

Supporting Information

For

Palladium-Catalyzed Double-Isocyanide Insertion

via Oxidative N-O Cleavage of Acetyl Oximes:

Syntheses of 2*H*-Pyrrol-2-imines

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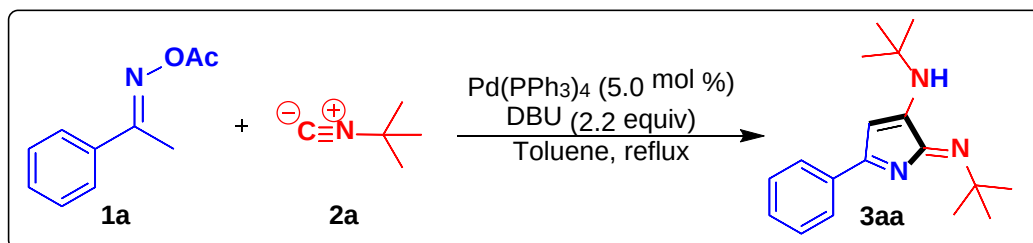
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1) General Information

Starting material were prepared according to the literature reported protocols.¹ ^1H , ^{13}C and DEPT NMR spectra were recorded on a 400 MHz Varian Unity Plus or Varian Mercury plus spectrometer or JEOL 400 MHz. The chemical shift (δ) values are reported in parts per million (ppm), and the coupling constants (J) are given in Hz. The spectra were recorded using CDCl_3 as a solvent. ^1H NMR chemical shifts are referenced to tetramethylsilane (TMS) (0 ppm). ^{13}C NMR was referenced to CDCl_3 (77.0 ppm). The abbreviations used are as follows: s, singlet; d, doublet; t, triplet; q, quartet; dd, doublet of doublet; ddd, doublet of doublet of doublet; dt, doublet of triplets; td, triplet of doublet; m, multiplet. Mass spectra and high-resolution mass spectra (HRMS) was measured using the ESI (FT-MS solariX) at National Sun Yat-Sen University, Kaohsiung, Taiwan or LTQ Orbitrap XL (Thermo Fischer Scientific) at National Chung Hsing University. Melting points were determined on an EZ-Melt (Automated melting point apparatus). All products reported showed ^1H NMR spectra in agreement with the assigned structures. Reaction progress and product mixtures were routinely monitored by TLC using Merck TLC aluminum sheets (silica gel 60 F254). Column chromatography was carried out with 230–400 mesh silica gel 60 (Merck)/neutral alumina and a mixture of hexane/ethyl acetate or hexane as an eluent.

2) General Experimental Procedure and Spectral Characterization

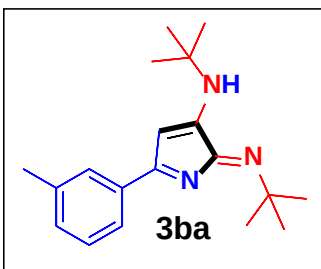
General procedure for preparation of (*Z*)-*N*-(*tert*-Butyl)-2-(*tert*-butylimino)-5-phenyl-2*H*-pyrrol-3-amine (3aa).



To an oven dried sealed tube was added (*E*)-1-phenylethan-1-one *O*-acetyl oxime (89 mg, 0.5 mmol) in 2.0 mL of toluene followed by the sequential addition of tertiary butyl isocyanide **2a** (121 μL , 1.05 mmol), DBU (164 μL , 1.1 mmol), and $\text{Pd}(\text{PPh}_3)_4$ (29 mg, 5 mol%). The reaction mixture was allowed to stir at reflux for 4h. After the completion, the reaction mixture was cooled to room temperature and diluted with 5.0 mL of water. The water layer was extracted

with (3X10 mL) of ethyl acetate and the combined ethyl acetate layer was given brine wash (1X10 mL). The final ethyl acetate layer was dried over sodium sulfate and concentrated under reduced pressure to get the crude compound. The obtained crude was purified using column chromatography by eluting from hexane to 5% ethyl acetate/hexane to afford pure (*Z*)-*N*-(*tert*-Butyl)-2-(*tert*-butylimino)-5-phenyl-2*H*-pyrrol-3-amine (**3aa**) as a dark red solid (122 mg, yield 86%); Mp 99-101 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.06 – 8.03 (m, 2H), 7.44 – 7.40 (m, 3H), 5.69 (s, 1H), 1.53 (s, 9H), 1.38 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 179.11, 163.08, 158.40, 134.71, 131.20, 130.99, 128.98, 128.37, 128.23, 90.40, 54.53, 54.26, 29.77; HRMS (ESI) calcd for C₁₈H₂₆N₃ [M + H]⁺: 284.2121; found: 284.2112.

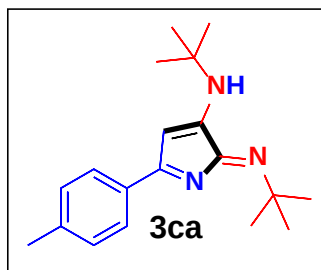
(*Z*)-*N*-(*tert*-Butyl)-2-(*tert*-butylimino)-5-(*o*-tolyl)-2*H*-pyrrol-3-amine (3ba**).** Following the



general procedure on a 0.5 mmol scale for 2 h giving the compound as a dark red solid (121 mg, yield 81%); Mp 107-108 °C; ¹H NMR (400 MHz, CDCl₃) δ 7.85-7.83 (m, 2H), 7.33-7.29 (m, 1H), 7.26-7.24 (m, 1H), 5.67 (s, 1H), 2.41 (s, 3H), 1.53 (s, 9H), 1.37 (s, 9H); ¹³C NMR (101 MHz, CDCl₃) δ 162.99, 137.83, 134.56, 131.83,

128.41, 128.14, 125.18, 90.40, 53.89, 53.43, 30.03, 29.47, 21.43; HRMS (ESI) calcd for C₁₉H₂₈N₃ [M + H]⁺: 298.2278; found: 298.2279.

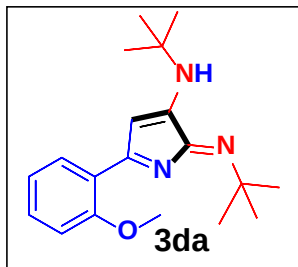
(*Z*)-*N*-(*tert*-Butyl)-2-(*tert*-butylimino)-5-(*p*-tolyl)-2*H*-pyrrol-3-amine (3ca**).** Following the



general procedure on a 0.5 mmol scale giving the compound as a dark red solid (128 mg, yield 86%); Mp 109-111 °C; ¹H NMR (400 MHz, CDCl₃) δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.22 (d, *J* = 8.0 Hz, 2H), 5.65 (s, 1H), 2.39 (s, 3H), 1.52 (s, 9H), 1.37 (s, 9H); ¹³C NMR (101 MHz, CDCl₃) δ 163.22, 157.71, 141.52, 131.85, 129.00, 128.02,

89.91, 54.58, 53.76, 30.07, 29.66, 21.64; HRMS (ESI) calcd for C₁₉H₂₈N₃ [M + H]⁺: 298.2278; found: 298.2267.

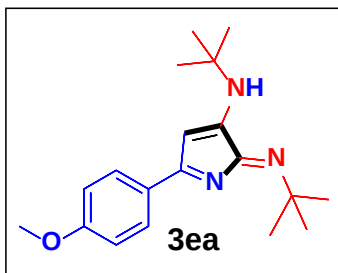
(*Z*)-*N*-(*tert*-Butyl)-2-(*tert*-butylimino)-5-(2-methoxyphenyl)-2*H*-pyrrol-3-amine (3da**).**



Following the general procedure on a 0.5 mmol scale for 1 h giving the compound as a dark brown solid (123 mg, yield 78%); Mp 87-89 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.38 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.34 (ddd, *J* = 8.3, 7.4, 1.9 Hz, 1H), 7.02 (ddd, *J* = 8.2, 7.6, 1.0 Hz, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.14 (s, 1H), 3.89 (s, 3H), 1.51 (s, 9H),

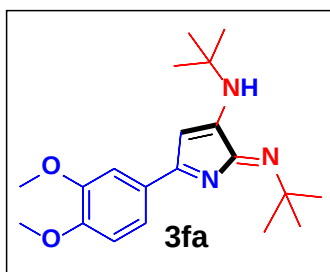
1.35 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 161.81, 160.76, 159.24, 131.32, 130.71, 123.47, 120.48, 110.79, 96.80, 55.40, 52.73, 30.17, 29.16; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{28}\text{N}_3\text{O}$ $[\text{M} + \text{H}]^+$: 314.2227; found: 314.2217.

(Z)-N-(*Tert*-Butyl)-2-(*tert*-butylimino)-5-(4-methoxyphenyl)-2*H*-pyrrol-3-amine (3ea).



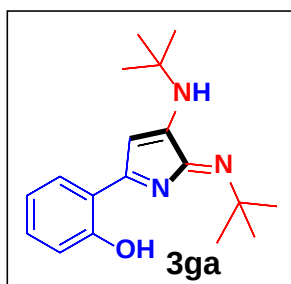
Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (127 mg, yield 81%); Mp 82-84 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.03 (d, J = 8.0 Hz, 2H), 6.94 (d, J = 8.0 Hz, 2H), 5.61 (s, 1H), 3.86 (s, 3H), 1.52 (s, 9H), 1.37 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 163.44, 162.25, 129.95, 127.31, 113.70, 89.28, 55.35, 54.76, 53.43, 30.20, 29.25; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{28}\text{N}_3\text{O}$ $[\text{M} + \text{H}]^+$: 314.2227; found: 314.2216.

(Z)-N-(*Tert*-butyl)-2-(*tert*-butylimino)-5-(3,4-dimethoxyphenyl)-2*H*-pyrrol-3-amine (3fa).

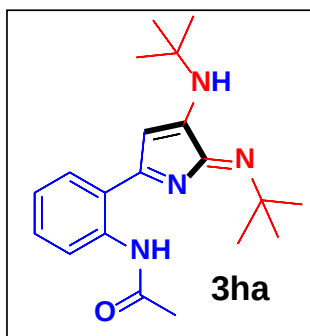


Following the general procedure on a 0.5 mmol scale giving the compound as a dark red sticky mass (143 mg, yield 83%); ^1H NMR (400 MHz, CDCl_3) δ 7.66-7.63 (m, 2H), 6.91 (d, J = 8.4 Hz, 1H), 5.60 (s, 1H), 3.96 (s, 3H), 3.94 (s, 3H), 1.52 (s, 9H), 1.38 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 163.30, 157.20, 151.92, 148.71, 127.55, 122.12, 115.85, 110.58, 110.43, 89.35, 55.94, 55.90, 30.19, 29.25; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{30}\text{O}_2\text{N}_3$ $[\text{M} + \text{H}]^+$: 344.2333; found: 344.2337.

(Z)-2-(3-(*Tert*-Butylamino)-2-(*tert*-butylimino)-2*H*-pyrrol-5-yl) phenol (3ga).

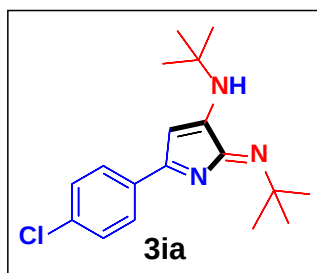


Following the general procedure on a 0.5 mmol scale for 1 h giving the compound as a dark red solid (134 mg, yield 89%); Mp 126-128 °C; ^1H NMR (400 MHz, CDCl_3) δ 14.87 (s, 1H), 7.56 (dd, J = 8.0, 1.6 Hz, 1H), 7.35 (ddd, J = 8.4, 7.2, 1.6 Hz, 1H), 6.92 (d, J = 8.4 Hz, 1H), 6.79 (t, J = 8.0 Hz, 1H), 5.60 (s, 1H), 1.45 (s, 9H), 1.42 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 166.84, 157.57, 152.62, 135.14, 129.51, 119.65, 117.78, 115.27, 87.17, 56.28, 52.45, 30.51, 28.70; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{26}\text{N}_3\text{O}$ $[\text{M} + \text{H}]^+$: 300.2070; found: 300.2062.

(Z)-N-(2-(3-(tert-Butylamino)-2-(tert-butylimino)-2H-pyrrol-5-yl)phenyl) acetamide (3ha).

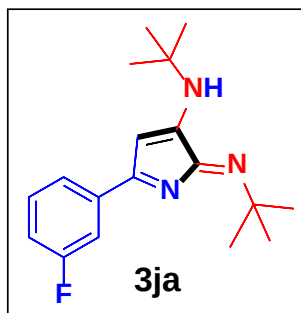
Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (143 mg, yield 84%); Mp 131-133 °C; ^1H NMR (400 MHz, CDCl_3) δ 13.05 (s, 1H), 8.81 (dd, J = 8.5, 1.0 Hz, 1H), 7.79 (dd, J = 8.0, 1.6 Hz, 1H), 7.47 (ddd, J = 8.7, 7.2, 1.6 Hz, 1H), 7.10 (ddd, J = 8.4, 7.6, 1.6 Hz, 1H), 5.66 (s, 1H), 2.25 (s, 3H), 1.52 (s, 9H), 1.41 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ

169.26, 161.66, 153.46, 141.47, 133.11, 130.20, 122.25, 120.48, 119.02, 89.93, 55.94, 52.31, 30.69, 28.63, 25.74; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{29}\text{ON}_4$ $[\text{M} + \text{H}]^+$: 341.2336; found: 341.2339.

(Z)-N-(tert-Butyl)-2-(tert-butylimino)-5-(4-chlorophenyl)-2H-pyrrol-3-amine (3ia).

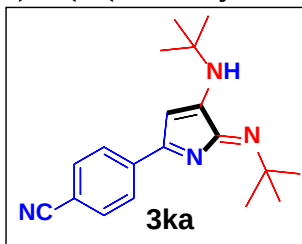
Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (135 mg, yield 85%); Mp 98-100 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.99 (d, J = 8.4 Hz, 2H), 7.40 (d, J = 8.4 Hz, 2H), 5.68 (s, 1H), 1.53 (s, 9H), 1.38 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 162.67, 136.75, 133.12, 129.15, 128.51, 90.45,

54.26, 29.79, 29.68, 29.63; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{25}\text{N}_3\text{Cl}$ $[\text{M} + \text{H}]^+$: 318.1732; found: 318.1730.

(Z)-N-(tert-Butyl)-2-(tert-butylimino)-5-(3-fluorophenyl)-2H-pyrrol-3-amine (3ja).

Following the general procedure on a 0.5 mmol scale for 2 h giving the compound as a dark red solid (113 mg, yield 75%); Mp 115-117 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.80–7.74 (m, 2H), 7.38 (td, J = 8.0, 5.6, 1H), 7.12 (tdd, J = 8.0, 2.8, 0.8 Hz, 1H), 5.69 (s, 1H), 1.52 (s, 9H), 1.37 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 162.88 (d, J_F = 244 Hz), 162.52, 159.15, 137.15 (d, J_F = 7.6 Hz), 129.73 (d, J_F = 7.6

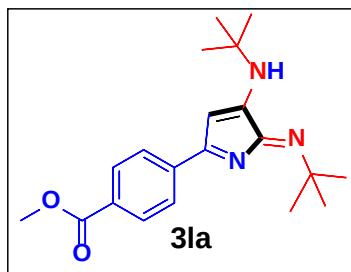
Hz), 123.53 (d, J_F = 2.0 Hz), 117.56 (d, J_F = 22.0 Hz), 114.51 (d, J_F = 22.0 Hz), 91.10, 54.82, 54.18, 29.79; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{25}\text{N}_3\text{F}$ $[\text{M} + \text{H}]^+$: 302.2027; found: 302.2020.

(Z)-4-(3-(tert-Butylamino)-2-(tert-butylimino)-2H-pyrrol-5-yl) benzonitrile (3ka)

Following the general procedure 0.5 mmol scale for 2 h giving the compound as a dark brown solid (120 mg, yield 78%); Mp 136-138 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.10 (d, J = 8.4 Hz, 2H), 7.69 (d, J = 8.4 Hz, 2H), 5.72 (s, 1H), 1.44 (s, 9H), 1.29 (s, 9H); ^{13}C NMR (101

MHz, CDCl₃) δ 161.83, 160.10, 138.85, 131.95, 127.96, 118.84, 113.25, 92.51, 55.74, 53.57, 30.04, 29.29; HRMS (ESI) calcd for C₁₉H₂₅N₄ [M + H]⁺: 309.2074; found: 309.2068.

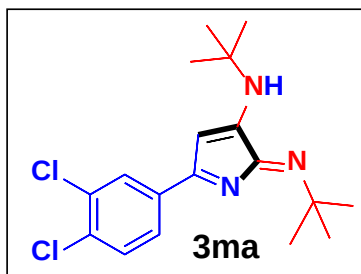
Methyl (Z)-4-(3-(*tert*-Butylamino)-2-(*tert*-butylimino)-2H-pyrrol-5-yl) benzoate (3la).



Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (121 mg, yield 71%); Mp 182-183 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.07 (s, 4H), 5.79 (s, 1H), 3.93 (s, 3H), 1.53 (s, 9H), 1.37 (s, 9H); ¹³C NMR (101 MHz, CDCl₃) δ 166.81, 162.25, 160.00, 138.81, 131.55, 129.47, 127.59,

91.95, 55.23, 53.88, 52.20, 29.89, 29.55; HRMS (ESI) calcd for C₂₀H₂₈N₃O₂ [M + H]⁺: 342.2176; found: 342.2166.

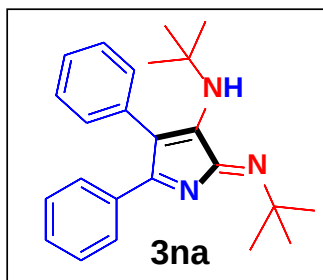
(Z)-N-(*tert*-Butyl)-2-(*tert*-butylimino)-5-(3,4-dichlorophenyl)-2H-pyrrol-3-amine (3ma).



Following the general procedure on a 0.5 mmol scale for 2 h giving the compound as a dark red solid (128 mg, yield 73%); Mp 177-178 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.11 (d, *J* = 4.0 Hz, 1H), 7.84 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.48 (d, *J* = 8.4 Hz, 1H), 5.69 (s, 1H), 1.53 (s, 9H), 1.38 (s, 9H); ¹³C NMR (101 MHz, CDCl₃) δ 162.25, 159.37, 134.72, 132.54, 130.22, 129.42, 126.85, 114.36, 91.03, 55.09, 54.05,

29.80, 29.58; HRMS (ESI) calcd for C₁₈H₂₄N₃Cl₂ [M + H]⁺: 353.1341; found: 353.1342.

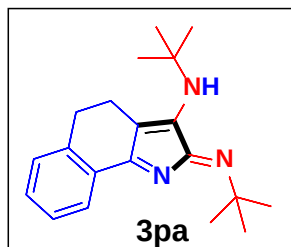
(Z)-N-(*tert*-Butyl)-2-(*tert*-butylimino)-4,5-diphenyl-2H-pyrrol-3-amine (3na).



Following the general procedure on a 0.5 mmol scale at 90 °C giving the compound as a dark red solid (104 mg, yield 58%); Mp 129-131 °C; ¹H NMR (400 MHz, CDCl₃) δ 7.43 (dd, *J* = 8.4, 1.2 Hz, 2H), 7.31 – 7.26 (m, 4H), 7.23 – 7.21 (m, 2H), 7.14 (t, *J* = 7.6 Hz, 2H), 1.54 (s, 9H), 1.06 (s, 9H); ¹³C NMR (101 MHz, CDCl₃) δ

137.48, 135.38, 132.56, 130.01, 129.42, 128.26, 127.49, 127.10, 30.68, 30.56, 29.68; HRMS (ESI) calcd for C₂₄H₃₀N₃ [M + H]⁺: 360.2434; found: 360.2433.

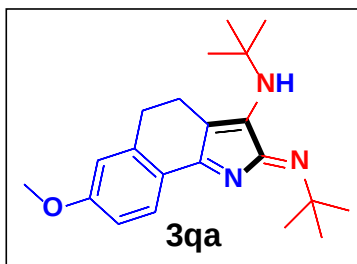
(Z)-N-(*tert*-Butyl)-2-(*tert*-butylimino)-4,5-dihydro-2H-benzo[*g*]indol-3-amine (3pa).



Following the general procedure on a 0.5 mmol scale giving the compound as a dark red solid (114 mg, yield 74%); Mp 136-140 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.14 (d, *J* = 7.6 Hz, 1H), 7.38 (td, *J* = 7.6, 1.6 Hz, 1H), 7.32-7.28 (m, 1H), 7.22 (d, *J* = 8.0 Hz, 1H), 2.93 (t, *J*

= 7.6 Hz, 2H), 2.80 (t, J = 7.2 Hz, 2H), 1.51 (s, 9H), 1.38 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 163.23, 151.07, 140.41, 130.61, 127.02, 125.77, 123.24, 122.70, 115.12, 98.64, 54.78, 50.64, 30.84, 30.12, 28.95, 23.08; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{28}\text{N}_3$ $[\text{M} + \text{H}]^+$: 310.2278; found: 310.2273.

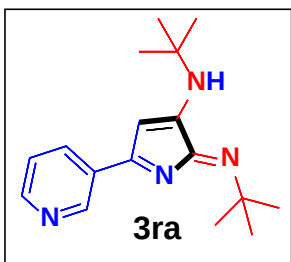
(Z)-N-(tert-Butyl)-2-(tert-butylimino)-7-methoxy-4,5-dihydro-2H-benzo[g]indol-3-amine (3qa).



(3qa). Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (134 mg, yield 79%); Mp 178-180 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, J = 8.8 Hz, 1H), 6.84 (dd, J = 8.6, 2.6 Hz, 1H), 6.74 (d, J = 2.4 Hz, 1H), 3.85 (s, 3H), 2.91 (t, J = 6.6 Hz, 2H), 2.80 (t, J = 7.2, 2H), 1.50

(s, 9H), 1.39 (s, 9H). ^{13}C NMR (101 MHz, CDCl_3) δ 162.71, 147.30, 143.86, 129.06, 123.79, 112.84, 112.61, 98.45, 55.78, 55.33, 51.00, 30.89, 30.80, 30.01, 23.80; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{30}\text{ON}_3$ $[\text{M} + \text{H}]^+$: 340.2383; found: 340.2378.

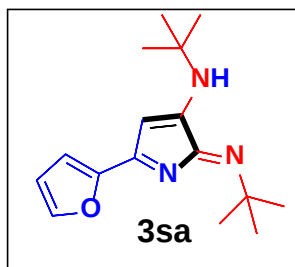
(Z)-N-(tert-Butyl)-2-(tert-butylimino)-5-(pyridin-3-yl)-2H-pyrrol-3-amine (3ra).



Following the general procedure on a 0.5 mmol scale giving the compound as a dark red solid (102 mg, yield 72%); Mp 108-109 °C; ^1H NMR (400 MHz, CDCl_3) δ 9.19 (dd, J = 2.4, 0.8, 1H), 8.64 (dd, J = 4.8, 1.6 Hz, 1H), 8.32 (dt, J = 8.0, 2.0 Hz, 1H), 7.35 (ddd, J = 8.0, 4.8, 0.8 Hz, 1H), 5.76 (s, 1H), 1.53 (s, 9H), 1.38 (s, 9H); ^{13}C NMR (100

MHz, CDCl_3) δ 162.15, 151.19, 149.17, 134.79, 130.32, 123.25, 90.97, 56.34, 53.98, 29.80, 29.65, 29.57; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{25}\text{N}_4$ $[\text{M} + \text{H}]^+$: 285.2074; found: 285.2068.

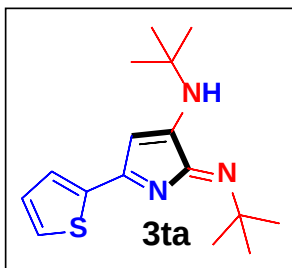
(Z)-N-(tert-Butyl)-2-(tert-butylimino)-5-(furan-2-yl)-2H-pyrrol-3-amine (3sa).



Following the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (112 mg, yield 82%); Mp 60-62 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, J = 1.2 Hz, 1H), 7.15 (d, J = 3.2 Hz, 1H), 6.54 (dd, J = 3.2, 1.6 Hz, 1H), 5.62 (s, 1H), 1.50 (s, 9H), 1.36 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 167.85, 162.84, 158.73,

151.33, 145.51, 114.55, 112.37, 90.13, 54.75, 53.99, 29.76; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{24}\text{N}_3\text{O}$ $[\text{M} + \text{H}]^+$: 274.1913; found: 274.1914.

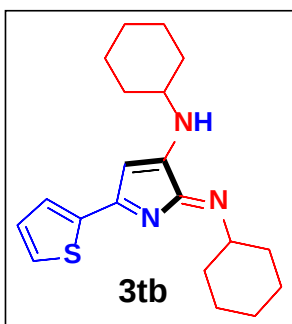
(Z)-N-(tert-Butyl)-2-(tert-butylimino)-5-(thiophen-2-yl)-2H-pyrrol-3-amine (3ta). Following



the general procedure on a 0.5 mmol scale giving the compound as a dark brown solid (115 mg, yield 80%); Mp 80-82 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.71 (dd, J = 3.6, 0.8 Hz, 1H), 7.52 (dd, J = 4.8, 0.4 Hz, 1H), 7.14 (dd, J = 4.8, 3.6 Hz, 1H), 5.56 (s, 1H), 1.51 (s, 9H), 1.37 (s, 9H); ^{13}C NMR (101 MHz, CDCl_3) δ 173.32, 163.11, 157.29,

140.11, 130.57, 129.44, 128.01, 89.56, 54.77, 53.71, 30.03, 29.26; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{24}\text{N}_3\text{S}$ $[\text{M} + \text{H}]^+$: 290.1685; found: 290.1675.

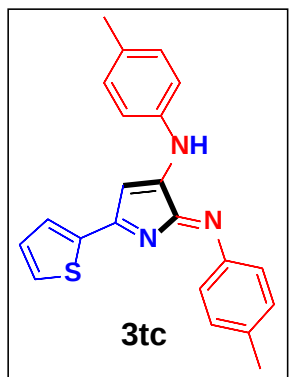
(Z)-N-Cyclohexyl-2-(cyclohexylimino)-5-(thiophen-2-yl)-2H-pyrrol-3-amine (3tb).



Following the general procedure on a 0.5 mmol scale at 90 °C giving the compound as red viscous oil (109 mg, yield 64%); ^1H NMR (400 MHz, CDCl_3) δ 7.65 (d, J = 2.8 Hz, 1H), 7.45 (dd, J = 4.8, 0.8 Hz, 1H), 7.06 (dd, J = 4.8, 4.0 Hz, 1H), 5.51 (s, 1H), 4.13 – 4.07 (m, 1H), 3.25 – 3.19 (m, 1H), 1.87 – 1.84 (m, 4H), 1.74 – 1.68 (m, 4H), 1.59 (d, J = 12.8 Hz, 2H), 1.38 – 1.27 (m, 8H), 1.21 – 1.14 (m, 2H); ^{13}C

NMR (101 MHz, CDCl_3) δ 177.39, 172.69, 163.92, 159.19, 139.62, 130.36, 129.65, 128.07, 89.38, 58.02, 55.52, 33.57, 33.01, 29.65, 29.62, 27.55, 25.68, 25.57, 24.75, 24.67; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{28}\text{N}_3\text{S}$ $[\text{M} + \text{H}]^+$: 342.1998; found: 342.1993.

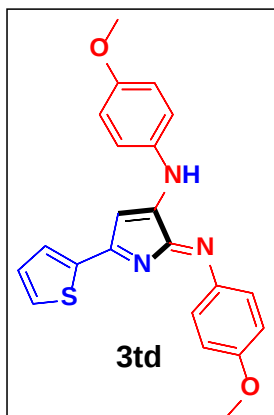
(Z)-5-(Thiophen-2-yl)-N-(p-tolyl)-2-(p-tolylimino)-2H-pyrrol-3-amine (3tc). Following the



general procedure on a 0.5 mmol scale for 6 h giving the compound as green color solid (98 mg, yield 55%); Mp 122-124 °C; ^1H NMR (400 Hz, CDCl_3) δ 7.84 – 7.80 (m, 3H), 7.61 (dd, J = 4.9, 0.9 Hz, 1H), 7.22 (d, J = 8.7 Hz, 4H), 7.19 (dd, J = 5.0, 3.8 Hz, 1H), 7.17- 7.15 (m, 2H), 6.11 (s, 1H), 2.37 (s, 6H); ^{13}C NMR (101 MHz, CDCl_3) δ 161.90, 139.87, 136.10, 134.60, 132.31, 131.31, 130.32, 129.95, 128.87, 124.35, 120.50, 92.61, 31.99, 30.07, 30.03, 21.56, 21.35; HRMS (ESI)

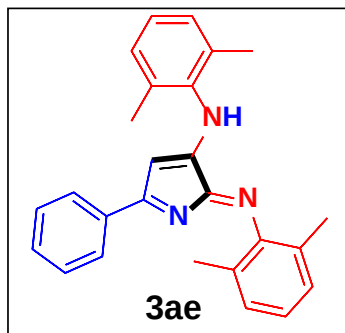
calcd for $\text{C}_{22}\text{H}_{20}\text{N}_3\text{S}$ $[\text{M} + \text{H}]^+$: 358.1372; found: 358.1375.

(Z)-N-(4-Methoxyphenyl)-2-((4-methoxyphenyl)imino)-5-(thiophen-2-yl)-2H-pyrrol-3-



amine (3td). Following the general procedure on a 0.5 mmol scale for 3 h giving the compound as a dark green solid (119 mg, yield 61%); Mp 211-213 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.96 (d, J = 8.5 Hz, 2H), 7.82 (d, J = 3.2 Hz, 1H), 7.62 (dd, J = 4.8, 0.8 Hz, 1H), 7.24 (d, J = 2.2 Hz, 1H), 7.20 (dd, J = 4.9, 3.8 Hz, 1H), 7.00 – 6.94 (m, 5H), 3.85 (s, 6H); ^{13}C NMR (101 MHz, CDCl_3) δ 158.02, 156.69, 131.78, 130.61, 128.45, 126.42, 121.60, 114.68, 114.23, 91.66, 55.55, 55.47; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{20}\text{O}_2\text{N}_3\text{S}$ $[\text{M} + \text{H}]^+$: 390.1271; found: 390.1258.

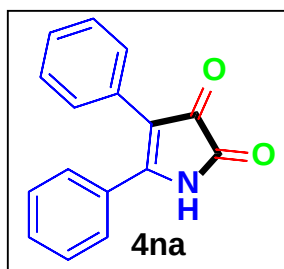
(Z)-N-(2,6-dimethylphenyl)-2-((2,6-dimethylphenyl)imino)-5-phenyl-2H-pyrrol-3-amine



(3ae) Following the general procedure on a 0.5 mmol scale for 16 h giving the compound as a dark red solid (95 mg, yield 50%); The NMR spectra shows two sets of proton due to its resonance character. Mp 220-222 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.91 (bs, 0.5H), 7.45 – 7.37 (m, 5H), 7.12 – 7.06 (m, 4H), 7.01 – 6.92 (m, 2H), 6.43 (bs, 0.6H), 5.46 (s, 1H), 2.24 (s, 6H), 2.17 (s, 6H);

^{13}C NMR (101 MHz, CDCl_3) δ 160.56, 155.69, 149.71, 146.02, 131.56, 128.99, 128.14, 127.68, 127.43, 126.39, 125.80, 123.63, 123.26, 94.66, 92.88, 32.16, 26.36, 23.41, 18.81, 18.11; HRMS (ESI) calcd for $\text{C}_{26}\text{H}_{26}\text{N}_3$ $[\text{M} + \text{H}]^+$: 380.2118; found: 380.2121.

4,5-Diphenyl-1H-pyrrole-2,3-dione (4na). Following the general procedure on a 0.5 mmol

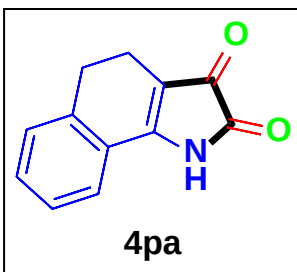


scale for 4 h at 90 °C. The reaction mass was cooled to room temperature followed by the addition of 5N HCl (5equiv) and then stirred at 80 °C for 1h. After the completion, the reaction mass was diluted with 5.0 mL of water. The water layer was extracted with (3X10 mL) of ethyl acetate. The combined ethyl acetate layer was given brine

wash (2X10 mL), dried over Na_2SO_4 and then concentrated under vacuum. The crude product was purified by column chromatography by eluting 5% EA/Hexane to 20% EA/Hexane to afford the pure compound as a dark red solid (37 mg, yield 30%); Mp 187-188 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.23 (s, 1H), 7.55-7.51 (m, 3H), 7.44-7.40 (m, 2H), 7.32 – 7.28 (m, 3H), 7.25-7.22 (m, 2H); ^{13}C NMR (101 MHz, CDCl_3) δ 161.33, 159.58, 132.94, 129.31, 129.26, 128.98, 128.67, 128.15, 127.88, 112.51, 68.81; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{12}\text{NO}_2$ $[\text{M} + \text{H}]^+$: 250.0863; found:

250.0856.

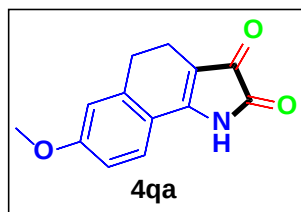
4,5-dihydro-2H-benzo[g]indole-2,3-dione (4pa). Following the general procedure on a 0.5



mmol scale for 4 h. The reaction mass was cooled to room temperature followed by the addition of 5N HCl (5equiv) and then stirred at 80 °C for 1h. After the completion, the reaction mass was diluted with 5.0 mL of water. The water layer was extracted with (3X10 mL) of ethyl acetate. The combined ethyl acetate layer was

given brine wash (2X10 mL), dried over Na₂SO₄ and then concentrated under vacuum. The crude product was purified by column chromatography by eluting 5% EA/Hexane to 20% EA/Hexane to afford the pure compound as a dark brown solid (68 mg, yield 69%); Mp 218-219 °C; ¹H NMR (400 MHz, CDCl₃) 9.18 (s, 1H), 7.57 (d, *J* = 7.6 Hz, 1H), 7.53 (td, *J* = 7.6, 1.2 Hz, 1H), 7.41 (t, *J* = 7.6 Hz, 1H), 7.36 (d, *J* = 7.6 Hz, 1H), 3.02 (t, *J* = 8.0 Hz, 2H), 2.58 (t, *J* = 8.4 Hz, 2H); ¹³C NMR (101 MHz, CDCl₃) δ 162.50, 162.01, 141.09, 133.80, 129.21, 127.50, 124.25, 123.44, 107.64, 27.85, 16.23; HRMS (ESI) calcd for C₁₂H₁₀NO₂ [M + H]⁺: 200.0706 ; found: 200.0703.

7-Methoxy-4,5-dihydro-1H-benzo[g]indole-2,3-dione (4qa). Following the general procedure



on a 0.5 mmol scale for 4 h. The reaction mass was cooled to room temperature followed by the addition of 5N HCl (5equiv) and then stirred at 80 °C for 1h. After the completion, the reaction mass was diluted with 5.0 mL of water. The water layer was extracted with (3X10

mL) of ethyl acetate. The combined ethyl acetate layer was given brine wash (2X10 mL), dried over Na₂SO₄ and then concentrated under vacuum. The crude product was purified by column chromatography by eluting 5% EA/Hexane to 20% EA/Hexane to afford the pure compound as a dark brown solid (80 mg, yield 70%); Mp 260-261 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.37 (s, 1H), 7.44 (d, *J* = 8.4 Hz, 1H), 6.92 – 6.90 (m, 2H), 3.91 (s, 3H), 2.98 (t, *J* = 8.0 Hz, 2H), 2.57 (t, *J* = 8.4 Hz, 2H); ¹³C NMR (101 MHz, CDCl₃) δ 164.34, 144.13, 125.35, 116.95, 115.48, 112.55, 55.66, 28.42, 16.33; HRMS (ESI) calcd for C₁₃H₁₂NO₃ [M + H]⁺ 230.0812; found: 230.0808.

3) References

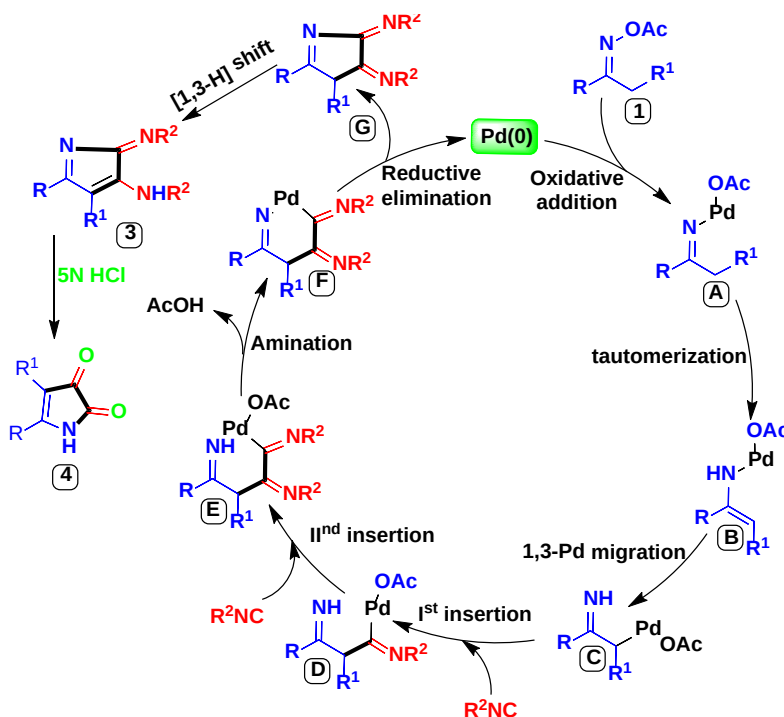
1. Too, P. C.; Wang, Y. -F.; Chiba, S. *Org. Lett.* **2010**, *12*, 5688.
2. Neufeldt, S. R.; Sanford, M. S.; *Org. Lett.* **2010**, *12*, 532.
3. Ren, Z. -H.; Zhang, Z. -Y.; Yang, B. -Q.; Wang, Y. -Y.; Guan, Z. -H. *Org. Lett.* **2011**, *13*,

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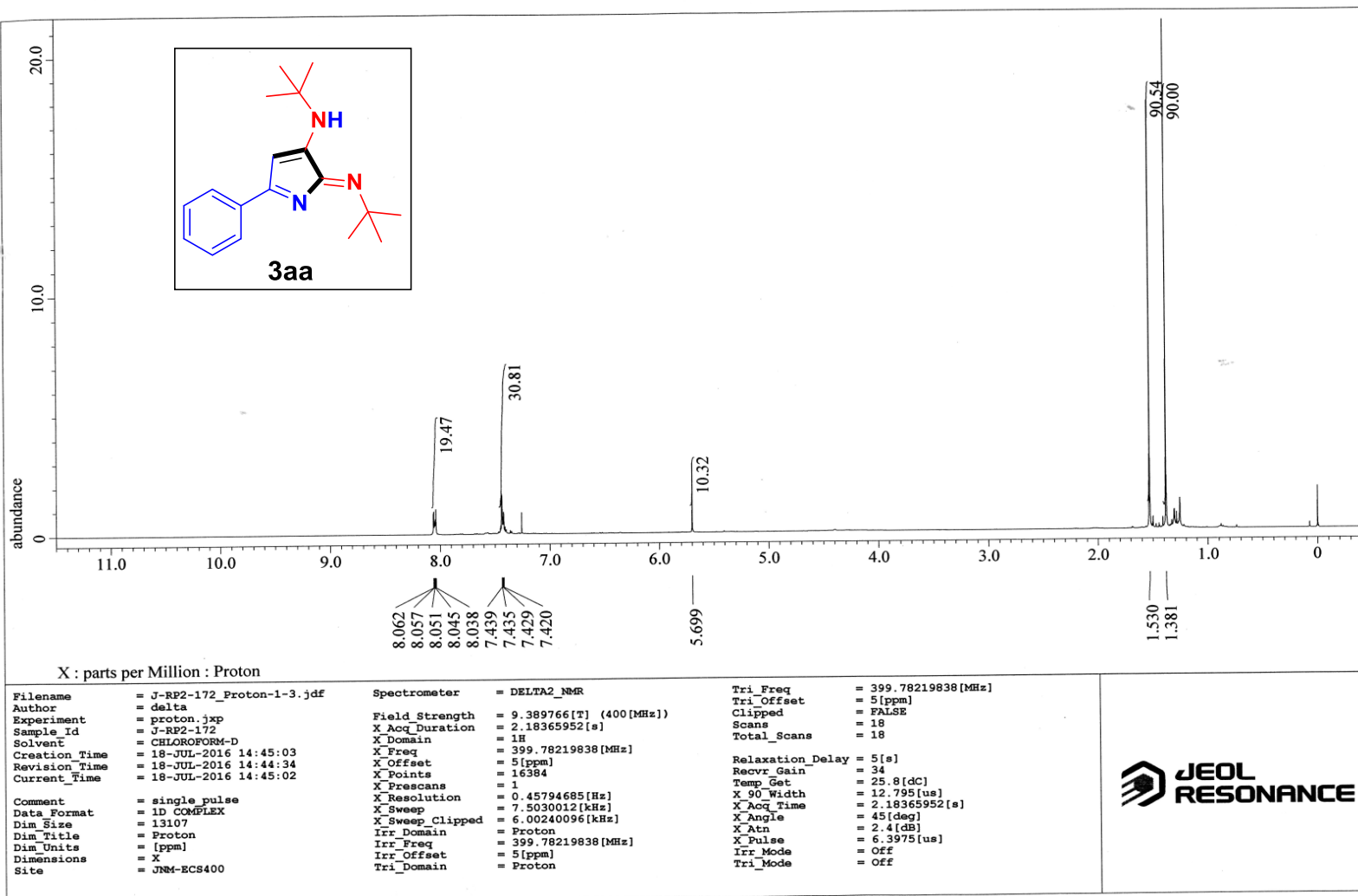
4. Malik, S.; Ahuja, P.; Sahu, K.; Khan, S. A. *Eur. J. Med. Chem.* **2014**, *84*, 42.
5. Too, P. C.; Chua, S. H.; Wong, S. H.; Chiba, S. *J. Org. Chem.* **2011**, *76*, 6159.
6. Ke, J.; Tang, Y.; Yi, H.; Li, Y.; Cheng, Y.; Liu, C.; Lei, A. *Angew. Chem. Int. Ed.* **2015**, *54*, 6604.
7. Ran, L.; Ren, Z. -H.; Wang, Y. -Y.; Guan, Z. -H. *Green Chem.* **2014**, *16*, 112.

