Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.


# Synthesis of β-hydroxysulfones through a copper(II)-catalyzed multicomponent reaction with the insertion of sulfur dioxide

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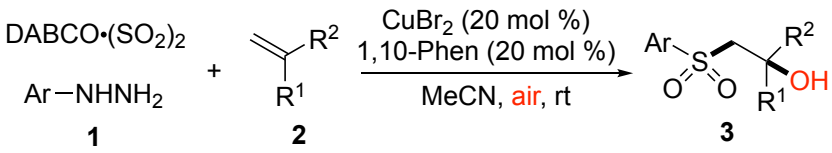
## Supporting Information

1. General experimental methods (S2).
2. General experimental procedure and characterization data (S2-S11).
3. $^{1}H$ and $^{13}C$ NMR spectra of compounds **3, 5, 7** and **8** (S12-S67).

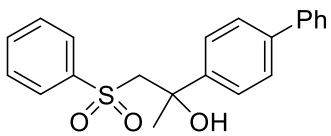
**General experimental methods:**

Unless otherwise stated, all commercial reagents were used as received. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (60-Å pore size, 32–63μm, standard grade). Analytical thin–layer chromatography was performed using glass plates pre-coated with 0.25 mm 230–400 mesh silica gel impregnated with a fluorescent indicator (254 nm). Thin layer chromatography plates were visualized by exposure to ultraviolet light. Organic solutions were concentrated on rotary evaporators at ~20 Torr at 25–35°C. Nuclear magnetic resonance (NMR) spectra are recorded in parts per million from internal tetramethylsilane on the δ scale. $^{1}H$ and $^{13}C$ NMR spectra were recorded in $CDCl_3$ on a Bruker DRX-400 spectrometer operating at 400 MHz and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants quoted in Hz. High resolution mass spectrometry (HRMS) spectra were obtained on a micrOTOF II Instrument.

*General experimental procedure for the reaction of arylhydrazines **1**, DABCO·$(SO_2)_2$, and alkenes **2** under air.*

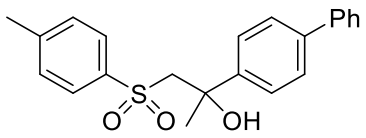



In a tube, arylhydrazines **1** (0.4 mmol) was added to a mixture of DABCO·$(SO_2)_2$ (0.4 mmol), alkenes **2** (0.2 mmol), $CuBr_2$ (0.04 mmol) and 1,10-Phen (0.04 mmol) in $CH_3CN$ (2 mL) under air atmosphere. The mixture was stirred at room temperature overnight. After completion of reaction as indicated by TLC, the solvent was evaporated and the residue was purified directly by flash column chromatography (*n*-hexane/ethyl acetate = 6:1-4:1) to give the corresponding product **3**.



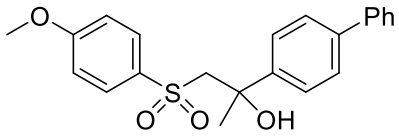
2-([1,1'-Biphenyl]-4-yl)-1-(phenylsulfonyl)propan-2-ol (**3a**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.58-7.56 (m, 2H), 7.53-7.56 (m, 3H), 7.49-7.43 (m, 2H), 7.39-7.29 (m, 7H), 4.72 (s, 1H), 3.84 (d, *J* = 14.8, 1H), 3.68 (d, *J* = 14.8, 1H), 1.73 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 143.1, 140.4, 140.0, 133.2, 129.0, 128.8, 127.5, 127.4, 126.9, 126.8, 125.1, 73.0, 66.6, 30.9. HRMS (ESI) calcd for $C_{21}H_{20}NaO_3S^+$: 375.1025 ($M+Na^+$), found: 375.1036.



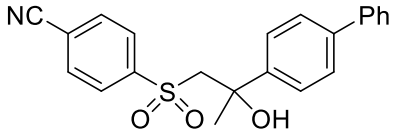

2-([1,1'-Biphenyl]-4-yl)-1-tosylpropan-2-ol (**3b**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.51 (d, *J* = 7.4 Hz, 2H), 7.46-7.41 (m, 4H), 7.39 - 7.31 (m, 5H), 7.11 (d, *J* = 8.1 Hz, 2H), 4.70 (s, 1H), 3.80 (d, *J* = 14.7, 1H), 3.65 (d, *J* = 14.7, 1H), 2.30 (s, 3H), 1.71 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 144.3, 143.2, 140.4, 140.0, 137.1. 129.6, 128.7, 127.5, 127.4, 126.9, 126.7, 125.1, 72.9, 66.6, 30.9, 21.4. HRMS (ESI) calcd for $C_{22}H_{22}NaO_3S^+$: 389.1182 ($M+Na^+$), found: 389.1193.



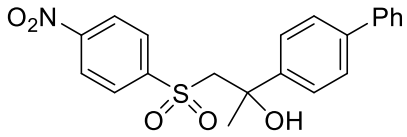

2-([1,1'-Biphenyl]-4-yl)-1-((4-methoxyphenyl)sulfonyl)propan-2-ol (**3c**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.53 (d, *J* = 7.5 Hz, 2H), 7.46-7.43 (m, 4H), 7.36 (m, 3H), 7.29 (d, *J* = 7.6 Hz, 2H), 6.73 (d, *J* = 8.0 Hz, 2H), 4.78 (s, 1H), 3.81 (d, *J* = 14.8 Hz, 1H), 3.72-3.61 (m, 4H), 1.69 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 163.4, 143.1, 140.4, 139.8, 131.4, 129.7, 128.8, 127.4, 126.9, 126.7, 125.2, 114.1, 72.9, 66.7, 55.4, 31.1. HRMS (ESI) calcd for $C_{22}H_{22}NaO_4S^+$: 405.1131 ($M+Na^+$), found: 405.1139.



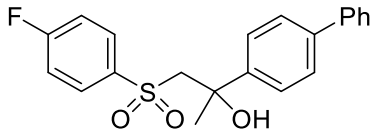

4-((2-([1,1'-Biphenyl]-4-yl)-2-hydroxypropyl)sulfonyl)benzonitrile (**3d**)

$^{1}$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.63-7.54 (m, 4H), 7.54-7.46 (m, 4H), 7.42-7.33 (m, 3H), 7.28-7.22 (m, 2H), 4.44 (s, 1H), 3.89 (d, *J* = 15.0 Hz, 1H), 3.74 (d, *J* = 15.0 Hz, 1H), 1.70 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 143.9, 142.6, 140.5, 139.8, 132.6, 129.0, 128.3, 127.7, 126.8, 125.3, 116.8, 116.8, 72.8, 66.8, 31.0. HRMS (ESI) calcd for $C_{22}H_{19}NNaO_3S^+$: 400.0978 ($M+Na^+$), found: 400.0993.



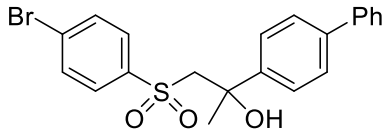

2-([1,1'-Biphenyl]-4-yl)-1-((4-nitrophenyl)sulfonyl)propan-2-ol (**3e**)

$^{1}$H NMR (400 MHz, $CDCl_3$): δ (ppm) 8.11 (d, *J* = 8.7 Hz, 2H), 7.69 (d, *J* = 8.7 Hz, 2H), 7.45-7.42 (m, 4H), 7.40-7.30 (m, 3H), 7.29-7.22 (m, 2H), 4.37 (s, 1H), 3.90 (d, *J* = 15.0 Hz, 1H), 3.75 (d, *J* = 15.0 Hz, 1H), 1.71 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 150.3, 145.4, 142.6, 140.7, 139.8, 129.1, 128.9, 127.7, 126.9, 126.8, 125.3, 124.0, 72.9, 67.0, 31.0. HRMS (ESI) calcd for $C_{21}H_{19}NNaO_5S^+$: 420.0876 ($M+Na^+$), found: 420.0894.




2-([1,1'-Biphenyl]-4-yl)-1-((4-fluorophenyl)sulfonyl)propan-2-ol (**3f**)

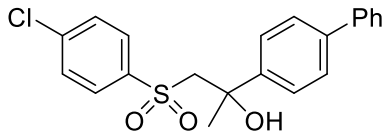
$^{1}$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.65-7.50 (m, 4H), 7.47 (t, *J* = 7.2 Hz, 2H), 7.39 (d, *J* = 7.1 Hz, 3H), 7.30 (d, *J* = 7.3 Hz, 2H), 6.98 (t, *J* = 7.8 Hz, 2H), 4.65 (s, 1H), 3.84 (d, *J* = 14.8 Hz, 1H), 3.70 (d, J = 14.8 Hz, 1H), 1.71 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 165.4 (d, $^{1}J_{CF}$ = 256.6 Hz), 142.9, 140.3, 140.2, 136.0, 130.4 (d, $^{3}J_{CF}$ = 9.7 Hz), 128.8, 127.5, 126.9, 126.8, 125.2, 116.2 (d, $^{2}J_{CF}$ = 22.7 Hz), 72.9, 66.8, 31.1. HRMS (ESI) calcd for $C_{21}H_{19}FNaO_3S^+$: 393.0931 ($M+Na^+$), found: 393.0951.




2-([1,1'-Biphenyl]-4-yl)-1-((4-bromophenyl)sulfonyl)propan-2-ol (**3g**)

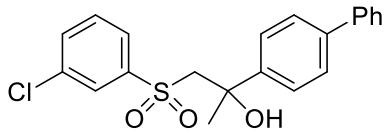
$^{1}$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.55 (d, *J* = 7.7 Hz, 2H), 7.48-7.42 (m, 4H), 7.41-7.32 (m, 5H), 7.26 (d, *J* = 7.5 Hz, 2H), 4.61 (s, 1H), 3.85 (d, *J* = 14.9 Hz, 1H), 3.69 (d, *J* =

14.9 Hz, 1H), 1.69 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.7, 140.4, 140.2, 138.9, 132.2, 129.0, 128.8, 128.6, 127.5, 127.1, 126.8, 125.2, 72.8, 66.7, 31.2. HRMS (ESI) calcd for $C_{21}H_{19}BrNaO_3S^+$: 453.0130 ($M+Na^+$), found: 453.0143.



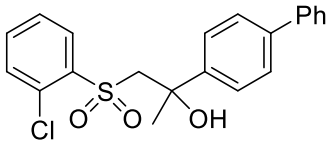

2-([1,1'-Biphenyl]-4-yl)-1-((4-chlorophenyl)sulfonyl)propan-2-ol (**3h**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.53 (d, *J* = 7.7 Hz, 2H), 7.47-7.41 (m, 4H), 7.39-7.35 (m, 3H), 7.26 (d, *J* = 7.7 Hz, 4H), 4.60 (s, 1H), 3.84 (d, *J* = 14.9 Hz, 1H), 3.68 (d, *J* = 14.9 Hz, 1H), 1.68 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.8, 140.4, 140.2, 140.0, 138.4, 129.2, 129.0, 128.8, 127.5, 127.0, 126.9, 125.2, 72.9, 66.8, 31.1. HRMS (ESI) calcd for $C_{21}H_{19}ClNaO_3S^+$: 409.0636 ($M+Na^+$), found: 409.0634.



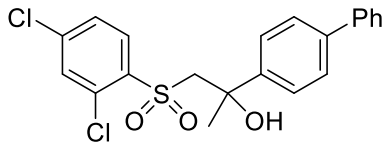

2-([1,1'-Biphenyl]-4-yl)-1-((3-chlorophenyl)sulfonyl)propan-2-ol (**3i**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.52 (d, *J* = 7.7 Hz, 2H), 7.49-7.40 (m, 5H), 7.38-7.34 (m, 3H), 7.31-7.20 (m, 3H), 4.58 (s, 1H), 3.86 (d, *J* = 14.9 Hz, 1H), 3.69 (d, *J* = 14.9 Hz, 1H), 1.70 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.7, 141.6, 140.3, 140.3, 135.2, 133.4, 130.2, 128.8, 127.9, 127.4, 127.0, 126.9, 125.6, 125.2, 72.9, 66.7, 31.2. HRMS (ESI) calcd for $C_{21}H_{19}ClNaO_3S^+$: 409.0636 ($M+Na^+$), found: 409.0640.



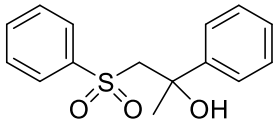

2-([1,1'-Biphenyl]-4-yl)-1-((2-chlorophenyl)sulfonyl)propan-2-ol (**3j**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.48-7.31 (m, 8H), 7.29-7.23 (m, 4H), 7.01 (t, *J* = 7.6 Hz, 1H), 4.67 (s, 1H), 4.40 (d, *J* = 15.2 Hz, 1H), 3.78 (d, *J* = 15.2 Hz, 1H), 1.68 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.5, 140.3, 140.0, 137.0, 134.1, 131.9, 131.3, 131.1, 128.8, 127.4, 127.2, 126.8, 126.7, 125.0, 72.8, 64.4, 31.2. HRMS (ESI) calcd for $C_{21}H_{19}ClNaO_3S^+$: 409.0636 ($M+Na^+$), found: 409.0645.



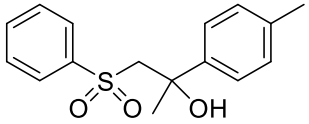

2-([1,1'-Biphenyl]-4-yl)-1-((2,4-dichlorophenyl)sulfonyl)propan-2-ol (**3k**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.49-7.40 (m, 5H), 7.38-7.32 (m, 1H), 7.32-7.23 (m, 5H), 6.95 (dd, *J* = 8.6, 2.0 Hz, 1H), 4.57 (s, 1H), 4.38 (d, *J* = 15.3 Hz, 1H), 3.76 (d, *J* = 15.3 Hz, 1H), 1.66 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.3, 140.5, 140.2, 140.0, 135.7, 132.8, 132.0, 131.0, 128.8, 127.5, 127.0, 126.7, 125.0, 72.7, 64.5, 31.2. HRMS (ESI) calcd for $C_{21}H_{18}Cl_2NaO_3S^+$: 443.0246 ($M+Na^+$), found: 443.0269.



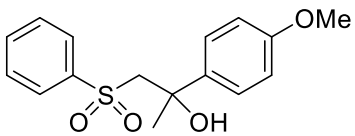

2-Phenyl-1-(phenylsulfonyl)propan-2-ol (**3l**)[1]

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.59 (d, *J* = 7.7 Hz, 2H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.37 (t, *J* = 7.4 Hz, 2H), 7.28 (d, *J* = 7.6 Hz, 2H), 7.21-7.10 (m, 3H), 4.62 (s, 1H), 3.74 (d, *J* = 14.7 Hz, 1H), 3.62 (d, *J* = 14.7 Hz, 1H), 1.71 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 144.2, 140.2, 133.4, 129.1, 128.2, 127.5, 127.2, 124.6, 73.1, 66.6, 30.8.



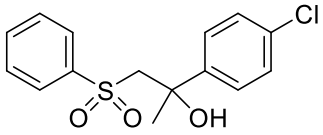

1-(Phenylsulfonyl)-2-(*p*-tolyl)propan-2-ol (**3m**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.57 (d, *J* = 7.7 Hz, 2H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 2H), 7.14 (d, *J* = 7.5 Hz, 2H), 6.96 (d, *J* = 7.6 Hz, 2H), 4.57 (s, 1H), 3.73 (d, *J* = 14.7 Hz, 1H), 3.60 (d, *J* = 14.7 Hz, 1H), 2.27 (s, 3H), 1.68 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 141.3, 140.2, 136.8, 133.2, 128.9, 128.8, 127.5, 124.5, 73.0, 66.8, 30.7, 20.8. HRMS (ESI) calcd for $C_{16}H_{18}NaO_3S^+$: 313.0869 ($M+Na^+$), found: 313.0871.



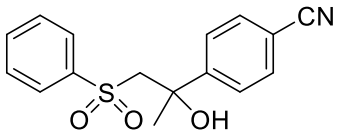

2-(4-Methoxyphenyl)-1-(phenylsulfonyl)propan-2-ol (**3n**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.63-7.56 (m, 2H), 7.56-7.51 (m, 1H), 7.39 (t, *J* = 7.8 Hz, 2H), 7.22-7.11 (m, 2H), 6.74-6.52 (m, 2H), 4.56 (s, 1H), 3.76 (s, 3H), 3.72 (d, *J* = 14.7 Hz, 1H), 3.59 (d, *J* = 14.7 Hz, 1H), 1.68 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 158.6, 140.3, 136.4, 133.3, 129.0, 127.5, 125.8, 113.5, 72.9, 66.8, 55.2, 30.8. HRMS (ESI) calcd for $C_{16}H_{18}NaO_4S^+$: 329.0818 ($M+Na^+$), found: 329.0834.



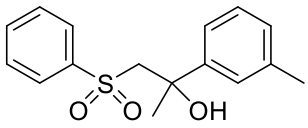

2-(4-Chlorophenyl)-1-(phenylsulfonyl)propan-2-ol (**3o**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.60-7.54 (m, 3H), 7.39 (t, *J* = 7.5 Hz, 2H), 7.18 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 7.6 Hz, 2H), 4.67 (s, 1H), 3.73 (d, *J* = 14.7 Hz, 1H), 3.60 (d, *J* = 14.7 Hz, 1H), 1.65 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 142.7, 139.9, 133.5, 133.1, 129.1, 128.3, 127.4, 126.2, 72.8, 66.4, 30.9. HRMS (ESI) calcd for $C_{15}H_{15}ClNaO_3S^+$: 333.0323 ($M+Na^+$), found: 333.0327.



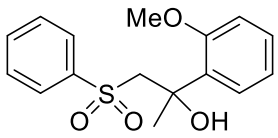

4-(2-Hydroxy-1-(phenylsulfonyl)propan-2-yl)benzonitrile (**3p**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.62-7.58 (m, 3H), 7.49-7.41 (m, 6H), 4.77 (s, 1H), 3.75 (d, *J* = 14.7 Hz, 1H), 3.63 (d, *J* = 14.7 Hz, 1H), 1.68 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 149.5, 139.8, 133.8, 132.0, 129.2, 127.5, 125.7, 118.4, 111.2, 73.0, 65.8, 30.8. HRMS (ESI) calcd for $C_{16}H_{15}NNaO_3S^+$: 324.0665 ($M+Na^+$), found: 324.0658.



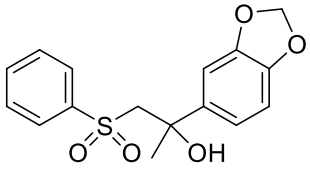

1-(Phenylsulfonyl)-2-(*m*-tolyl)propan-2-ol (**3q**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.59-7.54 (m, 2H), 7.53-7.49 (m, 1H), 7.40-7.31 (m, 2H), 7.14-7.04 (m, 2H), 6.99-6.93 (m, 2H), 4.60 (s, 1H), 3.75 (d, *J* = 14.7 Hz, 1H), 3.61 (d, *J* = 14.7 Hz, 1H), 2.18 (s, 3H), 1.67 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 144.1, 140.2, 137.8, 133.3, 128.9, 128.2, 127.9, 127.4, 125.4, 121.7, 73.0, 66.6, 30.8, 21.3. HRMS (ESI) calcd for $C_{16}H_{18}NaO_3S^+$: 313.0869 ($M+Na^+$), found: 313.0879.



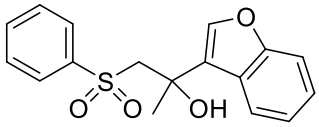

2-(3-Methoxyphenyl)-1-(phenylsulfonyl)propan-2-ol (**3r**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.64 (d, *J* = 7.7 Hz, 1H), 7.41 (t, *J* = 7.2 Hz, 1H), 7.31-7.27 (m, 2H), 7.22 (t, *J* = 7.2 Hz, 2H), 7.08 (t, *J* = 7.7 Hz, 1H), 6.97 (t, *J* = 7.5 Hz, 1H), 6.23 (d, *J* = 8.1 Hz, 1H), 4.87 (s, 1H), 4.55 (d, *J* = 14.9 Hz, 1H), 3.61 (d, *J* = 14.9 Hz, 1H), 3.37 (s, 3H), 1.57 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 154.8, 139.2, 132.7, 131.0, 129.0, 128.3, 127.5, 126.8, 120.7, 110.0, 71.7, 63.3, 54.3, 28.3. HRMS (ESI) calcd for $C_{16}H_{18}NaO_4S^+$: 329.0818 ($M+Na^+$), found: 329.0835.



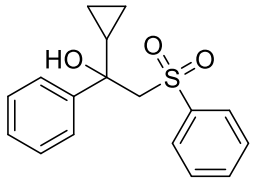

2-(Benzo[*d*][1,3]dioxol-5-yl)-1-(phenylsulfonyl)propan-2-ol (**3s**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.63 (d, *J* = 7.4 Hz, 2H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 2H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.68 (s, 1H), 6.61 (d, *J* = 8.1 Hz, 1H), 5.88 (d, *J* = 12.9 Hz, 2H), 4.60 (s, 1H), 3.71 (d, *J* = 14.7 Hz, 1H), 3.58 (d, *J* = 14.7 Hz, 1H), 1.66 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 147.5, 146.7, 140.1, 138.4, 133.4, 129.0, 127.5, 118.0, 107.8, 105.6, 101.0, 72.9, 66.6, 30.9. HRMS (ESI) calcd for $C_{16}H_{16}NaO_5S^+$: 343.0611 ($M+Na^+$), found: 343.0608.



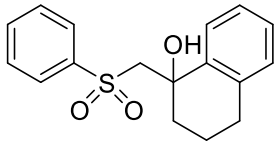

2-(Benzofuran-3-yl)-1-(phenylsulfonyl)propan-2-ol (**3t**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.52 (m, 2H), 7.48-7.43 (m, 1H), 7.21-7.07 (m, 3H), 7.07-7.01 (m, 2H), 6.94-6.88 (m, 1H), 6.71 (d, *J* = 0.8 Hz, 1H), 4.90 (s, 1H), 4.06 (d, *J* = 14.9 Hz, 1H), 3.63 (d, *J* = 14.9 Hz, 1H), 1.66 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 158.5, 154.3, 138.4, 133.0, 128.2, 127.7, 127.4, 123.9, 122.9, 121.1, 110.9, 103.2, 70.0, 64.0, 28.8. HRMS (ESI) calcd for $C_{17}H_{16}NaO_4S^+$: 339.0662 ($M+Na^+$), found: 339.0678.



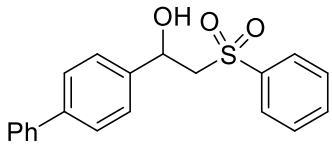
1-Cyclopropyl-1-phenyl-2-(phenylsulfonyl)ethan-1-ol (**3u**)

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.56-7.47 (m, 3H), 7.37-7.31 (m, 2H), 7.25-7.22 (m, 2H), 7.15-7.09 (m, 3H), 4.48 (s, 1H), 3.91 (d, *J* = 14.8 Hz, 1H), 3.72 (d, *J* = 14.8 Hz, 1H), 1.26-1.19 (m, 1H), 0.78-0.65 (m, 1H), 0.59-0.35 (m, 2H), 0.31-0.24 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 143.4, 133.3, 129.0, 128.4, 128.0, 127.5, 127.1, 125.1, 73.0, 65.9, 22.7, 2.4, 0.7. HRMS (ESI) calcd for $C_{17}H_{18}NaO_3S^+$: 325.0869 ($M+Na^+$), found: 325.0882.



1-((Phenylsulfonyl)methyl)-1,2,3,4-tetrahydronaphthalen-1-ol (**3v**)

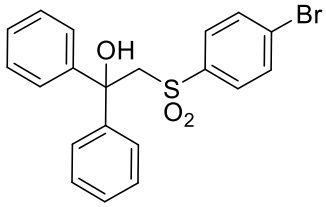
$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.96 (d, *J* = 7.7 Hz, 2H), 7.68 (t, *J* = 7.3 Hz, 1H), 7.59 (t, *J* = 7.5 Hz, 2H), 7.56-7.48 (m, 1H), 7.21-7.16 (m, 2H), 7.11-7.05 (m, 1H), 4.20 (s, 1H), 3.62 (d, *J* = 14.5 Hz, 1H), 3.56 (d, *J* = 14.5 Hz, 1H), 2.98-2.72 (m, 3H), 2.21-2.15 (m, 1H), 2.05-1.96 (m, 1H), 1.90-1.80 (m, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 141.0, 139.7, 136.2, 133.8, 129.4, 129.1, 127.9, 127.5, 126.4, 126.1, 72.6, 65.0, 35.5, 29.0, 19.9. HRMS (ESI) calcd for $C_{17}H_{18}NaO_3S^+$: 325.0869 ($M+Na^+$), found: 325.0886.



1-([1,1'-Biphenyl]-4-yl)-2-(phenylsulfonyl)ethan-1-ol (**3w**)

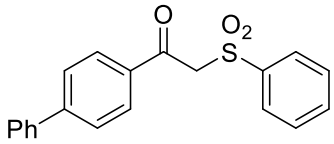
$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.99 (d, *J* = 7.5 Hz, 2H), 7.71 (t, *J* = 7.4 Hz, 1H), 7.61 (t, *J* = 7.7 Hz, 2H), 7.55 (d, *J* = 8.2 Hz, 4H), 7.46-7.34 (m, 5H), 5.35 (d, *J* = 9.8 Hz, 1H), 3.73 (s, 1H), 3.56 (dd, *J* = 14.3, 10.0 Hz, 1H), 3.40 (dd, *J* = 14.4, 1.6 Hz, 1H). $^{13}$C NMR

(100 MHz, $CDCl_3$): δ (ppm) 141.3, 140.4, 139.5, 139.1, 134.1, 129.5, 128.8, 128.0, 127.5, 127.1, 126.1, 68.2, 63.9. HRMS (ESI) calcd for $C_{20}H_{18}NaO_3S^+$: 361.0869 ($M+Na^+$), found: 361.0888.



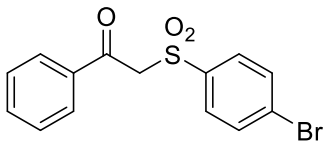

2-((4-Bromophenyl)sulfonyl)-1,1-diphenylethan-1-ol (**3x**)[2]

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.44 (d, *J* = 8.5 Hz, 2H), 7.35-7.29 (m, 6H), 7.22-7.18 (m, 6H), 5.19 (s, 1H), 4.19 (s, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 143.2, 139.0, 132.2, 129.0, 128.7, 128.2, 127.5, 125.7, 76.3, 65.5.




1-([1,1'-Biphenyl]-4-yl)-2-(phenylsulfonyl)ethan-1-one (**5a**)[2]

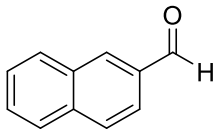
$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 8.03 (d, *J* = 8.5 Hz, 2H), 7.95-7.91 (m, 2H), 7.73-7.62 (m, 5H), 7.57 (t, *J* = 7.7 Hz, 2H), 7.52-7.41 (m, 3H), 4.78 (s, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 187.5, 147.0, 139.4, 138.7, 134.4, 134.2, 129.9, 129.2, 129.0, 128.6, 129.6, 127.4, 127.3, 63.5.




1-([1,1'-Biphenyl]-4-yl)-2-((4-bromophenyl)sulfonyl)ethan-1-one (**5b**)[2]

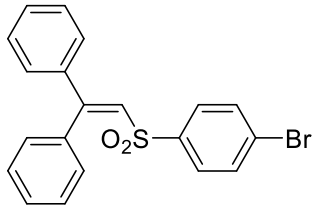
$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.94-7.88 (m, 2H), 7.75 (d, *J* = 8.6 Hz, 2H), 7.67 (d, *J* = 8.6 Hz, 2H), 7.62 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 4.74 (s, 2H). $^{13}$C NMR (100

MHz, $CDCl_3$): δ (ppm) 187.8, 137.5, 135.4, 134.4, 132.4, 130.1, 129.6, 129.1, 128.8, 63.1.




2-Naphthaldehyde (**7**)[3]

$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 10.18 (s, 1H), 8.36 (s, 1H), 8.09-7.90 (m, 4H), 7.69-7.60 (m, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 192.2, 136.4, 134.5, 132.6, 129.5, 129.1, 128.1, 127.1, 122.7.




(2-((4-Bromophenyl)sulfonyl)ethene-1,1-diyl)dibenzene (**8**)[3]

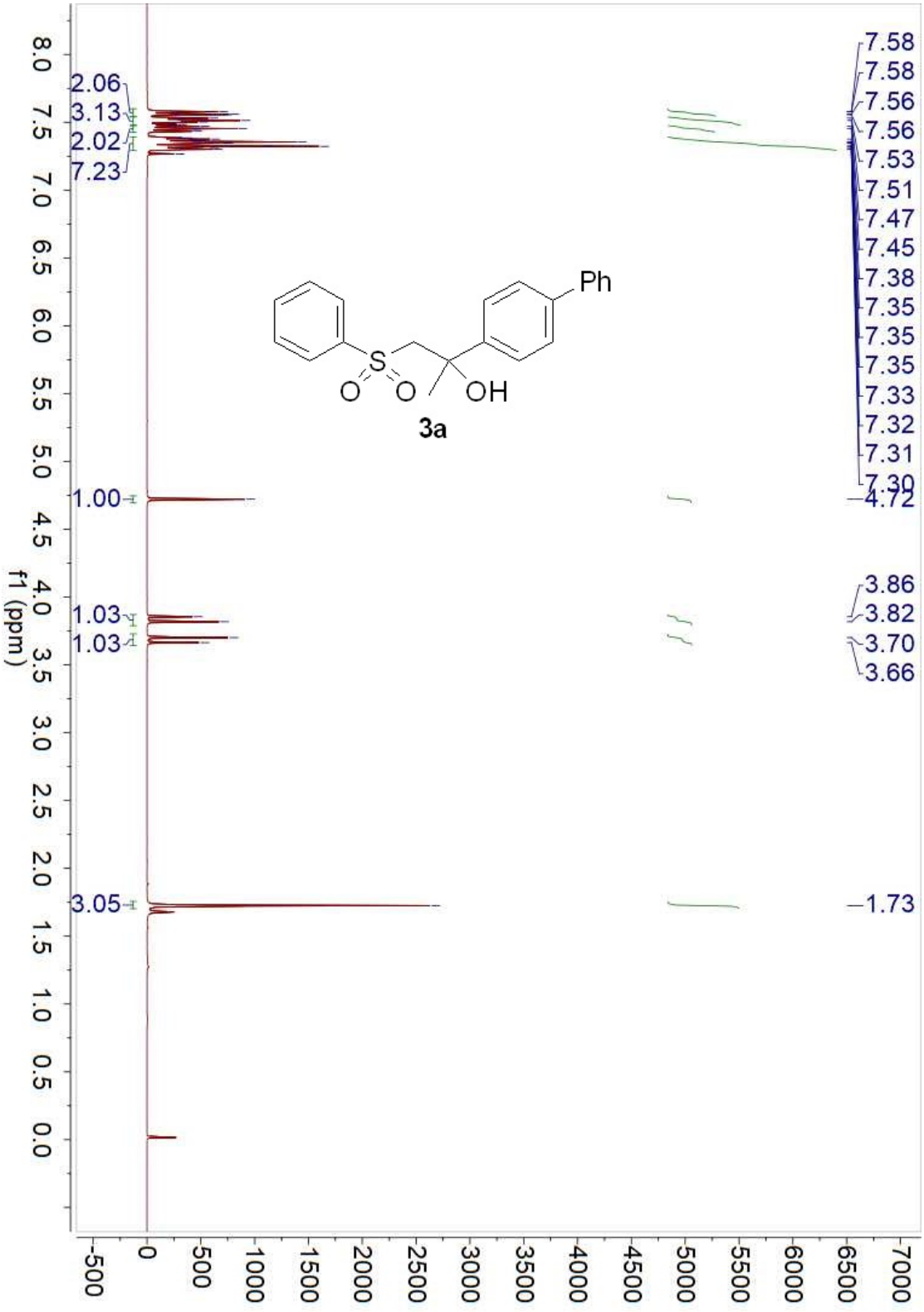
$^1$H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.46 (d, *J* = 8.6 Hz, 2H), 7.41-7.36 (m, 4H), 7.33-7.28 (m, 4H), 7.21 (d, *J* = 7.5 Hz, 2H), 7.06 (d, *J* = 7.2 Hz, 2H), 7.02 (s, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$): δ (ppm) 155.7, 140.3,138.8, 135.3, 131.8, 130.5, 129.7, 129.2, 129.0, 128.6, 128.4, 128.2, 128.0, 127.9.

