Supplementary Information (SI) for Organic Chemistry Frontiers.

Asymmetric construction of spirobenzofuran indolinones *via* cascade reaction of 3-hydroxyoxindoles with coumarins

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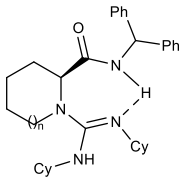
1. General Information

Unless otherwise noted, all catalytic reactions were run under nitrogen conditions, column chromatography was generally performed on silica gel (300–400 mesh) and reactions were monitored with thin layer chromatography (TLC) using 254 nm UV light. NMR characterization data were collected on bruker ASCENDTM operating at 400 MHz for ^{1}H NMR, 101MHz for ^{13}C{1H} NMR (with complete proton decoupling), and 376 MHz for ^{19}F{1H} NMR (with complete proton decoupling). ^{1}H NMR chemical shifts were reported in ppm from tetramethylsilane with the TMS resonance as the internal standard (δ = 0.00). ^{13}C NMR spectra chemical shifts are reported in ppm from thetetramethylsilane with the solvent resonance as internal standard ($CDCl_3$, δ = 77.16, $(CD_3)_2CO$, δ = 206.4). Spectra were reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), integration and assignment. High-resolution mass spectra (HRMS) were recorded on a Thermo Q-Exactive Focus (FTMS+c ESI). Enantiomeric excesses were determined by chiral SFC analysis using the corresponding commercial chiral column as stated in the experimental procedures at 35 °C with UV detector. Optical rotations were measured on Rudolph Research Analytic Automatic Polarimeter and reported as follows: $[\alpha]^{T}_{D}$ (c: g/100 mL, in CH_2Cl_2). Infrared spectra (IR) were recorded on Bruker Tensor II spectrometer with Plantium ATR accessory and the peaks are reported as absorption maxima (ν, cm^{-1}). Melting point ranges were determined on OptiMelt. X-ray crystallographic data were collected by a Bruker D8 Venture Photon II. Ester solvents obtained from commercial sources were used without further purification. THF (tetrahydrofuran), CH_2Cl_2 (dichloromethane), toluene were purified by usual methods before use and reagents obtained from commercial sources were used without further purification. Substrates 3-hydroxyoxindoles[1], 3-acyl-2*H*-chromenones[2] were synthesized according to the literature methods after modified.

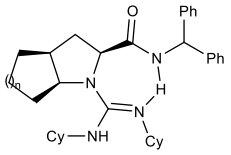
2. Synthesis of starting materials.

a) General procedure for the synthesis of chiral guanidines[3, 4].

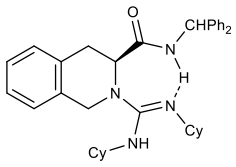
Scheme S1. Chiral guanidines were used in the manuscript.



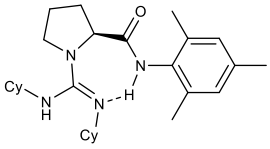
G1: n=0
G2: n=1



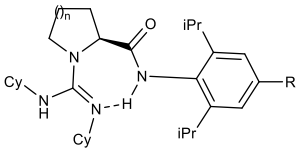
G3: n = 1
G4: n = 2



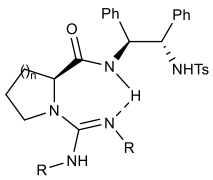
G5



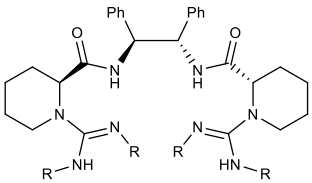
G6



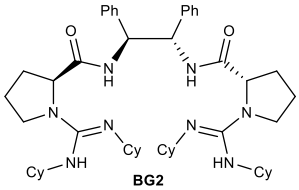
G7: n = 1, R = H
G8: n=2,R = H
G9: n = 2, R = *i*Pr



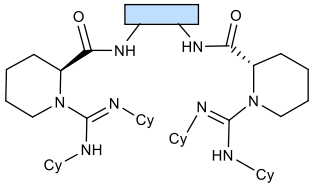
GS1: n=1, R = Cy
GS2: n=2, R = *i*Pr

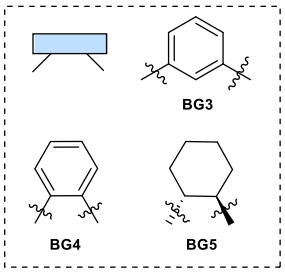


BG1: R = Cy
BG6: R = *i*Pr



BG2



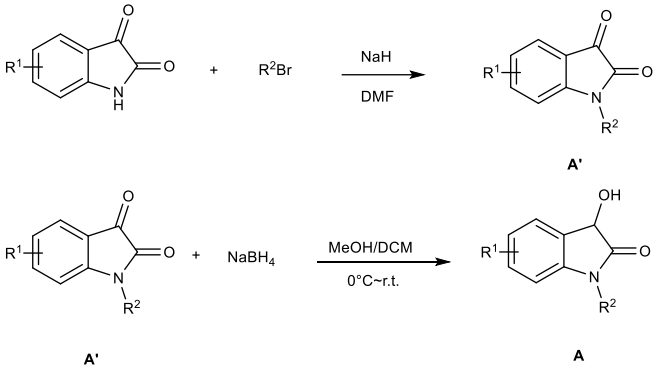


BG3

BG4

BG5

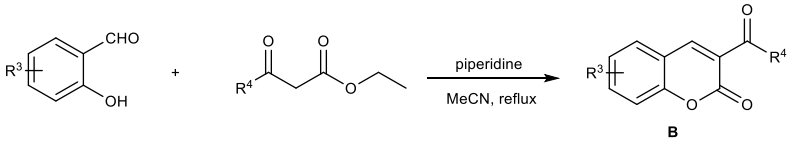
b) Typical procedure for the synthesis of 3-hydroxyoxindoles **A**.



Isatin was dissolved in DMF (1 M solution), then the solution was cooled down to 0 °C and NaH (60% in petroleum, 1.05 equiv.) was added in portions. The mixture was stirred at 0 °C for 15 minutes. Then alkyl bromide or allyl bromide (1.05 equiv.) was added dropwise to this mixture. The reaction was then allowed to stir for 15 minutes at 0 °C and 12 h at r.t., after which it was carefully quenched with water at 0 °C. The solution was extracted three times with CH_2Cl_2. The combined extracts were washed with brine, dried over Na_2SO_4, filtered and concentrated in vacuo. The crude product was purified by flash-column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 5:1) gave **A'**.

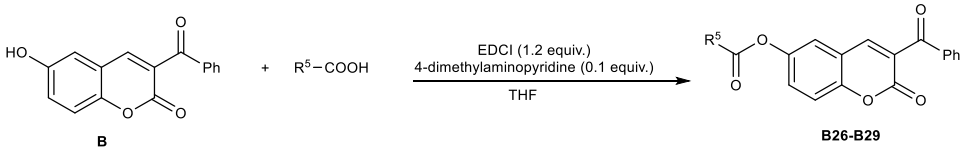
The obtained product **A'** was dissolved in MeOH/DCM (v/v=2/1) at 0 °C (0.5 M solution). Sodium borohydride (1.3 equiv.) was added in portions. The solution was stirred for 20 minutes. The reaction was quenched with the addition of water (2 mL for each mmol of isatin employed) and extracted three times with DCM, dried over Na_2SO_4, filtered and concentrated in vacuo. The crude product was purified by flash-column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 2:1) gave **A.**

c) Typical procedure for the synthesis of 3-acyl-2*H*-chromenones **B**.



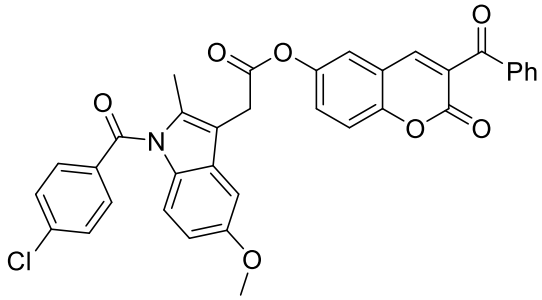
To a dry 100 mL flask were added substituted salicylaldehyde, ethyl substituted benzoyl (acetyl) acetates (1.0 equiv.), piperidine (0.13 equiv.), and acetonitrile (0.5 M). The solution was stirred under reflux for 4-12 h until the reaction completed (monitored by TLC). The mixture was filtered and recrystallized with anhydrous ethanol or crude product was purified by flash-column chromatography on silica gel. The product 3-acyl-2*H*-chromenones was obtained.

Typical procedure for the synthesis of 3-acyl-2*H*-chromenones B26-B29:



To a dry 100 mL flask were added appropriate carboxylic acid (5.0 mmol, 1.0 equiv.), EDC hydrochloride (1.15 g, 6.0 mmol, 1.2 equiv.), 4-dimethylaminopyridine (0.5 mmol, 0.1 equiv.), 3-acyl-2*H*-chromenones **B** (5.0 mmol, 1.0 equiv.) and THF (10 mL), then mixture stirred at r.t. for 12 h (monitored by TLC). The mixture was diluted with CH_2Cl_2 (10 mL), washed with H_2O (20 mL), saturated NaCl solution in sequence and dried by anhydrous Na_2SO_4. The solvent was evaporated under reduced pressure after filtration. The residue was purified by column chromatography on silica gel (petroleum ether/ethyl acetate = 3/1-2/1) to give pure product **B26-B29.**

3-benzoyl-2-oxo-2*H*-chromen-6-yl 2-(1-(4-chlorobenzoyl)-5-methoxy-2-methyl-1*H*-indol-3-yl)acetate (**B26**)



Yellow solid, 92% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.97 (s, 1H), 7.90 – 7.82 (m, 2H), 7.71 – 7.65 (m, 2H), 7.65 – 7.59 (m, 1H), 7.52 – 7.45 (m, 4H), 7.42 – 7.37 (m, 1H), 7.34 – 7.31 (m, 2H), 7.04 (d, *J* = 2.5 Hz, 1H), 6.87 (d, *J* = 9.0 Hz, 1H), 6.70 (dd, *J* = 9.0, 2.5 Hz, 1H), 3.94 (s, 2H), 3.84 (s, 3H), 2.48 (s, 3H).

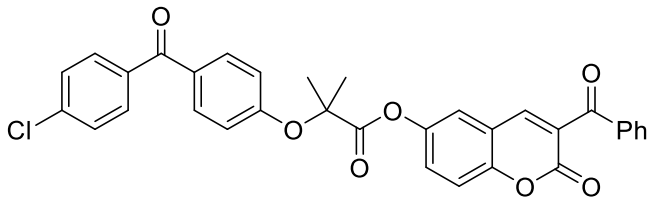
^{13}C NMR (101 MHz, Chloroform-*d*) δ 191.4, 169.3, 168.4, 158.1, 156.3, 152.3, 147.1, 144.5, 139.7, 136.6, 136.1, 134.1, 133.8, 131.4, 131.0, 130.5, 129.7, 129.3, 128.8, 127.9, 121.2, 118.6, 118.1, 115.2, 111.8, 111.5, 101.4, 55.9, 30.6, 13.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{35}H_{24}{}^{35}ClNO_7Na^+]$: 628.1134 found 628.1133.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{35}H_{24}{}^{37}ClNO_7Na^+]$: 630.1104 found 630.1110.

IR (neat) 3062, 2930, 1736, 1676, 1573, 1480, 1399, 1319, 1236, 1152, 1121, 924, 835, 732 cm^{-1}.

3-benzoyl-2-oxo-2*H*-chromen-6-yl 2-(4-(4-chlorobenzoyl)phenoxy)-2-methylpropanoate (**B27**)



White solid, 70% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.98 (s, 1H), 7.90 – 7.84 (m, 2H), 7.83 – 7.77 (m, 2H), 7.75 – 7.68 (m, 2H), 7.66 – 7.60 (m, 1H), 7.53 – 7.38 (m, 5H), 7.27 – 7.23 (m, 2H), 7.03 – 6.96 (m, 2H), 1.85 (s, 6H).

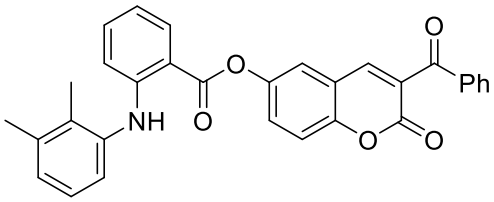
^{13}C NMR (101 MHz, Chloroform-*d*) δ 194.3, 191.3, 172.5, 159.4, 158.0, 152.5, 146.8, 144.3, 138.8, 136.3, 136.0, 134.2, 132.3, 131.3, 131.1, 129.7, 128.8, 128.8, 128.1, 126.7, 121.0, 118.7, 118.3, 117.4, 79.5, 25.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{33}H_{23}{}^{35}ClNO_7Na^+]$: 589.1025 found 589.1031.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{33}H_{23}{}^{37}ClNO_7Na^+]$: 591.0995 found 591.1014.

IR (neat) 3062, 1731, 1657, 1595, 1278, 1240, 1148, 1100, 925, 854, 733 cm^{-1}.

3-benzoyl-2-oxo-2*H*-chromen-6-yl 2-((2,3-dimethylphenyl)amino)benzoate (**B28**)



White solid, 69% yield.

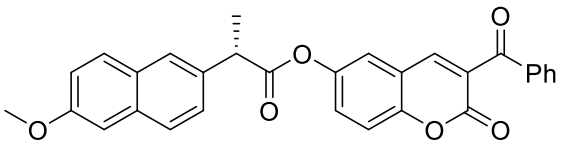
^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.09 (s, 1H), 8.18 (dd, *J* = 8.1, 1.5 Hz, 1H), 8.05 (s, 1H), 7.89 (dd, *J* = 8.2, 1.1 Hz, 2H), 7.67 – 7.59 (m, 1H), 7.55 – 7.45 (m, 5H), 7.36 – 7.32 (m, 1H), 7.19 – 7.09 (m, 2H), 7.05 (d, *J* = 6.9 Hz, 1H), 6.82 – 6.72 (m, 2H), 2.33 (s, 3H), 2.16 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 191.5, 167.2, 158.3, 152.4, 150.7, 147.3, 144.7, 138.5, 138.2, 136.2, 135.6, 134.1, 132.8, 131.9, 129.8, 128.8, 127.9, 127.8, 127.5, 126.2, 123.6, 121.8, 118.8, 118.2, 116.4, 114.1, 108.8, 20.7, 14.1.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{31}H_{23}NO_5Na^+]$: 512.1468 found 512.1478.

IR (neat) 3339, 3064, 1735, 1697, 1573, 1508, 1453, 1217, 1152, 1041, 743, 695 cm^{-1}.

3-benzoyl-2-oxo-2*H*-chromen-6-yl (*S*)-2-(6-methoxynaphthalen-2-yl)propanoate (**B29**)



White solid, 66% yield.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 (s, 1H), 7.89 – 7.82 (m, 2H), 7.80 – 7.70 (m, 3H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.53 – 7.43 (m, 3H), 7.35 (d, *J* = 9.5 Hz, 1H), 7.27 – 7.23 (m, 2H), 7.20 – 7.11 (m, 2H), 4.12 (q, *J* = 7.1 Hz, 1H), 3.92 (s, 3H), 1.71 (d, *J* = 7.1 Hz, 3H).

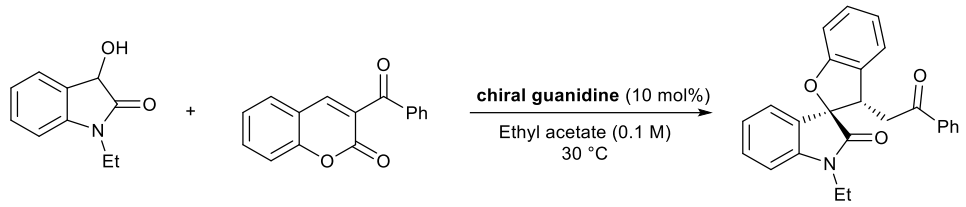
^{13}C NMR (101 MHz, Chloroform-*d*) δ 191.4, 173.2, 158.2, 158.0, 152.2, 147.3, 144.6, 136.1, 134.7, 134.1, 129.7, 129.4, 129.1, 128.8, 127.7, 127.7, 127.2, 126.3, 126.0, 121.2, 119.5, 118.6, 118.0, 105.7, 55.5, 45.6, 18.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{30}H_{22}O_6Na^+]$: 501.1309 found 501.1318.

IR (neat) 3059, 2935, 1741, 1665, 1605, 1571, 1485, 1238, 1145, 1070, 733, 696 cm^{-1}.

3. Optimization of reaction conditions.

Table S1. Screening of the chiral guanidines [a].

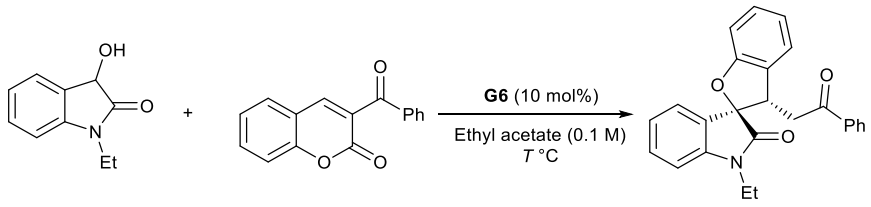


A1 B1 C1

Entry[a]	**chiral guanidine**	Yield (%)[b]	er[c]	dr[c]
1	**G1**	68	42:58	84:16
2	**G2**	61	38:62	80:20
3	**G3**	99	46:54	76:24
4	**G4**	99	47:53	77:23
5	**G5**	68	44:56	74:26
6	**G6**	99	34:66	76:24
7	**GS1**	81	48:52	83:17
8	**BG1**	99	54:46	60:40

[a] Unless otherwise noted, the reactions were carried out with **A1** (0.10 mmol), **B1** (0.10 mmol) and the catalyst (10 mol%) in ethyl acetate (0.1 M) at 30 °C for 12 h. [b] Yield of the isolated products. [c] Determined by chiral SFC.

Table S2. Screening of temperature[a].

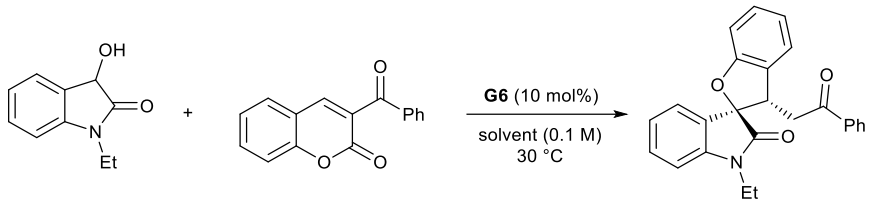


A1 B1 C1

Entry[a]	*T* °C	Yield (%)[b]	er[c]	dr[c]
1	40	99	35:65	74:26
2	35	99	35:65	74:26
3	30	99	34:66	76:24
4[d]	25	99	34:66	75:25
5[d]	20	99	34:66	75:25

[a] Unless otherwise noted, the reactions were carried out with **A1** (0.10 mmol), **B1** (0.10 mmol) and **G6** (10 mol%) in ethyl acetate (0.1 M) at *T* °C for 12 h. [b] Yield of the isolated products. [c] Determined by chiral SFC. [d] React for 4 days.

Table S3. Screening of solvents[a].

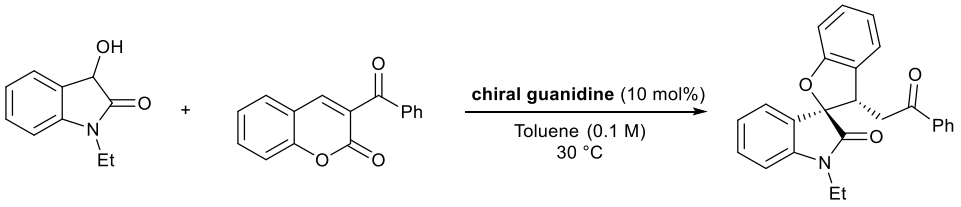


A1 **B1** **C1**

Entry[a]	solvent	Yield (%)[b]	er[c]	dr[c]
1	Propyl acetate	99	34:66	75:25
2	Isopropyl acetate	99	34:66	73:27
3	*tert*-Butyl acetate	8	42:58	>19:1
4	Ethyl propionate	99	36:64	75:25
5	Phenol acetate	81	42:58	77:23
6	CH_2Cl_2	99	64:36	58:42
7	Toluene	99	31:69	76:24
8	THF	99	33:67	74:26

[a] Unless otherwise noted, the reactions were carried out with **A1** (0.10 mmol), **B1** (0.10 mmol) and **G6** (10 mol%) in solvent (0.1 M) at 30 °C for 12 h. [b] Yield of the isolated products. [c] Determined by chiral SFC.

Table S4. Rescreening of the chiral guanidines[a].



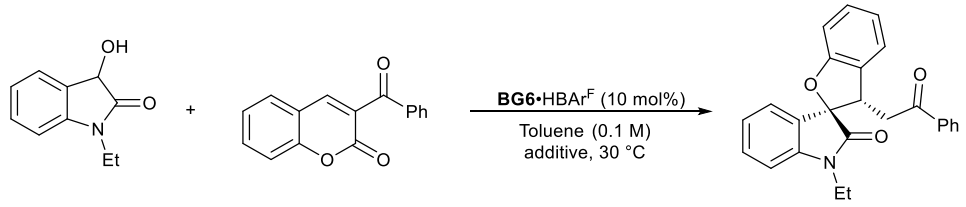
A1 **B1** **C1**

Entry[a]	**chiral guanidine**	Yield (%)[b]	er[c]	dr[c]
1	**G7**	31	40:60	85:15
2	**G8**	37	42:58	87:13
3	**G9**	35	43:57	87:13
4	**BG2**•$HBAr^F$	17	72:28	>19:1
5	**BG1**•$HBAr^F$	51	82:18	94:6

6	**GS2**	54	46:54	83:17
7[d]	**BG2**•HBAr^F	50	75:25	>19:1
8[d]	**BG1**•HBAr^F	99	85:15	>19:1
9[d]	**BG3**•HBAr^F	66	42:58	76:24
10[d]	**BG4**•HBAr^F	28	58:42	>19:1
11[d]	**BG5**•HBAr^F	99	47:53	47:53
12[d]	**BG6**•HBAr^F	99	86:14	19:1

[a] Unless otherwise noted, the reactions were carried out with **A1** (0.10 mmol), **B1** (0.10 mmol) and chiral guanidine (10 mol%) in toluene (0.1 M) at 30 °C for 12 h. [b] Yield of the isolated products. [c] Determined by chiral SFC. [d] React for 3 days.

Table S5. Screening of the additives[a].

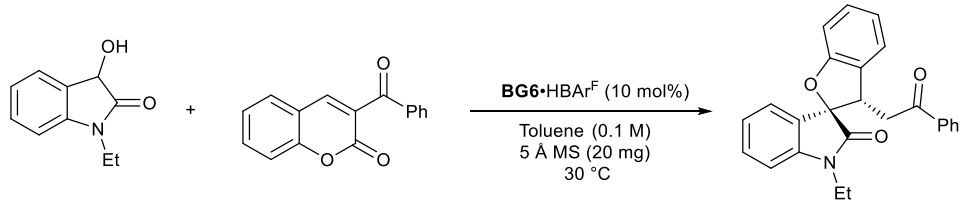


A1 **B1** **C1**

Entry[a]	additives	Yield (%)[b]	er[c]	dr[c]
1	3 Å MS (20 mg)	89	88:12	>19:1
2	4 Å MS (20 mg)	99	87:13	>19:1
3	5 Å MS (20 mg)	90	88:12	19:1
4	no additive	99	86:14	19:1

[a] Unless otherwise noted, the reactions were carried out with **A1** (0.10 mmol), **B1** (0.10 mmol), additives and **BG6**•HBAr^F (10 mol%) in toluene (0.1 M) at 30 °C for 48 h. [b] Yield of the isolated products. [c] Determined by chiral SFC.

Table S6. Screening of the substrate ratio[a].



A1 **B1** **C1**

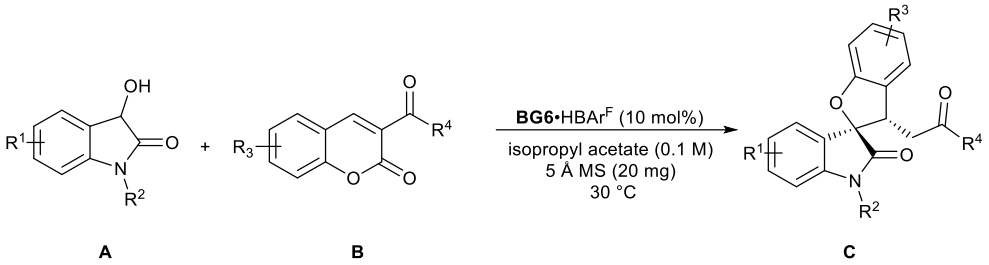
Entry[a]	**A1/B1**	Yield (%)[b]	er[c]	dr[c]
1	1.1/1	90	87:13	94:6

2	1.2/1	91	87:13	19:1
3	1.5/1	99	87:13	>19:1
4	1/1.1	88	88:12	94:6
5	1/1.2	80	88:12	94:6
6	1/1.3	75	88:12	19:1
7[d]	1.5/1	59	96:4	>19:1
8[e]	1.5/1	94	95:5	>19:1
9[f]	1.5/1	57	93:7	>19:1
10[g]	1.5/1	33	94:6	>19:1

[a] Unless otherwise noted, the reactions were carried out with **A1**, **B1**, 20mg 5 Å MS and **BG6**•$HBAr^F$ (10 mol%) in toluene (0.1 M) at 30 °C for 48 h. [b] Yield of the isolated products. [c] Determined by chiral SFC. [d] 1.0 mL THF were used. [e] 1.0 mL isopropyl acetate were used. [f] 1.0 mL isopropyl acetate and 5 mol% **BG6**•$HBAr^F$ were used. [g] 1.0 mL isopropyl acetate and 2.5 mol% **BG6**•$HBAr^F$ were used.

4. Typical procedure for the catalytic asymmetric reaction.

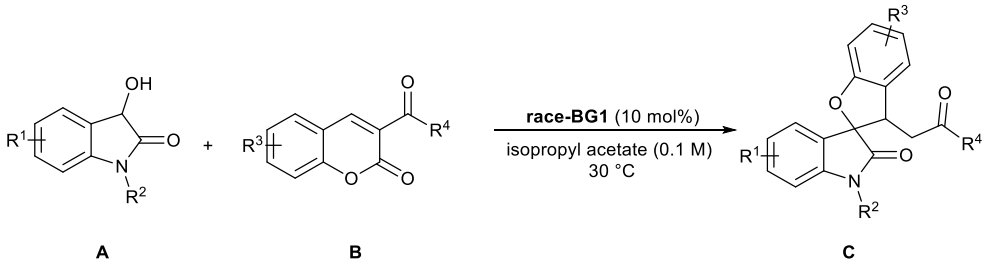
4.1 General procedure for the catalytic asymmetric reaction.



A B C

An oven-dried test tube was charged with **A** (0.15 mmol), **B** (0.10 mmol), **BG6•**HBAr^F (10 mol%), 5 Å MS (20 mg), extract and replace nitrogen three times, and isopropyl acetate (1.0 mL) was added under nitrogen atmosphere, the reaction mixture was stirred at 30 °C and detected by TLC. After the reaction was completed, the residue was subjected to column chromatography (silica gel, eluent: petroleum ether/ethyl acetate = 5:1 to 3:1) to afford the desired products.

4.2 General procedure for the preparation of the racemic products.



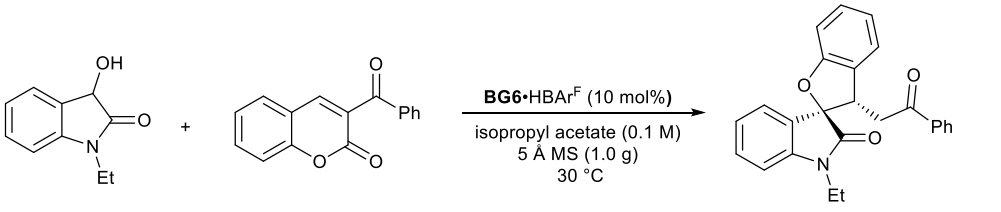
A B C

Method **1**: An oven-dried test tube was charged with **A** (0.15 mmol), **B** (0.10 mmol), **race-BG1** (10 mol%), extract and replace nitrogen three times, and isopropyl acetate (1.0 mL) was added under nitrogen atmosphere, the reaction mixture was stirred at 30 °C and detected by TLC. After the reaction was completed, the residue was subjected to column chromatography (silica gel, eluent: petroleum ether/ethyl acetate = 5:1 to 3:1) to afford the desired products.

Method **2**: An oven-dried test tube was charged with **A** (0.15 mmol), **B** (0.10 mmol), **DBN** (20 mol%), isopropyl acetate (1.0 mL) was added, the reaction mixture was stirred at 60 °C and detected by TLC. After the reaction was completed, the residue was subjected to column chromatography (silica gel, eluent: petroleum ether/ethyl acetate = 5:1 to 3:1) to afford the desired products (For racemic product **C1, C2, C5, C7, C8, C9, C10, C13, C14, C16, C17, C18, C19, C22, C26, C29, C30, C31, C33, C34, C35, C36, C37, C41, C44**).

Note: the diastereomers could be separated by silica gel column chromatography.

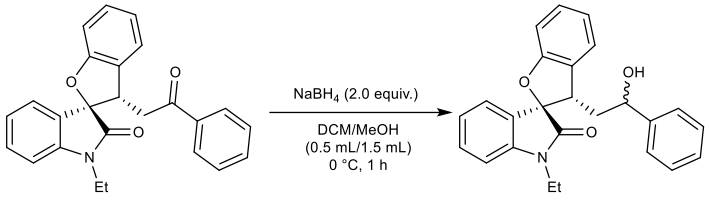
4.3 Experimental procedure for the gram-scale reaction.



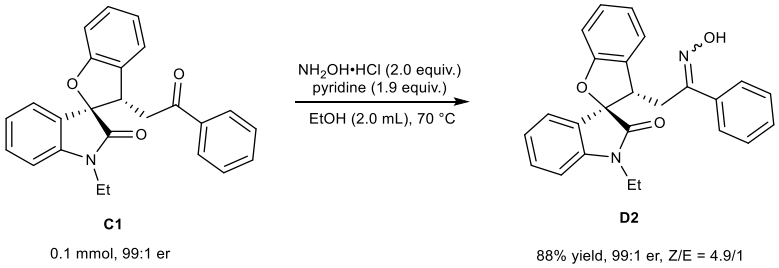
A1	B1	C1
(6.0 mmol, 1.062 g)	(4.0 mmol, 1.000 g)	1.52 g, >99% yield, 94:6 er, >19:1dr recrystallization: 99:1 er

An oven-dried round-bottom flask was charged with **A1** (6.0 mmol), **B1** (4.0 mmol), **BG6•**$HBAr^F$ (0.4 mmol, 10 mol%), 5 Å MS (1.0 g), extract and replace nitrogen three times, and isopropyl acetate (40 mL) was added under nitrogen atmosphere, the reaction mixture was stirred at 30 °C and detected by TLC. After the reaction was completed, remove the solvent by the vacuum evaporator, the residue was subjected to column chromatography (silica gel, eluent: petroleum ether/ethyl acetate = 5:1 to 3:1) to afford the desired product.

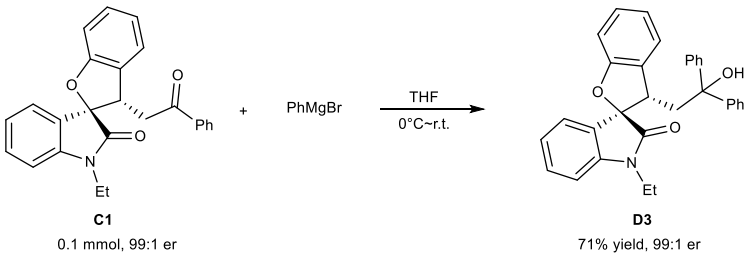
4.4 Experimental procedure for further transformation.



To an oven-dried reaction tube was added **C1** (38.3 mg, 0.10 mmol), DCM (0.5mL) and MeOH (1.5 mL), then $NaBH_4$ (7.5 mg, 0.20 mmol) was added at 0 °C (ice bath), the mixture was stirred for 1 h at 0 °C. After finished, the reaction was quenched with NH_4Cl (5 mL). The solution was extracted with CH_2Cl_2 (3×5 mL). The combined extracts were washed with brine (8.0 mL), dried (Na_2SO_4), filtered and concentrated in vacuo. The crude product was purified by flash-column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 2:1) gave **D1** (34.8 mg, 90% yield, 99:1 er, 83:17 dr).



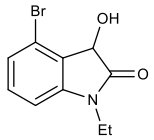
To an oven-dried reaction tube were added $NH_2OH·HCl$ (13.9 mg, 0.2 mmol), pyridine (16 μL, 0.19 mmol) and EtOH (1.5 mL), the mixture was stirred at 70 °C for 1 h, then **C1** (38.3 mg, 0.1 mmol) and EtOH (0.5 mL) was added, the mixture was stirred for another 8 h. Concentration of EtOH in vacuo and the residue was purified by flash column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 3/1) to afford product **D2**. (35.0 mg, 88% yield, 99:1 er, Z/E = 4.9/1).



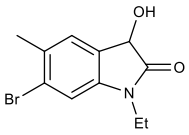
An oven-dried test tube was charged with **C1** (38.3 mg, 0.1 mmol) under N_2 atmosphere. After adding dry THF (1.0 mL), the system was stirred at 0 °C, followed by the injection of commercially available phenyl magnesium bromide (2.0 equiv., 1M in THF). The reaction was stirred at 0 °C for 30 min and then warmed up to room temperature for overnight. After finished, the reaction was

quenched with NH_4Cl (5 mL). The solution was extracted with ethyl acetate (3×5 mL). The combined extracts were washed with brine (8.0 mL), dried (Na_2SO_4), filtered and concentrated in vacuo. The reaction mixture was subjected to column chromatography on silica gel and eluted with petroleum ether/ethyl acetate (v/v 3:1) to afford the corresponding product **D3** (32.7 mg, 71% yield, 99:1 er).

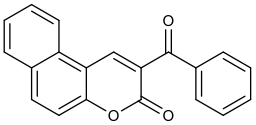
5. Unsuccessful substrates.



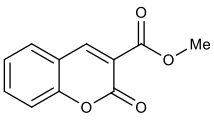
trace



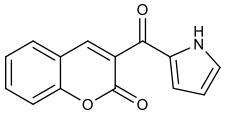
N.R.



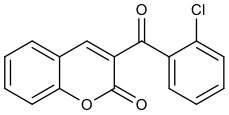
N.R.



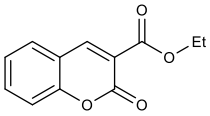
73% yield (impure)
83:17 dr, 40% ee



53% yield (impure)
>19:1 dr, 85% ee



complex



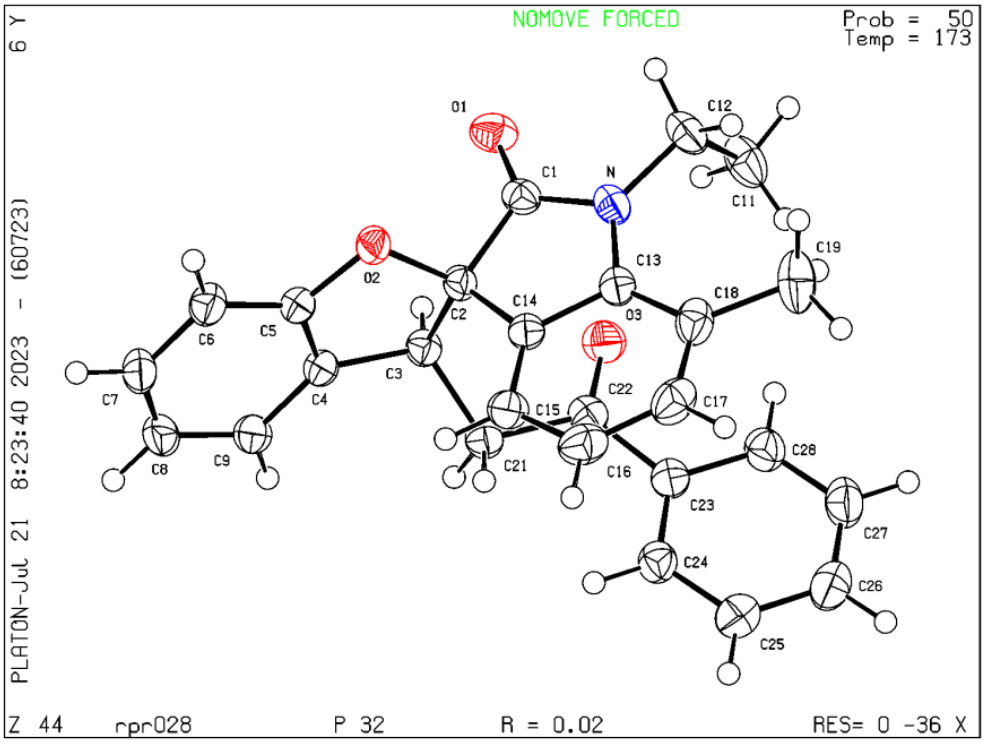
trace

The above-mentioned substrates all reacted under standard conditions.

6. X-ray crystal data.

Crystals suitable for the X-ray crystal structure analysis were obtained from a solution of compound **C13** in CH_2Cl_2 and petroleum ether at r.t. CCDC 2302490 contains the supplementary crystallographic data for this paper. These data are provided free of charge by The Cambridge Crystallographic Data Centre.

The colourless crystal in block-shape, with approximate dimensions of 0.140 × 0.214 × 0.306 mm^3, was selected and mounted for the single-crystal X-ray diffraction. The data set was collected by Bruker D8 Venture Photon II diffractometer at 173(2)K equipped with micro-focus Cu radiation source (K_α = 1.54178Å). Applied with face-indexed numerical absorption correction, the structure solution was solved and refinement was processed by SHELXTL (version 6.14) and OLEX 2.3 program package[a, b, c, d]. The structure was analyzed by ADDSYM routine implemented in PLATON suite and no higher symmetry was suggested[e].



Crystallographic Data for **C13**.

Formula	$C_{26}H_{23}NO_3$(**C13**)
Formula mass (amu)	397.45
Space group	$P3_2$
a (Å)	11.2675(3)
b (Å)	11.2675(3)
c (Å)	13.8644(4)
α (deg)	90
β (deg)	90
γ (deg)	120
V (Å^3)	1524.36(9)
Z	3
λ (Å)	1.54178
T (K)	173 K
ρ_{calcd} (g cm^{-3})	1.299
μ (mm^{-1})	0.677
Transmission factors	0.846-0.958
θ_{max} (deg)	79.521

No. of unique data, including $F_o^2 < 0$	4246
No. of unique data, with $F_o^2 > 2\sigma(F_o^2)$	4205
No. of variables	274
$R(F)$ for $F_o^2 > 2\sigma(F_o^2)$ [a]	0.0238
$R_w(F_o^2)$ [b]	0.0632
Goodness of fit	1.047

[a] $R(F) = \sum||F_o| - |F_c|| / \sum|F_o|$.

[b] $R_w(F_o^2) = [\sum[w(F_o^2 - F_c^2)^2] / \sum wF_o^4]^{1/2}$; $w^{-1} = [\sigma^2(F_o^2) + (Ap)^2 + Bp]$, where $p = [\max(F_o^2,0) + 2F_c^2] / 3$.

References:

[a] Sheldrick, G. M. *Acta Cryst.* 2008, **A64**, 112–122.

[b] Sheldrick, G. M. *Acta Cryst.* 2015, **A71**, 3–8.

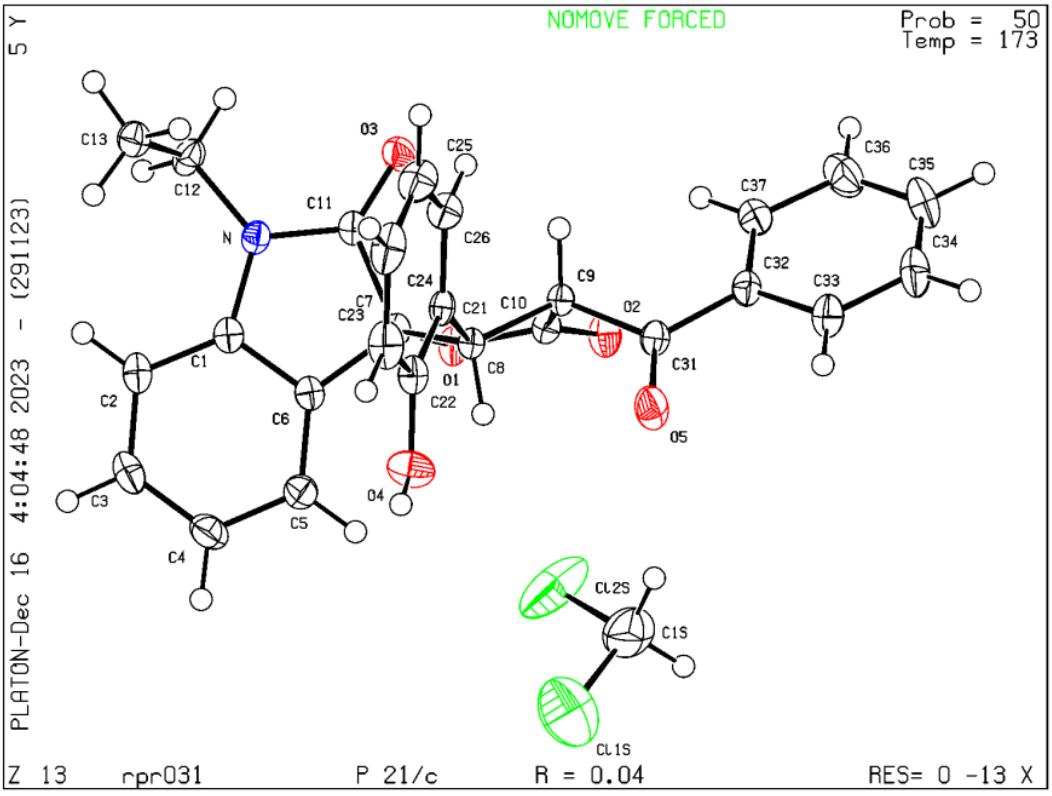
[c] Sheldrick, G. M. *Acta Cryst*. 2015, **C71**, 3–8.

[d] Dolomanov, O.V., Bourhis, L.J., Gildea, R.J., Howard, J. A. K., Puschmann, H. *J. Appl. Cryst*. 2009, **42**, 339-341.

[e] Spek, A. L. *J. Appl. Cryst.* 2003, **36**, 7–13.

Crystals suitable for the X-ray crystal structure analysis were obtained from a solution of compound **Int2** in CH_2Cl_2 at r.t. CCDC 2321099 contains the supplementary crystallographic data for this paper. These data are provided free of charge by The Cambridge Crystallographic Data Centre.

The orange crystal in block-shape, with approximate dimensions of 0.116 × 0.145 × 0.241 mm^3, was selected and mounted for the single-crystal X-ray diffraction. The data set was collected by Bruker D8 Venture Photon II diffractometer at 173(2)K equipped with micro-focus Cu radiation source (Kα = 1.54178Å). Applied with face-indexed numerical absorption correction, the structure solution was solved and refinement was processed by SHELXTL (version 6.14) and OLEX 2.3 program package[a, b, c, d]. The structure was analyzed by ADDSYM routine implemented in PLATON suite and no higher symmetry was suggested[e].



Crystallographic Data for **Int2**.

Formula	$C_{26}H_{21}NO_5$,CH_2Cl_2(**Int2**)
Formula mass (amu)	512.36
Space group	$P2_1/c$
a (Å)	18.3464(4)
b (Å)	8.3122(2)
c (Å)	16.0948(3)
α (deg)	90
β (deg)	99.9900(10)

γ (deg)	90
V (Å^3)	2417.23(9)
Z	4
λ (Å)	1.54178
T (K)	173 K
ρ_{calcd} (g cm^{-3})	1.408
μ (mm^{-1})	2.749
Transmission factors	0.793-0.997
θ_{max} (deg)	68.328
No. of unique data, including $F_o^2 < 0$	4416
No. of unique data, with $F_o^2 > 2\sigma(F_o^2)$	4021
No. of variables	321
$R(F)$ for $F_o^2 > 2\sigma(F_o^2)$ [a]	0.0404
$R_w(F_o^2)$ [b]	0.1017
Goodness of fit	1.052

[a] $R(F) = \sum||F_o| - |F_c|| / \sum|F_o|$.

[b] $R_w(F_o^2) = [\sum[w(F_o^2 - F_c^2)^2] / \sum wF_o^4]^{1/2}$; $w^{-1} = [\sigma^2(F_o^2) + (Ap)^2 + Bp]$, where $p = [\max(F_o^2,0) + 2F_c^2] / 3$.

References:

[a] Sheldrick, G. M. *Acta Cryst.* 2008, **A64**, 112–122.

[b] Sheldrick, G. M. *Acta Cryst.* 2015, **A71**, 3–8.

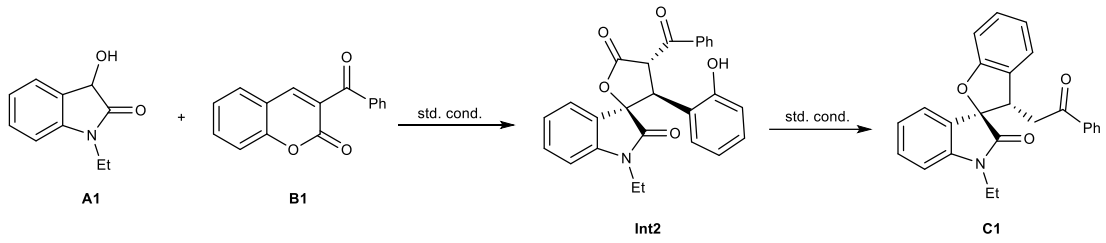
[c] Sheldrick, G. M. *Acta Cryst*. 2015, **C71**, 3–8.

[d] Dolomanov, O.V., Bourhis, L.J., Gildea, R.J., Howard, J. A. K., Puschmann, H. *J. Appl. Cryst*. 2009, **42**, 339-341.

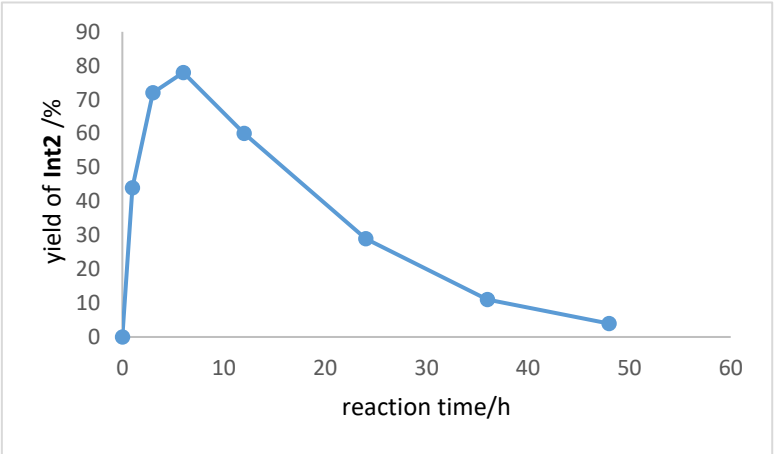
[e] Spek, A. L. *J. Appl. Cryst.* 2003, **36**, 7–13.

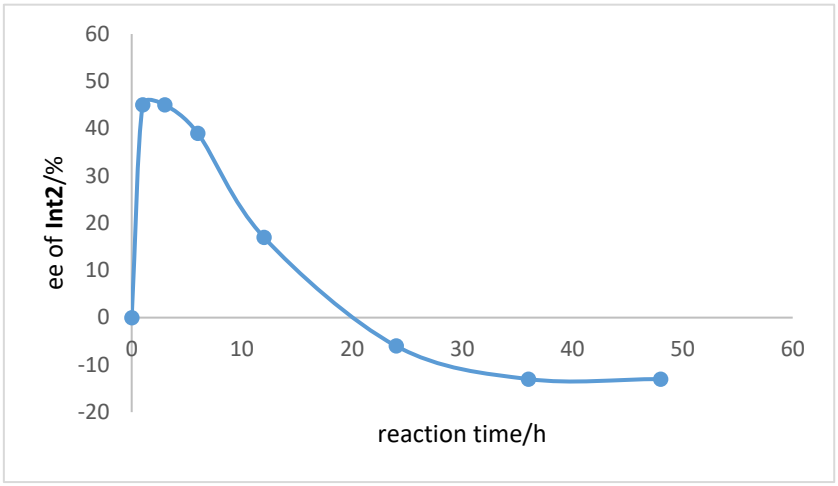
7. Control experiments and mechanistic studies

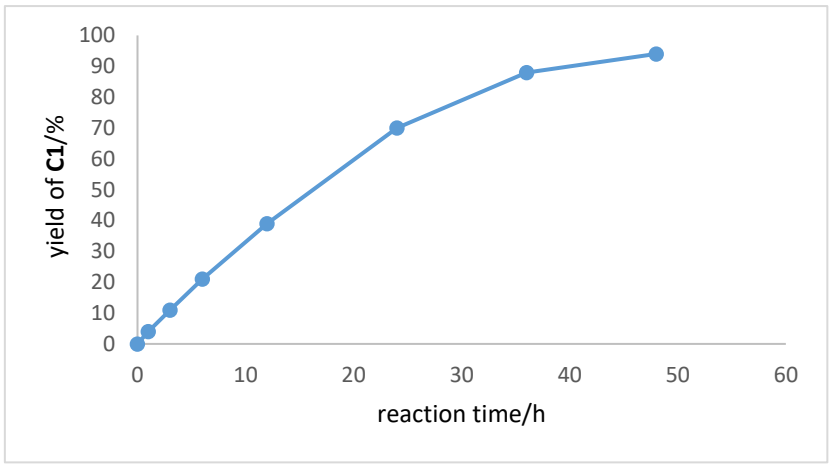
The intermediate **Int2** could be isolated during the reaction process, we monitoring the reaction system in different reaction times discovery the yield of **Int2** increased firstly then decreased gradually, and just obtained the moderate ee value of **Int2** in the early stage of the reaction, and the ee value of **Int2** gradually decreased along with the reaction progresses. The dr value of **Int2** was >19:1 and maintain all the time. The yield of final product **C1** increased gradually and the ee value of **C1** had a slight decrease.

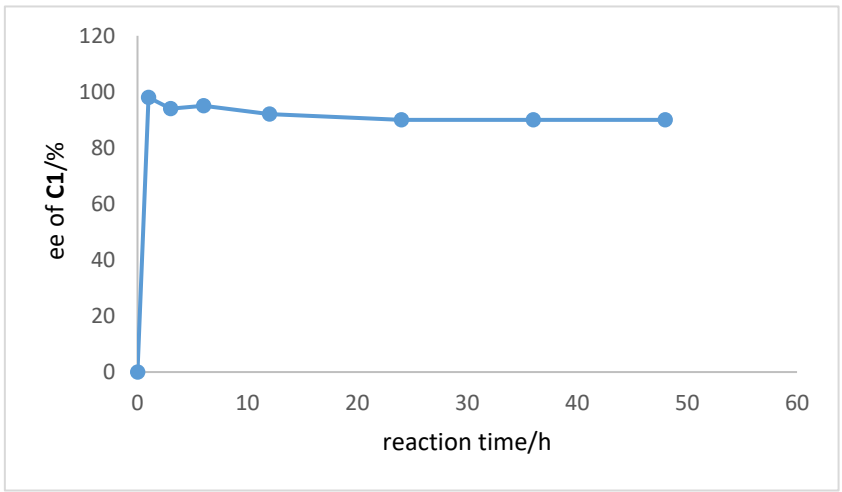


Reaction time/ h	Yield of **Int2** (%)	ee of **Int2** (%)	dr of **Int2**	Yield of **C1** (%)	ee of **C1** (%)	dr of **C1**
0	0	0	0	0	0	0
1	44	45	>19:1	4	98	>19:1
3	72	45	>19:1	11	94	>19:1
6	78	39	>19:1	21	95	>19:1
12	60	17	>19:1	39	92	>19:1
24	29	-6	>19:1	70	90	>19:1
36	11	-13	>19:1	88	90	>19:1
48	4	-13	>19:1	94	90	>19:1



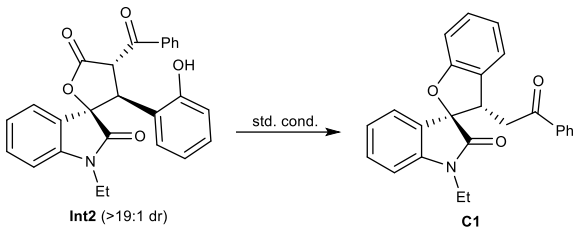






We choose racemic intermediate **Int2** as substrate, put intermediate **Int2** into standard conditions, by monitoring the ee and dr value of the product **C1**, it could be found that the racemic intermediate **Int2** could transform into product **C1** with high ee value. And intermediate **Int2** could be completely converted into product **C1**, the yield of product **C1** were increased as time goes on, the dr value of **C1** >19:1 all the time, only one type diastereoisomer could be detected in the reaction system. These control experiments demonstrate the process of releasing CO_2 involve the disappearance of chiral centers, the chiral guanidine not only control the first step of Michael

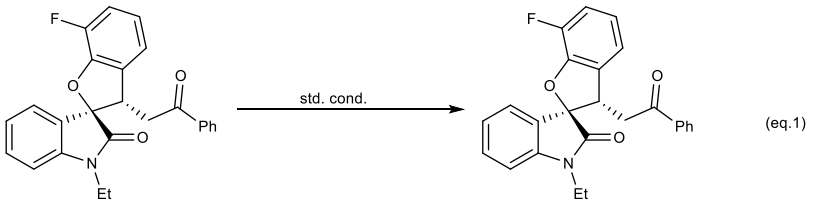
reaction, but also control the next cyclizing step, the ee and dr value of the product were determined in the last cyclizing step.



Int2 (>19:1 dr) **C1**

reaction time	yield of **C1** (%)	ee of **C1** (%)	dr of **C1**
15 h	20	96	>19:1
27 h	25	94	>19:1
39 h	39	93	>19:1
50 h	47	92	>19:1
110 h	99	91	>19:1

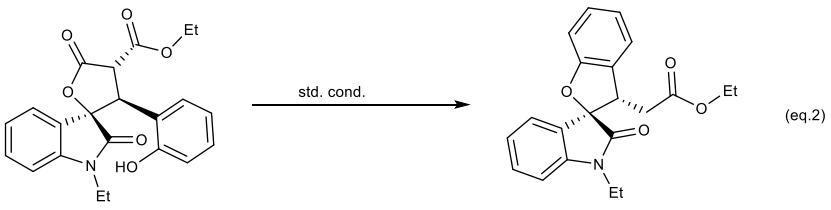
The ee and dr value of product **C37** were unchanging when once again putting it into standard condition (eq. 1). The process retro-Michael reaction then Michael reaction of final product could be ruled out. When using coumarin-3-carboxylate ester as substrate, using DBU as base, corresponding **Int2** could be isolated smoothly, no reaction occur in the standard condition, when increasing the reaction temperature to 60 ^{o}C, the corresponding final product could be isolated in 54% yield after 23 h (eq. 2).This can be inferred that last cyclizing step involve in Michael addition, due to the reaction activity of ester group weaker than carbonyl group, the reaction is difficult to occur for coumarin-3-carboxylate at standard condition.



C37 **C37** (eq.1)

9% ee, >19:1 dr
0% ee, 56:44 dr

9% ee, >19:1 dr (after 42 h)
0% ee, 56:44 dr (after 35 h)



(eq.2)

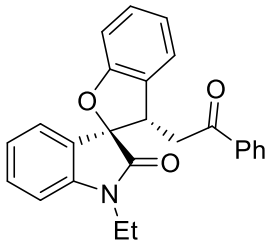
race, >19:1 dr

N.R. (after 84 h)

54% yield, 30% ee, 72:28 dr
(60 °C, after 23 h)

8. Spectral characterization data for the products

(2*R*,3*S*)-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C1):



White solid, 94% yield, 95:5 er, >19:1 dr, m.p. 63-67 °C, $[\alpha]^{21}_D$ = -57.3 (c = 0.4, in CH_2Cl_2). Reacted for 48 h.

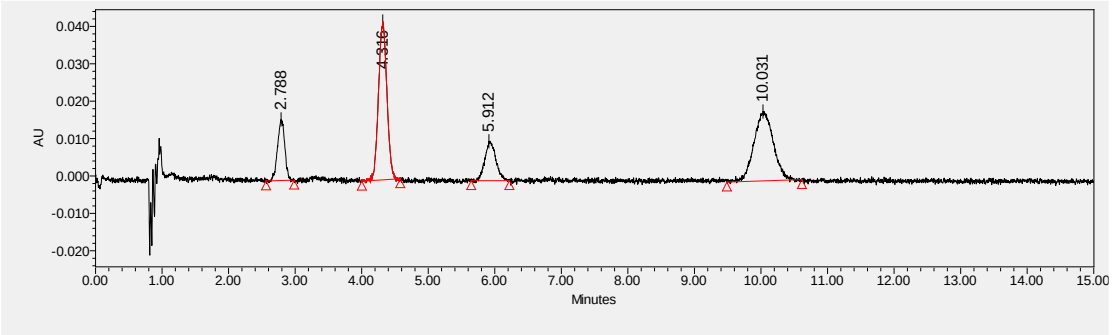
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.81 min, t_2 = 5.90 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.4 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.23 – 7.20 (m, 2H), 7.12 (t, *J* = 7.8 Hz, 1H), 7.06 (d, *J* = 7.3 Hz, 1H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.88 (d, *J* = 8.1 Hz, 1H), 6.81 – 6.70 (m, 2H), 4.64 (t, *J* = 7.5 Hz, 1H), 3.96 – 3.87 (m, 1H), 3.78 – 3.69 (m, 1H), 3.52 – 3.41 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

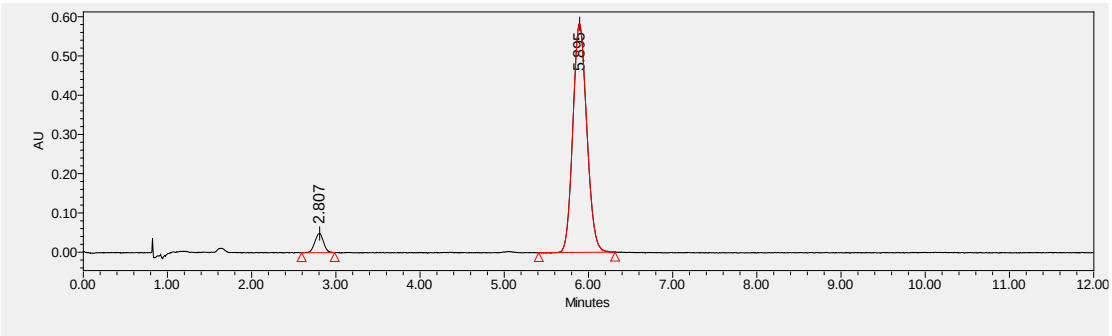
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.1, 158.8, 143.6, 136.3, 130.6, 129.0, 128.8, 128.5, 127.7, 125.8, 124.9, 123.9, 122.1, 121.4, 110.2, 109.0, 89.0, 44.4, 40.4, 35.1, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{21}NO_3Na^+]$: 406.1414 found 406.1414.

IR (neat) 3058, 2928, 1726, 1682, 1607, 1471, 1366, 1286, 1230, 1103, 994, 751, 692 cm^{-1}.

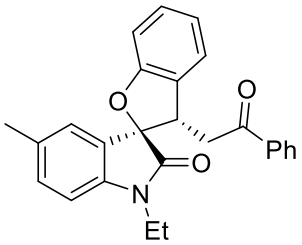


	Retention Time	Area	% Area
1	2.788	124179	12.47
2	4.316	372365	37.40
3	5.912	122133	12.27
4	10.031	377019	37.86



	Retention Time	Area	% Area
1	2.807	353321	5.02
2	5.895	6691459	94.98

(2*R*,3*S*)-1'-ethyl-5'-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C2):



Yellow solid, 99% yield, 94:6 er, >19:1 dr, m.p. 66-70 °C, $[\alpha]^{20}_{D}$ = -66.6 (c = 0.86, in CH_2Cl_2). Reacted for 108 h.

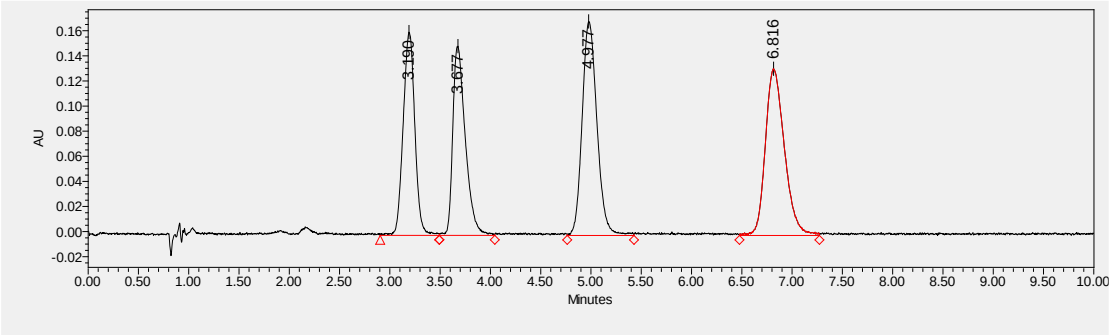
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.98 min, t_2 = 6.83 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 (d, *J* = 7.5 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.20 (m, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.94 – 6.83 (m, 3H), 6.60 (d, *J* = 8.5 Hz, 1H), 4.65 (dd, *J* = 10.6, 4.5 Hz, 1H), 3.93 – 3.84 (m, 1H), 3.75 – 3.66 (m, 1H), 3.51 (dd, *J* = 17.8, 10.7 Hz, 1H), 3.38 (dd, *J* = 17.8, 4.6 Hz, 1H), 2.04 (s, 3H), 1.35 (t, *J* = 7.2 Hz, 3H).

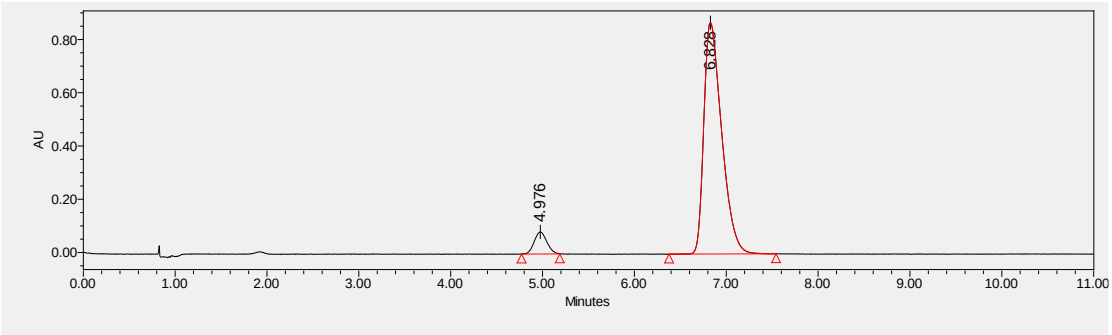
^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 175.0, 158.9, 141.2, 136.4, 133.1, 131.7, 130.8, 129.0, 128.9, 128.4, 127.6, 125.8, 123.9, 121.4, 110.2, 108.7, 89.1, 44.6, 40.5, 35.1, 20.8, 12.4

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1572.

IR (neat) 3058, 2979, 2934, 1724, 1682, 1486, 1369, 1217, 994, 750, 689 cm^{-1}.

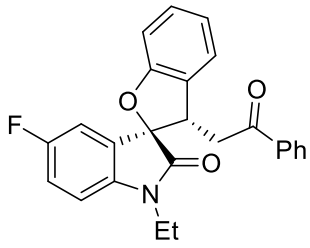


	Retention Time	Area	% Area
1	3.190	1312071	21.44
2	3.677	1310335	21.41
3	4.977	1745341	28.52
4	6.816	1751158	28.62



	Retention Time	Area	% Area
1	4.976	794727	6.36
2	6.828	11700483	93.64

(2*R*,3*S*)-1'-ethyl-5'-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C3):



White solid, 99% yield, 93:7 er, >19:1 dr, m.p. 66-68 °C, $[\alpha]_D^{20}$ = -55.8 (c = 0.76, in CH_2Cl_2). Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.67 min, t_2 = 6.43 min.

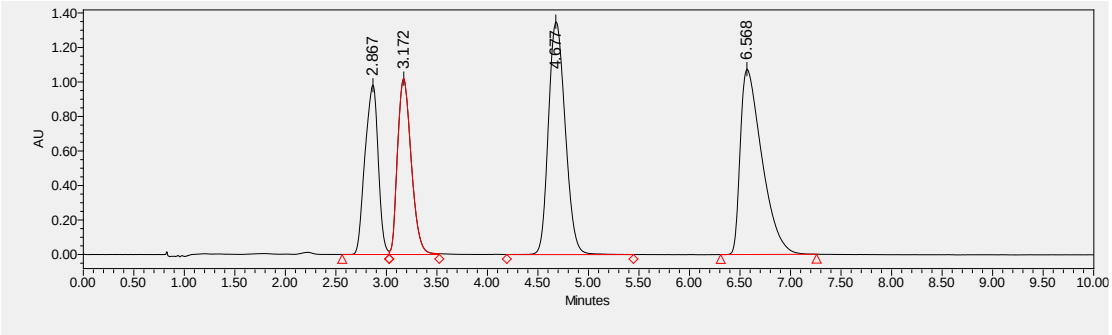
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.71 – 7.62 (m, 2H), 7.49 (t, *J* = 7.4 Hz, 1H), 7.35 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.20 (m, 2H), 6.99 (t, *J* = 7.4 Hz, 1H), 6.89 (m, 1H), 6.84 – 6.80 (t, *J* = 8.3 Hz, 2H), 6.69 – 6.62 (m, 1H), 4.64 (dd, *J* = 10.4, 4.8 Hz, 1H), 3.96 – 3.87 (m, 1H), 3.76 – 3.67 (m, 1H), 3.58 – 3.38 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.8, 174.8, 158.6, 158.5 (d, *J* = 242.4 Hz), 139.7, 136.0, 133.4, 129.2, 128.6, 128.4, 127.7, 127.1 (d, *J* = 7.6 Hz), 123.9, 121.6, 116.8 (d, *J* = 23.4 Hz), 112.9 (d, *J* = 24.7 Hz), 110.3, 109.5 (d, *J* = 7.8 Hz), 88.9, 44.6, 40.1, 35.2, 12.3.

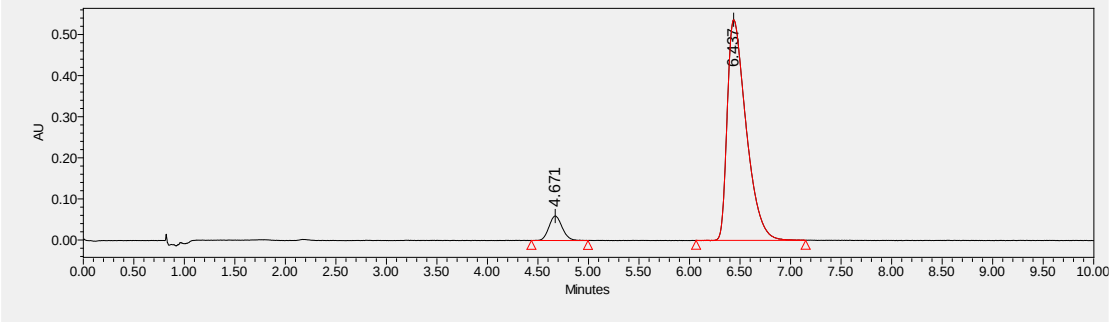
^{19}F NMR (376 MHz, Chloroform-*d*) δ -120.85.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1314.

IR (neat) 3059, 2981, 2936, 1727, 1682, 1485, 1454, 1240, 1206, 878, 817, 750, 688 cm^{-1}.

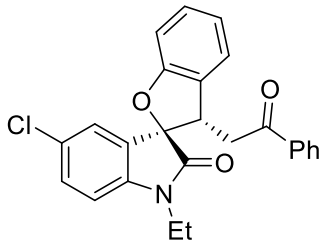


	Retention Time	Area	% Area
1	2.867	8903534	17.79
2	3.172	9602548	19.19
3	4.677	15582172	31.13
4	6.568	15960954	31.89



	Retention Time	Area	% Area
1	4.668	704328	7.05
2	6.434	9284544	92.95

(2*R*,3*S*)-5'-chloro-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C4):



White solid, 99% yield, 93:7 er, >19:1 dr, m.p. 67-72 °C, $[\alpha]^{20}_{D}$ = -115.1 (c = 0.80, in CH_2Cl_2). Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.56 min, t_2 = 8.63 min.

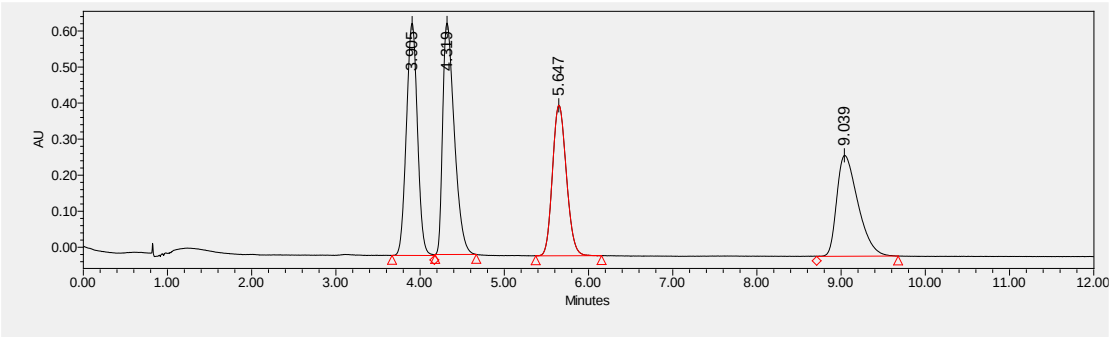
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.70 – 7.61 (m, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.7 Hz, 2H), 7.26 – 7.21 (m, 2H), 7.10 – 6.95 (m, 3H), 6.89 (d, *J* = 8.0 Hz, 1H), 6.63 (d, *J* = 8.3 Hz, 1H), 4.73 – 4.56 (m, 1H), 3.96 – 3.87 (m, 1H), 3.75 – 3.66 (m, 1H), 3.52 – 3.42 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 174.7, 158.5, 142.3, 136.0, 133.4, 130.4, 129.2, 128.6, 128.3, 127.7, 127.4, 127.4, 125.3, 123.9, 110.3, 109.9, 88.7, 44.7, 40.1, 35.2, 12.3.

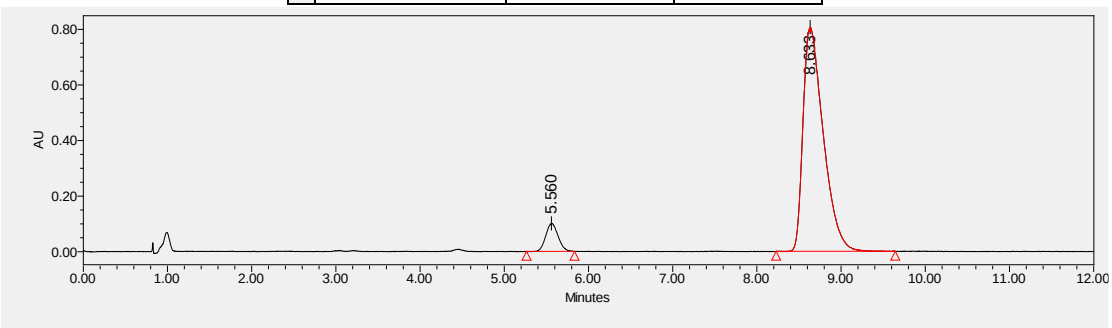
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{35}ClNO_3Na^+]$: 440.1024 found 440.1023.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{37}ClNO_3Na^+]$: 442.0994 found 442.0993.

IR (neat) 3061, 2981, 2936, 1731, 1682, 1604, 1481, 1366, 996, 867, 751, 689 cm^{-1}.

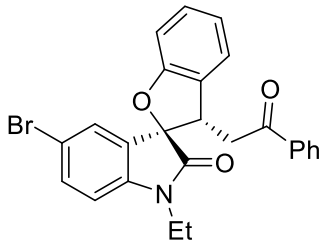


	Retention Time	Area	% Area
1	3.905	5861014	27.04
2	4.319	6156827	28.41
3	5.647	4777072	22.04
4	9.039	4878035	22.51



	Retention Time	Area	% Area
1	5.560	1027378	7.10
2	8.633	13447629	92.90

(2*R*,3*S*)-5'-bromo-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C5):



White solid, 99% yield, 93:7 er, >19:1 dr, m.p. 75-78 °C, $[\alpha]^{20}_{D}$ = -36.9 (c = 0.95, in CH_2Cl_2). Reacted for 108 h.

SFC Daicel Chiracel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.26 min, t_2 = 9.47 min.

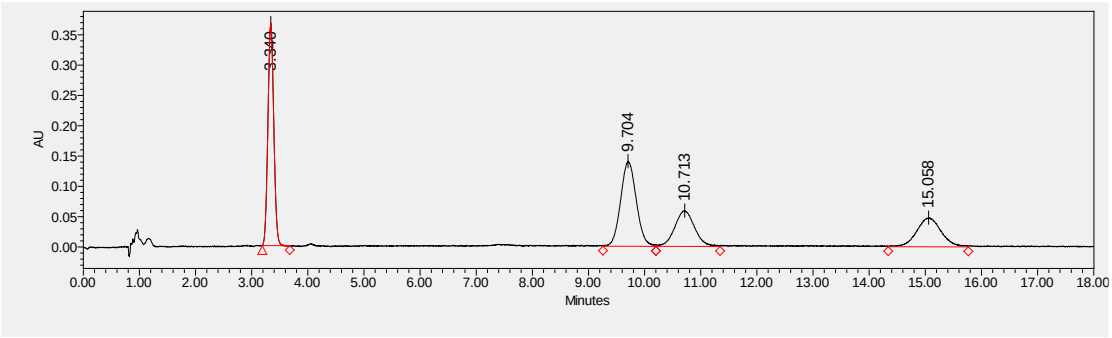
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.70 – 7.62 (m, 2H), 7.54 – 7.47 (m, 1H), 7.37 (t, *J* = 7.7 Hz, 2H), 7.26 – 7.15 (m, 4H), 7.01 (t, *J* = 7.4 Hz, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.58 (d, *J* = 8.3 Hz, 1H), 4.63 (t, *J* = 7.7 Hz, 1H), 3.91 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.70 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.54 – 3.44 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 174.5, 158.5, 142.7, 135.9, 133.4, 133.2, 129.2, 128.5, 128.2, 127.9, 127.7, 127.6, 123.8, 121.6, 114.5, 110.3, 88.6, 77.1, 44.7, 40.1, 35.2, 12.2.

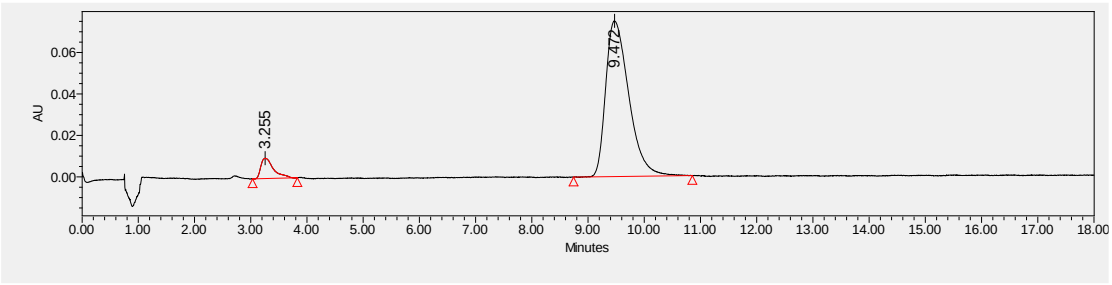
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0513.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0495.

IR (neat) 3060, 2980, 2935, 1731, 1682, 1480, 1428, 1241, 1148, 1112, 995, 752 cm^{-1}.

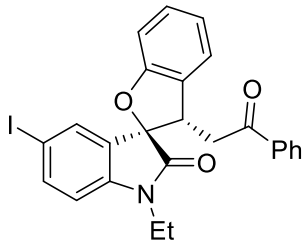


	Retention Time	Area	% Area
1	3.340	2654562	32.17
2	9.704	2706072	32.79
3	10.713	1441938	17.47
4	15.058	1449909	17.57



	Retention Time	Area	% Area
1	3.255	153552	6.69
2	9.472	2142875	93.31

(2*R*,3*S*)-1'-ethyl-5'-iodo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C6):



Yellow solid, 99% yield, 94:6 er, >19:1 dr, m.p. 77-82 °C, $[\alpha]^{20}_{D}$ = -147.7 (c = 0.92, in CH_2Cl_2). Reacted for 120 h.

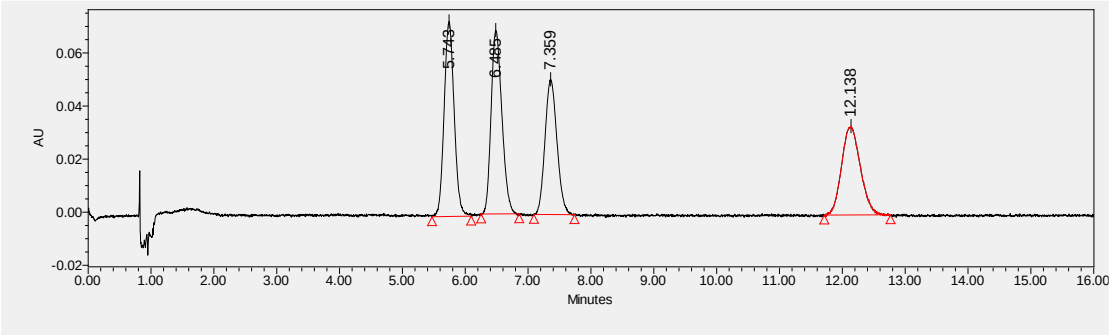
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 7.25 min, t_2 = 11.68 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.64 (d, *J* = 7.3 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.41 – 7.31 (m, 4H), 7.26 – 7.18 (m, 2H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.89 (d, *J* = 8.0 Hz, 1H), 6.48 (d, *J* = 8.2 Hz, 1H), 4.63 (dd, *J* = 10.7, 4.7 Hz, 1H), 3.89 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.69 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.56 – 3.38 (m, 2H), 1.36 (t, *J* = 7.2 Hz, 3H).

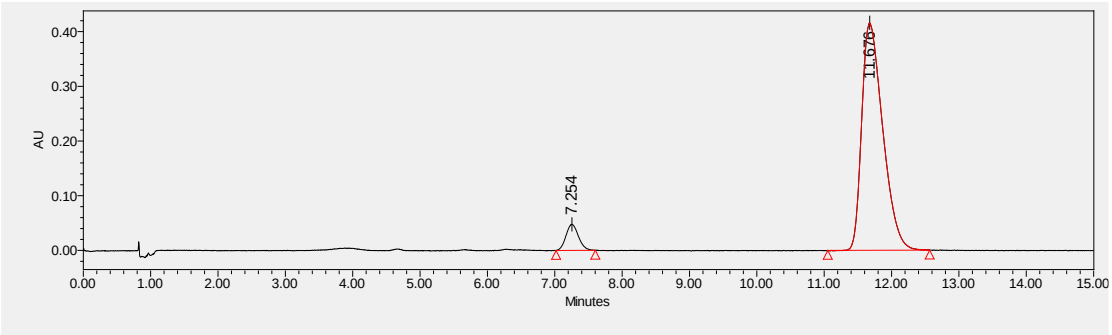
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 174.4, 158.6, 143.5, 139.3, 136.0, 133.5, 133.4, 129.2, 128.6, 128.2, 127.7, 123.9, 121.7, 110.9, 110.3, 88.5, 84.2, 44.9, 40.3, 35.2, 12.3.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}INO_3Na^+]$: 532.0380 found 532.0386.

IR (neat) 3058, 2980, 2934, 1727, 1680, 1600, 1477, 1348, 1227, 1111, 994, 814, 739, 691 cm^{-1}.

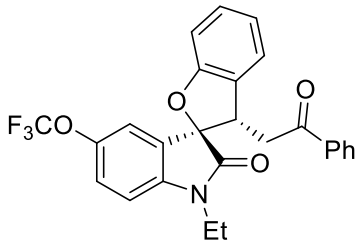


	Retention Time	Area	% Area
1	5.743	813760	27.10
2	6.485	824996	27.48
3	7.359	673625	22.44
4	12.138	689893	22.98



	Retention Time	Area	% Area
1	7.254	611658	6.36
2	11.676	9002916	93.64

(2*R*,3*S*)-1'-ethyl-3-(2-oxo-2-phenylethyl)-5'-(trifluoromethoxy)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C7):



White solid, 89% yield, 96:4 er, >19:1 dr, m.p. 64-68 °C, $[\alpha]_D^{20}$ = -51.3 (c = 0.83, in CH_2Cl_2). Reacted for 72 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.64 min, t_2 = 3.80 min.

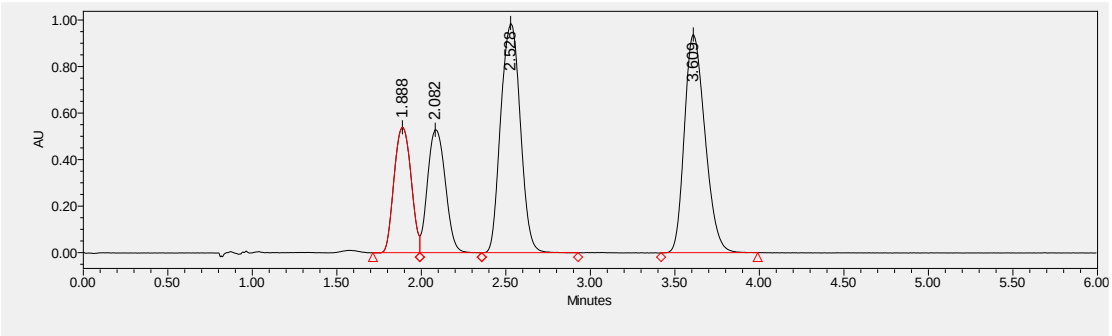
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 – 7.57 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 2H), 7.23 (dd, *J* = 7.5, 3.3 Hz, 2H), 7.06 – 6.97 (m, 2H), 6.95 (s, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.71 (d, *J* = 8.5 Hz, 1H), 4.65 (dd, *J* = 9.7, 5.6 Hz, 1H), 3.94 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.74 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.58 – 3.41 (m, 2H), 1.39 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 175.0, 158.6, 143.9, 142.6, 136.0, 133.5, 129.3, 128.6, 128.2, 127.6, 123.9, 123.8, 121.8, 119.2, 110.4, 109.3, 88.6, 44.6, 40.4, 35.4, 12.3.

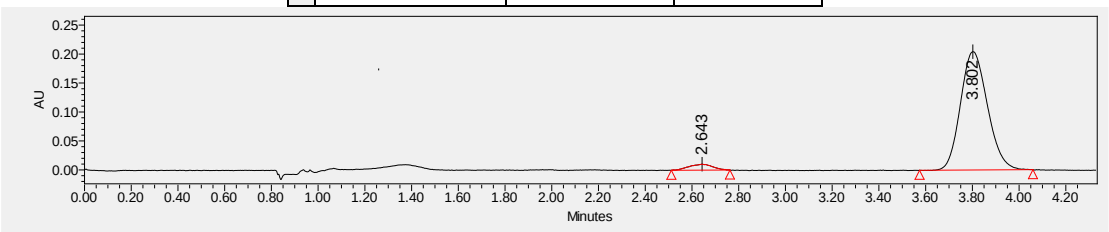
^{19}F NMR (376 MHz, Chloroform-*d*) δ -58.70.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{20}F_3NO_4Na^+]$: 490.1237 found 490.1238.

IR (neat) 3061, 2981, 1731, 1682, 1484, 1453, 1246, 1210, 1163, 1112, 995, 750, 689 cm^{-1}.

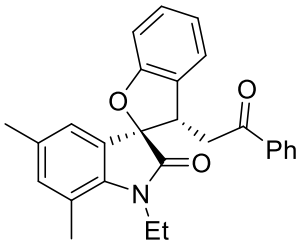


	Retention Time	Area	% Area
1	1.888	3763647	16.04
2	2.082	3860671	16.45
3	2.528	7924390	33.77
4	3.609	7917295	33.74



	Retention Time	Area	% Area
1	2.643	71287	4.16
2	3.802	1640611	95.84

(2*R*,3*S*)-1'-ethyl-5',7'-dimethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C8):



Yellow solid, 99% yield, 94:6 er, >19:1 dr, m.p. 59-62 °C, $[\alpha]\ ^{20}_{D}$ = -50.4 (c = 0.50, in CH_2Cl_2). Reacted for 120 h.

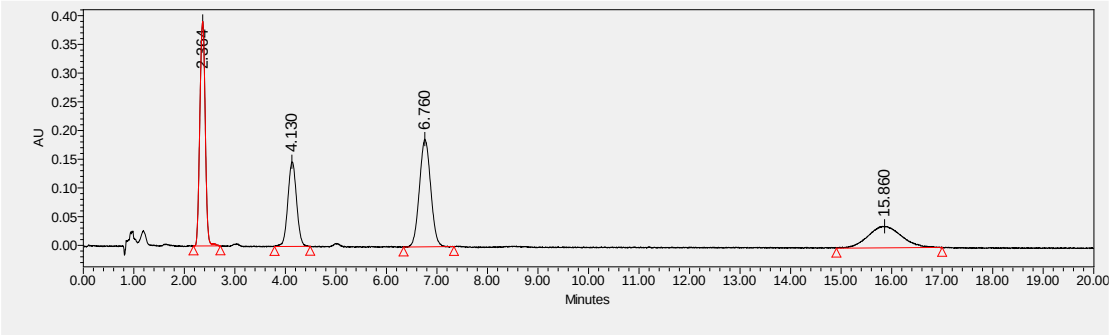
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.40 min, t_2 = 6.86 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.57 (m, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.23 – 7.19 (m, 2H), 6.97 (t, *J* = 7.2 Hz, 1H), 6.89 (d, *J* = 7.9 Hz, 1H), 6.70 (s, 1H), 6.60 (s, 1H), 4.65 (dd, *J* = 10.5, 4.6 Hz, 1H), 4.07 – 3.92 (m, 2H), 3.48 (dd, *J* = 17.6, 10.6 Hz, 1H), 3.32 (dd, *J* = 17.6, 4.7 Hz, 1H), 2.34 (s, 3H), 1.99 (s, 3H), 1.37 (t, *J* = 7.1 Hz, 3H).

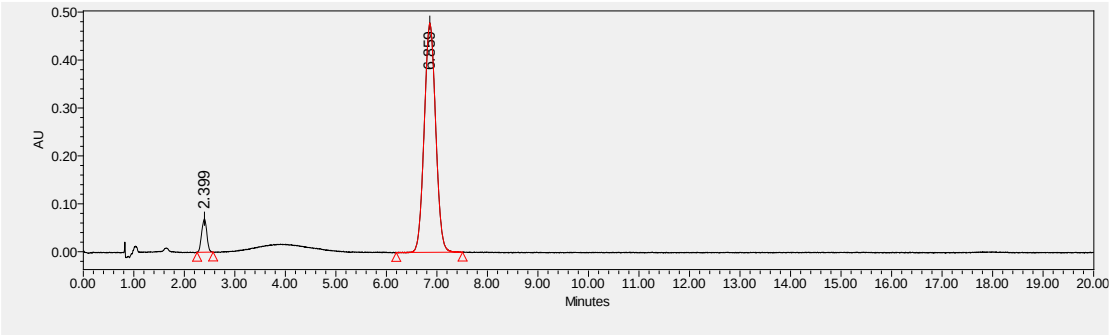
^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 176.2, 159.0, 139.0, 136.4, 134.9, 133.1, 131.7, 128.9, 128.4, 127.6, 126.7, 123.9, 123.5, 121.3, 119.7, 110.2, 88.4, 44.9, 40.2, 36.9, 20.4, 18.7, 14.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{27}H_{25}NO_3Na^+]$: 434.1727 found 434.1732.

IR (neat) 2975, 2923, 1719, 1681, 1597, 1476, 1356, 1227, 1113, 996, 896, 744, 691 cm^{-1}.

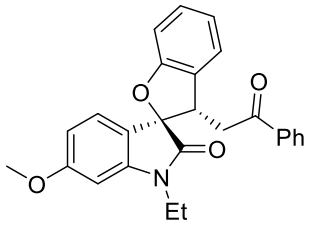


	Retention Time	Area	% Area
1	2.364	2896129	31.17
2	4.130	1761379	18.96
3	6.760	2904116	31.26
4	15.860	1728302	18.60



	Retention Time	Area	% Area
1	2.399	492890	6.15
2	6.859	7521287	93.85

(2*R*,3*S*)-1'-ethyl-6'-methoxy-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C9):



White solid, 69% yield, 94:6 er, 78:22 dr, m.p. 74-75 °C. Reacted for 96 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.90 min, t_2 = 4.25 min, t_3 = 6.23 min, t_4 = 7.98 min.

minor product

$[\alpha]^{20}_D$ = -48.0 (c = 0.05, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-d) δ 7.98 – 7.81 (m, 2H), 7.54 (t, J = 7.4 Hz, 1H), 7.42 (t, J = 7.7 Hz, 2H), 7.24 – 7.17 (m, 3H), 6.96 (t, J = 7.3 Hz, 1H), 6.90 (d, J = 8.0 Hz, 1H), 6.52 (dd, J = 8.2, 2.2 Hz, 1H), 6.44 (d, J = 2.1 Hz, 1H), 4.42 (dd, J = 9.2, 4.9 Hz, 1H), 3.94 (dd, J = 18.4, 9.3 Hz, 1H), 3.83 (s, 3H), 3.70 (dq, J = 14.6, 7.3 Hz, 1H), 3.51 (dq, J = 14.3, 7.2 Hz, 1H), 3.39 (dd, J = 18.4, 5.0 Hz, 1H), 1.19 (t, J = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.4, 173.3, 161.9, 158.9, 144.2, 136.6, 133.4, 129.4, 129.1, 128.7, 128.2, 124.5, 124.4, 122.7, 121.5, 110.4, 106.7, 96.9, 87.6, 55.7, 46.3, 41.2, 34.9, 12.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_4Na^+]$: 436.1519 found 436.1517.

