Structure Activity Relationship Study of 3,4'-Dimethoxyflavone for ArlRS Inhibition in *Staphylococcus aureus*

Supporting Information

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General biological experimental

Bacterial strains, media, and antibiotics *S. aureus* strains AH1263, AH5929, AH2360, AH2090 AH2087, AH2357, AH2106, AH1292, AH2099, AH2094, AH2084, AH2081, AH2075, AH2072, AH2066, AH2062, AH2216, AH3613, AH3614, AH1677, AH5151, AH5152, AH5380, AH5381, AH1716, AH1717, AH2222 were from our in-house library of *S. aureus* strains at The University of Colorado Anschutz School of Medicine, Aurora. MRSA strains MRSA ATCC BAA-1556 was obtained from the ATCC. Stock cultures were stored in 25% glycerol and maintained at -80 °C. Prior to use, colonies were grown on tryptic soy agar with either chloramphenicol (10 μg/mL strains AH1677, AH5151, AH5152, AH5380, AH5381) or erythromycin (10 μg/mL Strains AH3613, AH3614, AH 1716, AH1717, AH2222) or no antibiotic (all other strains). Cation adjusted mueller hinton broth (CAMHB) (cat# 212322) and tryptic soy broth (TSB) (cat# 211822) was purchased from BD. Oxacillin monosulfate was purchased from TCI (cat # 3LVBA-IK). Chloramphenicol was purchased from Alfa Aesar (cat # 10131638). Erythromycin was purchased from TCI (cat# JRD8F-AT). All assays were run twice from two separate cultures and then repeated at least two separate times (minimum of four biological replicates).

Biological assay protocols

GFP linked reporter strain assay: Bacteria was cultured overnighting in fresh TSB (3 mL) along with antibiotic (10 μg/mL) to select for intended plasmid. Overnight cultures were diluted 1:500 in TSB and antibiotic (1:1000 dilution from a 10μg/mL stock) was added. To aliquots (0.5 mL) was added compound from 10 mM stock solutions in DMSO, such that the compound concentration equaled 50 μM. Samples were then dispensed (200 μL) in a black 96 well plate so that each sample occupied two wells. Two wells were filled with only media and two wells were

filled with inoculated media with no compound. Plates were covered with a lid and placed in a BioTek Synergy HTX multi-mode reader plate reader. The plate was continually shaken using the fast orbital setting with an orbital frequency of 807cpm at 37 °C for 24 hours. The OD_{600} and fluorescence intensity with excitation at 485 nm and emission at 528 nm were recorded at the start then subsequently every hour with the gain set 35 and measurements being taken from the bottom of the plate.

Broth microdilution method for the determination of minimum inhibitory concentration (MIC): Bacteria were cultured for 4 to 6 hours in CAMHB and subcultured to 5 x 10^5 CFU/mL in fresh CAMHB. To aliquots (0.5 mL) was added compound from 10 mM stock solutions in DMSO, such that the compound concentration equaled the highest concentration tested. Samples were then dispensed (200 μL) into the first row of a 96-well microtiter plate in which all but the final row of subsequent wells were prefilled with 100 μL of the untreated bacterial subculture. The final row was filled with media to act as a sterility control and blank. Row one wells were mixed 6-7 times, then, 100 μL was withdrawn and transferred to row two. Row two wells were mixed 6-7 times followed by a 100 μL transfer from row two to row three. This procedure was used to serially dilute the rest of the rows of the microtiter plate, excluding the last prefilled row, which was used to measure growth in the absence of compound. Plates were then sealed with GLAD Press'n Seal and incubated under stationary conditions at 37 °C. After 16 hours, the plates were removed, and MIC values were measured by recording the OD_{600} of each well. MIC values were determined as the minimum concentration required to achieve 90% growth inhibition compared to growth in untreated wells

Broth microdilution method for measurement of oxacillin potentiation: Bacteria were cultured for 4 to 6 hours in CAMHB and diluted to 5 x 10^5 CFU/mL in fresh CAMHB. To aliquots (3 mL) was added compound from 10 mM stock solutions in DMSO. One aliquot was not dosed to allow measurement of the antibiotic MIC in the absence of compound. A 500 µL aliquot of each sample was dosed with oxacillin, and from this 200 µL was dispensed into the first row of a 96-well microtiter plate in which all but the final row of subsequent wells was prefilled with 100 µL of the corresponding compound dosed bacterial suspension The final row was filled with media to act as a sterility control and blank. Row one wells were mixed 6-7 times, then, 100 µL was withdrawn and transferred to row two. Row two wells were mixed 6-7 times followed by a 100 µL transfer from row two to row three. This procedure was used to serially dilute the rest of the rows of the microtiter plate, excluding the last prefilled row, which was used to measure growth in the presence of compound alone. Plates were then sealed with GLAD Press'n Seal and incubated under stationary conditions at 37 °C. After 16-18 hours, the plates were removed, and MIC values were measured by recording the OD_{600} of each well. MIC values were determined as the minimum concentration required to achieve 90% growth inhibition compared to growth in untreated wells.

Table S1: Average percent inhibition of fluorescence normalized to growth in *mgrA* P2-GFP, *spx* P2-GFP, *agr* P3-YFP, and P_{hla}-GFP reporter strains when treated with 50 μM of each compound.

Compound	*mgrA* P2-GFP reporter	*spx* P2-GFP reporter	*agr* P3-YFP reporter	P_{hla}-GFP reporter
1	19	18	21	27
3a	50	35	72	32
3b	37	25	23	-13
3c	42	32	73	10
3d	34	18	0	-44
3e	50	27	17	-62
3f	48	24	12	-88
3g	61	34	12	-46
3h	19	15	-13	-20
3i	17	17	25	38
3j	24	18	24	46
3k	19	3	1	52
3l	19	0	19	3
3m	27	-10	-17	13
3n	21	8	-9	15
3o	11	9	4	3
3p	36	30	32	26
3q	18	12	3	5
3r	11	10	5	-3
3s	14	8	-7	24
3t	25	3	-4	11
3u	6	3	2	-1
3v	23	22	31	5
3w	24	15	20	-29
3x	30	16	5	3
3y	29	28	25	-10
3z	21	12	18	-8
7a	24	11	21	34
7b	30	-4	6	15
10	13	2	-15	12
15	10	3	12	24

16	33	26	52	41
17	61	51	48	-46
18	5	26	-6	0
19	25	24	24	-5
20	13	12	9	-2
21	1	3	-3	12

[a]All values given as percent inhibition compared to untreated samples. [n] Negative values denote instances when fluorescence was increased compared to untreated samples.

Table S2: Strains of *S. aureus* used in this study and MIC of oxacillin in all deletion strains and MIC of oxacillin with 60 µM of compound 17 in strains with lower MICs than parent strain.

Strain number	LOCI	MIC of Oxacillin	MIC of Oxacillin with 60 µM of compound 17
ATCC BAA-1556	N/A	32	2
AH 1263	USA 300 LAC. CA-MRSA strain LAC, USA300-0114 PFGE type, Erm sensitive	32	1
AH 1292[2]	transduction of *agr*::tet from RN7208 into AH1263	32	N/A
AH 2216[3]	AH1263 Δ*saePQRS*	32	N/A
AH 2062[4]	AH1263 Δ*yesMN* LAC*SAUSA300_0217-18Δ	32	N/A
AH 2066[4]	AH1263 Δ*lytRS* LAC*SAUSA300_0254-55Δ	32	N/A
AH 2072[4]	AH1263 Δ*narL* LAC*SAUSA300_1219-20Δ	32	N/A
AH 2075[4]	AH1263 Δ*arl* LAC*SAUSA300_1307-08Δ	32	N/A
AH 2081[4]	AH1263 Δ*phoRS* LAC*SAUSA300_1638-39Δ	32	N/A
AH 2084[4]	AH1263 Δ*airRS* LAC*SAUSA300_1798-99Δ	32	N/A
AH 2087[4]	AH1263 Δ*vraRS* LAC*SAUSA300_1865-66Δ	8	1
AH 2090[4]	AH1263 Δ*kdpDE* LAC*SAUSA300_2035-36Δ	8	0.5
AH 2094[4]	LAC*SAUSA300_2308-09Δ	32	N/A
AH 2099[4]	AH1263 Δ*nsaRS* LAC*SAUSA300_2558-59Δ	32	N/A
AH2106[4]	AH1263 Δ*nreBC* LAC*SAUSA300_2337-38Δ	64	N/A
AH2357[4]	AH1263 Δ*srrAB* LAC*SAUSA300_1441-42Δ	64	N/A
AH2360	AH1263 Δ*graRS* LAC*SAUSA300_0645-46Δ	2	1
AH 5929[8]	AH1263 *mecA*::Tet	0.25	0.25

AH3613[5]	AH1263 + pHC68 (pCM11_P*mgrA*_sGFP, ermR)	N/A	N/A
AH3614[5]	AH1263 Δarl + pHC68 (pCM11_P*mgrA*_sGFP, ermR)	N/A	N/A
AH1677[6]	AH845 / pDB59 (*agr* type I reporter)	N/A	N/A
AH5151[7]	AH1263 + pHC151 (pCM29_P*sdr*D, camR)	N/A	N/A
AH5152[7]	AH1263 Δarl + pHC151 (pCM29_P*sdr*D, camR)	N/A	N/A
AH5380[7]	AH1263 + pHC177 (pCM29 _*spx*P2, camR)	N/A	N/A
AH5381[7]	AH1263 Δarl + pHC177 (pCM29 _*spx*P2, camR)	N/A	N/A
AH1716	AH1263 + pCM27 (P_{hla}_sGFP, ermR)	N/A	N/A
AH1717	AH1263 agr::tet + pCM27 (Phla_sGFP, ermR)	N/A	N/A
AH2222	AH1263 Δsae*PQRS* + pCM27 (P_{hla}_sGFP, ermR)	N/A	N/A

General Chemistry Experimental

All reactions were carried out under an atmosphere of nitrogen using anhydrous solvents unless otherwise specified. All chemical reagents for synthesis were used without further purification. Analytical thin layer chromatography (TLC) was performed using 250 μm Silica Gel 60 F254 pre-coated plates (EMD Chemicals Inc.). Flash column chromatography was performed using 230–400 mesh 60Å Silica Gel from Sorbent Technologies. NMR spectra were recorded using broadband probes on a Bruker AVANCE III HD Nanobay (400, 500 or 800 MHz for ^{1}H and 100 125 or 200 MHz for ^{13}C). All Spectra are presented using MestReNova (Mnova) software and ^{1}H NMR are typically displayed from 12 to -0.7 ppm without the use of the signal suppression function. Spectra were obtained in the following solvents (reference peaks also included for the ^{1}H and ^{13}C NMRs): *d6*-DMSO (^{1}H NMR: 2.50 ppm; ^{13}C NMR: 39.52 ppm), CD_3OD (^{1}H NMR: 3.31 ppm; ^{13}C NMR: 49.00 ppm) and d_1-$CDCl_3$ (^{1}H NMR: 7.26 ppm; ^{13}C NMR: 77.16 ppm). All NMR experiments were performed at room temperature. Chemical shift values (δ) are reported in parts per million (ppm) for all ^{1}H and ^{13}C spectra. ^{1}H NMR multiplicities are reported as: s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, m = multiplet, br = broad hept = heptet. High-resolution mass spectra were obtained for all new compounds from the mass spectrometry and proteomics facility at the University of Notre Dame performed on a Bruker-TOF-ESI spectrometer in positive module using direct infusion in 9:1 acetonitrile: water. The IR spectra analyses were conducted at the Center for Environmental Science and Technology (CEST) at University of Notre Dame using a Bruker Tensor 27, with a diamond lens ATR module, to gather transmission spectra. UV data was taken using a Thermo Scientific, Genesys 10 UV scanning spectrometer.

General procedure for aldol condensation

A mixture of the acetophenone (5-10 mmol, 1 equiv.) and the corresponding aldehyde (1 equiv.) in EtOH (20-40 mL) was stirred at room temperature without a cap and a 50% aqueous solution of NaOH (5-8 mL) was added. The reaction mixture was stirred at room temperature until all of the aldehyde had been consumed. HCl (10%) was then added until neutrality. Precipitated chalcones were generally filtered and crystallized from MeOH although in some cases the product was purified using column chromatography (Hexanes: EtOAc).

General procedure of Algar-Flynn-Oyamada cyclization and alkylation

A solution of the corresponding 2-hydroxychalcone (1-4 mmol) in 3.0 M KOH in MeOH (20-30 mL) was cooled to 0 °C with no cap. An aqueous solution of H_2O_2 (30%) (5-8 mL) was added to the chalcone solution. The resulting mixture was stirred and allowed to warm to room temperature and stirred overnight. The reaction mixture was again cooled to 0 °C and HCl (3 N) was added until the mixture reached pH 2. The precipitate was dissolved in EtOAC and washed with distilled water and brine three times each (20 mL). The organic layer was dried with anhydrous Na_2SO_4. The solvent was evaporated in vacuo and the residue run through a flash silica column. A portion of the resulting residue containing the product (20-100 mg) was added with K_2CO_3 (1.8 equiv.) to a flame dried vial, which was evacuated and placed under argon. The residue and base were then dissolved in CH_3CN (5 mL), and the mixture was heated to 40 °C. The desired alkyl halide (10 equiv.) was subsequently added, and the reaction was allowed to stir until the starting material was totally consumed (as evidenced by TLC). The reaction mixture was then, partitioned between ethyl acetate and water. The ethyl acetate layer was washed with brine, dried over Na_2SO_4, filtered and

concentrated. The crude material was purified by column chromatography to yield the final product.

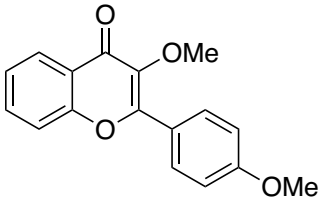
General Procedure for MOM protection

A RBF was charged with DCM (30 mL), aldehyde (1 equiv.) and Hunig's base (1.6 equiv.). MOM-Cl (5.9 M in MeOAc) (1.5 equiv.) was added slowly. Reaction was stirred overnight at rt. The reaction was subsequently diluted with DCM, washed with HCl (2x), sodium bicarbonate (2x), brine (2x), and dried over sodium sulfate before being purified via column chromatography.

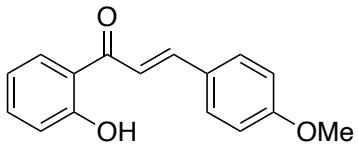
General procedure of MOM deprotection

Compound was added to vial and dissolved in DCM (1.5 mL). TFA (1.5 mL) was then added to the vial and the reaction was allowed to stir until the starting material was consumed (as evidenced by TLC). Following deprotection, compound was purified via column chromatography.

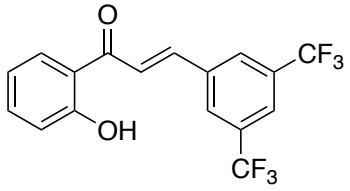
Previously Reported Compounds



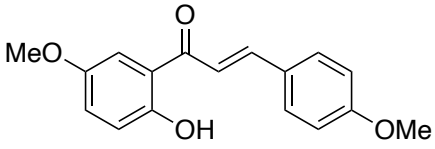
3-Methoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (1): was synthesized using the general procedure for Algar-Flynn-Oyamada cyclization and alkylation with **2a** and methyl iodide. Spectral data were consistent with previous reports.[9]



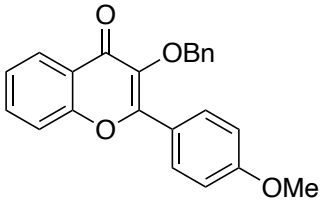
(*E*)-1-(2-Hydroxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2a): was synthesized using the general procedure for aldol condensation. Spectral data were consistent with previous reports.[10]



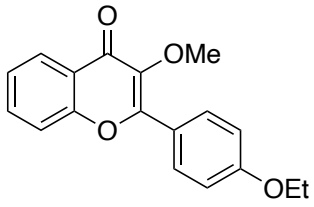
(*E*)-3-(3,5-Bis(trifluoromethyl)phenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2k): was synthesized using the general procedure for aldol condensation. Spectral data were consistent with previous reports.[11]



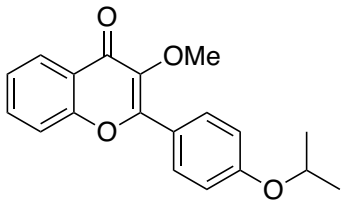
(*E*)-1-(2-Hydroxy-5-methoxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2q): was synthesized using the general procedure for aldol condensation. Spectral data were consistent with previous reports.[12]



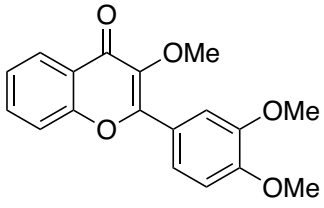
3-(Benzyloxy)-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3b) was synthesized using the general procedure procedure for Algar-Flynn-Oyamada cyclization and alkylation with **2a** and benzyl bromide. Spectral data were consistent with previous reports.[9]



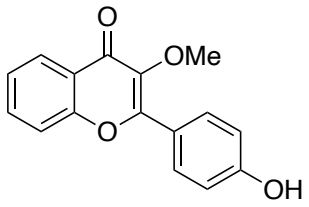
2-(4-Ethoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3j): was synthesized using the general procedure procedure for Algar-Flynn-Oyamada cyclization and alkylation with **2c** and methyl iodide. Spectral data were consistent with previous reports.[9]



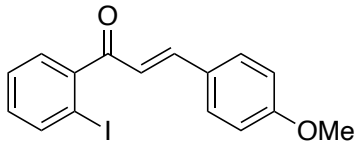
2-(4-Isopropoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3l): was synthesized using the general procedure procedure for Algar-Flynn-Oyamada cyclization and alkylation with **2e** and methyl iodide. Spectral data were consistent with previous reports.[9]



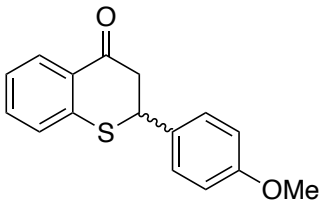
2-(3,4-Dimethoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3n): was synthesized using the general procedure procedure for Algar-Flynn-Oyamada cyclization and alkylation with **2g** and methyl iodide. Spectral data were consistent with previous reports.[9]



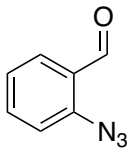
2-(4-Hydroxyphenyl)-3-methoxy-4*H*-chromen-4-one (7a): was synthesized using the general procedure procedure for Algar-Flynn-Oyamada cyclization and alkylation with **6a** and methyl iodide followed by MOM deprotection. Spectral data were consistent with previous reports.[13]



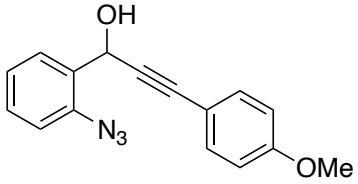
(*E*)-1-(2-Iodophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (8): was synthesized using the general procedure for aldol condensation. Spectral data were consistent with previous reports.[14]



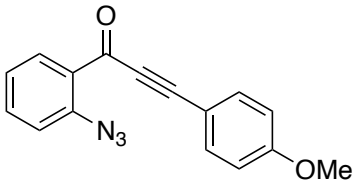
2-(4-Methoxyphenyl)thiochroman-4-one (9): Compound was synthesized using previously reported methods.[15] Spectral data were consistent with previous reports.[15]



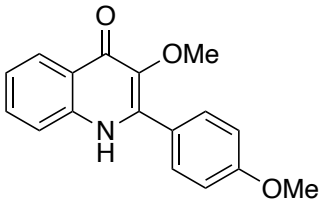
2-Azidobenzaldehyde (12): Compound was synthesized using previously reported methods.[16] Spectral data were consistent with previous reports.[16]



1-(2-Azidophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-ol (13): Compound was synthesized using previously reported methods.[16] Spectral data were consistent with previous reports.[16]

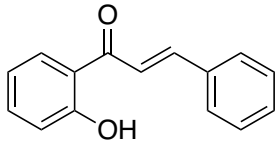


1-(2-Azidophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-one (14): Compound was synthesized using previously reported methods.[16] Spectral data were consistent with previous reports.[16]

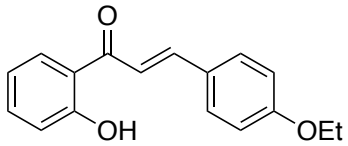


3-Methoxy-2-(4-methoxyphenyl)quinolin-4(1*H*)-one (15): Compound was synthesized using previously reported methods.[16] Spectral data were consistent with previous reports.[16]

Novel Compound Characterization

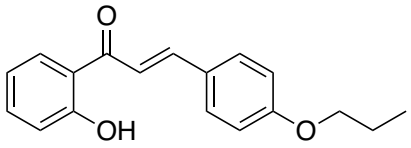


(*E*)-1-(2-Hydroxyphenyl)-3-phenylprop-2-en-1-one (2b): The general procedure for aldol condensation afforded **2g** as a yellow solid. Yield 39% (436 mg, 1.94 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.82 (s, 1H), 7.94 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.94 (d, *J* = 15.5 Hz, 1H), 7.71 – 7.66 (m, 3H), 7.51 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.47 – 7.42 (m, 3H), 7.04 (dd, *J* = 8.3, 1.2 Hz, 1H), 6.96 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.9, 163.7, 145.6, 136.6, 134.7, 131.1, 129.8, 129.2, 128.8, 120.23, 120.1, 119.0, 118.8. UV (λ_{max} nm): 314; IRν_{max} (cm^{-1}): 3080, 2360, 2342, 1638, 1571; HRMS (ESI): calcd. for $C_{15}H_{13}O_2$ $[M+H]^+$: 225.0910 , found: 225.0919

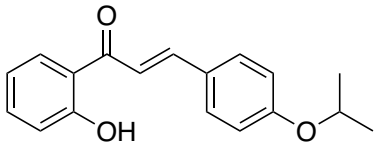


(*E*)-3-(4-Ethoxyphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2c): The general procedure for aldol condensation afforded **2c** as a yellow solid. Yield 64% (862 mg, 3.21 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.96 (s, 1H), 7.93 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.91 (d, *J* = 15.5 Hz, 1H), 7.68 – 7.59 (m, 2H), 7.55 (d, *J* = 15.4 Hz, 1H), 7.49 (ddd, *J* = 8.6, 7.1, 1.6 Hz, 1H), 7.03 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.97 – 6.91 (m, 3H), 4.10 (q, *J* = 7.0 Hz, 2H), 1.45 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.6, 163.6, 161.5, 145.4, 136.1, 130.6, 129.6, 127.1, 120.1, 118.8,

118.5, 117.3, 115.0, 63.7, 14.7. UV (λ_{max} nm): 364; IRν_{max} (cm^{-1}): 2980, 2359, 2331, 1633, 1603; HRMS (ESI): calcd. for $C_{17}H_{17}O_3$ $[M+H]^+$: 269.1172 found: 269.1179

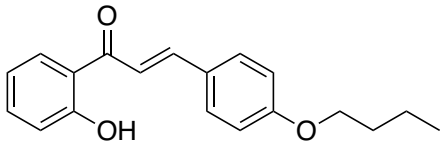


(*E*)-1-(2-Hydroxyphenyl)-3-(4-propoxyphenyl)prop-2-en-1-one (2d): The general procedure for aldol condensation afforded **2d** as an orange solid. Yield 81% (1.71 g, 6.05mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.96 (s, 1H), 7.93 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.91 (d, *J* = 15.4 Hz, 1H), 7.66 – 7.59 (m, 2H), 7.55 (d, *J* = 15.4 Hz, 1H), 7.49 (ddd, *J* = 8.6, 7.2, 1.7 Hz, 1H), 7.03 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.98 – 6.91 (m, 3H), 3.98 (t, *J* = 6.6 Hz, 2H), 1.91 – 1.78 (m, 2H), 1.06 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.7, 163.6, 161.8, 145.6, 136.2, 130.7, 129.6, 127.1, 120.2, 118.8, 118.6, 117.4, 115.1, 69.8, 22.6, 10.6. UV (λ_{max} nm): 360; IRν_{max} (cm^{-1}): 3038, 1693, 1558, 758; HRMS (ESI): calcd. for $C_{18}H_{19}O_3$ $[M+H]^+$: 283.1329 found: 283.1334

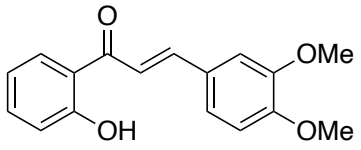


(*E*)-1-(2-Hydroxyphenyl)-3-(4-isopropoxyphenyl)prop-2-en-1-one (2e): The general procedure for aldol condensation afforded **2e** as a yellow solid. Yield 2% (65 mg, 0.23 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.97 (s, 1H), 7.93 (dd, *J* = 8.2, 1.8 Hz, 1H), 7.91 (d, *J* = 15.4 Hz, 1H), 7.65 – 7.59 (m, 2H), 7.54 (d, *J* = 15.4 Hz, 1H), 7.49 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.02 (dd, *J* = 8.3, 1.2 Hz, 1H), 6.97 – 6.90 (m, 3H), 4.64 (hept, *J* = 6.0 Hz, 1H), 1.37 (d, *J* = 6.0 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.8, 163.7, 160.7, 145.6, 136.3, 130.8, 129.7, 127.1, 120.3, 118.9,

118.7, 117.5, 116.1, 70.2, 22.1. UV (λ_{max} nm): 364; IRν_{max} (cm^{-1}): 2974, 2360, 2342, 1636, 1562; HRMS (ESI): calcd. for $C_{18}H_{19}O_3$ $[M+H]^+$: 283.1329, found: 283.1336.

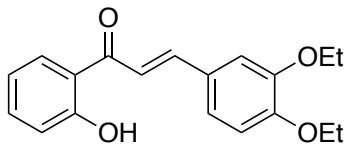


(*E*)-3-(4-Butoxyphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2f): The general procedure for aldol condensation afforded **2f** as a yellow solid. Yield 81% (1.79 g, 6.05 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.96 (s, 1H), 7.93 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.91 (d, *J* = 15.3 Hz, 1H), 7.64 – 7.61 (m, 2H), 7.54 (d, *J* = 15.4 Hz, 1H), 7.49 (ddd, *J* = 8.6, 7.1, 1.6 Hz, 1H), 7.02 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.98 – 6.90 (m, 3H), 4.02 (t, *J* = 6.5 Hz, 2H), 1.85 – 1.74 (m, 2H), 1.55 – 1.46 (m, 2H), 0.99 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.6, 163.6, 161.7, 145.5, 136.1, 130.6, 129.6, 127.0, 120.1, 118.8, 118.5, 117.2, 114.9, 67.9, 31.2, 19.2, 13.9. UV (λ_{max} nm): 362; IRν_{max} (cm^{-1}): 2951, 2358. 2326, 1634, 1557; HRMS (ESI): calcd. for $C_{19}H_{21}O_3$ $[M+H]^+$: 297.1485 found: 297.1485

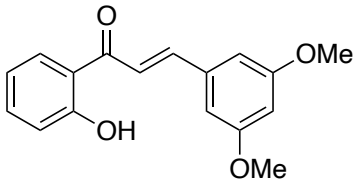


(*E*)-3-(3,4-Dimethoxyphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2g): The general procedure for aldol condensation afforded **2g** as an orange solid. Yield 37% (532 mg, 1.87 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.93 (s, 1H), 7.94 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.90 (d, *J* = 15.4 Hz, 1H), 7.53 (d, *J* = 15.4 Hz, 1H), 7.50 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.28 (dd, *J* = 8.4, 2.1 Hz, 1H), 7.18 (d, *J* = 2.1 Hz, 1H), 7.03 (dd, *J* = 8.4, 1.1 Hz, 1H), 6.98 – 6.94 (m, 1H), 6.92 (d, *J* = 8.3 Hz,

1H), 3.98 (s, 3H), 3.95 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.7, 163.7, 152.0, 149.4, 145.8, 136.3, 129.7, 127.7, 123.8, 120.2, 118.9, 118.8, 117.9, 111.3, 110.4, 56.2, 56.2. UV (λ_{max} nm): 360; IRν_{max} (cm^{-1}): 3017, 2360, 2342, 1638, 1566; HRMS (ESI): calcd. for $C_{17}H_{17}O_4$ $[M+H]^+$: 285.1121, found: 285.1129.

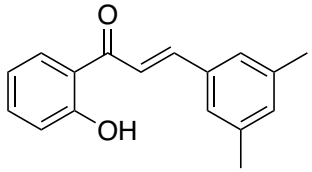


(*E*)-3-(3,4-Diethoxyphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2h): The general procedure for aldol condensation afforded **2h** as an orange solid. Yield 68% (1.06 g, 3.40 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.95 (s, 1H), 7.93 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.88 (d, *J* = 15.4 Hz, 1H), 7.51 (d, *J* = 15.3 Hz, 1H), 7.49 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.22 (dd, *J* = 19.0, 2.1 Hz, 2H), 7.03 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.95 (ddd, *J* = 8.4, 7.3, 1.3 Hz, 1H), 6.91 (d, *J* = 8.3 Hz, 1H), 4.17 (q, *J* = 7.0 Hz, 2H), 4.16 (q, *J* = 7.0 Hz, 2H), 3.49 (t, 3H), 1.50 (t, *J* = 7.0 Hz, 3H), 1.49 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.7, 163.6, 151.8, 148.9, 145.9, 136.2, 129.6, 127.5, 123.7, 120.2, 118.8, 118.6, 117.6, 112.7, 112.6, 64.8, 64.6, 14.9, 14.8. UV (λ_{max} nm): 376; IRν_{max} (cm^{-1}): 2982, 1631, 1506, 1139, 1038; HRMS (ESI): calcd. for $C_{19}H_{21}O_4$ $[M+H]^+$: 313.1434, found: 313.1440.

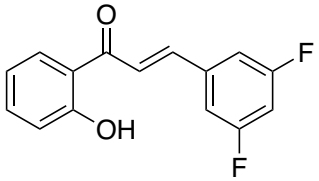


(*E*)-3-(3,5-Dimethoxyphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2i): The general procedure for aldol condensation afforded **2i** as a yellow orange solid. Yield 38 % (534 mg, 1.88

mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.79 (s, 1H), 7.92 (dd, *J* = 8.2, 1.7 Hz, 1H), 7.84 (d, *J* = 15.4 Hz, 1H), 7.61 (d, *J* = 15.4 Hz, 1H), 7.51 (ddd, *J* = 8.6, 7.2, 1.6 Hz, 1H), 7.04 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.96 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H), 6.80 (d, *J* = 2.2 Hz, 2H), 6.55 (t, *J* = 2.2 Hz, 1H), 3.86 (s, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.8, 163.7, 161.2, 145.6, 136.6, 136.5, 129.8, 120.7, 120.1, 119.0, 118.7, 106.7, 103.2, 55.6. UV (λ_{max} nm): 214; IRν_{max} (cm^{-1}): 3015, 2360, 2342, 1637, 1574; HRMS (ESI): calcd. for $C_{17}H_{17}O_4$ $[M+H]^+$: 285.1121, found: 285.112.

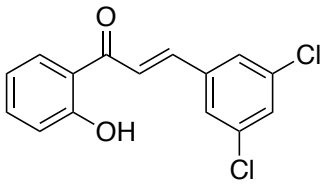


(*E*)-3-(3,5-Dimethylphenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2j): The general procedure for aldol condensation afforded **2j** as an orange brown solid. Yield 49% (622 mg, 2.47 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.87 (s, 1H), 7.95 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.88 (d, *J* = 15.5 Hz, 1H), 7.65 (d, *J* = 15.4 Hz, 1H), 7.50 (ddd, *J* = 8.6, 7.1, 1.6 Hz, 1H), 7.29 (s, 2H), 7.09 (s, 1H), 7.03 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.95 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H), 2.37 (s, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.8, 163.7, 145.9, 138.6, 136.3, 134.5, 132.9, 129.7, 126.6, 120.1, 119.6, 118.9, 118.6, 21.3. UV (λ_{max} nm): 210; IRν_{max} (cm^{-1}): 2915, 1639, 1484, 1201, 1155; HRMS (ESI): calcd. for $C_{17}H_{17}O_2$ $[M+H]^+$: 253.1223, found: 253.1231.

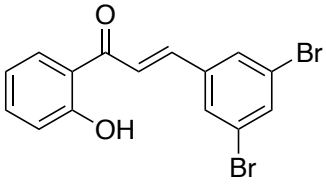


(*E*)-3-(3,5-Difluorophenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2l): The general procedure for aldol condensation afforded **2l** as a yellow solid. Yield 5% (67 mg, 0.26 mmol). ^{1}H

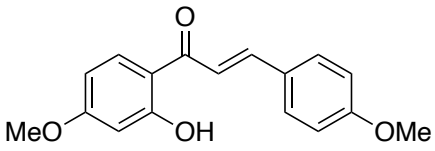
NMR (400 MHz, $CDCl_3$) δ 12.63 (s, 1H), 7.90 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.79 (d, *J* = 15.5 Hz, 1H), 7.63 (d, *J* = 15.5 Hz, 1H), 7.53 (ddd, *J* = 8.7, 7.2, 1.6 Hz, 1H), 7.17 (dt, *J* = 6.4, 2.1 Hz, 2H), 7.05 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.97 (ddd, *J* = 8.2, 7.1, 1.2 Hz, 1H), 6.89 (m, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.3, 163.8, 163.4 (dd, *J* = 249.6, 12.8 Hz), 142.7 (t, *J* = 3.0 Hz), 138.0 (t, *J* = 9.5 Hz), 137.0, 129.8, 122.7, 119.9, 119.2, 118.9, 111.3 (dd, *J* = 19.7, 5.9 Hz), 106.1 (t, *J* = 25.5 Hz). UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 3098, 2950, 2361, 2342, 1649; HRMS (ESI): calcd. for $C_{15}H_{11}F_2O_2$ $[M+H]^+$: 261.0722, found: 261.0729.



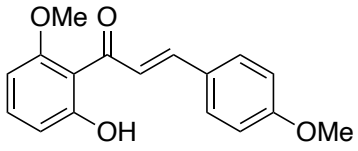
(*E*)-3-(3,5-Dichlorophenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2m): The general procedure of aldol condensation afforded **2m** as an orange solid. Yield 15% (225 mg, 0.77 mmol). ^{1}H NMR (500 MHz, $CDCl_3$) δ 12.62 (d, *J* = 0.3 Hz, 1H), 7.91 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.76 (dd, *J* = 15.5, 0.6 Hz, 1H), 7.65 (d, *J* = 15.3 Hz, 1H), 7.57 – 7.50 (m, 3H), 7.42 (t, *J* = 1.8 Hz, 1H), 7.05 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.97 (ddd, *J* = 8.2, 7.2, 1.2 Hz, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.1, 163.8, 142.2, 137.7, 137.0, 135.9, 130.5, 129.8, 126.8, 122.8, 119.9, 119.2, 118.9. UV (λ_{max} nm): 208; IRν_{max} (cm^{-1}): 3061, 2921, 2361, 2342, 1643; HRMS (ESI): calcd. for $C_{15}H_{11}Cl_2O_2$ $[M+H]^+$: 293.0131, found: 293.0129.



(*E*)-3-(3,5-Dibromophenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (2n): The general procedure for aldol condensation afforded **2n** as a yellow solid. Yield 16% (178 mg, 0.47 mmol)**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.62 (s, 1H), 7.91 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.79 – 7.70 (m, 4H), 7.63 (d, *J* = 15.5 Hz, 1H), 7.53 (ddd, *J* = 8.5, 7.1, 1.6 Hz, 1H), 7.05 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.97 (ddd, *J* = 8.2, 7.2, 1.2 Hz, 1H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.1, 163.8, 142.0, 138.2, 137.0, 135.9, 130.1, 129.8, 123.7, 122.8, 119.9, 119.2, 118.9. UV (λ_{max} nm): 208; IRν_{max} (cm^{-1}): 3054, 1642, 1567, 1484, 592; HRMS (ESI): calcd. for $C_{15}H_{11}Br_2O_2$ $[M+H]^+$: 380.9120, found: 380.9119.

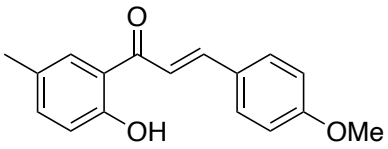


(*E*)-1-(2-Hydroxy-4-methoxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2o): The general procedure for aldol condensation afforded **2o** as a yellow solid. Yield 54% (764 mg, 2.69 mmol)**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.56 (s, 1H), 7.90 – 7.79 (m, 2H), 7.67 – 7.58 (m, 2H), 7.46 (d, *J* = 15.4 Hz, 1H), 7.00 – 6.89 (m, 2H), 6.48 (m, 2H), 3.86 (s, 3H), 3.86 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 191.9, 166.7, 166.1, 161.9, 144.3, 132.4, 131.2, 130.5, 127.6, 117.8, 114.5, 107.7, 101.1, 55.6, 55.5. UV (λ_{max} nm): 362; IRν_{max} (cm^{-1}): 3079, 1626, 1570, 1361, 1213; HRMS (ESI): calcd. for $C_{17}H_{17}O_4$ $[M+H]^+$: 285.1121 found: 285.1120

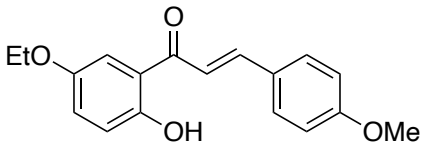


(*E*)-1-(2-Hydroxy-6-methoxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2p): The general procedure for aldol condensation afforded **2p** as an orange solid. Yield 48% (686 mg, 2.41

mmol)**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.24 (s, 1H), 7.82 (d, *J* = 24.5 Hz, 1H), 7.78 (d, *J* = 24.5 Hz, 1H), 7.62 – 7.55 (m, 2H), 7.35 (t, *J* = 8.3 Hz, 1H), 6.94 (d, *J* = 8.8 Hz, 1H), 6.62 (dd, *J* = 8.4, 1.0 Hz, 1H), 6.43 (dd, *J* = 8.3, 1.1 Hz, 1H), 3.95 (s, 3H), 3.86 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 194.2, 164.8, 161.6, 160.9, 143.1, 135.7, 130.2, 127.9, 125.1, 114.4, 111.9, 110.8, 101.5, 55.8, 55.3. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 3019, 1626, 1556, 1236, 1170; HRMS (ESI): calcd. for $C_{18}H_{19}O_4$ $[M+H]^+$: 299.1278 found: 299.1282.

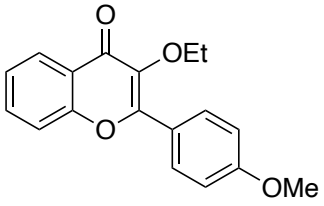


(*E*)-1-(2-Hydroxy-5-methylphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2r): The general procedure for aldol condensation afforded **2r** as an orange solid. Yield 49% (983 mg, 3.66 mmol)**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.79 (s, 1H), 7.92 (d, *J* = 15.4 Hz, 1H), 7.72 (d, *J* = 2.1 Hz, 1H), 7.70 – 7.65 (m, 2H), 7.57 (d, *J* = 15.4 Hz, 1H), 7.33 (dd, *J* = 8.4, 2.1 Hz, 1H), 6.99 (d, *J* = 8.7 Hz, 2H), 6.96 (d, *J* = 8.5 Hz, 1H), 3.90 (d, *J* = 0.8 Hz, 3H), 2.38 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.4, 161.9, 161.4, 145.0, 137.1, 130.5, 129.2, 127.7, 127.2, 119.6, 118.1, 117.4, 114.4, 55.3, 20.5. UV (λ_{max} nm): 356; IRν_{max} (cm^{-1}): 2999, 1632, 1602, 1574, 1165; HRMS (ESI): calcd. for $C_{17}H_{17}O_3$ $[M+H]^+$: 269.1172 found: 269.1180

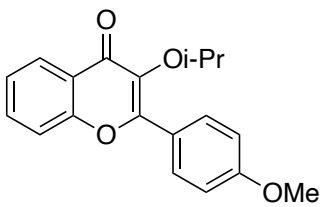


(*E*)-1-(5-Ethoxy-2-hydroxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (2s): The general procedure for aldol condensation afforded **2s** as an orange solid. Yield 73% (1.31 mg, 4.38

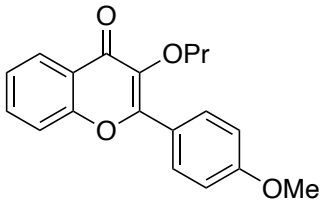
mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.47 (s, 1H), 7.90 (d, *J* = 15.4 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 2H), 7.48 (d, *J* = 15.3 Hz, 1H), 7.38 (d, *J* = 3.0 Hz, 1H), 7.13 (dd, *J* = 9.0, 3.0 Hz, 1H), 6.98 – 6.93 (m, 3H), 4.05 (q, *J* = 7.0 Hz, 2H), 3.87 (s, 3H), 1.44 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.3, 162.0, 157.8, 151.0, 145.4, 130.6, 127.3, 124.1, 119.8, 119.1, 117.5, 114.5, 114.0, 64.5, 55.4, 15.0. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2978, 2359, 2342, 1634, 1551; HRMS (ESI): calcd. for $C_{18}H_{19}O_4$ $[M+H]^+$: 299.1278 found: 299.1278.



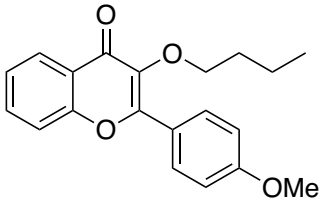
3-Ethoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3a): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and ethyl iodide afforded **3a** as a pale-yellow solid. Yield 66% (94 mg, 0.32 mmol). ^{1}H NMR (500 MHz, $CDCl_{3)}$ δ 8.29 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.05 (d, *J* = 9.0 Hz, 2H), 7.66 (ddt, *J* = 8.5, 7.1, 1.5 Hz, 1H), 7.51 (dd, *J* = 8.5, 1.2 Hz, 1H), 7.43 – 7.36 (m, 3H), 7.28 (dd, *J* = 5.1, 2.1 Hz, 3H), 6.97 (d, *J* = 9.0 Hz, 2H), 5.12 (s, 2H), 3.89 (s, 3H), 1.33 (t, 3H) ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.1, 161.6, 156.5, 155.3, 139.4, 136.9, 133.4, 130.7, 129.0, 128.3, 128.2, 125.9, 124.7, 124.3, 123.4, 118.0, 113.9, 74.1, 55.5. UV (λ_{max} nm): 226; IRν_{max} (cm^{-1}): 2974, 2360, 2341, 1638, 1601; HRMS (ESI): calcd. for $C_{23}H_{19}O_4$ $[M+H]^+$: 359.1278, found: 359.1283.



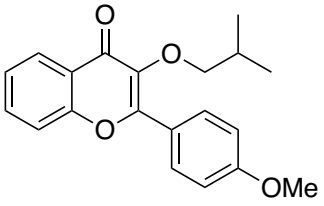
3-Isopropoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3c): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 2-iodopropane afforded **3c** as a pale-yellow solid. Yield 35% (52 mg, 0.17 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.17 (d, *J* = 9.0 Hz, 2H), 7.66 (ddd, *J* = 8.6, 7.1, 1.7 Hz, 1H), 7.52 (dd, *J* = 8.5, 1.2 Hz, 1H), 7.39 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 7.01 (d, *J* = 9.1 Hz, 2H), 4.68 (sep, *J* = 6.2 Hz, 1H), 3.90 (s, 3H), 1.20 (d, *J* = 6.2 Hz, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.5, 161.4, 156.4, 155.3, 138.7, 133.2, 130.8, 125.9, 124.6, 124.2, 124.0, 118.0, 113.7, 74.8, 55.5, 22.6. UV (λ_{max} nm): 330; IRν_{max} (cm^{-1}): 2981, 2360, 2342, 1632, 1601; HRMS (ESI): calcd. for $C_{19}H_{19}O_4$ $[M+H]^+$: 311.1278, found: 311.1280.



2-(4-Methoxyphenyl)-3-propoxy-4*H*-chromen-4-one (3d): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 1-iodopropane afforded **3d** as an egg-shell white solid. Yield 56% (82 mg, 0.26 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.13 (d, *J* = 8.9 Hz, 2H), 7.65 (ddd, *J* = 8.7, 7.0, 1.7 Hz, 1H), 7.51 (d, *J* = 8.4 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 1H), 7.02 (d, *J* = 9.0 Hz, 2H), 4.00 (t, *J* = 6.8 Hz, 2H), 3.89 (s, 3H), 1.75 (h, *J* = 7.2 Hz, 2H), 0.94 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.1, 161.4, 155.8, 155.2, 140.0, 133.2, 130.4, 125.7, 124.5, 124.2, 123.5, 117.9, 113.8, 74.2, 55.4, 23.4, 10.5. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2968, 2360, 2341, 1635, 1601; HRMS (ESI): calcd. for $C_{19}H_{19}O_4$ $[M+H]^+$: 311.1278, found: 311.1292.

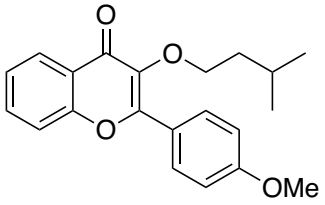


3-Butoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3e): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 1-iodobutane afforded **3e** as a cream colored solid. Yield 67% (103 mg, 0.32 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.12 (d, *J* = 9.0 Hz, 2H), 7.65 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.51 (dd, *J* = 8.4, 1.0 Hz, 1H), 7.37 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 1H), 7.01 (d, *J* = 9.0 Hz, 2H), 4.03 (t, *J* = 6.7 Hz, 2H), 3.89 (s, 3H), 1.77 – 1.65 (m, 2H), 1.47 – 1.33 (m, 2H), 0.90 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.2, 161.5, 155.9, 155.3, 140.2, 133.3, 130.5, 125.9, 124.6, 124.3, 123.6, 118.0, 113.9, 72.4, 55.5, 32.3, 19.2, 14.0. UV (λ_{max} nm): 204; IRν_{max} (cm^{-1}): 2936, 2362, 2332, 1638, 1602; HRMS (ESI): calcd. for $C_{20}H_{21}O_4$ $[M+H]^+$: 325.1434 , found: 325.143.

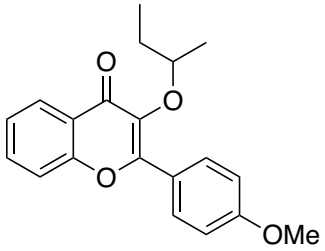


3-Isobutoxy-2-(4-methoxyphenyl)-4H-chromen-4-one (3f): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 2-iodo-2-methylpropane afforded **3f** as an orange oil. Yield 32% (50 mg, 0.15 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 8.0, 1.6 Hz, 1H), 8.14 – 8.08 (m, 2H), 7.66 (ddt, *J* = 8.2, 7.2, 1.3 Hz, 1H), 7.52 (d, *J* = 8.4 Hz, 1H), 7.39 (tt, *J* = 8.0, 1.0 Hz, 1H), 7.05 – 7.00 (m, 2H), 3.90 (d, *J* = 0.9 Hz, 3H), 3.79 (d, *J* = 6.6 Hz, 2H), 2.06 (hept, *J* = 6.7 Hz, 1H), 0.96 (dd, *J* = 6.7, 0.9 Hz, 6H). ^{13}C NMR (126 MHz,

$CDCl_3$) δ 175.2, 161.6, 156.0, 155.3, 140.3, 133.3, 130.6, 125.9, 124.7, 124.4, 123.5, 118.0, 113.9, 79.1, 55.5, 29.2, 19.4. UV (λ_{max} nm): 328; IRν_{max} (cm^{-1}): 2947, 2361, 2342, 1637, 1600; HRMS (ESI): calcd. for $C_{20}H_{21}O_4$ $[M+H]^+$: 325.1434 , found: 325.1431.

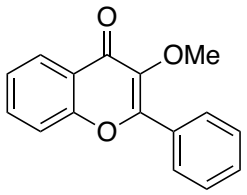


3-(Isopentyloxy)-2-(4-methoxyphenyl)-4H-chromen-4-one (3g): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 1-iodo-3-methylbutane afforded **3g** as an orange oil. Yield 35% (56 mg, 0.17 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.17 – 8.09 (m, 2H), 7.67 (ddd, *J* = 8.6, 7.0, 1.7 Hz, 1H), 7.53 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.40 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 7.07 – 6.99 (m, 2H), 4.05 (t, *J* = 6.8 Hz, 2H), 3.90 (s, 3H), 1.77 (dp, *J* = 13.3, 6.7 Hz, 1H), 1.62 (m, 2H), 0.88 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.3, 161.5, 156.0, 155.3, 140.2, 133.3, 130.5, 125.9, 124.6, 124.3, 123.6, 118.0, 113.9, 71.2, 55.5, 39.0, 25.0, 22.7. UV (λ_{max} nm): 324; IRν_{max} (cm^{-1}): 2955, 2361, 2342, 1637, 1602; HRMS (ESI): calcd. for $C_{21}H_{23}O_4$ $[M+H]^+$: 339.1591 found: 339.1601.

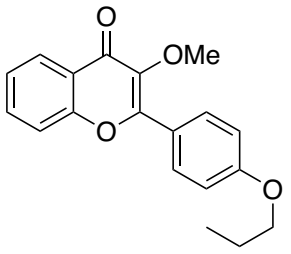


3-(Sec-butoxy)-2-(4-methoxyphenyl)-4H-chromen-4-one (3h): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2a** and 2-bromobutane afforded

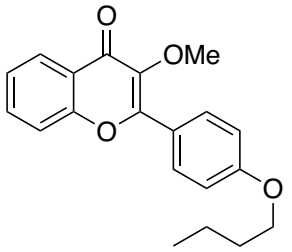
3h as an orange oil. Yield 20% (30 mg, 0.09mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 – 8.14 (m, 2H), 8.07 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.58 (td, *J* = 7.8, 1.7 Hz, 1H), 7.35 (td, *J* = 7.6, 1.2 Hz, 1H), 7.20 (dd, *J* = 8.1, 1.2 Hz, 1H), 7.03 – 6.94 (m, 2H), 4.98 (h, *J* = 6.3 Hz, 1H), 3.91 (s, 3H), 1.51 – 1.31 (m, 2H), 1.10 (d, *J* = 6.3 Hz, 3H), 0.82 (t, *J* = 7.5 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.6, 161.4, 156.5, 155.3, 138.7, 133.3, 130.9, 125.9, 124.6, 124.2, 124.0, 118.0, 113.7, 79.3, 55.5, 29.6, 19.2, 9.8. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2968, 2361, 2342, 1635, 1602; HRMS (ESI): calcd. for $C_{20}H_{21}O_4$ $[M+H]^+$: 325.1434 found: 325.1435.



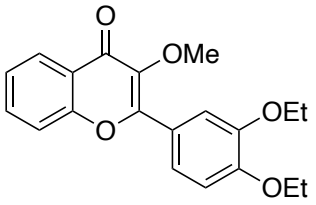
3-Methoxy-2-phenyl-4*H*-chromen-4-one (3i): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2b** and methyl iodide afforded **3i** as a rusty orange solid. Yield 9% (10 mg, 0.04 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (dd, *J* = 7.9, 1.7 Hz, 1H), 8.13 – 8.09 (m, 2H), 7.69 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.57 – 7.50 (m, 4H), 7.41 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 3.90 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.3, 155.8, 155.4, 141.7, 133.6, 131.1, 130.9, 128.7, 128.6, 126.0, 124.8, 124.4, 118.1, 60.3. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2924, 2360, 2342, 1638, 1607; HRMS (ESI): calcd. for $C_{16}H_{13}O_3$ $[M+H]^+$: 253.0859, found: 253.0868.



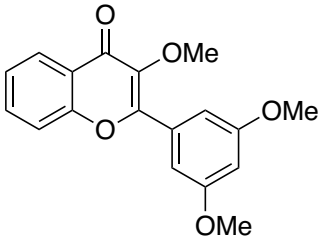
3-Methoxy-2-(4-propoxyphenyl)-4*H*-chromen-4-one (3k): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2d** and methyl iodide afforded **3k** as a pale-yellow solid. Yield 23% (54 mg, 0.17 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.15 – 8.07 (m, 2H), 7.67 (ddd, *J* = 8.7, 7.0, 1.7 Hz, 1H), 7.53 (d, *J* = 8.3 Hz, 1H), 7.44 – 7.35 (m, 1H), 7.07 – 6.98 (m, 2H), 4.02 (t, *J* = 6.6 Hz, 2H), 3.89 (s, 3H), 1.86 (m, 2H), 1.07 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.1, 161.3, 155.8, 155.3, 140.9, 133.4, 130.4 125.9, 124.7, 124.3, 123.1, 118.0, 114.6, 77.5, 77.2, 76.8, 69.8, 60.0, 22.6, 10.6. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2958, 2360, 2342, 1628, 1601; HRMS (ESI): calcd. for $C_{19}H_{19}O_4$ $[M+H]^+$: 311.1278, found: 311.1273.



2-(4-Butoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3m) Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2f** and methyl iodide afforded **3m** as a pale-yellow solid. Yield 26% (78 mg, 0.24 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.15 – 8.07 (m, 2H), 7.67 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.53 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.39 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 1H), 7.06 – 6.98 (m, 2H), 4.06 (t, *J* = 6.5 Hz, 2H), 3.89 (s, 3H), 1.82 (dq, *J* = 7.9, 6.4 Hz, 2H), 1.52 (h, *J* = 7.7 Hz, 2H), 1.00 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 161.2, 155.7, 155.2, 140.8, 133.3, 130.2, 125.8, 124.6, 124.2, 123.0, 117.9, 114.5, 67.9, 59.9, 31.2, 19.25, 13.9. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2960, 2360, 2342, 1627, 1601; HRMS (ESI): calcd. for $C_{20}H_{21}O_4$ $[M+H]^+$: 325.1434, found: 325.1434.

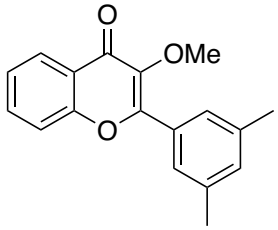


2-(3,4-Diethoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3o): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2h** and methyl iodide afforded **3o** as a pale-yellow solid. Yield 5% (16 mg, 0.05 mmol). ^{1}H NMR (800 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.76 (d, *J* = 2.1 Hz, 1H), 7.75 (dd, *J* = 8.5, 2.2 Hz, 1H), 7.67 (ddd, *J* = 8.6, 7.0, 1.6 Hz, 1H), 7.54 (dd, *J* = 8.4, 0.9 Hz, 1H), 7.40 (ddd, *J* = 8.1, 7.0, 1.0 Hz, 1H), 7.00 (d, *J* = 8.5 Hz, 1H), 4.20 (q, *J* = 6.9 Hz, 2H), 4.19 (q, *J* = 7.0 Hz, 2H), 3.88 (s, 3H), 1.51 (t, *J* = 7.0 Hz, 3H), 1.51 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (201 MHz, $CDCl_3$) δ 175.2, 156.0, 155.3, 151.3, 148.3, 141.0, 133.5, 126.0, 124.8, 124.3, 123.3, 122.4, 118.0, 113.8, 112.5, 64.9, 64.6, 60.1, 14.9, 14.9. UV (λ_{max} nm): 244; IRν_{max} (cm^{-1}): 2980, 2361, 2342, 1634, 1600; HRMS (ESI): calcd. for $C_{20}H_{21}O_5$ $[M+H]^+$: 341.1384, found: 341.1376.

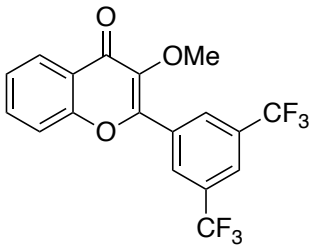


2-(3,5-Dimethoxyphenyl)-3-methoxy-4*H*-chromen-4-one (3p): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2i** and methyl iodide afforded **3p** as a tan solid. Yield 21% (32 mg, 0.10 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.69 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.54 (dd, *J* = 8.5, 1.1 Hz, 1H), 7.41 (ddd, *J* = 8.0, 7.1, 1.1 Hz, 1H), 7.29 (d, *J* = 2.3 Hz, 2H), 6.62 (t, *J* = 2.3 Hz, 1H), 3.90 (s, 3H), 3.88 (s, 6H). ^{13}C

NMR (101 MHz, $CDCl_3$) δ 175.3, 160.8, 155.4, 155.3, 141.8, 133.7, 132.7, 125.9, 124.8, 124.3, 118.2, 106.8, 103.0, 60.3, 55.7. UV (λ_{max} nm): 204; IRν_{max} (cm^{-1}): 2925, 2360, 2342, 1632, 1602; HRMS (ESI): calcd. for $C_{18}H_{17}O_5$ $[M+H]^+$: 313.1071, found: 313.1079.

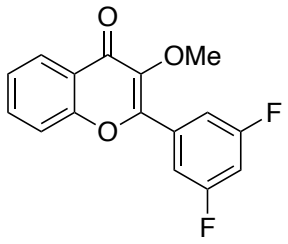


2-(3,5-Dimethylphenyl)-3-methoxy-4*H*-chromen-4-one (3q): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2j**, and methyl iodide afforded **3q** as an off-white solid. Yield 4% (12 mg, 0.04 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.70 – 7.66 (m, 3H), 7.55 (dd, *J* = 8.6, 1.1 Hz, 1H), 7.40 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 7.16 (t, *J* = 1.8 Hz, 1H), 3.89 (s, 3H), 2.43 – 2.41 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.3, 156.4, 155.5, 141.6, 138.2, 133.5, 132.6, 130.9, 126.4, 126.0, 124.8, 124.4, 118.2, 60.3, 21.6. UV (λ_{max} nm): 208; IRν_{max} (cm^{-1}): 2917, 2361, 2342, 1632, 1608; HRMS (ESI): calcd. for $C_{18}H_{17}O_3$ $[M+H]^+$: 281.1172, found: 281.1166.

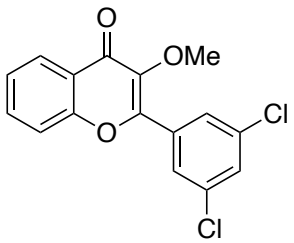


2-(3,5-Bis(trifluoromethyl)phenyl)-3-methoxy-4*H*-chromen-4-one (3r): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2k** and methyl iodide afforded **3r** as an off-white solid. Yield 8% (14 mg, 0.04 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ

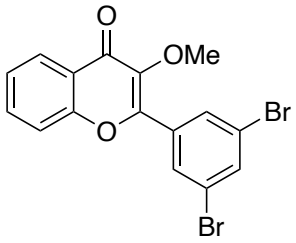
8.60 (d, J = 1.6 Hz, 2H), 8.28 (dd, J = 8.0, 1.7 Hz, 1H), 8.01 (s, 1H), 7.75 (ddd, J = 8.7, 7.1, 1.7 Hz, 1H), 7.65 – 7.58 (m, 1H), 7.55 – 7.36 (m, 1H), 4.00 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.03, 155.24, 151.65, 142.53, 134.29, 133.22, 132.27 (q, J = 33.8 Hz), 128.60 (d, J = 4.1 Hz), 126.13, 125.40, 124.25, 124.19 – 123.95 (m), 123.21 (q, J = 272.9 Hz), 118.22, 60.51. UV (λ_{max} nm): 204; IRν_{max} (cm^{-1}): 1957, 2361, 2342, 1638, 1134; HRMS (ESI): calcd. for $C_{18}H_{11}F_6O_3$ $[M+H]^+$: 389.0607, found: 389.0624.



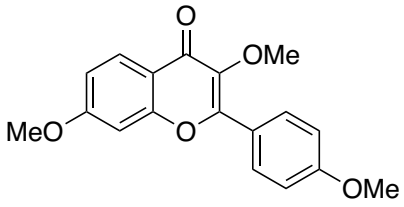
2-(3,5-Difluorophenyl)-3-methoxy-4H-chromen-4-one (3s): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2l** and methyl iodide afforded **3s** as an off-white solid. Yield 16% (15 mg, 0.05 mmol).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, J = 8.1, 1.7 Hz, 1H), 7.72 (m 3H), 7.55 (dd, J = 8.5, 1.2 Hz, 1H), 7.43 (ddd, J = 8.1, 7.1, 1.0 Hz, 1H), 6.97 (tt, J = 8.6, 2.4 Hz, 1H), 3.97 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.2, 163.1 (dd, J = 248.3, 12.7 Hz), 155.2, 152.5, 142.4, 134.1, 133.9 (t, J = 10.3 Hz), 126.1, 125.2, 124.2, 118.1, 111.7 (dd, J = 21.7, 6.8 Hz), 106.2 (t, J = 25.3 Hz), 60.4. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2950, 2361, 2342, 1649, 751; HRMS (ESI): calcd. for $C_{16}H_{11}F_2O_3$ $[M+H]^+$: 289.0671, found: 289.0677.



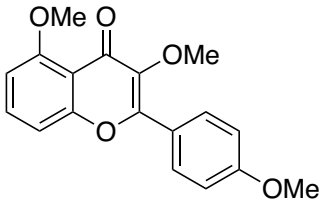
2-(3,5-Dichlorophenyl)-3-methoxy-4*H*-chromen-4-one (3t): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2m** and methyl iodide afforded **3t** as a white solid. Yield 31% (46 mg, 0.14 mmol).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 8.02 (d, *J* = 2.0 Hz, 2H), 7.72 (ddd, *J* = 8.6, 7.1, 1.7 Hz, 1H), 7.57 (d, *J* = 8.4 Hz, 1H), 7.50 (t, *J* = 1.9 Hz, 1H), 7.43 (ddd, *J* = 8.1, 7.0, 1.1 Hz, 1H), 3.96 (s, 3H). ^{13}C NMR (201 MHz, $CDCl_3$) δ 175.1, 155.3, 152.4, 142.3, 135.5, 134.1, 133.8, 130.6, 126.9, 126.1, 125.2, 124.2, 118.2, 60.5. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2947, 2360, 2342, 1649, 1135; HRMS (ESI): calcd. for $C_{16}H_{11}Cl_2O_3$ $[M+H]^+$: 321.0080 , found: 321.0073.



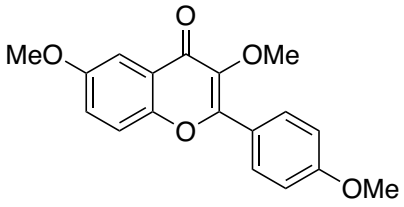
2-(3,5-Dibromophenyl)-3-methoxy-4*H*-chromen-4-one (3u): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2n** and methyl iodide afforded **3u** as a pale-yellow solid. Yield 3% (7 mg, 0.02 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (dd, *J* = 8.1, 1.7 Hz, 1H), 8.21 (d, *J* = 1.8 Hz, 2H), 7.80 (t, *J* = 1.8 Hz, 1H), 7.72 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.57 (dd, *J* = 8.5, 1.3 Hz, 1H), 7.43 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 3.96 (s, 3H). ^{13}C NMR (201 MHz, $CDCl_3$) δ 175.1, 155.3, 152.2, 142.3, 136.0, 134.3, 134.1, 130.2, 126.1, 125.2, 124.2, 123.2, 118.2, 60.5. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2919, 2360, 2342, 1652, 1023; HRMS (ESI): calcd. for $C_{16}H_{11}Br_2O_3$ $[M+H]^+$: 408.9069, found: 408.9060.



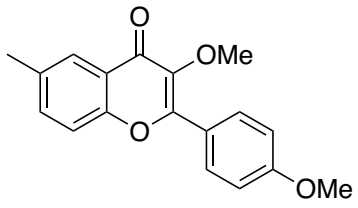
3,7-Dimethoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3v): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2o** and methyl iodide afforded **3v** as an off-white solid. Yield 12% (20 mg, 0.06 mmol). ^{1}H NMR (400 MHz, CD_3OD) δ 8.17 – 8.11 (m, 2H), 8.07 (d, *J* = 9.0 Hz, 1H), 7.17 (d, *J* = 2.4 Hz, 1H), 7.13 – 7.08 (m, 2H), 7.06 (dd, *J* = 9.0, 2.4 Hz, 1H), 3.96 (s, 3H), 3.90 (s, 3H), 3.79 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 164.1, 161.5, 157.1, 155.4, 140.8, 130.2, 127.3, 123.5, 118.2, 114.4, 114.1, 100.0, 60.1, 56.0, 55.6. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2915, 2361, 2342, 1606, 1258; HRMS (ESI): calcd. for $C_{19}H_{19}O_4$ $[M+H]^+$: 313.1071, found: 313.1074.