**Reference:**

[1] Q. Lu, J. Zhang, F. Wei, Y. Qi, H. Wang, Z. Liu, Aiwen Lei, *Angew. Chem. Int. Ed.* **2013**, *52*, 7156.

[2] Y.-S. Xiong, J. Weng, G. Lua, *Adv. Synth. Catal.* **2018**, *360*, 1611.

[3] M. Zhang, Y. Zhai, S. Ru, D. Zang, S. Han, H. Yu, Y. Wei, *Chem. Commun.* **2018**, *54*, 10164.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7.32
7.31
7.30
2.06
3.13
2.02
7.23
1.00
1.03
1.03
3.05
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3.66
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Ph
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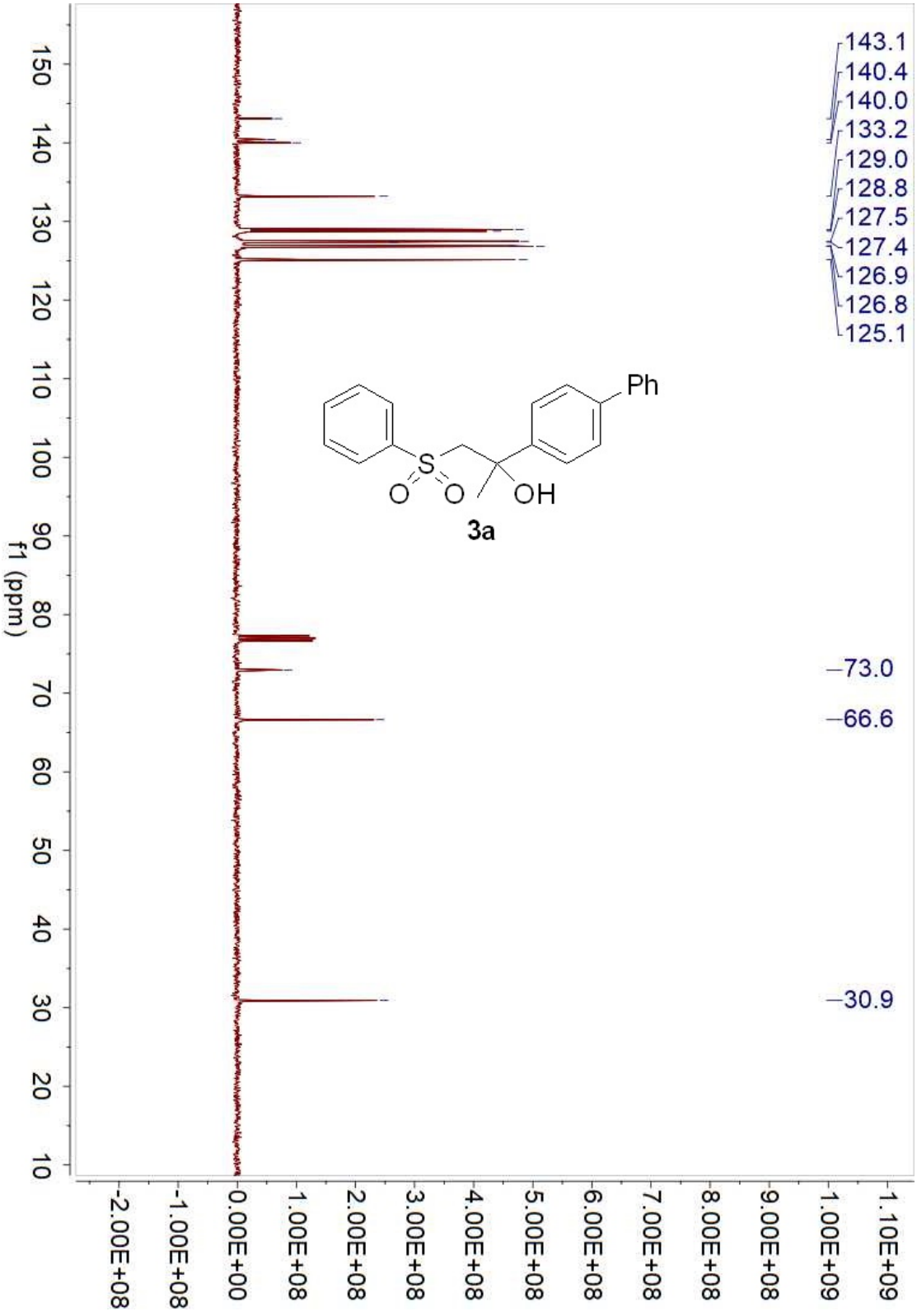
O
O
OH
3a
f1 (ppm)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30.9
Ph
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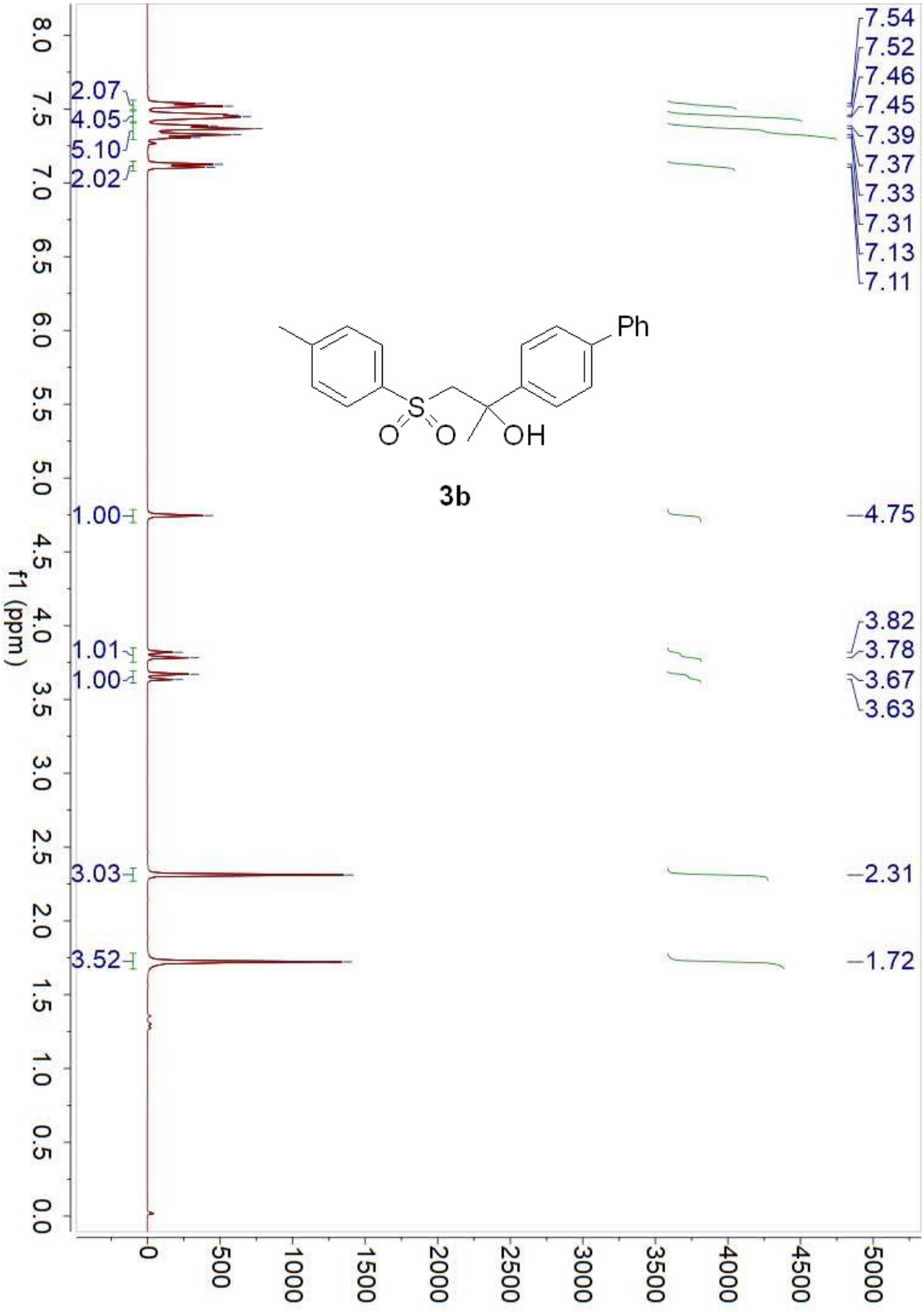
O
O
OH
3a
f1 (ppm)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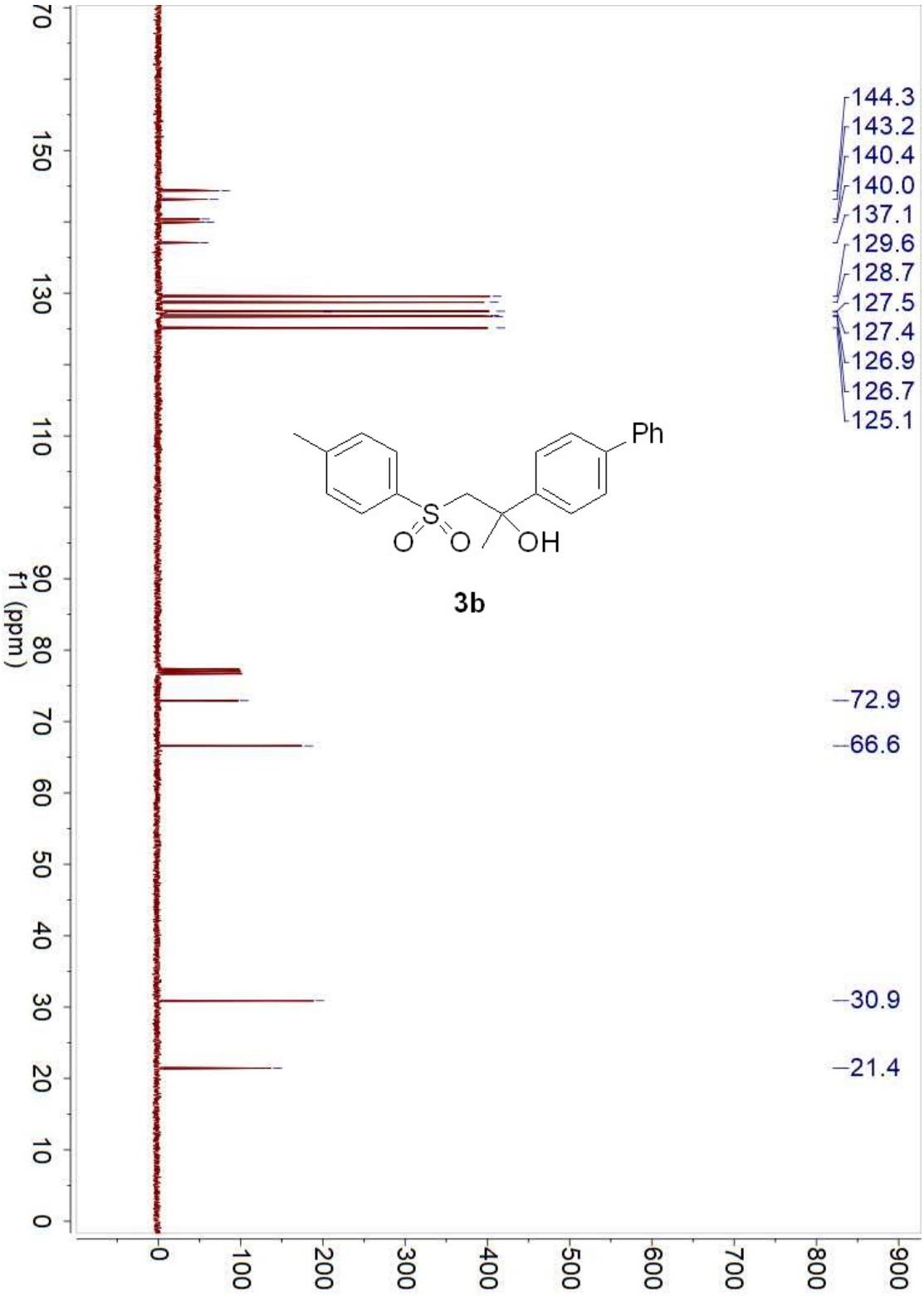
f1 (ppm)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Ph
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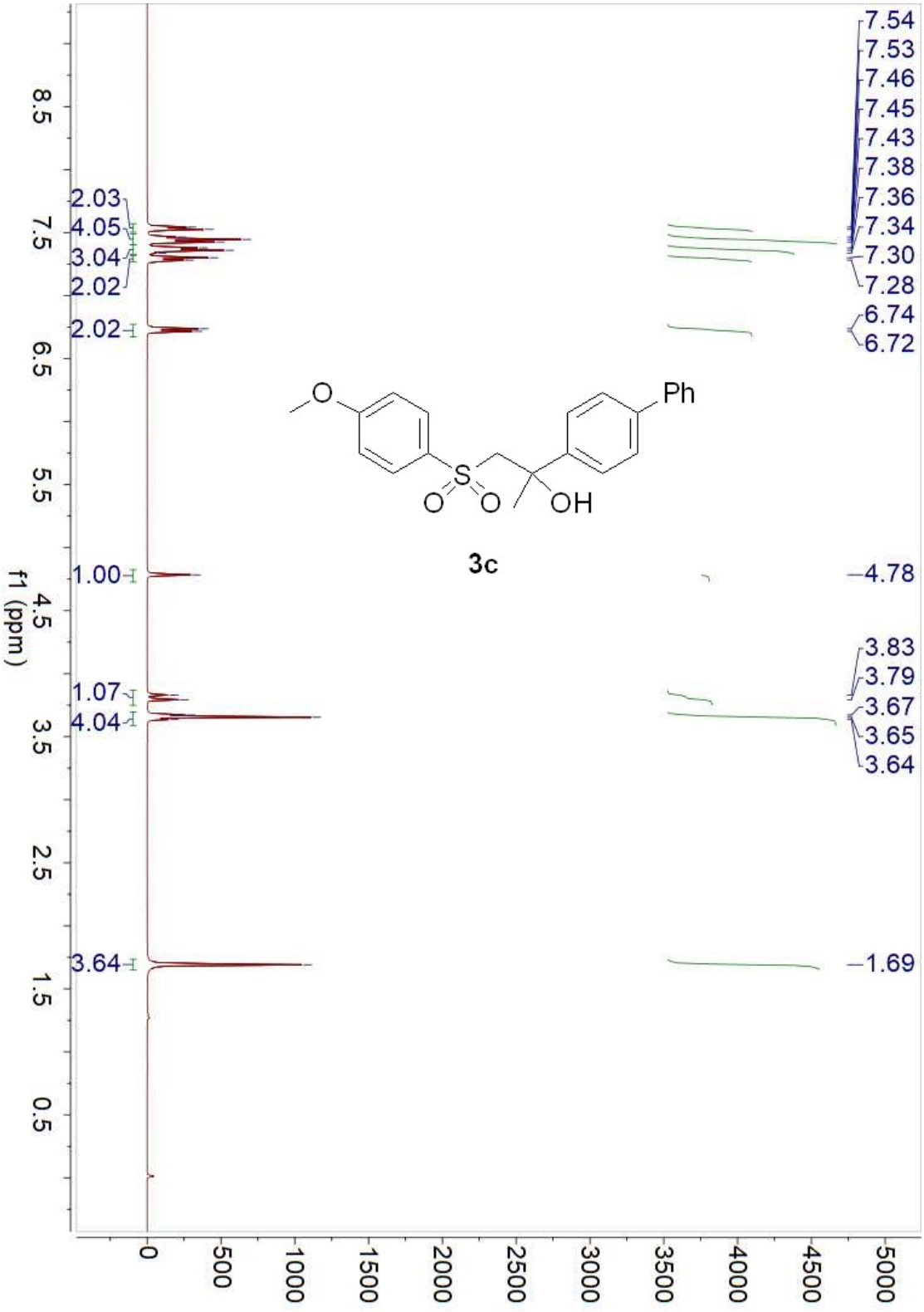
O
OH
3b
f1 (ppm)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Ph
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O
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OH
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f1 (ppm)
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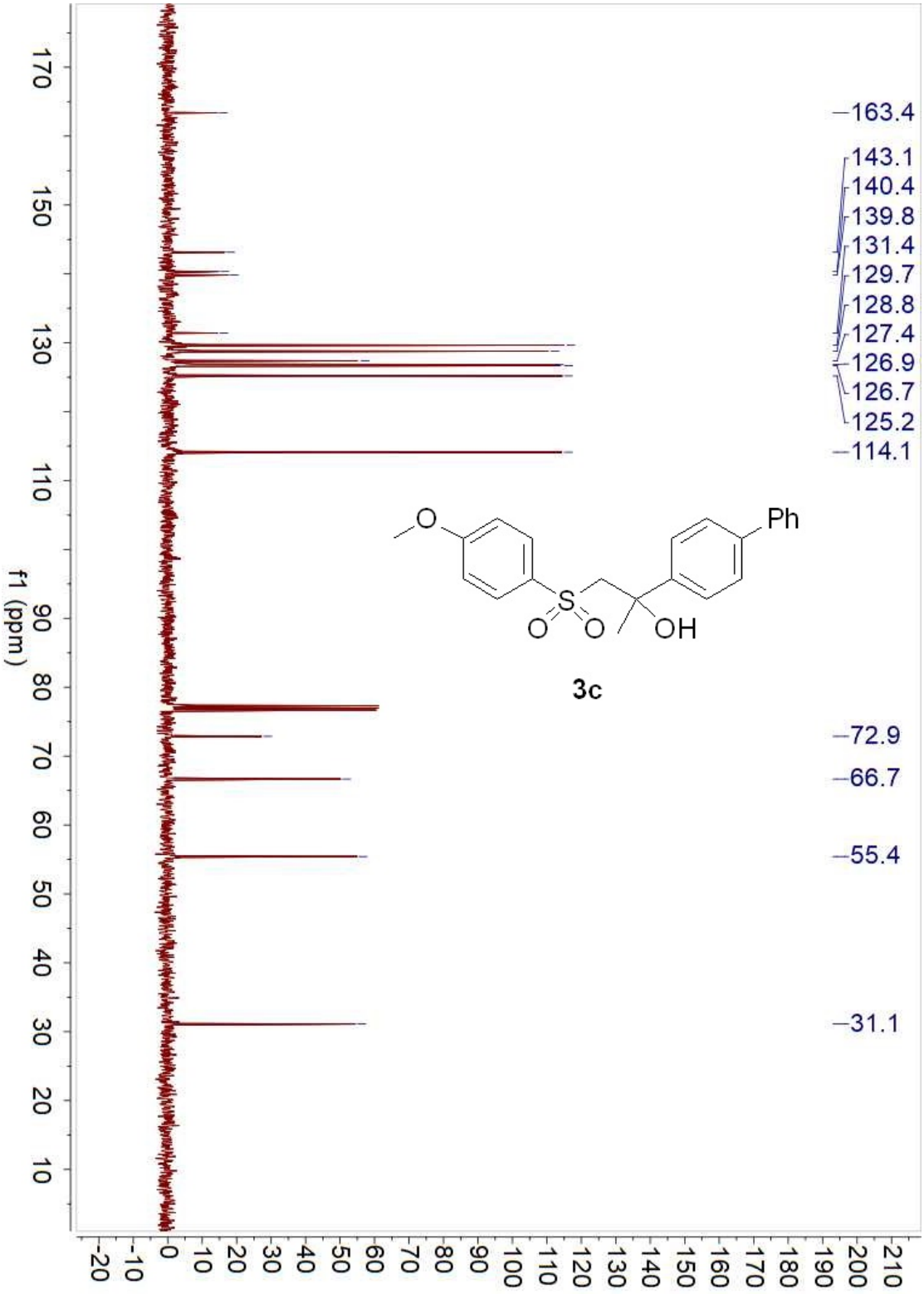
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31.1
f1 (ppm)
O
Ph
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O
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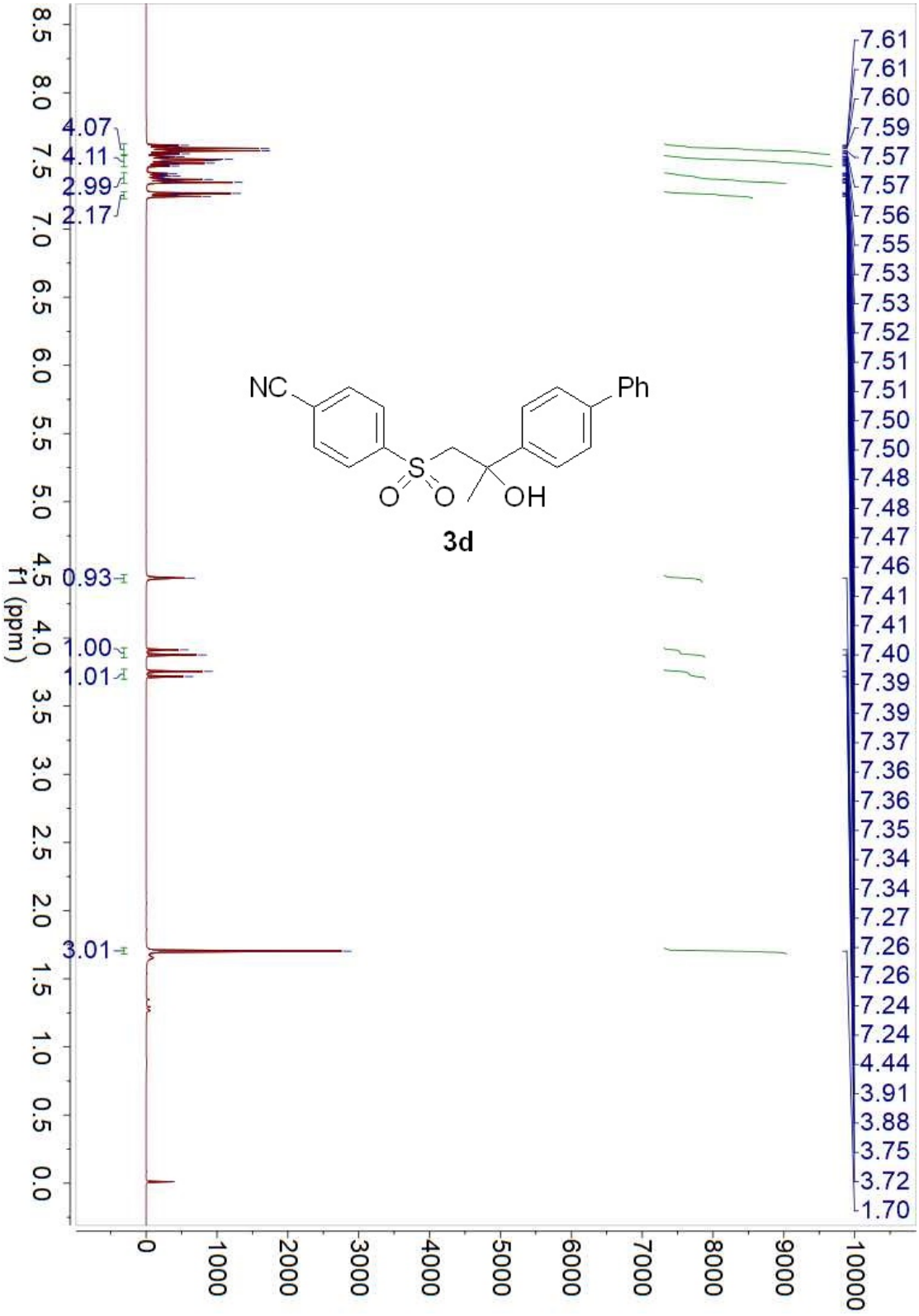
**3c**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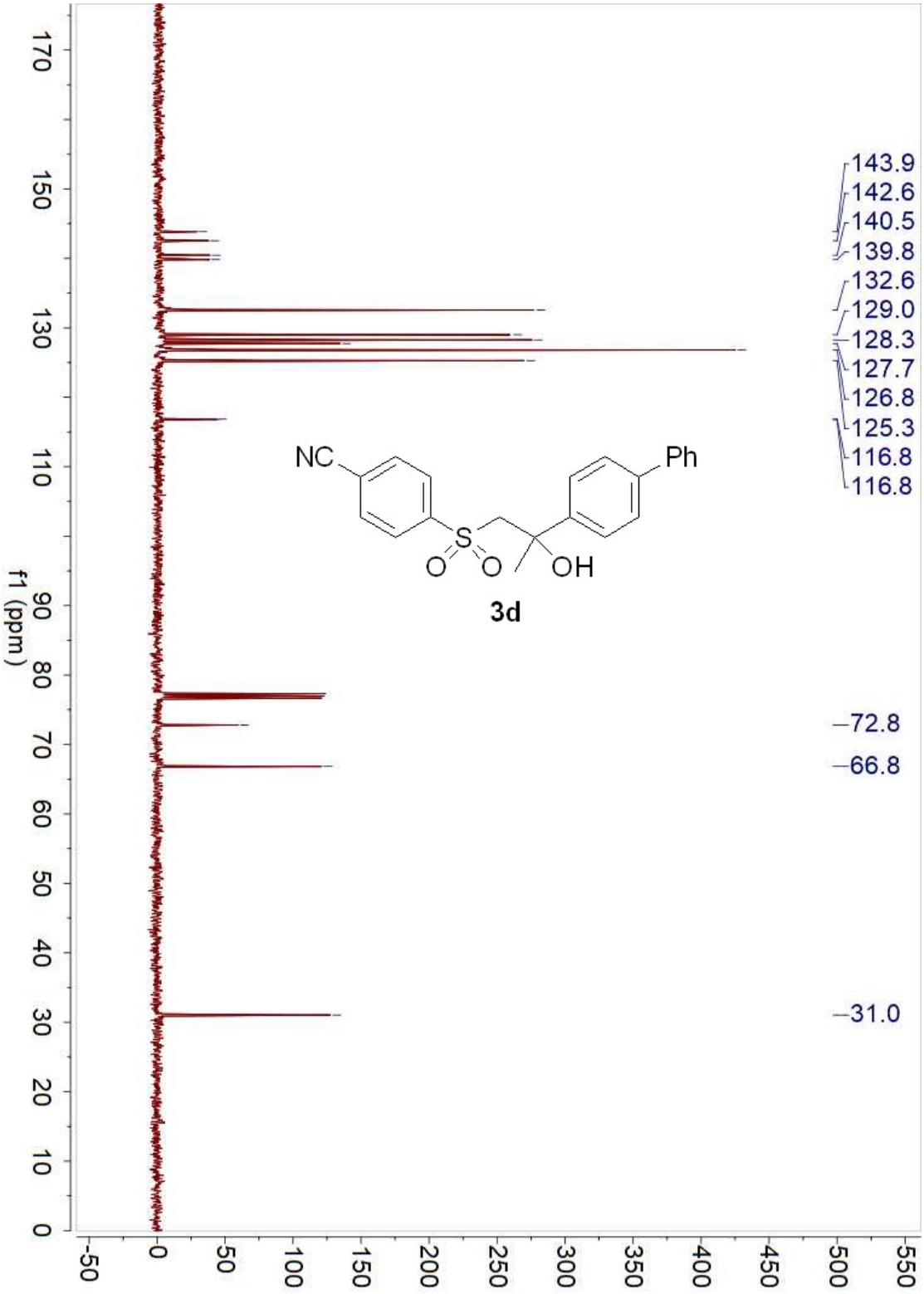
f1 (ppm)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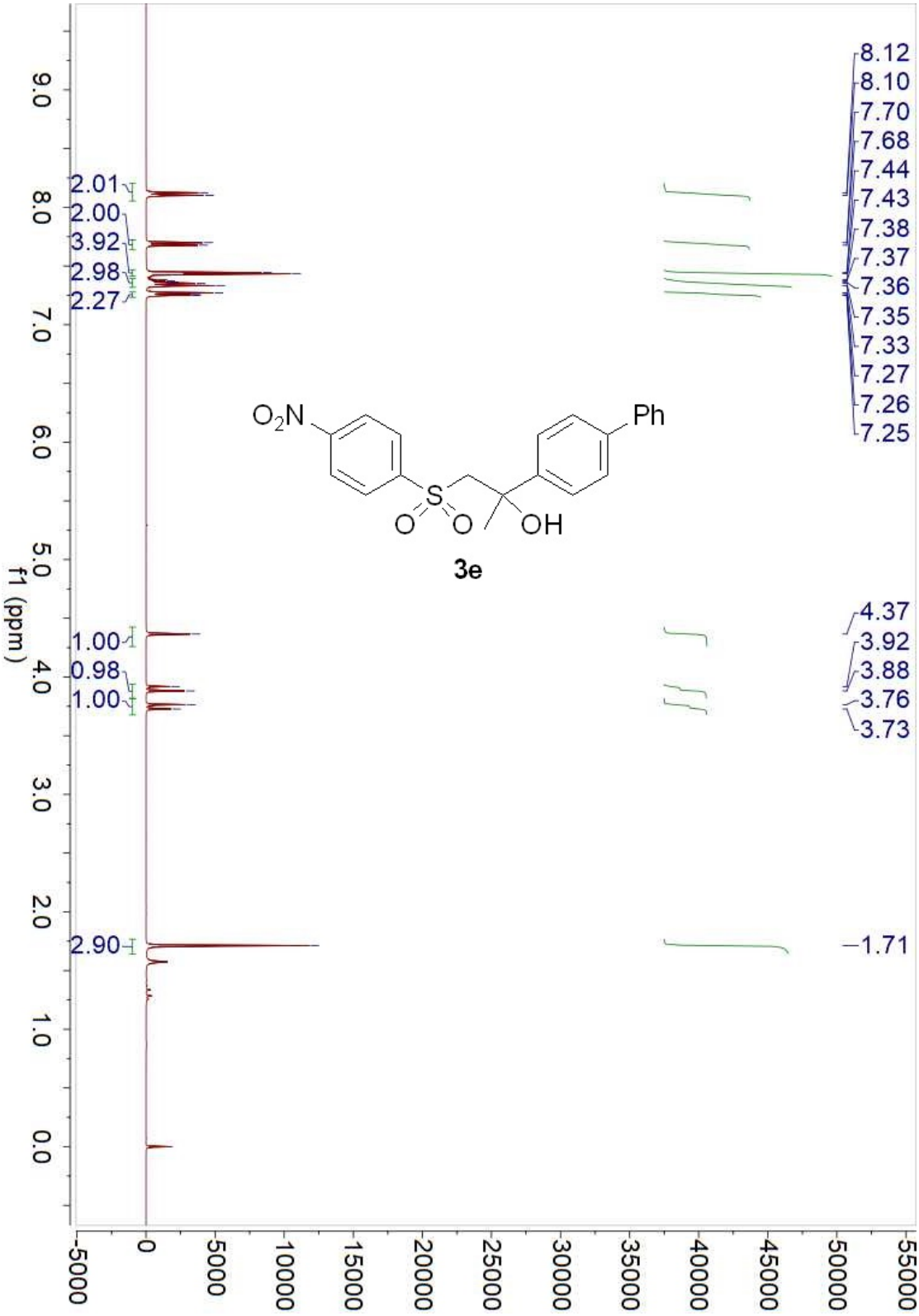
f1 (ppm)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2.27
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0.98
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2.90
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3.76
3.73
1.71
O2N
Ph
S
O
O
OH
3e
f1 (ppm)
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7.0
6.0
5.0
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3.0
2.0
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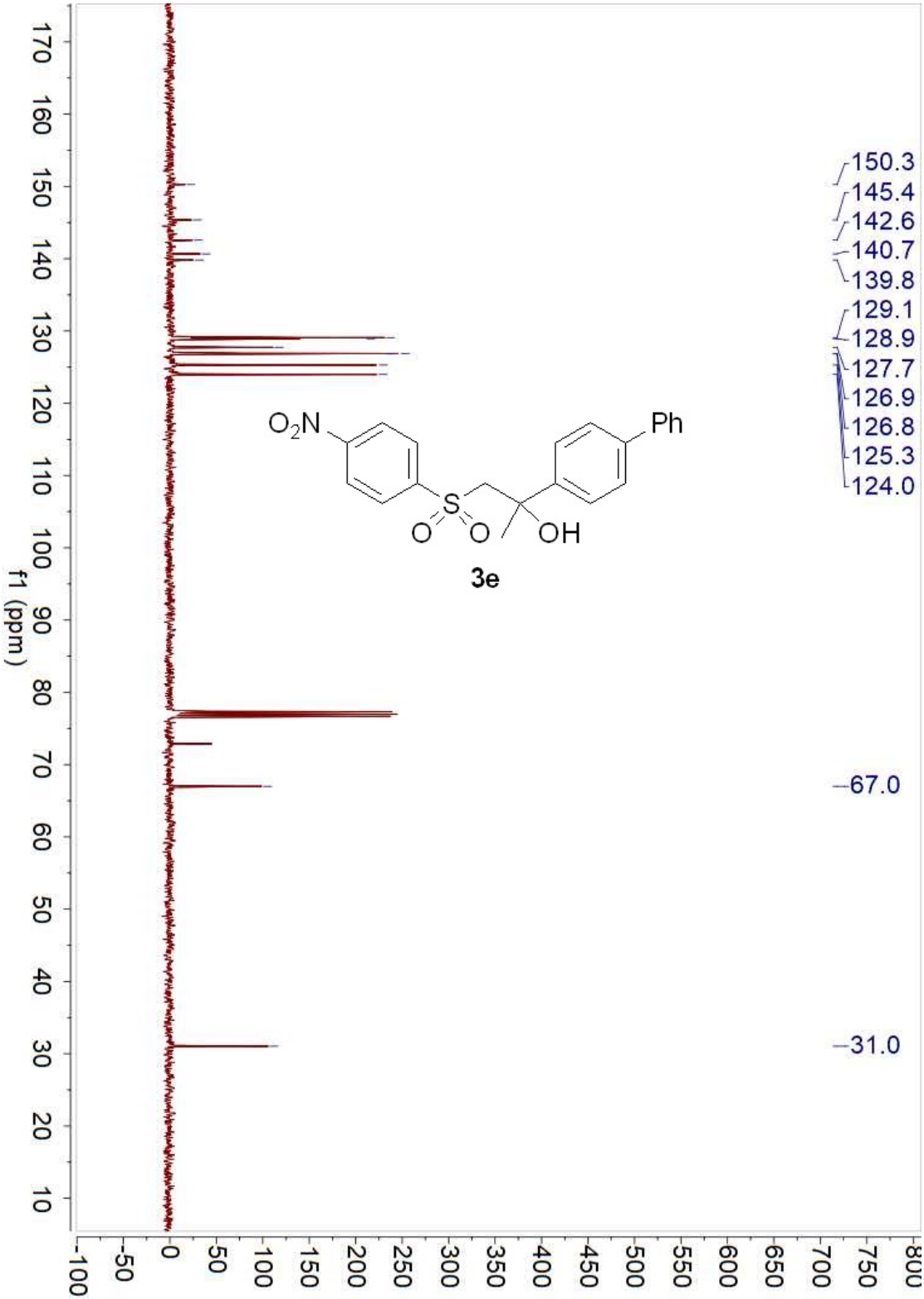
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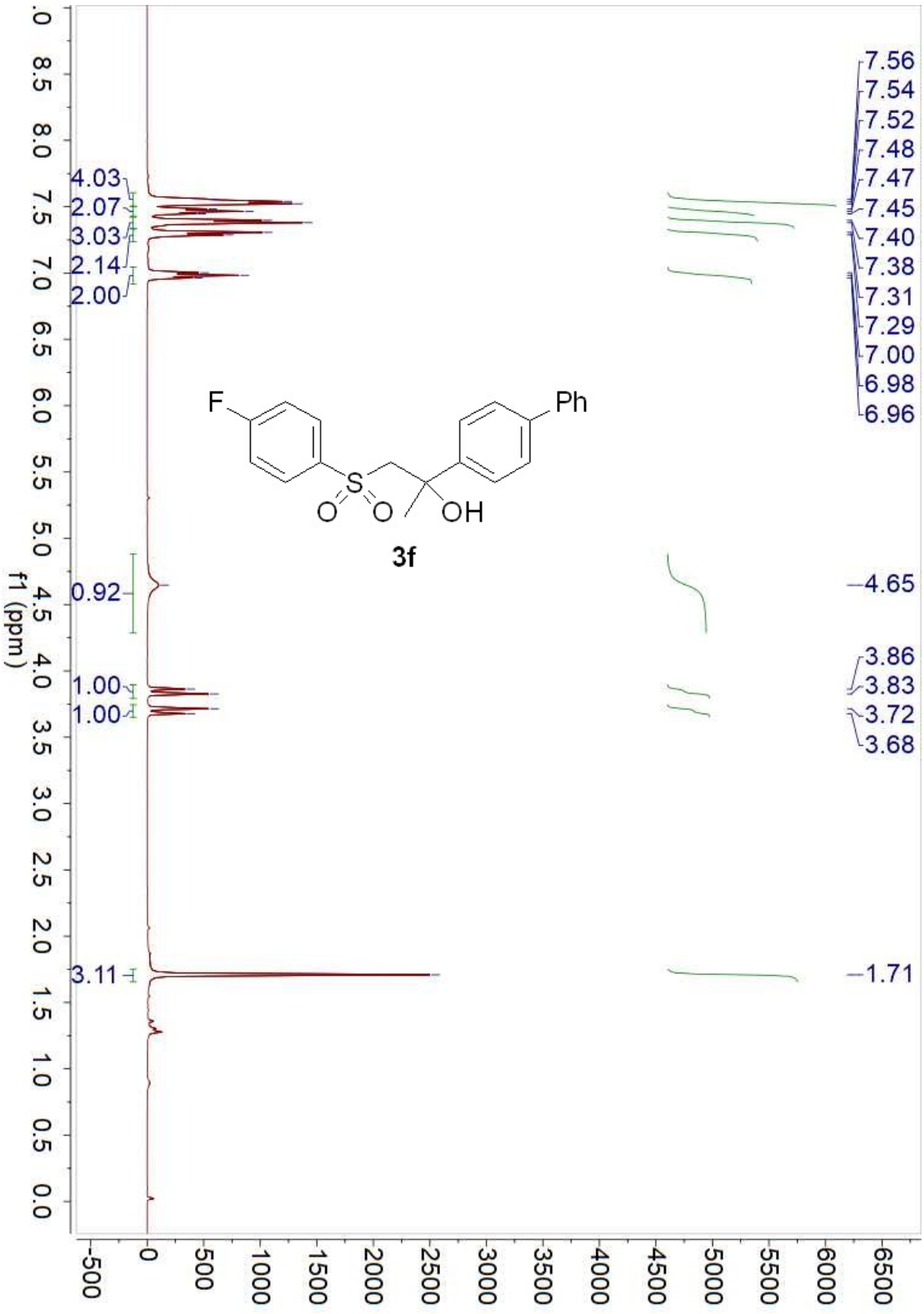
31.0
O2N
Ph
S
O
O
OH
3e
f1 (ppm)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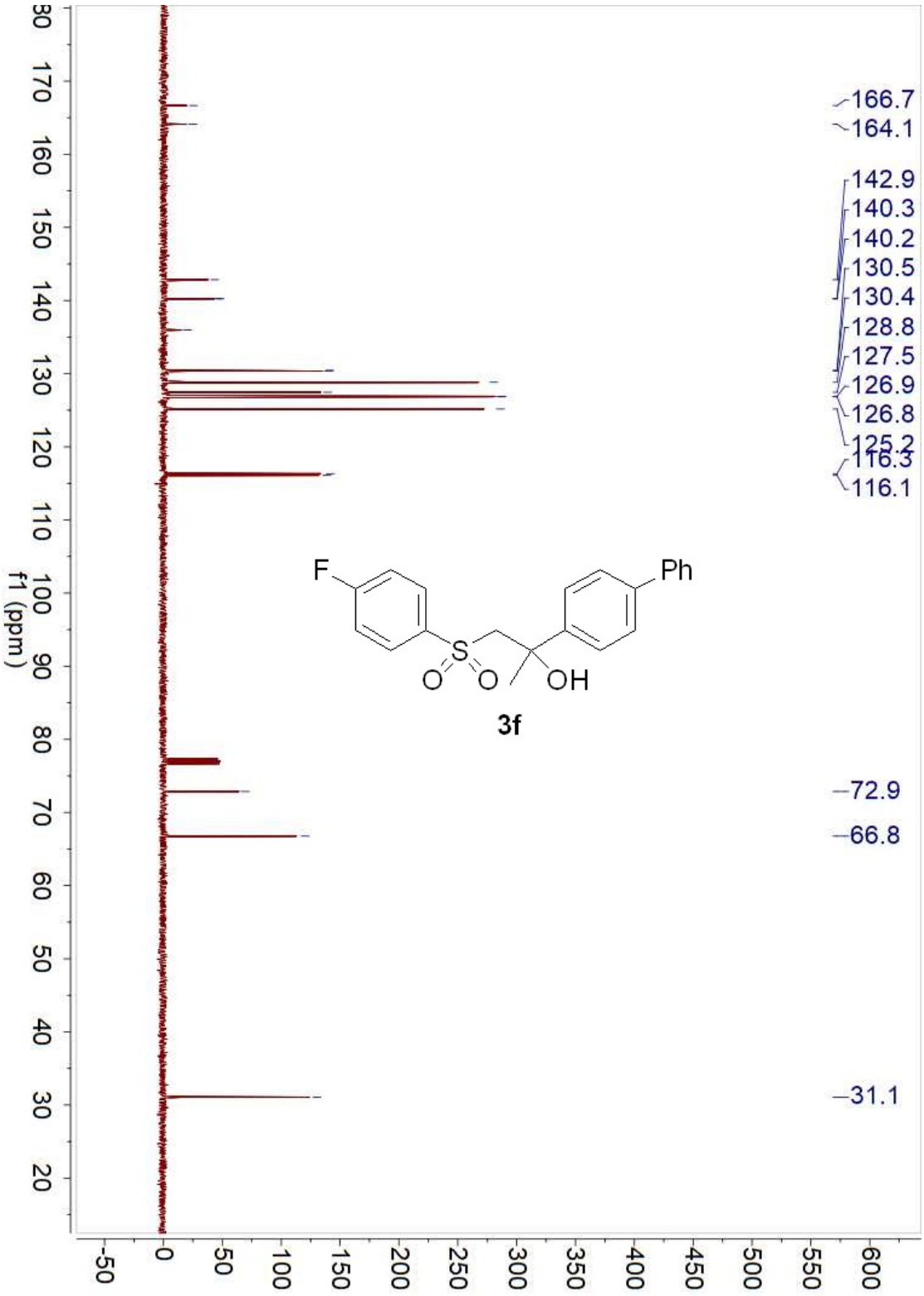
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F
Ph
S
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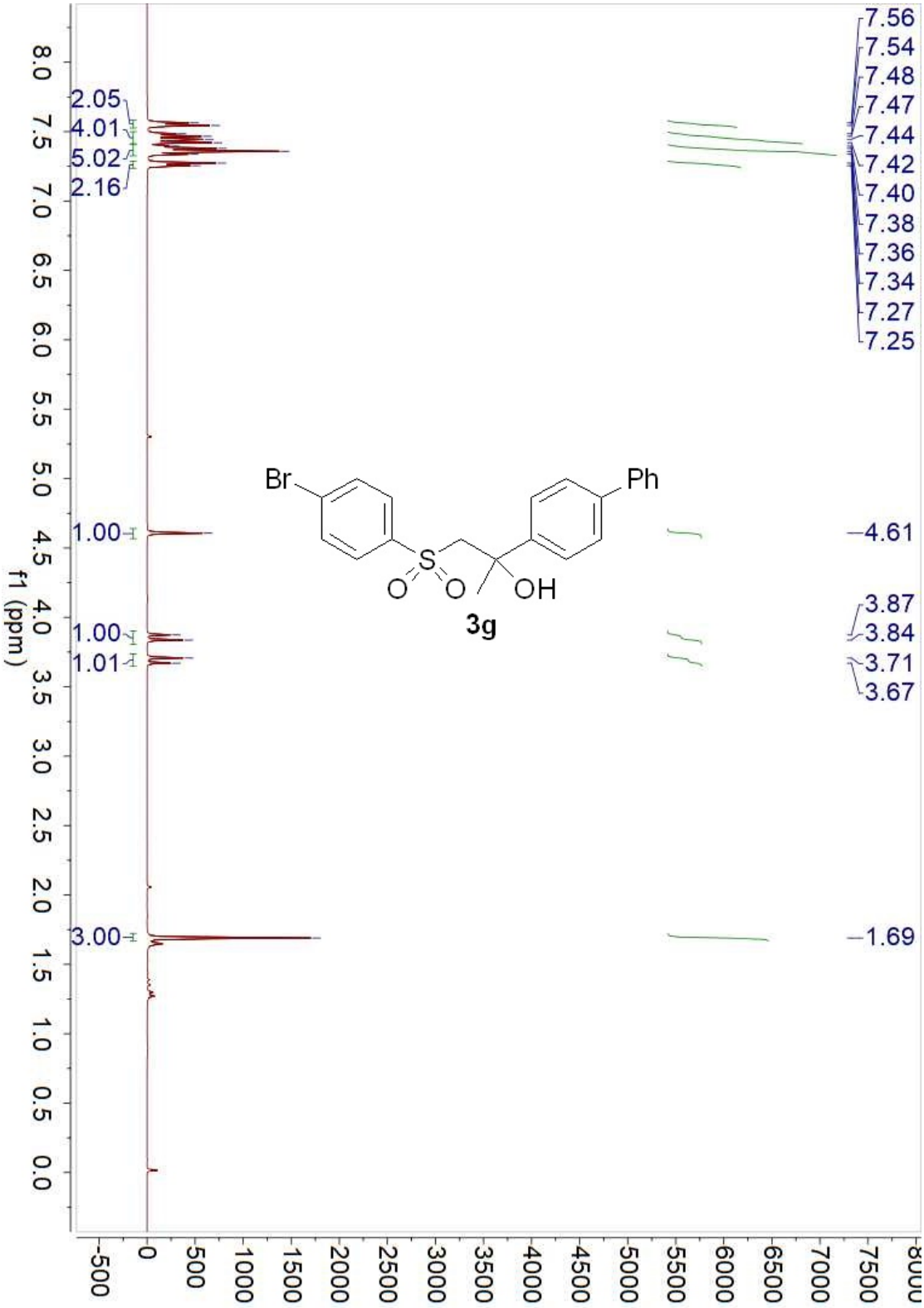
OH
3f
f1 (ppm)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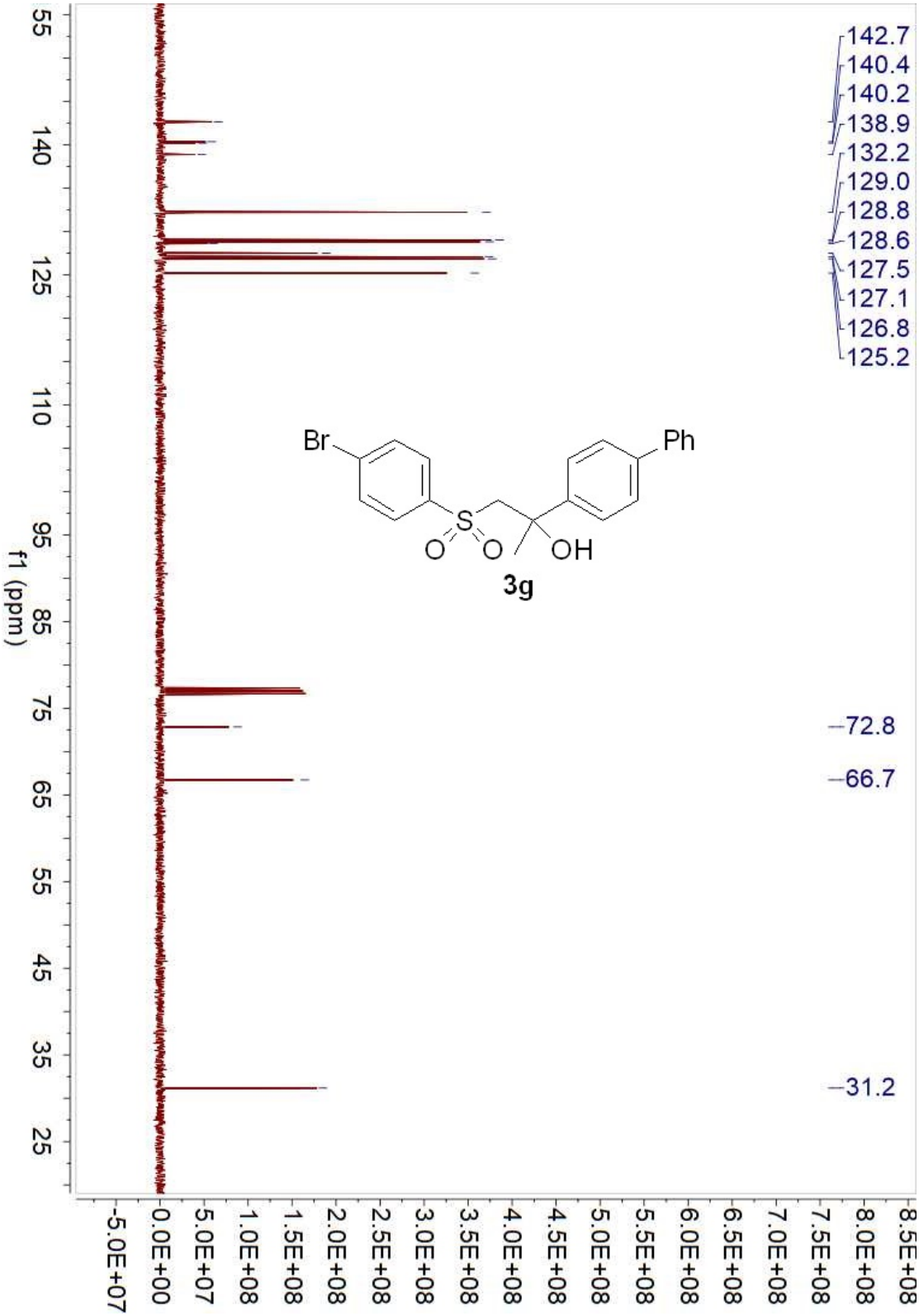
3g
f1 (ppm)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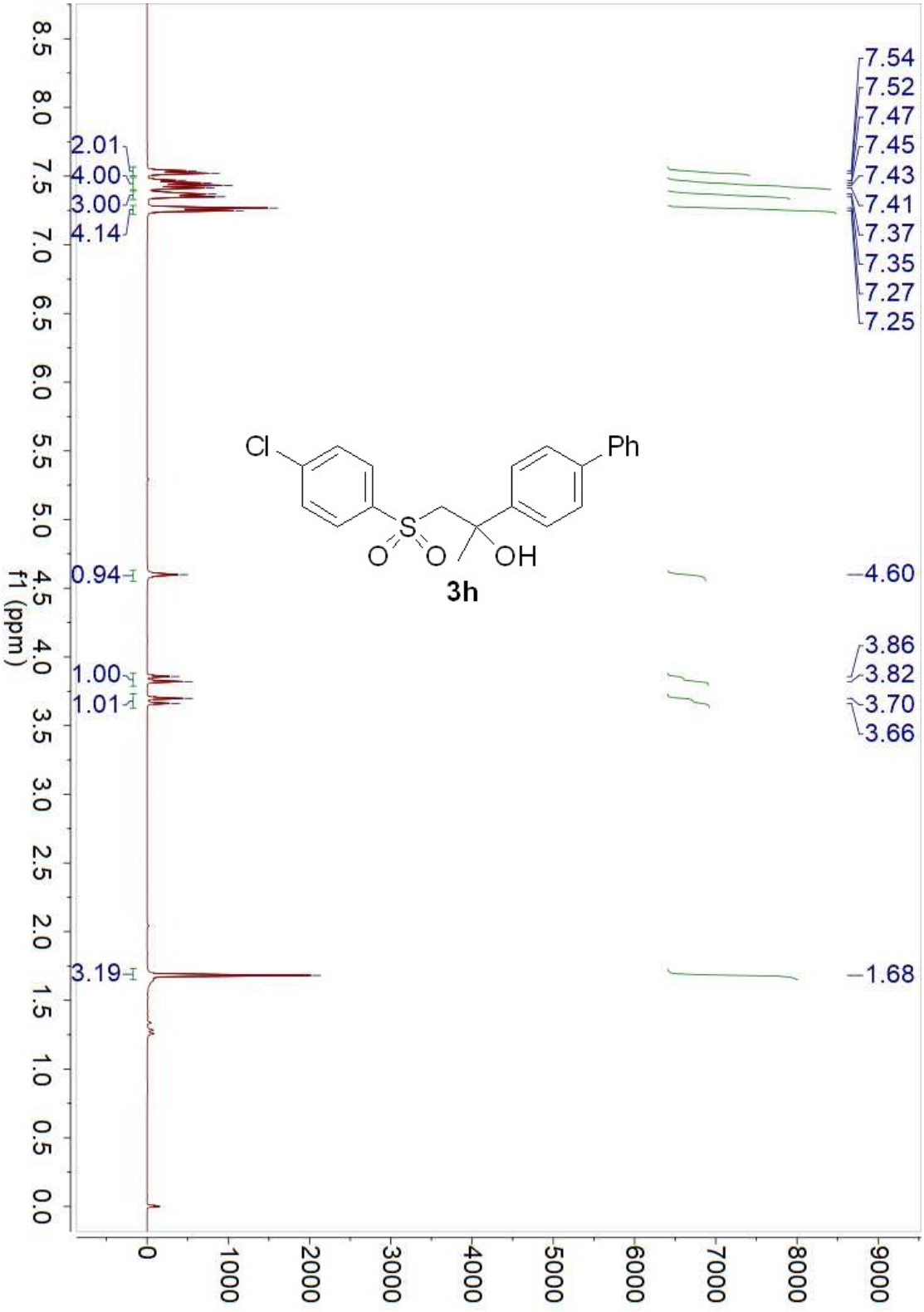
140.4
140.2
138.9
132.2
129.0
128.8
128.6
127.5
127.1
126.8
125.2
72.8
66.7
31.2
Br
Ph
S
O
O
OH
3g
f1 (ppm)