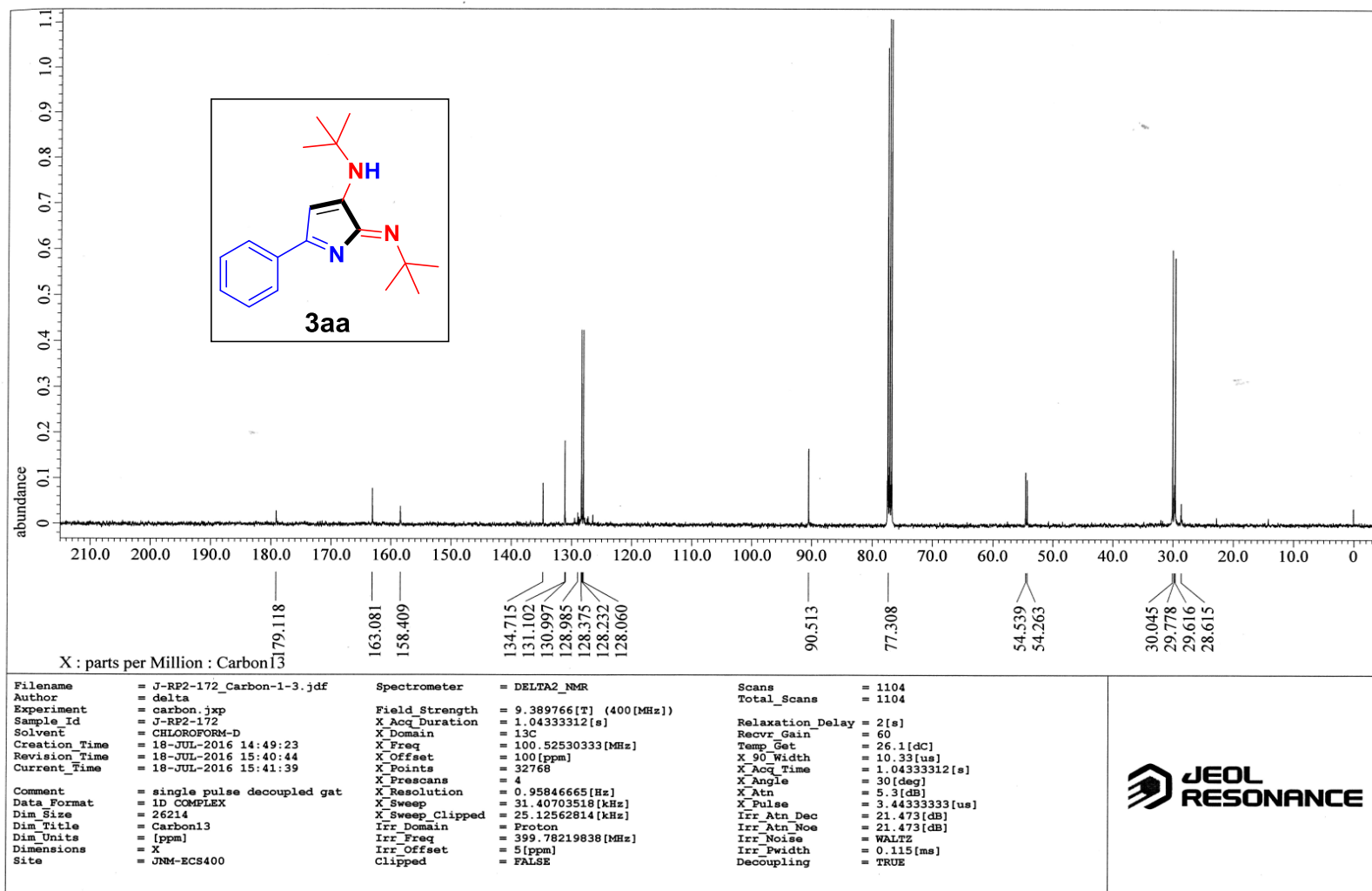
4) Alternative Reaction Mechanism

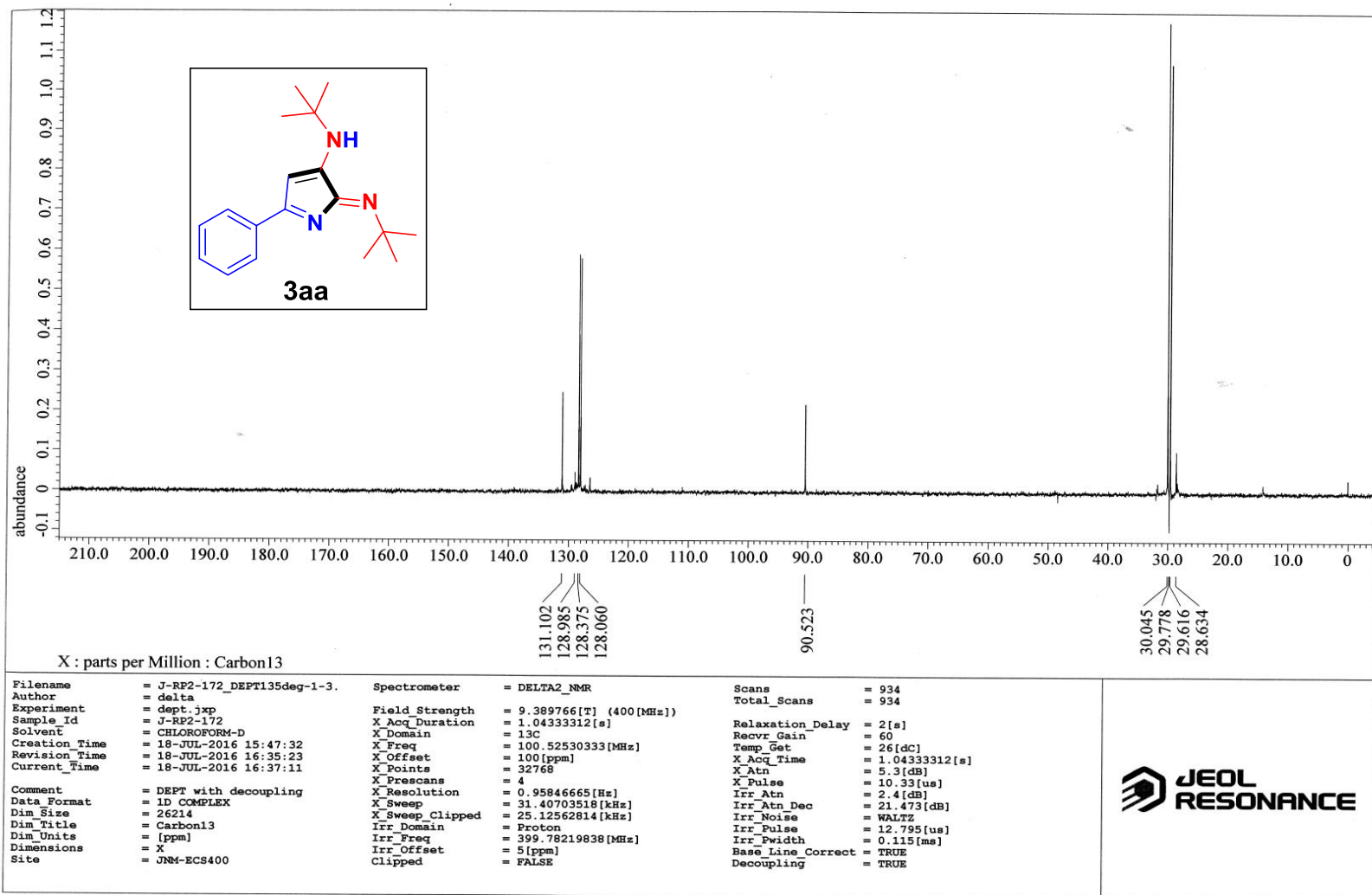
Oxidative addition of acetyl oxime **1** to Pd(0) affords the alkylideneaminopalladium(II) species **A**, which can undergo tautomerization to beget the enamine derived amido-Pd(II) species **B**. Further isomerization of **B** led to iminoalkyl-palladium(II) species **C** from N-bound enamido-Pd(II) species. Migratory insertion of isocyanides **2** generates the imidoyl-Pd(II) species **D**, which can undergo second isocyanide insertion to afford double isocyanide insertion intermediate **E**. Then the intermediate **E**, undergoes base promoted amination to form 6-member palladacycle intermediate **F**. Reduction elimination of **F** resulted in the formation of 2,4-dihydro-3*H*-pyrrol-3-imine intermediate **G** with the active regeneration of palladium(0) catalyst for the next catalytic cycle. A [1,3-H] shift of intermediate **G** resulted in the formation of 2*H*-pyrrole derivatives **3**.



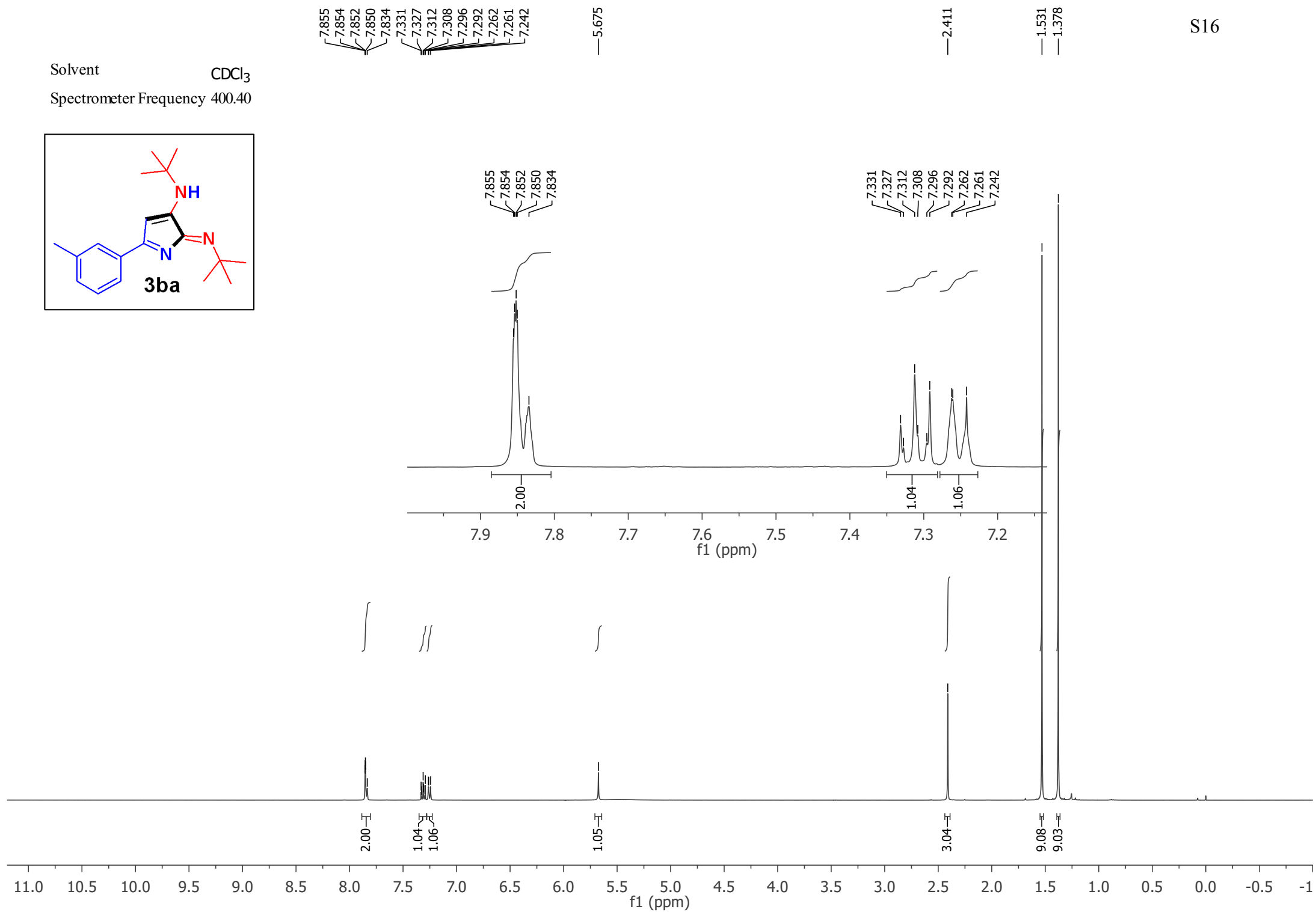
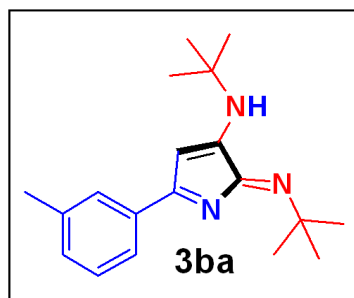
Scheme S1. Alternative plausible reaction mechanism







Solvent CDCl_3
Spectrometer Frequency 400.40



Solvent CDCl_3
Spectrometer Frequency 100.69

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—137.800

—134.560

—131.837

—128.415

—128.144

—125.180

—90.408

—53.890

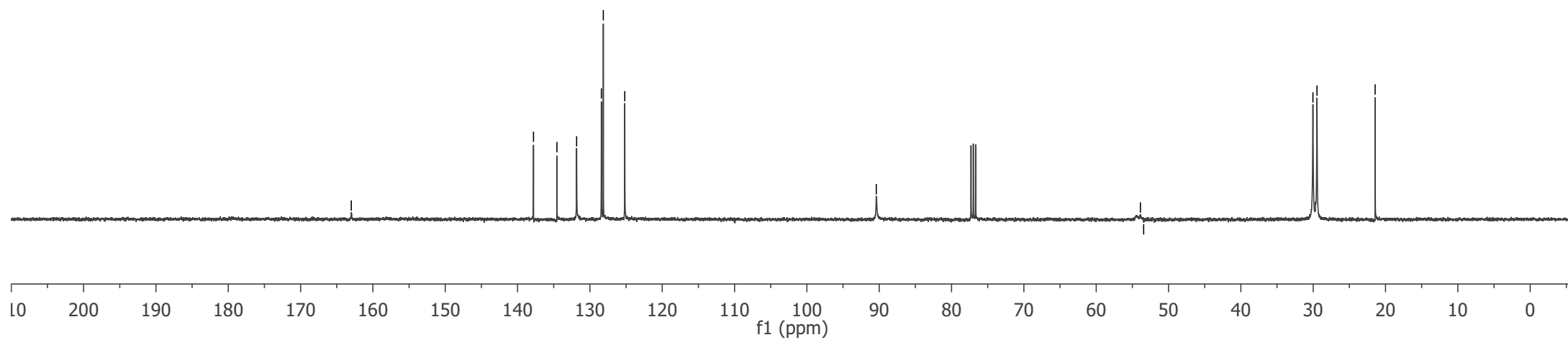
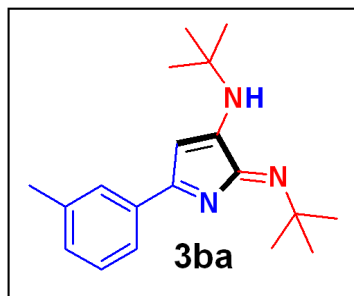
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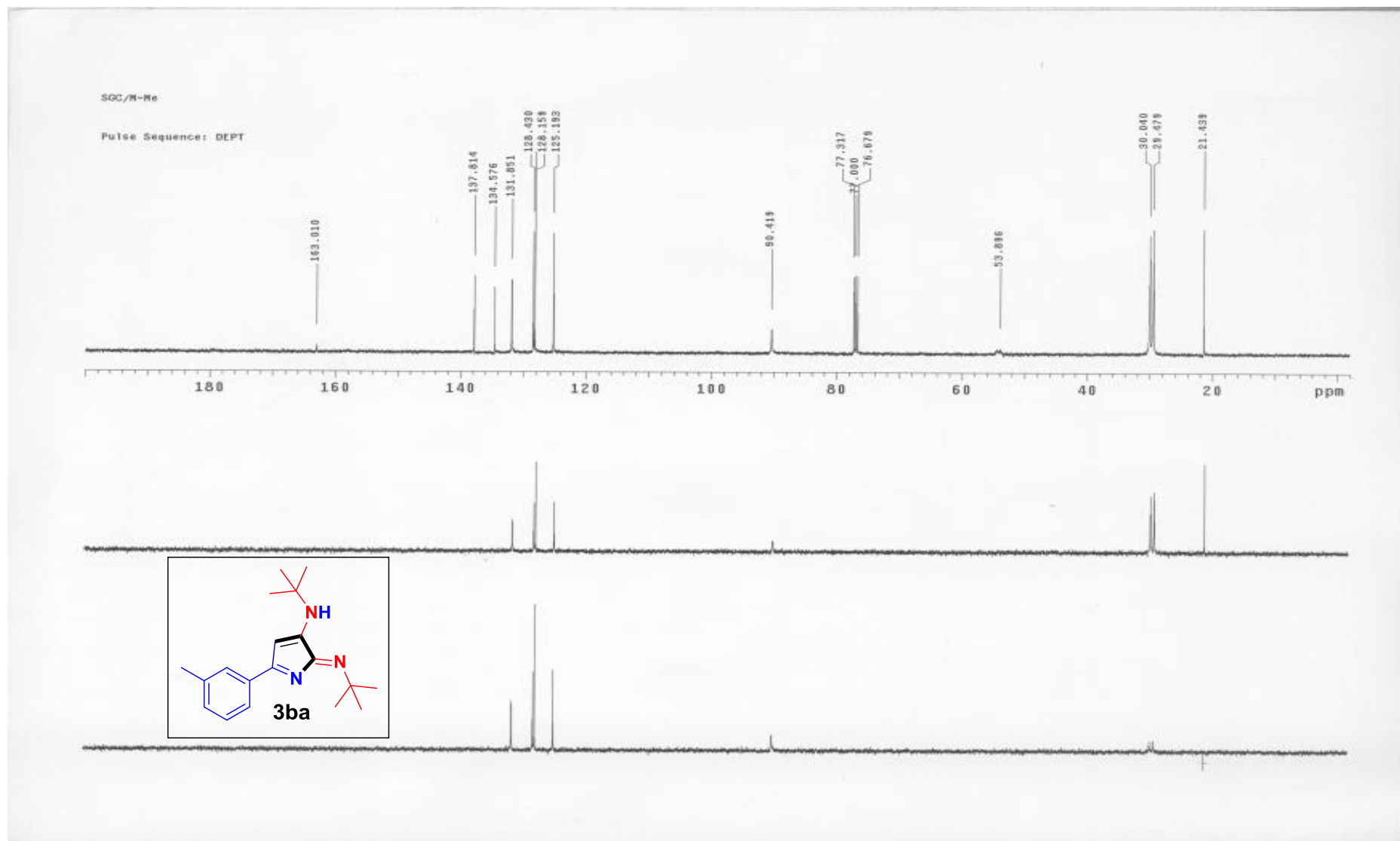
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—29.478

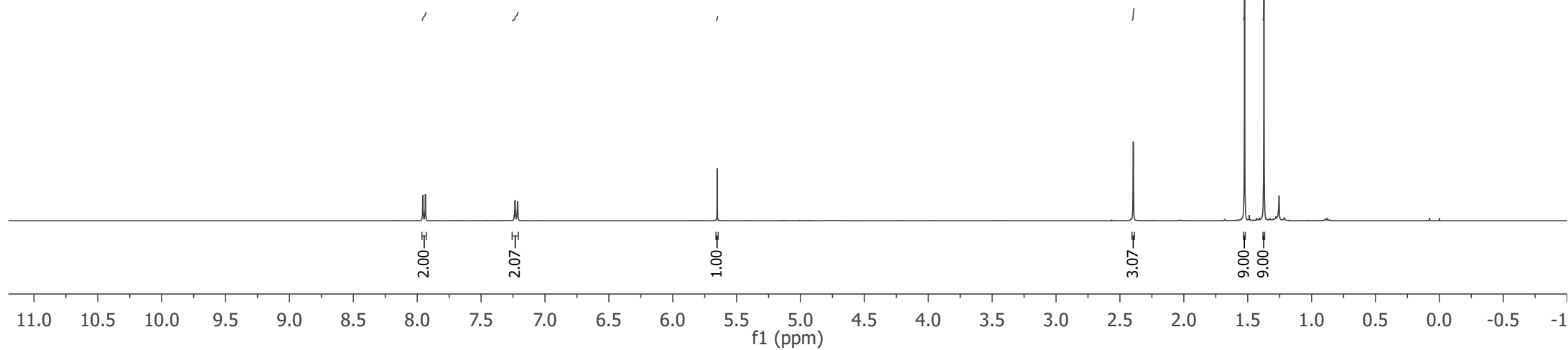
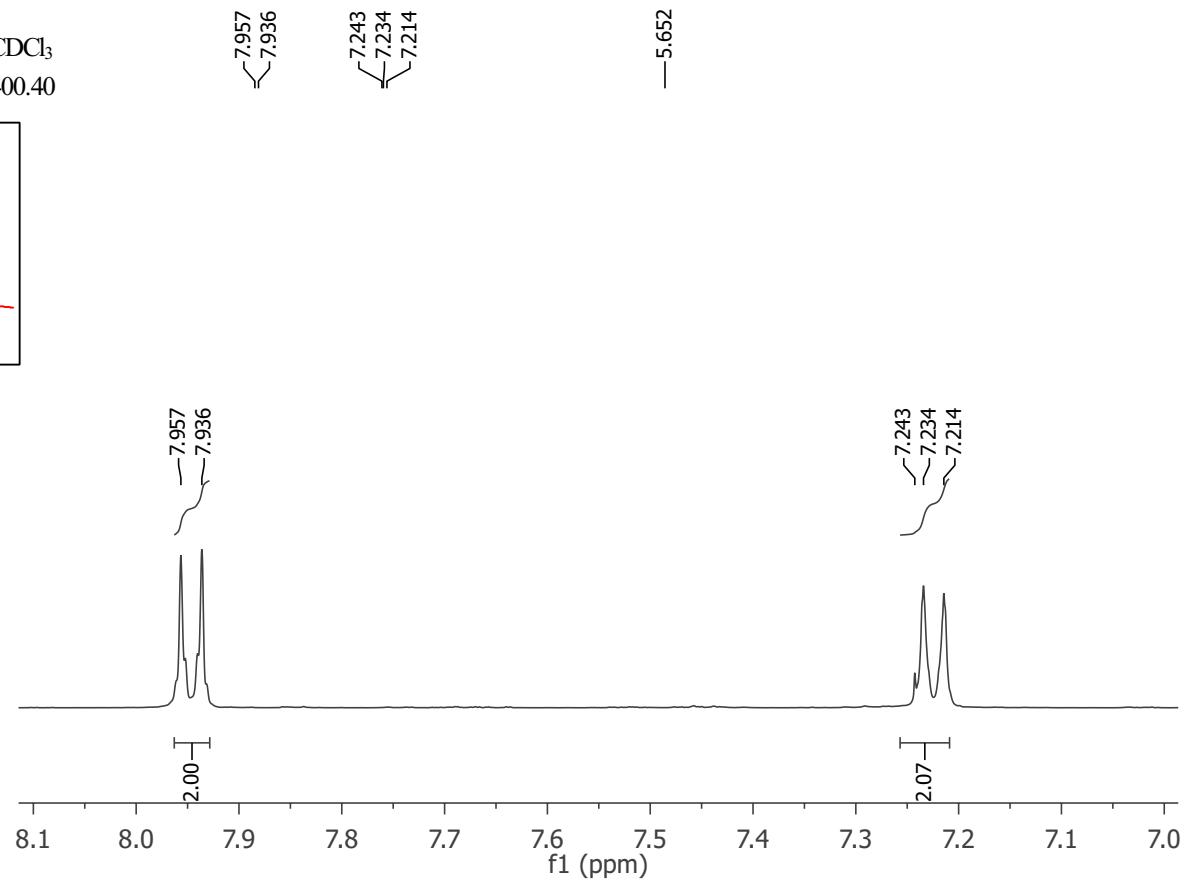
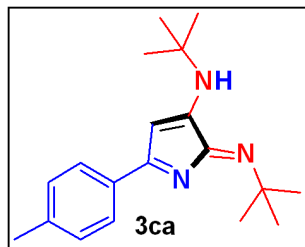
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S17



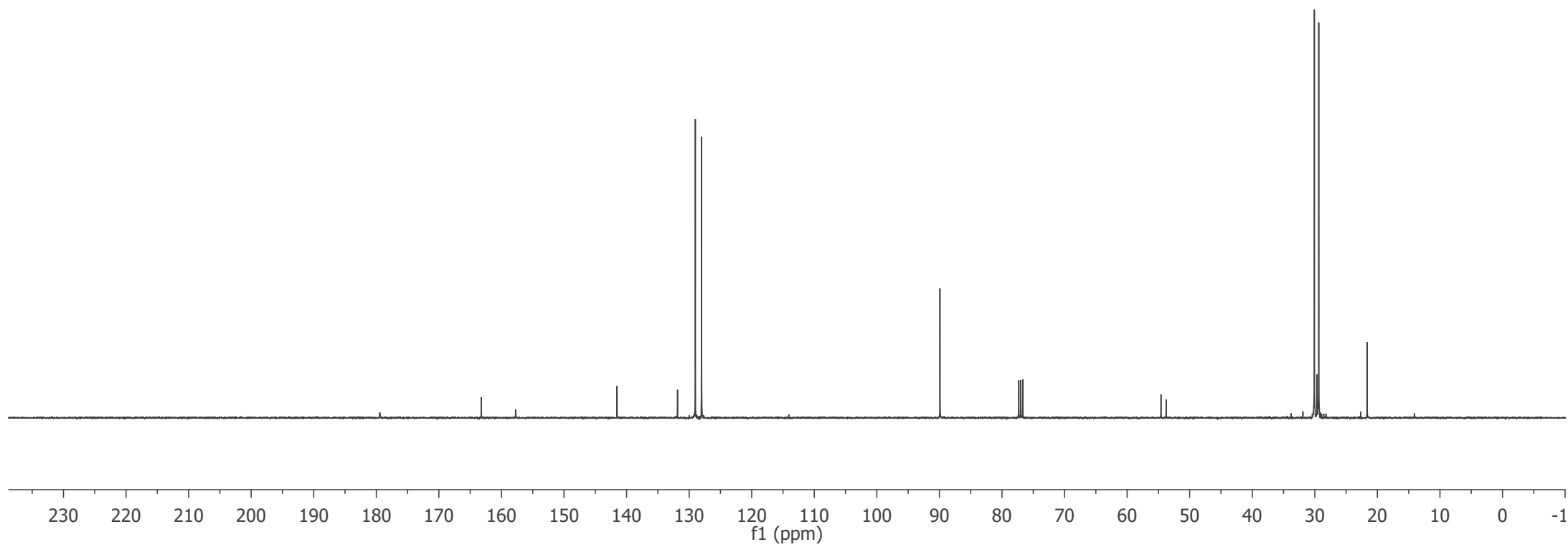
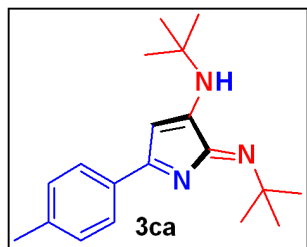


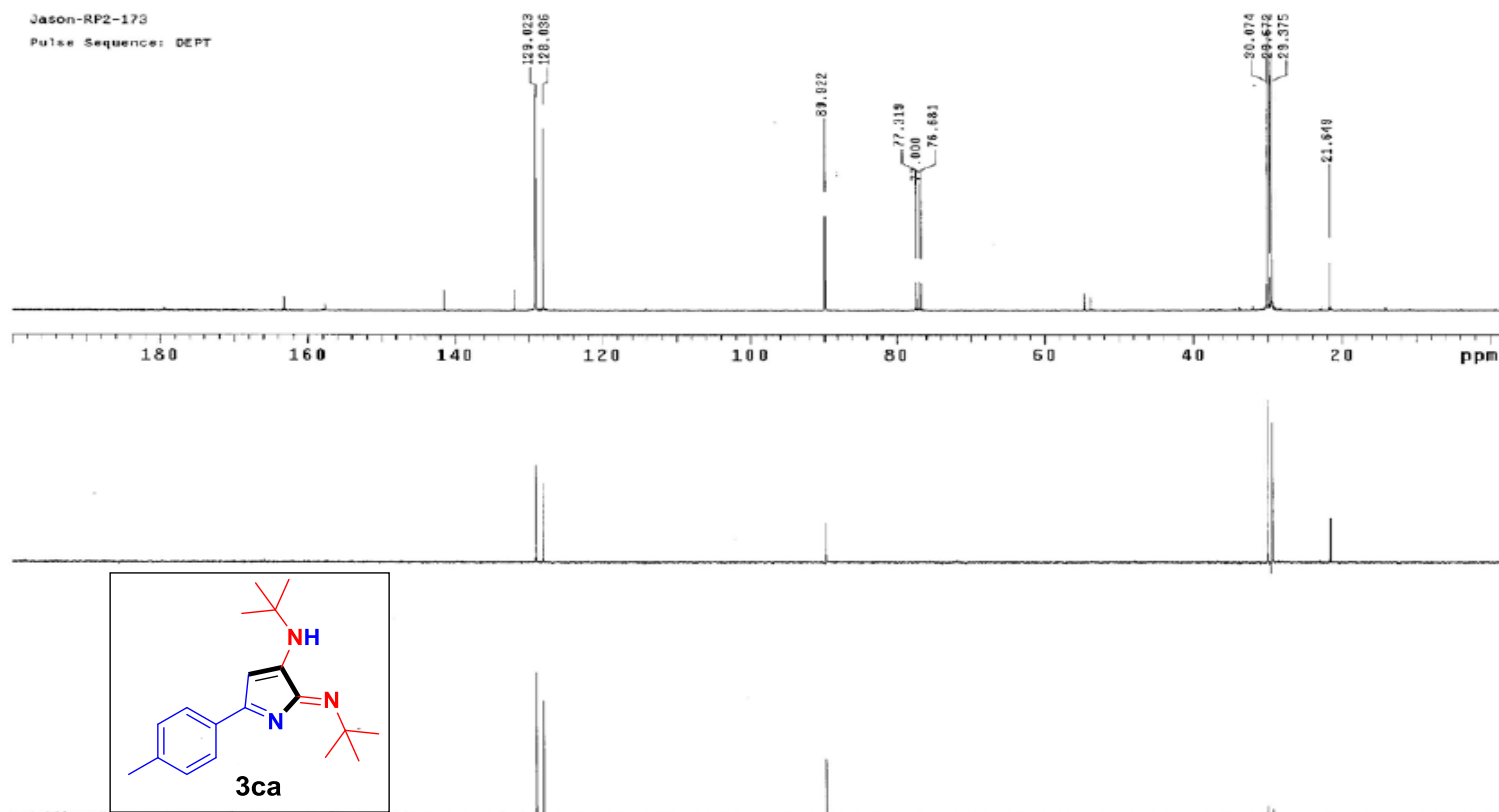
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Spectrometer Frequency 400.40



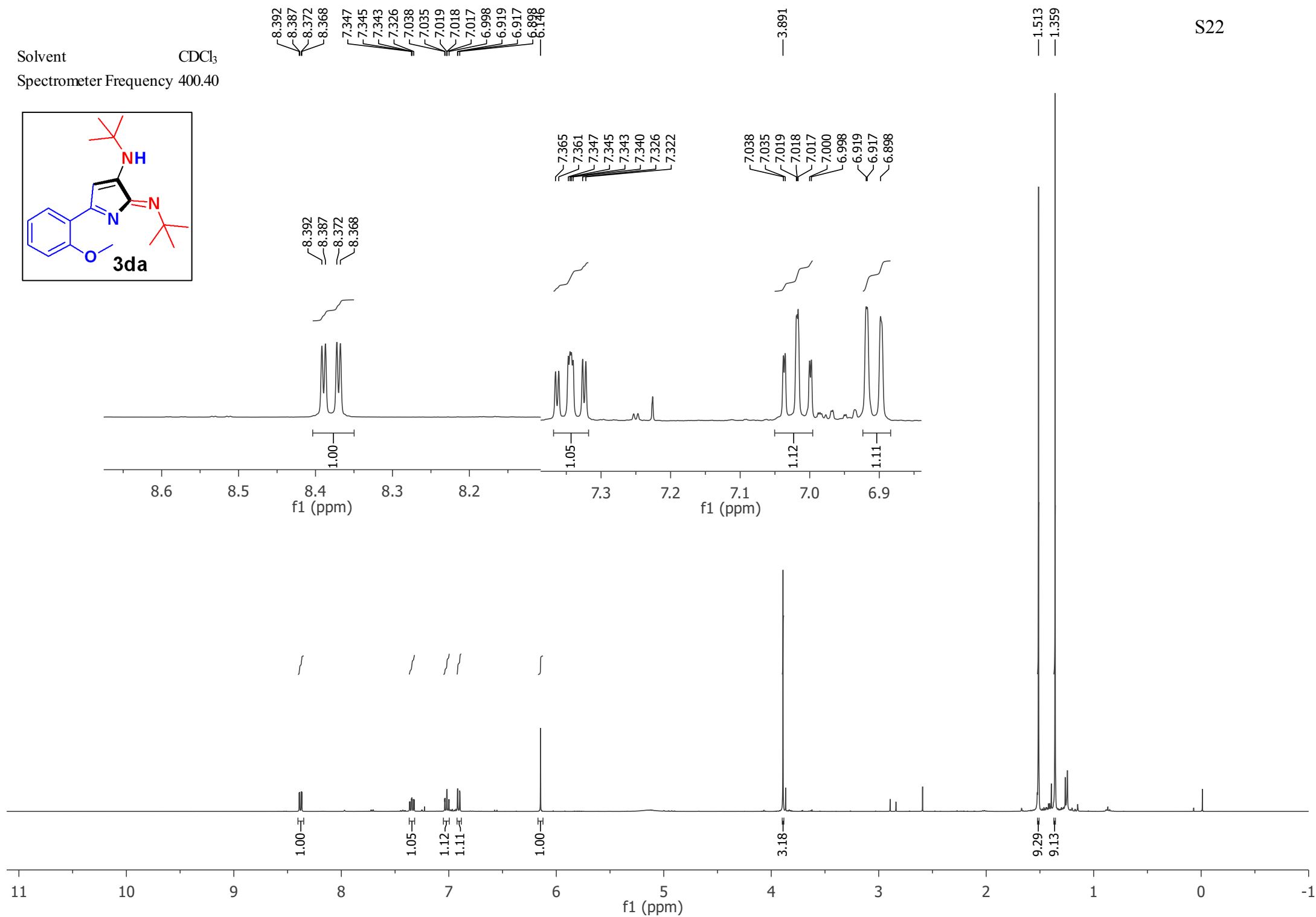
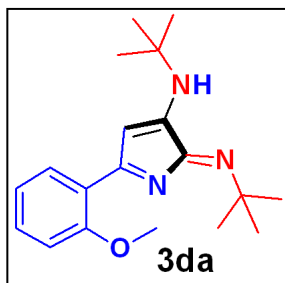
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131.855 129.007 128.024
—89.913
54.584 53.763
30.070 29.369 —21.643
S20

Solvent CDCl₃
Spectrometer Frequency 100.69

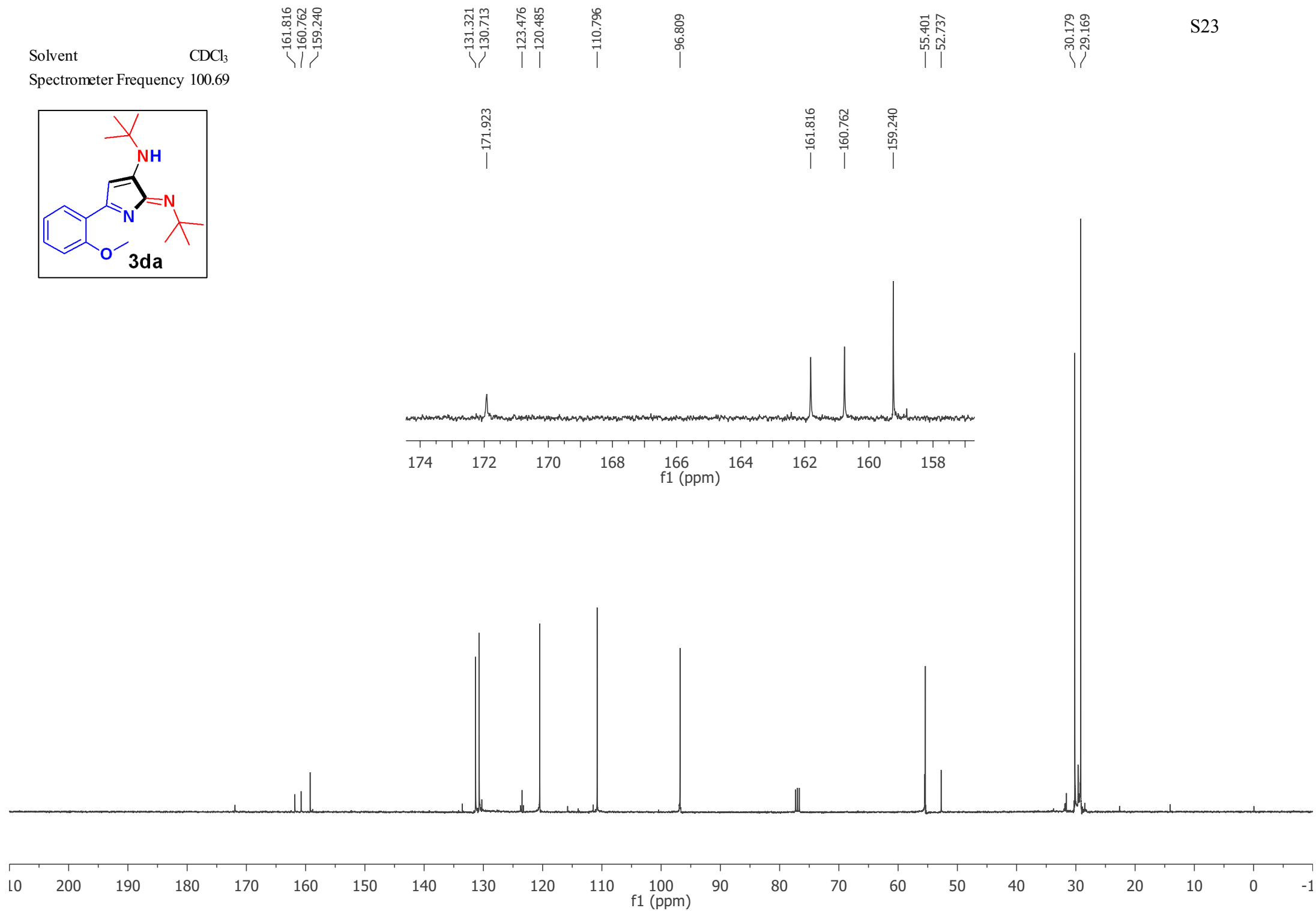
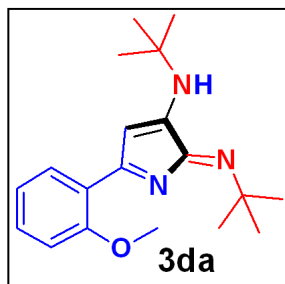




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Spectrometer Frequency 400.40