IR (neat) 2932, 1726, 1682, 1624, 1504, 1477, 1379, 1217, 1097, 994, 892, 747, 691 cm^{-1}.

major product

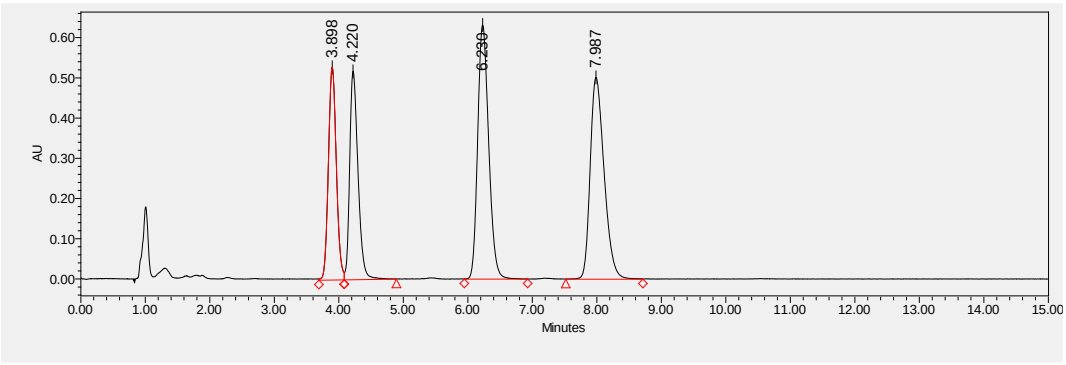
$[\alpha]^{21}_D$ = -41.6 (c = 0.31, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.65 (d, *J* = 7.6 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.34 (t, *J* = 7.7 Hz, 2H), 7.23 – 7.21 (m, 2H), 7.02 – 6.93 (m, 2H), 6.87 (d, *J* = 8.2 Hz, 1H), 6.28 (d, *J* = 2.0 Hz, 1H), 6.22 (dd, *J* = 8.2, 2.1 Hz, 1H), 4.61 (t, *J* = 7.6 Hz, 1H), 3.88 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.75 – 3.68 (m, 1H), 3.66 (s, 3H), 3.44 (d, *J* = 7.8 Hz, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

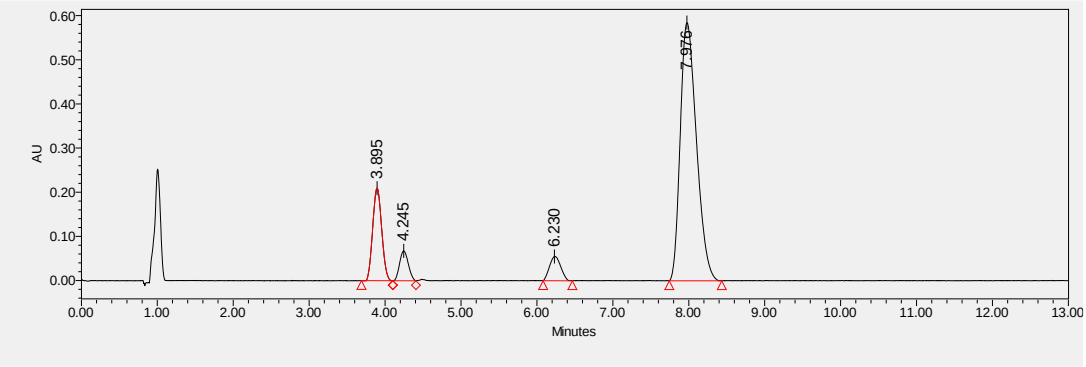
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 175.6, 162.0, 158.8, 145.3, 136.4, 133.2, 129.0, 128.9, 128.5, 127.8, 126.0, 123.9, 121.3, 117.9, 110.2, 105.7, 97.0, 89.0, 55.6, 44.5, 40.4, 35.1, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_4Na^+]$: 436.1519 found 436.1519.

IR (neat) 3059, 2933, 1726, 1620, 1455, 1378, 1216, 1098, 990, 884, 749, 693 cm^{-1}.

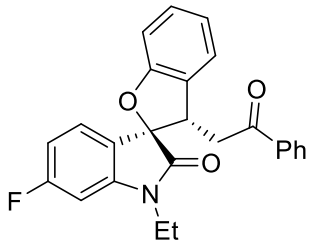


	Retention Time	Area	% Area
1	3.898	4525277	18.68
2	4.220	4661365	19.25
3	6.230	7505177	30.99
4	7.987	7527401	31.08



	Retention Time	Area	% Area
1	3.895	1726842	15.02
2	4.245	537958	4.68
3	6.230	565153	4.92
4	7.976	8664460	75.38

(2*R*,3*S*)-1'-ethyl-6'-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C10):



Yellow solid, 84% yield, 91:9 er, >19:1 dr, m.p. 59-61 °C, $[\alpha]^{20}_{D}$ = -40.8 (c = 0.66, in CH_2Cl_2). Reacted for 96 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.75 min, t_2 = 6.58 min.

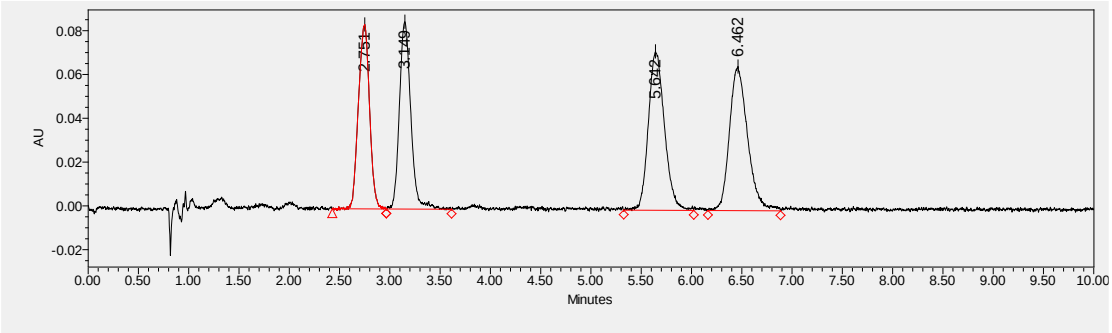
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.65 (d, *J* = 7.4 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.35 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.20 (m, 2H), 7.02 – 6.96 (m, 2H), 6.88 (d, *J* = 8.0 Hz, 1H), 6.51 – 6.37 (m, 2H), 4.61 (dd, *J* = 10.5, 4.6 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.77 – 3.66 (m, 1H), 3.56 – 3.37 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.41, 164.4 (d, *J* = 248.1 Hz), 158.6, 145.7 (d, *J* = 11.9 Hz), 136.1, 133.4, 129.1, 128.6, 128.5, 127.6, 126.2 (d, *J* = 10.1 Hz), 123.9, 121.5, 121.4 (d, *J* = 3.1 Hz), 110.3, 108.1 (d, *J* = 22.6 Hz), 97.8 (d, *J* = 27.6 Hz), 88.6, 44.5, 40.3, 35.3, 12.3.

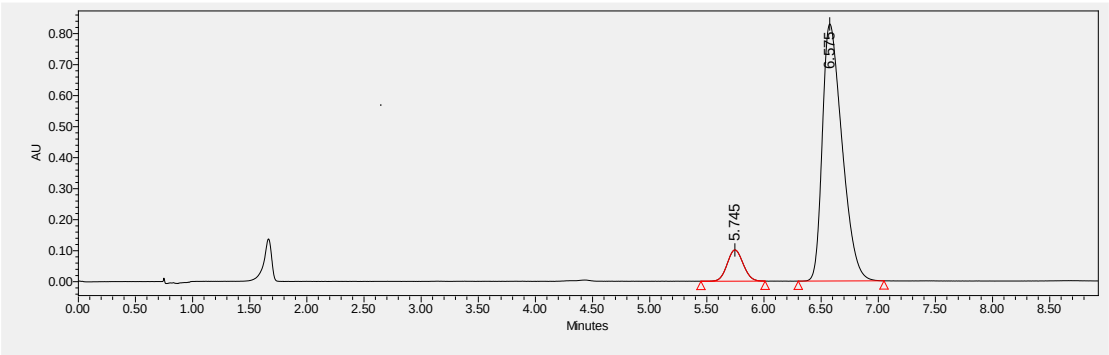
^{19}F NMR (376 MHz, Chloroform-*d*) δ -108.44.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1318.

IR (neat) 3062, 2982, 1732, 1681, 1612, 1453, 1379, 1354, 1200, 1088, 840, 749, 694 cm^{-1}.

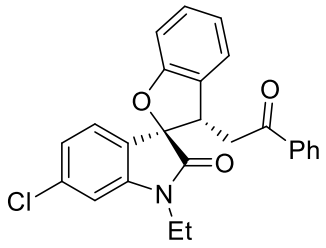


	Retention Time	Area	% Area
1	2.751	647713	21.93
2	3.149	672585	22.77
3	5.642	808263	27.36
4	6.462	825613	27.95



	Retention Time	Area	% Area
1	5.745	979613	8.98
2	6.575	9934344	91.02

(2*R*,3*S*)-6'-chloro-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C11):



Yellow solid, 99% yield, 92:8 er, >19:1 dr, m.p. 68-70 °C, $[\alpha]_D^{20}$ = -49.3 (c = 0.82, in CH_2Cl_2). Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 7.24 min, t_2 = 8.44 min.

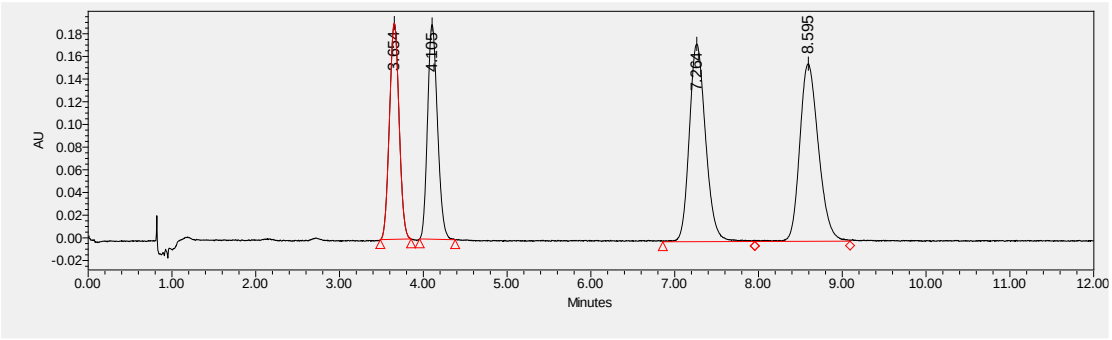
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.64 (d, *J* = 7.3 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.20 (m, 2H), 7.00 – 6.95 (m, 2H), 6.87 (d, *J* = 8.0 Hz, 1H), 6.72 – 6.70 (m, 2H), 4.61 (dd, *J* = 10.8, 4.4 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.75 – 3.66 (m, 1H), 3.57 – 3.35 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.1, 158.6, 145.0, 136.4, 136.1, 133.4, 129.2, 128.6, 128.4, 127.7, 125.8, 124.2, 123.9, 121.9, 121.6, 110.3, 109.6, 88.5, 44.6, 40.2, 35.3, 12.3.

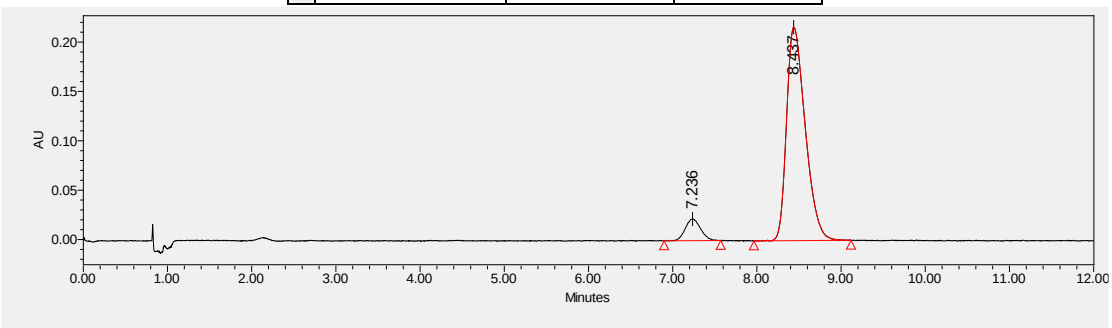
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{35}ClNO_3Na^+]$: 440.1024 found 440.1029.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{37}ClNO_3Na^+]$: 442.0994 found 442.1000.

IR (neat) 3062, 2981, 2936, 1733, 1682, 1605, 1483, 1369, 1230, 1011, 750, 693 cm^{-1}.

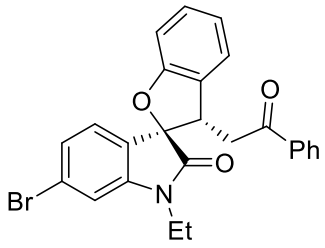


	Retention Time	Area	% Area
1	3.654	1523755	19.39
2	4.105	1554283	19.78
3	7.264	2354933	29.97
4	8.595	2425684	30.87



	Retention Time	Area	% Area
1	7.236	279292	7.74
2	8.437	3328450	92.26

(2*R*,3*S*)-6'-bromo-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C12):



Yellow solid, 93% yield, 93:7 er, >19:1 dr, m.p. 70-73 °C, $[\alpha]_D^{20}$ = -43.2 (c = 0.94, in CH_2Cl_2). Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 8.23 min, t_2 = 9.76 min.

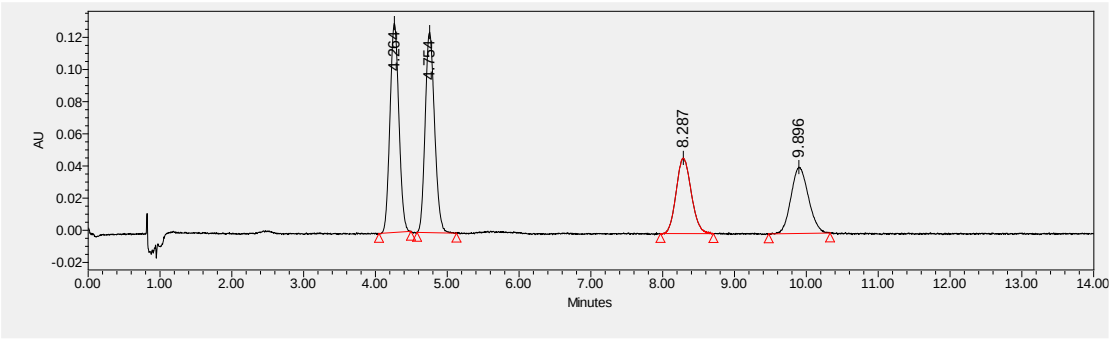
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 – 7.61 (m, 2H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.20 (m, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.93 – 6.83 (m, 4H), 4.61 (dd, *J* = 10.8, 4.4 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.69 (dt, *J* = 14.4, 7.2 Hz, 1H), 3.56 – 3.36 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 174.9, 158.6, 145.1, 136.1, 133.4, 129.2, 128.6, 128.4, 127.7, 126.0, 124.8, 124.7, 124.4, 123.9, 121.6, 112.4, 110.3, 88.6, 44.6, 40.2, 35.3, 12.3.

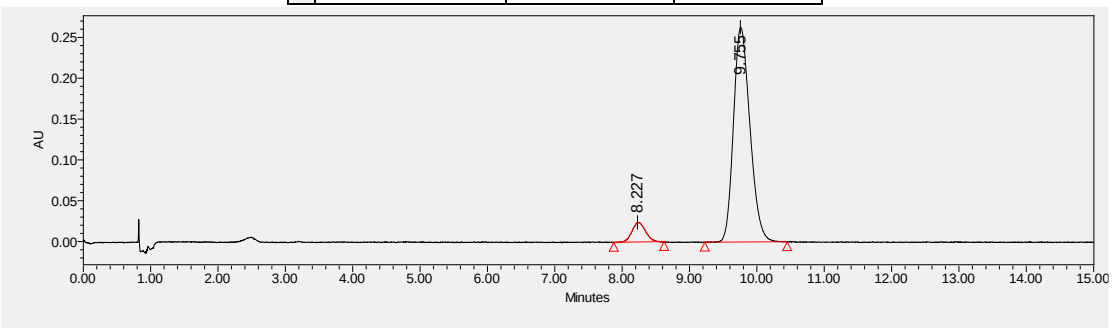
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0524.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0503.

IR (neat) 3061, 2981, 1733, 1682, 1601, 1482, 1429, 1230, 1000, 750, 693 cm^{-1}.

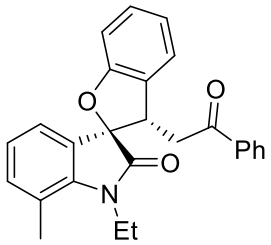


	Retention Time	Area	% Area
1	4.264	1118798	30.82
2	4.754	1133202	31.21
3	8.287	684341	18.85
4	9.896	694283	19.12



	Retention Time	Area	% Area
1	8.227	333171	6.95
2	9.755	4460394	93.05

(2*R*,3*S*)-1'-ethyl-7'-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C13):



Yellow solid, 87% yield, 93:7 er, >19:1 dr, m.p. 148-152 °C, $[\alpha]_D^{20}$ = -13.9 (c = 0.77, in CH_2Cl_2). Reacted for 108 h.

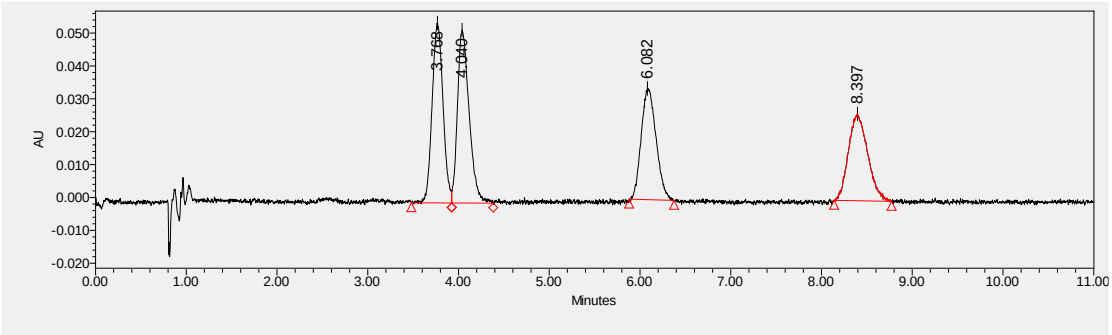
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 6.18 min, t_2 = 8.54 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.4 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.22 – 7.18 (m, 2H), 6.96 (t, *J* = 7.4 Hz, 1H), 6.93 – 6.81 (m, 3H), 6.67 (t, *J* = 7.5 Hz, 1H), 4.73 – 4.57 (m, 1H), 4.10 – 3.94 (m, 2H), 3.46 – 3.36 (m, 2H), 2.39 (s, 3H), 1.39 (t, *J* = 7.1 Hz, 3H).

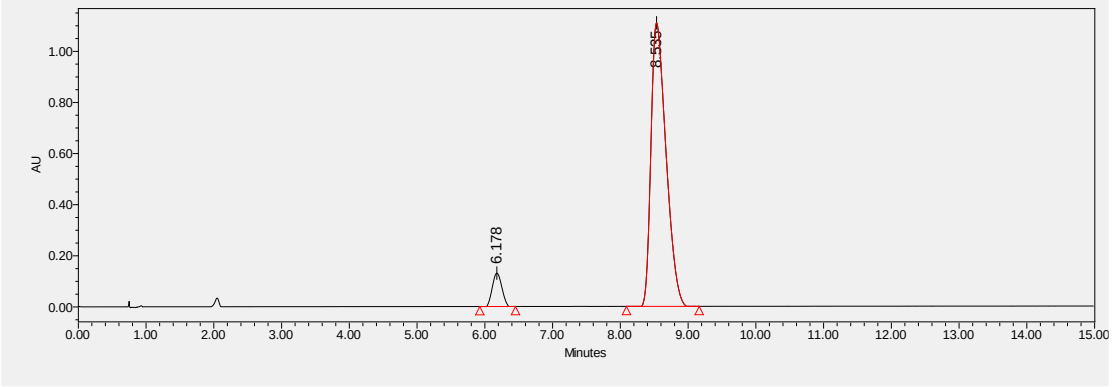
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 176.2, 158.9, 141.4, 136.3, 134.5, 133.2, 129.0, 128.9, 128.5, 127.7, 126.6, 123.9, 122.7, 122.1, 121.3, 120.0, 110.2, 88.4, 44.8, 40.1, 37.0, 18.9, 14.7.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1570.

IR (neat) 2924, 1725, 1683, 1599, 1455, 1361, 1227, 886, 751, 691 cm^{-1}.

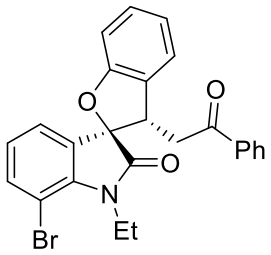


	Retention Time	Area	% Area
1	3.768	457802	26.88
2	4.040	471577	27.69
3	6.082	386722	22.70
4	8.397	387240	22.73



	Retention Time	Area	% Area
1	6.178	1266387	6.90
2	8.535	17082968	93.10

(2*R*,3*S*)-7'-bromo-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C14):



Yellow solid, 99% yield, 92.5:7.5 er, >19:1 dr, m.p. 63-67 °C, $[\alpha]\ ^{20}_{D}$ = 4.2 (c = 0.82, in CH_2Cl_2). Reacted for 120 h .

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 9.55 min, t_2 = 10.51 min.

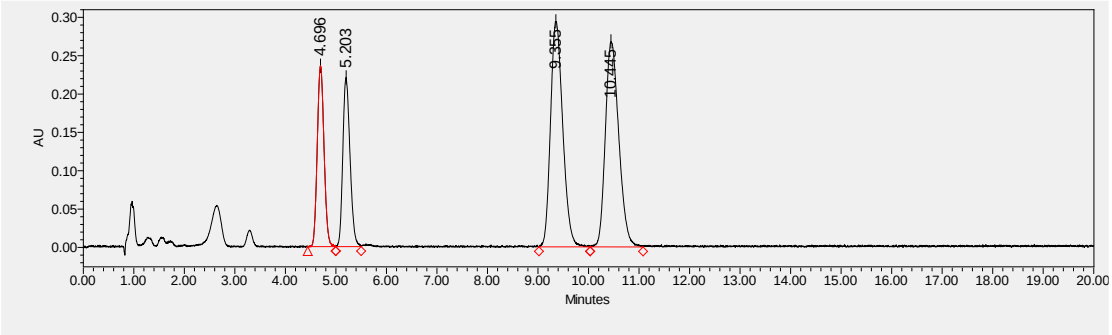
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.69 – 7.63 (m, 2H), 7.49 (t, *J* = 7.4 Hz, 1H), 7.35 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.17 (m, 3H), 7.02 – 6.95 (m, 2H), 6.88 (d, *J* = 7.9 Hz, 1H), 6.65 – 6.55 (m, 1H), 4.64 (dd, *J* = 10.4, 4.8 Hz, 1H), 4.30 – 4.21 (m, 2H), 3.55 – 3.30 (m, 2H), 1.45 (t, *J* = 7.1 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 175.9, 158.6, 141.4, 136.4, 136.1, 133.4, 129.2, 129.1, 128.6, 128.4, 127.7, 123.9, 123.8, 123.2, 121.6, 110.3, 102.7, 88.0, 45.0, 40.1, 36.8, 14.8.

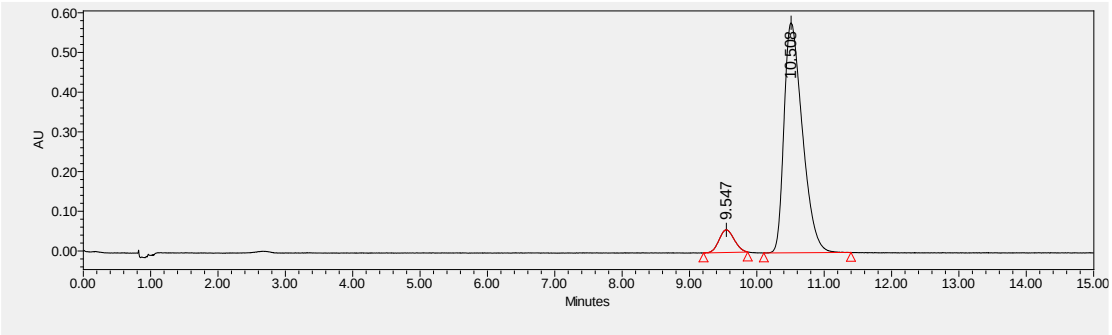
HRMS (ESI) m/z: [M + Na]$^+$ Calculated for [$C_{25}H_{20}{}^{79}BrNO_3Na^+$]: 484.0519 found 484.0522.

HRMS (ESI) m/z: [M + Na]$^+$ Calculated for [$C_{25}H_{20}{}^{81}BrNO_3Na^+$]: 486.0498 found 486.0502.

IR (neat) 3060, 2978, 1731, 1681, 1455, 1355, 1232, 1114, 859, 742, 693 cm^{-1}.

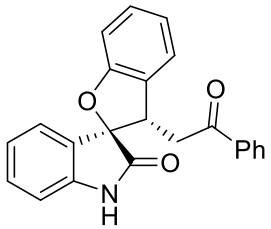


	Retention Time	Area	% Area
1	4.696	2202111	15.42
2	5.203	2186807	15.31
3	9.355	4937596	34.58
4	10.445	4952791	34.69



	Retention Time	Area	% Area
1	9.547	889187	7.51
2	10.508	10954733	92.49

(2*R*,3*S*)-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C15):



White solid, 99% yield, 80:20 er, 83:17 dr, m.p. 86-87 °C, Reacted for 120 h.

SFC Daicel Chiralpak AS-3, CO_2/MeOH = 80/20, 1.5 mL/min, λ = 240 nm, t_1 = 3.15 min, t_2 = 5.19 min, t_3 = 14.73 min, t_4 = 18.65 min.

minor product

$[\alpha]^{20}_D$ = -125.0 (c = 0.08, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 (d, *J* = 8.2 Hz, 2H), 7.64 (d, *J* = 23.2 Hz, 1H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.41 (t, *J* = 7.7 Hz, 2H), 7.31 – 7.27 (m, 1H), 7.26 – 7.19 (m, 3H), 7.04 (t, *J* = 7.6 Hz, 1H), 6.97 (t, *J* = 7.5 Hz, 1H), 6.92 (d, *J* = 8.0 Hz, 1H), 6.83 (d, *J* = 7.7 Hz, 1H), 4.48 (dd, *J* = 8.4, 5.6 Hz, 1H), 3.94 – 3.86 (m, 1H), 3.45 (dd, *J* = 18.4, 5.4 Hz, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.6, 174.9, 158.8, 140.4, 136.6, 133.5, 130.6, 130.6, 129.2, 129.2, 128.8, 128.2, 124.6, 124.0, 123.6, 121.8, 110.5, 110.4, 87.9, 46.4, 41.2.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{23}H_{17}NO_3Na^+]$: 378.1101 found 378.1105.

IR (neat) 3254, 2923, 1723, 1682, 1620, 1473, 1398, 1234, 1184, 1109, 995, 745, 686, 623 cm^{-1}.

major product

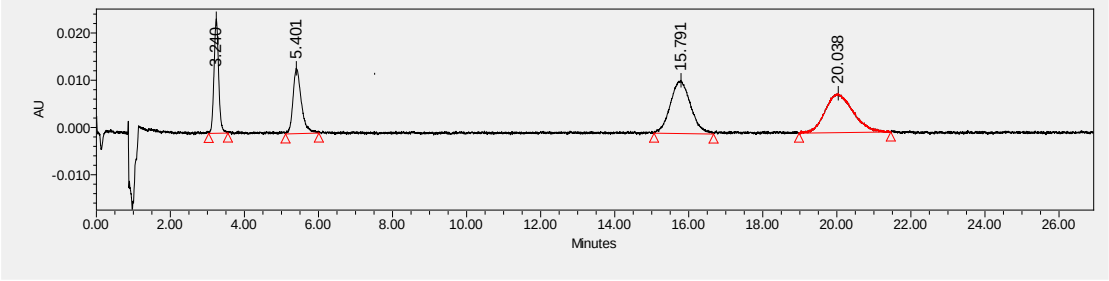
$[\alpha]^{20}_D$ = -70.1 (c = 0.53, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.55 (d, *J* = 43.5 Hz, 1H), 7.67 (d, *J* = 7.3 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.34 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.19 (m, 2H), 7.08 (t, *J* = 7.9 Hz, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.91 (d, *J* = 8.1 Hz, 1H), 6.83 – 6.75 (m, 2H), 4.68 (t, *J* = 7.4 Hz, 1H), 3.52 – 3.49 (m, 2H).

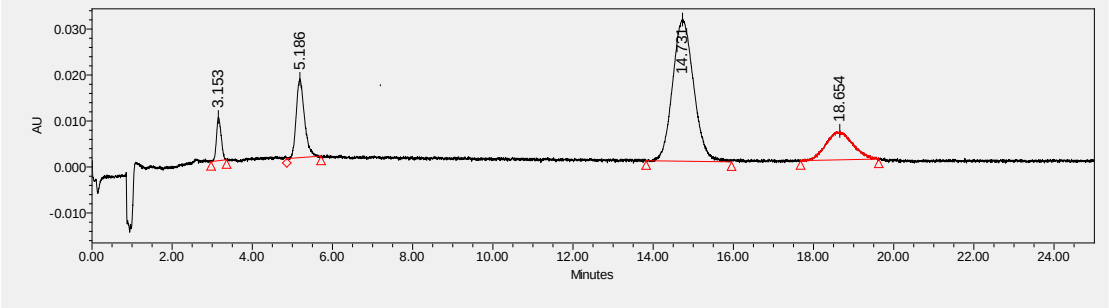
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.6, 177.5, 158.8, 141.7, 136.3, 133.4, 130.7, 129.1, 128.7, 128.6, 127.8, 126.0, 125.2, 124.1, 122.4, 121.5, 111.0, 110.3, 89.3, 44.3, 40.7.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{23}H_{17}NO_3Na^+]$: 378.1101 found 378.1104.

IR (neat) 3263, 3059, 1728, 1679, 1618, 1471, 1333, 1235, 1189, 995, 741, 686, 621 cm^{-1}.

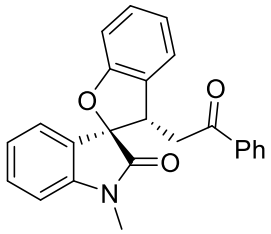


	Retention Time	Area	% Area
1	3.240	209840	16.39
2	5.401	216964	16.94
3	15.791	423866	33.10
4	20.038	429826	33.57



	Retention Time	Area	% Area
1	3.153	76251	4.42
2	5.186	244225	14.15
3	14.731	1121141	64.96
4	18.654	284238	16.47

(2*R*,3*S*)-1'-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C16):



White solid, 98% yield, 89:11 er, >19:1 dr, m.p. 151-153 °C, $[\alpha]\ ^{20}_{D}$ = -36.7 (c = 0.72, in CH_2Cl_2). Reacted for 108 h.

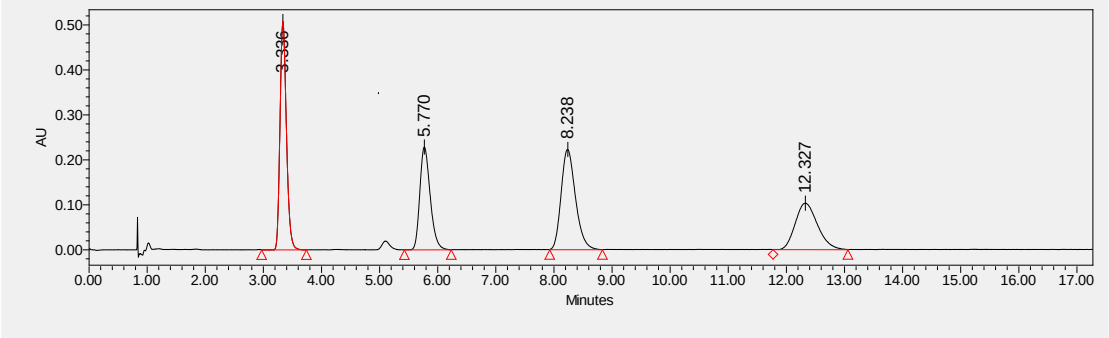
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.31 min, t_2 = 8.19 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.67 – 7.59 (m, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.20 (m, 2H), 7.14 (td, *J* = 7.8, 1.1 Hz, 1H), 7.07 (d, *J* = 7.3 Hz, 1H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 7.8 Hz, 1H), 4.62 (dd, *J* = 9.5, 5.5 Hz, 1H), 3.54 – 3.40 (m, 2H), 3.29 (s, 3H).

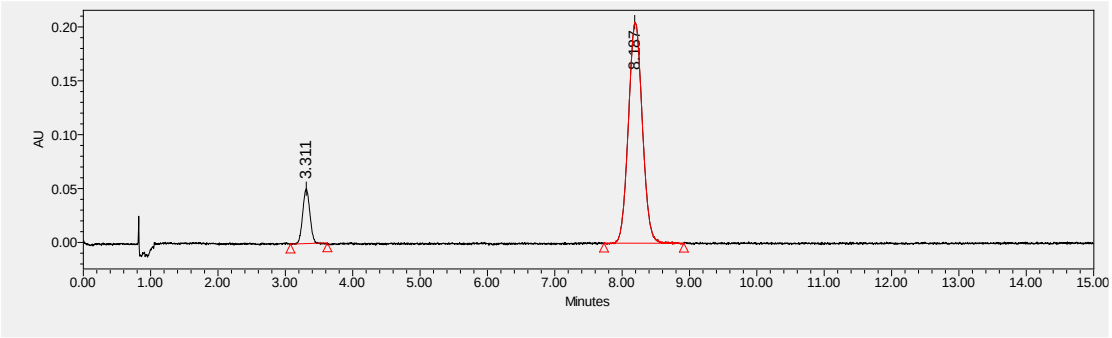
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.3, 175.6, 158.8, 144.5, 136.3, 133.2, 130.7, 129.1, 128.7, 128.5, 125.6, 124.7, 124.0, 122.3, 121.4, 110.2, 108.8, 89.0, 44.5, 40.6, 26.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{24}H_{19}NO_3Na^+]$: 392.1257 found 392.1257.

IR (neat) 3058, 2932, 1728, 1682, 1609, 1472, 1369, 1241, 991, 751, 692 cm^{-1}.

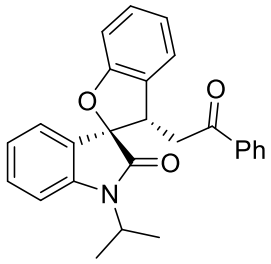


	Retention Time	Area	% Area
1	3.336	3896181	29.25
2	5.770	2839240	21.31
3	8.238	3828188	28.74
4	12.327	2756834	20.70



	Retention Time	Area	% Area
1	3.311	378948	11.41
2	8.187	2942201	88.59

(2*R*,3*S*)-1'-isopropyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C17):



Yellow solid, 76% yield, 91.5:8.5 er, >19:1 dr, m.p. 65-67 °C, $[\alpha]_D^{20}$ = -59.6 (c = 0.44, in CH_2Cl_2). Reacted for 120 h.

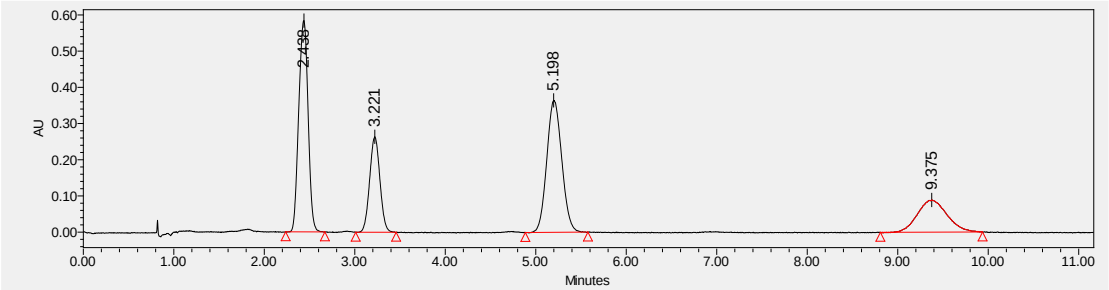
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.51 min, t_2 = 4.93 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.4 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.22 (m, 2H), 7.11 – 7.04 (m, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.87 (m, 2H), 6.75 (t, *J* = 7.5 Hz, 1H), 4.79 – 4.60 (m, 2H), 3.45 (d, *J* = 7.9 Hz, 2H), 1.56 (dd, *J* = 9.0, 7.1 Hz, 6H).

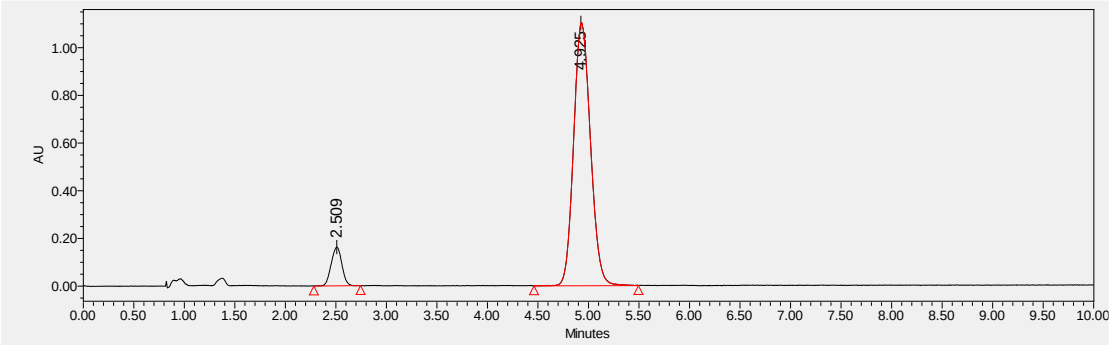
^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.8, 175.0, 158.8, 143.1, 136.1, 133.1, 130.3, 128.9, 128.7, 128.4, 127.5, 125.9, 124.9, 123.7, 121.6, 121.2, 110.5, 110.1, 88.7, 44.5, 44.1, 40.2, 19.3, 19.0.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1570.

IR (neat) 3059, 2979, 2935, 1725, 1682, 1605, 1474, 1359, 1241, 988, 752, 691 cm^{-1}.

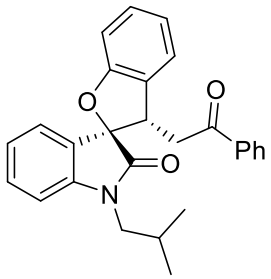


	Retention Time	Area	% Area
1	2.438	4187577	33.55
2	3.221	2075969	16.63
3	5.198	4208280	33.72
4	9.375	2009630	16.10



	Retention Time	Area	% Area
1	2.509	1190292	8.51
2	4.925	12800361	91.49

(2*R*,3*S*)-1'-isobutyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C18):



Yellow solid, 63% yield, 91:9 er, >19:1 dr, m.p. 57-58 °C, $[\alpha]_D^{20}$ = -17.7 (c = 0.35, in CH_2Cl_2). Reacted for 120 h.

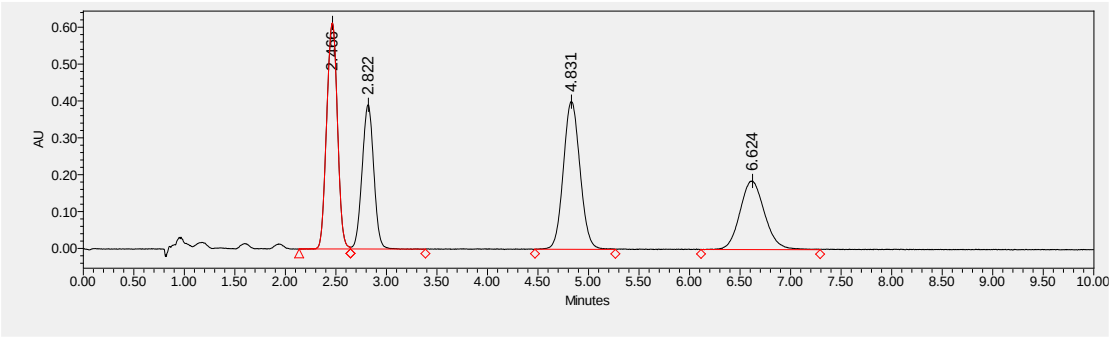
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.51 min, t_2 = 4.93 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.67 – 7.60 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.34 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.19 (m, 2H), 7.15 – 7.06 (m, 2H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.89 (d, *J* = 8.2 Hz, 1H), 6.79 – 6.72 (m, 2H), 4.64 (t, *J* = 7.5 Hz, 1H), 3.61 – 3.52 (m, 2H), 3.49 – 3.42 (m, 2H), 2.29 – 2.19 (m, 1H), 1.09 (d, *J* = 6.7 Hz, 3H), 1.03 (d, *J* = 6.7 Hz, 3H).

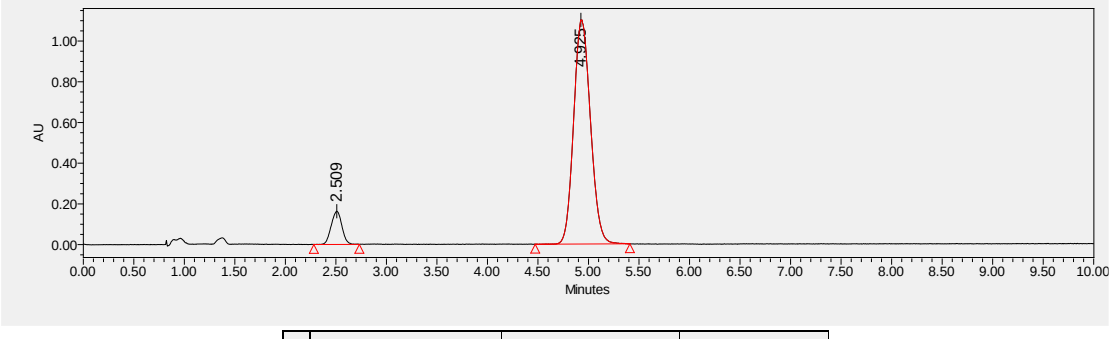
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.8, 158.9, 144.7, 136.4, 133.2, 130.5, 129.0, 128.9, 128.5, 127.7, 125.7, 124.9, 124.0, 122.0, 121.4, 110.3, 109.4, 88.9, 48.2, 44.3, 40.7, 27.5, 20.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{27}H_{25}NO_3Na^+]$: 434.1727 found 434.1729.

IR (neat) 3058, 2960, 1730, 1684, 1609, 1472, 1367, 1241, 993, 751, 694 cm^{-1}.

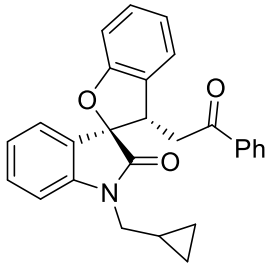


	Retention Time	Area	% Area
1	2.466	4550091	29.45
2	2.822	3148163	20.37
3	4.831	4594814	29.73
4	6.624	3159506	20.45



	Retention Time	Area	% Area
1	2.509	1206732	8.66
2	4.925	12733494	91.34

(2*R*,3*S*)-1'-(cyclopropylmethyl)-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C19):



Yellow solid, 98% yield, 92:8 er, >19:1 dr, m.p. 58-61 °C, $[\alpha]^{20}_{D}$ = -22.3 (c = 0.90, in CH_2Cl_2). Reacted for 120 h.

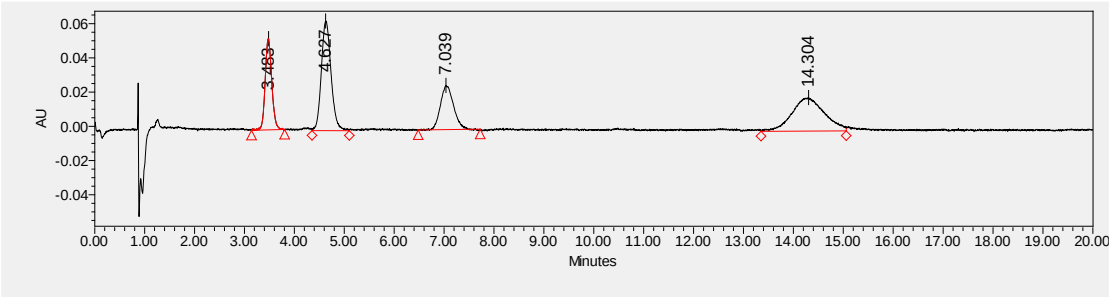
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.48 min, t_2 = 6.96 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.59 (m, 2H), 7.51 – 7.44 (m, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.22 (m, 2H), 7.14 (td, *J* = 7.8, 1.1 Hz, 1H), 7.08 (d, *J* = 7.3 Hz, 1H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.83 – 6.75 (m, 2H), 4.65 (t, *J* = 7.5 Hz, 1H), 3.72 (dd, *J* = 14.5, 6.4 Hz, 1H), 3.61 (dd, *J* = 14.5, 7.2 Hz, 1H), 3.44 (d, *J* = 7.5 Hz, 2H), 1.22-1.28 (m, 1H), 0.66 – 0.54 (m, 2H), 0.43-0.52 (d, *J* = 4.8 Hz, 2H).

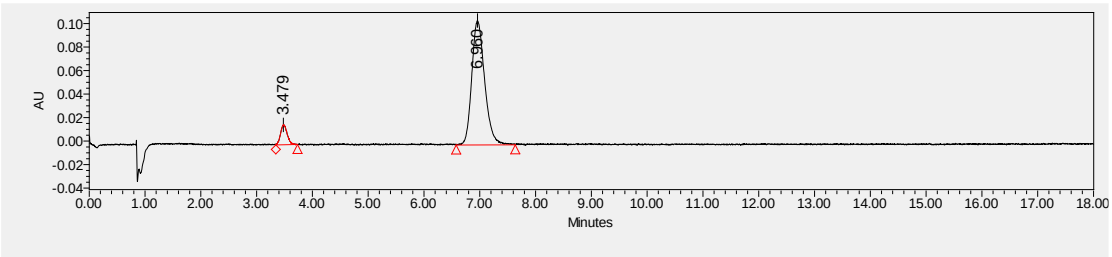
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.5, 158.9, 144.3, 136.4, 133.2, 130.6, 129.0, 128.9, 128.5, 127.7, 125.7, 124.9, 124.0, 122.1, 121.4, 110.3, 109.4, 89.0, 44.9, 44.5, 40.5, 9.5, 4.3, 4.1.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{27}H_{23}NO_3Na^+]$: 432.1570 found 432.1573.

IR (neat) 3060, 2919, 1729, 1683, 1608, 1476, 1364, 1239, 990, 752, 694 cm^{-1}.

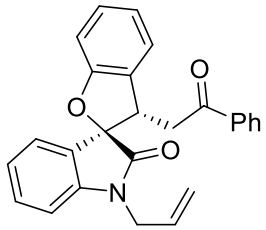


	Retention Time	Area	% Area
1	3.483	490536	18.06
2	4.627	868245	31.96
3	7.039	476084	17.53
4	14.304	881378	32.45



	Retention Time	Area	% Area
1	3.479	140454	7.63
2	6.960	1700488	92.37

(2*R*,3*S*)-1'-allyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C20):



Yellow solid, 93% yield, 94:6 er, >19:1 dr, m.p. 138-140 °C, $[\alpha]\ ^{20}_{D}$ = -49.0 (c = 0.70, in CH_2Cl_2). Reacted for 120 h.

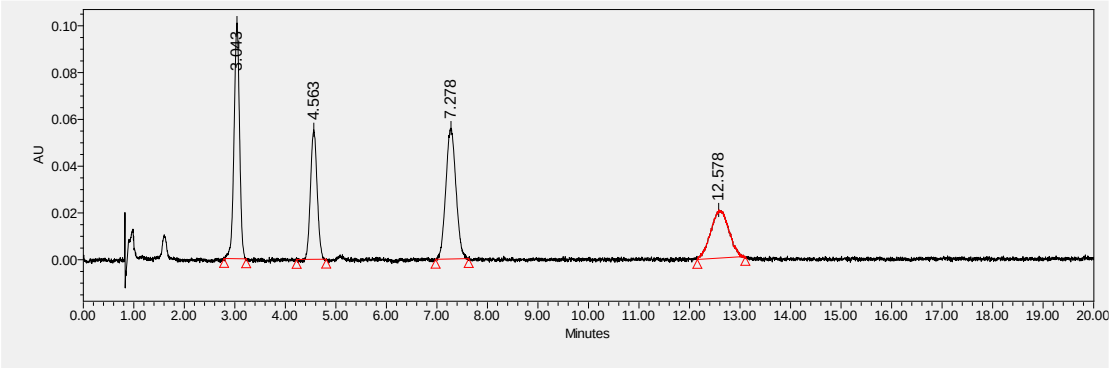
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.05 min, t_2 = 7.24 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.60 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.19 (m, 2H), 7.13 – 7.05 (m, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.89 (d, *J* = 8.1 Hz, 1H), 6.80 – 6.69 (m, 2H), 6.03 – 5.93 (m, 1H), 5.46 – 5.37 (m, 1H), 5.32 – 5.25 (m, 1H), 4.65 (t, *J* = 7.6 Hz, 1H), 4.55 – 4.48 (m, 1H), 4.37 – 4.31 (m, 1H), 3.52 – 3.44 (m, 2H).

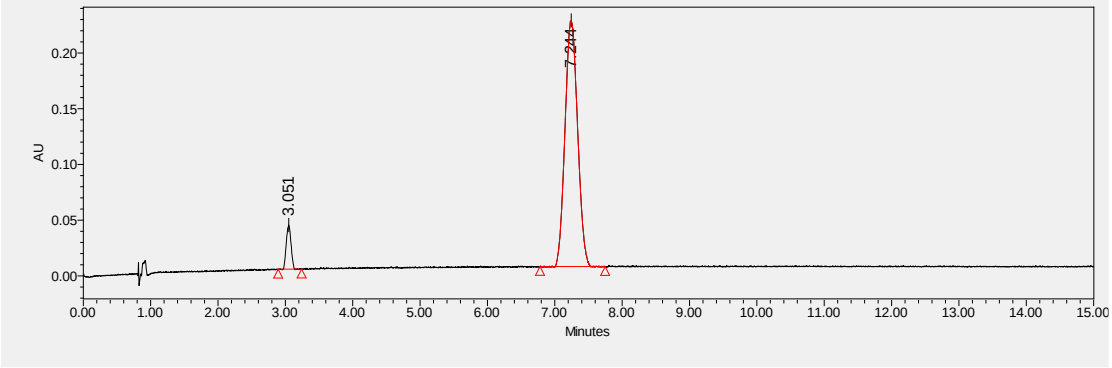
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 175.3, 158.8, 143.8, 136.3, 133.3, 131.7, 130.5, 129.1, 128.7, 128.5, 127.7, 125.6, 124.8, 123.9, 122.3, 121.4, 118.0, 110.3, 109.9, 89.0, 44.4, 43.0, 40.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{21}NO_3Na^+]$: 418.1414 found 418.1415.

IR (neat) 3058, 2915, 1729, 1682, 1608, 1472, 1363, 1239, 1186, 989, 750, 695 cm^{-1}.

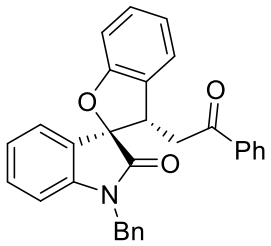


	Retention Time	Area	% Area
1	3.043	759784	29.74
2	4.563	509395	19.94
3	7.278	776389	30.39
4	12.578	509376	19.94



	Retention Time	Area	% Area
1	3.051	195818	6.38
2	7.244	2873283	93.62

(2*R*,3*S*)-1'-benzyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C21):



White solid, 78% yield, 90:10 er, >19:1 dr, m.p. 68-72 °C, $[\alpha]^{20}_D$ = -17.1 (c = 0.49, in CH_2Cl_2). Reacted for 120 h.

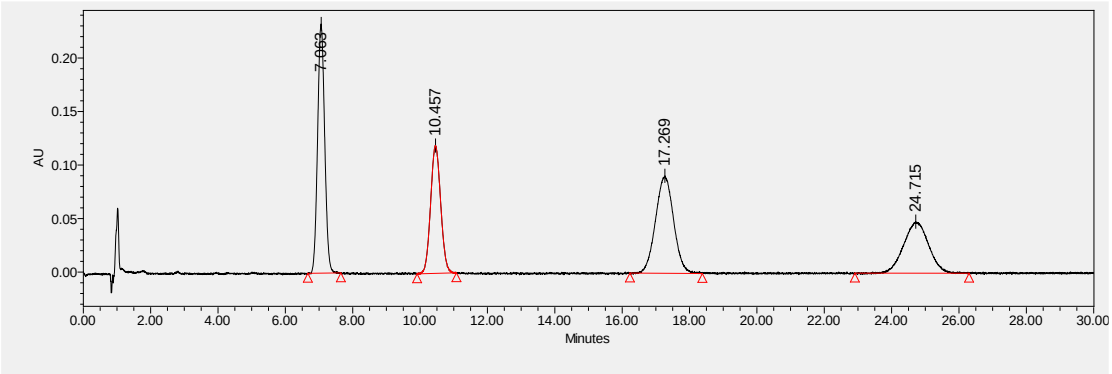
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 7.06 min, t_2 = 18.02 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.60 (m, 2H), 7.49 – 7.45 (m, 3H), 7.38 – 7.27 (m, 5H), 7.25 – 7.20 (m, 2H), 7.07 (d, *J* = 7.3 Hz, 1H), 7.03 – 6.96 (m, 2H), 6.91 (d, *J* = 8.1 Hz, 1H), 6.74 (t, *J* = 7.5 Hz, 1H), 6.55 (d, *J* = 7.9 Hz, 1H), 5.05 – 4.93 (m, 2H), 4.72 (t, *J* = 7.5 Hz, 1H), 3.51 (d, *J* = 7.3 Hz, 2H).

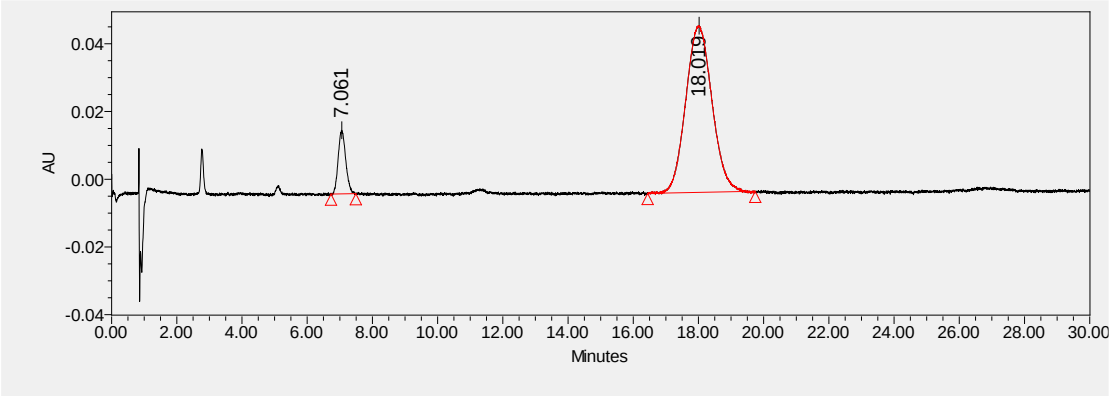
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.2, 175.8, 158.8, 143.8, 136.3, 135.6, 133.3, 130.6, 129.1, 128.9, 128.8, 128.6, 127.7, 127.7, 127.6, 125.6, 124.8, 124.0, 122.4, 121.5, 110.3, 110.1, 89.1, 44.5, 44.4, 40.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{30}H_{23}NO_3Na^+]$: 468.1570 found 468.1572.

IR (neat) 3059, 2918, 1730, 1682, 1608, 1476, 1360, 1239, 1180, 989, 750, 695 cm^{-1}.

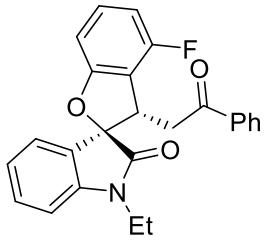


	Retention Time	Area	% Area
1	7.063	3388794	28.89
2	10.457	2481450	21.16
3	17.269	3383474	28.85
4	24.715	2475470	21.11



	Retention Time	Area	% Area
1	7.061	301690	9.88
2	18.019	2750687	90.12

(2*R*,3*S*)-1'-ethyl-4-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C22):



White solid, 96% yield, 91:9 er, 89:11 dr, m.p. 57-61 °C, Reacted for 144 h.

SFC Daicel Chiralpak IA-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.64 min, t_2 = 3.11 min, t_3 = 4.14 min, t_4 = 7.70 min.

minor product

$[\alpha]^{20}_D$ = -58.8 (c = 0.06, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 7.6 Hz, 2H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.42 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 8.1 Hz, 1H), 7.26 – 7.16 (m, 2H), 7.05 (t, *J* = 7.4 Hz, 1H), 6.90 (d, *J* = 7.9 Hz, 1H), 6.70 (t, *J* = 8.5 Hz, 2H), 4.56 (dd, *J* = 11.2, 2.7 Hz, 1H), 4.19 (dd, *J* = 18.5, 11.2 Hz, 1H), 3.77 – 3.68 (m, 1H), 3.60 – 3.41 (m, 2H), 1.17 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.4, 172.2, 160.7 (d, *J* = 8.6 Hz), 159.5 (d, *J* = 264.4 Hz), 142.5, 136.5, 133.4, 130.6 (d, *J* = 19.8 Hz), 130.6, 130.5, 128.7, 128.2, 123.4, 123.2, 115.5 (d, *J* = 19.5 Hz), 108.8, 108.6 (d, *J* = 20.3 Hz), 106.6 (d, *J* = 3.3 Hz), 87.9, 44.4, 39.3, 34.9, 12.4.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -118.60.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1323.

IR (neat) 2933, 1722, 1683, 1610, 1488, 1464, 1371, 1324, 1235, 1118, 991, 756, 690 cm^{-1}.

major product

$[\alpha]^{20}_D$ = -73.2 (c = 0.61, in CH_2Cl_2).

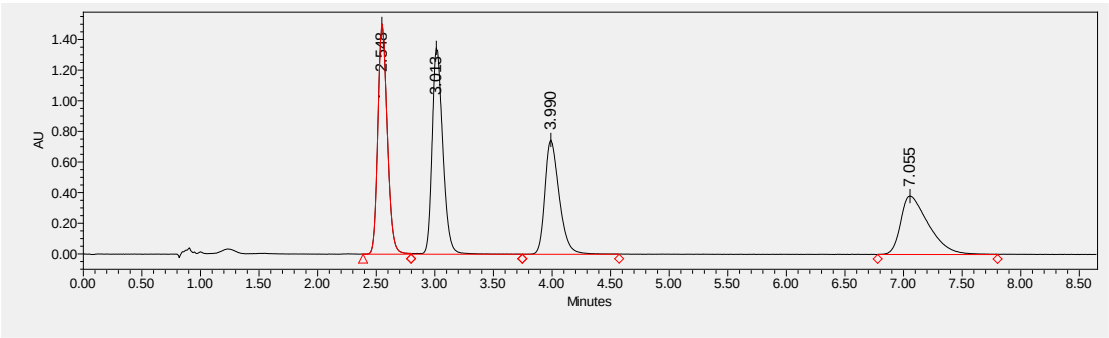
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 – 7.55 (m, 2H), 7.46 (t, *J* = 7.4 Hz, 1H), 7.31 (t, *J* = 7.7 Hz, 2H), 7.22 – 7.13 (m, 1H), 7.11 – 7.07 (m, 2H), 6.77 – 6.64 (m, 4H), 4.77 (dd, *J* = 11.8, 3.2 Hz, 1H), 3.98 – 3.89 (m, 1H), 3.82 – 3.69 (m, 2H), 3.57 (dd, *J* = 18.3, 11.8 Hz, 1H), 1.40 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.9, 174.7, 160.8 (d, *J* = 8.8 Hz), 159.8 (d, *J* = 247.0 Hz), 143.9, 136.2, 133.2, 130.8, 130.4 (d, *J* = 8.9 Hz), 128.5, 127.6, 125.3, 125.1, 122.1, 114.9 (d, *J* = 18.7 Hz), 109.0, 108.6 (d, *J* = 20.7 Hz), 106.3 (d, *J* = 3.3 Hz), 89.4, 43.2, 39.2, 35.2, 12.4.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -119.06.

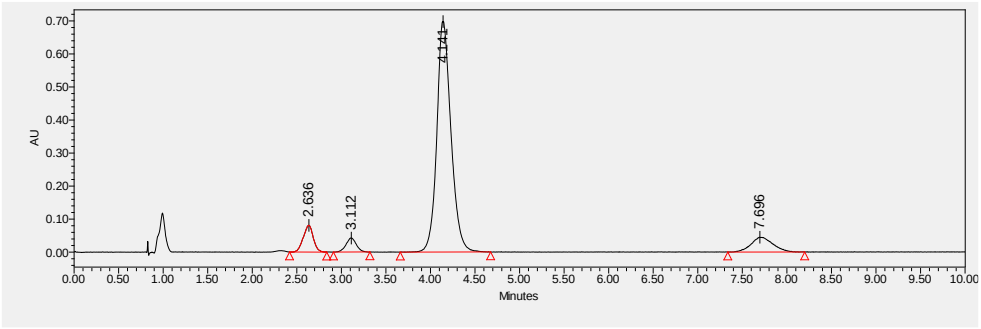
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1320.

IR (neat) 3061, 2981, 1728, 1610, 1461, 1369, 1262, 1211, 994, 755, 693 cm^{-1}.



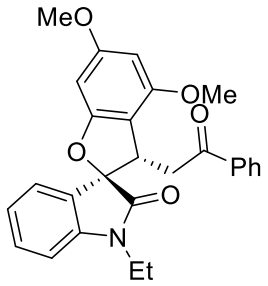
	Retention Time	Area	% Area
1	2.548	8389931	28.38
2	3.013	8537785	28.88

3	3.990	6340555	21.45
4	7.055	6294888	21.29



	Retention Time	Area	% Area
1	2.636	630421	6.67
2	3.112	339798	3.60
3	4.141	7711168	81.62
4	7.696	766017	8.11

(2*R*,3*S*)-1'-ethyl-4,6-dimethoxy-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C23):



Yellow solid, 93% yield, 94:6 er, >19:1 dr, m.p. 72-76 °C, $[\alpha]^{20}_D$ = -44.6 (c = 0.77, in CH_2Cl_2). Reacted for 144 h.

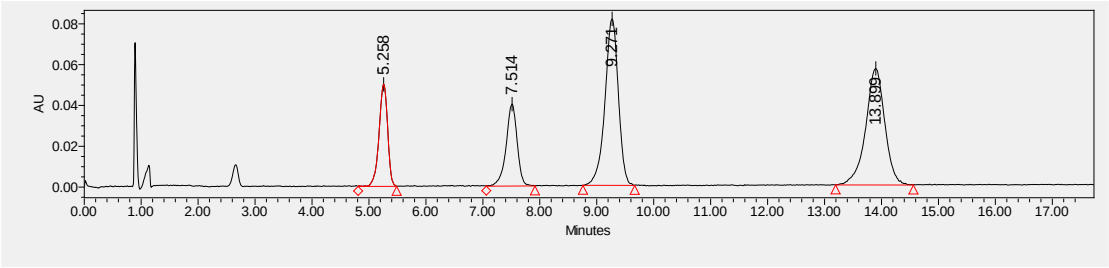
SFC Daicel Chiralpak IB-3, CO_2/MeOH = 90/10, 1.5 mL/min, λ = 240 nm, t_1 = 9.22 min, t_2 = 13.94 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.57 (d, *J* = 7.4 Hz, 2H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.31 – 7.28 (m, 2H), 7.13 (d, *J* = 7.3 Hz, 1H), 7.06 (t, *J* = 7.8 Hz, 1H), 6.70 (dd, *J* = 7.5, 5.0 Hz, 2H), 6.11 (dd, *J* = 15.3, 1.8 Hz, 2H), 4.60 (dd, *J* = 11.6, 3.5 Hz, 1H), 3.93 – 3.83 (m, 2H), 3.77 (d, *J* = 2.9 Hz, 6H), 3.73 (m, 1H), 3.42 (dd, *J* = 18.3, 11.6 Hz, 1H), 1.37 (t, *J* = 7.2 Hz, 3H).

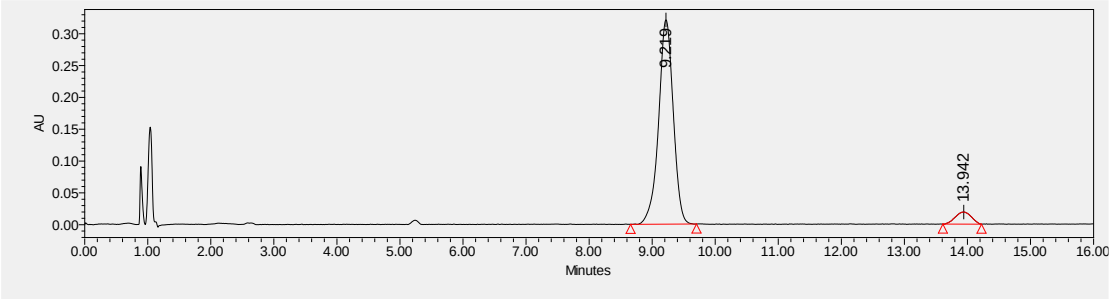
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.8, 175.2, 162.2, 160.8, 157.2, 143.8, 136.6, 132.8, 130.4, 128.3, 127.5, 126.0, 125.2, 121.9, 108.7, 107.0, 92.1, 89.5, 88.8, 55.7, 55.4, 43.4, 39.4, 35.0, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{27}H_{25}NO_5Na^+]$: 446.1625 found 446.1628.

IR (neat) 3058, 2937, 1725, 1680, 1605, 1459, 1365, 1207, 1142, 1118, 997, 753 cm^{-1}.

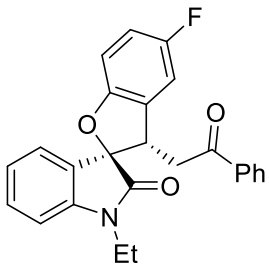


	Retention Time	Area	% Area
1	5.258	526904	14.12
2	7.514	541423	14.51
3	9.271	1334436	35.77
4	13.899	1327738	35.59



	Retention Time	Area	% Area
1	9.219	5181698	93.89
2	13.942	337156	6.11

(2*R*,3*S*)-1'-ethyl-5-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C24):



White solid, 88% yield, 94:6 er, >19:1 dr, m.p. 172-173 °C, $[\alpha]_D^{21}$ = -31.0 (c = 0.46, in CH_2Cl_2). Reacted for 108 h .

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.93 min, t_2 = 5.99 min.

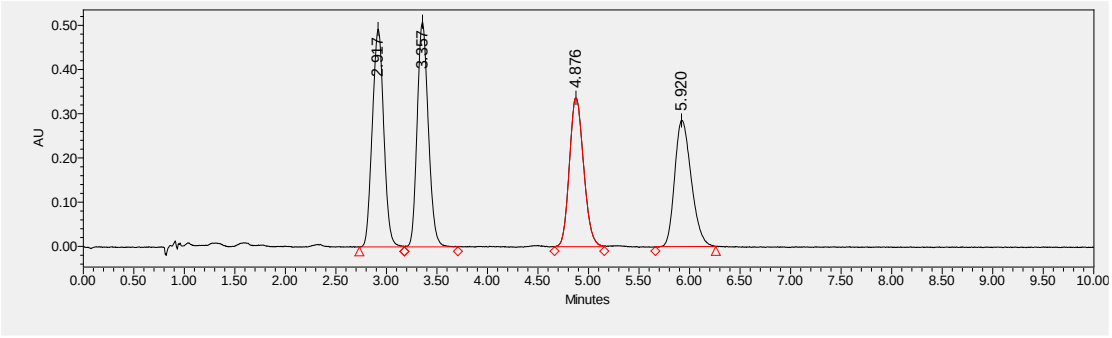
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.4 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.14 (t, *J* = 7.8 Hz, 1H), 7.08 (d, *J* = 7.4 Hz, 1H), 6.97 – 6.85 (m, 2H), 6.84 – 6.71 (m, 3H), 4.63 (dd, *J* = 8.9, 6.0 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.77 – 3.68 (m, 1H), 3.50 – 3.35 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 174.7, 158.2 (d, *J* = 238.3 Hz) 154.7, 143.6, 136.1, 133.3, 130.8, 130.3 (d, *J* = 8.5 Hz), 128.6, 127.7, 125.5, 124.9, 122.2, 115.2 (d, *J* = 24.1 Hz), 111.3 (d, *J* = 25.2 Hz), 110.4 (d, *J* = 8.5 Hz), 109.1, 89.7, 44.5, 40.2, 35.1, 12.4.

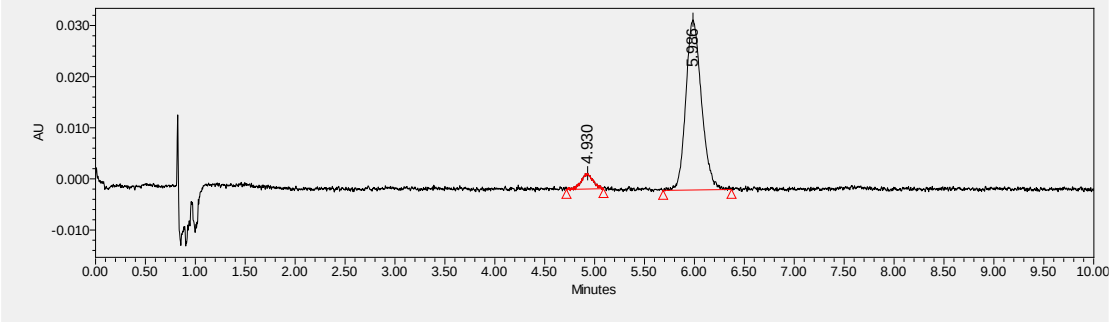
^{19}F NMR (376 MHz, Chloroform-*d*) δ -123.29.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1319.

IR (neat) 3061, 2981, 2935, 1725, 1683, 1476, 1368, 1208, 996, 754, 693 cm^{-1}.

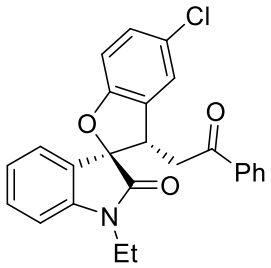


	Retention Time	Area	% Area
1	2.917	3876511	27.10
2	3.357	3891224	27.20
3	4.876	3289032	22.99
4	5.920	3247272	22.70



	Retention Time	Area	% Area
1	4.930	24838	6.42
2	5.986	362269	93.58

(2*R*,3*S*)-5-chloro-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C25):



White solid, 91% yield, 90:10 er, 85:15 dr, m.p. 70-73 °C, Reacted for 120 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.86 min, t_2 = 4.60 min, t_3 = 6.50 min, t_4 = 7.06 min.

minor prodcut

$[\alpha]^{21}_D$ = -38.1 (c = 0.08, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.92 – 7.86 (m, 2H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 8.2 Hz, 1H), 7.39 – 7.35 (m, 1H), 7.20 – 7.18 (m, 2H), 7.06 (t, *J* = 7.5 Hz, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.85 – 6.81 (m, 1H), 4.44 (dd, *J* = 9.0, 5.1 Hz, 1H), 3.95 (dd, *J* = 18.4, 9.1 Hz, 1H), 3.78 – 3.69 (m, 1H), 3.59 – 3.50 (m, 1H), 3.38 (dd, *J* = 18.4, 5.1 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.9, 172.4, 157.6, 142.6, 136.4, 133.6, 131.3, 130.7, 130.1, 129.1, 128.8, 128.2, 126.4, 124.7, 123.6, 123.5, 111.3, 108.9, 88.3, 46.2, 41.0, 34.9, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{35}ClNO_3Na^+]$: 440.1024 found 440.1028.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{37}ClNO_3Na^+]$: 442.0994 found 442.0999.

IR (neat) 2924, 2853, 1721, 1683, 1613, 1470, 1371, 1240, 1096, 995, 754, 500 cm^{-1}.

major product

$[\alpha]^{20}_D$ = -74.9 (c = 0.44, in CH_2Cl_2).

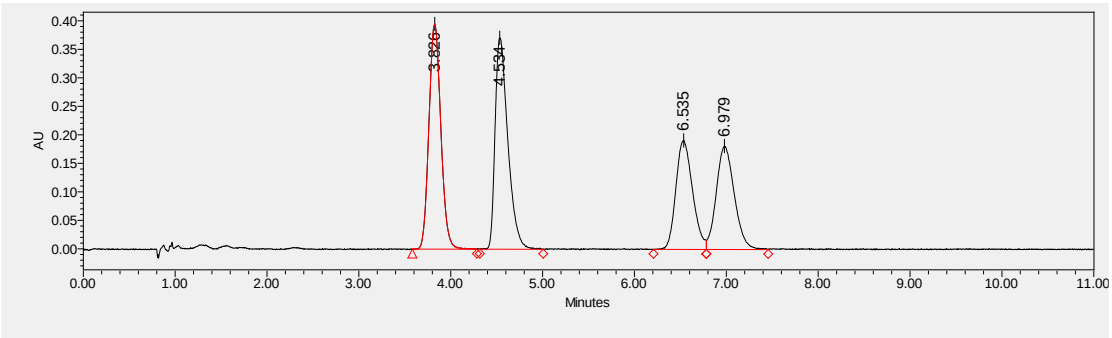
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.5 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.35 – 7.32 (m, 2H), 7.20 – 7.11 (m, 3H), 7.06 (d, *J* = 7.3 Hz, 1H), 6.79 (t, *J* = 8.0 Hz, 2H), 6.74 (d, *J* = 7.9 Hz, 1H), 4.62 (t, *J* = 7.5 Hz, 1H), 3.96 – 3.87 (m, 1H), 3.78 – 3.69 (m, 1H), 3.47 – 3.39 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 174.6, 157.6, 143.7, 136.1, 133.4, 130.9, 130.9, 129.0, 128.6, 127.7, 126.3, 125.4, 124.9, 124.2, 122.2, 111.2, 109.1, 89.7, 44.3, 40.2, 35.2, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{35}ClNO_3Na^+]$: 440.1024 found 440.1026.

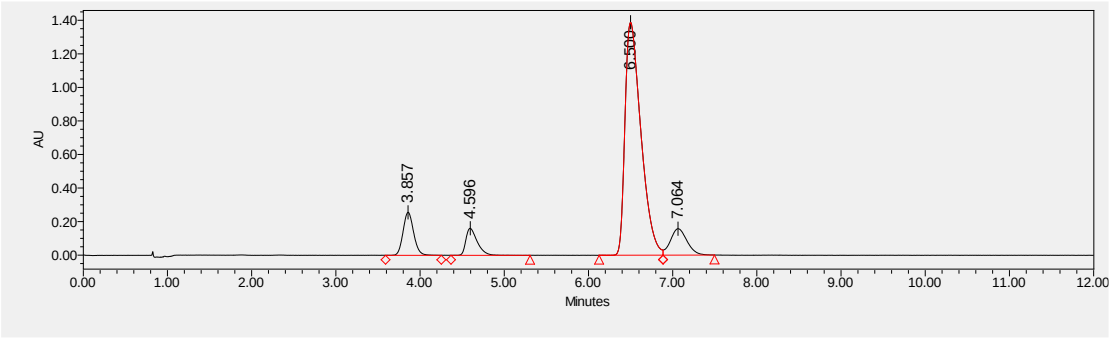
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{37}ClNO_3Na^+]$: 442.0994 found 442.0997.

IR (neat) 3060, 2980, 2934, 1727, 1683, 1610, 1469, 1369, 1243, 1097, 995, 754, 502 cm^{-1}.



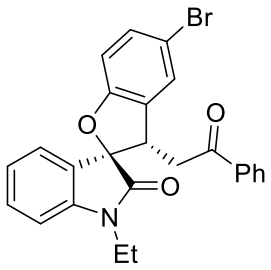
	Retention Time	Area	% Area
1	3.826	3554443	29.59
2	4.534	3572735	29.74

3	6.535	2411735	20.08
4	6.979	2473544	20.59



	Retention Time	Area	% Area
1	3.857	2249792	9.32
2	4.596	1526777	6.33
3	6.500	18205648	75.44
4	7.064	2150898	8.91

(2*R*,3*S*)-5-bromo-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C26):



White solid, 81% yield, 93:7 er, 85:15 dr, m.p. 72-76 °C, Reacted for 144 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.61 min, t_2 = 5.80 min, t_3 = 7.42 min, t_4 = 8.78 min.

minor product

$[\alpha]^{21}_D$ = -46.3 (c = 0.05, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.94 – 7.83 (m, 2H), 7.59 – 7.52 (m, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 – 7.31 (m, 3H), 7.28 (d, *J* = 1.2 Hz, 1H), 7.08 – 7.05 (m, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.82 – 6.76 (m, 1H), 4.44 (dd, *J* = 9.1, 5.0 Hz, 1H), 3.96 (dd, *J* = 18.4, 9.2 Hz, 1H), 4.00 – 3.93 (m, 1H), 3.78 – 3.69 (m, 1H), 3.37 (dd, *J* = 18.4, 5.0 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.9, 172.4, 158.2, 142.6, 136.4, 133.6, 132.0, 131.9, 130.8, 130.1, 128.8, 128.2, 127.6, 123.6, 123.5, 113.5, 112.0, 108.9, 88.3, 46.1, 41.1, 34.9, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0513.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0492.

IR (neat) 2926, 2854, 1721, 1614, 1469, 1371, 1240, 1097, 996, 860, 753, 645, 499 cm^{-1}.

major product

$[\alpha]^{20}_D$ = -78.7 (c = 0.31, in CH_2Cl_2).

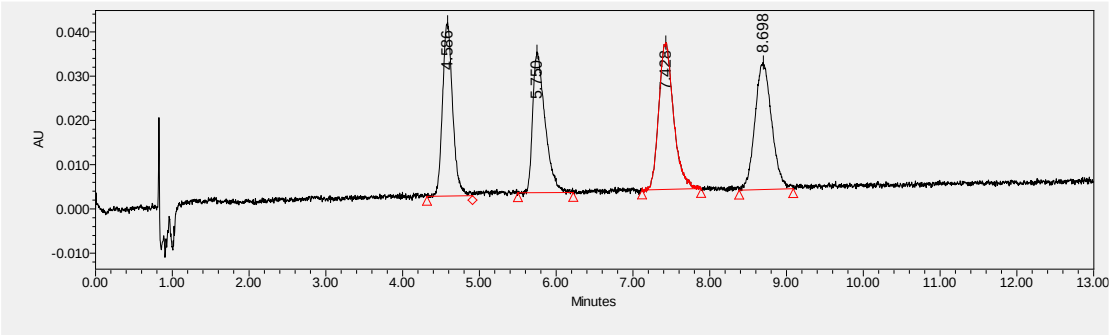
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 – 7.56 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.38 – 7.27 (m, 4H), 7.14 (td, *J* = 7.8, 1.1 Hz, 1H), 7.06 (d, *J* = 7.3 Hz, 1H), 6.84 – 6.69 (m, 3H), 4.78 – 4.54 (m, 1H), 3.96 – 3.87 (m, 1H), 3.78 – 3.69 (m, 1H), 3.45 (d, *J* = 2.6 Hz, 1H), 3.43 (s, 1H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.5, 174.6, 158.1, 143.7, 136.1, 133.4, 131.9, 131.4, 130.9, 128.6, 127.7, 127.1, 125.3, 124.9, 122.2, 113.3, 111.8, 109.1, 89.7, 44.3, 40.3, 35.2, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0524.

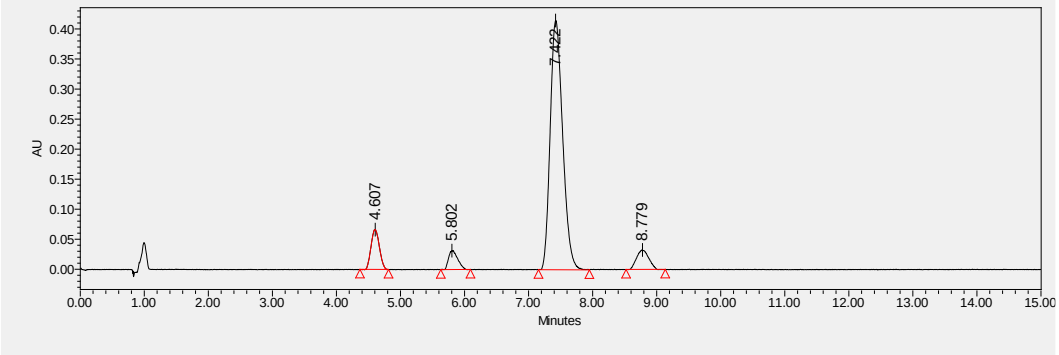
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0502.

IR (neat) 3060, 2933, 1728, 1610, 1468, 1368, 1241, 1136, 995, 864, 754, 633, 501 cm^{-1}.



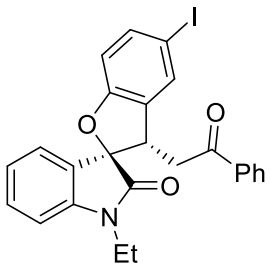
	Retention Time	Area	% Area
1	4.586	359617	22.55
2	5.750	356261	22.34
3	7.428	443558	27.82

4	8.698	435199	27.29



	Retention Time	Area	% Area
1	4.607	600908	8.64
2	5.802	313504	4.51
3	7.422	5612052	80.69
4	8.779	428272	6.16

(2*R*,3*S*)-1'-ethyl-5-iodo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C27):



White solid, 96% yield, 92:8 er, 80:20 dr, m.p. 82-84 °C, Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.89 min, t_2 = 7.45 min, t_3 = 8.77 min, t_4 = 11.31 min.

minor product

$[\alpha]_D^{20}$ = -25.6 (c = 0.09, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 7.5 Hz, 2H), 7.59 – 7.48 (m, 3H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 7.8 Hz, 1H), 7.27 – 7.26 (m, 1H), 7.06 (t, *J* = 7.5 Hz, 1H), 6.88 (d, *J* = 7.9 Hz, 1H), 6.70 (d, *J* = 8.3 Hz, 1H), 4.43 (dd, *J* = 9.2, 4.8 Hz, 1H), 3.97 (dd, *J* = 18.4, 9.3 Hz, 1H), 4.01 – 3.94 (m, 1H), 3.78 – 3.69 (m, 1H), 3.36 (dd, *J* = 18.4, 4.9 Hz, 1H), 1.19 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.9, 172.3, 159.0, 142.6, 138.0, 136.4, 133.6, 133.4, 132.4, 130.7, 130.1, 128.8, 128.2, 123.6, 123.5, 112.7, 108.9, 88.1, 83.1, 46.0, 41.2, 34.9, 29.8, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}NO_3INa^+]$: 532.0380 found 532.0385.

IR (neat) 2924, 2853, 1720, 1682, 1467, 1370, 1239, 995, 859, 753, 638, 553 cm^{-1}.

major product

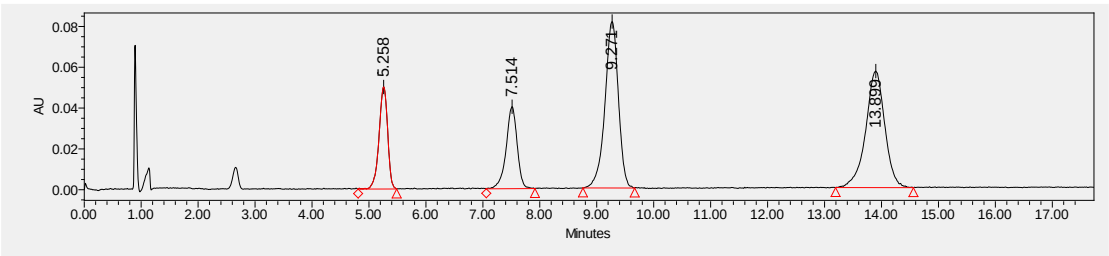
$[\alpha]_D^{20}$ = -92.2 (c = 0.49, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.3 Hz, 2H), 7.52 – 7.44 (m, 3H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.16 – 7.10 (m, 1H), 7.05 (d, *J* = 7.3 Hz, 1H), 6.78 (t, *J* = 7.5 Hz, 1H), 6.73 (d, *J* = 7.9 Hz, 1H), 6.67 (d, *J* = 8.8 Hz, 1H), 4.67 – 4.57 (m, 1H), 3.96 – 3.87 (m, 1H), 3.78 – 3.69 (m, 1H), 3.49 – 3.39 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

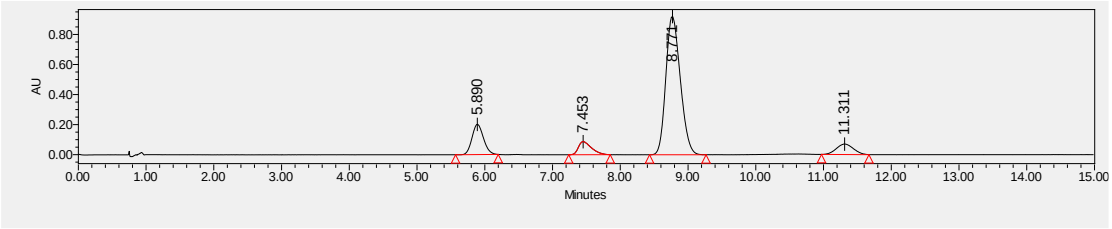
^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 174.6, 158.9, 143.7, 137.9, 136.1, 133.4, 132.8, 132.0, 130.9, 128.6, 127.7, 125.3, 124.9, 122.2, 112.5, 109.1, 89.5, 82.8, 44.1, 40.3, 35.2, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}NO_3INa^+]$: 532.0380 found 532.0388.

IR (neat) 3058, 2979, 2932, 1724, 1609, 1465, 1367, 1237, 1134, 994, 812, 752, 630, 500 cm^{-1}.

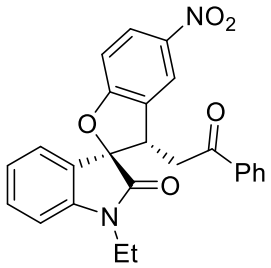


	Retention Time	Area	% Area
1	5.258	526904	14.12
2	7.514	541423	14.51
3	9.271	1334436	35.77
4	13.899	1327738	35.59



	Retention Time	Area	% Area
1	5.890	2366605	12.85
2	7.453	1166716	6.34
3	8.771	13657723	74.17
4	11.311	1223419	6.64

(2*R*,3*S*)-1'-ethyl-5-nitro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C28):



Yellow solid, 99% yield, 75:25 er, 64:36 dr, m.p. 87-89 °C, Reacted for 120 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.84 min, t_2 = 7.48 min, t_3 = 10.37 min, t_2 = 12.54 min.

minor product

$[\alpha]_D^{20}$ = -92.0 (c = 0.05, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.22 (dd, *J* = 8.8, 2.4 Hz, 1H), 8.17 – 8.16 (m, 1H), 7.67 – 7.61 (m, 2H), 7.54 – 7.46 (m, 1H), 7.35 (t, *J* = 7.7 Hz, 2H), 7.18 (td, *J* = 7.8, 1.2 Hz, 1H), 7.04 (dd, *J* = 7.5, 1.2 Hz, 1H), 6.95 (d, *J* = 8.8 Hz, 1H), 6.85 – 6.75 (m, 2H), 4.66 (dd, *J* = 10.1, 5.1 Hz, 1H), 3.95 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.76 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.61 – 3.46 (m, 2H), 1.41 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.1, 173.8, 163.9, 143.7, 142.7, 135.7, 133.5, 131.2, 130.6, 128.5, 127.6, 126.5, 124.9, 124.3, 122.2, 120.4, 110.0, 109.2, 90.9, 43.4, 40.1, 35.2, 12.3.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}N_2O_5Na^+]$: 451.1264 found 451.1267.

IR (neat) 3061, 2981, 2936, 1721, 1682, 1606, 1516, 1470, 1371, 1260, 992, 749, 688 cm^{-1}.

major product

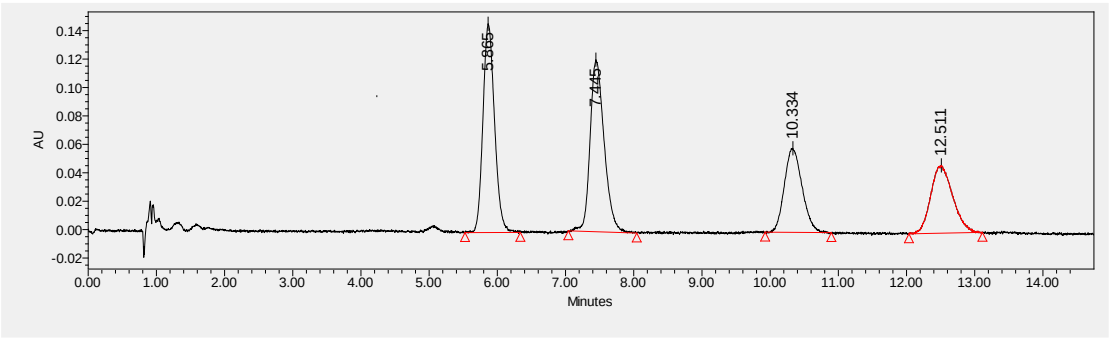
$[\alpha]_D^{20}$ = -40.0 (c = 0.28, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.22 (dd, *J* = 8.8, 2.3 Hz, 1H), 8.14 (s, 1H), 7.89 (d, *J* = 7.3 Hz, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.50 – 7.38 (m, 3H), 7.31 (d, *J* = 7.2 Hz, 1H), 7.11 (t, *J* = 7.5 Hz, 1H), 6.96 (d, *J* = 8.9 Hz, 1H), 6.91 (d, *J* = 7.9 Hz, 1H), 4.53 (dd, *J* = 8.9, 5.2 Hz, 1H), 3.96 (dd, *J* = 18.4, 9.1 Hz, 1H), 3.74 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.62 – 3.45 (m, 2H), 1.20 (t, *J* = 7.2 Hz, 3H).

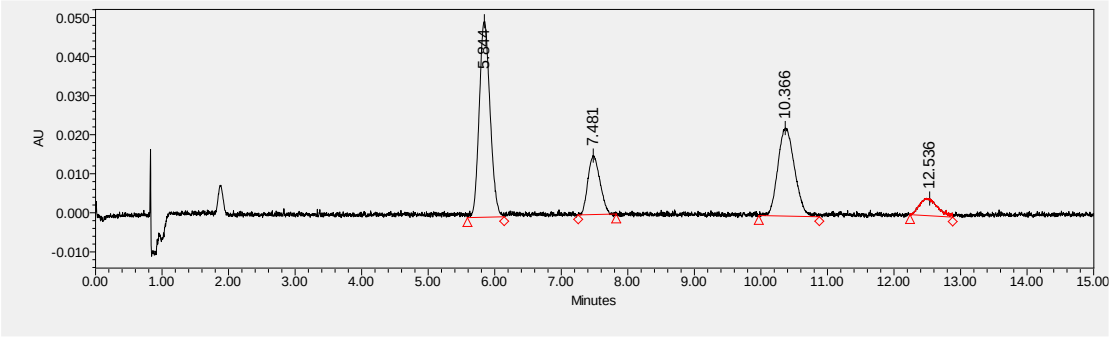
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.5, 171.6, 164.2, 143.0, 142.9, 136.1, 133.8, 131.2, 131.1, 129.1, 128.9, 128.2, 126.6, 123.8, 123.7, 121.0, 110.2, 109.1, 89.9, 45.3, 40.8, 35.0, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}N_2O_5Na^+]$: 451.1264 found 451.1271.

IR (neat) 2926, 1720, 1683, 1614, 1518, 1471, 1372, 1337, 1263, 1122, 994, 752, 650 cm^{-1}.

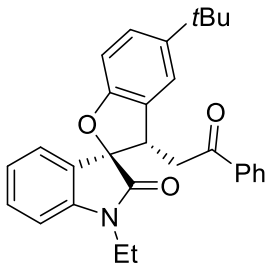


	Retention Time	Area	% Area
1	5.865	1735266	30.95
2	7.445	1733398	30.92
3	10.334	1071366	19.11
4	12.511	1066821	19.03



	Retention Time	Area	% Area
1	5.844	568281	45.93
2	7.481	190188	15.37
3	10.366	396530	32.05
4	12.536	82225	6.65

(2*R*,3*S*)-5-(tert-butyl)-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C29):



White solid, 77% yield, 93:7 er, >19:1 dr, m.p. 80-84 °C, $[\alpha]_D^{19}$ = -66.0 (c = 0.56, in CH_2Cl_2). Reacted for 108 h.

