Supplementary Information

Radical α-Addition Involved Electrooxidative [3+2] Annulation of Phenols and Electron-Deficient Alkenes

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1. General Information

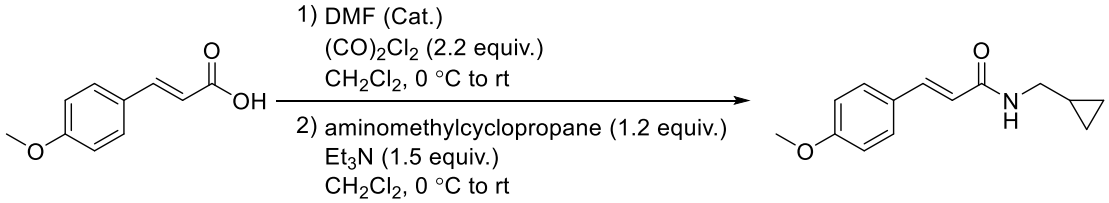
^{1}H NMR (400 MHz) spectra were recorded on a Bruker Avance 400 spectrometer and ^{1}H NMR (500 MHz) spectra were recorded on a Bruker Avance 500 spectrometer in $CDCl_3$ [using $CDCl_3$ (for 1 H, δ = 7.26) or $(CD_3)_2SO$ (for 1 H, δ = 2.50) as the internal standard]. ^{13}C NMR (101 MHz) spectra were recorded on a Bruker Avance 400 spectrometer and ^{13}C NMR (126 MHz) spectra were recorded on a Bruker Avance 500 spectrometer in $CDCl_3$ [using $CDCl_3$ (for ^{13}C, δ = 77.0 or $(CD_3)_2SO$ (for ^{13}C, δ = 39.52) as internal standard]. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublet, ddd = doublet of doublet of doublet, dt = doublet of triplet, m = multiplet, s br = single broad. High-resolution mass spectra were obtained with a Water XEVO G2 Q-Tof (Waters Corporation). X-ray crystallography analysis was performed on Bruker X8 APEX X-ray diffractionmeter. Melting points were uncorrected and were recorded on a Buchi B-54 melting point apparatus. Flash column chromatography was performed using Merck silica gel 60 with distilled solvents. Commercially available reagents were purchased from Energy Chemical, J & K Scientific, Adamas-beta and Sigma-Aldrich Co., Inc.

α, β-unsaturated carbonyl compounds **2a,**[1] **2b,**[2] **2c,**[3] **2d,**[1] **2e,**[3] **2f,**[4] **2g,**[5] **2h,**[6] **2i,**[7] **2j,**[8] **2k,**[1] **2l,**[9] **2m,**[9] **2q,**[10] **2r,**[10] and phenols **1ad,**[11] **1ag,**[12] **1ah,**[13] **1ai,**[13] **1aj,**[13] **1ak,**[13] **1al,**[14] were known compounds and prepared according to the literature procedures. Phenols **1a, 1aa, 1ab, 1ac, 1ae, 1af, 1am,** were purchased and used directly without further purification.

2. Synthesis of *α,β*-unsaturated carbonyl compounds

α,β-unsaturated carbonyl compounds **2n**, **2o**, **2p** were prepared by the procedure shown below.

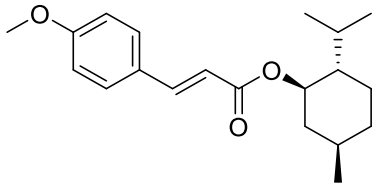
General procedure :



To a solution of (*E*)-3-(4-methoxyphenyl)acrylic acid (0.894 g, 5.02 mmol) and drops of DMF (cat.) in CH_2Cl_2 was slowly added $(CO)_2Cl_2$ (0.9 mL, 10.64 mmol) at 0 °C. The reaction mixture was warm to room temperature, and stirred under nitrogen atmosphere for 1h. The solvent was removed under vacuo to afford a crude acyl chloride product. The crude product was dissolved in CH_2Cl_2, Et_3N (1.0 mL, 7.19 mmol) and aminomethylcyclopropane (0.5 mL, 5.84 mmol) were added. The reaction mixture was

stirred at room temperature before it was cooled to 0 °C and quenched with water. The aqueous layer was extracted with CH_2Cl_2 three times. The combined organic extracts were washed with brine, dried over Na_2SO_4, and concentrated in vacuo. The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 5:1) to give **2p** (0.914 g) in 78% yield as a white solid, mp: 84-85 °C; ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.23-0.26 (m, 2H), 0.51-0.55 (m, 2H), 0.97-1.05 (m, 1H), 3.24 (dd, *J* = 7.0, 5.5 Hz, 2H), 3.82 (s, 3H), 5.74 (s, 1H), 6.28 (d, *J* = 15.5 Hz, 1H), 6.88 (d, *J* = 8.5 Hz, 2H), 7.45 (d, *J* = 8.5 Hz, 2H), 7.58 (d, *J* = 15.5 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 3.43, 10.77, 44.55, 55.32, 114.20, 118.34, 127.58, 129.27, 140.49, 160.78, 166.05; ESIHRMS: Found: m/z 232.1340. Calcd for $C_{14}H_{18}O_2$: $(M+H)^+$ 232.1338.

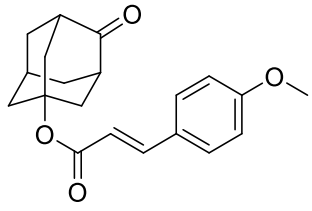
(1R,2S,5R)-2-isopropyl-5-methylcyclohexyl (*E*)-3-(4-methoxyphenyl)acrylate (2n)



Following general procedure, **2n** was synthesised in 29% yield (487.2 mg, 1.540 mmol) from the reaction of (*E*)-3-(4-methoxyphenyl)acrylic acid (1.294 g, 7.262 mmol) and *L*-menthol (938.6 mg, 6.006 mmol); White solid, mp 52-53°C.

^{1}H NMR (500 MHz, $CDCl_3$) δ 0.79 (d, *J* = 6.9 Hz, 3H), 0.89-0.94 (m, 7H), 1.04 (q, *J* = 12.0 Hz, 1H), 1.06-1.14 (m, 1H), 1.41-1.57 (m, 2H), 1.67-1.73 (m, 2H), 1.88-1.97 (m, 1H), 2.02-2.09 (m, 1H), 3.84 (s, 3H), 4.81 (ddd, *J* = 11.0, 10.5, 4.5 Hz, 1H), 6.30 (d, *J* = 16.0 Hz, 1H), 6.90 (d, *J* = 8.5 Hz, 2H), 7.48 (d, *J* = 8.5 Hz, 2H), 7.63 (d, *J* = 16.0 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 16.42, 20.77, 22.05, 23.53, 26.32, 31.41, 34.31, 41.06, 47.22, 55.34, 74.00, 114.25, 116.21, 127.27, 129.65, 144.00, 161.24, 166.91; ESIHRMS: Found: m/z 317.2114. Calcd for $C_{20}H_{29}O_3$: $(M+H)^+$ 317.2117.

(1s,3R,5S,7s)-4-oxoadamantan-1-yl (*E*)-3-(4-methoxyphenyl)acrylate (2o)

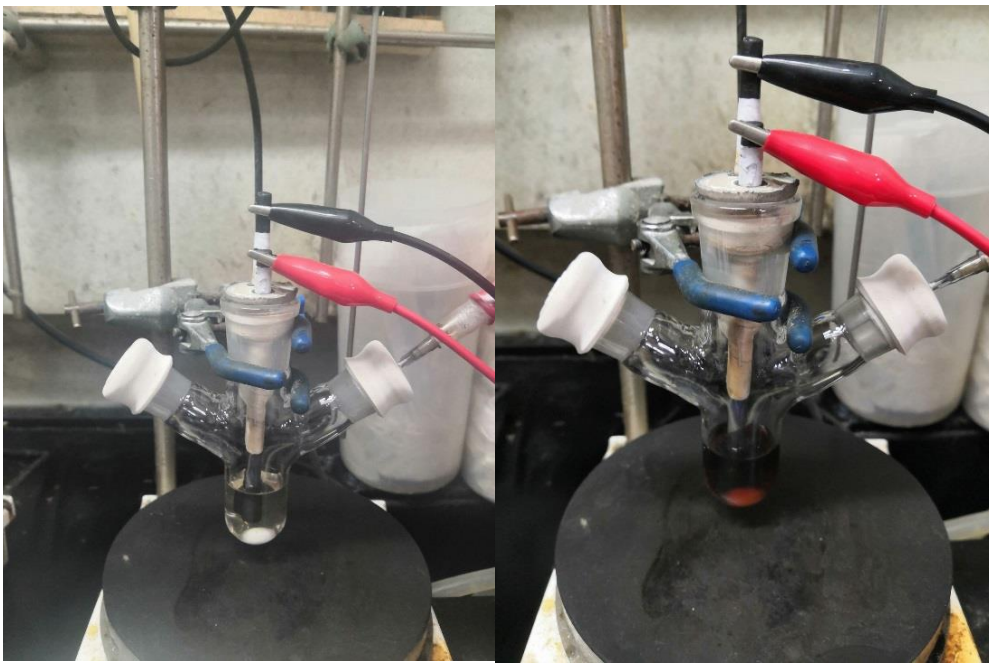


Following general procedure, **2o** was obtained in 30% yield (977.1 mg, 2.99 mmol) from the reaction of (*E*)-3-(4-methoxyphenyl)acrylic acid (2.167 g, 12.16 mmol) and 5-hydroxyadamantan-2-one (1.678 g, 10.10 mmol); white solid, mp 120-121 °C.

^{1}H NMR (500 MHz, $CDCl_3$) δ 1.96 (d, *J* = 12.9 Hz, 2H), 2.04-2.09 (m, 2H), 2.35-2.40 (m, 2H), 2.40-2.46 (m, 3H), 2.50 (d, *J* = 11.7 Hz, 2H), 2.68 (s, 2H), 3.84 (s, 3H), 6.23 (d, *J* = 16.0 Hz, 1H), 6.90 (d, *J* = 9.0 Hz, 2H), 7.45 (d, *J* = 9.0 Hz, 2H), 7.55 (d, *J* = 16.0 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 29.85, 38.21, 40.00, 41.41, 47.07, 55.35, 114.28, 116.80, 127.11, 129.67, 144.04, 161.31, 166.24, 215.78; ESIHRMS: Found: m/z 327.1594. Calcd for $C_{20}H_{23}O_4$: $(M+H)^+$ 327.1596.

3. Information for reaction set up:

3.1. Small scale reaction



Before After

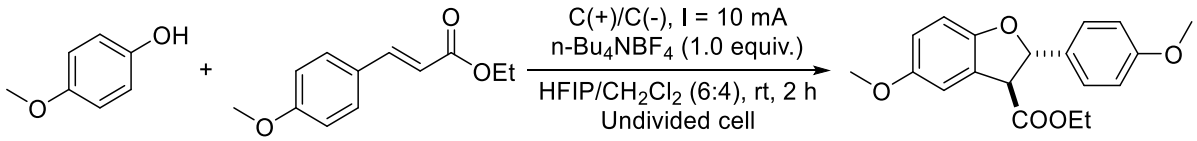
Supplementary Figure 1. Experimental setup diagram for the small scale r eaction.

3.2. Large scale reaction

Supplementary Figure 2. Experimental setup diagram for the large scale re action.

4. Electrooxidative annulation of phenols and electron-deficient alkenes

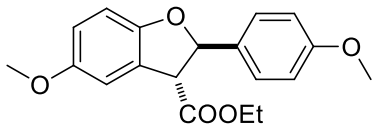
General procedure:



1a 1.5 equiv. **2a 1.0 equiv.** **3a**

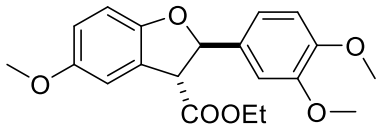
In an oven-dried undivided three-necked flask (10 mL) equipped with a stir bar, ethyl 4-methoxycinnamate (**2a**) (62.0 mg, 0.301 mmol), *p*-methoxylphenol (**1a**) (58.0 mg, 0.467 mmol), *n*-Bu_4NBF_4 (100.3 mg, 0.305 mmol) and HFIP/CH_2Cl_2 (3:2, 10 mL) were added. The flask was equipped with graphite rod electrode (Φ 6 mm) as the anode and cathode. The reaction mixture was stirred and electrolyzed at a constant current of 10 mA under room temperature and nitrogen atmosphere for 2 h. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 10 : 1) to afford product **3a** (81.4 mg, 0.248 mmol) in 82% yield.

Ethyl 5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3a)



Yellow solid, mp 45-46 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.34 (t, *J* = 7.2, 3H), 3.78 (s, 3H), 3.80 (s, 3H), 4.21-4.35 (m, 3H), 6.05 (d, *J* = 8.0, 1H), 6.78-6.83 (m, 2H), 6.89-6.92 (m, 2H), 6.96-6.97 (m, 1H), 7.34-7.38 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.16, 55.16, 55.90, 55.93, 61.48, 85.60, 109.70, 110.91, 113.98, 114.66, 124.87, 127.22, 132.60, 153.32, 154.24, 159.57, 170.54; ESIHRMS: Found: *m/z* 351.1204. Calcd for $C_{19}H_{20}O_5Na$: $(M+Na)^+$ 351.1208.

Ethyl-2-(3,4-dimethoxyphenyl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3b)



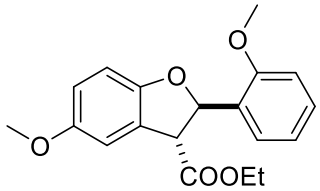
According to the general procedure, the reaction of **2b** (71.5 mg, 0.303 mmol), **1a** (59.1 mg, 0.476 mmol), *n*-Bu_4NBF_4 (100.3 mg, 0.305 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 5:1) afforded 89.3 mg (82%) of **3b** as yellow solid, mp 57-58 °C.

Procedure for gram scale synthesis

In an oven-dried two-necked flask (100 mL) equipped with a stir bar, (*E*)-ethyl 3-(3,4-dimethoxyphenyl)acrylate (**2b**)(1.208 g, 5.113 mmol), p-methoxylphenol (**1a**) (0.956g, 7.701 mmol), *n*-Bu_4NBF_4 (1.687 g, 5.123 mmol) and HFIP/CH_2Cl_2 (36/24 mL) were added. The bottle was equipped with graphite rod (Φ 6 mm) as the anode and cathode. The reaction mixture was stirred and electrolyzed at a constant current of 50 mA under room temperature and nitrogen atmosphere for 6 h. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 5 : 1) to afford product **3b** (1.199g, 3.346 mmol) in 66% yield.

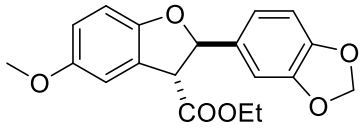
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2, 3H), 3.77 (s, 3H), 3.86 (s, 3H), 3.87 (s, 3H), 4.20-4.35 (m, 3H), 6.01 (d, *J* = 8.0, 1H), 6.76-6.83 (m, 2H), 6.85 (d, *J* = 8.0, 1H), 6.92-6.99 (m, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.22, 55.86, 55.89, 55.98, 61.58, 85.84, 108.990, 109.81, 110.94, 111.09, 114.71, 118.42, 124.92, 132.95, 149.04, 149.16, 153.31, 154.33, 170.58; ESIHRMS: Found: *m/z* 359.1508. Calcd for $C_{20}H_{23}O_6$: $(M+H)^+$ 359.1495.

Ethyl-5-methoxy-2-(2-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3c)



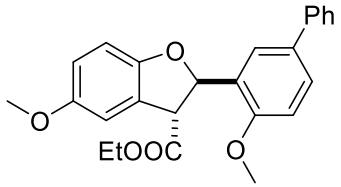
According to the general procedure, the reaction of **2c** (63.4 mg, 0.307 mmol), **1a** (61.1 mg, 0.492 mmol), *n*-Bu_4NBF_4 (102.0 mg, 0.310 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 10:1) afforded 53.1 mg (53%) of **3c** as pale yellow solid, mp 78-79 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 3.74 (s, 3H), 3.79 (s, 3H), 4.14 (d, *J* = 6.4 Hz, 1H), 4.20-4.35 (m, 2H), 6.33 (d, *J* = 6.4 Hz, 1H), 6.77 (dd, *J* = 8.8, 2.8 Hz, 1H), 6.83-6.86 (m, 2H), 6.87-6.89 (m, 1H), 6.91-6.95 (m, 1H), 7.24-7.29 (m, 1H), 7.40-7.42 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.30, 55.20, 55.48, 55.97, 61.26, 82.29, 109.76, 110.34, 110.67, 114.69, 120.50, 125.41, 125.41, 128.89, 129.30, 153.62, 154.16, 155.88, 171.40; ESIHRMS: Found: *m/z* 351.1204. Calcd for $C_{19}H_{20}NaO_5$: $(M+Na)^+$ 351.1208.

Ethyl-2-(benzo[d][1,3]dioxol-5-yl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3d)



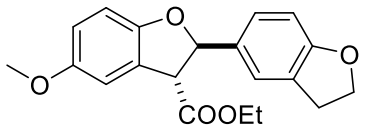
According to the general procedure, the reaction of **2d** (71.5 mg, 0.303 mmol), **1a** (59.1 mg, 0.476 mmol), *n*-Bu_4NBF_4 (100.3 mg, 0.305 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 5:1) to afford 89.3 mg (82%) of **3d** as pale solid, mp 60-61 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2, 3H), 3.77 (s, 3H), 4.19-4.34 (m, 3H), 5.94 (s, 2H), 5.99 (d, *J* = 7.6 Hz, 1H), 6.74-6.84 (m, 3H), 6.88-6.89 (m, 3H), 6.93-6.94 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.21, 55.98, 56.08, 61.60, 85.68, 101.11, 106.23, 108.24, 109.78, 110.97, 114.78, 119.53, 124.72, 134.51, 147.58, 147.97, 153.27, 154.34, 170.52; ESIHRMS: Found: m/z 365.1000. Calcd for $C_{19}H_{18}O_6Na$: $(M+Na)^+$ 365.1001.

Ethyl-5-methoxy-2-(4-methoxy-[1,1'-biphenyl]-3-yl)-2,3-dihydrobenzofuran-3-carboxylate (3e)



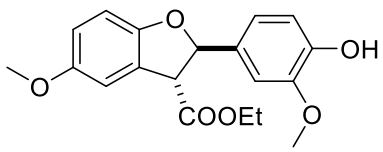
According to the general procedure, the reaction of **2e** (85.3 mg, 0.302 mmol), **1a** (62.6 mg, 0.504 mmol), *n*-Bu_4NBF_4 (103.1 mg, 0.313 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 10:1) to afford 99.0 mg (74%) of **3e** as white solid, mp 98-99 °C.
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.35 (t, *J* = 7.2 Hz, 3H), 3.76 (s, 3H), 3.85 (s, 3H), 4.22 (d, *J* = 6.4 Hz, 1H), 4.23-4.38 (m, 2H), 6.40 (d, *J* = 6.4 Hz, 1H), 6.79 (ddd, *J* = 8.8, 2.8, 0.8 Hz, 1H), 6.86 (dd, *J* = 2.8, 0.8 Hz, 1H), 6.89 (d, *J* = 8.8 Hz, 1H), 6.97 (d, *J* = 8.4 Hz, 1H), 7.27-7.32 (m, 1H), 7.38-7.42 (m, 2H), 7.50-7.54 (m, 3H), 7.67 (dd, *J* = 2.4, 0.8 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.35, 55.44, 55.56, 56.01, 61.33, 82.37, 109.86, 110.65, 110.77, 114.76, 124.83, 125.40, 126.72, 126.81, 127.42, 128.65, 129.65, 133.71, 140.70, 153.60, 154.22, 155.49, 171.41; ESIHRMS: Found: m/z 427.1518. Calcd for $C_{25}H_{24}O_5Na$: $(M+Na)^+$ 427.1521.

Ethyl-5-methoxy-2,2',3,3'-tetrahydro-[2,5'-bibenzofuran]-3-carboxylate (3f)



According to the general procedure, the reaction of **2f** (65.6 mg, 0.301 mmol), **1a** (60.3 mg, 0.486 mmol), *n*-Bu_4NBF_4 (101.3 mg, 0.308 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 10:1) afforded 71.3 mg (77%) of **3f** as yellow solid, mp 50-51 °C.
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.32 (t, *J* = 7.2 Hz, 3H), 3.18 (t, *J* = 8.8 Hz, 2H), 3.77 (s, 3H), 4.19-4.34 (m, 3H), 4.56 (t, *J* = 8.8 Hz, 2H), 6.00 (d, *J* = 7.8 Hz, 1H), 6.74-6.78 (m, 3H), 6.94-6.95 (m, 1H), 7.15 (dd, *J* = 8.2, 2.0 Hz, 1H), 7.24-7.25 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.30, 29.63, 56.06, 56.14, 61.60, 71.45, 86.08, 109.27, 109.82, 111.01, 114.78, 122.77, 125.03, 126.30, 127.67, 132.67, 153.43, 154.33, 160.33, 170.70; ESIHRMS: Found: *m/z* 362.1204. Calcd for $C_{19}H_{20}NaO_5$: $(M+Na)^+$ 363.1208.

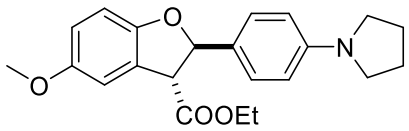
Ethyl-2-(4-hydroxy-3-methoxyphenyl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3g)



According to the general procedure, the reaction of **2g** (73.2 mg, 0.329 mmol), **1a** (62.0 mg, 0.499 mmol), *n*-Bu_4NBF_4 (110.0 mg, 0.334 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 10:1) afforded 73.8 mg (65%) of **3g** as bright yellow liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 3.78 (s, 3H), 3.88 (s, 3H), 4.20-4.35 (m, 3H), 5.64 (s, 1H), 6.00 (d, *J* = 8.4 Hz, 1H), 6.77-6.82 (m, 2H), 6.90-6.93 (m, 3H), 6.77-6.82 (m, 2H), 6.94-6.95 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.25, 55.96, 56.05, 56.09, 61.60, 86.00, 108.46, 109.84, 111.00, 114.48, 114.79, 119.16, 124.99, 132.43, 145.78, 146.70, 153.37, 154.38, 170.63; ESIHRMS: Found: *m/z* 345.1328. Calcd for $C_{19}H_{21}NaO_6$: $(M+H)^+$ 345.1338.

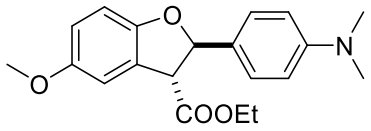
Ethyl-5-methoxy-2-(4-(pyrrolidin-1-yl)phenyl)-2,3-dihydrobenzofuran-3-carboxylate (3h)



According to the general procedure, the reaction of **2h** (74.2 mg, 0.303 mmol), **1a** (60.0 mg, 0.483 mmol), *n*-Bu_4NBF_4 (101.2 mg, 0.307 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =10:1) afforded 71.5 mg (64%) of **3h** as gray liquid.

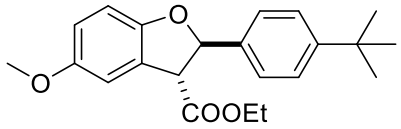
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 1.97-2.03 (m, 4H), 3.24-3.32 (m, 4H), 3.79 (s, 3H), 4.19-4.34 (m, 3H), 5.99 (d, *J* = 8.4 Hz, 1H), 6.54-6.57 (m, 2H), 6.78 (d, *J* = 1.6 Hz, 2H), 6.95-6.96 (m, 1H), 7.27-7.30 (m, 2H); ^{13}C NMR (101 MHz, Chloroform-*d*) δ = 14.22, 25.38, 47.63, 55.76, 55.99, 61.39, 86.48, 109.71, 110.83, 111.61, 114.61, 125.35, 127.32, 148.00, 153.51, 154.08, 170.81; ESIHRMS: Found: *m/z* 368.1860. Calcd for $C_{22}H_{26}NO_4$: $(M+H)^+$ 368.1862.

Ethyl-2-(4-(dimethylamino)phenyl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3i)



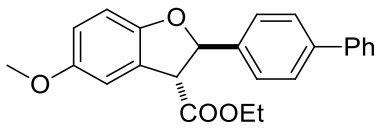
According to the general procedure, the reaction of **2i** (66.2 mg, 0.302 mmol), **1a** (57.6 mg, 0.464 mmol), *n*-Bu_4NBF_4 (101.5 mg, 0.308 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =10:1) afforded 86.0 mg (83%) of **3i** as pale yellow solid, mp 55-56 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 2.95 (s, 6H), 3.78 (s, 3H), 4.20-4.33 (m, 3H), 5.99 (d, *J* = 8.0 Hz, 1H), 6.70-6.74 (m, 2H), 6.78 (d, *J* = 1.6 Hz, 2H), 6.94-6.96 (m, 1H), 7.26-7.31 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.24, 40.49, 55.75, 56.01, 61.44, 86.23, 109.75, 110.88, 112.42, 114.65, 125.27, 127.18, 127.86, 150.69, 153.50, 154.14, 170.78; ESIHRMS: Found: *m/z* 342.1704. Calcd for $C_{20}H_{24}NO_4$: $(M+H)^+$ 342.1705.

Ethyl-2-(4-(*tert*-butyl)phenyl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3j)



According to the general procedure, the reaction of **2j** (72.3 mg, 0.311 mmol), **1a** (58.3 mg, 0.470 mmol), *n*-Bu_4NBF_4 (102.8 mg, 0.312 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) afforded 55.0 mg (50%) of **3j** as colorless liquid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.33-1.36 (m, 12H), 3.79 (s, 3H), 4.23-4.35 (m, 3H), 6.09 (d, *J* = 7.6 Hz, 1H), 6.79-6.80 (m, 2H), 6.97 (s, 1H), 7.36-7.42 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 14.22, 31.25, 34.53, 55.88, 55.97, 61.54, 85.63, 109.78, 111.95, 114.72, 124.87, 125.59, 137.62, 151.31, 153.45, 154.26, 170.64; ESIHRMS: Found: *m/z* 377.1733. Calcd for $C_{22}H_{26}NO_4$: $(M+H)^+$ 377.1729.

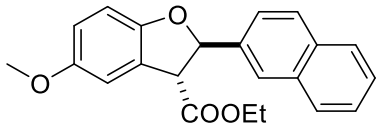
Ethyl-2-([1,1'-biphenyl]-4-yl)-5-methoxy-2,3-dihydrobenzofuran-3-carboxylate (3k)



According to the general procedure, the reaction of **2k** (76.2 mg, 0.302 mmol), **1a** (63.8 mg, 0.514 mmol), *n*-Bu_4NBF_4 (100.8 mg, 0.306 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) afforded 33.9 mg (30%) of **3k** as pale yellow solid, mp 64-65 °C.

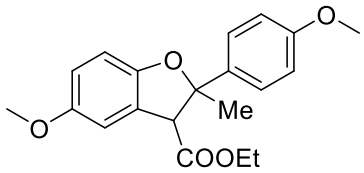
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.36 (t, *J* = 7.2 Hz, 3H), 3.79 (s, 3H), 4.23-4.37 (m, 3H), 6.15 (d, *J* = 7.8 Hz, 1H), 6.79-6.88 (m, 2H), 6.97 (d, *J* = 2.4 Hz, 1H), 7.34-7.37 (m, 1H), 7.45 (dd, *J* = 8.4, 6.8 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 2H), 7.57-7.61 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.26, 56.02, 56.09, 61.69, 85.50, 109.88, 111.03, 114.81, 124.72, 126.25, 127.09, 127.41, 127.46, 128.77, 139.69, 140.61, 141.27, 153.41, 154.37, 170.60; ESIHRMS: Found: *m/z* 397.1412. Calcd for $C_{24}H_{22}NaO_4$: $(M+Na)^+$ 397.1416.

Ethyl-5-methoxy-2-(naphthalen-2-yl)-2,3-dihydrobenzofuran-3-carboxylate (3l)



According to the general procedure, the reaction of **2l** (69.0 mg, 0.305 mmol), **1a** (60.8 mg, 0.490 mmol), *n*-Bu_4NBF_4 (101.8 mg, 0.309 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) afforded 35.1 mg (33%) of **3l** as pale yellow liquid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.35 (t, *J* = 7.2 Hz, 3H), 3.79 (s, 3H), 4.24-4.38 (m, 3H), 6.27 (d, *J* = 8.0 Hz, 1H), 6.83 (ddd, *J* = 8.8, 2.8, 0.8 Hz, 1H), 6.89 (d, *J* = 8.4 Hz, 1H), 6.97-6.98 (m, 1H), 7.48-7.51 (m, 3H), 7.83-7.87 (m, 3H), 7.90 (d, *J* = 0.8 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.26, 56.05, 56.14, 61.69, 85.88, 109.91, 111.08, 114.90, 123.31, 124.76, 124.93, 126.21, 126.36, 127.69, 128.08, 128.78, 133.14, 133.22, 137.99, 153.54, 154.44, 170.63; ESIHRMS: Found: *m/z* 371.1286. Calcd for $C_{24}H_{19}NaO_4$: $(M+H)^+$ 371.1283.

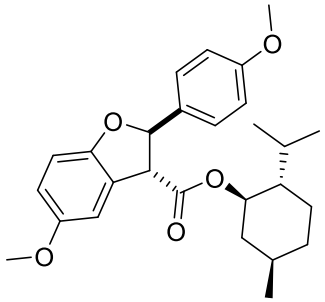
Ethyl-5-methoxy-2-(4-methoxyphenyl)-2-methyl-2,3-dihydrobenzofuran-3-carboxylate (3m)



According to the general procedure, the reaction of **2m** (66.5 mg, 0.302 mmol), **1a** (56.8 mg, 0.458 mmol), *n*-Bu_4NBF_4 (100.8 mg, 0.306 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1 then 10:1) afforded 79.4 mg (82%) of **3m** as yellow liquid. These two diastereomers could be separated by flash column chromatography, but the stereochemistry of each isomer was not assigned.

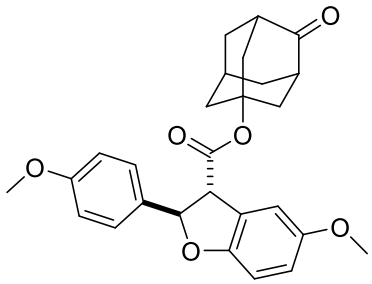
isomer 1: ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.0 Hz, 3H), 1.72 (s, 3H), 3.74 (s, 3H), 3.79 (s, 3H), 4.24-4.34 (m, 2H), 4.38 (s, 1H), 6.73 (s, 1H), 6.77 (d, *J* = 8.5 Hz, 1H), 6.84 (d, *J* = 8.5 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.24, 24.73, 55.22, 55.91, 60.10, 61.21, 90.55, 109.84, 111.75, 113.66, 114.79, 125.44, 125.85, 138.54, 153.14, 154.27, 158.78, 170.63; ESIHRMS: Found: *m/z* 365.1363. Calcd for $C_{20}H_{22}NaO_5$: $(M+Na)^+$ 365.1365.
isomer 2: ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.86 (t, *J* = 7.2 Hz, 3H), 1.85 (s, 3H), 3.60-3.66 (m, 1H), 3.71-3.75 (m, 1H), 3.76 (s, 3H), 3.78 (s, 3H), 4.22 (s, 1H), 6.76-6.87 (m, 5H), 7.34-7.36 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 13.60, 29.18, 55.19, 55.92, 60.74, 91.05, 110.09, 111.62, 113.17, 114.88, 125.79, 126.69, 133.87, 153.44, 154.22, 158.87, 170.12; ESIHRMS: Found: *m/z* 365.1364. Calcd for $C_{20}H_{22}NaO_5$: $(M+Na)^+$ 365.1365.

(1R,2S,5R)-2-isopropyl-5-methylcyclohexyl-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3n)



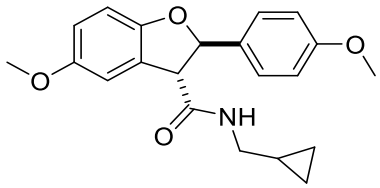
According to the general procedure, the reaction of **2n** (95.9 mg, 0.303 mmol), **1a** (61.8 mg, 0.498 mmol), *n*-Bu_4NBF_4 (109.6 mg, 0.333 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =30:1) afforded 101.8 mg (77%) of **3n** as colorless liquid.
^{1}H NMR (500 MHz, $CDCl_3$) δ 0.73 (d, *J* = 7.0 Hz, 3H), 0.85 (d, *J* = 7.0 Hz, 2H), 0.85-0.92 (m, 5H), 0.98 – 1.12 (m, 2H), 1.41-1.54 (m, 2H), 1.67-1.71 (m, 2H), 1.74 – 1.92 (m, 1H), 2.01-2.05 (m, 1H), 3.77 (s, 3H), 3.81 (s, 3H), 4.22 (t, 7.5 Hz, 1H), 4.78-4.84 (m, 1H), 6.01 (d, *J* = 8.0 Hz, 1H), 6.78-6.81 (m, 2H), 6.89 – 6.94 (m, 3H), 7.32-7.35 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 15.83, 16.21, 20.69, 20.89, 21.96, 22.91, 23.32, 25.95, 26.15, 31.38, 34.06, 34.11, 40.76, 40.88, 47.00, 47.03, 55.26, 55.94, 55.99, 56.32, 56.47, 75.59, 85.83, 85.90, 109.79, 109.87, 110.45, 110.64, 114.02, 114.88, 115.30, 124.96, 125.23, 127.17, 127.28, 132.70, 153.36, 153.44, 154.25, 154.31, 159.59, 170.30, 170.34; ESIHRMS: Found: *m/z* 461.2302. Calcd for $C_{27}H_{34}O_5Na$: $(M+Na)^+$ 461.2304.

(1s,3R,5S,7S)-4-oxoadamantan-1-yl-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3o)



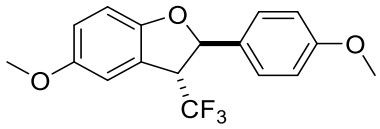
According to the general procedure, the reaction of **2o** (99.2 mg, 0.304 mmol), **1a** (58.2 mg, 0.469 mmol), *n*-Bu_4NBF_4 (100.6 mg, 0.306 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =5:1) afforded 97.5 mg (72%) of **3o** as white solid, mp 114-115 °C.
^{1}H NMR (400 MHz, $CDCl_3$) δ 1.93-1.97 (m, 2H), 2.02-2.05 (m, 2H), 2.36-2.40 (m, 5H), 2.43-2.49 (m, 2H), 2.67 (s, 2H), 3.77 (s, 3H), 3.80 (s, 3H), 4.17 (d, *J* = 8.0 Hz, 1H), 5.94 (d, *J* = 8.0 Hz, 1H), 6.78 (s, 2H), 6.88-6.91 (m, 3H), 7.31 (d, *J* = 8.8 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 29.81, 38.01, 39.92, 41.20, 41.24, 46.91, 55.26, 55.99, 56.65, 79.27, 85.54, 109.75, 110.99, 114.05, 114.49, 124.98, 127.29, 132.63, 153.37, 154.26, 159.64, 169.39, 214.97; ESIHRMS: Found: *m/z* 471.1789. Calcd for $C_{27}H_{28}O_6Na$: $(M+Na)^+$ 471.1784.

_N_-(cyclopropylmethyl)-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-amine (3p)



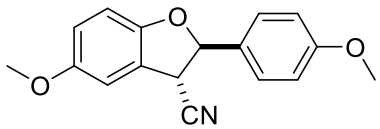
According to the general procedure, the reaction of **2p** (71.7 mg, 0.310 mmol), **1a** (117.4 mg, 0.946 mmol), *n*-Bu_4NBF_4 (103.7 mg, 0.315 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =5:1) afforded 53.2 mg (49%) of **3p** as white solid, mp 137-138 °C.
^{1}H NMR (400 MHz, $CDCl_3$) δ 0.17-0.21 (m, 2H), 0.47-0.52 (m, 2H), 0.86-0.99 (m, 1H), 3.15-3.18 (m, 2H), 3.77 (s, 3H), 3.80 (s, 3H), 4.05 (d, *J* = 6.8 Hz, 1H), 5.73-5.79 (m, 1H), 5.88 (d, *J* = 6.8 Hz, 1H), 6.79-6.82 (m, 2H), 6.83-6.86 (m, 1H), 6.87-6.90 (m, 2H), 7.31-7.35 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 3.32, 3.36, 10.72, 44.54, 55.30, 56.06, 58.65, 87.44, 110.32, 110.69, 114.06, 115.00, 125.63, 127.00, 132.98, 154.07, 154.55, 159.57, 170.52; ESIHRMS: Found: *m/z* 376.1520. Calcd for $C_{21}H_{23}NO_4Na$: $(M+Na)^+$ 376.1525.

5-methoxy-2-(4-methoxyphenyl)-3-(trifluoromethyl)-2,3-dihydrobenzofuran (3q)



According to the general procedure, the reaction of **2q** (62.3mg, 0.308 mmol), **1a** (58.1mg, 0.468 mmol), *n*-Bu_4NBF_4 (104.1 mg, 0.316 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =40:1) afforded 43.0 mg (43) of **3p** as pale yellow solid, mp 42-43 °C.
^{1}H NMR (400 MHz, $CDCl_3$) δ 3.9 (s, 3H), 3.70 (s, 3H), 3.90-3.98 (m, 1H), 5.65 (d, *J* = 5.6 Hz, 1H), 6.75-6.77 (m, 2H), 6.78-6.82 (m, 3H), 7.16-7.20 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 55.27, 55.56 (q, *J* = 28.7 Hz), 55.98, 83.15 (q, *J* = 2.6 Hz), 110.15, 111.35, 114.24, 116.24, 120.42 (q, *J* = 2.0 Hz), 125.77 (q, *J* = 279.8 Hz), 126.79, 132.34, 154.47, 154.52, 159.83; ^{19}F NMR (376 MHz, $CDCl_3$) δ -70.73 (d, *J* = 9.3 Hz); ESIHRMS: Found: *m/z* 325.1038. Calcd for C17H16O3F$_3$: $(M+H)^+$ 325.1052.

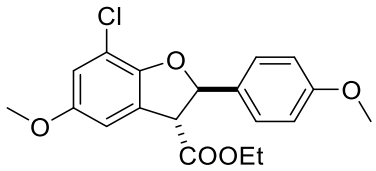
5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carbonitrile (3r)



In an oven-dried undivided three-necked flask (10 mL) equipped with a stir bar, **2r** (53.3 mg, 0.3113 mmol),*p*-methoxylphenol (**1a**) (59.1 mg, 0.476 mmol), *n*-Bu_4NPF_6 (197.5 mg,0.51 M) and HFIP/CH_2Cl_2 (3:2, 10 mL) were added. The flask was equipped with graphite rod electrode (φ6 mm) as the anode and cathode. The reaction mixture was stirred and electrolyzed at a constant potential of 2.5 V under room temperature and nitrogen atmosphere for 10 h. After evaporation of solvent, the crude residue was dissolved in $CDCl_3$ along with 20 μL $CHCl_2CHCl_2$ as internal standard for crude ^{1}H NMR. The result showed that the target product **3r** was detected in 48% yield. Purification by flash column chromatography on silica gel gave an inseparable mixture containing **2r** and **3r** (**2r**:**3r** = 1:1.15).
Yellow liquid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.22 (t, *J* = 8.5 Hz, 2H), 3.79 (s, 3H), 4.32 (d, *J* = 9.5Hz, 1H), 4.60 (t, *J* = 8.5 Hz, 2H), 5.73 (d, *J* = 9.5 Hz, 1H), 6.80 (d, *J* = 8.5 Hz, 1H), 6.83-6.85 (m, 2H), 6.92 (s, 1H), 7.21 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.29-7.31 (m, 1); ^{13}C NMR (126 MHz, $CDCl_3$) δ 29.46, 42.09, 56.02, 71.52, 87.66, 109.54, 109.79, 110.78, 116.29, 118.10, 122.24, 122.53, 126.13, 128.05, 129.67, 152.90, 155.00, 160.96; ESIHRMS: Found: *m/z* 316.0944. Calcd for C18H15NO3Na: $(M+Na)^+$ 316.0950.

Ethyl-7-chloro-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-

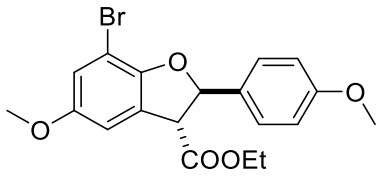
carboxylate (3aa)



According to the general procedure, the reaction of **2a** (62.9 mg, 0.305 mmol), **1aa** (73.7 mg, 0.465 mmol), *n*-Bu_4NBF_4 (104.8 mg, 0.318 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =20:1) afforded 89.0 mg (80%) of **3aa** as yellow liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.32 (t, *J* = 7.2 Hz, 3H), 3.76 (s, 3H), 3.80 (s, 3H), 4.12-4.34 (m, 3H), 6.10 (d, *J* = 8.0 Hz, 1H), 6.81 (dd, *J* = 2.4, 0.8 Hz, 1H), 6.86 (dd, *J* = 2.4, 1.2 Hz, 1H), 6.90 (d, *J* = 8.8 Hz, 2H), 7.34 (d, *J* = 8.8 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.17, 55.24, 56.11, 56.50, 61.74, 86.18, 110.07, 114.07, 114.78, 114.89, 126.16, 127.35, 131.88, 149.49, 154.50, 159.78, 169.99; ESIHRMS: Found: *m/z* 385.0815. Calcd for $C_{19}H_{19}O_5NaCl$: $(M+Na)^+$ 385.0819.

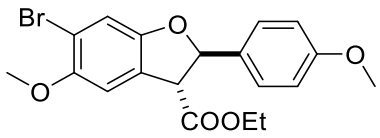
Ethyl-7-bromo-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3ab)



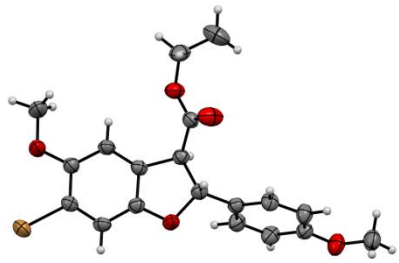
According to the general procedure, the reaction of **2a** (62.6 mg, 0.304 mmol), **1ab** (93.8 mg, 0.462 mmol), *n*-Bu_4NBF_4 (100.7 mg, 0.306 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =10:1) afforded 117.6 mg (95%) of **3ab** as brown liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.32 (t, *J* = 7.2 Hz, 3H), 3.76 (s, 3H), 3.80 (s, 3H), 4.20-4.33 (m, 3H), 6.10 (d, *J* = 7.6 Hz, 1H), 6.88-6.92 (m, 3H), 6.95 (dd, *J* = 2.8, 1.2 Hz, 1H), 7.32-7.36 (d, *J* = 2.8, 8.4 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.19, 55.27, 56.18, 56.81, 61.77, 85.88, 102.18, 110.86, 114.08, 117.35, 125.75, 127.32, 131.96, 150.92, 154.65, 159.76, 170.05; ESIHRMS: Found: *m/z* 429.0315. Calcd for $C_{19}H_{19}O_5NaBr$: $(M+Na)^+$ 429.0314.

Ethyl-6-bromo-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3ac)



According to the general procedure, the reaction of **2a** (62.9 mg, 0.305 mmol), **1ac** (93.1 mg, 0.459 mmol), *n*-Bu_4NBF_4 (102.4 mg, 0.311 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =10:1) afforded 97.0 mg (78%) of **3ac** as white solid, mp 93-94°C. Recrystallization from petroleum ether/ethyl acetate gave colorless crystals.



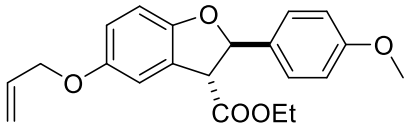
CCDC: 1968793. ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 3.81 (s, 3H), 3.85 (s, 3H), 4.19 (dd, *J* = 7.6, 1.2 Hz, 1H), 4.20-4.36 (m, 2H), 6.03 (d, *J* = 7.6 Hz, 1H), 6.88-6.92 (m, 2H), 6.97 (d, *J* = 1.2 Hz, 1H), 7.09 (s, 1H), 7.29-7.34 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.25, 55.30, 55.87, 57.15, 61.72, 86.12, 109.53, 112.41, 114.13, 114.43, 123.90, 127.22, 132.26, 150.71, 153.65, 159.76, 170.20; ESIHRMS: Found: *m/z* 429.0313. Calcd for $C_{19}H_{19}O_5NaBr$: $(M+Na)^+$ 429.0314.

Supplementary Table 1. Crystal data and structure refinement for 3ac

Empirical formula	$C_{19}H_{19}BrO_5$
Formula weight	407.25
Temperature/K	291(2)
Crystal system	triclinic
Space group	P-1
a/Å	8.9606(3)
b/Å	9.9217(4)
c/Å	11.8105(4)
α/°	72.290(3)
β/°	88.750(3)
γ/°	63.972(4)
Volume/Å^3	891.11(6)
Z	2
ρ_{calc}g/cm^3	1.518
μ/mm^{-1}	3.376
F(000)	416.0
Crystal size/mm^3	0.28 × 0.25 × 0.24

Radiation	CuKα (λ = 1.54184)
2Θ range for data collection/°	7.926 to 148.154
Index ranges	$-11 \leq h \leq 7$, $-12 \leq k \leq 8$, $-14 \leq l \leq 14$
Reflections collected	5844
Independent reflections	3476 [R_{int} = 0.0212, R_{sigma} = 0.0211]
Data/restraints/parameters	3476/0/229
Goodness-of-fit on F^2	1.047
Final R indexes [I>=2σ (I)]	R_1 = 0.0299, wR_2 = 0.0782
Final R indexes [all data]	R_1 = 0.0312, wR_2 = 0.0795
Largest diff. peak/hole / e $Å^{-3}$	0.40/-0.64

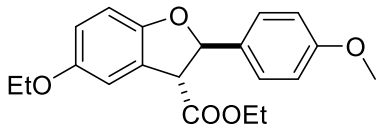
Ethyl-5-(allyloxy)-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate(3ad)



According to the general procedure, the reaction of **2a** (63.8 mg, 0.309 mmol), **1ad** (64.2 mg, 0.472 mmol), *n*-Bu_4NBF_4 (103.3 mg, 0.314 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =20:1) afforded 89.3 mg (81%) of **3ad** as yellow liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.34 (t, *J* = 7.1 Hz, 3H), 3.80 (s, 3H), 4.21-4.35 (m, 3H), 4.50 (ddd, *J* = 5.6, 1.6 Hz, 2H), 5.29 (ddt, *J* = 10.4, 2.8, 1.2 Hz, 1H), 5.42 (ddt, *J* = 17.2, 3.2, 1.6 Hz, 1H), 6.02-6.11 (m, 2H), 6.78-6.84 (m, 2H), 6.89-6.93 (m, 2H), 6.98-7.00 (m, 1H), 7.34-7.37 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.19, 55.19, 55.92, 61.50, 69.78, 85.63, 109.72, 111.98, 113.99, 115.81, 117.43, 124.85, 127.24, 132.59, 133.49, 153.23, 153.48, 159.59, 170.54; ESIHRMS: Found: *m/z* 377.1359. Calcd for $C_{21}H_{22}O_5Na$: $(M+Na)^+$ 377.1365.

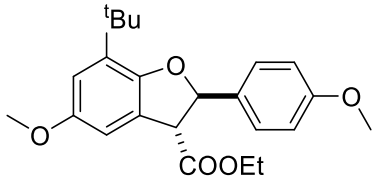
Ethyl-5-ethoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate(3ae)



According to the general procedure, the reaction of **2a** (62.5 mg, 0.303 mmol), **1ae** (63.3 mg, 0.458 mmol), *n*-Bu_4NBF_4 (101.6 mg, 0.319 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =10:1) afforded 67.7 mg (65%) of **3ae** as yellow liquid . ^{1}H NMR (400

MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 1.40 (t, *J* = 7.2 Hz, 3H), 3.80 (s, 3H), 3.99 (q, *J* = 7.2 Hz, 2H), 4.21-4.34 (m, 3H), 6.03 (d, *J* = 8.0 Hz, 1H), 6.78-6.80 (m, 2H), 6.90 (d, *J* = 8.8 Hz,, 2H), 6.94-6.96 (m, 1H), 7.35 (d, *J* = 8.8 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.22, 14.89, 55.23, 56.00, 61.52, 64.33, 85.63, 109.75, 111.70, 114.03, 115.57, 124.85, 127.27, 132.68, 153.32, 153.58, 159.61, 170.64; ESIHRMS: Found: *m/z* 365.1368. Calcd for $C_{20}H_{22}O_5Na$: $(M+Na)^+$ 365.1365.

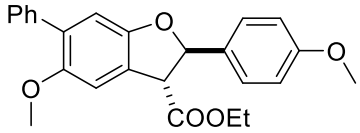
Ethyl-7-(tert-butyl)-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3af)



According to the general procedure, the reaction of **2a** (63.6 mg, 0.308 mmol), **1af** (83.8 mg, 0.465 mmol), *n*-Bu_4NBF_4 (103.4 mg, 0.314 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =20:1) afforded 105.6 mg (89%) of **3af** as yellow liquid .

^{1}H NMR (500 MHz, $CDCl_3$) δ 1.34 (t, *J* = 7.2 Hz, 3H), 1.39 (s, 9H), 3.78 (s, 3H), 3.81 (s, 3H), 4.16 (d, *J* = 8.4 Hz, 1H), 4.22-4.35 (m, 2H), 6.05 (d, *J* = 8.4 Hz, 1H), 6.79 (s, 2H), 6.91 (d, *J* = 7.2 Hz, 2H), 7.35 (d, *J* = 7.2 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 14.28, 29.15, 34.32, 55.26, 55.89, 56.18, 61.46, 84.94, 106.96, 113.22, 113.98, 124.65, 127.00, 133.51, 134.05, 151.43, 153.93, 159.42, 171.01; ESIHRMS: Found: *m/z* 407.1830. Calcd for $C_{23}H_{28}O_5Na$: $(M+Na)^+$ 407.1834.

