Supporting Information

Stereoselective Synthesis of Trifluoromethyl-substituted 2*H*-Furan-Amines from Enaminones

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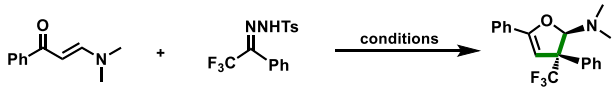
General methods and optimization of reaction conditions:

All reactions were carried out in flame or oven-dried glassware under argon atmosphere with freshly distilled dry solvents under anhydrous conditions unless otherwise indicated. Flash column chromatography was performed with silica gel 60 (230 - 400 mesh). Chromatograms were visualized by fluorescence quenching with UV light at 254 nm or by staining with I_2. NMR spectras were recorded at room temperature on 400 MHz Bruker spectrometers and 400 MHz Joel spectrometers. The residual solvent signals were taken as the reference (0.00 ppm for ^{1}H NMR spectra and 77.0 ppm for ^{13}C NMR spectra in $CDCl_3$). Chemical shift (δ) is reported in ppm, coupling constants (J) are given in Hz. The following abbreviations classify the multiplicity: s = singlet, d = doublet, t = triplet, m = multiplet, dd = doublet of doublet, q = quartet and br = broad signal. HRMS (ESI) spectra were recorded on a Waters Q-Tof premier TM mass spectrometer.

Table 1. Optimization of reaction conditions.[a]



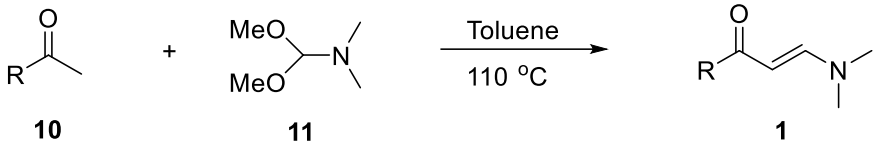
1a 2a 3aa

Entry	Metal	Base	Solvent	Conv.(%)[b]
1	$Rh_2(OAc)_4$	KO^{t}Bu	toluene	5
2	$FeCl_2$	KO^{t}Bu	toluene	2
3	CuCl	KO^{t}Bu	toluene	65
4	CuBr	KO^{t}Bu	toluene	62
5	CuI	KO^{t}Bu	toluene	48
6	$Cu(OAc)_2$	KO^{t}Bu	toluene	71
7	$CuCl_2$	KO^{t}Bu	toluene	72
8	$CuCl_2$	K_3PO_4	toluene	61
9	$CuCl_2$	K_2CO_3	toluene	71
10	$CuCl_2$	DBU	toluene	-
11	$CuCl_2$	Et_3N	toluene	-
12	$CuCl_2$	KO^{t}Bu	CH_2Cl_2	81
13	$CuCl_2$	KO^{t}Bu	DCE	33
14	$CuCl_2$	KO^{t}Bu	PhCl	66
15	$CuCl_2$[c]	KO^{t}Bu	CH_2Cl_2	82
16	$CuCl_2$[c]	KO^{t}Bu	CH_2Cl_2	86[d]/87[e]

[a]Experiments were performed with **1a** (0.10 mmol, 1.0 equiv.), **2a** (0.20 mmol, 2.0 equiv.), catalyst (20 mol %) and base (0.21 mmol, 2.1 equiv.) in solvent (4 mL) with stirring at 80 °C under Ar atmosphere until **1a** was completely consumed. [b]Yields were determined by ^{1}H NMR with tetrachloroethane as an internal standard. [c]5 mol % catalyst loading. [d]**2a** (0.25 mmol, 2.5 equiv.), base (0.26 mmol, 2.6 equiv.). [e]Isolated yields. DCE = dichloroethane.

General procedure for enaminones and their spectral datas:

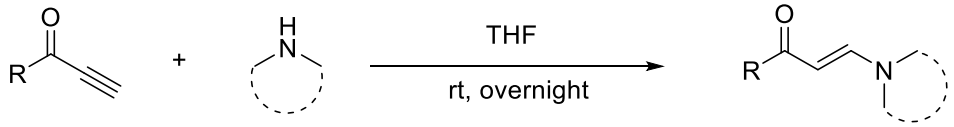
General procedure A for the synthesis of enaminones[1]:



10 **11** **1**

To a stirred solution of ketone **10** (5.0 mmol, 1.0 equiv.) in toluene (5 mL), 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 1.4 equiv.) was added and stirred at 110 °C. After completion of the reaction (monitored by TLC), it was quenched with water, extracted with ethyl acetate and dried with anhydrous Na_2SO_4. Then the reaction mixture was concentrated under reduced pressure and purified by column chromatography (hexane: ethyl acetate = 1 : 1) to give the desired product.

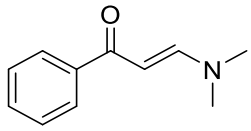
General procedure B for the synthesis of enaminones[2]:



12 **13** **1**

To a stirred solution of **12** (5.0 mmol, 1.0 equiv.) in THF (10 mL), amine **13** (12.0 mmol, 2.4 equiv.) was added dropwise and stirred at room temperature. After completion of the reaction (monitored by TLC), the reaction mixture is concentrated under reduced pressure and purified by column chromatography (hexane : ethyl acetate = 2 : 1) to give the desired product.

(*E*)-3-(Dimethylamino)-1-phenylprop-2-en-1-one (1a):



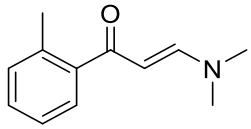
The title compound was prepared from acetophenone **10a** (5.0 mmol, 600.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general

1. Y. Jiang, V. Y. K. Zhong, L. Emmanuvel and C.-M. Park, *Chem. Commun.,* 2012, **48**, 3133-3135.

2. L. Šenica, U. Grošelj, M. Kasunič, D. Kočar, B. Stanovnik and J. Svete, *Eur. J. Org. Chem.,* 2014, **15**, 3067-3071.

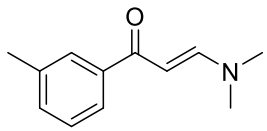
procedure A. The product was obtained as yellow solid in 98% yield (857.0 mg), Mp.90 – 91 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 – 7.89 (m, 2H), 7.79 (d, J = 12.4 Hz, 1H), 7.46 – 7.39 (m, 3H), 5.71 (d, J = 12.4 Hz, 1H), 3.12 (s, 3H), 2.91 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.6, 154.1, 140.4, 130.8, 128.0, 127.4, 92.1, 45.0, 37.2; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{14}NO^+$: 176.1075. Found: 176.1075.

(*E*)-3-(Dimethylamino)-1-(o-tolyl)prop-2-en-1-one (1b):



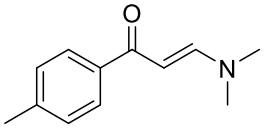
The title compound was prepared from 1-(*o*-tolyl)ethan-1-one **10b** (5.0 mmol, 670.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow brown oil in 82% yield (775.0 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 – 7.15 (m, 5H), 5.33 (d, J = 12.8 Hz, 1H), 3.03 (s, 3H), 2.84 (s, 3H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.4, 154.8, 141.8, 135.1, 130.4, 128.4, 126.8, 125.0, 97.7, 44.8, 36.9, 19.6; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{16}NO^+$: 190.1232. Found: 190.1232.

(*E*)-3-(Dimethylamino)-1-(m-tolyl)prop-2-en-1-one (1c):



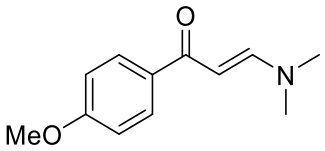
The title compound was prepared from 1-(*m*-tolyl)ethan-1-one **10c** (5.0 mmol, 670.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 65% yield (614.6 mg), Mp.35 – 37 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, J = 12.4 Hz, 1H), 7.71(s, 1H), 7.68 (d, J = 7.2 Hz, 1H), 7.31 – 7.24 (m, 2H), 5.70 (d, J = 12.4 Hz, 1H), 3.10 (s, 3H), 2.90 (s, 3H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.7, 154.0, 140.4, 137.6, 131.5, 127.9, 127.8, 124.4, 92.1, 44.8, 37.1, 21.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{16}NO$: 190.1232. Found: 190.1230.

(*E*)-3-(Dimethylamino)-1-(p-tolyl)prop-2-en-1-one (1d):



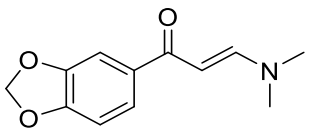
The title compound was prepared from 1-(*p*-tolyl)ethan-1-one **10d** (5.0 mmol, 670.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 76% yield (718.6 mg), Mp.87 – 89 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 - 7.77 (m, 3H), 7.21 (d, J = 7.9 Hz, 2H), 5.72 (d, J = 12.4 Hz, 1H), 3.11 (s, 3H), 2.94 (s, 3H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.4, 154.0, 141.2, 137.8, 128.8, 127.6, 92.1, 21.4; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{16}NO^+$: 190.1232. Found: 190.1228.

(*E*)-3-(Dimethylamino)-1-(4-methoxyphenyl)prop-2-en-1-one (1e):



The title compound was prepared from 1-(4-methoxyphenyl)ethan-1-one **10e** (5.0 mmol, 750.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 82% yield (840.5 mg), Mp.90 – 91 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 – 7.87 (m, 2H), 7.77 (d, J = 12.4 Hz, 1H), 6.90 – 6.87 (m, 2H), 5.69 (d, J = 12.4 Hz, 1H), 3.82 (s, 3H), 3.06 – 2.92 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.3, 161.9, 153.7, 133.0, 129.4, 113.2, 91.6, 55.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{16}NO_2^+$: 206.1181. Found: 206.1182.

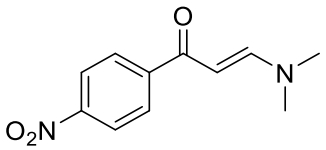
(*E*)-1-(Benzo[d][1,3]dioxol-5-yl)-3-(dimethylamino)prop-2-en-1-one (1f):



The title compound was prepared from 1-(benzo[*d*][1,3]dioxol-5-yl)ethan-1-one **10f** (5.0 mmol, 820.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 65% yield (962.0 mg), Mp.127 – 129 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 12.3 Hz, 1H), 7.50 – 7.48 (m, 1H), 7.45 – 7.42 (m, 1H), 6.82 (d, J = 8.12 Hz, 1H); 6.01 (s, 2H), 5.65 (d, J = 12.3 Hz, 1H), 3.14 (s, 3H), 2.92 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.9, 154.0, 149.9, 147.6, 135.1,

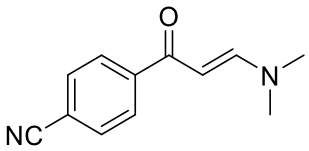
122.5, 107.9, 107.6, 101.4, 91.6; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{14}NO_3^+$: 220.0974. Found: 220.0977.

(*E*)-3-(Dimethylamino)-1-(4-nitrophenyl)prop-2-en-1-one (1g):



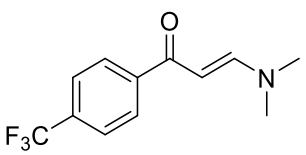
The title compound was prepared from 1-(4-nitrophenyl)ethan-1-one **10g** (5.0 mmol, 825.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 67% yield (737.5 mg), Mp.148 – 149 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 – 8.23 (m, 2H), 8.01 (d, J = 8.8 Hz, 2H), 7.86 (d, J = 12.4 Hz, 1H), 5.68 (d, J = 12.0 Hz, 1H), 3.21 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.0, 155.2, 149.0, 146.0, 128.3, 123.3, 91.9, 45.3, 37.4; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{13}N_2O_3^+$: 221.0926. Found: 221.0932.

(*E*)-4-(3-(Dimethylamino)acryloyl)benzonitrile (1h):



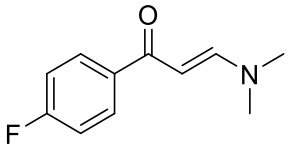
The title compound was prepared from 4-acetylbenzonitrile **10h** (5.0 mmol, 725.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 82% yield (820.0 mg), Mp.117 – 118 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, J = 8.4 Hz, 2H), 7.85 (d, J = 12.2 Hz, 1H), 7.71 – 7.69 (m, 2H), 5.66 (d, J = 12.2, 1H), 3.19 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.4, 155.1, 144.3, 132.1, 128.0, 118.6, 114.0, 91.7, 45.3, 37.4; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{13}N_2O^+$: 201.1028. Found: 201.1026.

(*E*)-3-(Dimethylamino)-1-(4-(trifluoromethyl)phenyl)prop-2-en-1-one (1i)



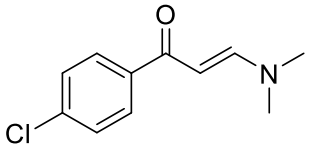
The title compound was prepared from 1-(4-(trifluoromethyl)phenyl)ethan-1-one **10i** (5.0 mmol, 940.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 76% yield (923.4 mg), Mp.107 – 109 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, J = 8.1 Hz, 2H), 7.84 (d, J = 12.2 Hz, 1H), 7.66 (d, J = 8.1 Hz, 2H), 5.68 (d, J = 12.2 Hz, 1H), 3.18 (s, 3H), 2.95 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.1, 154.8, 143.6, 132.2 (d, J = 32.5 Hz), 127.7, 125.1 (t, J = 3.6 Hz), 122.6, 91.9, 45.2, 37.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{12}H_{13}F_3NO^+$: 244.0949. Found: 244.0952.

(*E*)-3-(Dimethylamino)-1-(4-fluorophenyl)prop-2-en-1-one (1j):



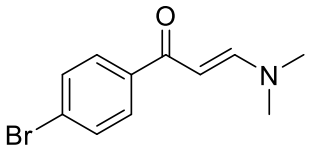
The title compound was prepared from 1-(4-fluorophenyl)ethan-1-one **10j** (5.0 mmol, 690.7 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 88% yield (849.2 mg), Mp.83 – 84 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 – 7.90 (m, 2H), 7.81 (d, J = 12.4 Hz, 1H), 7.10 – 7.05 (m, 2H), 5.67 (d, J = 12.4 Hz, 1H), 3.15 (s, 3H), 2.93 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.0, 165.7, 154.3, 136.6 (J = 3.0 Hz), 129.7 (J = 9.0 Hz), 114.9 (J = 21 Hz), 91.6, 45.0, 37.2; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{13}FNO^+$: 194.0981. Found: 194.0984.

(*E*)-1-(4-Chlorophenyl)-3-(dimethylamino)prop-2-en-1-one (1k):



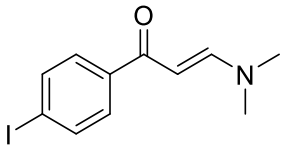
The title compound was prepared from 1-(4-chlorophenyl)ethan-1-one **10k** (5.0 mmol, 773.0 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 83% yield (867.4 mg), Mp.88 – 89 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 – 7.83 (m, 2H), 7.80 (d, J = 12.4 Hz, 1H), 7.39 – 7.35 (m, 2H), 5.66 (d, J = 12.4 Hz, 1H), 3.15 (s, 3H), 2.92 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.1, 154.5, 138.8, 136.9, 128.9, 128.2, 91.6; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{13}ClNO^+$: 210.0686. Found: 210.0690.

(*E*)-1-(4-Bromophenyl)-3-(dimethylamino)prop-2-en-1-one (1l):



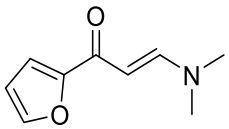
The title compound was prepared from 1-(4-bromophenyl)ethan-1-one **10l** (5.0 mmol, 995.3 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 84% yield (1062.0 mg), Mp.82 – 83 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, J = 12.4 Hz, 1H), 7.78 – 7.76 (m, 2H), 7.54 – 7.52 (m, 2H), 5.65 (d, J = 12.0 Hz, 1H), 3.14 (s, 3H), 2.92 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.1, 154.5, 139.2, 131.2, 129.1, 125.4, 91.6, 45.0, 37.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{13}BrNO^+$: 254.0181. Found: 254.0184.

(*E*)-3-(Dimethylamino)-1-(4-iodophenyl)prop-2-en-1-one (1m):



The title compound was prepared from 1-(4-iodophenyl)ethan-1-one **10m** (5.0 mmol, 1230.3 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 65% yield (978.5 mg), Mp.121 – 122 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 12.4 Hz, 1H), 7.75 – 7.73 (m, 2H), 7.63 – 7.61 (m, 2H), 5.64 (d, J = 12.4 Hz, 1H), 3.12 (s, 3H), 2.90 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.1, 154.4, 139.7, 137.1, 129.0, 97.7, 91.4, 45.0, 37.2; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{13}INO^+$: 302.0042. Found: 302.0039.

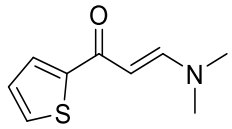
(*E*)-3-(Dimethylamino)-1-(furan-2-yl)prop-2-en-1-one (1n):



The title compound was prepared from 1-(furan-2-yl)ethan-1-one **10n** (5.0 mmol, 550.6 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 81% yield (668.3 mg), Mp.80 – 81 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, J = 12.4 Hz, 1H), 7.49 (s, 1H), 7.06 (d, J = 2.8 Hz, 1H), 6.48 (s, 1H), 5.68 (d, J = 12.8 Hz, 1H), 3.14 (s, 3H), 2.92 (s, 3H); ^{13}C NMR (100 MHz,

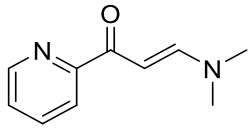
$CDCl_3$) δ 177.4, 154.7, 153.5, 144.1, 113.3, 111.7, 91.4, 44.9, 37.2; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_9H_{12}NO_2^+$: 166.0868. Found: 166.0869.

(*E*)-3-(Dimethylamino)-1-(thiophen-2-yl)prop-2-en-1-one (1o):



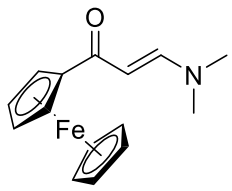
The title compound was prepared from 1-(thiophen-2-yl)ethan-1-one **10o** (5.0 mmol, 630.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 79% yield (715.0 mg), Mp.117 – 118 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, J = 12.4 Hz, 1H), 7.62 – 7.61 (m, 1H), 7.47 – 7.45 (m, 1H), 7.08 – 7.06 (m, 1H), 5.62 (d, J = 12.0 Hz, 1H), 3.10 (s, 3H), 2.90 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.6, 153.4, 147.3, 130.0, 128.2, 127.4, 91.5, 44.8, 37.1; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_9H_{12}NOS^+$: 182.0640. Found: 182.0640.

(*E*)-3-(Dimethylamino)-1-(pyridin-2-yl)prop-2-en-1-one (1p):



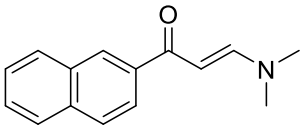
The title compound was prepared from 1-(pyridin-2-yl)ethan-1-one **10p** (5.0 mmol, 605.7 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as black solid in 71% yield (625.0 mg), Mp.124 – 125 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.64 – 8.62 (m, 1H), 8.15 (d, J = 10.4 Hz, 1H), 7.92 (d, J = 12.7 Hz, 1H), 7.83 – 7.77 (m, 1H), 7.38 – 7.34 (m, 1H), 6.45 (d, J = 12.7 Hz, 1H), 3.18 (s, 3H), 3.00 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.0, 155.5, 154.1, 147.7, 136.1, 124.8, 121.2, 90.4, 44.5, 36.8; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{10}H_{13}N_2O^+$: 177.1028. Found: 177.1030.

(*E*)-3-(dimethylamino)-1-ferrocenyl -2-en-1-one (1q):



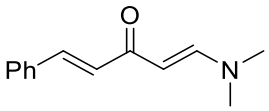
The title compound was prepared from acetylferrocene **10q** (5.0 mmol, 1140.4 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as red solid in 34% yield (481.4 mg), Mp. 65 – 66 ºC. ^{1}H NMR (400 MHz, CDCl3) δ 7.72 (d, J = 12.5 Hz, 1H), 5.37 (d, J = 12.5 Hz, 1H), 4.78 (s, 2H), 4.38 (s, 2H), 4.16 (s, 5H), 3.00 (s, 6H); ^{13}C NMR (100 MHz, CDCl3) δ 191.7, 151.6, 93.1, 82.5, 70.9, 69.8, 69.0; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{18}FeNO^+$: 284.0732. Found: 284.0733.

(*E*)-3-(Dimethylamino)-1-(naphthalen-2-yl)prop-2-en-1-one (1r):



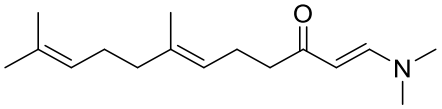
The title compound was prepared from 1-(naphthalen-2-yl)ethan-1-one **10r** (5.0 mmol, 851.1 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 77% yield (866.5 mg), Mp.113 – 114 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.40 (s, 1H), 8.03 – 8.00 (m, 1H), 7.95 – 7.93 (m, 1H), 7.88 – 7.84 (m, 3H), 7.55 – 7.48 (m, 2H), 5.87 (d, J = 12.4 Hz, 1H), 3.06 (d, J = 70.4 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.4, 154.2, 137.8, 134.7, 132.7, 129.1, 127.7, 127.6, 127.1, 126.1, 124.6, 92.3, 45.0, 37.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{16}NO^+$: 226.1232. Found: 226.1233.

(1*E*, 4*E*)-1-(Dimethylamino)-5-phenylpenta-1,4-dien-3-one (1s):



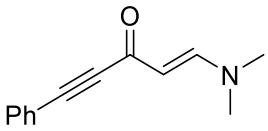
The title compound was prepared from (*E*)-4-phenylbut-3-en-2-one **10s** (5.0 mmol, 731.0 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 78% yield (784.0 mg), Mp.99 – 100 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, J = 12.4 Hz, 1H), 7.59 – 7.54 (m, 3H), 7.38 – 7.32 (m, 3H), 6.79 (d, J = 12.8 Hz, 1H), 5.28 (d, J = 12.8 Hz, 1H), 3.12 (s, 3H), 2.88 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 186.2, 153.3, 138.3, 135.7, 129.1, 128.6, 128.2, 127.8, 96.3, 44.9, 37.2; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{13}H_{16}NO^+$: 202.1232. Found: 202.1229.

(1*E*, 6*E*)-1-(Dimethylamino)-6,11-dimethyldodeca-1,6,10-trien-3-one (1t):



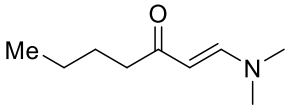
The title compound was prepared from (*E*)-6,10-dimethylundeca-5,9-dien-2-one **10t** (5.0 mmol, 971.6 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow oil in 72% yield (899.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, J = 12.8 Hz, 1H), 5.17 – 5.03 (m, 2H), 5.03 (d, J = 12.4 Hz, 1H), 3.00 – 2.84 (m, 6H), 2.36 – 2.29 (m, 4H), 2.06 – 2.03 (m, 3H), 1.99 – 1.97 (m, 1H), 1.62 – 1.59 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.6, 197.5, 152.1, 135.5, 135.3, 131.3, 131.1, 124.4, 124.2, 123.6, 95.7, 41.5, 39.6, 31.8, 26.6, 26.5, 25.6, 24.2, 24.1, 23.3, 17.5, 17.5; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{16}H_{28}NO^+$: 250.2171. Found: 250.2177.

(*E*)-1-(Dimethylamino)-5-phenylpent-1-en-4-yn-3-one (1u):



The title compound was prepared from 4-phenylbut-3-yn-2-one **10u** (5.0 mmol, 720.9 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as brown solid in 87% yield (865.8 mg), Mp.86 – 87 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, J = 12.8 Hz, 1H), 7.56 – 7.54 (m, 2H), 7.39 – 7.33 (m, 3H), 5.31 (d, J = 12.7 Hz, 1H), 3.16 (s, 3H), 2.87 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.1, 132.3, 129.6, 128.4, 121.3, 101.9, 45.3, 37.3; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{13}H_{14}NO^+$: 200.1075. Found: 200.1075.

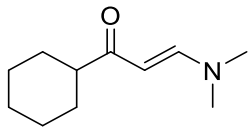
(*E*)-1-(Dimethylamino)hept-1-en-3-one (1v):



The title compound was prepared from hexan-2-one **10v** (5.0 mmol, 500.8 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as brown oil in, 52% yield (403.0 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, J = 12.7 Hz, 1H), 5.04 (d, J = 12.7 Hz, 1H), 3.03 – 2.84 (m, 6H), 2.35 – 2.31 (m, 2H), 1.62 – 1.54 (m, 2H), 1.38 – 1.31 (m, 2H), 0.93 – 0.87 (m, 3H); ^{13}C NMR (100

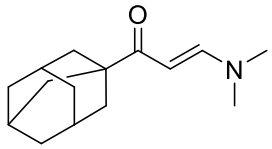
MHz, $CDCl_3$) δ 198.2, 152.1, 95.5, 44.4, 41.3, 36.8, 28.0, 22.5, 13.8; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_9H_{18}NO^+$: 156.1388. Found: 156.1285.

(*E*)-1-Cyclohexyl-3-(dimethylamino)prop-2-en-1-one (1w):



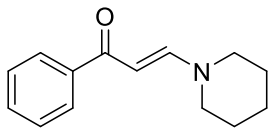
The title compound was prepared from 1-cyclohexylethan-1-one **10w** (5.0 mmol, 631.0 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 14% yield (127.4 mg), Mp.41 – 42 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, J = 12.4 Hz, 1H), 5.05 (d, J = 12.4 Hz, 1H), 3.05 (s, 3H), 2.83 (s, 3H), 2.30 – 2.24 (m, 1H), 1.80 – 1.76 (m, 4H), 1.68 – 1.65 (m, 1H), 1.44 – 1.15 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 200.8, 151.9, 93.6, 49.6, 44.2, 36.5, 29.3, 25.6; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{11}H_{20}NO^+$: 182.1545. Found: 182.1548.

(*E*)-1-(Adamantan-1-yl)-3-(dimethylamino)prop-2-en-1-one (1x)



The title compound was prepared from 1-(adamantan-1-yl)ethan-1-one **10x** (5.0 mmol, 891.4 mg) and 1,1-dimethoxy-*N*,*N*-dimethylmethanamine **11** (7.0 mmol, 834.1 mg) according to the general procedure A. The product was obtained as yellow solid in 34% yield (397.8 mg), Mp. 117 – 118 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, J = 12.4 Hz, 1H), 5.24 (d, J = 12.4 Hz, 1H), 2.87 (s, 6H), 2.02 (s, 3H), 1.83 (d, J = 2.8 Hz, 6H), 1.66 – 1.63 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 203.1, 153.3, 90.1, 44.0, 39.4, 36.9, 28.4; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{24}NO^+$: 234.1858. Found: 234.1858.

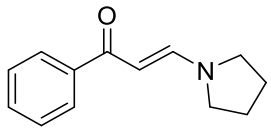
(*E*)-1-Phenyl-3-(piperidin-1-yl)prop-2-en-1-one (1y):



The title compound was prepared from 1-phenylprop-2-yn-1-one **12** (5.0 mmol, 650.8 mg) and piperidine **13y** (12.0 mmol, 1021.8 mg) according to the general procedure B. The product was

obtained as yellow solid in 85% yield (914.0 mg), Mp.93 – 95 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 – 7.87 (m, 2H), 7.78 (d, J = 12.5 Hz, 1H), 7.46 – 7.38 (m, 3H), 5.82 (d, J = 12.5 Hz, 1H), 3.36 (s, 4H), 1.66 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.9, 153.0, 140.7, 130.7, 128.0, 127.3, 91.1, 54.8, 23.9; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{14}H_{18}NO^+$: 216.1388. Found: 216.1390.

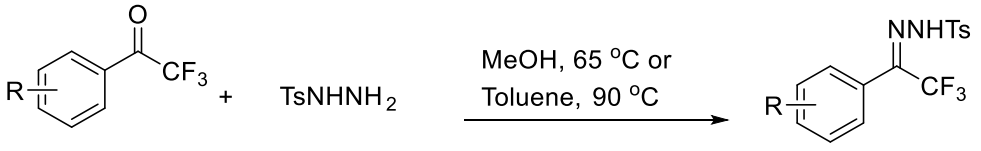
(*E*)-1-Phenyl-3-(pyrrolidin-1-yl)prop-2-en-1-one (1z):



The title compound was prepared from 1-phenylprop-2-yn-1-one **12** (5.0 mmol, 650.8 mg) and pyrrolidine **13z** (12.0 mmol, 853.4 mg) according to the general procedure B. The product was obtained as yellow solid in 87% yield (642.0 mg), Mp. 121 – 123 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (d, J = 12.4 Hz, 1H), 7.91 – 7.89 (m, 2H), 7.47 – 7.38 (m, 3H), 5.68 (d, J = 12.4 Hz, 1H), 3.55 (d, J = 5.5 Hz, 2H), 3.27 (s, 2H), 2.04 – 1.92 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.3, 149.8, 140.5, 130.6, 128.0, 127.4, 92.9, 52.2, 46.9, 25.1; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{13}H_{16}NO^+$: 202.1232. Found: 202.1230.

General procedure for the synthesis of trifluoromethylated *N*-tosylhydrazones:

N-Tosylhydrazones were prepared according to the literature procedure[3].



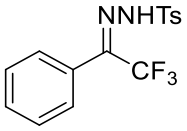
14 **15** **2**

To a round bottom flask surmounted with a reflux condenser was added *N*-tosylhydrazide **15** (5.0 mmol, 1.0 equiv.) and the minimum quantity of solvent (either methanol or toluene according to individual substrates) needed to dissolve the hydrazide at reflux (approximately 1.5 M). Subsequently the reaction was cooled to room temperature and trifluoroacetophenone **14** (5.0 mmol, 1.0 equiv.) was added in one portion. The reaction

3. X. Wang, Y. Xu, Y. Deng, Y. Zhou, J. Feng, G. Ji, Y. Zhang and J. Wang, *Chem. Eur. J.* 2014, **20**, 961-965.

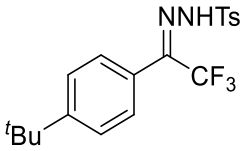
mixture was then stirred at 65 °C (MeOH) or 90 °C (Toluene) over 4-16 h (monitor by TLC). The solution was cooled down to 0 °C, at which point the product precipitated out of solution in most cases (precipitation can be induced by addition of pentane). The precipitate was collected by vacuum filtration and washed with pentane, in which case it was used without further purification. If no precipitation occurred, the solvent was removed under reduced pressure and the residue used in the next step without further purification.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide (2a):



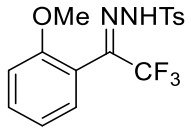
The title compound was prepared from 2,2,2-trifluoro-1-phenylethan-1-one **14a** (5.0 mmol, 870.6 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 82% yield (1403.6 mg), Mp.161 – 162 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (s, 1H), 7.82 (d, J = 8.4 Hz, 2H), 7.57 – 7.50 (m, 3H), 7.36 (d, J = 8.1 Hz, 2H), 7.27 – 7.22 (m, 2H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.0, 141.6 (q, J = 36.2 Hz), 134.5, 131.6, 130.0, 129.9, 128.2, 128.0, 125.2, 119.9 (q, J = 274.8 Hz), 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.33; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{14}F_3N_2O_2S^+$: 343.0728. Found: 343.0730.

(*Z*)-*N*'-(1-(4-(Tert-butyl)phenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide (2b):



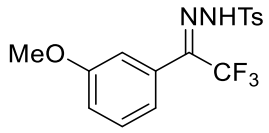
The title compound was prepared from 1-(4-(*tert*-butyl)phenyl)-2,2,2-trifluoroethan-1-one **14b** (5.0 mmol, 1151.2 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 60% yield (1195.3 mg), Mp.145 – 146 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.80 (d, J = 7.9 Hz, 1H), 7.51 (d, J = 7.9 Hz, 1H), 7.35 (d, J = 7.9 Hz, 1H), 7.17 (d, J = 7.9 Hz, 1H), 2.45 (s, 3H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.0, 144.9, 141.9 (q, J = 35.6 Hz), 134.6, 129.8, 128.0, 127.9, 127.0, 122.2, 120.0 (q, J = 275.0 Hz), 35.0, 31.0, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.32; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{22}F_3N_2O_2S^+$: 399.1354. Found: 399.1359.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(2-methoxyphenyl)ethylidene)benzenesulfonohydrazide (2c):



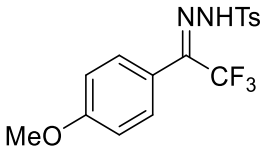
The title compound was prepared from 2,2,2-trifluoro-1-(2-methoxyphenyl)ethan-1-one **14c** (5.0 mmol, 1020.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 46% yield (856.4 mg), Mp.148 – 149 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (s, 1H), 7.83 (d, J = 8.3 Hz, 2H), 7.53 – 7.47 (m, 1H), 7.36 (d, J = 8.0 Hz, 2H), 7.16 (d, J = 7.6 Hz, 1H), 7.09 – 7.04 (m, 1H), 6.99 (d, J = 8.5 Hz, 1H), 3.65 (s, 3H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.2, 144.7, 139.5, 134.9, 133.2, 129.7, 129.6, 128.0, 121.8, 120.1 (q, J = 275.2 Hz), 114.2, 111.8, 55.8, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.17; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{16}H_{16}F_3N_2O_3S^+$: 373.0834. Found: 373.0883.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(3-methoxyphenyl)ethylidene)benzenesulfonohydrazide (2d):



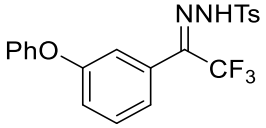
The title compound was prepared from 2,2,2-trifluoro-1-(3-methoxyphenyl)ethan-1-one **14d** (5.0 mmol, 1020.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 52% yield (968.1 mg), Mp.141 – 142 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (s, 1H), 7.82 (d, J = 8.3 Hz, 2H), 7.43 (t, J = 8.0 Hz, 1H), 7.36 (d, J = 8.1 Hz, 2H), 7.06 (m, 1H), 6.78 (d, J = 7.6 Hz, 1H), 6.72 (s, 1H), 3.82 (s, 3H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.6, 145.0 141.3 (q, J = 35.7 Hz), 134.5, 131.3, 129.9, 128.0, 126.3, 120.0, 119.9 (d, J = 274.8 Hz), 117.0, 113.5, 55.5, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.32; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{16}H_{16}F_3N_2O_3S^+$: 373.0834. Found: 373.0883.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(4-methoxyphenyl)ethylidene)benzenesulfonohydrazide (2e):



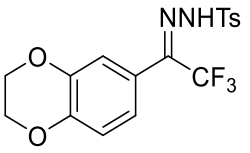
The title compound was prepared from 2,2,2-trifluoro-1-(4-methoxyphenyl)ethan-1-one **14e** (5.0 mmol, 1020.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 40% yield (744.7 mg), Mp.147 – 148 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (s, 1H), 7.81 (d, J = 8.2 Hz, 2H), 7.35 (d, J = 8.1 Hz, 2H), 7.19 (d, J = 8.5 Hz, 2H), 7.00 (d, J = 8.7 Hz, 2H), 3.85 (s, 3H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.8, 144.9, 141.6 (q, J = 35.6 Hz), 134.5, 129.8, 128.0, 120.0 (d, J = 275.0 Hz), 118.7, 116.9, 115.4, 55.5, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.31; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{16}H_{16}F_3N_2O_3S^+$: 373.0834. Found: 373.0883.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(3-phenoxyphenyl)ethylidene)benzenesulfonohydrazide (2f):



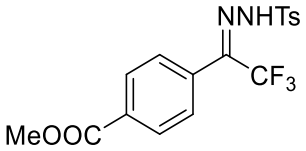
The title compound was prepared from 2,2,2-trifluoro-1-(3-phenoxyphenyl)ethan-1-one **14f** (5.0 mmol, 1331.1 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 47% yield (1020.7 mg), Mp.157 – 158 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.80 (d, J = 8.3 Hz, 2H), 7.48 – 7.37 (m, 3H), 7.36 – 7.32 (m, 2H), 7.23 – 7.17 (m, 1H), 7.13 – 7.09 (m, 1H), 7.05 (d, J = 7.5 Hz, 2H), 6.92 (d, J = 7.6 Hz, 1H), 6.85 – 6.82 (m, 1H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.1, 155.5, 145.0, 140.8 (q, J = 35.8 Hz), 134.4, 131.6, 130.2, 129.9, 128.0, 126.6, 124.6, 122.1, 120.7, 119.8 (d, J = 274.6 Hz), 119.7, 117.4, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.28; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{21}H_{18}F_3N_2O_3S^+$: 435.0998. Found: 435.0990.

(*Z*)-*N*'-(1-(2,3-Dihydrobenzo[*b*][1,4]dioxin-6-yl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide (2g):



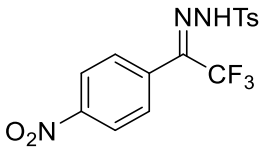
The title compound was prepared from 1-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)-2,2,2-trifluoroethan-1-one **14g** (5.0 mmol, 1160.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 62% yield (1240.0 mg), Mp. 99 – 100 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.80 (d, J = 8.3 Hz, 2H), 7.34 (d, J = 8.1 Hz, 2H), 6.96 (d, J = 8.3 Hz, 1H), 6.75 (d, J = 1.9 Hz, 1H), 6.71 (dd, J = 8.3, 2.0 Hz, 1H), 4.32 – 4.28 (m, 4H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, DMSO-D6) δ 146.1, 144.6, 144.2, 135.8, 130.2, 128.0, 122.2, 120.8 (q, J = 275.3 Hz), 119.6, 118.5, 117.9, 64.9, 64.6, 21.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.21; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{16}F_3N_2O_4S^+$: 401.0783. Found: 401.0780.

Methyl (*Z*)-4-(2,2,2-trifluoro-1-(2-tosylhydrazono)ethyl)benzoate (2h):



The title compound was prepared from methyl 4-(2,2,2-trifluoroacetyl)benzoate **14h** (5.0 mmol, 1160.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 80% yield (1601.2 mg), Mp.142 – 143 ºC. ^{1}H NMR (400 MHz, DMSO-D6) δ 11.77 (br, 1H), 8.09 (d, J = 8.4 Hz, 2H), 7.70 (d, J = 8.3 Hz, 2H), 7.53 (d, J = 8.1 Hz, 2H), 7.43 (d, J = 8.1 Hz, 2H), 3.89 (s, 3H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, DMSO-D6) δ 166.1, 144.6, 135.7, 132.0, 131.6, 130.4, 130.3, 129.6, 127.8, 120.6 (d, J = 274.9 Hz), 53.0, 21.5; ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.87; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{16}F_3N_2O_4S^+$: 401.0783. Found: 401.0783.

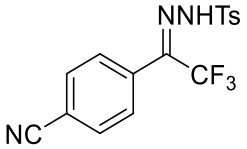
(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(4-nitrophenyl)ethylidene)benzenesulfonohydrazide (2i):



The title compound was prepared from 2,2,2-trifluoro-1-(4-nitrophenyl)ethan-1-one **14i** (5.0 mmol, 1095.6 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 37% yield (716.5 mg), Mp.157 – 158 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 – 8.34 (m, 2H), 8.12 (s, 1H), 7.79 (d, J = 8.3 Hz, 2H), 7.50 (d, J = 8.7 Hz, 2H), 7.37 (d, J = 8.3 Hz, 2H), 2.47 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$)

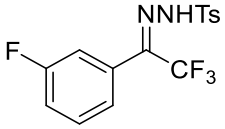
δ 149.6, 145.5, 138.8 (q, J = 36.5 Hz), 134.1, 131.6, 130.1, 130.0, 128.1, 125.1, 119.7 (d, J = 274.6 Hz), 21.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.71; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{13}F_3N_3O_4S^+$: 388.0579. Found: 388.0580.

(*Z*)-*N*'-(1-(4-Cyanophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide (2j):



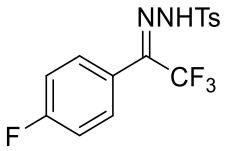
The title compound was prepared from 4-(2,2,2-trifluoroacetyl)benzonitrile **14j** (5.0 mmol, 995.7 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 52% yield (955.1 mg), Mp.152 – 153 ºC. ^{1}H NMR (400 MHz, DMSO-D6) δ 11.82 (br, 1H), 8.03 (d, J = 8.3 Hz, 2H), 7.70 (d, J = 8.2 Hz, 2H), 7.59 (d, J = 8.1 Hz, 2H), 7.44 (d, J = 8.1 Hz, 2H), 2.40 (s, 3H); ^{13}C NMR (100 MHz, DMSO-D6) δ 144.7, 135.8, 133.7, 131.8, 130.4, 129.9, 127.9, 126.1, 120.6 (d, J = 274.7 Hz), 118.7, 114.0, 21.6; ^{19}F NMR (376 MHz, DMSO-D6) δ -66.29; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{16}H_{13}F_3N_3O_2S^+$: 368.0681. Found: 368.0681.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(3-fluorophenyl)ethylidene)benzenesulfonohydrazide (2k):



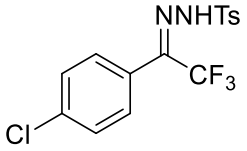
The title compound was prepared from 2,2,2-trifluoro-1-(3-fluorophenyl)ethan-1-one **14k** (5.0 mmol, 960.6 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 58% yield (1044.9 mg), Mp.135 – 136 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 7.82 (d, J = 8.4 Hz, 2H), 7.57 – 7.49 (m, 1H), 7.36 (d, J = 8.1 Hz, 2H), 7.29 – 7.23 (m, 1H), 7.05 (d, J = 7.7 Hz, 1H), 6.99 – 6.95 (m, 1H), 2.47 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.4, 161.9, 145.2, 134.3, 132.0 (d, J = 8.2 Hz), 129.9, 128.0, 127.0 (d, J = 7.7 Hz), 124.0 (d, J = 3.6 Hz), 119.8 (d, J = 274.8 Hz), 118.9 (d, J = 20.9 Hz), 115.6 (d, J = 23.1 Hz), 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.21, -108.49, -108.51, -108.52, -108.53, -108.54, -108.55; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{13}F_4N_2O_2S^+$: 361.0634. Found: 361.0630.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(4-fluorophenyl)ethylidene)benzenesulfonohydrazide (2l):



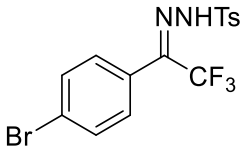
The title compound was prepared from 2,2,2-trifluoro-1-(4-fluorophenyl)ethan-1-one **14l** (5.0 mmol, 960.6 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 51% yield (918.8 mg), Mp.135 – 136 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.88 (d, J = 8.4 Hz, 2H), 7.81 (d, J = 8.4 Hz, 2H), 7.36 (d, J = 8.1 Hz, 2H), 6.99 (d, J = 8.3 Hz, 2H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.1, 140.5 (q, J = 36.2 Hz), 139.3, 134.3, 129.9, 129.7, 128.0, 124.5, 119.7 (d, J = 275.0 Hz), 98.5, 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.22, -115.43; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{13}F_4N_2O_2S^+$: 361.0634. Found: 361.0630.

(*Z*)-*N*'-(1-(4-Chlorophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide (2m):



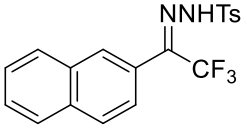
The title compound was prepared from 1-(4-chlorophenyl)-2,2,2-trifluoroethan-1-one **14m** (5.0 mmol, 1042.8 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 59% yield (1111.5 mg), Mp. 105 – 106 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.81 (d, J = 8.3 Hz, 2H), 7.52 (d, J = 8.5 Hz, 2H), 7.36 (d, J = 8.1 Hz, 2H), 7.21 (d, J = 8.4 Hz, 2H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.1, 140.0 (q, J = 35.9 Hz). 138.1, 134.3, 130.4, 129.9, 129.7, 128.0, 123.5, 119.8 (d, J = 274.9 Hz), 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.24; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{13}ClF_3N_2O_2S^+$: 377.0338. Found: 377.0342.

(*Z*)-*N*'-(1-(4-Bromophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide (2n):



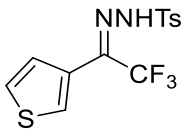
The title compound was prepared from 1-(4-bromophenyl)-2,2,2-trifluoroethan-1-one **14n** (5.0 mmol, 1265.1 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 71% yield (1495.3 mg), Mp.154 – 155 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (s, 1H), 7.82 (d, J = 8.3 Hz, 2H), 7.68 (d, J = 8.5 Hz, 2H), 7.36 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 8.2 Hz, 2H), 2.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.1, 140.2 (q, J = 36.2 Hz), 134.3, 133.4, 133.1, 129.9, 128.0, 126.4, 123.9, 119.7 (d, J = 274.9 Hz), 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.23; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{15}H_{13}BrF_3N_2O_2S^+$: 420.9833. Found: 420.9827.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(naphthalen-2-yl)ethylidene) benzenesulfonohydrazide (2o):



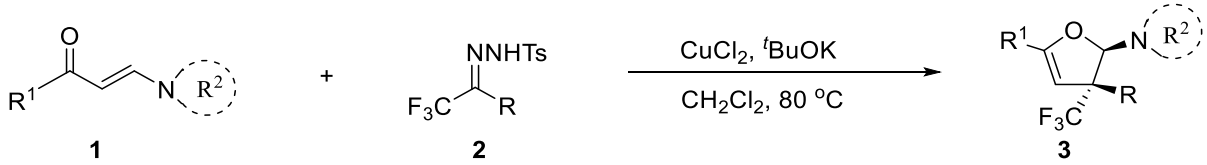
The title compound was prepared from 2,2,2-trifluoro-1-(naphthalen-2-yl)ethan-1-one **14o** (5.0 mmol, 1120.9 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 83% yield (1628.4 mg), Mp.166 – 167 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (s, 1H), 7.99 (d, J = 8.5 Hz, 1H), 7.93 – 7.85 (m, 2H), 7.84 – 7.77 (m, 3H), 7.67 – 7.57(m, 2H), 7.36 (d, J = 8.1 Hz, 2H), 7.29 – 7.25 (m, 1H), 2.47 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.0, 141.6 (q, J = 35.5 Hz), 134.5, 134.1, 132.9, 130.2, 129.9, 128.9, 128.5, 128.4, 128.1, 128.0, 127.6, 123.8, 122.4, 120.1 (d, J = 275.3 Hz), 21.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -67.98; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{16}F_3N_2O_2S^+$: 393.0885. Found: 393.0888.

(*Z*)-4-Methyl-*N*'-(2,2,2-trifluoro-1-(thiophen-3-yl)ethylidene)benzenesulfonohydrazide (2p):



The title compound was prepared from 2,2,2-trifluoro-1-(thiophen-3-yl)ethan-1-one **14p** (5.0 mmol, 900.7 mg) and *N*-tosylhydrazide **15** (5.0 mmol, 931.2 mg) according to the general procedure. The product was obtained as white solid in 46% yield (818.6 mg), Mp. 134 – 135 °C. ^{1}H NMR (400 MHz, DMSO-D6) δ 11.63 (s, 1H), 8.04 – 8.00 (m, 1H), 7.80 – 7.76 (m, 1H), 7.73 (d, J = 8.2 Hz, 2H), 7.42 (d, J = 8.5 Hz, 2H), 7.29 – 7.25 (m, 1H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, DMSO-D6) δ 144.6, 135.6, 131.1, 130.2, 128.4, 128.2, 127.1, 126.2, 122.1, 119.4, 21.6; ^{19}F NMR (376 MHz, DMSO-D6) δ -66.68; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{13}H_{12}F_3N_2O_2S^+$: 349.0248. Found: 349.0246.

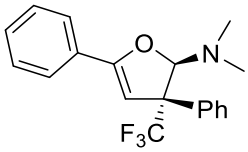
General procedure for 2*H*-furans and their spectral data:



1 **2** **3**

A mixture of **1** (0.2 mmol, 1.0 equiv.), **2** (0.5 mmol, 2.5 equiv.), $CuCl_2$ (0.01 mmol, 5 mol %), KO^{t}Bu (0.52 mmol, 2.6 equiv.) and CH_2Cl_2 (4 mL) was sealed in a Schlenk tube under Ar protection at 80 °C and the mixture was stirred for 24 h or until the **1** was consumed completely. Then the reaction mixture was filetered by diatomite and concentrated under reduced pressure and purified by column chromatography (Et_3N : PE = 1:20) to give the desired product **3**.

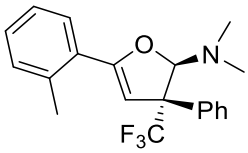
(*2R,3S*)-*N,N*-Dimethyl-3,5-diphenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3aa):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 87% yield (58.0 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.72 (m, 2H), 7.58 – 7.56 (m, 2H), 7.45 – 7.37 (m, 3H), 7.36 – 7.30 (m, 3H), 5.80 (s, 1H), 5.78 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, CDCl3) δ 158.3, 133.4, 130.1, 129.7, 129.5, 128.4, 127.9, 127.3, 126.9 (q, J = 283.6 Hz), 125.7, 100.4 (q, J = 2.9 Hz), 91.4 (d, J = 1.4 Hz), 62.7 (q, J = 25.3 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.50;

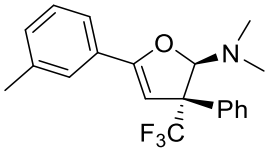
Selected IR (KBr) ν (cm^{-1}): 3061, 2947, 2850, 2797, 1686, 1645, 1599, 1579, 1494, 1449, 1152, 1048, 734, 697; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{19}F_3NO^+$: 334.1419. Found: 334.1411.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(*o*-tolyl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ba):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(*o*-tolyl)prop-2-en-1-one **1b** (0.2 mmol, 37.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 50% yield (34.7 mg), Mp. 47 – 48 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.55 (m, 3H), 7.38 – 7.31 (m, 3H), 7.30 – 7.20 (m, 3H), 5.75 (s, 1H), 5.50 (s, 1H), 2.53 (s, 3H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, CDCl3) δ 159.0, 136.7, 133.5, 131.2, 130.1, 130.1, 129.2, 128.5, 127.9, 127.4, 126.9 (q, J = 283.4 Hz), 125.7, 99.9 (q, J = 3.1 Hz), 95.4 (d, J = 2.0 Hz), 62.8 (q, J = 25.1 Hz), 39.9, 21.3; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.53; Selected IR (KBr) ν (cm^{-1}): 2948, 2850, 1653, 1493, 1450, 1339, 1171, 1152, 1028, 950, 747; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO^+$: 348.1575. Found: 348.1573.

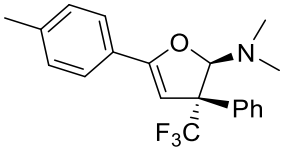
(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(*m*-tolyl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ca):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(*m*-tolyl)prop-2-en-1-one **1c** (0.2 mmol, 37.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 90% yield (62.5 mg), Mp.45 – 46 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 – 7.50 (m, 4H), 7.37 – 7.27 (m, 4H), 7.23

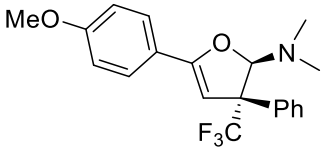
– 7.18 (m, 1H), 5.78 (s, 1H), 5.76 (s, 1H), 2.40 (s, 3H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.4, 138.1, 133.4, 130.3, 130.1, 129.7, 128.4, 127.9, 127.3, 126.9 (q, J = 283.6 Hz), 126.3, 122.9, 100.3 (d, J = 3.0 Hz), 91.3 (d, J = 1.7 Hz), 62.6 (q, J = 25.2 Hz), 39.7, 21.4; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.53; Selected IR (KBr) ν (cm^{-1}): 2947, 2797, 1646, 1601, 1580, 1491, 1450, 1346, 1152, 1055, 790, 741, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO^+$: 348.1575. Found: 348.1573.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(*p*-tolyl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3da):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(*p*-tolyl)prop-2-en-1-one **1d** (0.2 mmol, 37.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 85% yield (59.1 mg), Mp.77– 78 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.63 (m, 2H), 7.62 – 7.56 (m, 2H), 7.38 – 7.33 (m, 3H), 7.26 – 7.21 (m, 2H), 5.80 (s, 1H), 5.74 (s, 1H), 2.41 (s, 3H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.4, 139.6, 133.5, 130.2, 129.1, 127.9, 127.3, 127.0, 126.9 (q, J = 283.7 Hz), 125.6, 100.2 (q, J = 2.9 Hz), 90.6 (d, J = 1.7 Hz), 62.7 (q, J = 25.2 Hz), 39.7, 21.4; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.38; Selected IR (KBr) ν (cm^{-1}): 3030, 2947, 2850, 2797, 1645, 1511, 1450, 1346, 1257, 1150, 1047, 949, 746, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO^+$: 348.1575. Found: 348.1573.

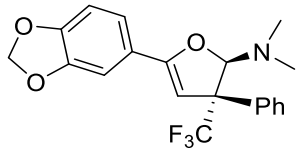
(*2R,3S*)-5-(4-Methoxyphenyl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ea):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(4-methoxyphenyl)prop-2-en-1-one **1e** (0.2 mmol, 41.1 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7

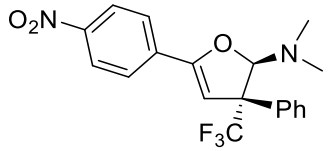
mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 85% yield (61.8 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.65 (m, 2H), 7.60 – 7.55 (m, 2H), 7.35 – 7.30 (m, 3H), 6.95 – 6.88 (m, 2H), 5.76 (s, 1H), 5.63 (s, 1H), 3.84 (s, 3H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.6, 158.1, 133.6, 130.2, 127.9, 127.3, 127.2, 127.0 (q, J = 283.6 Hz), 122.4, 113.8, 100.2 (q, J = 3.0 Hz), 89.5 (d, J = 1.8 Hz), 62.7 (q, J = 25.2 Hz), 55.4, 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.57; Selected IR (KBr) ν (cm^{-1}): 2947, 2840, 2797, 1647, 1609, 1512, 1450, 1302, 1254, 1151, 1049, 949, 746, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO_2^+$: 364.1524. Found: 364.1521.

(*2R,3S*)-5-(Benzo[*d*][1,3]dioxol-4-yl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3fa):



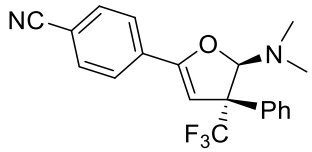
The title compound was prepared from (*E*)-1-(benzo[*d*][1,3]dioxol-5-yl)-3-(dimethylamino)prop-2-en-1-one **1f** (0.2 mmol, 43.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as white solid in 86% yield (64.9 mg), Mp.100 – 101 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.53 (m, 2H), 7.35 – 7.32 (m, 3H), 7.29 – 7.25 (m, 1H), 7.19 (d, J = 1.7 Hz, 1H), 6.84 (d, J = 8.1 Hz, 1H), 6.00 (s, 2H), 5.76 (s, 1H), 5.62 (s, 1H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.0, 148.8, 147.9, 133.5, 130.3, 128.0, 127.4, 127.0 (q, J = 281.6 Hz), 124.0, 120.1, 108.4, 106.3, 101.5, 100.4 (d, J = 1.8 Hz), 90.2, 62.8 (q, J = 25.0 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.59; Selected IR (KBr) ν (cm^{-1}): 2947, 2895, 2796, 1647, 1504, 1489, 1450, 1371, 1257, 1153, 1040, 812, 744, 697; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{19}F_3NO_3^+$: 378.1317. Found: 378.1308.

(*2R,3S*)-*N,N*-Dimethyl-5-(4-nitrophenyl)-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ga):



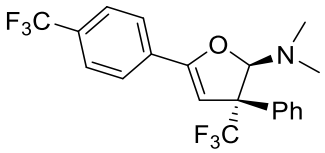
The title compound was prepared from (*E*)-3-(dimethylamino)-1-(4-nitrophenyl)prop-2-en-1-one **1g** (0.2 mmol, 44.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as yellow solid in 80% yield (60.5 mg), Mp.77 – 78 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 – 8.25 (m, 2H), 7.93 – 7.85 (m, 2H), 7.59 – 7.52 (m, 2H), 7.40 – 7.32 (m, 3H), 6.00 (s, 1H), 5.86 (s, 1H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.3, 148.1, 135.7, 132.7, 130.0, 128.2, 127.5, 126.6 (q, J = 283.8 Hz), 126.5, 123.8, 101.2 (q, J = 2.9 Hz), 95.6 (d, J = 1.8 Hz), 62.8 (q, J = 25.4 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.33; Selected IR (KBr) ν (cm^{-1}): 2949, 2852, 1642, 1596, 1523, 1450, 1345, 1154, 1048, 950, 744, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_3N_2O_3^+$: 379.1270. Found: 379.1275.

4-((*4S,5R*)-5-(Dimethylamino)-4-phenyl-4-(trifluoromethyl)-4,5-dihydrofuran-2-yl)benzonitrile (3ha):



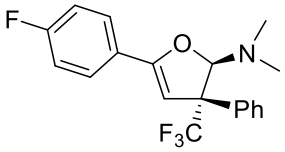
The title compound was prepared from (*E*)-4-(3-(dimethylamino)acryloyl)benzonitrile **1h** (0.2 mmol, 40.1 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.5). The product was obtained as white solid in 78% yield (55.9 mg), Mp.121 – 122 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 – 7.78 (m, 2H), 7.73 – 7.67 (m, 2H), 7.57 – 7.52 (m, 2H), 7.39 – 7.33 (m, 3H), 5.93 (s, 1H), 5.84 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) 156.5, 133.9, 132.7, 132.3, 130.0, 128.2, 127.5, 126.6 (q, J = 283.7 Hz), 126.2, 118.6, 112.8, 101.0 (q, J = 3.0 Hz), 94.8 (d, J = 2.0 Hz), 62.7 (q, J = 25.4 Hz), 39.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.38; Selected IR (KBr) ν (cm^{-1}): 2949, 2850, 2798, 2228, 1641, 1607, 1500, 1450, 1346, 1153, 1047, 950, 750, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{18}F_3N_2O^+$: 359.1371. Found: 359.1372.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-3-(trifluoromethyl)-5-(4-(trifluoromethyl)phenyl)-2,3-dihydrofuran-2-amine (3ia):



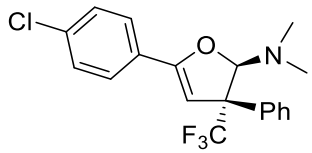
The title compound was prepared from (*E*)-3-(dimethylamino)-1-(4-(trifluoromethyl)phenyl)prop-2-en-1-one **1i** (0.2 mmol, 48.7 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 77% yield (61.8 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, J = 8.1 Hz, 2H), 7.67 (d, J = 8.2 Hz, 2H), 7.59 – 7.53 (m, 2H), 7.37 – 7.33 (m, 3H), 5.90 (s, 1H), 5.83 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.0, 133.1 (d, J = 1.2 Hz), 133.0, 131.2 (q, J = 32.4 Hz), 130.1, 128.1, 127.3, 126.7 (q, J = 281.8 Hz), 126.0, 125.5 (q, J = 3.9 Hz), 125.0 (q, J = 270.5 Hz), 100.9 (q, J = 2.8 Hz), 93.6, 62.7 (q, J = 25.2 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.72, -74.47; Selected IR (KBr) ν (cm^{-1}): 2990, 1355, 1259, 1165, 1128, 1066, 849, 750, 698; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{18}F_6NO^+$: 402.1293. Found: 402.1294.

(*2R,3S*)-5-(4-Fluorophenyl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ja):



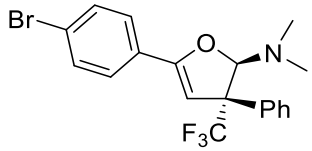
The title compound was prepared from (*E*)-3-(dimethylamino)-1-(4-fluorophenyl)prop-2-en-1-one **1j** (0.2 mmol, 38.6 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 92% yield (64.6 mg), Mp.42 – 43 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.68 (m, 2H), 7.58 – 7.53 (m, 2H), 7.36 – 7.32 (m, 3H), 7.13 – 7.06 (m, 2H), 5.79 (s, 1H), 5.71(s, 1H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4 (d, J = 249.4 Hz), 157.4, 133.3, 130.1, 128.0, 127.7 (d, J = 8.4 Hz), 127.4, 126.8 (q, J = 283.9 Hz), 126.0 (d, J = 3.4 Hz), 115.5 (d, J = 21.9 Hz), 100.6 (q, J = 3.0 Hz), 91.1, 62.7 (q, J = 25.3 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.56, -111.09; Selected IR (KBr) ν (cm^{-1}): 2951, 2851, 2799, 1649, 1605, 1508, 1450, 1259, 1232, 1154, 1047, 950, 806, 748, 697; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_4NO^+$: 352.1325. Found: 352.1325.

(*2R,3S*)-5-(4-Chlorophenyl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ka):



The title compound was prepared from (*E*)-1-(4-chlorophenyl)-3-(dimethylamino)prop-2-en-1-one **1k** (0.2 mmol, 41.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 90% yield (66.2 mg), Mp.47 – 48 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 – 7.63 (m, 2H), 7.58 – 7.52 (m, 2H), 7.40 – 7.33 (m, 5H), 5.79 (s, 1H), 5.76 (s, 1H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.3, 135.3, 133.2, 130.1, 128.7, 128.2, 128.0, 127.4, 127.0, 126.8 (q, J = 281.2 Hz), 100.6 (q, J = 2.9 Hz), 92.0 (d, J = 1.3 Hz), 62.7 (q, J = 25.0 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.51; Selected IR (KBr) ν (cm^{-1}): 2947, 2850, 2797, 1646, 1597, 1490, 1450, 1255, 1153, 1047, 950, 809, 746, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}ClF_3NO^+$: 368.1029. Found: 368.1025.

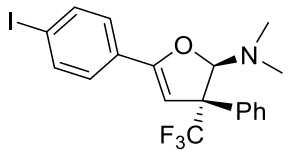
(*2R,3S*)-5-(4-Bromophenyl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3la):



The title compound was prepared from (*E*)-1-(4-bromophenyl)-3-(dimethylamino)prop-2-en-1-one **1l** (0.2 mmol, 50.8 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 88% yield (72.5 mg), Mp.49 - 50 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.72 (m, 2H), 7.61 – 7.56 (m, 2H), 7.46 – 7.39 (m, 3H), 7.37 – 7.33 (m, 3H), 5.80 (s, 1H), 5.78 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.3, 133.4, 130.2, 129.8, 129.5, 128.5, 128.0, 127.3, 126.9 (q, J = 281.9 Hz), 125.7, 100.4 (q, J = 2.8 Hz), 91.5, 62.4 (q, J = 24.9 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.48; Selected IR (KBr) ν (cm^{-1}): 3061, 2947, 2849, 2797, 1646, 1495, 1450, 1347, 1259,

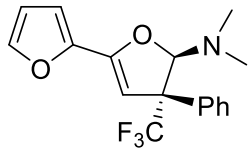
1152, 1048, 949, 814, 749, 697, 579; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}BrF_3NO^+$: 412.0524. Found: 412.0529.

(*2R,3S*)-5-(4-Iodophenyl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ma):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(4-iodophenyl)prop-2-en-1-one **1m** (0.2 mmol, 60.2 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 76% yield (69.8 mg), Mp.77 – 78 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.73 (m, 2H), 7.60 – 7.53 (m, 2H), 7.50 – 7.44 (m, 2H), 7.38 – 7.33 (m, 3H), 5.83 – 5.80 (m, 2H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.4, 137.6, 133.1, 130.1, 129.2, 128.0, 127.3, 127.4, 126.7 (q, J = 282.0 Hz), 100.6 (q, J = 2.8 Hz), 95.4, 92.2 (q, J = 1.2 Hz), 62.7 (q, J = 25.1 Hz), 39.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.45; Selected IR (KBr) ν (cm^{-1}): 2946, 2849, 2797, 1644, 1484, 1449, 1396, 1257, 1153, 1045, 1005, 949, 893, 808, 746, 703, 478; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_3INO^+$: 460.0385. Found: 460.0385.

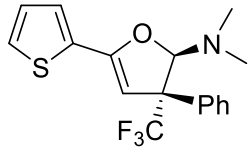
(*4S,5R*)-*N,N*-Dimethyl-4-phenyl-4-(trifluoromethyl)-4,5-dihydro-[2,2'-bifuran]-5-amine (3na):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(furan-2-yl)prop-2-en-1-one **1n** (0.2 mmol, 33.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as red oil in 49% yield (31.7 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 – 7.54 (m, 2H), 7.50 – 7.48 (m, 1H), 7.37 – 7.32 (m, 3H), 6.67 (d, J = 3.4 Hz, 1H), 6.48 (dd, J_1 = 3.4 Hz, J_2 = 1.8 Hz, 1H), 5.80 (s, 1H), 5.73 (s, 1H), 2.12 (s, 6H);

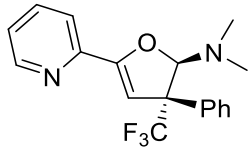
^{13}C NMR (100 MHz, $CDCl_3$) δ 150.4, 145.5, 143.5, 133.2, 130.1, 128.0, 127.4, 126.8 (q, J = 283.7 Hz), 111.3, 109.1, 101.2 (q, J = 2.9 Hz), 91.3 (d, J = 1.8 Hz), 62.4 (q, J = 25.3 Hz), 39.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.45; Selected IR (KBr) ν (cm^{-1}): 3063, 2925, 1735, 1671, 1570, 1467, 1398, 1259, 1236, 1168, 763, 699, 592; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{17}F_3NO_2^+$: 324.1211. Found: 324.1205.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(thiophen-2-yl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3oa):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(thiophen-2-yl)prop-2-en-1-one **1o** (0.2 mmol, 36.3 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as yellow oil in 63% yield (42.7 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.52 (m, 2H), 7.41 (dd, J = 3.7, 1.2 Hz, 1H), 7.36 – 7.32 (m, 4H), 7.07 (dd, J = 5.0, 3.6 Hz, 1H), 5.78 (s, 1H), 5.65 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.6, 133.3, 132.7, 130.2, 128.1, 127.6, 127.4, 126.9 (d, J = 283.7 Hz), 126.6, 126.1, 101.0 (d, J = 2.6 Hz), 91.1, 62.9 (q, J = 25.4 Hz), 39.7; ^{19}F NMR (376 MHz, CD_3OD) δ -74.49; Selected IR (KBr) ν (cm^{-1}): 2947, 1483, 1449, 1396, 1258, 1152, 1046, 1005, 949, 807, 748, 702; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{17}F_3NOS^+$: 340.0983. Found: 340.0980.

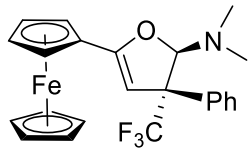
(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(pyridin-2-yl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3pa):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(pyridin-2-yl)prop-2-en-1-one **1p** (0.2 mmol, 35.3 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as red solid in 71% yield (47.5 mg), Mp.72

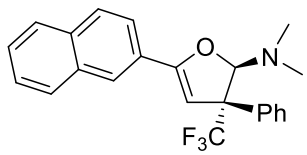
– 73 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.70 – 8.66 (m, 1H), 7.79 – 7.73 (m, 1H), 7.71 – 7.67 (m, 1H), 7.64 – 7.57 (m, 2H), 7.37 – 7.32 (m, 3H), 7.31 – 7.27 (m, 1H), 6.31 (s, 1H), 5.88 (s, 1H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.6, 149.8, 148.6, 136.7, 133.1, 130.2, 128.0, 127.4, 126.7 (q, J = 281.7 Hz), 123.9, 120.3, 101.3 (q, J = 2.9 Hz), 95.3 (d, J = 1.3 Hz), 62.6 (q, J = 25.1 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.31; Selected IR (KBr) ν (cm^{-1}): 3061, 2948, 1735, 1583, 1450, 1354, 1259, 1154, 1058, 950, 750, 704; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{18}H_{18}F_3N_2O^+$: 335.1371. Found: 335.1373.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(ferrocene-2-yl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3qa):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-ferrocenyl -2-en-1-one **1q** (0.2 mmol, 56.6 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as red oil in 52% yield (45.8 mg). ^{1}H NMR (400 MHz, CD_3OD) δ 7.57 – 7.55 (m, 2H), 7.32 – 7.30 (m, 3H), 5.72 (s, 1H), 5.51 (s, 1H), 4.66 – 4.65 (m, 1H), 4.59 – 4.58 (m, 1H), 4.33 – 4.29 (m, 2H), 4.17 (s, 5H), 2.09 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.4, 133.8, 130.3, 127.9, 127.3, 126.8 (q, J = 283.6 Hz), 100.0 (d, J = 2.4 Hz), 89.1, 74.1, 69.7, 69.5, 69.1, 67.1, 66.6, 62.7 (q, J = 25.1 Hz), 39.9; ^{19}F NMR (376 MHz, CD_3OD) δ -75.62; Selected IR (KBr) ν (cm^{-1}): 3061, 2946, 2850, 2797, 1645, 1585, 1484, 1450, 1396, 1258, 1234, 1152, 1046, 1005, 949, 810, 747, 697, 480; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{23}H_{23}F_3FeNO^+$: 442.1128. Found: 442.1132.

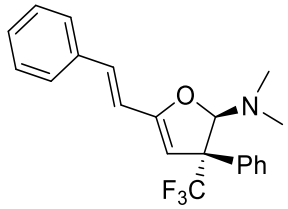
(*2R,3S*)-*N,N*-Dimethyl-5-(naphthalen-2-yl)-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ra):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-(naphthalen-2-yl)prop-2-en-1-one **1r** (0.2 mmol, 45.1 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-

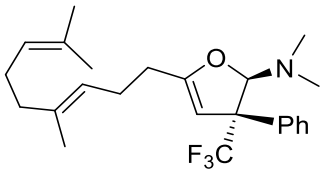
phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 86% yield (65.9 mg). ^{1}H NMR (400 MHz, CDCl3) δ 8.25 – 8.22 (m, 1H), 7.95 – 7.79 (m, 4H), 7.66 – 7.60 (m, 2H), 7.56 – 7.50 (m, 2H), 7.40 – 7.35 (m, 3H), 5.91 (s, 1H), 5.86 (s, 1H), 2.16 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.3, 133.8, 133.4, 133.1, 130.2, 128.6, 128.2, 128.0, 127.8, 127.4, 127.0, 126.9 (q, J = 282.1 Hz), 126.8, 126.6, 125.0, 123.4, 100.5 (q, J = 2.8 Hz), 92.3 (d, J = 1.2 Hz), 62.8 (q, J = 25.1 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.41; Selected IR (KBr) ν (cm^{-1}): 3060, 2981, 2947, 2849, 1645, 1450, 1363, 1260, 1152, 1047, 949, 815, 750, 696, 475; HRMS (ESI) m/z [M+H]$^+$: Calcd for $C_{23}H_{21}F_3NO^+$: 384.1575. Found: 384.1579.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-((*E*)-styryl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3sa):



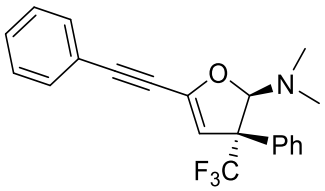
The title compound was prepared from (1*E*,4*E*)-1-(dimethylamino)-5-phenylpenta-1,4-dien-3-one **1s** (0.2 mmol, 40.3 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 70% yield (50.3 mg), Mp.59 – 60 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.47 (m, 4H), 7.40 – 7.27 (m, 6H), 7.09 (d, J = 16.0 Hz, 1H), 6.68 (d, J = 16.1 Hz, 1H), 5.74 (s, 1H), 5.46 (s, 1H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.4, 136.1, 133.3, 132.4, 130.1, 128.7, 128.4, 127.9, 127.3, 127.0, 126.8 (q, J = 281.9 Hz), 116.1, 100.4 (q, J = 2.9 Hz), 96.8 (d, J = 1.3 Hz), 62.5 (q, J = 25.1 Hz), 39.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.33; Selected IR (KBr) ν (cm^{-1}): 3060, 2947, 2950, 2797, 1649, 1604, 1449, 1397, 1259, 1152, 1046, 951, 809, 749, 694; HRMS (ESI) m/z [M+H]$^+$: Calcd for $C_{21}H_{21}F_3NO^+$: 360.1575. Found: 360.1569.

(*2R,3S*)-5-((*E*)-4,8-Dimethylnona-3,7-dien-1-yl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ta):



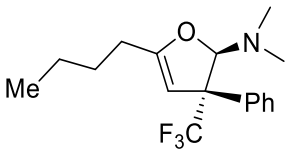
The title compound was prepared from (1*E*,6*E*)-1-(dimethylamino)-7,11-dimethyldodeca-1,6,10-trien-3-one **1t** (0.2 mmol, 49.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 57% yield (46.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.46 (m, 2H), 7.31 – 7.29 (m, 3H), 5.58 (s, 1H), 5.21 – 5.07 (m, 2H), 5.04 (s, 1H), 2.33 – 2.26 (m, 4H), 2.10 – 1.96 (m, 10H), 1.70 – 1.58 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.8, 136.1, 133.8, 131.4, 130.1, 127.7, 127.2, 127.0 (d, J = 283.3 Hz), 124.2, 123.0, 100.2 (q, J = 3.2 Hz), 91.7 (d, J = 1.9 Hz), 62.2 (q, J = 25.0 Hz), 39.7, 28.3, 26.7, 25.7, 25.1, 17.7, 16.2; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.81; Selected IR (KBr) ν (cm^{-1}): 2924, 1723, 1669, 1449, 1376, 1260, 1152, 1048, 951, 808, 749, 698; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{24}H_{33}F_3NO^+$: 408.2514. Found: 408.2515.

(*2R,3S*)-*N,N*-Dimethyl-3-phenyl-5-(phenylethynyl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ua):



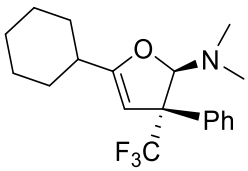
The title compound was prepared from (*E*)-1-(dimethylamino)-5-phenylpent-1-en-4-yn-3-one **1u** (0.2 mmol, 39.9 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 54% yield (38.6 mg), Mp.63 - 64 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.53 (m, 2H), 7.52 – 7.48 (m, 2H), 7.39 – 7.32 (m, 6H), 5.78 (s, 1H), 5.74 (s, 1H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 142.3, 132.6, 132.0, 130.0, 129.3, 128.4, 128.1, 127.4, 126.5 (q, J = 283.6 Hz), 121.4, 102.9 (d, J = 1.7 Hz), 101.0 (q, J = 3.0 Hz), 92.6, 79.0, 62.3 (q, J = 25.4 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.28; Selected IR (KBr) ν (cm^{-1}): 2989, 1449, 1260, 1155, 952, 750, 691; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{21}H_{19}F_3NO^+$: 358.1419. Found: 358.1414.

(*2R,3S*)-5-Butyl-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3va):



The title compound was prepared from (*E*)-1-(dimethylamino)hept-1-en-3-one **1v** (0.2 mmol, 31.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.8). The product was obtained as clear oil in 71% yield (44.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.47 (m, 2H), 7.33 – 7.29 (m, 3H), 5.57 (s, 1H), 5.03 (s, 1H), 2.26 (t, J = 7.6 Hz, 2H), 2.04 (s, 6H), 1.64 – 1.55 (m, 2H), 1.45 – 1.35 (m, 2H), 0.94 (t, J = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 133.8, 130.2, 127.7, 127.2, 127.0 (q, J = 283.1 Hz), 100.1 (d, J = 3.0 Hz), 91.4 (d, J = 1.9 Hz), 62.2 (q, J = 25.0 Hz), 39.7, 28.8, 28.0, 22.5, 14.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.92; Selected IR (KBr) ν (cm^{-1}): 3063, 2961, 2874, 1721, 1669, 1449, 1240, 1162, 1047, 760, 749, 699; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{23}F_3NO^+$: 314.1732. Found: 314.1727.

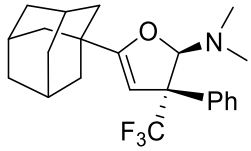
(*2R,3S*)-5-Cyclohexyl-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3wa):



The title compound was prepared from (*E*)-1-cyclohexyl-3-(dimethylamino)prop-2-en-1-one **1w** (0.2 mmol, 36.3 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.8). The product was obtained as clear oil in 68% yield (46.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 – 7.47 (m, 2H), 7.32 – 7.29 (m, 3H), 5.55 (s, 1H), 4.99 (s, 1H), 2.28 – 2.18 (m, 1H), 2.07 – 2.02 (m, 6H), 2.00 – 1.92 (m, 2H), 1.84 – 1.75 (m, 2H), 1.73 – 1.66 (m, 1H), 1.45 – 1.20 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.5, 133.9, 130.2, 127.7, 127.1, 127.0 (q, J = 281.6 Hz), 99.6 (q, J = 2.8 Hz), 89.2 (d, J = 1.5 Hz), 62.0, (q, J = 24.8 Hz), 39.7, 37.5, 30.7, 30.3, 26.1, 25.9, 25.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -75.09; Selected IR (KBr) ν

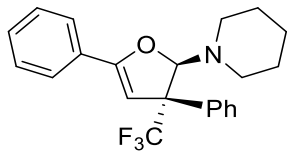
(cm^{-1}): 2930, 2854, 1449, 1258, 1195, 1152, 1084, 952, 750, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{25}F_3NO^+$: 340.1888. Found: 340.1880.