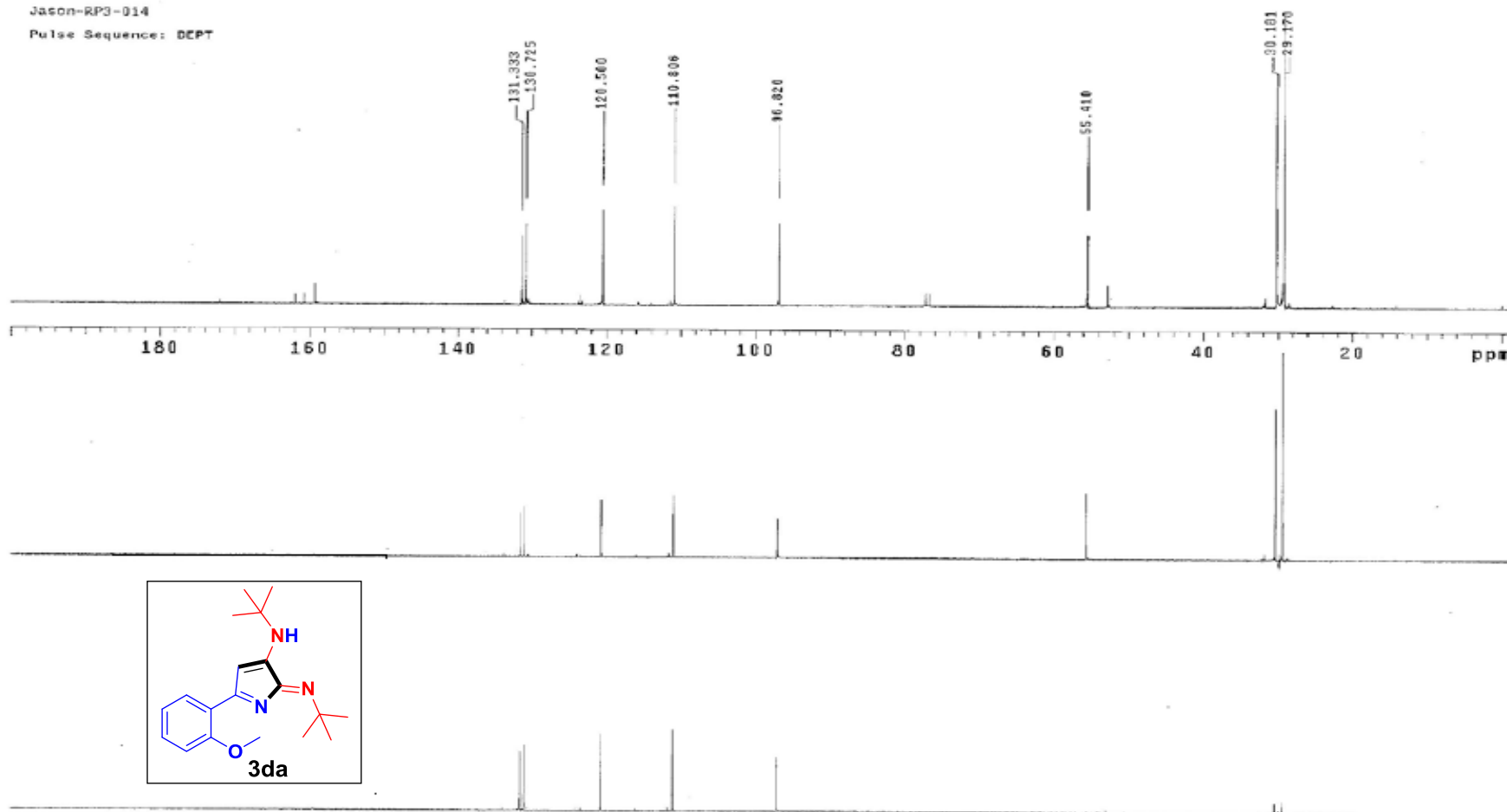


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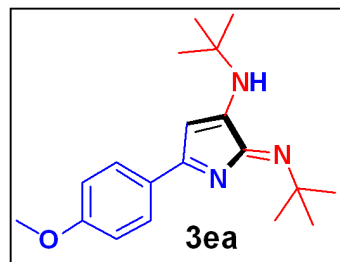


Jason-RP3-014

Pulse Sequence: DEPT



Solvent CDCl_3
Spectrometer Frequency 400.28



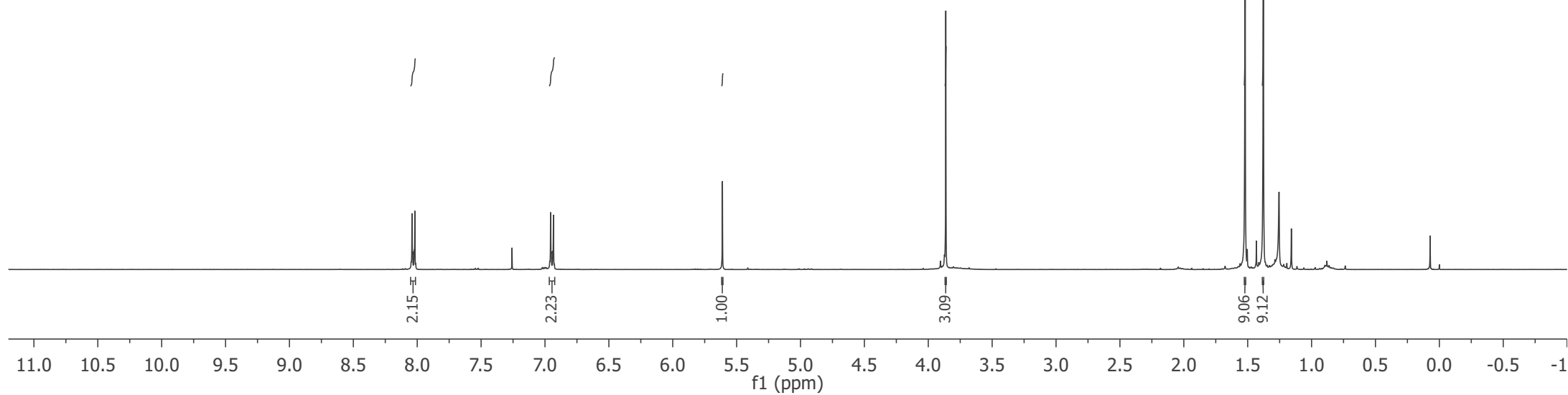
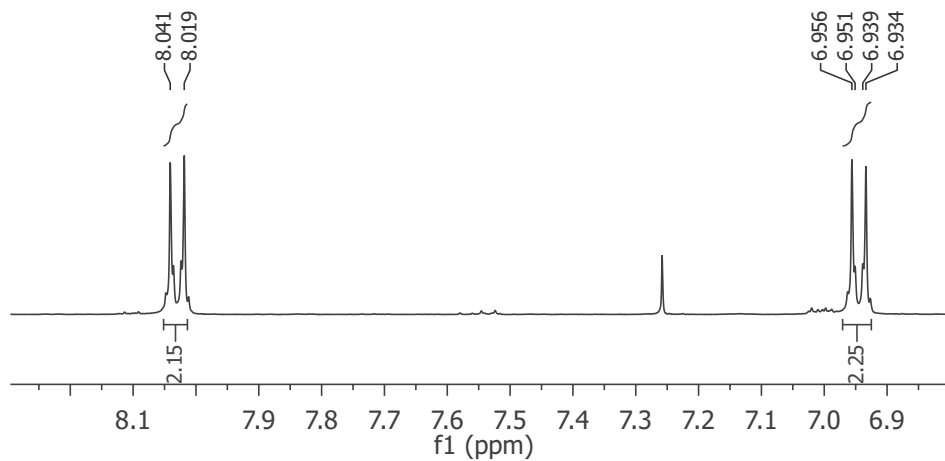
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6.951
6.939
6.934

5.611

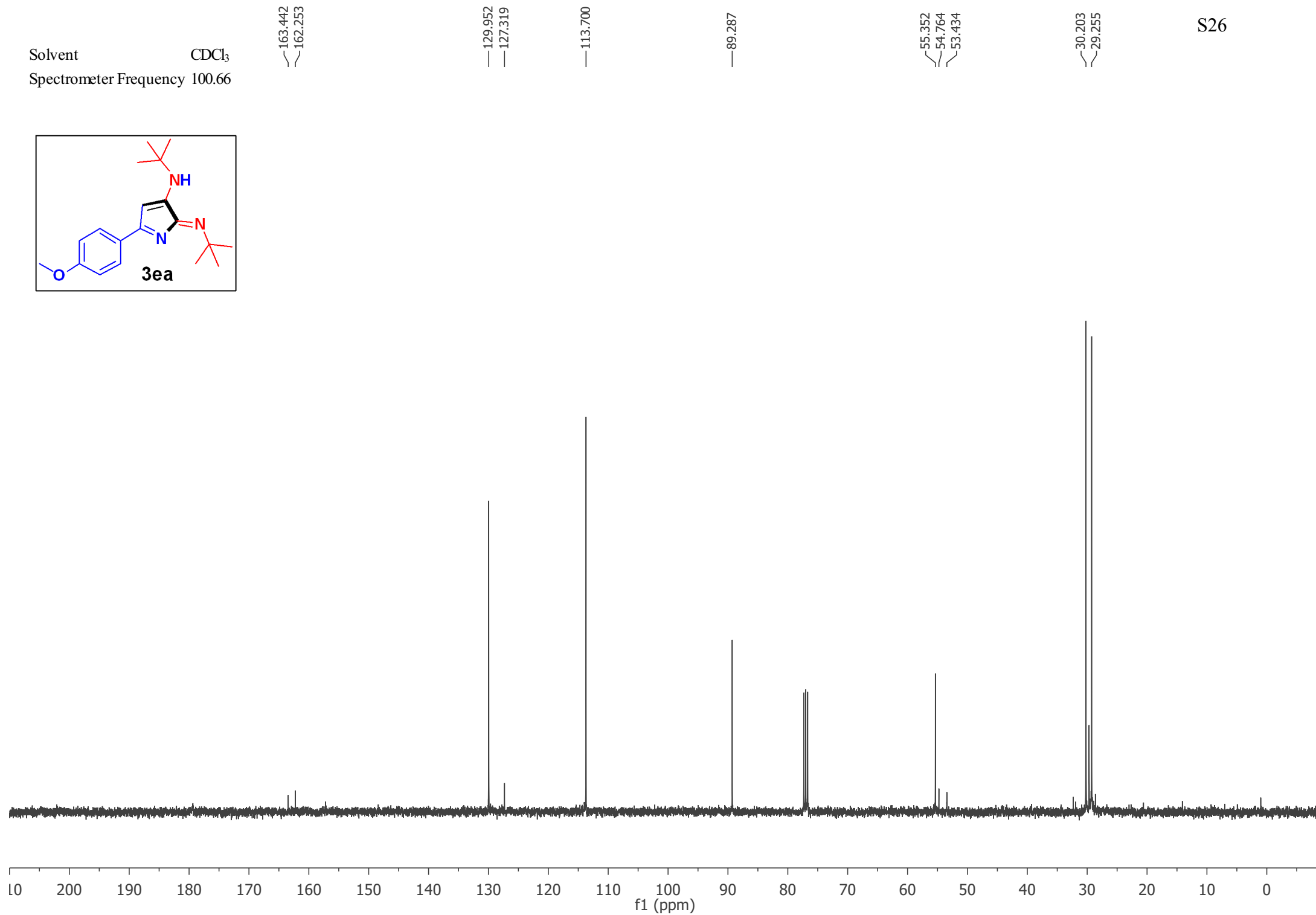
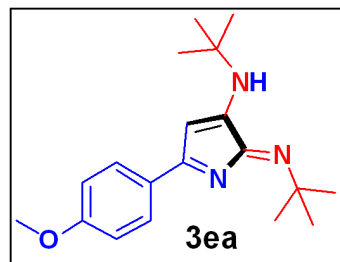
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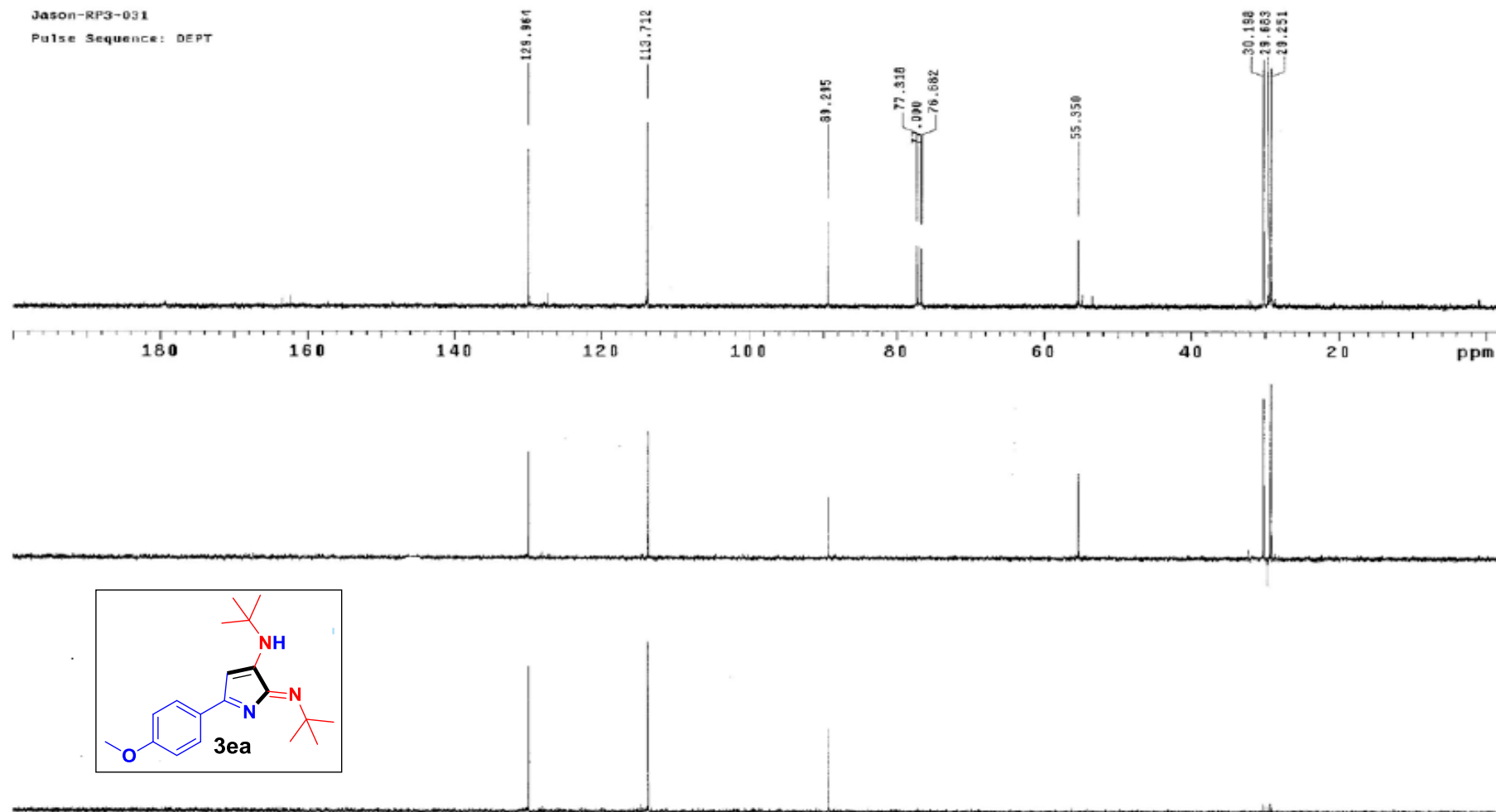
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1.378

S25

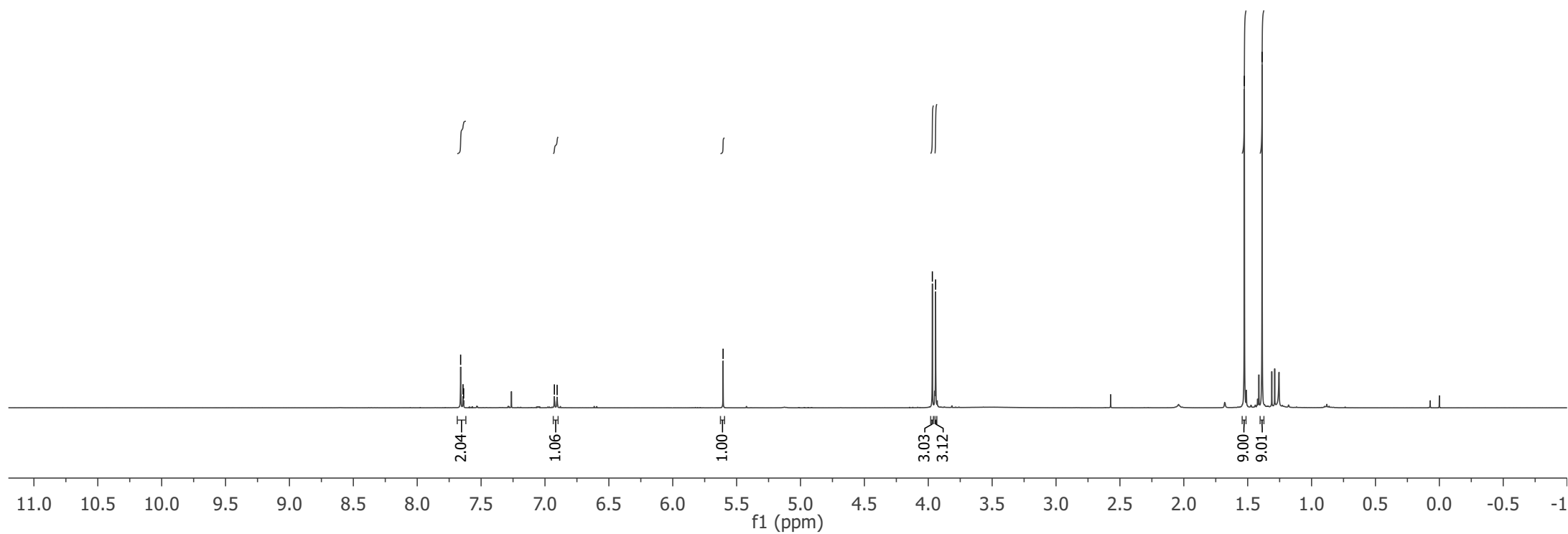
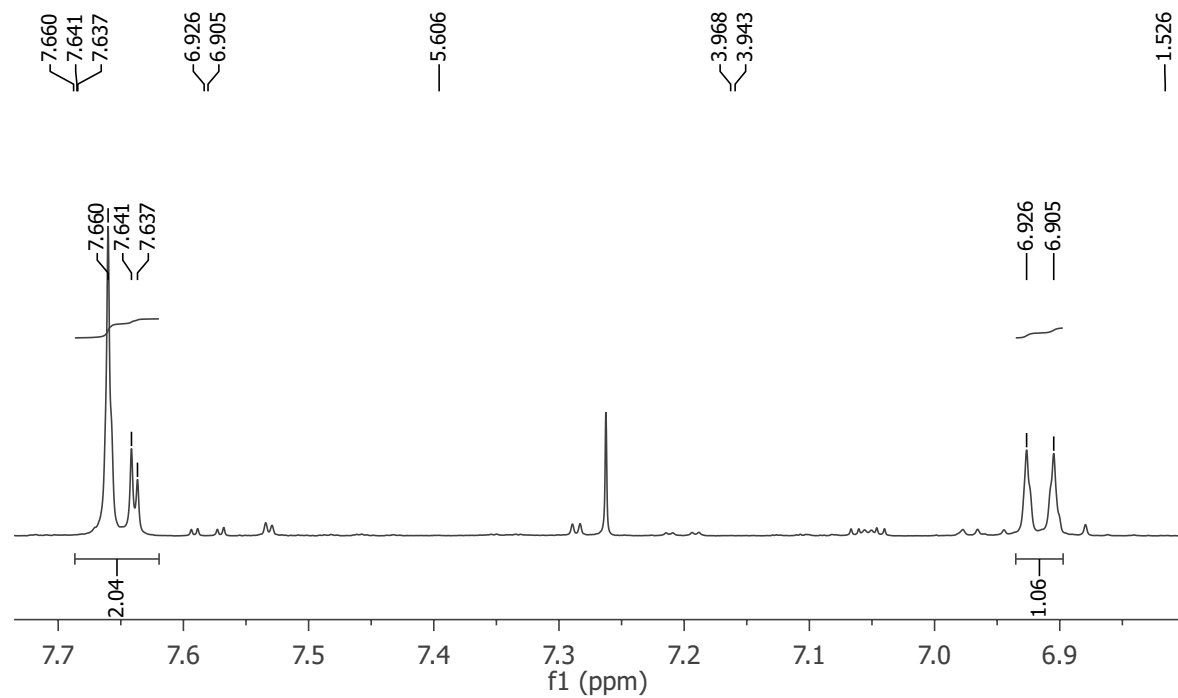
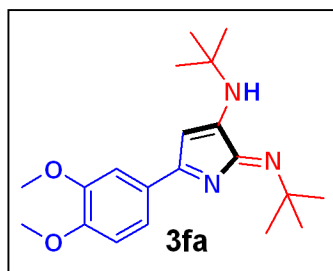


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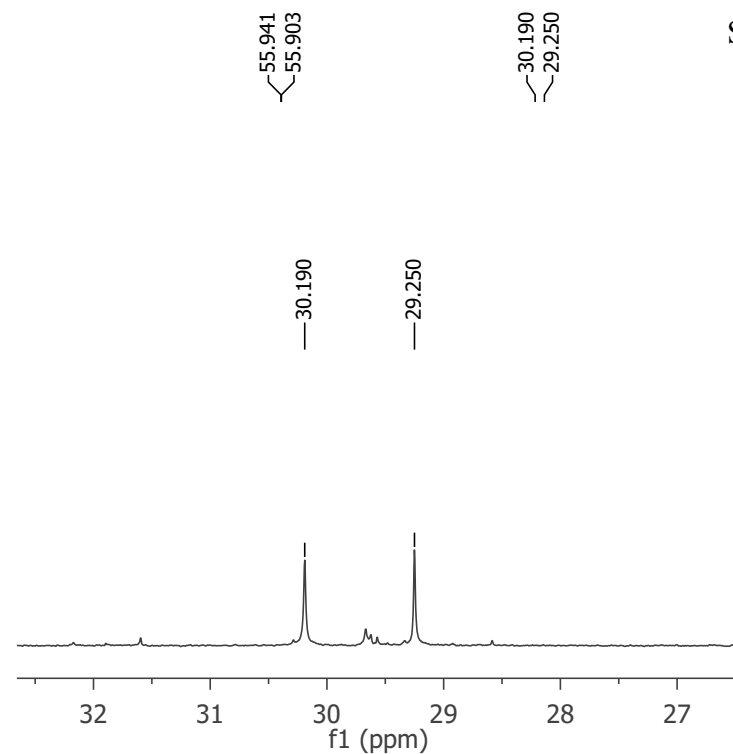
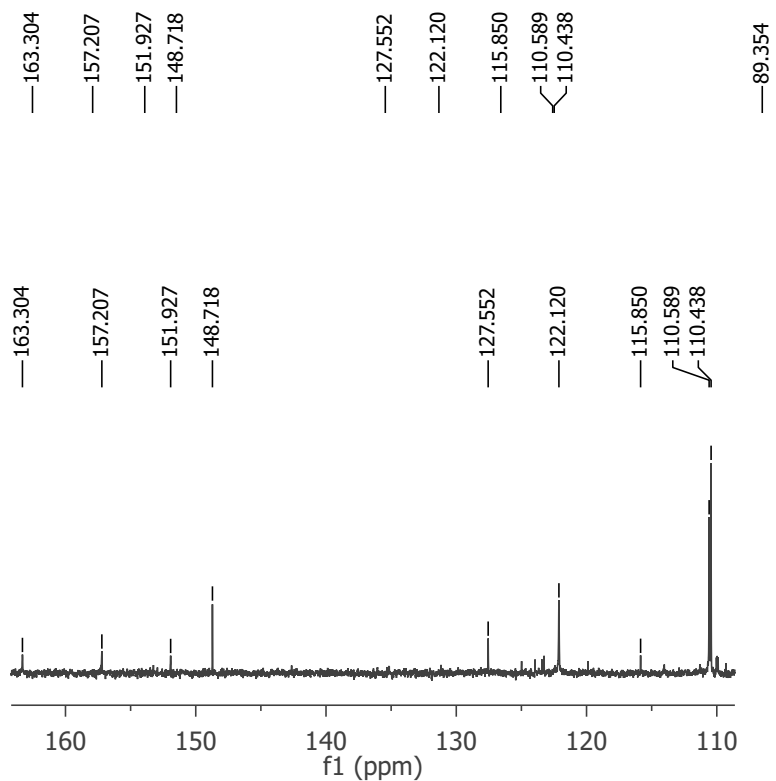
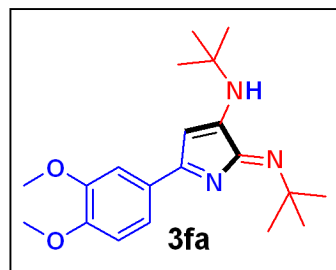




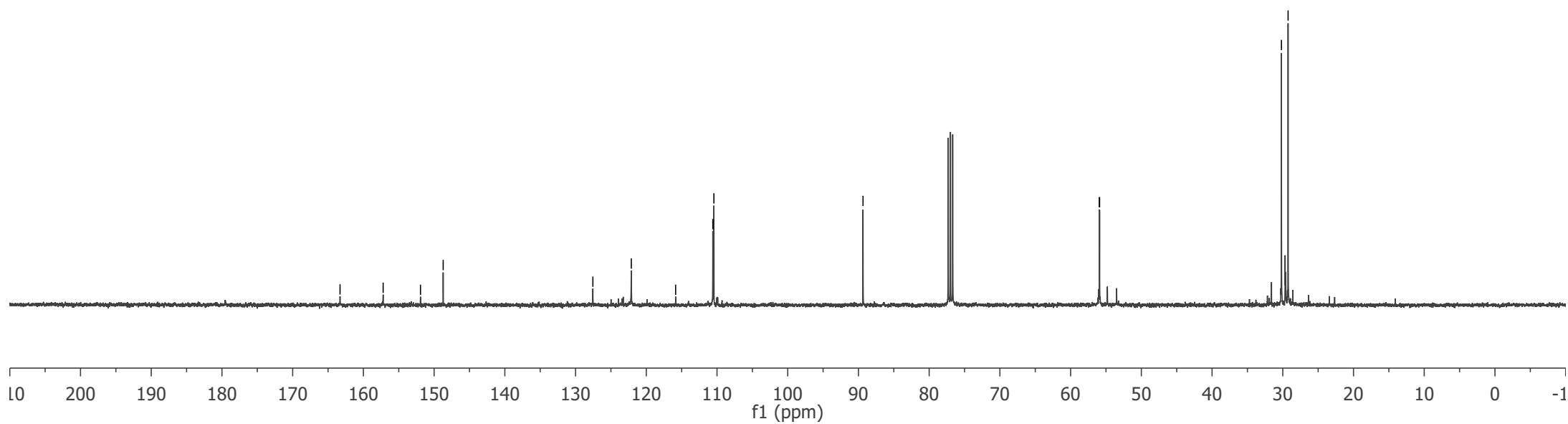
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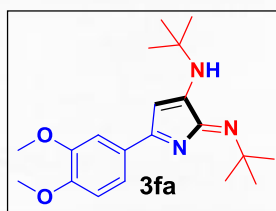
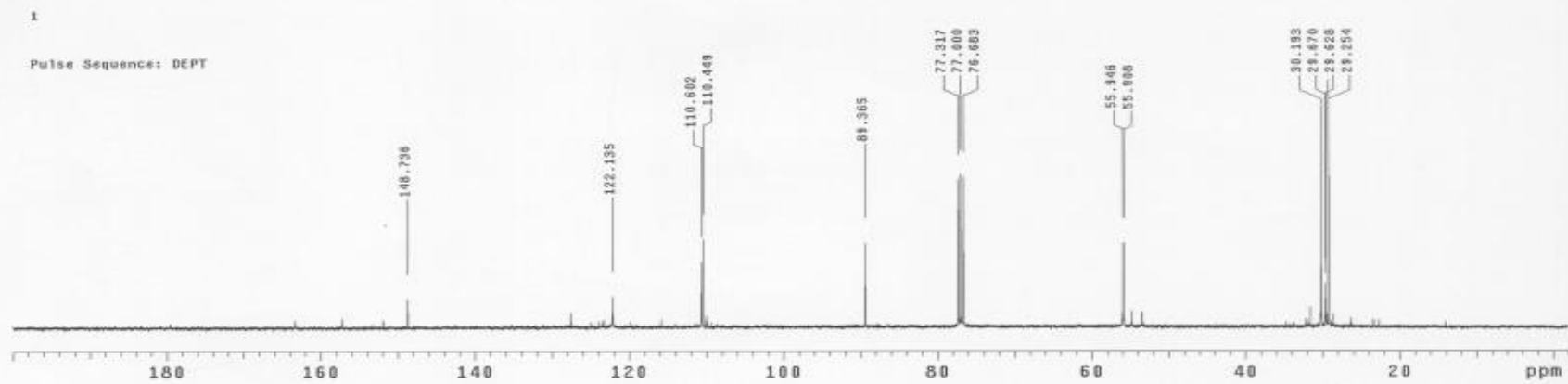


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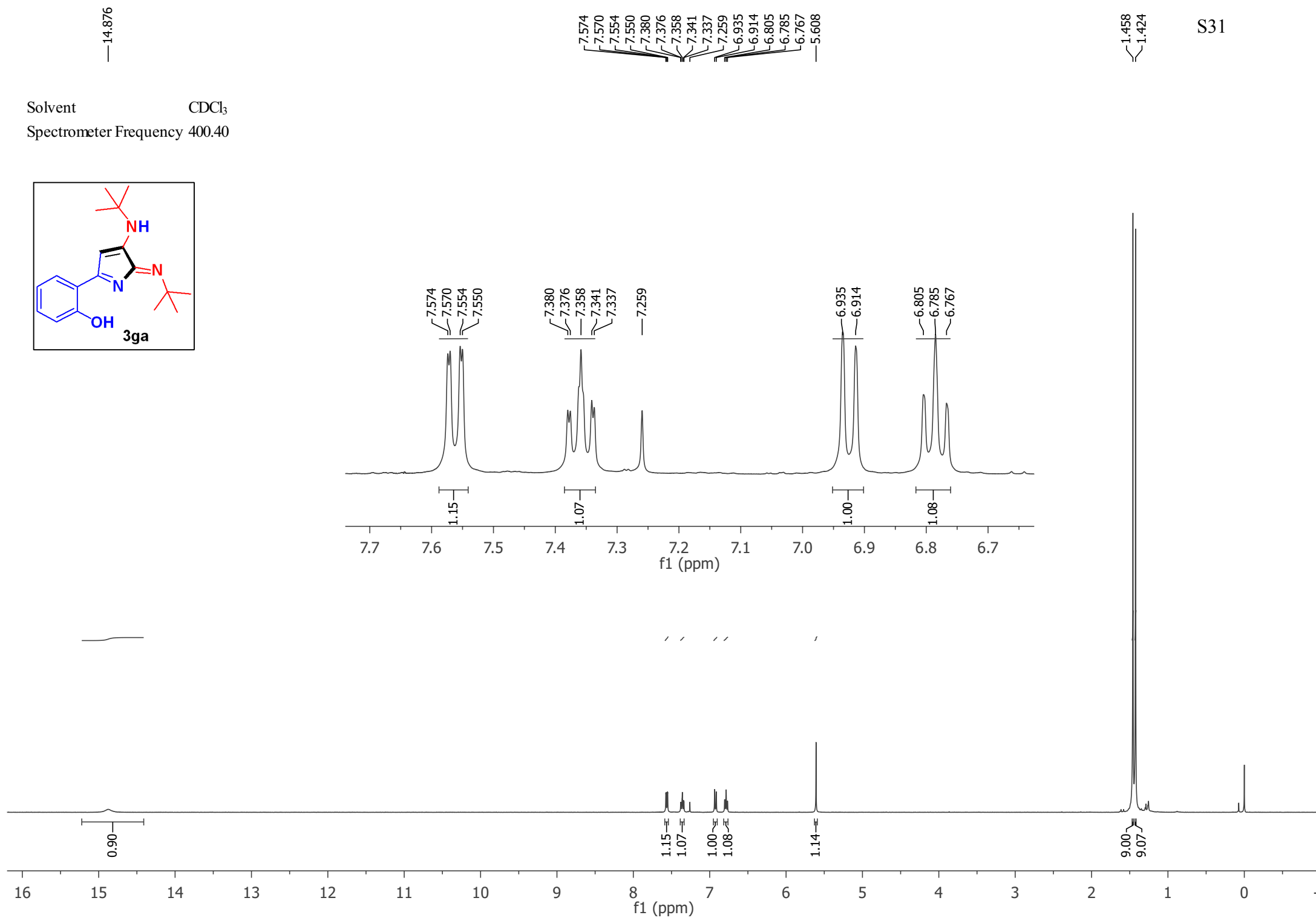
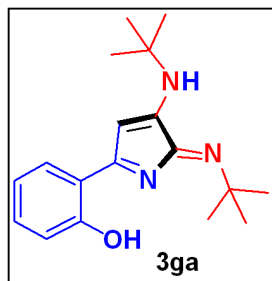


S29

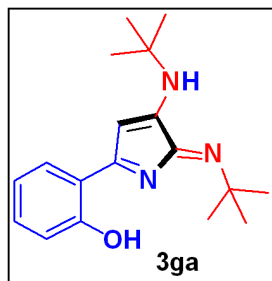




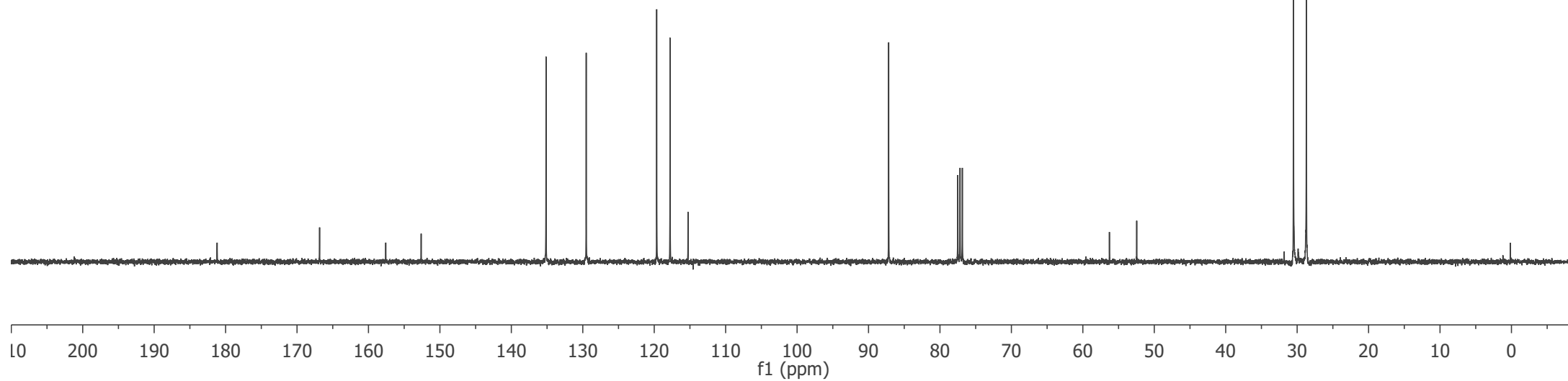
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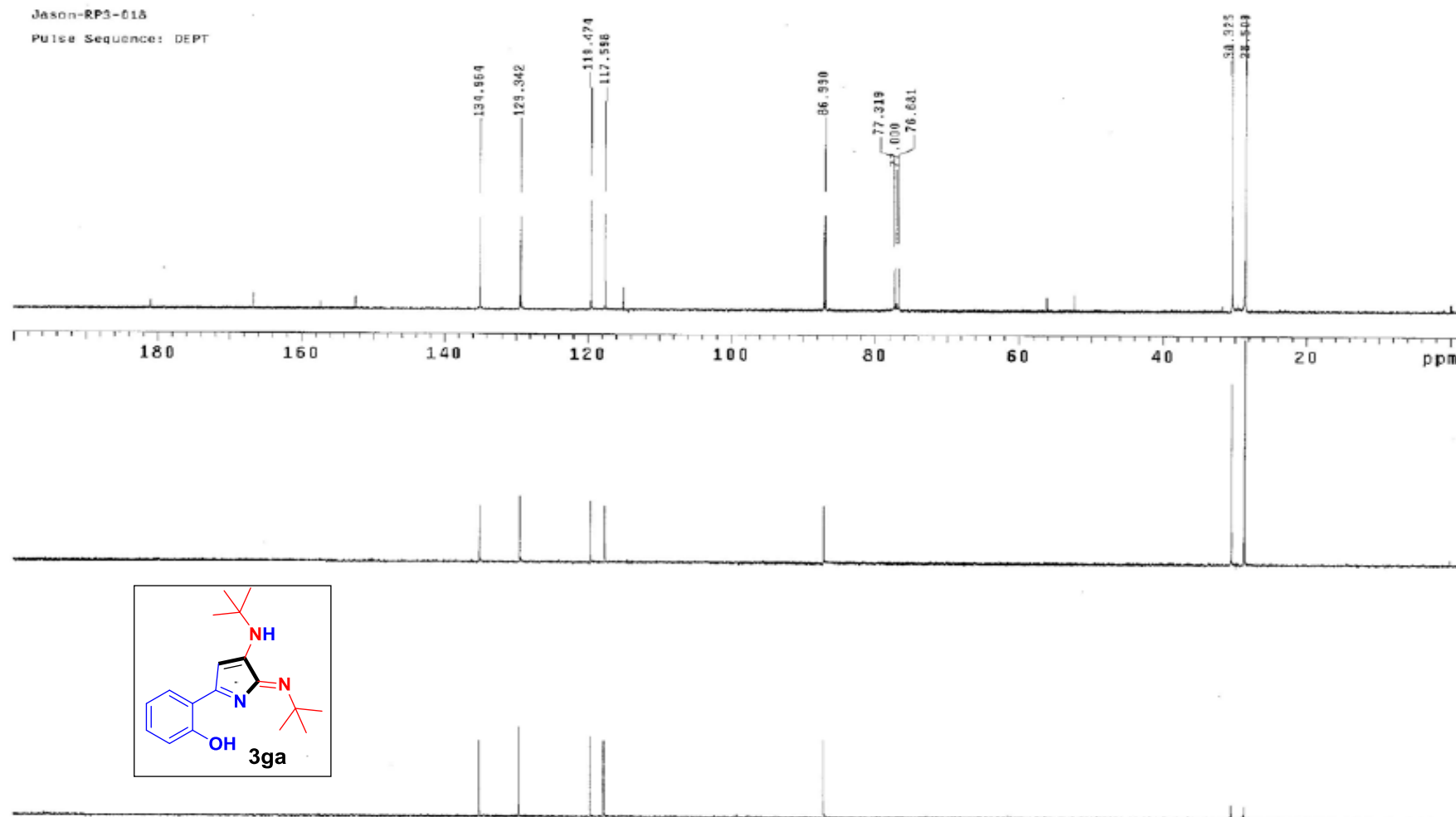


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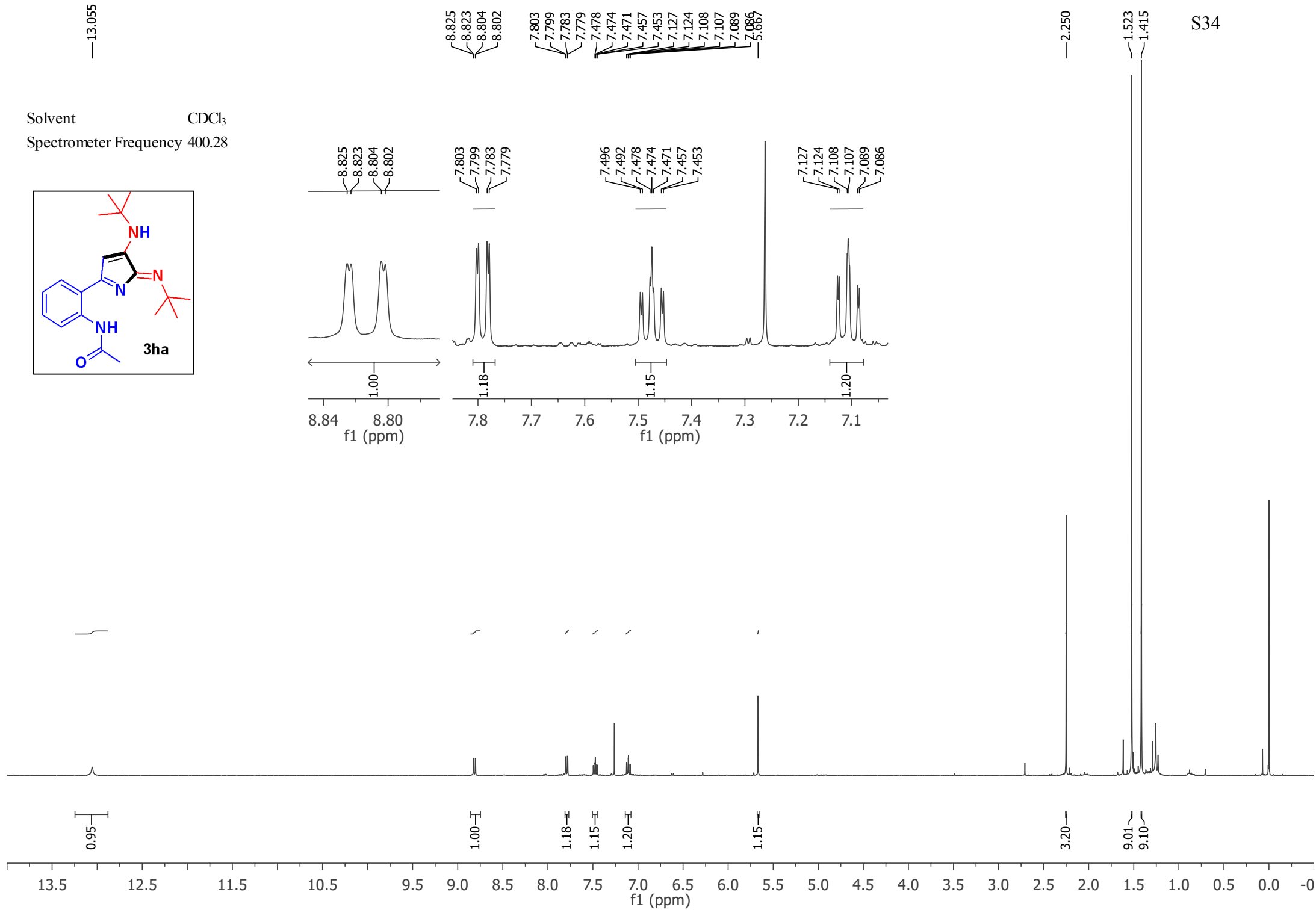
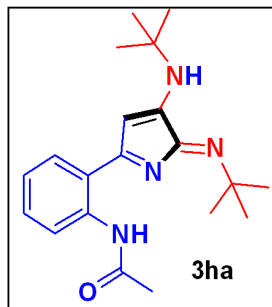