3,5-Dimethoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3w) Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2p** and methyl iodide afforded **3w** as a pale-yellow solid. Yield 4% (18 mg, 0.06 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 – 8.07 (m, 2H), 7.54 (t, *J* = 8.4 Hz, 1H), 7.06 – 6.99 (m, 2H), 6.79 (d, *J* = 8.2 Hz, 1H), 4.01 (s, 3H), 3.89 (d, *J* = 3.9 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 161.5, 160.1, 157.4, 153.4, 141.5, 133.5, 130.2, 123.3, 114.9, 114.1, 110.2, 105.7, 60.0, 56.6, 55.6. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2917, 2361, 2342, 1637, 1600; HRMS (ESI): calcd. for $C_{18}H_{17}O_5$ $[M+H]^+$: 313.1071, found: 313.1078.

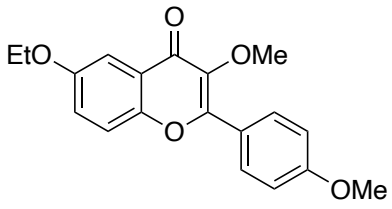


3,6-Dimethoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3x): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2q** and methyl iodide afforded **3x** as a tan solid. Yield 37% (72 mg, 0.23 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 – 8.07 (m, 2H), 7.61 (d, *J* = 3.1 Hz, 1H), 7.46 (d, *J* = 9.2 Hz, 1H), 7.26 (dd, *J* = 9.2, 3.0 Hz, 1H), 7.06 – 7.00 (m, 2H), 3.92 (s, 3H), 3.90 (s, 3H), 3.88 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 161.5, 156.6, 155.5, 150.2, 140.6, 130.3, 124.9, 123.7, 123.4, 119.4, 114.1, 104.6, 60.0, 56.0, 55.5. UV (λ_{max} nm): 330; IRν_{max} (cm^{-1}): 2926, 2360, 2342, 1158, 1611; HRMS (ESI): calcd. for $C_{18}H_{17}O_5$ $[M+H]^+$: 313.1071, found: 313.1075.

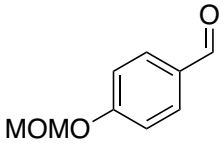


3-Methoxy-2-(4-methoxyphenyl)-6-methyl-4*H*-chromen-4-one (3y): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2r** and methyl iodide afforded **3y** as a tan solid. Yield 47% (90 mg, 0.30 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 – 8.08 (m, 2H), 8.05 (d, *J* = 2.6 Hz, 1H), 7.48 (dd, *J* = 8.6, 2.2 Hz, 1H), 7.42 (d, *J* = 8.6 Hz, 1H), 7.07 – 6.99 (m, 2H), 3.90 (s, 3H), 3.87 (s, 3H), 2.47 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 161.5, 155.5, 153.5, 140.8, 134.7, 134.5, 130.3, 125.0, 123.9, 123.4, 117.7, 114.0, 60.0, 55.5, 21.0.

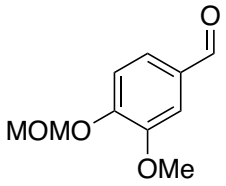
UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2918, 2360, 2342, 1604, 1024; HRMS (ESI): calcd. for $C_{18}H_{17}O_4$ $[M+H]^+$: 297.1121, found: 297.1124.



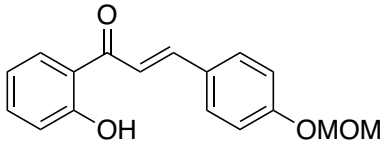
6-Ethoxy-3-methoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (3z): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2s** and methyl iodide afforded **3z** as an off-white solid. Yield 8% (19 mg, 0.06 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, *J* = 9.1 Hz, 2H), 7.59 (d, *J* = 3.1 Hz, 1H), 7.45 (d, *J* = 9.1 Hz, 1H), 7.25 (d, *J* = 12.2 Hz, 1H), 7.03 (d, *J* = 9.0 Hz, 2H), 4.15 (q, *J* = 7.0 Hz, 2H), 3.90 (s, 3H), 3.88 (s, 3H), 1.46 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.9, 161.6, 156.0, 155.6, 150.1, 140.6, 130.4, 124.9, 124.1, 123.5, 119.4, 114.1, 105.3, 64.3, 60.1, 55.6, 14.9. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2937, 2361, 2342, 1634, 1606; HRMS (ESI): calcd. for $C_{19}H_{19}O_5$ $[M+H]^+$: 327.1227, found: 327.1237.



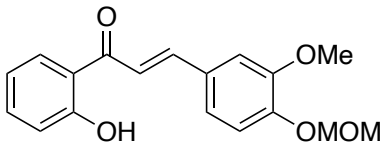
4-(Methoxymethoxy)benzaldehyde (5a): Following the general procedure for MOM protection with 4-hydroxybenzaldehyde afforded **5a** as an egg white colored oil. Yield 95% (1.30 g, 7.82 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.90 (s, 1H), 7.88 – 7.79 (m, 2H), 7.19 – 7.10 (m, 2H), 5.25 (s, 2H), 3.49 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 190.9, 162.2, 131.9, 130.8, 116.3, 94.1, 77.4, 77.2, 76.9, 56.4. UV (λ_{max} nm): 266; IRν_{max} (cm^{-1}): 2829, 2361, 2342, 1683, 975; HRMS (ESI): calcd. for $C_9H_{11}O_3$ $[M+H]^+$: 167.0703, found: 167.0710.



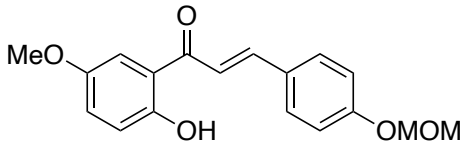
3-Methoxy-4-(methoxymethoxy)benzaldehyde (5b): Following the general procedure for MOM protection with 4-hydroxy-3-methooxybenzaldehyde afforded **5b** as a white solid. Yield 98% (128 mg, 0.65 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.84 (s, 1H), 7.40 (dd, *J* = 7.2, 1.7 Hz, 2H), 7.27 – 7.22 (m, 1H), 5.30 (s, 2H), 3.93 (s, 3H), 3.50 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 191.1, 152.1, 150.2, 131.2, 126.6, 114.8, 109.6, 95.1, 56.7, 56.2. UV (λ_{max} nm): 224; IRν_{max} (cm^{-1}): 2931, 2361, 2342, 1681, 970; HRMS (ESI): calcd. for $C_{10}H_{13}O_4$ $[M+H]^+$: 197.0808, found: 197.0805.



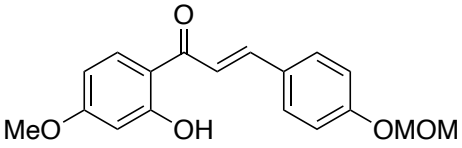
(*E*)-1-(2-Hydroxyphenyl)-3-(4-(methoxymethoxy)phenyl)prop-2-en-1-one (6a): Following the general procedure for aldol condensation using **5a** afforded **6a** as an orange oil. Yield 13% (283 mg, 1.00 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.92 (s, 1H), 7.95 – 7.87 (m, 2H), 7.66 – 7.60 (m, 2H), 7.56 (d, *J* = 15.4 Hz, 1H), 7.50 (ddd, *J* = 8.6, 7.1, 1.6 Hz, 1H), 7.12 – 7.07 (m, 2H), 7.03 (dd, *J* = 8.3, 1.2 Hz, 1H), 6.95 (ddd, *J* = 8.3, 7.2, 1.2 Hz, 1H), 5.24 (s, 2H), 3.50 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.8, 163.7, 159.7, 145.4, 136.4, 130.6, 129.7, 128.5, 120.2, 118.9, 118.8, 118.2, 116.7, 94.3, 56.4. UV (λ_{max} nm): 358; IRν_{max} (cm^{-1}): 2924, 2361, 2342, 1563, 1148; HRMS (ESI): calcd. for $C_{17}H_{17}O_4$ $[M+H]^+$: 285.1121, found: 285.1120.



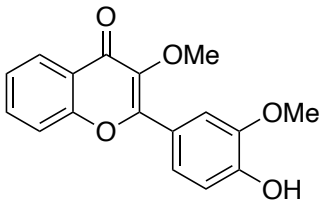
(*E*)-1-(2-Hydroxyphenyl)-3-(3-methoxy-4-(methoxymethoxy)phenyl)prop-2-en-1-one (6b): Following the general procedure for aldol condensation using **5b** afforded **6b** as a yellow solid. Yield 17% (370 mg, 1.18 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.90 (s, 1H), 7.94 (dd, *J* = 8.1, 1.6 Hz, 1H), 7.89 (d, *J* = 15.4 Hz, 1H), 7.54 (d, *J* = 15.4 Hz, 1H), 7.51 – 7.47 (m, 1H), 7.26 (dd, *J* = 8.4, 1.9 Hz, 1H), 7.20 (d, *J* = 8.4 Hz, 1H), 7.18 (d, *J* = 1.9 Hz, 1H), 7.03 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.00 – 6.91 (m, 1H), 5.30 (s, 2H), 3.97 (s, 3H), 3.53 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.8, 163.7, 150.0, 149.4, 145.6, 136.4, 129.7, 129.1, 123.1, 120.2, 118.9, 118.8, 118.5, 115.9, 111.3, 95.3, 56.6, 56.2. UV (λ_{max} nm): 368; IRν_{max} (cm^{-1}): 2961, 2360, 2342, 1635, 996; HRMS (ESI): calcd. for $C_{18}H_{19}O_5$ $[M+H]^+$: 315.1227, found: 315.1223.



(*E*)-1-(2-Hydroxy-5-methoxyphenyl)-3-(4-(methoxymethoxy)phenyl)prop-2-en-1-one (6c): Following the general procedure for aldol condensation using **5a** afforded **6c** as an orange solid. Yield 40% (952 mg, 3.03 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 12.46 (s, 1H), 7.90 (d, *J* = 15.4 Hz, 1H), 7.68 – 7.58 (m, 2H), 7.49 (d, *J* = 15.4 Hz, 1H), 7.36 (d, *J* = 3.1 Hz, 1H), 7.14 (dd, *J* = 9.1, 3.0 Hz, 1H), 7.11 – 7.07 (m, 2H), 6.98 (d, *J* = 9.0 Hz, 1H), 5.24 (s, 2H), 3.85 (s, 3H), 3.50 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 193.2, 159.6, 157.9, 151.7, 145.3, 130.5, 128.3, 123.6, 119.7, 119.2, 118.0, 116.6, 112.8, 94.1, 56.2, 56.0. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2899, 1643, 1568, 1148, 999; HRMS (ESI): calcd. for $C_{18}H_{19}O_5$ $[M+H]^+$: 315.1227 found: 315.1234.

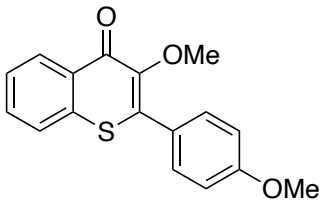


(*E*)-1-(2-Hydroxy-4-methoxyphenyl)-3-(4-(methoxymethoxy)phenyl)prop-2-en-1-one (6d): Following the general procedure for aldol condensation using **5a** afforded **6d** as an orange solid. Yield 49% (1.16 g, 3.68 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.53 (s, 1H), 7.90 – 7.79 (m, 2H), 7.65 – 7.57 (m, 2H), 7.47 (d, *J* = 15.4 Hz, 1H), 7.14 – 7.03 (m, 2H), 6.49 (d, *J* = 8.4 Hz, 2H), 5.23 (s, 2H), 3.86 (s, 3H), 3.50 (s, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 191.6, 166.5, 165.9, 159.2, 143.9, 131.1, 130.2, 128.3, 118.0, 116.4, 114.0, 107.4, 101.0, 94.0, 56.0, 55.3. UV (λ_{max} nm): 358; IRν_{max} (cm^{-1}): 2977, 1798, 1739, 1364, 1148; HRMS (ESI): calcd. for $C_{18}H_{19}O_5$ $[M+H]^+$: 315.1227 found: 315.1227.



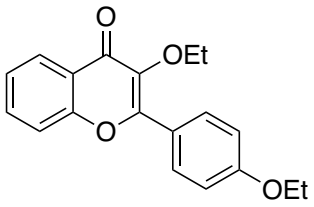
2-(4-Hydroxy-3-methoxyphenyl)-3-methoxy-4*H*-chromen-4-one (7b): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation with **6b** and methyl iodide, followed by MOM deprotection afforded **7b** as a light pink solid. Yield 10% (16 mg, 0.05 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (dd, *J* = 8.0, 1.7 Hz, 1H), 7.77 (d, *J* = 2.0 Hz, 1H), 7.73 (dd, *J* = 8.5, 2.0 Hz, 1H), 7.68 (ddd, *J* = 8.7, 7.1, 1.7 Hz, 1H), 7.54 (dd, *J* = 8.0, 0.9 Hz, 1H), 7.41 (ddd, *J* = 8.1, 7.1, 1.1 Hz, 1H), 7.07 (d, *J* = 8.4 Hz, 1H), 5.97 (s, 1H), 3.99 (s, 3H), 3.88 (s, 3H). ^{13}C NMR (201 MHz, $CDCl_3$) δ 175.1, 155.8, 155.3, 148.3, 146.4, 141.0, 133.5, 126.0, 124.8, 124.3,

123.1, 122.9, 118.0, 114.7, 111.2, 60.1, 56.3. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 3290, 2360, 2342, 1633, 1207; HRMS (ESI): calcd. for $C_{17}H_{15}O_5$ $[M+H]^+$: 299.0914, found: 299.0919.

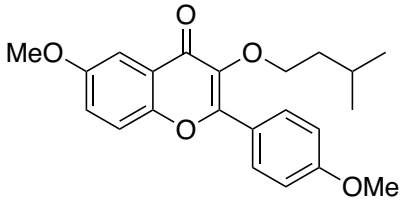


3-Methoxy-2-(4-methoxyphenyl)-4*H*-thiochromen-4-one (10): Compound was synthesized using previously reported methods.[15] Compound **9** (1.1 mmol) was dissolved in 1,4-dioxane (5 mL). Selenium dioxide (1.1 equiv.) was dissolved in water (150 µL) and added to the reaction mixture which was heated to 40 °C and allowed to stir for 3 hours. The reaction was allowed to cool to room temperature diluted with EtOAc, washed with brine three times and dried over sodium sulfate. The solvent was evaporated in vacuo and the residue was roughly purified using a flash column. Following rough purification, resulting residue (14 mg) was added with K_2CO_3 (1.8 equiv.) to a flame dried vial, which was evacuated and placed under argon. The residue and base were then dissolved in acetone (2 mL), and the mixture was heated to 40 °C. The desired alkyl halide (10 equiv.) was subsequently added, and the reaction was allowed to stir until the starting material was totally consumed (as evidenced by TLC). The reaction mixture was then, partitioned between ethyl acetate and water. The ethyl acetate layer was washed with brine, dried over Na_2SO_4, filtered and concentrated. The crude material was purified by column chromatography to yield the final product 10 as a white solid. Yield 1% (3 mg, 0.01 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56 (dt, *J* = 8.1, 1.1 Hz, 1H), 7.66 – 7.58 (m, 4H), 7.53 (ddd, *J* = 8.3, 5.3, 3.1 Hz, 1H), 7.05 – 6.96 (m, 2H), 3.88 (s, 3H), 3.71 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.9, 160.9, 147.3, 140.5, 137.1, 133.0, 131.3, 130.8, 129.2, 127.1, 126.0, 125.8, 114.2, 60.2,

55.6. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2918, 2360, 2342, 1647, 1044; HRMS (ESI): calcd. for $C_{17}H_{15}O_3S$ $[M+H]^+$: 299.0736 found: 299.0729.

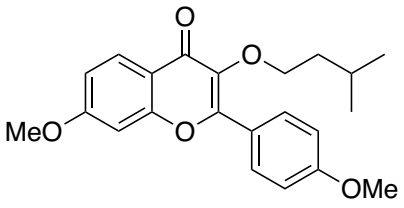


3-Ethoxy-2-(4-ethoxyphenyl)-4*H*-chromen-4-one (16): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2c** and ethyl iodide afforded **16** as a pale-yellow solid. Yield 10% (43 mg, 0.14 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (dd, *J* = 7.9, 1.7 Hz, 1H), 8.17 – 8.09 (m, 2H), 7.65 (ddd, *J* = 8.6, 7.0, 1.7 Hz, 1H), 7.51 (d, *J* = 8.4 Hz, 1H), 7.37 (t, *J* = 7.5 Hz, 1H), 7.04 – 6.96 (m, 2H), 4.12 (q, *J* = 7.0 Hz, 4H), 1.46 (t, *J* = 7.0 Hz, 3H), 1.33 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.3, 161.0, 156.0, 155.3, 139.9, 133.3, 130.5, 125.9, 124.6, 124.3, 123.4, 118.0, 114.4, 68.3, 63.8, 15.7, 14.9. UV (λ_{max} nm): 330; IRν_{max} (cm^{-1}): 2986, 2361, 2342, 1636, 1601; HRMS (ESI): calcd. for $C_{19}H_{19}O_4$ $[M+H]^+$: 311.1278 found: 311.1279.

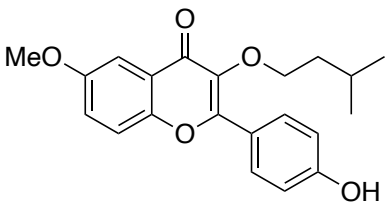


3-(Isopentyloxy)-6-methoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (17): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2q** and 1-iodo-3-methylbutane afforded **17** as a pale-yellow solid. Yield 12% (27 mg, 0.07 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 – 8.06 (m, 2H), 7.61 (d, *J* = 3.1 Hz, 1H), 7.45 (d, *J* = 9.1 Hz, 1H), 7.25 (dd,

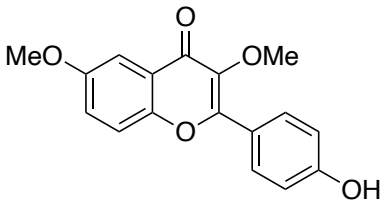
J = 9.1, 3.0 Hz, 1H), 7.04 – 6.99 (m, 2H), 4.05 (t, *J* = 6.8 Hz, 2H), 3.91 (s, 3H), 3.90 (s, 4H), 1.77 (dh, *J* = 13.2, 6.7 Hz, 1H), 1.62 (q, *J* = 6.8 Hz, 2H), 0.89 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.0, 161.5, 156.7, 155.8, 150.3, 139.9, 130.5, 125.0, 123.8, 123.7, 119.5, 114.0, 104.7, 71.2, 56.1, 55.6, 39.1, 25.0, 22.7. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2943, 2360, 2342, 1614, 1164; HRMS (ESI): calcd. for $C_{22}H_{25}O_5$ $[M+H]^+$: 369.1697 found: 369.1694.



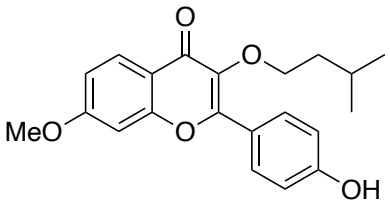
3-(Isopentyloxy)-7-methoxy-2-(4-methoxyphenyl)-4*H*-chromen-4-one (18): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation, **2o** and 1-iodo-3-methylbutane afforded **18** as an orange oil. Yield 9% (19 mg, 0.05 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.9 Hz, 1H), 8.13 – 8.08 (m, 2H), 7.03 – 7.00 (m, 2H), 6.99 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.92 (d, *J* = 2.4 Hz, 1H), 3.99 (t, *J* = 6.9 Hz, 2H), 3.92 (s, 3H), 3.90 (s, 3H), 1.73 (dh, *J* = 13.3, 6.7 Hz, 1H), 1.61 (q, *J* = 6.9 Hz, 2H), 0.86 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (101 MHz, CD_3OD) δ 176.4, 166.0, 163.2, 158.5, 157.9, 140.7, 131.4, 127.5, 124.3, 118.6, 116.0, 114.9, 101.1, 72.1, 56.6, 55.9, 40.0, 26.0, 22.9. UV (λ_{max} nm): 210; IRν_{max} (cm^{-1}): 2954, 2360, 2342, 1601, 1254; HRMS (ESI): calcd. for $C_{22}H_{25}O_5$ $[M+H]^+$: 369.1697 found: 369.1702.



2-(4-Hydroxyphenyl)-3-(isopentyloxy)-6-methoxy-4*H*-chromen-4-one (19): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation with **6c** and 1-iodo-3-methylbutane, followed by MOM deprotection afforded **19** as a pale-yellow solid. Yield 28% (45 mg, 0.13 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 – 8.03 (m, 2H), 7.62 (d, *J* = 3.1 Hz, 1H), 7.50 (d, *J* = 9.2 Hz, 1H), 7.32 (dd, *J* = 9.2, 3.0 Hz, 1H), 7.04 – 6.96 (m, 2H), 6.73 (s, 3H), 3.94 (t, *J* = 6.9 Hz, 2H), 3.91 (s, 3H), 1.71 (dp, *J* = 13.0, 6.5 Hz, 1H), 1.61 (q, *J* = 6.9 Hz, 2H), 0.84 (d, *J* = 6.5 Hz, 6H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 175.5, 159.1, 156.9, 156.8, 150.4, 139.7, 130.8, 124.7, 124.0, 122.9, 119.5, 115.8, 104.6, 77.4, 71.5, 56.0, 39.0, 25.0, 22.7. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 3101, 3025, 2362, 2342, 1585; HRMS (ESI): calcd. for $C_{21}H_{23}O_5$ $[M+H]^+$: 355.1540 found: 355.1542.

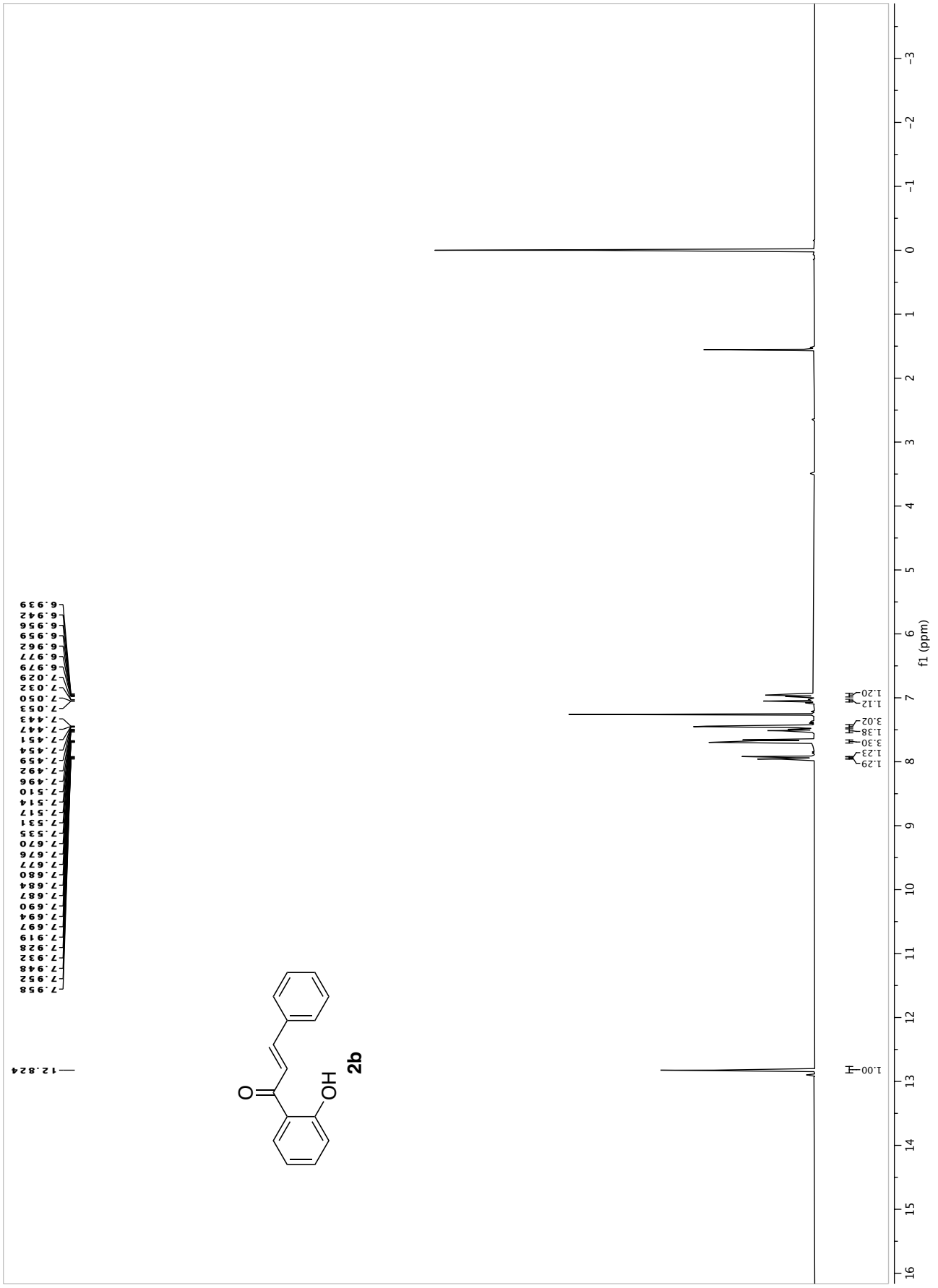


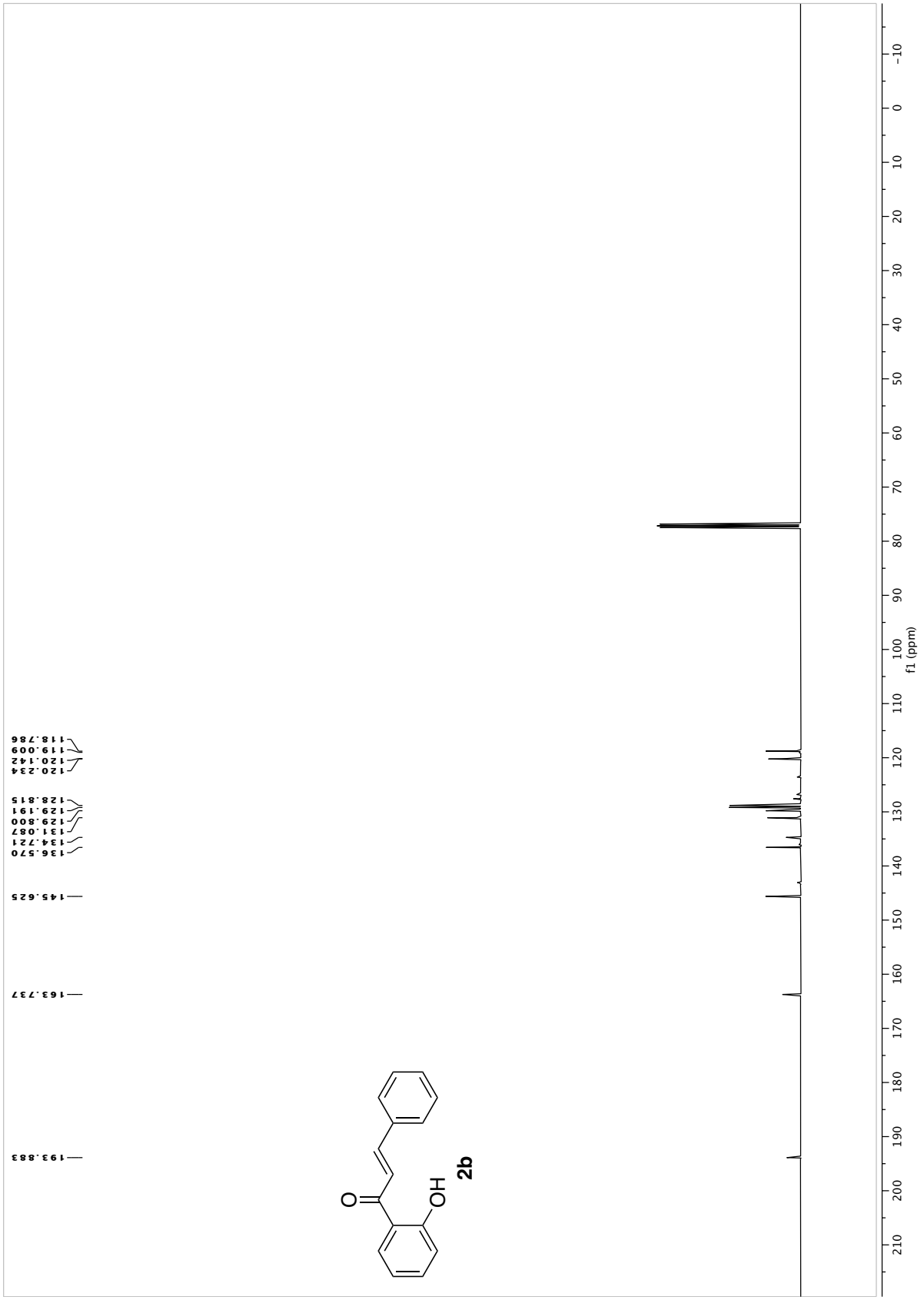
2-(4-Hydroxyphenyl)-3,6-dimethoxy-4*H*-chromen-4-one (20): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation with **6c** and iodomethane followed, by MOM deprotection afforded **20** as a light brown solid. Yield 28% (57 mg, 0.19 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 – 8.03 (m, 2H), 7.62 (d, *J* = 3.1 Hz, 1H), 7.46 (d, *J* = 9.1 Hz, 1H), 7.28 (dd, *J* = 9.1, 3.1 Hz, 1H), 7.03 – 6.95 (m, 2H), 3.92 (s, 3H), 3.88 (s, 3H). ^{13}C NMR (126 MHz, DMSO) δ 173.2, 159.9, 156.2, 155.1, 149.4, 139.4, 130.1, 124.2 123.1, 121.1, 119.9, 115.6, 104.4, 59.3, 55.7. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 3234, 2939, 2361, 2342, 1599; HRMS (ESI): calcd. for $C_{17}H_{15}O_5$ $[M+H]^+$: 299.0914 found: 299.0915.



2-(4-Hydroxyphenyl)-3-(isopentyloxy)-7-methoxy-4*H*-chromen-4-one (21): Following the general procedure for Algar-Flynn-Oyamada cyclization and alkylation with **6d** and 1-iodo-3-methylbutane, followed by MOM deprotection afforded **21** as a light brown solid. Yield 7% (35 mg, 0.10 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.9 Hz, 1H), 8.10 – 8.01 (m, 2H), 7.02 – 6.94 (m, 2H), 6.97 (dd, *J* = 9.0, 2.4 Hz, 1H), 6.91 (d, *J* = 2.4 Hz, 1H), 4.03 (t, *J* = 6.8 Hz, 2H), 3.92 (s, 3H), 1.75 (dp, *J* = 13.3, 6.6 Hz, 1H), 1.61 (q, *J* = 6.8 Hz, 2H), 0.87 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (126 MHz, CD_3OD) δ 176.5, 166.0, 161.5, 158.6, 158.5, 140.5, 131.6, 127.5, 123.1, 118.6, 116.4, 116.0, 101.1, 72.2, 56.6, 40.0, 26.0, 22.9. UV (λ_{max} nm): 202; IRν_{max} (cm^{-1}): 2959, 2360, 2341, 1580, 1173; HRMS (ESI): calcd. for $C_{21}H_{23}O_5$ $[M+H]^+$: 355.1540 found: 355.1547.

^{1}H and ^{13}C NMR spectra of novel compounds

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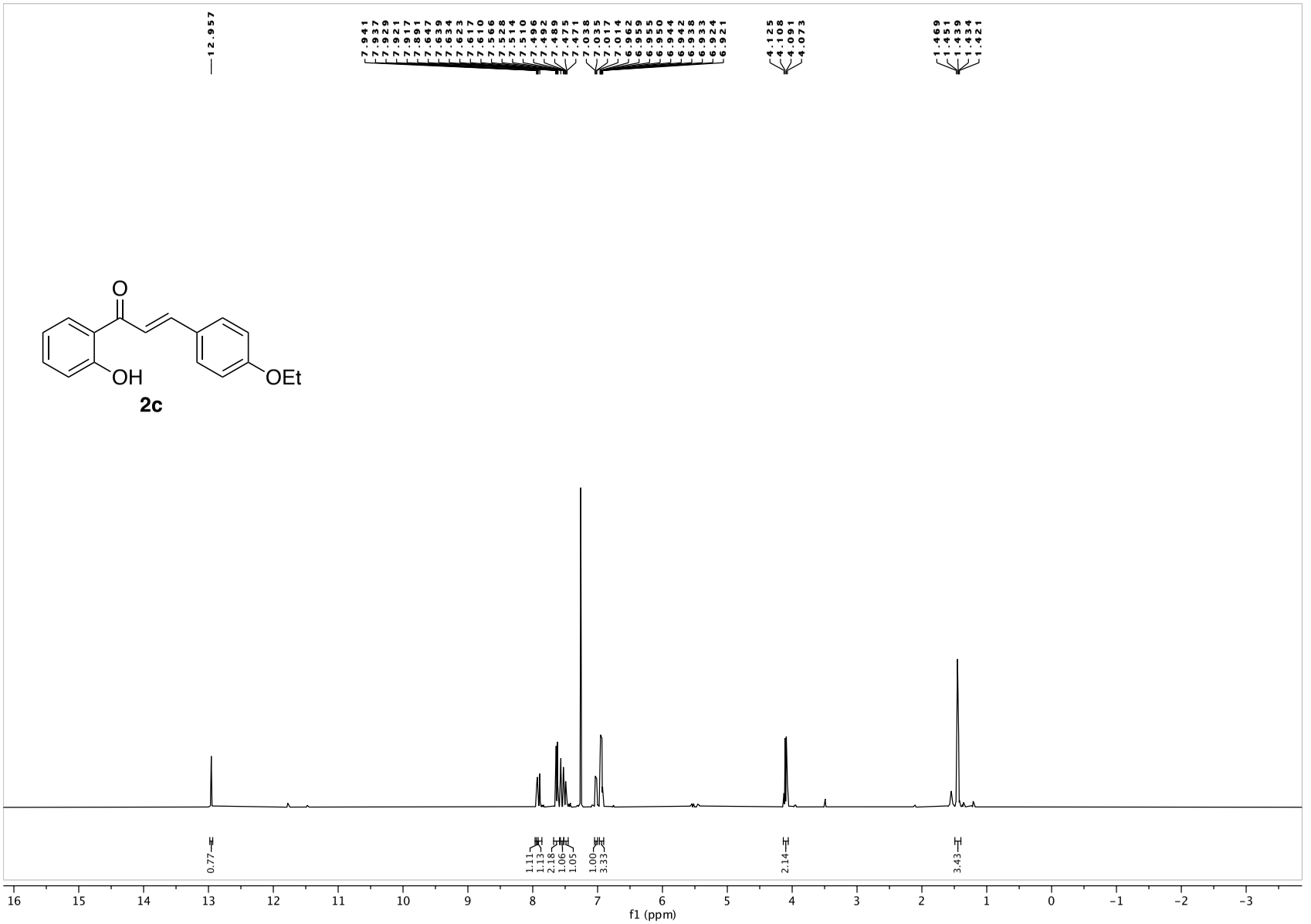
OH
2b
f1 (ppm)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−2
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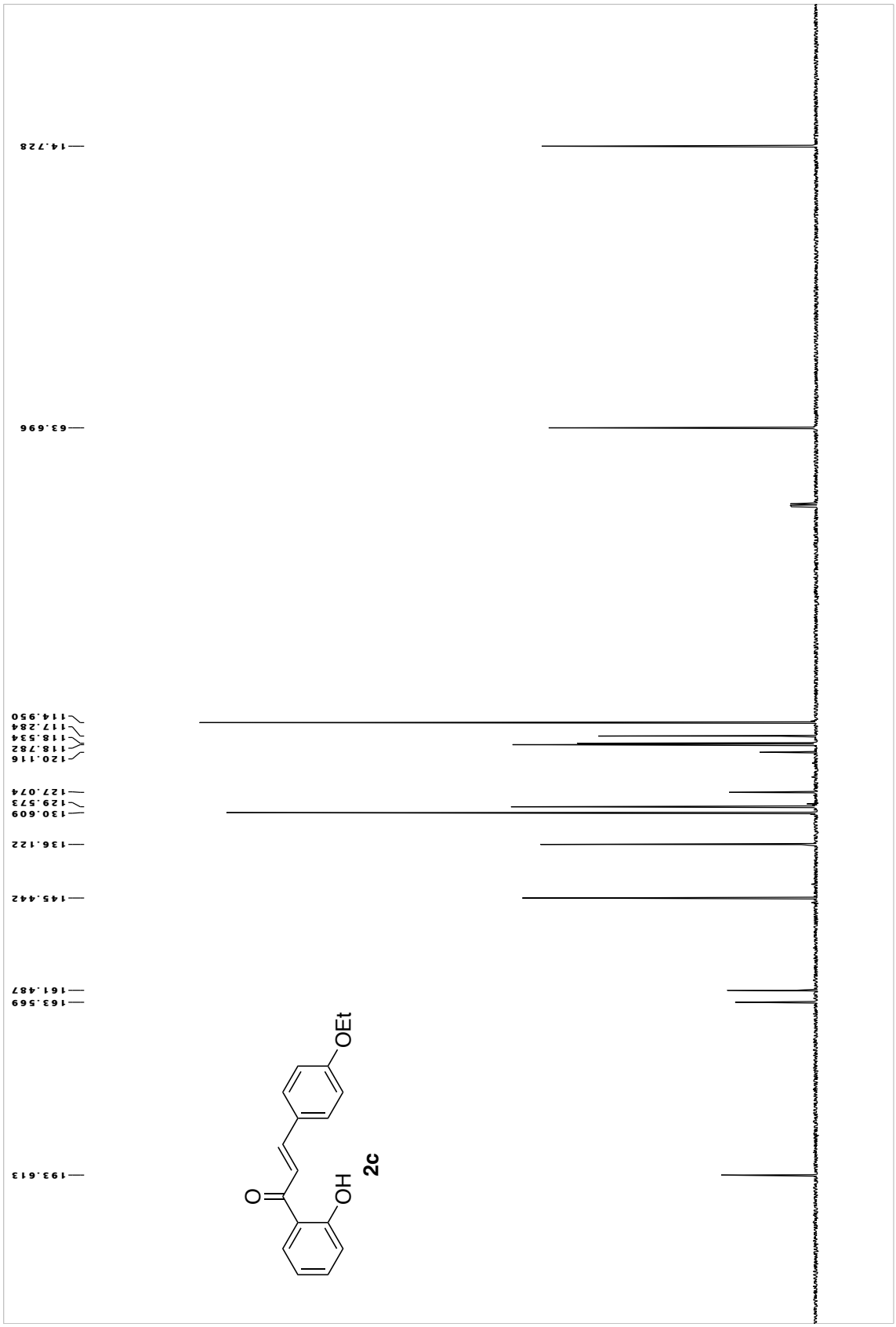
f1 (ppm)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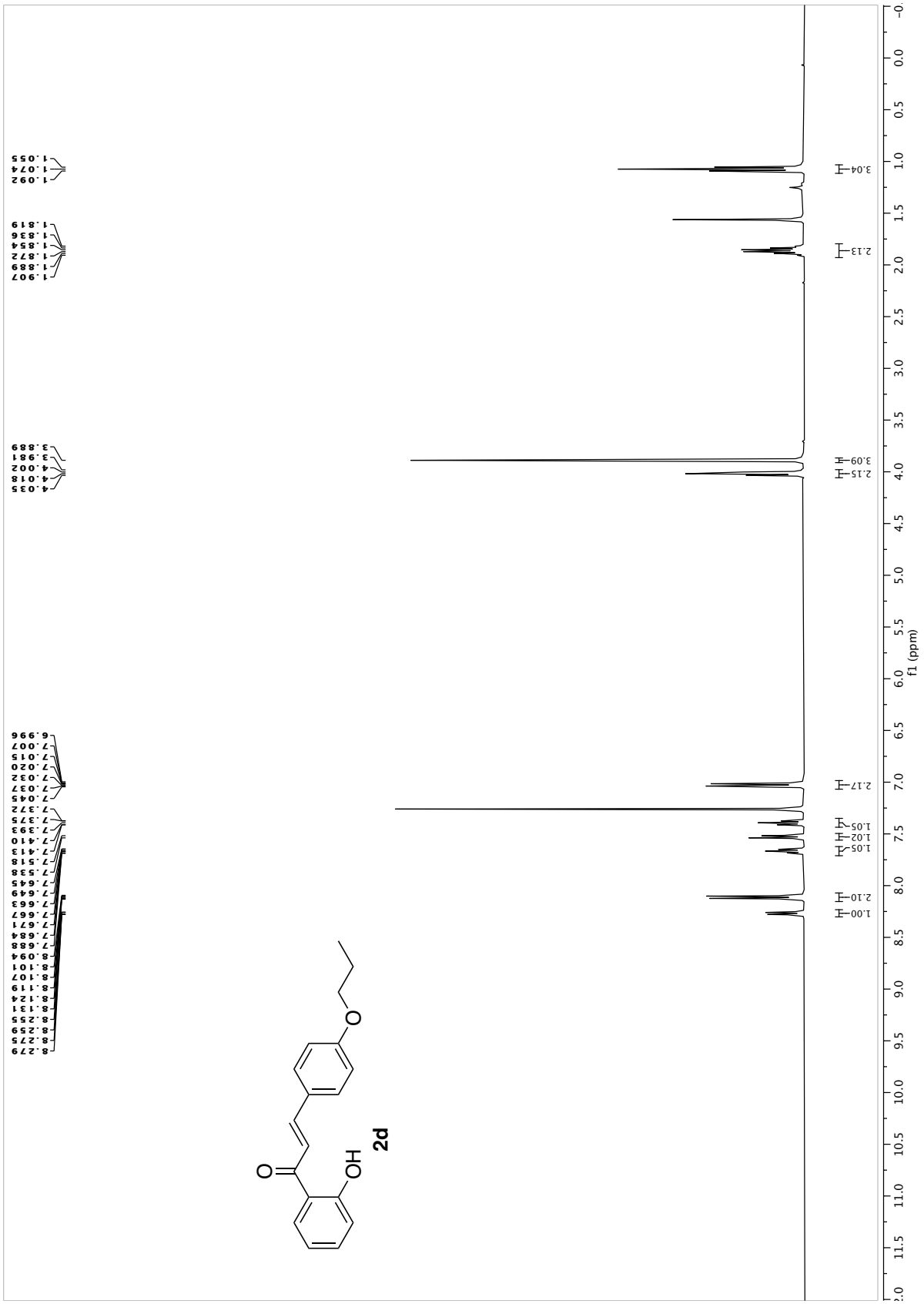
f1 (ppm)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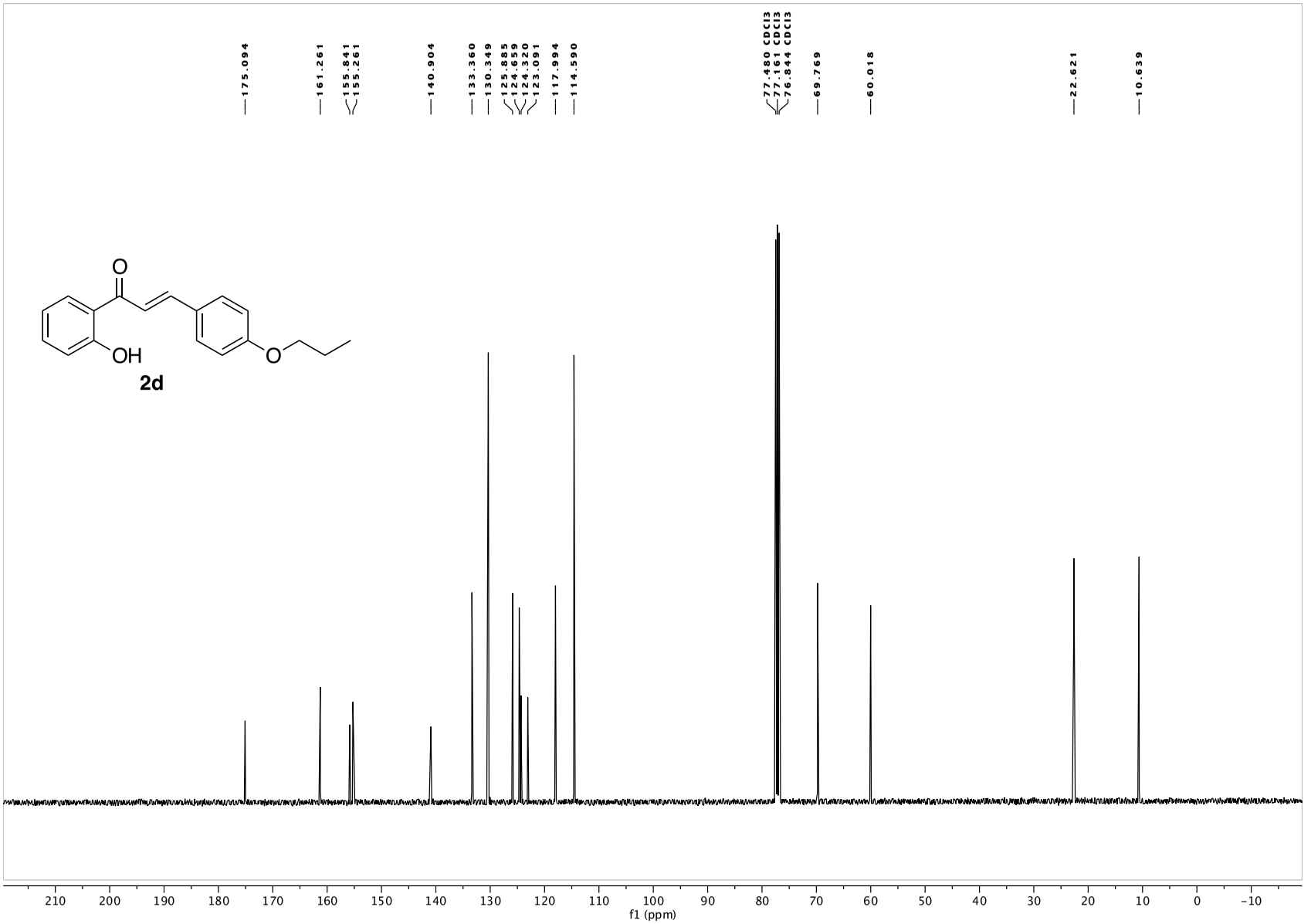
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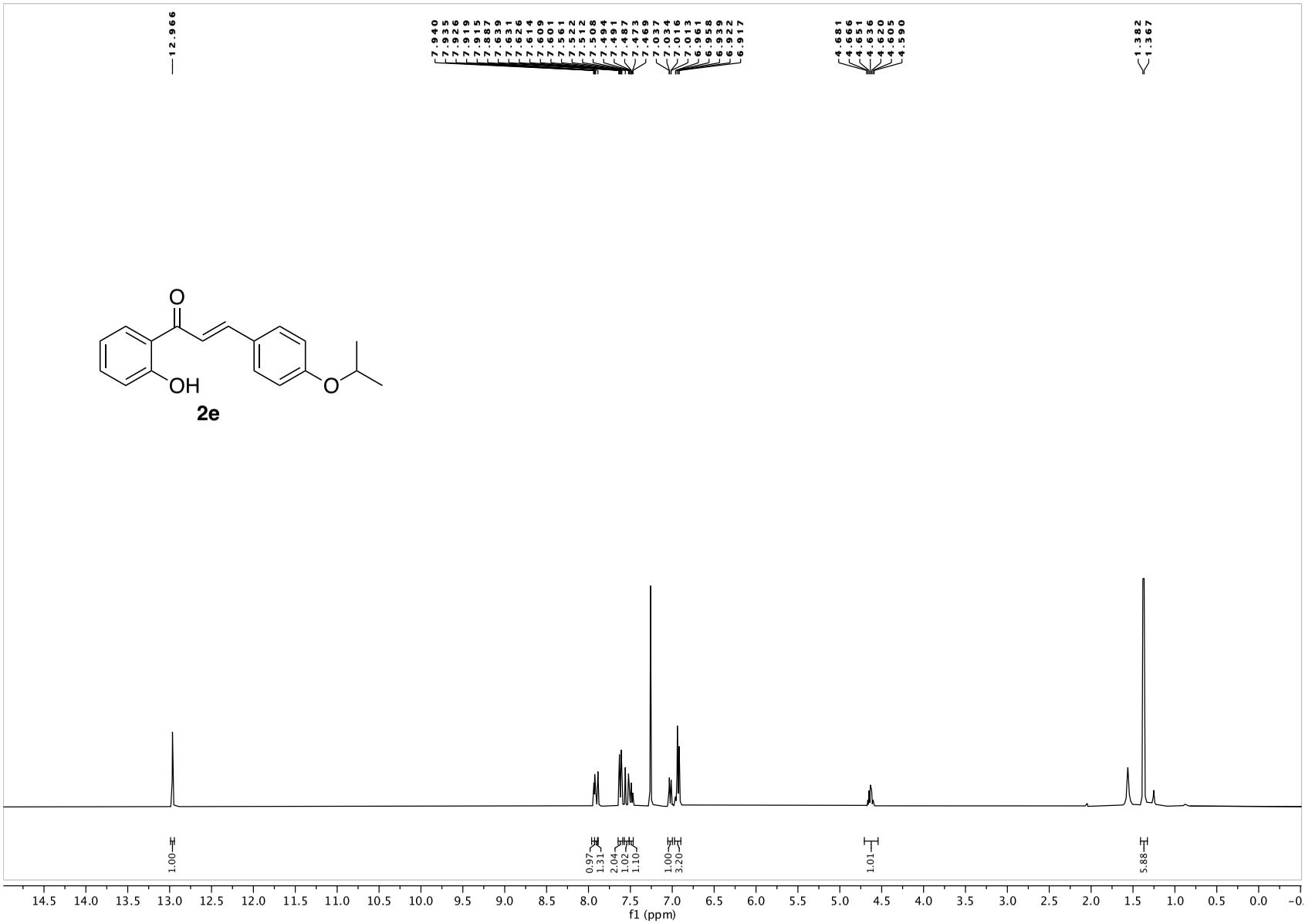
f1 (ppm)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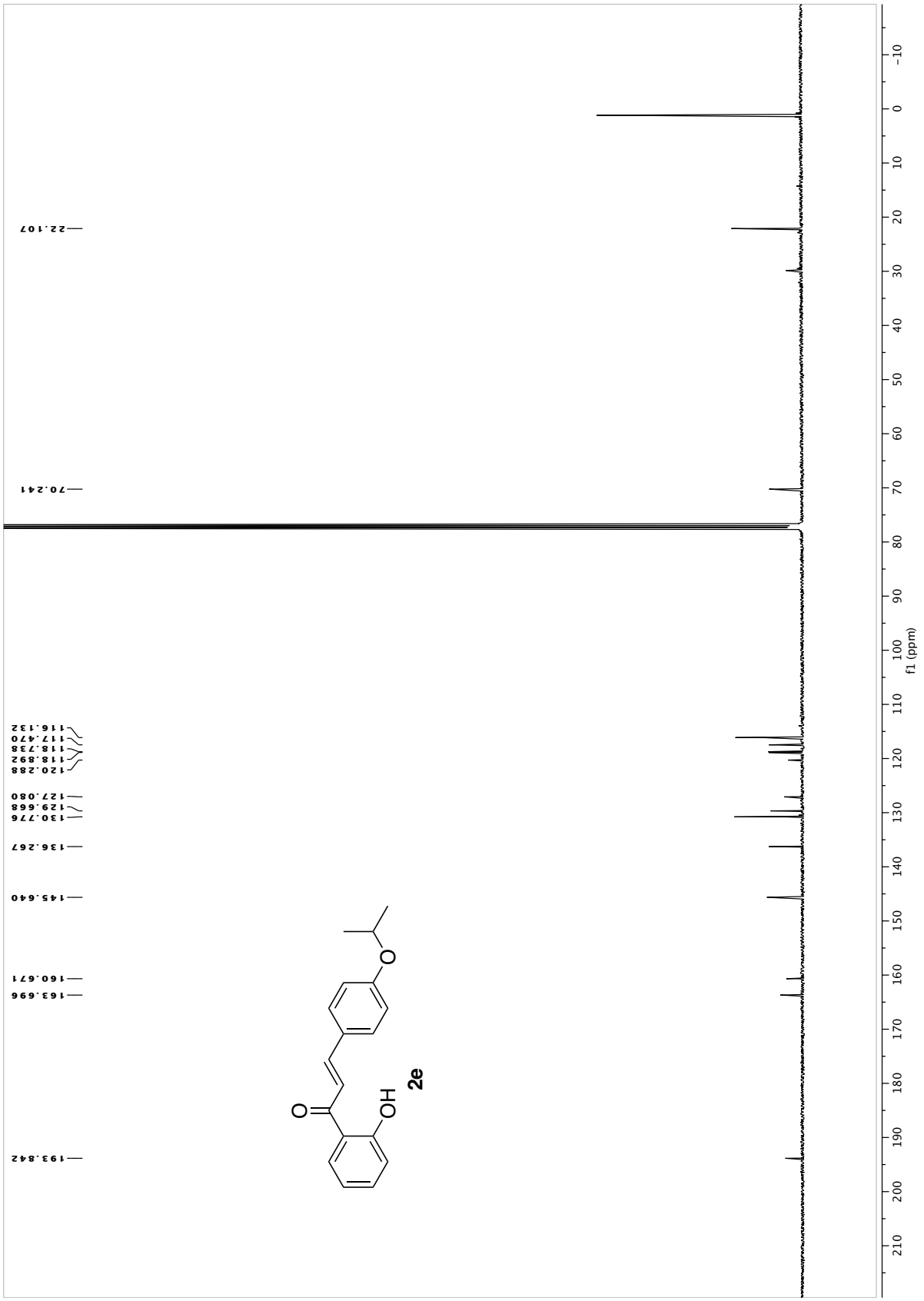
f1 (ppm)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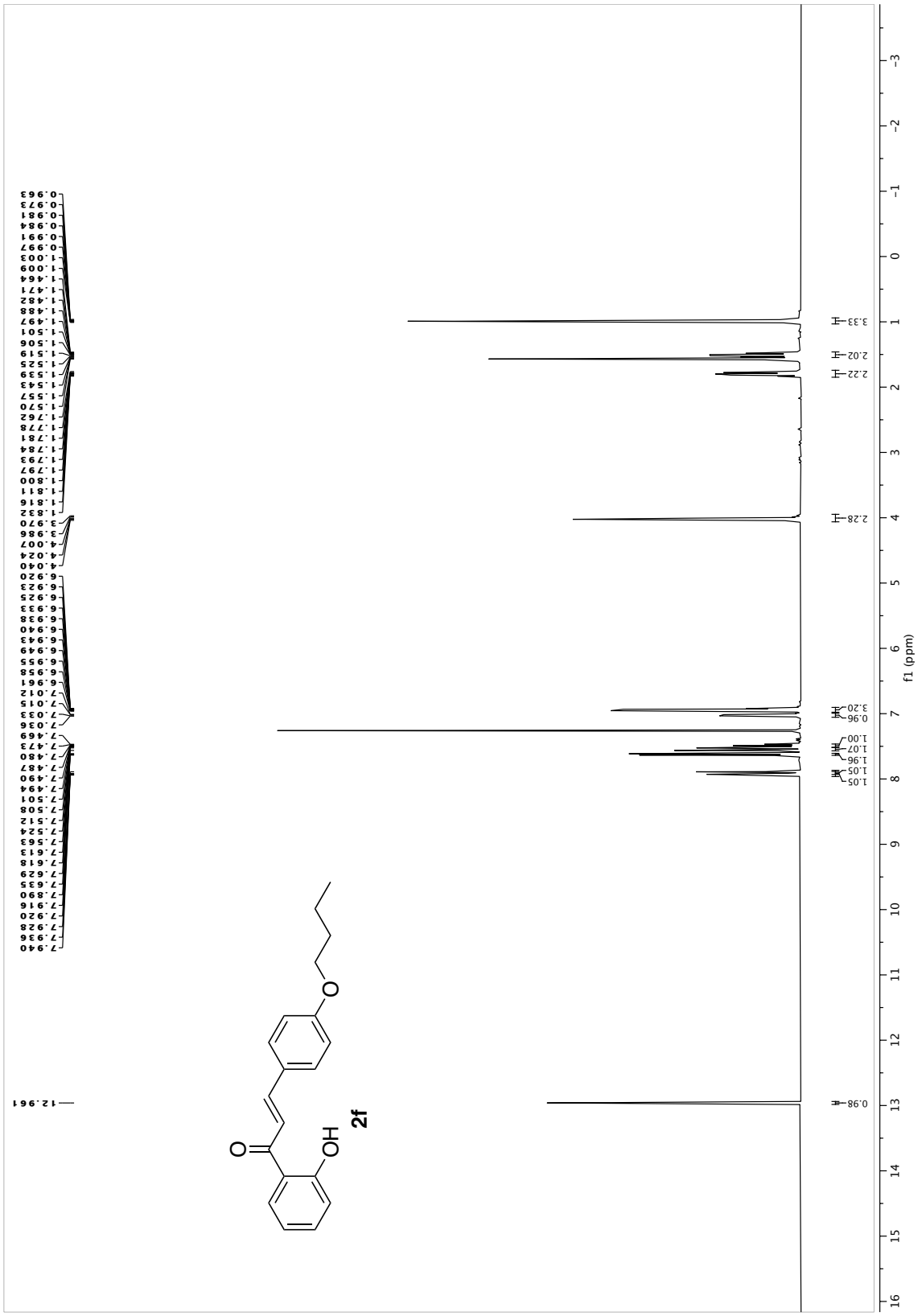
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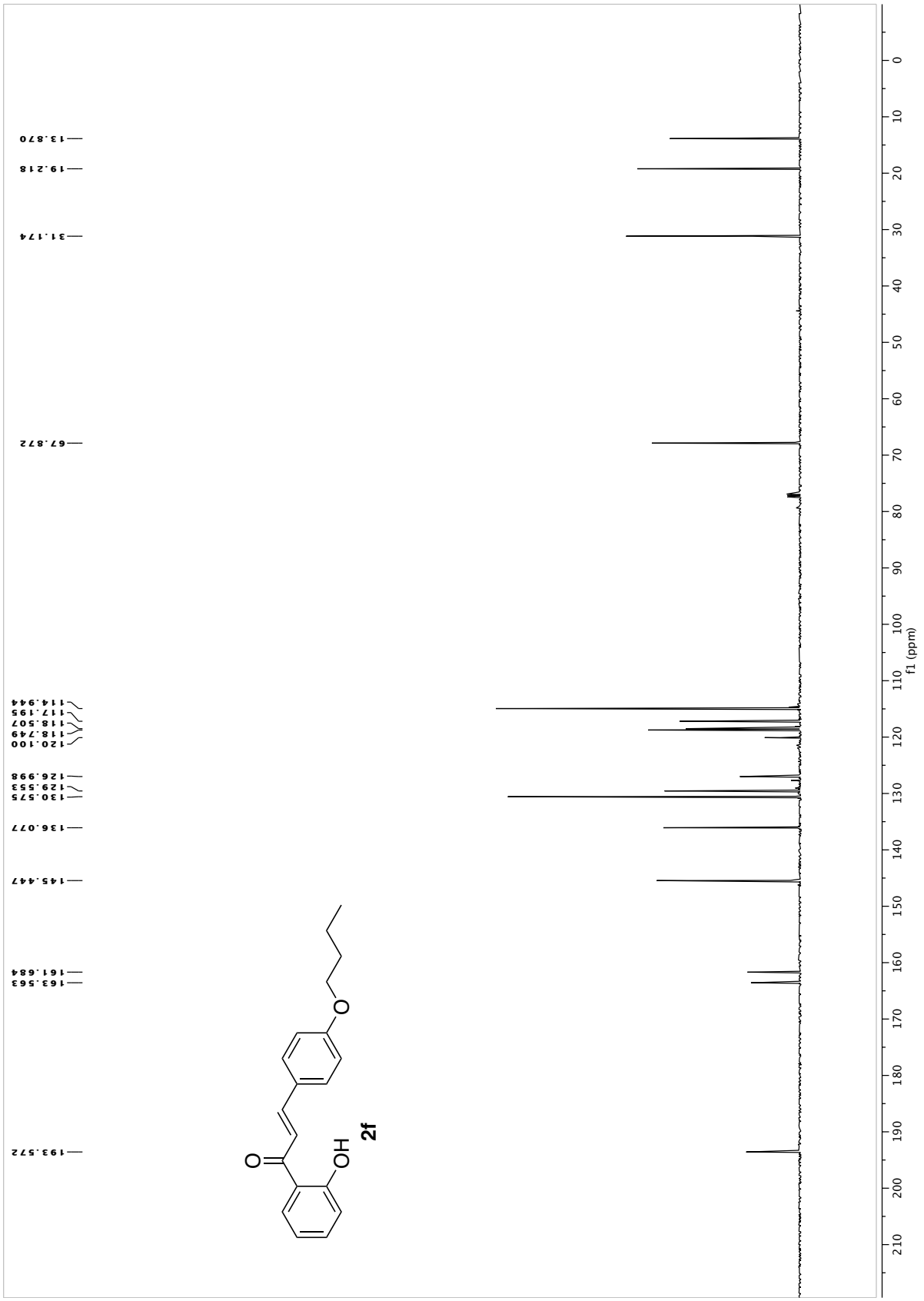
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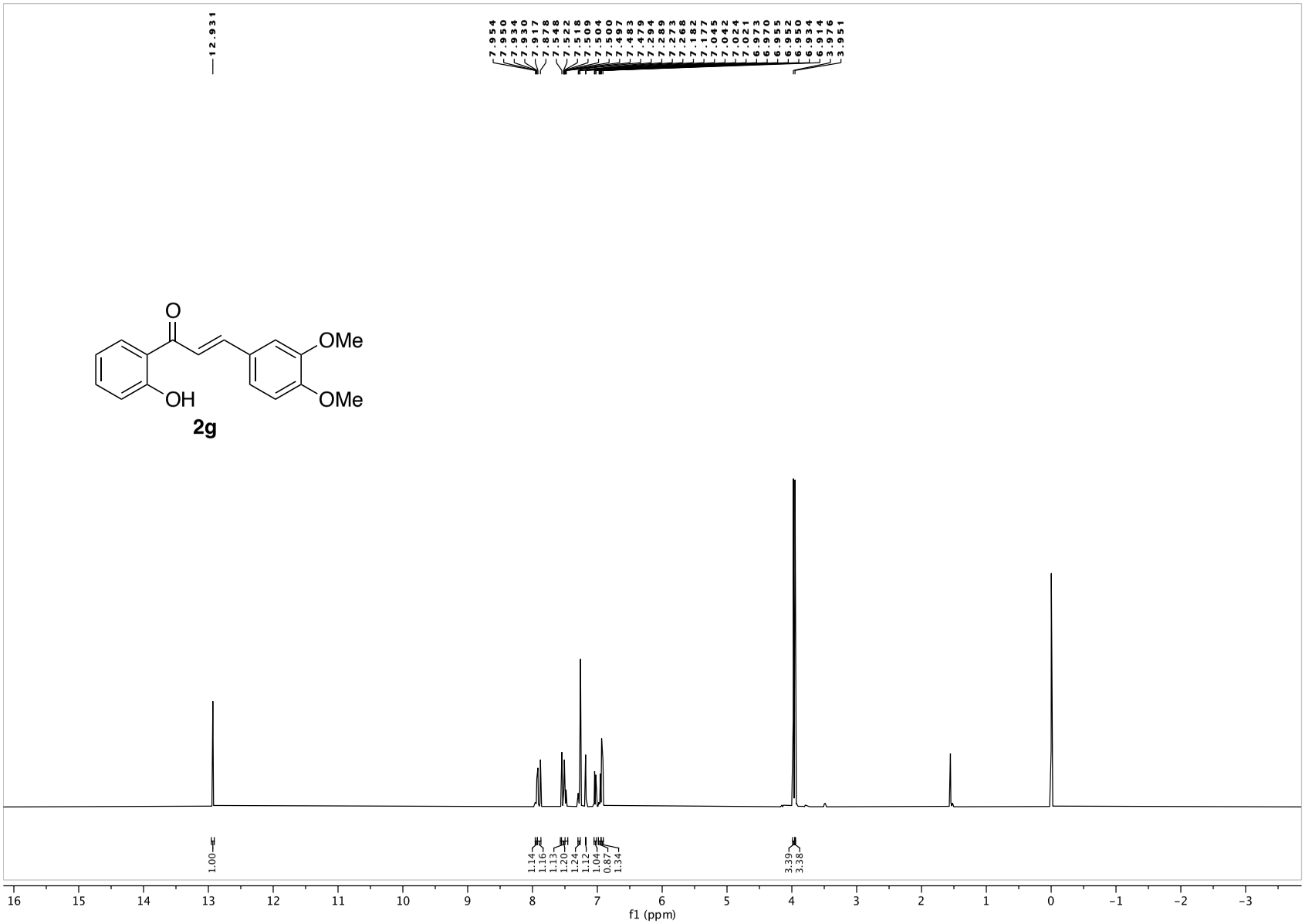
f1 (ppm)
2f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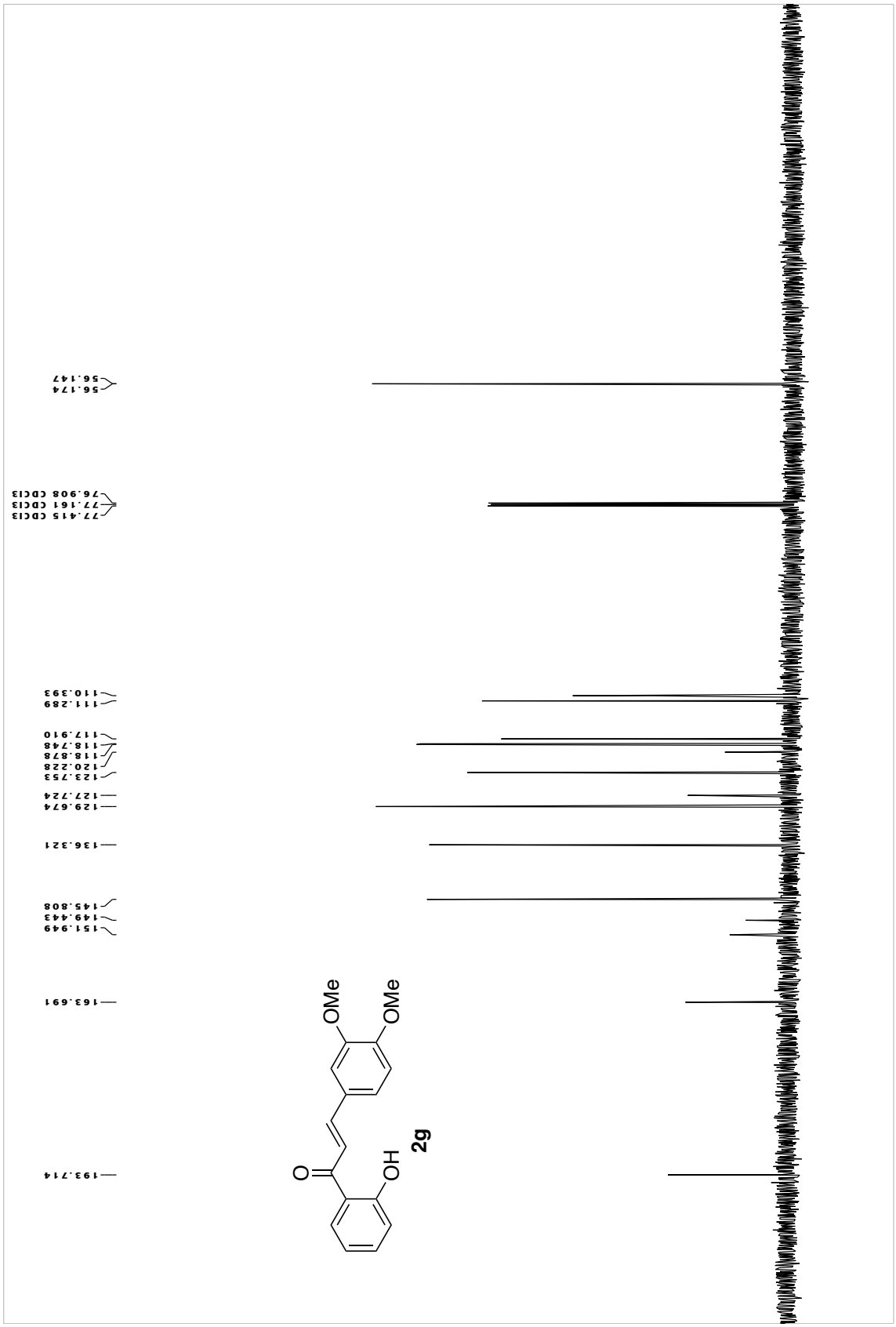
7.950
7.934
7.930
7.917
7.878
7.548
7.522
7.518
7.509
7.504
7.500
7.497
7.483
7.479
7.294
7.289
7.273
7.268
7.182
7.177
7.045
7.042
7.024
7.021
6.973
6.970
6.955
6.952
6.950
6.934
6.914
3.976
3.951
O
OMe
OMe
OH
2g
1.00
1.14
1.16
1.13
1.20
1.24
1.12
1.04
0.87
1.34
3.39
3.38
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)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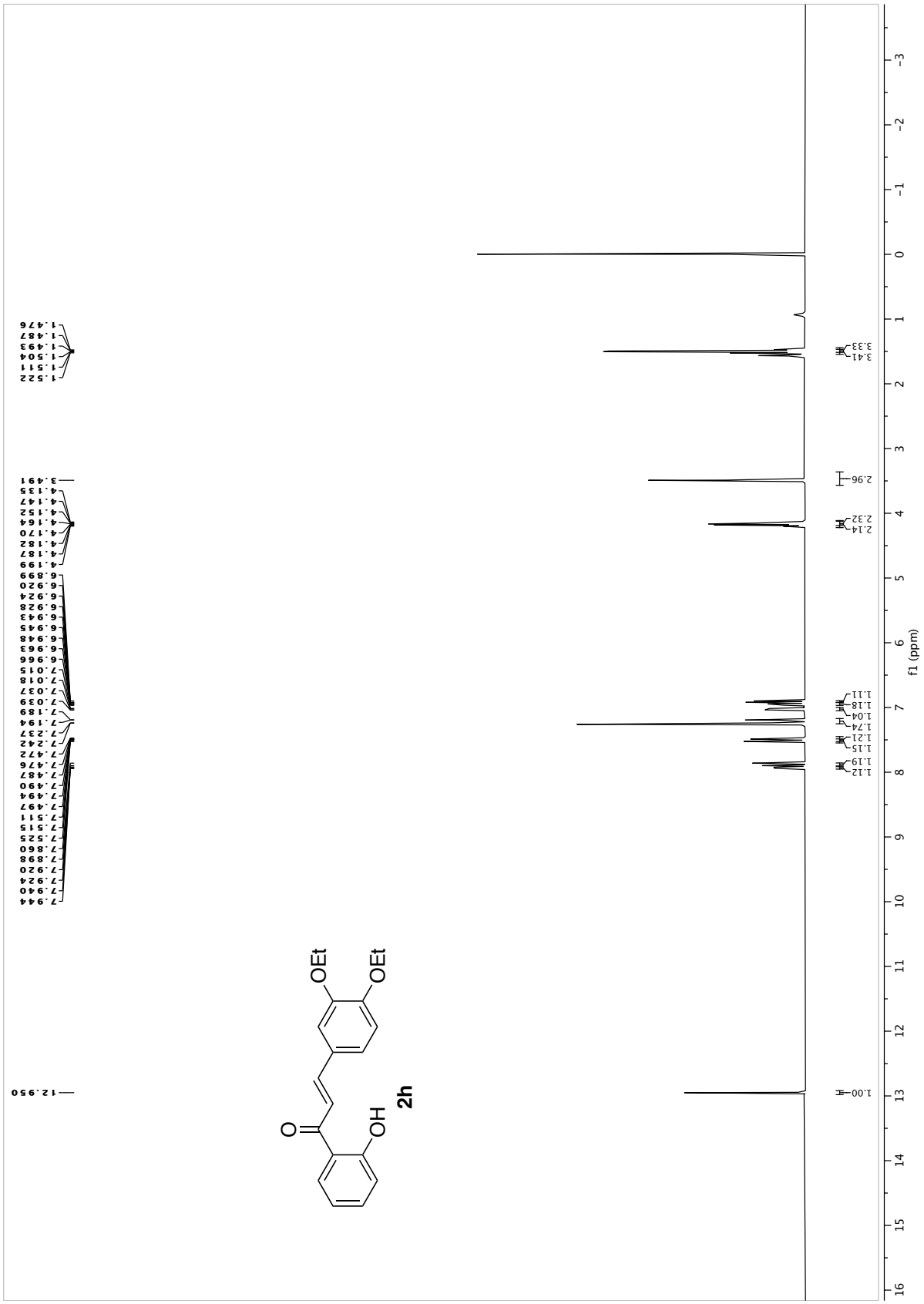
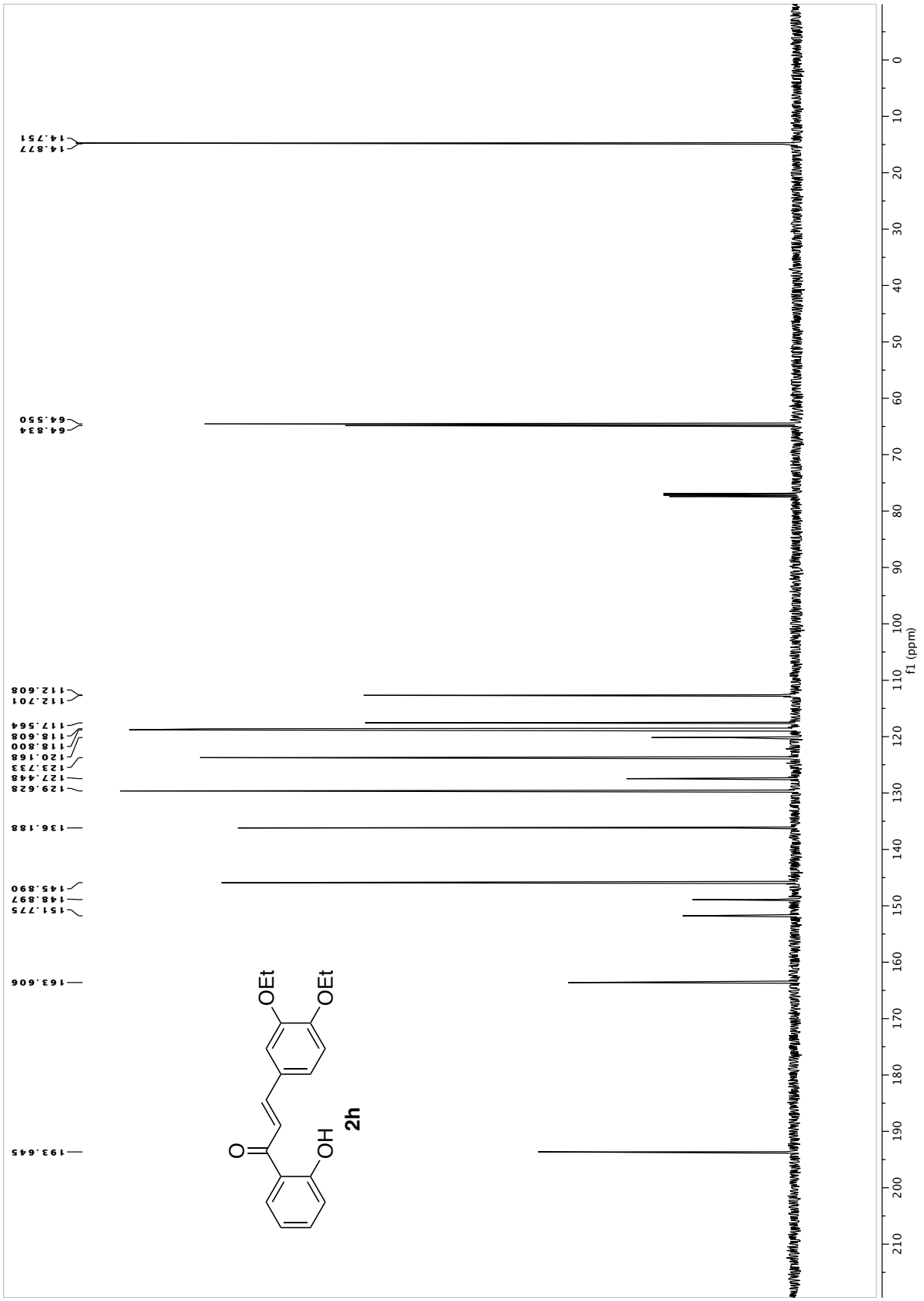
151.949
149.443
145.808
136.321
129.674
127.724
123.753
120.228
118.878
118.748
117.910
111.289
110.393
77.415 CDCl3
77.161 CDCl3
76.908 CDCl3
56.174
56.147
OMe
OMe
OH
O
2g
f1 (ppm)


