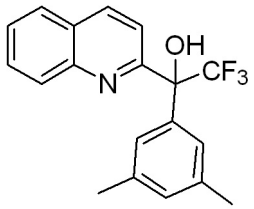


3k

-74.44

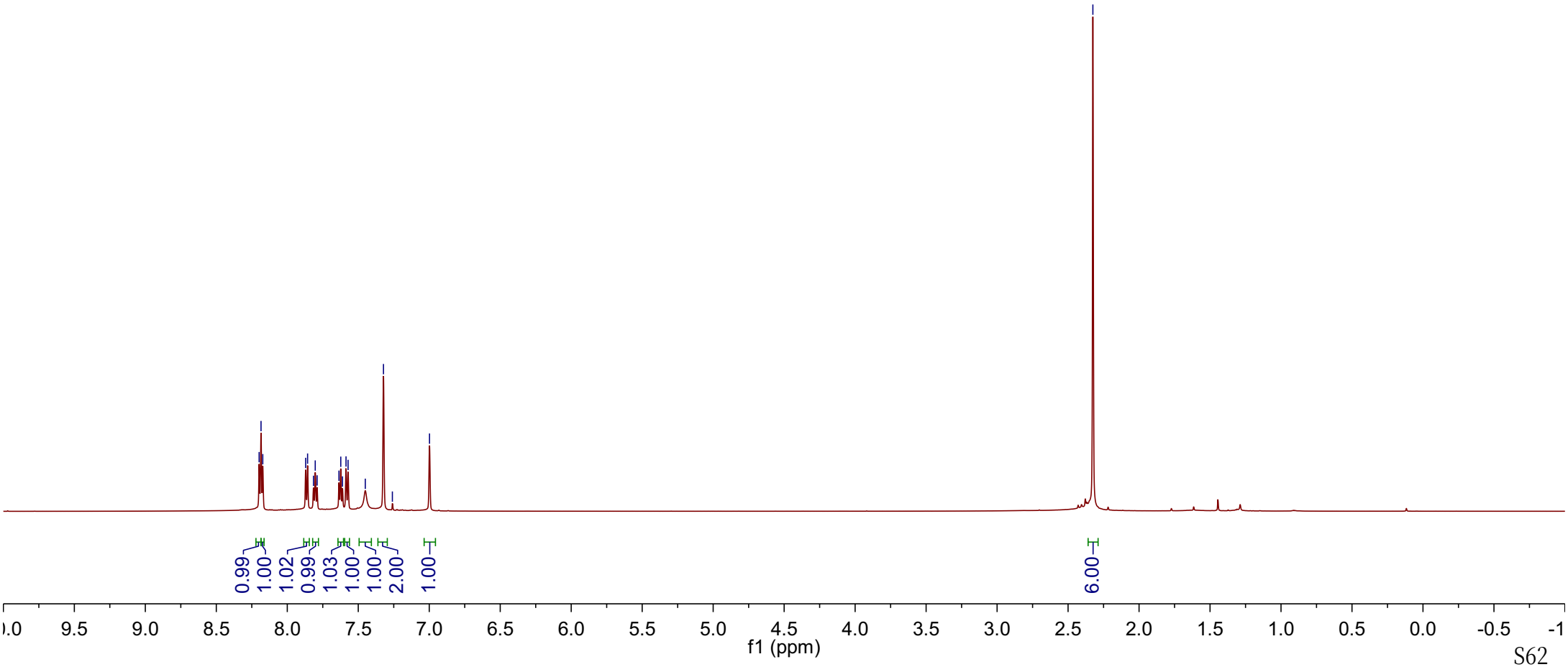
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

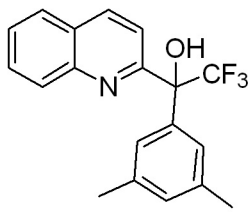




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

31

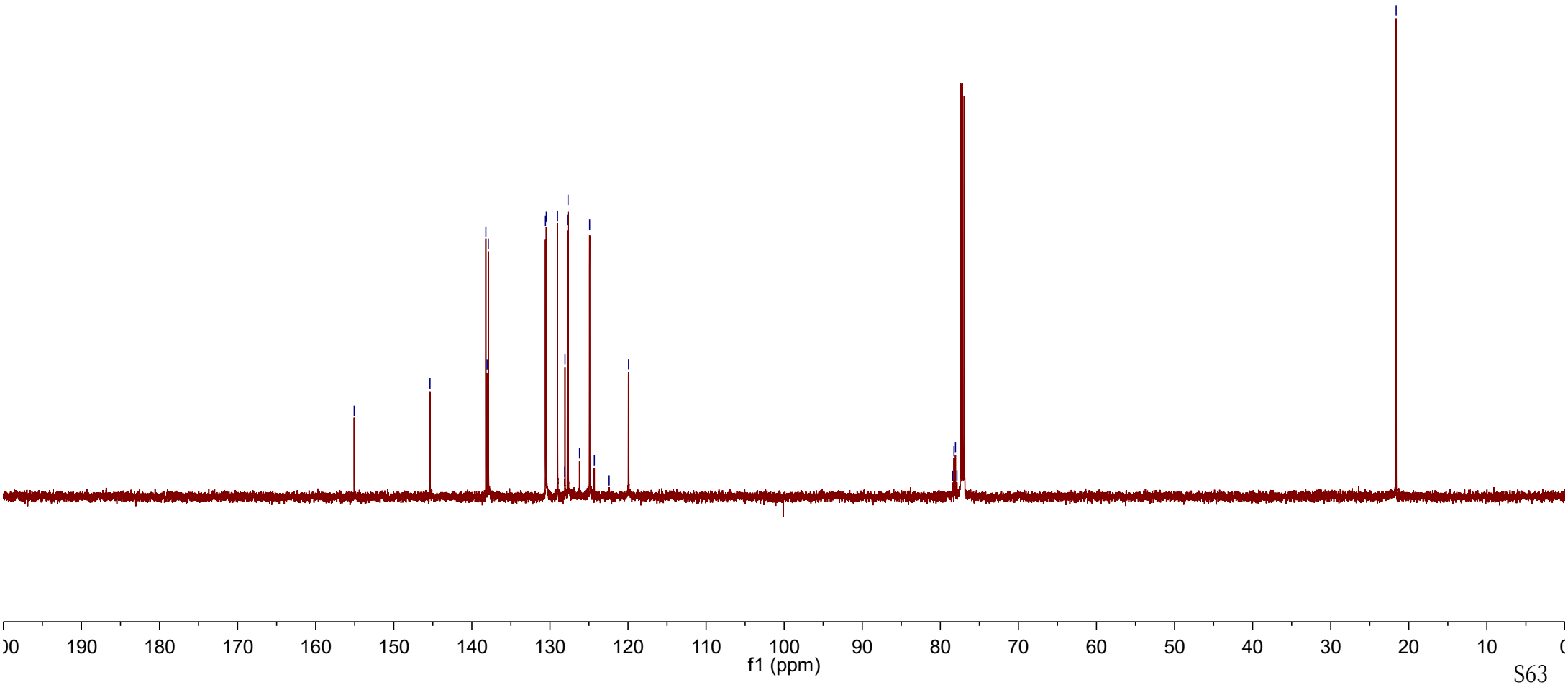


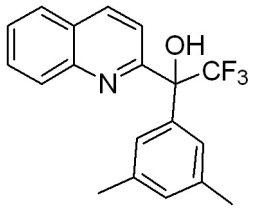


31

155.07
145.36
138.21
138.05
137.89
130.57
130.47
129.03
128.10
128.07
127.76
127.68
126.21
124.92
124.31
122.42
119.93
78.44
78.25
78.06
77.87
21.62

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

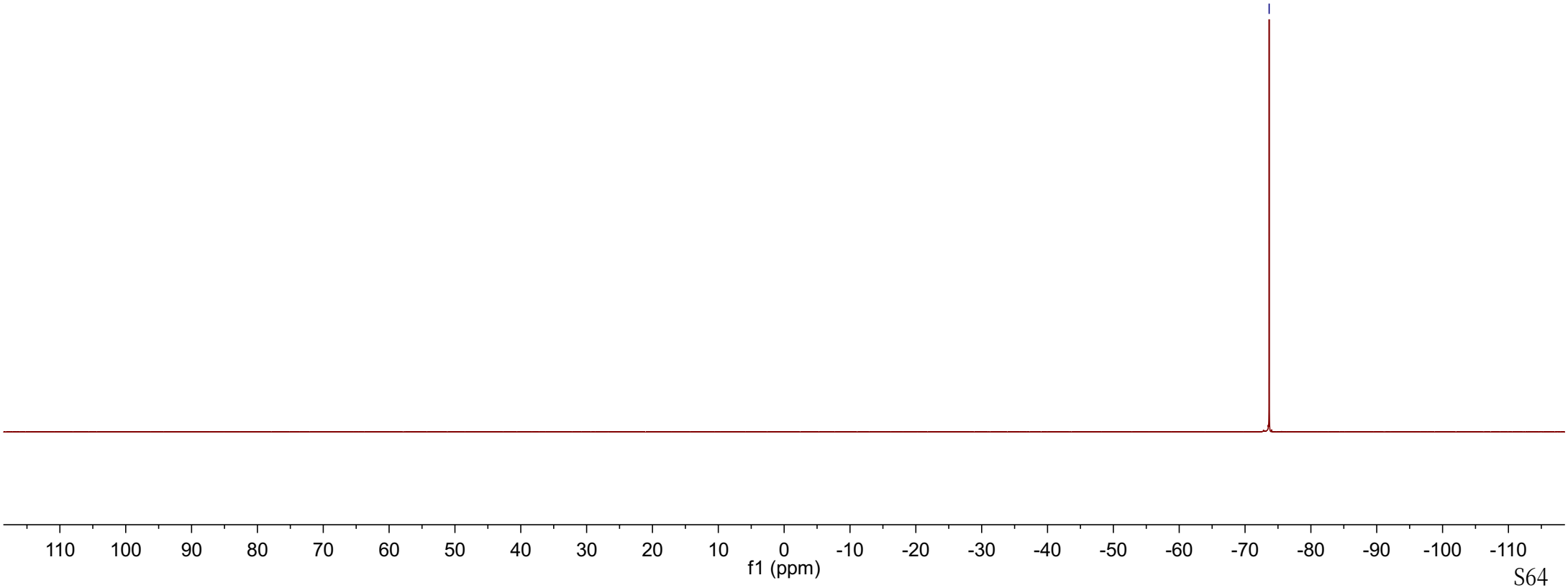


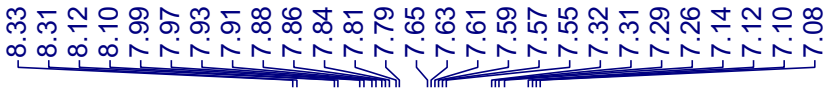


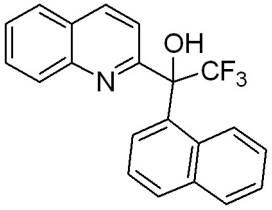
31

-73.66

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

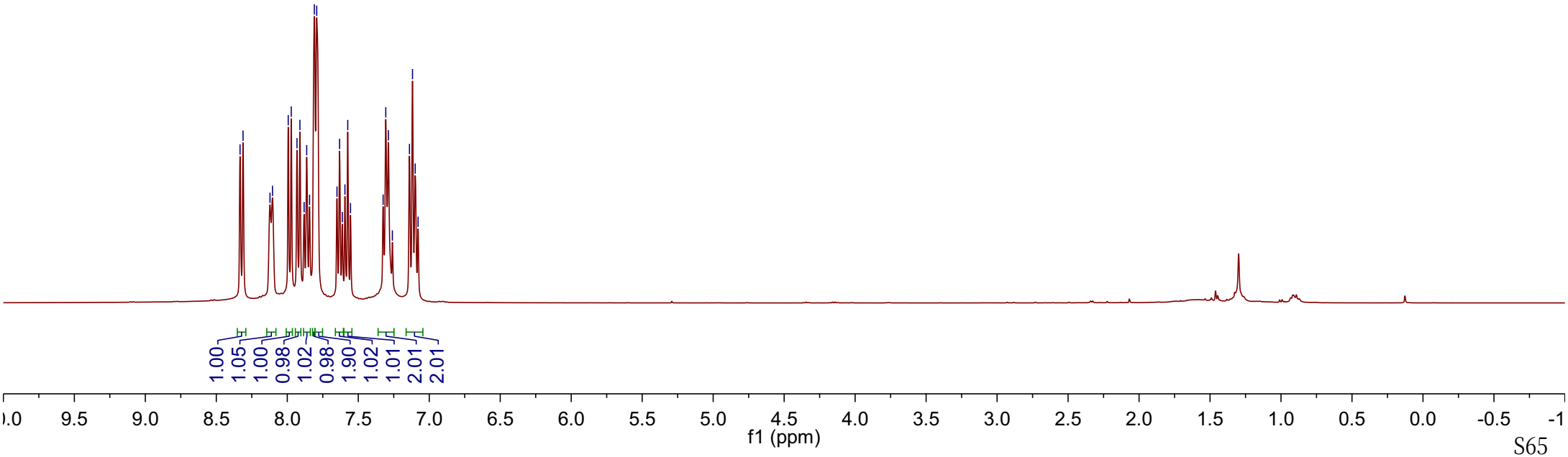


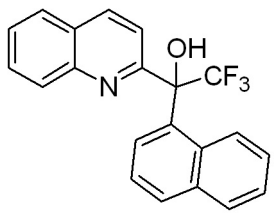




3m

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	400

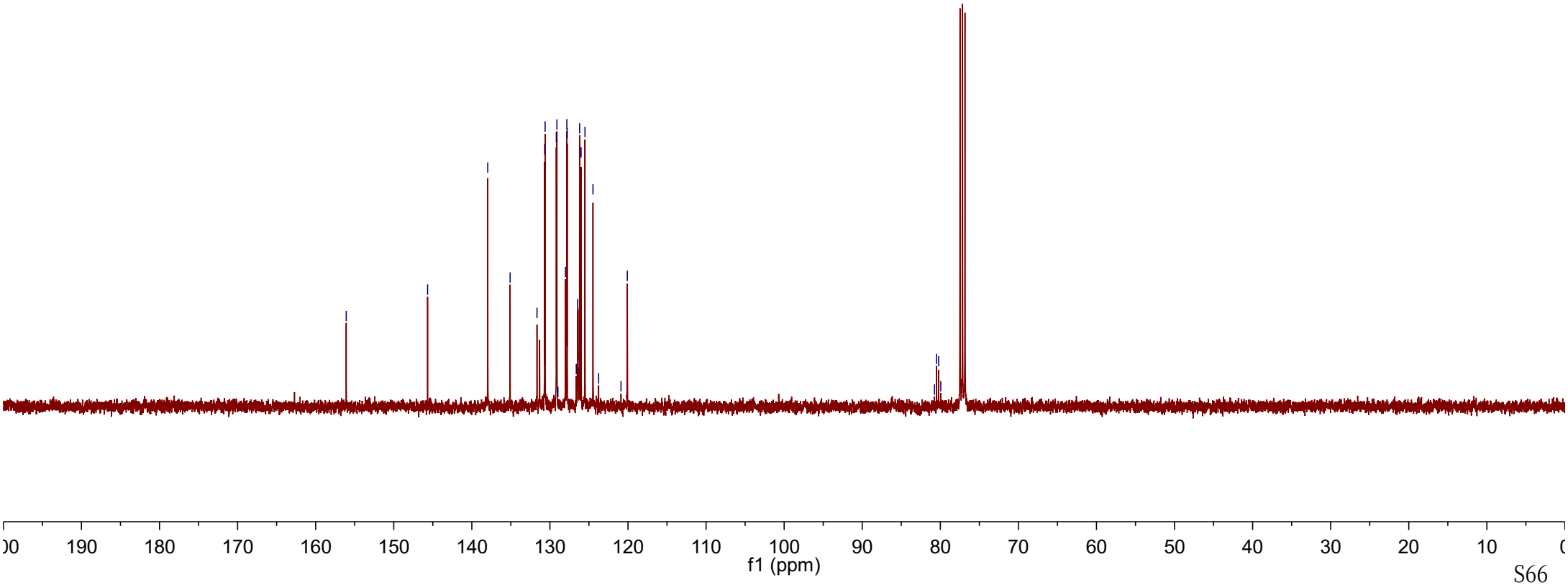


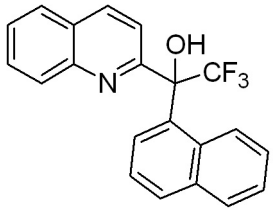


3m

156.09
145.67
137.96
135.10
131.66
130.67
130.61
129.18
129.10
128.97
128.02
127.83
127.78
126.62
126.45
126.20
126.01
125.51
124.48
123.76
120.90
120.09
80.75
80.48
80.21
79.94

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	100

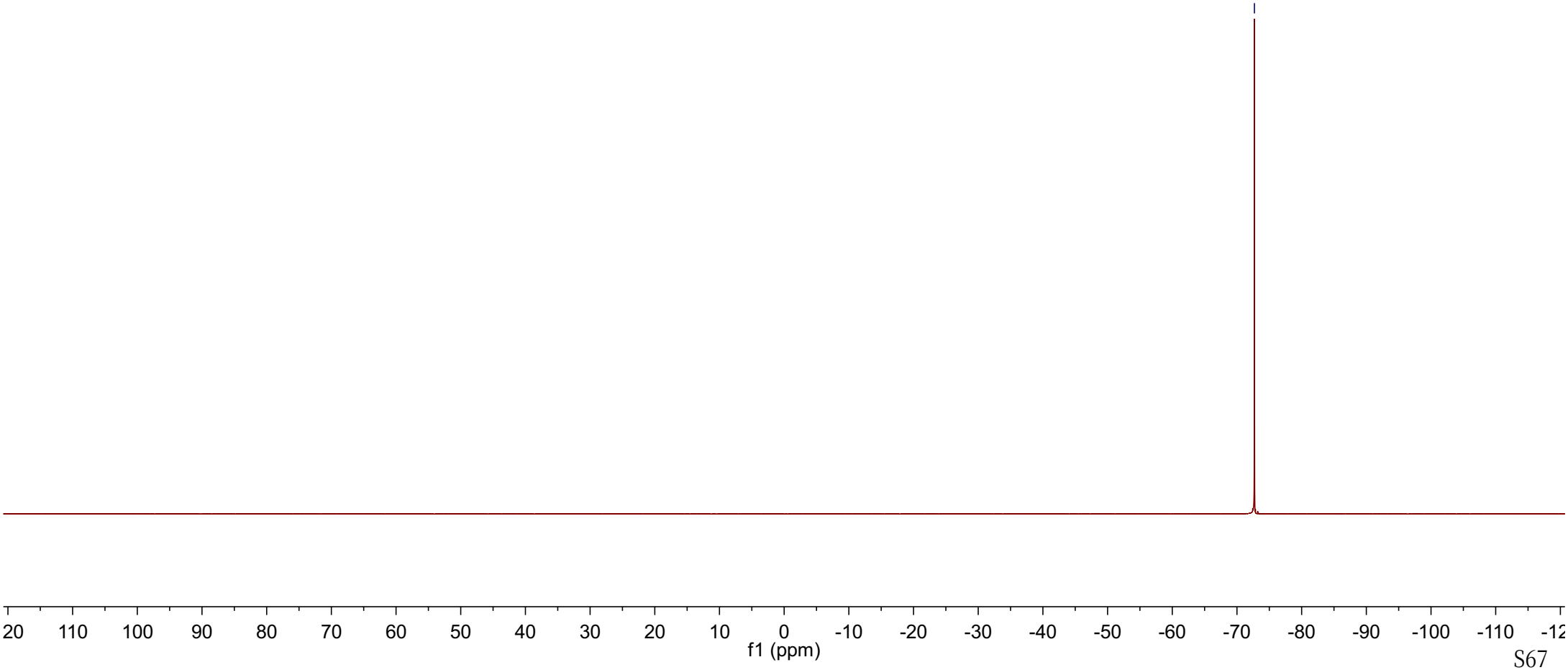


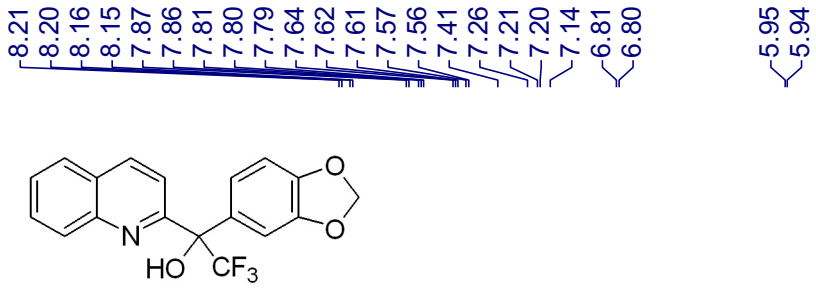


3m

-72.70

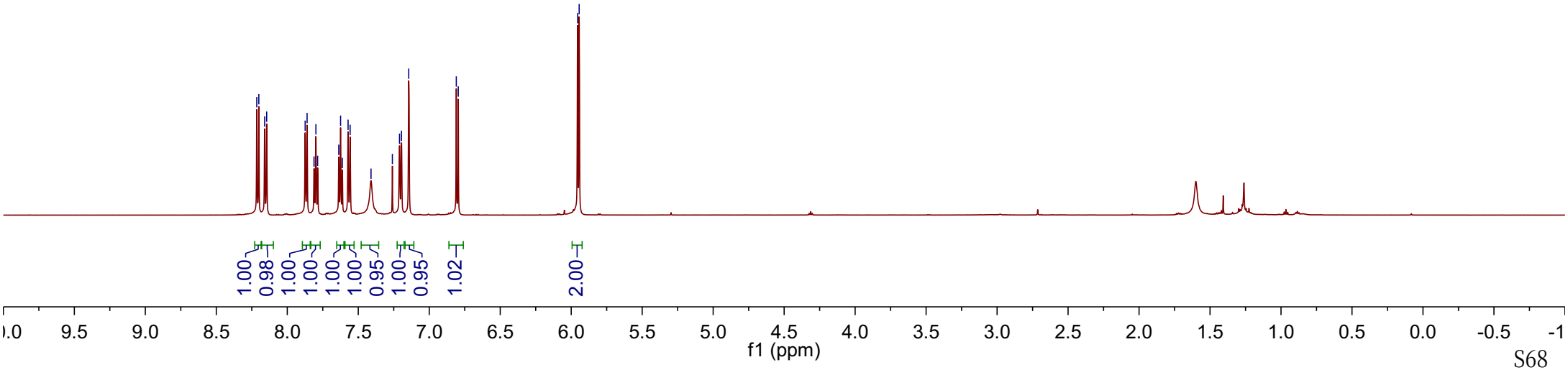
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	377

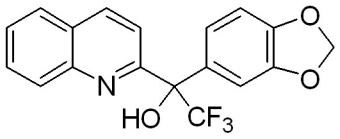




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3n

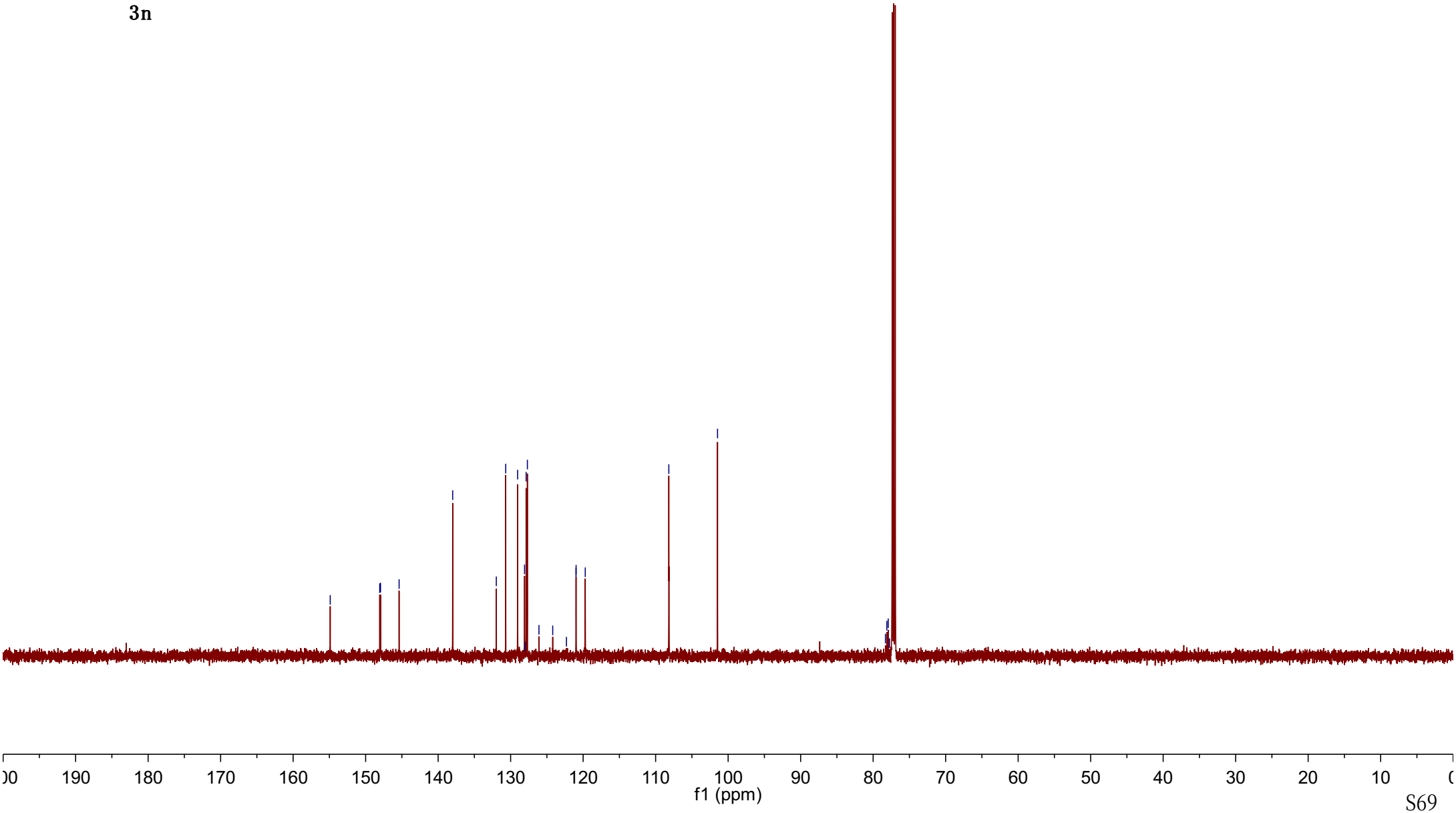


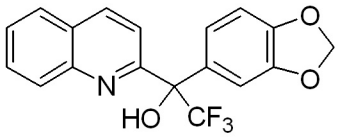


154.88
148.05
147.95
145.38
137.99
131.97
130.68
129.04
128.08
127.86
127.69
120.98
120.97
119.71
108.18
101.46
78.30
78.11
77.92
77.74

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

3n

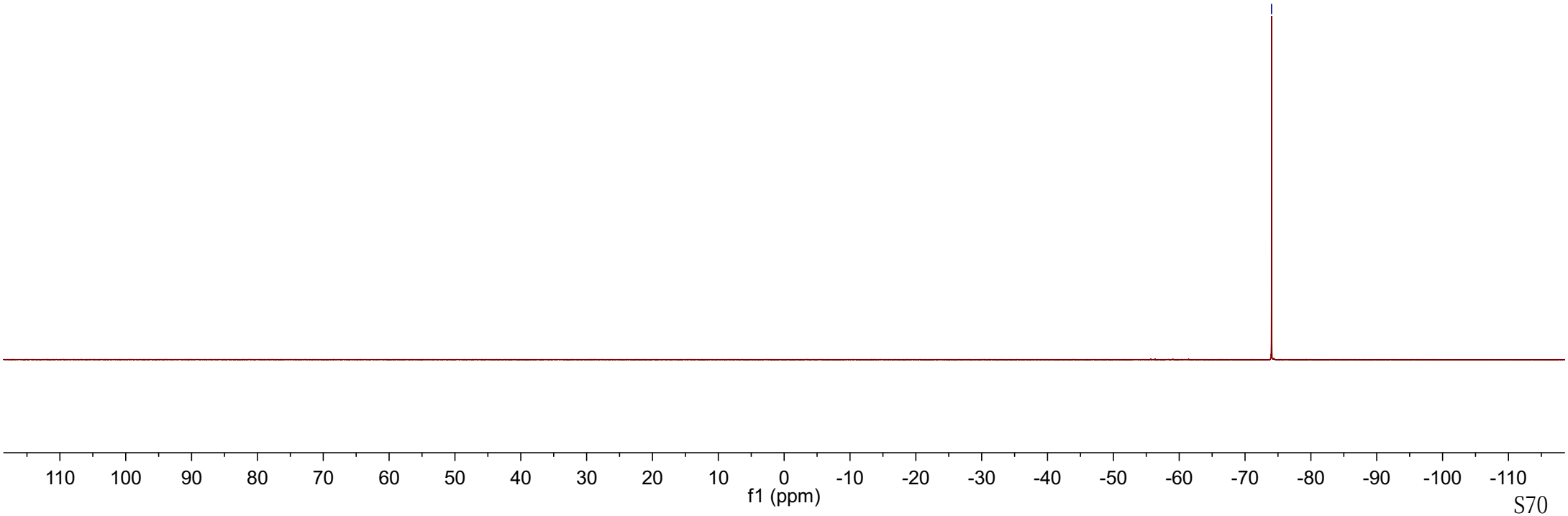


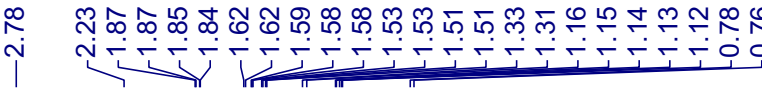


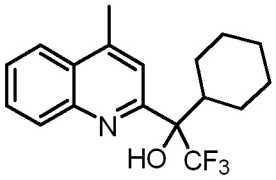
3n

-74.03

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

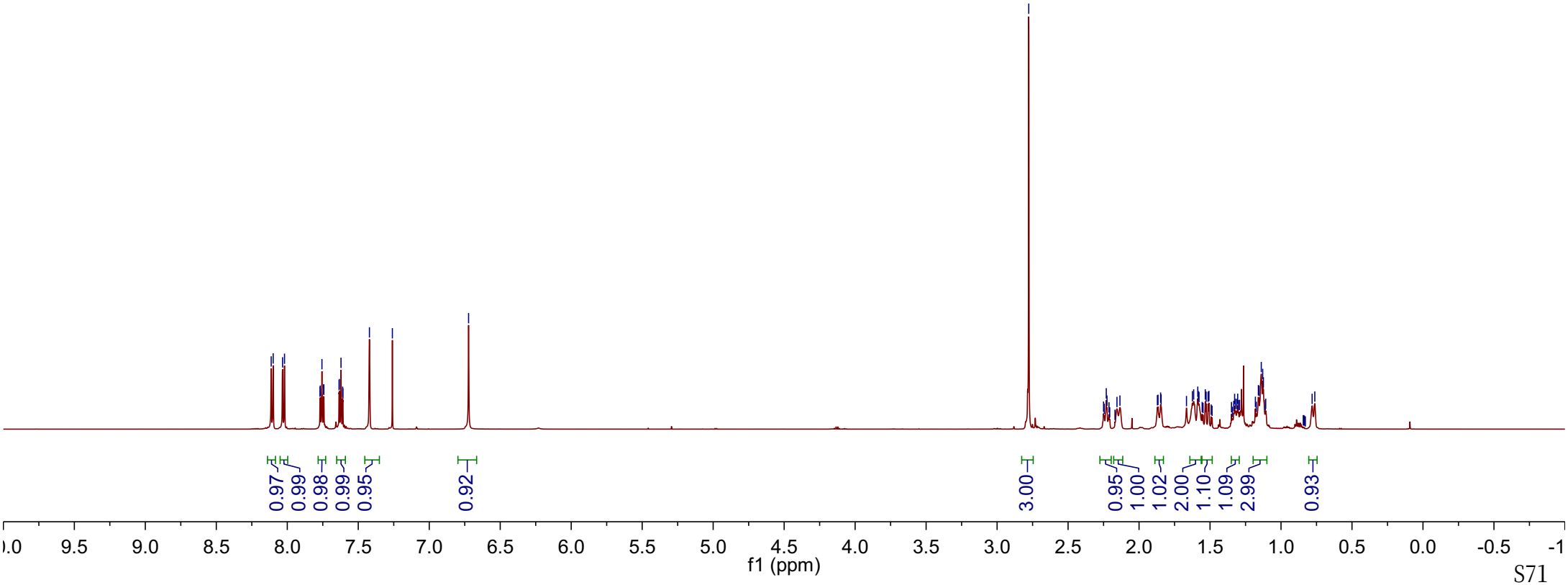


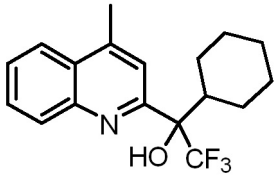




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3o

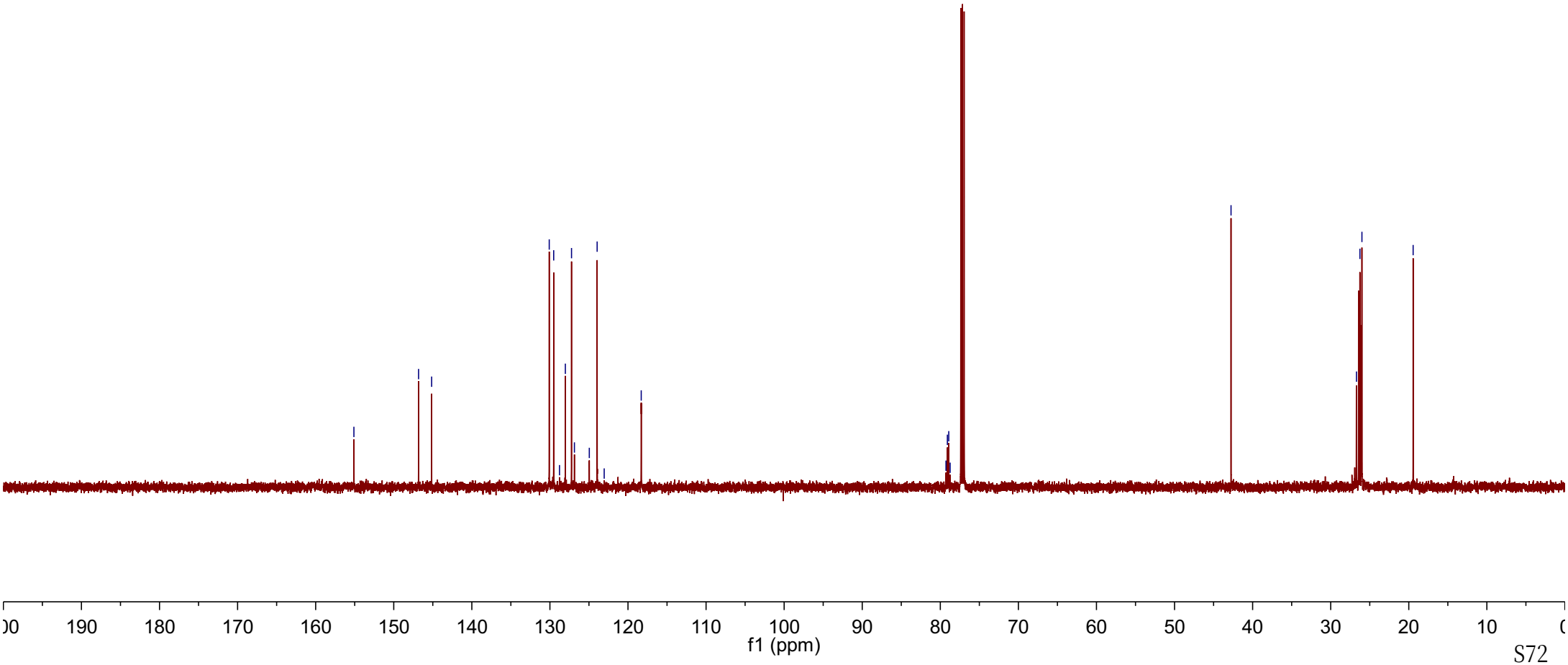


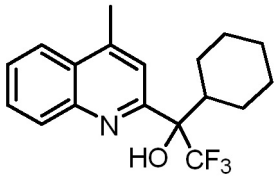


3o

155.10
146.82
145.15
130.09
129.52
128.77
128.02
127.23
126.86
124.95
123.95
123.05
118.30
79.27
79.10
78.92
78.74
42.77
26.70
26.26
26.00
19.44