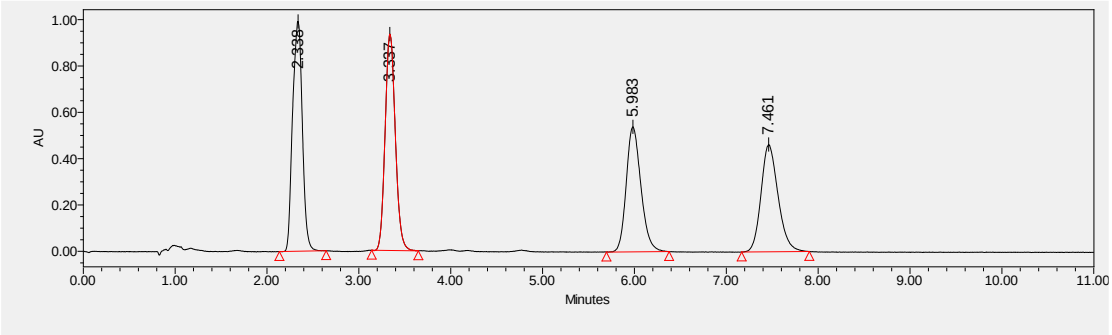
SFC Daicel Chiralcel OX-3, CO_2/MeOH = 80/20, 1.5 mL/min, λ = 240 nm, t_1 = 6.17 min, t_2 = 7.65 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.63 (d, *J* = 7.4 Hz, 2H), 7.47 (t, *J* = 7.3 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.18 (m, 2H), 7.10 (t, *J* = 6.6 Hz, 2H), 6.80 (d, *J* = 8.4 Hz, 1H), 6.78 – 6.69 (m, 2H), 4.62 (dd, *J* = 9.0, 6.1 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.78 – 3.69 (m, 1H), 3.52 – 3.42 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 1H). 1.33 (s, 9H).

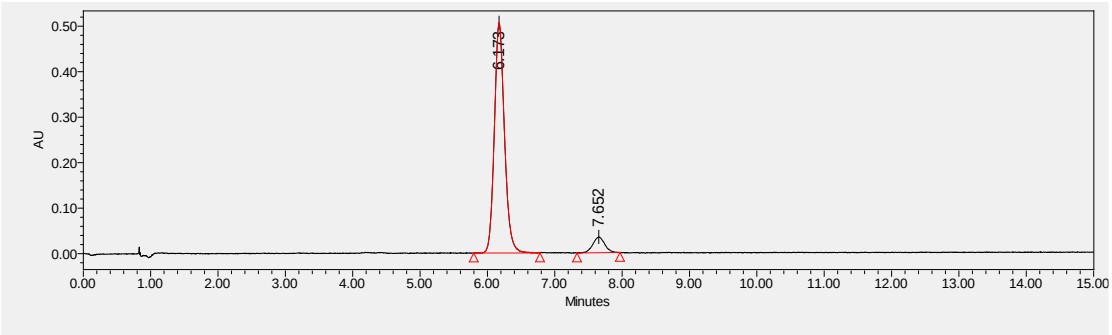
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 175.2, 156.5, 144.4, 143.6, 136.3, 133.0, 130.4, 128.4, 128.1, 127.6, 125.9, 125.8, 125.0, 121.9, 120.6, 109.3, 108.8, 89.0, 44.6, 40.5, 34.9, 34.5, 31.8, 12.3.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{29}H_{29}NO_3Na^+]$: 462.2040 found 462.2040.

IR (neat) 3059, 2960, 1729, 1610, 1489, 1366, 1249, 1214, 997, 754, 691 cm^{-1}.

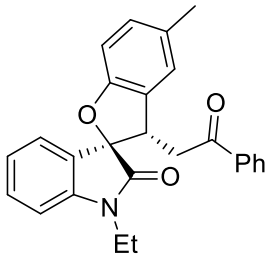


	Retention Time	Area	% Area
1	2.338	7296016	27.60
2	3.337	7197221	27.23
3	5.983	5990449	22.66
4	7.461	5947920	22.50



	Retention Time	Area	% Area
1	6.173	5280856	92.57
2	7.652	423884	7.43

(2*R*,3*S*)-1'-ethyl-5-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C30):



White solid, 87% yield, 96:4 er, >19:1 dr, m.p. 70-72 °C, $[\alpha]_D^{19}$ = -81.3 (c = 0.58, in CH_2Cl_2). Reacted for 144 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.82 min, t_2 = 6.96 min.

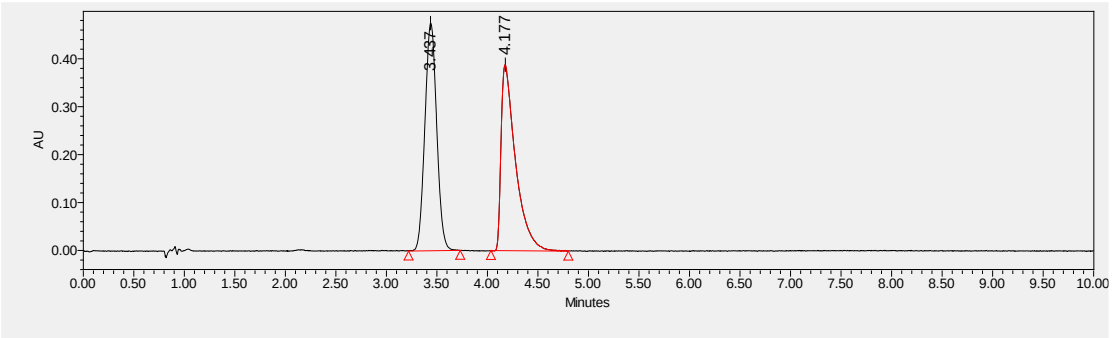
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.67 – 7.58 (m, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.14 – 7.05 (m, 2H), 7.01 – 7.00 (m, 2H), 6.78 – 6.71 (m, 3H), 4.61 (t, *J* = 7.5 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.78 – 3.69 (m, 1H), 3.48 – 3.38 (m, 2H), 2.33 (s, 3H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.1, 156.8, 143.6, 136.3, 133.2, 130.7, 129.4, 128.8, 128.5, 127.7, 125.9, 124.9, 124.5, 122.1, 109.8, 108.9, 89.1, 44.5, 40.4, 35.1, 21.0, 12.4.

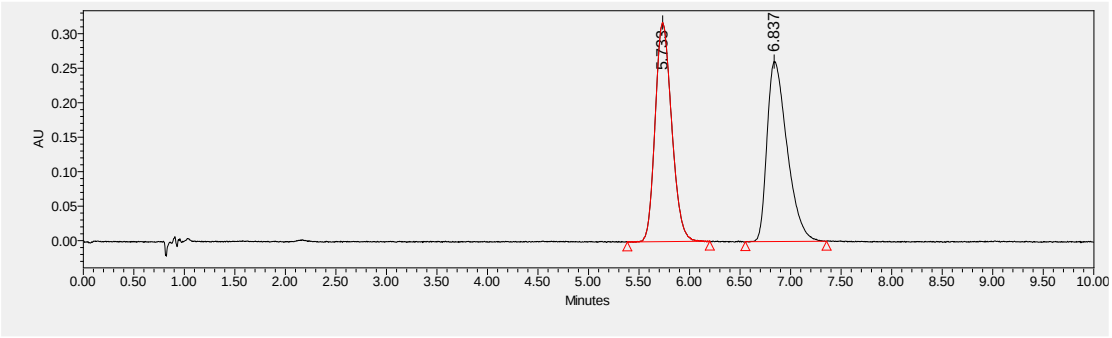
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1570.

IR (neat) 3057, 2979, 1725, 1682, 1609, 1486, 1365, 1248, 1215, 1102, 996, 809, 753, 693 cm^{-1}.

Racemate: 1:1 dr determined by UPCC. The racemate isolation by UPCC of each diastereomer as below:

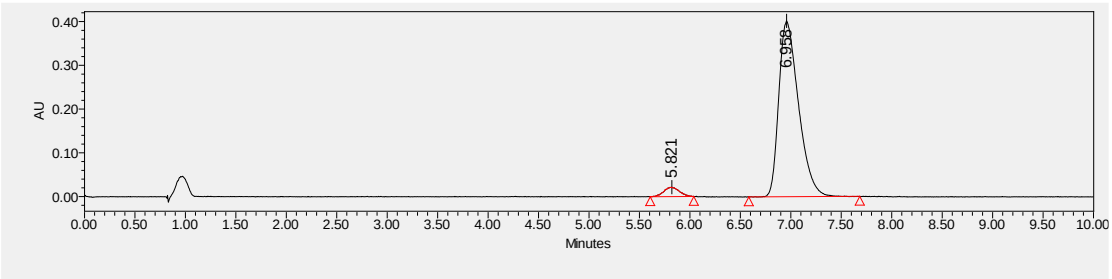


	Retention Time	Area	% Area
1	3.437	3862700	50.10
2	4.177	3846551	49.90



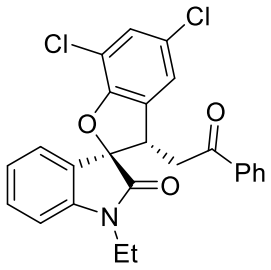
	Retention Time	Area	% Area
1	5.733	3594714	50.00
2	6.837	3594993	50.00

The UPCC spectra of asymmetric catalytic product as below:



	Retention Time	Area	% Area
1	5.821	230540	4.06
2	6.958	5441700	95.94

(2*R*,3*S*)-5,7-dichloro-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C31):



White solid, 99% yield, 73:27 er, 65:35 dr, m.p. 85-88 °C, Reacted for 120 h.

SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.21 min, t_2 = 4.67 min, t_3 = 9.72 min, t_4 = 11.04 min.

minor product

$[\alpha]_D^{20}$ = -24.1 (c = 0.22, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.59 (m, 2H), 7.49 (t, *J* = 7.4 Hz, 1H), 7.34 (t, *J* = 7.7 Hz, 2H), 7.25 – 7.22 (m, 1H), 7.19 – 7.13 (m, 1H), 7.12 – 7.05 (m, 2H), 6.81 (t, *J* = 7.5 Hz, 1H), 6.75 (d, *J* = 7.9 Hz, 1H), 4.69 – 4.65 (d, *J* = 5.3 Hz, 1H), 3.93 (dq, *J* = 14.5, 7.2 Hz, 1H), 3.71 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.52 – 3.36 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.2, 174.0, 153.9, 143.8, 136.0, 133.5, 132.1, 131.1, 129.1, 128.6, 127.7, 126.6, 125.1, 124.8, 122.7, 122.3, 116.2, 109.2, 90.1, 44.9, 40.3, 35.3, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{19}{}^{35}Cl_2NO_3Na^+]$: 474.0634 found 474.0640.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{19}{}^{37}Cl_2NO_3Na^+]$: 476.0605 found 476.0609.

IR (neat) 3061, 2980, 1721, 1682, 1610, 1456, 1369, 1209, 998, 751, 692, 552 cm^{-1}.

major product

$[\alpha]_D^{20}$ = -33.1 (c = 0.52, in CH_2Cl_2).

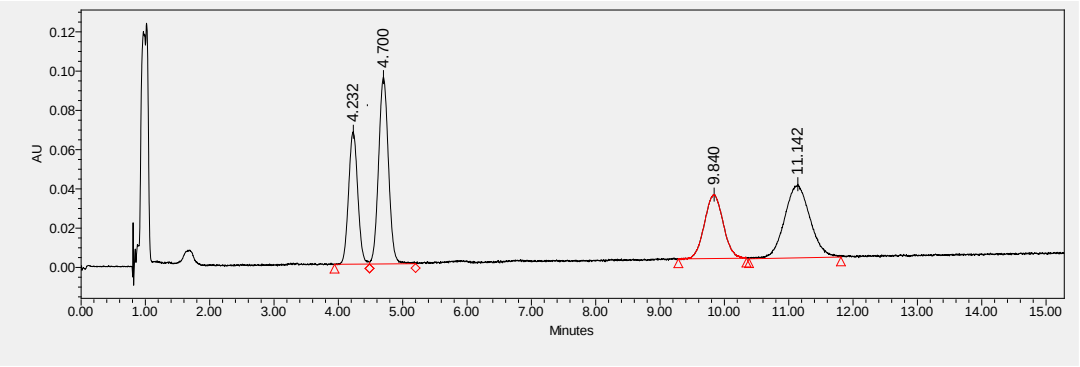
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 8.1 Hz, 2H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.38 (t, *J* = 7.8 Hz, 1H), 7.31 (d, *J* = 7.4 Hz, 1H), 7.26 – 7.22 (m, 1H), 7.12 – 7.05 (m, 2H), 6.87 (d, *J* = 7.9 Hz, 1H), 4.51 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.90 (dd, *J* = 18.4, 8.7 Hz, 1H), 3.75 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.53 (dq, *J* = 14.3, 7.1 Hz, 1H), 3.40 (dd, *J* = 18.4, 5.4 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.5, 171.7, 154.0, 142.9, 136.2, 133.7, 132.5, 131.0, 129.2, 129.1, 128.8, 128.2, 126.7, 123.9, 123.6, 123.2, 116.2, 108.9, 88.8, 46.7, 40.7, 34.9, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{19}{}^{35}Cl_2NO_3Na^+]$: 474.0634 found 474.0639.

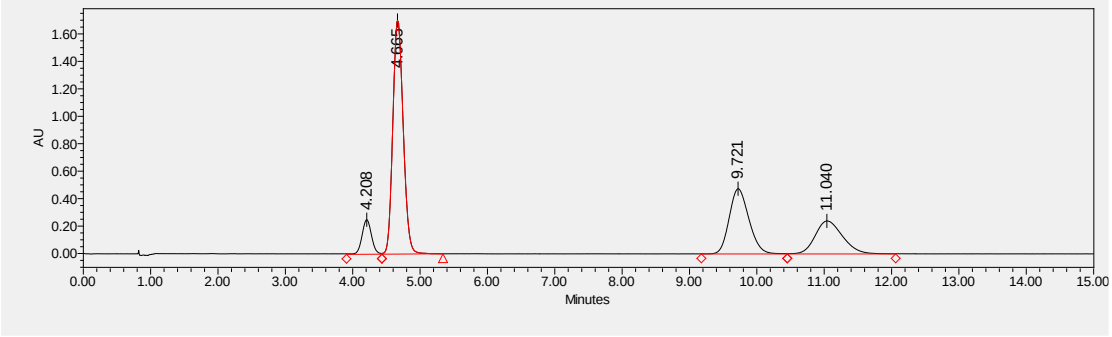
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{19}{}^{37}Cl_2NO_3Na^+]$: 476.0605 found 476.0611.

IR (neat) 3060, 2929, 1719, 1682, 1613, 1489, 1453, 1370, 1209, 1096, 998, 751, 690, 556 cm^{-1}.



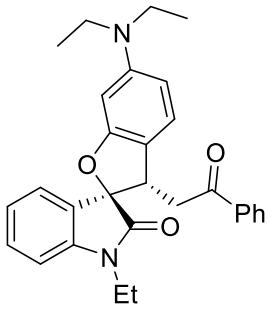
	Retention Time	Area	% Area
1	4.232	668569	19.90
2	4.700	1014183	30.18
3	9.840	656980	19.55

4	11.142	1020450	30.37



	Retention Time	Area	% Area
1	4.208	2474234	6.66
2	4.665	18250995	49.13
3	9.721	9626994	25.91
4	11.040	6796807	18.30

(2*R*,3*S*)-6-(diethylamino)-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C32):



Yellow solid, 99% yield, 92:8 er, >19:1 dr, m.p. 64-68 °C, $[\alpha]_D^{19}$ = 13.5 (c = 0.84, in CH_2Cl_2). Reacted for 120 h.

SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.46 min, t_2 = 8.48 min.

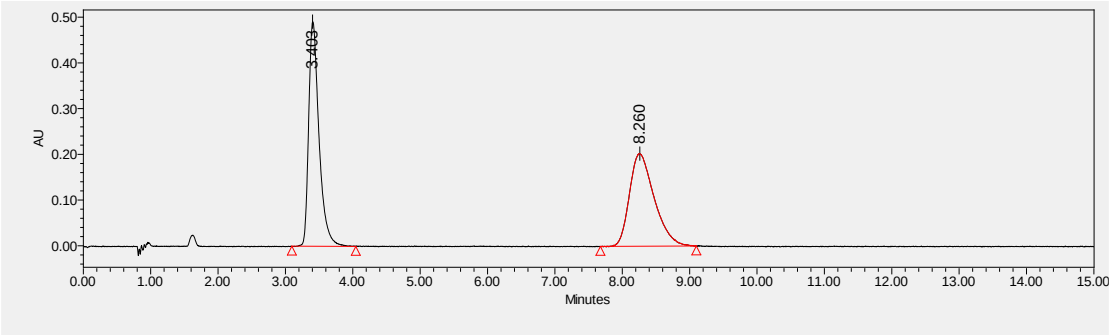
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 – 7.57 (m, 2H), 7.49 – 7.43 (m, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.13 – 7.08 (m, 2H), 7.00 (d, *J* = 8.2 Hz, 1H), 6.82 – 6.67 (m, 2H), 6.36 – 6.22 (m, 2H), 4.63 – 4.42 (m, 1H), 3.94 – 3.85 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.80 – 3.70 (dq, *J* = 14.3, 7.1 Hz, 1H), 3.40 – 3.30 (m, 6H), 1.36 (t, *J* = 7.2 Hz, 3H), 1.16 (t, *J* = 7.0 Hz, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.4, 175.3, 160.5, 149.5, 143.6, 136.5, 133.0, 130.4, 128.5, 127.7, 126.3, 125.0, 124.0, 122.0, 115.0, 108.8, 105.0, 94.3, 89.3, 44.9, 44.0, 40.8, 35.0, 12.7, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{29}H_{30}N_2O_3Na^+]$: 477.2149 found 477.2150.

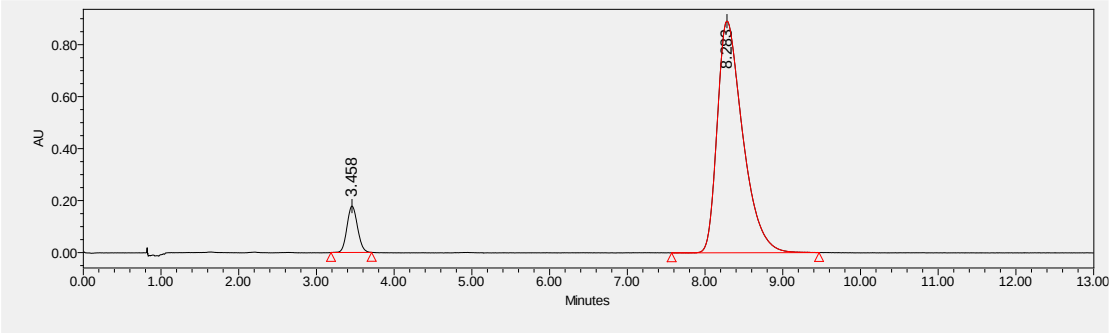
IR (neat) 3058, 2971, 1726, 1617, 1507, 1359, 1213, 1119, 996, 750, 693 cm^{-1}.

Racemate: 65:35 dr determined by ^{1}H NMR. The racemate isolation by UPCC of the major diastereomer as below:



	Retention Time	Area	% Area
1	3.403	5230144	50.38
2	8.260	5150283	49.62

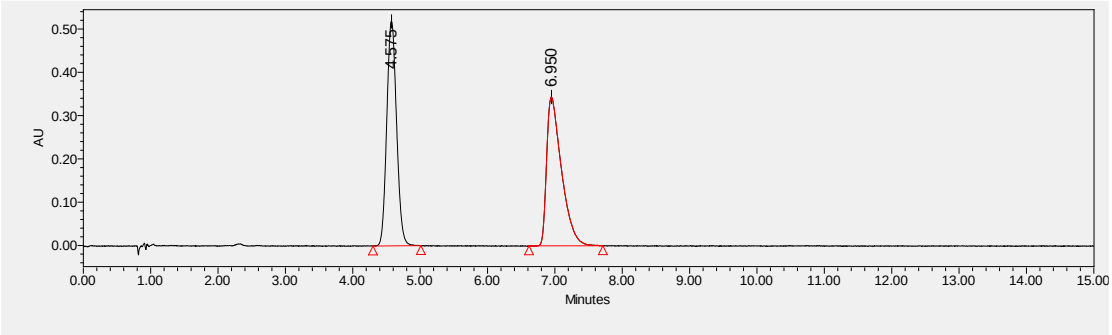
The UPCC spectra of the asymmetric catalytic product:



	Retention Time	Area	% Area
1	3.458	1681511	7.66
2	8.283	20257513	92.34

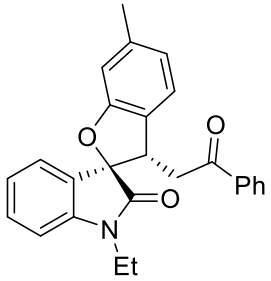
The racemate isolation by UPCC of the minor diastereomer as below :

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.58 min, t_2 = 6.95 min.



	Retention Time	Area	% Area
1	4.575	5260489	50.01
2	6.950	5257464	49.99

(2*R*,3*S*)-1'-ethyl-6-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C33):



White solid, 97% yield, 93:7 er, >19:1 dr, m.p. 64-67 °C, $[\alpha]^{21}_D$ = -23.4 (c = 0.74, in CH_2Cl_2). Reacted for 120 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 6.25 min, t_2 = 7.45 min.

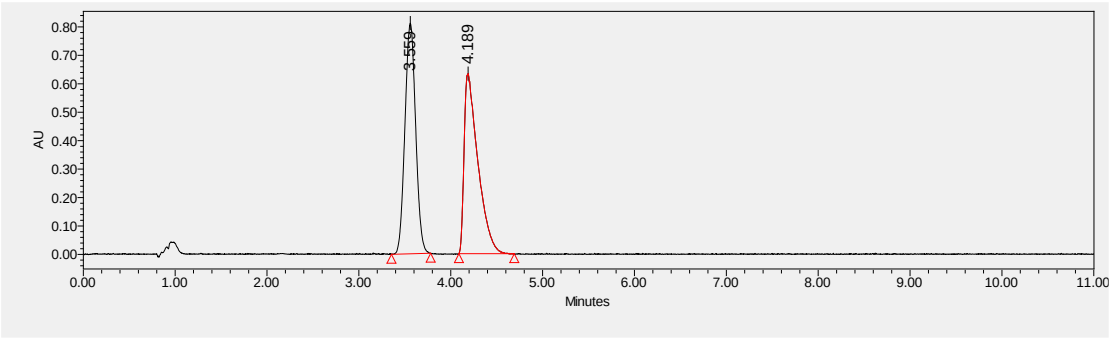
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 (d, *J* = 7.3 Hz, 2H), 7.46 (t, *J* = 7.4 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.14 – 7.03 (m, 3H), 6.82 – 6.67 (m, 4H), 4.58 (t, *J* = 7.5 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.77 – 3.68 (m, 1H), 3.47 – 3.38 (m, 2H), 2.34 (s, 3H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 175.1, 159.1, 143.6, 139.3, 136.3, 133.1, 130.5, 128.5, 127.6, 125.9, 125.8, 124.9, 123.5, 122.1, 122.0, 110.9, 108.9, 44.2, 40.5, 35.0, 21.6, 12.4.

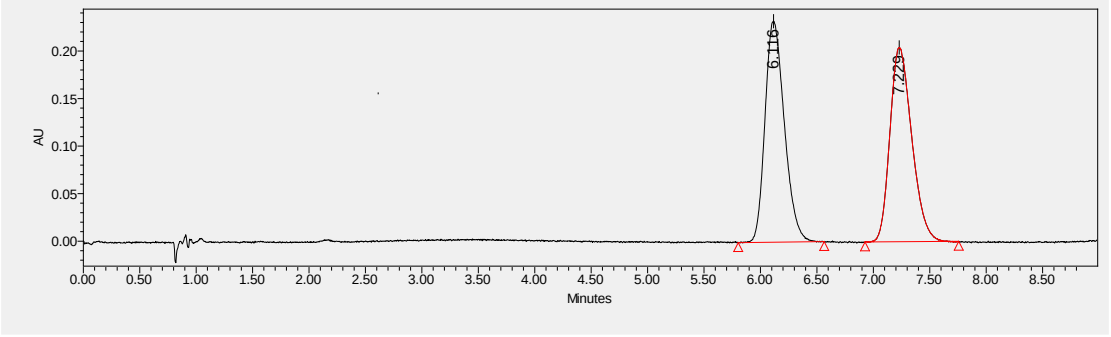
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1569.

IR (neat) 3056, 2979, 1725, 1681, 1609, 1492, 1364, 1259, 996, 750, 692, 499 cm^{-1}.

Racemate: 1:1 dr determined by UPCC analysis of the mixture. The racemate isolation by UPCC of each diastereomer as below:

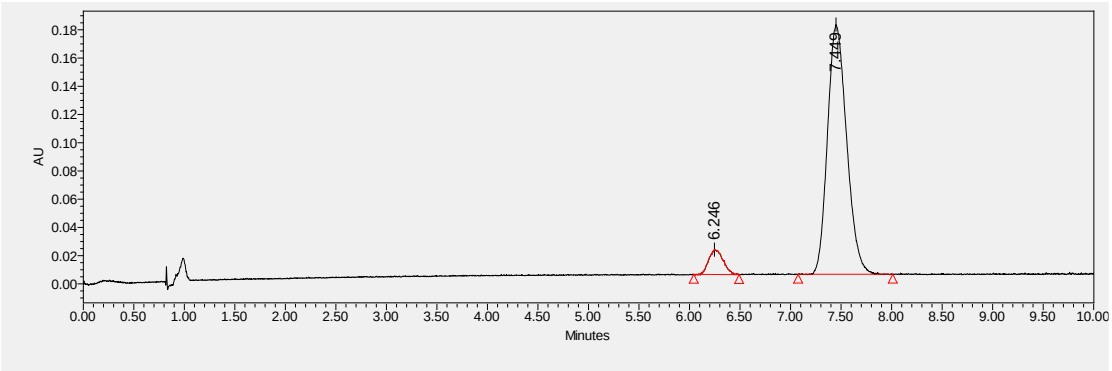


	Retention Time	Area	% Area
1	3.559	6581475	50.00
2	4.189	6580240	50.00



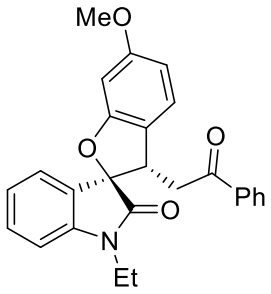
	Retention Time	Area	% Area
1	6.116	2770803	50.19
2	7.229	2749420	49.81

The UPCC of asymmetric catalytic product as below:



	Retention Time	Area	% Area
1	6.246	174823	6.98
2	7.449	2328448	93.02

(2*R*,3*S*)-1'-ethyl-6-methoxy-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C34):



Yellow solid, 90% yield, 91:9 er, >19:1 dr, m.p. 63-66 °C, $[\alpha]^{20}_D$ = -16.4 (c = 0.78, in CH_2Cl_2). Reacted for 120 h.

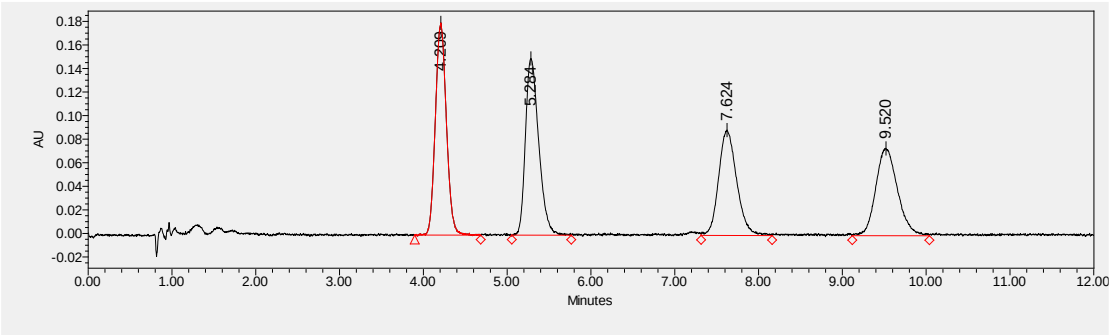
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 7.76 min, t_2 = 9.72 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.55 (m, 2H), 7.50 – 7.42 (m, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.15 – 7.05 (m, 3H), 6.84 – 6.68 (m, 2H), 6.56 – 6.43 (m, 2H), 4.64 – 4.51 (m, 1H), 3.93 – 3.86 (m, 1H), 3.81 – 3.66 (m, 4H), 3.46 – 3.37 (m, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

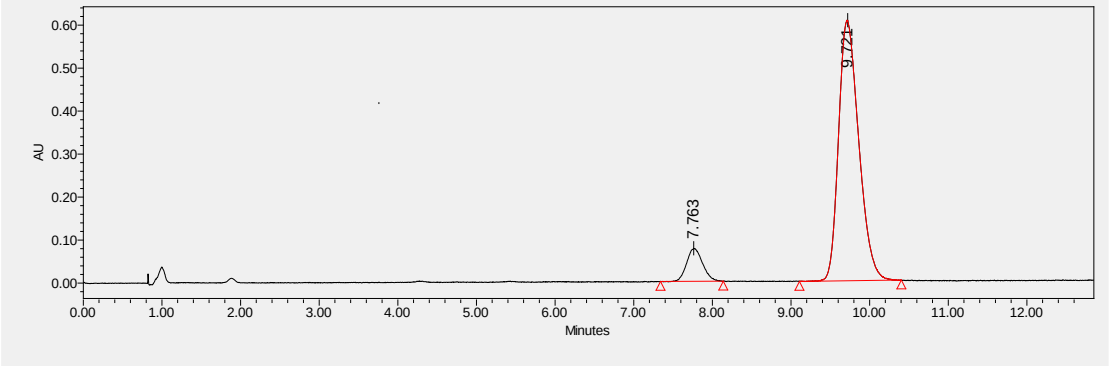
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 174.9, 161.1, 160.1, 143.6, 136.3, 133.2, 130.6, 128.5, 127.6, 125.8, 124.9, 124.0, 122.1, 120.7, 108.9, 107.1, 96.8, 89.7, 55.7, 43.8, 40.6, 35.1, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_4Na^+]$: 436.1519 found 436.1521.

IR (neat) 3059, 2936, 1726, 1612, 1494, 1366, 1285, 1149, 1026, 754, 693 cm^{-1}.

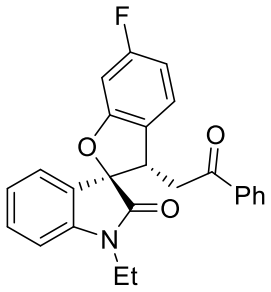


	Retention Time	Area	% Area
1	4.209	1645190	27.50
2	5.284	1653211	27.63
3	7.624	1342241	22.44
4	9.520	1341766	22.43



	Retention Time	Area	% Area
1	7.763	1081854	9.10
2	9.721	10801319	90.90

(2*R*,3*S*)-1'-ethyl-6-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C35):



Yellow solid, 74% yield, 92:8 er, 83:17 dr, m.p. 139-142 °C. Reacted for 144 h.

SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.44 min, t_2 = 3.53 min, t_3 = 4.76 min, t_4 = 7.02 min.

minor product

$[\alpha]^{20}_D$ = -29.5 (c = 0.09, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 – 7.83 (m, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 (td, *J* = 7.8, 1.2 Hz, 1H), 7.28 (d, *J* = 7.4 Hz, 1H), 7.12 (dd, *J* = 8.1, 6.2 Hz, 1H), 7.09 – 7.04 (m, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.72 – 6.58 (m, 2H), 4.40 (dd, *J* = 9.0, 5.1 Hz, 1H), 3.93 (dd, *J* = 18.4, 9.1 Hz, 1H), 3.74 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.55 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.38 (dd, *J* = 18.4, 5.1 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.2, 172.4, 163.8 (d, *J* = 244.9 Hz), 160.0 (d, *J* = 13.0 Hz), 142.6, 136.5, 133.5, 130.7, 130.2, 128.8, 128.2, 124.9 (d, J = 2.6 Hz), 124.8, 124.7, 123.5 (d, J = 10.8 Hz), 108.8, 108.3 (d, J = 22.9 Hz), 99.0 (d, J = 26.9 Hz), 88.9, 45.6, 41.3, 34.9, 12.5.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -112.91.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1320.

IR (neat) 3061, 2929, 1719, 1682, 1612, 1490, 1369, 1270, 1134, 994, 840, 752, 616 cm^{-1}.

major product

$[\alpha]^{20}_D$ = -40.0 (c = 0.54, in CH_2Cl_2).

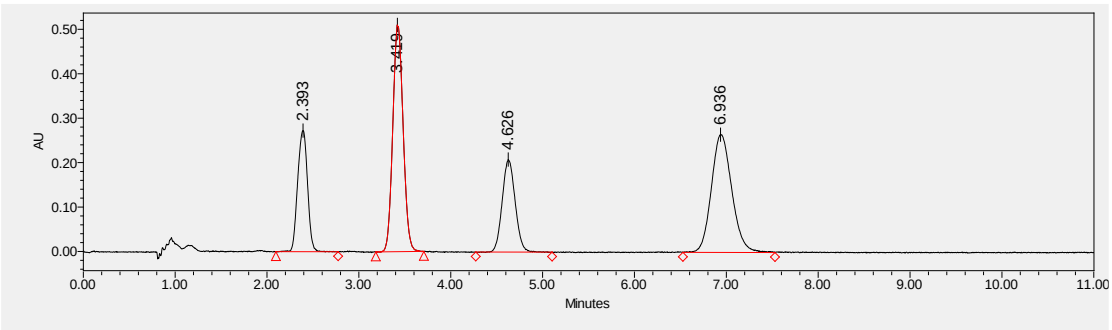
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.67 – 7.58 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.18 – 7.05 (m, 3H), 6.79 (t, *J* = 7.4 Hz, 1H), 6.74 (d, *J* = 7.9 Hz, 1H), 6.67 (td, *J* = 9.1, 2.3 Hz, 1H), 6.61 (dd, *J* = 9.2, 2.2 Hz, 1H), 4.57 (t, *J* = 7.5 Hz, 1H), 3.91 (dq, *J* = 14.5, 7.2 Hz, 1H), 3.73 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.42 (d, *J* = 7.6 Hz, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.8, 174.6, 163.7 (d, *J* = 244.6 Hz), 159.9 (d, *J* = 13.1 Hz), 143.7, 136.2, 133.3, 130.8, 128.6, 127.7, 125.4, 125.0, 124.5 (d, *J* = 2.6 Hz), 124.2 (d, *J* = 10.4 Hz), 122.2, 109.1, 108.0 (d, *J* = 23.0 Hz), 98.8 (d, *J* = 26.9 Hz), 90.1, 43.7, 40.5, 35.2, 12.4.

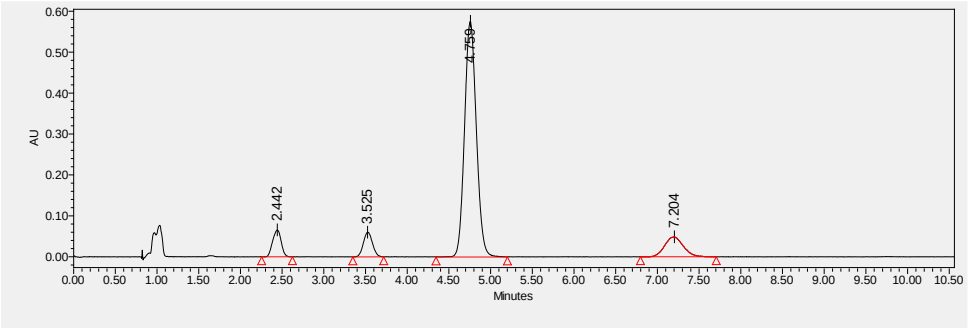
^{19}F NMR (376 MHz, Chloroform-*d*) δ -113.01.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1322.

IR (neat) 3062, 2932, 1727, 1683, 1611, 1491, 1369, 1271, 1134, 996, 840, 754, 616 cm^{-1}.

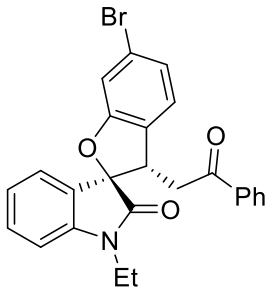


	Retention Time	Area	% Area
1	2.393	2036265	16.72
2	3.419	3994741	32.80
3	4.626	2040781	16.76
4	6.936	4107807	33.73



	Retention Time	Area	% Area
1	2.442	467259	6.36
2	3.525	458841	6.25
3	4.759	5664066	77.11
4	7.204	754880	10.28

(2*R*,3*S*)-6-bromo-1'-ethyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C36):



White solid, 98% yield, 90:10 er, 65:35 dr, m.p. 68-71 °C, Reacted for 120 h.

SFC Daicel Chiralpak AS-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 2.57 min, t_2 = 2.90 min, t_3 = 4.59 min, t_4 = 10.75 min

minor product

$[\alpha]^{20}_D$ = -22.1 (c = 0.47, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.88 (d, *J* = 7.6 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 7.4 Hz, 1H), 7.28 – 7.26 (m, 1H), 7.13 – 7.02 (m, 4H), 6.88 (d, *J* = 7.8 Hz, 1H), 4.40 (dd, *J* = 8.9, 5.2 Hz, 1H), 3.92 (dd, *J* = 18.4, 9.0 Hz, 1H), 3.73 (dq, *J* = 14.4, 7.3 Hz, 1H), 3.54 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.37 (dd, *J* = 18.4, 5.2 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.0, 172.3, 159.9, 142.7, 136.4, 133.6, 130.8, 130.0, 128.8, 128.7, 128.2, 125.5, 124.7, 123.6, 123.5, 122.2, 114.0, 108.9, 88.5, 45.8, 41.0, 34.9, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0515.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0500.

IR (neat) 3060, 2925, 2854, 1718, 1612, 1470, 1369, 1318, 1213, 1097, 993, 750, 689 cm^{-1}.

major product

$[\alpha]^{20}_D$ = -11.2 (c = 0.53, in CH_2Cl_2).

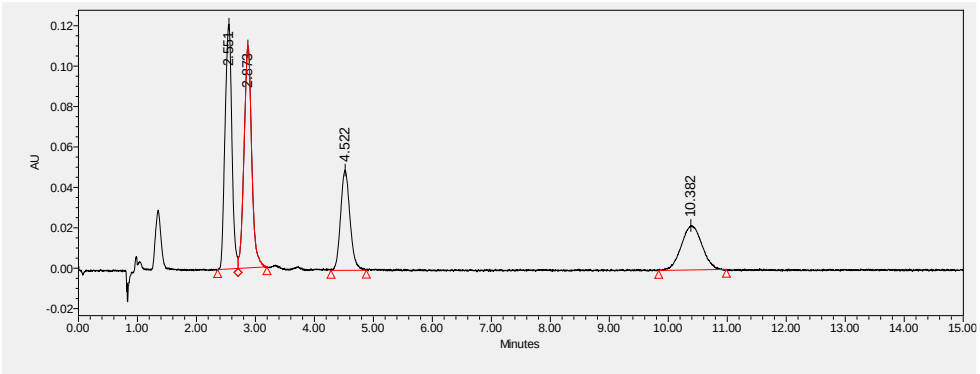
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.67 – 7.58 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.18 – 7.01 (m, 5H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.74 (d, *J* = 7.9 Hz, 1H), 4.56 (t, *J* = 7.5 Hz, 1H), 3.91 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.73 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.42 (d, *J* = 7.6 Hz, 2H), 1.37 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 174.6, 159.8, 143.7, 136.2, 133.3, 130.9, 128.6, 128.3, 127.7, 125.3, 125.0, 124.5, 122.2, 122.0, 113.8, 109.1, 89.8, 44.0, 40.3, 35.2, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{79}BrNO_3Na^+]$: 484.0519 found 484.0523.

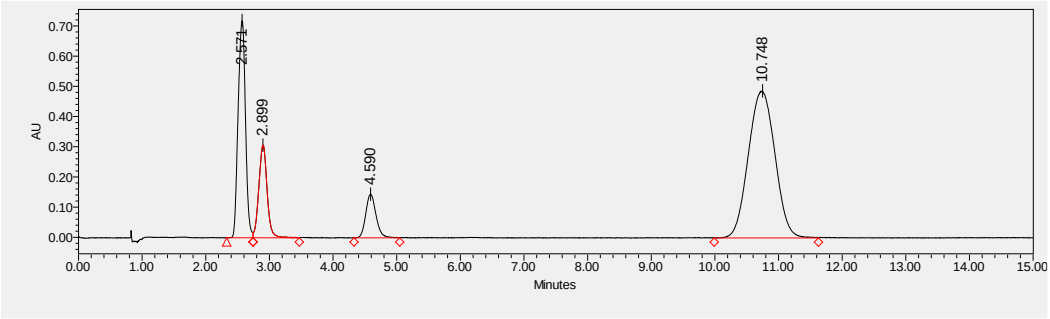
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}{}^{81}BrNO_3Na^+]$: 486.0498 found 486.0504.

IR (neat) 3060, 2979, 1724, 1683, 1608, 1471, 1368, 1223, 1102, 934, 753, 689 cm^{-1}.



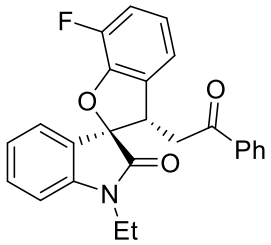
	Retention Time	Area	% Area
1	2.551	970093	31.99
2	2.873	981502	32.36

3	4.522	547300	18.05
4	10.382	533793	17.60



	Retention Time	Area	% Area
1	2.571	5777650	23.77
2	2.899	2771862	11.40
3	4.590	1620147	6.67
4	10.748	14134426	58.16

(2*R*,3*S*)-1'-ethyl-7-fluoro-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C37):



Yellow solid, 91% yield, 89:11 er, 61:39 dr, m.p. 62-66 °C, Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.40 min, t_2 = 3.84 min, t_3 = 5.63 min, t_4 = 7.07 min.

minor product

$[\alpha]\ ^{20}_{D}$ = -67.6 (c = 0.12, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 (d, *J* = 7.7 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 7.8 Hz, 1H), 7.29 (d, *J* = 7.4 Hz, 1H), 7.09 – 6.96 (m, 3H), 6.91 (dt, *J* = 8.0, 4.0 Hz, 1H), 6.88 (d, *J* = 7.7 Hz, 1H), 4.51 (dd, *J* = 9.2, 5.0 Hz, 1H), 3.99 (dd, *J* = 18.4, 9.3 Hz, 1H), 3.73 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.54 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.41 (dd, *J* = 18.4, 5.0 Hz, 1H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.0, 172.1, 147.7 (d, J = 247.1 Hz), 145.6 (d, J = 10.8 Hz), 142.7, 136.5, 133.5, 132.9 (d, J = 2.8 Hz), 130.8, 130.0, 128.8, 128.2, 123.7, 123.5, 122.2 (d, J = 5.6 Hz), 119.8 (d, J = 3.4 Hz), 116.4 (d, J = 16.9 Hz), 108.8, 88.9, 46.5, 41.1, 34.9, 12.5.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -137.50.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{30}FNO_3Na^+]$: 424.1319 found 424.1322.

IR (neat) 2925, 2854, 1722, 1683, 1614, 1487, 1371, 1262, 1212, 1022, 754, 689 cm^{-1}.

major product

$[\alpha]\ ^{20}_{D}$ = -47.1 (c = 0.07, in CH_2Cl_2).

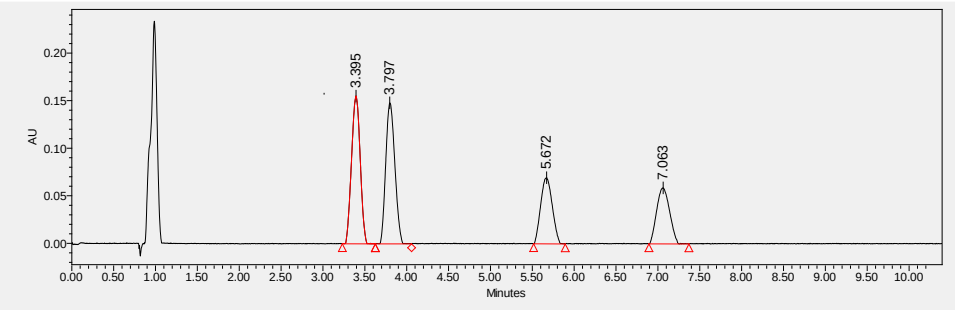
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 7.4 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 7.14 (td, *J* = 7.8, 1.3 Hz, 1H), 7.09 (d, *J* = 7.4 Hz, 1H), 7.05 – 6.96 (m, 2H), 6.94 – 6.90 (m, 1H), 6.78 (t, *J* = 7.5 Hz, 1H), 6.73 (d, *J* = 7.9 Hz, 1H), 4.68 (t, *J* = 7.6 Hz, 1H), 3.92 (dq, *J* = 14.5, 7.2 Hz, 1H), 3.74 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.53 – 3.44 (m, 2H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 174.4, 147.6 (d, *J* = 246.9 Hz) 145.5 (d, J = 10.8 Hz), 143.8, 136.2, 133.3, 132.5 (d, J = 2.8 Hz), 130.9, 128.6, 127.7, 125.2, 125.1, 122.2, 122.1 (d, J = 5.4 Hz), 119.3 (d, *J* = 3.5 Hz), 116.4 (d, J = 17.0 Hz), 109.1, 90.2, 44.6, 40.4, 35.2, 12.4.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -137.75.

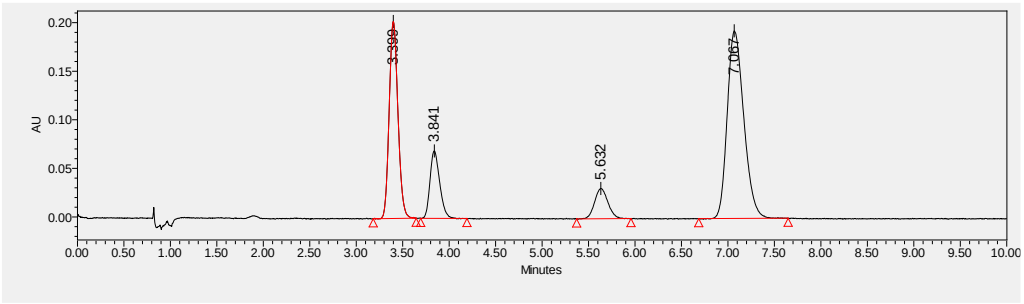
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{30}FNO_3Na^+]$: 424.1319 found 424.1329.

IR (neat) 3059, 2980, 1724, 1683, 1610, 1477, 1369, 1262, 1212, 1024, 755, 693 cm^{-1}.



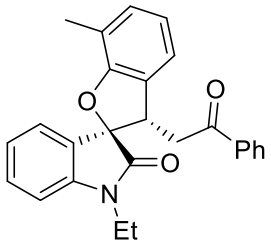
	Retention Time	Area	% Area
1	3.395	1118560	31.62

2	3.797	1121310	31.70
3	5.672	666627	18.84
4	7.063	631174	17.84



	Retention Time	Area	% Area
1	3.399	1329279	29.34
2	3.841	504561	11.14
3	5.632	310082	6.84
4	7.067	2386550	52.68

(2*R*,3*S*)-1'-ethyl-7-methyl-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C38):



White solid, 98% yield, 91:9 er, >19:1 dr, m.p. 74-75 °C, $[\alpha]\ ^{20}_{D}$ = -15.4 (c = 0.76, in CH_2Cl_2). Reacted for 144 h.

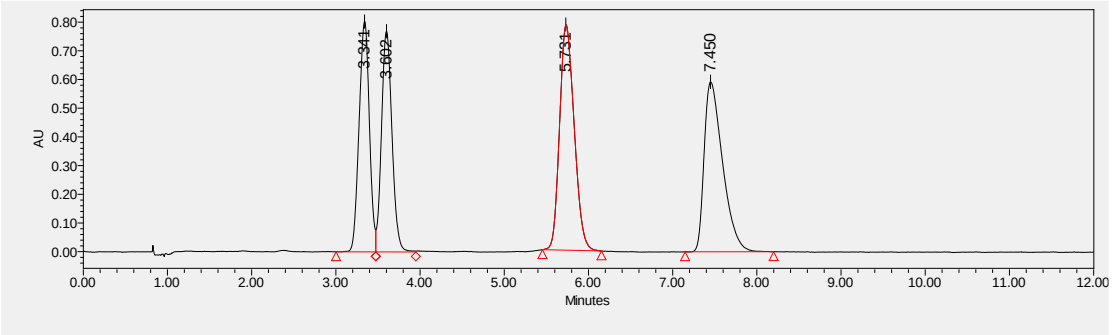
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.33 min, t_2 = 3.61 min.t_3 = 5.74 min, t_4 = 7.43 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.64 – 7.57 (m, 2H), 7.46 (t, *J* = 7.4 Hz, 1H), 7.31 (t, *J* = 7.7 Hz, 2H), 7.11 (td, *J* = 7.8, 1.1 Hz, 1H), 7.06 – 7.02 (m, 3H), 6.88 (t, *J* = 7.5 Hz, 1H), 6.80 – 6.70 (m, 2H), 4.64 (t, *J* = 7.6 Hz, 1H), 3.99 – 3.90 (m, 1H), 3.75 – 3.66 (m, 1H), 3.43 (d, *J* = 7.6 Hz, 2H), 2.20 (s, 3H), 1.38 (t, *J* = 7.2 Hz, 3H).

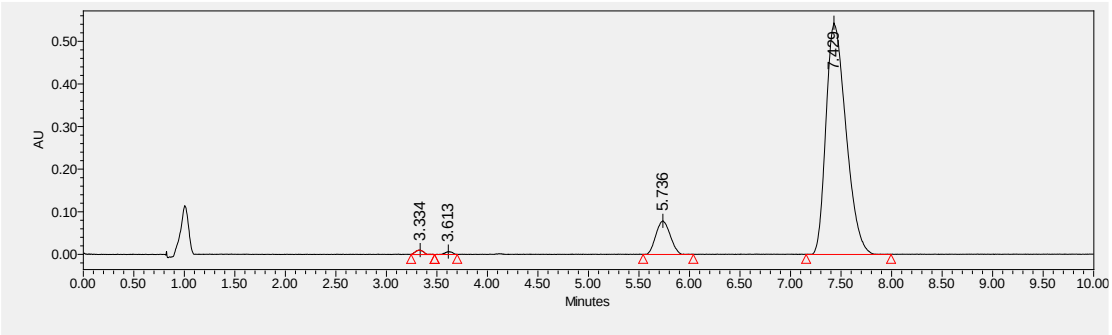
^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.0, 175.3, 157.4, 143.6, 136.3, 133.1, 130.5, 130.3, 128.5, 128.0, 127.6, 126.2, 124.9, 122.0, 121.2, 121.1, 120.4, 108.9, 88.8, 44.8, 40.4, 35.1, 15.3, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{23}NO_3Na^+]$: 420.1570 found 420.1570.

IR (neat) 3057, 2980, 1727, 1683, 1609, 1462, 1367, 1321, 1208, 861, 756, 691 cm^{-1}.

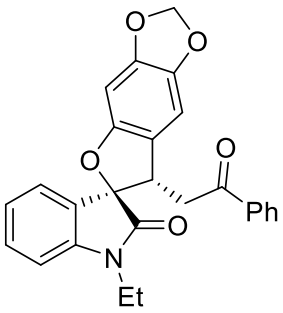


	Retention Time	Area	% Area
1	3.341	6818954	21.34
2	3.602	6660961	20.85
3	5.731	9462807	29.62
4	7.450	9007550	28.19



	Retention Time	Area	% Area
1	3.334	58768	0.71
2	3.613	35154	0.42
3	5.736	772112	9.27
4	7.429	7463133	89.60

(3*R*,7'*S*)-1-ethyl-7'-(2-oxo-2-phenylethyl)-7'*H*-spiro[indoline-3,6'-[1,3]dioxolo[4,5-f]benzofuran]-2-one (C39):



Yellow solid, 99% yield, 93:7 er, >19:1 dr, m.p. 77-81 °C, $[\alpha]_D^{20}$ = -50.0 (c = 0.80, in CH_2Cl_2). Reacted for 108 h.

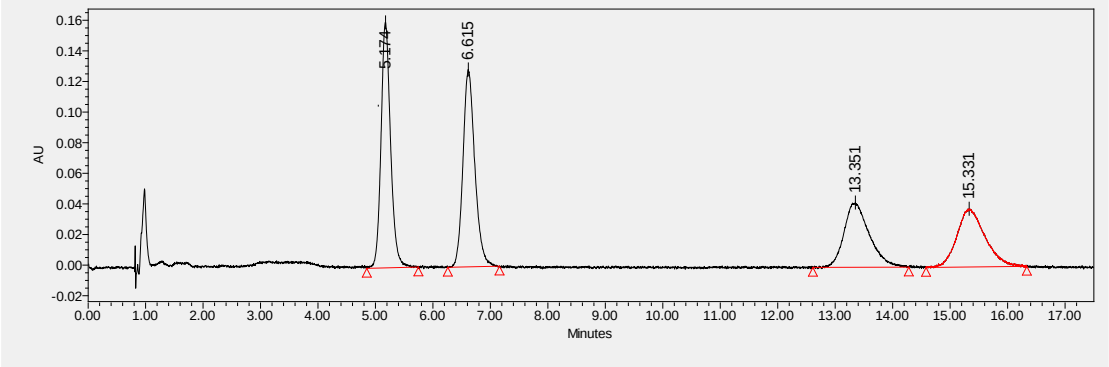
SFC Daicel Chiralpak IA-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 12.26 min, t_2 = 14.85 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 (d, *J* = 7.4 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 2H), 7.17 – 7.10 (m, 2H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.72 (d, *J* = 8.1 Hz, 1H), 6.67 (s, 1H), 6.45 (s, 1H), 5.93 (d, *J* = 10.5 Hz, 2H), 4.54 (dd, *J* = 9.2, 5.8 Hz, 1H), 3.94 – 3.85 (m, 1H), 3.73 (dt, *J* = 14.2, 7.2 Hz, 1H), 3.47 – 3.29 (m, 2H), 1.35 (t, *J* = 7.2 Hz, 3H).

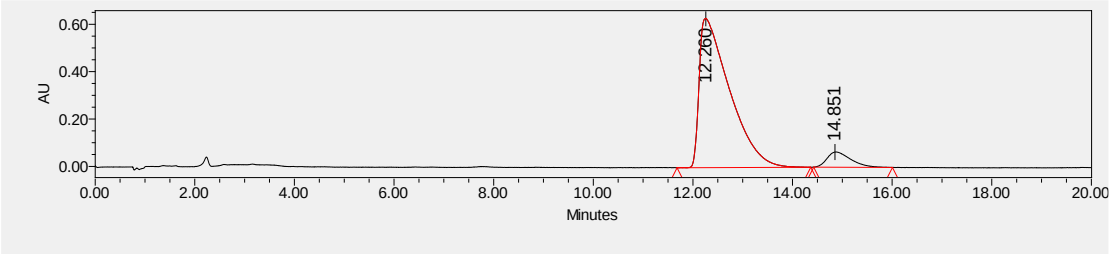
^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 174.9, 153.3, 148.1, 143.5, 142.4, 136.3, 133.2, 130.6, 128.5, 127.6, 125.8, 124.9, 122.1, 119.6, 109.0, 104.1, 101.5, 93.7, 89.7, 44.4, 40.6, 35.0, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{21}NO_5Na^+]$: 450.1312 found 450.1314.

IR (neat) 3060, 2980, 2886, 1726, 1611, 1465, 1367, 1259, 1215, 1150, 936, 753, 692 cm^{-1}.

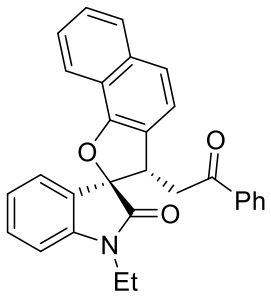


	Retention Time	Area	% Area
1	5.174	1853709	29.58
2	6.615	1846917	29.47
3	13.351	1282511	20.47
4	15.331	1283116	20.48



	Retention Time	Area	% Area
1	12.260	26581167	92.55
2	14.851	2138727	7.45

(3*R*,3'*S*)-1-ethyl-3'-(2-oxo-2-phenylethyl)-3'*H*-spiro[indoline-3,2'-naphtho[1,2-b]furan]-2-one (C40):



White solid, 99% yield, 86:14 er, 90:10 dr, m.p. 86-90 °C, Reacted for 108 h.

SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 8.77 min, t_2 = 12.96 min, t_3 = 17.62 min, t_4 = 22.53 min.

minor product

$[\alpha]^{21}_D$ = -42.8 (c = 0.08, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.96 (d, *J* = 7.5 Hz, 1H), 7.91 (d, *J* = 7.3 Hz, 2H), 7.87 – 7.82 (m, 1H), 7.58 – 7.49 (m, 2H), 7.49 – 7.40 (m, 4H), 7.39 – 7.33 (m, 2H), 7.24 (d, *J* = 7.4 Hz, 1H), 7.01 (t, *J* = 7.3 Hz, 1H), 6.92 (d, *J* = 7.9 Hz, 1H), 4.60 (dd, *J* = 10.0, 4.2 Hz, 1H), 4.14 (dd, *J* = 18.5, 10.0 Hz, 1H), 3.81 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.56 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.45 (dd, *J* = 18.5, 4.3 Hz, 1H), 1.23 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.6, 172.8, 154.5, 142.6, 136.7, 134.6, 133.4, 131.4, 130.5, 128.8, 128.2, 128.0, 126.4, 125.8, 123.4, 123.4, 122.1, 122.1, 121.8, 121.6, 120.9, 108.7, 88.2, 47.4, 41.6, 34.9, 29.9, 12.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{29}H_{23}NO_3Na^+]$: 456.1570 found 456.1576.

IR (neat) 3058, 2923, 1721, 1681, 1613, 1370, 1275, 1095, 806, 752, 689 cm^{-1}.

major product

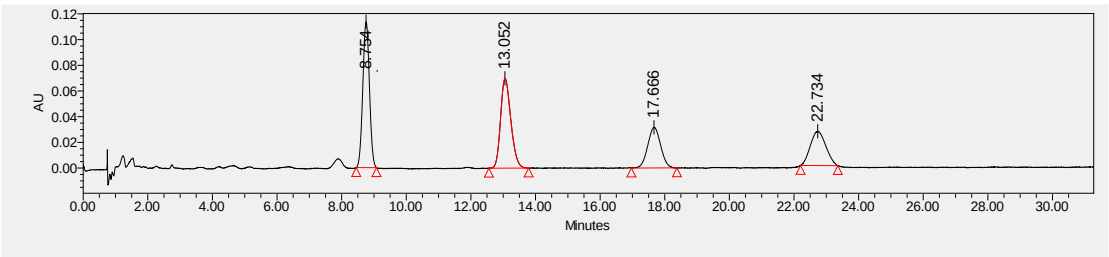
$[\alpha]^{20}_D$ = 60.9 (c = 0.28, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.94 (d, *J* = 7.6 Hz, 1H), 7.84 (d, *J* = 7.5 Hz, 1H), 7.63 (d, *J* = 7.4 Hz, 2H), 7.51 – 7.40 (m, 4H), 7.40 – 7.31 (m, 3H), 7.12 (t, *J* = 7.8 Hz, 1H), 7.07 (d, *J* = 7.3 Hz, 1H), 6.77 – 6.71 (m, 2H), 4.84 (t, *J* = 7.6 Hz, 1H), 3.98 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.76 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.54 (d, *J* = 7.6 Hz, 2H), 1.42 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.1, 175.3, 154.5, 143.8, 136.4, 134.6, 133.2, 130.6, 128.5, 127.9, 127.7, 126.3, 126.1, 125.7, 125.2, 122.1, 122.1, 121.6, 121.4, 121.4, 120.7, 109.0, 89.7, 45.5, 40.7, 35.2, 12.5.

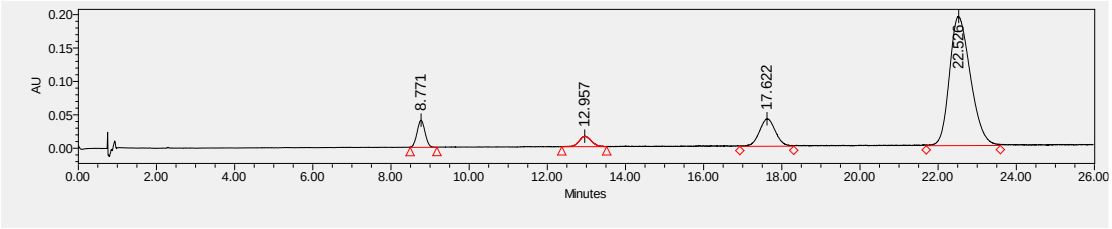
HRMS (ESI) m/z: $[M + K]^+$ Calculated for $[C_{29}H_{23}NO_3K^+]$: 472.1310 found 472.1317.

IR (neat) 3057, 2979, 1724, 1681, 1607, 1367, 1313, 1214, 1006, 806, 749, 694 cm^{-1}.



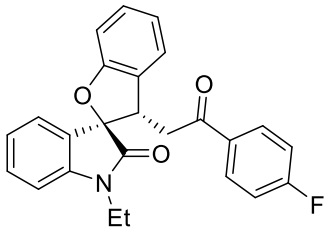
	Retention Time	Area	% Area
1	8.754	416446	32.33
2	13.052	401733	31.19
3	17.666	233184	18.10

4	22.734	236683	18.38



	Retention Time	Area	% Area
1	8.771	573763	6.18
2	12.957	334718	3.61
3	17.622	1168887	12.60
4	22.526	7200928	77.61

(2*R*,3*S*)-1'-ethyl-3-(2-(4-fluorophenyl)-2-oxoethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C41):



White solid, 91% yield, 96:4 er, >19:1 dr, m.p. 68-72 °C, $[\alpha]^{20}_{D}$ = -42.9 (c = 0.71, in CH_2Cl_2). Reacted for 144 h.

SFC Daicel Chiralpak IB-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.37 min, t_2 = 5.77 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.66 – 7.62 (m, 2H), 7.25 – 7.18 (m, 2H), 7.12 (td, *J* = 7.8, 1.0 Hz, 1H), 7.05 (d, *J* = 7.3 Hz, 1H), 7.02 – 6.94 (m, 3H), 6.88 (d, *J* = 8.0 Hz, 1H), 6.80 – 6.68 (m, 2H), 4.64 (t, *J* = 7.6 Hz, 1H), 3.95 – 3.87 (m, 1H), 3.77 – 3.68 (m, 1H), 3.49 – 3.38 (m, 2H), 1.36 (t, *J* = 7.2 Hz, 3H).

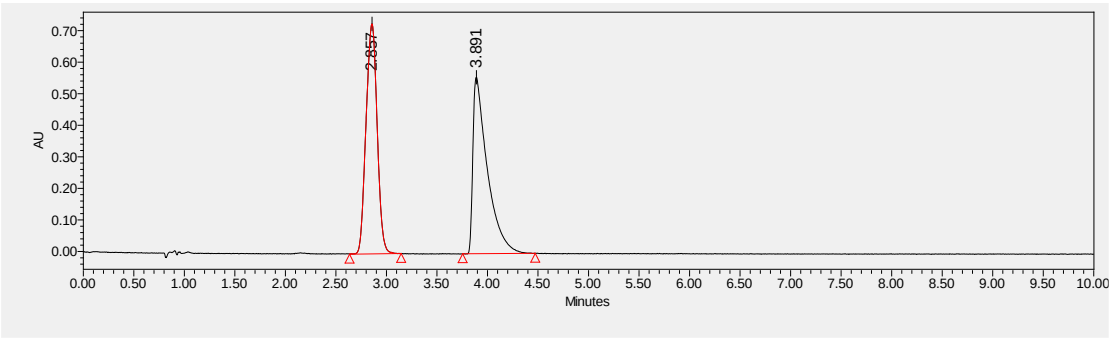
^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.4, 175.0, 165.8 (d, *J* = 254.8 Hz), 158.8, 143.6, 132.7 (d, *J* = 3.1 Hz), 130.6, 130.3 (d, *J* = 9.3 Hz), 129.1, 128.6, 125.7, 124.9, 123.9, 122.1, 121.4, 115.6 (d, *J* = 21.9 Hz), 110.3, 109.0, 88.9, 44.5, 40.3, 35.1, 12.4.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -105.10.

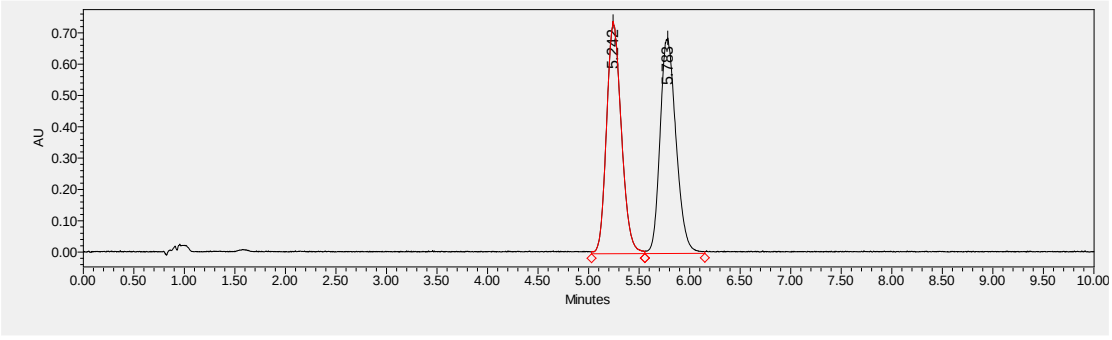
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{20}FNO_3Na^+]$: 424.1319 found 424.1320.

IR (neat) 3060, 2982, 1725, 1682, 1601, 1470, 1366, 1229, 996, 838, 750, 557 cm^{-1}.

Racemate: 1:1.2 dr determined by UPCC analysis of the mixture. The racemate isolation by UPCC of each diastereomer as below:

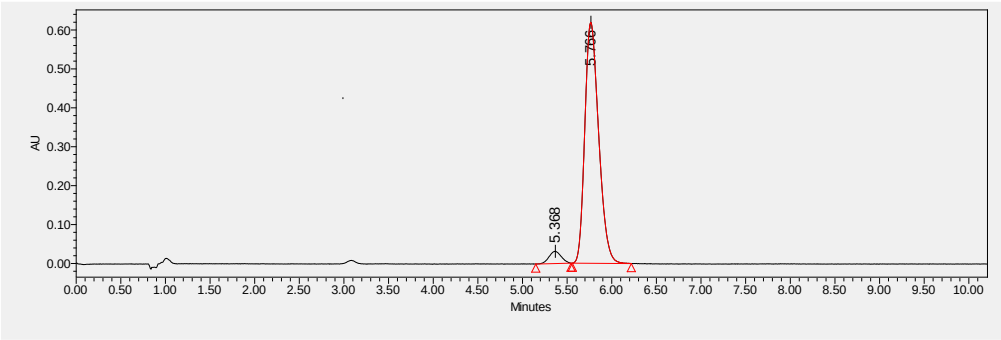


	Retention Time	Area	% Area
1	2.857	5576900	50.14
2	3.891	5546357	49.86



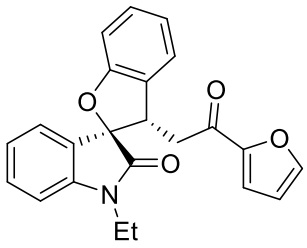
	Retention Time	Area	% Area
1	5.242	7520705	49.90
2	5.783	7549442	50.10

The UPCC spectra of asymmetric catalytic product as below:



	Retention Time	Area	% Area
1	5.368	300951	4.31
2	5.766	6679790	95.69

(2*R*,3*S*)-1'-ethyl-3-(2-(furan-2-yl)-2-oxoethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C42):



White solid, 51% yield, 95:5 er, >19:1 dr, m.p. 66-69 °C, $[\alpha]\ ^{20}_{D}$ = -8.1 (c = 0.38, in CH_2Cl_2). Reacted for 120 h.

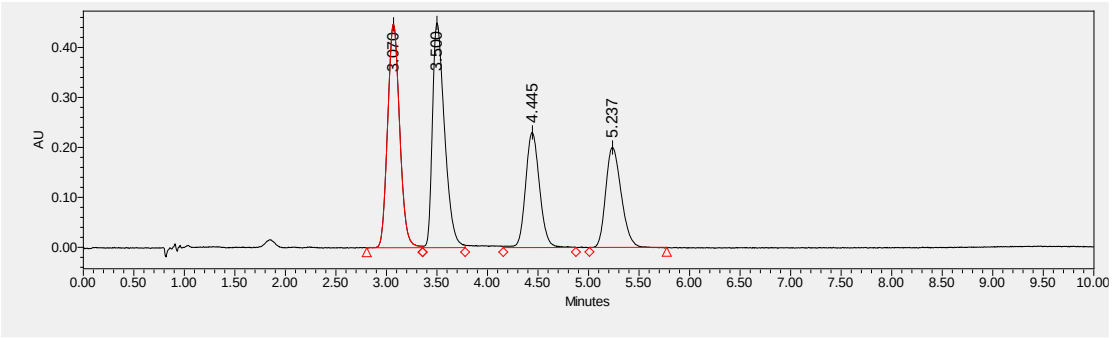
SFC Daicel Chiralcel OD-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.51 min, t_2 = 5.38 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.47 – 7.41 (m, 1H), 7.24 – 7.14 (m, 3H), 7.10 (d, *J* = 7.4 Hz, 1H), 7.00 – 6.93 (m, 1H), 6.92 – 6.86 (m, 2H), 6.85 – 6.80 (m, 1H), 6.74 (d, *J* = 7.9 Hz, 1H), 6.40 (dd, *J* = 3.6, 1.7 Hz, 1H), 4.61 (dd, *J* = 10.2, 6.2 Hz, 1H), 3.85 (dd, *J* = 14.2, 7.2 Hz, 1H), 3.79 – 3.72 (m, 1H), 3.38 – 3.18 (m, 2H), 1.33 (t, *J* = 7.2 Hz, 3H).

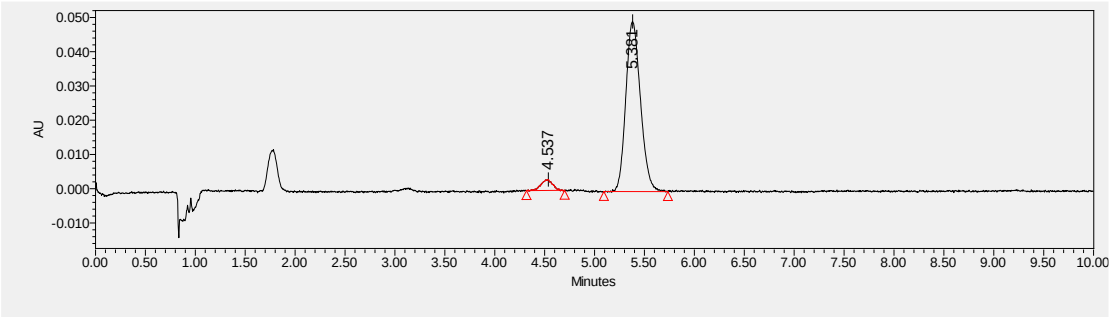
^{13}C NMR (101 MHz, Chloroform-*d*) δ 185.9, 174.9, 158.8, 152.1, 146.3, 143.6, 130.7, 129.0, 128.7, 125.7, 125.1, 124.0, 122.1, 121.4, 116.8, 112.2, 110.2, 109.0, 88.9, 44.1, 40.0, 35.1, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{23}H_{19}NO_4Na^+]$: 396.1206 found 396.1202.

IR (neat) 2980, 1728, 1673, 1611, 1469, 1369, 1236, 1020, 754, 692 cm^{-1}.

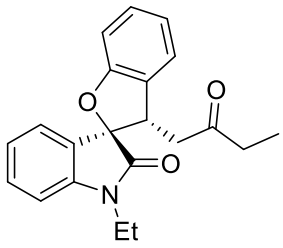


	Retention Time	Area	% Area
1	3.070	3705971	31.41
2	3.500	3748374	31.77
3	4.445	2211019	18.74
4	5.237	2133650	18.08



	Retention Time	Area	% Area
1	4.508	29520	4.95
2	5.382	566392	95.05

(2*R*,3*S*)-1'-ethyl-3-(2-oxobutyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C43):



White solid, 84% yield, 88:12 er, >19:1 dr, m.p. 149-153 °C, $[\alpha]_D^{20}$ = -54.5 (c = 1.07, in CH_2Cl_2). Reacted for 120 h.

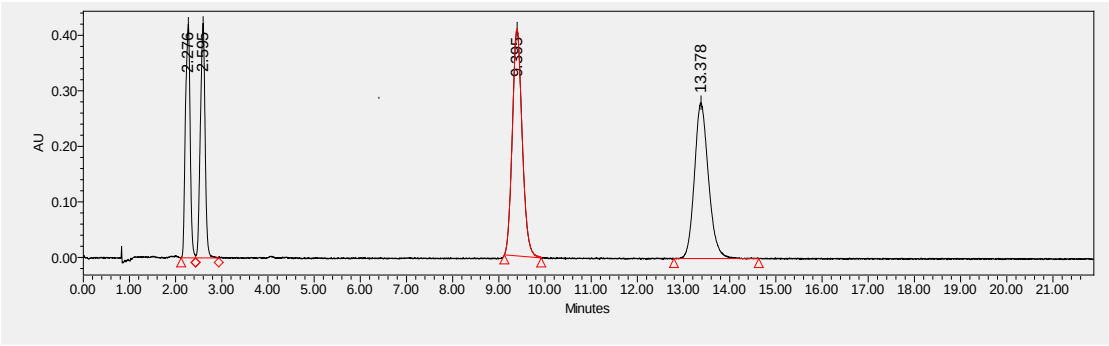
SFC Daicel Chiralcel OX-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 9.39 min, t_2 = 13.17 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.30 (td, *J* = 7.8, 1.1 Hz, 1H), 7.19 (t, *J* = 7.7 Hz, 1H), 7.12 – 7.06 (m, 2H), 6.94 (t, *J* = 7.5 Hz, 2H), 6.83 (dd, *J* = 15.1, 7.9 Hz, 2H), 4.47 (dd, *J* = 10.8, 4.8 Hz, 1H), 3.87 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.73 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.03 – 2.76 (m, 2H), 2.19 – 2.01 (m, 1H), 1.76 – 1.66 (m, 1H), 1.35 (t, *J* = 7.2 Hz, 3H), 0.69 (t, *J* = 7.3 Hz, 3H).

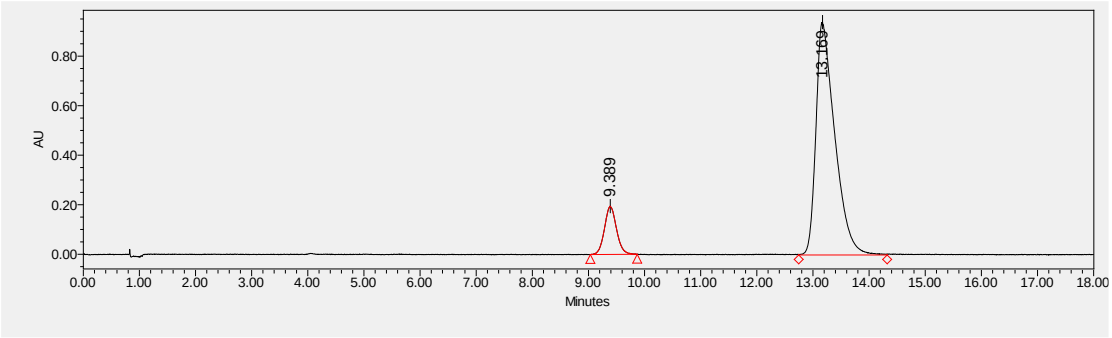
^{13}C NMR (101 MHz, Chloroform-*d*) δ 208.1, 175.0, 158.8, 143.8, 130.7, 128.9, 128.6, 125.8, 125.1, 123.7, 122.0, 121.3, 110.1, 108.9, 88.8, 44.0, 43.8, 35.5, 35.1, 12.4, 7.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{21}H_{21}NO_3Na^+]$: 358.1414 found 358.1412.

IR (neat) 3050, 2976, 2936, 1721, 1607, 1468, 1367, 1237, 1107, 890, 749 cm^{-1}.

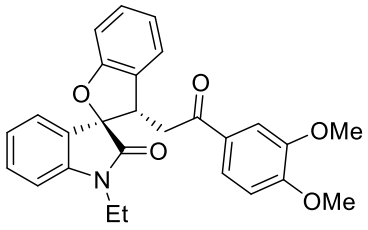


	Retention Time	Area	% Area
1	2.276	2961291	16.55
2	2.595	2986704	16.69
3	9.395	6041025	33.76
4	13.378	5906778	33.01



	Retention Time	Area	% Area
1	9.389	2882077	11.62
2	13.169	21930840	88.38

(2*R*,3*S*)-3-(2-(3,4-dimethoxyphenyl)-2-oxoethyl)-1'-ethyl-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C44):



White solid, 99% yield, 93:7 er, >19:1 dr, m.p. 76-77 °C, $[\alpha]^{21}_D$ = -26.0 (c = 0.78, in CH_2Cl_2). Reacted for 120 h.

SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 4.19 min, t_2 = 6.26 min.

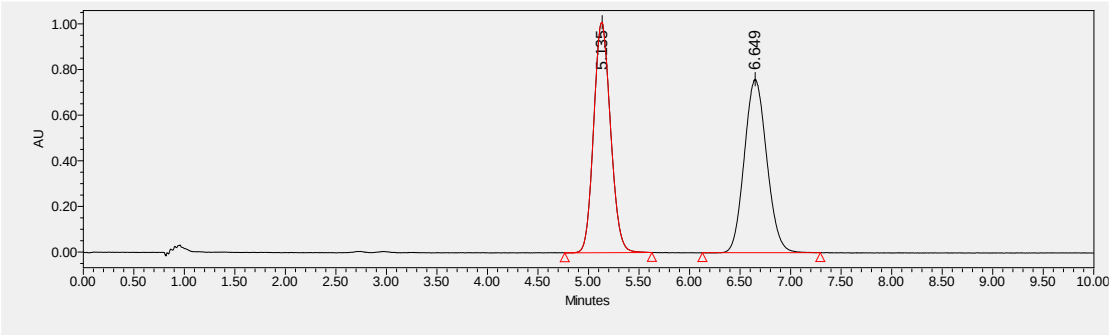
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.26 (dd, *J* = 8.4, 1.9 Hz, 1H), 7.24 – 7.18 (m, 3H), 7.14 (td, *J* = 7.8, 1.1 Hz, 1H), 7.07 (d, *J* = 7.3 Hz, 1H), 6.97 (t, *J* = 7.4 Hz, 1H), 6.89 (d, *J* = 8.0 Hz, 1H), 6.79 (t, *J* = 7.5 Hz, 1H), 6.77 – 6.70 (m, 2H), 4.64 (t, *J* = 7.5 Hz, 1H), 3.95 – 3.86 (m, 4H), 3.84 (s, 3H), 3.79 – 3.70 (m, 1H), 3.40 (d, *J* = 7.6 Hz, 2H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 195.5, 175.0, 158.8, 153.3, 148.8, 143.6, 130.6, 129.6, 129.0, 128.9, 125.8, 124.9, 122.3, 122.1, 121.4, 110.2, 109.9, 109.8, 108.9, 89.1, 56.1, 56.0, 44.5, 39.8, 35.0, 12.4.

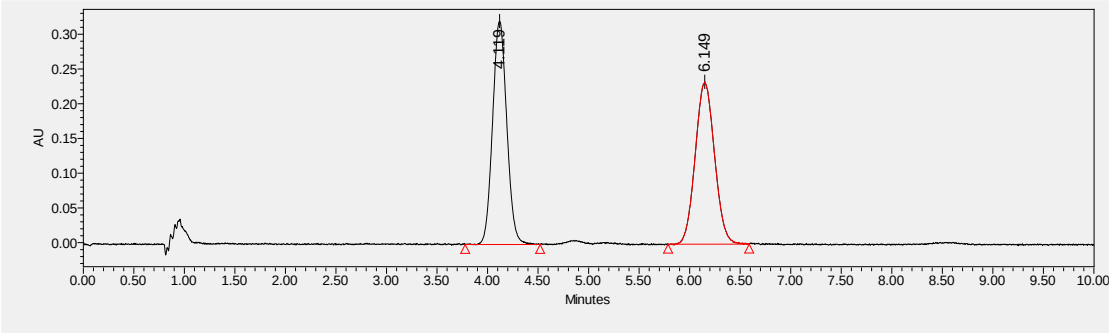
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{27}H_{25}NO_5Na^+]$: 466.1625 found 466.1620.

IR (neat) 2936, 1725, 1670, 1590, 1513, 1459, 1366, 1260, 1153, 1018, 905, 746 cm^{-1}.

Racemate: 1:1 dr determined by UPCC analysis of the mixture. The racemate isolation by UPCC of each diastereomer as below:

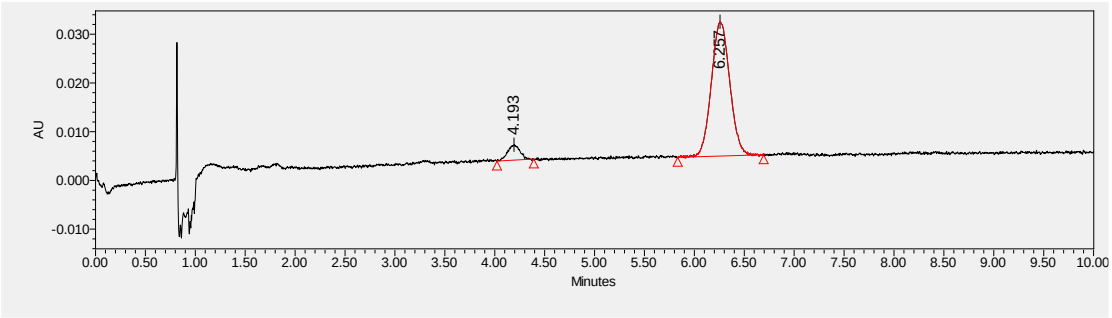


	Retention Time	Area	% Area
1	5.135	11675241	49.92
2	6.649	11710399	50.08



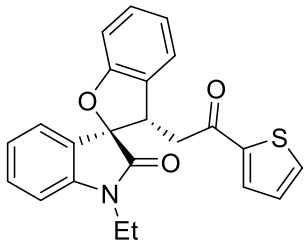
	Retention Time	Area	% Area
1	4.119	3144655	50.37
2	6.149	3098731	49.63

The UPCC spectra of asymmetric catalytic product as below:



	Retention Time	Area	% Area
1	4.193	26988	7.08
2	6.257	354387	92.92

(2*R*,3*S*)-1'-ethyl-3-(2-oxo-2-(thiophen-2-yl)ethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (C45):



Yellow solid, 84% yield, 95:5 er, >19:1 dr, m.p. 68-72 °C, $[\alpha]_D^{20}$ = -11.8 (c = 0.64, in CH_2Cl_2). Reacted for 108 h.

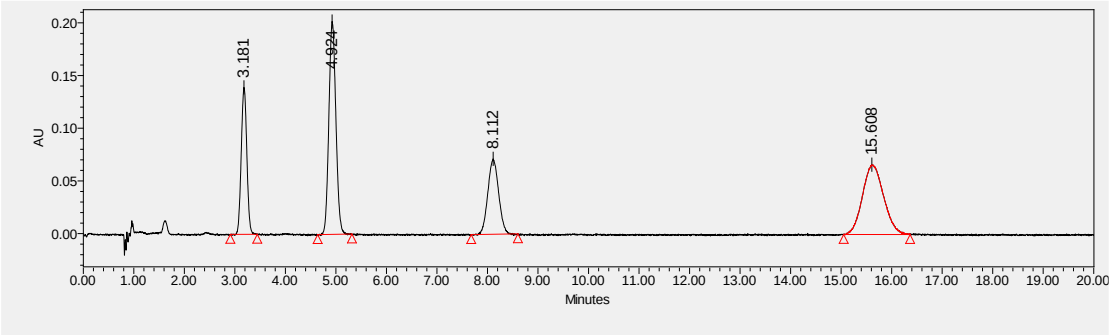
SFC Daicel Chiralcel OJ-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 3.21 min, t_2 = 8.23 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.51 (d, *J* = 4.9 Hz, 1H), 7.36 (d, *J* = 3.7 Hz, 1H), 7.25 – 7.17 (m, 2H), 7.16 – 7.06 (m, 2H), 7.01 – 6.94 (m, 2H), 6.89 (d, *J* = 8.0 Hz, 1H), 6.81 (t, *J* = 7.5 Hz, 1H), 6.70 (d, *J* = 7.9 Hz, 1H), 4.65 (dd, *J* = 9.2, 6.2 Hz, 1H), 3.92 – 3.83 (m, 1H), 3.75 – 3.66 (m, 1H), 3.41 – 3.28 (m, 2H), 1.34 (t, *J* = 7.2 Hz, 3H).

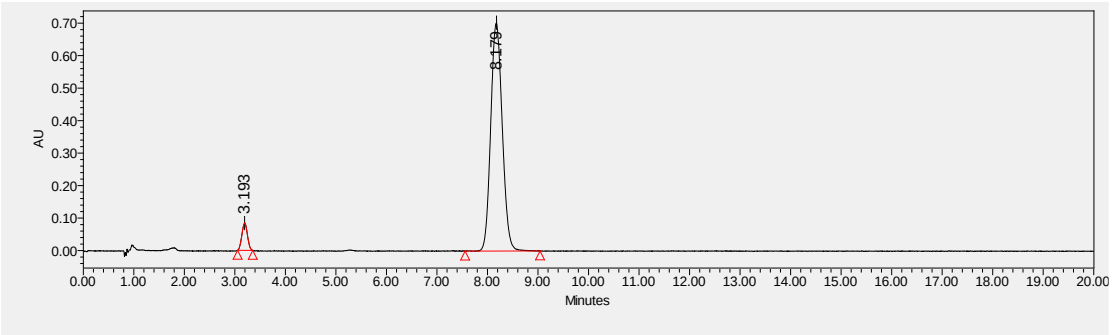
^{13}C NMR (101 MHz, Chloroform-*d*) δ 189.5, 174.9, 158.9, 143.6, 143.3, 133.7, 131.7, 130.7, 129.1, 128.5, 127.9, 125.6, 125.0, 123.9, 122.1, 121.4, 110.3, 109.0, 88.9, 44.6, 40.7, 35.1, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{23}H_{19}NO_3SNa^+]$: 412.0978 found 412.0981.

IR (neat) 3059, 2980, 2935, 1726, 1659, 1610, 1471, 1369, 1233, 857, 751 cm^{-1}.

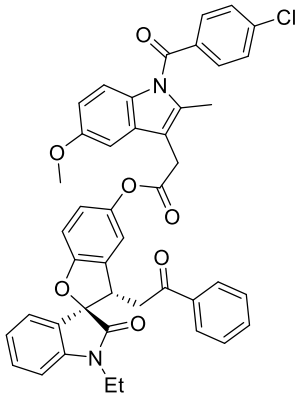


	Retention Time	Area	% Area
1	3.181	1072886	17.88
2	4.924	1943868	32.40
3	8.112	1061643	17.70
4	15.608	1920964	32.02



	Retention Time	Area	% Area
1	3.193	640472	5.44
2	8.179	11124298	94.56

(2*R*,3*S*)-1'-ethyl-2'-oxo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-5-yl 2-(1-(4-chlorobenzoyl)-5-methoxy-2-methyl-1*H*-indol-3-yl)acetate (C46):



White solid, 75% yield, 90:10 er, 86:14 dr, m.p. 98-101 °C. Reacted for 120 h .

SFC Daicel Chiralcel OJ-3, CO_2/EtOH = 80/20, 1.5 mL/min, λ = 240 nm, t_1 = 19.73 min, t_2 = 21.42 min, t_3 = 37.41 min, t_4 = 52.60 min.

minor product

$[\alpha]^{21}_D$ = -29.4 (c = 0.12, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.86 (d, *J* = 7.4 Hz, 2H), 7.68 (d, *J* = 8.5 Hz, 2H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.47 (d, *J* = 8.5 Hz, 2H), 7.41 (t, *J* = 7.7 Hz, 2H), 7.38 – 7.33 (m, 1H), 7.28 – 7.26 (m, 1H), 7.08 – 7.02 (m, 2H), 6.96 – 6.83 (m, 5H), 6.69 (dd, *J* = 9.0, 2.5 Hz, 1H), 4.42 (dd, *J* = 9.3, 4.8 Hz, 1H), 3.99 (dd, *J* = 18.4, 9.4 Hz, 1H), 3.89 (s, 2H), 3.84 (s, 3H), 3.75 – 3.68 (m, 1H), 3.53 (dq, *J* = 14.3, 7.1 Hz, 1H), 3.34 (dd, *J* = 18.5, 4.8 Hz, 1H), 2.46 (s, 3H), 1.18 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.0, 172.5, 169.9, 168.5, 156.6, 156.3, 145.2, 142.6, 139.5, 136.4, 136.0, 134.0, 133.5, 131.4, 131.0, 130.7, 130.6, 130.4, 130.3, 129.3, 128.8, 128.2, 123.6, 123.5, 121.9, 117.9, 115.2, 112.2, 112.0, 110.5, 108.8, 101.4, 88.4, 55.9, 46.3, 41.1, 34.9, 30.7, 13.6, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{44}H_{35}{}^{35}ClN_2O_7Na^+]$: 761.2025 found 761.2027.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{44}H_{35}{}^{37}ClN_2O_7Na^+]$: 763.1996 found 763.2020.

IR (neat) 2924, 2853, 1754, 1682, 1612, 1477, 1368, 1319, 1217, 1136, 1091, 995, 752, 690 cm^{-1}.

major product

$[\alpha]^{21}_D$ = -36.2 (c = 1.10, in CH_2Cl_2).