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28.703

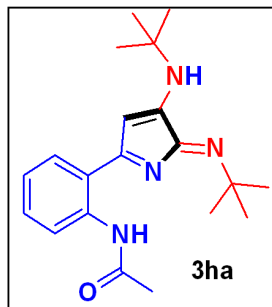




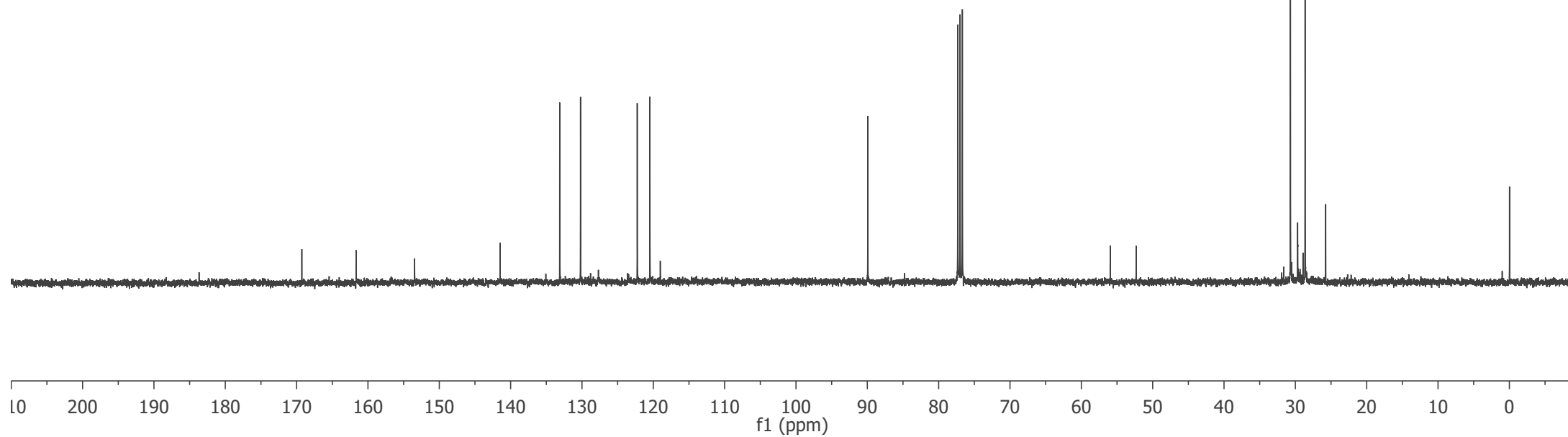
Solvent CDCl_3
Spectrometer Frequency 400.28

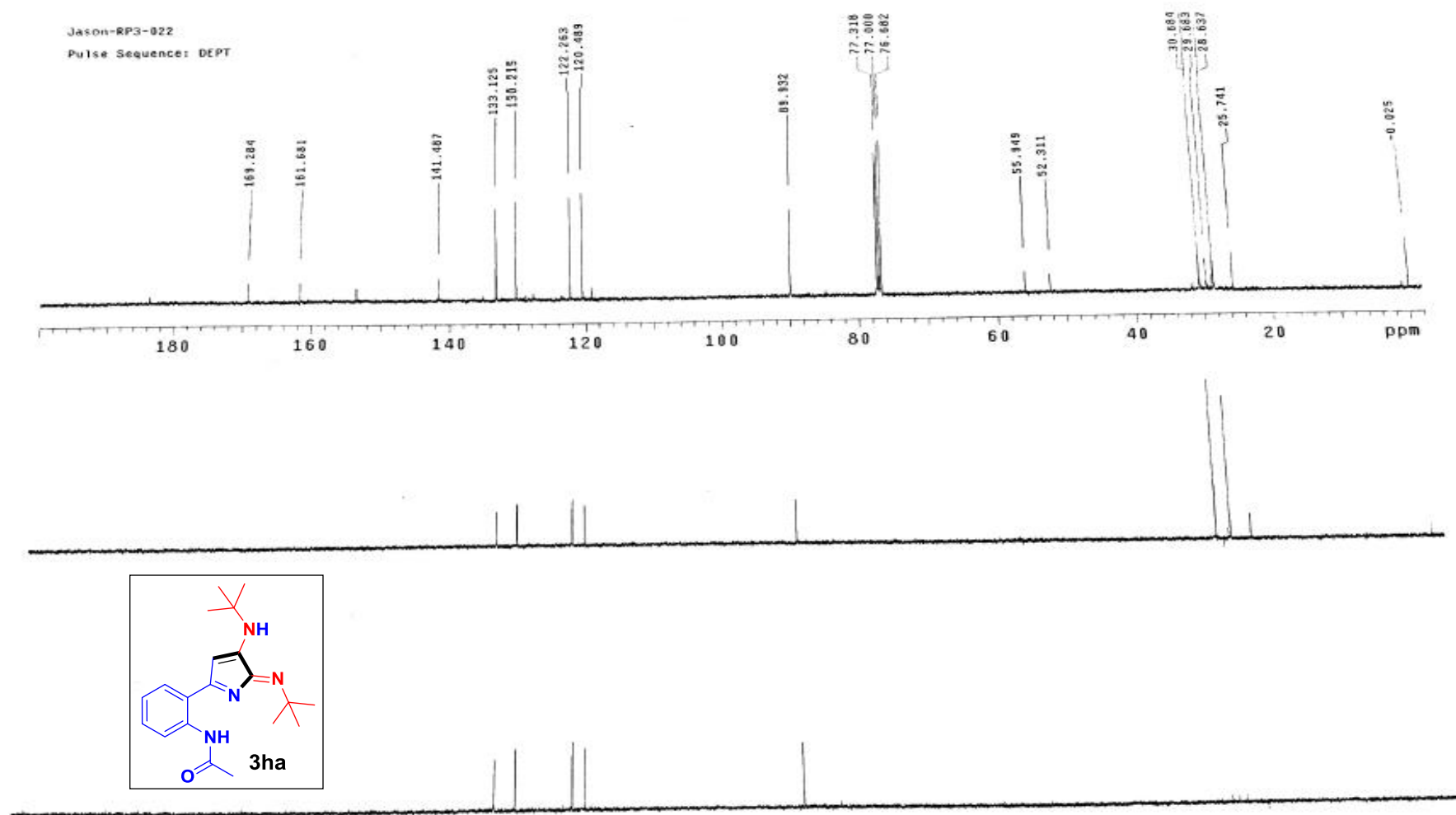


Solvent CDCl_3
Spectrometer Frequency 100.66

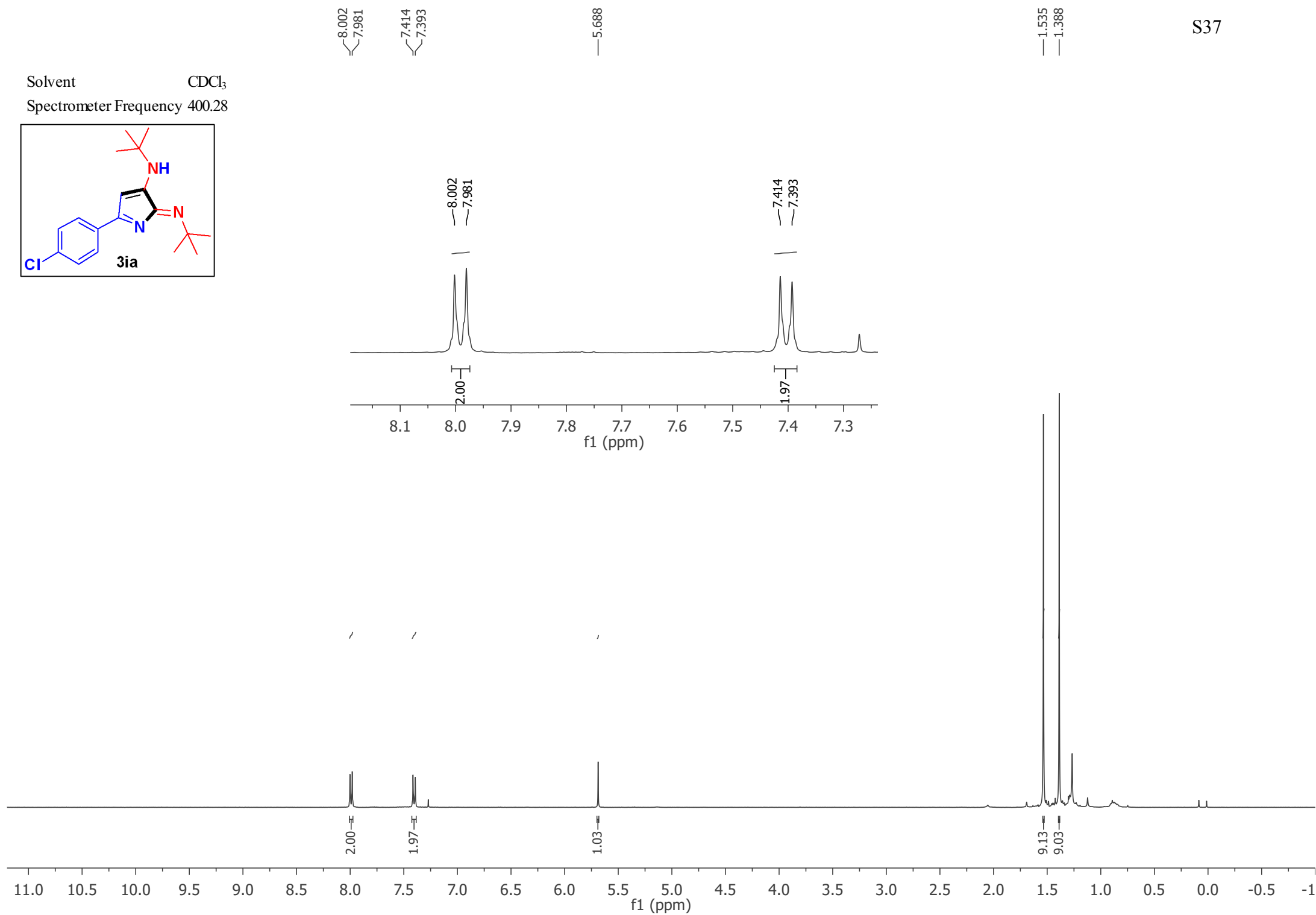
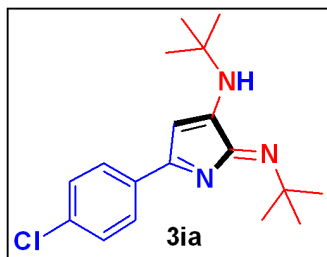


169.269
161.666
153.467
141.473
133.117
130.206
122.254
120.480
119.023
89.930
55.947
52.314
30.690
28.637
25.748

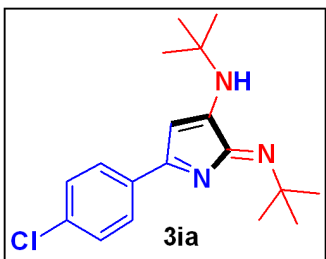




Solvent CDCl_3
Spectrometer Frequency 400.28



Solvent CDCl_3
Spectrometer Frequency 100.66



—162.671

—136.759

—133.128

—129.156

—128.514

—90.456

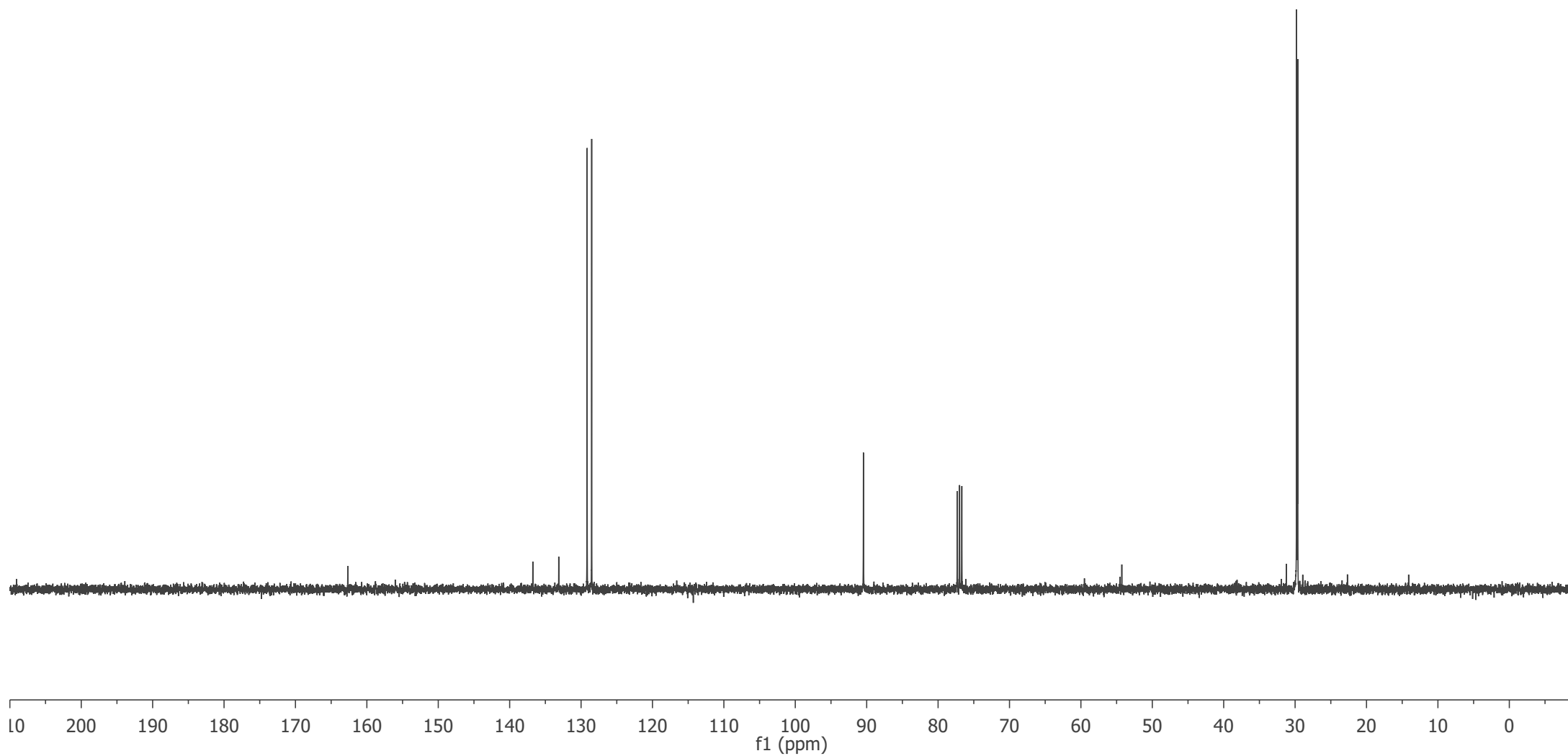
—54.268

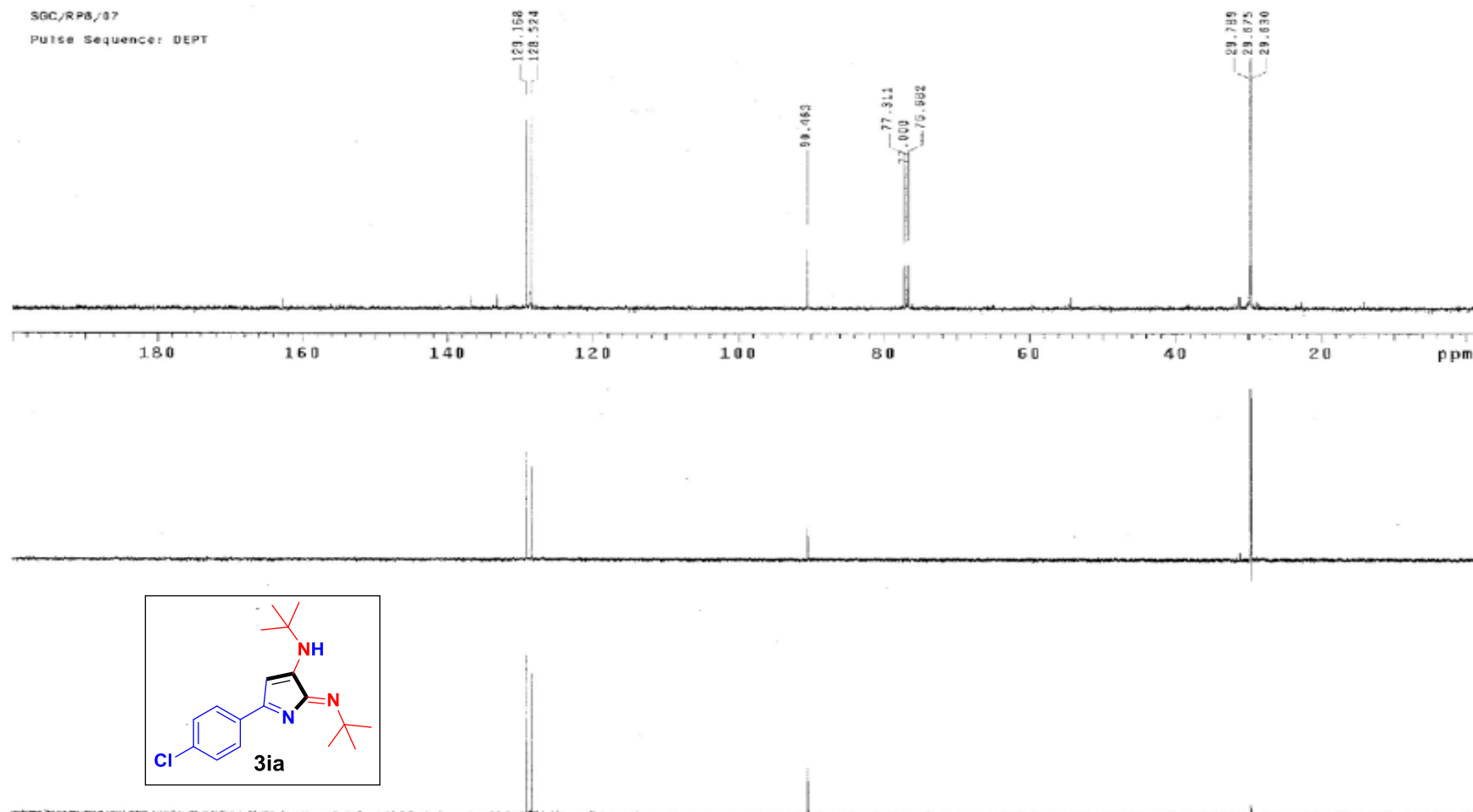
—29.793

—29.681

—29.634

S38

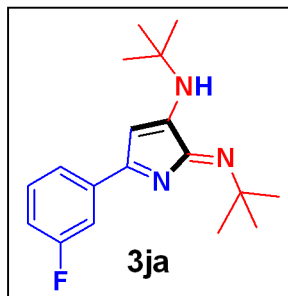




Solvent

CDCl₃

Spectrometer Frequency 400.40



7.800
7.797
7.794
7.778
7.775
7.769
7.754
7.750
7.747
7.743
7.408
7.393
7.388
7.373
7.368
7.354
7.147
7.143
7.129
7.126
7.122
5.695

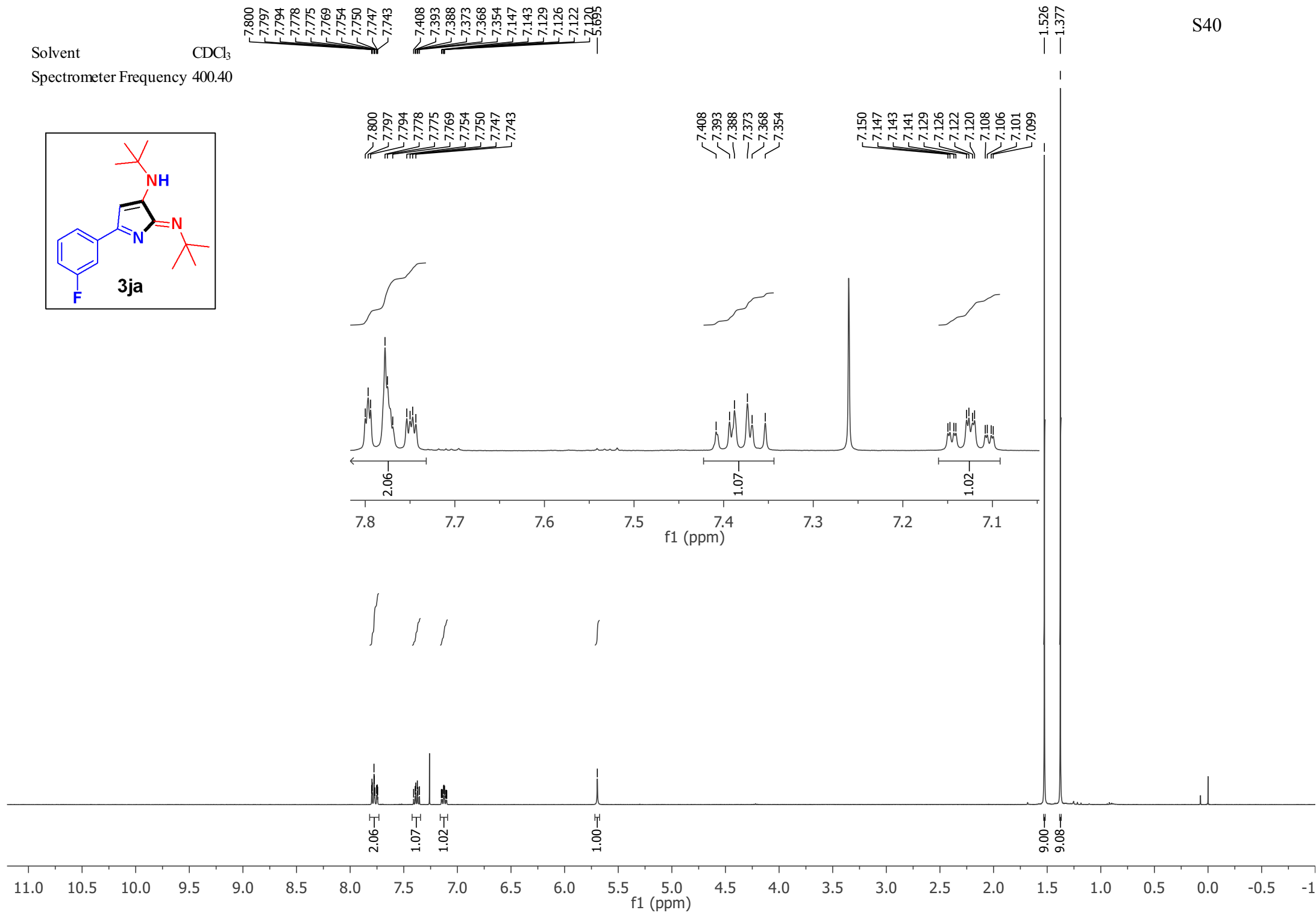
7.800
7.797
7.794
7.778
7.775
7.769
7.754
7.750
7.747
7.743

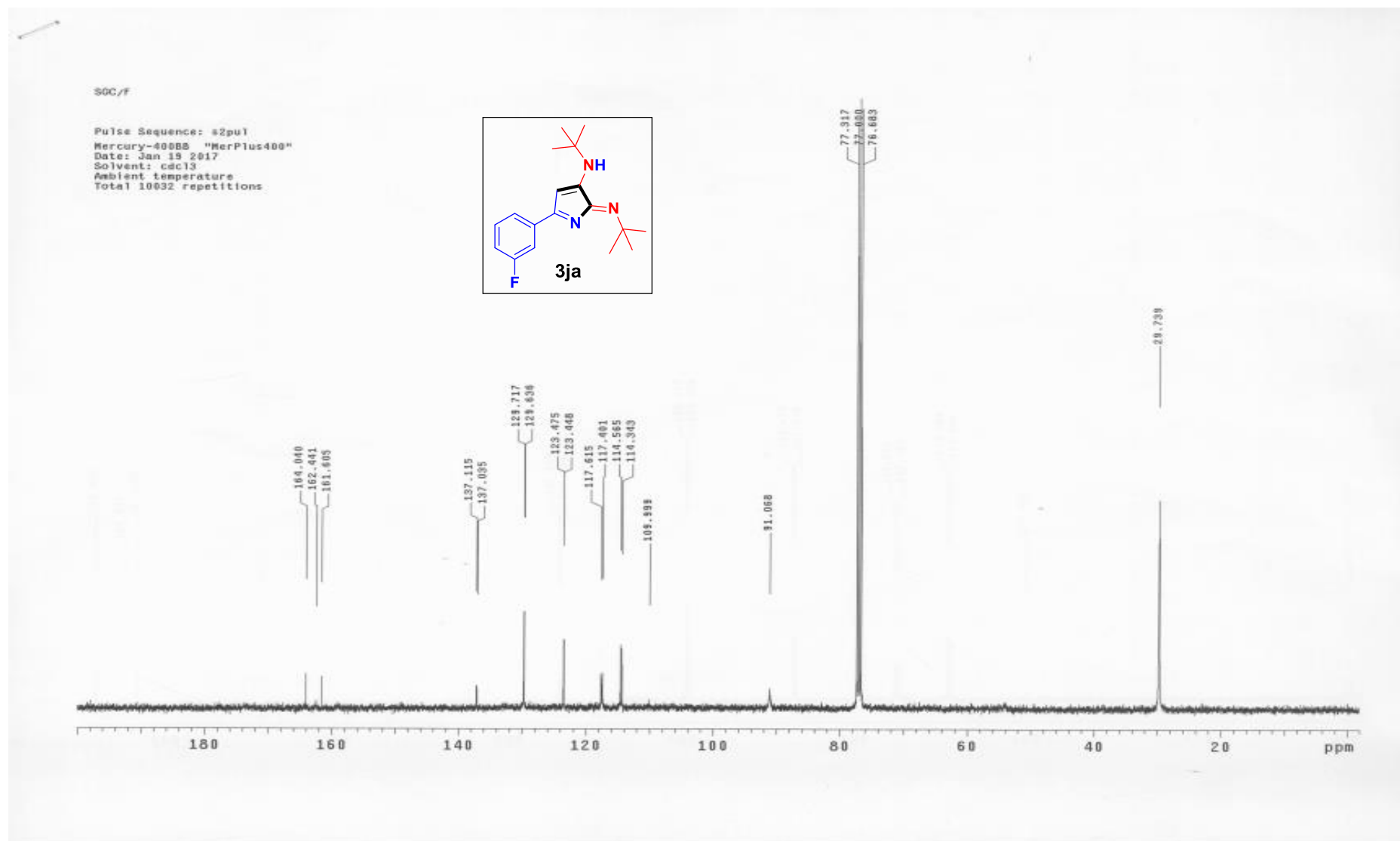
7.408
7.393
7.388
7.373
7.368
7.354

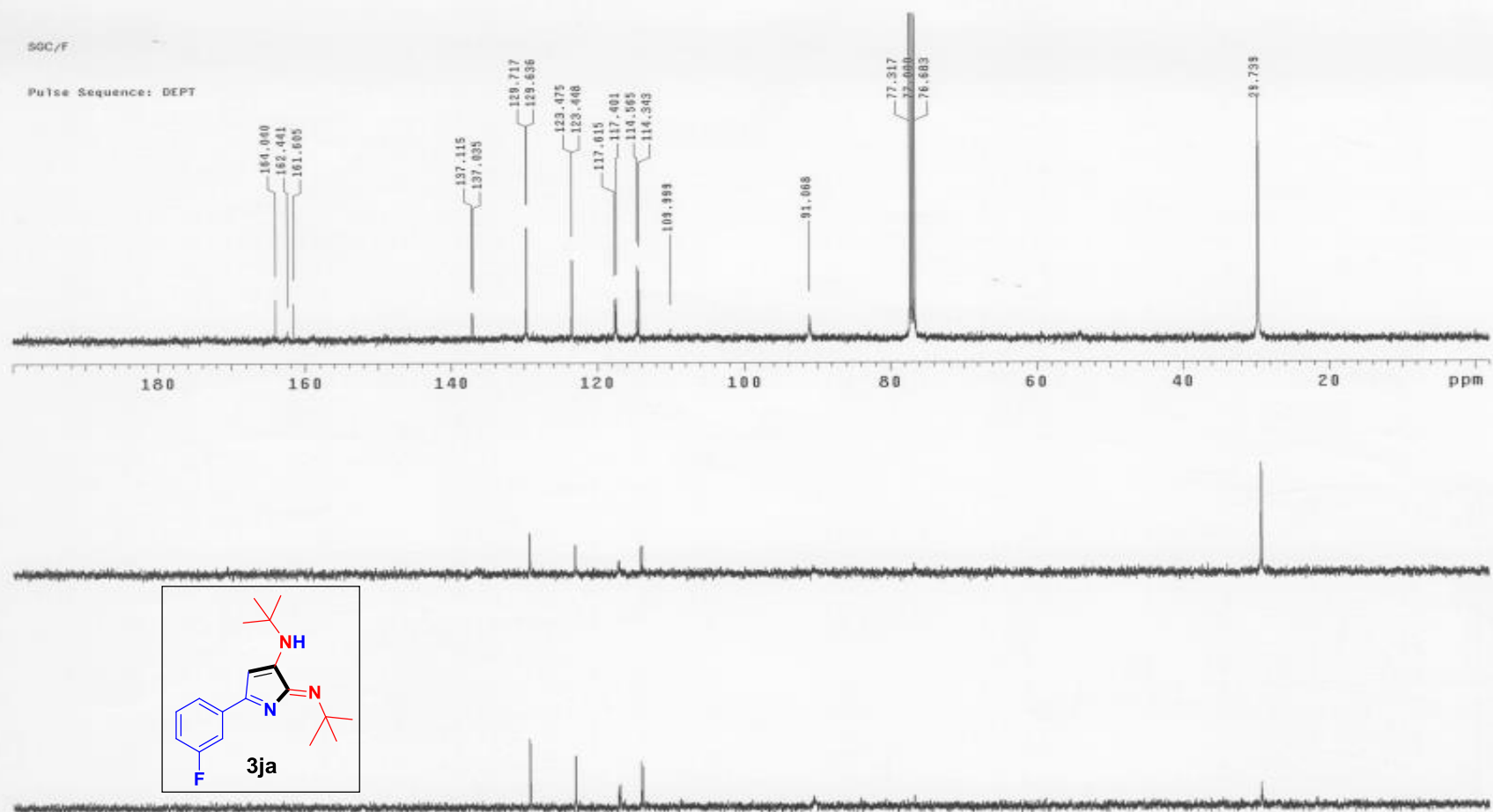
7.150
7.147
7.143
7.141
7.129
7.126
7.122
7.120
7.108
7.106
7.101
7.099

1.526
1.377

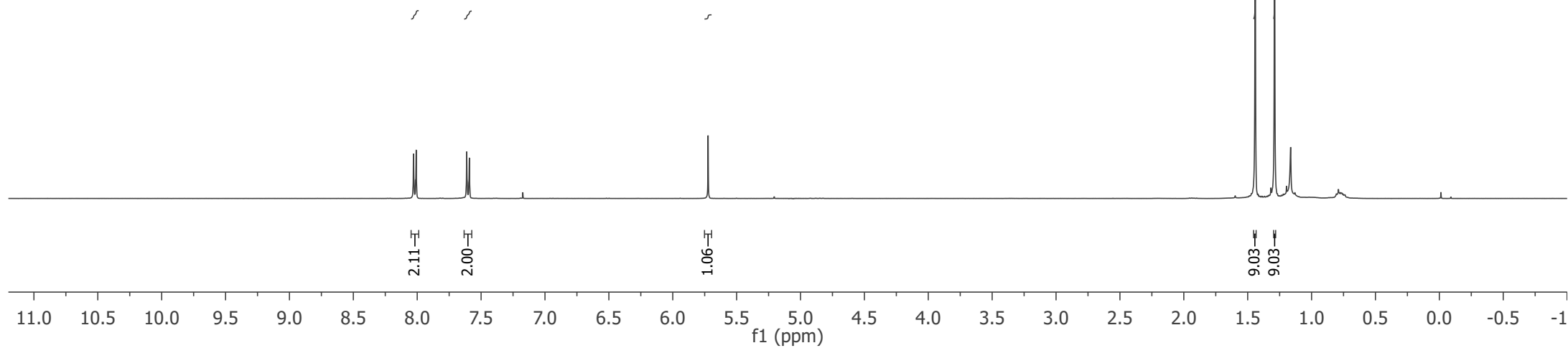
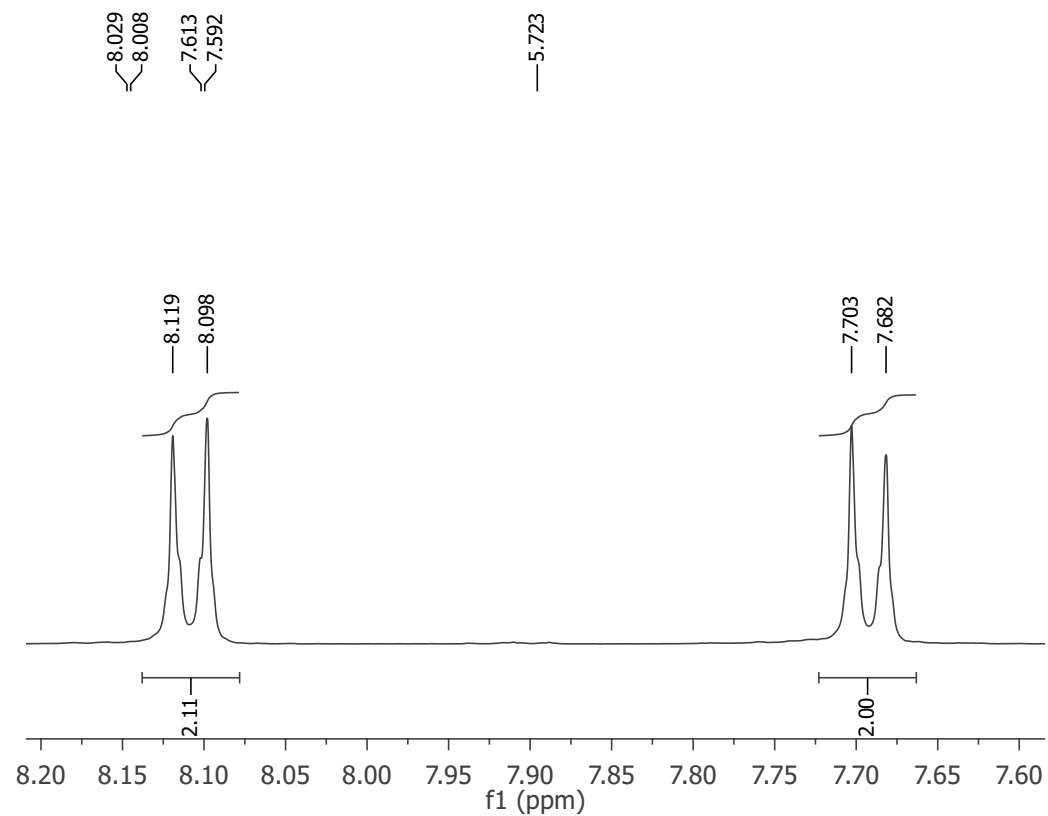
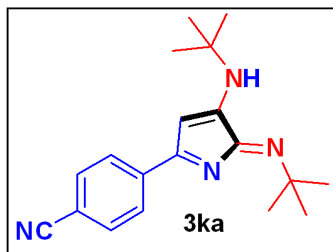
S40



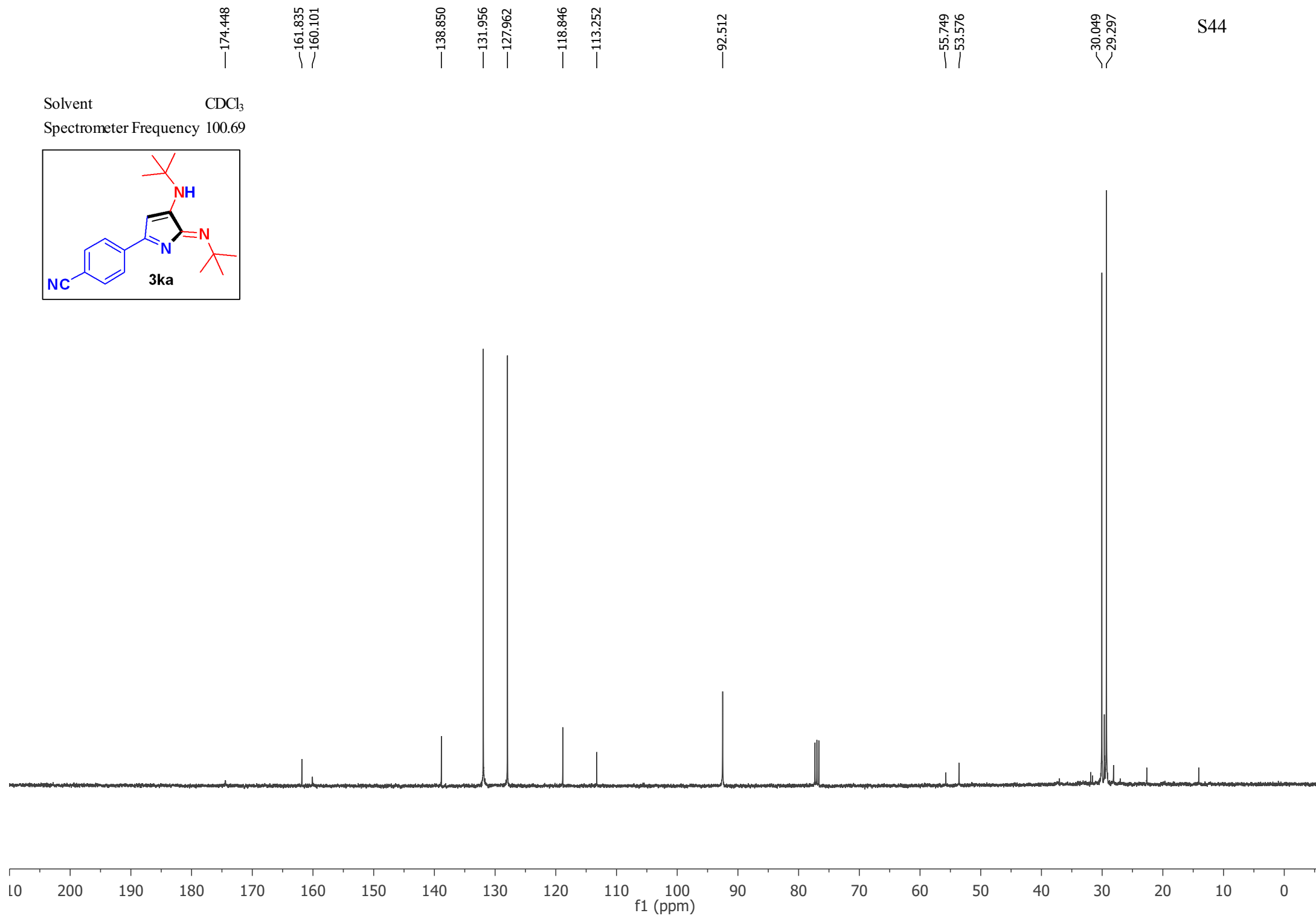
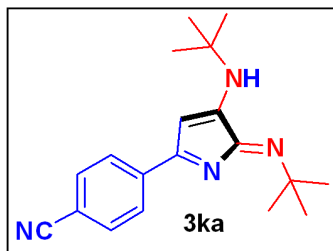