Ethyl-5-methoxy-2-(4-methoxyphenyl)-6-phenyl-2,3-dihydrobenzofuran-3-carboxylate (3ag)

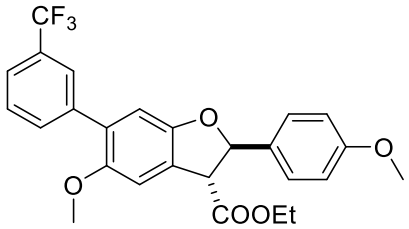


According to the general procedure, the reaction of **2a** (63.1 mg, 0.306 mmol), **1ag** (92.1 mg, 0.460 mmol), *n*-Bu_4NBF_4 (102.4 mg, 0.311 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =20:1) afforded 88 mg (71%) of **3ag** as yellow liquid .

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.38 (t, *J* = 7.2 Hz, 3H), 3.77 (s, 3H), 3.83 (s, 3H), 4.25-4.41 (m, 3H), 6.09 (d, *J* = 8.0 Hz, 1H), 6.90 (s, 1H), 6.93 (d, *J* = 8.4 Hz, 2H), 7.06 (d, *J* = 1.2 Hz, 1H), 7.32-7.37 (m, 1H), 7.38-7.45 (m, 4H), 7.53-7.56 (m, 2H); ^{13}C NMR (101

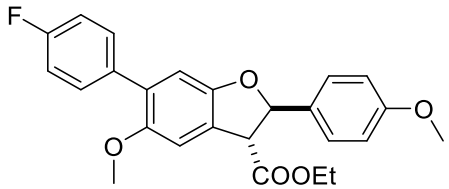
MHz, $CDCl_3$) δ 14.27, 55.25, 56.17, 56.58, 61.57, 85.72, 109.13, 111.66, 114.08, 123.34, 127.04, 127.29, 127.96, 129.40, 132.20, 132.69, 138.33, 151.29, 153.46, 159.66, 170.66; ESIHRMS: Found: *m/z* 427.1516. Calcd for $C_{25}H_{24}O_5Na$: $(M+Na)^+$ 427.1521.

Ethyl-5-methoxy-2-(4-methoxyphenyl)-6-(3-(trifluoromethyl)phenyl)-2,3-dihydrobenzofuran-3-carboxylate (3ah)



According to the general procedure, the reaction of **2a** (62.8 mg, 0.305 mmol), **1ah** (124.0 mg, 0.462 mmol), *n*-Bu_4NBF_4 (101.0 mg, 0.307 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 1 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =15:1) afforded 95.2 mg (66%) of **3ah** as pale yellow liquid.
^1H NMR (500 MHz, $CDCl_3$) δ 1.36 (t, *J* = 7.2 Hz, 3H), 3.77 (s, 3H), 3.82 (s, 3H), 4.24-4.38 (m, 3H), 6.07 (d, *J* = 7.5 Hz, 1H), 6.86 (s, 1H), 6.92 (d, *J* = 8.5 Hz, 2H), 7.05 (s, 1H), 7.37 (d, *J* = 8.5 Hz, 2H), 7.52 (dd, *J* = 7.5, 8.0 Hz, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.69 (d, *J* = 7.5 Hz, 1H), 7.78 (s, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 14.31, 55.31, 56.17, 56.50, 61.69, 85.81, 109.07, 111.53, 114.12, 123.77 (q, *J* = 3.8 Hz), 124.22 (q, *J* = 272.2 Hz), 124.25, 126.32 (q, *J* = 3.8 Hz), 127.29, 128.42, 130.34 (q, *J* = 32.0 Hz), 130.44, 132.59, 132.75, 139.04, 151.17, 153.52, 159.71, 170.56; ^{19}F NMR (471 MHz, $CDCl_3$) δ -62.52; ESIHRMS: Found: *m/z* 495.1395. Calcd for $C_{26}H_{23}O_5NaF_3$: $(M+Na)^+$ 495.1395.

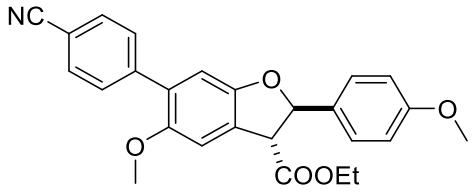
Ethyl-6-(4-fluorophenyl)-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3ai)



According to the general procedure, the reaction of **2a** (63.2 mg, 0.306 mmol), **1ai** (100.6 mg, 0.461 mmol), *n*-Bu_4NBF_4 (103.2 mg, 0.313 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =25:1) afforded 88.6 mg (68%) of **3ai** as yellow liquid . ^1H NMR (400

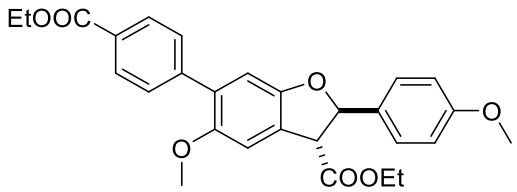
MHz, $CDCl_3$) δ 1.36 (t, *J* = 7.2 Hz, 3H), 3.75 (s, 3H), 3.82 (s, 3H), 4.23-4.39(m, 3H), 6.07 (d, *J* = 7.6 Hz, 1H), 6.84 (s, 1H), 6.90-6.94 (m, 2H), 7.03 (d, *J* = 1.2 Hz, 1H), 7.06-7.12 (m, 2H), 7.35-7.39 (m, 2H), 7.46-7.51 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.30, 55.30, 56.17, 56.56, 61.62, 85.78, 109.14, 111.56, 114.12, 114.89 (d, *J* = 21.4 Hz), 123.50, 127.30, 131.03 (d, *J* = 8.0 Hz), 131.12, 132.66, 134.24 (d, *J* = 3.1 Hz), 151.20, 153.49, 159.71, 162.05 (d, *J* = 247.1 Hz), 170.65; ^{19}F NMR (376 MHz, $CDCl_3$) δ -115.53 (m); ESIHRMS: Found: *m/z* 445.1418. Calcd for $C_{25}H_{23}O_5FNa$: $(M+Na)^+$ 445.1427.

Ethyl-6-(4-cyanophenyl)-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3aj)



According to the general procedure, the reaction of **2a** (62.6 mg, 0.304 mmol), **1aj** (101.4 mg, 0.450 mmol), *n*-Bu_4NBF_4 (102.2 mg, 0.310 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =5:1) afforded 124.8 mg (95%) of **3aj** as yellow solid, mp 44-45 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 1.36 (t, *J* = 7.1 Hz, 3H), 3.77 (s, 3H), 3.81 (s, 3H), 4.23-4.39 (m, 3H), 6.07 (d, *J* = 8.0 Hz, 1H), 6.84 (s, 1H), 6.90-6.93 (m, 2H), 7.06 (d, *J* = 1.2 Hz, 1H), 7.34-7.38 (m, 2H), 7.60-7.63 (m, 2H), 7.67-7.70 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.27, 55.28, 56.10, 56.44, 61.70, 85.88, 109.17, 110.56, 111.28, 114.13, 119.03, 124.93, 127.25, 129.87, 130.15, 131.75, 132.43, 143.16, 151.14, 153.53, 159.74, 170.42; ESIHRMS: Found: *m/z* 430.1657. Calcd for $C_{26}H_{24}NO5$: $(M+H)^+$430.1654.

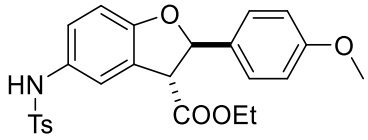
Ethyl-6-(4-(ethoxycarbonyl)phenyl)-5-methoxy-2-(4-methoxyphenyl)-2,3-dihydrobenzofuran-3-carboxylate (3ak)



According to the general procedure, the reaction of **2a** (62.4 mg, 0.303 mmol), **1ak** (123.0 mg, 0.452 mmol), *n*-Bu_4NBF_4 (99.6 mg, 0.303 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =5:1) afforded 122.4 mg (85%) of **3ak** as bright yellow liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.36 (t, *J* = 7.2 Hz, 3H), 1.41 (t, *J* = 7.2 Hz, 3H), 3.75 (s, 3H), 3.81 (s, 3H), 4.23-4.37 (m, 3H), 4.40 (q, *J* = 7.2 Hz, 2H), 6.07 (d, *J* = 8.0 Hz, 1H), 6.87 (s, 1H), 6.91 (d, *J* = 8.8 Hz, 2H), 7.04 (d, *J* = 0.8 Hz), 1H), 7.36 (d, *J* = 8.8 Hz, 2H), 7.58 (d, *J* = 8.8 Hz, 2H), 8.07 (d, *J* = 8.8 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.30, 14.34, 55.31, 56.187, 56.59, 60.86, 61.66, 85.82, 109.27, 111.49, 114.13, 124.26, 127.29, 129.00, 129.24, 129.42, 131.06, 132.60, 143.03, 151.31, 153.52, 159.72, 166.55, 170.56; ESIHRMS: Found: *m/z* 477.1908. Calcd for $C_{28}H_{29}NO_7$: $(M+H)^+$477.1913.

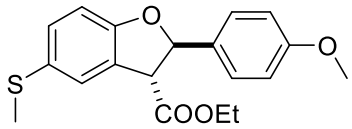
Ethyl-2-(4-methoxyphenyl)-5-((4-methylphenyl)sulfonamido)-2,3-dihydrobenzofuran-3-carboxylate (3al)



According to the general procedure, the reaction of **2a** (63.1, 0.306 mmol), **1al** (122.9 mg, 0.467 mmol), *n*-Bu_4NBF_4 (104.3 mg, 0.317 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =4:1) afforded 117.2 mg (83%) of **3al** as white solid, mp 103-104 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.28 (t, *J* = 7.2 Hz, 3H), 2.39 (s, 3H), 3.80 (s, 3H), 4.16-4.28 (m, 3H), 6.03 (d, *J* = 7.6 Hz, 1H), 6.68 (s, 1H), 6.69 (d, *J* = 8.8 Hz, 1H), 6.83 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.88 (d, *J* = 8.8 Hz, 2H), 7.15-7.18 (m, 1H), 7.23 (d, *J* = 8.0 Hz, 2H), 7.30 (d, *J* = 8.8 Hz, 2H), 7.60 (d, *J* = 8.4 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.13, 21.50, 55.30, 55.32, 61.75, 86.06, 109.95, 114.12, 121.83, 125.15, 125.88, 127.26, 127.32, 129.20, 129.52, 132.14, 136.01, 143.65, 157.69, 159.77, 170.30; ESIHRMS: Found: *m/z* 490.1290. Calcd for $C_{25}H_{25}NO6NaS$: $(M+Na)^+$490.1300.

Ethyl-2-(4-methoxyphenyl)-5-(methylthio)-2,3-dihydrobenzofuran-3-carboxylate (3am)



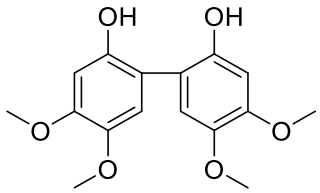
According to the general procedure, the reaction of **2a** (62.4, 0.303 mmol), **1am** (65.1 mg, 0.464 mmol), *n*-Bu_4NBF_4 (101.6 mg, 0.309 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) was electrolyzed under nitrogen atmosphere at room temperature for 2.5 h. The subsequent purification by flash column chromatography on silica gel (petroleum ether : ethyl acetate =30:1) afforded 62.5 mg (60%) of **3am** as pale yellow liquid.

^{1}H NMR (400 MHz, $CDCl_3$) δ 1.33 (t, *J* = 7.2 Hz, 3H), 2.46 (s, 3H), 3.80 (s, 3H), 4.21-4.35 (m, 3H), 6.06 (d, *J* = 8.0 Hz, 1H), 6.83 (d, *J* = 8.4 Hz, 1H), 6.90 (d, *J* = 8.8 Hz,

2H), 7.24 (ddd, *J* = 8.4, 2.0, 0.8 Hz, 1H), 7.33 (d, *J* = 8.8 Hz, 2H), 7.36-7.38 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 14.24, 18.52, 55.29, 55.49, 61.68, 85.88, 110.33, 114.12, 125.18, 126.12, 127.29, 129.04, 130.81, 132.37, 158.05, 159.74, 170.45; ESIHRMS: Found: *m/z* 367.0981. Calcd for $C_{19}H_{20}O_4NaS$: $(M+Na)^+$ 367.0980.

5. Mechanistic studies

5.1. Synthesis of 4,4',5,5'-tetramethoxy-[1,1'-biphenyl]-2,2'-diol (5)



In an oven-dried two-necked flask, a stir bar, **2a** (62.2 mg, 0.302 mmol), **1o** (70.0 mg, 0.454 mmol), *n*-Bu_4NBF_4 (100.3 mg, 0.305 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) were added. The flask was equipped with graphite rod (Φ 6 mm) as the anode and cathode. The reaction mixture was stirred and electrolyzed at a constant current of 10 mA under room temperature and nitrogen atmosphere for 75 min. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 2 : 1) to afford product **5** (50.3 mg) in 87% yield as brown solid, mp 166-167 °C. ^{1}H NMR (500 MHz, $(CD_3)_2SO$) δ 3.68 (s, 6H), 3.73 (s, 6H), 6.53 (s, 2H), 6.77 (s, 2H), 8.87 (s, 2H); ^{13}C NMR (126 MHz, $(CD_3)_2SO$) δ 55.49 , 56.39 , 101.41 , 115.93 , 116.62 , 141.84 , 147.98 , 148.63; ESIHRMS: Found: *m/z* 329.0996. Calcd for $C_{16}H_{18}O_6Na$: $(M+Na)^+$ 329.1001.

5.2. Computational studies

All the calculations were performed using Gaussian 16 software packages.[16] Solution-phase geometry optimizations of all of the minima and transition states involved were carried out at the (U)B3LYP[17] /6-31G(d)[18] level of theory with an empirical dispersion term (Grimme-D3(0))[19] as implemented. SMD solvation model[20] for the mix solvent system of CF_3CH_2OH/CH_2Cl_2 (3:2) was adopted. Vibrational frequency analysis was calculated at the same level of theory to validate each structure as either a minimum or a transition state and to evaluate its zero-point energy and thermal corrections at 298 K. For each transition state, the intrinsic reaction coordinate (IRC) analysis was conducted to ensure that it connects the right reactant and product.[21] To obtain more accurate energies, single point energy calculations were performed at the SMD/(U)M06-2X[22]/6-311+G(d,p)[23] level of theory with an empirical dispersion term (Grimme-D3(0))[19] as implemented. Unless otherwise specified, all of the conformers were located but only the ones with the lowest Gibbs energies were reported.

Table 1. Thermal correction of Gibbs free energy (TCG, hartree) and single point energies (SP,

hartree) in solvent CF_3CH_2OH/CH_2Cl_2 (3:2) for all species involved in this study

Compounds	TCG	SP	Compounds	TCG	E
2a	0.194273	-691.286591	**Int-a-II**	0.311269	-1112.617674
II	0.092267	-421.308446	**TS-b-I**	0.308129	-1112.565178
TS-a-I	0.310336	-1112.577527	**Int-b-I**	0.309109	-1112.574783
Int-a-I	0.309134	-1112.588731	**Int-b-II**	0.311694	-1112.611122

Cartesian coordinates for all optimized geometries

2a

C	2.67141200	-1.40348800	-0.00097000
C	1.33033400	-1.06437200	-0.00103200
C	0.92094300	0.28928500	-0.00037700
C	1.92425300	1.27508600	0.00023900
C	3.27919200	0.94955000	0.00034600
C	3.65918700	-0.39951900	-0.00024200
H	2.98789400	-2.44231000	-0.00150000
H	0.58924800	-1.85826100	-0.00168500
H	1.63606700	2.32350800	0.00069700
H	4.02023200	1.74020200	0.00087000
C	-0.47385800	0.70547700	-0.00027700
H	-0.64196600	1.78225700	-0.00061500
C	-1.57149200	-0.08139300	0.00031200
H	-1.52077300	-1.16534500	0.00086500
C	-2.91188900	0.51484600	0.00038400
O	-3.86913400	-0.43923200	0.00062000
C	-5.24449800	0.02262600	0.00013200
H	-5.40665200	0.64393500	-0.88703700
H	-5.40693100	0.64497900	0.88651700
C	-6.12853200	-1.20734800	0.00071700
H	-7.18097300	-0.90305600	0.00035500
H	-5.94456200	-1.81990300	-0.88871200
H	-5.94486700	-1.81883200	0.89094600
O	-3.17069900	1.71462600	-0.00073500
O	4.94391600	-0.84205400	-0.00020300
C	6.00029900	0.12429000	0.00064600
H	6.92658300	-0.45304600	0.00061100
H	5.96124400	0.75494800	-0.89552400
H	5.96069100	0.75396200	0.89748400

II

C	0.86199700	0.27791000	0.00000300
C	0.35357700	-1.04482800	0.00001100
C	-1.00723500	-1.24721600	0.00001400
C	-1.94624100	-0.14231700	0.00001700
C	-1.37921500	1.19470200	-0.00000400
C	-0.02463600	1.39047800	-0.00000600
H	1.02868700	-1.89268700	0.00001500
H	-1.42020000	-2.25186300	0.00001700
H	-2.06984400	2.03303300	-0.00001400
H	0.40912100	2.38627900	-0.00001600
O	-3.19544700	-0.33491400	-0.00000100
O	2.16840900	0.59004200	-0.00000200
C	3.14944300	-0.46184200	-0.00002000
H	4.11517400	0.04474700	-0.00003800
H	3.05363800	-1.08092900	0.89802500
H	3.05360300	-1.08092900	-0.89806100

TS-a-I

C	2.92356400	-1.06385900	-1.24827500
C	1.57329600	-1.01470200	-0.96138400
C	1.10090900	-1.05015500	0.38282400
C	2.08177300	-1.15425500	1.40602900
C	3.43941300	-1.20112200	1.12604200
C	3.87296900	-1.15150600	-0.21100800
H	3.27910400	-1.03726700	-2.27413200
H	0.86606300	-0.95150900	-1.78109500
H	1.75427500	-1.18469800	2.44219400
H	4.15121500	-1.27196400	1.94025800
C	-0.27386300	-0.97924900	0.73619500
H	-0.51979300	-1.03206700	1.79313100
C	-1.35780900	-0.74561800	-0.16368900
H	-1.19848800	-1.01628900	-1.20494100
C	-2.70834900	-1.17217400	0.32960300
O	-3.59209700	-1.23591300	-0.67806800
C	-4.97728200	-1.48946500	-0.31193000
H	-5.28761700	-0.71340900	0.39441400
H	-5.03536800	-2.46082000	0.18896300
C	-5.78667800	-1.45541400	-1.59057700
H	-6.84220900	-1.63689300	-1.36024800
H	-5.70114500	-0.47814400	-2.07808900
H	-5.44660400	-2.22754200	-2.28931300
O	-2.99251000	-1.39865900	1.49472200
O	5.17262900	-1.18737300	-0.60564700
C	6.19019200	-1.29983400	0.39533700
H	7.13645400	-1.31752500	-0.14832100
H	6.17393600	-0.43979800	1.07528100
H	6.07905100	-2.22742500	0.96924900
C	-0.39858900	1.64766800	-1.03057000
C	-1.65578400	1.13285400	-0.52633900
C	-2.15388200	1.62610100	0.78559900
C	-1.14007000	2.15131700	1.68538100
C	0.11844500	2.40220500	1.23182500
C	0.48746200	2.20433900	-0.15176100
H	-0.14983300	1.48366000	-2.07190900

H	-1.43051200	2.37086200	2.70852900
H	0.88021500	2.81190200	1.89046800
O	-3.35498600	1.52321100	1.10783800
O	1.74412300	2.64199600	-0.44039100
C	2.17026900	2.58595100	-1.80507000
H	1.52079700	3.20044400	-2.44107500
H	3.18475000	2.98862800	-1.81603500
H	2.18073000	1.55528800	-2.17459900
H	-2.44820700	0.99998300	-1.25974800

Int-a-I

C	-3.00388900	-1.01549000	1.27589300
C	-1.65381800	-0.93630800	0.99316900
C	-1.16372300	-1.03977200	-0.34647800
C	-2.14314800	-1.23841200	-1.36414800
C	-3.50029100	-1.31541400	-1.08464900
C	-3.94521700	-1.20107400	0.24393800
H	-3.36510400	-0.93771200	2.29764800
H	-0.95738600	-0.79548100	1.81273800
H	-1.81135600	-1.32458600	-2.39607300
H	-4.20388800	-1.46139700	-1.89637500
C	0.20116700	-0.95293200	-0.69543700
H	0.46486000	-1.05739700	-1.74417500
C	1.32217100	-0.61892100	0.23315500
H	1.09136500	-0.89567800	1.26778500
C	2.59657800	-1.37653400	-0.13599900
O	3.56903400	-1.14898200	0.75853600
C	4.87045000	-1.72924700	0.46668200
H	5.19518300	-1.35972800	-0.51131500
H	4.76425100	-2.81699800	0.40946500
C	5.80572100	-1.30291800	1.57792100
H	6.80358300	-1.71668300	1.39556600
H	5.88547700	-0.21123200	1.62118500
H	5.45133600	-1.66791700	2.54811000
O	2.72403600	-2.11373900	-1.09722500
O	-5.24991700	-1.25848300	0.63701700
C	-6.25299200	-1.45278200	-0.36351400
H	-7.20459300	-1.47012800	0.17132700
H	-6.25623700	-0.62978000	-1.08871600
H	-6.11124500	-2.40516600	-0.88887700
C	0.47316700	1.68619300	0.86797500
C	1.63439400	0.94746200	0.27914700
C	2.08201100	1.39123000	-1.11130800
C	1.24477400	2.34552900	-1.82728200
C	0.15739700	2.88925900	-1.23338800
C	-0.23116700	2.57334500	0.13441200
H	0.20142200	1.43747200	1.88697900
H	1.53240200	2.60263100	-2.84230700
H	-0.46854800	3.60299700	-1.76373000
O	3.10830200	0.91382700	-1.60972800
O	-1.33429500	3.27253100	0.53321700
C	-1.84294500	2.99827900	1.84051100
H	-1.10656700	3.25444300	2.61285800
H	-2.72756900	3.62744700	1.95550200
H	-2.12403000	1.94236400	1.93651700
H	2.50553000	1.05234400	0.93774700

Int-a-II

C	3.28399300	0.24729600	-1.21356500
C	1.99254600	-0.10931100	-0.87593300
C	1.72192800	-0.93559700	0.25873000
C	2.84991100	-1.36326200	1.01820400
C	4.14800000	-1.00701800	0.68149500
C	4.37727200	-0.19496600	-0.44310700
H	3.48113600	0.87725300	-2.07654200
H	1.17330500	0.25708900	-1.48576900
H	2.68381500	-1.99001100	1.89114100
H	4.97242200	-1.35832600	1.29145400
C	0.42308500	-1.33025900	0.64765300
H	0.31382800	-1.92663400	1.54831700
C	-0.83875100	-0.91014800	-0.06586100
H	-0.67803200	-0.91789800	-1.14720100
C	-1.94752200	-1.90964700	0.22730900
O	-2.48676700	-2.41970900	-0.87194700
C	-3.58384400	-3.37082400	-0.69661400
H	-4.37852700	-2.87250900	-0.13376700
H	-3.21242400	-4.21392100	-0.10679000
C	-4.03048100	-3.78730300	-2.08064300
H	-4.85590000	-4.50235500	-1.99482500
H	-4.37897700	-2.92220400	-2.65478500
H	-3.21151200	-4.26691500	-2.62723600
O	-2.31264600	-2.20922400	1.36193100
O	5.60565800	0.21815700	-0.86731100
C	6.75615500	-0.19576900	-0.12561500
H	7.61278300	0.24708200	-0.63746100
H	6.71766400	0.17183100	0.90710000
H	6.85649100	-1.28807700	-0.12332700
C	-1.29302700	0.51032600	0.31503000

C	-1.39966400	1.47453100	-0.68778200
C	-1.54391700	0.88944000	1.65229000
C	-1.71682100	2.80691300	-0.39491300
H	-1.21625600	1.20365000	-1.72391800
C	-1.85497000	2.21855900	1.93986500
C	-1.93741400	3.18394000	0.93327200
H	-2.04000800	2.49096300	2.97507000
H	-2.17993800	4.20670500	1.19725900
O	-1.45887600	0.01779300	2.71152700
H	-1.70132300	-0.88654700	2.40769600
O	-1.77938600	3.65285000	-1.47358000
C	-2.07939500	5.02648800	-1.22816100
H	-1.32147300	5.49413900	-0.58641500
H	-2.07449500	5.51183000	-2.20650700
H	-3.06895100	5.14557700	-0.76838300

TS-b-I

C	-1.94406200	-2.01893000	1.18895600
C	-0.70378500	-1.47118400	0.89287900
C	-0.43985400	-0.90811000	-0.36926300
C	-1.47413600	-0.90932100	-1.31283600
C	-2.73113400	-1.45115900	-1.03184900
C	-2.97015600	-2.00862400	0.22964800
H	-2.14644500	-2.45052500	2.16488200
H	0.06027100	-1.46301100	1.66477400
H	-1.30080800	-0.47089300	-2.29222100
H	-3.50241800	-1.43089800	-1.79278500
C	0.85873000	-0.25638500	-0.71060300
H	0.96877900	-0.06787800	-1.77873000
C	2.06864300	-0.74642100	-0.11957800
H	2.06852400	-1.32705000	0.79430800
C	3.35561300	-0.35139600	-0.65844900
O	4.38179200	-0.89648700	0.03111700
C	5.71675500	-0.55639000	-0.42342900
H	5.83666900	0.53120700	-0.37466100
H	5.82149200	-0.86427200	-1.46936300
C	6.69412500	-1.27677600	0.48168600
H	7.71928800	-1.04546900	0.17221900
H	6.56643900	-0.96050700	1.52266100
H	6.55112300	-2.36140200	0.42493500
O	3.51747200	0.39593300	-1.62510300
O	-4.15482400	-2.56077800	0.62396400
C	-5.24789700	-2.54323200	-0.29684300
H	-6.08260500	-3.01543700	0.22500800
H	-5.52139700	-1.51633400	-0.57019000
H	-5.01504400	-3.11412200	-1.20418800
C	-1.63581900	2.05824100	1.17176500
C	-0.51941300	1.75360000	1.88562900
C	0.76843800	1.56488100	1.23174300
C	0.76637300	1.57809700	-0.26148300
C	-0.40273800	2.09720000	-0.93532100
C	-1.58521000	2.24399400	-0.26540900
H	-2.57953800	2.18444600	1.69092200
H	-0.37489500	2.25760200	-2.00896300
O	1.81079600	1.33462000	1.86937900
O	-2.67838000	2.60668000	-0.99309600
C	-3.96578200	2.63718200	-0.36523800
H	-4.01996600	3.41307900	0.40742100
H	-4.67129200	2.87460700	-1.16367100
H	-4.21835700	1.66114400	0.06566000
H	-0.55258900	1.64702300	2.96581900
H	1.72578600	1.86736700	-0.68595400

Int-b-I

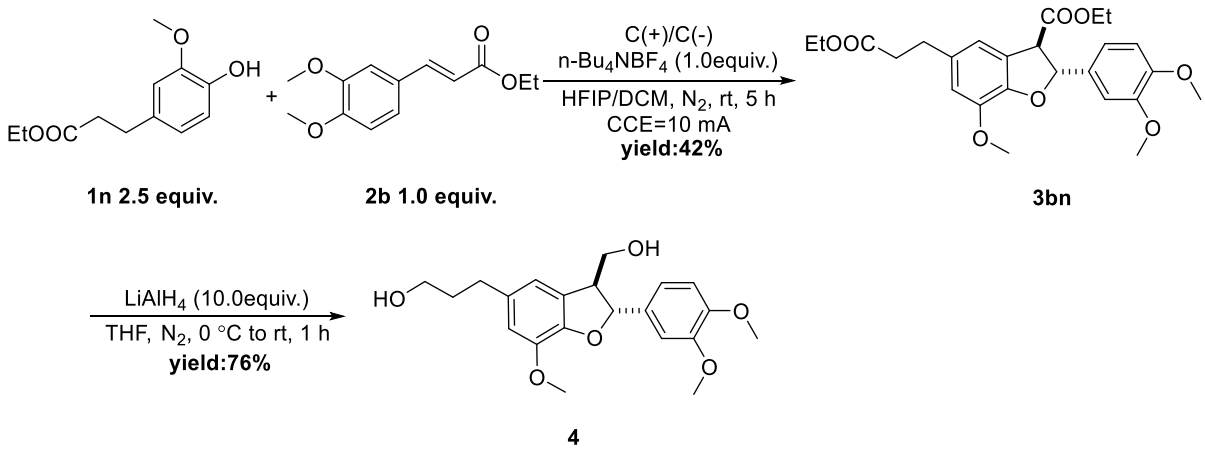
C	-1.95251800	-2.01450300	1.27971800
C	-0.77493000	-1.34671800	0.96488900
C	-0.49356900	-0.95435800	-0.35514100
C	-1.43586600	-1.25655000	-1.34182400
C	-2.62662800	-1.92662000	-1.04475100
C	-2.88877800	-2.30741100	0.27633100
H	-2.16841500	-2.31673300	2.30048300
H	-0.06903900	-1.12550300	1.76052100
H	-1.24440800	-0.96215600	-2.37104100
H	-3.32960000	-2.14187900	-1.84106200
C	0.76080000	-0.17733100	-0.71225300
H	0.86326400	-0.14786900	-1.80505300
C	2.00947200	-0.76562700	-0.15605300
H	1.97942200	-1.52769400	0.61303900
C	3.30196700	-0.31754000	-0.62248100
O	4.31944800	-0.93684000	0.01877800
C	5.65994200	-0.54477000	-0.37207300
H	5.77358100	0.53176800	-0.20494700
H	5.78546100	-0.73820700	-1.44292200
C	6.62522800	-1.35475900	0.46809600
H	7.65449900	-1.08780200	0.20426900
H	6.47708900	-1.15302200	1.53456600
H	6.48940600	-2.42750900	0.29235100
O	3.47905000	0.52995700	-1.50125900

O	-4.01498500	-2.96361000	0.68913200
C	-5.00718900	-3.28128500	-0.28869500
H	-5.80664000	-3.78969300	0.25418000
H	-5.40652700	-2.37538300	-0.76171100
H	-4.60775200	-3.95112600	-1.06049300
C	-1.55080300	2.57523500	1.12832800
C	-0.49597700	2.11127900	1.84521500
C	0.66158400	1.51982300	1.19237500
C	0.62681200	1.37486400	-0.32011000
C	-0.55170500	1.97608900	-1.00768200
C	-1.58335300	2.52151600	-0.32662400
H	-2.39550900	3.00145600	1.65906400
H	-0.58607900	1.93384100	-2.09281200
O	1.64059100	1.11220000	1.83380600
O	-2.64016500	3.01389800	-1.04841000
C	-3.73042900	3.63900900	-0.36628500
H	-3.40218800	4.51596000	0.20526200
H	-4.41756500	3.96059000	-1.15173700
H	-4.24846700	2.93663400	0.29824200
H	-0.48429300	2.16332500	2.92983700
H	1.54788400	1.83409100	-0.70230500

Int-b-II

C	2.98491700	-1.50828600	-1.32386500
C	1.65231700	-1.17886000	-1.09567800
C	1.18131900	-0.91914600	0.20101400
C	2.09572000	-1.00311500	1.25620400
C	3.43731500	-1.33121700	1.04713700
C	3.88775900	-1.58715800	-0.25415700
H	3.34533800	-1.71043700	-2.32841300
H	0.98112500	-1.12560500	-1.94739200
H	1.75808600	-0.80510300	2.27105900
H	4.10989500	-1.38665600	1.89520600
C	-0.25673900	-0.51999000	0.51080900
H	-0.46897500	-0.84775700	1.53346600
C	-1.27721400	-1.13948300	-0.39187900
H	-1.10987500	-1.20720100	-1.46042000
C	-2.56219500	-1.55010900	0.11390800
O	-3.32944300	-2.13659300	-0.82056300
C	-4.64975700	-2.57775700	-0.40000600
H	-5.19697600	-1.71301300	-0.01070500
H	-4.53229800	-3.30372300	0.41116800
C	-5.32390900	-3.18187800	-1.61332000
H	-6.32619700	-3.52797300	-1.33817900
H	-5.42042200	-2.44154000	-2.41480500
H	-4.75332300	-4.03705900	-1.99132400
O	-2.94380700	-1.39518500	1.28636500
O	5.17187200	-1.92126900	-0.58254900
C	6.13333600	-2.02472800	0.46964900
H	7.07339300	-2.29792100	-0.01408900
H	6.25765900	-1.06859600	0.99318200
H	5.85460700	-2.80354800	1.19048000
C	-0.88190900	3.79619700	0.44704100
C	-1.52059200	2.99842100	1.39734300
C	-1.35069400	1.61235400	1.41799800
C	-0.48843900	1.00419200	0.47625800
C	0.12693800	1.80636000	-0.48699800
C	-0.05815300	3.19219300	-0.51091100
H	-1.04119400	4.86814700	0.45978800
H	0.79126800	1.36520100	-1.22321100
O	-1.99620700	0.91355000	2.40766800
O	0.61378300	3.86366000	-1.50093200
C	0.47682100	5.28313800	-1.55874100
H	0.84203500	5.75938700	-0.63970200
H	1.09002000	5.60724900	-2.40236900
H	-0.56568500	5.57924600	-1.73273500
H	-2.17358100	3.44831400	2.13977700
H	-2.28553000	0.02851400	2.07847000

6. Synthesis of 3,4'-di-O-methycedrusin (4)



In an oven-dried undivided three-necked flask (10 mL) equipped with a stir bar, ethyl-3-(4-hydroxy-3-methoxyphenyl)propanoate (172.1 mg, 0.767 mmol), ethyl 4-methoxycinnamate (**2b**) (71.5 mg, 0.303 mmol), *n*-Bu_4NBF_4 (100.3 mg, 0.305 mmol) and HFIP/CH_2Cl_2 (3:2 10 mL) were added. The bottle was equipped with graphite rod electrode (ϕ 6 mm) as the anode and cathode. The reaction mixture was stirred and electrolyzed at a constant current of 10 mA under room temperature and nitrogen atmosphere for 5 h. After evaporation of solvent, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 8 : 1) to afford product **3bn** (54.1 mg, 0.126 mmol) in 42% yield as a yellow liquid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.23 (t, *J* = 7.2 Hz, 3H), 1.32 (t, *J* = 7.5 Hz, 3H), 2.59 (t, *J* = 8.0 Hz, 2H), 2.90 (t, *J* = 8.0 Hz, 2H), 3.84-3.88 (m, 9H), 4.12 (q, *J* = 7.5 Hz, 2H), 4.19-4.32 (m, 3H), 6.04 (d, *J* = 8.5 Hz, 1H), 6.69 (s, 1H), 6.80 (s, 1H), 6.82 (d, *J* = 8.5 Hz, 1H), 6.93 (s, 1H), 6.96 (d, *J* = 8.5 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 14.14, 14.19, 30.82, 36.31, 55.83, 55.85, 55.99, 56.00, 60.34, 61.52, 86.62, 109.17, 110.93, 112.72, 116.30, 118.73, 125.21, 132.50, 134.16, 144.16, 146.20, 149.05, 170.60, 172.80; ESIHRMS: Found: *m/z* 481.1839. Calcd for $C_{25}H_{30}O_8Na$: $(M+Na)^+$ 481.1838.

To a solution of $LiAlH_4$ (69.7 mg, 1.84 mmol) in dry THF (3 mL) was added a solution of **3bn (**84.2 mg, 0.184 mmol**)** dissolved in dry THF (3 mL) dropwise at 0 ˚C. The reaction was continued at 0 ˚C for 5 min and at ambient temperature for additional 1 h. After the residual $LiAlH_4$ had been destroyed by adding water dropwise to the cooled mixture, concentrated HCl was then added dropwise until two clear layers formed. After separation, the aqueous layer was extracted with ethyl acetate (10 mL x 3) and the combined extracts were then dried over Na_2SO_4, filtered and evaporated at reduced pressure. The residue was purified by column chromatography with ethyl acetate- petroleum ether as eluent (4:1) to afford product **4** (52.1 mg, 0.139 mmol) in 76% yield as a colorless liquid. The ^{1}H and ^{13}C NMR data (shown below) of this compound were identical to the reported ones.[15] ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.77 (s br, 2H), 1.77-1.90 (m, 2H), 2.65 (t, *J* = 7.5 Hz, 2H), 3.60 (dd, *J* = 5.5, 12.0 Hz, 1H), 3.67 (t, *J* = 6.5 Hz, 2H), 3.84 (s, 3H), 3.85 (s, 3H), 3.87 (s, 3H), 3.89 (d, *J* = 5.0 Hz, 1H), 3.95 (dd, *J* = 11.0, 6.0 Hz, 1H), 5.55 (d, *J* = 7.5 Hz, 1H), 6.66 (s, 1H), 6.67 (s, 1H), 6.82 (d, *J* = 8.5 Hz, 1H),

6.94-6.95 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 31.94, 34.54, 53.72, 55.87, 55.95, 62.19, 63.82, 87.71, 109.27, 110.90, 112.34, 115.95, 118.65, 127.71, 133.65, 135.35, 144.12, 146.48, 148.87, 149.05; ESIHRMS: Found: *m/z* 397.1634. Calcd for $C_{21}H_{26}O_6Na$: $(M+Na)^+$ 397.16927.

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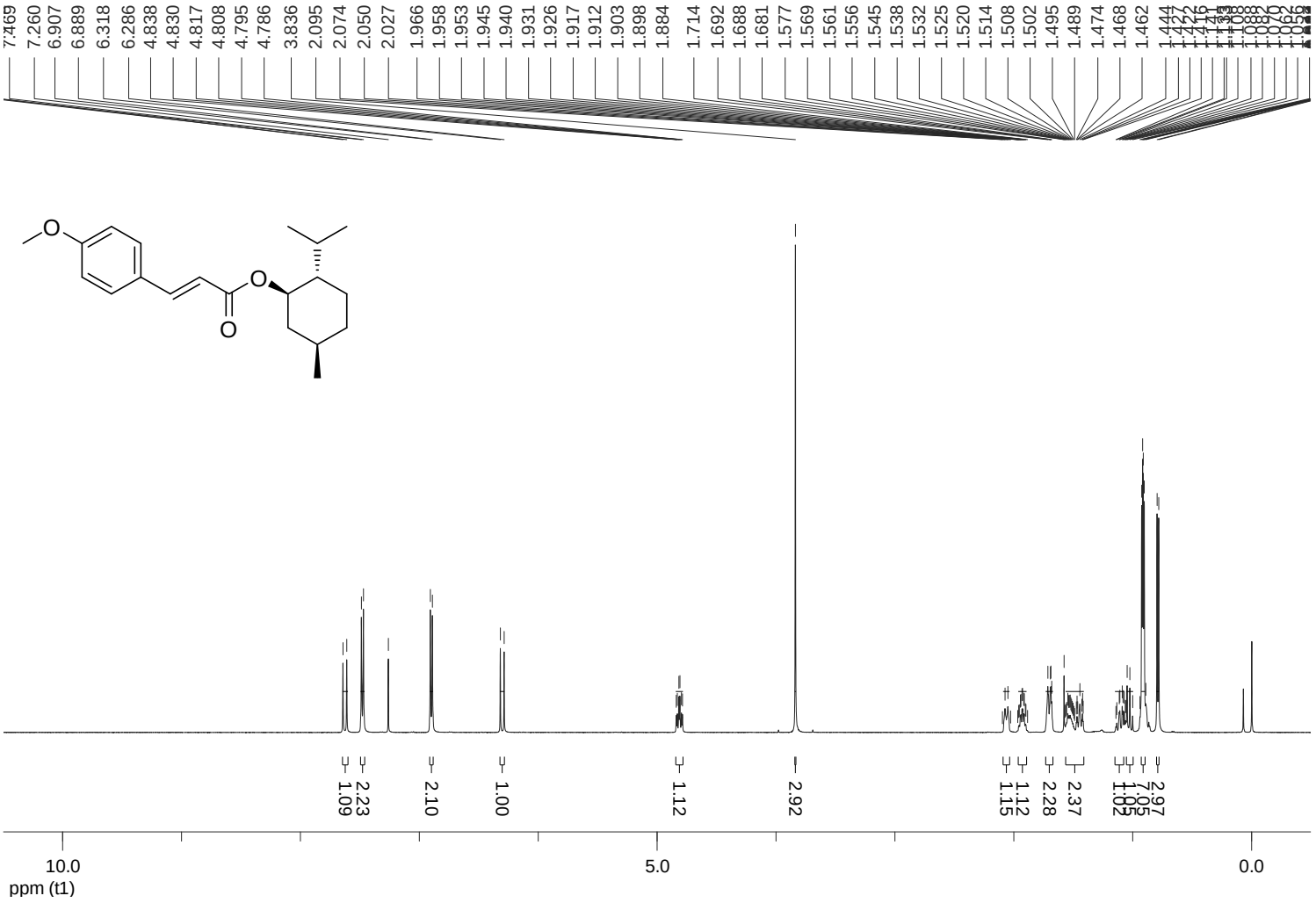
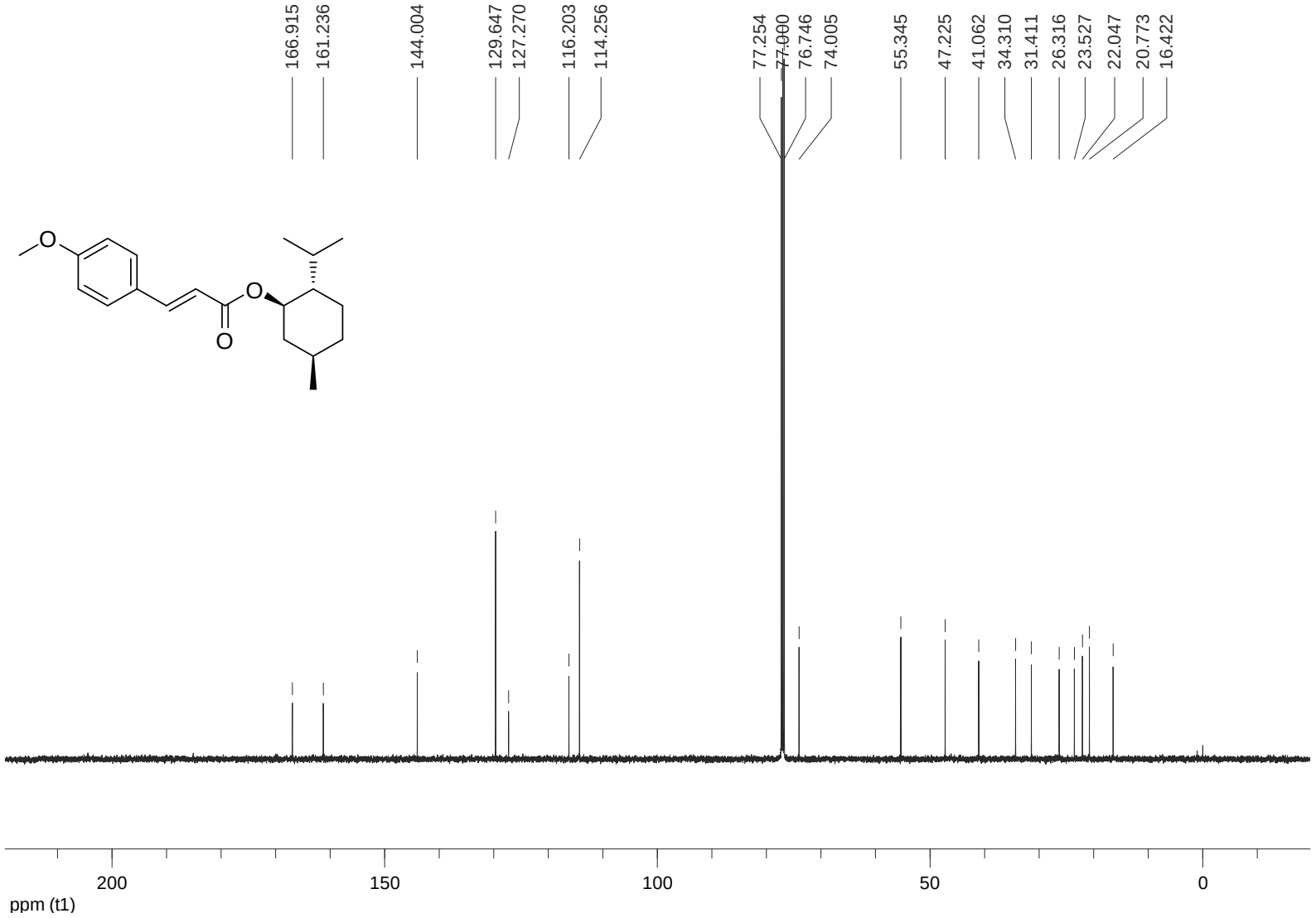
8. Copies of ^{1}H NMR and ^{13}C NMR Spectra