OEt
OEt
O
OH
2h
f1 (ppm)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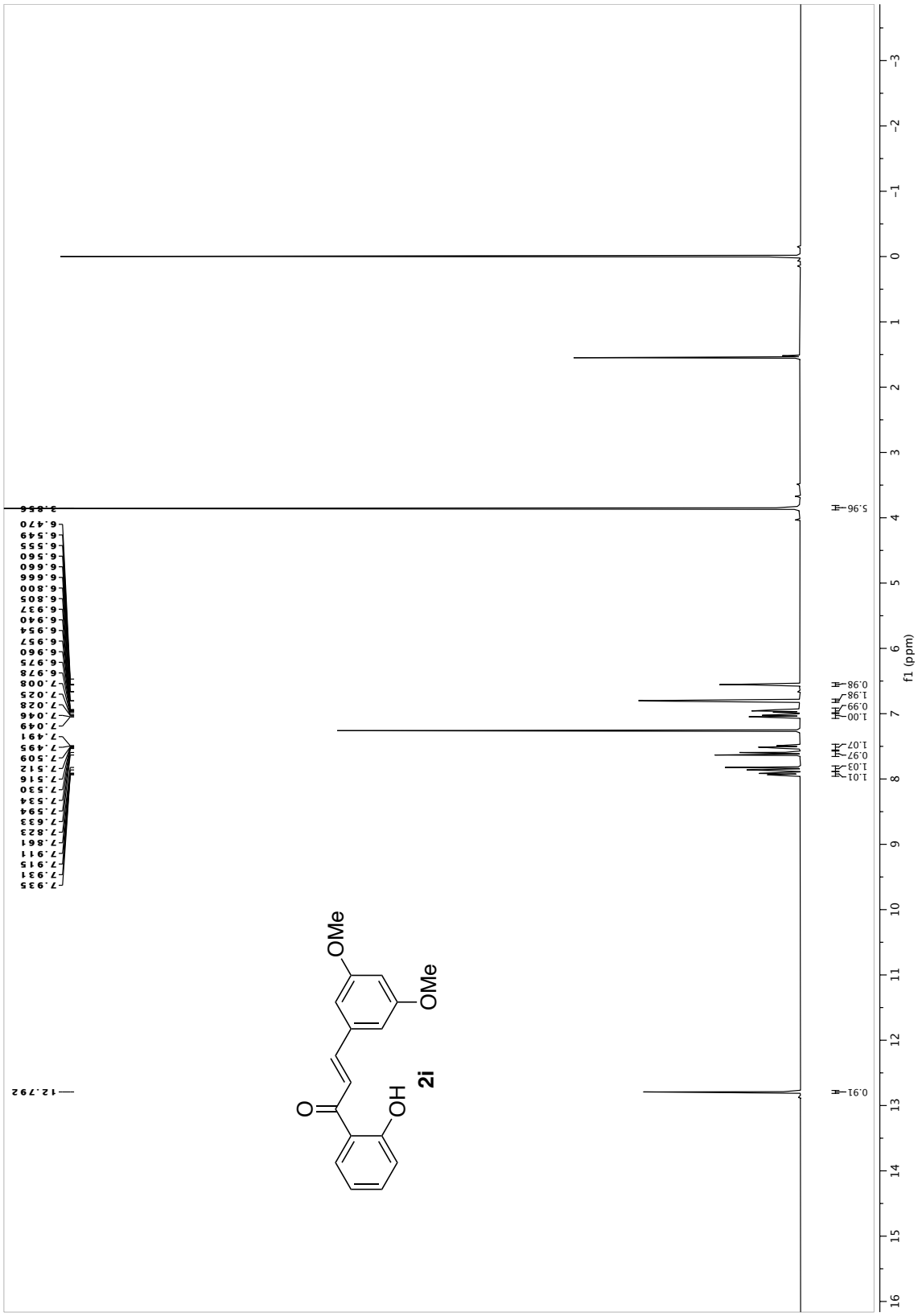
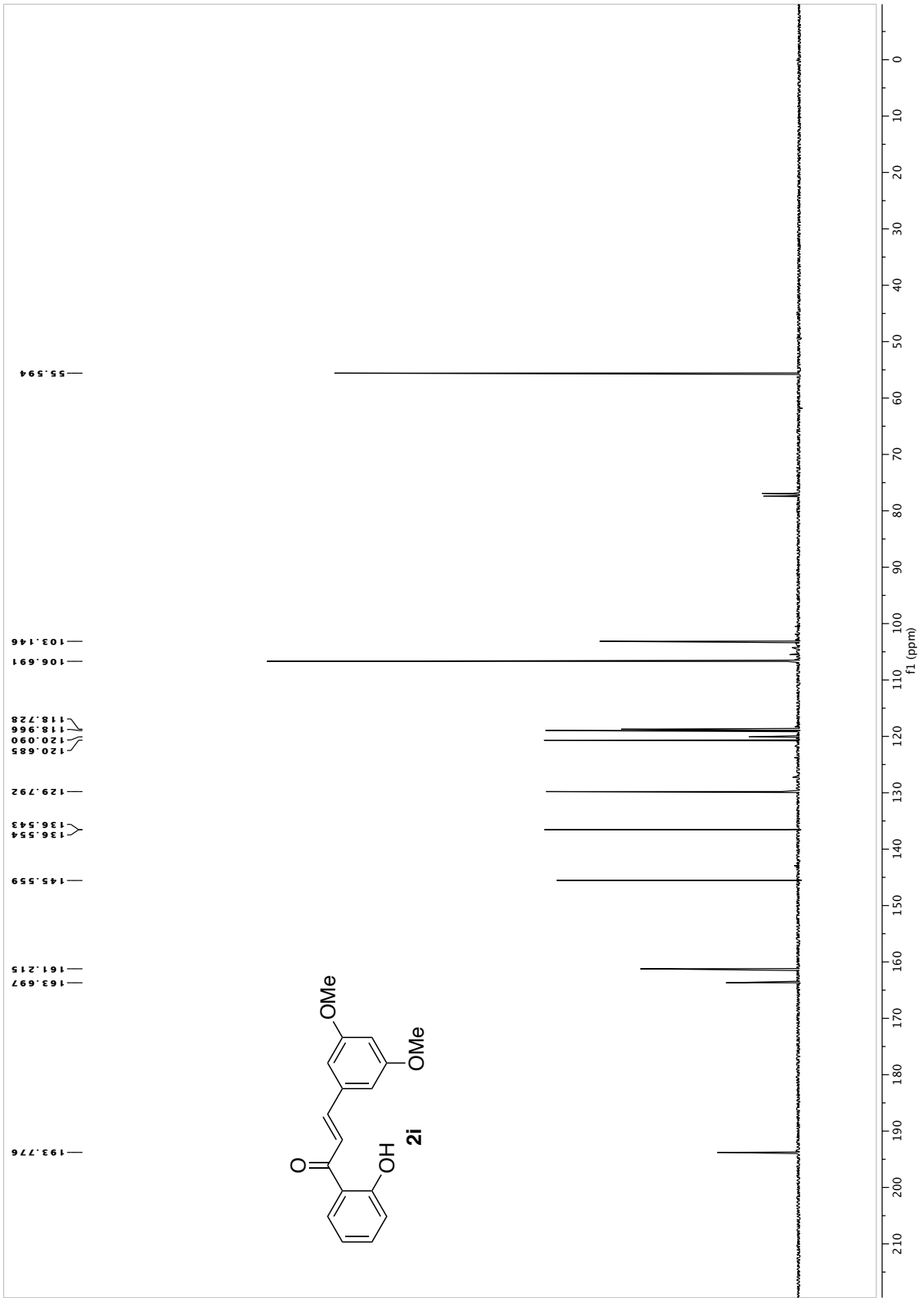
151.775
148.897
145.890
136.188
129.628
127.448
123.733
120.168
118.800
118.608
117.564
112.701
112.608
64.834
64.550
14.877
14.751
OEt
OEt
OH
O
2h
f1 (ppm)


OMe
OMe
O
OH
2i
f1 (ppm)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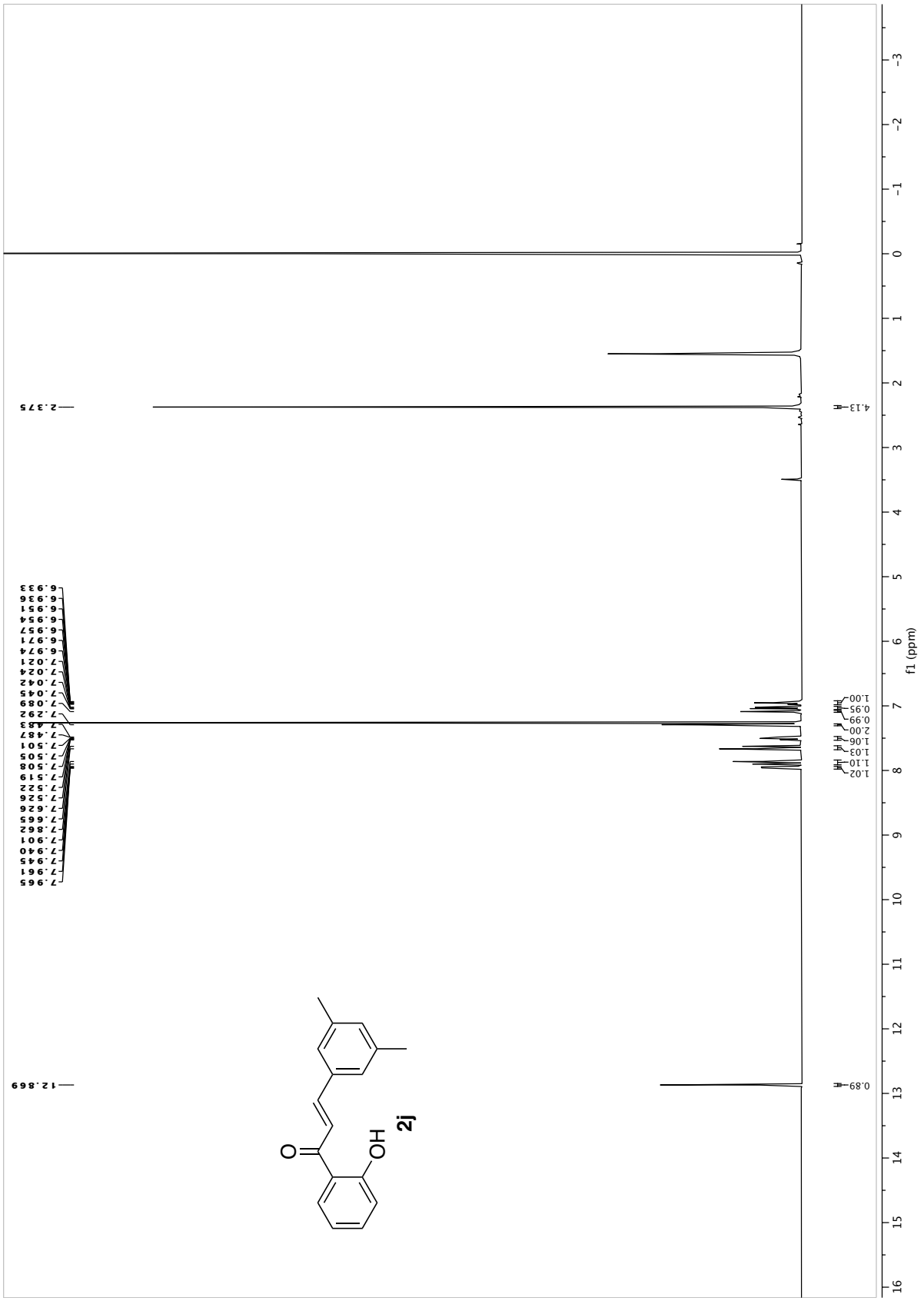
161.215
145.559
136.554
136.543
129.792
120.685
120.090
118.966
118.728
106.691
103.146
55.594
OMe
OMe
OH
O
2i
f1 (ppm)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7.626
7.526
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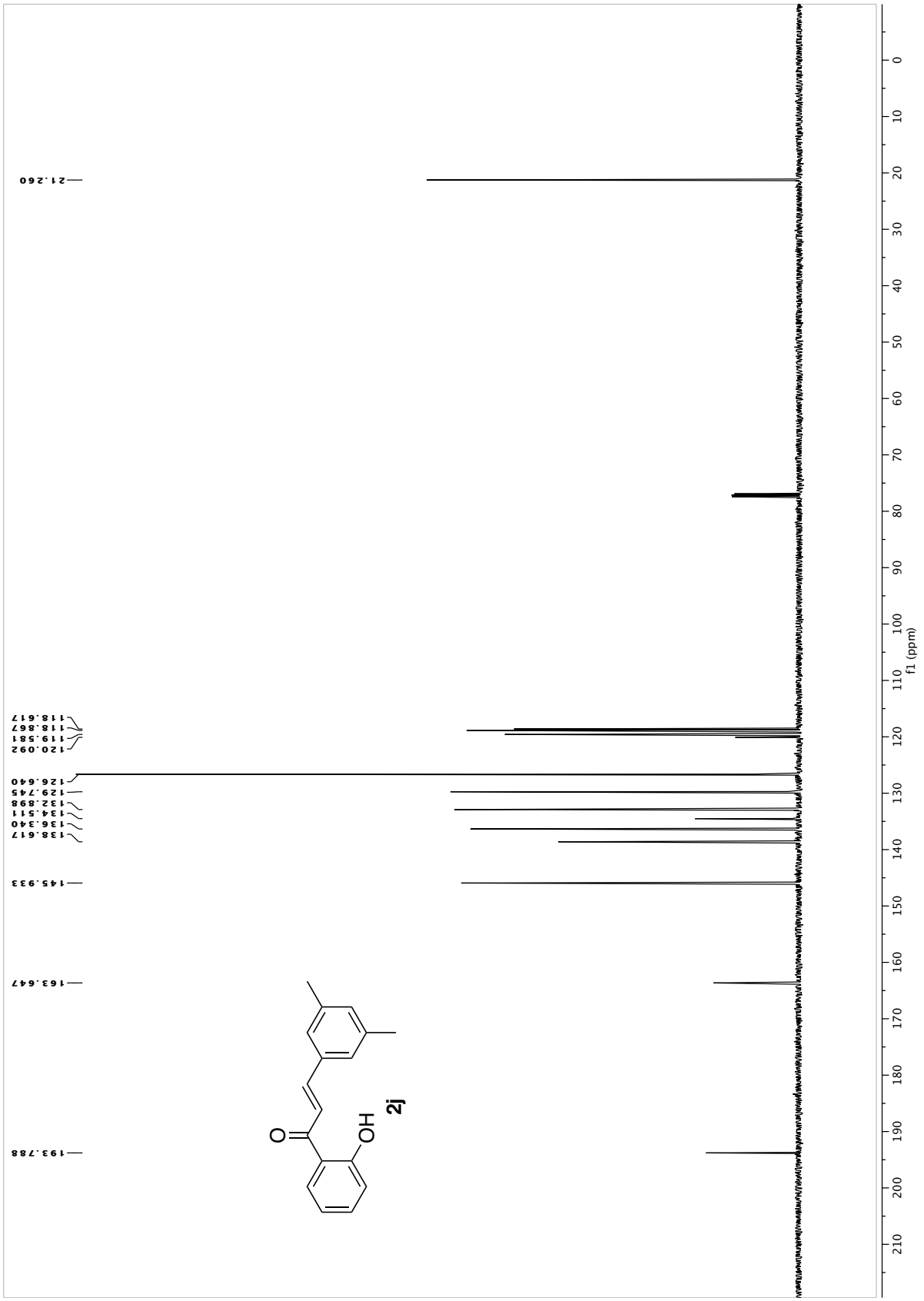
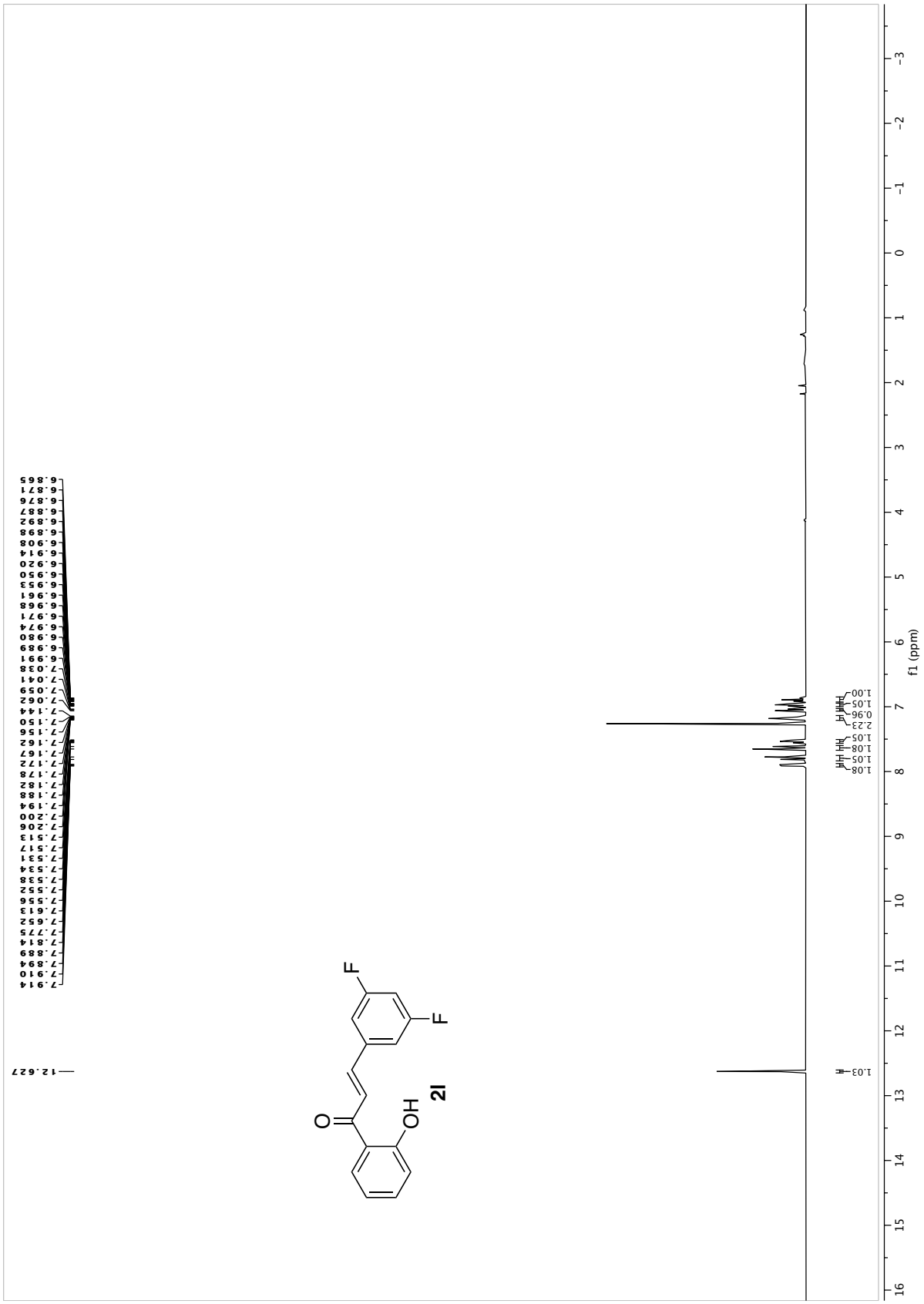
7.519
7.508
7.505
7.501
7.487
7.483
7.292
7.089
7.045
7.042
7.024
7.021
6.974
6.971
6.957
6.954
6.951
6.936
6.933
2.375
4.13
0.89
1.02
1.10
1.03
1.06
2.00
0.99
0.95
1.00
O
OH
2j
f1 (ppm)


193.788
163.647
145.933
138.617
136.340
134.511
132.898
129.745
126.640
120.092
119.581
118.867
118.617
21.260
O
OH
2j
f1 (ppm)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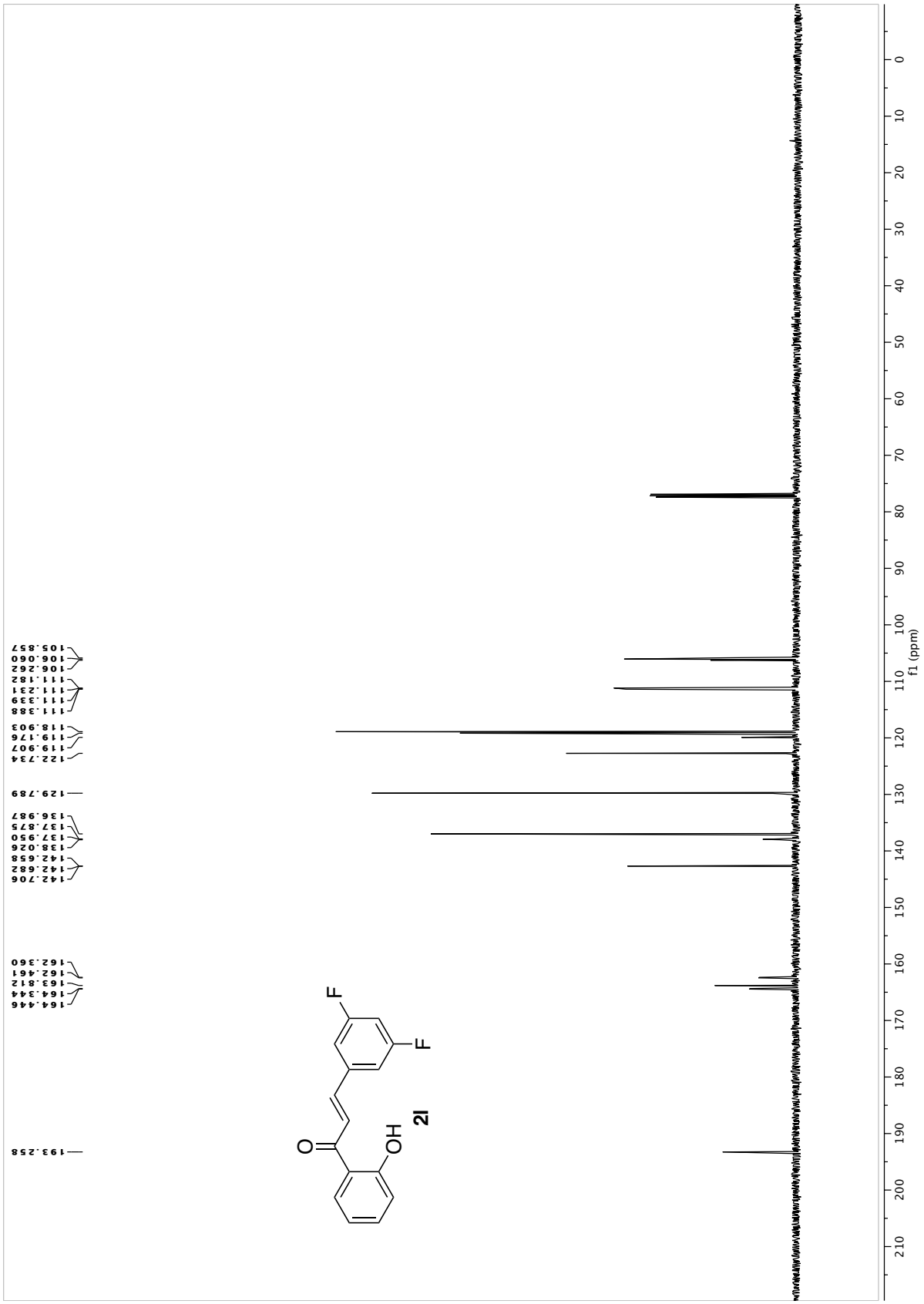
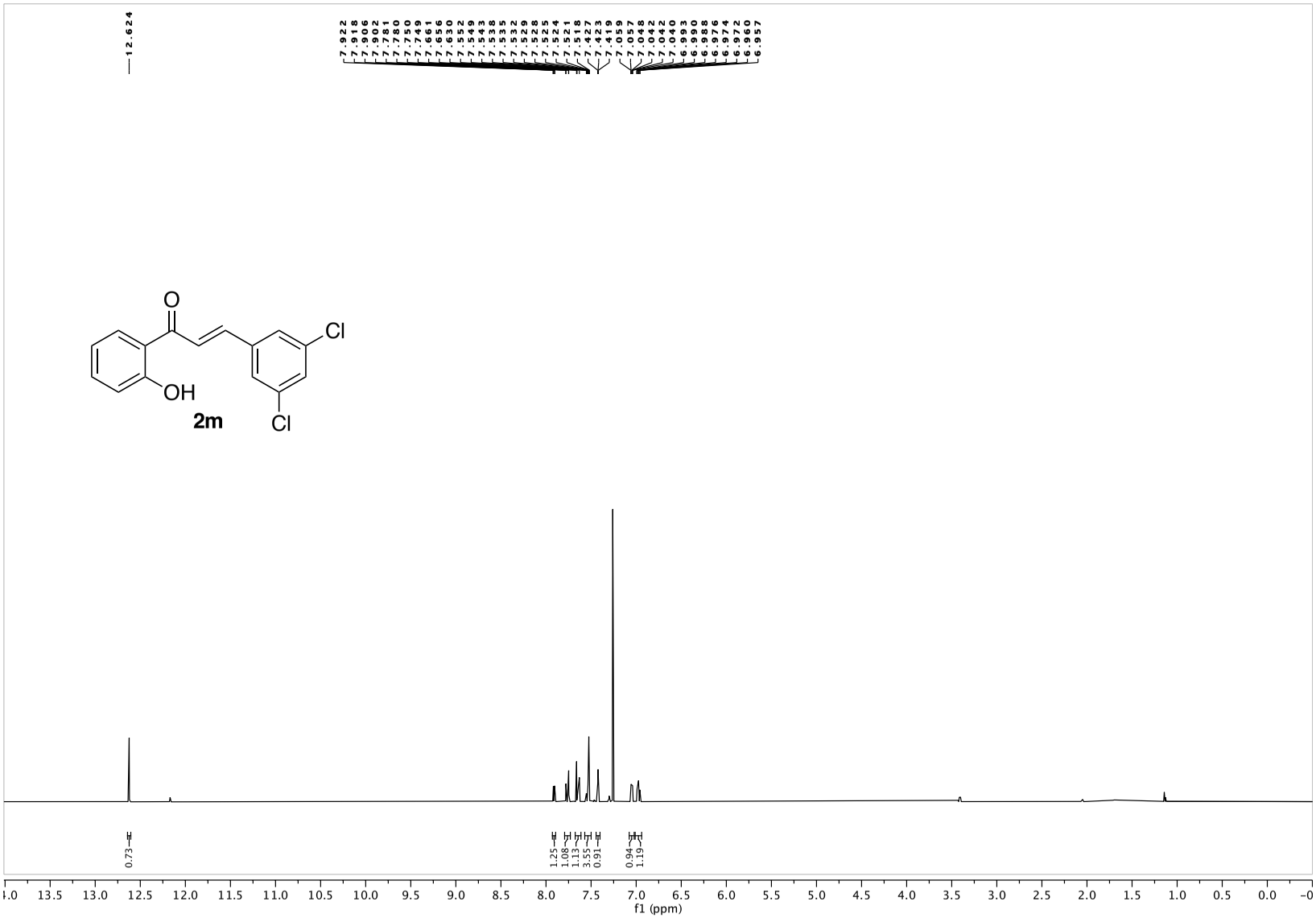
7.914
7.910
7.894
7.889
7.814
7.775
7.652
7.613
7.556
7.552
7.538
7.534
7.531
7.517
7.513
7.206
7.200
7.194
7.188
7.182
7.178
7.172
7.167
7.162
7.156
7.150
7.144
7.062
7.059
7.041
7.038
6.991
6.989
6.980
6.974
6.971
6.968
6.961
6.953
6.950
6.920
6.914
6.908
6.898
6.892
6.887
6.876
6.871
6.865
F
F
O
OH
2l
1.03
1.08
1.05
1.08
1.05
2.23
0.96
1.05
1.00
f1 (ppm)


193.258
164.446
164.344
163.812
162.461
162.360
142.706
142.682
142.658
138.026
137.950
137.875
136.987
129.789
122.734
119.907
119.176
118.903
111.388
111.339
111.231
111.182
106.262
106.060
105.857
F
F
O
OH
2l
f1 (ppm)


12.624
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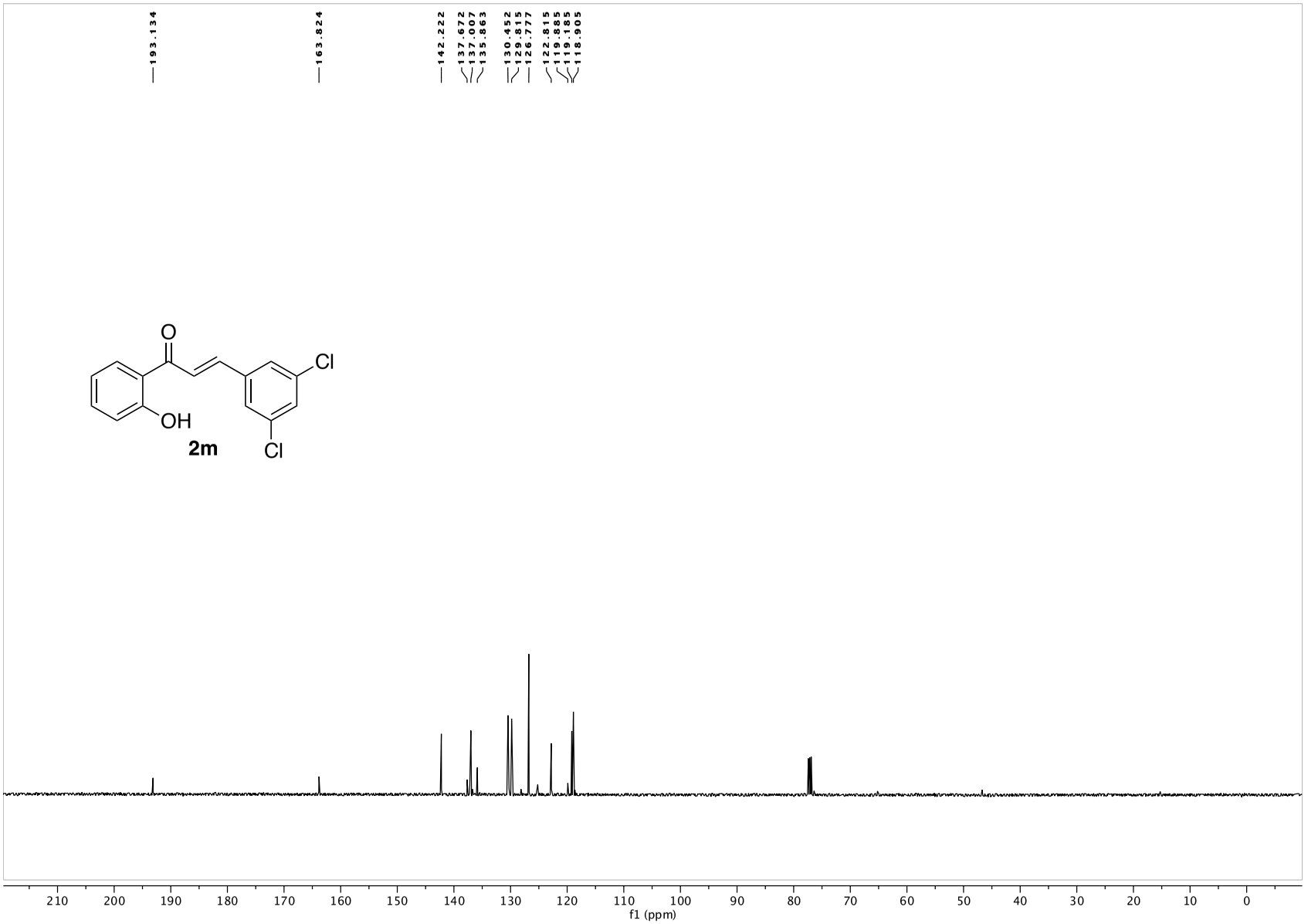
7.918
7.906
7.902
7.781
7.780
7.750
7.749
7.661
7.656
7.630
7.552
7.549
7.543
7.538
7.535
7.532
7.528
7.525
7.524
7.521
7.518
7.427
7.423
7.419
7.059
7.057
7.048
7.042
7.042
7.040
6.993
6.990
6.988
6.976
6.974
6.972
6.960
6.957
O
Cl
OH
Cl
2m
0.73
1.25
1.08
1.13
3.55
0.91
0.94
1.19
f1 (ppm)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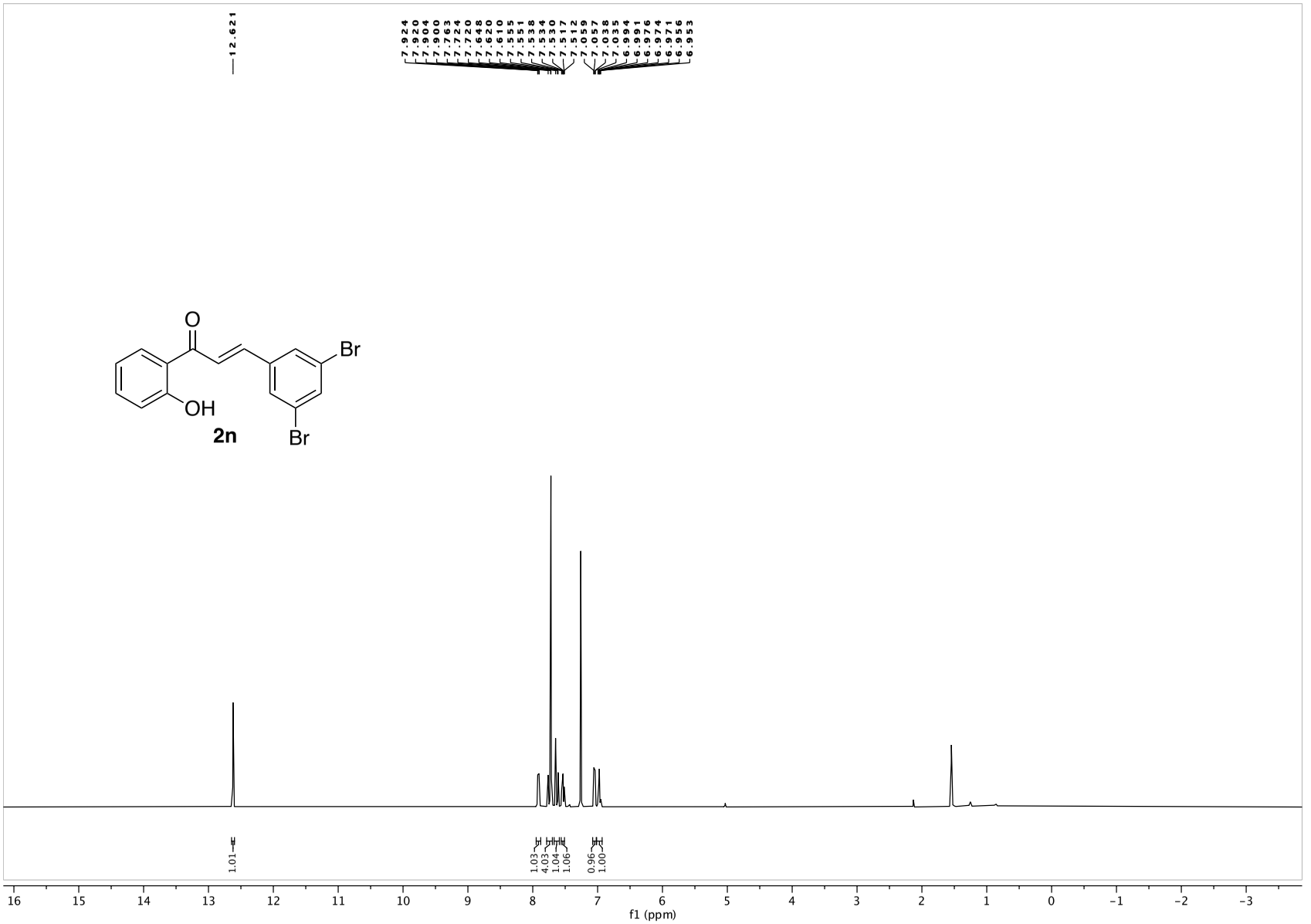
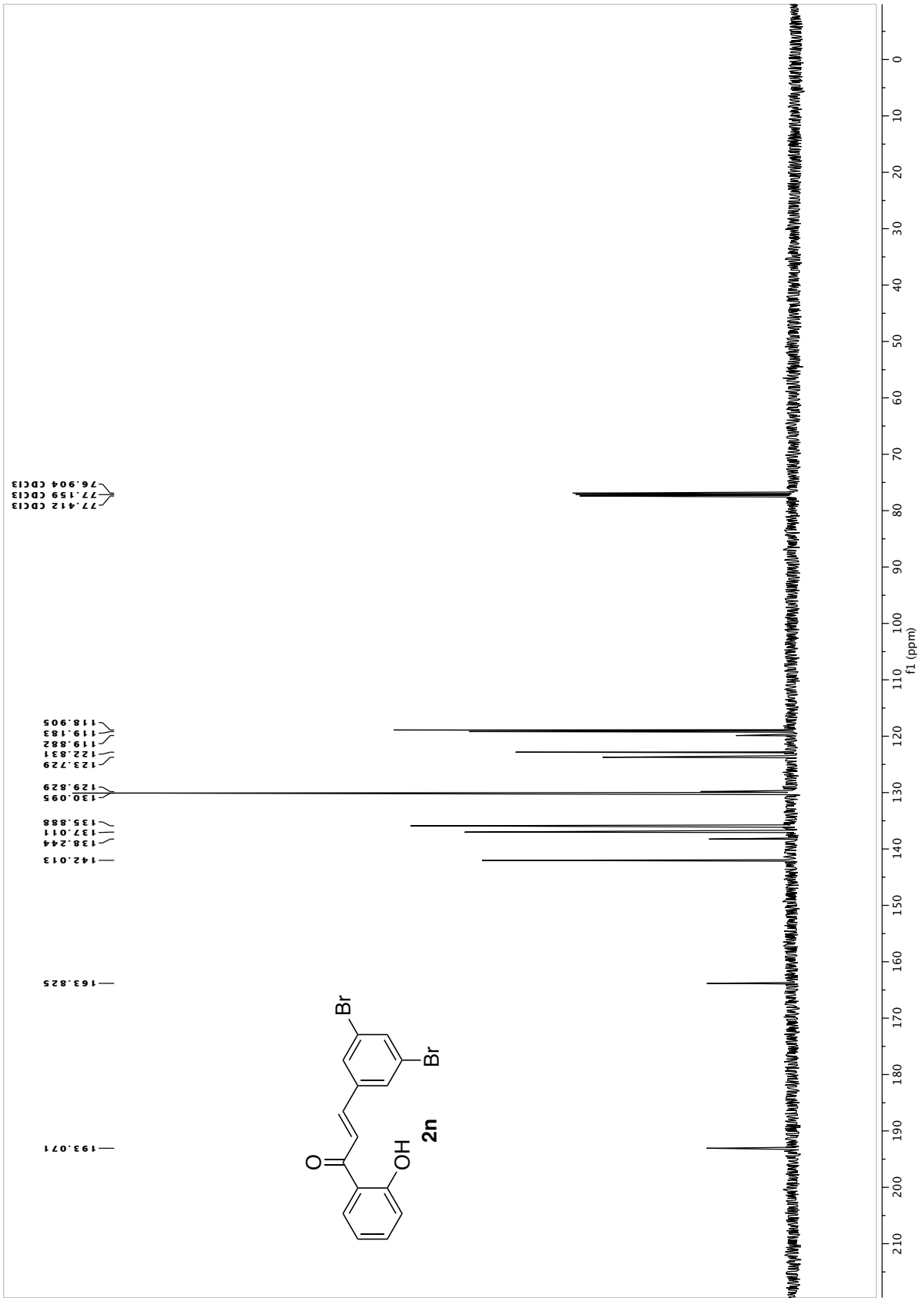
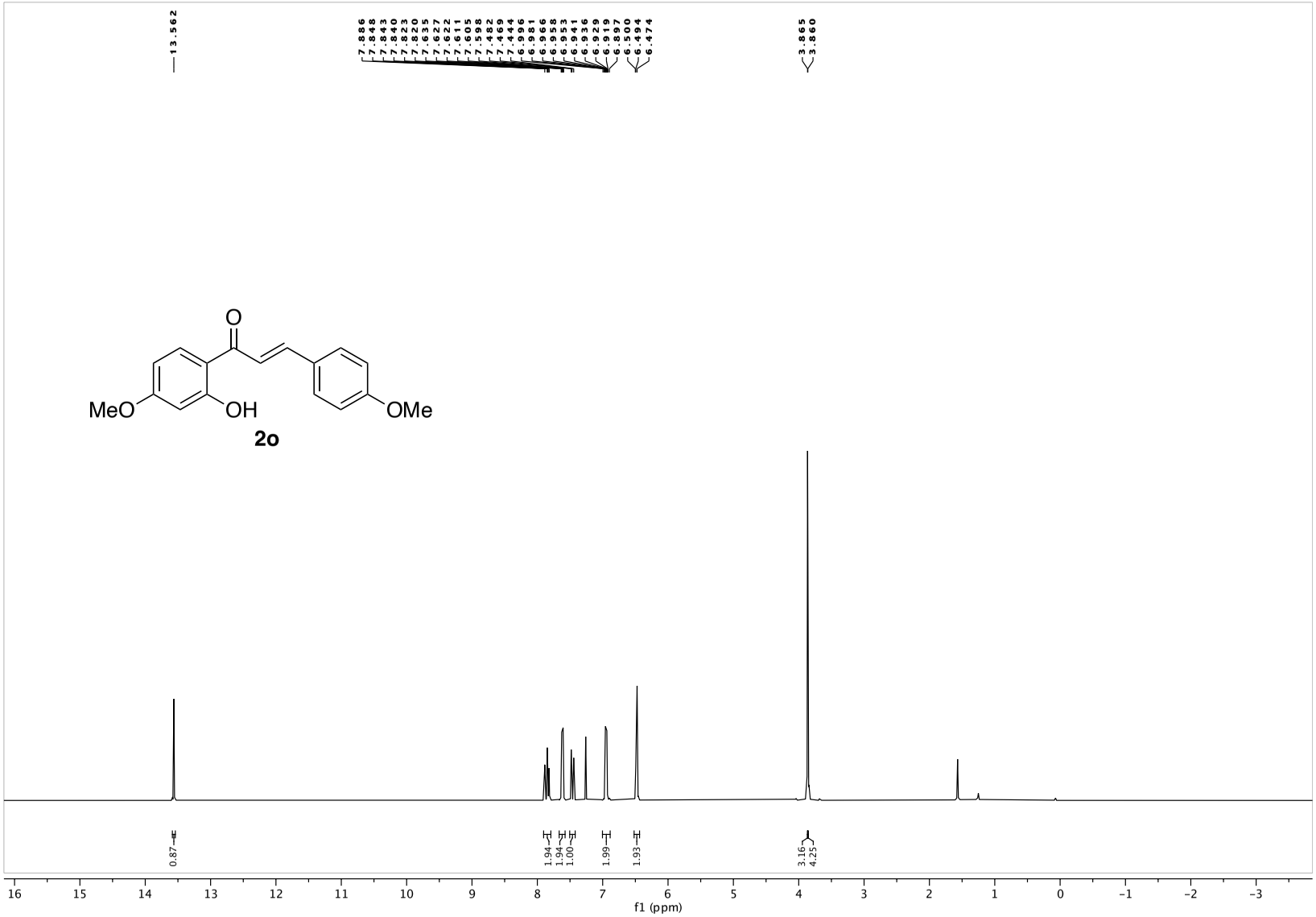
163.824
142.222
137.672
137.007
135.863
130.452
129.815
126.777
122.815
119.885
119.185
118.905
O
OH
Cl
Cl
2m
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


12.621
7.924
7.920
7.904
7.900
7.763
7.724
7.720
7.648
7.620
7.610
7.555
7.551
7.538
7.534
7.530
7.517
7.512
7.059
7.057
7.038
7.035
6.994
6.991
6.976
6.974
6.971
6.956
6.953
O
Br
OH
Br
2n
1.01
1.03
4.03
1.04
1.06
0.96
1.00
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)