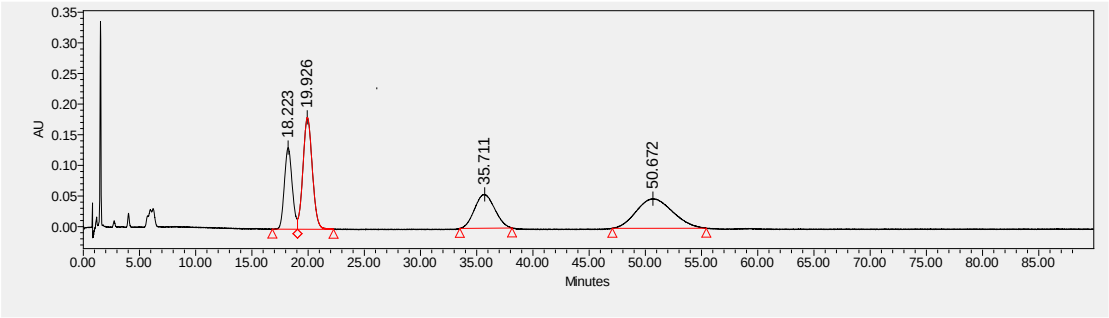
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.68 (d, *J* = 8.4 Hz, 2H), 7.59 (d, *J* = 7.7 Hz, 2H), 7.48 – 7.44 (m, 3H), 7.31 (t, *J* = 7.7 Hz, 2H), 7.12 (t, *J* = 7.8 Hz, 1H), 7.08 – 7.03 (m, 2H), 6.95 – 6.86 (m, 3H), 6.82 (d, *J* = 8.6 Hz, 1H), 6.76 (t, *J* = 7.5 Hz, 1H), 6.74 – 6.67 (m, 2H), 4.61 (dd, *J* = 10.0, 4.8 Hz, 1H), 3.95 – 3.84 (m, 3H), 3.84 (s, 3H), 3.77 – 3.68 (m, 1H), 3.49 – 3.32 (m, 2H), 2.46 (s, 3H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 174.7, 169.9, 168.5, 156.5, 156.3, 145.1, 143.6, 139.5, 136.4, 136.1, 134.0, 133.3, 131.3, 131.0, 130.8, 130.7, 129.9, 129.3, 128.5, 127.7, 125.4, 125.0, 122.2, 121.7, 117.4, 115.2, 112.2, 111.9, 110.2, 109.0, 101.5, 89.7, 76.8, 55.9, 44.4, 40.3, 35.1, 30.6, 13.6, 12.4.

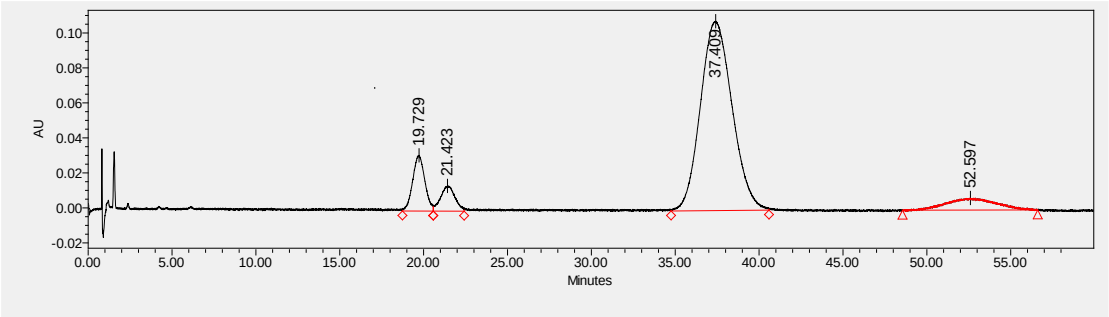
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{44}H_{35}{}^{35}ClN_2O_7Na^+]$: 761.2025 found 761.2018.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{44}H_{35}{}^{37}ClN_2O_7Na^+]$: 763.1996 found 763.2005.

IR (neat) 3061, 2934, 1728, 1682, 1609, 1477, 1363, 1319, 1212, 1140, 997, 754, 692 cm^{-1}.

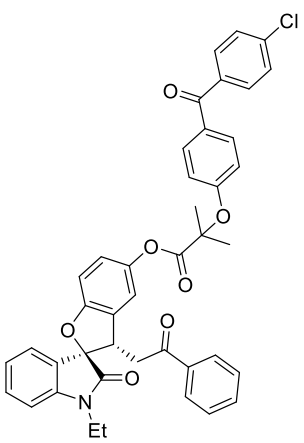


	Retention Time	Area	% Area
1	18.223	6426650	18.55
2	19.926	10528078	30.39
3	35.711	6860691	19.80
4	50.672	10828536	31.26



	Retention Time	Area	% Area
1	19.729	1595096	8.83
2	21.423	850001	4.70
3	37.409	14242023	78.83
4	52.597	1378853	7.63

(2*R*,3*S*)-1'-ethyl-2'-oxo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-5-yl 2-(4-(4-chlorobenzoyl)phenoxy)-2-methylpropanoate (C47):



White solid, 89% yield, 92:8 er, 77:23 dr, m.p. 83-85 °C, Reacted for 120 h .

SFC Daicel Chiralcel OD-3, CO_2/EtOH = 80/20, 1.5 mL/min, λ = 240 nm, t_1 = 7.25 min, t_2 = 7.88 min, t_3 = 12.22 min, t_4 = 13.41 min.

minor product

$[\alpha]^{21}_D$ = -30.5 (c = 0.09, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.85 (d, *J* = 7.3 Hz, 2H), 7.81 – 7.75 (m, 2H), 7.73 – 7.67 (m, 2H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.46 – 7.34 (m, 5H), 7.28 – 7.26 (m, 1H), 7.05 (t, *J* = 7.5 Hz, 1H), 6.99 (dd, *J* = 9.2, 2.2 Hz, 2H), 6.88 – 6.81 (m, 4H), 4.43 (dd, *J* = 9.0, 5.0 Hz, 1H), 3.97 (dd, *J* = 18.4, 9.2 Hz, 1H), 3.75 – 3.68 (m, 1H), 3.54 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.34 (dd, *J* = 18.4, 5.0 Hz, 1H), 1.82 (s, 6H), 1.19 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.9, 194.3, 172.9, 172.4, 159.7, 156.8, 144.9, 142.6, 138.6, 136.5, 136.4, 133.5, 132.3, 131.3, 130.9, 130.7, 130.6, 130.2, 128.8, 128.7, 128.2, 123.6, 123.5, 121.6, 117.7, 117.5, 110.6, 108.8, 88.4, 79.6, 46.4, 41.1, 34.9, 29.8, 25.6, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{42}H_{34}{}^{35}ClNO_7Na^+]$: 722.1916 found 722.1917.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{42}H_{34}{}^{37}ClNO_7Na^+]$: 724.1887 found 724.1907.

IR (neat) 2929, 2854, 1753, 1720, 1596, 1479, 1370, 1307, 1203, 1134, 996, 757, 689 cm^{-1}.

major product

$[\alpha]^{21}_D$ = -36.2 (c = 1.10, in CH_2Cl_2).

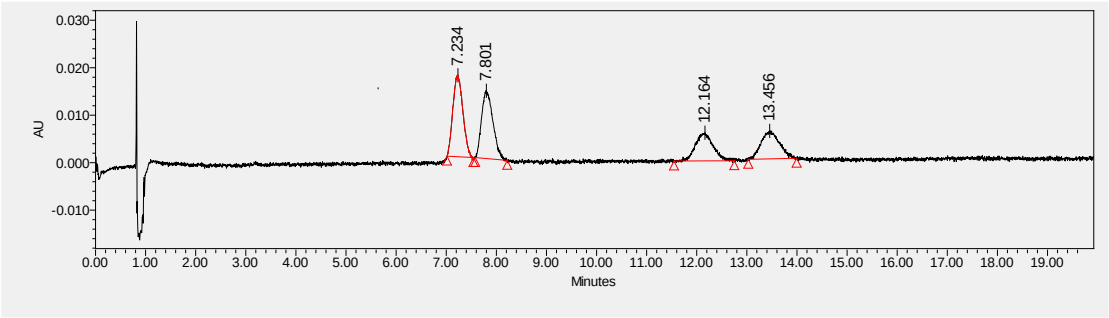
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.85 – 7.75 (m, 2H), 7.73 – 7.64 (m, 2H), 7.62 – 7.53 (m, 2H), 7.50 – 7.38 (m, 3H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.13 (td, *J* = 7.8, 1.3 Hz, 1H), 7.07 (dd, *J* = 7.4, 1.3 Hz, 1H), 7.04 – 6.96 (m, 2H), 6.89 – 6.69 (m, 5H), 4.62 (dd, *J* = 10.0, 4.9 Hz, 1H), 3.90 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.73 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.52 – 3.32 (m, 2H), 1.84 (s, 6H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.6, 194.3, 174.7, 172.9, 159.7, 156.7, 144.8, 143.6, 138.6, 136.4, 136.1, 133.3, 132.3, 131.3, 130.9, 130.8, 130.2, 128.7, 128.6, 127.7, 125.4, 125.0, 122.2, 121.4, 117.5, 117.1, 110.4, 109.1, 89.8, 79.6, 44.4, 40.3, 35.1, 25.7, 25.6, 12.4.

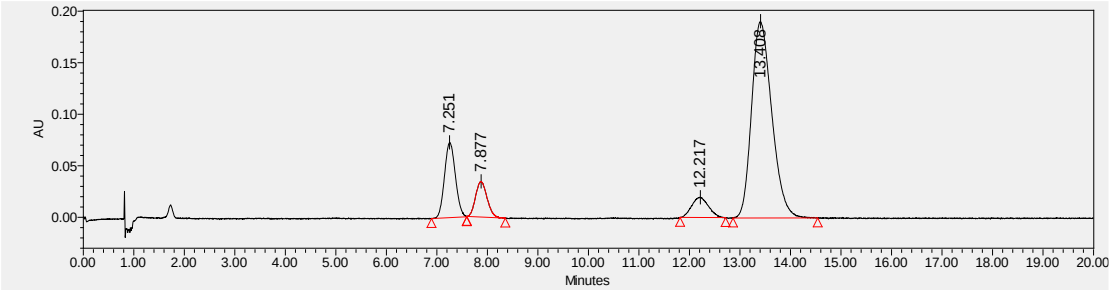
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{42}H_{34}{}^{35}ClNO_7Na^+]$: 722.1916 found 722.1902.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{42}H_{34}{}^{37}ClNO_7Na^+]$: 724.1887 found 724.1890.

IR (neat) 3061, 2934, 1728, 1682, 1609, 1477, 1363, 1319, 1212, 1140, 997, 754, 692 cm^{-1}.

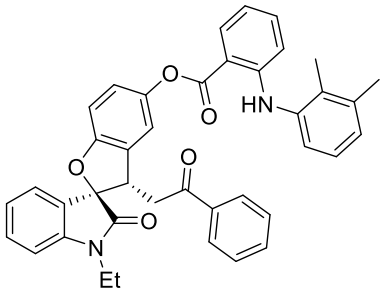


	Retention Time	Area	% Area
1	7.234	238228	31.45
2	7.801	224544	29.64
3	12.164	145336	19.19
4	13.456	149414	19.72



	Retention Time	Area	% Area
1	7.251	1092811	14.79
2	7.877	543774	7.36
3	12.217	450120	6.09
4	13.408	5301092	71.75

(2*R*,3*S*)-1'-ethyl-2'-oxo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-5-yl 2-((2,3-dimethylphenyl)amino)benzoate (C48):



White solid, 64% yield, 91:9 er, 89:11 dr, m.p. 100-104 °C. Reacted for 120 h.

SFC Daicel Chiralcel OJ-3, CO_2/EtOH = 80/20, 1.5 mL/min, λ = 240 nm, t_1 = 9.84 min, t_2 = 15.37 min, t_3 = 19.43 min, t_4 = 27.55 min.

minor product

$[\alpha]^{21}_D$ = -45.7 (c = 0.07, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.19 (s, 1H), 8.24 – 8.14 (m, 1H), 7.89 (d, *J* = 7.5 Hz, 2H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.45 – 7.28 (m, 5H), 7.19 – 7.02 (m, 6H), 6.94 (d, *J* = 8.5 Hz, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.78 (d, *J* = 8.5 Hz, 1H), 6.73 (t, *J* = 7.5 Hz, 1H), 4.50 (dd, *J* = 9.2, 4.8 Hz, 1H), 4.04 (dd, *J* = 18.4, 9.4 Hz, 1H), 3.74 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.55 (dq, *J* = 14.3, 7.1 Hz, 1H), 3.42 (dd, *J* = 18.4, 4.8 Hz, 1H), 2.33 (s, 3H), 2.18 (s, 3H), 1.20 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.1, 172.5, 167.9, 156.6, 150.4, 145.2, 142.6, 138.5, 138.4, 136.5, 135.1, 133.5, 132.8, 132.0, 130.6, 130.5, 130.5, 128.8, 128.2, 127.2, 126.1, 123.7, 123.5, 122.5, 118.4, 116.3, 114.0, 110.6, 109.8, 108.8, 88.4, 46.4, 41.2, 34.9, 20.7, 14.2, 12.5.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{40}H_{34}N_2O_5Na^+]$: 645.2360 found 645.2369.

IR (neat) 3333, 2927, 1723, 1688, 1609, 1578, 1475, 1369, 1196, 1140, 1043, 746, 692 cm^{-1}.

major product

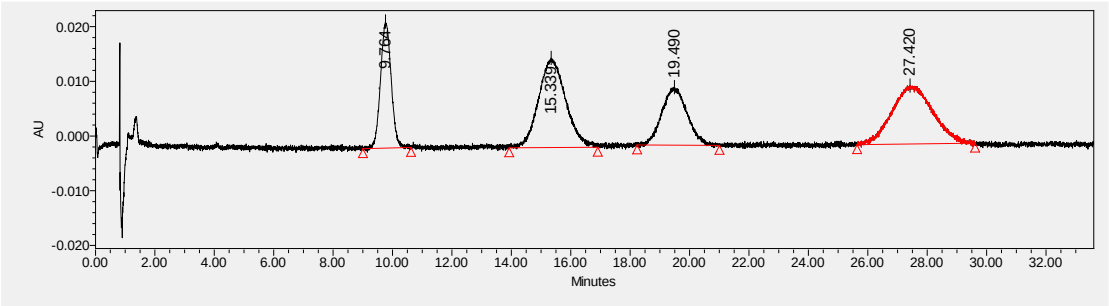
$[\alpha]^{21}_D$ = -55.9 (c = 0.94, in CH_2Cl_2).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 9.18 (s, 1H), 8.19 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.62 (d, *J* = 7.4 Hz, 2H), 7.46 (t, *J* = 7.3 Hz, 1H), 7.32 (t, *J* = 7.7 Hz, 3H), 7.18 – 7.09 (m, 5H), 7.08 – 7.03 (m, 2H), 6.92 (d, *J* = 8.5 Hz, 1H), 6.79 (t, *J* = 8.6 Hz, 2H), 6.74 (t, *J* = 7.2 Hz, 2H), 4.69 (dd, *J* = 9.7, 5.2 Hz, 1H), 3.93 (dq, *J* = 14.4, 7.2 Hz, 1H), 3.75 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.59 – 3.40 (m, 2H), 2.33 (s, 3H), 2.18 (s, 3H), 1.38 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 174.8, 167.9, 156.5, 150.4, 145.2, 143.7, 138.6, 138.4, 136.2, 135.1, 133.3, 132.8, 132.1, 130.8, 130.1, 128.6, 127.7, 127.2, 126.1, 125.6, 125.1, 123.5, 122.4, 122.2, 118.0, 116.4, 110.4, 109.9, 109.0, 89.8, 44.5, 40.3, 35.2, 20.8, 14.2, 12.4.

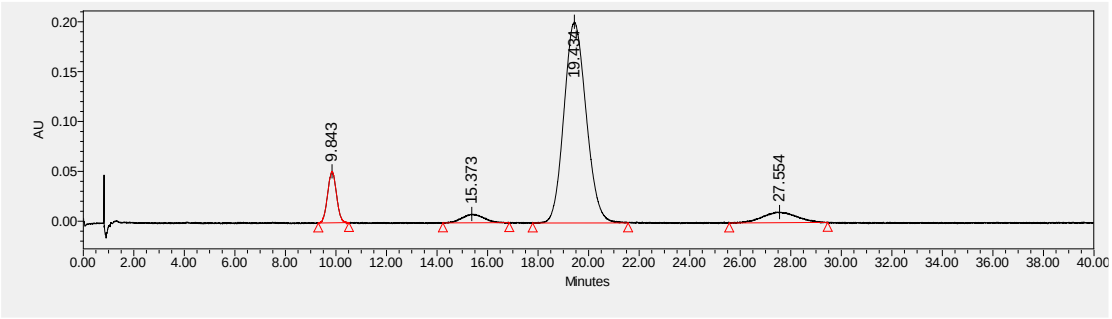
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{40}H_{34}N_2O_5Na^+]$: 645.2360 found 645.2360.

IR (neat) 3333, 3061, 2933, 1728, 1688, 1608, 1578, 1477, 1368, 1198, 1141, 1043, 747, 694 cm^{-1}.



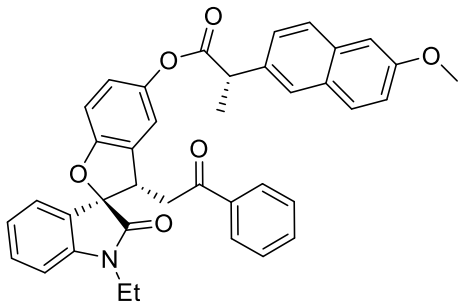
	Retention Time	Area	% Area
1	9.764	577991	17.81

2	15.339	1031704	31.80
3	19.490	621559	19.16
4	27.420	1013310	31.23



	Retention Time	Area	% Area
1	9.843	1253345	8.34
2	15.373	514301	3.42
3	19.434	12264987	81.62
4	27.554	994967	6.62

(2*R*,3*S*)-1'-ethyl-2'-oxo-3-(2-oxo-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-5-yl (*S*)-2-(6-methoxynaphthalen-2-yl)propanoate (C49):



White solid, 85% yield, >19:1 dr, m.p. 148-151 °C, $[\alpha]_D^{20}$ = 6.1 (c = 0.58, in CH_2Cl_2). Reacted for 84 h.

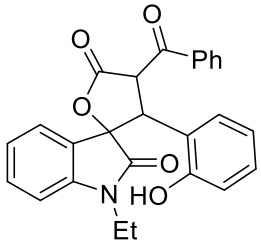
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.81 – 7.72 (m, 3H), 7.61 – 7.55 (m, 2H), 7.51 (dd, *J* = 8.5, 1.8 Hz, 1H), 7.45 (t, *J* = 7.4 Hz, 1H), 7.30 (t, *J* = 7.7 Hz, 2H), 7.19 – 7.08 (m, 3H), 7.04 (d, *J* = 7.4 Hz, 1H), 6.90 – 6.67 (m, 5H), 4.60 (dd, *J* = 10.2, 4.7 Hz, 1H), 4.10 (q, *J* = 7.1 Hz, 1H), 3.95 – 3.88 (m, 4H), 3.77 – 3.67 (m, 1H), 3.49 – 3.28 (m, 2H), 1.70 (d, *J* = 7.1 Hz, 3H), 1.36 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 196.7, 174.7, 173.8, 157.9, 156.3, 145.3, 143.6, 136.1, 135.3, 134.0, 133.2, 130.7, 129.8, 129.5, 129.1, 128.5, 127.7, 127.5, 126.3, 126.3, 125.5, 124.9, 122.1, 121.7, 119.3, 117.4, 110.2, 109.0, 105.7, 89.7, 55.5, 45.7, 44.4, 40.2, 35.1, 18.7, 12.4.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{39}H_{33}NO_6Na^+]$: 634.2200 found 634.2194.

IR (neat) 3058, 2978, 2935, 1727, 1683, 1607, 1477, 1369, 1207, 1143, 996, 898, 751, 693 cm^{-1}.

4-benzoyl-1'-ethyl-3-(2-hydroxyphenyl)-3,4-dihydro-5H-spiro[furan-2,3'-indoline]-2',5-dione (Int2)



White solid.

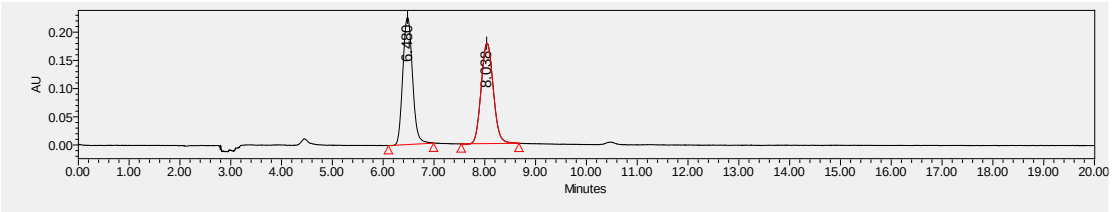
SFC Daicel Chiralcel OJH, CO_2/MeOH = 80/20, 1.0 mL/min, λ = 240 nm, t_1 = 6.48 min, t_2 = 8.04 min.

^{1}H NMR (400 MHz, Acetone-d_6) δ 8.25 (s, 1H), 8.04 – 7.98 (m, 2H), 7.65 – 7.61 (m, 1H), 7.60 – 7.54 (m, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 7.29 – 7.23 (m, 2H), 7.08 – 7.01 (m, 1H), 6.84 (td, *J* = 8.1, 1.6 Hz, 1H), 6.78 (d, *J* = 7.9 Hz, 1H), 6.61 – 6.54 (m, 1H), 6.48 (dd, *J* = 8.1, 0.9 Hz, 1H), 5.97 (d, *J* = 12.8 Hz, 1H), 5.37 (d, *J* = 12.8 Hz, 1H), 3.54 (dq, *J* = 14.5, 7.3 Hz, 1H), 3.29 (dq, *J* = 14.2, 7.1 Hz, 1H), 0.68 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, Acetone-d_6) δ 193.9, 173.6, 172.2, 156.8, 144.4, 137.3, 135.0, 132.0, 130.2, 129.9, 129.8, 129.2, 126.7, 125.3, 123.8, 120.2, 118.7, 116.2, 109.6, 86.1, 52.0, 46.3, 35.0, 12.4.

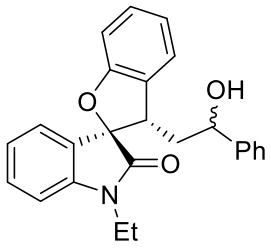
HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{26}H_{21}NO_5Na^+]$: 450.1312 found 450.1317.

IR (neat) 3369, 2976, 1785, 1709, 1613, 1461, 1377, 1267, 1164, 1024, 753, 681 cm^{-1}.



	Retention Time	Area	% Area
1	6.480	2991023	50.40
2	8.038	2943872	49.60

(2*R*,3*S*)-1'-ethyl-3-((*R*)-2-hydroxy-2-phenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (D1):



White solid, 90% yield, 99:1 er, 83:17 dr, m.p. 66-70 °C, $[\alpha]^{20}_{D}$ = 7.0 (c = 0.60, in CH_2Cl_2).

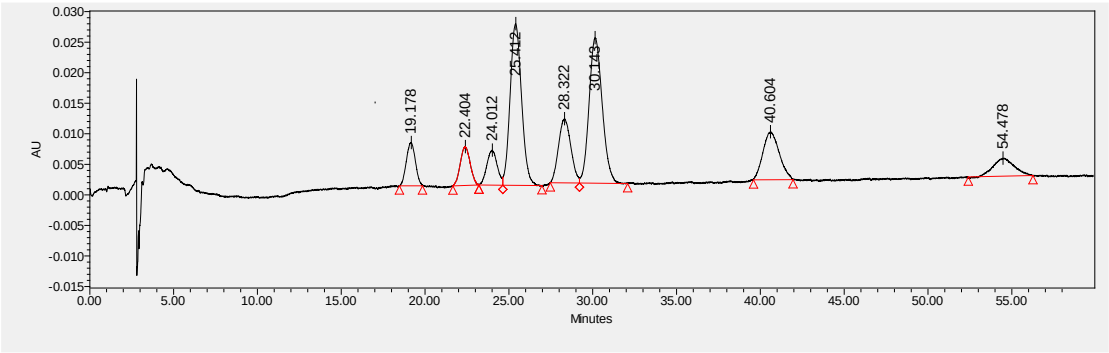
SFC Daicel Chiralcel OJH, CO_2/EtOH = 90/10, 1.0 mL/min, λ = 240 nm, t_1 = 22.13 min, t_2 = 25.16 min, t_3 = 29.59 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.43 – 7.27 (m, 2H), 7.26 – 6.81 (m, 11H), 4.58 – 4.39 (m, 1H), 4.14 – 4.02 (m, 1H), 3.91 – 3.70 (m, 2H), 2.24 – 2.16 (m, 1H), 2.06 – 1.86 (m, 2H), 1.30 (t, *J* = 7.2 Hz, 3H).

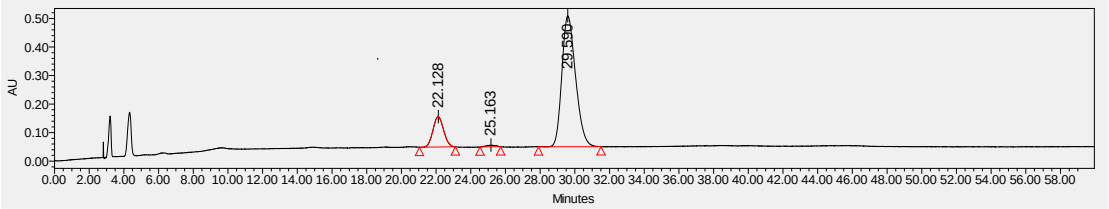
^{13}C NMR (101 MHz, Chloroform-*d*) δ 175.0, 158.5, 144.1, 143.3, 130.6, 130.1, 128.7, 128.7, 128.0, 125.9, 125.3, 124.2, 122.6, 121.3, 110.1, 109.0, 90.0, 73.1, 45.8, 39.7, 35.1, 12.7.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{23}NO_3Na^+]$: 408.1570 found 408.1564.

IR (neat) 3435, 3056, 2934, 1713, 1608, 1465, 1370, 1229, 1015, 861, 745, 698 cm^{-1}.

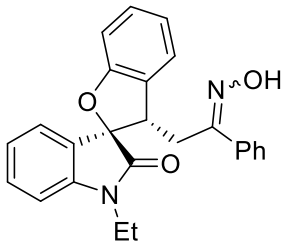


	Retention Time	Area	% Area
1	19.178	264495	5.69
2	22.404	260658	5.61
3	24.012	246708	5.31
4	25.412	1252172	26.95
5	28.322	534925	11.51
6	30.143	1296259	27.90
7	40.604	529350	11.39
8	54.478	261909	5.64



	Retention Time	Area	% Area
1	22.128	4525301	15.15
2	25.163	207892	0.70
3	29.590	25136544	84.15

(2*R*,3*S*)-5-chloro-1'-ethyl-3-((Z)-2-(hydroxyimino)-2-phenylethyl)-3H-spiro[benzofuran-2,3'-indolin]-2'-one (D2):



White solid, 88% yield, 99:1 er, Z/E = 4.9:1, m.p. 82-85 °C, $[\alpha]\ ^{20}_{D}$ = 8.9 (c = 0.71, in CH_2Cl_2).

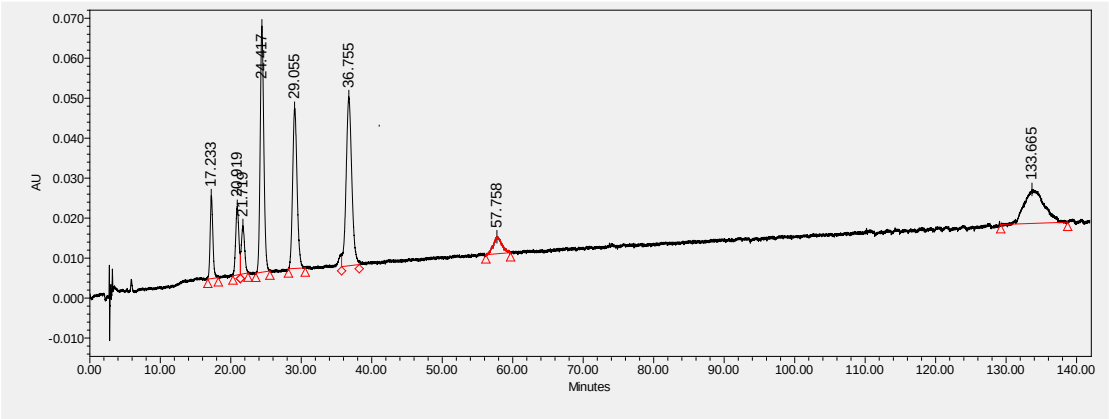
SFC Daicel Chiralcel OJH, CO_2/MeOH = 90/10, 1.5 mL/min, λ = 240 nm, t_1 = 20.83 min, t_2 = 24.35 min, t_3 = 36.63 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.94 (s, 1H), 7.34 – 7.26 (m, 1H), 7.25 – 6.60 (m, 12H), 4.61 – 4.56 (t, *J* = 7.4 Hz, 1H), 3.68 (dq, *J* = 14.4, 7.2, 6.8 Hz, 1H), 3.51 (dq, *J* = 14.3, 7.2 Hz, 1H), 3.26 (m, 1H), 2.87 – 2.66 (m, 1H), 1.34 – 1.17 (m, 3H).

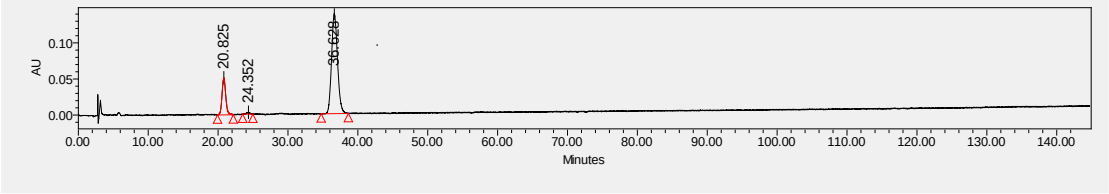
^{13}C NMR (101 MHz, Chloroform-*d*) δ 174.5, 158.6, 156.9, 143.0, 135.1, 130.8, 129.5, 129.2, 128.8, 128.5, 126.3, 125.2, 124.4, 122.7, 121.6, 110.1, 109.1, 89.4, 45.8, 35.1, 27.2, 12.6.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{25}H_{22}N_2O_3Na^+]$: 421.1523 found 421.1528.

IR (neat) 3317, 3055, 2933, 1712, 1608, 1467, 1371, 1228, 1105, 1107, 965, 937, 740, 695 cm^{-1}.

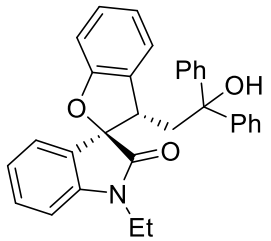


	Retention Time	Area	% Area
1	17.233	559778	5.72
2	20.919	547086	5.59
3	21.719	390734	3.99
4	24.417	2181019	22.28
5	29.055	1757932	17.96
6	36.755	2350539	24.02
7	57.758	354053	3.62
8	133.665	1645830	16.82



	Retention Time	Area	% Area
1	20.825	1893411	18.56
2	24.352	81663	0.80
3	36.628	8225112	80.64

(2*R*,3*S*)-1'-ethyl-3-(2-hydroxy-2,2-diphenylethyl)-3*H*-spiro[benzofuran-2,3'-indolin]-2'-one (D3):



Light green solid, 71% yield, 99:1 er, >19:1 dr, m.p. 79-84 °C, $[\alpha]^{21}_D$ = -79 (c = 0.55, in CH_2Cl_2).

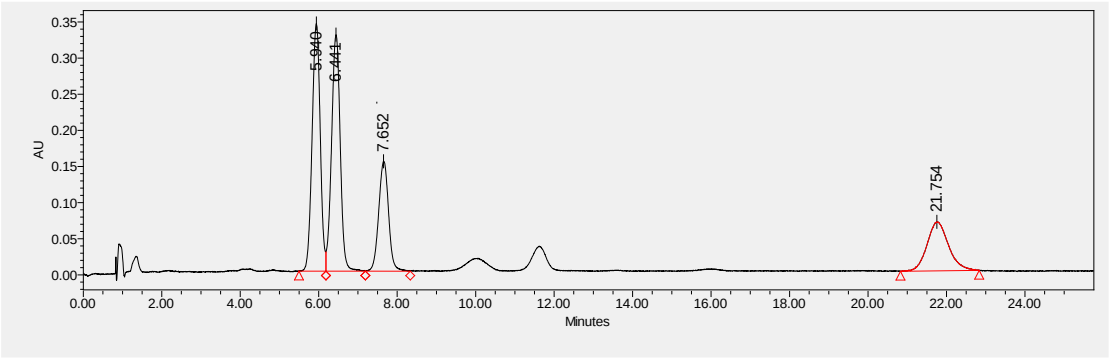
SFC Daicel Chiralcel OX-3, CO_2/MeOH = 85/15, 1.5 mL/min, λ = 240 nm, t_1 = 5.95 min, t_2 = 6.47 min, t_3 = 7.60 min, t_4 = 21.88 min.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.39 – 7.29 (m, 5H), 7.23 – 7.16 (m, 4H), 7.16 – 7.08 (m, 5H), 6.97 – 6.90 (m, 2H), 6.86 (d, *J* = 7.8 Hz, 1H), 6.78 (d, *J* = 7.8 Hz, 1H), 4.02 (d, *J* = 8.5 Hz, 1H), 3.89 – 3.80 (m, 1H), 3.75 – 3.66 (m, 1H), 2.93 (dd, *J* = 14.8, 2.3 Hz, 1H), 2.72 (dd, *J* = 14.8, 8.7 Hz, 1H), 1.33 (t, *J* = 7.2 Hz, 3H).

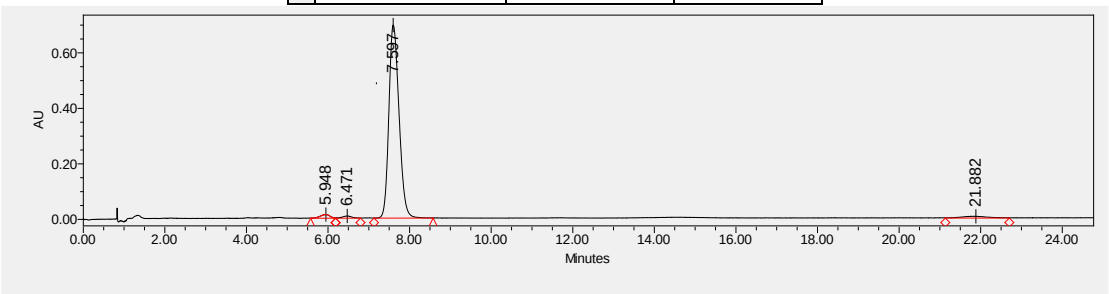
^{13}C NMR (101 MHz, Chloroform-*d*) δ 174.4, 158.2, 147.4, 145.2, 143.6, 130.7, 130.6, 128.6, 128.5, 127.5, 127.2, 127.1, 126.2, 126.1, 125.1, 123.9, 122.5, 121.2, 109.9, 108.9, 90.7, 78.1, 43.8, 42.1, 35.1, 12.7.

HRMS (ESI) m/z: $[M + Na]^+$ Calculated for $[C_{31}H_{27}NO_3Na^+]$: 484.1883 found 484.1883.

IR (neat) 3464, 3056, 2933, 1722, 1608, 1469, 1371, 1233, 1102, 748, 700 cm^{-1}.



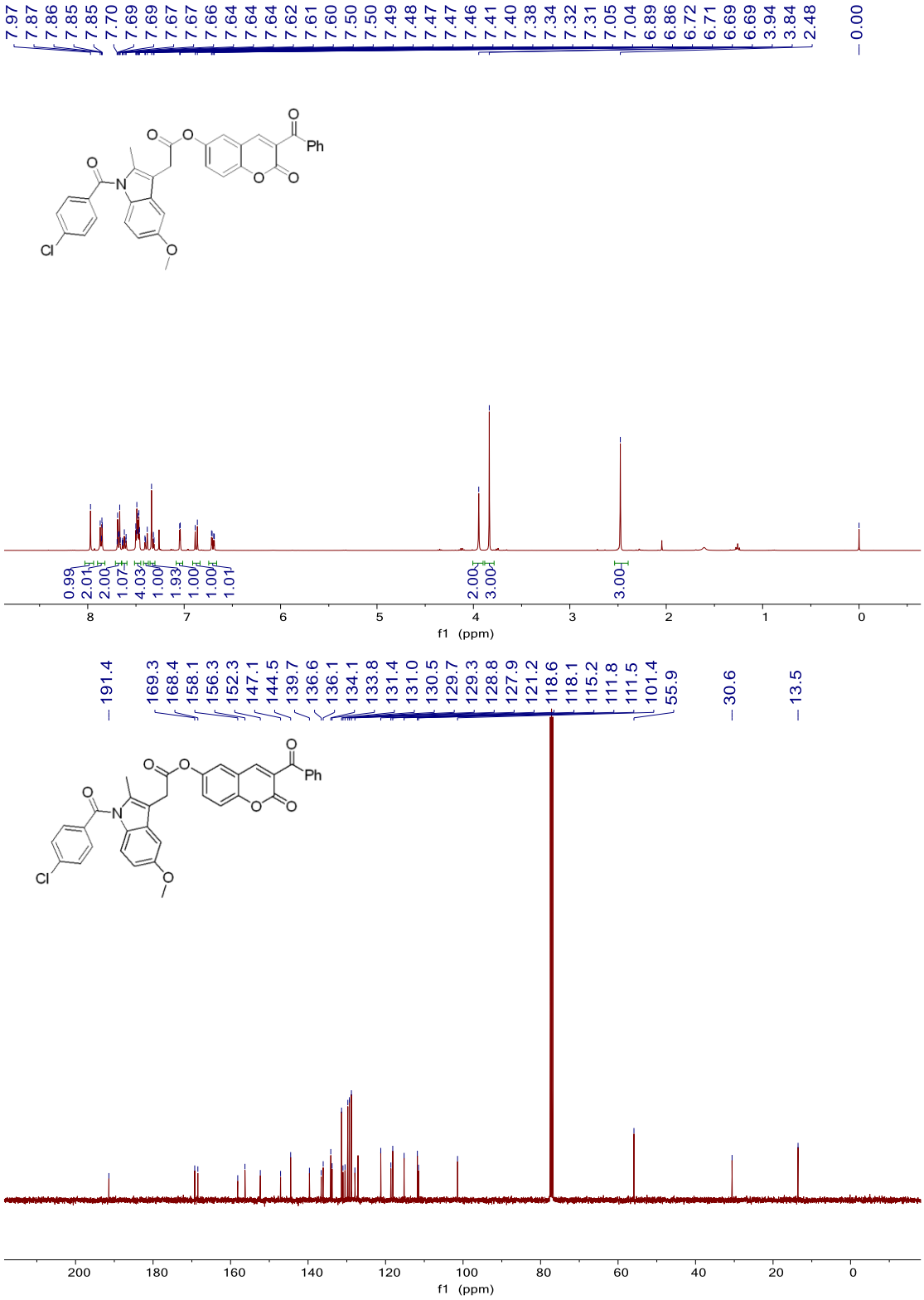
	Retention Time	Area	% Area
1	5.940	4933895	32.49
2	6.441	5018744	33.05
3	7.652	2657007	17.50
4	21.754	2576231	16.96



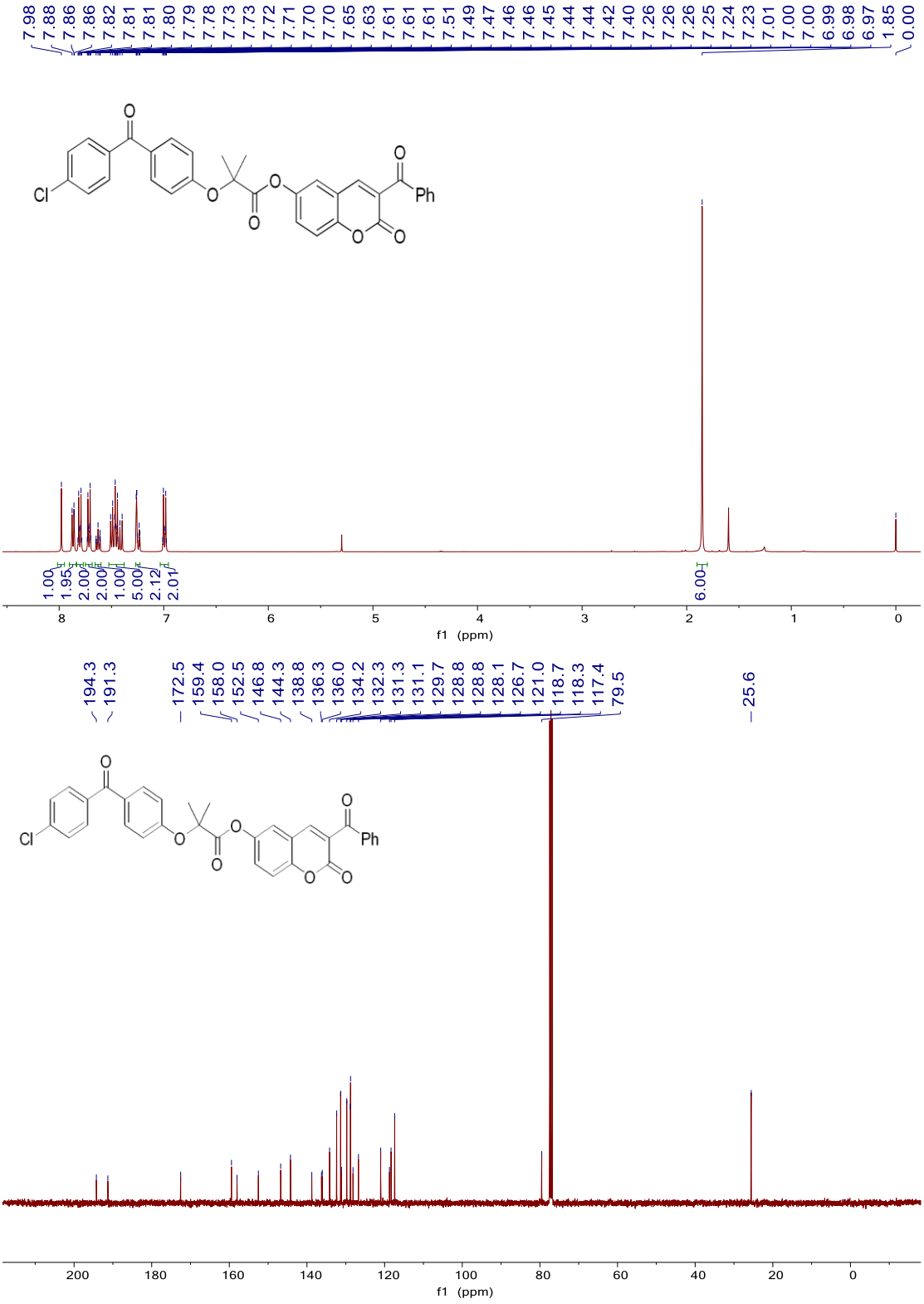
	Retention Time	Area	% Area
1	5.948	222463	1.75
2	6.471	130380	1.03
3	7.597	12039730	94.97
4	21.882	284328	2.24

9. Copies of ^{1}H, ^{13}C and ^{19}F NMR spectra of the products

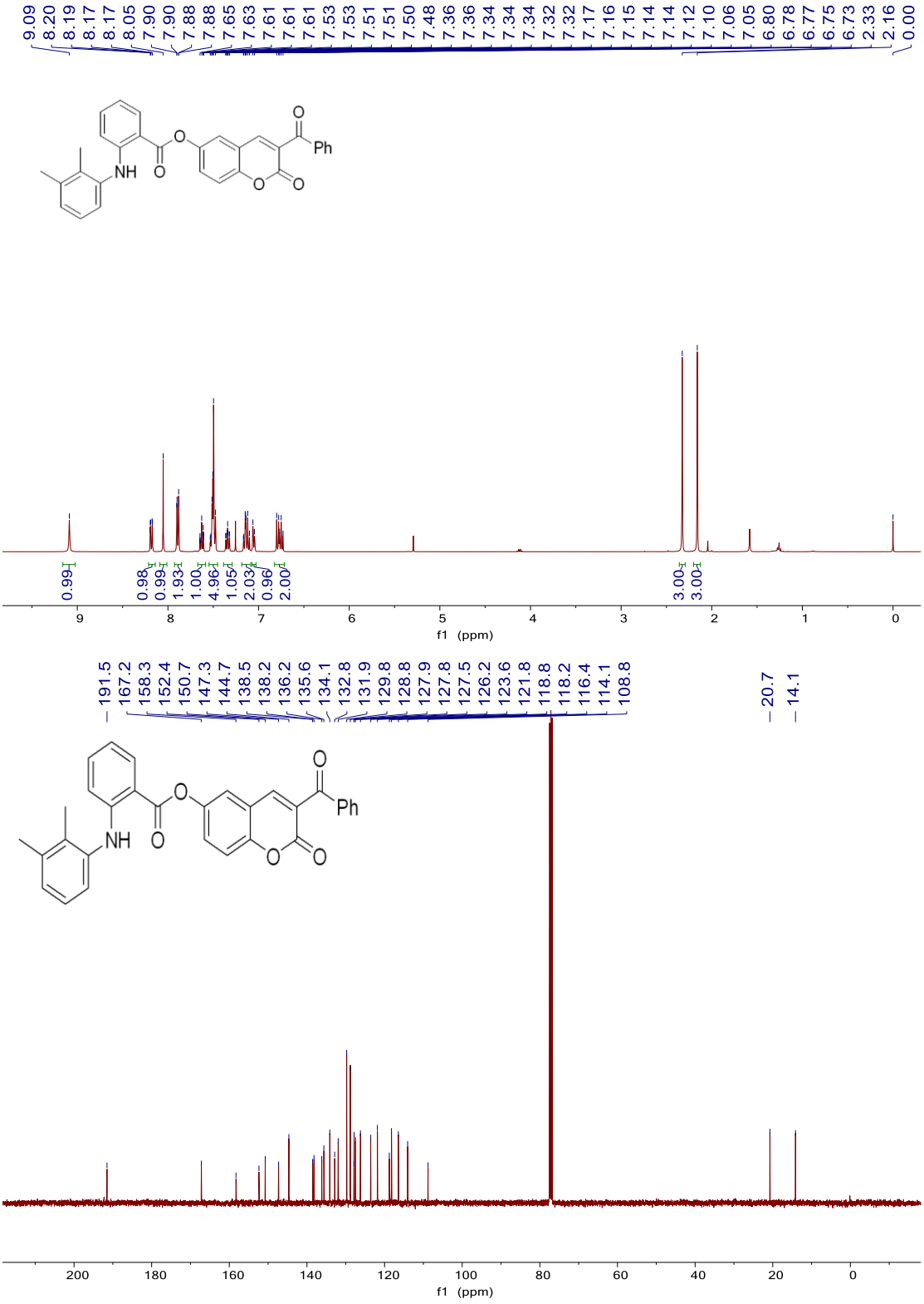
B26



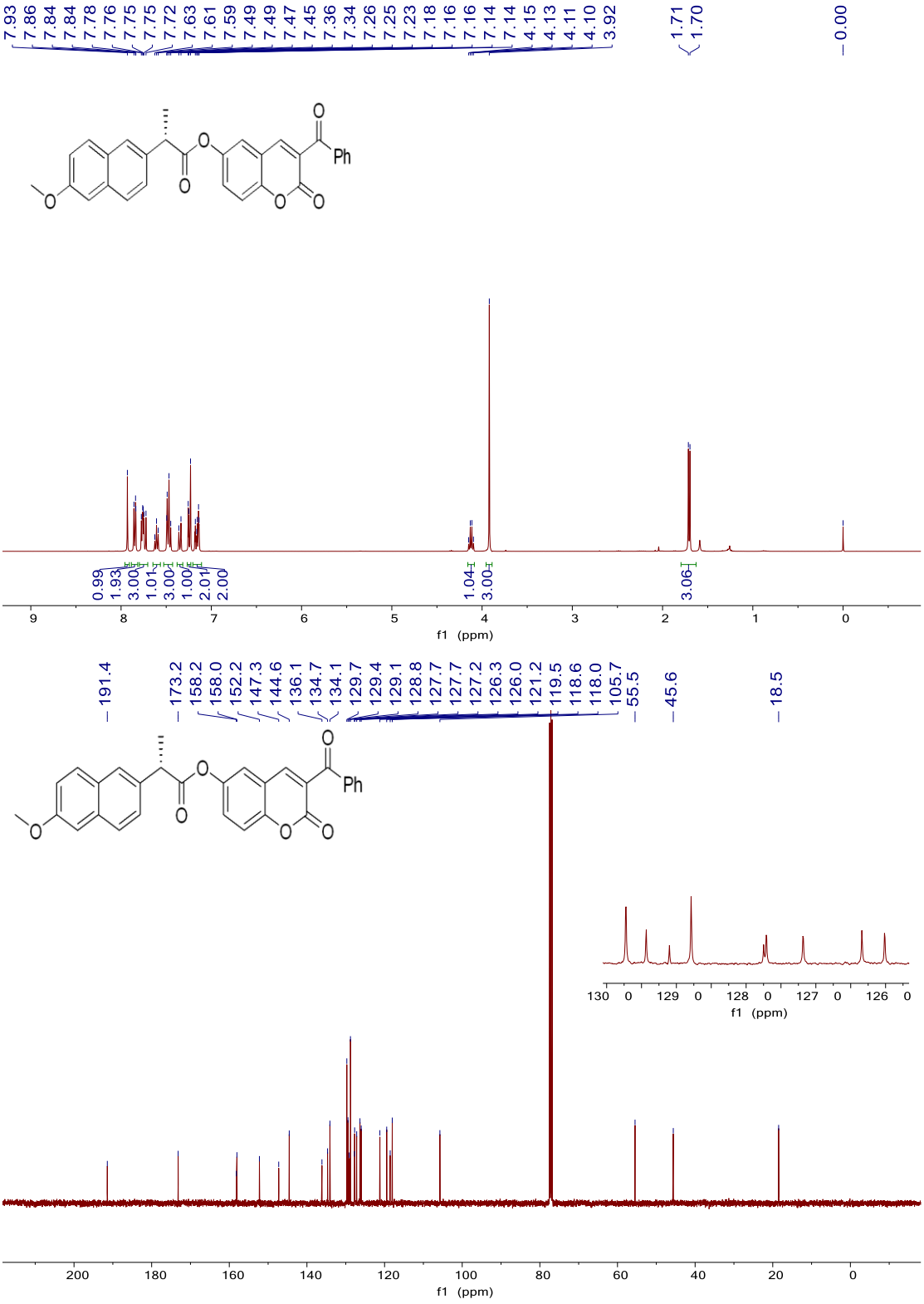
B27


7.98 7.88 7.86 7.86 7.82 7.81 7.81 7.80 7.79 7.78 7.73 7.73 7.72 7.71 7.70 7.70 7.65 7.63 7.61 7.61 7.61 7.51 7.49 7.47 7.46 7.46 7.45 7.44 7.44 7.42 7.40 7.26 7.26 7.25 7.24 7.23 7.01 7.00 7.00 6.99 6.98 6.97 1.85 0.00
Cl
O
Ph
1.00 1.95 2.00 2.00 1.00 5.00 2.12 2.01 6.00
f1 (ppm)
194.3 191.3 172.5 159.4 158.0 152.5 146.8 144.3 138.8 136.3 136.0 134.2 132.3 131.3 131.1 129.7 128.8 128.8 128.1 126.7 121.0 118.7 118.3 117.4 79.5 25.6
f1 (ppm)

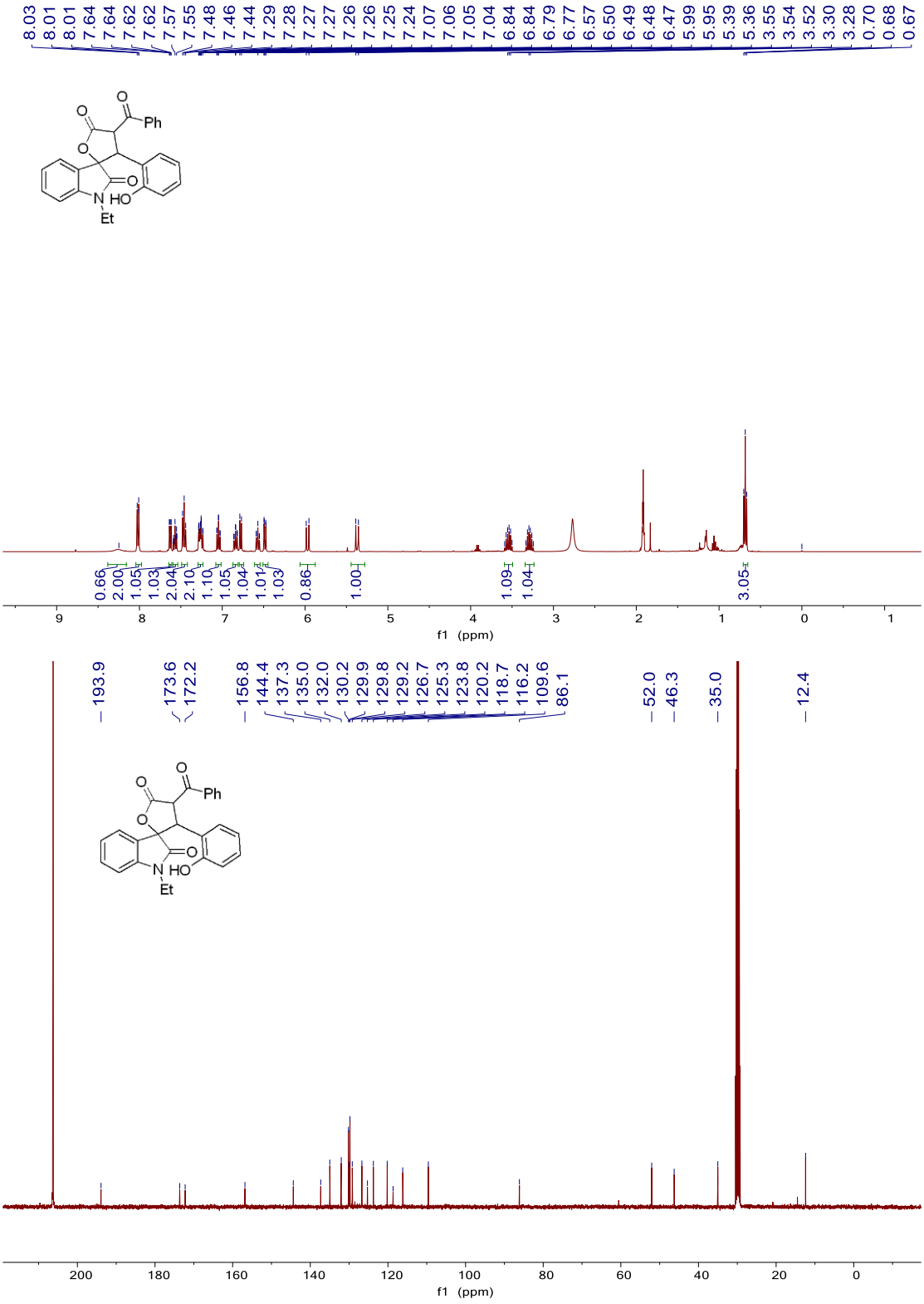
B28


9.09 8.20 8.19 8.17 8.17 8.05 7.90 7.90 7.88 7.88 7.65 7.63 7.61 7.61 7.61 7.53 7.53 7.51 7.51 7.50 7.48 7.36 7.36 7.34 7.34 7.34 7.32 7.32 7.17 7.16 7.15 7.14 7.14 7.12 7.10 7.06 7.05 6.80 6.78 6.77 6.75 6.73 2.33 2.16 0.00
NH
O
Ph
0.99 0.98 0.99 1.93 1.00 4.96 1.05 2.03 0.96 2.00 3.00 3.00
f1 (ppm)
191.5 167.2 158.3 152.4 150.7 147.3 144.7 138.5 138.2 136.2 135.6 134.1 132.8 131.9 129.8 128.8 127.9 127.8 127.5 126.2 123.6 121.8 118.8 118.2 116.4 114.1 108.8
20.7 14.1
f1 (ppm)

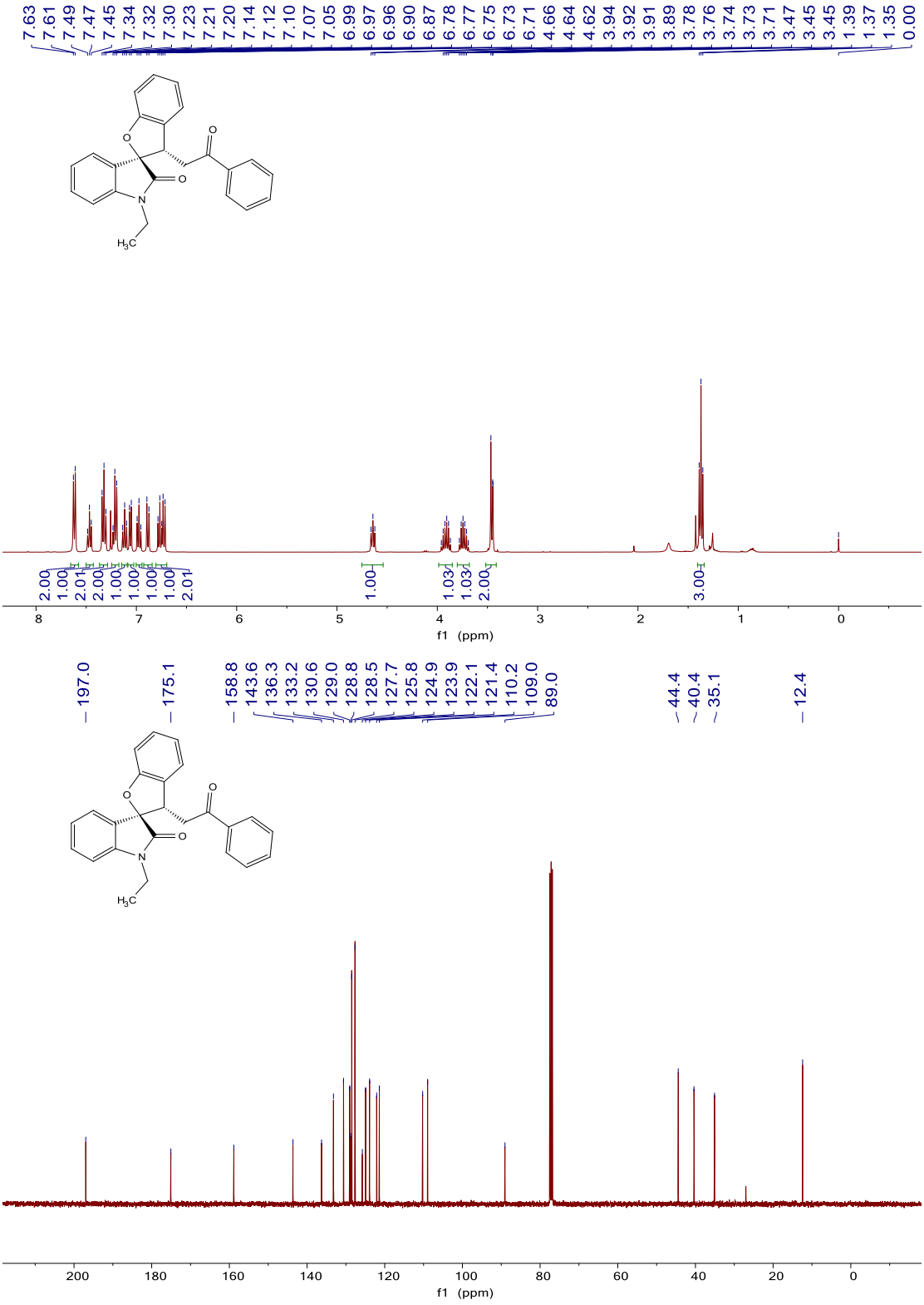
B29


7.93 7.86 7.84 7.84 7.78 7.76 7.75 7.75 7.72 7.63 7.61 7.59 7.49 7.49 7.47 7.45 7.36 7.34 7.26 7.25 7.23 7.18 7.16 7.16 7.14 7.14 4.15 4.13 4.11 4.10 3.92
1.71 1.70
0.00
Ph
0.99 1.93 3.00 1.01 3.00 1.00 2.01 2.00
1.04 3.00
3.06
f1 (ppm)
191.4 173.2 158.2 158.0 152.2 147.3 144.6 136.1 134.7 134.1 129.7 129.4 129.1 128.8 127.7 127.7 127.2 126.3 126.0 121.2 119.5 118.6 118.0 105.7 55.5 45.6 18.5
Ph
130 0 129 0 128 0 127 0 126 0
f1 (ppm)
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

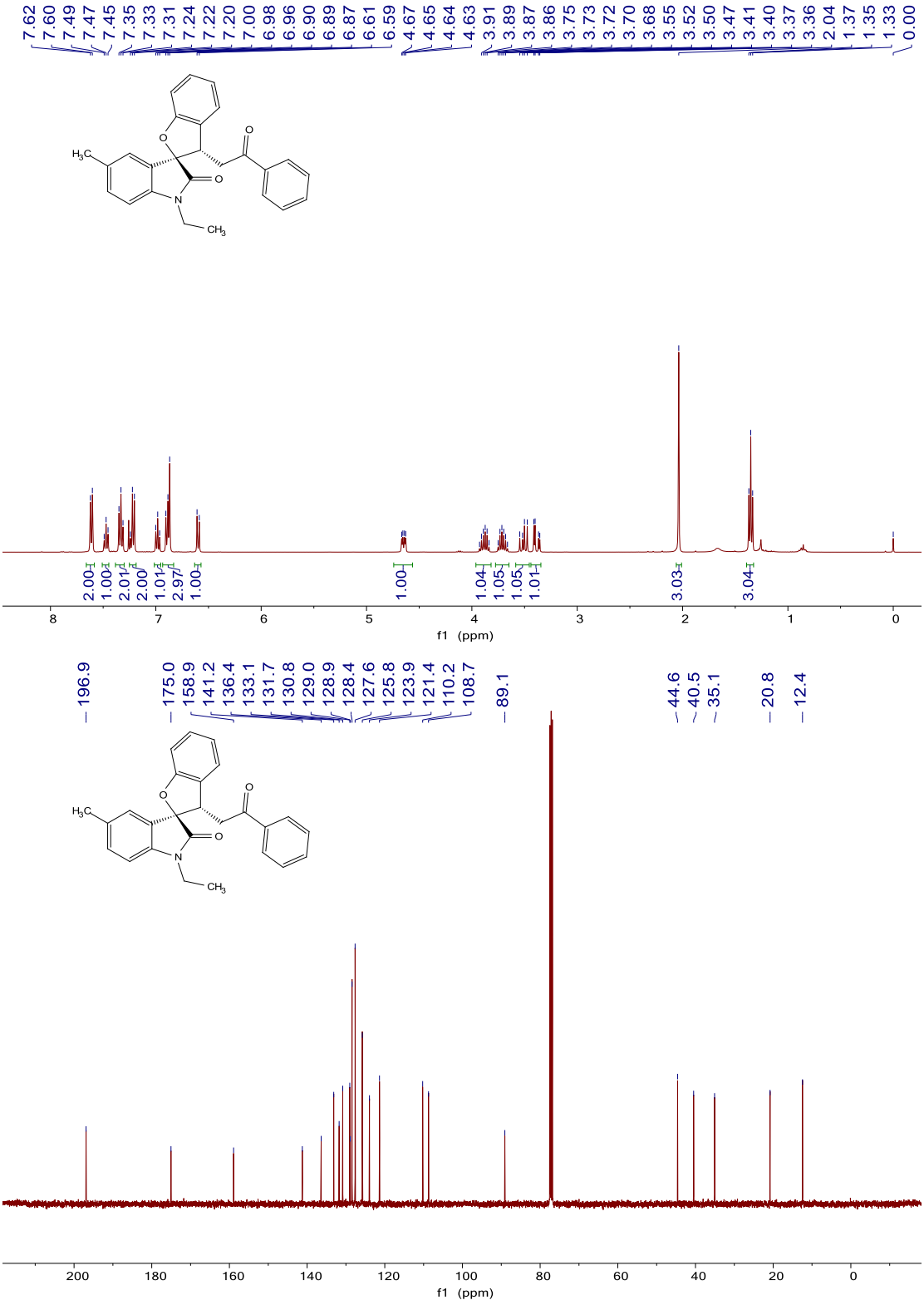
Int2


8.03 8.01 8.01 7.64 7.64 7.62 7.62 7.57 7.55 7.48 7.46 7.44 7.29 7.28 7.27 7.27 7.26 7.26 7.25 7.24 7.07 7.06 7.05 7.04 6.84 6.84 6.79 6.77 6.57 6.50 6.49 6.48 6.47 5.99 5.95 5.39 5.36 3.55 3.54 3.52 3.30 3.28 0.70 0.68 0.67
O
O
Ph
O
O
N
HO
Et
0.66 2.00 1.05 1.03 2.04 2.10 1.10 1.05 1.04 1.01 1.03 0.86 1.00 1.09 1.04 3.05
9 8 7 6 5 4 3 2 1 0 1
f1 (ppm)
193.9 173.6 172.2 156.8 144.4 137.3 135.0 132.0 130.2 129.9 129.8 129.2 126.7 125.3 123.8 120.2 118.7 116.2 109.6 86.1 52.0 46.3 35.0 12.4
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

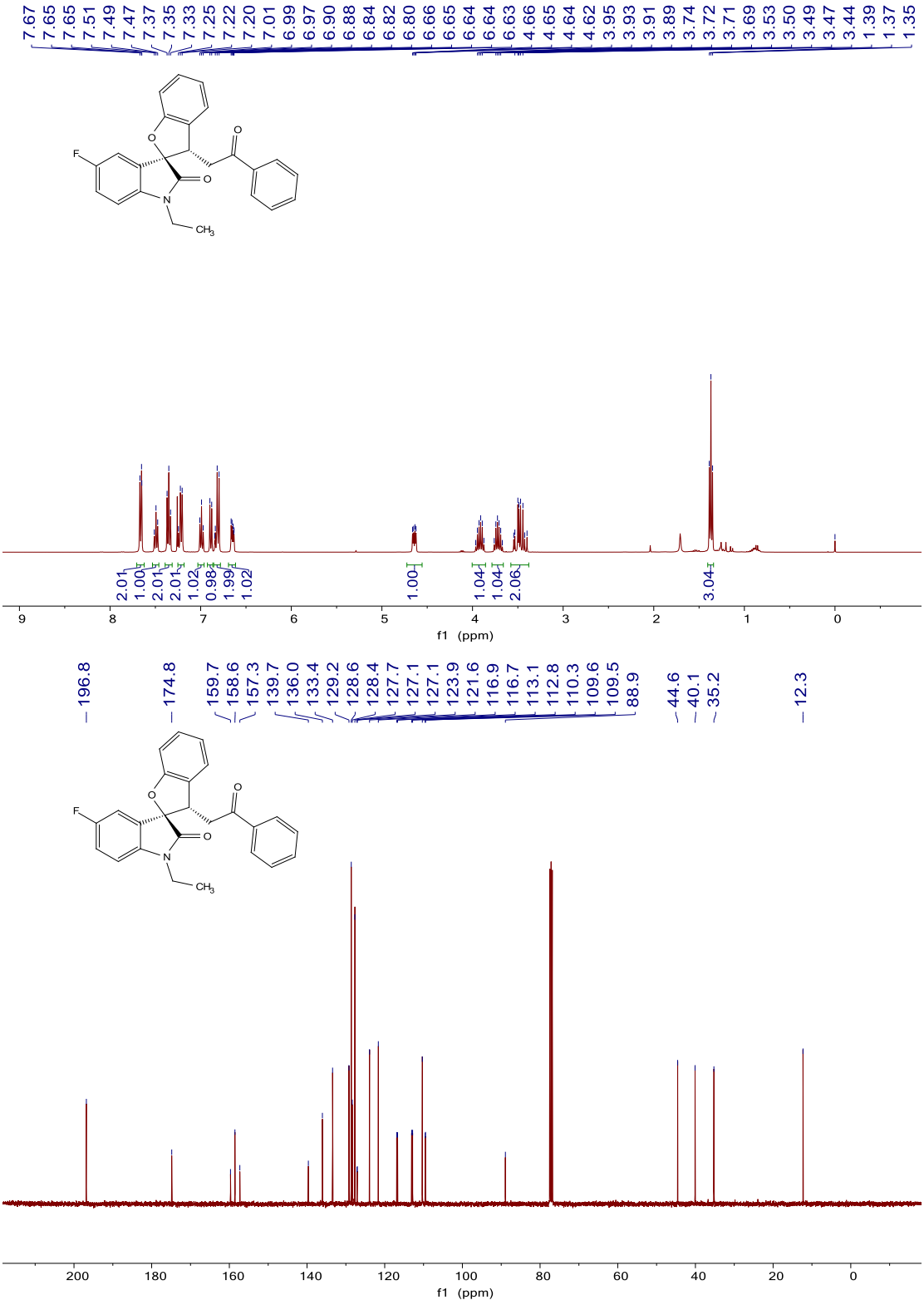
C1

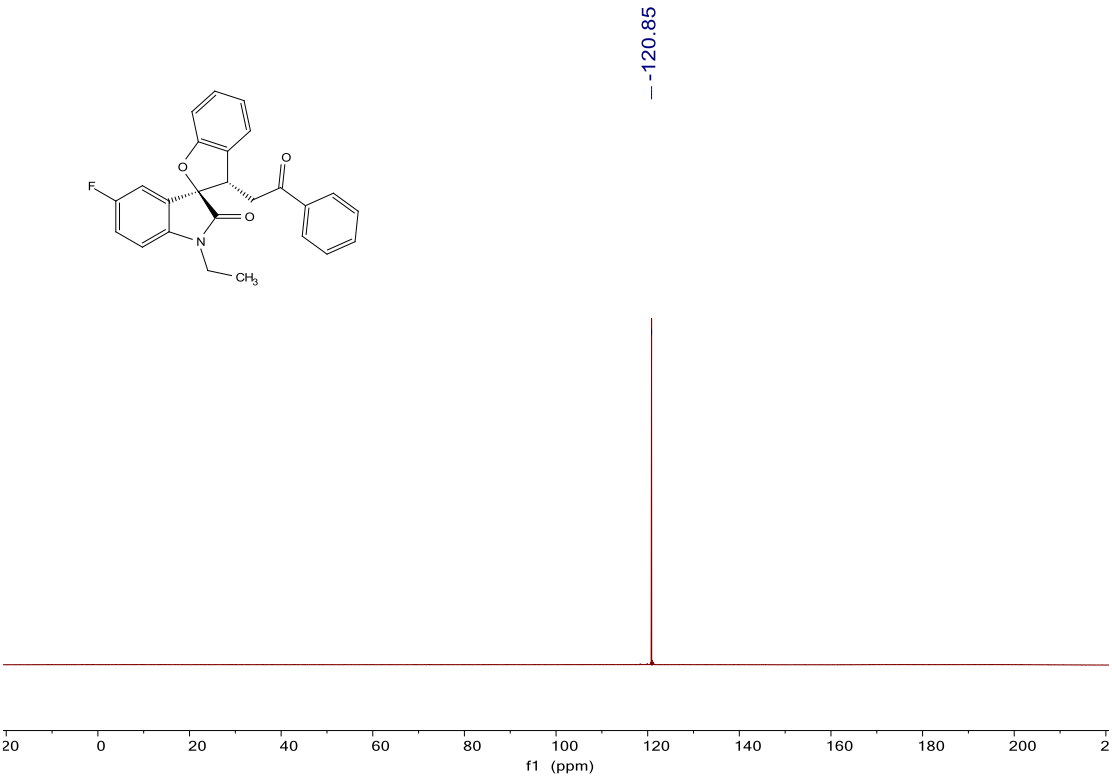

7.63 7.61 7.49 7.47 7.45 7.34 7.32 7.30 7.23 7.21 7.20 7.14 7.12 7.10 7.07 7.05 6.99 6.97 6.96 6.90 6.87 6.78 6.77 6.75 6.73 6.71 4.66 4.64 4.62 3.94 3.92 3.91 3.89 3.78 3.76 3.74 3.73 3.71 3.47 3.45 1.39 1.37 1.35 0.00
O
O
O
N
H3C
2.00 1.00 2.01 2.00 1.00 1.00 1.00 1.00 2.01
1.00
1.03 1.03 2.00
3.00
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 175.1 158.8 143.6 136.3 133.2 130.6 129.0 128.8 128.5 127.7 125.8 124.9 123.9 122.1 121.4 110.2 109.0 89.0
44.4 40.4 35.1
12.4
O
O
O
N
H3C
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

C2

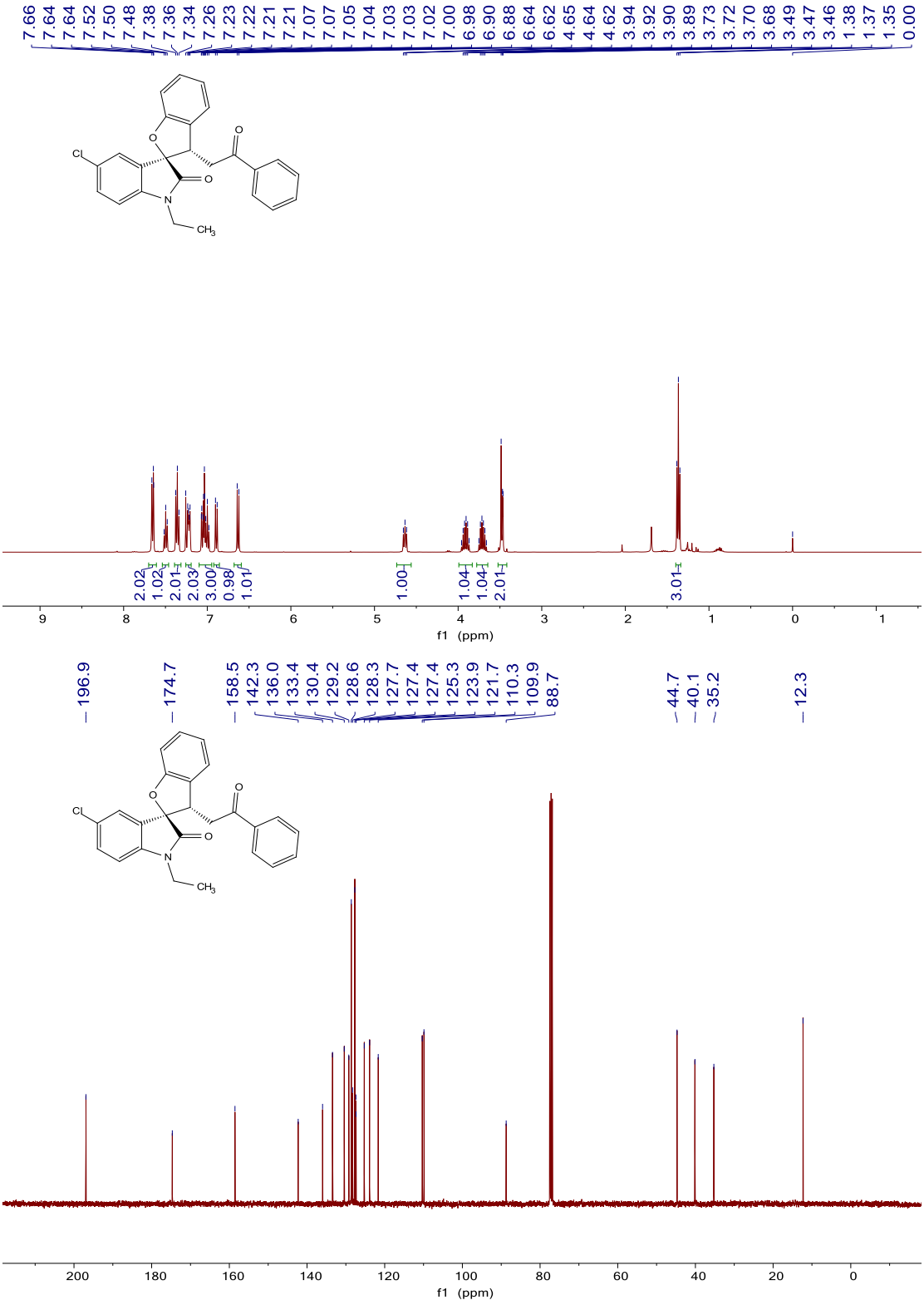

7.62 7.60 7.49 7.47 7.45 7.35 7.33 7.31 7.24 7.22 7.20 7.00 6.98 6.96 6.90 6.89 6.87 6.61 6.59 4.67 4.65 4.64 4.63 3.91 3.89 3.87 3.86 3.75 3.73 3.72 3.70 3.68 3.55 3.52 3.50 3.47 3.41 3.40 3.37 3.36 2.04 1.37 1.35 1.33 0.00
2.00 1.00 2.01 2.00 1.01 2.97 1.00 1.00 1.04 1.05 1.05 1.01 3.03 3.04
f1 (ppm)
196.9 175.0 158.9 141.2 136.4 133.1 131.7 130.8 129.0 128.9 128.4 127.6 125.8 123.9 121.4 110.2 108.7 89.1 44.6 40.5 35.1 20.8 12.4
f1 (ppm)

C3

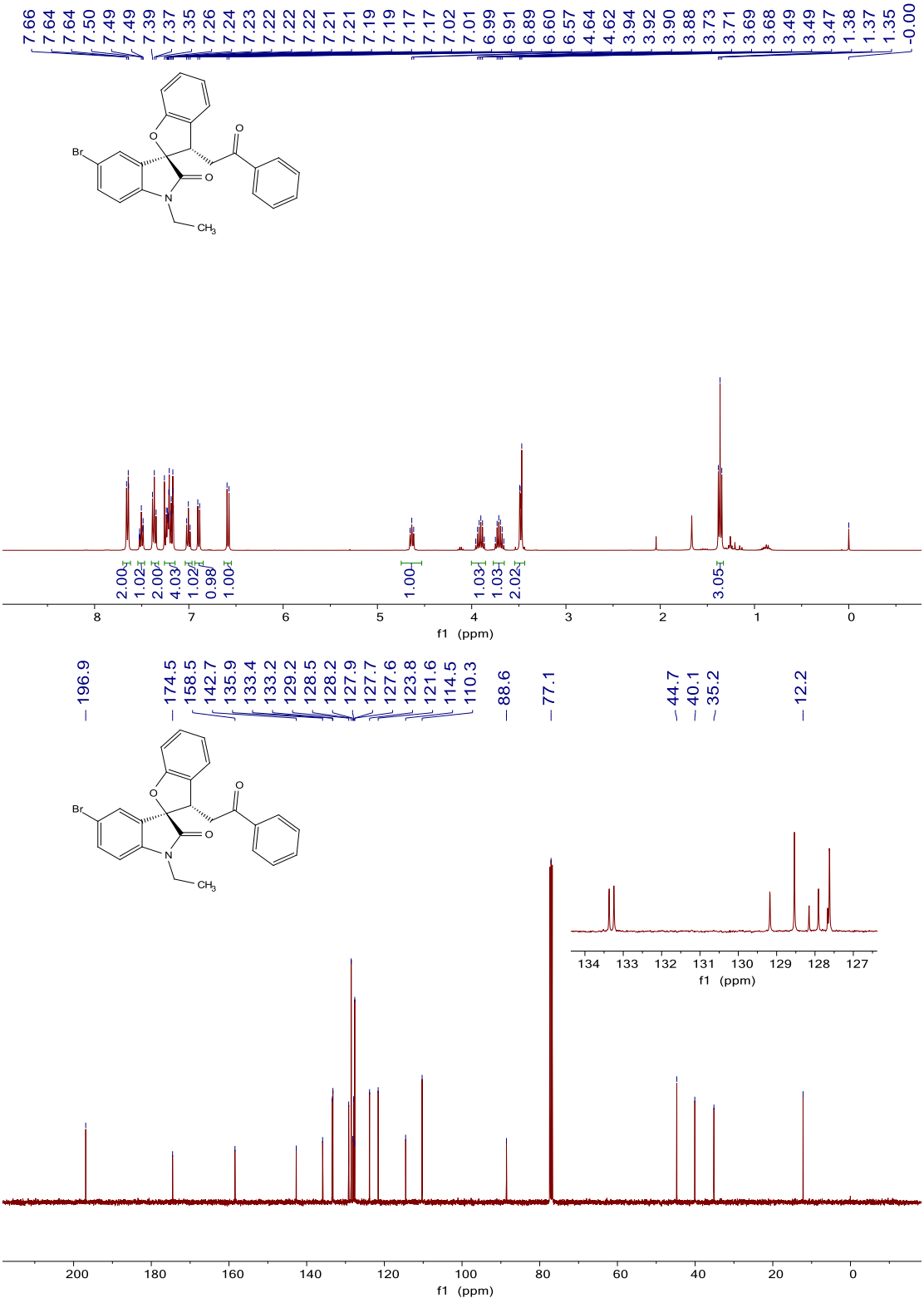

7.67 7.65 7.65 7.51 7.49 7.47 7.37 7.35 7.33 7.25 7.22 7.20 7.01 6.99 6.97 6.90 6.88 6.84 6.82 6.80 6.66 6.65 6.64 6.64 6.63 4.66 4.65 4.64 4.62 3.95 3.93 3.91 3.89 3.74 3.72 3.71 3.69 3.53 3.50 3.49 3.47 3.44 1.39 1.37 1.35
F
O
O
O
N
CH3
2.01 1.00 2.01 2.01 1.02 0.98 1.99 1.02 1.00 1.04 1.04 2.06 3.04
f1 (ppm)
196.8 174.8 159.7 158.6 157.3 139.7 136.0 133.4 129.2 128.6 128.4 127.7 127.1 127.1 123.9 121.6 116.9 116.7 113.1 112.8 110.3 109.6 109.5 88.9 44.6 40.1 35.2 12.3
f1 (ppm)


-120.85
F
O
O
O
N
CH3
20
0
20
40
60
80
100
120
140
160
180
200
2
f1 (ppm)

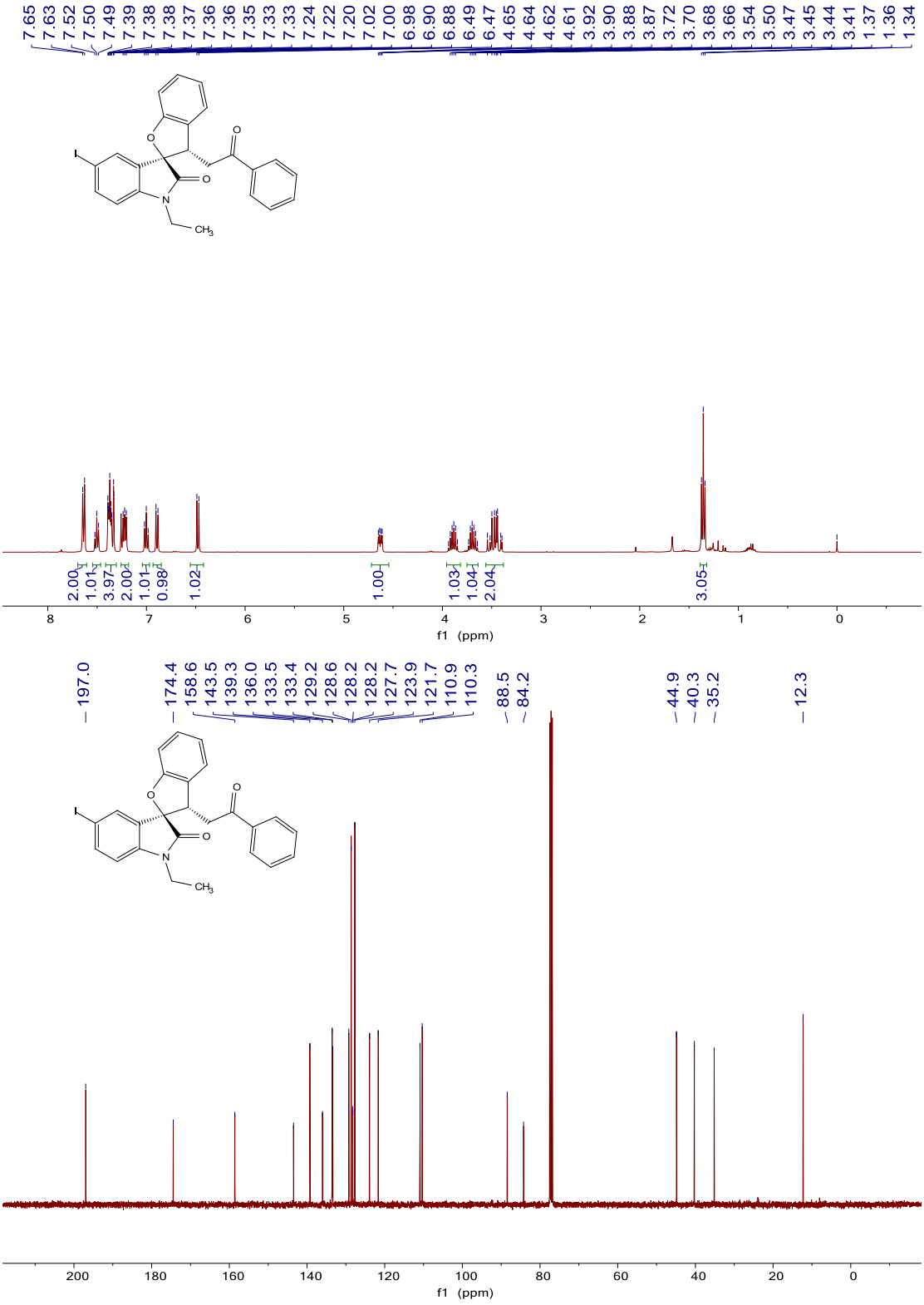
C4


7.66 7.64 7.64 7.52 7.50 7.48 7.38 7.36 7.34 7.26 7.23 7.22 7.21 7.21 7.07 7.07 7.05 7.04 7.03 7.03 7.02 7.00 6.98 6.90 6.88 6.64 6.62 4.65 4.64 4.62 3.94 3.92 3.90 3.89 3.73 3.72 3.70 3.68 3.49 3.47 3.46 1.38 1.37 1.35 0.00
Cl
O
O
O
N
CH3
2.02 1.02 2.01 2.03 3.00 0.98 1.01 1.00 1.04 1.04 2.01 3.01
f1 (ppm)
196.9 174.7 158.5 142.3 136.0 133.4 130.4 129.2 128.6 128.3 127.7 127.4 127.4 125.3 123.9 121.7 110.3 109.9 88.7 44.7 40.1 35.2 12.3
f1 (ppm)

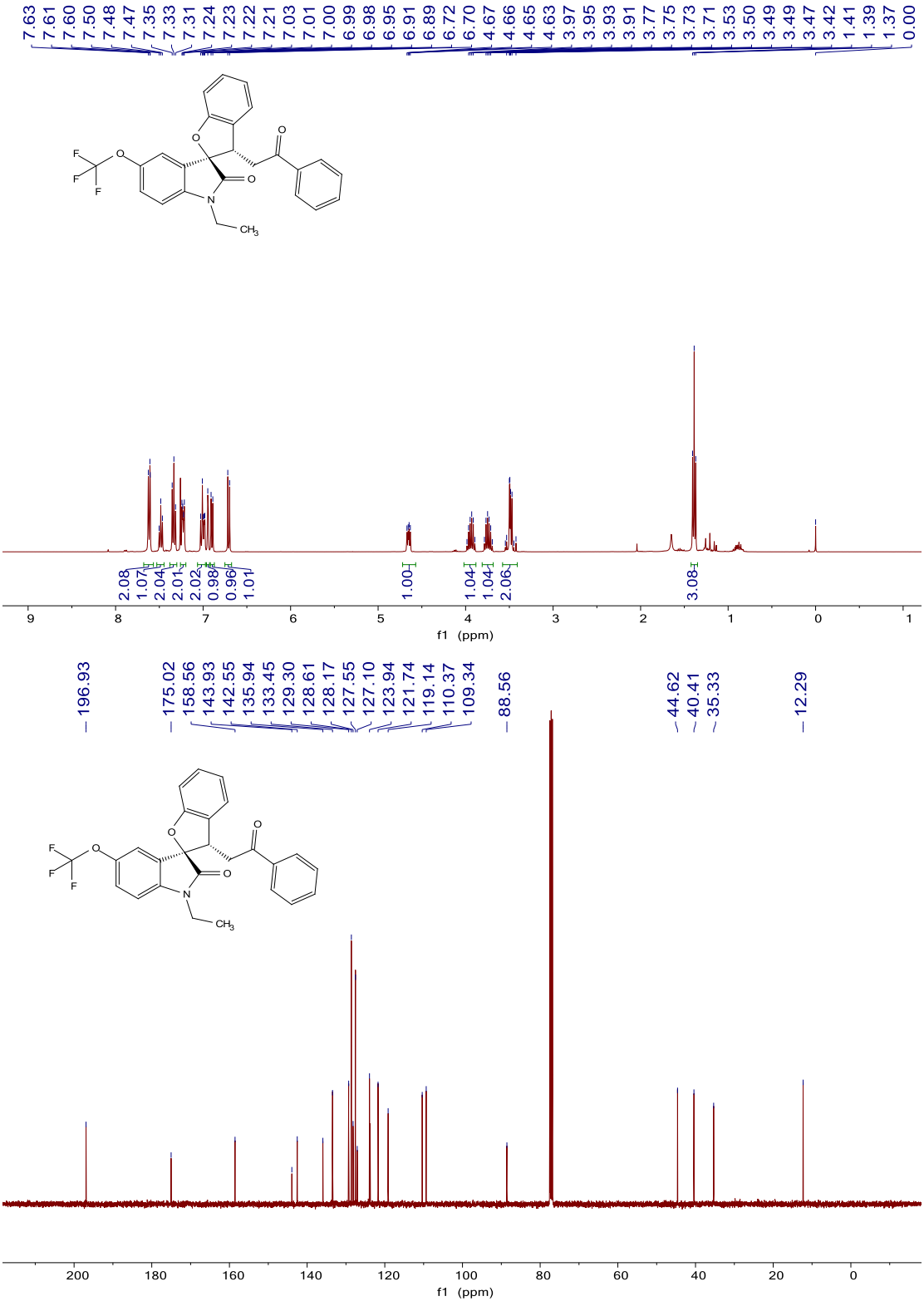
C5

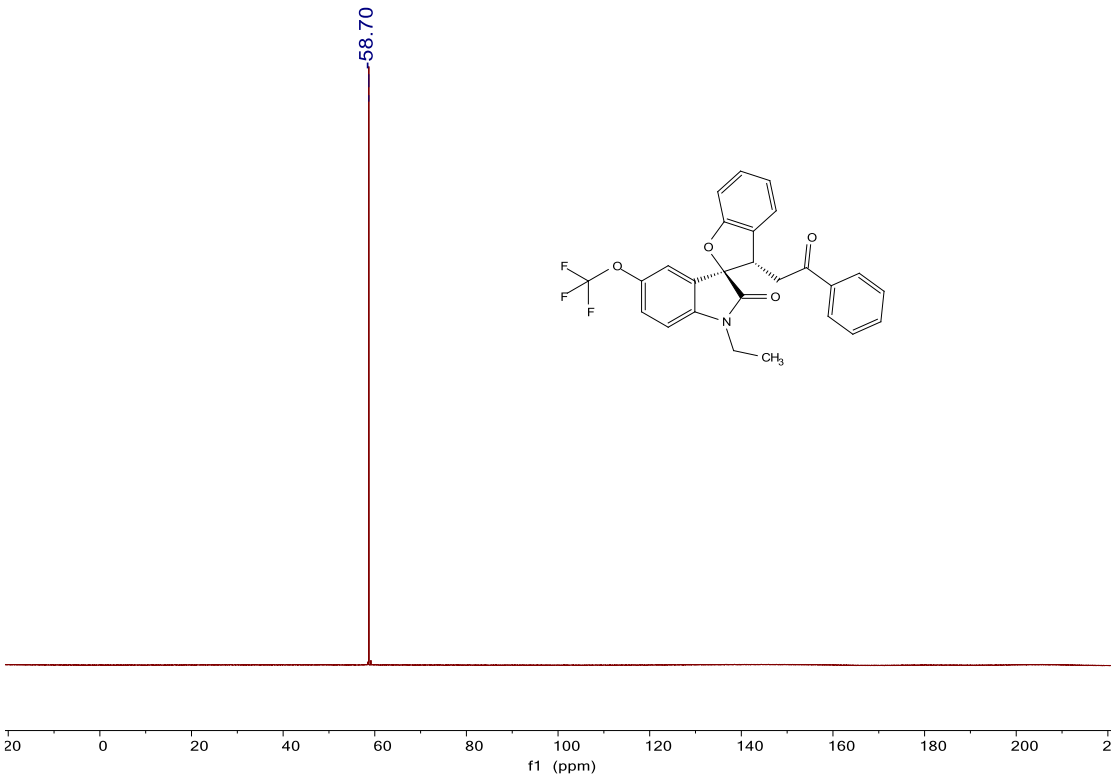

7.66 7.64 7.64 7.50 7.49 7.49 7.39 7.37 7.35 7.26 7.24 7.23 7.22 7.22 7.22 7.21 7.21 7.19 7.19 7.17 7.17 7.02 7.01 6.99 6.91 6.89 6.60 6.57 4.64 4.62 3.94 3.92 3.90 3.88 3.73 3.71 3.69 3.68 3.49 3.49 3.47 1.38 1.37 1.35 -0.00
Br
O
O
O
N
CH3
2.00 1.02 2.00 4.03 1.02 0.98 1.00 1.00 1.03 1.03 2.02 3.05
f1 (ppm)
196.9 174.5 158.5 142.7 135.9 133.4 133.2 129.2 128.5 128.2 127.9 127.7 127.6 123.8 121.6 114.5 110.3 88.6 77.1 44.7 40.1 35.2 12.2
f1 (ppm)
f1 (ppm)