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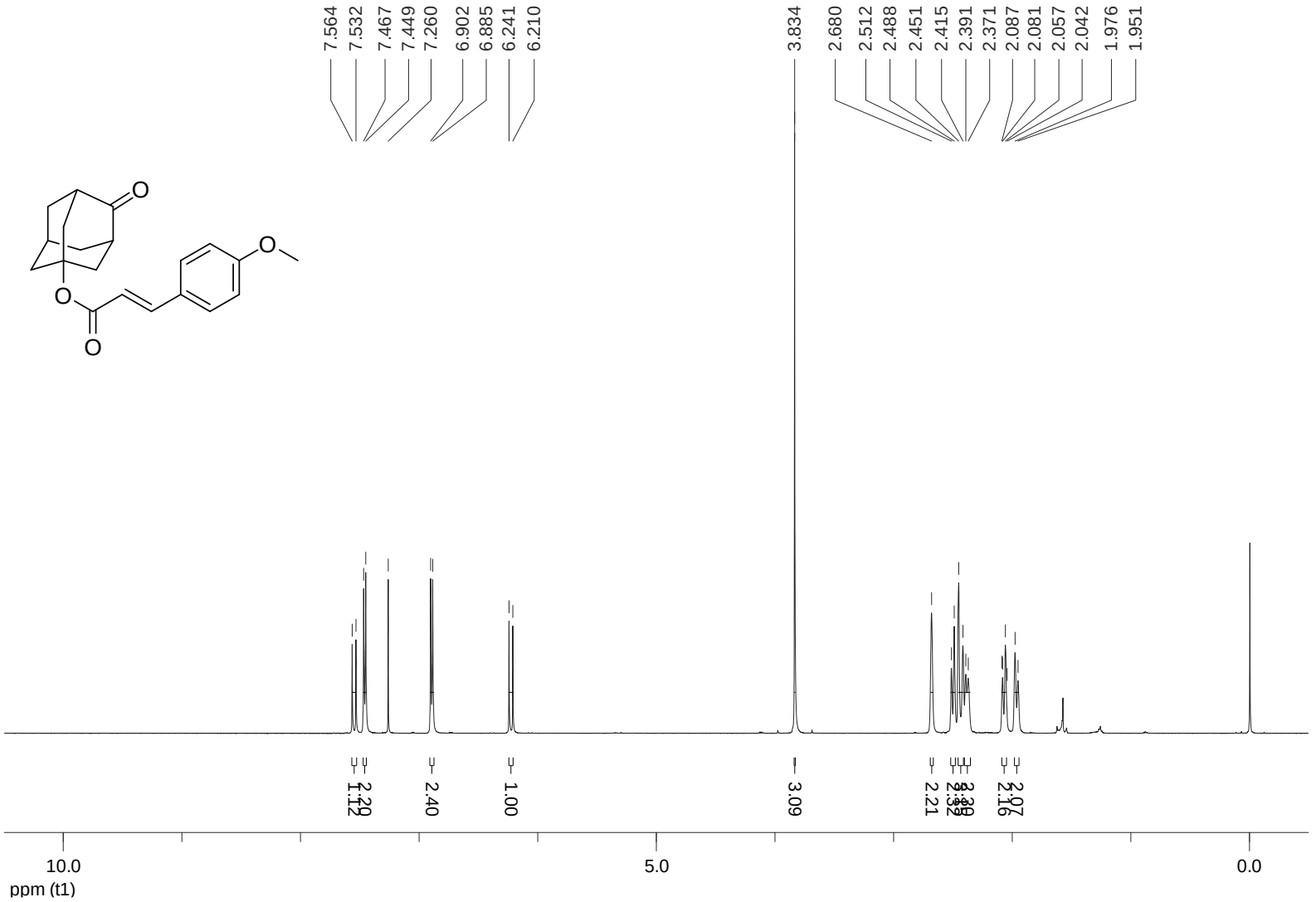
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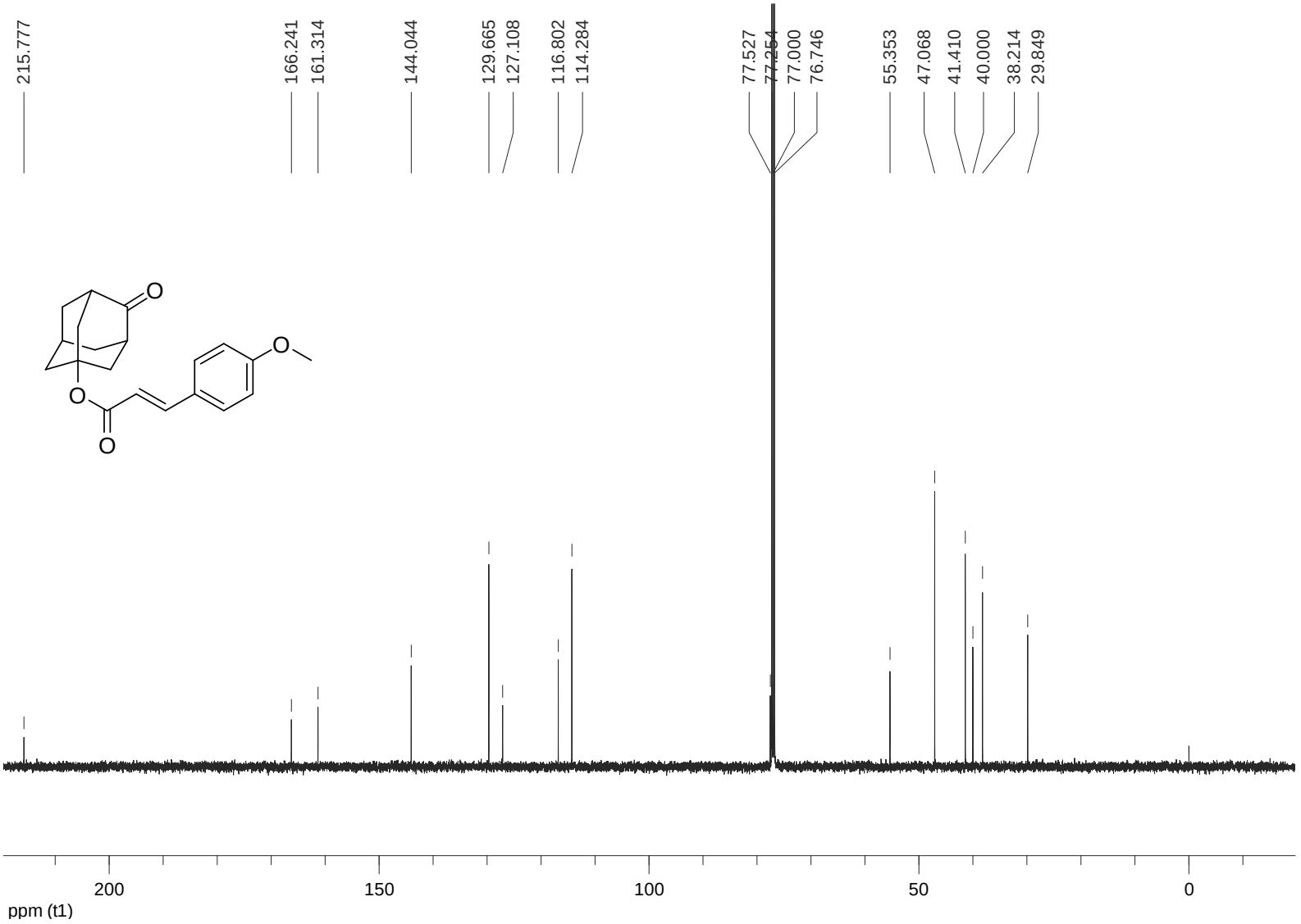
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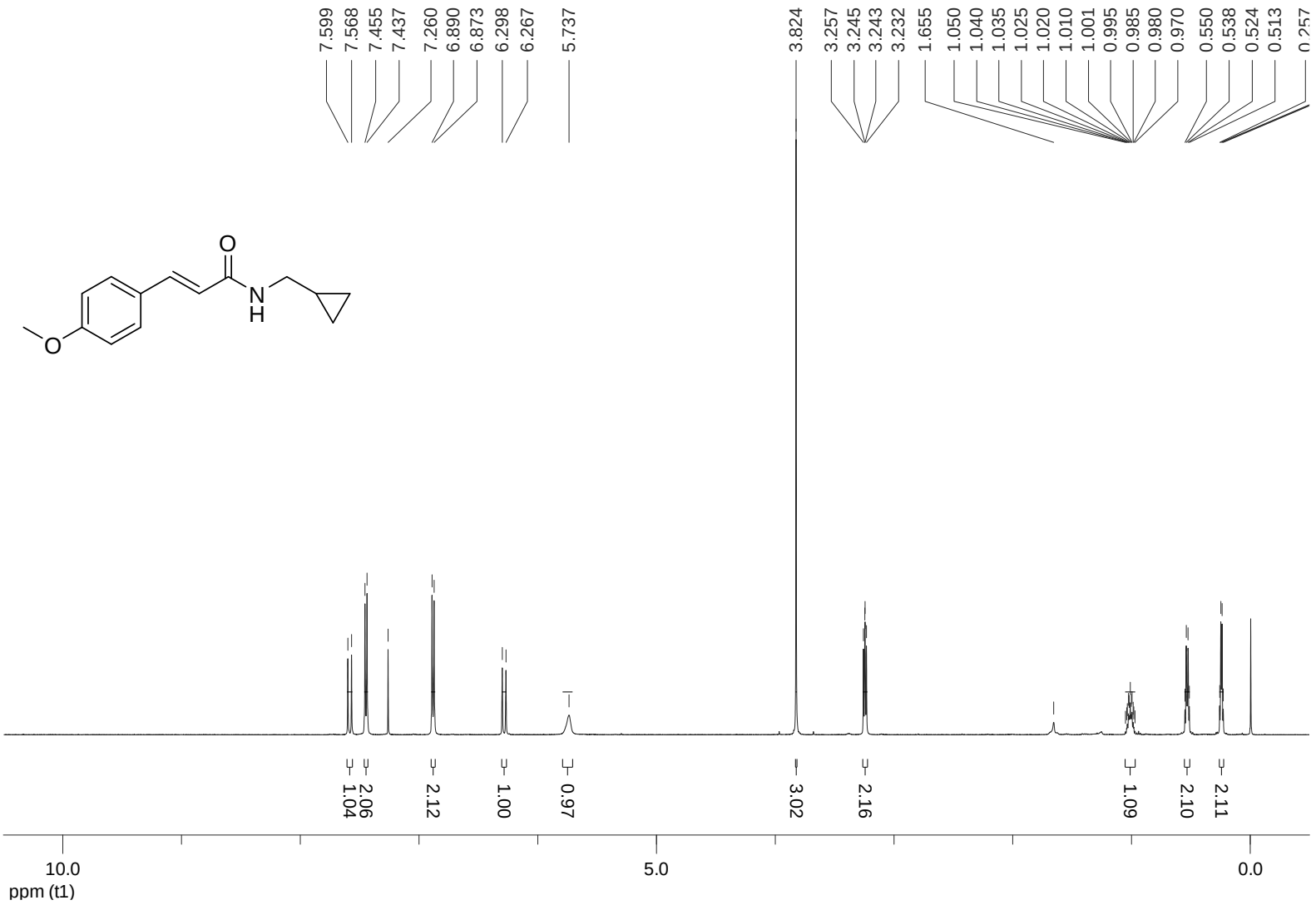
ppm (t1)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1.040
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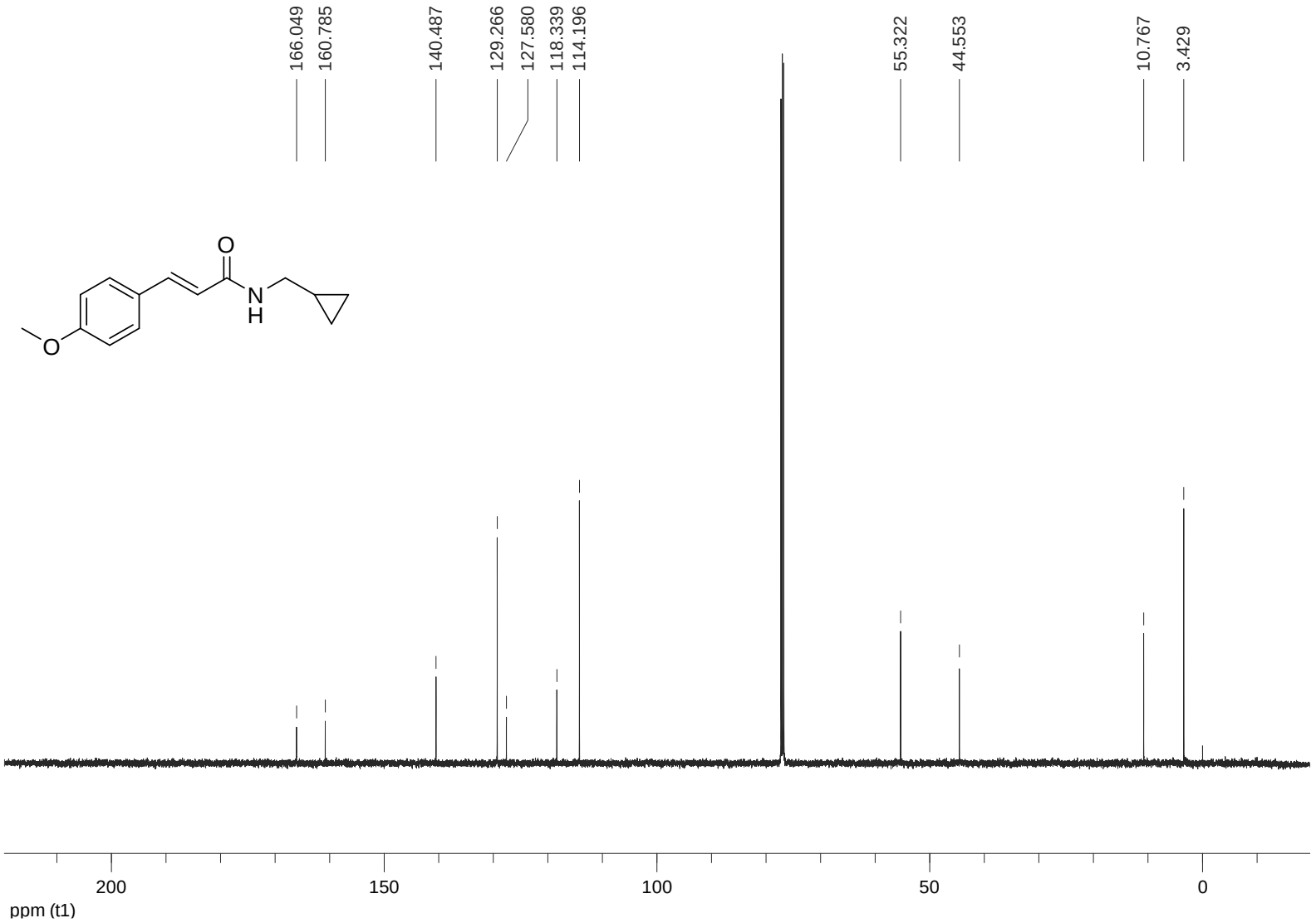
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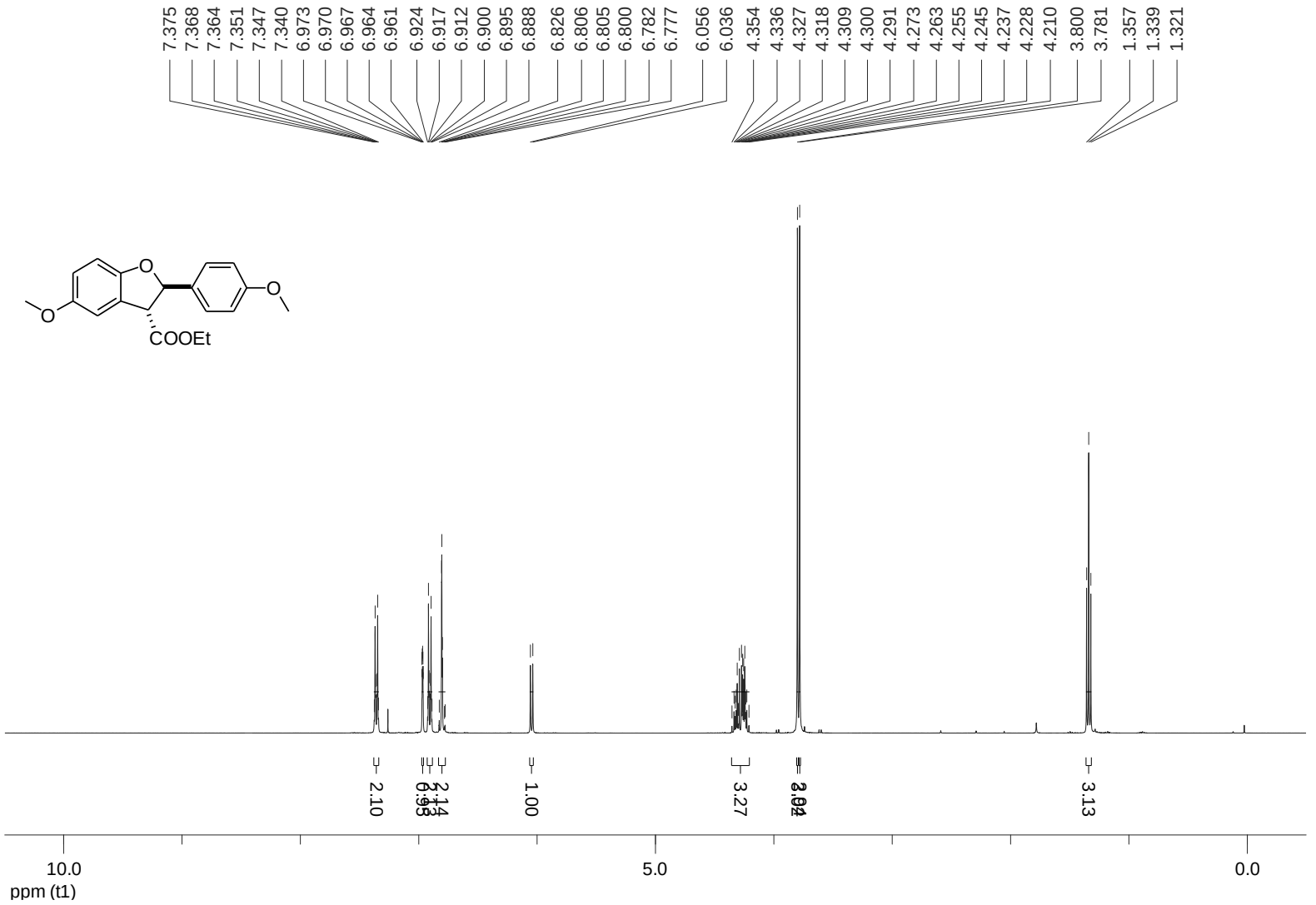
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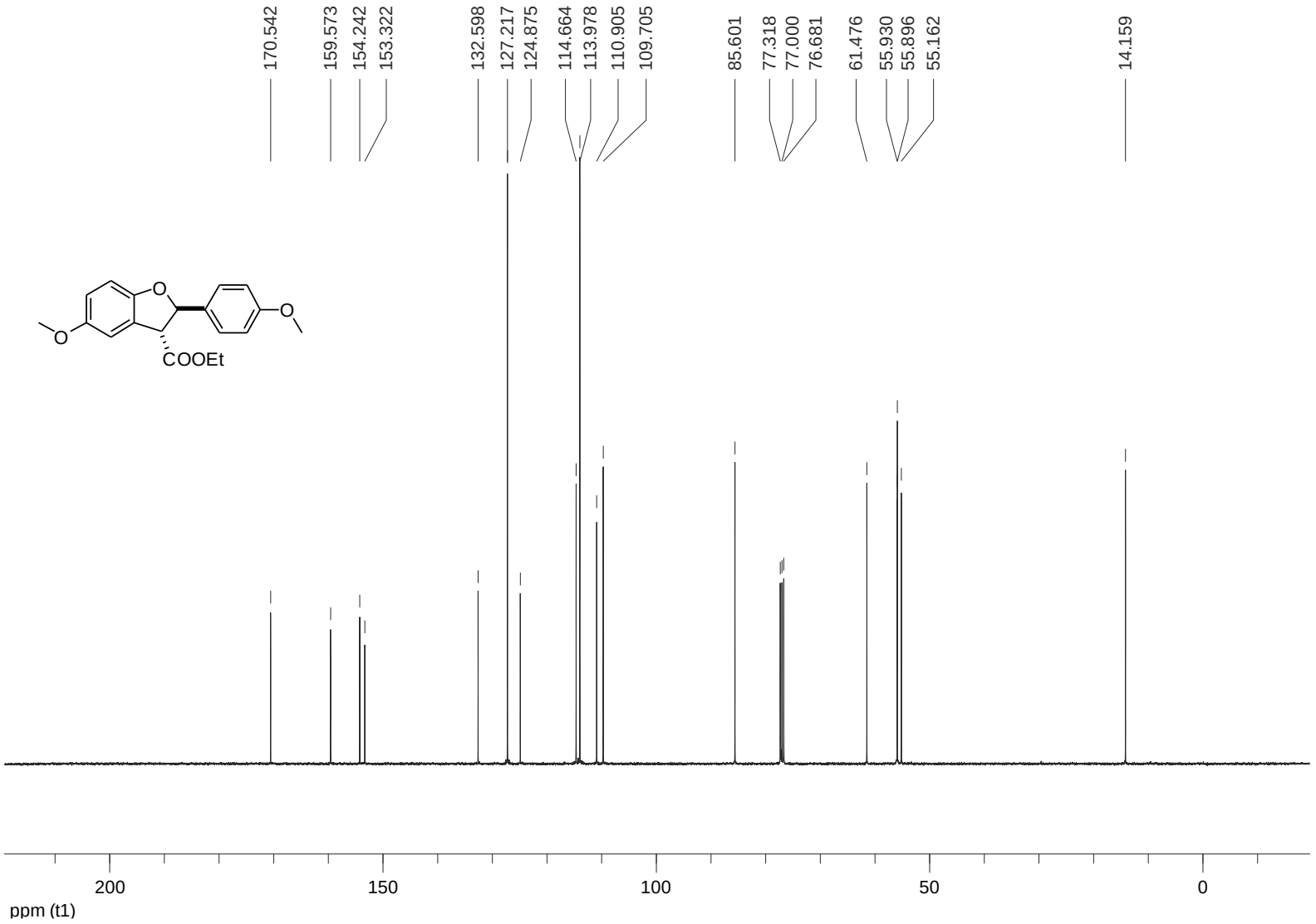
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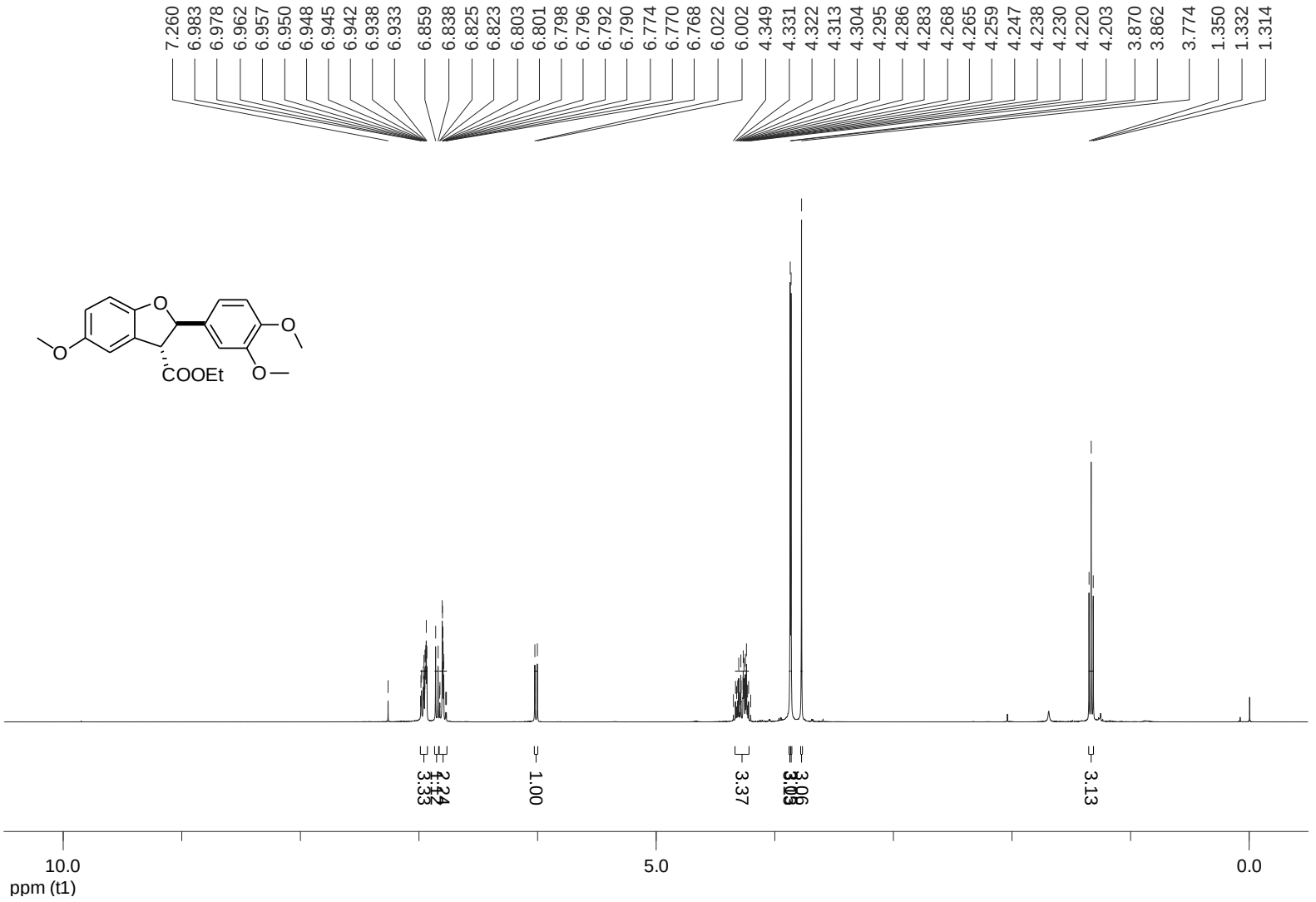
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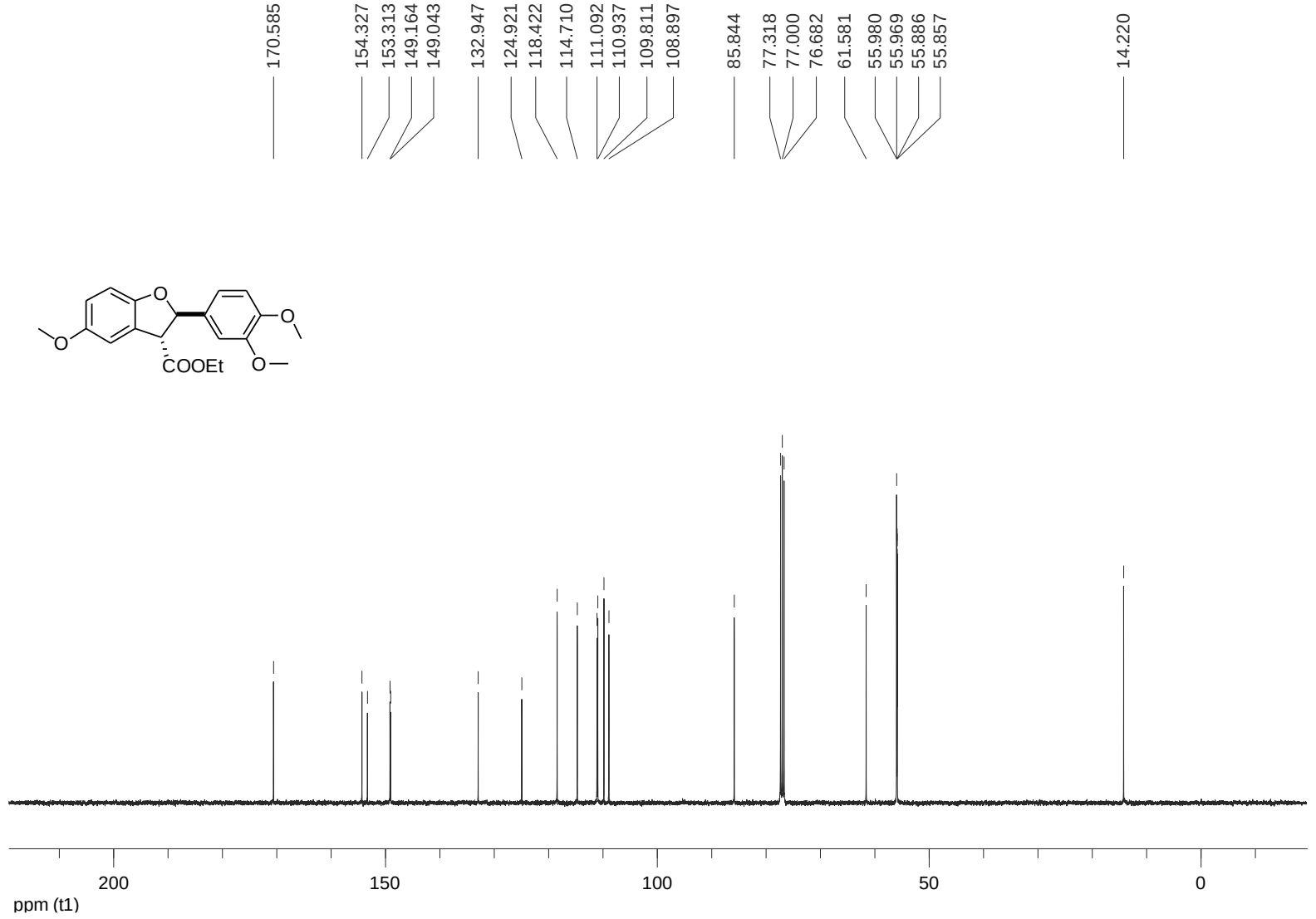
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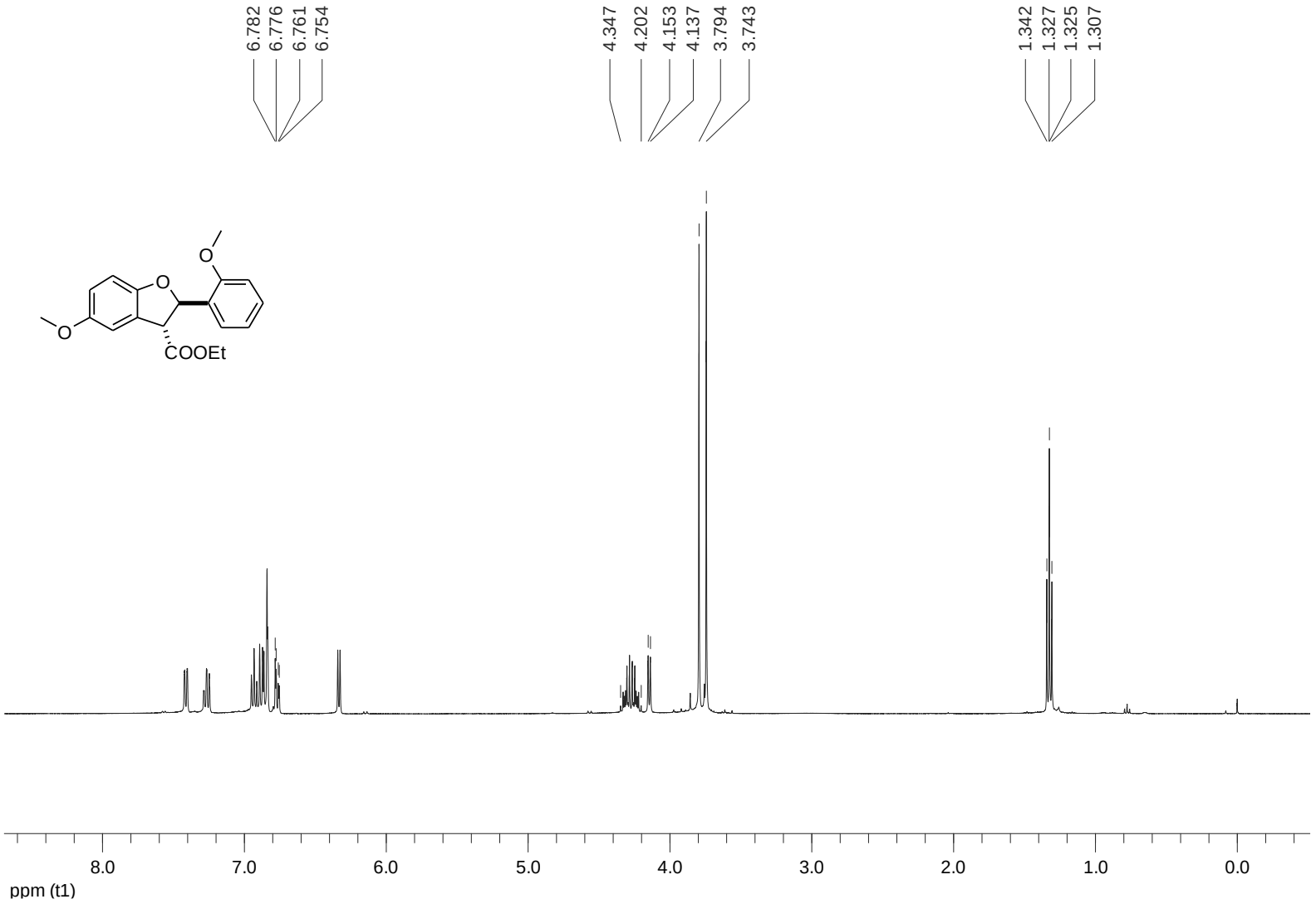
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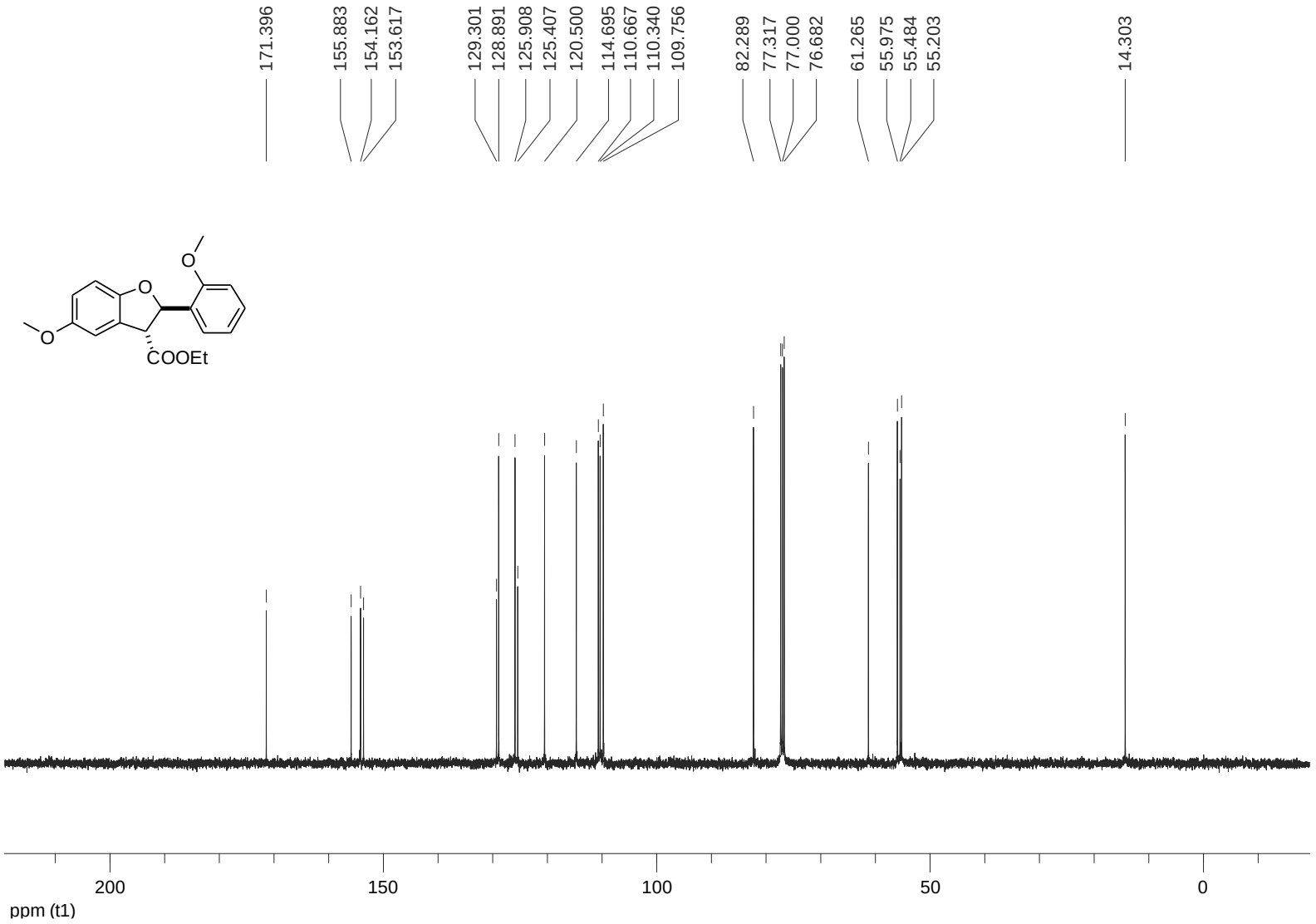
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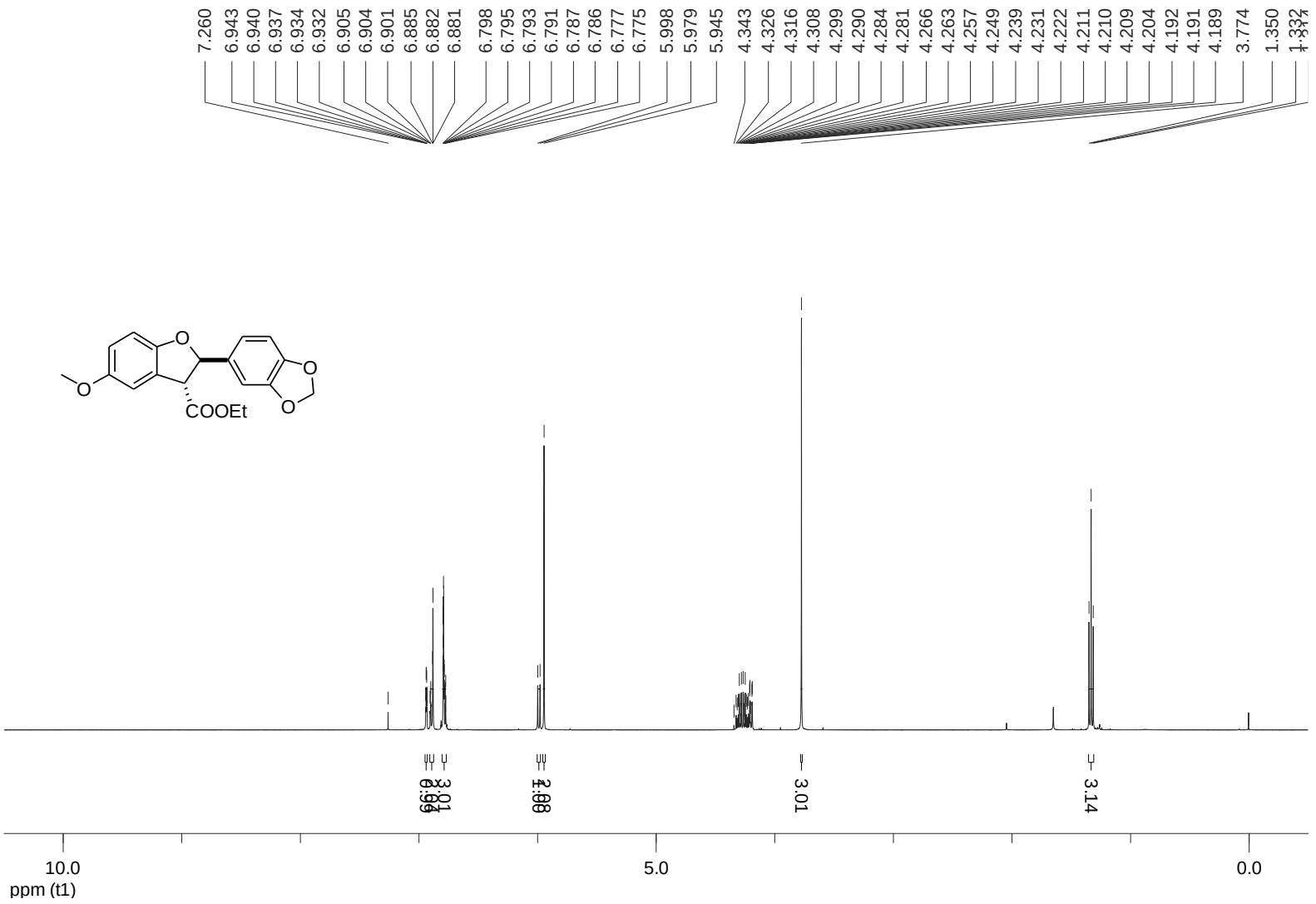
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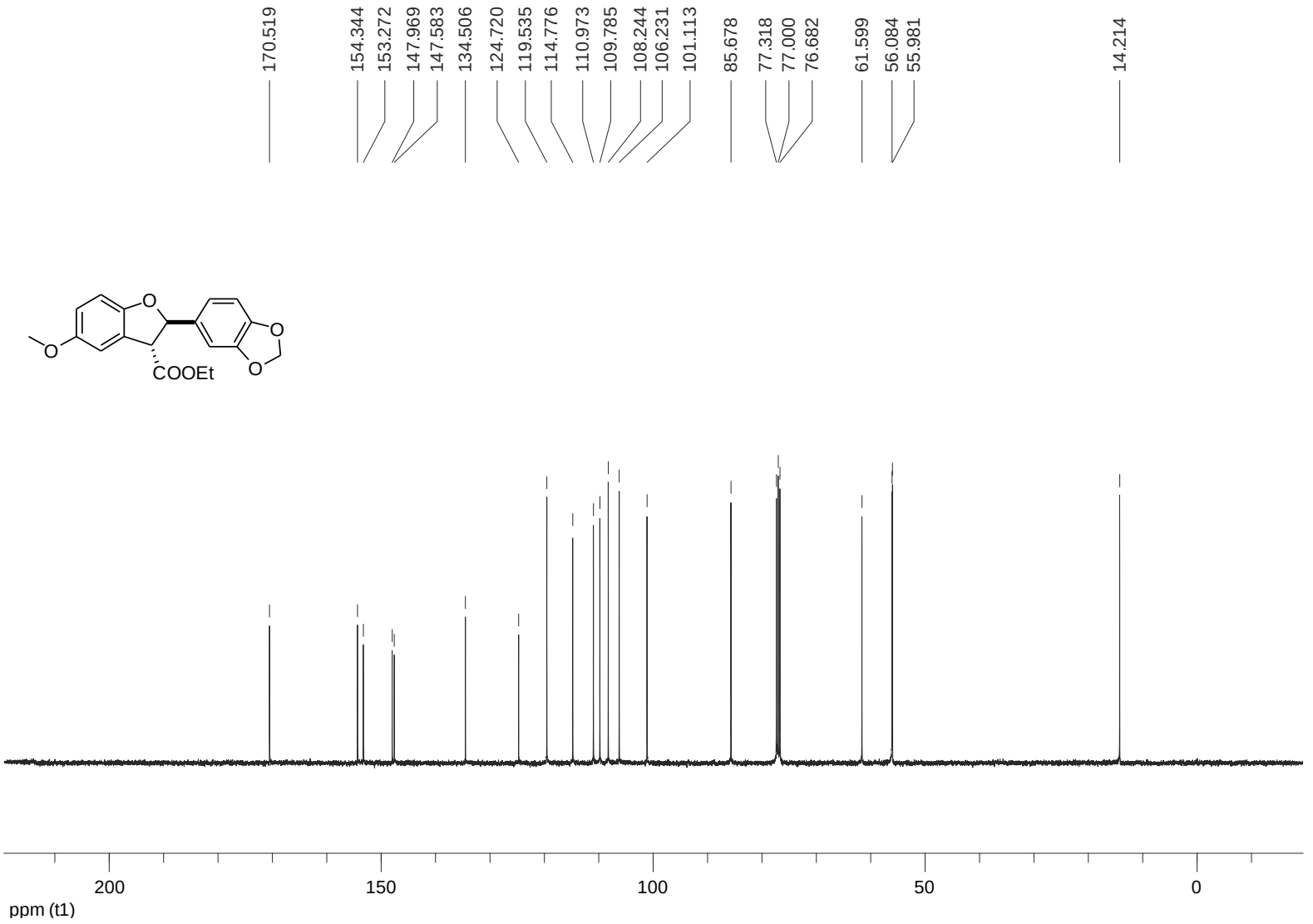
ppm (t1)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119.535
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110.973
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106.231
101.113
85.678
77.318
77.000
76.682
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14.214
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O
O
O
COOEt
200
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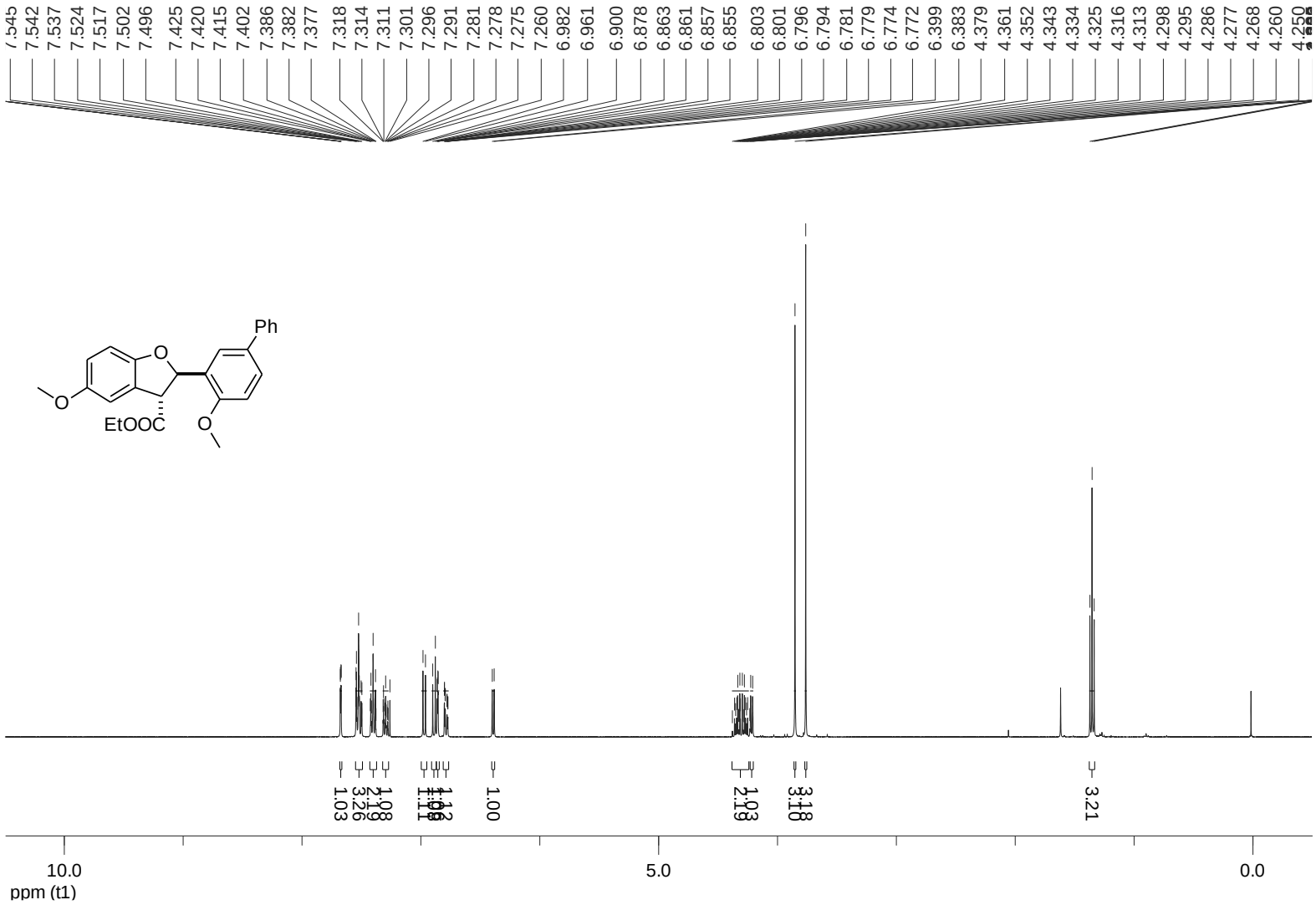
100
50
0
ppm (t1)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7.382
7.377
7.318
7.314
7.311
7.301
7.296
7.291
7.281
7.278
7.275
7.260
6.982
6.961
6.900
6.878
6.863
6.861
6.857
6.855
6.803
6.801
6.796
6.794
6.781
6.779
6.774
6.772
6.399
6.383
4.379
4.361
4.352
4.343
4.334
4.325
4.316
4.313
4.298
4.295
4.286
4.277
4.268
4.260
4.250
Ph
O
O
EtOOC
O
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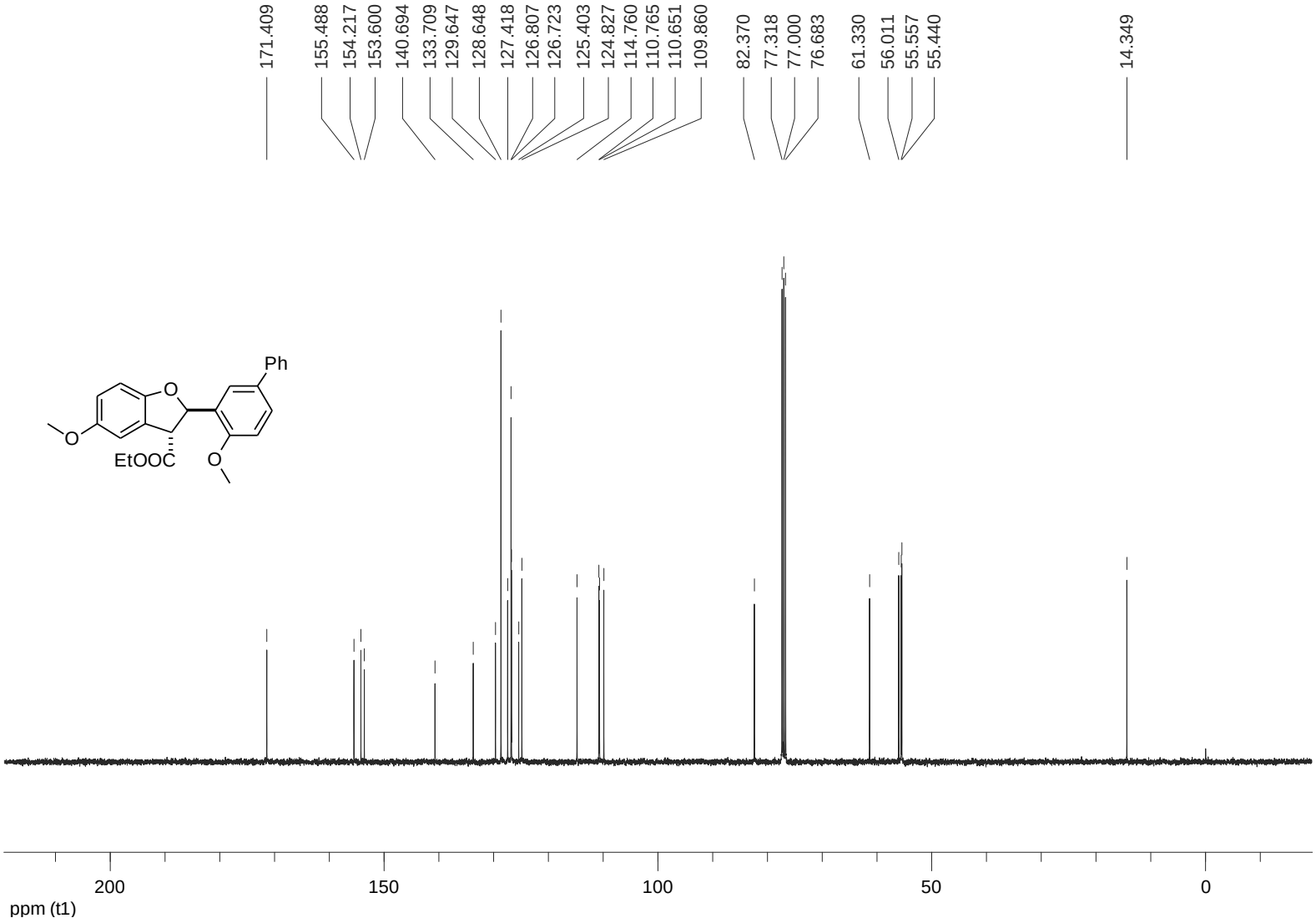
3.26
1.08
1.11
1.00
2.19
3.18
3.21
10.0
5.0
0.0
ppm (t1)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128.648
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126.807
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125.403
124.827
114.760
110.765
110.651
109.860
82.370
77.318
77.000
76.683
61.330
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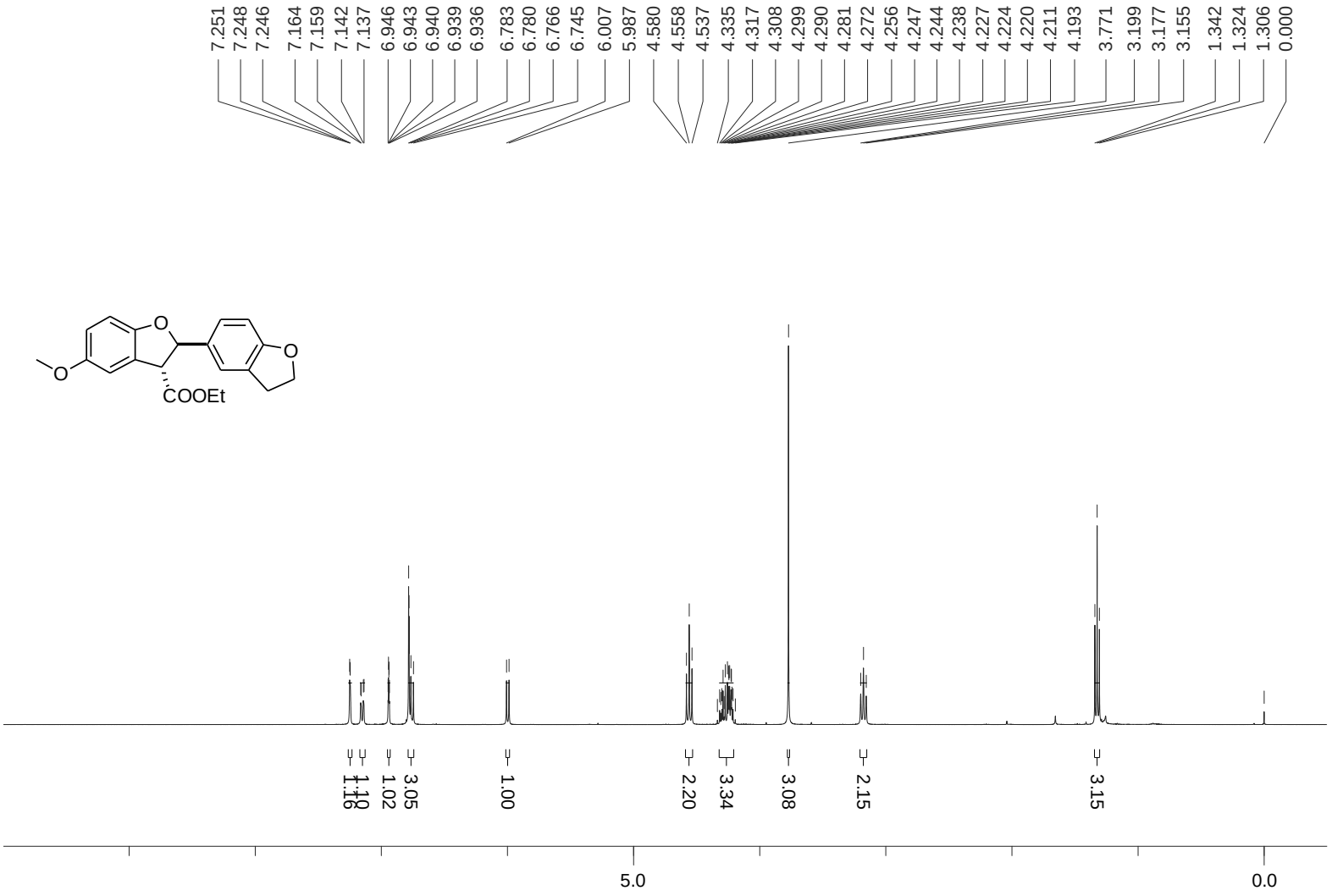
55.440
14.349
Ph
O
O
EtOOC
O
200
150
100
50
0
ppm (t1)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7.142
7.137
6.946
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6.940
6.939
6.936
6.783
6.780
6.766
6.745
6.007
5.987
4.580
4.558
4.537
4.335
4.317
4.308
4.299
4.290
4.281
4.272
4.256
4.247
4.244
4.238
4.227
4.224
4.220
4.211
4.193
3.771
3.199
3.177
3.155
1.342
1.324
1.306
0.000
O
O
O
COOEt
1.16
1.10
1.02
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1.00
2.20
3.34
3.08
2.15
3.15
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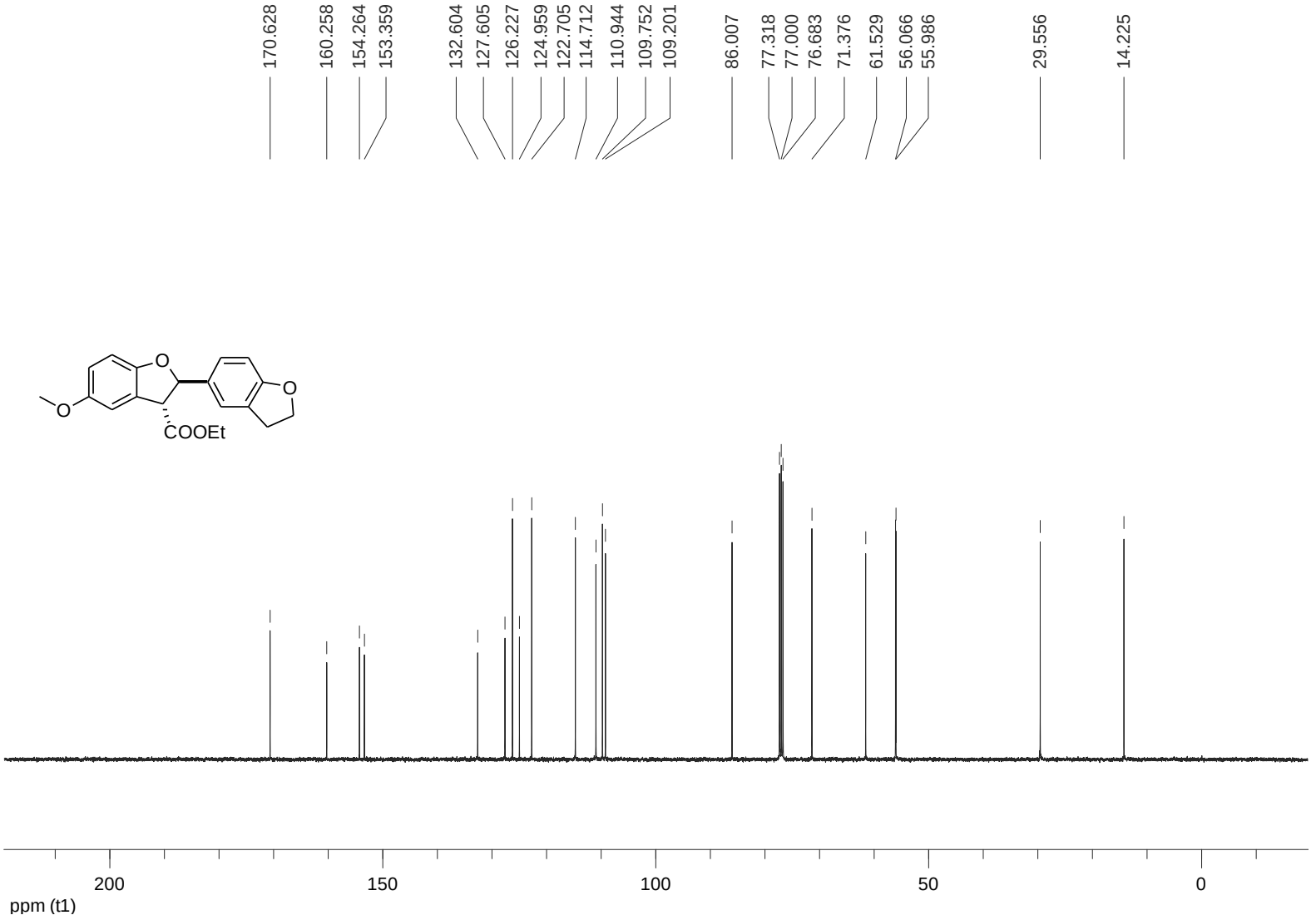
ppm (t1)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109.201
86.007
77.318
77.000
76.683
71.376
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29.556
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O
O
COOEt
200
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100
50
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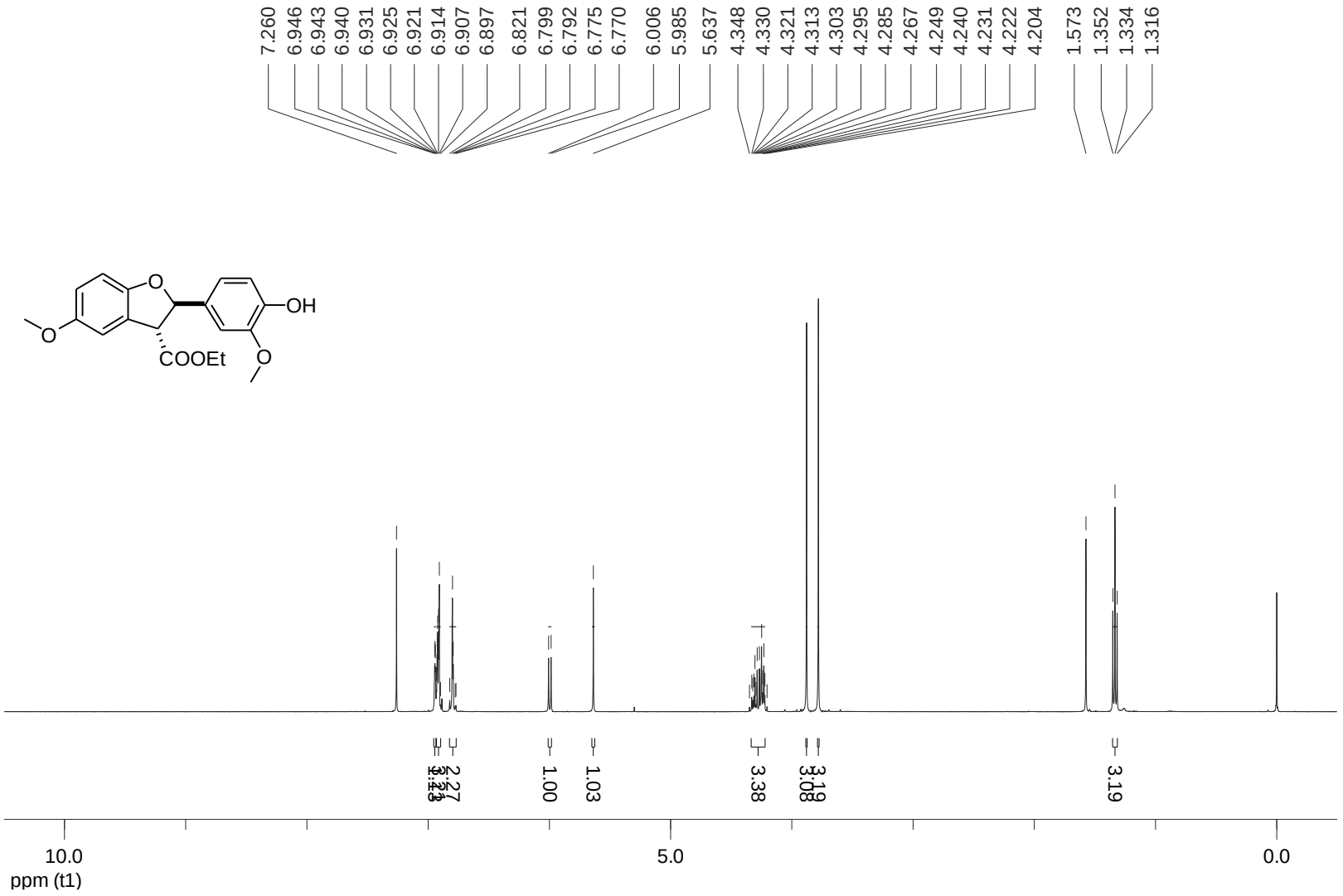
ppm (t1)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6.925
6.921
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6.907
6.897
6.821
6.799
6.792
6.775
6.770
6.006
5.985
5.637
4.348
4.330
4.321
4.313
4.303
4.295
4.285
4.267
4.249
4.240
4.231
4.222
4.204
1.573
1.352
1.334
1.316
O
OH
O
COOEt
O
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1.03
3.38
3.19
3.19
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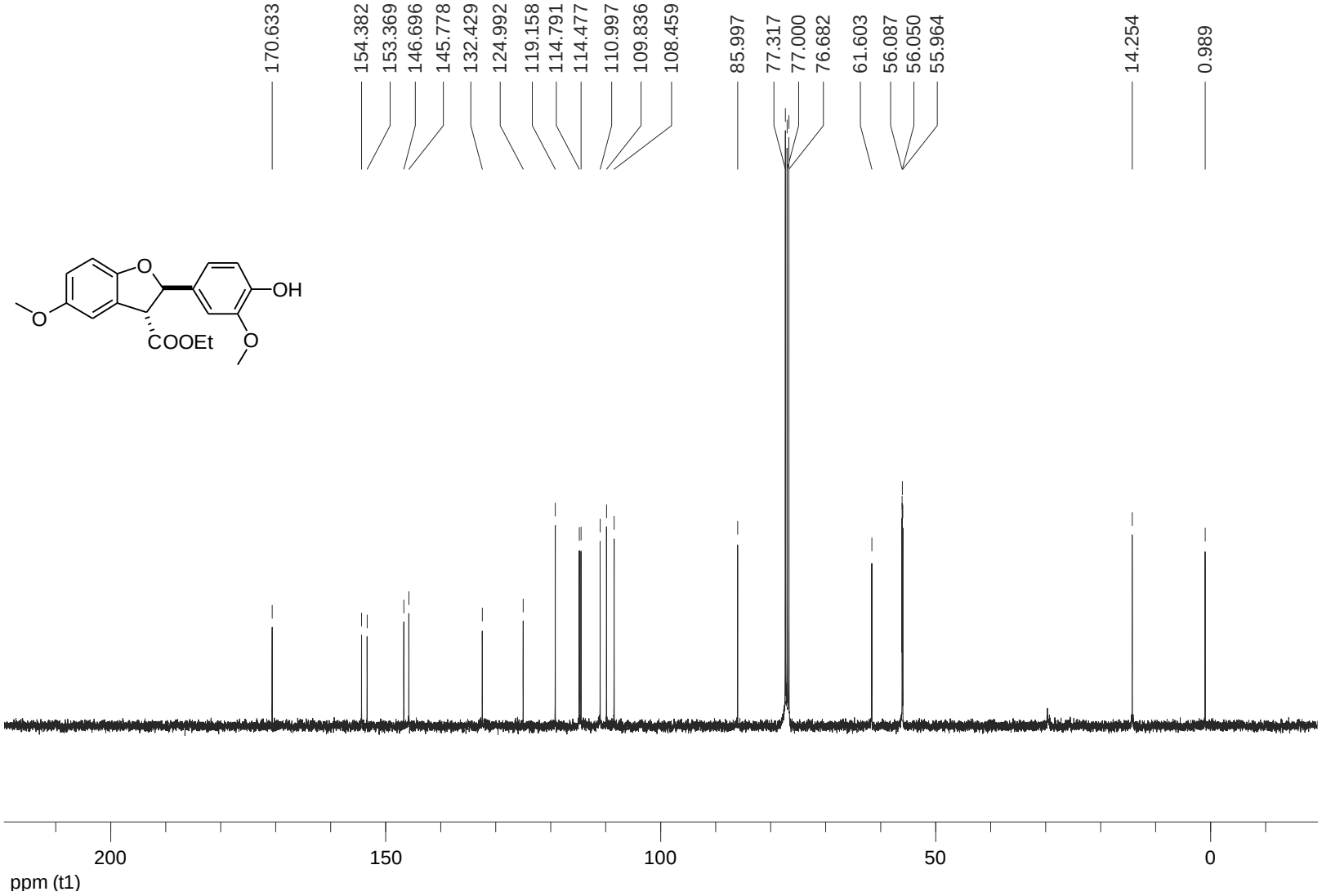
0.0
ppm (t1)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119.158
114.791
114.477
110.997
109.836
108.459
85.997
77.317
77.000
76.682
61.603
56.087
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14.254
0.989
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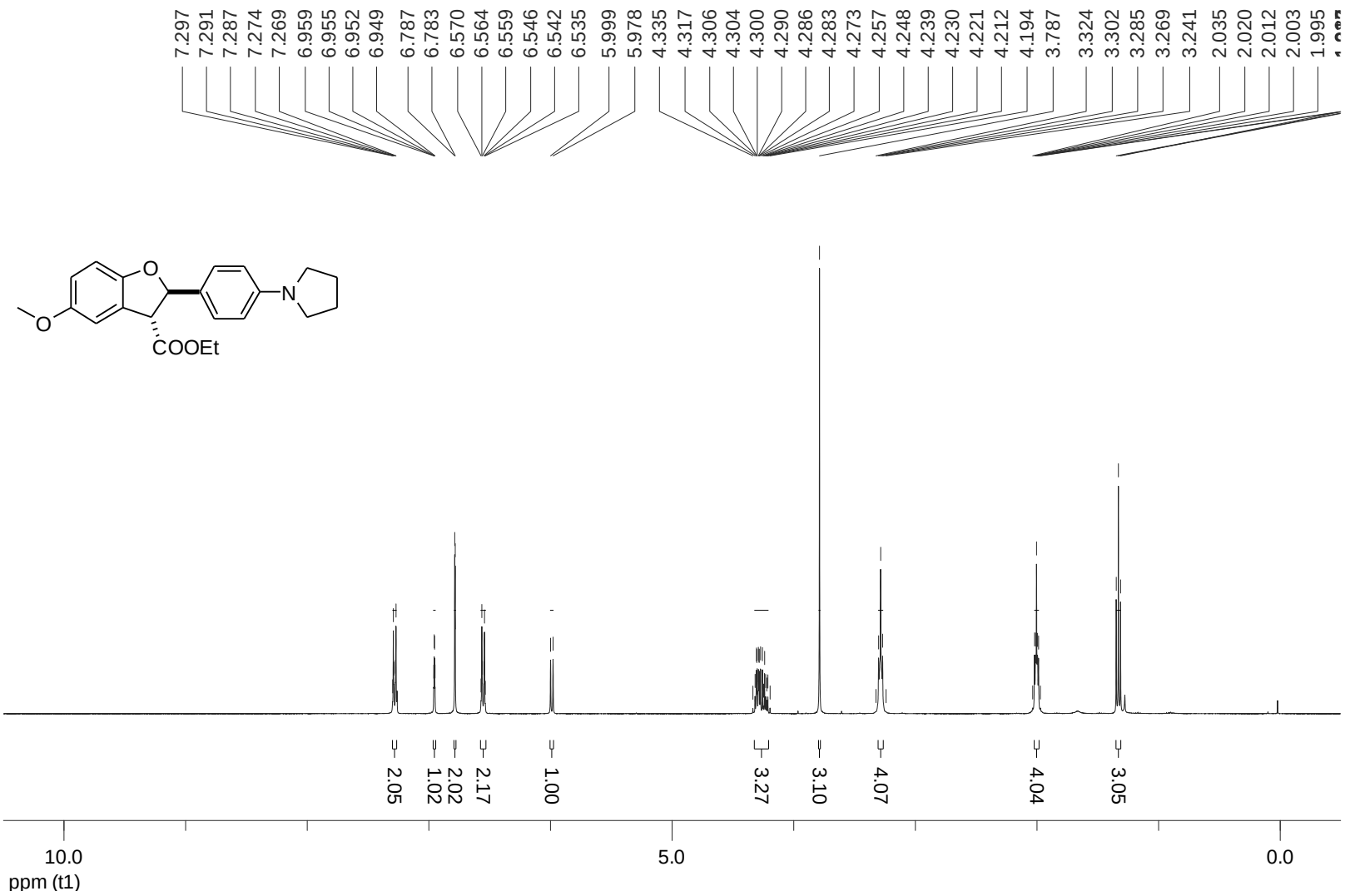
OH
O
COOEt
O
200
150
100
50
0
ppm (t1)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7.269
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6.955
6.952
6.949
6.787
6.783
6.570
6.564
6.559
6.546
6.542
6.535
5.999
5.978
4.335
4.317
4.306
4.304
4.300
4.290
4.286
4.283
4.273
4.257
4.248
4.239
4.230
4.221
4.212
4.194
3.787
3.324
3.302
3.285
3.269
3.241
2.035
2.020
2.012
2.003
1.995
O
N
O
COOEt
2.05
1.02
2.02
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3.27
3.10
4.07
4.04
3.05
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5.0
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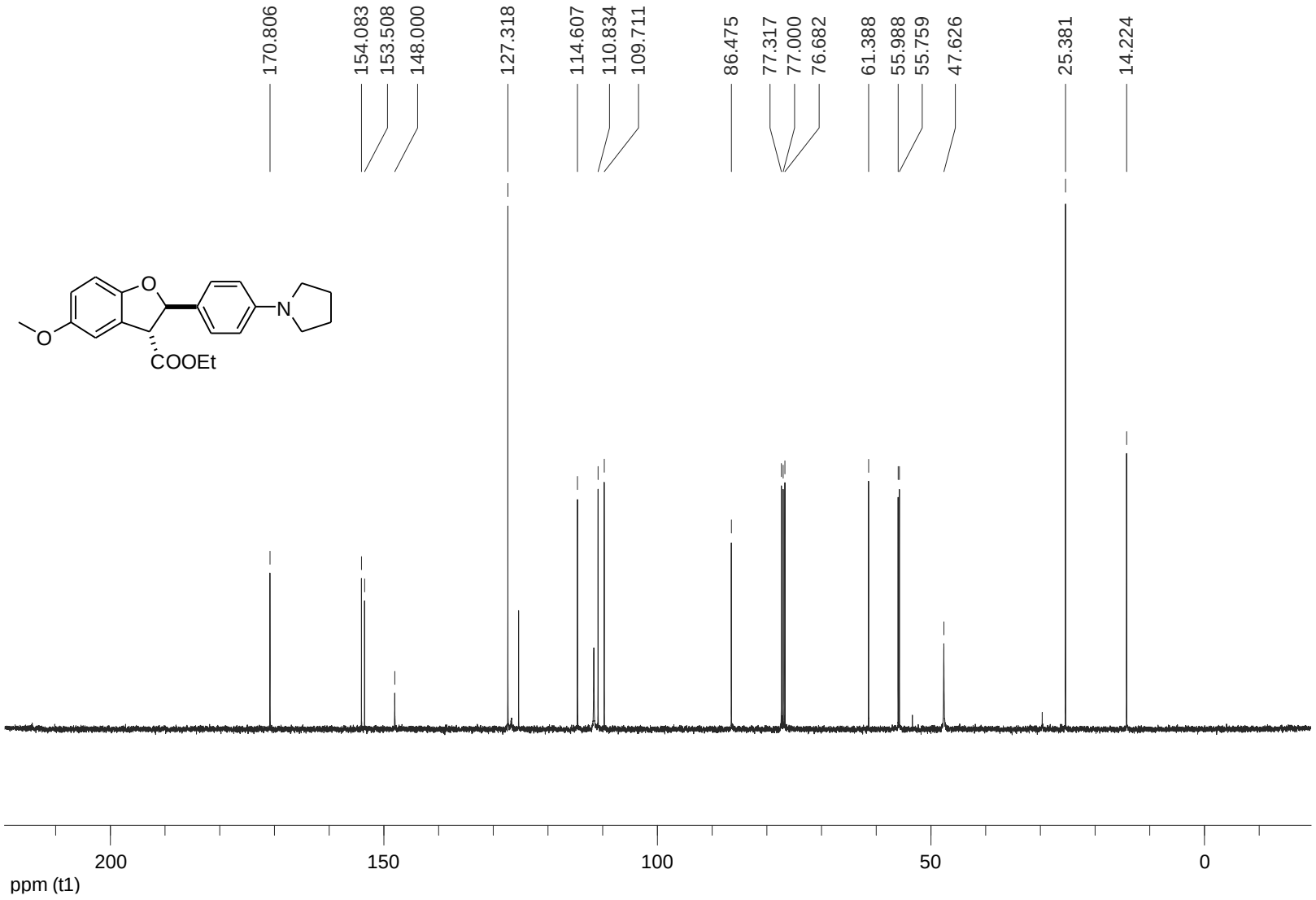
ppm (t1)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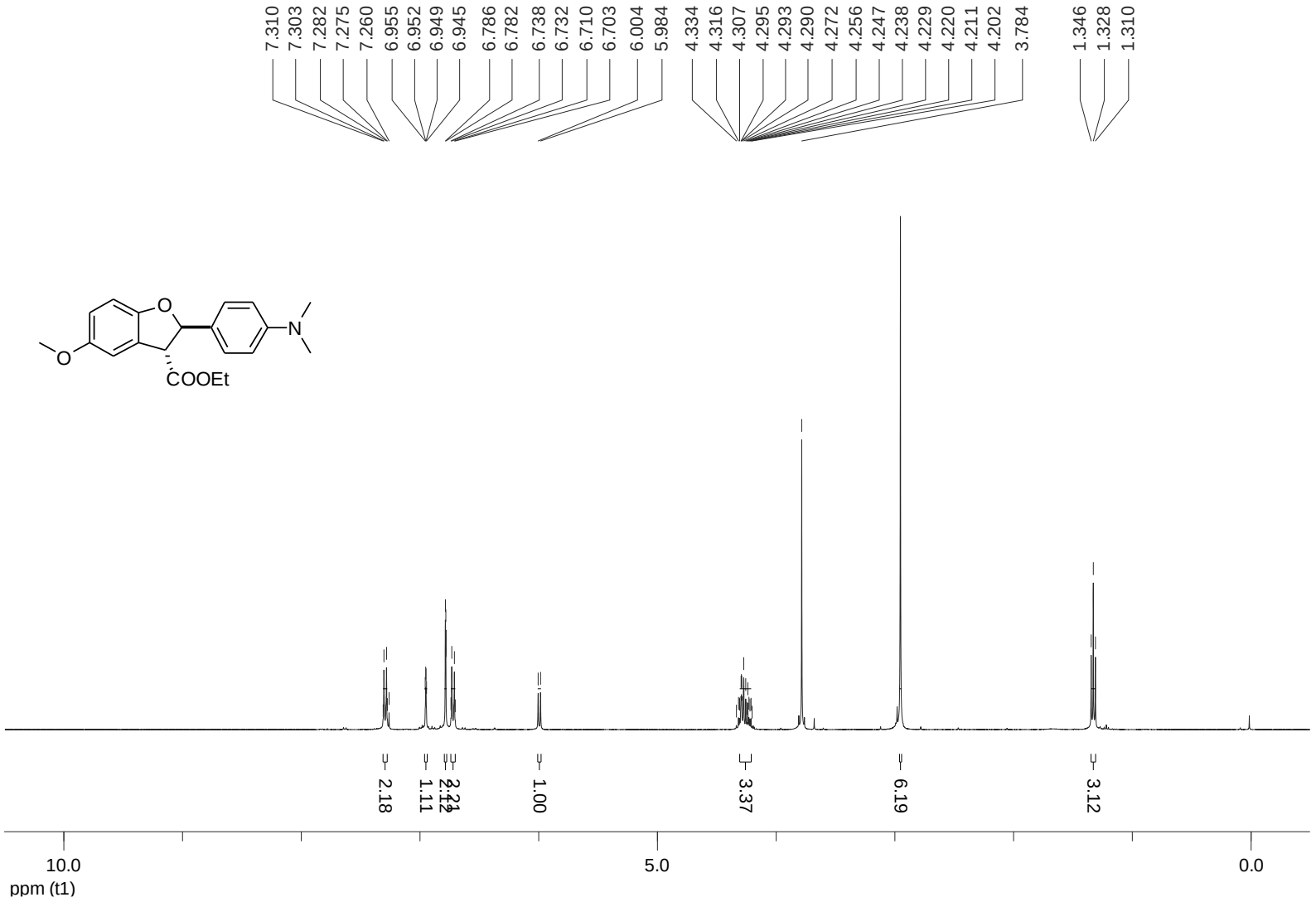
110.834
109.711
86.475
77.317
77.000
76.682
61.388
55.988
55.759
47.626
25.381
14.224
O
N
O
COOEt
200
150
100
50
0
ppm (t1)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6.782
6.738
6.732
6.710
6.703
6.004
5.984
4.334
4.316
4.307
4.295
4.293
4.290
4.272
4.256
4.247
4.238
4.229
4.220
4.211
4.202
3.784
1.346
1.328
1.310
O
N
O
COOEt
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2.12
2.21
1.00
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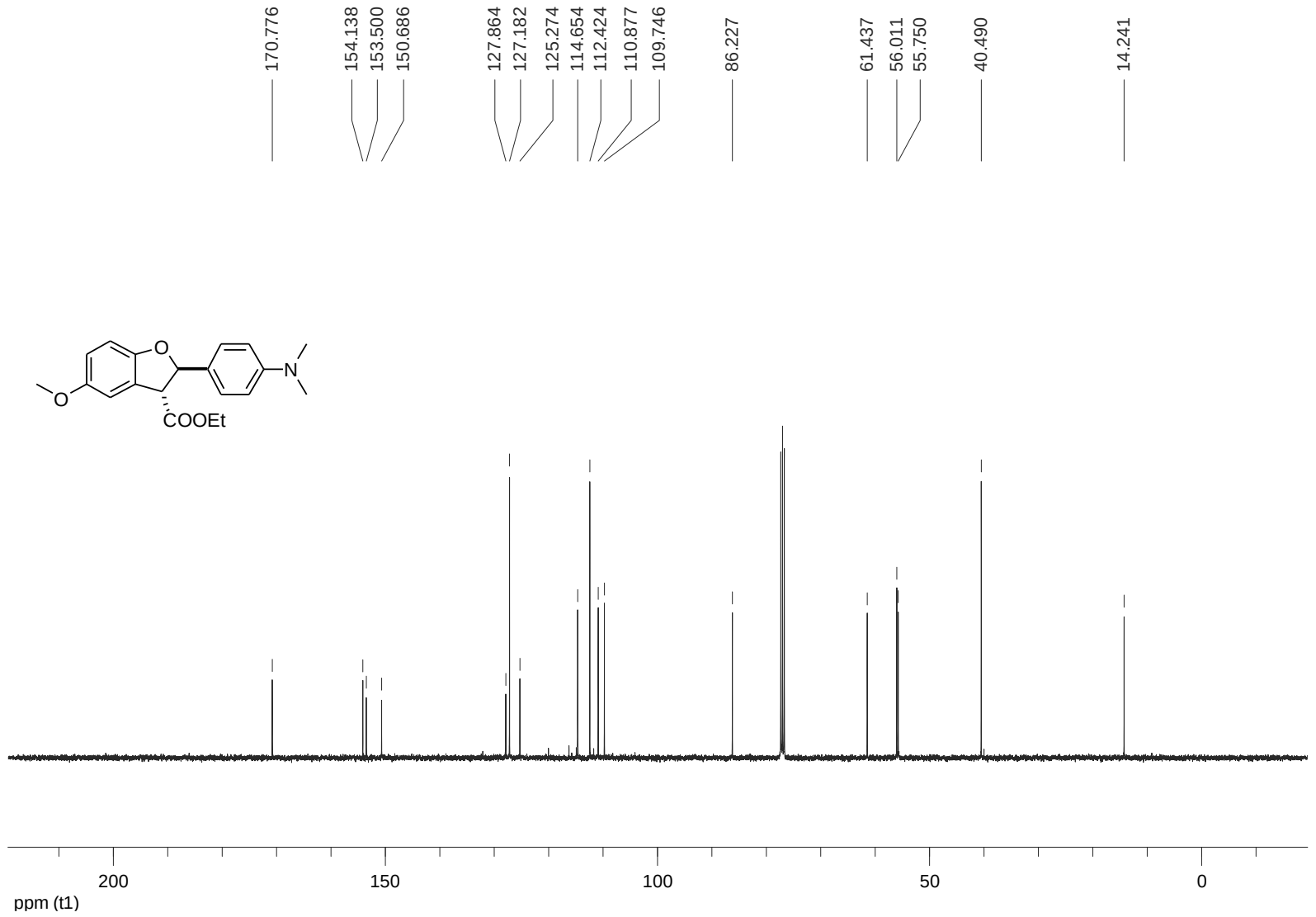
3.12
10.0
5.0
0.0
ppm (t1)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114.654
112.424
110.877
109.746
86.227
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40.490
14.241
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N
O
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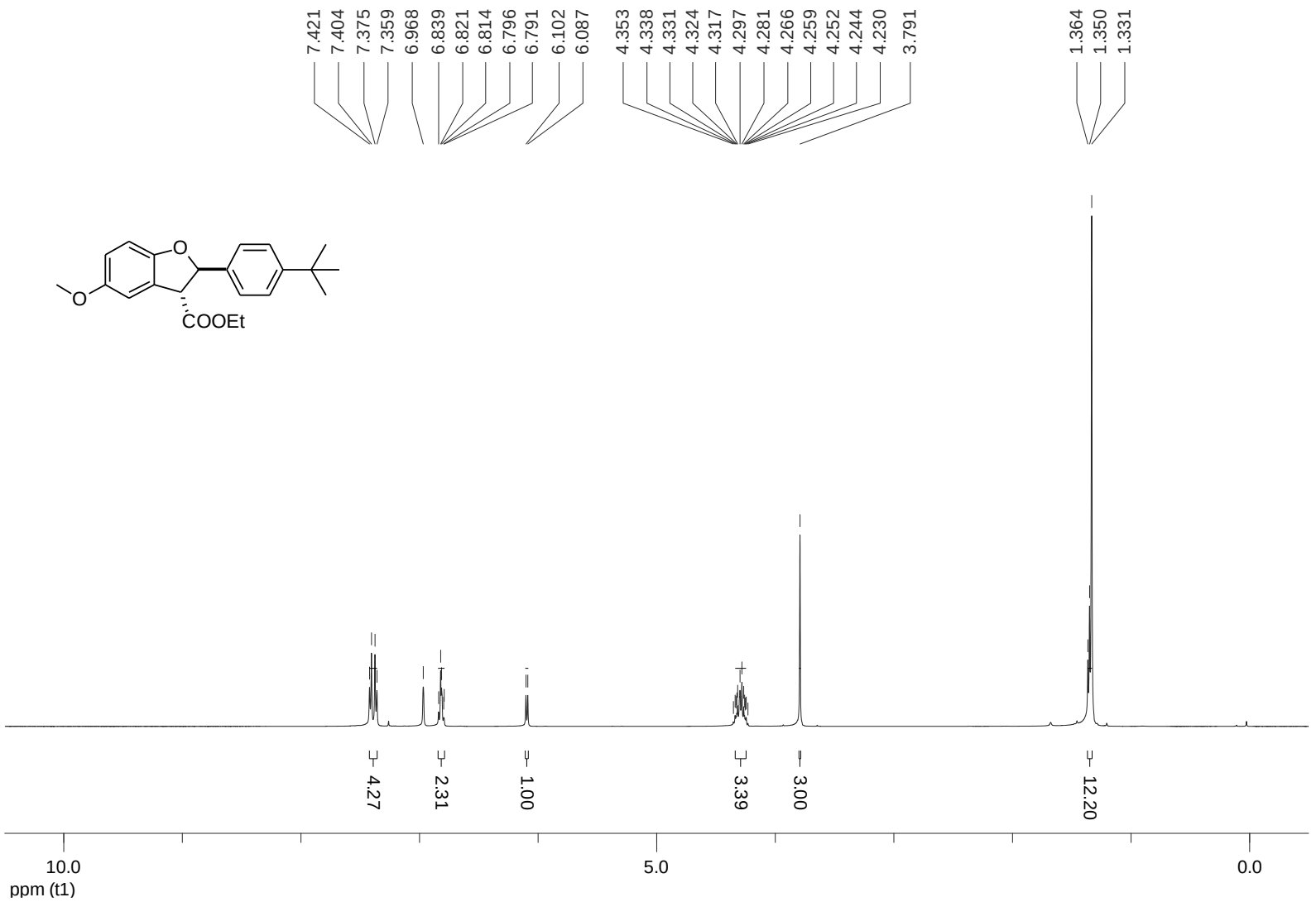
200
150
100
50
0
ppm (t1)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6.814
6.796
6.791
6.102
6.087
4.353
4.338
4.331
4.324
4.317
4.297
4.281
4.266
4.259
4.252
4.244
4.230
3.791
1.364
1.350
1.331
O
O
COOEt
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2.31
1.00
3.39
3.00
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10.0
5.0
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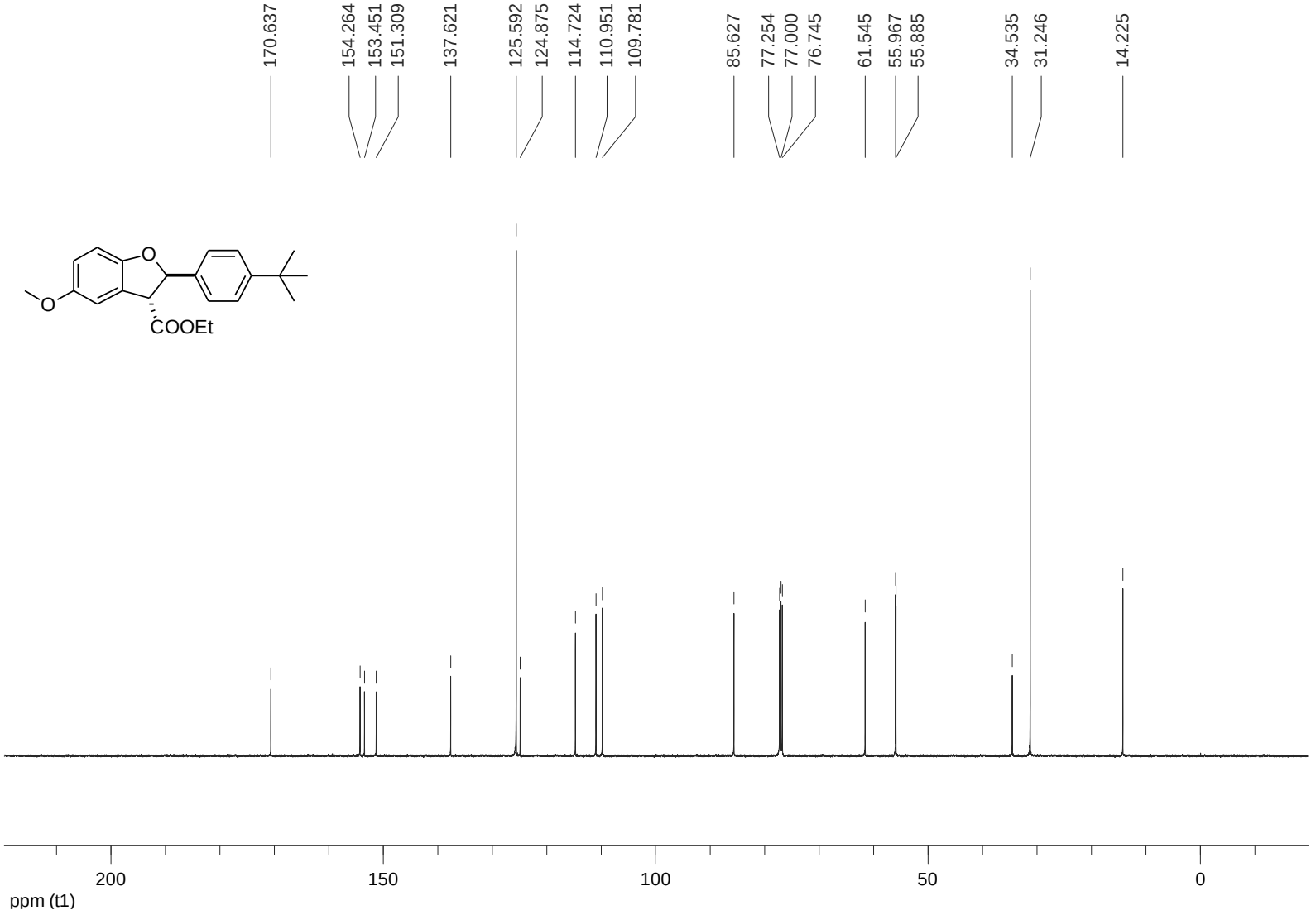
ppm (t1)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114.724
110.951
109.781
85.627
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77.000
76.745
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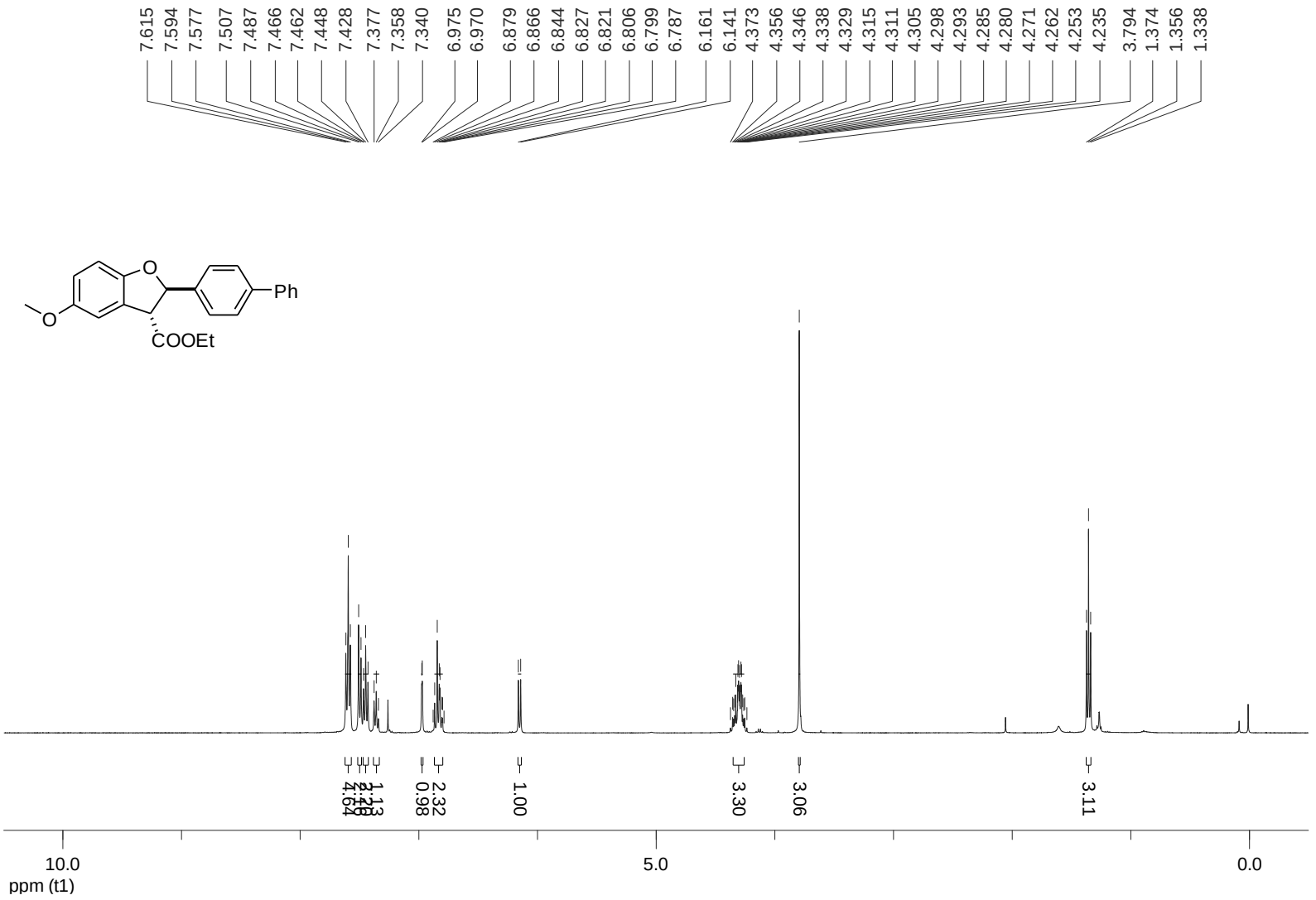
34.535
31.246
14.225
O
O
COOEt
200
150
100
50
0
ppm (t1)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6.970
6.879
6.866
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6.827
6.821
6.806
6.799
6.787
6.161
6.141
4.373
4.356
4.346
4.338
4.329
4.315
4.311
4.305
4.298
4.293
4.285
4.280
4.271
4.262
4.253
4.235
3.794
1.374
1.356
1.338
O
O
Ph
COOEt
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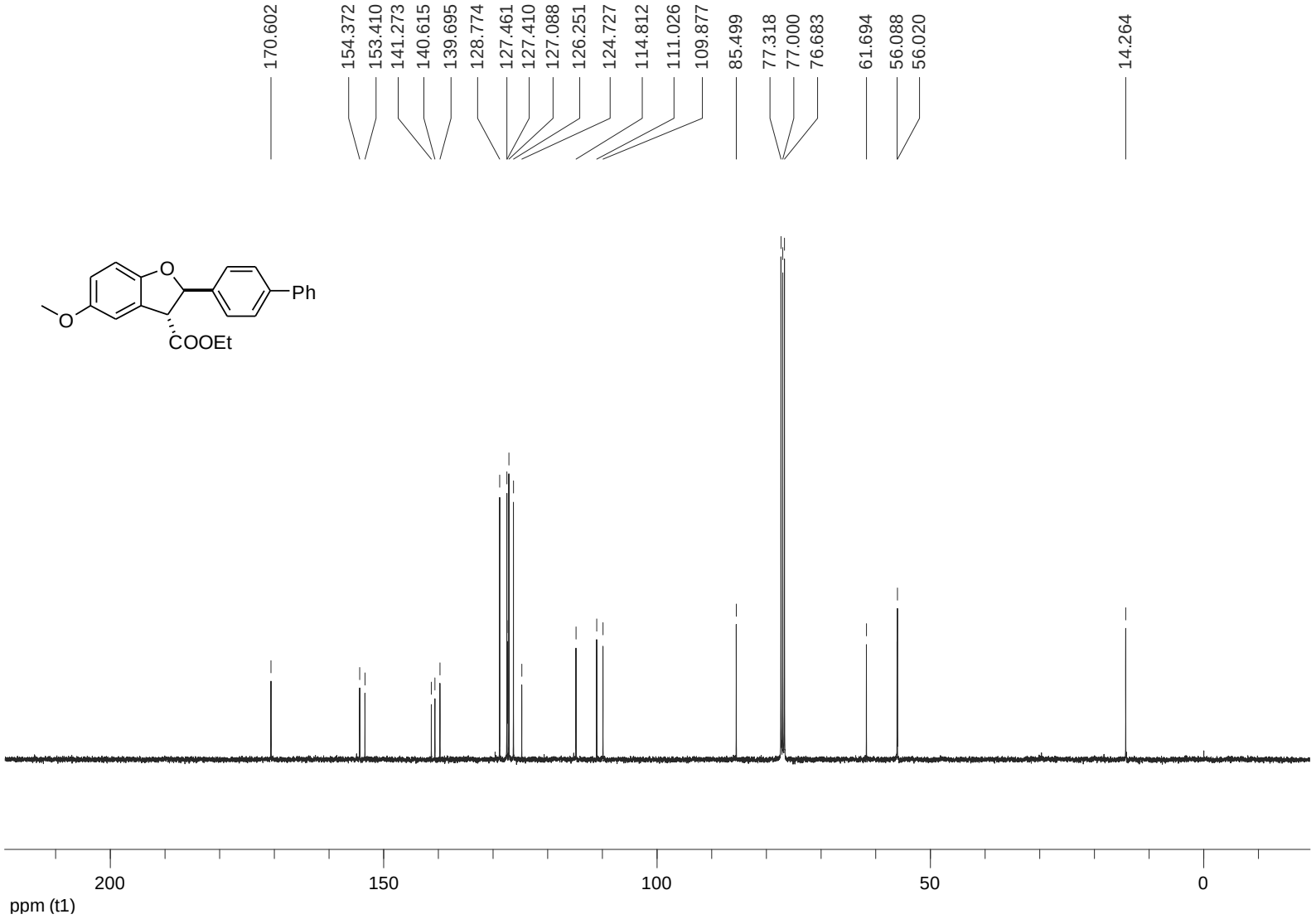
ppm (t1)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126.251
124.727
114.812
111.026
109.877
85.499
77.318
77.000
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56.020
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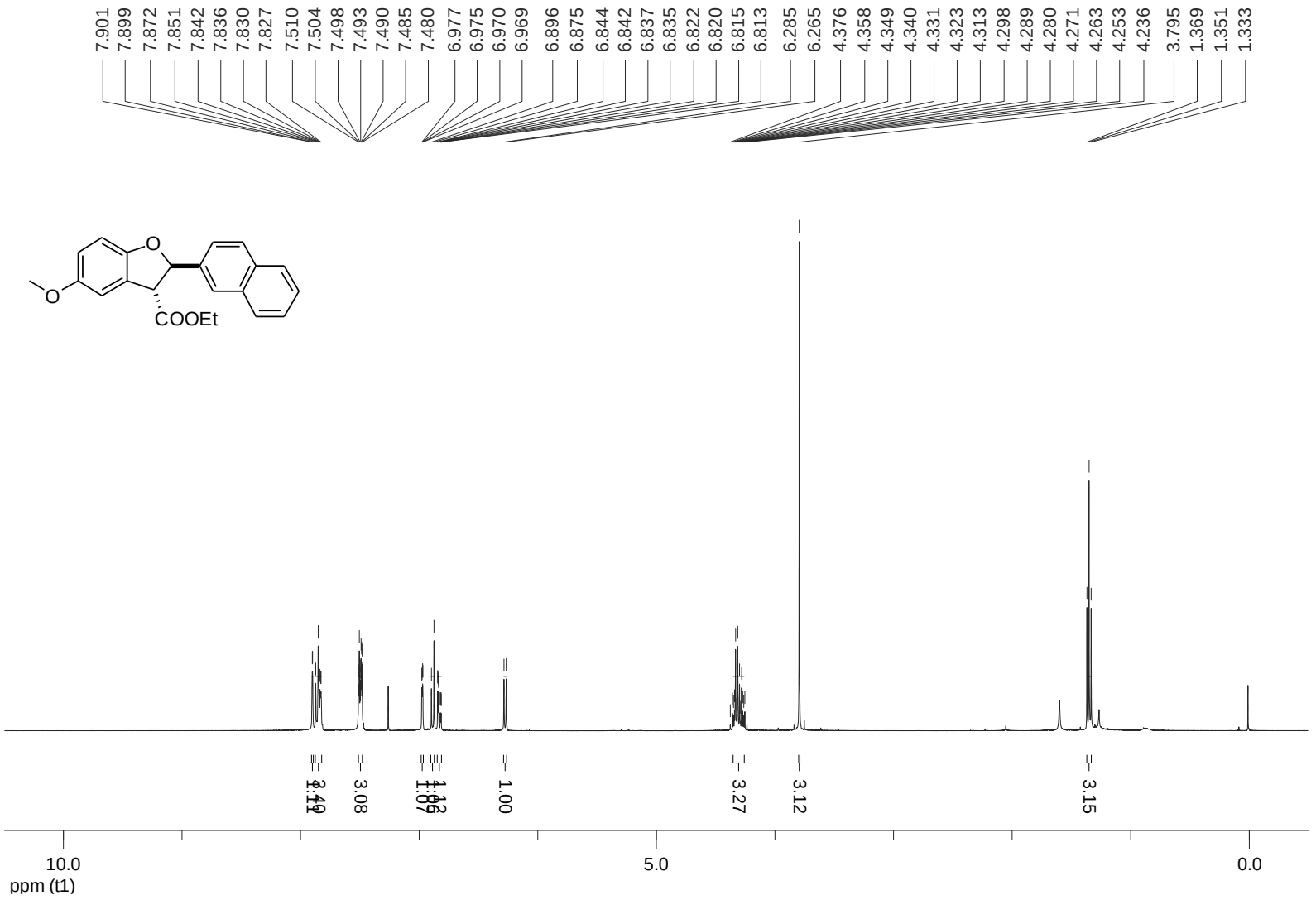
O
Ph
O
COOEt
200
150
100
50
0
ppm (t1)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7.827
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7.504
7.498
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7.490
7.485
7.480
6.977
6.975
6.970
6.969
6.896
6.875
6.844
6.842
6.837
6.835
6.822
6.820
6.815
6.813
6.285
6.265
4.376
4.358
4.349
4.340
4.331
4.323
4.313
4.298
4.289
4.280
4.271
4.263
4.253
4.236
3.795
1.369
1.351
1.333
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10.0
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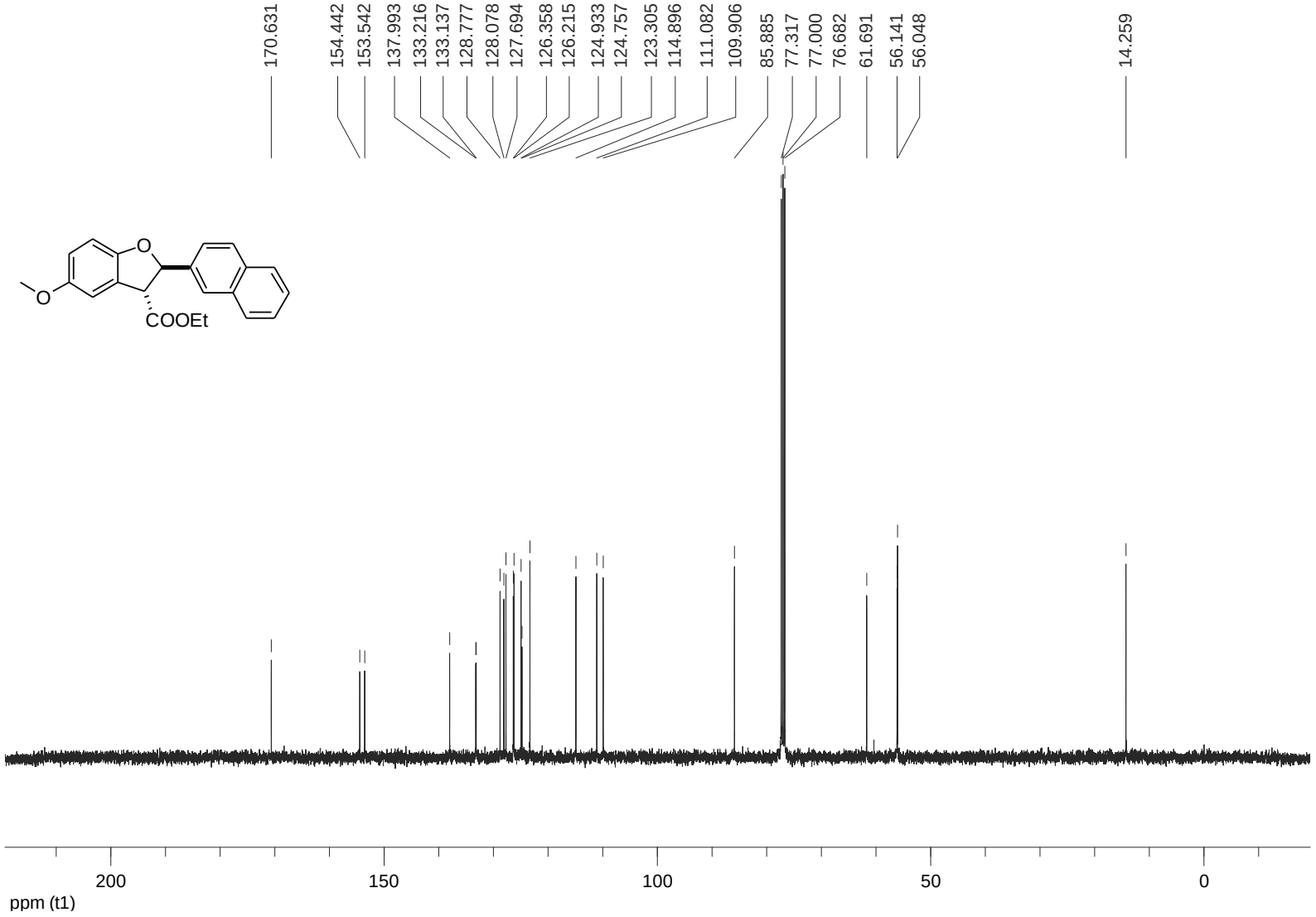
ppm (t1)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128.078
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126.215
124.933
124.757
123.305
114.896
111.082
109.906
85.885
77.317
77.000
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56.141
56.048
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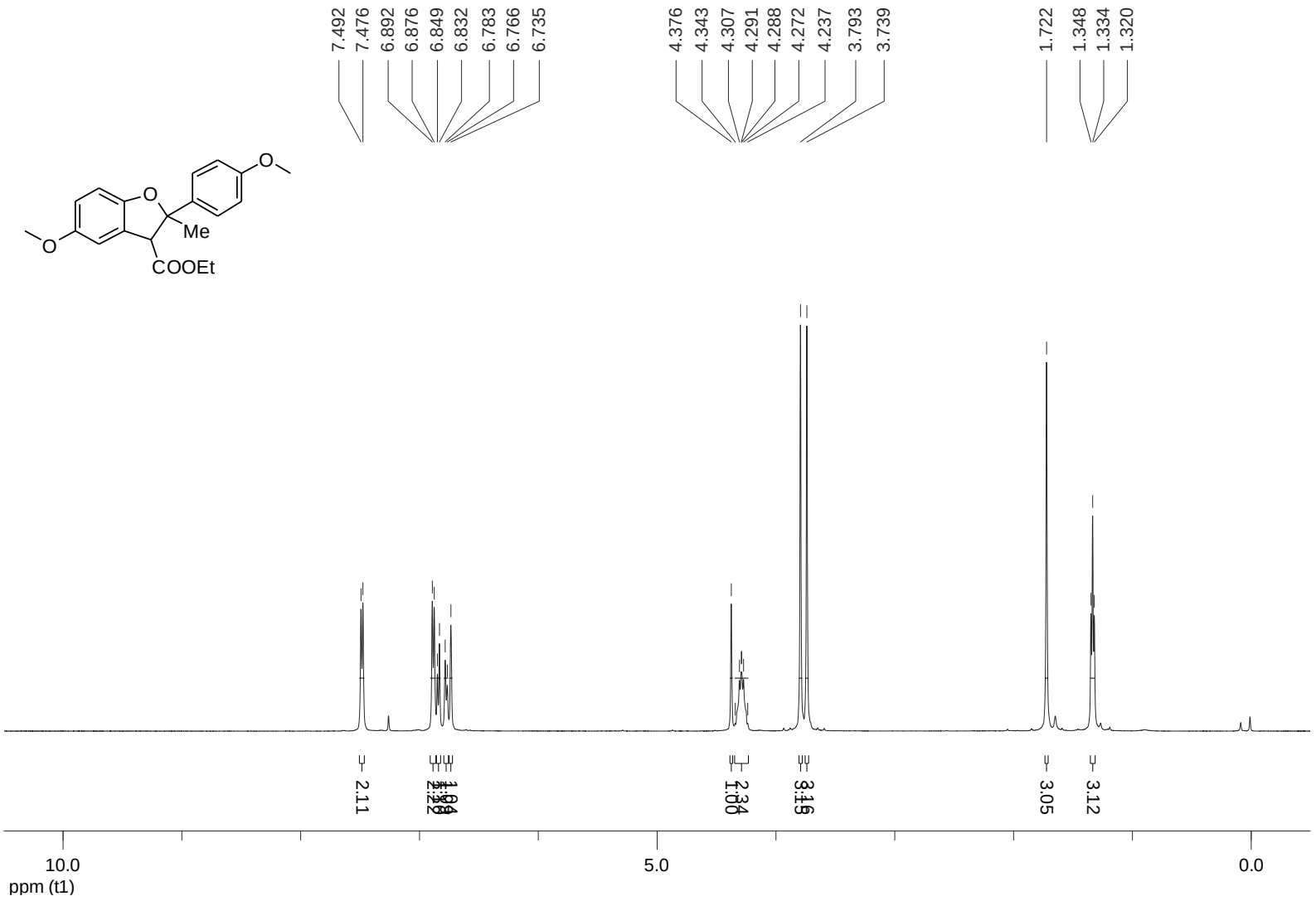
O
O
COOEt
200
150
100
50
0
ppm (t1)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6.766
6.735
4.376
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4.307
4.291
4.288
4.272
4.237
3.793
3.739
1.722
1.348
1.334
1.320
O
O
O
Me
COOEt
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1.00
2.34
3.16
3.05
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10.0
5.0
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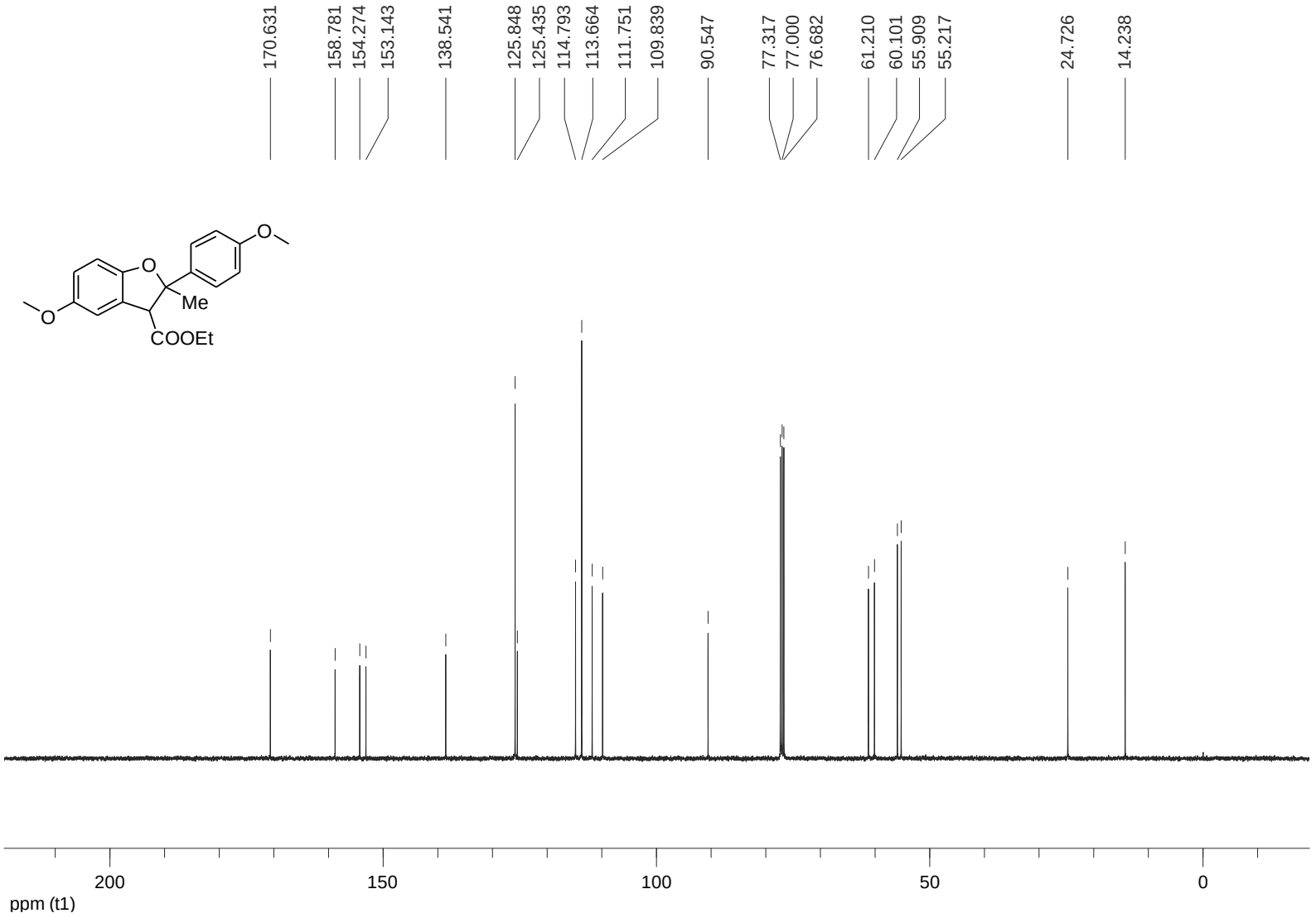
ppm (t1)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125.435
114.793
113.664
111.751
109.839
90.547
77.317
77.000
76.682
61.210
60.101
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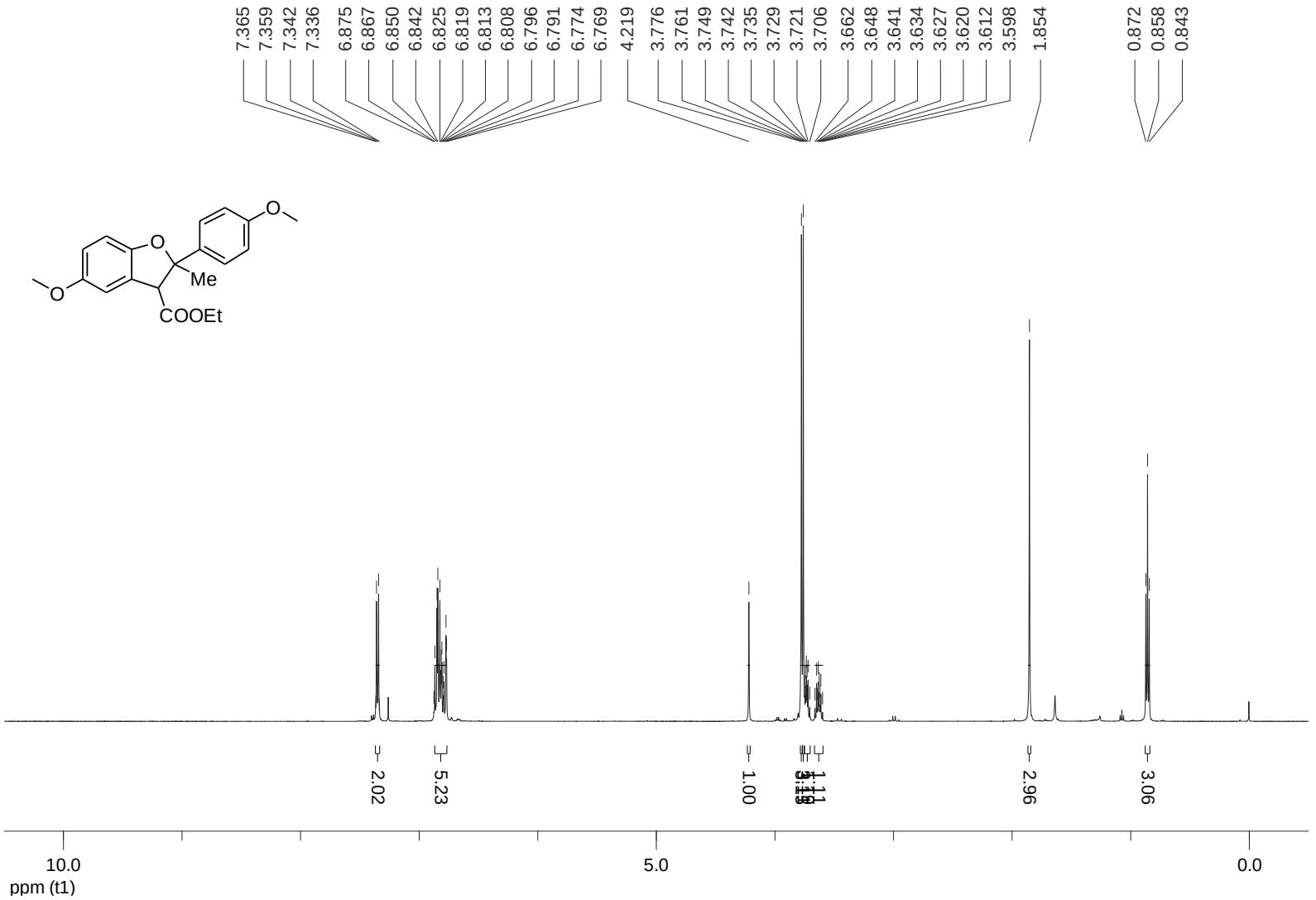
24.726
14.238
O
O
O
Me
COOEt
200
150
100
50
0
ppm (t1)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6.808
6.796
6.791
6.774
6.769
4.219
3.776
3.761
3.749
3.742
3.735
3.729
3.721
3.706
3.662
3.648
3.641
3.634
3.627
3.620
3.612
3.598
1.854
0.872
0.858
0.843
O
O
O
Me
COOEt
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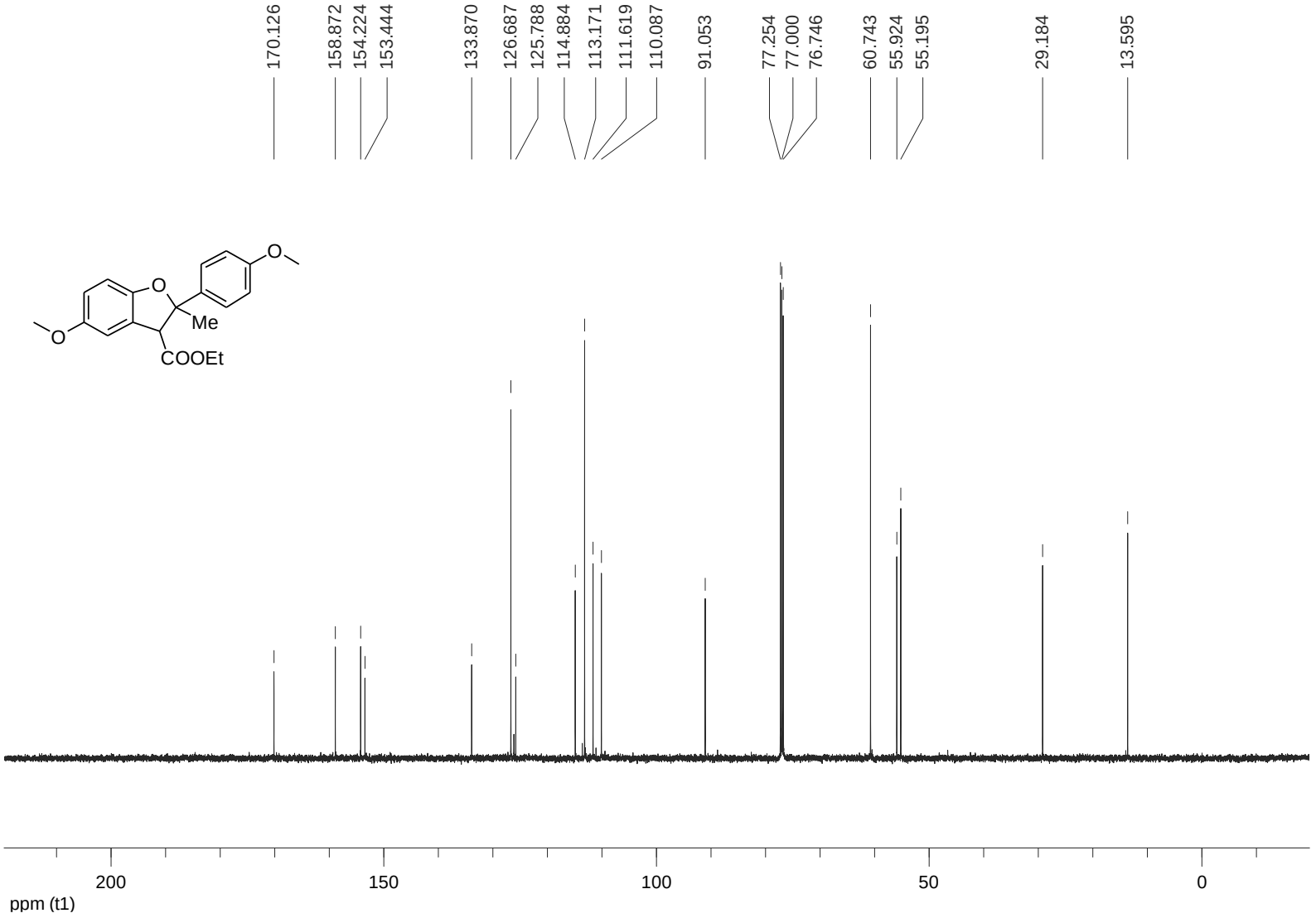
10.0
5.0
0.0
ppm (t1)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111.619
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77.000
76.746
60.743
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29.184
13.595
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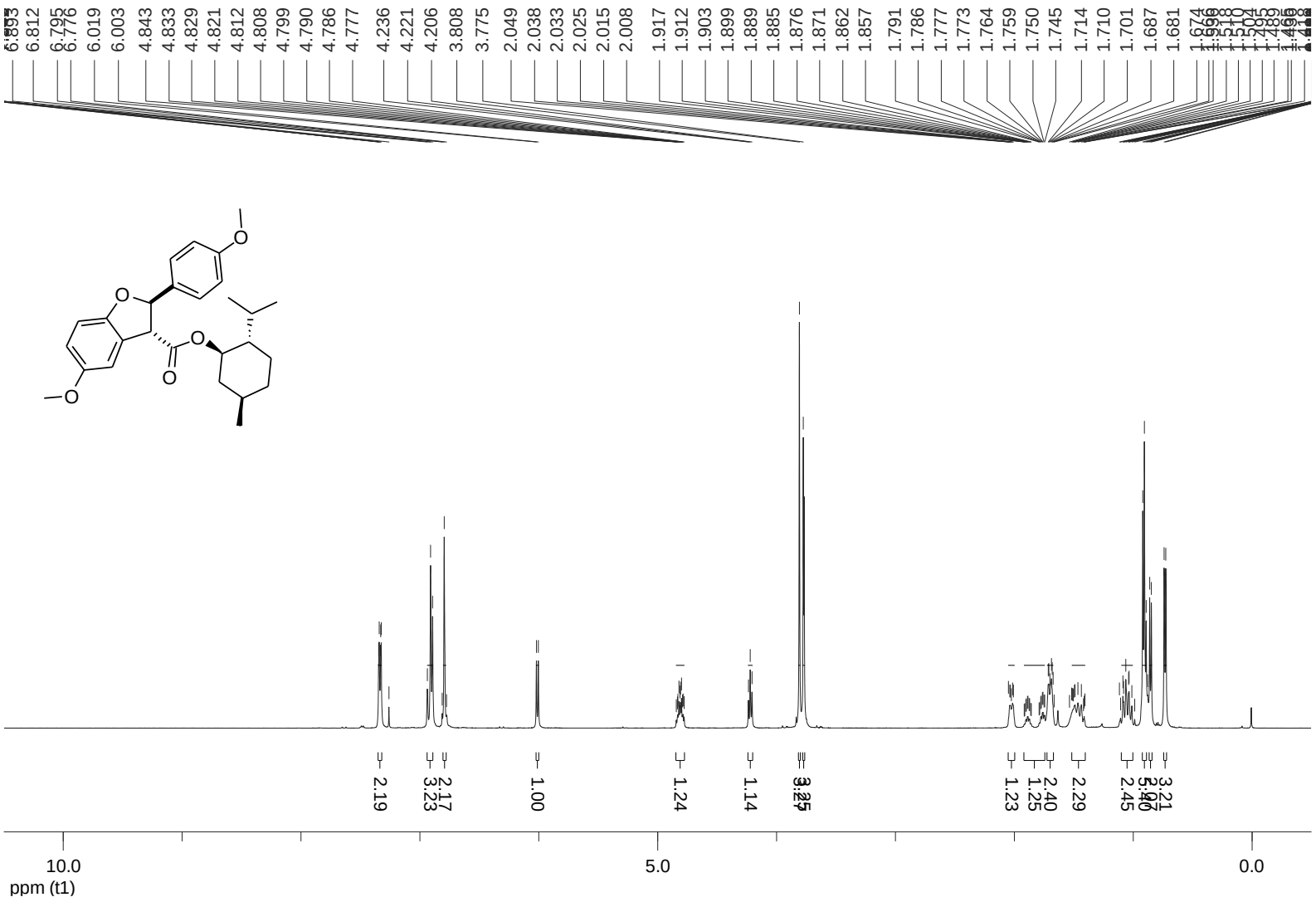
O
O
Me
COOEt
200
150
100
50
0
ppm (t1)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4.799
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4.221
4.206
3.808
3.775
2.049
2.038
2.033
2.025
2.015
2.008
1.917
1.912
1.903
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1.889
1.885
1.876
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1.862
1.857
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1.777
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1.714
1.710
1.701
1.687
1.681
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3.23
2.17
1.00
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10.0
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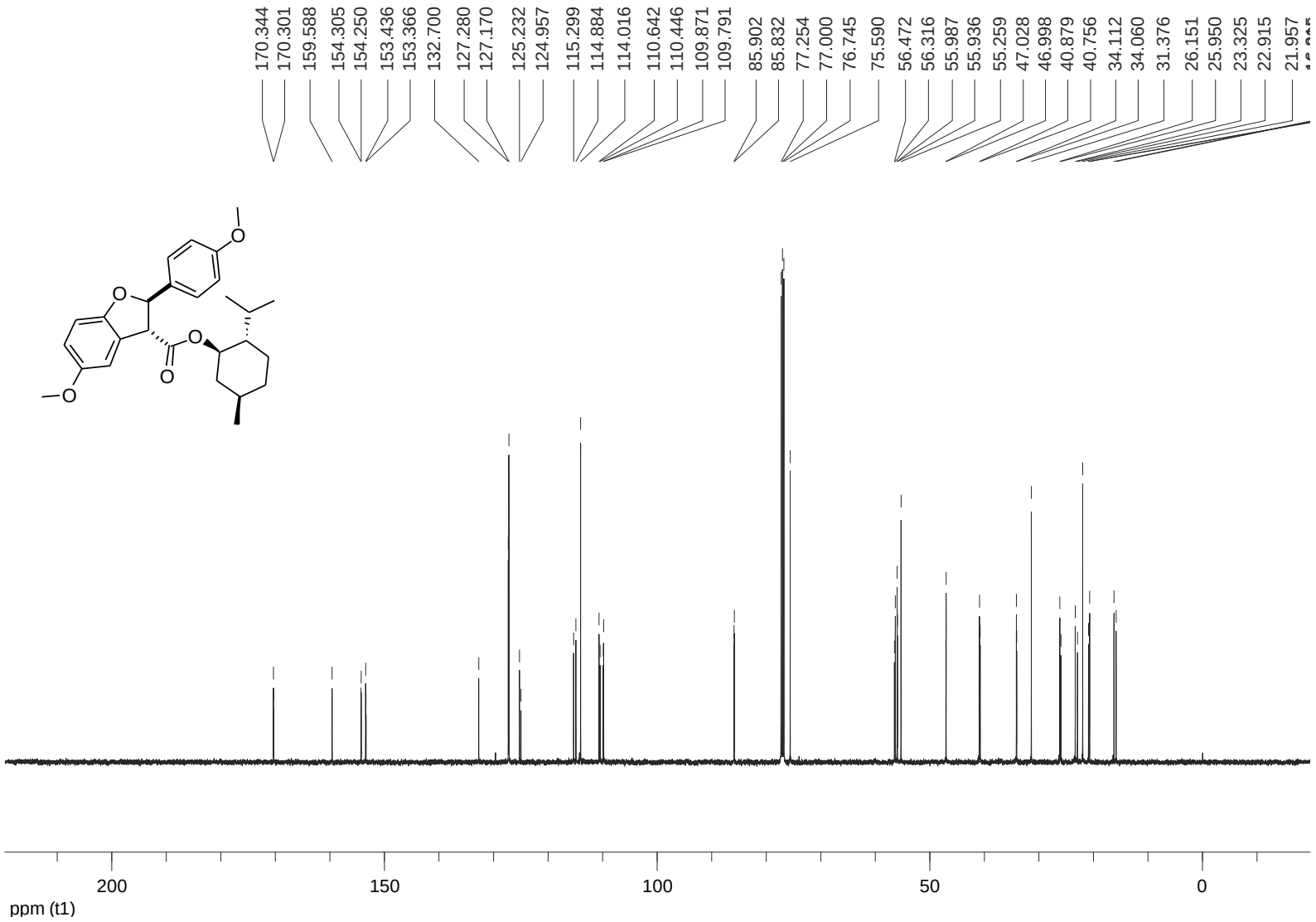
ppm (t1)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114.884
114.016