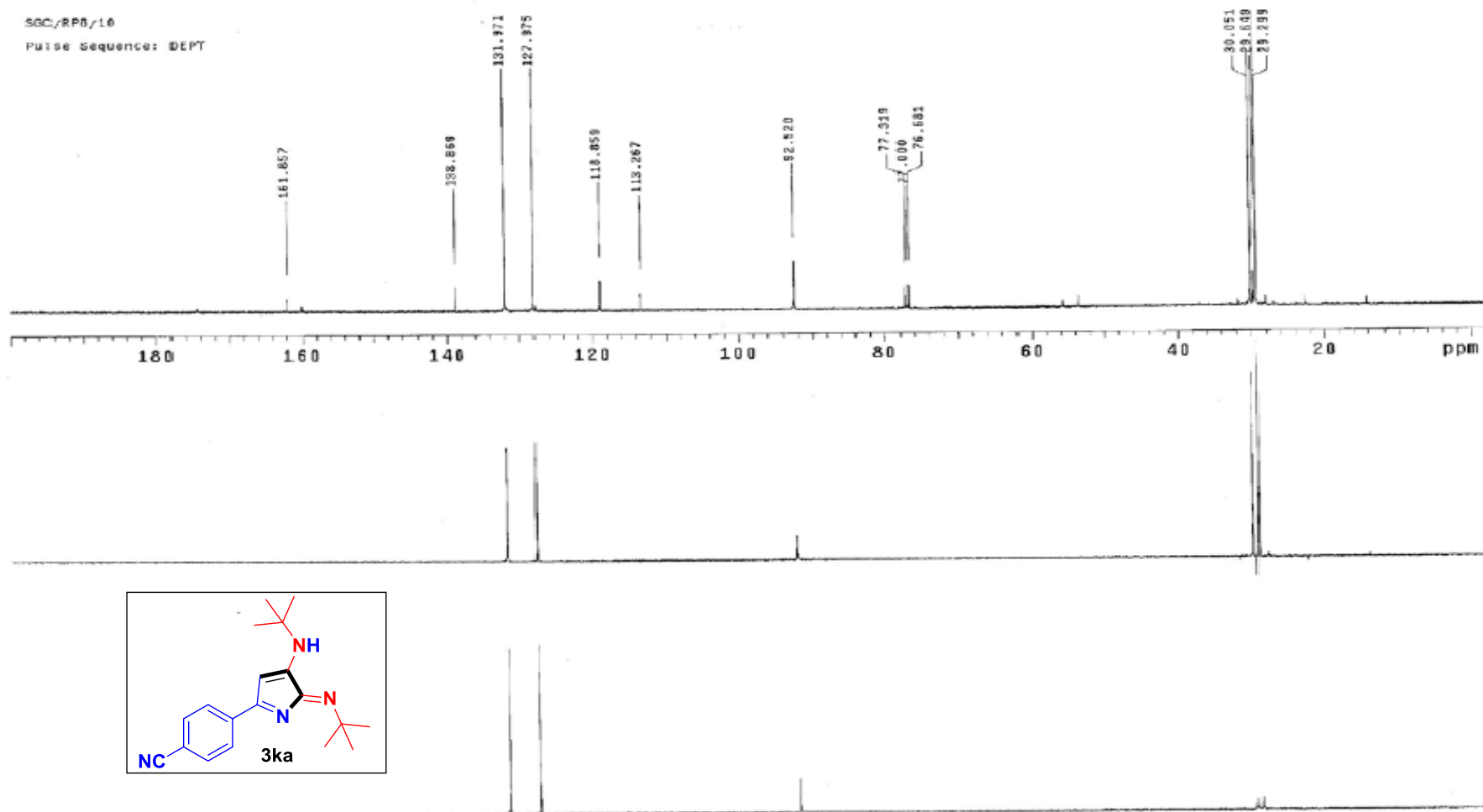


Solvent	CDCl ₃
Spectrometer Frequency	400.40

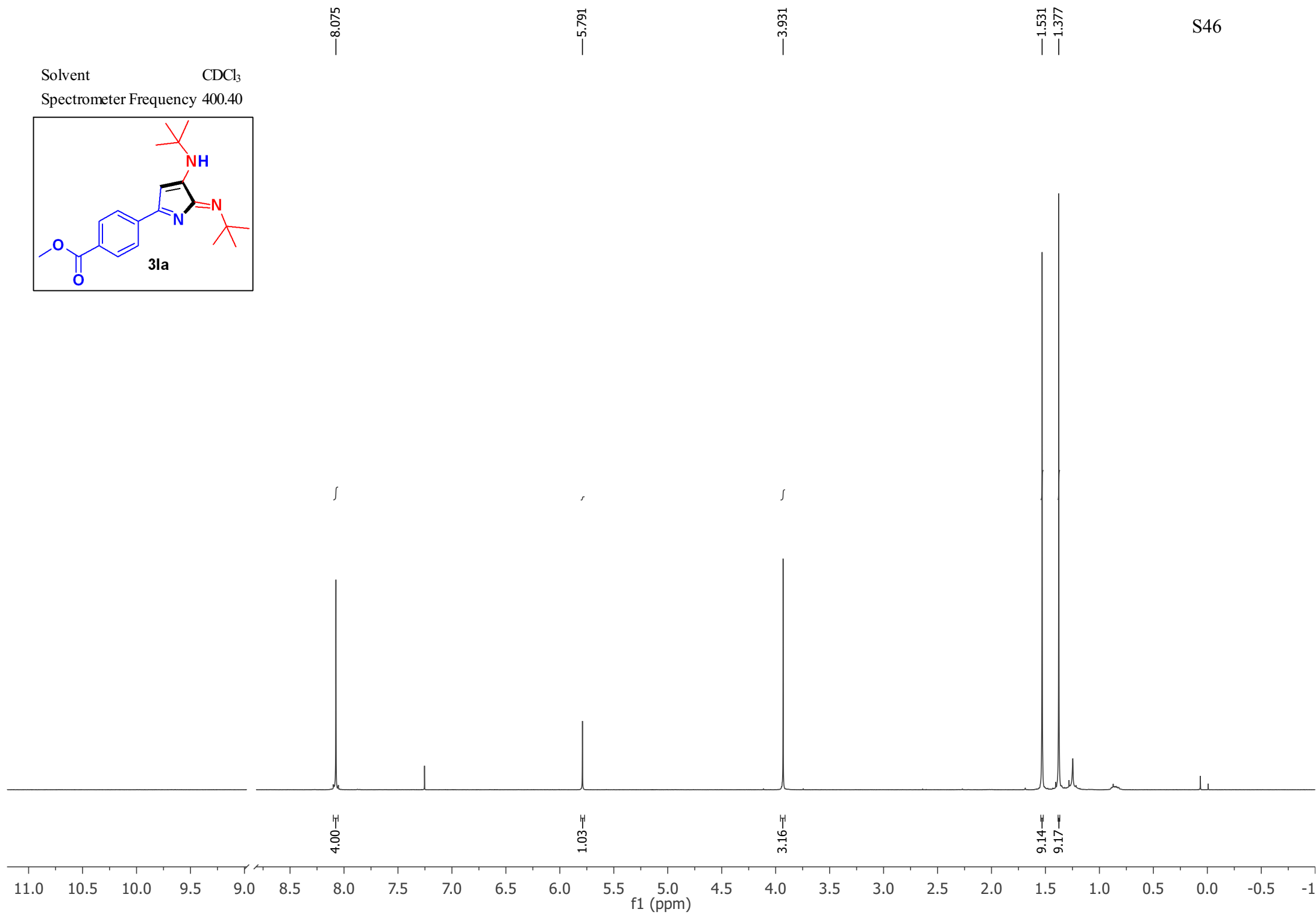
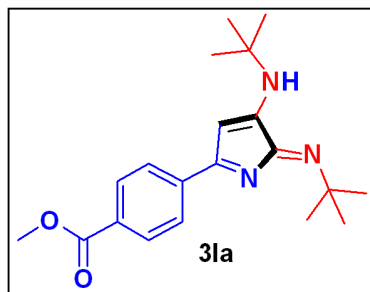


Solvent CDCl_3
Spectrometer Frequency 100.69





Solvent CDCl_3
Spectrometer Frequency 400.40



—166.809
—162.252

—138.815

—131.557

—129.472

—127.593

—55.233

—91.955

—53.880

52.200

55.233

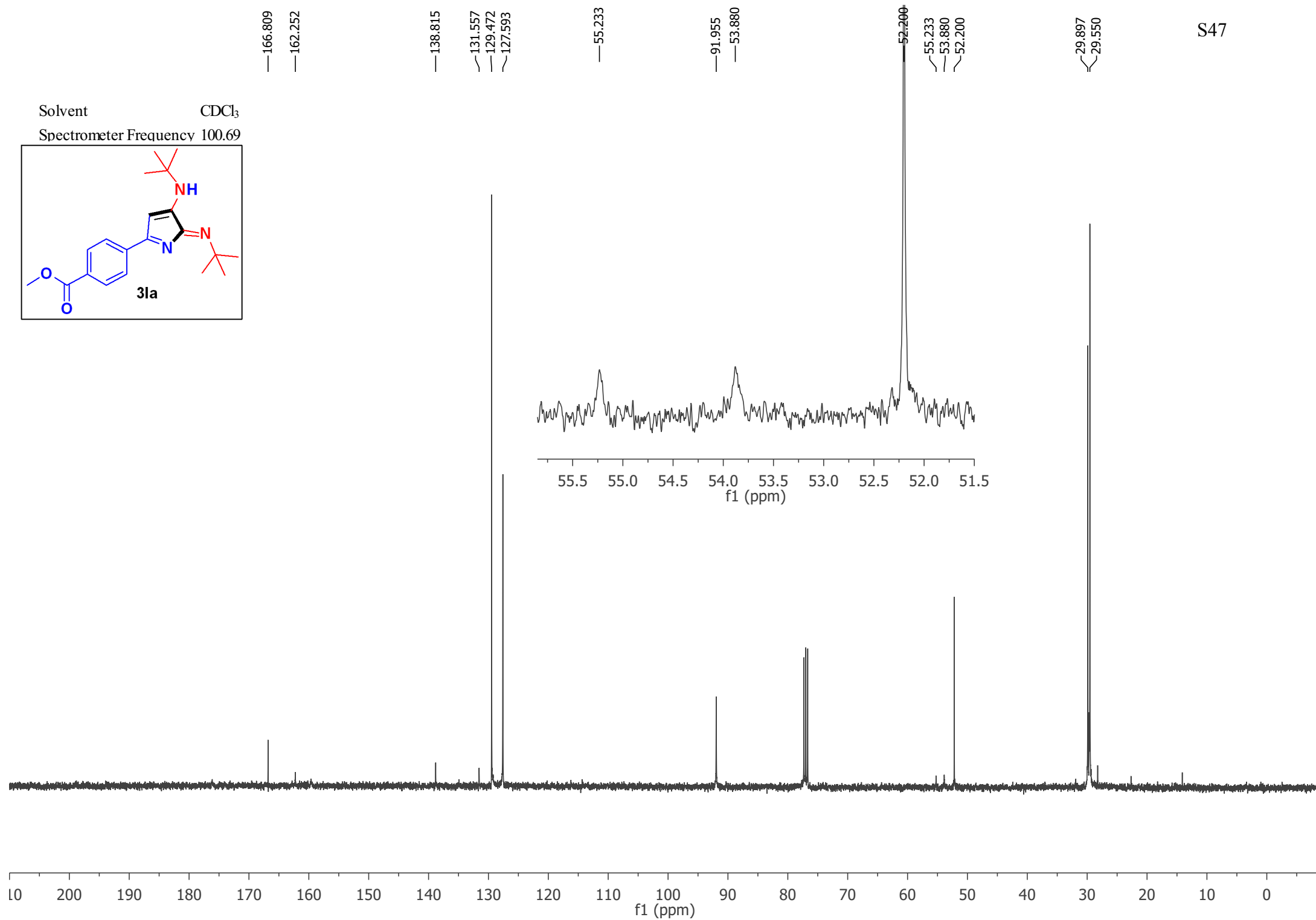
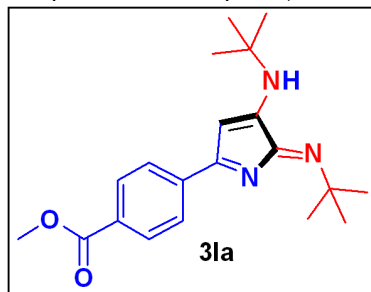
53.880

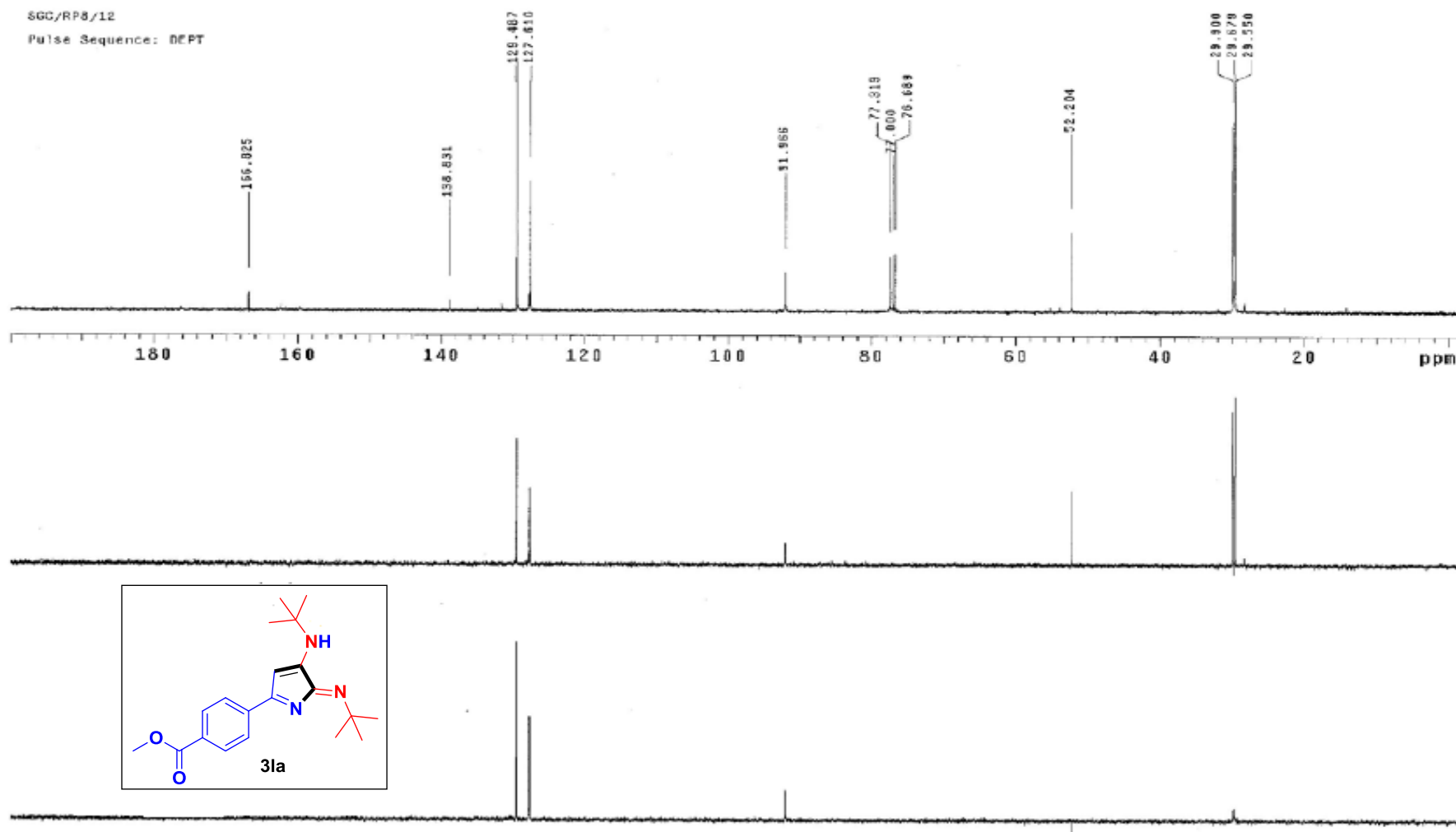
52.200

29.897

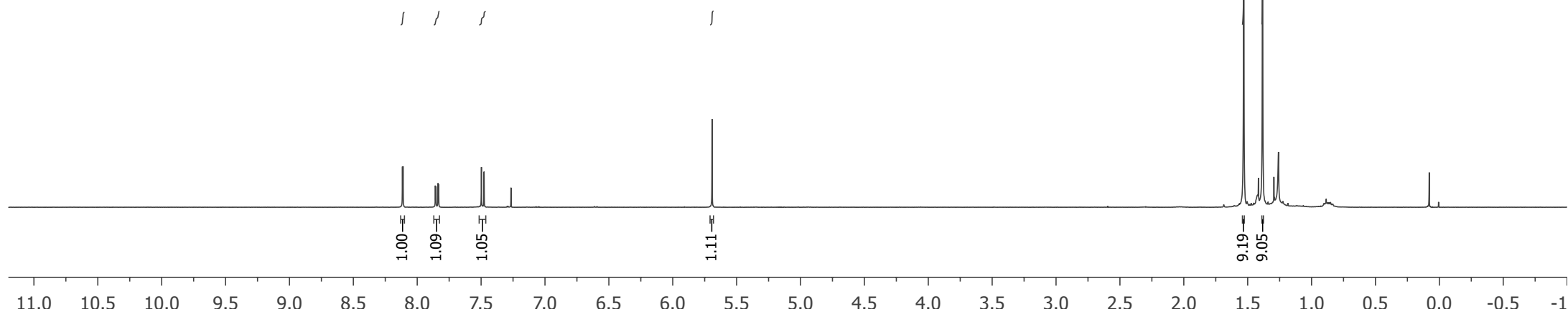
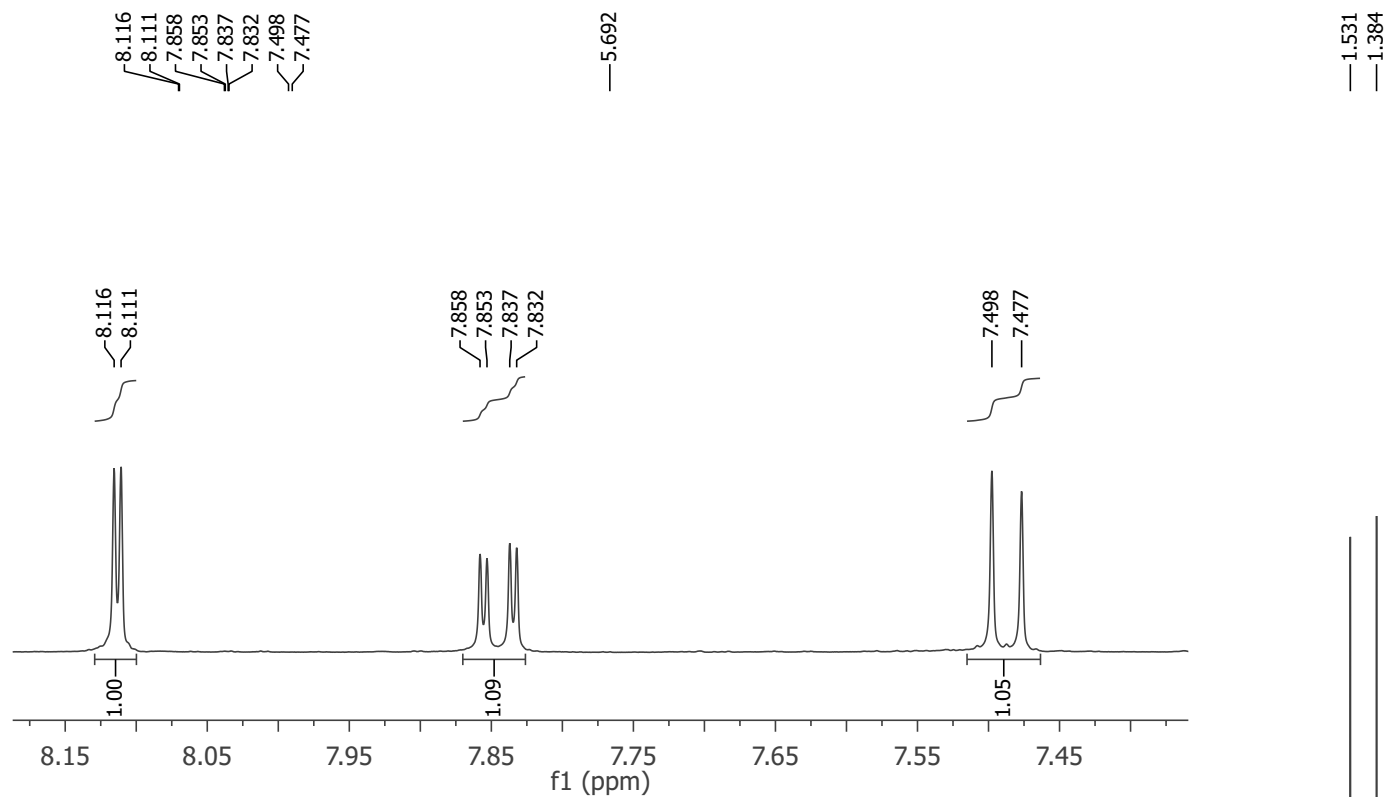
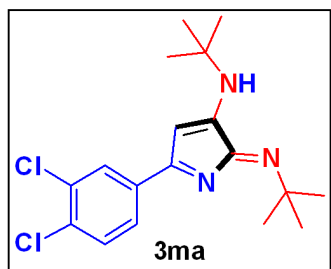
29.550

Solvent CDCl_3
Spectrometer Frequency 100.69

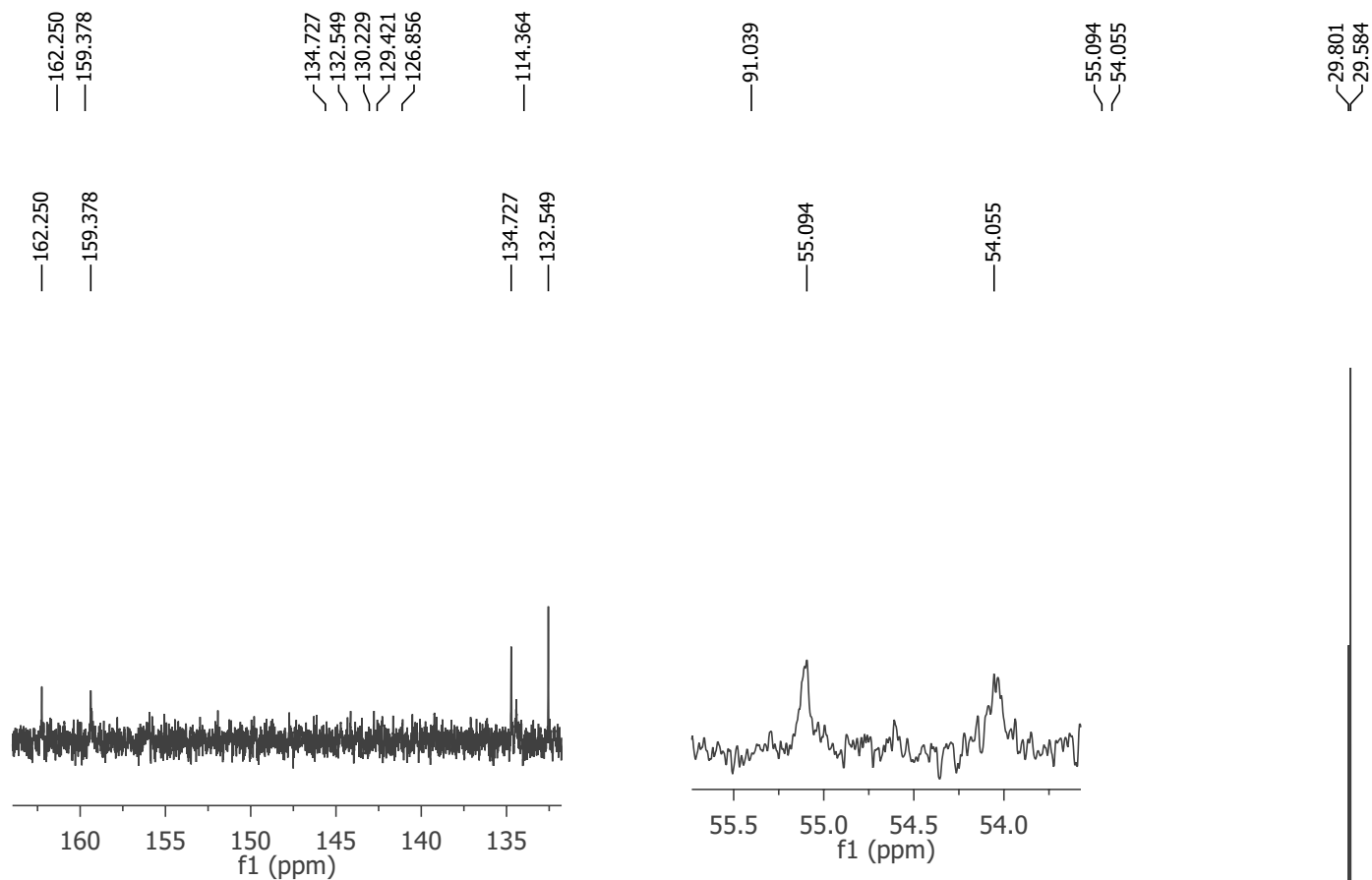
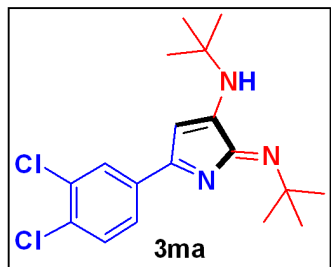




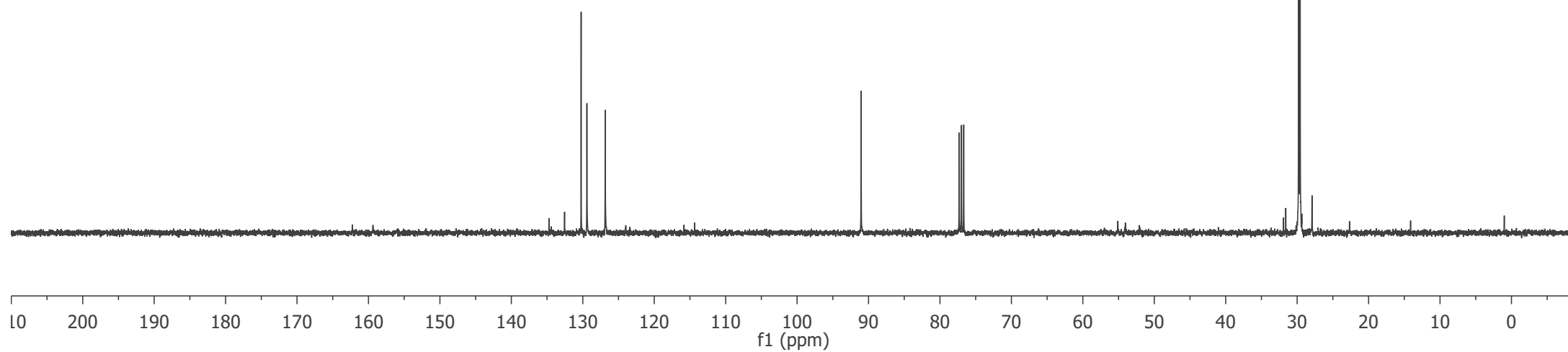
Solvent CDCl_3
Spectrometer Frequency 400.40



Solvent CDCl_3
Spectrometer Frequency 100.69

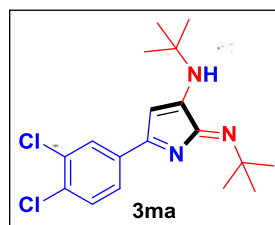
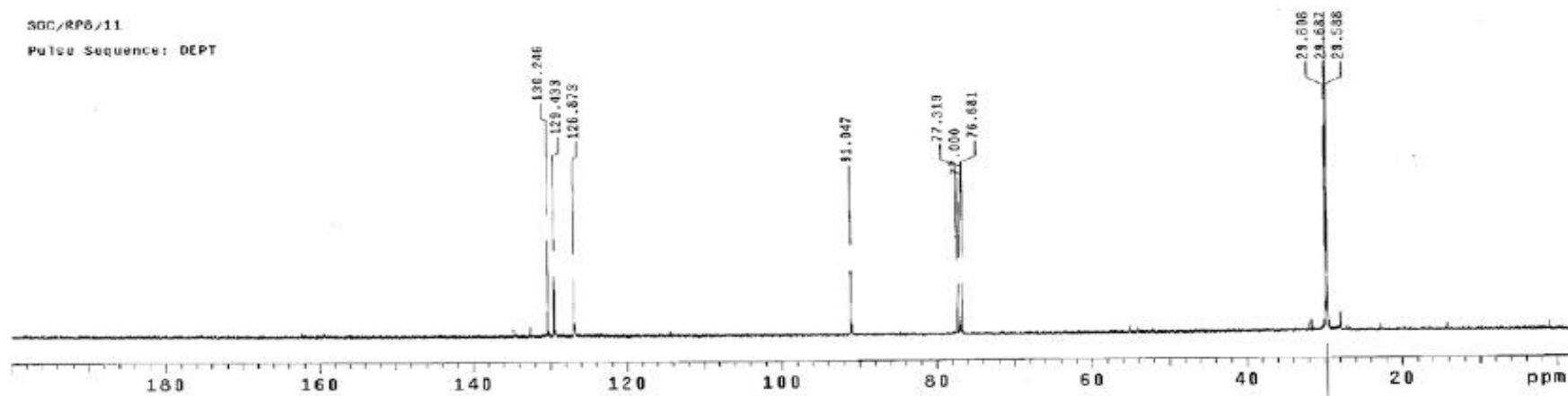


S50

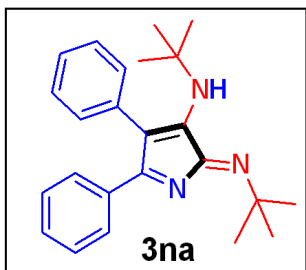


SGC/RP6/11

Pulse Sequence: DEPT



Solvent CDCl_3
Spectrometer Frequency 400.40

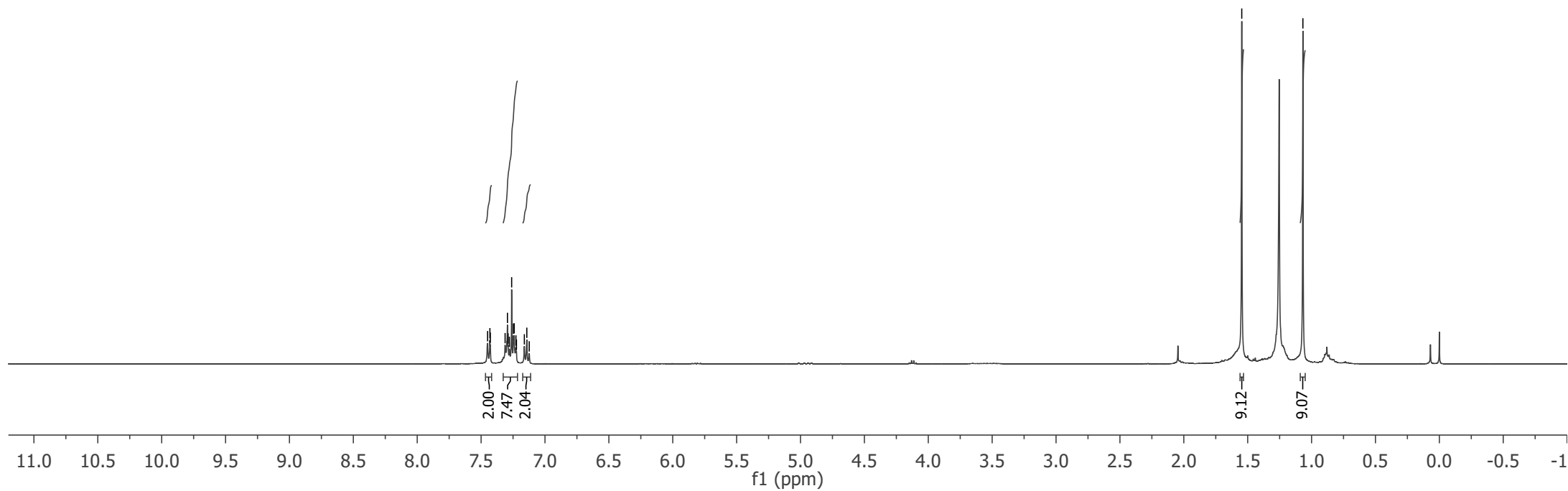
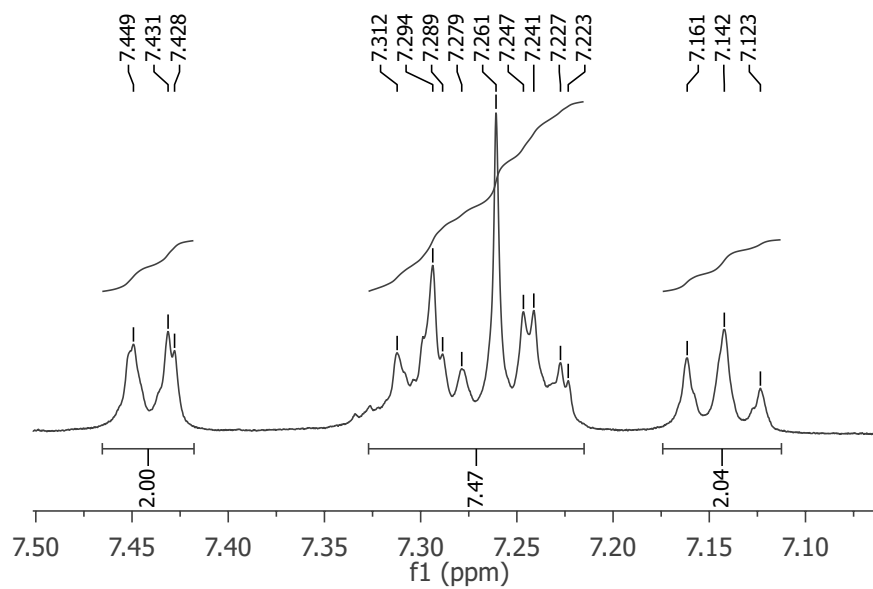


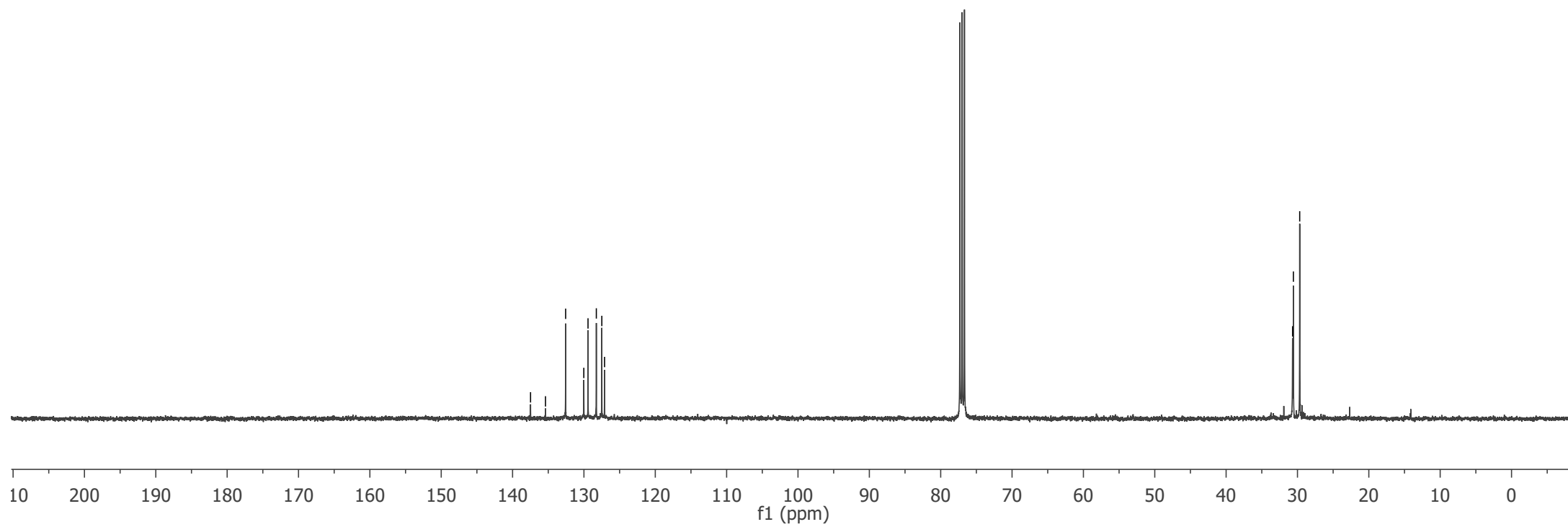
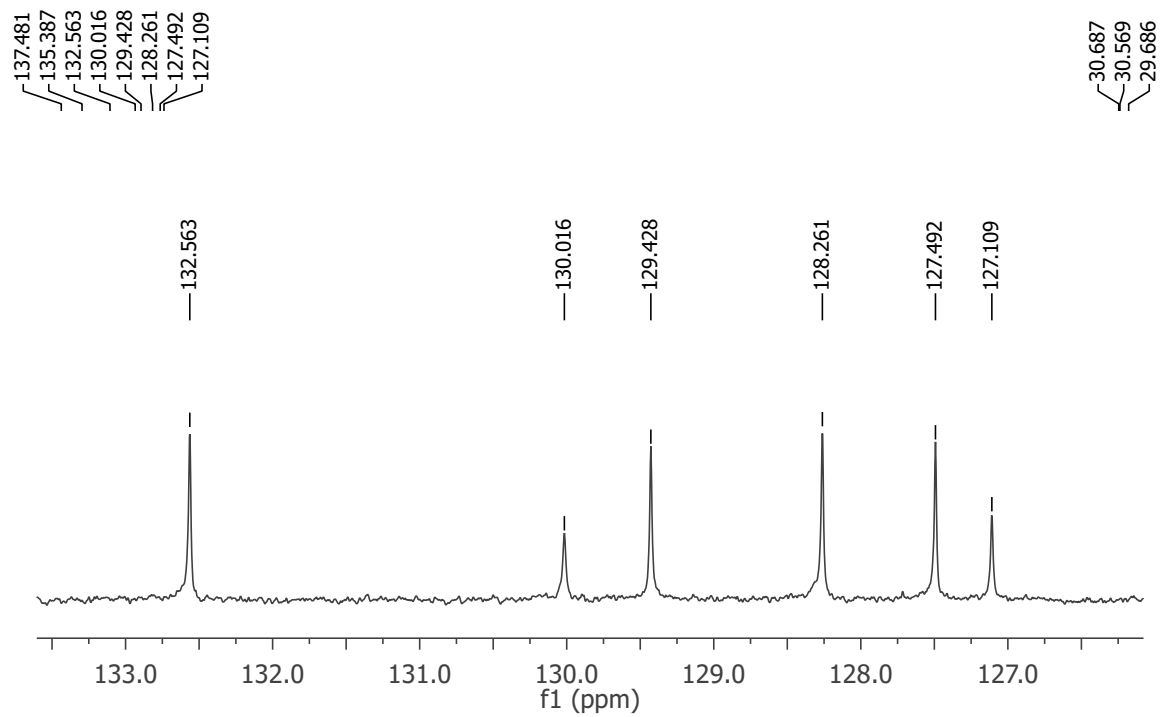
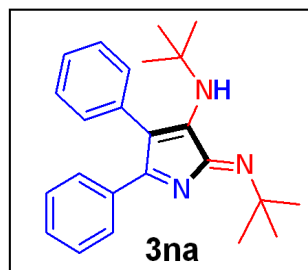
7.449
7.431
7.428
7.312
7.294
7.289
7.279
7.261
7.247
7.241
7.227
7.223
7.161
7.142
7.123

—1.546

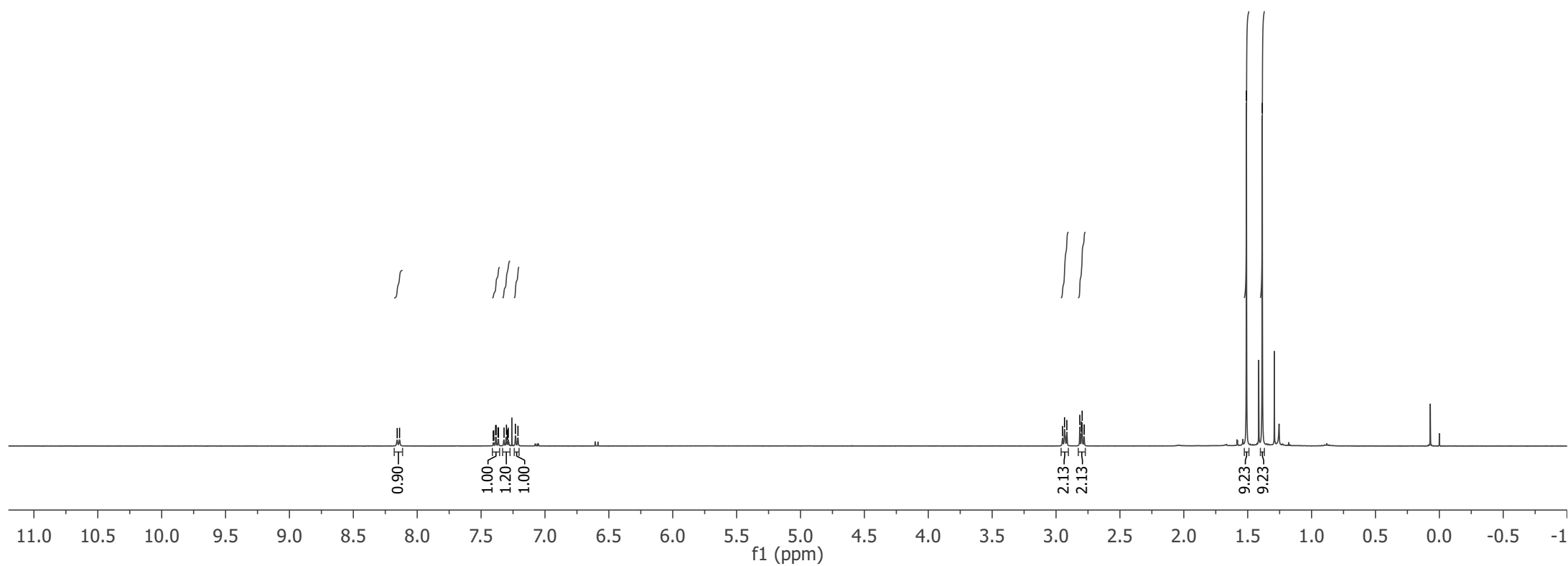
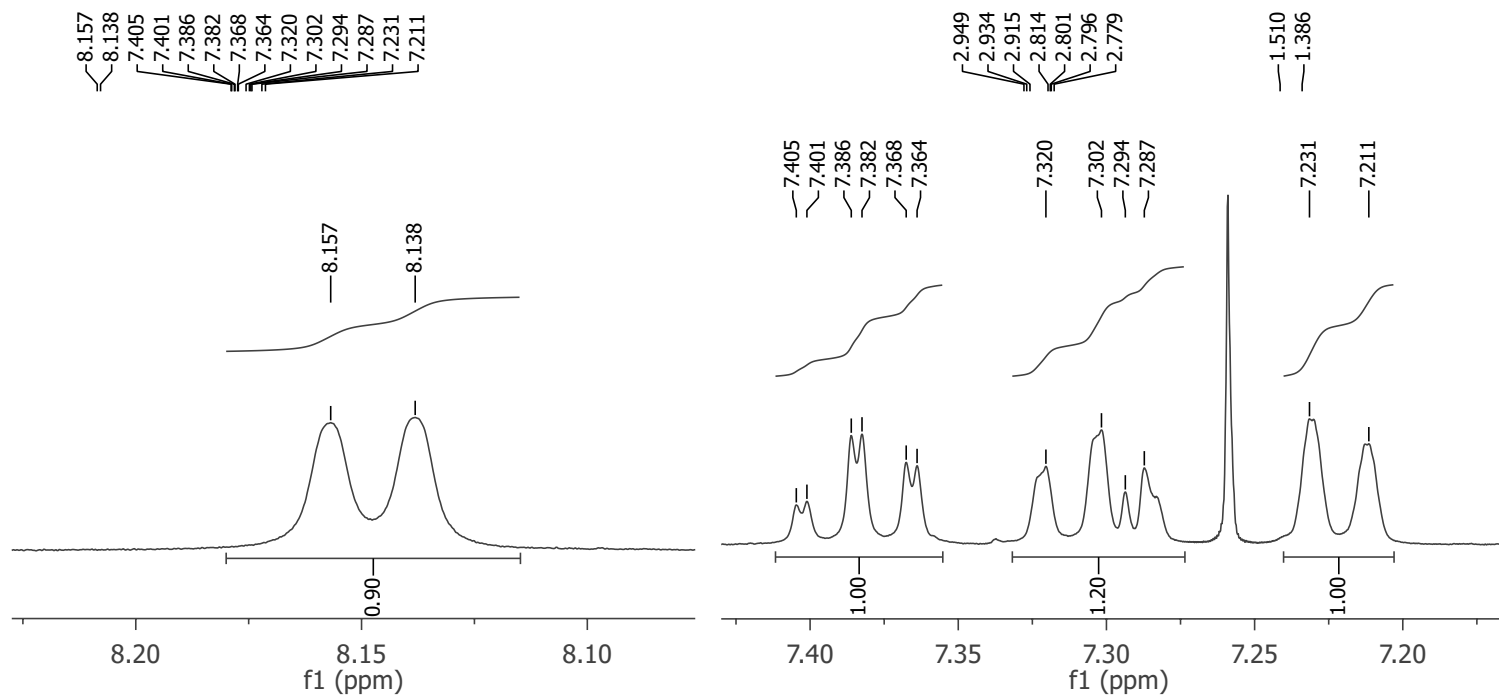
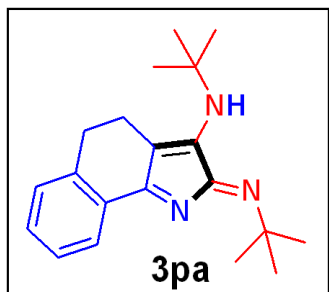
—1.068

