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# Supporting Information

## Electrochemical oxidative dehydrogenative annulation of 1-(2-aminophenyl)pyrroles with cleavage of ethers to synthesize pyrrolo[1,2-*a*]quinoxaline derivatives

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# General remark

All the electrochemical reactions were performed in an undivided cell unless otherwise noted. The electrolysis instrument used is an adjustable DC regulated power supply (WANPTEK WPS605B).

$^{1}$H NMR, and $^{13}$C NMR spectra were recorded on Bruker 400M in $CDCl_3$ or $d_6$-DMSO. All $^{1}$H NMR and $^{13}$C NMR chemical shifts were given as δ value (ppm) with reference to tetramethylsilane (TMS) as an internal standard. The NMR peak multiplicities identified as s = singlet, br s = broad singlet, d = doublet, t = triplet, q = quartet, m = multiplet; coupling constants (*J*) were reported in Hz. All compounds were further characterized by HRMS; copies of their $^{1}$H NMR and $^{13}$C NMR spectra were provided. Cyclic voltammograms were obtained on a CHI 660C potentiostat (CH Instruments, Inc.).

Products were purified by flash chromatography on 200–300 mesh silica gels. Yields refer to chromatographically and spectroscopically pure materials unless otherwise stated. All melting points were determined without correction. All reactions were carried out under air in oven-dried glassware, unless otherwise noted. All reagents were purchased commercially and used as received, unless otherwise noted.

# General procedures for the electrolysis

## 1. The materials used to make the electrolytic cell

All the materials used to make the electrolytic cell were commercially available (Figure S1). The anode was carbon rod electrode ( Φ 6 mm) and the cathode was platinum plate electrode (1.0 cm × 1.0 cm × 0.1mm) (Shanghai yueci).

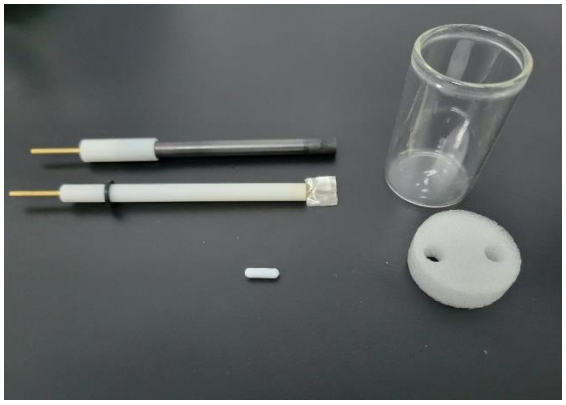
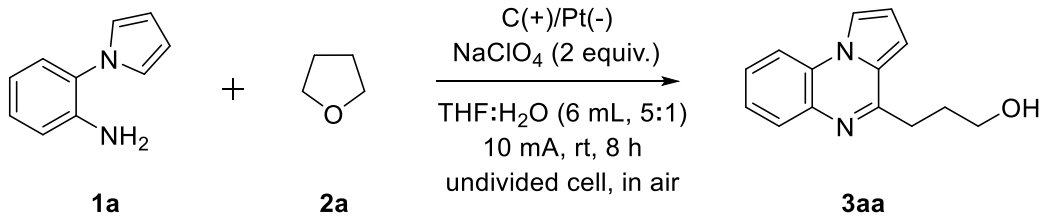


**Figure S1.** The materials used to make the electrolytic cell for the synthesis of 3-

(pyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol

## 2. General procedure for the electrosynthesis of 3-(pyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol




**1a** **2a** **3aa**

An undivided test column-type electrolysis cell (20 mL) was charged with a stir bar, 2-(1*H*-pyrrol-1-yl)aniline **1a** (0.2 mmol, 1.0 equiv.), $NaClO_4$ (0.4 mmol, 2 equiv.), THF **2a** (5.0 mL) and $H_2O$ (1.0 mL), and the resulting suspension was stirred until the solids were dissolved. Then the prepared electrodes were placed into the reaction mixture. The anode was carbon rod electrode (6 mm) and the cathode was platinum plate electrode (1.0 cm × 1.0 cm × 0.1mm). The mixture was electrolyzed at a constant current of 10 mA at 25 ℃ until the reagent and its intermediate were consumed entirely (monitored by TLC). The reaction electrodes were taken out, washed twice with ethyl acetate (10 mL) ultrasonically, and the ethyl acetate was combined with the reaction mixture. The combined mixture was washed with $H_2O$ (10 mL × 3), brine, dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The resulting crude product was purified by silica gel column chromatography with petroleum ether and ethyl acetate (2:1) as eluents to afford the desired product.

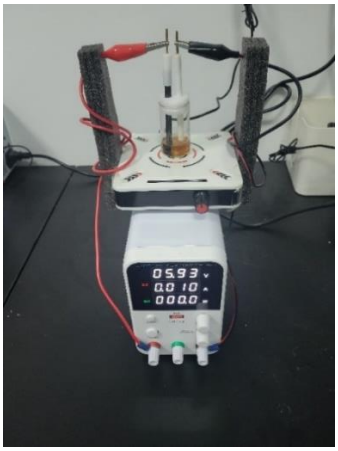


**Figure S2.** Reaction setup.

## Cyclic voltammetry experiments

The cyclic voltammetry experiments were carried out with a computer-controlled electrochemical analyzer for electrochemical measurements. The experiment was performed in a three-electrode cell (volume 20 mL) with THF and $H_2O$ (V:V = 5:1, 6 mL) as the solvent, $NaClO_4$ (0.4 mmol) as the supporting electrolyte, the tested compound (0.2 mmol), glassy carbon (diameter 3 mm) as the working electrode, Pt plate (1.0 cm × 1.0 cm × 0.1mm) as the auxiliary electrode, and Ag/AgCl (saturated aqueous KCl) as the reference electrode. The scan speed was 100 mV/s. The potential ranges investigated were 0 V to +1.8 V, then we performed the following experiments.

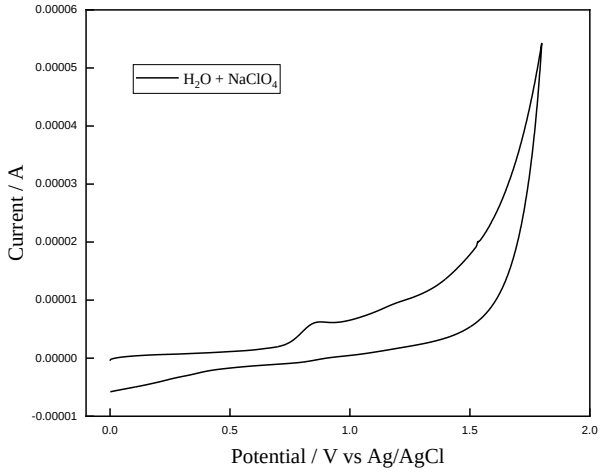



**Figure S3.** Cyclic voltammogram of $NaClO_4$ (0.4 mmol) as an electrolyte in $H_2O$ (6 mL).

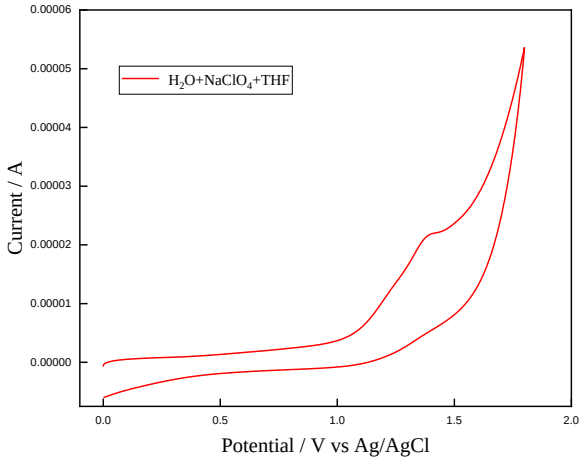


**Figure S4.** Cyclic voltammogram of $NaClO_4$ (0.4 mmol) as an electrolyte in THF and $H_2O$ (V:V = 5:1, 6 mL).

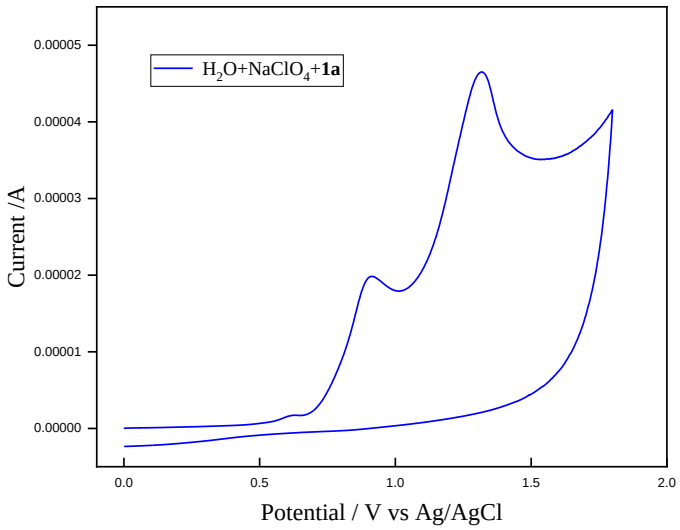



**Figure S5.** Cyclic voltammogram of **1a** (0.2 mmol) and $NaClO_4$ (0.4 mmol) as an electrolyte in $H_2O$ (6 mL).

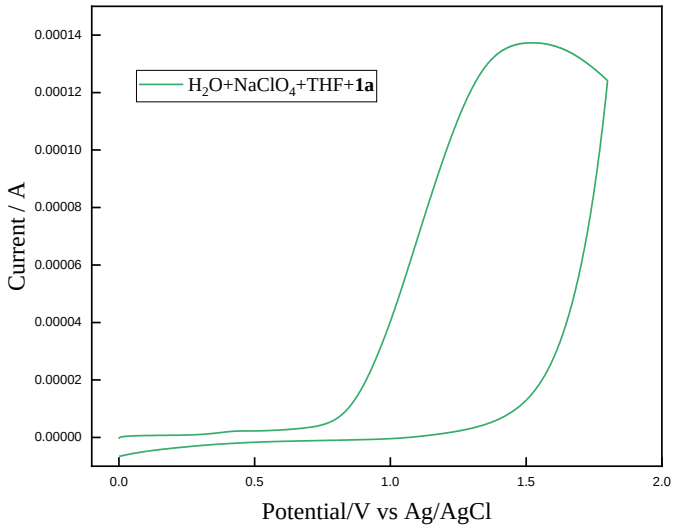
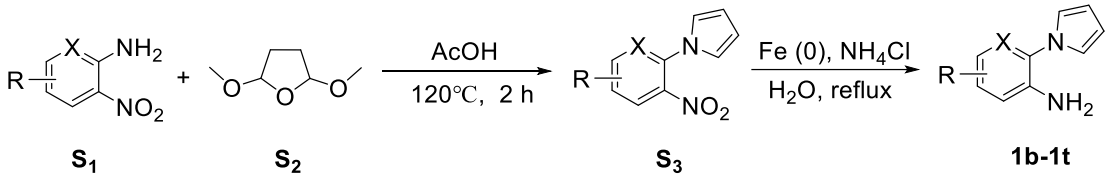



**Figure S6.** Cyclic voltammogram of **1a** (0.2 mmol) and $NaClO_4$ (0.4 mmol) as an electrolyte in THF and $H_2O$ (V:V = 5:1, 6 mL).

## Synthesis of 2-(1*H*-pyrrol-1-yl)anilines

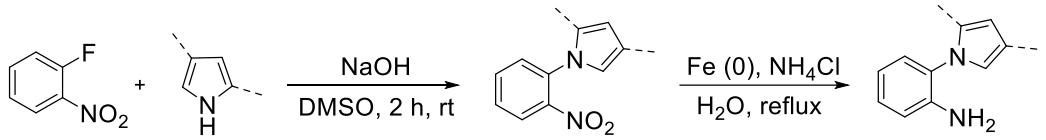
### 1. General procedure for the synthesis of 1b-1t [1]




**S1** **S2** **S3** **1b-1t**

Compound **1a** was purchased from commercial sources and used as received. Substituted 2-(1*H*-pyrrol-1-yl)anilines **1b-1t** were prepared in the following method. A mixture of substituted **S1** (5 mmol) and **S2** (5 mmol) in acetic acid (25 mL) was refluxed for 2 h with vigorous stirring. After cooling, the reaction mixture was poured into water (100 mL) and extracted with ethyl acetate three times (3×20 mL). The combined organic layers were dried with anhydrous $Na_2SO_4$ and the solvent was removed in vacuo to afford **S3**. Then, the residue **S3** was added to iron powder (20 mmol) and $NH_4Cl$ (6 mmol) in water (60 mL) and refluxed for 4 h. After cooling, the reaction mixture was poured into water (100 mL) and extracted with ethyl acetate three times (3×20 mL). The combined organic layers were dried with anhydrous $Na_2SO_4$ and the solvent was removed in vacuo to afford a residue. The residue was purified by column chromatography on silica gel using petroleum ether/EtOAc as eluent to provide the desired product **1b-1t**.

### 2. General procedure for the synthesis of 1u-1v.[2]



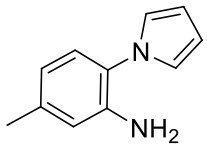

**S4** **S5** **S6** **1u-1v**

To a well-stirred solution of *N*-heterocycle **S5** (5.0 mmol) in DMSO (5.0 mL), NaOH (5.0 mmol) and 1-fluoro-2-nitrobenzene **S4** (5.0 mmol) were added slowly. The reaction mixture was stirred vigorously for 2 h at room temperature until no more starting material was detected by TLC analysis. The reaction mixture was extracted with ethyl acetate and saturated brine. Then the organic phase was combined and dried with anhydrous $Na_2SO_4$. The solvent was evaporated to obtain desired products **S6** which were directly used for next step without further purification.

The residue **S6** was added to iron powder (20 mmol) and $NH_4Cl$ (6 mmol) in water (60 mL) and refluxed for 4 h. After cooling, the reaction mixture was poured into water (100 mL) and extracted with ethyl acetate three times (3×60 mL). The combined

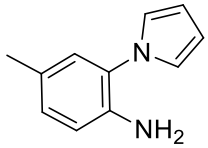
organic layers were dried with anhydrous $Na_2SO_4$ and the solvent was removed in vacuo to afford the residue. The residue was purified by column chromatography on silica gel to provide the desired products **1u-1v**.

## Characterization data of products



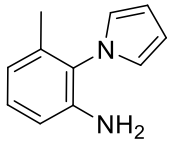
**5-methyl-2-(1*H*-pyrrol-1-yl)aniline (1b)**

White solid (627.8 mg, 73% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.03-7.01 (d, *J* = 8.0 Hz, 1 H), 6.80-6.79 (m, 2 H), 6.60-6.56 (m, 2 H), 6.32-6.31 (m, 2 H), 3.62 (br s, 2 H), 2.30 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 141.9, 138.6, 127.0, 125.2, 121.9, 119.2, 116.6, 109.2, 21.2.



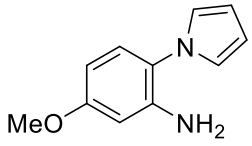
**4-methyl-2-(1*H*-pyrrol-1-yl)aniline (1c)**

White solid (610.6 mg, 71% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 6.97-6.96 (m, 2 H), 6.83-6.82 (m, 2 H), 6.70 (d, *J* = 6.4 Hz, 1 H), 6.33-6.32 (m, 2 H), 3.57 (br s, 2 H), 2.26 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 139.3, 129.0, 127.9, 127.5, 127.4, 121.6, 116.2, 109.2, 20.2.



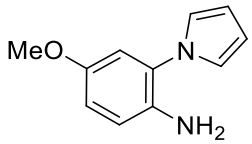
**3-methyl-2-(1*H*-pyrrol-1-yl)aniline (1d)**

White solid (626.9 mg, 73% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.09-7.05 (m, 1 H), 6.65-6.64 (m, 4 H), 6.36-6.35 (m, 2 H), 3.43 (br s, 2 H), 2.00 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.8, 136.9, 128.7, 126.7, 121.4, 119.6, 113.1, 109.3, 17.1.



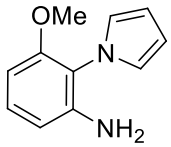
**5-methoxy-2-(1*H*-pyrrol-1-yl)aniline (1e)**

White solid (639.8 mg, 68% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.07-7.05 (m, 1 H), 6.78-6.77 (m, 2 H), 6.34-6.31 (m, 4 H), 3.79 (s, 3 H), 3.68 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =159.9, 143.4, 128.2, 122.1, 121.2, 109.2, 103.6, 101.1, 55.4.



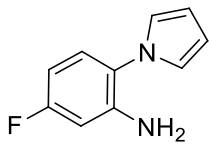

**4-methoxy-2-(1*H*-pyrrol-1-yl)aniline (1f)**

White solid (695.6 mg, 74% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 6.85-6.84 (m, 2 H), 6.79-6.73 (m, 3 H), 6.34-6.33 (m, 2 H), 3.74 (s, 3 H), 3.44 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 152.5, 135.5, 128.1, 121.7, 117.3, 114.8, 112.5, 109.5, 55.9.



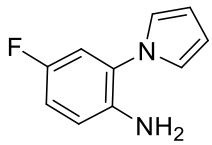

**3-methoxy-2-(1*H*-pyrrol-1-yl)aniline (1g)**

White solid (625.5 mg, 65% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.11-7.07 (m, 1 H), 6.68-6.67 (m, 2 H), 6.39-6.33 (m, 4 H), 3.69 (s, 3 H), 3.56 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.2, 144.7, 129.0, 122.0, 116.1, 108.9, 108.2, 100.9, 55.7.




**5-fluoro-2-(1*H*-pyrrol-1-yl)aniline (1h)**

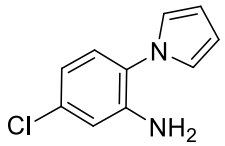
White solid (589.4 mg, 67% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.09-7.05 (m, 1 H), 6.77-6.76 (m, 2 H), 6.48-6.42 (m, 2 H), 6.33 (d, *J* = 2.4 Hz, 2 H), 3.77 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 162.8 (d, *J* = 243.1 Hz, 1 C), 144.0 (d, *J* = 11.7 Hz, 1 C), 128.6 (d, *J* = 10.7 Hz, 1 C), 123.6, 121.9, 109.6, 104.8 (d, *J* = 22.9 Hz, 1 C), 102.4 (d, *J* = 25.9 Hz, 1 C).




**4-fluoro-2-(1*H*-pyrrol-1-yl)aniline (1i)**

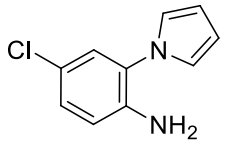
White solid (580.6 mg, 66% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 6.91-6.87

(m, 2 H), 6.83 (d, *J* = 2.0 Hz, 2 H), 6.74-6.70 (m, 1 H), 6.35-6.34 (m, 2 H), 3.59 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 155.5 (d, *J* = 236.3 Hz, 1 C), 138.1 (d, *J* = 2.4 Hz, 1 C), 127.7 (d, *J* = 9.5 Hz, 1 C), 121.5, 116.7 (d, *J* = 8.2 Hz, 1 C), 115.2 (d, *J* = 21.9 Hz, 1 C), 114.0 (d, *J* = 23.6 Hz, 1 C), 109.8.



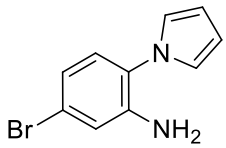

**5-chloro-2-(1*H*-pyrrol-1-yl)aniline (1j)**

White solid (720.0 mg, 75% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.06-7.04 (d, *J* = 8.4 Hz, 1 H), 6.79-7.77 (m, 3 H), 6.75-6.72 (m, 1 H), 6.34-6.33 (m, 2 H), 3.77 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.2, 134.0, 128.2, 125.9, 121.6, 118.2, 115.6, 109.8.



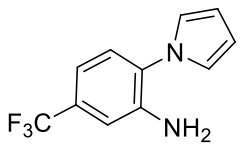

**4-chloro-2-(1*H*-pyrrol-1-yl)aniline (1k)**

White solid (729.6 mg, 76% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.14-7.09 (m, 2 H), 6.81-6.80 (m, 2 H), 6.70 (d, *J* = 8.4 Hz, 1 H), 6.34-6.33 (m, 2 H), 3.72 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 140.7, 128.4, 128.0, 127.0, 122.6, 121.5, 116.9, 109.9.




**5-bromo-2-(1*H*-pyrrol-1-yl)aniline (1l)**

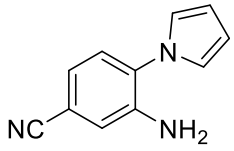
White solid (810.8 mg, 69% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.00-6.97 (m, 1 H), 6.94-6.93 (m, 1 H), 6.90-6.86 (m, 1 H), 6.80-6.78 (m, 2 H), 6.34-6.33 (m, 2 H), 3.77 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.6, 128.6, 126.6, 122.1, 121.8, 121.4, 118.7, 110.0.




**2-(1*H*-pyrrol-1-yl)-5-(trifluoromethyl)aniline (1m)**

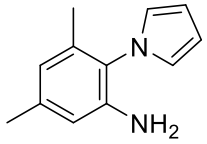
White solid (723.2 mg, 64% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.23 (d, *J* = 10.2 Hz, 1 H), 7.03-7.01 (m, 2 H), 6.85-6.83 (m, 2 H), 6.38-6.36 (m, 2 H), 3.93 (br s, 2

H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 142.4, 130.8 (q, *J* = 32.2 Hz, 1 C), 130.0, 127.6, 124.2 (q, *J* = 270.6 Hz, 1 C), 121.6, 115.2 (q, *J* = 3.7 Hz, 1 C), 113.0 (q, *J* = 3.7 Hz, 1 C), 110.3.



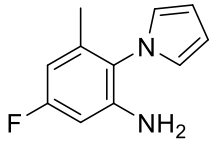

**3-amino-4-(1*H*-pyrrol-1-yl)benzonitrile (1n)**

White solid (539.8 mg, 59% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.43-7.41 (m, 2 H), 6.81-6.78 (m, 3 H), 6.38-6.36 (m, 2 H), 4.31 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 146.5, 132.7, 131.2, 126.8, 121.4, 119.2, 115.7, 110.4, 100.2.



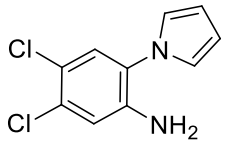

**3,5-dimethyl-2-(1*H*-pyrrol-1-yl)aniline (1o)**

White solid (675.9 mg, 73% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 6.64-6.63 (m, 2 H), 6.48 (d, *J* = 7.6 Hz, 3 H), 6.35-6.34 (m, 2 H), 3.45 (br s, 2 H), 2.26 (s, 3H), 1.96 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.6, 138.8, 136.7, 124.5, 121.7, 120.7, 113.8, 109.2, 21.3, 17.1.



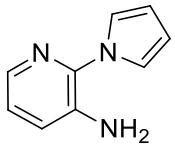

**5-fluoro-3-methyl-2-(1*H*-pyrrol-1-yl)aniline (1p)**

White solid (618.4 mg, 65% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 6.62-6.61 (m, 2 H), 6.37-6.31 (m, 4 H), 3.60 (br s, 2 H), 1.96 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 162.6 (d, *J* = 242.6 Hz, 1 C), 145.3 (d, *J* = 12.3 Hz, 1 C), 139.0 (d, *J* = 30.3 Hz, 1 C), 122.7 (d, *J* = 2.5 Hz, 1 C), 121.6, 109.6, 106.1 (d, *J* = 22.3 Hz, 1 C), 99.6 (d, *J* = 25.6 Hz, 1 C), 17.4 (d, *J* = 1.8 Hz, 1 C).



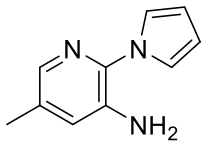

**4,5-dichloro-2-(1*H*-pyrrol-1-yl)aniline (1q)**

White solid (757.1 mg, 67% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.22 (s, 1 H), 6.88 (s, 1 H), 6.79-6.77 (m, 2 H), 6.35-6.33 (m, 2 H), 3.79 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 141.8, 132.2, 128.6, 126.9, 121.7, 120.8, 117.1, 110.4.



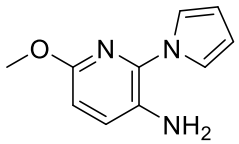
**2-(1*H*-pyrrol-1-yl)pyridin-3-amine (1r)**

White solid (615.3 mg, 77% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.92-7.90 (m, 1 H), 7.15-7.14 (m, 2 H), 7.10-7.06 (m, 2 H), 6.36-6.35 (m, 2 H), 3.87 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 139.8, 138.6, 136.1, 124.4, 123.1, 120.4, 110.2.



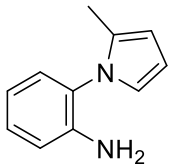
**5-methyl-2-(1*H*-pyrrol-1-yl)pyridin-3-amine (1s)**

White solid (650.4 mg, 75% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.75-7.74 (m, 1 H), 7.11-7.09 (m, 2 H), 6.94-6.93 (m, 1 H), 6.35-6.34 (m, 2 H), 3.79 (br s, 2 H), 2.28 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 138.8, 137.7, 135.5, 133.0, 124.8, 120.3, 109.8, 17.9.



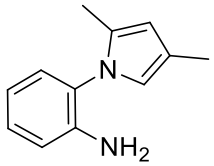
**2-(cyclopenta-2,4-dien-1-yl)-6-methoxypyridin-3-amine (1t)**

White solid (670.2 mg, 71% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.24-7.23 (m, 2 H), 7.14-7.02 (m, 1 H), 6.71-6.69 (m, 1 H), 6.59-6.57 (m, 1 H), 6.36-6.35 (m, 2 H), 3.86 (s, 3 H), 3.49 (br s, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 138.8, 137.7, 135.5, 133.0, 124.8, 120.2, 109.7, 53.6.



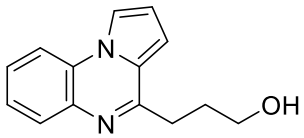
**2-(2-methyl-1*H*-pyrrol-1-yl)aniline (1u)**

White solid (634.7 mg, 74% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.21-7.17 (m, 1 H), 7.11-7.09 (m, 1 H), 6.80-6.76 (m, 2 H), 6.63-6.62 (m, 1 H), 6.23-6.21 (m, 1 H), 6.05-6.03 (m, 1 H), 3.52 (br s, 2 H), 2.05 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.7, 129.9, 129.2, 128.7, 126.1, 120.9, 118.2, 115.7, 108.4, 107.1, 11.9.



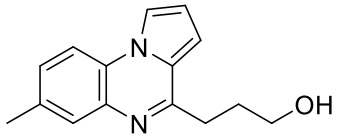
**2-(2,4-dimethyl-1*H*-pyrrol-1-yl)aniline (1v)**

White solid (625.9 mg, 67% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.19-7.13 (m, 1H), 7.08-7.05 (m, 1 H), 6.77-6.72 (m, 2 H), 6.37 (s, 1 H), 5.88 (s, 1 H), 3.53 (br s, 2 H), 2.10 (d, *J* = 0.4 Hz, 3 H), 1.99 (d, *J* = 0.8 Hz, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 143.8, 129.8, 129.0, 128.7, 126.3, 119.0, 118.6, 118.1, 115.7, 108.9, 12.0, 11.9.



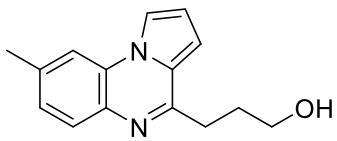
**3-(pyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3aa)**[3]

Yellow oil (40.2 mg, 89% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.90-7.86 (m, 2 H), 7.81-7.79 (m, 2 H), 7.48-7.38 (m, 2 H), 6.95-6.93 (m, 1 H), 6.85-6.83 (m, 1 H), 4.28 (br s, 1 H), 3.82 (t, *J* = 8.4 Hz, 2 H), 3.23 (t, *J* = 6.8 Hz, 2 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.7, 135.0, 128.9, 127.2, 127.2, 125.8, 125.2, 114.7, 113.8, 113.7, 106.9, 62.5, 32.8, 29.7; HRMS calcd for $C_{22}H_{17}O$ $[M+H]^+$ 227.1179; found: 227.1176.



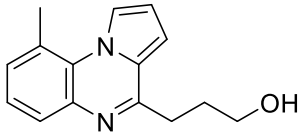
**3-(7-methylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ba)**

Light yellow solid (39.8 mg, 83% yield), melting point: 108-110 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.87-7.86 (m, 1 H), 7.70-7.68 (m, 2 H), 7.29-7.26 (m, 1 H), 6.93-6.91 (m, 1 H), 6.83-6.81 (m, 1 H), 4.67 (br s, 1 H), 3.82 (t, *J* = 5.6 Hz, 2 H), 3.23 (t, *J* = 6.4 Hz, 2 H), 2.46 (s, 3 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.6, 135.1, 134.9, 128.7, 128.4, 125.7, 125.0, 114.6, 113.5, 113.4, 106.7, 62.6, 32.9, 29.6, 21.1; HRMS calcd for $C_{15}H_{16}N_2O$ $[M+H]^+$ 241.1335; found: 241.1329.



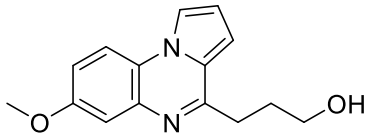
**3-(8-methylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ca)**

Yellow oil (29.3 mg, 61% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.90-7.89 (m, 1 H), 7.78 (d, *J* = 8.4 Hz, 1 H), 7.63 (s, 1 H), 7.24 (d, *J* = 8 Hz, 1 H), 6.94-6.93 (m, 1 H), 6.86-6.85 (m, 1 H), 3.81 (t, *J* = 5.6 Hz, 2 H), 3.24 (t, *J* = 6.8 Hz, 2 H), 2.54 (s, 3 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =155.6, 137.8, 132.9, 128.6, 126.9, 126.6, 125.9, 114.5, 113.8, 113.7, 106.6, 62.7, 32.8, 29.5, 21.8; HRMS calcd for $C_{15}H_{16}N_2O$ $[M+H]^+$ 241.1335; found: 241.1328.



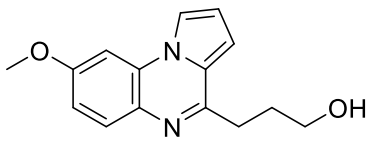

**3-(9-methylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3da)**

Yellow oil (23.5 mg, 49% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.33-8.32 (m, 1 H), 7.79-7.76 (m, 1 H), 7.31-7.29 (m, 2 H), 7.00-7.29 (m, 1 H), 6.86-6.84 (m, 1 H), 3.82 (t, *J* = 5.6 Hz, 2 H), 3.25 (t, *J* = 6.4 Hz, 2 H), 2.93 (s, 3 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.2, 136.5, 130.8, 127.5, 127.3, 127.0, 125.4, 124.7, 120.5, 113.1, 106.4, 62.7, 32.7, 29.5, 23.9; HRMS calcd for $C_{15}H_{16}N_2O$ $[M+H]^+$ 241.1335; found: 241.1327.




**3-(7-methoxypyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ea)**

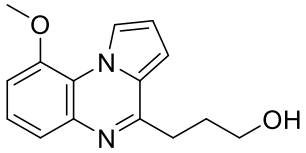
Light yellow solid (32.2 mg, 63% yield), melting point: 105-107 °C. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.82-7.81(m, 1 H), 7.69 (d, *J* = 8.8 Hz, 1 H), 7.31 (d, *J* = 2.8 Hz, 1 H), 7.08-7.05 (m, 1 H), 6.91-6.90 (m, 1 H), 6.81-6.79 (m, 1 H), 3.88 (s, 3 H), 3.82 (t, *J* = 5.6 Hz, 2 H), 3.21 (t, *J* = 6.8 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =157.1, 157.0, 136.2, 125.5, 121.4, 116.4, 114.6, 114.3, 113.40, 110.2, 106.5, 62.6, 55.7, 32.8, 29.8; HRMS calcd for $C_{15}H_{16}N_2O_2$ $[M+H]^+$ 257.1285; found: 257.1280.




**3-(8-methoxypyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3fa)**

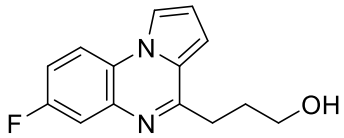
Light yellow solid (33.8 mg, 66% yield), melting point: 105-108 °C. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.81-7.79 (m, 2 H), 7.22 (d, *J* = 2.4 Hz, 1 H), 7.02-6.99 (m, 1 H), 6.91-6.90 (m, 1 H), 6.86-6.84 (m, 1 H), 3.94 (s, 3 H), 3.81 (t, *J* = 5.6 Hz, 2 H), 3.22

(t, $J$ = 6.4 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 158.8, 154.0, 130.1, 129.4, 127.9, 125.8, 114.3, 113.8, 112.6, 106.4, 97.6, 62.7, 55.8, 32.7, 29.6; HRMS calcd for $C_{15}H_{16}N_2O_2$ $[M+H]^+$ 257.1285; found: 257.1277.



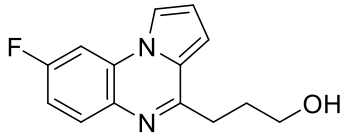

**3-(9-methoxypyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ga)**

Light yellow solid (25.6 mg, 50% yield), melting point: 101-103 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.76-8.75 (m, 1 H), 7.53-7.51 (m, 1 H), 7.34 (t, $J$ = 8.4 Hz, 1 H), 7.03 (d, $J$ = 7.2 Hz, 1 H), 6.99-6.98 (m, 1 H), 6.83-6.81 (m, 1 H), 4.07 (s, 3 H), 3.81 (t, $J$ = 5.6 Hz, 2 H), 3.25 (t, $J$ = 6.4 Hz, 2 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.8, 149.8, 137.1, 126.2, 124.5, 122.6, 120.9, 118.5, 112.7, 108.8, 106.3, 62.7, 56.2, 32.8, 29.5; HRMS calcd for $C_{15}H_{16}N_2O_2$ $[M+H]^+$ 257.1285; found: 257.1279.




**3-(7-fluoropyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ha)**

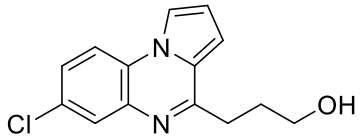
Yellow oil (35.1 mg, 72% yield), melting point: 105-108 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.86-7.85 (m, 1 H), 7.76-7.72 (m, 1 H), 7.55-7.52 (m, 1 H), 7.21-7.16 (m, 1 H), 6.96-6.94 (m, 1 H), 6.85-6.83 (m, 1 H), 4.47 (br s, 1 H), 3.81 (t, $J$ = 5.6 Hz, 2 H), 3.20 (t, $J$ = 6.8 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 159.8 (d, $J$ = 242.4 Hz, 1 C), 158.1, 136.3 (d, $J$ = 11.3 Hz, 1 C), 125.6, 123.8 (d, $J$ = 1.6 Hz, 1 C), 114.9 (d, $J$ = 13.3 Hz, 1 C), 114.9, 114.7 (d, $J$ = 6.8 Hz, 1 C), 114.3 (d, $J$ = 22.3 Hz, 1 C), 113.9, 107.2, 62.4, 32.6, 29.8; $^{19}$F NMR (377 MHz, $CDCl_3$, ppm): δ = -116.5; HRMS calcd for $C_{14}H_{13}FN_2O$ $[M+H]^+$ 245.1085; found: 245.1078.




**3-(8-fluoropyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ia)**

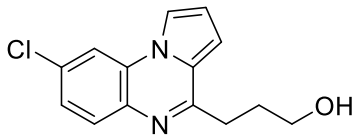
Light yellow solid (29.8 mg, 61% yield), melting point: 108-111 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.87-7.83 (m, 1 H), 7.80-7.79 (m, 1 H), 7.49-7.46 (m, 1 H), 7.15-7.10 (m, 1 H), 6.95-6.94 (m, 1 H), 6.88-6.87 (m, 1 H), 3.81 (t, $J$ = 5.6 Hz, 2 H), 3.22 (t, $J$ = 6.8 Hz, 2 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =

161.2 (d, $J$ = 246.3 Hz, 1 C), 155.9 (d, $J$ = 2.5 Hz, 1 C), 131.7 (d, $J$ = 2.3 Hz, 1 C), 130.7 (d, $J$ = 9.7 Hz, 1 C), 127.8 (d, $J$ = 11.2 Hz, 1 C), 125.5, 114.9, 114.2, 113.1 (d, $J$ = 23 Hz, 1 C), 107.1, 100.5 (d, $J$ = 26.7 Hz, 1 C), 62.6, 32.6, 29.6; $^{19}$F NMR (377 MHz, $CDCl_3$, ppm): δ = -111.3; HRMS calcd for $C_{14}H_{13}FN_2O$ $[M+H]^+$ 245.1085; found: 245.1079.



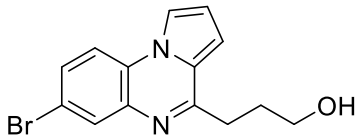

**3-(7-chloropyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ja)**

Light yellow solid (35.9 mg, 69% yield), melting point: 115-118 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.88-7.86 (m, 2 H), 7.73 (d, $J$ = 8.8 Hz, 1 H), 7.43-7.40 (m, 1 H), 6.98-6.96 (m,1 H), 6.88-6.86 (m, 1 H), 3.81 (t, $J$ = 5.6 Hz, 2 H), 3.22 (t, $J$ = 6.8 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 158.0, 136.0, 130.4, 128.4, 127.2, 125.8, 125.7, 115.0, 114.8, 114.2, 107.5, 62.5, 32.6, 29.6; HRMS calcd for $C_{14}H_{13}ClN_2O$ $[M+H]^+$ 261.0789; found: 261.0784.