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

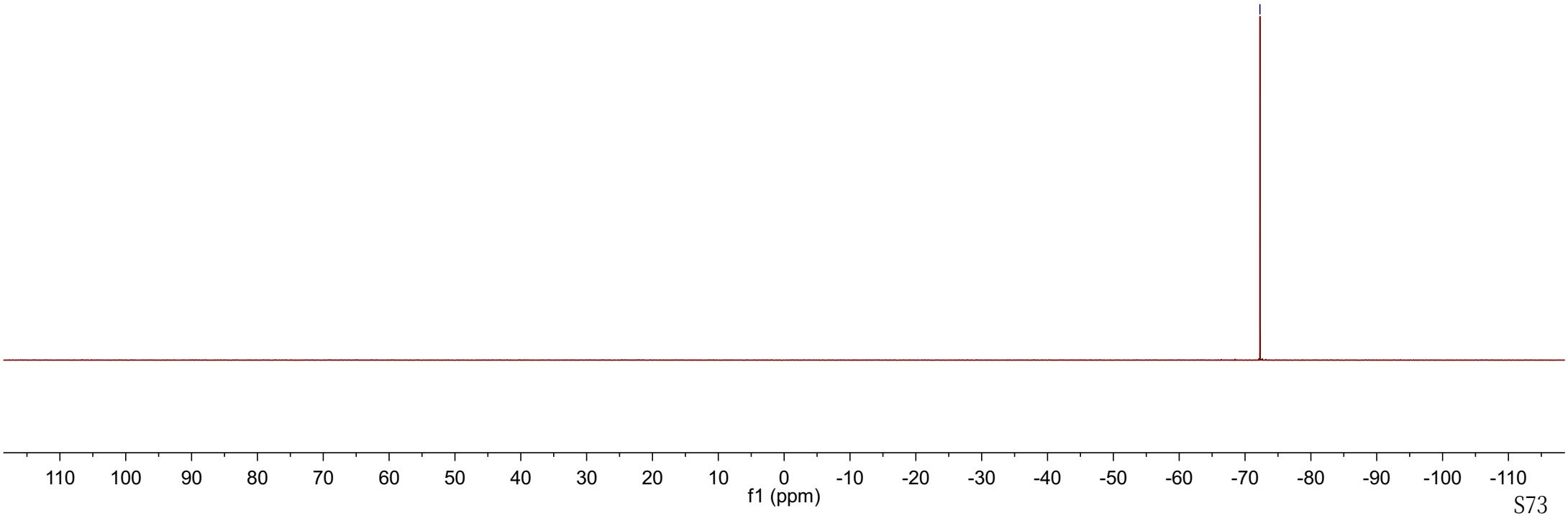


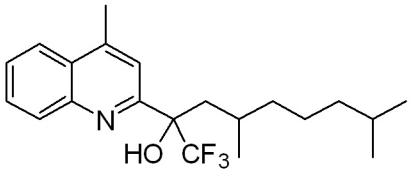


3o

-72.26

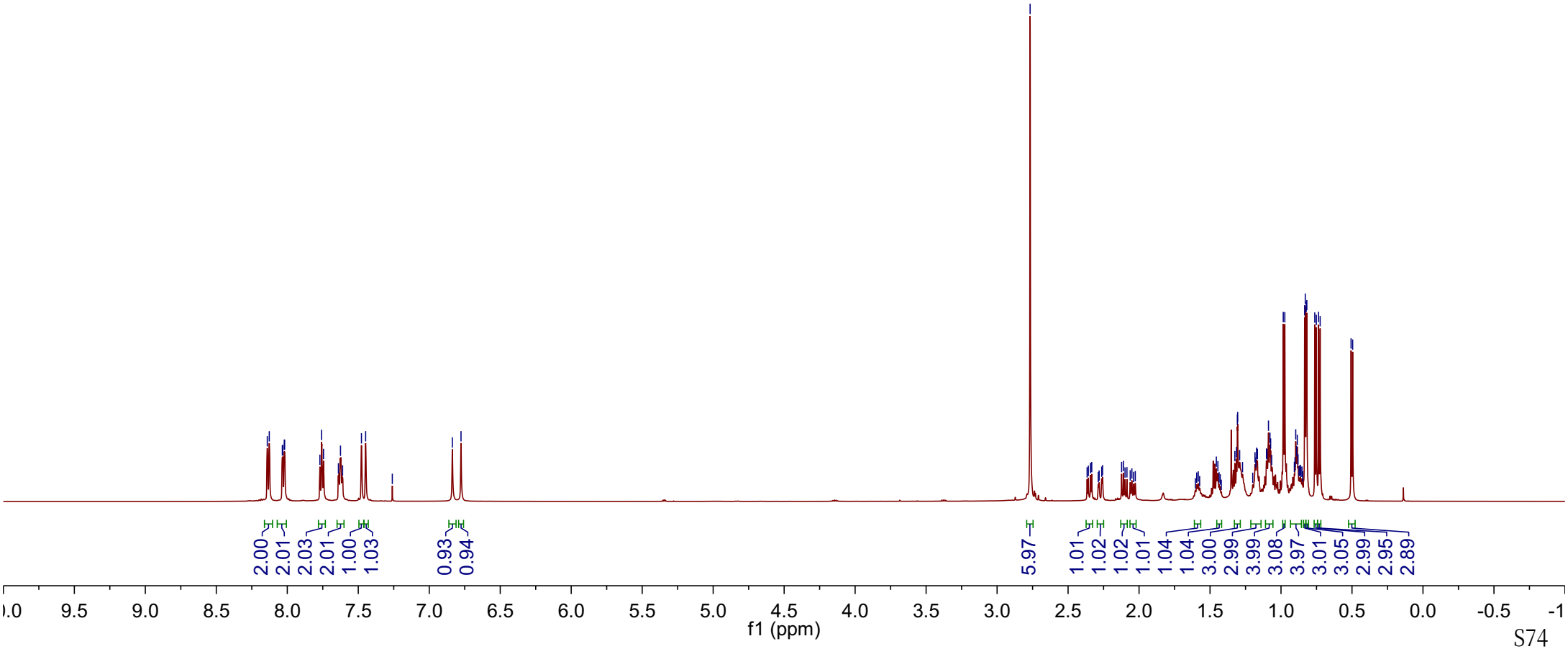
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





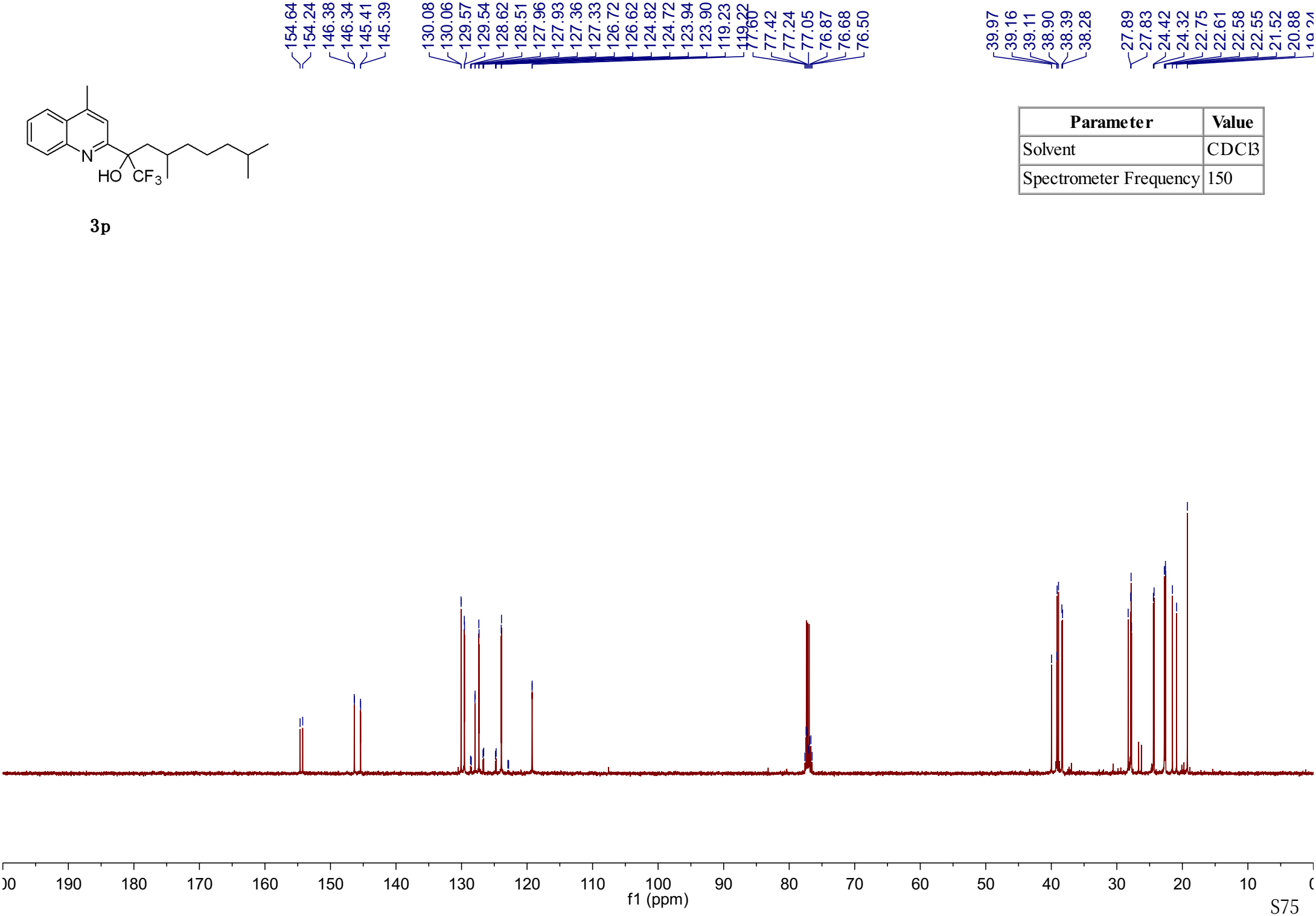
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

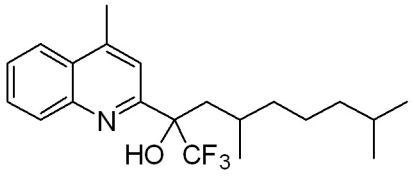
3p



3p

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

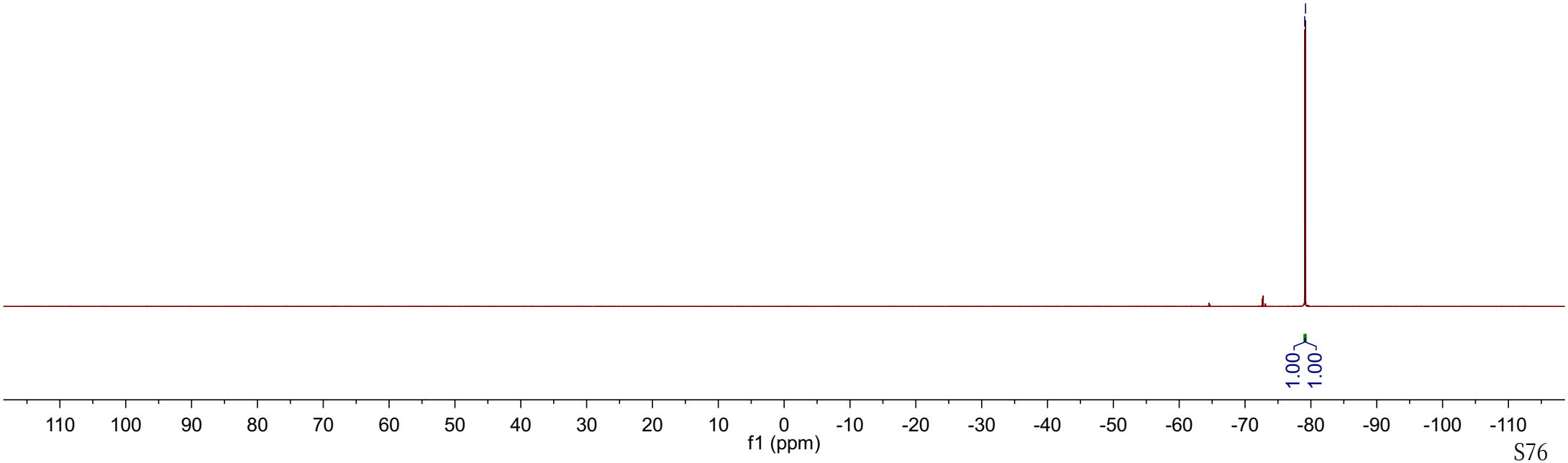


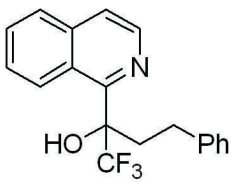


3p

-79.06
-79.19

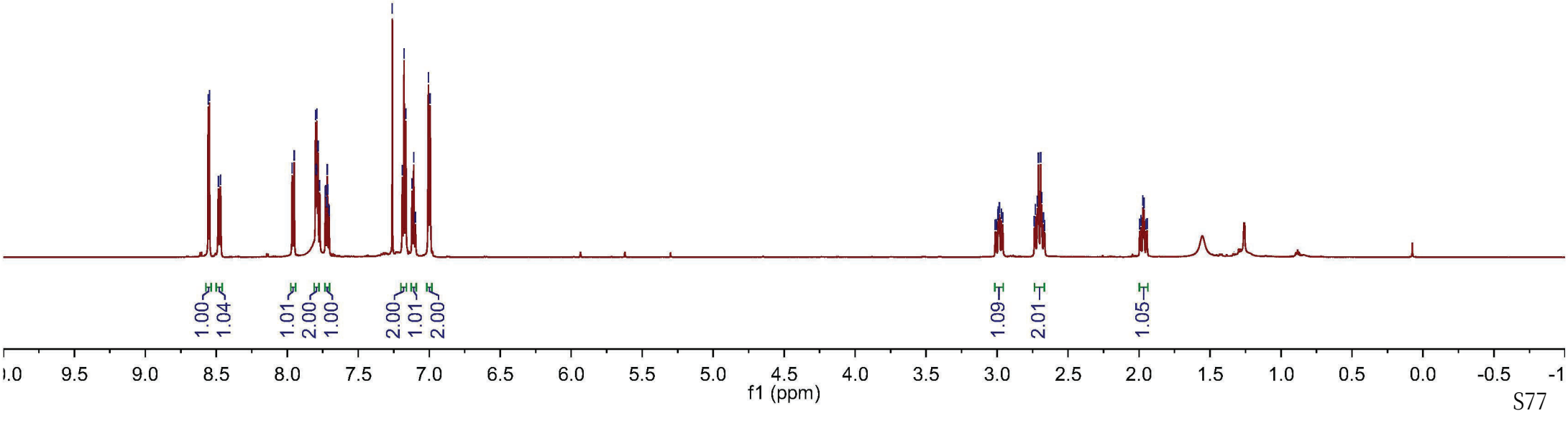
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

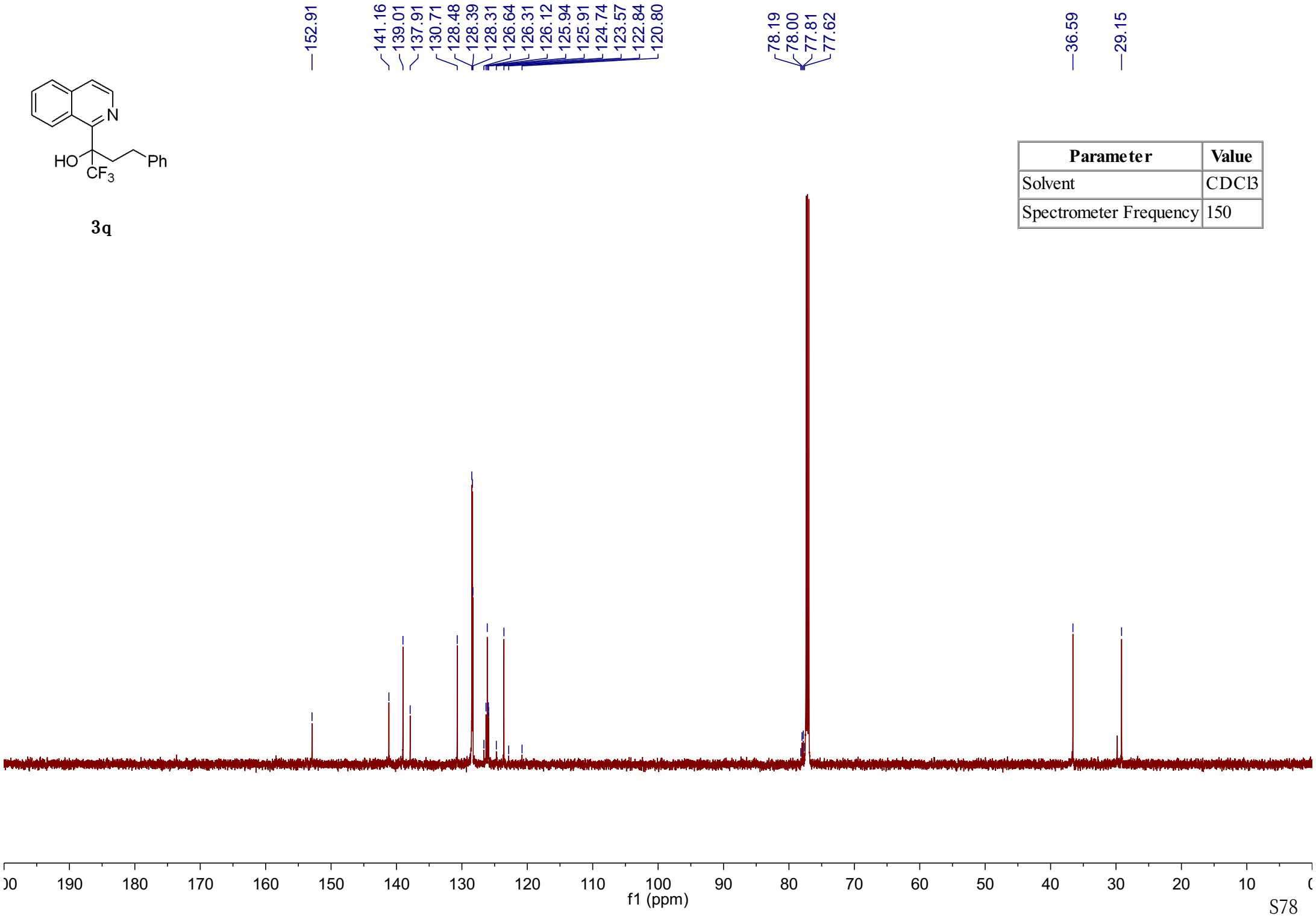


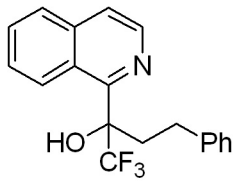


3p

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



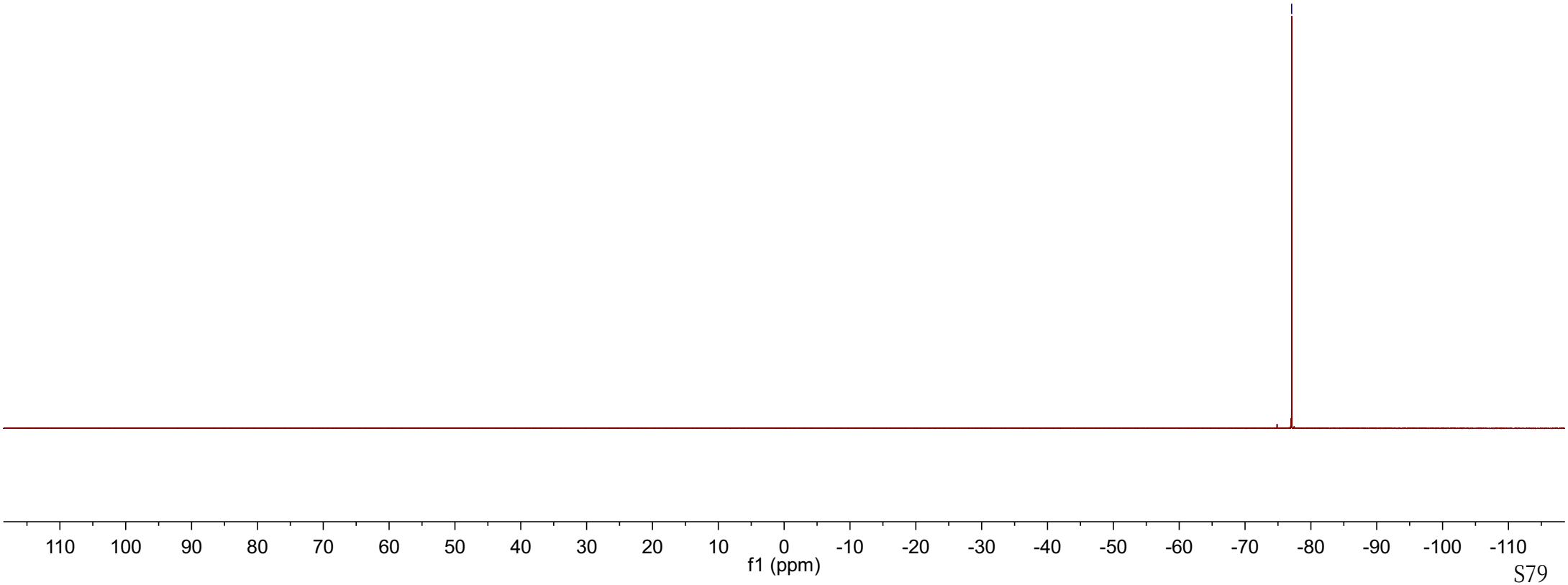

152.91
141.16
139.01
137.91
130.71
128.48
128.39
128.31
126.64
126.31
126.12
125.94
125.91
124.74
123.57
122.84
120.80
78.19
78.00
77.81
77.62
36.59
29.15
HO
CF3
N
Ph
3q
Parameter
Value
Solvent
CDCl3
Spectrometer Frequency
150
f1 (ppm)

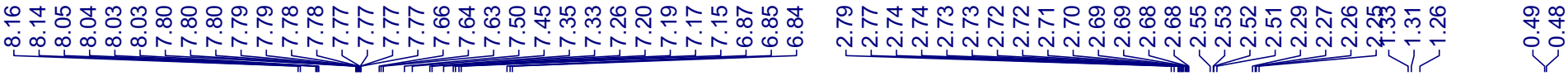


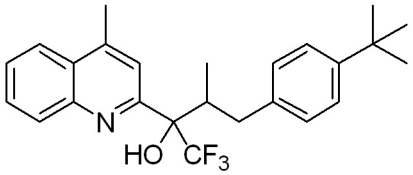
3q

-77.08

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

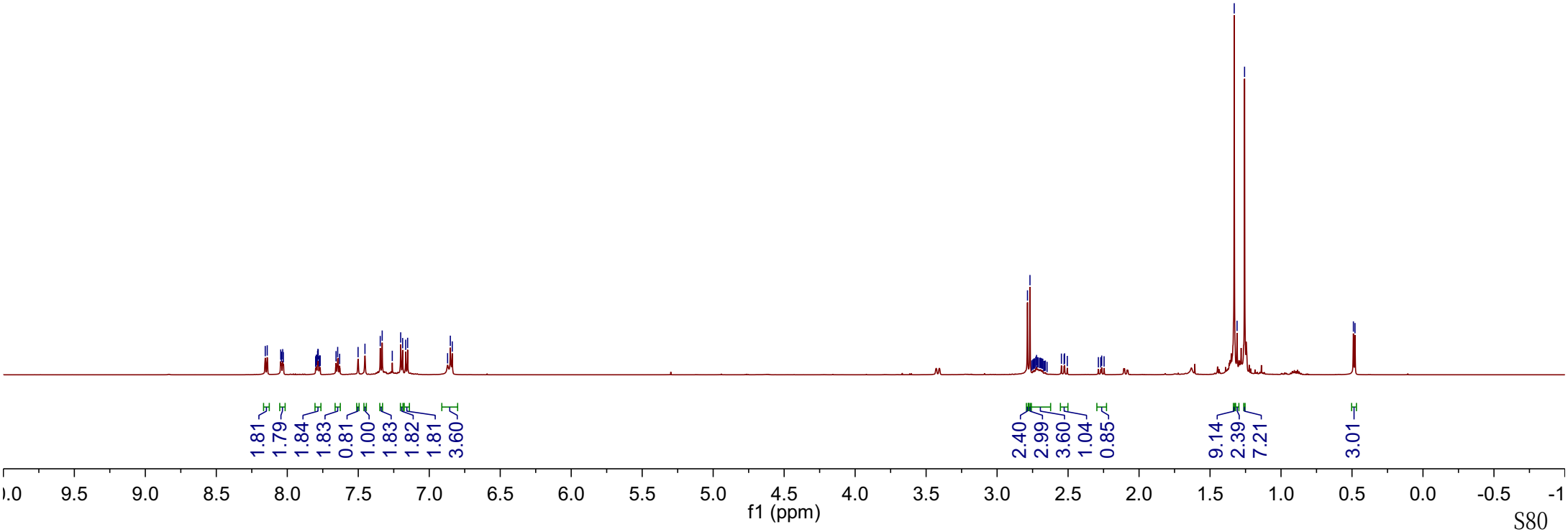


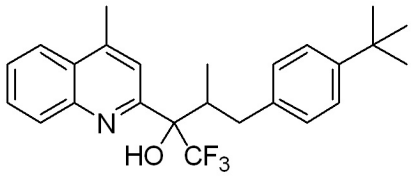




3r

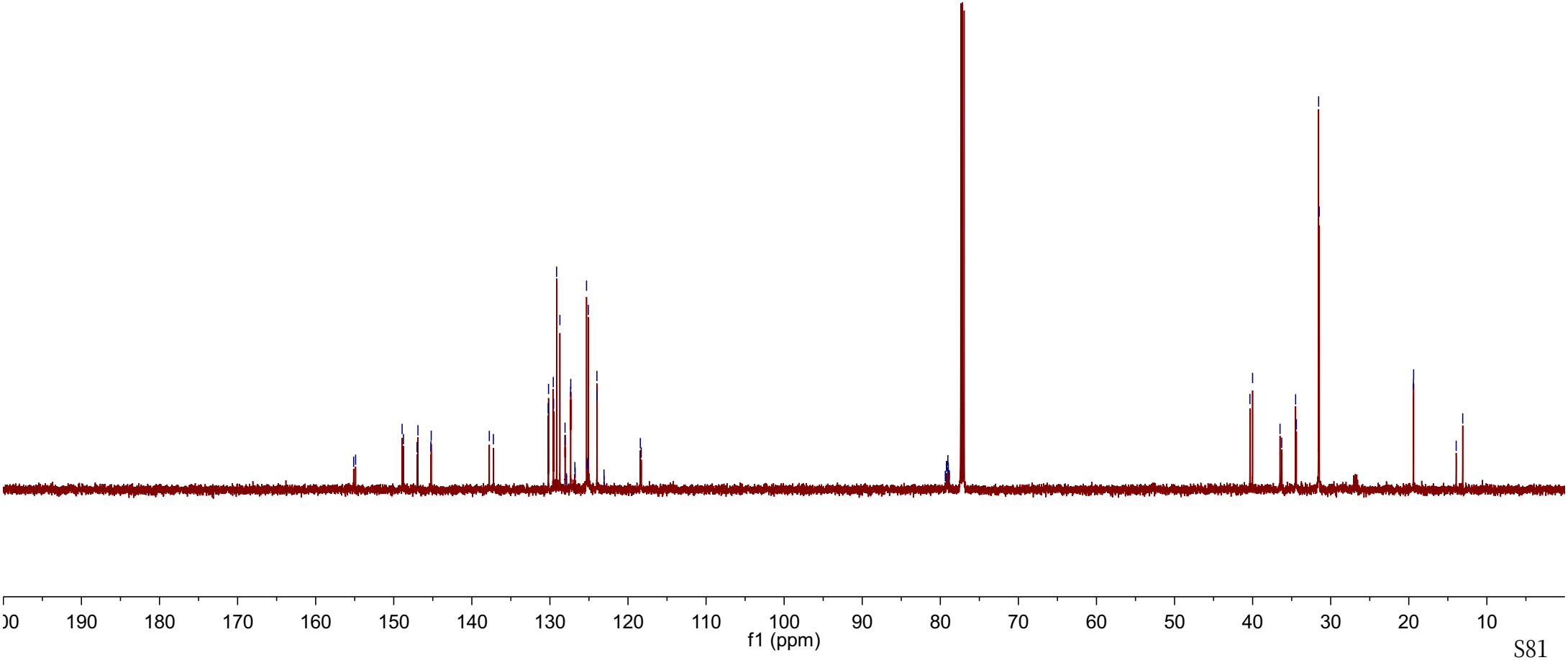
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