7.54
7.52
7.47
7.45
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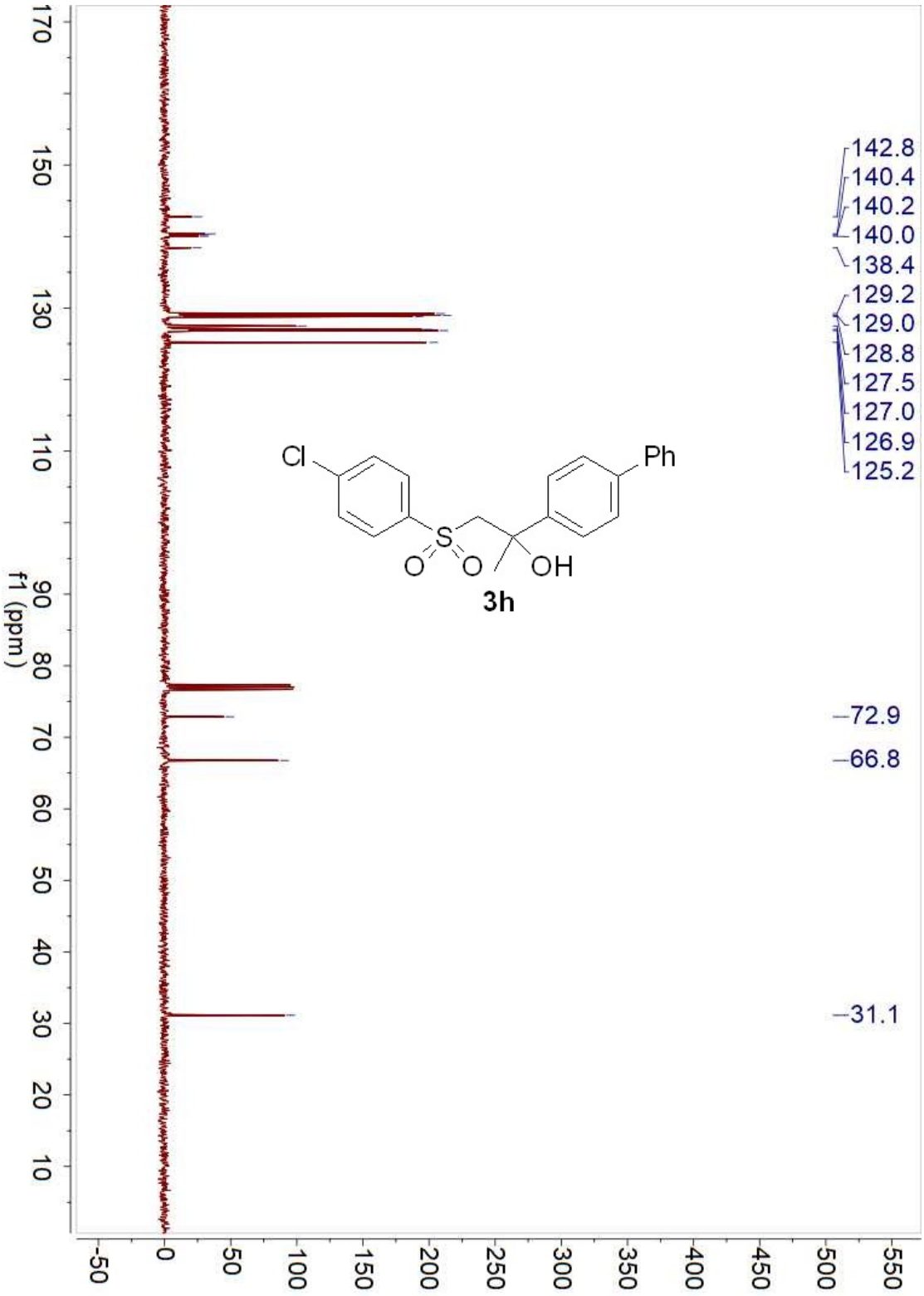
7.41
7.37
7.35
7.27
7.25
2.01
4.00
3.00
4.14
0.94
1.00
1.01
3.19
4.60
3.86
3.82
3.70
3.66
1.68
Cl
Ph
S
O
O
OH
3h
f1 (ppm)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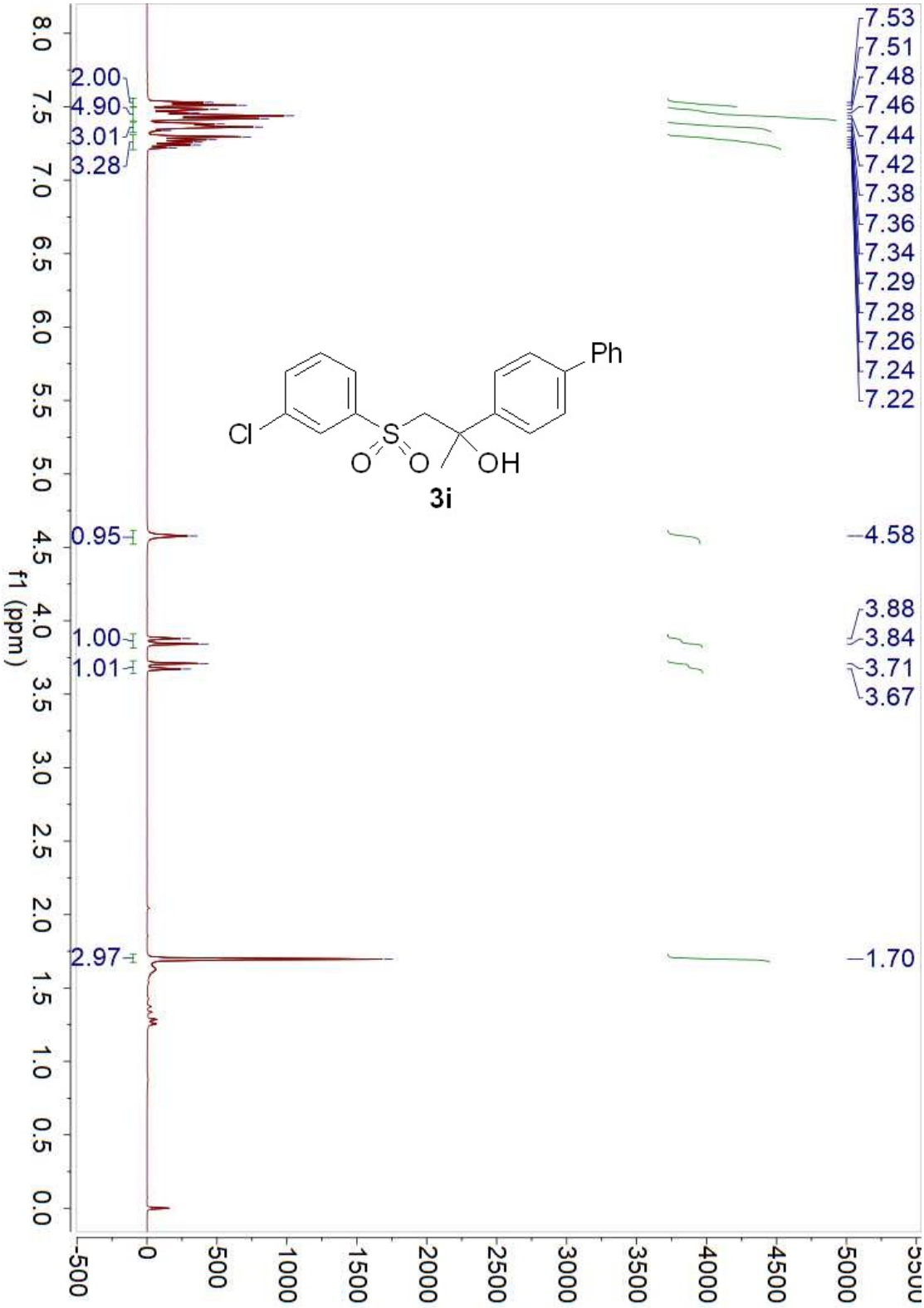
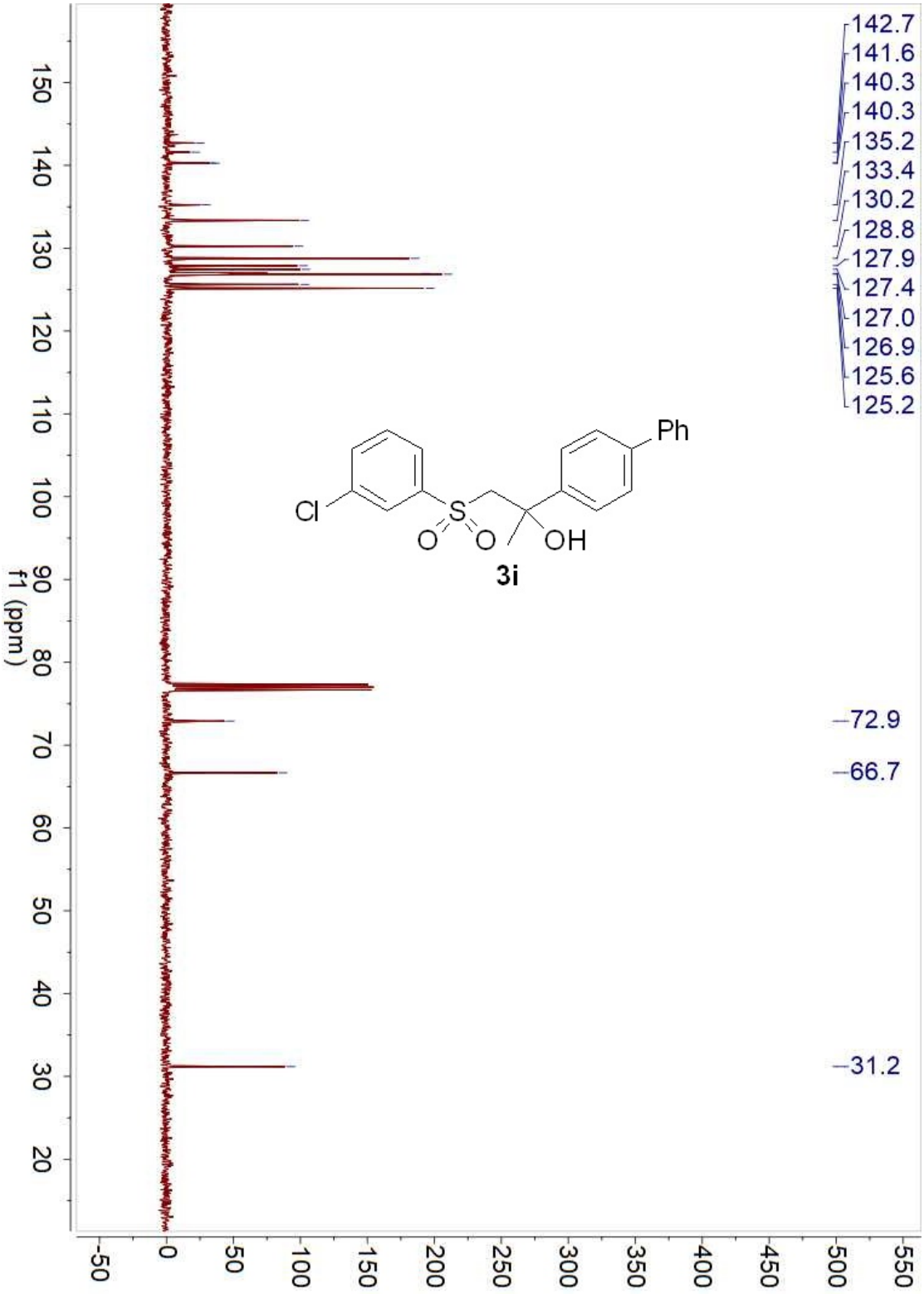
140.4
140.2
140.0
138.4
129.2
129.0
128.8
127.5
127.0
126.9
125.2
72.9
66.8
31.1
Cl
Ph
S
O
O
OH
3h
f1 (ppm)