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109.791
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85.832
77.254
77.000
76.745
75.590
56.472
56.316
55.987
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55.259
47.028
46.998
40.879
40.756
34.112
34.060
31.376
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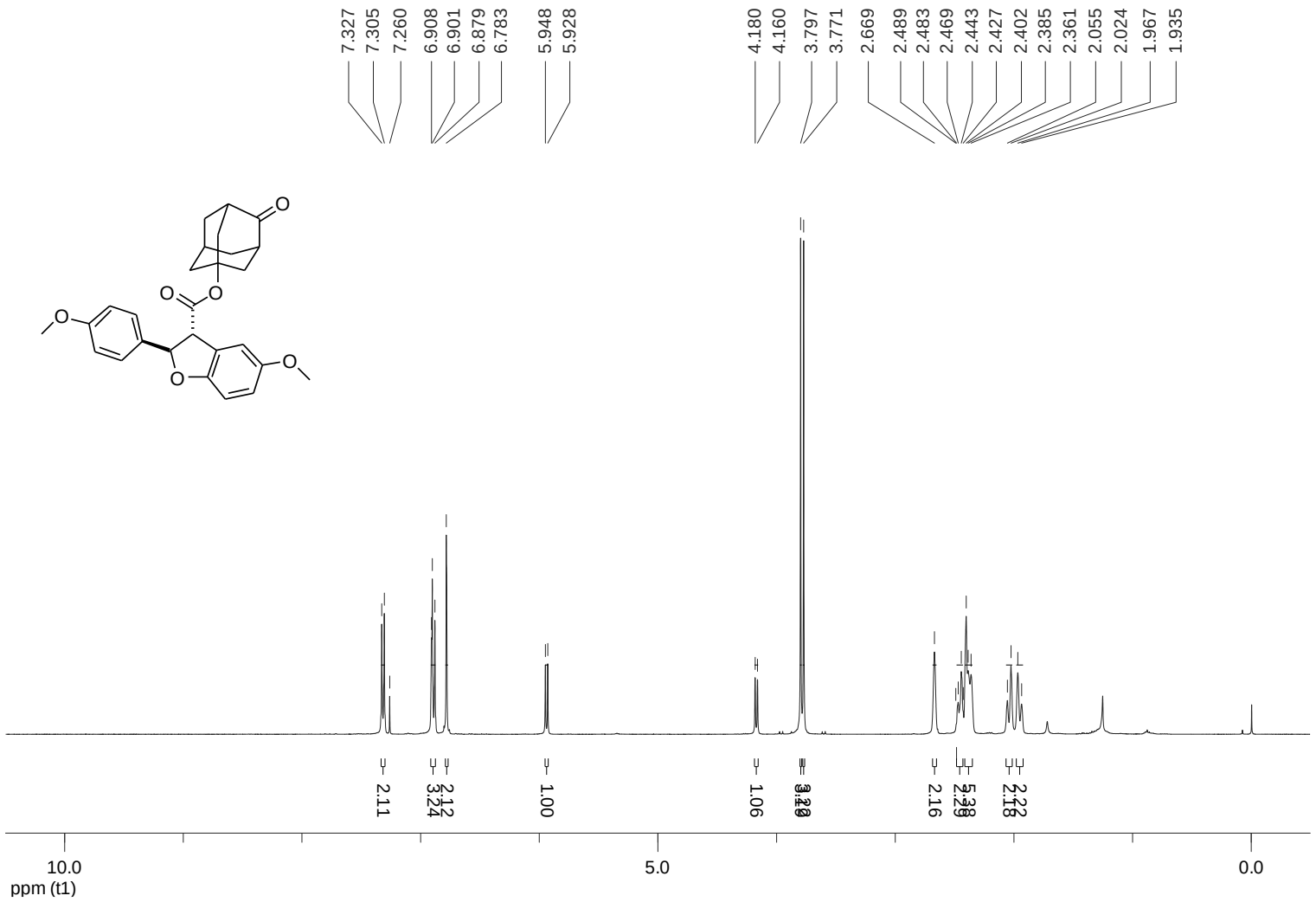
O
O
O
O
200
150
100
50
0
ppm (t1)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6.879
6.783
5.948
5.928
4.180
4.160
3.797
3.771
2.669
2.489
2.483
2.469
2.443
2.427
2.402
2.385
2.361
2.055
2.024
1.967
1.935
O
O
O
O
O
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3.24
2.12
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1.06
2.16
10.0
5.0
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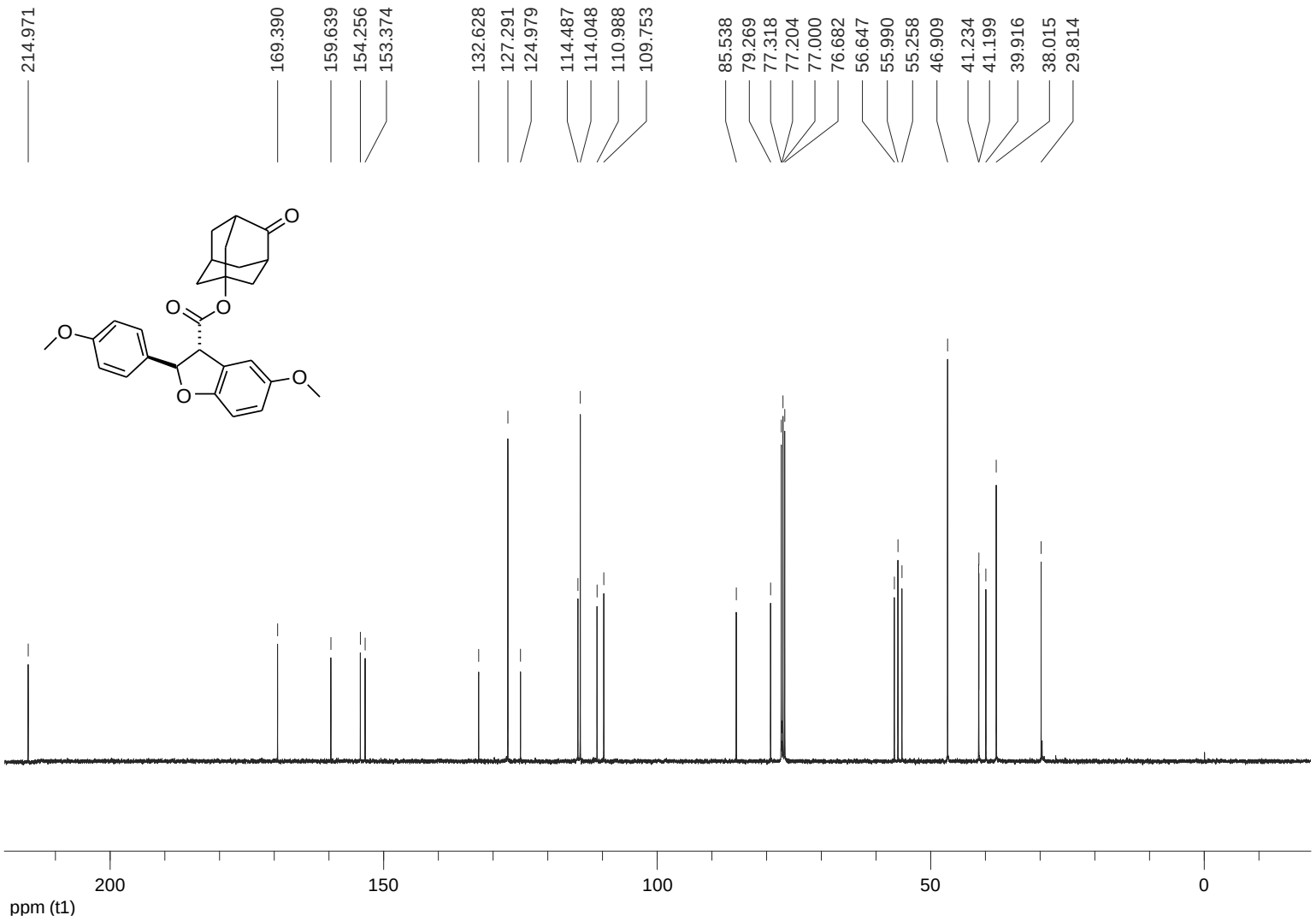
ppm (t1)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85.538
79.269
77.318
77.204
77.000
76.682
56.647
55.990
55.258
46.909
41.234
41.199
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38.015
29.814
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O
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O
O
O
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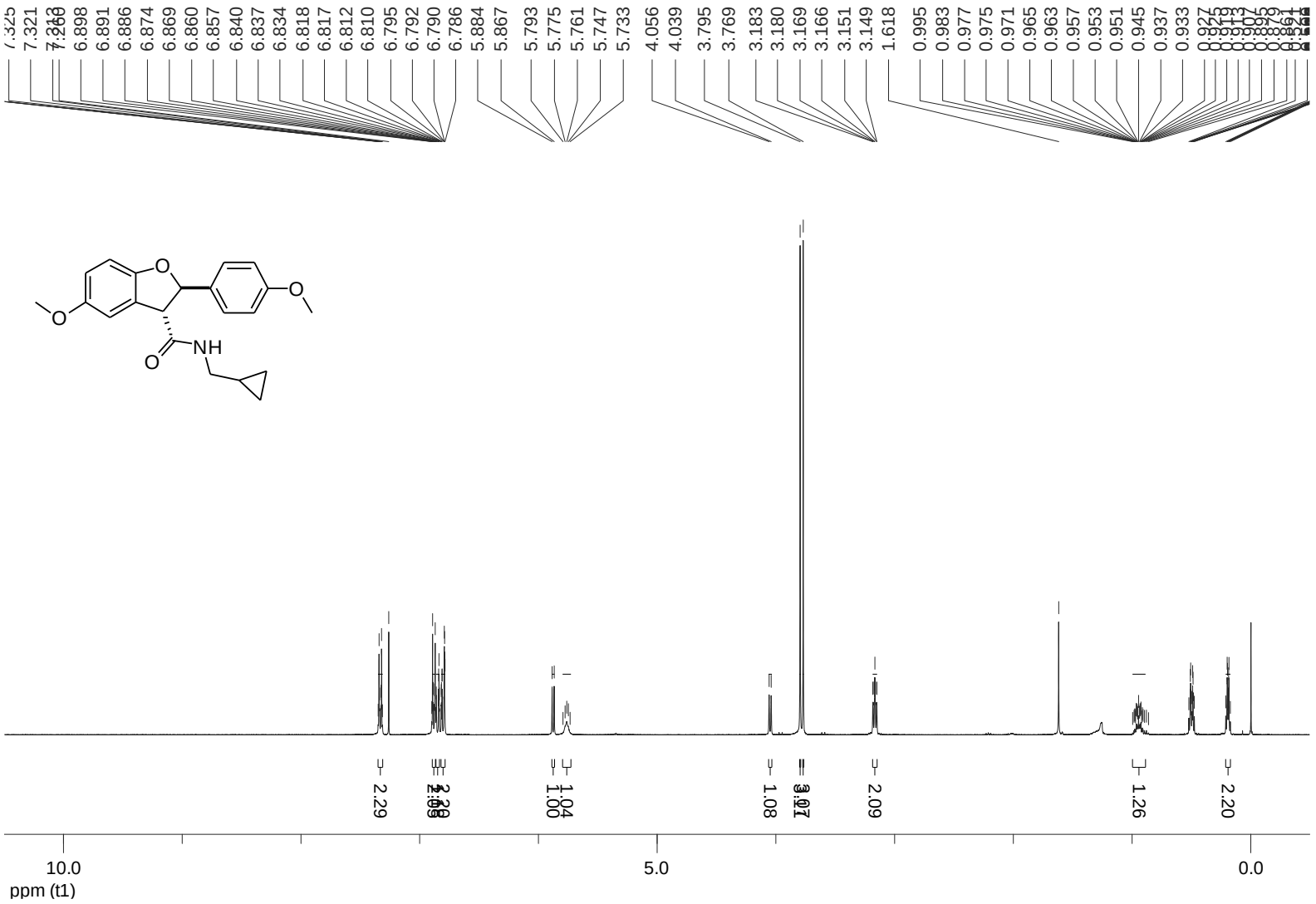
ppm (t1)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6.860
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6.818
6.817
6.812
6.810
6.795
6.792
6.790
6.786
5.884
5.867
5.793
5.775
5.761
5.747
5.733
4.056
4.039
3.795
3.769
3.183
3.180
3.169
3.166
3.151
3.149
1.618
0.995
0.983
0.977
0.975
0.971
0.965
0.963
0.957
0.953
0.951
0.945
0.937
0.933
O
O
O
NH
O
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1.00
1.08
2.09
1.26
2.20
10.0
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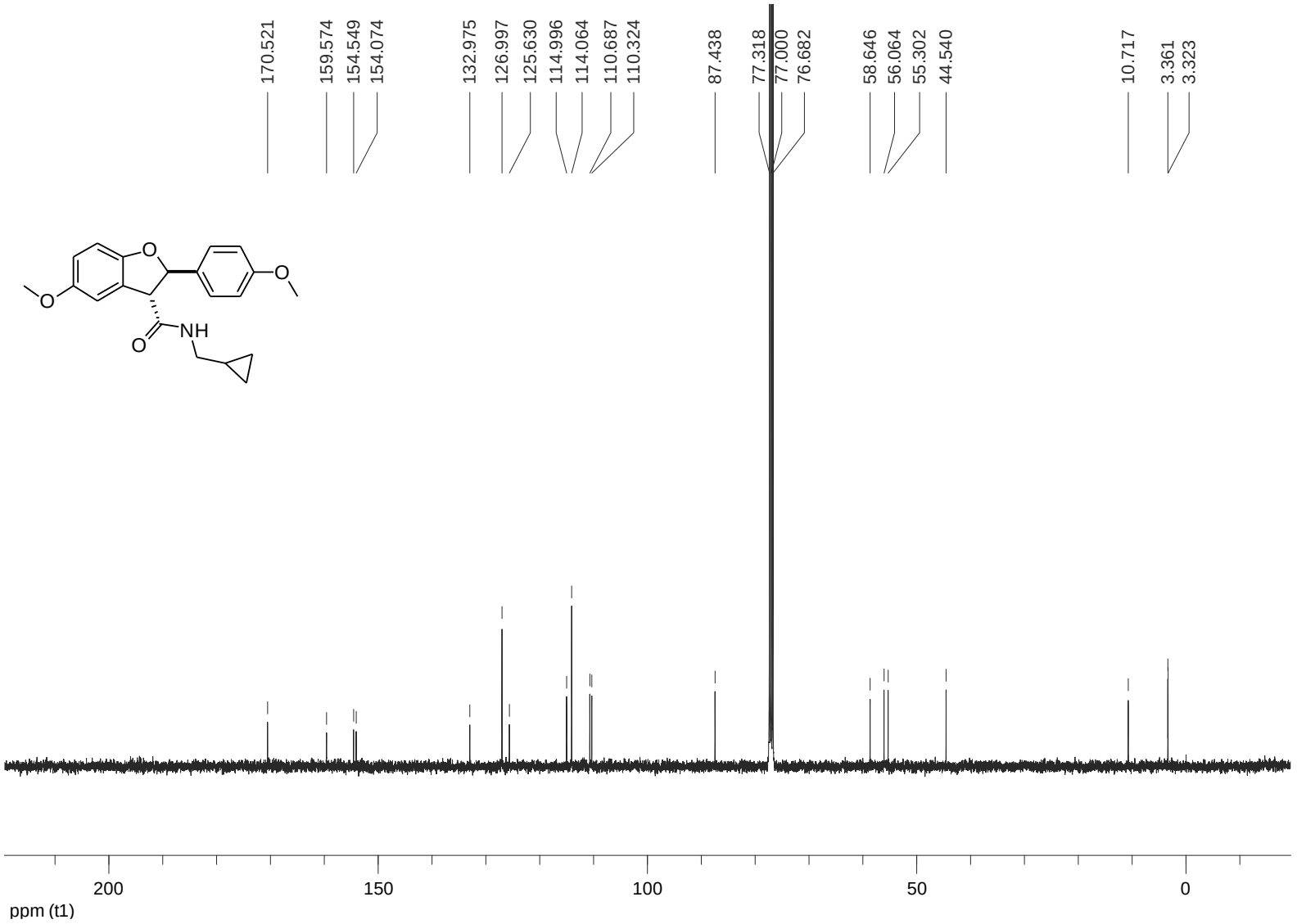
ppm (t1)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77.000
76.682
58.646
56.064
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3.361
3.323
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O
NH
O
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100
50
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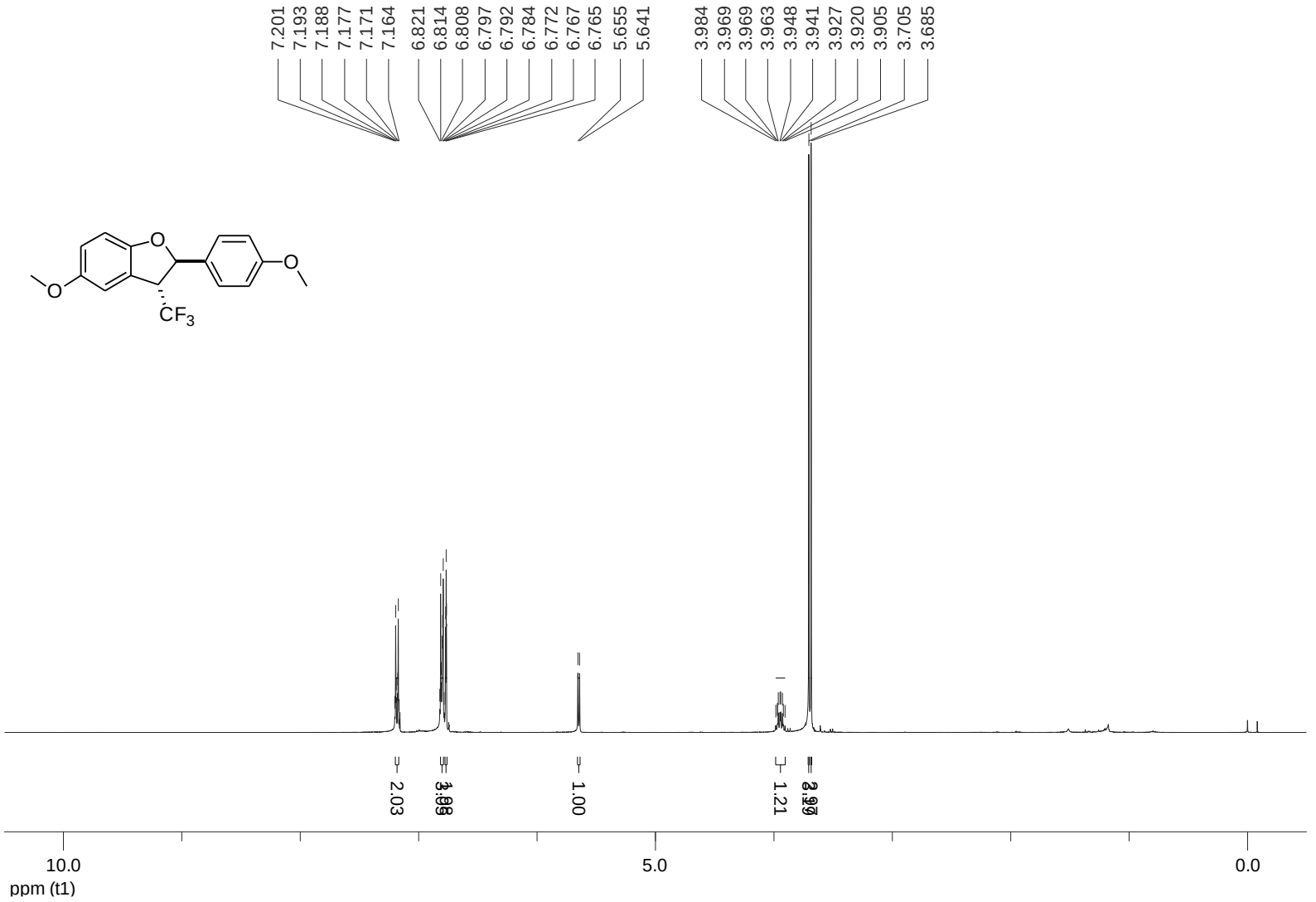
ppm (t1)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7.188
7.177
7.171
7.164
6.821
6.814
6.808
6.797
6.792
6.784
6.772
6.767
6.765
5.655
5.641
3.984
3.969
3.969
3.963
3.948
3.941
3.927
3.920
3.905
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3.685
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O
O
CF3
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1.00
1.21
10.0
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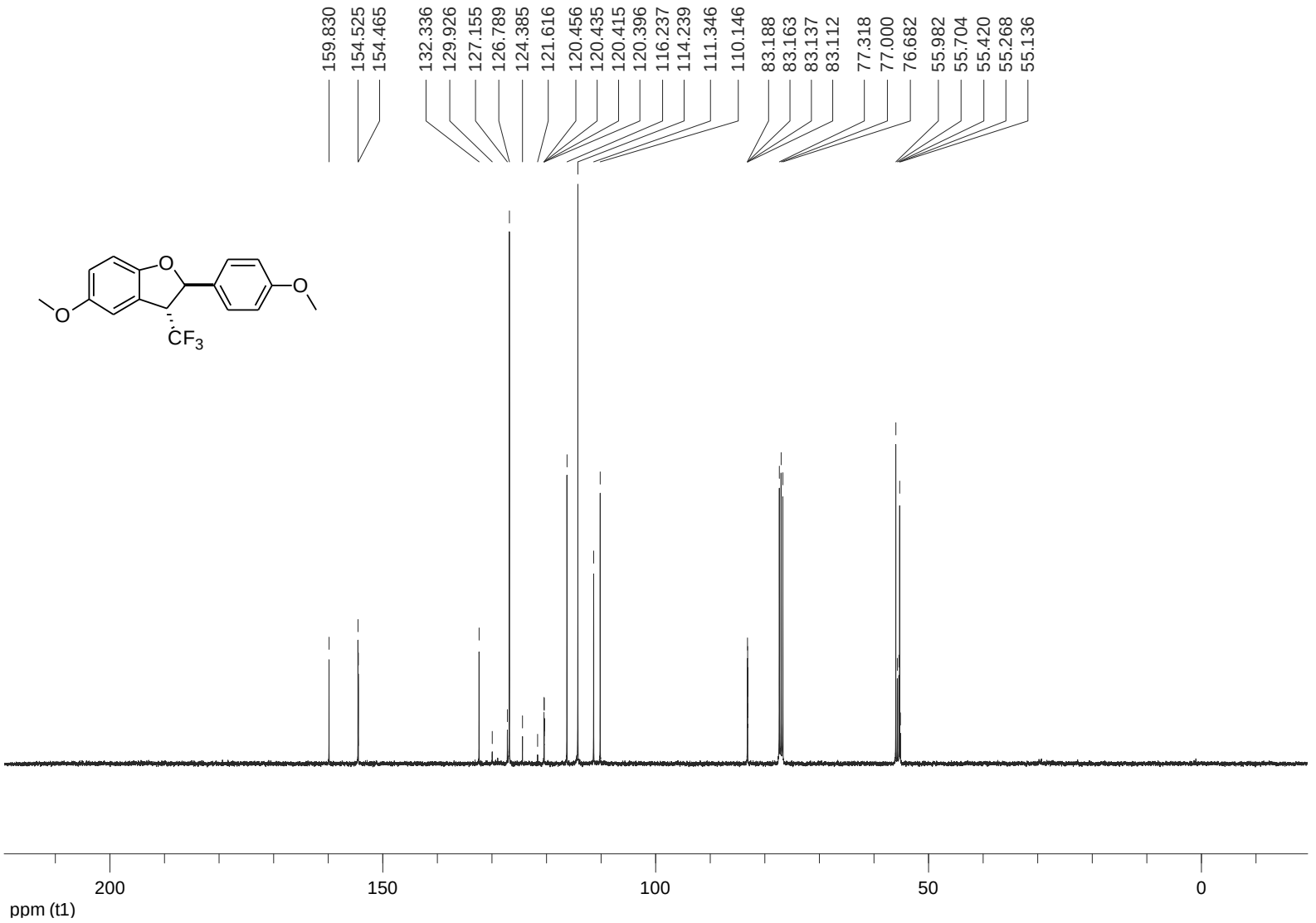
0.0
ppm (t1)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120.415
120.396
116.237
114.239
111.346
110.146
83.188
83.163
83.137
83.112
77.318
77.000
76.682
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55.420
55.268
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O
O
CF3
200
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100
50
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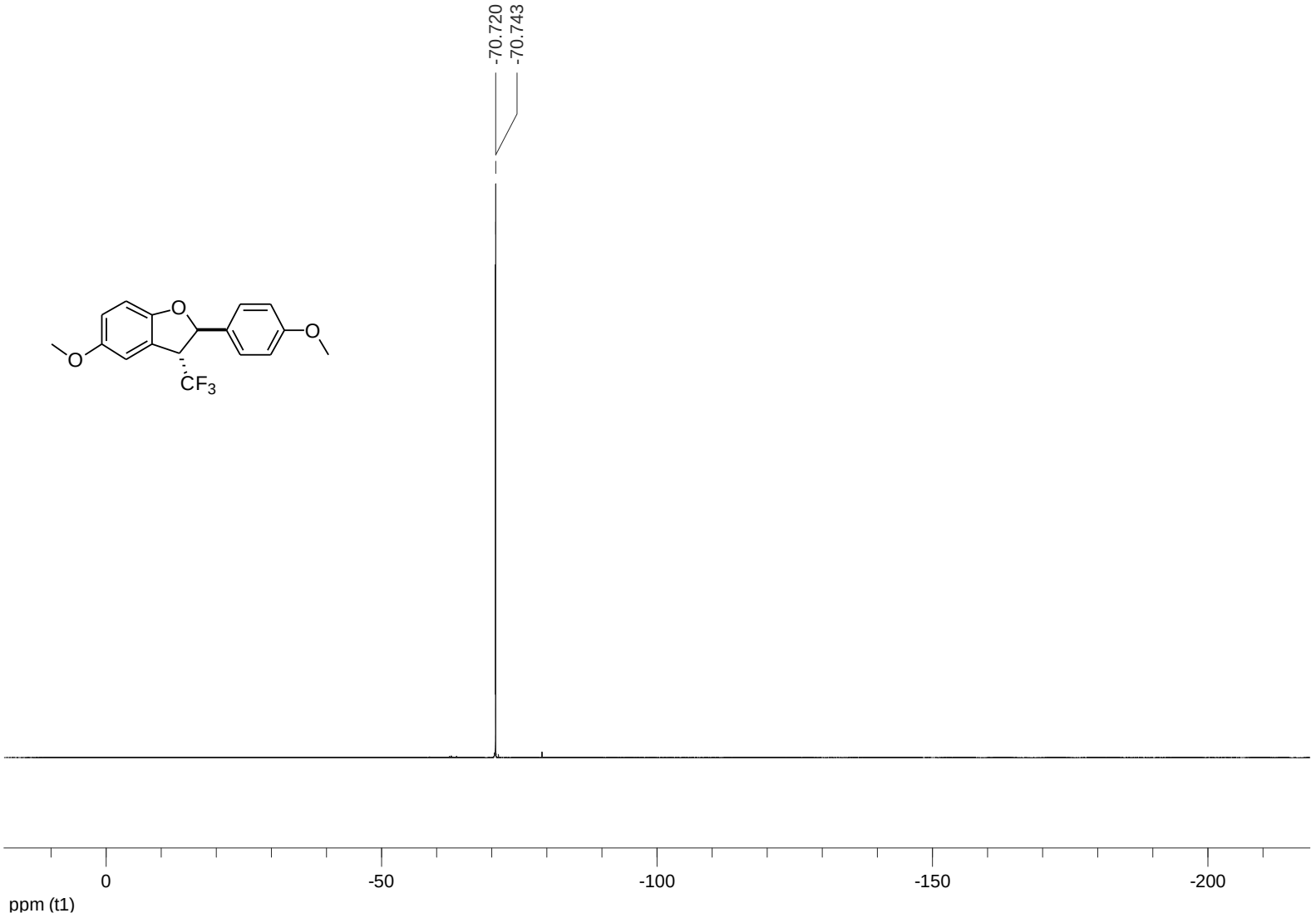
ppm (t1)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O
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CF3
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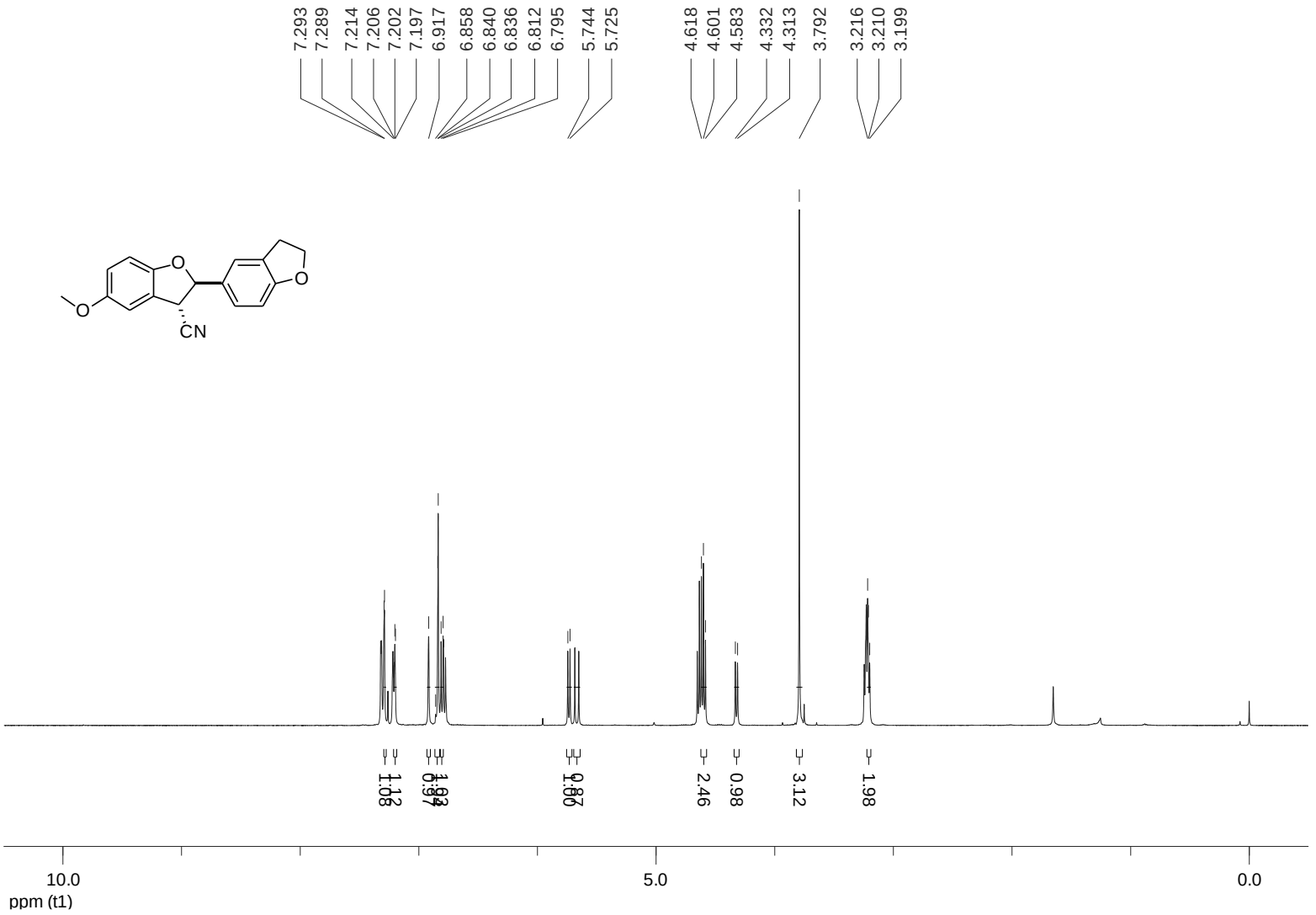
-100
-150
-200
ppm (t1)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7.197
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6.858
6.840
6.836
6.812
6.795
5.744
5.725
4.618
4.601
4.583
4.332
4.313
3.792
3.216
3.210
3.199
O
O
O
CN
1.12
1.08
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1.00
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2.46
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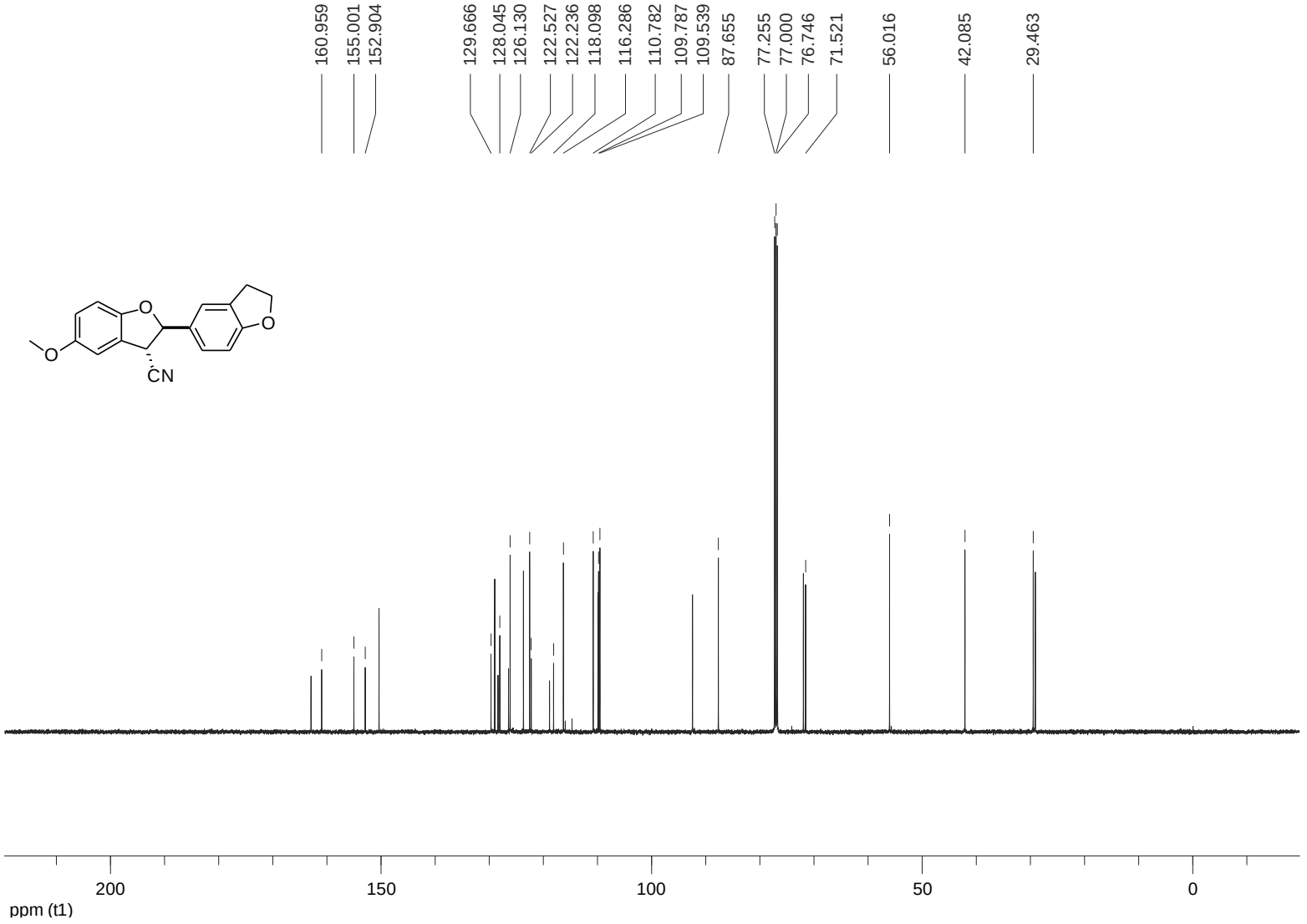
0.0
ppm (t1)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122.527
122.236
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110.782
109.787
109.539
87.655
77.255
77.000
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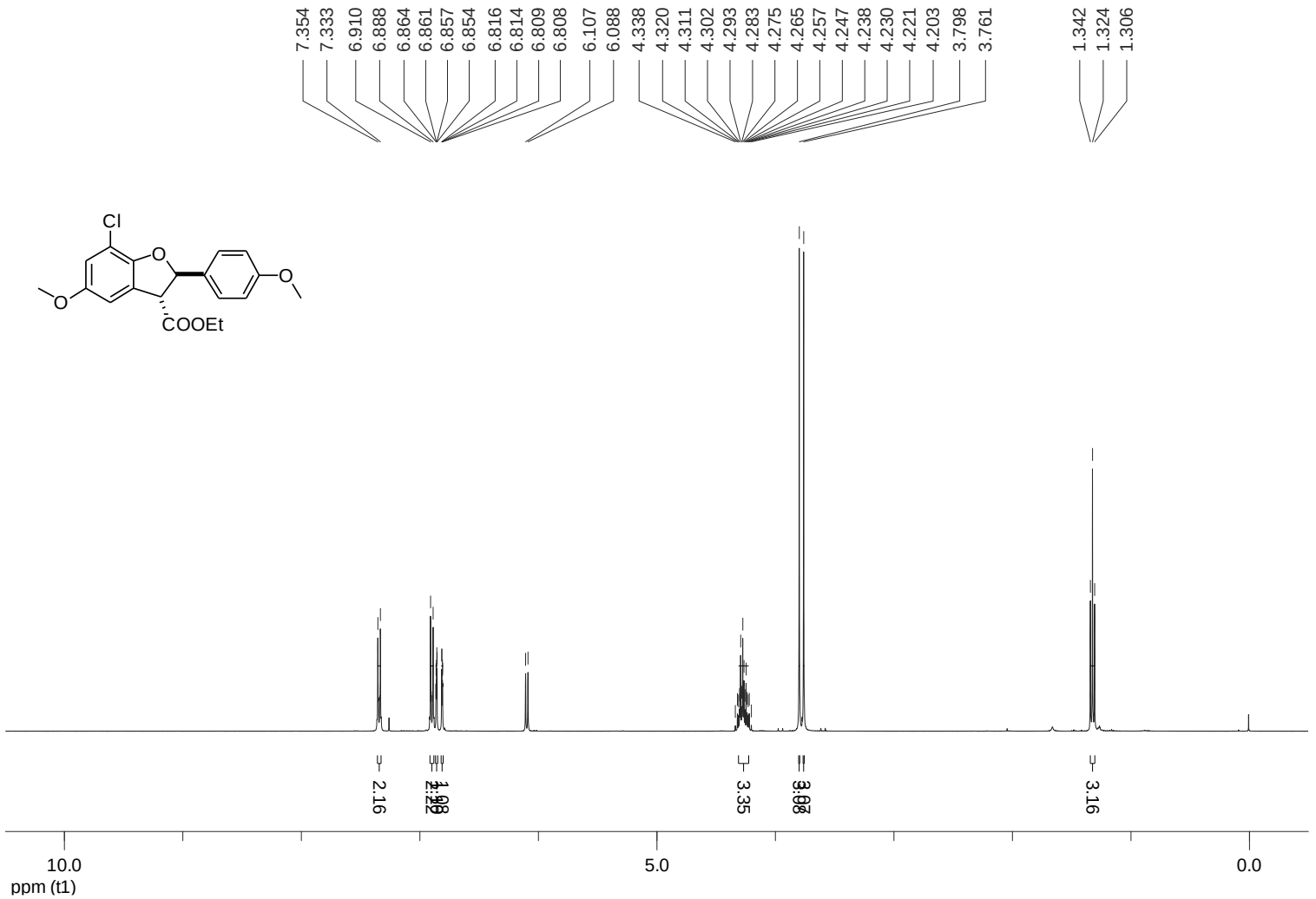
42.085
29.463
O
O
O
CN
200
150
100
50
0
ppm (t1)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6.864
6.861
6.857
6.854
6.816
6.814
6.809
6.808
6.107
6.088
4.338
4.320
4.311
4.302
4.293
4.283
4.275
4.265
4.257
4.247
4.238
4.230
4.221
4.203
3.798
3.761
1.342
1.324
1.306
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O
O
COOEt
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10.0
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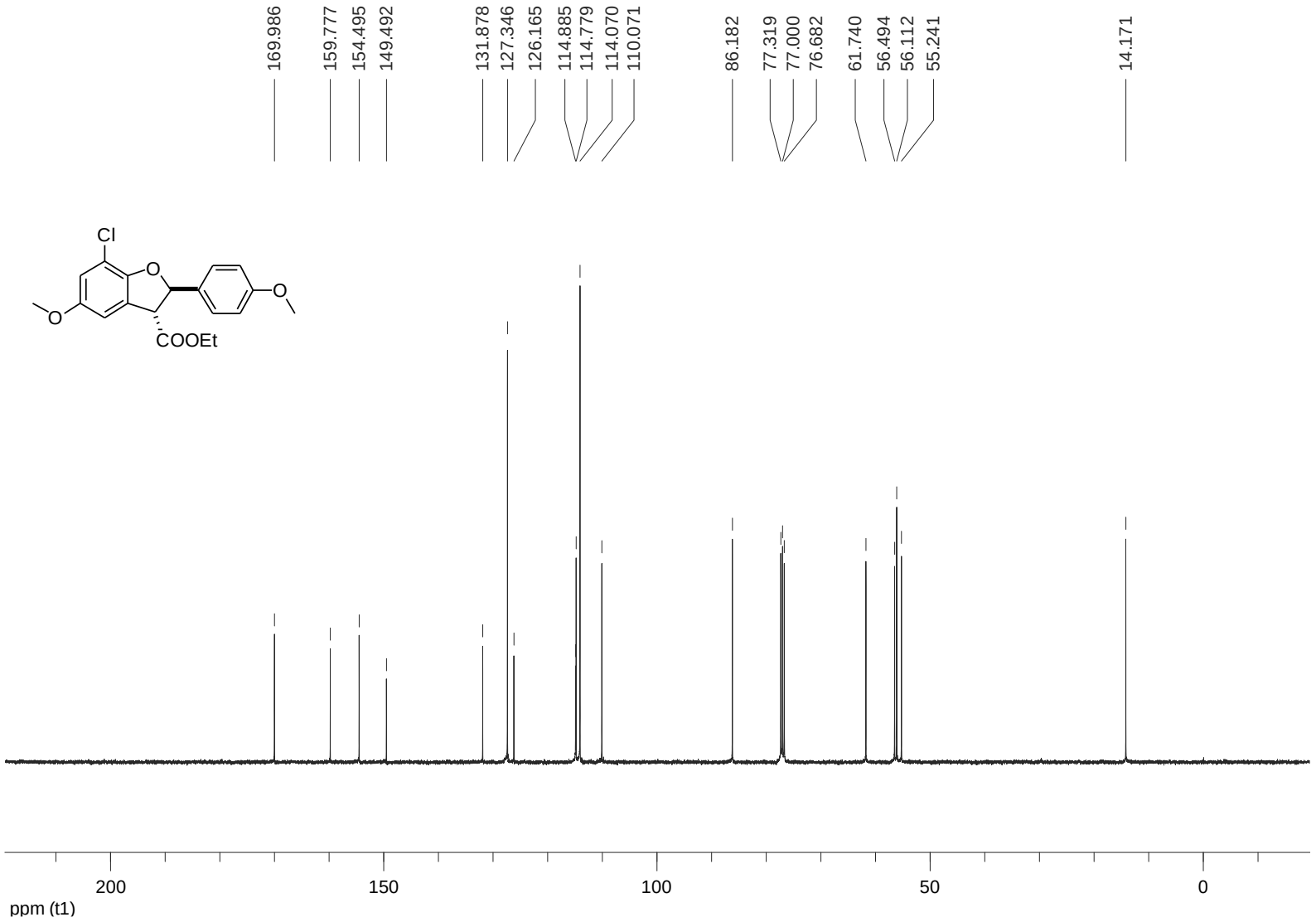
ppm (t1)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77.000
76.682
61.740
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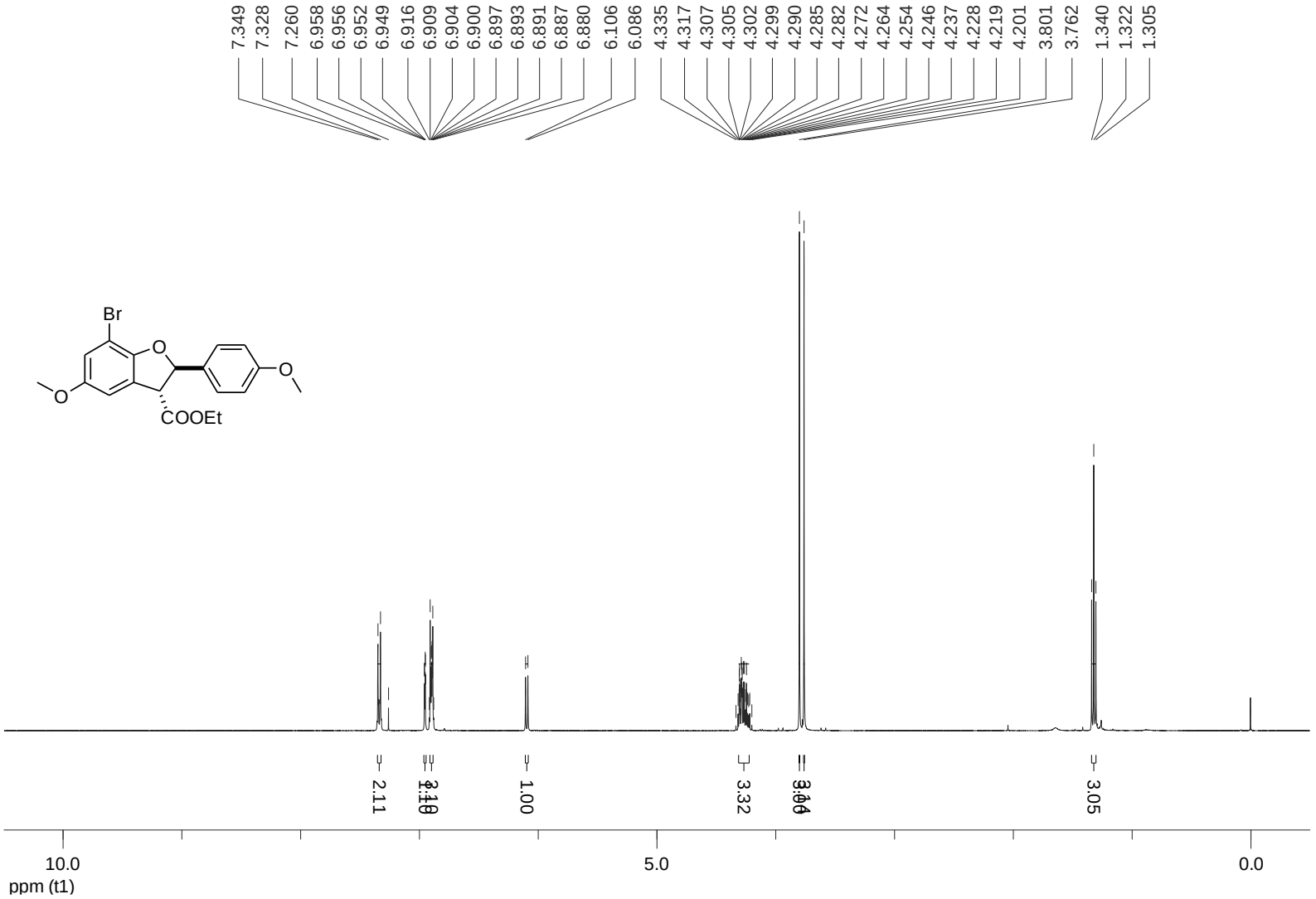
55.241
14.171
Cl
O
O
O
COOEt
200
150
100
50
0
ppm (t1)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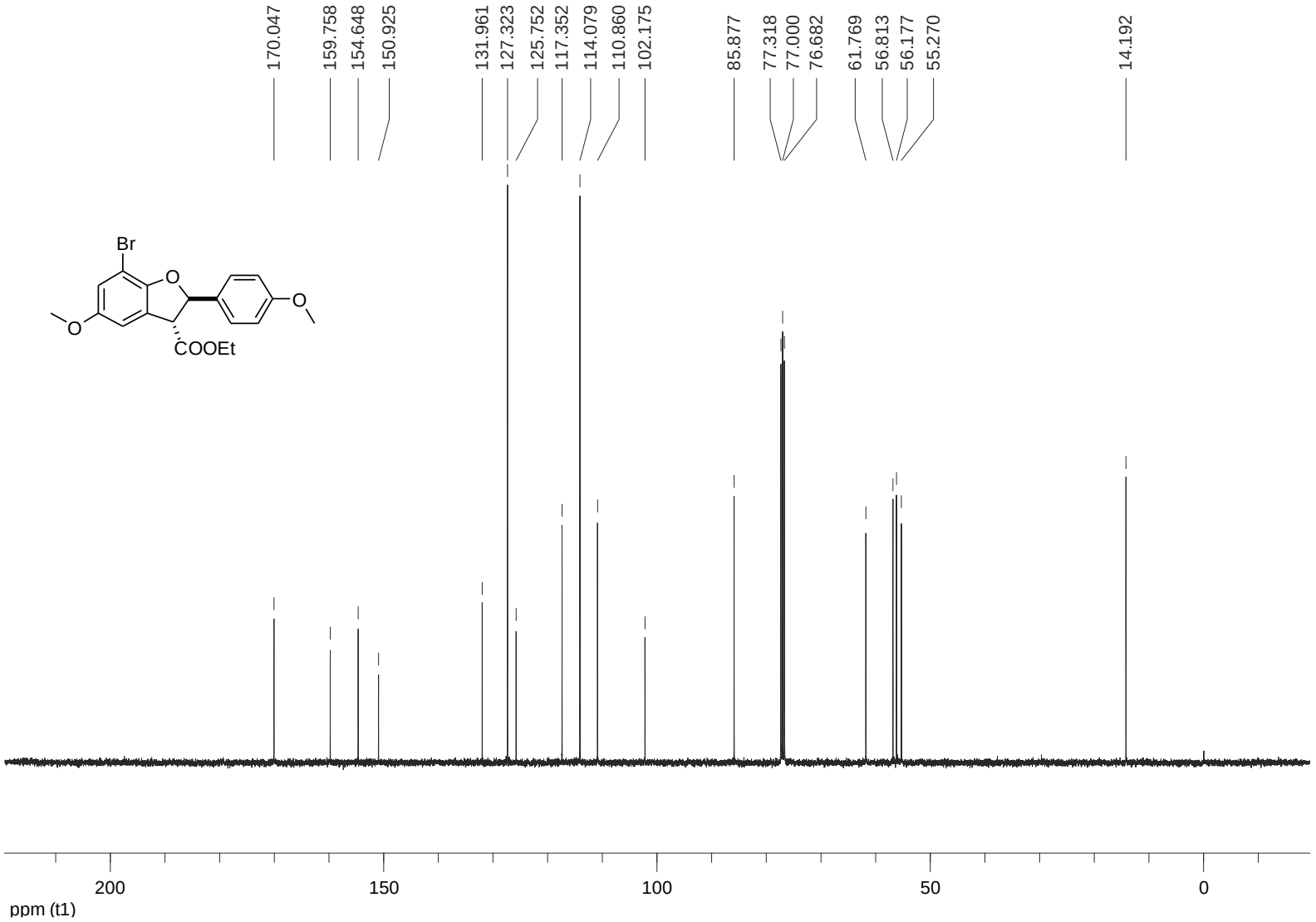
6.952
6.949
6.916
6.909
6.904
6.900
6.897
6.893
6.891
6.887
6.880
6.106
6.086
4.335
4.317
4.307
4.305
4.302
4.299
4.290
4.285
4.282
4.272
4.264
4.254
4.246
4.237
4.228
4.219
4.201
3.801
3.762
1.340
1.322
1.305
Br
O
O
O
COOEt
2.11
1.00
3.32
3.05
10.0
5.0
0.0
ppm (t1)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77.318
77.000
76.682
61.769
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55.270
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Br
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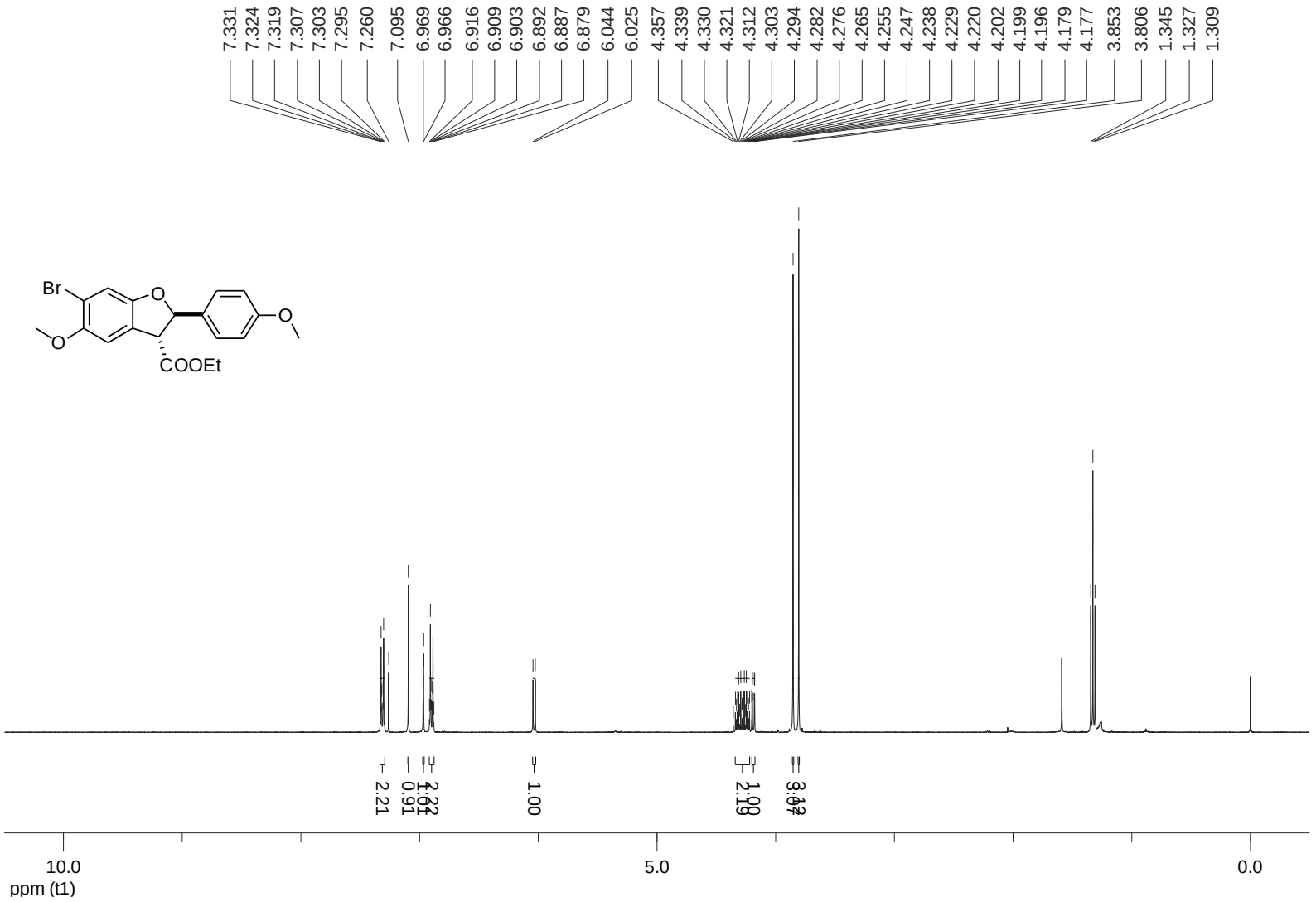
O
O
COOEt
200
150
100
50
0
ppm (t1)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7.303
7.295
7.260
7.095
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6.966
6.916
6.909
6.903
6.892
6.887
6.879
6.044
6.025
4.357
4.339
4.330
4.321
4.312
4.303
4.294
4.282
4.276
4.265
4.255
4.247
4.238
4.229
4.220
4.202
4.199
4.196
4.179
4.177
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1.345
1.327
1.309
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O
O
O
COOEt
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10.0
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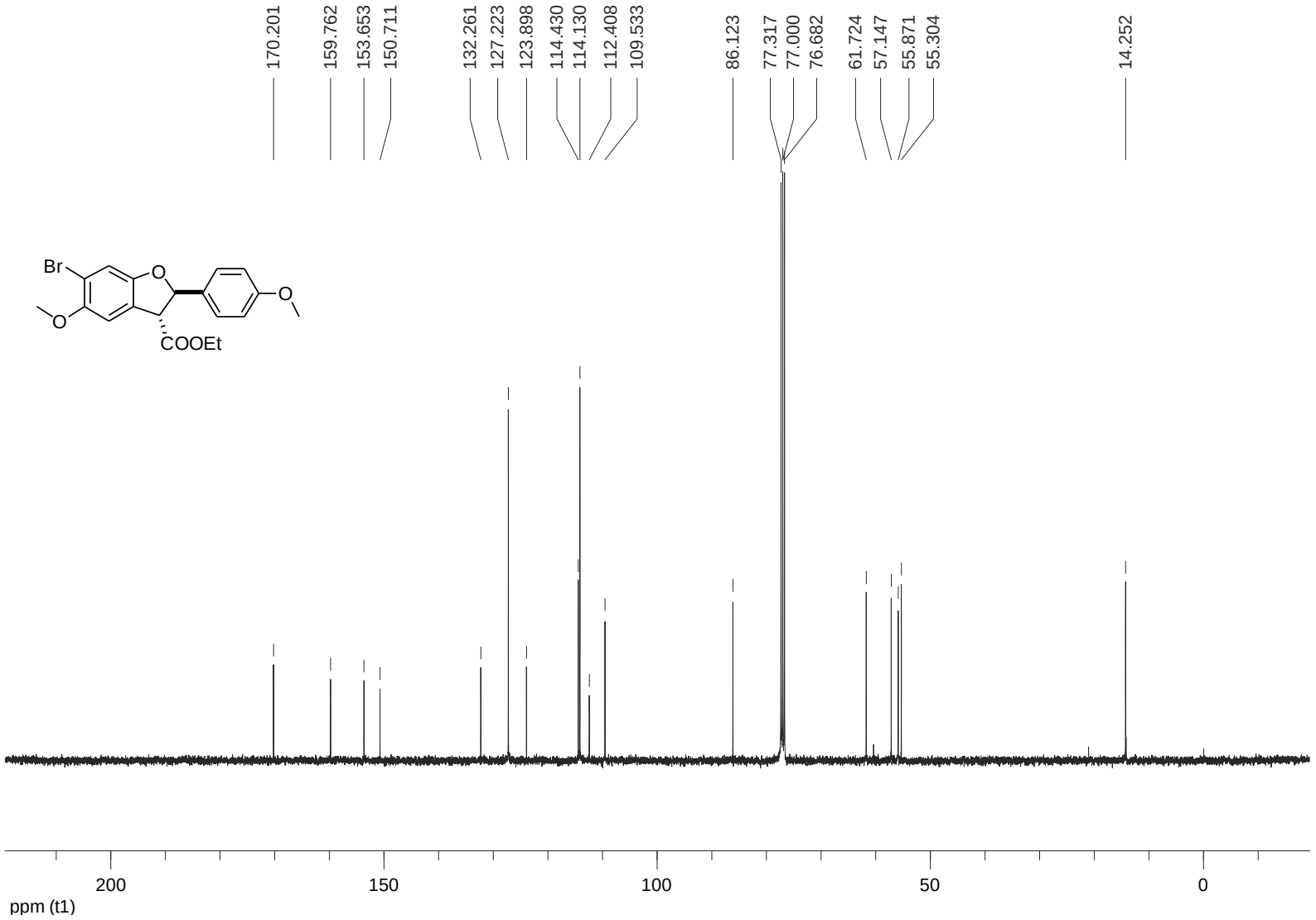
ppm (t1)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112.408
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77.000
76.682
61.724
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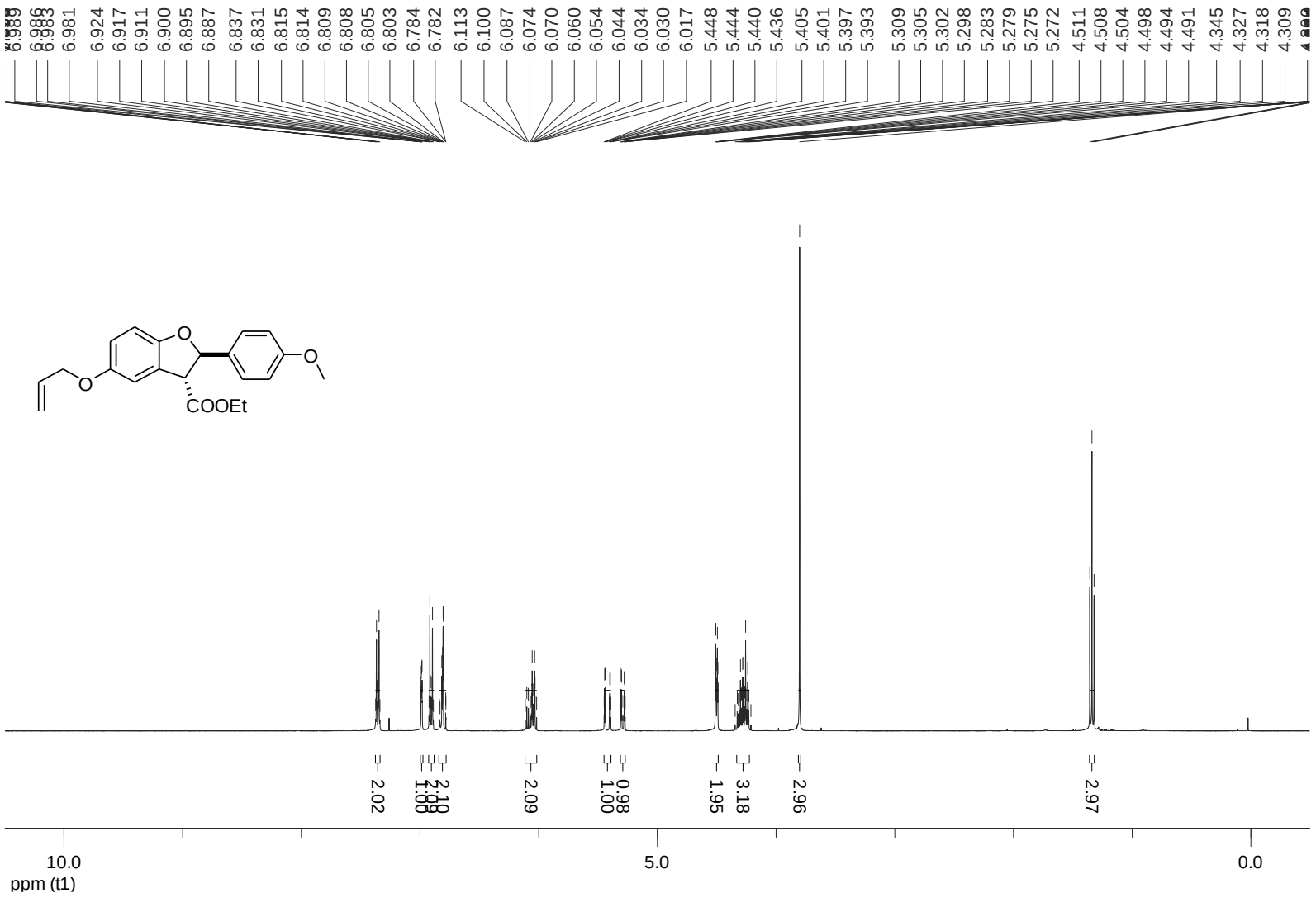
55.304
14.252
Br
O
O
O
COOEt
200
150
100
50
0
ppm (t1)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6.887
6.837
6.831
6.815
6.814
6.809
6.808
6.805
6.803
6.784
6.782
6.113
6.100
6.087
6.074
6.070
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6.054
6.044
6.034
6.030
6.017
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5.444
5.440
5.436
5.405
5.401
5.397
5.393
5.309
5.305
5.302
5.298
5.283
5.279
5.275
5.272
4.511
4.508
4.504
4.498
4.494
4.491
4.345
4.327
4.318
4.309
O
O
O
COOEt
2.02
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1.00
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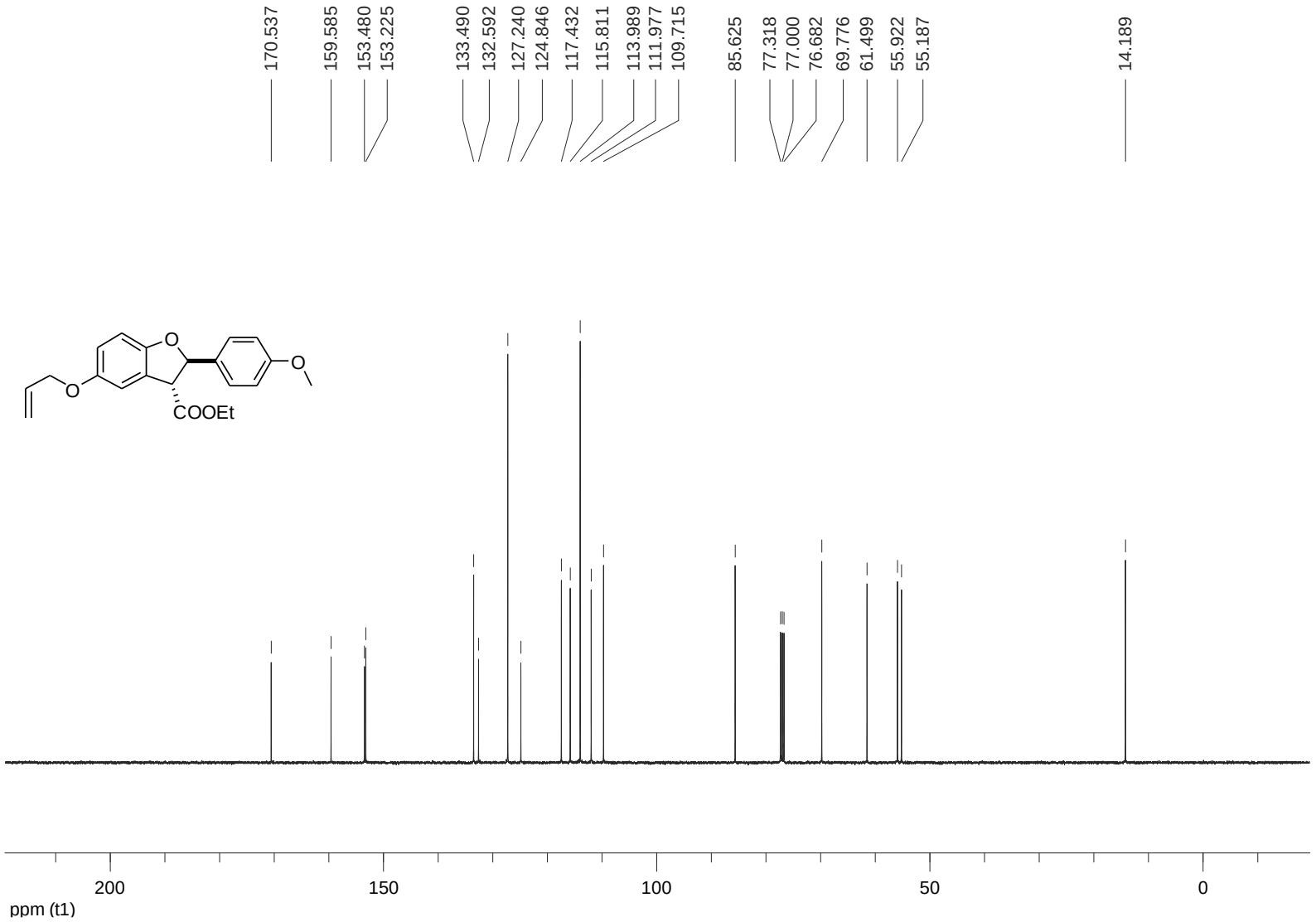
ppm (t1)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85.625
77.318
77.000
76.682
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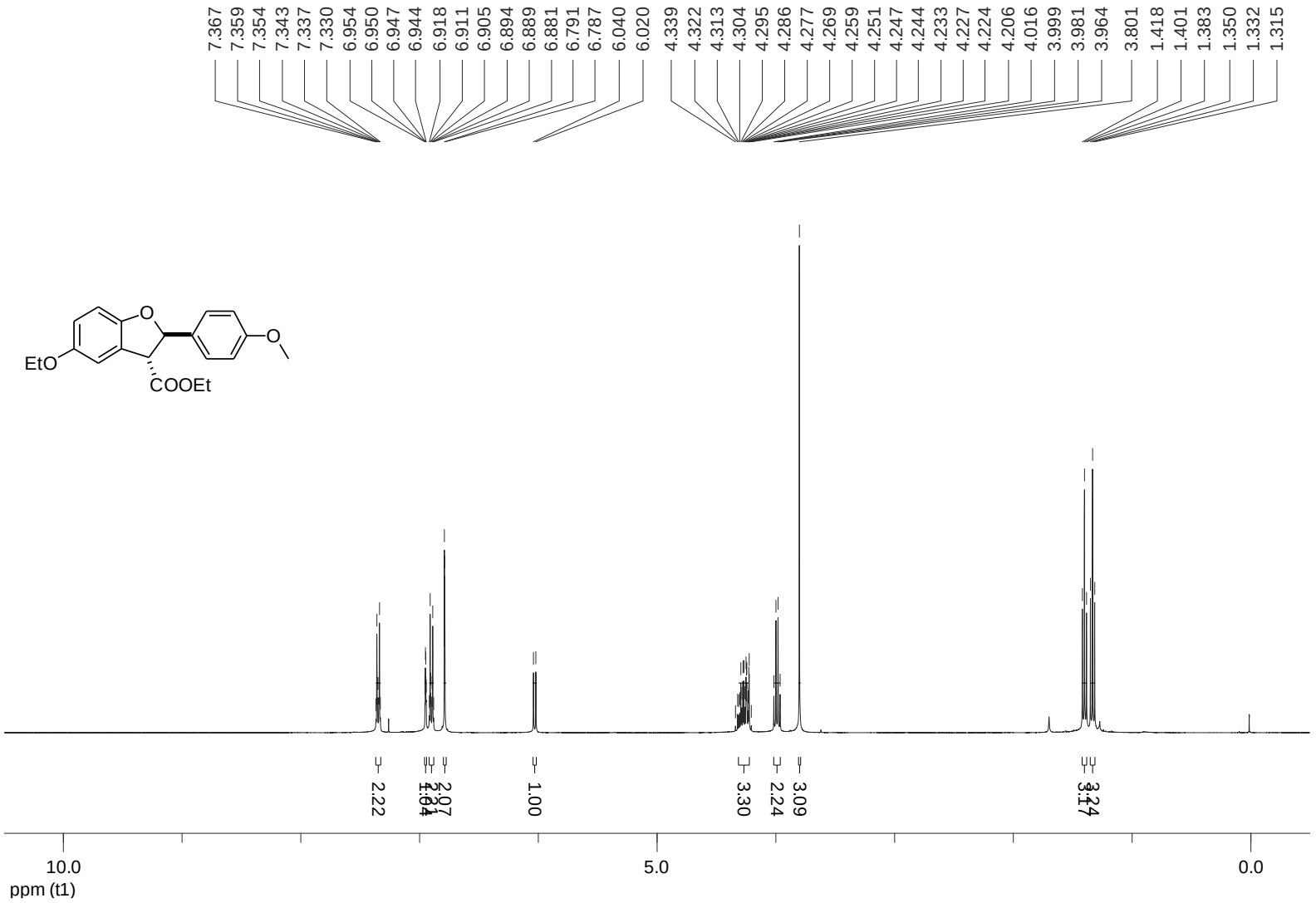
O
O
O
COOEt
200
150
100
50
0
ppm (t1)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6.905
6.894
6.889
6.881
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4.313
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4.251
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4.244
4.233
4.227
4.224
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4.016
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3.981
3.964
3.801
1.418
1.401
1.383
1.350
1.332
1.315
EtO
O
O
COOEt
2.22
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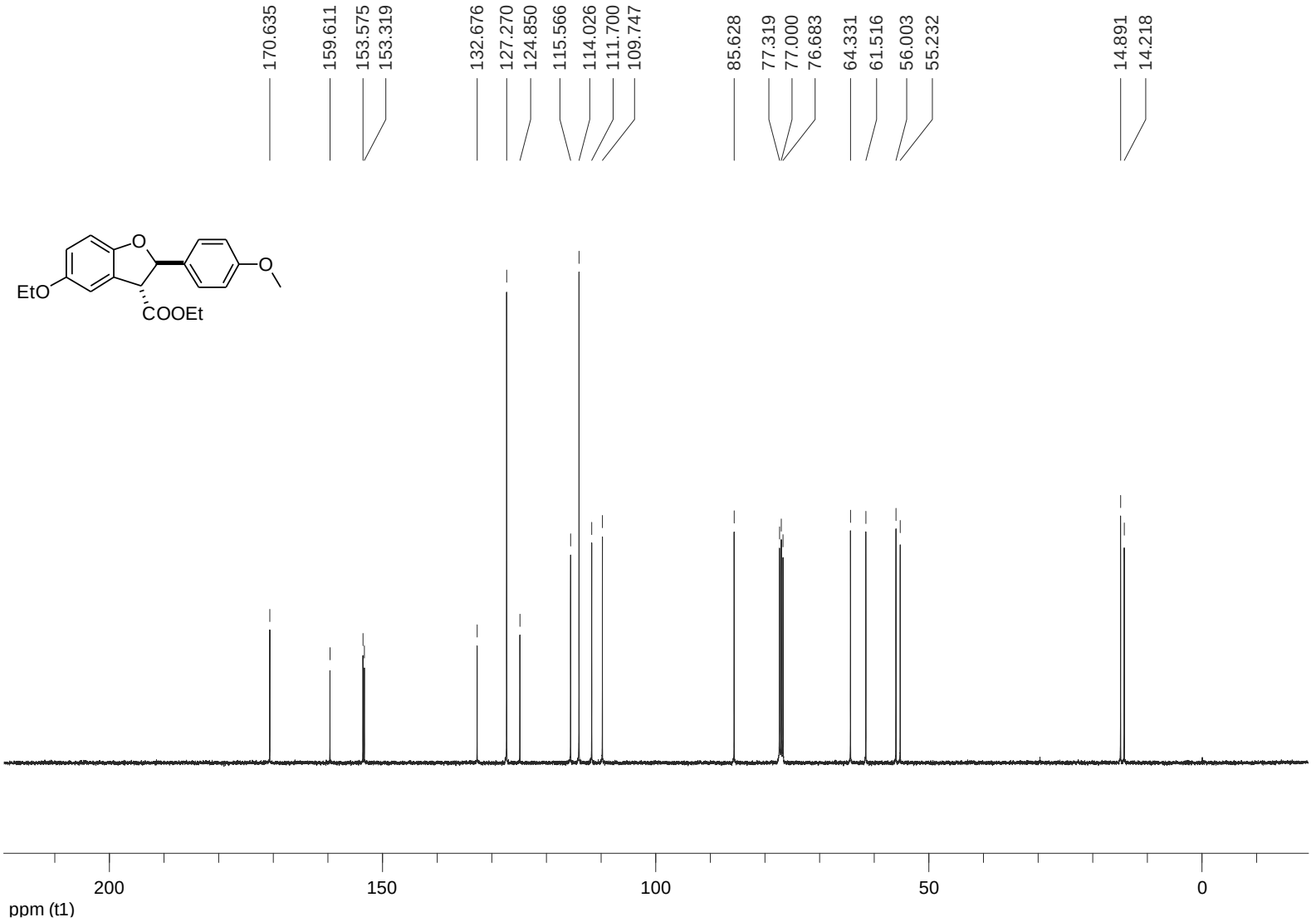
ppm (t1)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85.628
77.319
77.000
76.683
64.331
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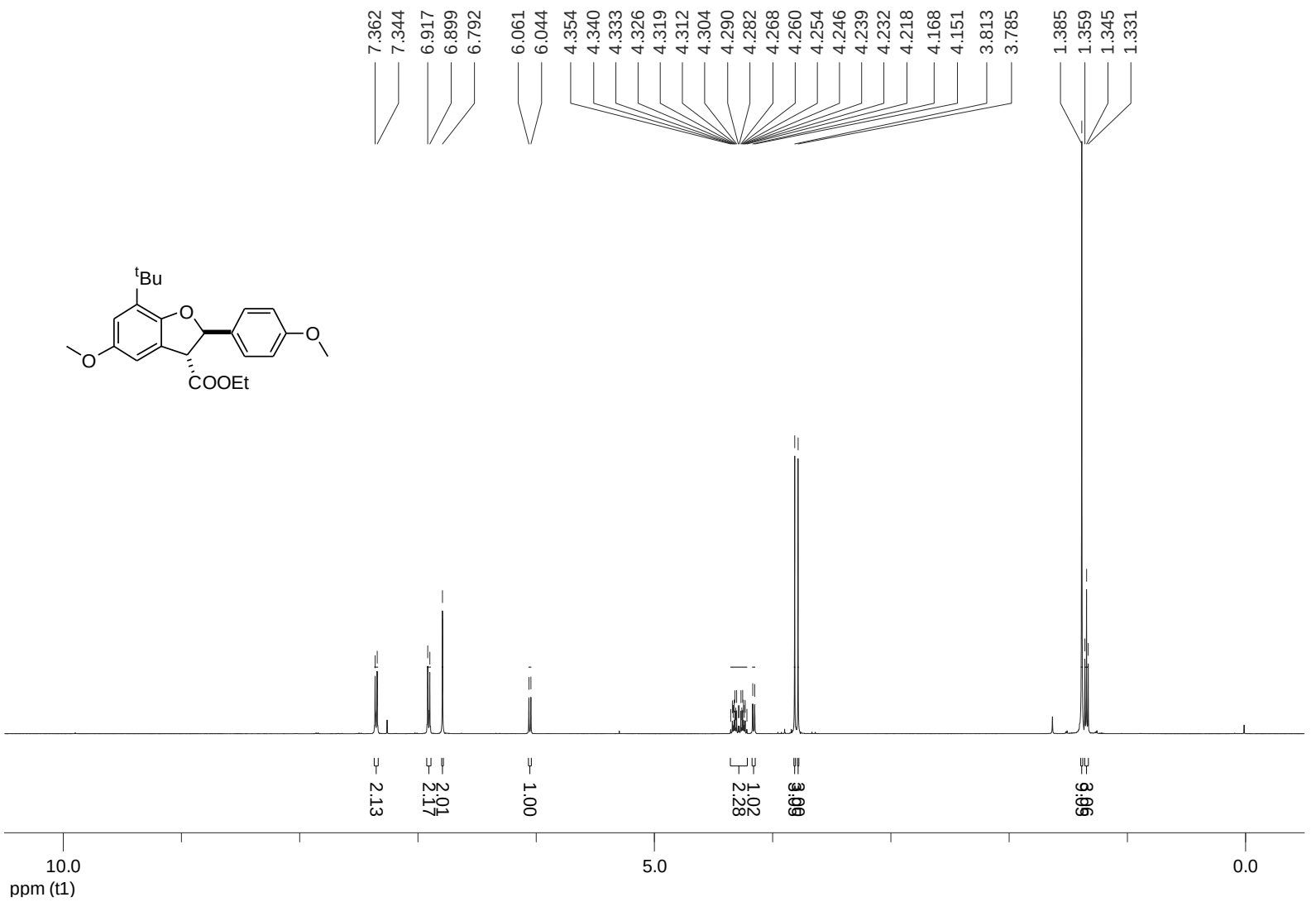
14.891
14.218
EtO
O
O
COOEt
200
150
100
50
0
ppm (t1)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4.260
4.254
4.246
4.239
4.232
4.218
4.168
4.151
3.813
3.785
1.385
1.359
1.345
1.331
tBu
O
O
O
COOEt
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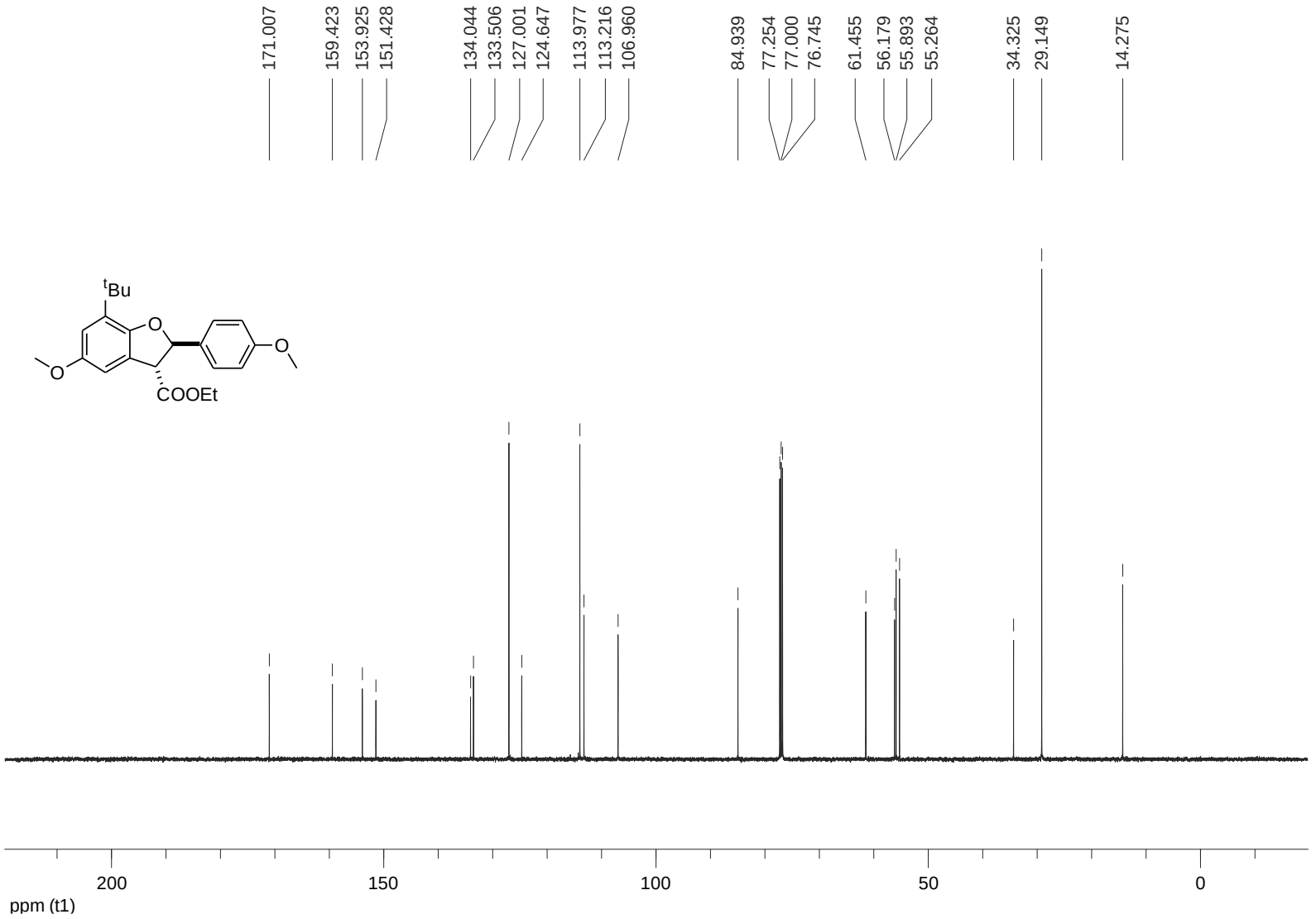
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77.000
76.745
61.455
56.179
55.893
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14.275
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O
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COOEt
200
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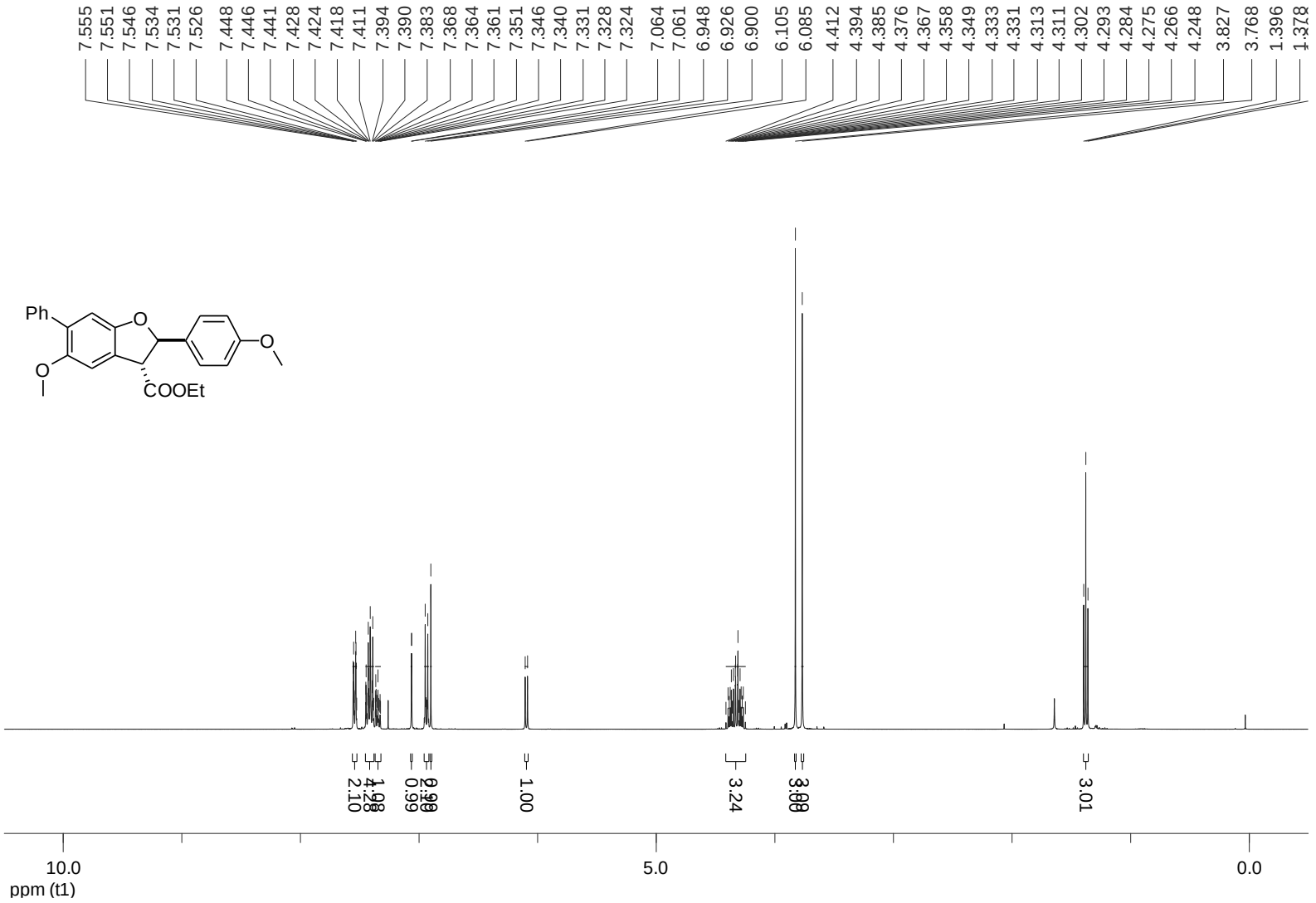
100
50
0
ppm (t1)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7.411
7.394
7.390
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7.368
7.364
7.361
7.351
7.346
7.340
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4.349
4.333
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4.311
4.302
4.293
4.284
4.275
4.266
4.248
3.827
3.768
1.396
1.378
Ph
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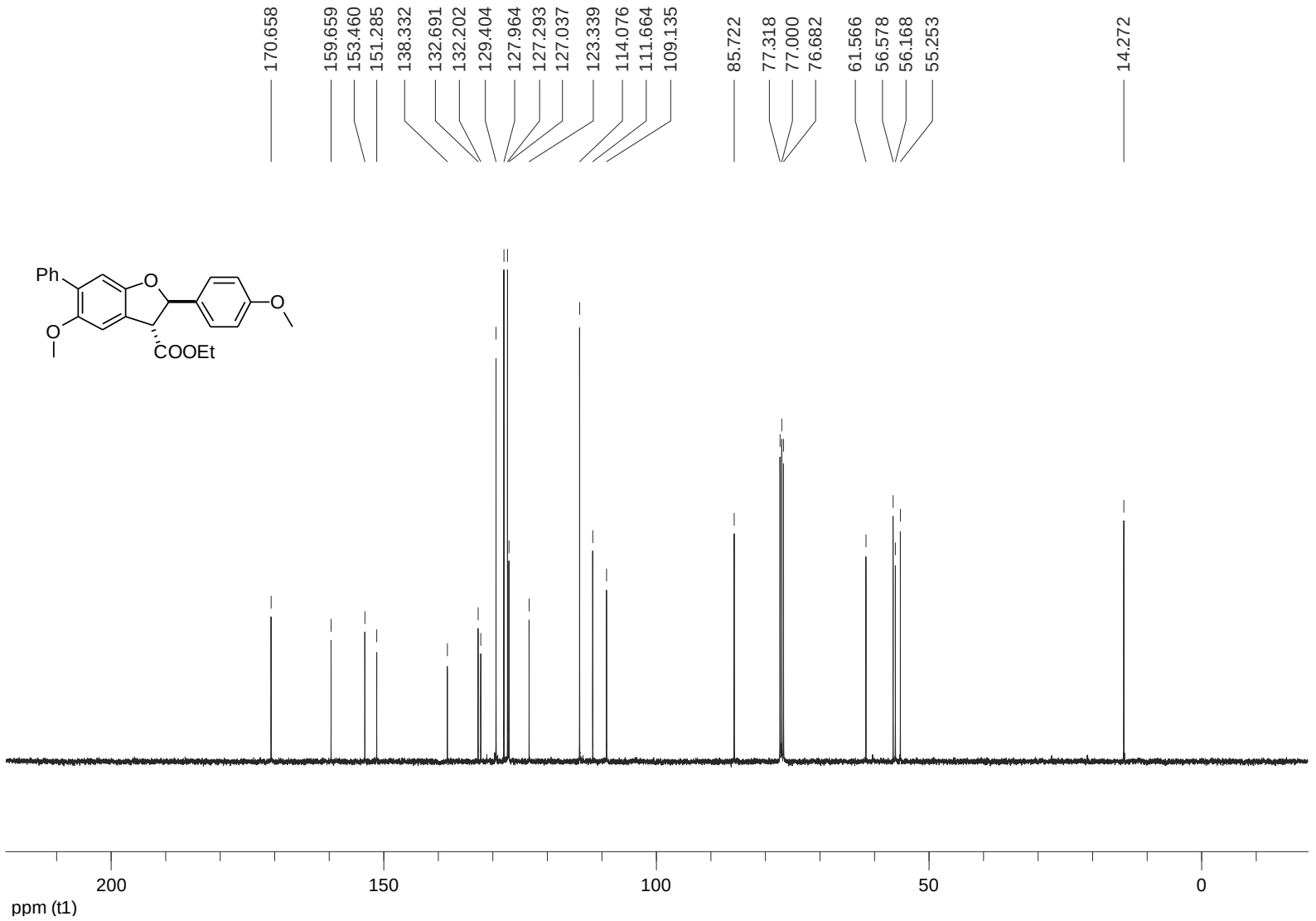
ppm (t1)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127.293
127.037
123.339
114.076
111.664
109.135
85.722
77.318
77.000
76.682
61.566
56.578
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55.253
14.272
Ph
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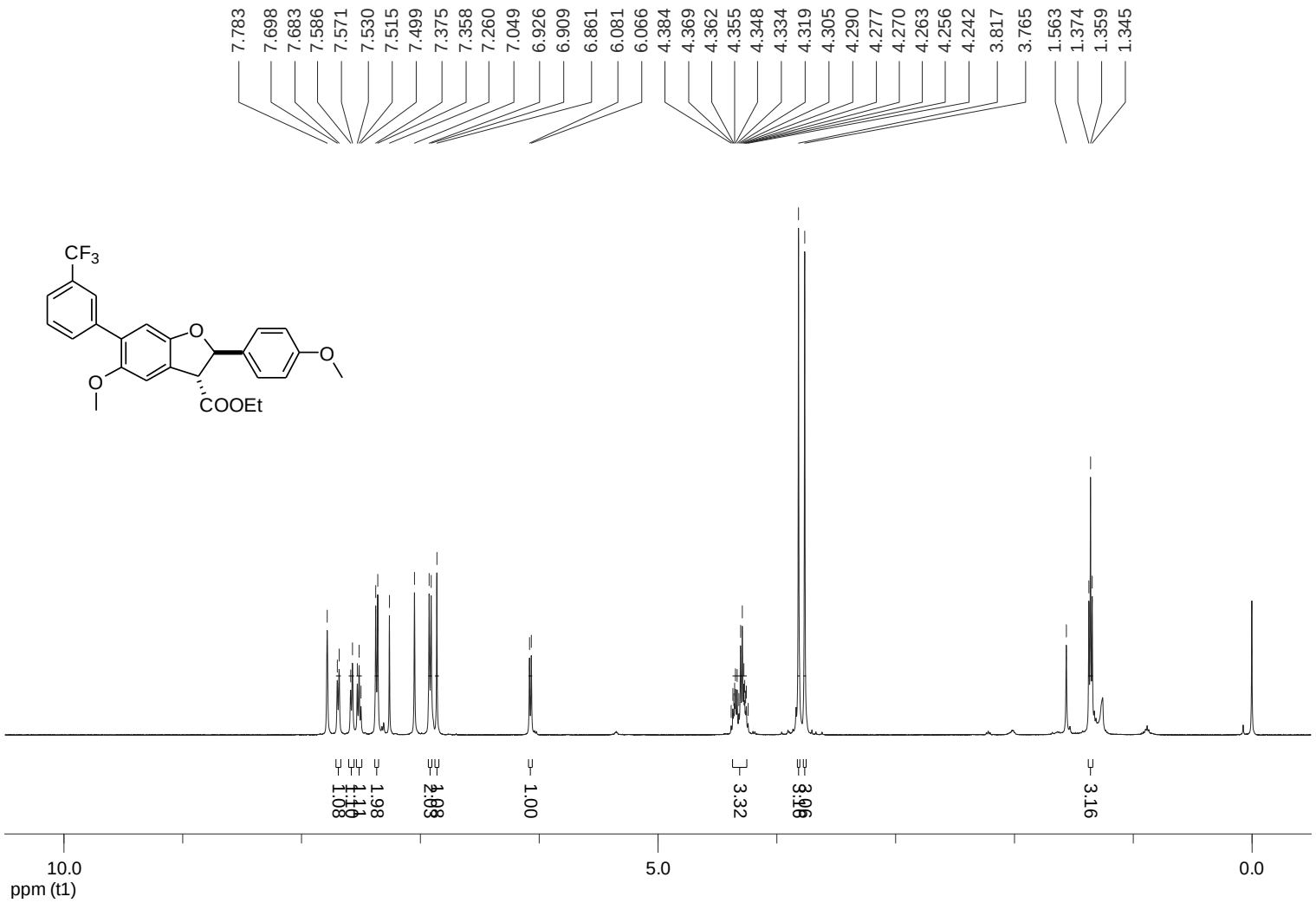
O
O
COOEt
200
150
100
50
0
ppm (t1)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7.260
7.049
6.926
6.909
6.861
6.081
6.066
4.384
4.369
4.362
4.355
4.348
4.334
4.319
4.305
4.290
4.277
4.270
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4.256
4.242
3.817
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1.374
1.359
1.345
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COOEt
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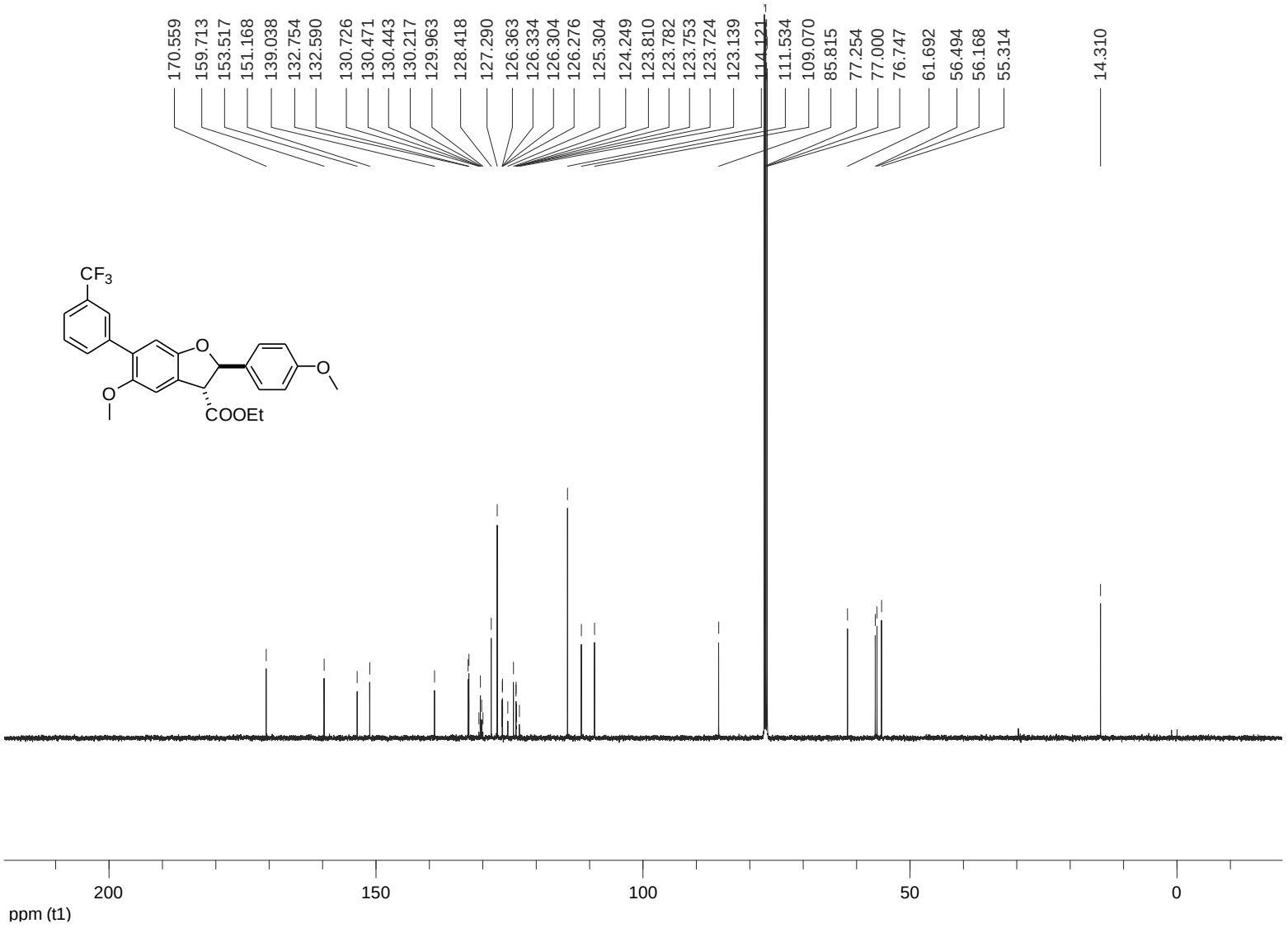
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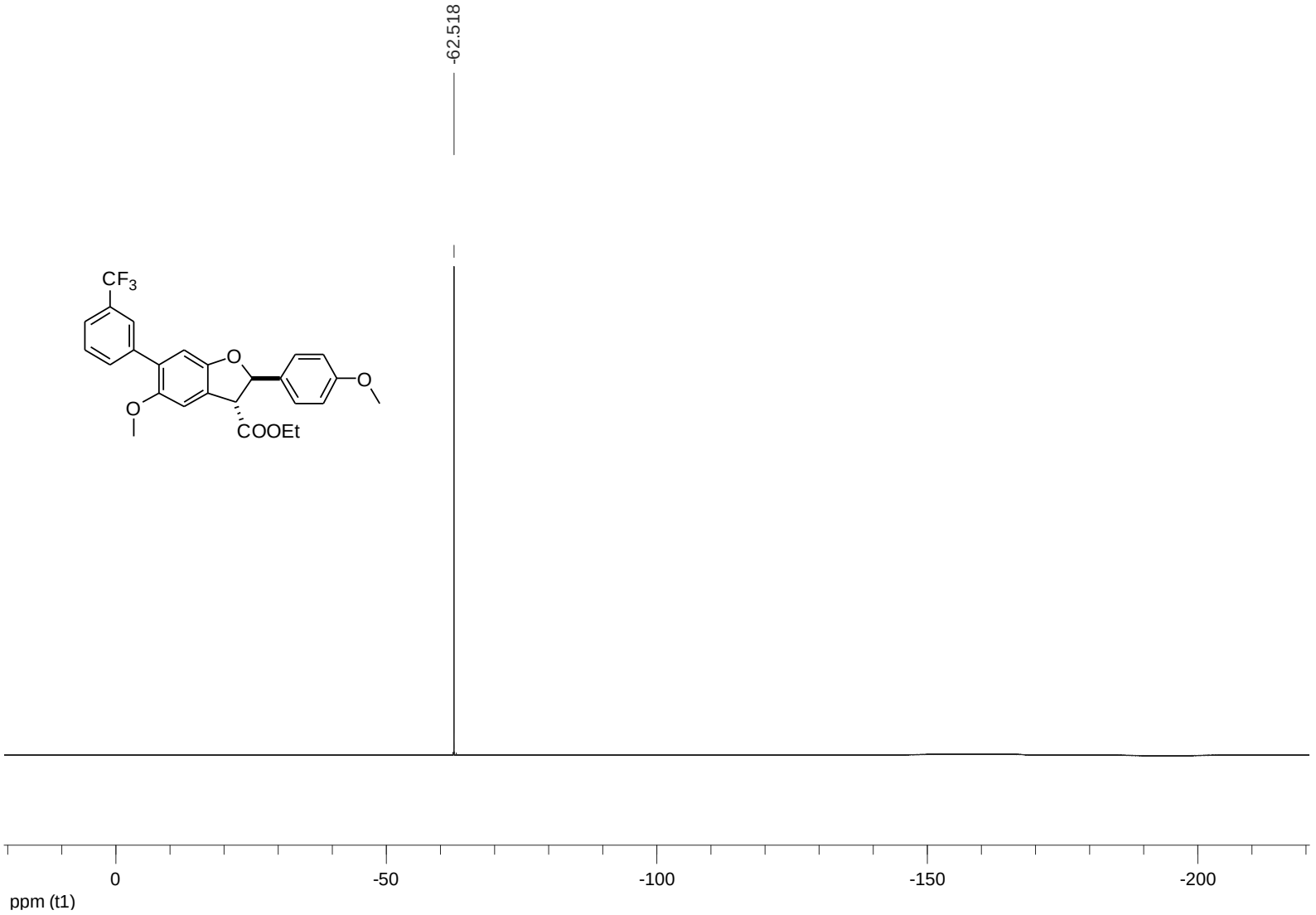
128.418
127.290
126.363
126.334
126.304
126.276
125.304
124.249
123.810
123.782
123.753
123.724
123.139
114.121
111.534
109.070
85.815
77.254
77.000
76.747
61.692
56.494
56.168
55.314
14.310
CF3
O
O
O
COOEt
200
150
100
50
0
ppm (t1)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O
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COOEt
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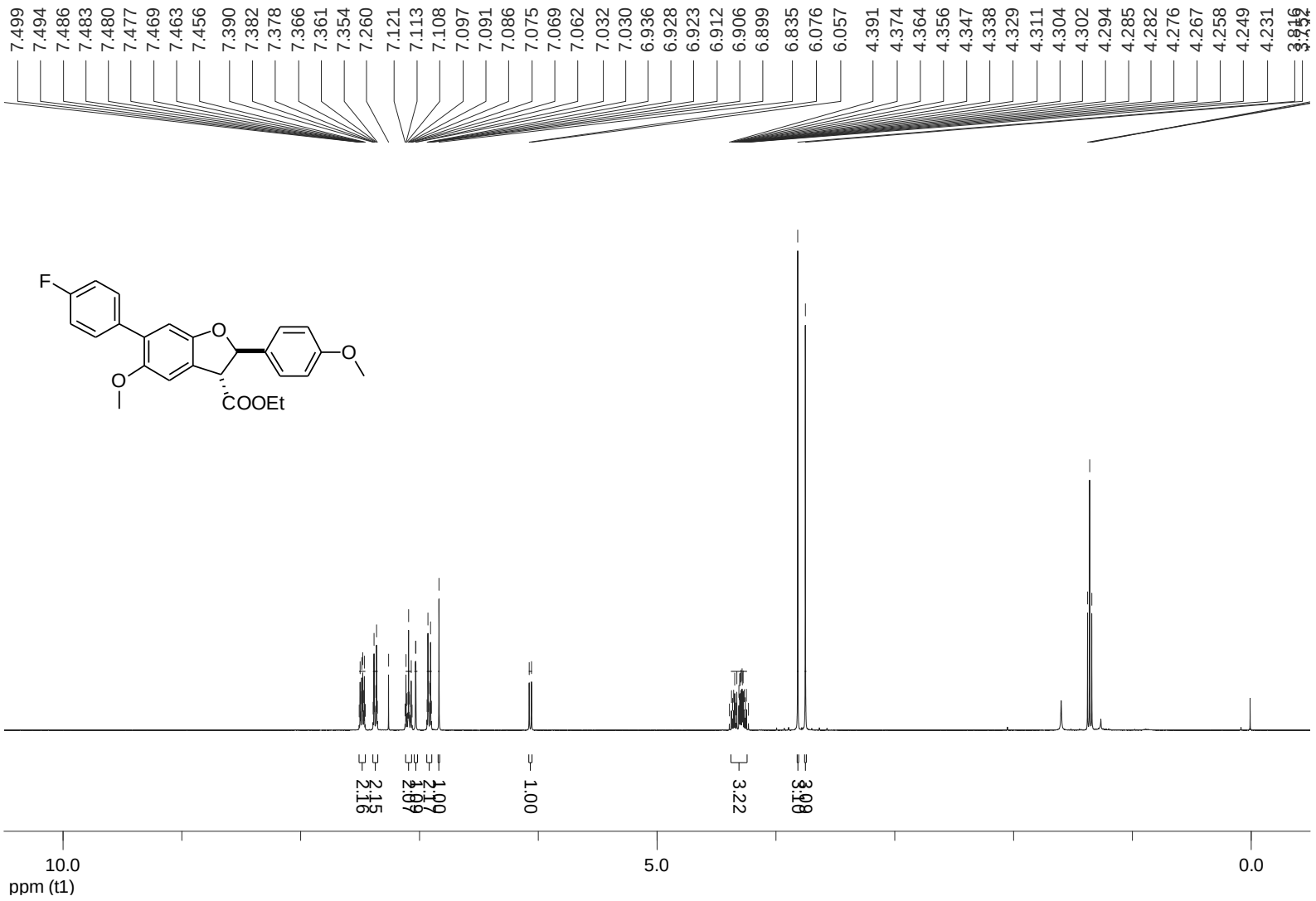
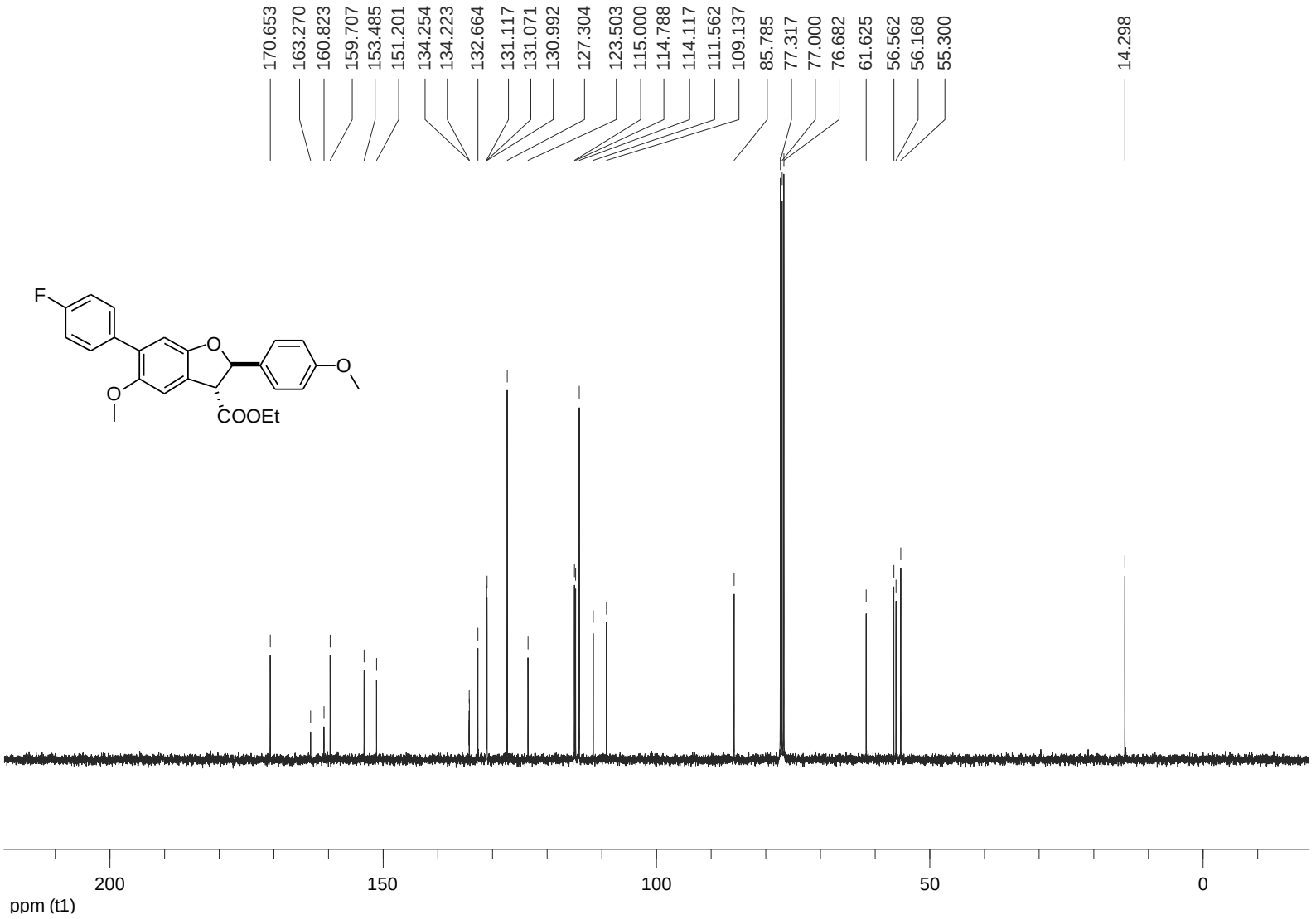
-50
-100
-150
-200
ppm (t1)