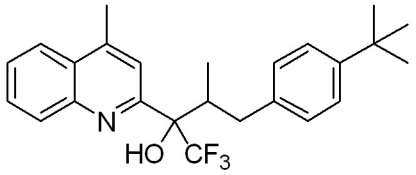




3r

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150





3r

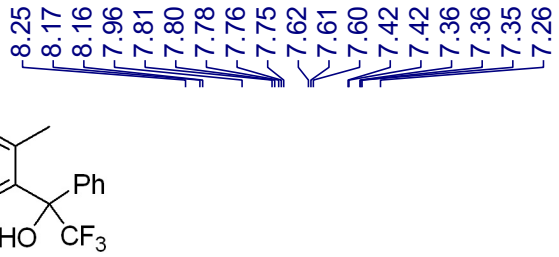
-72.01
-72.66

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

1.00
0.80

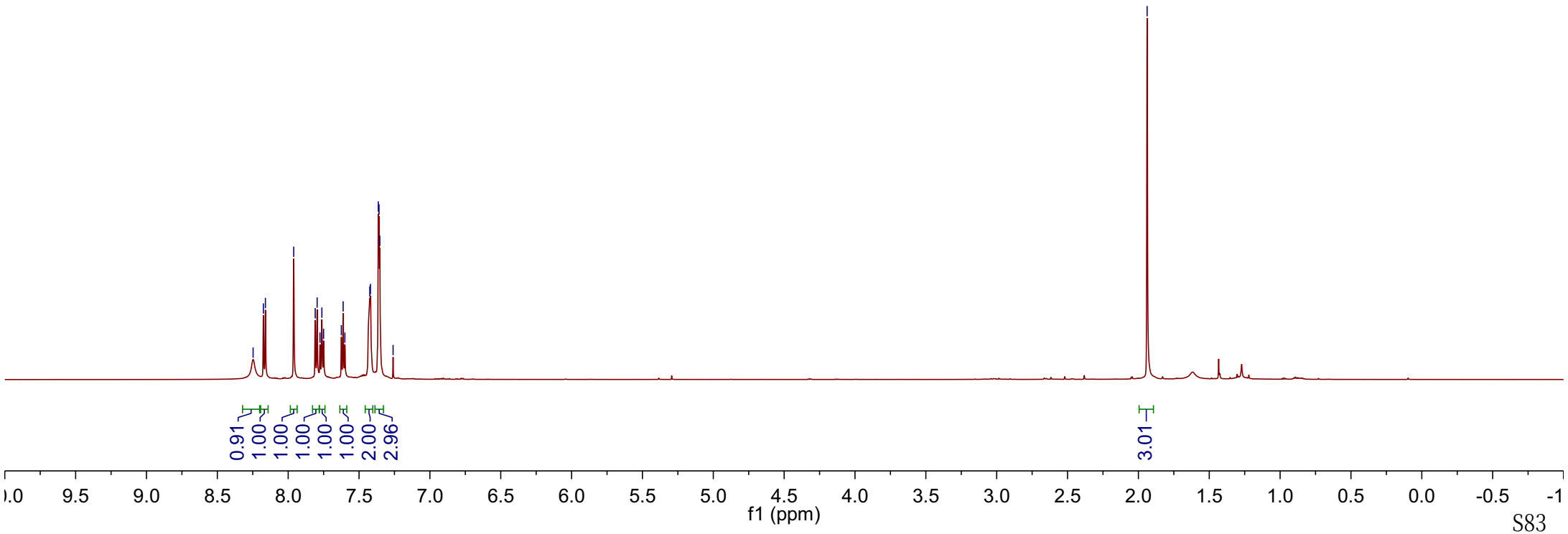
110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110

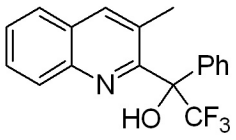
f1 (ppm)



Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3s

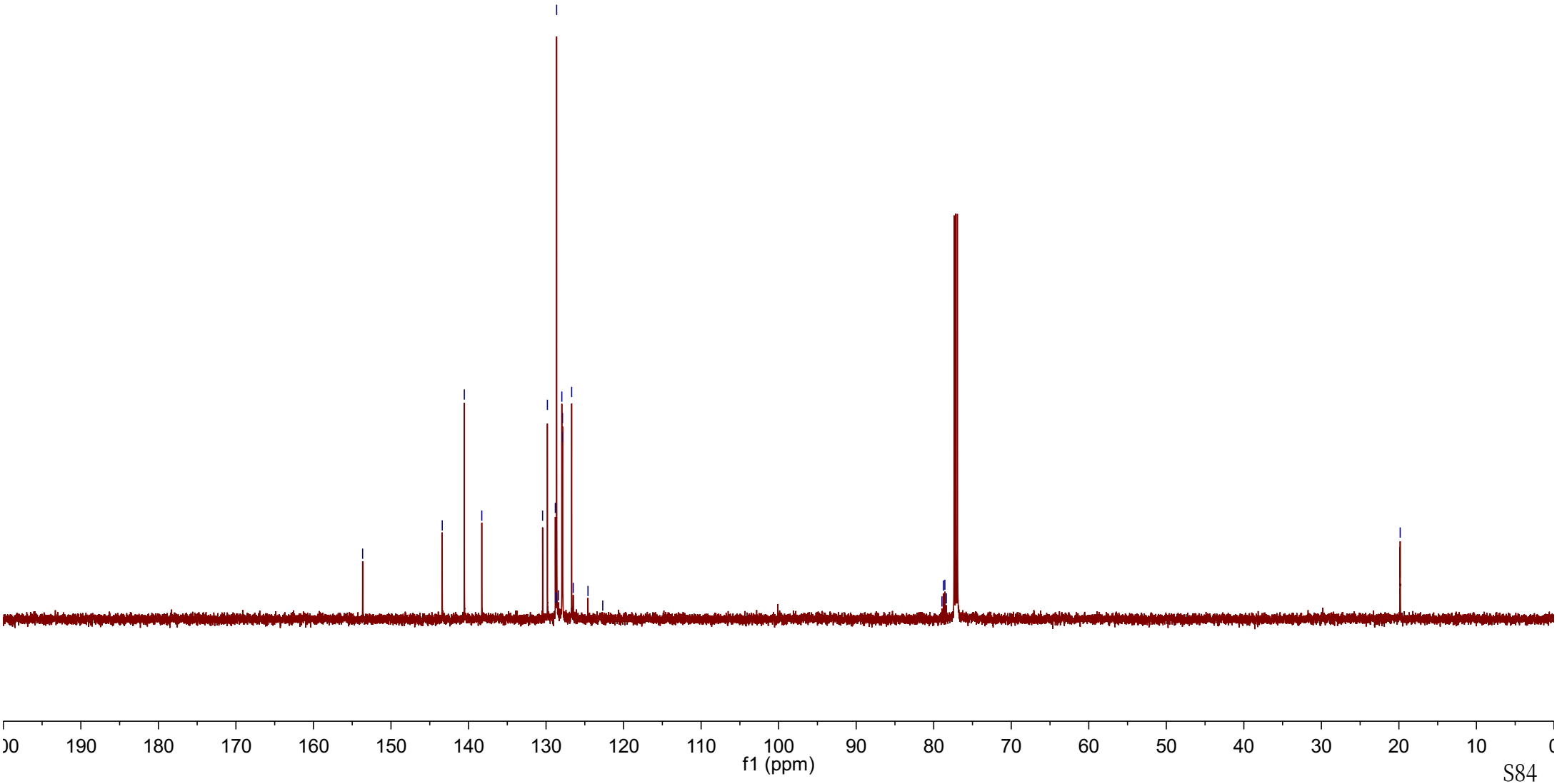


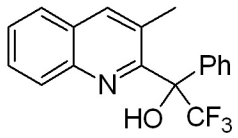


3s

153.66
143.39
140.54
138.29
130.45
129.83
128.80
128.70
128.63
128.39
127.96
127.88
127.87
126.70
126.49
124.59
122.69
78.94
78.75
78.56
78.37
19.83

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	151

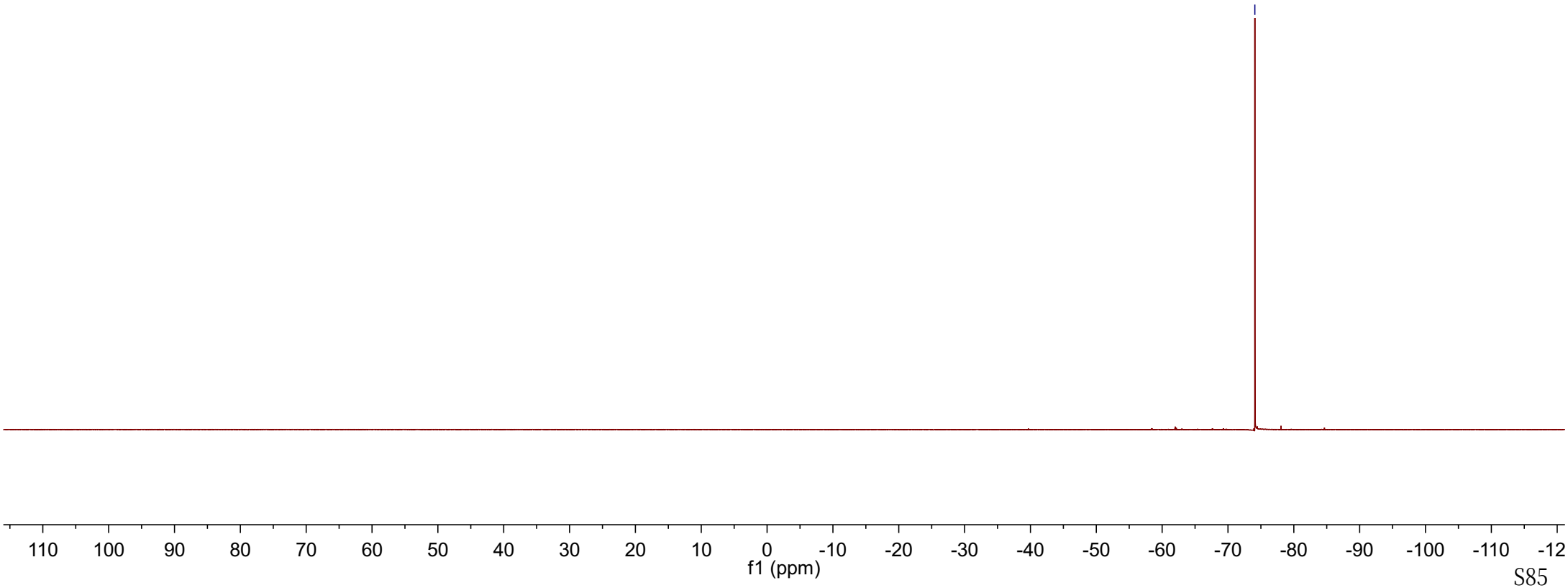




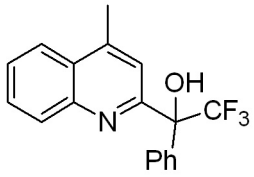
3s

-74.08

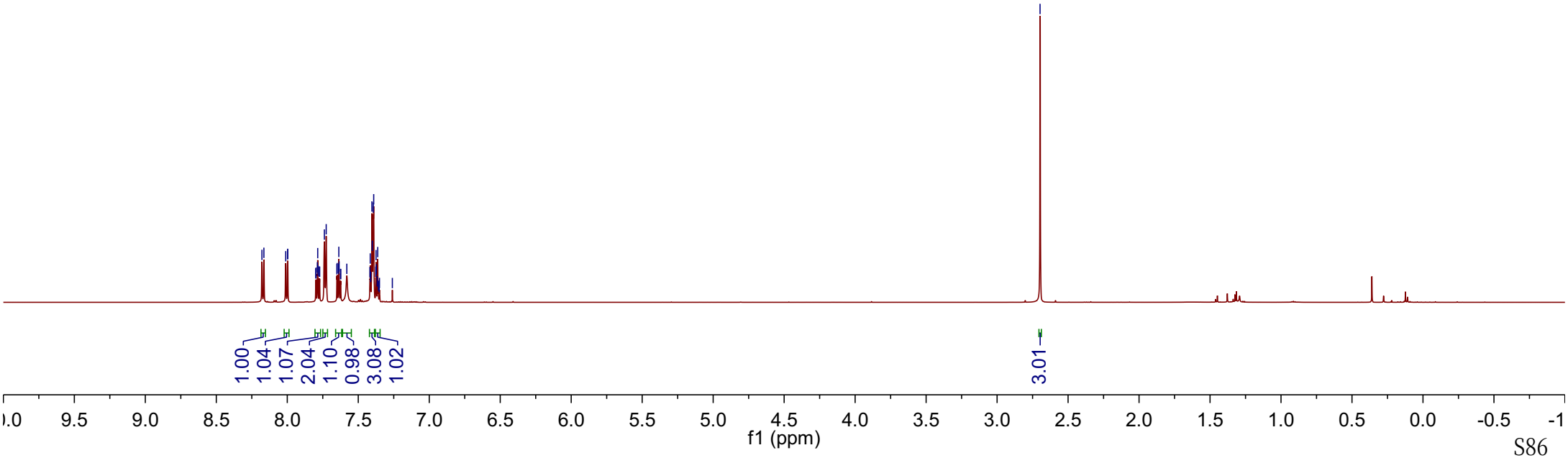
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

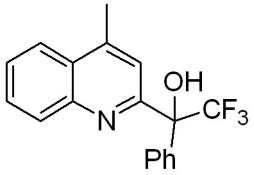


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



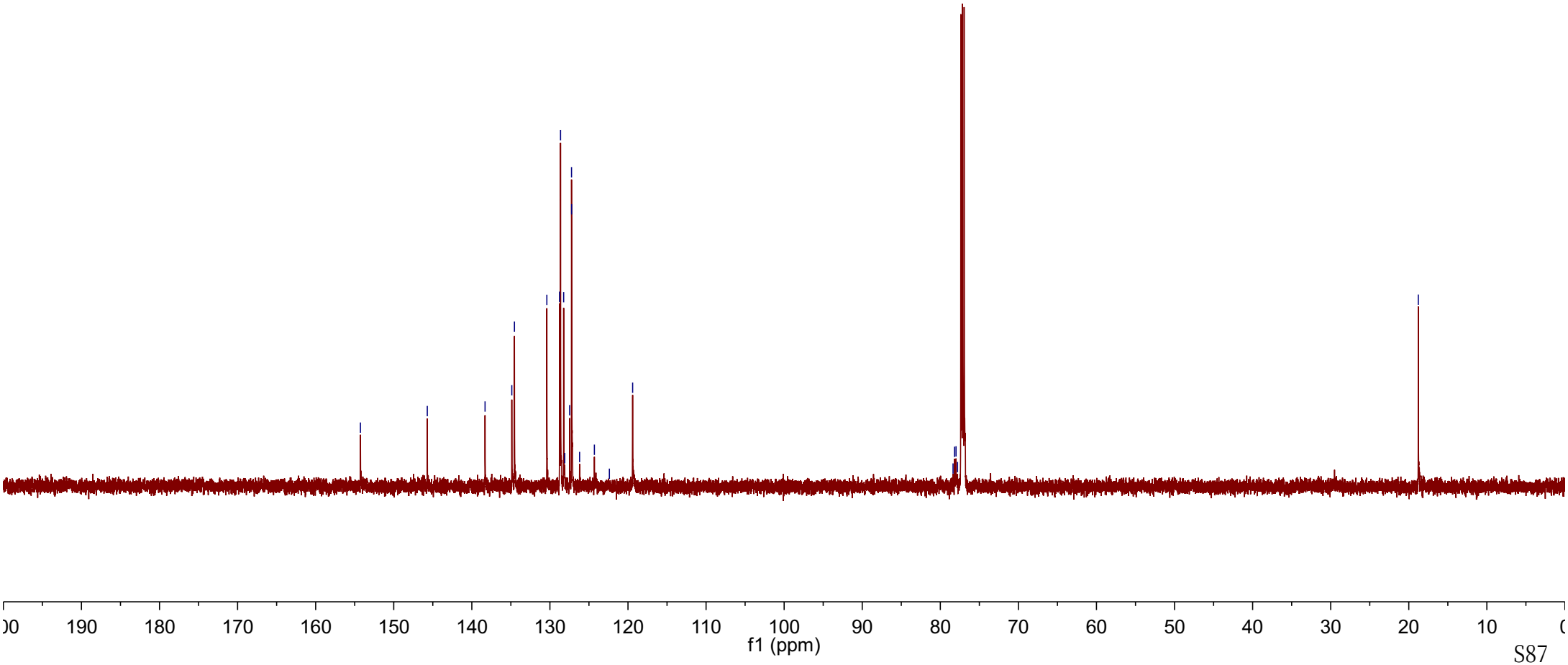
3t

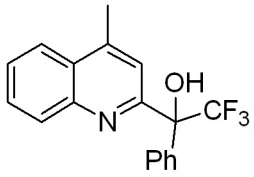




3t

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

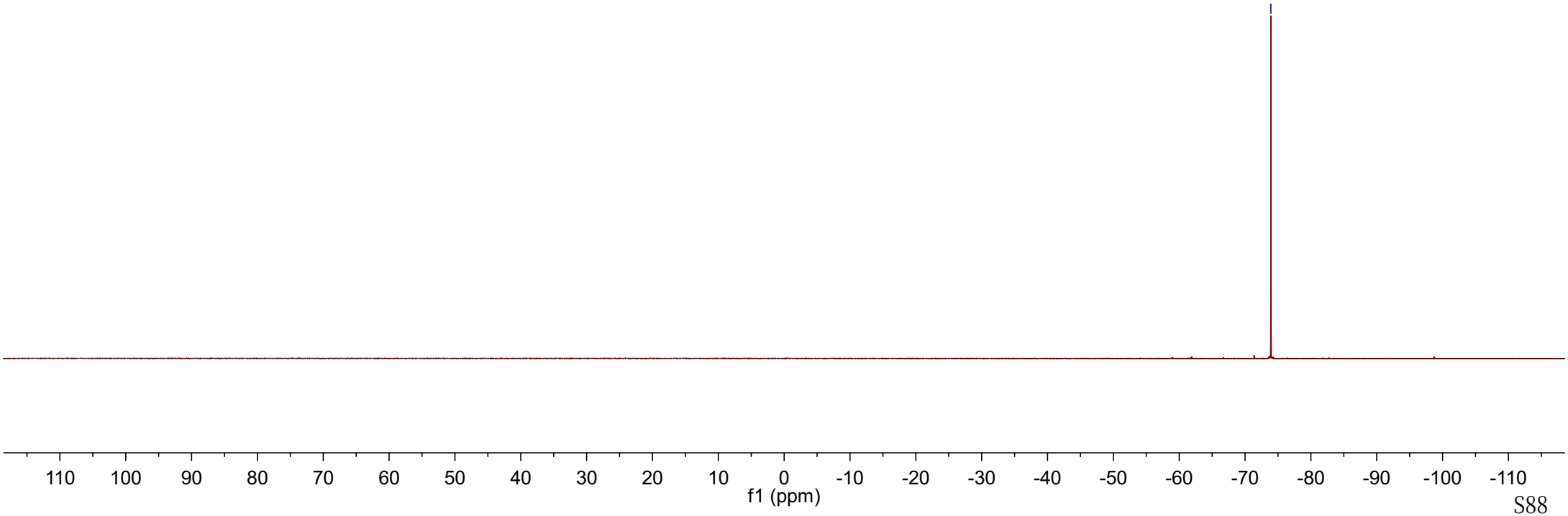


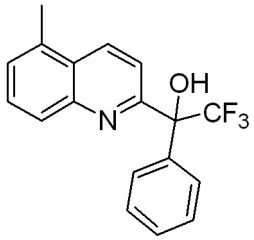


3t

-73.92

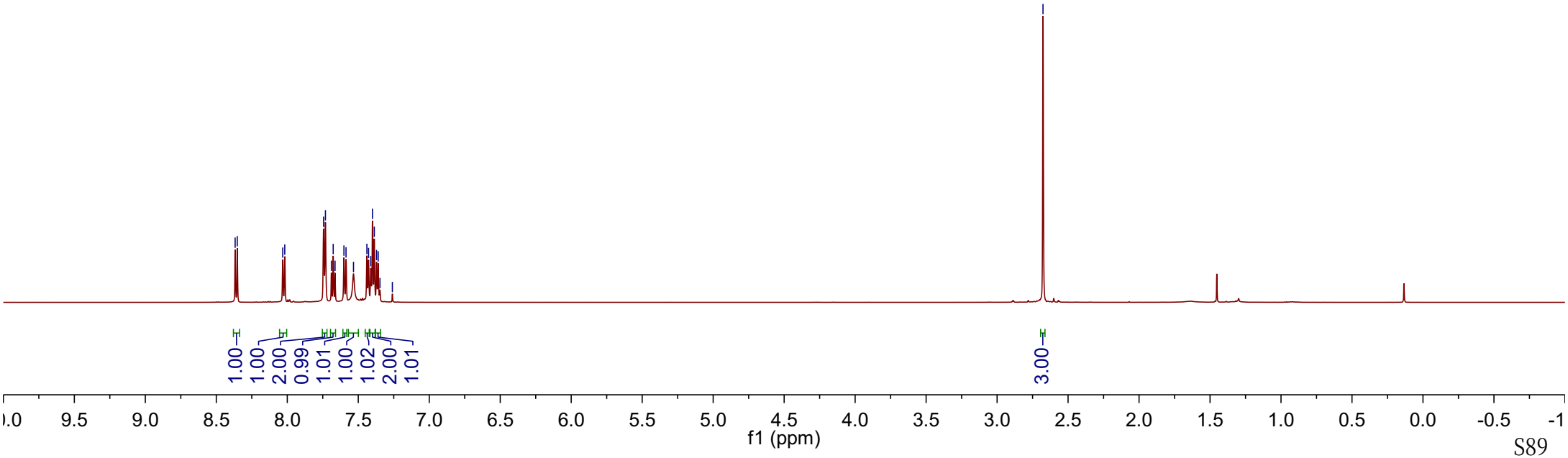
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

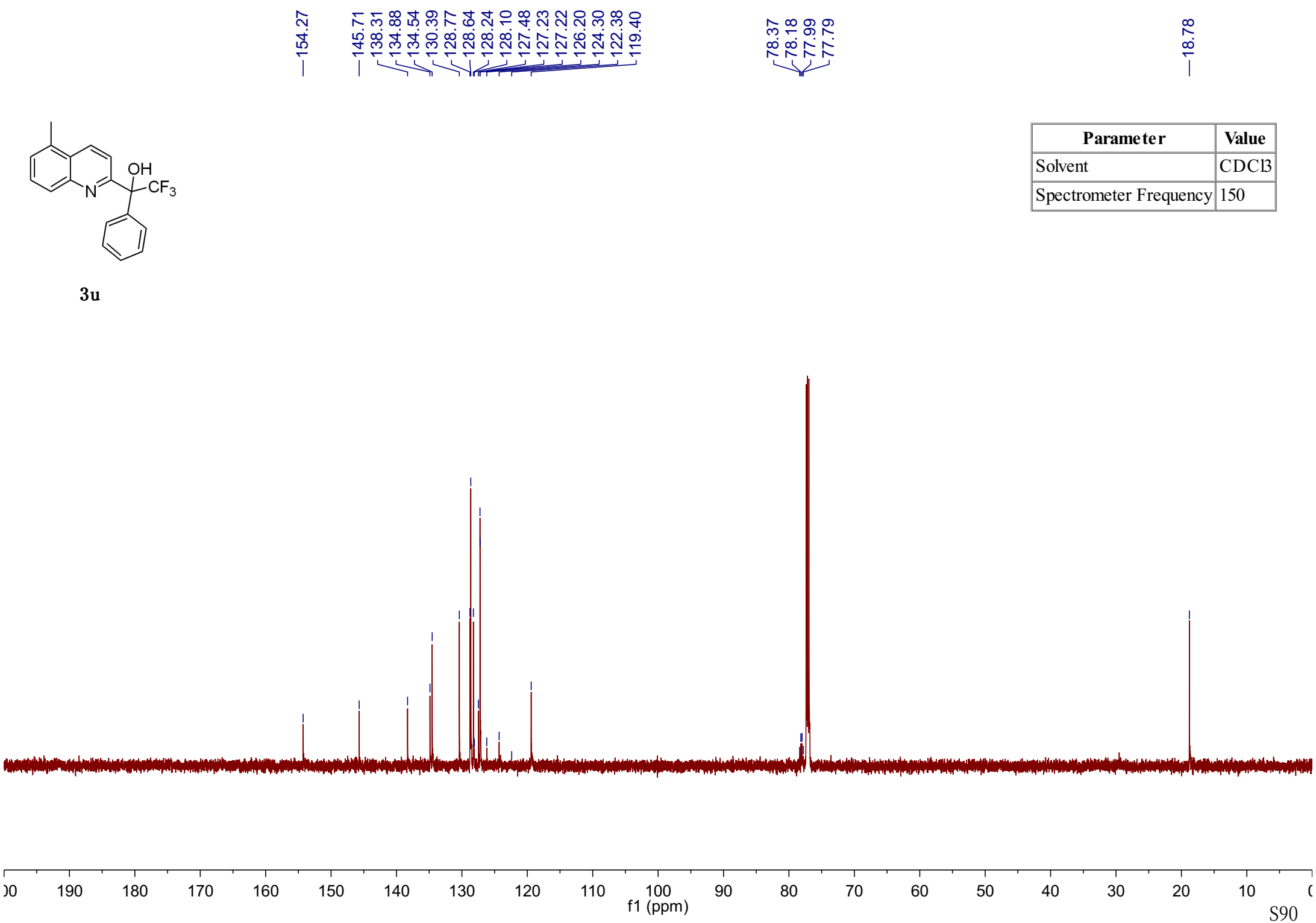


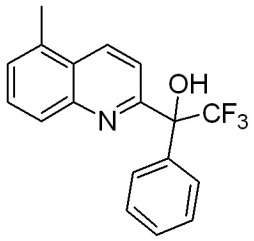


3u

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



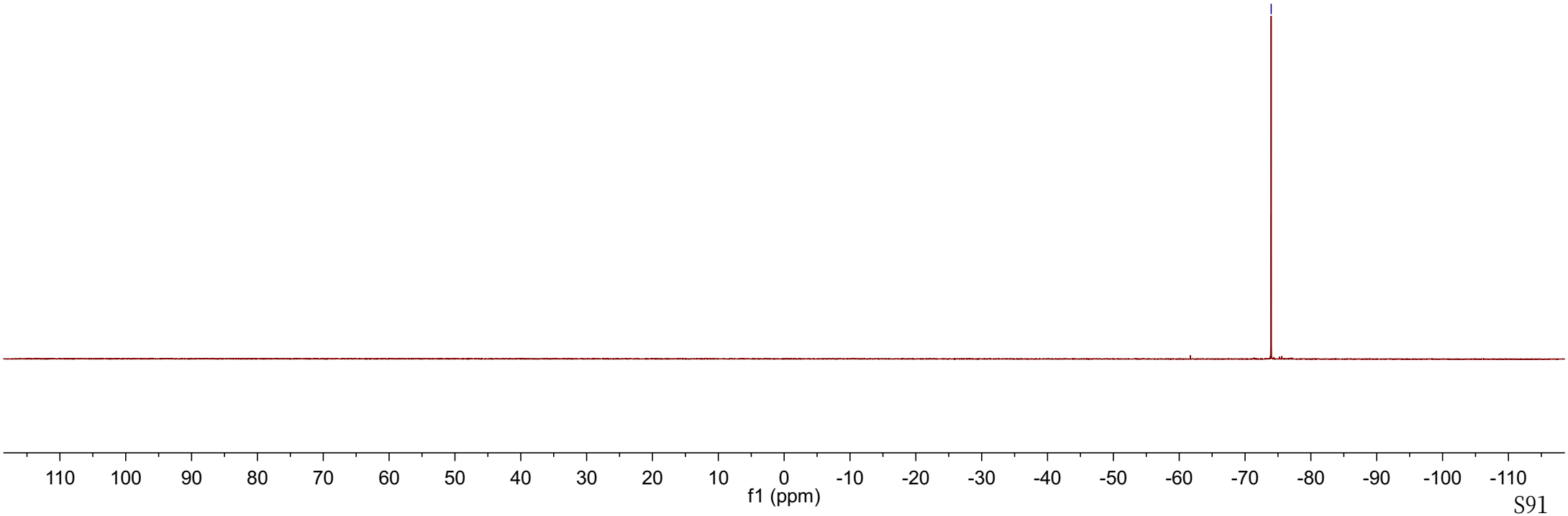

154.27
145.71
138.31
134.88
134.54
130.39
128.77
128.64
128.24
128.10
127.48
127.23
127.22
126.20
124.30
122.38
119.40
78.37
78.18
77.99
77.79
18.78
OH
N
CF3
3u
Parameter
Value
Solvent
CDCl3
Spectrometer Frequency
150
f1 (ppm)



3u

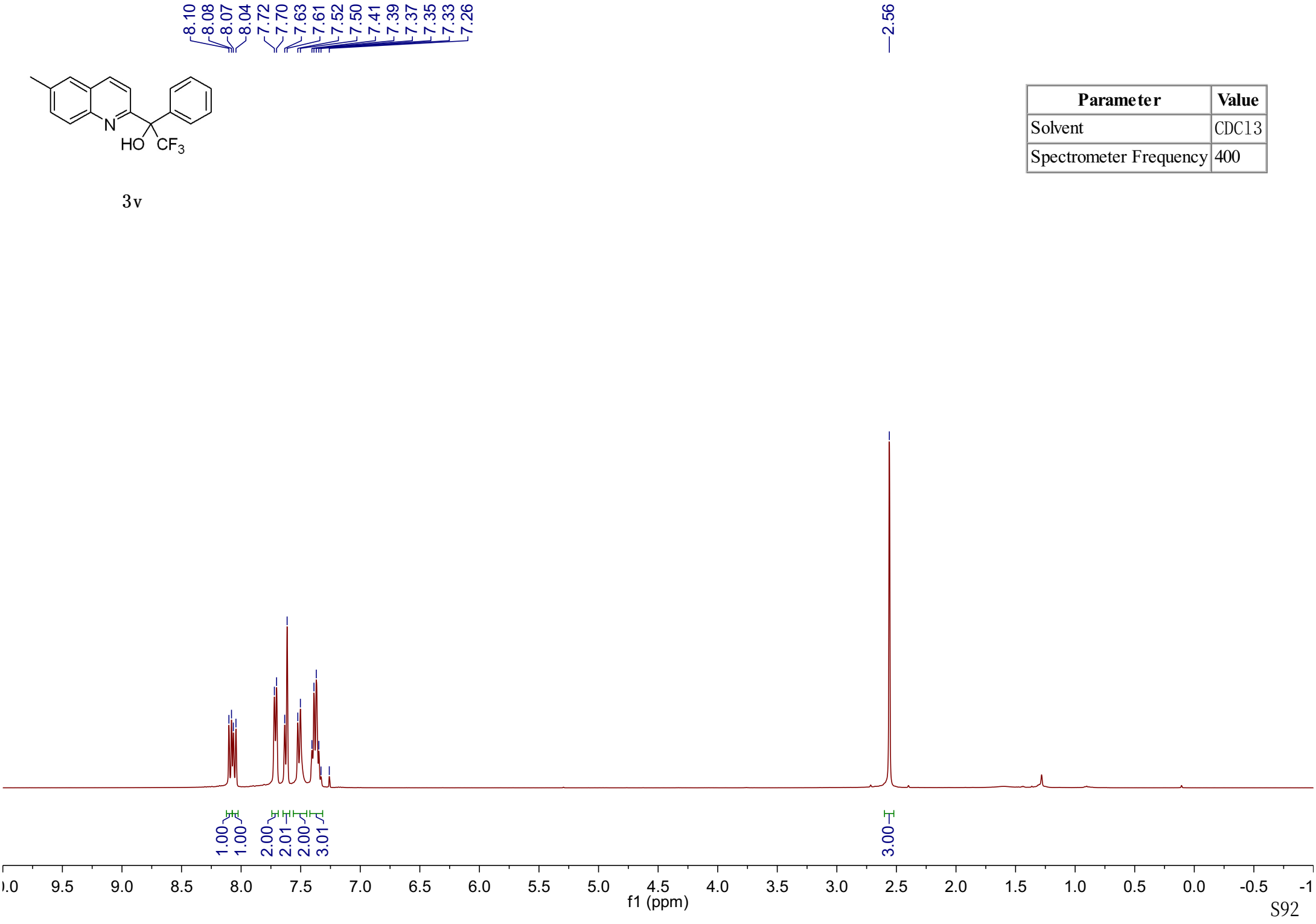
-73.97

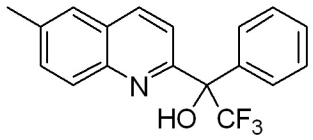
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565