7.53
7.51
7.48
7.46
7.44
7.42
7.38
7.36
7.34
7.29
7.28
7.26
7.24
7.22
2.00
4.90
3.01
3.28
0.95
1.00
1.01
2.97
4.58
3.88
3.84
3.71
3.67
1.70
Ph
Cl
S
O
O
OH
3i
f1 (ppm)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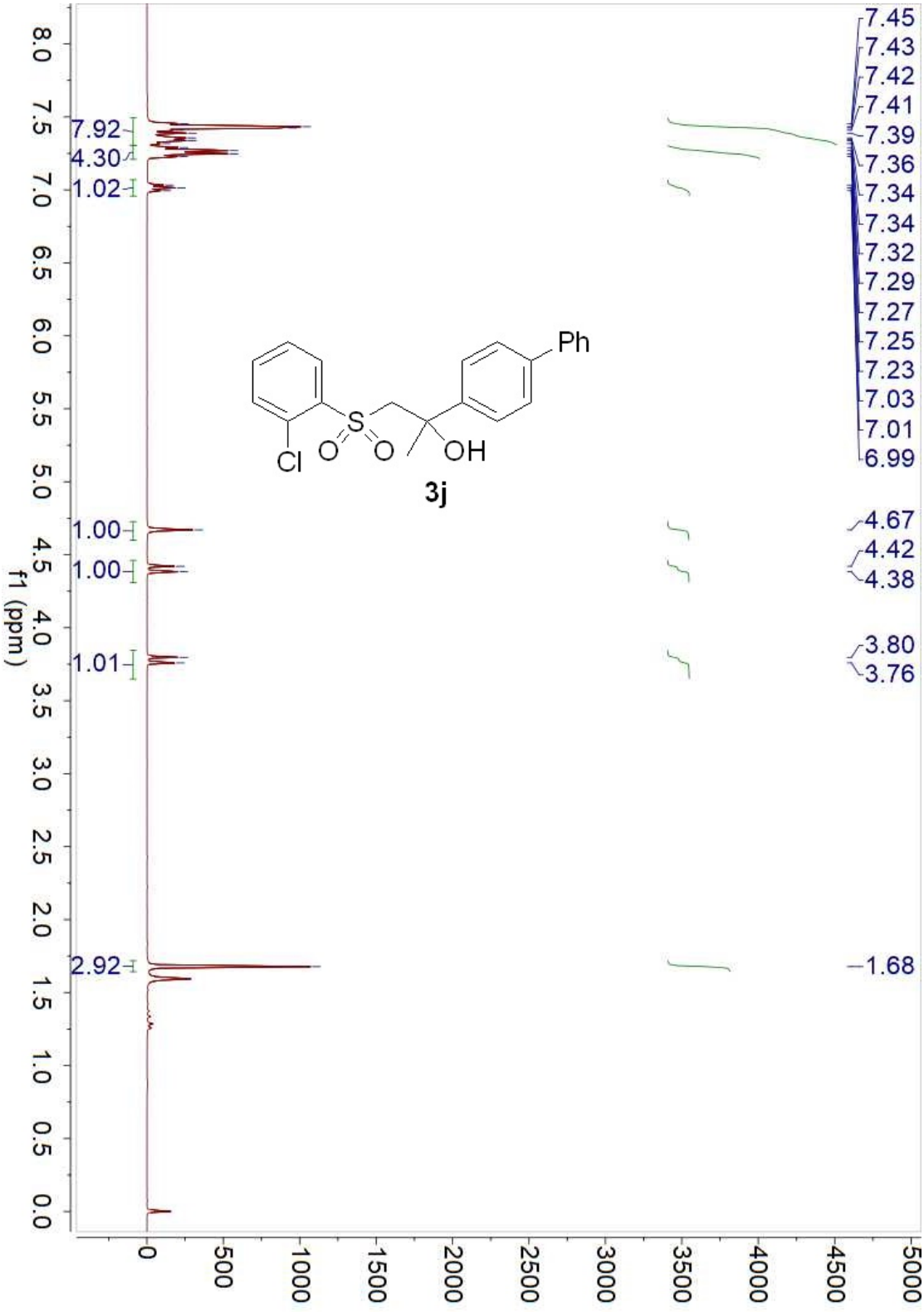
141.6
140.3
140.3
135.2
133.4
130.2
128.8
127.9
127.4
127.0
126.9
125.6
125.2
72.9
66.7
31.2
Ph
Cl
S
O
O
OH
3i
f1 (ppm)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1.02
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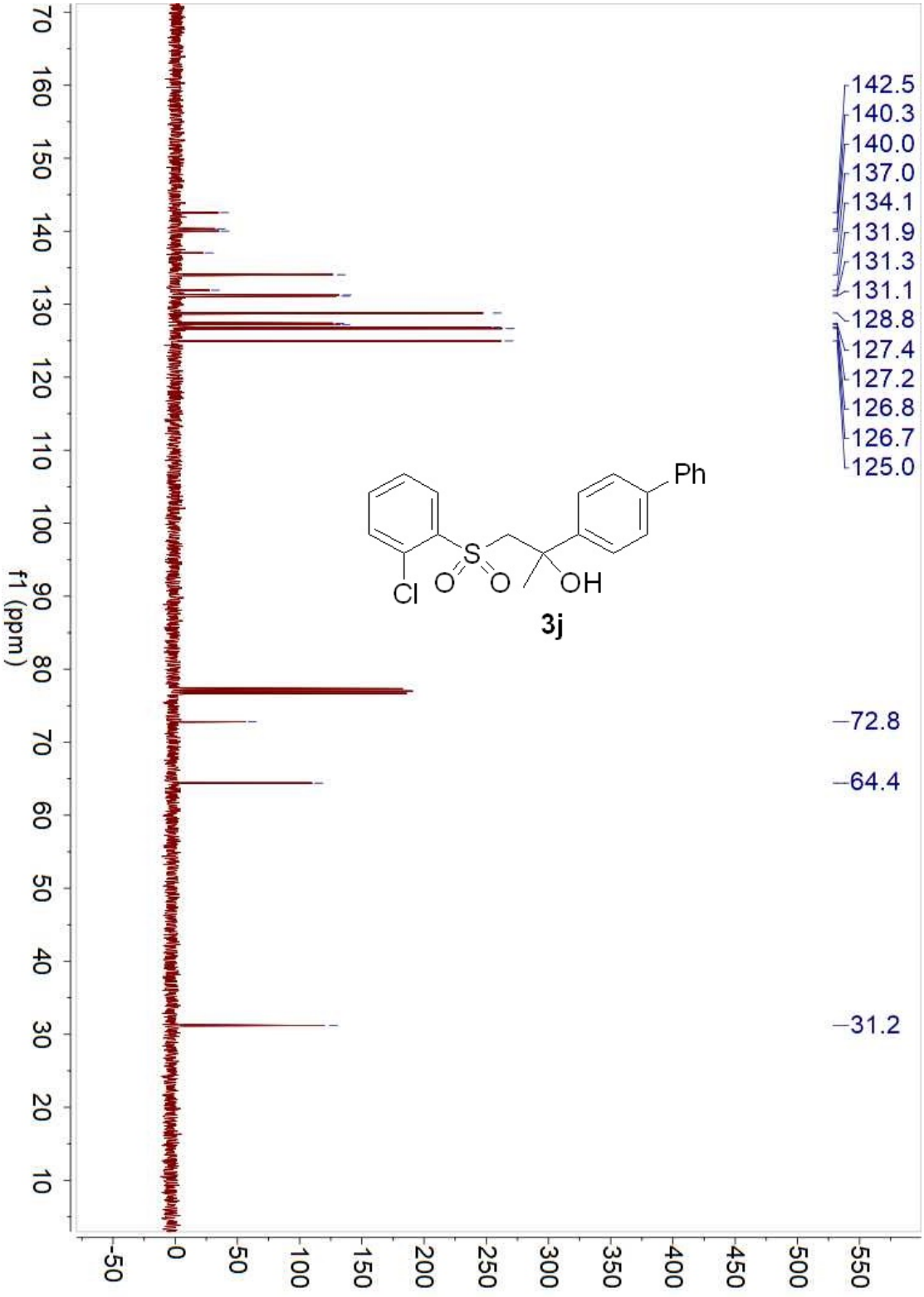
1.00
1.01
2.92
7.45
7.43
7.42
7.41
7.39
7.36
7.34
7.34
7.32
7.29
7.27
7.25
7.23
7.03
7.01
6.99
4.67
4.42
4.38
3.80
3.76
1.68
Ph
S
O
O
Cl
OH
3j
f1 (ppm)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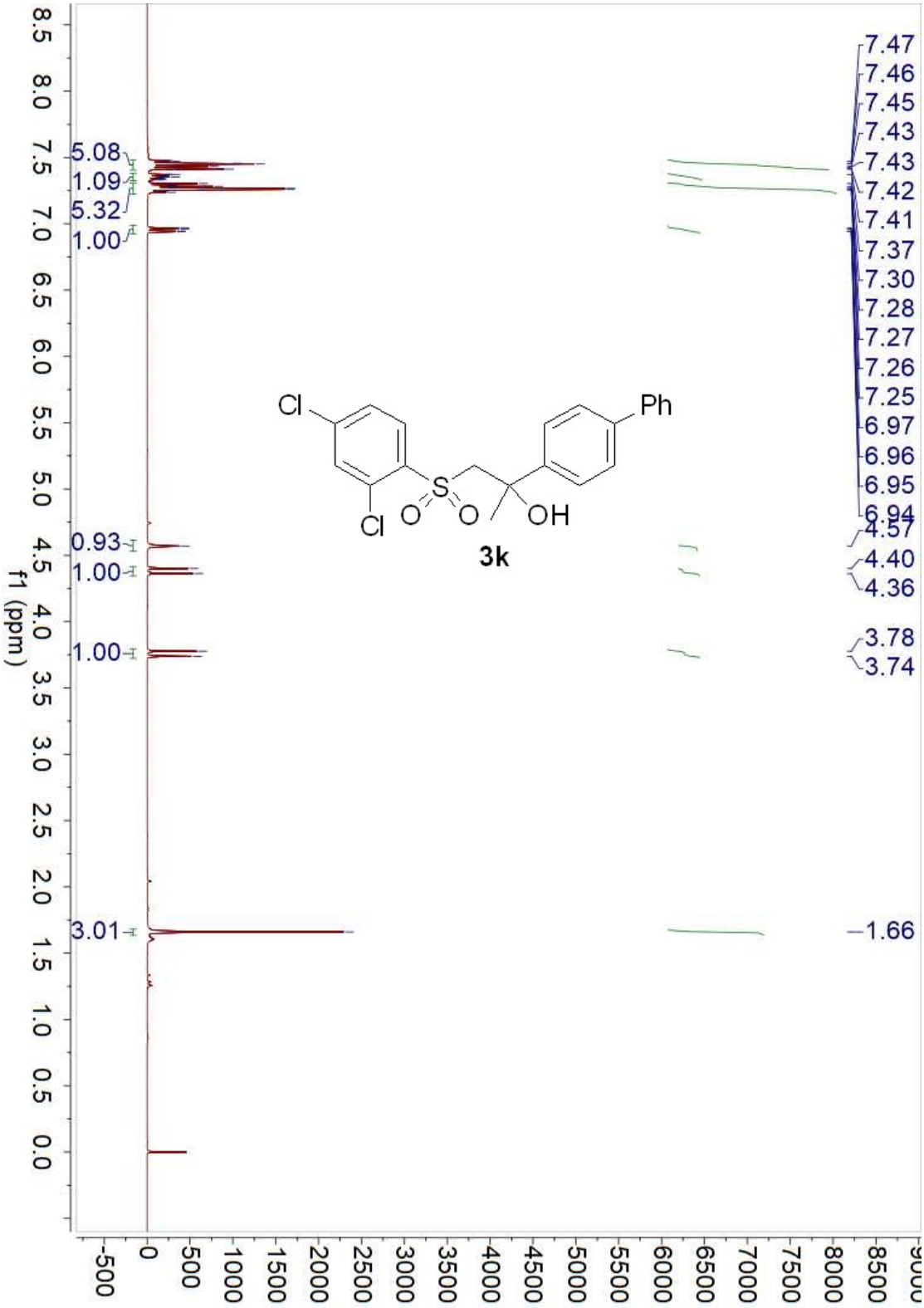
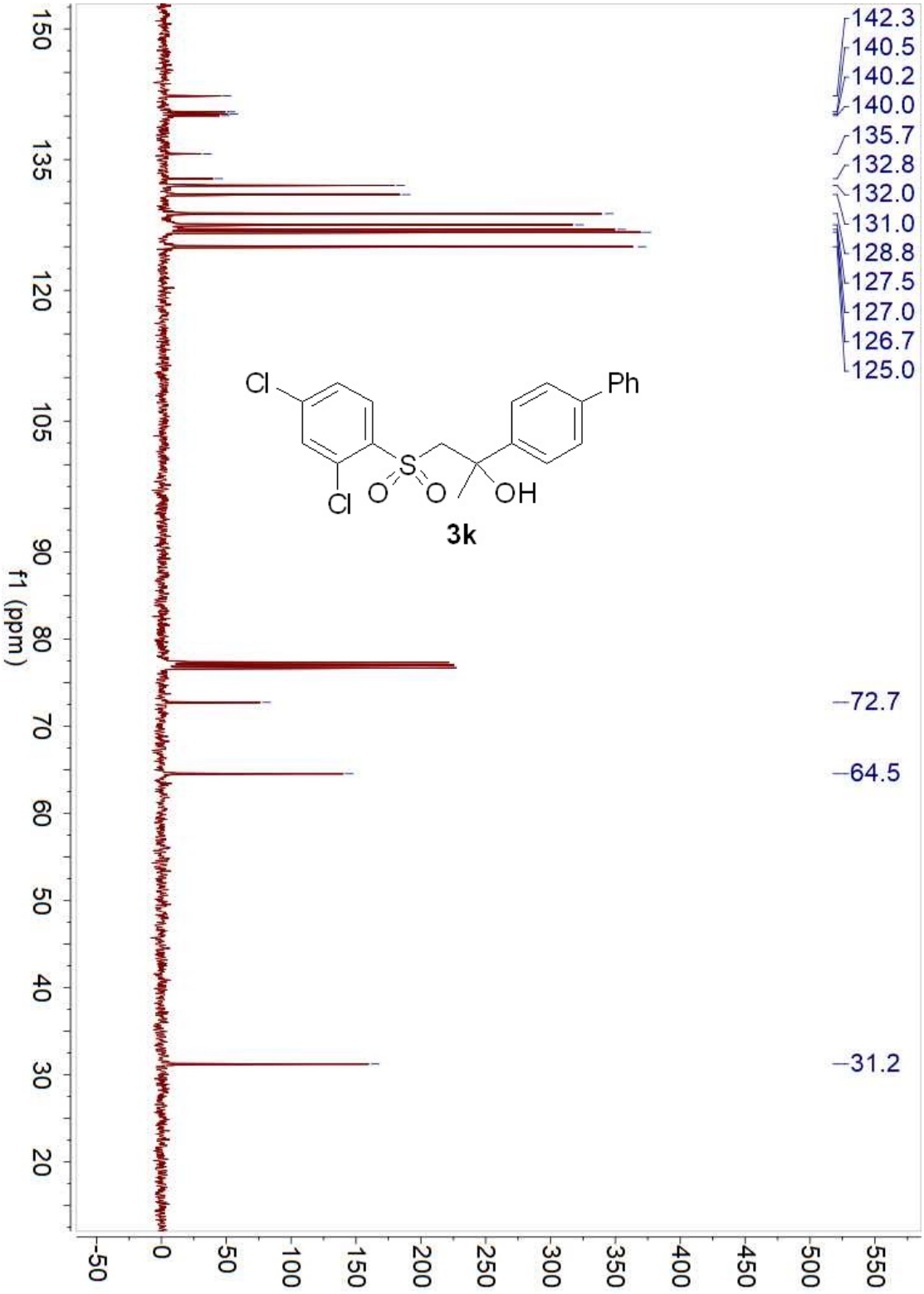
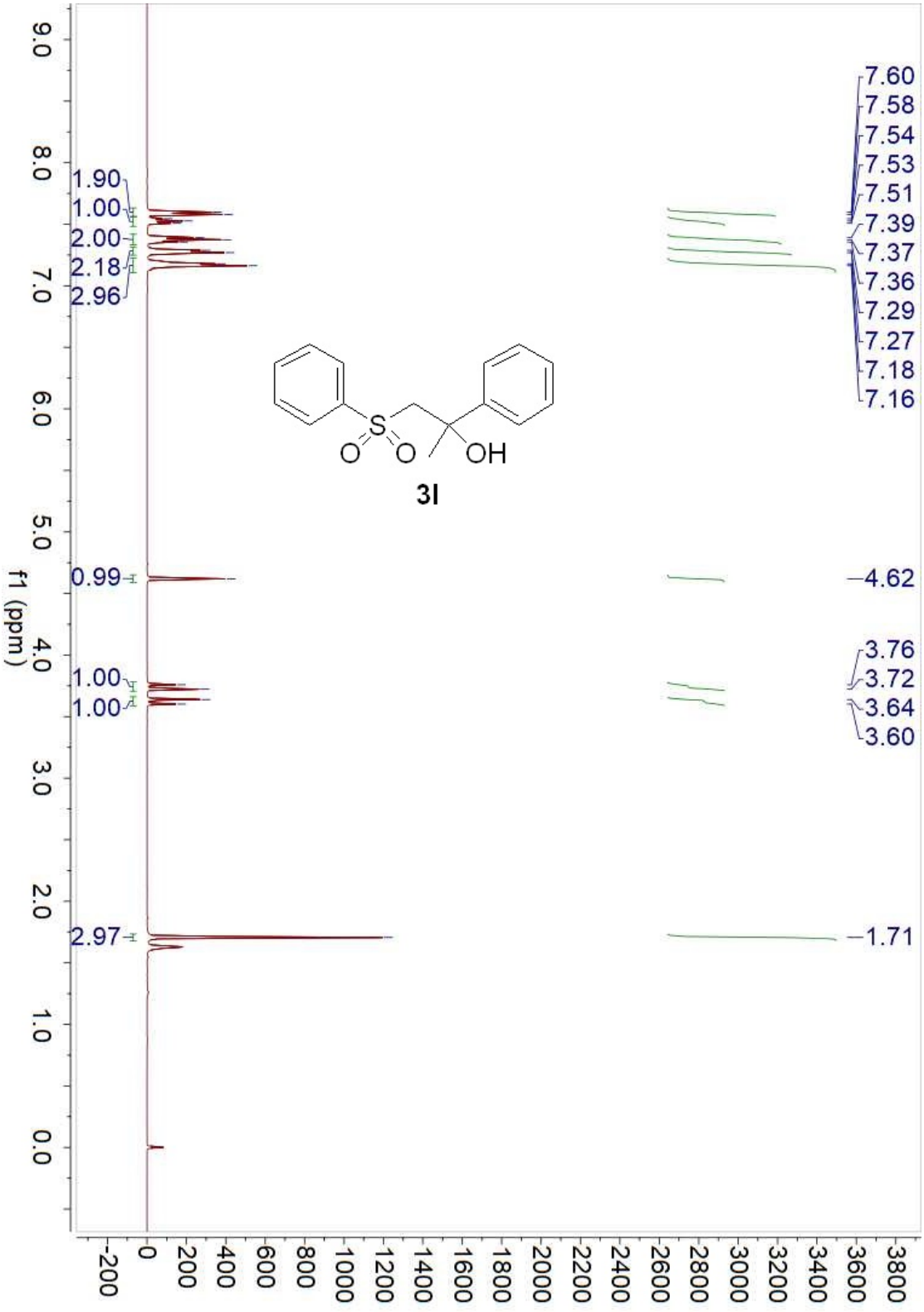
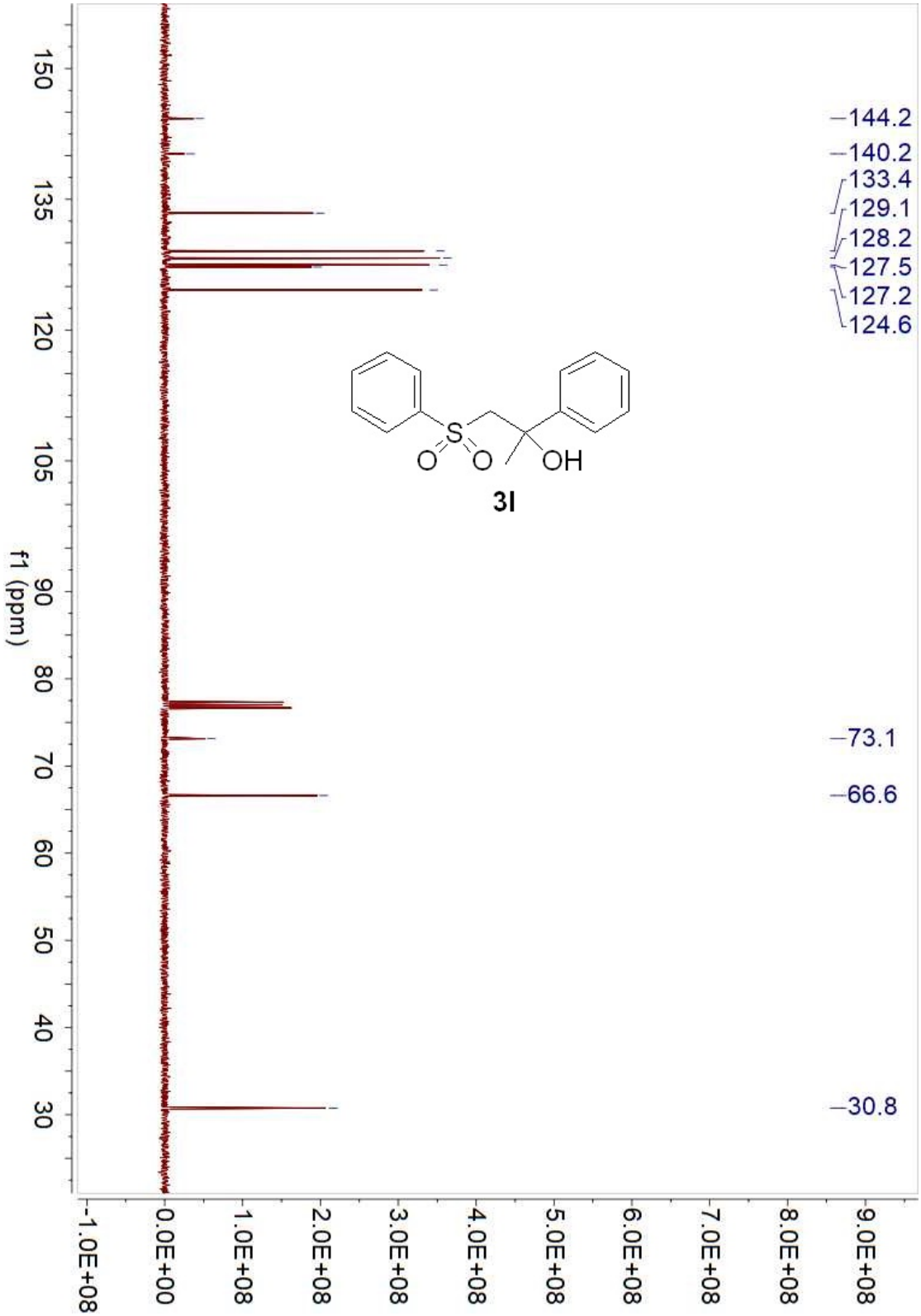
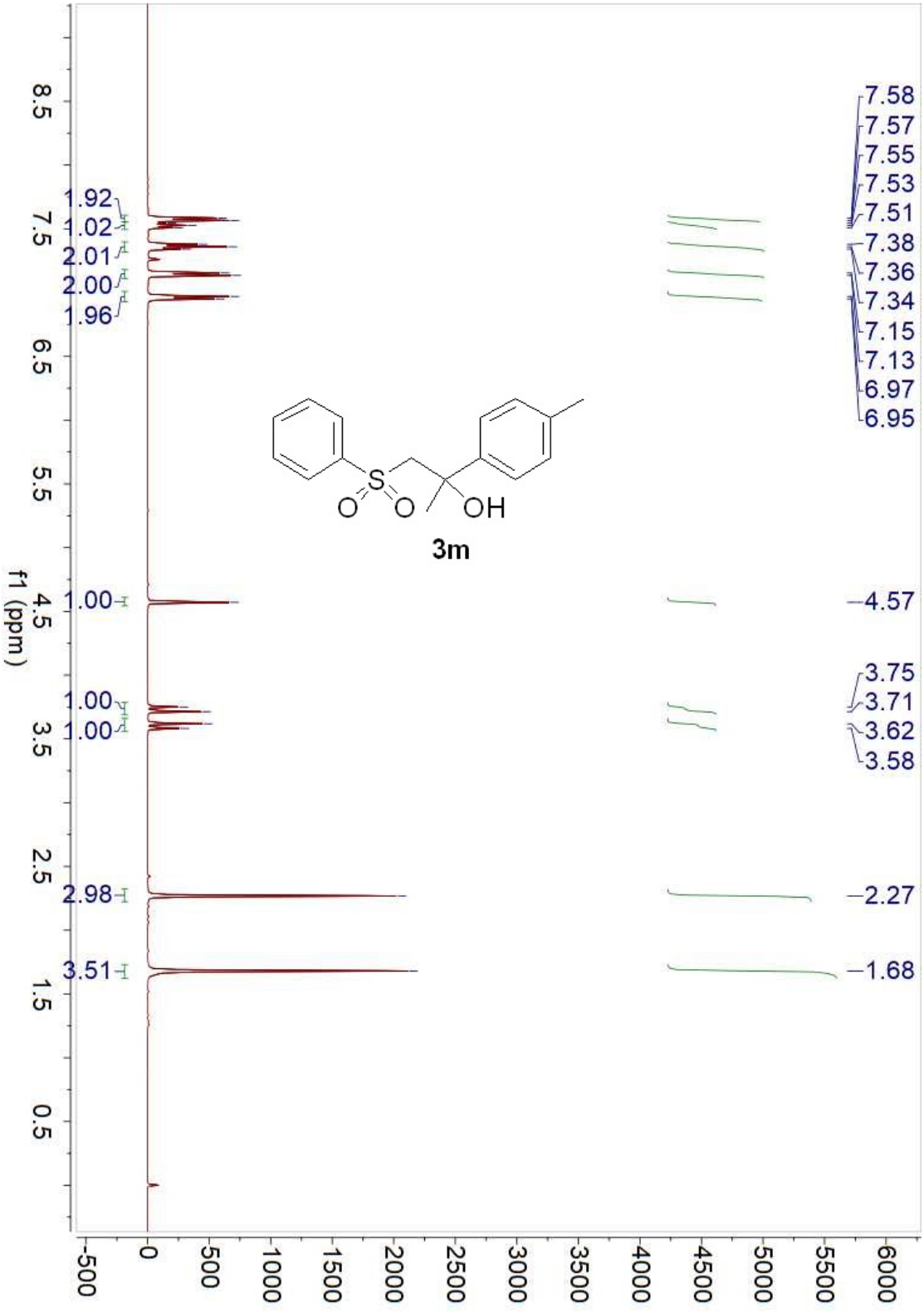
140.3
140.0
137.0
134.1
131.9
131.3
131.1
128.8
127.4
127.2
126.8
126.7
125.0
72.8
64.4
31.2
Ph
S
O
O
Cl
OH
3j
f1 (ppm)