193.071
163.825
142.013
138.244
137.011
135.888
130.095
129.829
123.729
122.831
119.882
119.183
118.905
77.412 CDCl3
77.159 CDCl3
76.904 CDCl3
Br
Br
O
OH
2n
f1 (ppm)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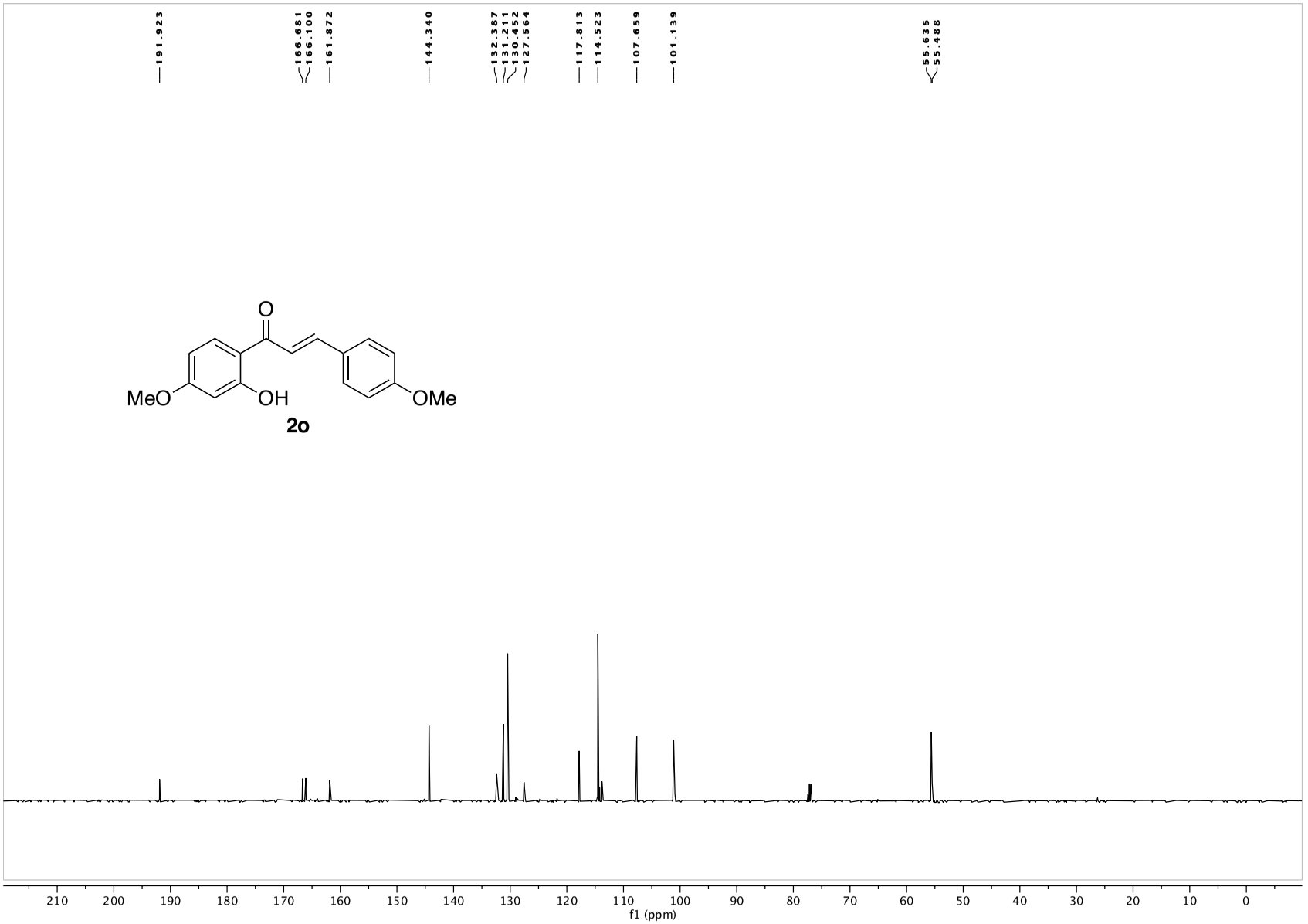
7.848
7.843
7.840
7.823
7.820
7.635
7.627
7.622
7.611
7.605
7.598
7.482
7.469
7.444
6.996
6.981
6.966
6.958
6.953
6.941
6.936
6.929
6.919
6.897
6.500
6.494
6.474
3.865
3.860
O
MeO
OH
OMe
2o
0.87
1.94
1.94
1.00
1.99
1.93
3.16
4.25
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)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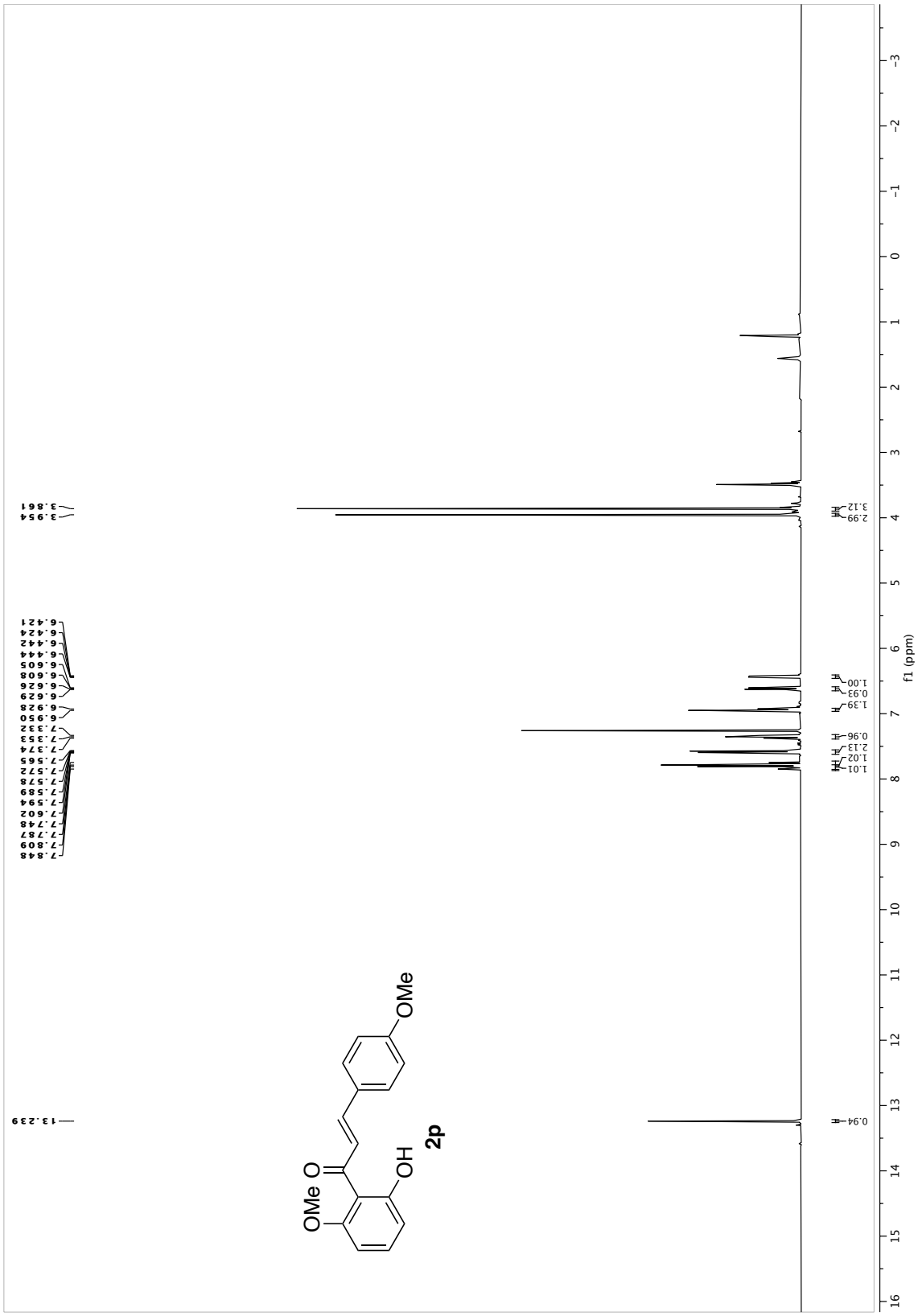
166.100
161.872
144.340
132.387
131.211
130.452
127.564
117.813
114.523
107.659
101.139
55.635
55.488
O
MeO
OH
OMe
2o
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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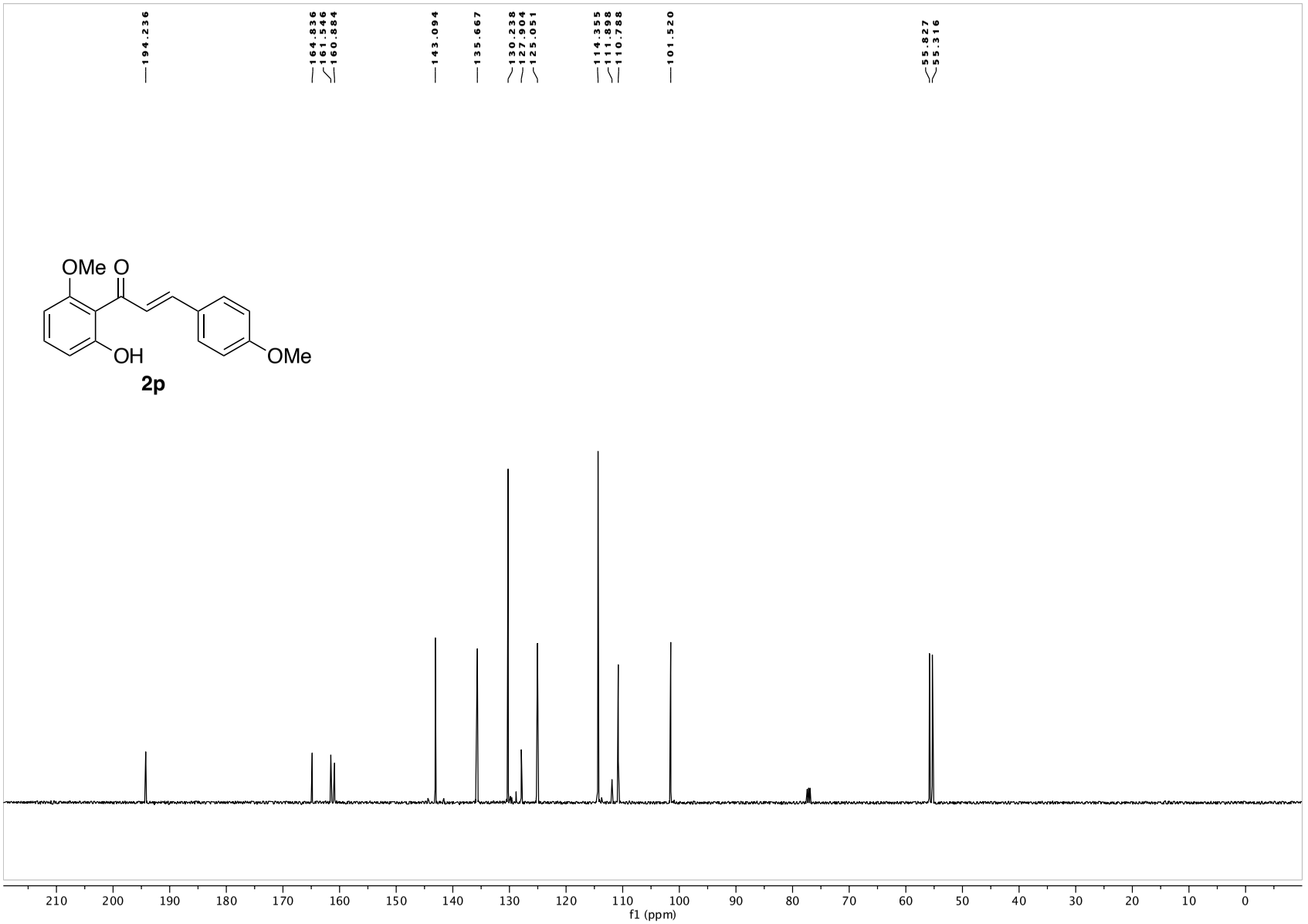
7.787
7.748
7.602
7.594
7.589
7.578
7.572
7.565
7.374
7.353
7.332
6.950
6.928
6.629
6.626
6.608
6.605
6.444
6.442
6.424
6.421
3.954
3.861
0.94
3.12
2.99
1.02
2.13
1.01
0.96
1.39
0.93
1.00
OMe
OH
O
OMe
2p
f1 (ppm)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143.094
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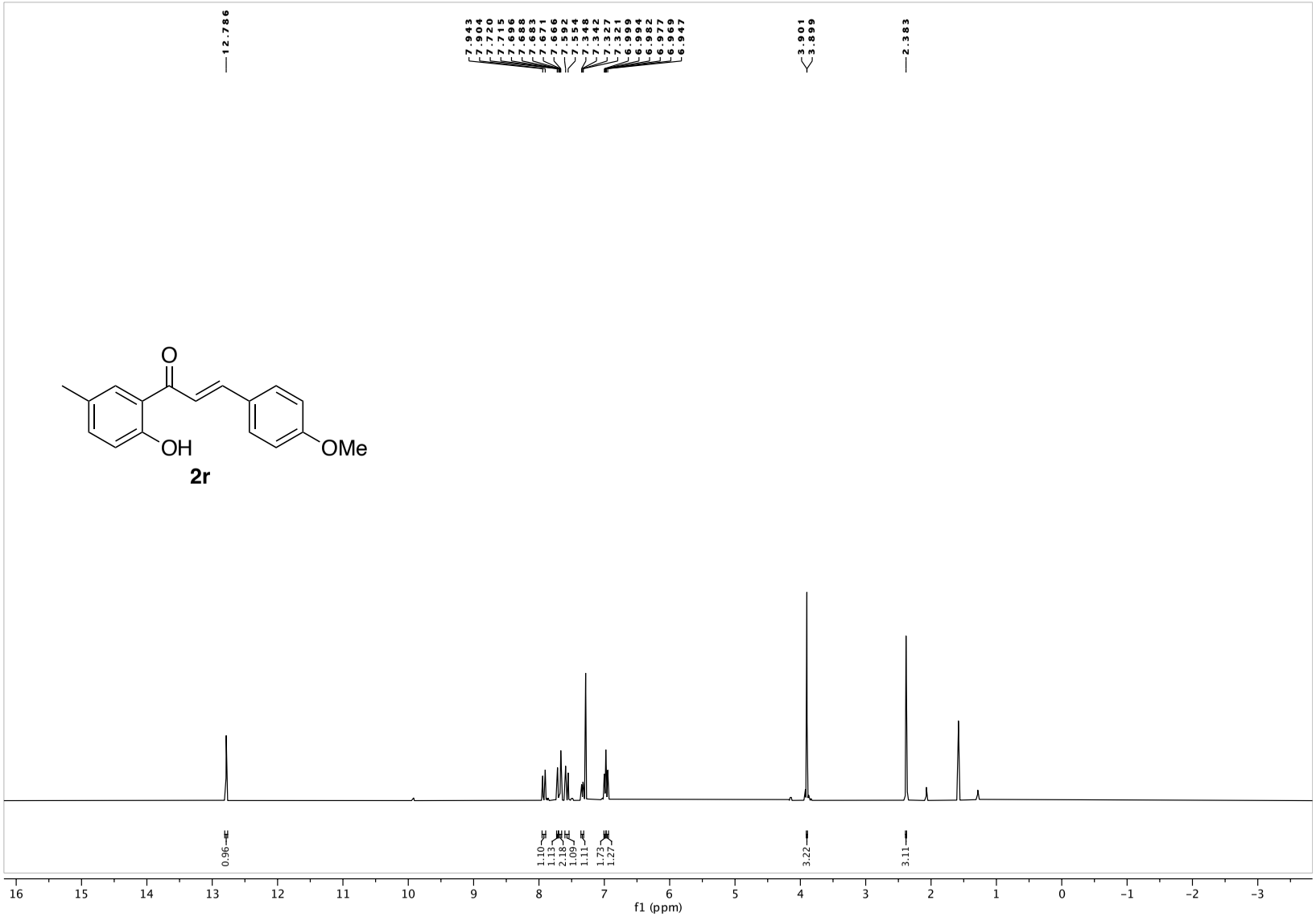
130.238
127.904
125.051
114.355
111.898
110.788
101.520
55.827
55.316
OMe O
OH
OMe
2p
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.671
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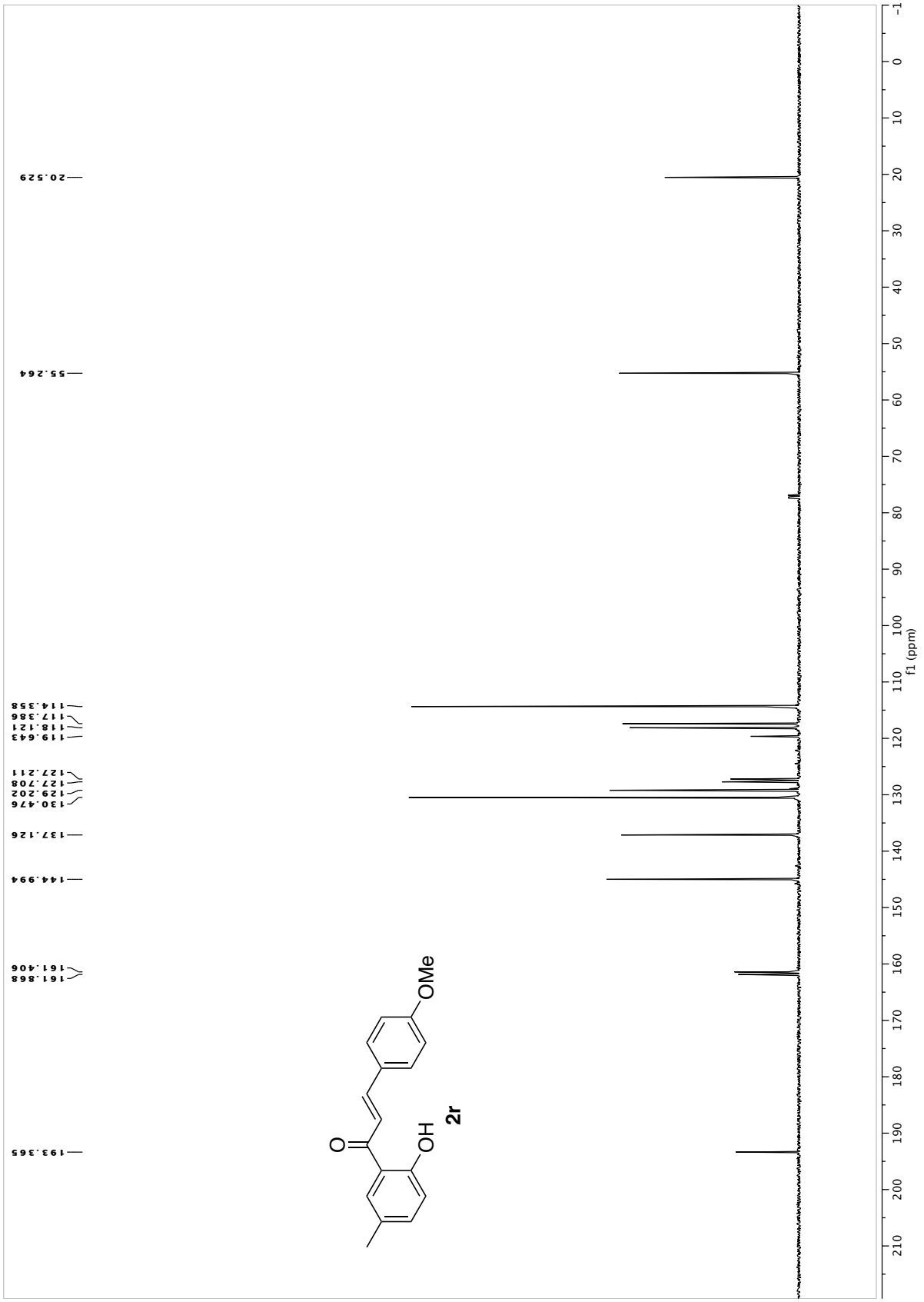
7.592
7.554
7.348
7.342
7.327
7.321
6.999
6.994
6.982
6.977
6.969
6.947
3.901
3.899
2.383
O
OH
OMe
2r
0.96
1.10
1.13
2.18
1.09
1.11
1.73
1.27
3.22
3.11
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)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129.202
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127.211
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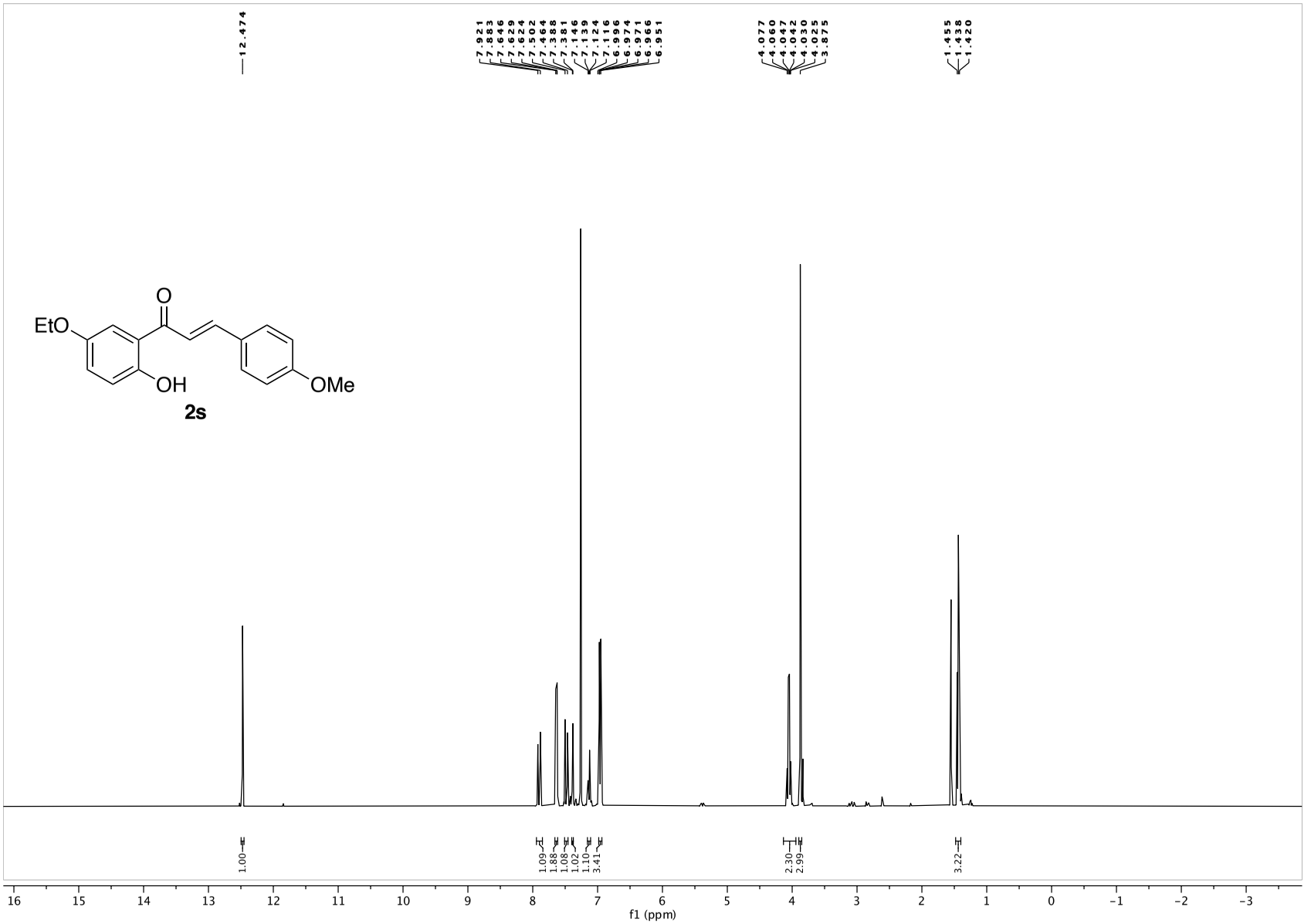
118.121
117.386
114.358
55.264
20.529
OMe
OH
O
2r
f1 (ppm)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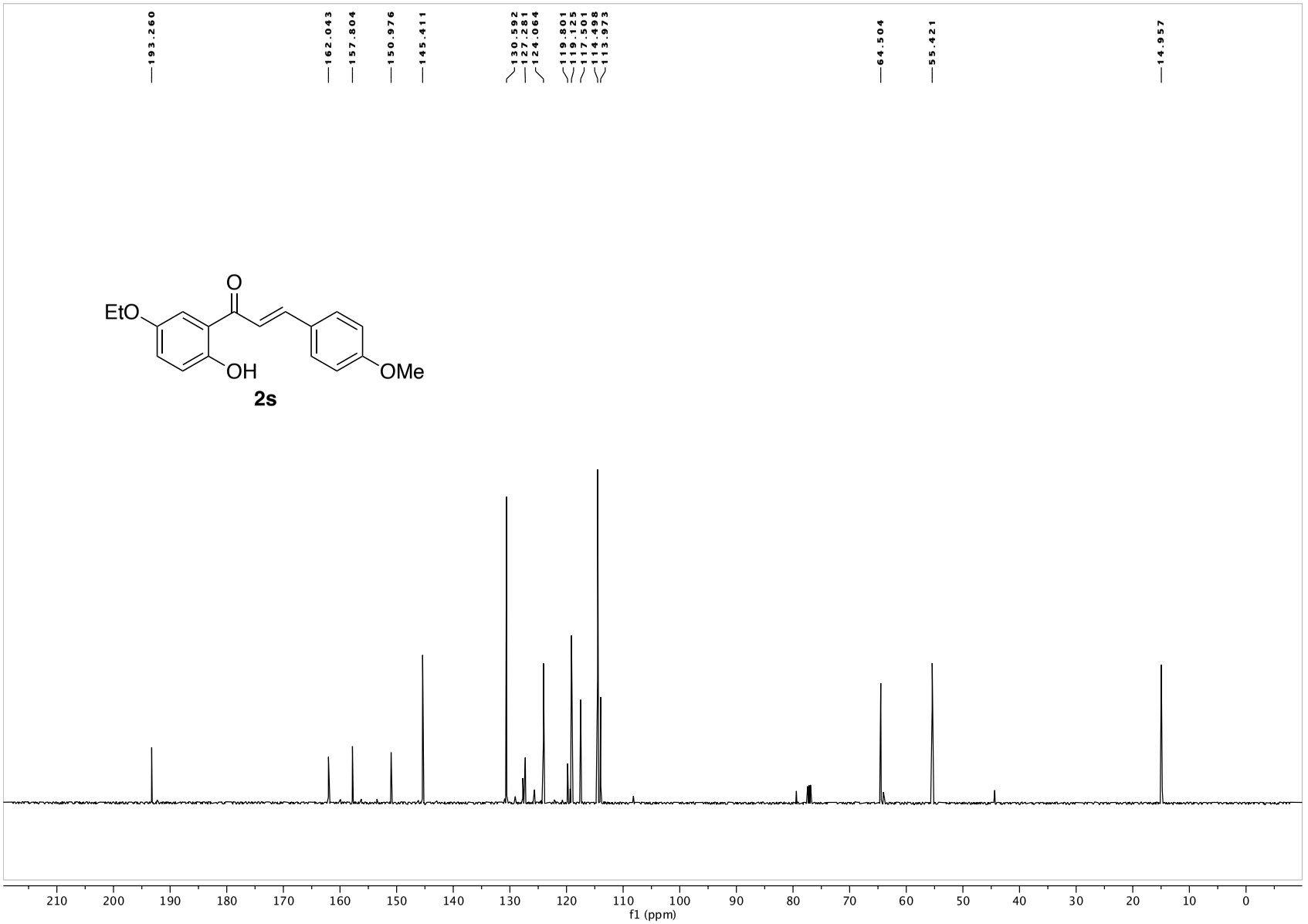
7.502
7.464
7.388
7.381
7.146
7.139
7.124
7.116
6.996
6.974
6.971
6.966
6.951
4.077
4.060
4.047
4.042
4.030
4.025
3.875
1.455
1.438
1.420
EtO
O
OH
OMe
2s
1.00
1.09
1.88
1.08
1.02
1.10
3.41
2.30
2.99
3.22
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)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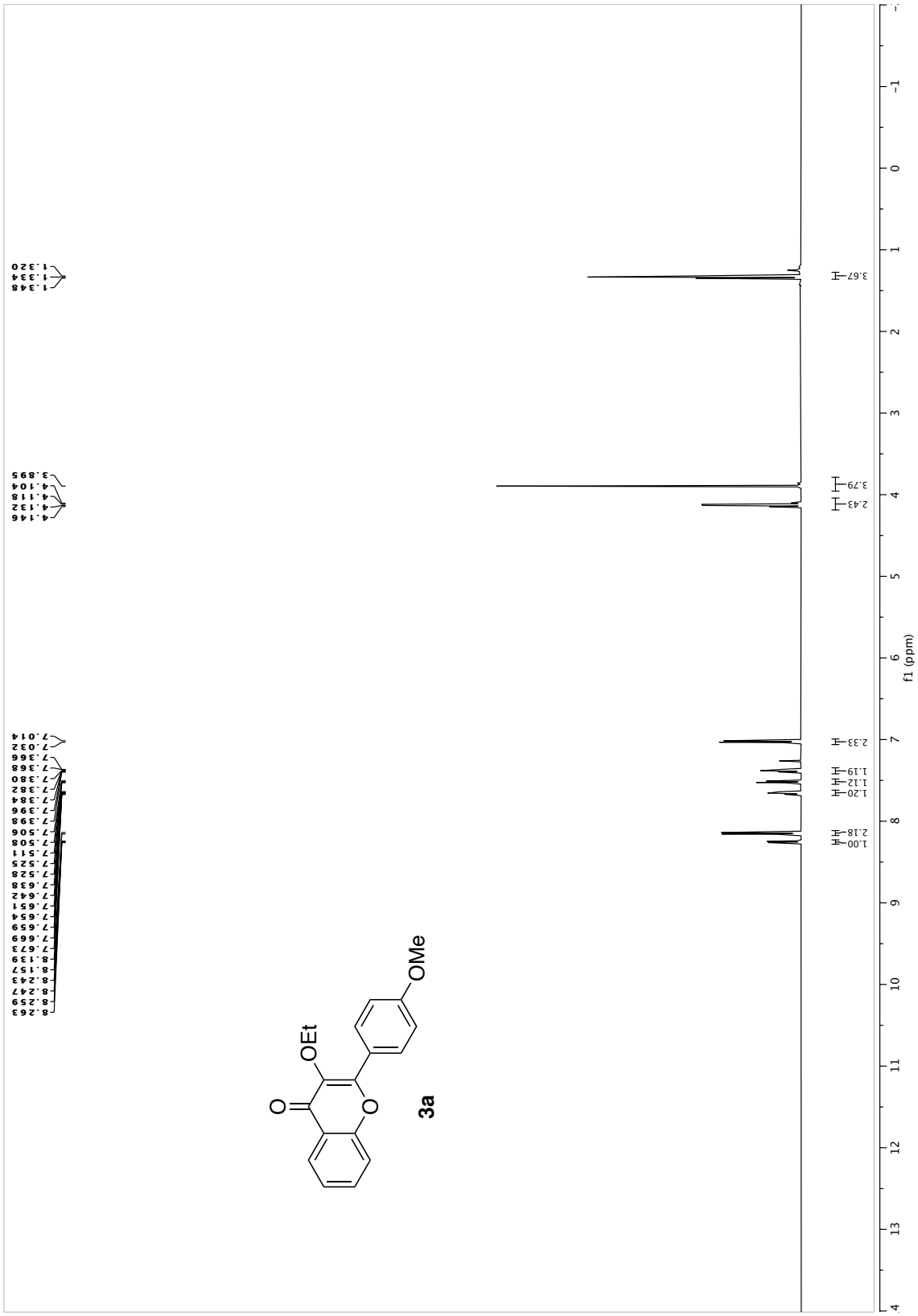
145.411
130.592
127.281
124.064
119.801
119.125
117.501
114.498
113.973
64.504
55.421
14.957
O
EtO
OH
OMe
2s
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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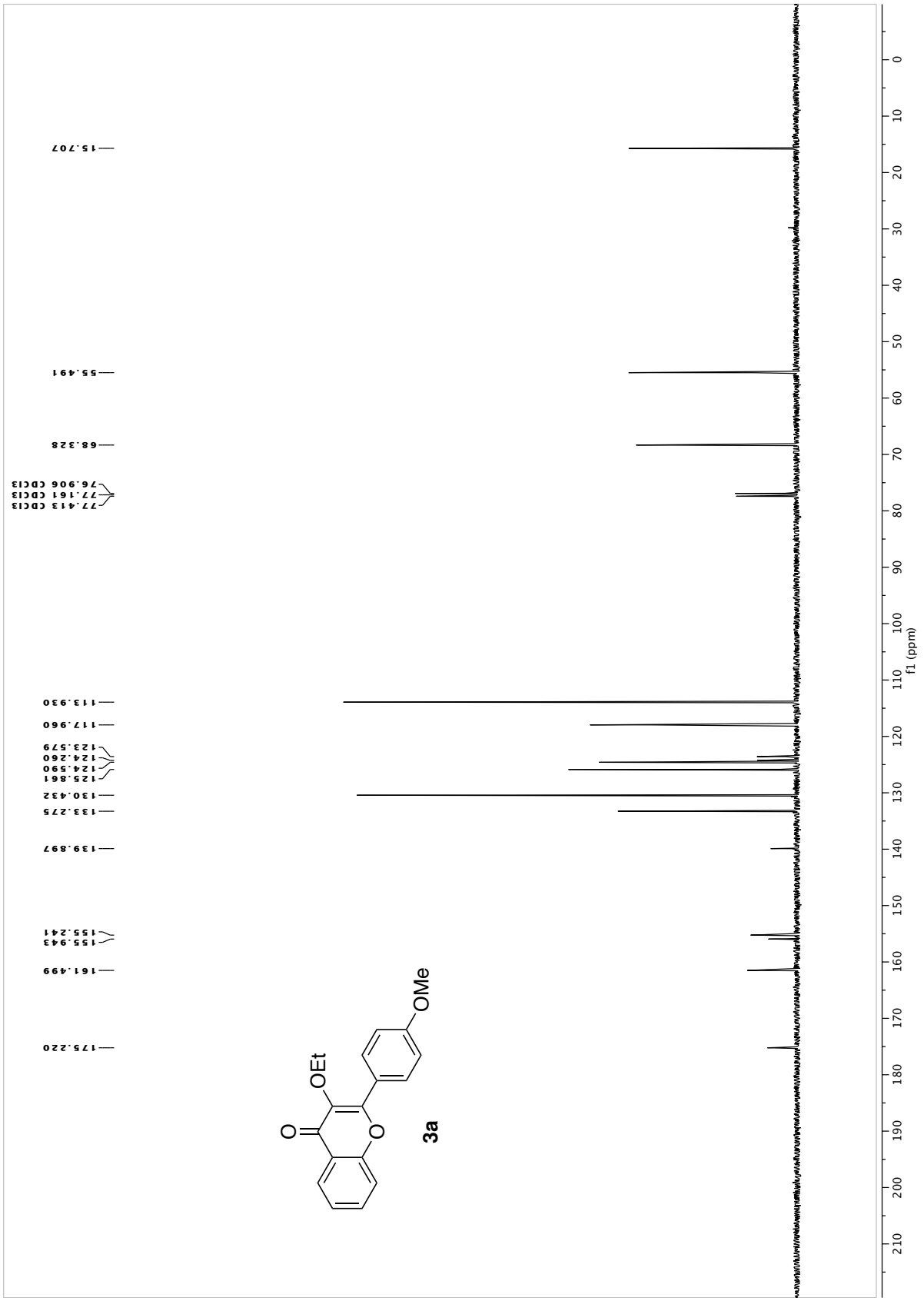
8.247
8.243
8.157
8.139
7.673
7.669
7.659
7.654
7.651
7.642
7.638
7.528
7.525
7.511
7.508
7.506
7.398
7.396
7.384
7.382
7.380
7.368
7.366
7.032
7.014
4.146
4.132
4.118
4.104
3.895
1.348
1.334
1.320
OEt
OMe
O
O
3a
1.00
2.18
1.20
1.12
1.19
2.33
2.43
3.79
3.67
f1 (ppm)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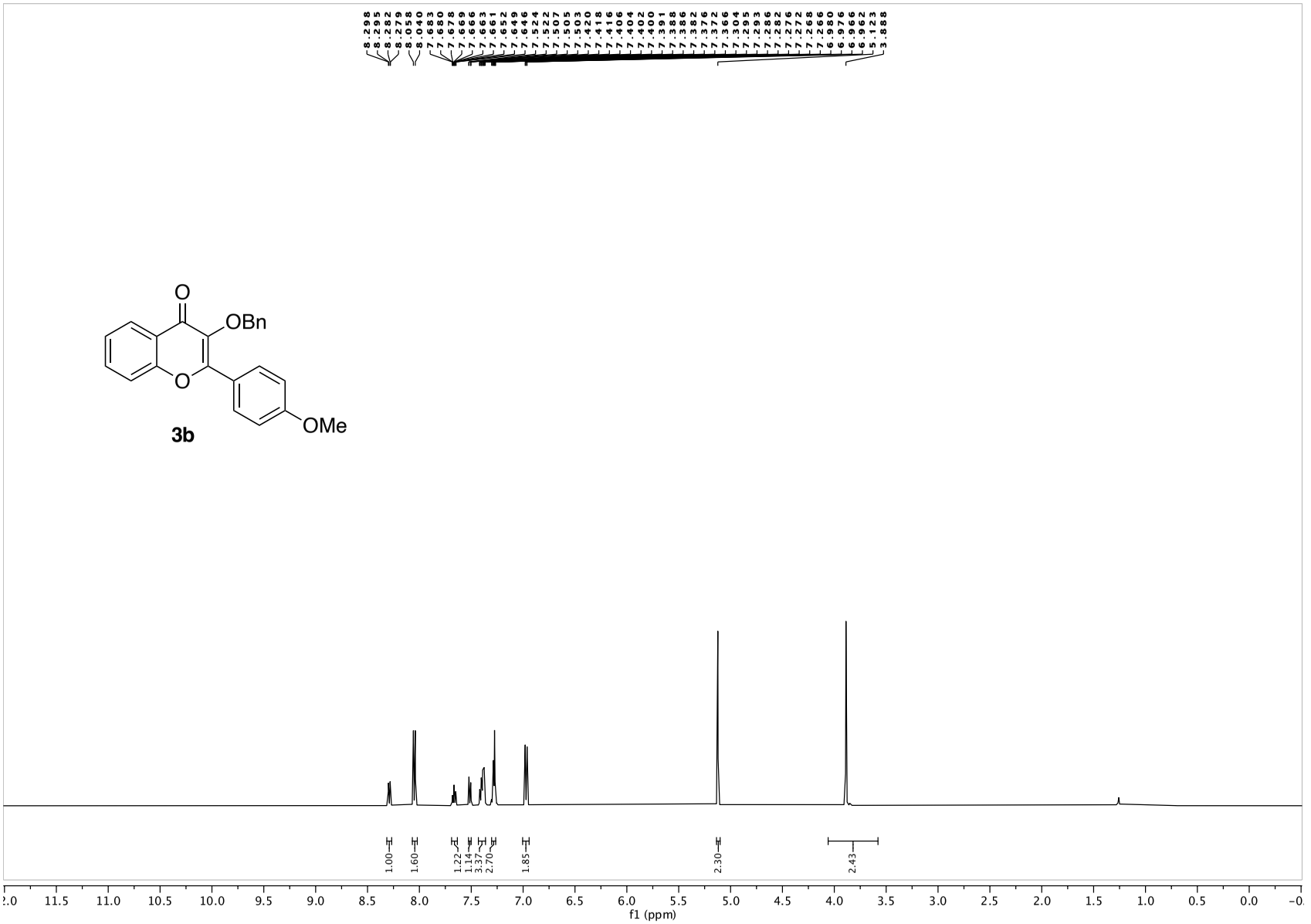
155.943
155.241
139.897
133.275
130.432
125.861
124.590
124.260
123.579
117.960
113.930
77.413 CDCl3
77.161 CDCl3
76.906 CDCl3
68.328
55.491
15.707
OEt
OMe
O
O
3a
f1 (ppm)


8.298
8.295
8.282
8.279
8.058
8.040
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7.680
7.678
7.669
7.666
7.661
7.652
7.648
7.646
7.524
7.522
7.507
7.505
7.503
7.420
7.418
7.416
7.406
7.404
7.402
7.400
7.391
7.388
7.386
7.382
7.376
7.372
7.366
7.304
7.295
7.293
7.286
7.282
7.276
7.272
7.268
7.266
6.980
6.976
6.966
6.962
5.123
3.888
O
OBn
O
OMe
3b
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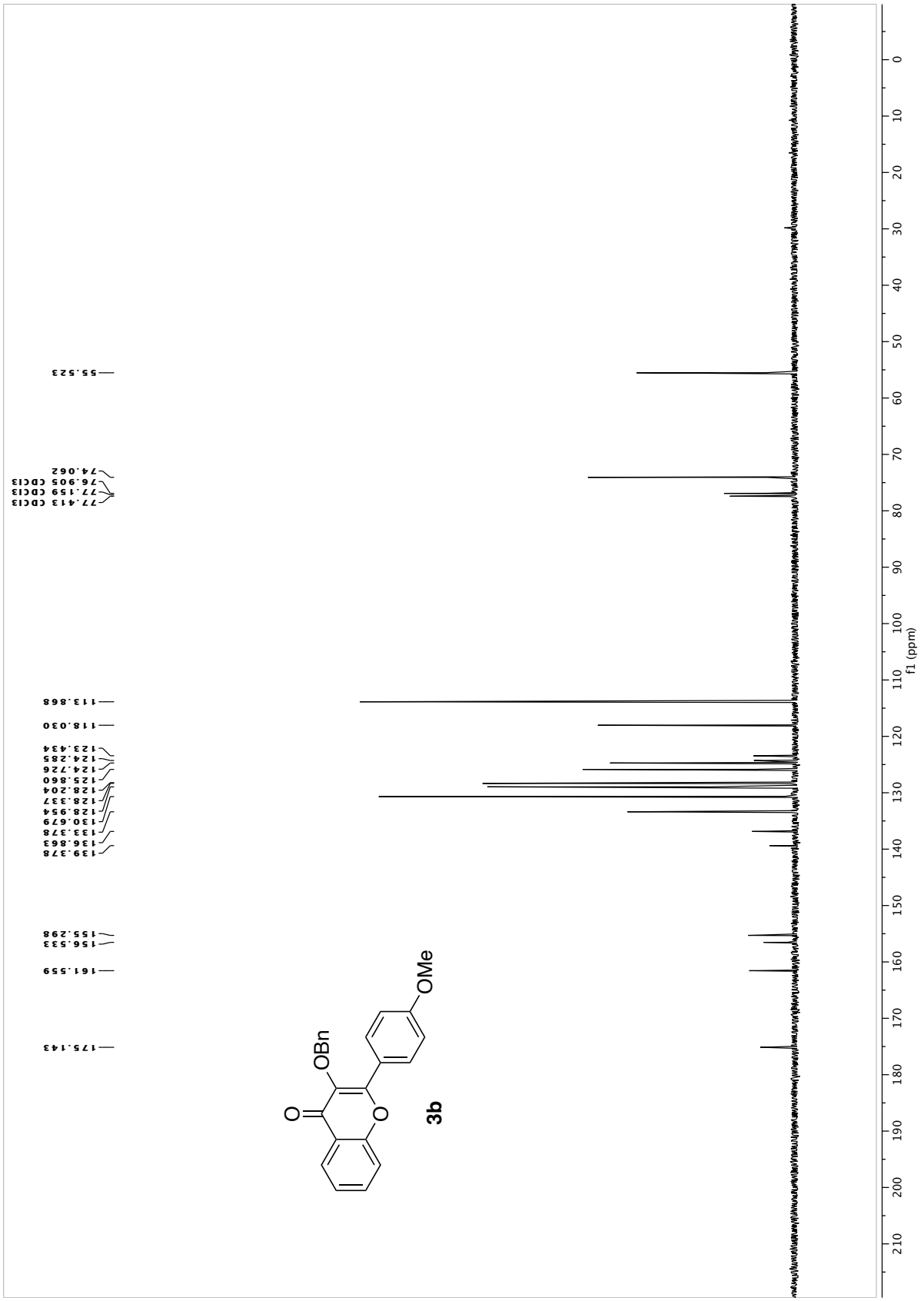
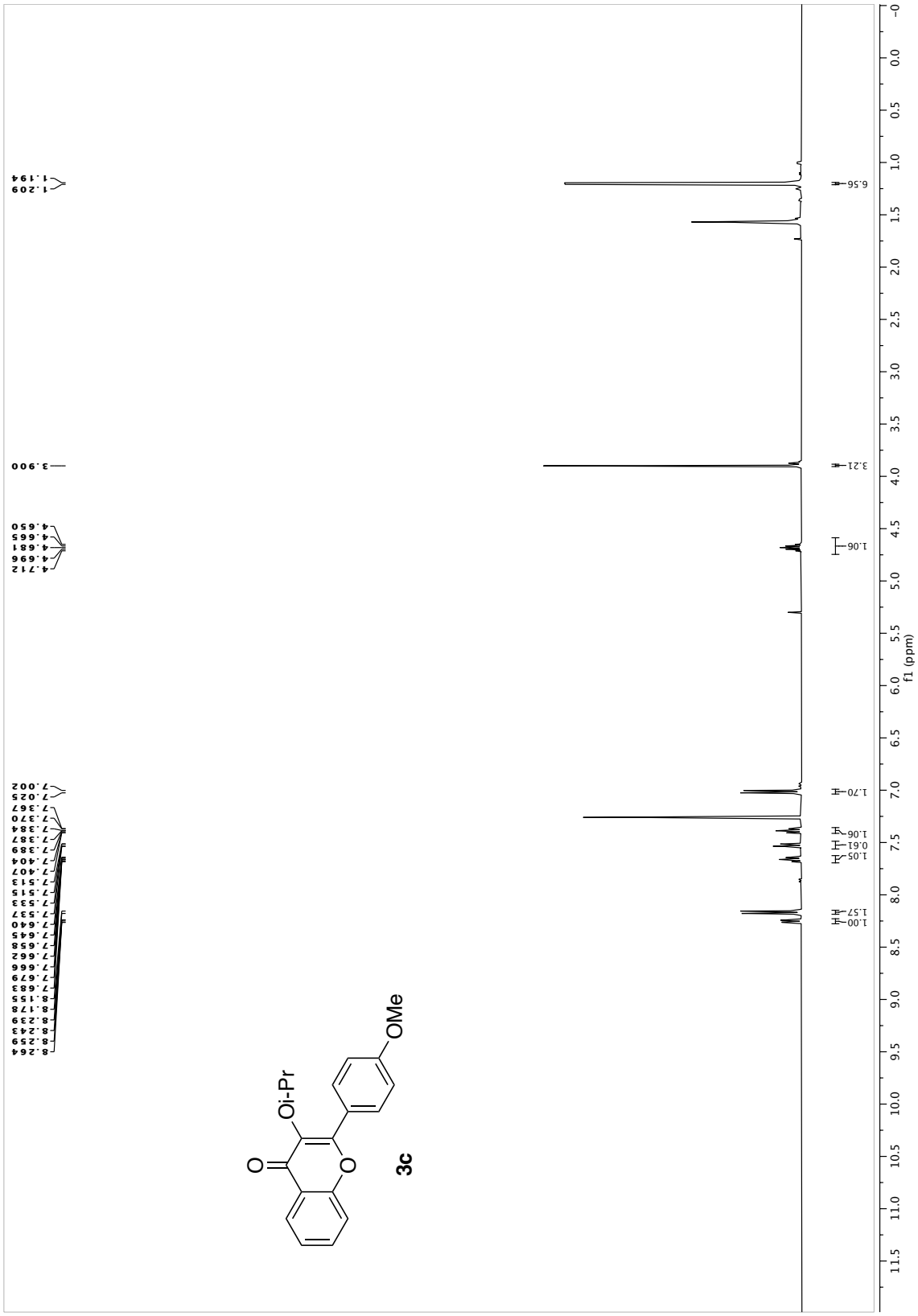
1.22
1.14
3.37
2.70
1.85
2.30
2.43
f1 (ppm)


175.143
161.559
156.533
155.298
139.378
136.863
133.378
130.679
128.954
128.337
128.204
125.860
124.726
124.285
123.434
118.030
113.868
77.413 CDCl3
77.159 CDCl3
76.905 CDCl3
74.062
55.523
OBn
OMe
O
O
3b
f1 (ppm)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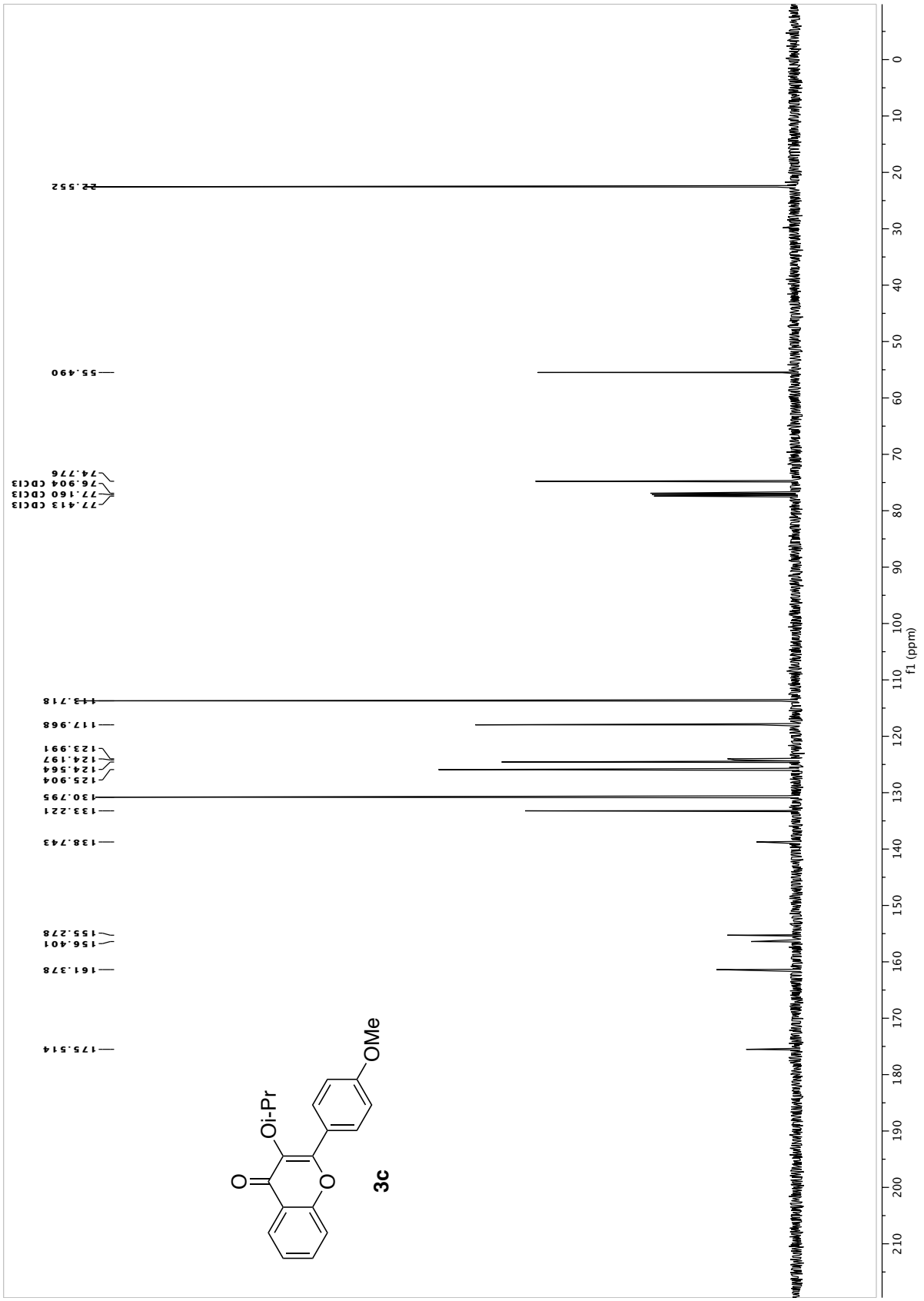
8.259
8.243
8.239
8.178
8.155
7.683
7.679
7.666
7.662
7.658
7.645
7.640
7.537
7.533
7.515
7.513
7.407
7.404
7.389
7.387
7.384
7.370
7.367
7.025
7.002
4.712
4.696
4.681
4.665
4.650
3.900
1.209
1.194
O
Oi-Pr
O
OMe
3c
1.00
1.57
1.05
0.61
1.06
1.70
1.06
3.21
6.56
f1 (ppm)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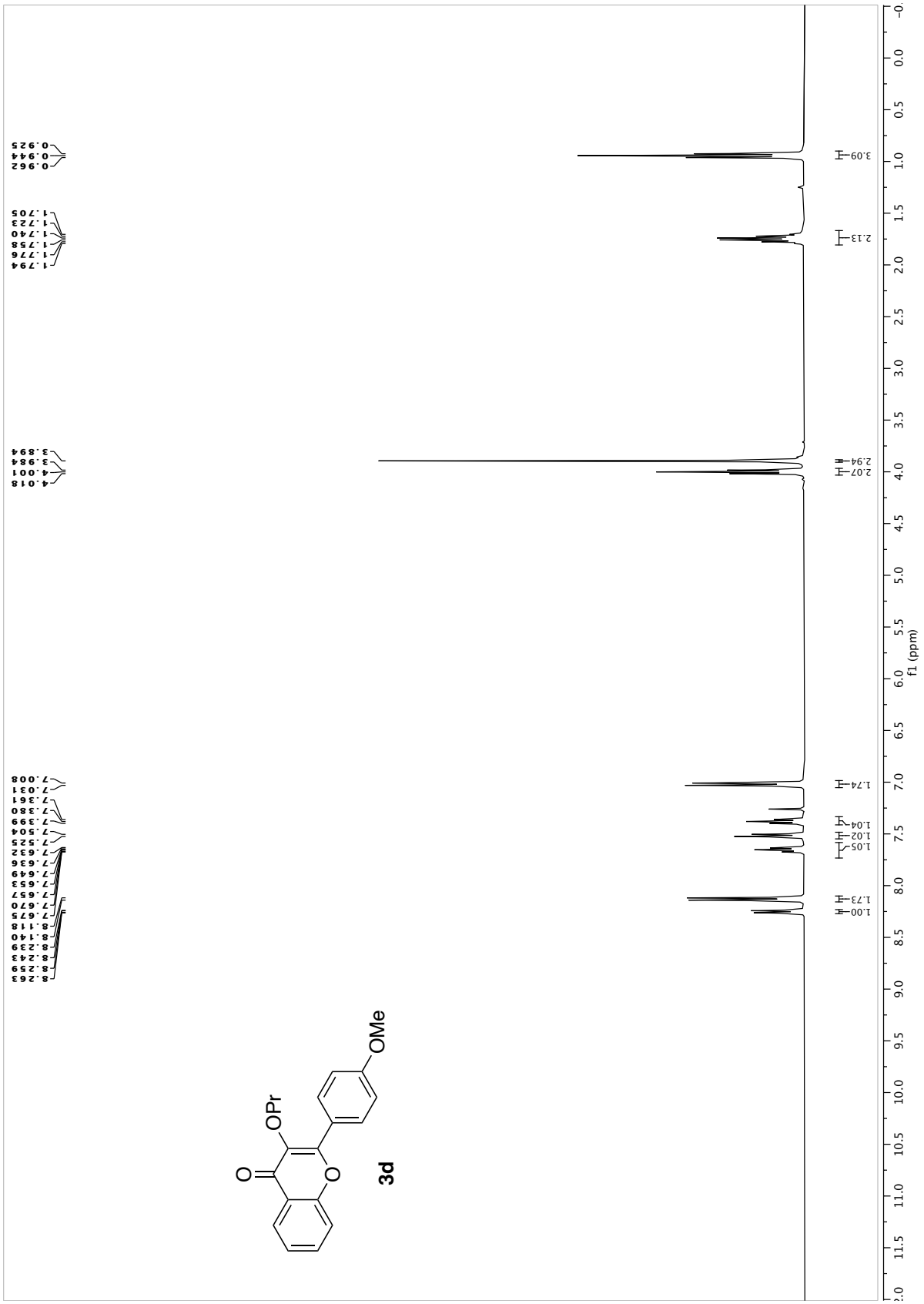
161.378
156.401
155.278
138.743
133.221
130.795
125.904
124.564
124.197
123.991
117.968
113.718
77.413 CDCl3
77.160 CDCl3
76.904 CDCl3
74.776
55.490
22.552
Oi-Pr
OMe
O
O
3c
f1 (ppm)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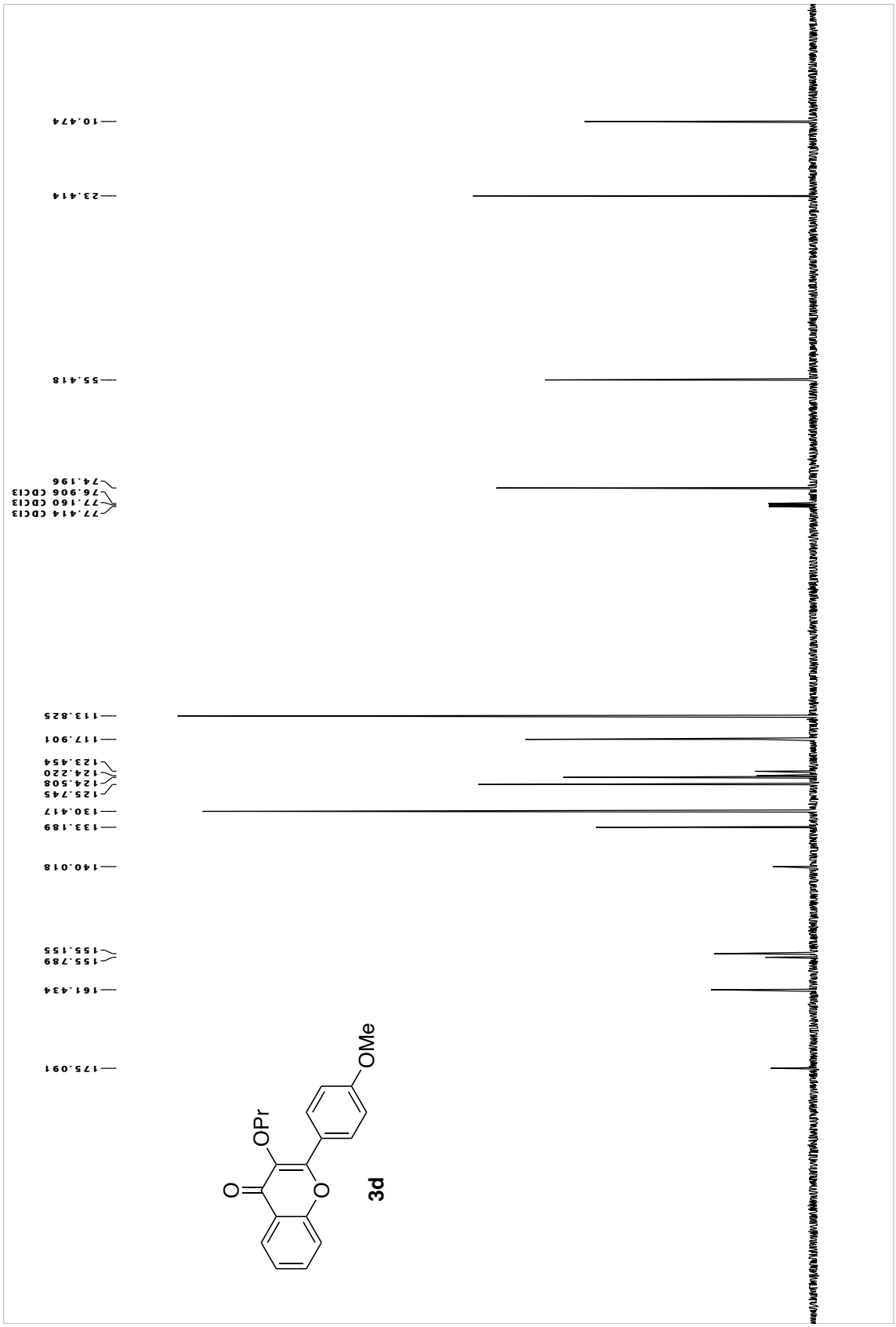
8.243
8.239
8.140
8.118
7.675
7.670
7.657
7.653
7.649
7.636
7.632
7.525
7.504
7.399
7.380
7.361
7.031
7.008
4.018
4.001
3.984
3.894
1.794
1.776
1.758
1.740
1.723
1.705
0.962
0.944
0.925
1.00
1.73
1.05
1.02
1.04
1.74
2.07
2.94
2.13
3.09
f1 (ppm)
OPr
OMe
O
O
3d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55.418
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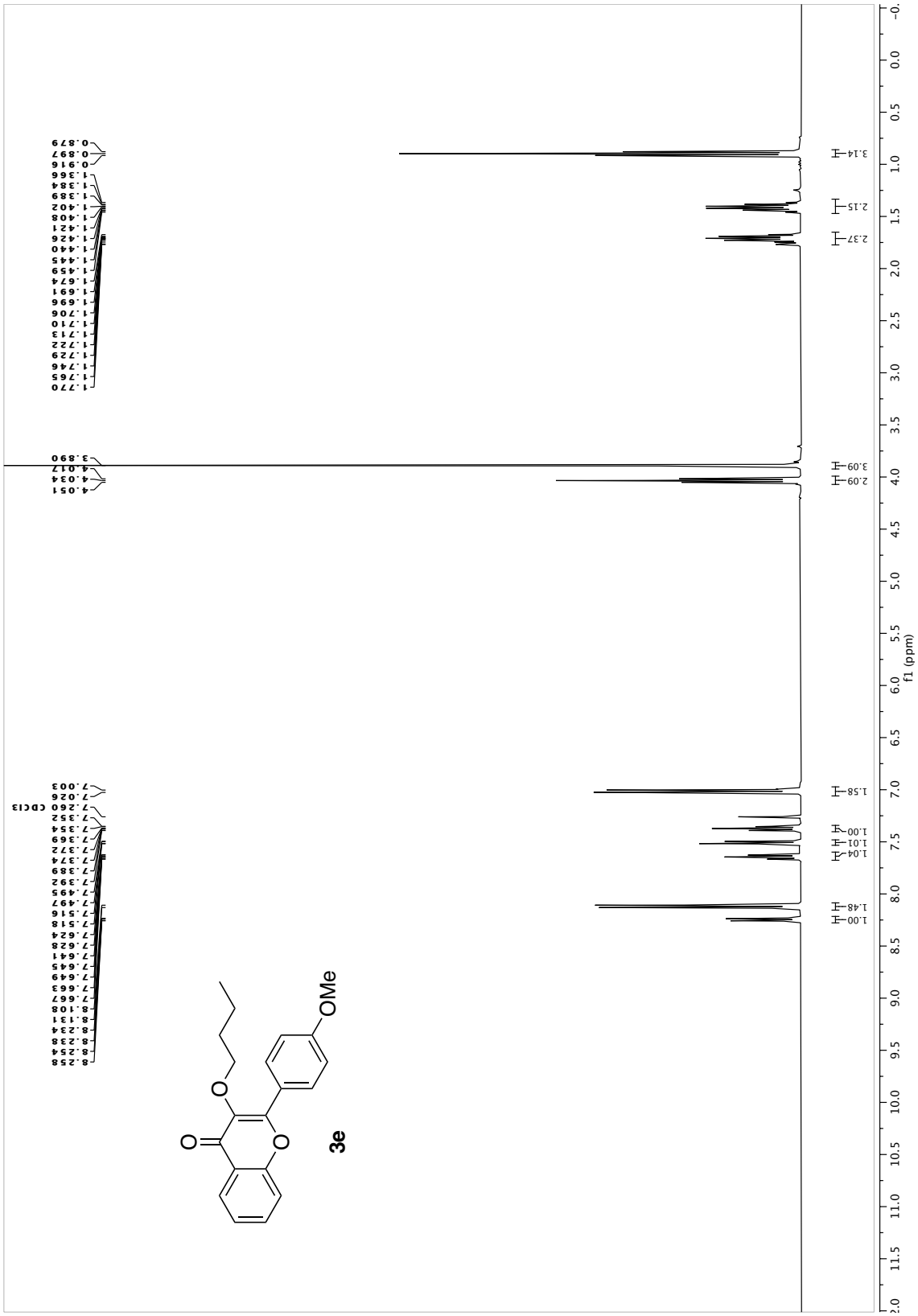
76.906 CDCl3
77.160 CDCl3
77.414 CDCl3
113.825
117.901
123.454
124.220
124.508
125.745
130.417
133.189
140.018
155.155
155.789
161.434
175.091
OMe
OPr
O
O
3d
f1 (ppm)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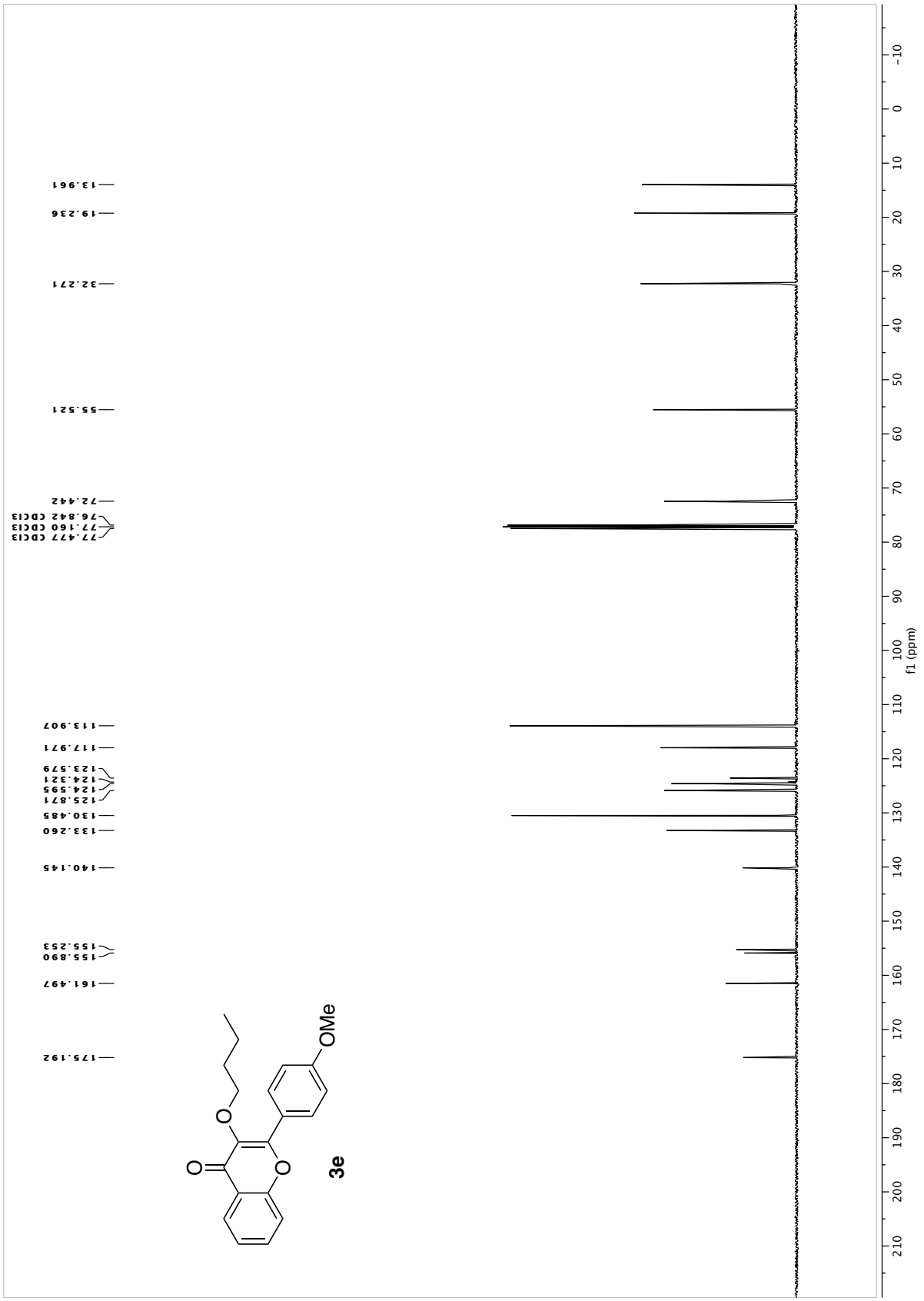
8.254
8.238
8.234
8.131
8.108
7.667
7.663
7.649
7.645
7.641
7.628
7.624
7.518
7.516
7.497
7.495
7.392
7.389
7.374
7.372
7.369
7.354
7.352
7.260 CDCl3
7.026
7.003
4.051
4.034
4.017
3.890
1.770
1.765
1.746
1.729
1.722
1.713
1.710
1.706
1.696
1.691
1.674
1.459
1.445
1.440
1.426
1.421
1.408
1.402
1.389
1.384
1.366
0.916
0.897
0.879
1.00
1.48
1.00
1.04
1.01
1.00
1.58
3.09
2.09
3.09
2.37
2.15
3.14
OMe
O
O
O
3e
f1 (ppm)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32.271
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72.442
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77.160 CDCl3
77.477 CDCl3
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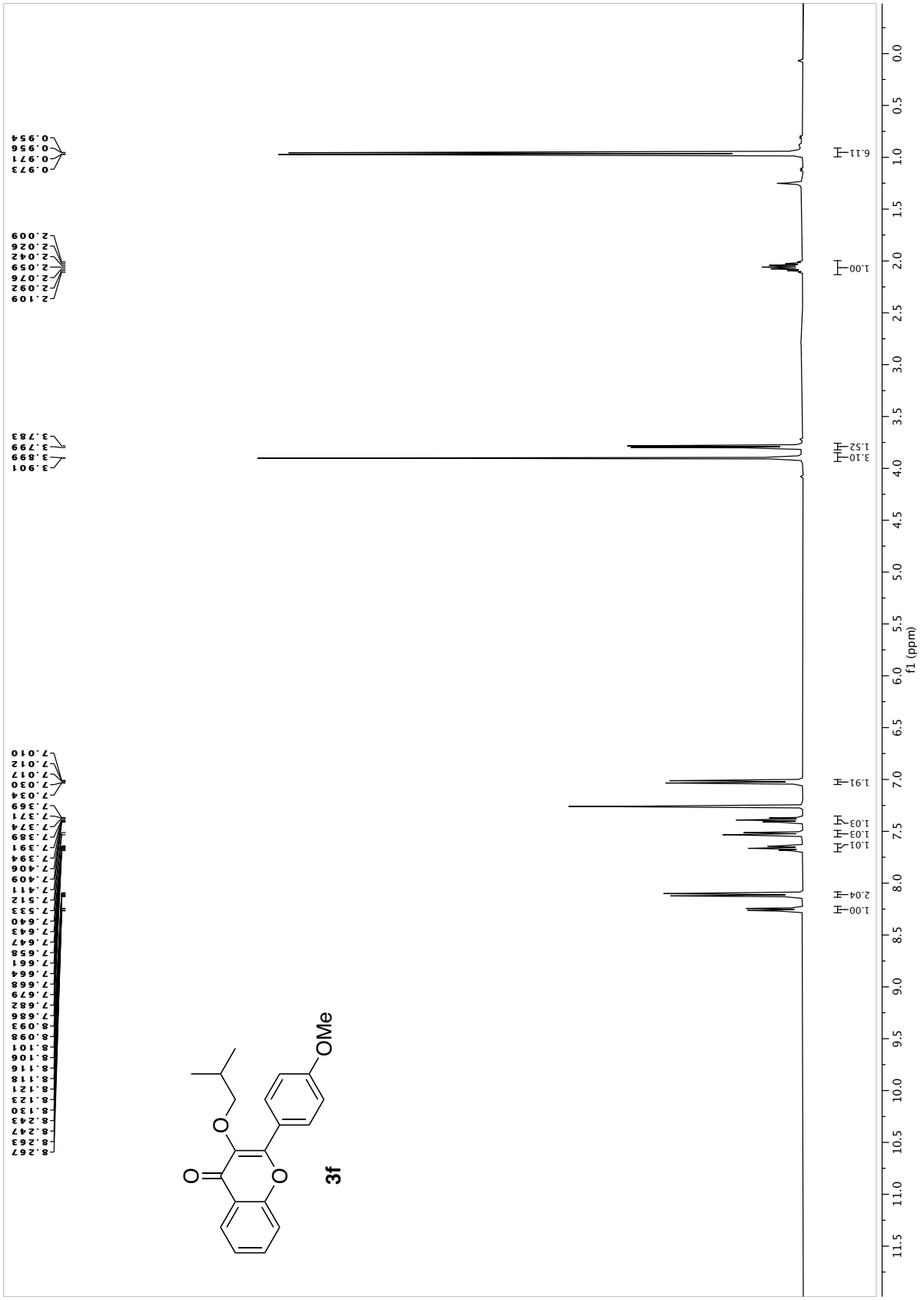
117.971
123.579
124.321
124.595
125.871
130.485
133.260
140.145
155.253
155.890
161.497
175.192
OMe
O
O
O
3e
f1 (ppm)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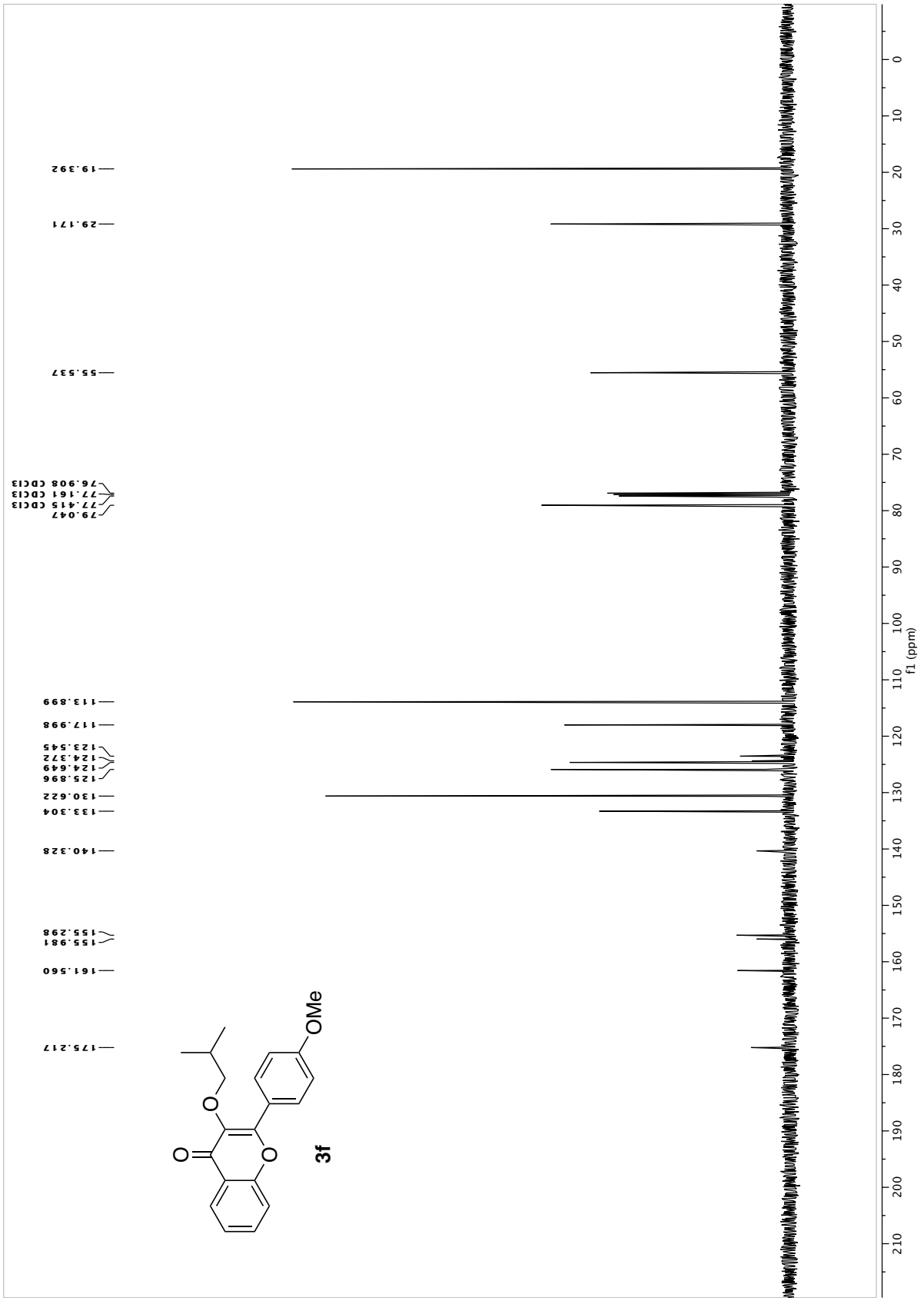
8.123
8.121
8.118
8.116
8.106
8.101
8.098
8.093
7.686
7.682
7.679
7.668
7.664
7.661
7.658
7.647
7.643
7.640
7.533
7.512
7.411
7.409
7.406
7.394
7.391
7.389
7.374
7.371
7.369
7.034
7.030
7.017
7.012
7.010
3.901
3.899
3.799
3.783
2.109
2.092
2.076
2.059
2.042
2.026
2.009
0.973
0.971
0.956
0.954
1.00
2.04
1.03
1.03
1.01
1.91
3.10
1.52
1.00
6.11
OMe
O
O
O
3f
f1 (ppm)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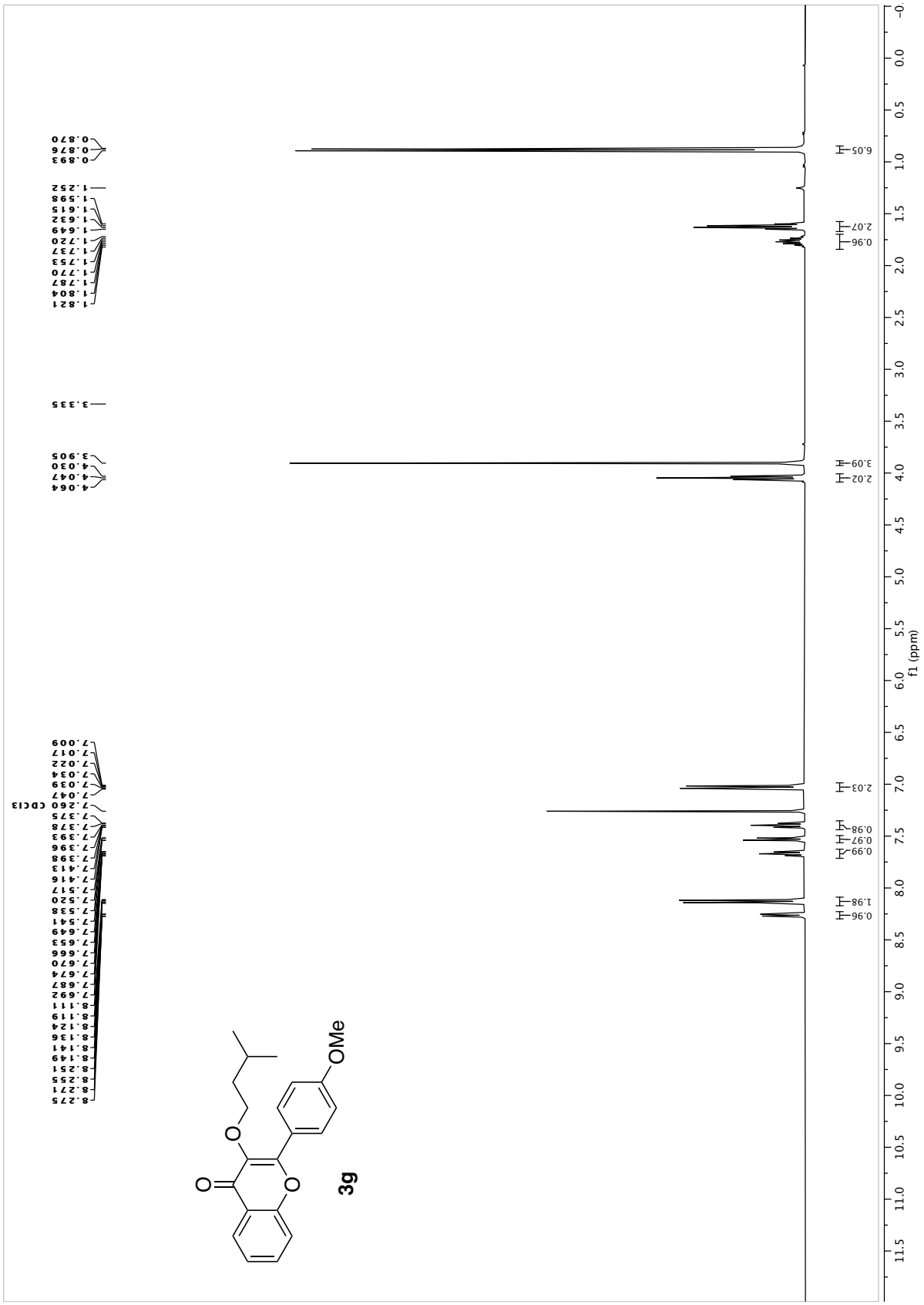
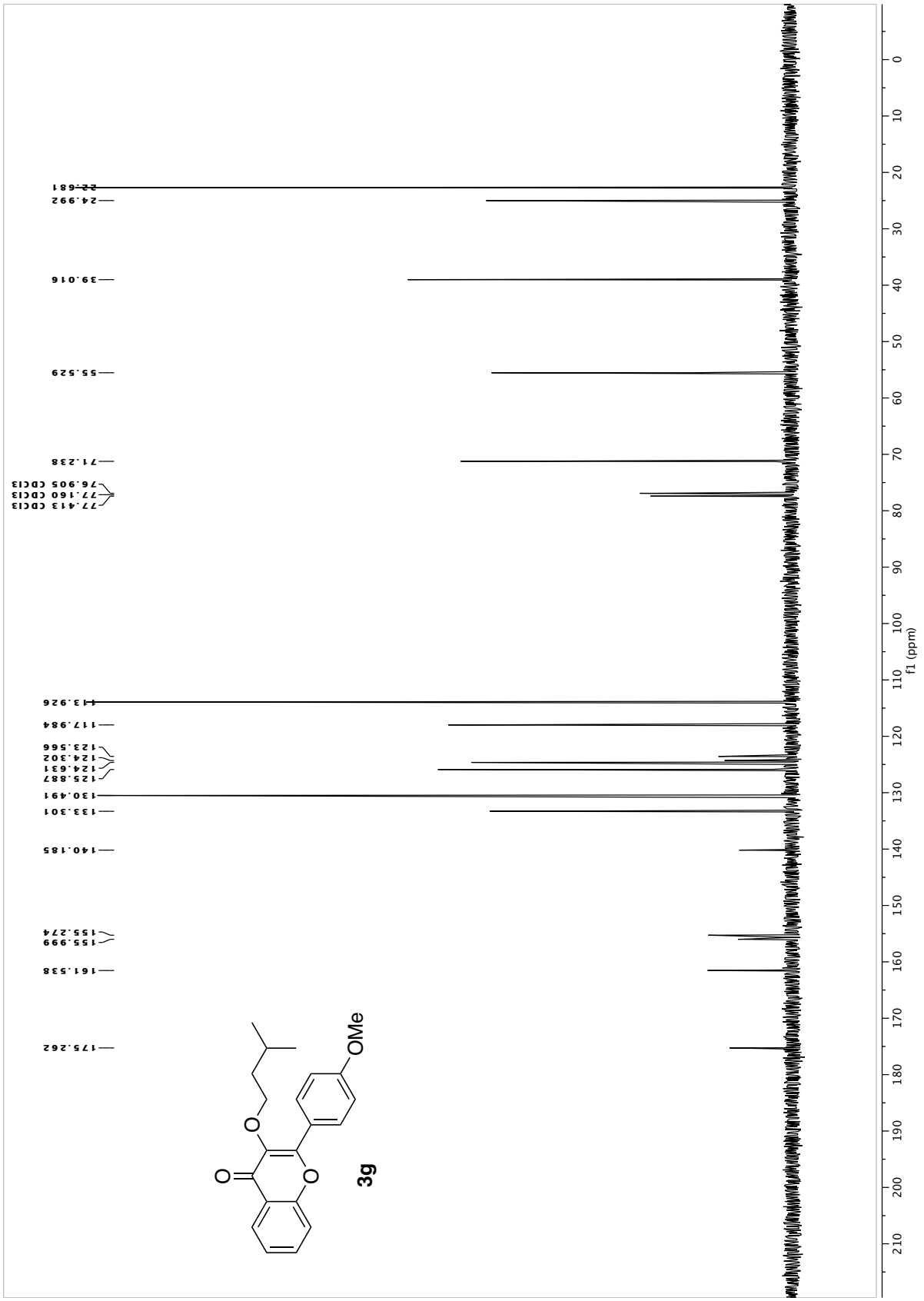
29.171
55.537
76.908 CDCl3
77.161 CDCl3
77.415 CDCl3
79.047
113.899
117.998
123.545
124.372
124.649
125.896
130.622
133.304
140.328
155.298
155.981
161.560
175.217
OMe
O
O
O
3f
f1 (ppm)