**3-(8-chloropyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ka)**

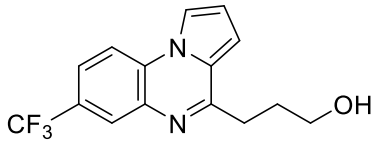
Light yellow solid (28.6 mg, 55% yield), melting point: 88-90 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.84-7.83 (m, 1 H), 7.80-7.78 (m, 2 H), 7.36-7.33 (m, 1 H), 6.96-6.95 (m,1 H), 6.88-6.86 (m, 1 H), 3.81 (t, $J$ = 6 Hz, 2 H), 3.21 (t, $J$ = 6.8 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.0, 133.6, 132.6, 130.1, 127.7, 125.7, 125.6, 114.9, 114.3, 113.8, 107.4, 62.5, 32.6, 29.6; HRMS calcd for $C_{14}H_{13}ClN_2O$ $[M+H]^+$ 261.0789; found: 261.0783.




**3-(7-bromopyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3la)**

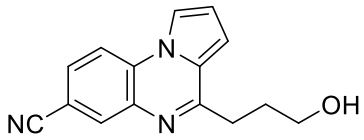
Light yellow solid (26.8 mg, 44% yield), melting point: 130-133 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.06-8.05 (m, 1 H), 7.90-7.89 (m, 1 H), 7.71-7.68 (m,1 H), 7.59-7.55 (m, 1 H), 6.99-6.97 (m, 1 H), 6.89-6.87 (m, 1 H), 4.11 (br s, 1 H), 3.81 (t, $J$ = 7.2 Hz, 2 H), 3.23 (t, $J$ = 8.4 Hz, 2 H), 2.21-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.9, 136.4, 131.5, 129.9, 126.2, 125.7, 117.8, 115.0, 114.9, 114.1,

107.4, 62.5, 32.6, 29.5; HRMS calcd for $C_{14}H_{13}BrN_2O$ $[M+H]^+$ 305.0284; found: 305.0278.



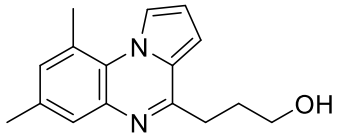

**3-(7-(trifluoromethyl)pyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ma)**

Light yellow solid (44.7 mg, 76% yield), melting point: 110-113 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.18 (s, 1 H), 7.96-7.95 (m, 1 H), 7.92-7.89 (m, 1 H), 7.72-7.68 (m,1 H), 7.03-7.01 (m, 1 H), 6.93-6.91 (m, 1 H), 3.88 (br s, 1 H), 3.82 (t, *J* = 7.6 Hz, 2 H), 3.24 (t, *J* = 8.8 Hz, 2 H), 2.23-2.15 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 158.4, 135.0, 129.3, 126.9 (q, *J* = 32.8 Hz, 1 C), 126.7 (q, *J* = 4.0 Hz, 1 C), 126.0, 123.6 (q, *J* = 3.6 Hz, 1 C), 122.1, 115.3, 114.7, 114.4, 107.9, 62.5, 32.5, 29.6; $^{19}$F NMR (377 MHz, $CDCl_3$, ppm): δ = -61.9; HRMS calcd for $C_{15}H_{14}F_3N_2O$ $[M+H]^+$ 295.1053; found: 295.1041.



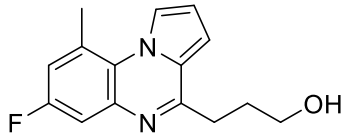

**4-(3-hydroxypropyl)pyrrolo[1,2-*a*]quinoxaline-7-carbonitrile (3na)**

Light yellow solid (20.1 mg, 40% yield), melting point: 147-149 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.20 (d, *J* = 2 Hz, 1 H), 7.96-7.95 (m, 1 H), 7.90 (d, *J* = 8.4 Hz, 1 H), 7.73-7.70 (m,1 H), 7.06-7.05 (m, 1 H), 6.97-6.95 (m, 1 H), 3.82 (t, *J* = 5.6 Hz, 2 H), 3.24 (t, *J* = 6.8 Hz, 2 H), 2.22-2.15 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 159.0, 135.3, 133.6, 130.2, 129.9, 126.0, 118.4, 115.7, 115.3, 114.9, 108.6, 108.5, 62.4, 32.4, 29.6; HRMS calcd for $C_{15}H_{13}N_3O$ $[M+H]^+$ 252.1131; found: 252.1129.



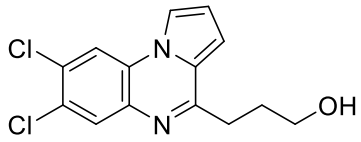

**3-(7,9-dimethylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3oa)**

Yellow oil (22.9 mg, 45% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.28-8.27 (m, 1 H), 7.58 (s, 1 H), 7.11 (s, 1 H), 6.97-6.96 (m, 1 H), 6.84-6.82 (m, 1 H), 3.81 (t, *J* = 5.2 Hz, 2 H), 3.24 (t, *J* = 6.4 Hz, 2 H), 2.89 (s, 3 H), 2.42 (s, 3 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.0, 136.4, 134.4, 132.0, 127.1, 126.9, 125.3, 125.0, 120.2, 112.9, 106.2, 62.7, 32.8, 29.4, 23.7, 20.7; HRMS calcd for $C_{16}H_{18}N_2O$ $[M+H]^+$ 255.1492; found: 255.1486.



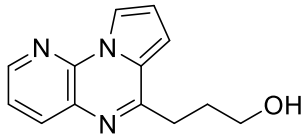
**3-(7-fluoro-9-methylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3pa)**

Light yellow solid (31.0 mg, 60% yield), melting point: 122-124 ºC. $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.25-8.23 (m, 1 H), 7.44-7.41 (m, 1 H), 7.02-6.98 (m, 2 H), 6.84-6.83 (m, 1 H), 4.50 (br s, 1 H), 3.80 (t, *J* = 5.6 Hz, 2 H), 3.20 (t, *J* = 6.4 Hz, 2 H), 2.89 (s, 3 H), 2.18-2.12 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =158.6 (d, *J* = 242.1 Hz, 1 C), 157.3, 138.0 (d, *J* = 11.6 Hz, 1 C), 127.4 (d, *J* = 8.7 Hz, 1 C), 126.9, 124.1 (d, *J* = 2.6 Hz, 1 C), 120.3, 117.9 (d, *J* = 23.4 Hz, 1 C), 113.2, 112.5 (d, *J* = 21.7 Hz, 1 C), 106.6, 62.5, 32.5, 29.6, 24.0 (d, *J* = 1.4 Hz, 1 C); $^{19}$F NMR (377 MHz, $CDCl_3$, ppm): δ = -118.0; HRMS calcd for $C_{15}H_{16}FN_2O$ $[M+H]^+$ 259.1241; found: 259.1236.



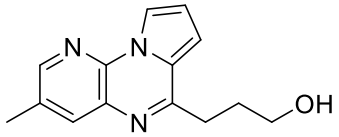
**3-(7,8-dichloropyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3qa)**

Light yellow solid (21.8 mg, 37% yield), melting point: 130-133 ºC. $^{1}$H NMR (400 MHz, *d*6-DMSO, ppm): δ = 8.60 (s, 1 H), 8.48-8.47 (m, 1 H), 7.96 (s, 1 H), 7.10-7.08 (m,1 H), 6.94-6.91 (m, 1 H), 4.58 (t, *J* = 6.8 Hz, 1 H), 3.58-3.52 (m, 2 H), 3.00 (t, *J* = 10 Hz, 2 H), 2.01-1.92 (m, 2 H); $^{13}$C NMR (100 MHz, *d*6-DMSO, ppm): δ =158.5, 135.1, 129.4, 128.9, 127.0, 126.4, 124.9, 117.1, 116.5, 114.3, 107.6, 60.4, 31.2, 30.6; HRMS calcd for $C_{14}H_{12}Cl_2N_2O$ $[M+H]^+$ 295.0399; found: 295.0392.



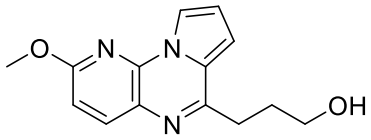
**3-(pyrido[3,2-*e*]pyrrolo[1,2-*a*]pyrazin-6-yl)propan-1-ol (3ra)**

Black oil (25.9 mg, 57% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.51-8.50 (m, 1 H), 8.39-8.38 (m, 1 H), 8.18-8.16 (m, 1 H), 7.43-7.40 (m, 1 H), 7.03-7.02 (m, 1 H), 6.90-6.89 (m, 1 H), 3.82 (t, *J* = 6 Hz, 2 H), 3.24 (t, *J* = 6.8 Hz, 2 H), 2.21-2.15 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.9, 146.4, 139.3, 136.3, 130.1, 127.2, 121.6, 116.1, 114.3, 108.5, 62.5, 32.5, 29.8; HRMS calcd for $C_{13}H_{13}N_3O$ $[M+H]^+$ 228.1131; found: 228.1134.



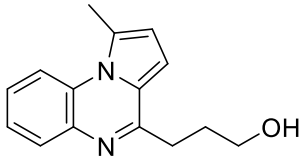
**3-(3-methylpyrido[3,2-*e*]pyrrolo[1,2-*a*]pyrazin-6-yl)propan-1-ol (3sa)**

Yellow oil (25.1 mg, 52% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.35-8.33 (m, 2 H), 7.97 (s, 1 H), 7.00-6.99 (m, 1 H), 6.88-6.86 (m, 1 H), 3.81 (t, *J* = 5.6 Hz, 2 H), 3.24 (t, *J* = 6.4 Hz, 2 H), 2.48 (s, 3 H), 2.20-2.14 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.8, 146.9, 137.4, 136.3, 131.4, 129.6, 127.1, 115.8, 114.0, 108.2, 62.6, 32.6, 29.6, 18.1; HRMS calcd for $C_{14}H_{15}N_3O$ $[M+H]^+$ 242.1288; found: 242.1279.



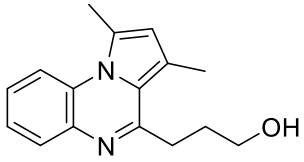
**3-(2-methoxy-9a*H*-cyclopenta[*c*][1,5]naphthyridin-6-yl)propan-1-ol (3ta)**

Yellow oil (18.0 mg, 35% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.24-8.23 (m, 1 H), 8.07 (d, *J* = 8.8 Hz, 1 H), 6.95-6.94 (m, 1 H), 6.89-6.88 (m, 1 H), 6.84 (d, *J* = 8.8 Hz, 1 H), 4.08 (s, 3 H), 3.80 (t, *J* = 5.6 Hz, 2 H), 3.22 (t, *J* = 6.4 Hz, 2 H), 2.19-2.13 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 161.7, 154.2, 139.2, 136.6, 127.3, 124.3, 115.0, 114.1, 109.3, 106.9, 62.5, 54.1, 32.4, 29.8; HRMS calcd for $C_{15}H_{16}N_2O_2$ $[M+H]^+$ 258.1237; found: 258.1244.



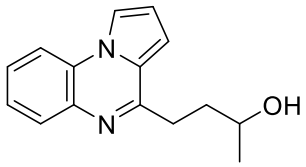
**3-(1-methylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3ua)**

Yellow oil (21.1 mg, 44% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.23-8.21 (m, 1 H), 7.89-7.86 (m, 1 H), 7.43-7.36 (m, 2 H), 6.89 (d, *J* = 4 Hz, 1 H), 6.57 (d, *J* = 4 Hz, 1 H), 3.80 (t, *J* = 5.6 Hz, 2 H), 3.20 (t, *J* = 6.4 Hz, 2 H), 2.94 (s, 3 H), 2.18-2.12 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.5, 136.3, 129.7, 129.5, 128.8, 126.6, 126.3, 124.8, 115.3, 115.2, 106.3, 62.6, 32.5, 29.8, 17.8; HRMS calcd for $C_{15}H_{17}N_2O$ $[M+H]^+$ 241.1335; found: 241.1329.



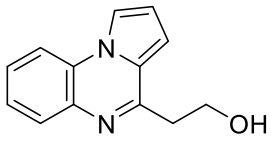
**3-(1,3-dimethylpyrrolo[1,2-*a*]quinoxalin-4-yl)propan-1-ol (3va)**

Light yellow solid (17.3 mg, 34% yield), melting point: 109-113 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.15-8.13 (m, 1 H), 7.80-7.78 (m, 1 H), 7.36-7.31 (m, 2 H), 6.38 (s, 1 H), 3.79 (t, *J* = 5.2 Hz, 2 H), 3.30 (t, *J* = 6.8 Hz, 2 H), 2.86 (s, 3 H), 2.57 (s, 3 H), 2.16-2.10 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.1, 136.0, 129.7, 128.3, 128.0, 125.9, 124.5, 123.6, 118.8, 117.6, 62.5, 33.9, 29.7, 17.8, 14.9; HRMS calcd for $C_{16}H_{19}N_2O$ $[M+H]^+$ 255.1492; found: 255.1485.



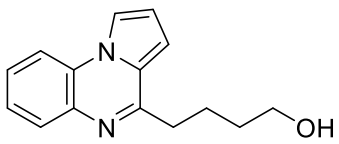

**4-(pyrrolo[1,2-*a*]quinoxalin-4-yl)butan-2-ol (3ab)**

Yellow oil (35.5 mg, 74% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.95-7.90 (m, 2 H), 7.85-7.83 (m, 1 H), 7.52-7.41 (m, 2 H), 6.98-6.97 (m, 1 H), 6.89-6.87 (m, 1 H), 5.06 (br s, 1 H), 4.03-3.95 (m, 1 H), 3.35-3.18 (m, 2 H), 2.12-2.01 (m, 2 H), 1.30 (d, *J* = 6.4 Hz, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 156.9, 135.0, 129.0, 127.2, 127.2, 125.8, 125.3, 114.7, 113.7, 113.7, 106.8, 67.6, 35.9, 31.9, 23.6; HRMS calcd for $C_{15}H_{17}N_2O$ $[M+H]^+$ 241.1335; found: 241.1327.




**2-(pyrrolo[1,2-*a*]quinoxalin-4-yl)ethan-1-ol (3ac)**

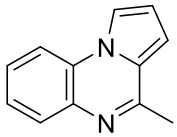
Light yellow solid (17.0 mg, 40% yield), melting point: 121-123 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.94-7.93 (m, 3 H), 7.52-7.41 (m, 2 H), 6.91-6.85 (m, 2 H), 4.67 (s, 1 H), 4.21 (s, 1 H), 3.24 (t, *J* = 7.2 Hz, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ =156.1, 135.0, 129.3, 129.1, 127.2, 125.7, 125.1, 114.6, 113.7, 113.6, 106.4, 60.3, 35.3; HRMS calcd for $C_{13}H_{12}N_2O$ $[M+H]^+$ 213.1022; found: 213.1017.




**4-(pyrrolo[1,2-*a*]quinoxalin-4-yl)butan-1-ol (3ad)**

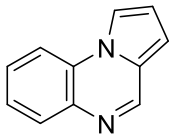
Yellow oil (19.7 mg, 41% yield). $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.92-7.89 (m, 2 H), 7.84-7.82 (m, 1 H), 7.50-7.40 (m, 2 H), 6.93-6.92 (m, 1 H), 6.86-6.84 (m, 1 H), 3.70 (t, *J* = 6 Hz, 2 H), 3.09 (t, *J* = 7.6 Hz, 2 H), 2.09-2.01 (m, 2 H), 1.79-1.72 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 157.1, 135.5, 129.2, 127.3, 127.1, 125.9, 125.2,

114.4, 113.7, 113.6, 106.5, 62.0, 34.4, 32.4, 23.4; HRMS calcd for $C_{15}H_{17}N_2O$ $[M+H]^+$ 241.1335; found: 241.1328.



**pyrrolo[1,2-*a*]quinoxalin-4-ylmethanol (4aa)**

Light yellow solid (19.3 mg, 53% yield), melting point: 132-133 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.92-7.90 (m, 2 H), 7.82 (d, *J* = 7.6 Hz, 1 H), 7.49-7.40 (m, 2 H), 6.90-6.89 (m, 1 H), 6.86-6.84 (m, 1 H), 2.73 (s, 3 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 153.7, 135.9, 129.2, 127.3, 126.9, 126.3, 125.1, 114.3, 113.7, 113.5, 106.5, 22.0; HRMS calcd for $C_{12}H_{11}N_2$ $[M+H]^+$ 183.0917; found: 183.0911.



**pyrrolo[1,2-*a*]quinoxaline (4ab)**

**4ab-1**

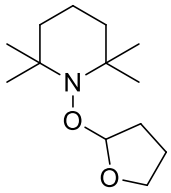
White solid (12.1 mg, 36% yield), melting point: 126-128 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.81 (s, 1 H), 7.97-7.92 (m, 2 H), 7.86 (d, *J* = 8 Hz, 1 H), 7.54-7.50 (m, 1 H), 7.47-7.43 (m, 1 H), 6.91-6.87 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 145.8, 135.8, 130.1, 128.0, 127.8, 126.4, 125.2, 114.2, 114.1, 113.8, 107.4; HRMS calcd for $C_{11}H_9N_2$ $[M+H]^+$ 169.0760; found: 169.0762.

**4ab-2**

White solid (18.8 mg, 56% yield), melting point: 126-128 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.81 (s, 1 H), 7.97-7.92 (m, 2 H), 7.86 (d, *J* = 8 Hz, 1 H), 7.54-7.50 (m, 1 H), 7.46-7.43 (m, 1 H), 6.91-6.87 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 145.8, 135.8, 130.1, 128.0, 127.8, 126.5, 125.2, 114.2, 114.0, 113.8, 107.3; HRMS calcd for $C_{11}H_9N_2$ $[M+H]^+$ 169.0760; found: 169.0760.

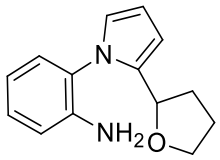
**4ab-3**

White solid (14.8 mg, 44% yield), melting point: 126-128 ºC. $^1$H NMR (400 MHz, $CDCl_3$, ppm): δ = 8.81 (s, 1 H), 7.96-7.91 (m, 2 H), 7.85 (d, *J* = 8.4 Hz, 1 H), 7.53-7.49 (m, 1 H), 7.46-7.42 (m, 1 H), 6.90-6.87 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 145.8, 135.8, 130.1, 128.0, 127.8, 126.5, 125.2, 114.2, 114.0, 113.8, 107.3; HRMS calcd for $C_{11}H_9N_2$ $[M+H]^+$ 169.0760; found: 169.0759.



**2,2,6,6-tetramethyl-1-((tetrahydrofuran-2-yl)oxy)piperidine (5)** [4]

Colorless oil (16.8 mg, 37% yield). $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 5.37-5.34 (m, 1 H), 3.92-3.79 (m, 2 H), 2.04-1.74 (m, 4 H), 1.59-1.39 (m, 5 H), 1.34-1.31 (m, 1 H), 1.22 (s, 3 H), 1.17-1.00 (m, 9 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 109.5, 66.6, 60.1, 58.5, 40.0, 39.6, 33.8, 33.3, 31.2, 23.9, 20.4, 20.0, 17.2; HRMS calcd for $C_{13}H_{26}NO_2$ $[M+H]^+$ 228.1958; found: 228.1951.



**2-(2-(tetrahydrofuran-2-yl)-1*H*-pyrrol-1-yl)aniline (6)**

White solid (13.3 mg, 29% yield), melting point: 88-90 °C. $^{1}$H NMR (400 MHz, $CDCl_3$, ppm): δ = 7.28-7.25 (m, 1 H), 7.14-7.13 (m, 1 H), 6.96-6.91 (m, 1 H), 6.82-6.76 (m, 1 H), 6.73-6.70 (m, 1 H), 6.30-6.28 (m, 1 H), 5.99-5.97 (m, 1 H), 4.51-4.47 (m, 1 H), 3.68-3.64 (m, 2 H), 1.95-1.82 (m, 2 H), 1.75-1.66 (m, 2 H); $^{13}$C NMR (100 MHz, $CDCl_3$, ppm): δ = 135.7, 129.3, 125.4, 124.6, 119.0, 115.4, 114.6, 114.1, 109.9, 104.0, 62.7, 50.8, 31.9, 28.5; HRMS calcd for $C_{14}H_{17}N_2O$ $[M+H]^+$ 229.1336; found: 229.1333.

## References


[1] C.-X. Xie, L. Feng, W.-L. Li, X.-J. Ma, X.-K. Ma, Y.-H. Liu and C. Ma. *Org. Biomol. Chem*., 2016, **14**, 8529.
[2] Z.-Y. Zhang, C.-X. Xie, X.-C. Tan, G.-L. Song, L.-L. Wen, H. Gao, and C. Ma, *Org. Chem. Front.*, 2015, **2**, 942.
[3] Z. Y. An, L. B. Zhao, M. Z. Wu, J. X. Ni, Z. J. Qi, G. Q. Yu and R. L. Yan, *Chem. Commun*., 2017, **53**, 11572.
[4] (a) D. Liu, C. Liu, H. Li, and A. Lei, *Chem. Commun.,* 2014, **50**, 3623; (b) S. Pan, J. Liu, H. Li, Z. Wang, X. Guo and Z. Li, *Org. Lett.,* 2010, **12**, 1932.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7.897
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7.806
7.788
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7.459
7.444
7.417
7.413
7.397
7.394
6.944
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6.934
6.850
6.844
6.840
6.834
4.275
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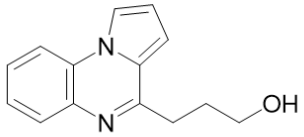
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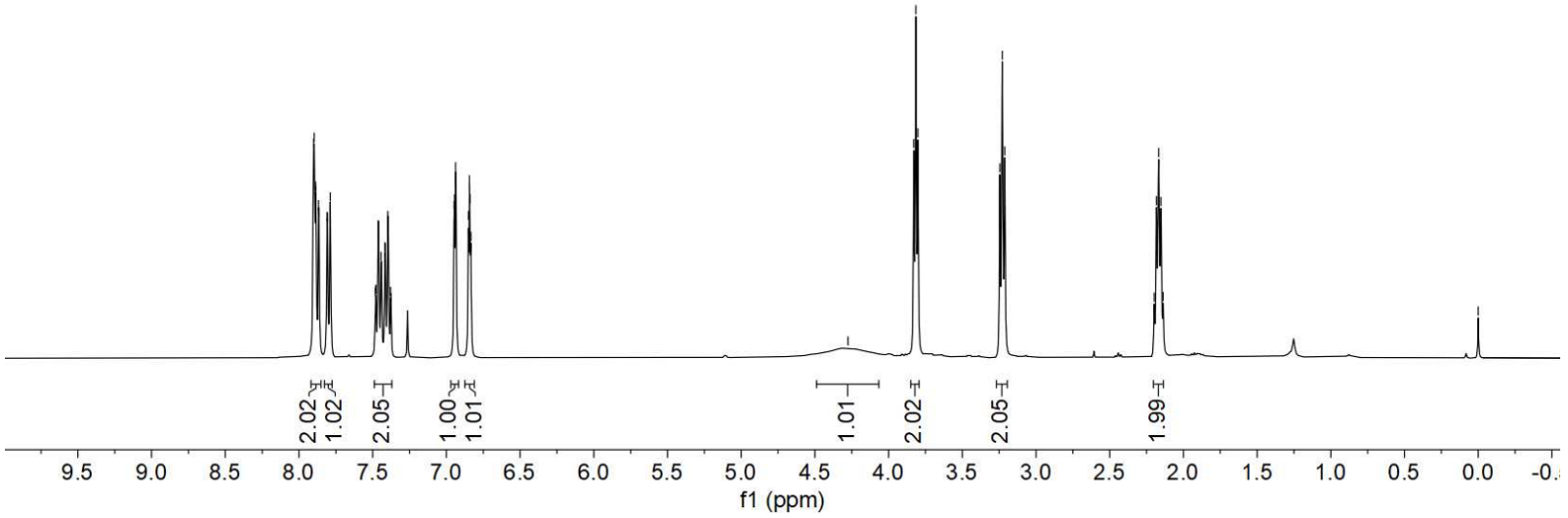
**3aa**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8.0
7.5
7.0
6.5
6.0
5.5
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3.5
3.0
2.5
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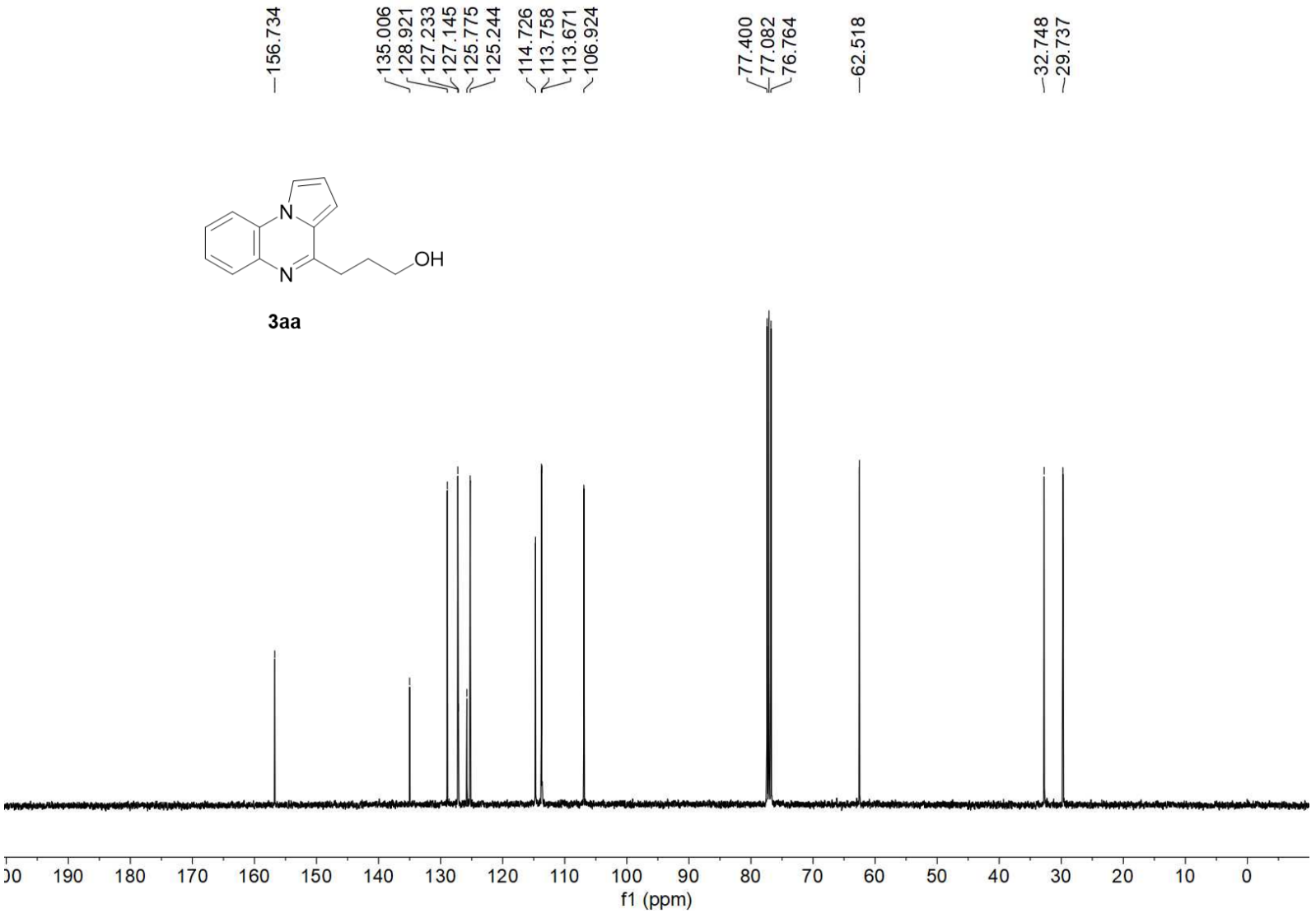
f1 (ppm)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77.082
76.764
62.518
32.748
29.737
N
N
OH
3aa
190
180
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130
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110
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90
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70
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50
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30
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10
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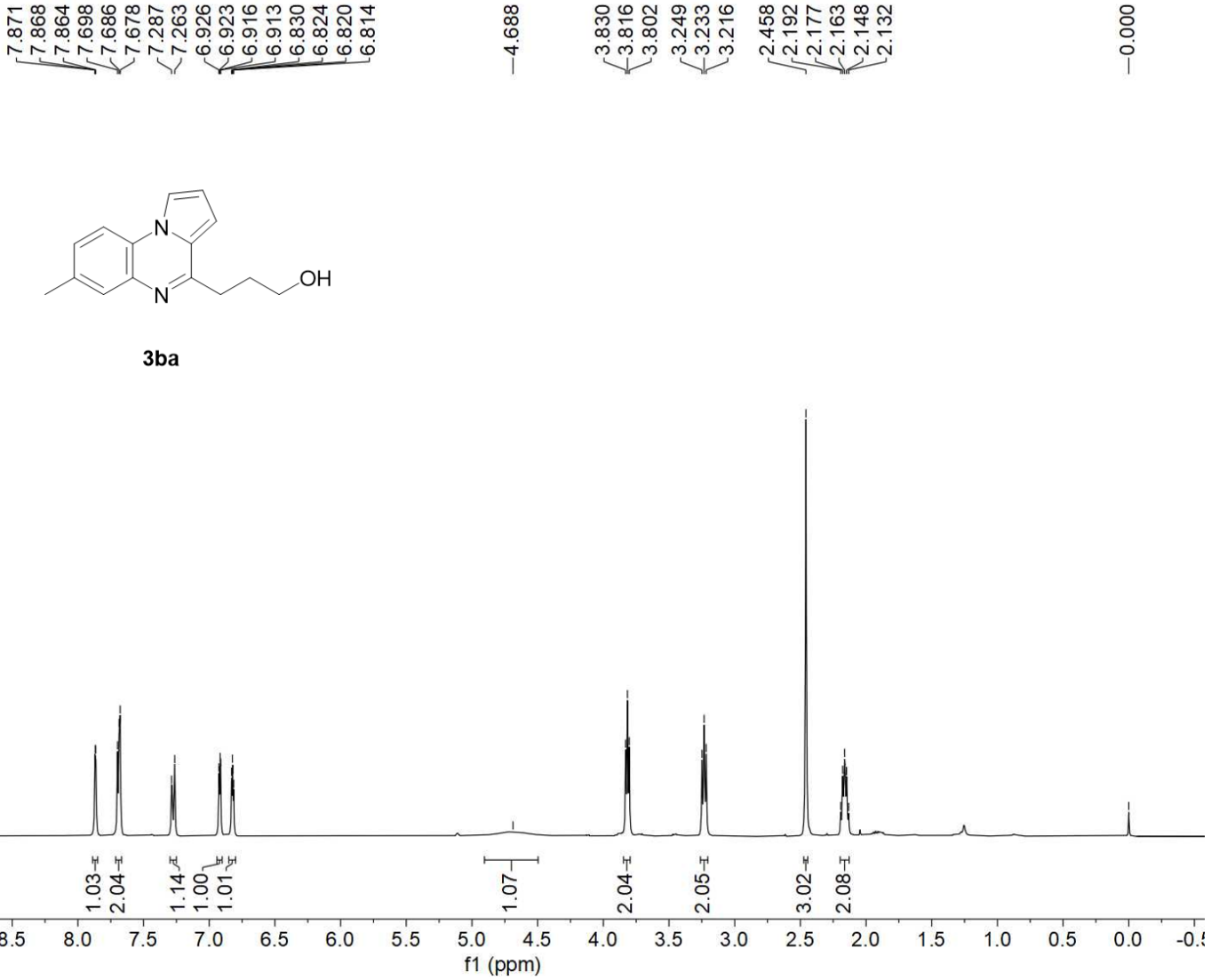
f1 (ppm)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6.913
6.830
6.824
6.820
6.814
4.688
3.830
3.816
3.802
3.249
3.233
3.216
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2.192
2.177
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2.148
2.132
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N
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1.01
1.07
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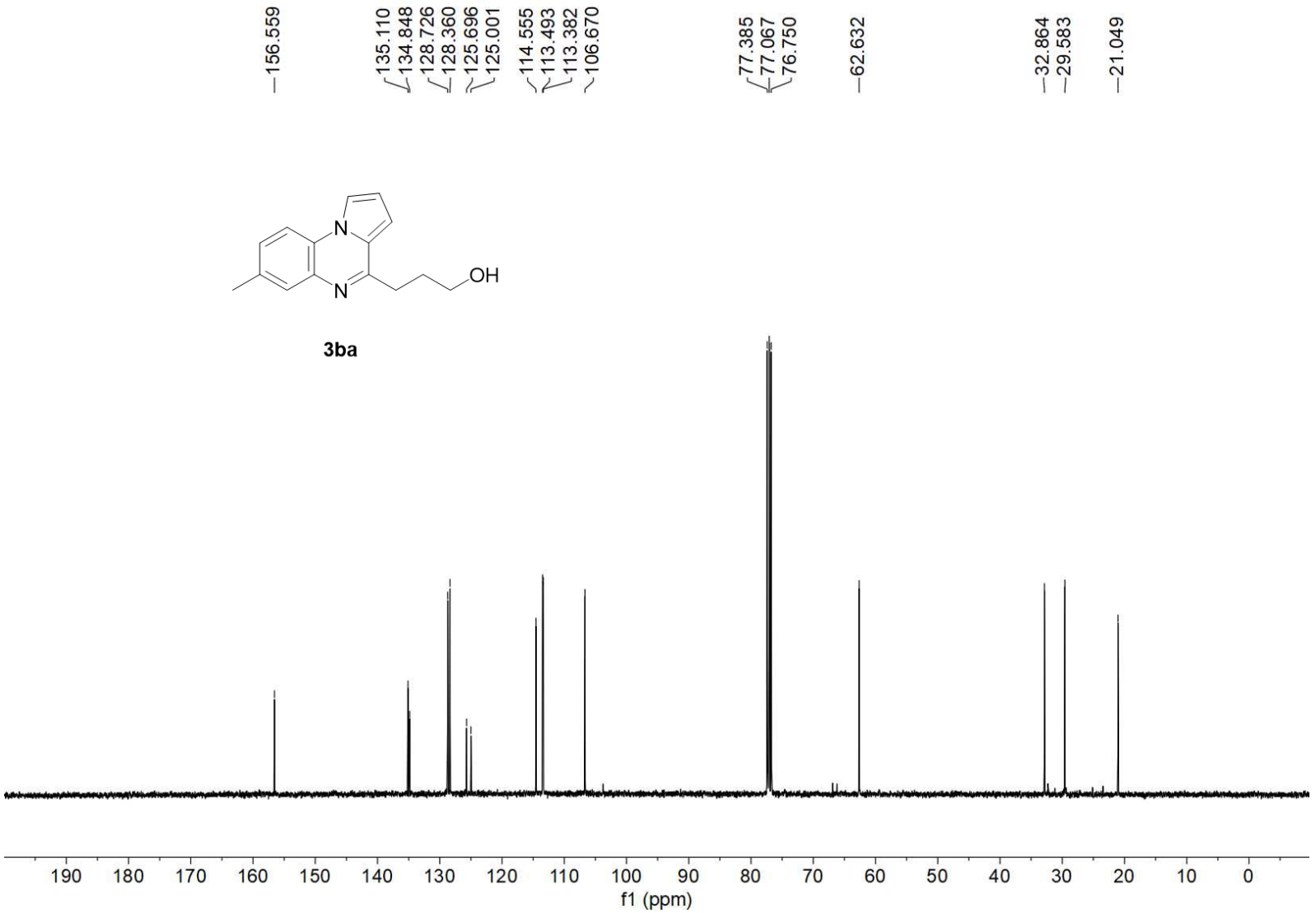
2.05
3.02
2.08
f1 (ppm)