7.499
7.494
7.486
7.483
7.480
7.477
7.469
7.463
7.456
7.390
7.382
7.378
7.366
7.361
7.354
7.260
7.121
7.113
7.108
7.097
7.091
7.086
7.075
7.069
7.062
7.032
7.030
6.936
6.928
6.923
6.912
6.906
6.899
6.835
6.076
6.057
4.391
4.374
4.364
4.356
4.347
4.338
4.329
4.311
4.304
4.302
4.294
4.285
4.282
4.276
4.267
4.258
4.249
4.231
F
O
O
O
COOEt
2.16
2.15
2.09
2.09
1.09
2.17
1.00
3.22
3.08
3.10
10.0
5.0
0.0
ppm (t1)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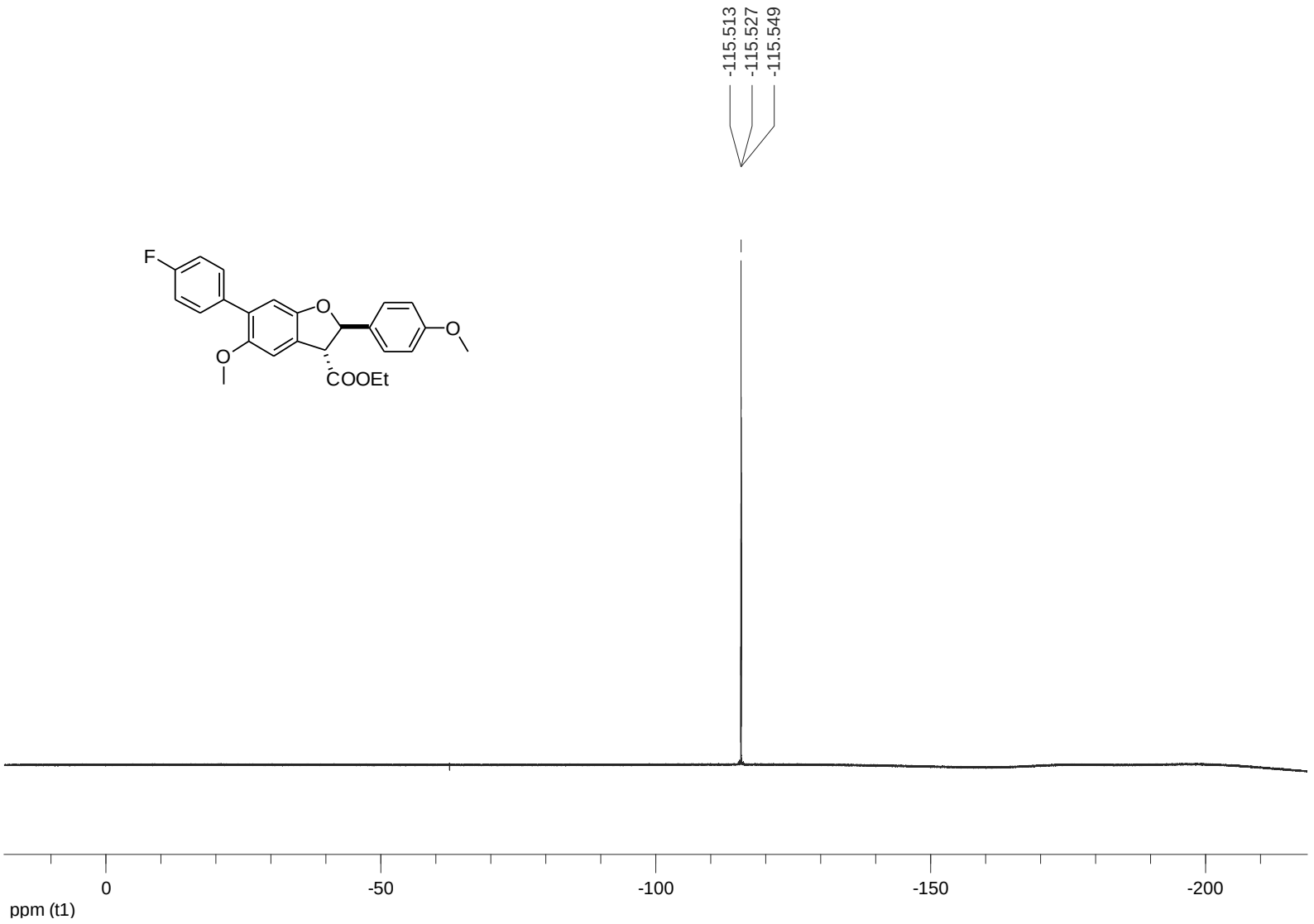
163.270
160.823
159.707
153.485
151.201
134.254
134.223
132.664
131.117
131.071
130.992
127.304
123.503
115.000
114.788
114.117
111.562
109.137
85.785
77.317
77.000
76.682
61.625
56.562
56.168
55.300
14.298
F
O
O
O
COOEt
200
150
100
50
0
ppm (t1)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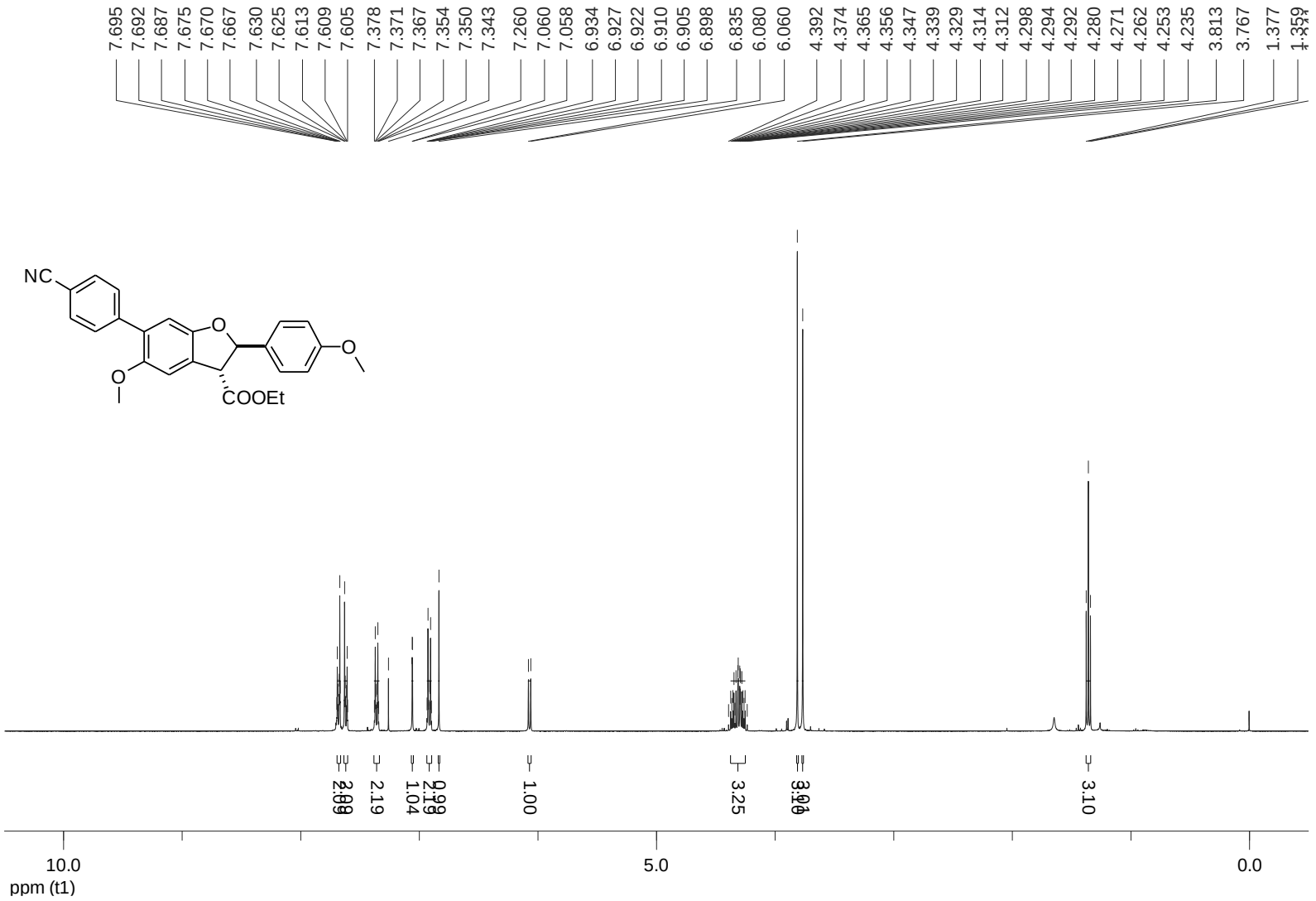
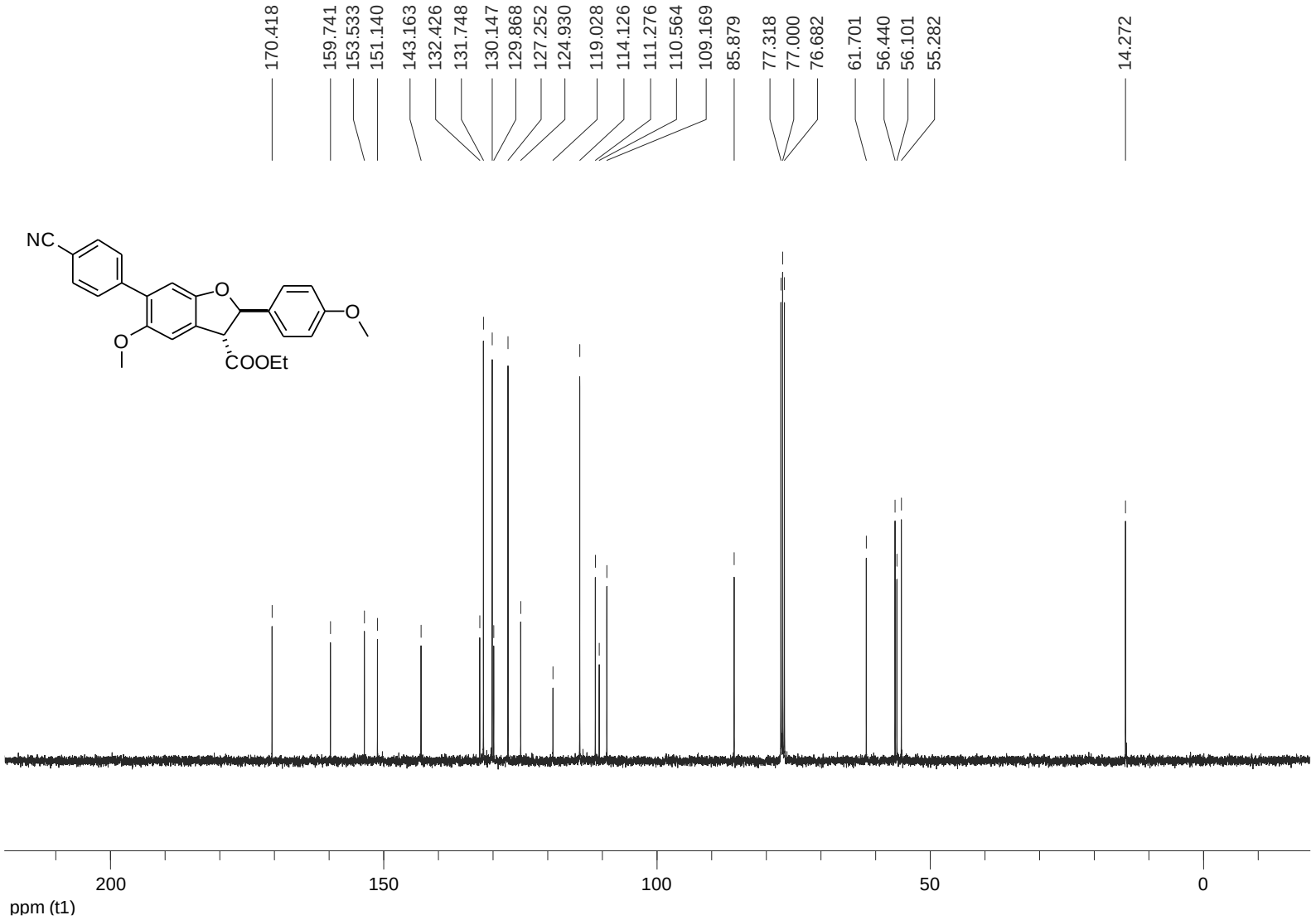
-115.527
-115.549
F
O
O
O
COOEt
0
-50
-100
-150
-200
ppm (t1)