C6

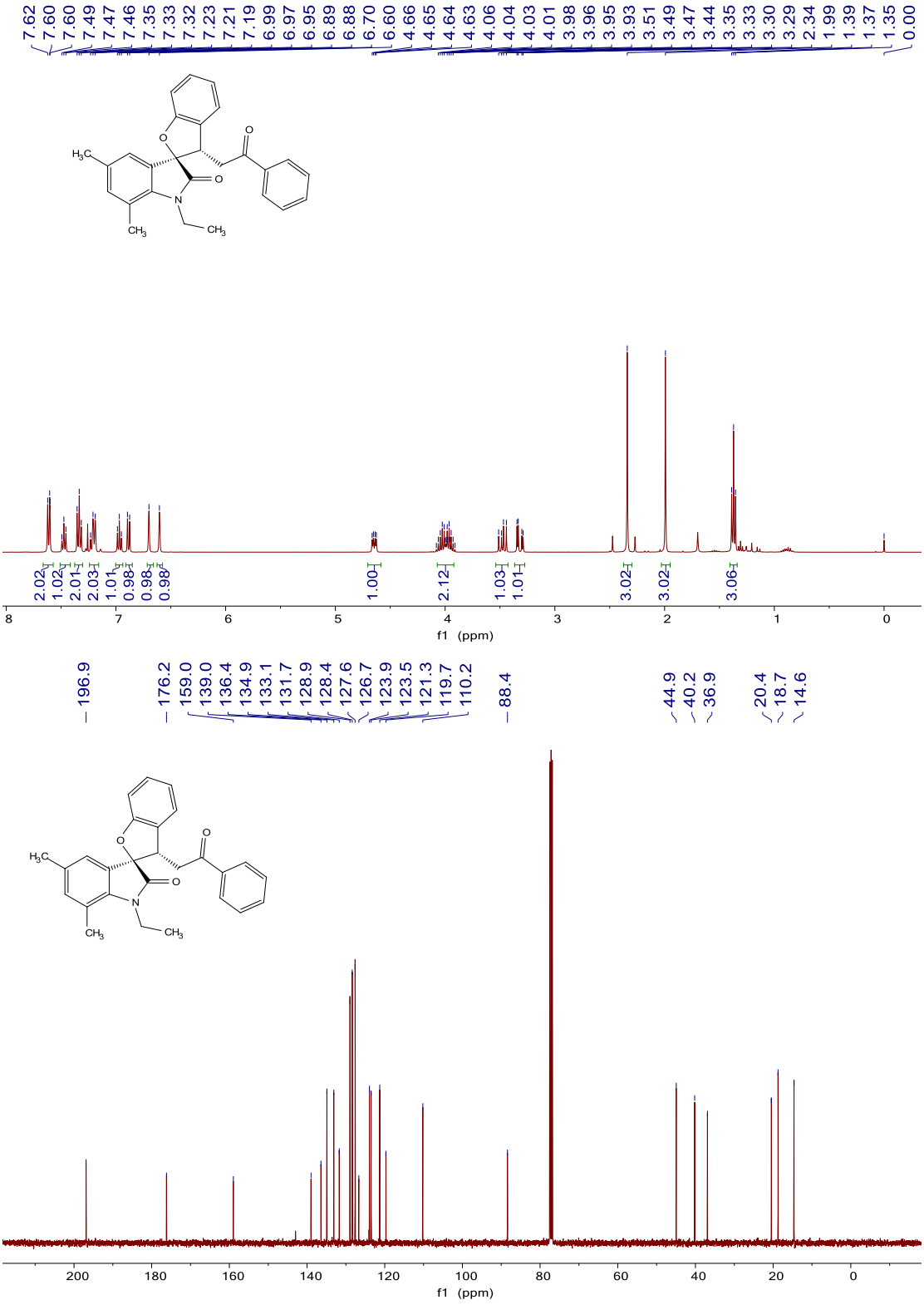

7.65 7.63 7.52 7.50 7.49 7.39 7.38 7.38 7.37 7.36 7.36 7.35 7.33 7.33 7.24 7.22 7.20 7.02 7.00 6.98 6.90 6.88 6.49 6.47 4.65 4.64 4.62 4.61 3.92 3.90 3.88 3.87 3.72 3.70 3.68 3.66 3.54 3.50 3.47 3.45 3.44 3.41 1.37 1.36 1.34
O
O
I
O
N
CH3
2.00 1.01 3.97 2.00 1.01 0.98 1.02 1.00 1.03 1.04 2.04 3.05
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 174.4 158.6 143.5 139.3 136.0 133.5 133.4 129.2 128.6 128.2 128.2 127.7 123.9 121.7 110.9 110.3 88.5 84.2 44.9 40.3 35.2 12.3
O
O
I
O
N
CH3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

C7

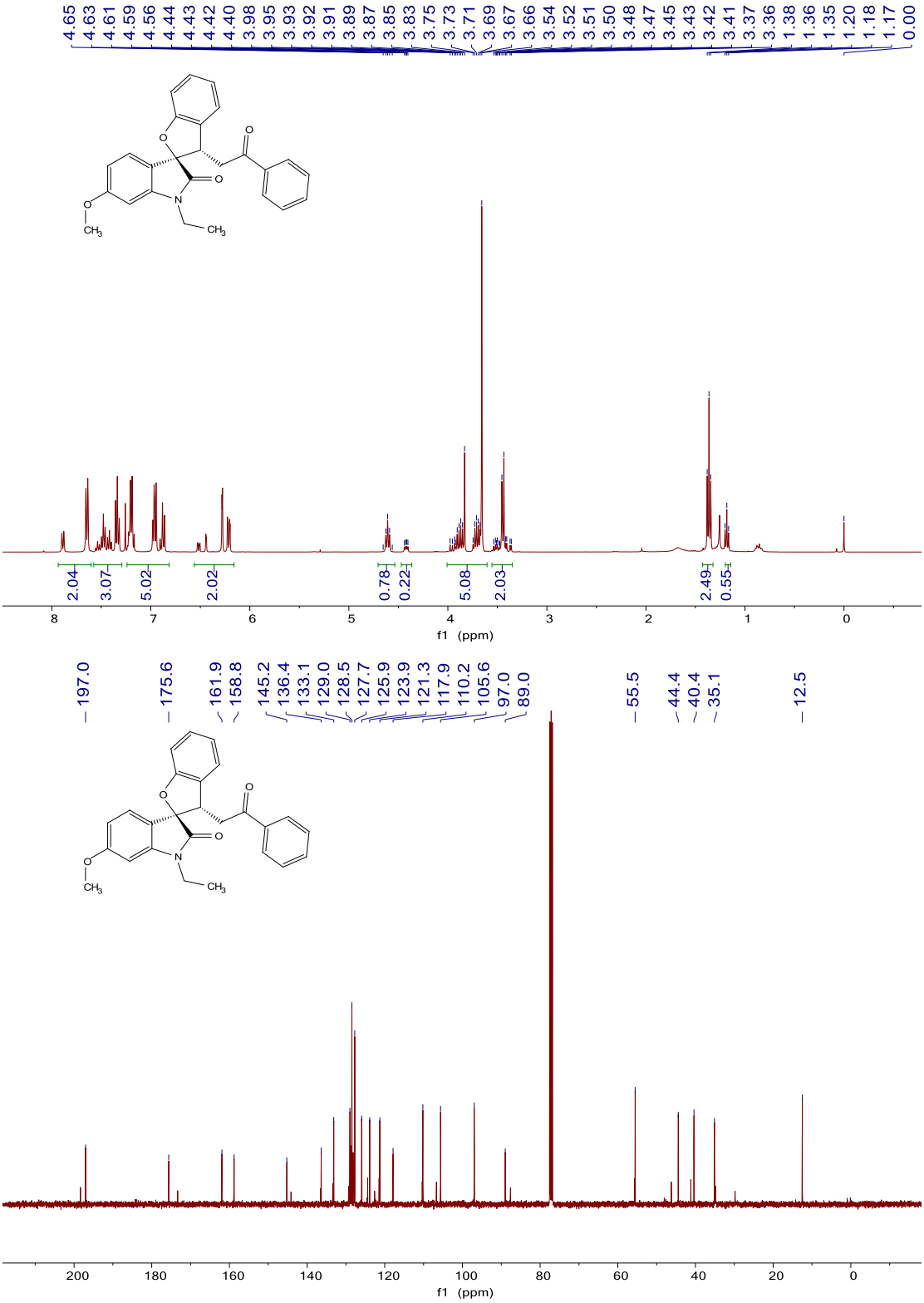

7.63 7.61 7.60 7.50 7.48 7.47 7.35 7.33 7.31 7.24 7.23 7.22 7.21 7.03 7.01 7.00 6.99 6.98 6.95 6.91 6.89 6.72 6.70 4.67 4.66 4.65 4.63 3.97 3.95 3.93 3.91 3.77 3.75 3.73 3.71 3.53 3.50 3.49 3.49 3.47 3.42 1.41 1.39 1.37 0.00
2.08 1.07 2.04 2.01 2.02 0.98 0.96 1.01 1.00 1.04 1.04 2.06 3.08
f1 (ppm)
196.93 175.02 158.56 143.93 142.55 135.94 133.45 129.30 128.61 128.17 127.55 127.10 123.94 121.74 119.14 110.37 109.34 88.56 44.62 40.41 35.33 12.29
f1 (ppm)


58.70
F
F
F
O
O
O
O
N
CH3
20
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

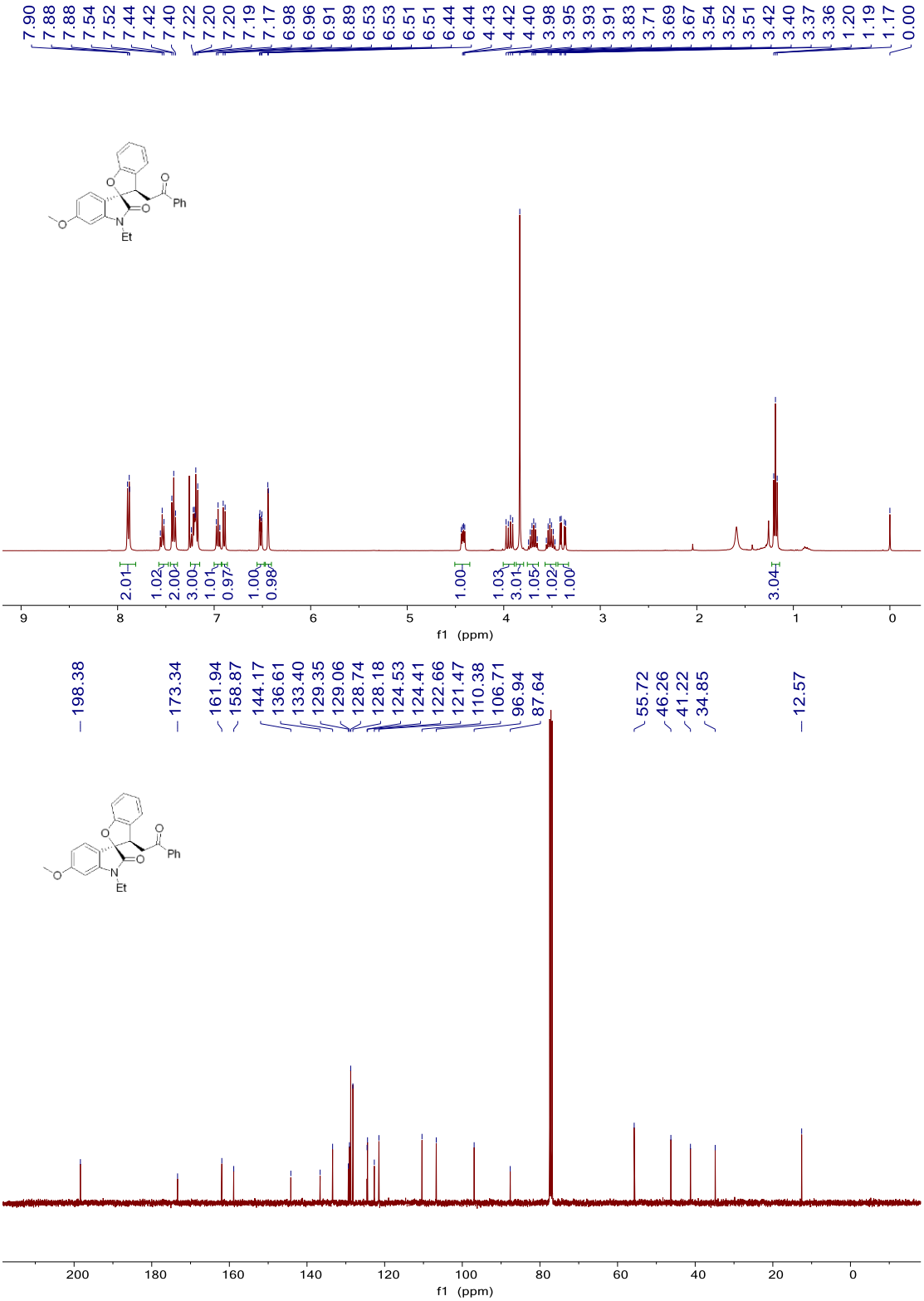
C8


7.62 7.60 7.60 7.49 7.47 7.46 7.35 7.33 7.32 7.23 7.21 7.19 6.99 6.97 6.95 6.89 6.88 6.70 6.60 4.66 4.65 4.64 4.63 4.06 4.04 4.03 4.01 3.98 3.96 3.95 3.93 3.51 3.49 3.47 3.44 3.35 3.33 3.30 3.29 2.34 1.99 1.39 1.37 1.35 0.00
2.02 1.02 2.01 2.03 1.01 0.98 0.98 0.98 1.00 2.12 1.03 1.01 3.02 3.02 3.06
f1 (ppm)
196.9 176.2 159.0 139.0 136.4 134.9 133.1 131.7 128.9 128.4 127.6 126.7 123.9 123.5 121.3 119.7 110.2 88.4 44.9 40.2 36.9 20.4 18.7 14.6
f1 (ppm)

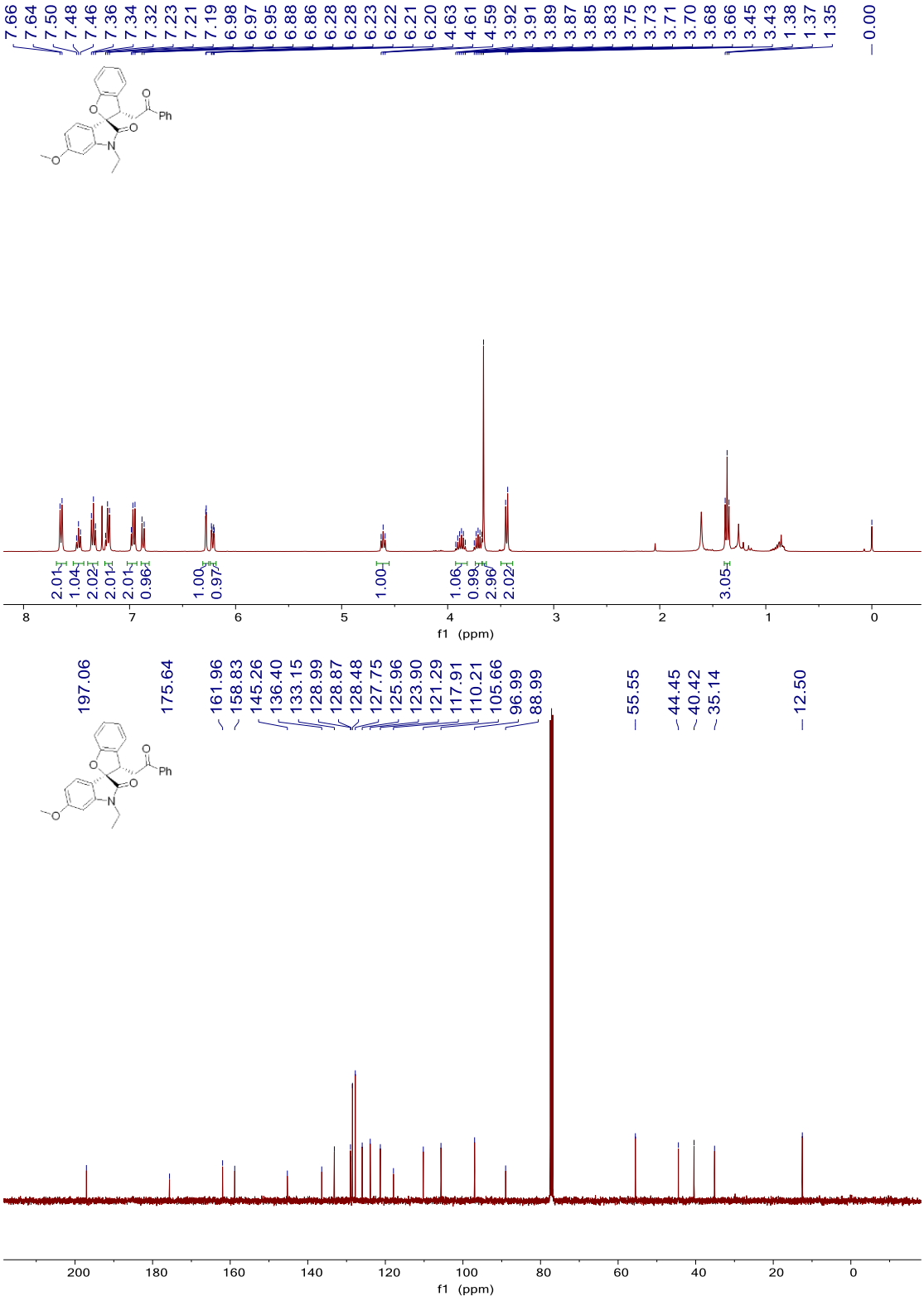
C9


4.65 4.63 4.61 4.59 4.56 4.44 4.43 4.42 4.40 3.98 3.95 3.93 3.92 3.91 3.89 3.87 3.85 3.83 3.75 3.73 3.71 3.69 3.67 3.66 3.54 3.52 3.51 3.50 3.48 3.47 3.45 3.43 3.42 3.41 3.37 3.36 1.38 1.36 1.35 1.20 1.18 1.17 0.00
2.04 3.07 5.02 2.02 0.78 0.22 5.08 2.03 2.49 0.55
f1 (ppm)
197.0 175.6 161.9 158.8 145.2 136.4 133.1 129.0 128.5 127.7 125.9 123.9 121.3 117.9 110.2 105.6 97.0 89.0 55.5 44.4 40.4 35.1 12.5
f1 (ppm)

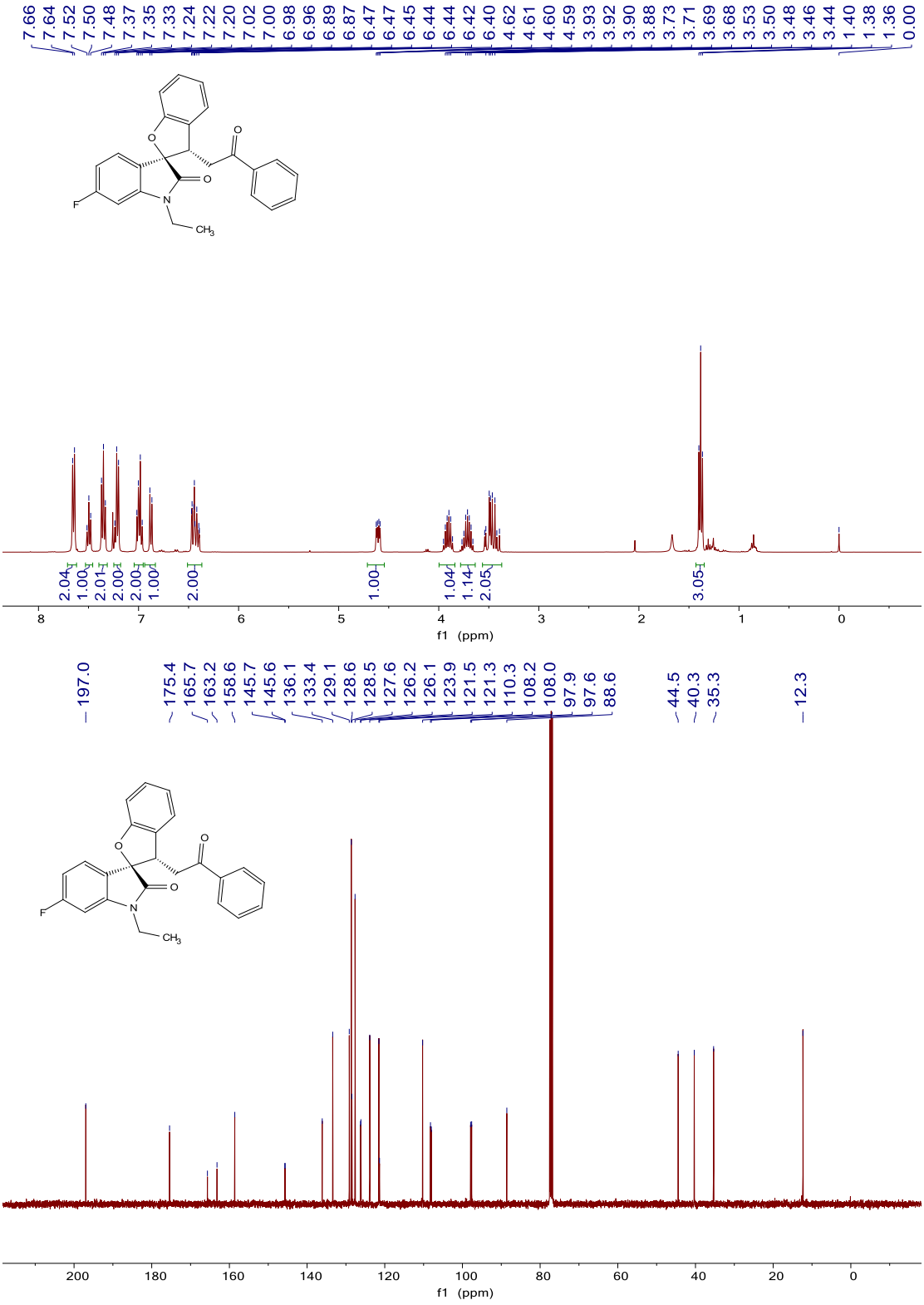
Minor diastereomer of C9

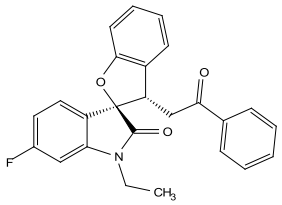


Major diastereomer of C9



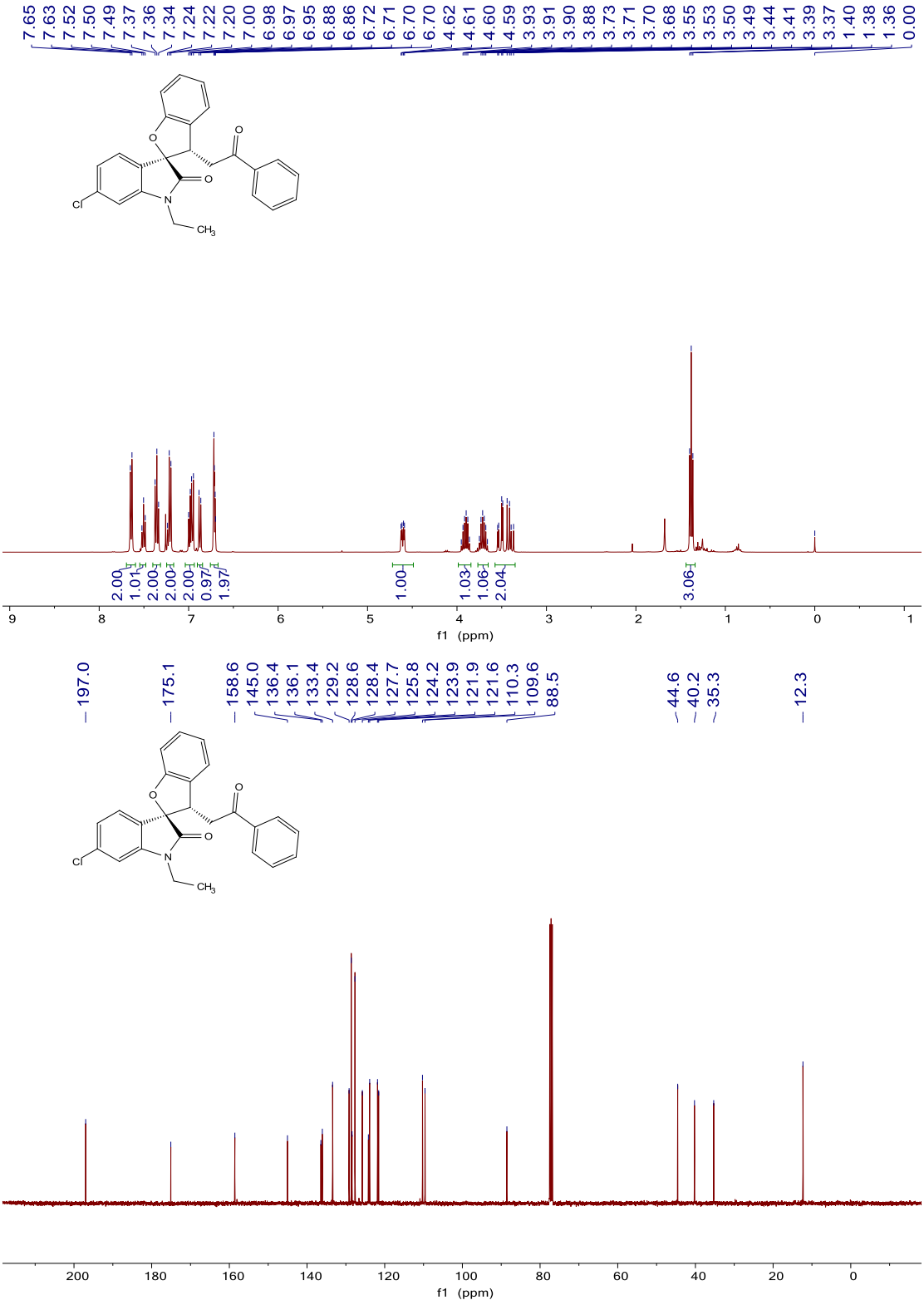
C10


7.66 7.64 7.52 7.50 7.48 7.37 7.35 7.33 7.24 7.22 7.20 7.02 7.00 6.98 6.96 6.89 6.87 6.47 6.45 6.44 6.44 6.42 6.40 4.62 4.61 4.60 4.59 3.93 3.92 3.90 3.88 3.73 3.71 3.69 3.68 3.53 3.50 3.48 3.46 3.44 1.40 1.38 1.36 0.00
O
O
O
F
N
CH3
2.04 1.00 2.01 2.00 2.00 1.00 2.00 1.00 1.04 1.14 2.05 3.05
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 175.4 165.7 163.2 158.6 145.7 145.6 136.1 133.4 129.1 128.6 128.5 127.6 126.2 126.1 123.9 121.5 121.3 110.3 108.2 108.0 97.9 97.6 88.6 44.5 40.3 35.3 12.3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

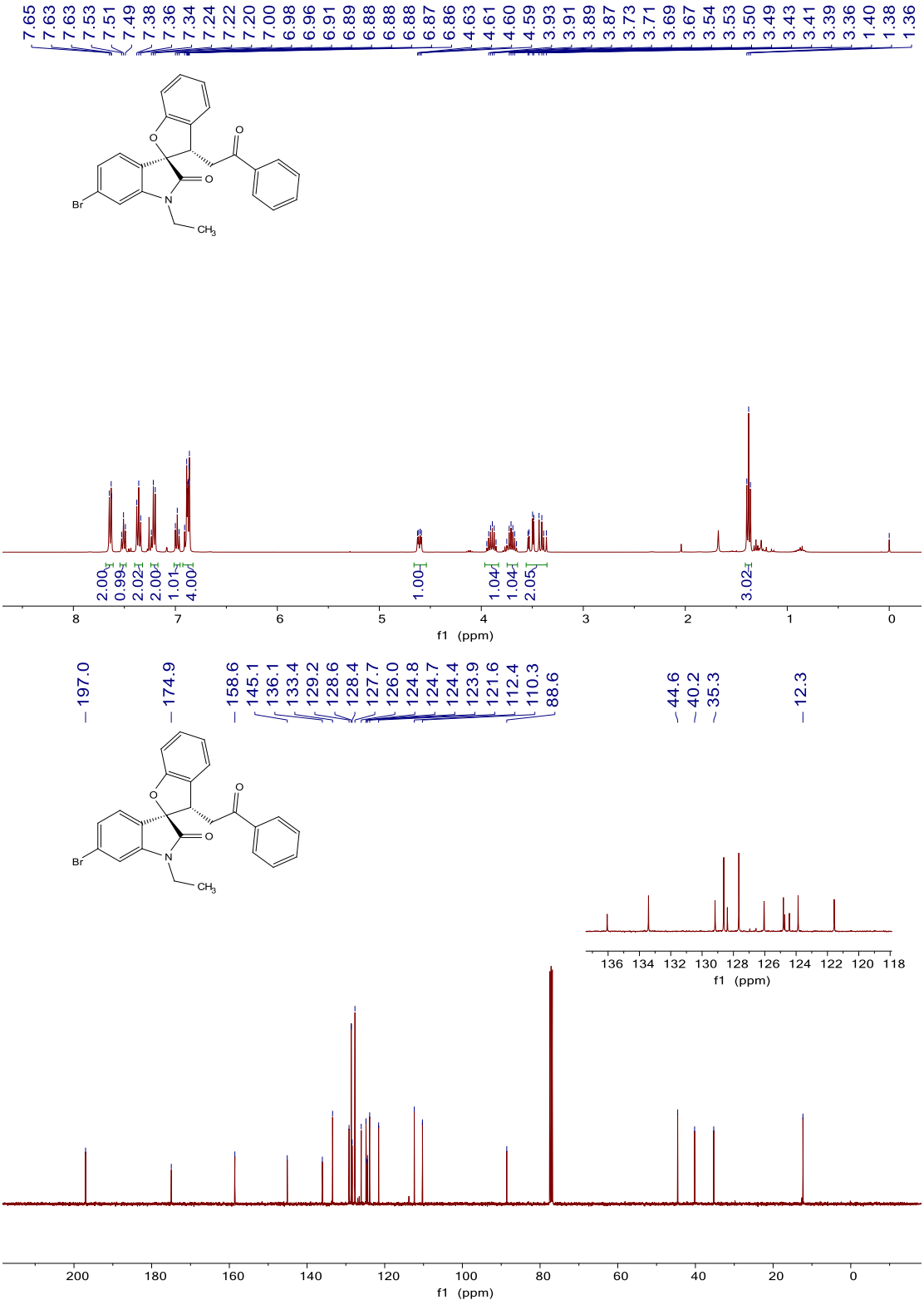

O
O
O
F
N
CH3

-108.44
20
0
20
40
60
80
100
120
140
160
180
200
2
f1 (ppm)

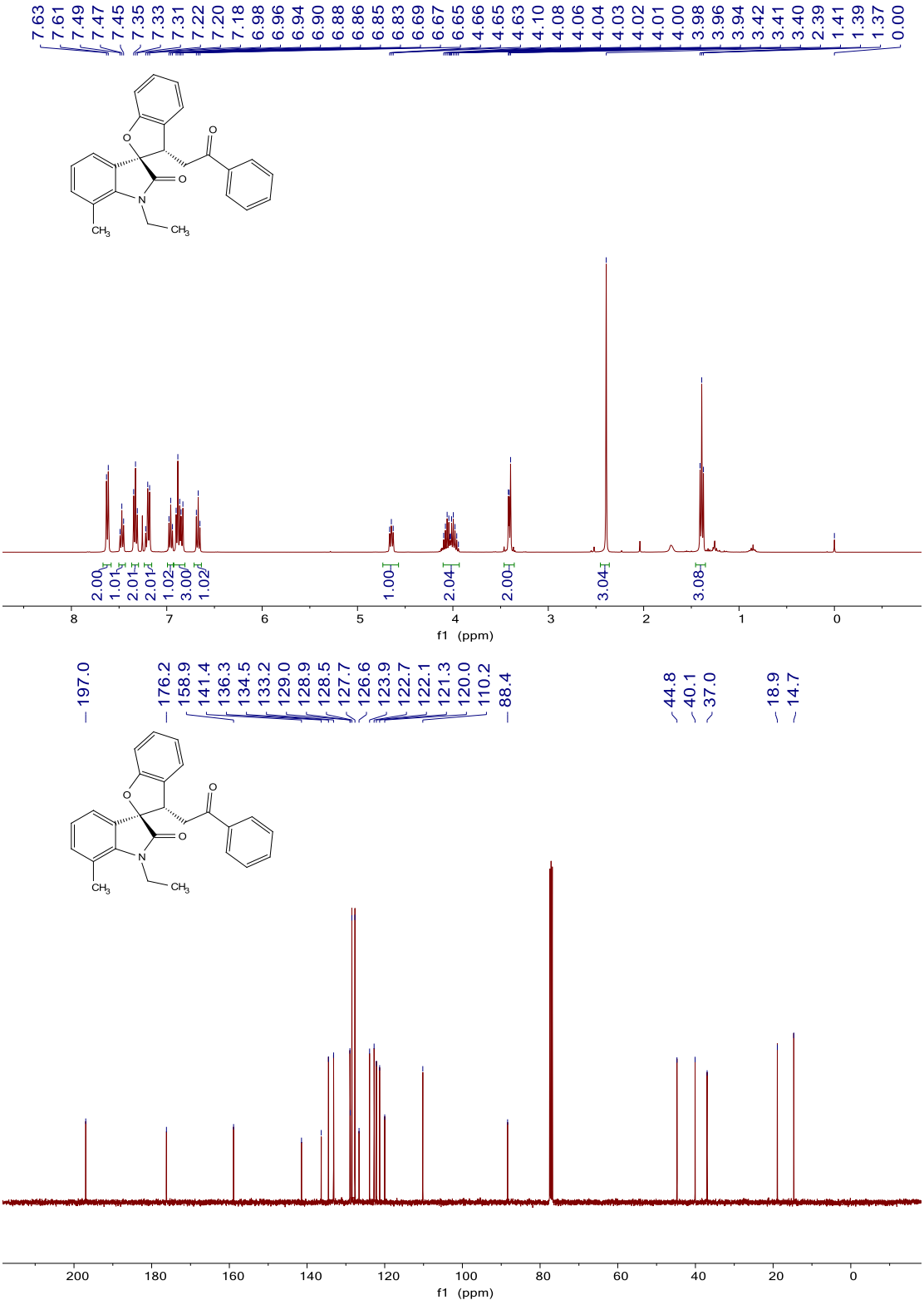
C11


7.65 7.63 7.52 7.50 7.49 7.37 7.36 7.34 7.24 7.22 7.20 7.00 6.98 6.97 6.95 6.88 6.86 6.72 6.71 6.70 6.70 4.62 4.61 4.60 4.59 3.93 3.91 3.90 3.88 3.73 3.71 3.70 3.68 3.55 3.53 3.50 3.49 3.44 3.41 3.39 3.37 1.40 1.38 1.36 0.00
O
O
O
N
Cl
CH3
2.00 1.01 2.00 2.00 2.00 0.97 1.97 1.00 1.03 1.06 2.04 3.06
f1 (ppm)
197.0 175.1 158.6 145.0 136.4 136.1 133.4 129.2 128.6 128.4 127.7 125.8 124.2 123.9 121.9 121.6 110.3 109.6 88.5 44.6 40.2 35.3 12.3
f1 (ppm)

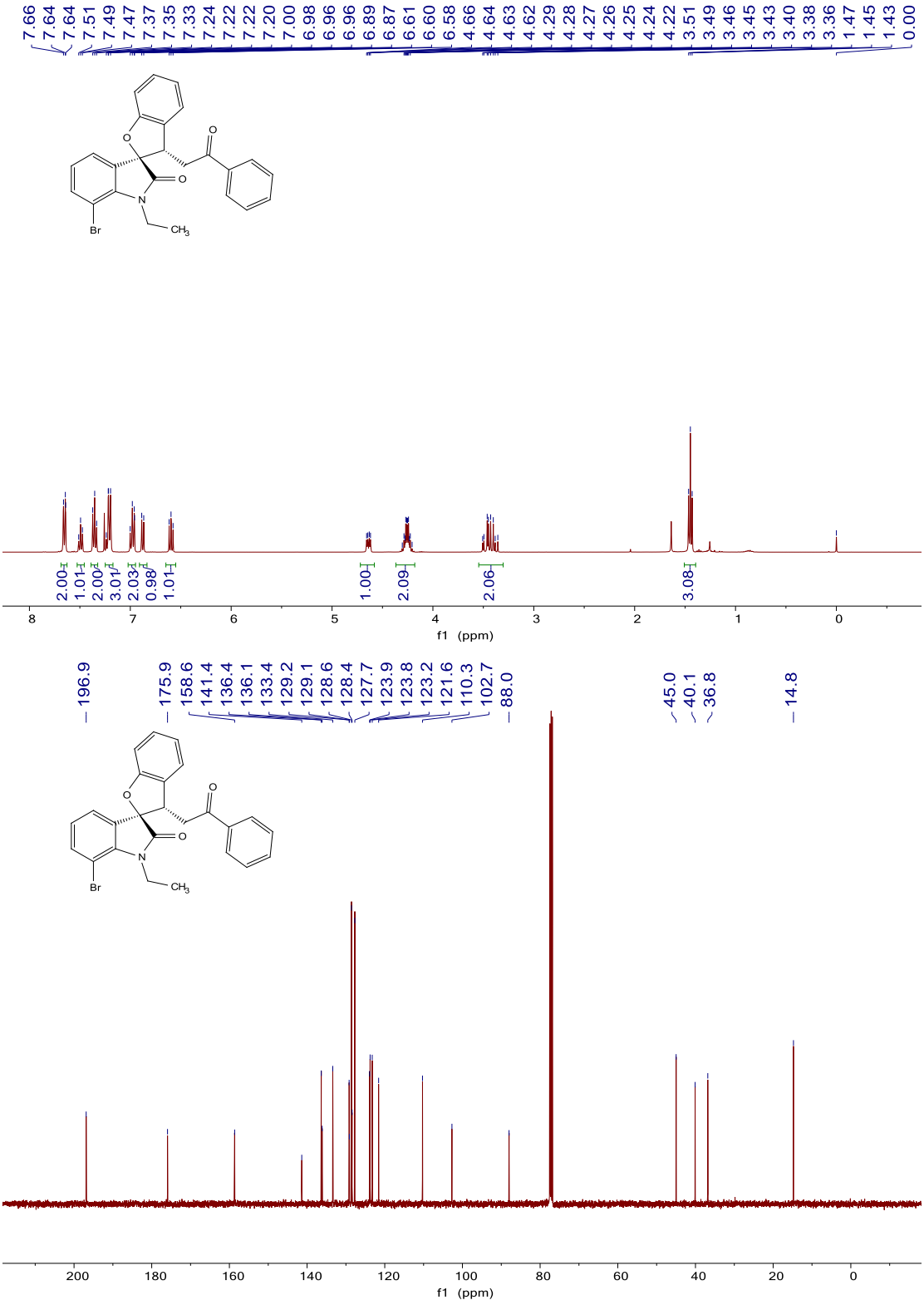
C12


7.65 7.63 7.63 7.53 7.51 7.49 7.38 7.36 7.34 7.24 7.22 7.20 7.00 6.98 6.96 6.91 6.89 6.88 6.88 6.87 6.86 4.63 4.61 4.60 4.59 3.93 3.91 3.89 3.87 3.73 3.71 3.69 3.67 3.54 3.53 3.50 3.49 3.43 3.41 3.39 3.36 1.40 1.38 1.36
O
O
O
Br
N
CH3
2.00 0.99 2.02 2.00 1.01 4.00 1.00 1.04 1.04 2.05 3.02
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 174.9 158.6 145.1 136.1 133.4 129.2 128.6 128.4 127.7 126.0 124.8 124.7 124.4 123.9 121.6 112.4 110.3 88.6 44.6 40.2 35.3 12.3
136 134 132 130 128 126 124 122 120 118
f1 (ppm)
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

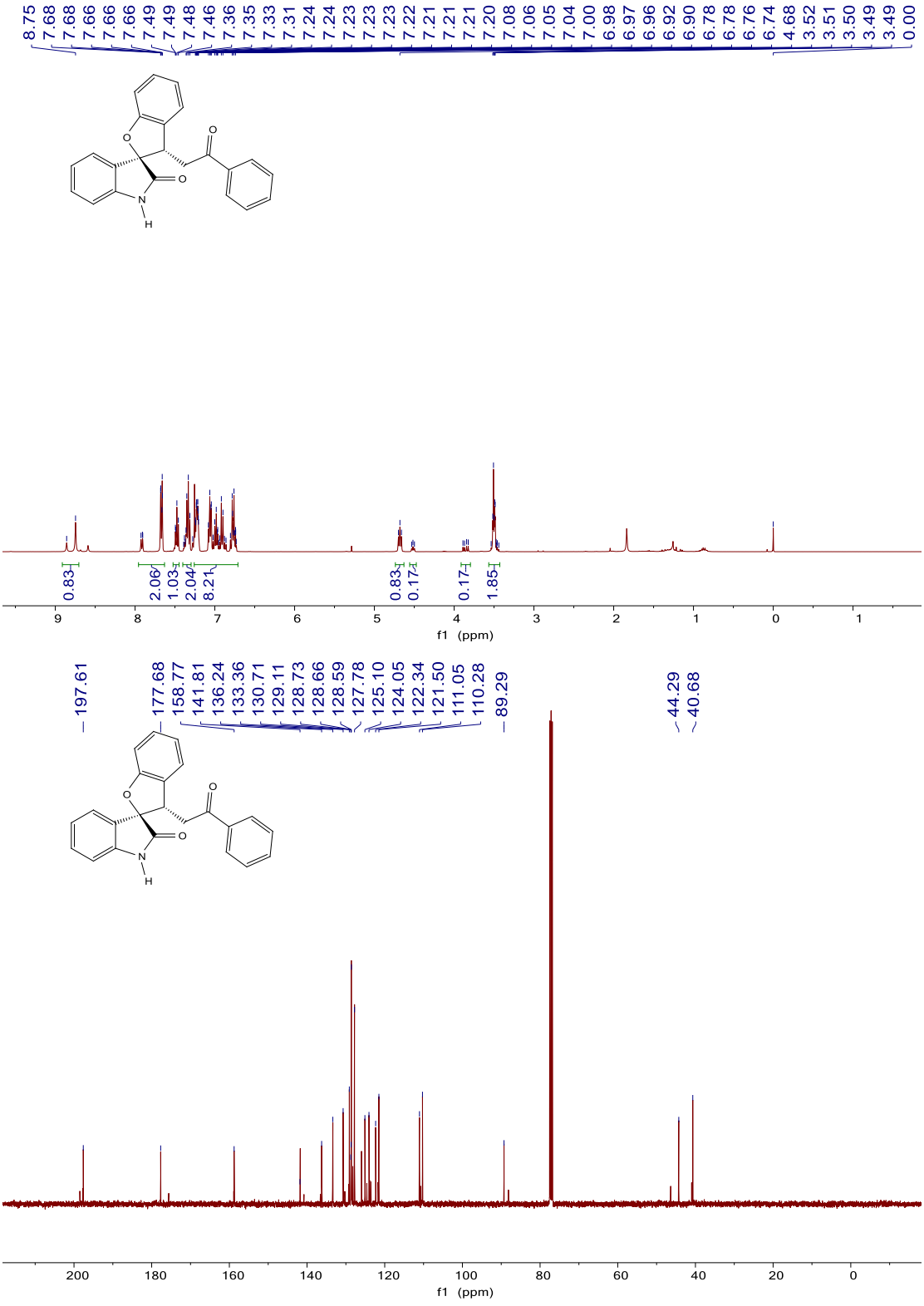
C13


7.63 7.61 7.49 7.47 7.45 7.35 7.33 7.31 7.22 7.20 7.18 6.98 6.96 6.94 6.90 6.88 6.86 6.85 6.83 6.69 6.67 6.65 4.66 4.65 4.63 4.10 4.08 4.06 4.04 4.03 4.02 4.01 4.00 3.98 3.96 3.94 3.42 3.41 3.40 2.39 1.41 1.39 1.37 0.00
O
O
O
N
CH3
CH3
2.00 1.01 2.01 2.01 1.02 3.00 1.02 1.00 2.04 2.00 3.04 3.08
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 176.2 158.9 141.4 136.3 134.5 133.2 129.0 128.9 128.5 127.7 126.6 123.9 122.7 122.1 121.3 120.0 110.2 88.4 44.8 40.1 37.0 18.9 14.7
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

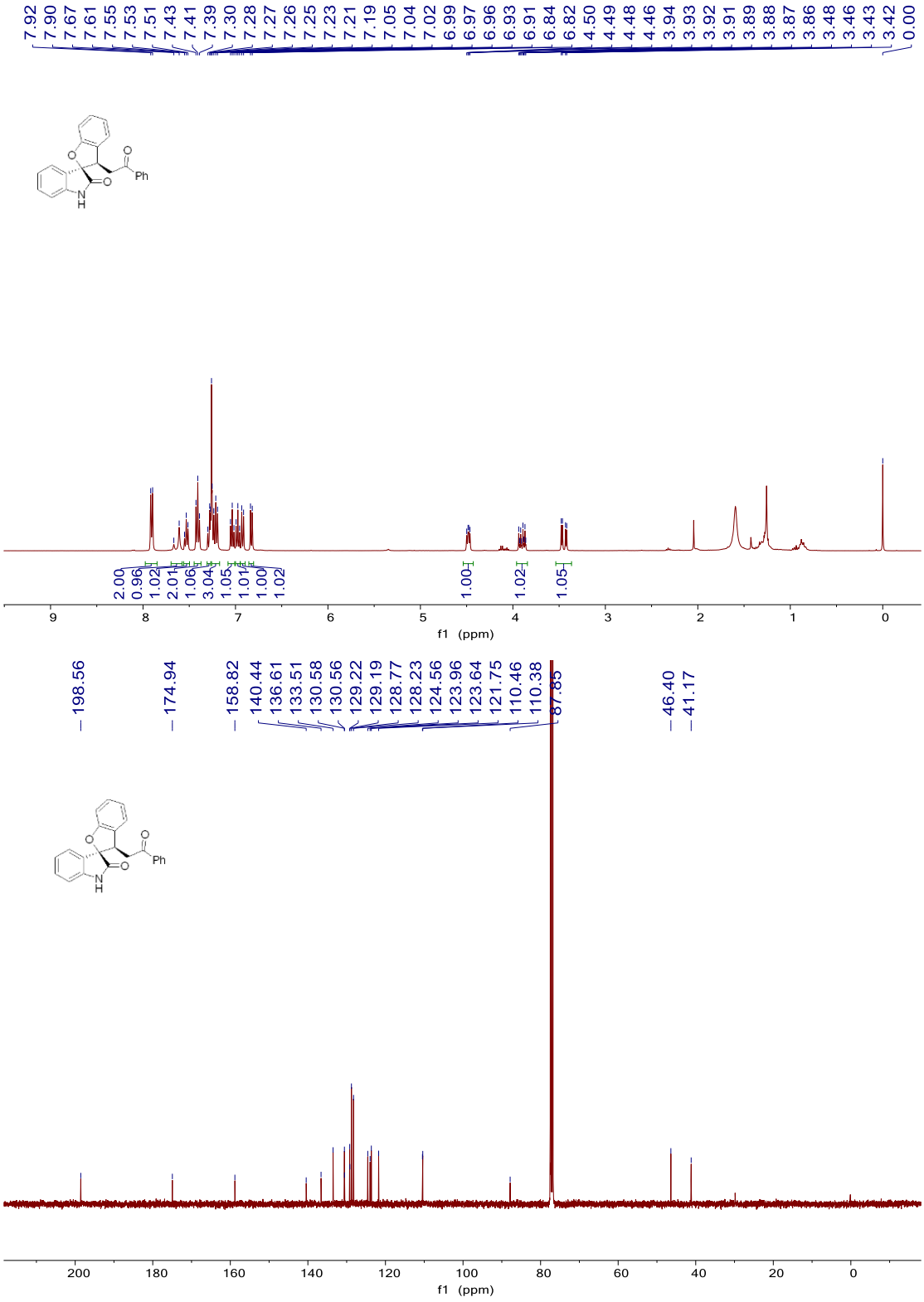
C14


7.66 7.64 7.64 7.51 7.49 7.47 7.37 7.35 7.33 7.24 7.22 7.22 7.20 7.00 6.98 6.96 6.96 6.89 6.87 6.61 6.60 6.58 4.66 4.64 4.63 4.62 4.29 4.28 4.27 4.26 4.25 4.24 4.22 3.51 3.49 3.46 3.45 3.43 3.40 3.38 3.36 1.47 1.45 1.43 0.00
O
O
O
N
Br
CH3
2.00 1.01 2.00 3.01 2.03 0.98 1.01 1.00 2.09 2.06 3.08
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.9 175.9 158.6 141.4 136.4 136.1 133.4 129.2 129.1 128.6 128.4 127.7 123.9 123.8 123.2 121.6 110.3 102.7 88.0 45.0 40.1 36.8 14.8
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

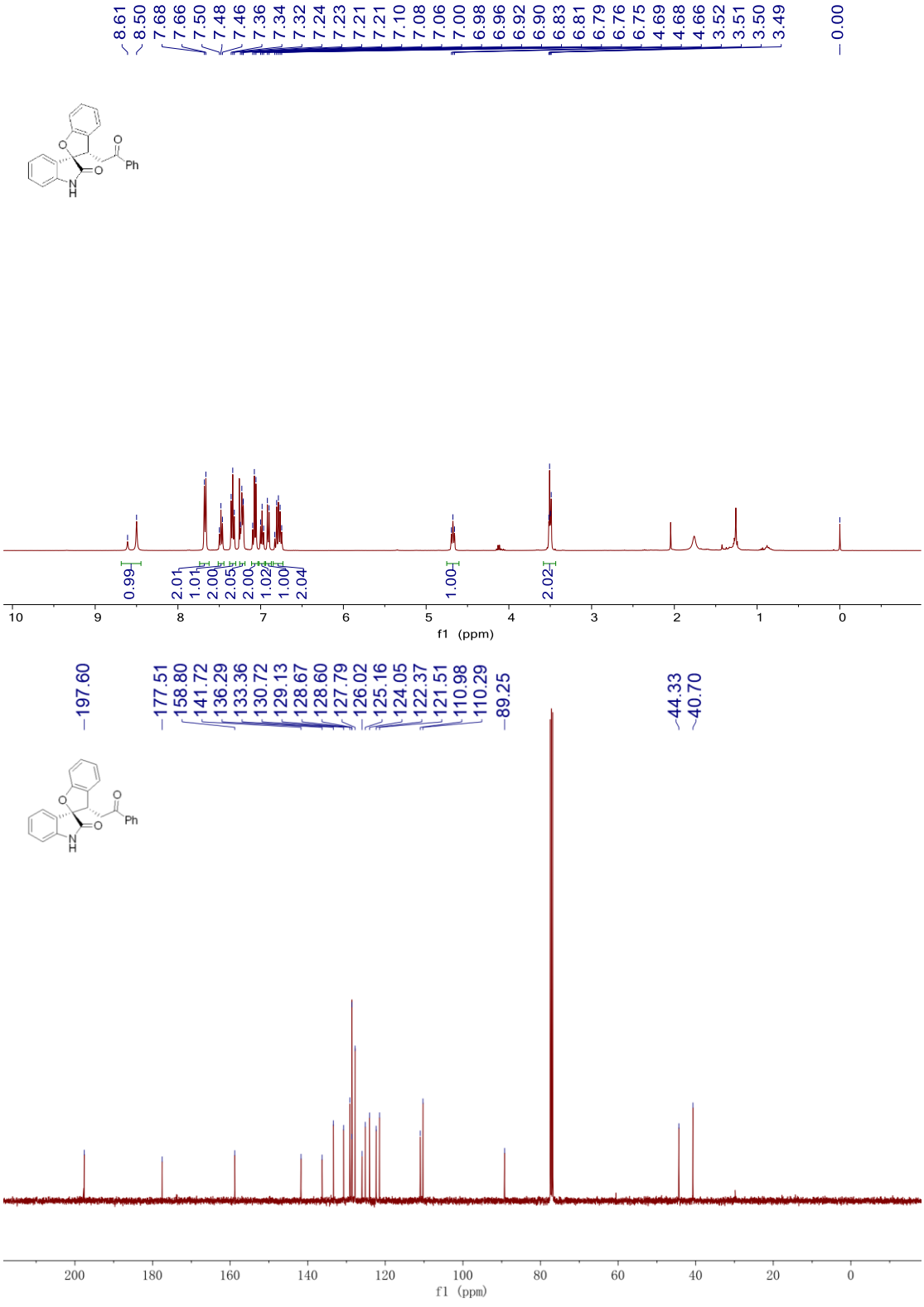
C15


8.75 7.68 7.68 7.66 7.66 7.66 7.49 7.49 7.48 7.46 7.36 7.35 7.33 7.31 7.24 7.24 7.23 7.23 7.23 7.22 7.21 7.21 7.21 7.20 7.08 7.06 7.05 7.04 7.00 6.98 6.97 6.96 6.92 6.90 6.78 6.78 6.76 6.74 4.68 3.52 3.51 3.50 3.49 3.49 0.00
O
O
O
N
H
0.83 2.06 1.03 2.04 8.21 0.83 0.17 0.17 1.85
9 8 7 6 5 4 3 2 1 0 1
f1 (ppm)
197.61 177.68 158.77 141.81 136.24 133.36 130.71 129.11 128.73 128.66 128.59 127.78 125.10 124.05 122.34 121.50 111.05 110.28 89.29 44.29 40.68
O
O
O
N
H
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

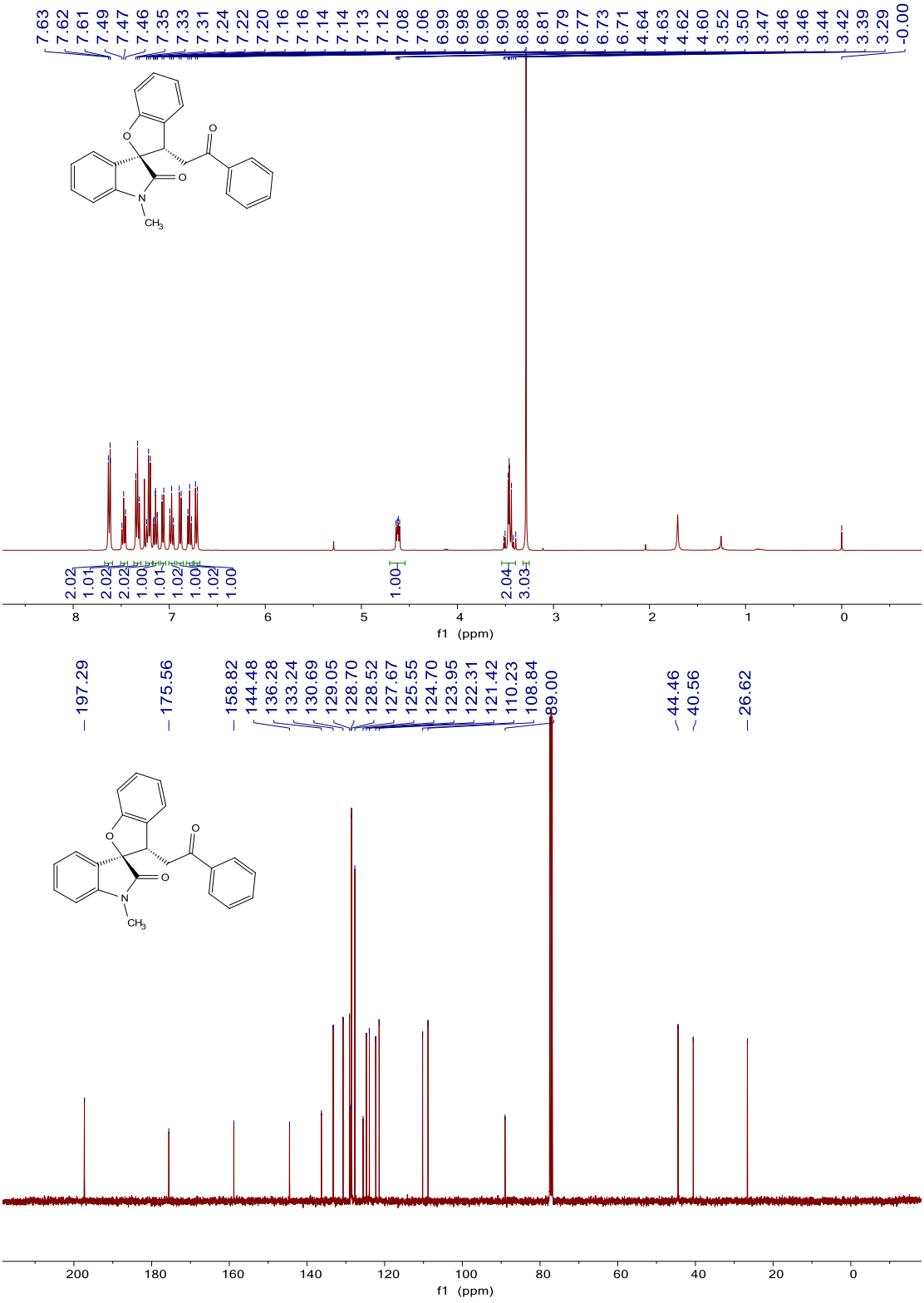
Minor diastereomer of C15



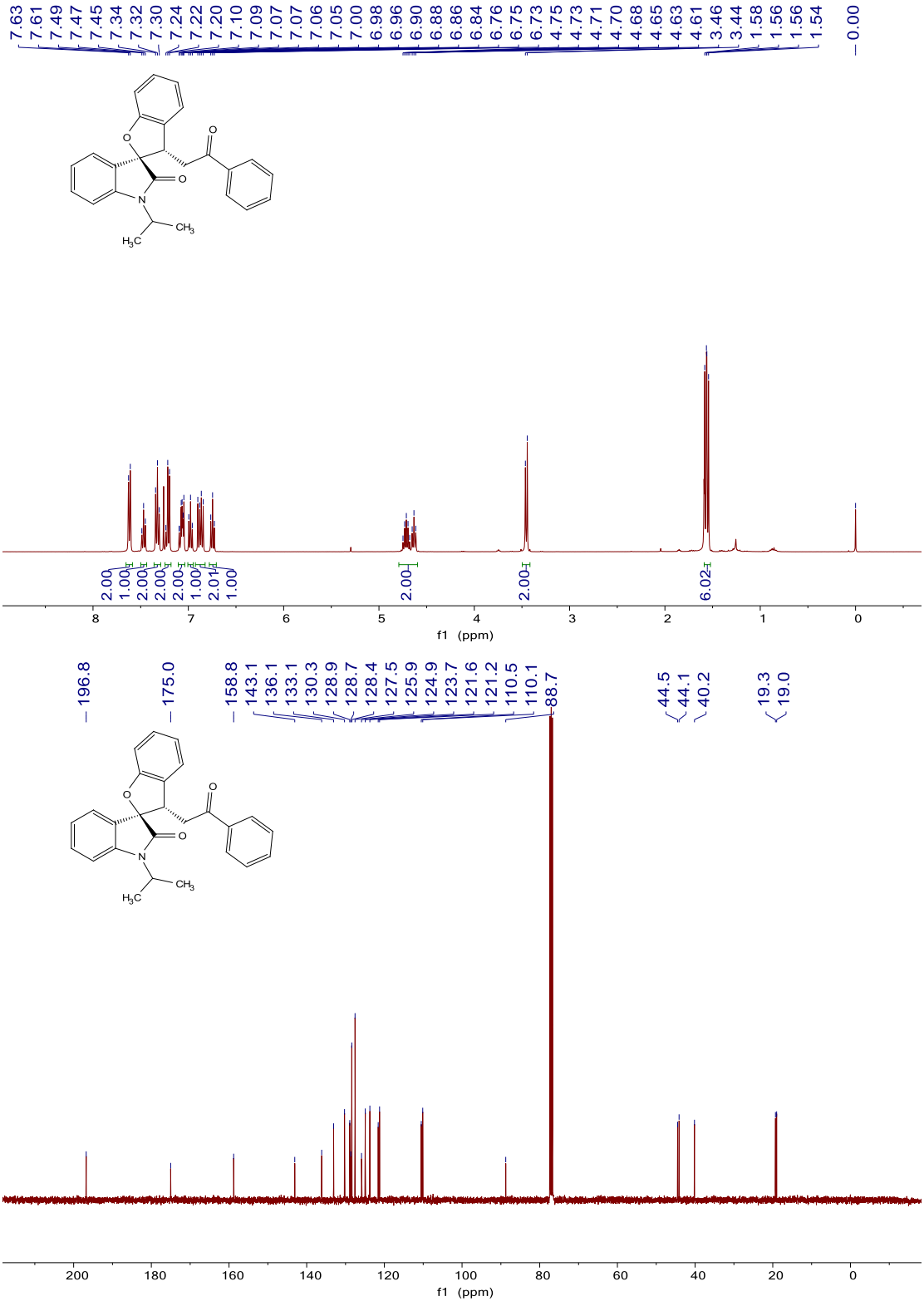
Major diastereomer of C15



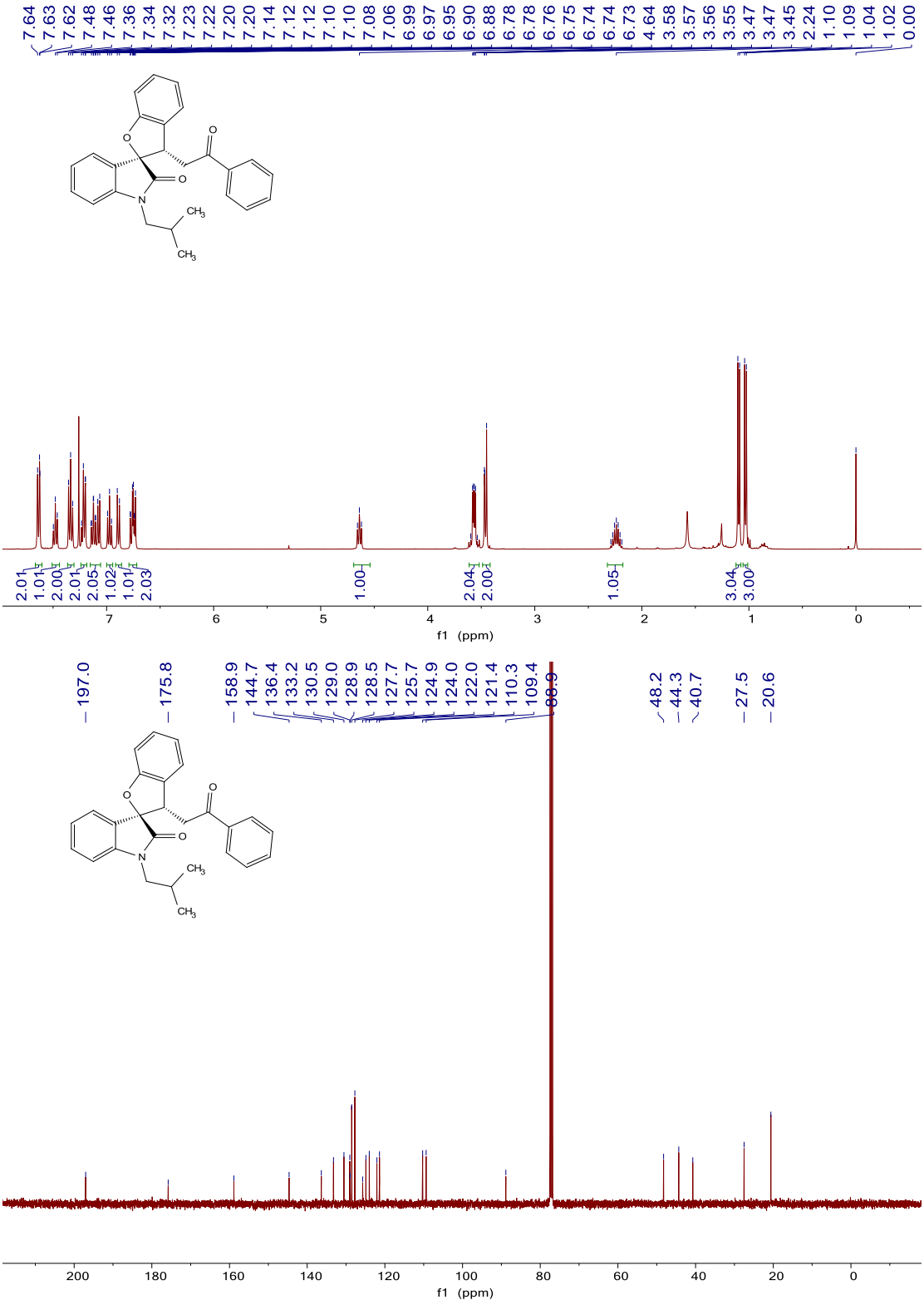
C16


7.63 7.62 7.61 7.49 7.47 7.46 7.35 7.33 7.31 7.24 7.22 7.20 7.16 7.16 7.14 7.14 7.13 7.12 7.08 7.06 6.99 6.98 6.96 6.90 6.88 6.81 6.79 6.77 6.73 6.71 4.64 4.63 4.62 4.60 3.52 3.50 3.47 3.46 3.46 3.44 3.42 3.39 3.29 -0.00
O
O
O
N
CH3
2.02 1.01 2.02 2.02 1.00 1.01 1.02 1.00 1.02 1.00 1.00 2.04 3.03
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.29 175.56 158.82 144.48 136.28 133.24 130.69 129.05 128.70 128.52 127.67 125.55 124.70 123.95 122.31 121.42 110.23 108.84 89.00 44.46 40.56 26.62
O
O
O
N
CH3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

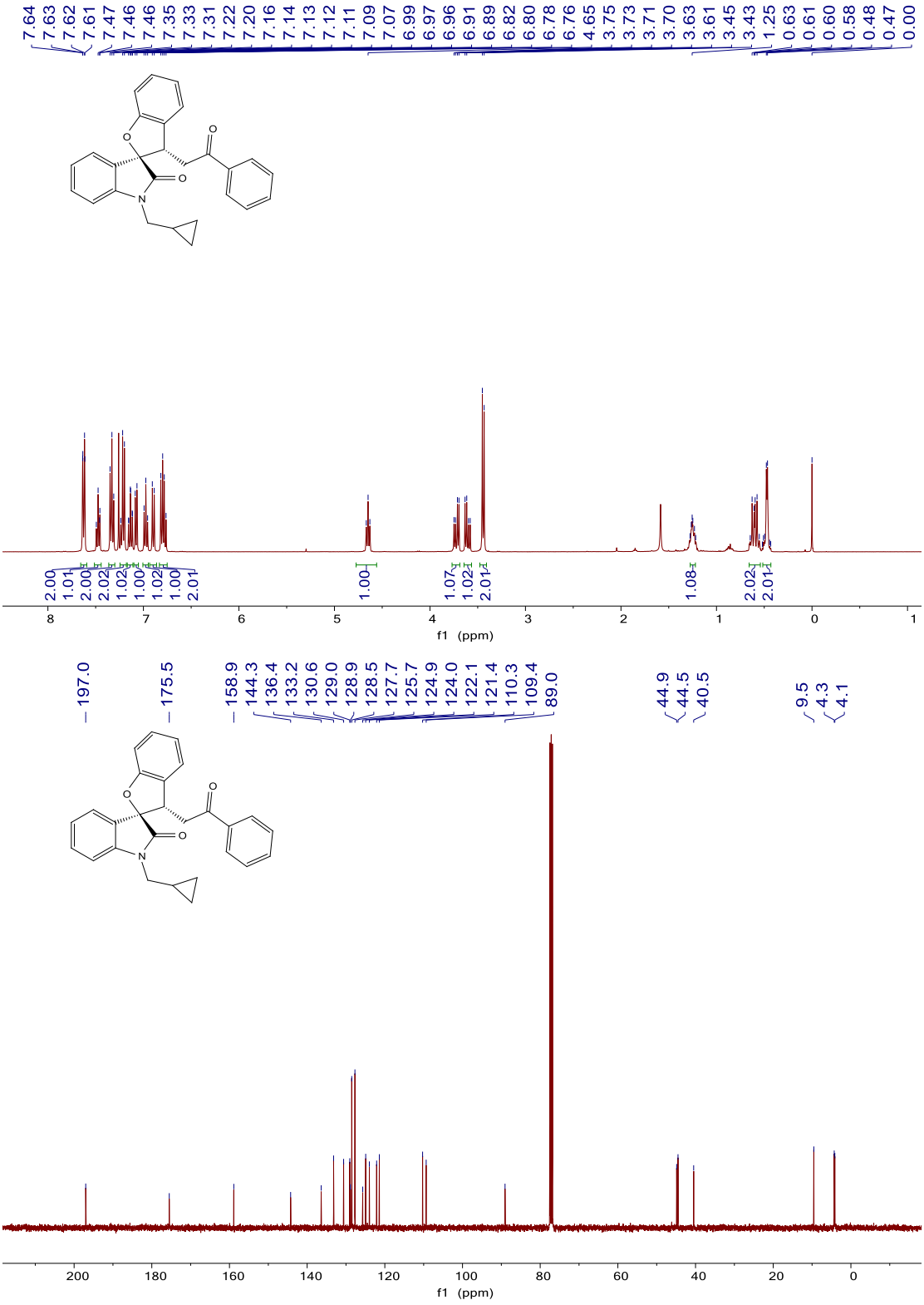
C17


7.63 7.61 7.49 7.47 7.45 7.34 7.32 7.30 7.24 7.22 7.20 7.10 7.09 7.07 7.07 7.06 7.05 7.00 6.98 6.96 6.90 6.88 6.86 6.84 6.76 6.75 6.73 4.75 4.73 4.71 4.70 4.68 4.65 4.63 4.61 3.46 3.44 1.58 1.56 1.56 1.54 0.00
O
O
O
N
CH3
H3C
2.00 1.00 2.00 2.00 2.00 1.00 2.01 1.00 2.00 2.00 6.02
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.8 175.0 158.8 143.1 136.1 133.1 130.3 128.9 128.7 128.4 127.5 125.9 124.9 123.7 121.6 121.2 110.5 110.1 88.7 44.5 44.1 40.2 19.3 19.0
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

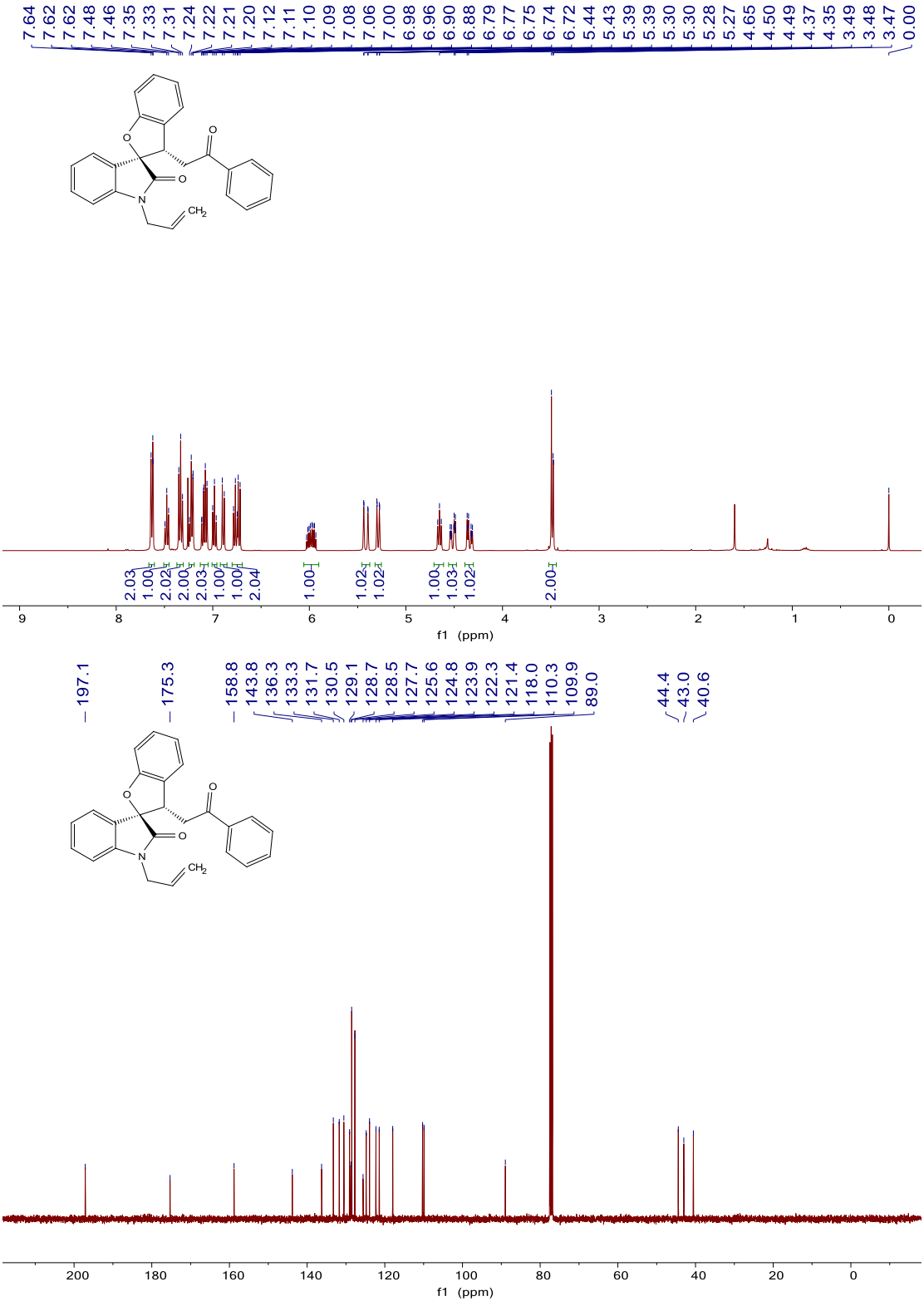
C18


7.64 7.63 7.62 7.48 7.46 7.36 7.34 7.32 7.23 7.22 7.20 7.20 7.14 7.12 7.12 7.10 7.10 7.08 7.06 6.99 6.97 6.95 6.90 6.88 6.78 6.78 6.76 6.75 6.74 6.74 6.73 4.64 3.58 3.57 3.56 3.55 3.47 3.47 3.45 2.24 1.10 1.09 1.04 1.02 0.00
O
O
O
N
CH3
CH3
2.01 1.01 2.00 2.01 2.05 1.02 1.01 2.03 1.00 2.04 2.00 1.05 3.04 3.00
7 6 5 4 3 2 1 0
f1 (ppm)
197.0 175.8 158.9 144.7 136.4 133.2 130.5 129.0 128.9 128.5 127.7 125.7 124.9 124.0 122.0 121.4 110.3 109.4 88.9 48.2 44.3 40.7 27.5 20.6
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

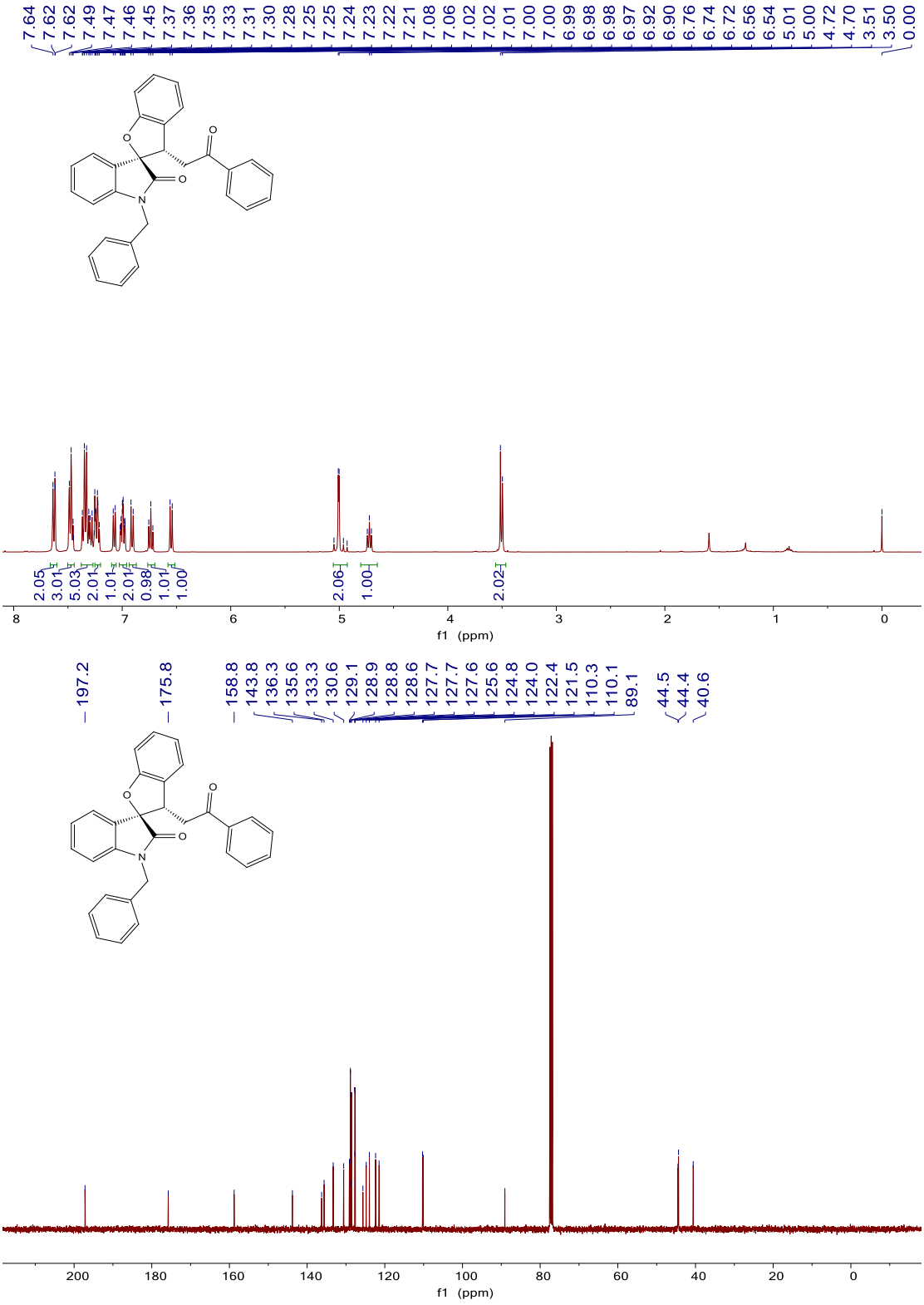
C19


7.64 7.63 7.62 7.61 7.47 7.46 7.46 7.35 7.33 7.31 7.22 7.20 7.16 7.14 7.13 7.12 7.11 7.09 7.07 6.99 6.97 6.96 6.91 6.89 6.82 6.80 6.78 6.76 4.65 3.75 3.73 3.71 3.70 3.63 3.61 3.45 3.43 1.25 0.63 0.61 0.60 0.58 0.48 0.47 0.00
O
O
O
N
2.00 1.01 2.00 2.02 1.02 1.00 1.02 1.00 2.01 1.00 1.07 1.02 2.01 1.08 2.02 2.01
8 7 6 5 4 3 2 1 0 1
f1 (ppm)
197.0 175.5 158.9 144.3 136.4 133.2 130.6 129.0 128.9 128.5 127.7 125.7 124.9 124.0 122.1 121.4 110.3 109.4 89.0 44.9 44.5 40.5 9.5 4.3 4.1
O
O
O
N
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

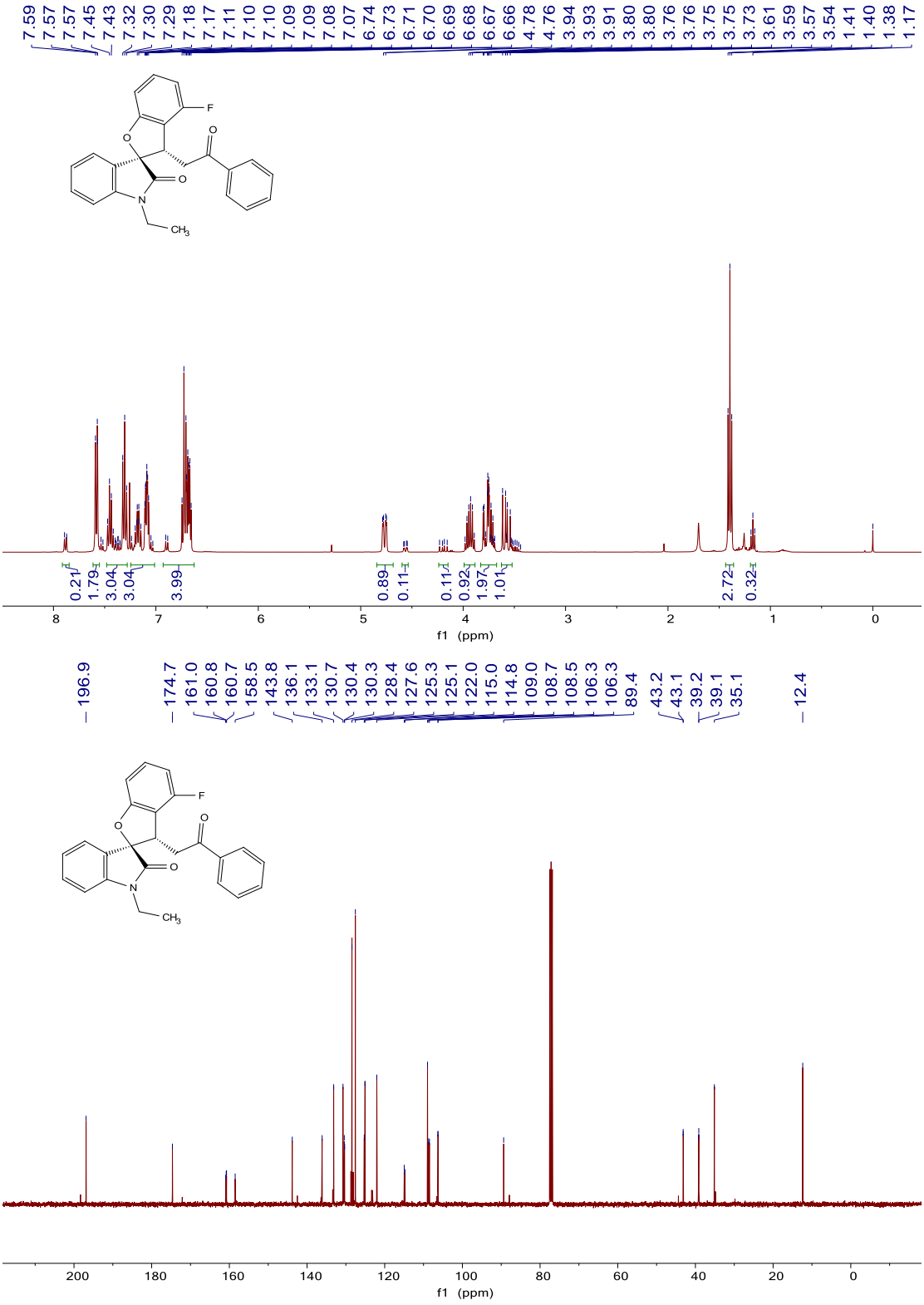
C20

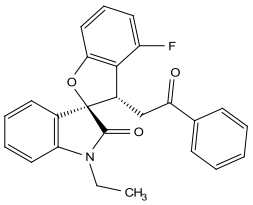

7.64 7.62 7.62 7.48 7.46 7.35 7.33 7.31 7.24 7.22 7.21 7.20 7.12 7.11 7.10 7.09 7.08 7.06 7.00 6.98 6.96 6.90 6.88 6.79 6.77 6.75 6.74 6.72 5.44 5.43 5.39 5.39 5.30 5.30 5.28 5.27 4.65 4.50 4.49 4.37 4.35 3.49 3.48 3.47 0.00
O
O
O
N
CH2
2.03 1.00 2.02 2.00 2.03 1.00 1.00 2.04 1.00 1.02 1.02 1.00 1.03 1.02 2.00
9 8 7 6 5 4 3 2 1 0
f1 (ppm)
197.1 175.3 158.8 143.8 136.3 133.3 131.7 130.5 129.1 128.7 128.5 127.7 125.6 124.8 123.9 122.3 121.4 118.0 110.3 109.9 89.0 44.4 43.0 40.6
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

C21

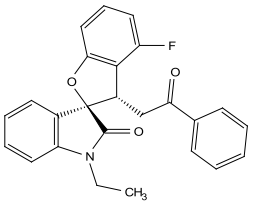

7.64 7.62 7.62 7.49 7.47 7.46 7.45 7.37 7.36 7.35 7.33 7.31 7.30 7.28 7.25 7.25 7.24 7.23 7.22 7.21 7.08 7.06 7.02 7.02 7.01 7.00 7.00 6.99 6.98 6.98 6.97 6.92 6.90 6.76 6.74 6.72 6.56 6.54 5.01 5.00 4.72 4.70 3.51 3.50 0.00
O
O
O
N
2.05 3.01 5.03 2.01 1.01 2.01 0.98 1.01 1.00 2.06 1.00 2.02
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.2 175.8 158.8 143.8 136.3 135.6 133.3 130.6 129.1 128.9 128.8 128.6 127.7 127.7 127.6 125.6 124.8 124.0 122.4 121.5 110.3 110.1 89.1 44.5 44.4 40.6
O
O
O
N
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

C22


7.59 7.57 7.57 7.45 7.43 7.32 7.30 7.29 7.18 7.17 7.11 7.10 7.10 7.09 7.09 7.08 7.07 6.74 6.73 6.71 6.70 6.69 6.68 6.67 6.66 4.78 4.76 3.94 3.93 3.91 3.80 3.80 3.76 3.75 3.75 3.73 3.61 3.59 3.57 3.54 1.41 1.40 1.38 1.17
F
O
O
O
N
CH3
0.21 1.79 3.04 3.04 3.99 0.89 0.11 0.11 0.92 1.97 1.01 2.72 0.32
f1 (ppm)
196.9 174.7 161.0 160.8 160.7 158.5 143.8 136.1 133.1 130.7 130.4 130.3 128.4 127.6 125.3 125.1 122.0 115.0 114.8 109.0 108.7 108.5 106.3 106.3 89.4 43.2 43.1 39.2 39.1 35.1 12.4
f1 (ppm)

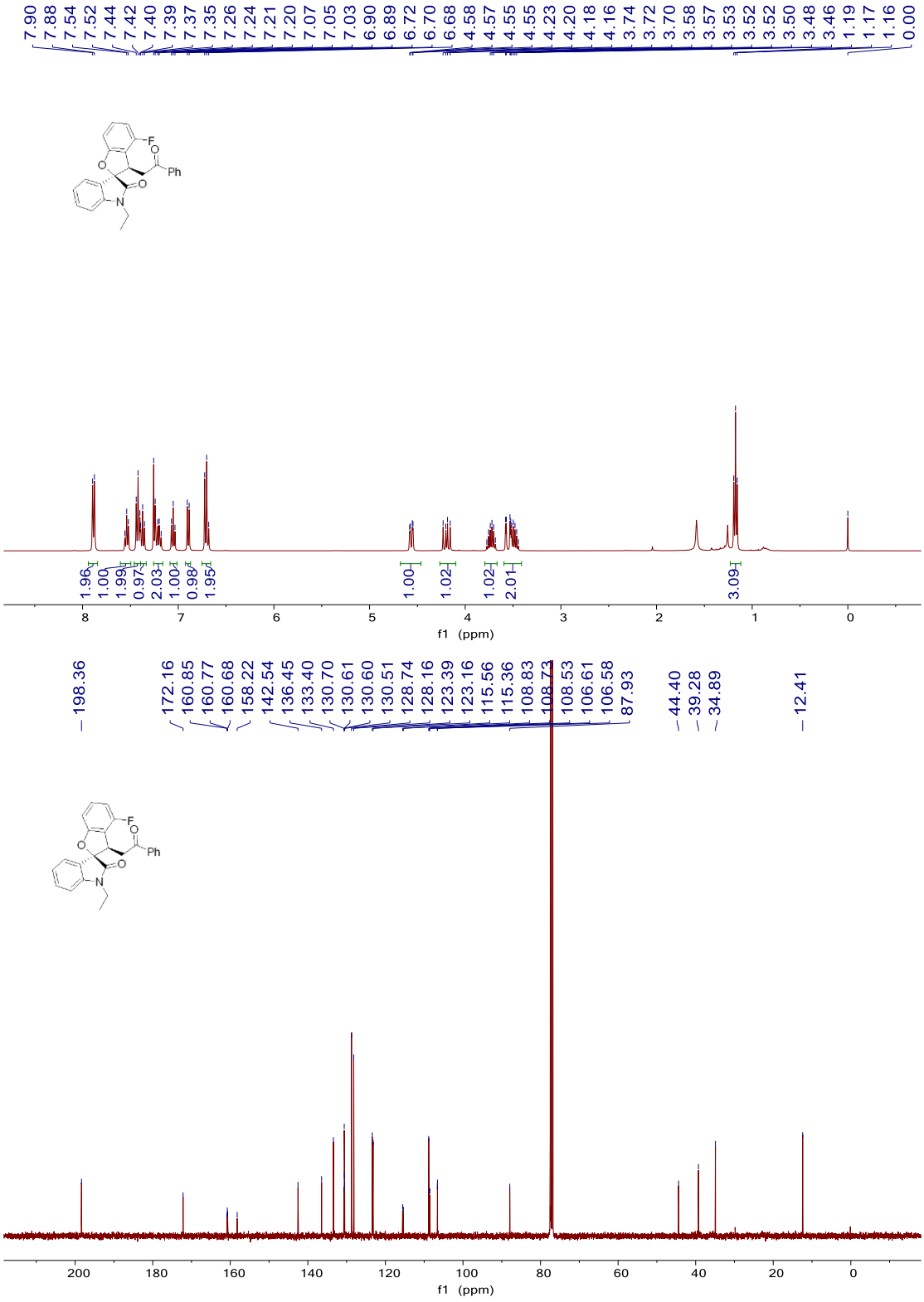

F
O
O
O
N
CH3

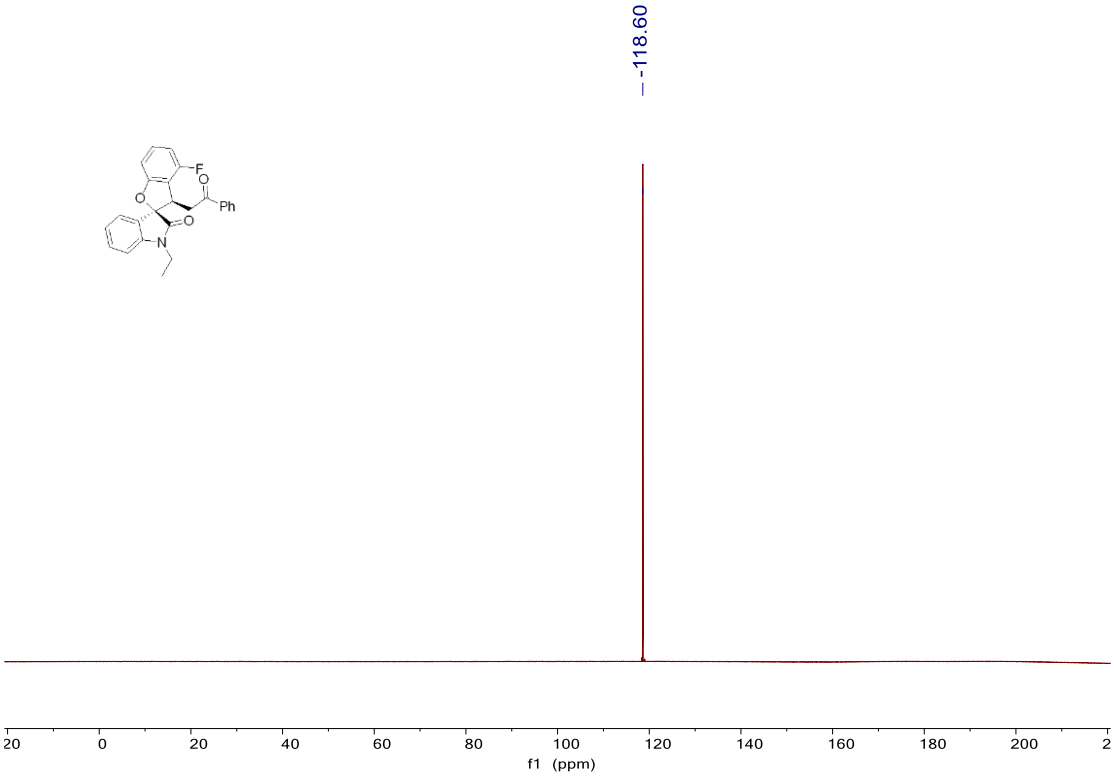
-119.10
20
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)