(*2R,3S*)-5-((1r,3*R,5S*)-Adamantan-1-yl)-*N,N*-dimethyl-3-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3xa):



The title compound was prepared from (*E*)-1-(adamantan-1-yl)-3-(dimethylamino)prop-2-en-1-one **1x** (0.2 mmol, 46.7 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.8). The product was obtained as clear oil in 30% yield (23.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.47 (m, 2H), 7.32 – 7.28 (m, 3H), 5.53 (s, 1H), 4.92 (s, 1H), 2.03 (s, 9H), 1.92 – 1.83 (m, 6H), 1.79 – 1.69 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.1, 134.0, 130.3, 127.7, 127.2, 127.1 (q, J = 283.3 Hz), 99.4 (q, J = 2.9 Hz), 87.9, 61.9 (q, J = 25.0 Hz), 40.0, 39.8, 36.9, 35.0, 28.2; ^{19}F NMR (376 MHz, $CDCl_3$) δ -75.11; Selected IR (KBr) ν (cm^{-1}): 2906, 2851, 1653, 1452, 1258, 1170, 1151, 1044, 950, 809, 749, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{23}H_{29}F_3NO^+$: 392.2201. Found: 392.2202.

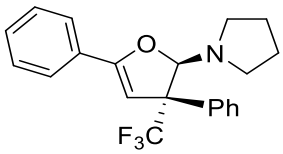
1-((*2R,3S*)-3,5-Diphenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-yl)piperidine (3ya):



The title compound was prepared from (*E*)-1-phenyl-3-(piperidin-1-yl)prop-2-en-1-one **1y** (0.2 mmol, 43.1 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 63% yield (47.1 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.69 (m, 2H), 7.62 – 7.56 (m, 2H), 7.43 – 7.37 (m, 3H), 7.35 – 7.31 (m, 3H), 5.78 (s, 1H), 5.73 (s, 1H), 2.59 – 2.37 (m, 4H), 1.31 – 1.16 (m, 4H), 1.09 – 0.91 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.1, 133.6, 130.3, 129.9, 129.4, 128.4, 127.8, 127.1, 127.0 (q, J = 283.7 Hz), 125.7, 101.1 (q, J = 3.0 Hz), 91.7 (d, J = 1.8 Hz), 62.6 (q, J =

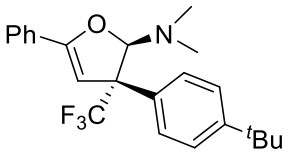
25.3 Hz), 49.0, 25.3, 24.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.36; Selected IR (KBr) ν (cm^{-1}): 3060, 2935, 2854, 1494, 1449, 1345, 1259, 1171, 1153, 1056, 952, 749, 692; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{22}H_{23}F_3NO^+$: 374.1732. Found: 374.1729.

1-((*2R,3S*)-3,5-Diphenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-yl)pyrrolidine (3za):



The title compound was prepared from (*E*)-1-phenyl-3-(pyrrolidin-1-yl)prop-2-en-1-one **1z** (0.2 mmol, 40.3 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-phenylethylidene)benzenesulfonohydrazide **2a** (0.5 mmol, 171.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 76% yield (54.6 mg), Mp.40 – 41 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.70 (m, 2H), 7.60 – 7.55 (m, 2H), 7.42 – 7.37 (m, 3H), 7.34 – 7.30 (m, 3H), 6.07 (s, 1H), 5.73 (s, 1H), 2.68 – 2.60 (m, 2H), 2.36 – 2.28 (m, 2H), 1.54 – 1.4 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.3, 133.9, 130.1, 129.8, 129.4, 128.4, 127.8, 127.1, 126.9 (q, J = 283.9 Hz), 125.7, 97.2 (d, J = 1.8 Hz), 91.1, 62.6 (q, J = 25.0 Hz), 47.1, 24.4; ^{19}F NMR (376 MHz, $CDCl_3$) δ -73.98; Selected IR (KBr) ν (cm^{-1}): 3060, 2935, 2854, 1646, 1495, 1449, 1346, 1259, 1171, 1153, 1056, 953, 749, 698; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{21}H_{21}F_3NO^+$: 360.1575. Found: 360.1572.

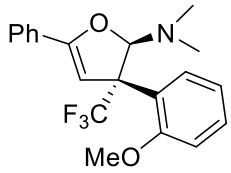
(*2R,3S*)-3-(4-(Tert-butyl)phenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ab):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-*N*'-(1-(4-(*tert*-butyl)phenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide **2b** (0.5 mmol, 199.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow solid in 94% yield (73.2 mg), Mp.65 - 66 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.73 (m, 2H), 7.52 – 7.47 (m, 2H), 7.45 – 7.34 (m, 5H), 5.80 (s, 1H), 5.78 (s, 1H), 2.14 (s, 6H), 1.35 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.2, 150.8,

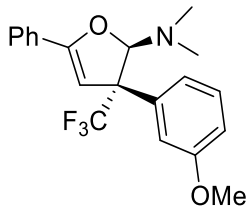
130.2, 130.0, 129.8, 129.5, 128.5, 127.1 (d, J = 283.8 Hz), 125.8, 124.4, 100.4 (d, J = 2.3 Hz), 91.8, 62.4 (q, J = 25.3 Hz), 39.8, 34.6, 31.4; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.42; Selected IR (KBr) ν (cm^{-1}): 3058, 2964, 2904, 2870, 2797, 1648, 1602, 1495, 1450, 1399, 1347, 1259, 1154, 1048, 1024, 821, 749, 686, 584; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{23}H_{27}F_3NO^+$: 390.2045. Found: 390.2048.

(*2R,3S*)-3-(2-Methoxyphenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ac):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(2-methoxyphenyl)ethylidene)benzenesulfonohydrazide **2c** (0.5 mmol, 186.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 88% yield (63.9 mg), Mp.110 – 111 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (dd, J = 8.0, 1.6 Hz, 2H), 7.45 (d, J = 7.8 Hz, 1H), 7.41 – 7.31 (m, 4H), 6.97 – 6.93 (m, 2H), 5.89 (s, 1H), 5.83 (s, 1H), 3.83 (s, 3H), 2.15 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.4, 157.8, 130.9, 130.0, 129.8, 129.4, 128.5, 127.1 (q, J = 284.5 Hz), 125.8, 122.2, 120.1, 112.8, 99.6, 92.6, 62.7 (q, J = 26.8 Hz), 56.0, 40.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -73.83; Selected IR (KBr) ν (cm^{-1}): 3061, 2993, 2942, 2838, 2795, 1641, 1600, 1493, 1449, 1342, 1258, 1155,1041, 948, 751, 688; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO_2^+$: 364.1524. Found: 364.1525.

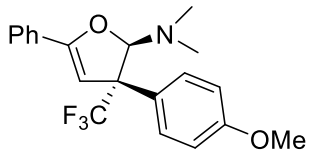
(*2R,3S*)-3-(3-Methoxyphenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ad):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(3-

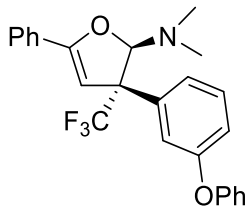
methoxyphenyl)ethylidene)benzenesulfonohydrazide **2d** (0.5 mmol, 186.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 81% yield (58.9 mg), Mp.57 – 58 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 – 7.70 (m, 2H), 7.45 – 7.37 (m, 3H), 7.30 – 7.22 (m, 1H), 7.20 – 7.12 (m, 2H), 6.92 – 6.87 (m, 1H), 5.78 (s, 1H), 5.73 (s, 1H), 3.82 (s, 3H), 2.14 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.7, 158.4, 135.0, 129.8, 129.6, 128.6, 128.3, 126.9 (d, J = 283.7 Hz), 125.8, 122.7, 117.2, 112.7, 100.5 (d, J = 2.9 Hz), 91.6 (d, J = 1.8 Hz), 62.7 (q, J = 25.2 Hz), 55.4, 39.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.34; Selected IR (KBr) ν (cm^{-1}): 2953, 2851, 2797, 1721, 1647, 1602, 1583, 1493, 1450, 1347, 1261, 1172, 1151, 1046, 955, 747, 696; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO_2^+$: 364.1524. Found: 364.1525.

(*2R,3S*)-3-(4-Methoxyphenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ae):



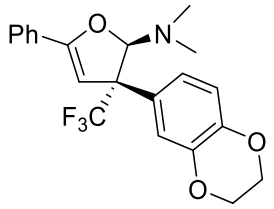
The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(4-methoxyphenyl)ethylidene)benzenesulfonohydrazide **2e** (0.5 mmol, 186.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 63% yield (45.8 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.70 (m, 2H), 7.52 – 7.45 (m, 2H), 7.43 – 7.37 (m, 3H), 6.90 – 6.84 (m, 2H), 5.76 (s, 1H), 5.73 (s, 1H), 3.82 (s, 3H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.2, 158.1, 131.2, 129.8, 129.4, 128.4, 126.9 (q, J = 283.9 Hz), 125.7, 125.3, 112.7, 100.3 (d, J = 3.0 Hz), 91.7 (d, J = 1.5 Hz), 61.9 (q, J = 25.4 Hz), 55.2, 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.86; Selected IR (KBr) ν (cm^{-1}): 2939, 2839, 1515, 1493, 1449, 1257, 1153, 1045, 950, 822, 749, 688; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{21}F_3NO_2^+$: 364.1524. Found: 364.1525.

(*2R,3S*)-*N,N*-Dimethyl-3-(3-phenoxyphenyl)-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3af):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(3-phenoxyphenyl)ethylidene)benzenesulfonohydrazide **2f** (0.5 mmol, 217.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 72% yield (61.3 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 - 7.69 (m, 2H), 7.42 – 7.37 (m, 3H), 7.35 – 7.28 (m, 5H), 7.12 – 7.06 (m, 1H), 7.01 – 6.96 (m, 3H), 5.74 (s, 1H), 5.72 (s, 1H), 2.15 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.6, 157.6, 155.7, 135.4, 129.8, 129.7, 129.6, 128.6, 128.5, 126.8 (q, J = 283.8 Hz), 125.8, 125.3, 123.0, 122.6, 119.1, 118.2, 100.3 (d, J = 2.0 Hz), 91.3, 62.7 (q, J = 25.4 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.35; Selected IR (KBr) ν (cm^{-1}): 3063, 2946, 2851, 2797, 1646, 1852, 1488, 1450, 1244, 1174, 1148, 1046, 904, 740, 694; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{25}H_{23}F_3NO_2^+$: 426.1681. Found: 426.1684.

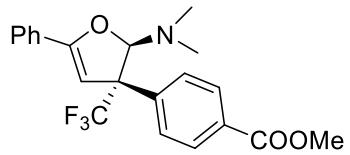
(*2R,3S*)-3-(2,3-Dihydrobenzo[b][1,4]dioxin-6-yl)-N,N-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ag):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-*N*'-(1-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide **2g** (0.5 mmol, 200.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 85% yield (66.6 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.69 (m, 2H), 7.42 – 7.37 (m, 3H), 7.10 – 7.08 (m, 1H), 7.05 – 7.02 (m, 1H), 6.83 – 6.80 (m, 1H), 5.73 (s, 1H), 5.67 (s, 1H), 4.27 (s, 4H), 2.15 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.2, 143.4, 142.5, 129.8, 128.5, 126.9 (q, J = 283.5 Hz), 126.5, 125.8, 125.5, 123.4, 119.5, 116.1, 100.4, 91.8, 64.5, 64.4, 62.1 (q, J = 24.9 Hz), 39.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.58; Selected IR (KBr) ν (cm^{-1}): 2978, 1510, 1307, 1250,

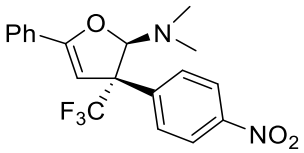
1171, 1069, 1047, 898, 749; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{21}H_{21}F_3NO_3^+$: 392.1474. Found: 392.1480.

Methyl 4-((*2R,3S*)-2-(dimethylamino)-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-3-yl)benzoate (3ah):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), methyl (*Z*)-4-(2,2,2-trifluoro-1-(2-tosylhydrazono)ethyl)benzoate **2h** (0.5 mmol, 200.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 39% yield (30.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.99 (m, 2H), 7.76 – 7.71 (m, 2H), 7.69 – 7.64 (m, 2H), 7.44 – 7.39 (m, 3H), 5.81 (s, 1H), 5.78 (s, 1H), 3.93 (s, 3H), 2.11 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.0, 158.8, 138.7, 130.4, 129.8, 129.6, 128.6, 128.5, 126.7 (q, J = 283.7 Hz), 125.8, 100.4 (d, J = 3.1 Hz), 90.9, 63.0 (q, J = 25.3 Hz), 52.3, 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.12; Selected IR (KBr) ν (cm^{-1}): 3175, 2955, 1726, 1598, 1438, 1362, 1278, 1195, 1171, 1078, 999, 876, 748, 562; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{21}H_{21}F_3NO_3^+$: 392.1474. Found: 392.1476.

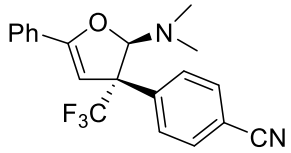
(*2R,3S*)-*N,N*-Dimethyl-3-(4-nitrophenyl)-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ai):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(4-nitrophenyl)ethylidene)benzenesulfonohydrazide **2i** (0.5 mmol, 193.7 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as yellow oil in 44% yield (33.3 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 – 8.18 (m, 2H), 7.80 – 7.71 (m, 4H), 7.45 – 7.41 (m, 3H), 5.82 (s, 1H), 5.75 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.4, 147.7, 141.0, 131.4, 130.0, 129.3, 128.6, 126.4 (q, J = 284.2 Hz), 125.9, 122.4, 100.2 (d, J = 22.2 Hz), 90.2,

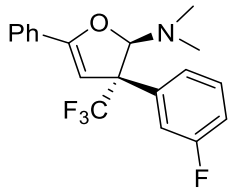
63.1 (q, J = 25.4 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.00; Selected IR (KBr) ν (cm^{-1}): 2949, 1599, 1523, 1350, 1258, 1172, 1047, 749, 693; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_3N_2O_3^+$: 379.1270. Found: 379.1266.

4-((*2R,3S*)-2-(Dimethylamino)-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-3-yl)benzonitrile (3aj):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-*N*'-(1-(4-cyanophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide **2j** (0.5 mmol, 183.7 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.6). The product was obtained as white solid in 57% yield (40.9 mg), Mp.86 – 87 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 – 7.61 (m, 4H), 7.59 – 7.54 (m, 2H), 7.37 – 7.32 (m, 3H), 5.72 (s, 1H), 5.65 (s, 1H), 2.02 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.3, 139.0, 136.6, 131.1, 130.0, 129.3, 128.6, 126.5 (q, J = 283.8 Hz), 125.9, 118.7, 112.1, 100.2 (d, J = 1.9 Hz), 90.2, 63.0 (q, J = 25.7 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.07; Selected IR (KBr) ν (cm^{-1}): 2952, 2229, 11726, 1492,1450, 1259, 1153, 1047, 822, 748, 697; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{20}H_{18}F_3NO_2^+$: 359.1371. Found: 359.1375.

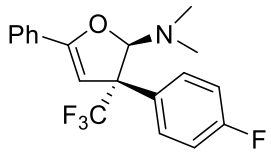
(*2R,3S*)-3-(3-Fluorophenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ak):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(3-fluorophenyl)ethylidene)benzenesulfonohydrazide **2k** (0.5 mmol, 180.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as clear oil in 76% yield (53.4 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.70 (m, 2H), 7.44 – 7.38 (m, 3H), 7.37 – 7.27 (m,

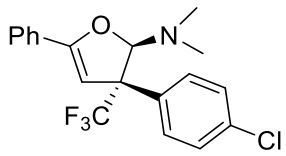
3H), 7.09 – 7.02 (m, 1H), 5.78 (s, 1H), 5.70 (s, 1H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 160.8, 158.8, 136.0 (d, J = 7.3 Hz), 129.7, 129.6, 128.7 (d, J = 8.0 Hz), 128.6, 126.7 (q, J = 283.7 Hz), 125.8, 117.7 (d, J = 23.2 Hz), 115.1 (d, J = 20.9 Hz), 100.4 (d, J = 2.5 Hz), 91.1, 62.7 (q, J = 26.2 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.32, -113.75; Selected IR (KBr) ν (cm^{-1}): 2947, 1588, 1492, 1347, 1262, 1243, 1177, 1146, 12046, 748, 693; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_4NO^+$: 352.1325. Found: 352.1326.

(*2R,3S*)-3-(4-Fluorophenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3al):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(4-fluorophenyl)ethylidene)benzenesulfonohydrazide **2l** (0.5 mmol, 180.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 66% yield (46.4 mg), Mp.56 – 57 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.65 (m, 4H), 7.44 – 7.38 (m, 3H), 7.33 – 7.28 (m, 2H), 5.76 (s, 1H), 5.69 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.7, 136.6, 133.3, 132.2, 129.8, 129.6, 128.6, 126.7 (q, J = 283.6 Hz), 125.8, 100.2 (d, J = 2.3 Hz), 94.5, 90.9, 62.6 (q, J = 25.5 Hz), 39.8; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.45; Selected IR (KBr) ν (cm^{-1}): 2945, 1560, 1486, 1449, 1393, 1346, 1258, 1153, 1046, 952, 807, 749; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}F_4NO^+$: 352.1325. Found: 352.1326.

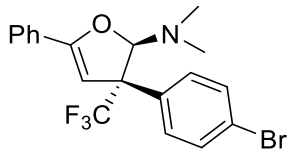
(*2R,3S*)-3-(4-Chlorophenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3am):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-*N*'-(1-(4-chlorophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide **2m** (0.5 mmol, 188.4 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE =

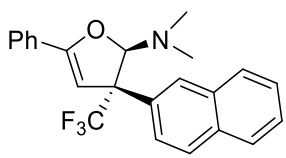
5%, Rf = 0.7). The product was obtained as white solid in 70% yield (51.5 mg), Mp.57 – 58 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.68 (m, 2H), 7.50 (d, J = 8.3 Hz, 2H), 7.45 – 7.38 (m, 3H), 7.35 – 7.29 (m, 2H), 5.77 (s, 1H), 5.71 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.6, 134.2, 132.0, 131.5, 129.7, 129.6, 128.5, 127.6, 126.7 (q, J = 283.9 Hz), 125.7, 100.2 (d, J = 3.1 Hz), 91.0 (d, J = 1.9 Hz), 62.4 (q, J = 25.3 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.61; Selected IR (KBr) ν (cm^{-1}): 2948, 2851, 2798, 1646, 1597, 1494, 1258, 1172, 1153, 1096, 1047, 953, 814, 741, 697, 579; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}ClF_3NO^+$: 368.1029. Found: 368.1032.

(*2R,3S*)-3-(4-Bromophenyl)-*N,N*-dimethyl-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3an):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-*N*'-(1-(4-bromophenyl)-2,2,2-trifluoroethylidene)-4-methylbenzenesulfonohydrazide **2n** (0.5 mmol, 210.6 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as white solid in 46% yield (37.9 mg), Mp.62 – 63 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.68 (m, 2H), 7.50 – 7.38 (m, 7H), 5.76 (s, 1H), 5.71 (s, 1H), 2.12 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.7, 132.6, 131.9, 130.5, 129.7, 129.5, 128.5, 126.6 (q, J = 283.7 Hz), 125.7, 122.5, 100.2 (d, J = 3.0 Hz), 90.9 (d, J = 1.9 Hz), 62.4 (q, J = 25.5 Hz), 39.7; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.59; Selected IR (KBr) ν (cm^{-1}): 2947, 1653, 1589, 1491, 1449, 1397, 1347, 1257, 1171, 1154, 1046, 952, 810, 740, 691, 579, 511; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{18}BrF_3NO^+$: 412.0524. Found: 412.0529.

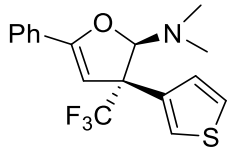
(*2R,3S*)-*N,N*-Dimethyl-3-(naphthalen-2-yl)-5-phenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ao):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(naphthalen-2-

yl)ethylidene)benzenesulfonohydrazide **2o** (0.5 mmol, 196.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 96% yield (73.6 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 8.01 (m, 1H), 7.87 – 7.82 (m, 2H), 7.81 – 7.76 (m, 3H), 7.71 – 7.68 (m, 1H), 7.50 – 7.48 (m, 2H), 7.45 – 7.38 (m, 3H), 5.92 (s, 1H), 5.88 (s, 1H), 2.13 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.6, 132.9, 132.7, 131.5, 131.4, 129.9, 129.7, 129.2, 128.6, 128.5, 128.4, 127.6, 127.1 (q, J = 284.3 Hz), 126.6, 126.0, 125.9, 100.5 (d, J = 2.4 Hz), 91.7, 63.0 (q, J = 25.3 Hz), 39.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.00; Selected IR (KBr) ν (cm^{-1}): 2946, 1449, 1248, 1171, 1151, 1048, 813, 748, 688, 476; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{23}H_{21}F_3NO^+$: 384.1575. Found: 384.1580.

(*2R,3S*)-*N,N*-Dimethyl-5-phenyl-3-(thiophen-3-yl)-3-(trifluoromethyl)-2,3-dihydrofuran-2-amine (3ap):



The title compound was prepared from (*E*)-3-(dimethylamino)-1-phenylprop-2-en-1-one **1a** (0.2 mmol, 35.0 mg), (*Z*)-4-methyl-*N*'-(2,2,2-trifluoro-1-(thiophen-3-yl)ethylidene)benzenesulfonohydrazide **2p** (0.5 mmol, 174.2 mg), $CuCl_2$ (0.01 mmol, 1.7 mg), KO^{t}Bu (0.52 mmol, 58.3 mg) in CH_2Cl_2 (4 mL) according to the general procedure (EA/PE = 5%, Rf = 0.7). The product was obtained as yellow oil in 57% yield (38.7 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.69 (m, 2H), 7.41 – 7.39 (m, 4H), 7.29 – 7.27 (m, 1H), 7.23 – 7.21 (m, 1H), 5.73 (s, 1H), 5.65 (s, 1H), 2.17 (s, 6H); ^{13}C NMR (100 MHz, CDCl3) δ 158.4, 134.0, 129.7, 129.5, 129.4, 128.5, 126.5 (d, J = 283.0 Hz), 125.7, 125.3, 124.0, 100. 1 (d, J = 2.5 Hz), 92.3, 60.5 (q, J = 26.1 Hz), 39.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -75.25; Selected IR (KBr) ν (cm^{-1}): 2946, 1735, 1654, 1449, 1413, 1259, 1169, 1048,749, 698; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{17}F_3NOS^+$: 340.0983. Found: 340.0977.

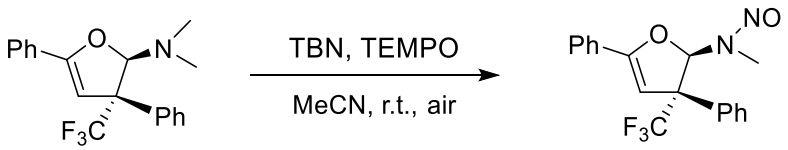
General procedure for applications and their spectral data

(*1R,3R,4R,5S*)-*N,N*-Dimethyl-1,4-diphenyl-4-(trifluoromethyl)-2,6-dioxabicyclo[3.1.0]hexan-3-amine (4aa):

3aa **4aa**

A solution of **3aa** (0.2 mmol, 66.7 mg) and *m*CPBA (0.3 mmol, 51.8 mg) was kept at r.t. for 3 h. After completion monitored by TLC (by UV visualization), the solvent was removed under reduced pressure. The products were separated by silica gel column chromatography to afford the product **4aa** as white solid in 93% yield (64.9 mg) (MeOH/DCM = 5%, Rf = 0.4), Mp.85 – 86 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 – 7.65 (m, 4H), 7.48 – 7.43(m, 3H), 7.38 – 7.33 (m, 3H), 5.85 (s, 1H), 5.82 (s, 1H), 3.37 (s, 3H), 2.56 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.2, 130.7, 130.4, 129.4, 129.0, 127.8, 127.7, 126.2 (q, J = 284.4 Hz), 125.7, 102.3 (d, J = 2.0 Hz), 96.9 (d, J = 2.0 Hz), 65.3 (q, J = 26.2 Hz), 61.7, 50.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -71.01; Selected IR (KBr) ν (cm^{-1}): 3061, 2962, 1666, 1496, 1449, 1284, 1256, 1181, 1153, 1074, 1008, 758, 716, 697; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{19}H_{19}F_3NO_2^+$: 350.1368. Found: 350.1362.

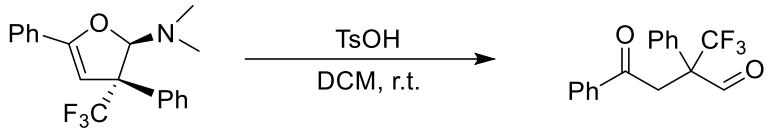
_N_-((_2R,3S_)-3,5-Diphenyl-3-(trifluoromethyl)-2,3-dihydrofuran-2-yl)-N-methylnitrous amide (5aa):



3aa **5aa**

A solution of **3aa** (0.2 mmol, 66.7 mg) and TEMPO (0.02 mmol, 3 mg) in MeCN (2 mL) was mixed fully, then *tert*-Butyl nitrite (0.3 mmol, 36 ul) was added dropwise under air atmosphere. The reaction solution was stirred under room temperature. After completion monitored by TLC (by UV visualization), the solvent was removed under reduced pressure. The products were separated by silica gel column chromatography to afford the product **5aa** as white solid in 75% yield (52.3 mg) (EA/PE = 10%, Rf = 0.3), Mp.127 – 128 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.71 (m, 2H), 7.64 (s, 1H), 7.48 – 7.44 (m, 3H), 7.37 – 7.32 (m, 5H), 5.99 (s, 1H), 2.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.1, 131.7, 130.6, 129.3, 129.1, 128.8, 128.7, 128.2, 126.3(q, J = 283.7 Hz), 126.0, 95.6 (d, J = 2.1 Hz), 92.6, 64.1 (q, J = 26.6 Hz), 27.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -73.40; Selected IR (KBr) ν (cm^{-1}): 2966, 1477, 1449, 1374, 1259, 1182, 1156, 1010, 749, 712; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{18}H_{16}F_3N_2O_2^+$: 349.1164. Found: 349.1166.

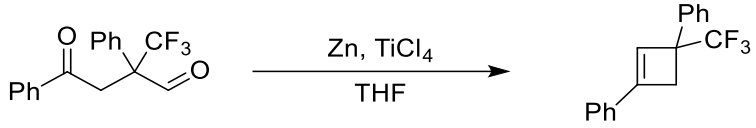
4-Oxo-2,4-diphenyl-2-(trifluoromethyl)butanal (6aa):



3aa **6aa**

A solution of **3aa** (0.2 mmol, 66.7 mg) and TsOH•H_2O (0.2 mmol, 38.0 mg) in DCM (2 mL) was mixed fully at room temperature. After completion monitored by TLC (by UV visualization), the solvent was removed under reduced pressure. The products were separated by silica gel column chromatography to afford the product **6aa** as white solid in 99% yield (60.6 mg) (EA/PE = 5%, Rf = 0.5), Mp.84 – 85 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.24 – 10.20 (m, 1H), 8.00 – 7.96 (m, 2H), 7.67 – 7.61 (m, 1H), 7.54 – 7.48 (m, 2H), 7.43 – 7.39 (m, 5H), 4.31 (d, J = 18.0 Hz, 1H), 4.20 (d, J = 18.1 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 196.0, 194.7, 135.4, 134.2, 131.7, 129.0, 129.0, 128.9, 128.3, 128.0, 124.8 (d, J = 284.4 Hz), 59.4 (q, J = 23.2 Hz), 41.3; ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.39; Selected IR (KBr) ν (cm^{-1}): 2965, 1734, 1685, 1597, 1449, 1356, 1244, 1171, 1001, 750, 701; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{14}F_3O_2^+$: 307.0946. Found: 307.0946.

(3-(Trifluoromethyl)cyclobut-1-ene-1,3-diyl)dibenzene (7aa):

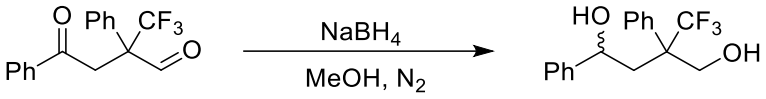


6aa **7aa**

In a flame-dried flask, dry THF (2 mL) was added to zinc dust (1.6 mmol, 104.6 mg). The flask was cooled in an ice bath, and titanium tetrachloride (1M) (0.8 mmol, 0.8 mL) was added dropwise. A yellow cloud formed and the solution became dark blue. After 15 min, a solution of **6aa** (0.2 mmol, 61.3 mg) in THF (1 mL) was added to the reaction mixture. The reaction mixture was then heated to reflux for 3 h. After cooling the reaction to ambient temperature, 5 mL water was added and gas evolution was seen. After the bubbling subsided, the mixture was extracted with ethyl acetate (3 x 20 mL). The organic layers were combined, dried over $MgSO_4$, filtered and the solvent was removed *in vacuo*. The resulting brown oil was purified by column chromatography to give **7aa** as yellow solid in 42% yield (23.1 mg) (EA/PE = 5%, Rf = 0.7), Mp.65 – 66 ºC. ^{1}H NMR (400 MHz, CDCl3) δ 7.51 – 7.45 (m, 2H), 7.44 – 7.31 (m, 8H), 6.67 (d, J = 1.0 Hz, 1H), 3.51 (d, J = 13.0 Hz, 1H), 3.08 (d, J = 13.0 Hz, 1H); ^{13}C NMR (100 MHz,

$CDCl_3$) δ 149.0, 137.2, 133.0, 129.1, 128.7, 128.6, 128.2, 127.7, 126.6 (q, J = 126.6 Hz), 125.1, 123.6 (q, J = 2.8 Hz), 52.0 (q, J = 28.9 Hz), 37.9 (q, J = 2.7 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.12; Selected IR (KBr) ν (cm^{-1}): 2931, 1448, 1295, 1148, 1007, 868, 749, 698; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{14}F_3^+$: 275.1048. Found: 275.1045.

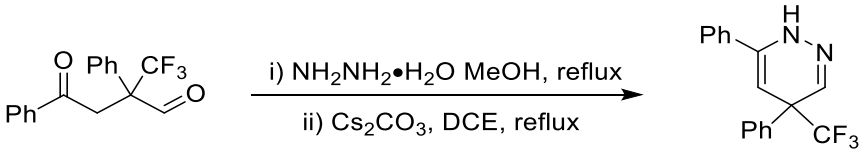
1,3-Diphenyl-3-(trifluoromethyl)butane-1,4-diol (8aa):



6aa **8aa**

To a solution of **6aa** (0.20 mmol, 61.3 mg) in MeOH (2 mL) was added $NaBH_4$ (0.4 mmol, 83.2 mg) at room temperature and the reaction mixture was stirred at the same temperature for 30 min under nitrogen atmosphere. The mixture was poured into H_2O (5 mL) and extracted with EtOAc (10 mL). The organic layer was washed with brine (10 mL) and dried with Na_2SO_4. After removal of the solvent, the residue was subjected to column chromatography to give **8aa** as colorless oil in 95% yield (58.9 mg) (EA/PE = 10%, Rf = 0.3). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.43 (m, 2H), 7.38 – 7.27 (m, 8H), 5.18 (d, J = 9.7 Hz, 1H), 4.46 – 4.31 (m, 2H), 3.88 (m, 1H), 3.03 (s, 1H), 2.59 – 2.51 (m, 1H), 2.40 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.7, 137.2, 131.8, 129.1, 129.0, 128.9, 128.6, 128.2, 128.0, 125.5, 125.4, 71.6, 60.5 (d, J = 3.1 Hz), 52.1 (q, J = 21.7 Hz), 42.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ –74.12; Selected IR (KBr) ν (cm^{-1}): 2968, 1492, 1449, 1275, 1261, 1144, 1058, 749, 699; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{18}F_3O_2^+$: 311.1259. Found: 311.1258.

4,6-Diphenyl-4-(trifluoromethyl)-1,4-dihydropyridazine (9aa):



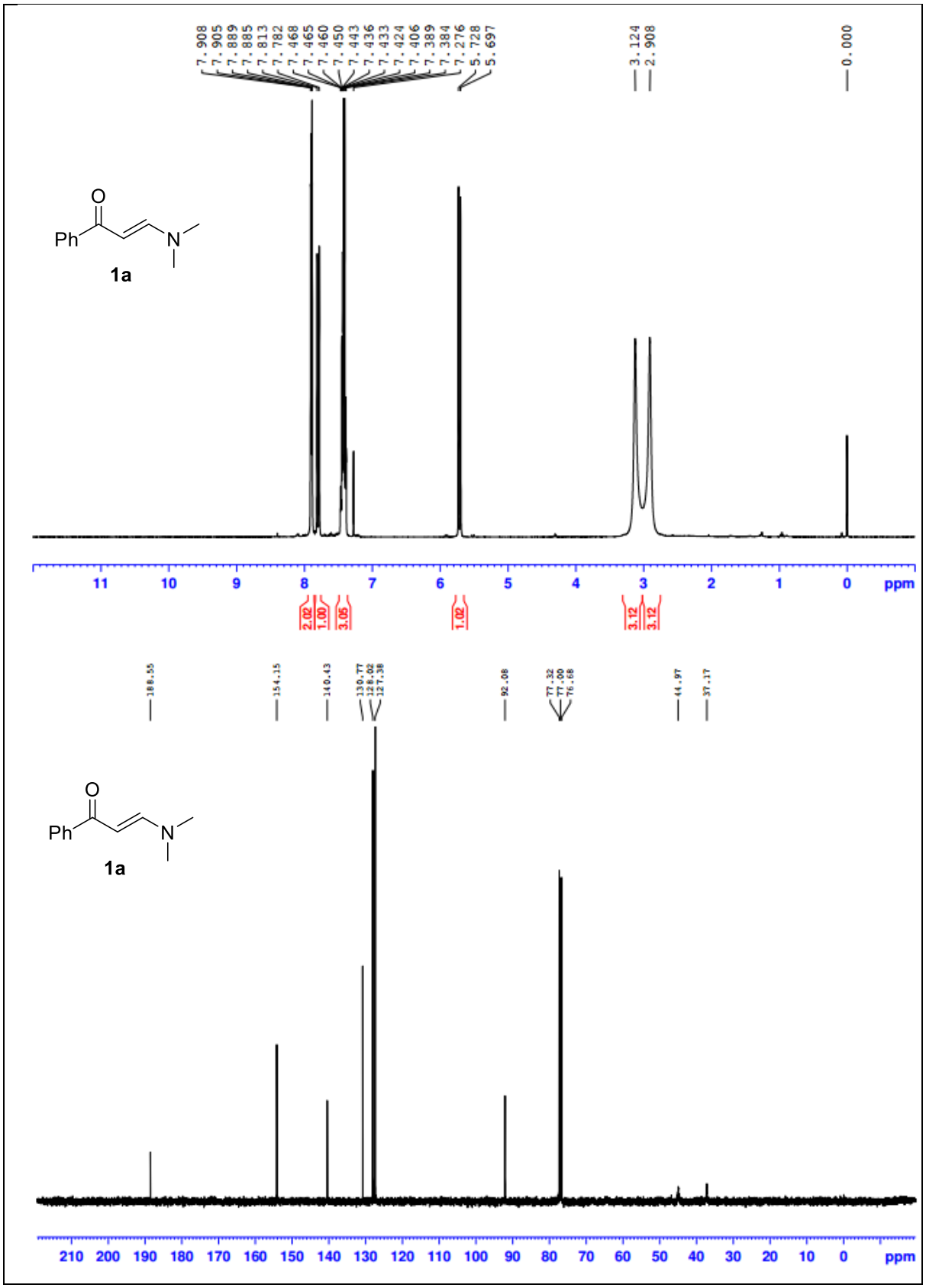
6aa **9aa**

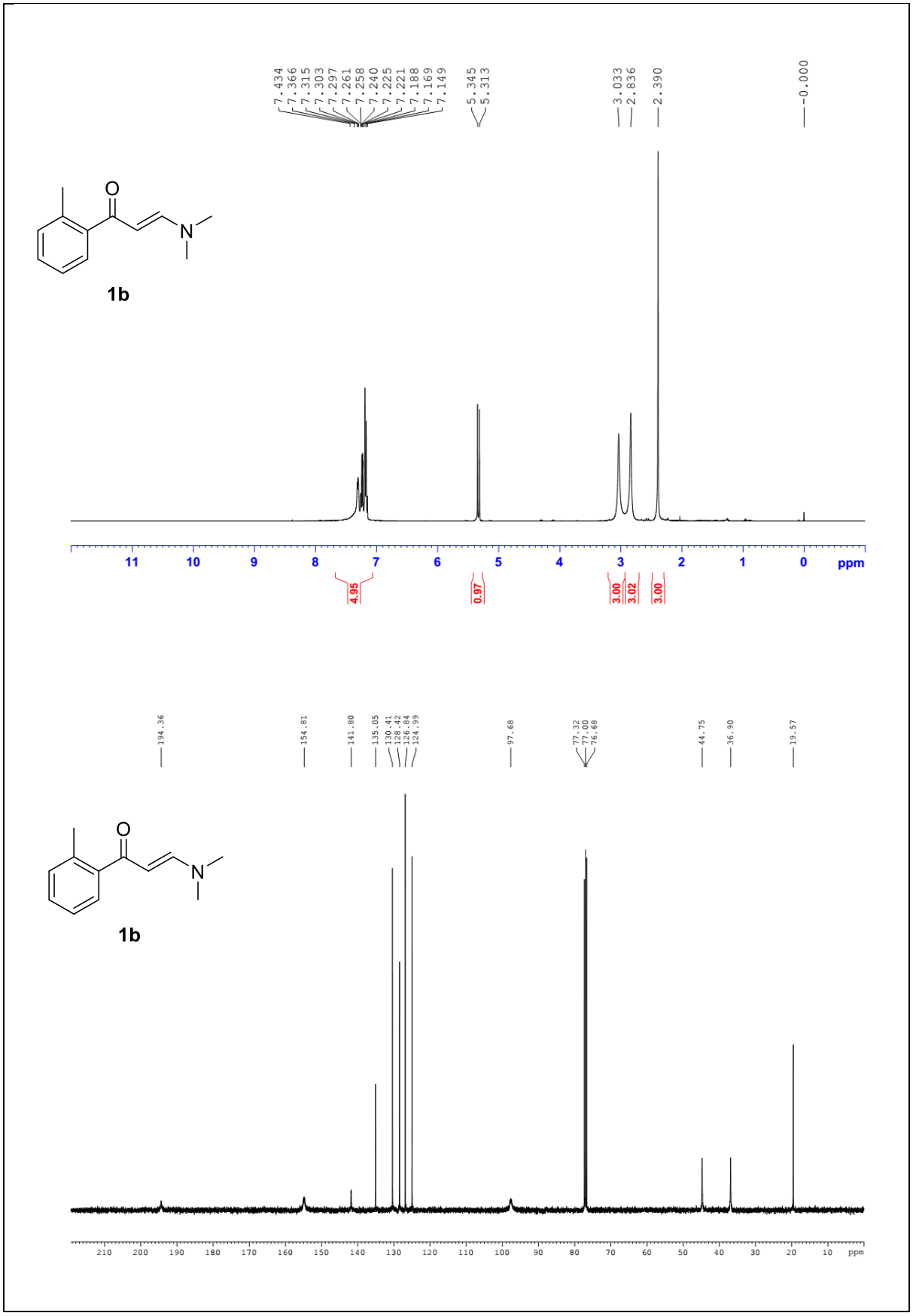
Step 1: To a flask was added **6aa** (0.2 mmol, 61.3 mg) and methanol (2 mL), the mixture was heated to 60 °C and stirred until 6aa was dissolved. Then N_2H_4 • H_2O (0.44 mmol, 22mg) was added. After approximately 2 h, the reaction was completed (TLC), solvent was removed under vacuum and the solid was used without further purification.

Step 2: Under argon atmosphere, the crude product of step 1, Cs_2CO_3 (0.6 mmol, 195.5 mg), and DCE (4 mL) were added to a 10 mL sealed tube. The resulting solution was stirred at reflux

for 12 h. The mixture was then cooled to room temperature and solvent was removed under vacuum. The crude residue was purified by column chromatography to afford product **9aa** as white solid in (two steps yield: 94%, EA/PE = 10%, Rf = 0.3). Mp.81 - 82 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (s, 1H), 7.54 – 7.47 (m, 4H), 7.46 – 7.38 (m, 5H), 7.35 – 7.30 (m, 1H), 6.90 – 6.89 (m, 1H), 5.13 (t, *J* = 2.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.1, 139.6, 134.1, 130.2, 129.7, 129.1, 128.8, 128.1, 127.5, 125.8, 125.5 (q, *J* = 283.5 Hz), 90.3 (d, *J* = 2.6 Hz), 48.2 (q, *J* = 27.4 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ –72.03; Selected IR (KBr) ν (cm^{-1}): 2966, 1691, 1460, 1275, 1260, 1153, 750, 695; HRMS (ESI) m/z $[M+H]^+$: Calcd for $C_{17}H_{14}F_3N_2^+$: 303.1104. Found: 303.1103.