**3ba**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77.067
76.750
62.632
32.864
29.583
21.049
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N
OH
3ba
190
180
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130
120
110
100
90
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50
40
30
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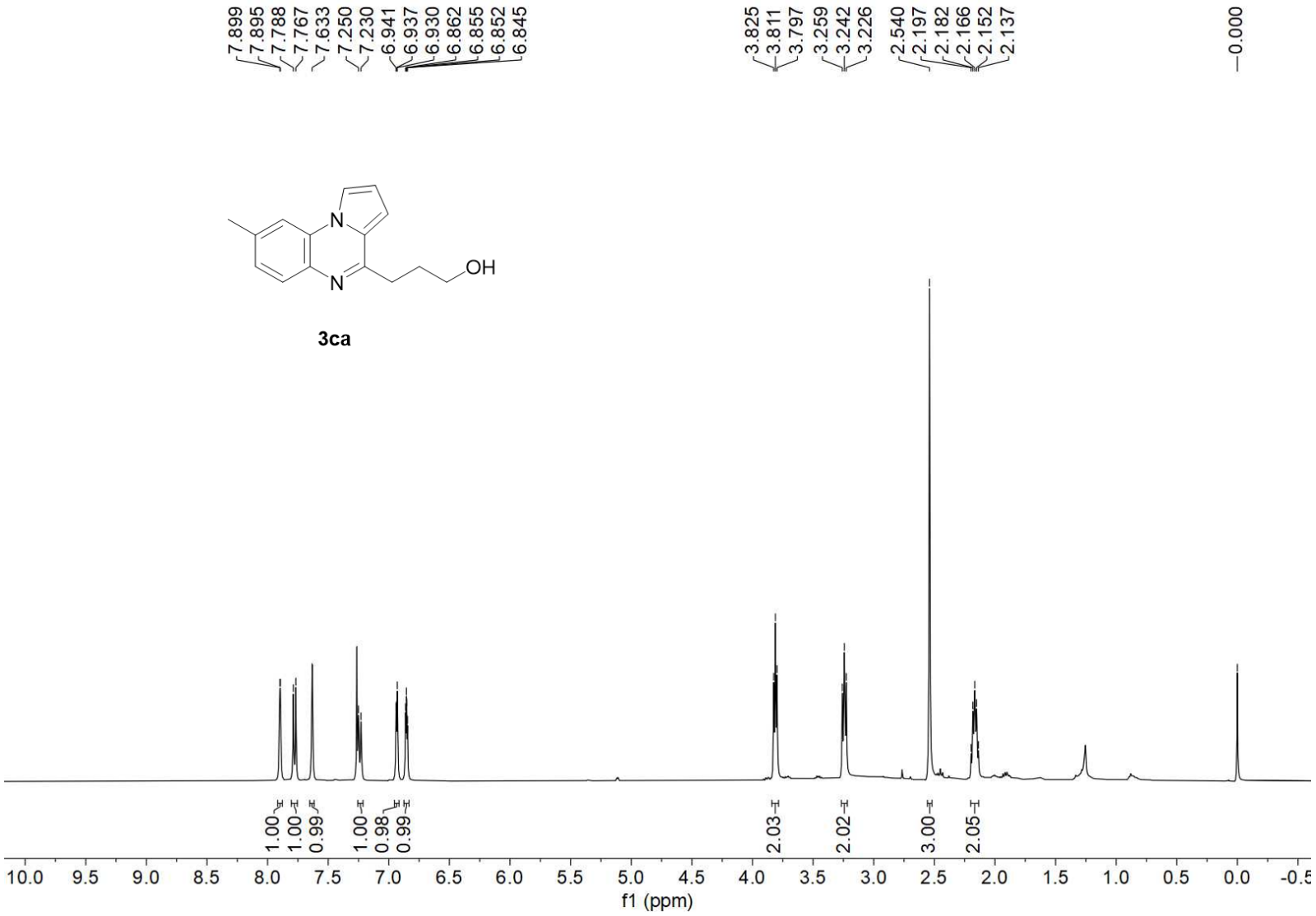
10
0
f1 (ppm)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3.825
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3.242
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2.540
2.197
2.182
2.166
2.152
2.137
0.000
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OH
1.00
1.00
0.99
1.00
0.98
0.99
2.03
2.02
3.00
2.05
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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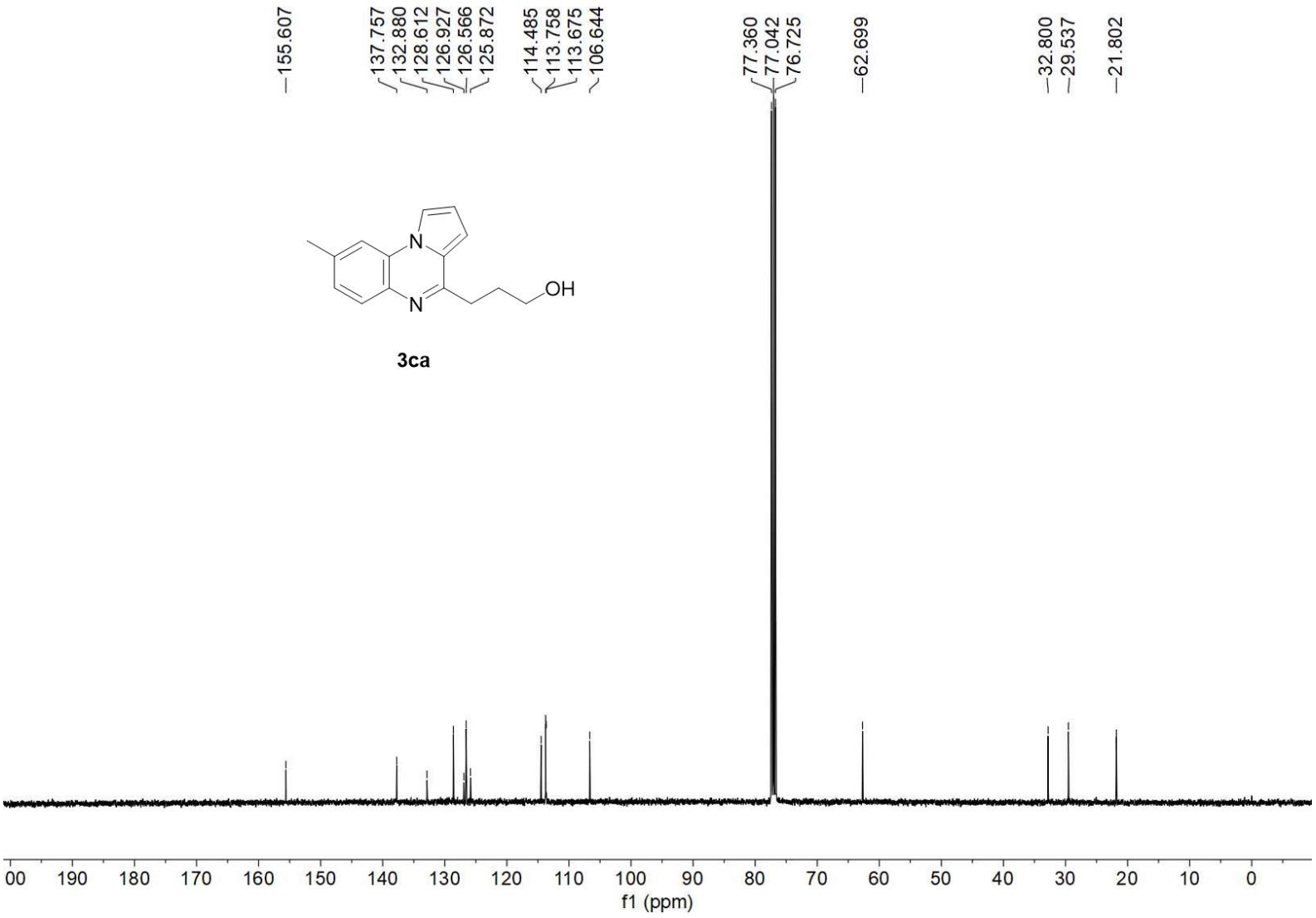
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77.042
76.725
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21.802
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N
OH
3ca
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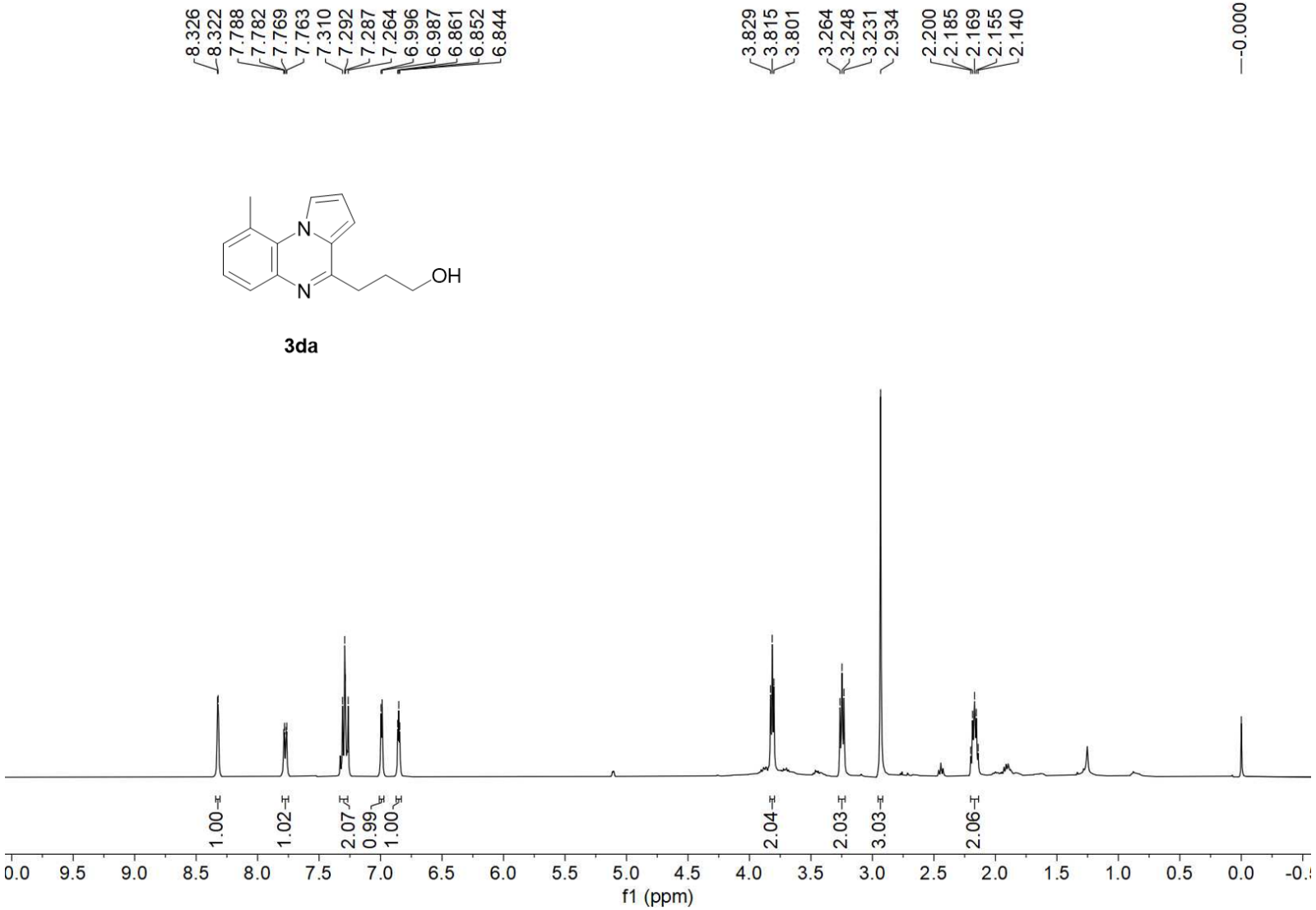
f1 (ppm)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6.861
6.852
6.844
3.829
3.815
3.801
3.264
3.248
3.231
2.934
2.200
2.185
2.169
2.155
2.140
-0.000
N
N
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3.03
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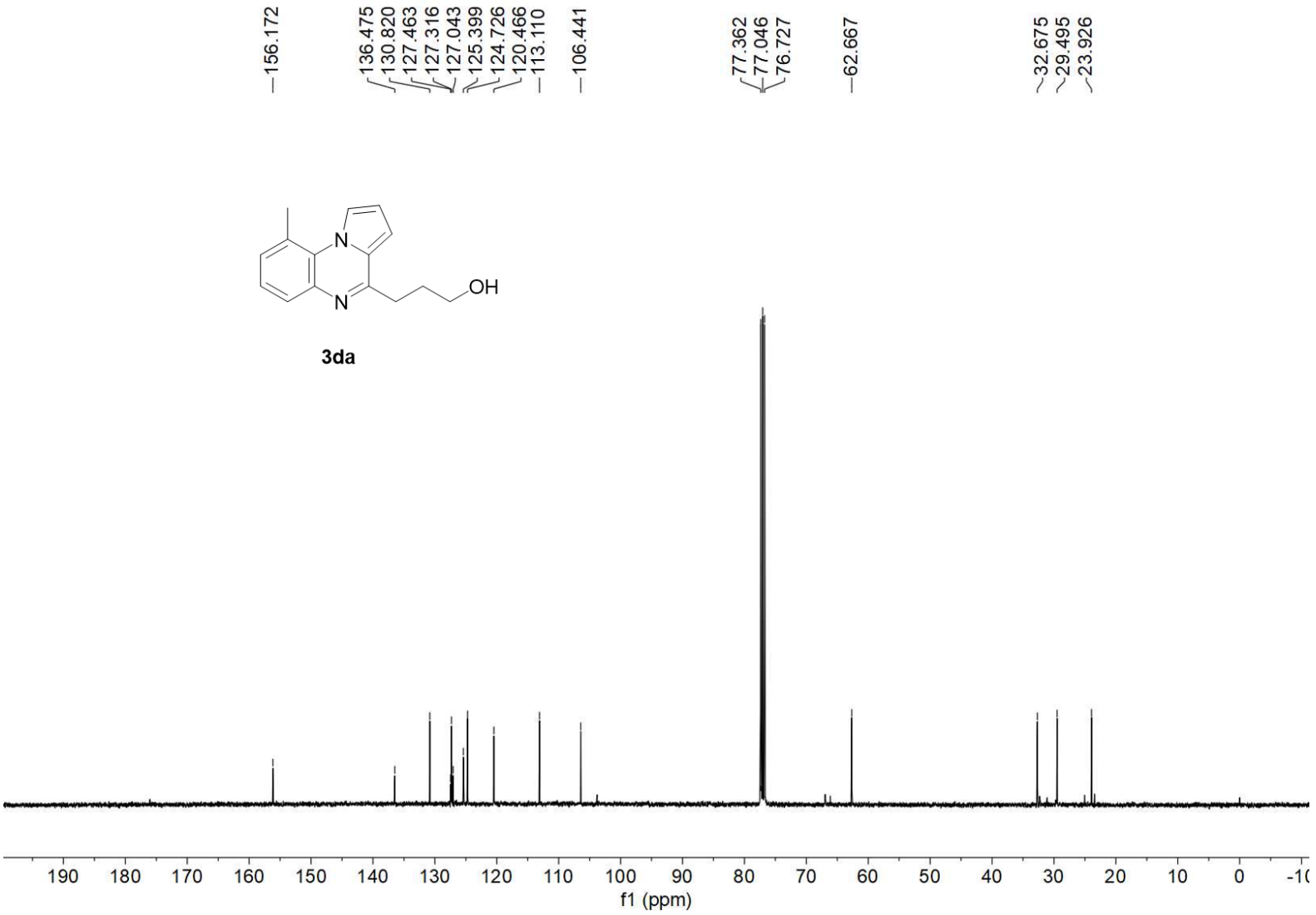
f1 (ppm)

**3da**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76.727
62.667
32.675
29.495
23.926
N
N
OH
3da
190
180
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130
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110
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90
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50
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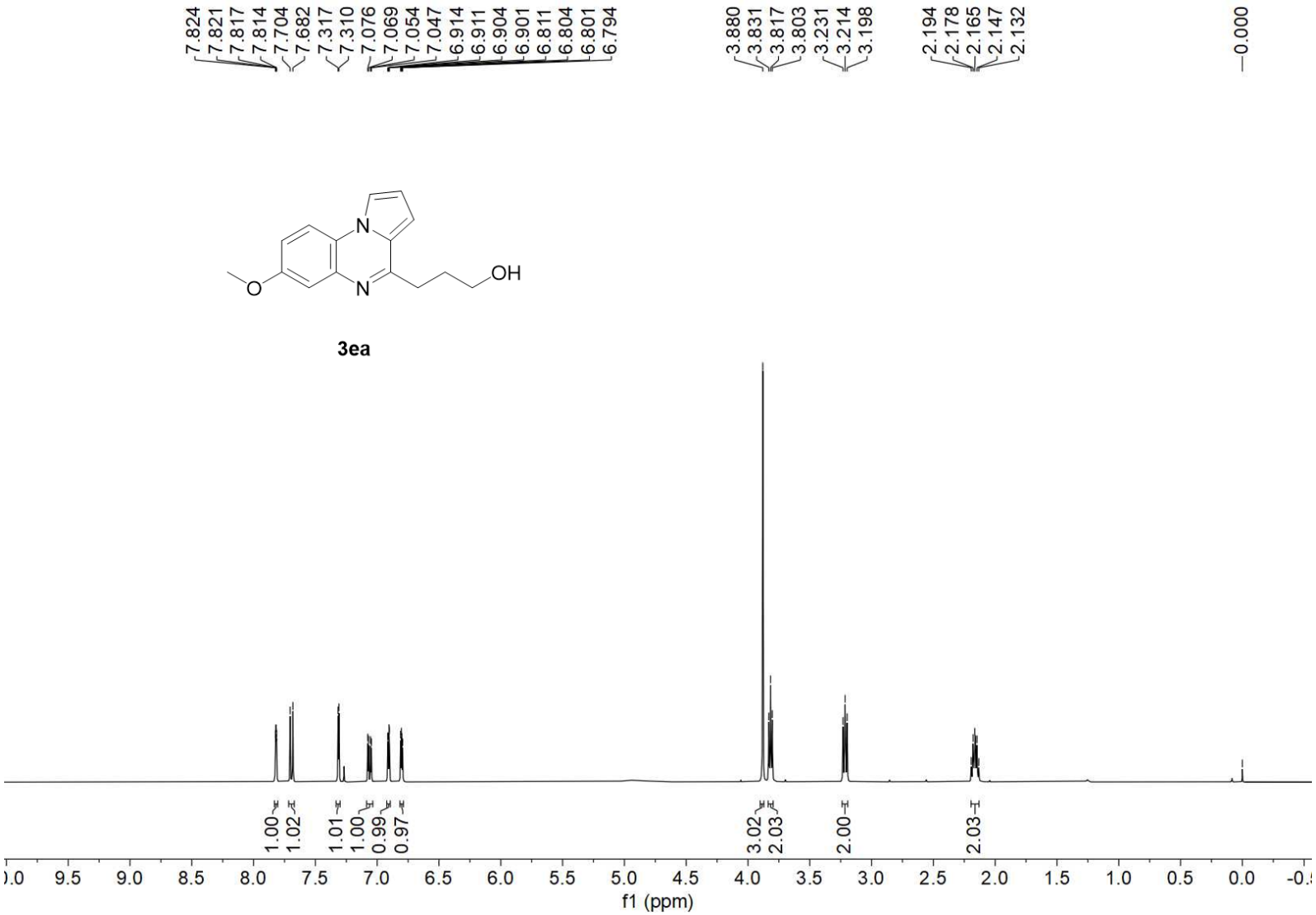
f1 (ppm)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3.803
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3.214
3.198
2.194
2.178
2.165
2.147
2.132
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N
O
OH
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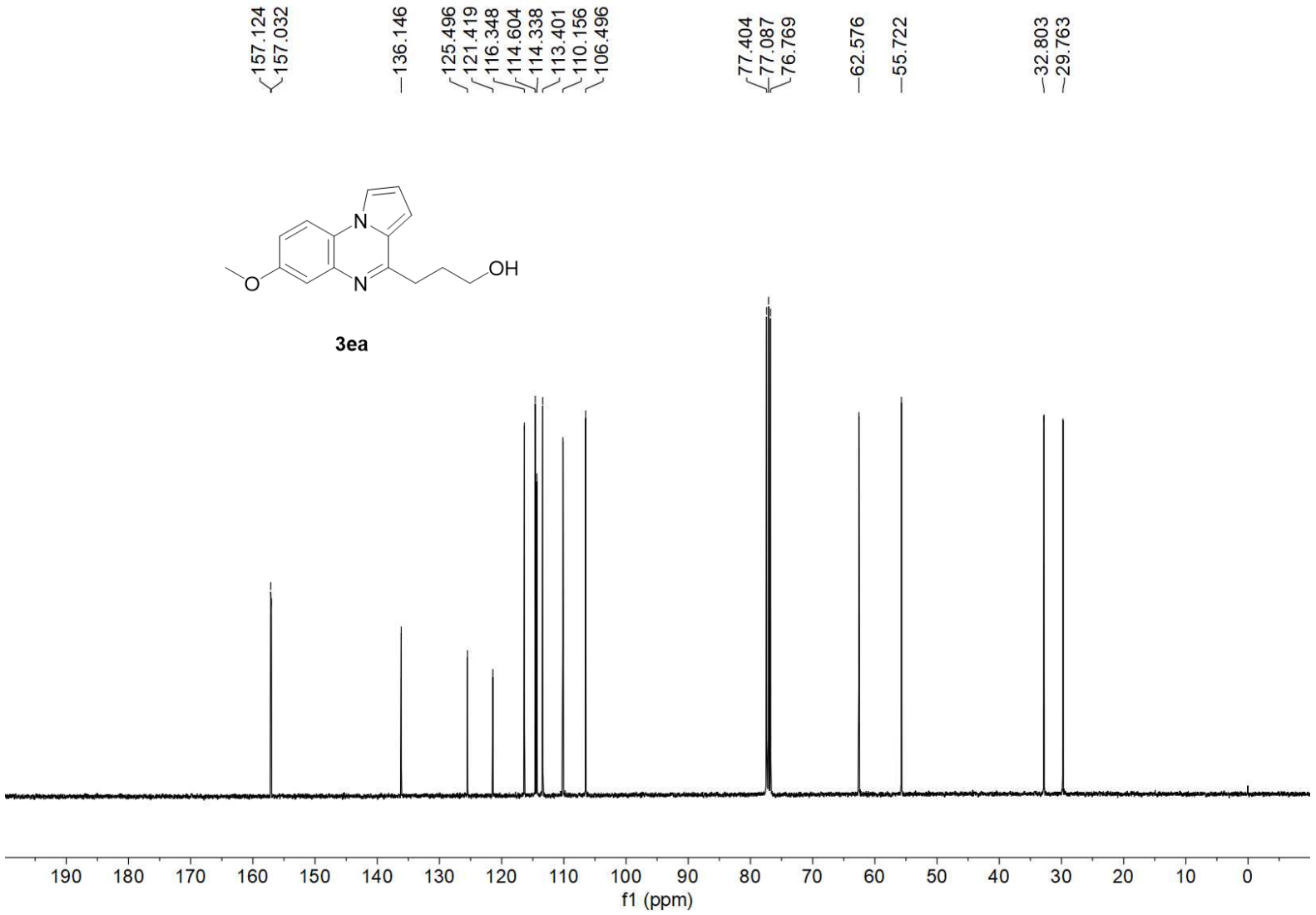
2.00
2.03
f1 (ppm)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114.338
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77.087
76.769
62.576
55.722
32.803
29.763
N
N
O
OH
3ea
190
180
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50
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10
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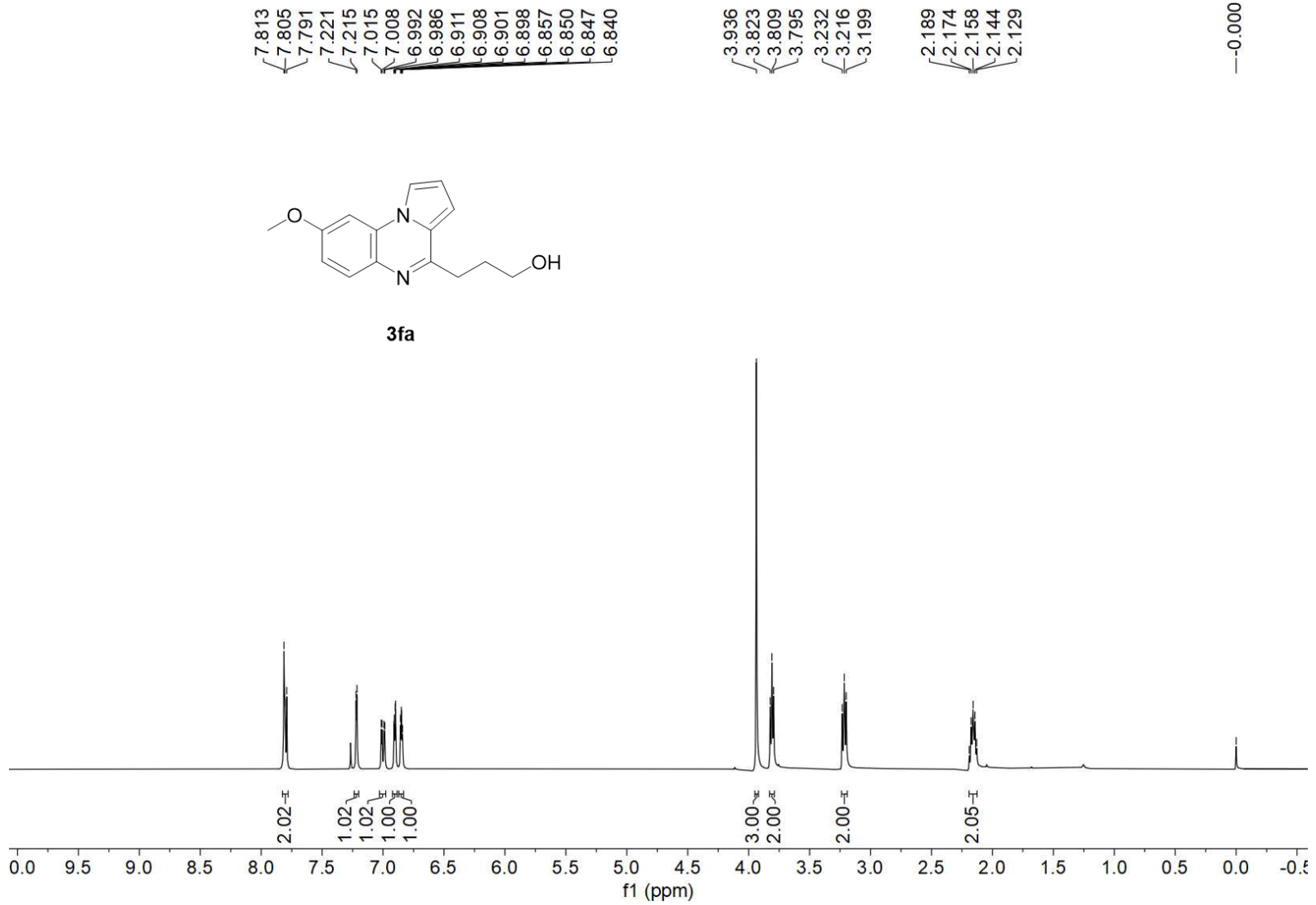
f1 (ppm)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6.901
6.898
6.857
6.850
6.847
6.840
3.936
3.823
3.809
3.795
3.232
3.216
3.199
2.189
2.174
2.158
2.144
2.129
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O
N
N
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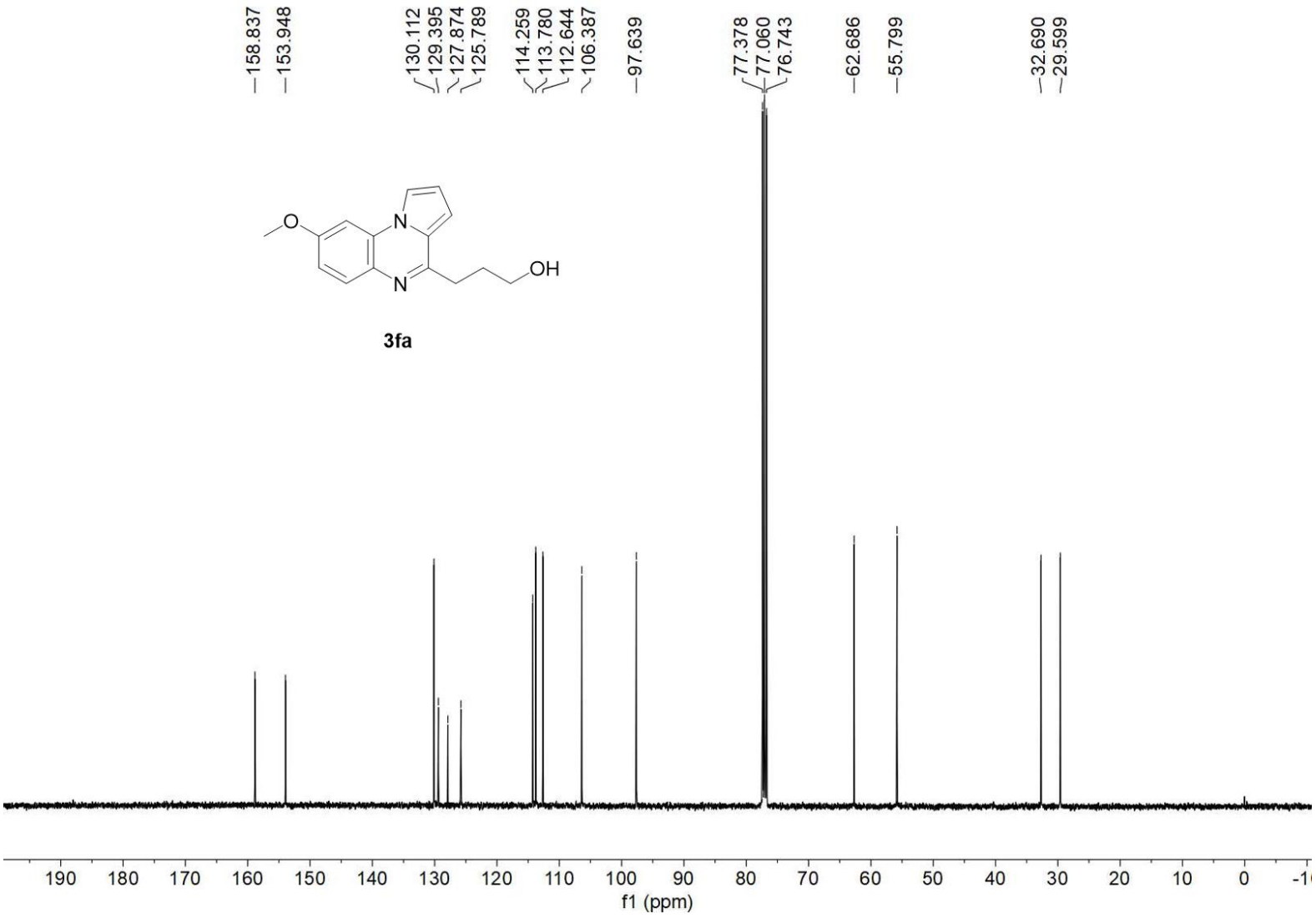
f1 (ppm)

**3fa**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77.378
77.060
76.743
62.686
55.799
32.690
29.599
O
N
N
OH
3fa
190
180
170
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150
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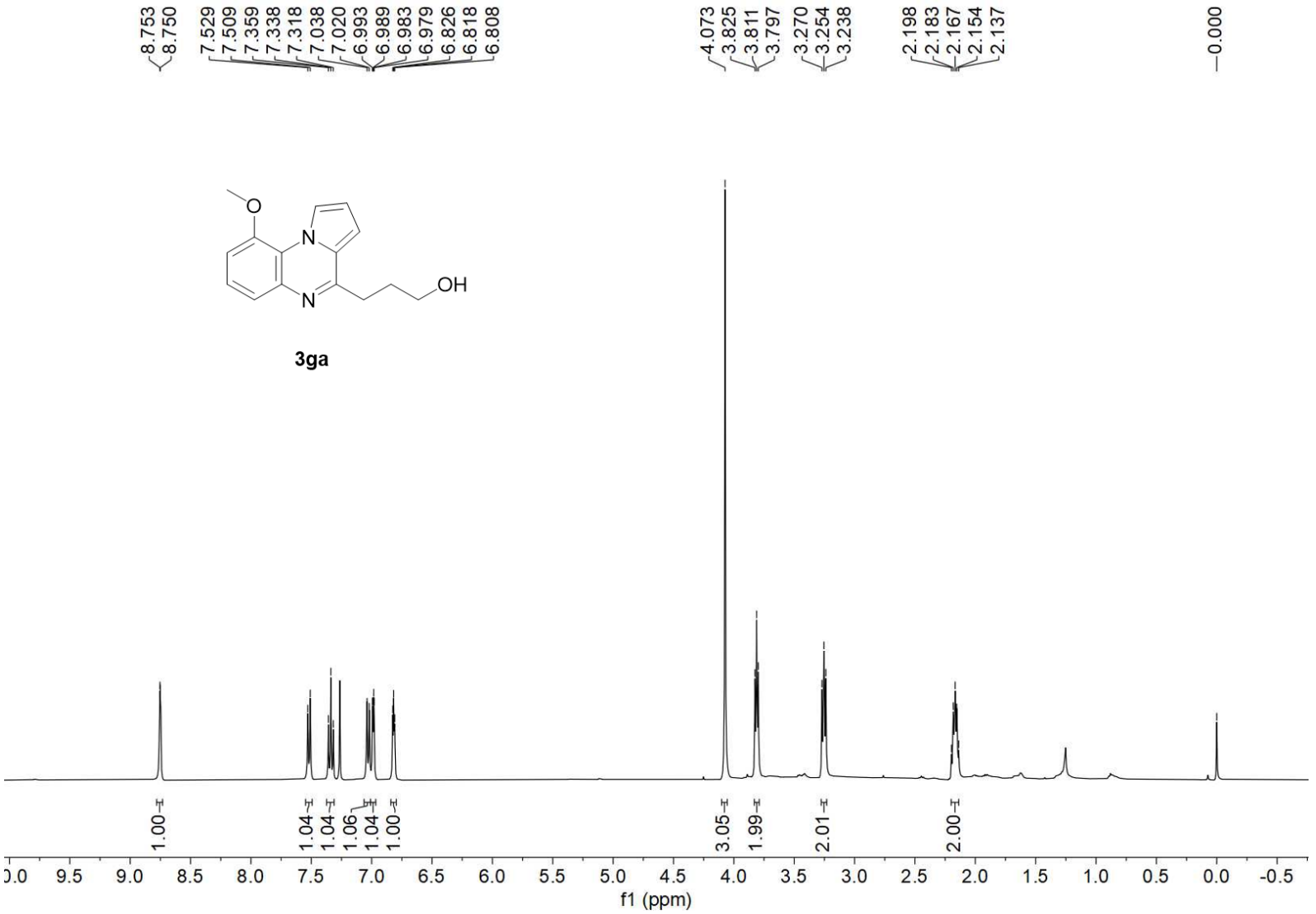
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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6.979
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6.818
6.808
4.073
3.825
3.811
3.797
3.270
3.254
3.238
2.198
2.183
2.167
2.154
2.137
0.000
O
N
N
OH
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1.06
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1.00
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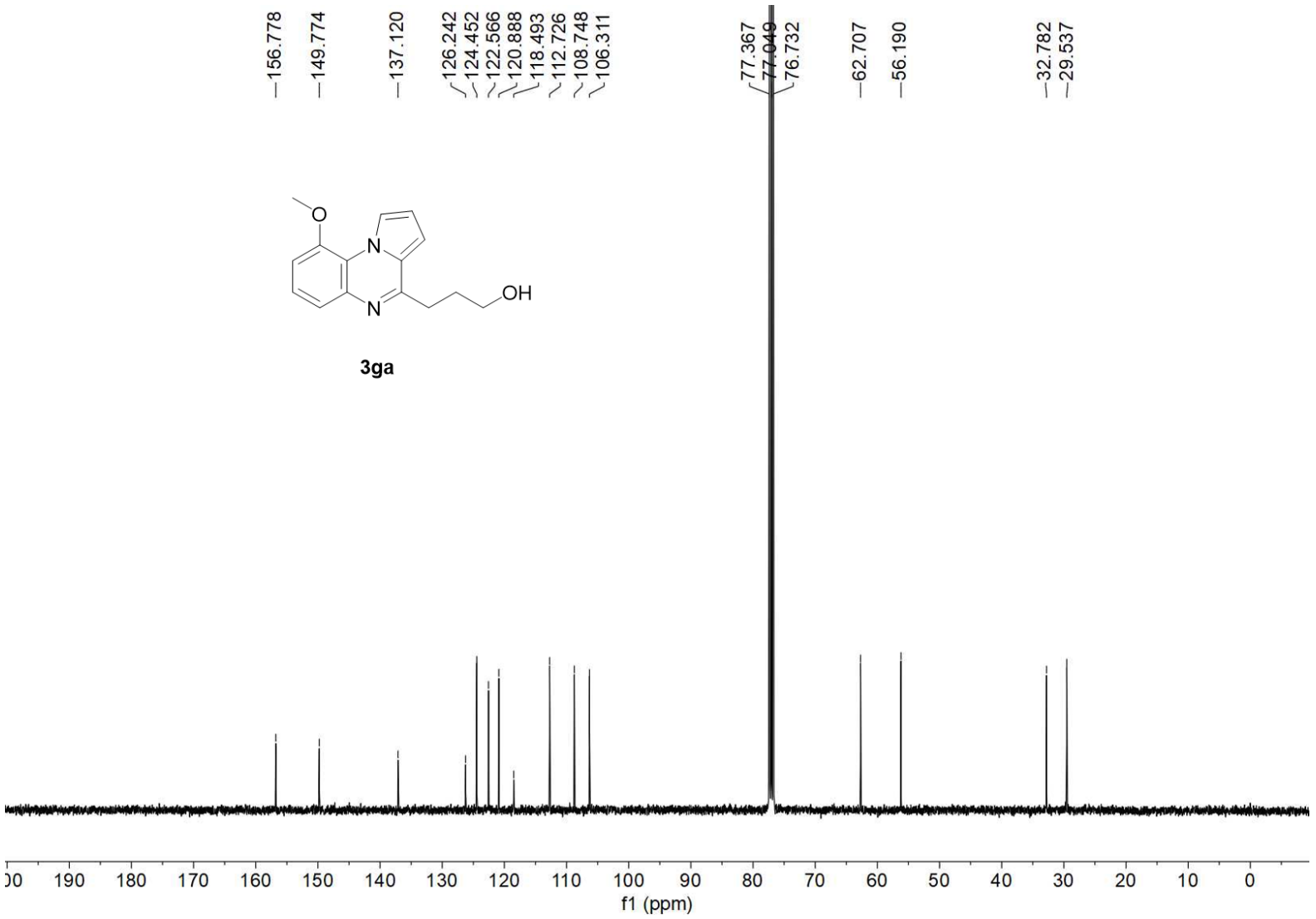
2.01
2.00
f1 (ppm)