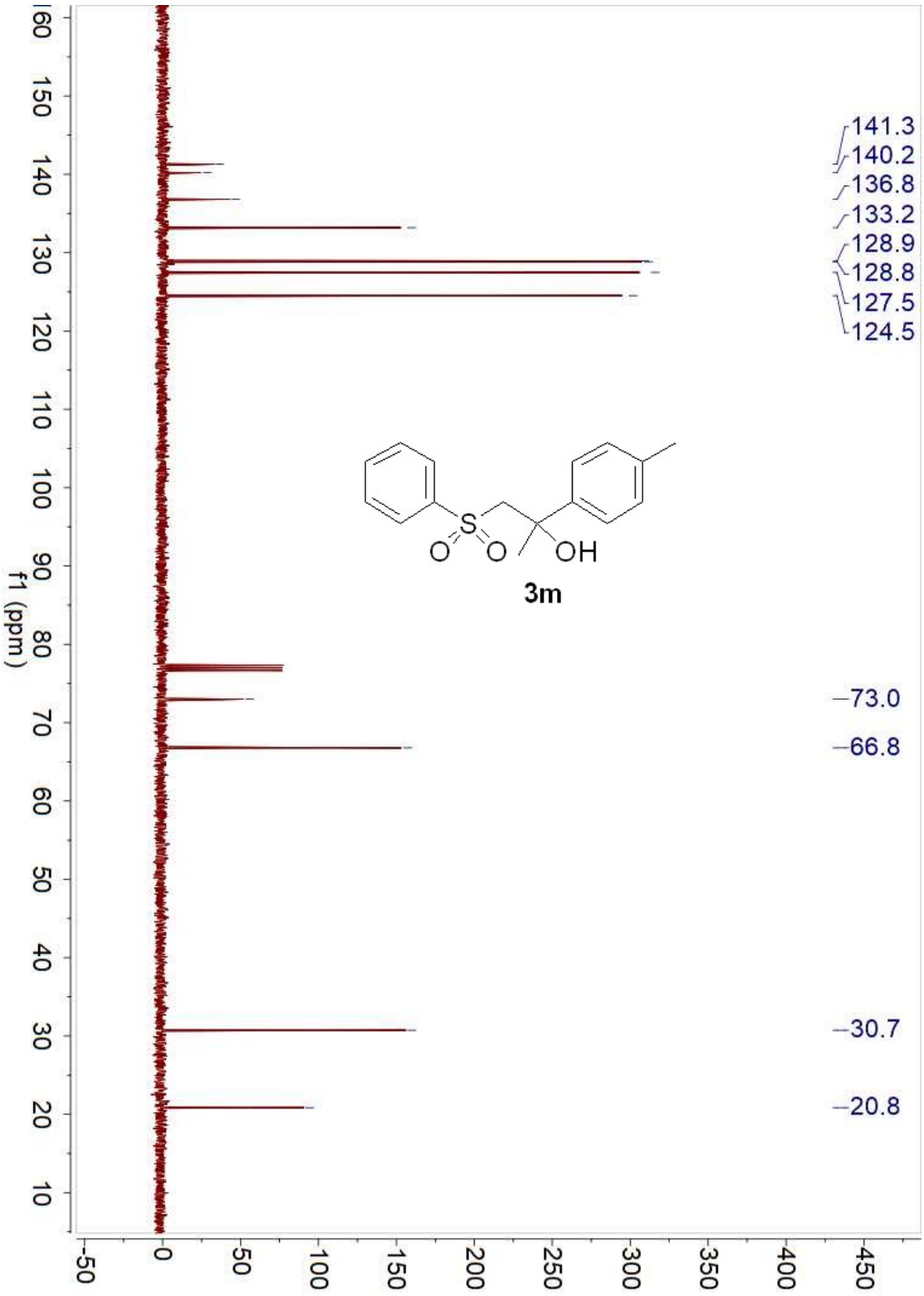

7.47
7.46
7.45
7.43
7.43
7.42
7.41
7.37
7.30
7.28
7.27
7.26
7.25
6.97
6.96
6.95
6.94
4.57
4.40
4.36
3.78
3.74
1.66
5.08
1.09
5.32
1.00
0.93
1.00
1.00
3.01
Cl
Ph
S
O
O
OH
Cl
3k
f1 (ppm)

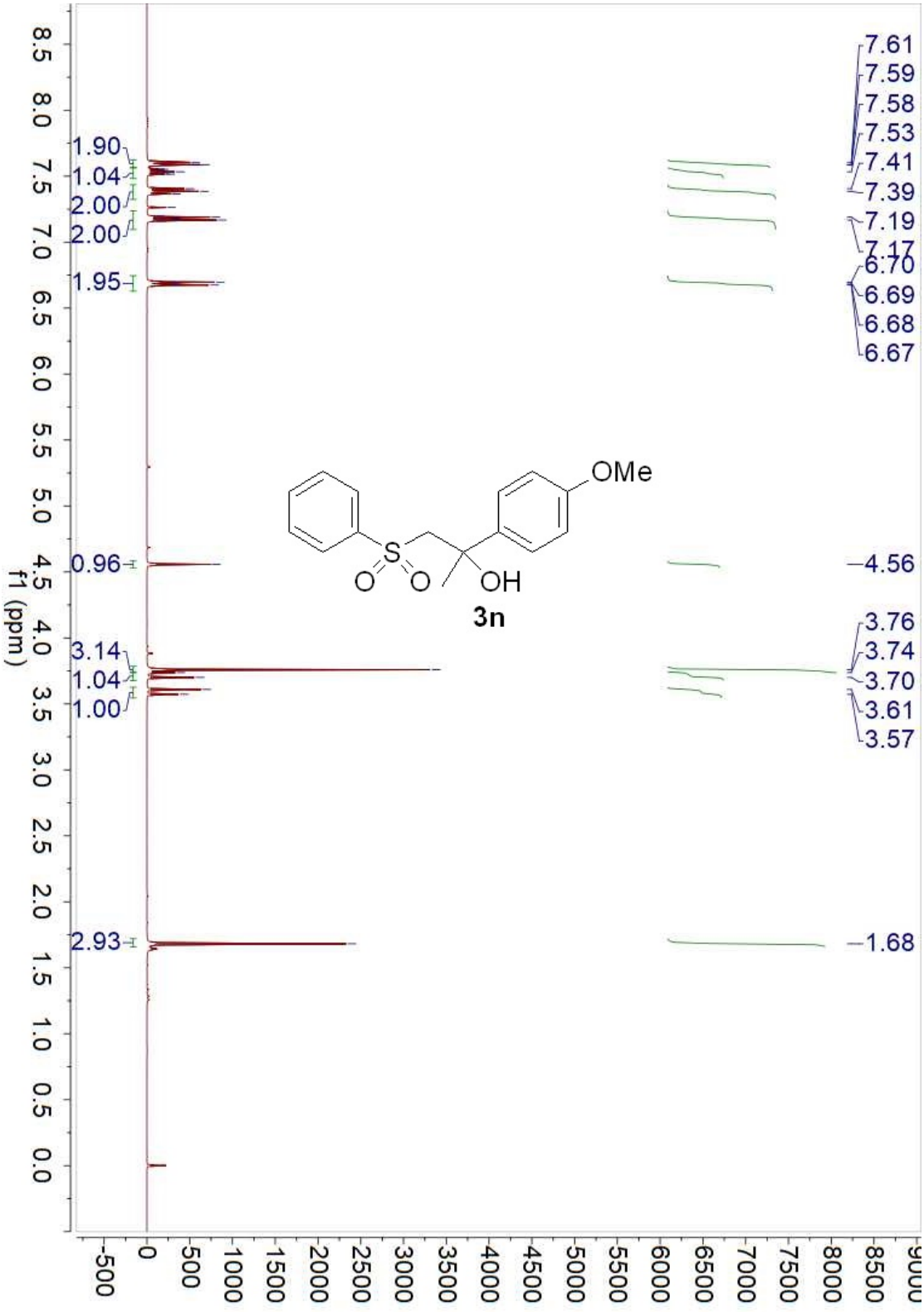

142.3
140.5
140.2
140.0
135.7
132.8
132.0
131.0
128.8
127.5
127.0
126.7
125.0
72.7
64.5
31.2
Cl
Cl
S
O
O
OH
Ph
3k
f1 (ppm)

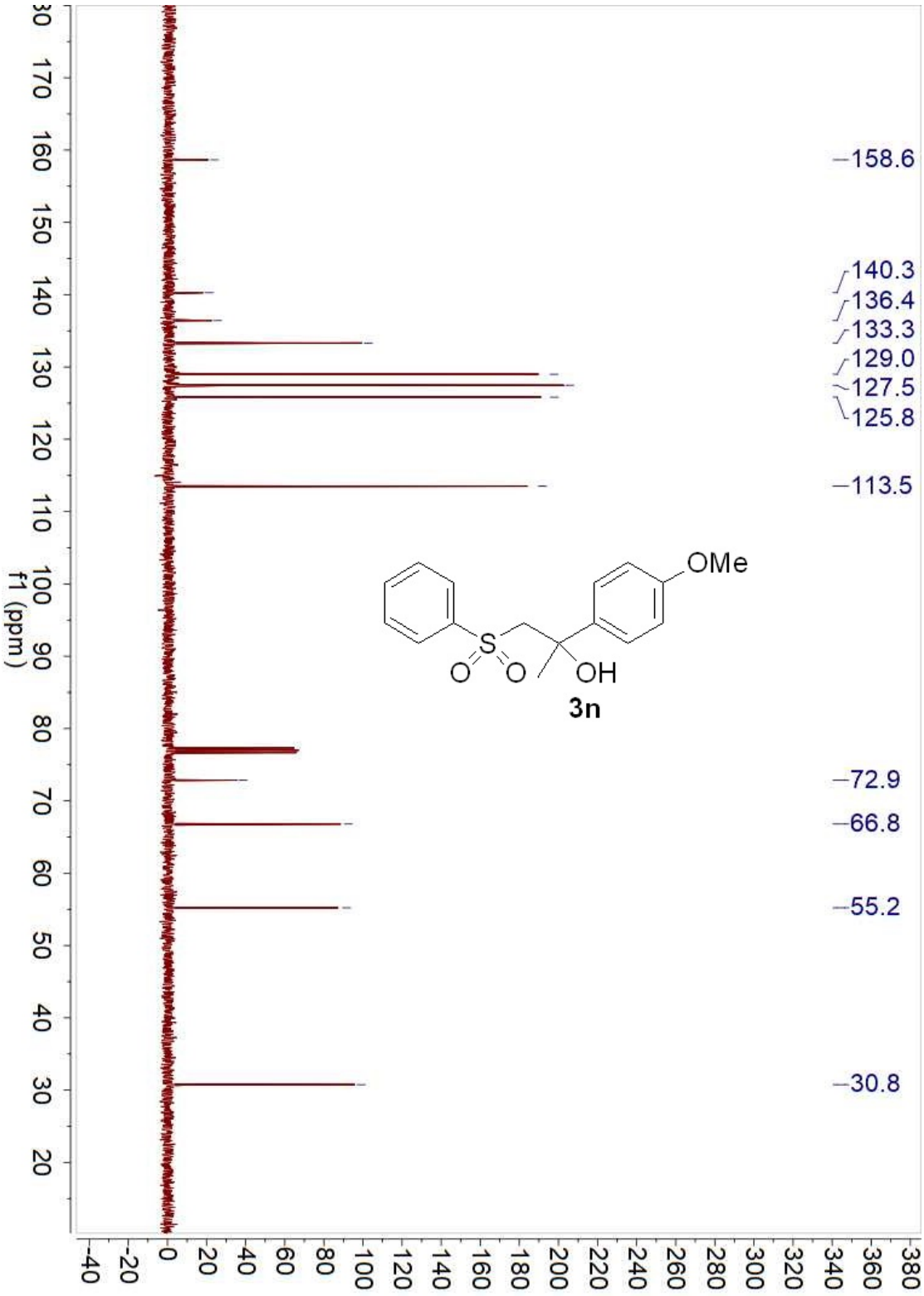

7.60
7.58
7.54
7.53
7.51
7.39
7.37
7.36
7.29
7.27
7.18
7.16
4.62
3.76
3.72
3.64
3.60
1.71
1.90
1.00
2.00
2.18
2.96
0.99
1.00
1.00
2.97
S
O
O
OH
3l
f1 (ppm)

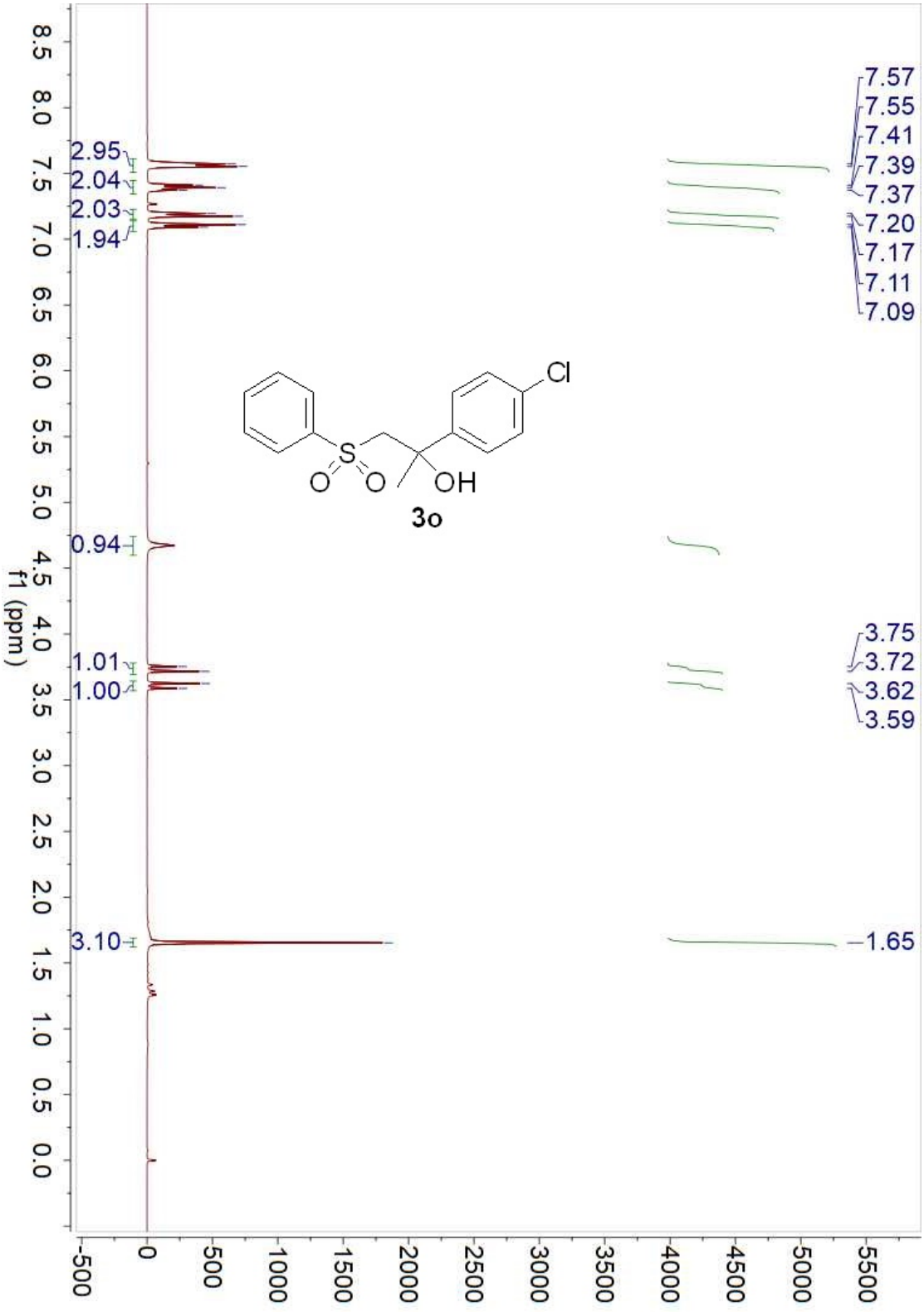

144.2
140.2
133.4
129.1
128.2
127.5
127.2
124.6
73.1
66.6
30.8
S
O
O
OH
3l
f1 (ppm)

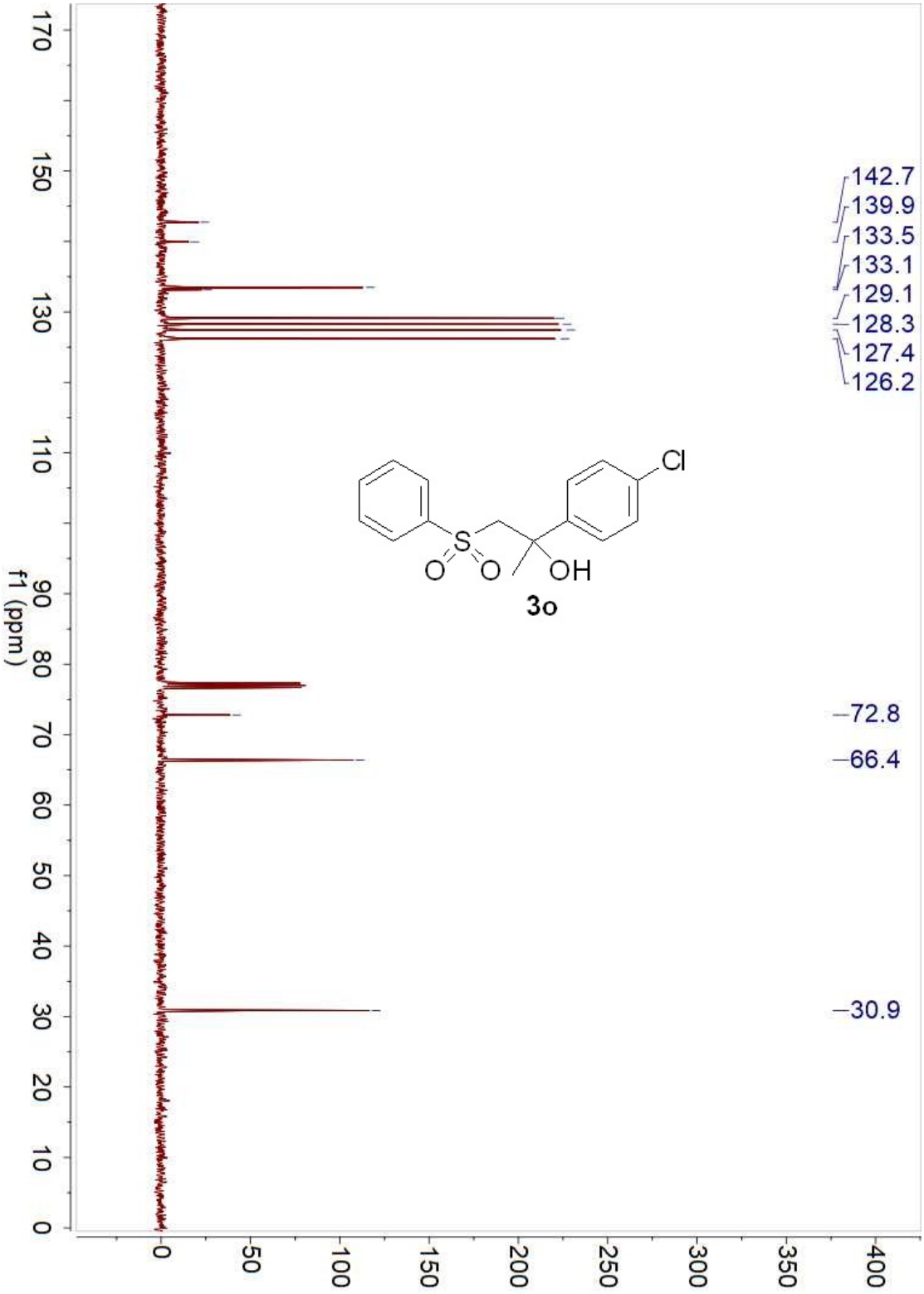

7.58
7.57
7.55
7.53
7.51
7.38
7.36
7.34
7.15
7.13
6.97
6.95
1.92
1.02
2.01
2.00
1.96
1.00
1.00
1.00
2.98
3.51
4.57
3.75
3.71
3.62
3.58
2.27
1.68
O
S
O
OH
3m
f1 (ppm)

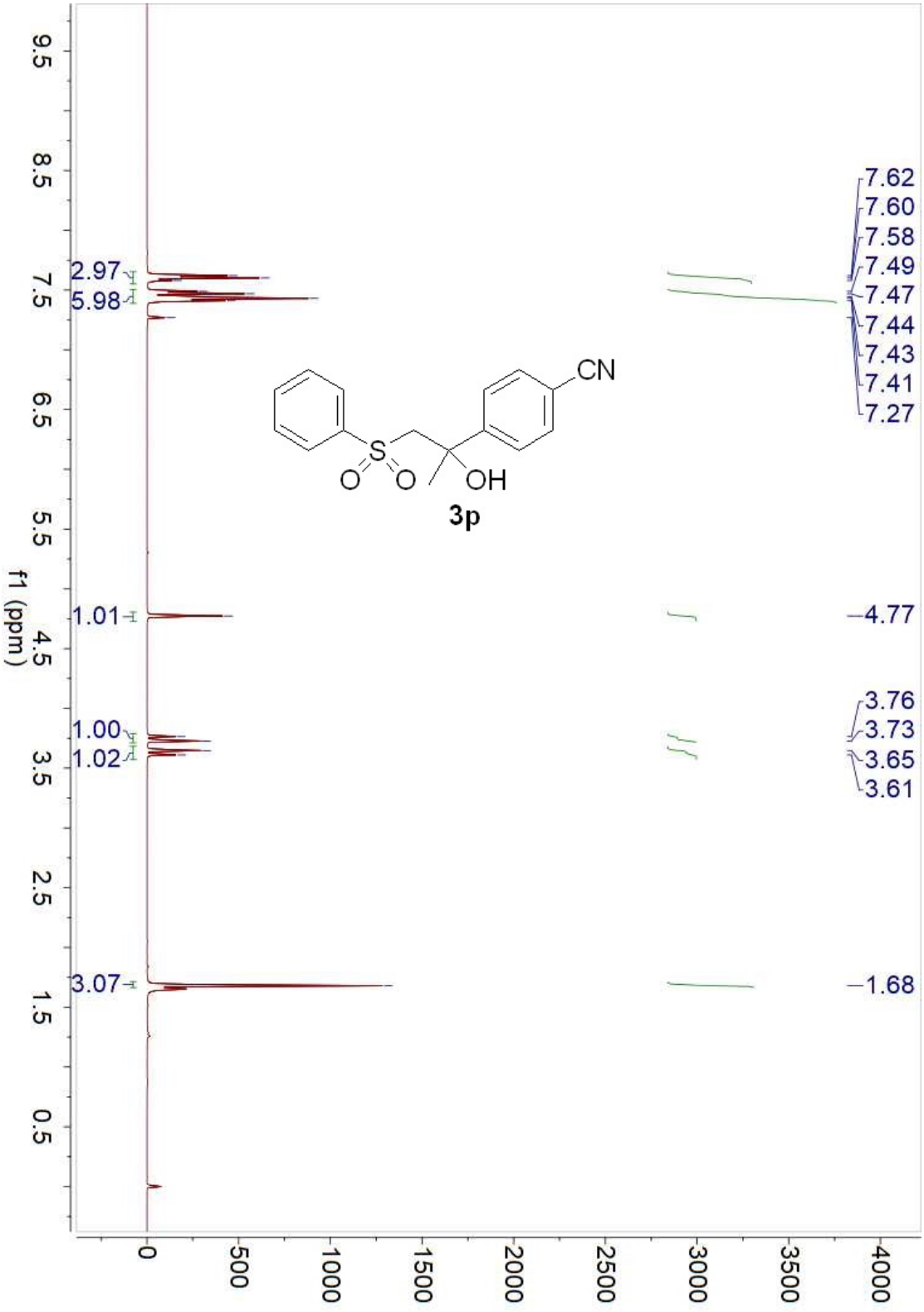

141.3
140.2
136.8
133.2
128.9
128.8
127.5
124.5
73.0
66.8
30.7
20.8
S
O
O
OH
3m
f1 (ppm)

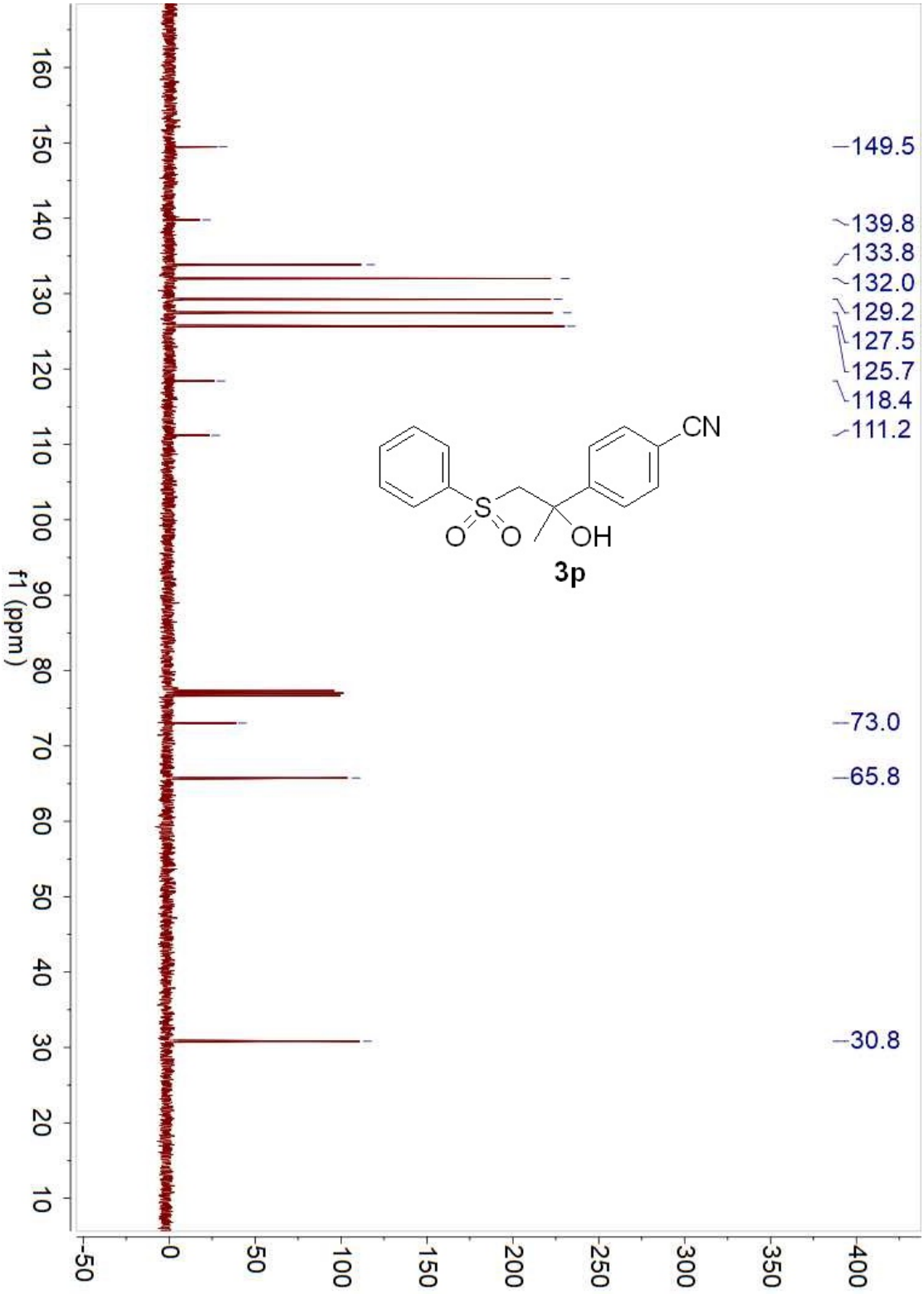

7.61
7.59
7.58
7.53
7.41
7.39
7.19
7.17
6.70
6.69
6.68
6.67
1.90
1.04
2.00
2.00
1.95
0.96
3.14
1.04
1.00
2.93
4.56
3.76
3.74
3.70
3.61
3.57
1.68
OMe
S
O
O
OH
3n
f1 (ppm)

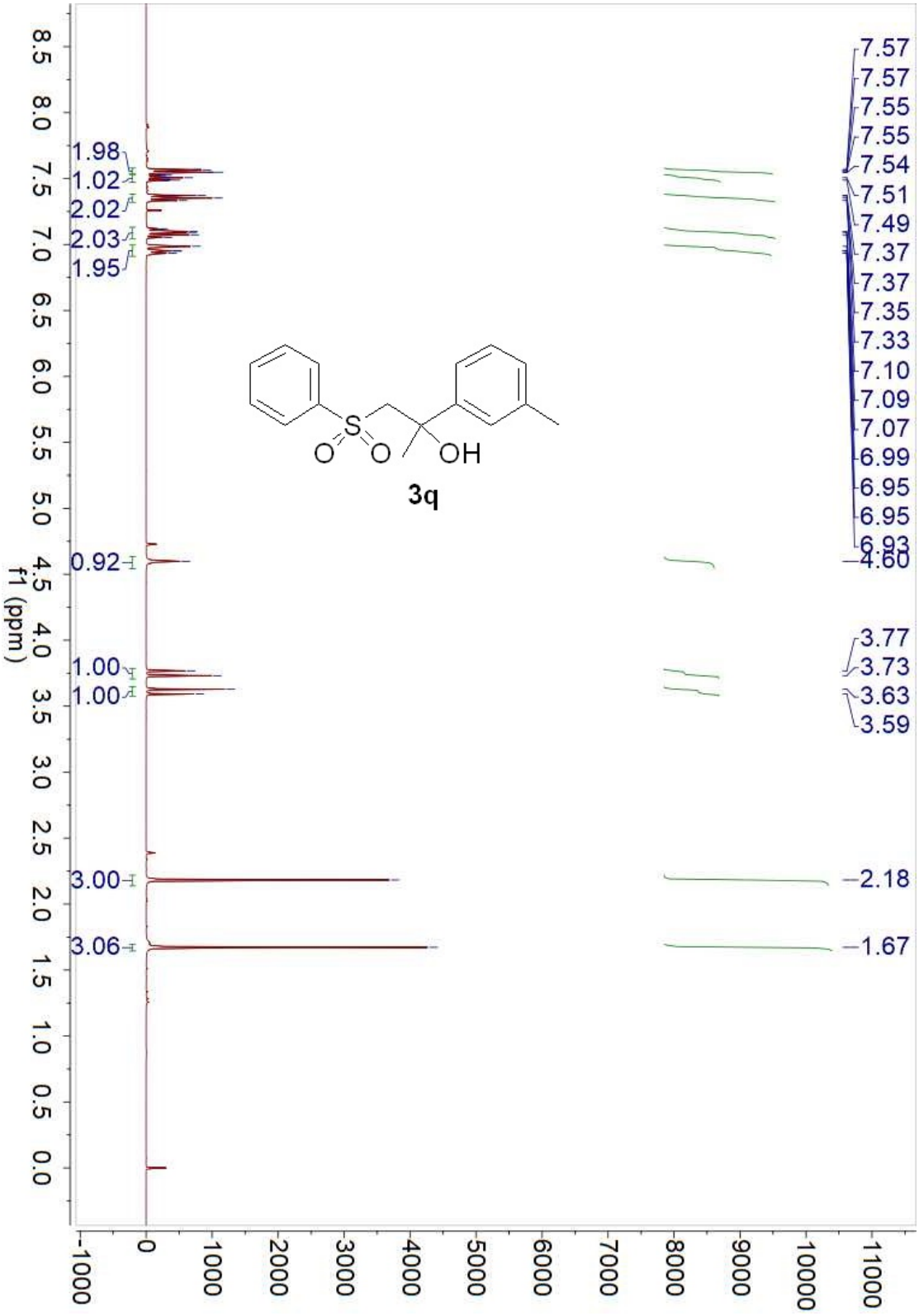

158.6
140.3
136.4
133.3
129.0
127.5
125.8
113.5
72.9
66.8
55.2
30.8
OMe
S
O
O
OH
3n
f1 (ppm)