NMR Spectra for enaminones

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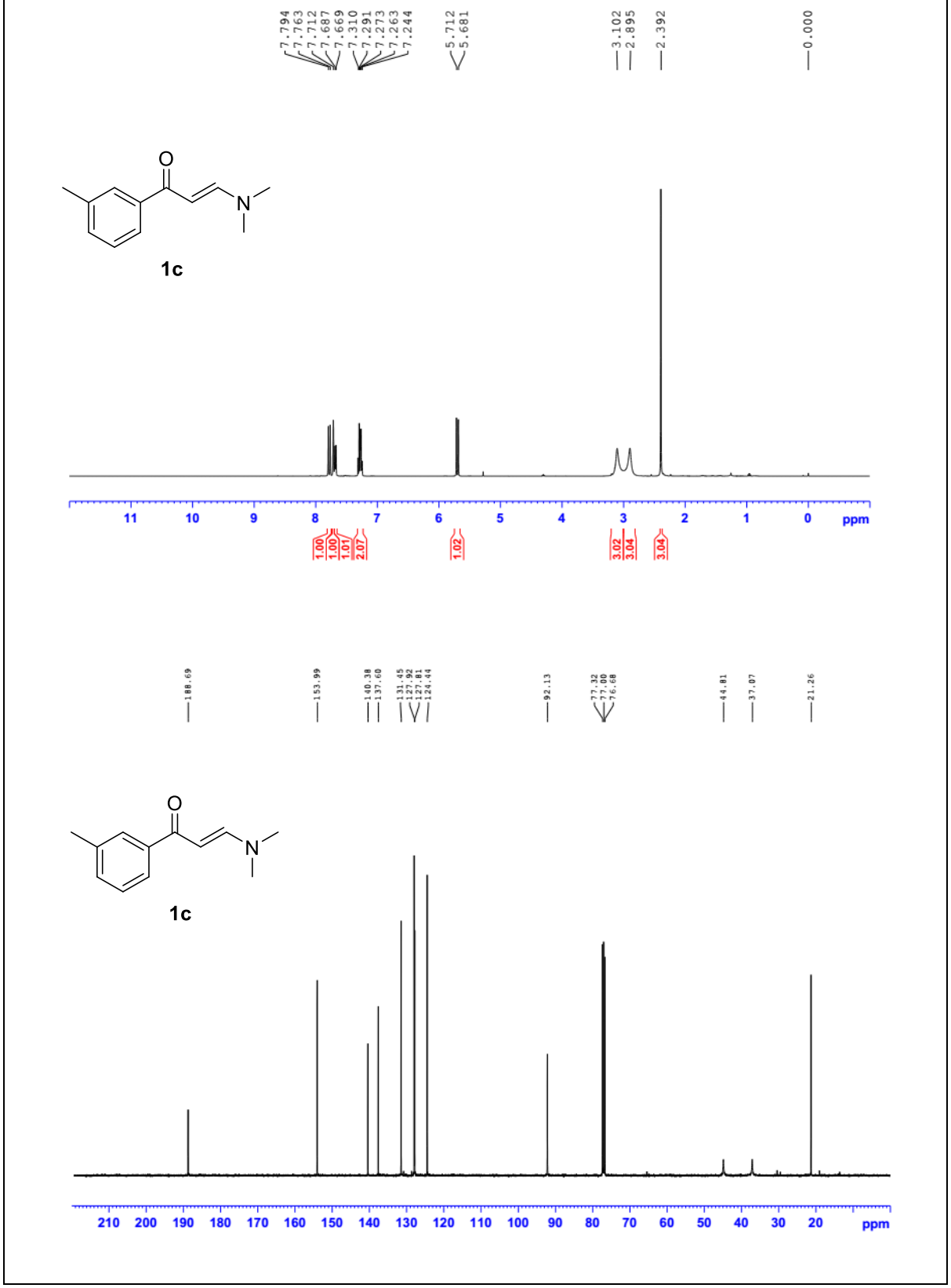
7.297
7.261
7.258
7.240
7.225
7.221
7.188
7.169
7.149
5.345
5.313
3.033
2.836
2.390
-0.000
O
N
1b
11
10
9
8
7
6
5
4
3
2
1
0
ppm
4.95
0.97
3.00
3.02
3.00
194.36
154.81
141.80
135.05
130.41
128.42
126.84
124.99
97.68
77.32
77.00
76.68
44.75
36.90
19.57
O
N
1b
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm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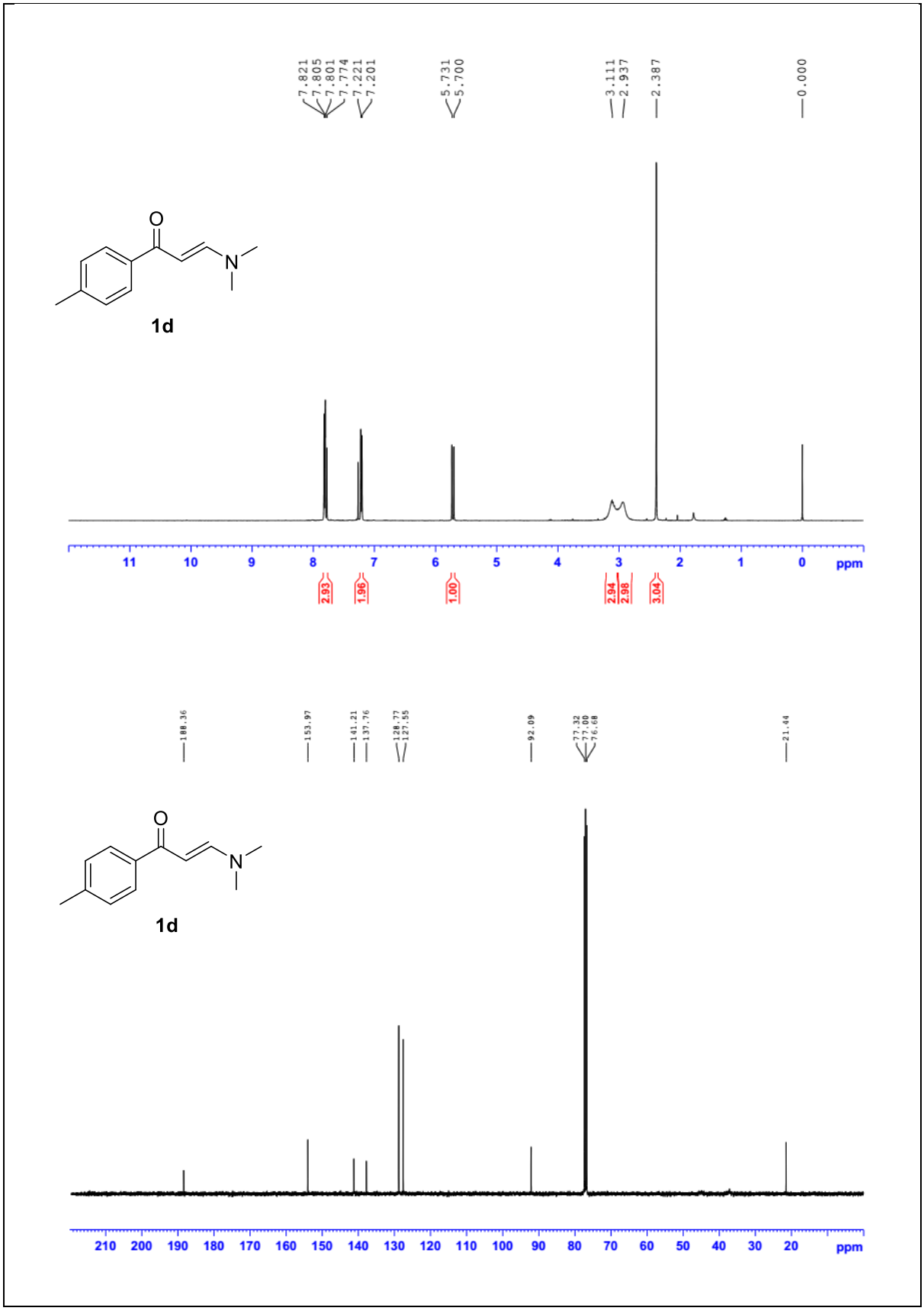
7.763
7.712
7.687
7.669
7.310
7.291
7.273
7.263
7.244
5.712
5.681
3.102
2.895
2.392
0.000
O
N
1c
11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.00 1.00 1.01 2.07 1.02 3.02 3.04 3.04
188.69
153.99
140.38
137.60
131.45
127.92
127.81
124.44
92.13
77.32
77.00
76.68
44.81
37.07
21.26
O
N
1c
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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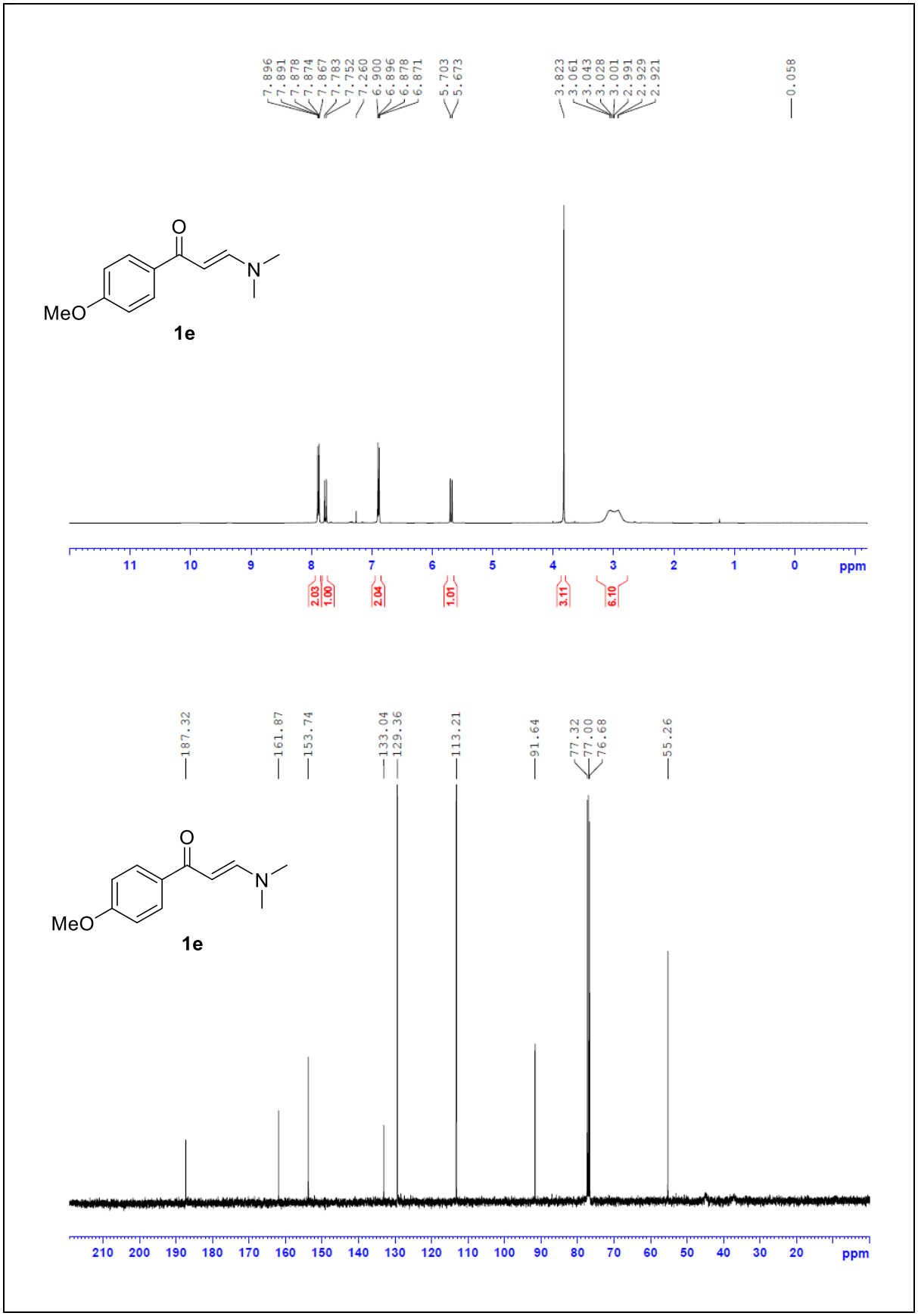
7.805
7.801
7.774
7.221
7.201
5.731
5.700
3.111
2.937
2.387
0.000
O
N
1d
11 10 9 8 7 6 5 4 3 2 1 0 ppm
2.93
1.96
1.00
2.94
2.98
3.04
188.36
153.97
141.21
137.76
128.77
127.55
92.09
77.32
77.00
76.68
21.44
O
N
1d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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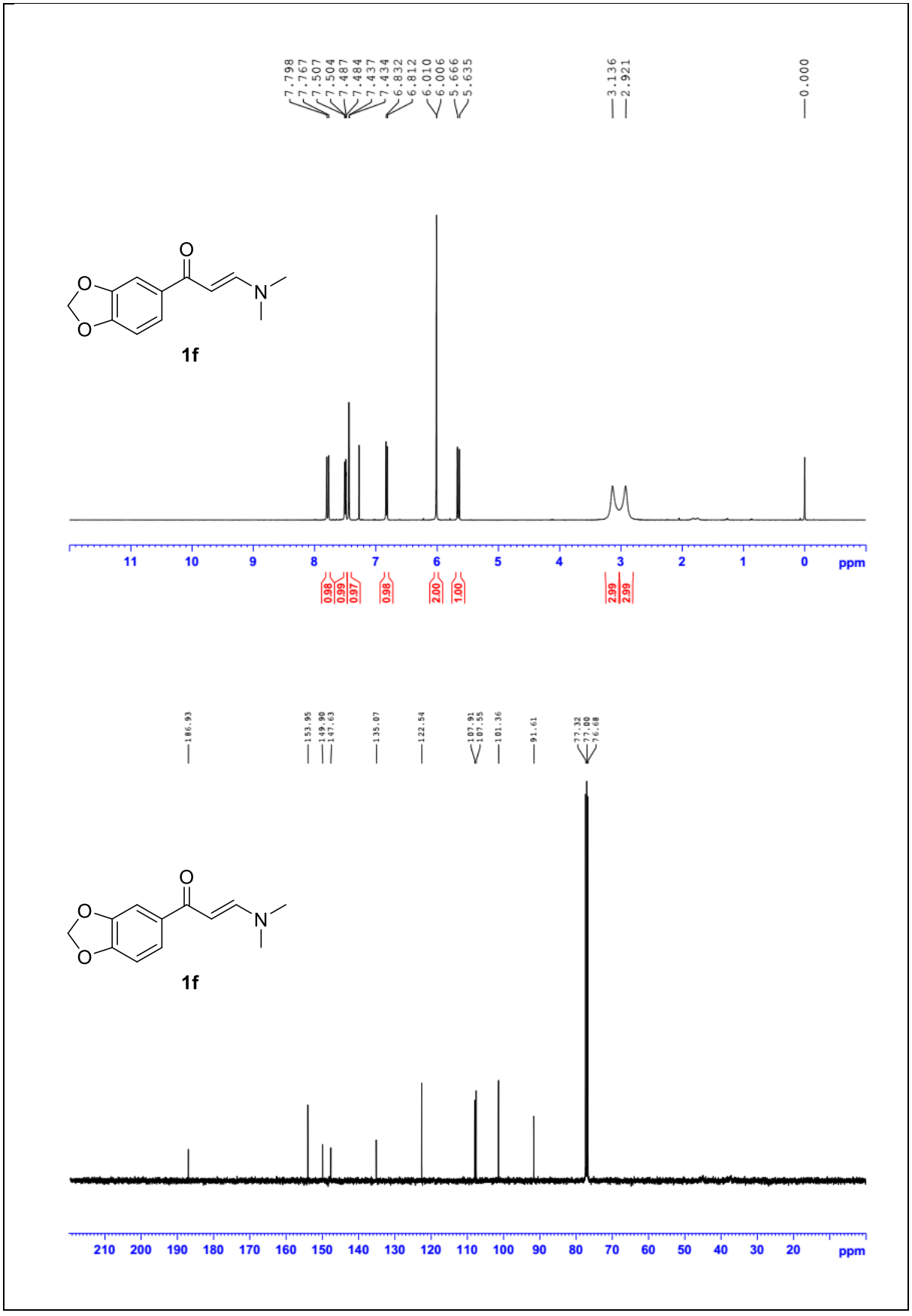
7.891
7.878
7.874
7.867
7.783
7.752
7.260
6.900
6.896
6.878
6.871
5.703
5.673
3.823
3.061
3.043
3.028
3.001
2.991
2.929
2.921
0.058
O
N
MeO
1e
11 10 9 8 7 6 5 4 3 2 1 0 ppm
2.03
1.00
2.04
1.01
3.11
6.10
187.32
161.87
153.74
133.04
129.36
113.21
91.64
77.32
77.00
76.68
55.26
O
N
MeO
1e
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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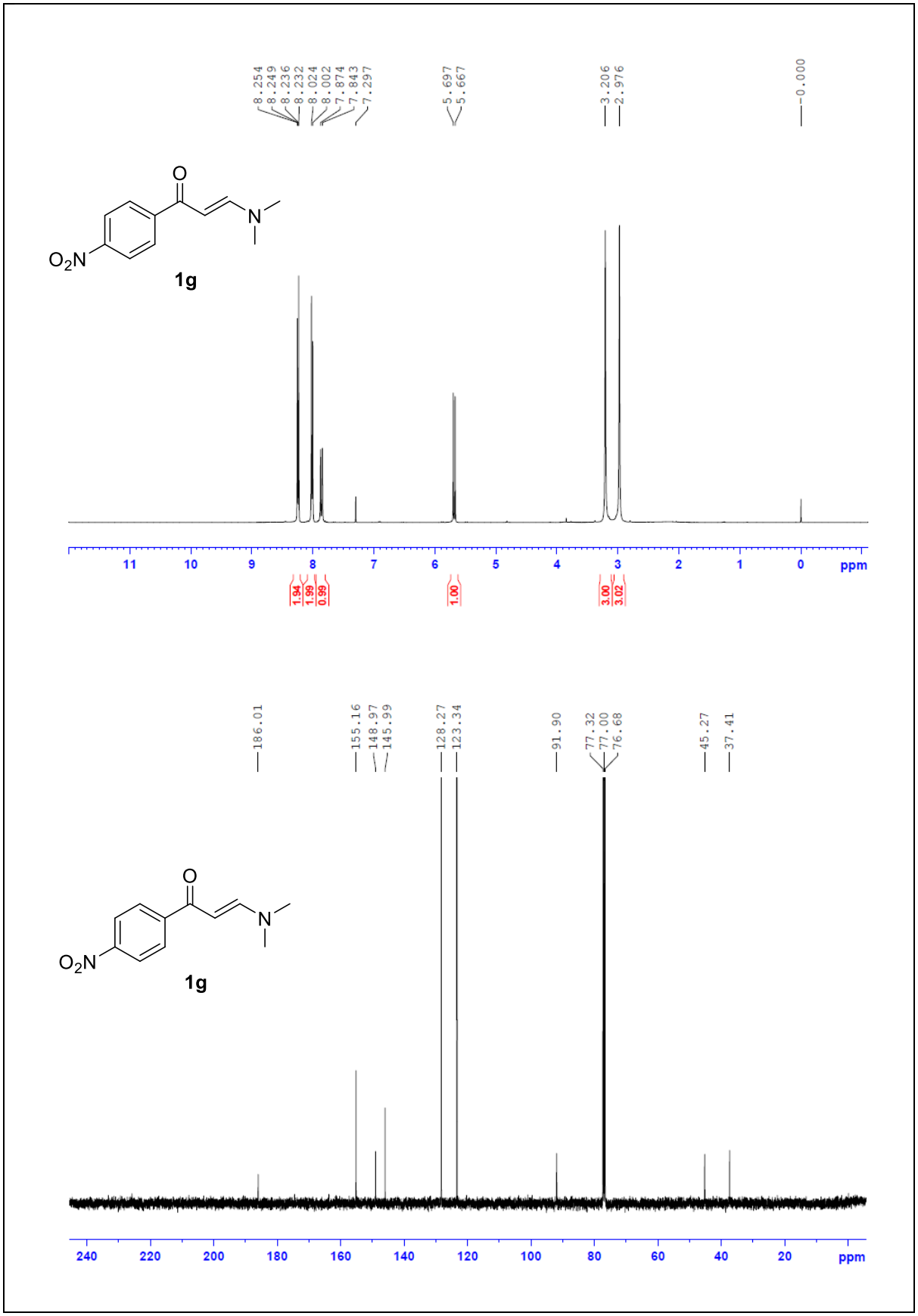
7.487
7.484
7.437
7.434
6.832
6.812
6.010
6.006
5.666
5.635
3.136
2.921
0.000
O
O
O
N
1f
11 10 9 8 7 6 5 4 3 2 1 0 ppm
0.98 0.99 0.97 0.98 2.00 1.00 2.99 2.99
186.93
153.95
149.90
147.63
135.07
122.54
107.91
107.55
101.36
91.61
77.32
77.00
76.68
O
O
O
N
1f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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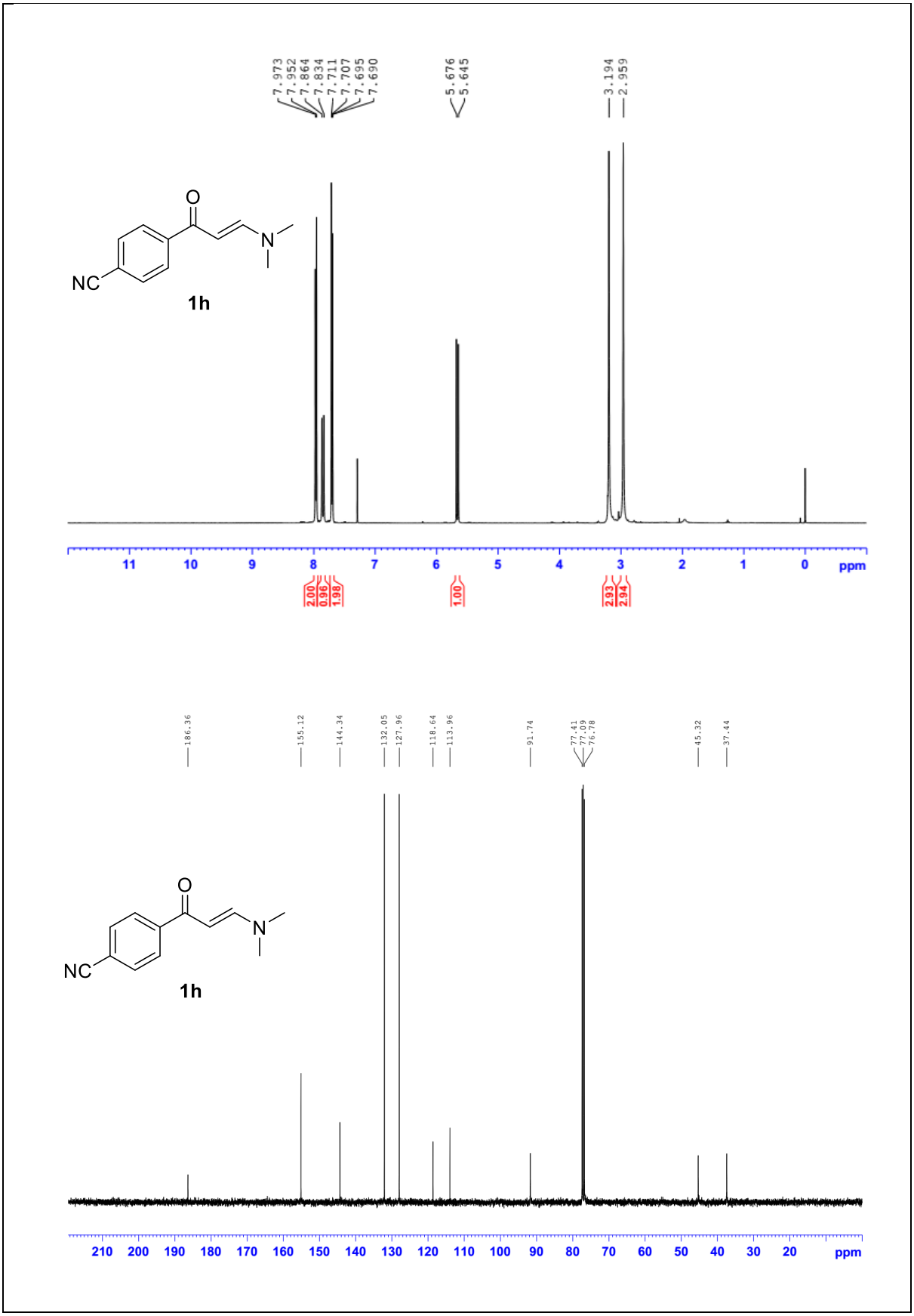
8.249
8.236
8.232
8.024
8.002
7.874
7.843
7.297
5.697
5.667
3.206
2.976
0.000
O
N
O2N
1g
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.94
1.99
0.99
1.00
3.00
3.02
186.01
155.16
148.97
145.99
128.27
123.34
91.90
77.32
77.00
76.68
45.27
37.41
O
N
O2N
1g
240
220
200
180
160
140
120
100
80
60
40
20
ppm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7.864
7.834
7.711
7.707
7.695
7.690
5.676
5.645
3.194
2.959
O
N
NC
1h
11 10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
0.96
1.98
1.00
2.93
2.94
186.36
155.12
144.34
132.05
127.96
118.64
113.96
91.74
77.41
77.09
76.78
45.32
37.44
O
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NC
1h
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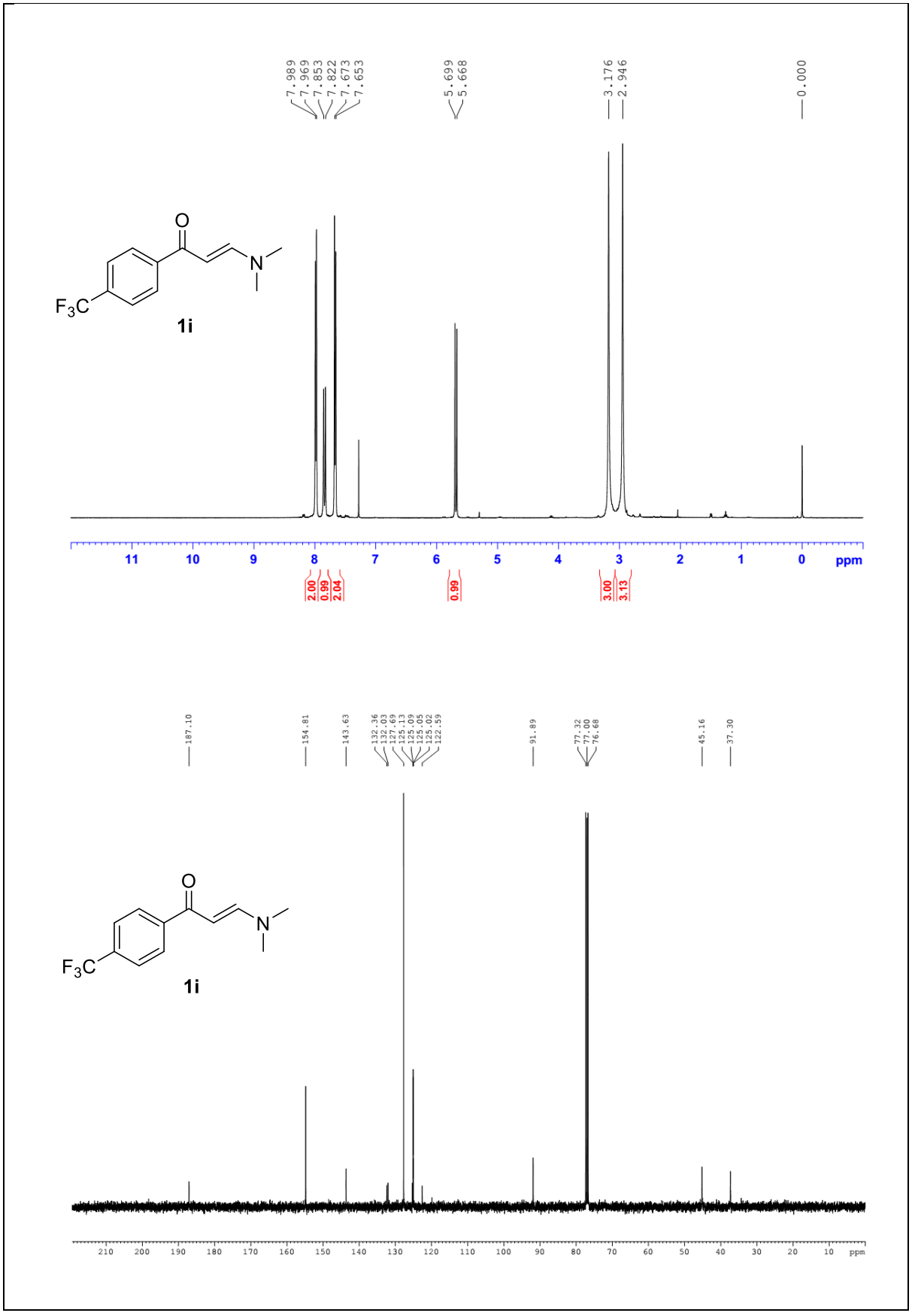
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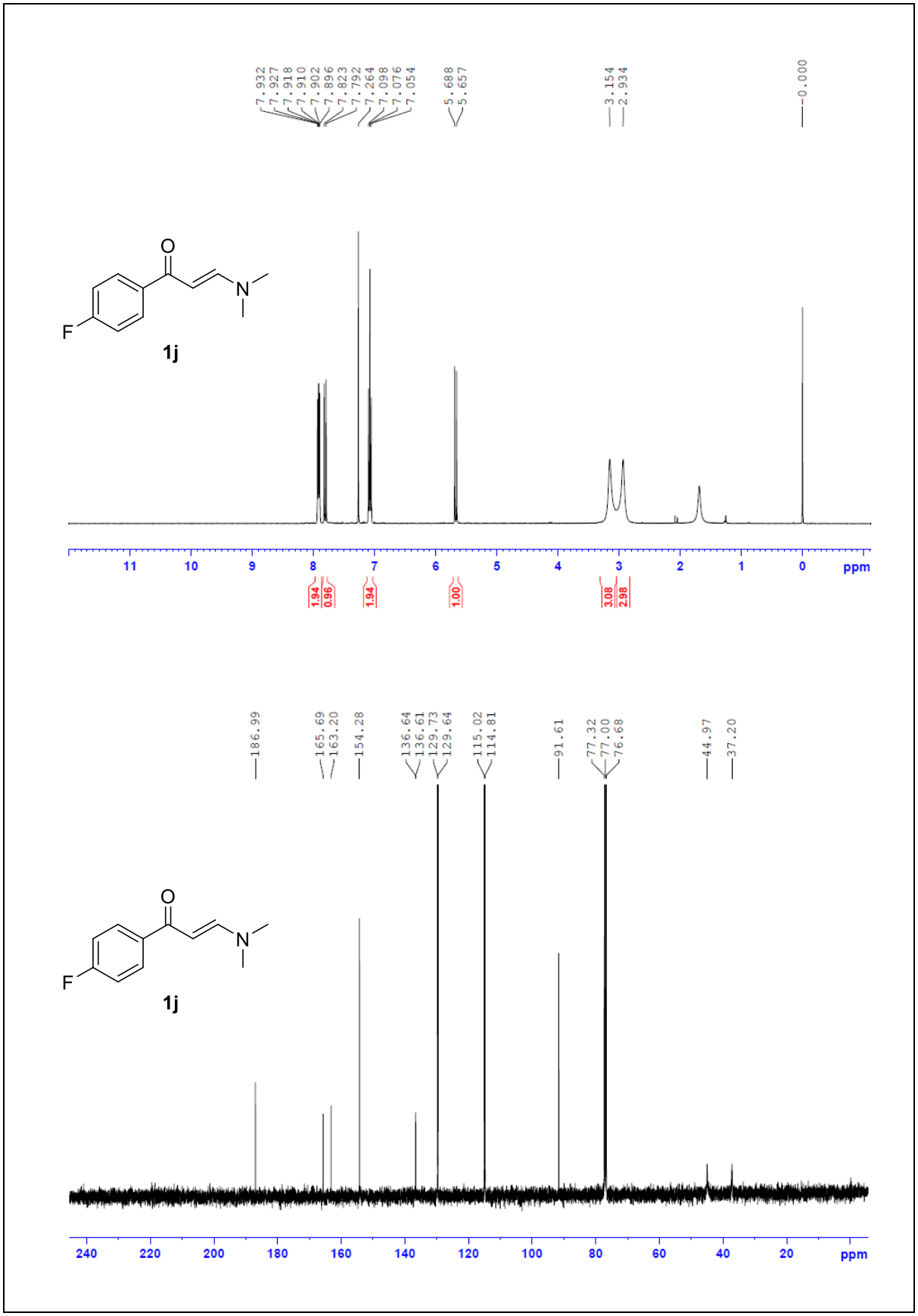
7.673
7.653
5.699
5.668
3.176
2.946
0.000
O
N
F3C
1i
11 10 9 8 7 6 5 4 3 2 1 0 ppm
2.00
0.99
2.04
0.99
3.00
3.13
187.10
154.81
143.63
132.36
132.03
127.69
125.13
125.09
125.05
125.02
122.59
91.89
77.32
77.00
76.68
45.16
37.30
O
N
F3C
1i
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm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7.918
7.910
7.902
7.896
7.823
7.792
7.264
7.098
7.076
7.054
5.688
5.657
3.154
2.934
0.000
O
N
F
1j
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.94
0.96
1.94
1.00
3.08
2.98
186.99
165.69
163.20
154.28
136.64
136.61
129.73
129.64
115.02
114.81
91.61
77.32
77.00
76.68
44.97
37.20
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N
F
1j
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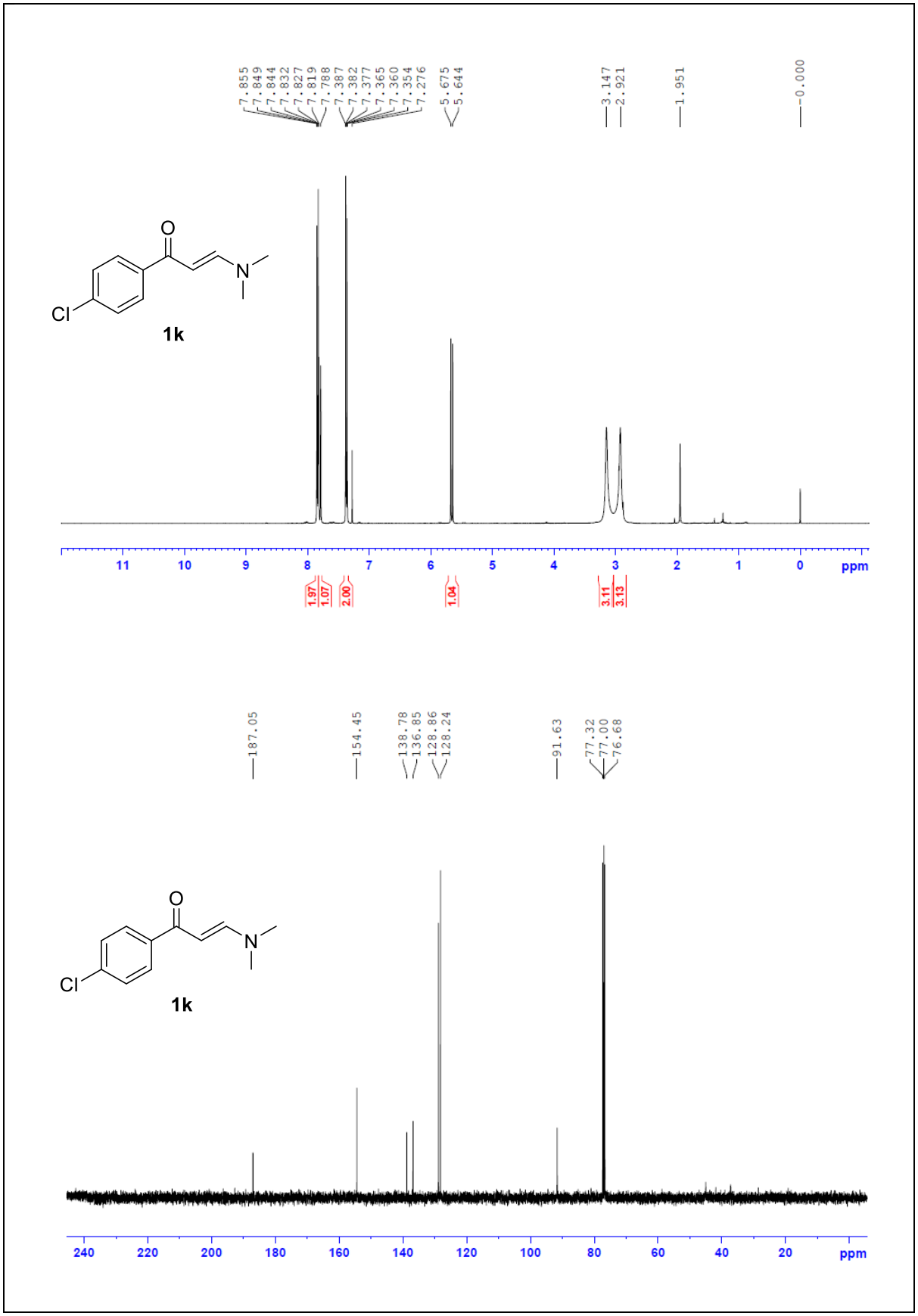
220
200
180
160
140
120
100
80
60
40
20
ppm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7.360
7.354
7.276
5.675
5.644
3.147
2.921
1.951
0.000
O
N
Cl
1k
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.97
1.07
2.00
1.04
3.11
3.13
187.05
154.45
138.78
136.85
128.86
128.24
91.63
77.32
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76.68
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N
Cl
1k
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200
180
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140
120
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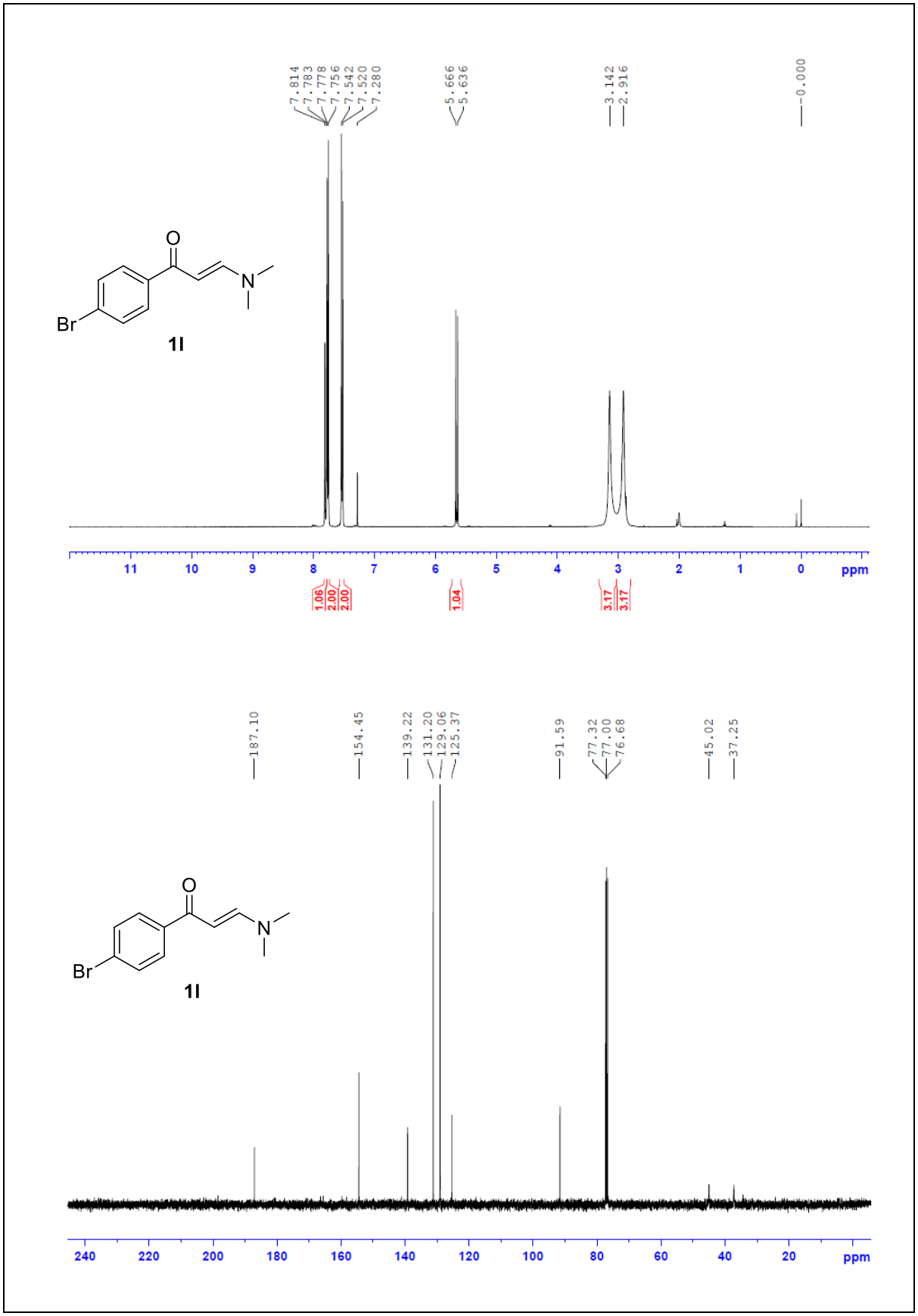
80
60
40
20
ppm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N
Br
1l
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.06
2.00
2.00
1.04
3.17
3.17
187.10
154.45
139.22
131.20
129.06
125.37
91.59
77.32
77.00
76.68
45.02
37.25
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N
Br
1l
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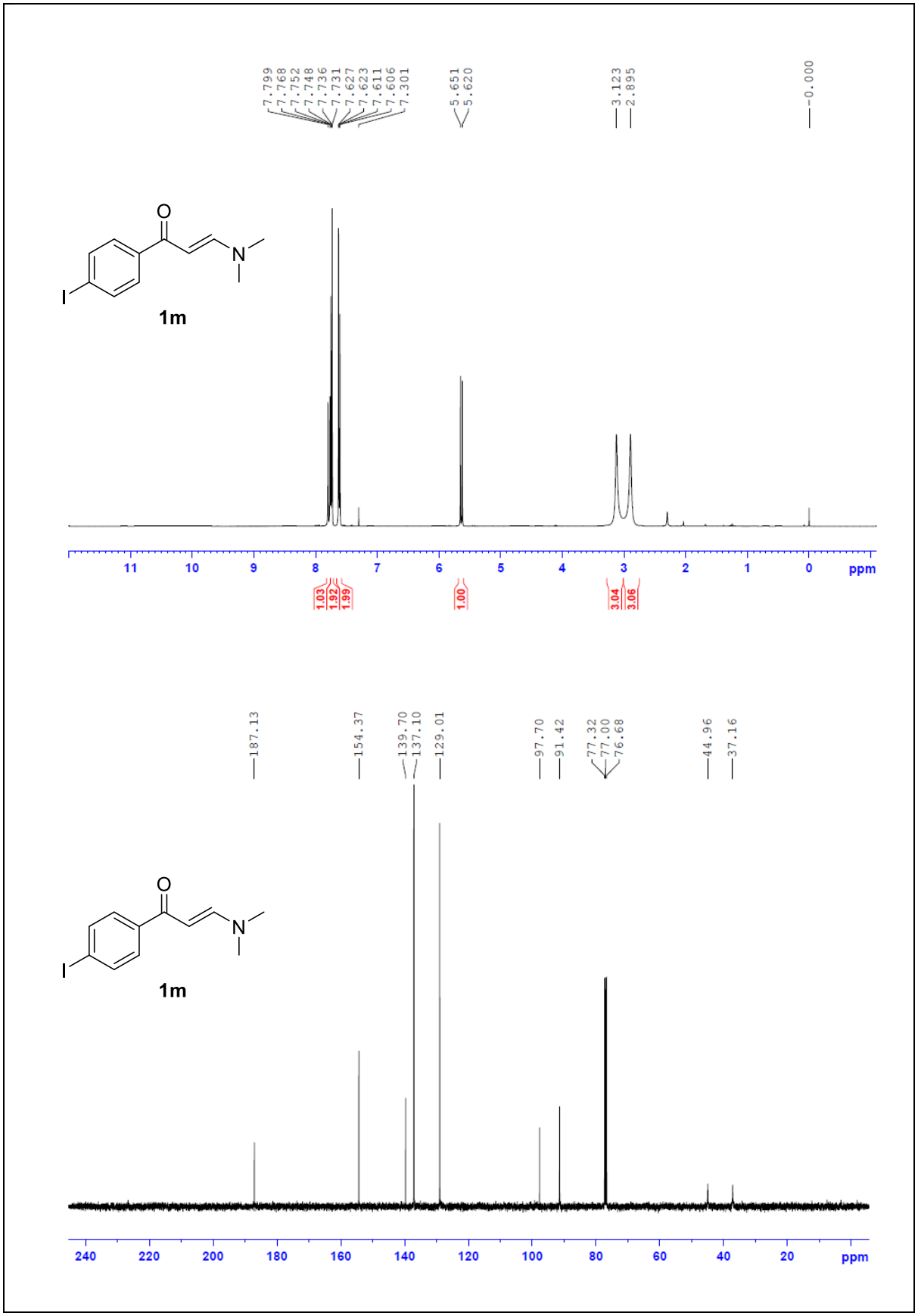
220
200
180
160
140
120
100
80
60
40
20
ppm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7.611
7.606
7.301
5.651
5.620
3.123
2.895
0.000
O
N
I
1m
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.03
1.92
1.99
1.00
3.04
3.06
187.13
154.37
139.70
137.10
129.01
97.70
91.42
77.32
77.00
76.68
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37.16
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I
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200
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140
120
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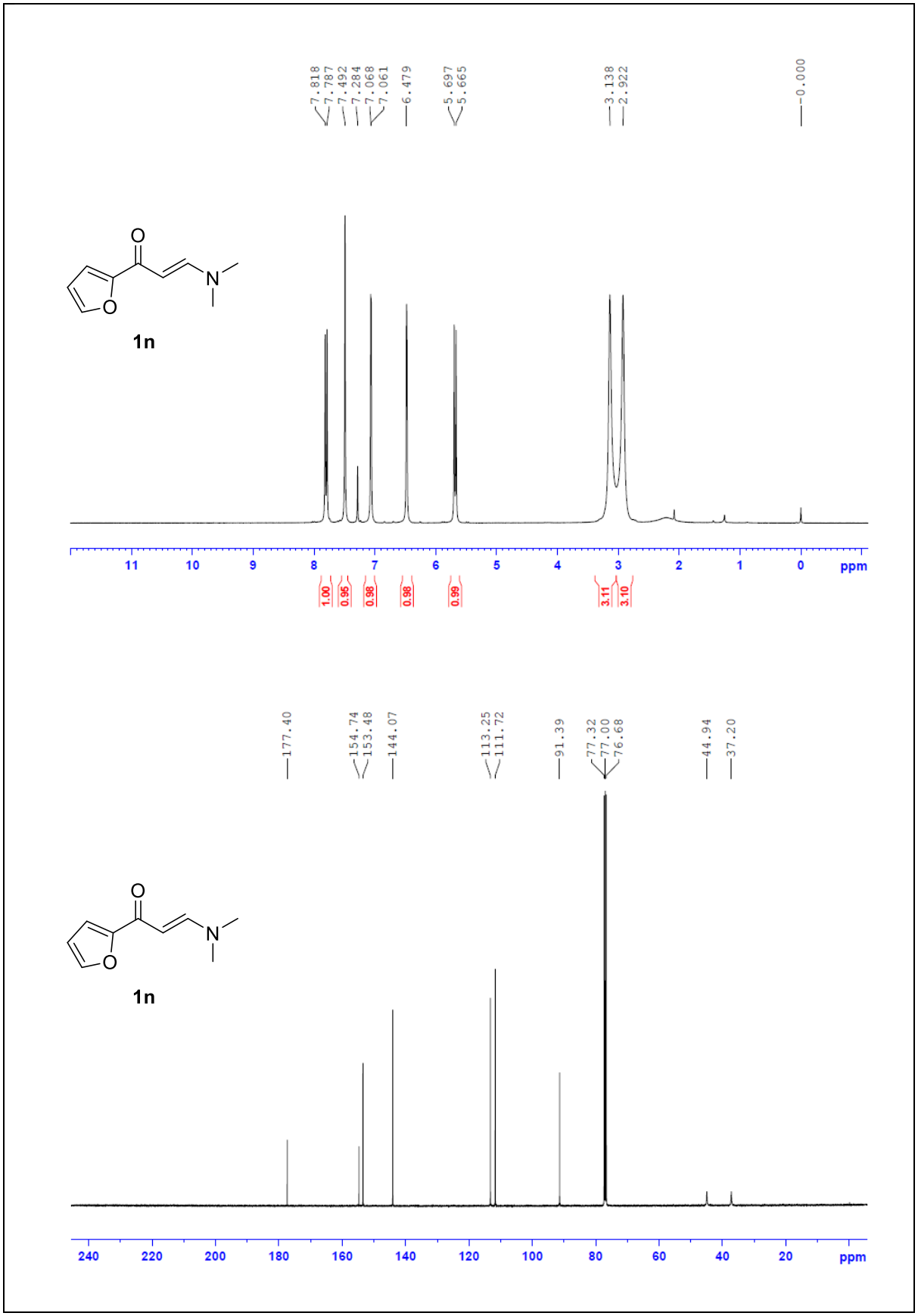
80
60
40
20
ppm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O
N
O
1n
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
0.95
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0.98
0.99
3.11
3.10
177.40
154.74
153.48
144.07
113.25
111.72
91.39
77.32
77.00
76.68
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140
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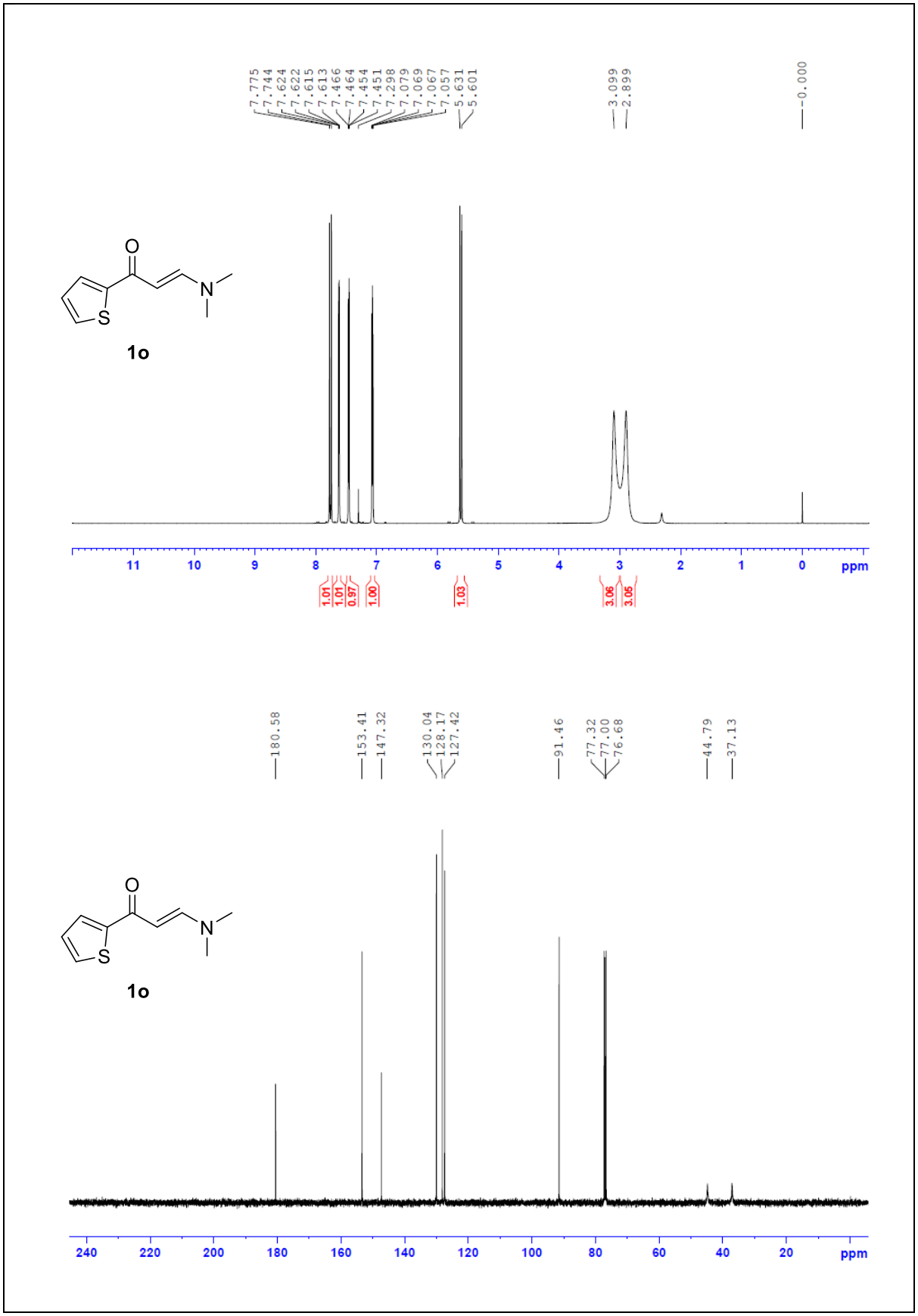
80
60
40
20
ppm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7.613
7.466
7.464
7.454
7.451
7.298
7.079
7.069
7.067
7.057
5.631
5.601
3.099
2.899
0.000
O
N
S
1o
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.01
1.01
0.97
1.00
1.03
3.06
3.05
180.58
153.41
147.32
130.04
128.17
127.42
91.46
77.32
77.00
76.68
44.79
37.13
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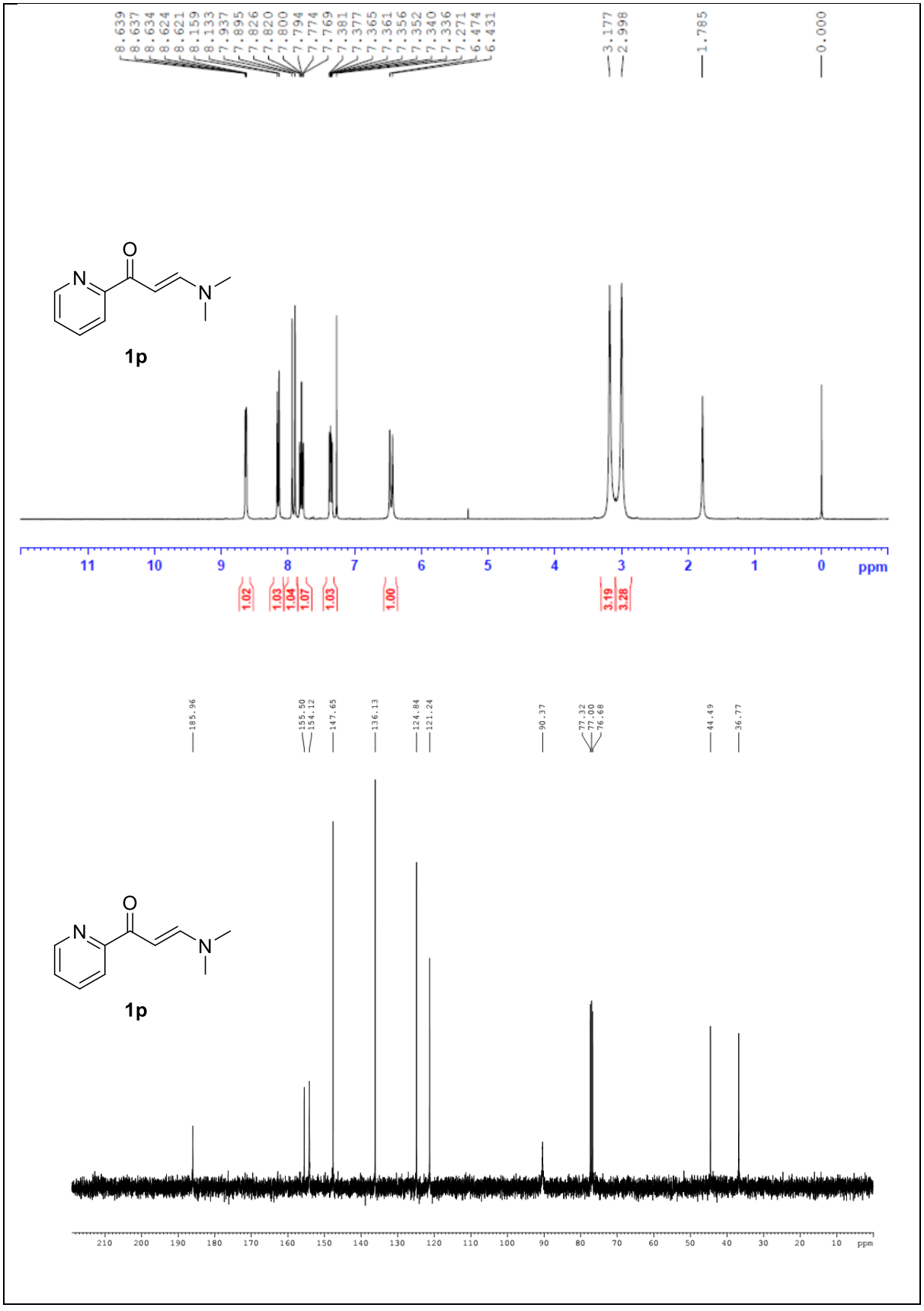
220
200
180
160
140
120
100
80
60
40
20
ppm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8.624
8.621
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7.794
7.774
7.769
7.381
7.377
7.365
7.361
7.356
7.352
7.340
7.336
7.271
6.474
6.431
3.177
2.998
1.785
0.000
O
N
N
1p
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.02
1.03
1.04
1.07
1.03
1.00
3.19
3.28
185.96
155.50
154.12
147.65
136.13
124.84
121.24
90.37
77.32
77.00
76.68
44.49
36.77
O
N
N
1p
210
200
190
180
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140
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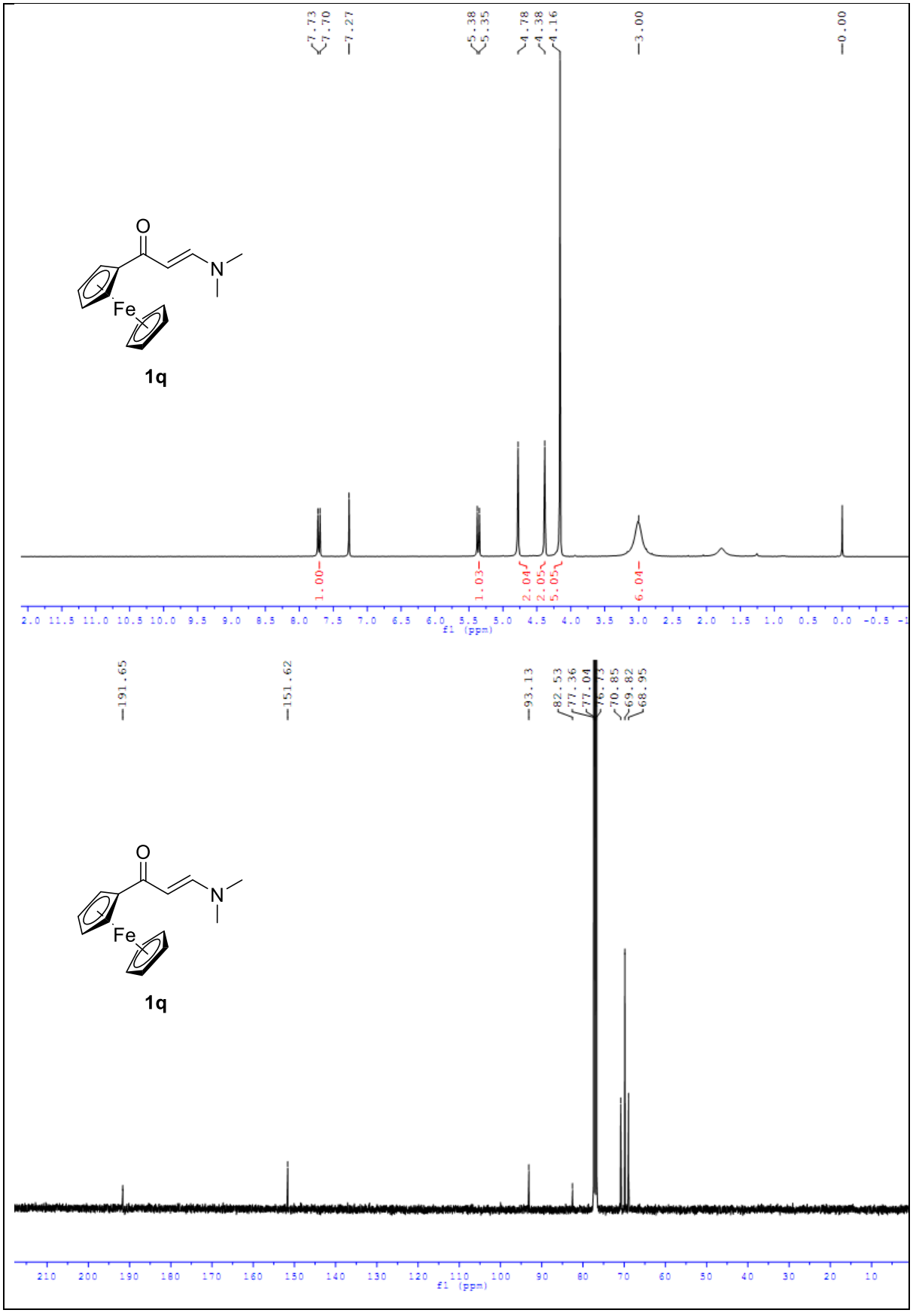
90
80
70
60
50
40
30
20
10
ppm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7.70
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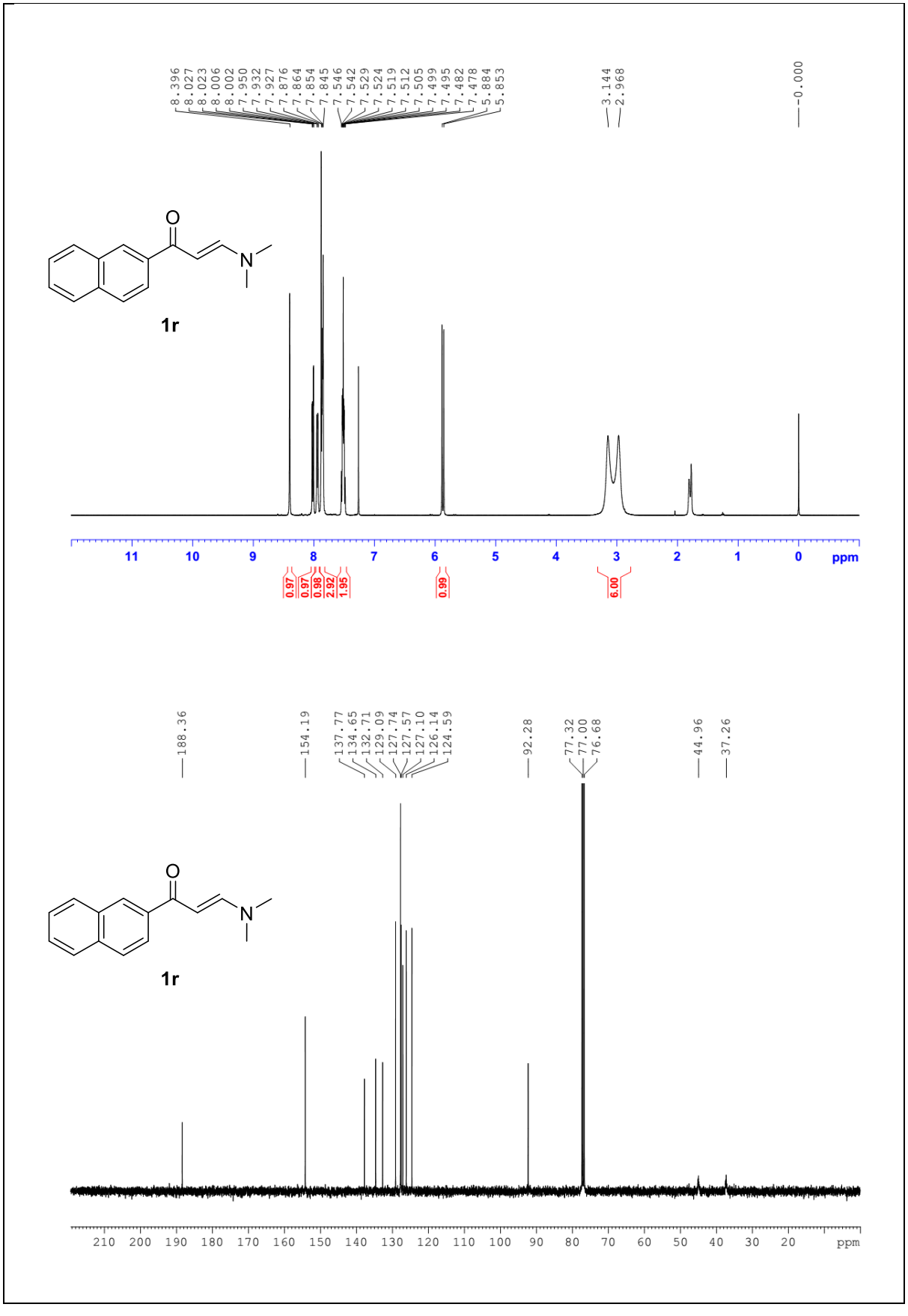
5.38
5.35
4.78
4.38
4.16
3.00
0.00
O
N
Fe
1q
1.00
1.03
2.04
2.05
5.05
6.04
f1 (ppm)
191.65
151.62
93.13
82.53
77.36
77.04
76.73
70.85
69.82
68.95
O
N
Fe
1q
f1 (ppm)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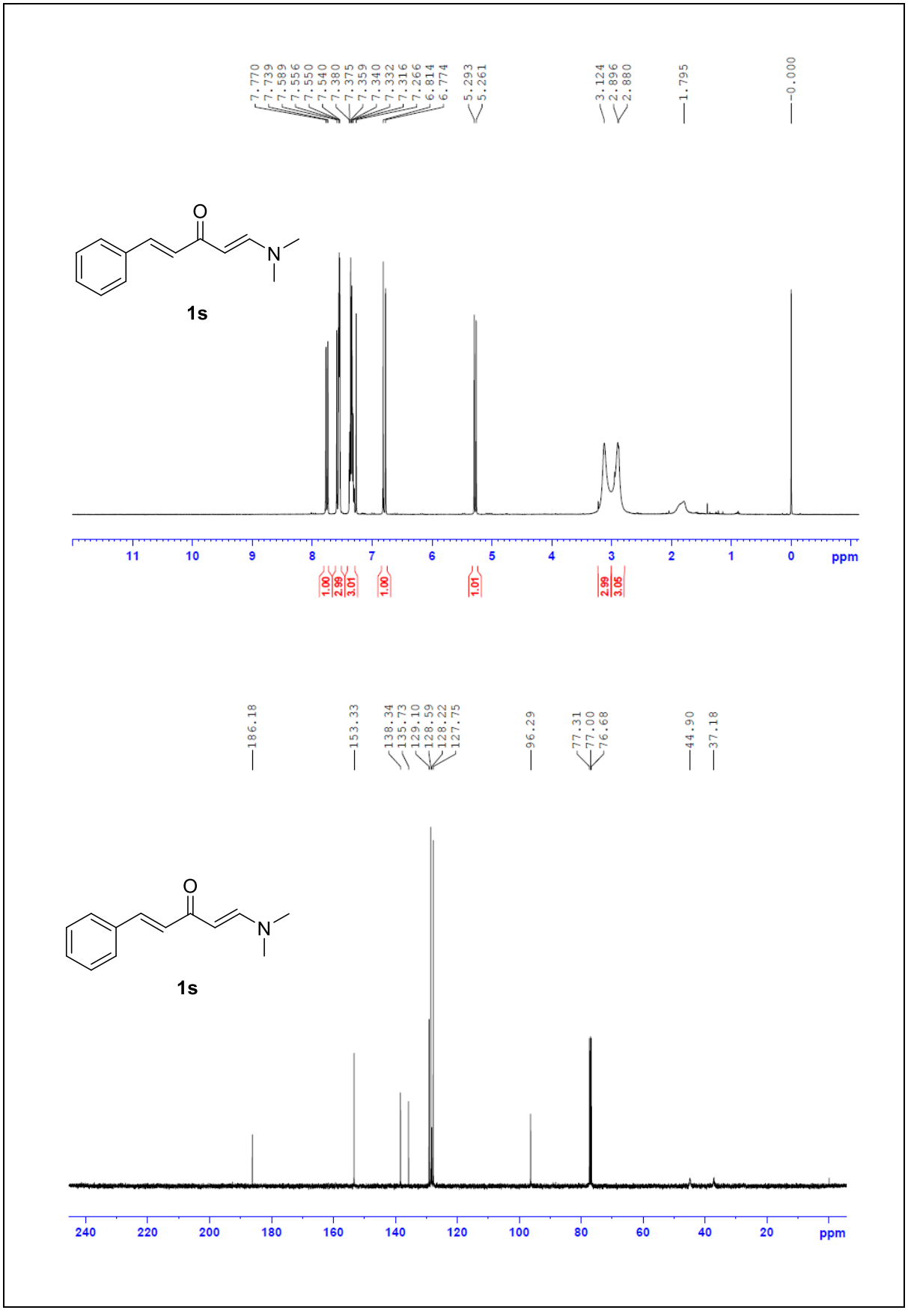
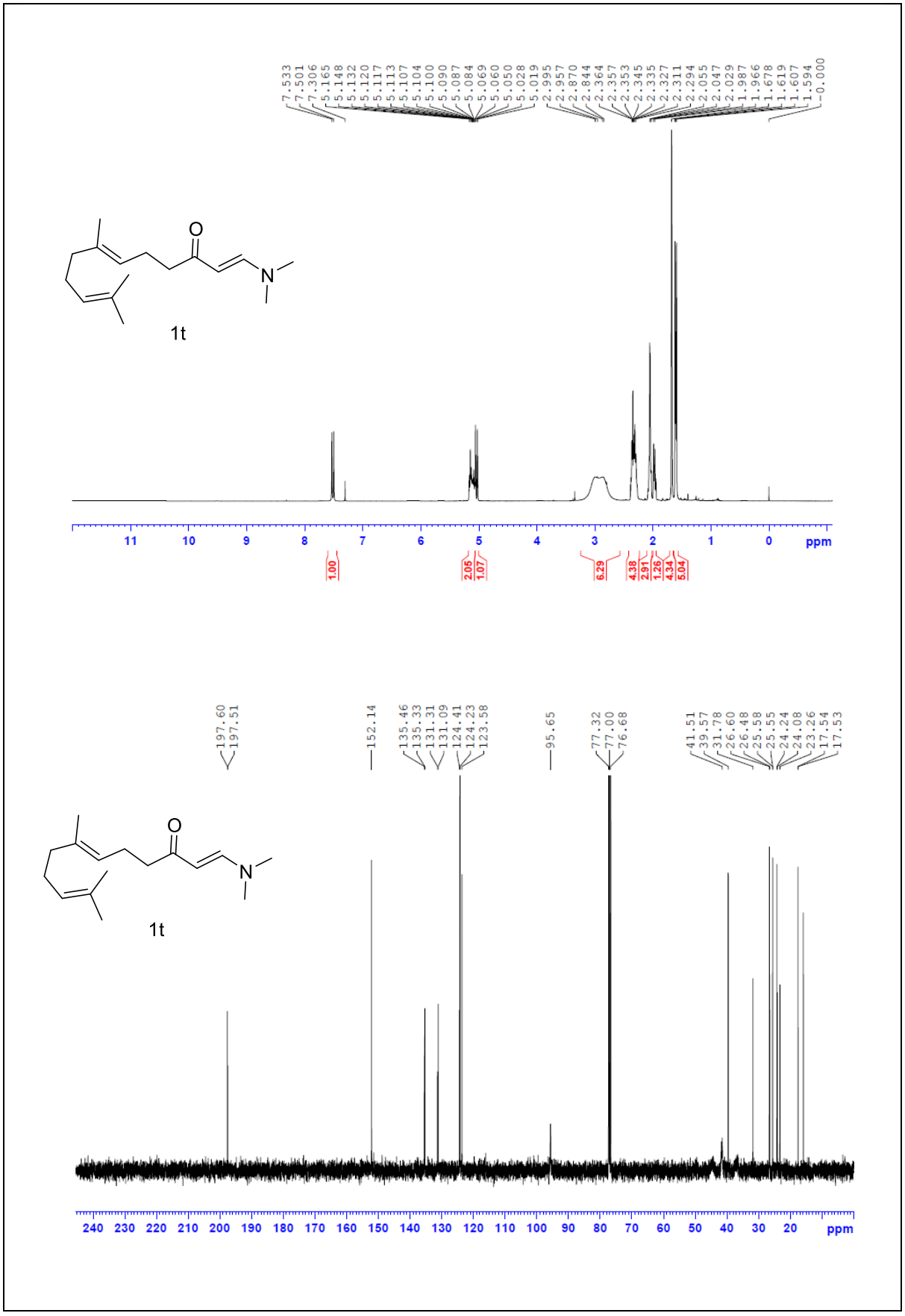
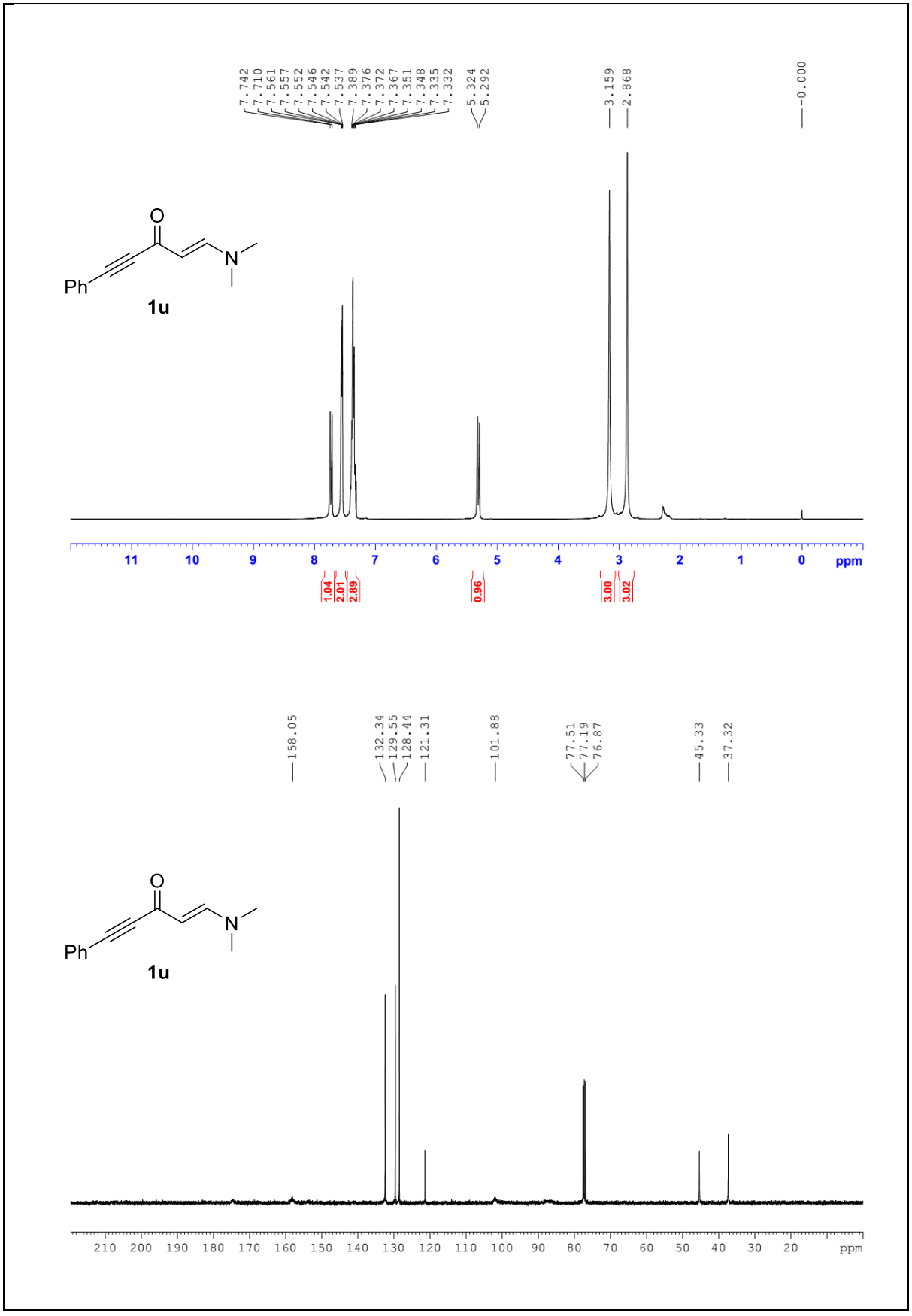
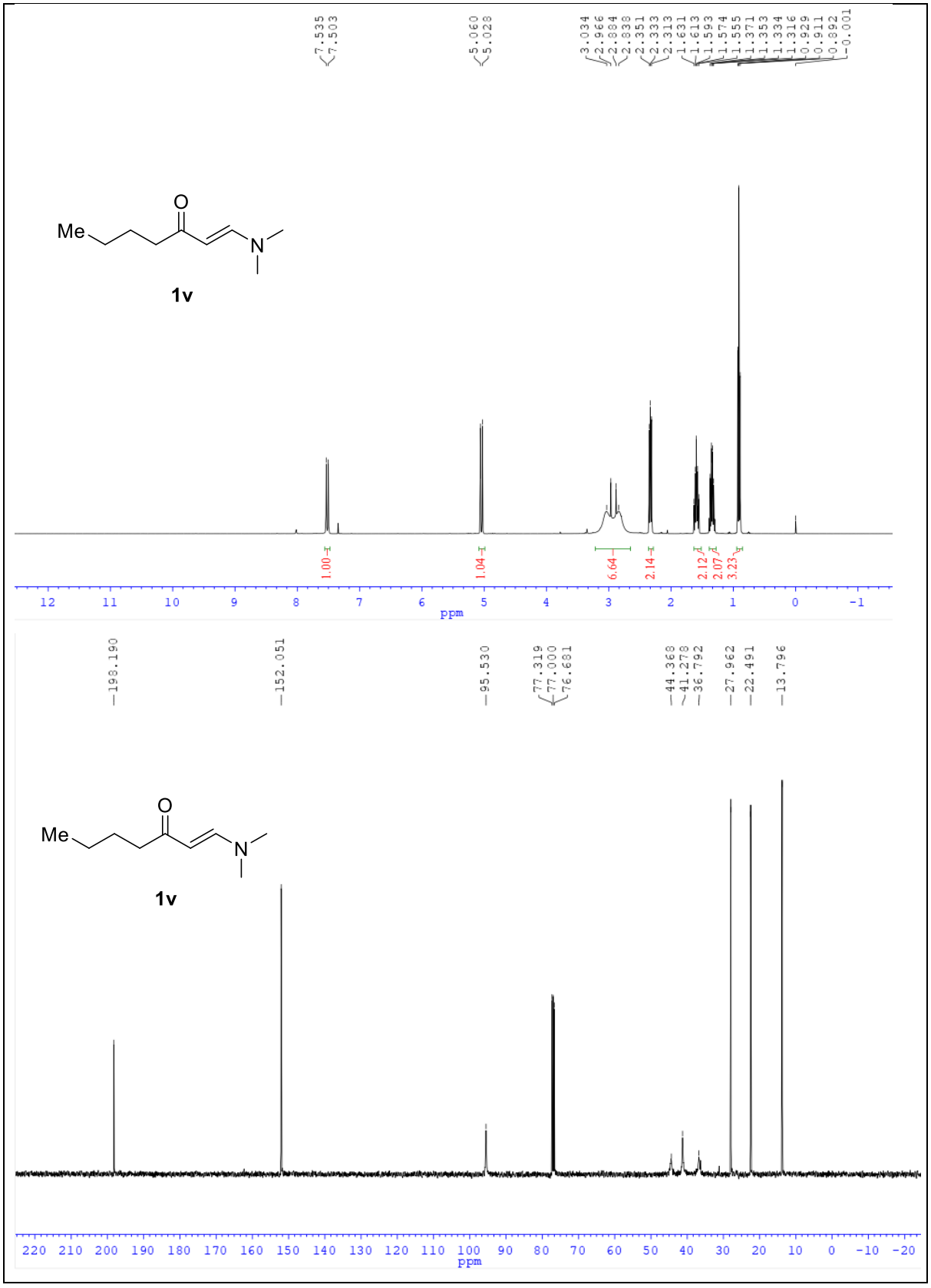
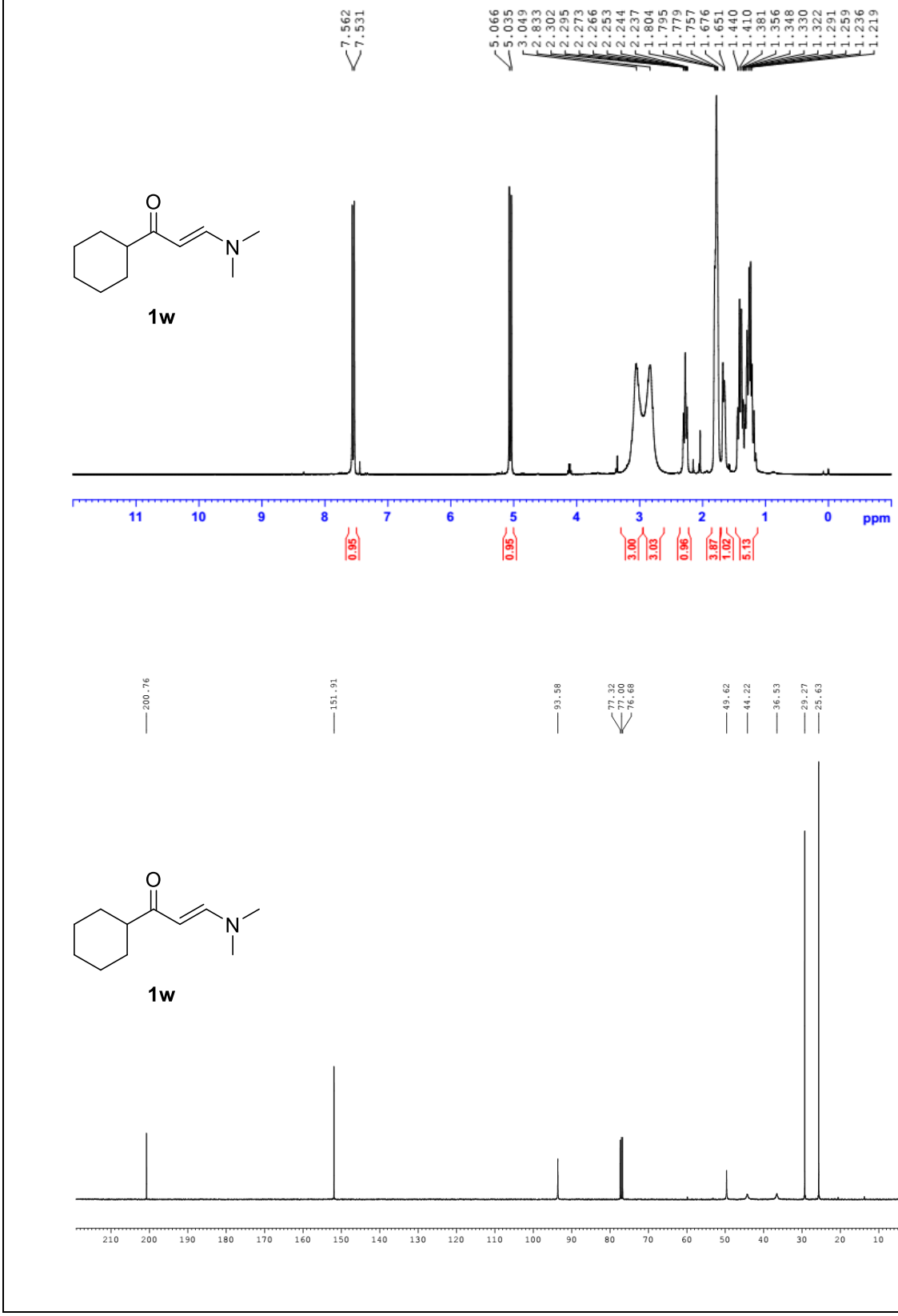
7.524
7.519
7.512
7.505
7.499
7.495
7.482
7.478
5.884
5.853
3.144
2.968
0.000
O
N
1r
11 10 9 8 7 6 5 4 3 2 1 0 ppm
0.97 0.97 0.98 2.92 1.95 0.99 6.00
188.36
154.19
137.77
134.65
132.71
129.09
127.74
127.57
127.10
126.14
124.59
92.28
77.32
77.00
76.68
44.96
37.26
O
N
1r
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

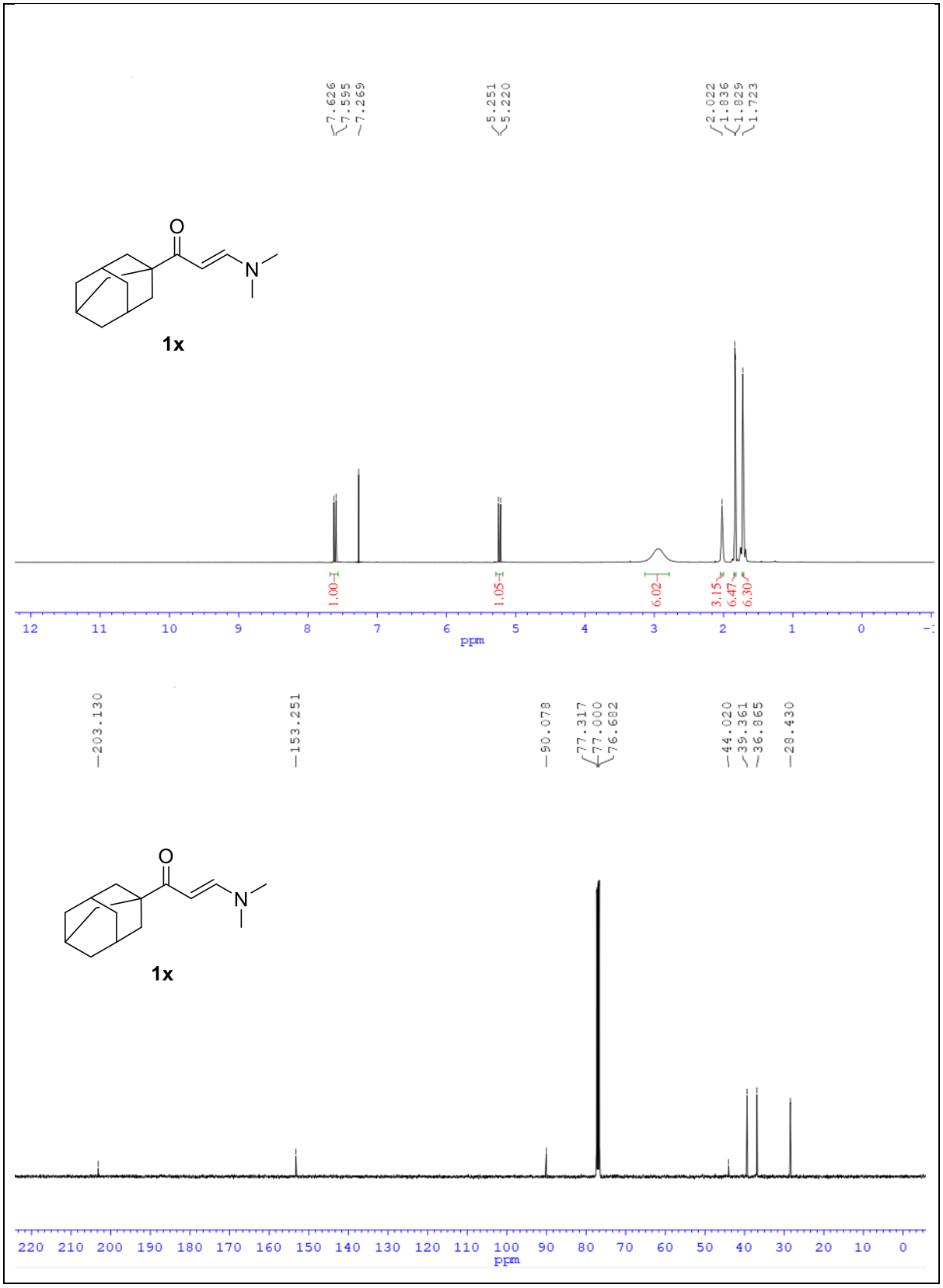

7.770
7.739
7.589
7.556
7.550
7.540
7.380
7.375
7.359
7.340
7.332
7.316
7.266
6.814
6.774
5.293
5.261
3.124
2.896
2.880
1.795
-0.000
O
N
1s
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
2.99
3.01
1.00
1.01
2.99
3.06
186.18
153.33
138.34
135.73
129.10
128.59
128.22
127.75
96.29
77.31
77.00
76.68
44.90
37.18
O
N
1s
240
220
200
180
160
140
120
100
80
60
40
20
ppm

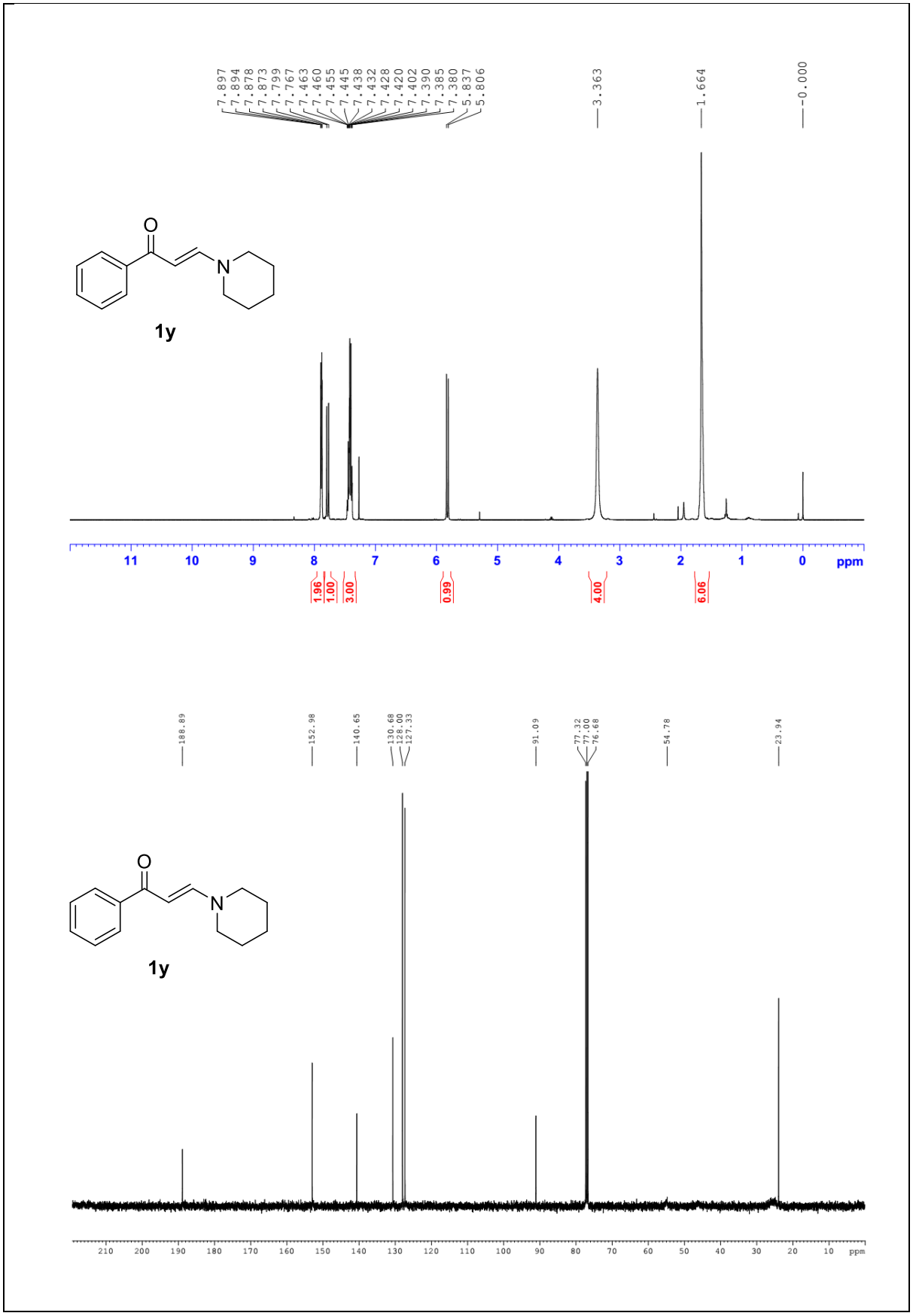

7.533
7.501
7.306
5.165
5.148
5.132
5.120
5.117
5.113
5.107
5.104
5.100
5.090
5.087
5.084
5.069
5.060
5.050
5.028
5.019
2.995
2.957
2.870
2.844
2.364
2.357
2.353
2.345
2.335
2.327
2.311
2.294
2.055
2.047
2.029
1.987
1.966
1.678
1.619
1.607
1.594
0.000
O
N
1t
11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.00
2.05
1.07
6.29
4.38
2.91
1.26
4.34
5.04
197.60
197.51
152.14
135.46
135.33
131.31
131.09
124.41
124.23
123.58
95.65
77.32
77.00
76.68
41.51
39.57
31.78
26.60
26.48
25.58
25.55
24.24
24.08
23.26
17.54
17.53
O
N
1t
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm

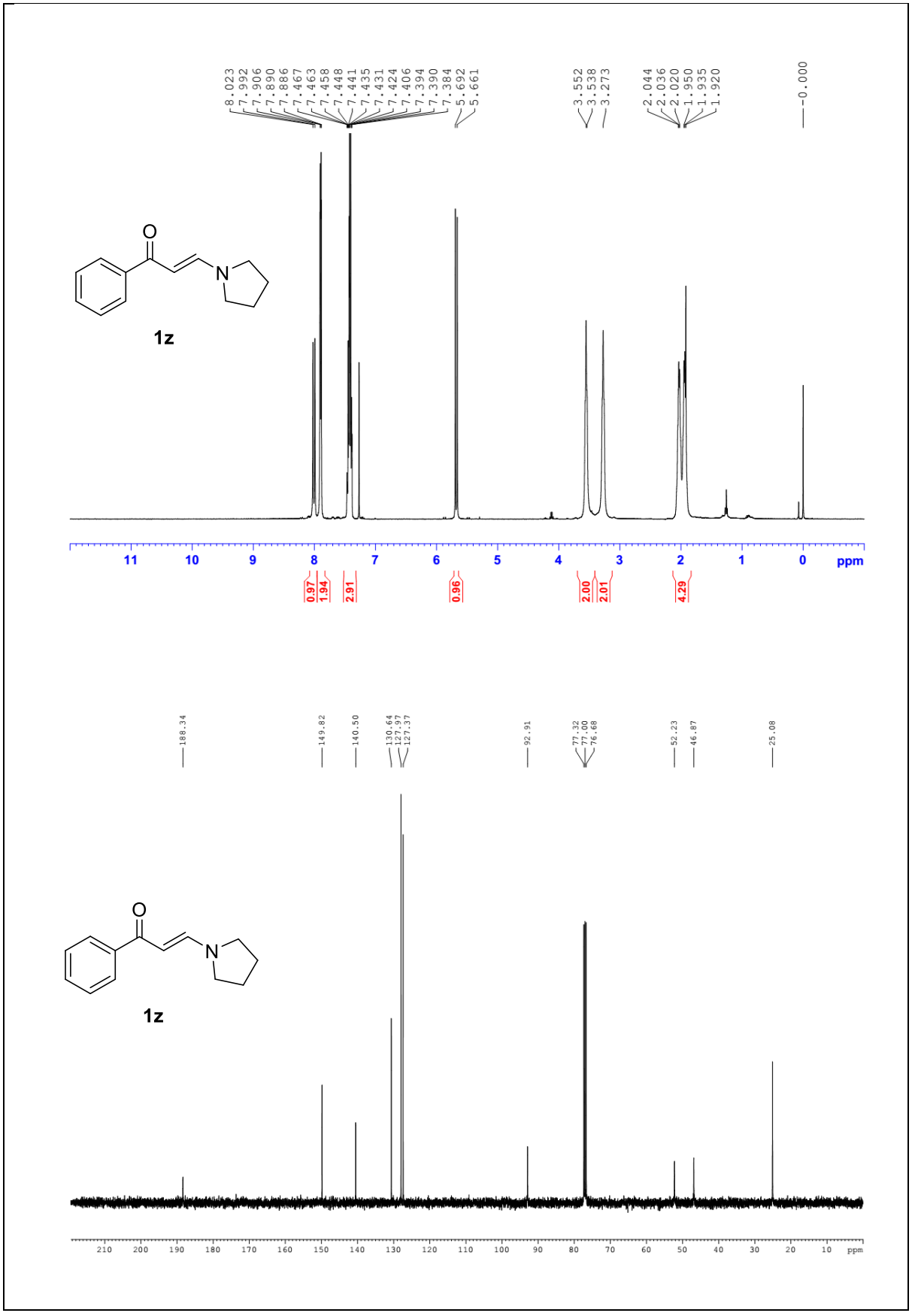

7.742
7.710
7.561
7.557
7.552
7.546
7.542
7.537
7.389
7.376
7.372
7.367
7.351
7.348
7.335
7.332
5.324
5.292
3.159
2.868
0.000
O
N
Ph
1u
11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.04
2.01
2.89
0.96
3.00
3.02
158.05
132.34
129.55
128.44
121.31
101.88
77.51
77.19
76.87
45.33
37.32
O
N
Ph
1u
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm


7.535
7.503
5.060
5.028
3.034
2.966
2.884
2.838
2.351
2.333
2.313
1.631
1.613
1.593
1.574
1.555
1.371
1.353
1.334
1.316
0.929
0.911
0.892
-0.001
O
Me
N
1v
1.00
1.04
6.64
2.14
2.12
2.07
3.23
12 11 10 9 8 7 6 5 4 3 2 1 0 -1
ppm
198.190
152.051
95.530
77.319
77.000
76.681
44.368
41.278
36.792
27.962
22.491
13.796
O
Me
N
1v
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
ppm

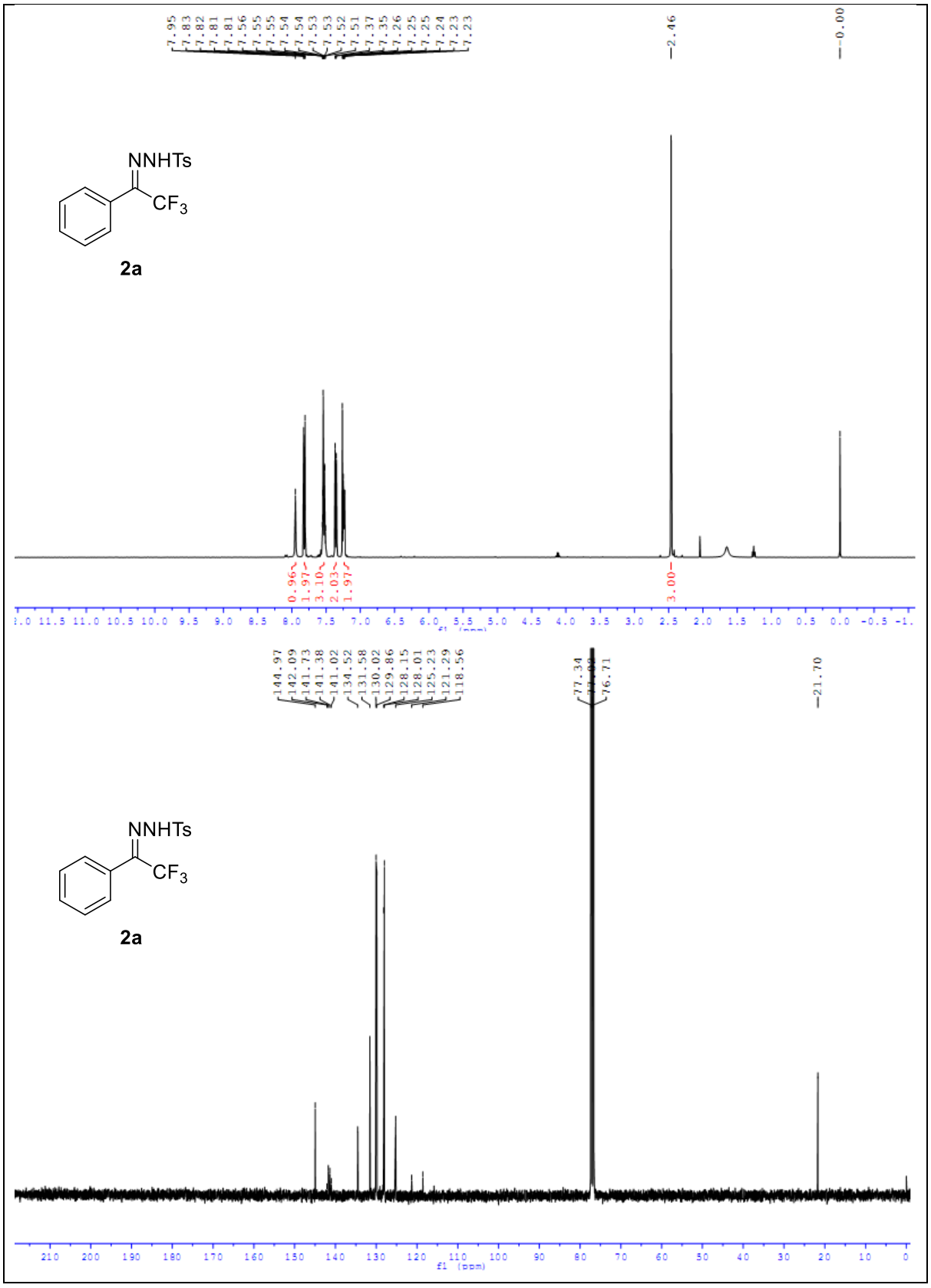

7.562
7.531
5.066
5.035
3.049
2.833
2.302
2.295
2.273
2.266
2.253
2.244
2.237
1.804
1.795
1.779
1.757
1.676
1.651
1.440
1.410
1.381
1.356
1.348
1.330
1.322
1.291
1.259
1.236
1.219
O
N
1w
11 10 9 8 7 6 5 4 3 2 1 0 ppm
0.95
0.95
3.00
3.03
0.96
3.87
1.02
5.13
200.76
151.91
93.58
77.32
77.00
76.68
49.62
44.22
36.53
29.27
25.63
O
N
1w
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

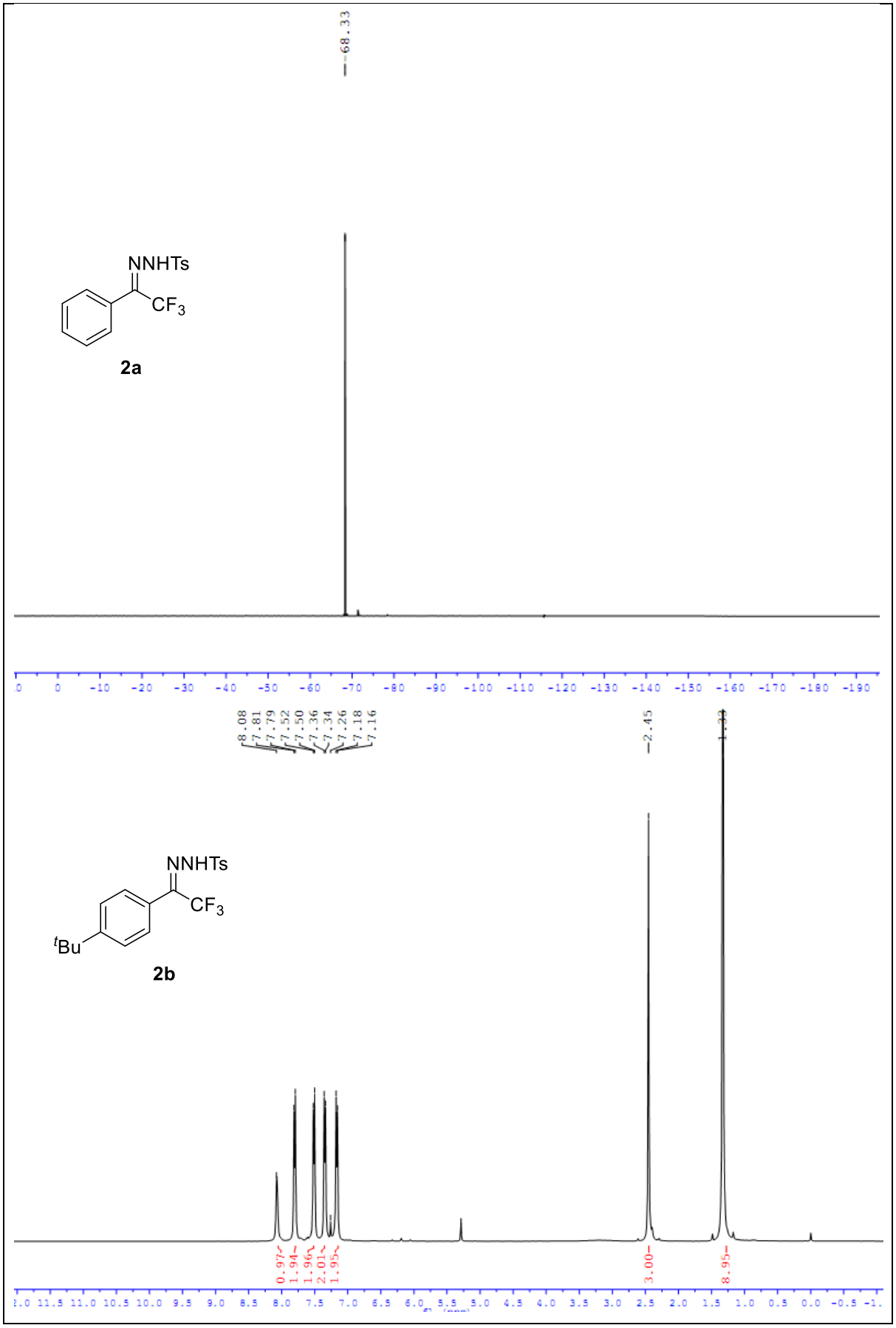

7.626
7.595
7.269
5.251
5.220
2.022
1.836
1.829
1.723
O
N
1x
1.00
1.05
6.02
3.15
6.47
6.30
12 11 10 9 8 7 6 5 4 3 2 1 0
ppm
203.130
153.251
90.078
77.317
77.000
76.682
44.020
39.361
36.865
28.430
O
N
1x
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
ppm

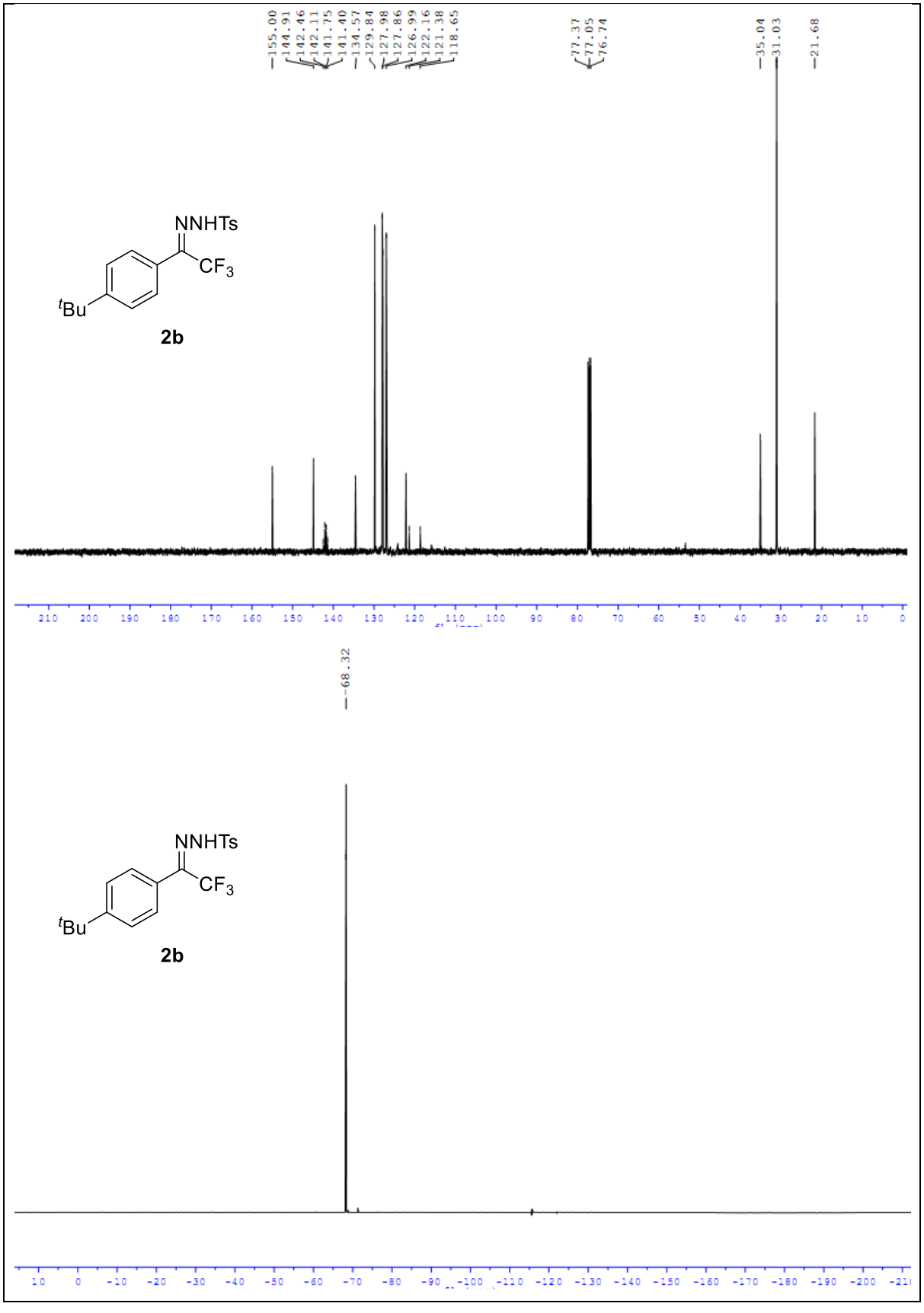

7.897
7.894
7.878
7.873
7.799
7.767
7.463
7.460
7.455
7.445
7.438
7.432
7.428
7.420
7.402
7.390
7.385
7.380
5.837
5.806
3.363
1.664
0.000
O
N
1y
11 10 9 8 7 6 5 4 3 2 1 0 ppm
1.96
1.00
3.00
0.99
4.00
6.06
188.89
152.98
140.65
130.68
128.00
127.33
91.09
77.32
77.00
76.68
54.78
23.94
O
N
1y
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

