Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Regioselective Synthesis of *N*-Containing Polycyclic Compounds *via* Radical Annulation Cyclization of 1,7-Dienes with Aldehydes

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1.General Information

Unless otherwise stated, all commercial reagents were used as received. aminobenzene (BK, 99%), benzaldehyde (Innochem, >98%) and phenylethynyl (Innochem, >98%) were used without further treatment. All reagents and solvents were commercially available and used without any further purification unless specified. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (0.25mm, 300-400 mesh). Analytical thin-layer chromatography was performed using glass plates pre-coated with 0.25mm 300-400 mesh silica gel impregnated with a fluorescent indicator (254 nm). All reactions were carried out with magnetic stirring and in dried glassware.Nuclear magnetic resonance (NMR) spectra are recorded in parts per million from internal tetramethylsilane on the δ scale. 1H NMR, 19F NMR and 13C NMR spectra were recorded in CDCl3 on a Bruker DRX-400 spectrometer operating at 400 MHz, 376 MHz and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants quated in Hz. The solvent peak was used as a reference value, for 1H NMR: TMS = 0.00 ppm, for 13C NMR: CDCl3 = 77.00 ppm. The following abbreviations were used to explain multiplicities: s = singlet, d = doublet, dd = doublet of doublet, t = triplet, td = triplet of doublet, q = quartet, m = multiplet, and br = broad. High-resolution mass spectra (HRMS) were obtained on an Agilent mass spectrometer using ESI-TOF (electrospray ionization-time of flight).

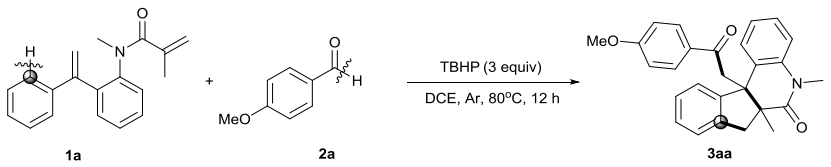
2. Experiment Section

2.1 General Procedure for the Synthesis of Substrates

All *N*-methyl-*N*-(2-(1-phenylvinyl)phenyl)methacrylamide **1**[1] were synthesized according to the known methods and all aldehydes **2** were purchased from Energy Chemical.

2.2 Table S1. Optimization of Reaction Conditions[a]

Initially, we chose *N*-methyl-*N*-(2-(1-phenylvinyl)phenyl)methacrylamide (1a) and *p*-methoxybenzaldehyde (2a) as model substrates to explore the optimum reaction conditions (Table 1). As expected, the desired *N*-containing polycyclic product 3aa was isolated in 74% yield when the 1a (0.2 mmol) reacted with 2a (0.3 mmol, 1.5 equiv) in the presence of 3 equiv TBHP (*tert*-Butyl hydroperoxide, 70% solution in water) and DCE (2 mL) at 80 ^{o}C under an argon atmosphere for 12 h (entry 1). We found that the oxidant and an argon atmosphere played a key role in this transformation, and the reaction did not occur in the absence of oxidant or under an oxygen atmosphere (entries 2-3). Inspired by these results, a series of other oxidants, including DTBP (*di-tert*-Butyl peroxide), TBPB *(tert*-Butyl peroxybenzoate), *m*-CPBA (*m*-Chloroperbenzoicacid), $K_2S_2O_8$, Oxone and $PhI(OAc)_2$, were investigated (entries 4-9). The result shows that TBHP was most efficient oxidant. As changing the amount of TBHP, the yield of product 3aa declined (entries 10-11). Next, we further explored the effect of reaction solvents. This oxidative radical annulation reaction could also be conducted in acetone, and afforded slightly lower yield than DCE (entry 12). Surprisingly, other solvents, including DMSO, THF, 1,4-dioxane, CH_3CN and toluene, were not compatible with this reaction (entries 13-17). Notably, the temperature had an influence in the current reaction, convert the reaction temperature of 60 ^{o}C or 100 ^{o}C resulted in the decline of reaction yields (entries 18 and 19). Additionally, the yield of 3aa could not be increased obviously when the reaction time was extended to 24 h (entry 20). It is noteworthy that conducting the reaction with 1 mmol scale of 1,7-dienes 1a still achieved a moderate yield (entry 21).



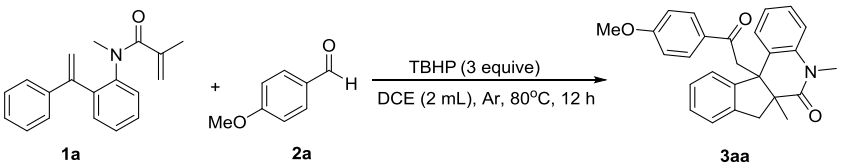
1a 2a 3aa

Entry	Variation from the standard conditions	Isolated yield (%)
1	none	74
2[b]	air	0
3[b]	without TBHP	0
4	DTBP instead of TBHP	65%
5	TBPB instead of TBHP	50%

6	*m*-CPBA instead of TBHP	28%
7[b]	$K_2S_2O_8$ instead of TBHP	0
8[b]	oxone instead of TBHP	0
9[b]	$PhI(OAc)_2$ instead of TBHP	trace
10[c]	none	55%
11[d]	none	68%
12	Acetone instead of DCE	65%
13[b]	DMSO instead of DCE	0
14[b]	THF instead of DCE	0
15[b]	1,4-dioxane instead of DCE	0
16[b]	CH_3CN instead of DCE	trace
17[b]	toluene instead of DCE	trace
18	at 60 ^oC (oil bath)	54%
19	at 100 ^oC (oil bath)	70%
20	24 h	75%
21[e]	none	63%

[a] Reaction conditions: 1a (0.2 mmol), 2a (0.3 mmol, 1.5 equiv), TBHP (0.6 mmol, 3 equiv) and solvent (2 mL) at 80 ^oC under an argon atmosphere for 12 h. [b] The most of substrate 1a was recovered. [c] TBHP (2 equiv) instead of TBHP (3 equiv). [d] TBHP(4 equiv) instead of TBHP(3 equiv). [e] 1 mmol scale reaction.

2.3 Typical Experimental Procedure

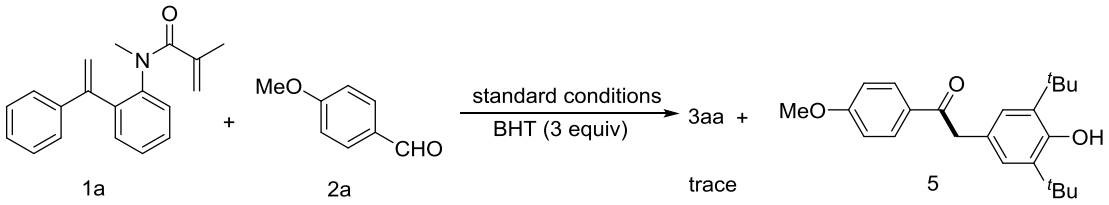


To a Schlenk tube were added *N*-methyl-*N*-(2-(1-phenylvinyl)phenyl)methacrylamide **1a** (0.2 mmol), p-methoxybenzaldehyde **2a** (0.3 mmol, 1.5 equiv), TBHP (0.6 mmol, 3 equiv) and DCE (2 mL). Then the tube was stirred at 80 ^oC in Ar atmosphere for the indicated time until complete

consumption of starting material as monitored by TLC analysis. The residue was purified by silica gel flash column chromatography (petroleum ether/ethyl acetate = 10 : 1) to afford the desired products. A scaled-up experiment conducted in the presence of **1a** (1 g, 3.6 mmol), **2a** (0.74 g, 1.5 equiv), TBHP (0.97 g, 3 equiv), and DCE (30 mL) at 80 ^{o}C for 24 h under an argon atmosphere. Until complete consumption of the starting material was observed by TLC and/or GC-MS analysis, the reaction mixture removal of the solvent, the crude product was purified by column chromatography (petroleum ether/ethyl acetate, 10 : 1) to provide the desired product **3aa** (0.93 g) in 63% yield.

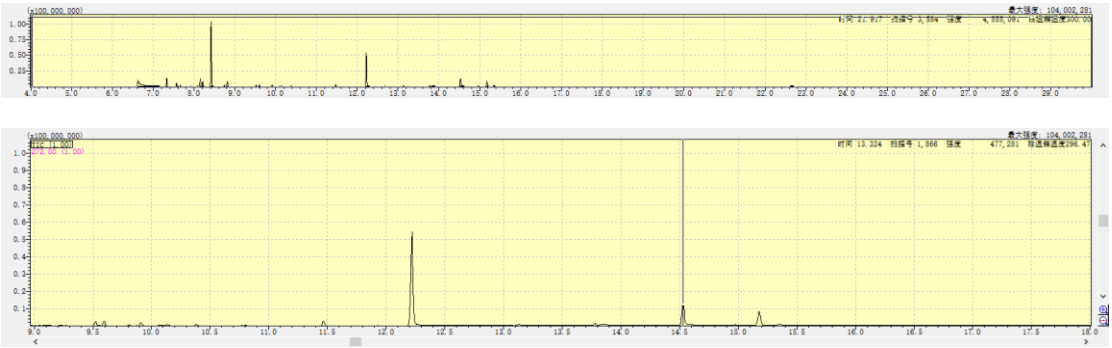
2.4 Control Experiments

2.4.1 GC-MS Analysis of Raw Reaction Mixture by Using BHT as Radical Inhibitor

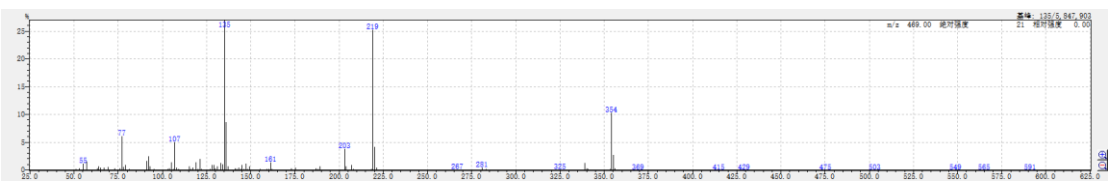


Chemical Formula: $C_{23}H_{30}O_3$
Exact Mass: 354.2195
Molecular Weight: 354.4900

Spectra of GC-MS



MS Spectra of the peak at 14.530 min



[MS Spectrum]