7.57
7.55
7.41
7.39
7.37
7.20
7.17
7.11
7.09
2.95
2.04
2.03
1.94
0.94
1.01
1.00
3.10
3.75
3.72
3.62
3.59
1.65
Cl
S
O
O
OH
3o
f1 (ppm)


142.7
139.9
133.5
133.1
129.1
128.3
127.4
126.2
72.8
66.4
30.9
Cl
S
O
O
OH
3o
f1 (ppm)


f1 (ppm)
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
0
500
1000
1500
2000
2500
3000
3500
4000
2.97
5.98
1.01
1.00
1.02
3.07
7.62
7.60
7.58
7.49
7.47
7.44
7.43
7.41
7.27
4.77
3.76
3.73
3.65
3.61
1.68
CN
S
O
O
OH
3p


149.5
139.8
133.8
132.0
129.2
127.5
125.7
118.4
111.2
73.0
65.8
30.8
CN
S
O
O
OH
3p
f1 (ppm)


7.57
7.57
7.55
7.55
7.54
7.51
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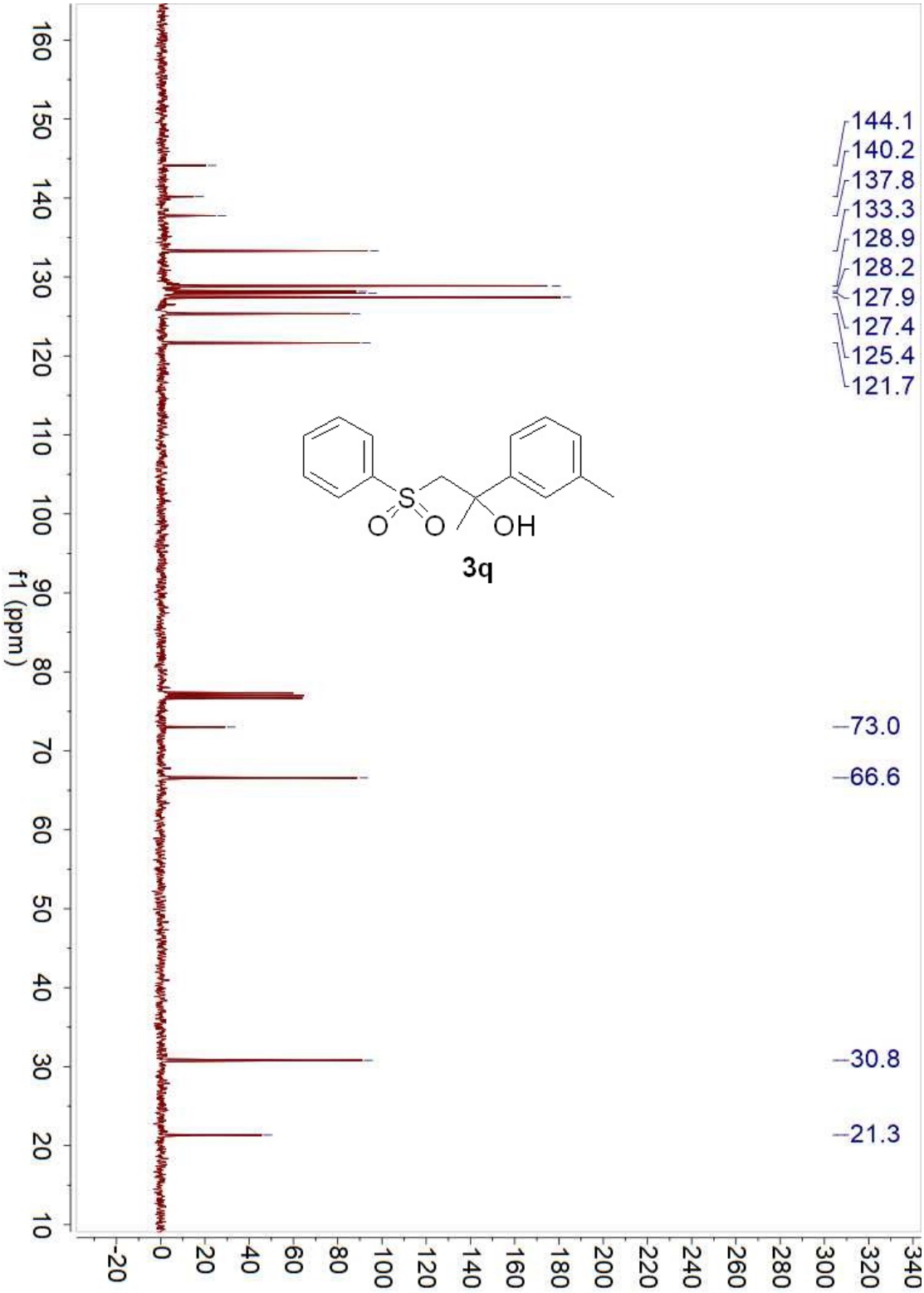
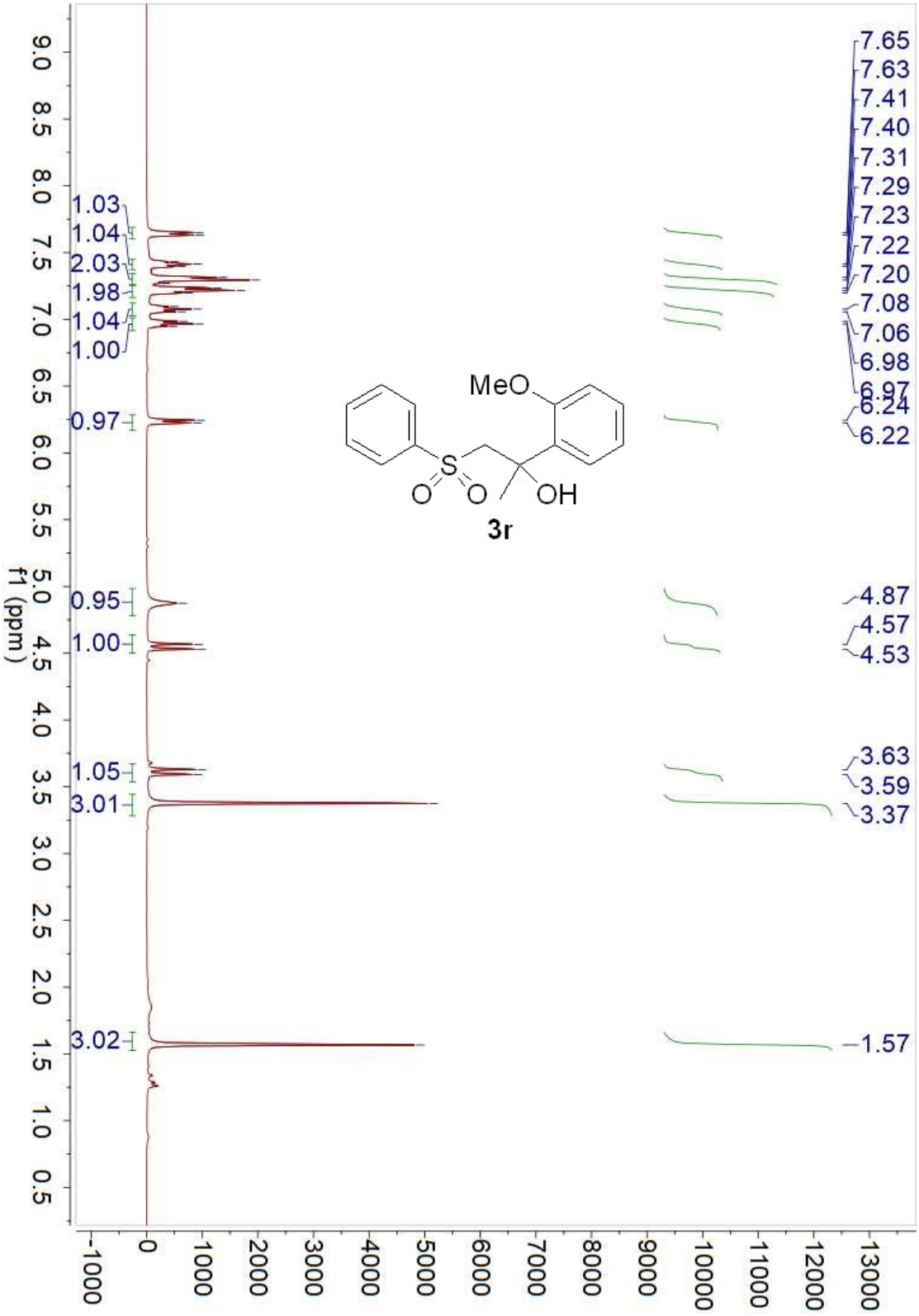
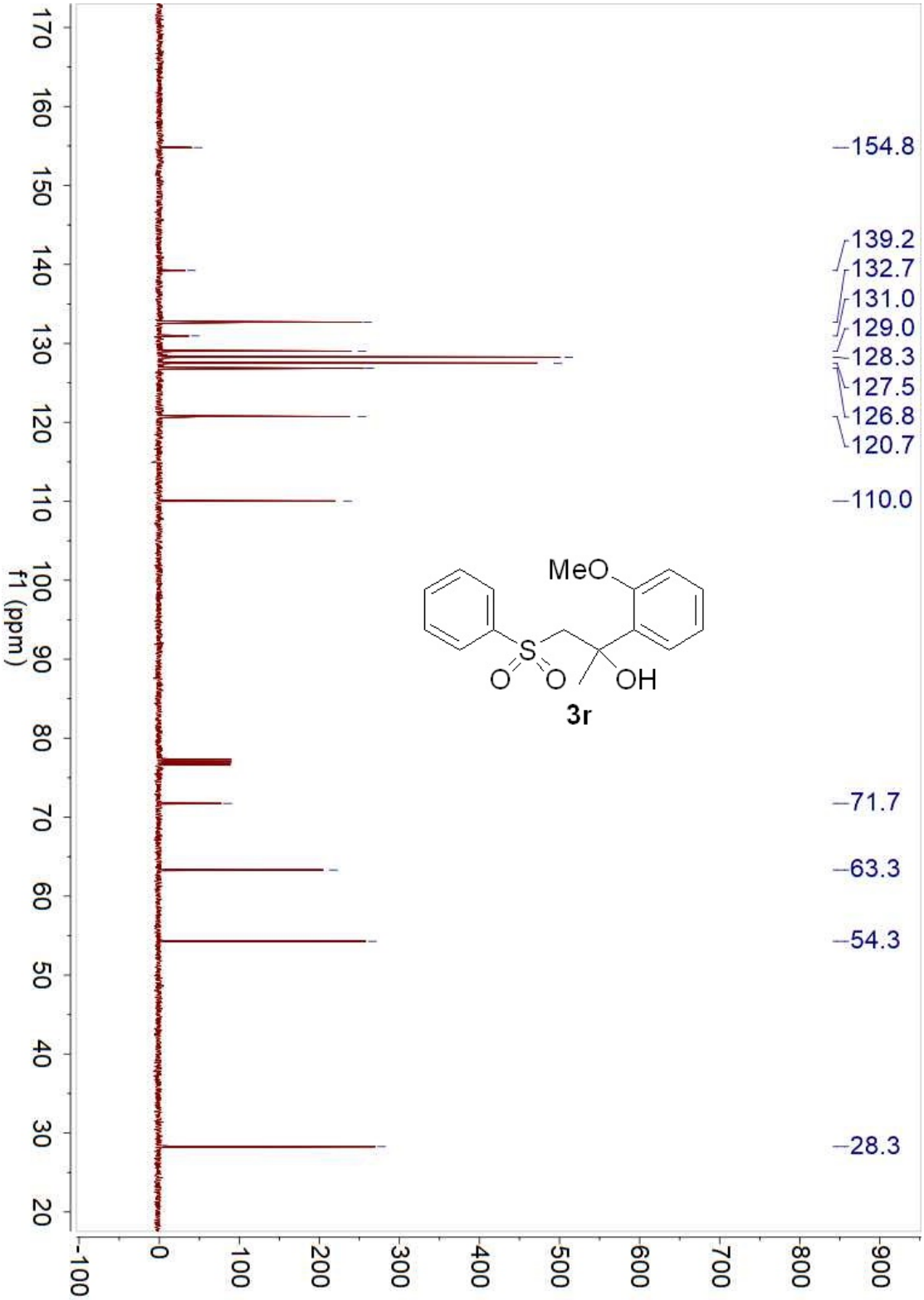
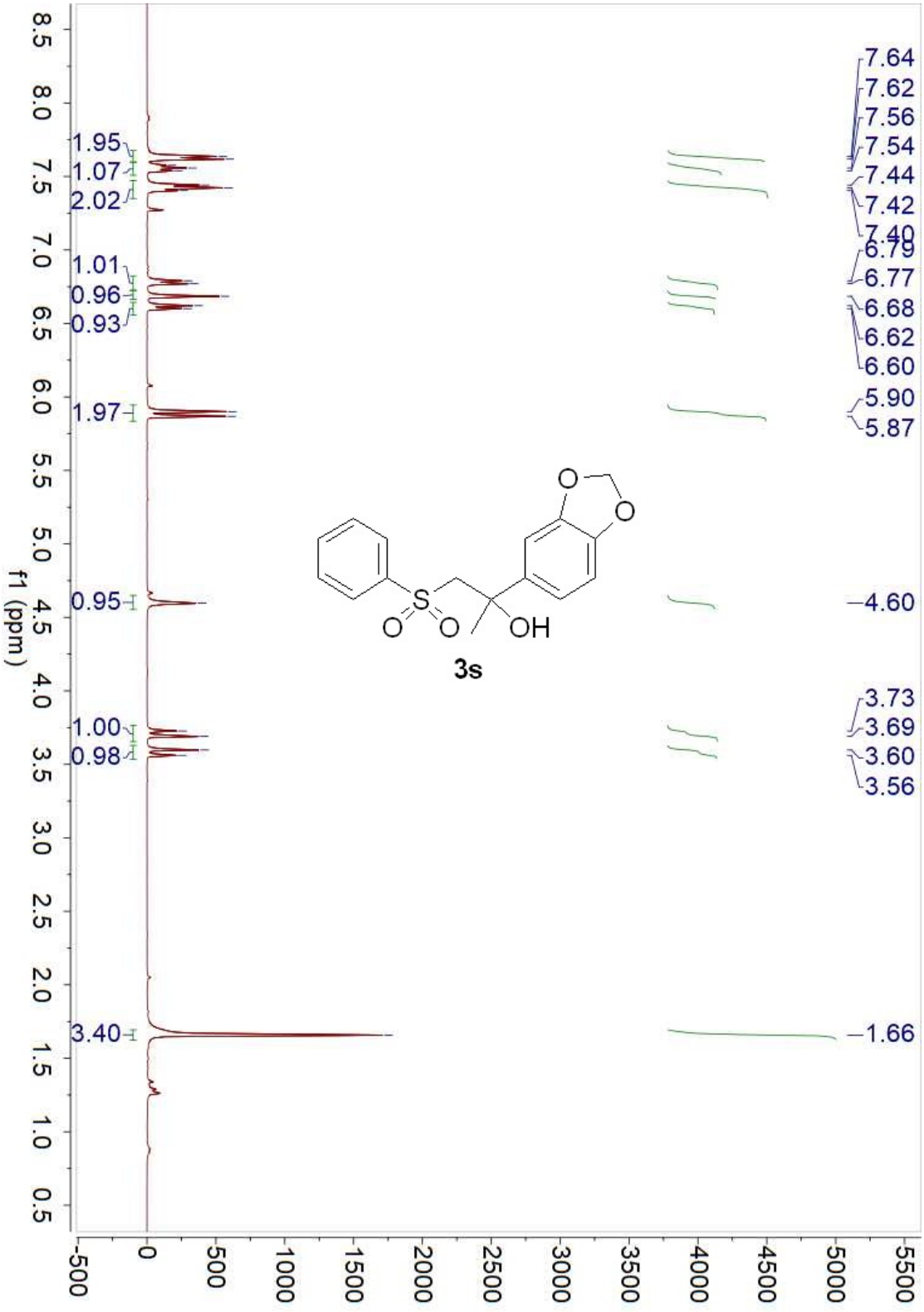
7.37
7.37
7.35
7.33
7.10
7.09
7.07
6.99
6.95
6.95
6.93
4.60
3.77
3.73
3.63
3.59
2.18
1.67
1.98
1.02
2.02
2.03
1.95
0.92
1.00
1.00
3.00
3.06
S
O
O
OH
3q
f1 (ppm)


144.1
140.2
137.8
133.3
128.9
128.2
127.9
127.4
125.4
121.7
73.0
66.6
30.8
21.3
S
O
O
OH
3q
f1 (ppm)


7.65
7.63
7.41
7.40
7.31
7.29
7.23
7.22
7.20
7.08
7.06
6.98
6.97
6.24
6.22
4.87
4.57
4.53
3.63
3.59
3.37
1.57
1.03
1.04
2.03
1.98
1.04
1.00
0.97
0.95
1.00
1.05
3.01
3.02
MeO
S
O
O
OH
3r
f1 (ppm)


154.8
139.2
132.7
131.0
129.0
128.3
127.5
126.8
120.7
110.0
71.7
63.3
54.3
28.3
MeO
S
O
O
OH
3r
f1 (ppm)


7.64
7.62
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7.54
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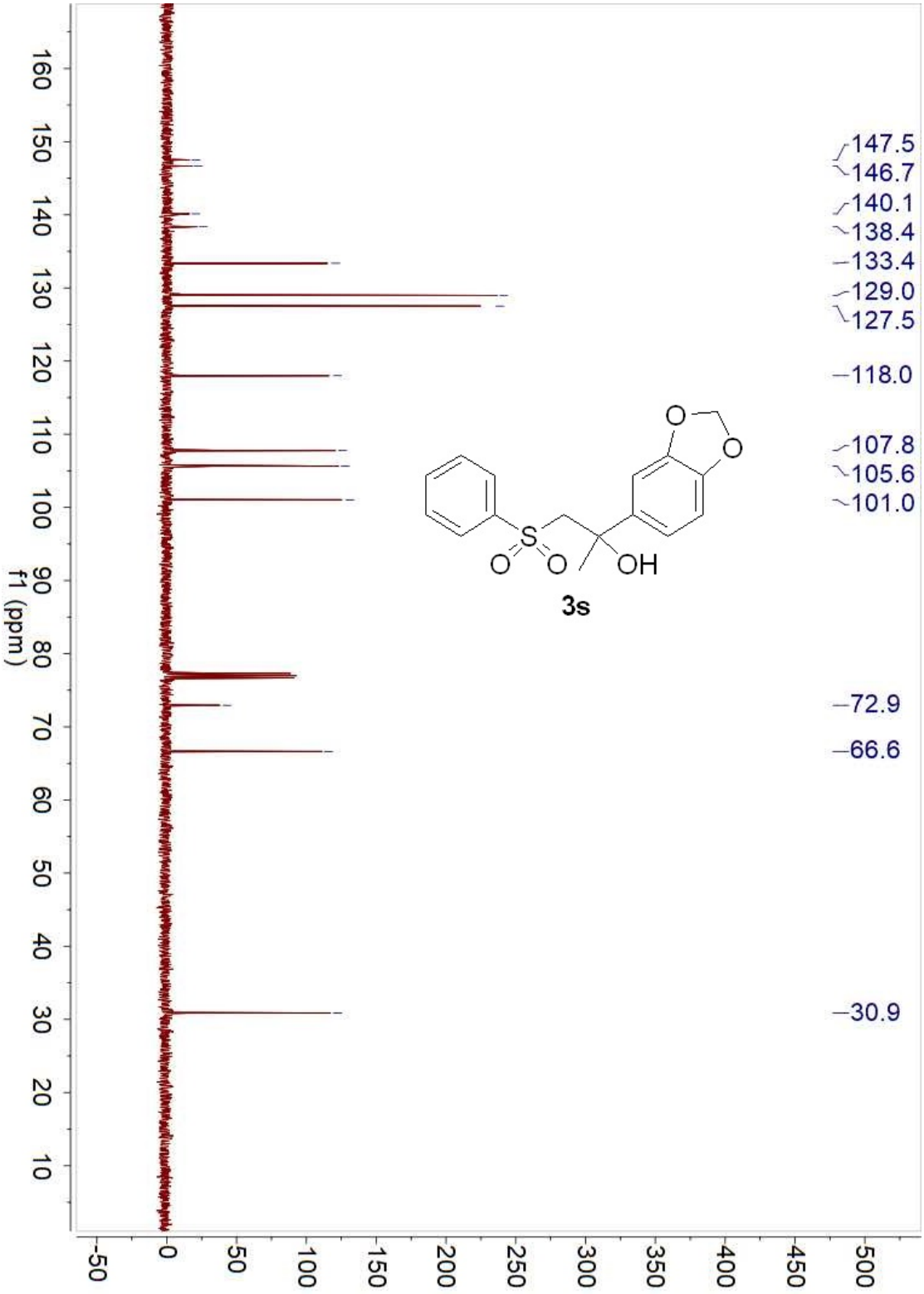
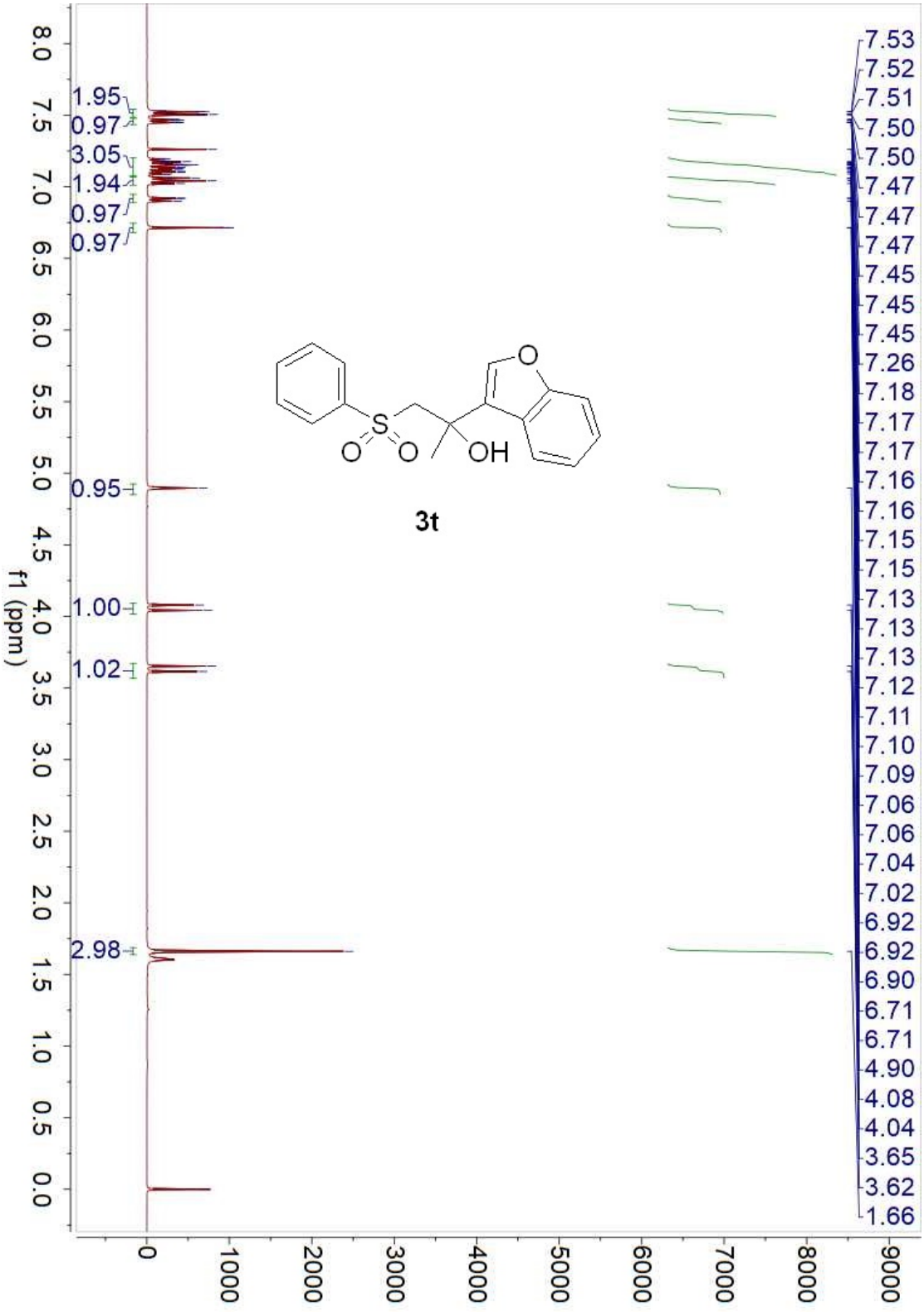
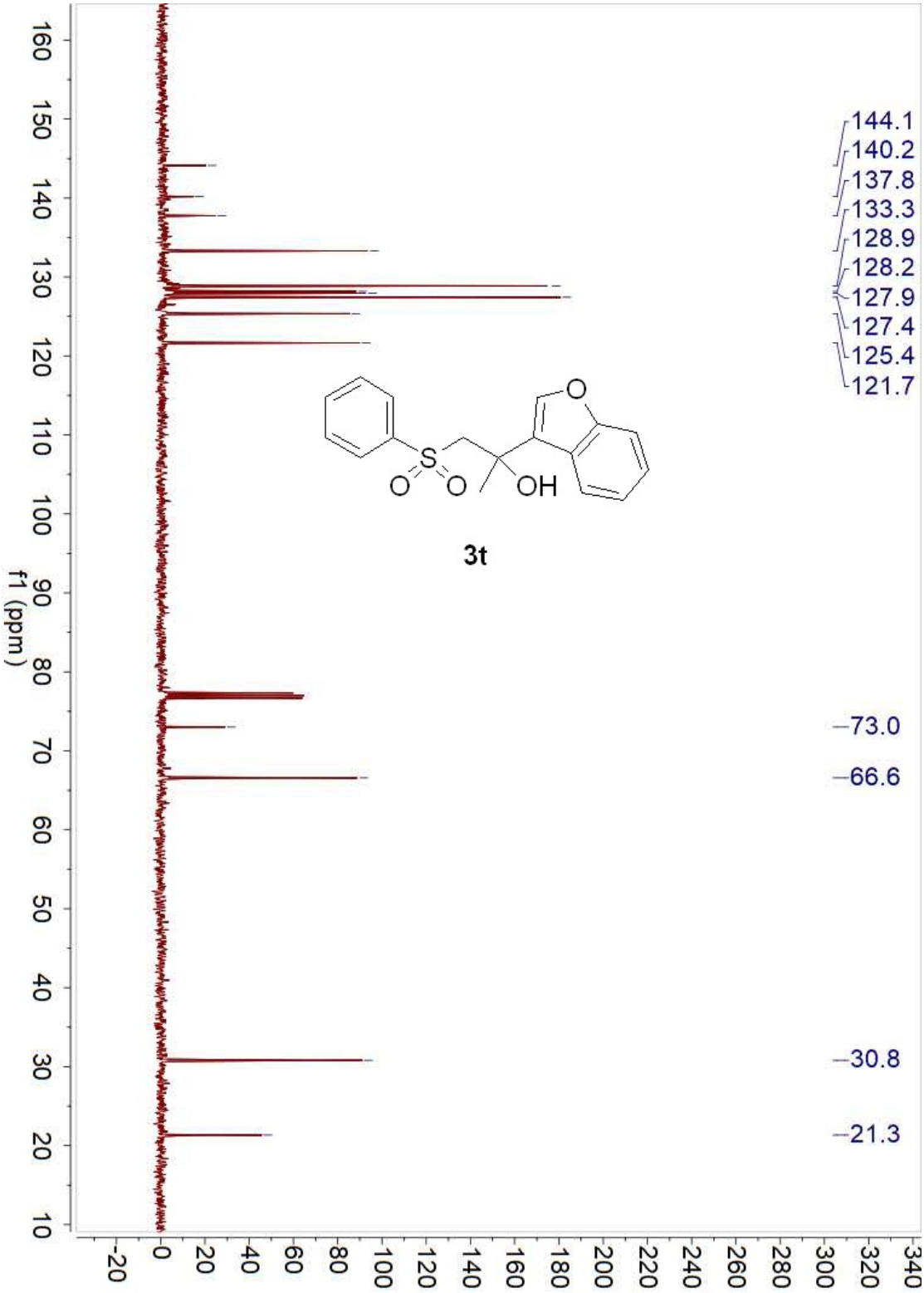
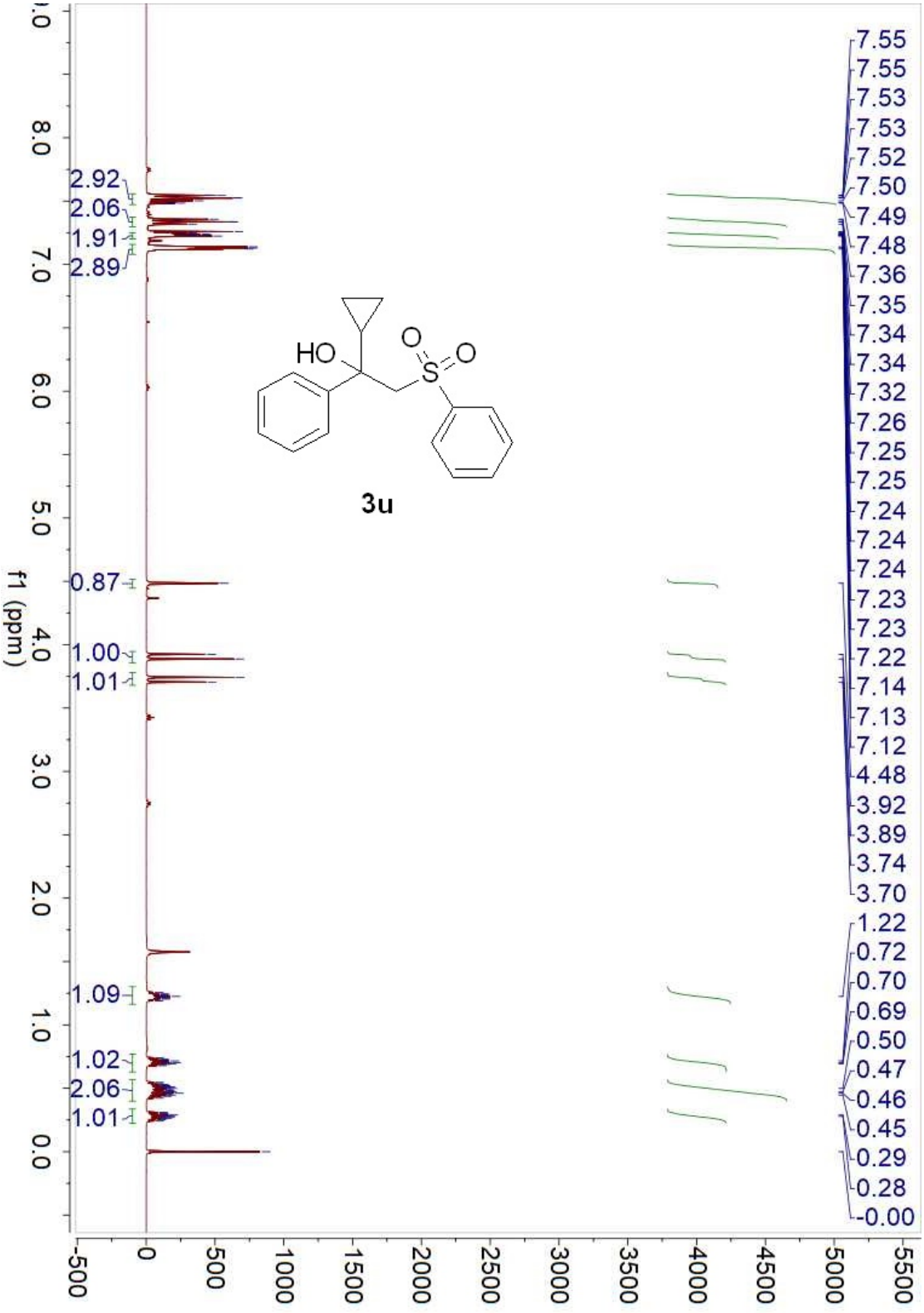
7.42
7.40
6.79
6.77
6.68
6.62
6.60
5.90
5.87
4.60
3.73
3.69
3.60
3.56
1.66
1.95
1.07
2.02
1.01
0.96
0.93
1.97
0.95
1.00
0.98
3.40
f1 (ppm)
3s