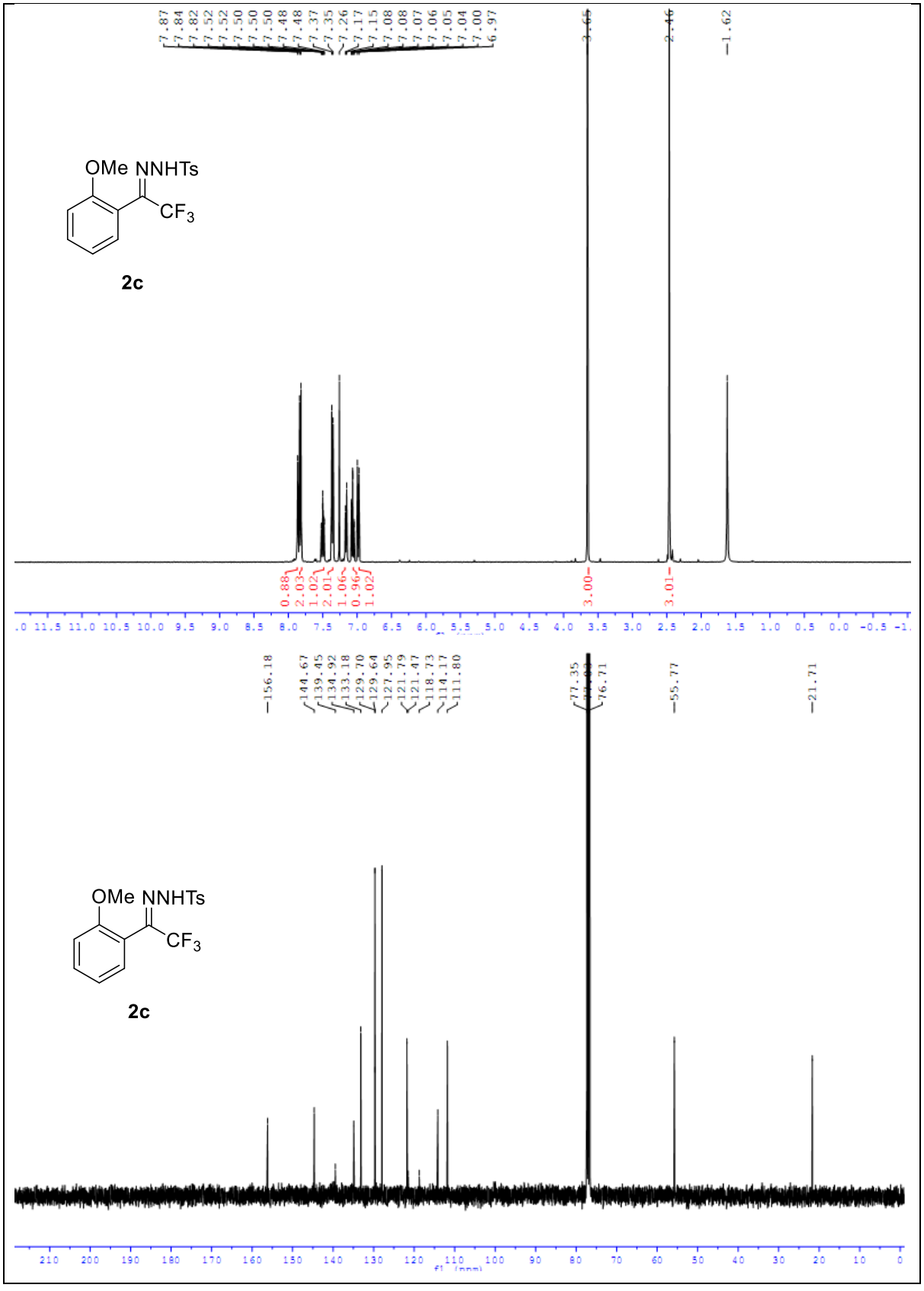

8.023
7.992
7.906
7.890
7.886
7.467
7.463
7.458
7.448
7.441
7.435
7.431
7.424
7.406
7.394
7.390
7.384
5.692
5.661
3.552
3.538
3.273
2.044
2.036
2.020
1.950
1.935
1.920
0.000
O
N
1z
11
10
9
8
7
6
5
4
3
2
1
0
ppm
0.97
1.94
2.91
0.96
2.00
2.01
4.29
188.34
149.82
140.50
130.64
127.97
127.37
92.91
77.32
77.00
76.68
52.23
46.87
25.08
O
N
1z
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

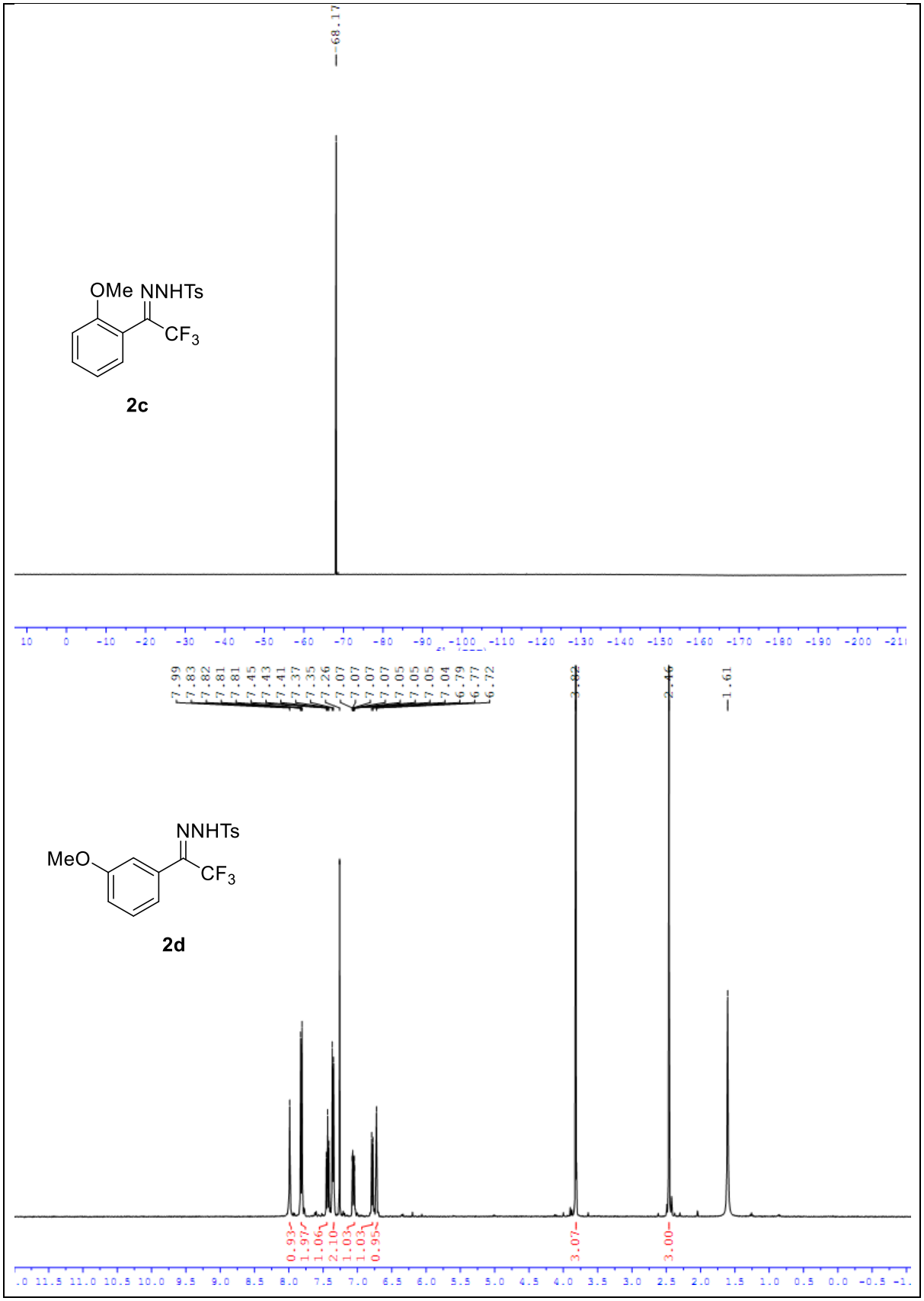
NMR Spectra for trifluoromethylated *N*-tosylhydrazones

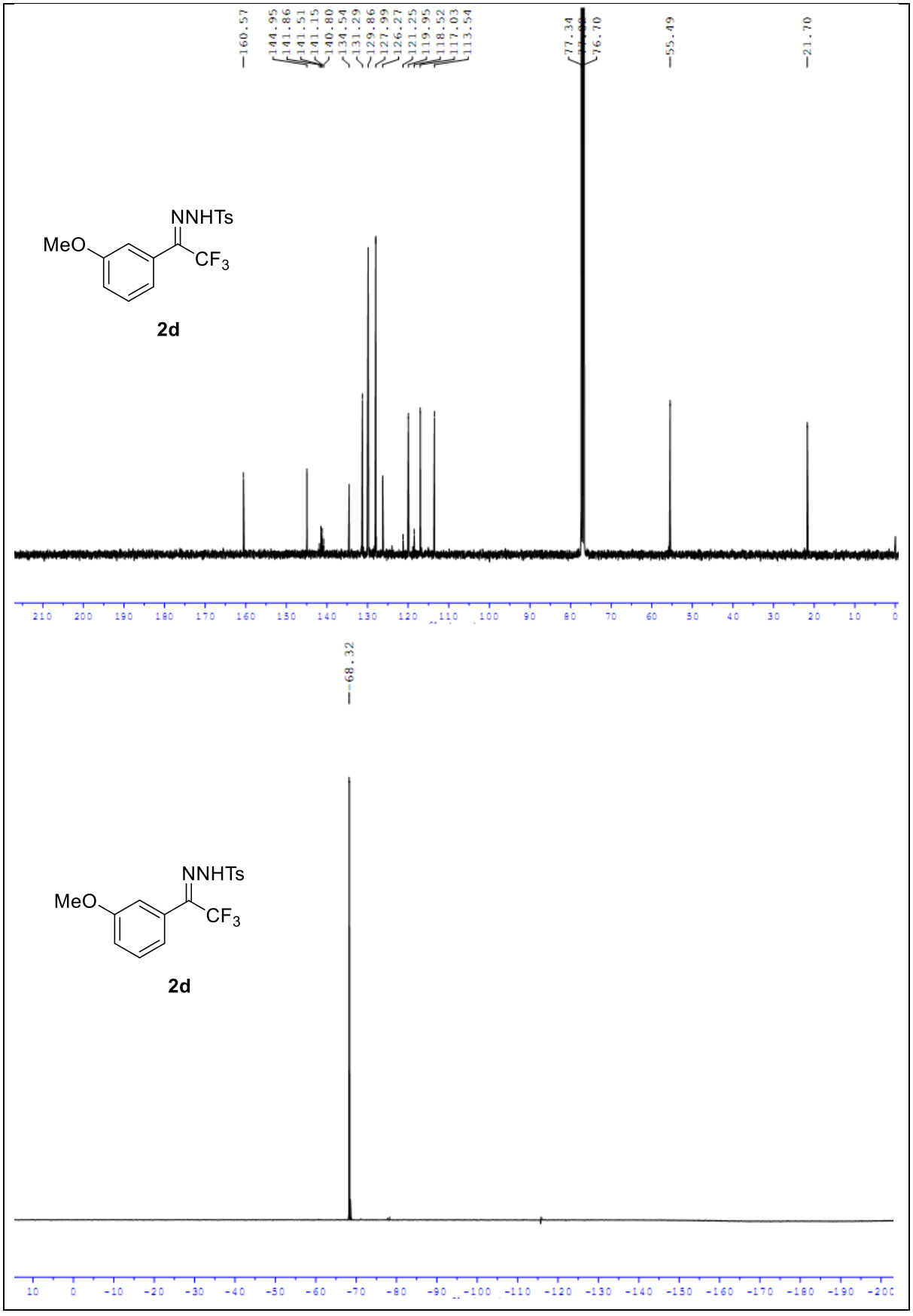


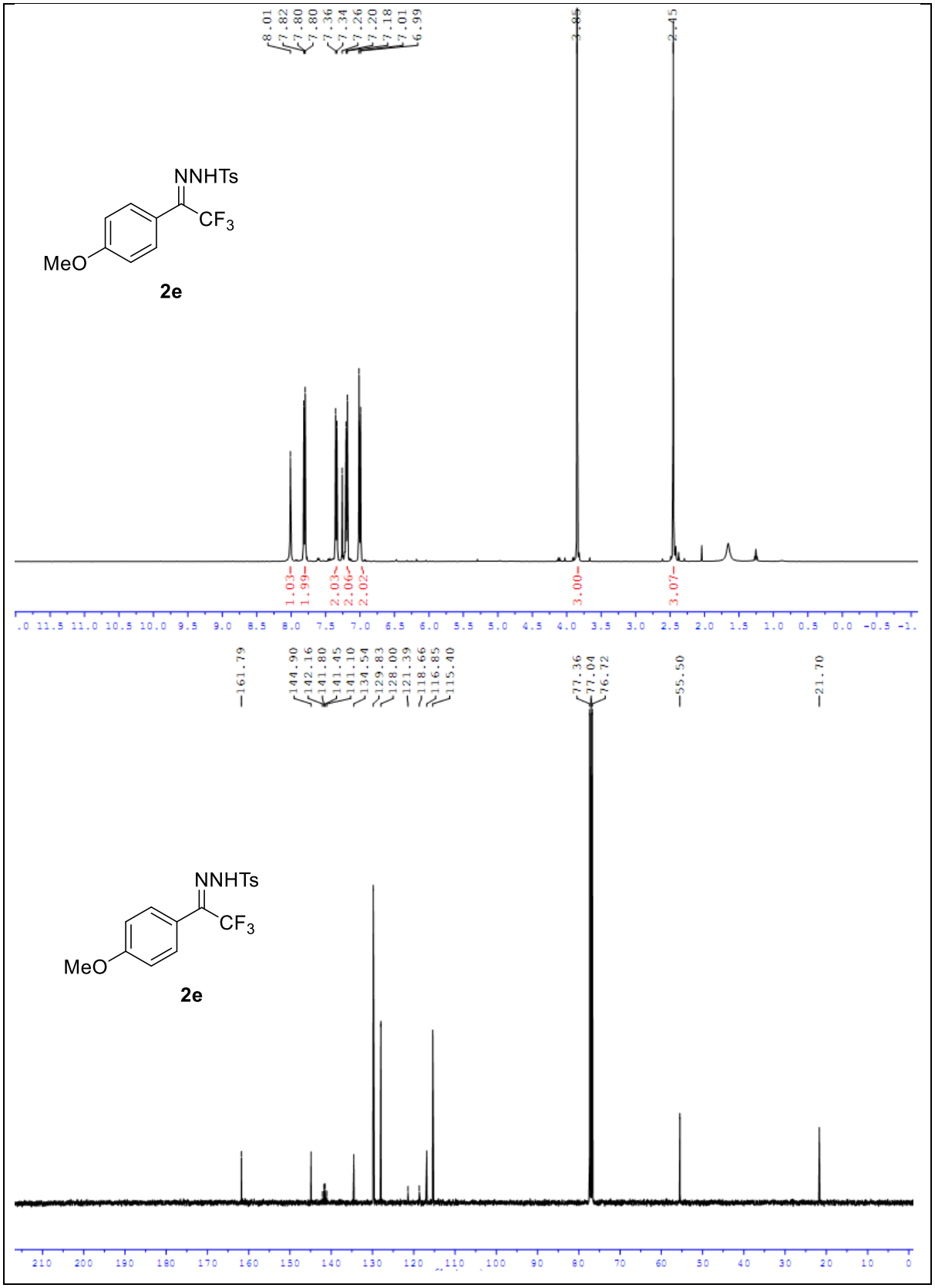

-68.33
NNHTs
CF3
2a
8.08
7.81
7.79
7.52
7.50
7.36
7.34
7.26
7.18
7.16
2.45
1.33
NNHTs
CF3
tBu
2b
0.97
1.94
1.96
2.01
1.95
3.00
8.95

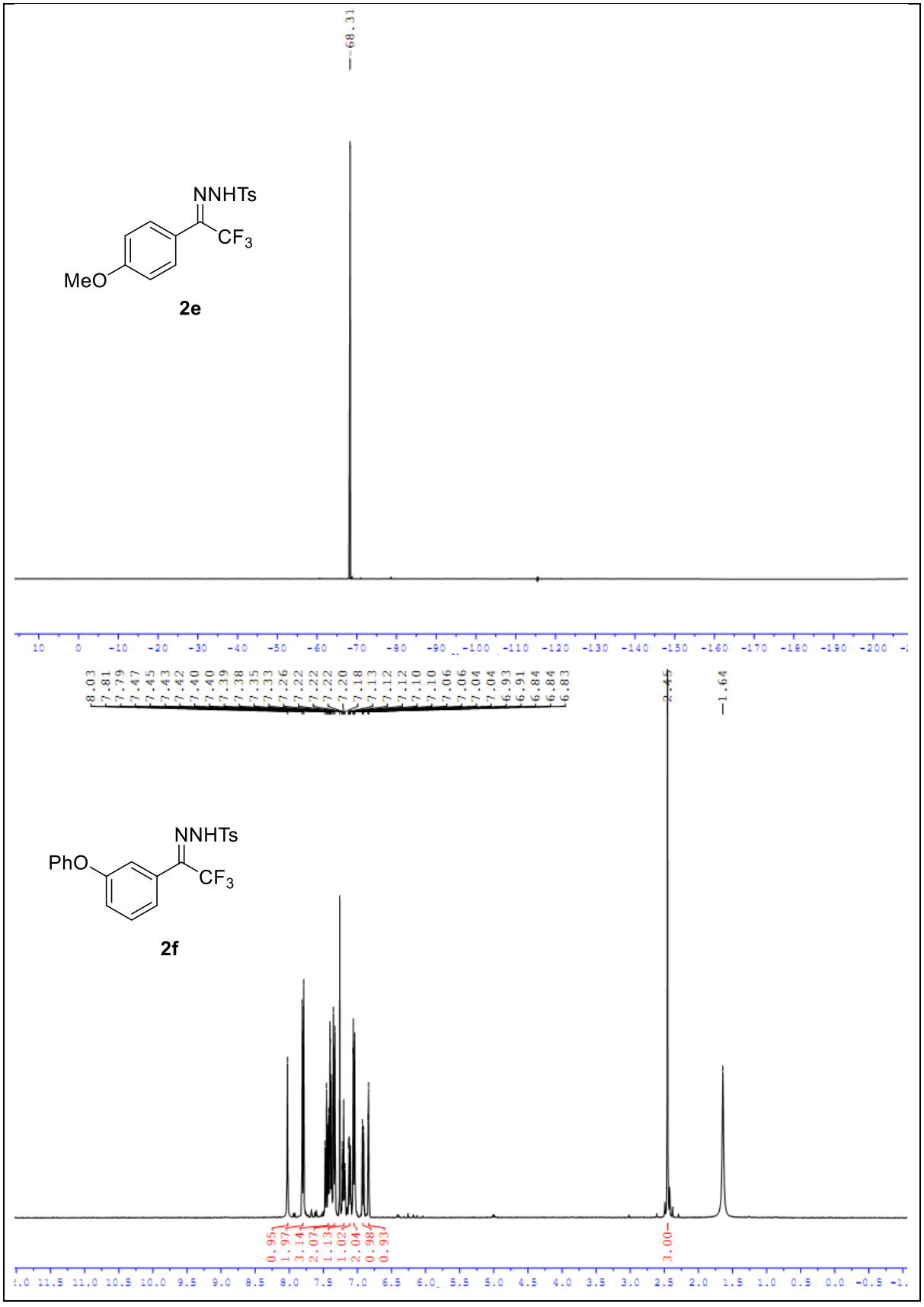

155.00
144.91
142.46
142.11
141.75
141.40
134.57
129.84
127.98
127.86
126.99
122.16
121.38
118.65
77.37
77.05
76.74
35.04
31.03
21.68
NNHTs
CF3
tBu
2b
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
-68.32
NNHTs
CF3
tBu
2b
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200

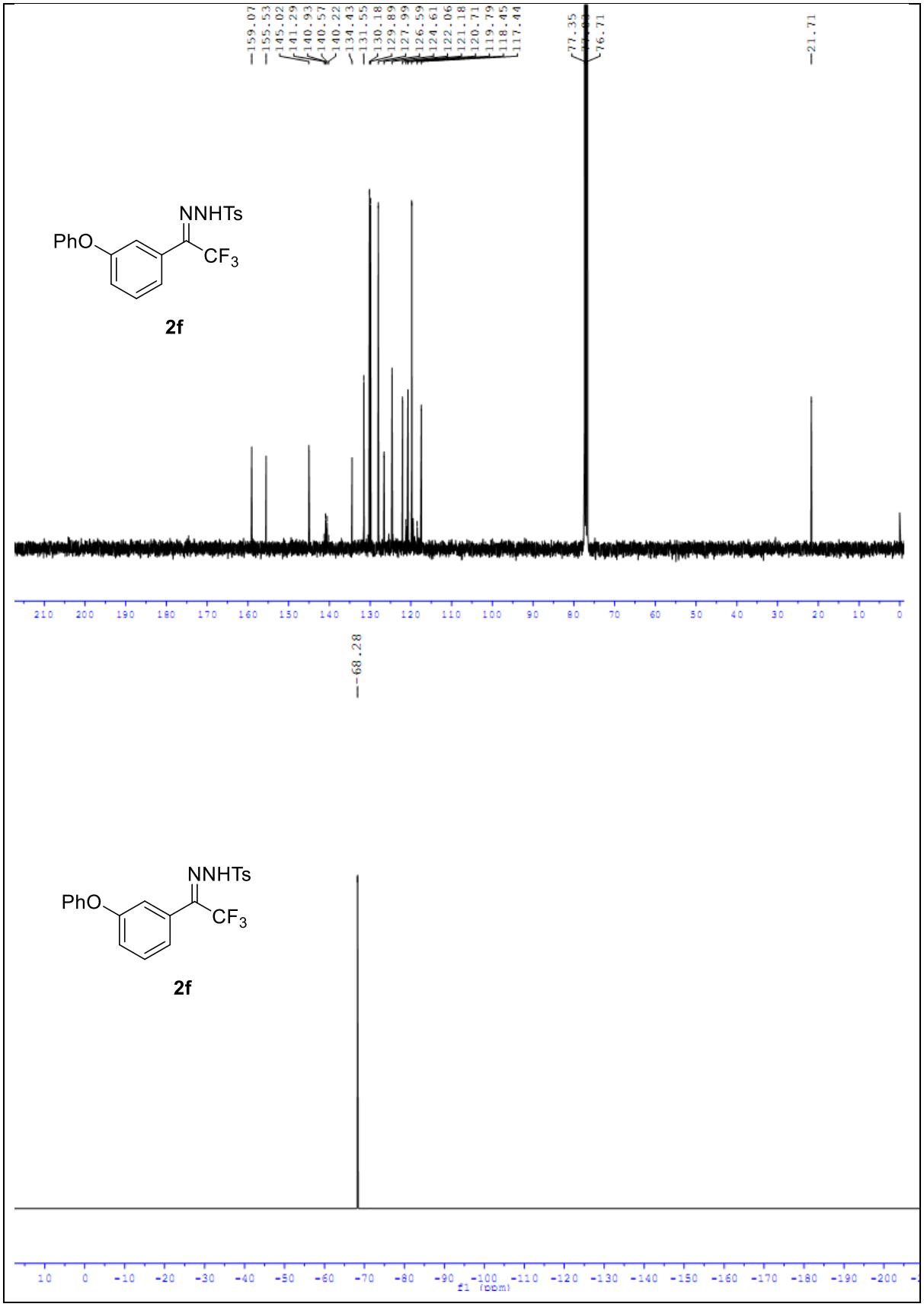

OMe NNHTs
CF3
2c
7.87
7.84
7.82
7.52
7.50
7.50
7.48
7.48
7.37
7.35
7.26
7.17
7.15
7.08
7.08
7.07
7.06
7.05
7.04
7.00
6.97
3.65
2.46
1.62
0.88
2.03
1.02
2.01
1.06
0.96
1.02
3.00
3.01
156.18
144.67
139.45
134.92
133.18
129.70
129.64
127.95
121.79
121.47
118.73
114.17
111.80
77.35
77.03
76.71
55.77
21.71
OMe NNHTs
CF3
2c

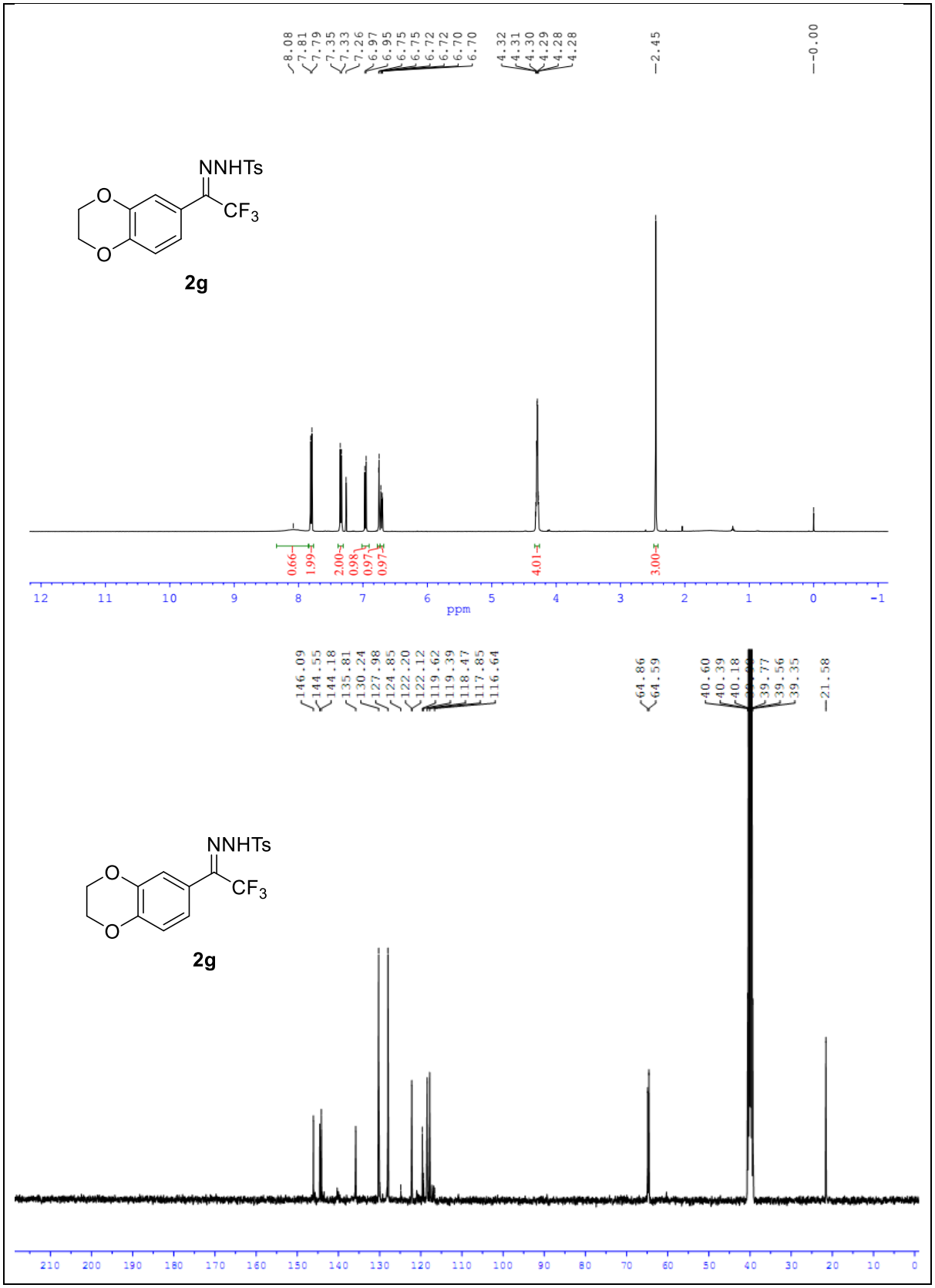

-68.17
OMe NNHTs
CF3
2c
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
7.99
7.83
7.82
7.81
7.81
7.45
7.43
7.41
7.37
7.35
7.26
7.07
7.07
7.07
7.07
7.05
7.05
7.04
6.79
6.77
6.72
3.82
2.46
1.61
NNHTs
MeO
CF3
2d
0.93
1.97
1.06
2.10
1.03
1.03
0.95
3.07
3.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5

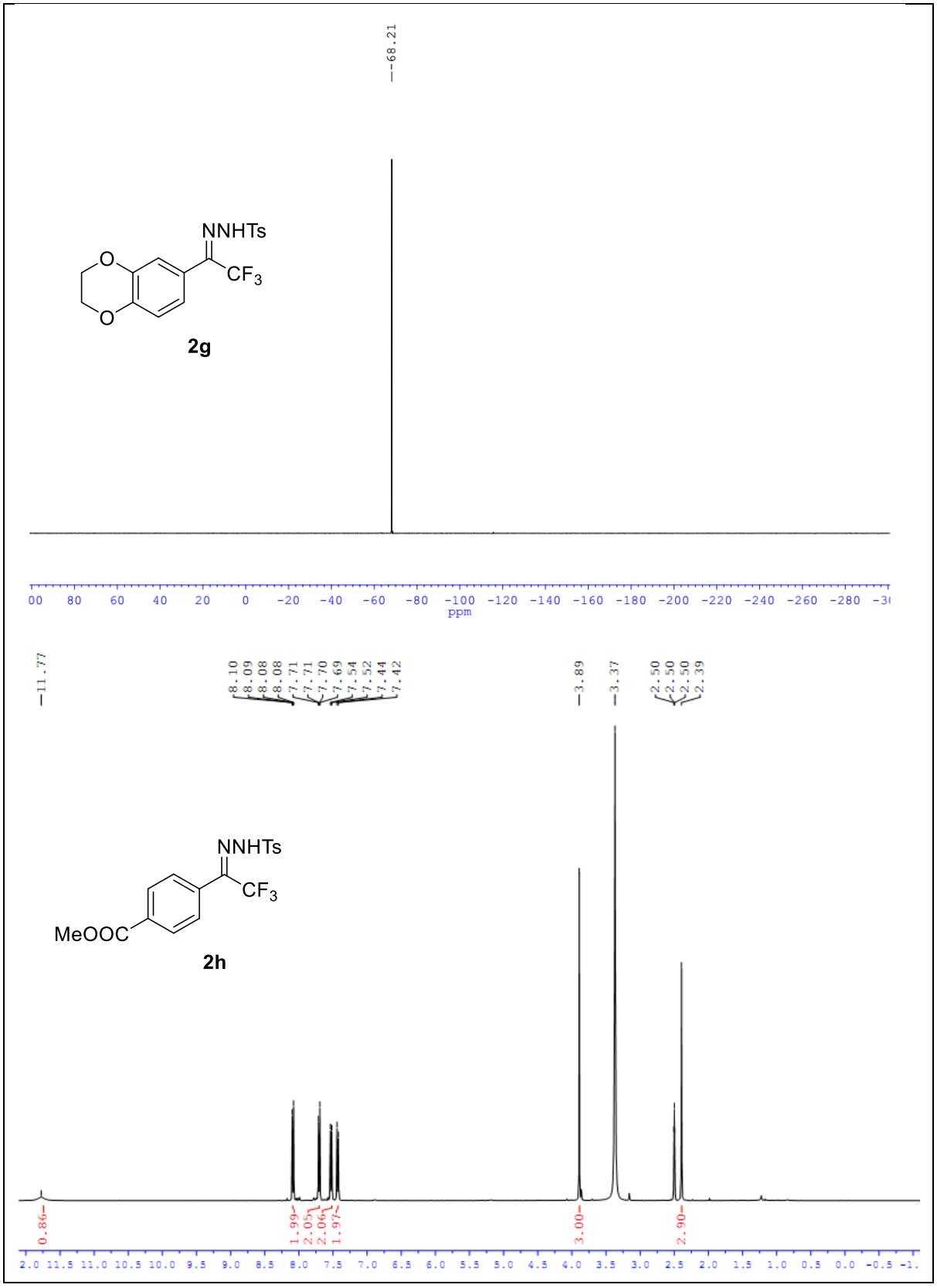

160.57
144.95
141.86
141.51
141.15
140.80
134.54
131.29
129.86
127.99
126.27
121.25
119.95
118.52
117.03
113.54
77.34
76.70
55.49
21.70
NNHTs
MeO
CF3
2d
68.32
NNHTs
MeO
CF3
2d

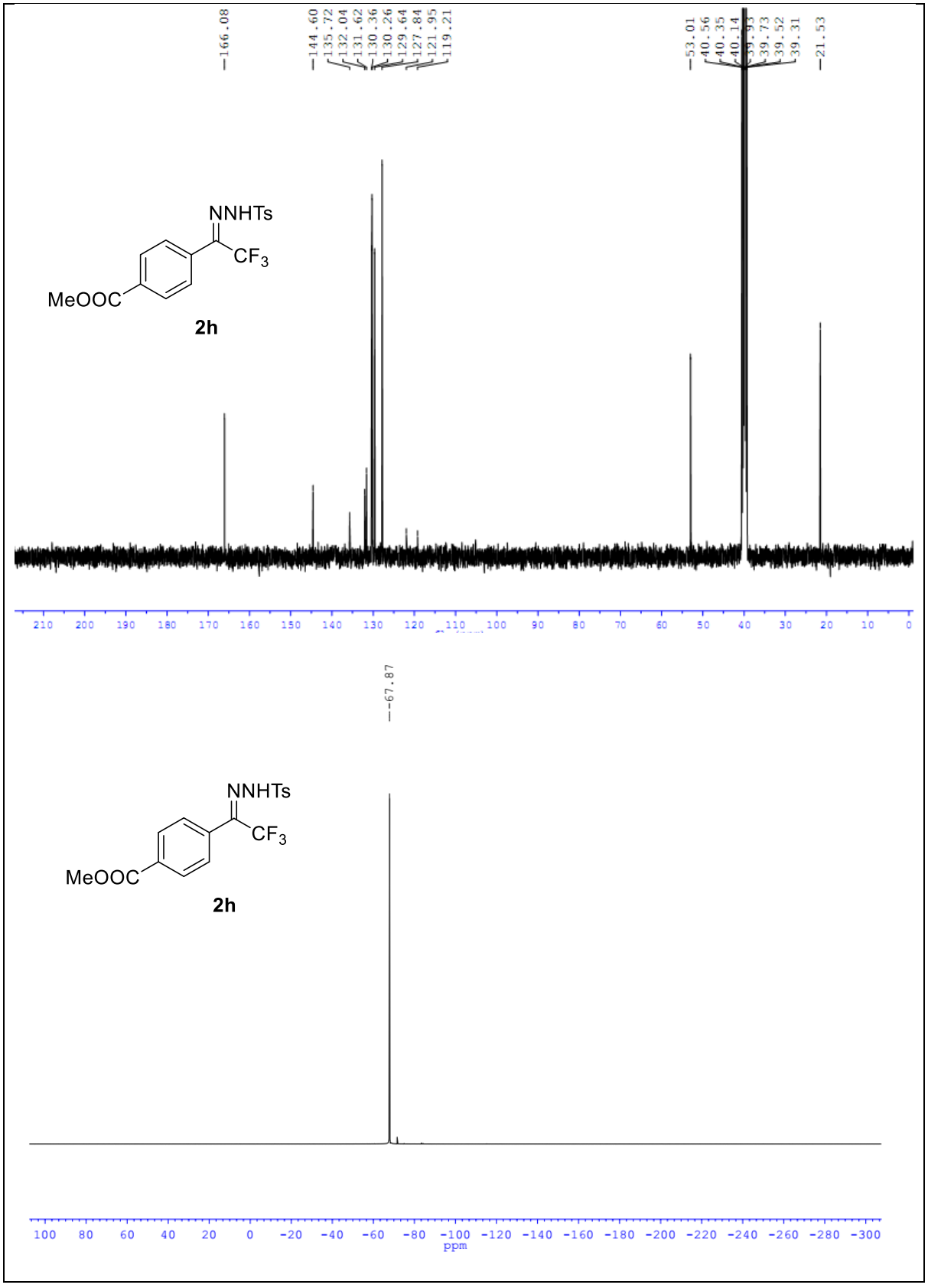

NNHTs
CF3
MeO
2e
8.01
7.82
7.80
7.80
7.36
7.34
7.26
7.20
7.18
7.01
6.99
3.84
2.45
1.03
1.99
2.03
2.06
2.02
3.00
3.07
NNHTs
CF3
MeO
2e
161.79
144.90
142.16
141.80
141.45
141.10
134.54
129.83
128.00
121.39
118.66
116.85
115.40
77.36
77.04
76.72
55.50
21.70

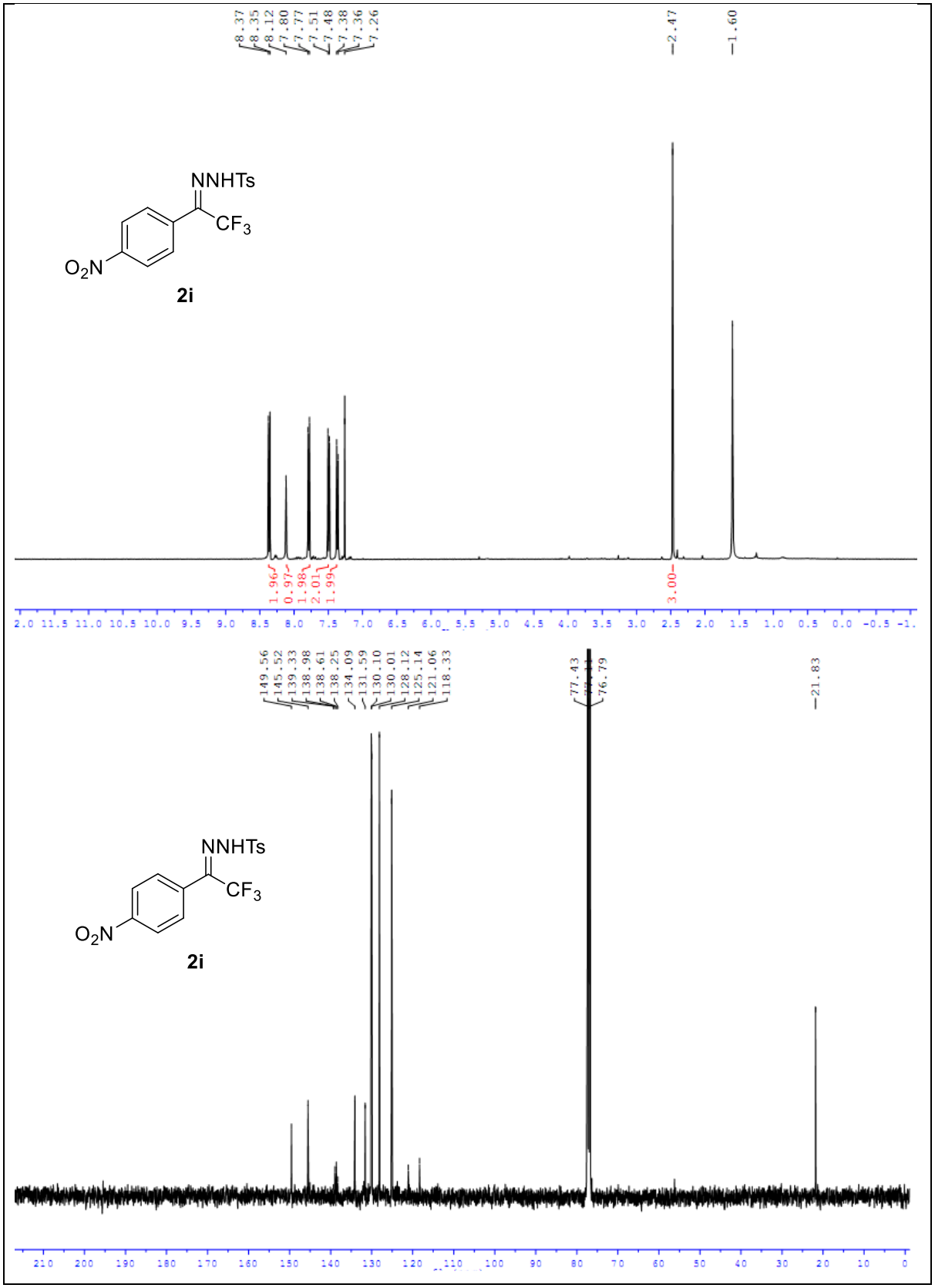

-68.31
NNHTs
CF3
MeO
2e
8.03
7.81
7.79
7.47
7.45
7.43
7.42
7.40
7.40
7.39
7.38
7.35
7.33
7.26
7.22
7.22
7.22
7.20
7.18
7.13
7.12
7.12
7.10
7.10
7.06
7.06
7.04
7.04
6.93
6.91
6.84
6.84
6.83
2.45
1.64
NNHTs
PhO
CF3
2f
0.95
1.97
3.14
2.07
1.13
1.02
2.04
0.98
0.93
3.00

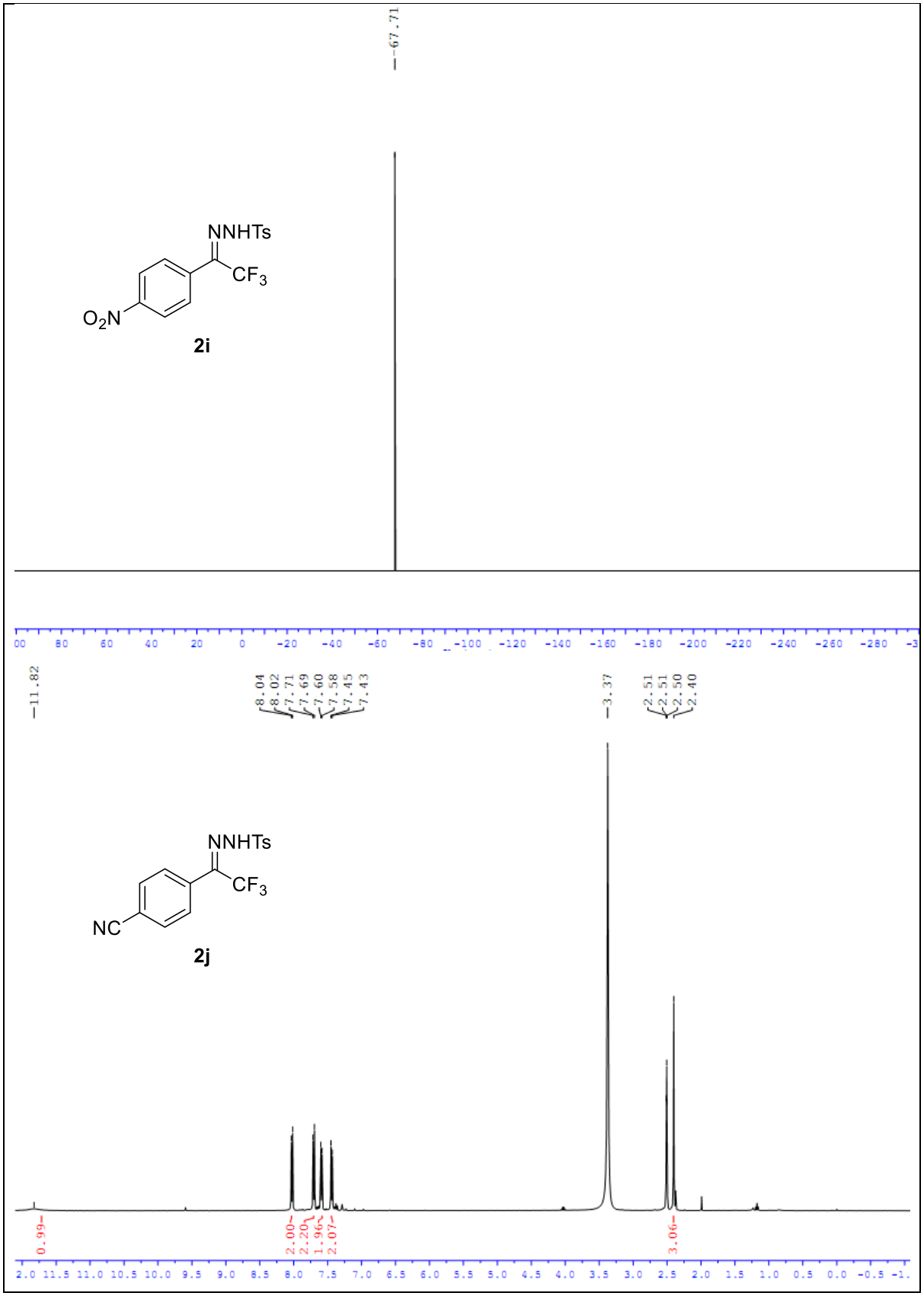

159.07
155.53
145.02
141.29
140.93
140.57
140.22
134.43
131.55
130.18
129.89
127.99
126.59
124.61
122.06
121.18
120.71
119.79
118.45
117.44
77.35
77.03
76.71
21.71
NNHTs
PhO
CF3
2f
68.28
NNHTs
PhO
CF3
2f

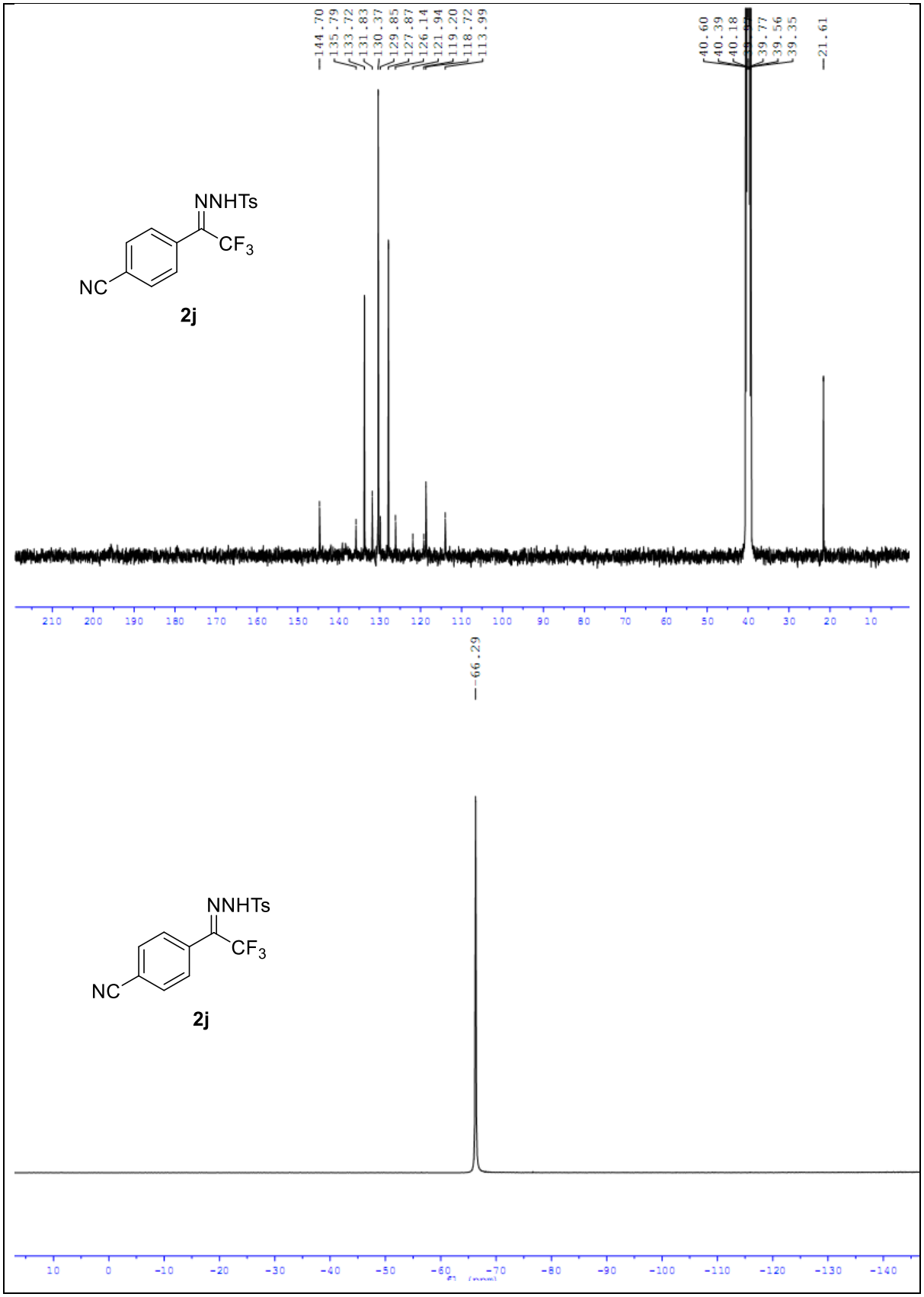

8.08
7.81
7.79
7.35
7.33
7.26
6.97
6.95
6.75
6.75
6.72
6.72
6.70
6.70
4.32
4.31
4.30
4.29
4.28
4.28
2.45
0.00
NNHTs
CF3
O
O
2g
0.66
1.99
2.00
0.98
0.97
0.97
4.01
3.00
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
ppm
146.09
144.55
144.18
135.81
130.24
127.98
124.85
122.20
122.12
119.62
119.39
118.47
117.85
116.64
64.86
64.59
40.60
40.39
40.18
39.77
39.56
39.35
21.58
NNHTs
CF3
O
O
2g
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

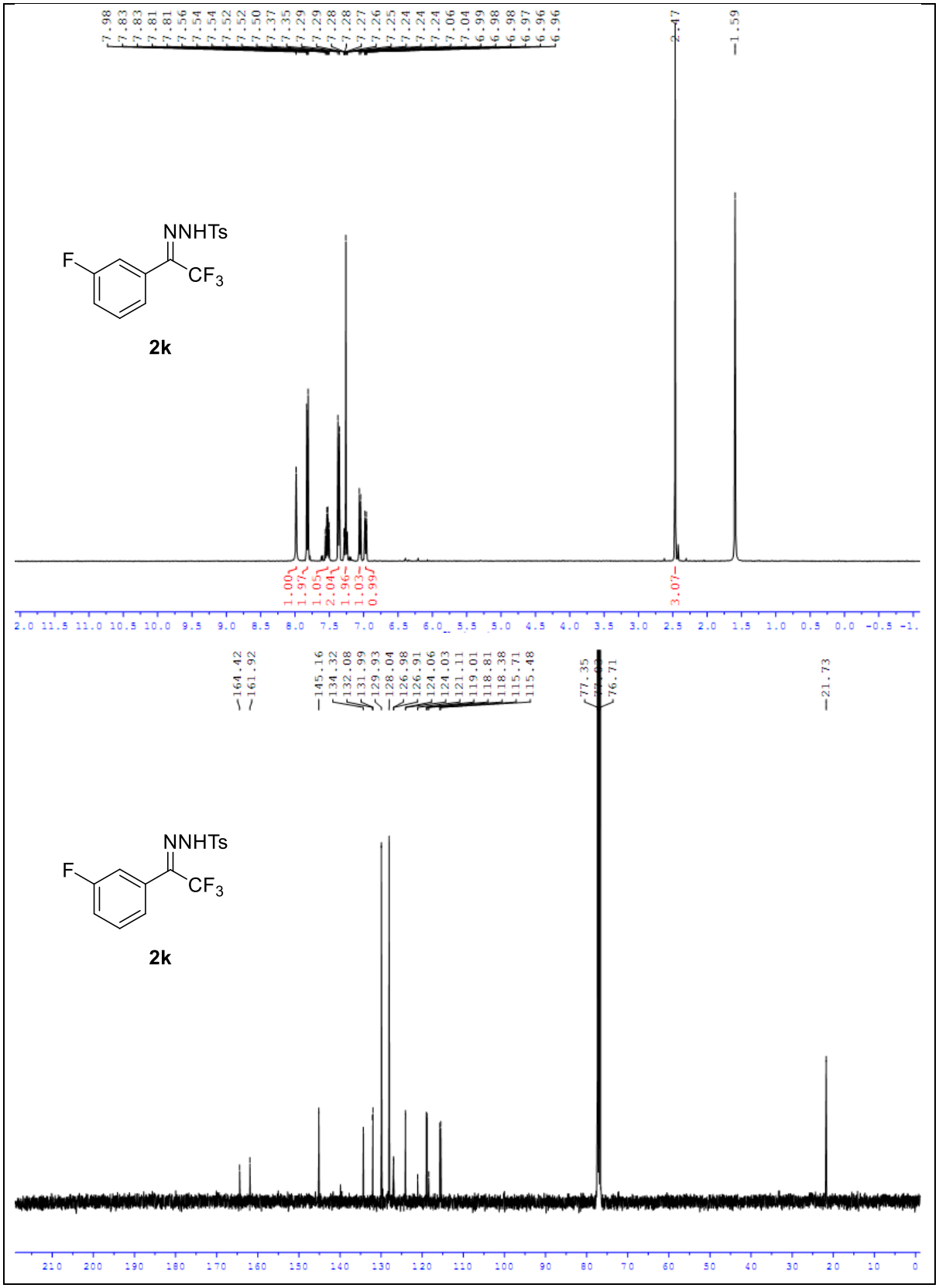

-68.21
NNHTs
CF3
O
O
2g
00 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280
ppm
11.77
8.10
8.09
8.08
8.08
7.71
7.71
7.70
7.69
7.54
7.52
7.44
7.42
3.89
3.37
2.50
2.50
2.50
2.39
NNHTs
CF3
MeOOC
2h
0.86
1.99
2.05
2.06
1.97
3.00
2.90
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.

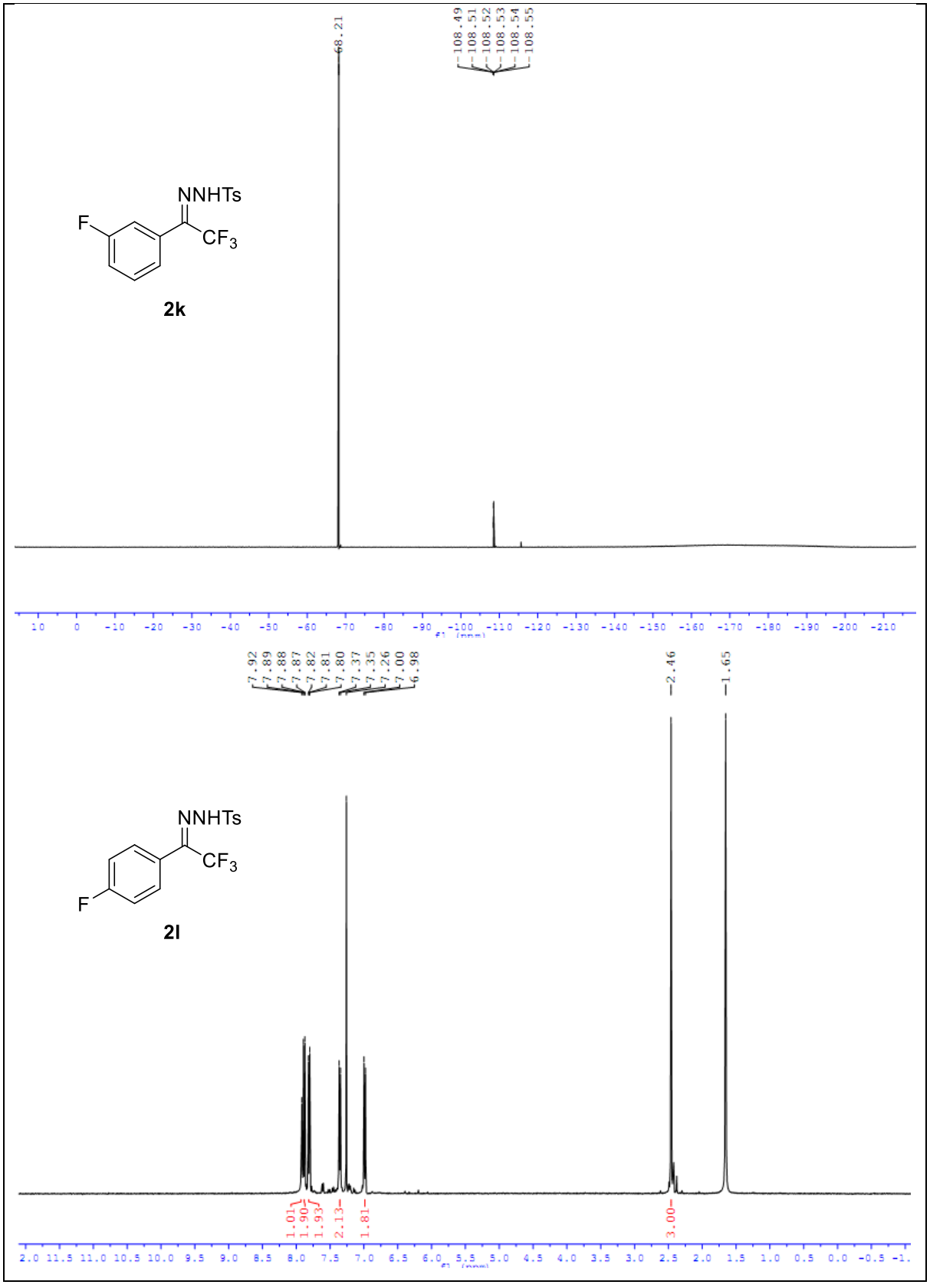

166.08
144.60
135.72
132.04
131.62
130.36
130.26
129.64
127.84
121.95
119.21
53.01
40.56
40.35
40.14
39.93
39.73
39.52
39.31
21.53
NNHTs
CF3
MeOOC
2h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
-67.87
NNHTs
CF3
MeOOC
2h
100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300
ppm

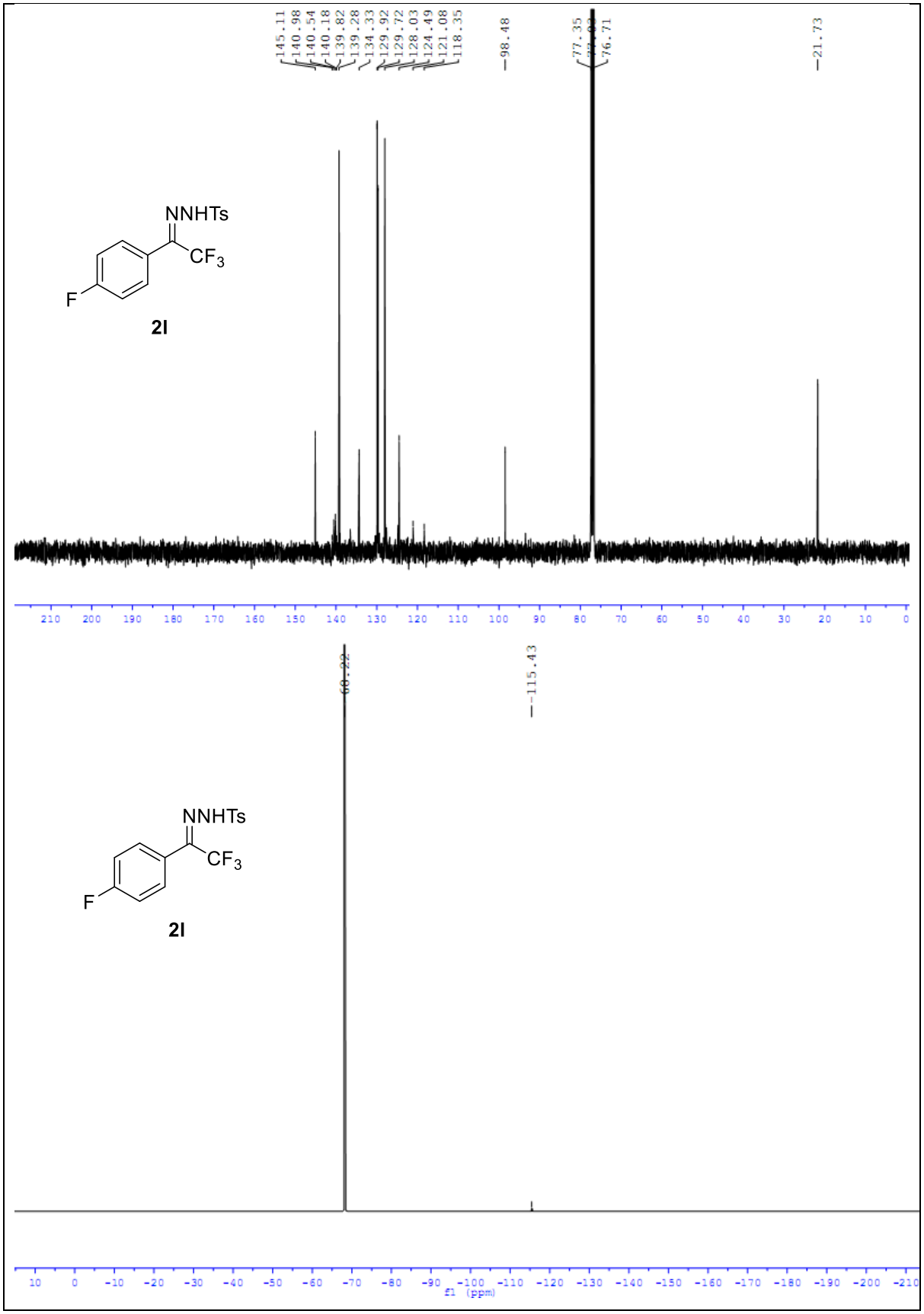

8.37
8.35
8.12
7.80
7.77
7.51
7.48
7.38
7.36
7.26
2.47
1.60
NNHTs
CF3
O2N
2i
1.96
0.97
1.98
2.01
1.99
3.00
149.56
145.52
139.33
138.98
138.61
138.25
134.09
131.59
130.10
130.01
128.12
125.14
121.06
118.33
77.43
76.79
21.83
NNHTs
CF3
O2N
2i


-67.71
NNHTs
CF3
O2N
2i
-11.82
8.04
8.02
7.71
7.69
7.60
7.58
7.45
7.43
-3.37
2.51
2.51
2.50
2.40
NNHTs
CF3
NC
2j
0.99
2.00
2.20
1.96
2.07
3.06


144.70
135.79
133.72
131.83
130.37
129.85
127.87
126.14
121.94
119.20
118.72
113.99
40.60
40.39
40.18
39.77
39.56
39.35
21.61
NNHTs
CF3
NC
2j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
-66.29
NNHTs
CF3
NC
2j
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140


NNHTs
F
CF3
2k
NNHTs
F
CF3
2k


68.21
108.49
108.51
108.52
108.53
108.54
108.55
NNHTs
F
CF3
2k
7.92
7.89
7.88
7.87
7.82
7.81
7.80
7.37
7.35
7.26
7.00
6.98
2.46
1.65
NNHTs
CF3
F
2l
1.01
1.90
1.93
2.13
1.81
3.00


145.11
140.98
140.54
140.18
139.82
139.28
134.33
129.92
129.72
128.03
124.49
121.08
118.35
98.48
77.35
76.71
21.73
NNHTs
CF3
F
2l
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
68.22
-115.43
NNHTs
CF3
F
2l
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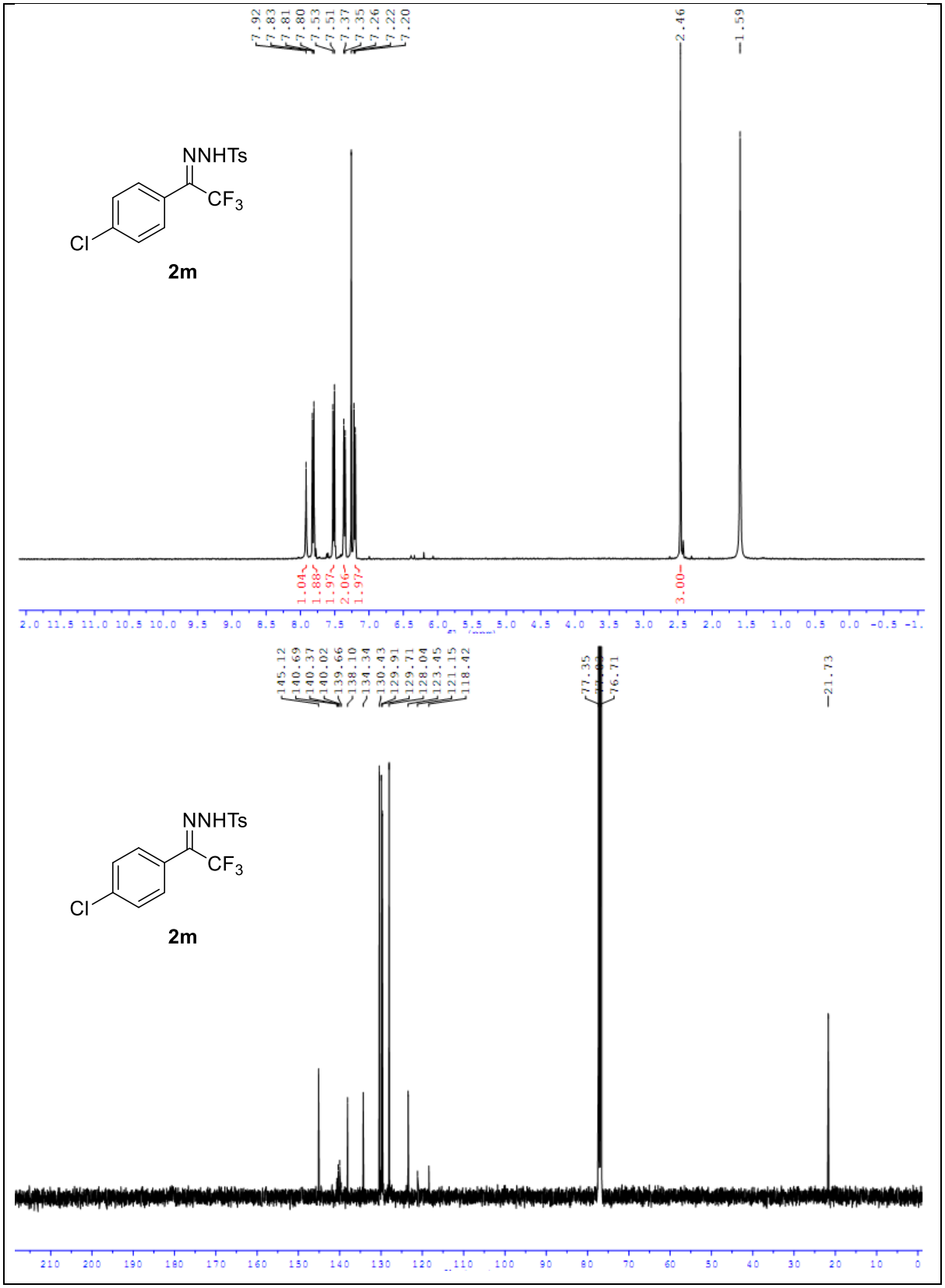
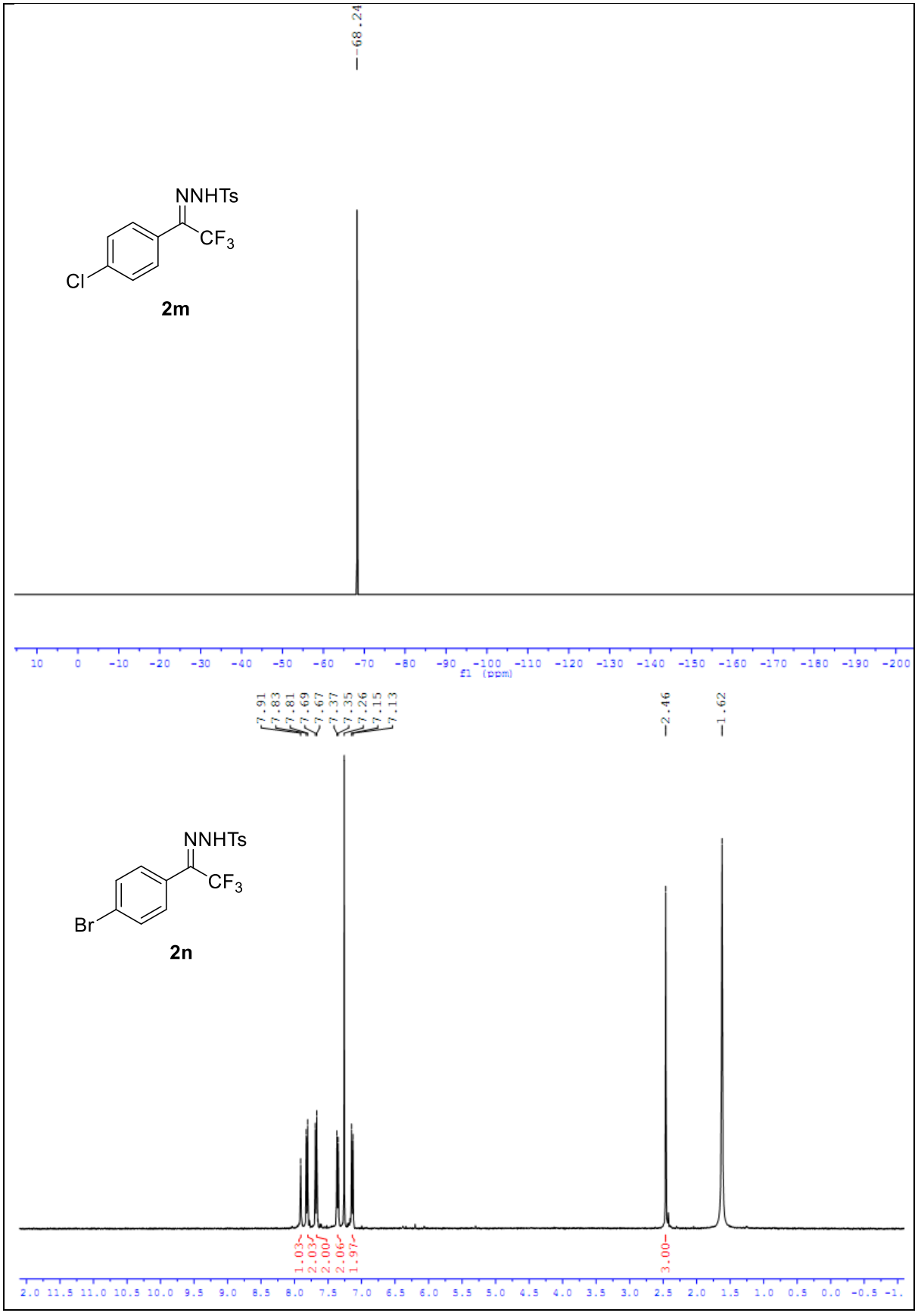
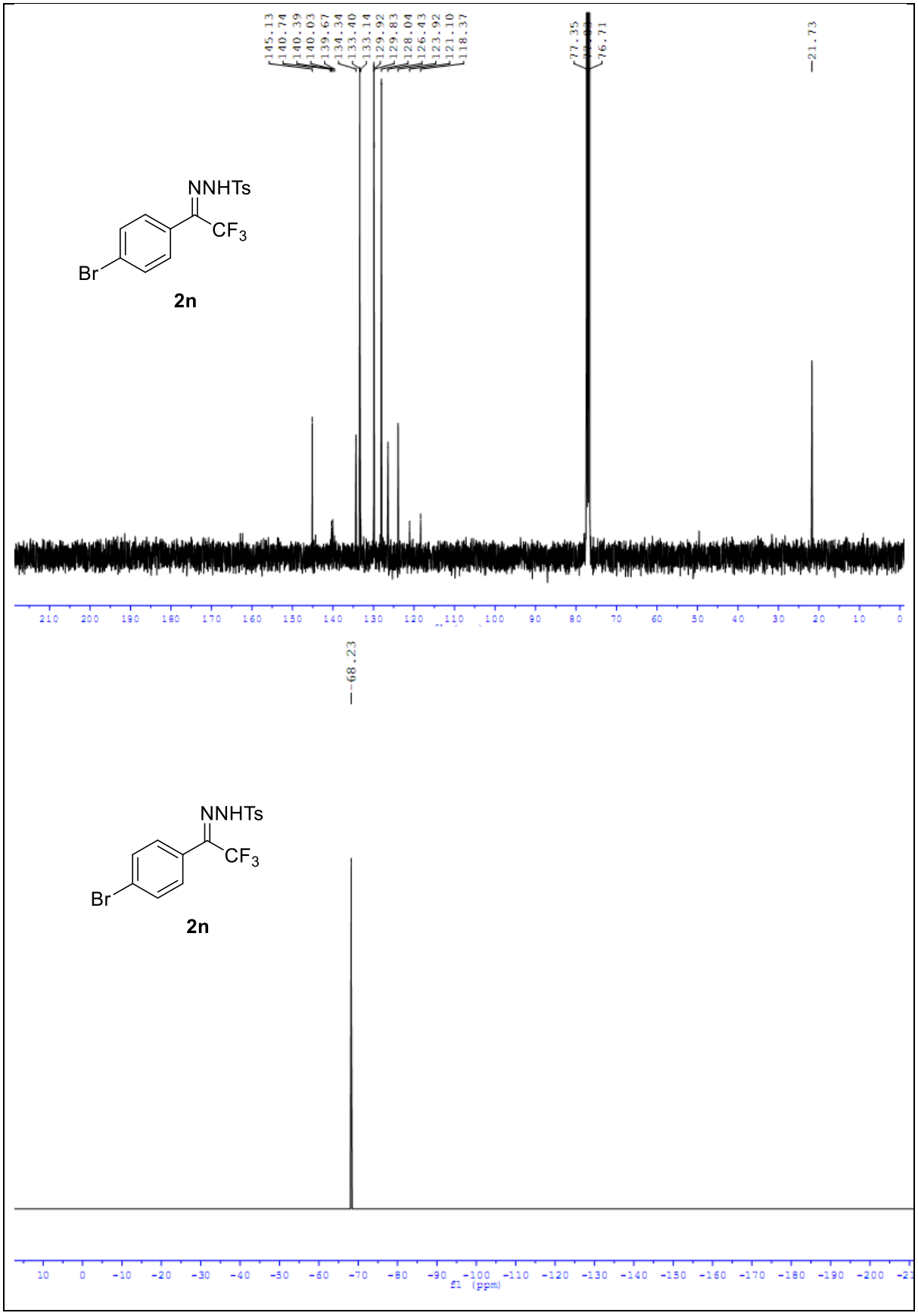
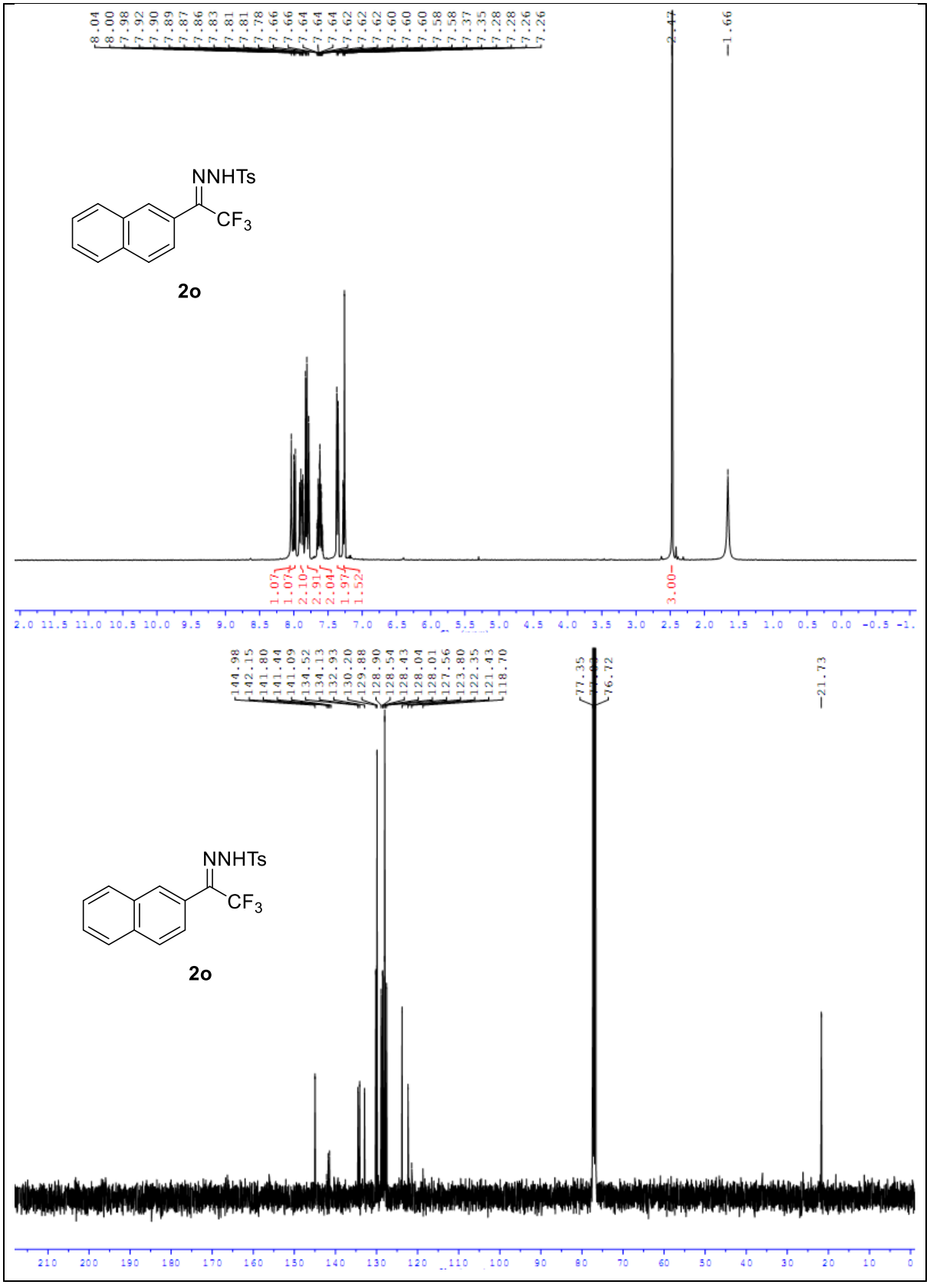
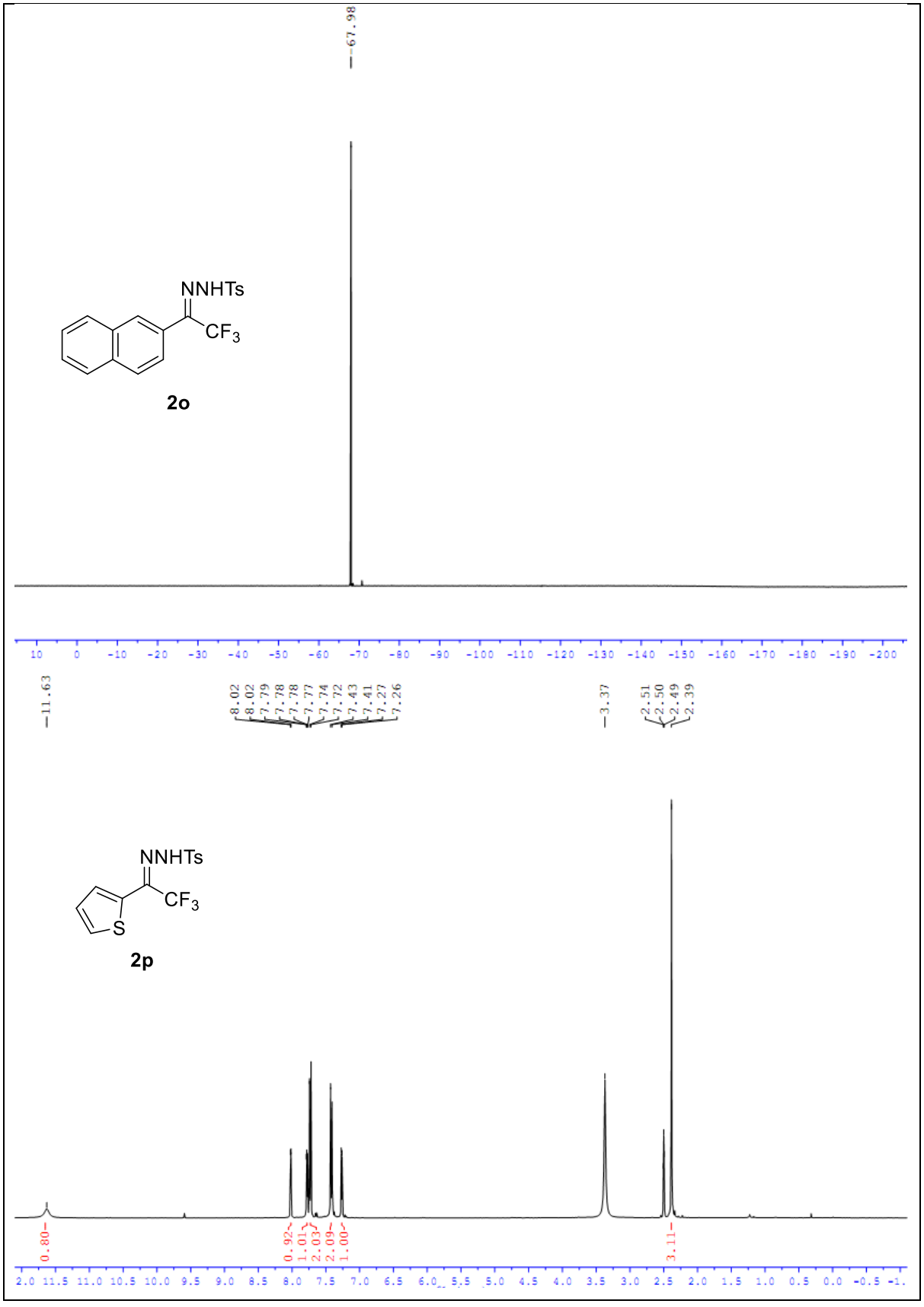
f1 (ppm)

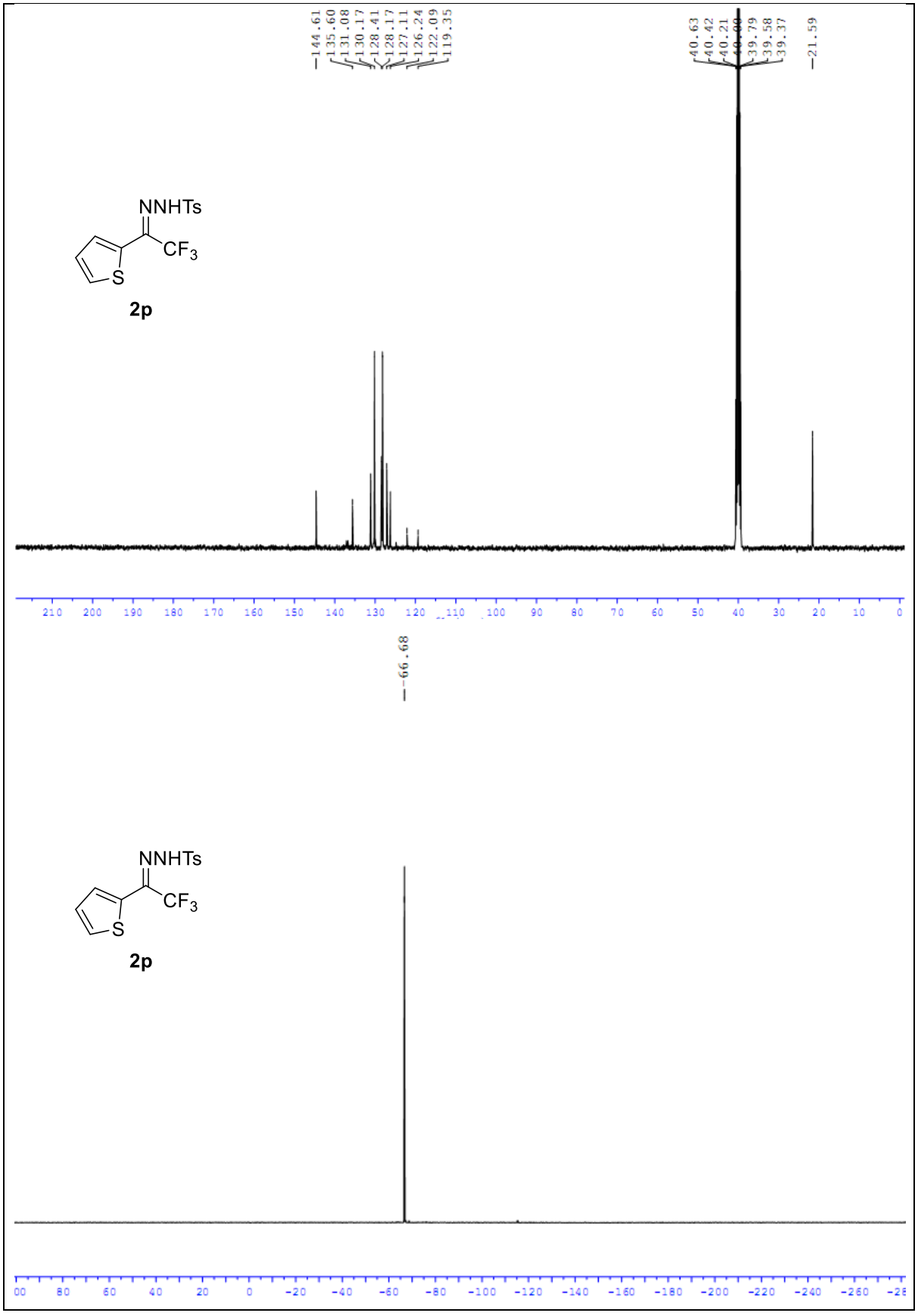

NNHTs
CF3
Cl
2m
NNHTs
CF3
Cl
2m


-68.24
NNHTs
CF3
Cl
2m
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)
7.91
7.83
7.81
7.69
7.67
7.37
7.35
7.26
7.15
7.13
2.46
1.62
NNHTs
CF3
Br
2n
1.03
2.03
2.00
2.06
1.97
3.00
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.