**3ga**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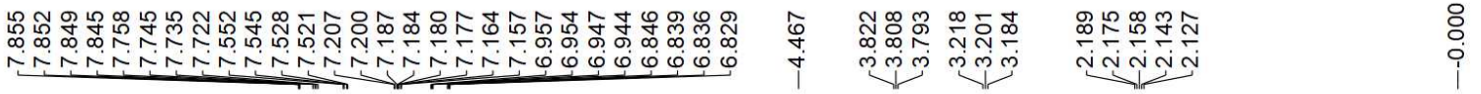
OH
3ga
f1 (ppm)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7.177
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6.944
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6.829
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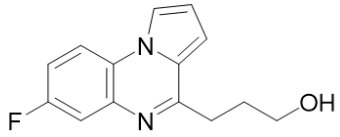
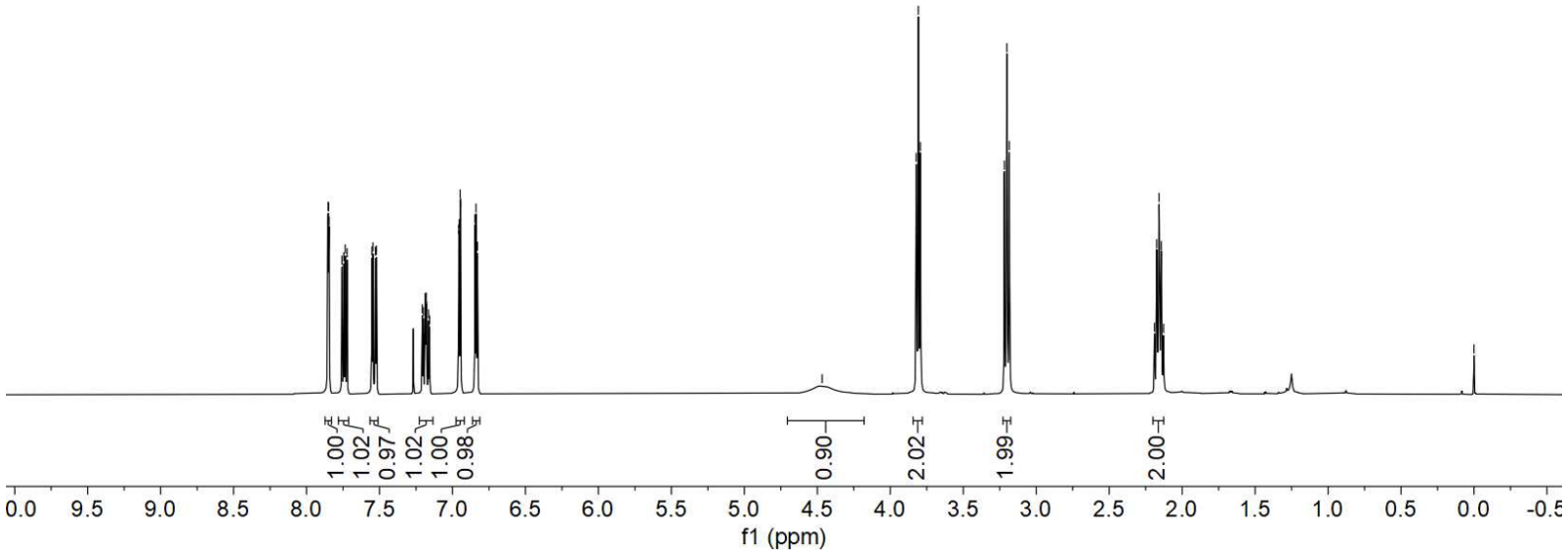

N
F
N
OH

**3ha**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9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
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3.0
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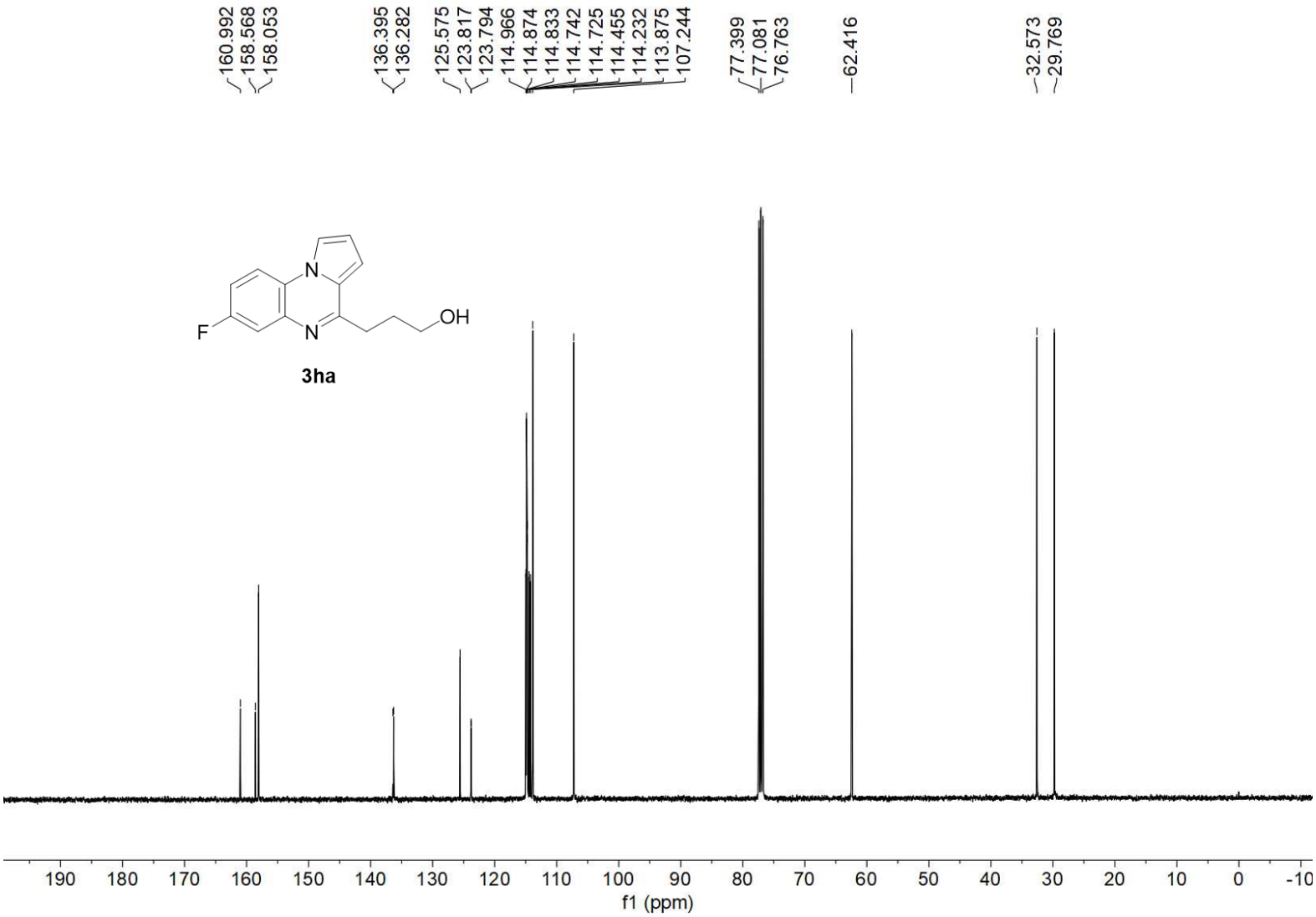
f1 (ppm)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114.874
114.833
114.742
114.725
114.455
114.232
113.875
107.244
77.399
77.081
76.763
62.416
32.573
29.769
N
N
F
OH
3ha
190
180
170
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120
110
100
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80
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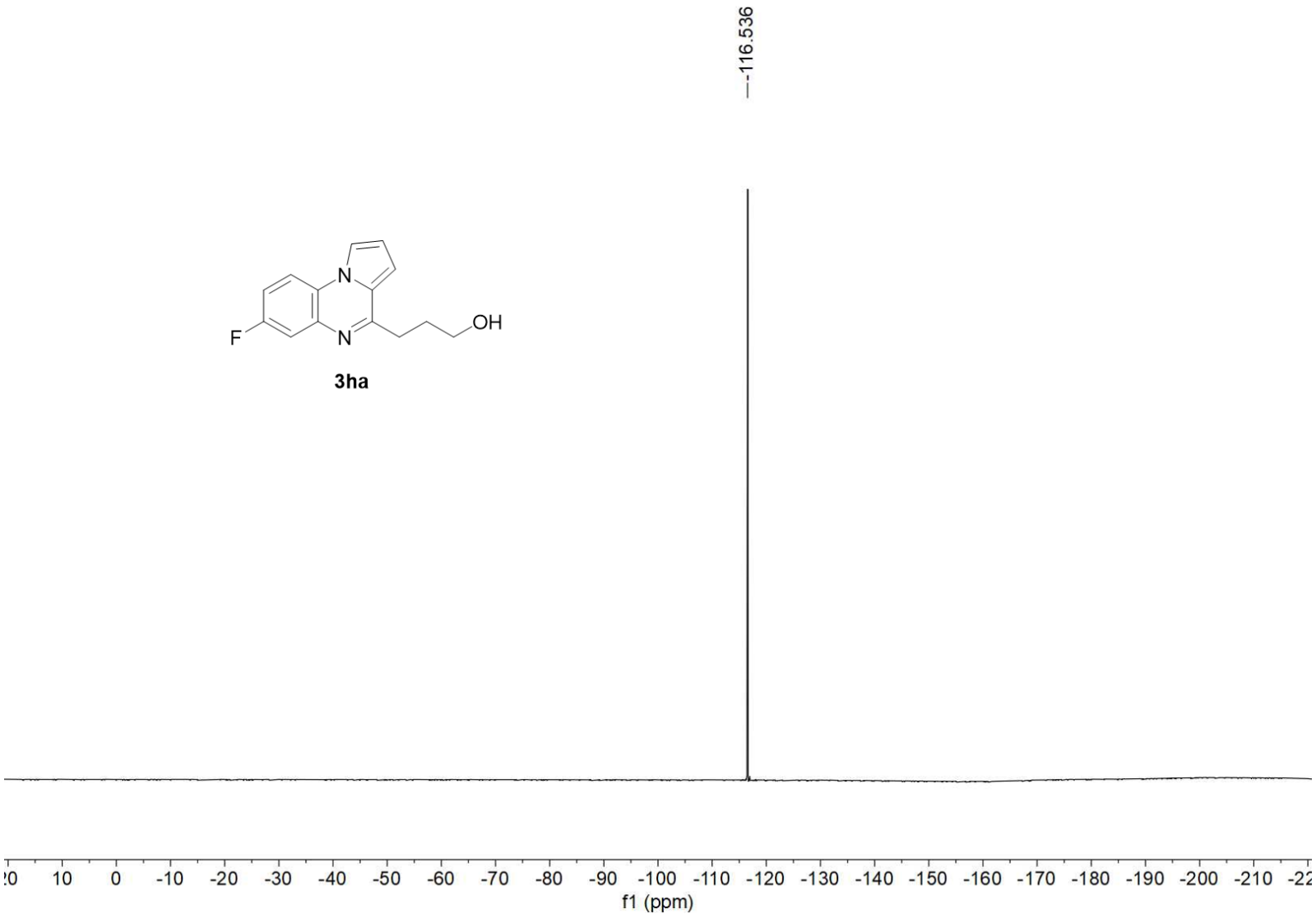
30
20
10
0
-10
f1 (ppm)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-60
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-170
-180
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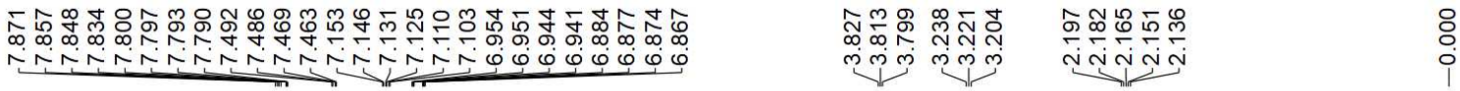
-200
-210
f1 (ppm)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7.125
7.110
7.103
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6.951
6.944
6.941
6.884
6.877
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6.867
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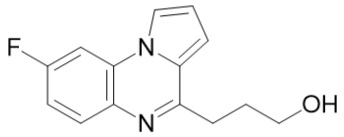
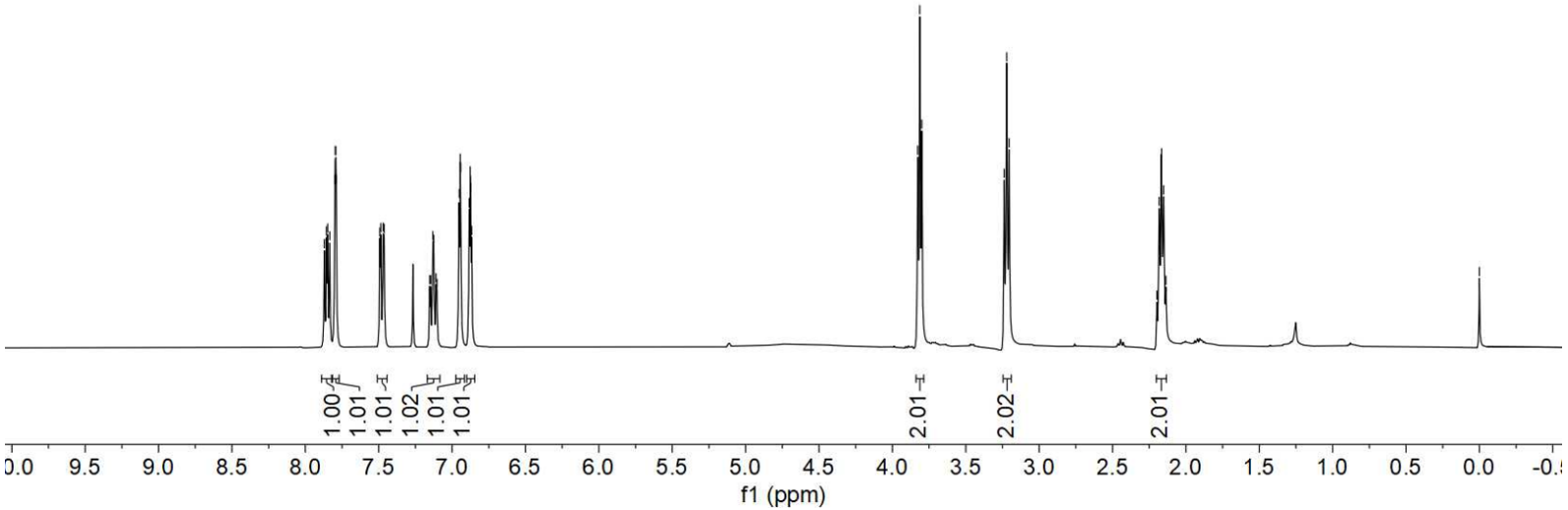

F
N
N
OH

**3ia**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1.01
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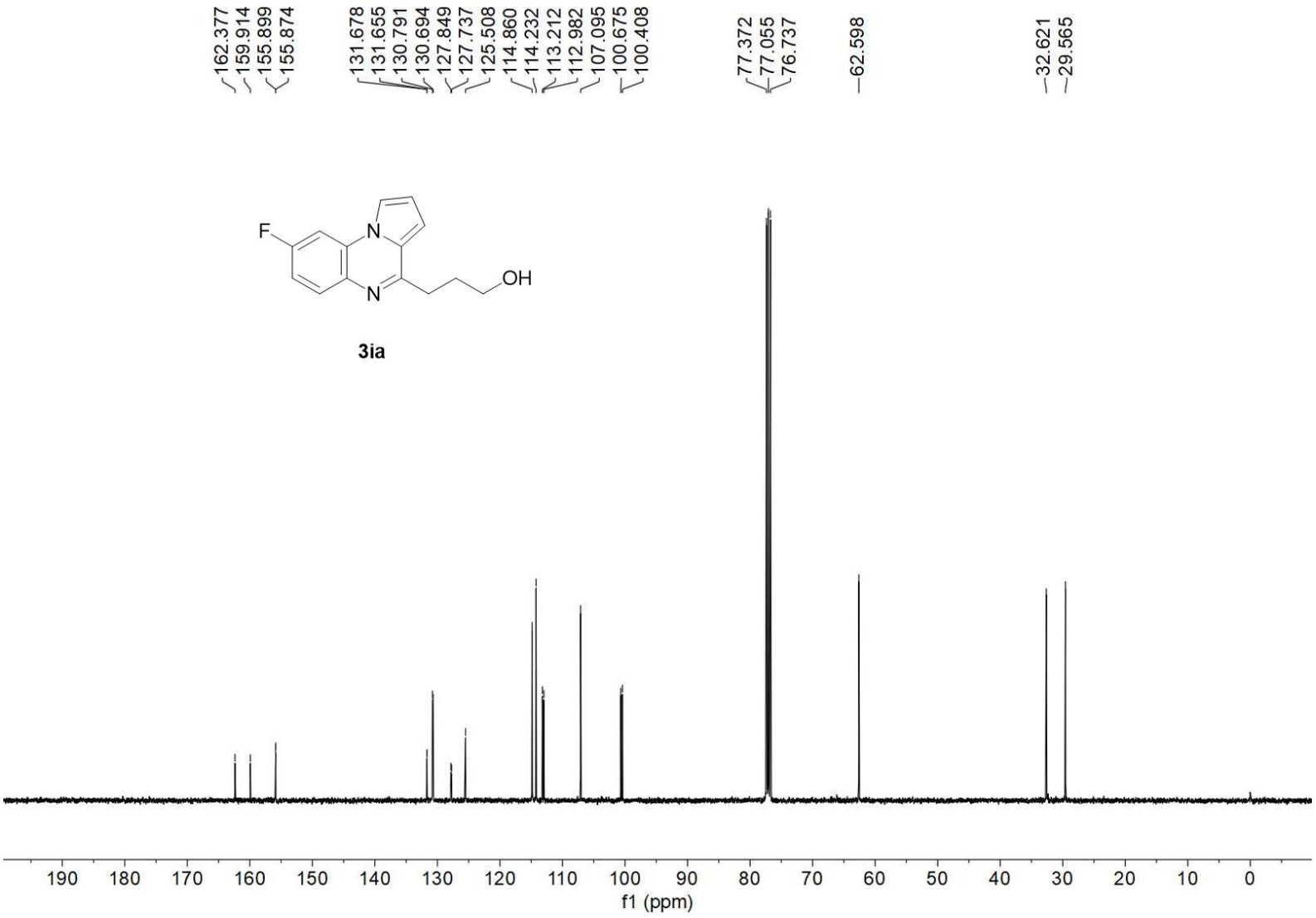
1.01
1.01
2.01
2.02
2.01
f1 (ppm)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114.232
113.212
112.982
107.095
100.675
100.408
77.372
77.055
76.737
62.598
32.621
29.565
F
N
N
OH
3ia
190
180
170
160
150
140
130
120
110
100
90
80
70
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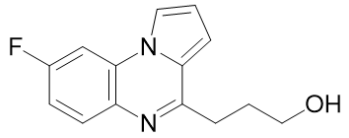
50
40
30
20
10
0
f1 (ppm)


F
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N
OH

**3ia**


-111.266
10
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-10
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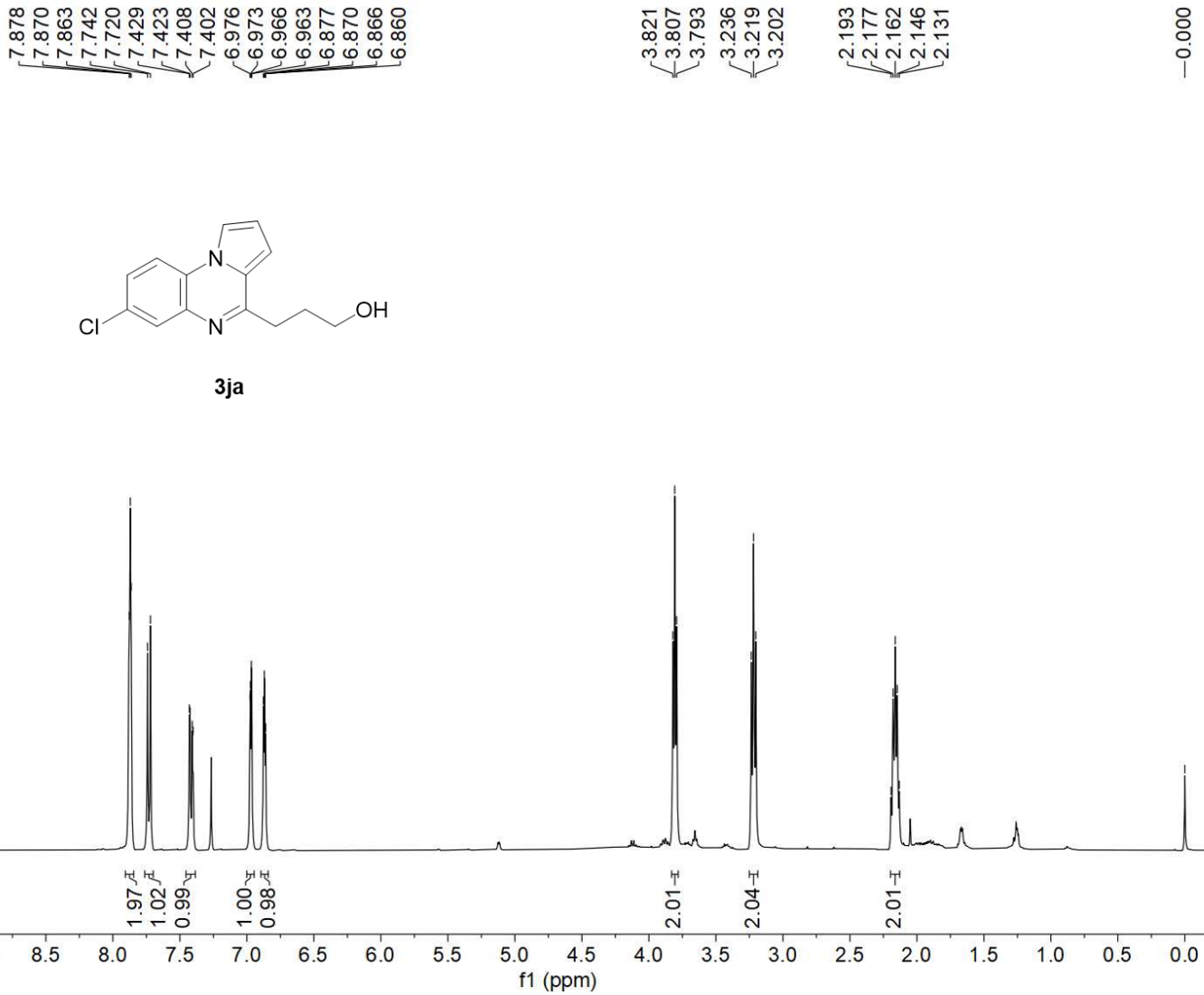
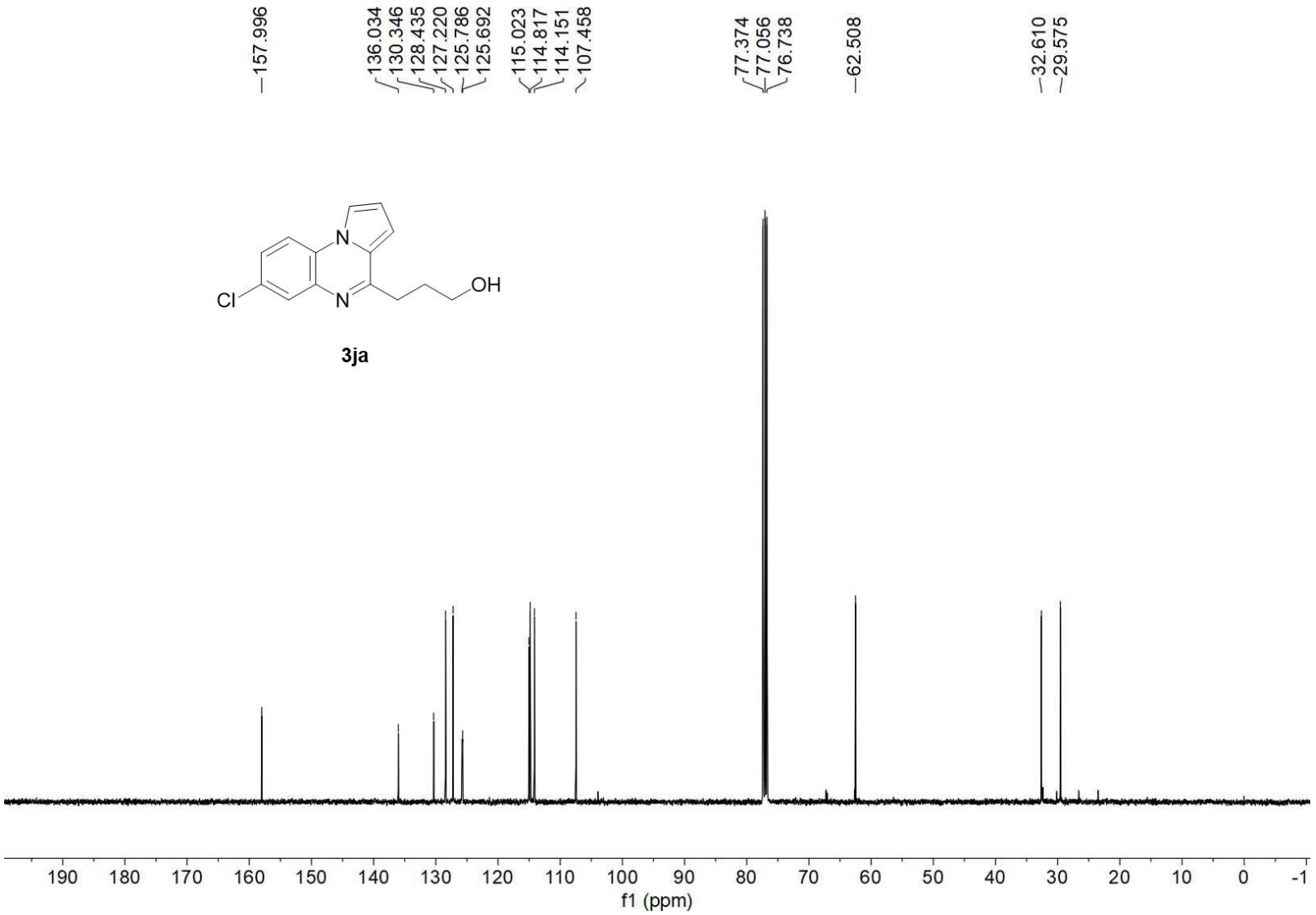
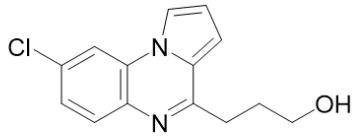
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)


7.878
7.870
7.863
7.742
7.720
7.429
7.423
7.408
7.402
6.976
6.973
6.966
6.963
6.877
6.870
6.866
6.860
3.821
3.807
3.793
3.236
3.219
3.202
2.193
2.177
2.162
2.146
2.131
0.000
N
N
Cl
OH
1.97
1.02
0.99
1.00
0.98
2.01
2.04
2.01
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)

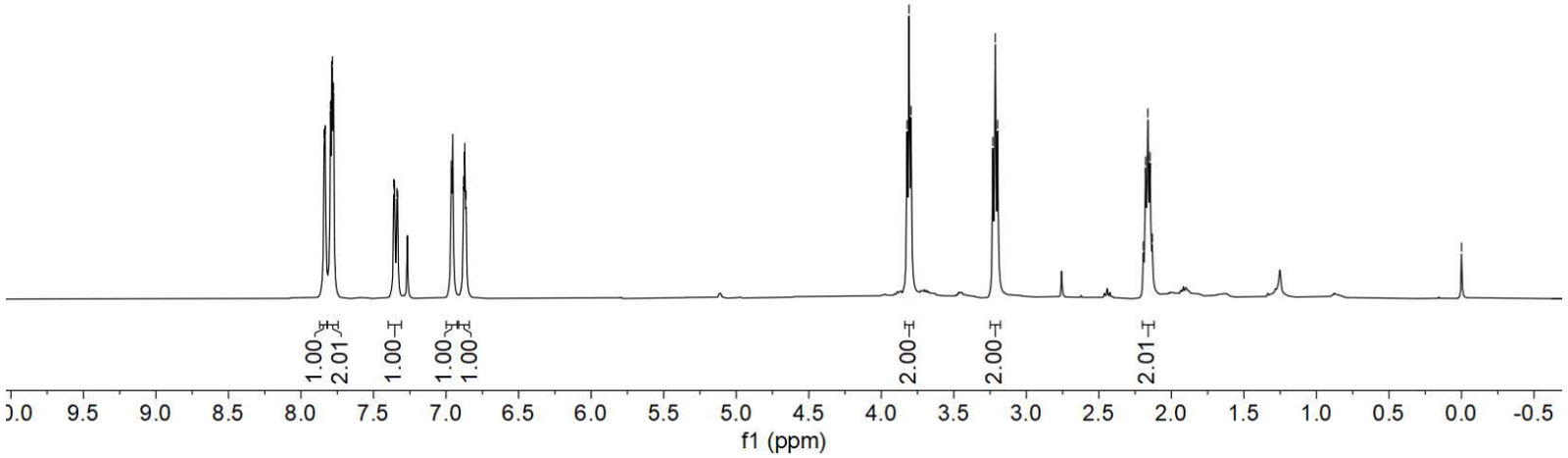
**3ja**

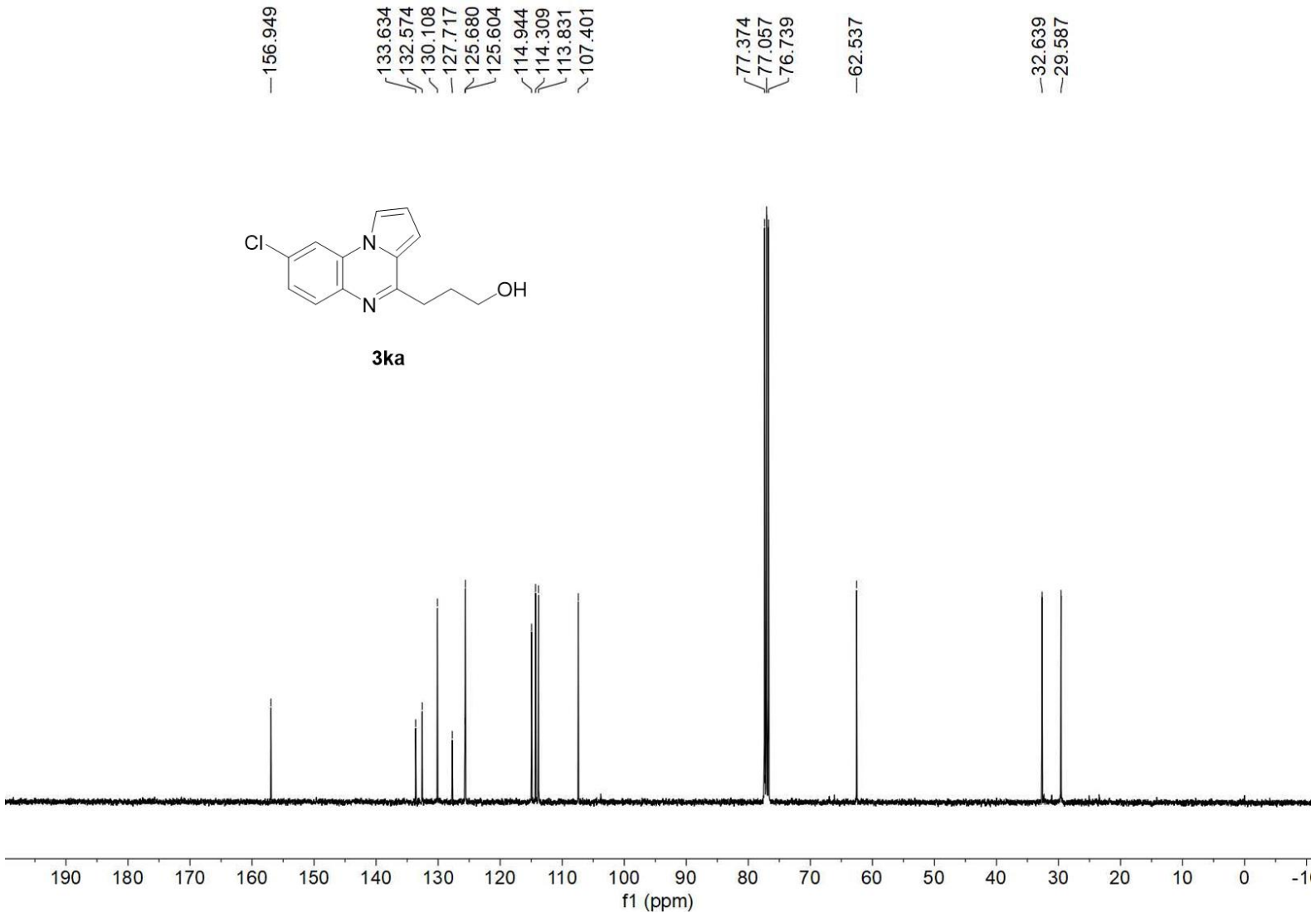

157.996
136.034
130.346
128.435
127.220
125.786
125.692
115.023
114.817
114.151
107.458
77.374
77.056
76.738
62.508
32.610
29.575
N
N
Cl
OH
3ja
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1
f1 (ppm)


7.840
7.833
7.798
7.789
7.784
7.776
7.361
7.355
7.339
7.334
6.964
6.954
6.879
6.871
6.863
3.823
3.808
3.794
3.231
3.214
3.198
2.193
2.178
2.162
2.147
2.131
0.000

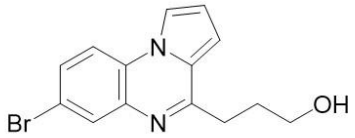

Cl
N
N
OH

**3ka**

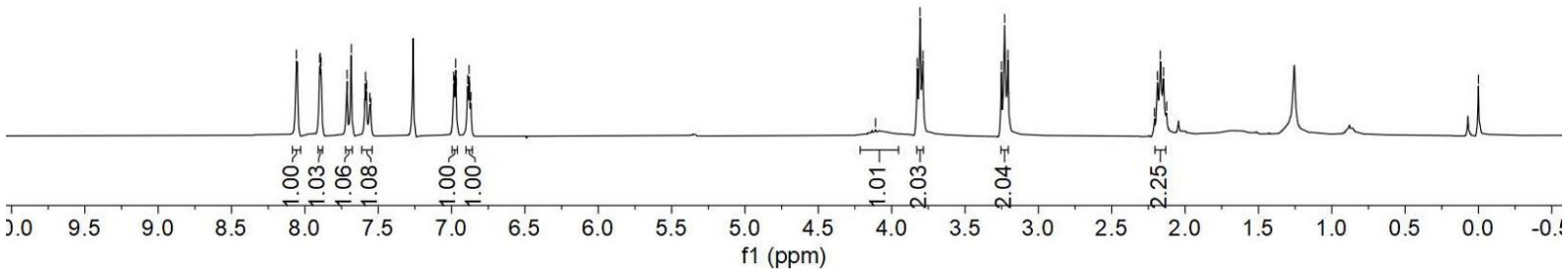

1.00
2.01
1.00
1.00
1.00
2.00
2.00
2.01
f1 (ppm)

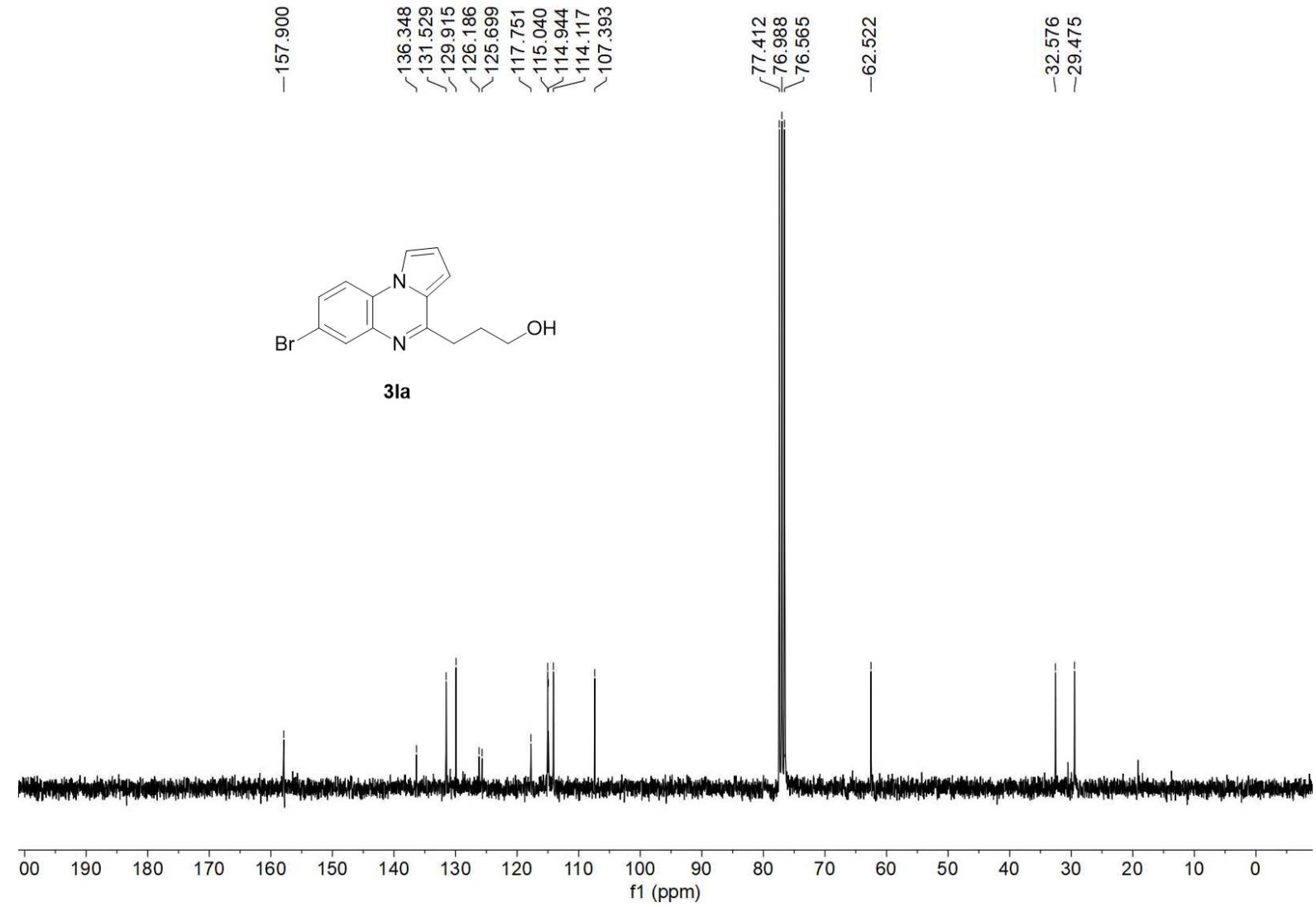

156.949
133.634
132.574
130.108
127.717
125.680
125.604
114.944
114.309
113.831
107.401
77.374
77.057
76.739
62.537
32.639
29.587
Cl
N
N
OH
3ka
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