# of Peaks 551

Raw Spectrum 14.530 (scan : 2107)

Background No Background Spectrum

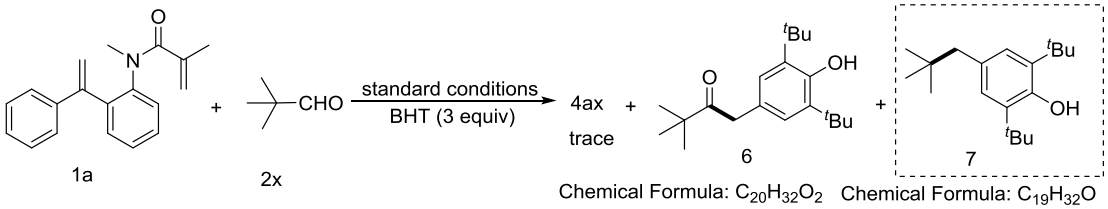
Base Peak m/z 135.05 (Inten : 5,847,903)

Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.00	6026	0.10	84.00	1095	0.02	117.10	31329	0.54
51.00	12350	0.21	85.10	1601	0.03	118.10	7930	0.14
52.05	3690	0.06	86.10	452	0.01	119.10	84138	1.44
53.00	22674	0.39	87.05	1561	0.03	120.10	14446	0.25
54.05	2143	0.04	88.05	1667	0.03	121.10	121857	2.08
55.05	71668	1.23	89.05	7096	0.12	122.10	11854	0.20
56.05	8073	0.14	90.05	3032	0.05	123.10	8081	0.14
57.05	91681	1.57	91.05	99640	1.70	124.15	11590.02	
58.00	4684	0.08	92.00	151089	2.58	125.05	1547	0.03
59.05	4296	0.07	93.05	38946	0.67	126.05	2457	0.04
60.05	494	0.01	94.10	6865	0.12	127.05	16976	0.29
61.05	998	0.02	95.05	11392	0.19	128.10	54530	0.93
62.00	1862	0.03	96.05	7492	0.13	129.10	56834	0.97
63.00	17793	0.30	96.90	4142	0.07	130.10	21087	0.36
64.00	43564	0.74	97.90	11670.02		131.10	41617	0.71
65.00	24865	0.43	98.90	11740.02		132.10	10281	0.18
66.00	4414	0.08	99.85	355	0.01	133.10	79198	1.35
67.00	25974	0.44	100.15	352	0.01	134.15	60989	1.04
68.00	2540	0.04	101.05	2081	0.04	135.05	5847903	100.00
69.00	35276	0.60	102.05	4756	0.08	136.05	509883	8.72
70.05	2392	0.04	103.05	17581	0.30	137.05	45628	0.78
71.15	2529	0.04	104.05	19118	0.33	138.10	3217	0.06
72.05	1051	0.02	105.05	82817	1.42	139.10	2502	0.04
73.05	24142	0.41	106.05	16080	0.27	140.05	1779	0.03
74.05	3712	0.06	107.05	294210	5.03	141.10	22695	0.39
75.05	6034	0.10	108.05	27256	0.47	142.10	11785	0.20
76.05	20513	0.35	109.10	10970	0.19	143.10	26420	0.45
77.00	360516	6.16	110.05	1257	0.02	144.10	10734	0.18
78.00	35058	0.60	111.05	2107	0.04	145.10	53457	0.91
79.05	57637	0.99	111.85	1049	0.02	146.10	14524	0.25
80.05	8078	0.14	113.05	1204	0.02	147.10	69287	1.18
81.05	17630	0.30	114.15	1399	0.02	148.10	11383	0.19
82.05	2709	0.05	115.05	42392	0.72	149.05	40506	0.69
83.05	9962	0.17	116.05	16121	0.28	150.05	4282	0.07

151.05	2328	0.04	195.05	3084	0.05	239.00	3897	0.07
152.05	5347	0.09	196.00	1247	0.02	240.05	1241	0.02
153.05	8131	0.14	197.05	1274	0.02	240.95	1432	0.02
154.05	4394	0.08	198.05	489	0.01	242.15	510	0.01
155.05	11199	0.19	199.00	1442	0.02	243.10	1804	0.03
156.10	8852	0.15	200.10	486	0.01	244.00	684	0.01
157.05	9210	0.16	201.10	1670	0.03	245.15	536	0.01
158.10	5201	0.09	202.15	4826	0.08	246.05	383	0.01
159.10	16886	0.29	203.10	225878	3.86	247.05	992	0.02
160.10	10862	0.19	204.05	42368	0.72	247.95	1358	0.02
161.10	87783	1.50	205.10	9289	0.16	248.95	3214	0.05
162.10	17050	0.29	206.05	2547	0.04	250.05	1746	0.03
163.10	9782	0.17	207.00	53641	0.92	250.95	2767	0.05
164.15	1865	0.03	208.00	12686	0.22	252.05	1673	0.03
165.10	61100.10		209.00	9590	0.16	253.05	3239	0.06
166.05	2365	0.04	210.05	2282	0.04	254.05	659	0.01
167.05	1920	0.03	211.05	1495	0.03	255.05	3006	0.05
168.10	1047	0.02	211.95	878	0.02	256.05	617	0.01
169.10	3078	0.05	213.00	1929	0.03	256.90	321	0.01
170.10	9146	0.16	213.95	305	0.01	257.90	350	0.01
171.05	7210	0.12	215.00	1913	0.03	259.05	400	0.01
172.15	2473	0.04	216.05	1057	0.02	260.10	546	0.01
173.05	17838	0.31	217.10	7559	0.13	261.05	358	0.01
174.15	6057	0.10	218.15	11625	0.20	262.05	737	0.01
175.10	28657	0.49	219.15	1480697	25.32	263.05	880	0.02
176.10	5428	0.09	220.10	248609	4.25	264.05	1056	0.02
177.05	3755	0.06	221.10	27620	0.47	265.00	5186	0.09
178.05	4922	0.08	222.10	3703	0.06	266.00	1641	0.03
179.05	4071	0.07	223.00	2327	0.04	267.00	5910	0.10
180.05	676	0.01	224.05	1550	0.03	268.05	1785	0.03
181.05	2562	0.04	225.05	1450	0.02	269.10	2087	0.04
182.10	745	0.01	226.05	11800.02		270.20	769	0.01
183.05	11320.02		227.05	3582	0.06	271.20	367	0.01
184.15	951	0.02	228.05	885	0.02	272.20	169	0.00
185.10	5754	0.10	229.05	851	0.01	273.20	164	0.00
186.15	1797	0.03	230.10	340	0.01	274.20	226	0.00
187.05	19928	0.34	231.10	1238	0.02	275.20	329	0.01
188.10	15582	0.27	232.05	1240	0.02	276.00	286	0.00
189.10	44706	0.76	233.10	3159	0.05	277.05	572	0.01
190.05	7052	0.12	234.05	1072	0.02	278.05	371	0.01
191.05	10225	0.17	235.00	2153	0.04	279.05	1903	0.03
192.00	31110.05		236.05	1426	0.02	280.05	1745	0.03
193.00	5724	0.10	237.10	1903	0.03	281.00	25153	0.43
194.00	2558	0.04	238.05	1055	0.02	282.05	71180.12	

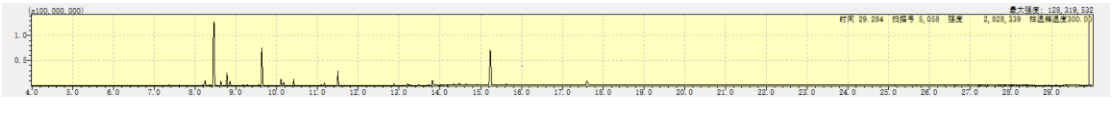
283.05	12016	0.21	309.15	1367	0.02	334.80	27	0.00
284.05	3028	0.05	310.15	524	0.01	336.15	283	0.00
284.95	636	0.01	311.05	1805	0.03	337.15	1222	0.02
286.00	150	0.00	312.15	694	0.01	338.15	9248	0.16
287.00	98	0.00	313.00	308	0.01	339.15	79736	1.36
288.00	142	0.00	314.00	591	0.01	340.15	20982	0.36
289.00	142	0.00	315.00	174	0.00	341.00	11473	0.20
290.00	103	0.00	316.00	33	0.00	342.05	3023	0.05
291.00	174	0.00	317.00	57	0.00	343.00	2036	0.03
292.10	110	0.00	318.00	38	0.00	343.95	638	0.01
293.10	1294	0.02	319.00	137	0.00	344.90	159	0.00
294.15	577	0.01	320.00	151	0.00	345.90	76	0.00
295.05	4853	0.08	321.00	646	0.01	346.90	70	0.00
296.05	2337	0.04	322.15	543	0.01	347.90	34	0.00
297.10	7263	0.12	323.15	3530	0.06	348.90	81	0.00
298.10	2268	0.04	324.05	1389	0.02	349.90	50	0.00
299.10	655	0.01	325.00	4186	0.07	350.90	156	0.00
300.10	254	0.00	325.95	1096	0.02	352.25	705	0.01
301.10	114	0.00	326.95	2827	0.05	**353.25**	**12624**	**0.22**
302.10	79	0.00	328.00	1006	0.02	**354.15**	**605597**	**10.36**
303.10	81	0.00	328.85	643	0.01	**355.15**	**160370**	**2.74**
304.10	209	0.00	329.80	71	0.00	356.10	24650	0.42
305.10	169	0.00	330.80	90	0.00	357.15	4088	0.07
305.90	326	0.01	331.80	62	0.00	358.15	383	0.01
306.95	607	0.01	332.80	84	0.00	359.10	711	0.01
308.10	252	0.00	333.80	24	0.00	360.10	161	0.00