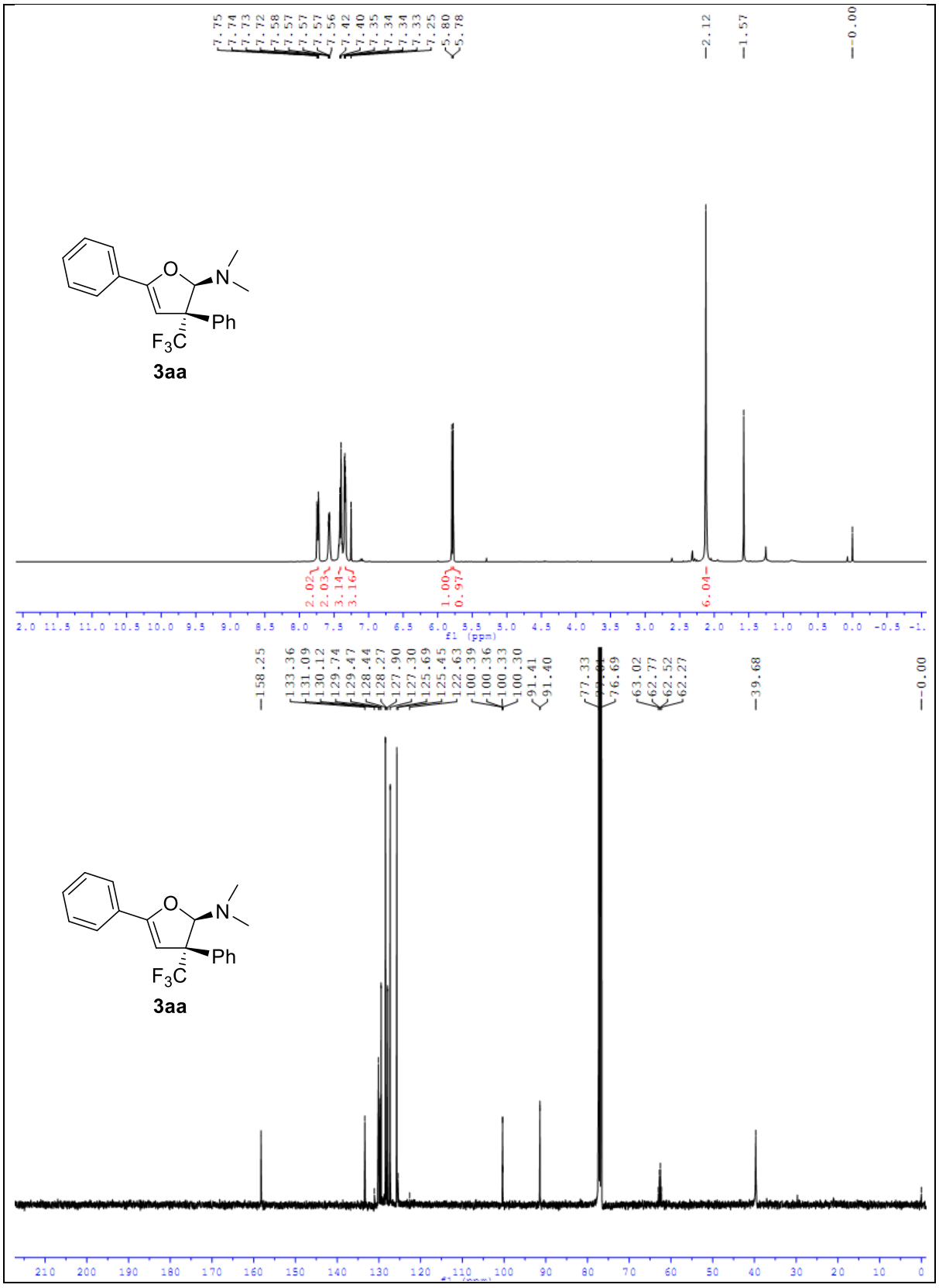

145.13
140.74
140.39
140.03
139.67
134.34
133.40
133.14
129.92
129.83
128.04
126.43
123.92
121.10
118.37
77.35
77.03
76.71
21.73
NNHTs
CF3
Br
2n
68.23
NNHTs
CF3
Br
2n
f1 (ppm)

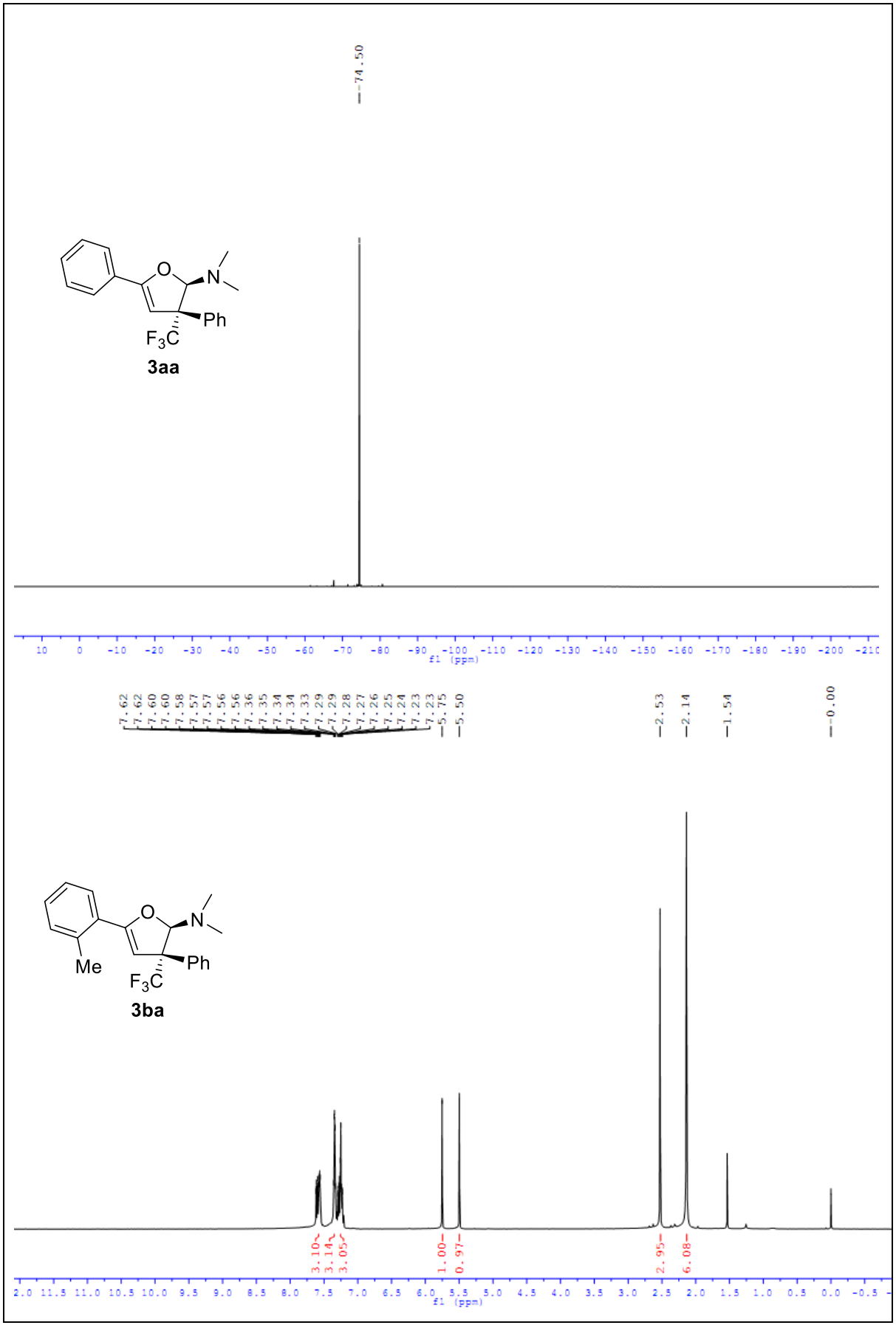

NNHTs
CF3
2o
NNHTs
CF3
2o

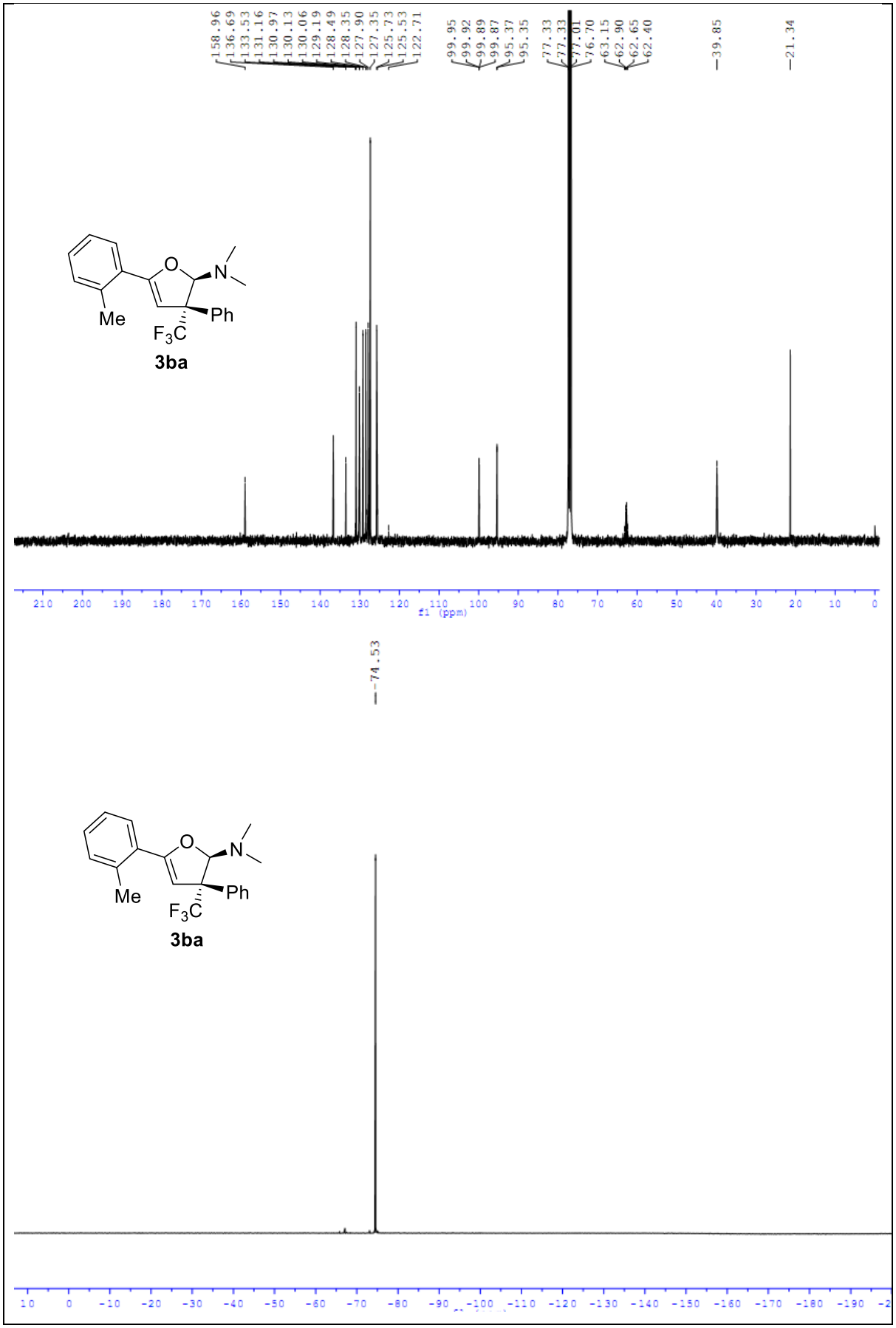

-67.98
NNHTs
CF3
2o
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
11.63
8.02
8.02
7.79
7.78
7.78
7.77
7.74
7.72
7.43
7.41
7.27
7.26
3.37
2.51
2.50
2.49
2.39
NNHTs
CF3
S
2p
0.80
0.92
1.01
2.03
2.09
1.00
3.11
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.

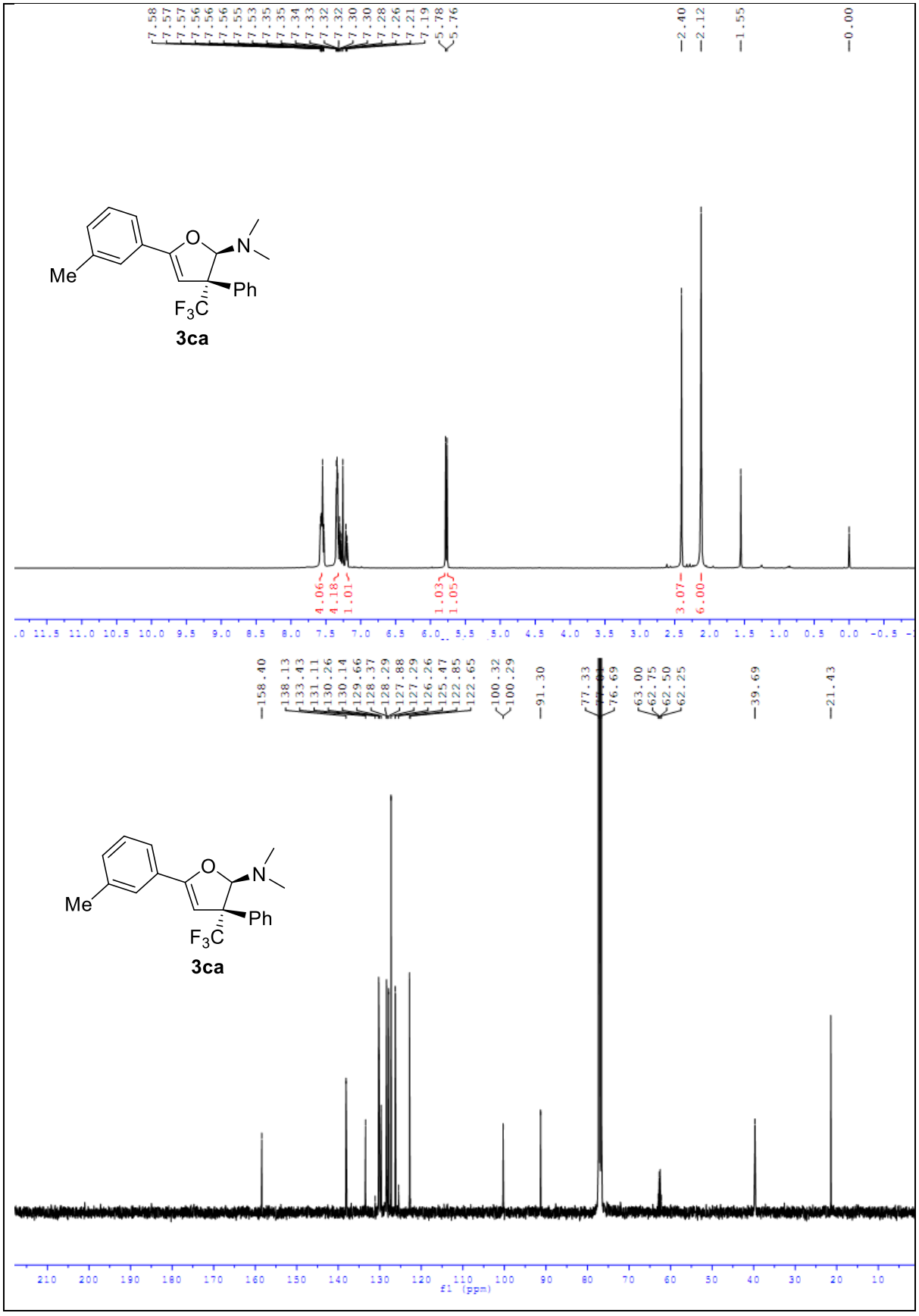

144.61
135.60
131.08
130.17
128.41
128.17
127.11
126.24
122.09
119.35
40.63
40.42
40.21
40.00
39.79
39.58
39.37
21.59
NNHTs
CF3
S
2p
66.68
NNHTs
CF3
S
2p

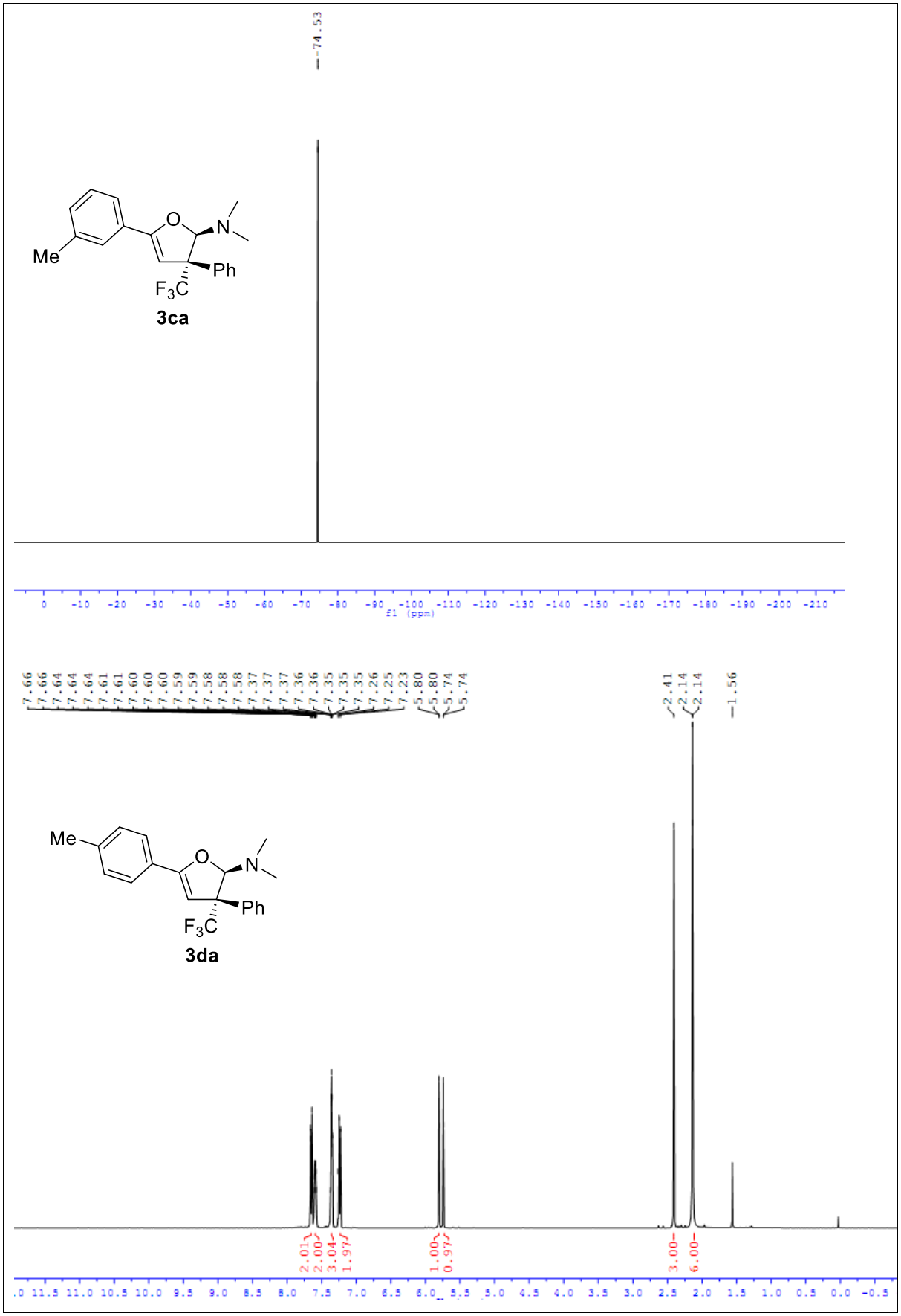
NMR spectra of 2*H*-furans

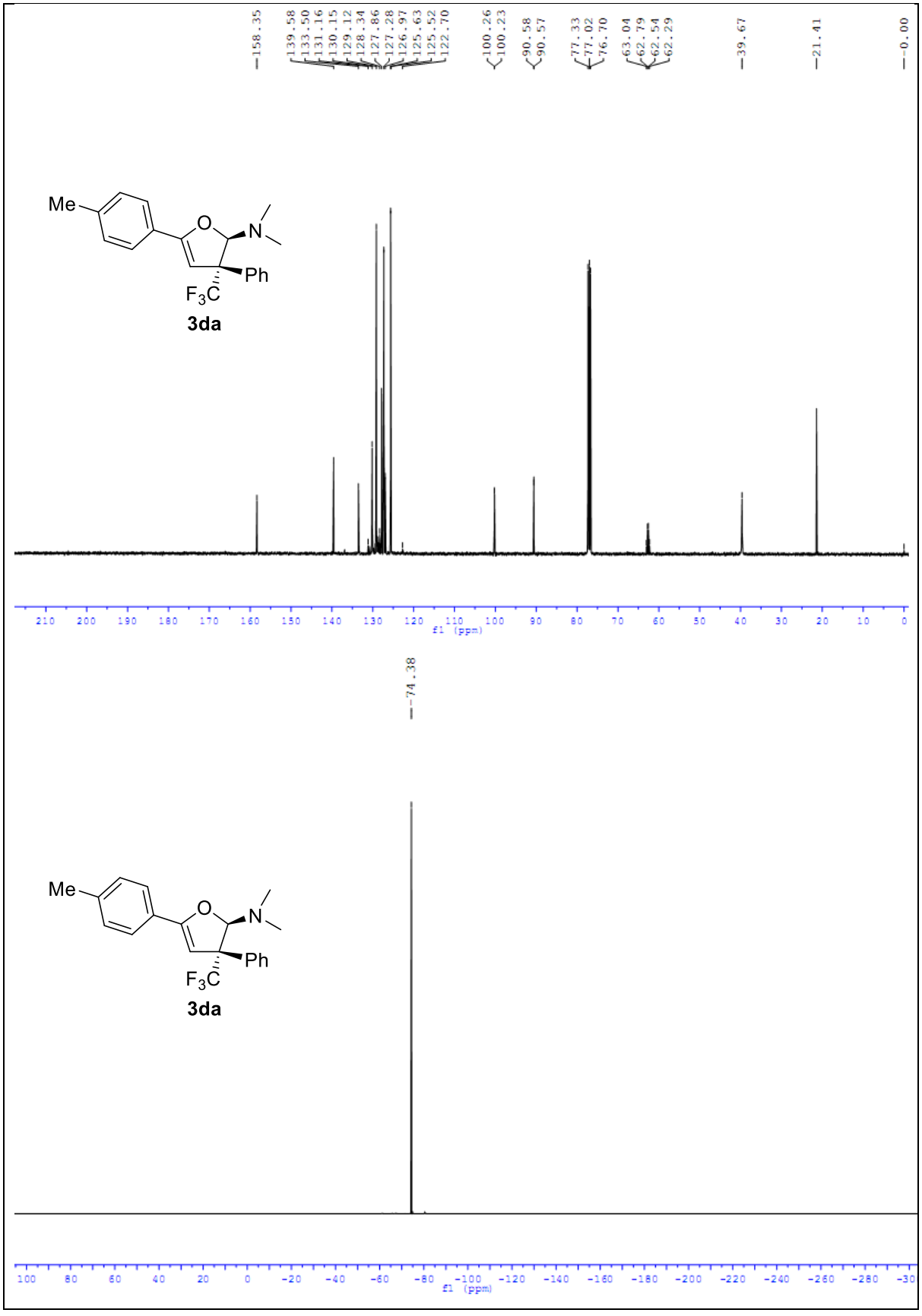


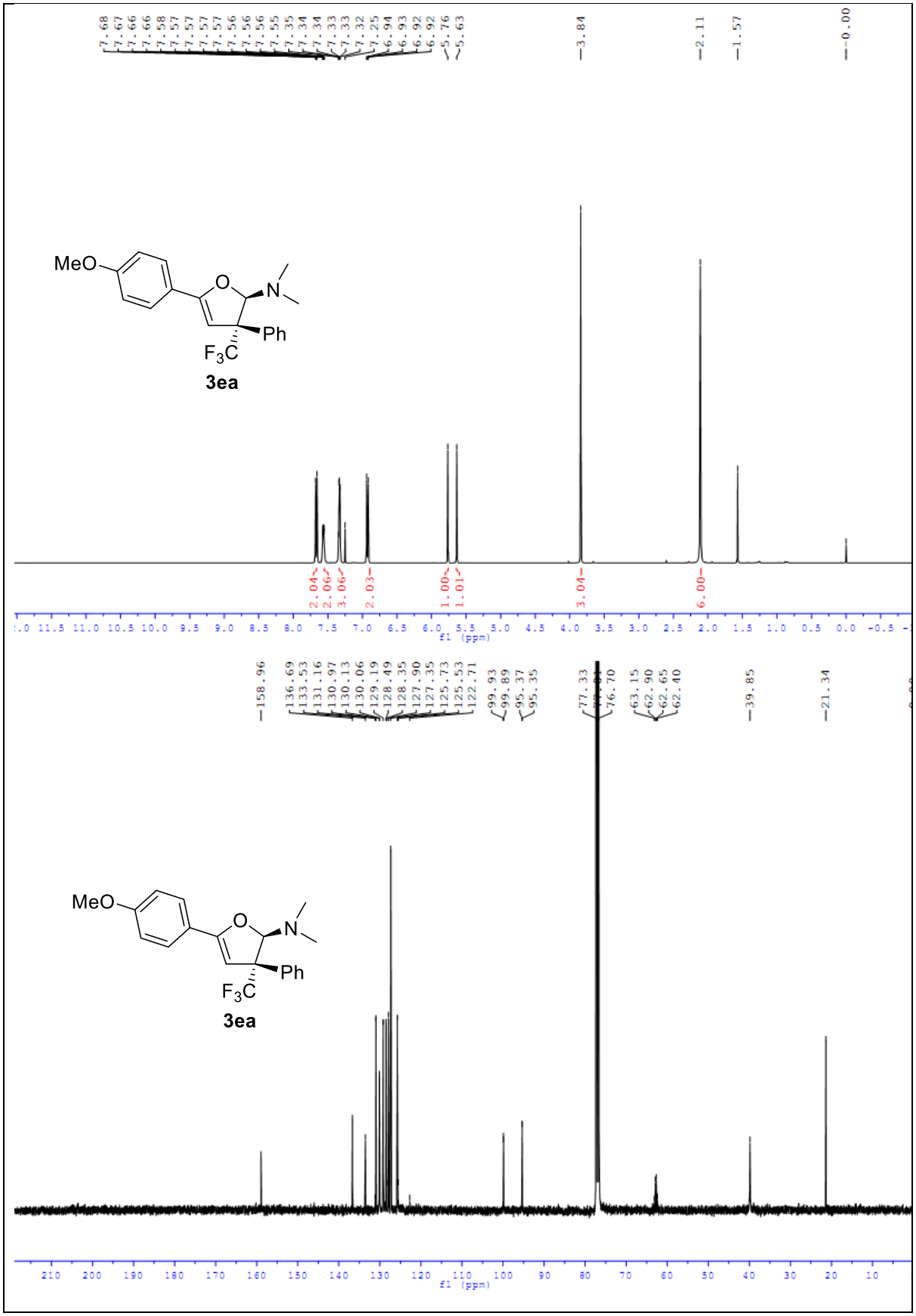

-74.50
O
N
Ph
F3C
3aa
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
7.62 7.62 7.60 7.60 7.58 7.57 7.57 7.56 7.56 7.36 7.35 7.34 7.34 7.33 7.29 7.29 7.28 7.27 7.26 7.25 7.24 7.23 7.23
5.75
5.50
2.53
2.14
1.54
0.00
O
N
Me
Ph
F3C
3ba
3.10
3.14
3.05
1.00
0.97
2.95
6.08
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

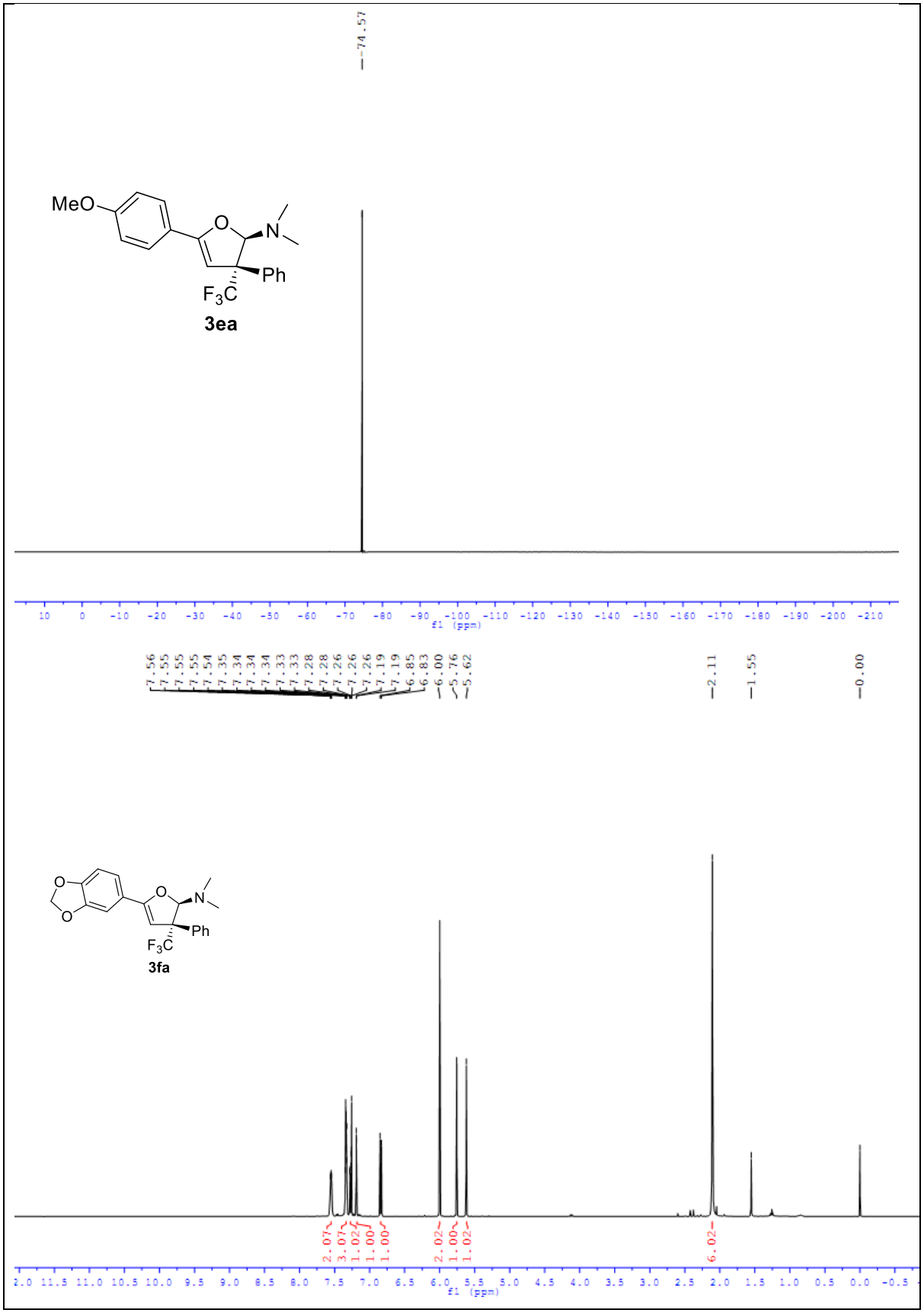

158.96
136.69
133.53
131.16
130.97
130.13
130.06
129.19
128.49
128.35
127.90
127.35
125.73
125.53
122.71
99.95
99.92
99.89
99.87
95.37
95.35
77.33
77.33
77.01
76.70
63.15
62.90
62.65
62.40
39.85
21.34
O
N
Me
Ph
F3C
3ba
f1 (ppm)
-74.53
O
N
Me
Ph
F3C
3ba

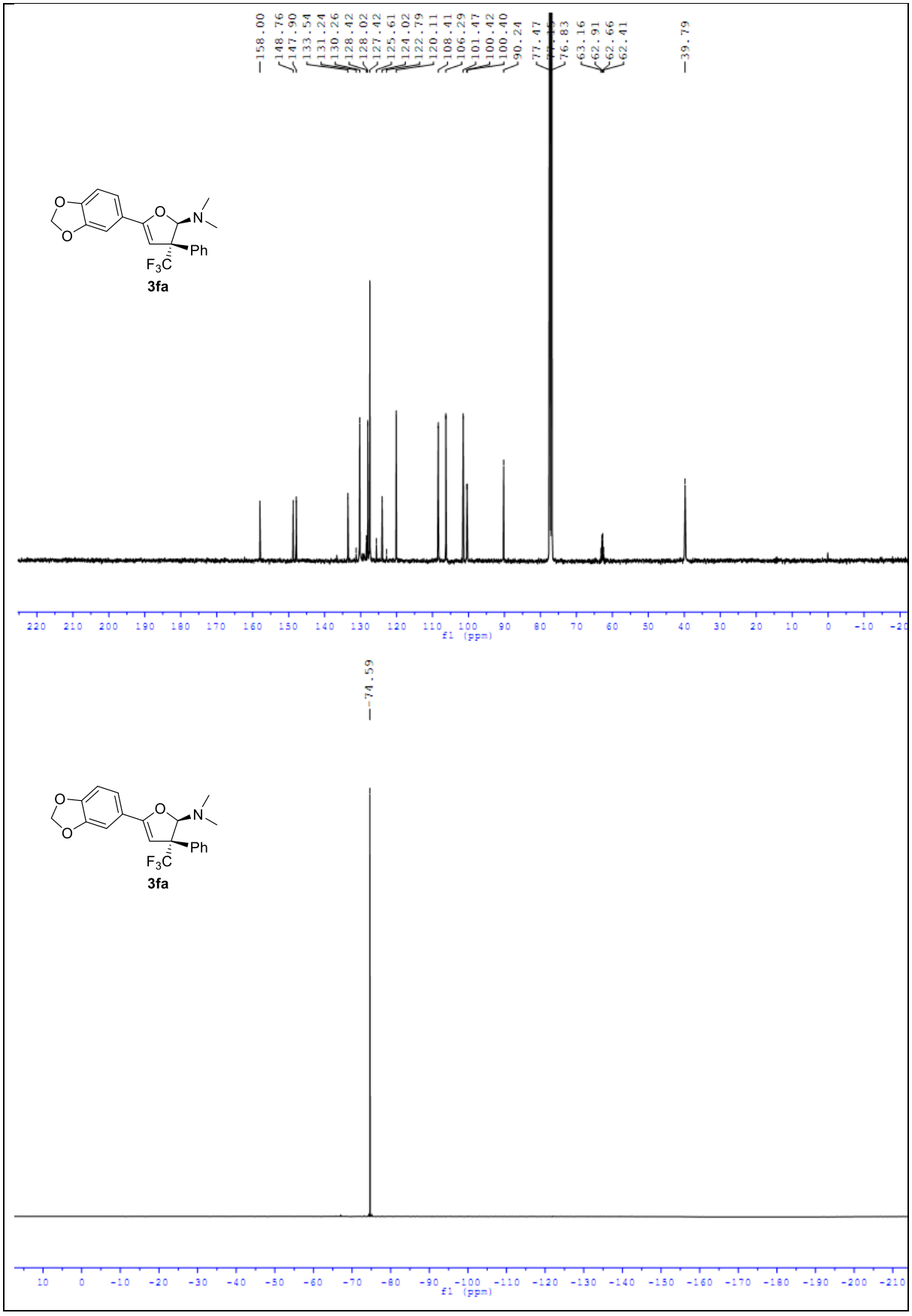

7.58
7.57
7.57
7.56
7.56
7.56
7.55
7.53
7.35
7.35
7.34
7.33
7.32
7.32
7.30
7.30
7.28
7.26
7.21
7.19
5.78
5.76
2.40
2.12
1.55
0.00
Me
O
N
Ph
F3C
3ca
4.06
4.18
1.01
1.03
1.05
3.07
6.00
158.40
138.13
133.43
131.11
130.26
130.14
129.66
128.37
128.29
127.88
127.29
126.26
125.47
122.85
122.65
100.32
100.29
91.30
77.33
76.69
63.00
62.75
62.50
62.25
39.69
21.43
Me
O
N
Ph
F3C
3ca
f1 (ppm)

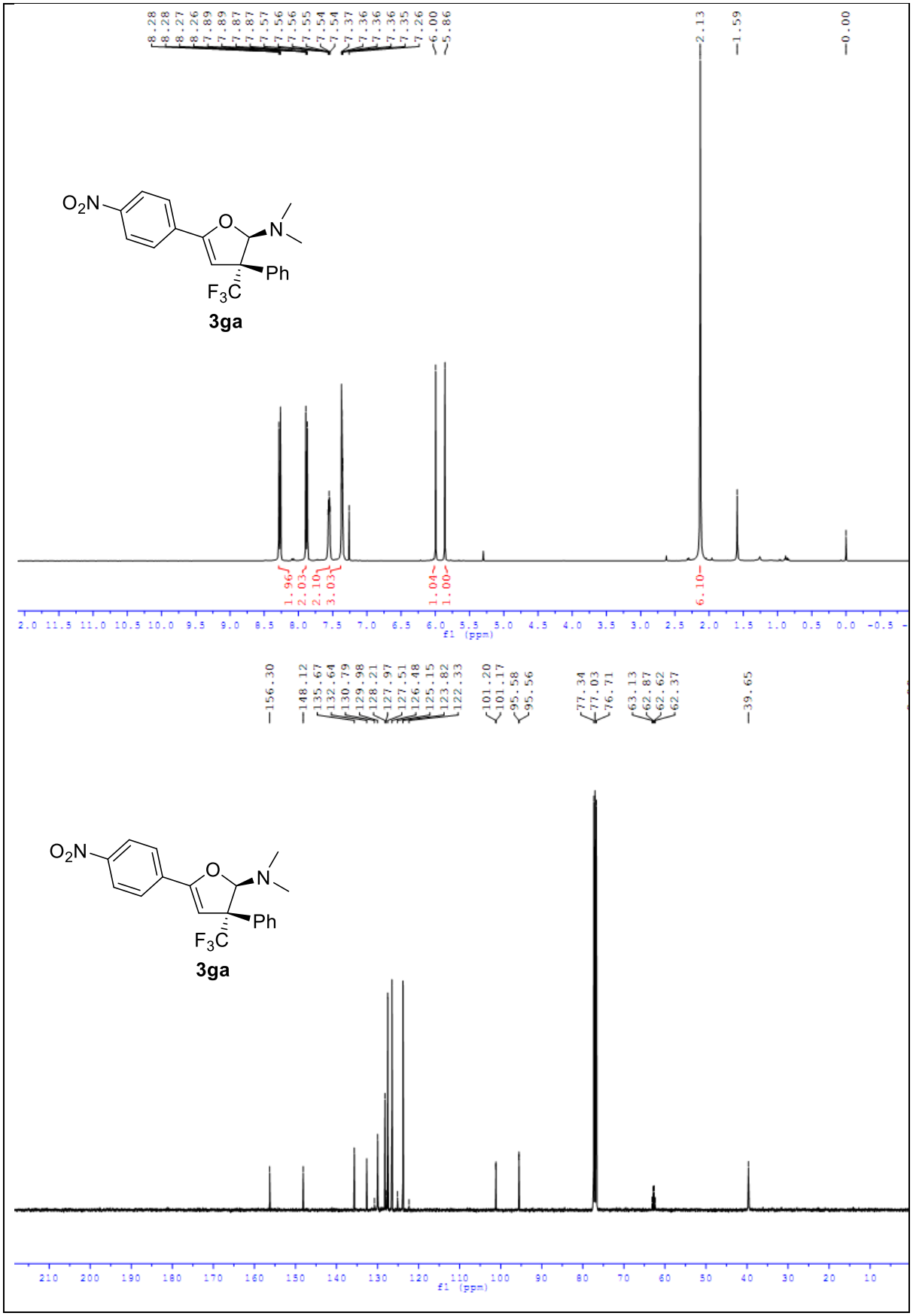

-74.53
Me
O
N
Ph
F3C
3ca
f1 (ppm)
7.66
7.66
7.64
7.64
7.64
7.61
7.61
7.60
7.60
7.60
7.59
7.59
7.58
7.58
7.58
7.37
7.37
7.37
7.36
7.36
7.35
7.35
7.35
7.26
7.25
7.23
5.80
5.80
5.74
5.74
2.41
2.14
2.14
1.56
Me
O
N
Ph
F3C
3da
2.01
2.00
3.04
1.97
1.00
0.97
3.00
6.00

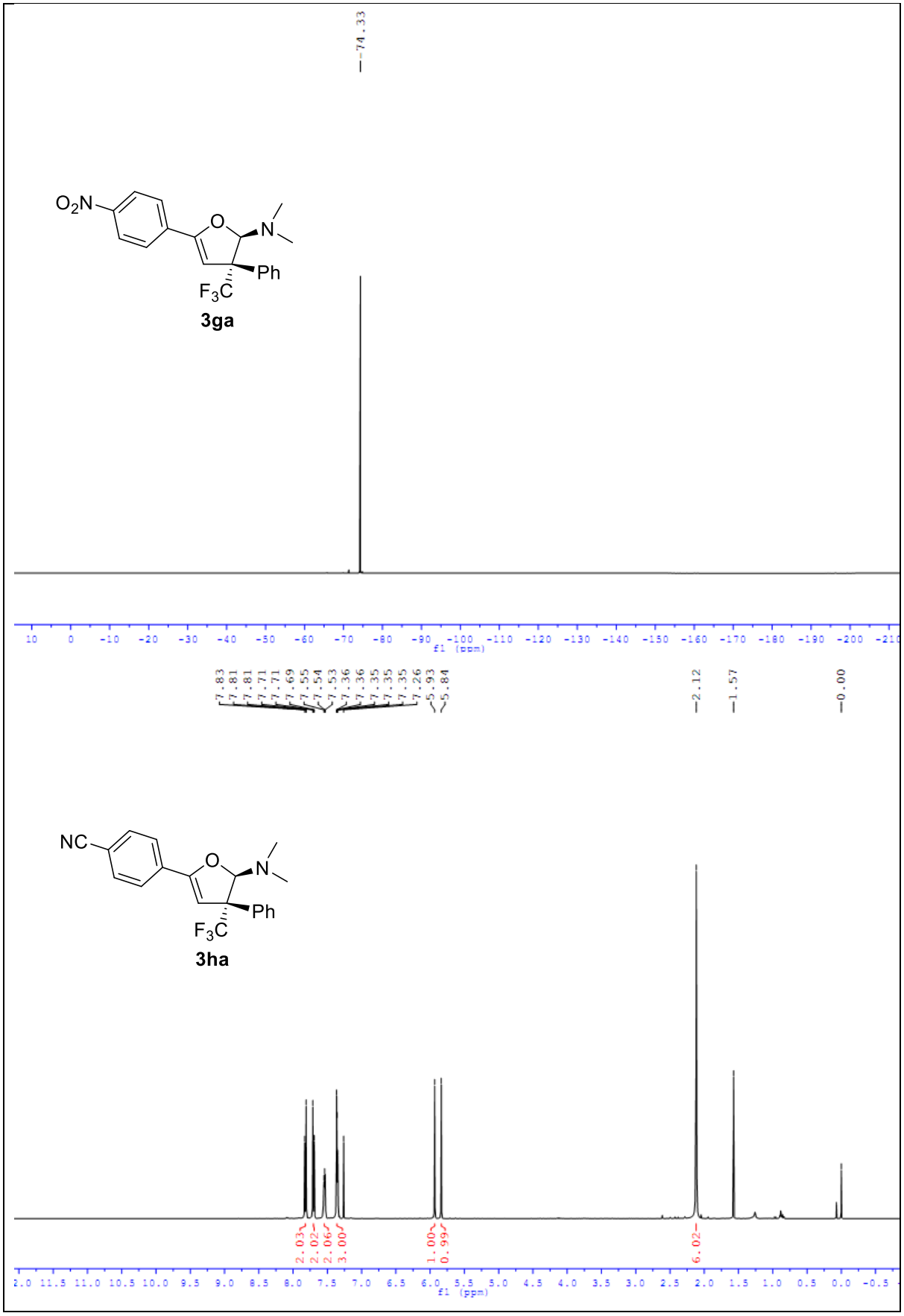

158.35
139.58
133.50
131.16
130.15
129.12
128.34
127.86
127.28
126.97
125.63
125.52
122.70
100.26
100.23
90.58
90.57
77.33
77.02
76.70
63.04
62.79
62.54
62.29
39.67
21.41
0.00
Me
O
N
Ph
F3C
3da
f1 (ppm)
-74.38
Me
O
N
Ph
F3C
3da
f1 (ppm)

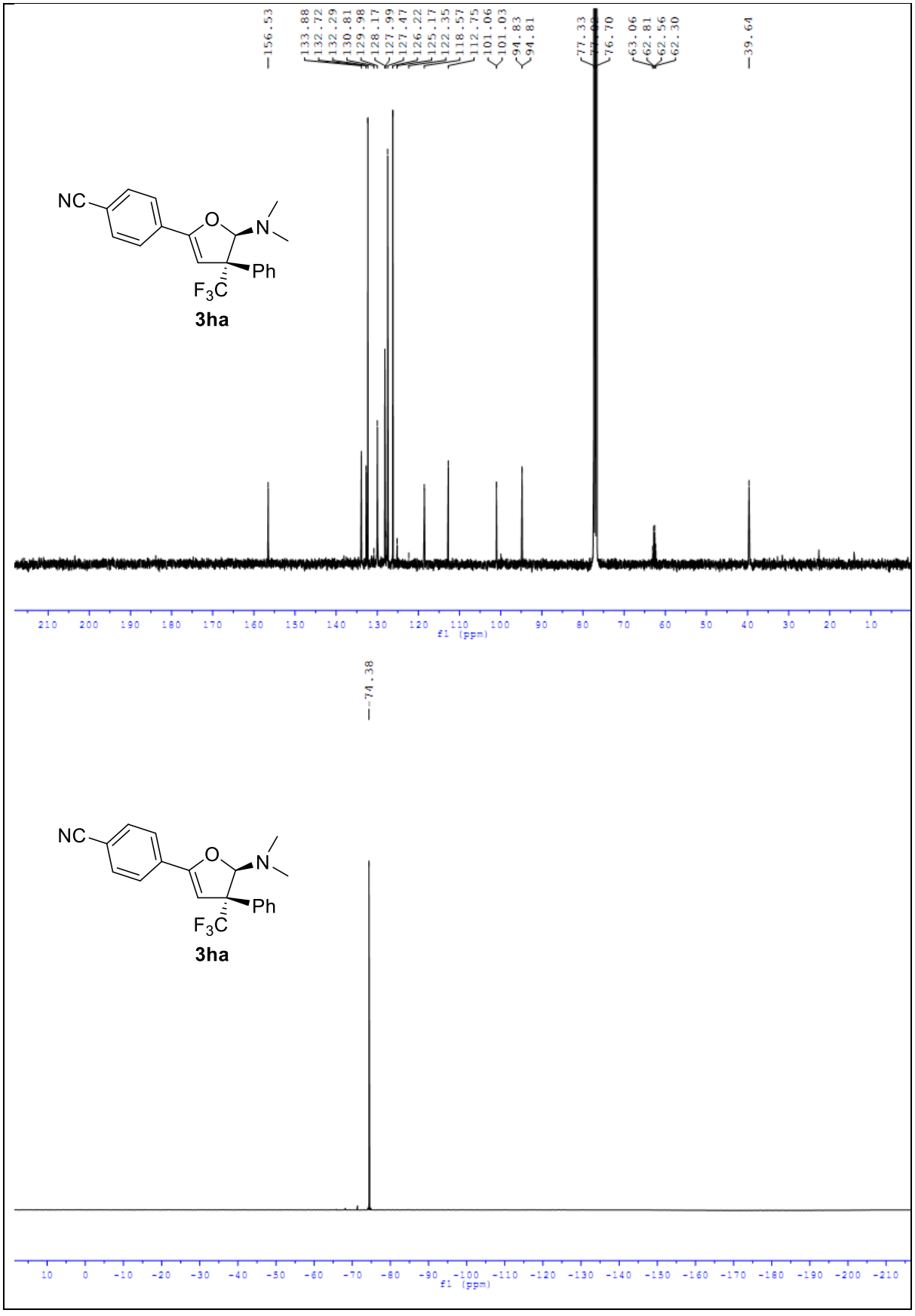

MeO
O
N
Ph
F3C
3ea
MeO
O
N
Ph
F3C
3ea

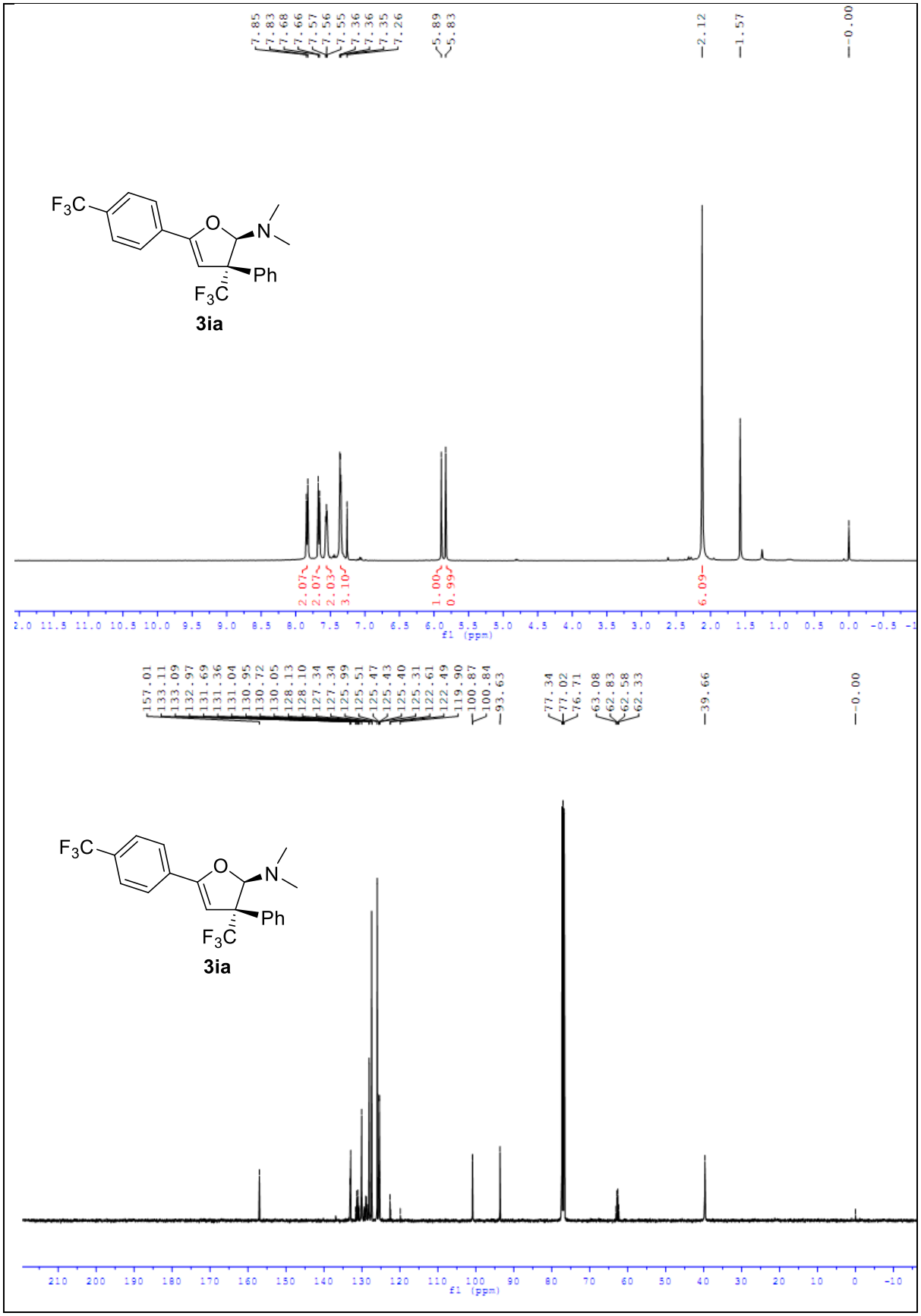

-74.57
MeO
O
N
Ph
F3C
3ea
f1 (ppm)
7.56
7.55
7.55
7.55
7.54
7.35
7.34
7.34
7.34
7.33
7.33
7.28
7.28
7.26
7.26
7.26
7.19
7.19
6.85
6.83
6.00
5.76
5.62
2.11
1.55
0.00
O
O
O
N
Ph
F3C
3fa
2.07
3.07
1.02
1.00
1.00
2.02
1.00
1.02
6.02
f1 (ppm)

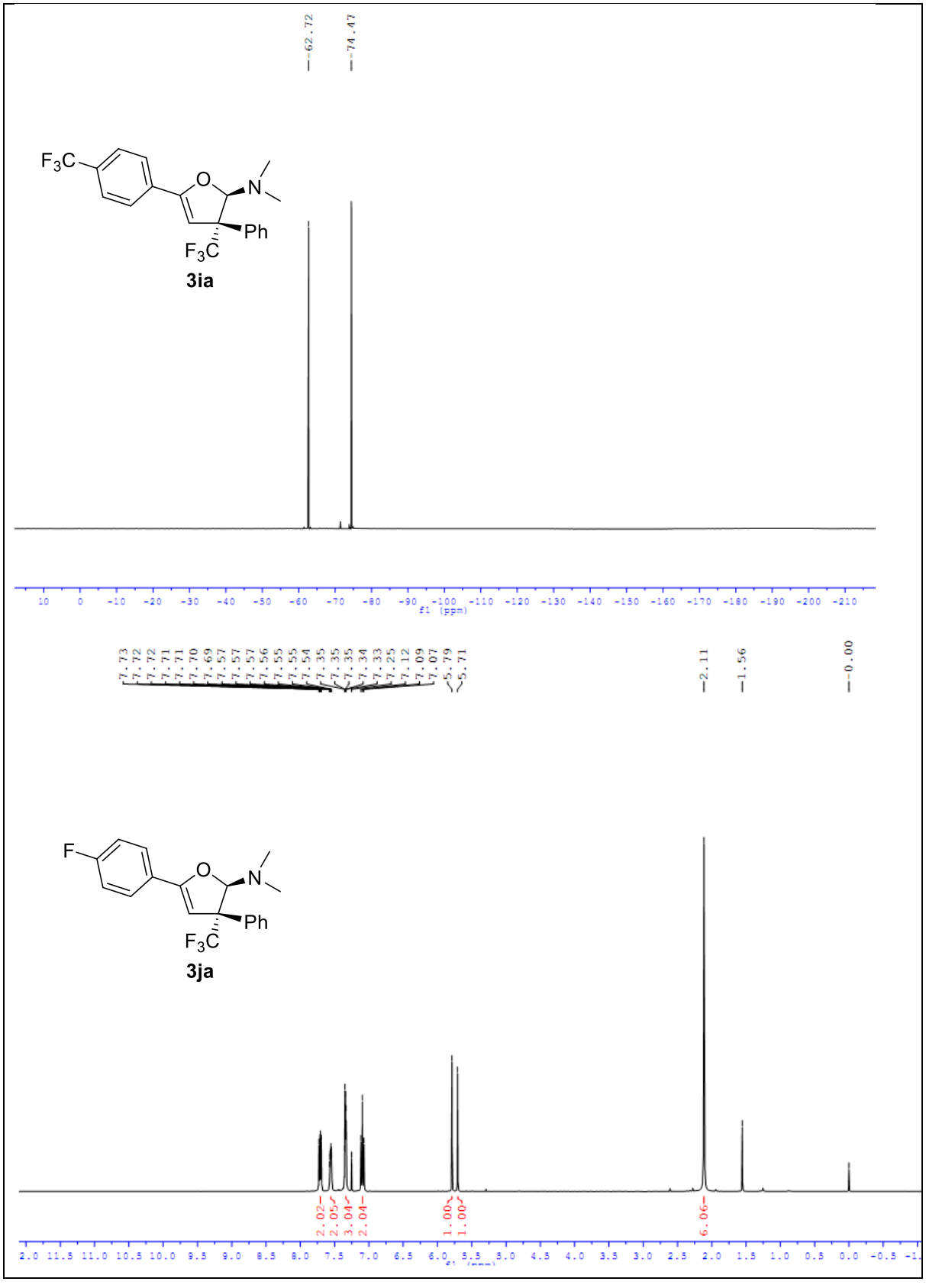

158.00
148.76
147.90
133.54
131.24
130.26
128.42
128.02
127.42
125.61
124.02
122.79
120.11
108.41
106.29
101.47
100.42
100.40
90.24
77.47
76.83
63.16
62.91
62.66
62.41
39.79
O
O
O
N
Ph
F3C
3fa
f1 (ppm)
-74.59
O
O
O
N
Ph
F3C
3fa
f1 (ppm)

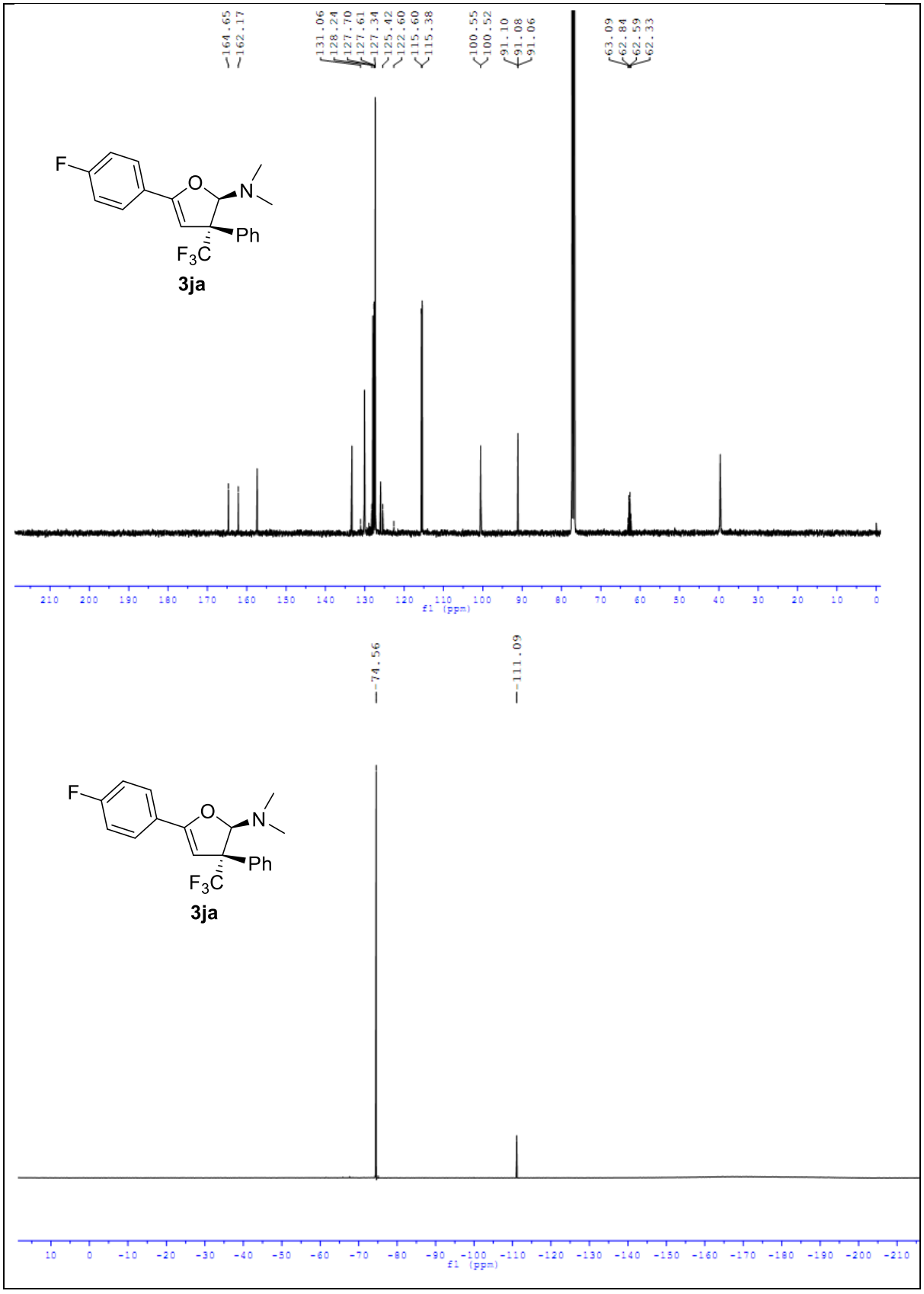

8.28
8.28
8.27
8.26
7.89
7.89
7.87
7.87
7.57
7.56
7.56
7.55
7.54
7.54
7.37
7.36
7.36
7.35
7.26
6.00
5.86
2.13
1.59
0.00
O2N
O
N
Ph
F3C
3ga
1.96
2.03
2.10
3.03
1.04
1.00
6.10
f1 (ppm)
156.30
148.12
135.67
132.64
130.79
129.98
128.21
127.97
127.51
126.48
125.15
123.82
122.33
101.20
101.17
95.58
95.56
77.34
77.03
76.71
63.13
62.87
62.62
62.37
39.65
O2N
O
N
Ph
F3C
3ga
f1 (ppm)


-74.33
O2N
O
N
Ph
F3C
3ga
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
7.83
7.81
7.81
7.71
7.71
7.69
7.55
7.54
7.53
7.36
7.35
7.35
7.35
7.26
5.93
5.84
2.12
1.57
0.00
NC
O
N
Ph
F3C
3ha
2.03
2.02
2.06
3.00
1.00
0.99
6.02
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


156.53
133.88
132.72
132.29
130.81
129.98
128.17
127.99
127.47
126.22
125.17
122.35
118.57
112.75
101.06
101.03
94.83
94.81
77.33
76.70
63.06
62.81
62.56
62.30
39.64
NC
O
N
Ph
F3C
3ha
f1 (ppm)
74.38
NC
O
N
Ph
F3C
3ha
f1 (ppm)


7.85
7.83
7.68
7.66
7.57
7.56
7.55
7.36
7.35
7.26
5.89
5.83
2.12
1.57
0.00
F3C
O
N
Ph
F3C
3ia
2.07
2.07
2.03
3.10
1.00
0.99
6.09
f1 (ppm)
157.01
133.11
133.09
132.97
131.69
131.36
131.04
130.95
130.72
130.05
128.13
128.10
127.34
127.34
125.99
125.51
125.47
125.43
125.40
125.31
122.61
122.49
119.90
100.87
100.84
93.63
77.34
77.02
76.71
63.08
62.83
62.58
62.33
39.66
0.00
F3C
O
N
Ph
F3C
3ia
f1 (ppm)