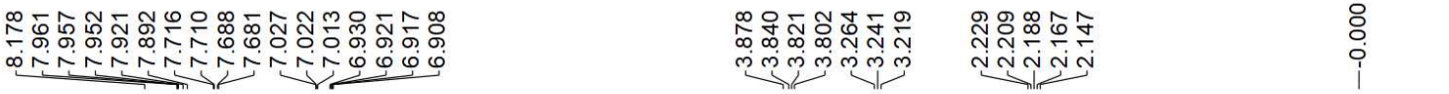

8.057
8.050
7.899
7.895
7.890
7.713
7.689
7.683
7.592
7.586
7.579
7.558
7.550
6.985
6.981
6.972
6.967
6.890
6.881
6.876
6.868
4.110
3.825
3.807
3.787
3.251
3.230
3.207
2.208
2.188
2.169
2.147
2.125
-0.000

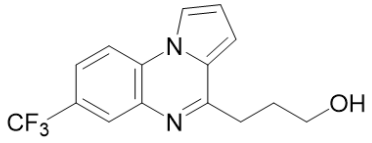

N
Br
N
OH

**3la**

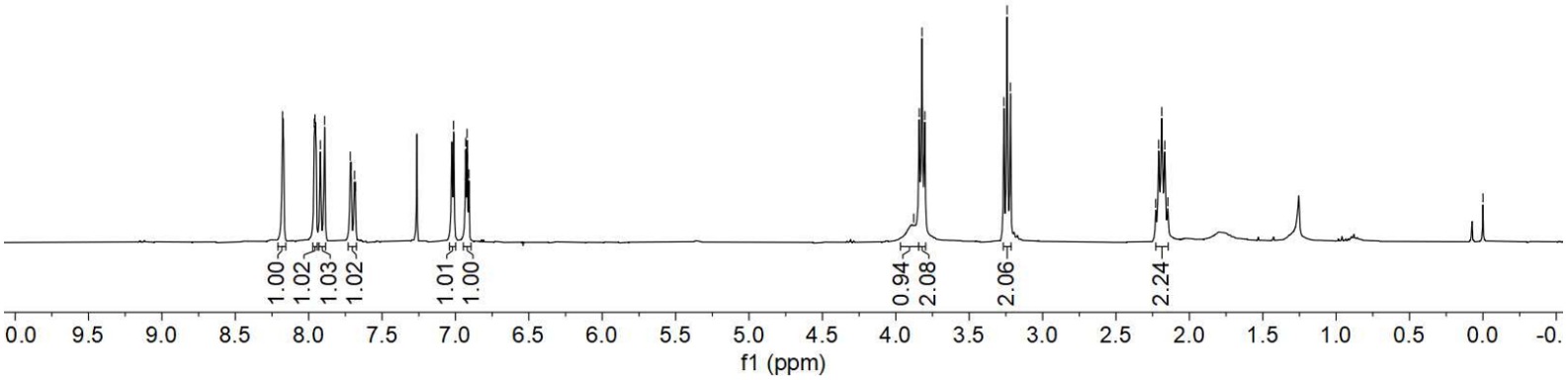

1.00
1.03
1.06
1.08
1.00
1.00
1.01
2.03
2.04
2.25
f1 (ppm)

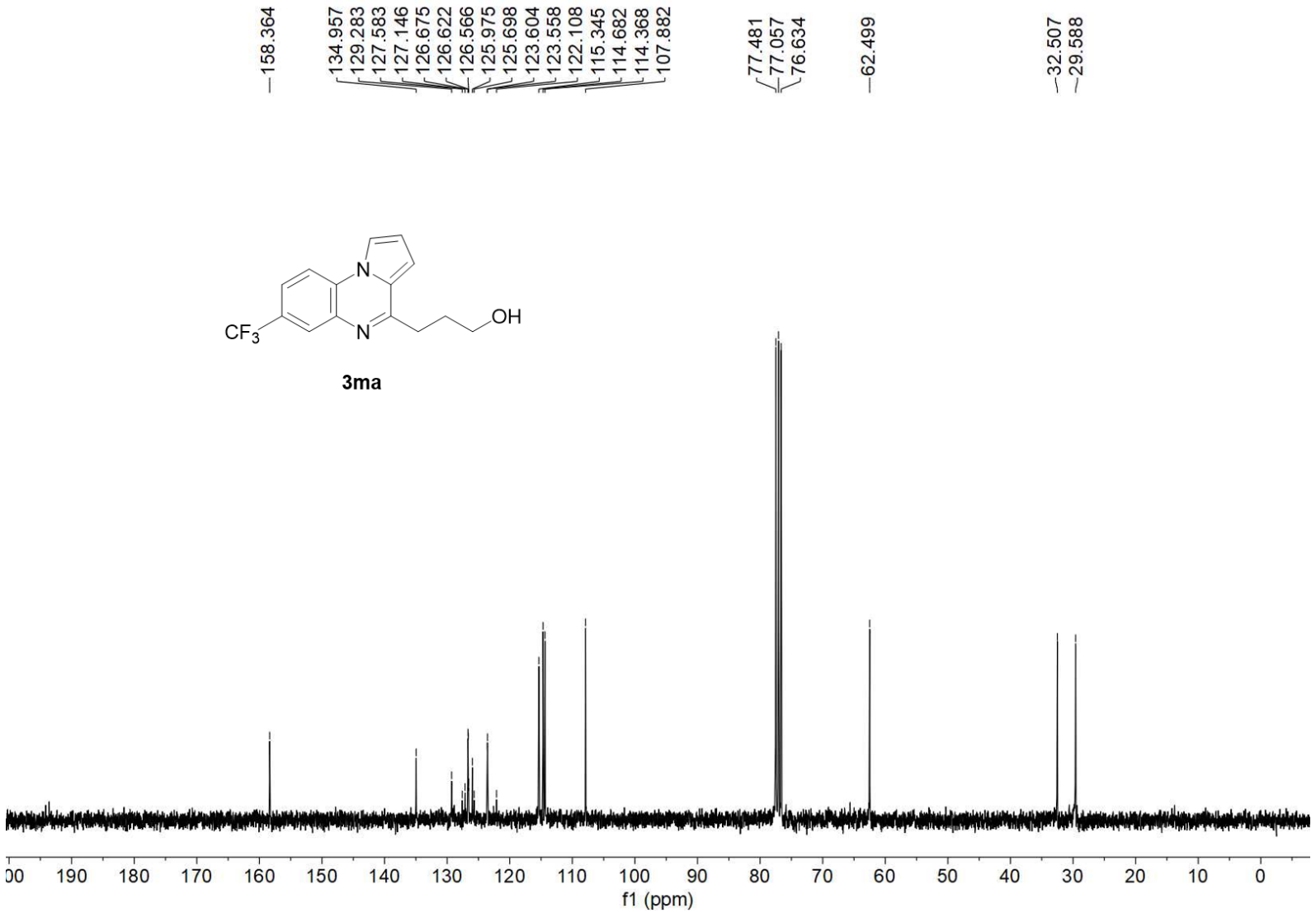

157.900
136.348
131.529
129.915
126.186
125.699
117.751
115.040
114.944
114.117
107.393
77.412
76.988
76.565
62.522
32.576
29.475
N
N
Br
OH
3la
f1 (ppm)

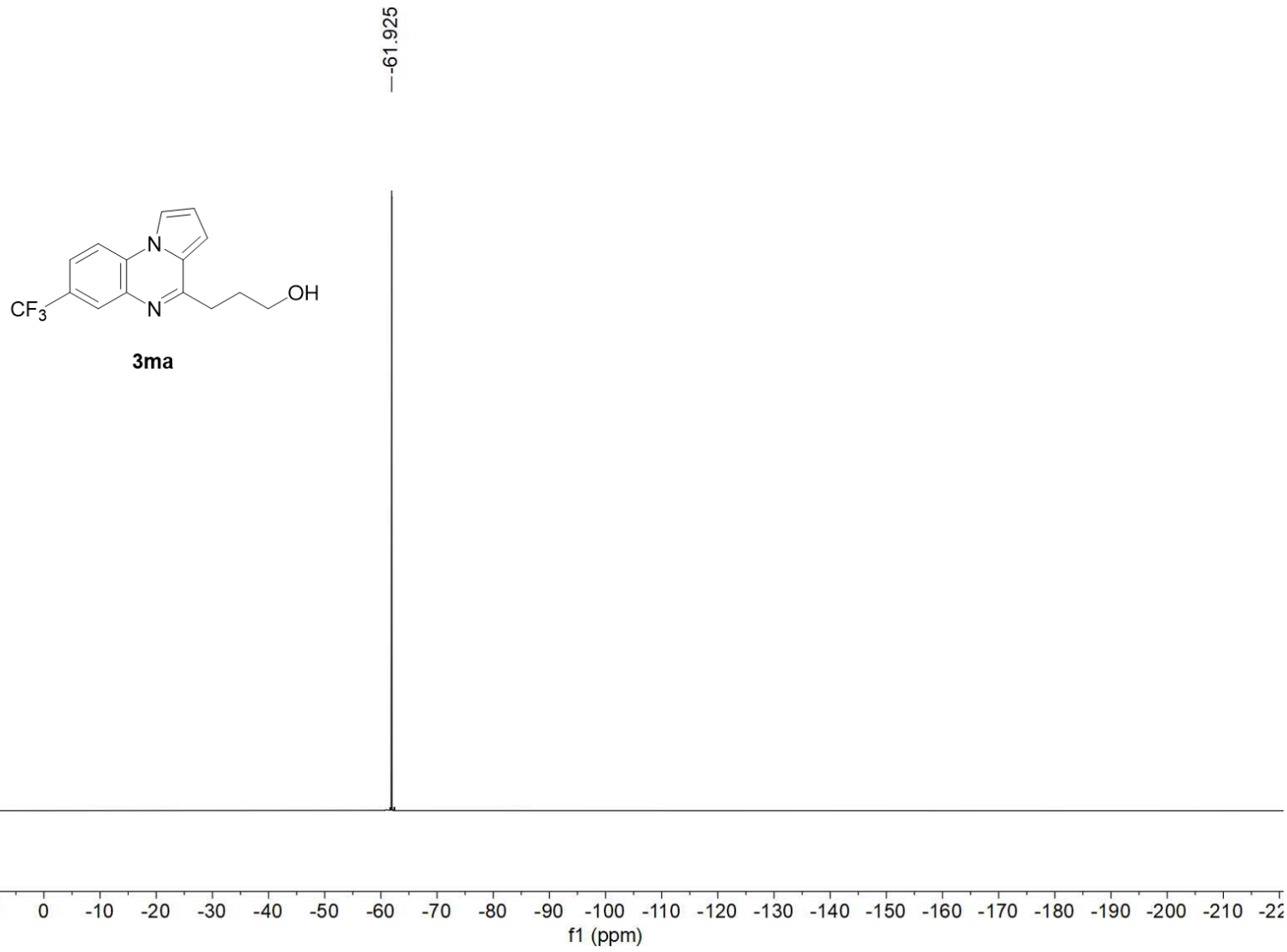

8.178
7.961
7.957
7.952
7.921
7.892
7.716
7.710
7.688
7.681
7.027
7.022
7.013
6.930
6.921
6.917
6.908
3.878
3.840
3.821
3.802
3.264
3.241
3.219
2.229
2.209
2.188
2.167
2.147
-0.000


N
N
CF3
OH

**3ma**

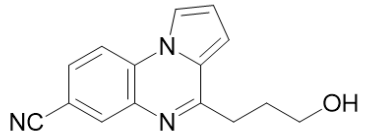

1.00
1.02
1.03
1.02
1.01
1.00
0.94
2.08
2.06
2.24
0.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)


158.364
134.957
129.283
127.583
127.146
126.675
126.622
126.566
125.975
125.698
123.604
123.558
122.108
115.345
114.682
114.368
107.882
77.481
77.057
76.634
62.499
32.507
29.588
N
N
CF3
OH
3ma
f1 (ppm)

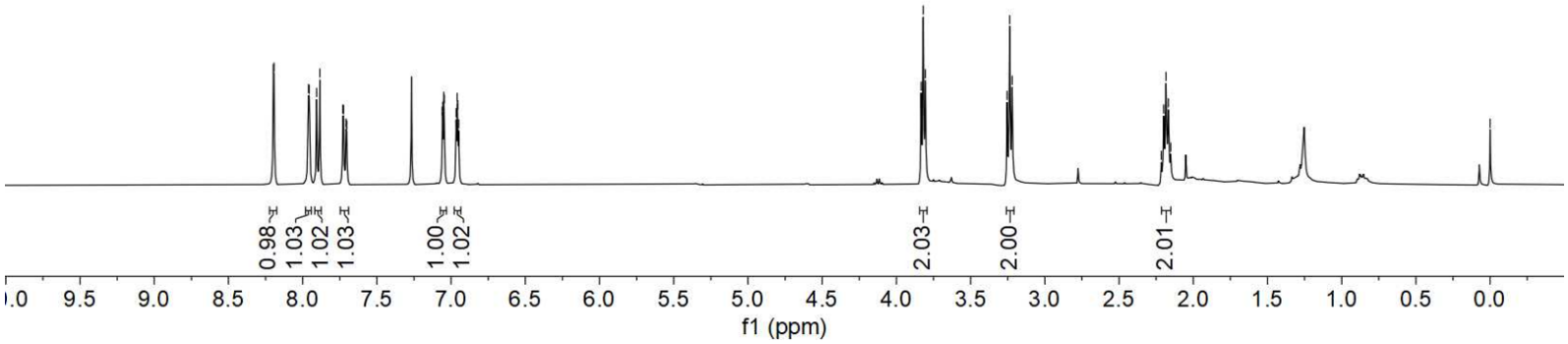

-61.925
N
N
CF3
OH
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

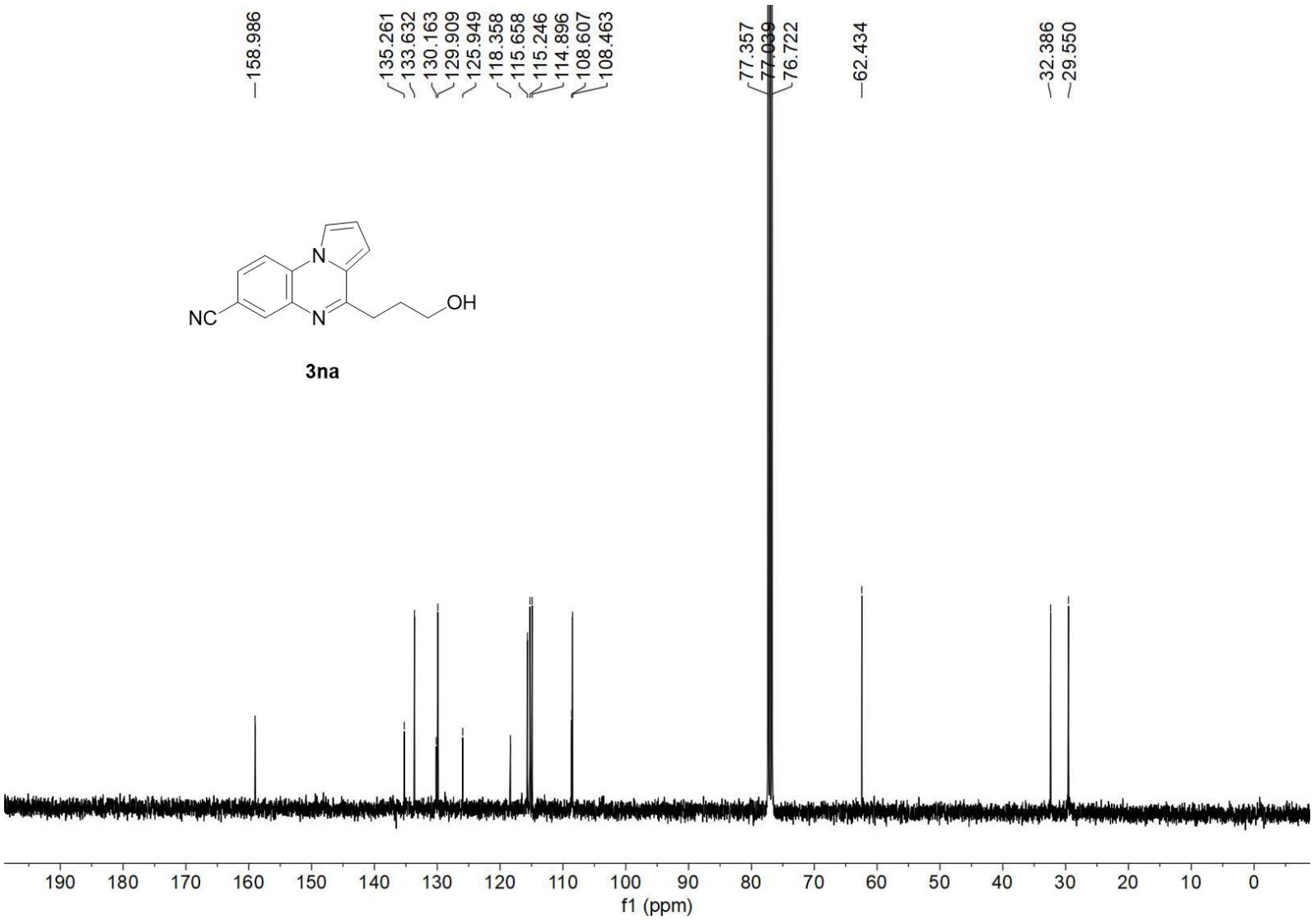
**3ma**

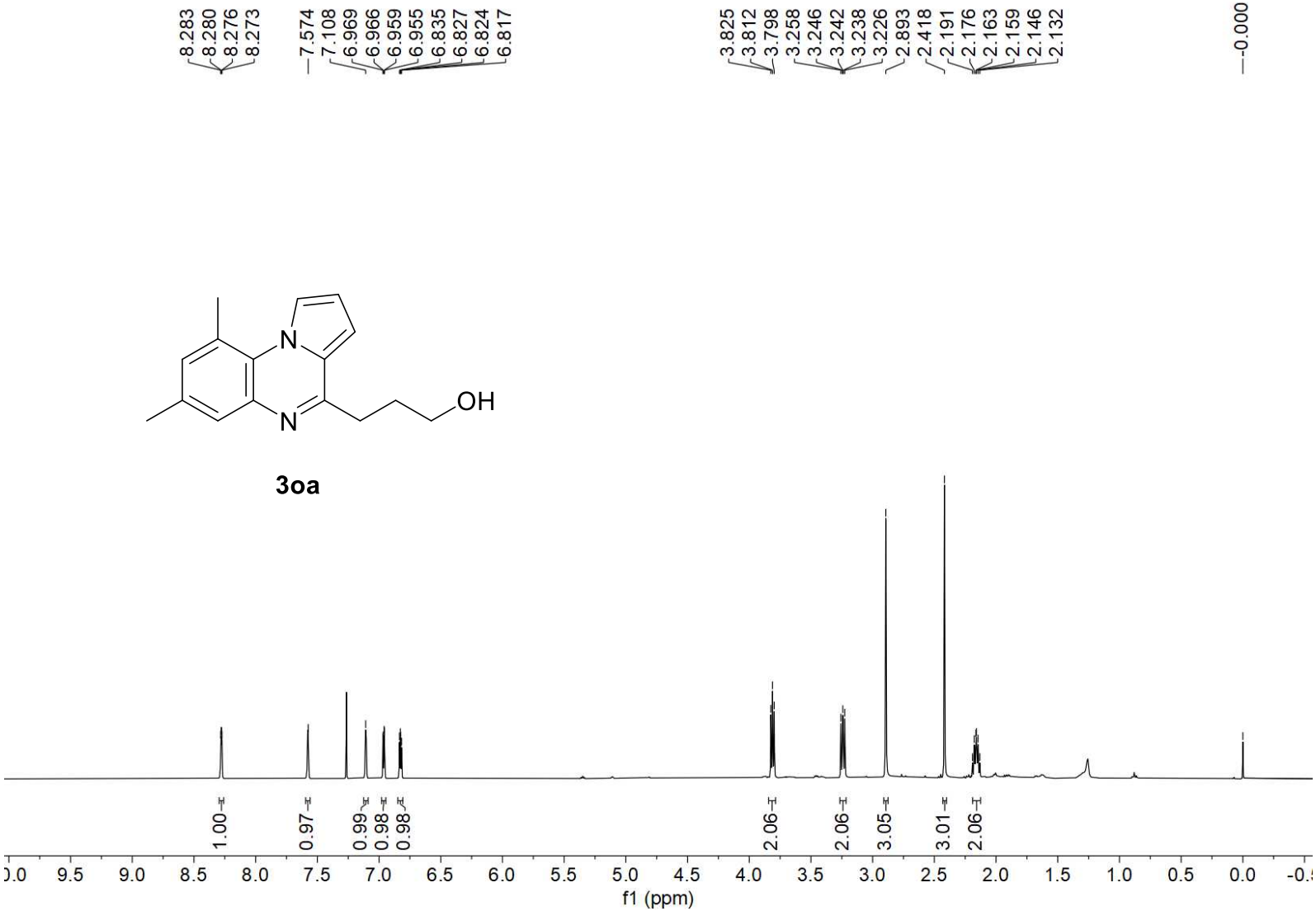

8.198
8.193
7.960
7.956
7.906
7.885
7.729
7.725
7.708
7.703
7.059
7.056
7.049
7.046
6.966
6.959
6.956
6.949
3.833
3.819
3.804
3.254
3.237
3.220
2.215
2.199
2.183
2.168
2.152
0.000


N
NC
N
OH

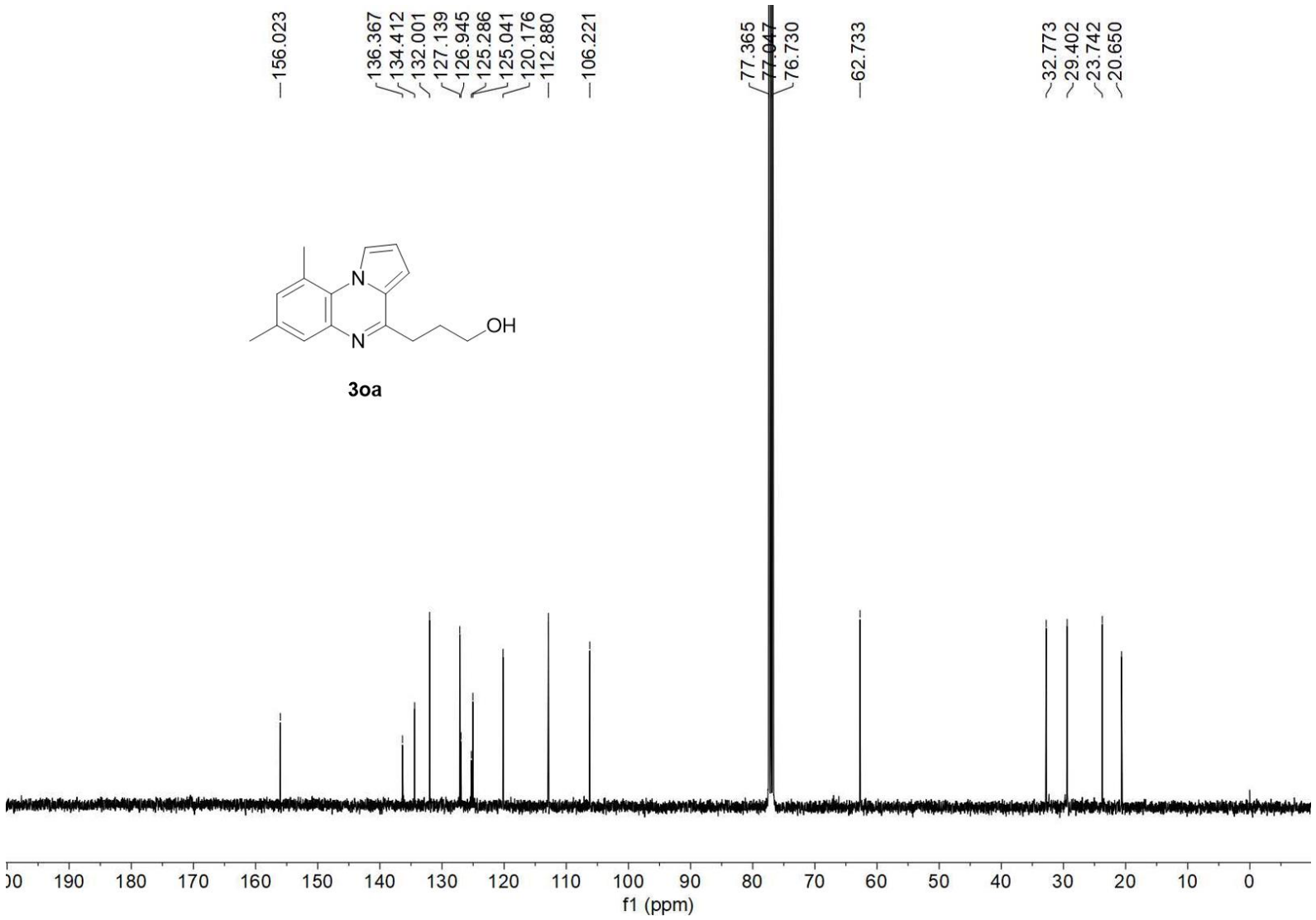
**3na**

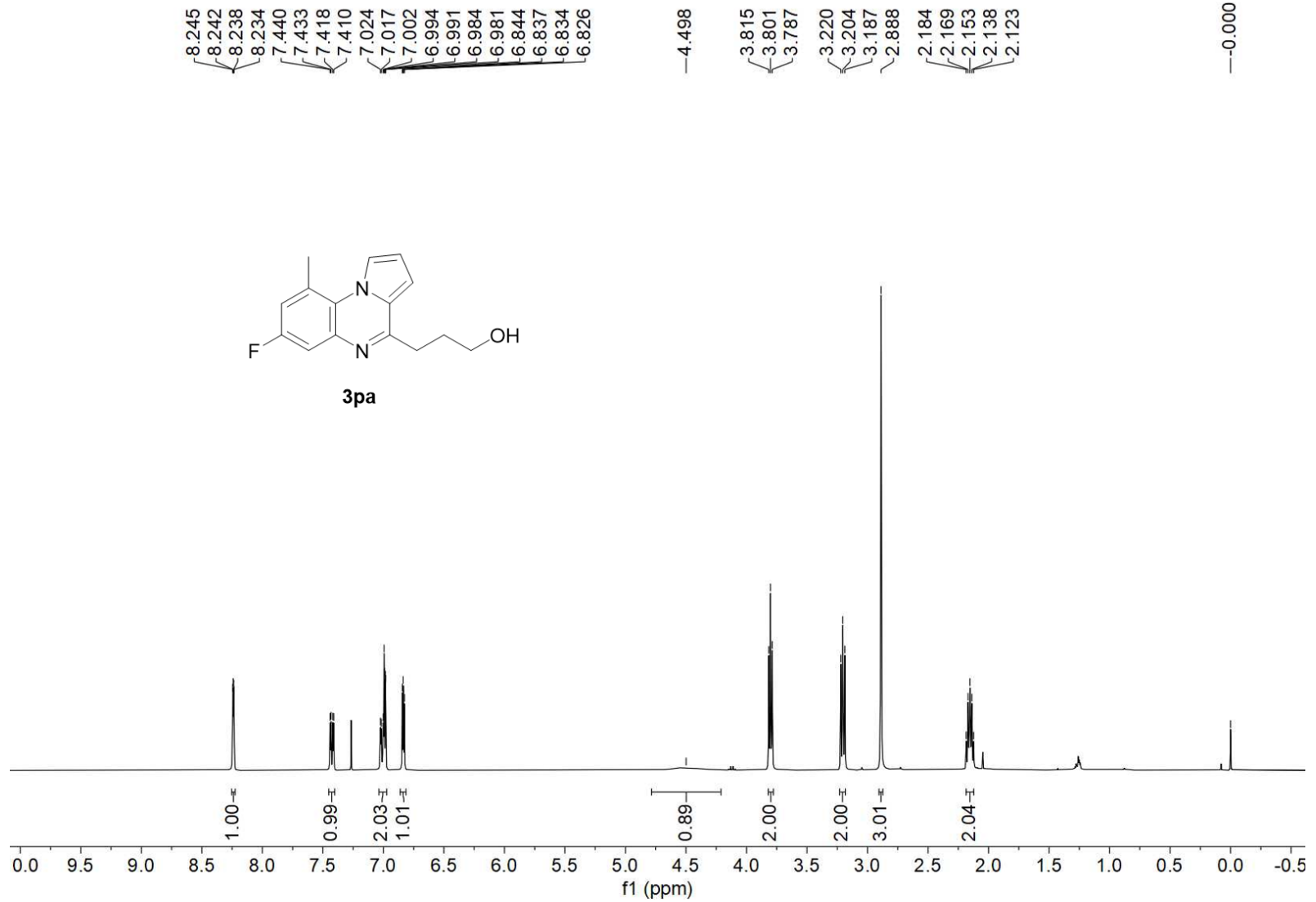

0.98
1.03
1.02
1.03
1.00
1.02
2.03
2.00
2.01
f1 (ppm)


158.986
135.261
133.632
130.163
129.909
125.949
118.358
115.658
115.246
114.896
108.607
108.463
77.357
77.039
76.722
62.434
32.386
29.550
N
N
NC
OH
3na
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

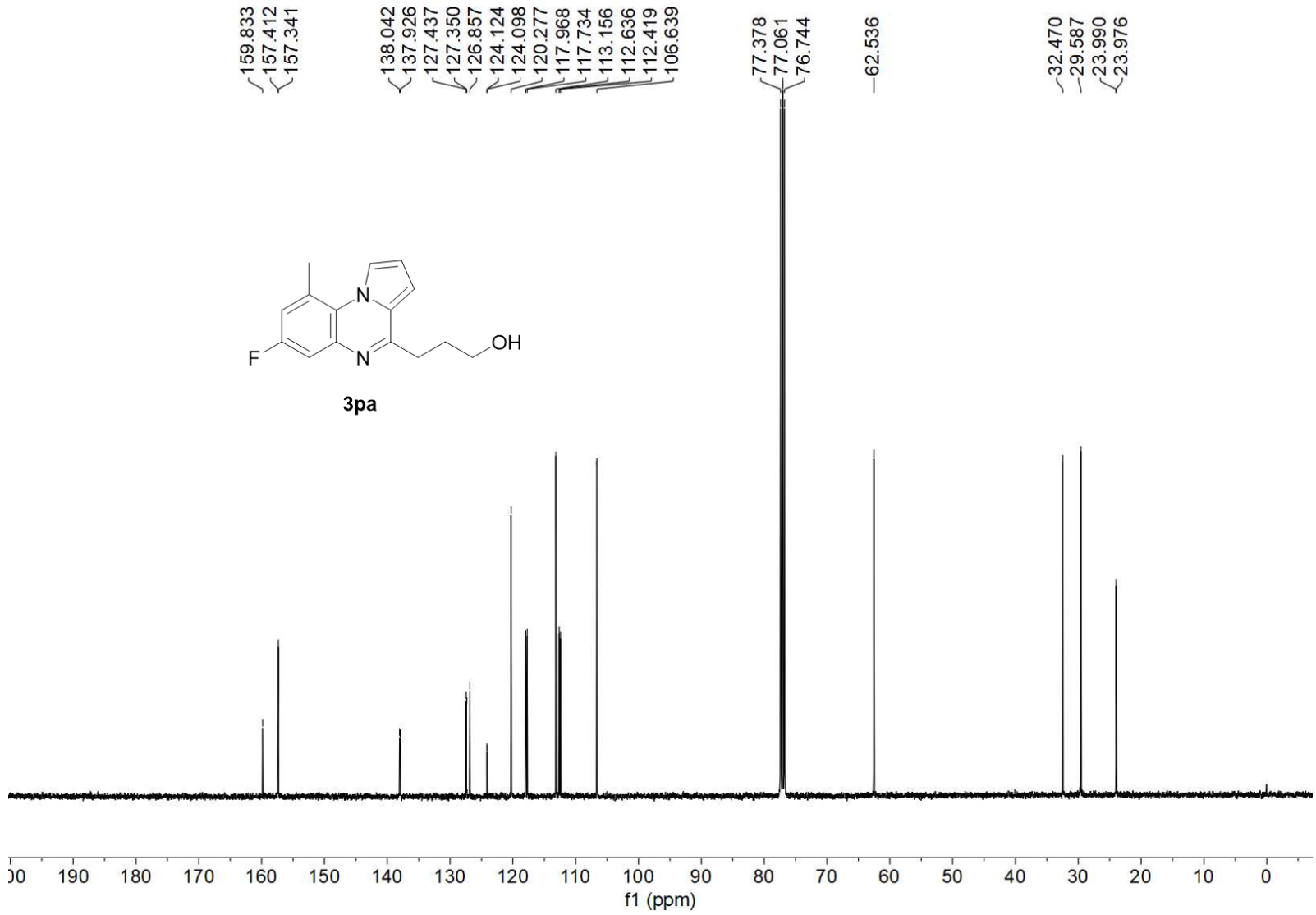

8.283
8.280
8.276
8.273
7.574
7.108
6.969
6.966
6.959
6.955
6.835
6.827
6.824
6.817
3.825
3.812
3.798
3.258
3.246
3.242
3.238
3.226
2.893
2.418
2.191
2.176
2.163
2.159
2.146
2.132
-0.000
N
N
OH
1.00
0.97
0.99
0.98
0.98
2.06
2.06
3.05
3.01
2.06
f1 (ppm)

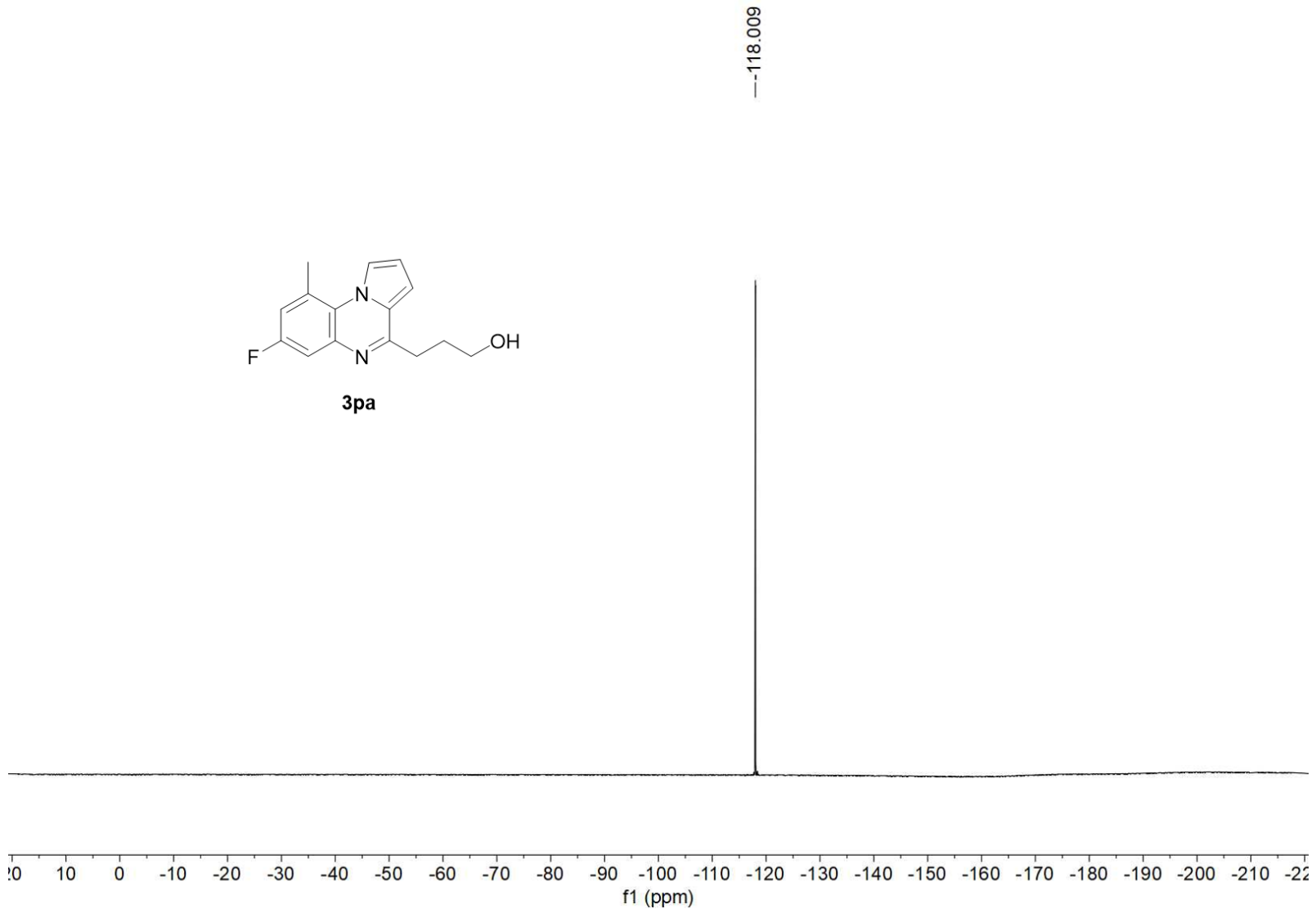
**3oa**


156.023
136.367
134.412
132.001
127.139
126.945
125.286
125.041
120.176
112.880
106.221
77.365
77.047
76.730
62.733
32.773
29.402
23.742
20.650
N
N
OH
3oa
f1 (ppm)