8.275
8.271
8.255
8.251
8.149
8.141
8.136
8.124
8.119
8.111
7.692
7.687
7.674
7.670
7.666
7.653
7.649
7.541
7.538
7.520
7.517
7.416
7.413
7.398
7.396
7.393
7.378
7.375
7.260 CDCl3
7.047
7.039
7.034
7.022
7.017
7.009
4.064
4.047
4.030
3.905
3.335
1.821
1.804
1.787
1.770
1.753
1.737
1.720
1.649
1.632
1.615
1.598
1.252
0.893
0.876
0.870
6.05
2.07
0.96
2.02
3.09
2.03
0.98
0.97
0.99
1.98
0.96
OMe
O
O
O
3g
f1 (ppm)


22.681
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39.016
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71.238
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77.160 CDCl3
77.413 CDCl3
113.926
117.984
123.566
124.302
124.631
125.887
130.491
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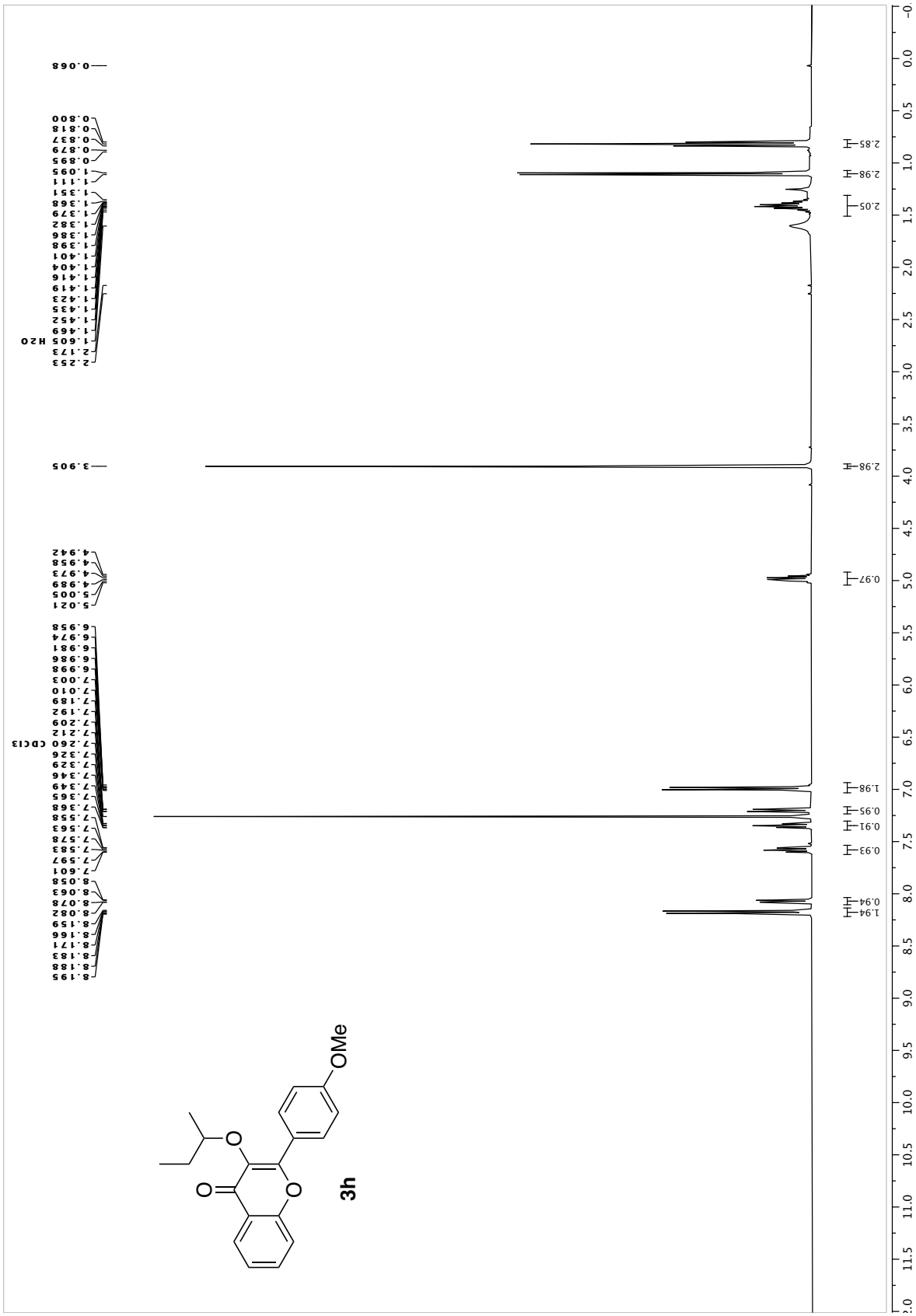
140.185
155.274
155.999
161.538
175.262
OMe
O
O
O
3g
f1 (ppm)


OMe
O
O
O
3h
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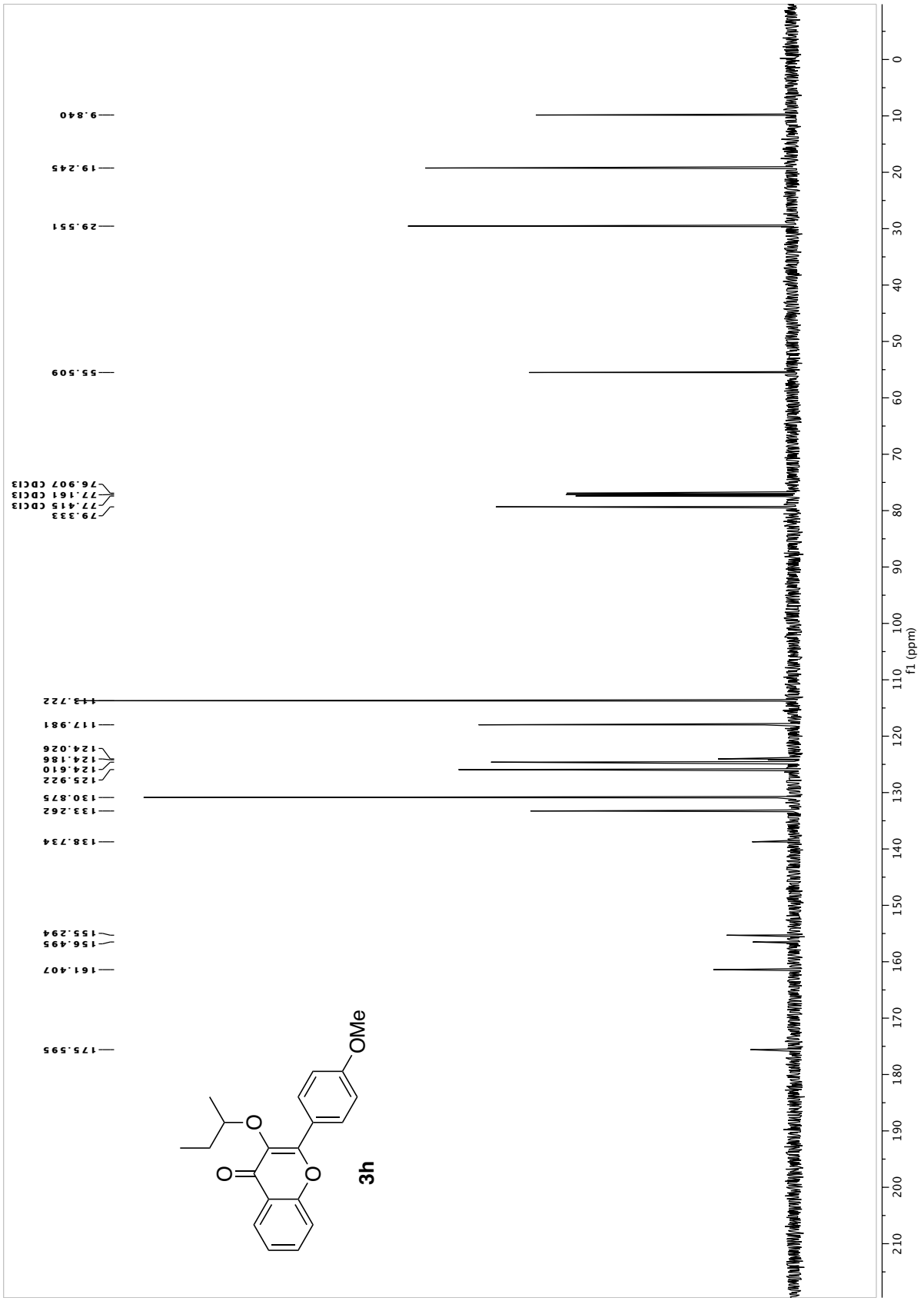
8.188
8.183
8.171
8.166
8.159
8.082
8.078
8.063
8.058
7.601
7.597
7.583
7.578
7.563
7.558
7.368
7.365
7.349
7.346
7.329
7.326
7.260 CDCl3
7.212
7.209
7.192
7.189
7.010
7.003
6.998
6.986
6.981
6.974
6.958
5.021
5.005
4.989
4.973
4.958
4.942
3.905
2.253
2.173
1.605 H2O
1.469
1.452
1.435
1.423
1.419
1.416
1.404
1.401
1.398
1.386
1.382
1.379
1.368
1.351
1.111
1.095
0.895
0.879
0.837
0.818
0.800
0.068
1.94
0.94
0.93
0.91
0.95
1.98
0.97
2.98
2.05
2.98
2.85
f1 (ppm)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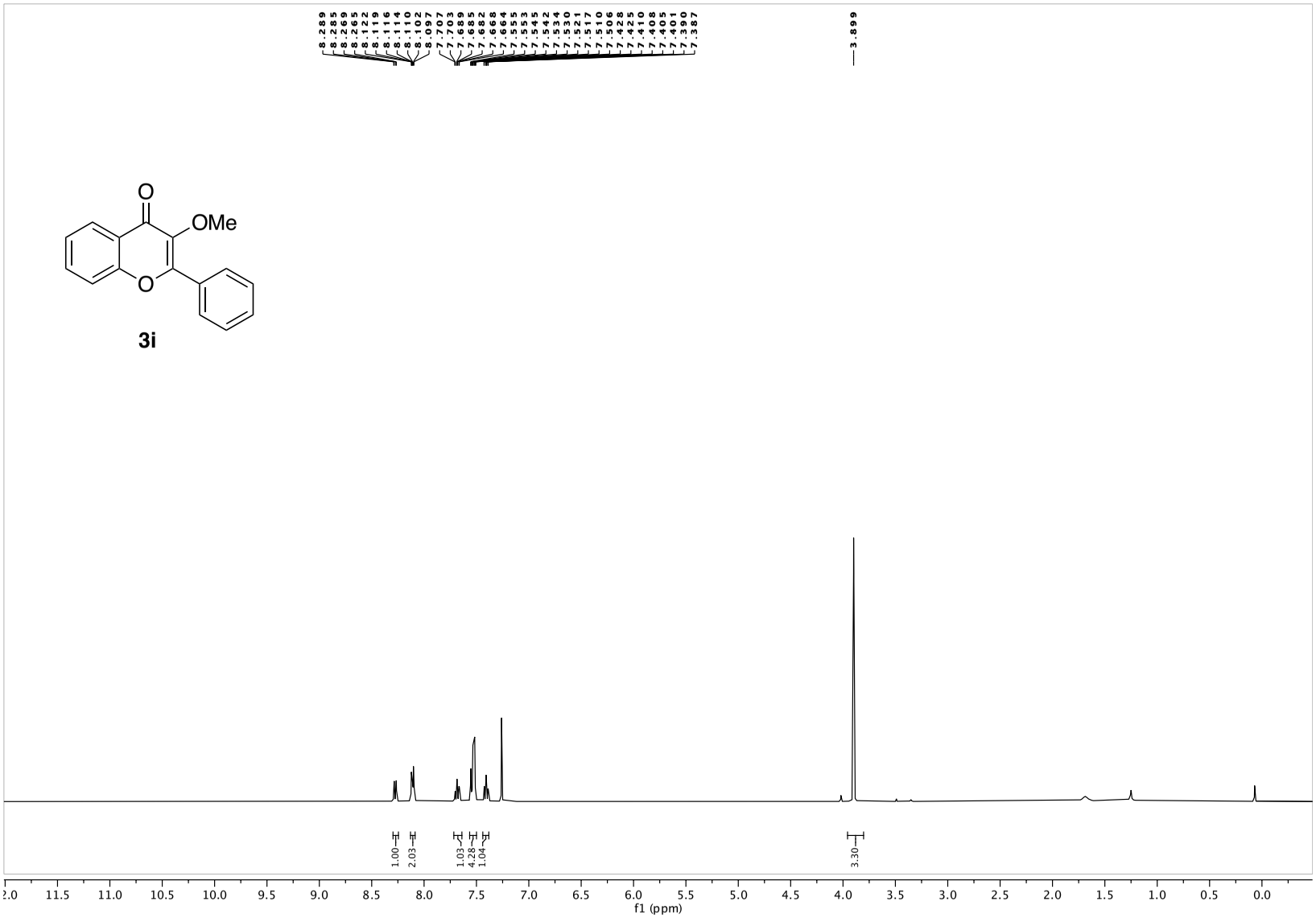
19.245
29.551
55.509
76.907 CDCl3
77.161 CDCl3
77.415 CDCl3
79.333
113.722
117.981
124.026
124.186
124.610
125.922
130.875
133.262
138.734
155.294
156.495
161.407
175.595
OMe
O
O
O
3h
f1 (ppm)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8.114
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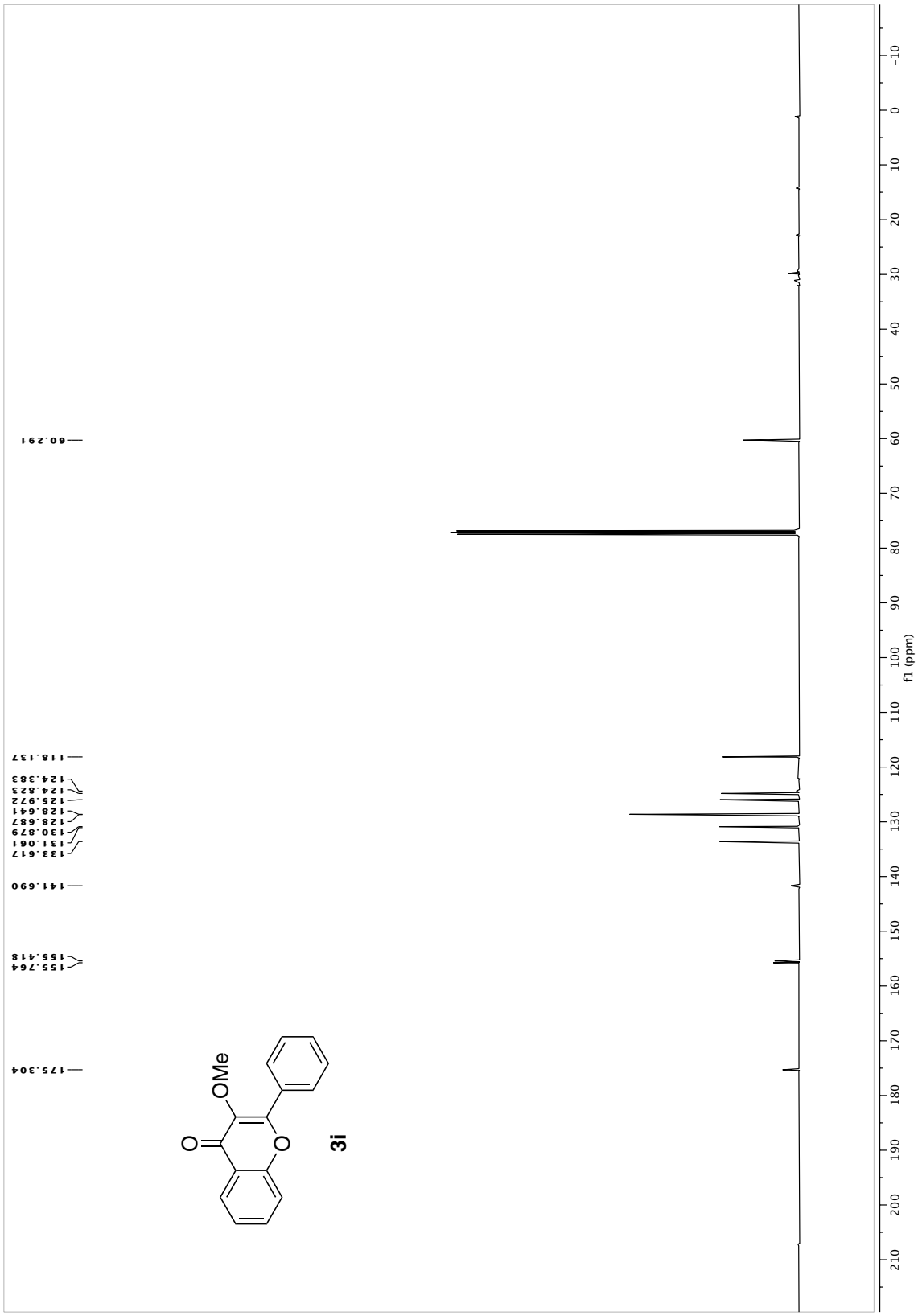
8.102
8.097
7.707
7.703
7.689
7.685
7.682
7.668
7.664
7.555
7.553
7.545
7.542
7.534
7.530
7.521
7.517
7.510
7.506
7.428
7.425
7.410
7.408
7.405
7.401
7.390
7.387
3.899
O
OMe
O
3i
1.00
2.03
1.03
4.28
1.04
3.30
f1 (ppm)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155.764
155.418
141.690
133.617
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130.879
128.687
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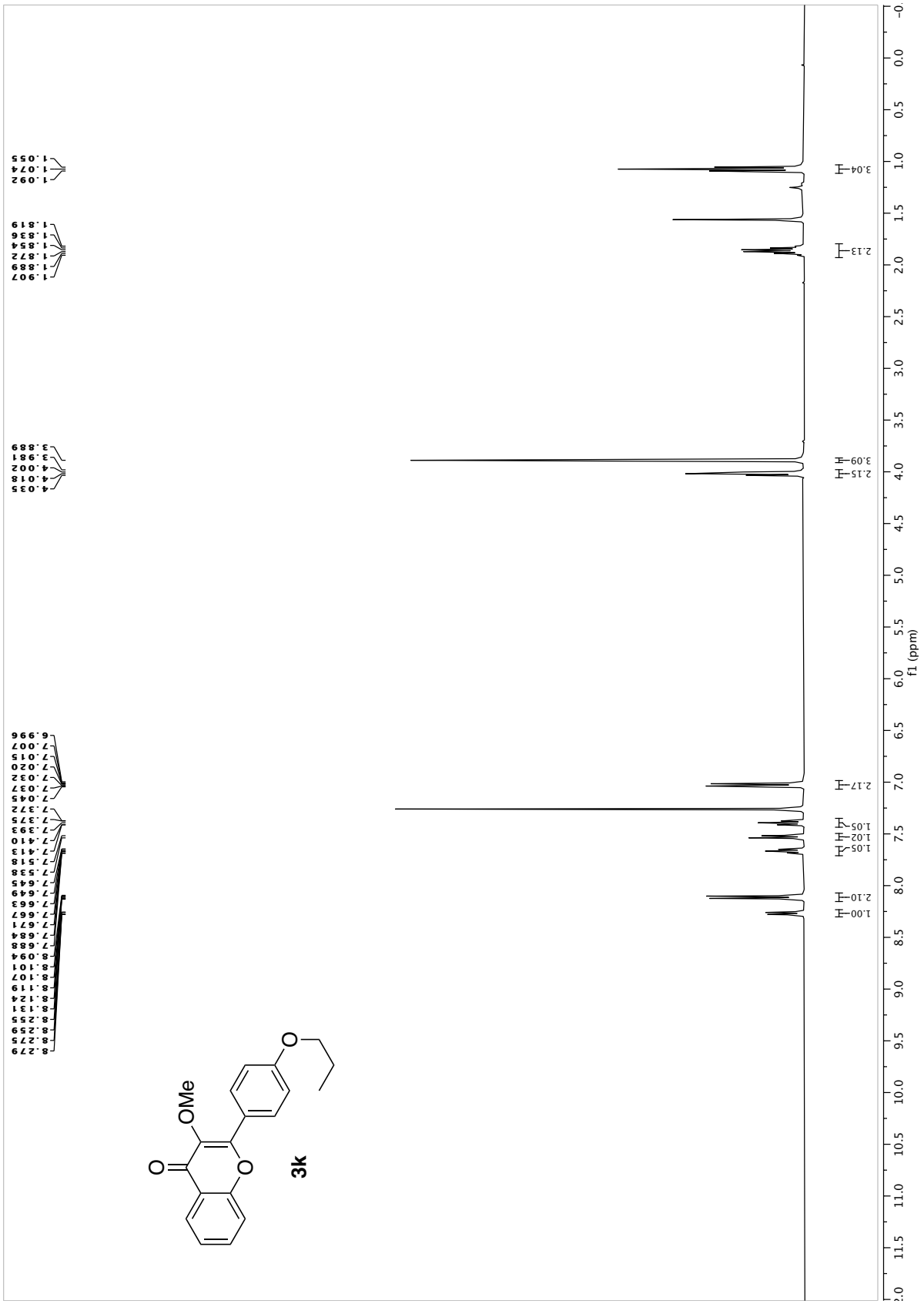
125.972
124.823
124.383
118.137
60.291
OMe
O
O
3i
f1 (ppm)


OMe
O
O
O
3k
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8.131
8.124
8.119
8.107
8.101
8.094
7.688
7.684
7.671
7.667
7.663
7.649
7.645
7.538
7.518
7.413
7.410
7.393
7.375
7.372
7.045
7.037
7.032
7.020
7.015
7.007
6.996
4.035
4.018
4.002
3.981
3.889
1.907
1.889
1.872
1.854
1.836
1.819
1.092
1.074
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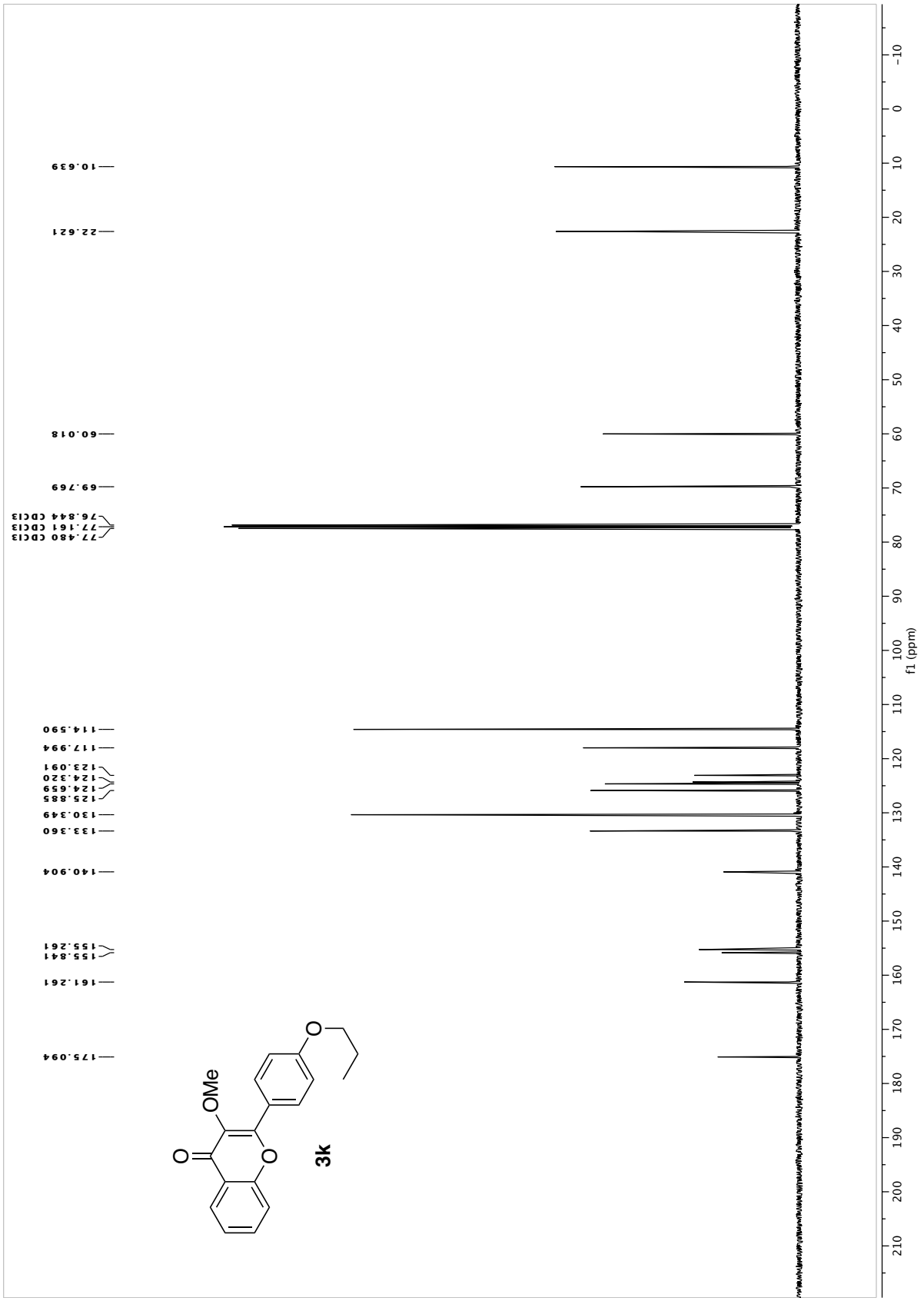
1.05
1.02
1.05
2.17
2.15
3.09
2.13
3.04
f1 (ppm)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155.261
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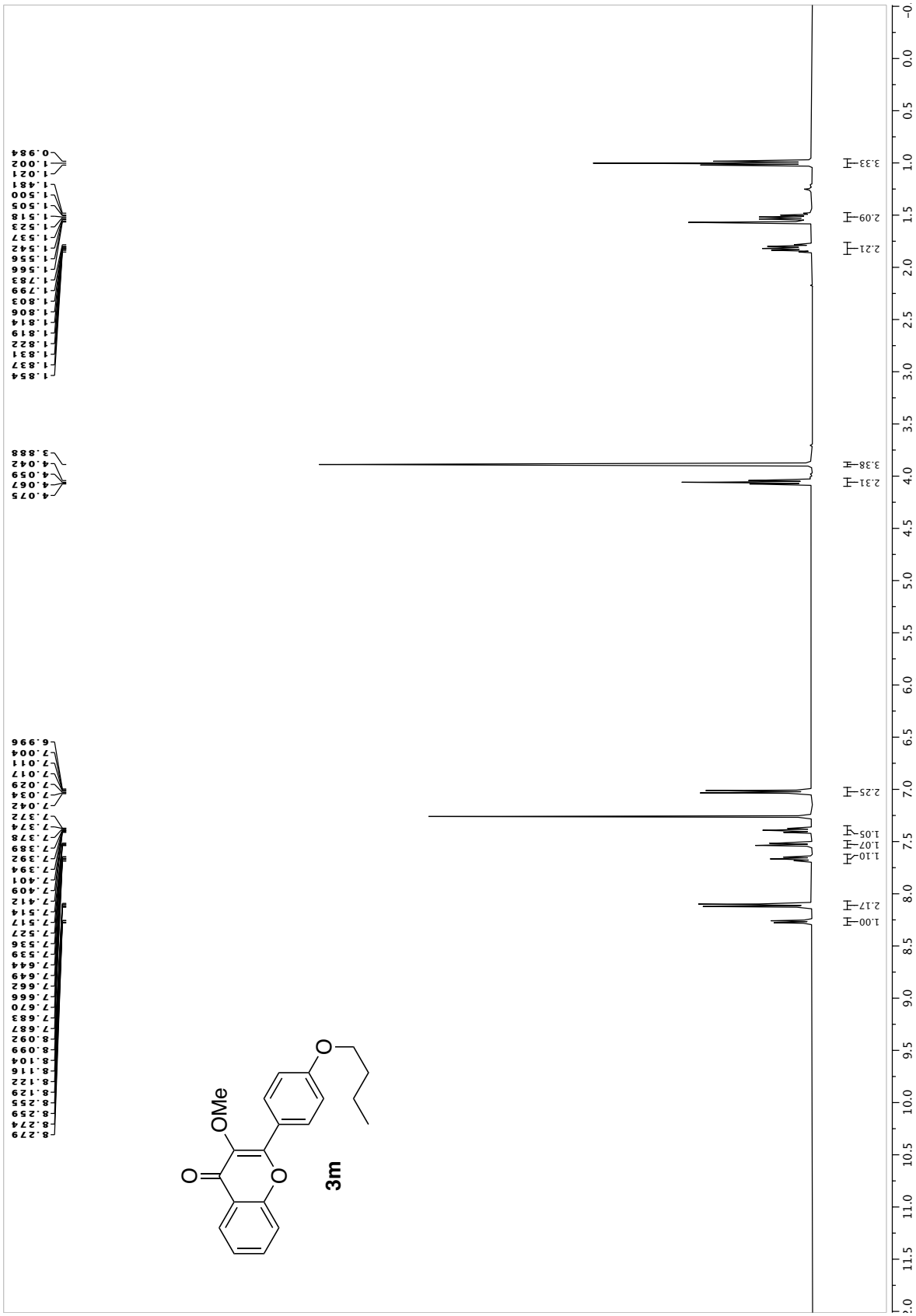
125.885
124.659
124.320
123.091
117.994
114.590
77.480 CDCl3
77.161 CDCl3
76.844 CDCl3
69.769
60.018
22.621
10.639
f1 (ppm)
OMe
O
O
O
3k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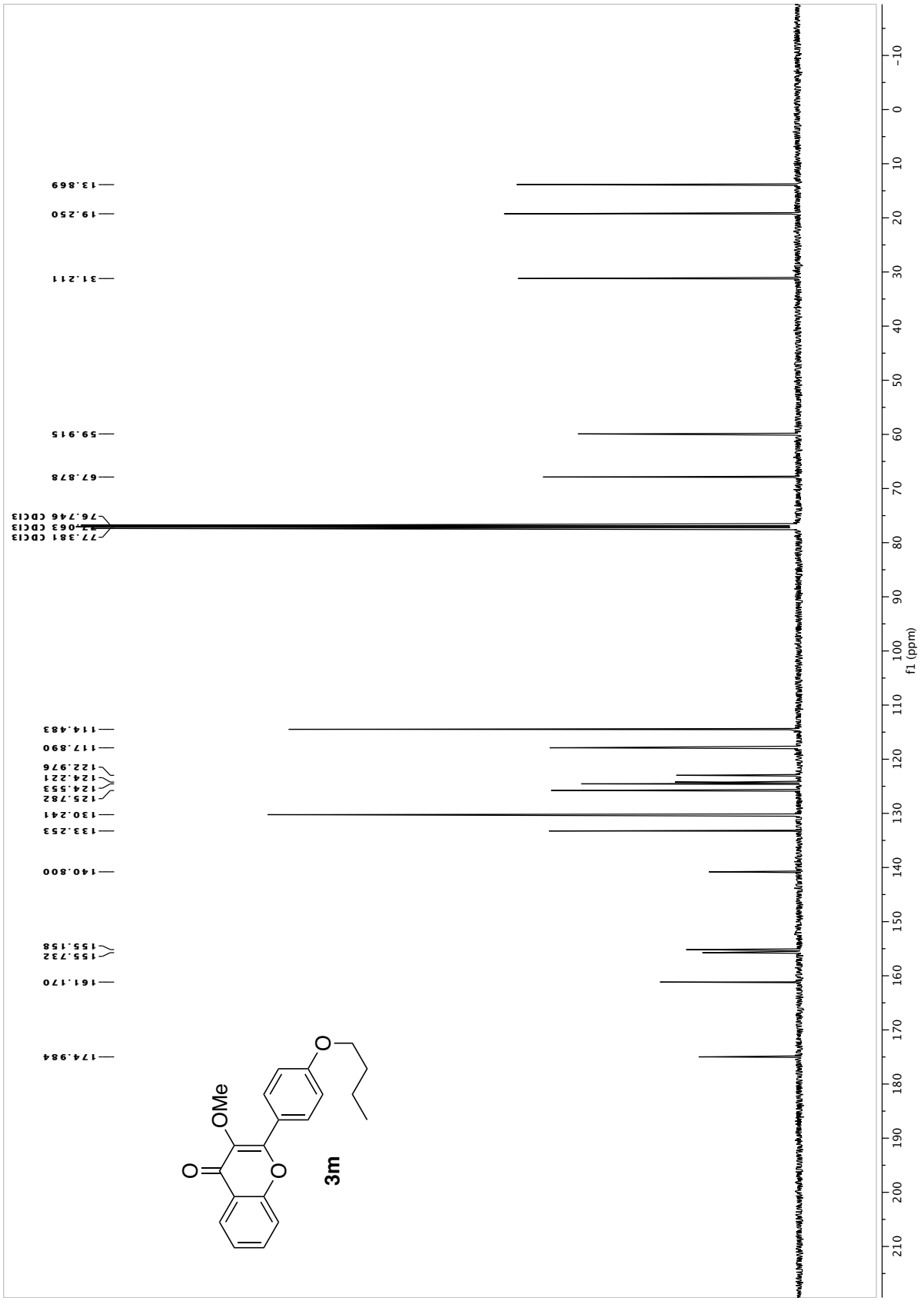
8.122
8.116
8.104
8.099
8.092
7.687
7.683
7.670
7.666
7.662
7.649
7.644
7.539
7.536
7.527
7.517
7.514
7.412
7.409
7.401
7.394
7.392
7.389
7.378
7.374
7.372
7.042
7.034
7.029
7.017
7.011
7.004
6.996
4.075
4.067
4.059
4.042
3.888
1.854
1.837
1.831
1.822
1.819
1.814
1.806
1.803
1.799
1.783
1.566
1.556
1.542
1.537
1.523
1.518
1.505
1.500
1.481
1.021
1.002
0.984
3.33
2.09
2.21
3.38
2.31
2.25
1.05
1.07
1.10
2.17
1.00
f1 (ppm)
OMe
O
O
O
3m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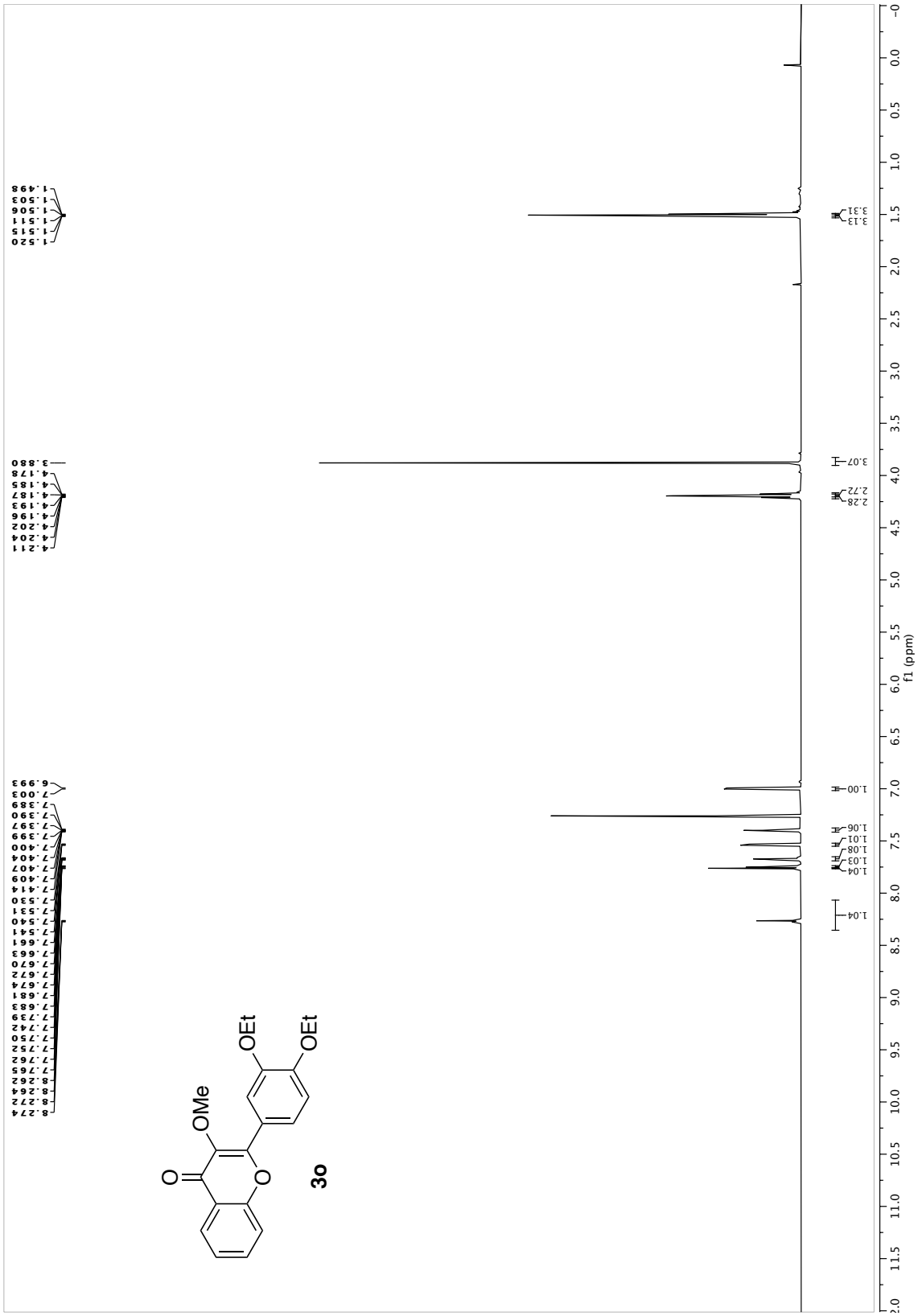
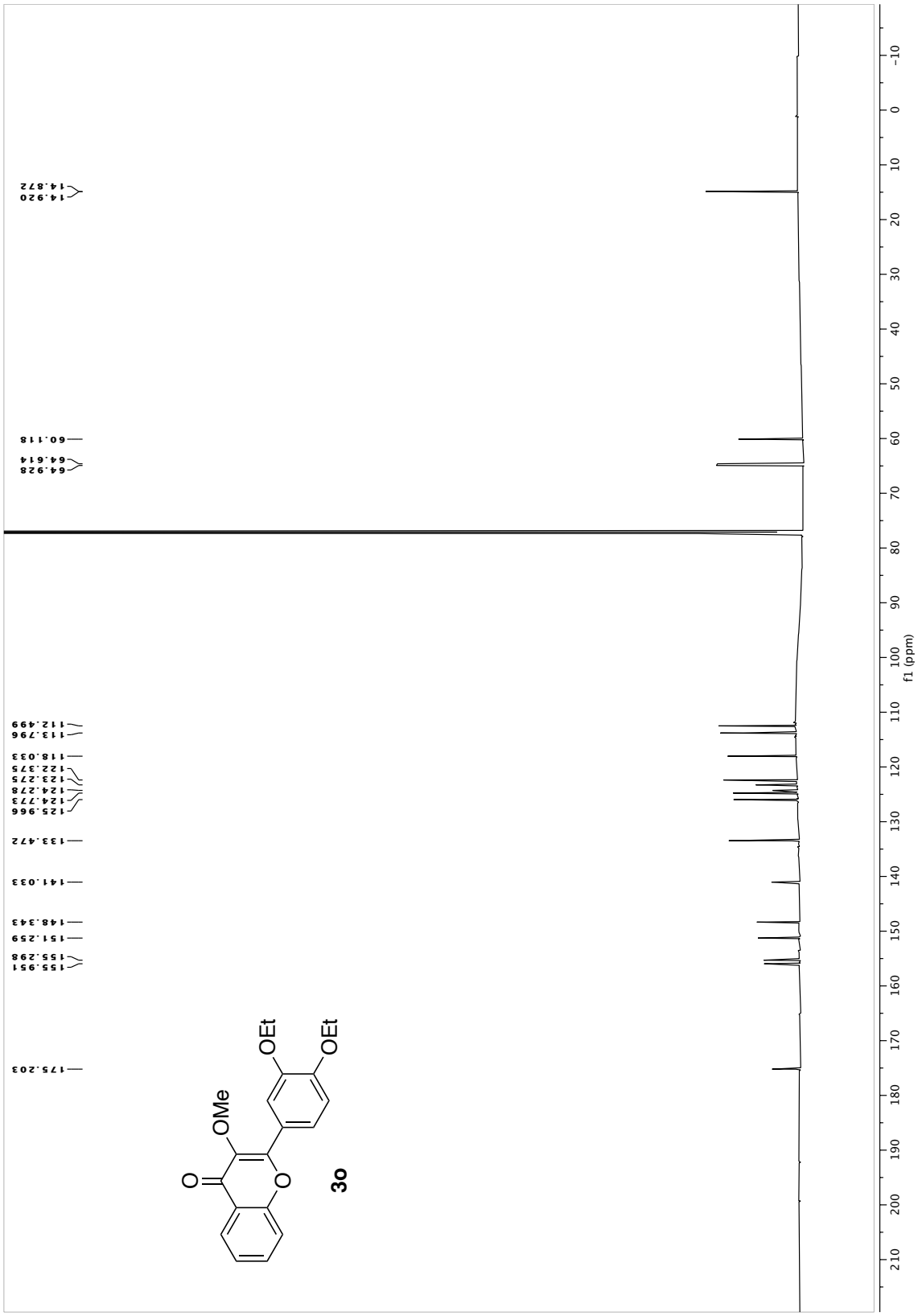
130.241
125.782
124.553
124.221
122.976
117.890
114.483
77.381 CDCl3
77.063 CDCl3
76.746 CDCl3
67.878
59.915
31.211
19.250
13.869
OMe
O
O
O
3m
f1 (ppm)