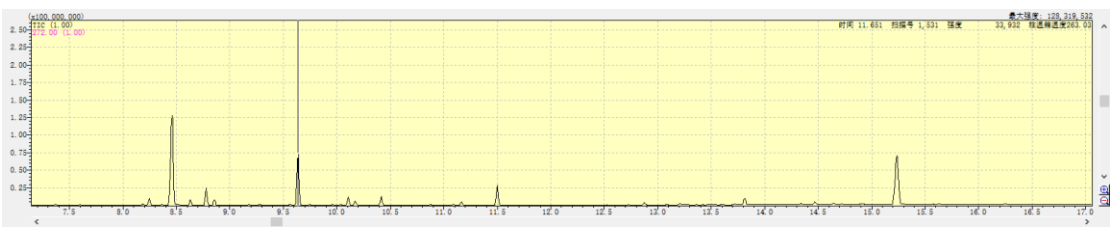


Chemical Formula: $C_{20}H_{32}O_2$
Exact Mass: 304.2402
Molecular Weight: 304.4740

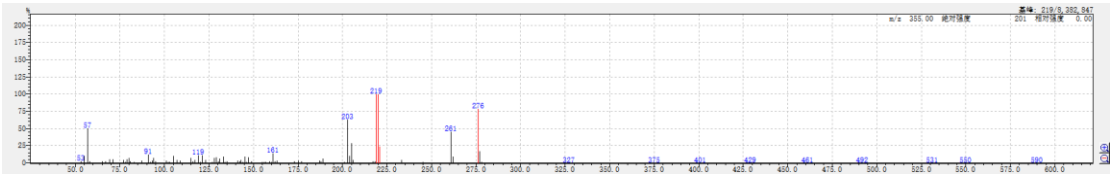
Chemical Formula: $C_{19}H_{32}O$
Exact Mass: 276.2453
Molecular Weight: 276.4640

Spectra of GC-MS





MS Spectra of the peak at 9.635 min



[MS Spectrum]

# of Peaks 476

Raw Spectrum 9.635 (scan : 1128)

Background No Background Spectrum

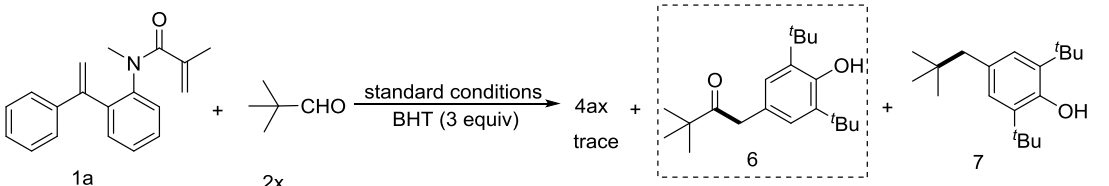
Base Peak m/z 219.05 (Inten : 8,382,847)

Event# 1

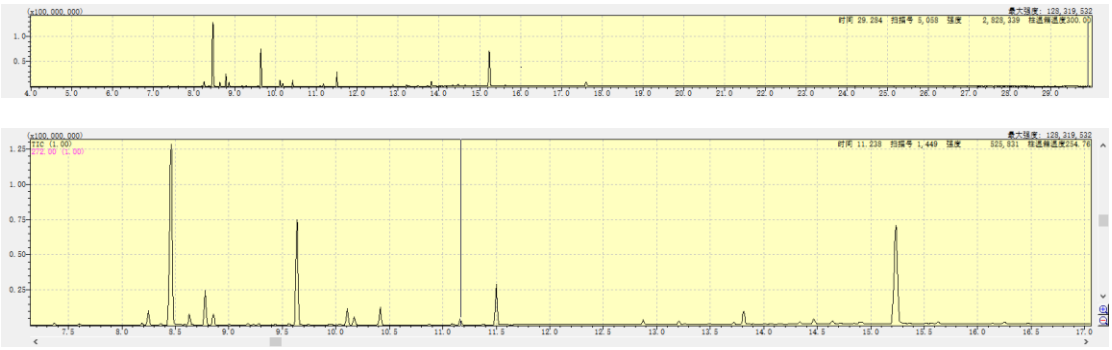
m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.05	9424	0.11	77.05	419269	5.00	104.15	69442	0.83
51.05	70743	0.84	78.05	129136	1.54	105.05	913903	10.90
52.05	32754	0.39	79.05	454240	5.42	106.05	116995	1.40
53.05	205325	2.45	80.05	653266	7.79	107.05	376344	4.49
54.15	23765	0.28	81.00	208386	2.49	108.15	64501	0.77
55.05	871115	10.39	82.05	24009	0.29	109.05	347603	4.15
56.15	116066	1.38	83.05	138897	1.66	110.05	22563	0.27
57.05	4282275	51.08	84.00	19006	0.23	111.05	10439	0.12
58.05	233755	2.79	85.05	31326	0.37	112.05	963	0.01
59.05	28038	0.33	86.05	81898	0.98	113.05	2594	0.03
60.00	3004	0.04	87.05	297400	3.55	114.05	12317	0.15
61.00	388	0.00	87.95	28529	0.34	115.05	624697	7.45
62.05	2982	0.04	89.00	38463	0.46	116.05	219718	2.62
63.05	30243	0.36	90.05	17707	0.21	117.05	426318	5.09
64.05	91184	1.09	91.05	1055231	12.59	118.15	79987	0.95
65.00	222935	2.66	92.05	122537	1.46	119.05	979461	11.68
66.00	55214	0.66	93.05	364346	4.35	120.10	155078	1.85
67.05	249775	2.98	94.05	644805	7.69	121.10	957993	11.43
68.05	18066	0.22	95.00	215751	2.57	122.10	112321	1.34
69.05	473817	5.65	96.00	15169	0.18	123.10	447716	5.34
70.10	50241	0.60	97.05	29566	0.35	124.05	34619	0.41
71.05	482077	5.75	98.10	3902	0.05	125.10	3316	0.04
72.05	69380	0.83	99.05	2875	0.03	126.15	9258	0.11
73.05	109736	1.31	100.05	21000	0.25	127.05	179260	2.14
73.95	14020	0.17	101.05	305639	3.65	128.05	662116	7.90
75.00	11151	0.13	102.00	140265	1.67	129.05	696161	8.30
76.05	34131	0.41	103.00	167618	2.00	130.10	264386	3.15

131.05	555786	6.63	175.00	367178	4.38	219.05	8382847	100.00
132.05	121362	1.45	176.05	66515	0.79	220.00	8382478	100.00
133.05	818396	9.76	177.00	248722	2.97	220.95	2037338	24.30
134.05	163648	1.95	178.00	38722	0.46	222.05	68114	0.81
135.05	239598	2.86	179.00	8026	0.10	223.00	3924	0.05
136.10	30092	0.36	179.95	5539	0.07	224.00	169	0.00
137.05	16629	0.20	181.00	11218	0.13	225.00	111	0.00
138.05	1963	0.02	182.00	8574	0.10	226.00	110	0.00
139.00	17098	0.20	183.00	18015	0.21	227.05	1379	0.02
140.05	11222	0.13	184.05	9799	0.12	228.00	575	0.01
141.00	319310	3.81	185.00	74852	0.89	229.00	9644	0.12
142.05	244739	2.92	186.05	24170	0.29	230.05	2480	0.03
143.05	371530	4.43	187.00	334410	3.99	231.00	48841	0.58
144.05	150281	1.79	188.00	237486	2.83	232.05	10276	0.12
145.05	776814	9.27	189.00	546188	6.52	233.05	375856	4.48
146.05	184628	2.20	190.00	83550	1.00	234.05	65969	0.79
147.05	696611	8.31	191.00	40338	0.48	235.00	6679	0.08
148.05	119367	1.42	191.95	5704	0.07	236.05	682	0.01
149.05	272667	3.25	192.90	2031	0.02	237.00	756	0.01
150.05	31269	0.37	194.00	777	0.01	238.00	154	0.00
151.00	12537	0.15	195.00	6657	0.08	239.00	190	0.00
152.00	44847	0.53	196.00	4180	0.05	240.00	46	0.00
153.00	106407	1.27	197.00	7626	0.09	240.90	569	0.01
154.00	61377	0.73	198.00	2948	0.04	242.00	180	0.00
155.00	148777	1.77	199.00	9414	0.11	243.00	11174	0.13
156.05	135879	1.62	200.05	4761	0.06	244.05	3629	0.04
157.00	196356	2.34	201.00	142006	1.69	245.00	157388	1.88
158.00	76303	0.91	202.05	66688	0.80	246.00	31058	0.37
159.00	277865	3.31	203.00	5300180	63.23	247.05	24853	0.30
160.05	152675	1.82	204.00	922318	11.00	248.00	5740	0.07
161.00	1192383	14.22	205.00	2450465	29.23	248.90	770	0.01
162.00	242750	2.90	206.00	377583	4.50	249.70	378	0.00
163.00	327785	3.91	207.00	36513	0.44	251.00	239	0.00
164.00	61783	0.74	207.95	2649	0.03	251.95	1288	0.02
165.00	41412	0.49	209.00	945	0.01	253.00	249	0.00
166.00	15916	0.19	209.90	529	0.01	254.00	159	0.00
167.00	50503	0.60	210.90	898	0.01	255.00	284	0.00
168.00	18892	0.23	212.05	709	0.01	256.00	170	0.00
169.00	40273	0.48	213.00	2588	0.03	257.00	926	0.01
170.00	117538	1.40	214.05	1235	0.01	258.05	793	0.01
171.00	113738	1.36	215.05	25231	0.30	259.05	32235	0.38
172.05	46957	0.56	216.05	7437	0.09	260.15	55414	0.66
173.00	237977	2.84	217.00	272982	3.26	261.05	3807735	45.42
174.00	87260	1.04	218.05	247552	2.95	262.05	778063	9.28

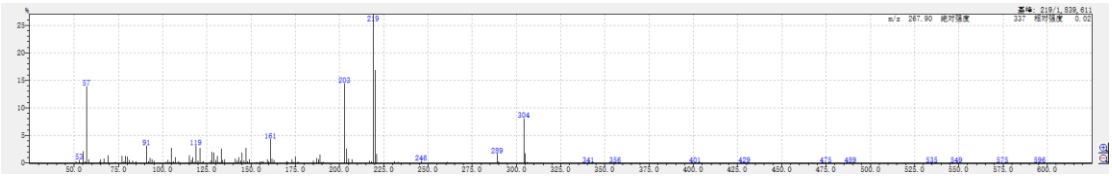
263.05	81333	0.97	271.10	94	0.00	279.05	14190	0.17
264.00	6498	0.08	272.10	310	0.00	280.05	815	0.01
265.05	623	0.01	273.15	425	0.01	280.95	914	0.01
266.00	137	0.00	274.10	9406	0.11	282.00	260	0.00
267.05	552	0.01	**275.15**	**72374**	**0.86**	283.00	185	0.00
268.10	105	0.00	**276.10**	**6620028**	**78.97**	284.00	81	0.00
269.10	135	0.00	**277.10**	**1453306**	**17.34**			
270.10	279	0.00	278.05	164956	1.97			