-62.72
-74.47
F3C
O
N
Ph
F3C
3ia
7.73
7.72
7.72
7.71
7.71
7.70
7.69
7.57
7.57
7.57
7.56
7.55
7.55
7.54
7.35
7.35
7.35
7.34
7.33
7.25
7.12
7.09
7.07
5.79
5.71
2.11
1.56
0.00
F
O
N
Ph
F3C
3ja
2.02
2.05
3.04
2.04
1.00
1.00
6.06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127.70
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125.42
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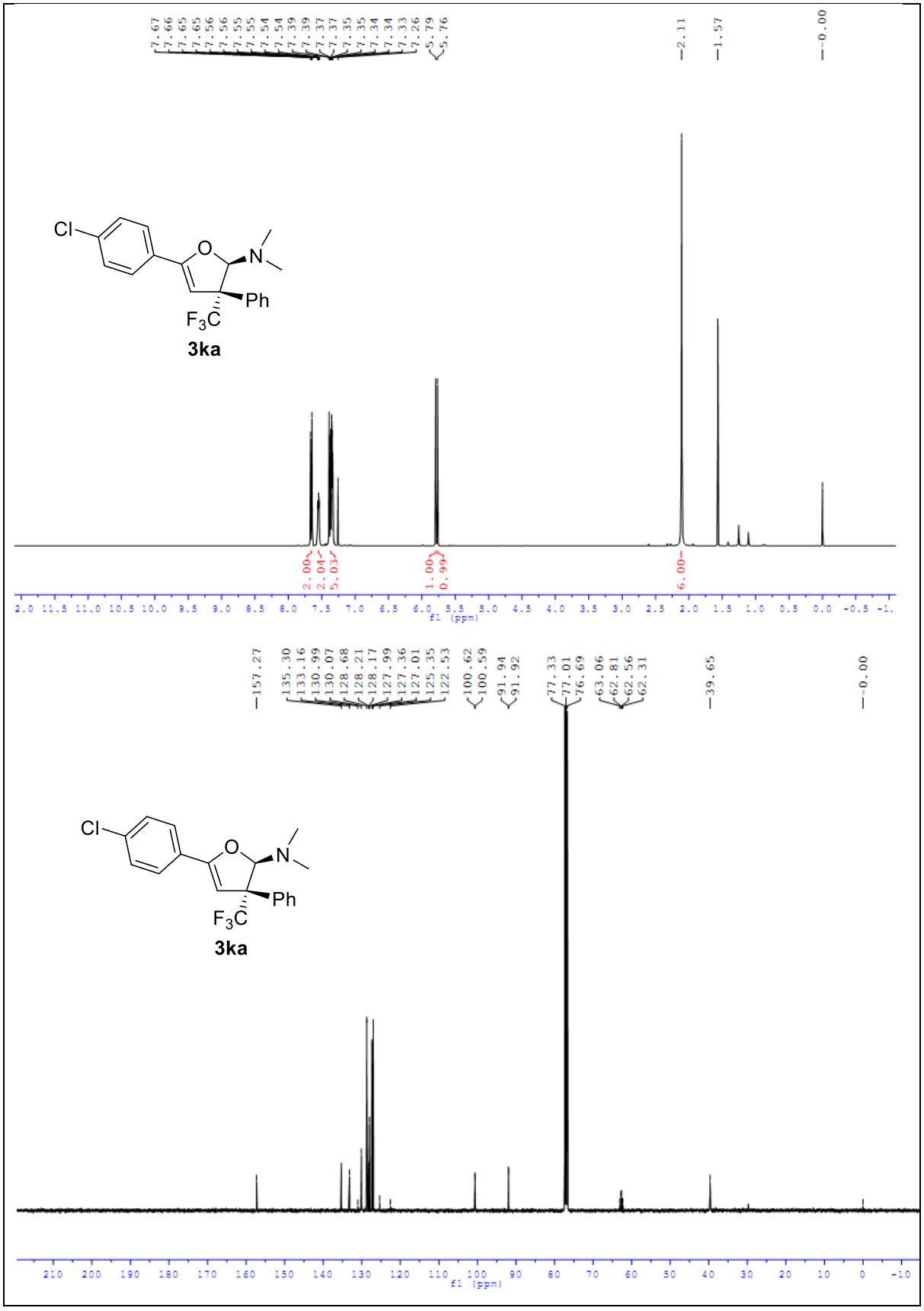
115.60
115.38
100.55
100.52
91.10
91.08
91.06
63.09
62.84
62.59
62.33
F
O
N
Ph
F3C
3ja
f1 (ppm)
-74.56
-111.09
F
O
N
Ph
F3C
3ja
f1 (ppm)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7.55
7.55
7.54
7.54
7.39
7.39
7.37
7.37
7.35
7.35
7.34
7.34
7.33
7.26
5.79
5.76
2.11
1.57
0.00
Cl
O
N
Ph
F3C
3ka
2.00
2.04
5.03
1.00
0.99
6.00
f1 (ppm)
157.27
135.30
133.16
130.99
130.07
128.68
128.21
128.17
127.99
127.36
127.01
125.35
122.53
100.62
100.59
91.94
91.92
77.33
77.01
76.69
63.06
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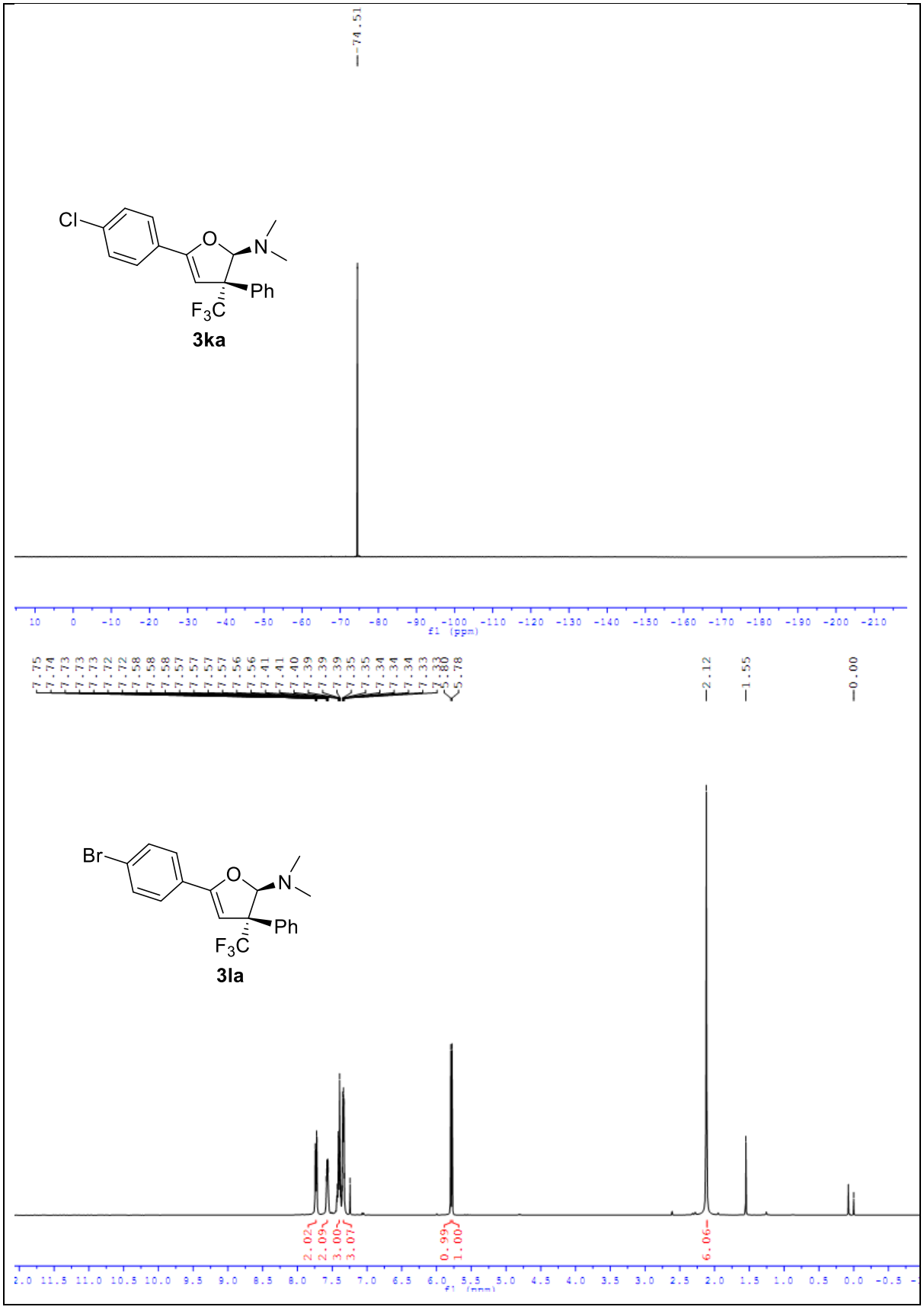
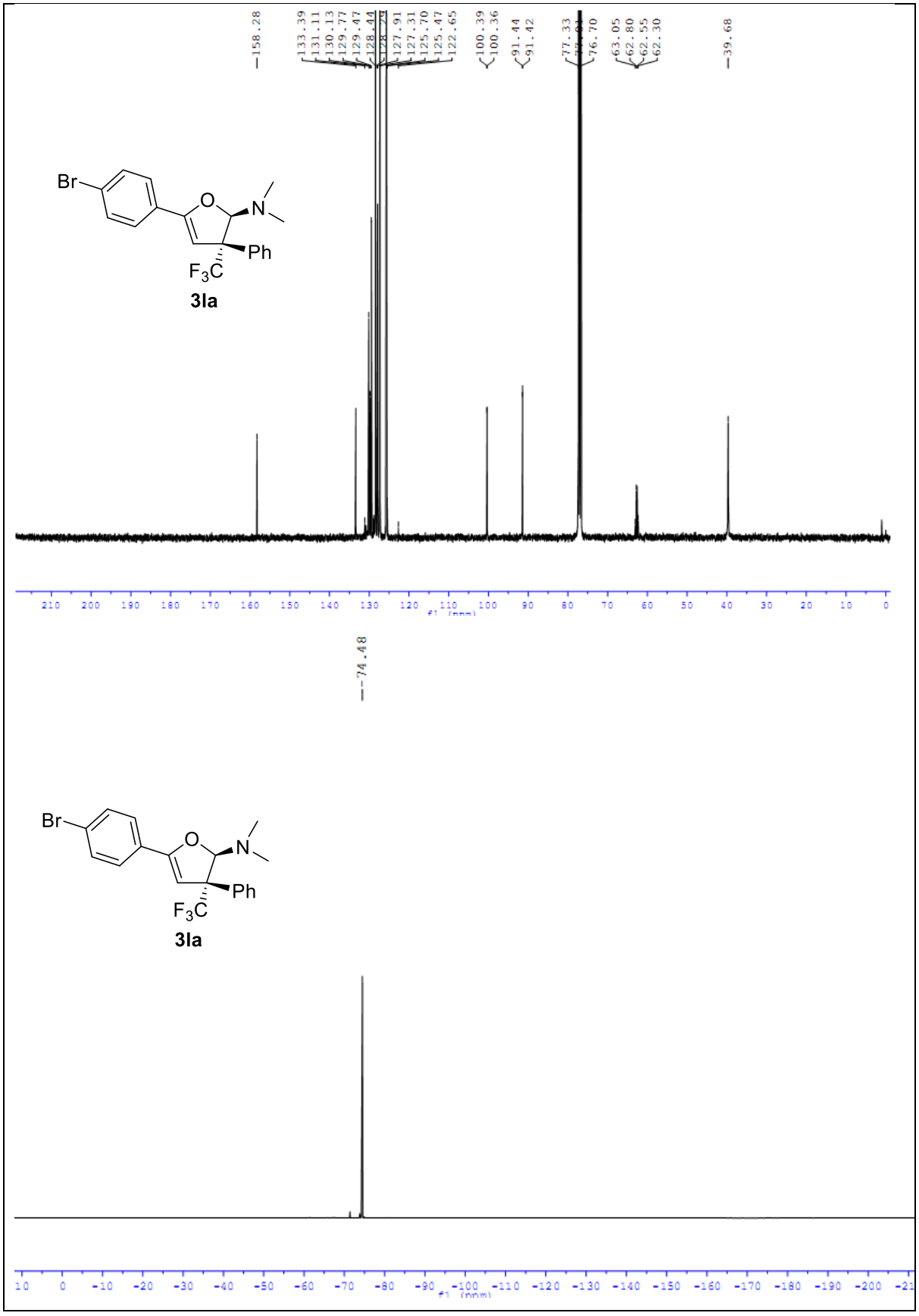
62.56
62.31
39.65
0.00
Cl
O
N
Ph
F3C
3ka
f1 (ppm)


-74.51
Cl
O
N
Ph
F3C
3ka
f1 (ppm)
7.75
7.74
7.73
7.73
7.73
7.72
7.72
7.58
7.58
7.58
7.57
7.57
7.57
7.57
7.56
7.56
7.41
7.41
7.40
7.39
7.39
7.39
7.35
7.35
7.34
7.34
7.34
7.33
5.80
5.78
2.12
1.55
0.00
Br
O
N
Ph
F3C
3la
2.02
2.09
3.00
3.07
0.99
1.00
6.06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125.47
122.65
100.39
100.36
91.44
91.42
77.33
76.70
63.05
62.80
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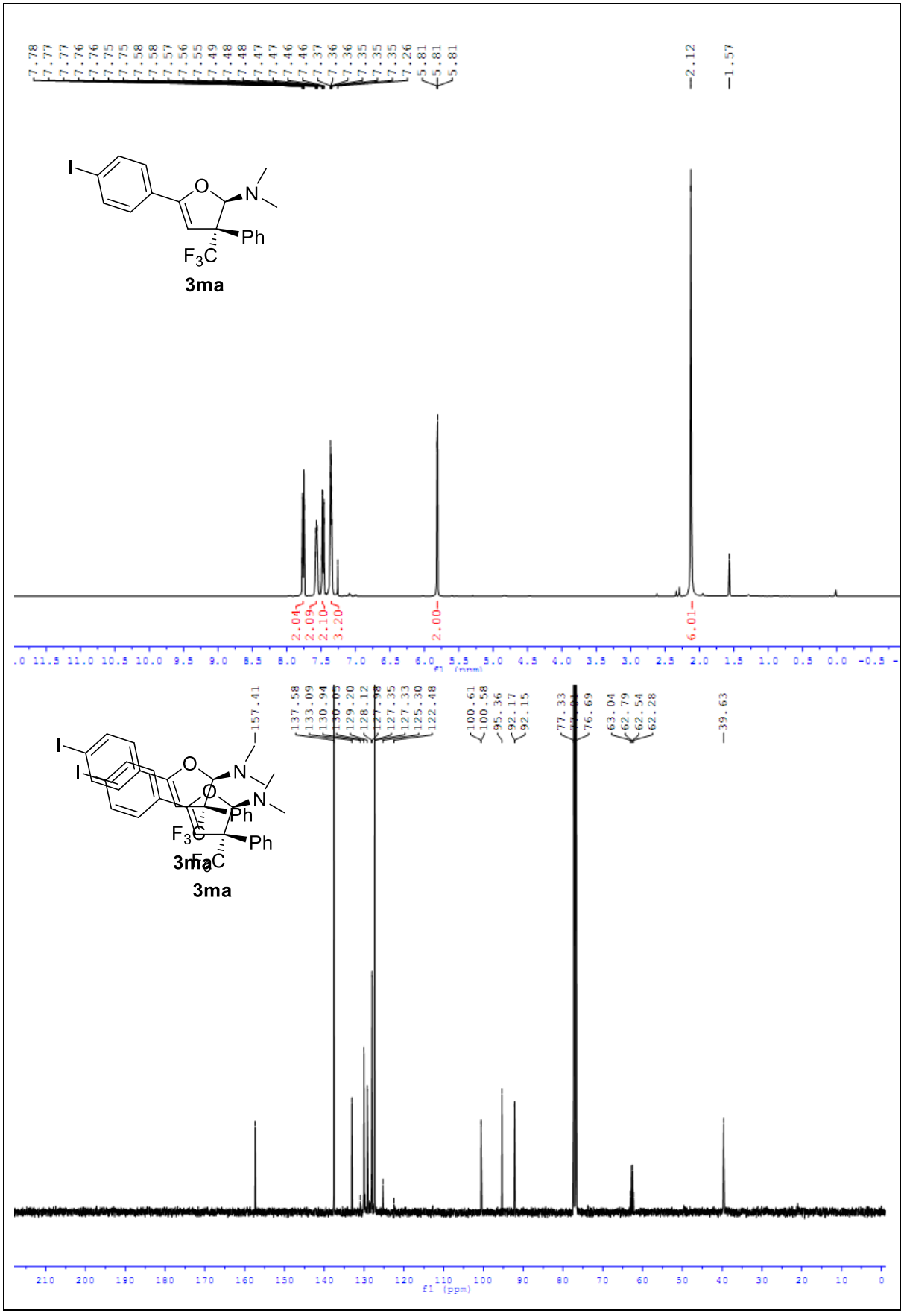
62.30
39.68
Br
O
N
Ph
F3C
3la
-74.48
Br
O
N
Ph
F3C
3la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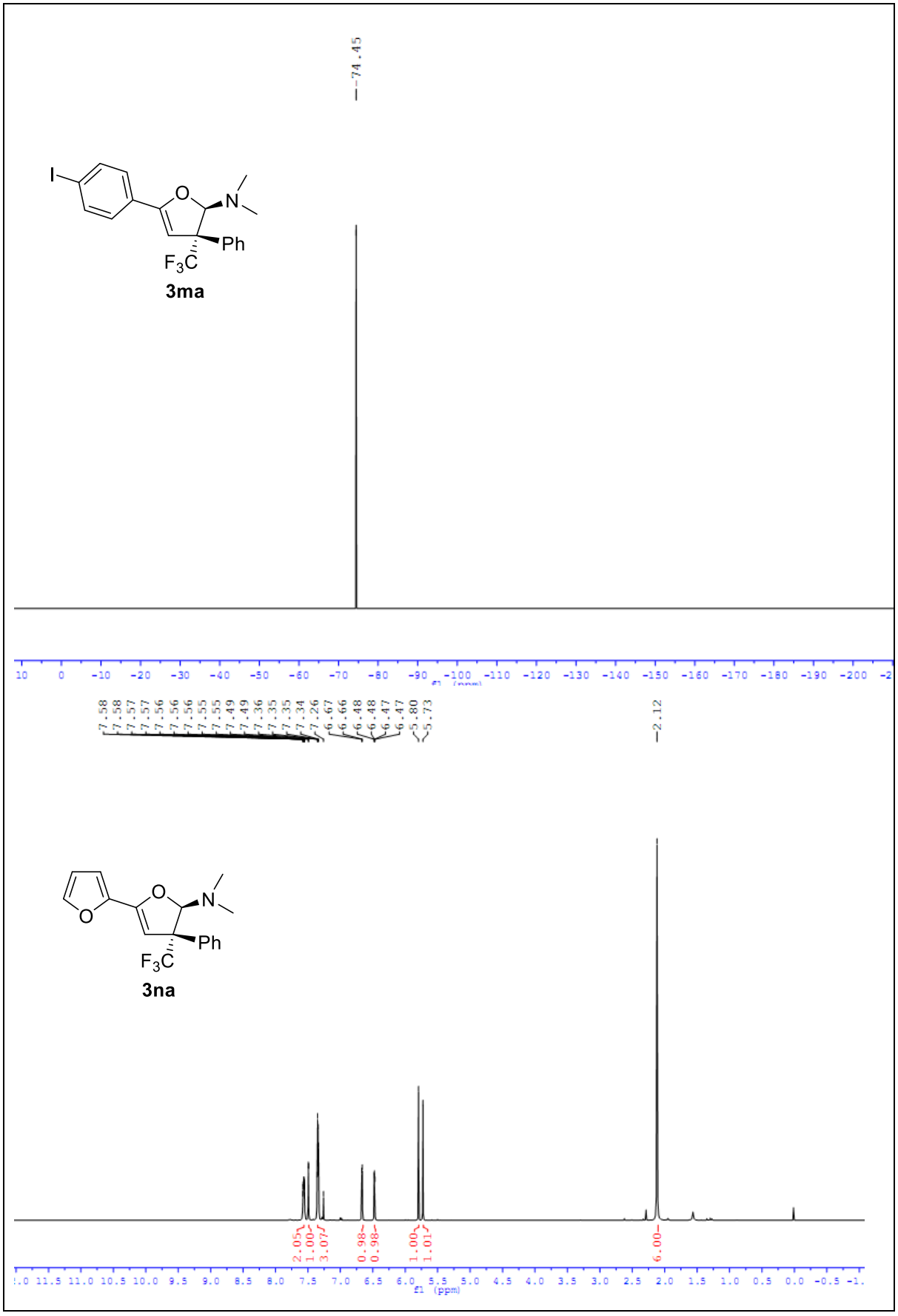
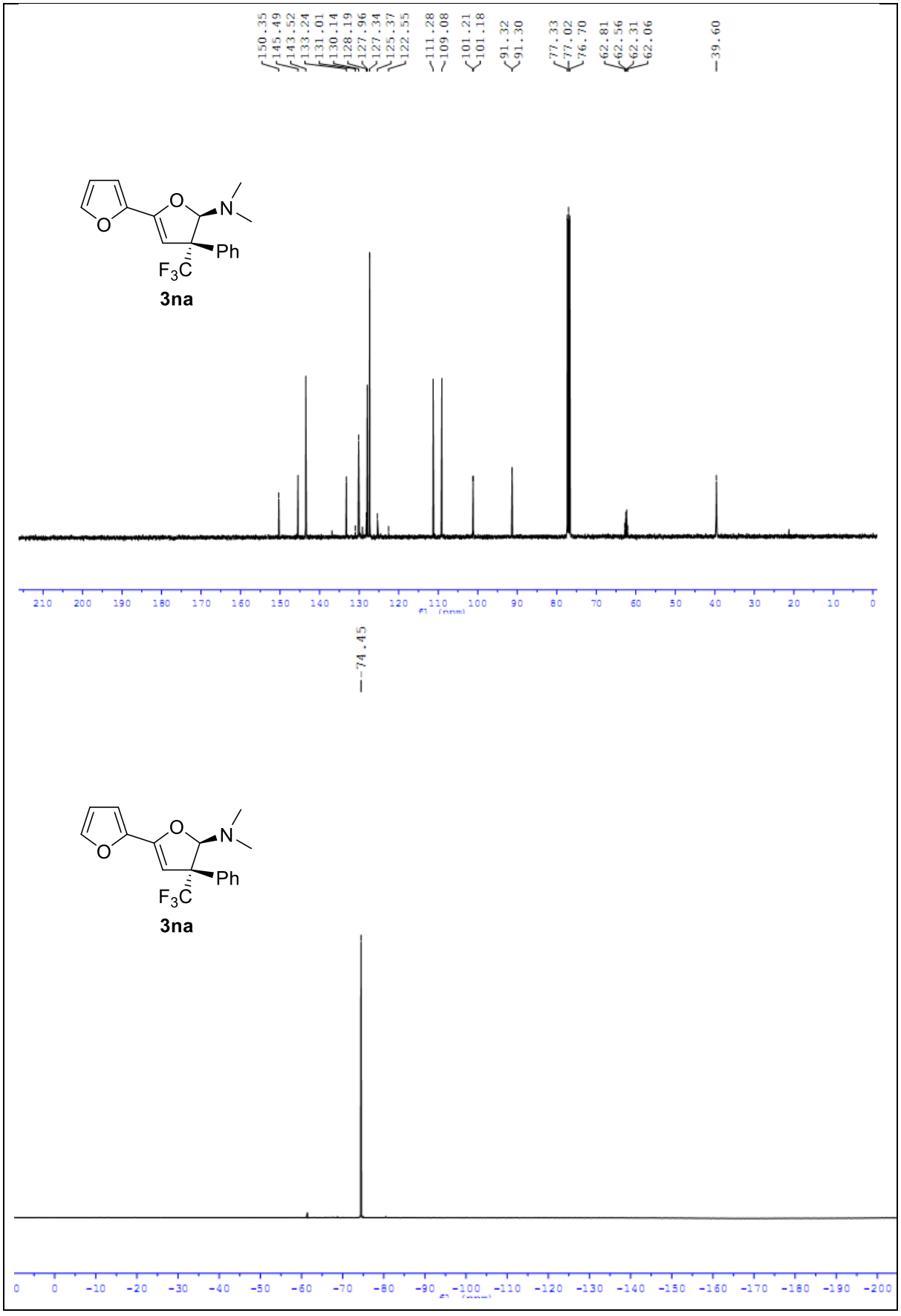
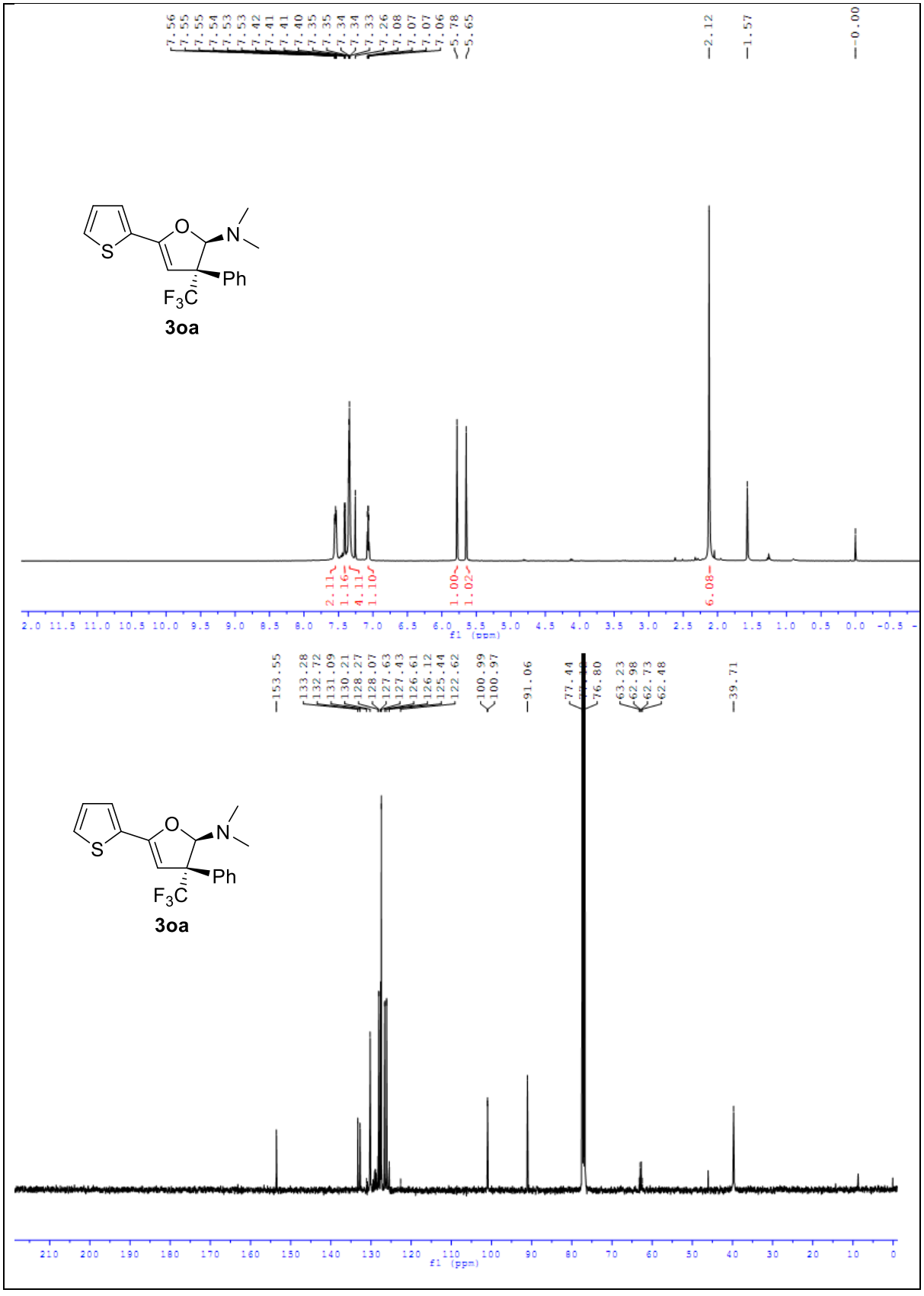
7.77
7.77
7.76
7.76
7.75
7.75
7.58
7.58
7.57
7.56
7.55
7.49
7.48
7.48
7.47
7.47
7.46
7.46
7.37
7.36
7.36
7.35
7.35
7.26
5.81
5.81
5.81
2.12
1.57
I
O
N
Ph
F3C
3ma
2.04
2.09
2.10
3.20
2.00
6.01
f1 (ppm)
157.41
137.58
133.09
130.94
130.05
129.20
128.12
127.98
127.35
127.33
125.30
122.48
100.61
100.58
95.36
92.17
92.15
77.33
77.01
76.69
63.04
62.79
62.54
62.28
39.63
I
O
N
O
N
Ph
F3C
Ph
3ma
f1 (ppm)


-74.45
I
O
N
Ph
F3C
3ma
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
7.58
7.58
7.57
7.57
7.56
7.56
7.56
7.55
7.55
7.49
7.49
7.36
7.35
7.35
7.34
7.26
6.67
6.66
6.48
6.48
6.47
6.47
5.80
5.73
2.12
O
O
N
Ph
F3C
3na
2.05
1.00
3.07
0.98
0.98
1.00
1.01
6.00
f1 (ppm)


150.35
145.49
143.52
133.24
131.01
130.14
128.19
127.96
127.34
125.37
122.55
111.28
109.08
101.21
101.18
91.32
91.30
77.33
77.02
76.70
62.81
62.56
62.31
62.06
39.60
O
N
Ph
F3C
3na
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
-74.45
O
N
Ph
F3C
3na
0 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)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7.55
7.55
7.54
7.53
7.53
7.42
7.41
7.41
7.40
7.35
7.35
7.34
7.34
7.33
7.26
7.08
7.07
7.07
7.06
5.78
5.65
2.12
1.57
0.00
O
N
S
Ph
F3C
3oa
2.11
1.16
4.11
1.10
1.00
1.02
6.08
f1 (ppm)
153.55
133.28
132.72
131.09
130.21
128.27
128.07
127.63
127.43
126.61
126.12
125.44
122.62
100.99
100.97
91.06
77.44
76.80
63.23
62.98
62.73
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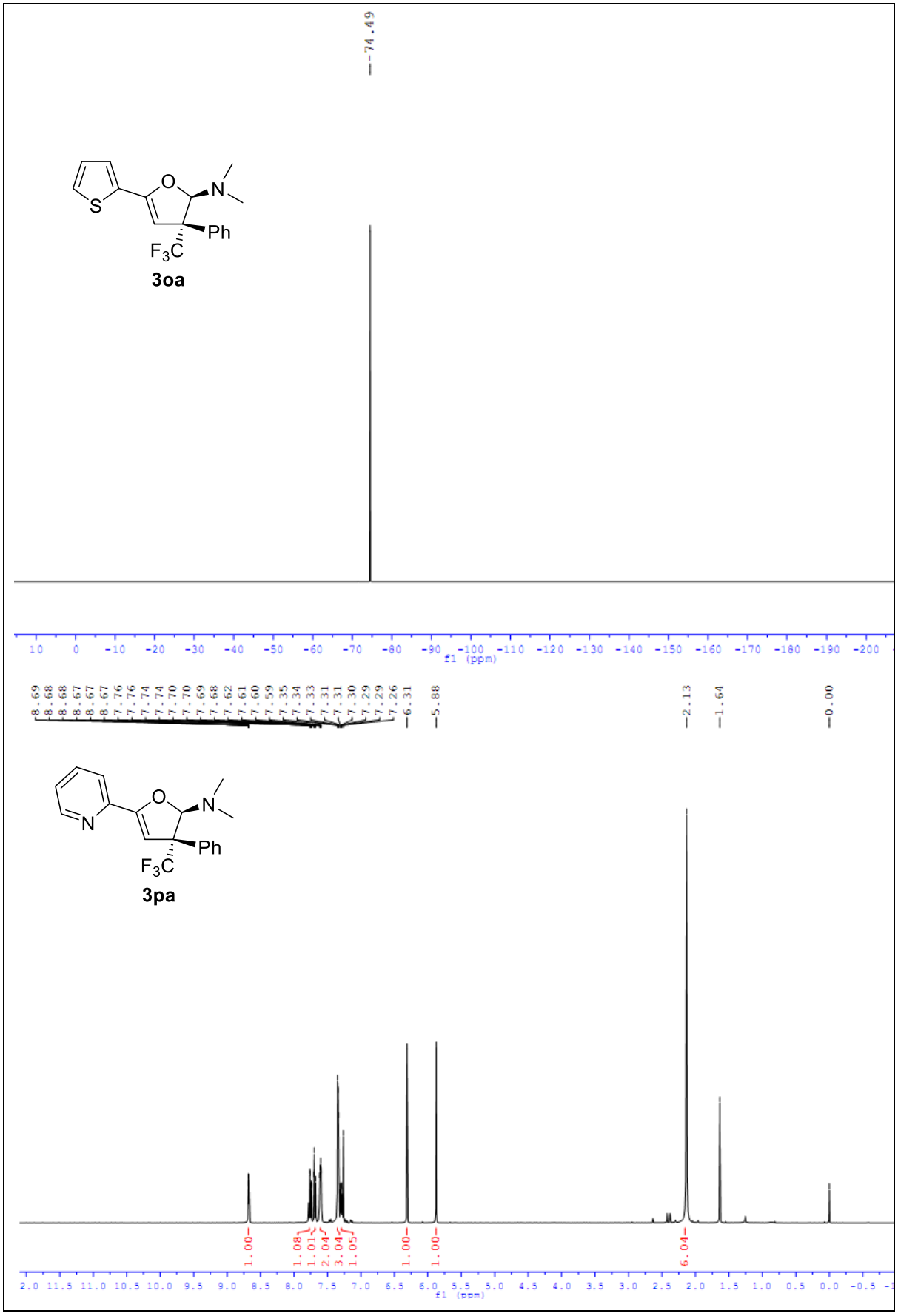
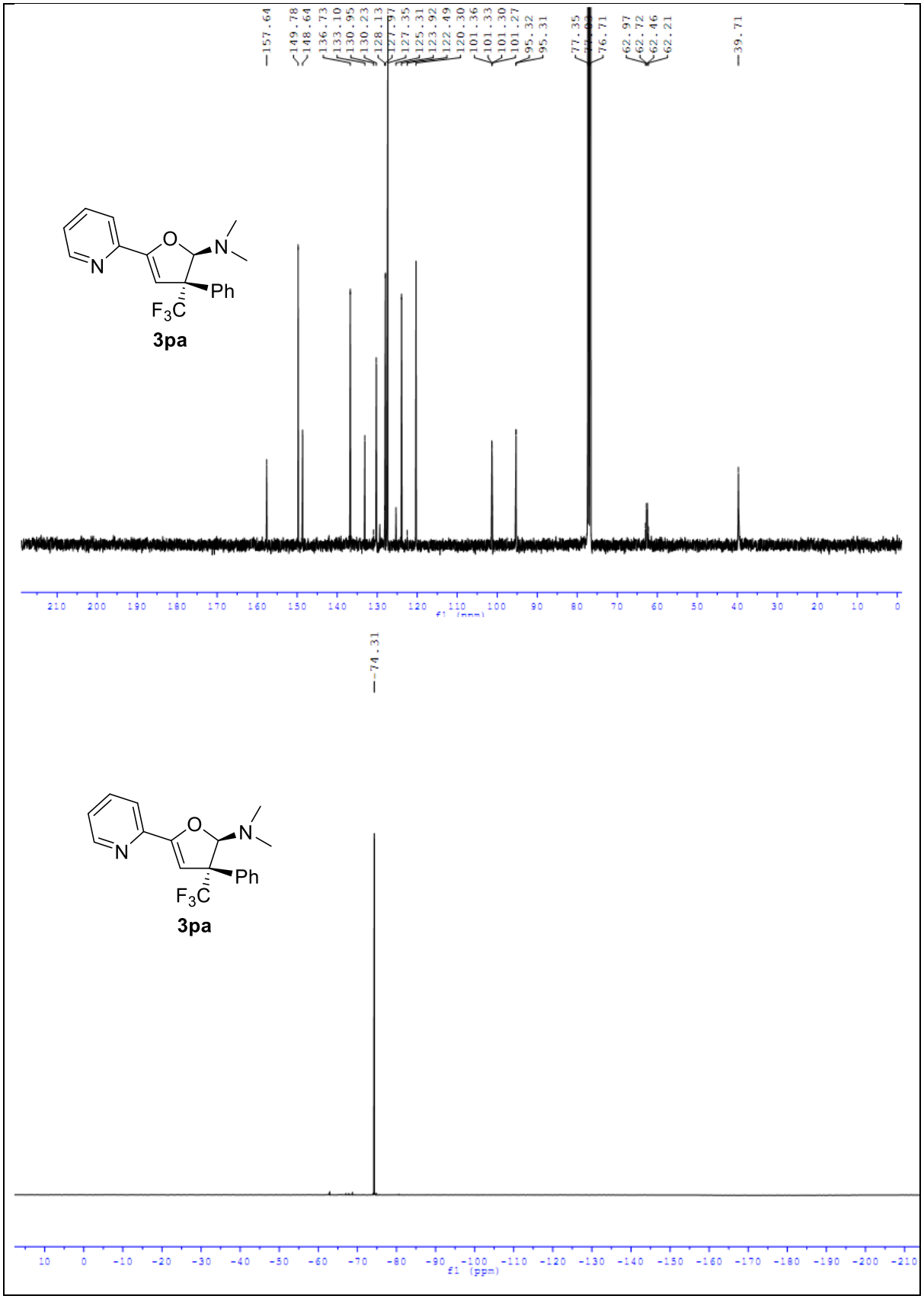
O
N
S
Ph
F3C
3oa
f1 (ppm)


-74.49
O
N
S
Ph
F3C
3oa
f1 (ppm)
8.69
8.68
8.68
8.67
8.67
8.67
7.76
7.76
7.74
7.74
7.70
7.70
7.69
7.68
7.62
7.61
7.60
7.59
7.35
7.34
7.33
7.31
7.31
7.30
7.29
7.29
7.26
6.31
5.88
2.13
1.64
0.00
O
N
N
Ph
F3C
3pa
1.00
1.08
1.01
2.04
3.04
1.05
1.00
1.00
6.04
f1 (ppm)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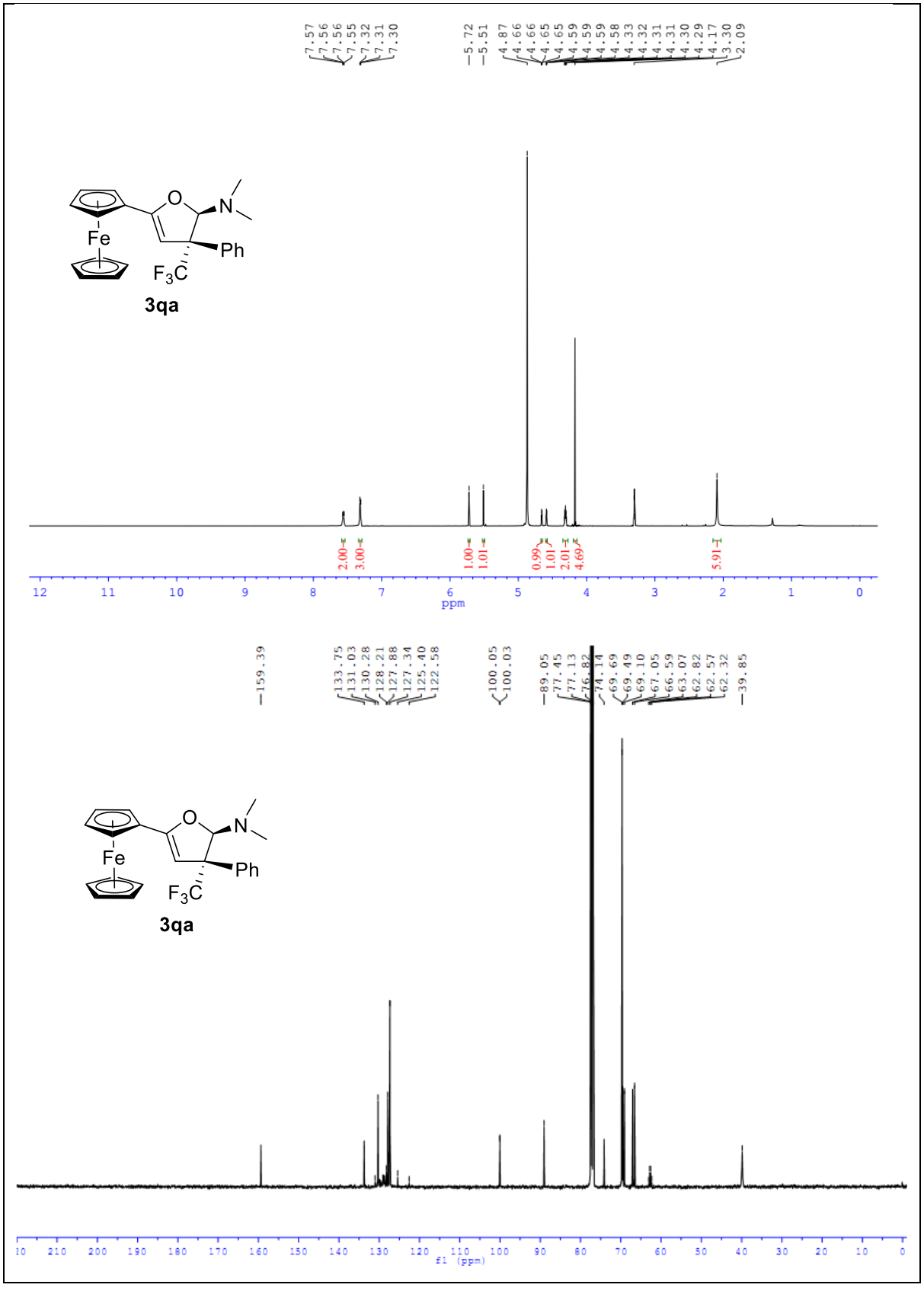
148.64
136.73
133.10
130.95
130.23
128.13
127.97
127.35
125.31
123.92
122.49
120.30
101.36
101.33
101.30
101.27
95.32
95.31
77.35
76.71
62.97
62.72
62.46
62.21
39.71
O
N
N
Ph
F3C
3pa
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
-74.31
O
N
N
Ph
F3C
3pa
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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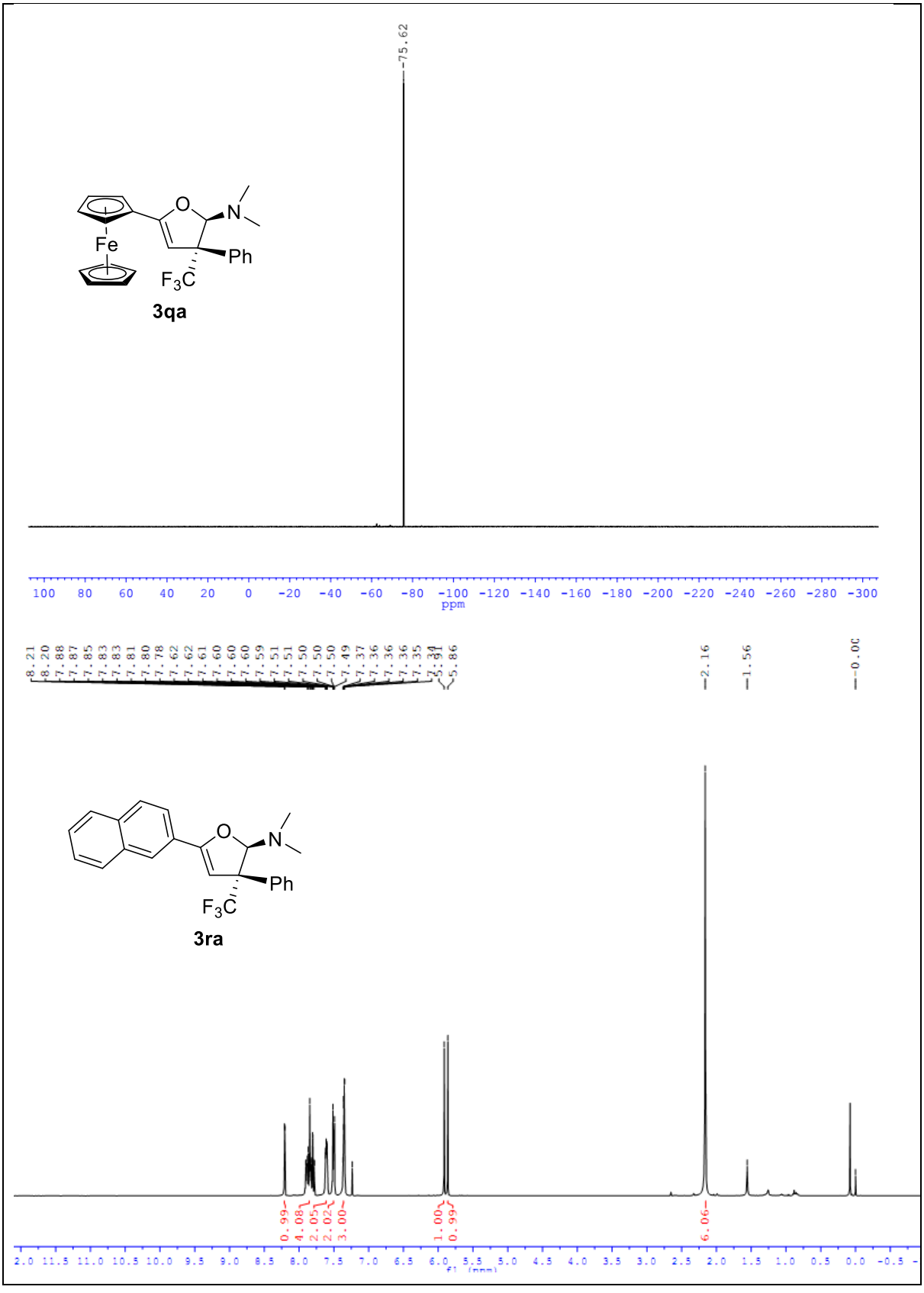
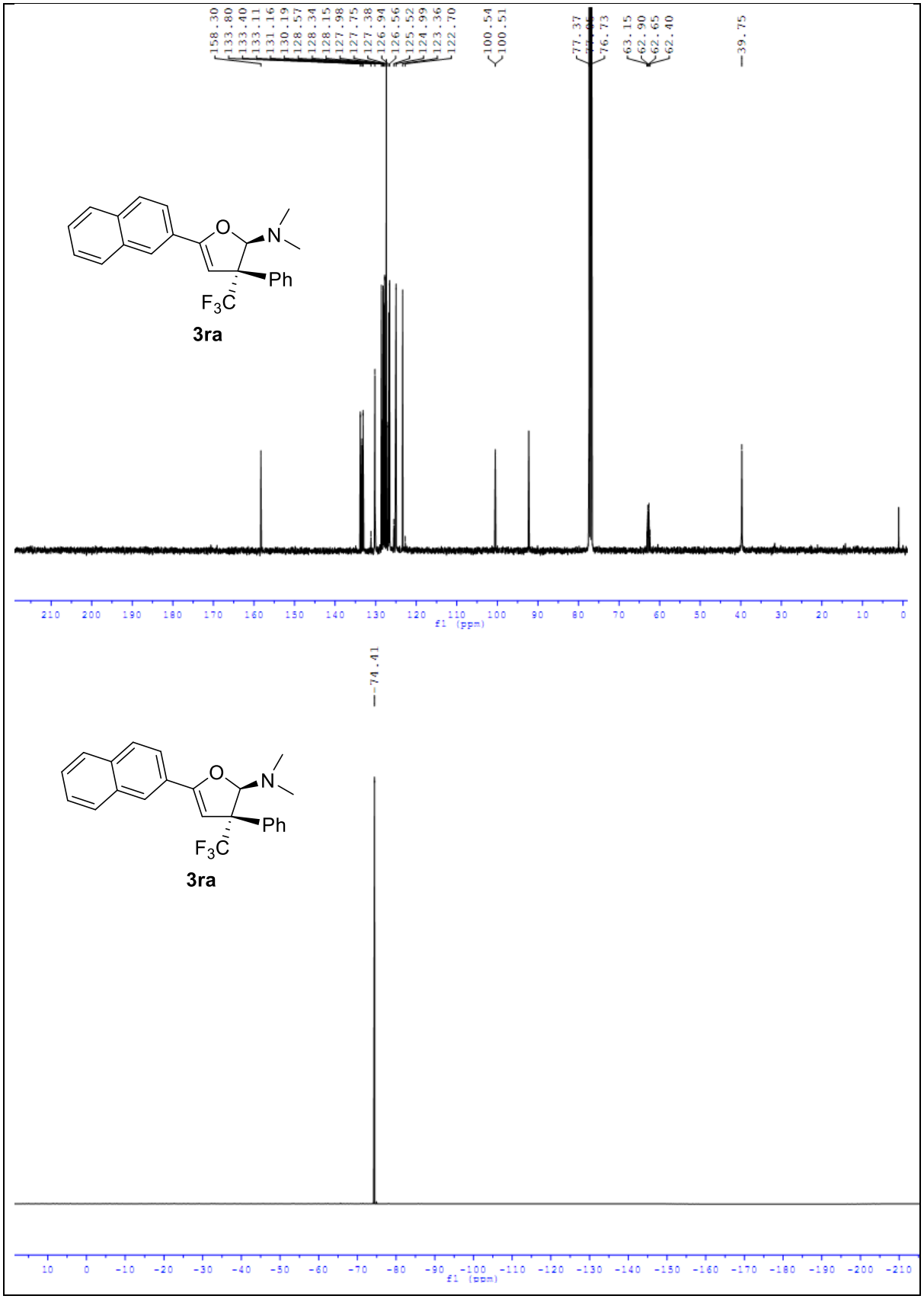
7.56
7.56
7.55
7.32
7.31
7.30
5.72
5.51
4.87
4.66
4.66
4.65
4.65
4.59
4.59
4.59
4.58
4.33
4.32
4.31
4.31
4.30
4.29
4.17
3.30
2.09
O
N
Fe
Ph
F3C
3qa
2.00
3.00
1.00
1.01
0.99
1.01
2.01
4.69
5.91
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm
159.39
133.75
131.03
130.28
128.21
127.88
127.34
125.40
122.58
100.05
100.03
89.05
77.45
77.13
76.82
74.14
69.69
69.49
69.10
67.05
66.59
63.07
62.82
62.57
62.32
39.85
O
N
Fe
Ph
F3C
3qa
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-75.62
Fe
O
N
Ph
F3C
3qa
100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300
ppm
8.21
8.20
7.88
7.87
7.85
7.83
7.83
7.81
7.80
7.78
7.62
7.62
7.61
7.60
7.60
7.60
7.59
7.51
7.51
7.50
7.50
7.50
7.49
7.37
7.36
7.36
7.35
7.34
5.91
5.86
2.16
1.56
0.00
O
N
Ph
F3C
3ra
0.99
4.08
2.05
2.02
3.00
1.00
0.99
6.06
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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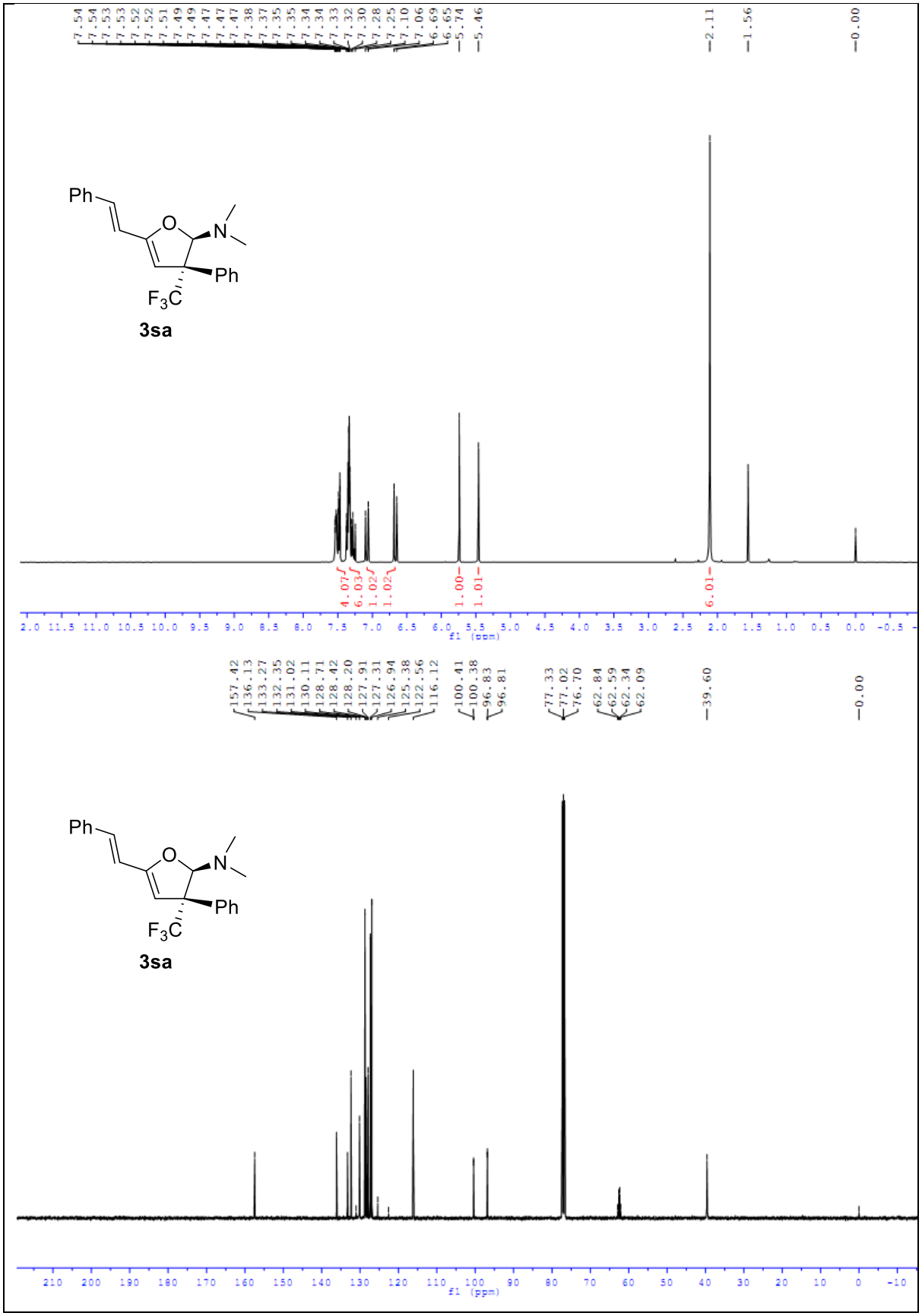
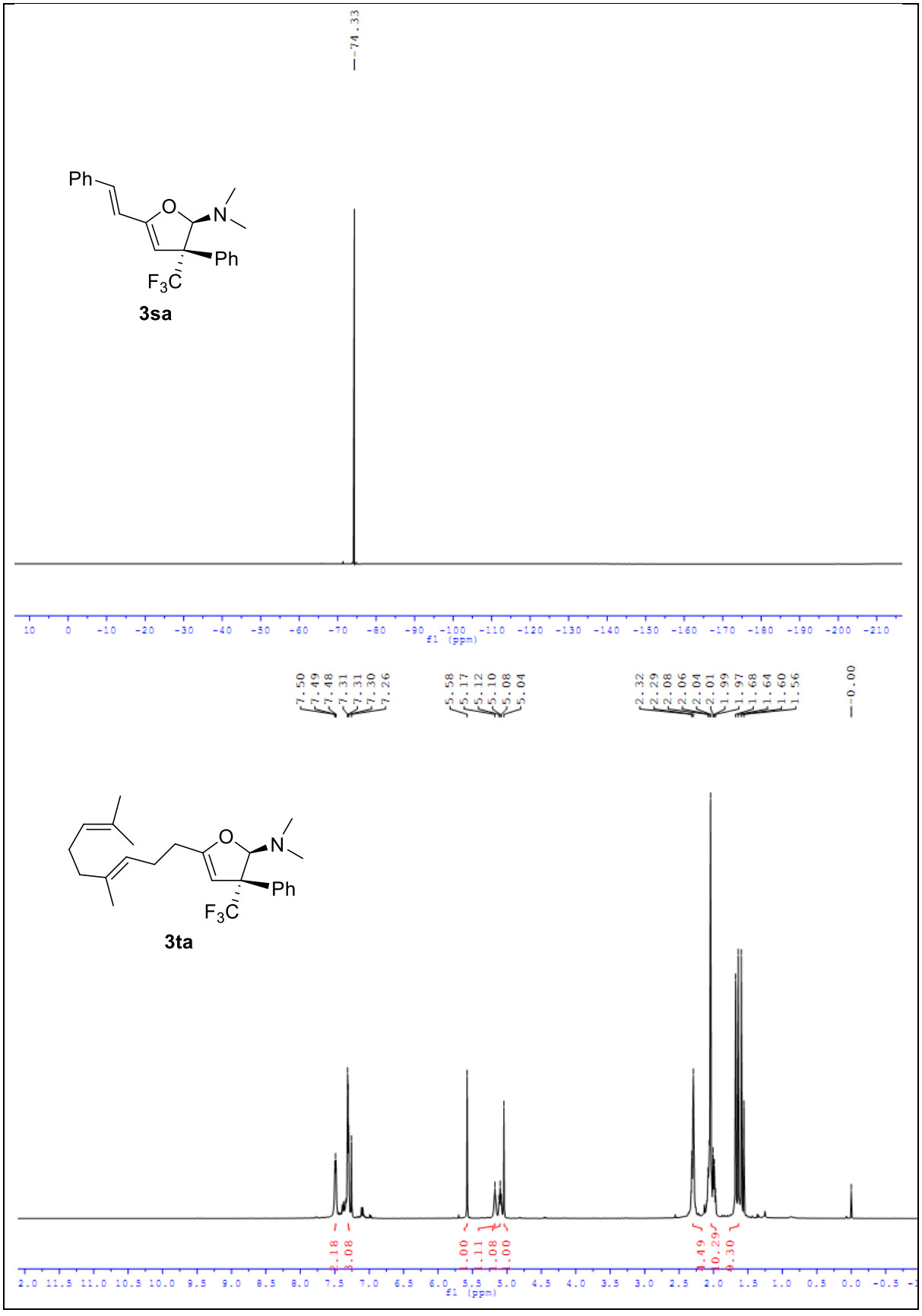
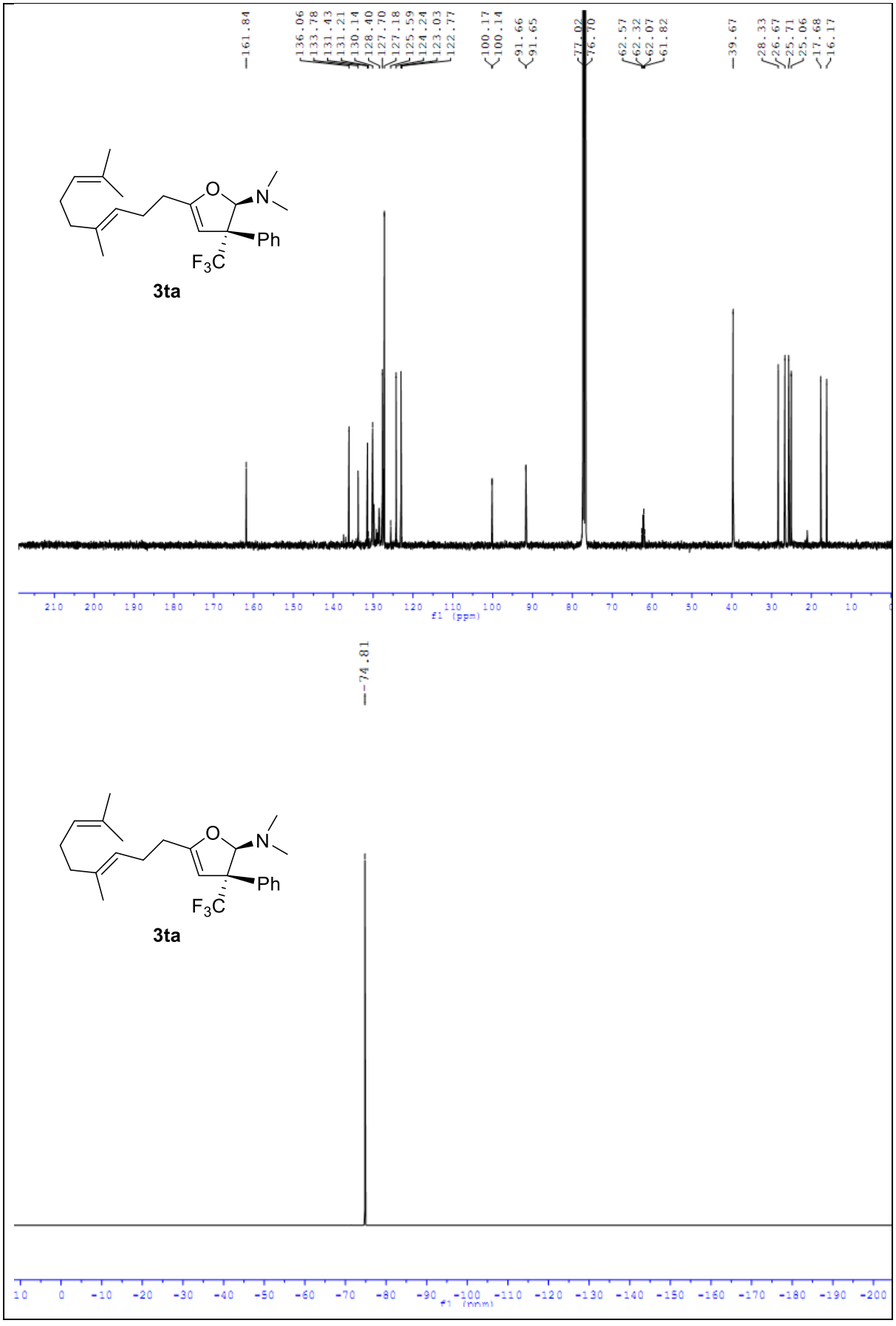
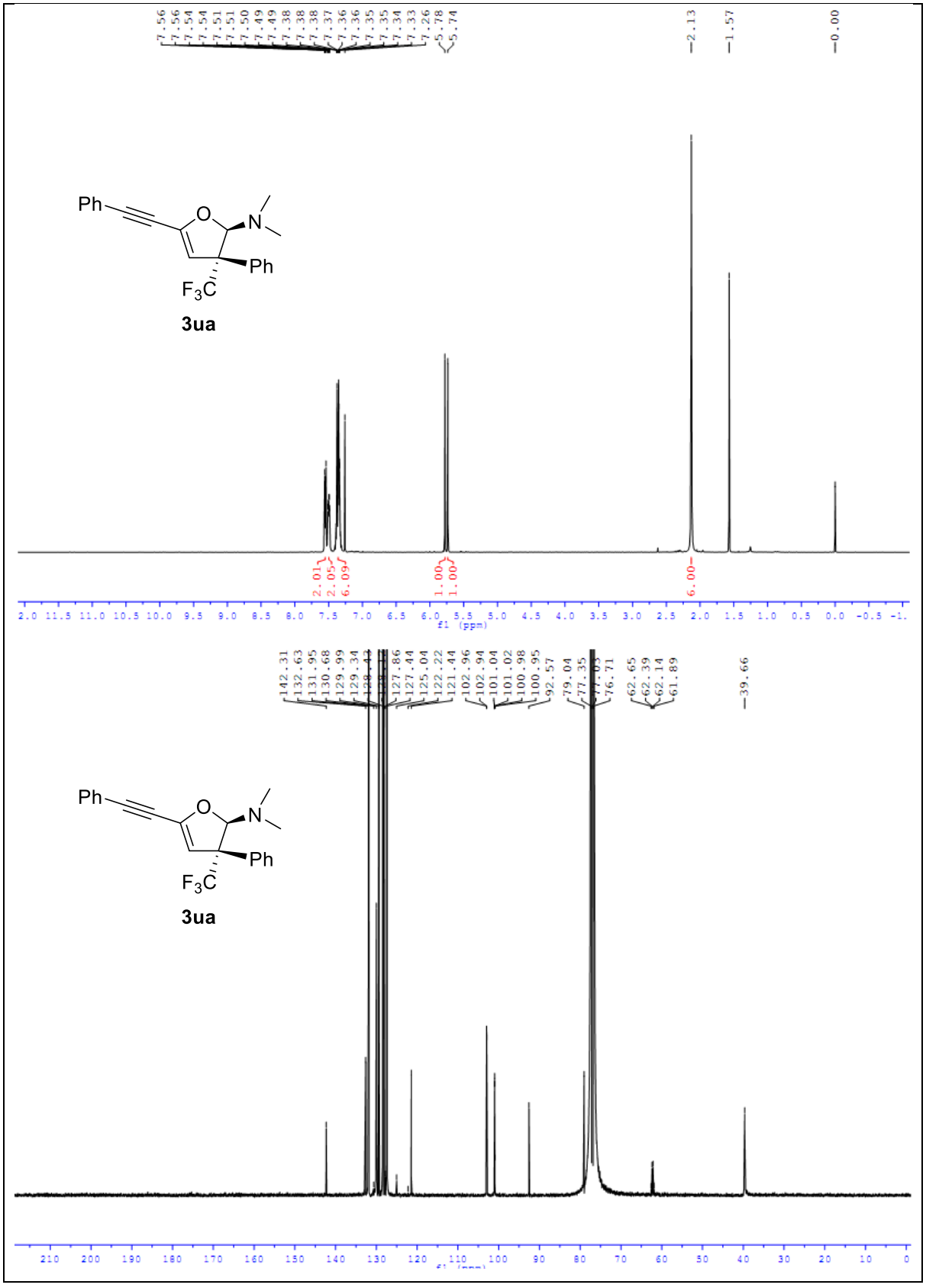
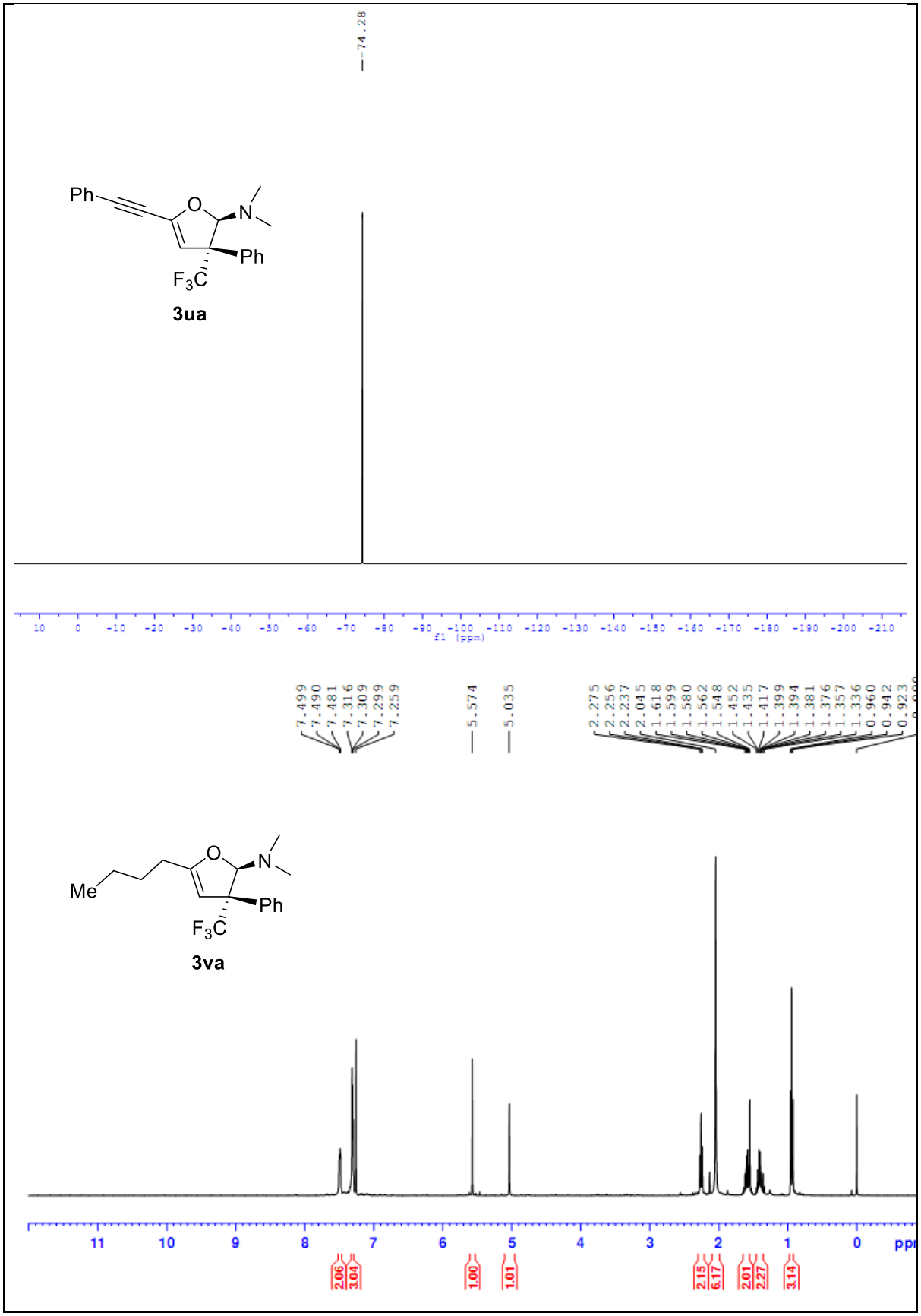
133.11
131.16
130.19
128.57
128.34
128.15
127.98
127.75
127.38
126.94
126.56
125.52
124.99
123.36
122.70
100.54
100.51
77.37
76.73
63.15
62.90
62.65
62.40
39.75
O
N
Ph
F3C
3ra
f1 (ppm)
-74.41
O
N
Ph
F3C
3ra
f1 (ppm)

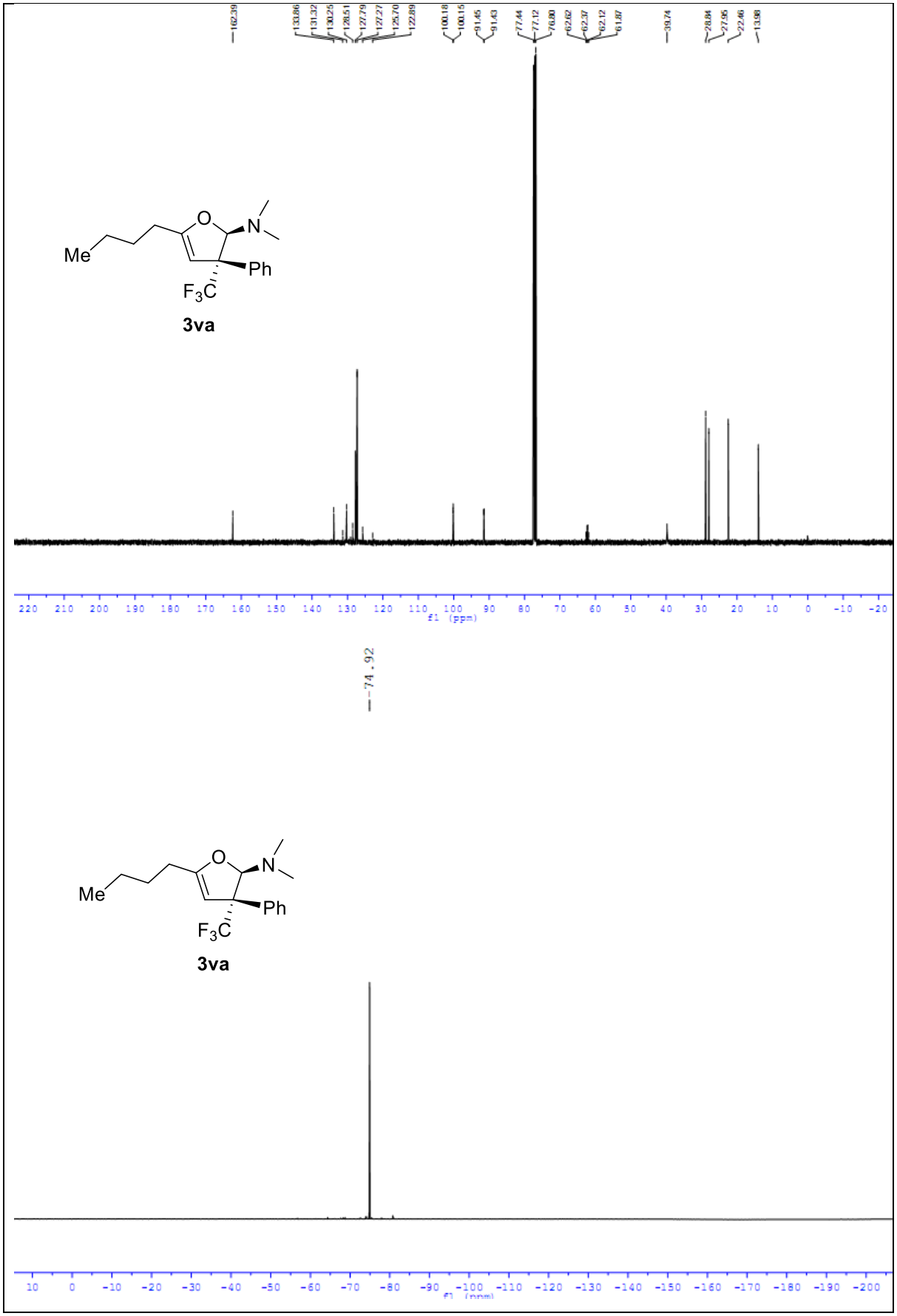

Ph
O
N
Ph
F3C
3sa
f1 (ppm)
Ph
O
N
Ph
F3C
3sa
f1 (ppm)


-74.33
Ph
O
N
Ph
F3C
3sa
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
7.50
7.49
7.48
7.31
7.31
7.30
7.26
5.58
5.17
5.12
5.10
5.08
5.04
2.32
2.29
2.08
2.06
2.04
2.01
1.99
1.97
1.68
1.64
1.60
1.56
0.00
O
N
Ph
F3C
3ta
2.18
3.08
1.00
1.11
1.08
1.00
4.49
10.29
9.30
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


161.84
136.06
133.78
131.43
131.21
130.14
128.40
127.70
127.18
125.59
124.24
123.03
122.77
100.17
100.14
91.66
91.65
77.02
76.70
62.57
62.32
62.07
61.82
39.67
28.33
26.67
25.71
25.06
17.68
16.17
O
N
Ph
F3C
3ta
f1 (ppm)
-74.81
O
N
Ph
F3C
3ta
f1 (ppm)


Ph
O
N
Ph
F3C
3ua
f1 (ppm)
Ph
O
N
Ph
F3C
3ua
f1 (ppm)


-74.28
Ph
O
N
Ph
F3C
3ua
f1 (ppm)
7.499
7.490
7.481
7.316
7.309
7.299
7.259
5.574
5.035
2.275
2.256
2.237
2.045
1.618
1.599
1.580
1.562
1.548
1.452
1.435
1.417
1.399
1.394
1.381
1.376
1.357
1.336
0.960
0.942
0.923
Me
O
N
Ph
F3C
3va
ppm
2.06
3.04
1.00
1.01
2.15
6.17
2.01
2.27
3.14