7.695
7.692
7.687
7.675
7.670
7.667
7.630
7.625
7.613
7.609
7.605
7.378
7.371
7.367
7.354
7.350
7.343
7.260
7.060
7.058
6.934
6.927
6.922
6.910
6.905
6.898
6.835
6.080
6.060
4.392
4.374
4.365
4.356
4.347
4.339
4.329
4.314
4.312
4.298
4.294
4.292
4.280
4.271
4.262
4.253
4.235
3.813
3.767
1.377
1.359
NC
O
O
O
COOEt
2.09
2.19
1.04
2.19
1.00
3.25
3.10
10.0
5.0
0.0
ppm (t1)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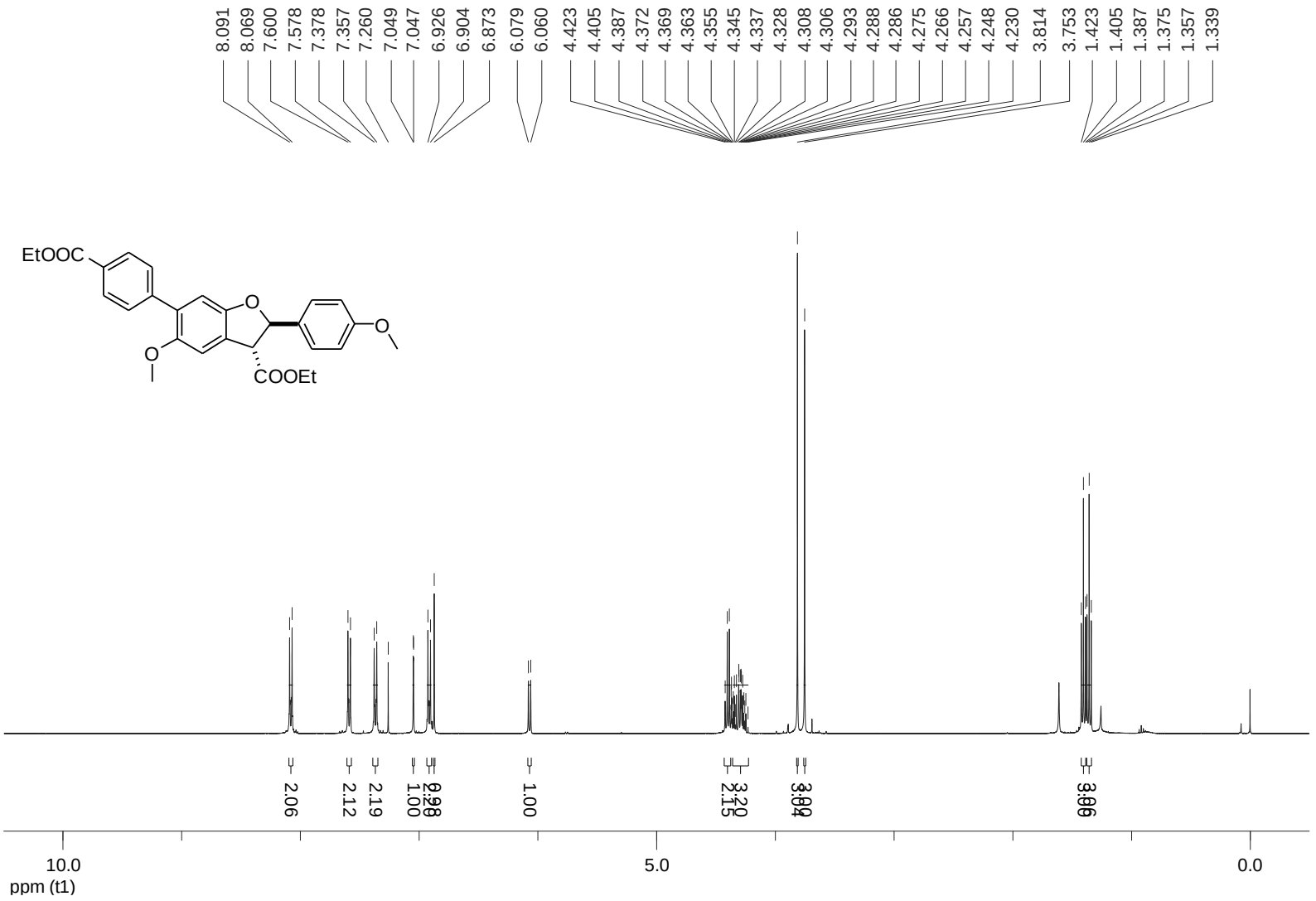
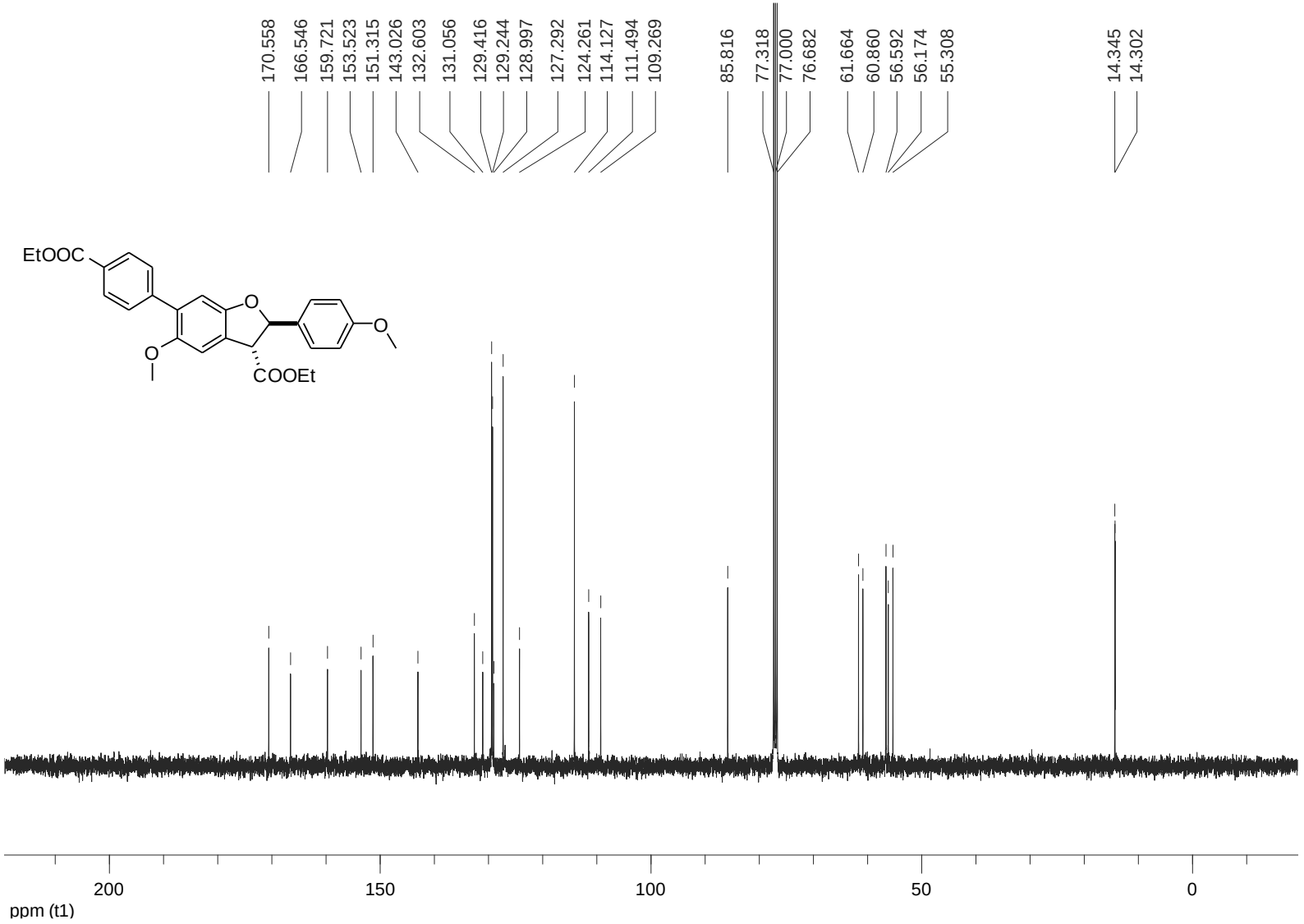
159.741
153.533
151.140
143.163
132.426
131.748
130.147
129.868
127.252
124.930
119.028
114.126
111.276
110.564
109.169
85.879
77.318
77.000
76.682
61.701
56.440
56.101
55.282
14.272
NC
O
O
O
COOEt
200
150
100
50
0
ppm (t1)