Spectra of GC-MS



MS Spectra of the peak at 11.160 min



[MS Spectrum]

# of Peaks 477

Raw Spectrum 11.160 (scan : 1433)

Background No Background Spectrum

Base Peak m/z 219.05 (Inten : 1,755,819)

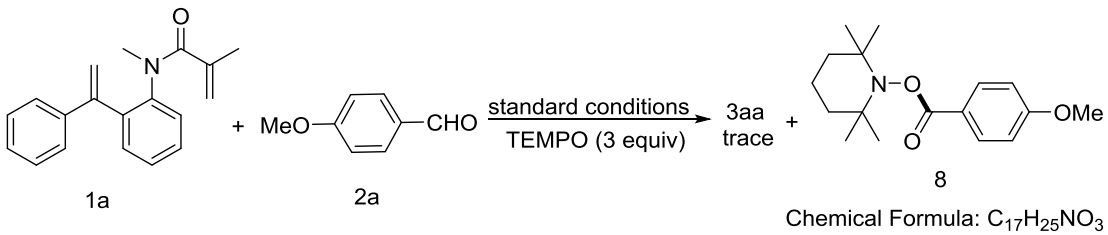
Event# 1

m/z Absolute Intensity Relative Intensity

50.00	951	0.05	94.05	10439	0.59	138.00	113	0.01
51.00	3961	0.23	95.05	5798	0.33	139.05	925	0.05
52.00	2039	0.12	96.05	2028	0.12	140.05	322	0.02
53.00	8327	0.47	97.00	1404	0.08	141.05	12111	0.69
54.05	802	0.05	98.00	140	0.01	142.05	8295	0.47
55.05	31044	1.77	99.10	417	0.02	143.00	18884	1.08
56.15	5750	0.33	100.10	406	0.02	144.05	6969	0.40
57.05	197158	11.23	101.05	738	0.04	145.05	30374	1.73
58.05	11161	0.64	102.05	3716	0.21	146.00	7988	0.45
59.05	1816	0.10	103.05	9283	0.53	147.05	43726	2.49
60.10	135	0.01	104.10	3034	0.17	148.10	6540	0.37
61.10	471	0.03	105.05	43262	2.46	149.05	10506	0.60
62.10	254	0.01	106.05	6275	0.36	150.10	1074	0.06
63.10	1521	0.09	107.10	15790	0.90	151.05	756	0.04
64.05	2602	0.15	108.05	1838	0.10	152.05	1639	0.09
65.05	9304	0.53	109.05	5472	0.31	153.00	3689	0.21
66.05	2089	0.12	110.00	884	0.05	154.00	2022	0.12
67.05	11299	0.64	111.10	734	0.04	155.05	6166	0.35
68.10	990	0.06	112.10	97	0.01	156.00	6185	0.35
69.10	19569	1.11	113.10	490	0.03	157.00	6942	0.40
70.05	2050	0.12	114.05	403	0.02	158.05	2806	0.16
71.00	2634	0.15	115.05	24052	1.37	159.00	11730	0.67
72.05	1217	0.07	116.05	8817	0.50	160.05	6180	0.35
73.10	4396	0.25	117.05	17828	1.02	161.05	73270	4.17
74.05	751	0.04	118.15	3429	0.20	162.00	13230	0.75
75.00	1374	0.08	119.05	48301	2.75	163.05	8969	0.51
76.05	1081	0.06	120.10	7151	0.41	164.05	1656	0.09
77.05	19705	1.12	121.10	42778	2.44	164.95	1246	0.07
78.10	6033	0.34	122.10	4494	0.26	165.95	404	0.02
79.10	18918	1.08	123.10	6052	0.34	166.95	1054	0.06
80.10	18105	1.03	124.05	576	0.03	168.00	658	0.04
81.05	8670	0.49	125.10	276	0.02	169.00	1471	0.08
82.10	1209	0.07	126.15	507	0.03	170.05	5198	0.30
83.05	6760	0.39	127.05	81160.46		171.05	4519	0.26
84.05	825	0.05	128.05	31545	1.80	171.95	940	0.05
85.10	6806	0.39	129.05	30549	1.74	173.00	10666	0.61
86.05	1227	0.07	130.10	9959	0.57	174.00	4471	0.25
86.95	1531	0.09	131.10	21265	1.21	175.05	19845	1.13
88.05	1013	0.06	132.05	4700	0.27	176.00	3439	0.20
89.05	2314	0.13	133.10	43506	2.48	176.95	5277	0.30
90.15	683	0.04	134.05	9709	0.55	177.95	1292	0.07
91.05	44796	2.55	135.05	12771	0.73	178.95	1339	0.08
92.05	5342	0.30	136.10	1697	0.10	180.00	407	0.02
93.10	14807	0.84	137.05	1494	0.09	180.95	601	0.03

182.00	396	0.02	224.00	135	0.01	265.90	186	0.01
183.00	692	0.04	225.00	241	0.01	266.90	1114	0.06
184.05	454	0.03	226.00	108	0.01	267.95	456	0.03
185.05	7178	0.41	227.00	276	0.02	268.90	353	0.02
186.05	1631	0.09	228.00	132	0.01	269.90	167	0.01
187.00	15009	0.85	229.05	694	0.04	271.10	660	0.04
188.00	10417	0.59	229.95	494	0.03	272.10	31	0.00
189.00	26030	1.48	231.00	7585	0.43	273.05	1837	0.10
190.00	3977	0.23	231.95	1239	0.07	274.20	678	0.04
190.95	3057	0.17	233.05	3685	0.21	275.15	377	0.02
192.00	772	0.04	234.00	950	0.05	276.10	588	0.03
192.95	3206	0.18	235.00	750	0.04	277.25	536	0.03
193.90	615	0.04	236.00	695	0.04	279.20	42	0.00
194.90	354	0.02	237.00	262	0.01	279.90	52	0.00
195.90	102	0.01	238.00	65	0.00	280.90	2548	0.15
197.05	428	0.02	239.00	113	0.01	282.00	588	0.03
198.00	305	0.02	239.90	111	0.01	283.00	572	0.03
199.10	718	0.04	240.95	690	0.04	284.00	70	0.00
200.05	315	0.02	241.90	166	0.01	285.00	145	0.01
200.95	1248	0.07	242.90	241	0.01	286.00	175	0.01
202.05	1691	0.10	244.00	230	0.01	287.10	521	0.03
203.00	246174	14.02	245.00	1732	0.10	288.15	486	0.03
204.00	45522	2.59	246.05	6380	0.36	289.05	30416	1.73
205.05	16202	0.92	247.00	1538	0.09	290.10	6839	0.39
205.95	2528	0.14	248.10	756	0.04	291.10	700	0.04
206.90	12818	0.73	249.10	407	0.02	292.10	434	0.02
207.90	2799	0.16	250.00	282	0.02	293.10	63	0.00
208.90	2082	0.12	251.00	609	0.03	294.10	143	0.01
209.90	174	0.01	251.95	402	0.02	295.10	105	0.01
210.90	393	0.02	252.90	231	0.01	297.10	33	0.00
211.90	74	0.00	253.90	3	0.00	299.10	29	0.00
212.90	342	0.02	254.90	150	0.01	300.10	63	0.00
213.90	110	0.01	255.90	746	0.04	301.00	102	0.01
215.00	953	0.05	256.90	278	0.02	302.05	1276	0.07
215.95	335	0.02	257.90	119	0.01	**303.15**	**943**	**0.05**
217.00	9417	0.54	259.10	802	0.05	**304.10**	**159734**	**9.10**
218.05	6492	0.37	260.05	364	0.02	**305.10**	**40391**	**2.30**
219.05	1755819	100.00	261.05	4509	0.26	306.10	5471	0.31
220.05	299952	17.08	262.05	960	0.05	307.10	394	0.02
221.00	33009	1.88	263.05	949	0.05	308.10	106	0.01
222.05	2328	0.13	264.00	231	0.01	309.10	130	0.01
223.00	380	0.02	265.00	463	0.03	310.10	52	0.00

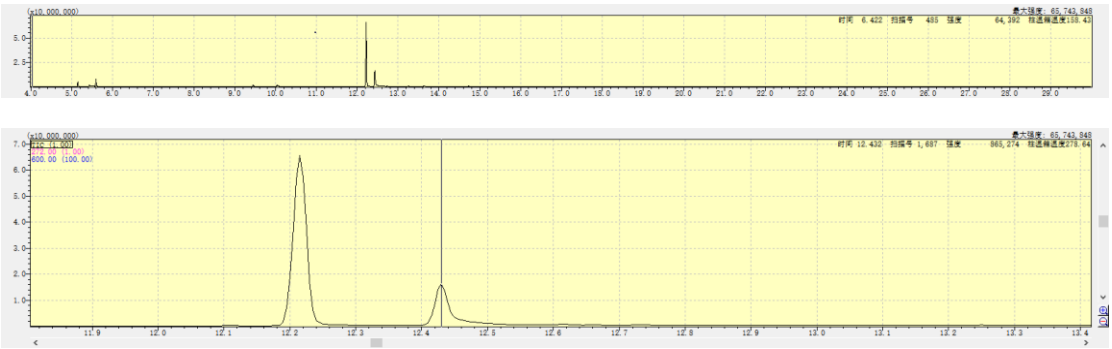
2.4.2 GC-MS Analysis of Raw Reaction Mixture by Using TMEPO as Radical Inhibitor



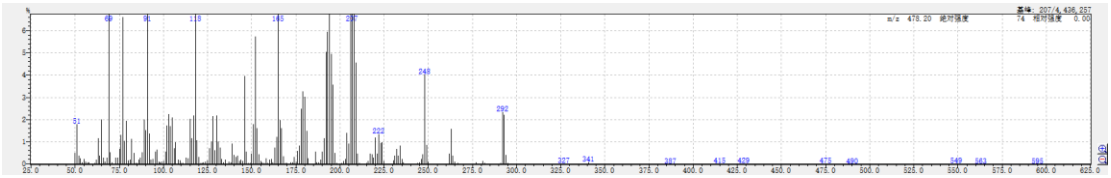
1a 2a 8

Chemical Formula: $C_{17}H_{25}NO_3$
Exact Mass: 291.18
Molecular Weight: 291.39

Spectra of GC-MS



The MS spectra of the peak at 12.430min



[MS Spectrum]