S52

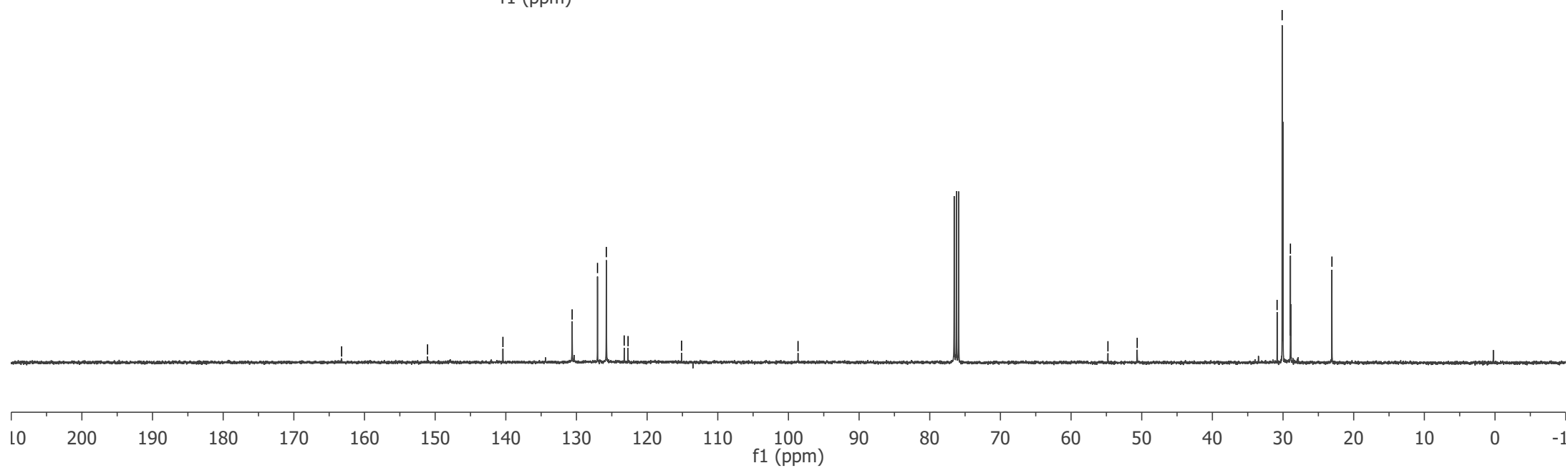
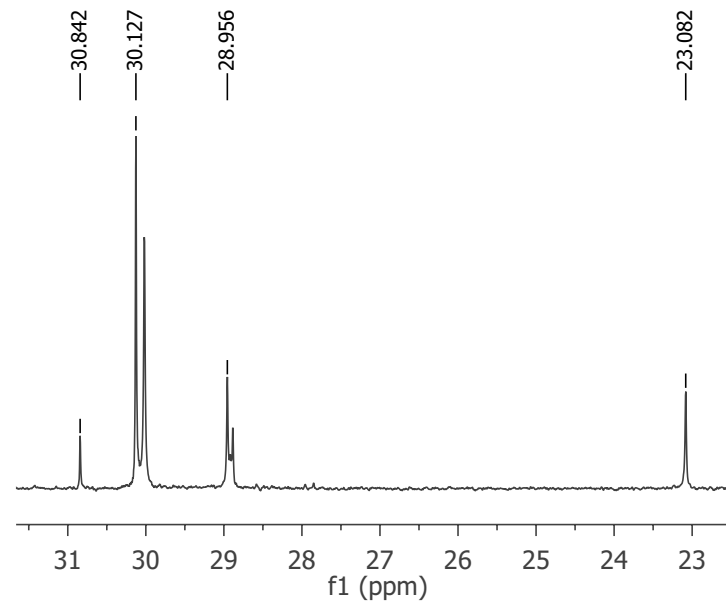
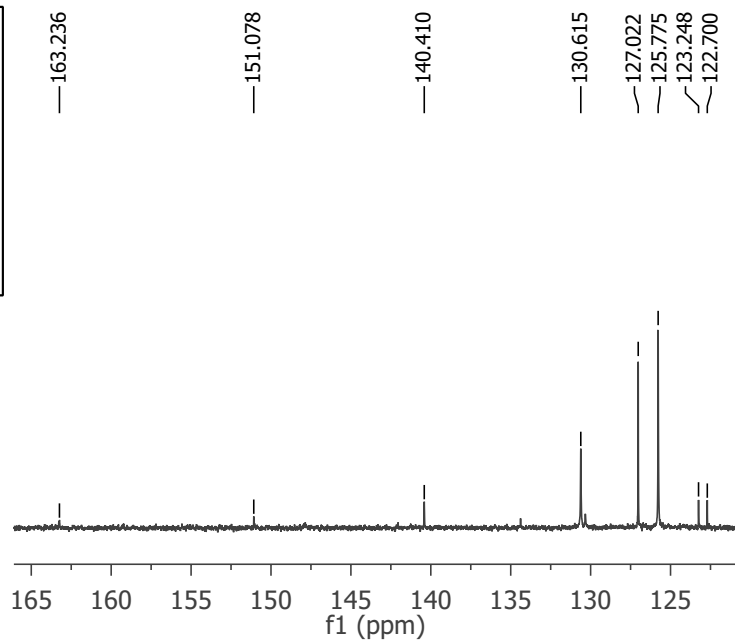
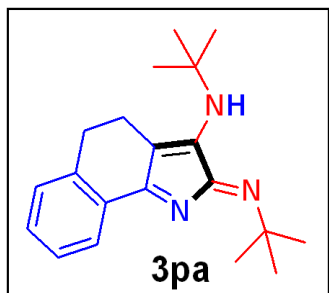




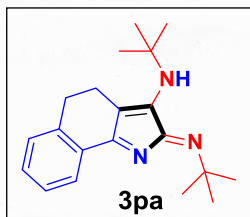
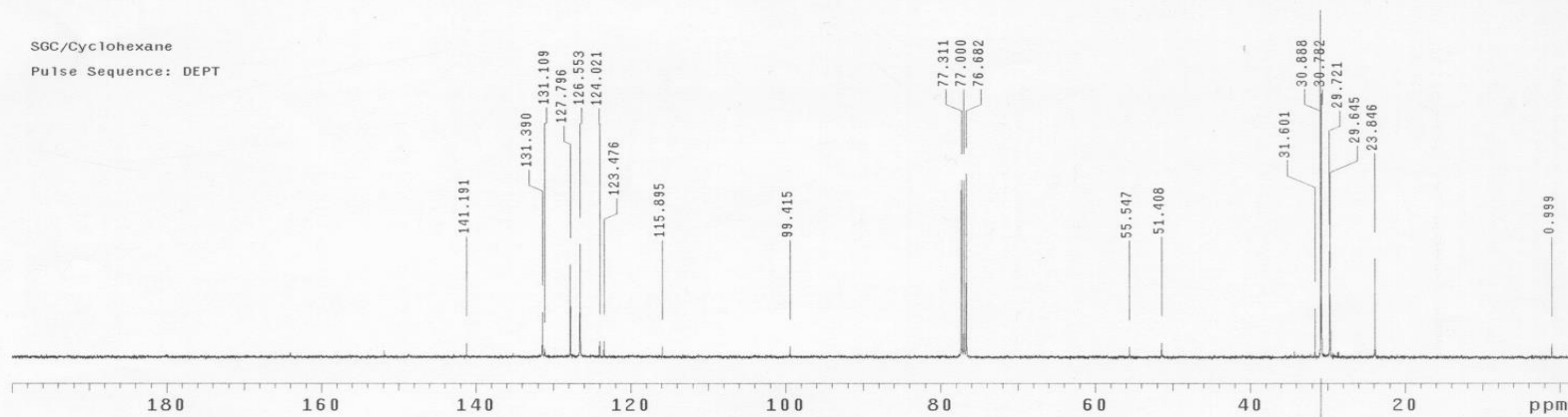
Solvent CDCl_3
Spectrometer Frequency 400.28



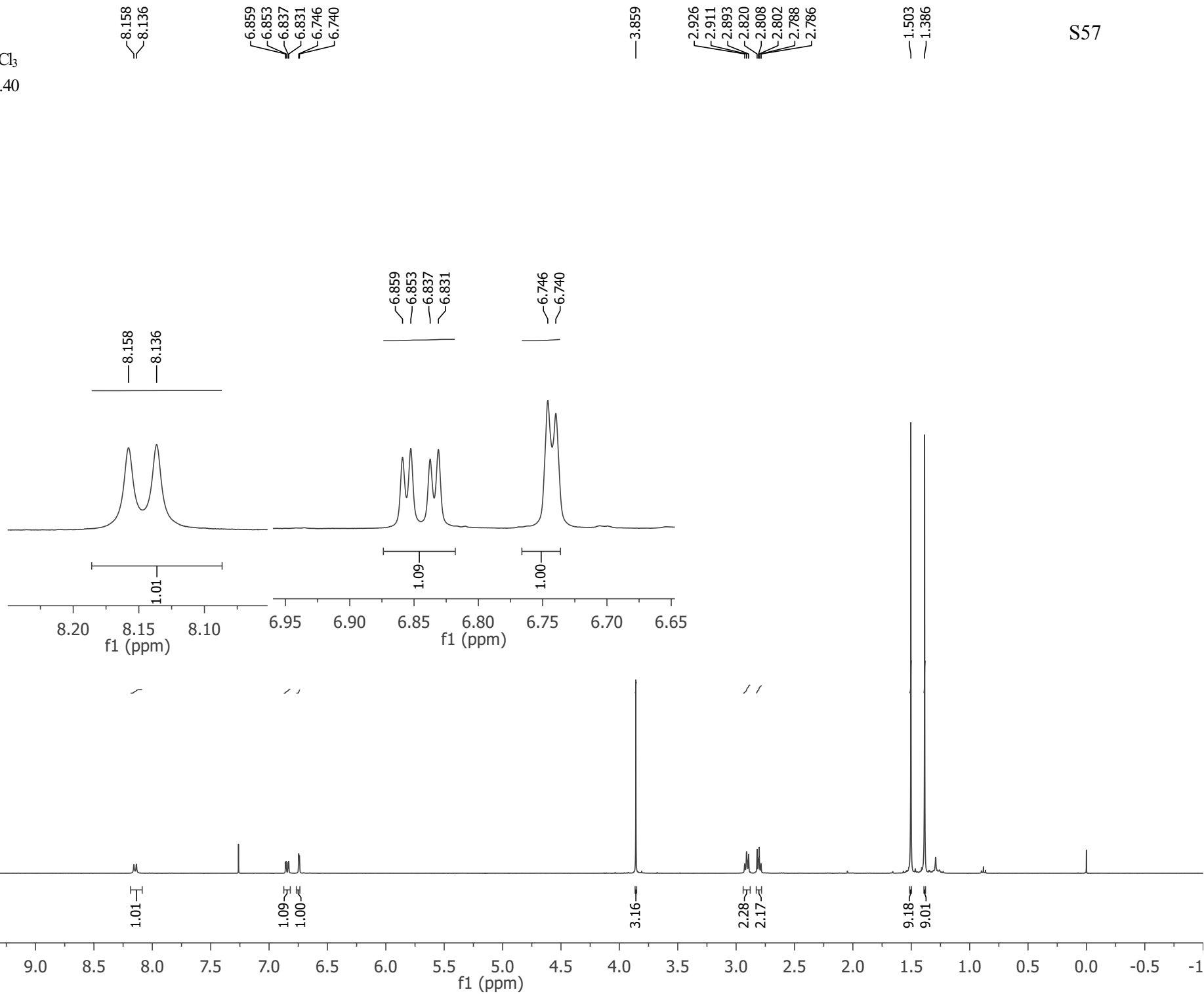
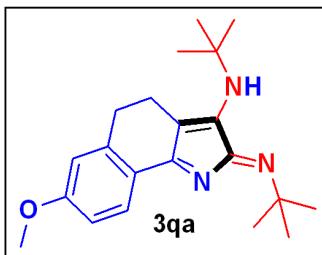
Solvent CDCl_3
Spectrometer Frequency 100.66



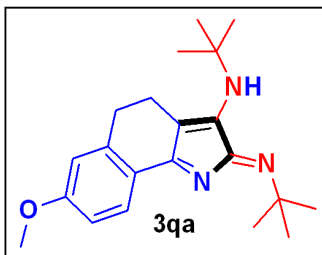
SGC/Cyclohexane
Pulse Sequence: DEPT



Solvent CDCl_3
Spectrometer Frequency 400.40

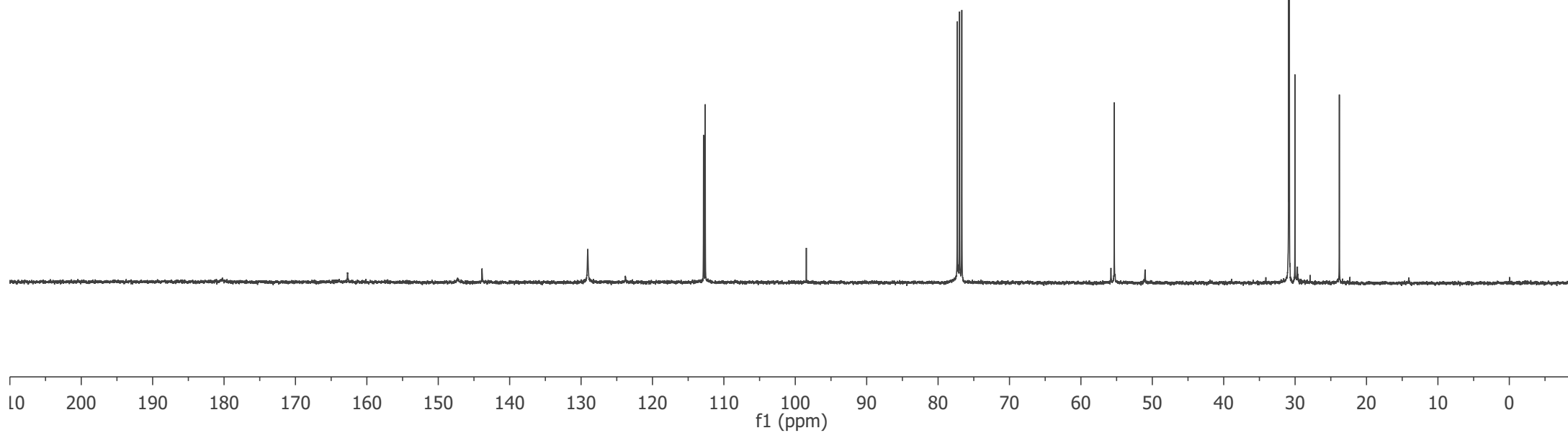


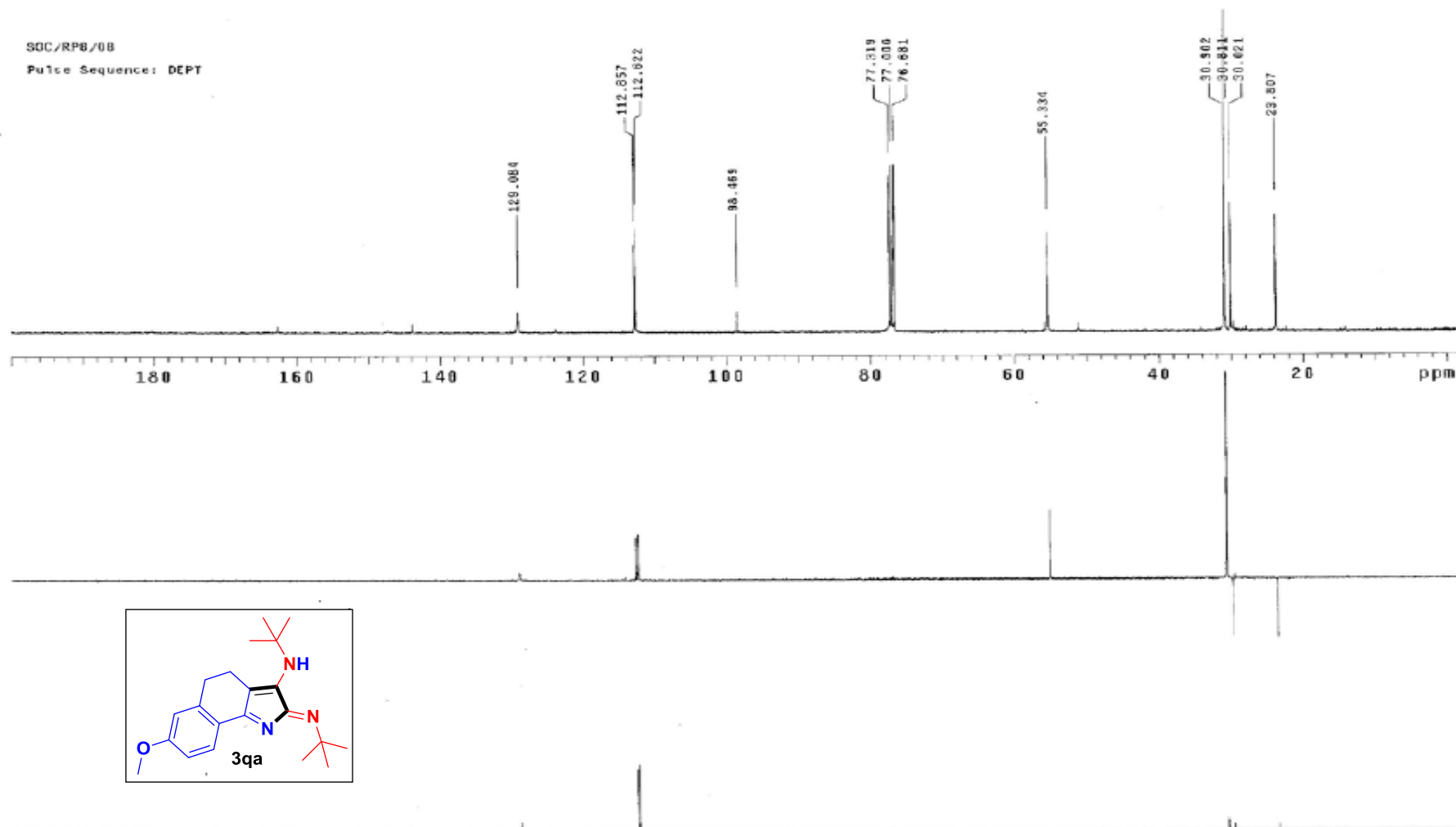
Solvent CDCl_3
Spectrometer Frequency 100.69



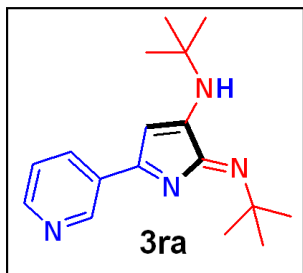
—162.714 —143.865 —129.069 —123.797 —112.847 —112.612 —98.455 —55.787 —55.331 —51.006 —30.897 —30.805 —30.018 —23.805

S58





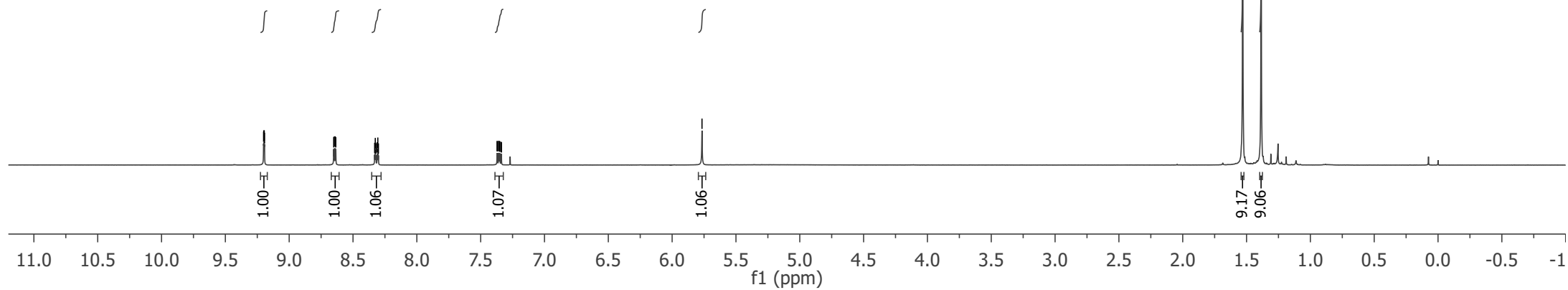
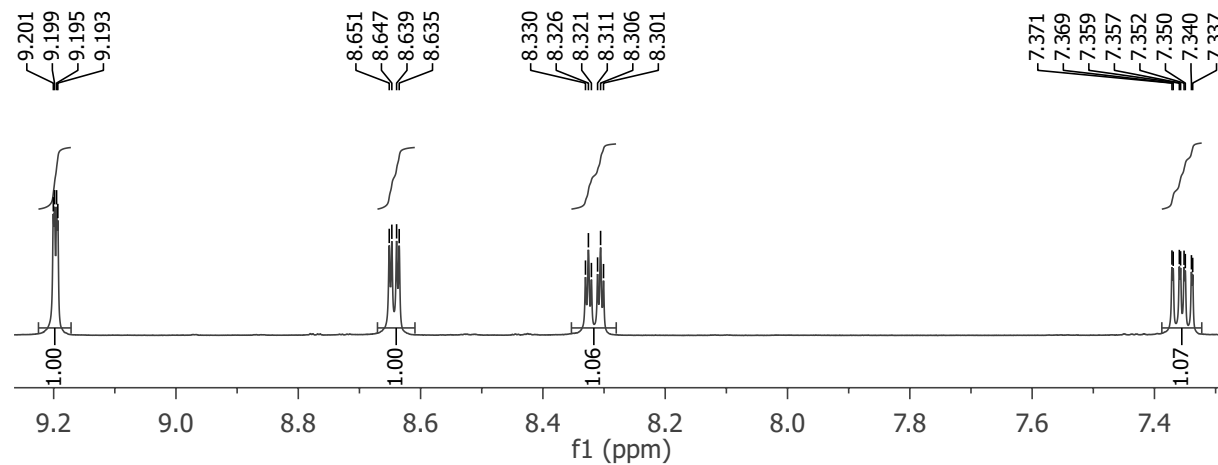
Solvent CDCl_3
Spectrometer Frequency 400.40



9.201
9.199
9.195
9.193
8.651
8.647
8.639
8.330
8.326
8.311
8.306
7.371
7.369
7.359
7.357
7.352
7.350
7.340
7.337

5.766

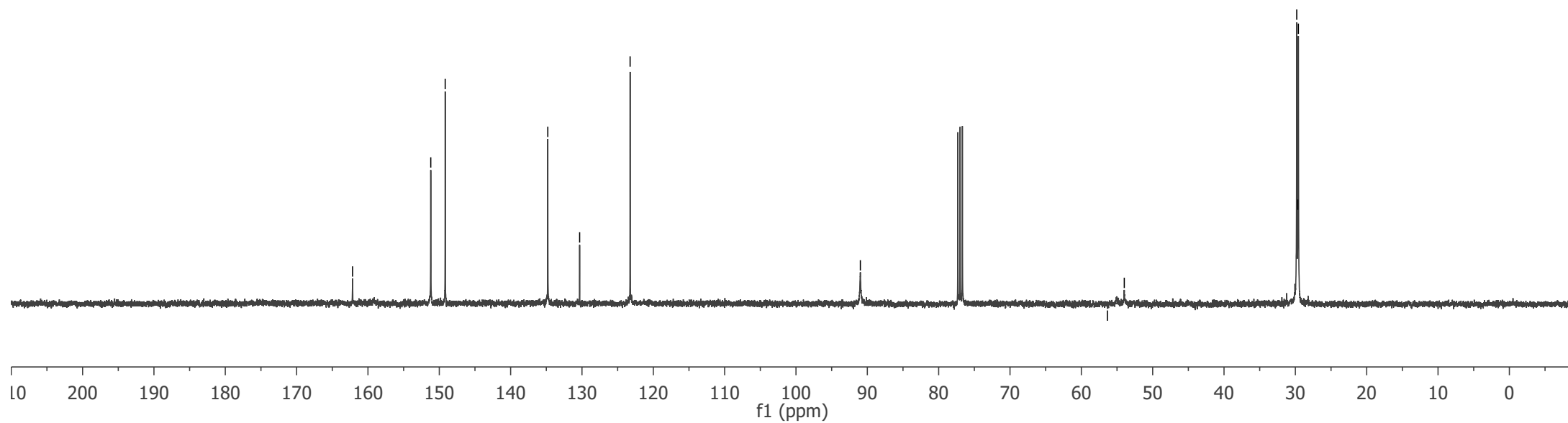
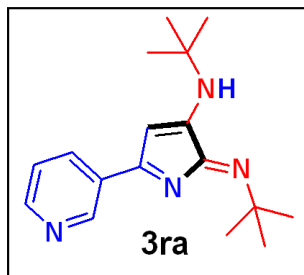
1.530
1.385

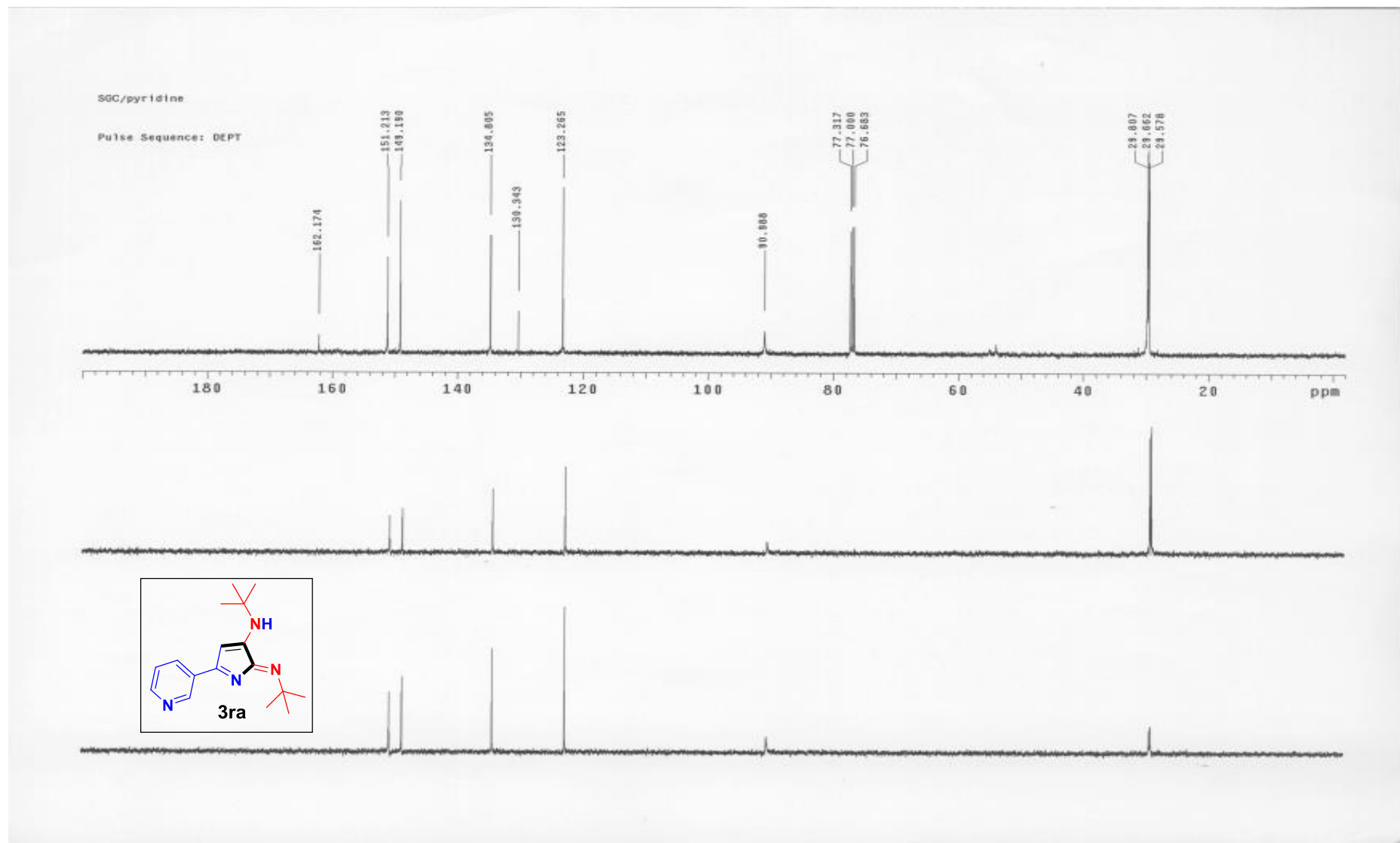


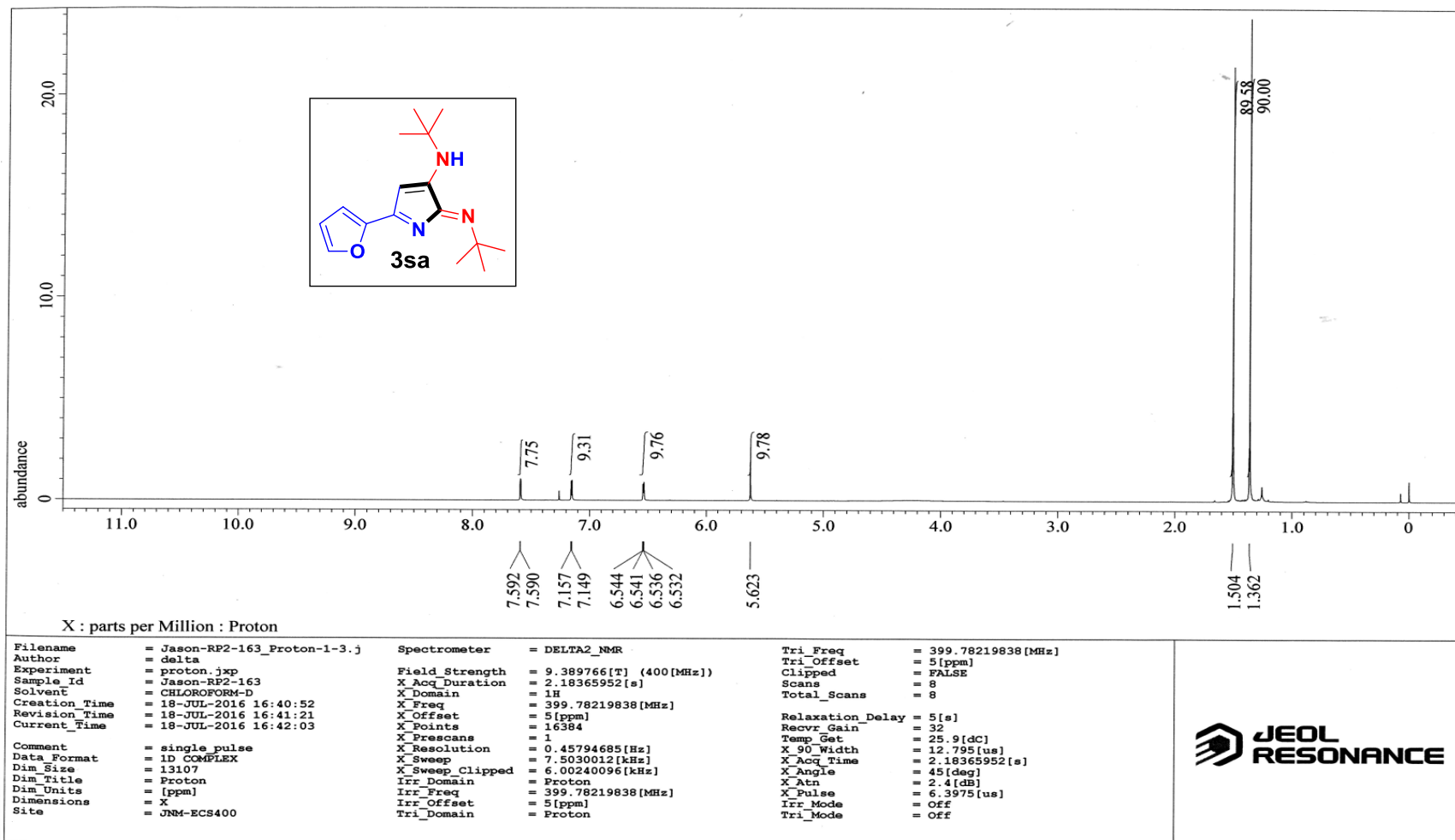
Solvent CDCl_3
Spectrometer Frequency 100.69

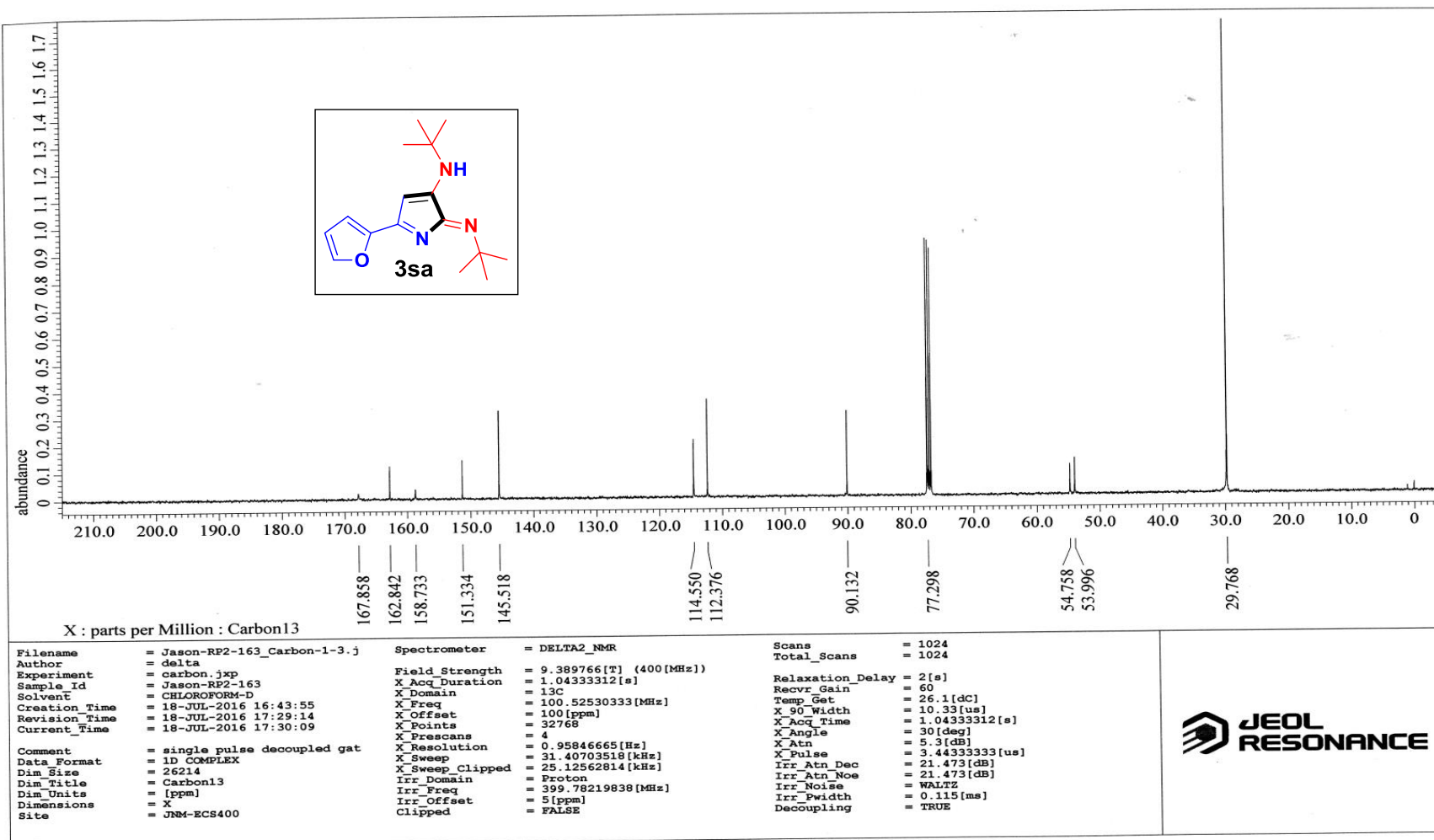
162.156
151.195
149.173
134.790
130.327
123.253
90.977
56.348
53.980
29.806
29.658
29.576