8.091
8.069
7.600
7.578
7.378
7.357
7.260
7.049
7.047
6.926
6.904
6.873
6.079
6.060
4.423
4.405
4.387
4.372
4.369
4.363
4.355
4.345
4.337
4.328
4.308
4.306
4.293
4.288
4.286
4.275
4.266
4.257
4.248
4.230
3.814
3.753
1.423
1.405
1.387
1.375
1.357
1.339
EtOOC
O
O
O
COOEt
2.06
2.12
2.19
1.00
1.00
1.00
3.00
3.06
10.0
5.0
0.0
ppm (t1)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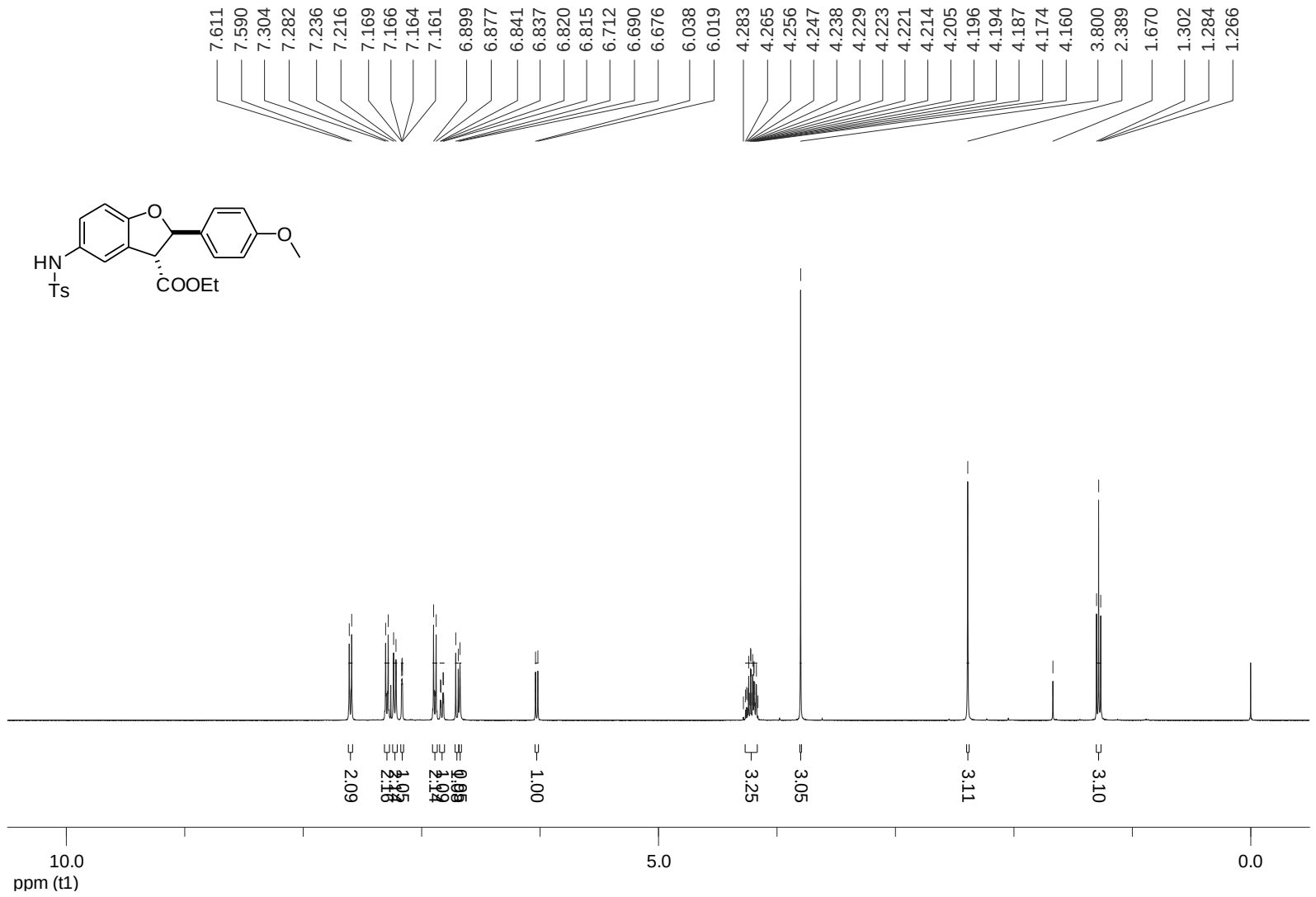
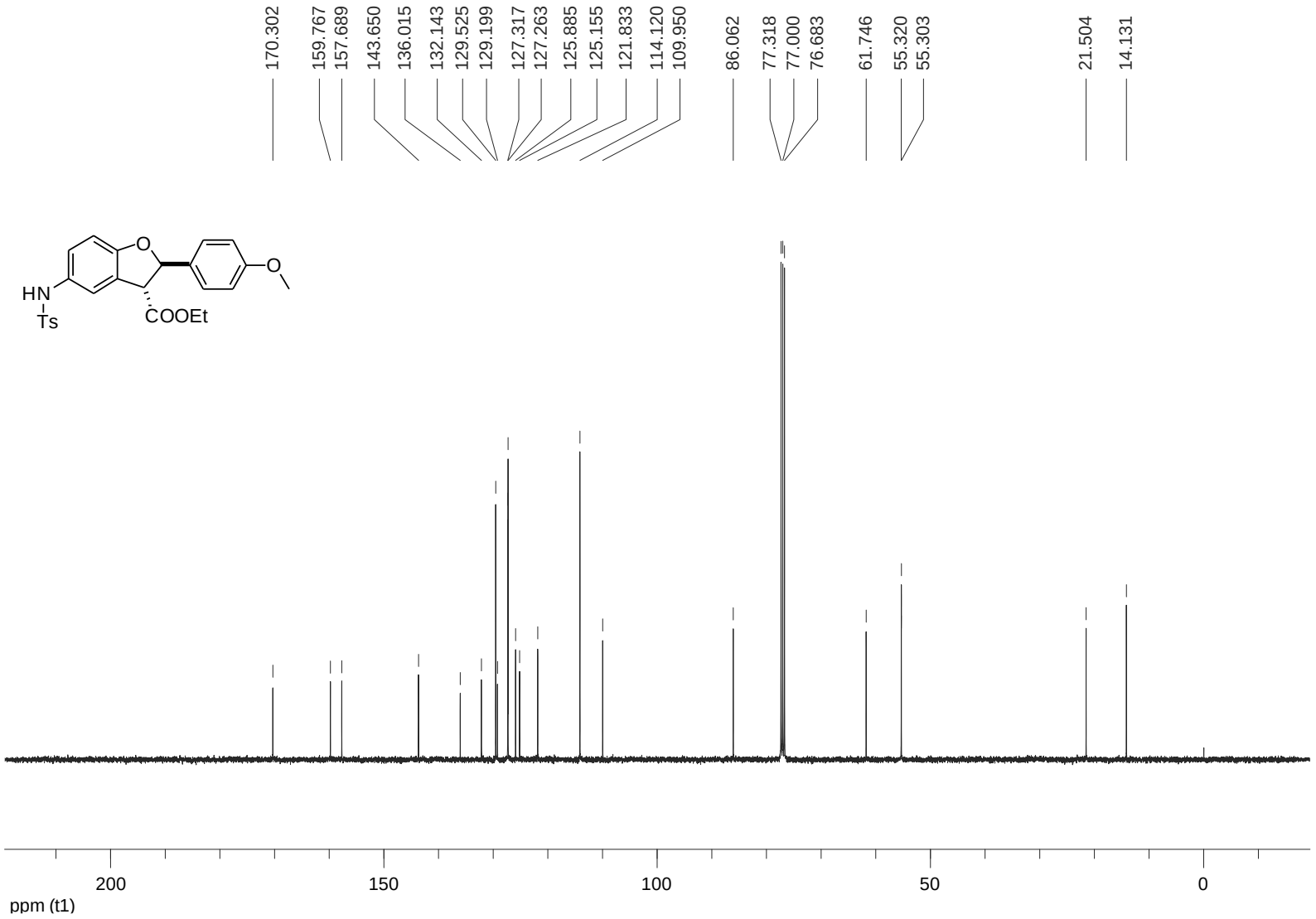
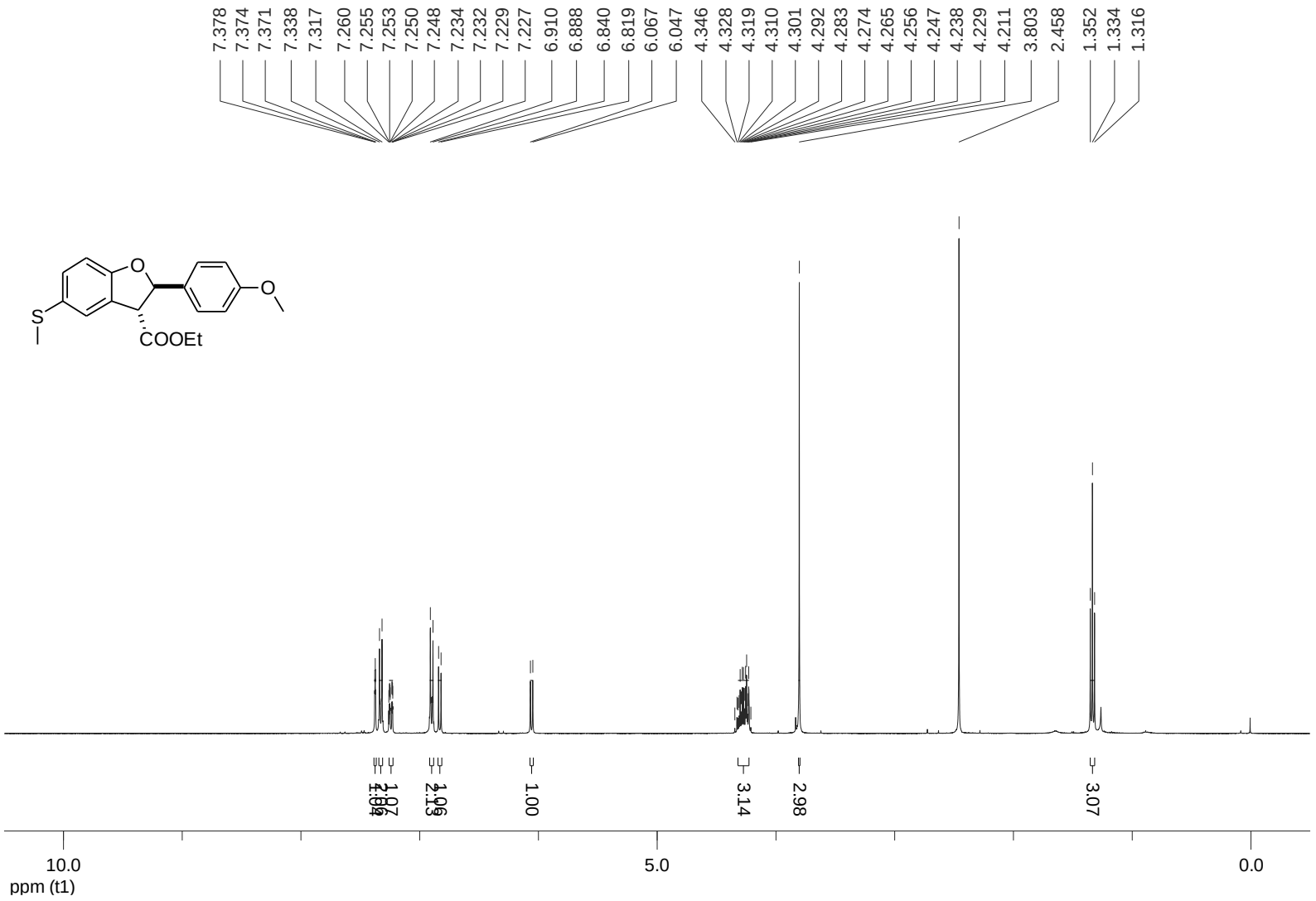
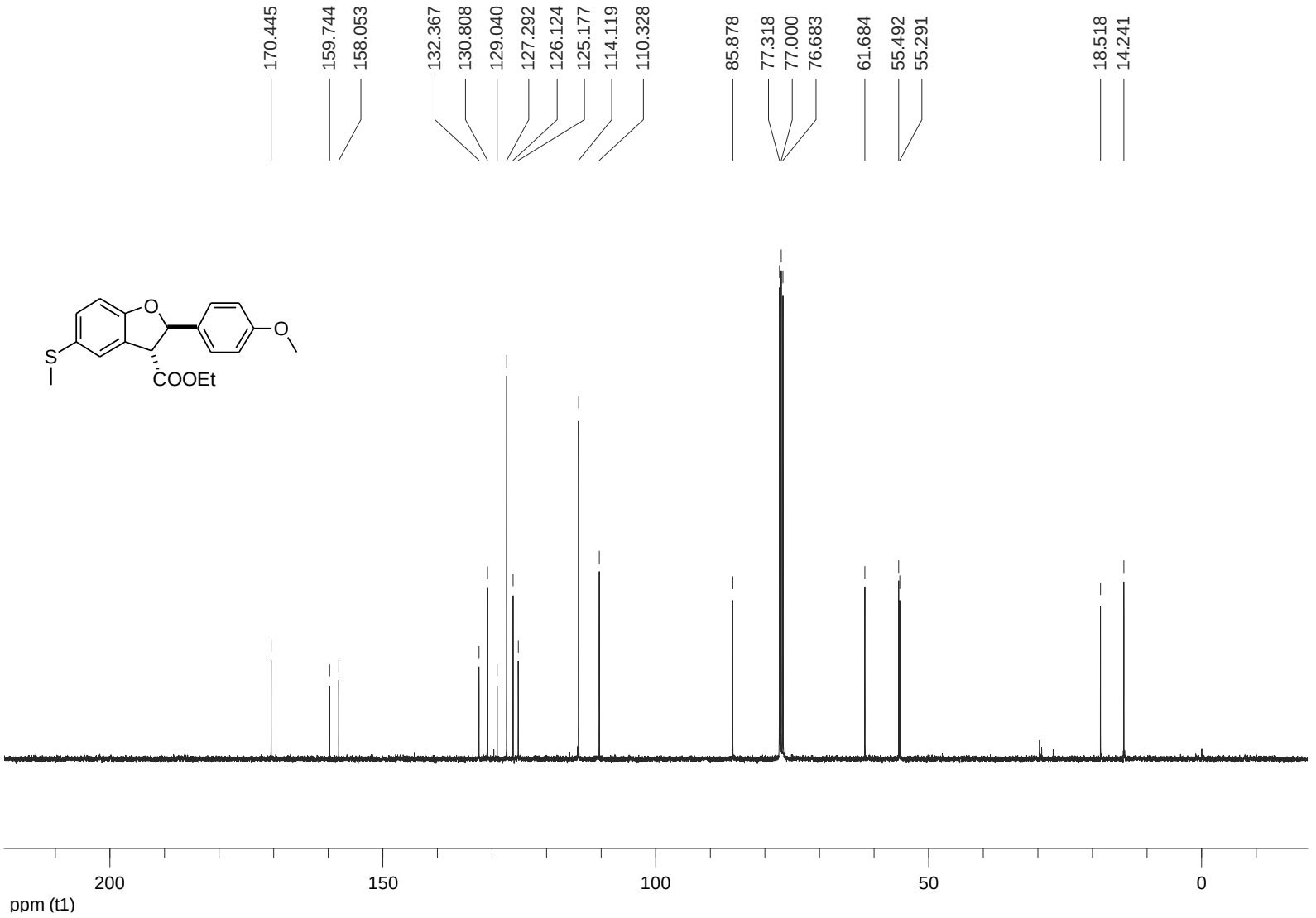
166.546
159.721
153.523
151.315
143.026
132.603
131.056
129.416
129.244
128.997
127.292
124.261
114.127
111.494
109.269
85.816
77.318
77.000
76.682
61.664
60.860
56.592
56.174
55.308
14.345
14.302
EtOOC
O
O
O
COOEt
200
150
100
50
0
ppm (t1)