# of Peaks 543

Raw Spectrum 12.430 (scan : 1687)

Background No Background Spectrum

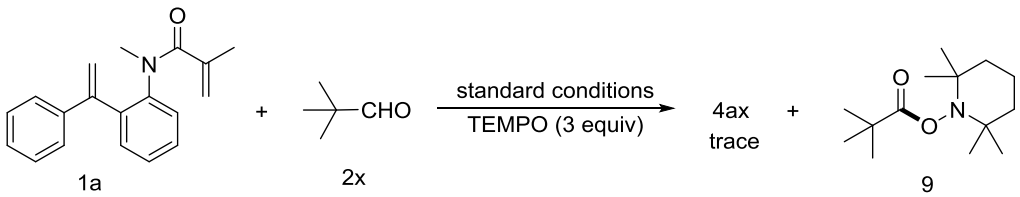
Base Peak m/z 207.05 (Inten : 4,436,257)

Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.00	22145	0.50	55.00	10769	0.24	60.05	623	0.01
51.00	79815	1.80	56.05	5871	0.13	61.05	2396	0.05
52.00	17870	0.40	57.05	3491	0.08	62.00	9735	0.22
53.00	12583	0.28	57.95	4515	0.10	63.00	51641	1.16
54.00	4534	0.10	59.00	1302	0.03	64.00	17774	0.40

65.00	89946	2.03	109.35	7395	0.17	153.05	72740	1.64
66.00	13914	0.31	110.35	2960	0.07	154.05	20405	0.46
67.00	5194	0.12	111.05	2564	0.06	155.10	6366	0.14
68.05	13553	0.31	112.05	1974	0.04	156.05	4056	0.09
69.00	405210	9.13	113.05	13413	0.30	157.10	2233	0.05
70.00	24666	0.56	114.10	11702	0.26	158.10	12550	0.28
70.95	3850	0.09	115.05	90906	2.05	159.10	2921	0.07
72.05	603	0.01	116.05	52341	1.18	160.10	9950	0.22
73.00	12825	0.29	117.10	97362	2.19	161.05	10418	0.23
74.00	13438	0.30	118.05	506802	11.42	162.15	4424	0.10
75.00	31070	0.70	119.10	48170	1.09	163.05	33973	0.77
76.00	58823	1.33	120.05	15214	0.34	164.15	54425	1.23
77.00	293820	6.62	121.05	2476	0.06	165.05	348180	7.85
78.00	47338	1.07	121.85	2454	0.06	166.05	88086	1.99
79.00	87098	1.96	122.85	3450	0.08	167.05	71871	1.62
80.05	8673	0.20	123.80	5788	0.13	168.05	16683	0.38
81.15	9607	0.22	125.05	7907	0.18	169.10	3255	0.07
82.05	50556	1.14	126.05	31520	0.71	170.05	2204	0.05
83.40	22735	0.51	127.10	45964	1.04	171.10	1250	0.03
84.35	2471	0.06	128.05	95670	2.16	172.10	4377	0.10
84.95	2159	0.05	129.10	27878	0.63	173.15	3842	0.09
86.05	9768	0.22	130.10	97572	2.20	174.05	14533	0.33
87.00	13150	0.30	131.15	45682	1.03	175.15	49110.11	
88.05	24145	0.54	132.05	33390	0.75	176.05	26448	0.60
89.05	89528	2.02	133.00	11343	0.26	177.05	37397	0.84
90.05	68586	1.55	134.05	3363	0.08	178.05	111147	2.51
91.05	641333	14.46	135.05	9741	0.22	179.05	145319	3.28
92.05	61098	1.38	136.15	1783	0.04	180.05	134505	3.03
93.05	9539	0.22	137.05	5139	0.12	181.05	66653	1.50
94.10	11356	0.26	138.15	4526	0.10	182.05	11483	0.26
95.55	26058	0.59	139.05	40873	0.92	183.00	2002	0.05
96.50	29060	0.66	140.05	18205	0.41	184.05	1872	0.04
97.45	5046	0.11	141.05	14212	0.32	185.05	730	0.02
98.05	4629	0.10	142.05	17444	0.39	186.05	24829	0.56
99.05	5804	0.13	143.05	6826	0.15	186.95	4175	0.09
100.05	6345	0.14	144.05	9955	0.22	188.05	3547	0.08
101.15	25405	0.57	145.15	6951	0.16	189.05	9023	0.20
102.15	77186	1.74	146.05	176112	3.97	190.05	25975	0.59
103.05	99796	2.25	147.05	24868	0.56	191.05	52553	1.18
104.05	75830	1.71	148.05	2223	0.05	192.05	224881	5.07
105.00	93238	2.10	149.15	2453	0.06	193.05	265385	5.98
106.05	32718	0.74	150.05	21830	0.49	194.05	1382073	31.15
107.05	44208	1.00	151.05	80240	1.81	195.05	220224	4.96
108.40	9596	0.22	152.05	255593	5.76	196.05	159485	3.60

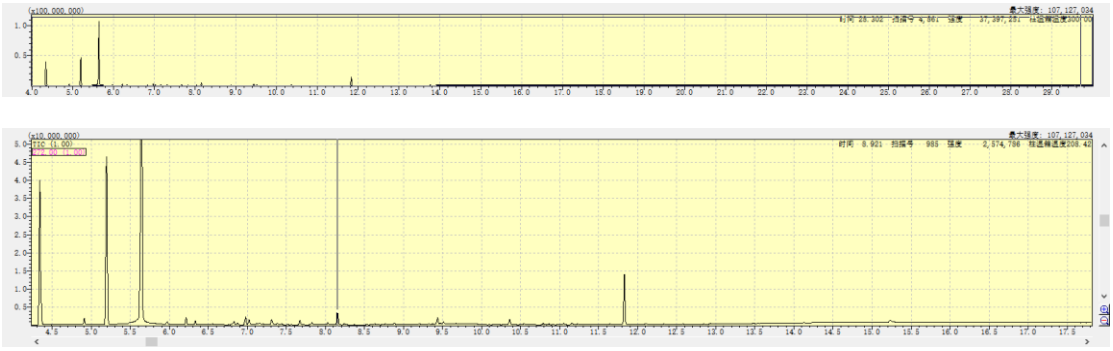
197.05	23225	0.52	233.05	17961	0.40	268.90	609	0.01
198.10	2148	0.05	234.05	37932	0.86	269.90	193	0.00
199.05	293	0.01	235.05	10802	0.24	270.90	154	0.00
199.95	1072	0.02	236.05	3799	0.09	271.90	145	0.00
201.00	2252	0.05	237.05	1253	0.03	272.90	68	0.00
202.00	6572	0.15	238.05	1560	0.04	274.10	1550	0.03
203.05	11252	0.25	239.00	316	0.01	275.00	774	0.02
204.05	62299	1.40	240.00	313	0.01	276.15	758	0.02
205.15	42028	0.95	241.00	135	0.00	277.10	3402	0.08
206.15	509328	11.48	242.05	445	0.01	278.05	1481	0.03
207.05	4436257	100.00	242.95	442	0.01	279.10	302	0.01
208.05	1331653	30.02	244.00	3062	0.07	280.00	151	0.00
209.05	203611	4.59	245.05	3446	0.08	281.00	6788	0.15
210.00	20913	0.47	246.05	10428	0.24	281.95	2687	0.06
211.00	2287	0.05	247.05	19733	0.44	282.95	1387	0.03
212.00	428	0.01	248.05	178919	4.03	283.90	238	0.01
212.95	618	0.01	249.05	38507	0.87	284.90	114	0.00
214.00	1538	0.03	250.00	5329	0.12	285.90	22	0.00
215.00	2847	0.06	251.05	11360.03		286.90	122	0.00
216.05	6090	0.14	252.05	328	0.01	287.90	27	0.00
217.05	21404	0.48	253.00	634	0.01	288.90	54	0.00
218.05	20142	0.45	254.05	479	0.01	**289.90**	**114**	**0.00**
219.05	13527	0.30	255.15	303	0.01	**291.15**	**2426**	**0.05**
220.05	54122	1.22	256.05	563	0.01	**292.10**	**104238**	**2.35**
221.05	21912	0.49	257.15	523	0.01	293.10	98999	2.23
222.00	60857	1.37	258.10	916	0.02	294.05	18718	0.42
223.05	43307	0.98	259.05	821	0.02	295.10	3185	0.07
224.05	44764	1.01	260.05	1807	0.04	296.00	567	0.01
225.00	7174	0.16	261.15	1614	0.04	297.00	174	0.00
225.95	903	0.02	262.05	21128	0.48	298.00	76	0.00
227.05	707	0.02	263.05	71096	1.60	299.00	33	0.00
228.05	2001	0.05	264.05	18045	0.41	300.00	21	0.00
229.10	1487	0.03	265.10	5042	0.11	301.00	62	0.00
230.10	8239	0.19	266.00	782	0.02	302.00	46	0.00
231.05	17473	0.39	267.00	2322	0.05	303.00	57	0.00
232.05	30863	0.70	267.95	335	0.01	304.00	66	0.00



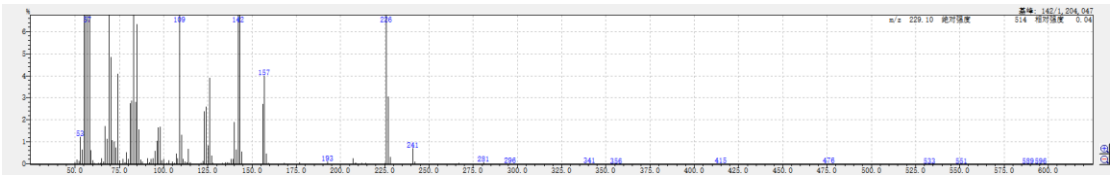
1a 2x 9

Chemical Formula: $C_{14}H_{27}NO_2$
Exact Mass: 241.2042
Molecular Weight: 241.3750