8.245
8.242
8.238
8.234
7.440
7.433
7.418
7.410
7.024
7.017
7.002
6.994
6.991
6.984
6.981
6.844
6.837
6.834
6.826
4.498
3.815
3.801
3.787
3.220
3.204
3.187
2.888
2.184
2.169
2.153
2.138
2.123
0.000
N
N
F
OH
1.00
0.99
2.03
1.01
0.89
2.00
2.00
3.01
2.04
0.0 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)

**3pa**


159.833
157.412
157.341
138.042
137.926
127.437
127.350
126.857
124.124
124.098
120.277
117.968
117.734
113.156
112.636
112.419
106.639
77.378
77.061
76.744
62.536
32.470
29.587
23.990
23.976
N
N
F
OH
3pa
f1 (ppm)


-118.009
N
F
N
OH
3pa
10
0
-10
-20
-30
-40
-50
-60
-70
-80
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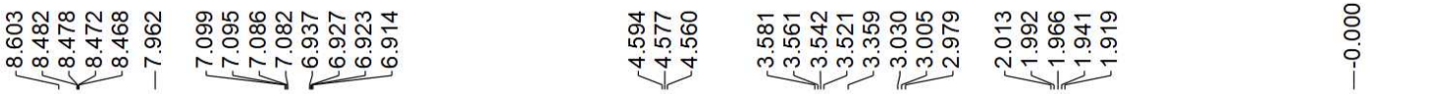
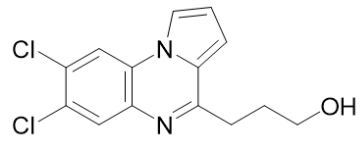
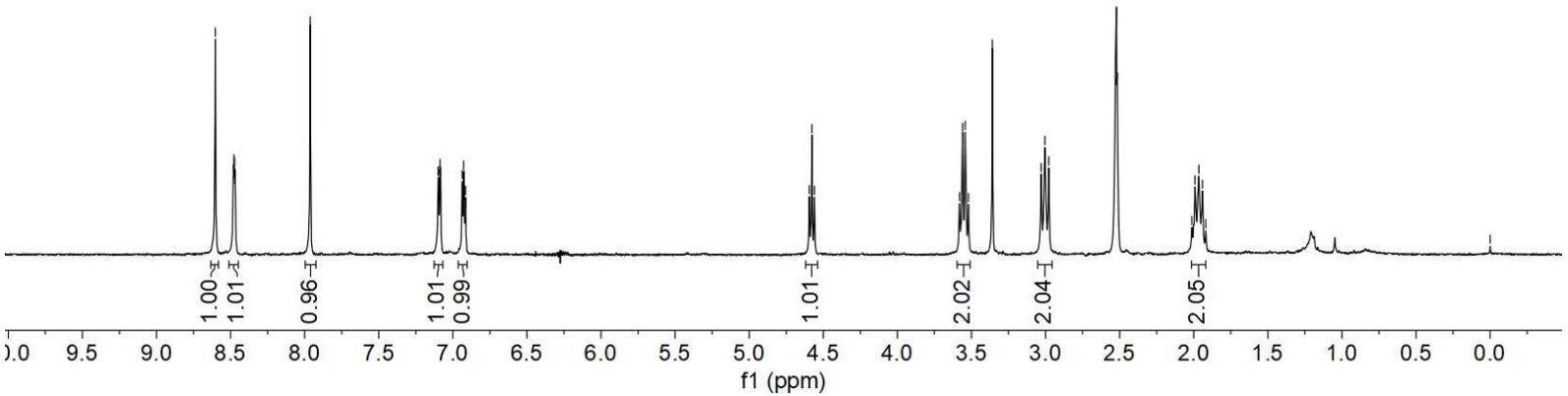
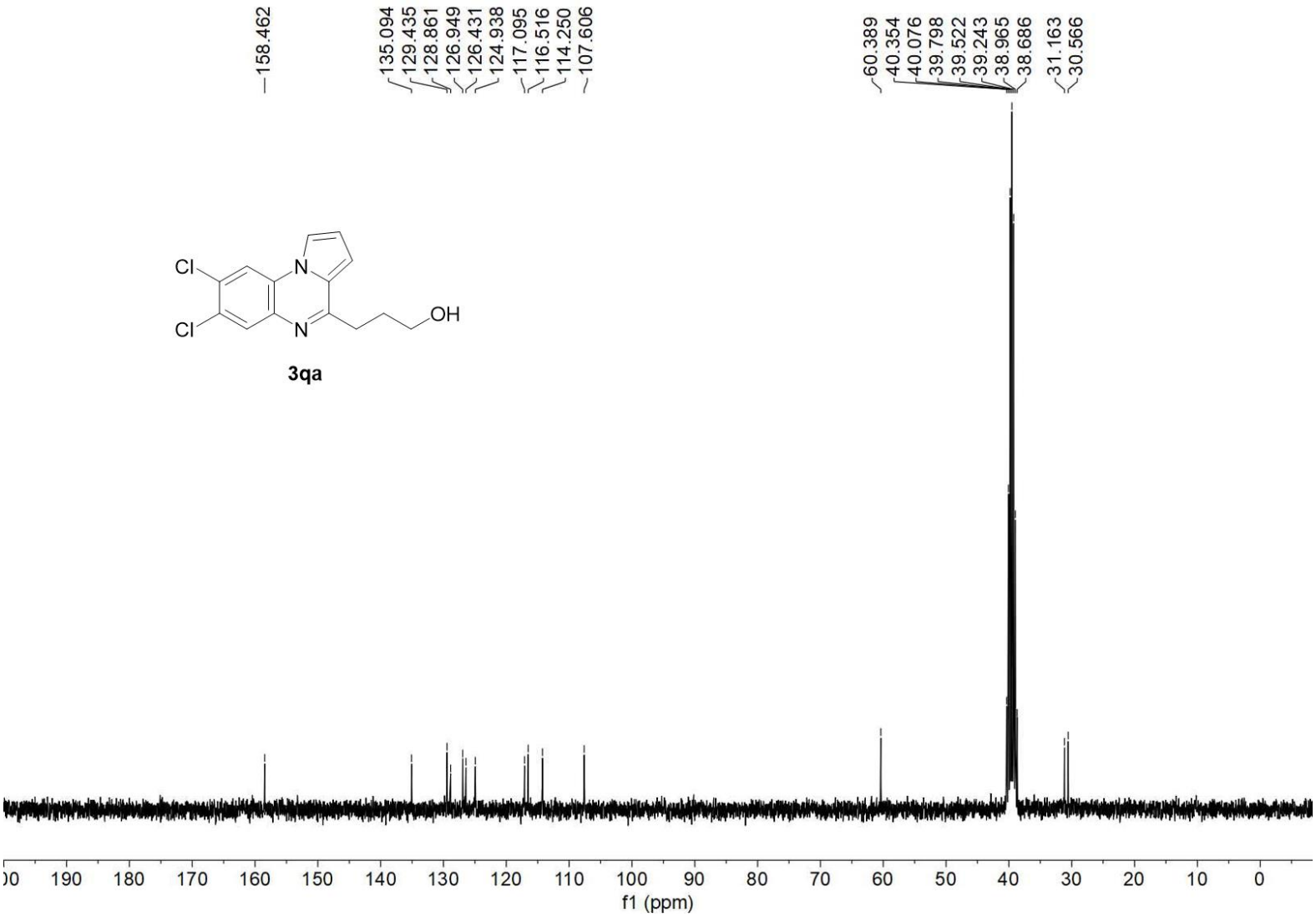
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

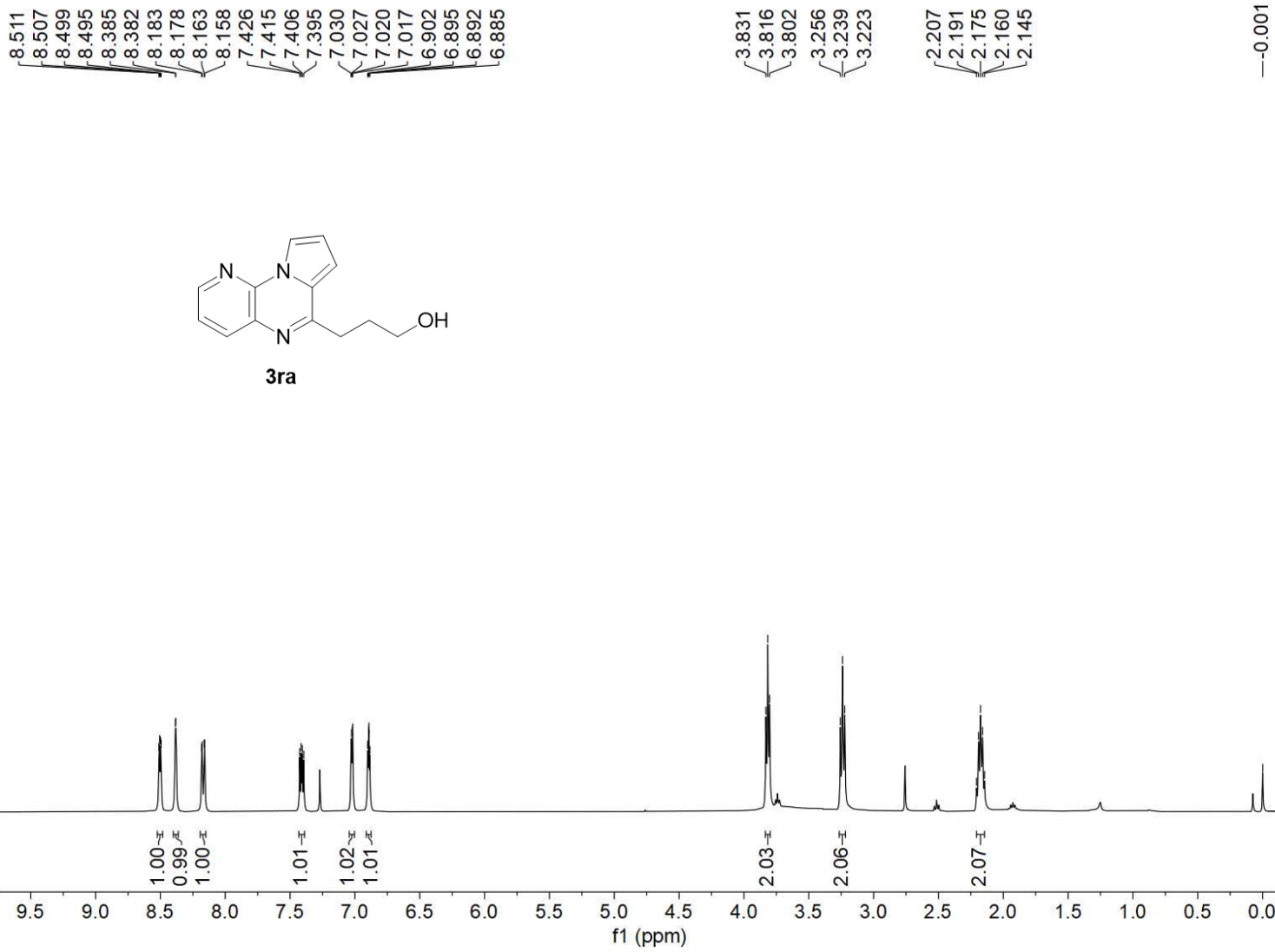

8.603
8.482
8.478
8.472
8.468
7.962
7.099
7.095
7.086
7.082
6.937
6.927
6.923
6.914
4.594
4.577
4.560
3.581
3.561
3.542
3.521
3.359
3.030
3.005
2.979
2.013
1.992
1.966
1.941
1.919
0.000

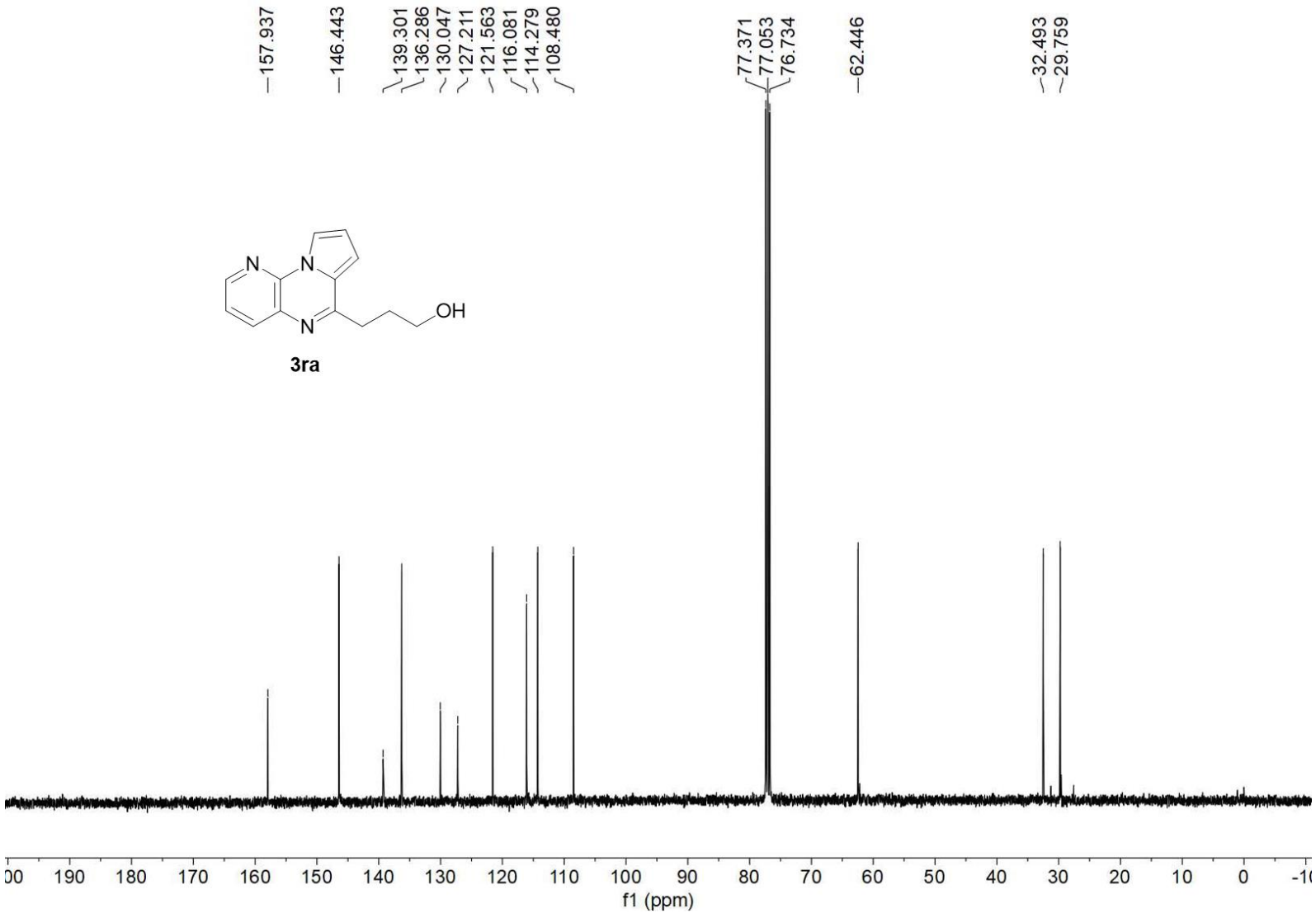

Cl
Cl
N
N
OH

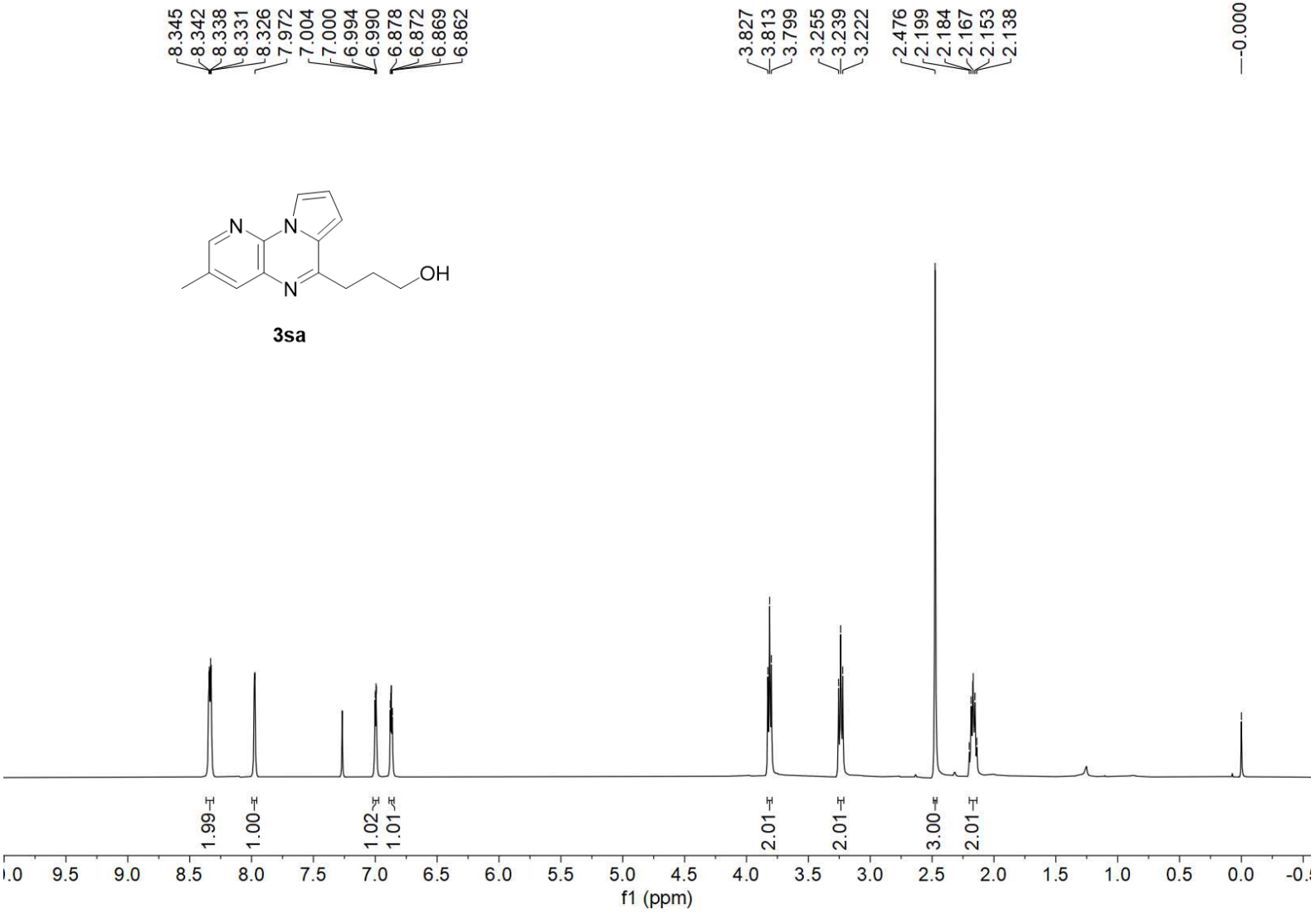
**3qa**


1.00
1.01
0.96
1.01
0.99
1.01
2.02
2.04
2.05
f1 (ppm)

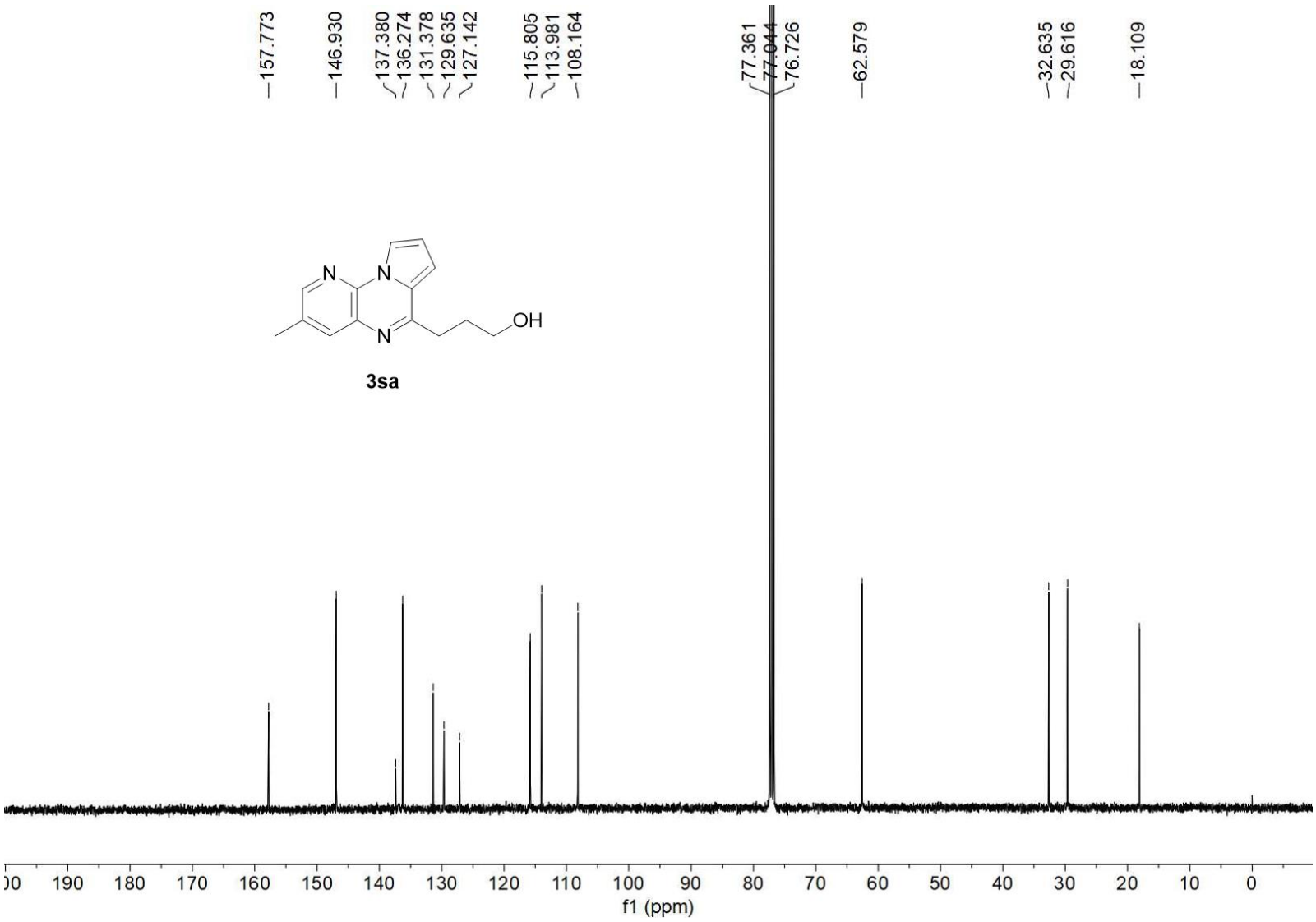

158.462
135.094
129.435
128.861
126.949
126.431
124.938
117.095
116.516
114.250
107.606
60.389
40.354
40.076
39.798
39.522
39.243
38.965
38.686
31.163
30.566
Cl
Cl
N
N
OH
3qa
f1 (ppm)

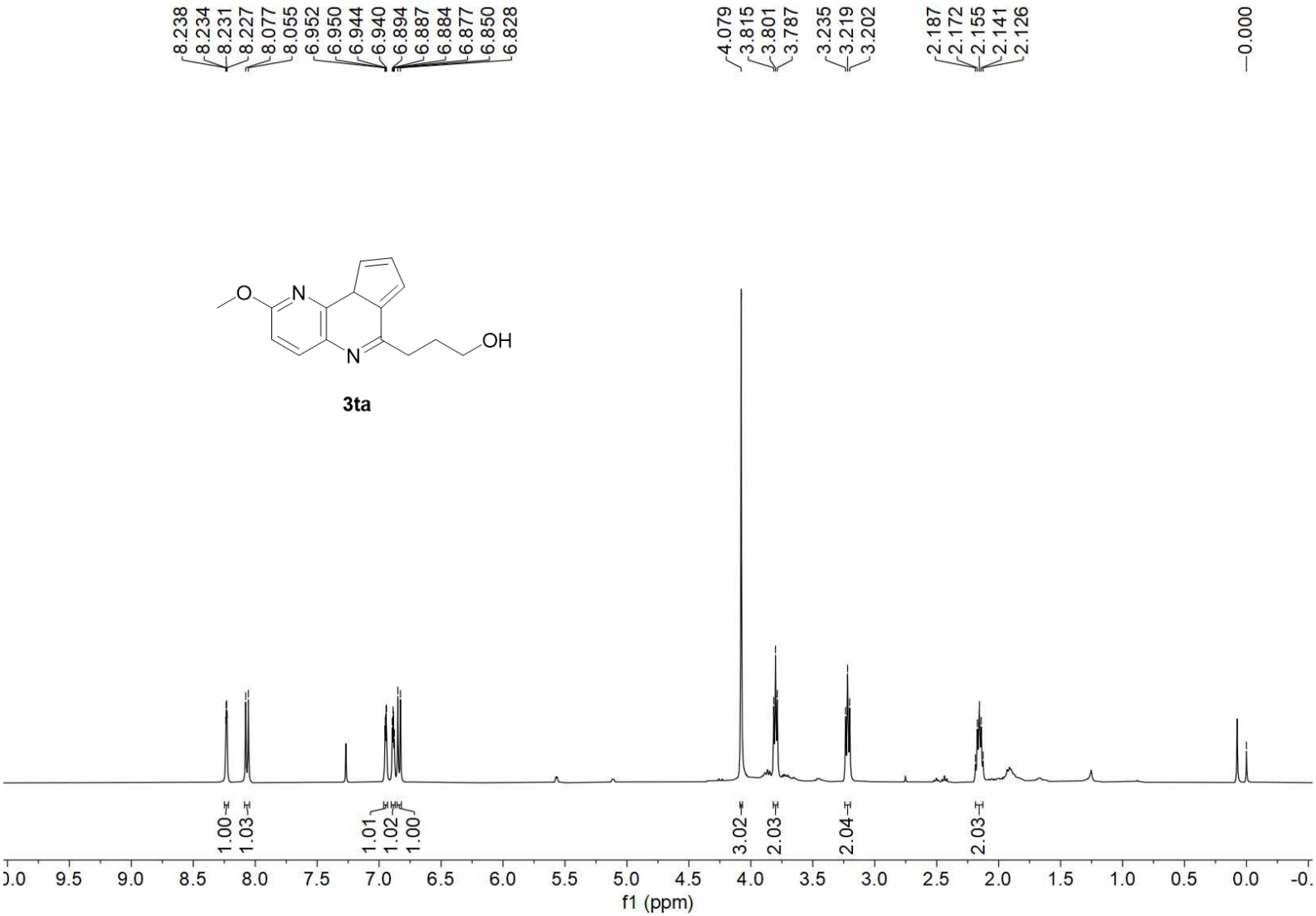

8.511
8.507
8.499
8.495
8.385
8.382
8.183
8.178
8.163
8.158
7.426
7.415
7.406
7.395
7.030
7.027
7.020
7.017
6.902
6.895
6.892
6.885
3.831
3.816
3.802
3.256
3.239
3.223
2.207
2.191
2.175
2.160
2.145
-0.001
N
N
N
OH
3ra
1.00
0.99
1.00
1.01
1.02
1.01
2.03
2.06
2.07
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

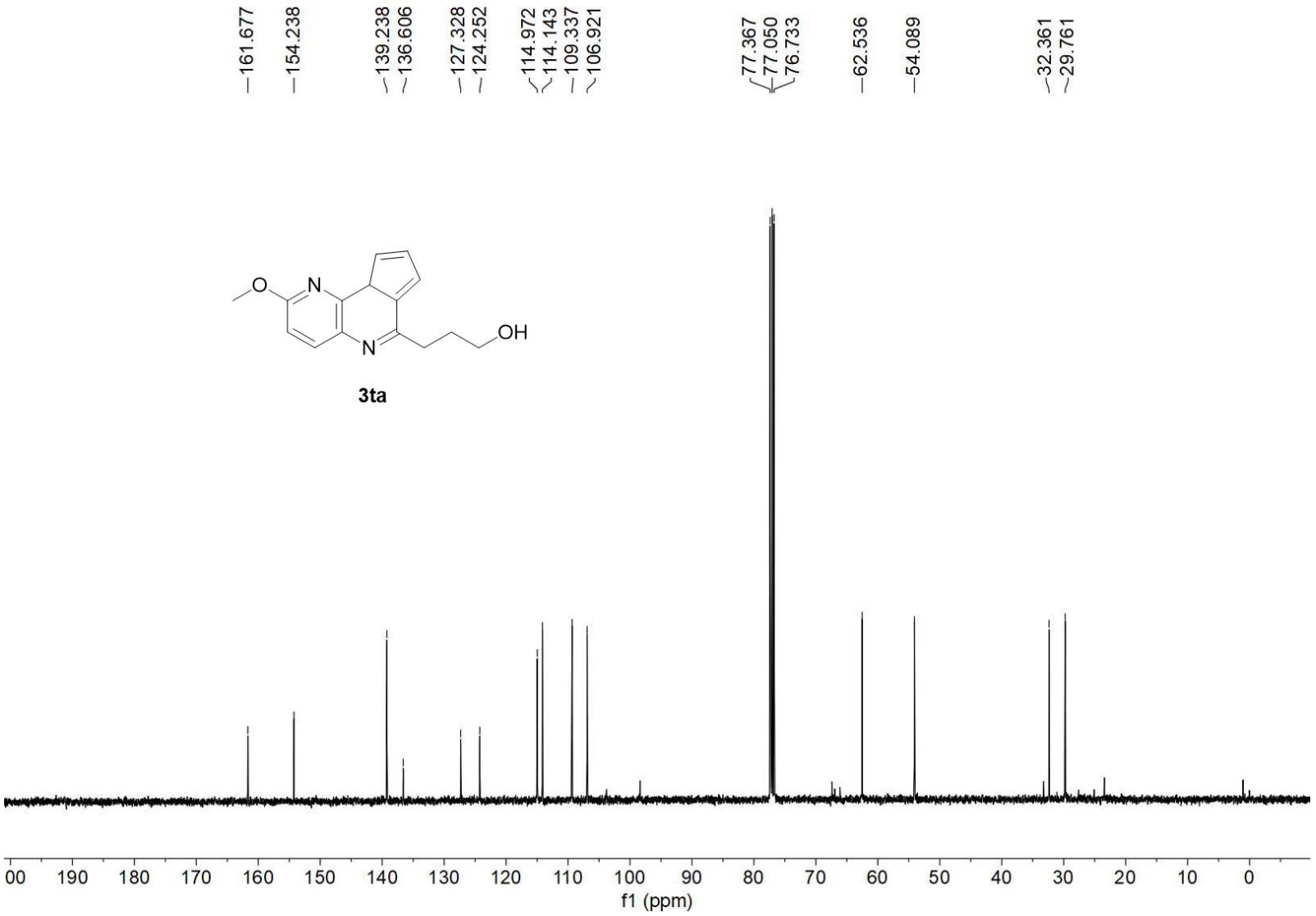

157.937
146.443
139.301
136.286
130.047
127.211
121.563
116.081
114.279
108.480
77.371
77.053
76.734
62.446
32.493
29.759
N
N
N
OH
3ra
f1 (ppm)

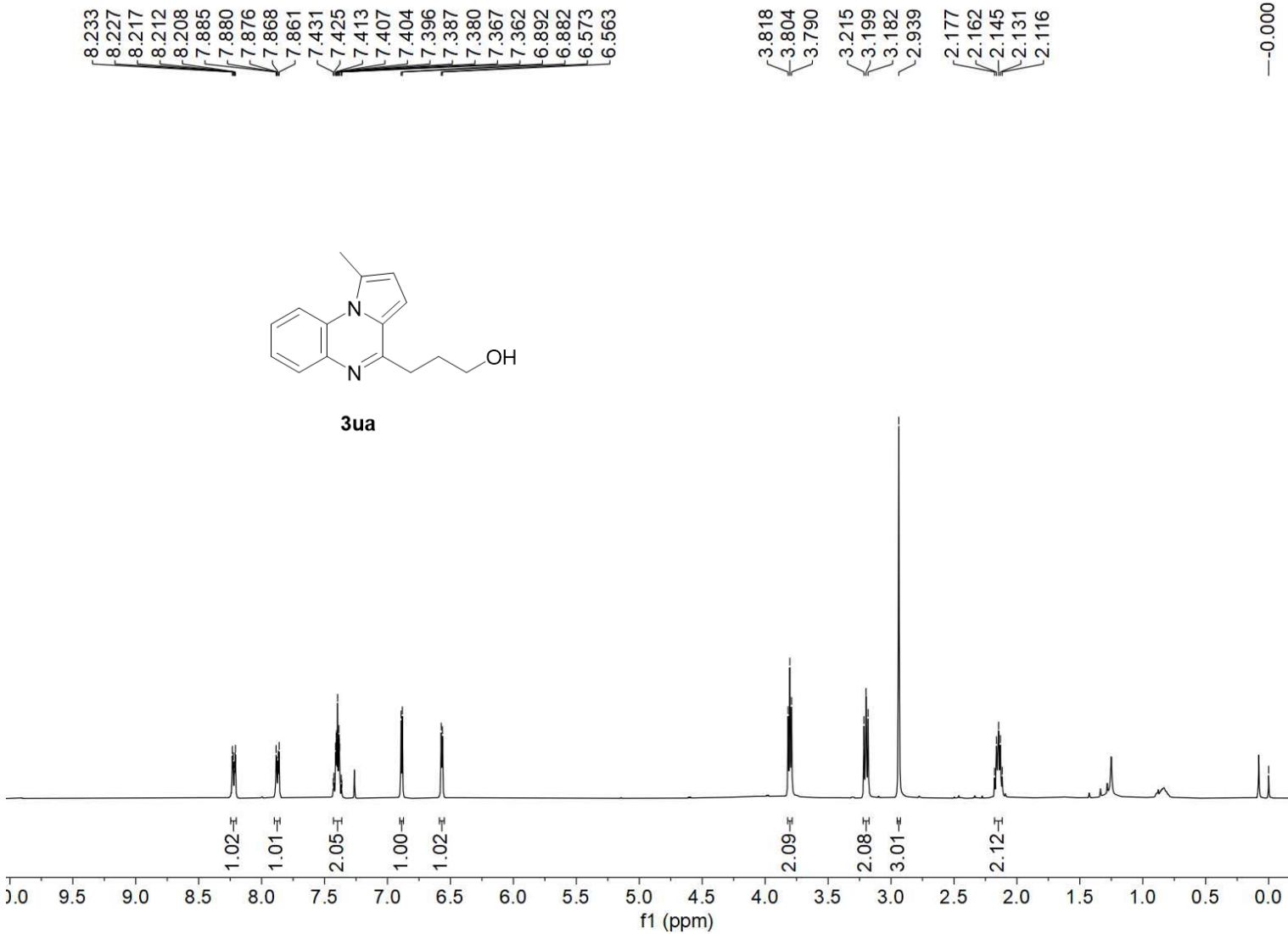

8.345
8.342
8.338
8.331
8.326
7.972
7.004
7.000
6.994
6.990
6.878
6.872
6.869
6.862
3.827
3.813
3.799
3.255
3.239
3.222
2.476
2.199
2.184
2.167
2.153
2.138
-0.000
N
N
N
OH
1.99
1.00
1.02
1.01
2.01
2.01
3.00
2.01
f1 (ppm)