OMe
OEt
OEt
O
O
3o
f1 (ppm)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112.499
113.796
118.033
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124.278
124.773
125.966
133.472
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148.343
151.259
155.298
155.951
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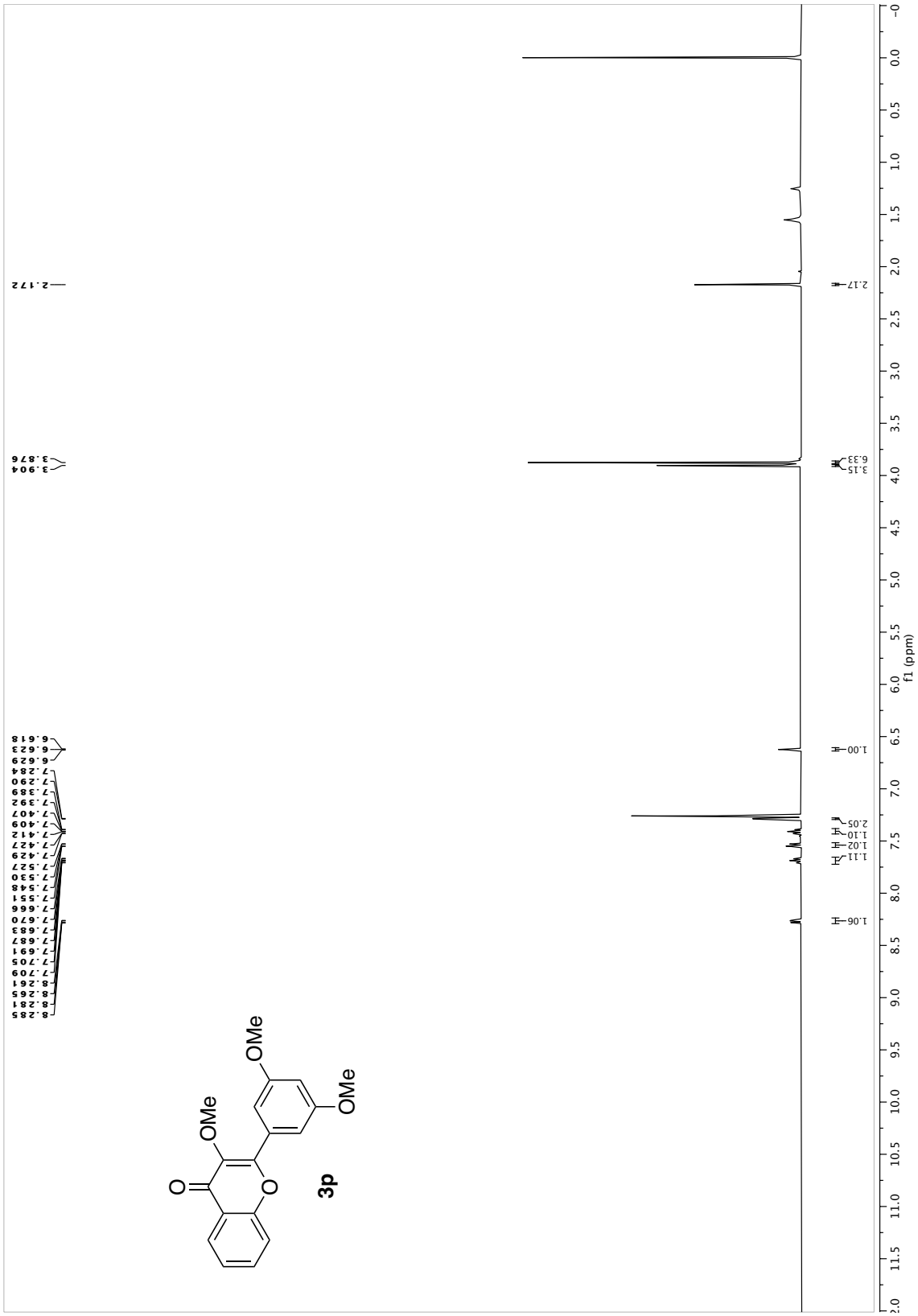
OEt
OEt
OMe
O
O
3o
f1 (ppm)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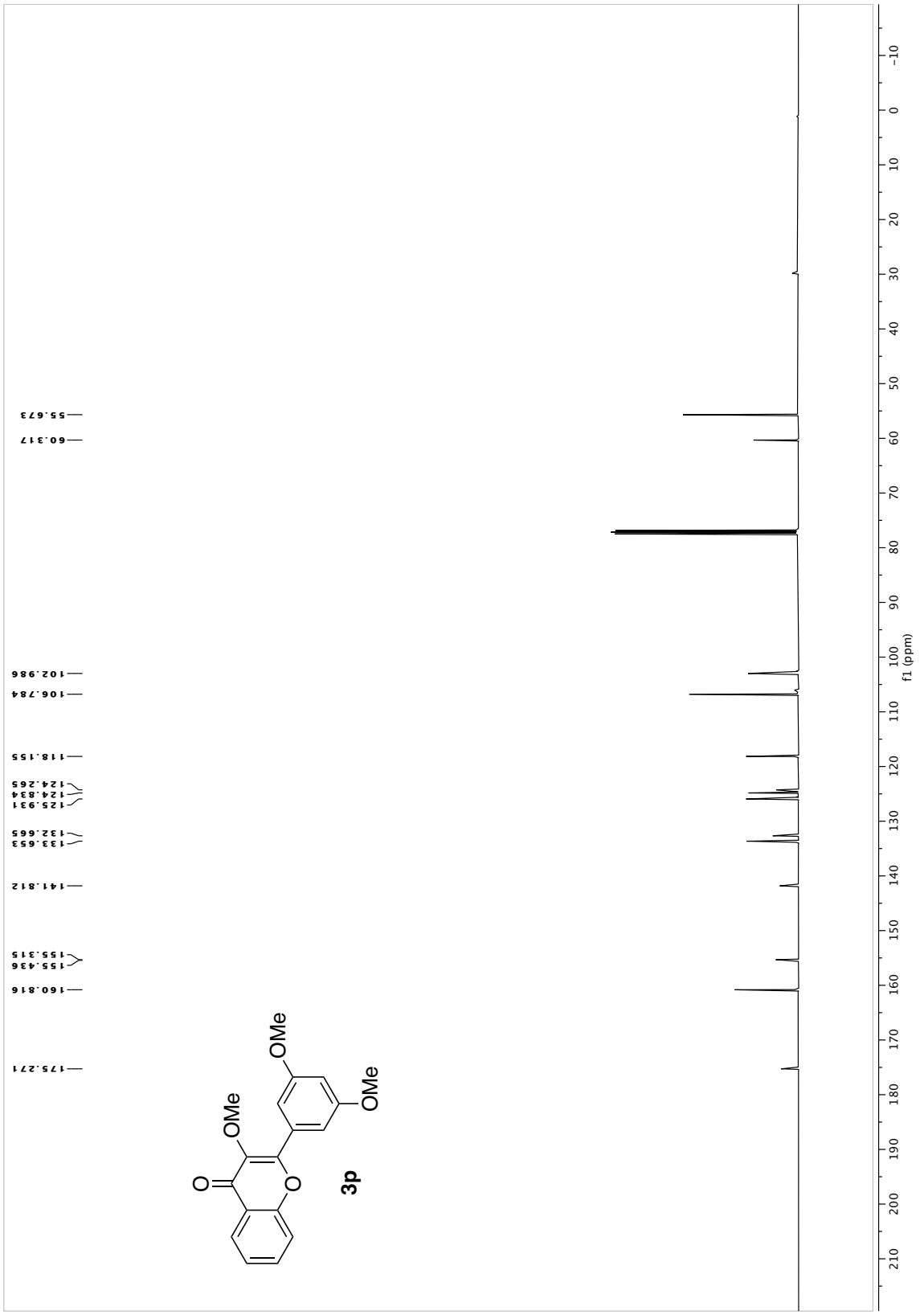
7.548
7.530
7.527
7.429
7.427
7.412
7.409
7.407
7.392
7.389
7.290
7.284
6.629
6.623
6.618
3.904
3.876
2.172
1.06
1.11
1.02
1.10
2.05
1.00
6.33
3.15
2.17
OMe
OMe
OMe
O
O
3p
f1 (ppm)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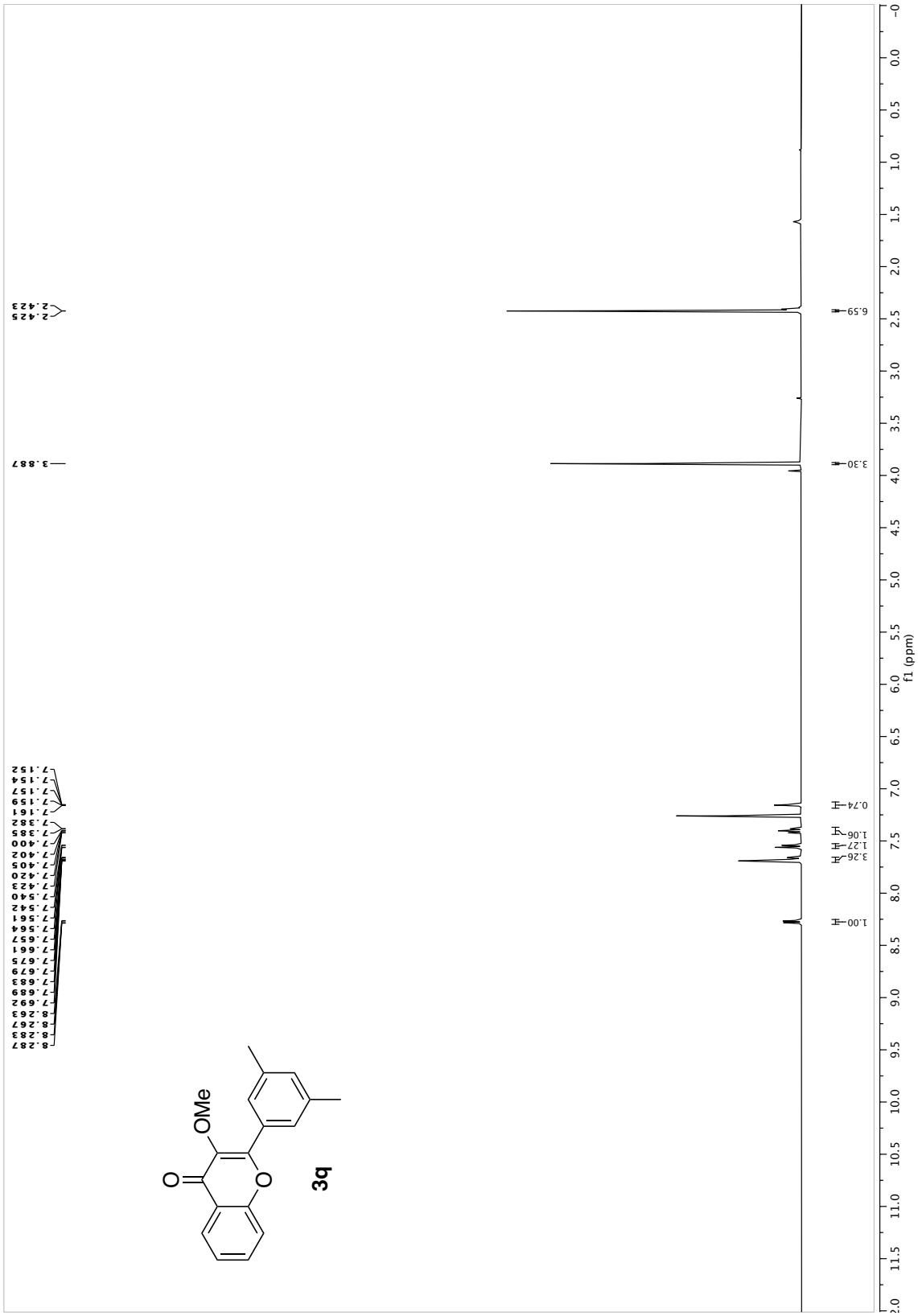
102.986
60.317
55.673
OMe
OMe
OMe
O
O
3p
f1 (ppm)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8.283
8.267
8.263
7.692
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7.675
7.661
7.657
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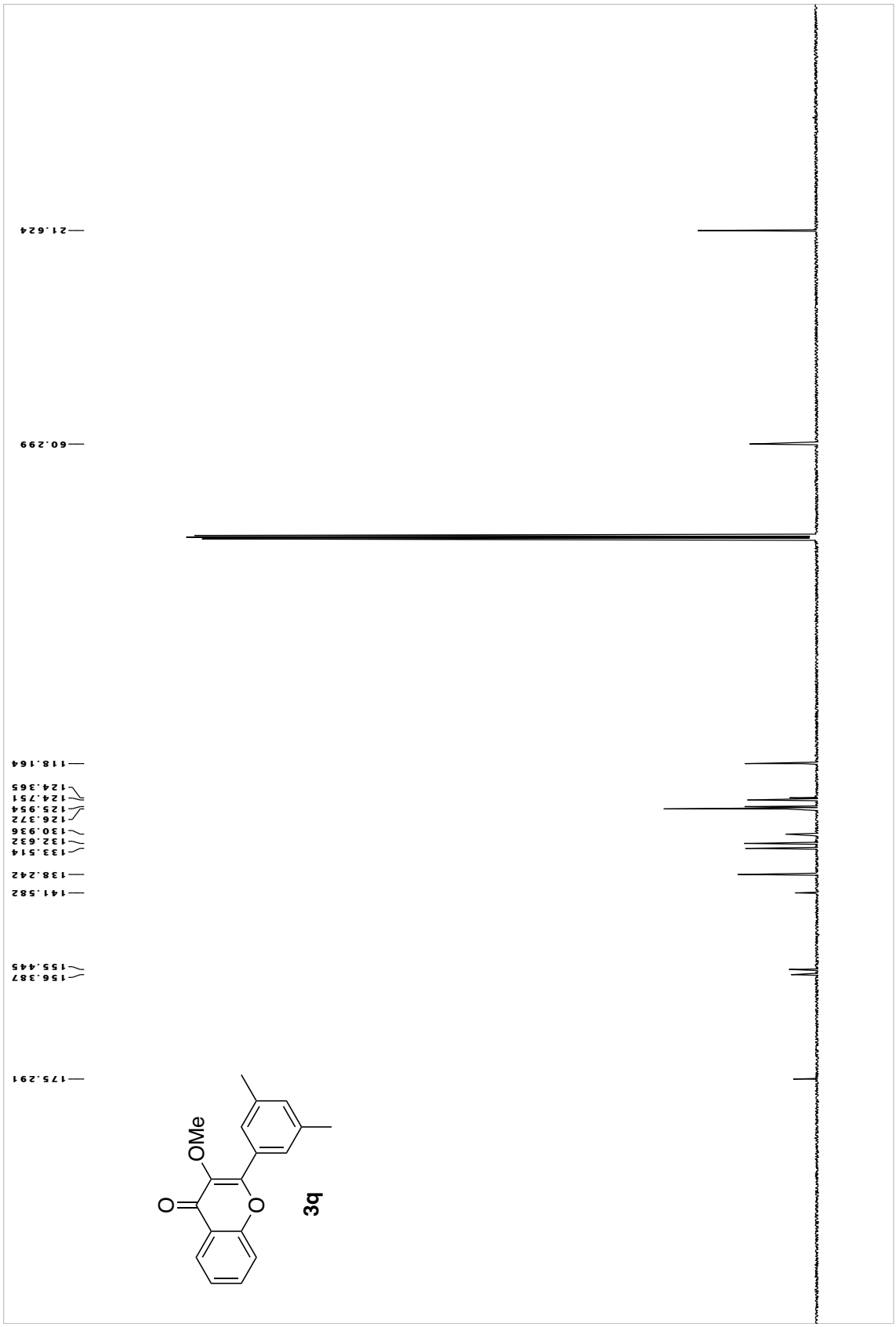
7.561
7.542
7.540
7.423
7.420
7.405
7.402
7.400
7.385
7.382
7.161
7.159
7.157
7.154
7.152
3.887
2.425
2.423
1.00
3.26
1.27
1.06
0.74
3.30
6.59
f1 (ppm)
OMe
O
O
3q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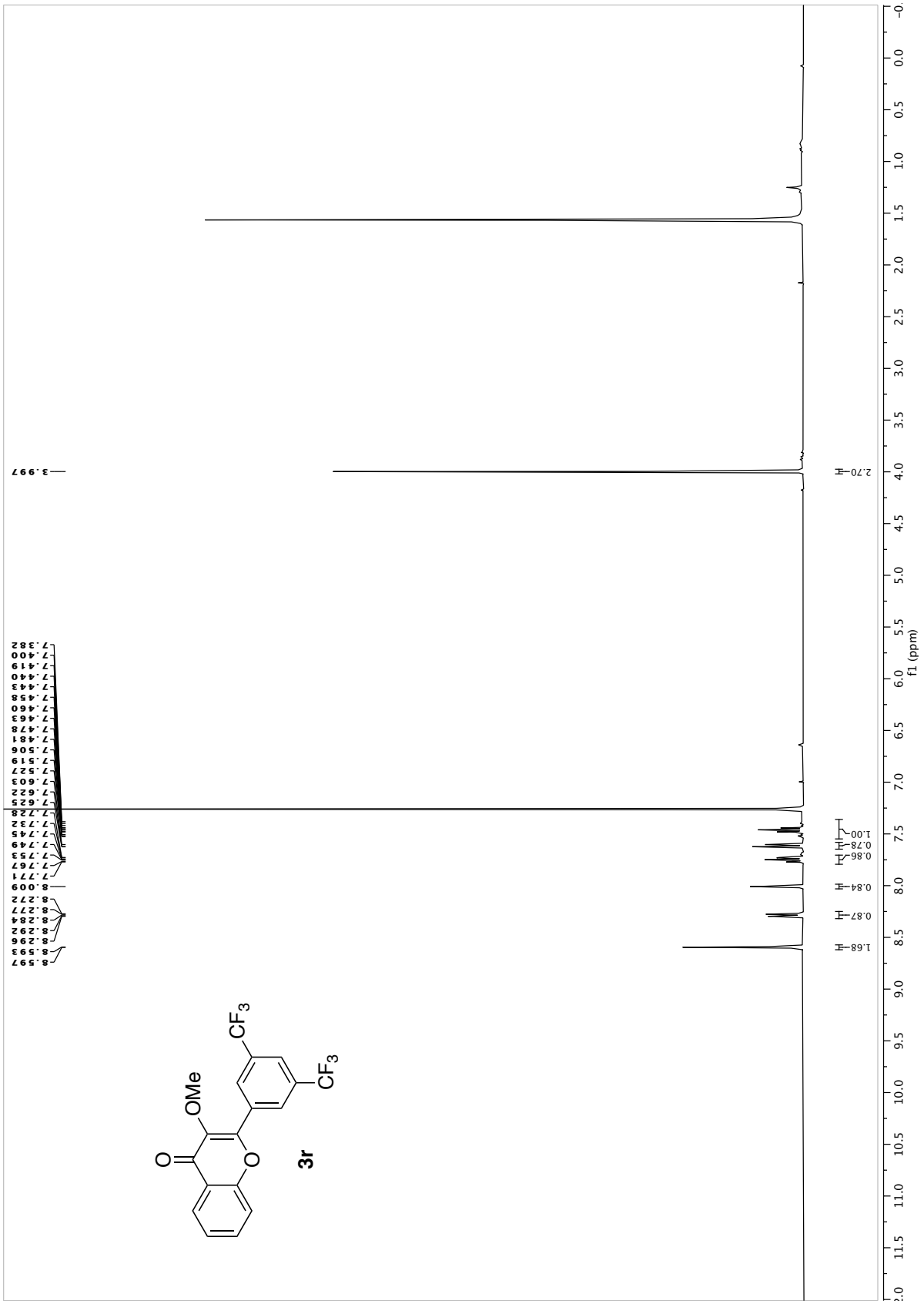
141.582
138.242
133.514
132.632
130.936
126.372
125.954
124.751
124.365
118.164
60.299
21.624
OMe
O
O
3q
f1 (ppm)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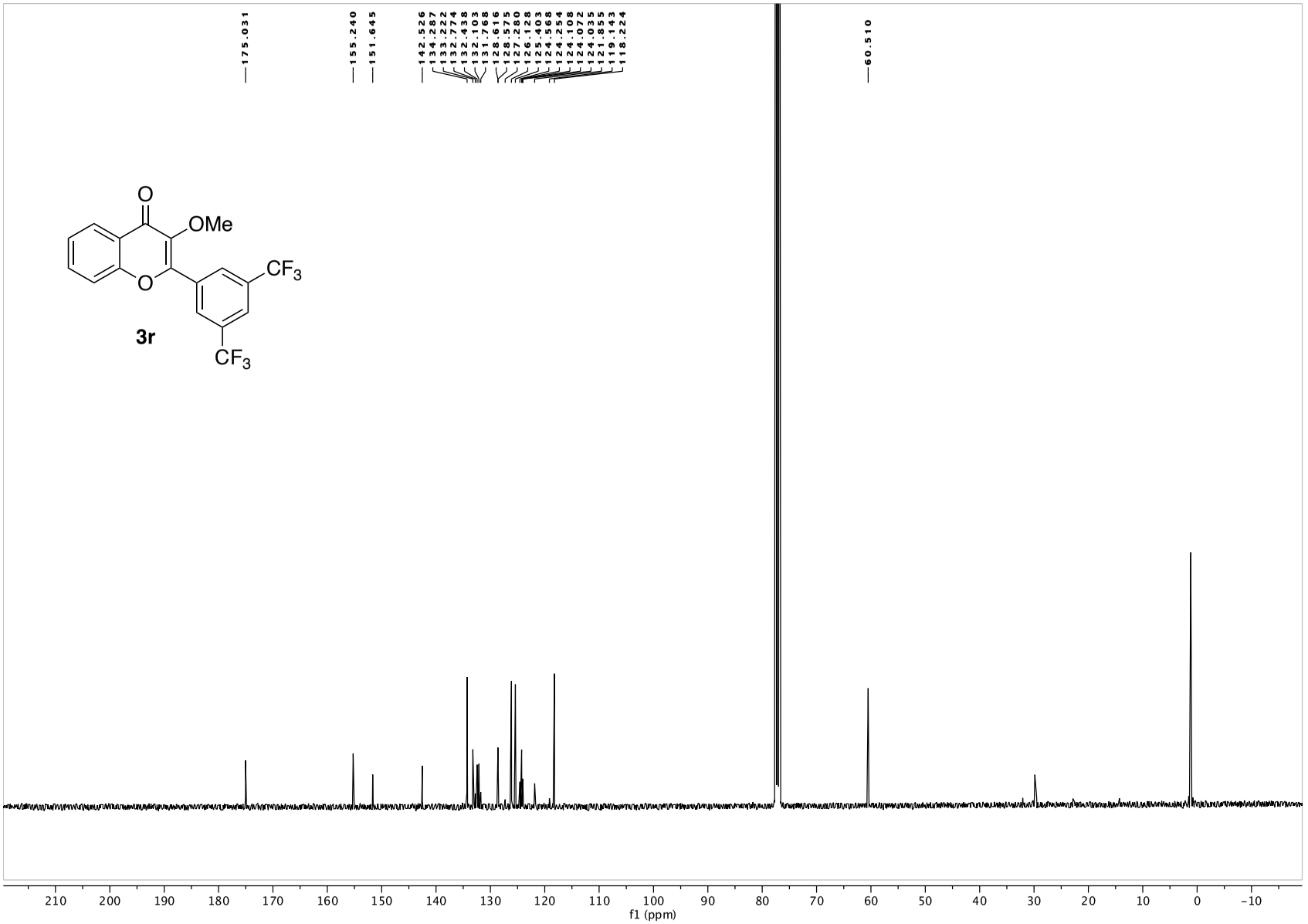
8.593
8.296
8.292
8.284
8.277
8.272
8.009
7.771
7.767
7.753
7.749
7.745
7.732
7.728
7.625
7.622
7.603
7.527
7.519
7.506
7.481
7.478
7.463
7.460
7.458
7.443
7.440
7.419
7.400
7.382
3.997
2.70
1.68
0.87
0.84
0.86
0.78
1.00
OMe
O
O
CF3
CF3
3r
f1 (ppm)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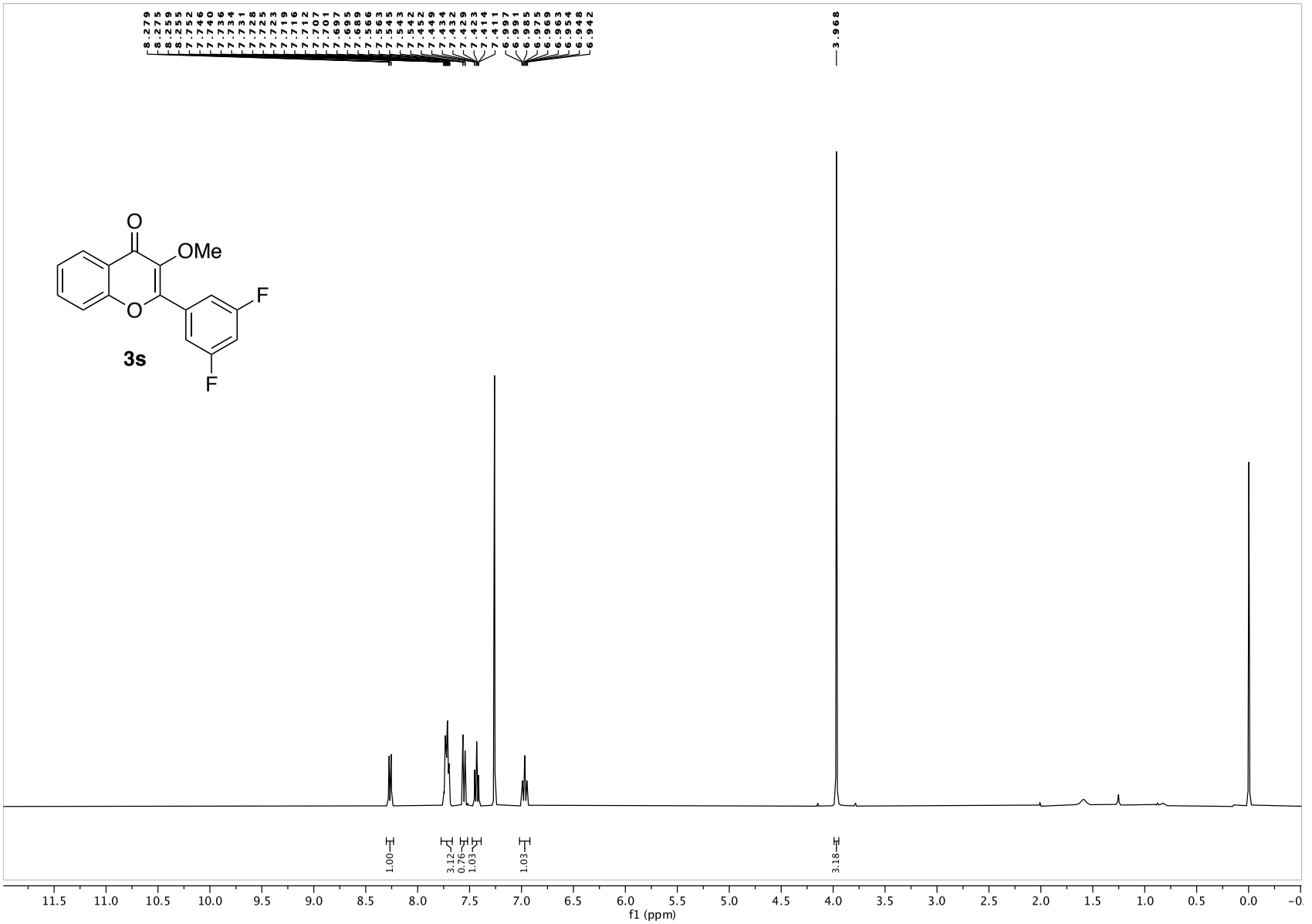
151.645
142.526
134.287
133.222
132.774
132.438
132.103
131.768
128.616
128.575
127.280
126.128
125.403
124.568
124.254
124.108
124.072
124.035
121.855
119.143
118.224
60.510
O
OMe
O
CF3
CF3
3r
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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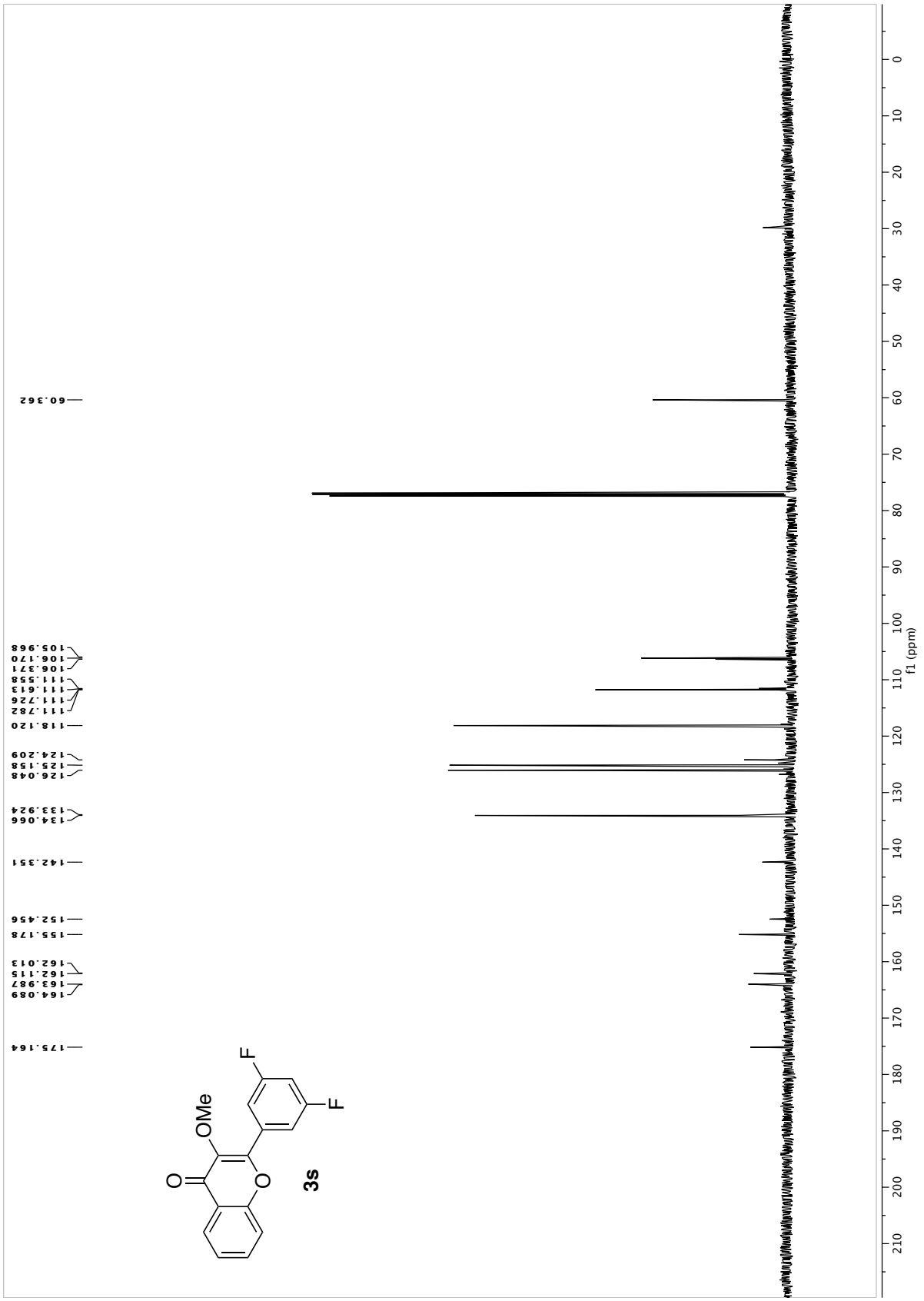
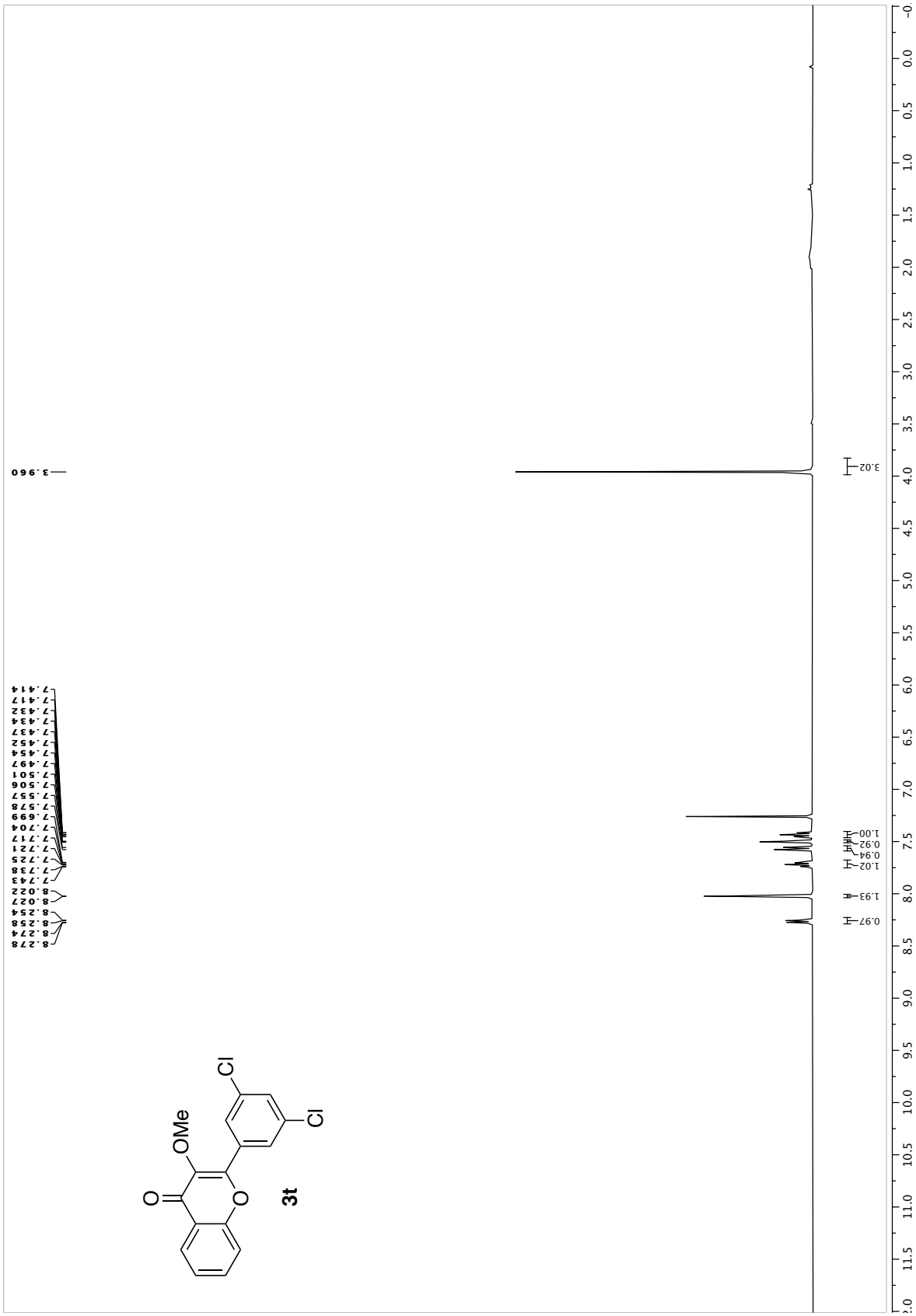
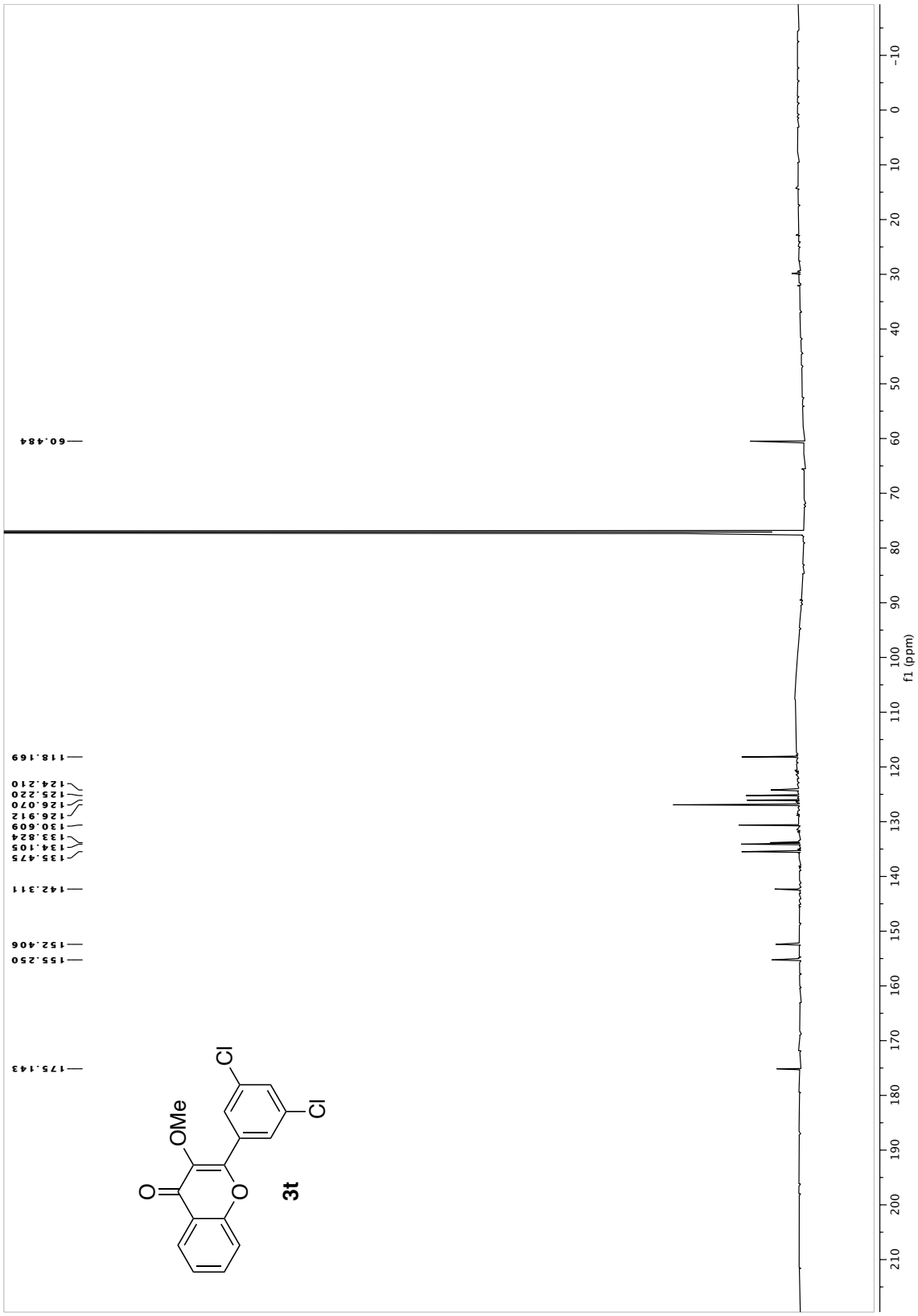
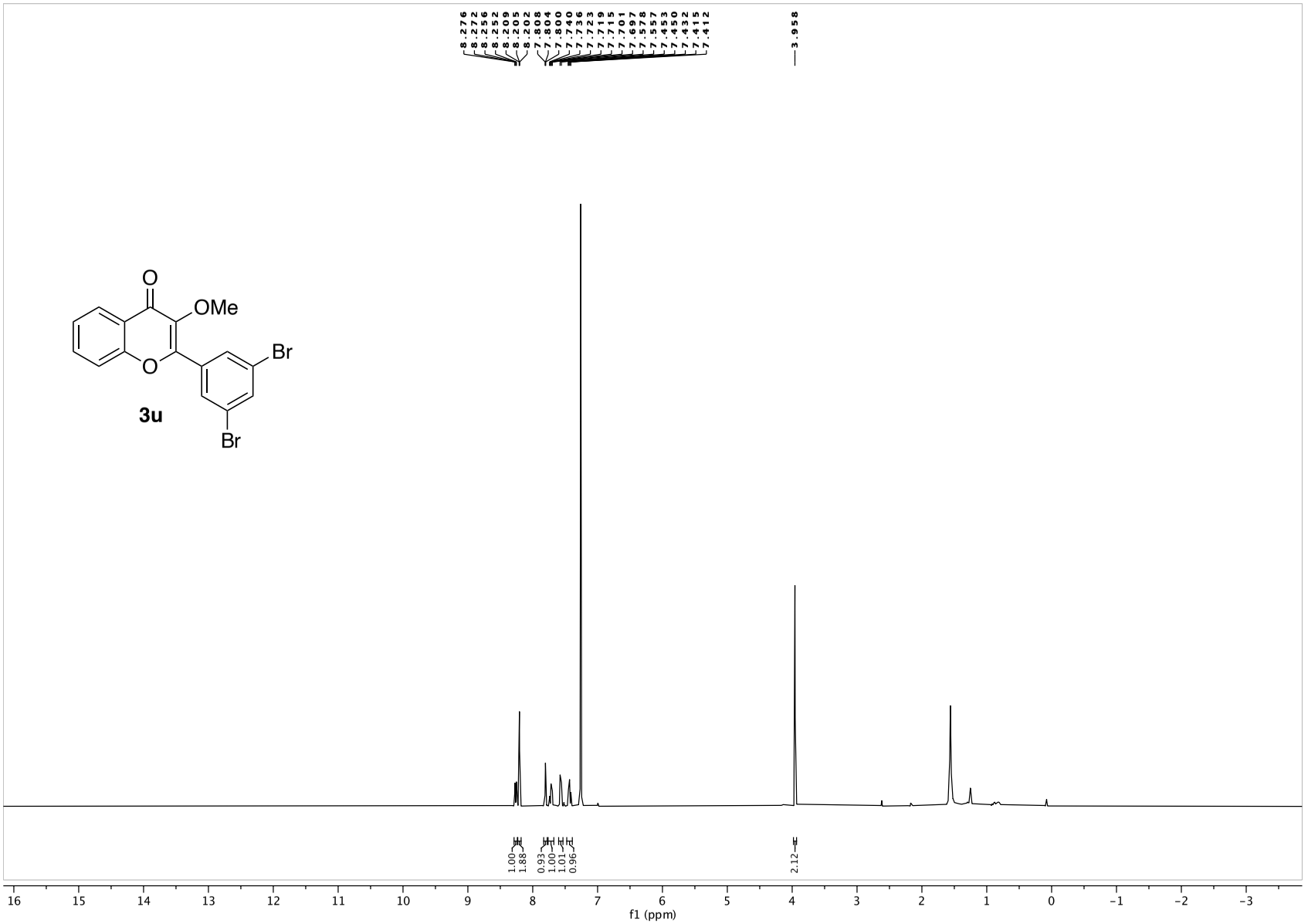
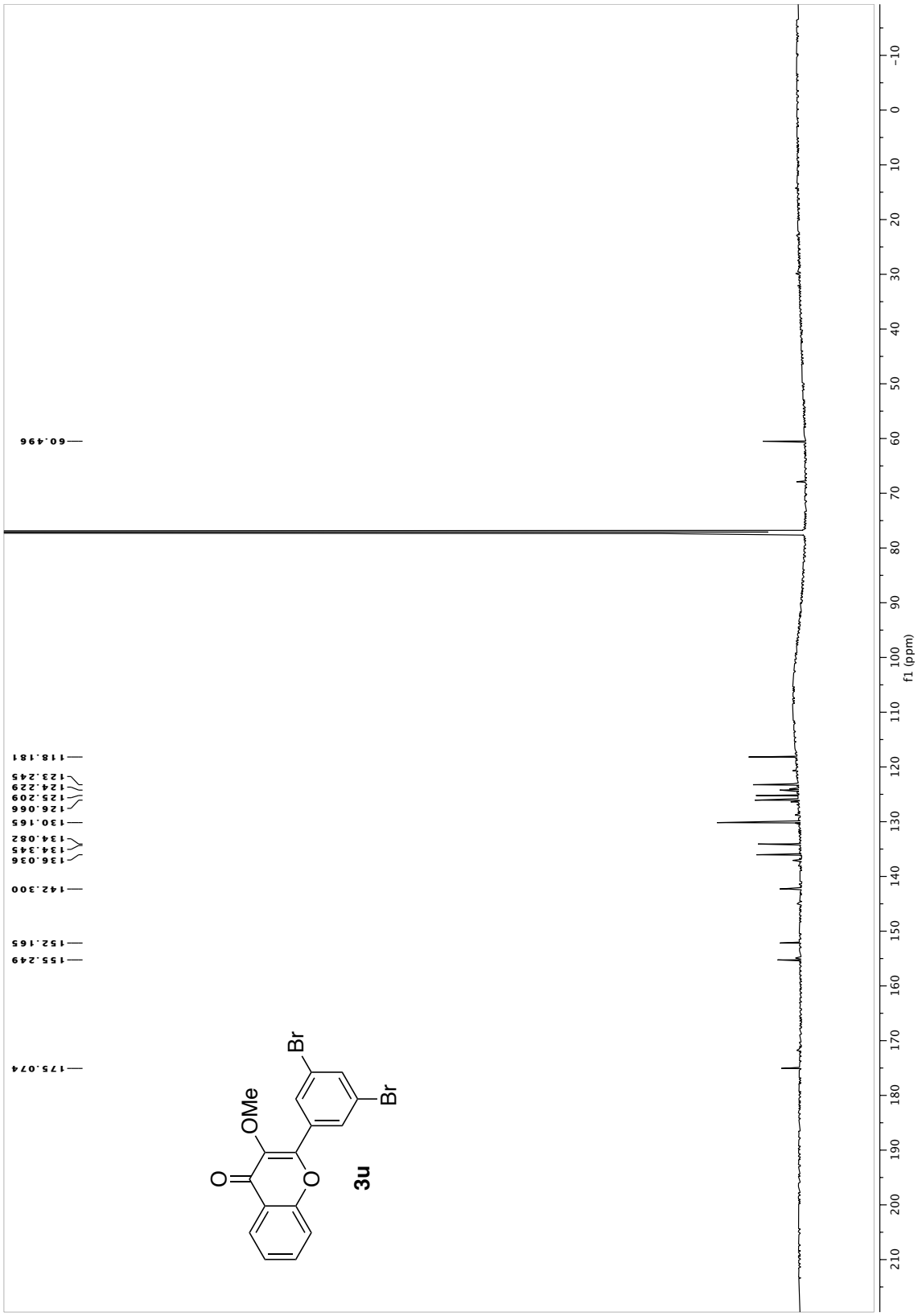
8.275
8.259
8.255
7.752
7.746
7.740
7.736
7.734
7.731
7.728
7.725
7.723
7.719
7.716
7.712
7.707
7.701
7.697
7.695
7.689
7.566
7.563
7.545
7.543
7.542
7.452
7.449
7.434
7.432
7.429
7.423
7.414
7.411
6.997
6.991
6.985
6.975
6.969
6.954
6.948
6.942
3.968
O
OMe
O
F
F
3s
1.00
3.12
0.76
1.03
1.03
3.18
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

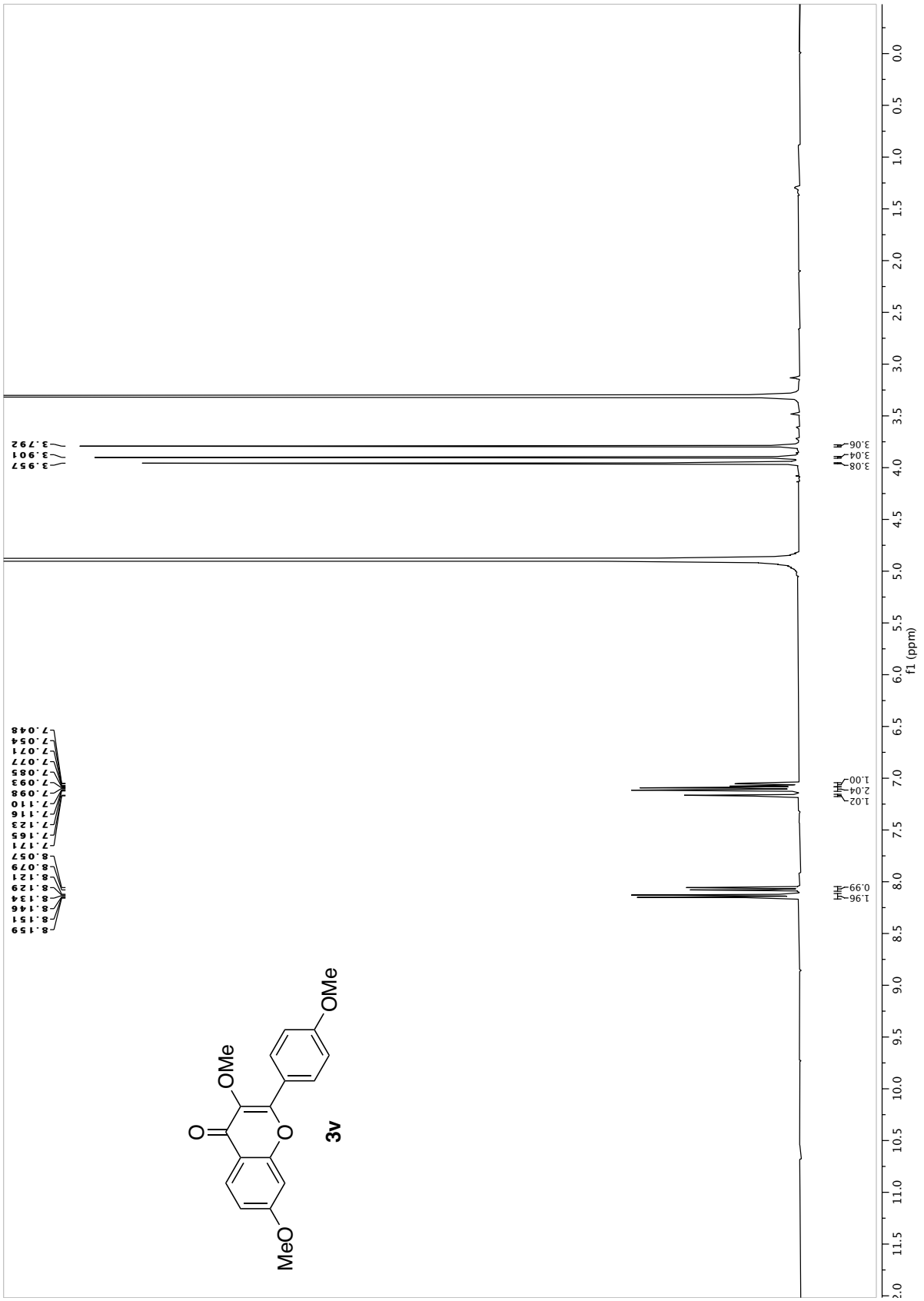

OMe
O
O
F
F
3s
175.164
164.089
163.987
162.115
162.013
155.178
152.456
142.351
134.066
133.924
126.048
125.158
124.209
118.120
111.782
111.726
111.613
111.558
106.371
106.170
105.968
60.362
f1 (ppm)

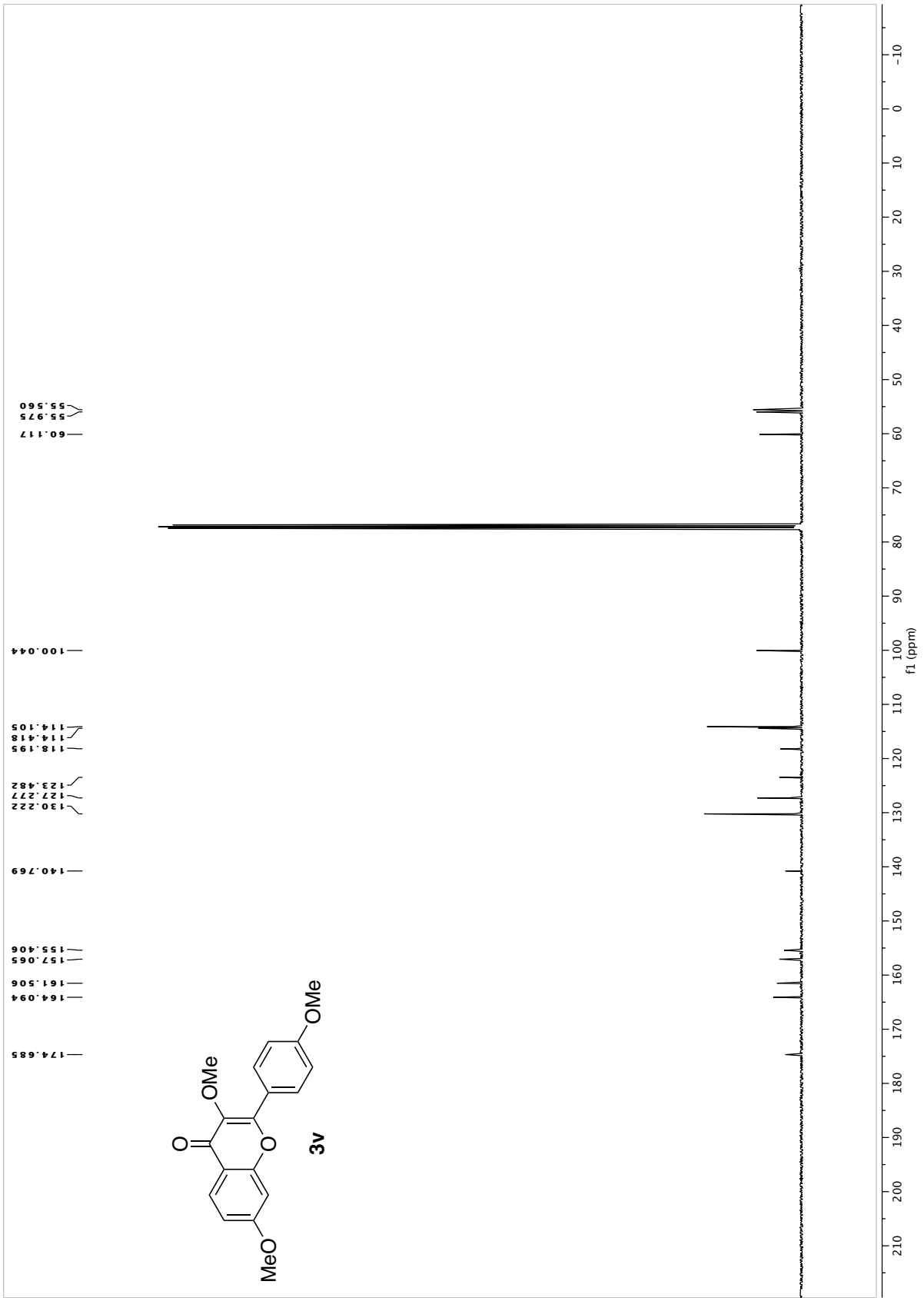

8.278
8.274
8.258
8.254
8.027
8.022
7.743
7.738
7.725
7.721
7.717
7.704
7.699
7.578
7.557
7.506
7.501
7.497
7.454
7.452
7.437
7.434
7.432
7.417
7.414
3.960
3.02
1.02
0.94
0.92
1.00
1.93
0.97
f1 (ppm)
OMe
Cl
Cl
O
O
3t

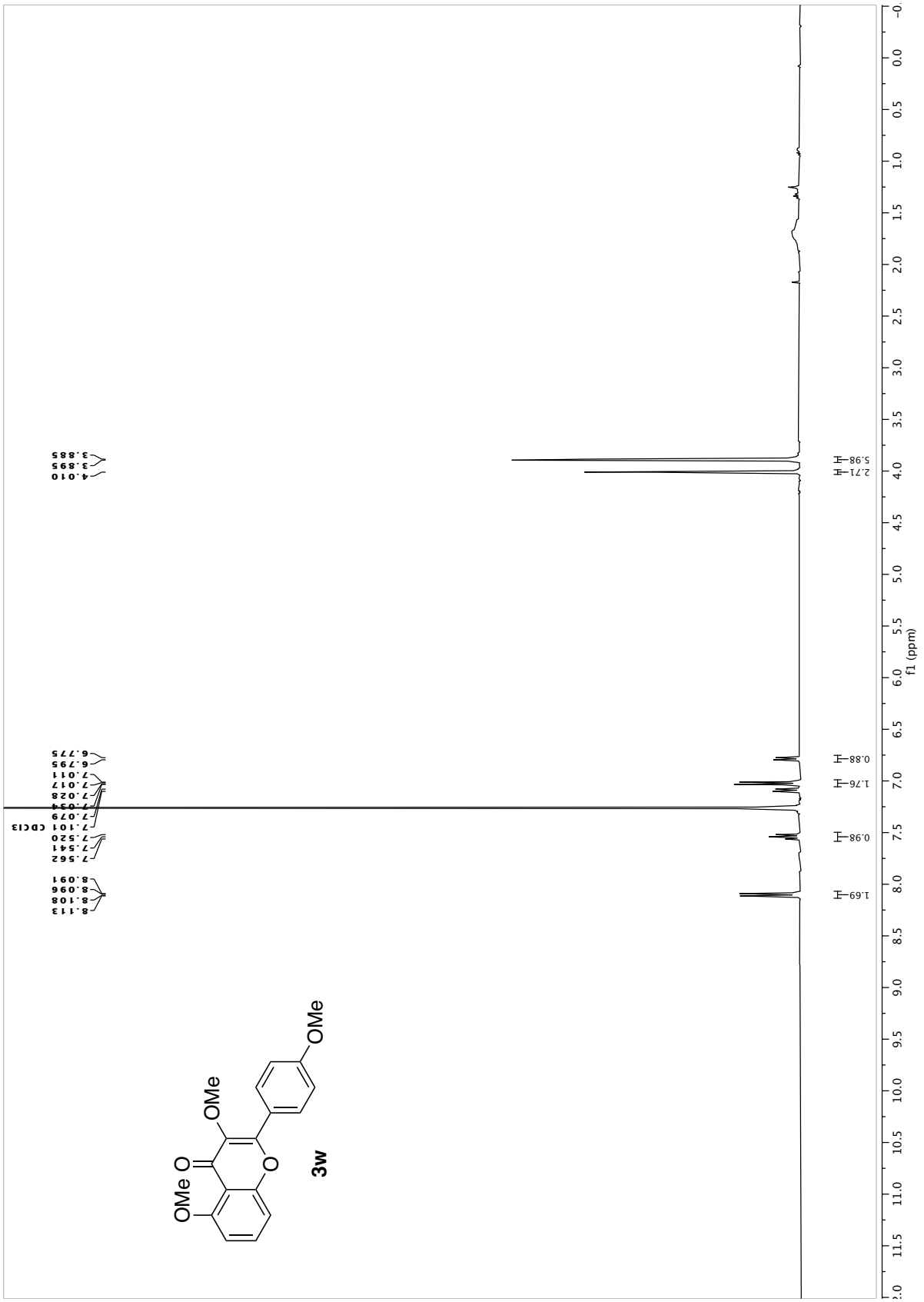

60.484
118.169
124.210
125.220
126.070
126.912
130.609
133.824
134.105
135.475
142.311
152.406
155.250
175.143
Cl
Cl
OMe
O
O
3t
f1 (ppm)

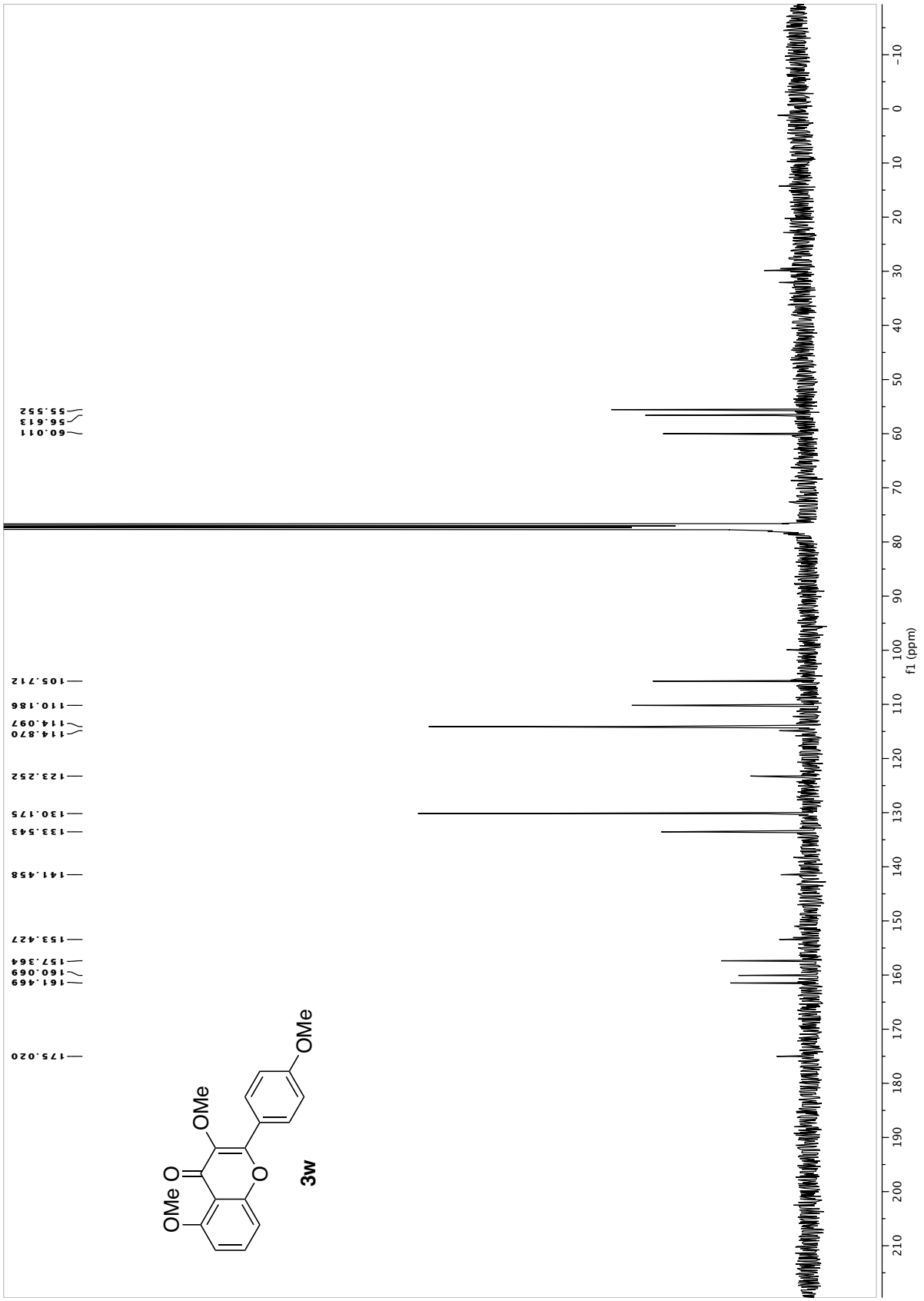

8.276
8.272
8.256
8.252
8.209
8.205
8.202
7.808
7.804
7.800
7.740
7.736
7.723
7.719
7.715
7.701
7.697
7.578
7.557
7.453
7.450
7.432
7.415
7.412
3.958
O
OMe
O
Br
Br
3u
1.00
1.88
0.93
1.00
1.01
0.96
2.12
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)

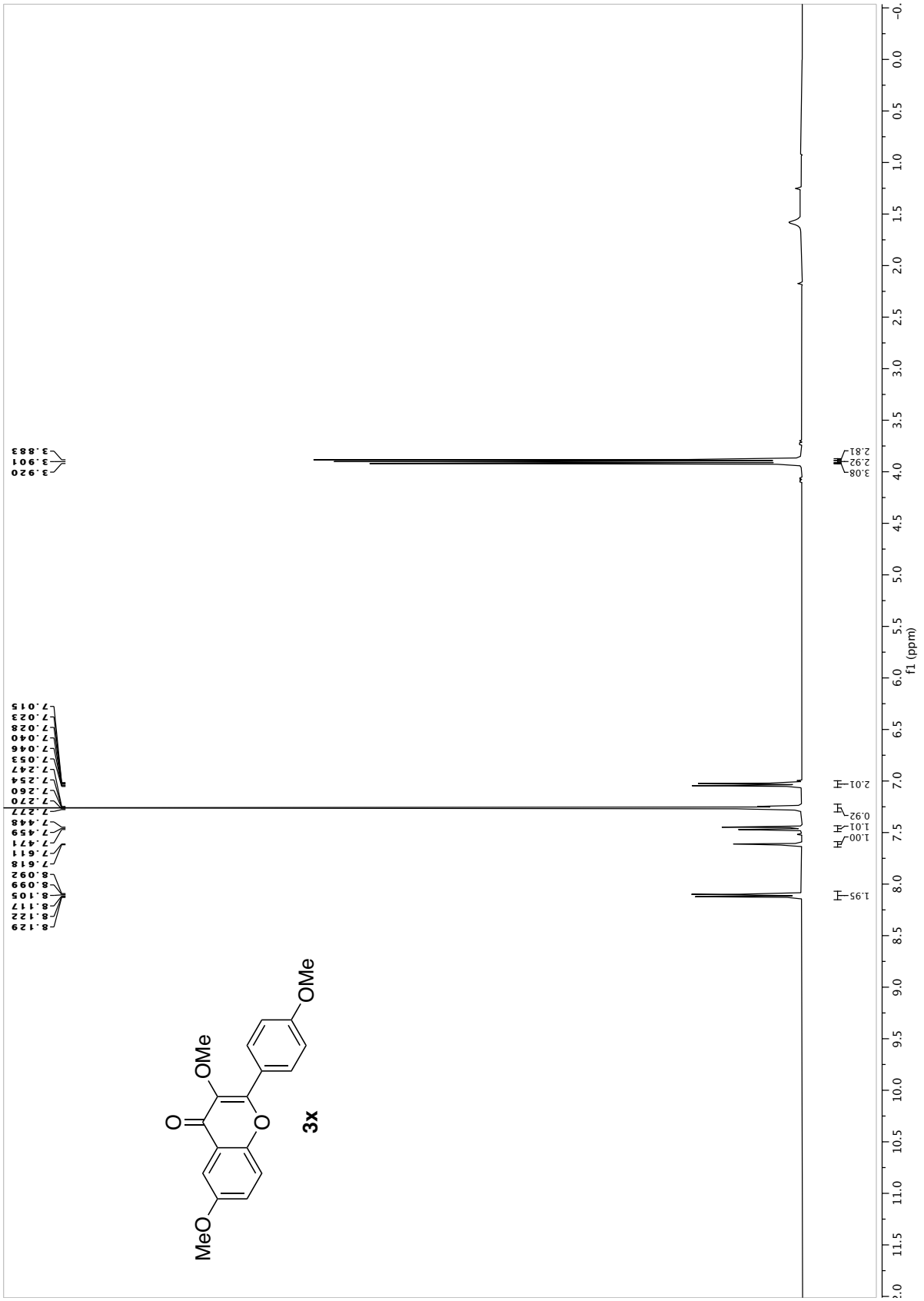

175.074
155.249
152.165
142.300
136.036
134.345
134.082
130.165
126.066
125.209
124.229
123.245
118.181
60.496
OMe
O
O
Br
Br
3u
f1 (ppm)

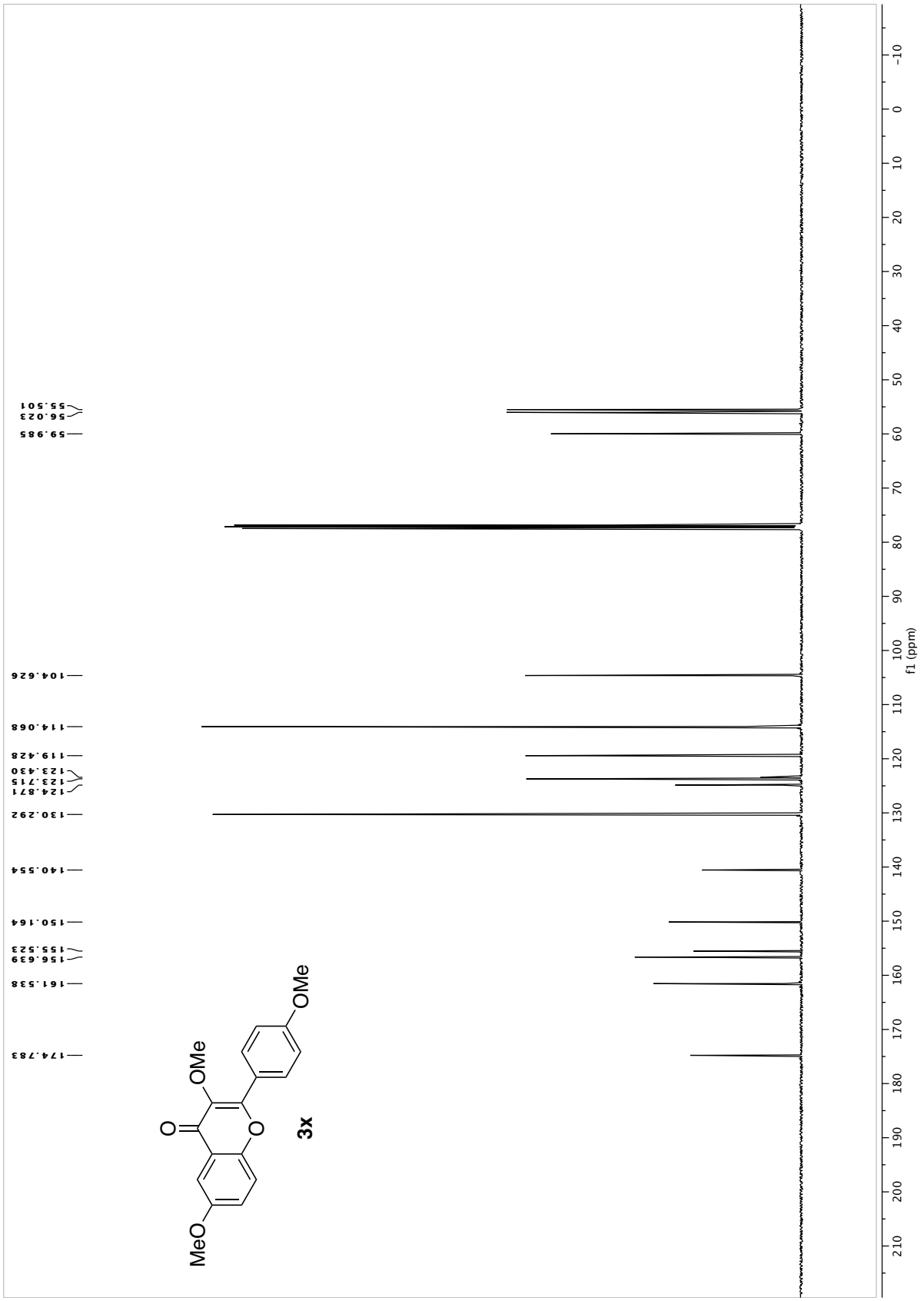

OMe
OMe
MeO
O
O
3v
f1 (ppm)

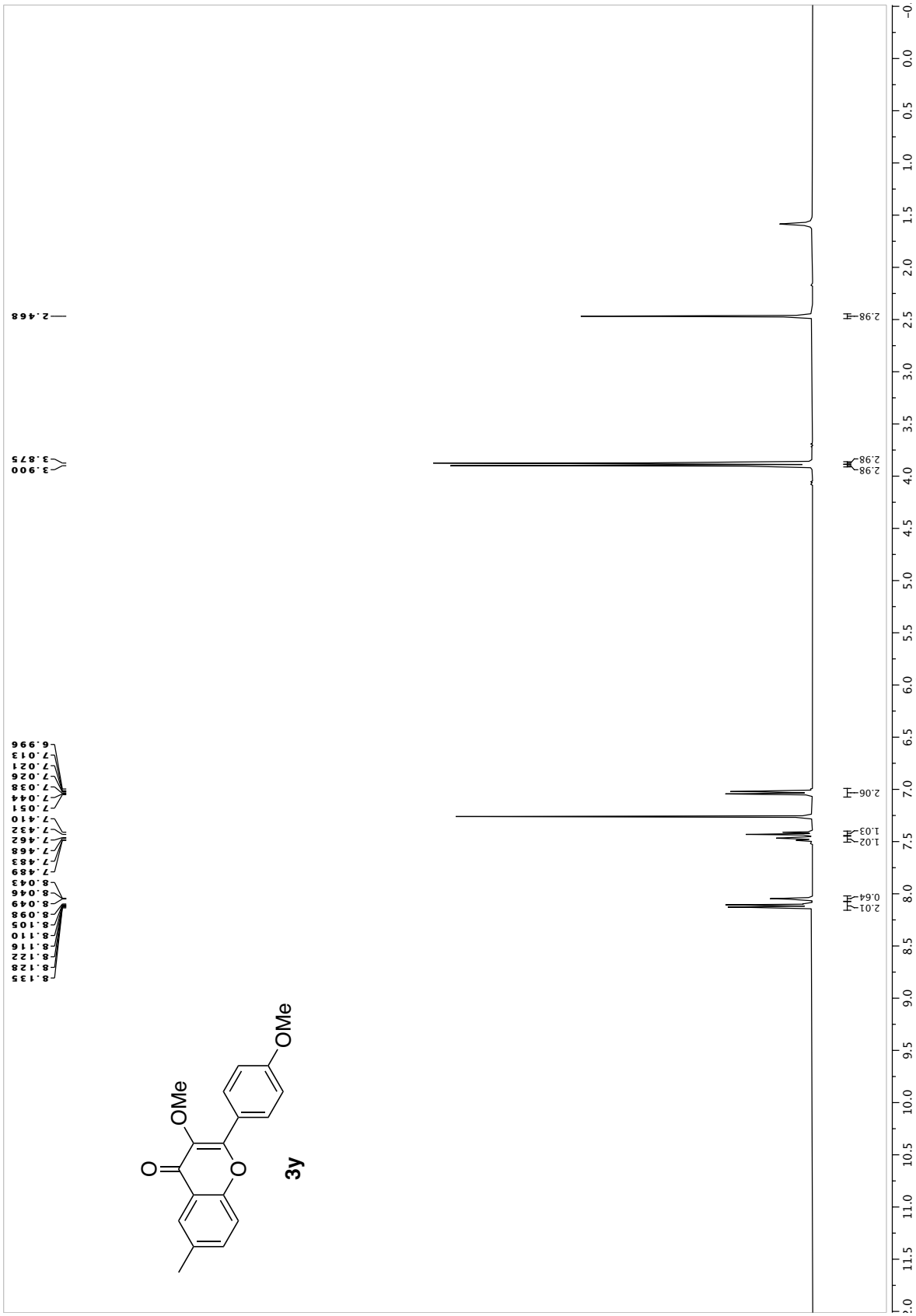

174.685
164.094
161.506
157.065
155.406
140.769
130.222
127.277
123.482
118.195
114.418
114.105
100.044
60.117
55.975
55.560
OMe
OMe
MeO
O
O
3v
f1 (ppm)