Spectra of GC-MS



The MS spectra of the peak at 8.150min



[MS Spectrum]

# of Peaks 411

Raw Spectrum 8.150 (scan : 831)

Background No Background Spectrum

Base Peak m/z 142.10 (Inten : 1,204,047)

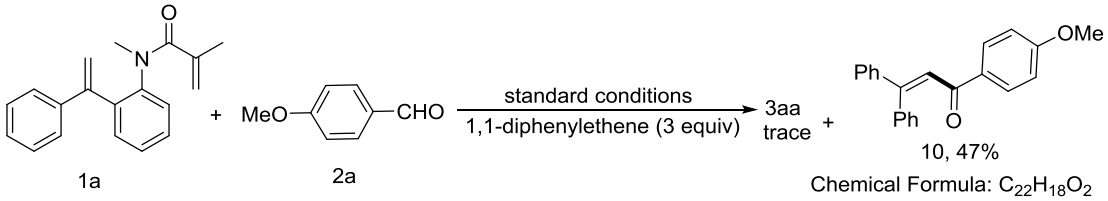
Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.05	964	0.08	67.05	21077	1.75	84.05	33983	2.82
51.05	2690	0.22	68.05	13877	1.15	85.05	76542	6.36
52.05	1814	0.15	69.05	123416	10.25	86.05	18892	1.57
53.00	15175	1.26	70.10	58551	4.86	87.05	2552	0.21
54.00	8007	0.67	71.05	13227	1.10	88.05	1551	0.13
55.05	218973	18.19	72.10	12358	1.03	89.00	444	0.04
56.05	118435	9.84	73.05	9177	0.76	90.10	102	0.01
57.05	1002049	83.22	74.05	49461	4.11	91.10	3162	0.26
58.05	127951	10.63	75.05	2168	0.18	92.10	11830.10	
59.10	7593	0.63	76.05	349	0.03	93.05	2999	0.25
60.05	2339	0.19	77.05	3064	0.25	94.05	3228	0.27
60.90	575	0.05	78.10	1281	0.11	95.10	7497	0.62
62.10	444	0.04	79.05	6758	0.56	96.10	12764	1.06
63.10	882	0.07	80.05	2940	0.24	97.05	20332	1.69
64.05	588	0.05	81.10	33324	2.77	98.05	20453	1.70
65.00	3282	0.27	82.05	34904	2.90	99.05	2144	0.18
66.05	1472	0.12	83.05	101684	8.45	100.10	2895	0.24

101.05	436	0.04	145.10	521	0.04	188.90	102	0.01
101.95	604	0.05	146.10	92	0.01	189.90	21	0.00
103.00	2217	0.18	147.00	506	0.04	190.75	424	0.04
104.15	426	0.04	148.00	134	0.01	191.70	172	0.01
105.10	1378	0.11	149.00	194	0.02	192.90	1311	0.11
106.15	597	0.05	150.00	135	0.01	193.90	273	0.02
107.05	5716	0.47	151.00	183	0.02	194.90	153	0.01
108.05	3406	0.28	151.95	328	0.03	195.90	130	0.01
109.10	93601	7.77	152.95	351	0.03	196.90	44	0.00
110.10	16254	1.35	154.05	533	0.04	197.90	126	0.01
111.10	2772	0.23	155.15	436	0.04	198.90	70	0.01
112.10	1506	0.13	156.10	33138	2.75	199.90	39	0.00
113.05	1122	0.09	157.05	48292	4.01	202.90	223	0.02
114.05	8611	0.72	158.05	5883	0.49	203.90	2	0.00
115.00	964	0.08	159.05	653	0.05	204.90	82	0.01
116.00	524	0.04	160.10	94	0.01	205.90	31	0.00
117.05	461	0.04	161.10	89	0.01	206.90	3367	0.28
118.10	308	0.03	162.10	97	0.01	208.00	633	0.05
119.10	394	0.03	163.10	206	0.02	208.90	636	0.05
120.05	503	0.04	164.10	223	0.02	209.90	207	0.02
121.05	813	0.07	165.10	124	0.01	210.90	162	0.01
122.10	1886	0.16	166.10	49	0.00	212.00	786	0.07
123.10	29063	2.41	167.10	90	0.01	213.00	68	0.01
124.10	31494	2.62	168.05	806	0.07	214.05	792	0.07
125.10	10092	0.84	169.10	337	0.03	215.10	132	0.01
126.10	47114	3.91	170.10	313	0.03	216.10	54	0.00
127.10	4863	0.40	171.10	102	0.01	217.10	31	0.00
128.10	794	0.07	172.10	92	0.01	218.10	58	0.00
129.00	463	0.04	173.10	135	0.01	219.10	206	0.02
130.00	142	0.01	174.10	41	0.00	220.10	62	0.01
131.15	527	0.04	175.10	50	0.00	221.10	162	0.01
132.00	185	0.02	175.95	482	0.04	222.10	86	0.01
133.05	821	0.07	176.90	1226	0.10	223.10	16	0.00
133.95	403	0.03	177.90	382	0.03	224.10	190	0.02
134.95	1232	0.10	178.90	297	0.02	225.05	726	0.06
136.05	930	0.08	179.90	68	0.01	226.05	24443	8 20.30
137.05	634	0.05	180.90	29	0.00	227.05	3717	8 3.09
138.10	2873	0.24	181.90	90	0.01	228.05	4050	0.34
139.10	2774	0.23	182.90	103	0.01	229.10	514	0.04
140.10	22932	1.90	183.90	8	0.00	230.10	6	0.00
141.15	7912	0.66	184.90	27	0.00	231.10	11	0.00
142.10	120404	7 100.00	185.90	29	0.00	232.10	42	0.00
143.10	113090	9.39	186.90	65	0.01	233.10	33	0.00
144.05	6837	0.57	187.90	27	0.00	234.10	279	0.02

235.10	214	0.02	239.10	16	0.00	243.00	154	0.01
236.10	82	0.01	**240.10**	**21**	**0.00**	247.00	19	0.00
237.10	145	0.01	**241.05**	**8851**	**0.74**			
238.10	47	0.00	**242.00**	**1540**	**0.13**			

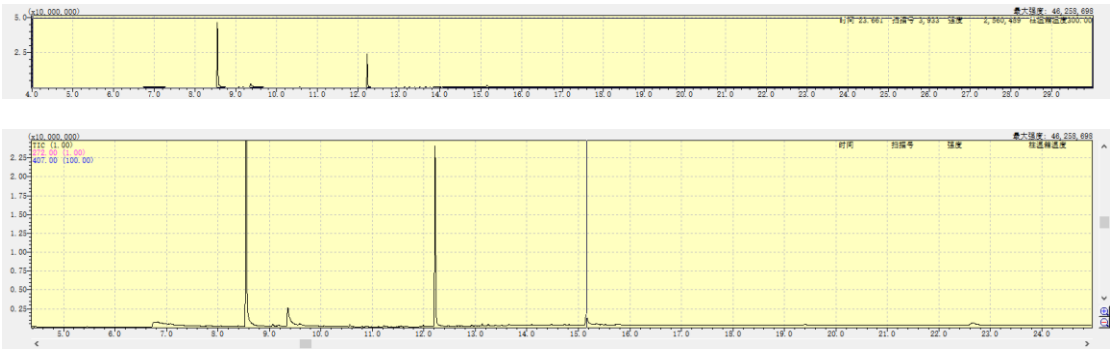
2.4.3 GC-MS Analysis of Raw Reaction Mixture by Using 1,1-diphenylethene as Radical Inhibitor



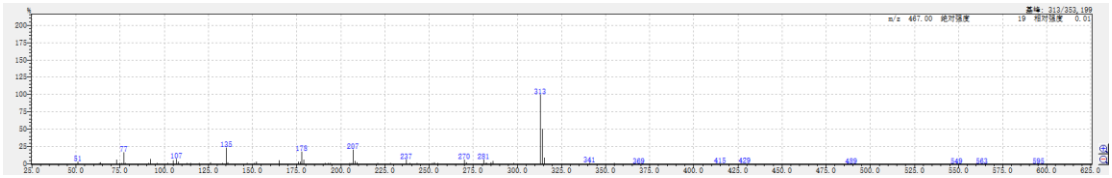
1a 2a 10, 47%

Chemical Formula: $C_{22}H_{18}O_2$
Exact Mass: 314.13
Molecular Weight: 314.38

Spectra of GC-MS



The MS spectra of the peak at 15.150min



[MS Spectrum]

# of Peaks 549

Raw Spectrum 15.150 (scan : 2231)

Background No Background Spectrum

Base Peak m/z 313.10 (Inten : 346,735)

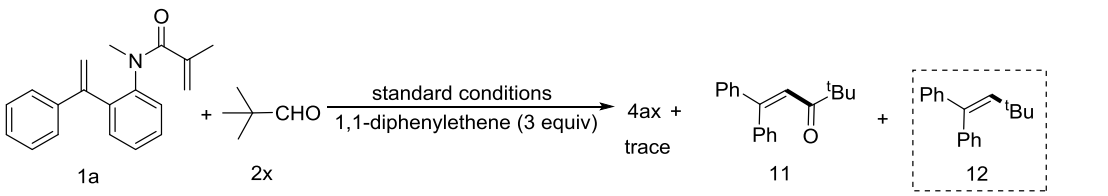
Event# 1

m/z	Absolute Intensity	Relative Intensity						
50.00	2865	0.83	52.95	1706	0.49	56.05	1027	0.30
51.00	11081	3.20	53.90	190	0.05	57.05	1246	0.36
52.00	1839	0.53	54.95	1783	0.51	57.95	375	0.11