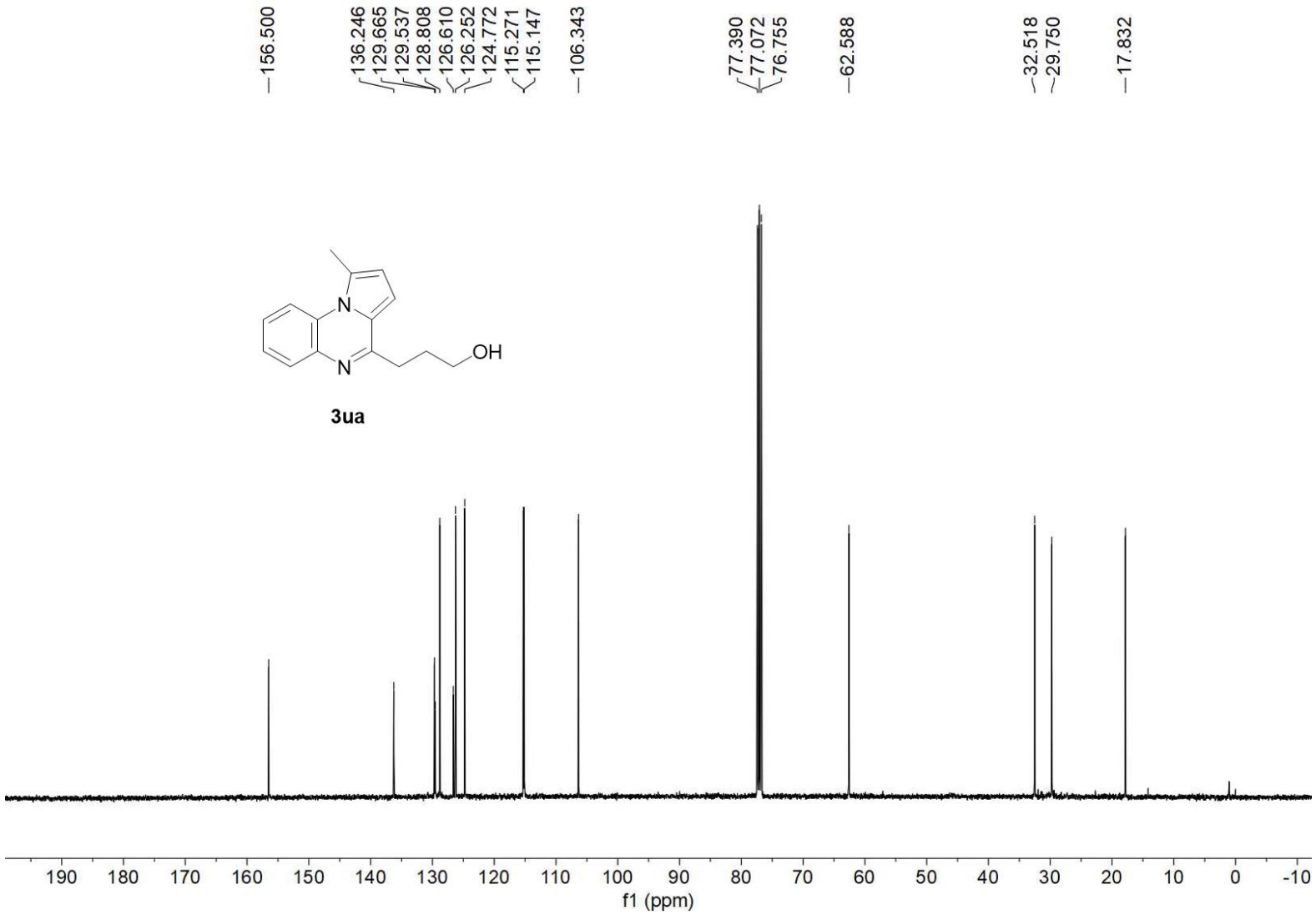
**3sa**

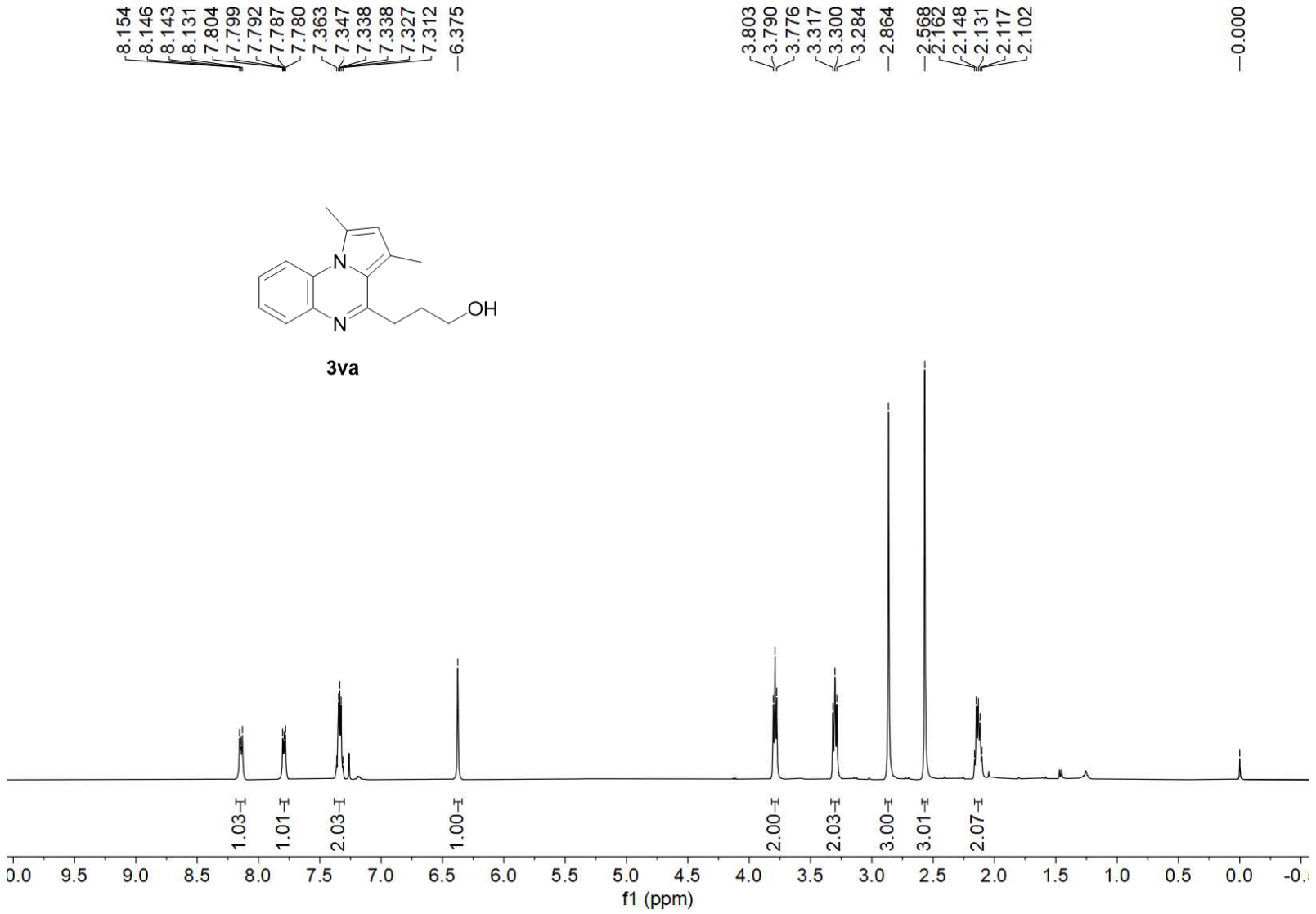

157.773
146.930
137.380
136.274
131.378
129.635
127.142
115.805
113.981
108.164
77.361
77.044
76.726
62.579
32.635
29.616
18.109
N
N
N
OH
3sa
f1 (ppm)

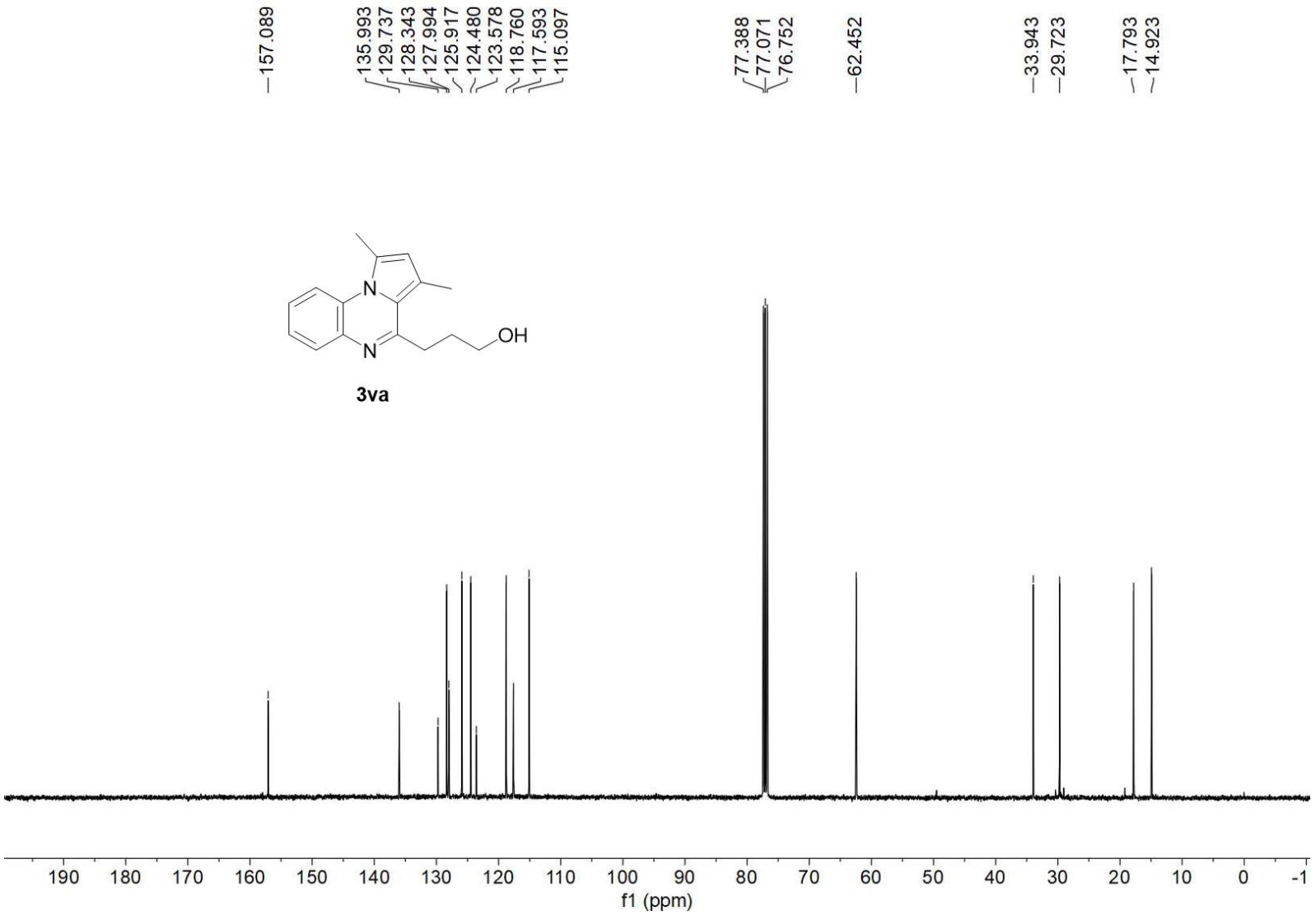

8.238
8.234
8.231
8.227
8.077
8.055
6.952
6.950
6.944
6.940
6.894
6.887
6.884
6.877
6.850
6.828
4.079
3.815
3.801
3.787
3.235
3.219
3.202
2.187
2.172
2.155
2.141
2.126
0.000
O
N
N
OH
3ta
1.00
1.03
1.01
1.02
1.00
3.02
2.03
2.04
2.03
f1 (ppm)

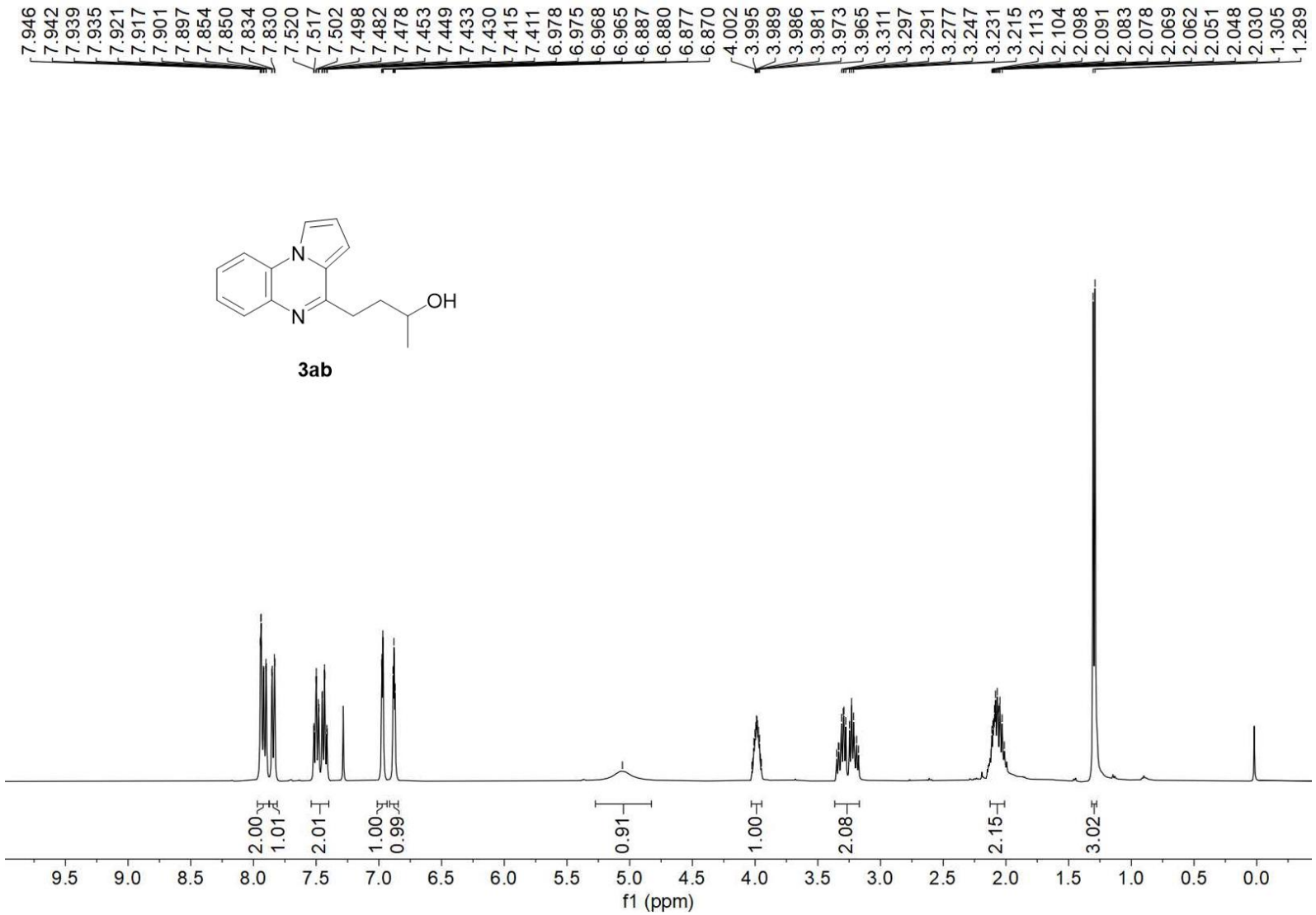

161.677
154.238
139.238
136.606
127.328
124.252
114.972
114.143
109.337
106.921
77.367
77.050
76.733
62.536
54.089
32.361
29.761
O
N
N
OH
3ta
f1 (ppm)

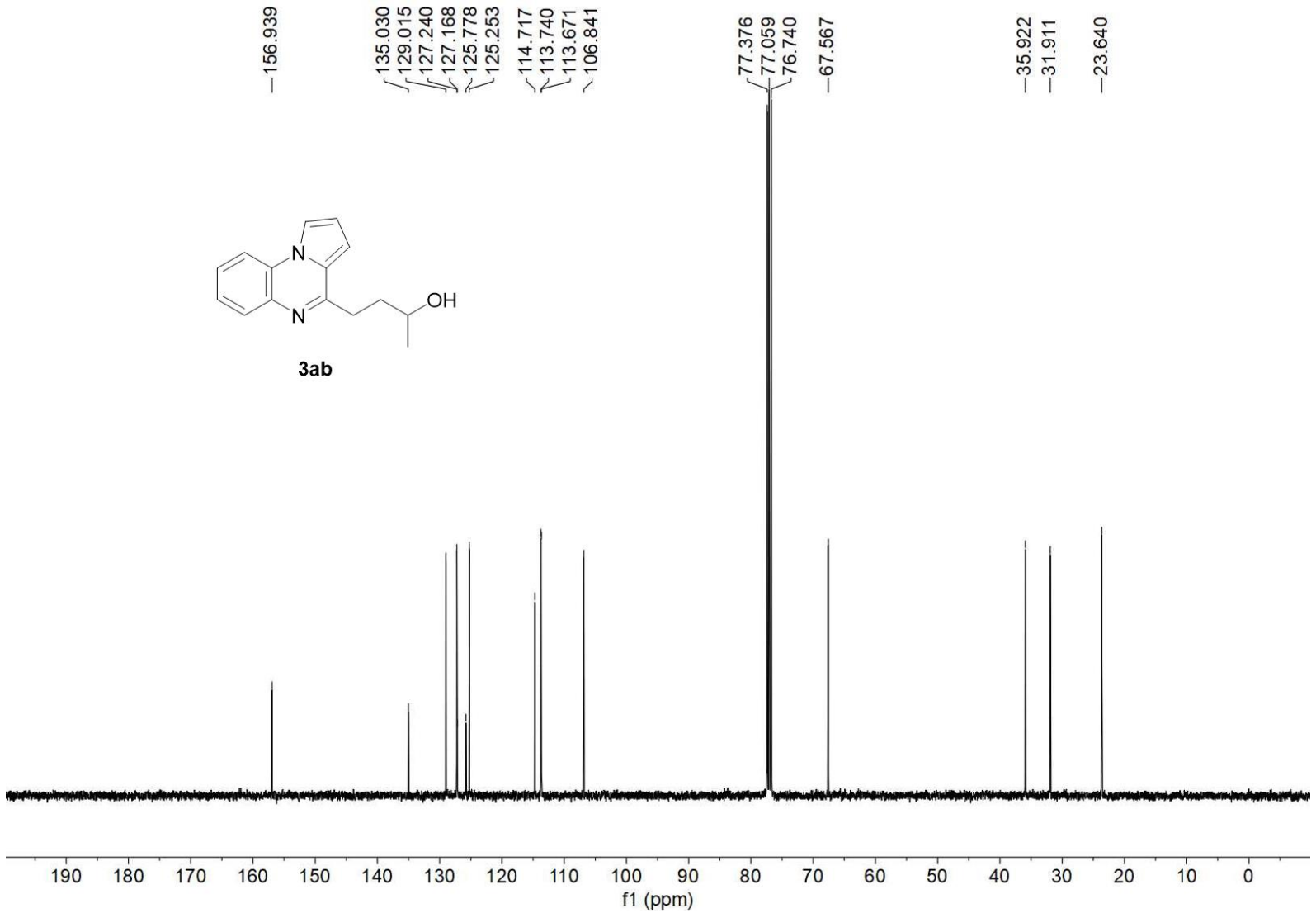

8.233
8.227
8.217
8.212
8.208
7.885
7.880
7.876
7.868
7.861
7.431
7.425
7.413
7.407
7.404
7.396
7.387
7.380
7.367
7.362
6.892
6.882
6.573
6.563
3.818
3.804
3.790
3.215
3.199
3.182
2.939
2.177
2.162
2.145
2.131
2.116
-0.000
N
N
OH
3ua
1.02
1.01
2.05
1.00
1.02
2.09
2.08
3.01
2.12
f1 (ppm)


156.500
136.246
129.665
129.537
128.808
126.610
126.252
124.772
115.271
115.147
106.343
77.390
77.072
76.755
62.588
32.518
29.750
17.832
N
N
OH
3ua
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

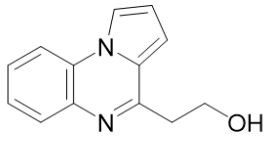

8.154
8.146
8.143
8.131
7.804
7.799
7.792
7.787
7.780
7.363
7.347
7.338
7.338
7.327
7.312
6.375
3.803
3.790
3.776
3.317
3.300
3.284
2.864
2.568
2.162
2.148
2.131
2.117
2.102
0.000
N
N
OH
3va
1.03
1.01
2.03
1.00
2.00
2.03
3.00
3.01
2.07
f1 (ppm)


157.089
135.993
129.737
128.343
127.994
125.917
124.480
123.578
118.760
117.593
115.097
77.388
77.071
76.752
62.452
33.943
29.723
17.793
14.923
N
N
OH
3va
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)

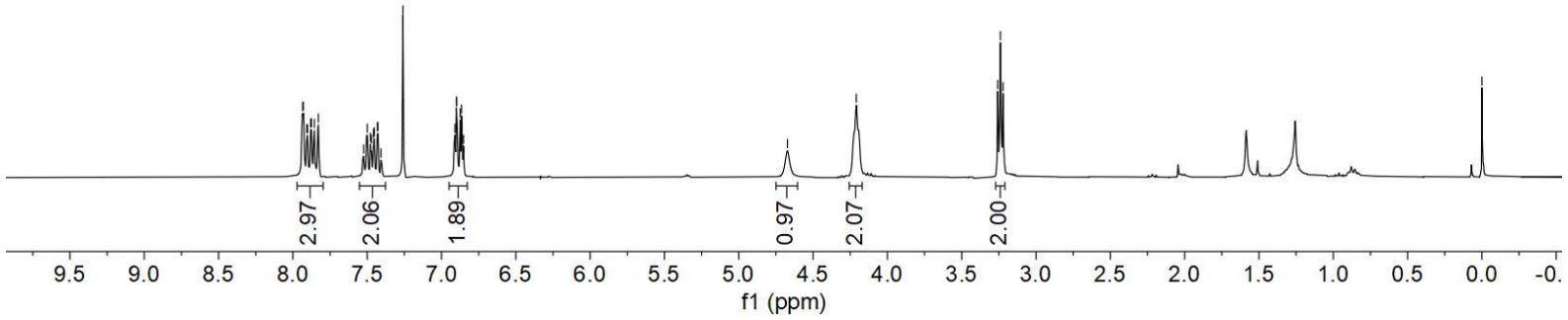

7.946
7.942
7.939
7.935
7.921
7.917
7.901
7.897
7.854
7.850
7.834
7.830
7.520
7.517
7.502
7.498
7.482
7.478
7.453
7.449
7.433
7.430
7.415
7.411
6.978
6.975
6.968
6.965
6.887
6.880
6.877
6.870
4.002
3.995
3.989
3.986
3.981
3.973
3.965
3.311
3.297
3.291
3.277
3.247
3.231
3.215
2.113
2.104
2.098
2.091
2.083
2.078
2.069
2.062
2.051
2.048
2.030
1.305
1.289
N
N
OH
3ab
2.00
1.01
2.01
1.00
0.99
0.91
1.00
2.08
2.15
3.02
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

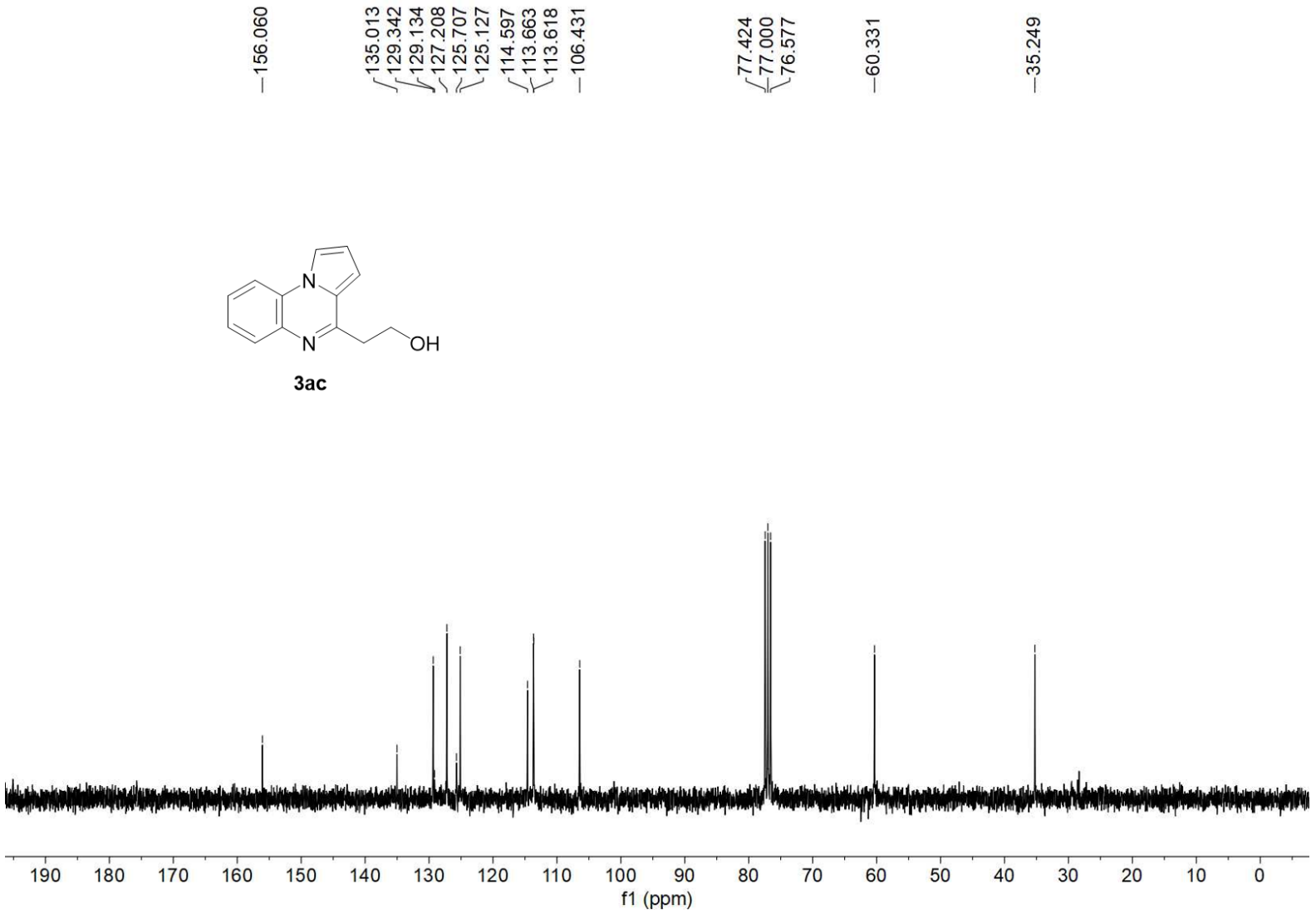

156.939
135.030
129.015
127.240
127.168
125.778
125.253
114.717
113.740
113.671
106.841
77.376
77.059
76.740
67.567
35.922
31.911
23.640
N
N
OH
3ab
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.934
7.930
7.906
7.902
7.880
7.875
7.855
7.829
7.524
7.499
7.478
7.472
7.458
7.453
7.431
7.429
7.407
7.259
6.909
6.900
6.898
6.874
6.865
6.852
4.673
4.209
3.257
3.239
3.222
0.000

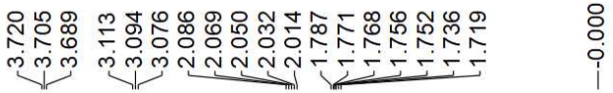

N
N
OH

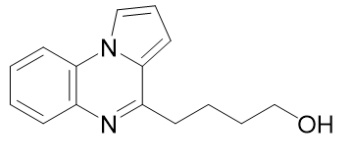
**3ac**


2.97
2.06
1.89
0.97
2.07
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

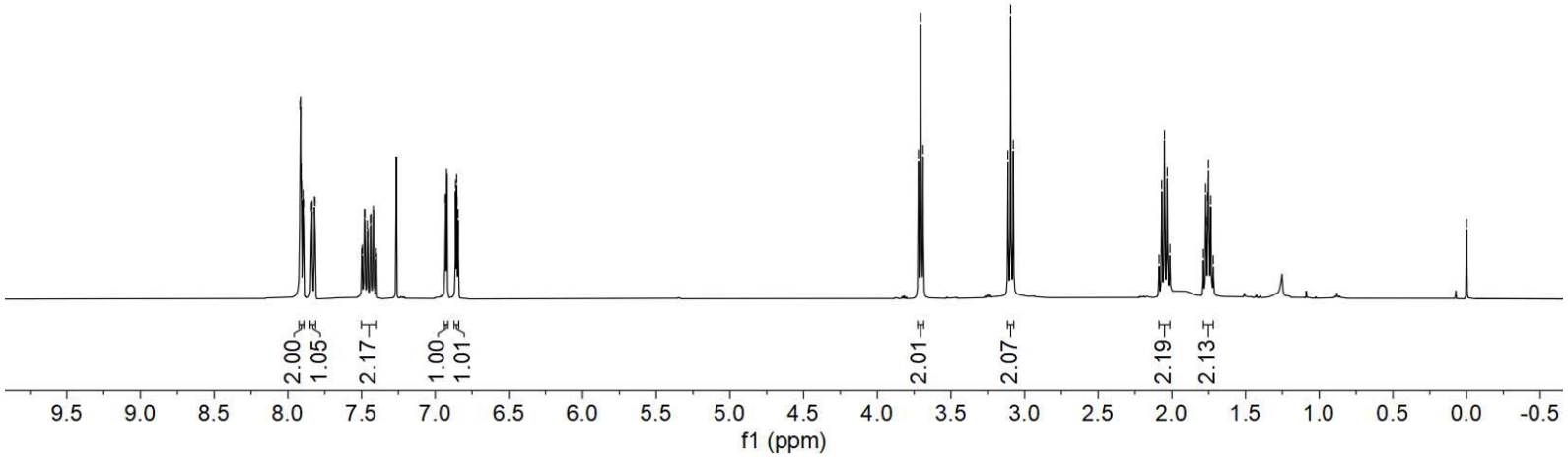

156.060
135.013
129.342
129.134
127.208
125.707
125.127
114.597
113.663
113.618
106.431
77.424
77.000
76.577
60.331
35.249
N
N
OH
3ac
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

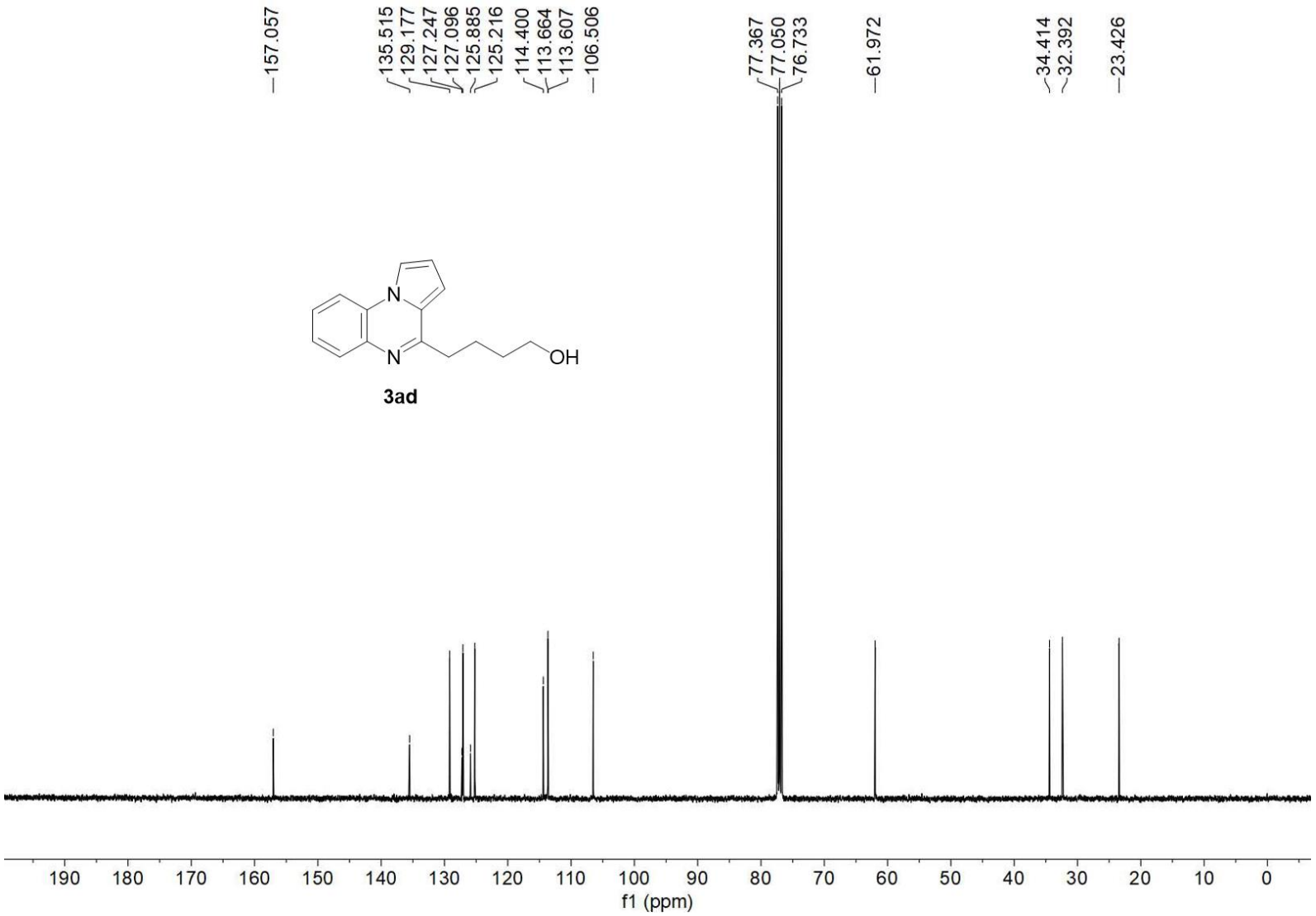

7.917
7.913
7.910
7.907
7.898
7.894
7.840
7.836
7.820
7.816
7.481
7.478
7.436
7.420
7.416
6.932
6.929
6.922
6.919
6.861
6.854
6.851
6.844

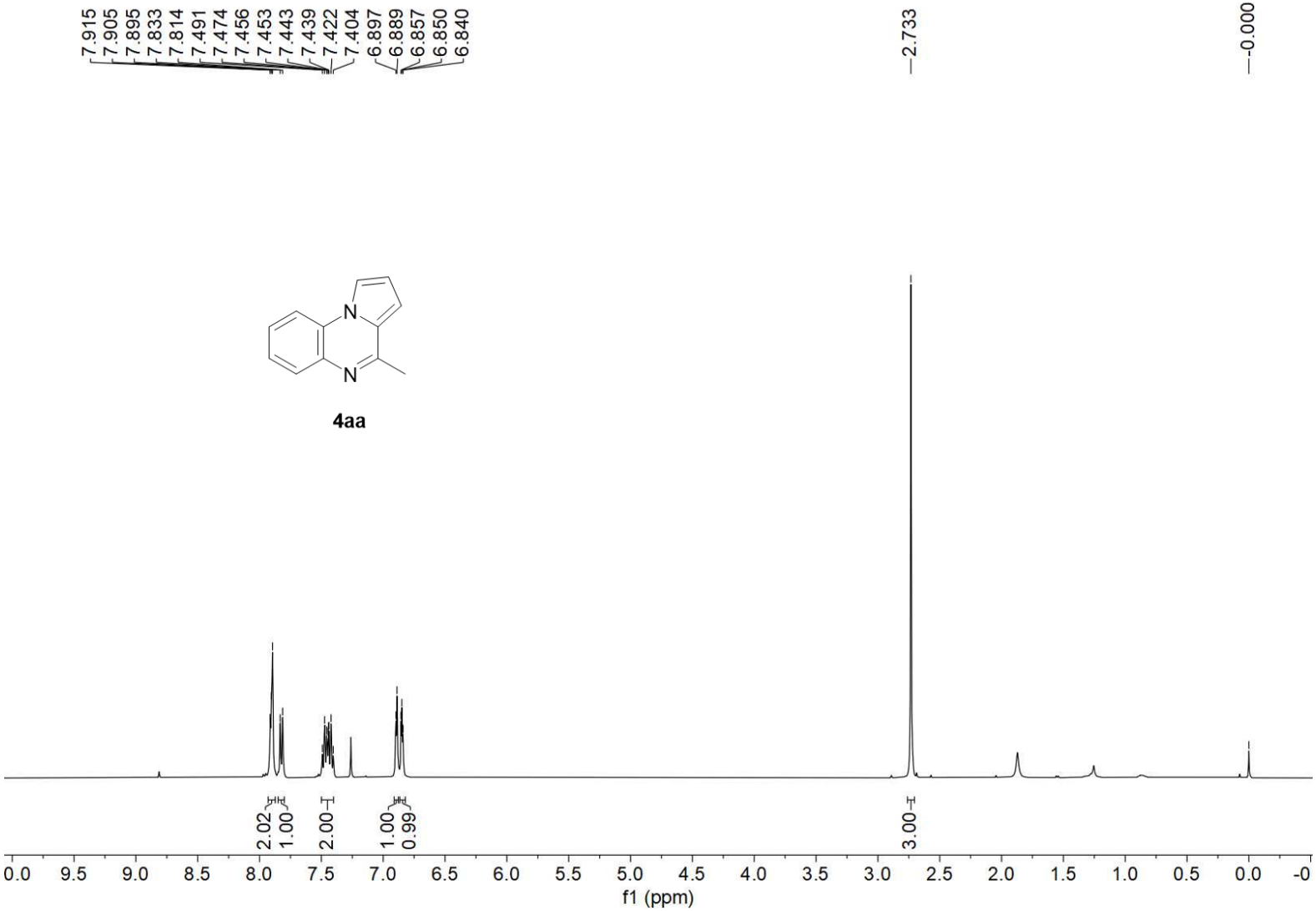

3.720
3.705
3.689
3.113
3.094
3.076
2.086
2.069
2.050
2.032
2.014
1.787
1.771
1.768
1.756
1.752
1.736
1.719
-0.000