3v

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	400





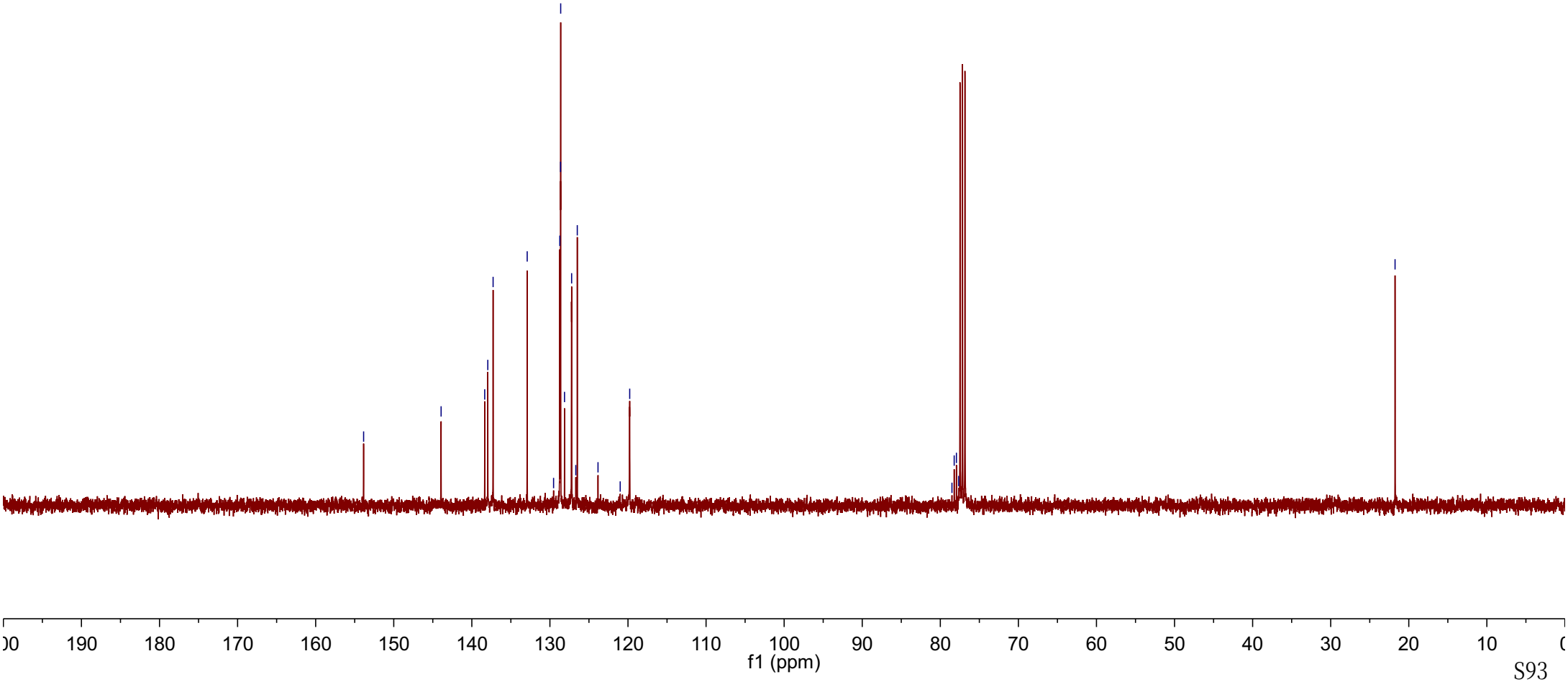
3v

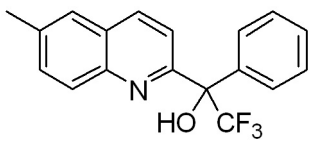
153.86
143.93
138.35
137.95
137.28
132.91
129.53
128.73
128.64
128.62
128.13
127.22
126.68
126.49
123.84
121.00
119.78

78.51
78.22
77.93
77.65

21.76

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	100

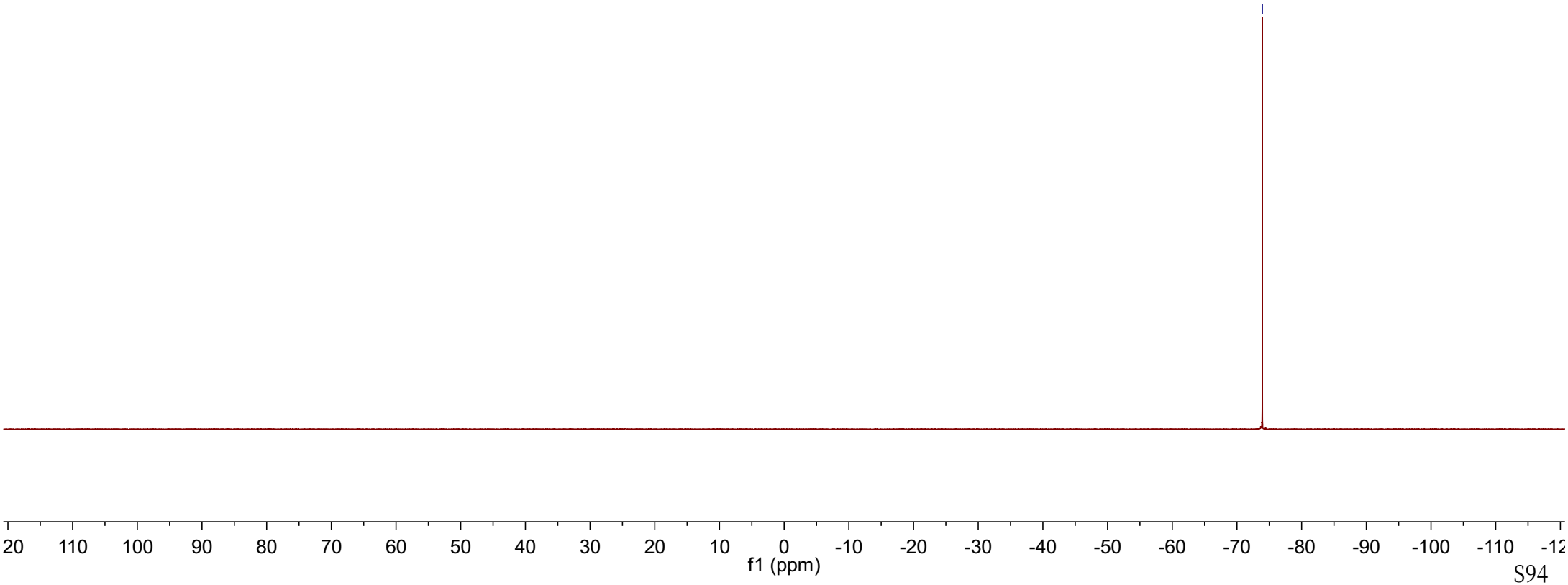


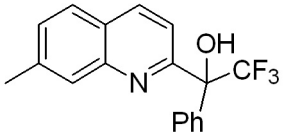


3v

-73.92

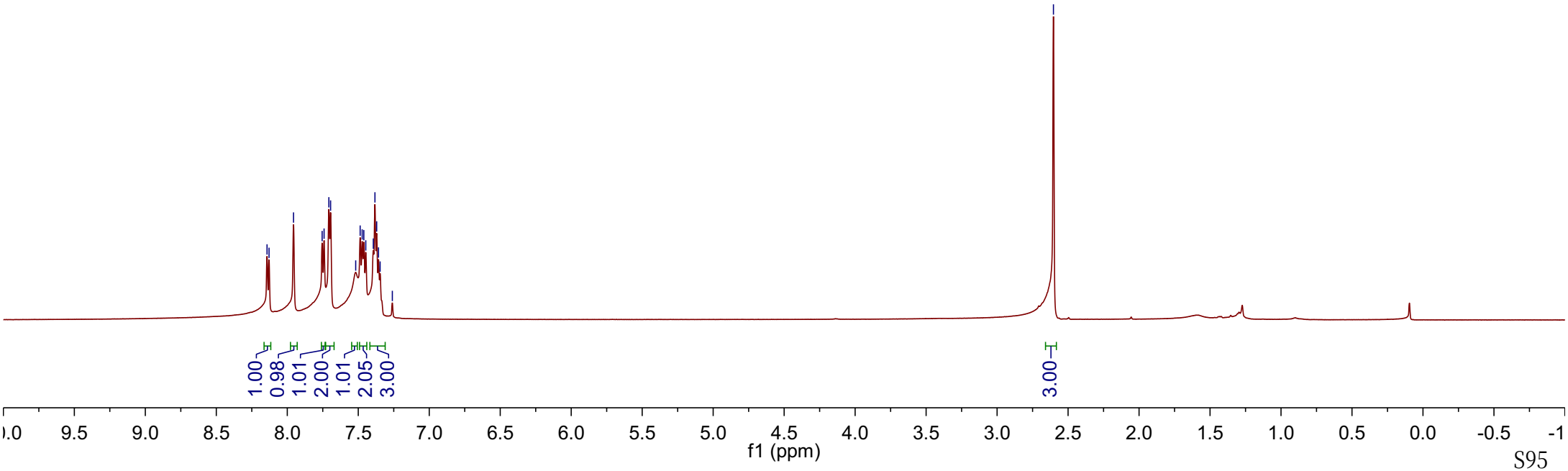
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	377

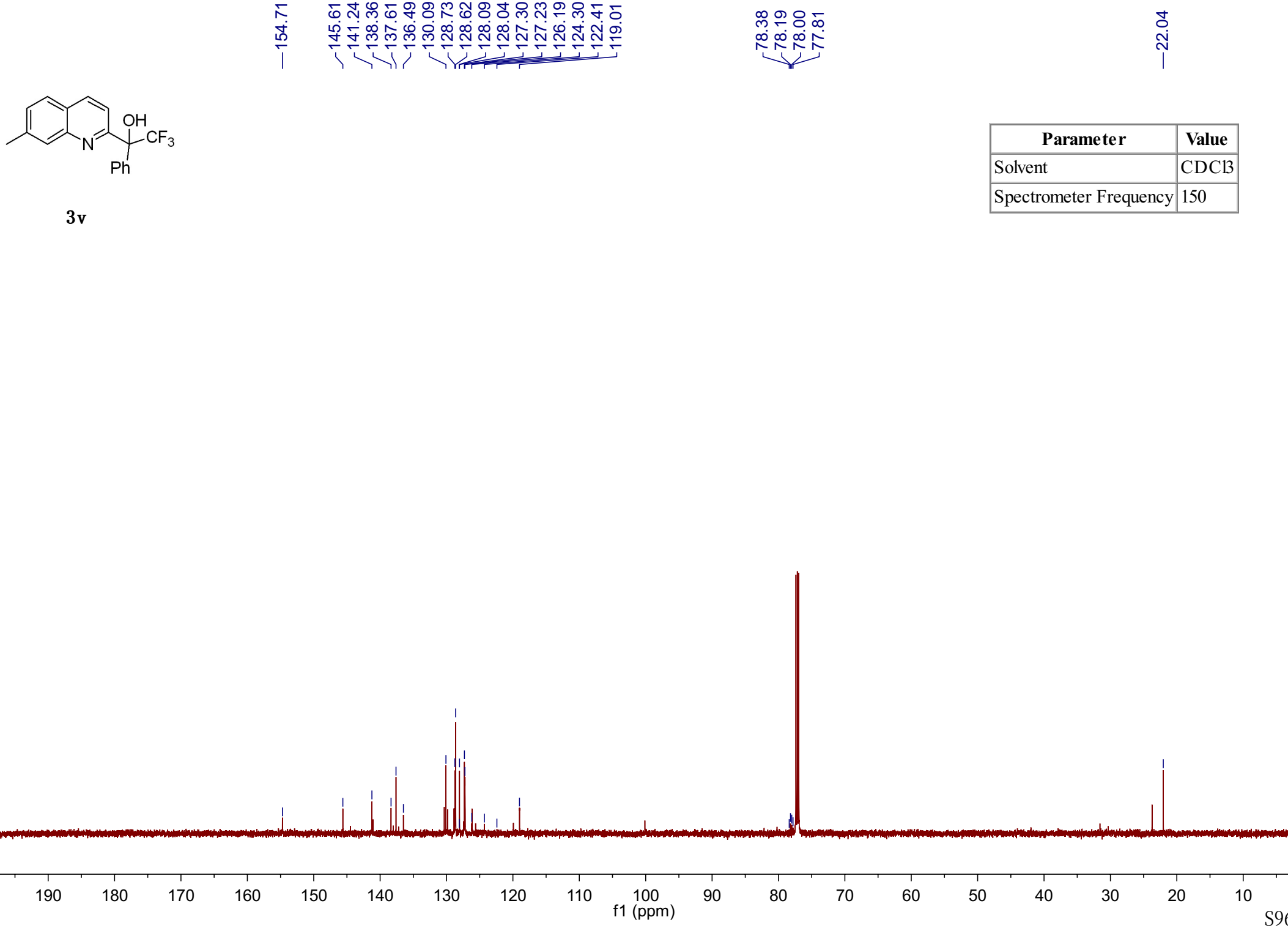


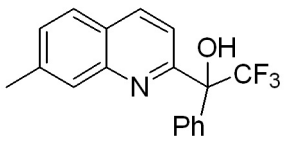


3w

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



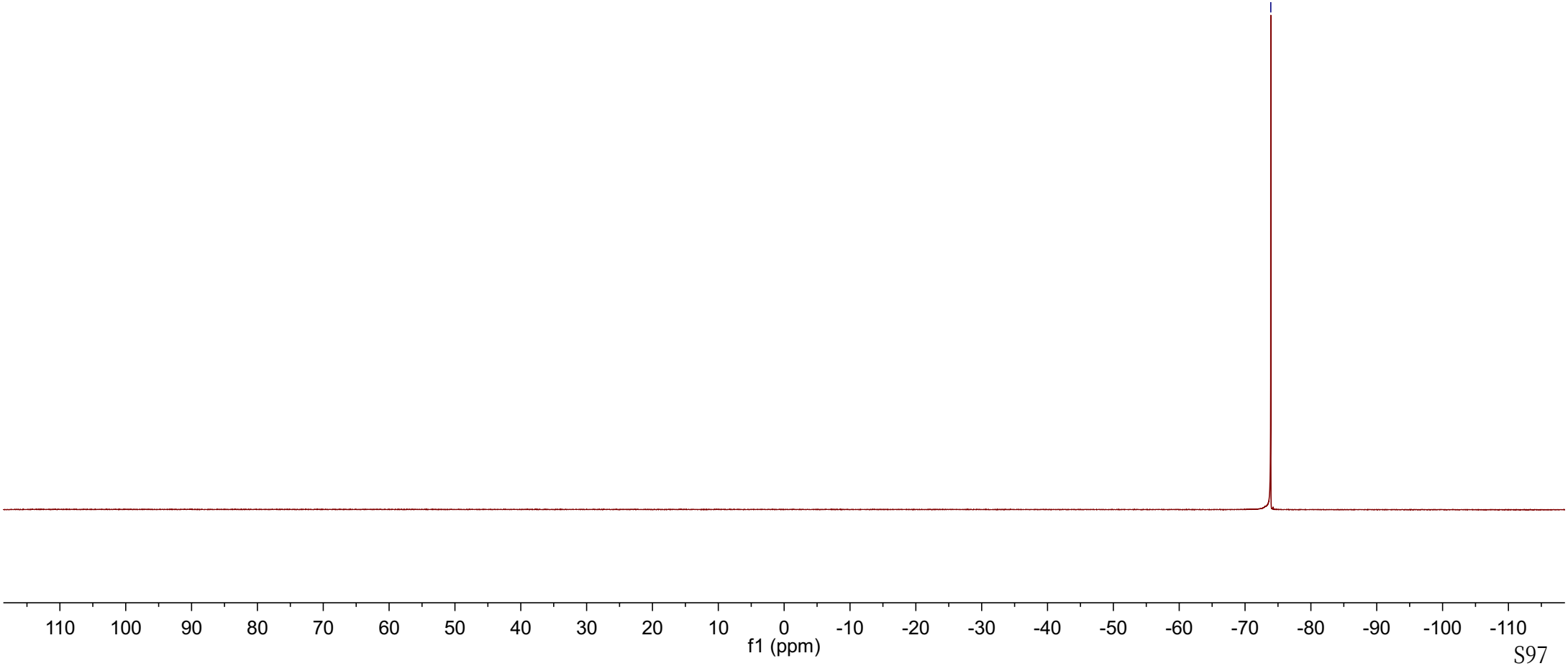

154.71
145.61
141.24
138.36
137.61
136.49
130.09
128.73
128.62
128.09
128.04
127.30
127.23
126.19
124.30
122.41
119.01
78.38
78.19
78.00
77.81
22.04
OH
CF3
N
Ph
3v
Parameter
Value
Solvent
CDCl3
Spectrometer Frequency
150
f1 (ppm)

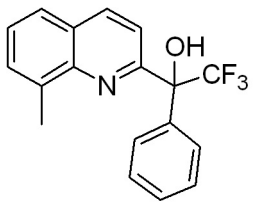


3w

-73.91

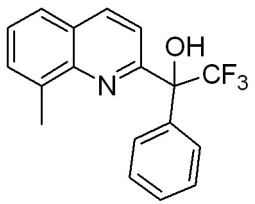
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





3x

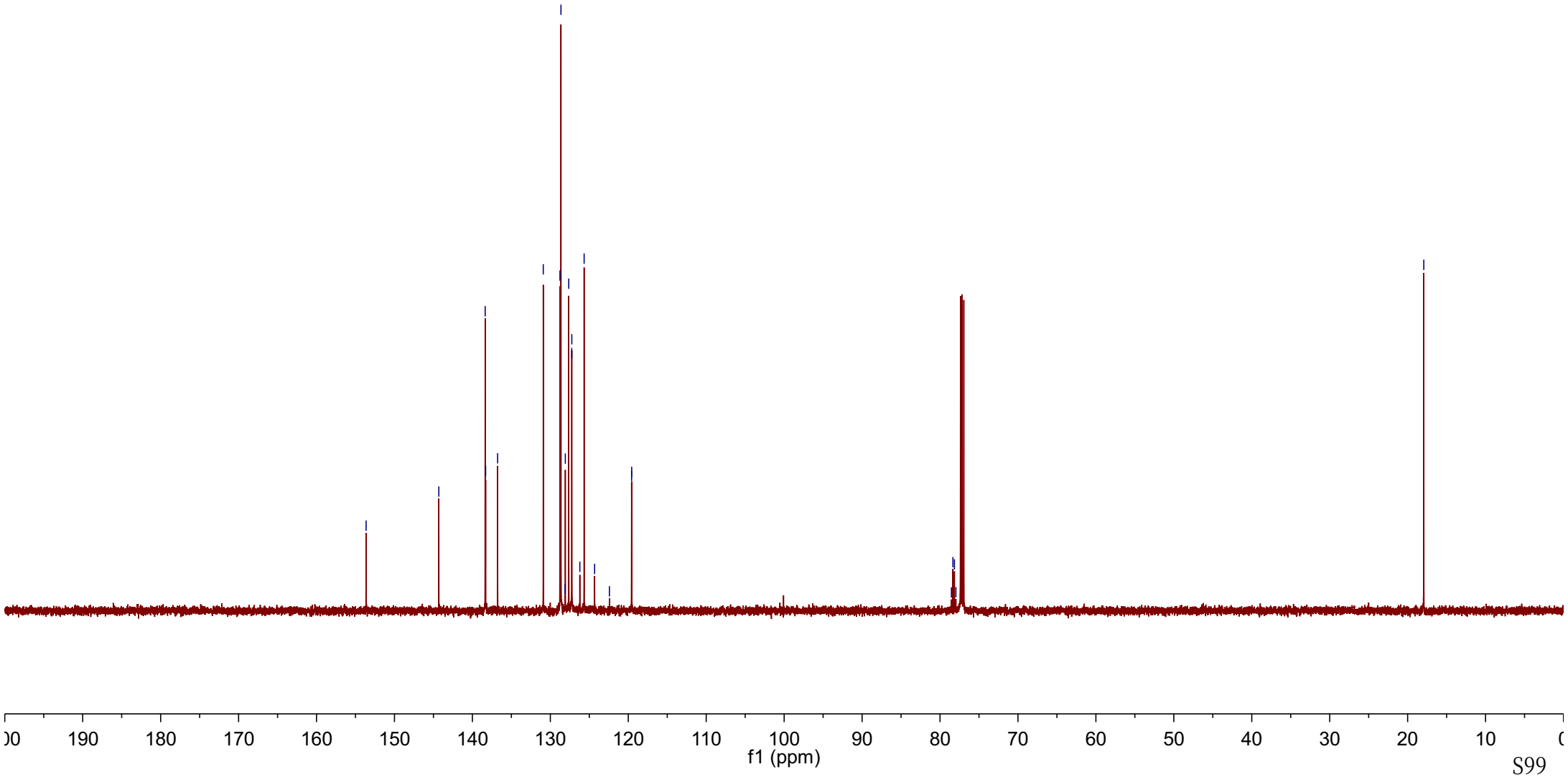
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

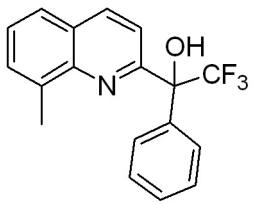


3x

153.64
144.31
138.36
138.30
136.76
130.90
128.77
128.64
128.11
128.08
127.64
127.25
127.24
126.21
125.66
124.32
122.42
119.57
119.56
78.54
78.34
78.15
77.96
17.93

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

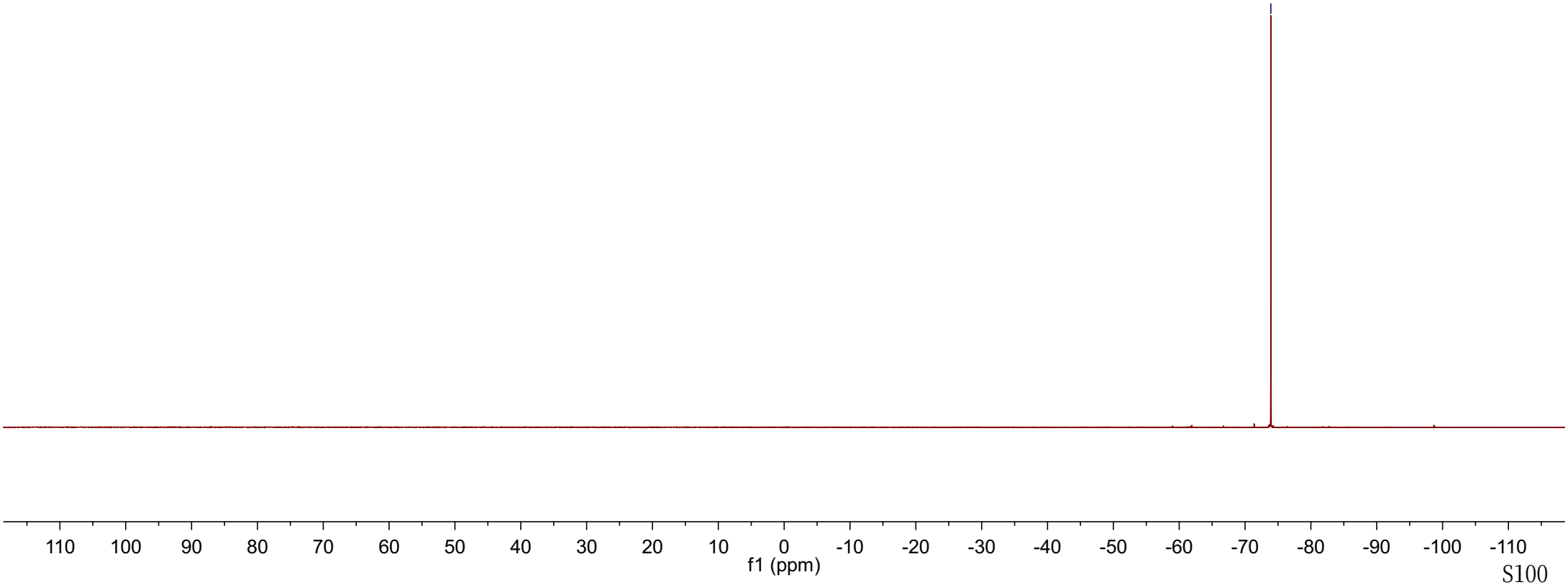


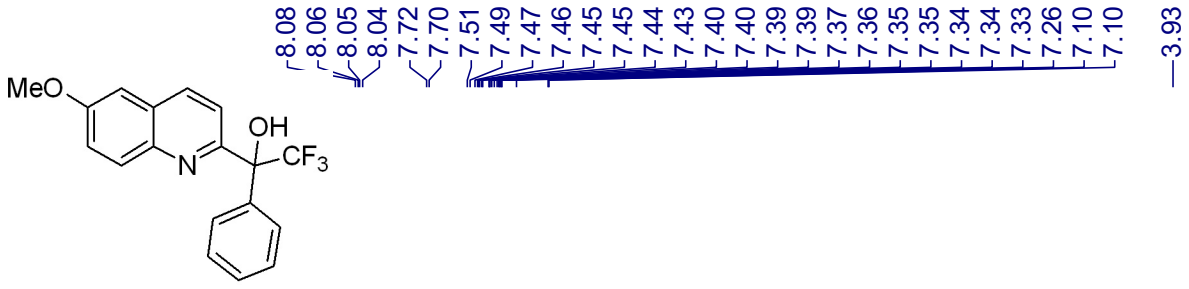


3x

-73.92

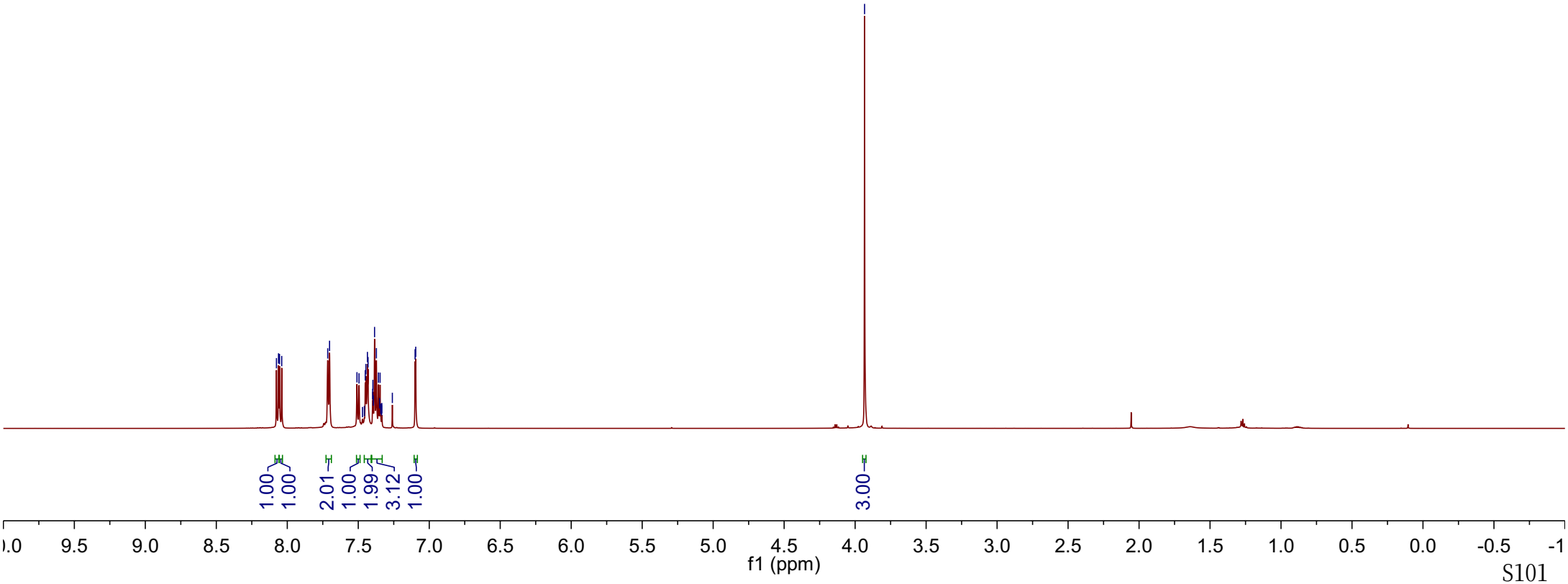
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

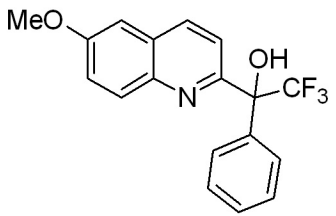




3y

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

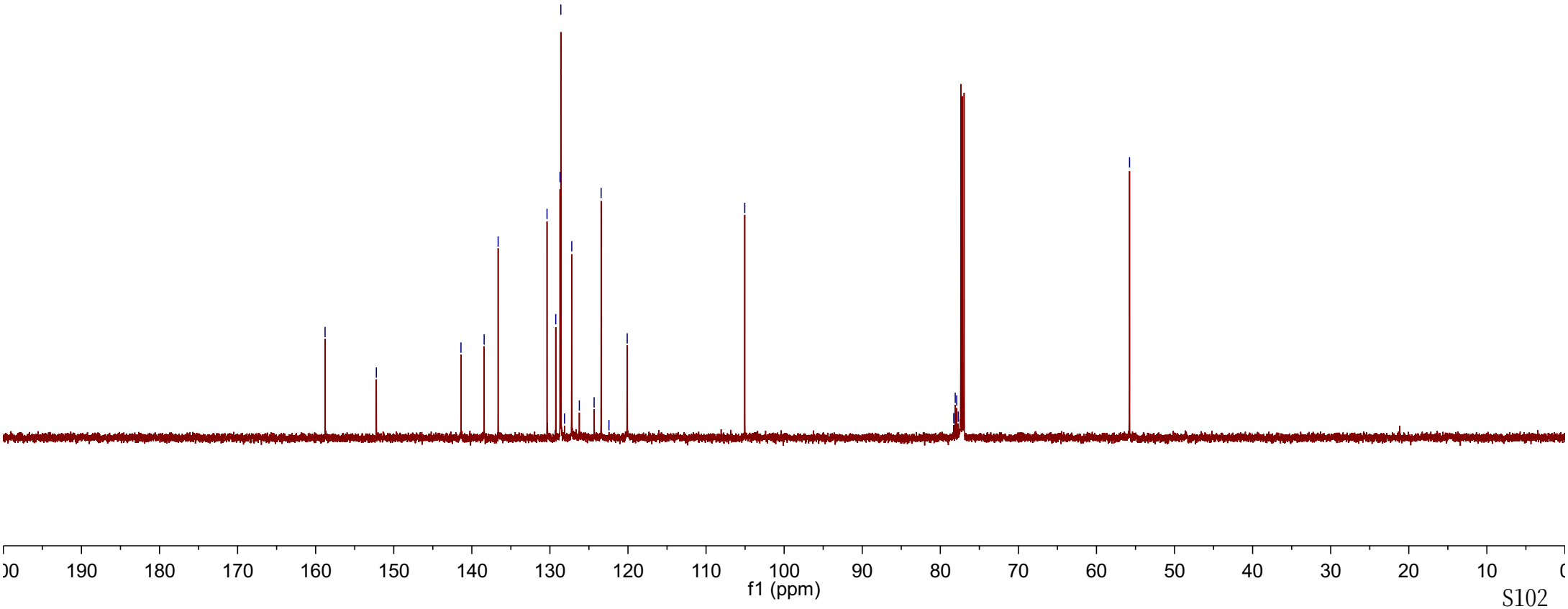


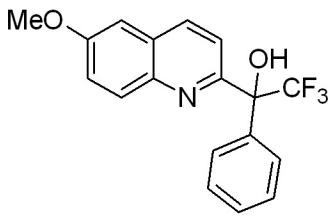


3y

158.80
152.23
141.39
138.42
136.63
130.37
129.25
128.71
128.60
128.13
127.20
126.23
124.34
123.44
78.28
78.09
77.90
77.71
55.76