58.95	1659	0.48	102.95	3105	0.90	147.05	6232	1.80
59.95	368	0.11	104.05	1527	0.44	148.15	1856	0.54
61.00	970	0.28	105.05	18131	5.23	149.10	2732	0.79
62.00	1279	0.37	106.15	3044	0.88	150.05	3350	0.97
63.05	7225	2.08	107.05	26475	7.64	151.10	6369	1.84
64.00	10135	2.92	108.05	12633	3.64	152.05	14350	4.14
65.00	2999	0.86	109.00	1814	0.52	153.05	2330	0.67
66.10	722	0.21	109.95	593	0.17	153.95	464	0.13
67.05	418	0.12	111.05	672	0.19	154.95	666	0.19
68.00	209	0.06	112.15	803	0.23	155.95	2198	0.63
69.00	1598	0.46	113.10	6039	1.74	156.95	4292	1.24
70.05	509	0.15	114.10	2740	0.79	157.85	982	0.28
71.10	846	0.24	115.05	4879	1.41	158.90	274	0.08
72.05	422	0.12	116.05	908	0.26	159.90	111	0.03
73.05	23675	6.83	116.75	1084	0.31	161.00	636	0.18
74.00	3612	1.04	117.75	989	0.29	162.05	616	0.18
75.00	5892	1.70	118.75	3043	0.88	163.00	2783	0.80
76.05	6704	1.93	119.65	6747	1.95	164.15	2619	0.76
77.00	58868	16.98	121.00	3932	1.13	165.10	19071	5.50
78.00	6167	1.78	122.10	1210	0.35	166.05	4215	1.22
79.00	3474	1.00	123.05	922	0.27	167.05	2249	0.65
79.95	358	0.10	124.15	383	0.11	168.05	1046	0.30
81.05	823	0.24	125.15	31180.90		169.05	1852	0.53
82.00	900	0.26	126.10	9580	2.76	170.00	249	0.07
83.00	764	0.22	127.05	3427	0.99	171.00	167	0.05
83.90	250	0.07	128.10	3660	1.06	172.00	63	0.02
84.95	763	0.22	129.05	1908	0.55	173.00	185	0.05
86.05	856	0.25	130.05	596	0.17	174.05	603	0.17
86.95	2055	0.59	131.05	1646	0.47	175.15	1363	0.39
88.05	1828	0.53	132.05	2060	0.59	176.05	13084	3.77
89.00	3364	0.97	133.00	6350	1.83	177.05	13522	3.90
89.95	543	0.16	134.05	3456	1.00	178.05	62917	18.15
91.05	5558	1.60	135.05	80804	23.30	179.05	24411	7.04
92.00	26897	7.76	136.00	9329	2.69	180.05	4394	1.27
93.05	2751	0.79	137.10	2353	0.68	181.05	888	0.26
94.05	1337	0.39	138.05	802	0.23	182.00	553	0.16
94.95	1722	0.50	139.00	3841	1.11	183.05	513	0.15
96.00	6652	1.92	140.05	1671	0.48	184.00	732	0.21
96.95	1976	0.57	141.05	3462	1.00	185.00	279	0.08
97.95	721	0.21	142.10	2169	0.63	186.00	190	0.05
99.05	11320.33		143.05	1669	0.48	187.00	580	0.17
100.05	1048	0.30	144.10	249	0.07	187.95	389	0.11
101.05	3506	1.01	145.10	481	0.14	188.90	2161	0.62
102.05	6525	1.88	146.05	279	0.08	190.05	1030	0.30

191.00	8026	2.31	234.95	917	0.26	279.00	444	0.13
192.05	2316	0.67	236.05	2136	0.62	280.05	1824	0.53
192.95	61181.76		237.05	23408	6.75	281.00	25273	7.29
194.00	4948	1.43	238.05	4936	1.42	282.00	8433	2.43
195.05	2299	0.66	239.05	7172	2.07	283.00	5940	1.71
196.05	567	0.16	240.05	3565	1.03	284.05	2051	0.59
196.95	486	0.14	241.00	41181.19		285.10	10810	3.12
197.90	108	0.03	242.05	2124	0.61	286.10	17367	5.01
198.90	254	0.07	243.05	5470	1.58	287.10	3492	1.01
200.05	574	0.17	244.10	1550	0.45	288.05	560	0.16
201.05	682	0.20	245.05	647	0.19	289.10	212	0.06
202.00	2446	0.71	246.10	306	0.09	290.10	132	0.04
202.95	11910.34		247.05	445	0.13	291.10	130	0.04
204.05	890	0.26	247.95	323	0.09	292.10	76	0.02
205.05	7258	2.09	248.95	2231	0.64	293.10	489	0.14
206.05	7966	2.30	250.00	1721	0.50	294.20	226	0.07
207.00	74932	21.61	250.95	1868	0.54	295.15	1673	0.48
208.00	16604	4.79	252.05	6357	1.83	296.00	690	0.20
209.05	11807	3.41	253.05	88112.54		297.05	2308	0.67
210.05	2282	0.66	254.05	4094	1.18	298.05	7763	2.24
211.00	1665	0.48	255.00	5158	1.49	299.00	3684	1.06
211.95	377	0.11	256.10	1634	0.47	300.00	577	0.17
212.95	1253	0.36	256.90	689	0.20	301.00	166	0.05
214.05	382	0.11	258.20	335	0.10	302.00	100	0.03
215.05	4605	1.33	259.15	305	0.09	303.00	94	0.03
216.05	1284	0.37	260.20	156	0.04	304.00	225	0.06
217.05	831	0.24	260.80	146	0.04	305.00	121	0.03
218.00	663	0.19	261.75	643	0.19	306.00	57	0.02
219.05	964	0.28	263.00	572	0.16	307.00	210	0.06
220.05	296	0.09	264.05	411	0.12	308.00	87	0.03
221.05	6576	1.90	265.00	4854	1.40	309.00	305	0.09
222.00	2562	0.74	265.95	11880.34		310.00	273	0.08
222.95	1515	0.44	266.95	4186	1.21	311.05	1031	0.30
224.00	738	0.21	268.05	2470	0.71	312.15	4165	1.20
225.05	495	0.14	269.05	4546	1.31	**313.10**	**346735**	**100.00**
226.00	2614	0.75	270.05	22371	6.45	**314.10**	**178004**	**51.34**
227.05	1781	0.51	271.05	10591	3.05	**315.05**	**32792**	**9.46**
228.05	5649	1.63	272.00	1772	0.51	316.10	4766	1.37
229.00	1849	0.53	273.15	436	0.13	317.00	862	0.25
229.95	631	0.18	274.20	186	0.05	318.00	281	0.08
231.05	728	0.21	275.10	198	0.06	319.00	66	0.02
232.00	257	0.07	276.10	615	0.18	320.00	127	0.04
233.00	342	0.10	277.10	222	0.06	321.00	126	0.04
234.05	355	0.10	278.05	521	0.15	322.00	65	0.02

323.00	238	0.07	324.95	2022	0.58	326.90	2916	0.84
324.00	134	0.04	325.95	628	0.18	328.05	645	0.19

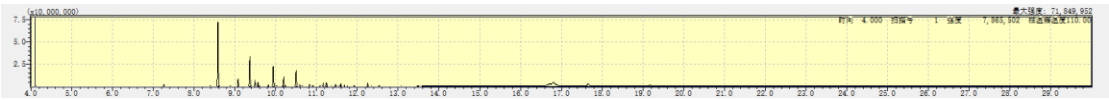


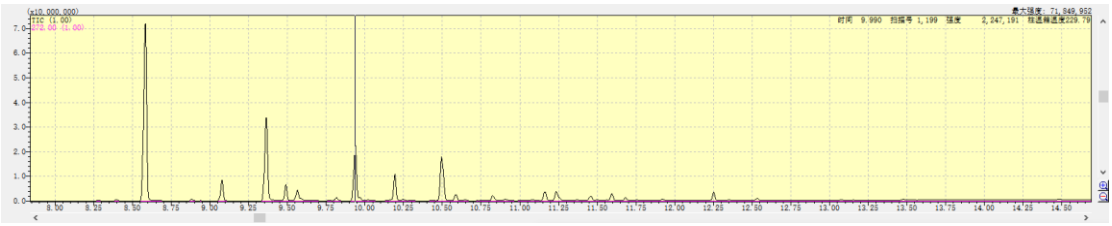
1a 2x 11 12

Chemical Formula: $C_{19}H_{20}O$
Exact Mass: 264.1514
Molecular Weight: 264.3680

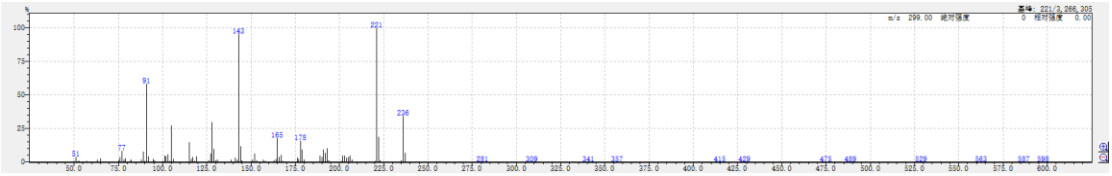
Chemical Formula: $C_{18}H_{20}$
Exact Mass: 236.1565
Molecular Weight: 236.3580

Spectra of GC-MS





The MS spectra of the peak at 9.940min



[MS Spectrum]

# of Peaks 533

Raw Spectrum 9.940 (scan : 1189)

Background No Background Spectrum

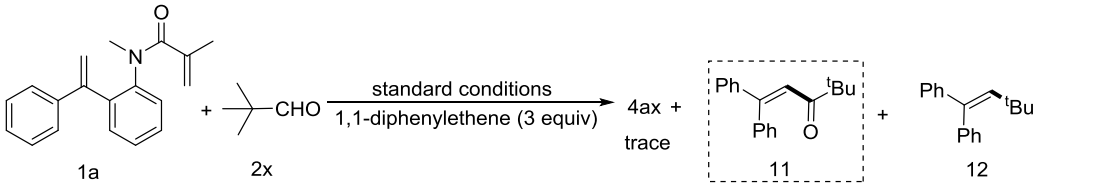
Base Peak m/z 143.05 (Inten : 3,165,151)

Event# 1

m/z	Absolute Intensity	Relative Intensity						
50.05	27839	0.88	55.05	20264	0.64	60.00	260	0.01
51.00	137417	4.34	56.10	4702	0.15	61.05	1391	0.04
52.05	27570	0.87	57.10	29585	0.93	62.05	13837	0.44
53.05	26391	0.83	58.05	2253	0.07	63.00	76073	2.40
54.05	1577	0.05	59.10	234	0.01	64.05	14078	0.44