F
O
O
O
N
CH3

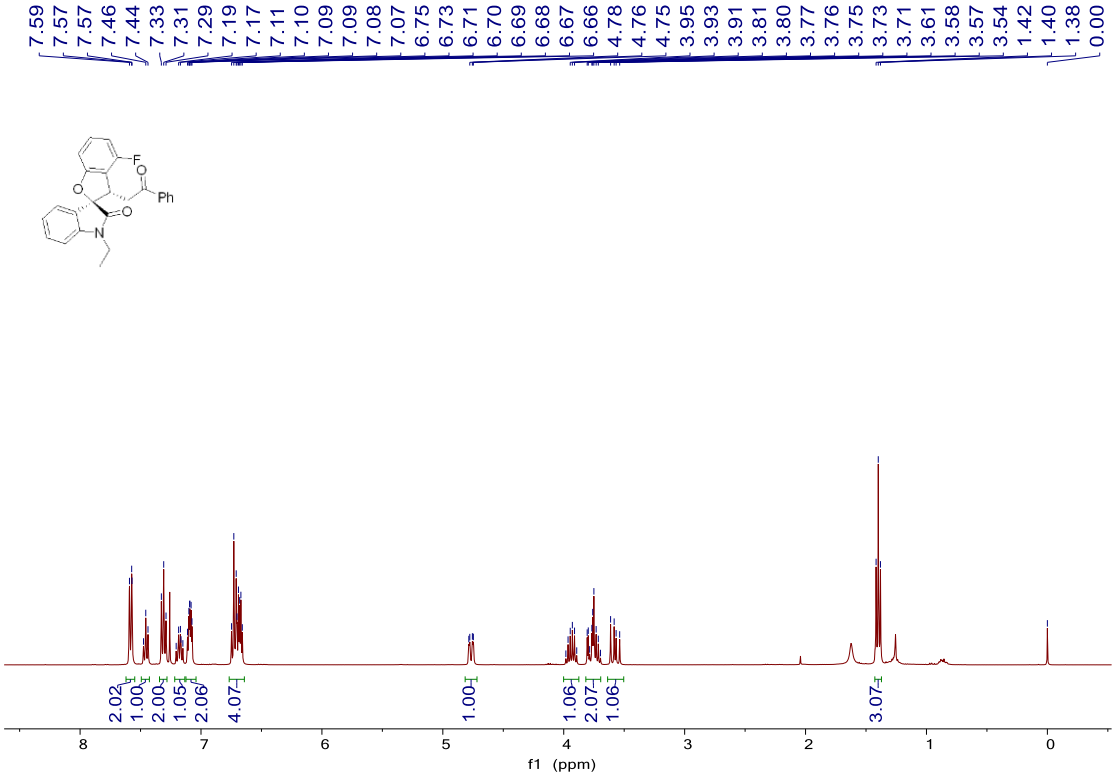
-119.10
0.10
0.89
118 2
118 4
118 6
118 8
119 0
119 2
119 4
119 6
119 8
120 0
120 2
120
f1 (ppm)

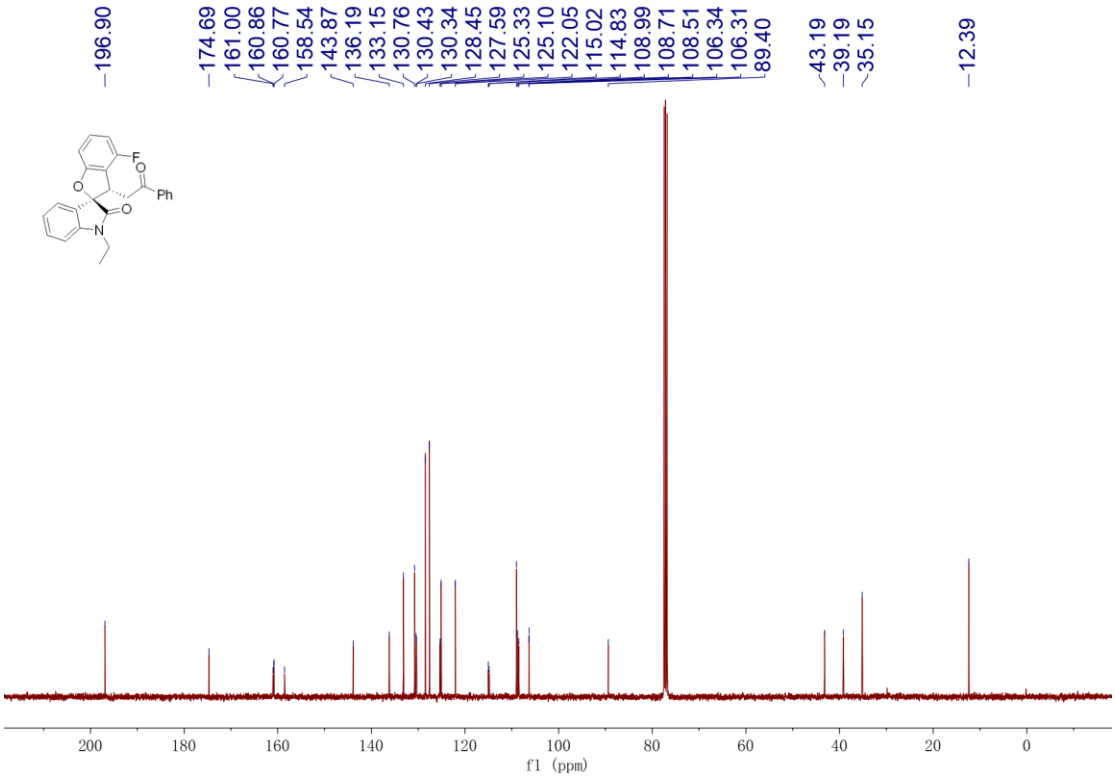
Minor diastereomer of C22

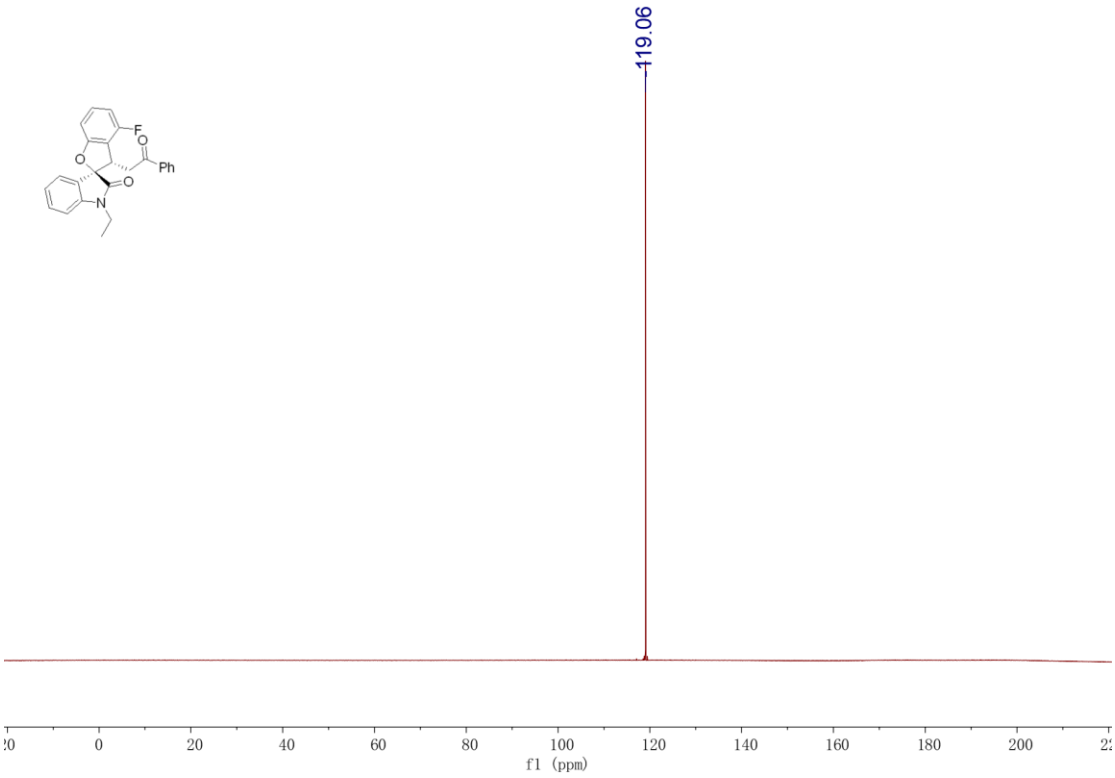




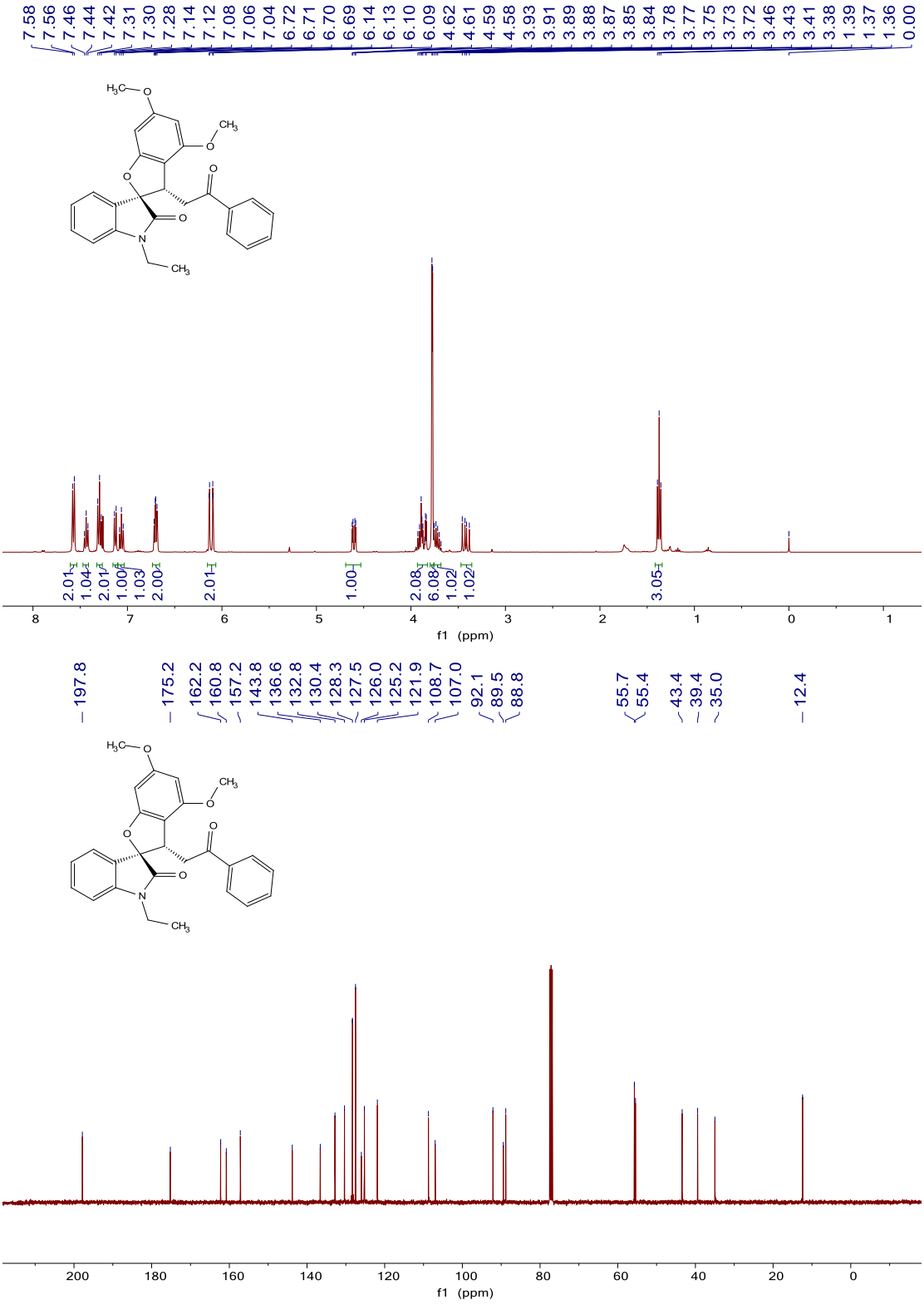
Major diastereomer of C22



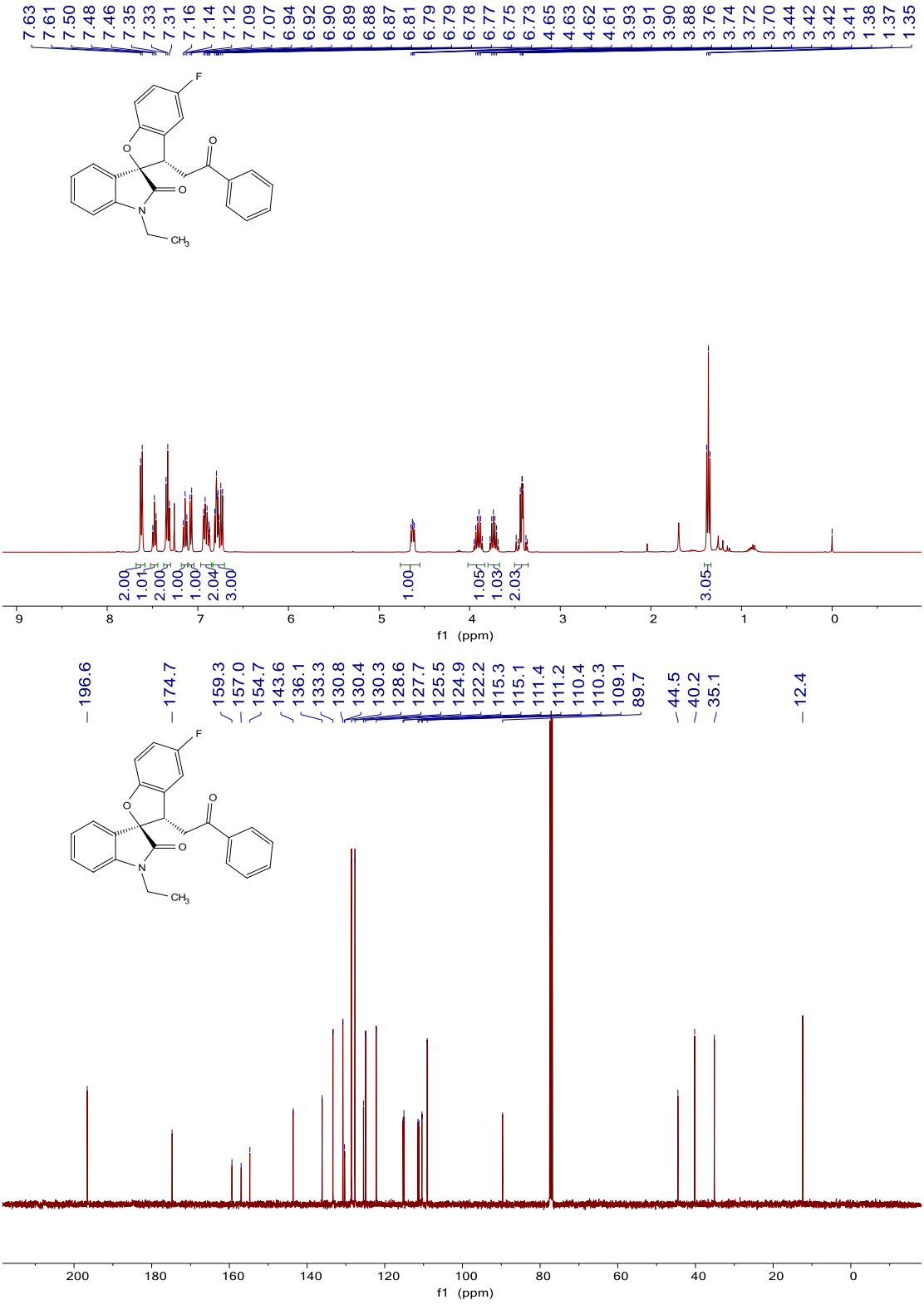

196.90
174.69
161.00
160.86
160.77
158.54
143.87
136.19
133.15
130.76
130.43
130.34
128.45
127.59
125.33
125.10
122.05
115.02
114.83
108.99
108.71
108.51
106.34
106.31
89.40
43.19
39.19
35.15
12.39
F
O
Ph
O
N
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)

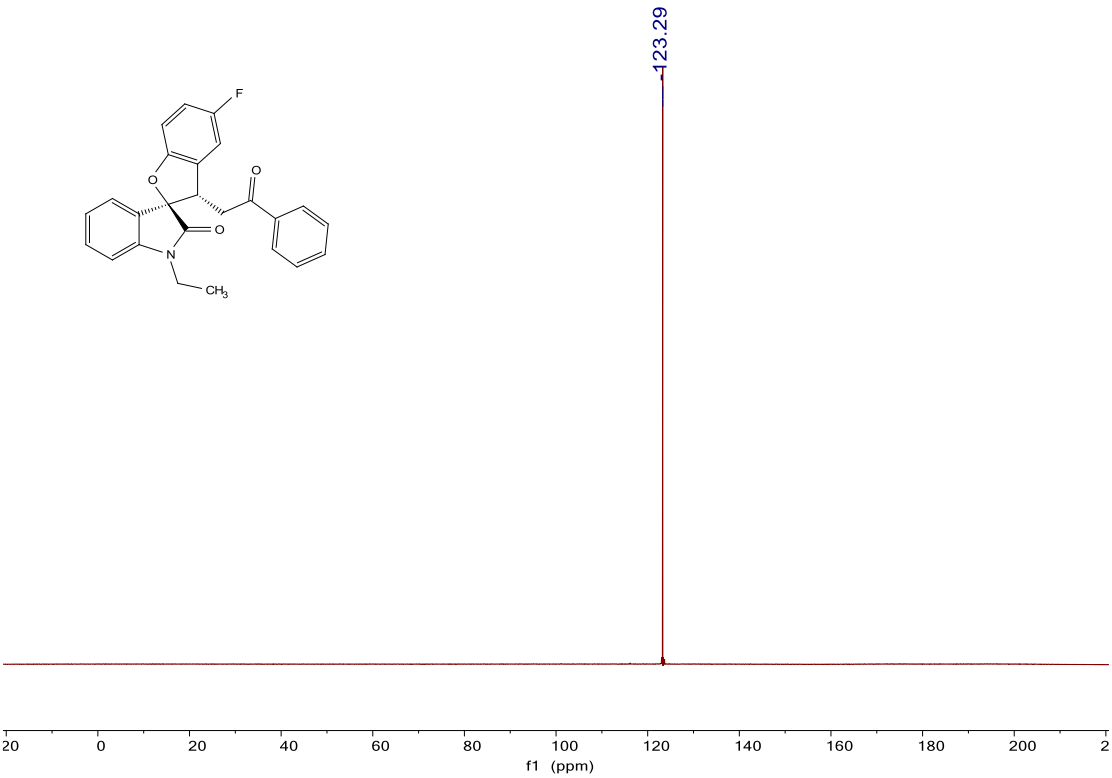

119.06
F
O
Ph
O
N
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

C23

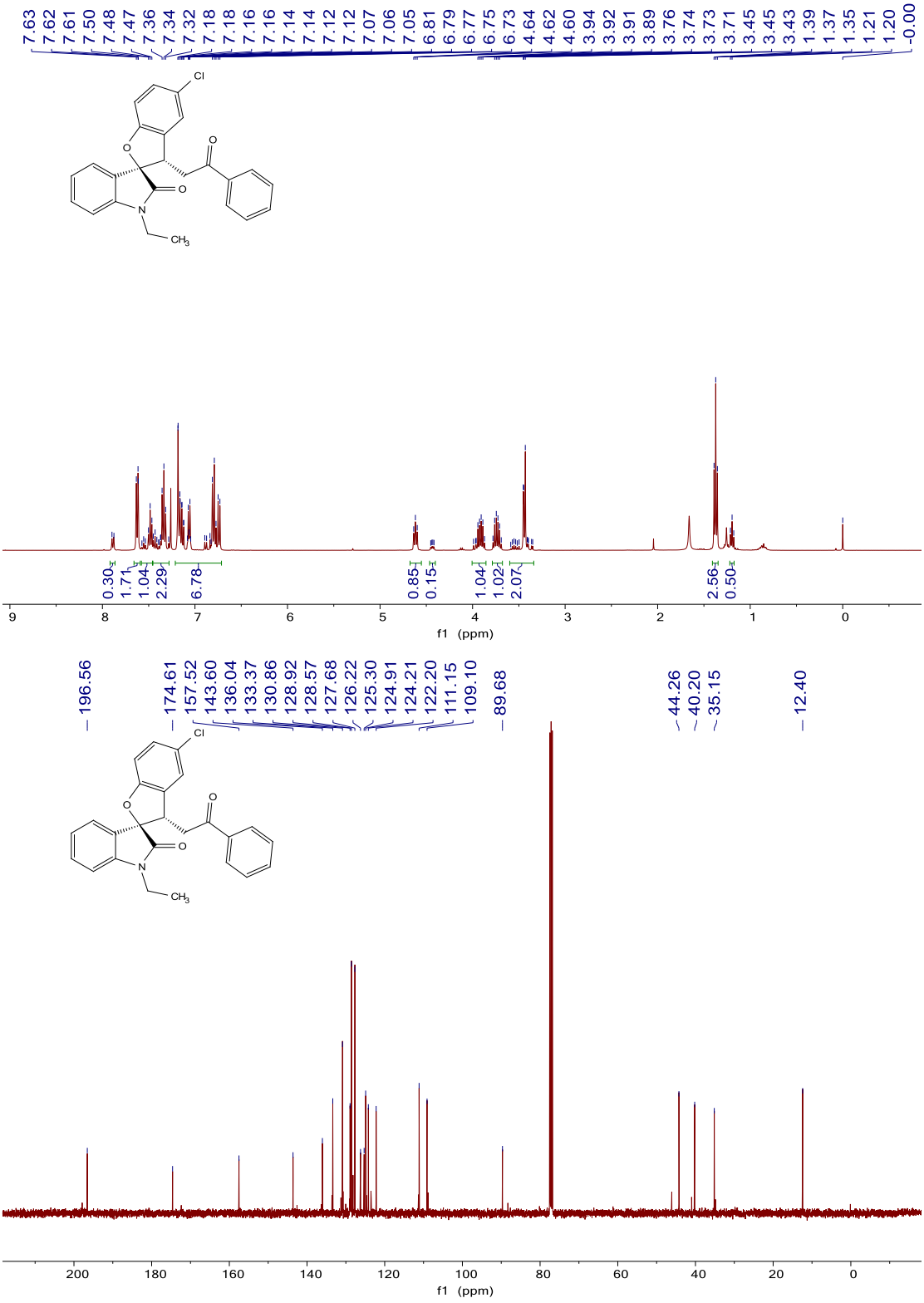

7.58 7.56 7.46 7.44 7.42 7.31 7.30 7.28 7.14 7.12 7.08 7.06 7.04 6.72 6.71 6.70 6.69 6.14 6.13 6.10 6.09 4.62 4.61 4.59 4.58 3.93 3.91 3.89 3.88 3.87 3.85 3.84 3.78 3.77 3.75 3.73 3.72 3.46 3.43 3.41 3.38 1.39 1.37 1.36 0.00
2.01 1.04 2.01 1.00 1.03 2.00 2.01 1.00 2.08 6.08 1.02 1.02 3.05
f1 (ppm)
197.8 175.2 162.2 160.8 157.2 143.8 136.6 132.8 130.4 128.3 127.5 126.0 125.2 121.9 108.7 107.0 92.1 89.5 88.8 55.7 55.4 43.4 39.4 35.0 12.4
f1 (ppm)

C24

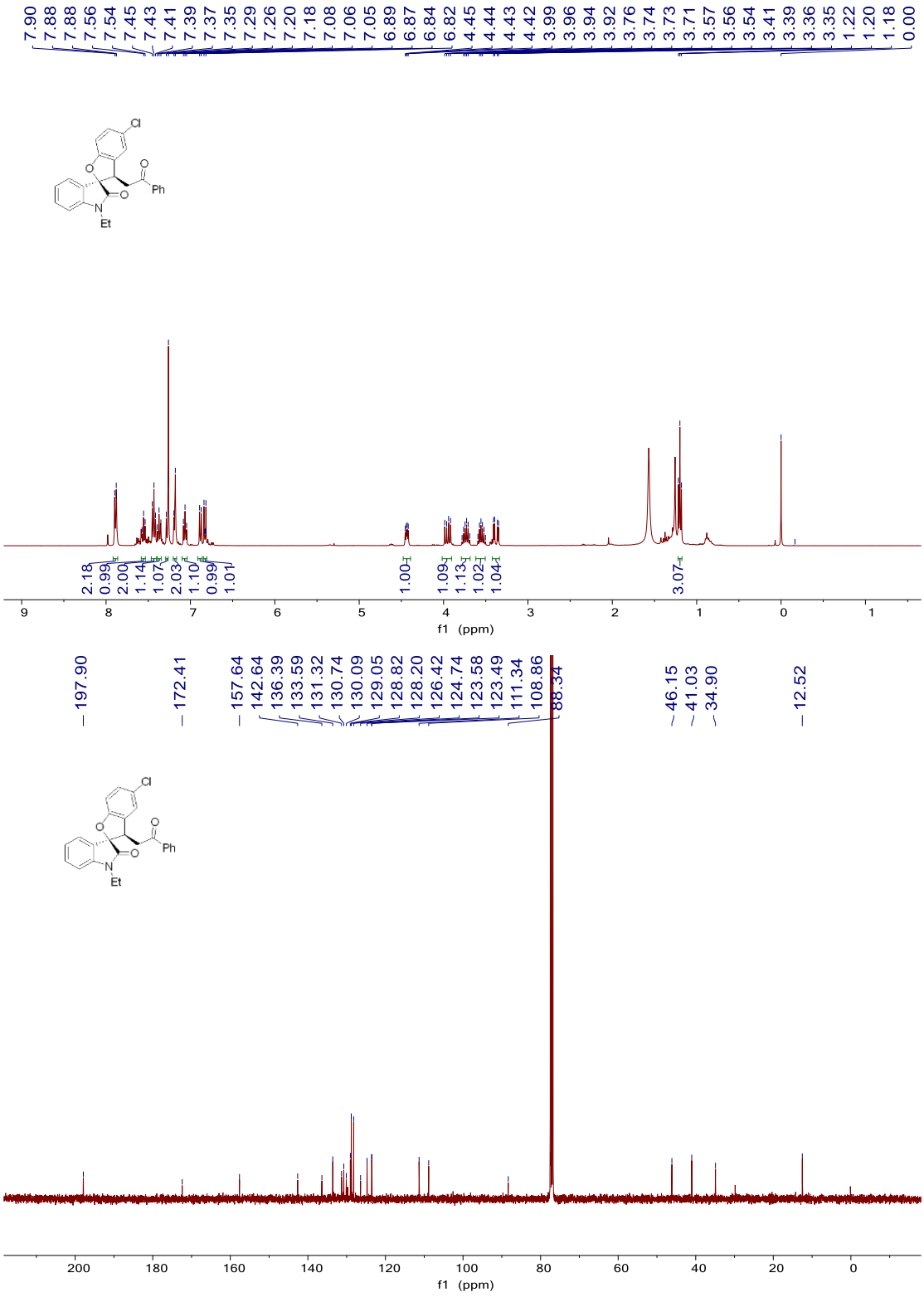

7.63
7.61
7.50
7.48
7.46
7.35
7.33
7.31
7.16
7.14
7.12
7.09
7.07
6.94
6.92
6.90
6.89
6.88
6.87
6.81
6.79
6.79
6.78
6.77
6.75
6.73
4.65
4.63
4.62
4.61
3.93
3.91
3.90
3.88
3.76
3.74
3.72
3.70
3.44
3.42
3.41
1.38
1.37
1.35
F
O
O
O
N
CH3
2.00
1.01
2.00
1.00
1.00
2.04
3.00
1.00
1.05
1.03
2.03
3.05
f1 (ppm)
196.6
174.7
159.3
157.0
154.7
143.6
136.1
133.3
130.8
130.4
130.3
128.6
127.7
125.5
124.9
122.2
115.3
115.1
111.4
111.2
110.4
110.3
109.1
89.7
44.5
40.2
35.1
12.4
f1 (ppm)


123.29
F
O
O
O
N
CH3
20
0
20
40
60
80
100
120
140
160
180
200
2
f1 (ppm)

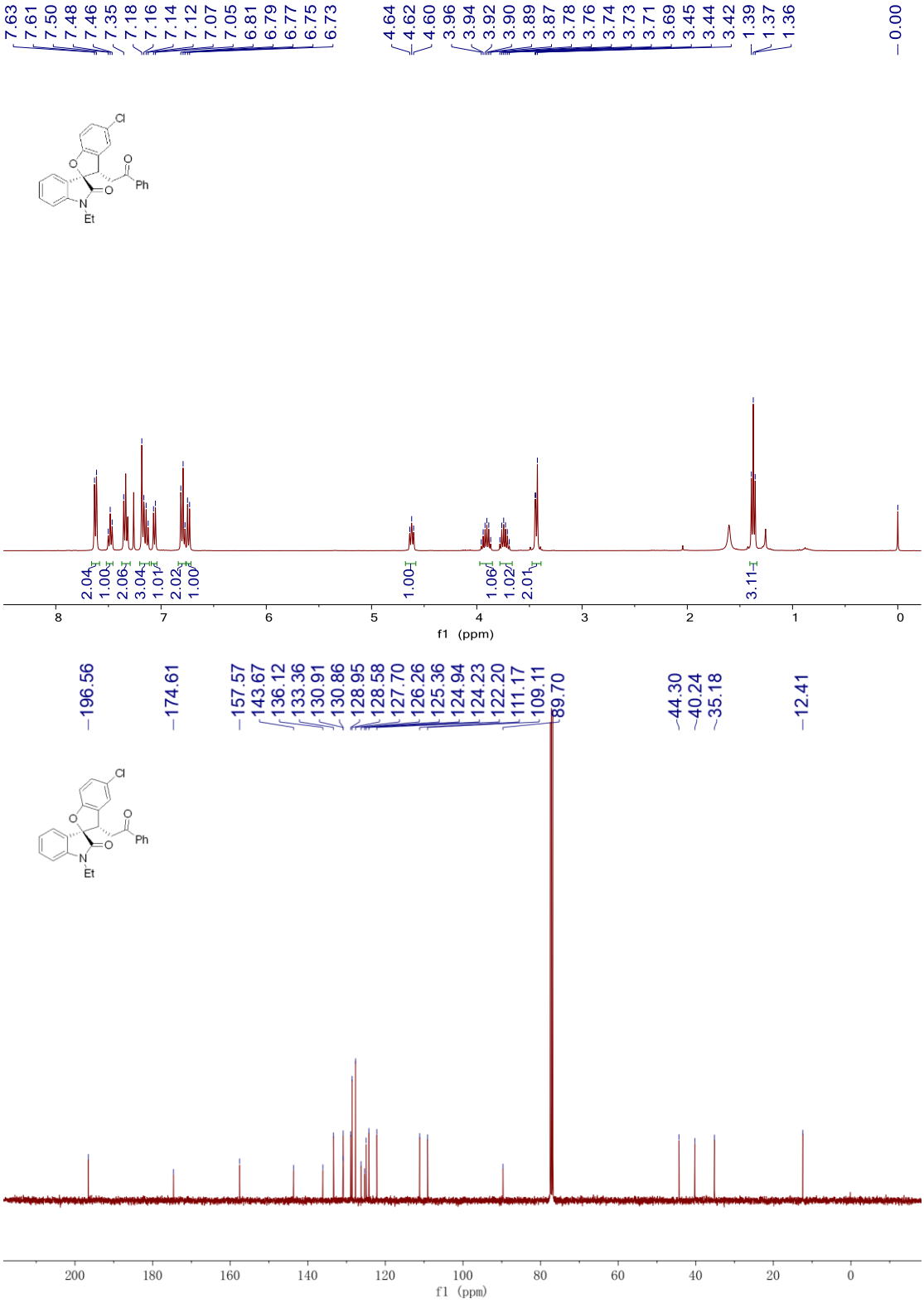
C25


7.63 7.62 7.61 7.50 7.48 7.47 7.36 7.34 7.32 7.18 7.18 7.16 7.16 7.14 7.14 7.12 7.12 7.07 7.06 7.05 6.81 6.79 6.77 6.75 6.73 4.64 4.62 4.60 3.94 3.92 3.91 3.89 3.76 3.74 3.73 3.71 3.45 3.45 3.43 1.39 1.37 1.35 1.21 1.20 -0.00
Cl
O
O
O
N
CH3
0.30 1.71 1.04 2.29 6.78 0.85 0.15 1.04 1.02 2.07 2.56 0.50
f1 (ppm)
196.56 174.61 157.52 143.60 136.04 133.37 130.86 128.92 128.57 127.68 126.22 125.30 124.91 124.21 122.20 111.15 109.10 89.68 44.26 40.20 35.15 12.40
f1 (ppm)

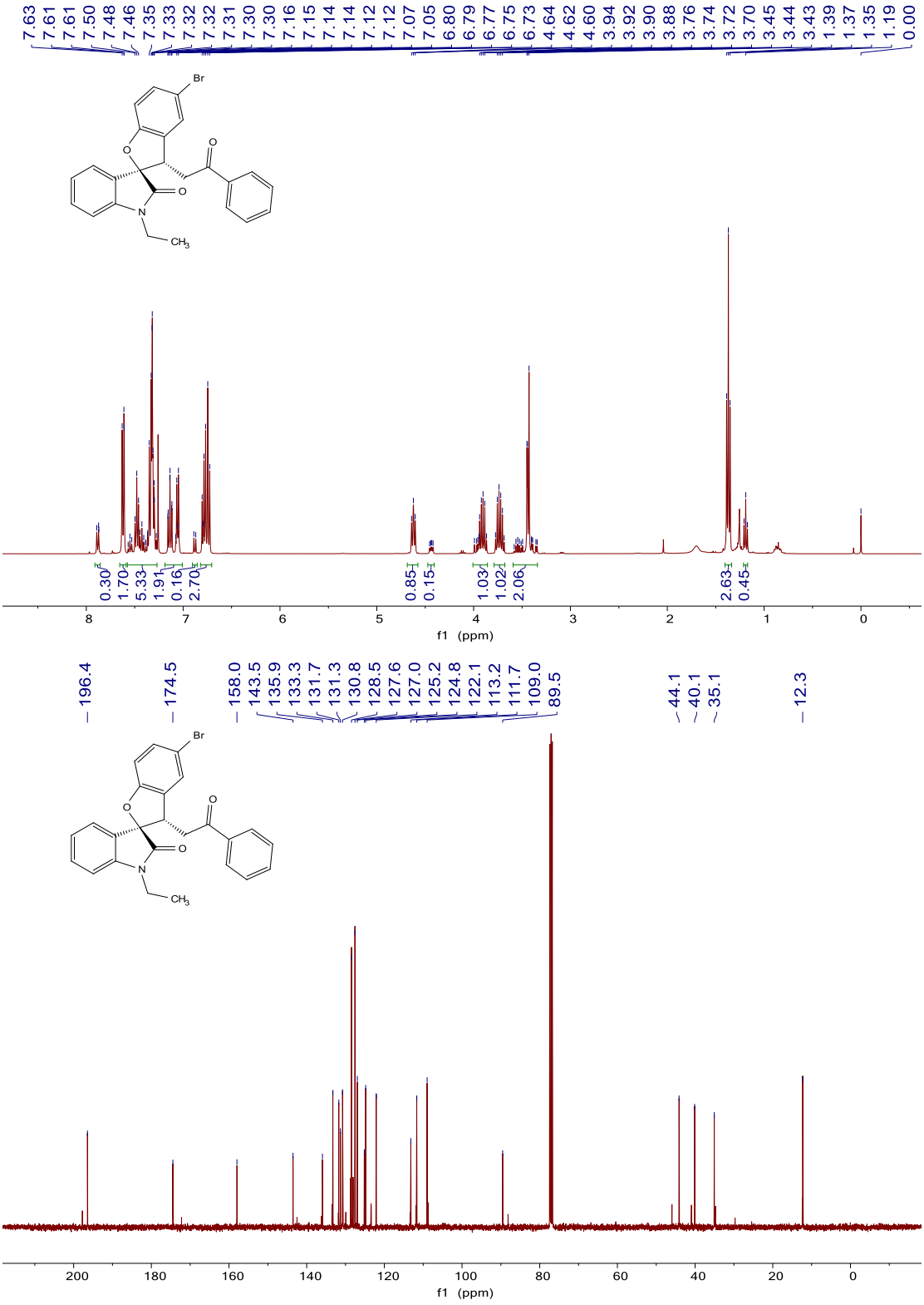
Minor diastereomer of C25



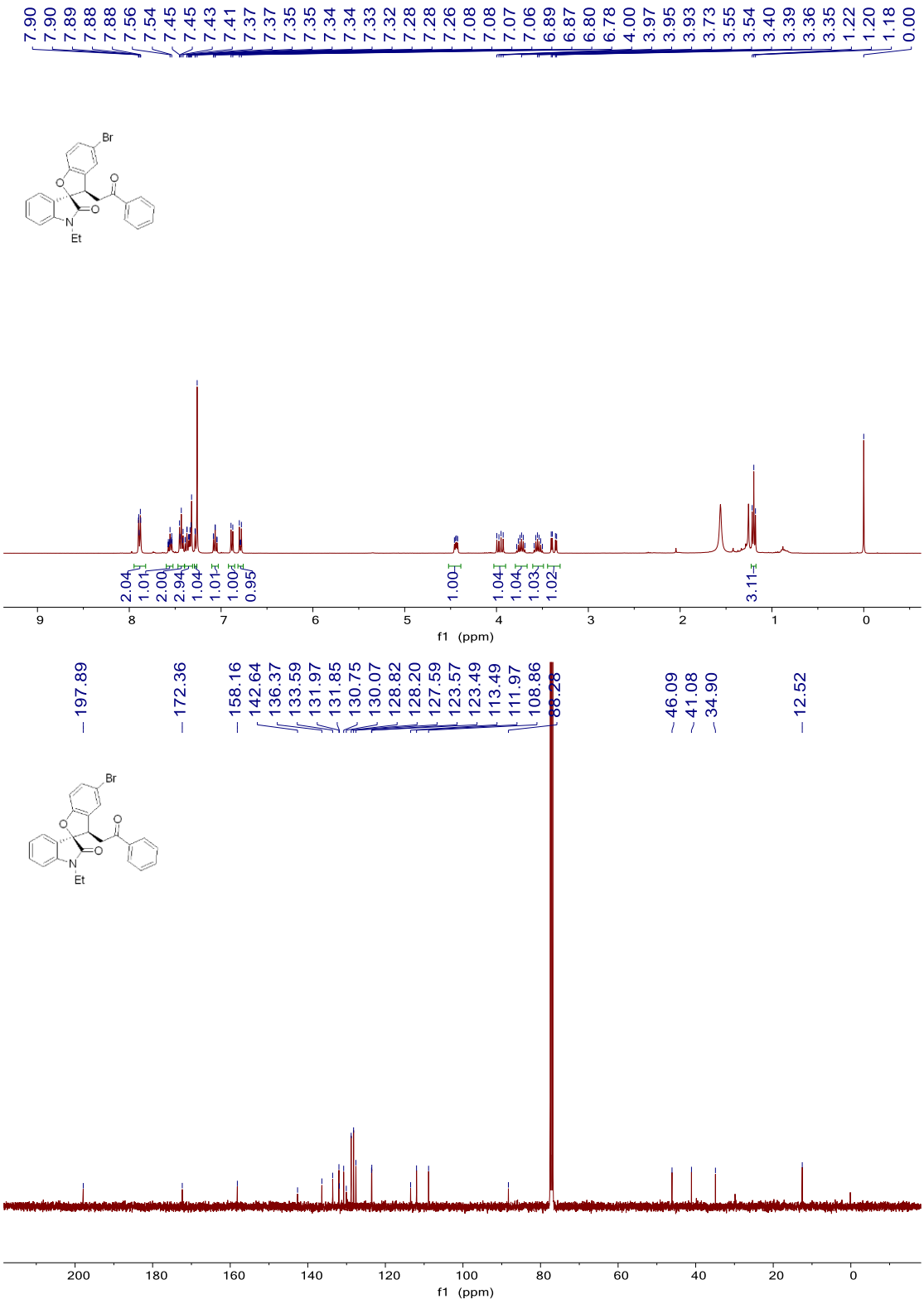
Major diastereomer of C25



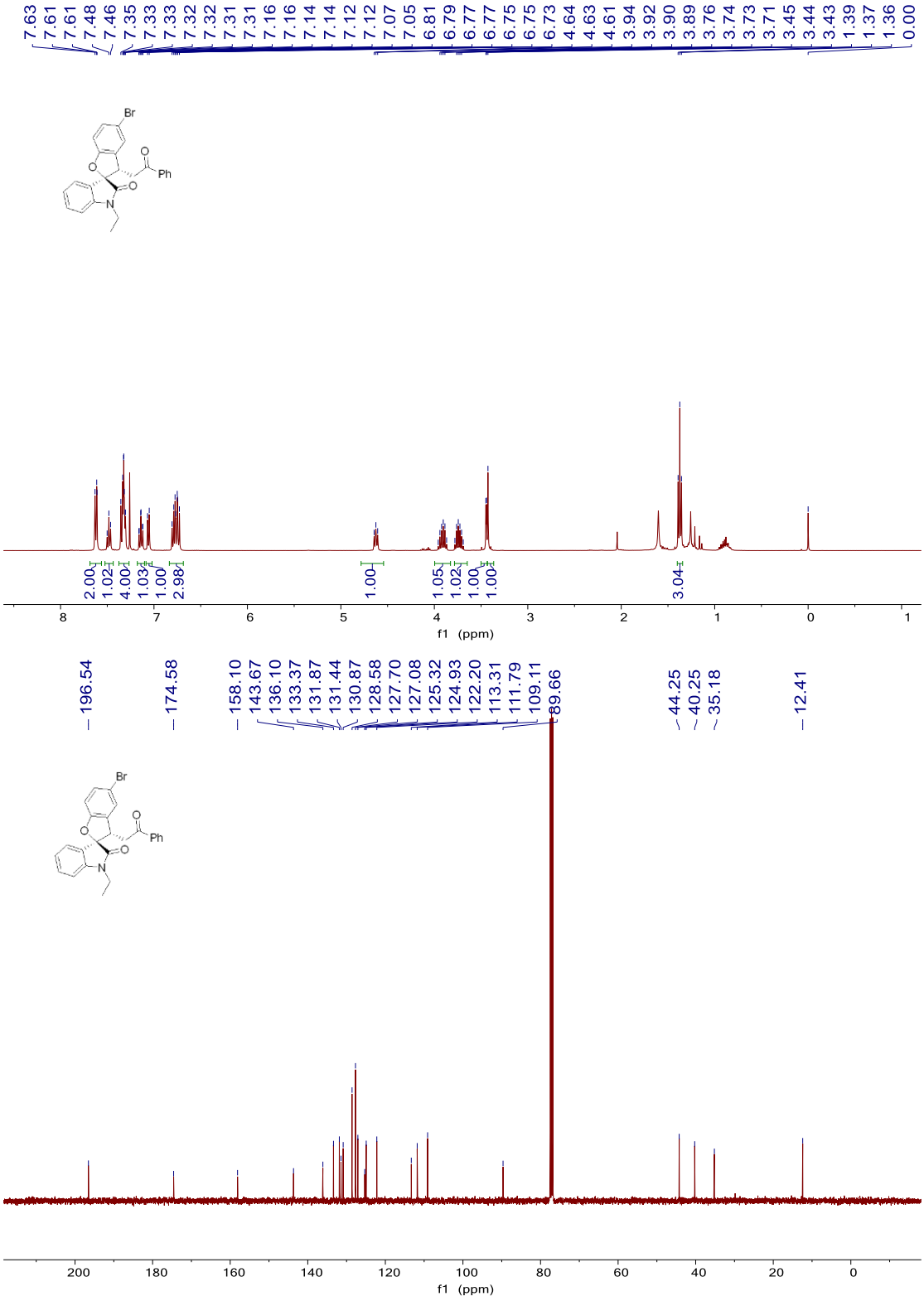
C26


7.63 7.61 7.61 7.50 7.48 7.46 7.35 7.33 7.32 7.32 7.31 7.30 7.30 7.16 7.15 7.14 7.14 7.12 7.07 7.05 6.80 6.79 6.77 6.75 6.73 4.64 4.62 4.60 3.94 3.92 3.90 3.88 3.76 3.74 3.72 3.70 3.45 3.44 3.43 1.39 1.37 1.35 1.19 0.00
Br
O
O
O
N
CH3
0.30 1.70 5.33 1.91 0.16 2.70 0.85 0.15 1.03 1.02 2.06 2.63 0.45
f1 (ppm)
196.4 174.5 158.0 143.5 135.9 133.3 131.7 131.3 130.8 128.5 127.6 127.0 125.2 124.8 122.1 113.2 111.7 109.0 89.5 44.1 40.1 35.1 12.3
f1 (ppm)

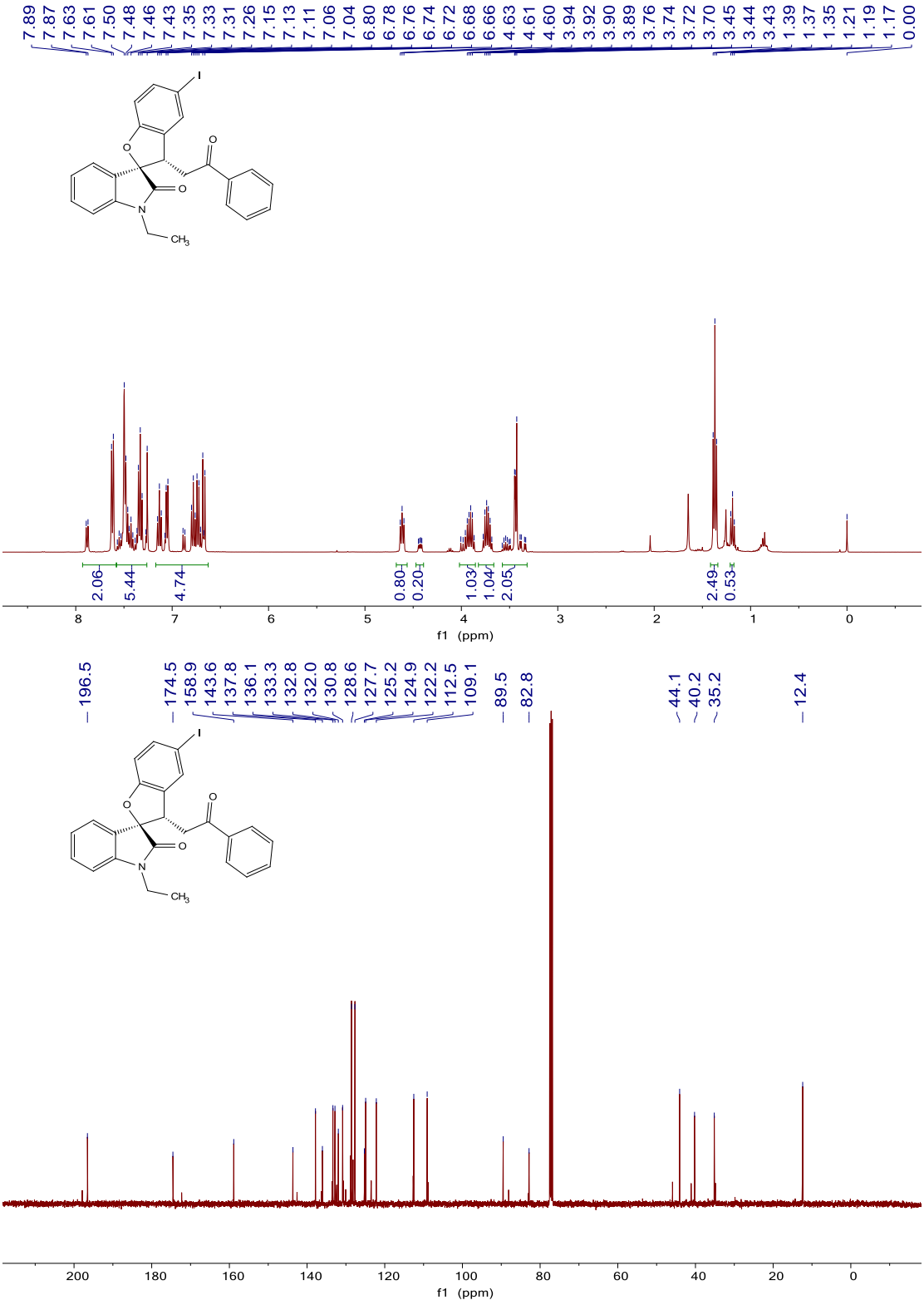
Minor diastereomer of C26



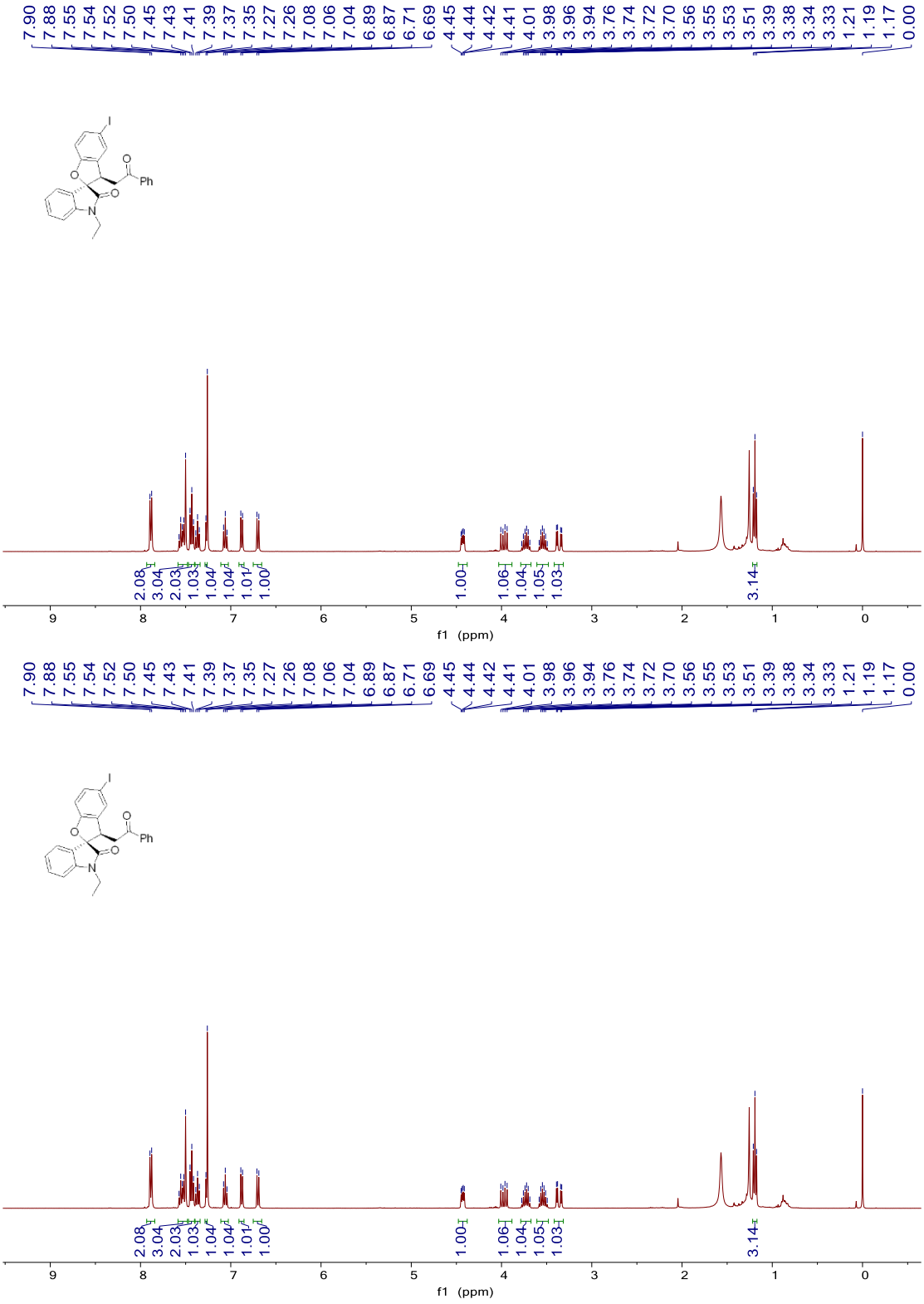
Major diastereomer of C26



C27

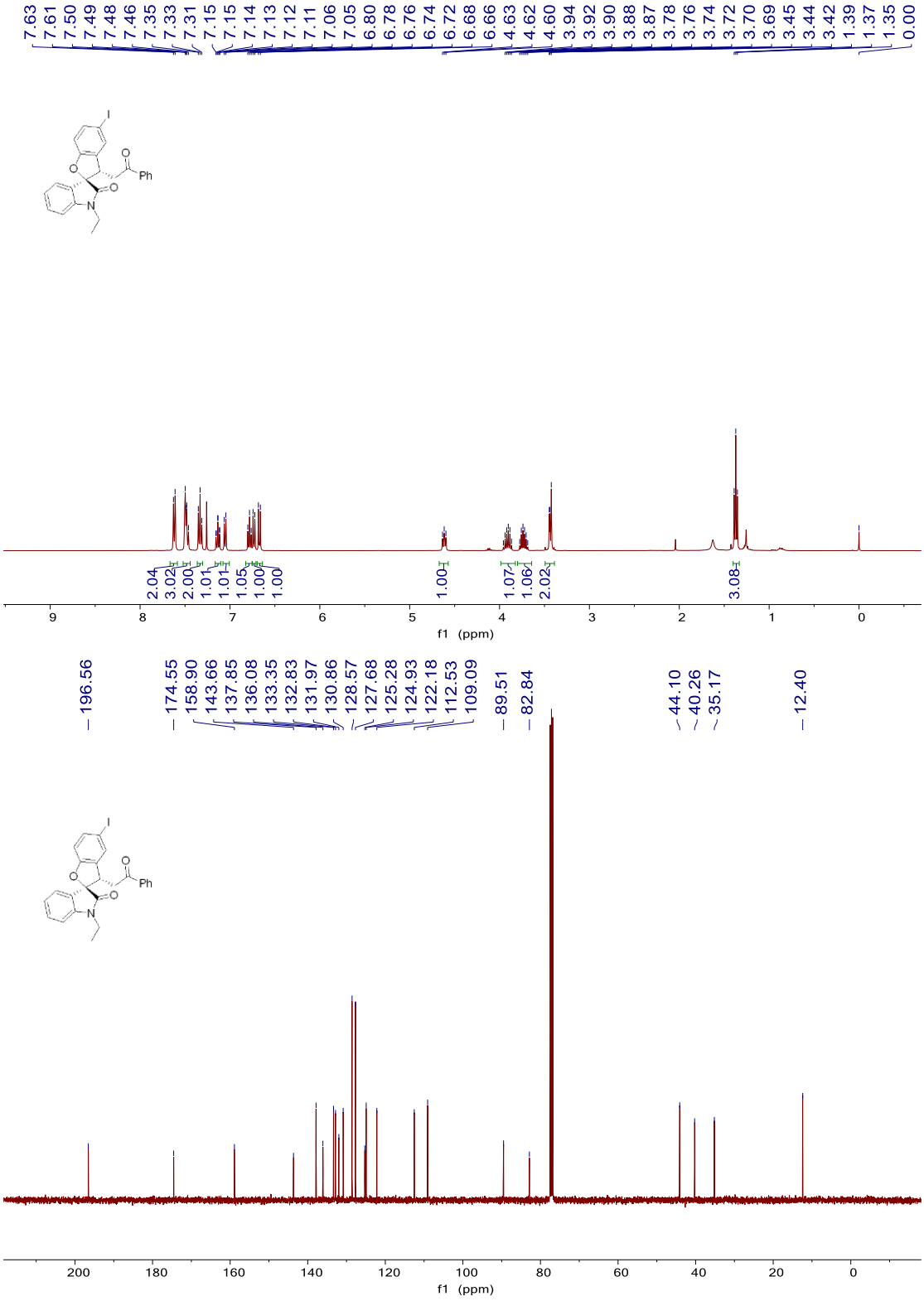

7.89 7.87 7.63 7.61 7.50 7.48 7.46 7.43 7.35 7.33 7.31 7.26 7.15 7.13 7.11 7.06 7.04 6.80 6.78 6.76 6.74 6.72 6.68 6.66 4.63 4.61 4.60 3.94 3.92 3.90 3.89 3.76 3.74 3.72 3.70 3.45 3.44 3.43 1.39 1.37 1.35 1.21 1.19 1.17 0.00
I
O
O
O
N
CH3
2.06 5.44 4.74 0.80 0.20 1.03 1.04 2.05 2.49 0.53
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.5 174.5 158.9 143.6 137.8 136.1 133.3 132.8 132.0 130.8 128.6 127.7 125.2 124.9 122.2 112.5 109.1 89.5 82.8 44.1 40.2 35.2 12.4
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

Minor diastereomer of C27

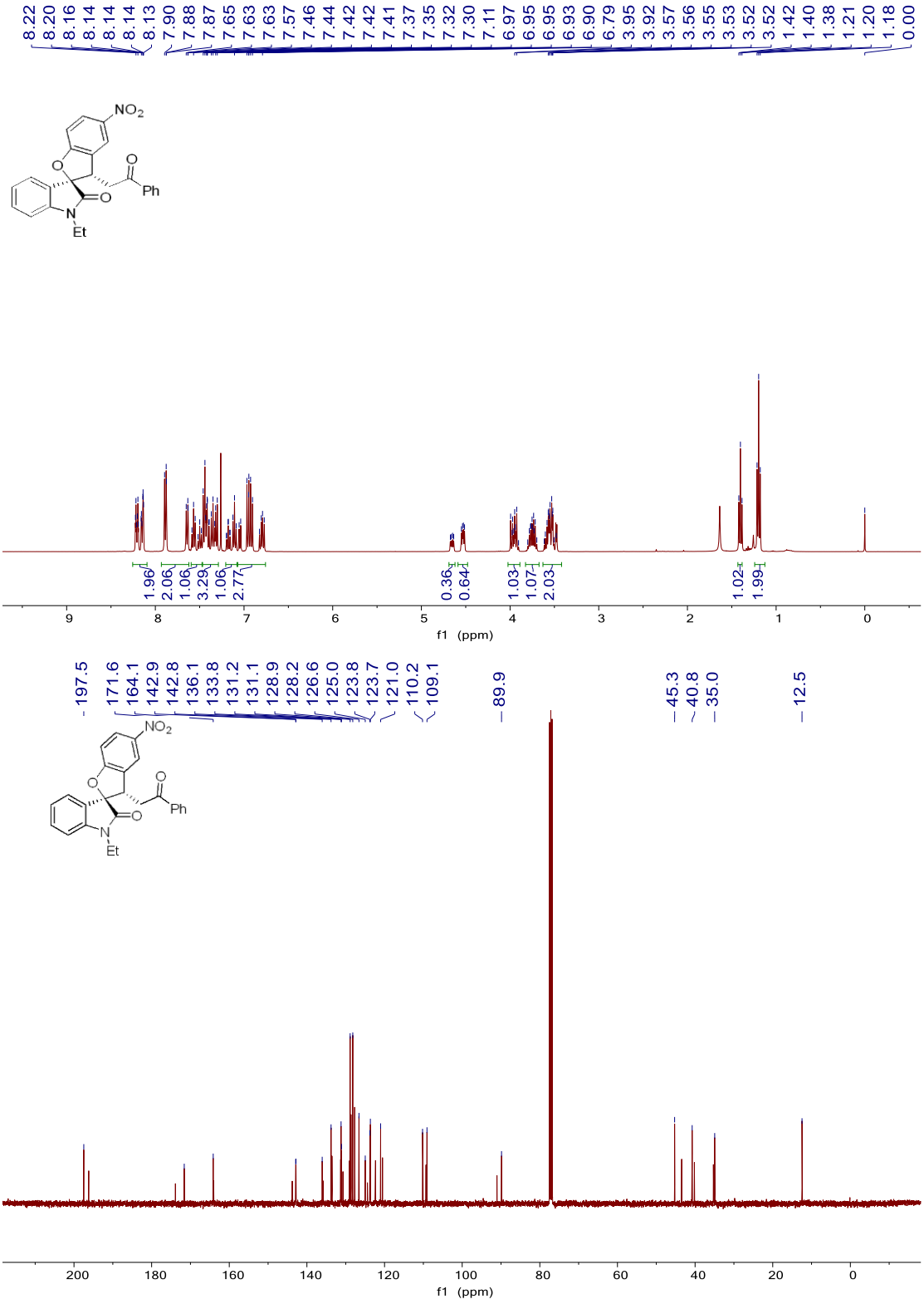


7.90 7.88 7.55 7.54 7.52 7.50 7.45 7.43 7.41 7.39 7.37 7.35 7.27 7.26 7.08 7.06 7.04 6.89 6.87 6.71 6.69
4.45 4.44 4.42 4.41 4.01 3.98 3.96 3.94 3.76 3.74 3.72 3.70 3.56 3.55 3.53 3.51 3.39 3.38 3.34 3.33 1.21 1.19 1.17 0.00
I
O
Ph
O
O
N
2.08 3.04 2.03 1.03 1.04 1.04 1.01 1.00
1.00 1.06 1.04 1.05 1.03
3.14
9 8 7 6 5 4 3 2 1 0
f1 (ppm)

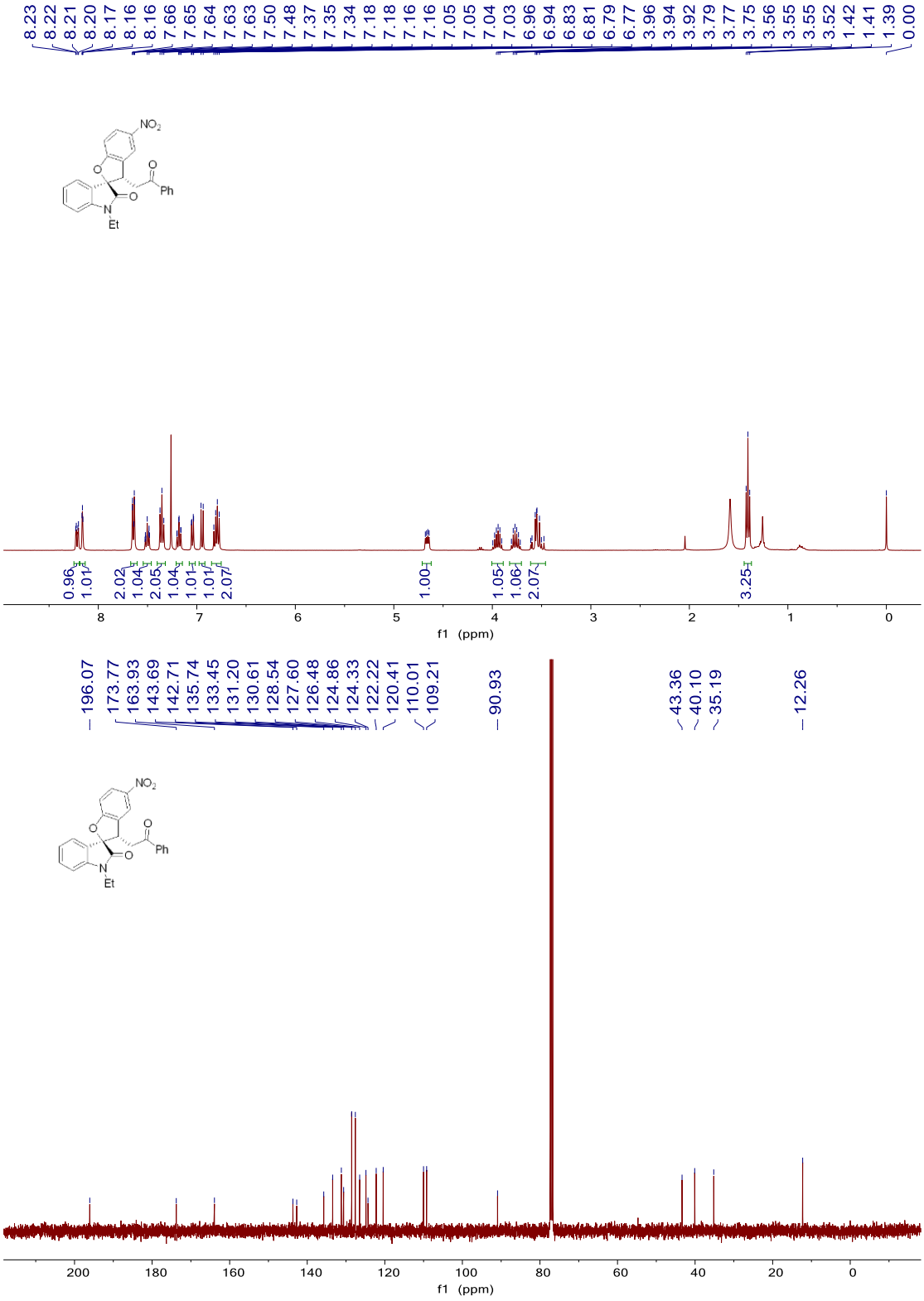
Major diastereomer of C27



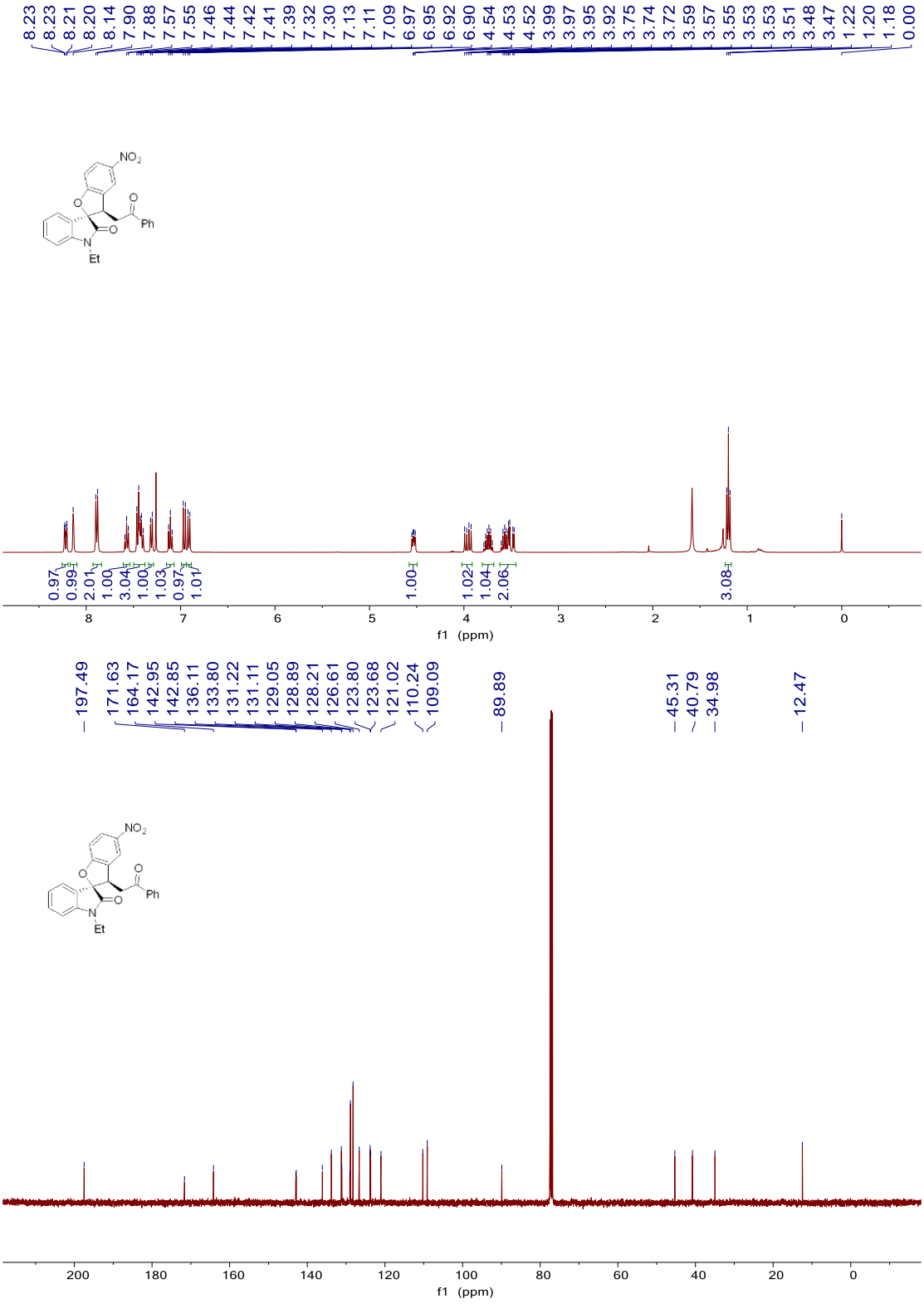
C28


8.22 8.20 8.16 8.14 8.14 8.14 8.13 7.90 7.88 7.87 7.65 7.63 7.63 7.57 7.46 7.44 7.42 7.42 7.41 7.37 7.35 7.32 7.30 7.11 6.97 6.95 6.95 6.93 6.90 6.79 3.95 3.92 3.57 3.56 3.55 3.53 3.52 3.52 1.42 1.40 1.38 1.21 1.20 1.18 0.00
NO2
O
Ph
N
Et
1.96 2.06 1.06 3.29 1.06 2.77 0.36 0.64 1.03 1.07 2.03 1.02 1.99
f1 (ppm)
197.5 171.6 164.1 142.9 142.8 136.1 133.8 131.2 131.1 128.9 128.2 126.6 125.0 123.8 123.7 121.0 110.2 109.1 89.9 45.3 40.8 35.0 12.5
f1 (ppm)

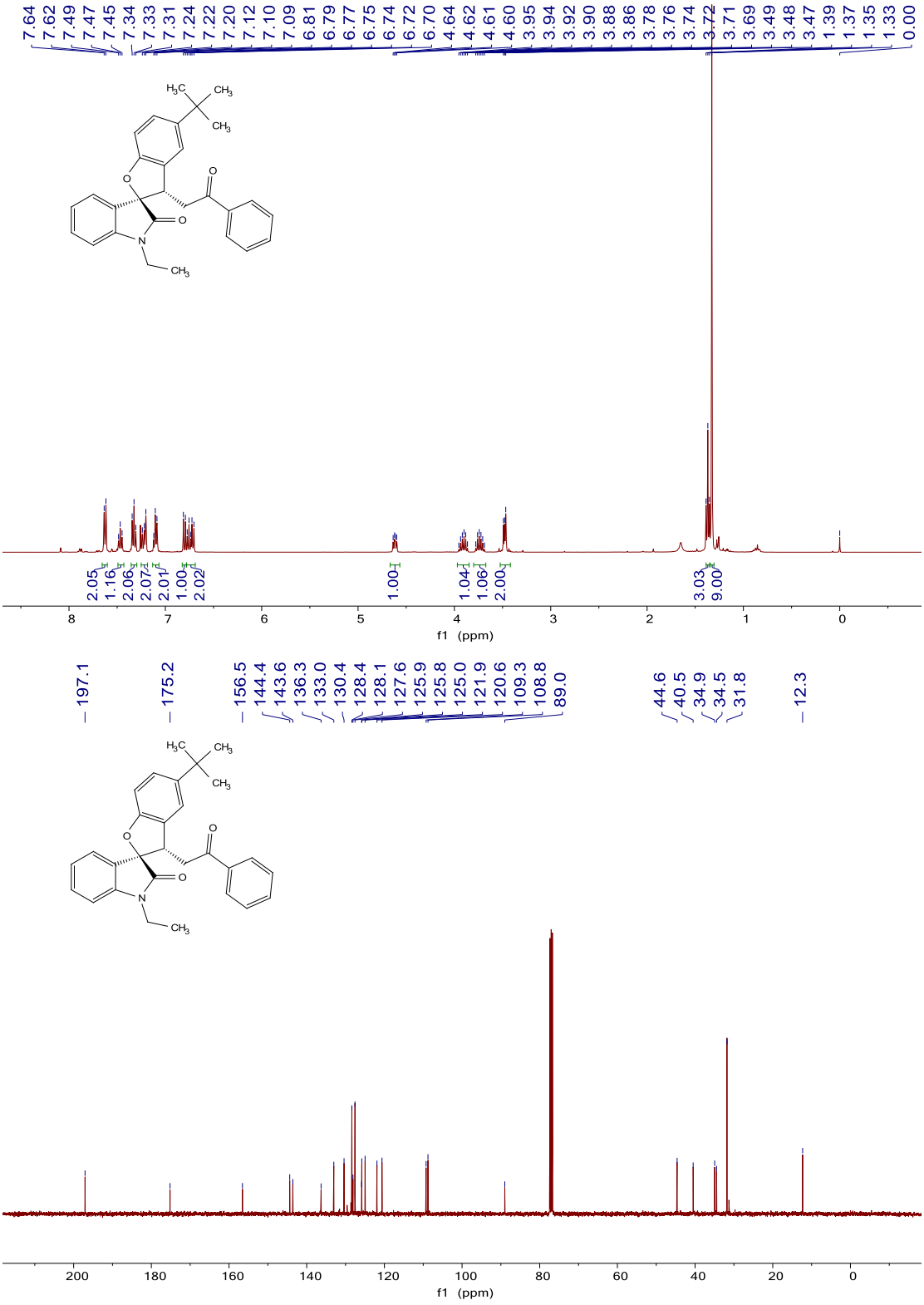
Minor diastereomer of C28



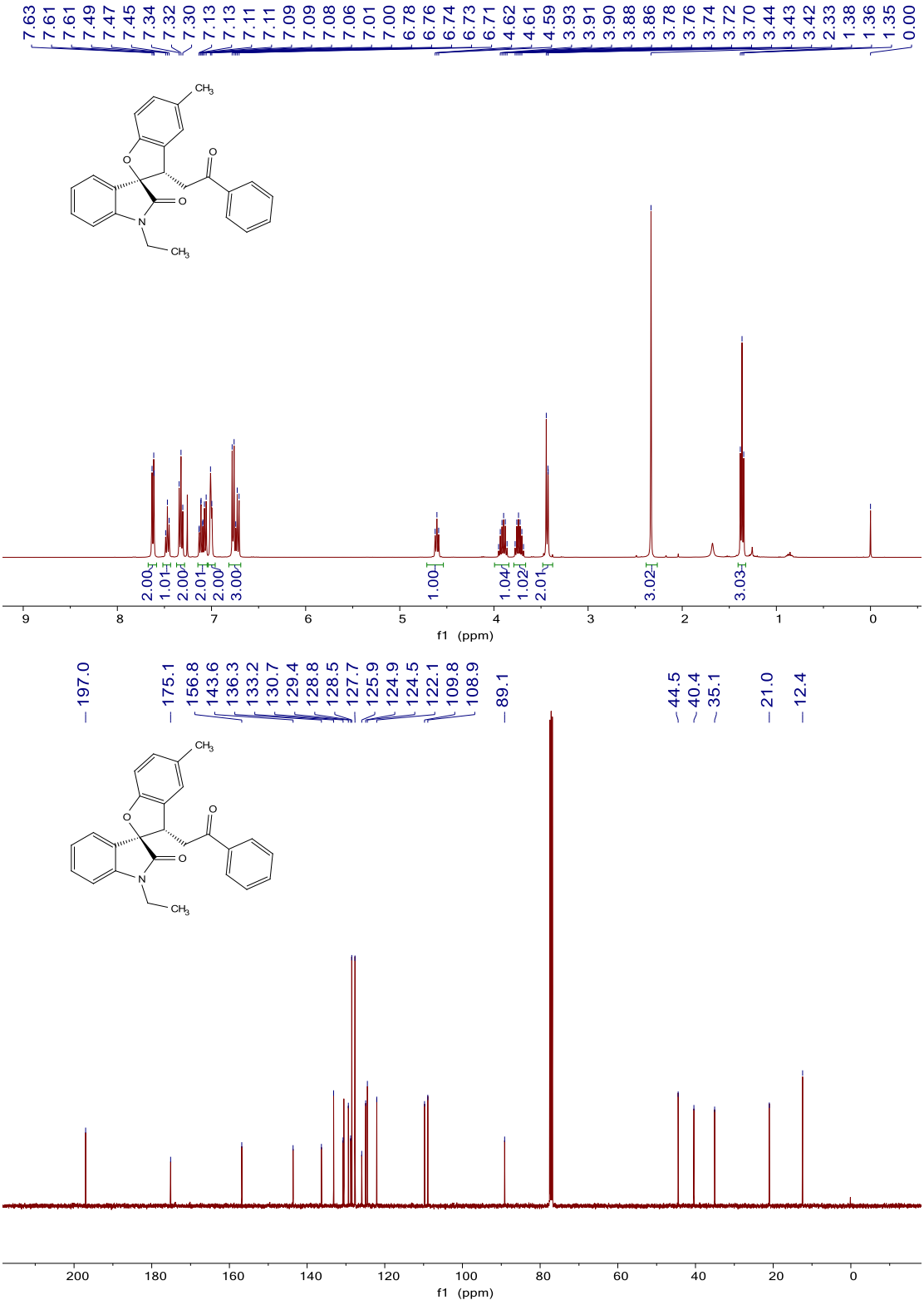
Major diastereomer of C28



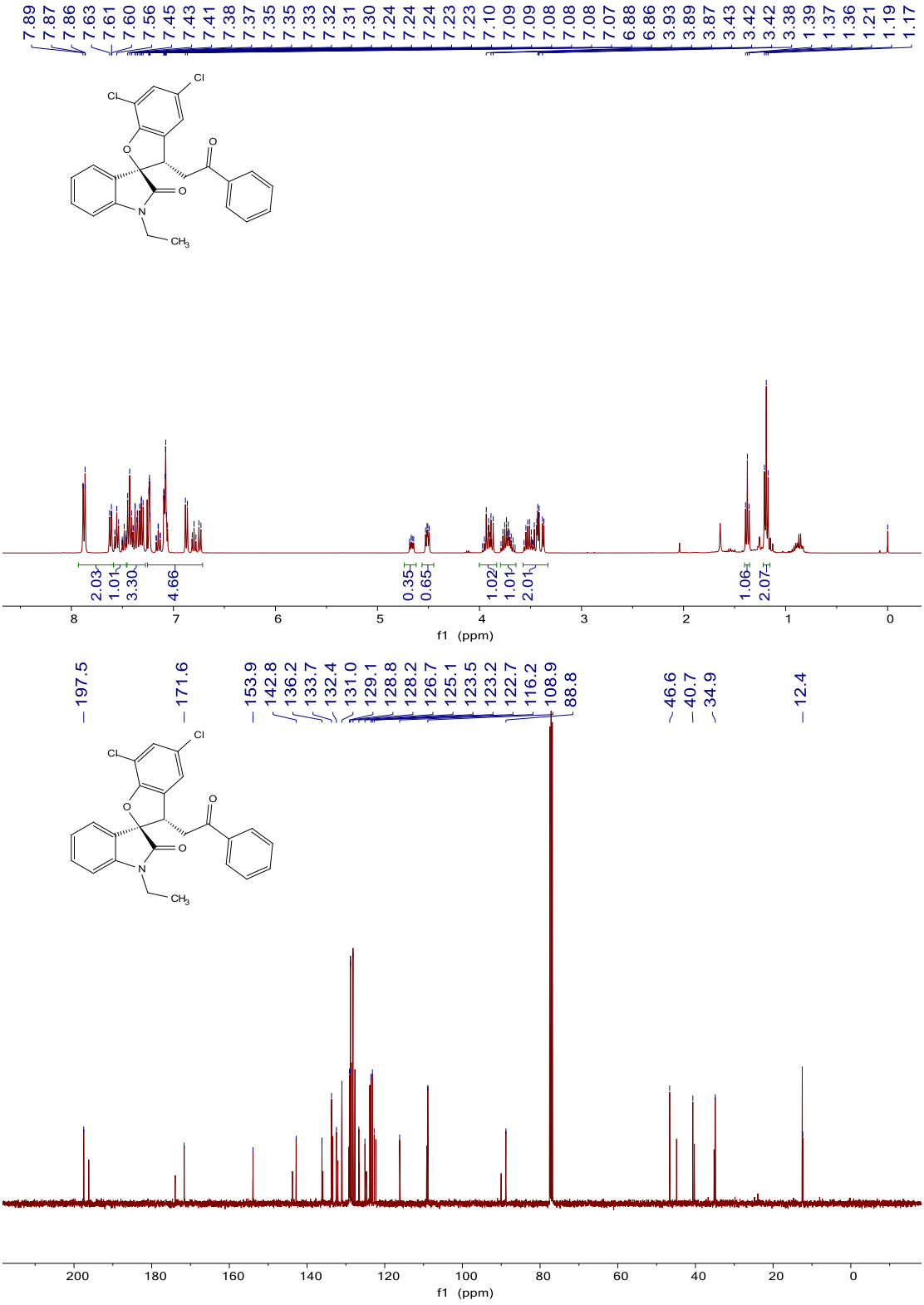
C29


7.64 7.62 7.49 7.47 7.45 7.34 7.33 7.31 7.24 7.22 7.20 7.12 7.10 7.09 6.81 6.79 6.77 6.75 6.74 6.72 6.70 4.64 4.62 4.61 4.60 3.95 3.94 3.92 3.90 3.88 3.86 3.78 3.76 3.74 3.72 3.71 3.69 3.49 3.48 3.47 1.39 1.37 1.35 1.33 0.00
2.05 1.16 2.06 2.07 2.01 1.00 2.02 1.00 1.04 1.06 2.00 3.03 9.00
f1 (ppm)
197.1 175.2 156.5 144.4 143.6 136.3 133.0 130.4 128.4 128.1 127.6 125.9 125.8 125.0 121.9 120.6 109.3 108.8 89.0 44.6 40.5 34.9 34.5 31.8 12.3
f1 (ppm)

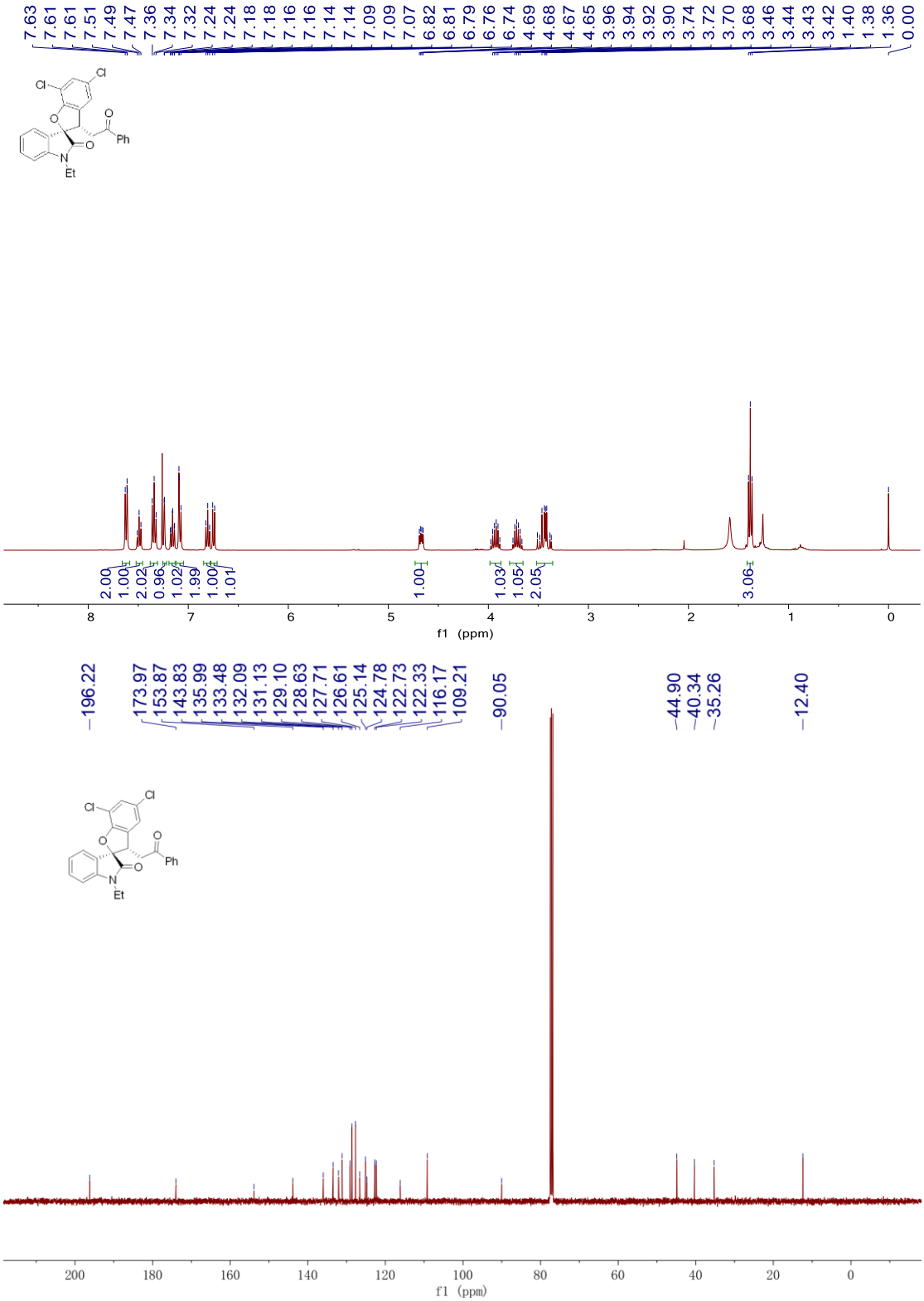
C30


7.63 7.61 7.61 7.49 7.47 7.45 7.34 7.32 7.30 7.13 7.13 7.11 7.11 7.09 7.09 7.08 7.06 7.01 7.00 6.78 6.76 6.74 6.73 6.71 4.62 4.61 4.59 3.93 3.91 3.90 3.88 3.86 3.78 3.76 3.74 3.72 3.70 3.44 3.43 3.42 2.33 1.38 1.36 1.35 0.00
CH3
O
O
O
N
CH3
2.00 1.01 2.00 2.01 2.00 3.00 1.00 1.04 1.02 2.01 3.02 3.03
f1 (ppm)
197.0 175.1 156.8 143.6 136.3 133.2 130.7 129.4 128.8 128.5 127.7 125.9 124.9 124.5 122.1 109.8 108.9 89.1 44.5 40.4 35.1 21.0 12.4
f1 (ppm)

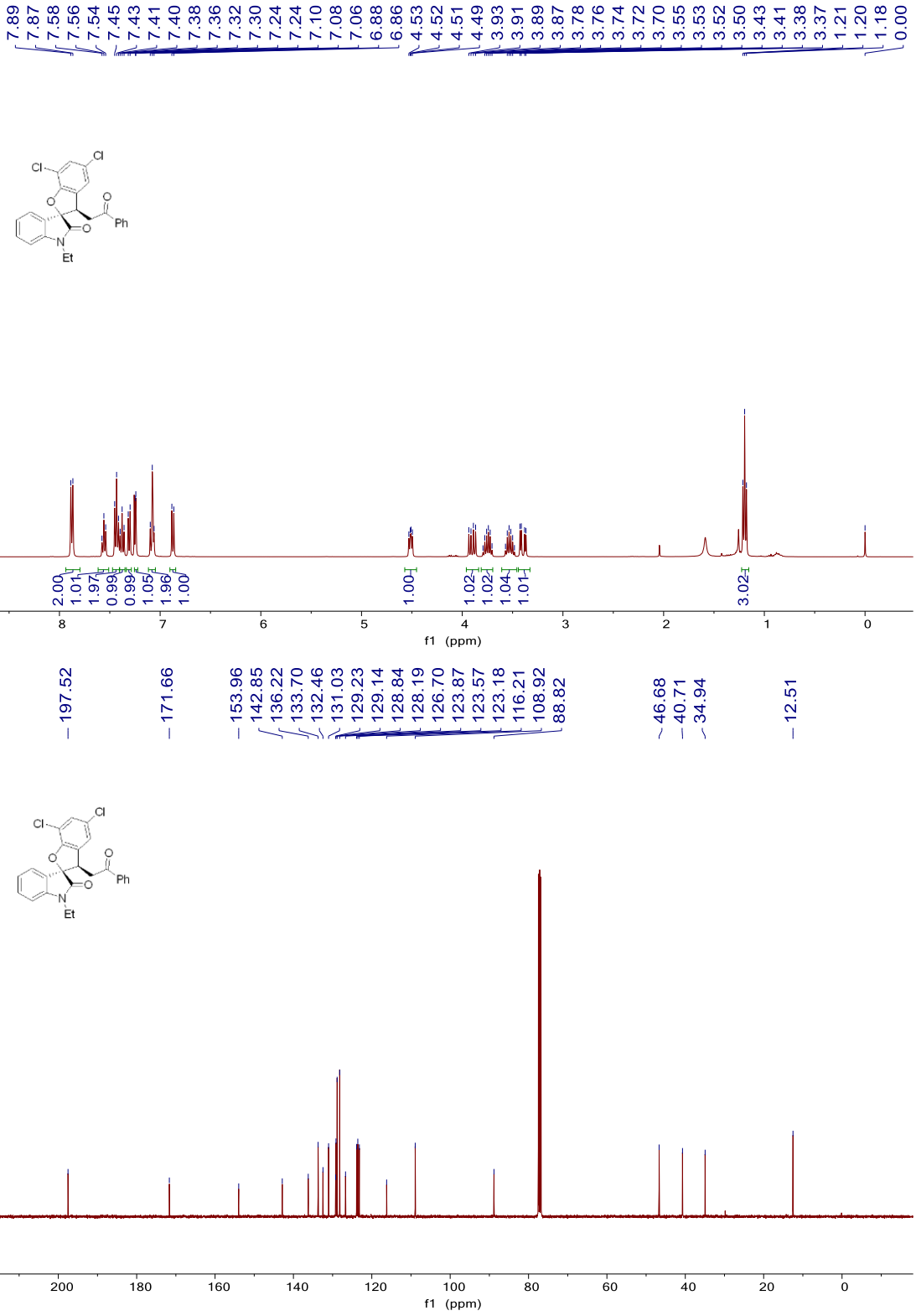
C31


7.89 7.87 7.86 7.63 7.61 7.60 7.56 7.45 7.43 7.41 7.38 7.37 7.35 7.35 7.33 7.32 7.31 7.30 7.24 7.24 7.24 7.23 7.23 7.10 7.09 7.09 7.08 7.08 7.08 7.07 6.88 6.86 3.93 3.89 3.87 3.43 3.42 3.42 3.38 1.39 1.37 1.36 1.21 1.19 1.17
Cl
Cl
O
O
O
N
CH3
2.03 1.01 3.30 4.66 0.35 0.65 1.02 1.01 2.01 1.06 2.07
f1 (ppm)
197.5 171.6 153.9 142.8 136.2 133.7 132.4 131.0 129.1 128.8 128.2 126.7 125.1 123.5 123.2 122.7 116.2 108.9 88.8 46.6 40.7 34.9 12.4
f1 (ppm)