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

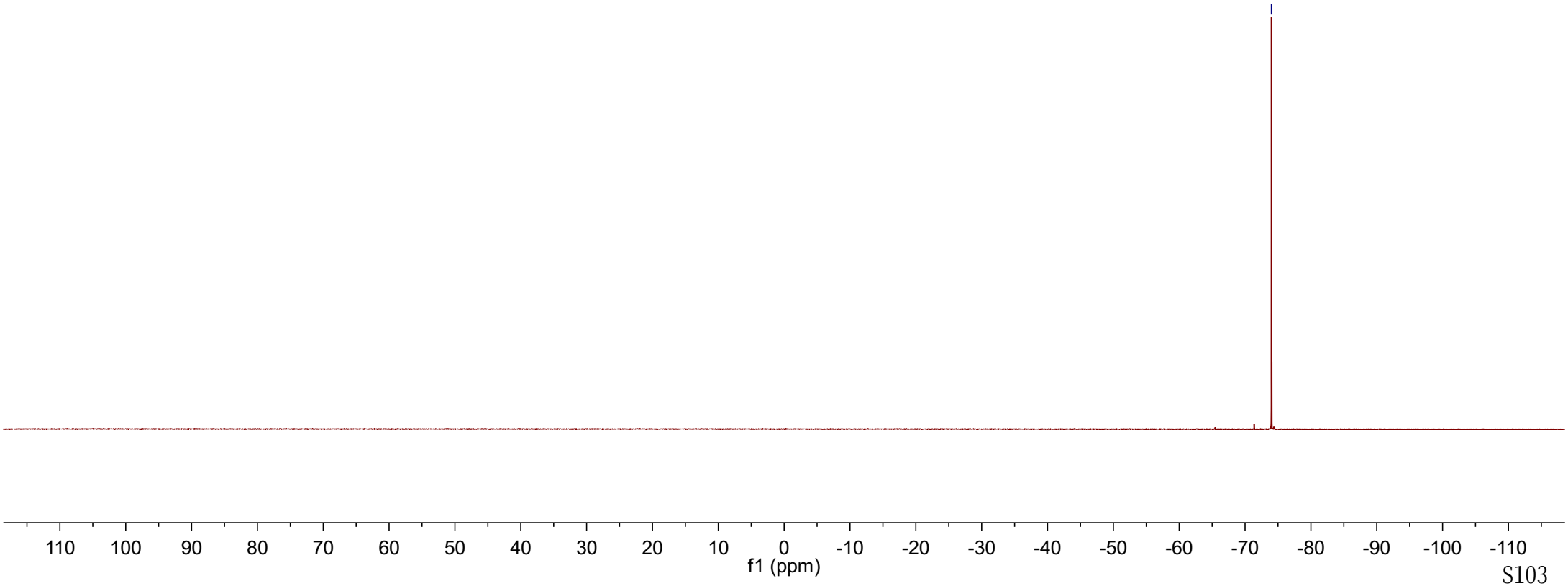


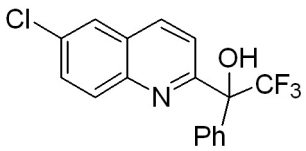


3y

-74.00

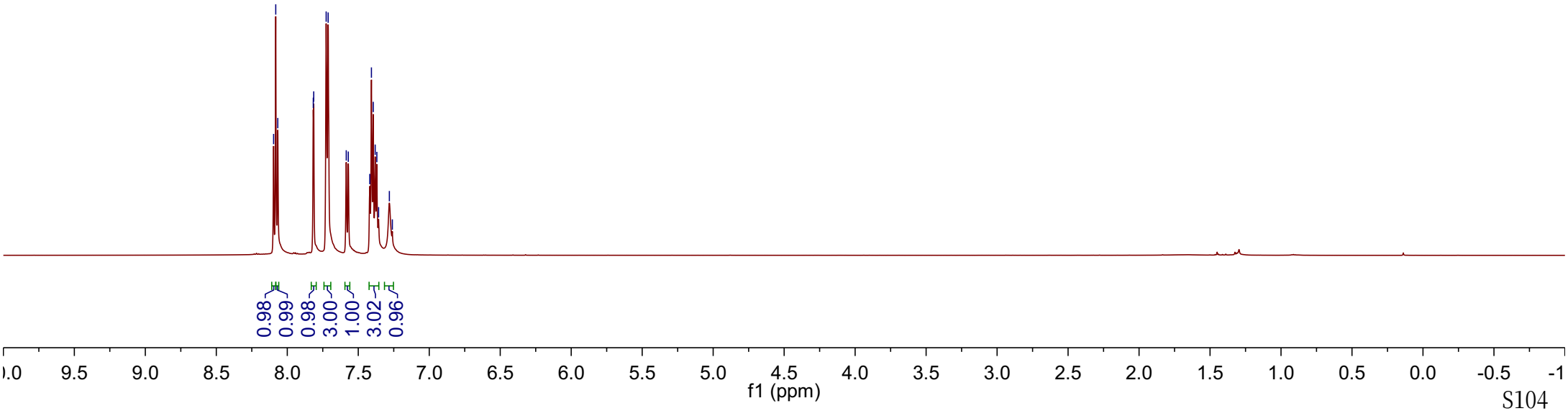
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

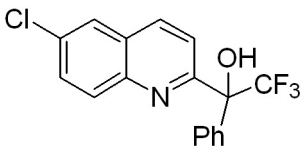




3z

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

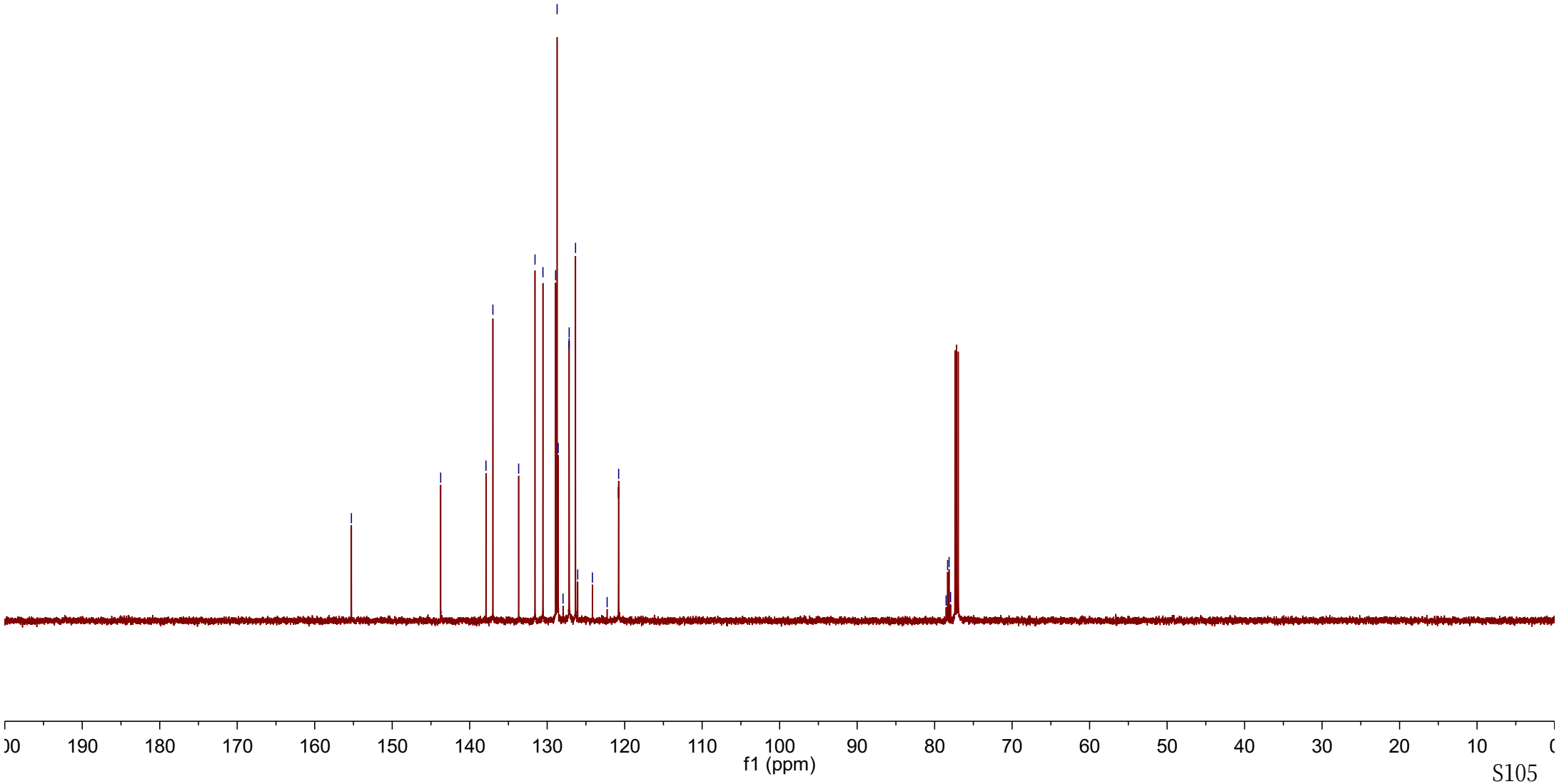


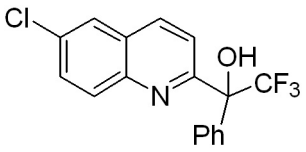


3z

155.26
143.74
137.90
137.01
133.68
131.57
130.55
128.91
128.72
128.57
127.96
127.17
127.16
126.34
126.06
124.16
122.26
120.78
78.52
78.32
78.13
77.94

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

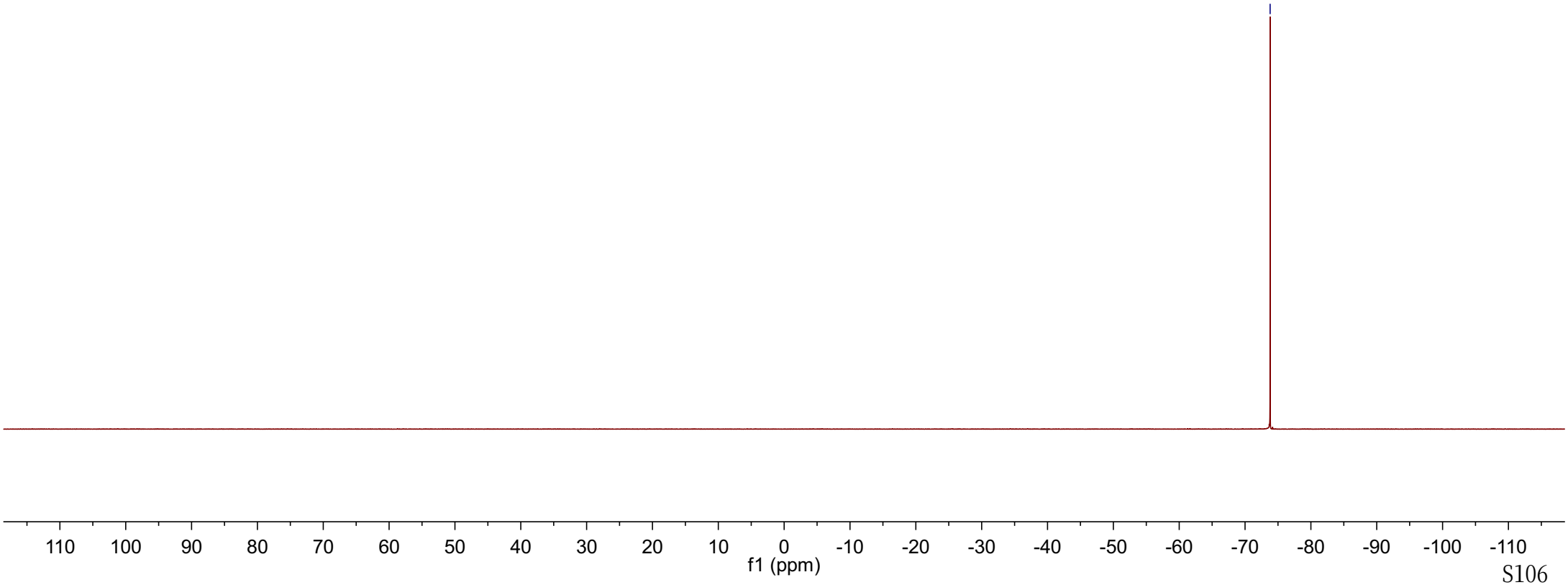


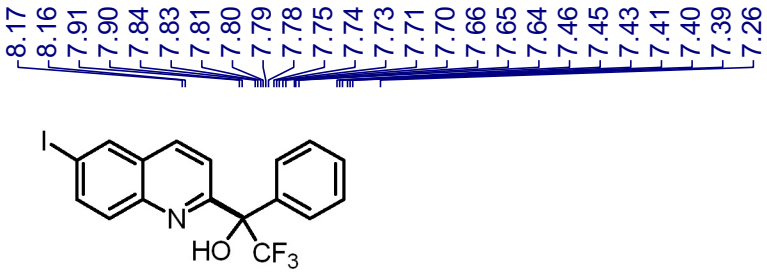


3z

-73.81

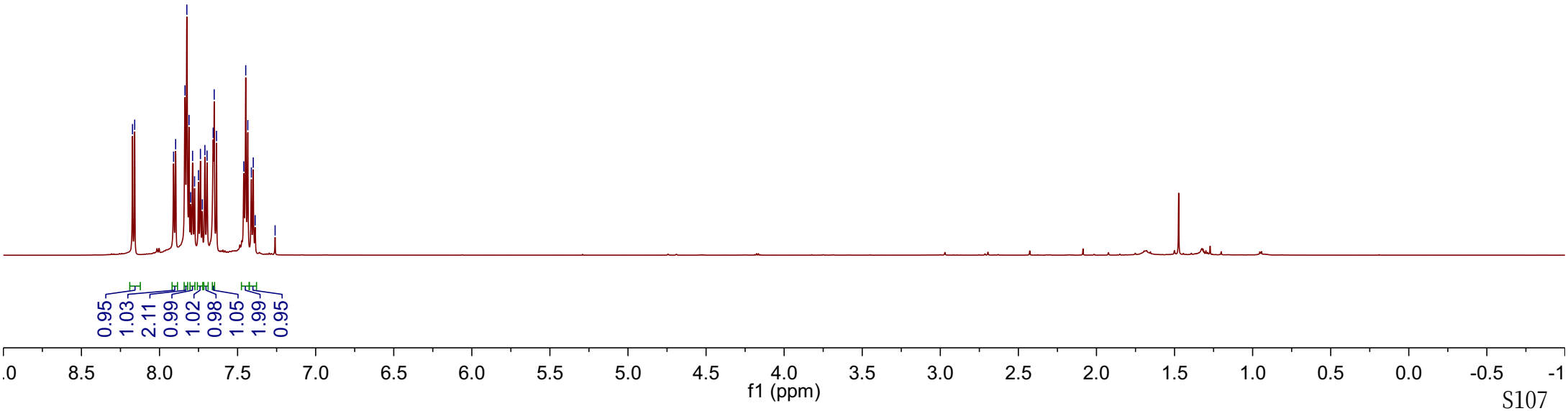
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

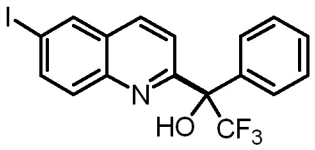




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3aa



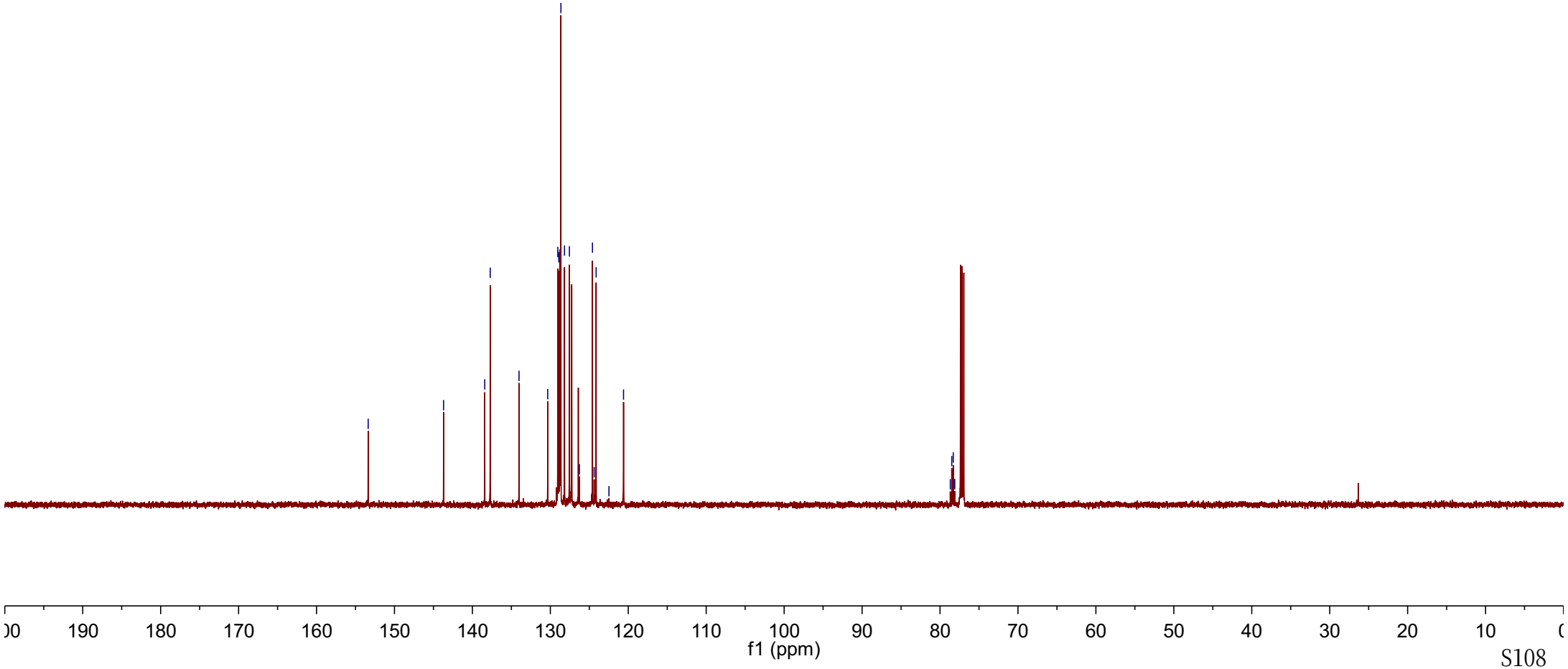


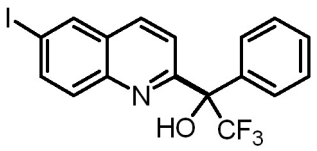
153.37
143.70
138.42
137.71
134.02
130.34
129.04
128.91
128.64
128.18
127.55
126.27
124.59
124.37
124.12
122.48
120.61

78.68
78.49
78.30
78.11

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

3aa

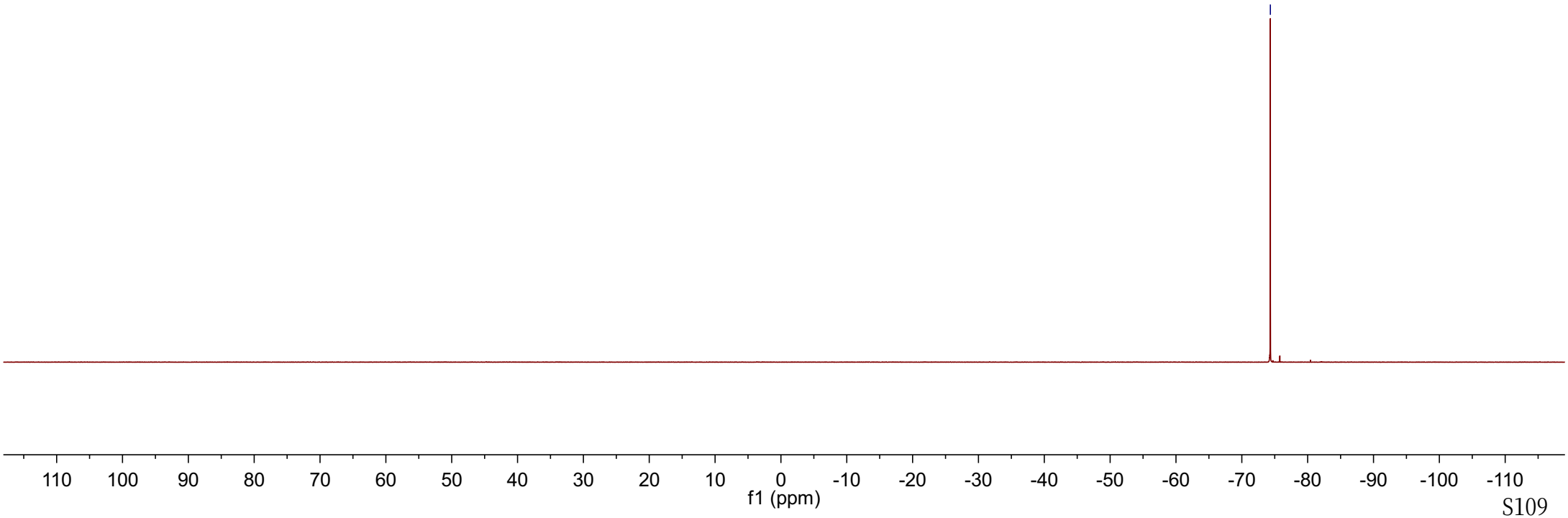




3aa

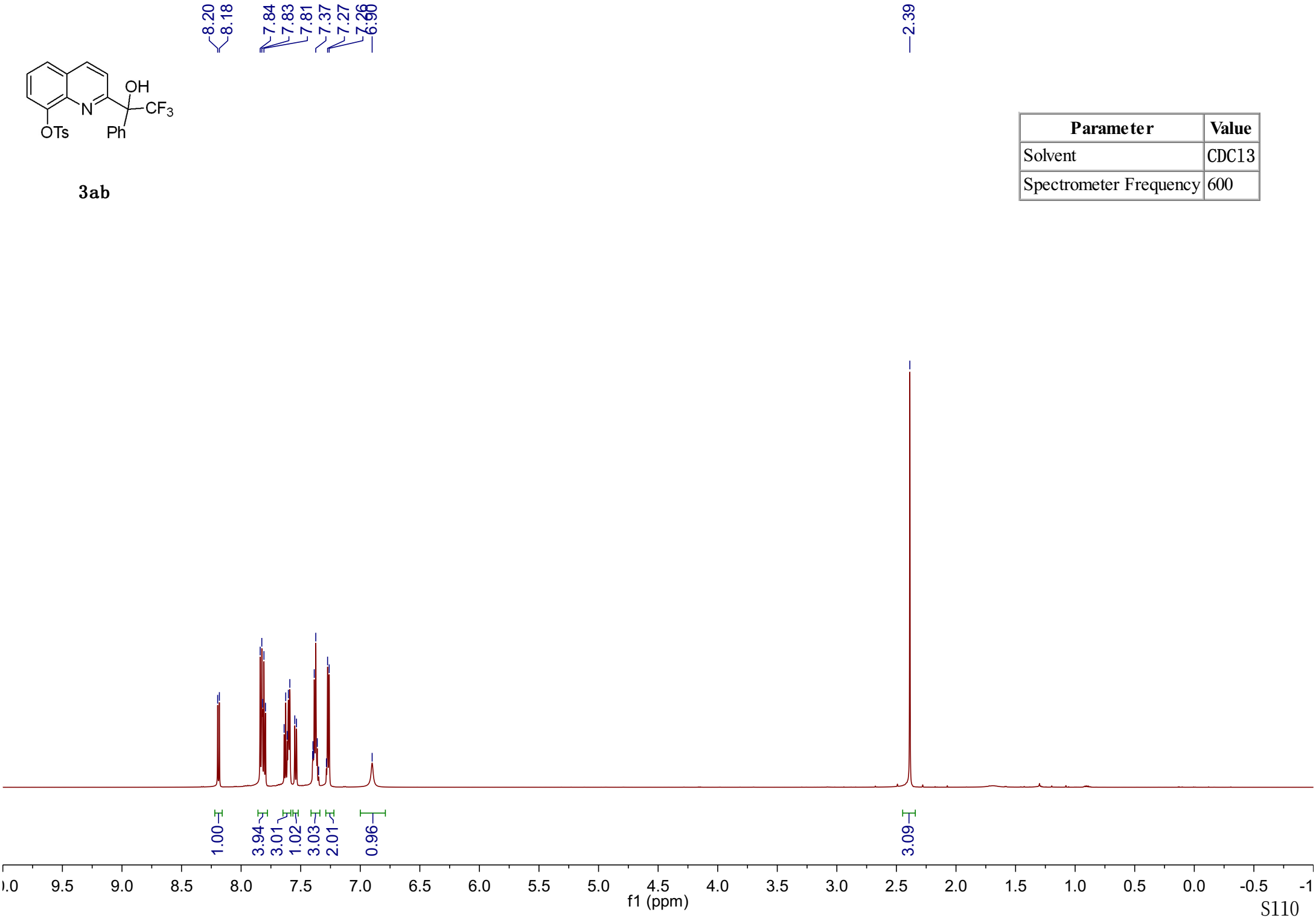
-74.34

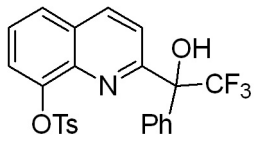
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565



3ab

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	600

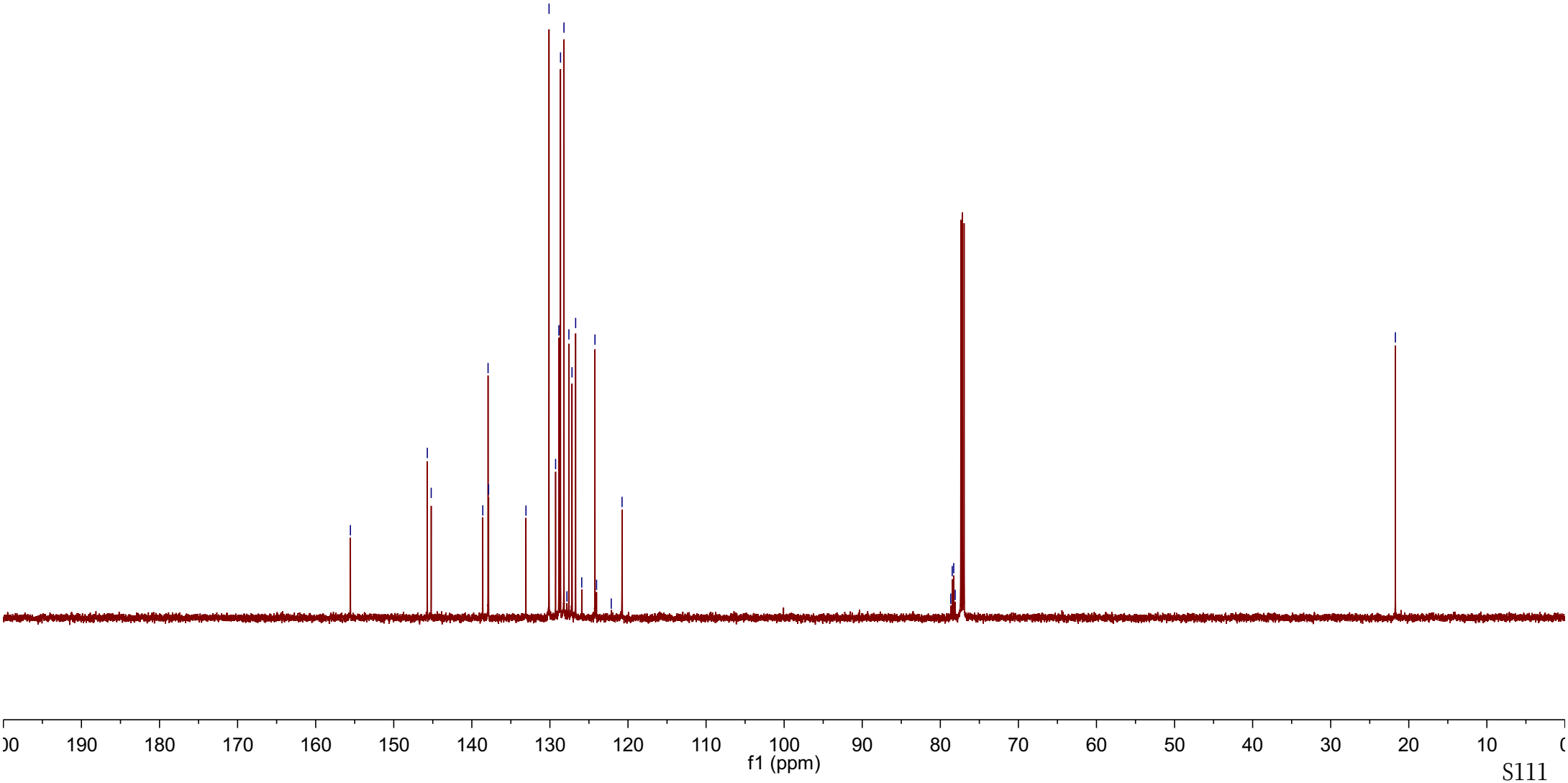


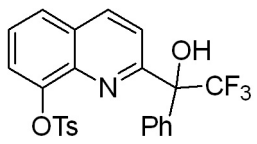


3ab

155.55
145.70
145.20
138.60
137.92
137.85
133.07
130.11
129.27
128.85
128.64
128.20
127.82
127.57
127.17
126.70
125.92
124.23
124.02
122.15
120.76
78.67
78.47
78.28
78.09
21.72

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	150

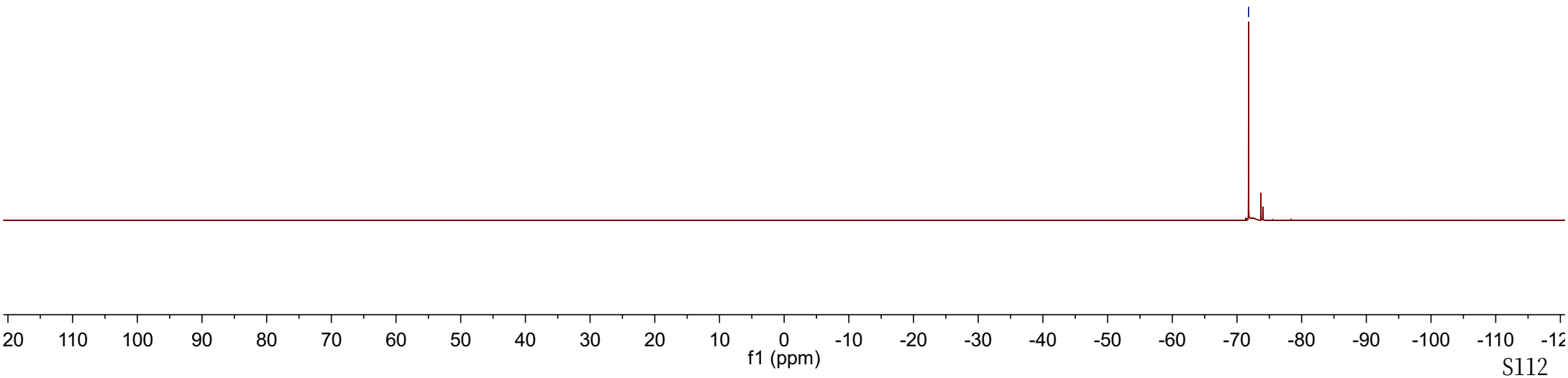


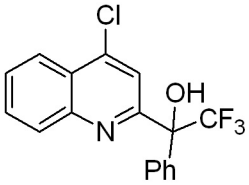


3ab

-71.79

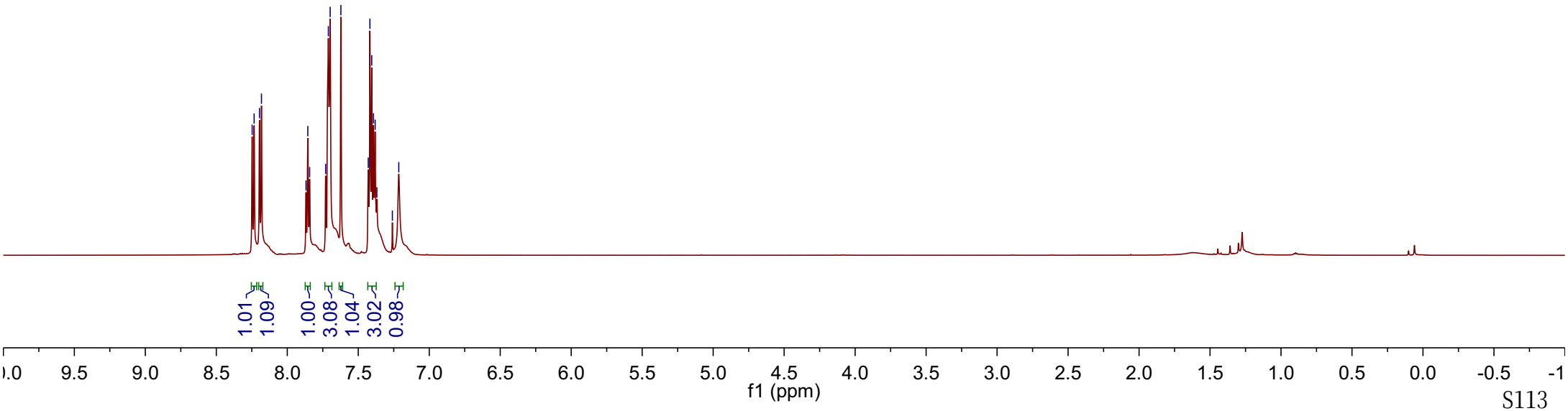
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	377