N
N
OH

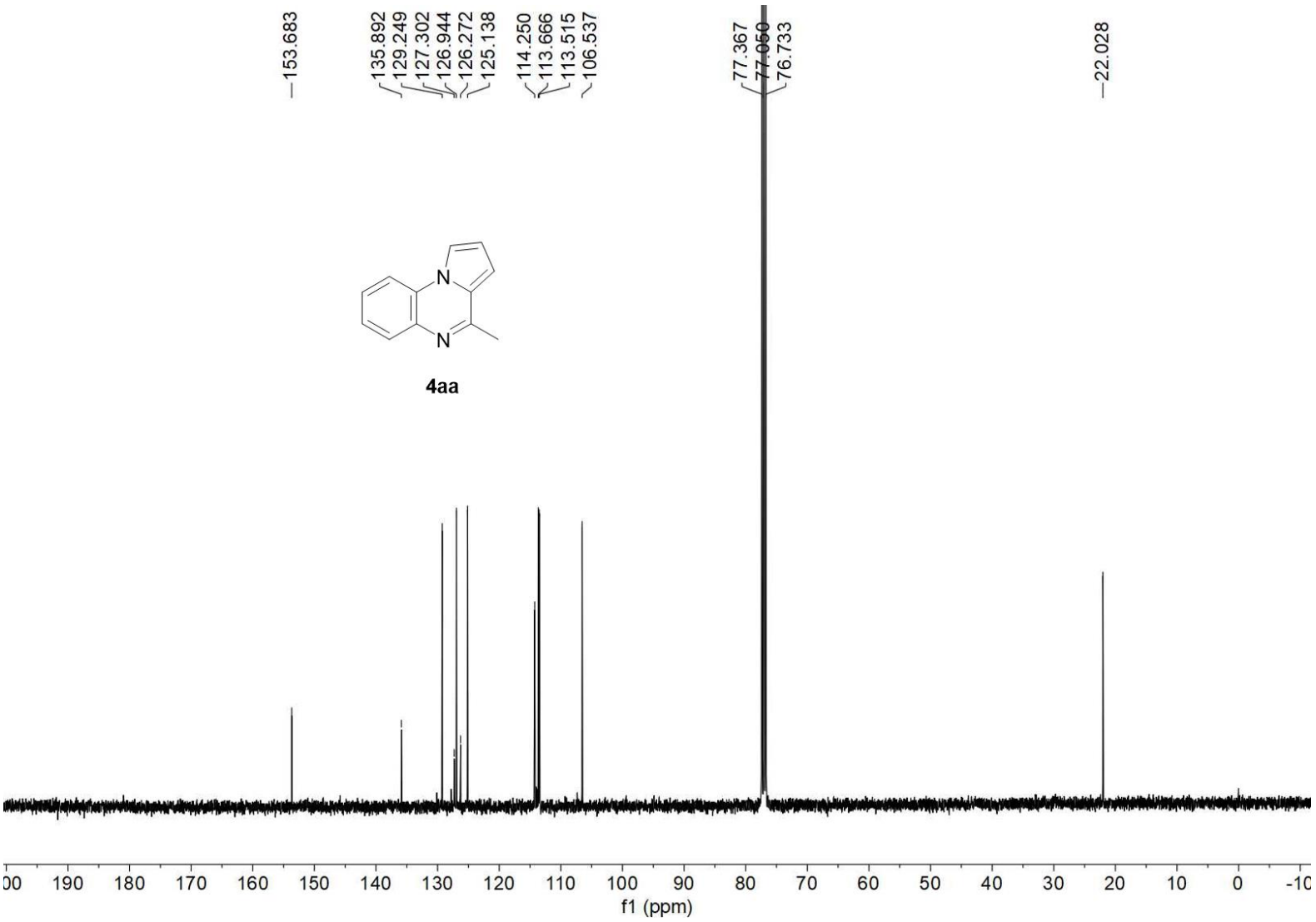
**3ad**

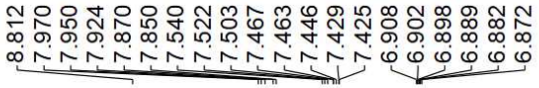

2.00
1.05
2.17
1.00
1.01
2.01
2.07
2.19
2.13
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

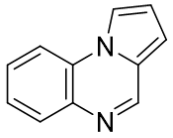

157.057
135.515
129.177
127.247
127.096
125.885
125.216
114.400
113.664
113.607
106.506
77.367
77.050
76.733
61.972
34.414
32.392
23.426
N
N
OH
3ad
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.915
7.905
7.895
7.833
7.814
7.491
7.474
7.456
7.453
7.443
7.439
7.422
7.404
6.897
6.889
6.857
6.850
6.840
2.733
-0.000
N
N
2.02
1.00
2.00
1.00
0.99
3.00
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

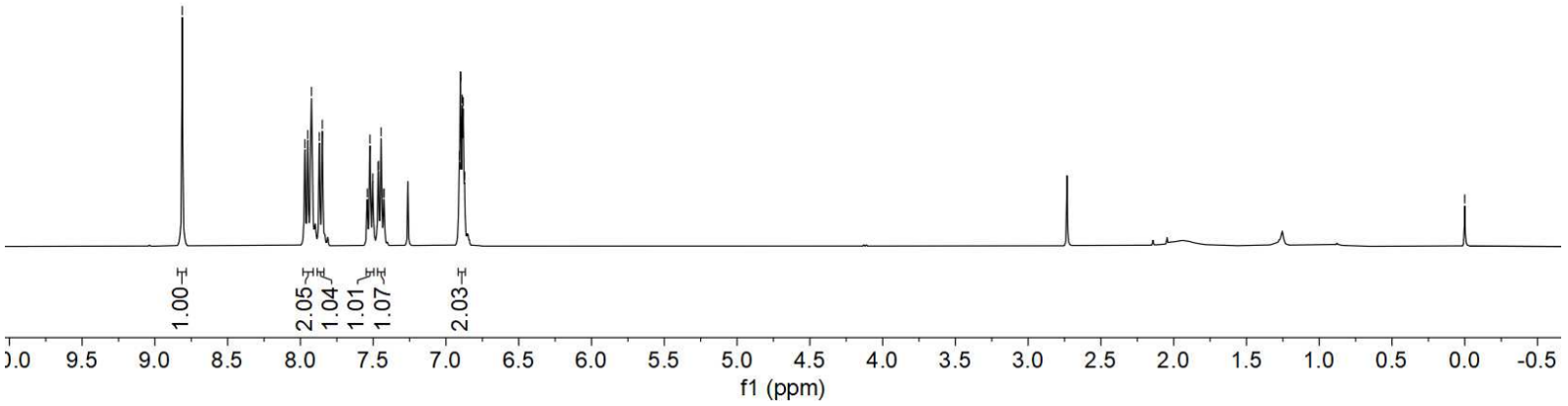
**4aa**

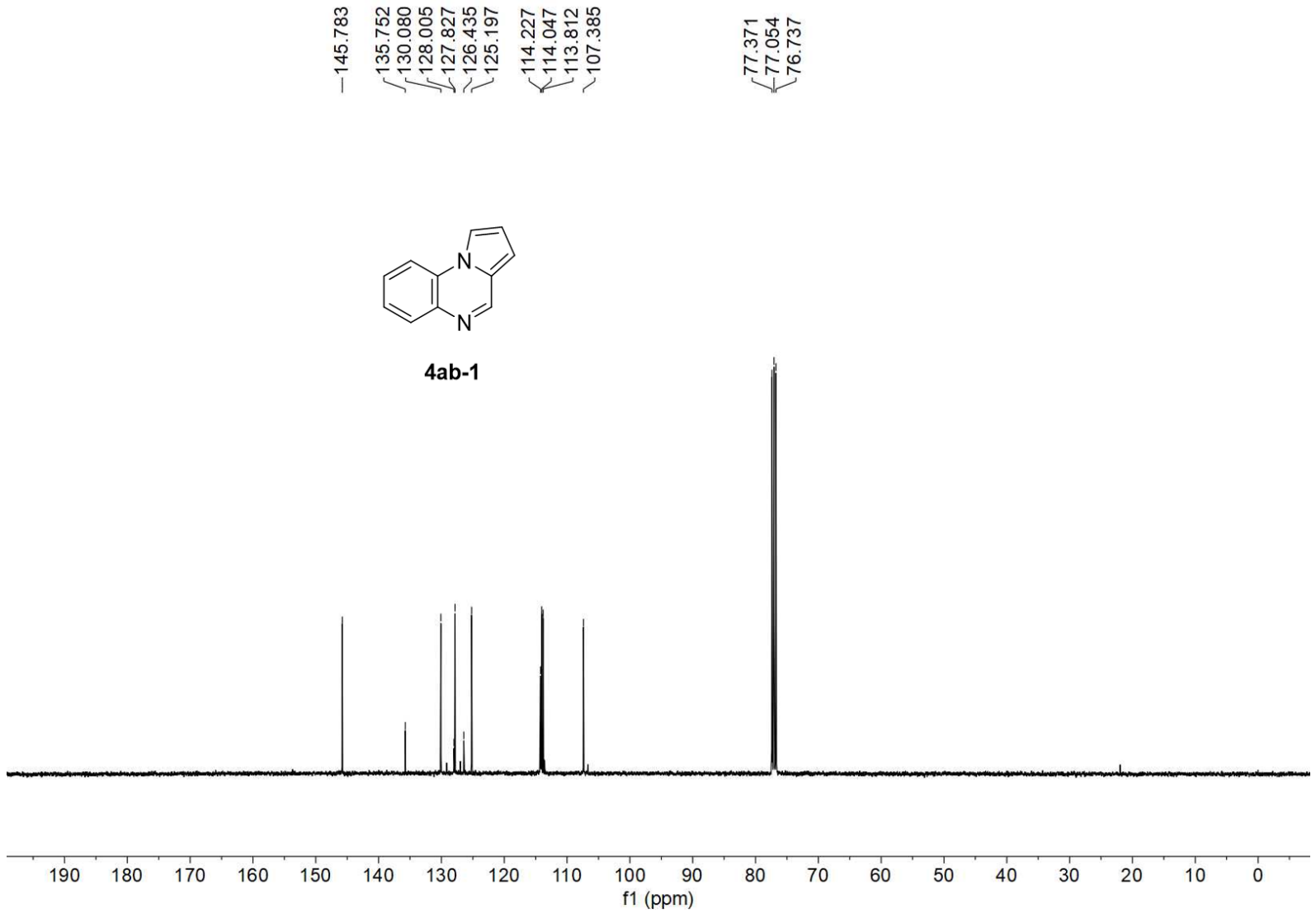

153.683
135.892
129.249
127.302
126.944
126.272
125.138
114.250
113.666
113.515
106.537
77.367
77.050
76.733
22.028
N
N
4aa
f1 (ppm)

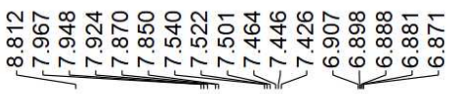

8.812
7.970
7.950
7.924
7.870
7.850
7.540
7.522
7.503
7.467
7.463
7.446
7.429
7.425
6.908
6.902
6.898
6.889
6.882
6.872
0.000


N
N

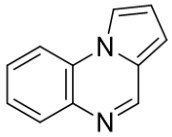
**4ab-1**


1.00
2.05
1.04
1.01
1.07
2.03
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)

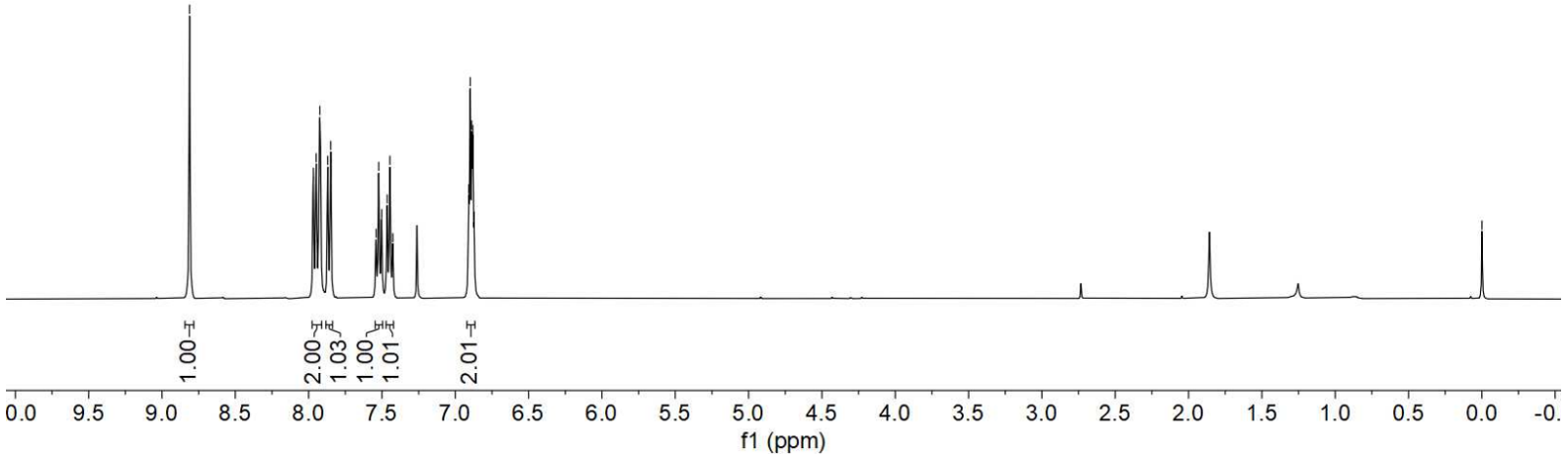

145.783
135.752
130.080
128.005
127.827
126.435
125.197
114.227
114.047
113.812
107.385
77.371
77.054
76.737
N
N
4ab-1
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

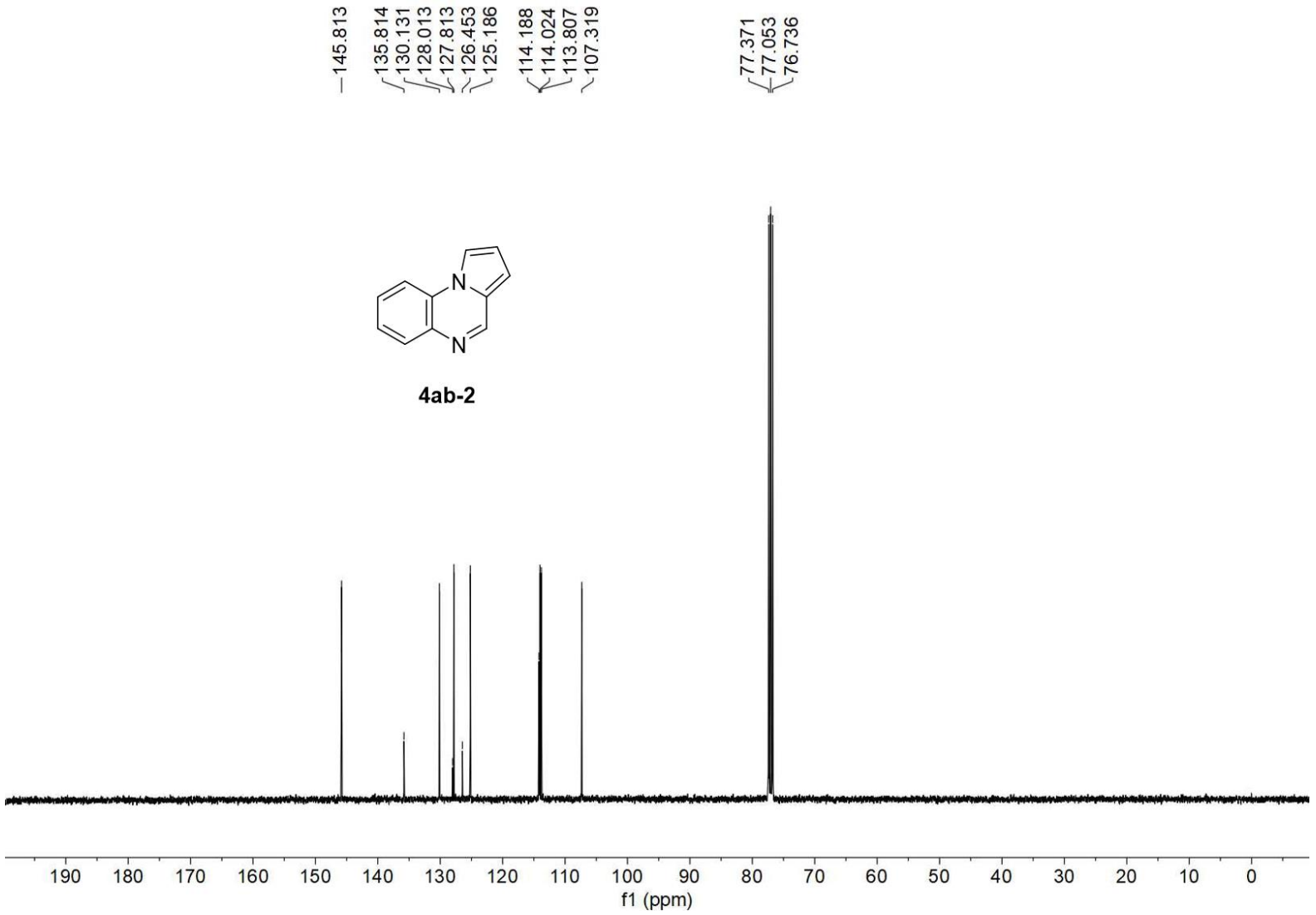

8.812
7.967
7.948
7.924
7.870
7.850
7.540
7.522
7.501
7.464
7.446
7.426
6.907
6.898
6.888
6.881
6.871


-0.000

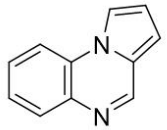

N
N

**4ab-2**

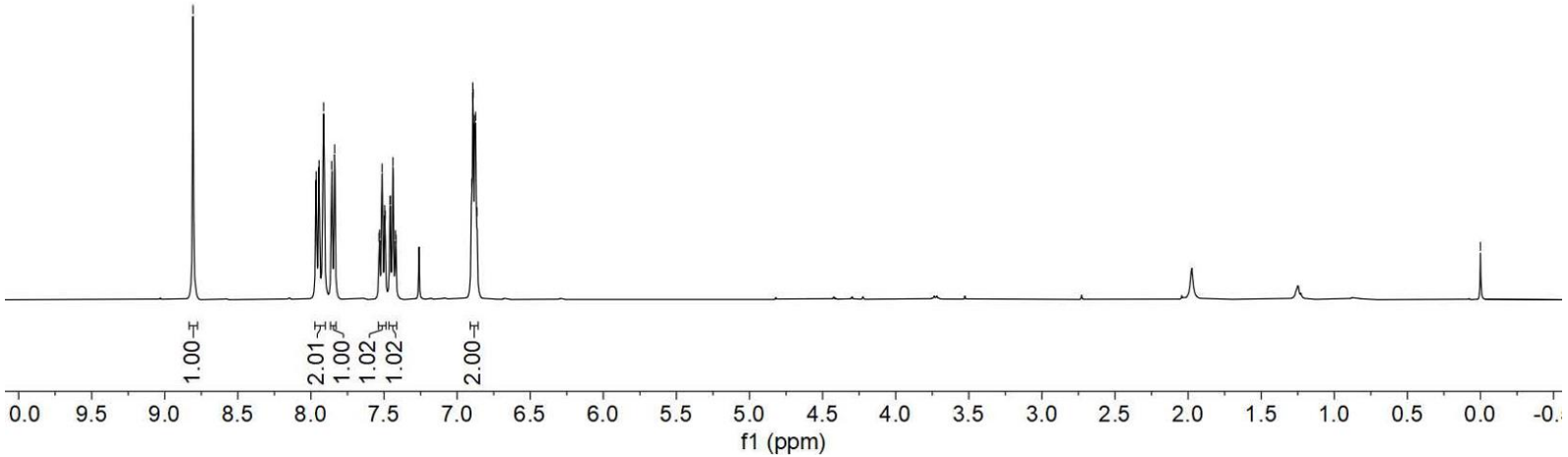

1.00
2.00
1.03
1.00
1.01
2.01
0.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)

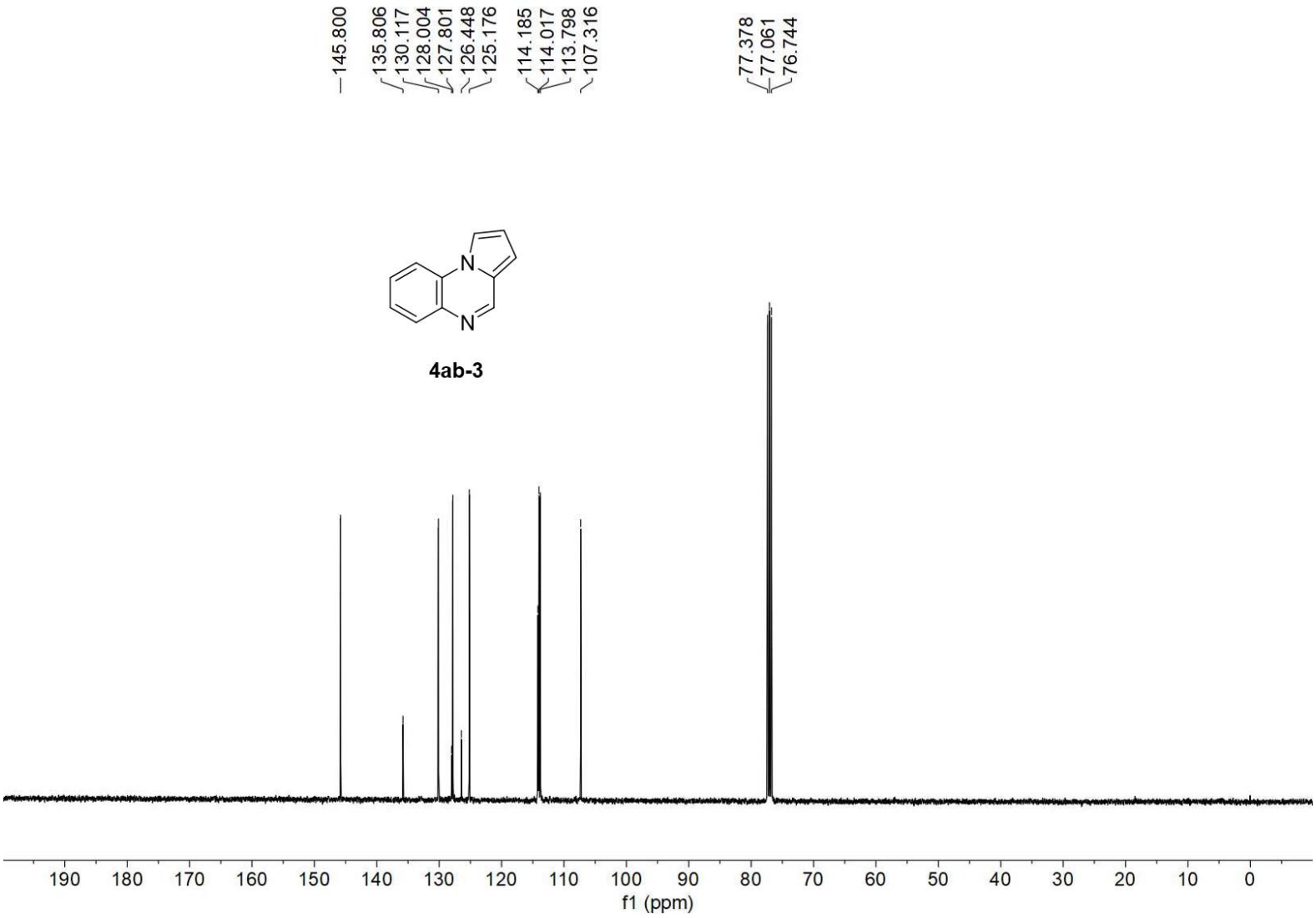

145.813
135.814
130.131
128.013
127.813
126.453
125.186
114.188
114.024
113.807
107.319
77.371
77.053
76.736
N
N
4ab-2
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

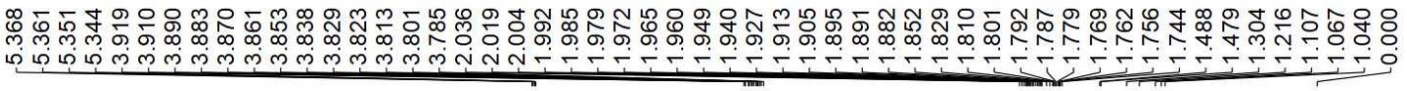

8.807
7.964
7.945
7.914
7.859
7.838
7.534
7.530
7.513
7.496
7.492
7.460
7.456
7.439
7.422
7.418
6.900
6.893
6.890
6.881
6.874
6.865
0.000

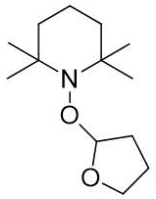


**4ab-3**

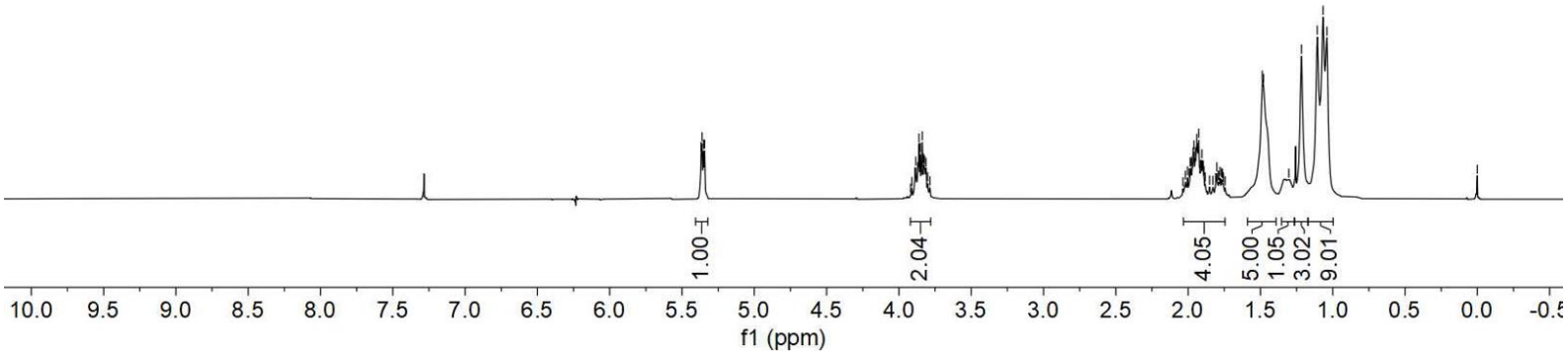

1.00
2.01
1.00
1.02
1.02
2.00
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


145.800
135.806
130.117
128.004
127.801
126.448
125.176
114.185
114.017
113.798
107.316
77.378
77.061
76.744
N
N
4ab-3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


5.368
5.361
5.351
5.344
3.919
3.910
3.890
3.883
3.870
3.861
3.853
3.838
3.829
3.823
3.813
3.801
3.785
2.036
2.019
2.004
1.992
1.985
1.979
1.972
1.965
1.960
1.949
1.940
1.927
1.913
1.905
1.895
1.891
1.882
1.852
1.829
1.810
1.801
1.792
1.787
1.779
1.769
1.762
1.756
1.744
1.488
1.479
1.304
1.216
1.107
1.067
1.040
0.000


N
O
O

**5**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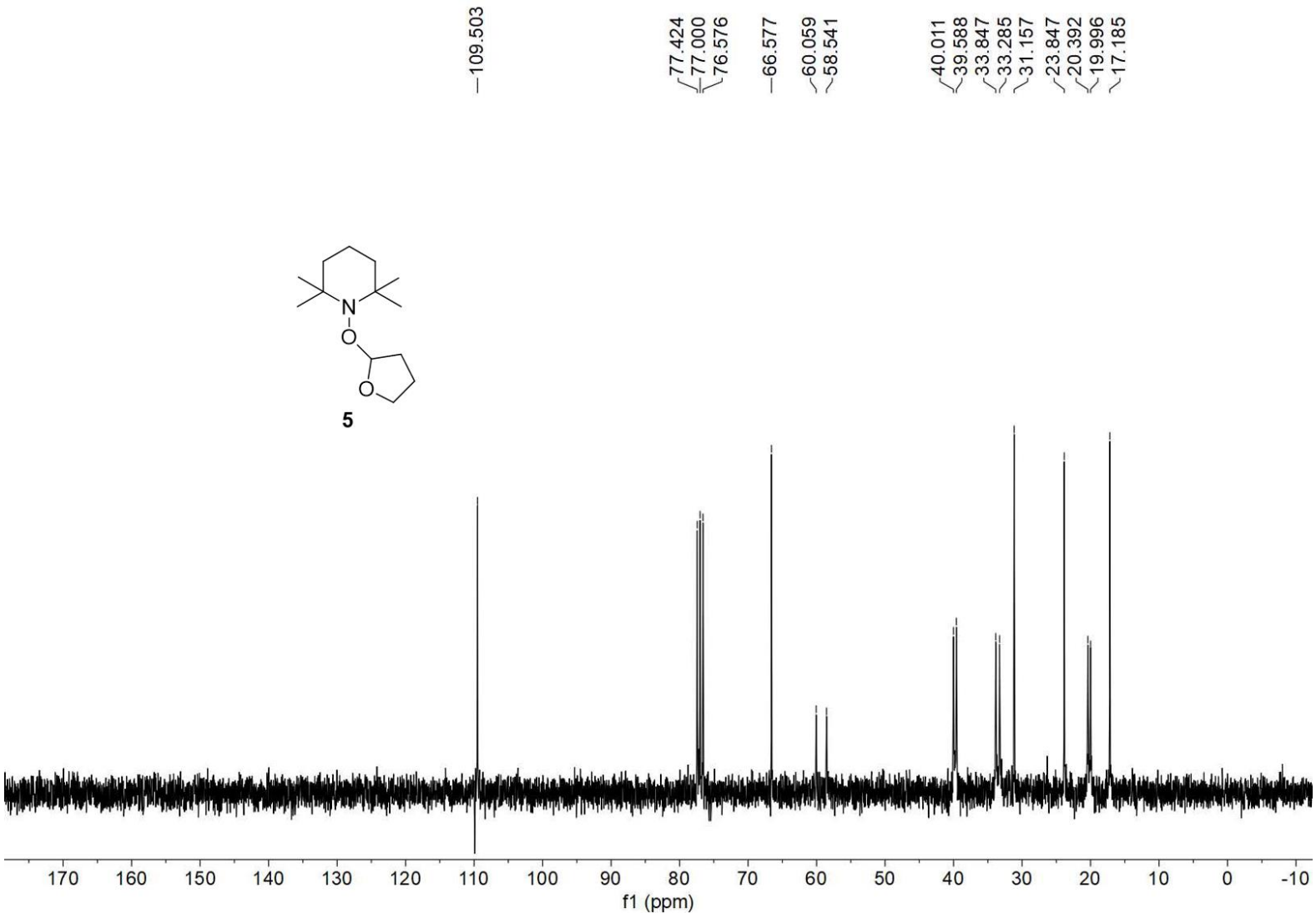
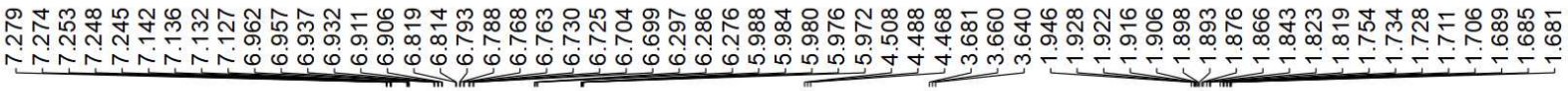
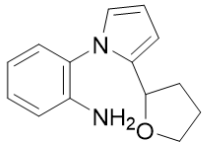
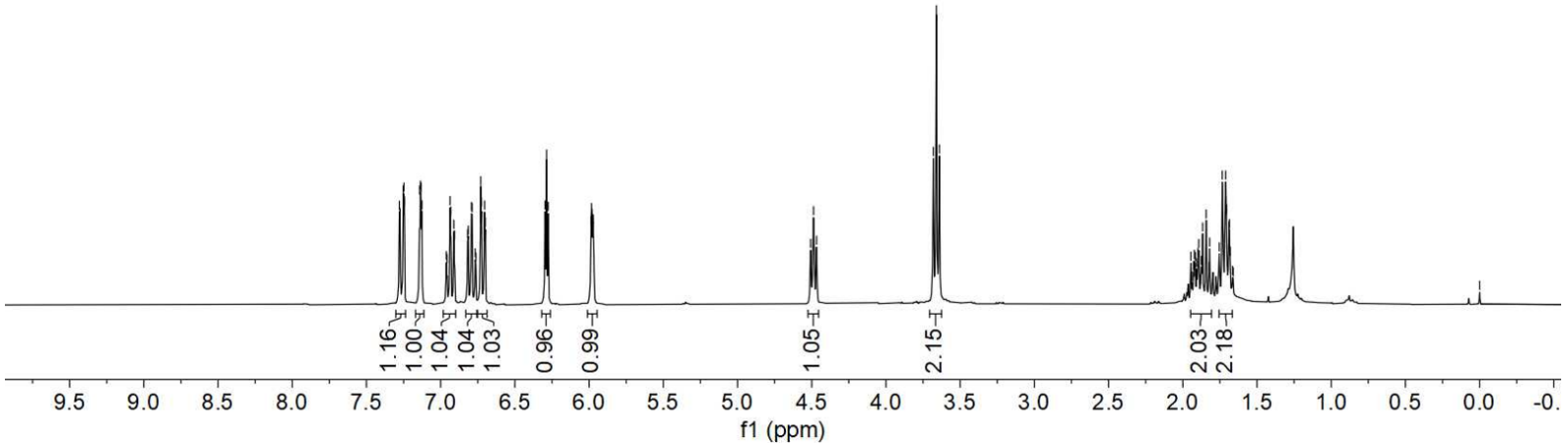
2.04
4.05
5.00
1.05
3.02
9.01
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


109.503
77.424
77.000
76.576
66.577
60.059
58.541
40.011
39.588
33.847
33.285
31.157
23.847
20.392
19.996
17.185
N
O
O
5
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


7.279
7.274
7.253
7.248
7.245
7.142
7.136
7.132
7.127
6.962
6.957
6.937
6.932
6.911
6.906
6.819
6.814
6.793
6.788
6.768
6.763
6.730
6.725
6.704
6.699
6.297
6.286
6.276
5.988
5.984
5.980
5.976
5.972
4.508
4.488
4.468
3.681
3.660
3.640
1.946
1.928
1.922
1.916
1.906
1.898
1.893
1.876
1.866
1.843
1.823
1.819
1.754
1.734
1.728
1.711
1.706
1.689
1.685
1.681


N
NH2
O

**6**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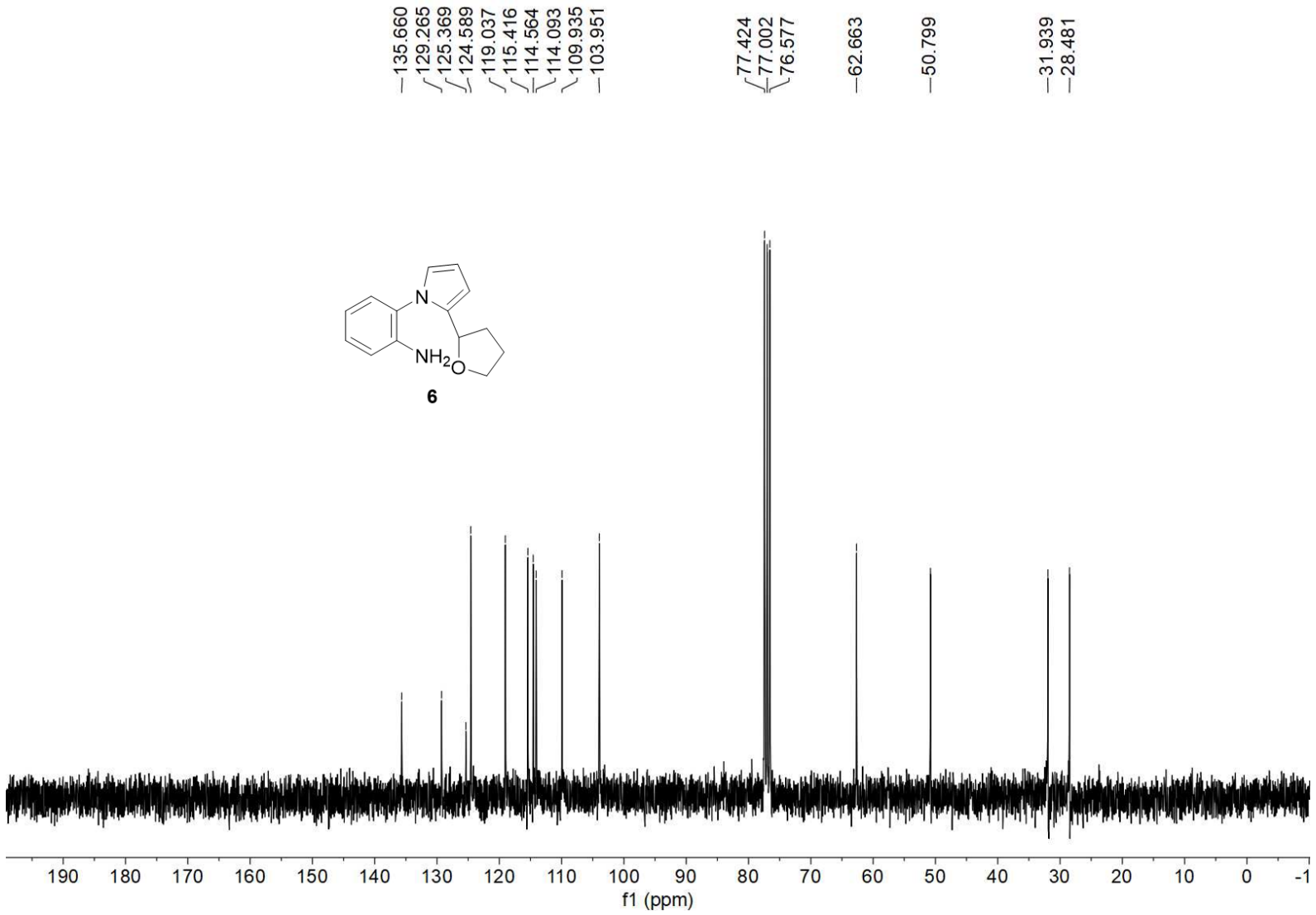
1.00
1.04
1.04
1.03
0.96
0.99
1.05
2.15
2.03
2.18
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)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129.265
125.369
124.589
119.037
115.416
114.564
114.093
109.935
103.951
77.424
77.002
76.577
62.663
50.799
31.939
28.481
N
NH2
O
6
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)