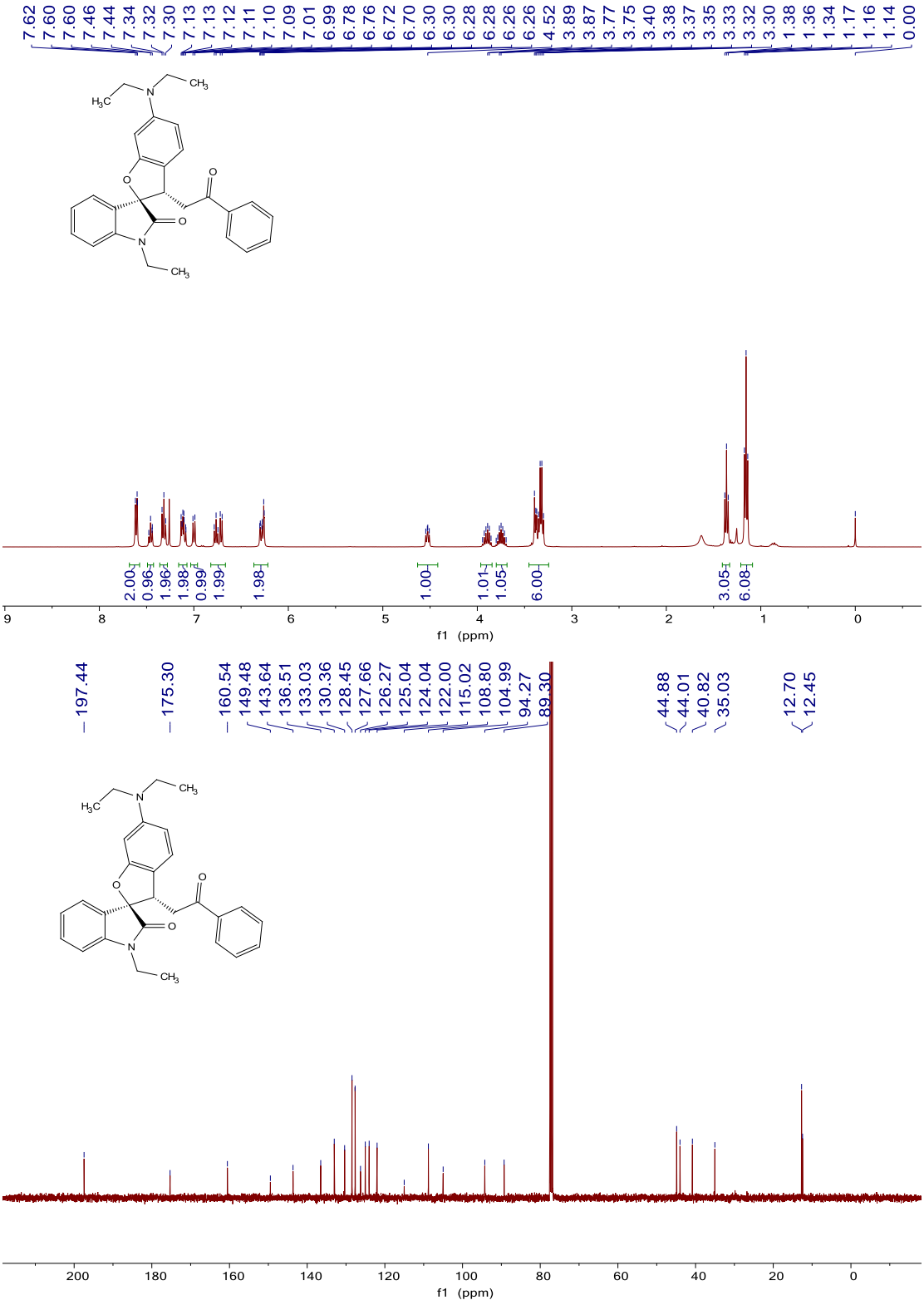
Minor diastereomer of C31



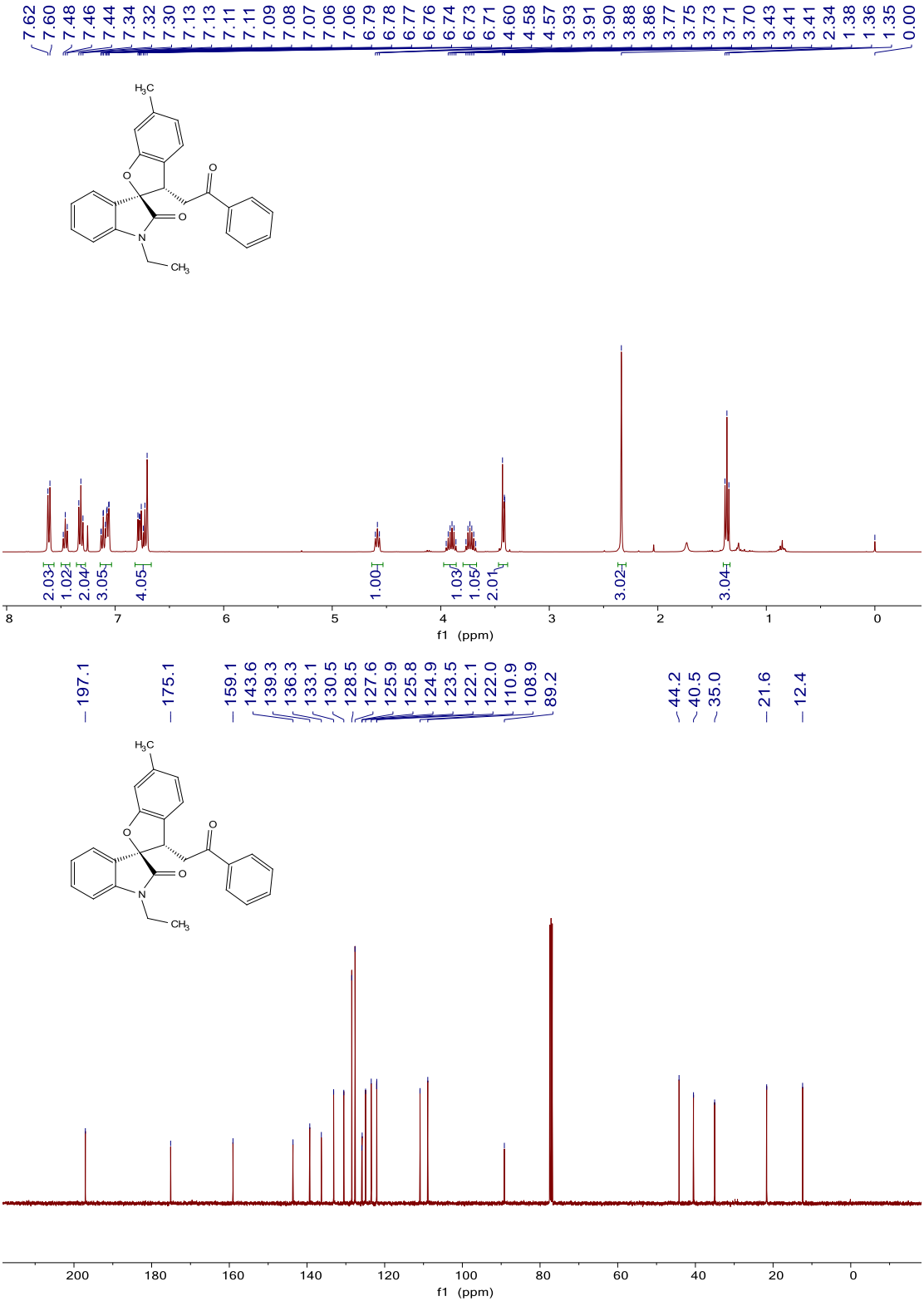
Major diastereomer of C31



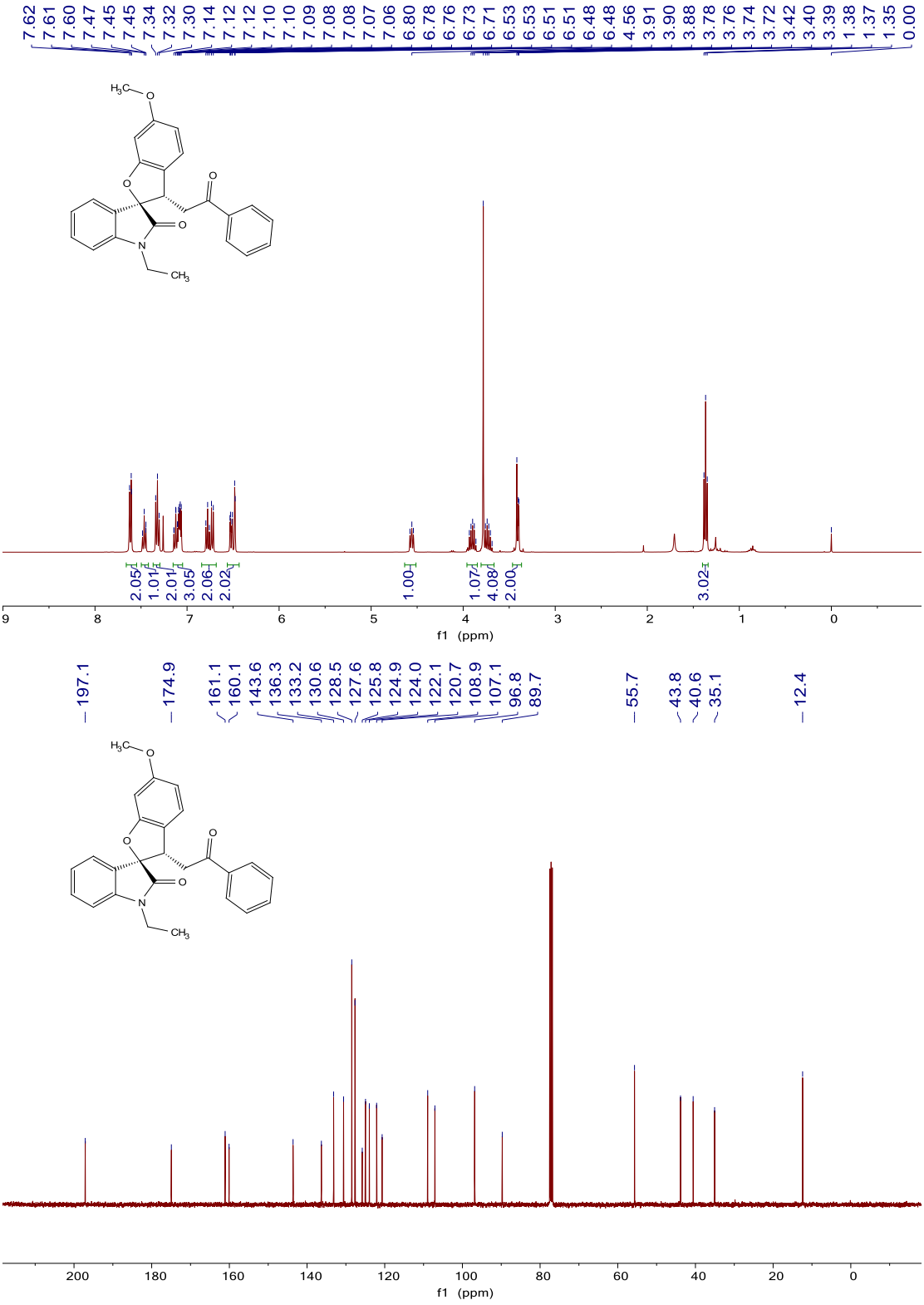
C32


7.62 7.60 7.60 7.46 7.44 7.34 7.32 7.30 7.13 7.13 7.12 7.11 7.10 7.09 7.01 6.99 6.78 6.76 6.72 6.70 6.30 6.30 6.28 6.28 6.26 4.52 3.89 3.87 3.77 3.75 3.40 3.38 3.37 3.35 3.33 3.32 3.30 1.38 1.36 1.34 1.17 1.16 1.14 0.00
2.00 0.96 1.96 1.98 0.99 1.99 1.98 1.00 1.01 1.05 6.00 3.05 6.08
f1 (ppm)
197.44 175.30 160.54 149.48 143.64 136.51 133.03 130.36 128.45 127.66 126.27 125.04 124.04 122.00 115.02 108.80 104.99 94.27 89.30 44.88 44.01 40.82 35.03 12.70 12.45
f1 (ppm)

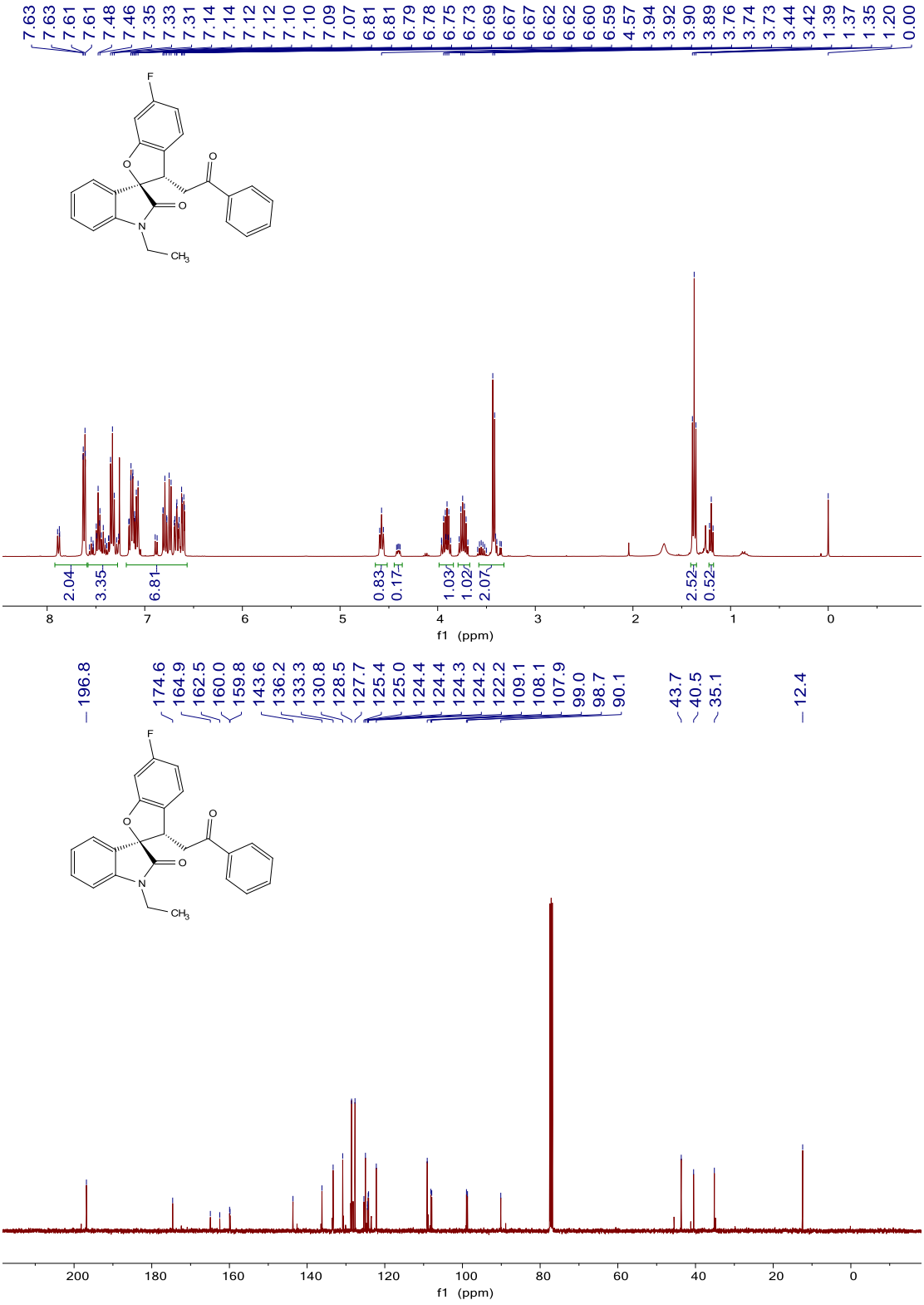
C33

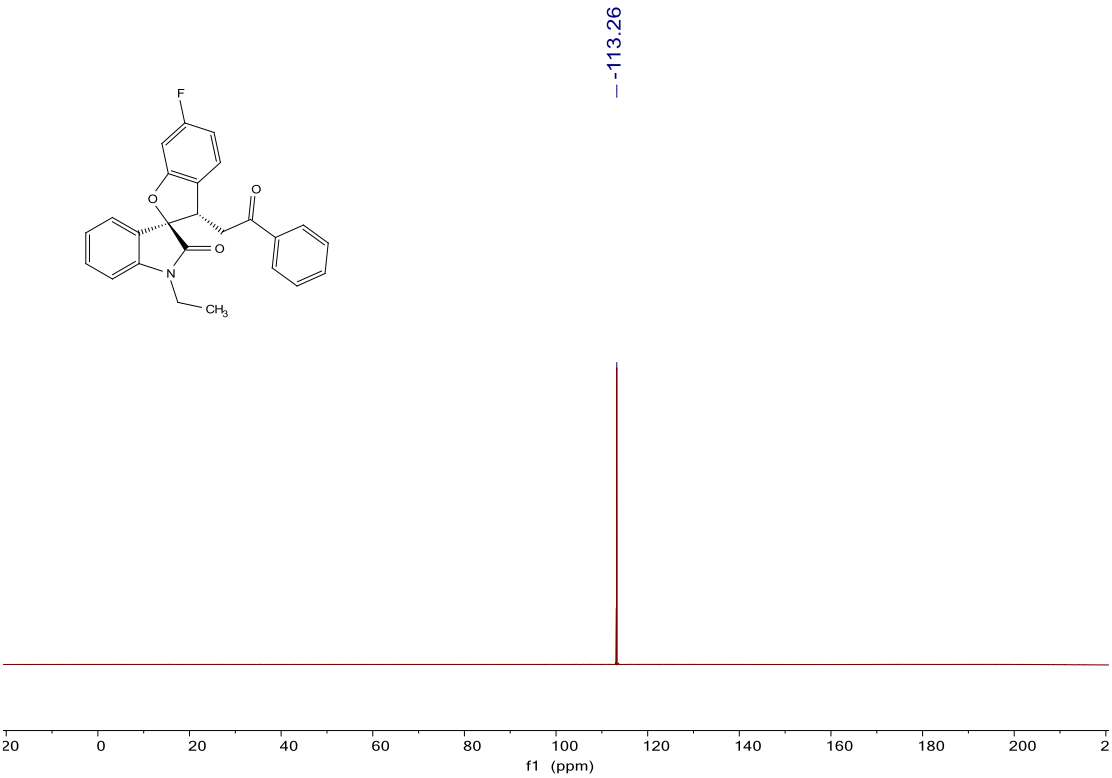

7.62
7.60
7.48
7.46
7.44
7.34
7.32
7.30
7.13
7.13
7.11
7.11
7.09
7.08
7.07
7.06
7.06
6.79
6.78
6.77
6.76
6.74
6.73
6.71
4.60
4.58
4.57
3.93
3.91
3.90
3.88
3.86
3.77
3.75
3.73
3.71
3.70
3.43
3.41
3.41
2.34
1.38
1.36
1.35
0.00
H3C
O
O
O
N
CH3
2.03
1.02
2.04
3.05
4.05
1.00
1.03
1.05
2.01
3.02
3.04
f1 (ppm)
197.1
175.1
159.1
143.6
139.3
136.3
133.1
130.5
128.5
127.6
125.9
125.8
124.9
123.5
122.1
122.0
110.9
108.9
89.2
44.2
40.5
35.0
21.6
12.4
f1 (ppm)

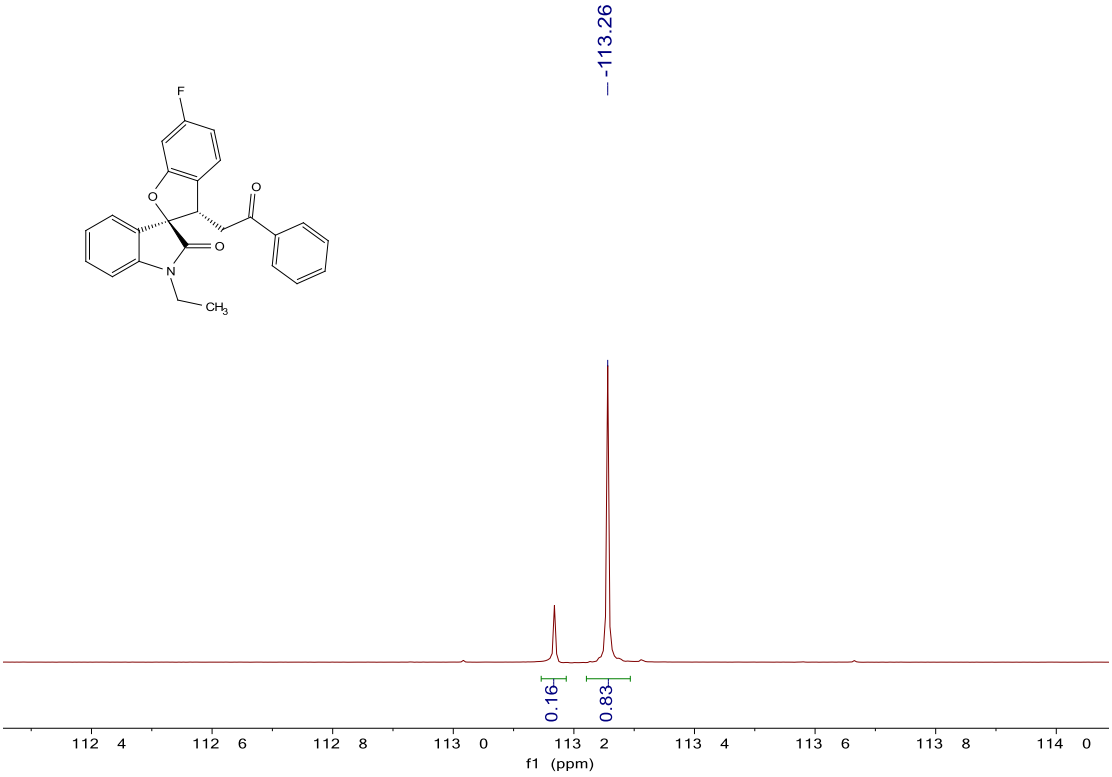
C34


7.62 7.61 7.60 7.47 7.45 7.45 7.34 7.32 7.30 7.14 7.12 7.12 7.10 7.10 7.09 7.08 7.08 7.07 7.06 6.80 6.78 6.76 6.73 6.71 6.53 6.53 6.51 6.51 6.48 6.48 4.56 3.91 3.90 3.88 3.78 3.76 3.74 3.72 3.42 3.40 3.39 1.38 1.37 1.35 0.00
2.05 1.01 2.01 3.05 2.06 2.02 1.00 1.07 4.08 2.00 3.02
f1 (ppm)
197.1 174.9 161.1 160.1 143.6 136.3 133.2 130.6 128.5 127.6 125.8 124.9 124.0 122.1 120.7 108.9 107.1 96.8 89.7 55.7 43.8 40.6 35.1 12.4
f1 (ppm)

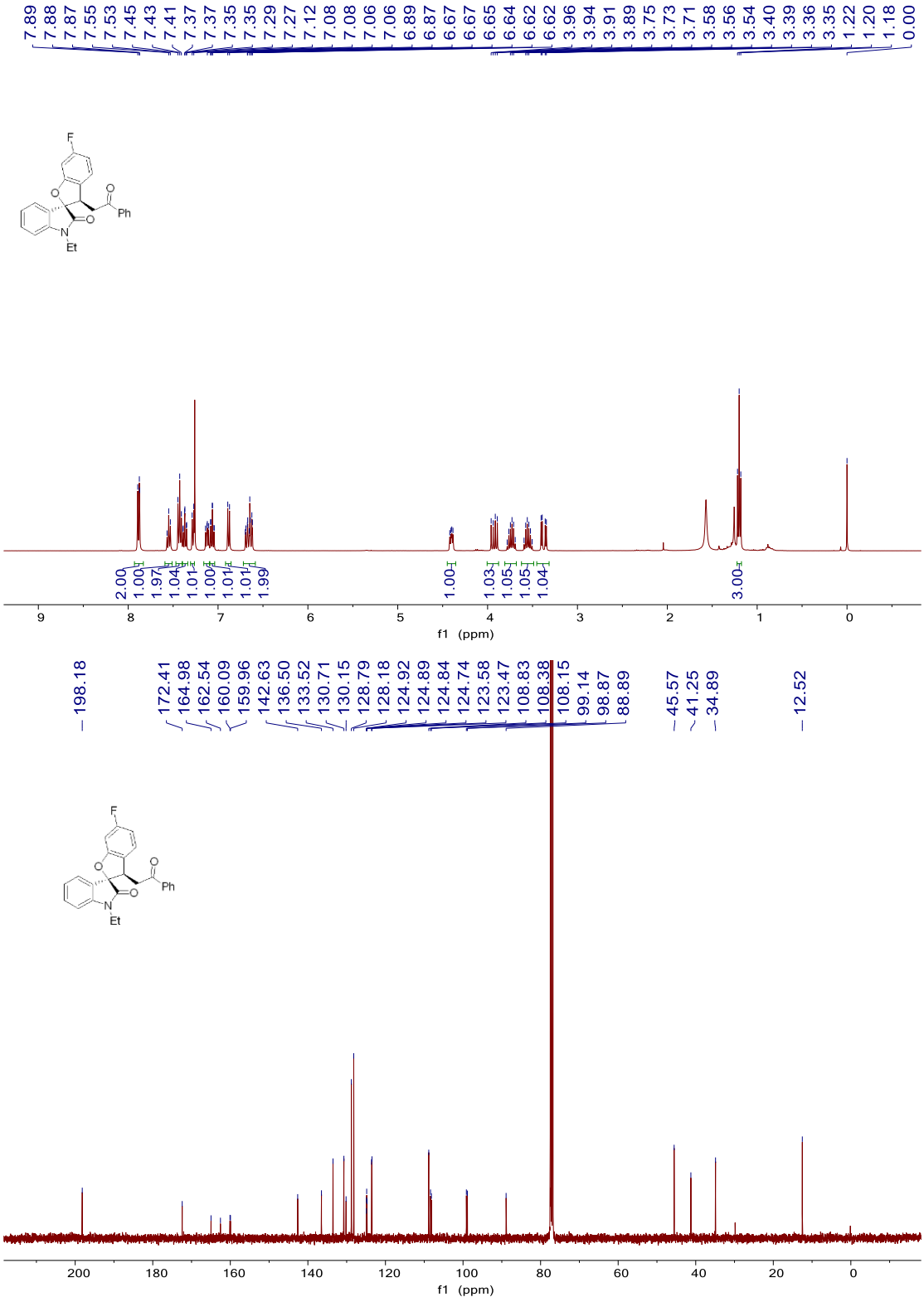
C35

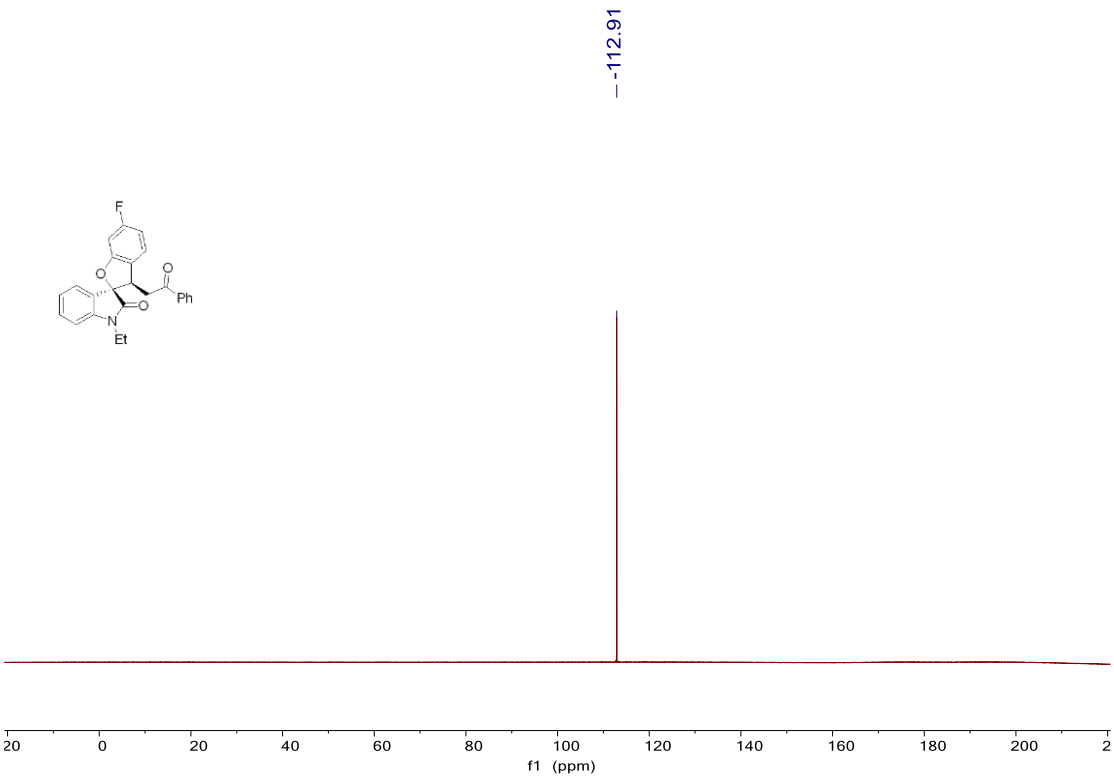

7.63 7.63 7.61 7.61 7.48 7.46 7.35 7.33 7.31 7.14 7.14 7.12 7.12 7.10 7.10 7.09 7.07 6.81 6.81 6.79 6.78 6.75 6.73 6.69 6.67 6.67 6.62 6.62 6.60 6.59 4.57 3.94 3.92 3.90 3.89 3.76 3.74 3.73 3.44 3.42 1.39 1.37 1.35 1.20 0.00
F
O
O
O
N
CH3
2.04 3.35 6.81 0.83 0.17 1.03 1.02 2.07 2.52 0.52
f1 (ppm)
196.8 174.6 164.9 162.5 160.0 159.8 143.6 136.2 133.3 130.8 128.5 127.7 125.4 125.0 124.4 124.4 124.3 124.2 122.2 109.1 108.1 107.9 99.0 98.7 90.1 43.7 40.5 35.1 12.4
f1 (ppm)


-113.26
F
O
O
O
N
CH3
20
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

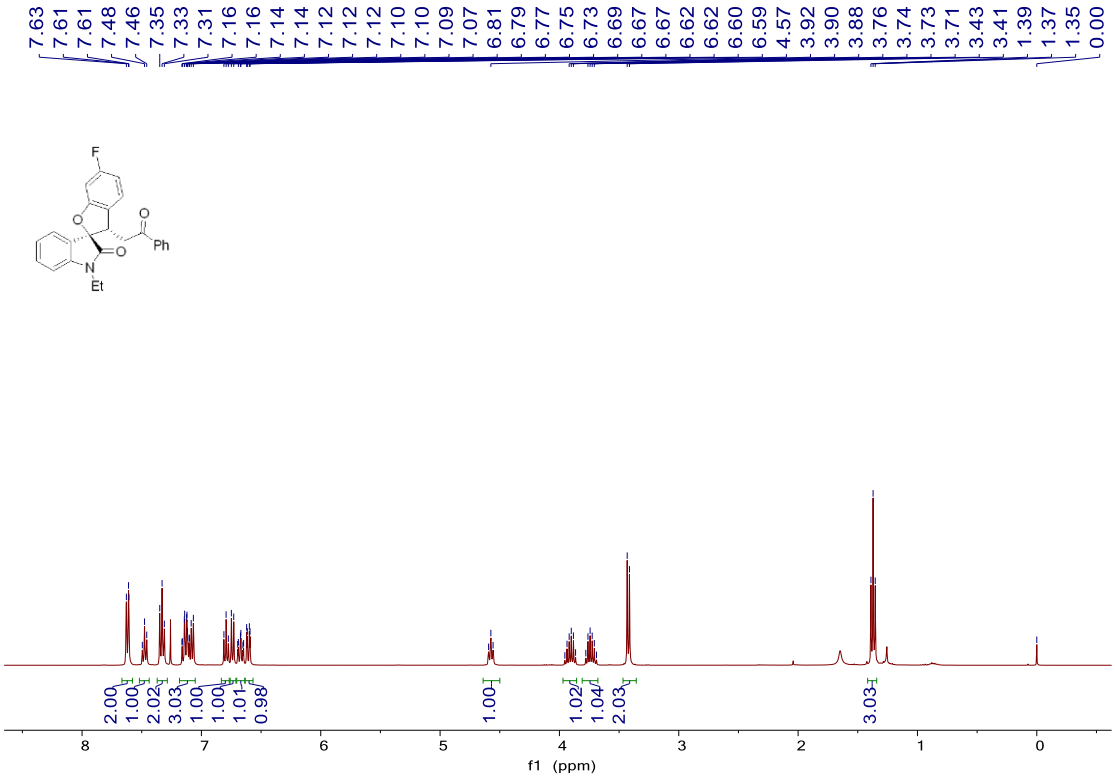

-113.26
F
O
O
O
N
CH3
0.16
0.83
112 4
112 6
112 8
113 0
113 2
113 4
113 6
113 8
114 0
f1 (ppm)

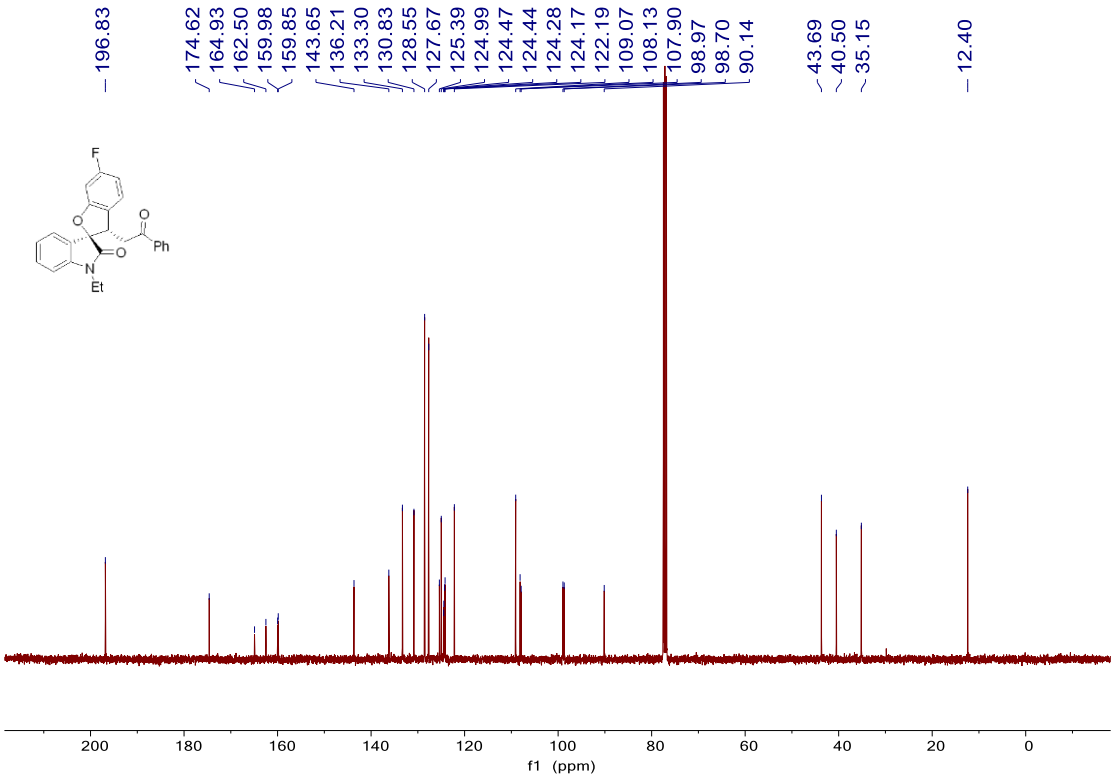
Minor diastereomer of C35

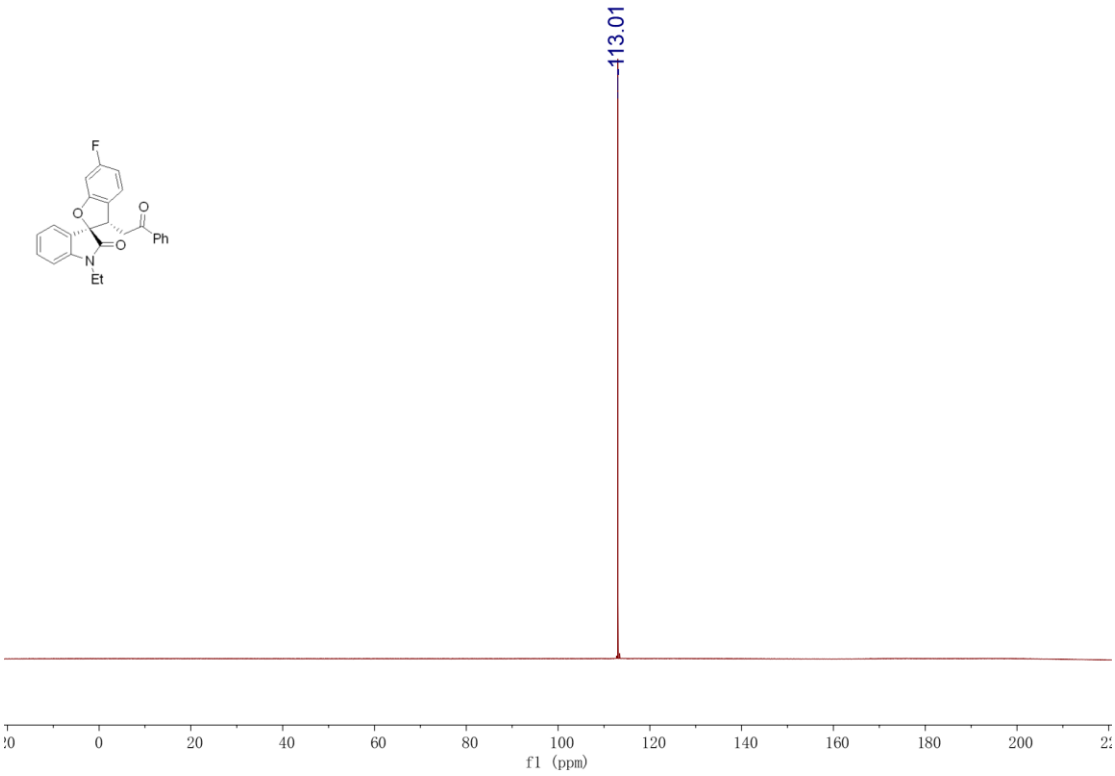




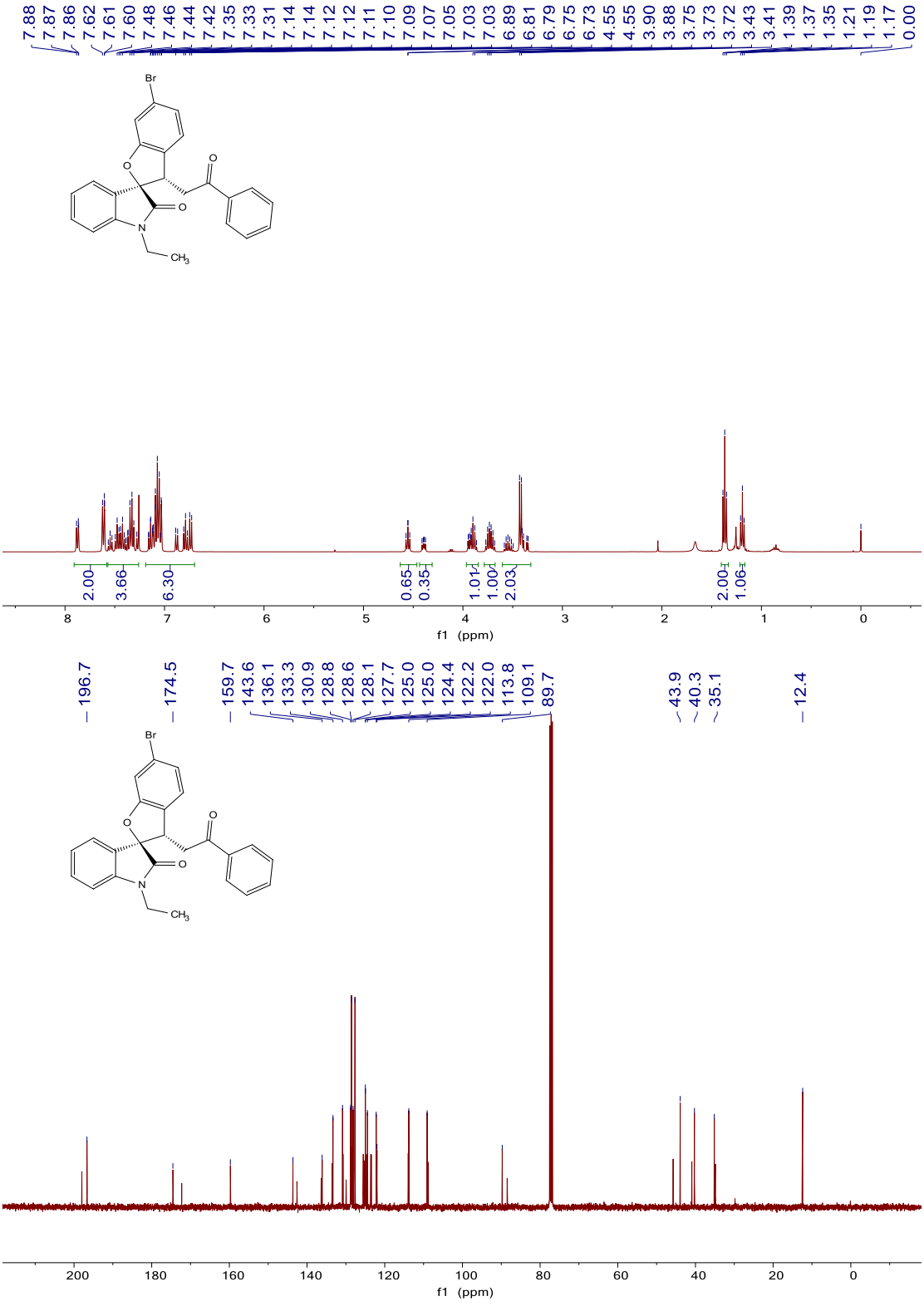
Major diastereomer of C35



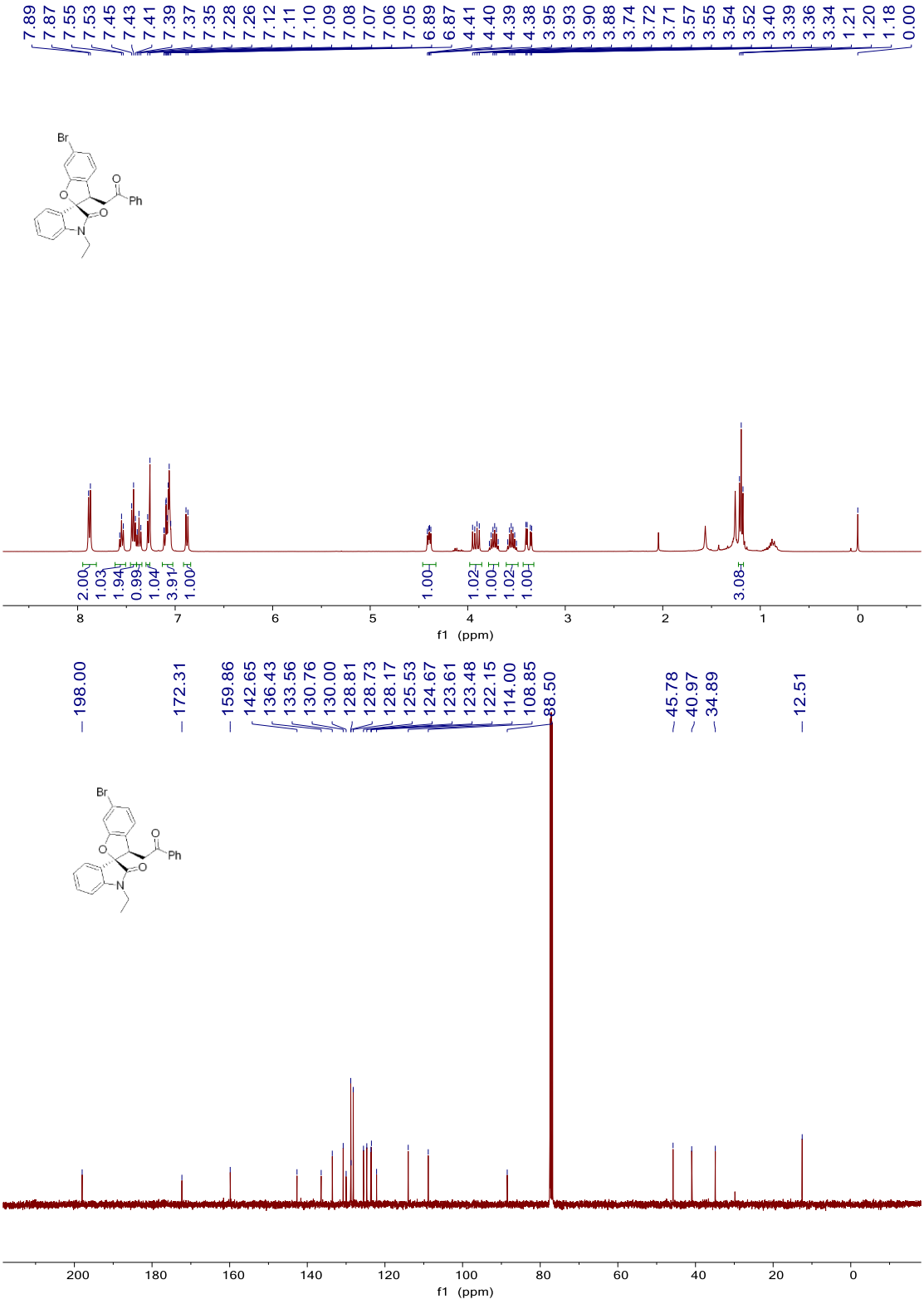

196.83
174.62
164.93
162.50
159.98
159.85
143.65
136.21
133.30
130.83
128.55
127.67
125.39
124.99
124.47
124.44
124.28
124.17
122.19
109.07
108.13
107.90
98.97
98.70
90.14
43.69
40.50
35.15
12.40
F
O
O
Ph
N
Et
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)


113.01
F
O
O
Ph
N
Et
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

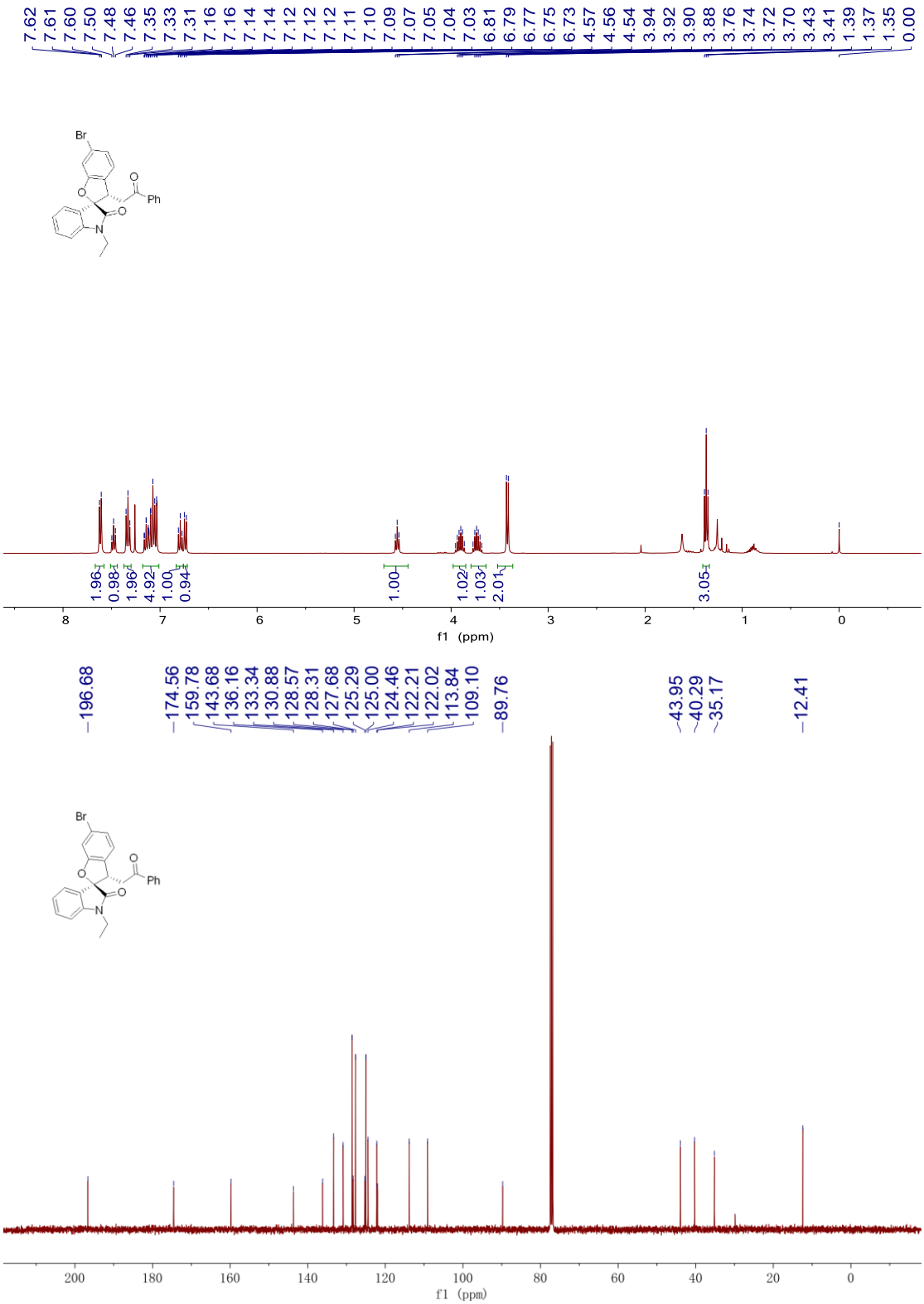
C36


7.88 7.87 7.86 7.62 7.61 7.60 7.48 7.46 7.44 7.42 7.35 7.33 7.31 7.14 7.14 7.12 7.12 7.11 7.10 7.09 7.07 7.05 7.03 7.03 6.89 6.81 6.79 6.75 6.73 4.55 4.55 3.90 3.88 3.75 3.73 3.72 3.43 3.41 1.39 1.37 1.35 1.21 1.19 1.17 0.00
Br
O
O
O
N
CH3
2.00 3.66 6.30 0.65 0.35 1.01 1.00 2.03 2.00 1.06
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.7 174.5 159.7 143.6 136.1 133.3 130.9 128.8 128.6 128.1 127.7 125.0 125.0 124.4 122.2 122.0 113.8 109.1 89.7 43.9 40.3 35.1 12.4
Br
O
O
O
N
CH3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

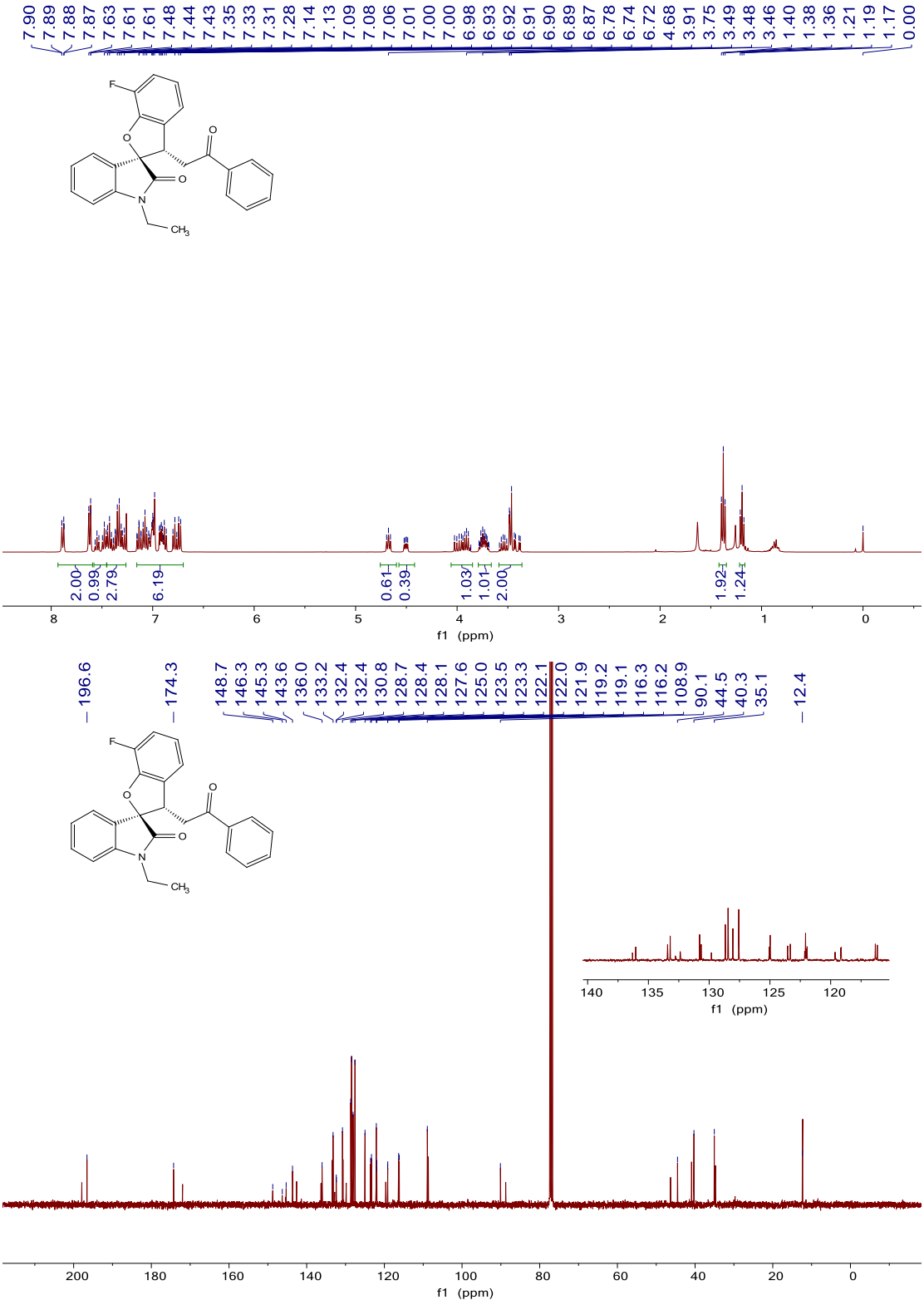
Minor diastereomer of C36

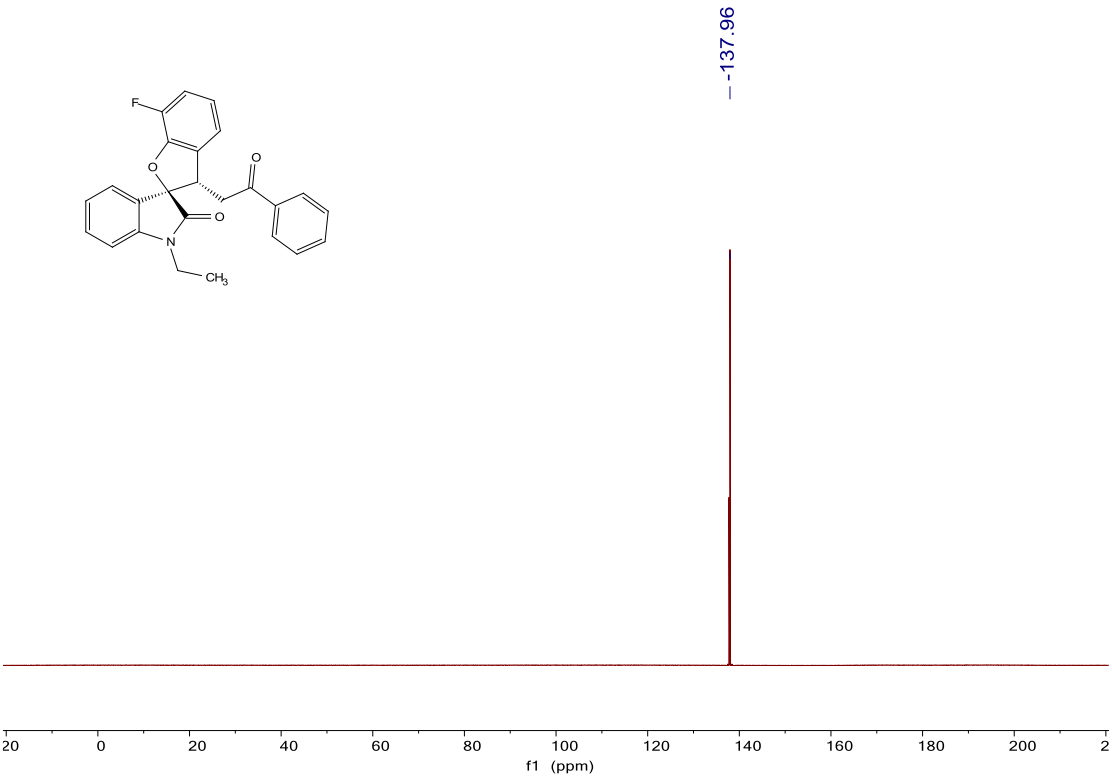


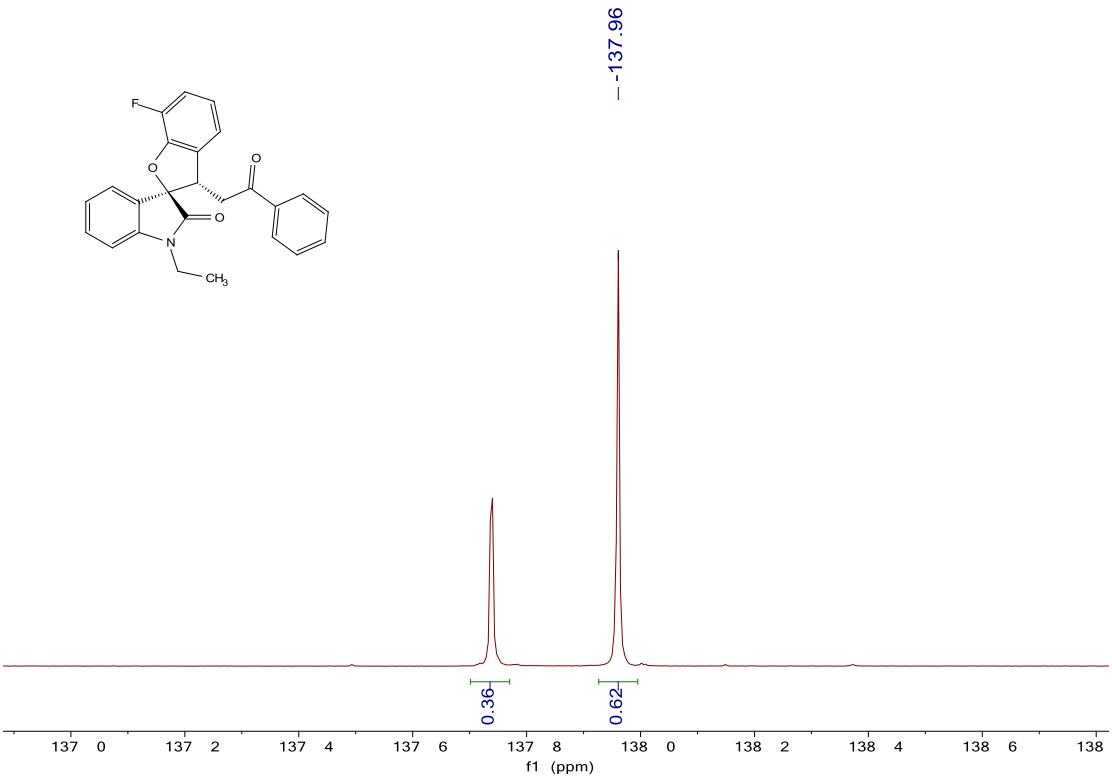
Major diastereomer of C36



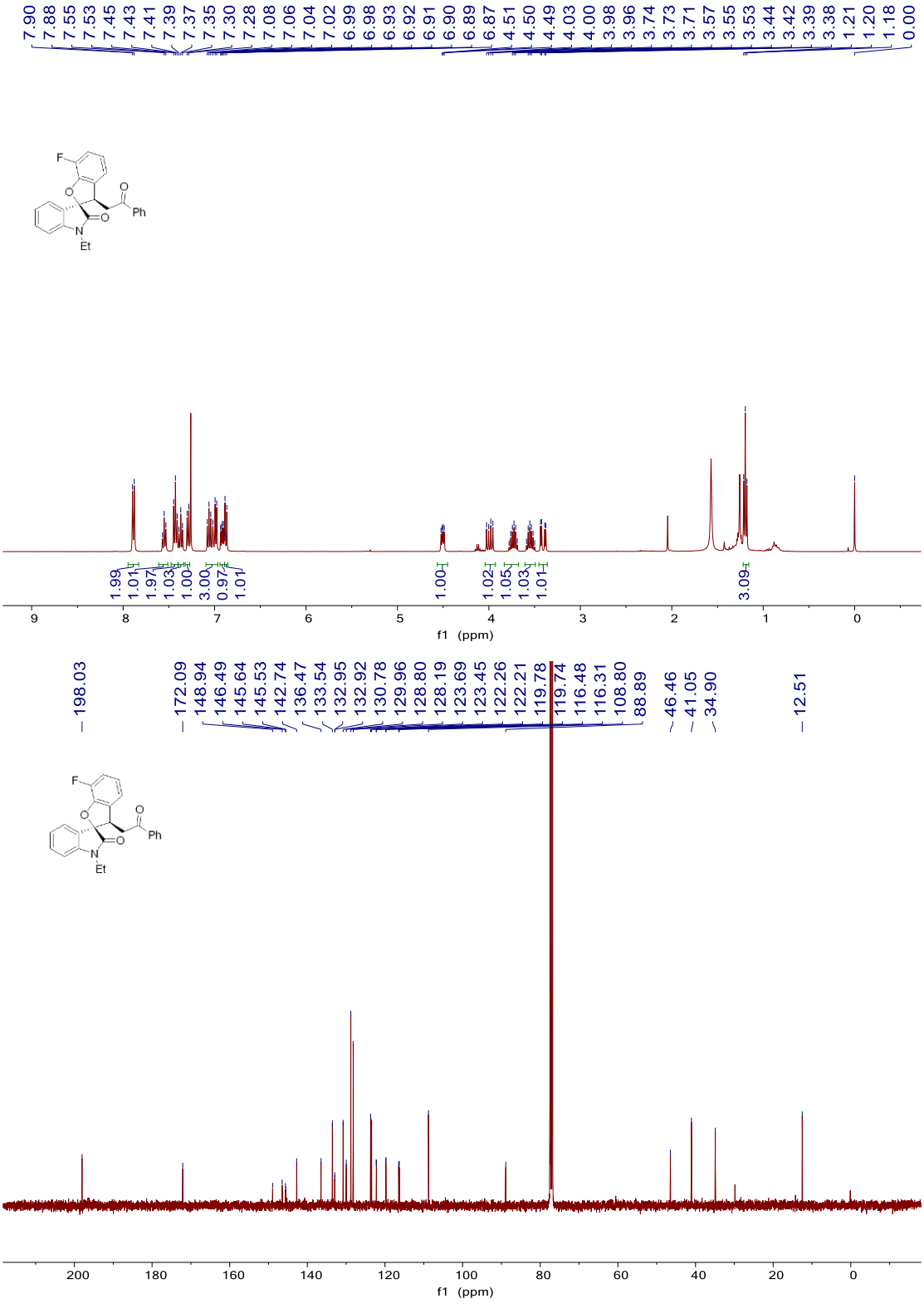
C37

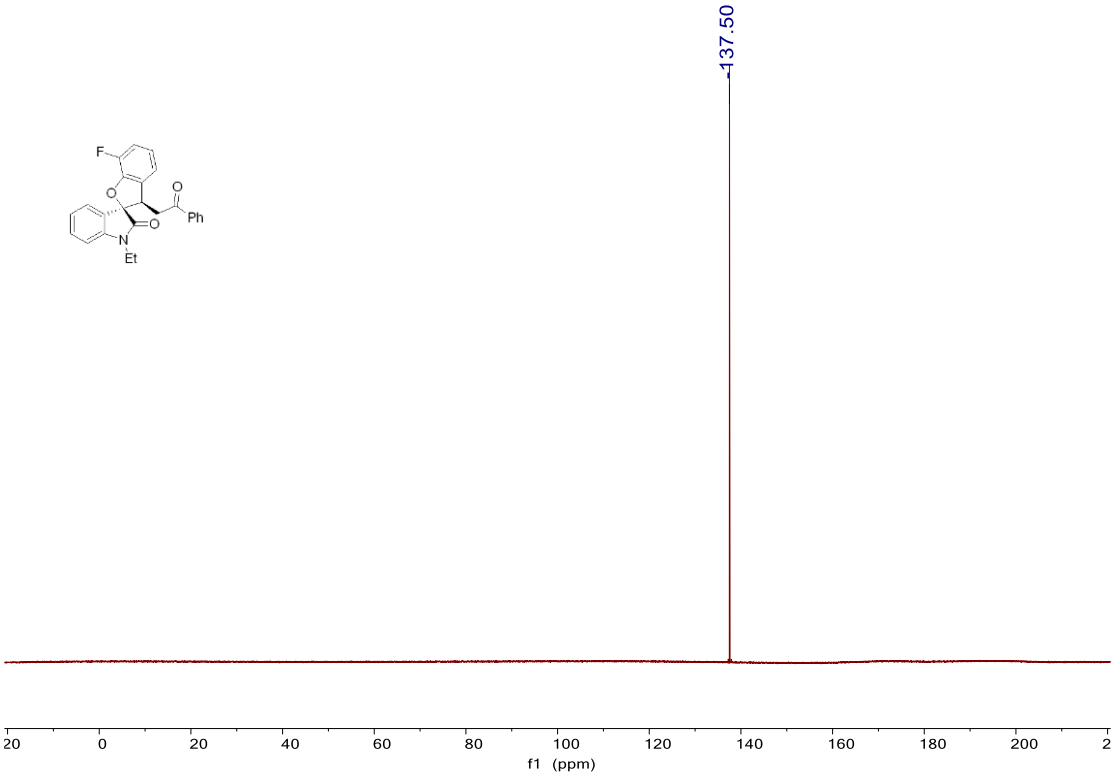

7.90 7.89 7.88 7.87 7.63 7.61 7.61 7.48 7.44 7.43 7.35 7.33 7.31 7.28 7.14 7.13 7.09 7.08 7.06 7.01 7.00 7.00 6.98 6.93 6.92 6.91 6.90 6.89 6.87 6.78 6.74 6.72 4.68 3.91 3.75 3.49 3.48 3.46 1.40 1.38 1.36 1.21 1.19 1.17 0.00
F
O
O
O
N
CH3
2.00 0.99 2.79 6.19 0.61 0.39 1.03 1.01 2.00 1.92 1.24
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.6 174.3 148.7 146.3 145.3 143.6 136.0 133.2 132.4 132.4 130.8 128.7 128.4 128.1 127.6 125.0 123.5 123.3 122.1 122.0 121.9 119.2 119.1 116.3 116.2 108.9 90.1 44.5 40.3 35.1 12.4
140 135 130 125 120
f1 (ppm)
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)


-137.96
F
O
O
O
N
CH3
20
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

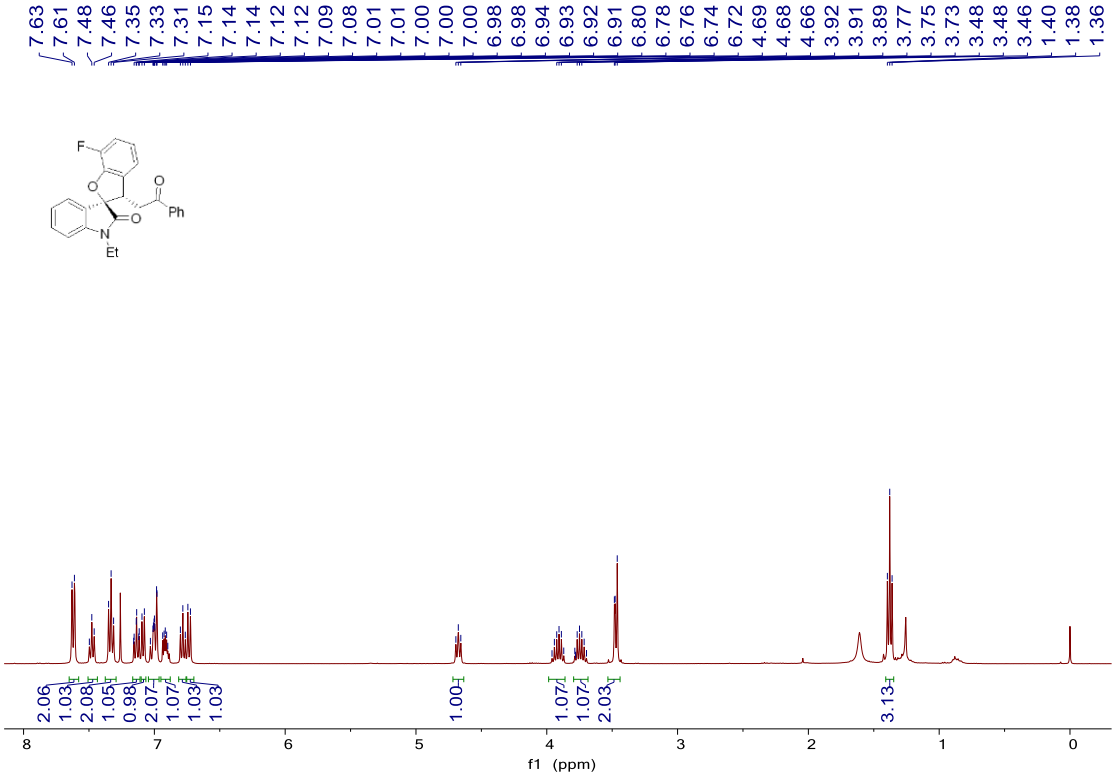

-137.96
F
O
O
O
N
CH3
0.36
0.62
137 0
137 2
137 4
137 6
137 8
138 0
138 2
138 4
138 6
138
f1 (ppm)

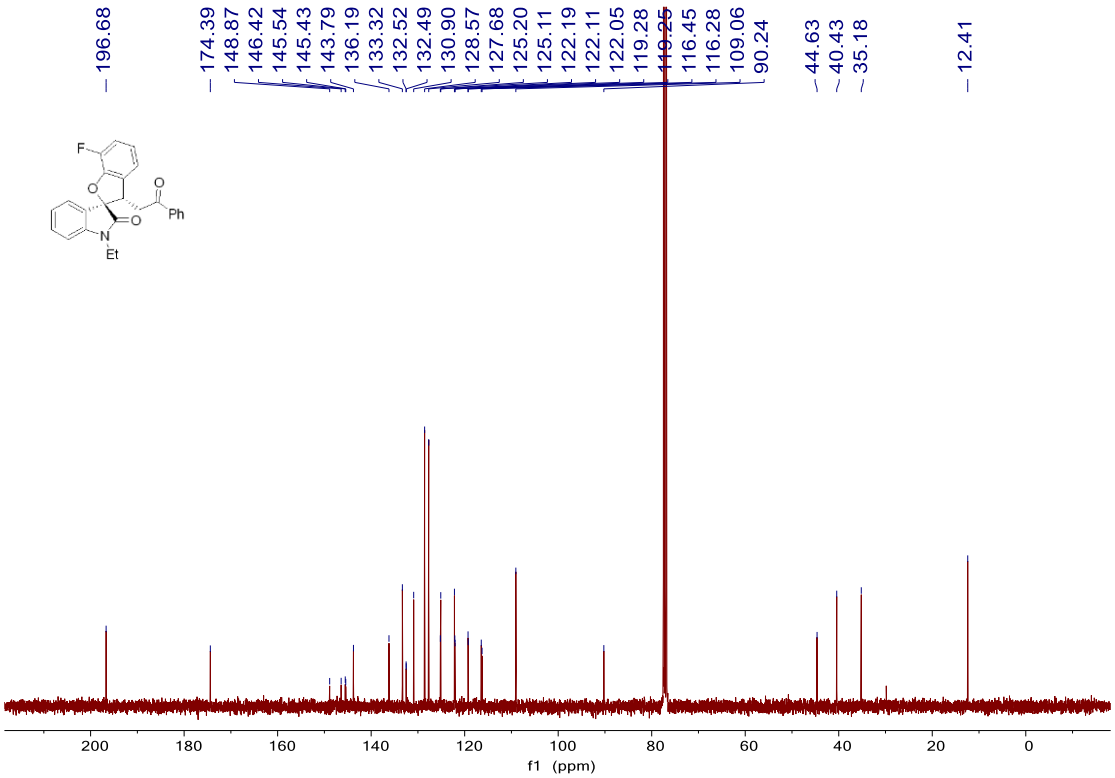
Minor diastereomer of C37

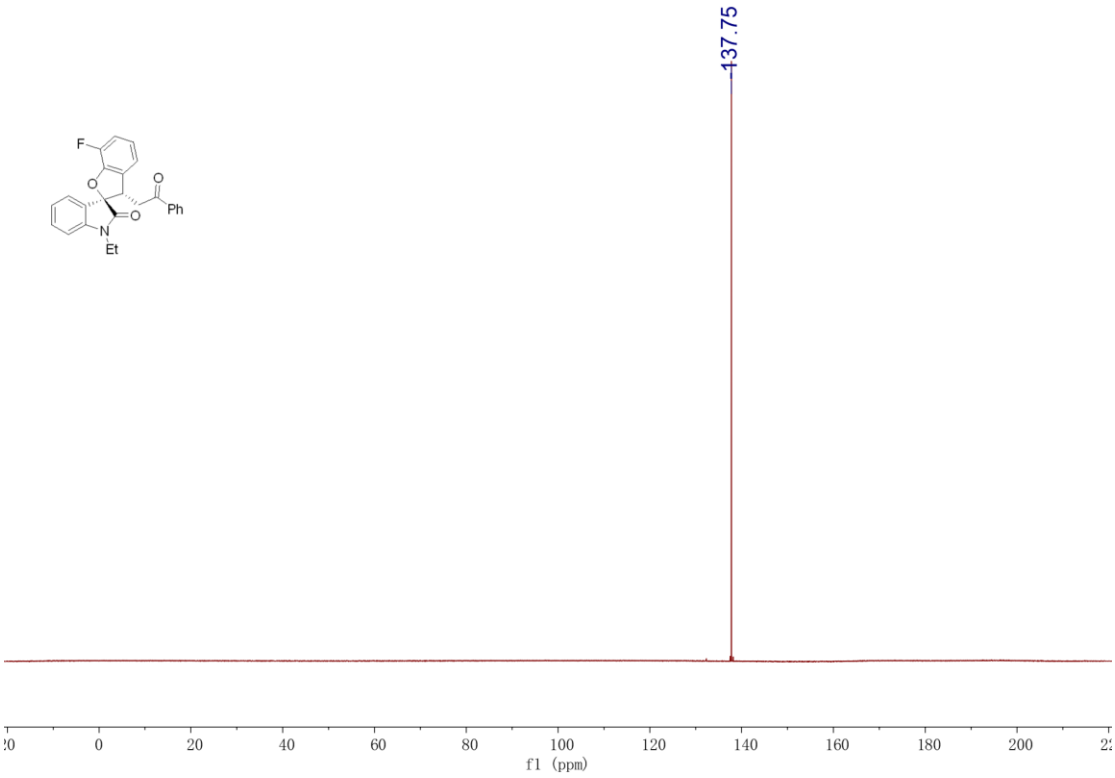




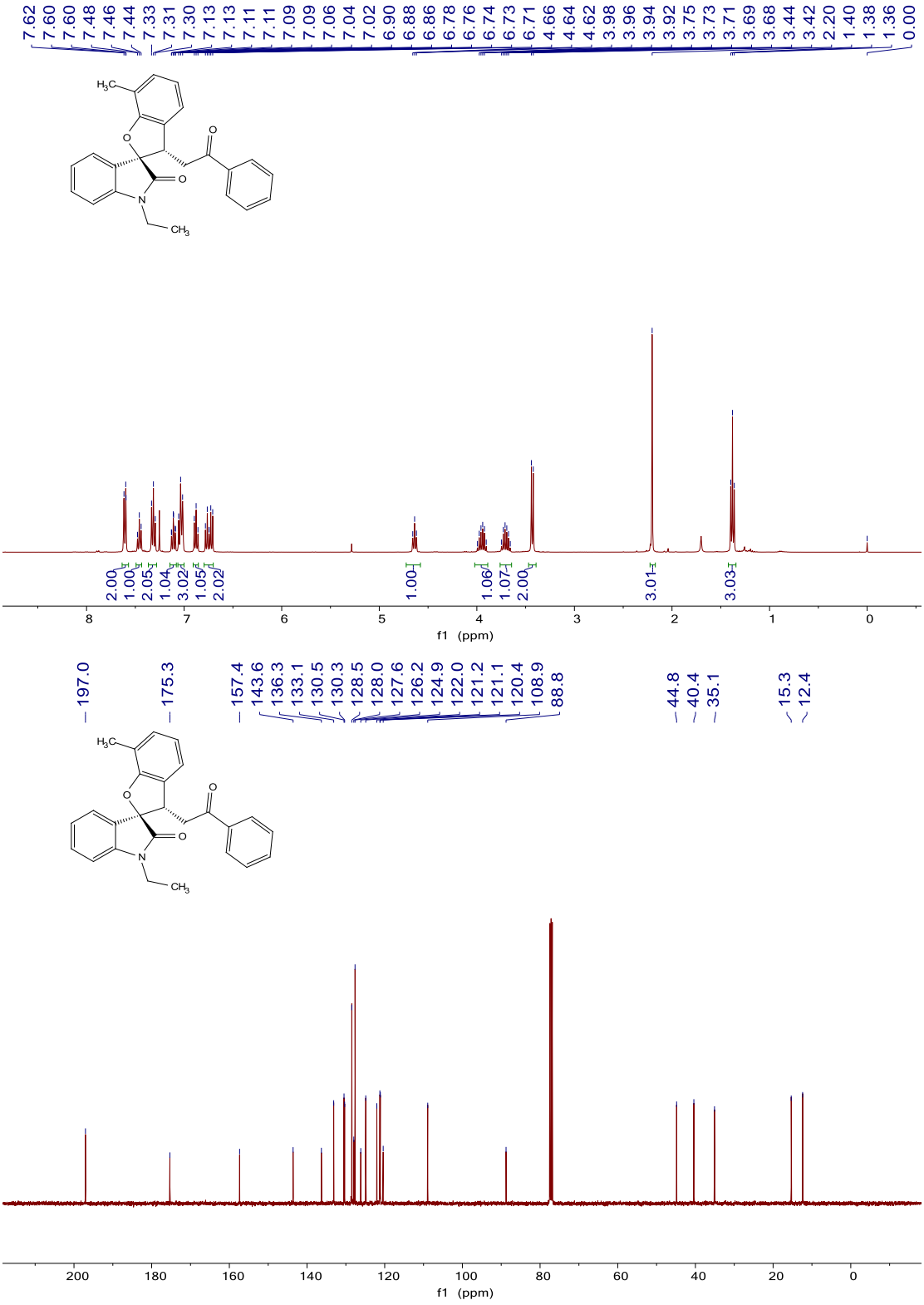
Major diastereomer of C37



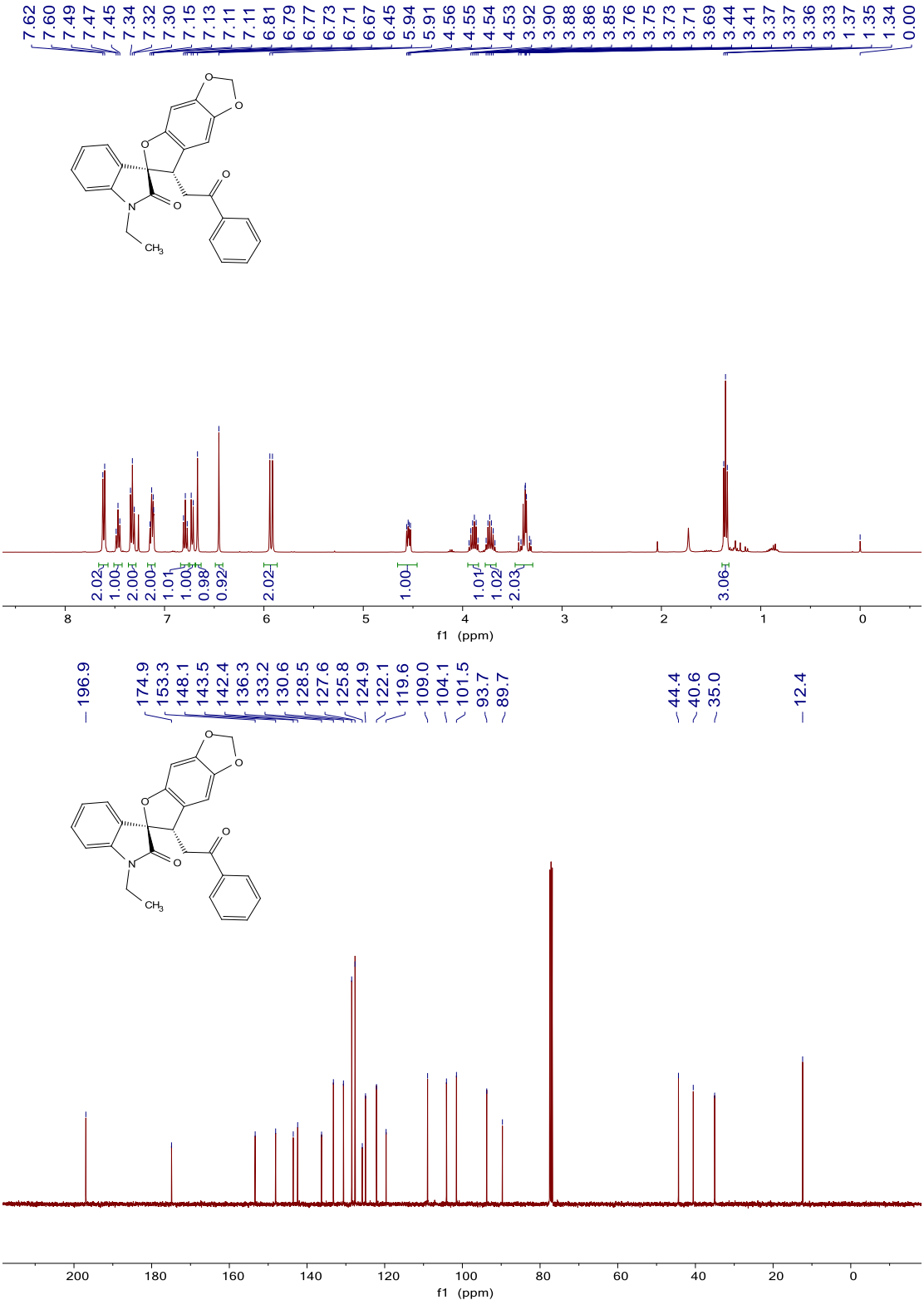

196.68
174.39
148.87
146.42
145.54
145.43
143.79
136.19
133.32
132.52
132.49
130.90
128.57
127.68
125.20
125.11
122.19
122.11
122.05
119.28
116.45
116.28
109.06
90.24
44.63
40.43
35.18
12.41
F
O
O
Ph
N
Et
200
180
160
140
120
100
80
60
40
20
0
f1 (ppm)


137.75
F
O
O
Ph
N
Et
0
20
40
60
80
100
120
140
160
180
200
f1 (ppm)

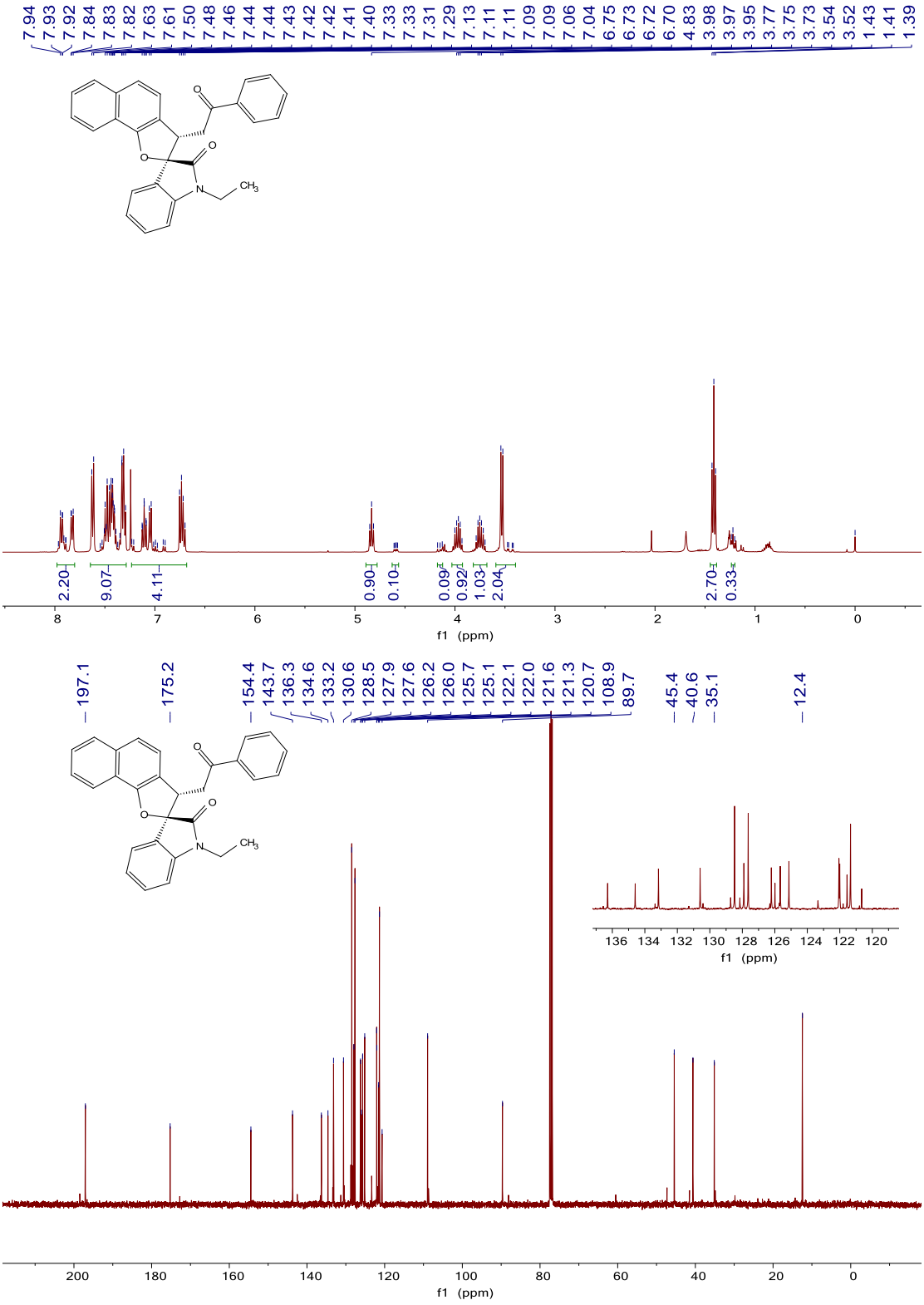
C38


7.62 7.60 7.60 7.48 7.46 7.44 7.33 7.31 7.30 7.13 7.13 7.11 7.11 7.09 7.09 7.06 7.04 7.02 6.90 6.88 6.86 6.78 6.76 6.74 6.73 6.71 4.66 4.64 4.62 3.98 3.96 3.94 3.92 3.75 3.73 3.71 3.69 3.68 3.44 3.42 2.20 1.40 1.38 1.36 0.00
H3C
O
O
O
N
CH3
2.00 1.00 2.05 1.04 3.02 1.05 2.02 1.00 1.06 1.07 2.00 3.01 3.03
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.0 175.3 157.4 143.6 136.3 133.1 130.5 130.3 128.5 128.0 127.6 126.2 124.9 122.0 121.2 121.1 120.4 108.9 88.8 44.8 40.4 35.1 15.3 12.4
H3C
O
O
O
N
CH3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