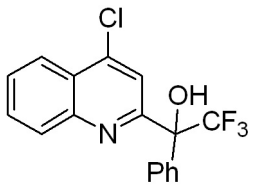




3ac

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

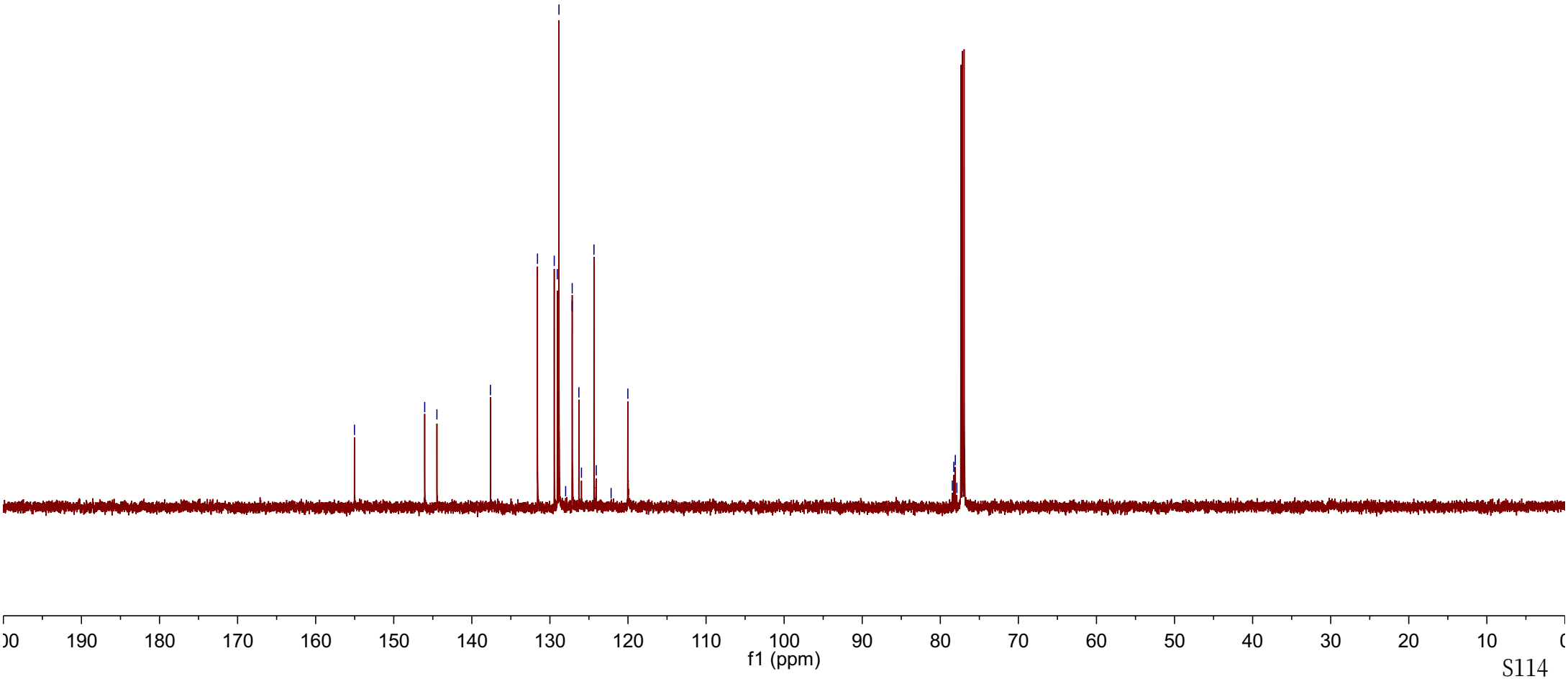


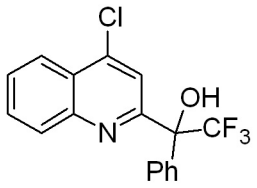


3ac

155.03
146.04
144.47
137.61
131.59
129.45
129.05
128.84
127.98
127.15
127.14
126.29
125.96
124.36
124.06
122.16
120.02
78.46
78.27
78.08
77.88

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

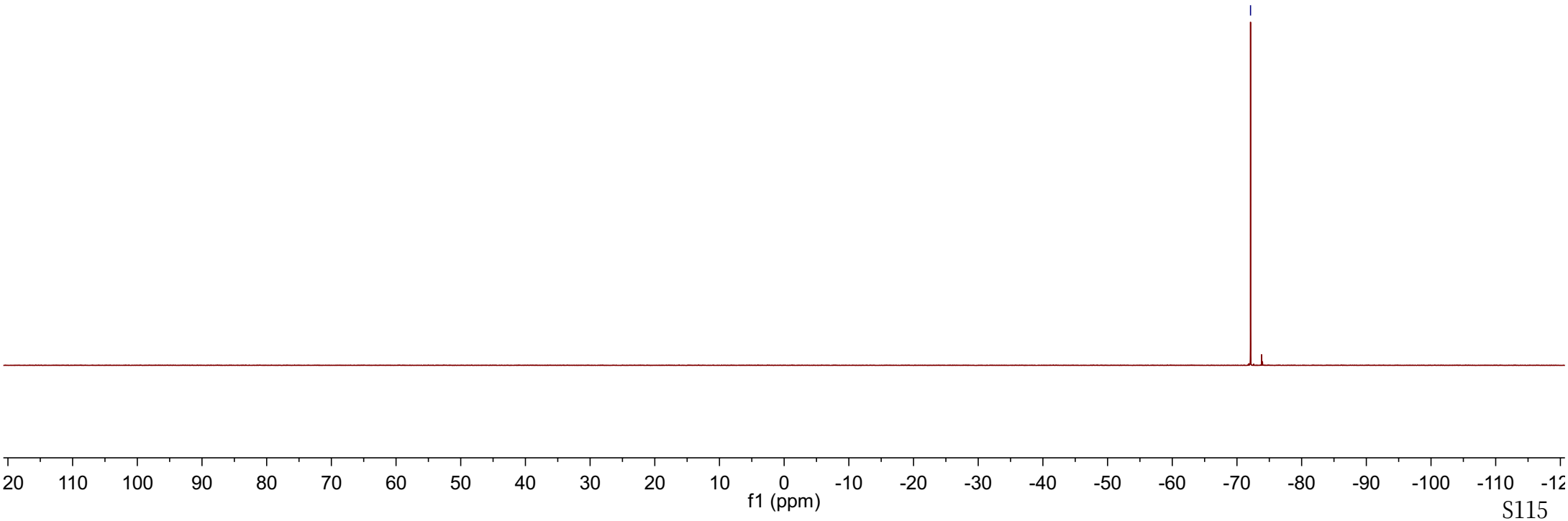


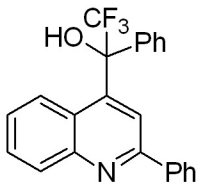


3ac

-72.10

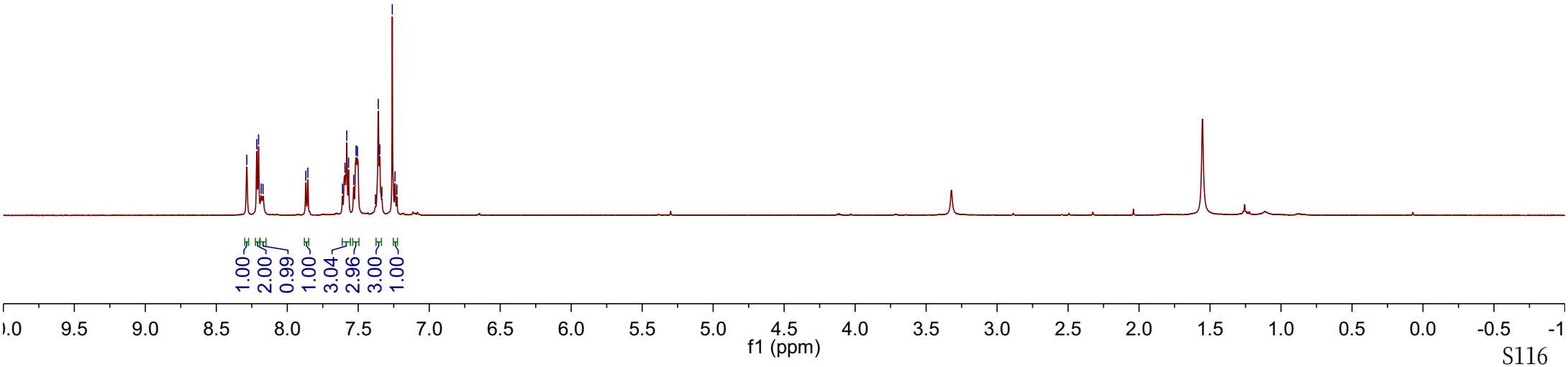
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	377

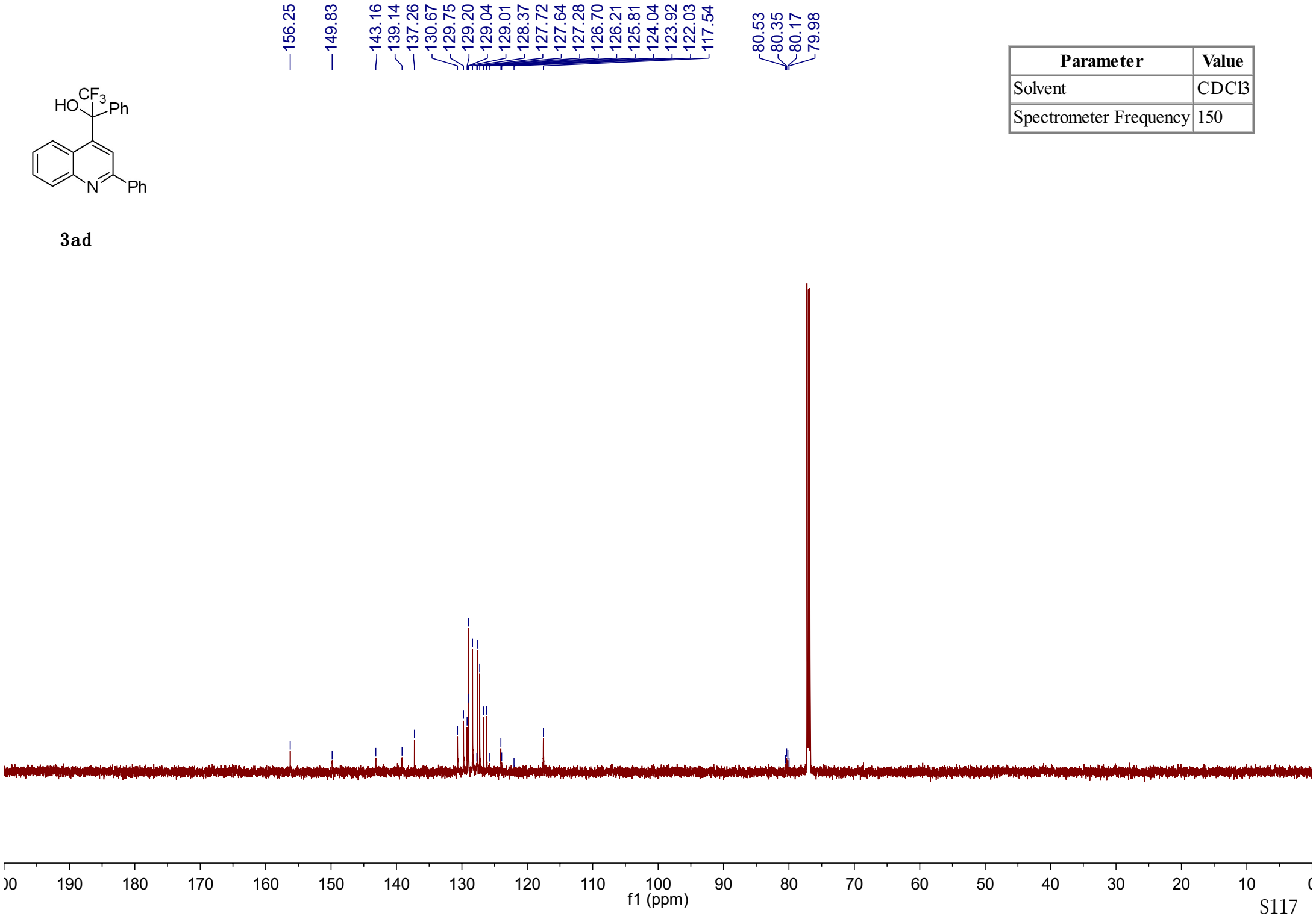


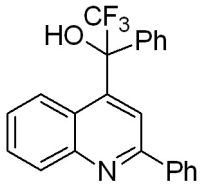


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3ad



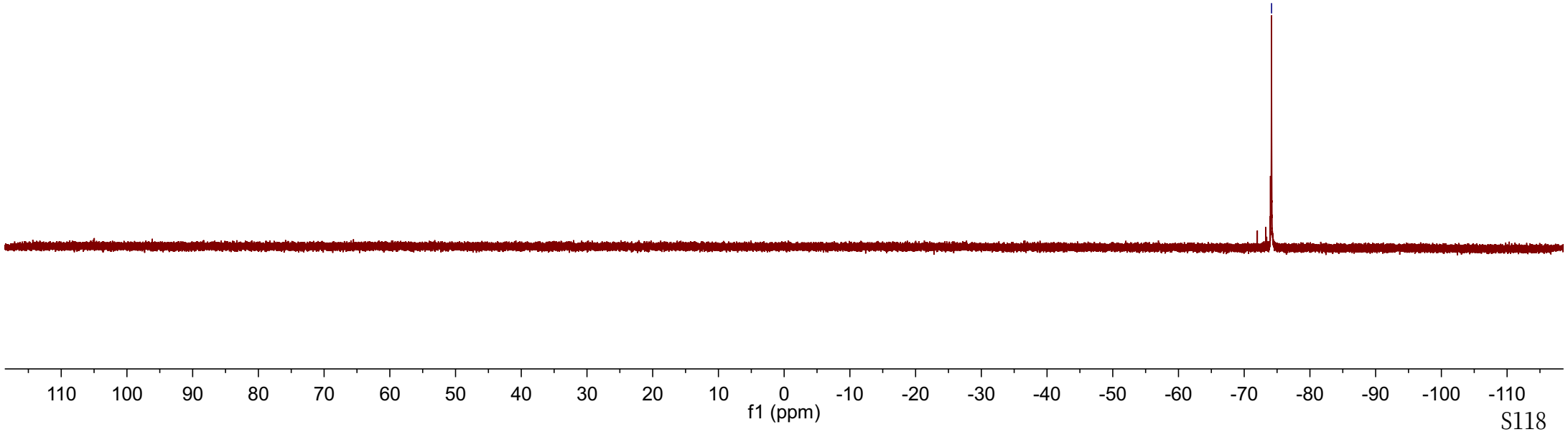

156.25
149.83
143.16
139.14
137.26
130.67
129.75
129.20
129.04
129.01
128.37
127.72
127.64
127.28
126.70
126.21
125.81
124.04
123.92
122.03
117.54
80.53
80.35
80.17
79.98
HO
CF3
Ph
N
Ph
3ad
Parameter
Value
Solvent
CDCl3
Spectrometer Frequency
150
f1 (ppm)

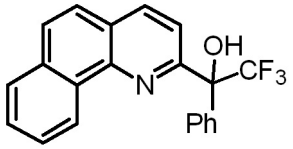


3ad

-74.16

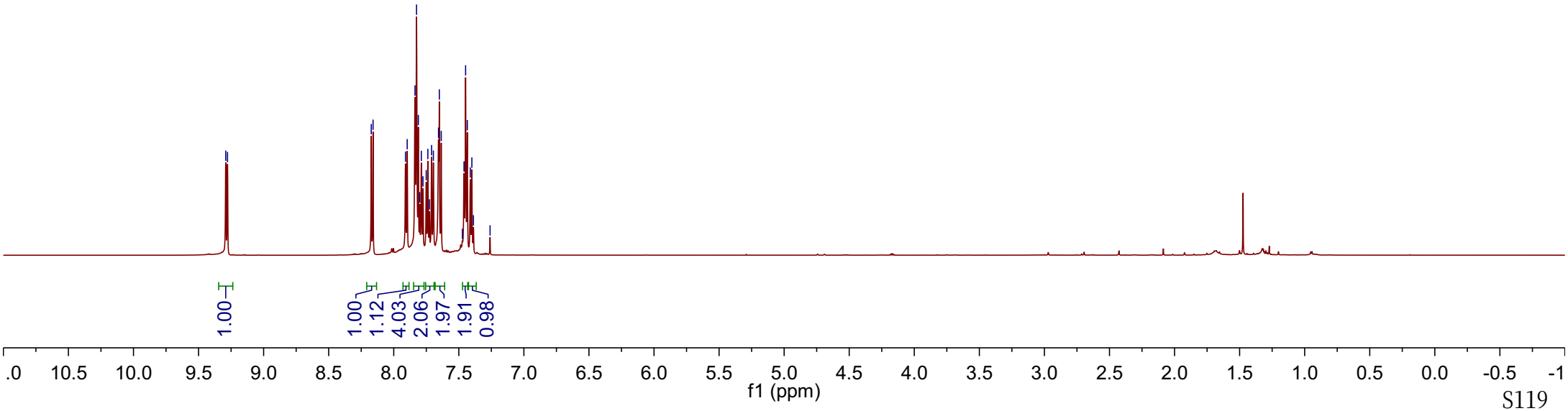
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

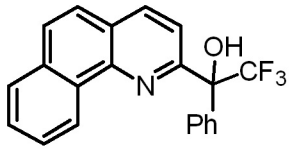




3ae

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



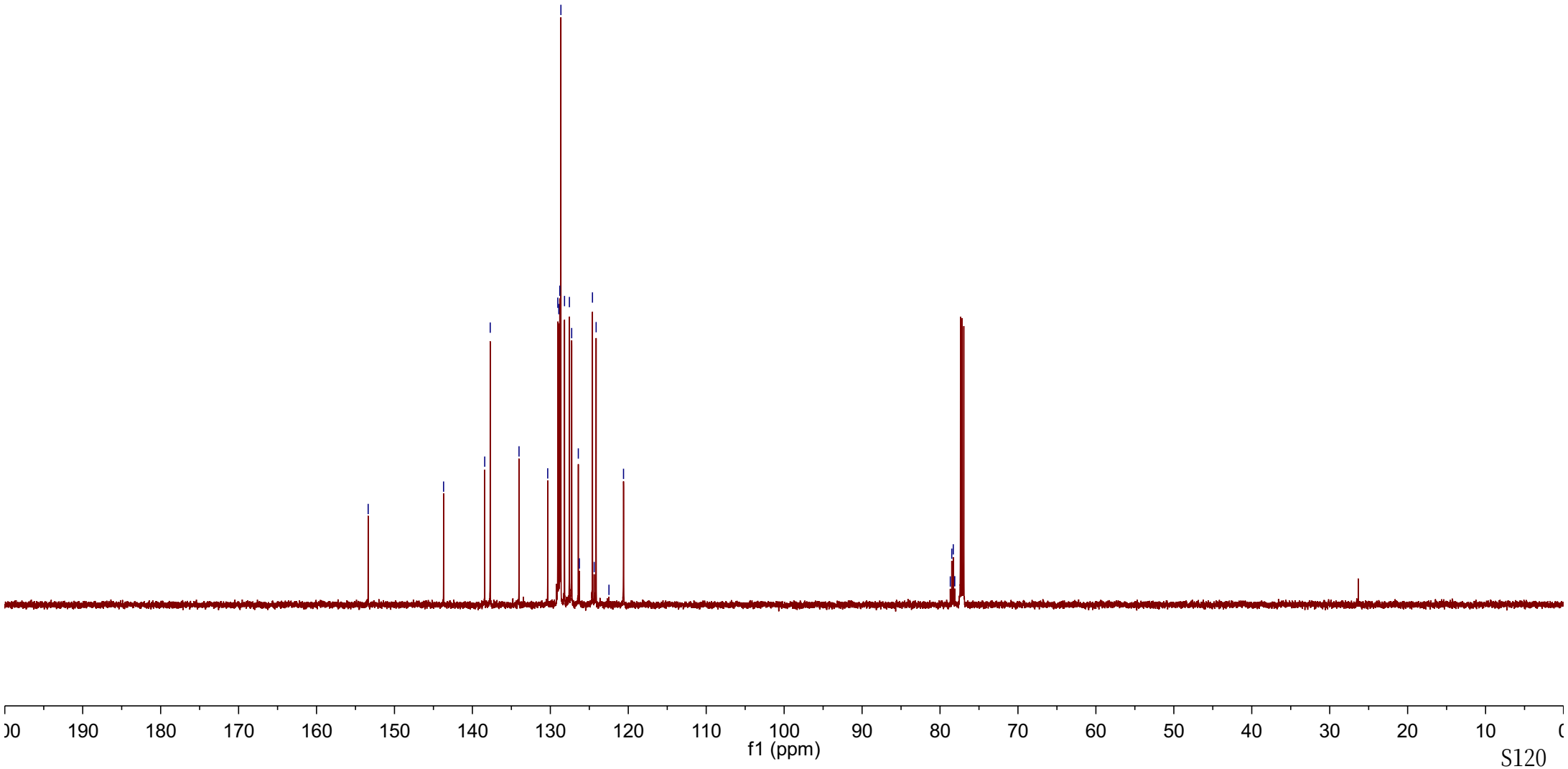


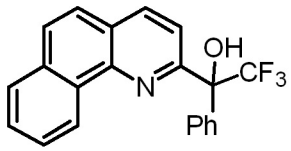
153.37
143.70
138.42
137.71
134.02
130.34
129.04
128.91
128.79
128.64
128.18
127.55
127.26
126.41
126.27
124.59
124.37
124.12
122.48
120.61

78.68
78.49
78.30
78.11

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

3ae

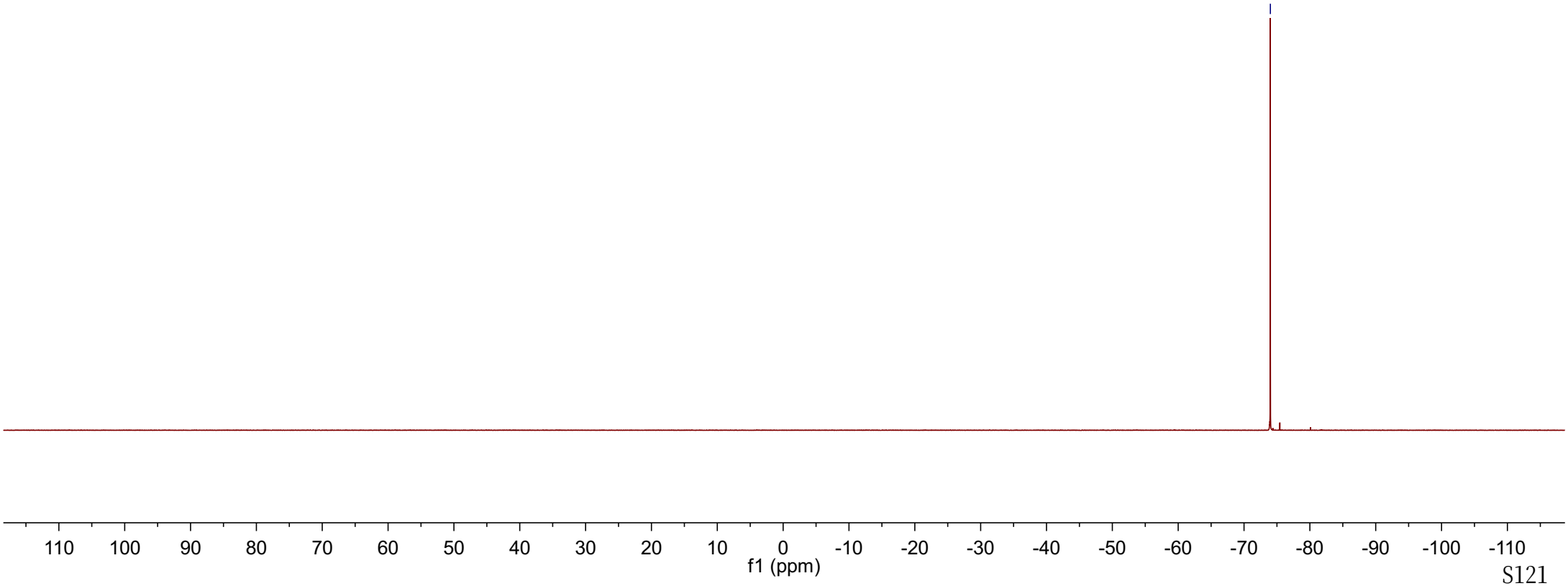




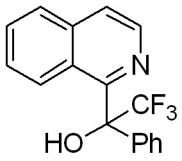
3ae

-74.00

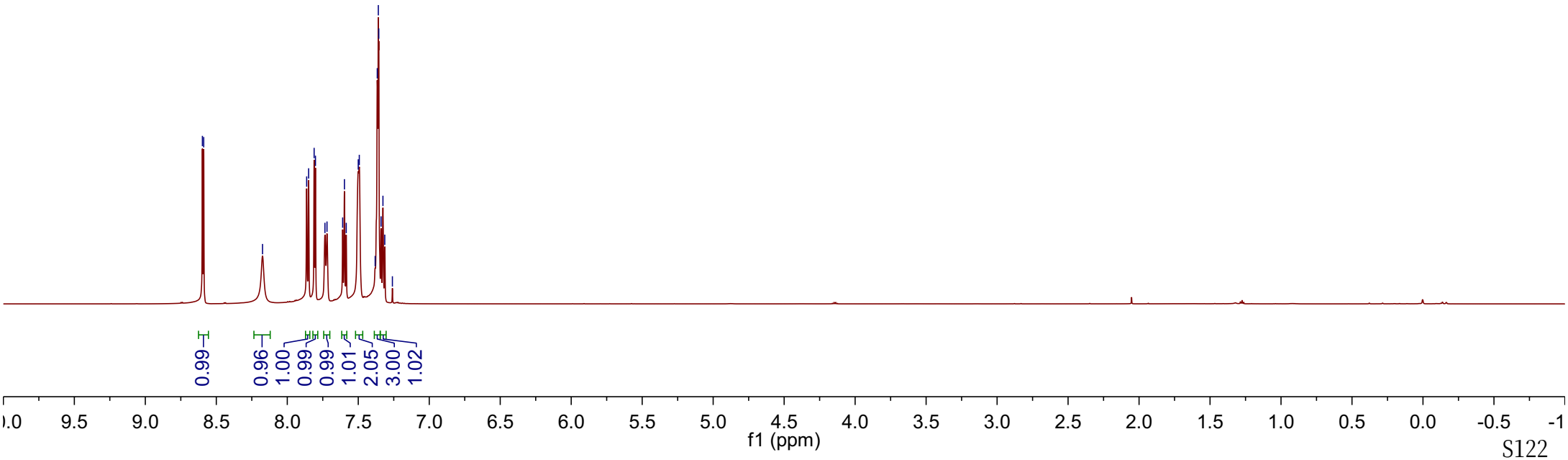
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

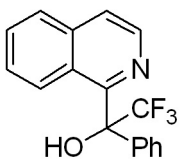


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



3af

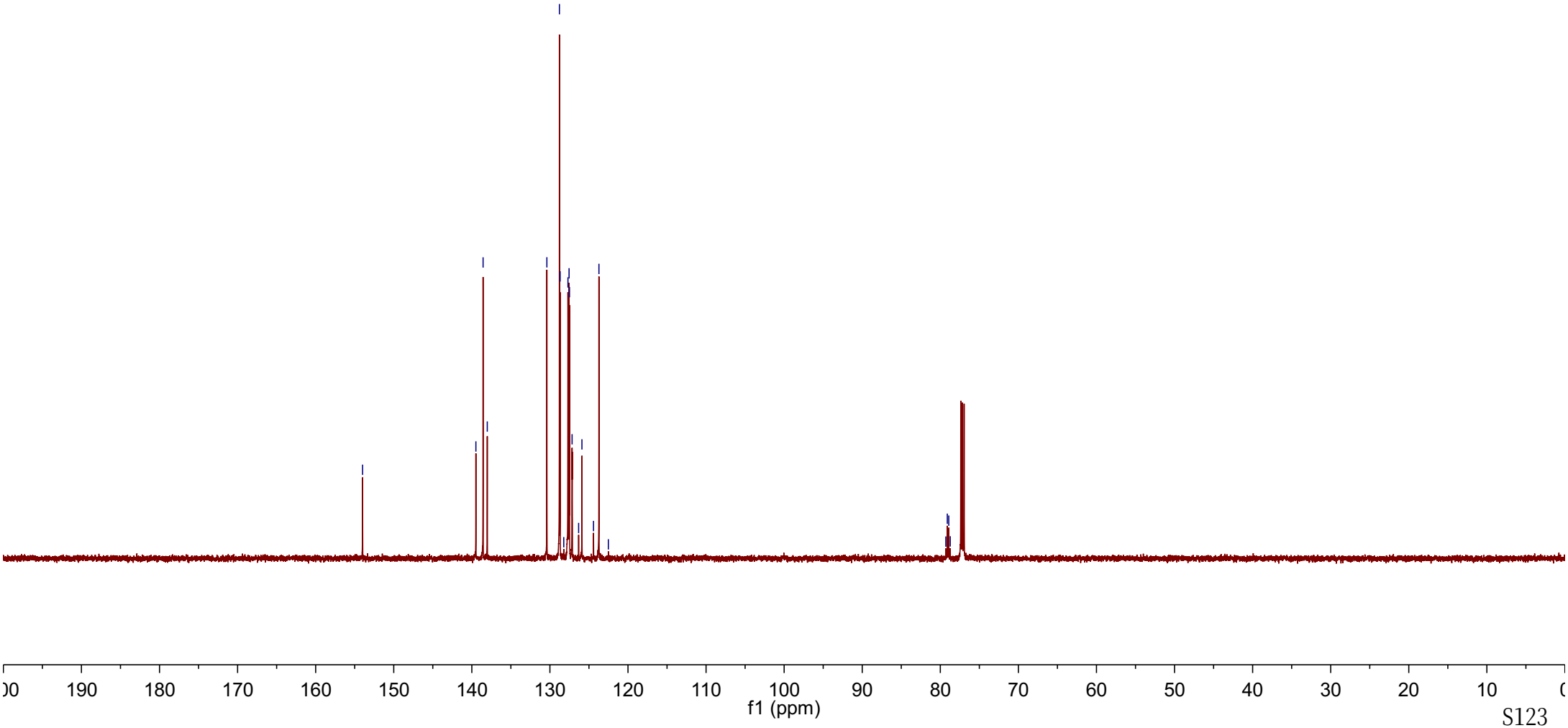


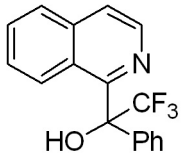


3af

153.99
139.48
138.56
138.02
130.39
128.78
128.69
128.23
127.69
127.55
127.49
127.16
126.32
125.90
124.42
123.72
122.51
79.30
79.10
78.92
78.72