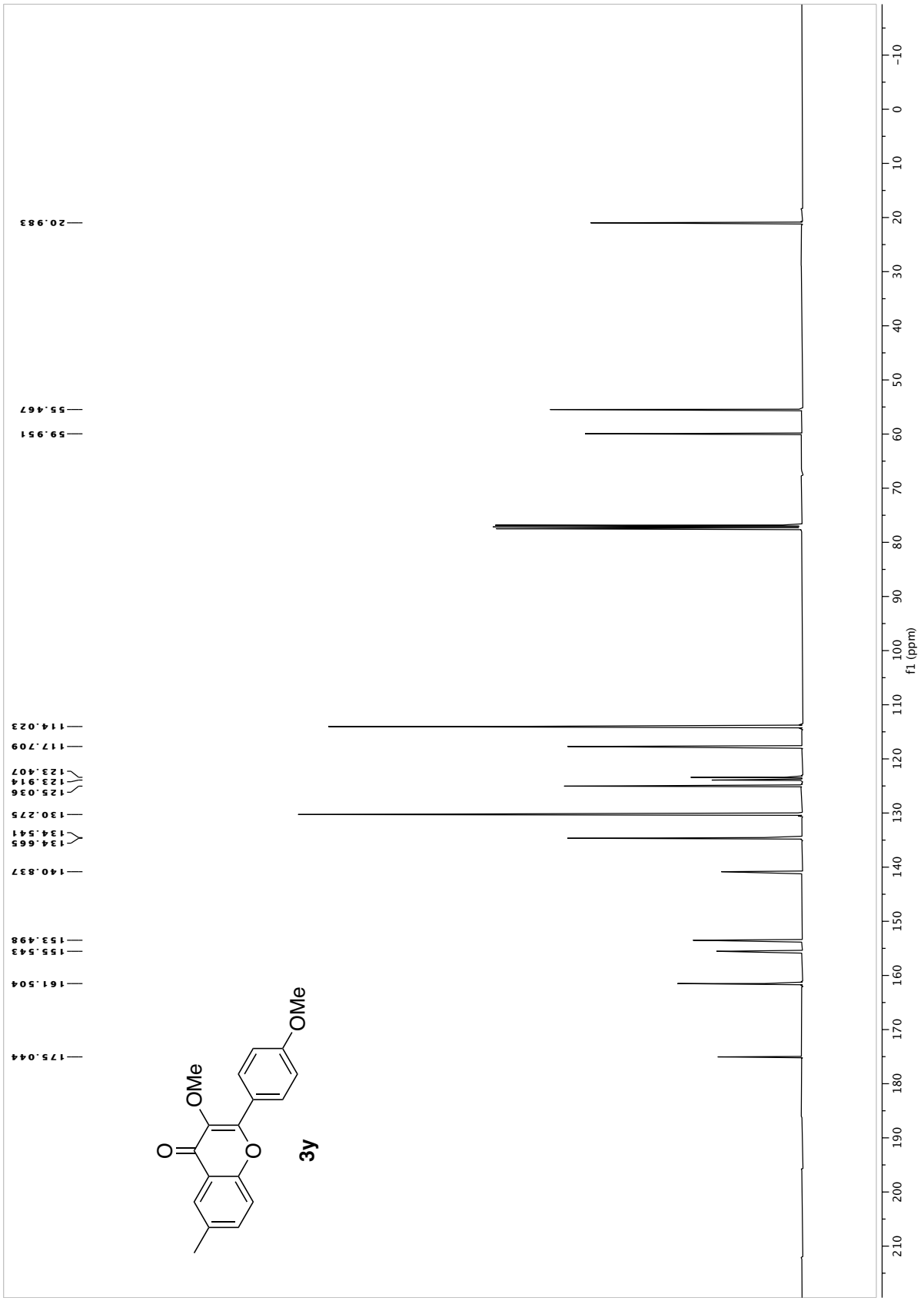

OMe
OMe
OMe
O
O
O
3w
8.113
8.108
8.096
8.091
7.562
7.541
7.520
7.101
CDCl3
7.079
7.054
7.028
7.017
7.011
6.795
6.775
4.010
3.895
3.885
1.69
0.98
1.76
0.88
5.98
2.71
f1 (ppm)

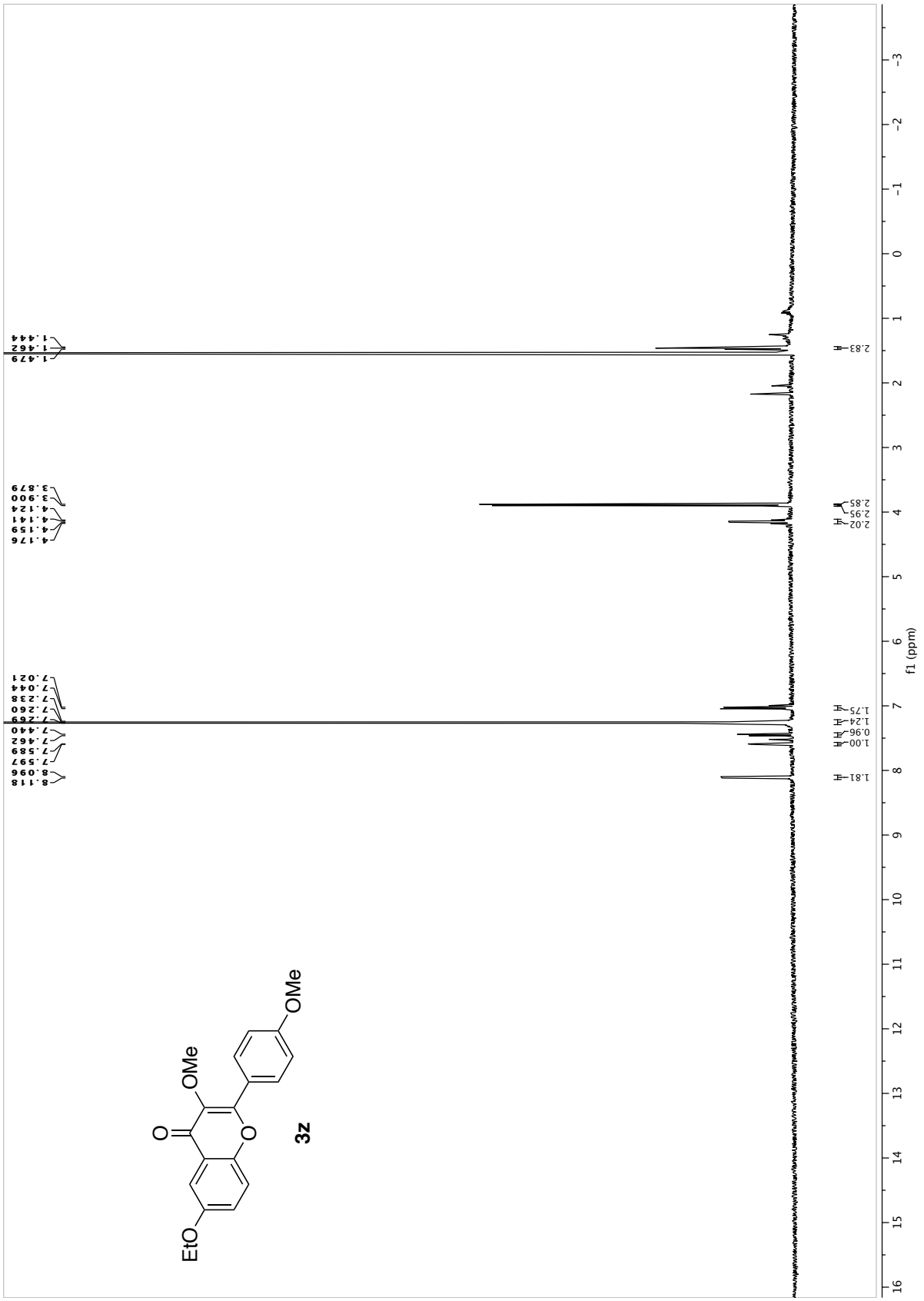

OMe O
OMe
O
OMe
3w
175.020
161.469
160.069
157.364
153.427
141.458
133.543
130.175
123.252
114.870
114.097
110.186
105.712
60.011
56.613
55.552
f1 (ppm)


8.129
8.122
8.117
8.105
8.099
8.092
7.618
7.611
7.471
7.459
7.448
7.277
7.270
7.260
7.254
7.247
7.053
7.046
7.040
7.028
7.023
7.015
3.920
3.901
3.883
1.95
1.00
1.01
0.92
2.01
3.08
2.92
2.81
f1 (ppm)
OMe
OMe
MeO
O
O
3x

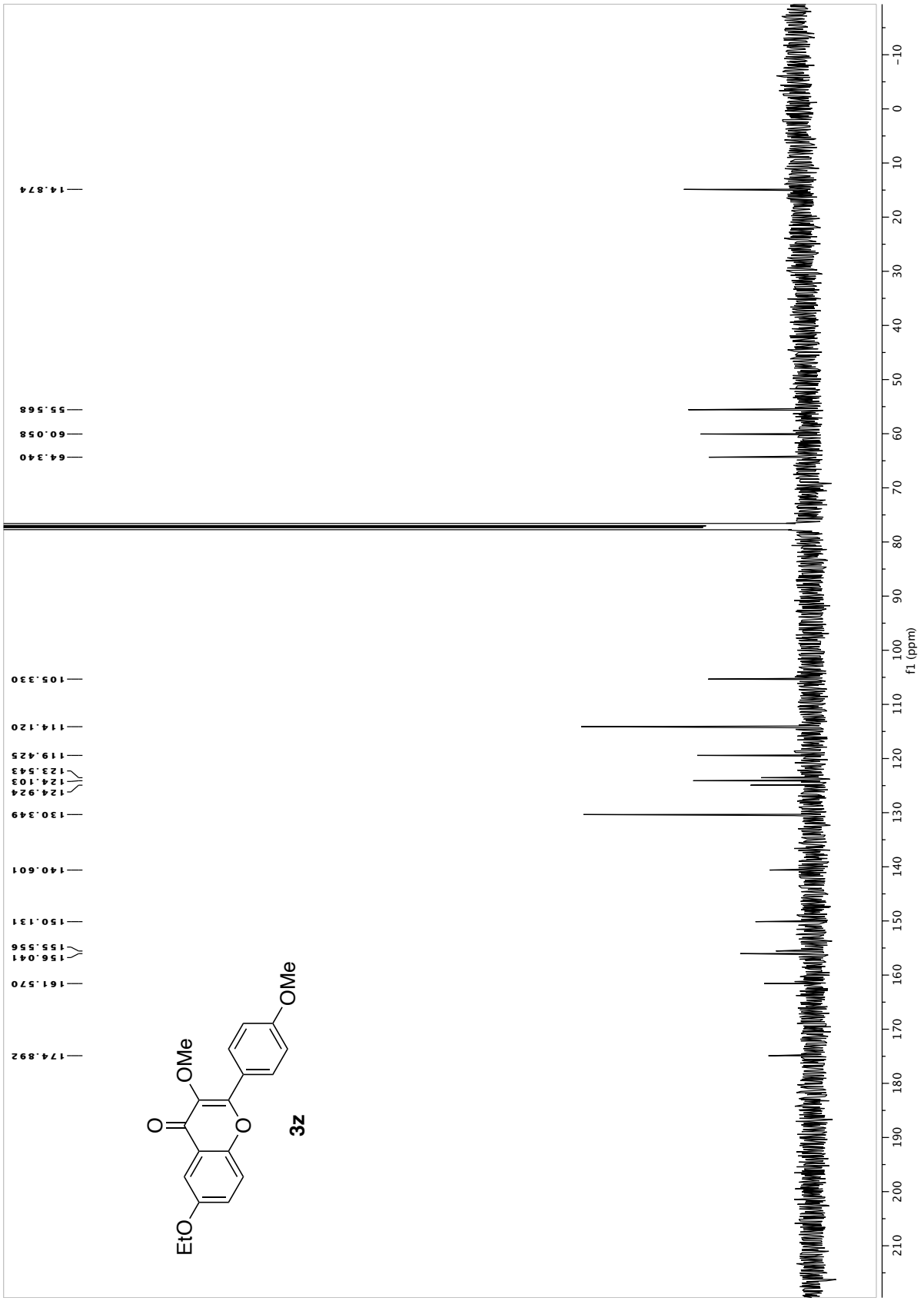

174.783
161.538
156.639
155.523
150.164
140.554
130.292
124.871
123.715
123.430
119.428
114.068
104.626
59.985
56.023
55.501
MeO
OMe
O
O
OMe
3x
f1 (ppm)

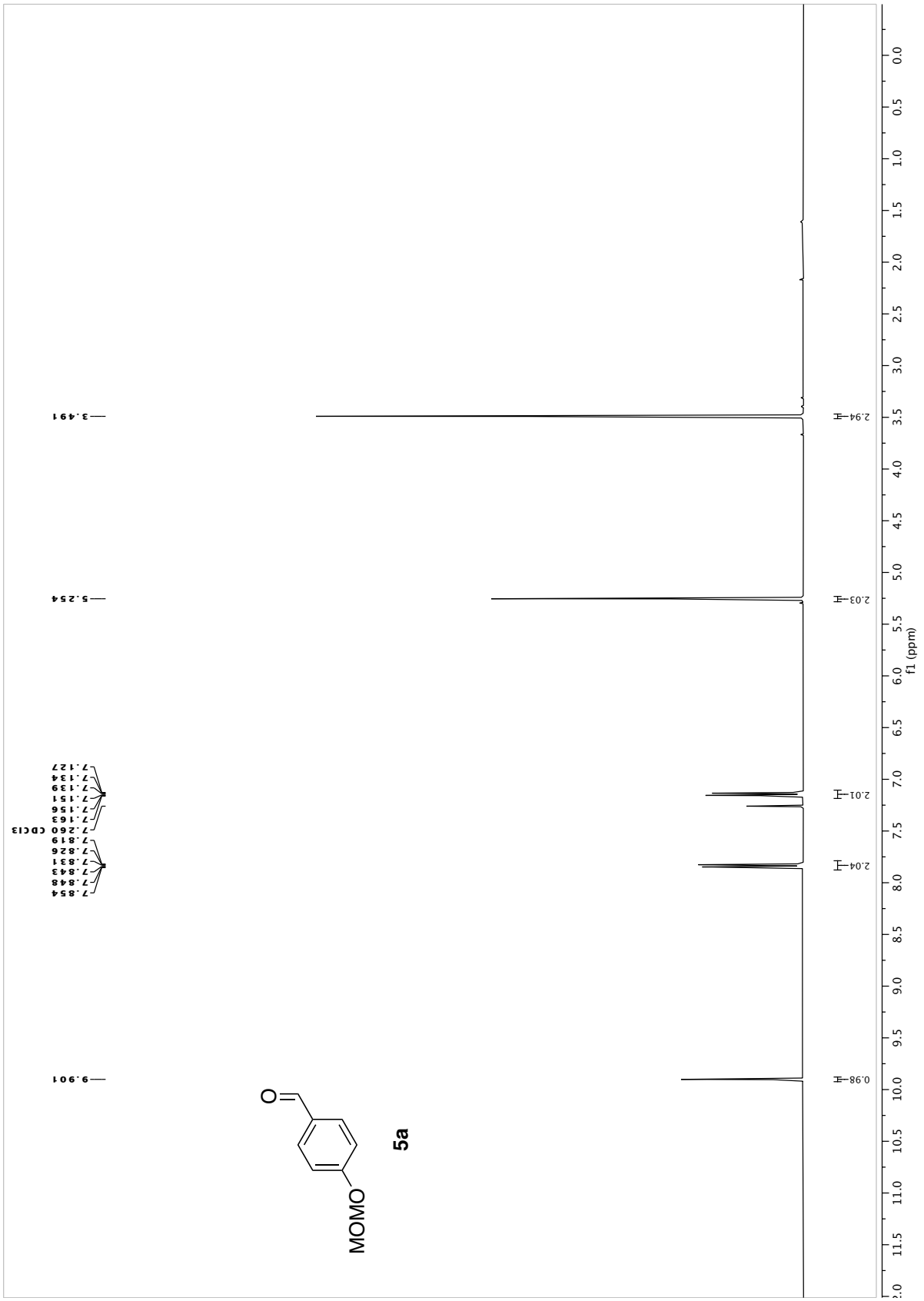

8.135
8.128
8.122
8.116
8.110
8.105
8.098
8.049
8.046
8.043
7.489
7.483
7.468
7.462
7.432
7.410
7.051
7.044
7.038
7.026
7.021
7.013
6.996
3.900
3.875
2.468
2.98
2.98
2.06
1.02
1.03
2.01
0.64
f1 (ppm)
OMe
OMe
O
O
3y

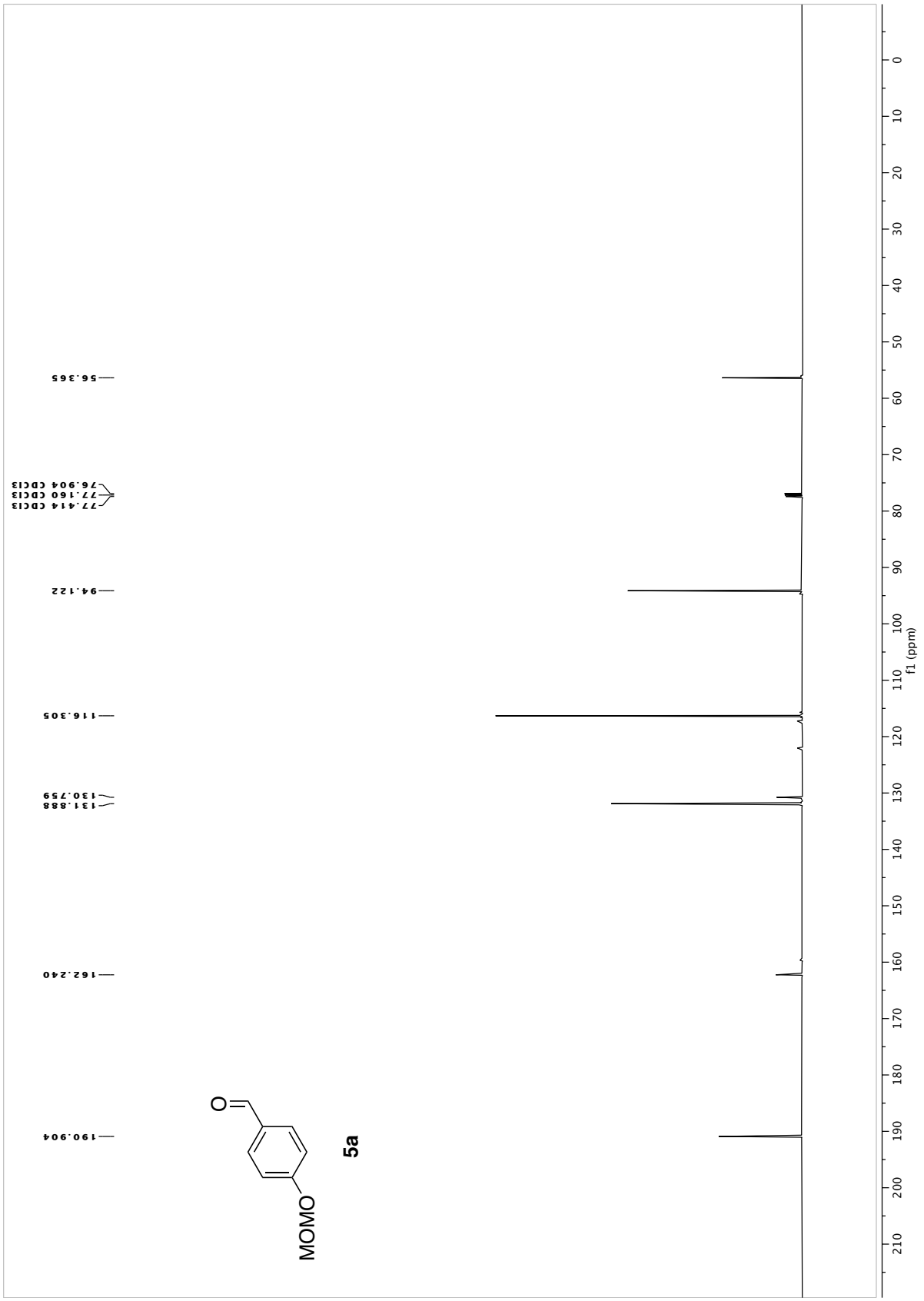

OMe
OMe
O
O
3y
175.044
161.504
155.543
153.498
140.837
134.665
134.541
130.275
125.036
123.914
123.407
117.709
114.023
59.951
55.467
20.983
f1 (ppm)

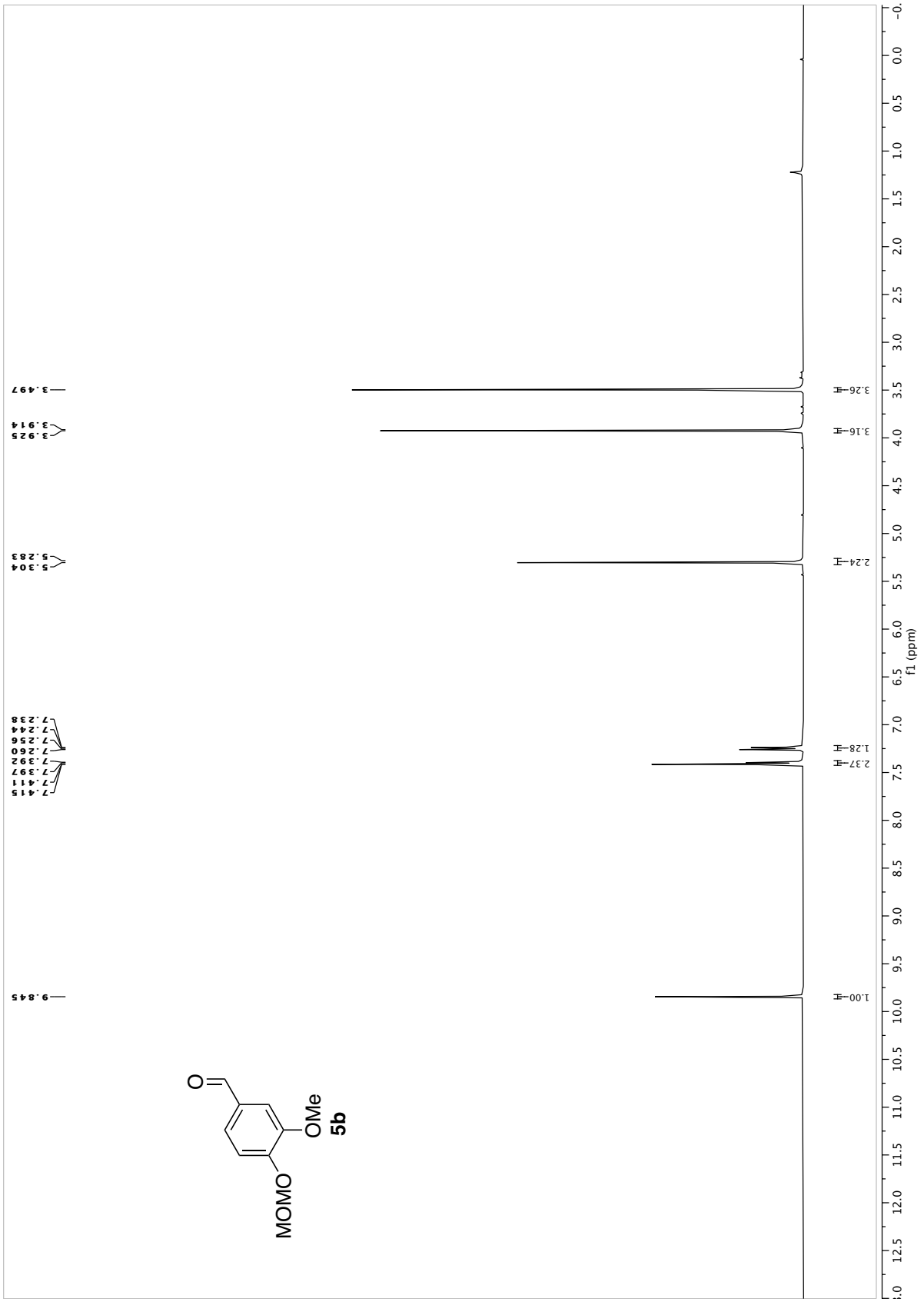

8.118
8.096
7.597
7.589
7.462
7.440
7.269
7.260
7.238
7.044
7.021
4.176
4.159
4.141
4.124
3.900
3.879
1.479
1.462
1.444
1.81
1.00
0.96
1.24
1.75
2.02
2.95
2.85
2.83
f1 (ppm)
OMe
OMe
O
O
EtO

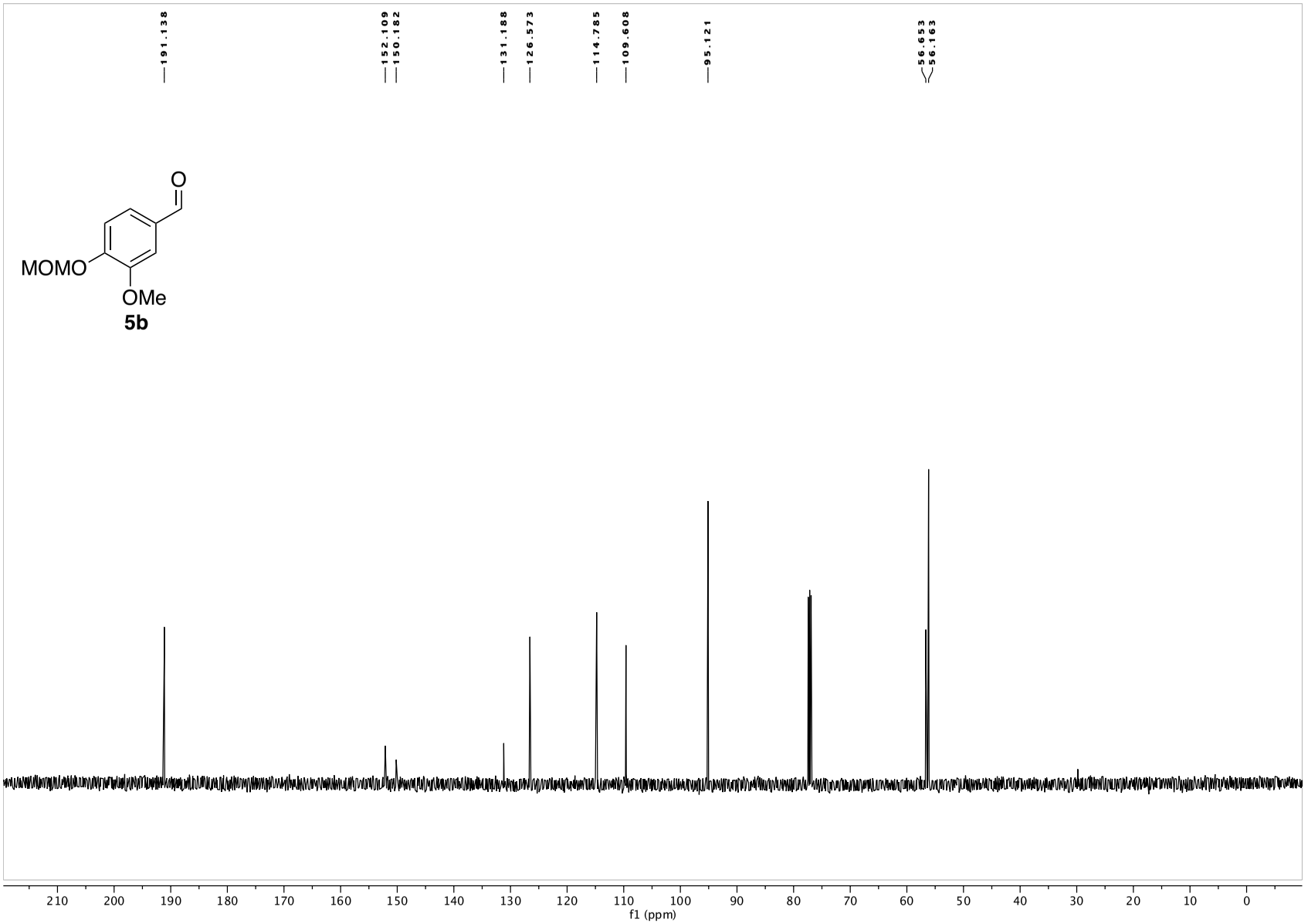
3z

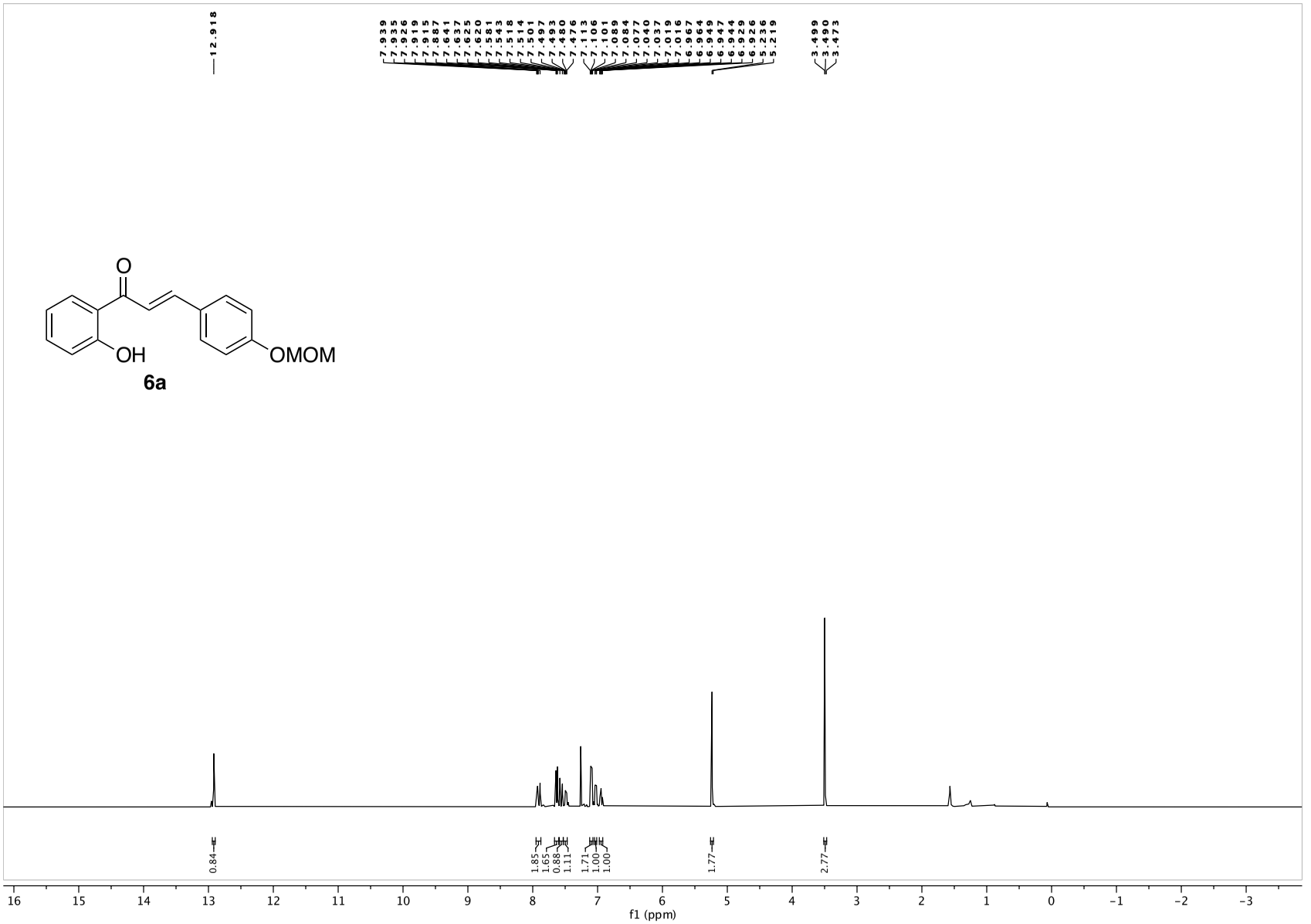

174.892
161.570
156.041
155.556
150.131
140.601
130.349
124.924
124.103
123.543
119.425
114.120
105.330
64.340
60.058
55.568
14.874
OMe
OMe
O
O
EtO
3z
f1 (ppm)

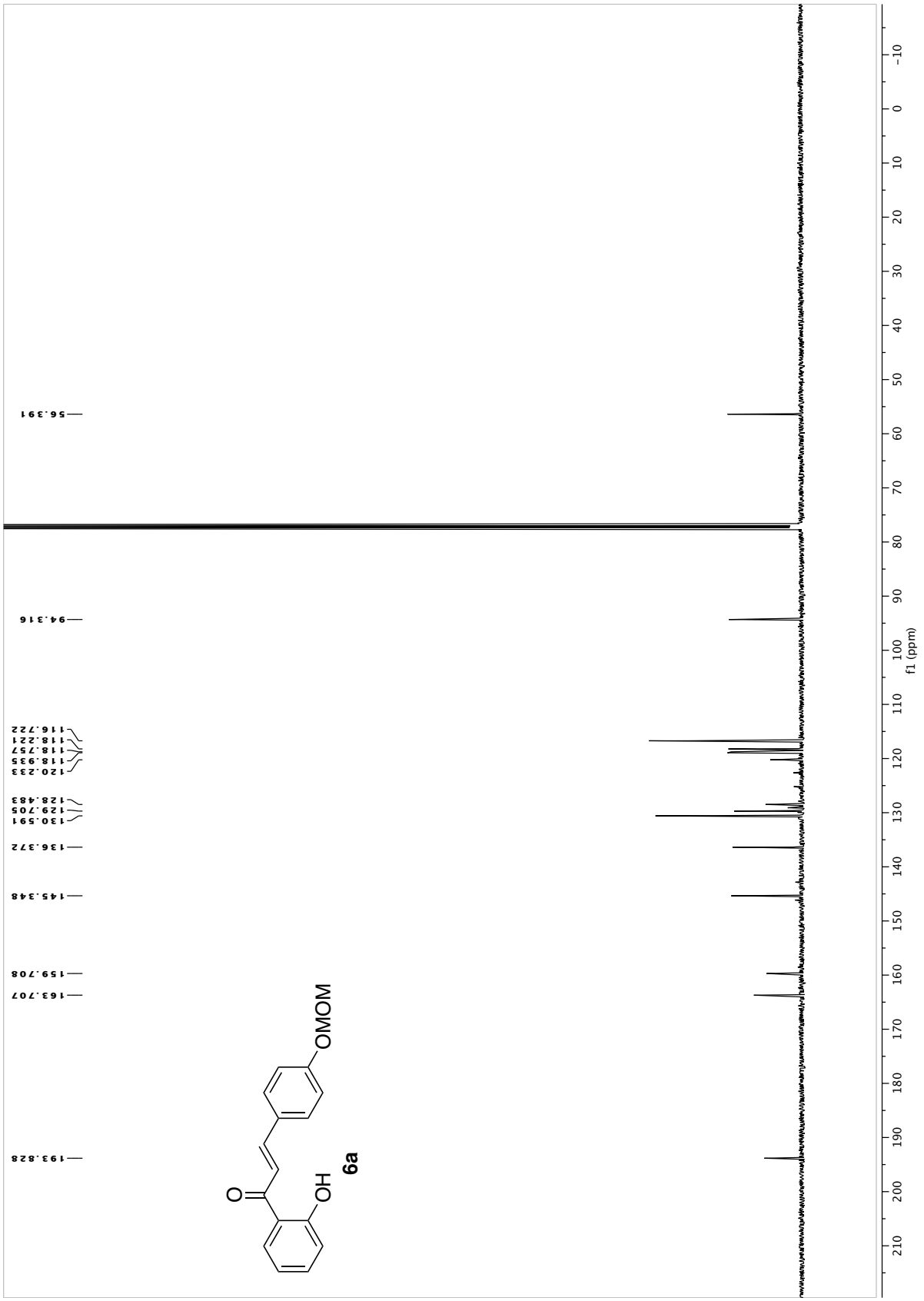

9.901
7.854
7.848
7.843
7.831
7.826
7.819
7.260 CDCl3
7.163
7.156
7.151
7.139
7.134
7.127
5.254
3.491
0.98
2.04
2.01
2.03
2.94
MOMO
O
5a
f1 (ppm)

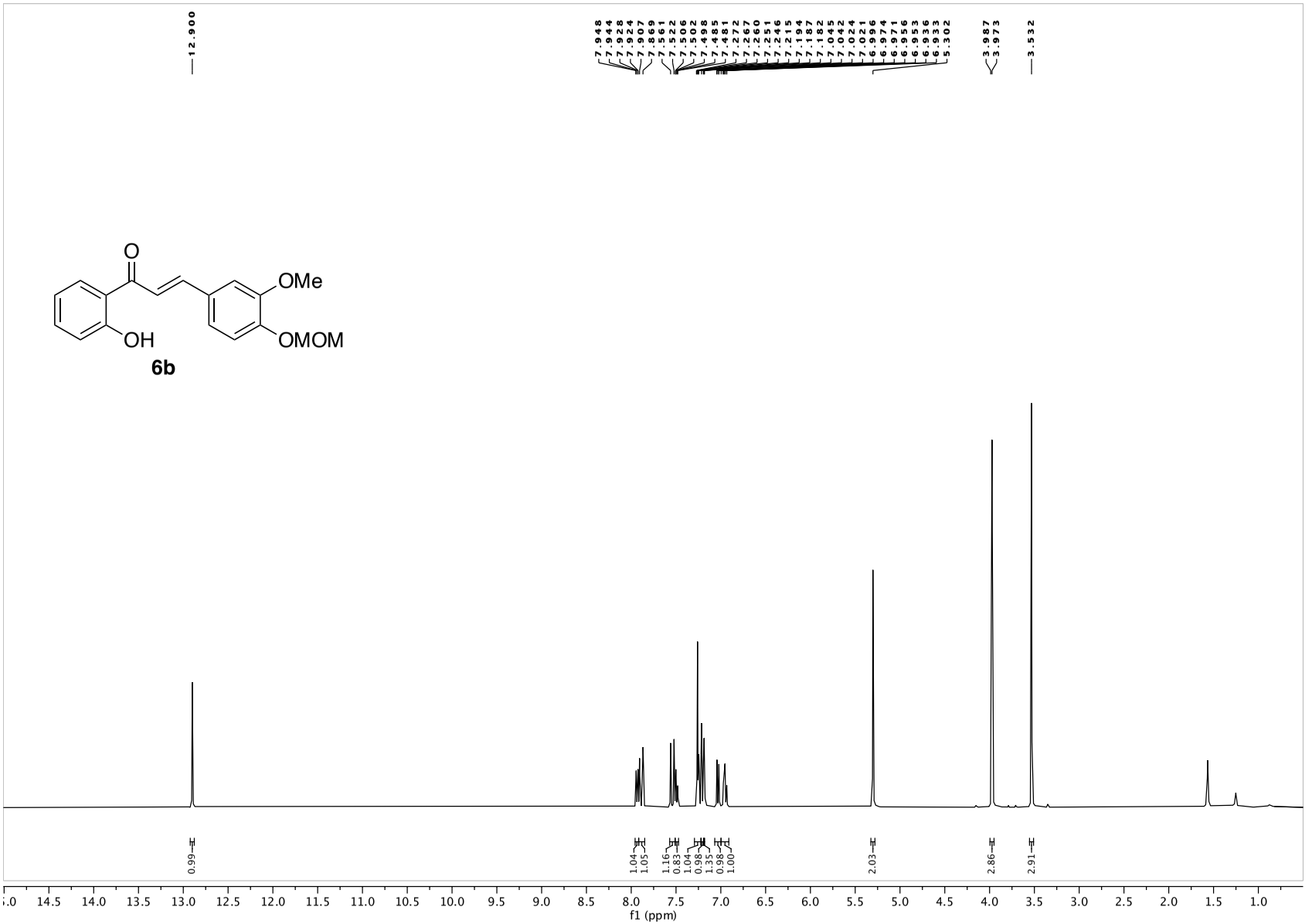

190.904
162.240
131.888
130.759
116.305
94.122
77.414 CDCl3
77.160 CDCl3
76.904 CDCl3
56.365
MOMO
O
5a
f1 (ppm)

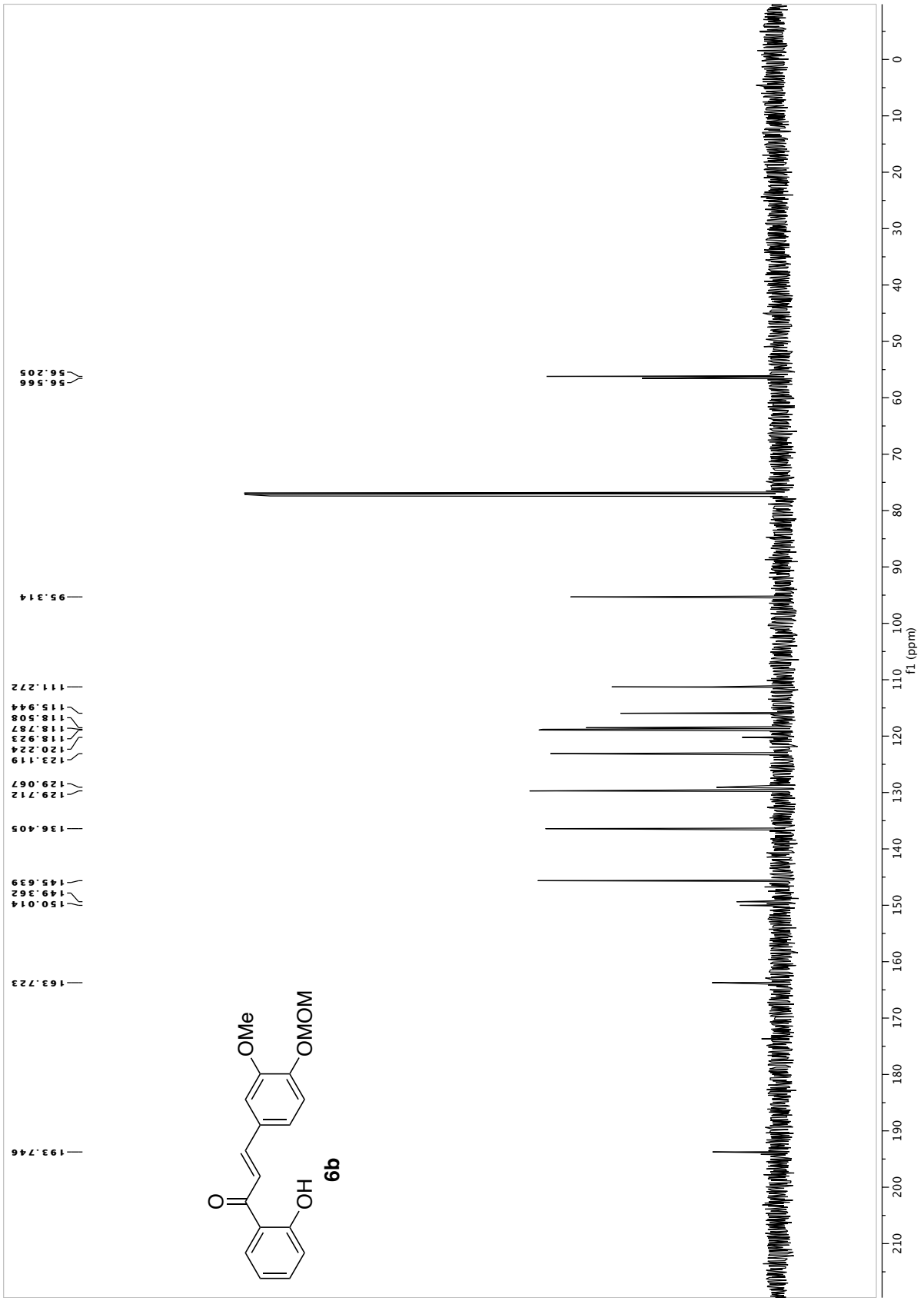

9.845
7.415
7.411
7.397
7.392
7.260
7.256
7.244
7.238
5.304
5.283
3.925
3.914
3.497
1.00
2.37
1.28
2.24
3.16
3.26
f1 (ppm)
MOMO
OMe
O
5b

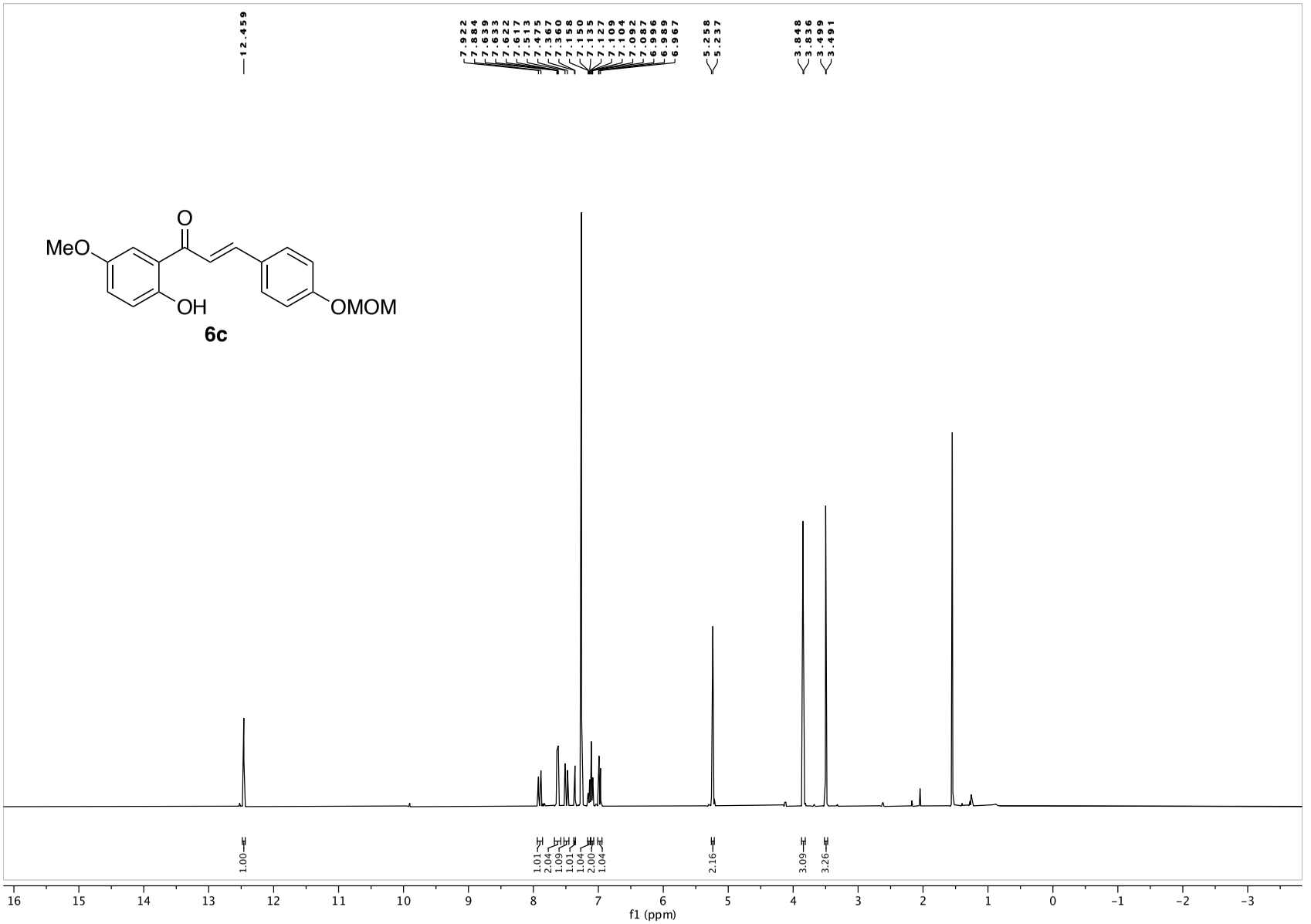

191.138
152.109
150.182
131.188
126.573
114.785
109.608
95.121
56.653
56.163
O
MOMO
OMe
5b
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

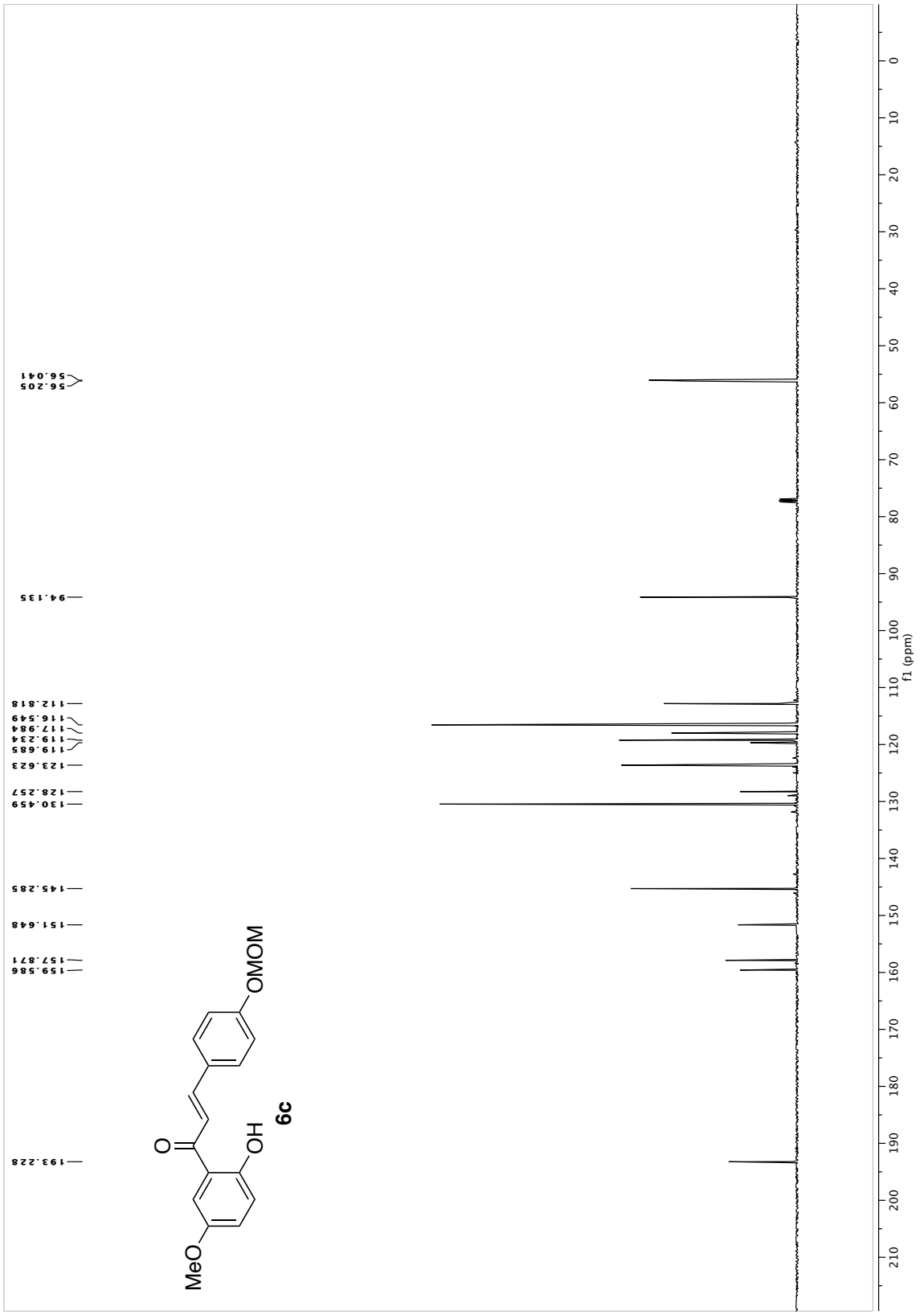

12.918
7.939
7.935
7.926
7.919
7.915
7.887
7.641
7.637
7.625
7.620
7.581
7.543
7.518
7.514
7.501
7.497
7.493
7.480
7.476
7.113
7.106
7.101
7.089
7.084
7.077
7.040
7.037
7.019
7.016
6.967
6.964
6.949
6.947
6.944
6.928
6.926
5.236
5.219
3.499
3.490
3.473
O
OH
OMOM
6a
0.84
1.85
1.65
0.88
1.11
1.71
1.00
1.00
1.77
2.77
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)


193.828
163.707
159.708
145.348
136.372
130.591
129.705
128.483
120.233
118.935
118.757
118.221
116.722
94.316
56.391
OMOM
OH
O
6a
f1 (ppm)


12.900
7.948
7.944
7.928
7.924
7.907
7.869
7.561
7.522
7.506
7.502
7.498
7.485
7.481
7.272
7.267
7.260
7.251
7.246
7.215
7.194
7.187
7.182
7.045
7.042
7.024
7.021
6.996
6.974
6.971
6.956
6.953
6.936
6.933
5.302
3.987
3.973
3.532
O
OMe
OH
OMOM
6b
0.99
1.04
1.05
1.16
0.83
1.04
0.98
1.35
0.98
1.00
2.03
2.86
2.91
f1 (ppm)


193.746
163.723
150.014
149.362
145.639
136.405
129.712
129.067
123.119
120.224
118.923
118.787
118.508
115.944
111.272
95.314
56.566
56.205
OMe
OMOM
OH
O
6b
f1 (ppm)


12.459
7.922
7.884
7.639
7.633
7.622
7.617
7.513
7.475
7.367
7.360
7.158
7.150
7.135
7.127
7.109
7.104
7.092
7.087
6.996
6.989
6.967
5.258
5.237
3.848
3.836
3.499
3.491
MeO
O
OH
OMOM
6c
1.00
1.01
2.04
1.09
1.01
2.00
1.04
2.16
3.09
3.26
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)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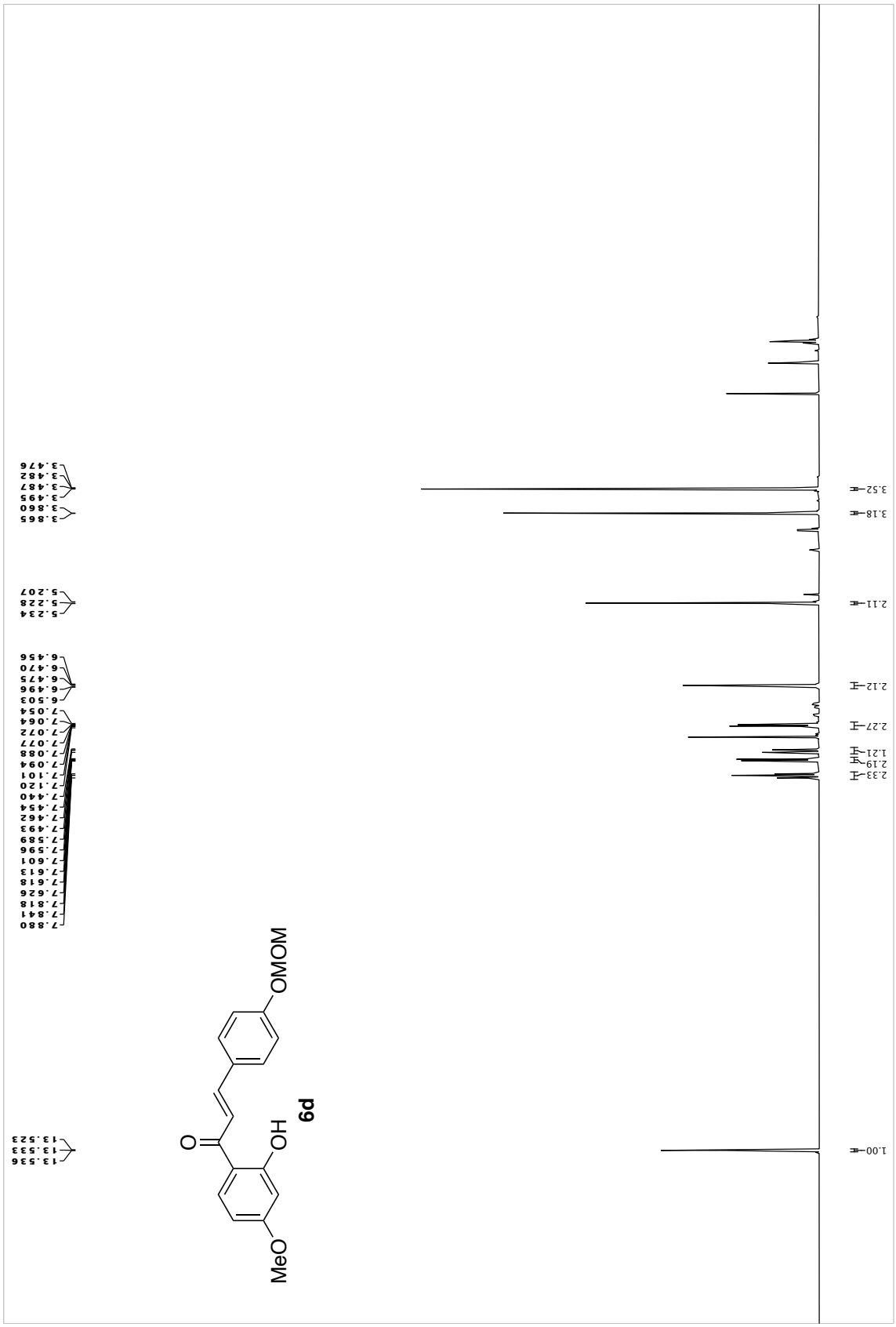
159.586
157.871
151.648
145.285
130.459
128.257
123.623
119.685
119.234
117.984
116.549
112.818
94.135
56.205
56.041
MeO
OH
O
OMOM
6c
f1 (ppm)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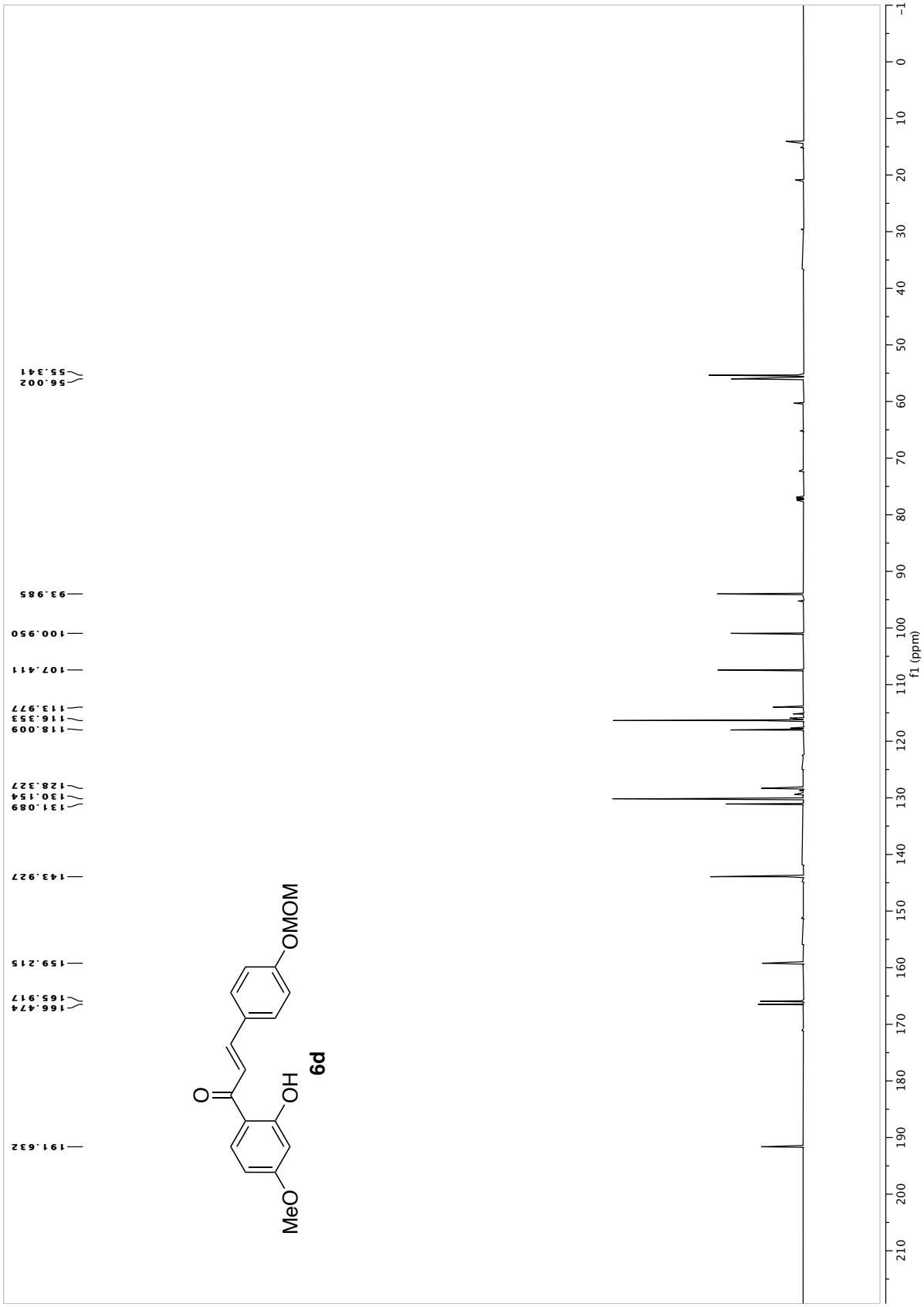
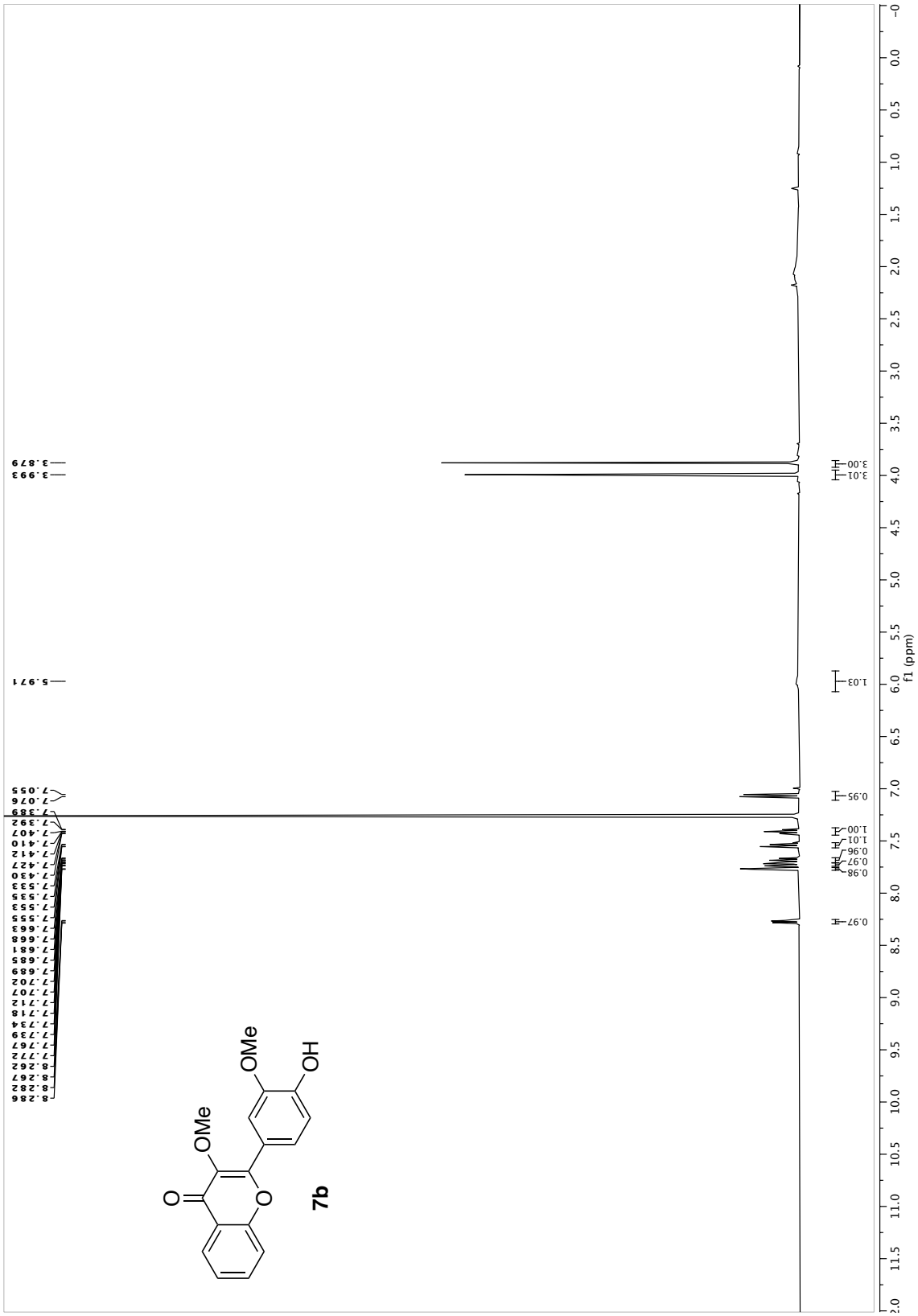
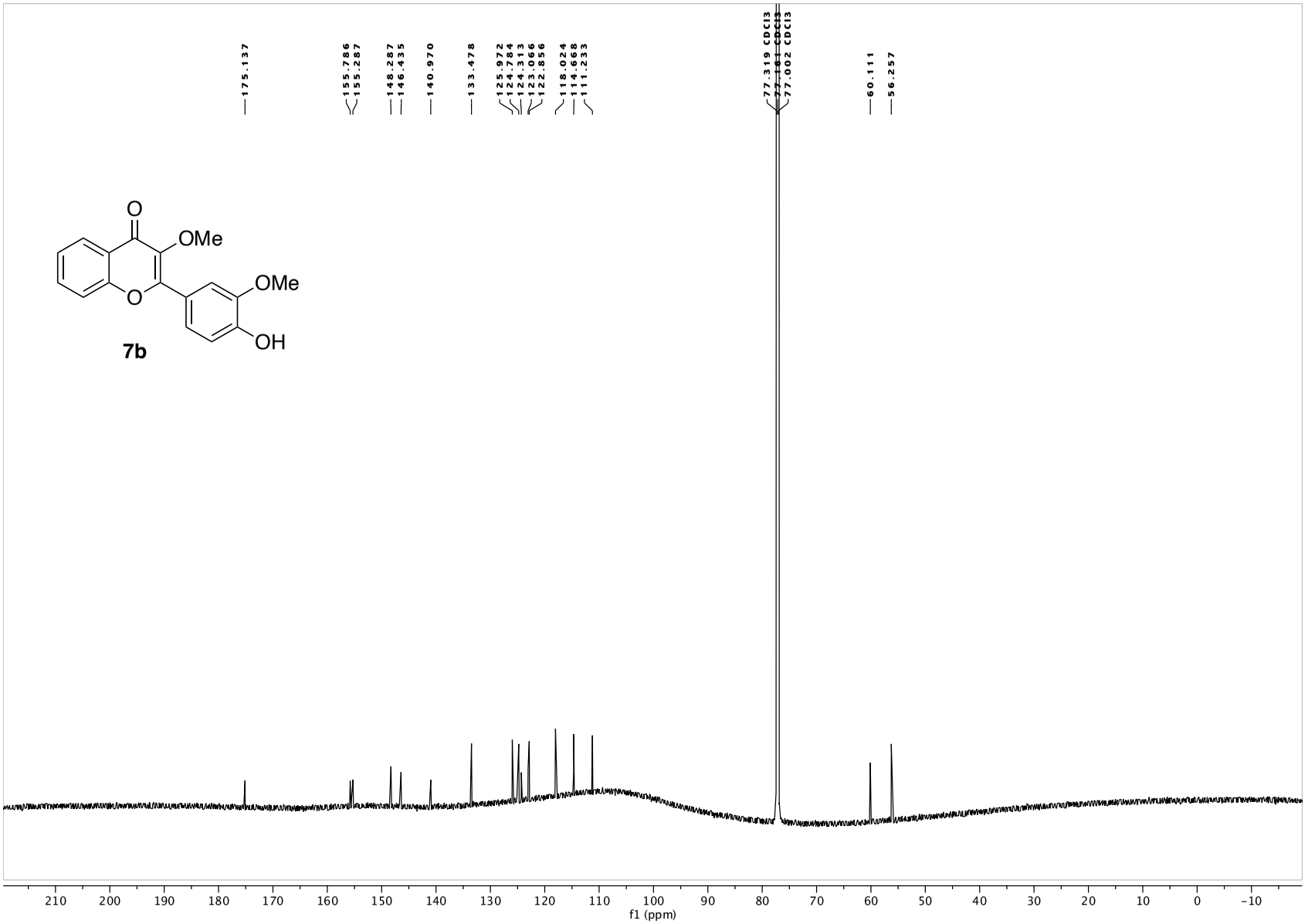
13.533
13.523
7.880
7.841
7.818
7.626
7.618
7.613
7.601
7.596
7.589
7.493
7.462
7.454
7.440
7.120
7.101
7.094
7.088
7.077
7.072
7.064
7.054
6.503
6.496
6.475
6.470
6.456
5.234
5.228
5.207
3.865
3.860
3.495
3.487
3.482
3.476
OMOM
OH
O
MeO
6d
1.00
3.52
3.18
2.11
2.12
2.27
1.21
2.19
2.33
f1 (ppm)