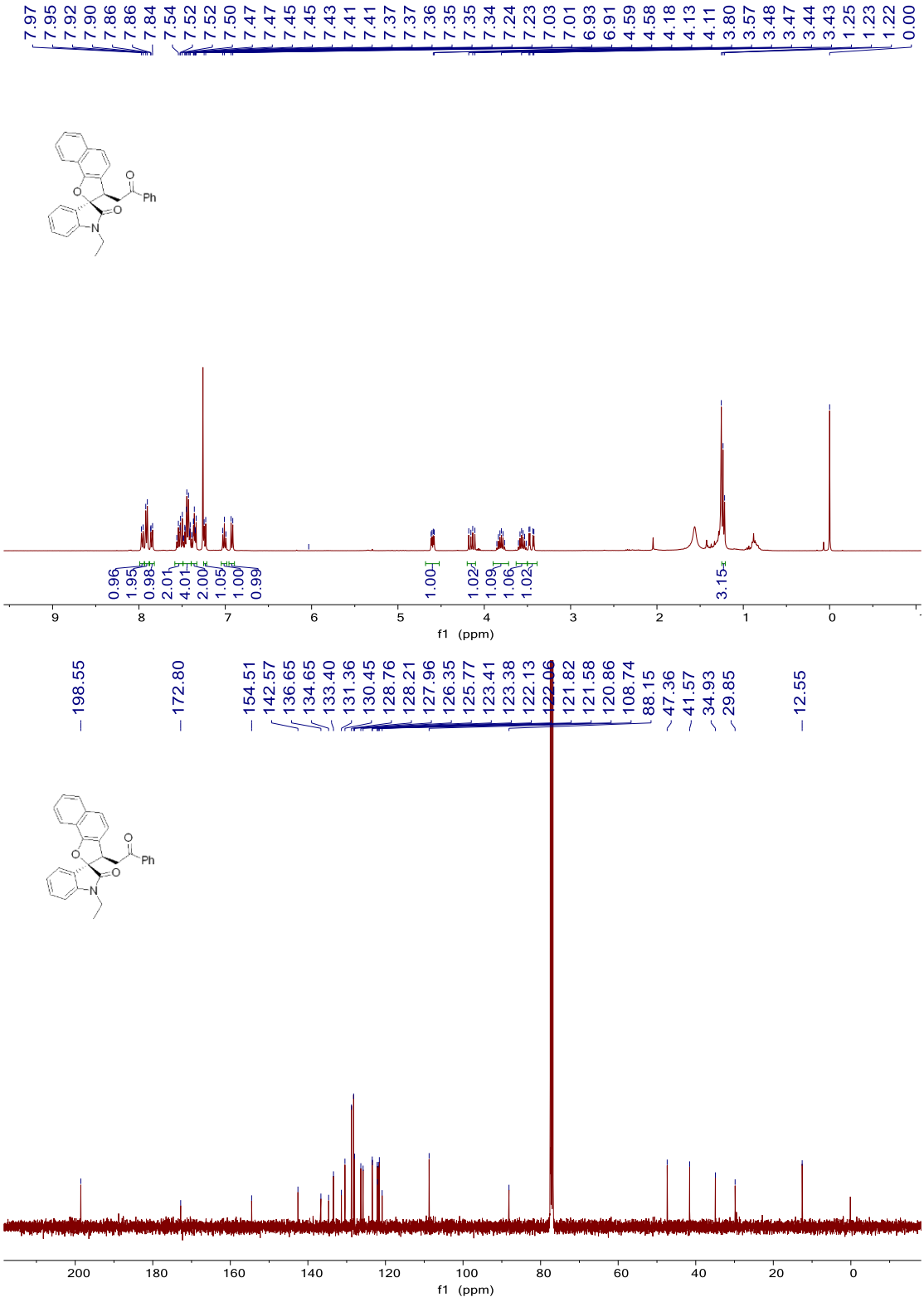
C39


7.62 7.60 7.49 7.47 7.45 7.34 7.32 7.30 7.15 7.13 7.11 7.11 6.81 6.79 6.77 6.73 6.71 6.67 6.45 5.94 5.91 4.56 4.55 4.54 4.53 3.92 3.90 3.88 3.86 3.85 3.76 3.75 3.73 3.71 3.69 3.44 3.41 3.37 3.37 3.36 3.33 1.37 1.35 1.34 0.00
O
O
O
O
O
N
CH3
2.02 1.00 2.00 1.01 1.00 0.98 0.92 2.02 1.00 1.01 1.02 2.03 3.06
8 7 6 5 4 3 2 1 0
f1 (ppm)
196.9 174.9 153.3 148.1 143.5 142.4 136.3 133.2 130.6 128.5 127.6 125.8 124.9 122.1 119.6 109.0 104.1 101.5 93.7 89.7 44.4 40.6 35.0 12.4
O
O
O
O
O
N
CH3
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

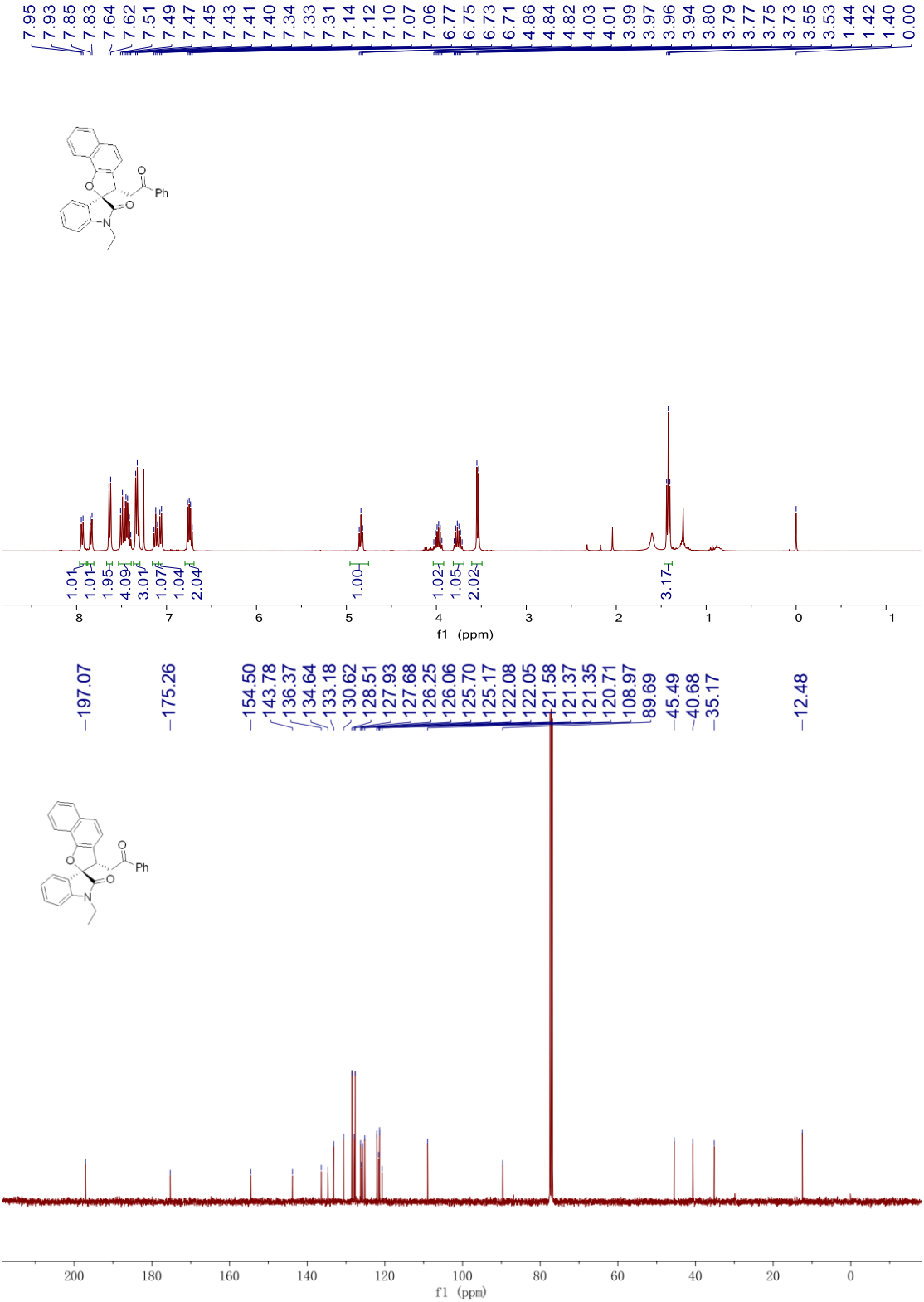
C40


7.94 7.93 7.92 7.84 7.83 7.82 7.63 7.61 7.50 7.48 7.46 7.44 7.44 7.43 7.42 7.42 7.41 7.40 7.33 7.33 7.31 7.29 7.13 7.11 7.11 7.09 7.09 7.06 7.04 6.75 6.73 6.72 6.70 4.83 3.98 3.97 3.95 3.77 3.75 3.73 3.54 3.52 1.43 1.41 1.39
O
O
O
N
CH3
2.20 9.07 4.11 0.90 0.10 0.09 0.92 1.03 2.04 2.70 0.33
8 7 6 5 4 3 2 1 0
f1 (ppm)
197.1 175.2 154.4 143.7 136.3 134.6 133.2 130.6 128.5 127.9 127.6 126.2 126.0 125.7 125.1 122.1 122.0 121.6 121.3 120.7 108.9 89.7 45.4 40.6 35.1 12.4
136 134 132 130 128 126 124 122 120
f1 (ppm)
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

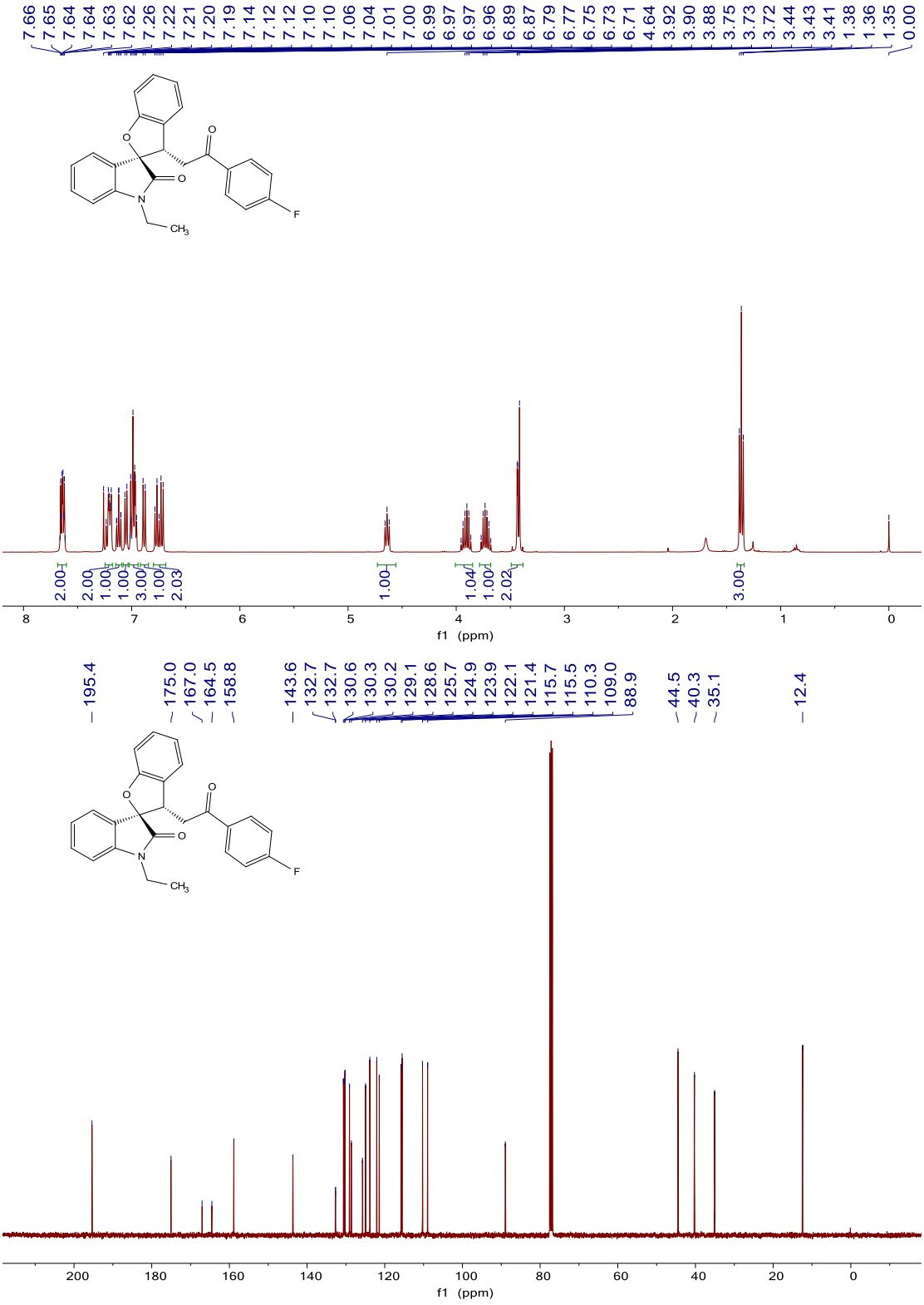
Minor diastereomer of C40

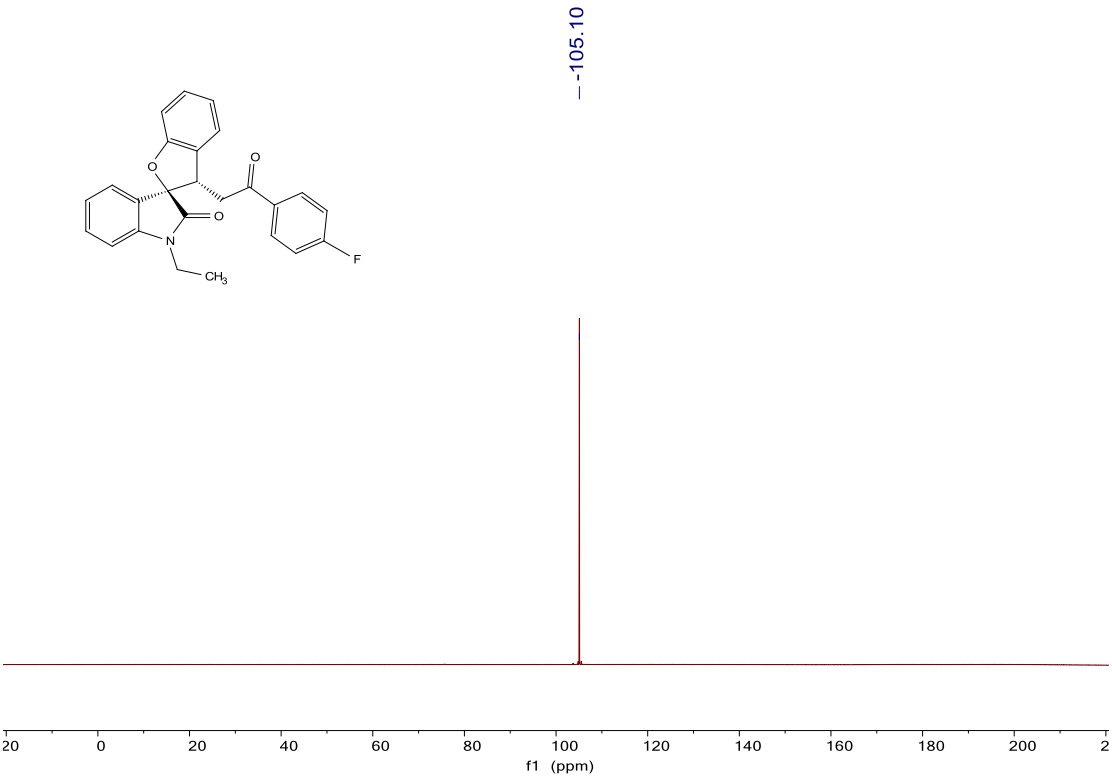


Major diastereomer of C40

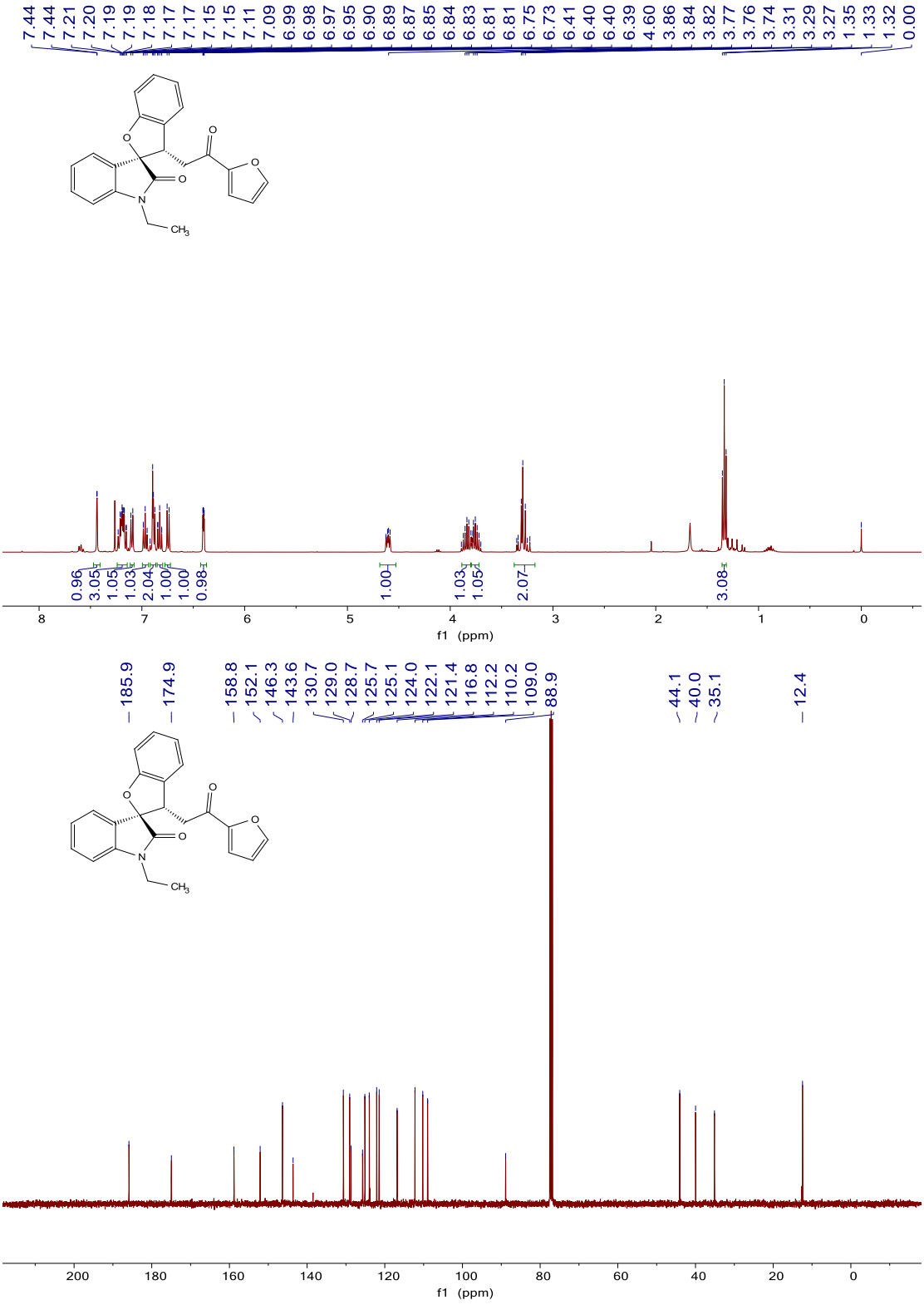


C41

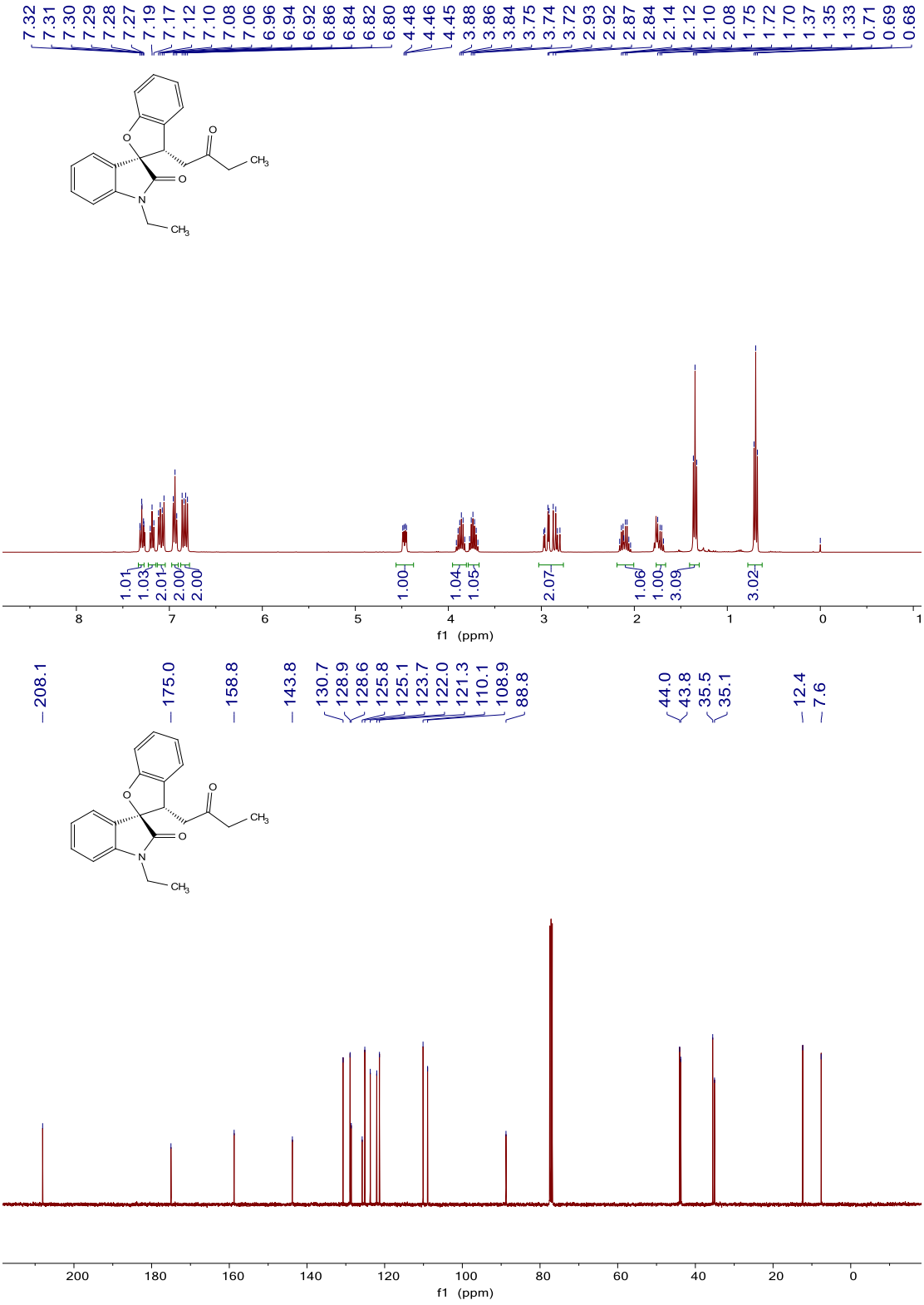

7.66 7.65 7.64 7.64 7.63 7.62 7.26 7.22 7.21 7.20 7.19 7.14 7.12 7.12 7.10 7.10 7.06 7.04 7.01 7.00 6.99 6.97 6.97 6.96 6.89 6.87 6.79 6.77 6.75 6.73 6.71 4.64 3.92 3.90 3.88 3.75 3.73 3.72 3.44 3.43 3.41 1.38 1.36 1.35 0.00
O
O
O
N
CH3
F
2.00 2.00 1.00 1.00 3.00 1.00 2.03 1.00 1.04 1.00 2.02 3.00
8 7 6 5 4 3 2 1 0
f1 (ppm)
195.4 175.0 167.0 164.5 158.8 143.6 132.7 132.7 130.6 130.3 130.2 129.1 128.6 125.7 124.9 123.9 122.1 121.4 115.7 115.5 110.3 109.0 88.9 44.5 40.3 35.1 12.4
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)


-105.10
O
O
O
N
CH3
F
20
0
20
40
60
80
100
120
140
160
180
200
2
f1 (ppm)

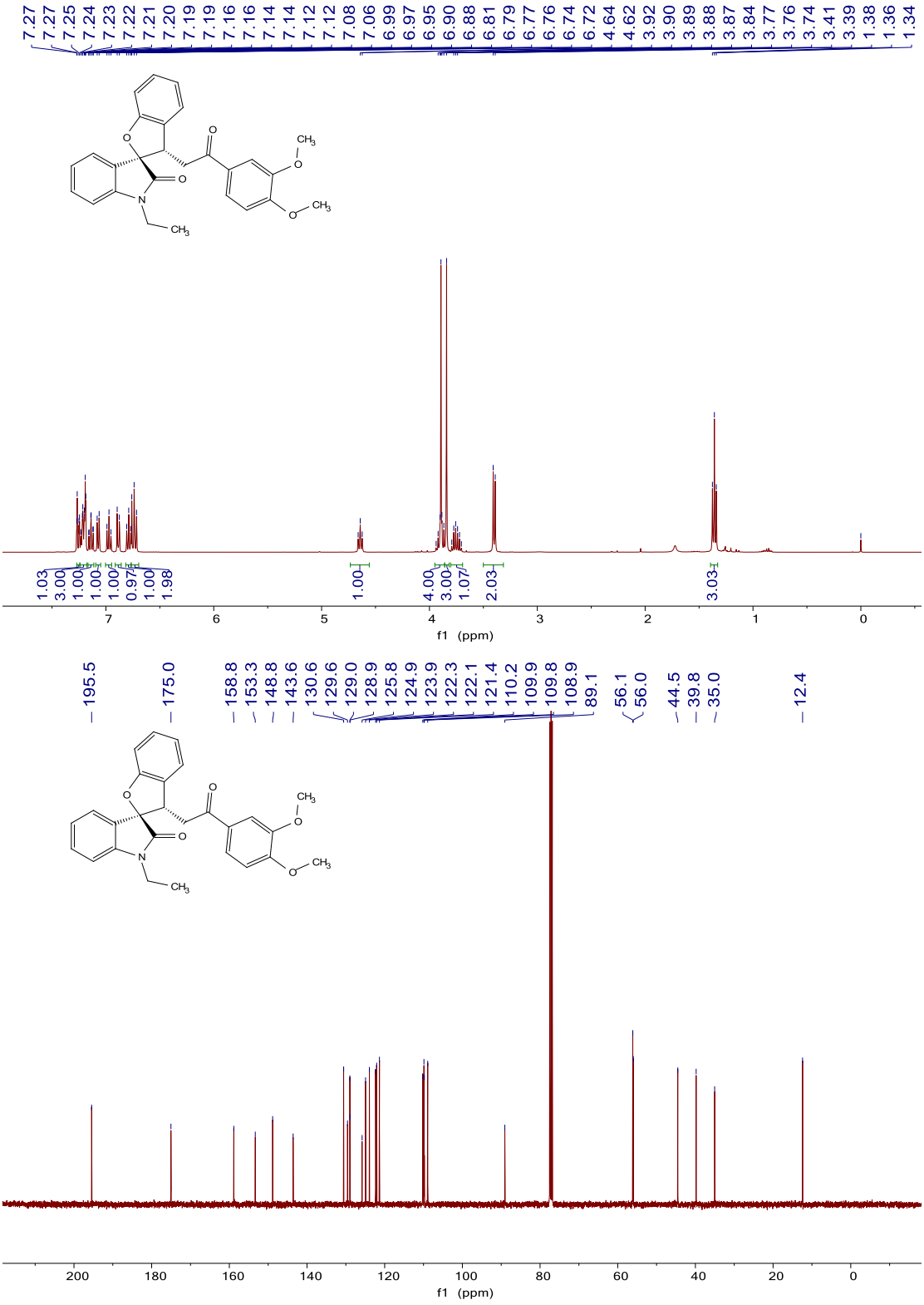
C42


7.44 7.44 7.21 7.20 7.19 7.19 7.18 7.17 7.17 7.15 7.15 7.11 7.09 6.99 6.98 6.97 6.95 6.90 6.89 6.87 6.85 6.84 6.83 6.81 6.81 6.75 6.73 6.41 6.40 6.40 6.39 4.60 3.86 3.84 3.82 3.77 3.76 3.74 3.31 3.29 3.27 1.35 1.33 1.32 0.00
0.96 3.05 1.05 1.03 2.04 1.00 1.00 0.98 1.00 1.03 1.05 2.07 3.08
f1 (ppm)
185.9 174.9 158.8 152.1 146.3 143.6 130.7 129.0 128.7 125.7 125.1 124.0 122.1 121.4 116.8 112.2 110.2 109.0 88.9 44.1 40.0 35.1 12.4
f1 (ppm)

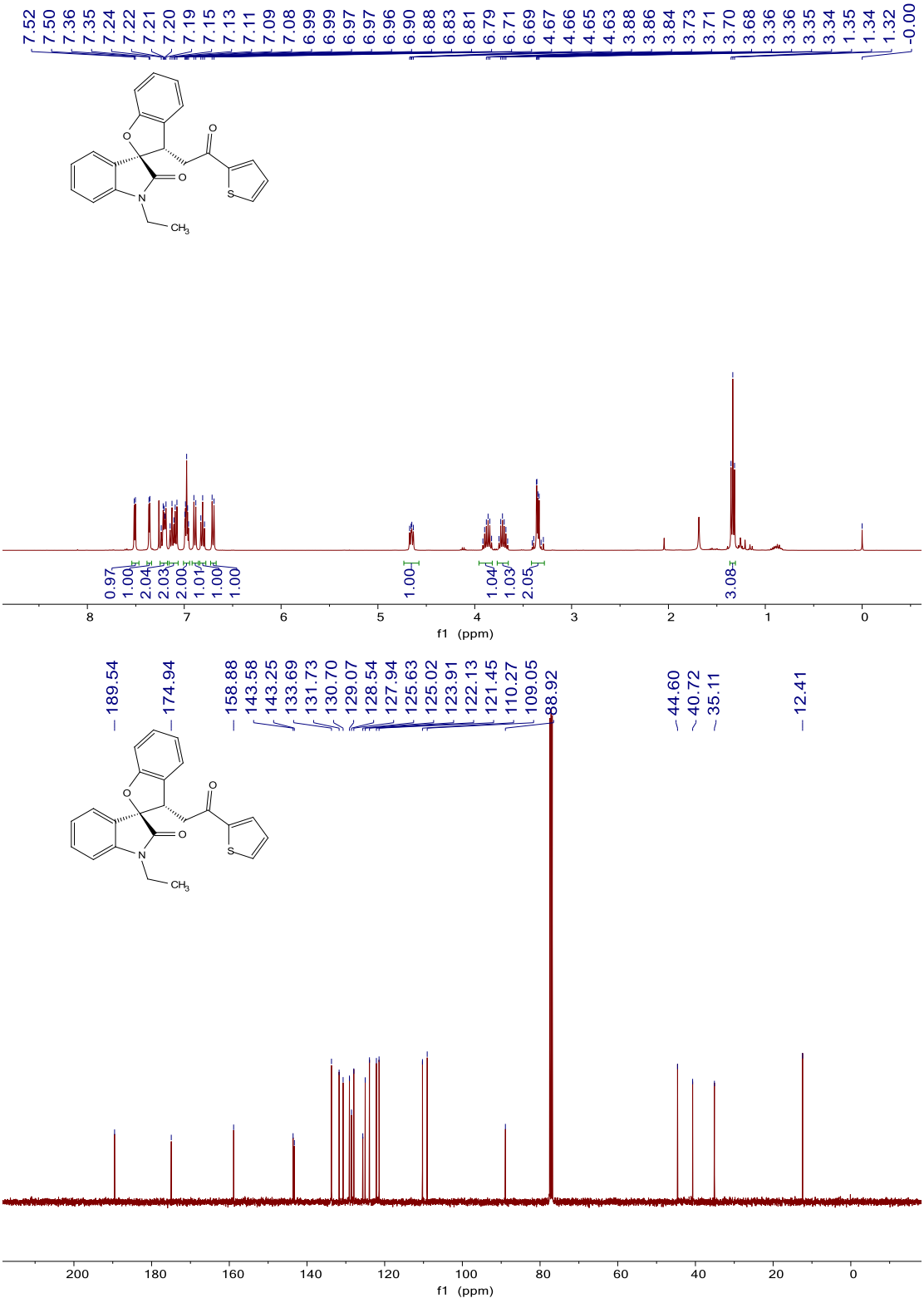
C43


7.32
7.31
7.30
7.29
7.28
7.27
7.19
7.17
7.12
7.10
7.08
7.06
6.96
6.94
6.92
6.86
6.84
6.82
6.80
4.48
4.46
4.45
3.88
3.86
3.84
3.75
3.74
3.72
2.93
2.92
2.87
2.84
2.14
2.12
2.10
2.08
1.75
1.72
1.70
1.37
1.35
1.33
0.71
0.69
0.68
O
O
CH3
O
N
CH3
1.01
1.03
2.01
2.00
2.00
1.00
1.04
1.05
2.07
1.06
1.00
3.09
3.02
f1 (ppm)
208.1
175.0
158.8
143.8
130.7
128.9
128.6
125.8
125.1
123.7
122.0
121.3
110.1
108.9
88.8
44.0
43.8
35.5
35.1
12.4
7.6
f1 (ppm)

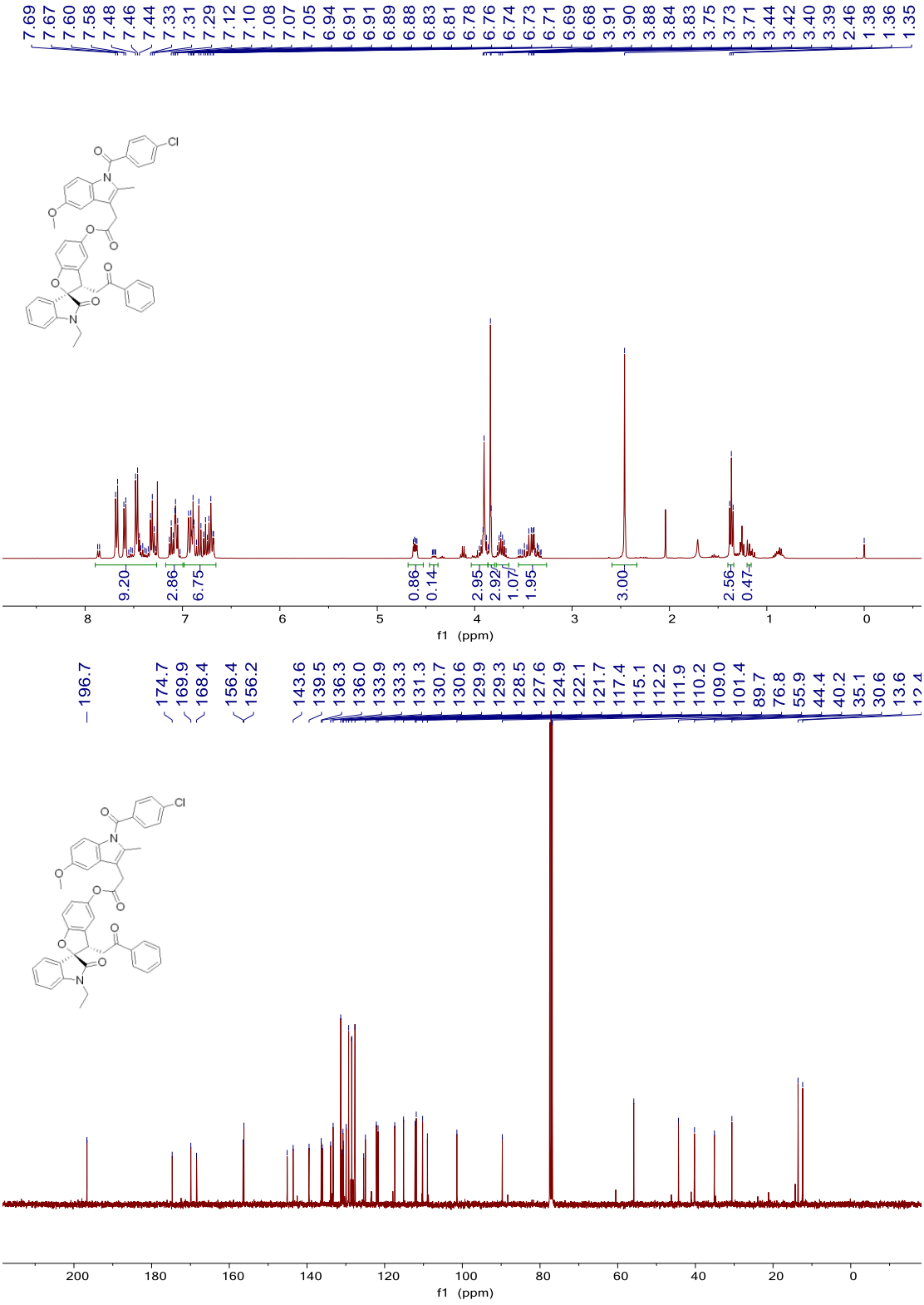
C44


7.27 7.27 7.25 7.24 7.23 7.22 7.21 7.20 7.19 7.19 7.16 7.16 7.14 7.14 7.12 7.12 7.08 7.06 6.99 6.97 6.95 6.90 6.88 6.81 6.79 6.77 6.76 6.74 6.72 4.64 4.62 3.92 3.90 3.89 3.88 3.87 3.84 3.77 3.76 3.74 3.41 3.39 1.38 1.36 1.34
1.03 3.00 1.00 1.00 1.00 0.97 1.00 1.98 1.00 4.00 3.00 1.07 2.03 3.03
f1 (ppm)
195.5 175.0 158.8 153.3 148.8 143.6 130.6 129.6 129.0 128.9 125.8 124.9 123.9 122.3 122.1 121.4 110.2 109.9 109.8 108.9 89.1 56.1 56.0 44.5 39.8 35.0 12.4
f1 (ppm)

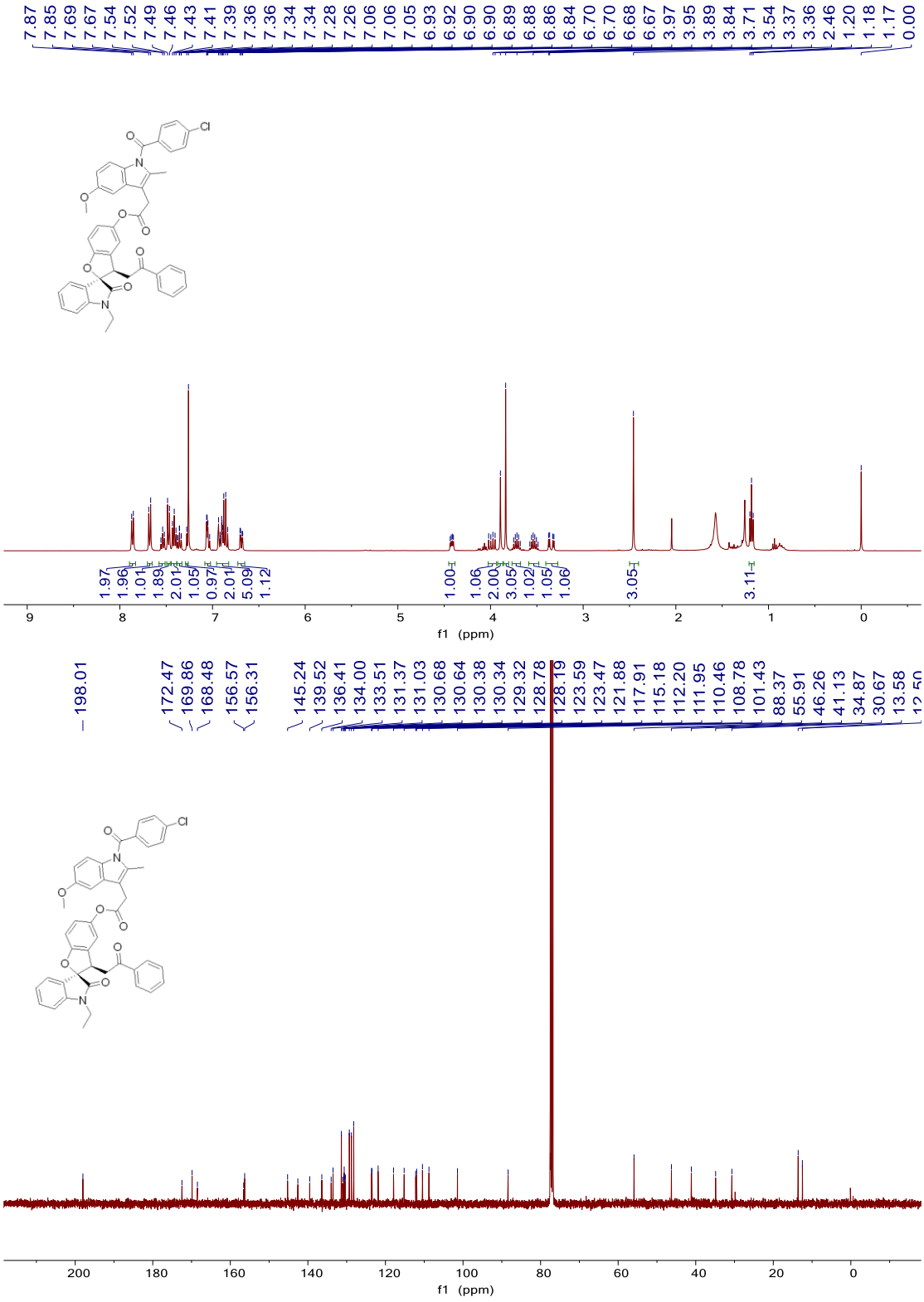
C45


7.52
7.50
7.36
7.35
7.24
7.22
7.21
7.20
7.19
7.15
7.13
7.11
7.09
7.08
6.99
6.99
6.97
6.97
6.96
6.90
6.88
6.83
6.81
6.79
6.71
6.69
4.67
4.66
4.65
4.63
3.88
3.86
3.84
3.73
3.71
3.70
3.68
3.36
3.36
3.35
3.34
1.35
1.34
1.32
-0.00
O
O
O
N
S
CH3
0.97
1.00
2.04
2.03
2.00
1.01
1.00
1.00
1.00
1.04
1.03
2.05
3.08
f1 (ppm)
189.54
174.94
158.88
143.58
143.25
133.69
131.73
130.70
129.07
128.54
127.94
125.63
125.02
123.91
122.13
121.45
110.27
109.05
88.92
44.60
40.72
35.11
12.41
f1 (ppm)

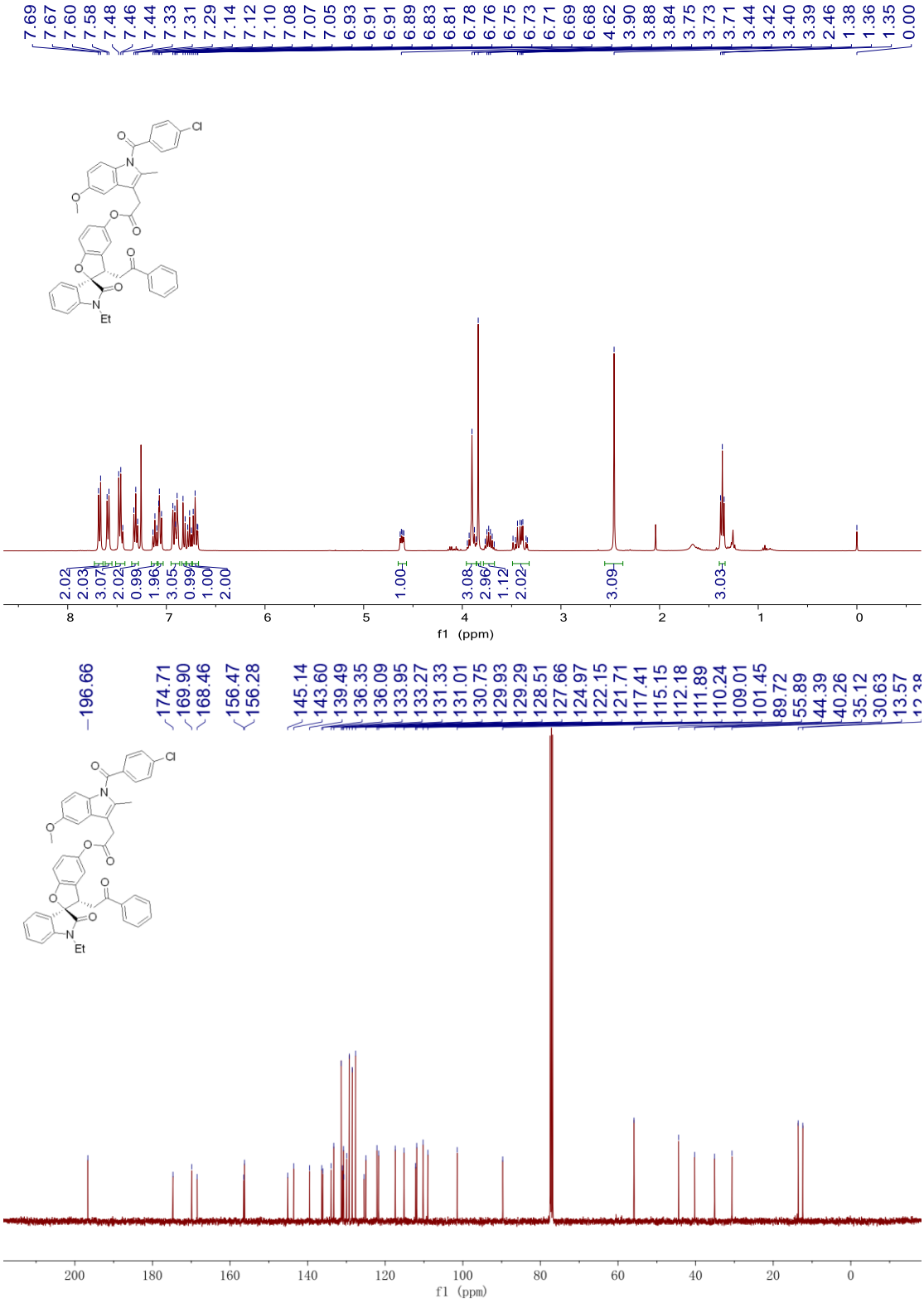
C46


7.69 7.67 7.60 7.58 7.48 7.46 7.44 7.33 7.31 7.29 7.12 7.10 7.08 7.07 7.05 6.94 6.91 6.91 6.89 6.88 6.83 6.81 6.78 6.76 6.74 6.73 6.71 6.69 6.68 3.91 3.90 3.88 3.84 3.83 3.75 3.73 3.71 3.44 3.42 3.40 3.39 2.46 1.38 1.36 1.35
Cl
9.20 2.86 6.75 0.86 0.14 2.95 2.92 1.07 1.95 3.00 2.56 0.47
f1 (ppm)
196.7 174.7 169.9 168.4 156.4 156.2 143.6 139.5 136.3 136.0 133.9 133.3 131.3 130.7 130.6 129.9 129.3 128.5 127.6 124.9 122.1 121.7 117.4 115.1 112.2 111.9 110.2 109.0 101.4 89.7 76.8 55.9 44.4 40.2 35.1 30.6 13.6
Cl
f1 (ppm)

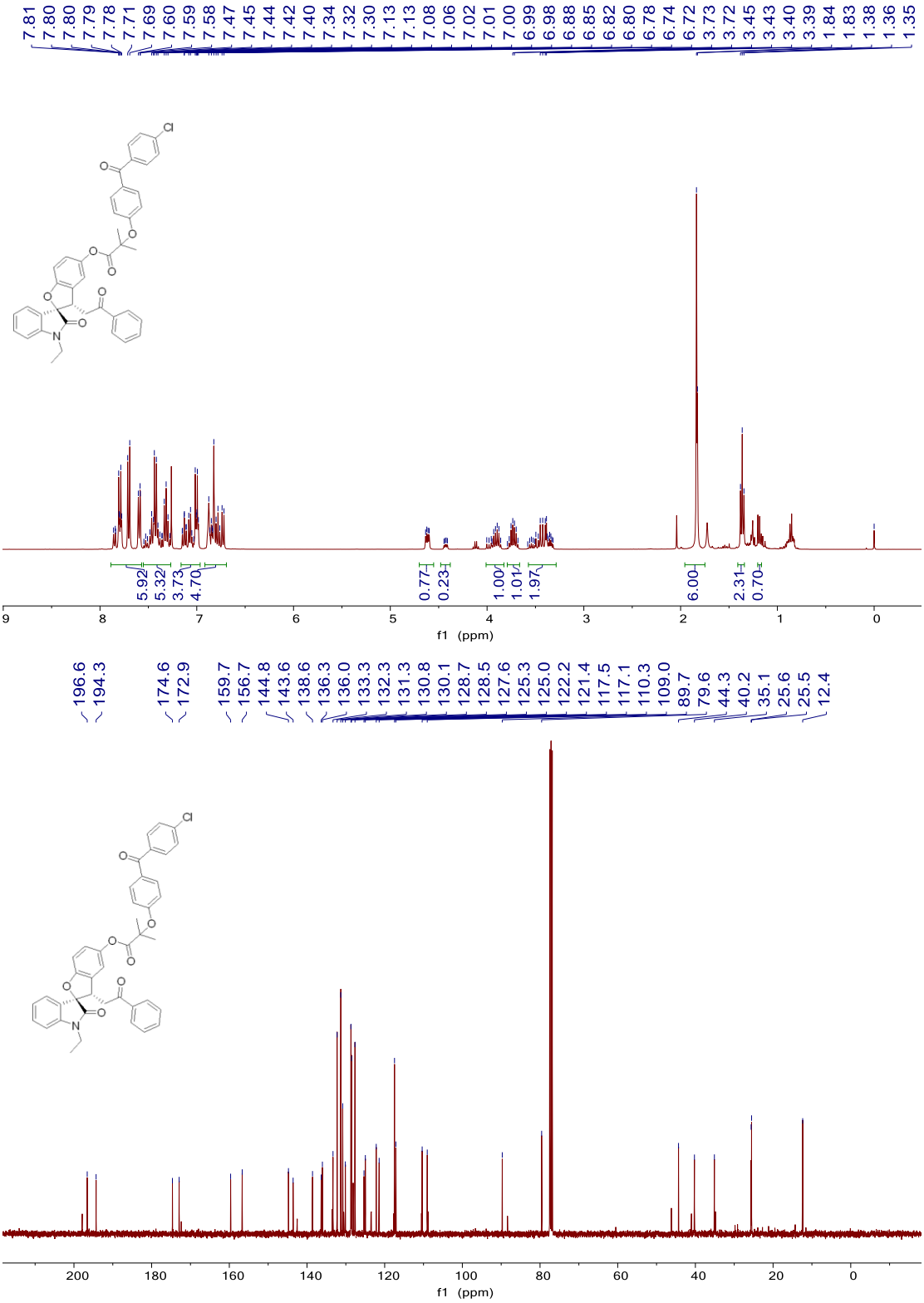
Minor diastereomer of C46



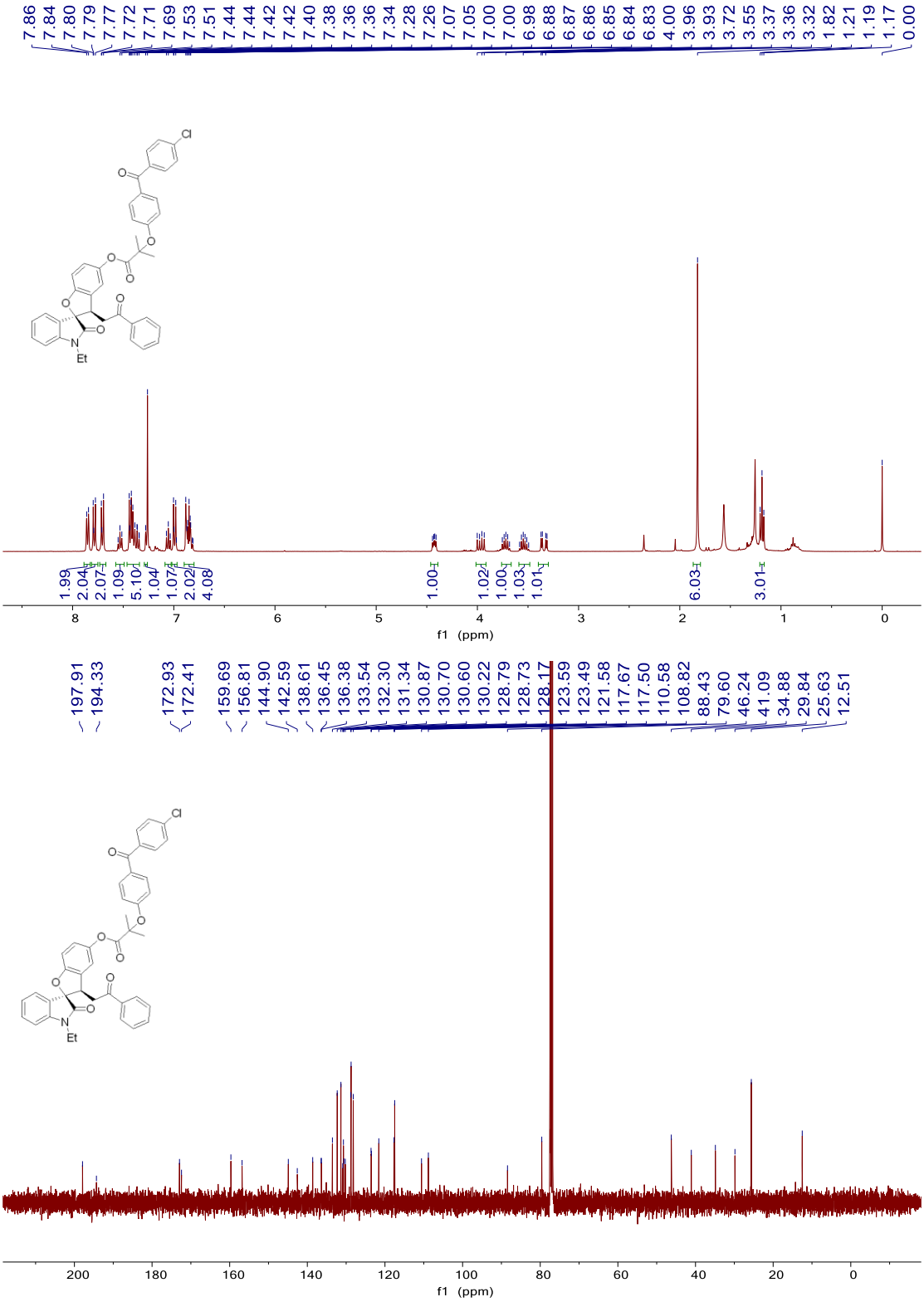
Major diastereomer of C46



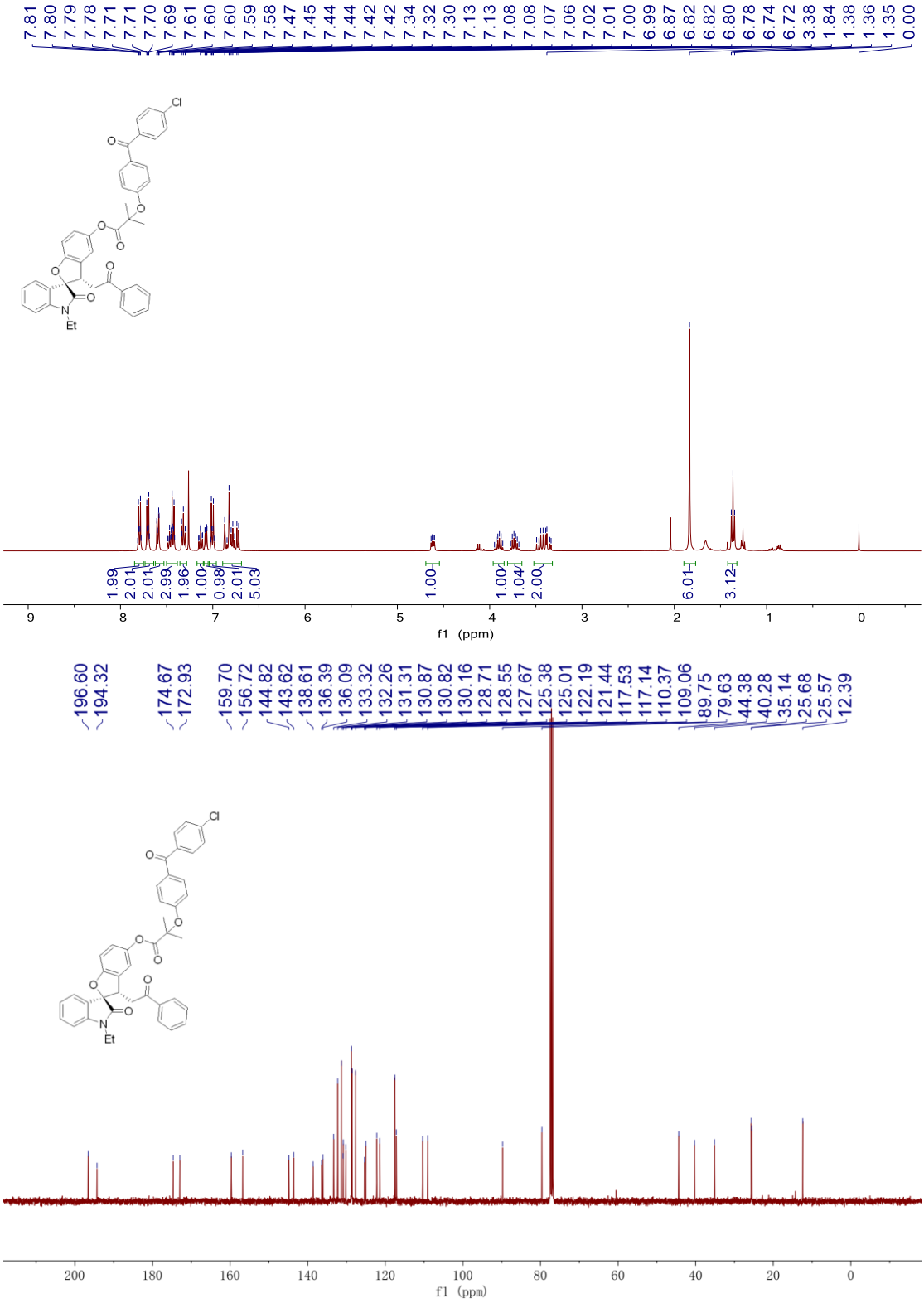
C47


7.81 7.80 7.80 7.79 7.78 7.71 7.69 7.60 7.59 7.58 7.47 7.45 7.44 7.42 7.40 7.34 7.32 7.30 7.13 7.08 7.06 7.02 7.01 7.00 6.99 6.98 6.88 6.85 6.82 6.80 6.78 6.74 6.72 3.73 3.72 3.45 3.43 3.40 3.39 1.84 1.83 1.38 1.36 1.35
Cl
O
O
O
O
O
O
O
N
5.92 5.32 3.73 4.70 0.77 0.23 1.00 1.01 1.97 6.00 2.31 0.70
9 8 7 6 5 4 3 2 1 0
f1 (ppm)
196.6 194.3 174.6 172.9 159.7 156.7 144.8 143.6 138.6 136.3 136.0 133.3 132.3 131.3 130.8 130.1 128.7 128.5 127.6 125.3 125.0 122.2 121.4 117.5 117.1 110.3 109.0 89.7 79.6 44.3 40.2 35.1 25.6 25.5 12.4
Cl
O
O
O
O
O
O
O
N
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

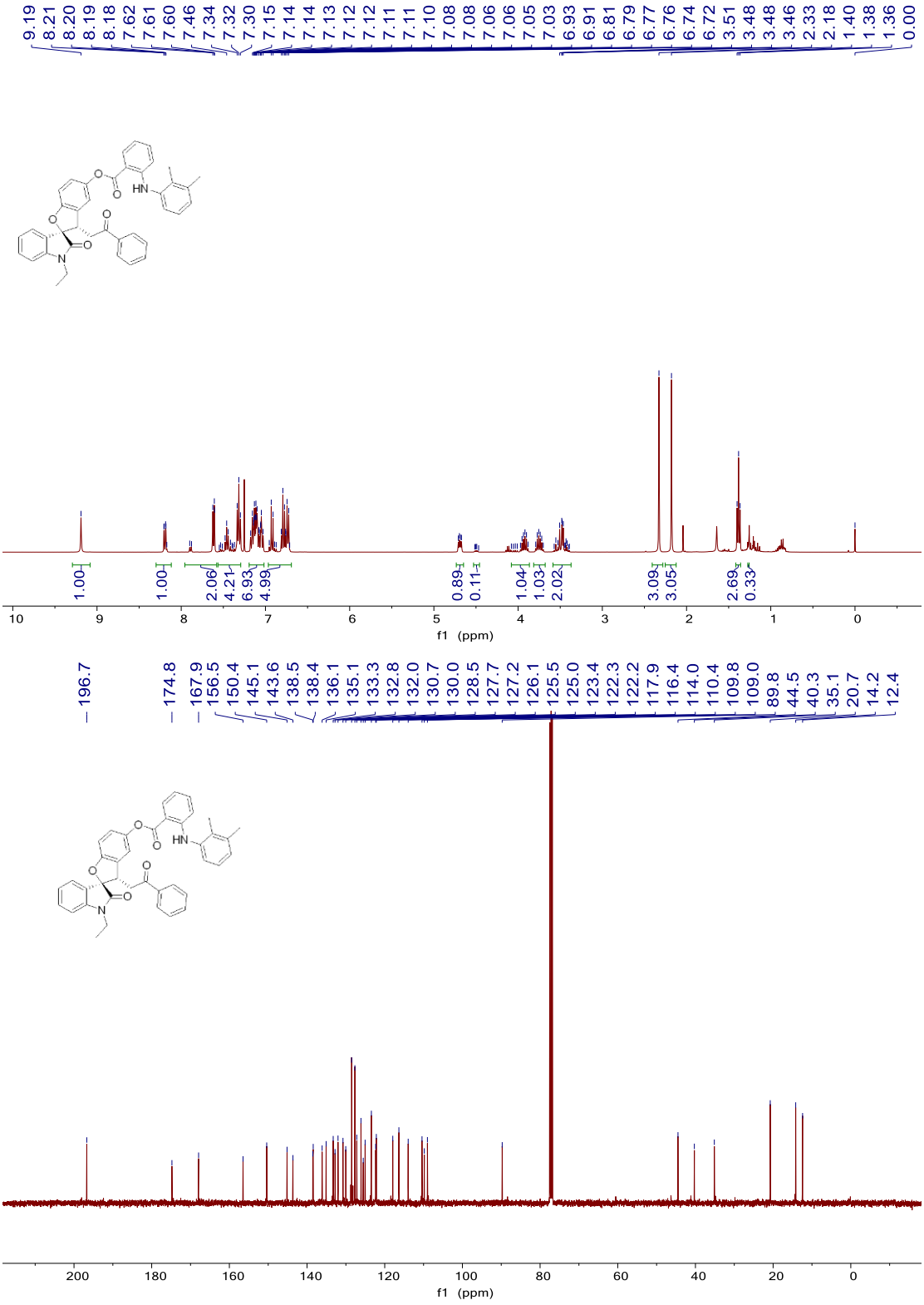
Minor diastereomer of C47



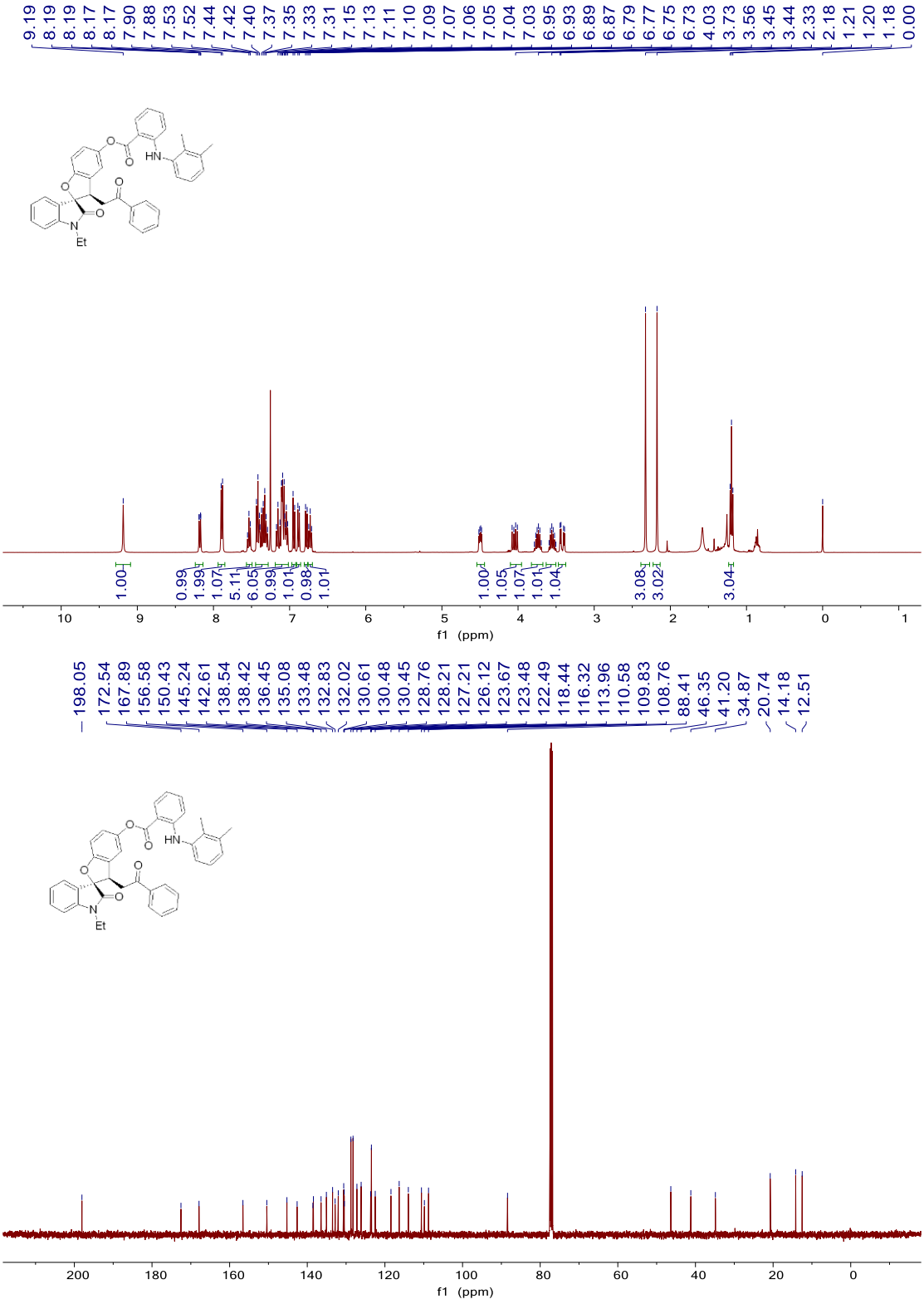
Major diastereomer of C47



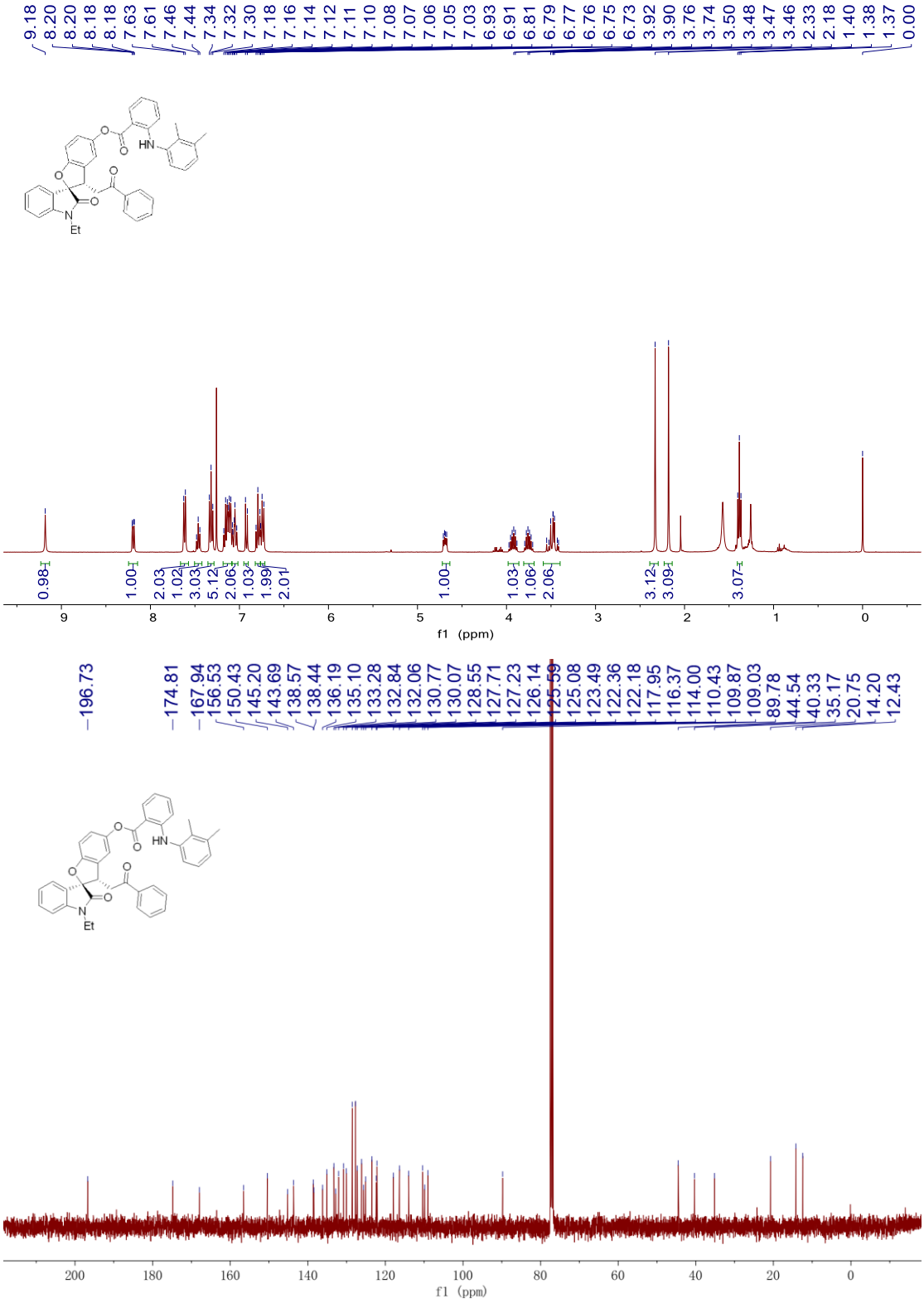
C48


9.19
8.21
8.20
8.19
8.18
7.62
7.61
7.60
7.46
7.34
7.32
7.30
7.15
7.14
7.14
7.13
7.12
7.12
7.11
7.11
7.10
7.08
7.08
7.06
7.06
7.05
7.03
6.93
6.91
6.81
6.79
6.77
6.76
6.74
6.72
3.51
3.48
3.48
3.46
2.33
2.18
1.40
1.38
1.36
0.00
HN
O
N
1.00
1.00
2.06
4.21
6.93
4.99
0.89
0.11
1.04
1.03
2.02
3.09
3.05
2.69
0.33
f1 (ppm)
196.7
174.8
167.9
156.5
150.4
145.1
143.6
138.5
138.4
136.1
135.1
133.3
132.8
132.0
130.7
130.0
128.5
127.7
127.2
126.1
125.5
125.0
123.4
122.3
122.2
117.9
116.4
114.0
110.4
109.8
109.0
89.8
44.5
40.3
35.1
20.7
14.2
12.4
f1 (ppm)

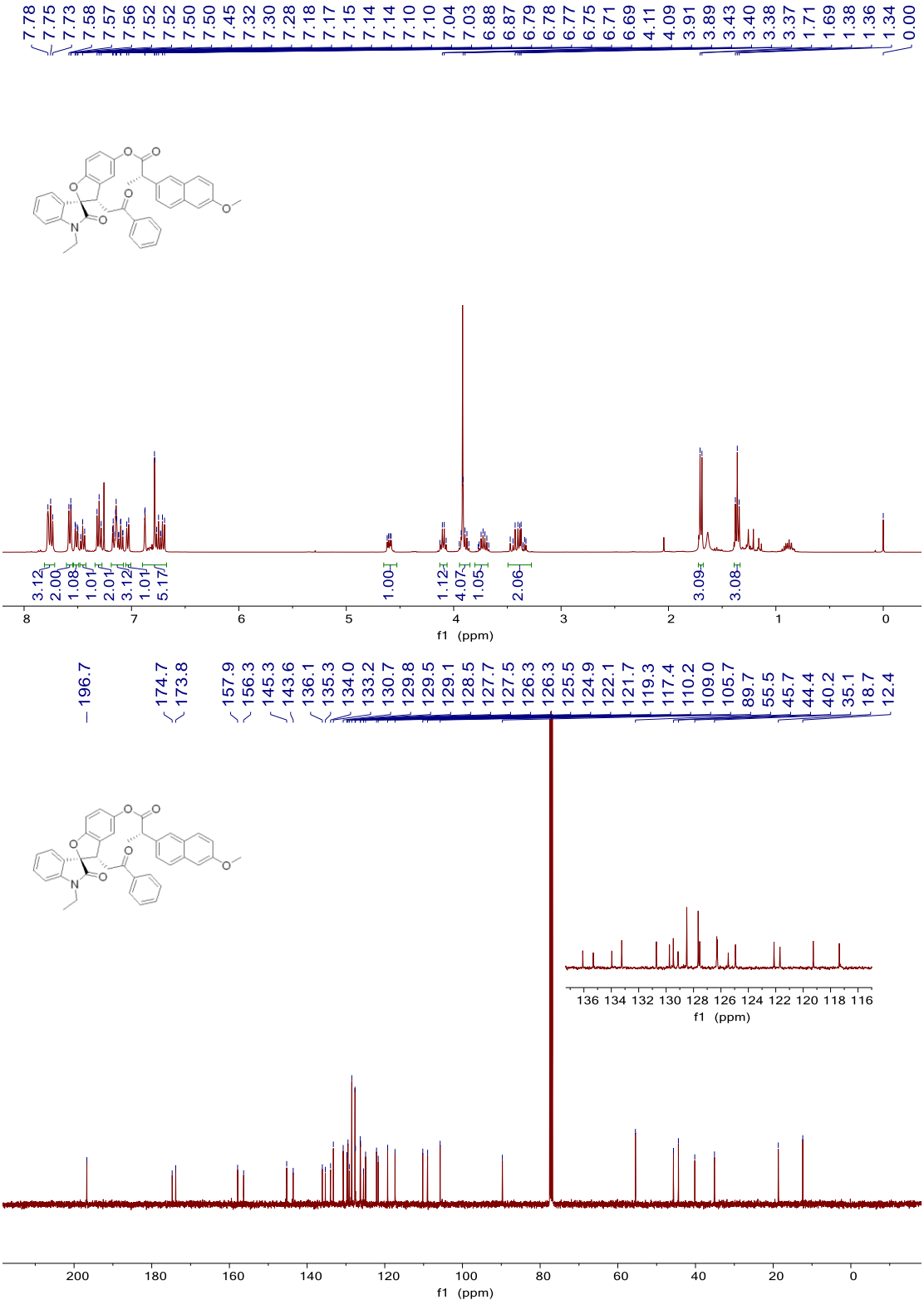
Minor diastereomer of C48



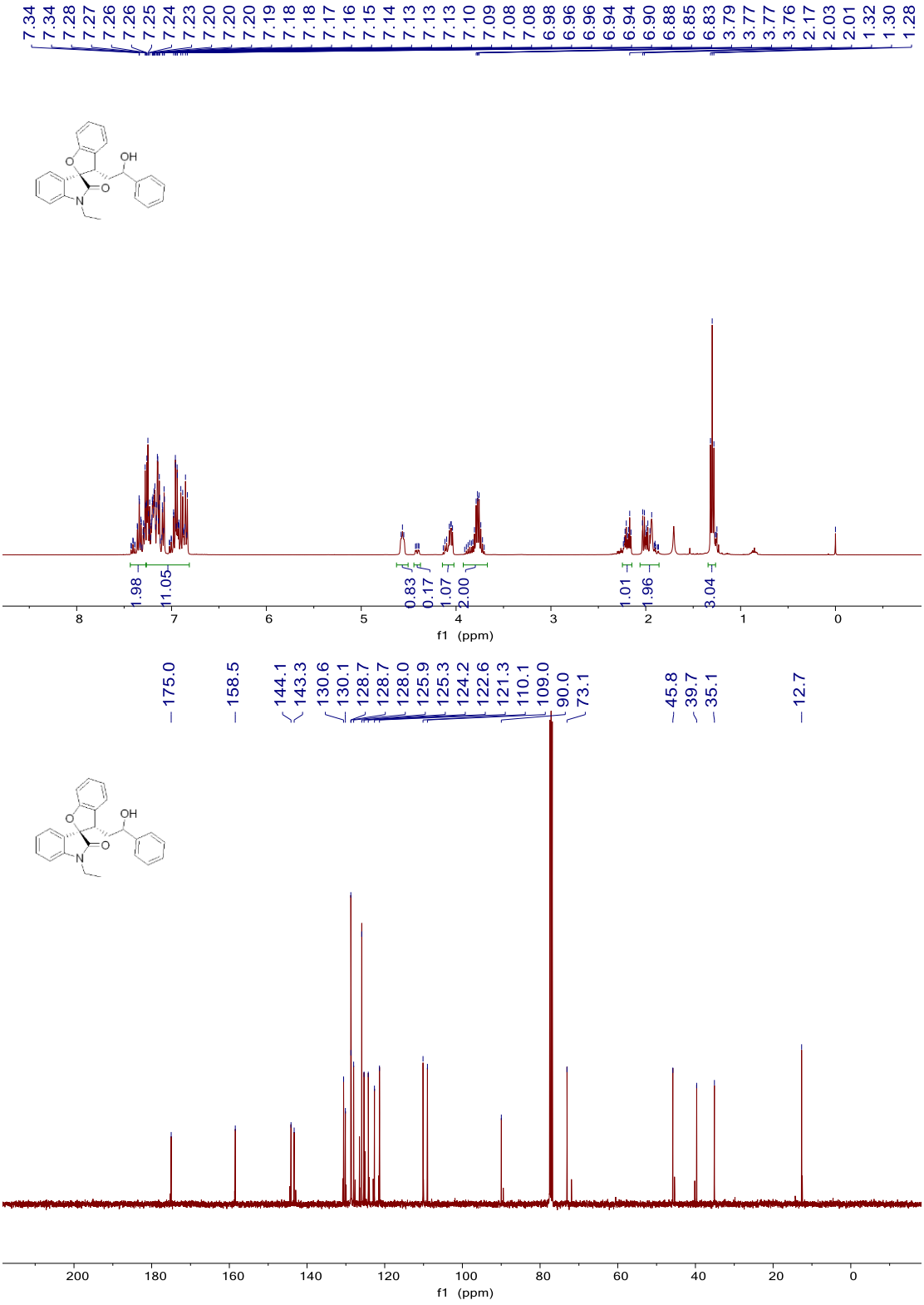
Major diastereomer of C48



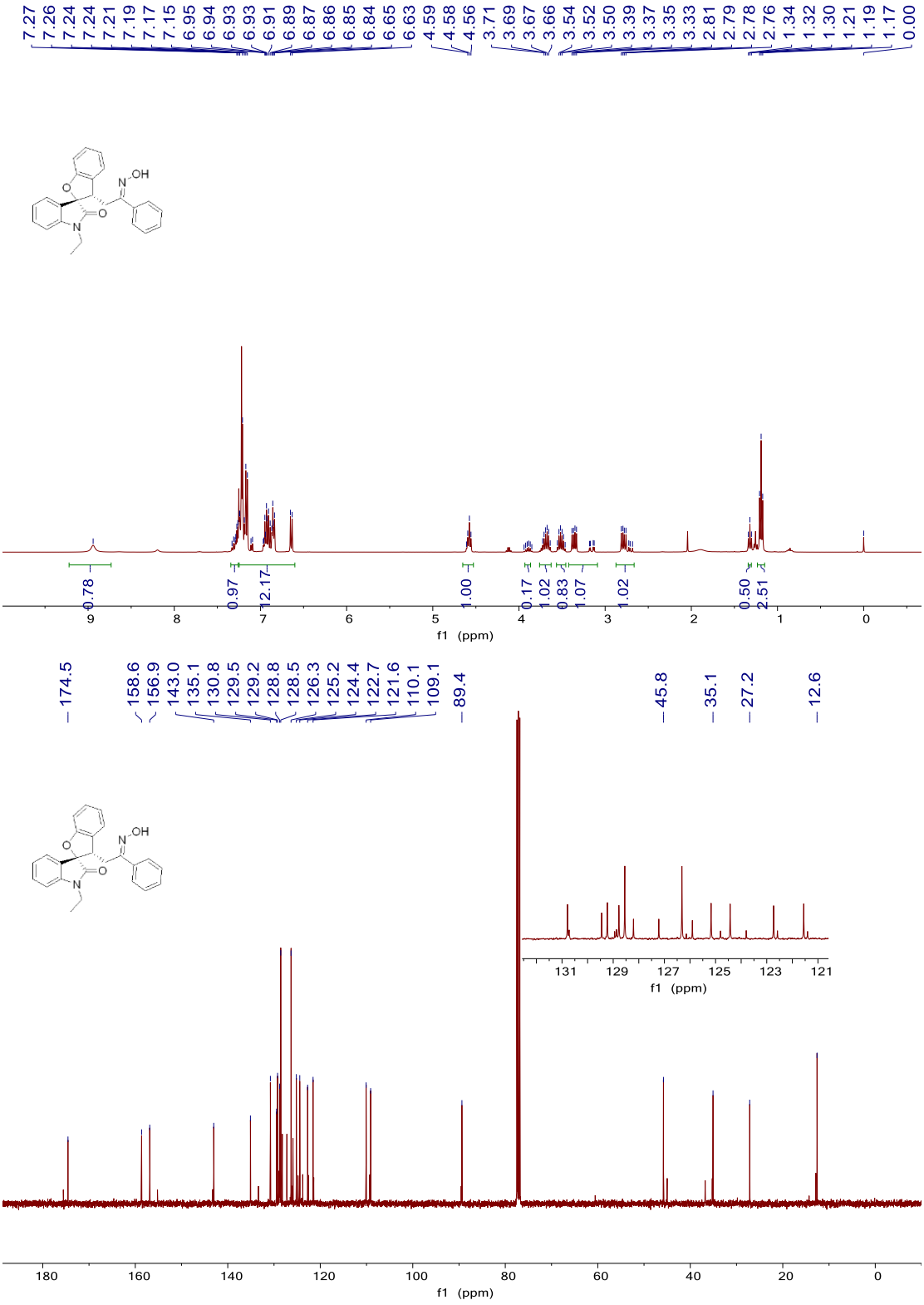
C49


7.78 7.75 7.73 7.58 7.57 7.56 7.52 7.52 7.50 7.50 7.45 7.32 7.30 7.28 7.18 7.17 7.15 7.14 7.14 7.10 7.10 7.04 7.03 6.88 6.87 6.79 6.78 6.77 6.75 6.71 6.69 4.11 4.09 3.91 3.89 3.43 3.40 3.38 3.37 1.71 1.69 1.38 1.36 1.34 0.00
3.12 2.00 1.08 1.01 2.01 3.12 1.01 5.17 1.00 1.12 4.07 1.05 2.06 3.09 3.08
f1 (ppm)
196.7 174.7 173.8 157.9 156.3 145.3 143.6 136.1 135.3 134.0 133.2 130.7 129.8 129.5 129.1 128.5 127.7 127.5 126.3 126.3 125.5 124.9 122.1 121.7 119.3 117.4 110.2 109.0 105.7 89.7 55.5 45.7 44.4 40.2 35.1 18.7 12.4
136 134 132 130 128 126 124 122 120 118 116
f1 (ppm)
200 180 160 140 120 100 80 60 40 20 0
f1 (ppm)

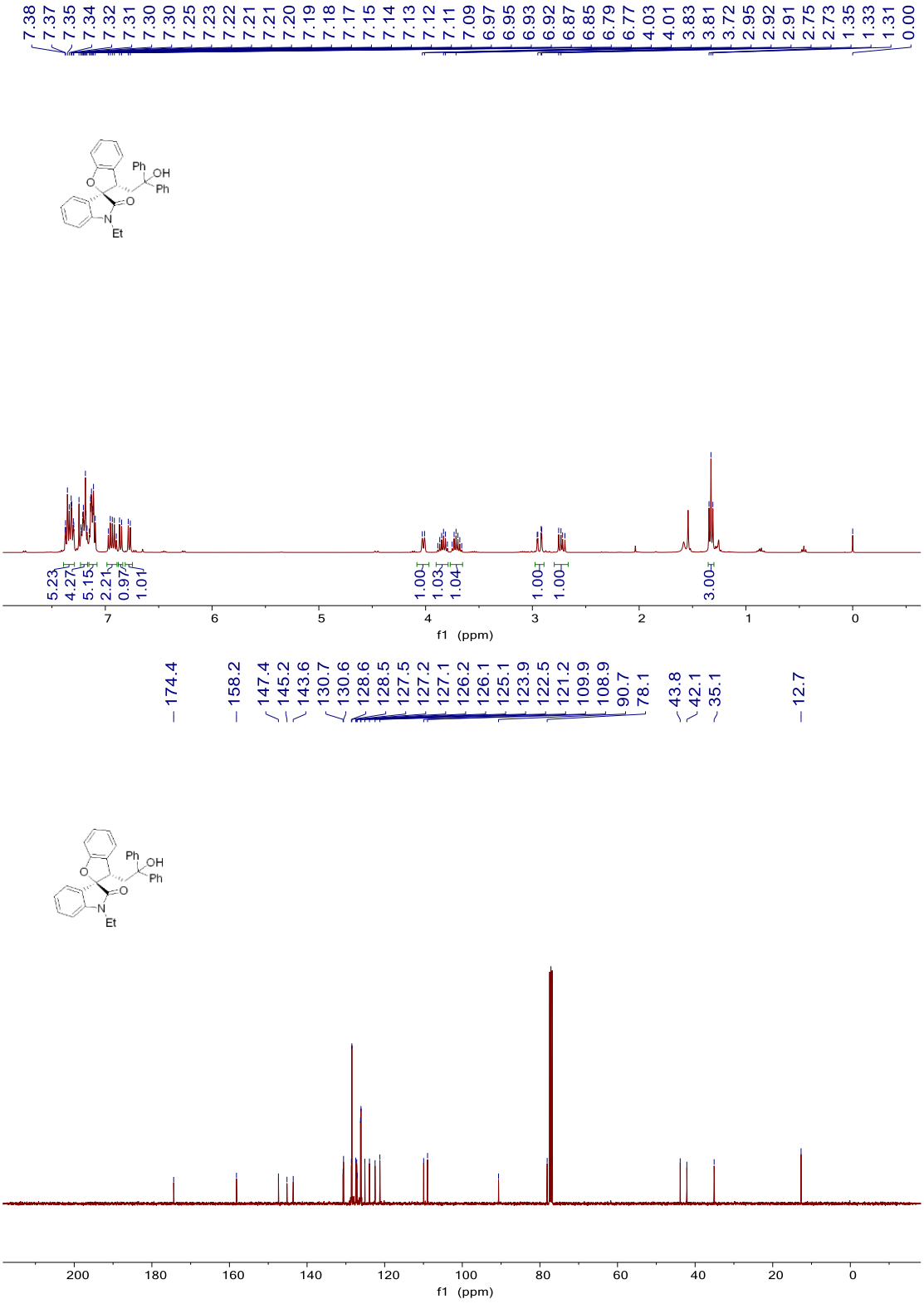
D1


7.34 7.34 7.28 7.27 7.26 7.26 7.25 7.24 7.23 7.20 7.20 7.20 7.19 7.18 7.18 7.17 7.16 7.15 7.14 7.13 7.13 7.13 7.10 7.09 7.08 7.08 6.98 6.96 6.96 6.94 6.94 6.90 6.88 6.85 6.83 3.79 3.77 3.77 3.76 2.17 2.03 2.01 1.32 1.30 1.28
OH
O
O
N
1.98 11.05 0.83 0.17 1.07 2.00 1.01 1.96 3.04
f1 (ppm)
175.0 158.5 144.1 143.3 130.6 130.1 128.7 128.7 128.0 125.9 125.3 124.2 122.6 121.3 110.1 109.0 90.0 73.1 45.8 39.7 35.1 12.7
f1 (ppm)

D2


7.27 7.26 7.24 7.24 7.21 7.19 7.17 7.15 6.95 6.94 6.93 6.93 6.91 6.89 6.87 6.86 6.85 6.84 6.65 6.63 4.59 4.58 4.56 3.71 3.69 3.67 3.66 3.54 3.52 3.50 3.39 3.37 3.35 3.33 2.81 2.79 2.78 2.76 1.34 1.32 1.30 1.21 1.19 1.17 0.00
OH
O
N
O
N
0.78 0.97 12.17 1.00 0.17 1.02 0.83 1.07 1.02 0.50 2.51
f1 (ppm)
174.5 158.6 156.9 143.0 135.1 130.8 129.5 129.2 128.8 128.5 126.3 125.2 124.4 122.7 121.6 110.1 109.1 89.4 45.8 35.1 27.2 12.6
f1 (ppm)
f1 (ppm)

D3


7.38 7.37 7.35 7.34 7.32 7.31 7.30 7.30 7.25 7.23 7.22 7.21 7.21 7.20 7.19 7.18 7.17 7.15 7.14 7.13 7.12 7.11 7.09 6.97 6.95 6.93 6.92 6.87 6.85 6.79 6.77 4.03 4.01 3.83 3.81 3.72 2.95 2.92 2.91 2.75 2.73 1.35 1.33 1.31 0.00
Ph
OH
Ph
O
O
N
Et
5.23 4.27 5.15 2.21 0.97 1.01 1.00 1.03 1.04 1.00 1.00 3.00
f1 (ppm)
174.4 158.2 147.4 145.2 143.6 130.7 130.6 128.6 128.5 127.5 127.2 127.1 126.2 126.1 125.1 123.9 122.5 121.2 109.9 108.9 90.7 78.1 43.8 42.1 35.1 12.7
f1 (ppm)

10. Reference.

1. Mattia Silvi, Indranil Chatterjee, Yiankai Liu, and Paolo Melchiorre. Controlling the Molecular Topology of Vinylogous Iminium Ions by Logical Substrate Design: Highly Regio- and Stereoselective Aminocatalytic 1,6-Addition to Linear 2,4-Dienals, *Angew. Chem.* 2013, **125**, 10980–10983.
2. (*a*) Andrew M. Beekman and Russell A. Barrow. Syntheses of the Fungal Metabolites Boletopsins 7, 11, and 12 from the Papua New Guinea Medicinal Mushroom Boletopsis sp. *J. Org. Chem*. 2014, **79**, 1017-1024. (*b*) Shu-Mei Yang, Ganapuram Madhusudhan Reddy, Meng-Hsien Liu, Tzu-Ping Wang, Jhen-Kuei Yu, and Wenwei Lin, Diastereoselective Synthesis of Rauhut−Currier-Type Adducts via an Unexpected α-Addition of α,β-Unsaturated γ-Butyrolactams to Coumarin Derivatives, *J. Org. Chem.* 2017, **82**, 781−789.
3. Z. P. Yu, X. H. Liu, L. Zhou, L. L. Lin and X. M. Feng, Bifunctional Guanidine via an Amino Amide Skeleton for Asymmetric Michael Reactions of β-Ketoesters with Nitroolefins: A Concise Synthesis of Bicyclic β-Amino Acids, *Angew. Chem. Int. Ed.* 2009, **48**, 5195-5198.
4. S. X. Dong, X. H. Liu, Y. L. Zhang, L. L. Lin and X. M. Feng, Asymmetric Synthesis of 3,4-Diaminochroman-2-ones Promoted by Guanidine and Bisguanidium Salt, *Org. Lett.* 2011, **13**, 5060-5063.