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

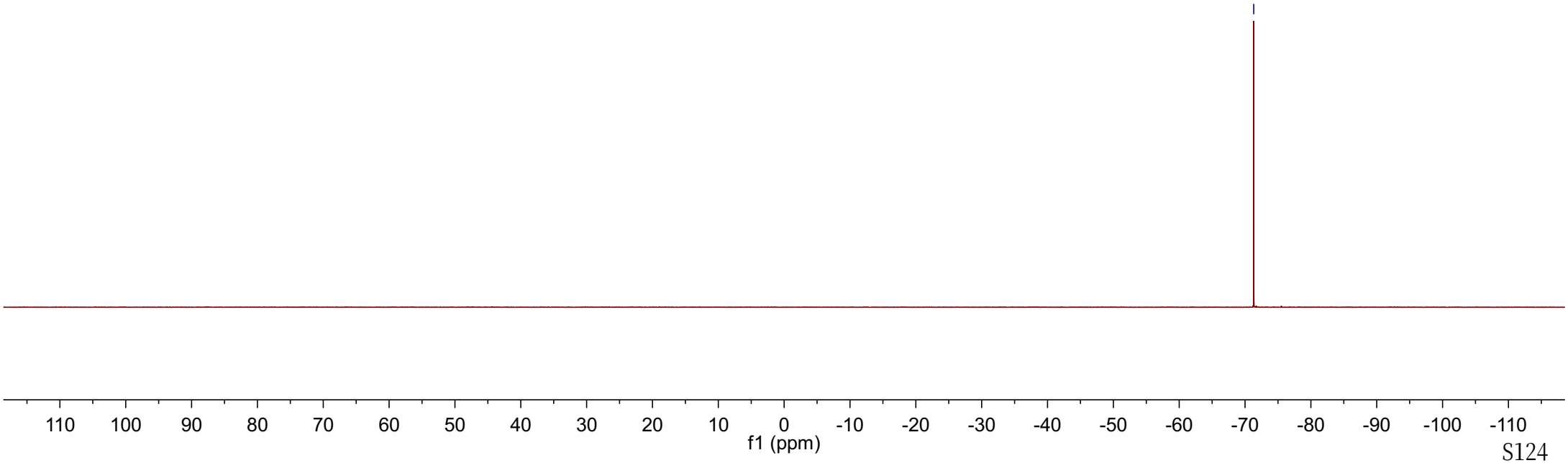


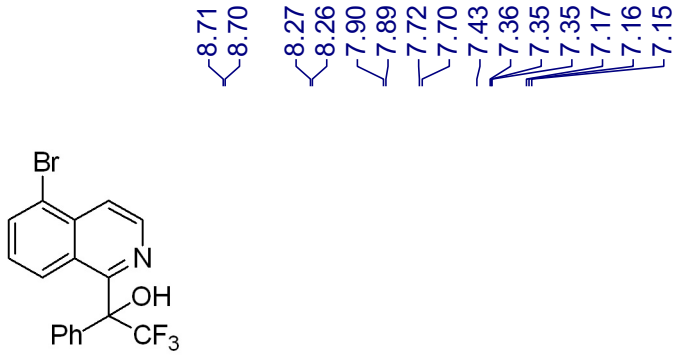


3af

-71.32

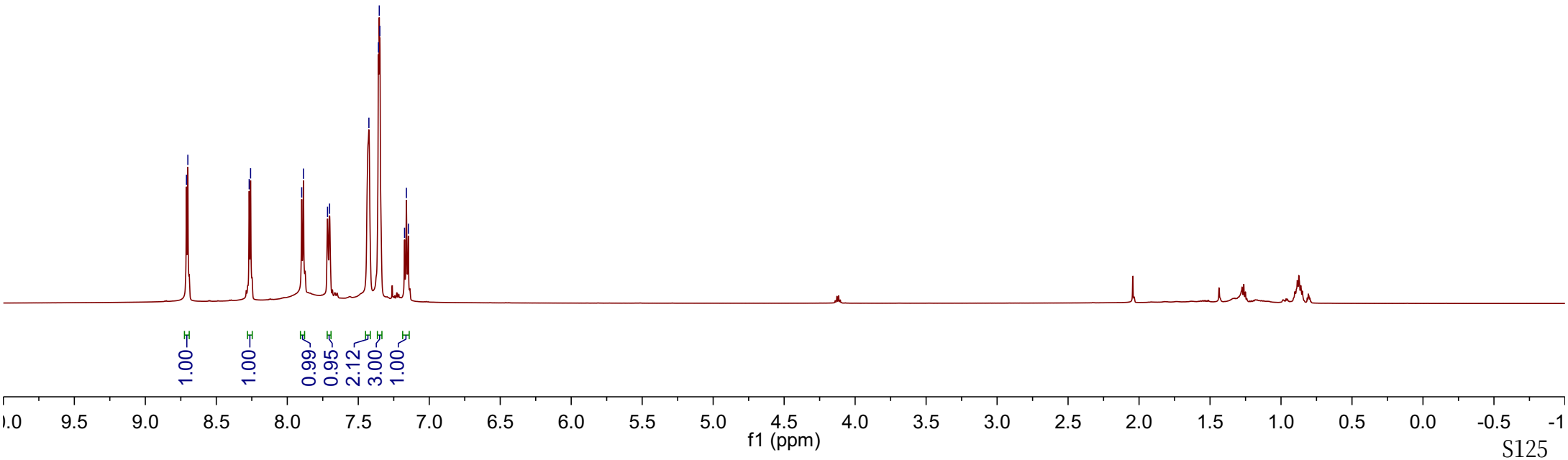
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

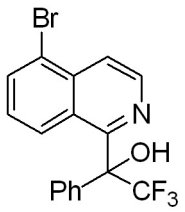




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3ag

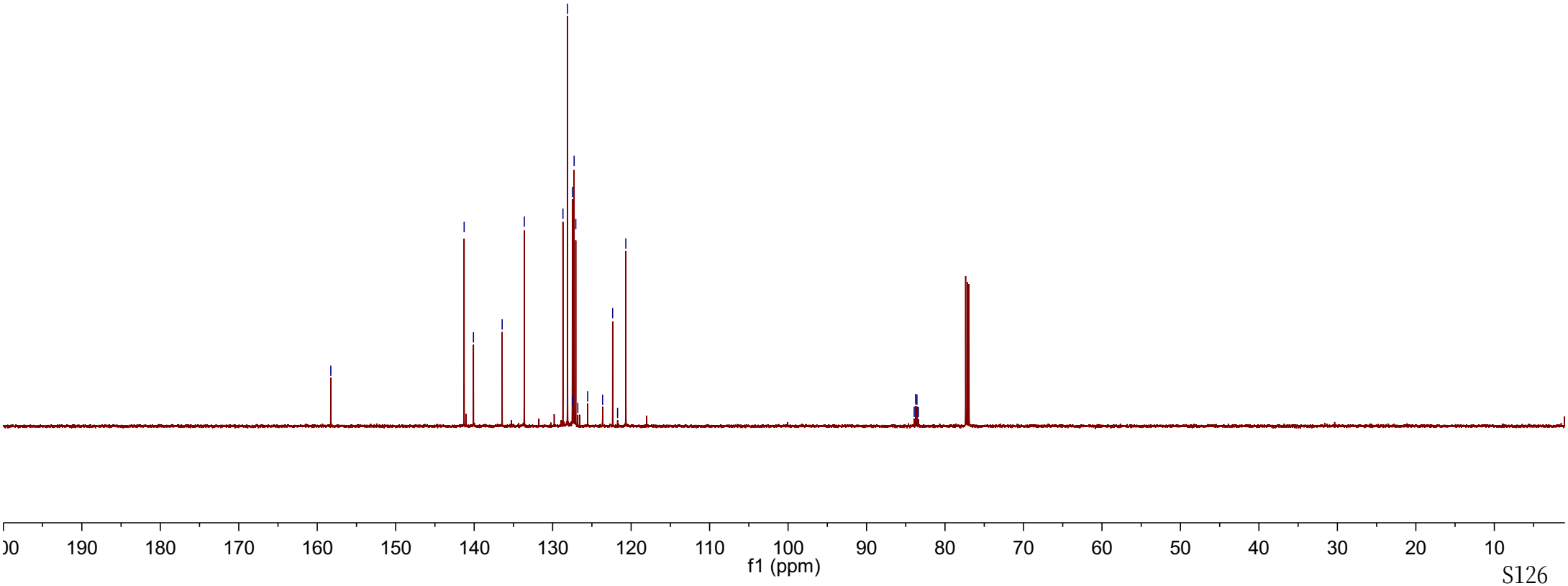


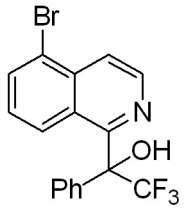


3ag

158.27
141.28
140.09
136.44
133.61
128.69
128.10
127.49
127.45
127.26
127.05
126.80
125.54
123.63
122.36
121.73
120.67
83.93
83.75
83.58
83.40

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

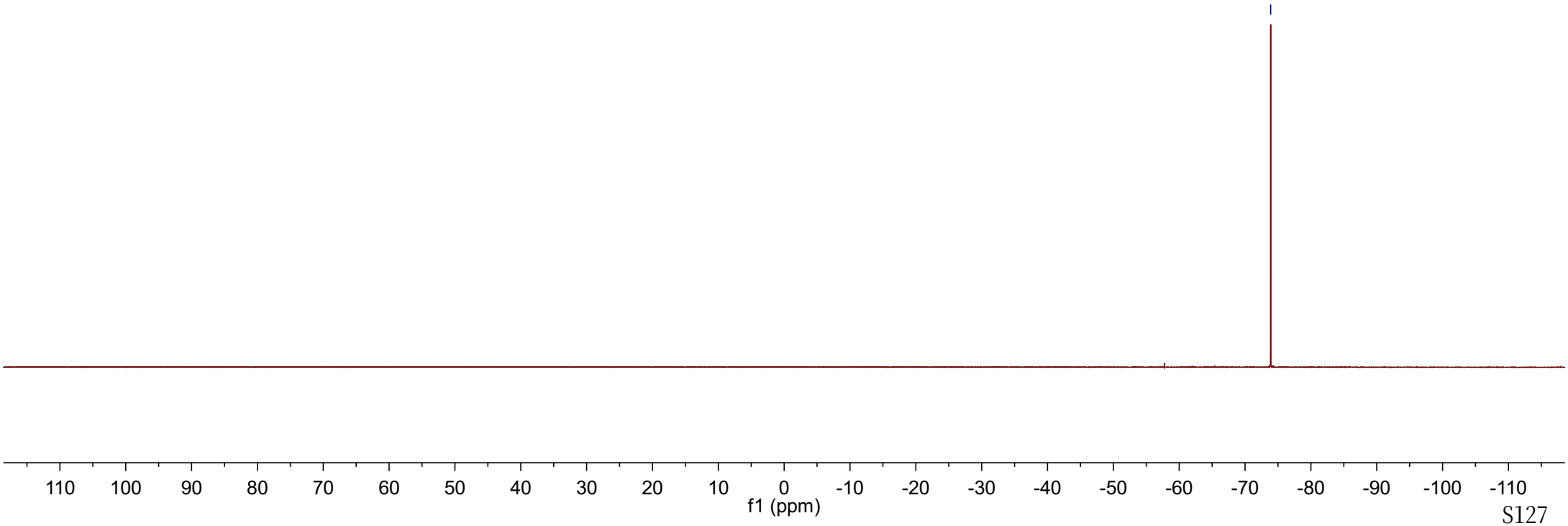


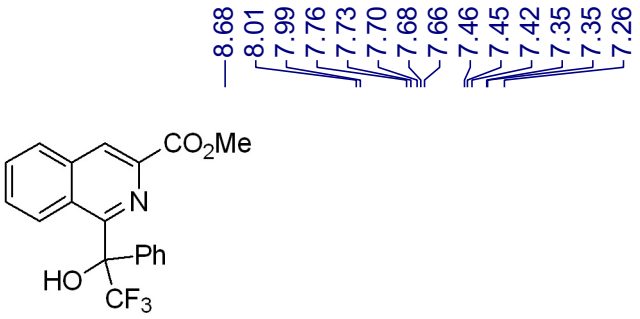


3ag

-73.89

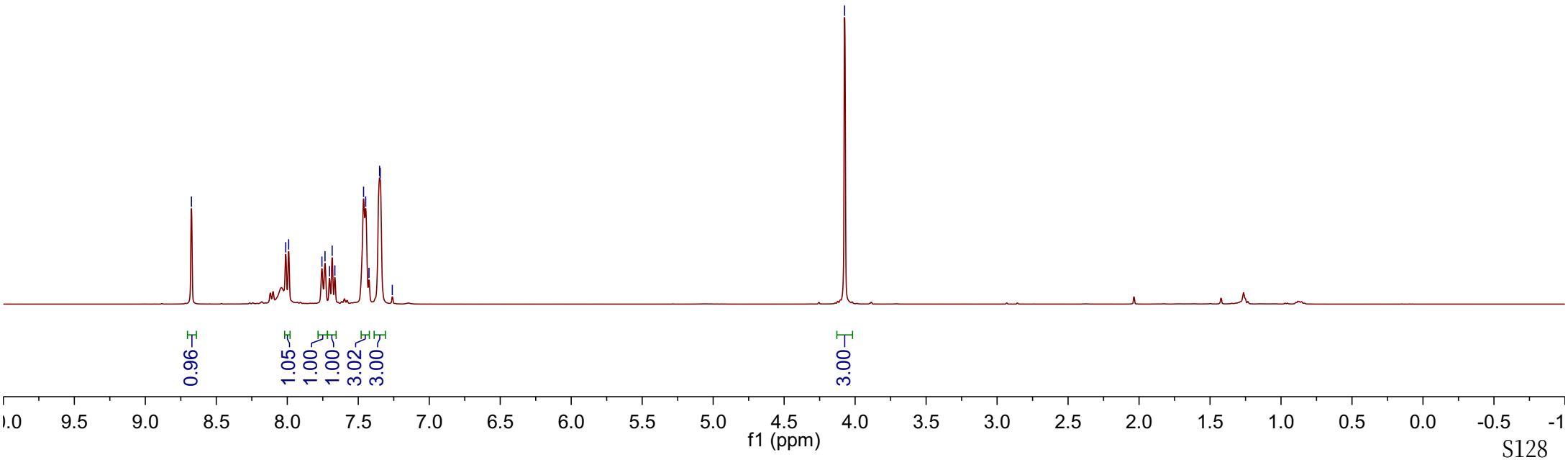
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





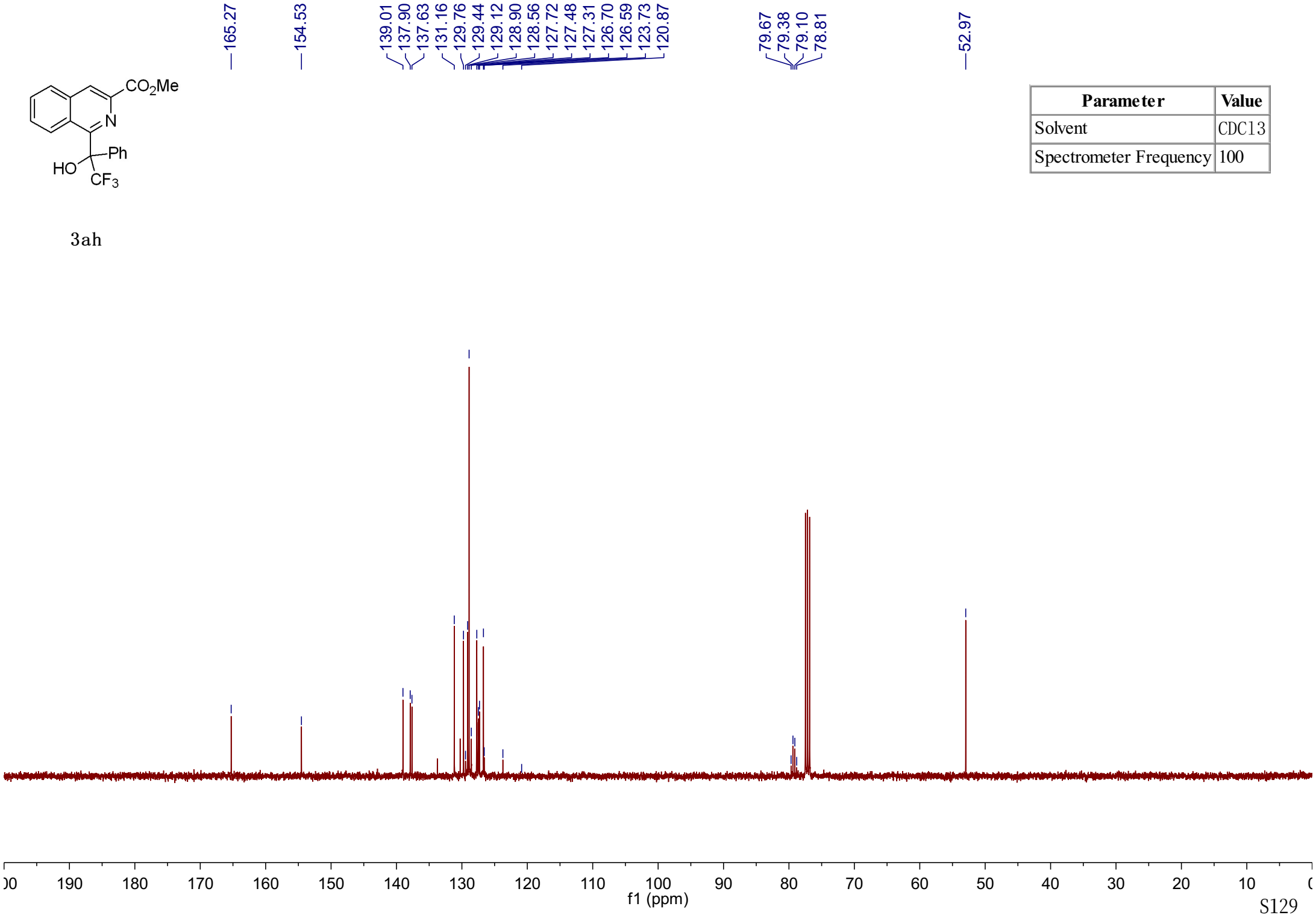
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	400

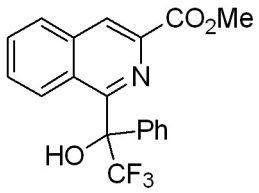
3ah



3ah

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	100

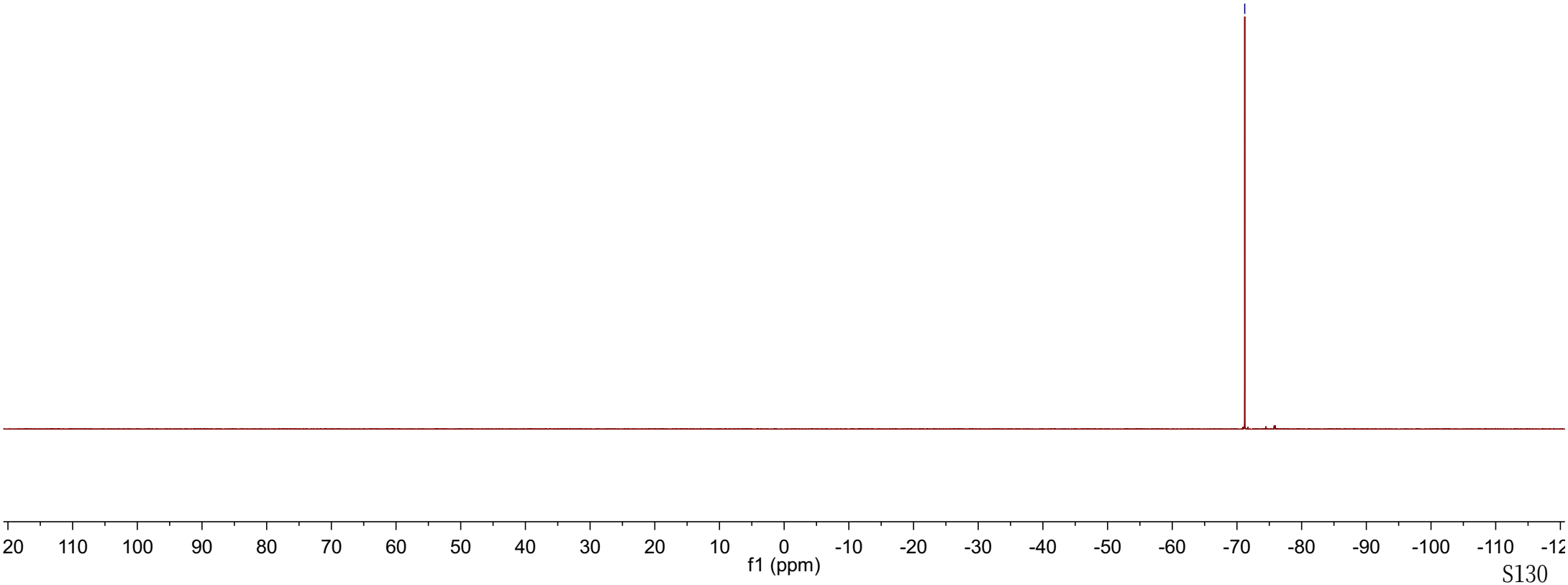




3ah

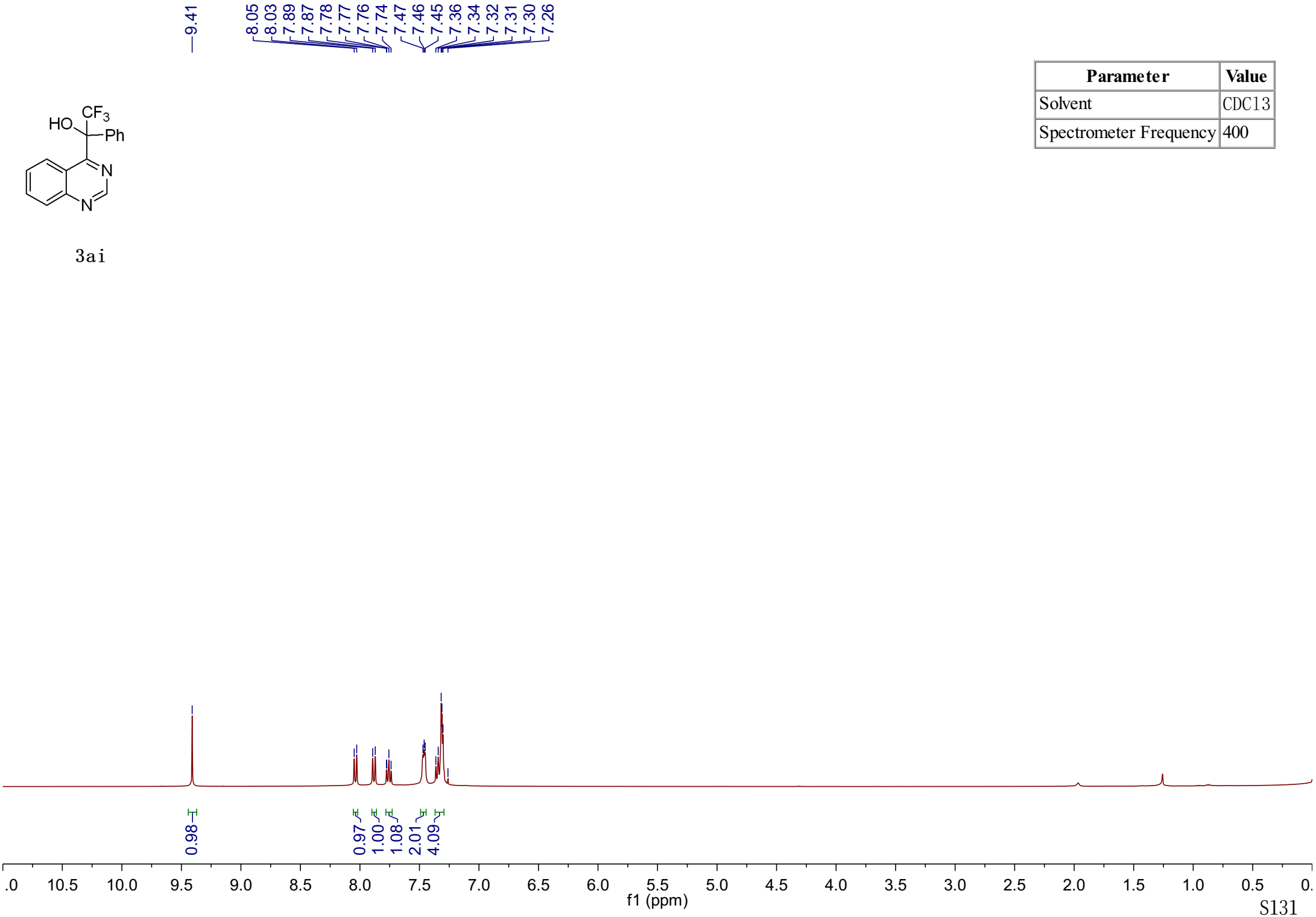
-71.20

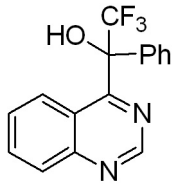
Parameter	Value
Solvent	CDC13
Spectrometer Frequency	377



3ai

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	400

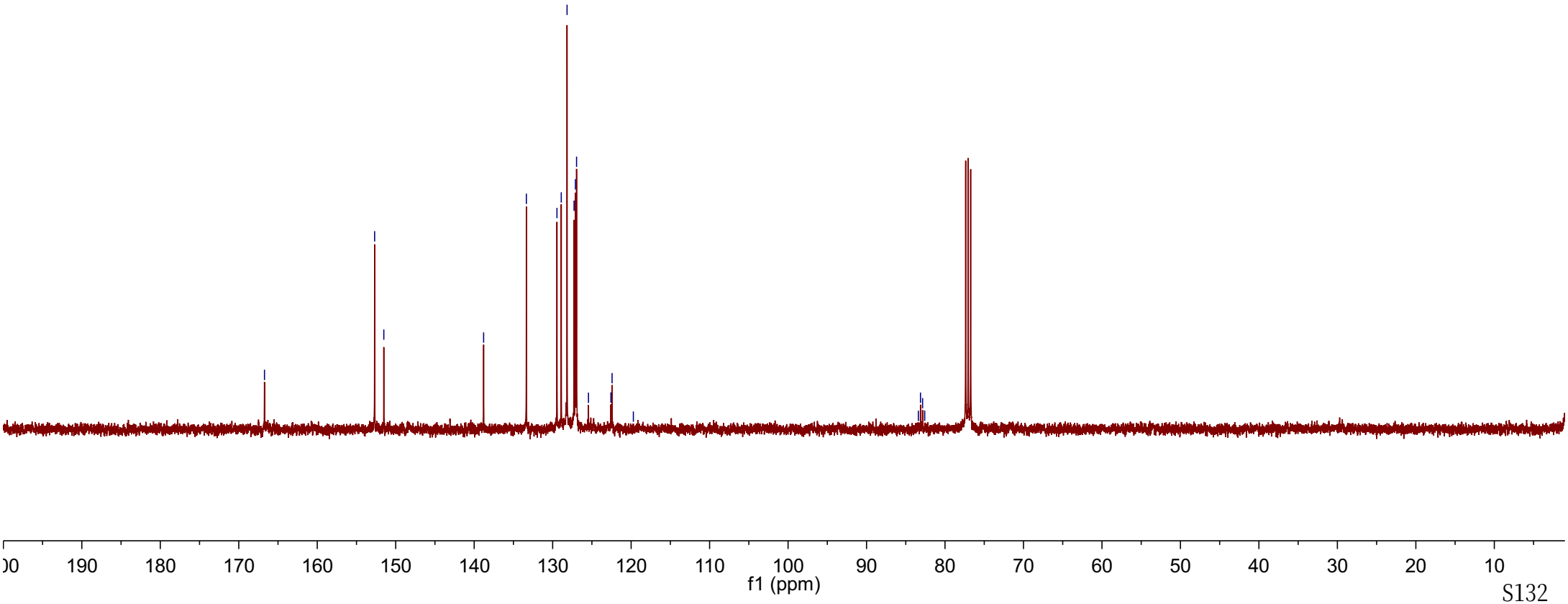


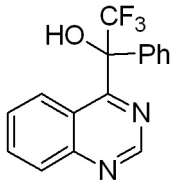


3ai

166.72
152.69
151.52
138.80
133.35
129.45
128.90
128.17
127.27
127.10
126.95
125.44
122.58
122.43
119.71
83.40
83.13
82.86
82.59

Parameter	Value
Solvent	CDC13
Spectrometer Frequency	100

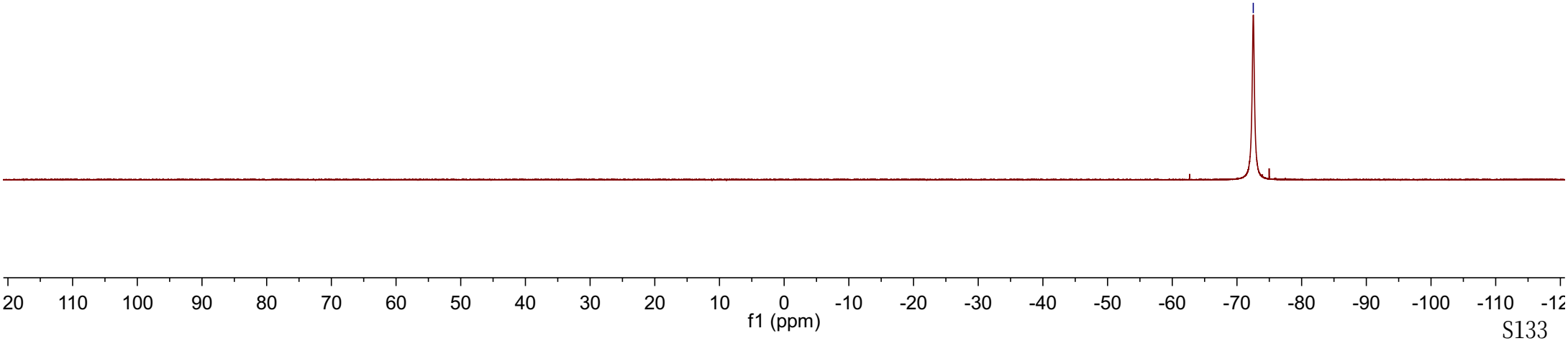


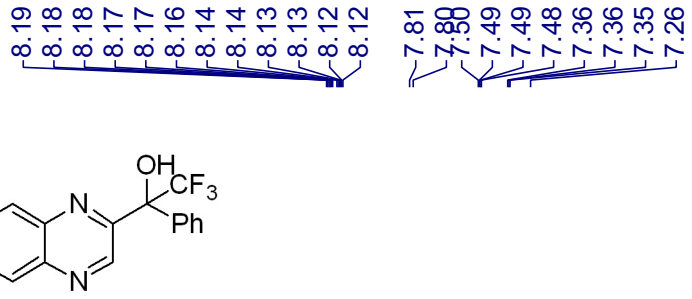


3ai

-72.52

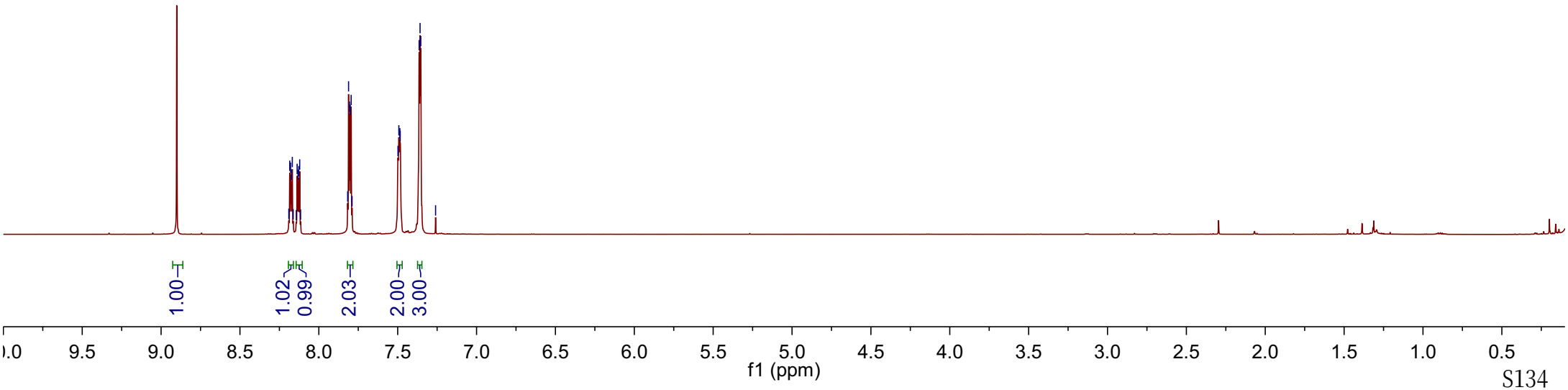
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	377