147.5
146.7
140.1
138.4
133.4
129.0
127.5
118.0
107.8
105.6
101.0
72.9
66.6
30.9
f1 (ppm)
3s


1.95
0.97
3.05
1.94
0.97
0.97
0.95
1.00
1.02
2.98
f1 (ppm)
7.53
7.52
7.51
7.50
7.50
7.47
7.47
7.47
7.45
7.45
7.45
7.26
7.18
7.17
7.17
7.16
7.16
7.15
7.15
7.13
7.13
7.13
7.12
7.11
7.10
7.09
7.06
7.06
7.04
7.02
6.92
6.92
6.90
6.71
6.71
4.90
4.08
4.04
3.65
3.62
1.66
O
S
O
O
OH

**3t**


144.1
140.2
137.8
133.3
128.9
128.2
127.9
127.4
125.4
121.7
73.0
66.6
30.8
21.3
O
S
O
O
OH
3t
f1 (ppm)


HO
O
S
O
3u
f1 (ppm)
2.92
2.06
1.91
2.89
0.87
1.00
1.01
1.09
1.02
2.06
1.01
7.55
7.55
7.53
7.53
7.52
7.50
7.49
7.48
7.36
7.35
7.34
7.34
7.32
7.26
7.25
7.25
7.24
7.24
7.24
7.23
7.23
7.22
7.14
7.13
7.12
4.48
3.92
3.89
3.74
3.70
1.22
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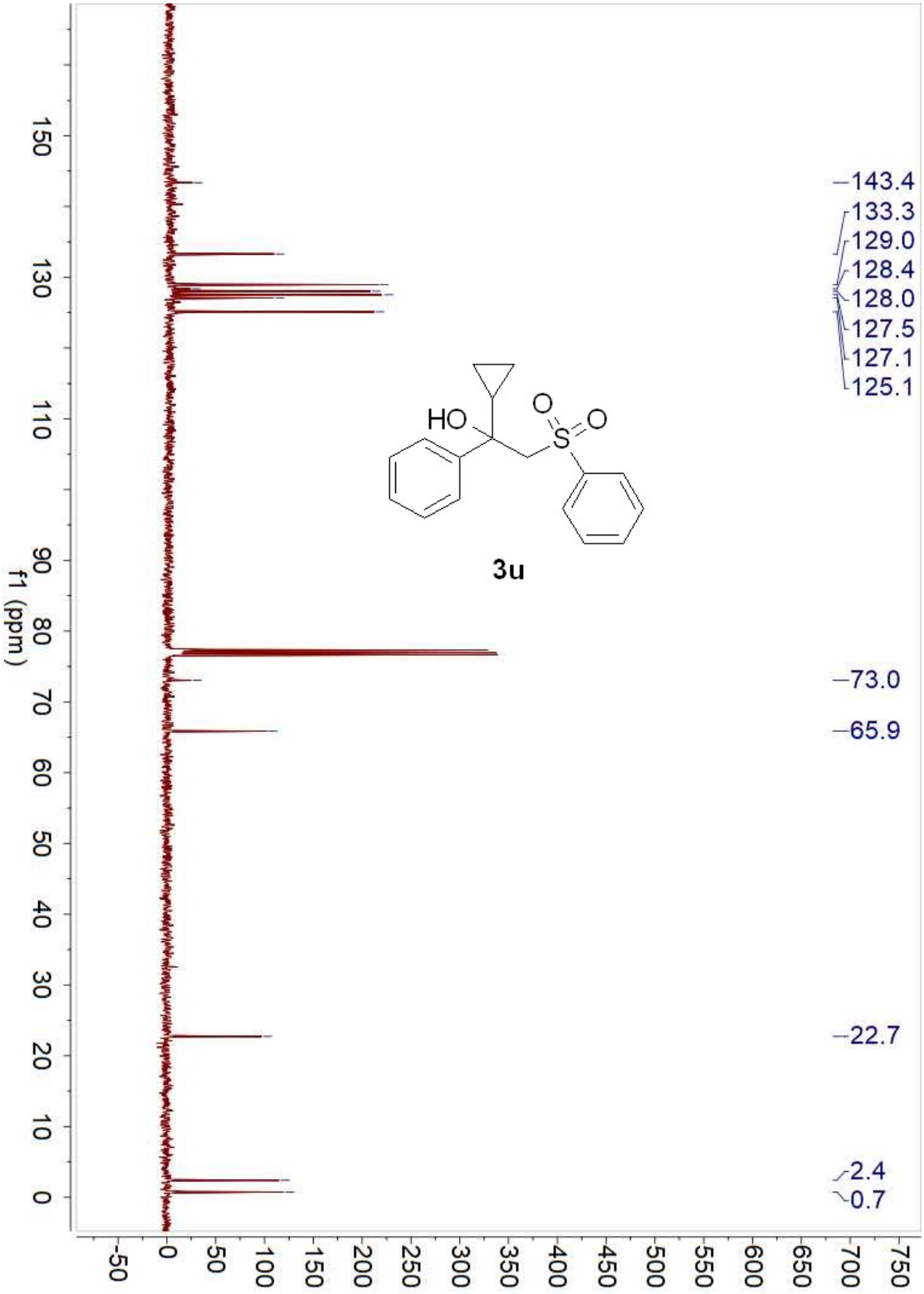
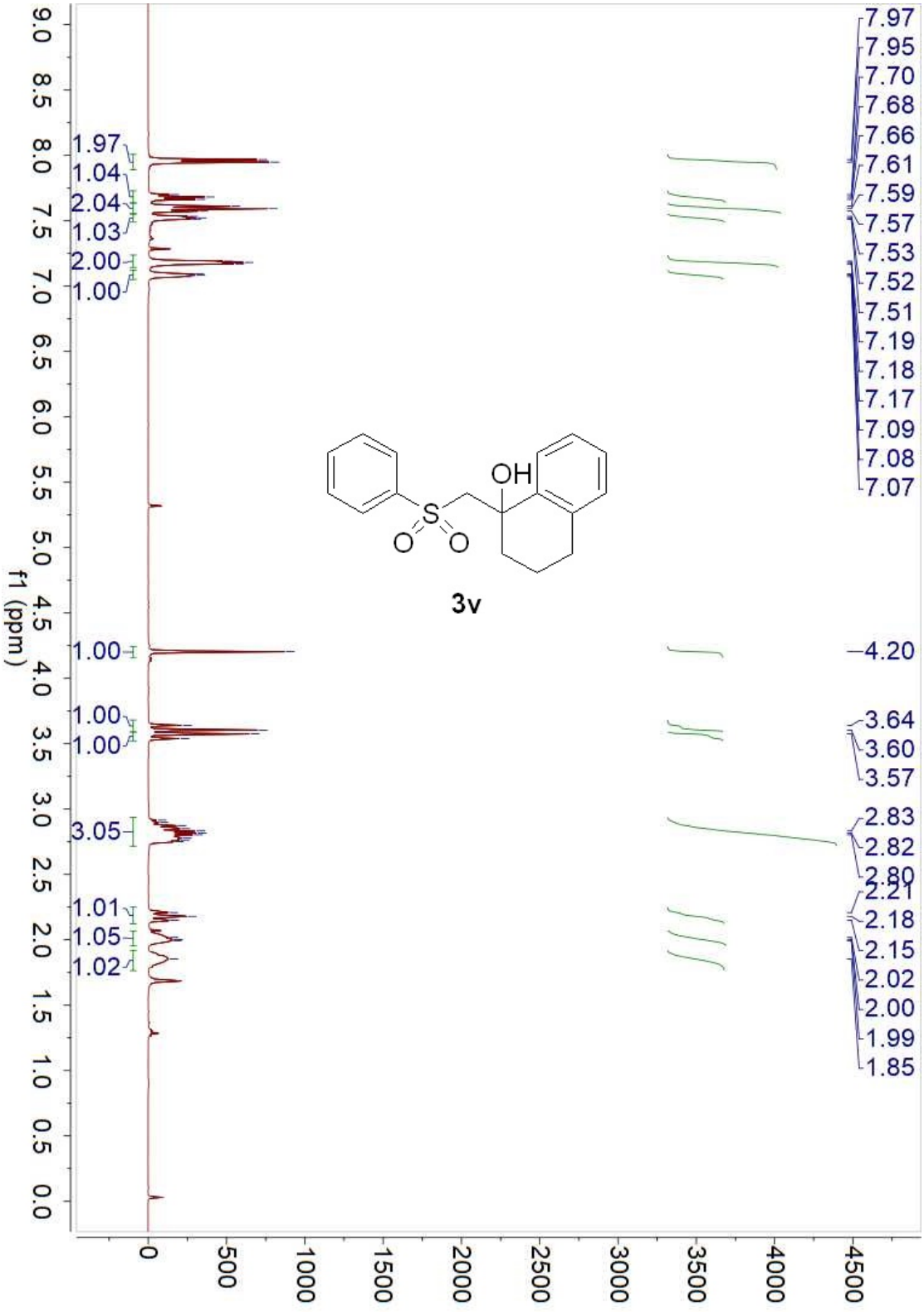
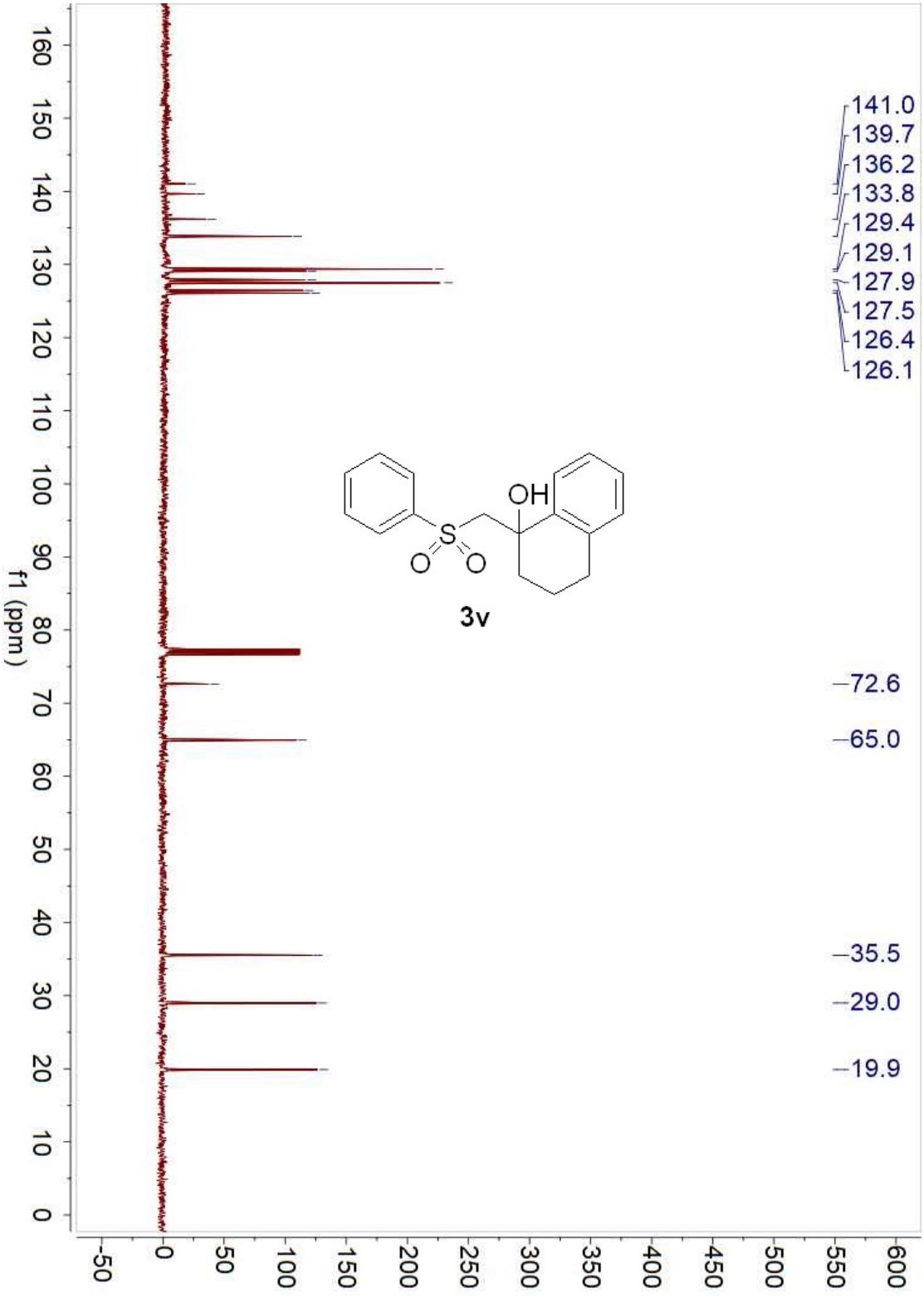
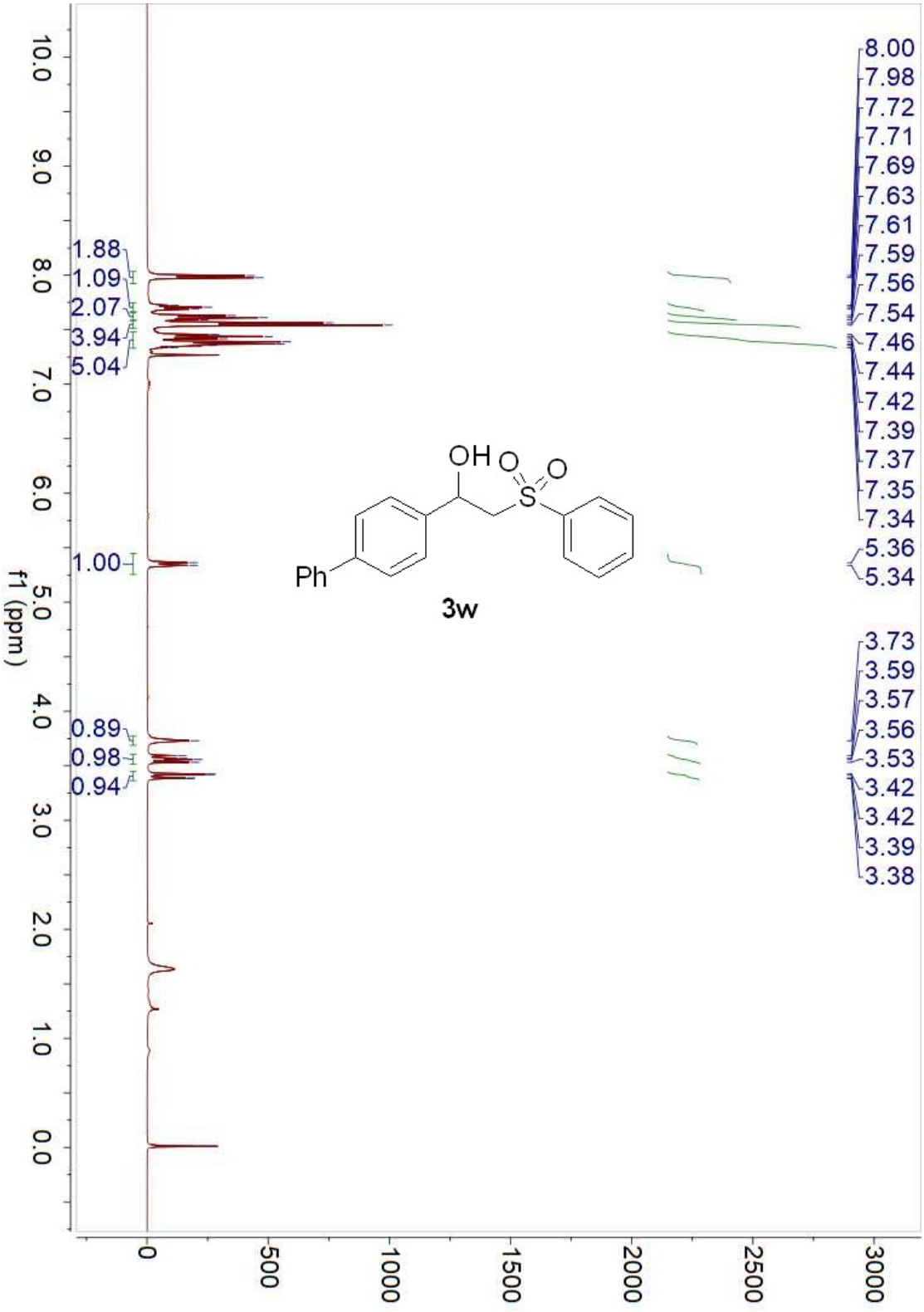
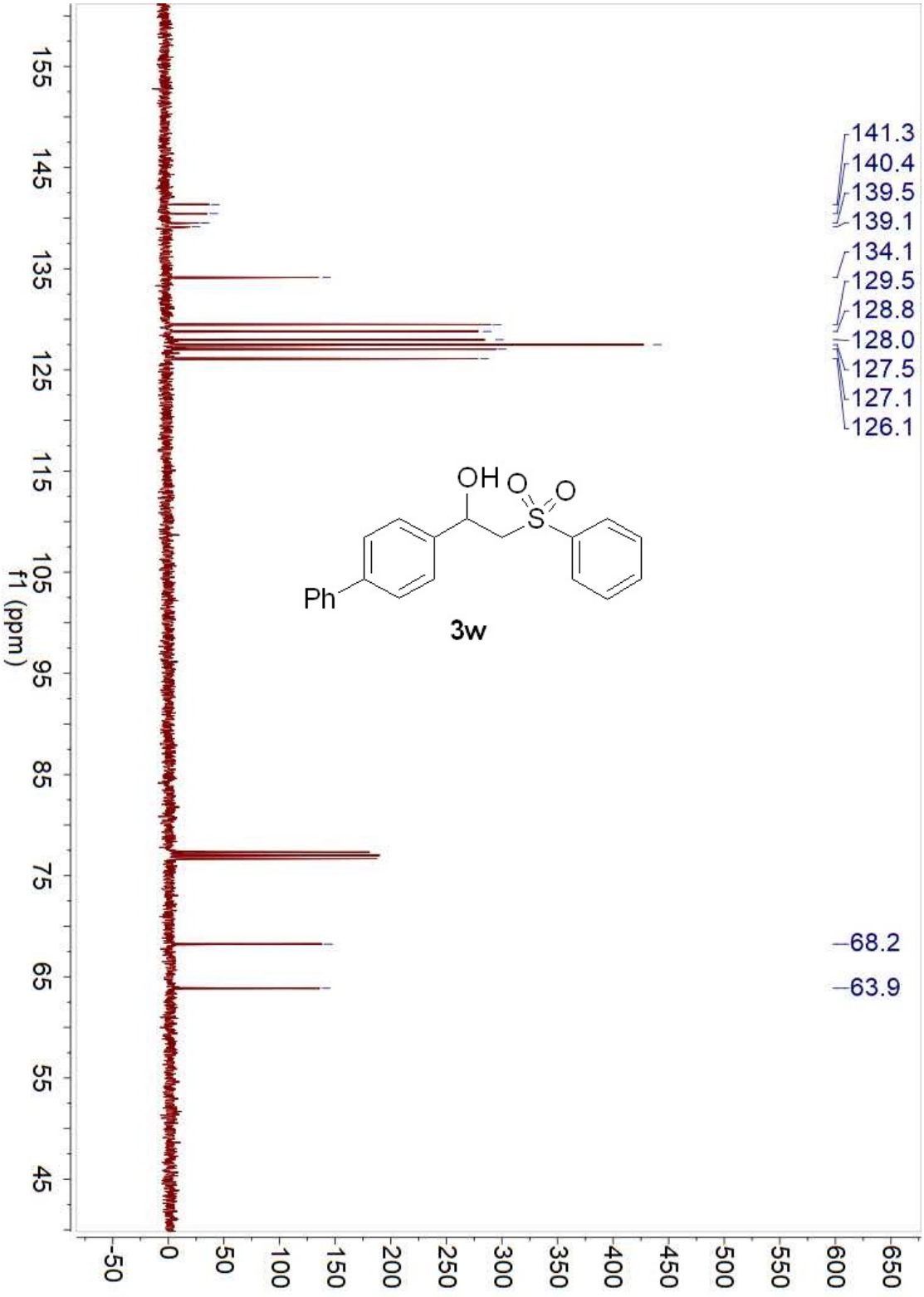
0.70
0.69
0.50
0.47
0.46
0.45
0.29
0.28
-0.00

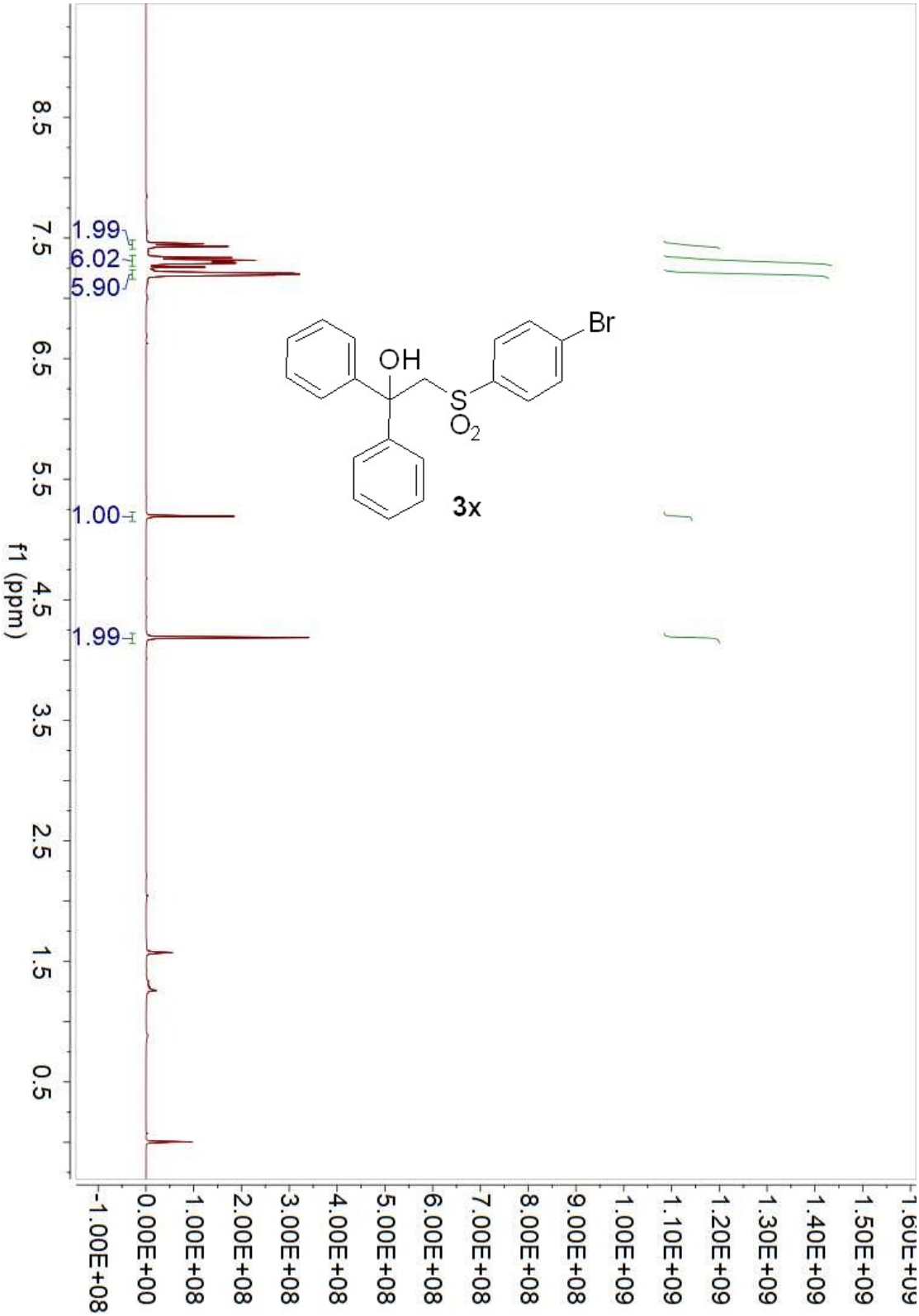

143.4
133.3
129.0
128.4
128.0
127.5
127.1
125.1
73.0
65.9
22.7
2.4
0.7
HO
O
S
O
3u
f1 (ppm)

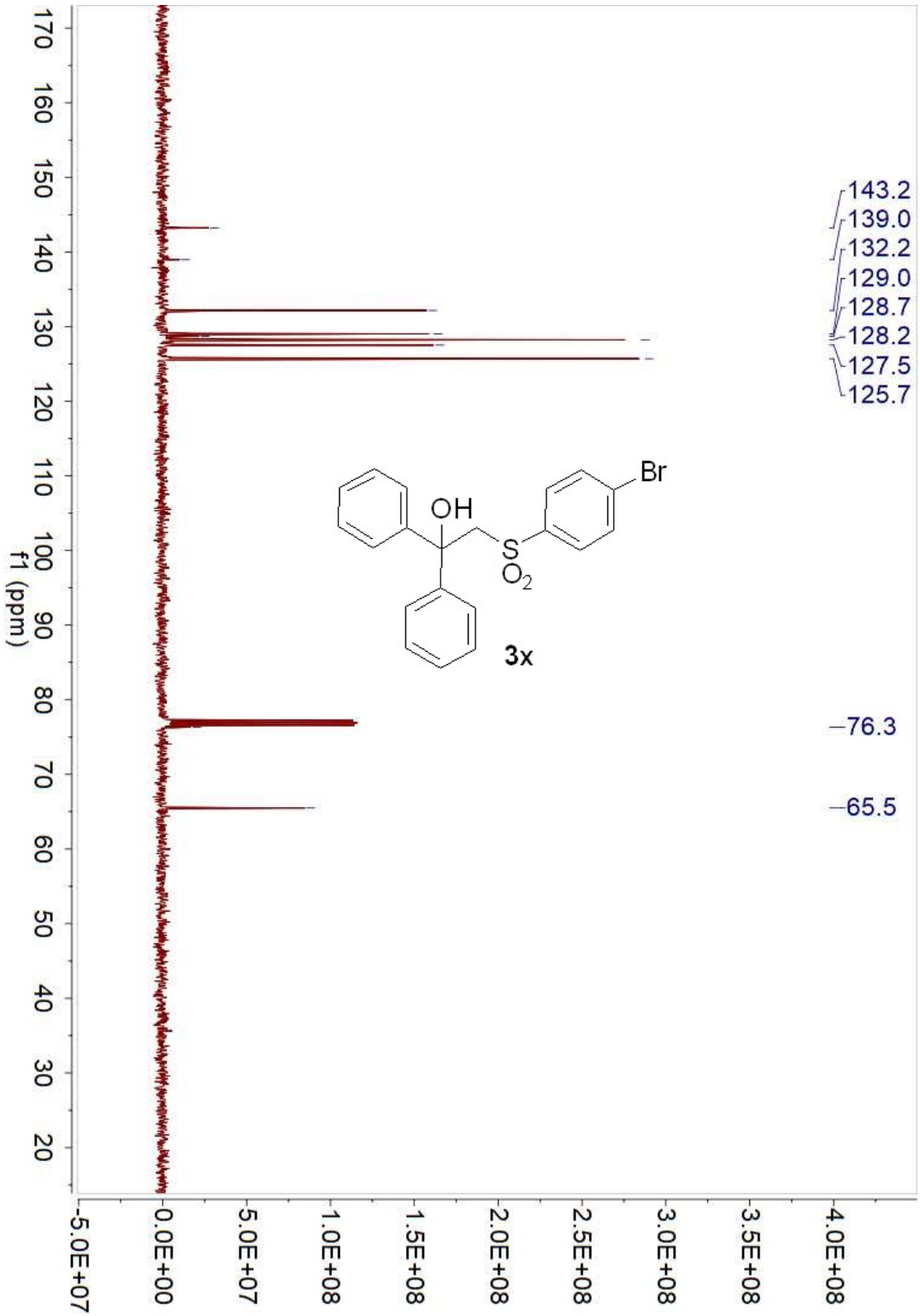

7.97
7.95
7.70
7.68
7.66
7.61
7.59
7.57
7.53
7.52
7.51
7.19
7.18
7.17
7.09
7.08
7.07
4.20
3.64
3.60
3.57
2.83
2.82
2.80
2.21
2.18
2.15
2.02
2.00
1.99
1.85
1.97
1.04
2.04
1.03
2.00
1.00
1.00
1.00
1.00
3.05
1.01
1.05
1.02
OH
S
O
O
3v
f1 (ppm)