162.39
133.86
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127.79
127.27
125.70
122.89
100.18
100.15
91.45
91.43
77.44
77.12
76.80
62.62
62.37
62.12
61.87
39.74
28.84
27.95
22.46
13.98
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F3C
3va
f1 (ppm)
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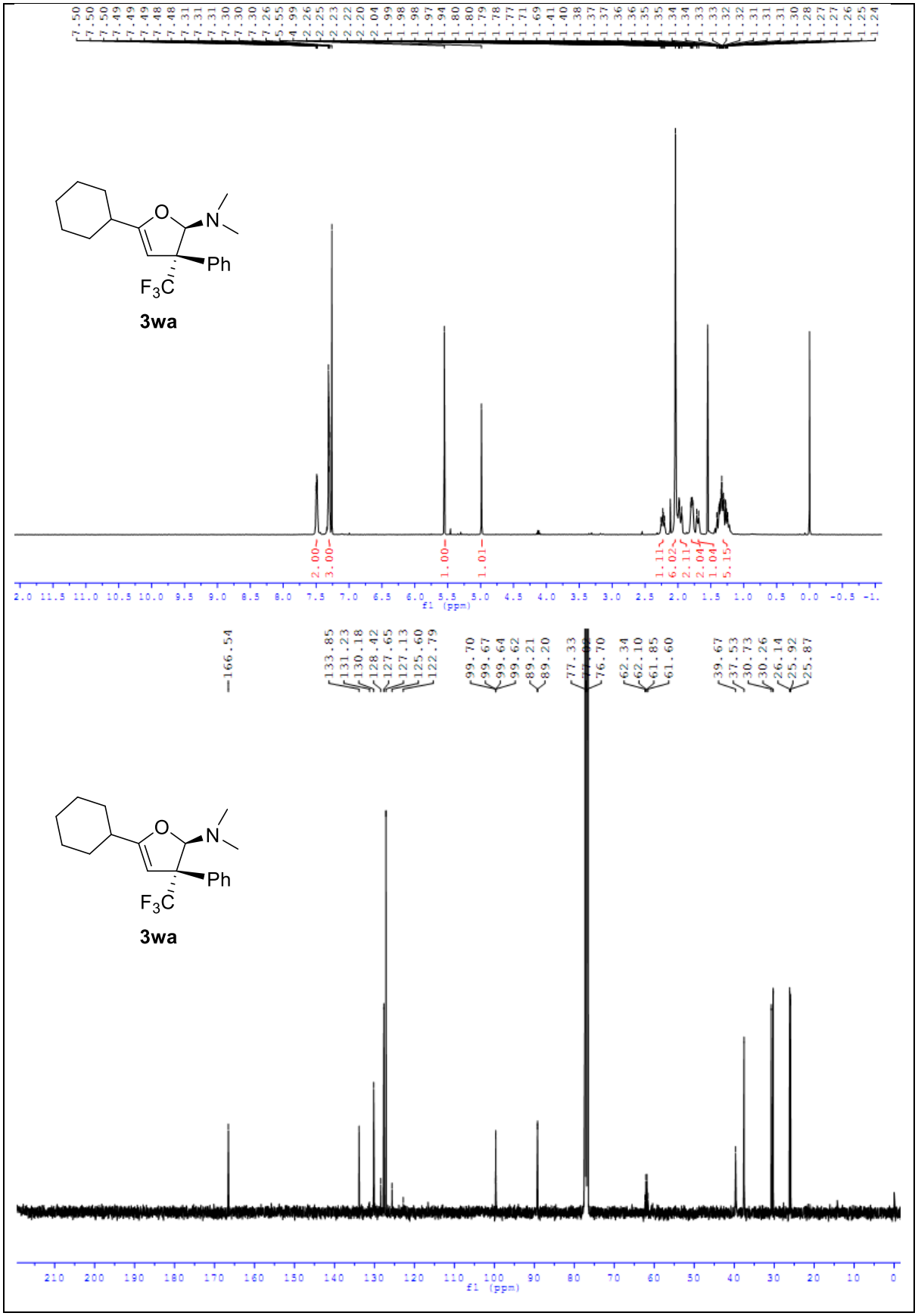
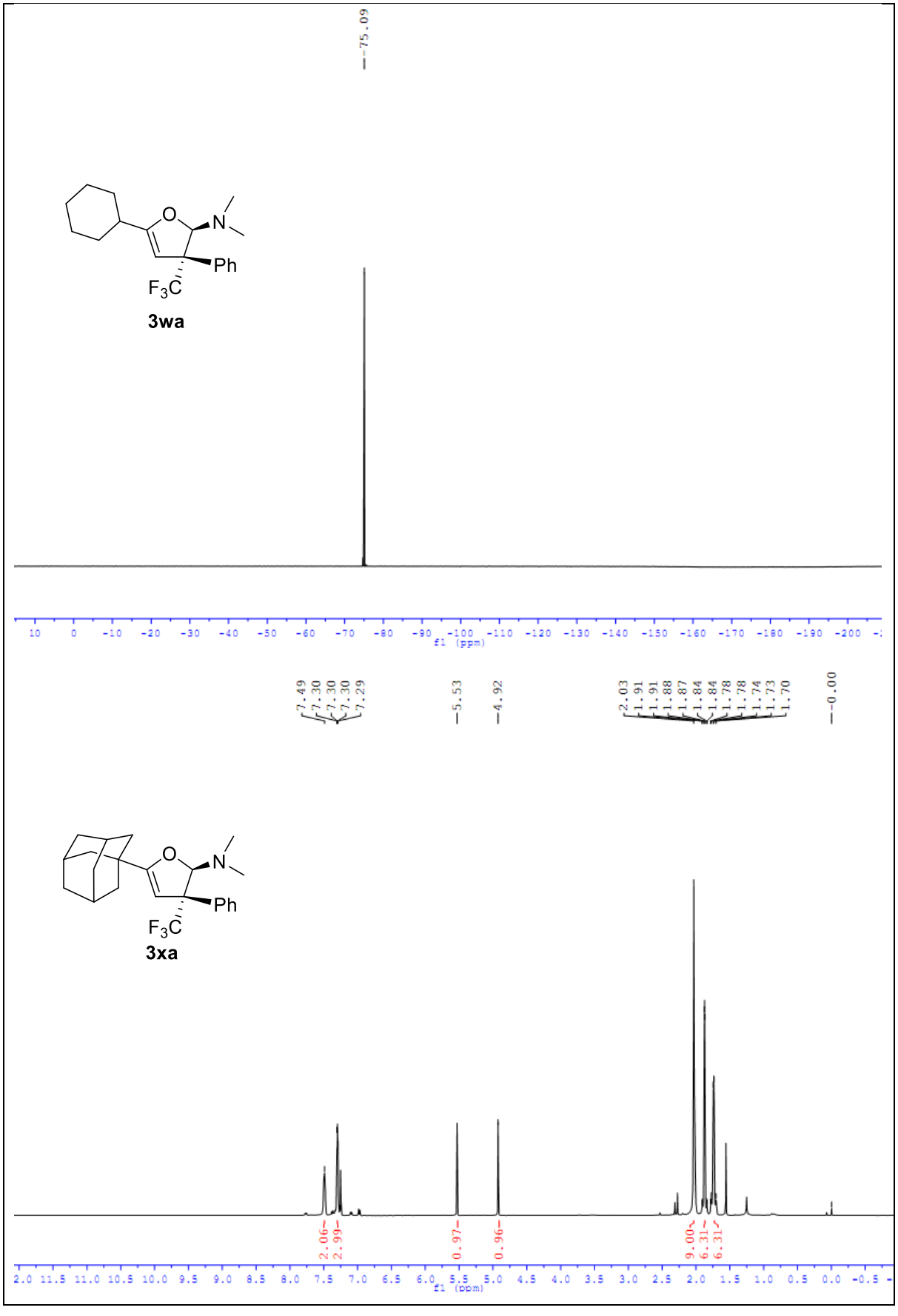
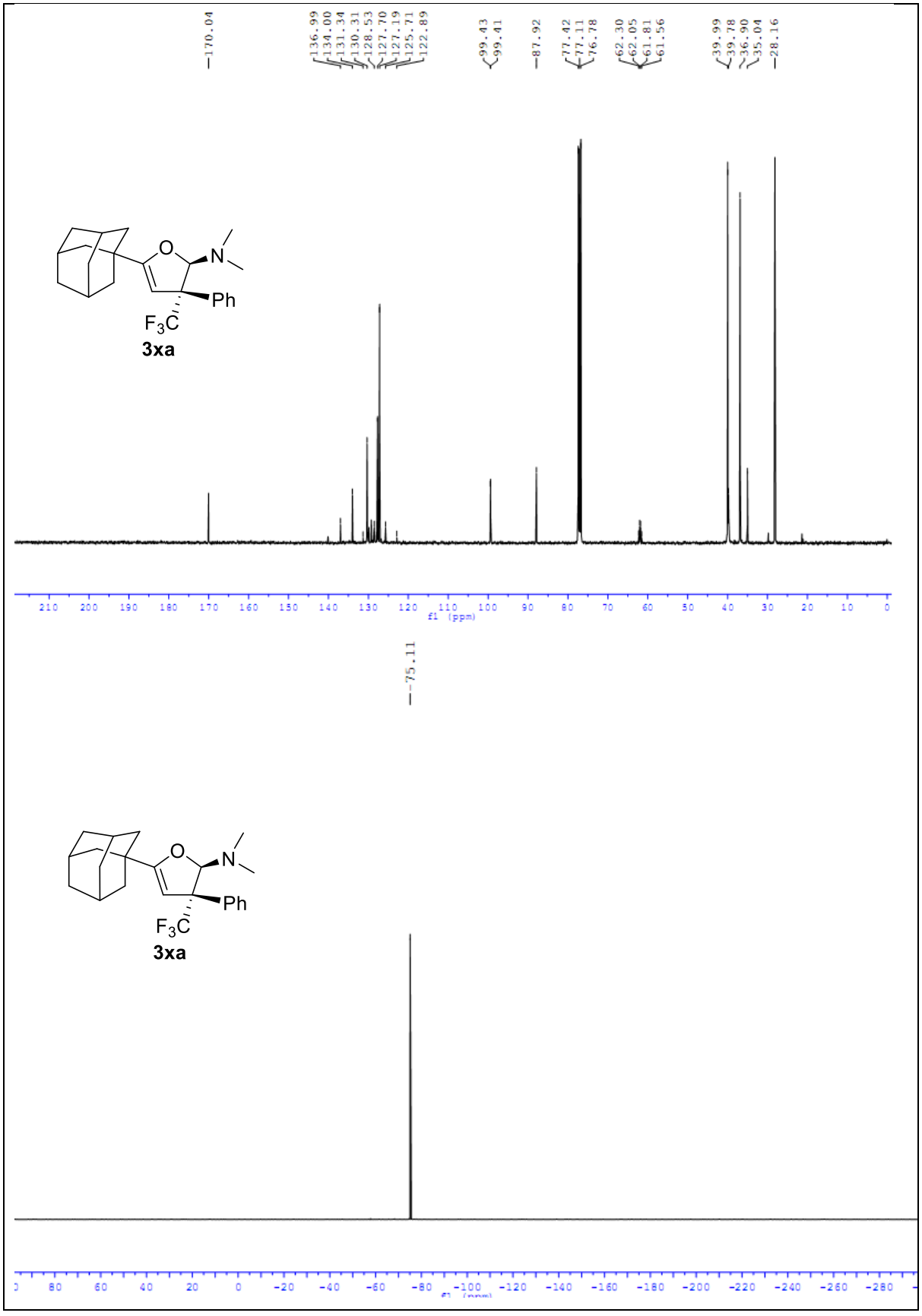
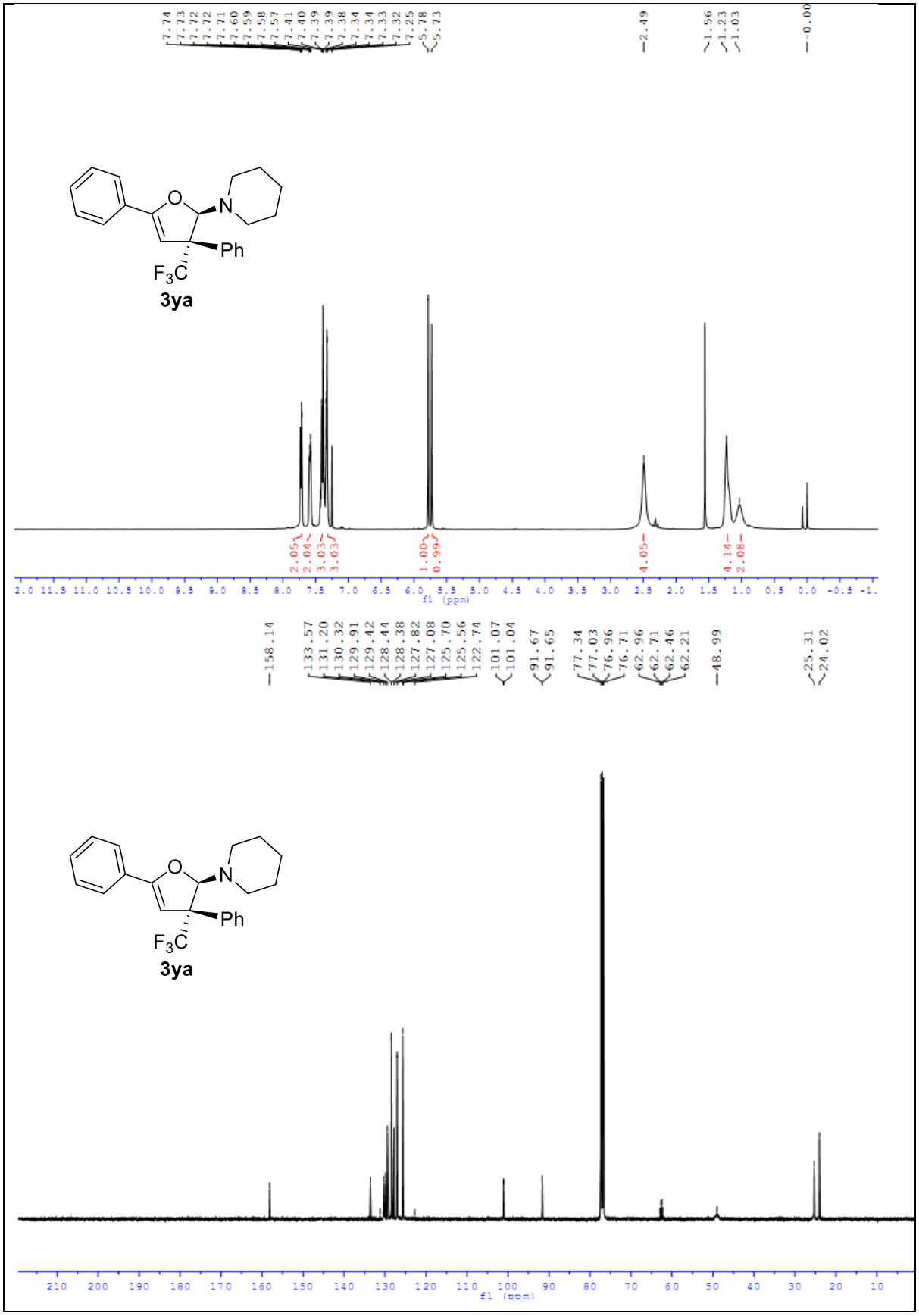
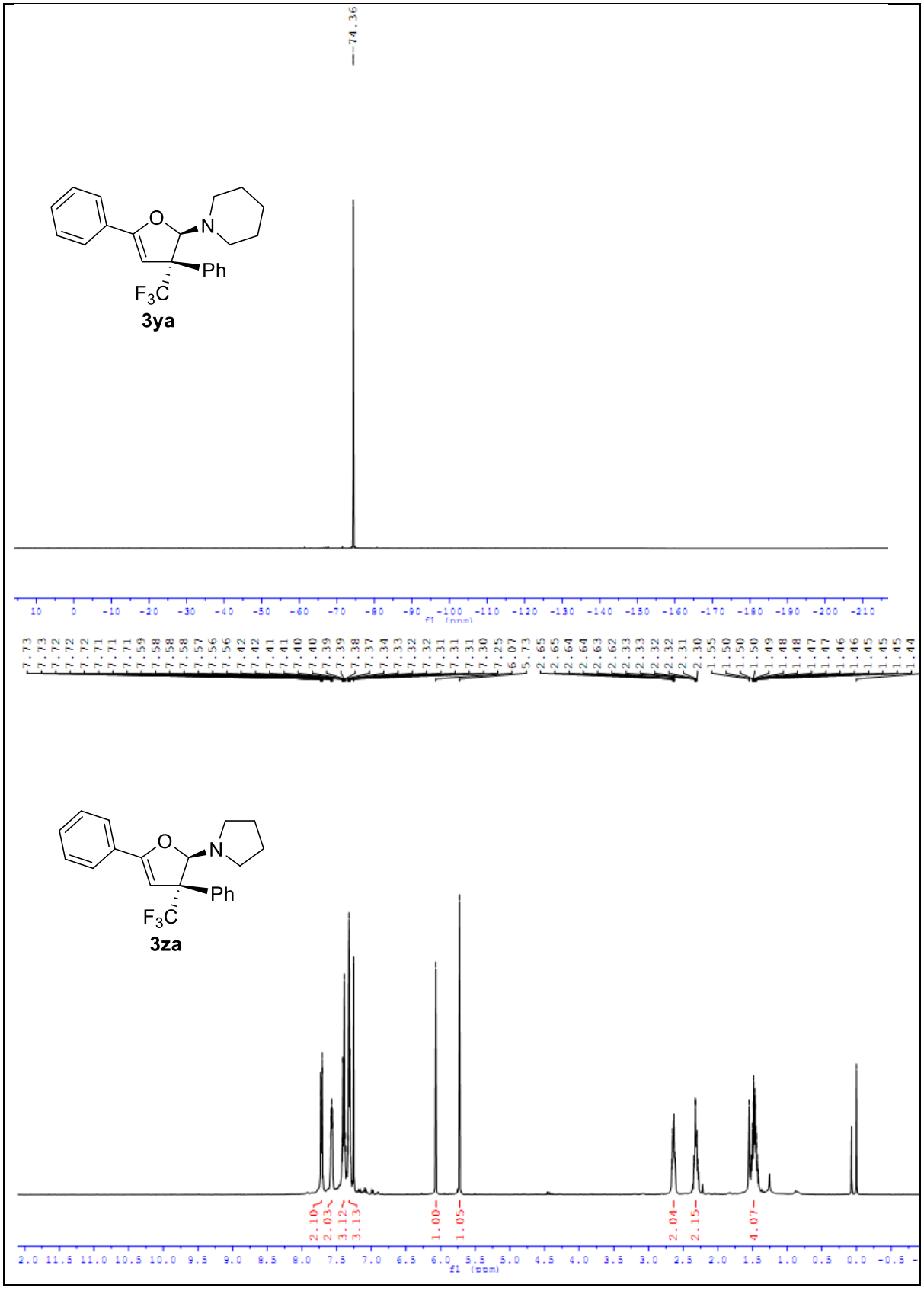
O
N
Me
Ph
F3C
3va
f1 (ppm)

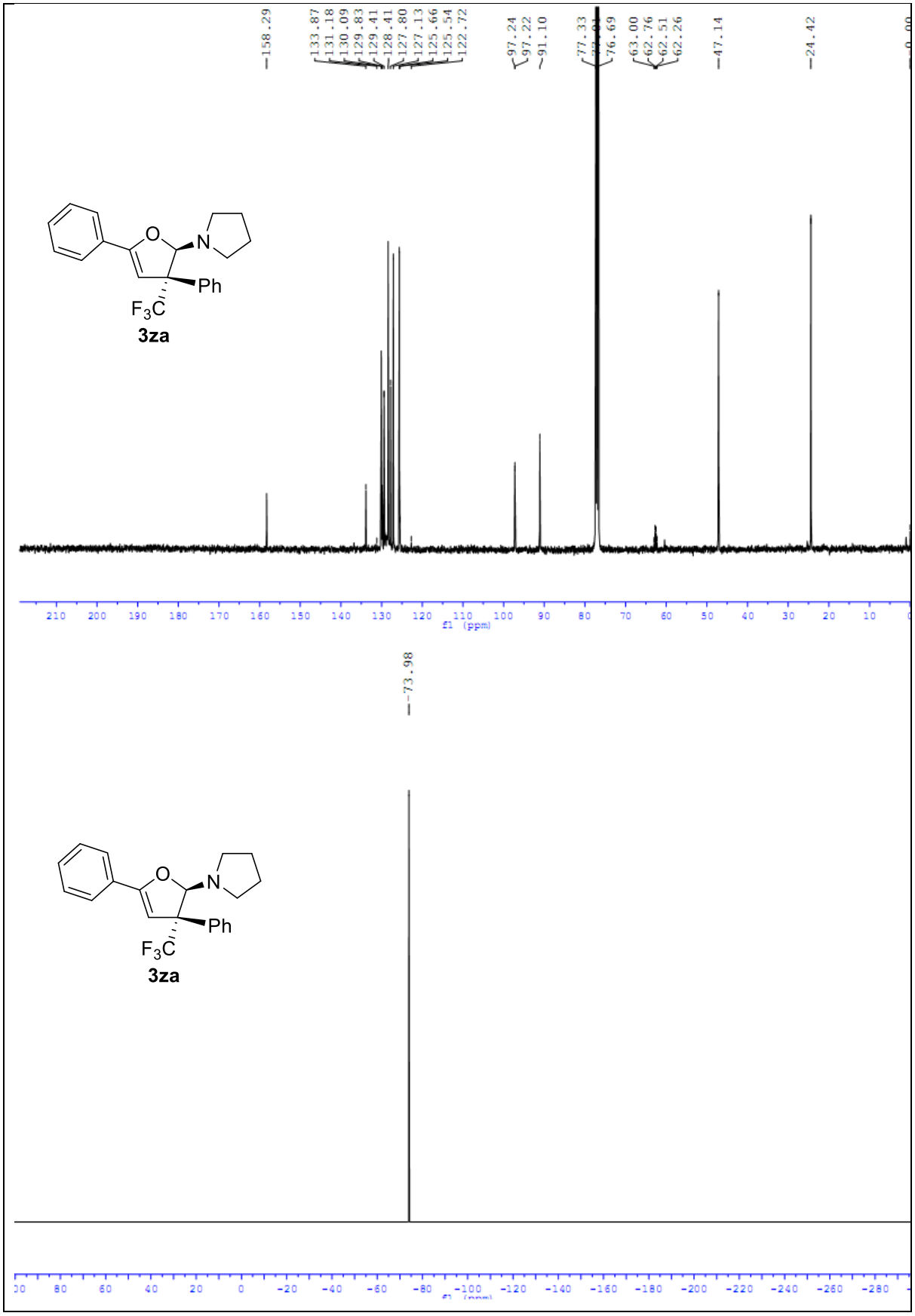

O
N
Ph
F3C
3wa
f1 (ppm)
O
N
Ph
F3C
3wa
f1 (ppm)

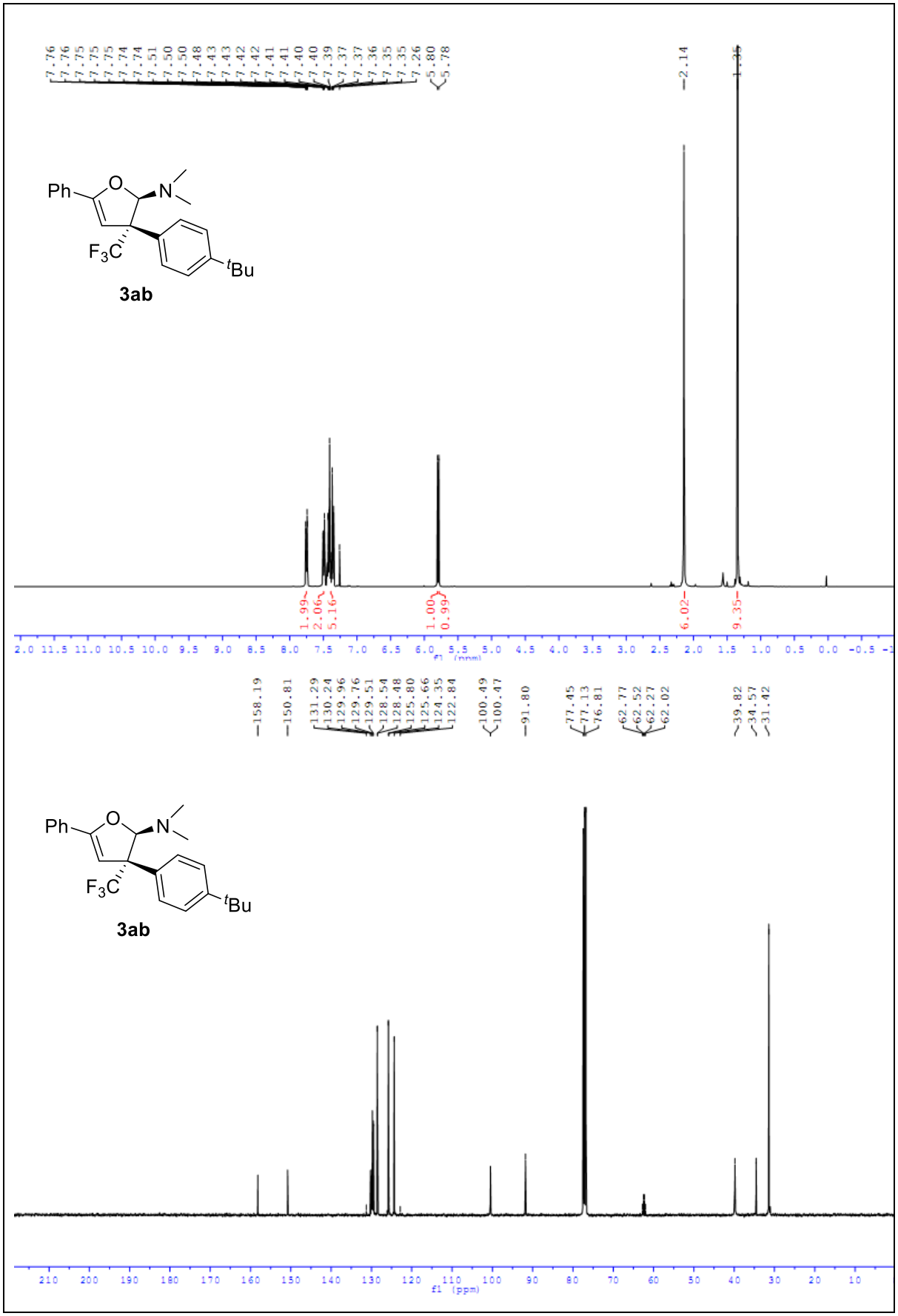

-75.09
O
N
Ph
F3C
3wa
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)
7.49
7.30
7.30
7.30
7.29
5.53
4.92
2.03
1.91
1.91
1.88
1.87
1.84
1.84
1.78
1.78
1.74
1.73
1.70
0.00
O
N
Ph
F3C
3xa
2.06
2.99
0.97
0.96
9.00
6.31
6.31
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

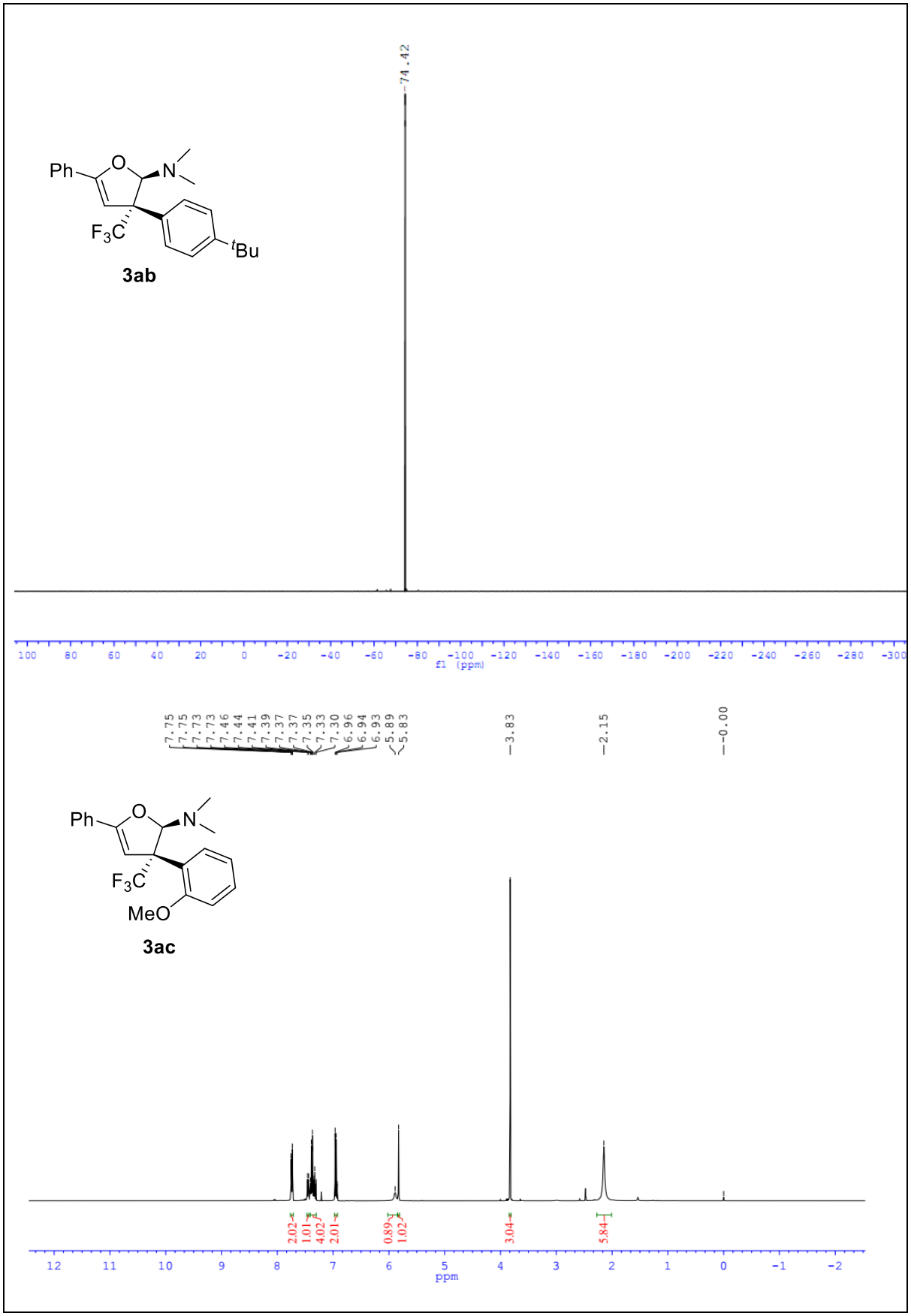

170.04
136.99
134.00
131.34
130.31
128.53
127.70
127.19
125.71
122.89
99.43
99.41
87.92
77.42
77.11
76.78
62.30
62.05
61.81
61.56
39.99
39.78
36.90
35.04
28.16
O
N
Ph
F3C
3xa
f1 (ppm)
-75.11
O
N
Ph
F3C
3xa

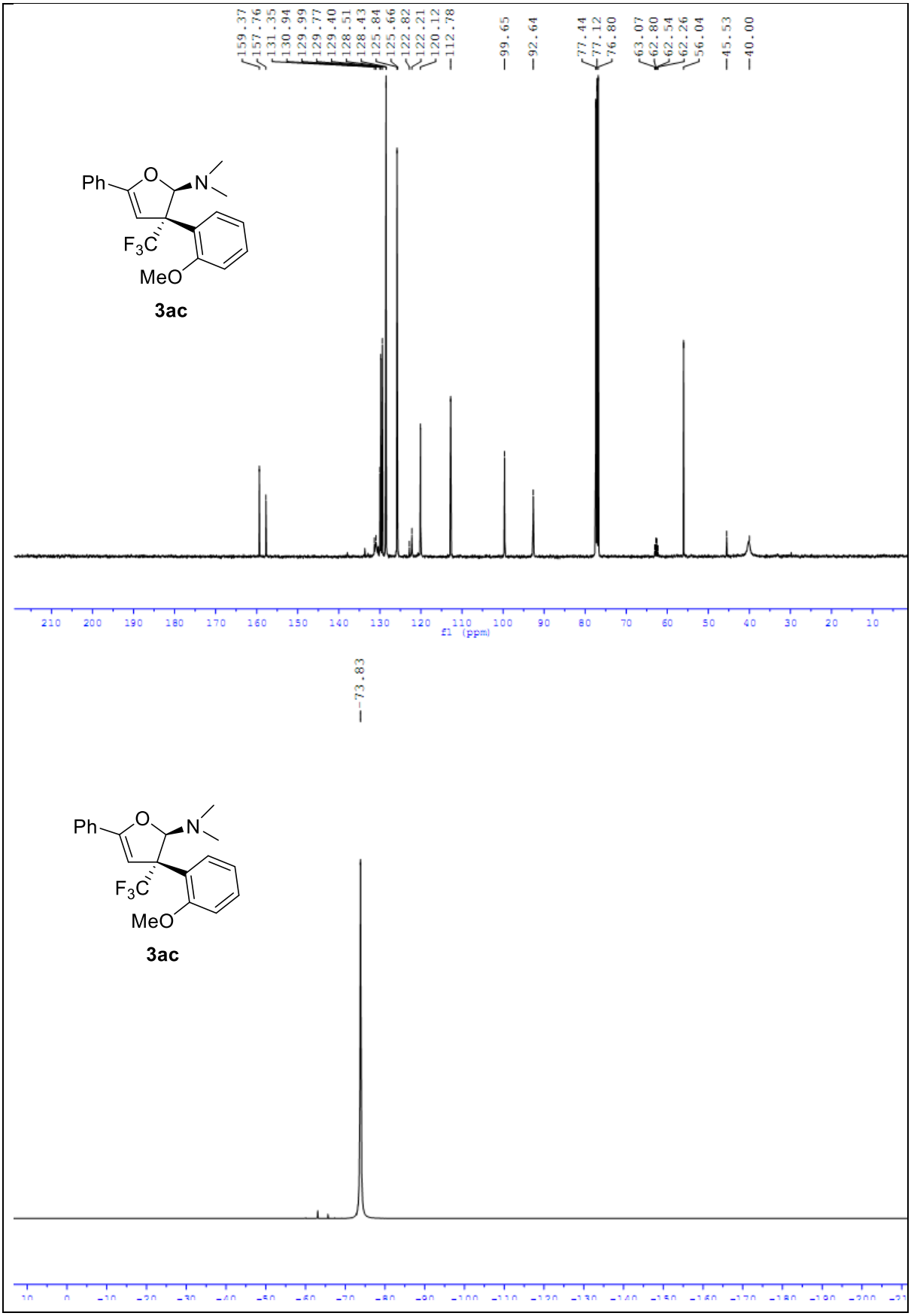

7.74
7.73
7.72
7.72
7.71
7.60
7.59
7.58
7.57
7.41
7.40
7.39
7.39
7.38
7.34
7.34
7.33
7.32
7.25
5.78
5.73
2.49
1.56
1.23
1.03
0.00
O
N
Ph
F3C
3ya
2.05
2.04
3.03
3.03
1.00
0.99
4.05
4.14
2.08
f1 (ppm)
158.14
133.57
131.20
130.32
129.91
129.42
128.44
128.38
127.82
127.08
125.70
125.56
122.74
101.07
101.04
91.67
91.65
77.34
77.03
76.96
76.71
62.96
62.71
62.46
62.21
48.99
25.31
24.02
O
N
Ph
F3C
3ya
f1 (ppm)

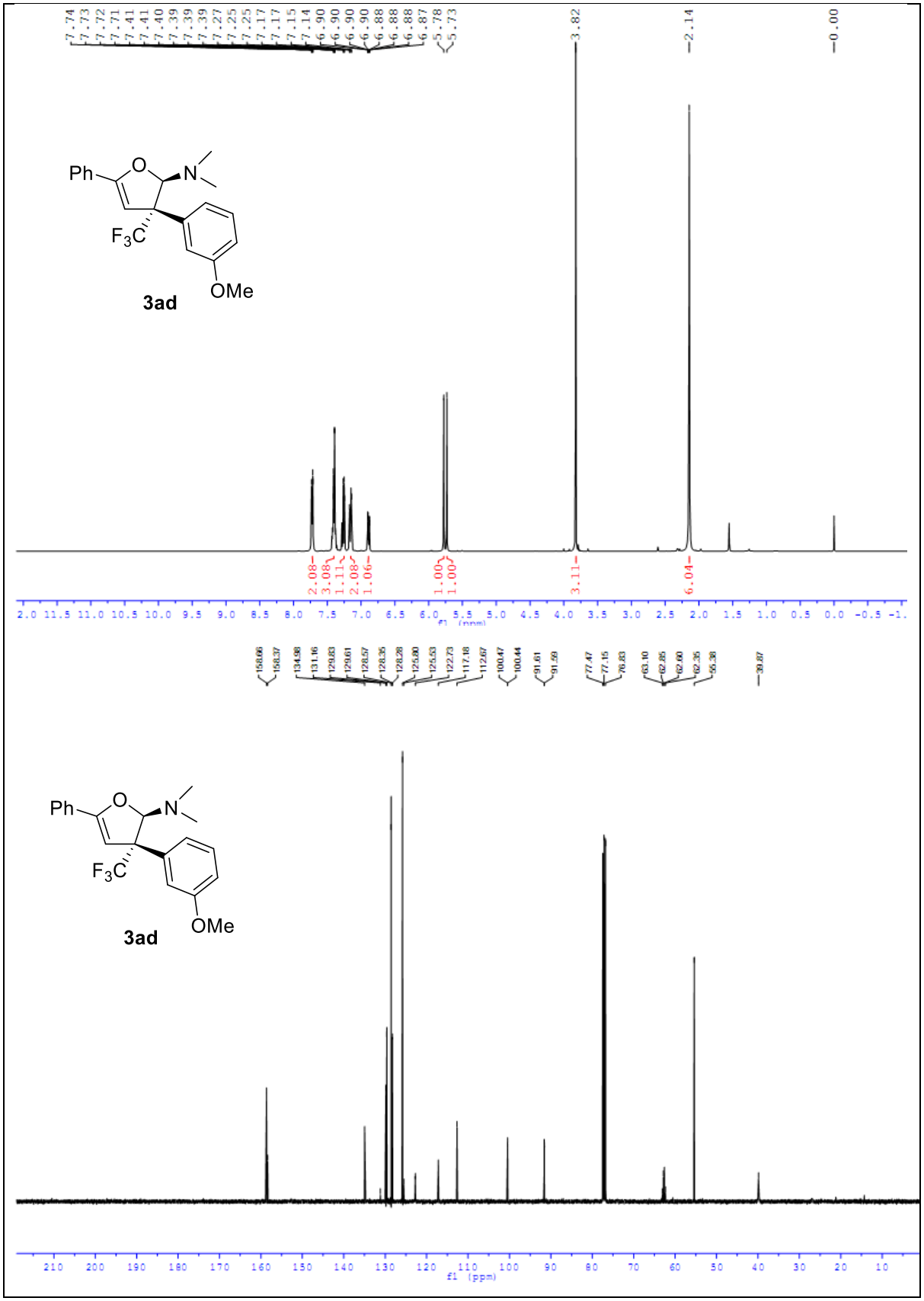

-74.36
O
N
Ph
F3C
3ya
7.73 7.73 7.72 7.72 7.71 7.71 7.59 7.58 7.58 7.57 7.56 7.56 7.42 7.42 7.41 7.41 7.40 7.40 7.39 7.39 7.38 7.37 7.34 7.33 7.32 7.32 7.31 7.31 7.31 7.30 7.25 6.07 5.73 2.65 2.64 2.64 2.63 2.62 2.33 2.32 2.32 2.31 2.30 1.55 1.50 1.50 1.50 1.49 1.48 1.47 1.47 1.46 1.46 1.45 1.45 1.44
O
N
Ph
F3C
3za
2.10 2.03 3.12 3.13 1.00 1.05 2.04 2.15 4.07
f1 (ppm)

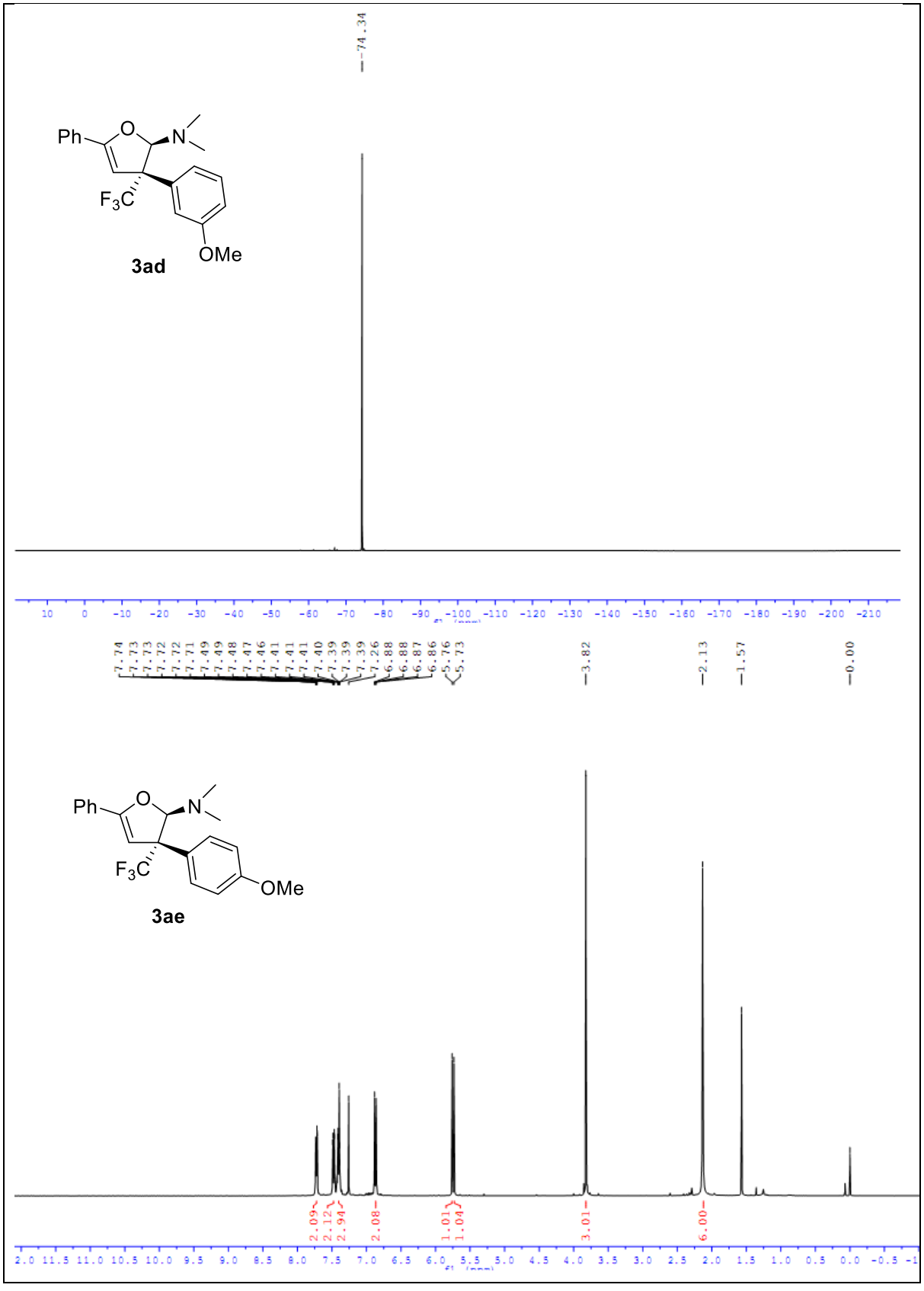

158.29
133.87
131.18
130.09
129.83
129.41
128.41
127.80
127.13
125.66
125.54
122.72
97.24
97.22
91.10
77.33
76.69
63.00
62.76
62.51
62.26
47.14
24.42
f1 (ppm)
O
N
Ph
F3C
3za
-73.98
O
N
Ph
F3C
3za

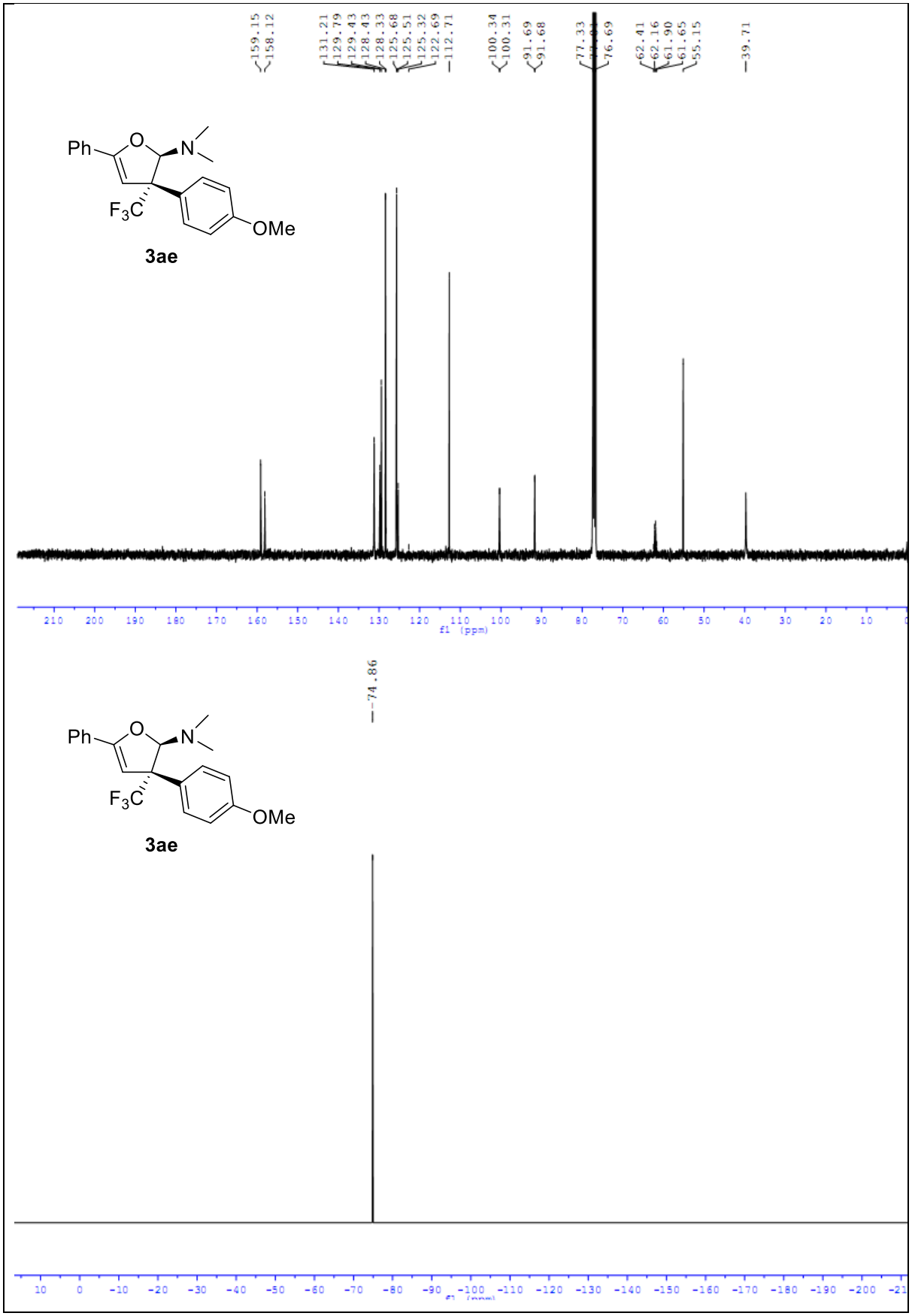

Ph
O
N
F3C
tBu
3ab
Ph
O
N
F3C
tBu
3ab

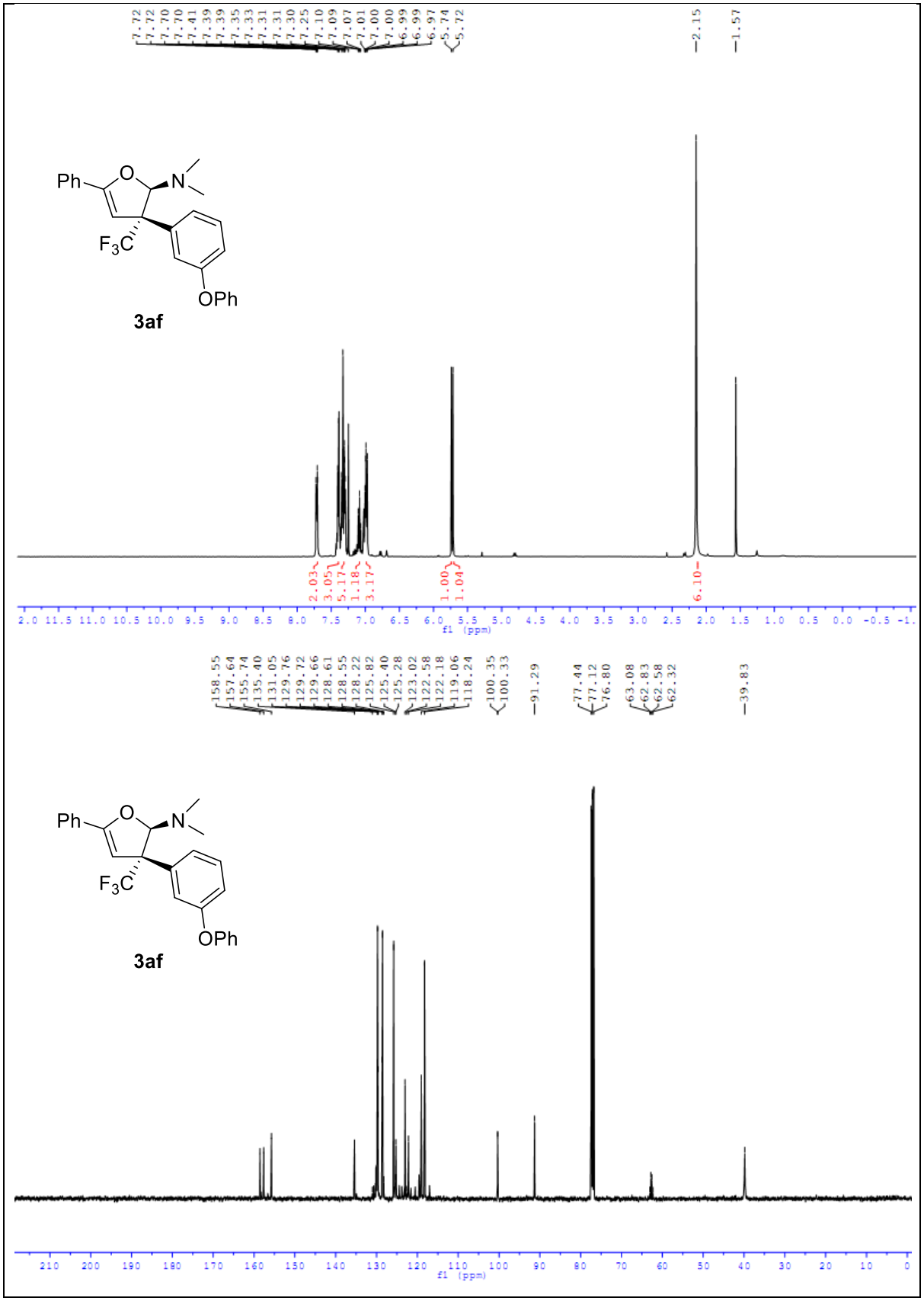

Ph
O
N
F3C
tBu
3ab
-74.42
100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300
f1 (ppm)
7.75
7.75
7.73
7.73
7.46
7.44
7.41
7.39
7.37
7.37
7.35
7.33
7.30
6.96
6.94
6.93
5.89
5.83
3.83
2.15
0.00
Ph
O
N
F3C
MeO
3ac
2.02
1.01
4.02
2.01
0.89
1.02
3.04
5.84
12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2
ppm

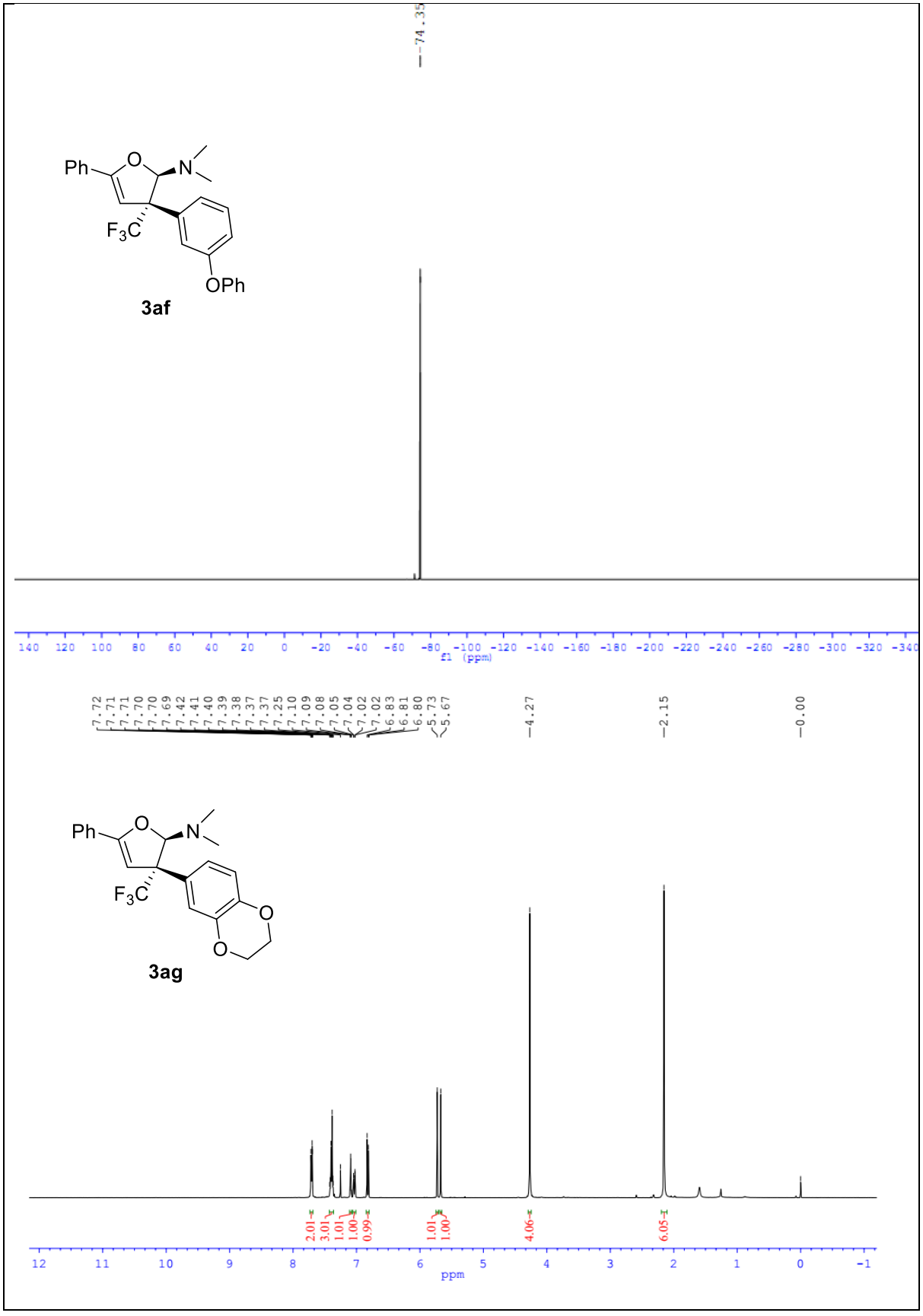

159.37
157.76
131.35
130.94
129.99
129.77
129.40
128.51
128.43
125.84
125.66
122.82
122.21
120.12
112.78
99.65
92.64
77.44
77.12
76.80
63.07
62.80
62.54
62.26
56.04
45.53
40.00
Ph
O
N
F3C
MeO
3ac
f1 (ppm)
-73.83
Ph
O
N
F3C
MeO
3ac

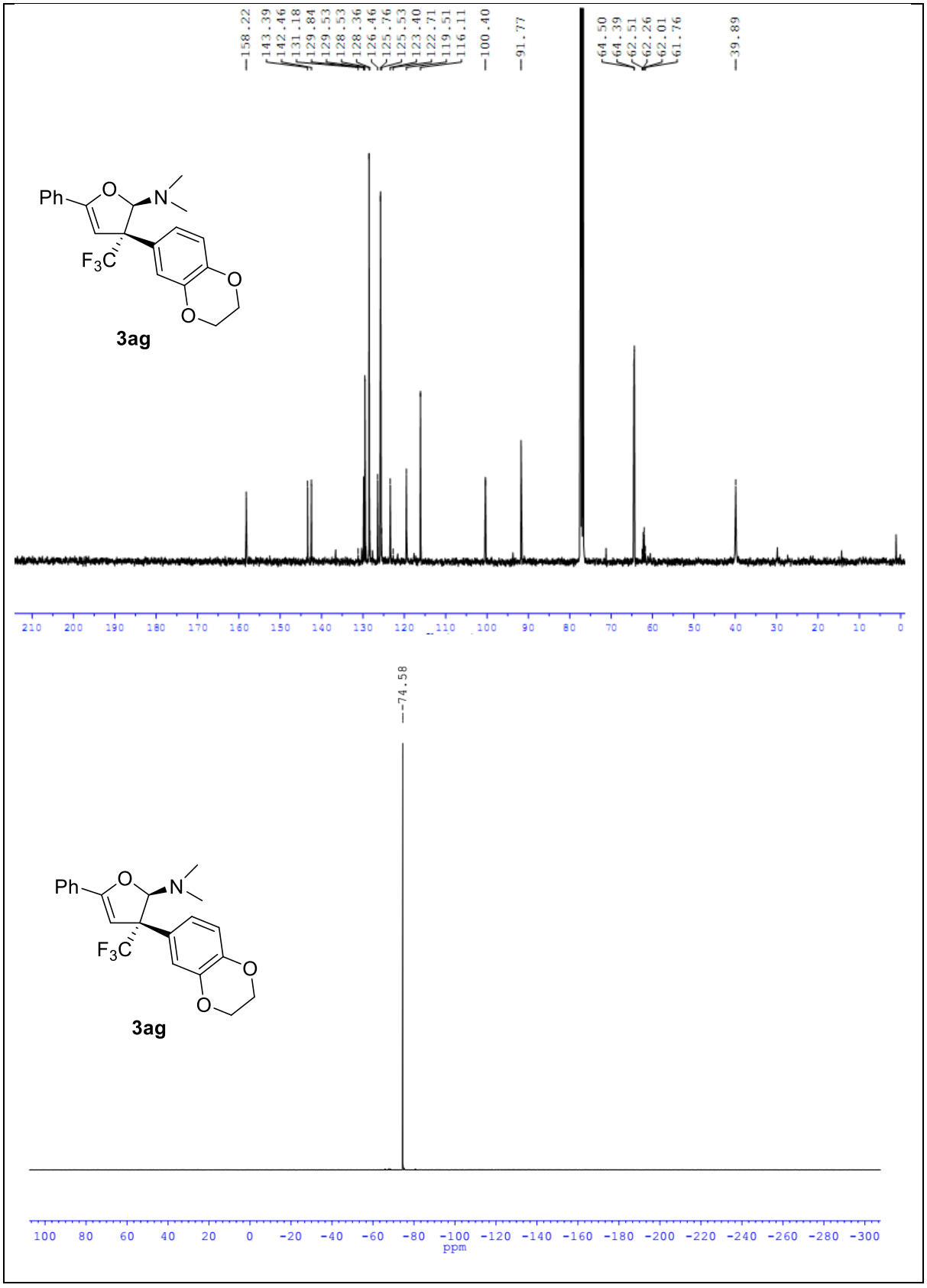

Ph
O
N
F3C
OMe
3ad
7.74
7.73
7.72
7.71
7.41
7.41
7.40
7.39
7.39
7.39
7.27
7.25
7.17
7.17
7.15
7.14
6.90
6.90
6.90
6.90
6.88
6.88
6.87
5.78
5.73
3.82
2.14
0.00
2.08
3.08
1.11
2.08
1.06
1.00
1.00
3.11
6.04
f1 (ppm)
Ph
O
N
F3C
OMe
3ad
f1 (ppm)

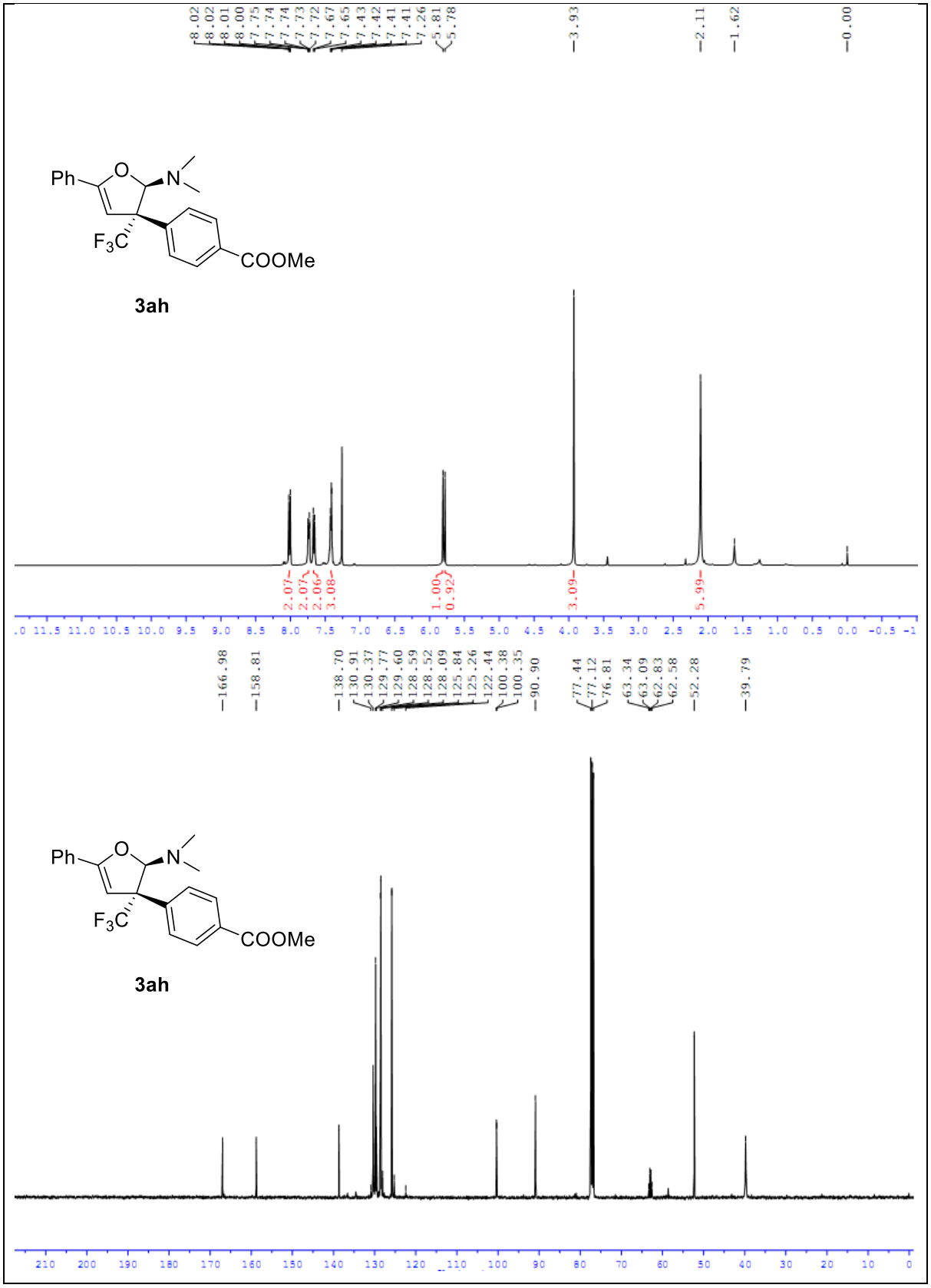

-74.34
Ph
O
N
F3C
OMe
3ad
7.74
7.73
7.73
7.72
7.72
7.71
7.49
7.49
7.48
7.47
7.46
7.41
7.41
7.41
7.40
7.39
7.39
7.39
7.26
6.88
6.88
6.87
6.86
5.76
5.73
3.82
2.13
1.57
0.00
Ph
O
N
F3C
OMe
3ae
2.09
2.12
2.94
2.08
1.01
1.04
3.01
6.00

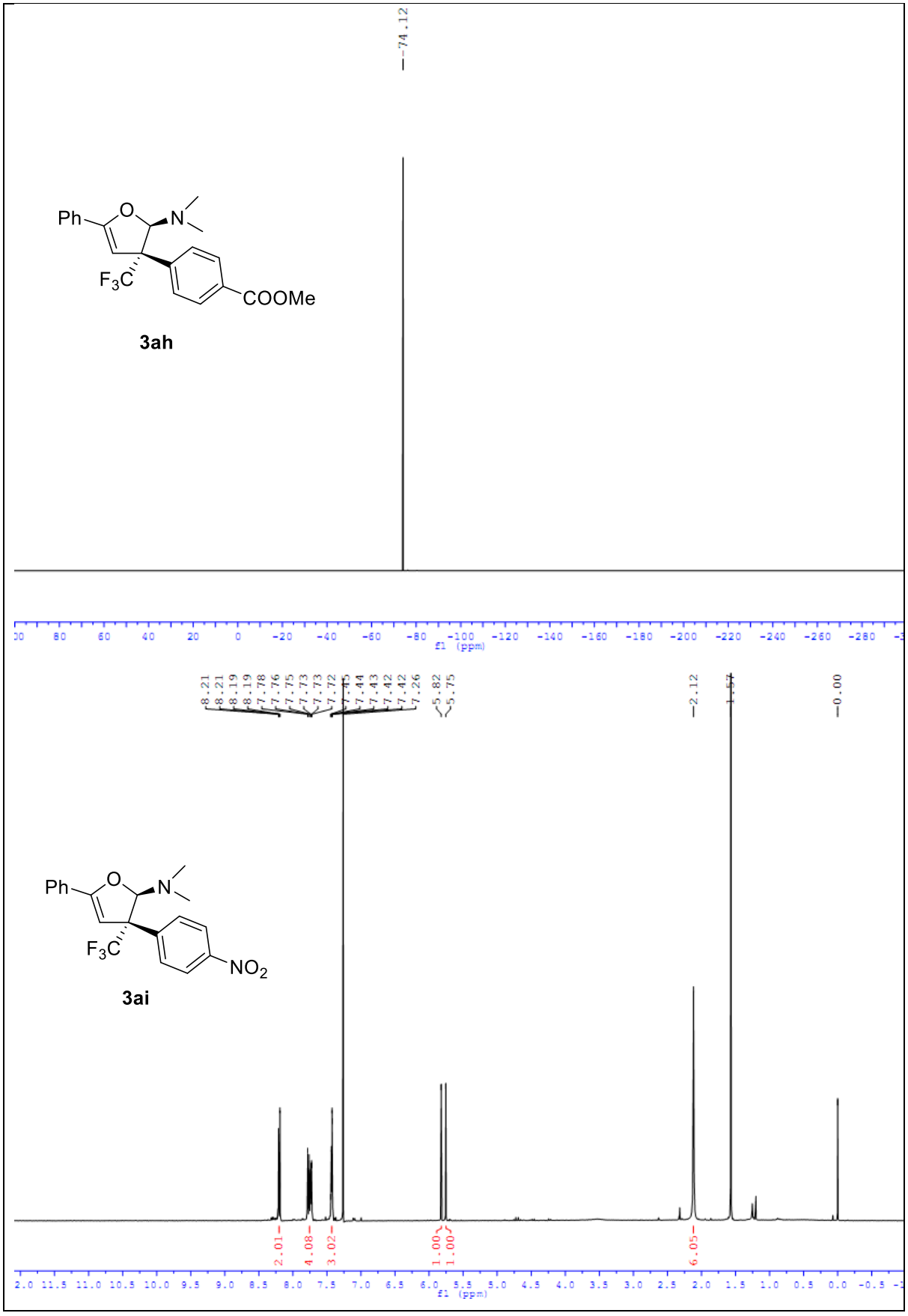

159.15
158.12
131.21
129.79
129.43
128.43
128.33
125.68
125.51
125.32
122.69
112.71
100.34
100.31
91.69
91.68
77.33
76.69
62.41
62.16
61.90
61.65
55.15
39.71
Ph
O
N
F3C
OMe
3ae
f1 (ppm)
-74.86
Ph
O
N
F3C
OMe
3ae

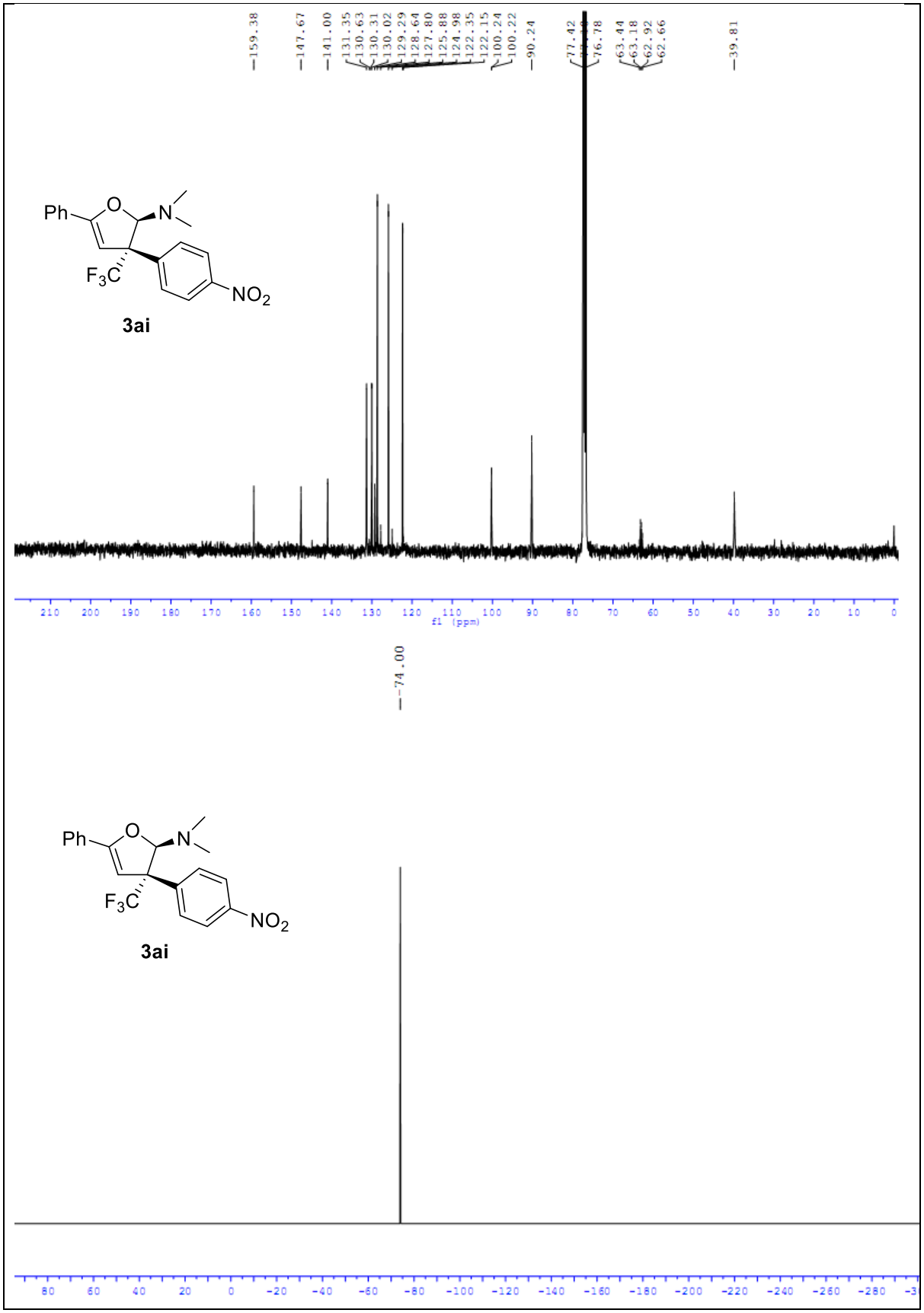

7.72
7.72
7.70
7.70
7.41
7.39
7.39
7.35
7.33
7.31
7.31
7.30
7.25
7.10
7.09
7.07
7.01
7.00
7.00
6.99
6.99
6.97
5.74
5.72
2.15
1.57
Ph
O
N
F3C
OPh
3af
2.03
3.05
5.17
1.18
3.17
1.00
1.04
6.10
f1 (ppm)
158.55
157.64
155.74
135.40
131.05
129.76
129.72
129.66
128.61
128.55
128.22
125.82
125.40
125.28
123.02
122.58
122.18
119.06
118.24
100.35
100.33
91.29
77.44
77.12
76.80
63.08
62.83
62.58
62.32
39.83
Ph
O
N
F3C
OPh
3af
f1 (ppm)

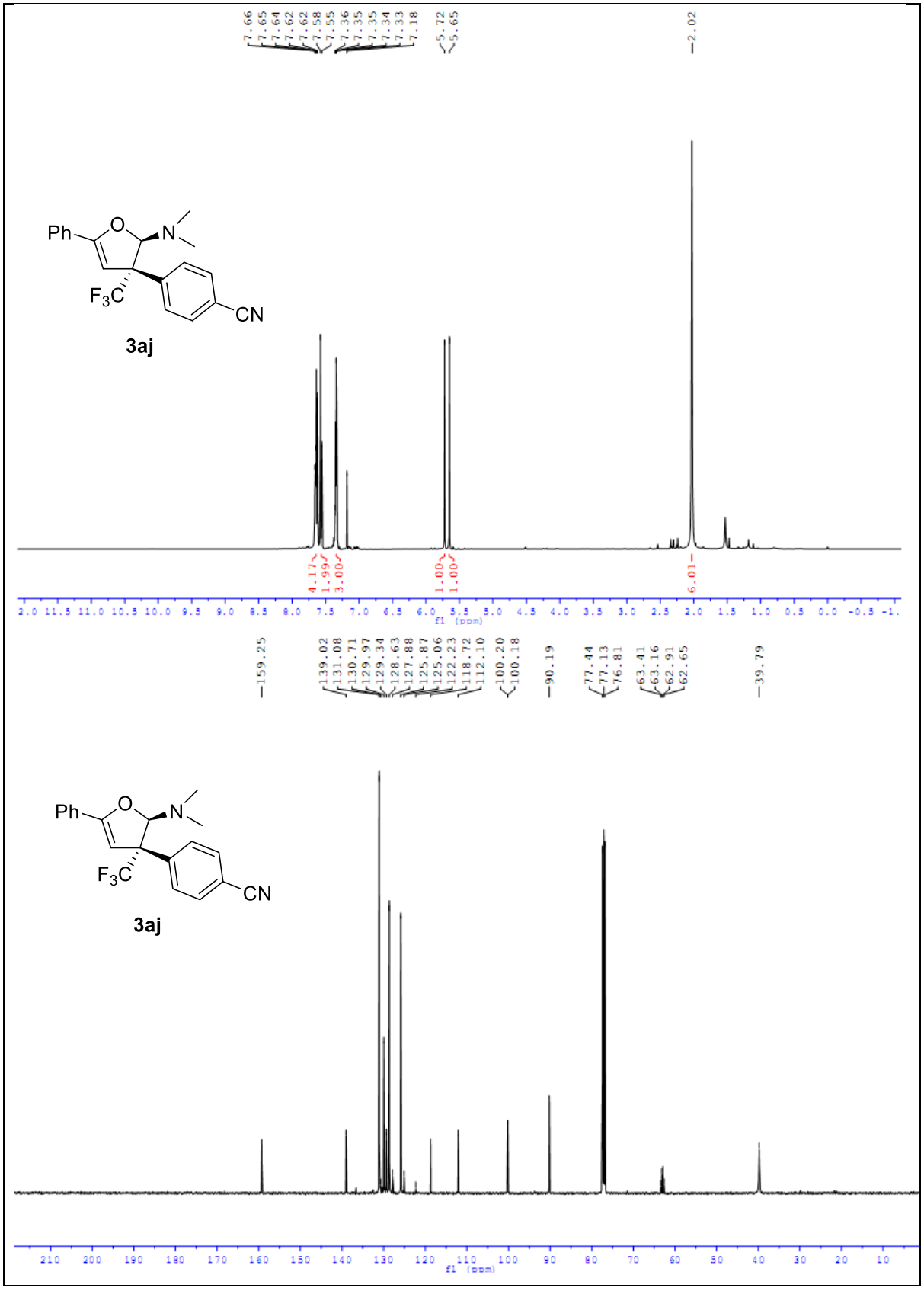

-74.35
Ph
O
N
F3C
OPh
3af
140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300 -320 -340
f1 (ppm)
7.72
7.71
7.71
7.70
7.70
7.69
7.42
7.41
7.40
7.39
7.38
7.37
7.37
7.25
7.10
7.09
7.08
7.05
7.04
7.02
7.02
6.83
6.81
6.80
5.73
5.67
4.27
2.15
0.00
Ph
O
N
F3C
O
O
3ag
2.01
3.01
1.01
1.00
0.99
1.01
1.00
4.06
6.05
12 11 10 9 8 7 6 5 4 3 2 1 0 -1
ppm

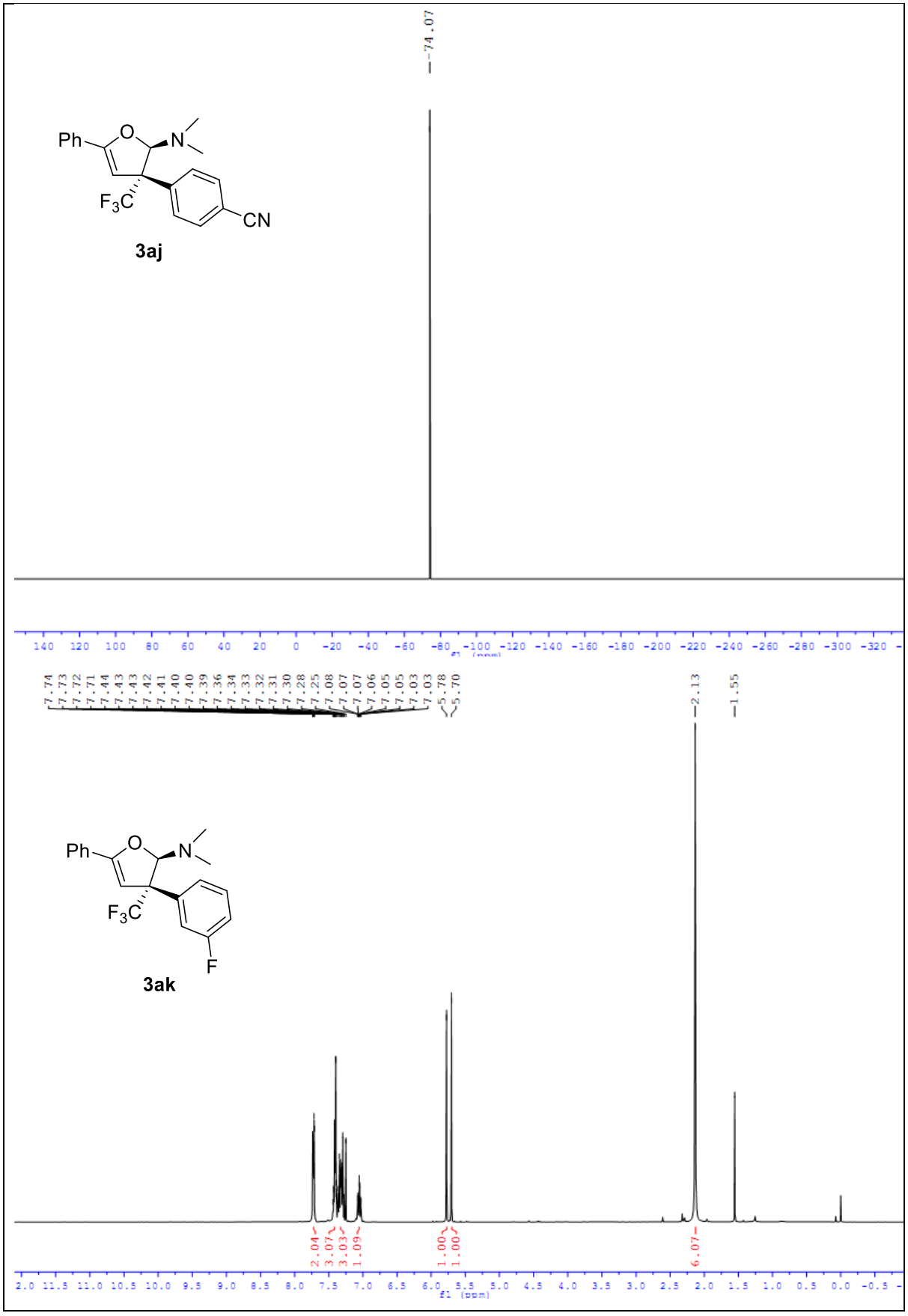

158.22
143.39
142.46
131.18
129.84
129.53
128.53
128.36
126.46
125.76
125.53
123.40
122.71
119.51
116.11
100.40
91.77
64.50
64.39
62.51
62.26
62.01
61.76
39.89
Ph
O
N
F3C
O
O
3ag
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
-74.58
Ph
O
N
F3C
O
O
3ag
100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300
ppm