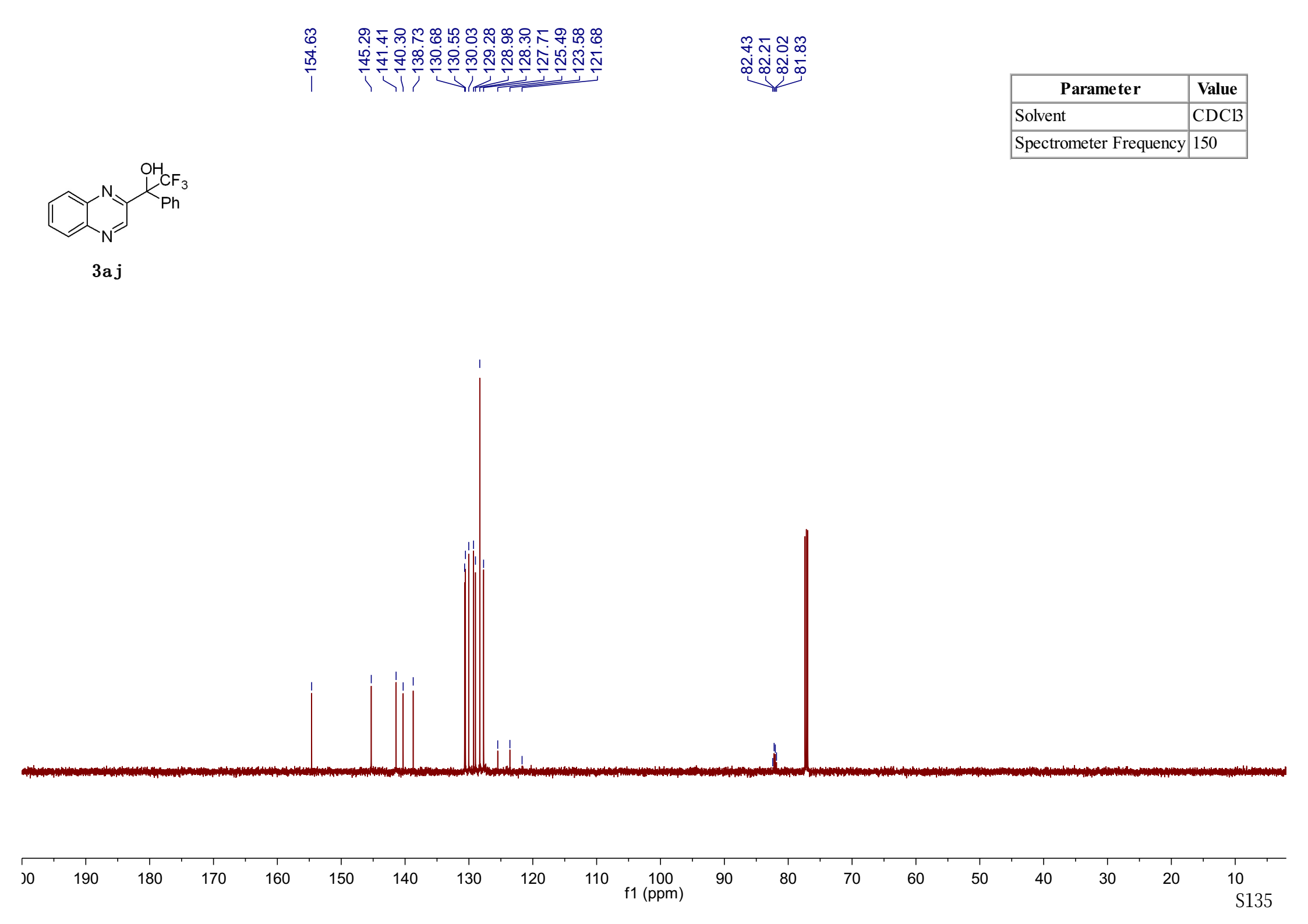


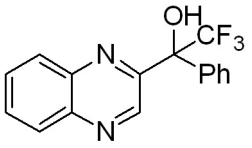


Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3aj



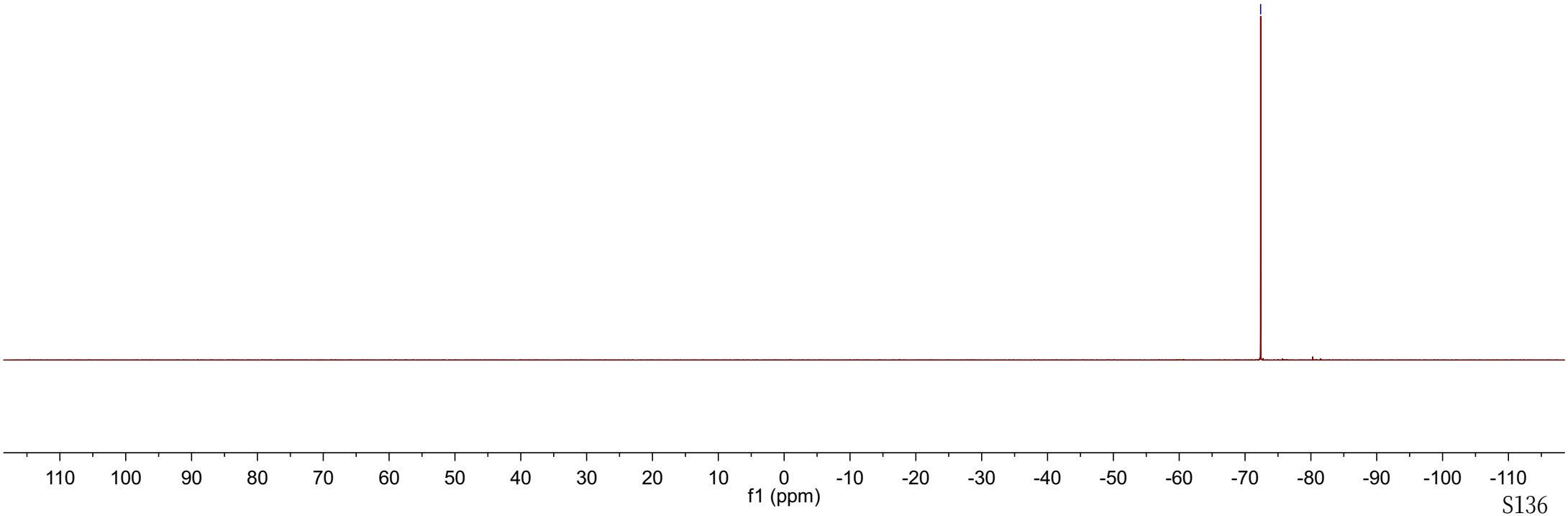

154.63
145.29
141.41
140.30
138.73
130.68
130.55
130.03
129.28
128.98
128.30
127.71
125.49
123.58
121.68
82.43
82.21
82.02
81.83
Parameter
Value
Solvent
CDCl3
Spectrometer Frequency
150
OH
CF3
Ph
N
N
3aj
f1 (ppm)

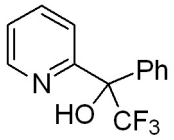


3aj

-72.37

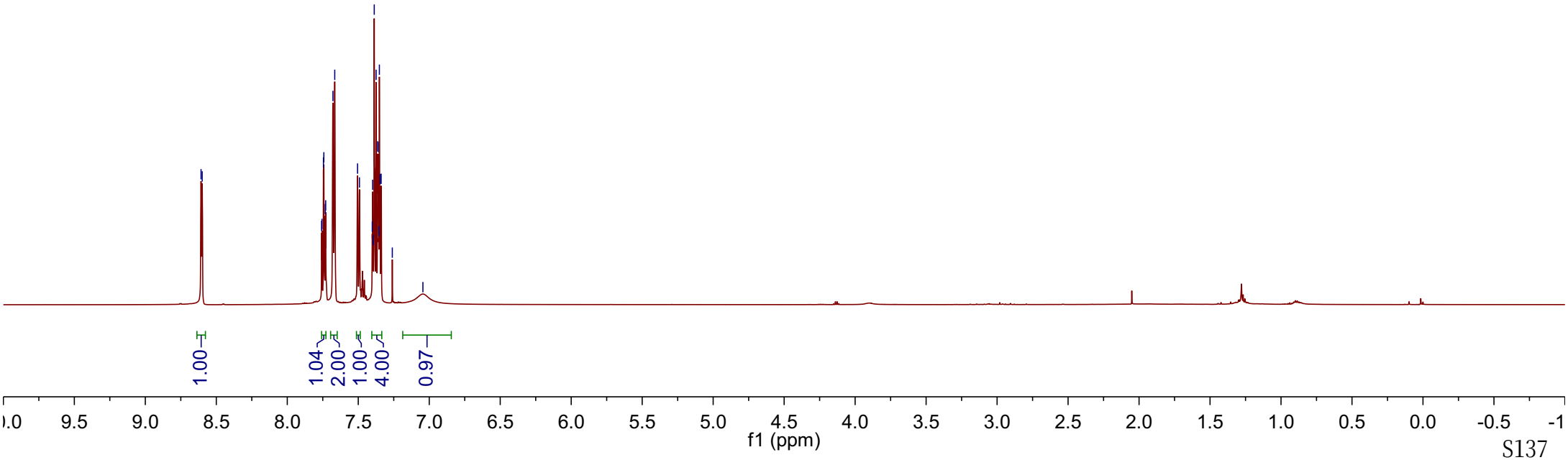
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565





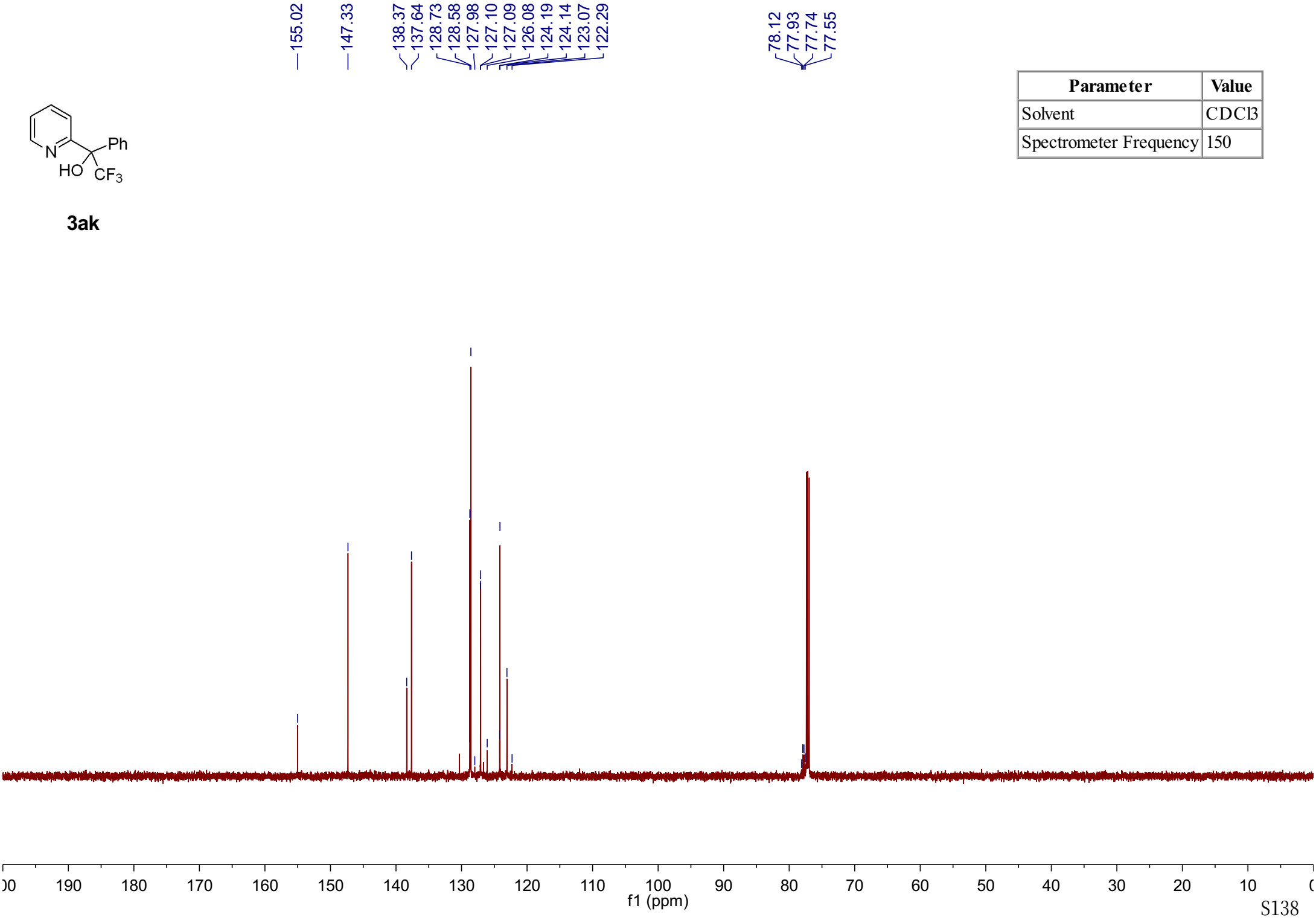
3ak

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600



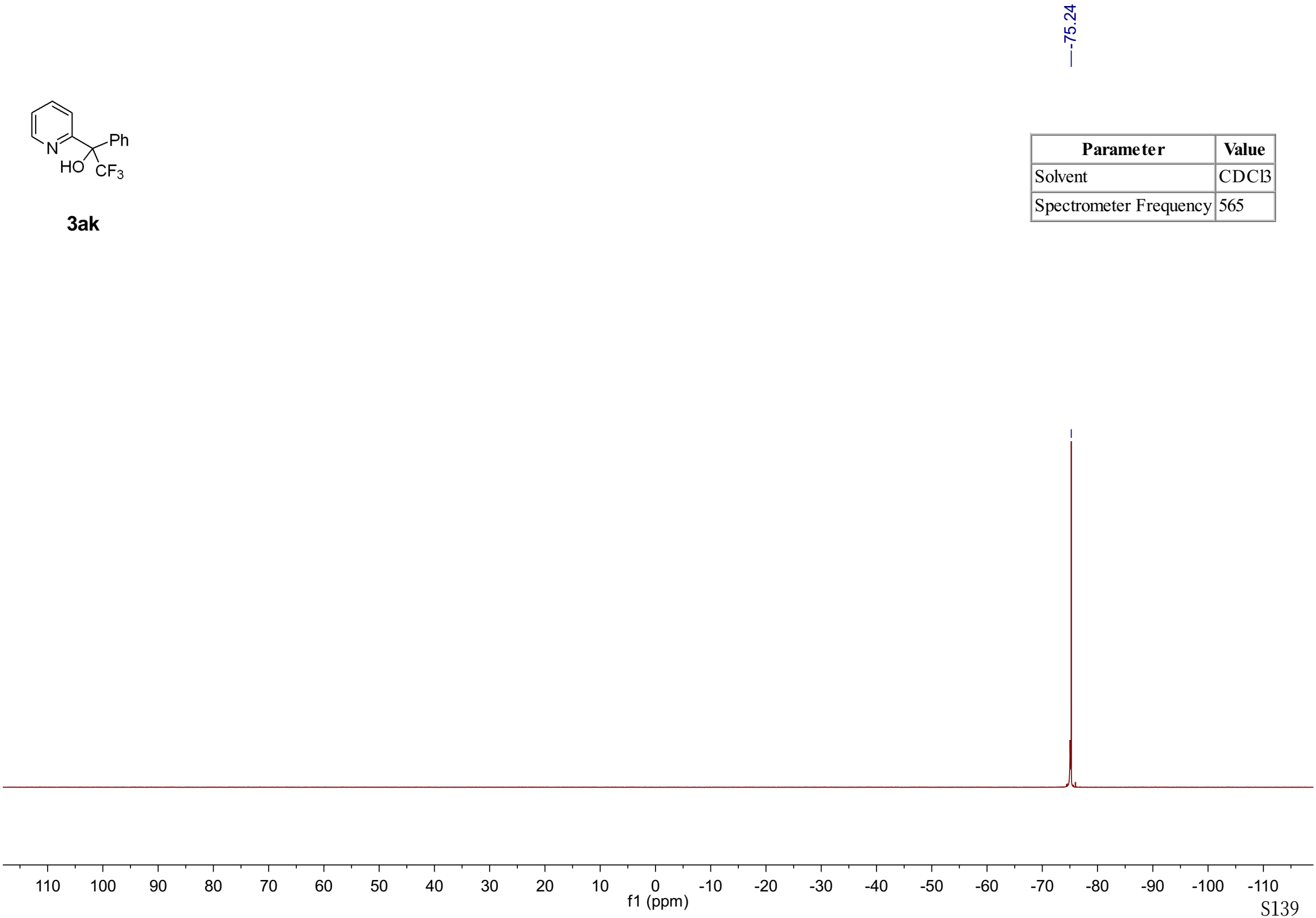
3ak

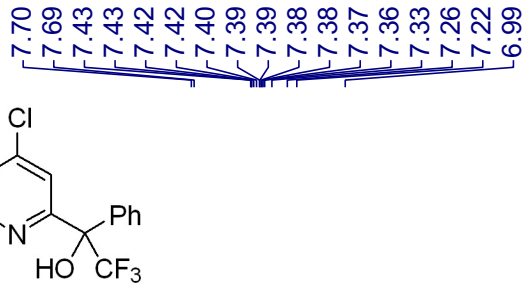
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150



3ak

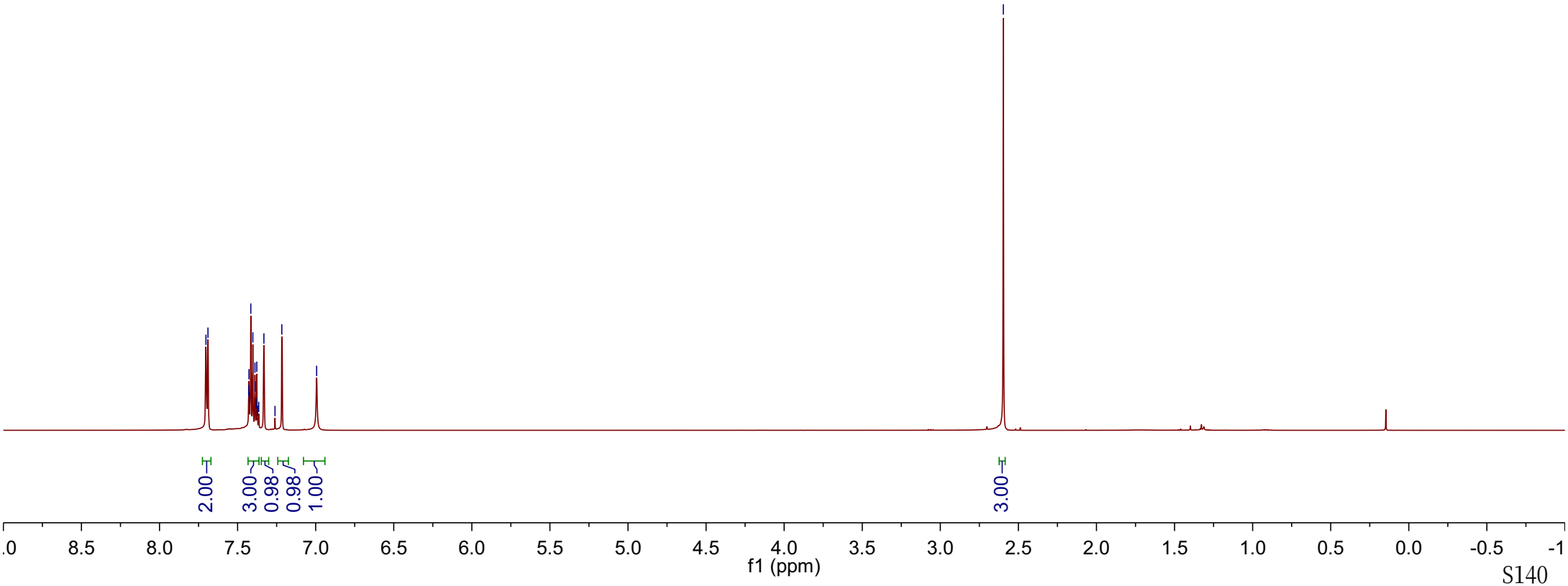
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565

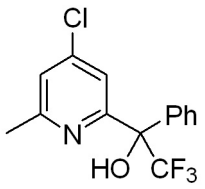




Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

3al

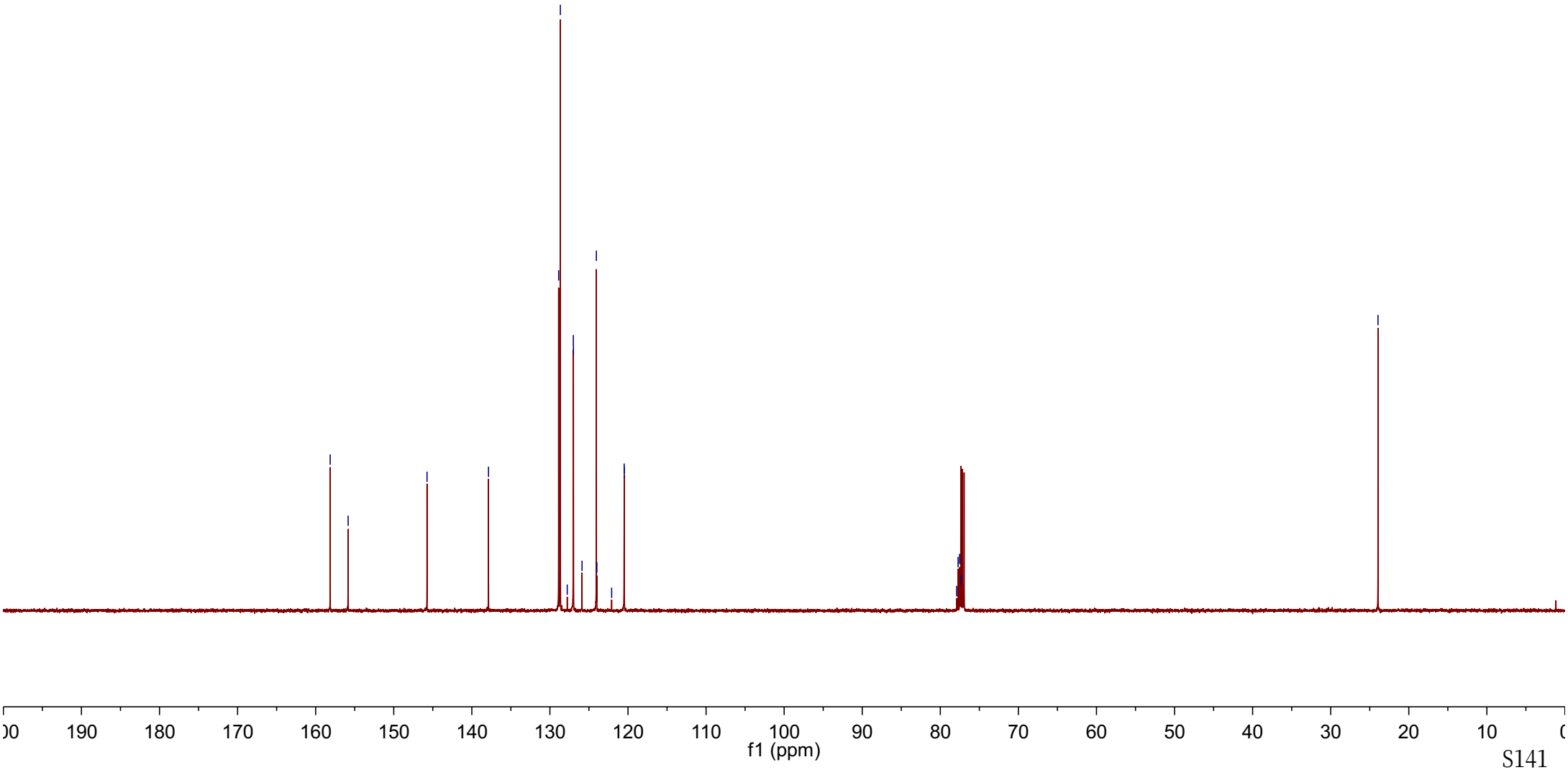


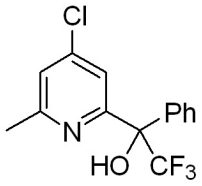


3al

158.14
155.84
145.74
137.87
128.88
128.66
127.78
127.00
126.99
125.89
124.05
123.99
122.09
120.49
120.48
77.91
77.72
77.53
77.34
23.94

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150

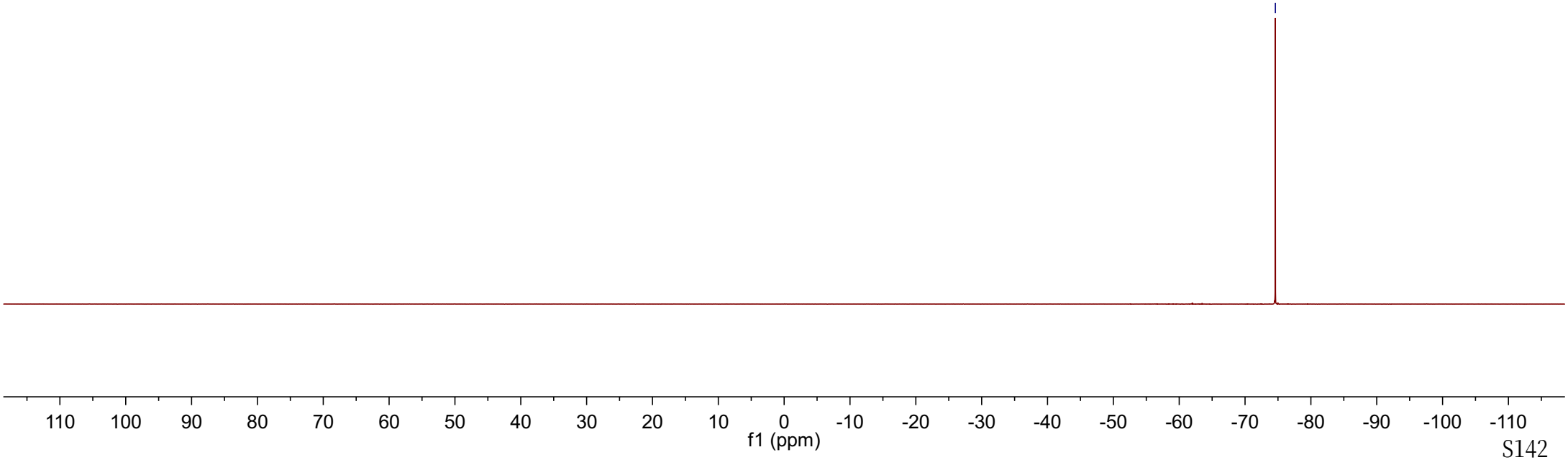




3al

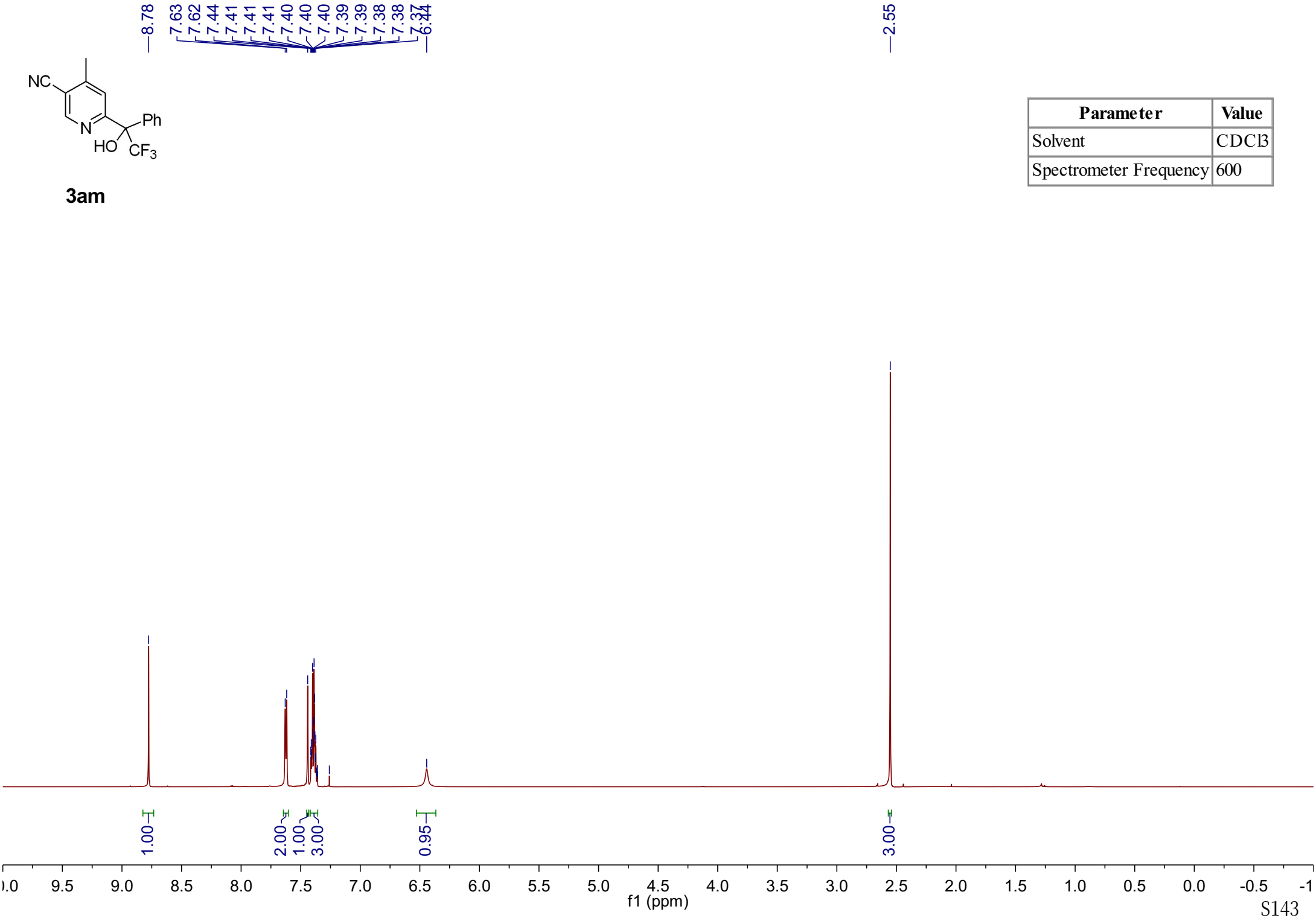
-74.60

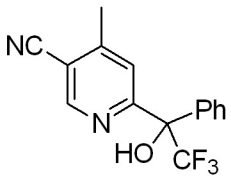
Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565



3am

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	600

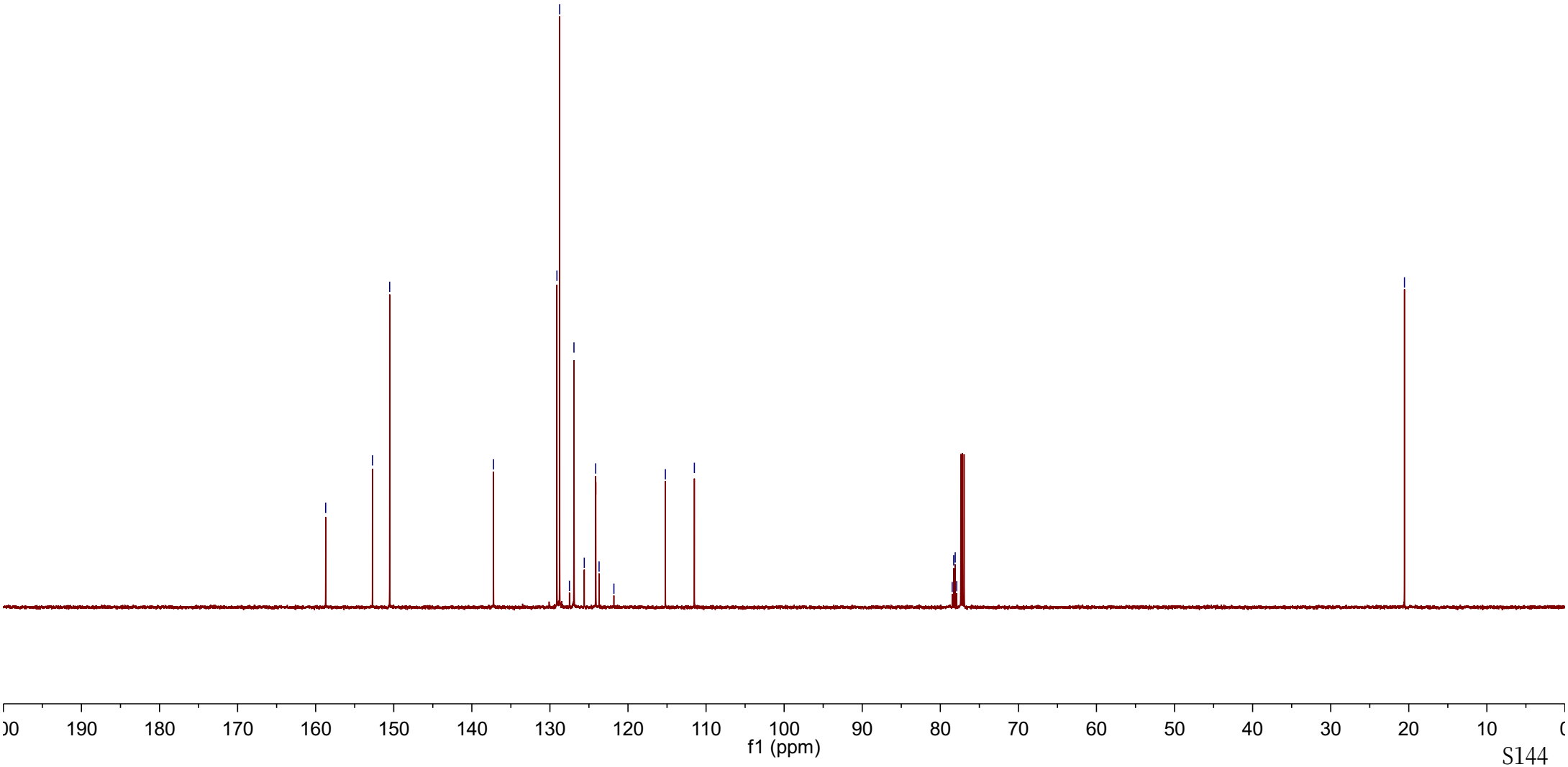


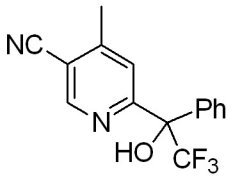


3am

158.72
152.72
150.52
137.22
129.10
128.75
126.92
125.60
124.14
111.50
78.48
78.28
78.09
77.90
20.55

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	150





3am

-74.23

Parameter	Value
Solvent	CDCl3
Spectrometer Frequency	565