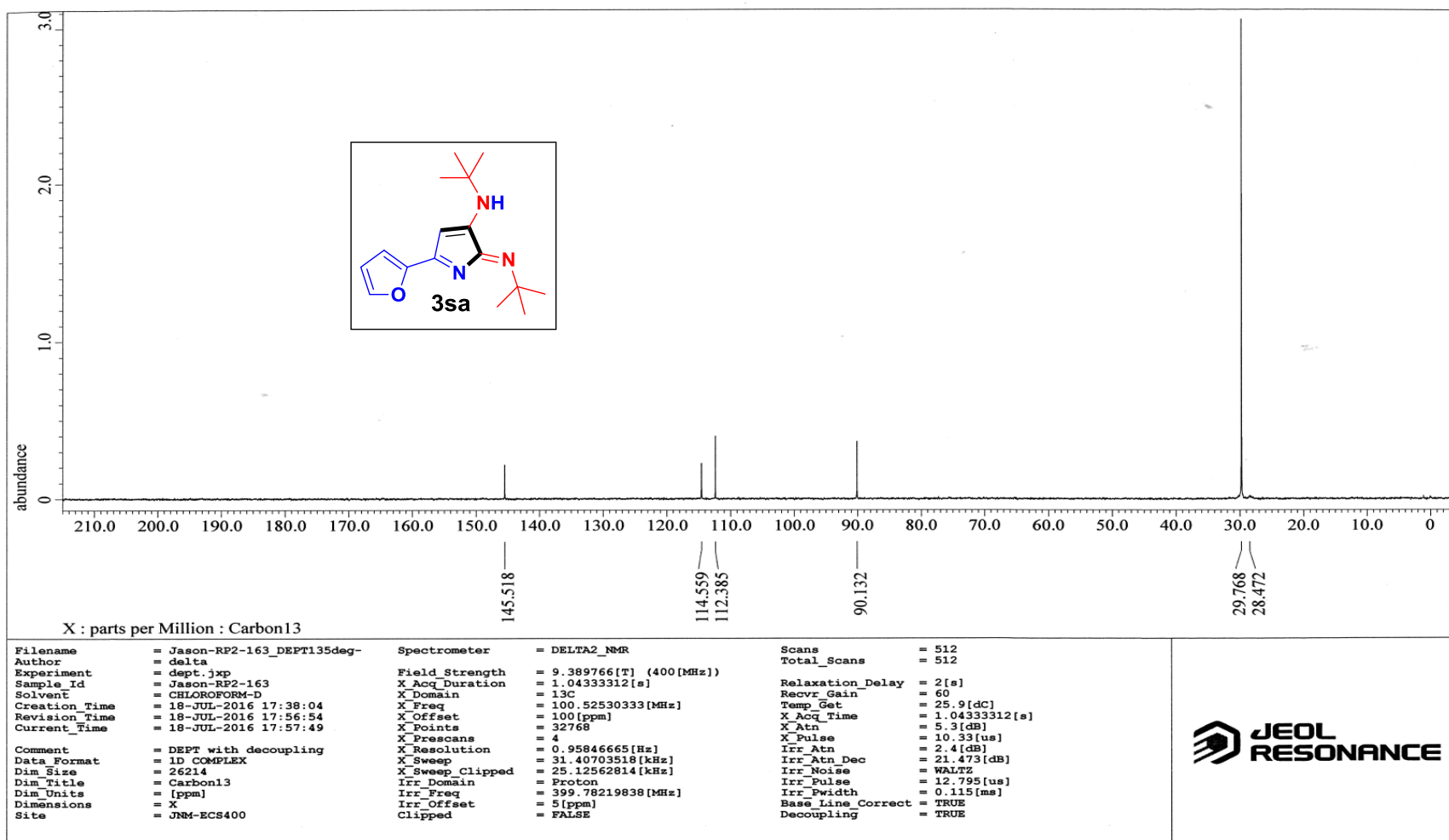
S61



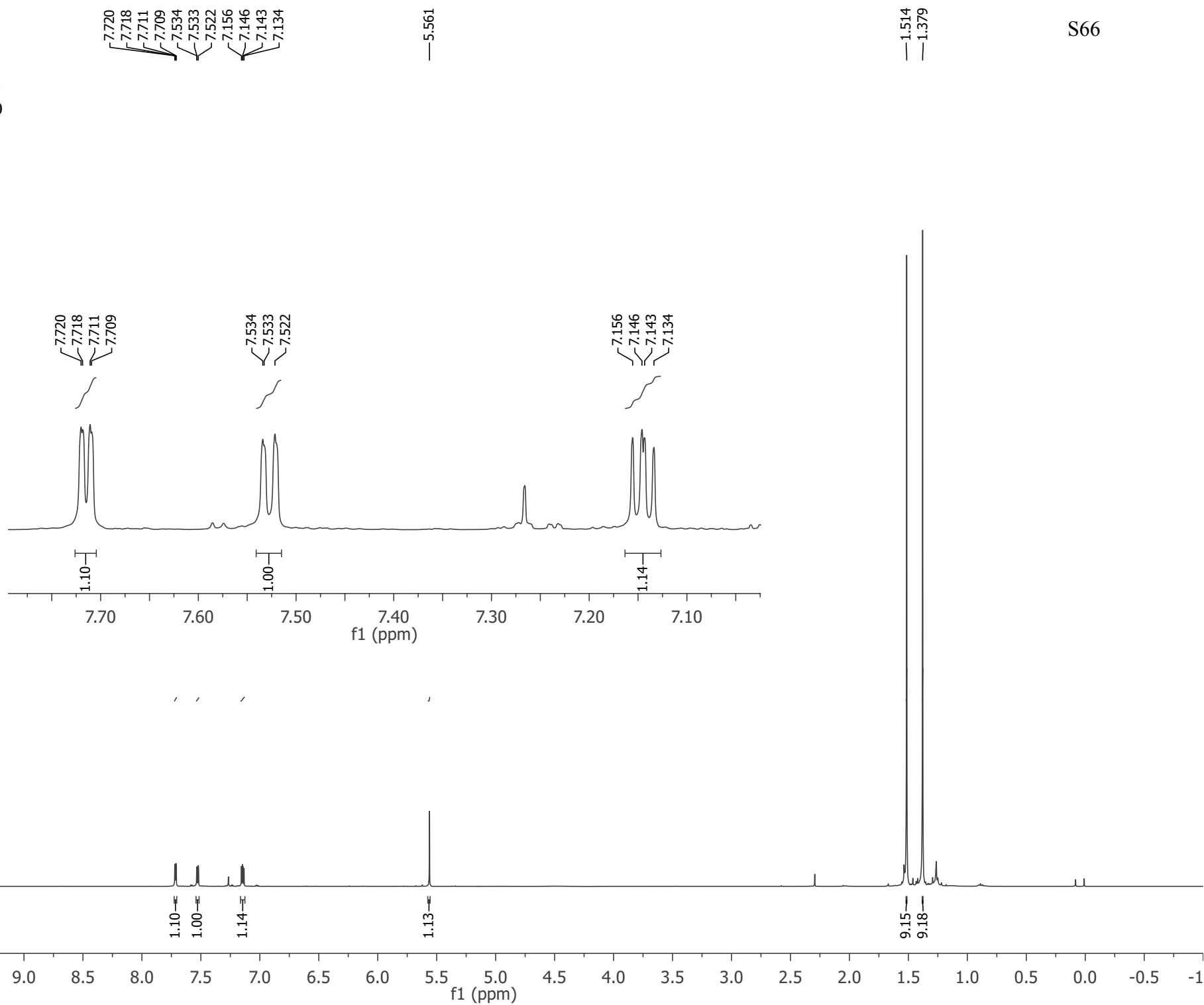
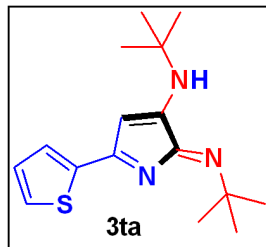




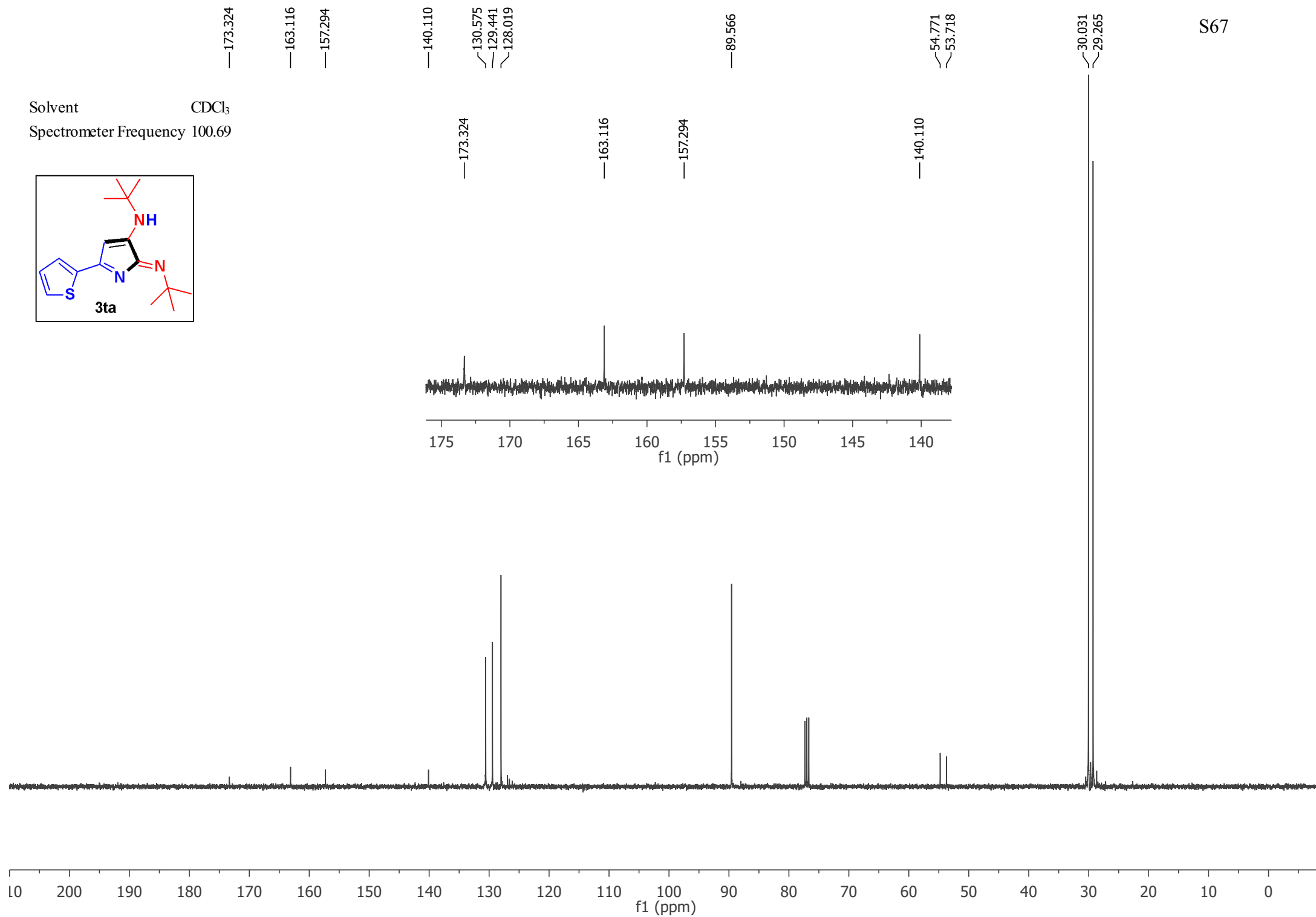
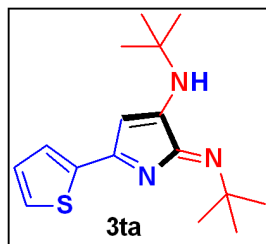


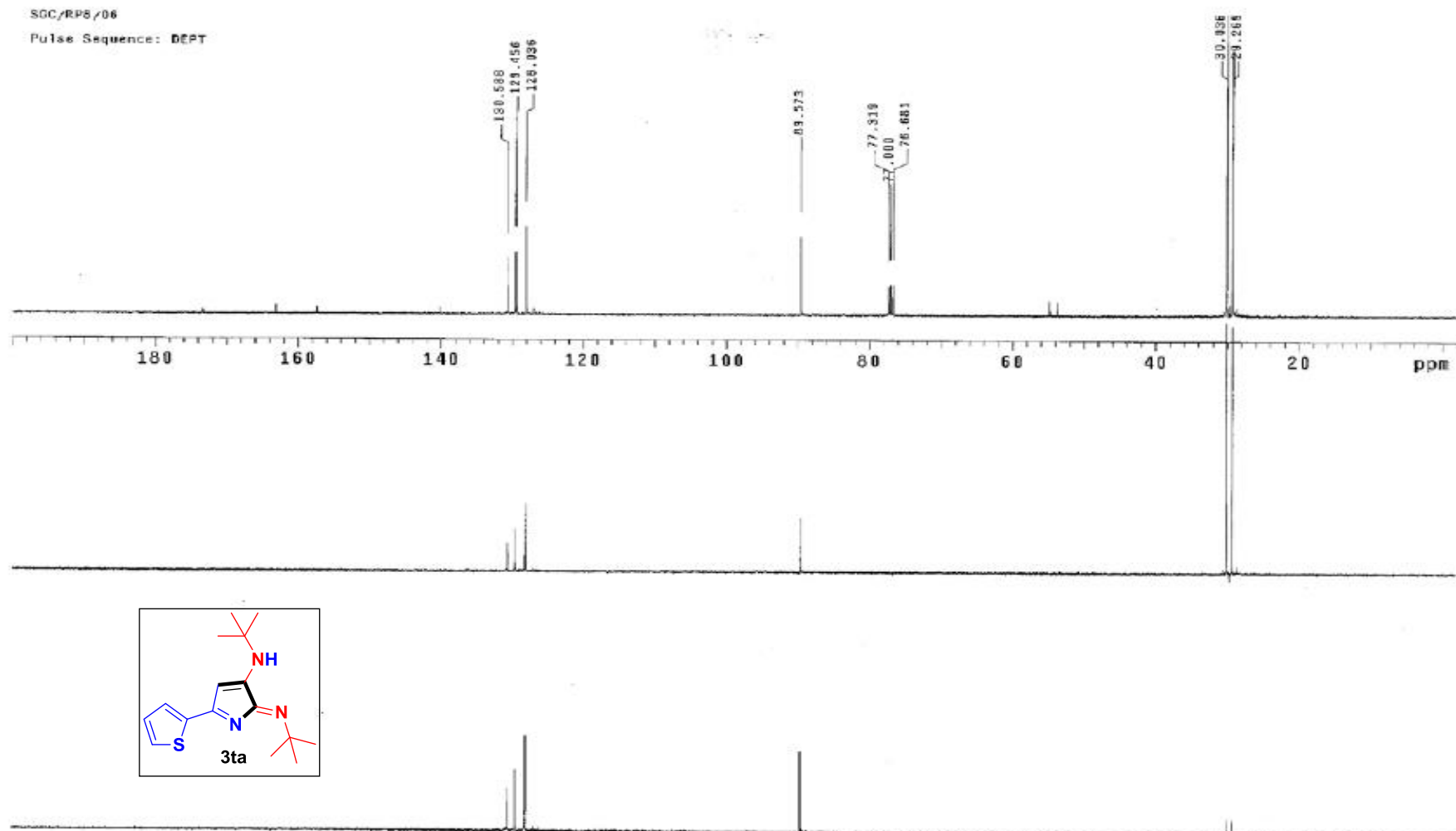


Solvent CDCl_3
Spectrometer Frequency 400.40

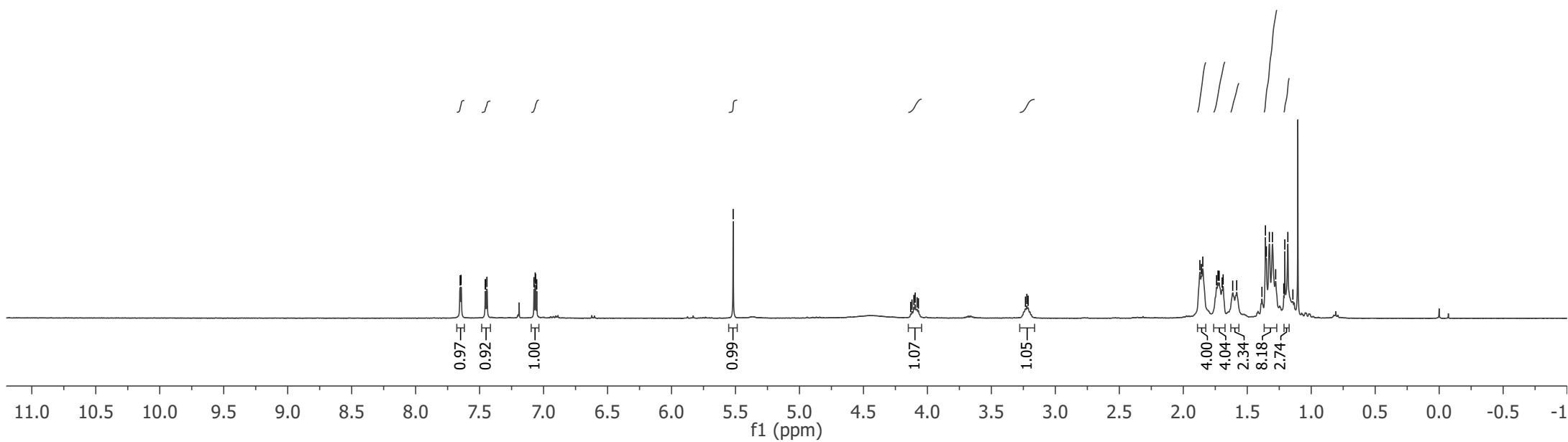
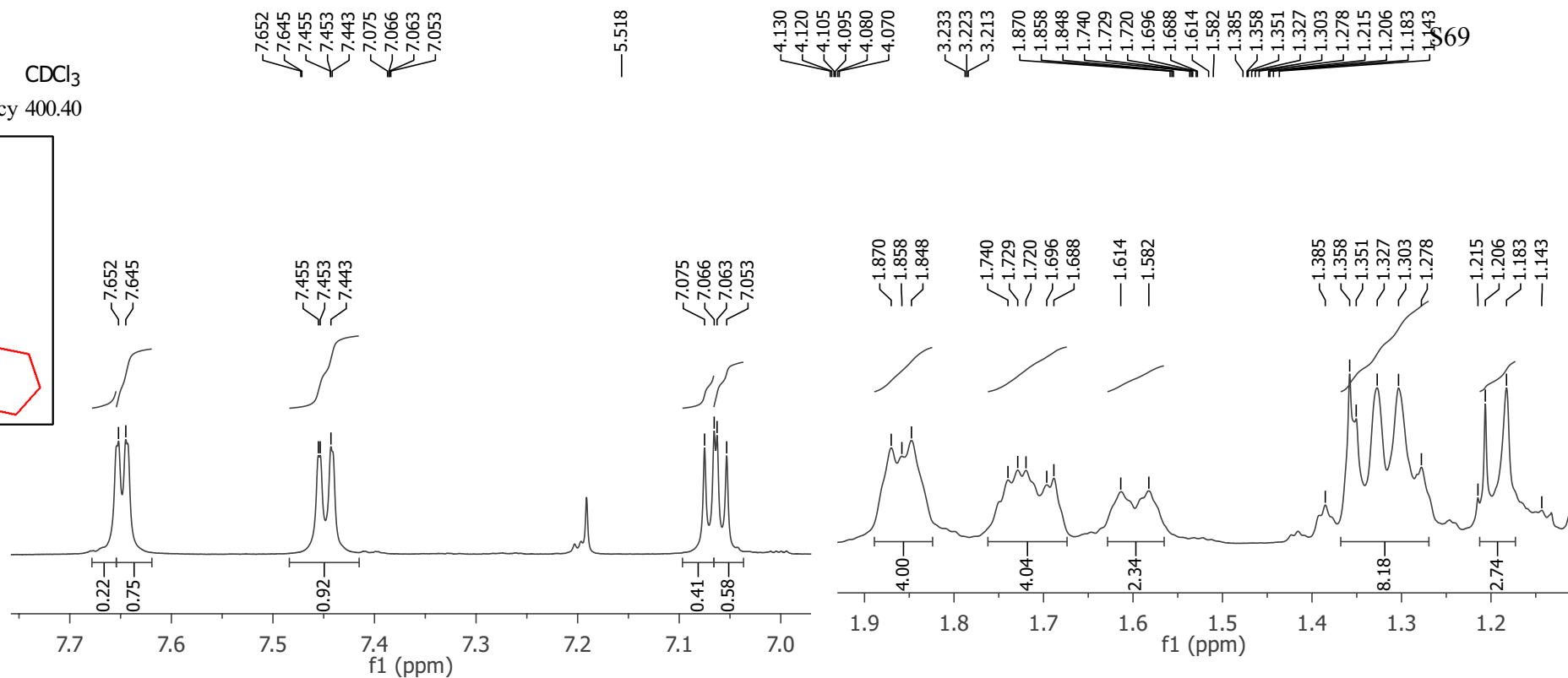
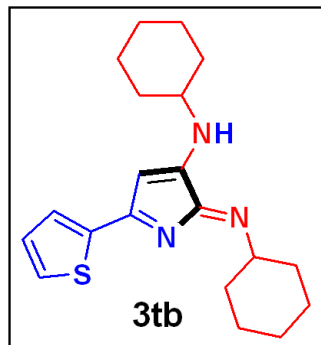


Solvent CDCl_3
Spectrometer Frequency 100.69

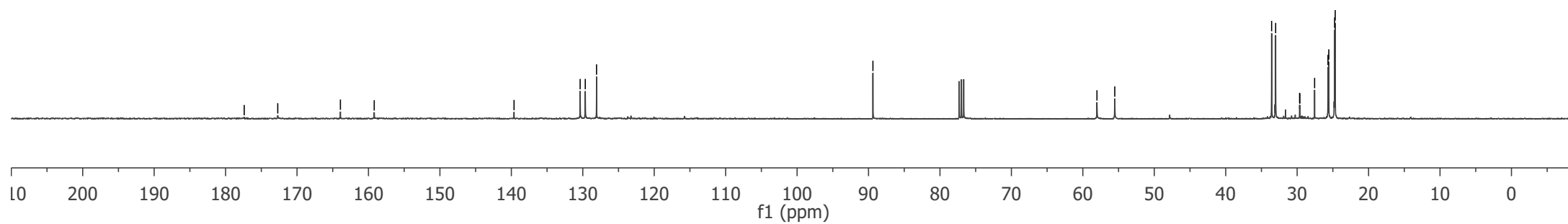
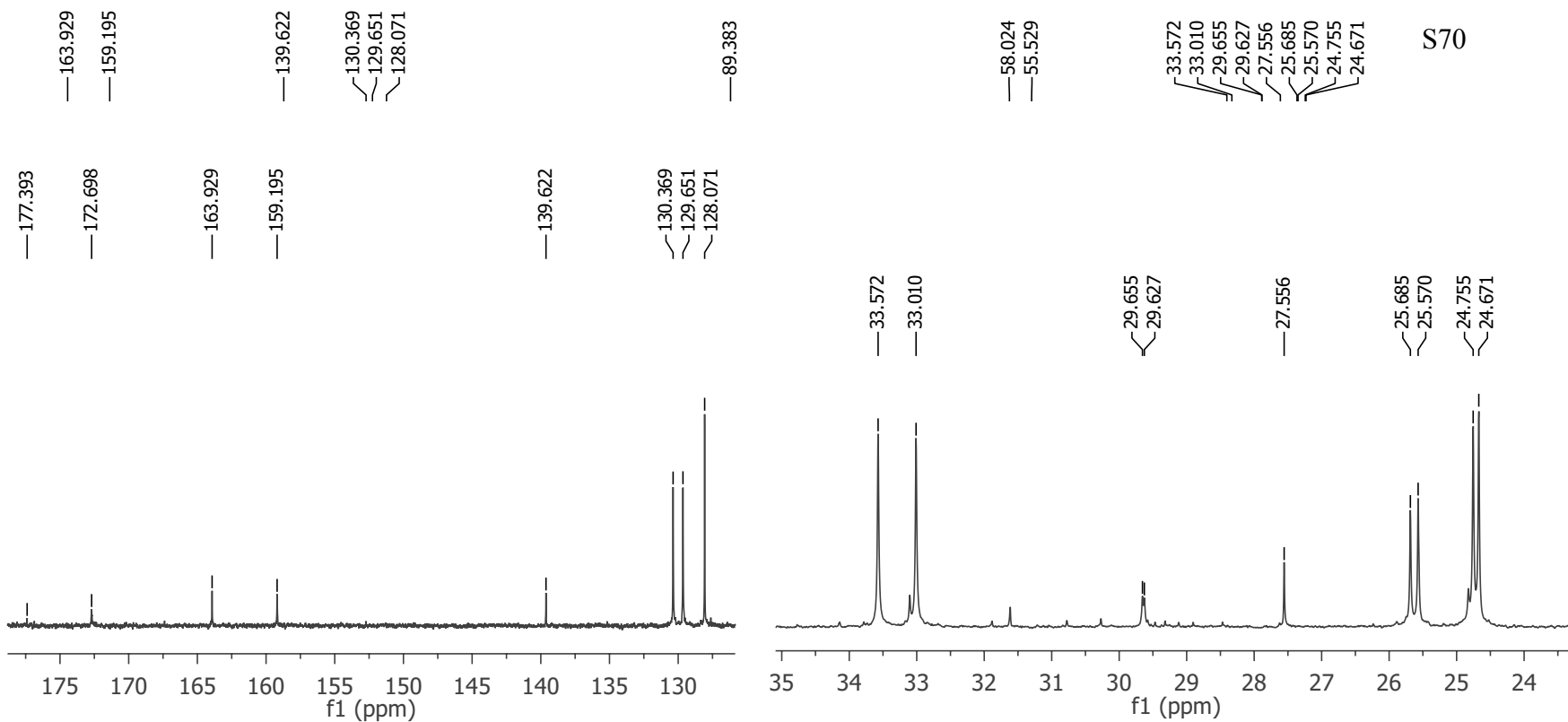
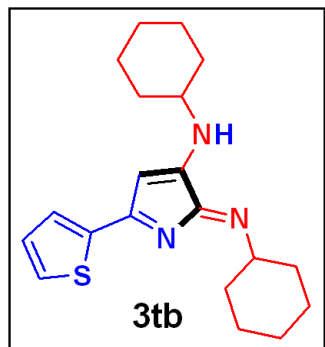


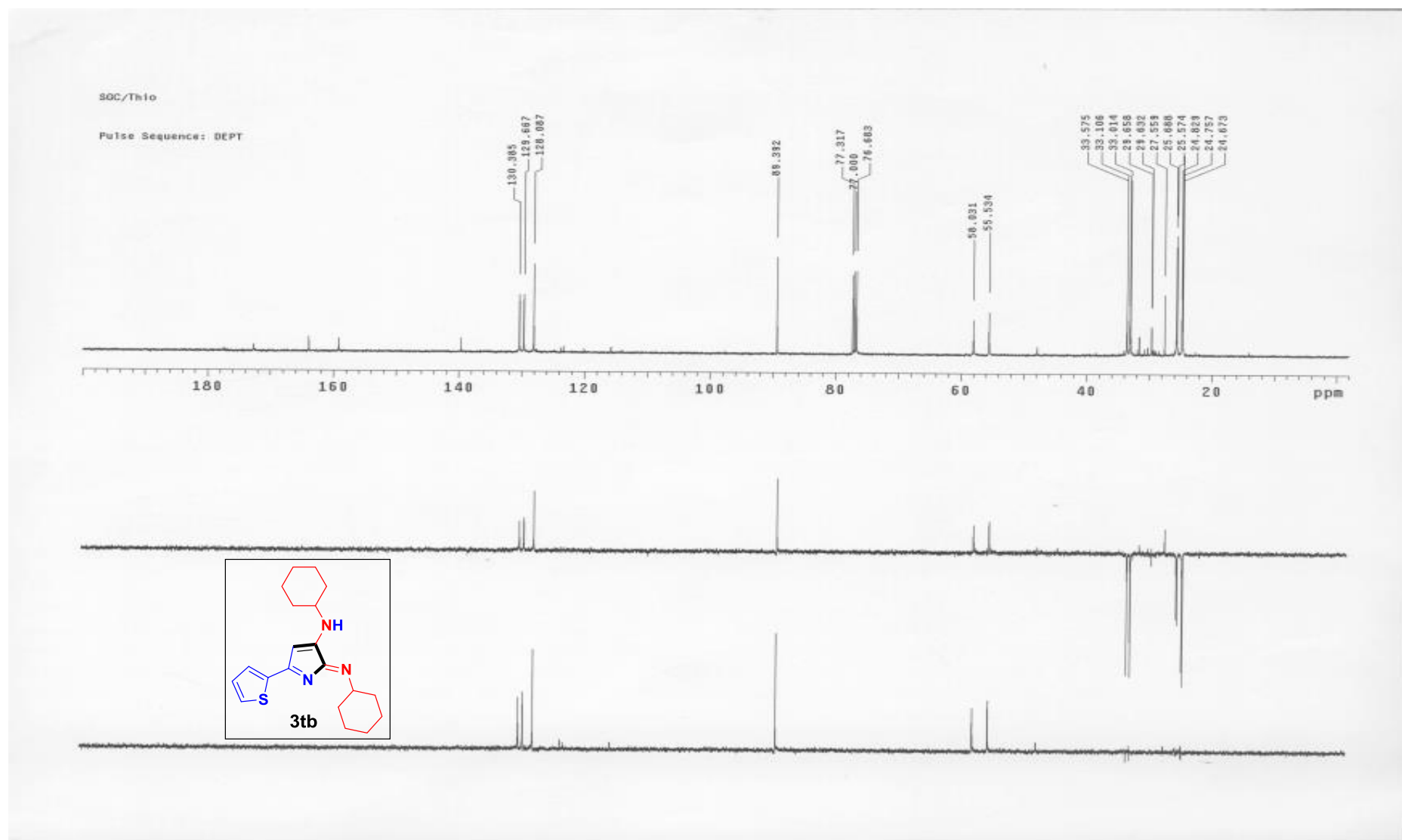


Solvent CDCl_3
Spectrometer Frequency 400.40

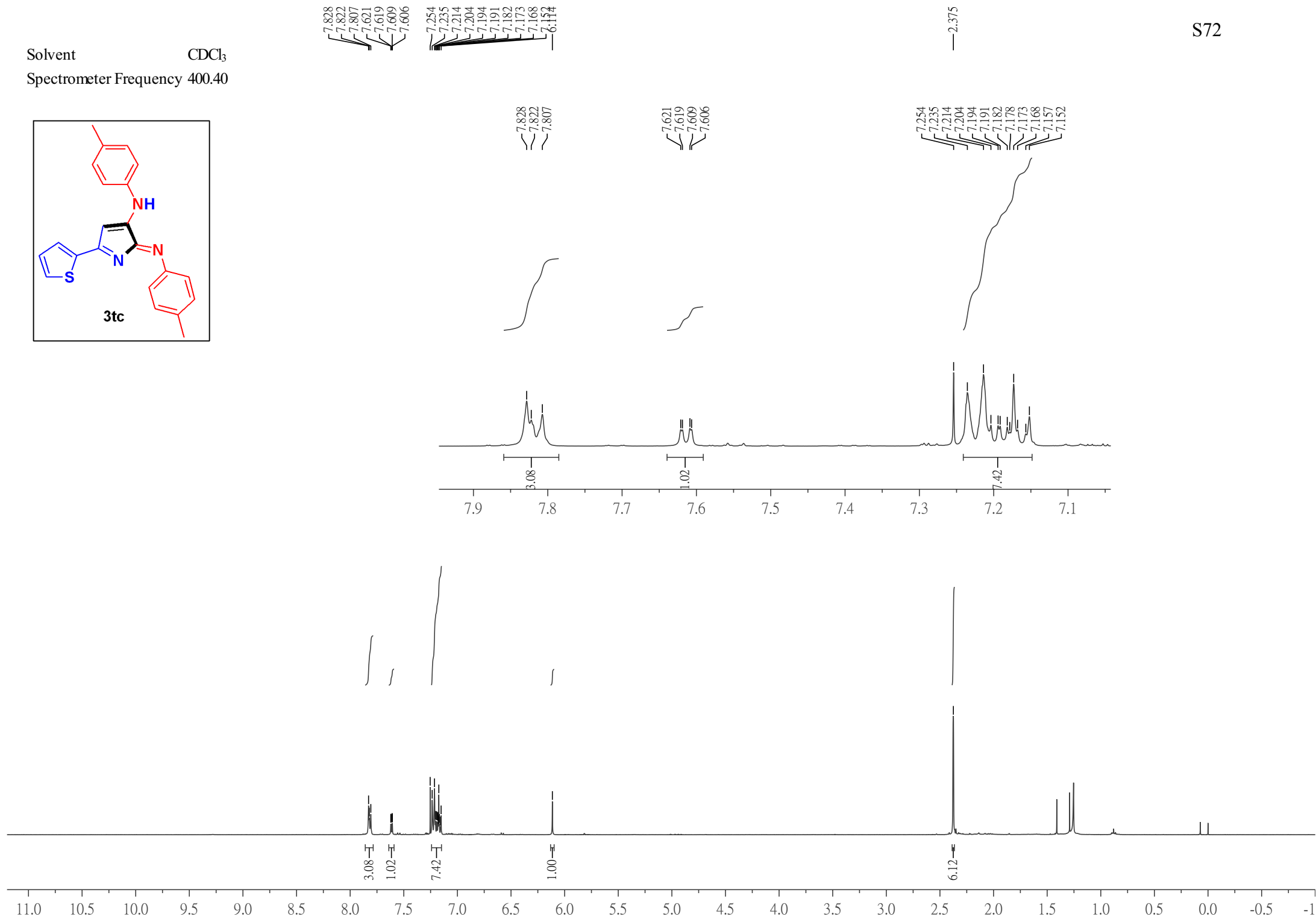
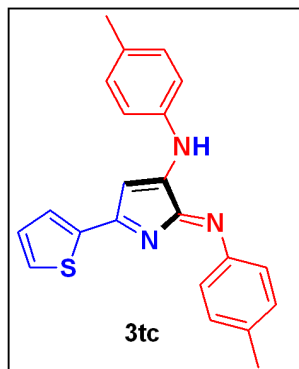


Solvent CDCl_3
Spectrometer Frequency 100.69

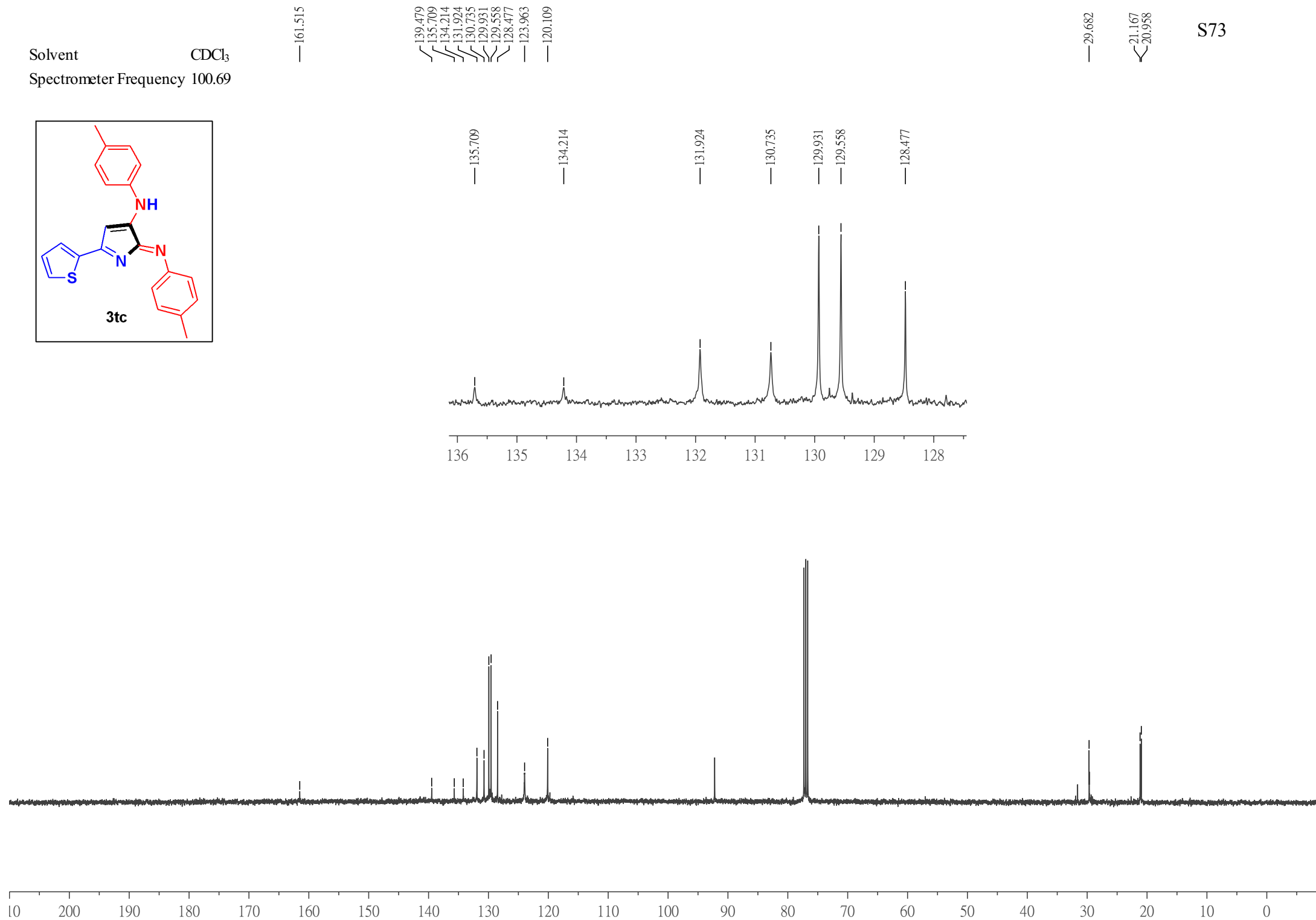
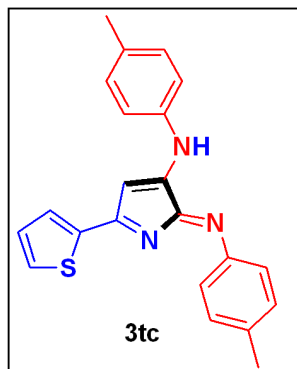




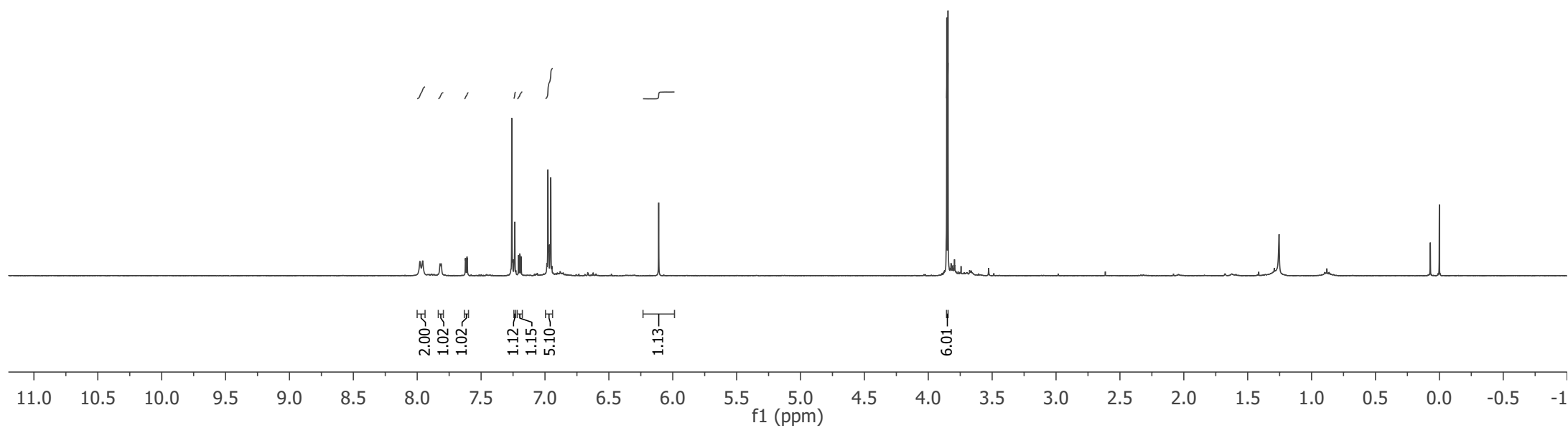
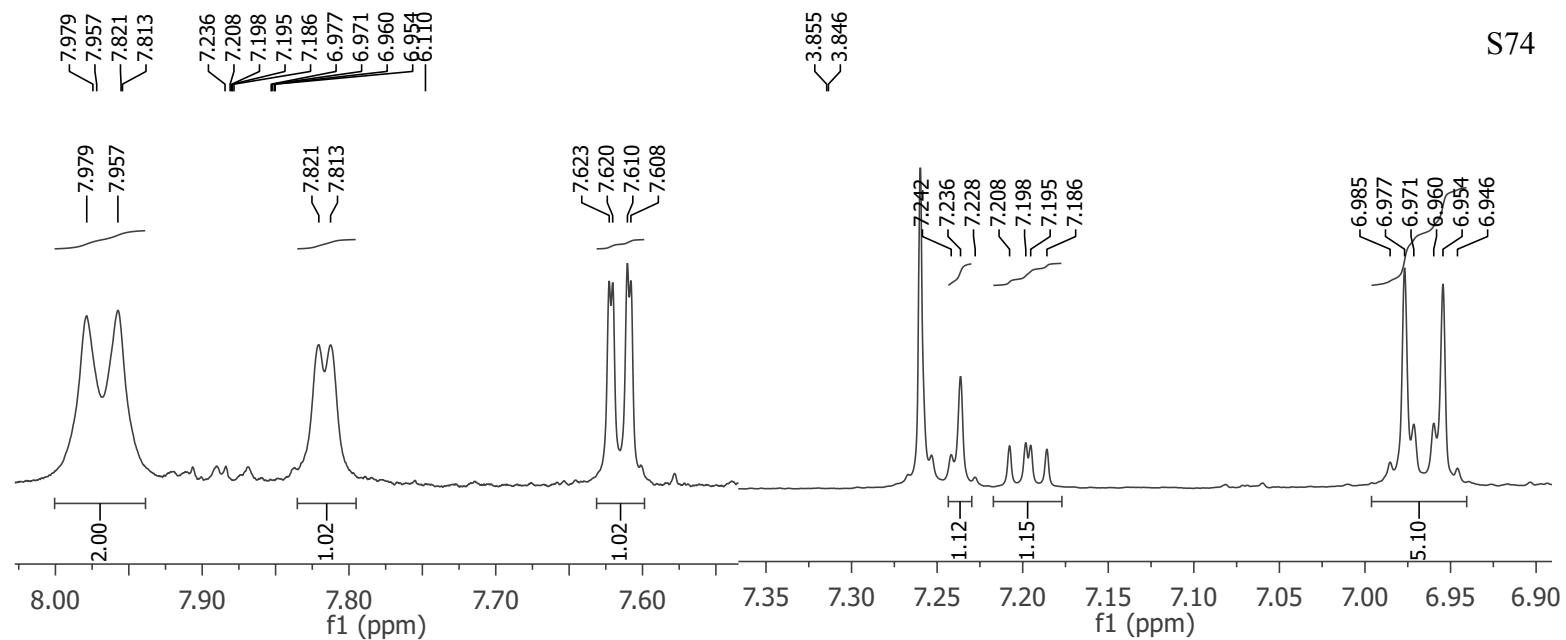
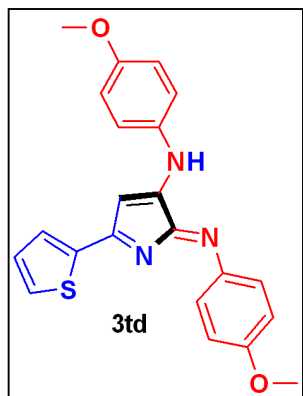
Solvent CDCl_3
Spectrometer Frequency 400.40