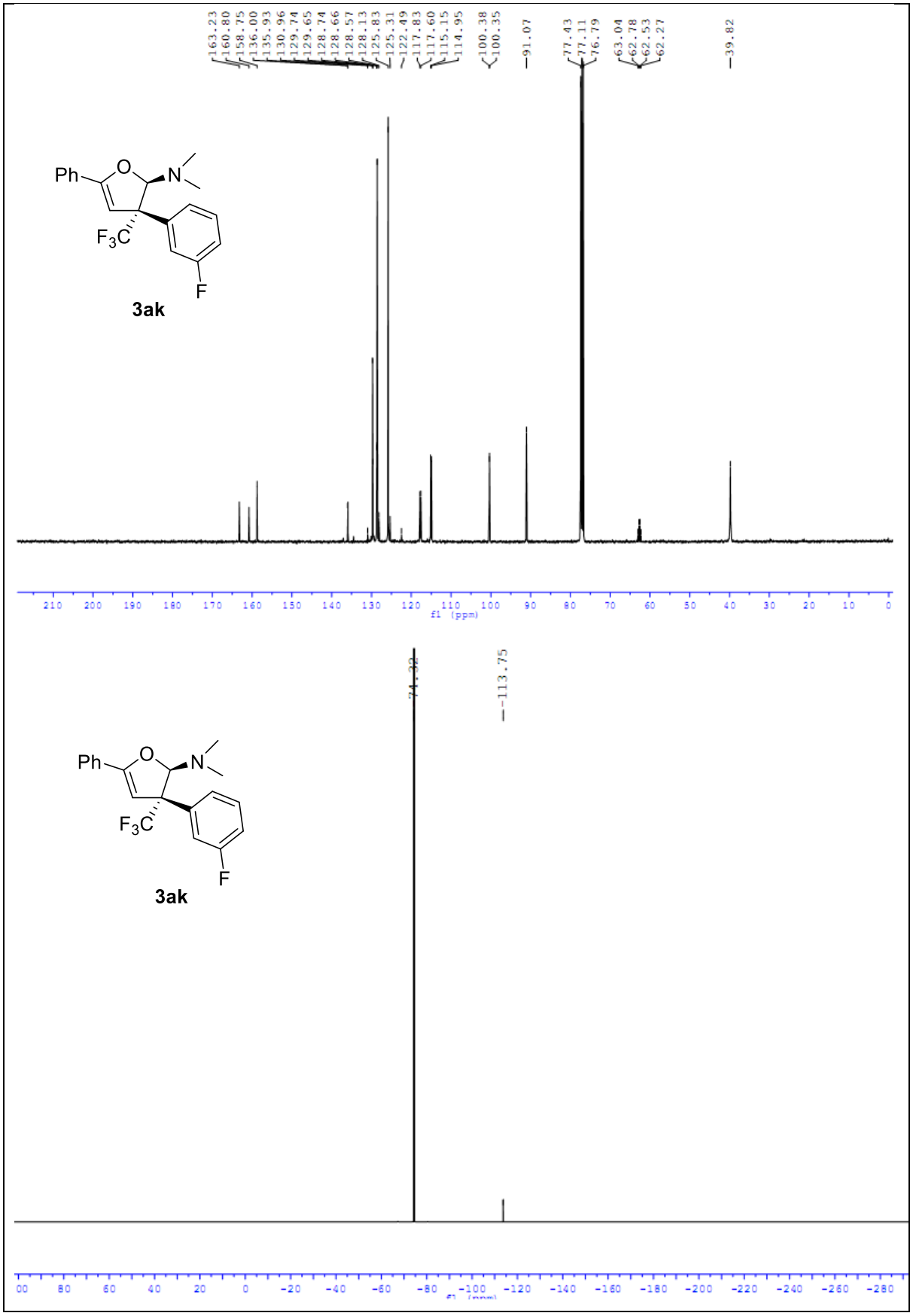

8.02
8.02
8.01
8.00
7.75
7.74
7.74
7.73
7.72
7.67
7.65
7.43
7.42
7.41
7.41
7.26
5.81
5.78
3.93
2.11
1.62
0.00
Ph
O
N
F3C
COOMe
3ah
2.07
2.07
2.06
3.08
1.00
0.92
3.09
5.99
166.98
158.81
138.70
130.91
130.37
129.77
129.60
128.59
128.52
128.09
125.84
125.26
122.44
100.38
100.35
90.90
77.44
77.12
76.81
63.34
63.09
62.83
62.58
52.28
39.79
Ph
O
N
F3C
COOMe
3ah

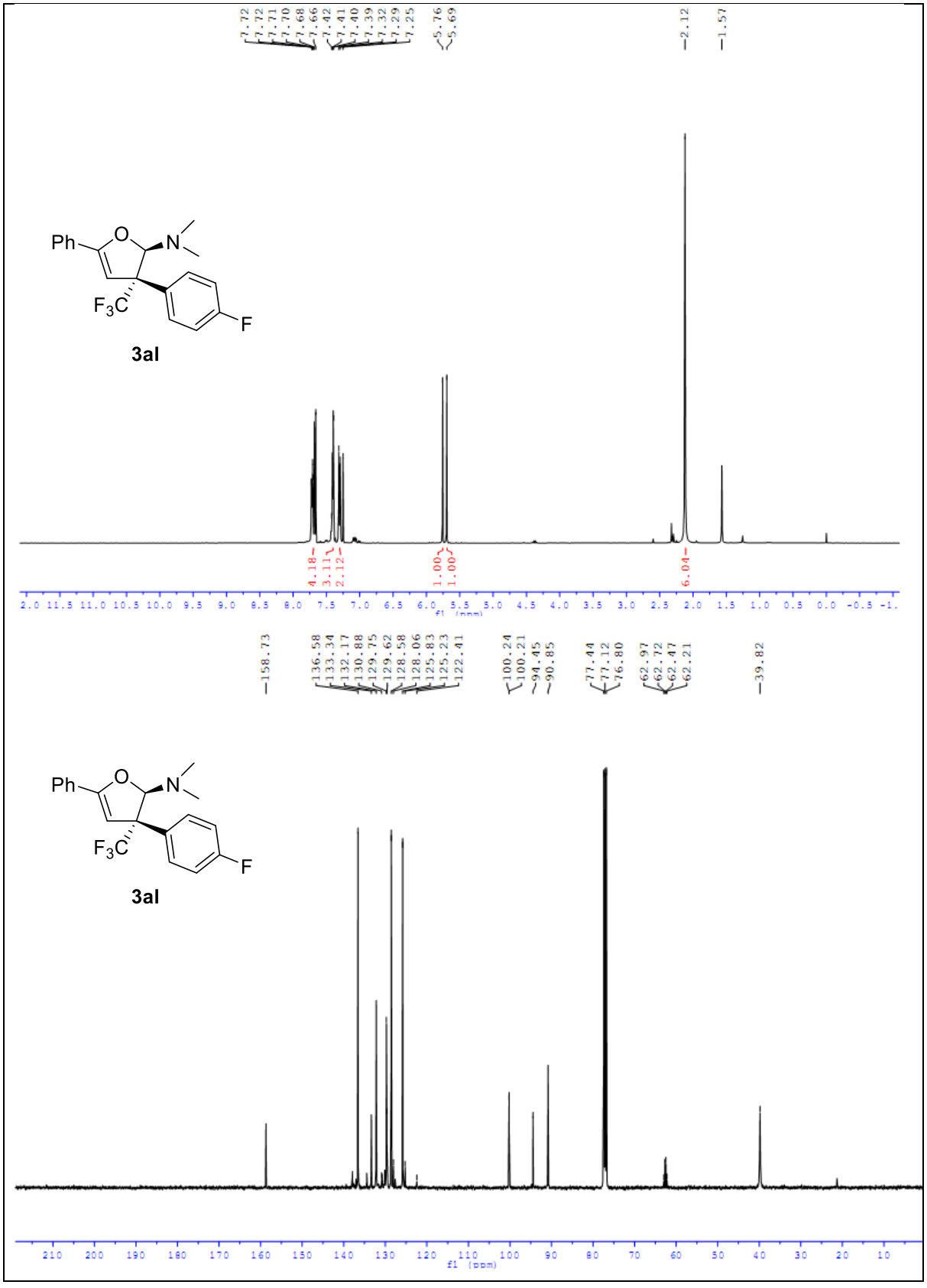

-74.12
Ph
O
N
F3C
COOMe
3ah
f1 (ppm)
8.21
8.21
8.19
8.19
7.78
7.76
7.75
7.73
7.73
7.72
7.45
7.44
7.43
7.42
7.42
7.26
5.82
5.75
2.12
1.57
0.00
Ph
O
N
F3C
NO2
3ai
2.01
4.08
3.02
1.00
1.00
6.05
f1 (ppm)

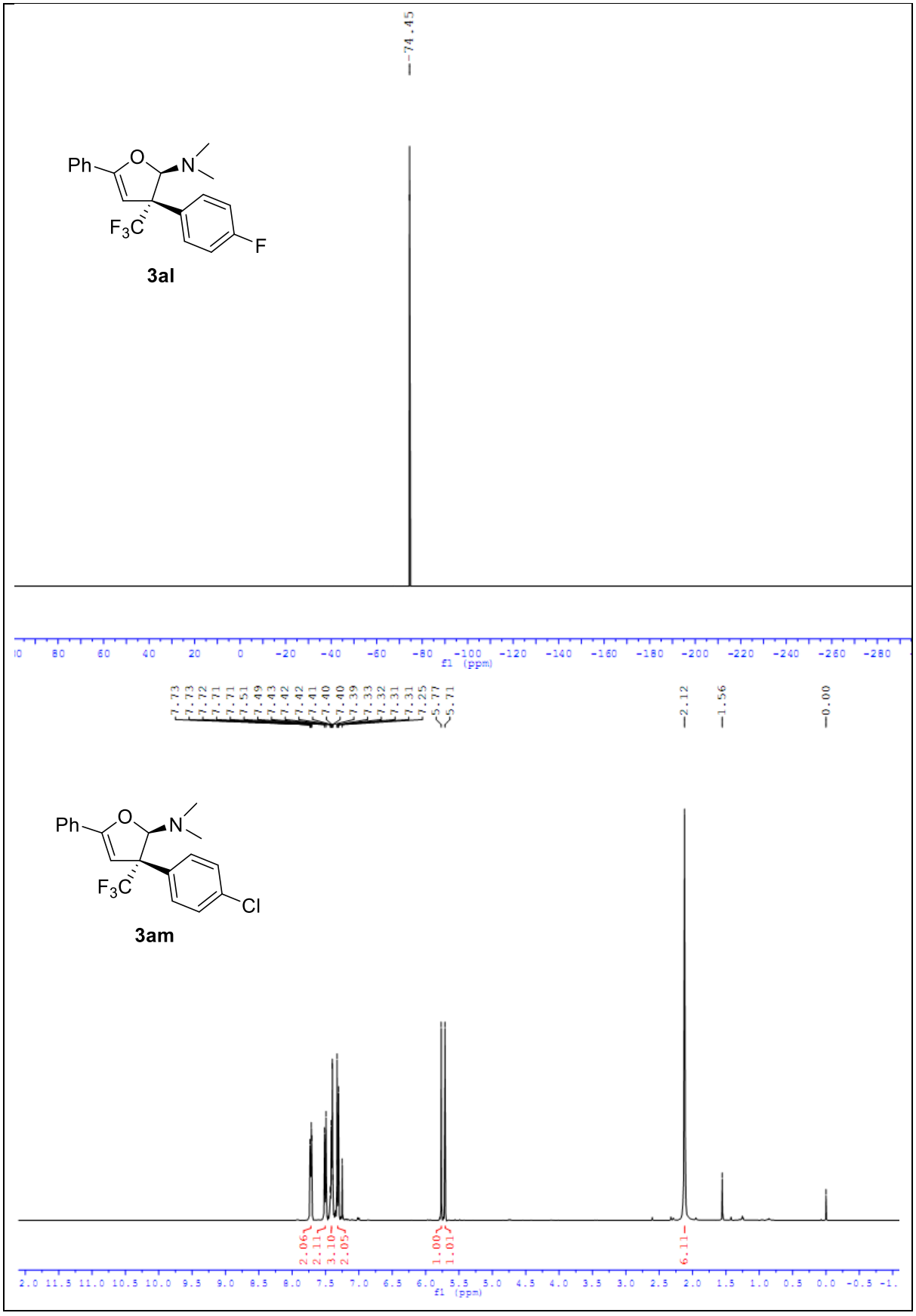

159.38
147.67
141.00
131.35
130.63
130.31
130.02
129.29
128.64
127.80
125.88
124.98
122.35
122.15
100.24
100.22
90.24
77.42
76.78
63.44
63.18
62.92
62.66
39.81
Ph
O
N
F3C
NO2
3ai
f1 (ppm)
-74.00
Ph
O
N
F3C
NO2
3ai

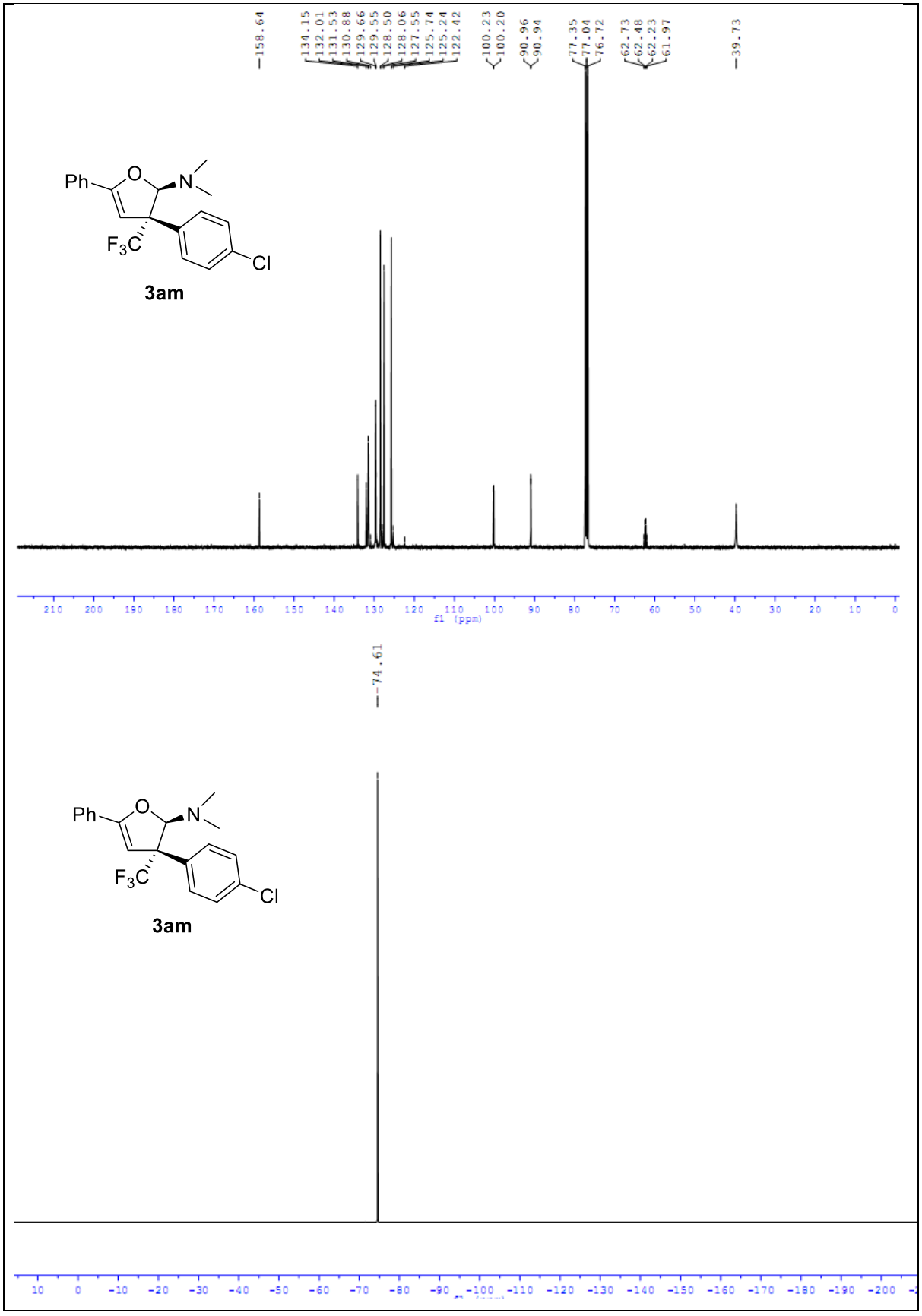

7.66
7.65
7.64
7.62
7.62
7.58
7.55
7.36
7.35
7.35
7.34
7.33
7.18
5.72
5.65
2.02
Ph
O
N
F3C
CN
3aj
4.17
1.99
3.00
1.00
1.00
6.01
f1 (ppm)
159.25
139.02
131.08
130.71
129.97
129.34
128.63
127.88
125.87
125.06
122.23
118.72
112.10
100.20
100.18
90.19
77.44
77.13
76.81
63.41
63.16
62.91
62.65
39.79
Ph
O
N
F3C
CN
3aj
f1 (ppm)

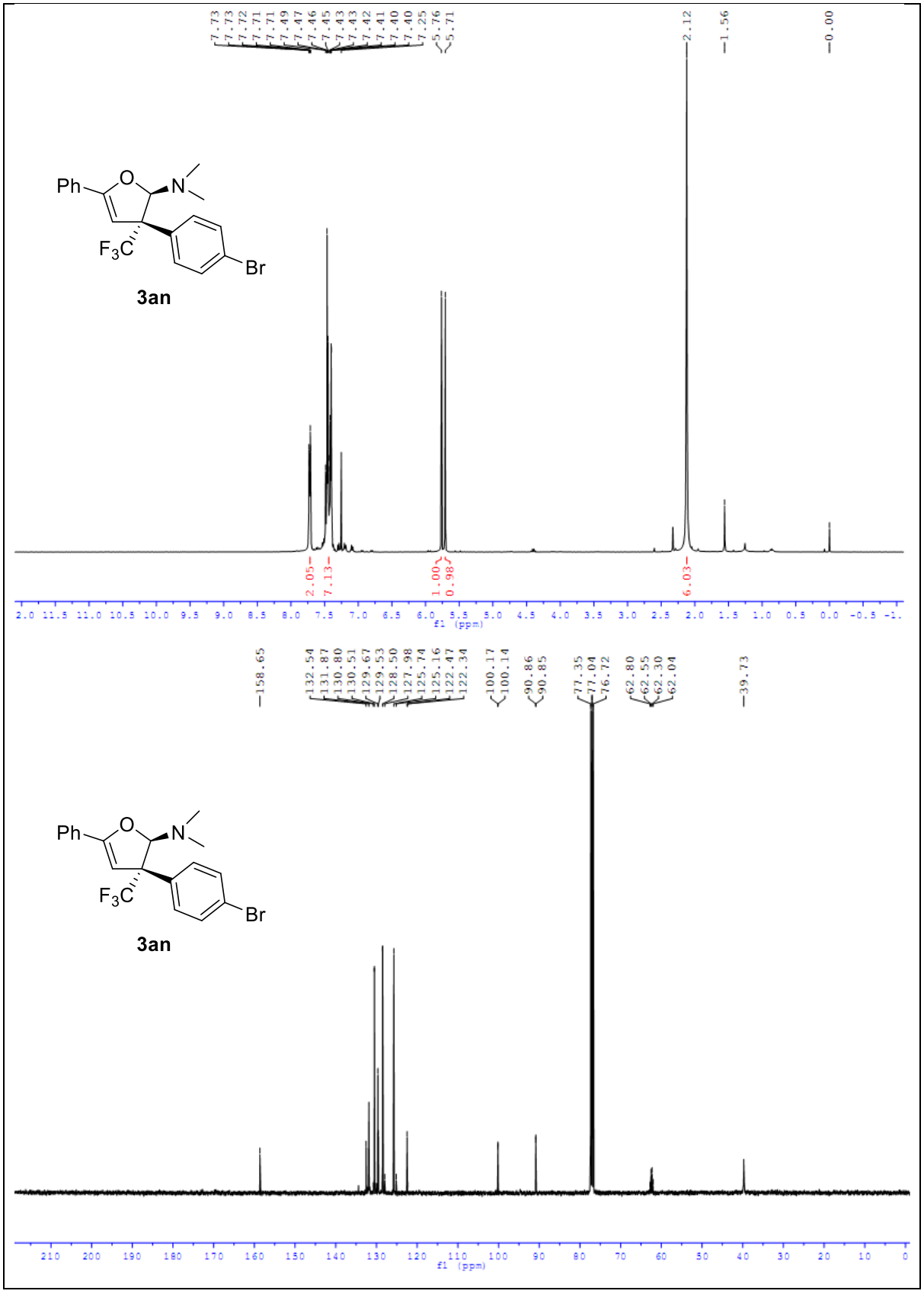

-74.07
Ph
O
N
F3C
CN
3aj
7.74
7.73
7.72
7.71
7.44
7.43
7.43
7.42
7.41
7.40
7.40
7.39
7.36
7.34
7.33
7.32
7.31
7.30
7.28
7.25
7.08
7.07
7.07
7.06
7.05
7.05
7.03
7.03
5.78
5.70
2.13
1.55
Ph
O
N
F3C
F
3ak
2.04
3.07
3.03
1.09
1.00
1.00
6.07
f1 (ppm)

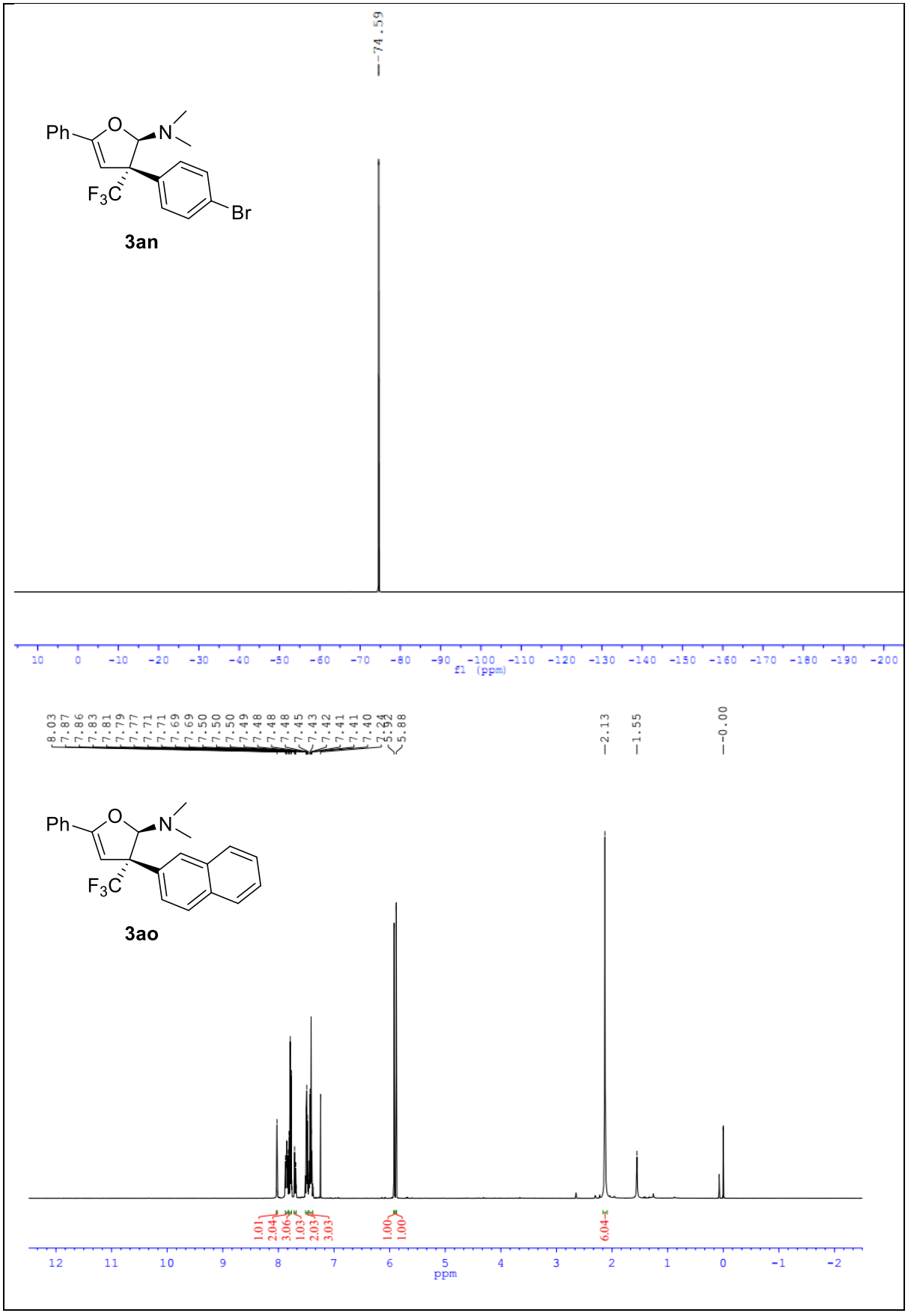

163.23
160.80
158.75
136.00
135.93
130.96
129.74
129.65
128.74
128.66
128.57
128.13
125.83
125.31
122.49
117.83
117.60
115.15
114.95
100.38
100.35
91.07
77.43
77.11
76.79
63.04
62.78
62.53
62.27
39.82
Ph
O
N
F3C
F
3ak
f1 (ppm)
74.32
-113.75
Ph
O
N
F3C
F
3ak

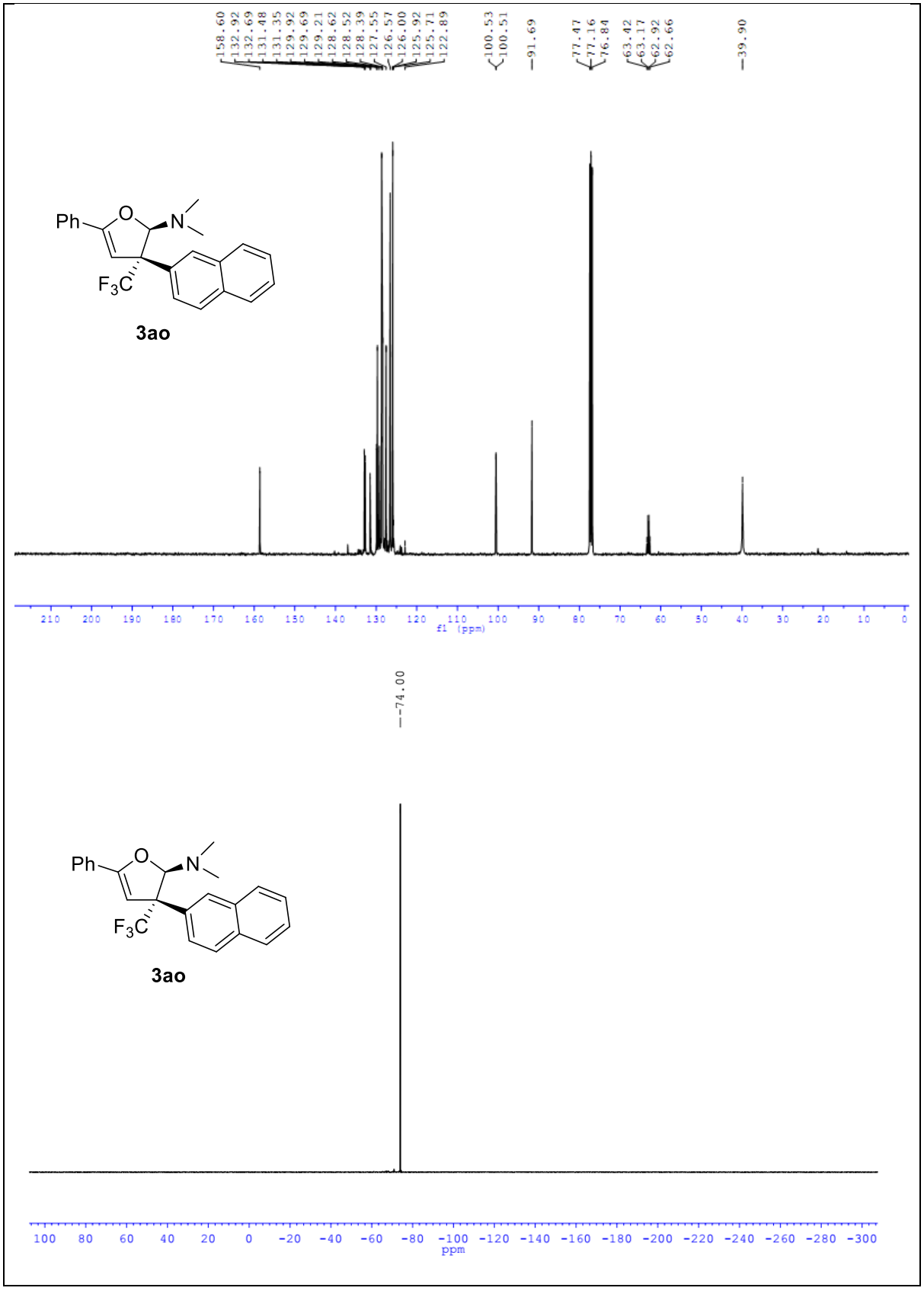

7.72
7.72
7.71
7.70
7.68
7.66
7.42
7.41
7.40
7.39
7.32
7.29
7.25
5.76
5.69
2.12
1.57
Ph
O
N
F3C
F
3al
4.18
3.11
2.12
1.00
1.00
6.04
158.73
136.58
133.34
132.17
130.88
129.75
129.62
128.58
128.06
125.83
125.23
122.41
100.24
100.21
94.45
90.85
77.44
77.12
76.80
62.97
62.72
62.47
62.21
39.82
Ph
O
N
F3C
F
3al

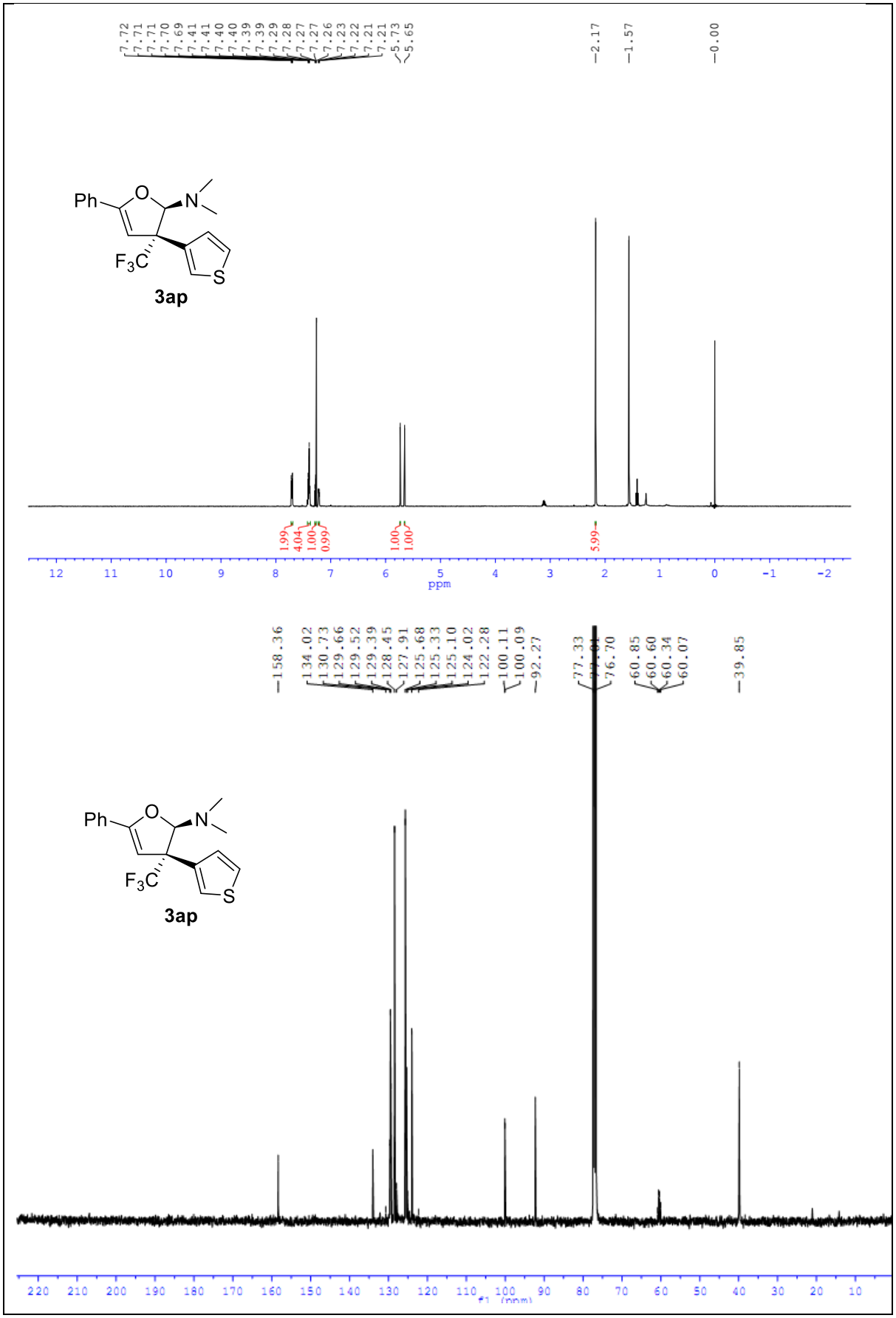

-74.45
Ph
O
N
F3C
F
3al
f1 (ppm)
7.73
7.73
7.72
7.71
7.71
7.51
7.49
7.43
7.42
7.42
7.41
7.40
7.40
7.39
7.33
7.32
7.31
7.31
7.25
5.77
5.71
2.12
1.56
0.00
Ph
O
N
F3C
Cl
3am
2.06
2.11
3.10
2.05
1.00
1.01
6.11
f1 (ppm)

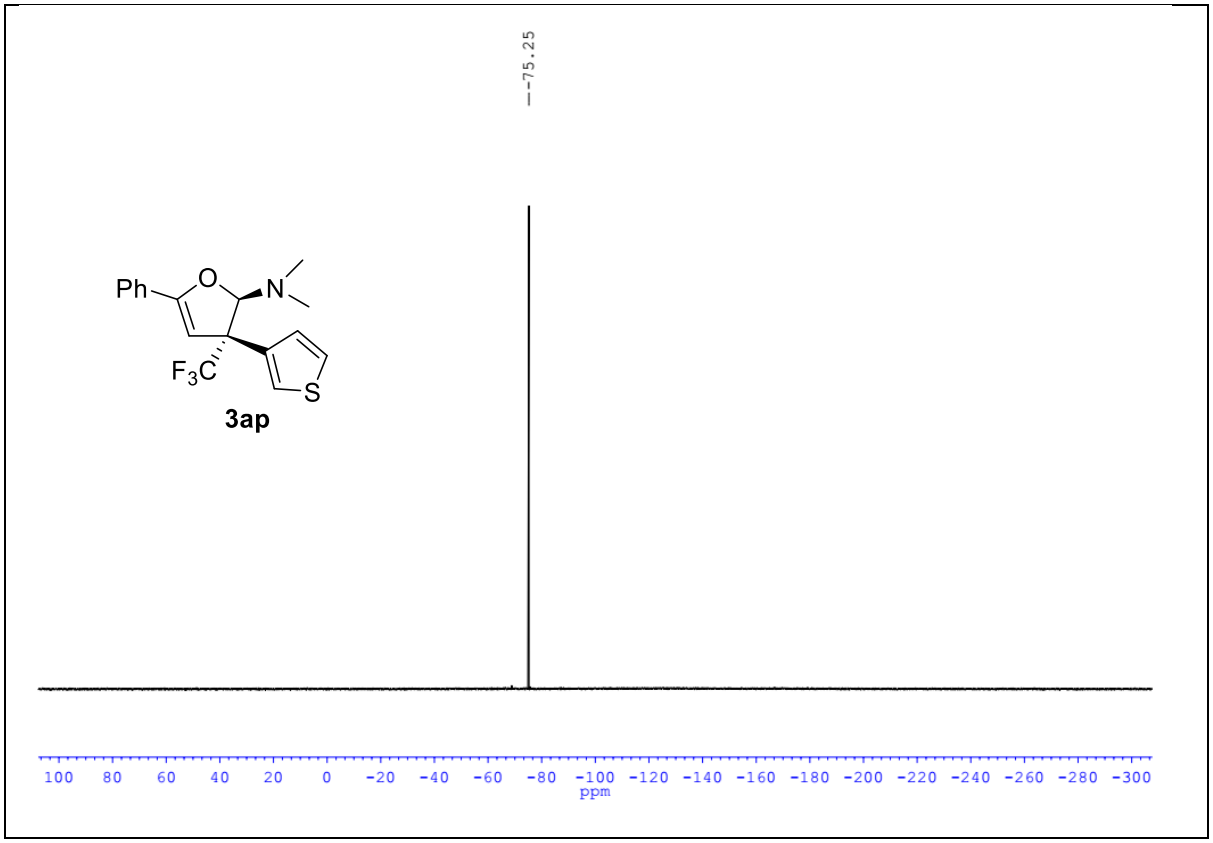

158.64
134.15
132.01
131.53
130.88
129.66
129.55
128.50
128.06
127.55
125.74
125.24
122.42
100.23
100.20
90.96
90.94
77.35
77.04
76.72
62.73
62.48
62.23
61.97
39.73
Ph
O
N
F3C
Cl
3am
f1 (ppm)
-74.61
Ph
O
N
F3C
Cl
3am


Ph
O
N
F3C
Br
3an
7.73
7.72
7.71
7.49
7.47
7.46
7.45
7.43
7.42
7.41
7.40
7.25
5.76
5.71
2.12
1.56
0.00
2.05
7.13
1.00
0.98
6.03
f1 (ppm)
158.65
132.54
131.87
130.80
130.51
129.67
129.53
128.50
127.98
125.74
125.16
122.47
122.34
100.17
100.14
90.86
90.85
77.35
77.04
76.72
62.80
62.55
62.30
62.04
39.73
f1 (ppm)

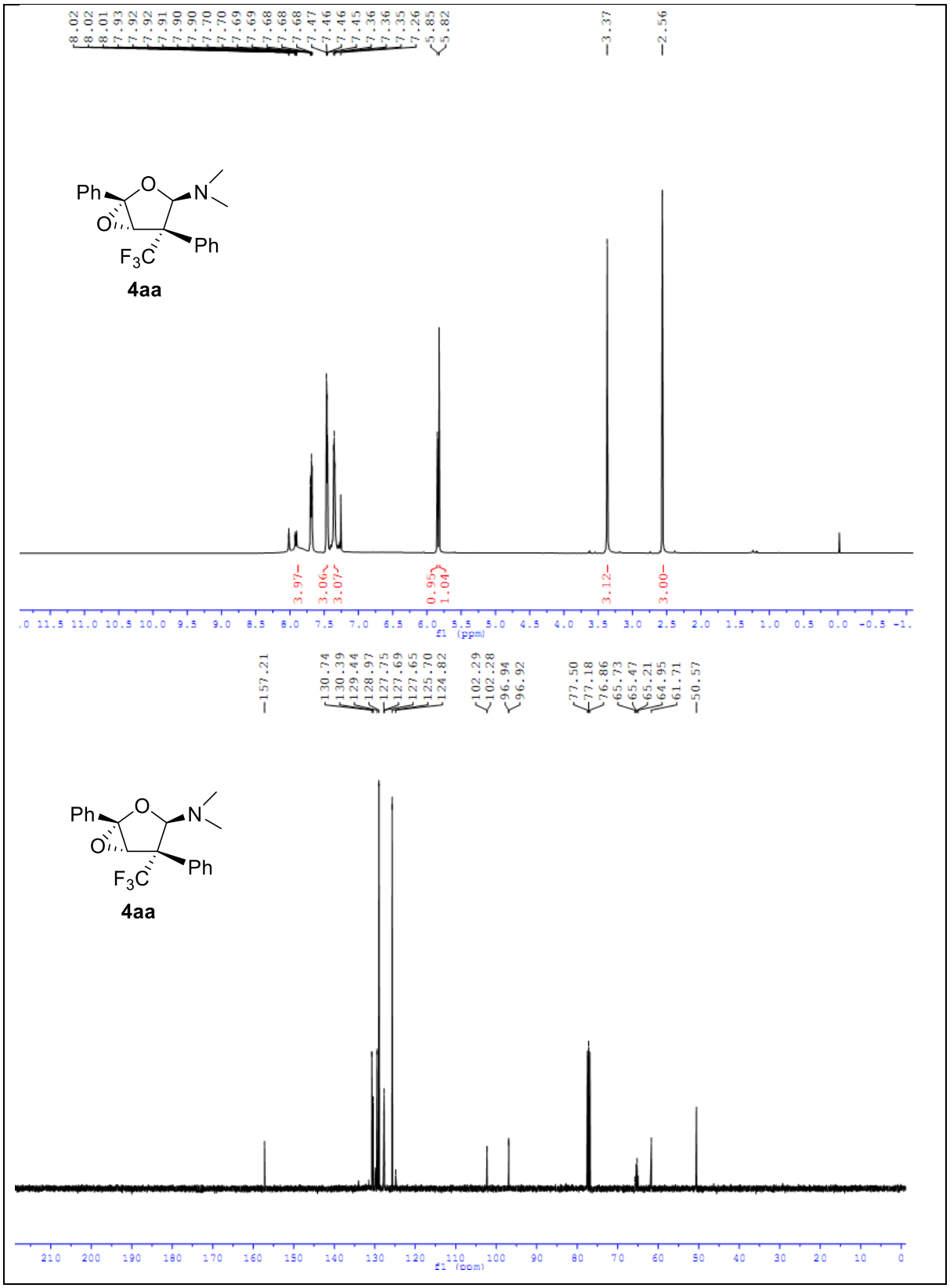

-74.59
Ph
O
N
F3C
Br
3an
f1 (ppm)
8.03
7.87
7.86
7.83
7.81
7.79
7.77
7.71
7.71
7.69
7.69
7.50
7.50
7.50
7.49
7.48
7.48
7.48
7.45
7.43
7.42
7.41
7.41
7.40
5.92
5.88
2.13
1.55
0.00
Ph
O
N
F3C
3ao
1.01
2.04
3.06
1.03
2.03
3.03
1.00
1.00
6.04
ppm

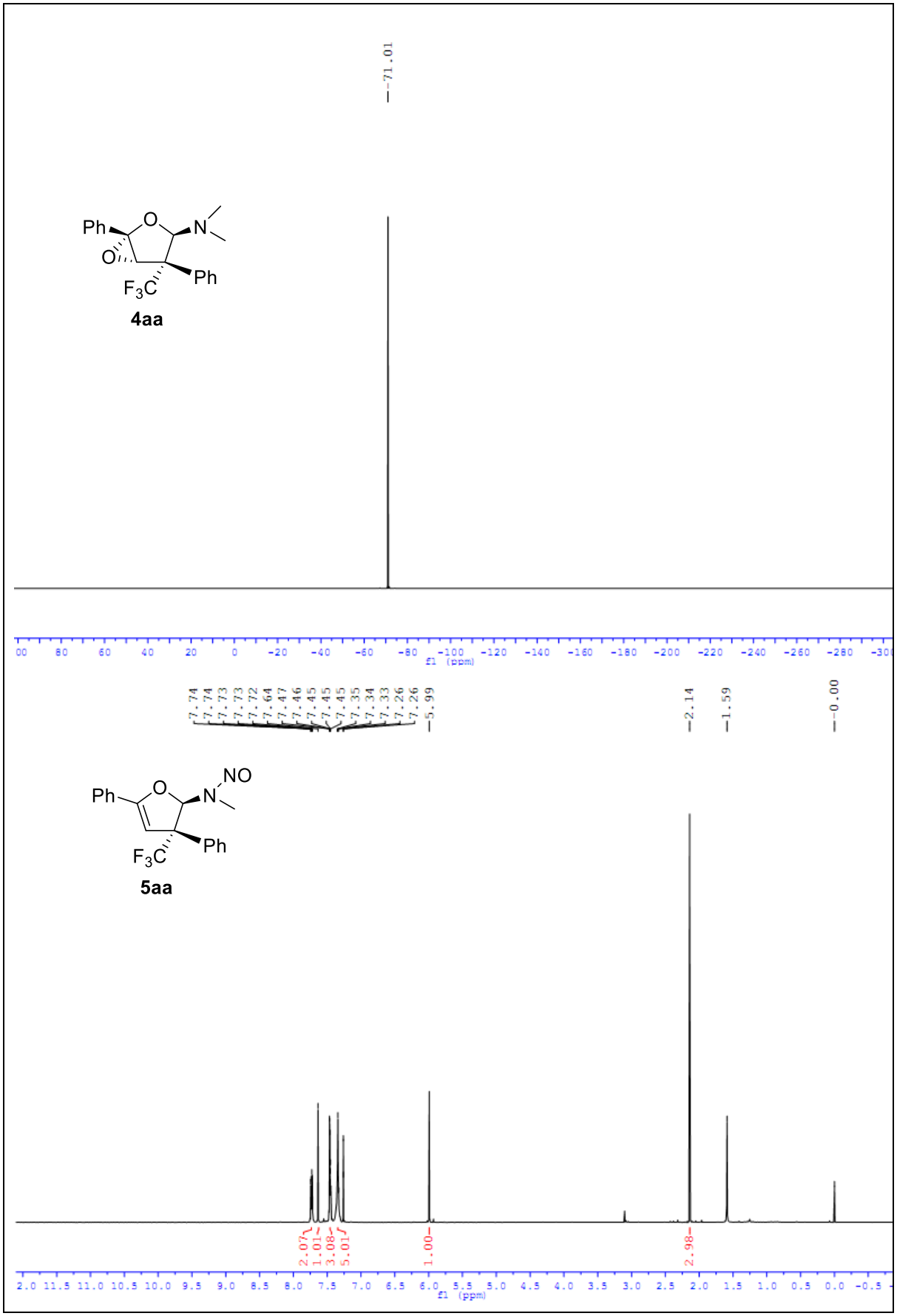

158.60
132.92
132.69
131.48
131.35
129.92
129.69
129.21
128.62
128.52
128.39
127.55
126.57
126.00
125.92
125.71
122.89
100.53
100.51
91.69
77.47
77.16
76.84
63.42
63.17
62.92
62.66
39.90
Ph
O
N
F3C
3ao
f1 (ppm)
-74.00
Ph
O
N
F3C
3ao
ppm

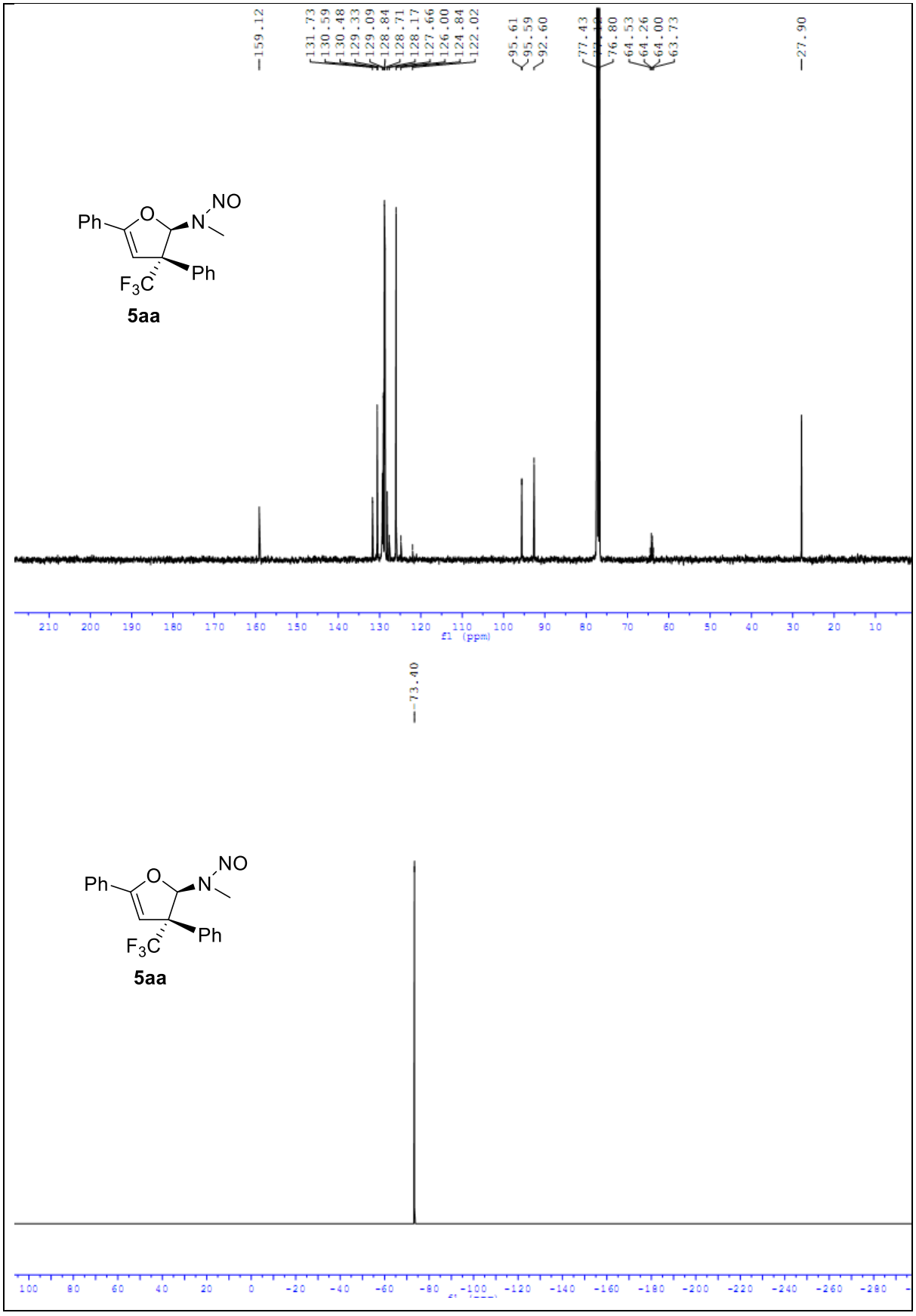

7.72
7.71
7.71
7.70
7.69
7.41
7.41
7.40
7.40
7.39
7.39
7.29
7.28
7.27
7.27
7.26
7.23
7.22
7.21
7.21
5.73
5.65
2.17
1.57
0.00
Ph
O
N
F3C
S
3ap
1.99
4.04
1.00
0.99
1.00
1.00
5.99
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
ppm
158.36
134.02
130.73
129.66
129.52
129.39
128.45
127.91
125.68
125.33
125.10
124.02
122.28
100.11
100.09
92.27
77.33
77.01
76.70
60.85
60.60
60.34
60.07
39.85
Ph
O
N
F3C
S
3ap
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

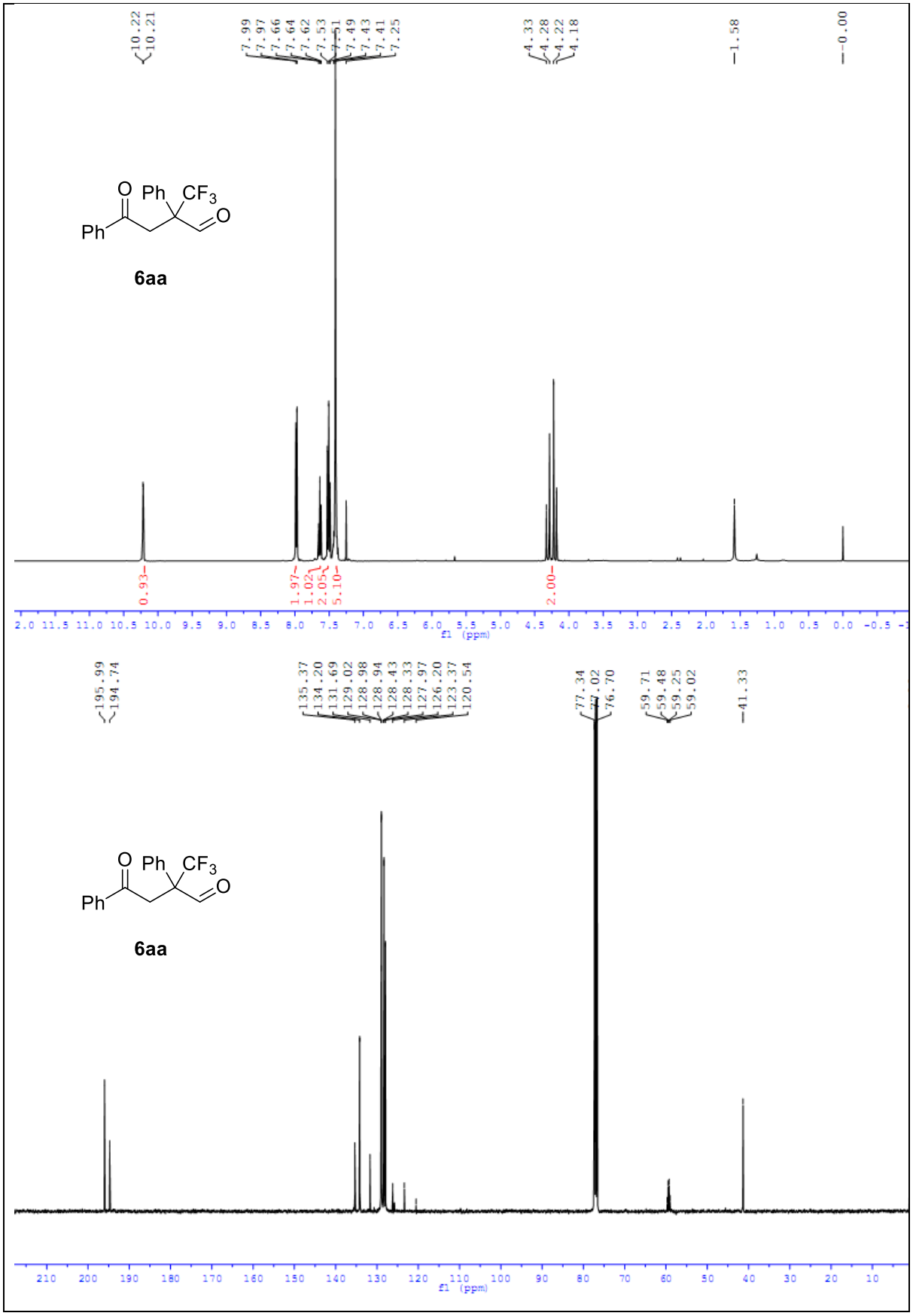

-75.25
Ph
O
N
F3C
S
3ap
100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300
ppm

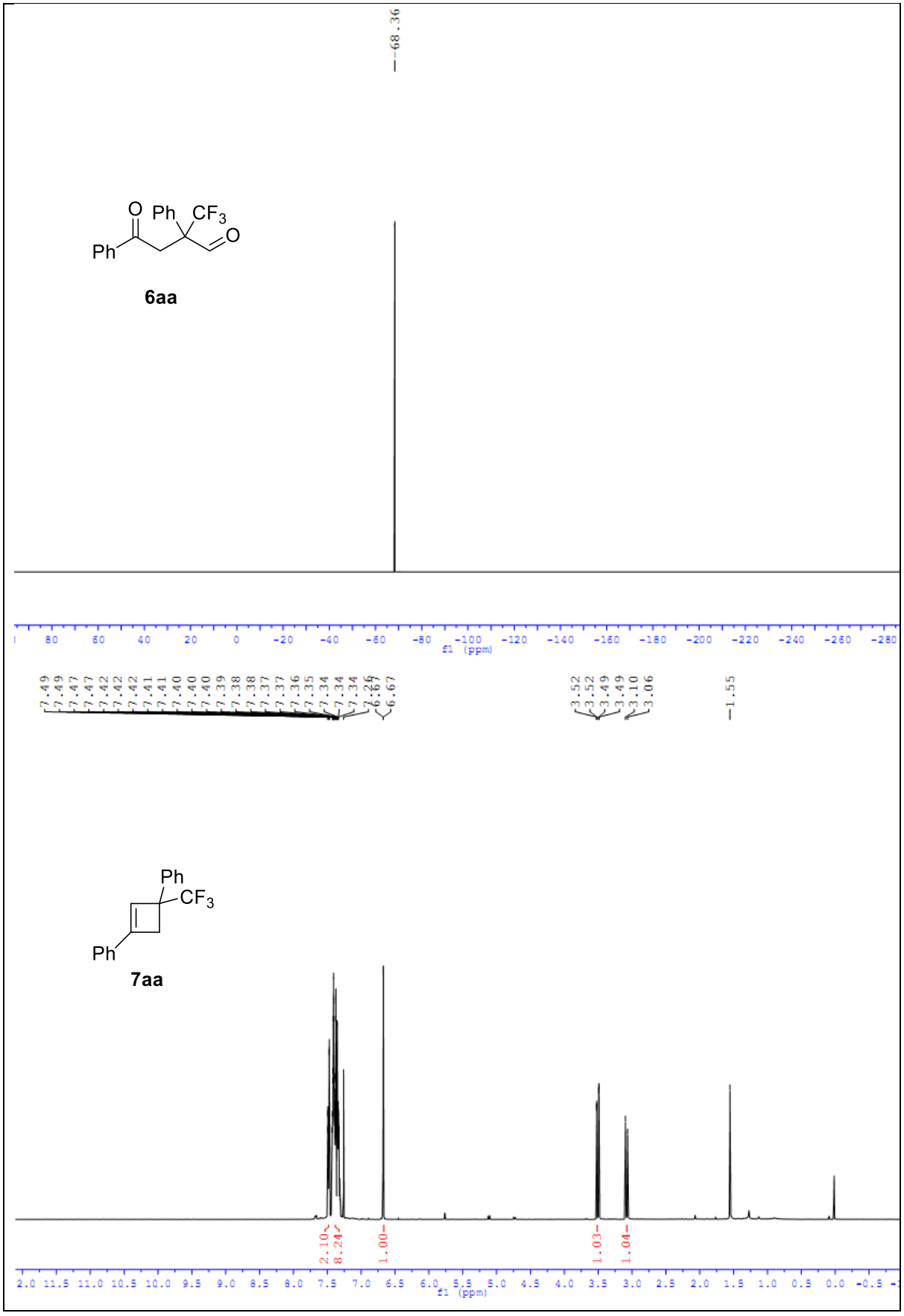
NMR Spectral for 2*H*-Furan applications

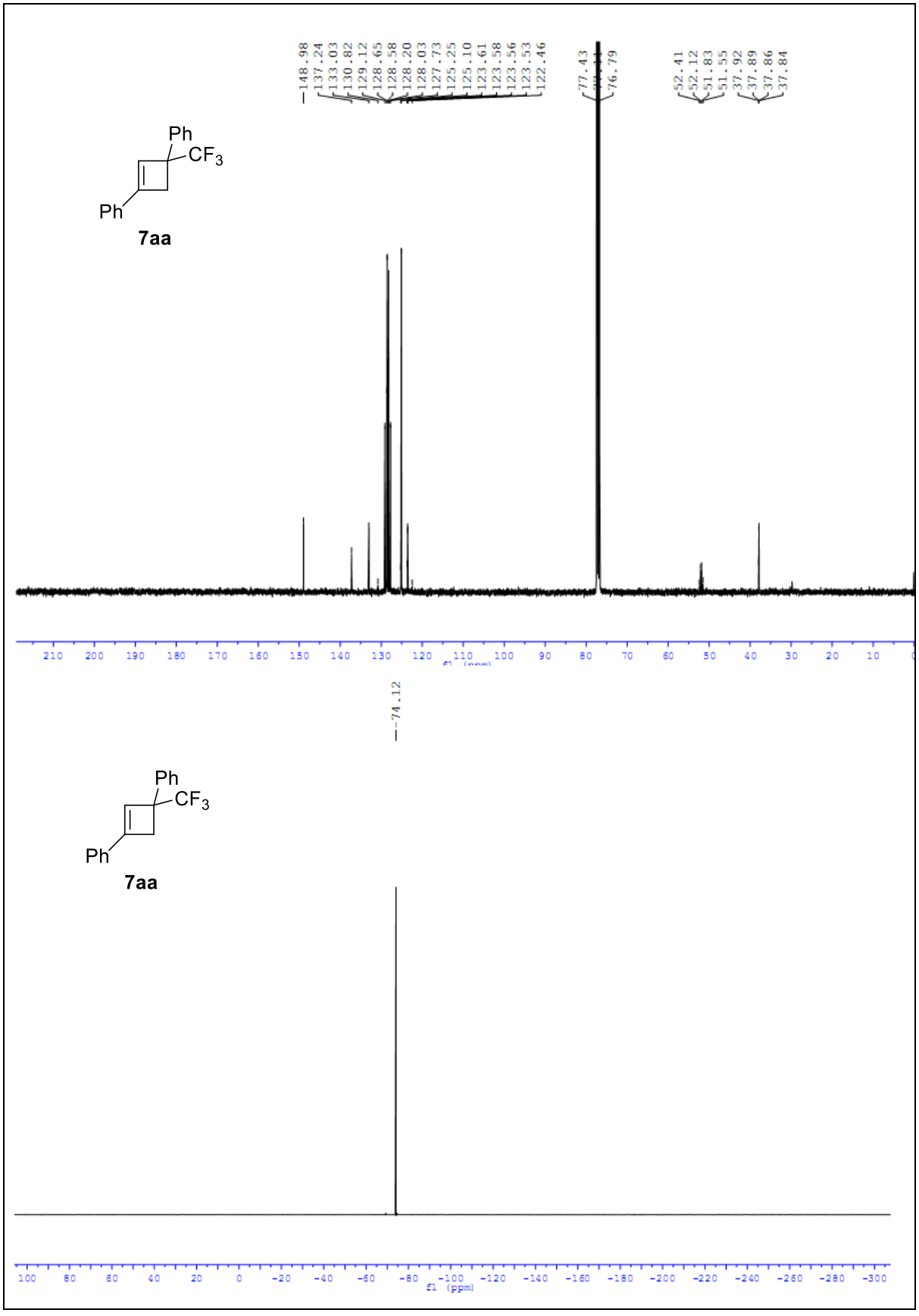


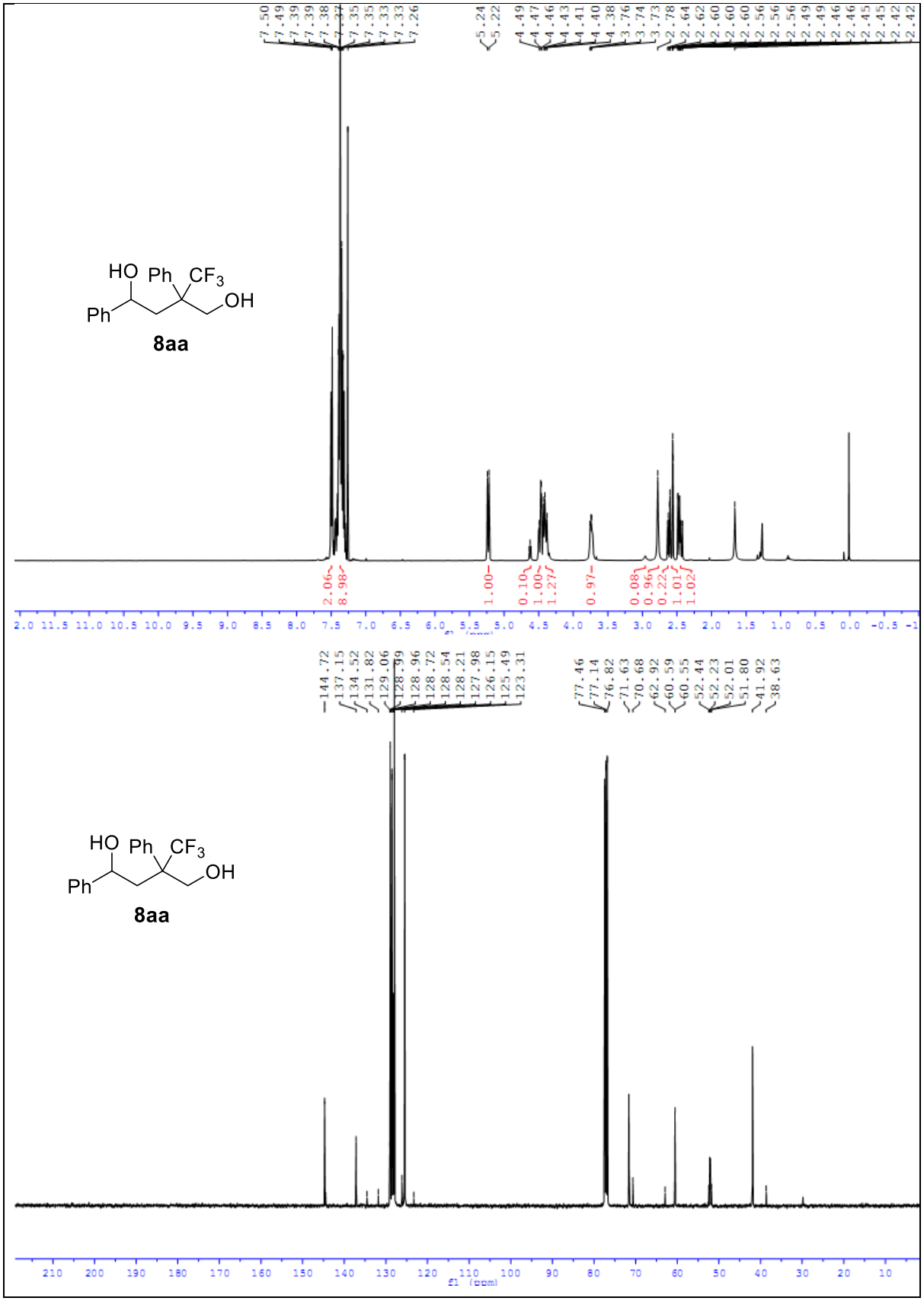

-71.01
Ph
O
N
O
F3C
Ph
4aa
f1 (ppm)
7.74
7.74
7.73
7.73
7.72
7.64
7.47
7.46
7.45
7.45
7.45
7.35
7.34
7.33
7.26
7.26
5.99
2.14
1.59
0.00
Ph
O
N
NO
F3C
Ph
5aa
2.07
1.01
3.08
5.01
1.00
2.98
f1 (ppm)

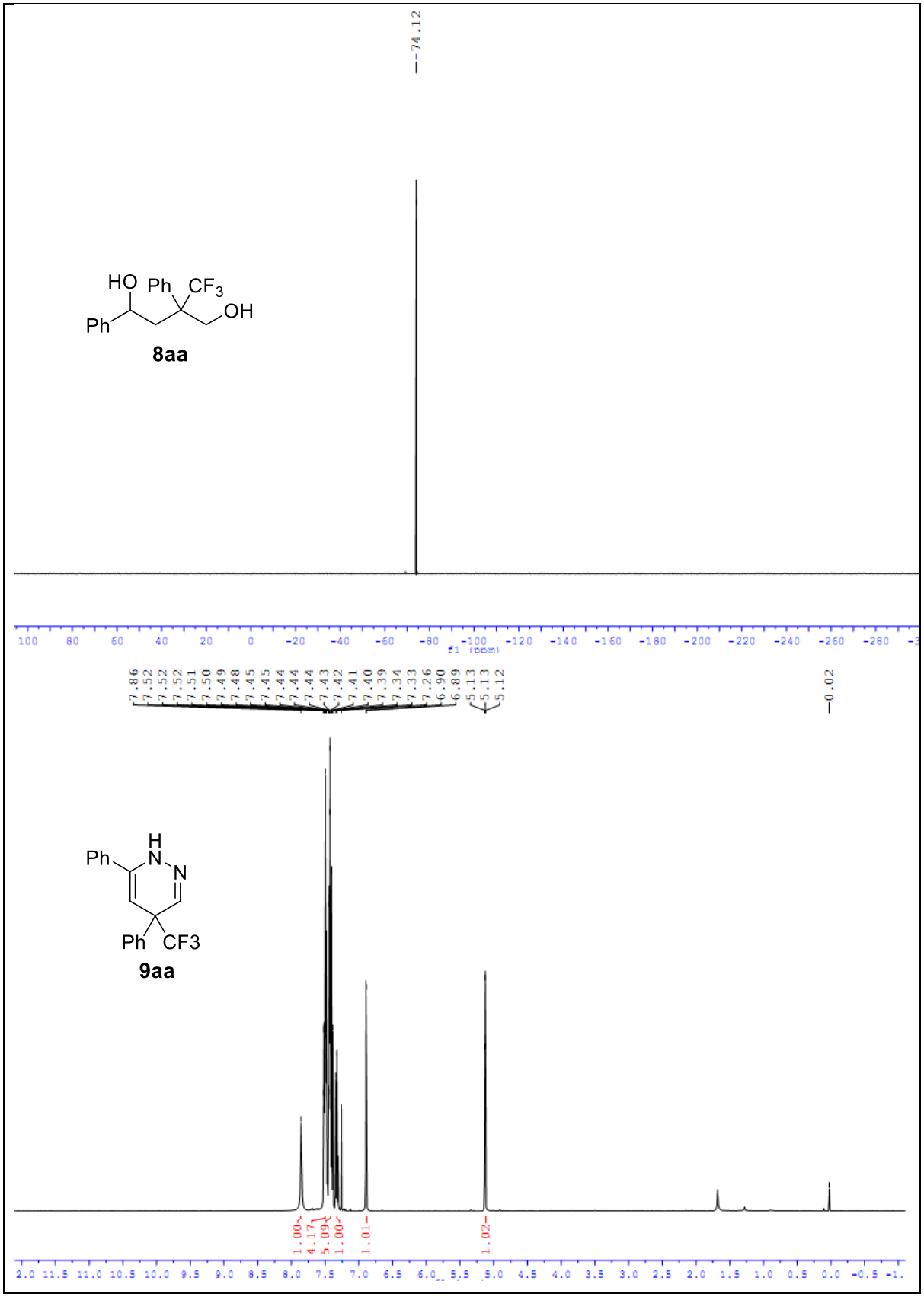

159.12
131.73
130.59
130.48
129.33
129.09
128.84
128.71
128.17
127.66
126.00
124.84
122.02
95.61
95.59
92.60
77.43
76.80
64.53
64.26
64.00
63.73
27.90
Ph
O
N
NO
Ph
F3C
5aa
f1 (ppm)
-73.40
Ph
O
N
NO
Ph
F3C
5aa

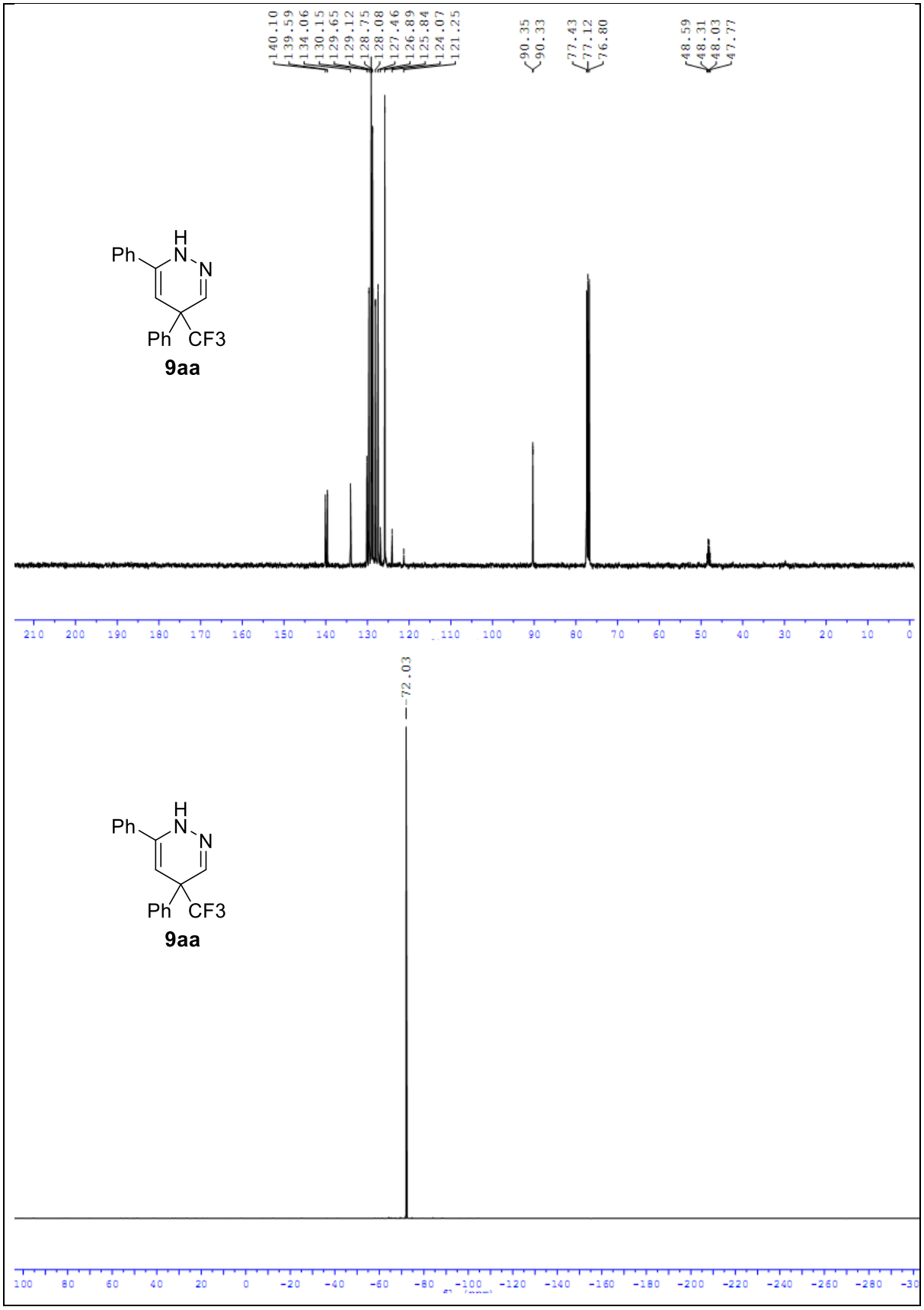

10.22
10.21
7.99
7.97
7.66
7.64
7.62
7.53
7.51
7.49
7.43
7.41
7.25
4.33
4.28
4.22
4.18
1.58
0.00
O
Ph
CF3
O
Ph
6aa
0.93
1.97
1.02
2.05
5.10
2.00
f1 (ppm)
195.99
194.74
135.37
134.20
131.69
129.02
128.98
128.94
128.43
128.33
127.97
126.20
123.37
120.54
77.34
77.02
76.70
59.71
59.48
59.25
59.02
41.33
O
Ph
CF3
O
Ph
6aa
f1 (ppm)


-68.36
O
Ph
CF3
Ph
O
6aa
80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280
f1 (ppm)
7.49 7.49 7.47 7.47 7.42 7.42 7.42 7.41 7.41 7.40 7.40 7.40 7.39 7.38 7.38 7.37 7.37 7.36 7.35 7.34 7.34 7.34 7.26 6.67 6.67
3.52 3.52 3.49 3.49 3.10 3.06
1.55
Ph
CF3
Ph
7aa
2.10
8.24
1.00
1.03
1.04
2.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


148.98
137.24
133.03
130.82
129.12
128.65
128.58
128.20
128.03
127.73
125.25
125.10
123.61
123.58
123.56
123.53
122.46
77.43
76.79
52.41
52.12
51.83
51.55
37.92
37.89
37.86
37.84
Ph
CF3
Ph
7aa
-74.12
Ph
CF3
Ph
7aa
f1 (ppm)


HO Ph CF3
Ph OH
8aa
7.50 7.49 7.39 7.39 7.38 7.37 7.35 7.35 7.33 7.33 7.26
5.24 5.22
4.49 4.47 4.46 4.43 4.41 4.40 4.38 3.76 3.74 3.73
2.78 2.64 2.62 2.60 2.60 2.56 2.56 2.49 2.49 2.46 2.46 2.45 2.42 2.42
2.06 8.98 1.00 0.10 1.00 1.27 0.97 0.08 0.96 0.22 1.01 1.02
144.72 137.15 134.52 131.82 129.06 128.99 128.96 128.72 128.54 128.21 127.98 126.15 125.49 123.31
77.46 77.14 76.82 71.63 70.68 62.92 60.59 60.55 52.44 52.23 52.01 51.80 41.92 38.63
HO Ph CF3
Ph OH
8aa


-74.12
HO
Ph
CF3
OH
Ph
8aa
f1 (ppm)
7.86
7.52
7.52
7.52
7.51
7.50
7.49
7.48
7.45
7.45
7.44
7.44
7.44
7.43
7.42
7.41
7.40
7.39
7.34
7.33
7.26
6.90
6.89
5.13
5.13
5.12
0.02
Ph
H
N
N
Ph
CF3
9aa
1.00
4.17
5.09
1.00
1.01
1.02


140.10
139.59
134.06
130.15
129.65
129.12
128.75
128.08
127.46
126.89
125.84
124.07
121.25
90.35
90.33
77.43
77.12
76.80
48.59
48.31
48.03
47.77
Ph
H
N
N
Ph
CF3
9aa
-72.03
Ph
H
N
N
Ph
CF3
9aa