7.611
7.590
7.304
7.282
7.236
7.216
7.169
7.166
7.164
7.161
6.899
6.877
6.841
6.837
6.820
6.815
6.712
6.690
6.676
6.038
6.019
4.283
4.265
4.256
4.247
4.238
4.229
4.223
4.221
4.214
4.205
4.196
4.194
4.187
4.174
4.160
3.800
2.389
1.670
1.302
1.284
1.266
HN
Ts
O
O
COOEt
2.09
1.00
3.25
3.05
3.11
3.10
10.0
5.0
0.0
ppm (t1)


170.302
159.767
157.689
143.650
136.015
132.143
129.525
129.199
127.317
127.263
125.885
125.155
121.833
114.120
109.950
86.062
77.318
77.000
76.683
61.746
55.320
55.303
21.504
14.131
O
O
HN
Ts
COOEt
200
150
100
50
0
ppm (t1)


7.378
7.374
7.371
7.338
7.317
7.260
7.255
7.253
7.250
7.248
7.234
7.232
7.229
7.227
6.910
6.888
6.840
6.819
6.067
6.047
4.346
4.328
4.319
4.310
4.301
4.292
4.283
4.274
4.265
4.256
4.247
4.238
4.229
4.211
3.803
2.458
1.352
1.334
1.316
O
O
S
COOEt
1.00
3.14
2.98
3.07
10.0
5.0
0.0
ppm (t1)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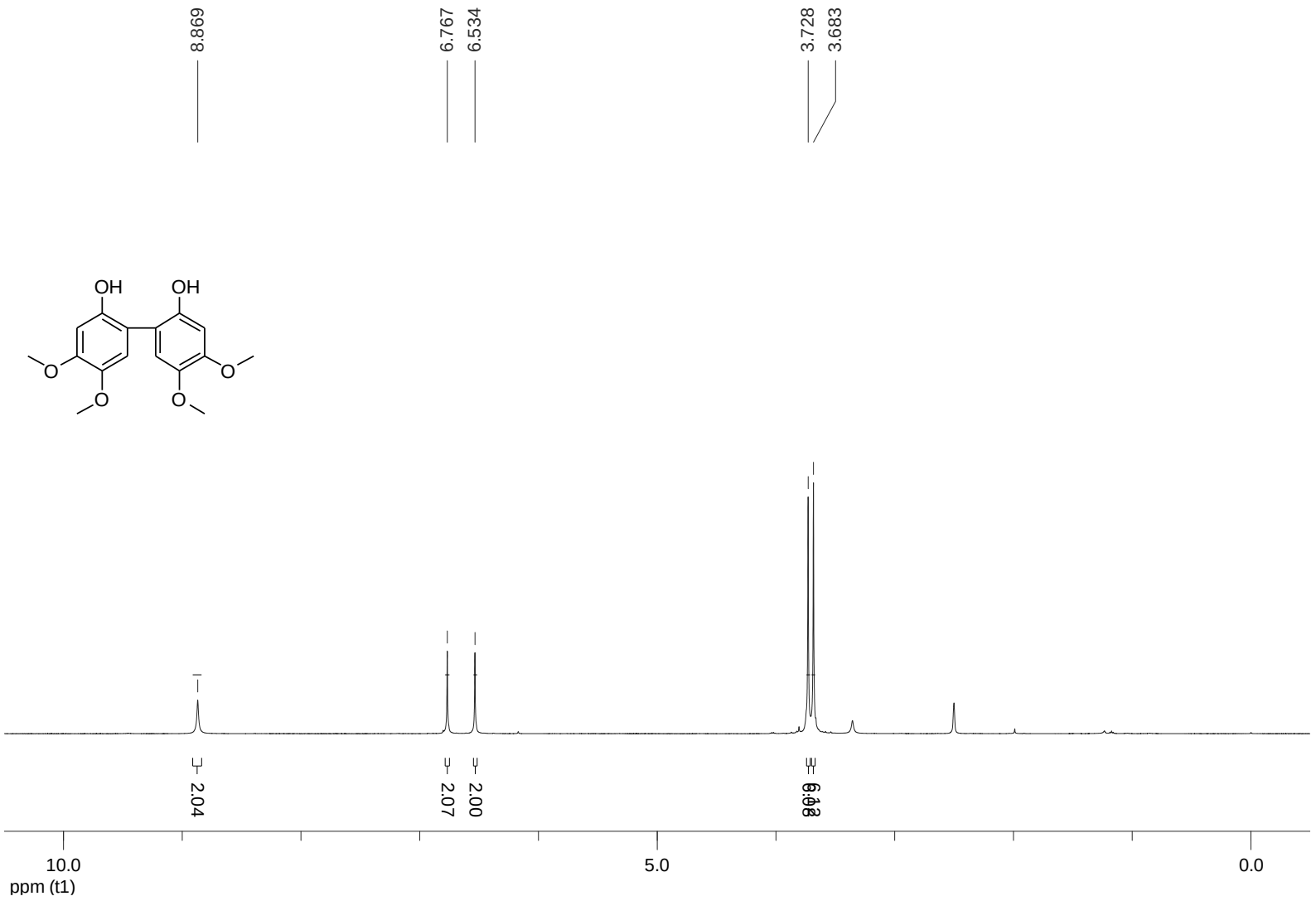
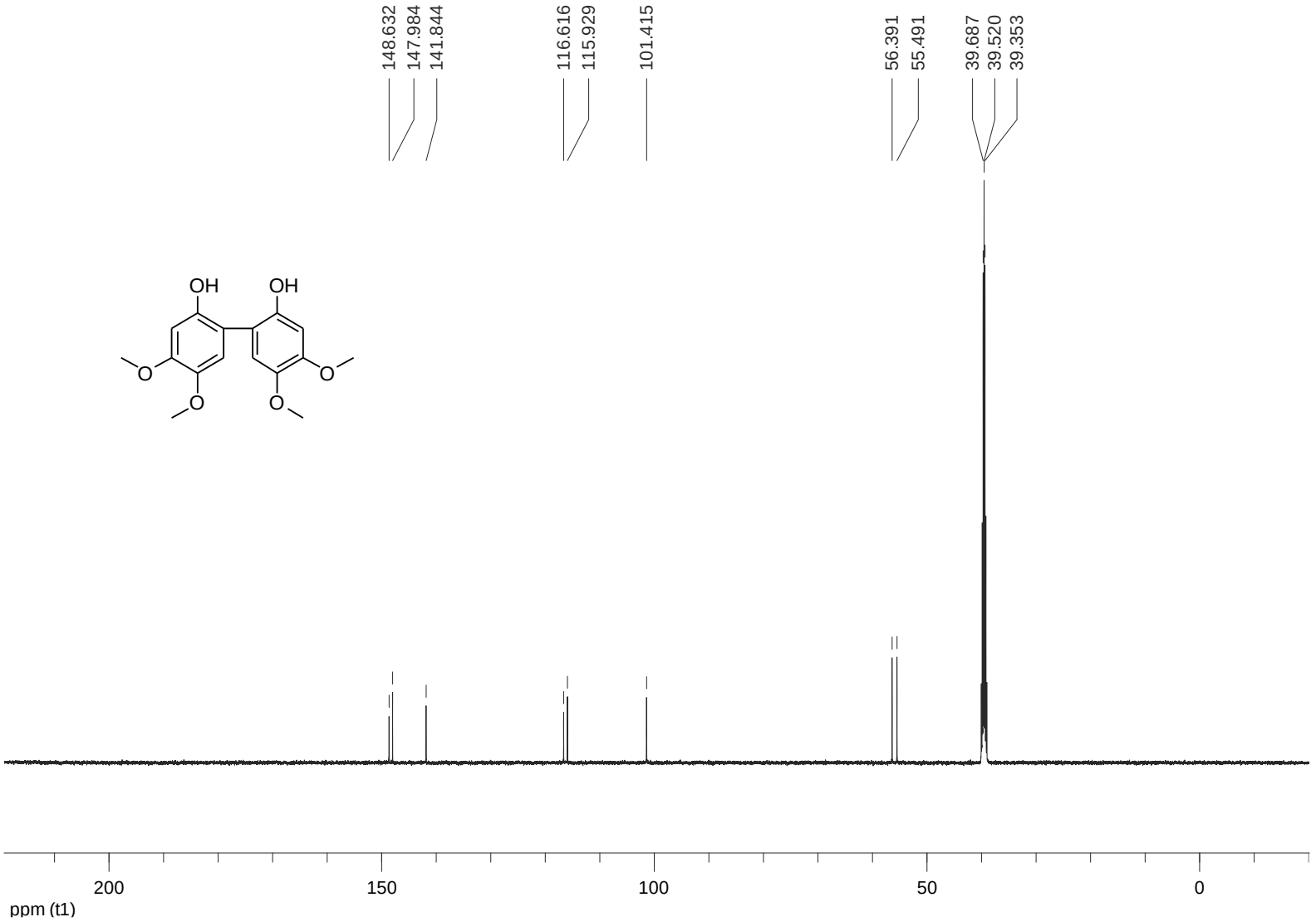
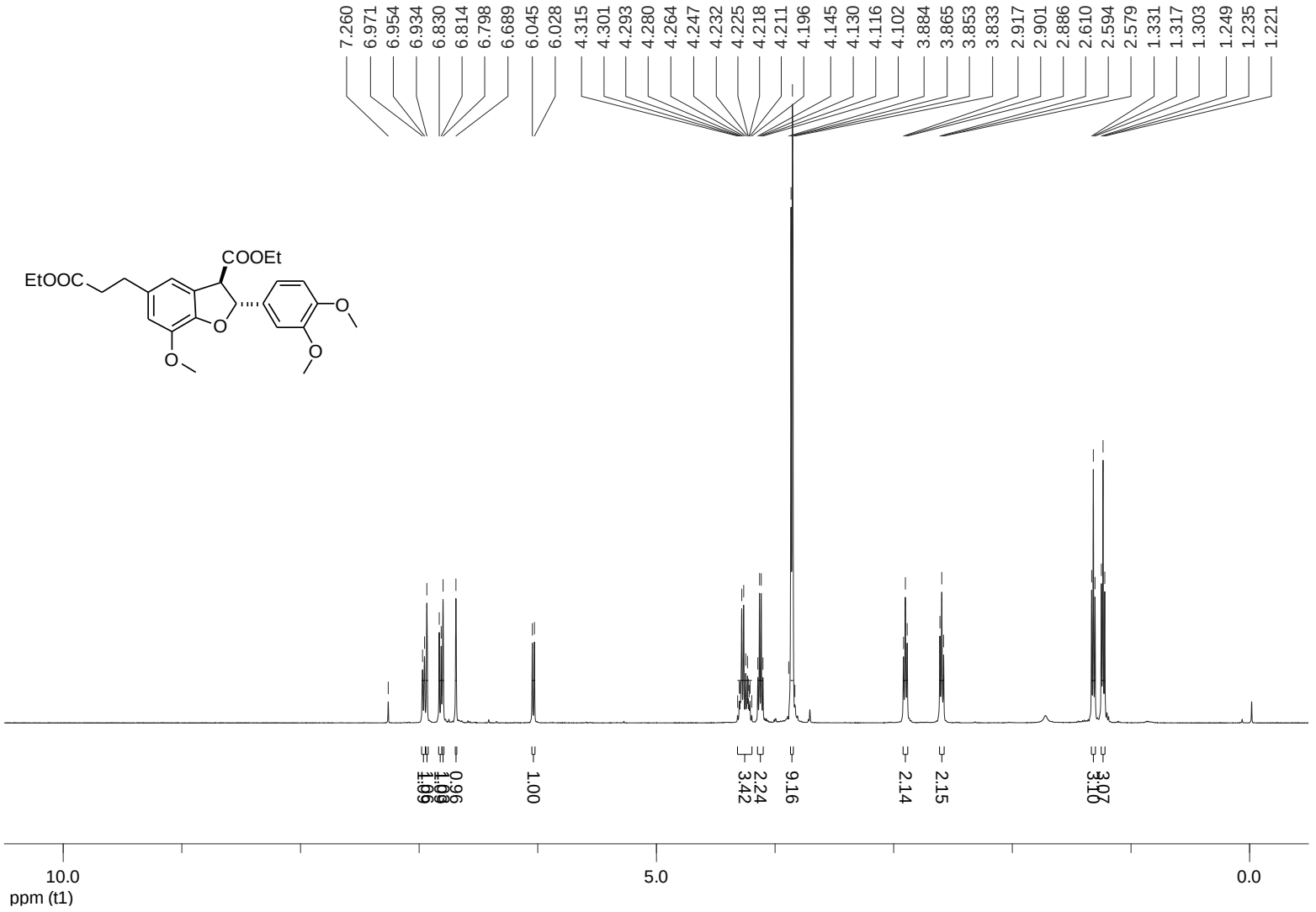
159.744
158.053
132.367
130.808
129.040
127.292
126.124
125.177
114.119
110.328
85.878
77.318
77.000
76.683
61.684
55.492
55.291
18.518
14.241
O
O
S
COOEt
200
150
100
50
0
ppm (t1)


8.869
6.797
6.534
3.728
3.683
OH
OH
O
O
O
O
2.04
2.07
2.00
6.13
6.08
10.0
5.0
0.0
ppm (t1)


148.632
147.984
141.844
116.616
115.929
101.415
56.391
55.491
39.687
39.520
39.353
OH
OH
O
O
O
O
200
150
100
50
0
ppm (t1)


7.260
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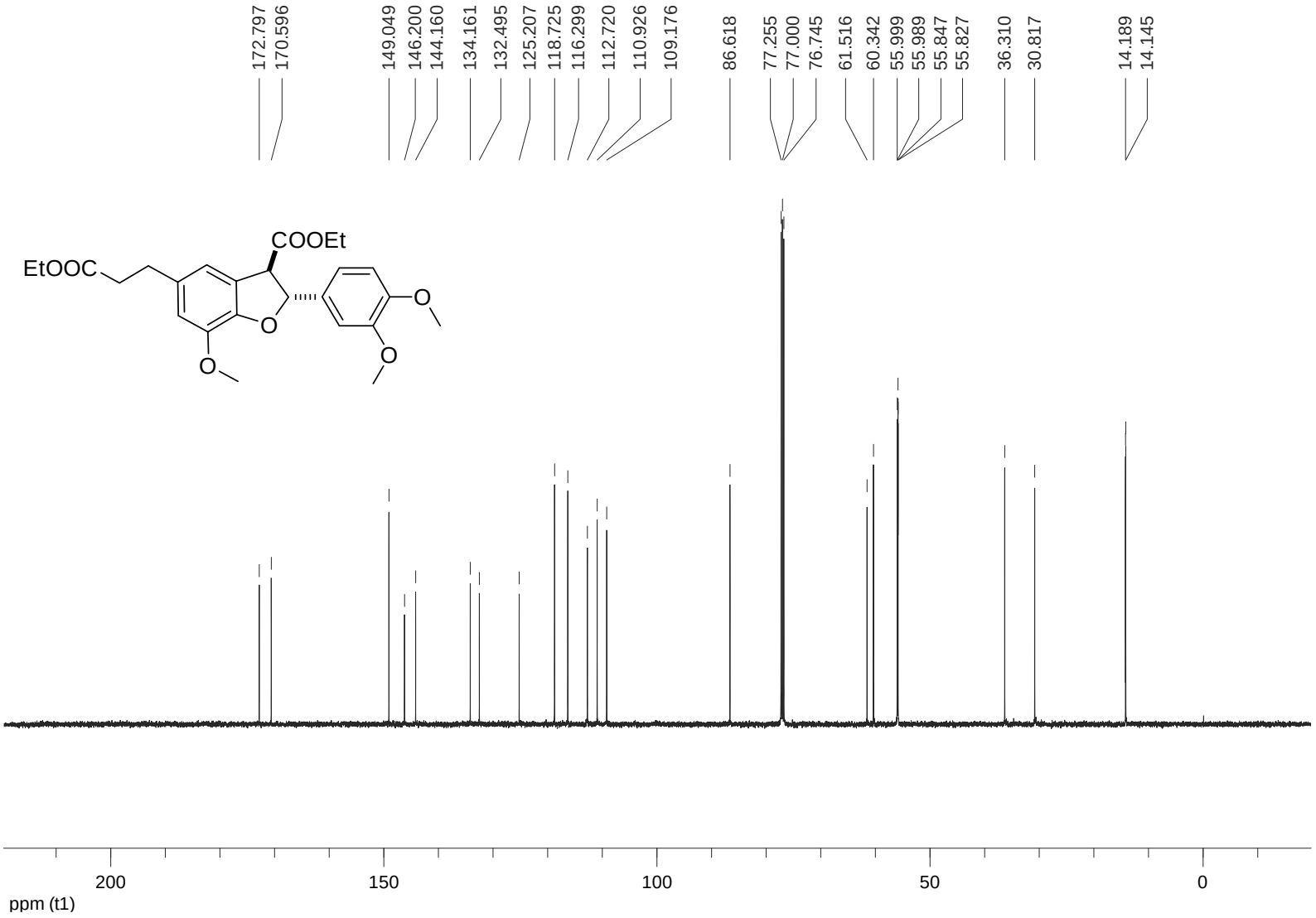
6.954
6.934
6.830
6.814
6.798
6.689
6.045
6.028
4.315
4.301
4.293
4.280
4.264
4.247
4.232
4.225
4.218
4.211
4.196
4.145
4.130
4.116
4.102
3.884
3.865
3.853
3.833
2.917
2.901
2.886
2.610
2.594
2.579
1.331
1.317
1.303
1.249
1.235
1.221
COOEt
EtOOC
O
O
O
O
1.00
2.24
3.42
9.16
2.14
2.15
3.07
10.0
5.0
0.0
ppm (t1)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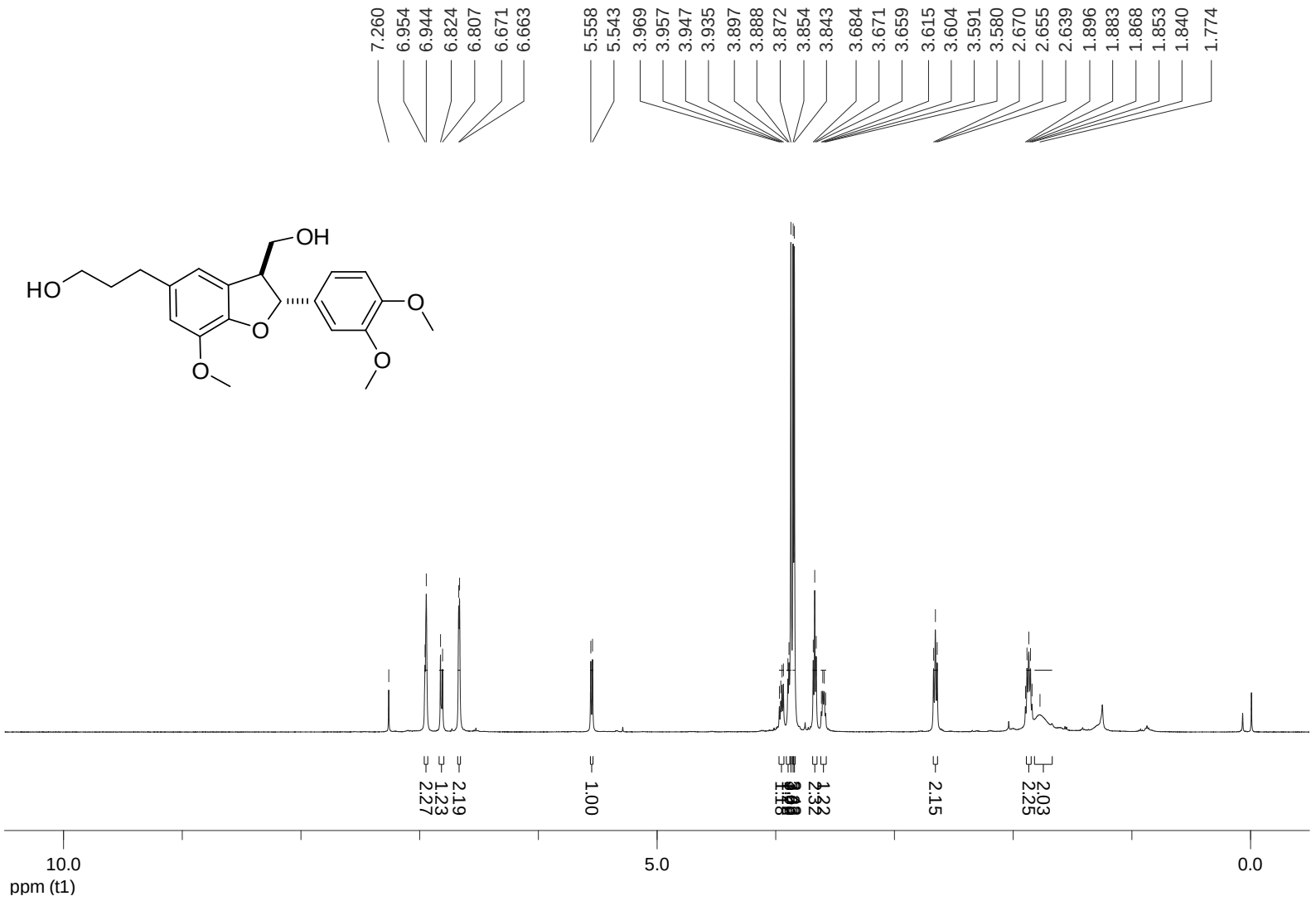
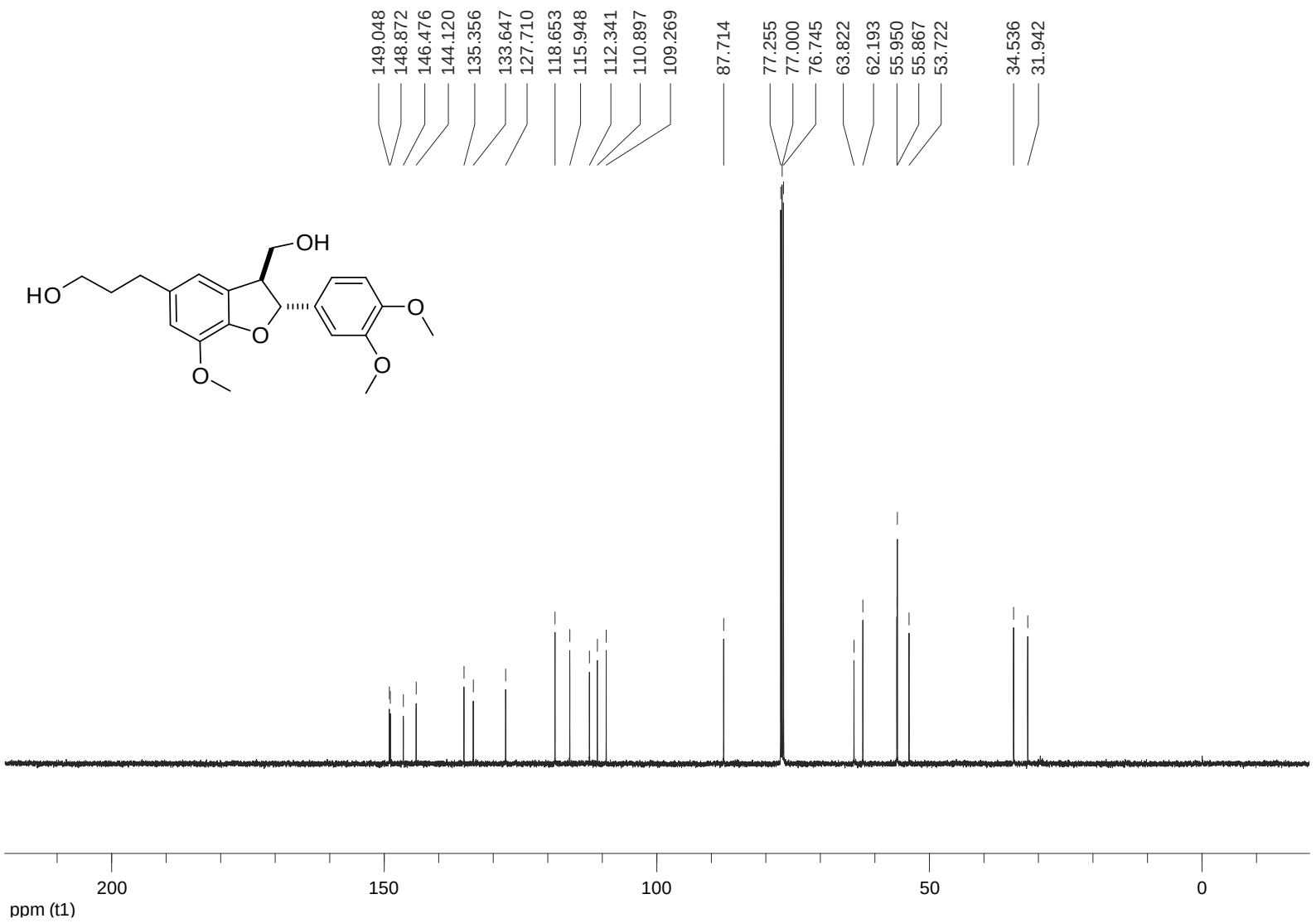
170.596
149.049
146.200
144.160
134.161
132.495
125.207
118.725
116.299
112.720
110.926
109.176
86.618
77.255
77.000
76.745
61.516
60.342
55.999
55.989
55.847
55.827
36.310
30.817
14.189
14.145
COOEt
EtOOC
O
O
O
O
200
150
100
50
0
ppm (t1)


7.260
6.954
6.944
6.824
6.807
6.671
6.663
5.558
5.543
3.969
3.957
3.947
3.935
3.897
3.888
3.872
3.854
3.843
3.684
3.671
3.659
3.615
3.604
3.591
3.580
2.670
2.655
2.639
1.896
1.883
1.868
1.853
1.840
1.774
HO
OH
O
O
O
O
2.27
1.23
2.19
1.00
2.15
2.25
2.03
10.0
5.0
0.0
ppm (t1)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144.120
135.356
133.647
127.710
118.653
115.948
112.341
110.897
109.269
87.714
77.255
77.000
76.745
63.822
62.193
55.950
55.867
53.722
34.536
31.942
HO
OH
O
O
O
O
200
150
100
50
0
ppm (t1)