191.632
166.474
165.917
159.215
143.927
131.089
130.154
128.327
118.009
116.353
113.977
107.411
100.950
93.985
56.002
55.341
OMOM
OH
O
MeO
6d
f1 (ppm)


8.286
8.282
8.267
8.262
7.772
7.767
7.739
7.734
7.718
7.712
7.707
7.702
7.689
7.685
7.681
7.668
7.663
7.555
7.553
7.535
7.533
7.430
7.427
7.412
7.410
7.407
7.392
7.389
7.076
7.055
5.971
3.993
3.879
0.97
0.95
1.03
0.98
0.97
0.96
1.01
1.00
3.01
3.00
f1 (ppm)
OMe
OMe
OH
O
O
7b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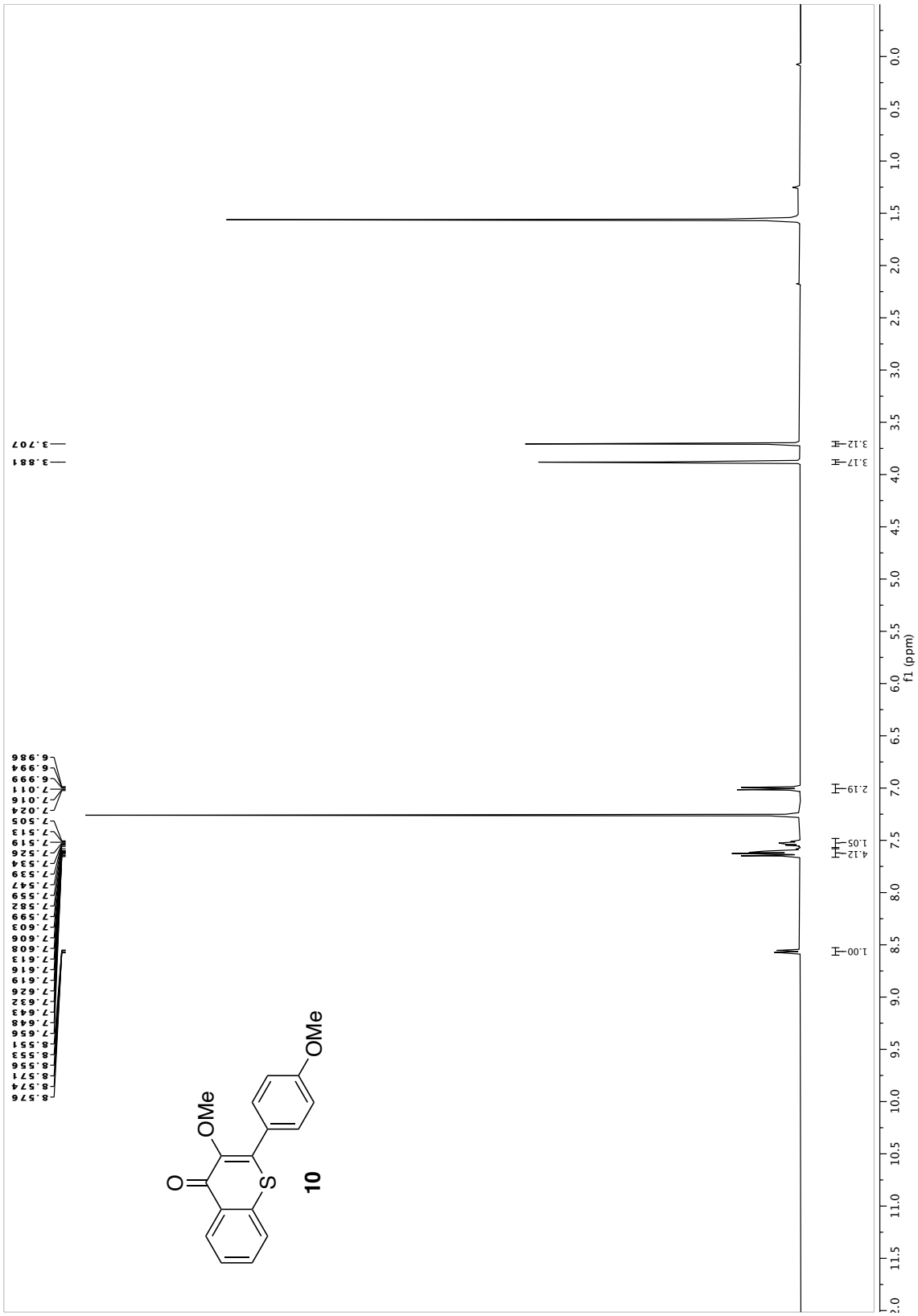
155.786
155.287
148.287
146.435
140.970
133.478
125.972
124.784
124.313
123.066
122.856
118.024
114.668
111.233
77.319 CDCl3
77.161 CDCl3
77.002 CDCl3
60.111
56.257
O
OMe
O
OMe
OH
7b
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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8.574
8.571
8.556
8.553
8.551
7.656
7.648
7.643
7.632
7.626
7.619
7.616
7.613
7.608
7.606
7.603
7.599
7.582
7.559
7.547
7.539
7.534
7.526
7.519
7.513
7.505
7.024
7.016
7.011
6.999
6.994
6.986
3.881
3.707
1.00
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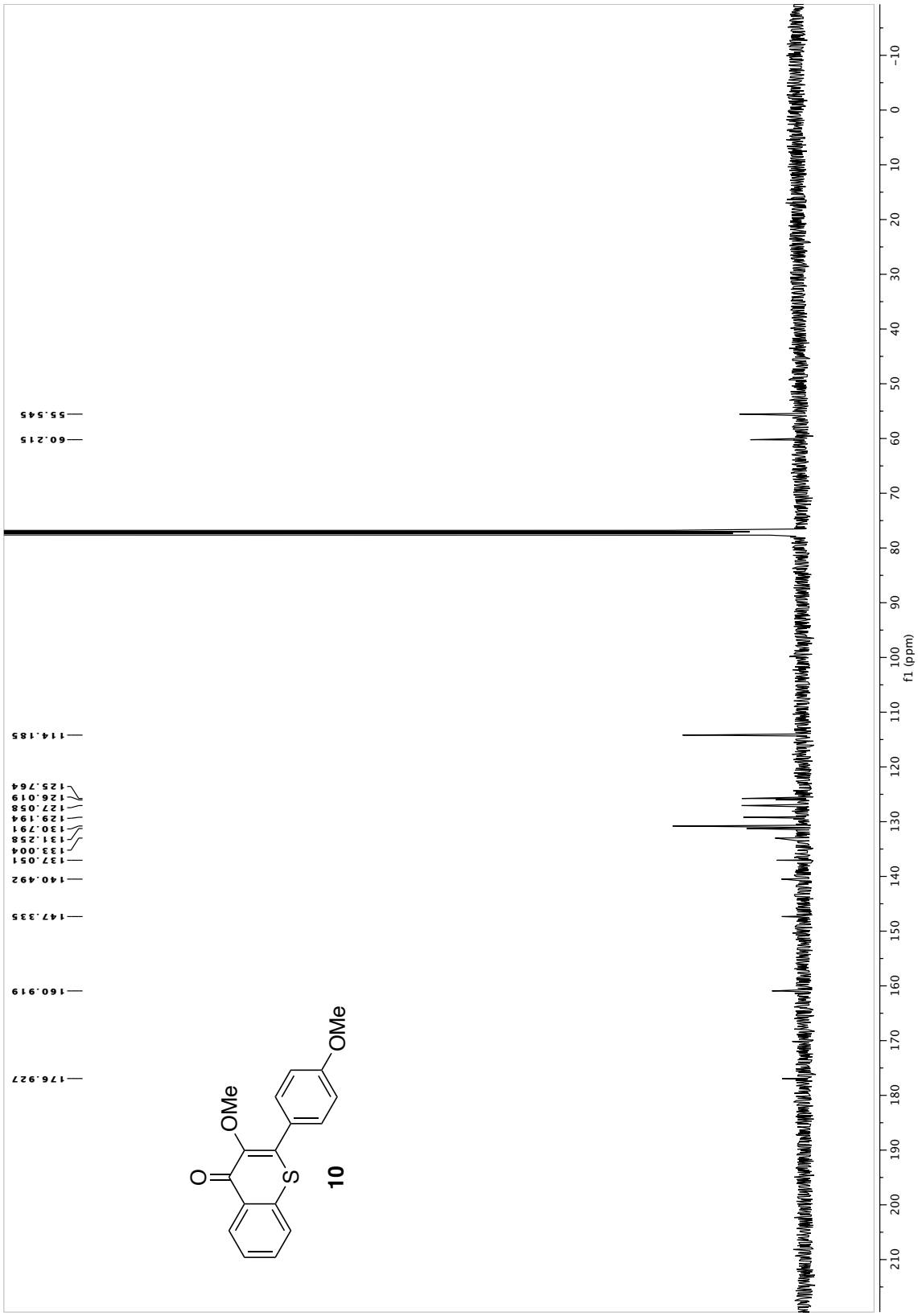
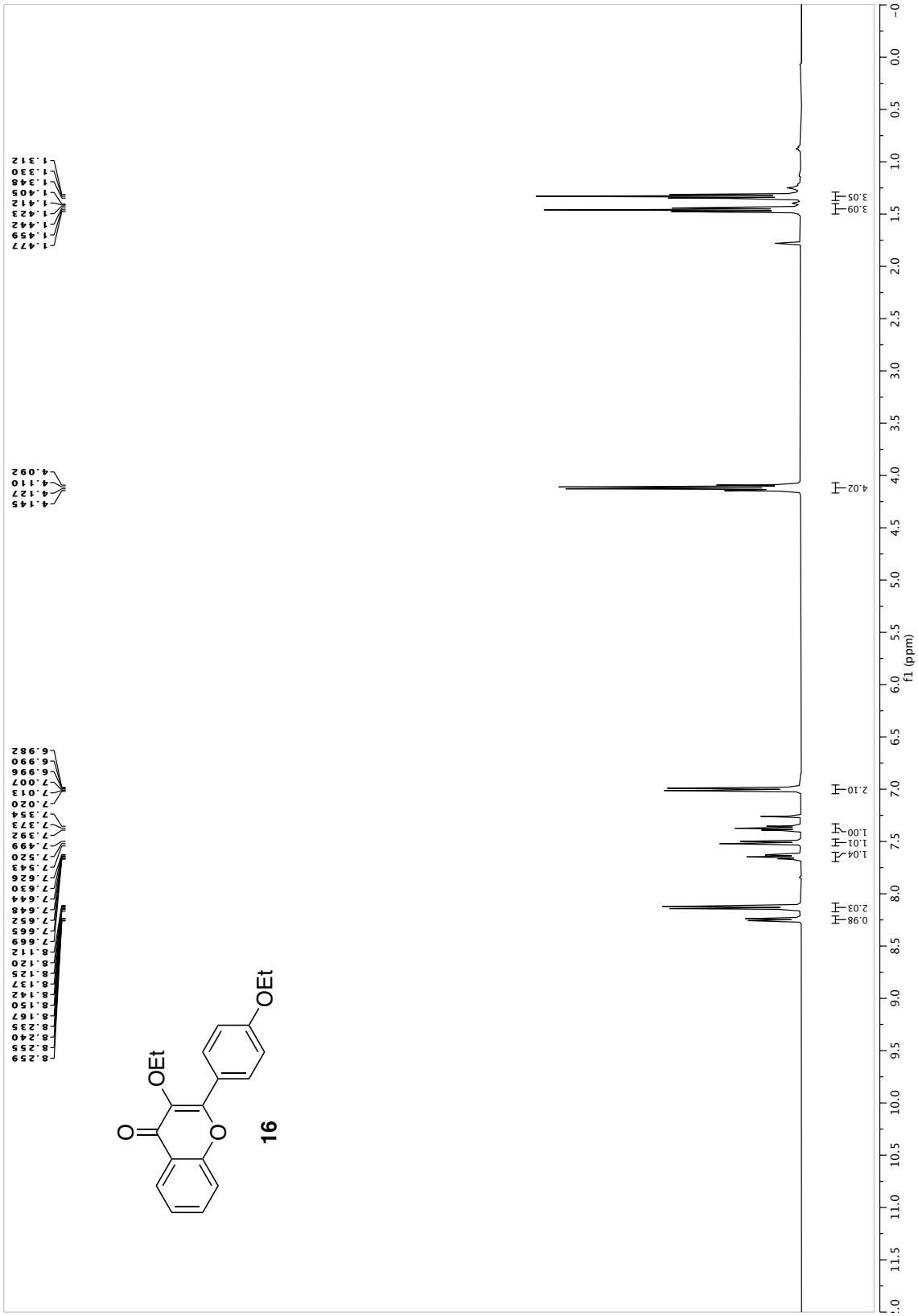
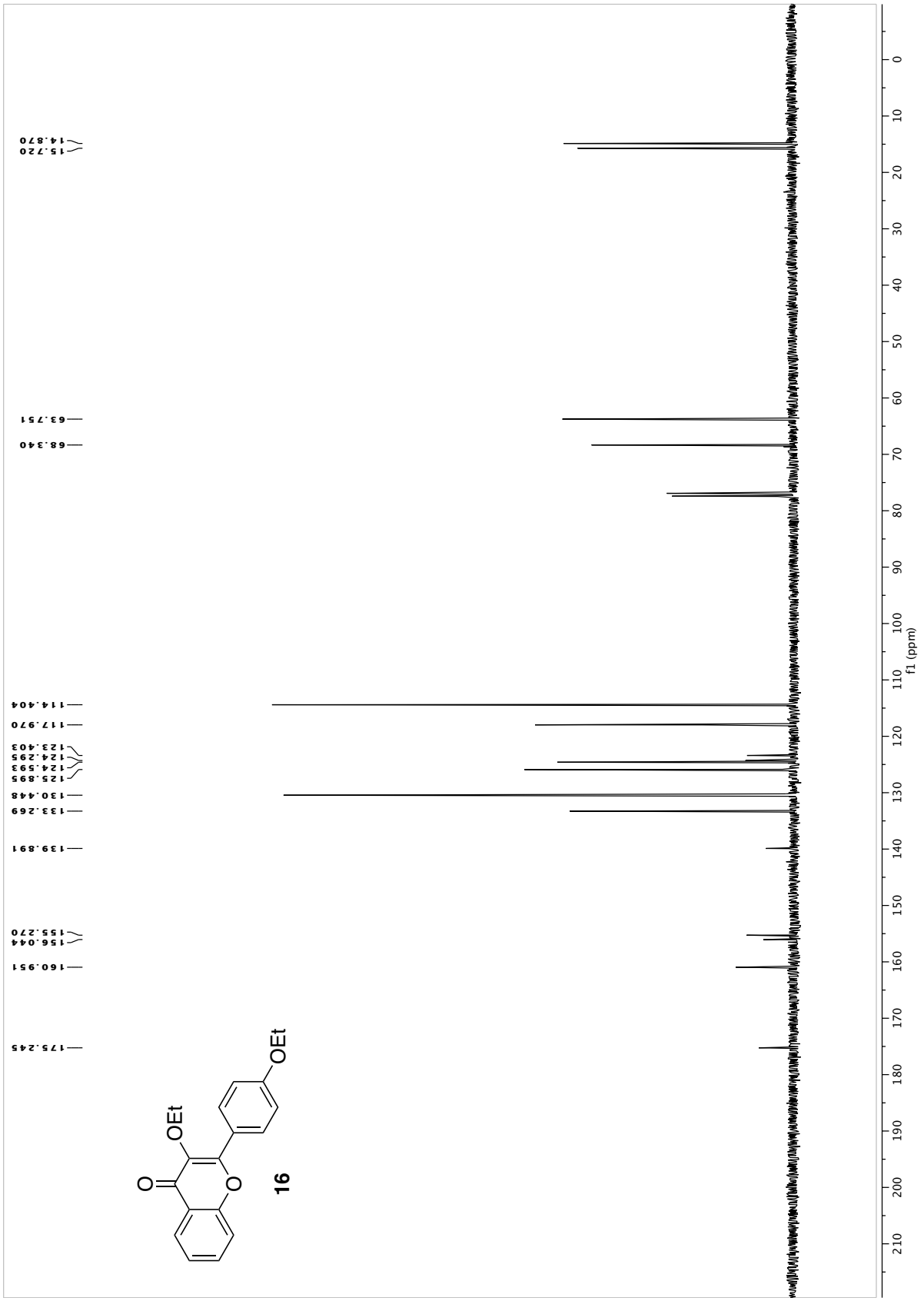
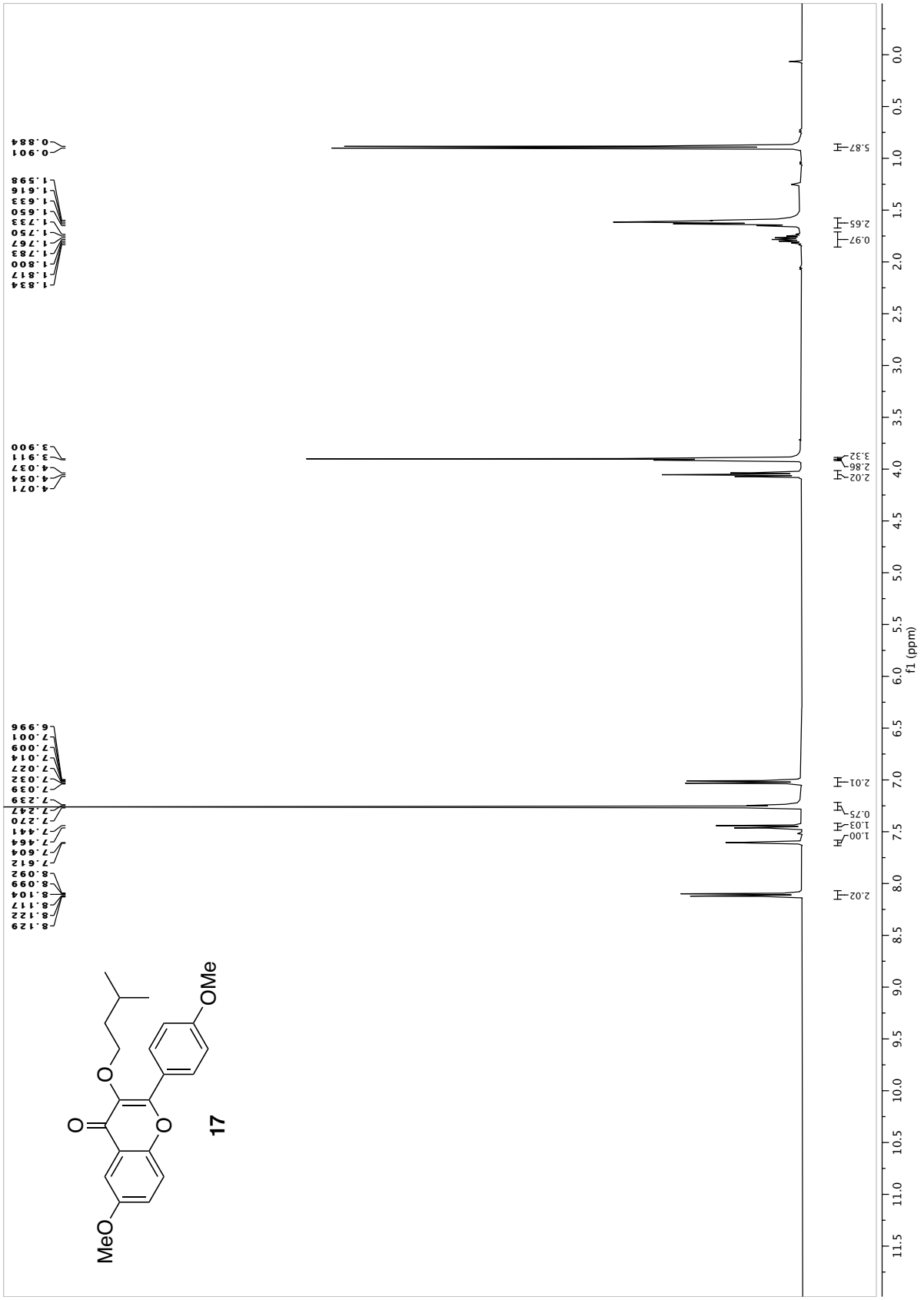
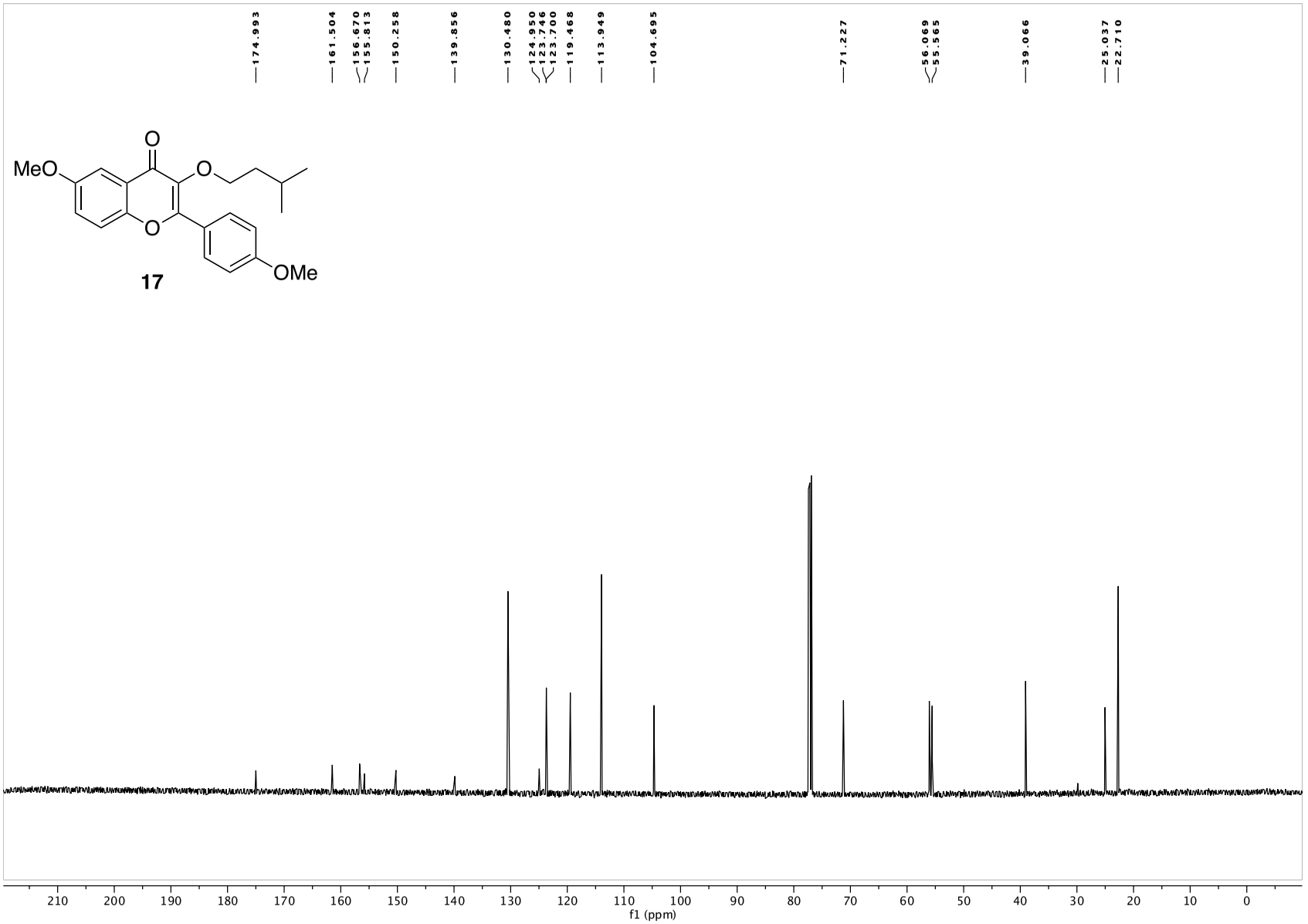
3.17
3.12
OMe
OMe
O
S
10
f1 (ppm)

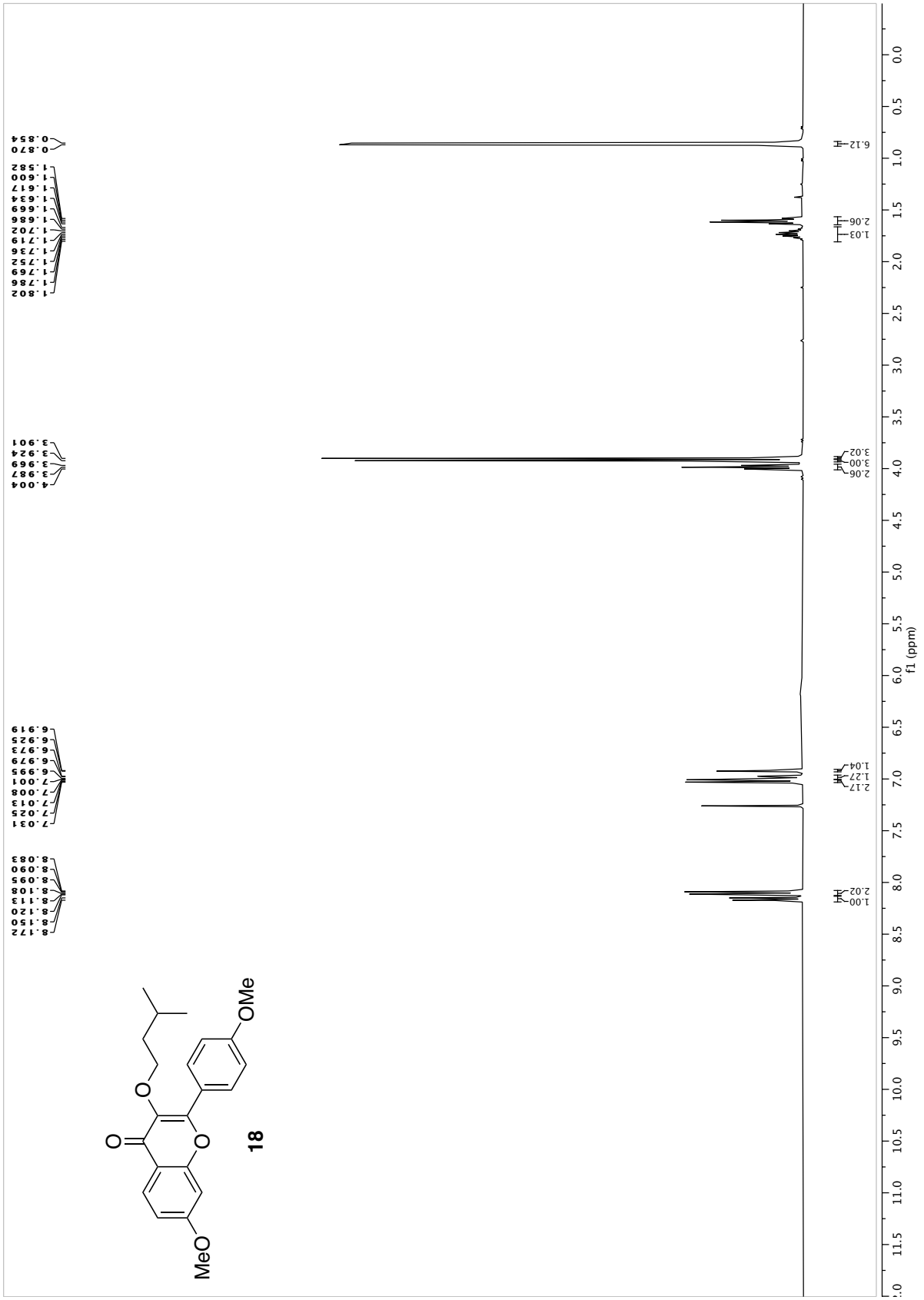

55.545
60.215
114.185
125.764
126.019
127.058
129.194
130.791
131.258
133.004
137.051
140.492
147.335
160.919
176.927
f1 (ppm)
OMe
OMe
O
S
10

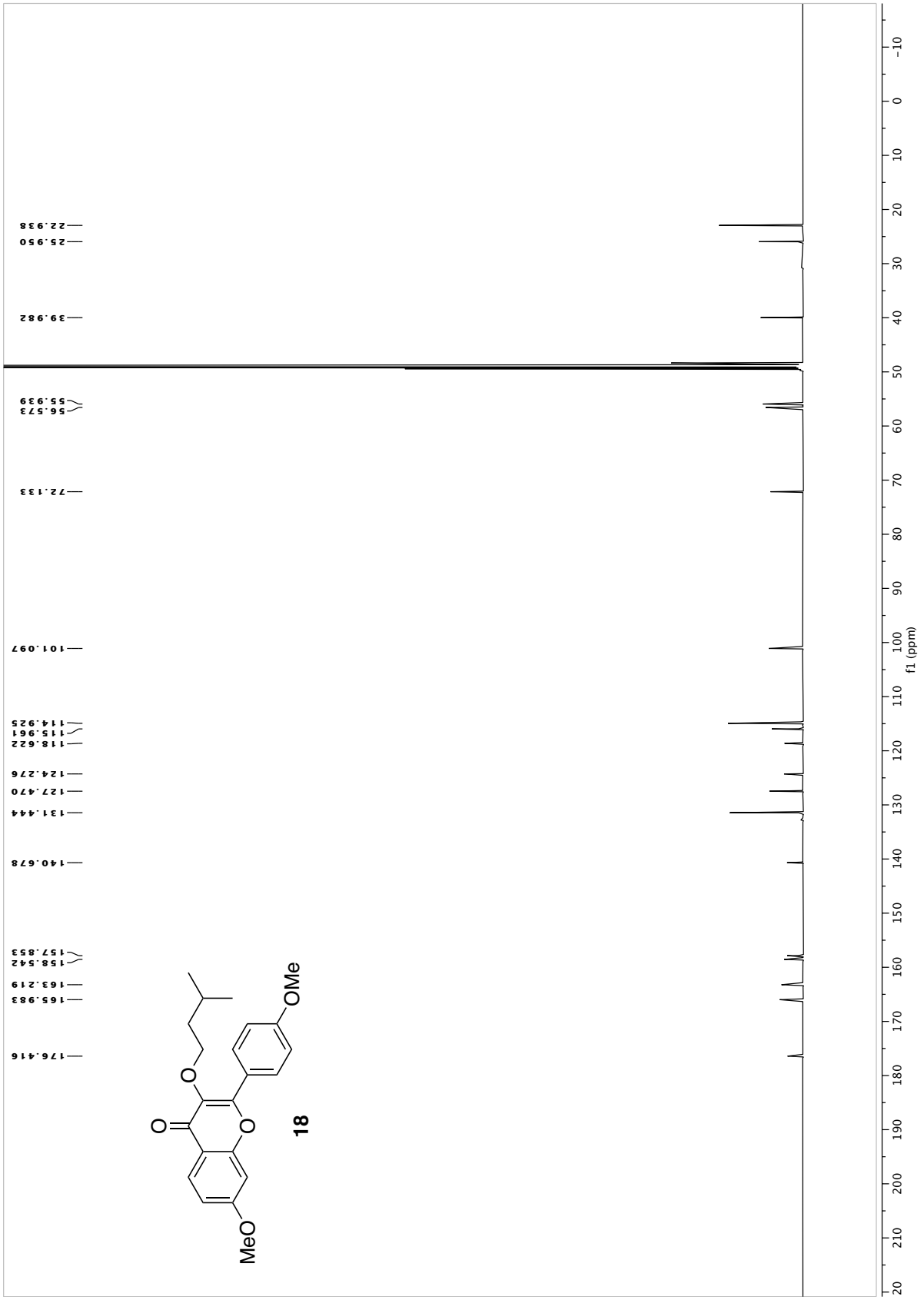

OEt
OEt
O
O
16
f1 (ppm)

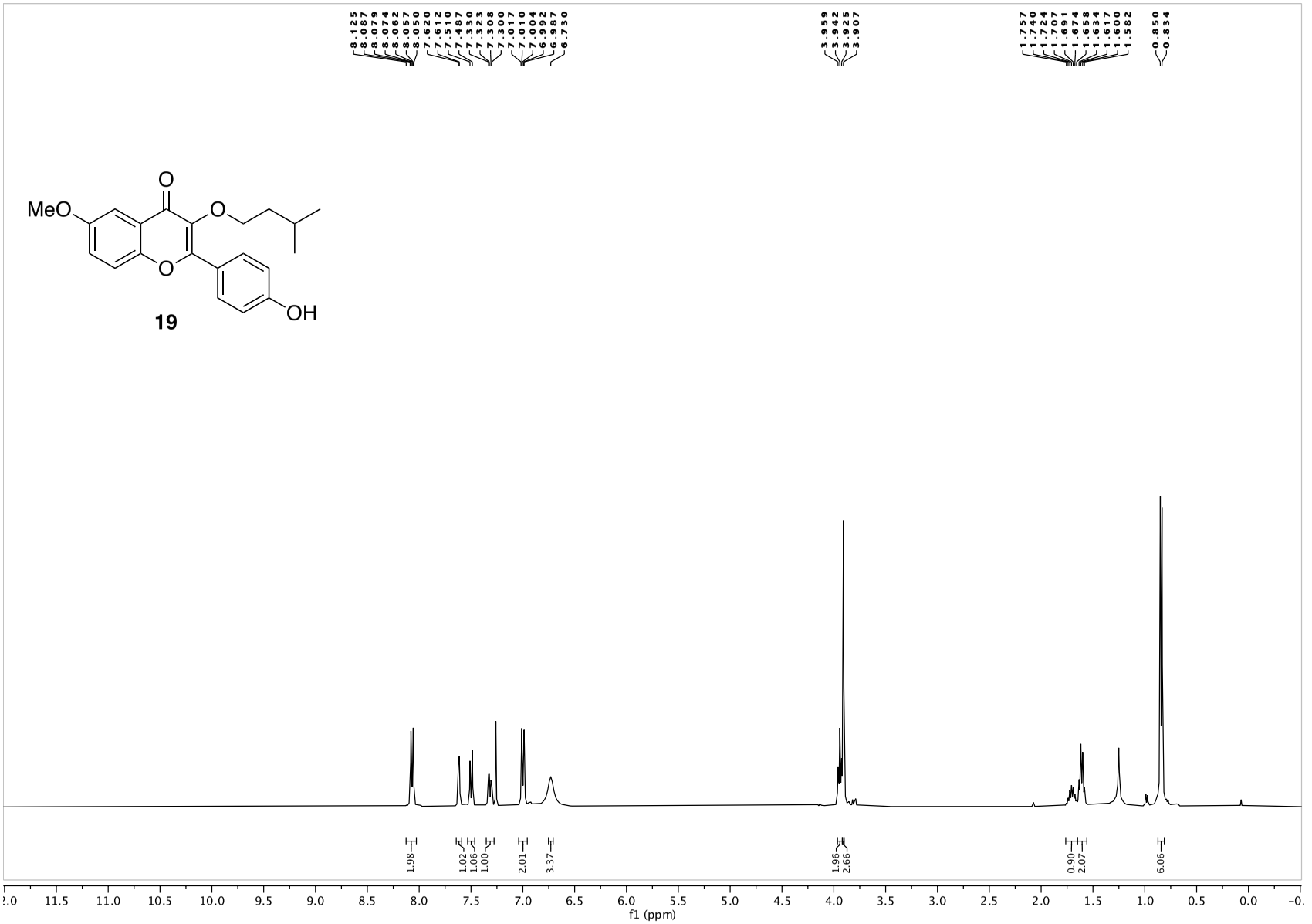

175.245
160.951
156.044
155.270
139.891
133.269
130.448
125.895
124.593
124.295
123.403
117.970
114.404
68.340
63.751
15.720
14.870
f1 (ppm)
OEt
OEt
O
O
16

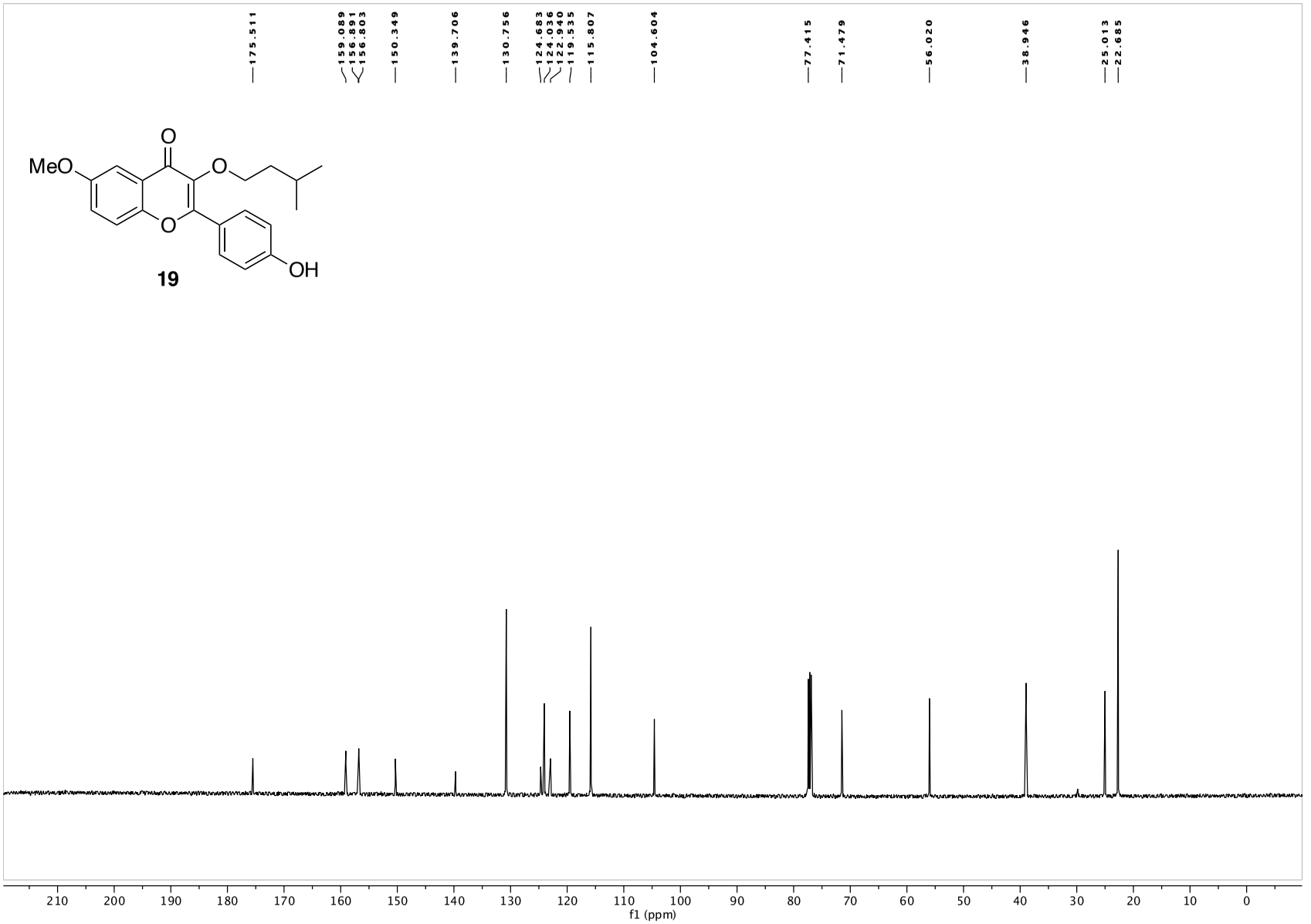

8.129
8.122
8.117
8.104
8.099
8.092
7.612
7.604
7.464
7.441
7.270
7.247
7.239
7.039
7.032
7.027
7.014
7.009
7.001
6.996
4.071
4.054
4.037
3.911
3.900
1.834
1.817
1.800
1.783
1.767
1.750
1.733
1.650
1.633
1.616
1.598
0.901
0.884
5.87
2.65
0.97
3.32
2.86
2.02
2.01
0.75
1.03
1.00
2.02
MeO
O
O
O
OMe
17
f1 (ppm)

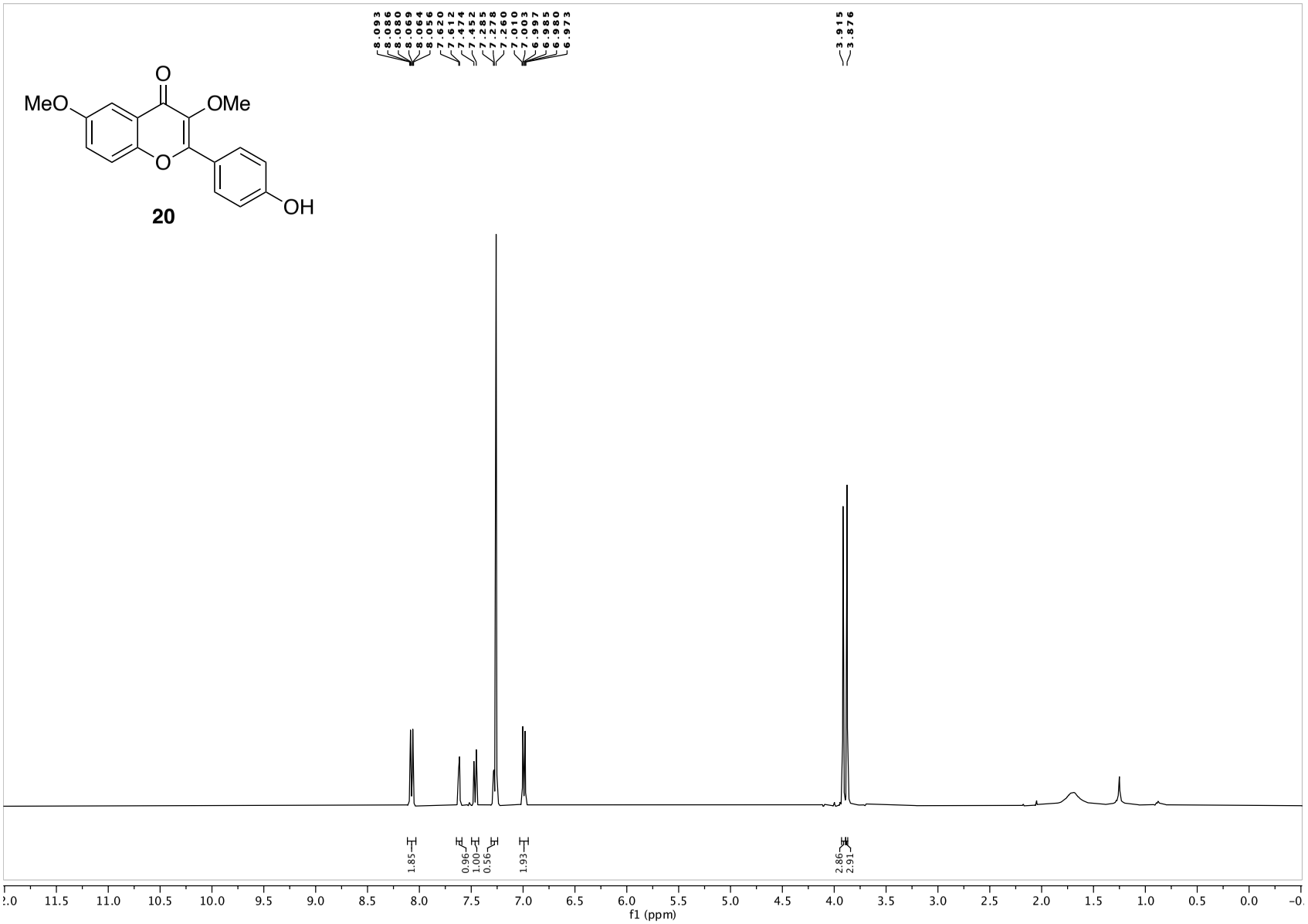

174.993
161.504
156.670
155.813
150.258
139.856
130.480
124.950
123.746
123.700
119.468
113.949
104.695
71.227
56.069
55.565
39.066
25.037
22.710
MeO
O
O
O
OMe
17
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.172
8.150
8.120
8.113
8.108
8.095
8.090
8.083
7.031
7.025
7.013
7.008
7.001
6.995
6.979
6.973
6.925
6.919
4.004
3.987
3.969
3.924
3.901
1.802
1.786
1.769
1.752
1.736
1.719
1.702
1.686
1.669
1.634
1.617
1.600
1.582
0.870
0.854
6.12
2.06
1.03
2.06
3.00
3.02
2.17
1.27
1.04
1.00
2.02
f1 (ppm)
MeO
O
O
O
OMe
18


22.938
25.950
39.982
55.939
56.573
72.133
101.097
114.925
115.961
118.622
124.276
127.470
131.444
140.678
157.853
158.542
163.219
165.983
176.416
MeO
OMe
O
O
O
18
f1 (ppm)


8.125
8.097
8.079
8.074
8.062
8.057
8.050
7.620
7.612
7.510
7.487
7.330
7.323
7.308
7.300
7.017
7.010
7.004
6.992
6.987
6.730
3.959
3.942
3.925
3.907
1.757
1.740
1.724
1.707
1.691
1.674
1.658
1.634
1.617
1.600
1.582
0.850
0.834
O
MeO
O
O
OH
19
1.98
1.02
1.06
1.00
2.01
3.37
1.96
2.66
0.90
2.07
6.06
f1 (ppm)


175.511
159.089
156.891
156.803
150.349
139.706
130.756
124.683
124.036
122.940
119.535
115.807
104.604
77.415
71.479
56.020
38.946
25.013
22.685
MeO
O
O
O
OH
19
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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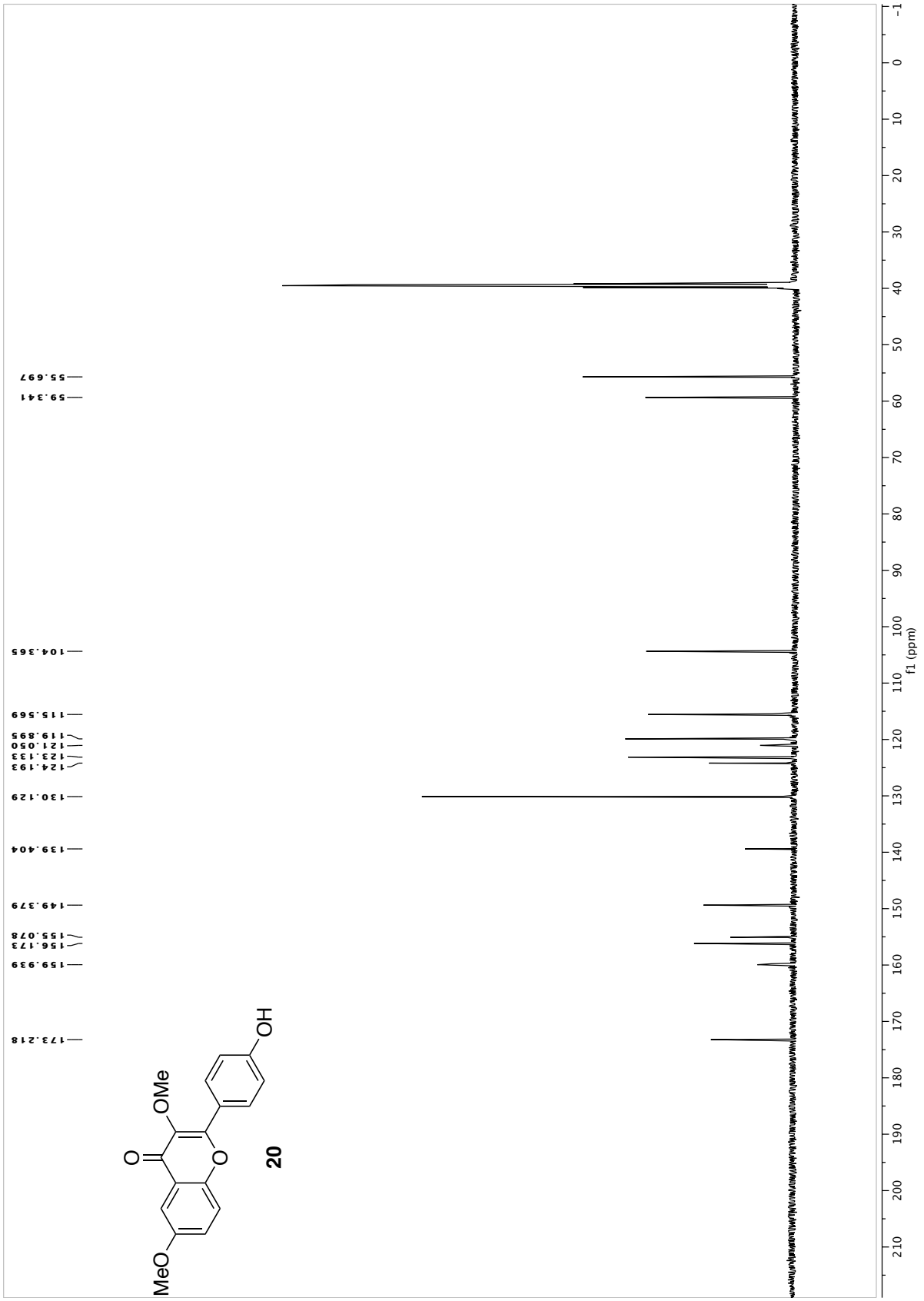
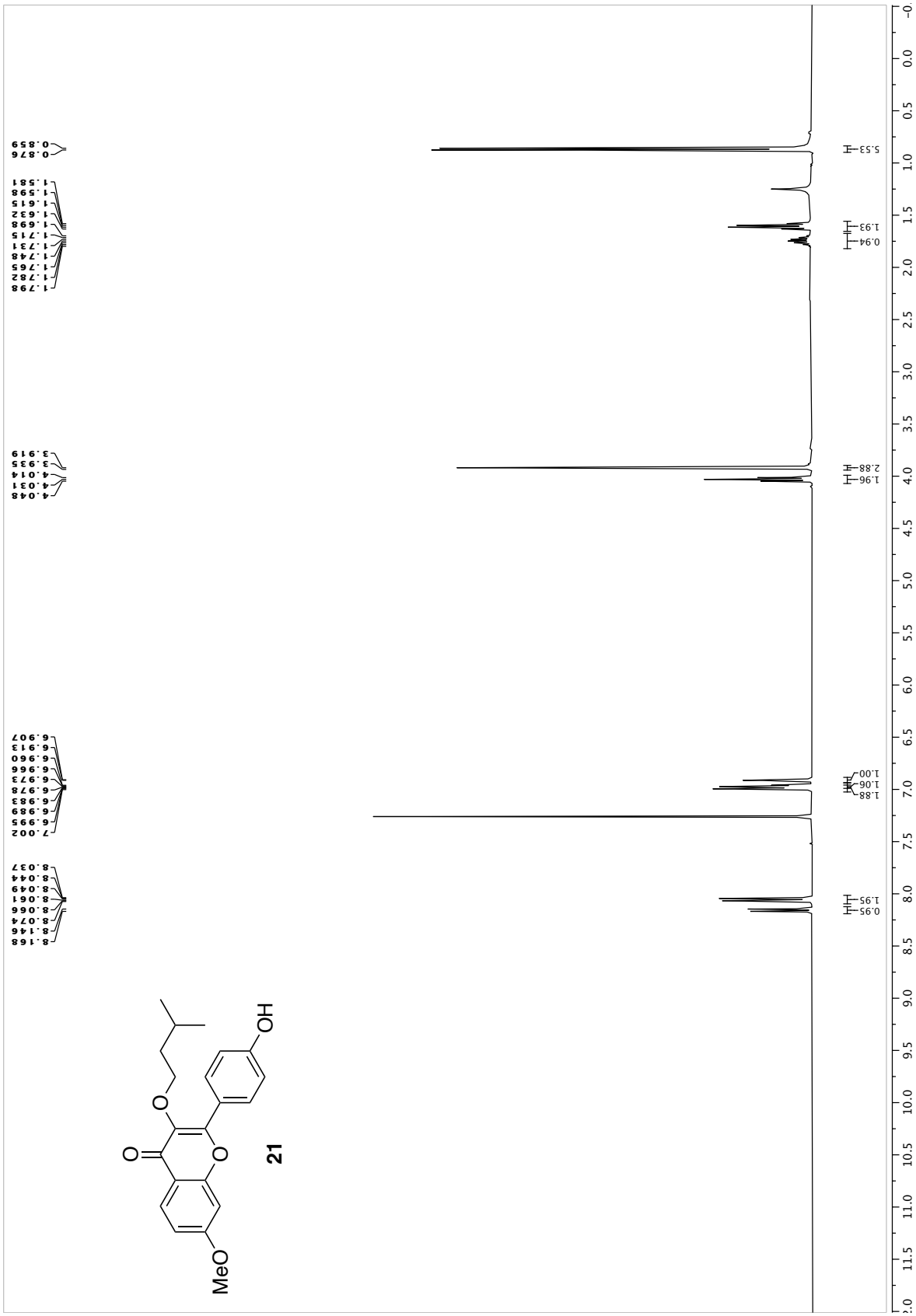
8.086
8.080
8.069
8.064
8.056
7.620
7.614
7.612
7.474
7.472
7.455
7.275
7.260
7.010
7.003
6.997
6.985
6.980
6.973
3.915
3.876
MeO
OMe
O
O
OH
20
1.85
0.96
1.00
0.56
1.93
2.86
2.91
f1 (ppm)


MeO
OMe
O
O
OH
20
173.218
159.939
156.173
155.078
149.379
139.404
130.129
124.193
123.133
121.050
119.895
115.569
104.365
59.341
55.697
f1 (ppm)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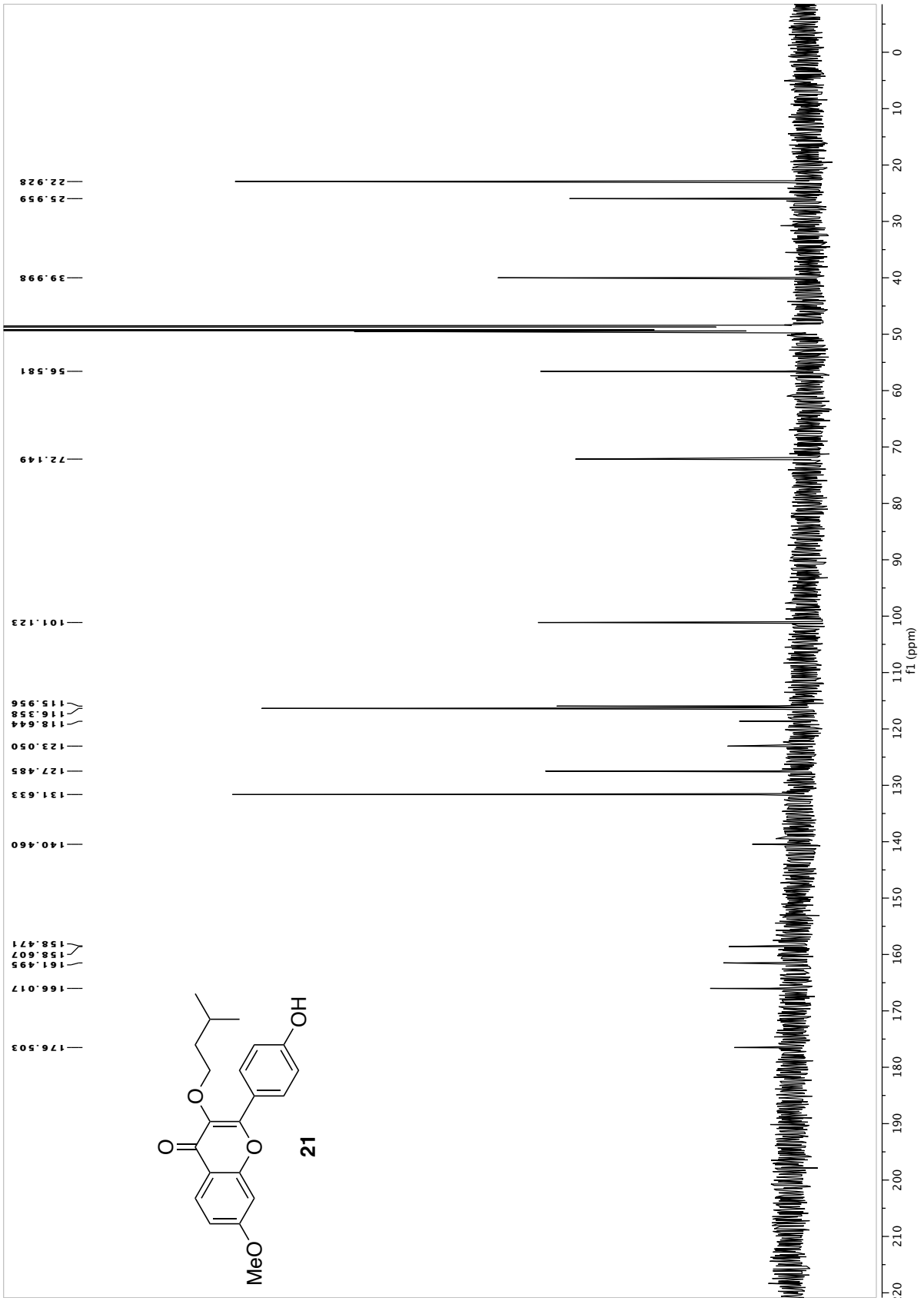
8.061
8.049
8.044
8.037
7.002
6.995
6.989
6.983
6.978
6.973
6.966
6.960
6.913
6.907
4.048
4.031
4.014
3.935
3.919
1.798
1.782
1.765
1.748
1.731
1.715
1.698
1.632
1.615
1.598
1.581
0.876
0.859
5.53
1.93
0.94
1.96
2.88
1.88
1.06
1.00
0.95
1.95
f1 (ppm)
21
O
O
O
MeO
OH


22.928
25.959
39.998
56.581
72.149
101.123
115.956
118.644
116.358
123.050
127.485
131.633
140.460
158.471
158.607
161.495
166.017
176.503
f1 (ppm)
MeO
OH
O
O
O
21

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