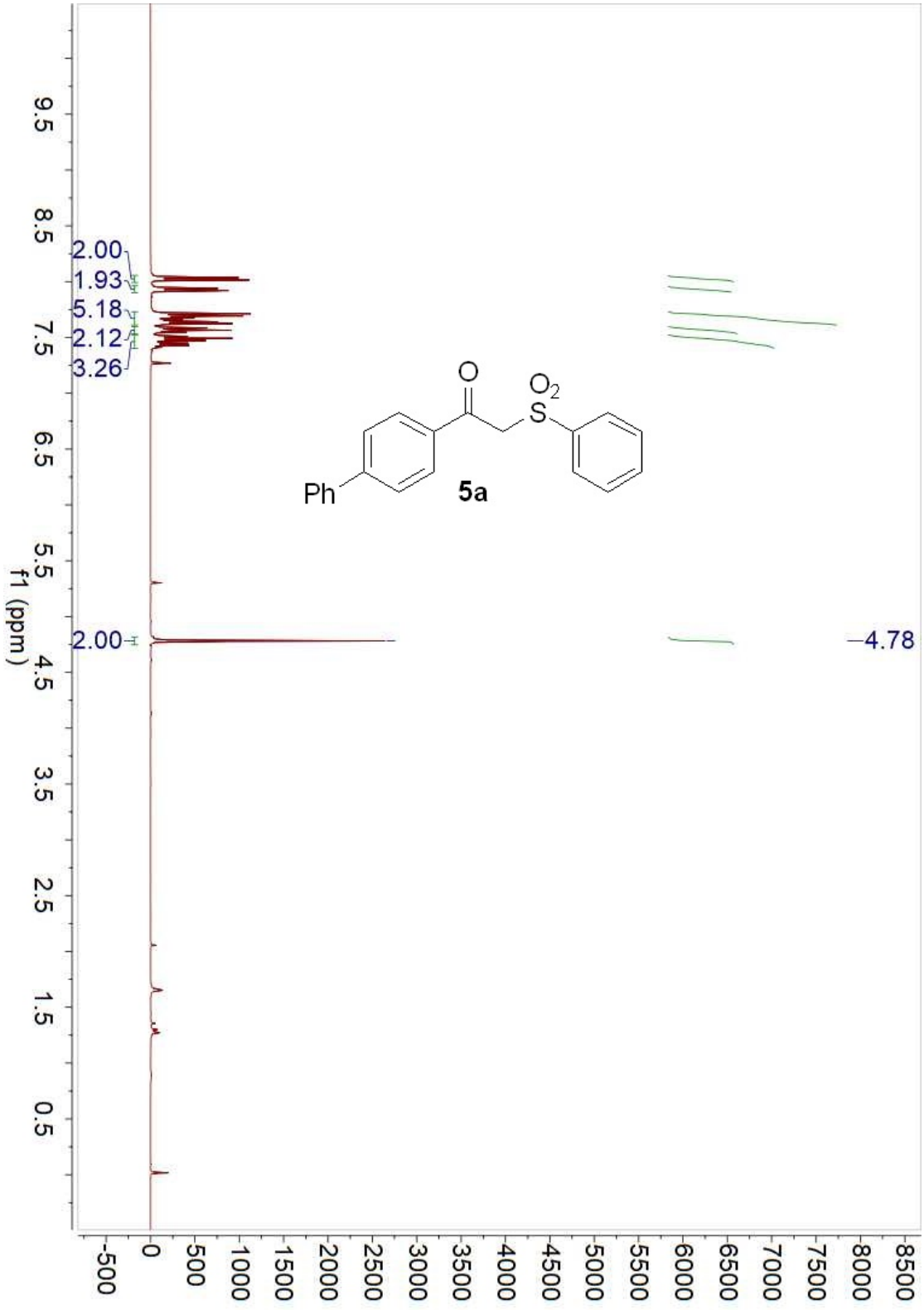

141.0
139.7
136.2
133.8
129.4
129.1
127.9
127.5
126.4
126.1
OH
S
O
O
3v
72.6
65.0
35.5
29.0
19.9
f1 (ppm)

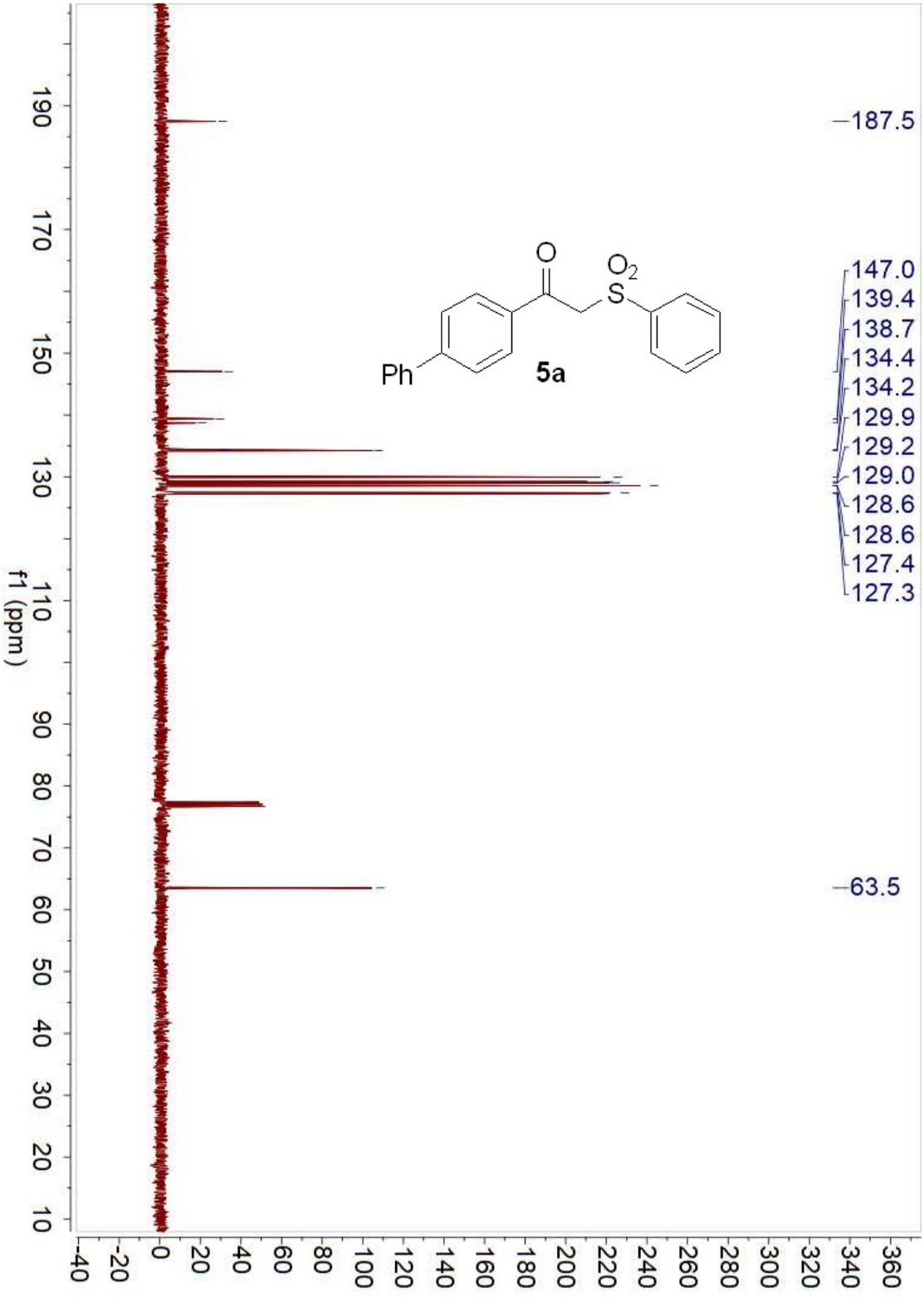

8.00
7.98
7.72
7.71
7.69
7.63
7.61
7.59
7.56
7.54
7.46
7.44
7.42
7.39
7.37
7.35
7.34
5.36
5.34
3.73
3.59
3.57
3.56
3.53
3.42
3.42
3.39
3.38
1.88
1.09
2.07
3.94
5.04
1.00
0.89
0.98
0.94
OH
O
O
S
Ph
3w
f1 (ppm)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
500
1000
1500
2000
2500
3000

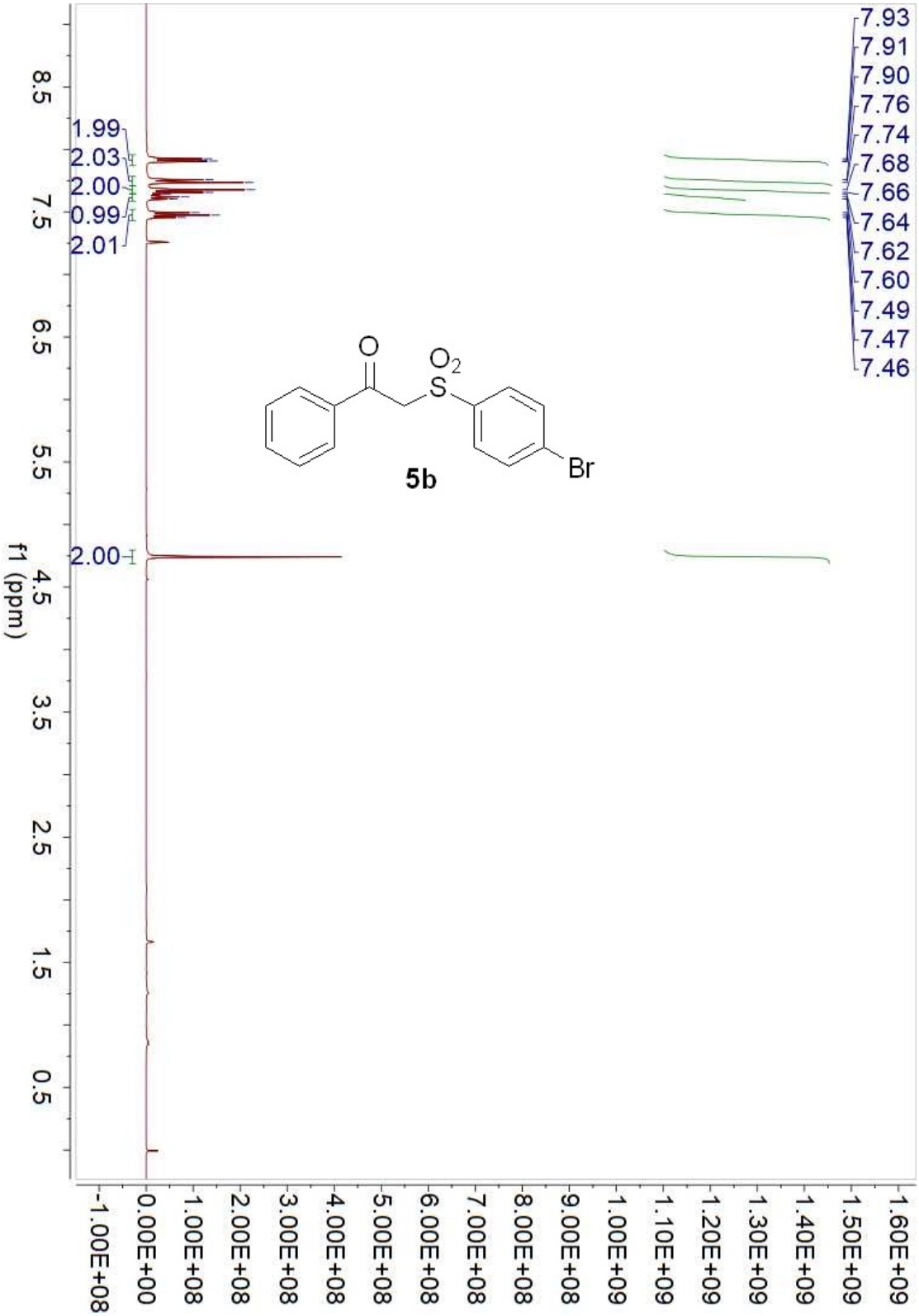

141.3
140.4
139.5
139.1
134.1
129.5
128.8
128.0
127.5
127.1
126.1
68.2
63.9
OH
O
O
S
Ph
3w
f1 (ppm)

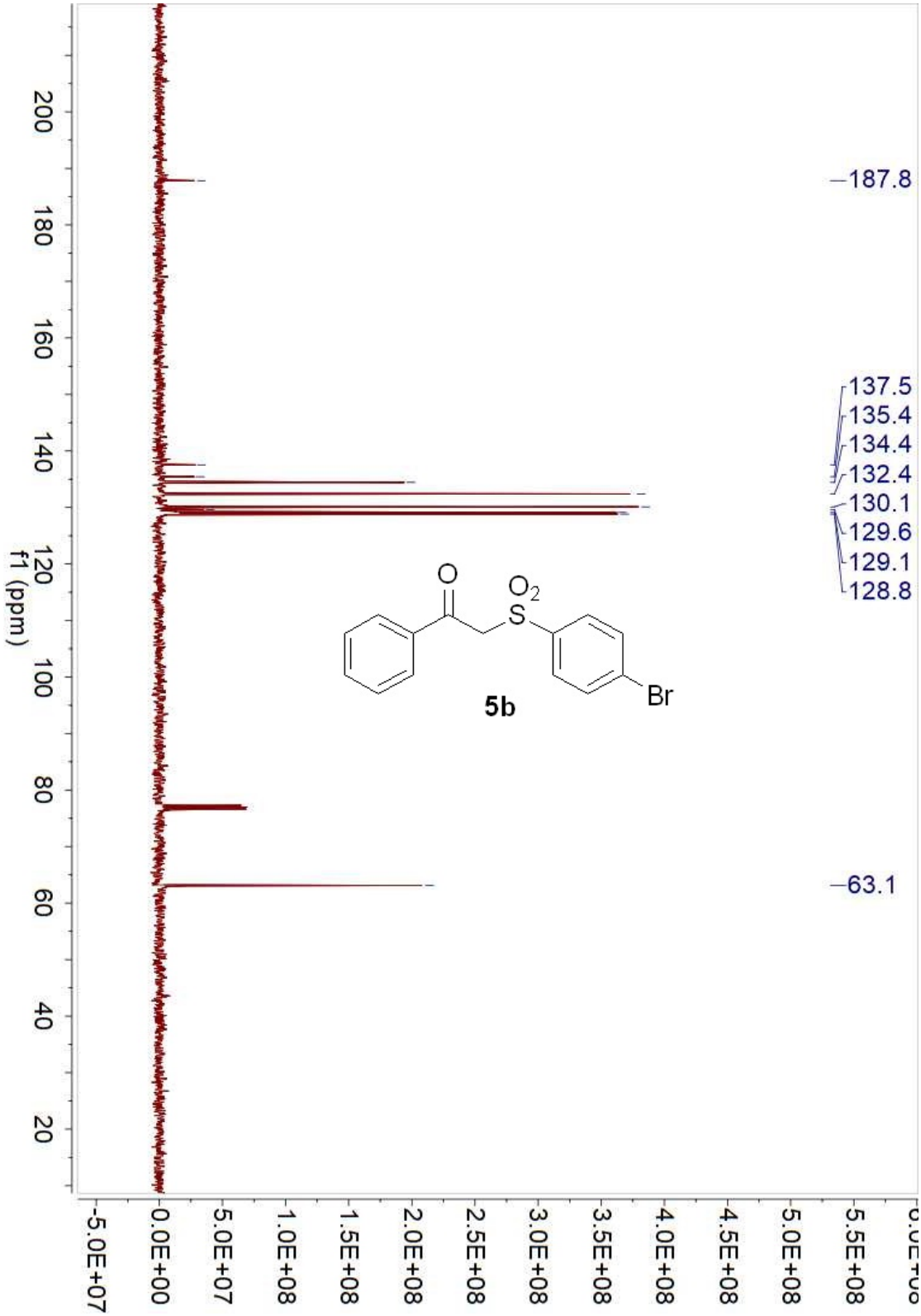

1.99
6.02
5.90
1.00
1.99
OH
S
O2
Br
3x
f1 (ppm)

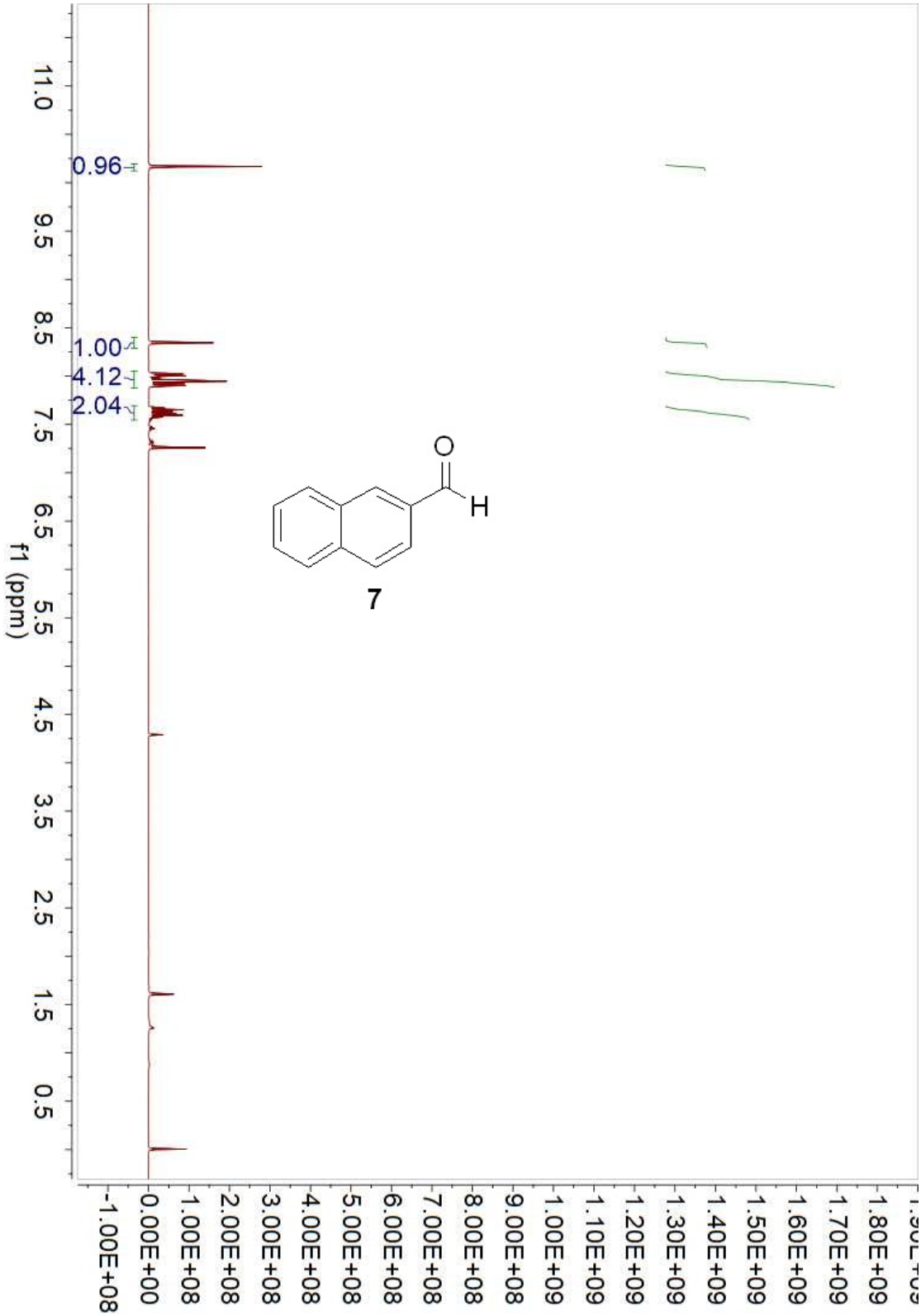

143.2
139.0
132.2
129.0
128.7
128.2
127.5
125.7
76.3
65.5
OH
S
O2
Br
3x
f1 (ppm)

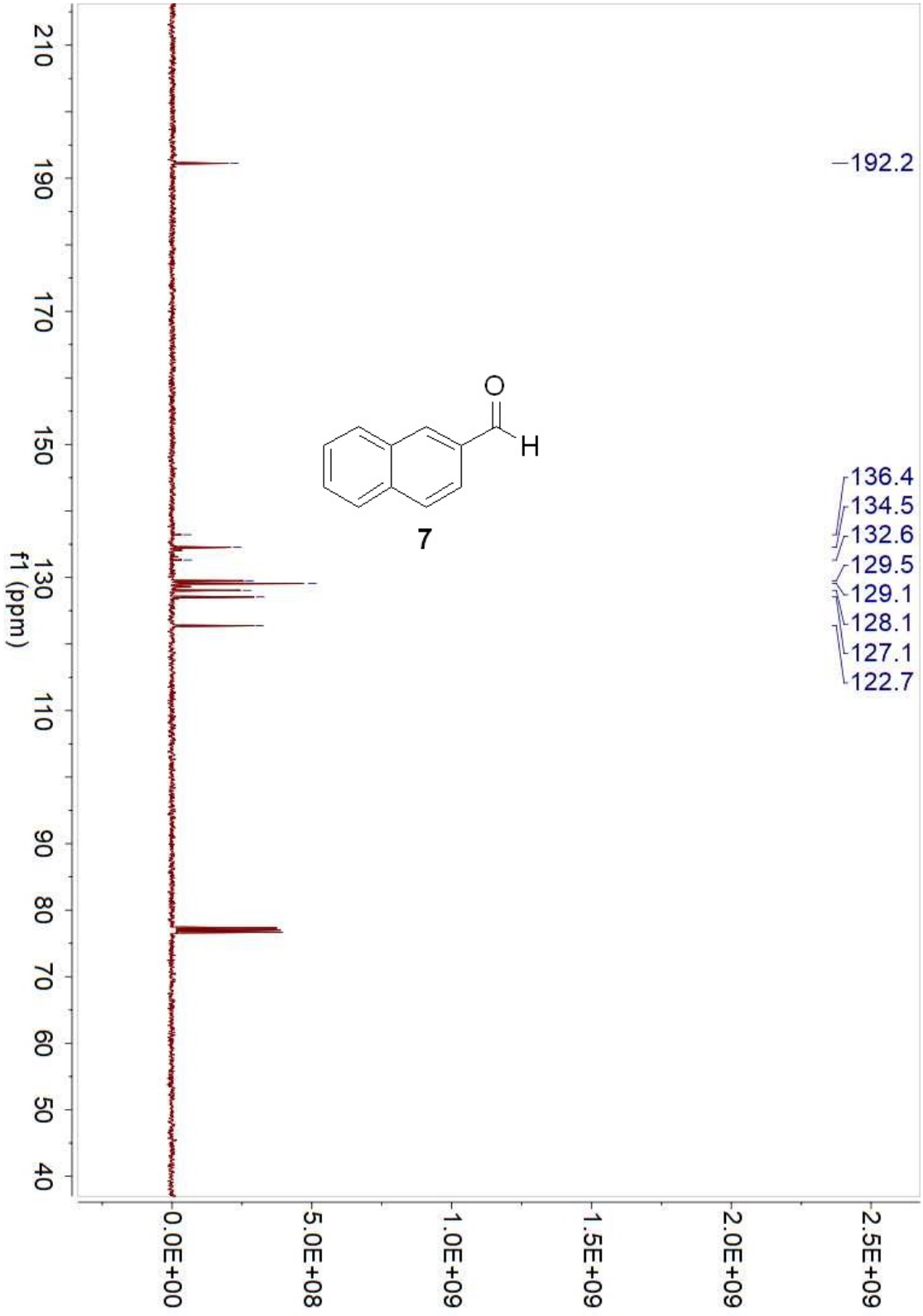

2.00
1.93
5.18
2.12
3.26
2.00
4.78
O
O2
S
Ph
5a
f1 (ppm)

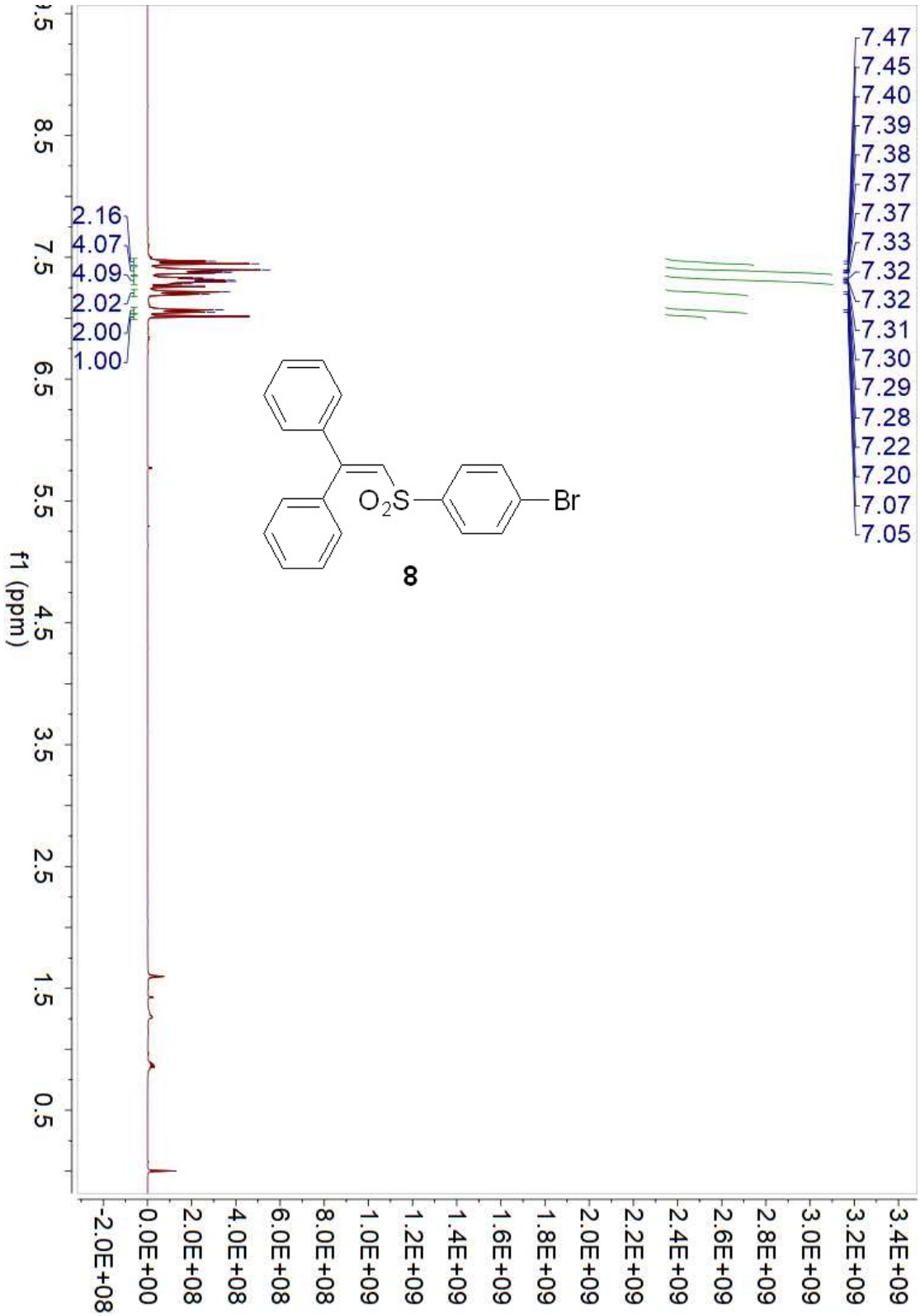

187.5
147.0
139.4
138.7
134.4
134.2
129.9
129.2
129.0
128.6
128.6
127.4
127.3
63.5
O
O2
S
Ph
5a
f1 (ppm)

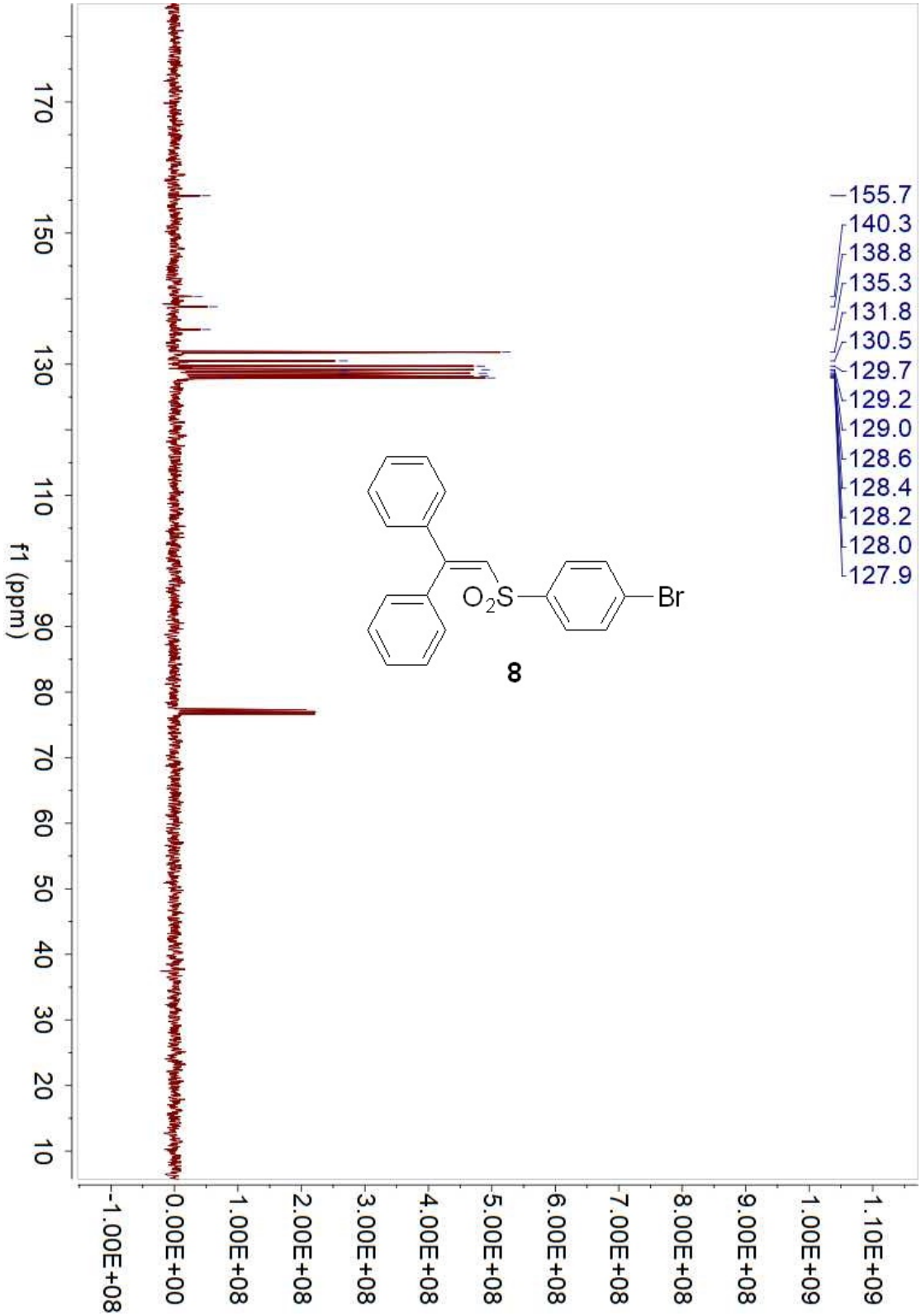

7.93
7.91
7.90
7.76
7.74
7.68
7.66
7.64
7.62
7.60
7.49
7.47
7.46
1.99
2.03
2.00
0.99
2.01
2.00
O
O2
S
Br
5b
f1 (ppm)


187.8
137.5
135.4
134.4
132.4
130.1
129.6
129.1
128.8
63.1
O
O2
S
Br
5b
f1 (ppm)


0.96
1.00
4.12
2.04
O
H
7
f1 (ppm)


192.2
136.4
134.5
132.6
129.5
129.1
128.1
127.1
122.7
O
H
7
f1 (ppm)
210
190
170
150
130
110
90
80
70
60
50
40
0.0E+00
5.0E+08
1.0E+09
1.5E+09
2.0E+09
2.5E+09


7.47
7.45
7.40
7.39
7.38
7.37
7.37
7.33
7.32
7.32
7.31
7.30
7.29
7.28
7.22
7.20
7.07
7.05
2.16
4.07
4.09
2.02
2.00
1.00
O2S
Br
8
f1 (ppm)


155.7
140.3
138.8
135.3
131.8
130.5
129.7
129.2
129.0
128.6
128.4
128.2
128.0
127.9
O2S
Br
8
f1 (ppm)