Solvent CDCl_3
Spectrometer Frequency 100.69



Solvent CDCl_3
Spectrometer Frequency 400.40



Solvent CDCl_3
Spectrometer Frequency 100.69

158.025

131.780

130.608

128.457

126.428

121.604

114.688

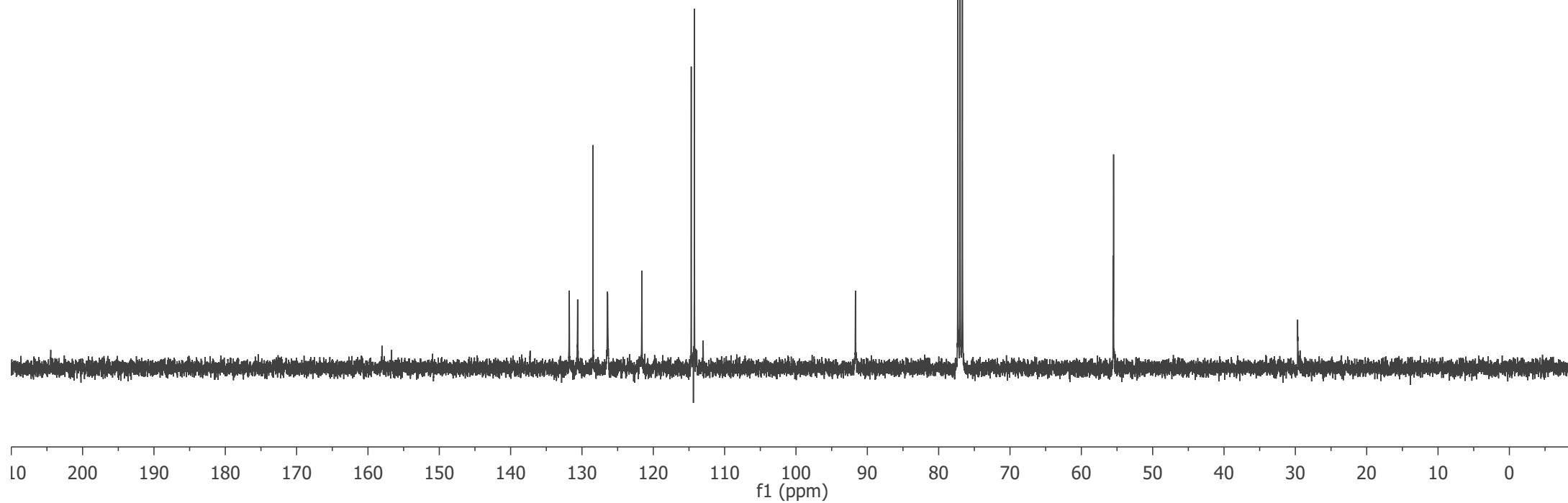
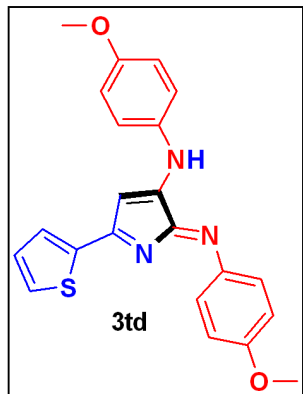
114.232

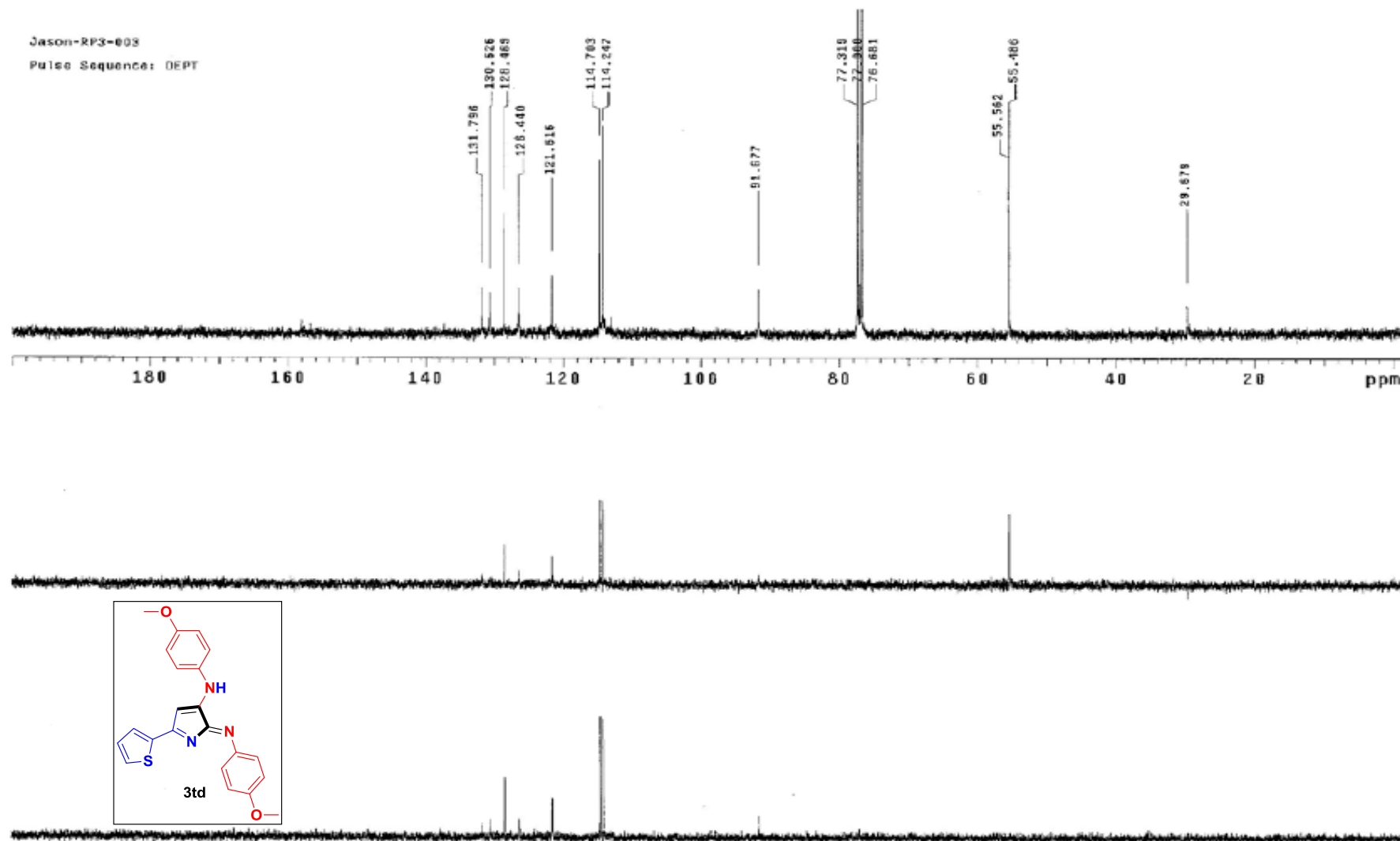
91.667

55.556

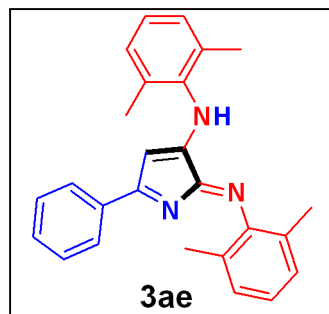
55.478

S75





Solvent CDCl_3
Spectrometer Frequency 400.40

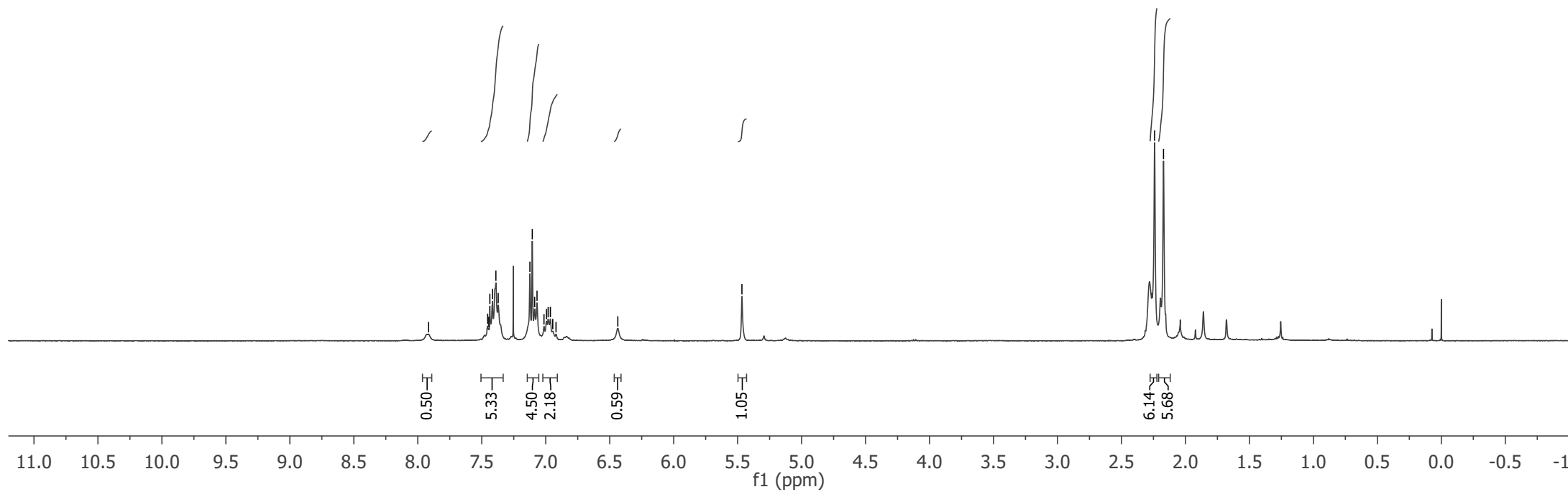
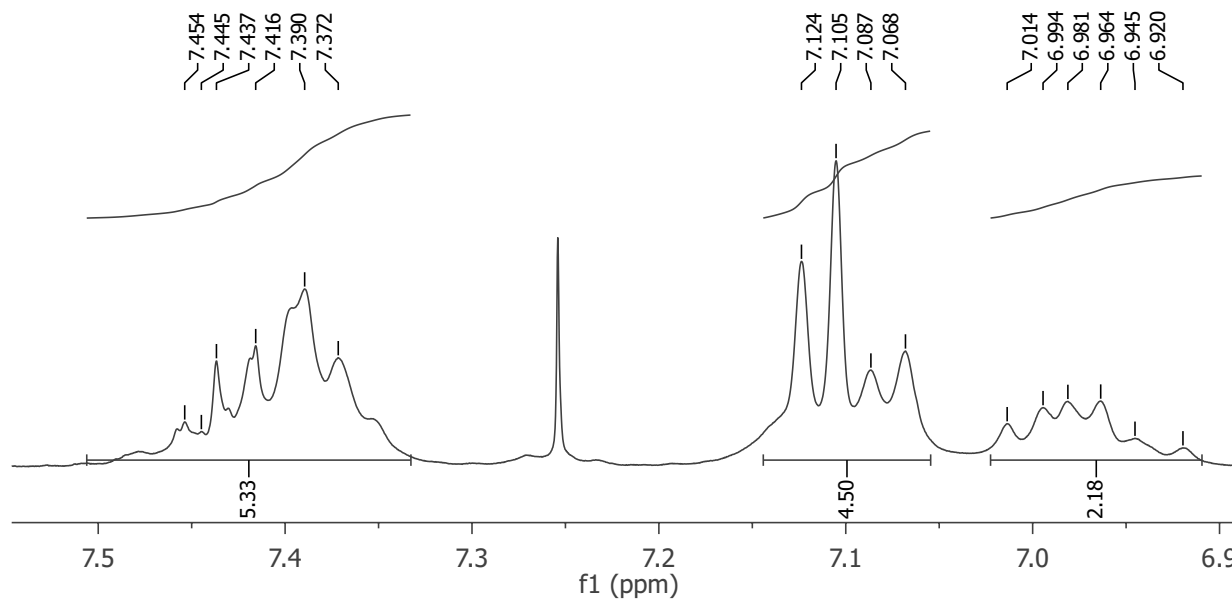


7.917
7.437
7.416
7.390
7.372
7.124
7.105
7.087
7.068
6.954
6.937

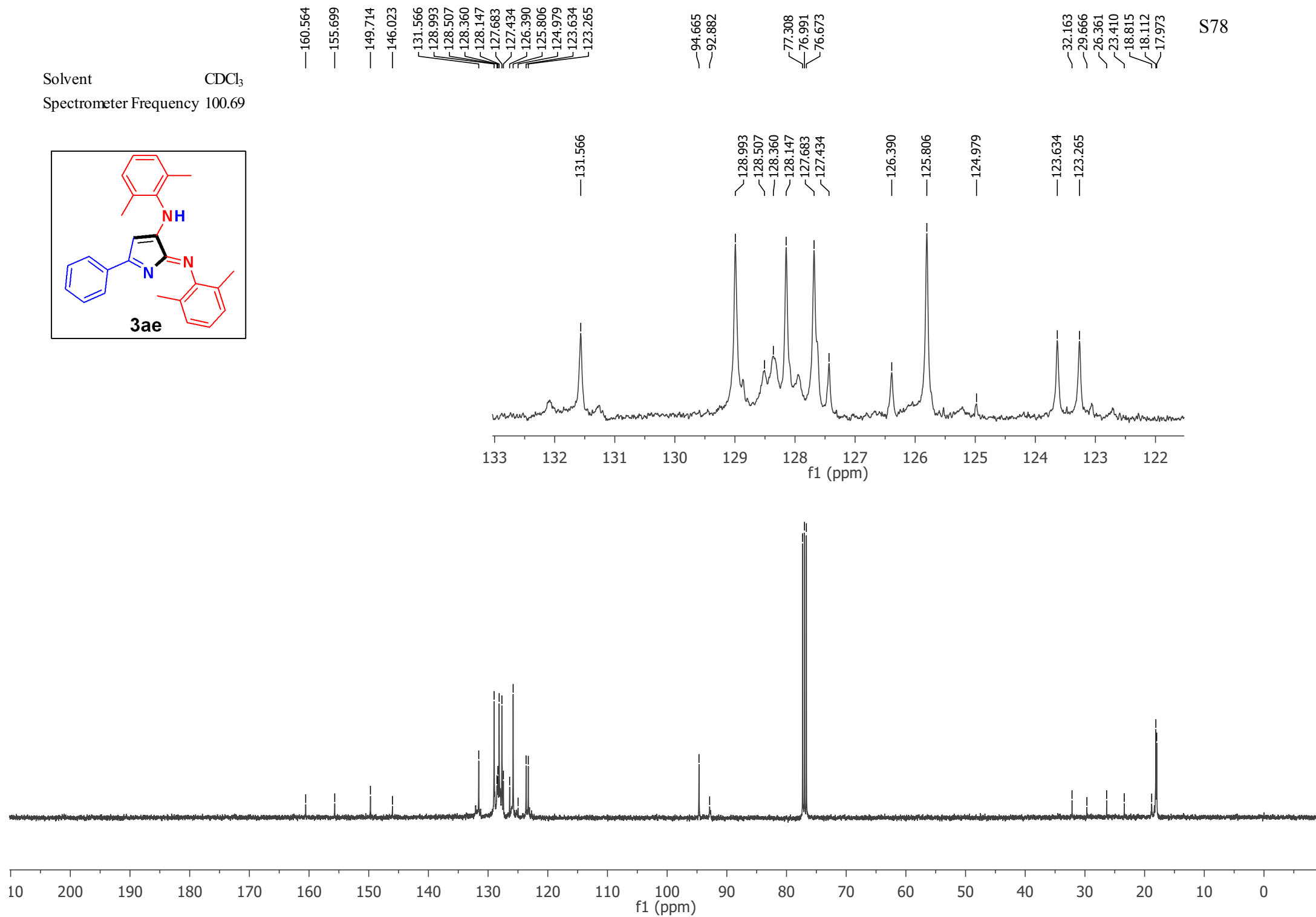
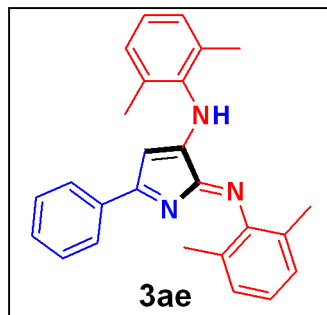
5.466

2.241
2.171

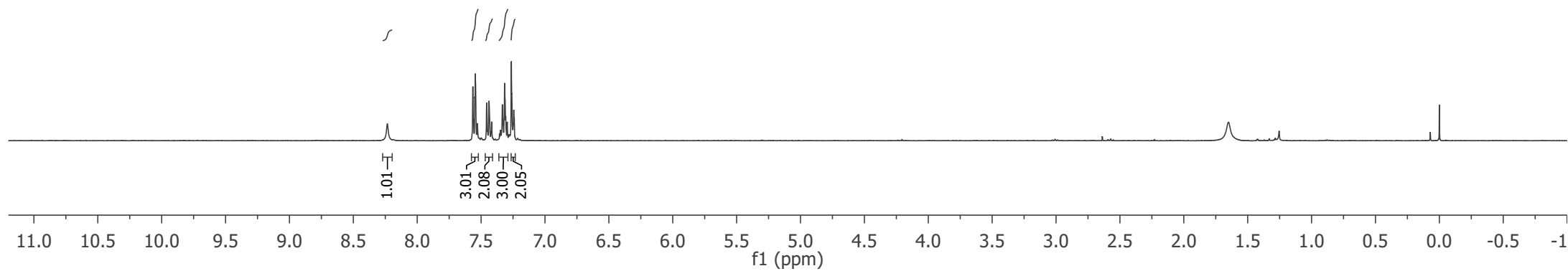
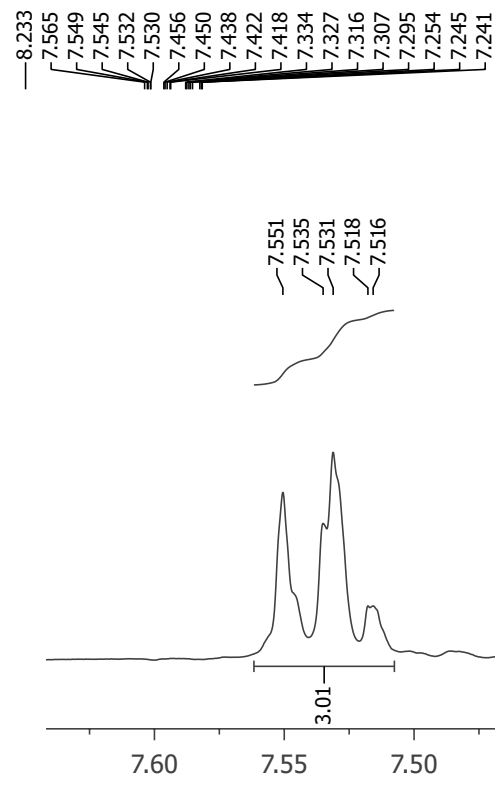
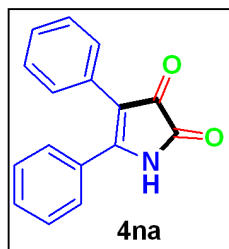
S77



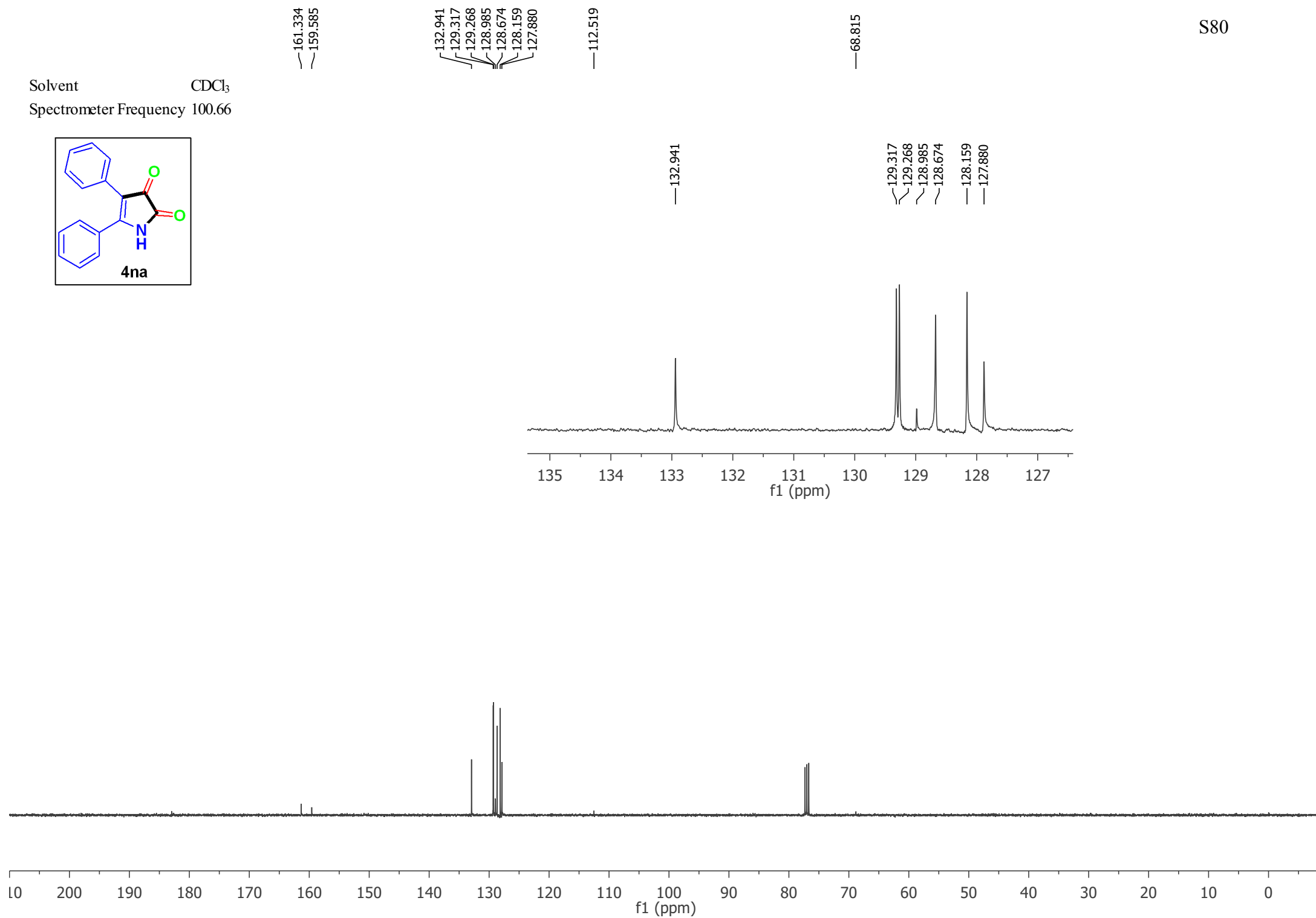
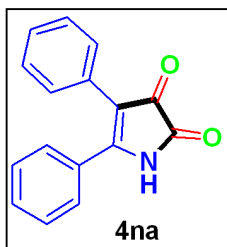
Solvent CDCl_3
Spectrometer Frequency 100.69

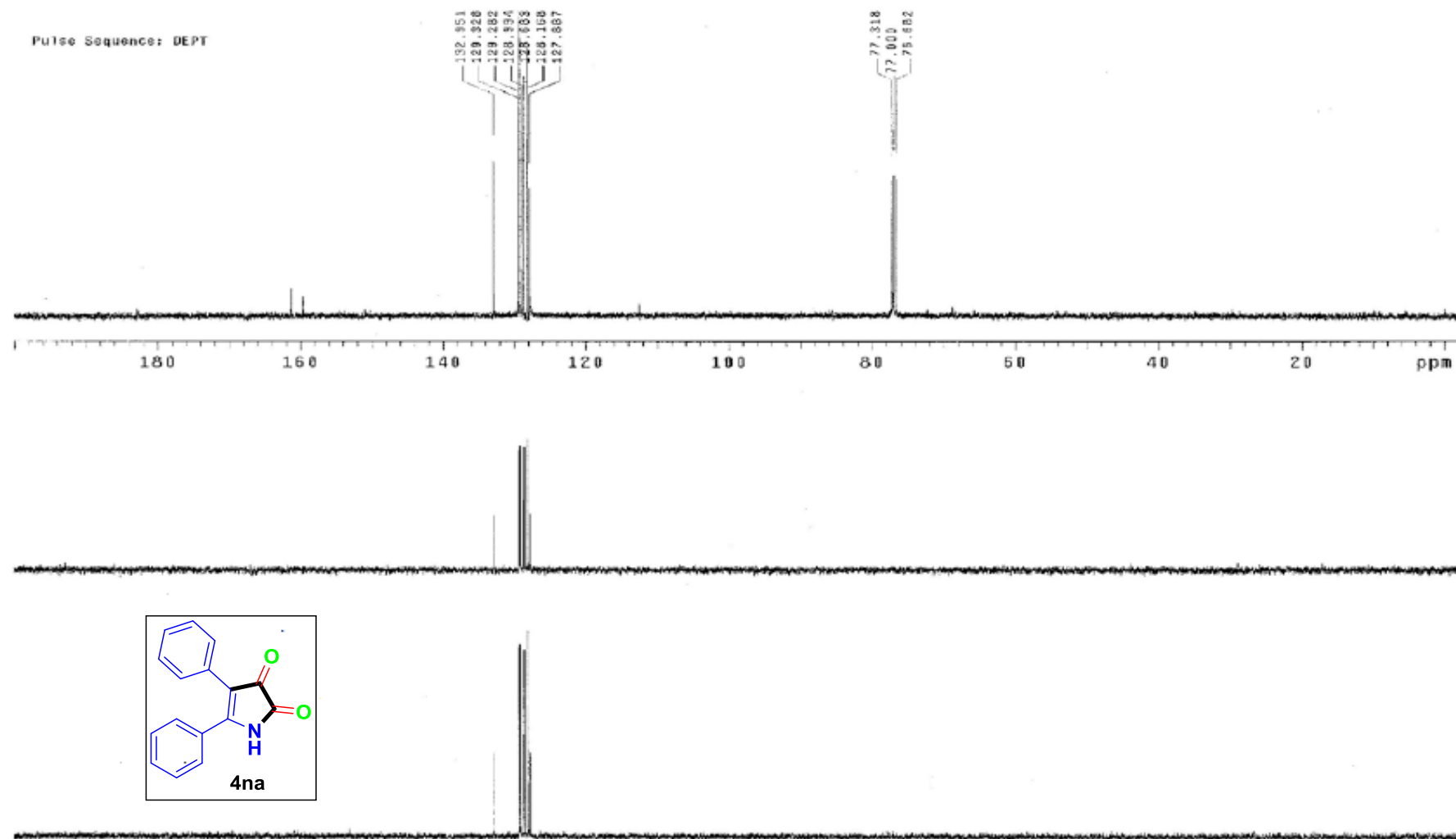


Solvent CDCl_3
Spectrometer Frequency 400.28

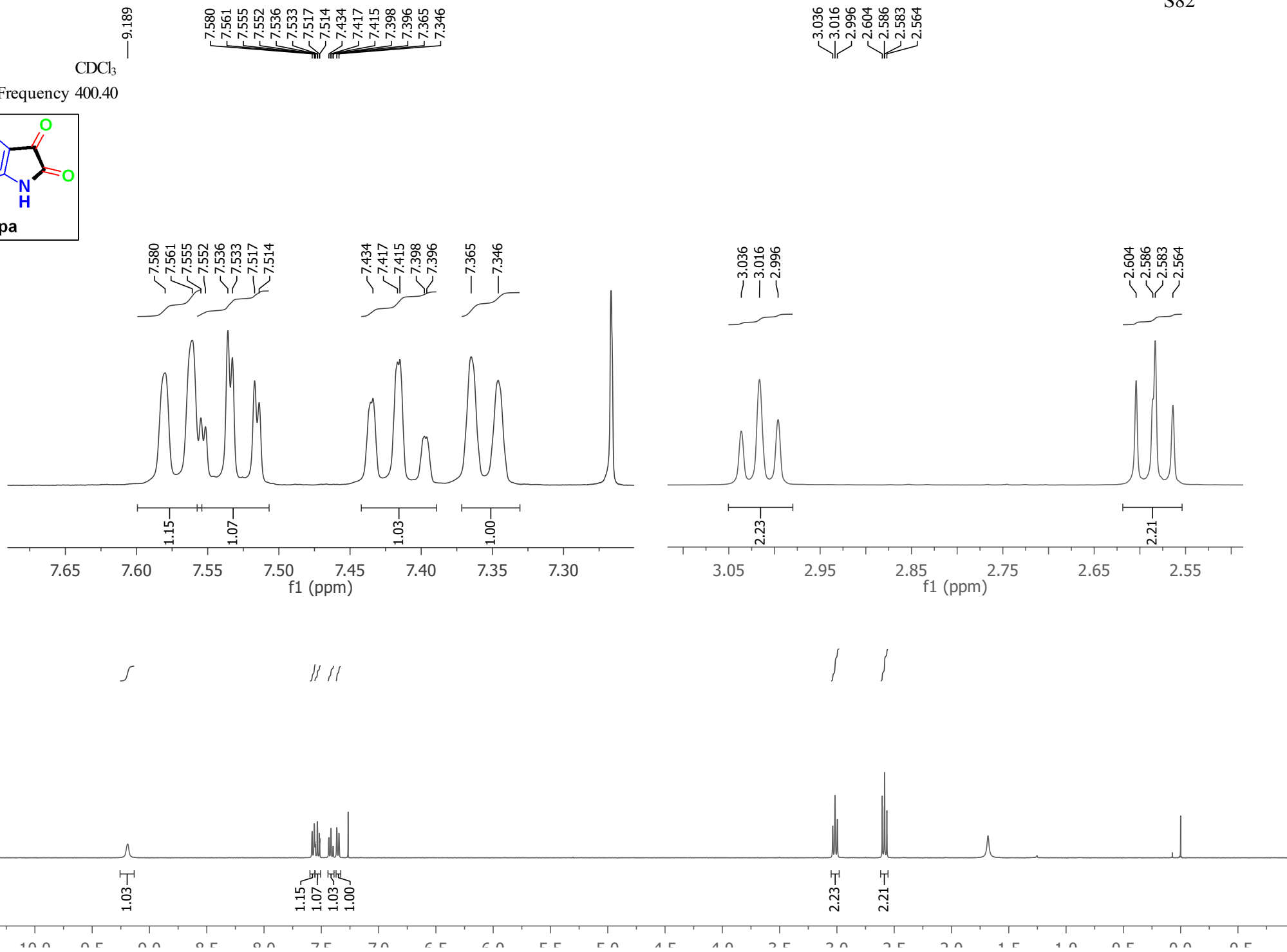
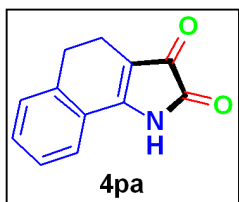


Solvent CDCl_3
Spectrometer Frequency 100.66





Solvent CDCl_3
Spectrometer Frequency 400.40



162.503
162.014

141.098

133.800
129.213
127.504
124.257
123.445

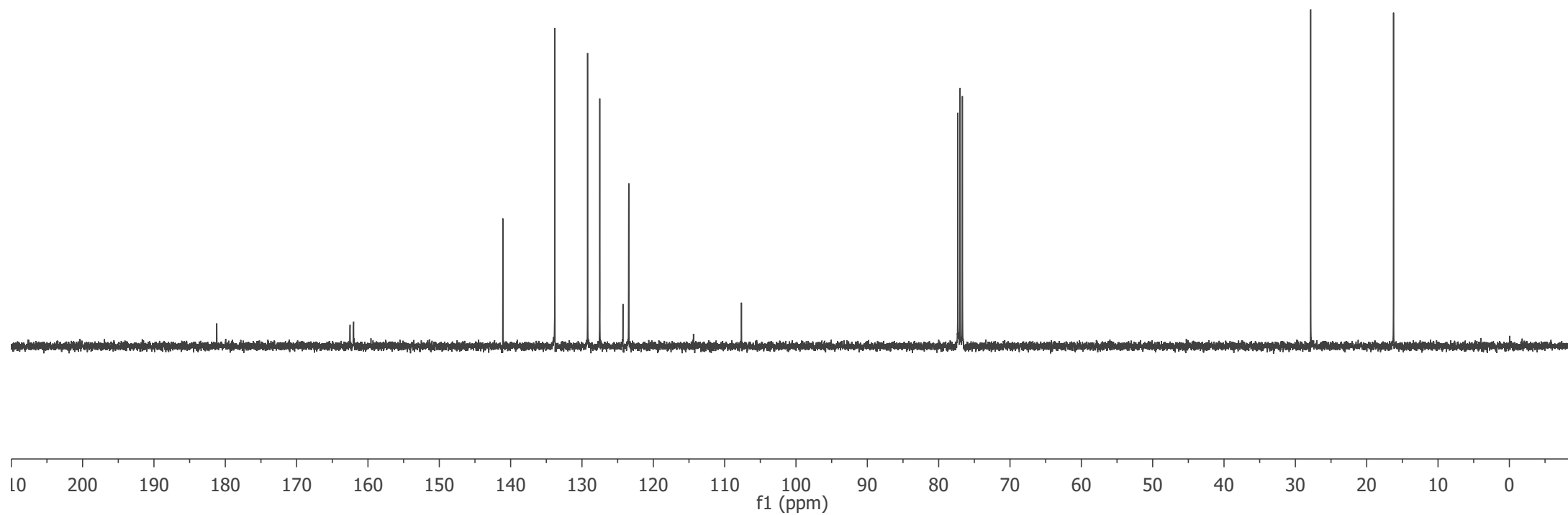
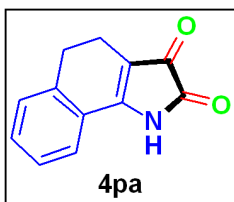
107.643

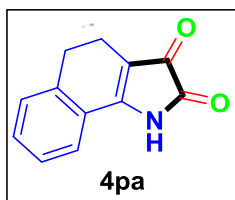
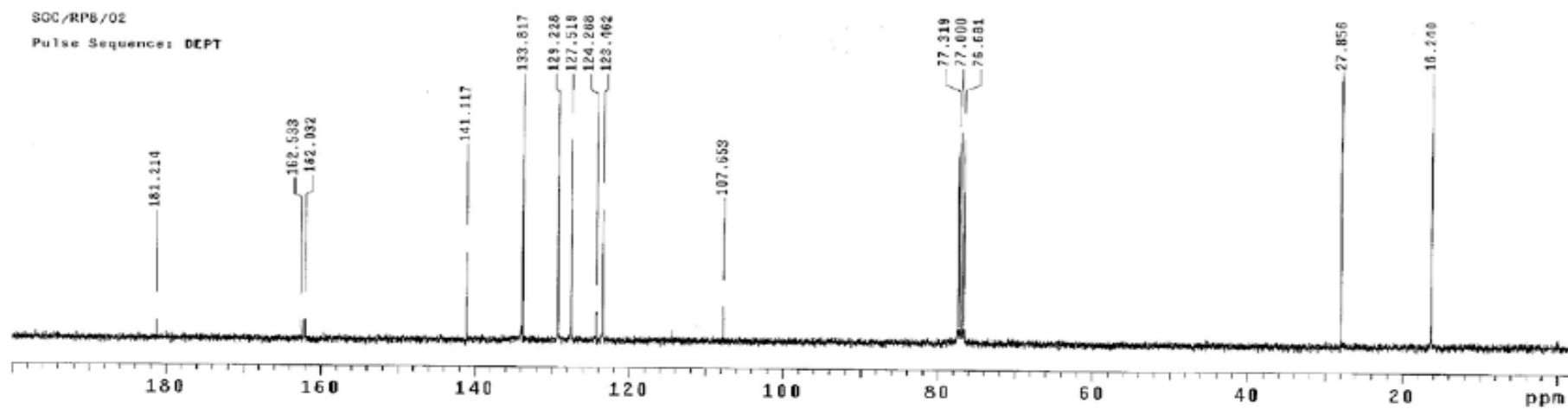
27.853

16.237

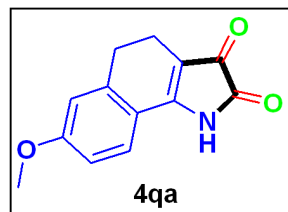
S83

Solvent CDCl_3
Spectrometer Frequency 100.69

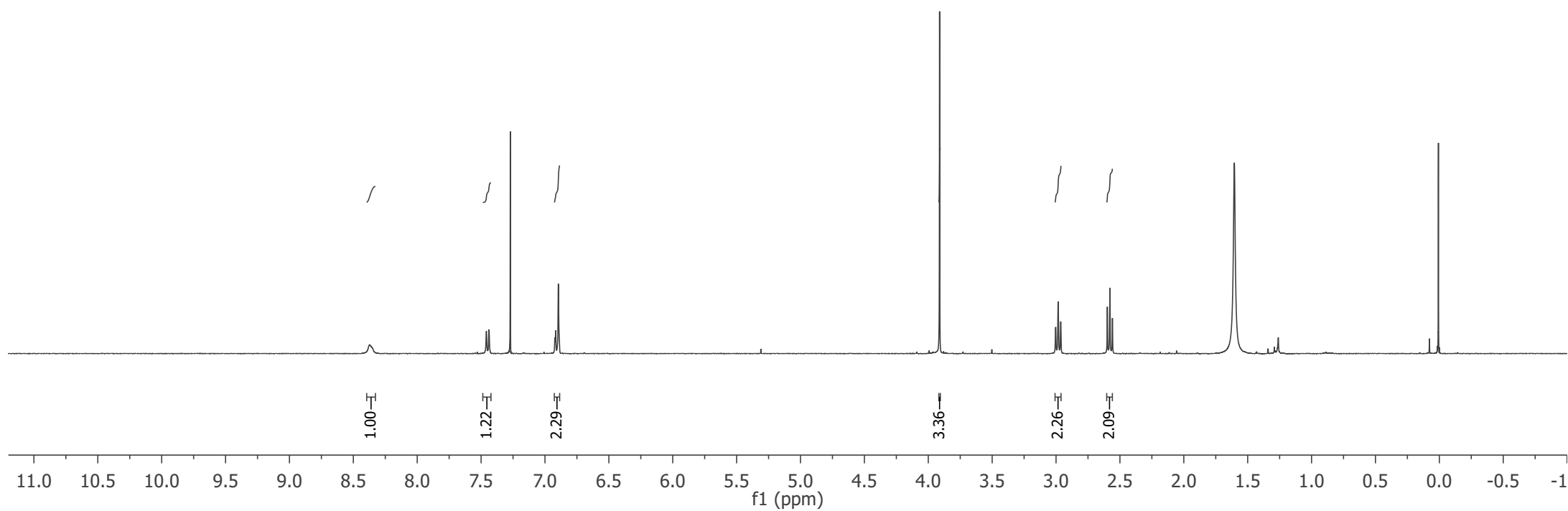
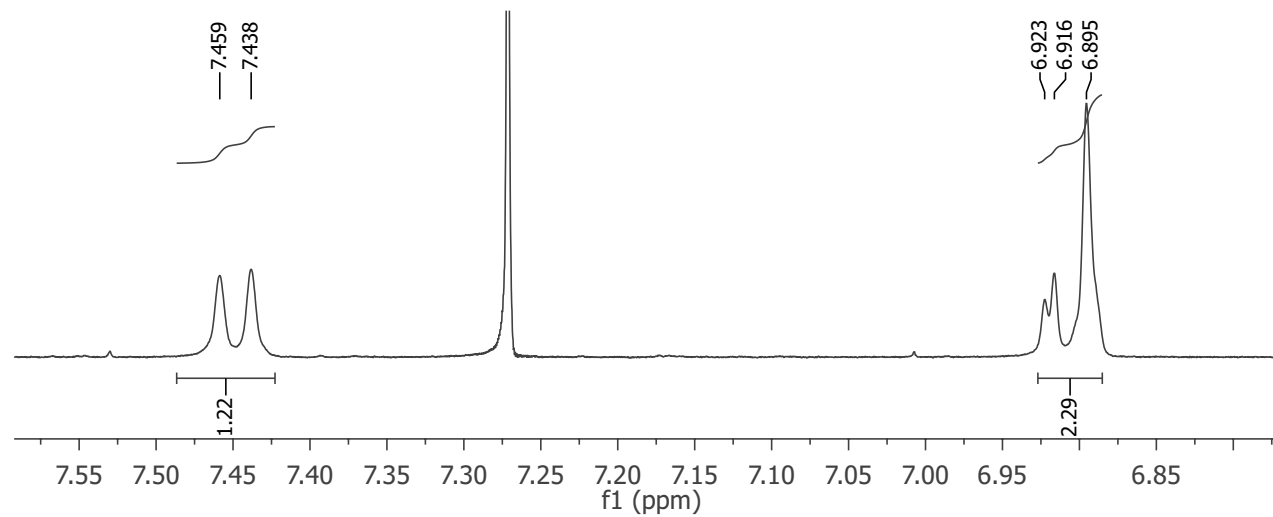




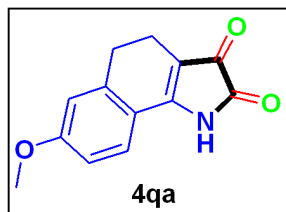
Solvent CDCl_3
Spectrometer Frequency 400.28



— 8.373
7.459
7.438
6.923
6.916
6.895
— 3.912
3.003
2.983
2.963
2.599
2.578
2.559



Solvent CDCl_3
Spectrometer Frequency 100.66



—144.131 —125.350 ~116.959 ~115.482 ~112.553 —55.669 —28.423 —16.339 S86