65.05	100308	3.17	109.05	7810	0.25	153.00	45537	1.44
66.05	7281	0.23	110.10	9676	0.31	154.00	7255	0.23
67.05	6538	0.21	111.05	5489	0.17	155.05	6609	0.21
67.95	1263	0.04	112.00	1932	0.06	156.05	2909	0.09
68.35	1041	0.03	113.05	24810	0.78	157.05	56964	1.80
69.30	12854	0.41	114.05	13030	0.41	158.05	39058	1.23
70.25	4212	0.13	115.05	496767	15.69	159.05	23714	0.75
71.25	1882	0.06	116.05	77488	2.45	160.05	2886	0.09
72.00	654	0.02	117.05	141490	4.47	161.05	1952	0.06
73.00	1961	0.06	118.10	30585	0.97	162.00	7223	0.23
74.05	24621	0.78	119.05	149374	4.72	162.95	54482	1.72
75.05	52017	1.64	120.10	15956	0.50	164.00	79650	2.52
76.05	135029	4.27	121.10	1287	0.04	165.00	577993	18.26
77.05	296418	9.37	121.95	11370	0.04	166.00	126311	3.99
78.05	68614	2.17	123.10	1388	0.04	167.00	174431	5.51
79.05	97950	3.09	124.05	1277	0.04	168.00	25503	0.81
80.45	4088	0.13	125.05	6664	0.21	169.00	2297	0.07
81.55	27378	0.86	126.05	49659	1.57	170.00	625	0.02
82.45	62300	1.97	127.05	222196	7.02	171.00	130	0.00
83.45	11905	0.38	128.05	1006822	31.81	172.00	62	0.00
84.95	1095	0.03	129.05	342357	10.82	173.00	230	0.01
86.00	9319	0.29	130.10	49655	1.57	173.95	5192	0.16
87.05	24603	0.78	131.10	65780	2.08	175.05	10329	0.33
88.00	73002	2.31	132.10	10220	0.32	175.95	109479	3.46
89.05	280639	8.87	133.05	2073	0.07	177.00	76994	2.43
89.95	32727	1.03	134.05	689	0.02	178.00	524404	16.57
91.05	1995219	63.04	134.95	1378	0.04	178.95	308847	9.76
92.05	152408	4.82	136.00	242	0.01	180.00	58495	1.85
92.60	22847	0.72	137.00	7954	0.25	181.00	19316	0.61
93.65	16838	0.53	138.05	6394	0.20	182.00	4532	0.14
94.65	89255	2.82	139.00	73990	2.34	183.00	1246	0.04
95.55	47864	1.51	140.00	9508	0.30	184.00	247	0.01
96.55	21747	0.69	141.05	122303	3.86	184.95	479	0.02
97.95	7051	0.22	142.05	66451	2.10	185.95	771	0.02
99.10	7530	0.24	143.05	3165151	100.00	186.95	10594	0.33
100.10	31430	0.99	144.05	384517	12.15	188.05	12197	0.39
101.05	178500	5.64	145.05	57144	1.81	188.95	168754	5.33
102.05	153404	4.85	146.05	5345	0.17	190.00	121258	3.83
103.05	197284	6.23	147.00	833	0.03	191.00	306135	9.67
104.15	29039	0.92	147.95	379	0.01	192.00	222558	7.03
105.10	933361	29.49	149.00	3706	0.12	193.00	334759	10.58
106.10	86159	2.72	150.00	32129	1.02	194.00	54194	1.71
107.40	18228	0.58	151.00	69625	2.20	195.00	5866	0.19
108.35	9552	0.30	152.00	217113	6.86	196.00	11530.04	

196.95	425	0.01	212.95	5308	0.17	229.10	327	0.01
198.00	1057	0.03	213.95	2132	0.07	230.10	169	0.01
199.05	1837	0.06	214.95	16902	0.53	231.10	206	0.01
199.95	18965	0.60	216.00	5578	0.18	232.05	369	0.01
201.00	24519	0.77	217.00	5958	0.19	233.00	588	0.02
201.95	167778	5.30	218.00	3759	0.12	234.00	1854	0.06
202.95	160605	5.07	218.95	18156	0.57	**235.05**	**43463**	**1.37**
203.95	104315	3.30	220.05	25161	0.79	**236.00**	**1073607**	**33.92**
205.00	124089	3.92	221.00	3151194	99.56	**237.00**	**211913**	**6.70**
206.00	161238	5.09	222.00	580988	18.36	238.00	18494	0.58
207.00	68982	2.18	223.00	50559	1.60	238.95	11400.04	
208.00	10207	0.32	223.95	3152	0.10	240.00	82	0.00
209.00	1700	0.05	224.95	314	0.01	240.95	470	0.01
209.85	339	0.01	226.00	510	0.02	241.90	121	0.00
210.80	636	0.02	227.00	255	0.01			
212.00	390	0.01	228.05	442	0.01			



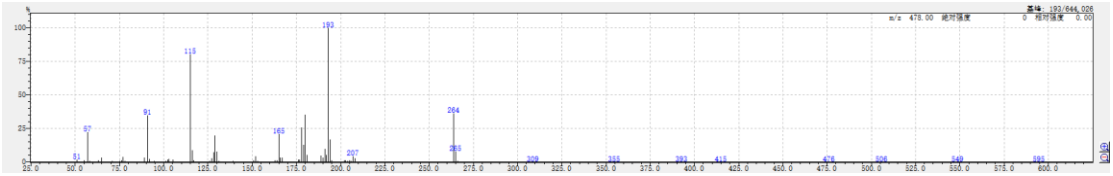
1a 2x 11 12

Chemical Formula: $C_{19}H_{20}O$
Exact Mass: 264.1514
Molecular Weight: 264.3680

Chemical Formula: $C_{18}H_{20}$
Exact Mass: 236.1565
Molecular Weight: 236.3580

Spectra of GC-MS

The MS spectra of the peak at 11.165min



[MS Spectrum]

# of Peaks 533

Raw Spectrum 11.165 (scan : 1434)

Background No Background Spectrum

Base Peak m/z 193.00 (Inten : 600,054)

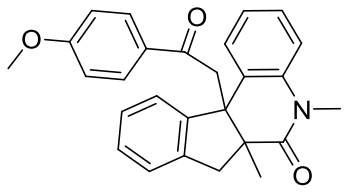
Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
50.00	3076	0.51	88.00	4396	0.73	125.05	1392	0.23
51.00	12596	2.10	89.00	21089	3.51	126.05	5566	0.93
52.00	2529	0.42	90.00	3094	0.52	127.05	18984	3.16
53.05	3804	0.63	91.05	229909	38.31	128.05	48754	8.12
54.00	556	0.09	92.05	17491	2.91	129.05	131918	21.98
55.05	9644	1.61	93.45	1473	0.25	130.05	50094	8.35
56.15	4104	0.68	94.40	5270	0.88	131.05	6829	1.14
57.05	153481	25.58	95.35	3708	0.62	132.05	555	0.09
58.05	6967	1.16	96.35	2064	0.34	133.00	1588	0.26
59.05	344	0.06	96.95	1676	0.28	133.90	602	0.10
60.00	103	0.02	98.05	1089	0.18	135.05	1771	0.30
61.00	410	0.07	99.10	1316	0.22	136.00	199	0.03
62.00	2150	0.36	100.05	1547	0.26	137.00	1550	0.26
63.00	10535	1.76	101.05	5509	0.92	137.95	734	0.12
64.05	1951	0.33	102.05	13645	2.27	139.05	7439	1.24
65.05	25122	4.19	103.05	16676	2.78	140.05	11700.19	
66.10	1782	0.30	104.05	3201	0.53	141.05	4204	0.70
67.15	901	0.15	105.05	13084	2.18	142.05	11470.19	
68.10	249	0.04	106.10	1609	0.27	143.00	3054	0.51
69.15	4715	0.79	107.15	1432	0.24	144.05	358	0.06
70.05	1500	0.25	108.05	1099	0.18	145.05	901	0.15
71.10	5342	0.89	109.10	255	0.04	146.00	11860.20	
72.05	344	0.06	110.10	710	0.12	147.00	1326	0.22
73.00	2708	0.45	110.95	490	0.08	148.05	276	0.05
74.05	2354	0.39	112.05	560	0.09	148.95	2797	0.47
75.00	5983	1.00	113.05	3632	0.61	150.00	3830	0.64
76.05	9957	1.66	114.05	3401	0.57	151.00	8329	1.39
77.05	26273	4.38	115.05	521836	86.96	152.00	28065	4.68
78.05	6974	1.16	116.05	55888	9.31	153.00	7582	1.26
79.05	4524	0.75	117.05	9149	1.52	154.10	1726	0.29
80.55	424	0.07	118.05	1056	0.18	155.00	11850.20	
81.55	2307	0.38	119.00	1247	0.21	156.05	433	0.07
82.55	4067	0.68	120.00	249	0.04	157.00	481	0.08
83.45	887	0.15	121.00	562	0.09	158.00	214	0.04
85.00	462	0.08	122.00	340	0.06	159.00	439	0.07
86.00	1295	0.22	123.00	193	0.03	160.00	201	0.03
87.05	2450	0.41	124.15	489	0.08	161.00	337	0.06

161.95	11230.19		198.00	148	0.02	233.80	247	0.04
162.95	8793	1.47	198.90	194	0.03	234.85	559	0.09
164.05	10482	1.75	199.90	1343	0.22	235.90	767	0.13
165.00	131530	21.92	201.05	1801	0.30	236.90	401	0.07
165.95	21418	3.57	202.00	9369	1.56	237.90	74	0.01
167.00	21378	3.56	202.95	10228	1.70	238.90	236	0.04
168.00	3162	0.53	204.00	6055	1.01	239.90	234	0.04
169.00	746	0.12	205.00	8682	1.45	240.95	672	0.11
170.00	210	0.03	206.00	7617	1.27	242.00	63	0.01
171.00	559	0.09	206.95	28751	4.79	243.00	218	0.04
172.00	145	0.02	208.00	20887	3.48	244.00	42	0.01
173.00	322	0.05	208.90	4054	0.68	245.00	340	0.06
174.05	648	0.11	209.85	701	0.12	246.00	191	0.03
174.95	1049	0.17	210.90	247	0.04	246.95	1528	0.25
176.00	13199	2.20	211.90	126	0.02	248.20	378	0.06
177.00	13202	2.20	212.90	598	0.10	249.00	577	0.10
177.95	162202	27.03	214.00	247	0.04	249.85	431	0.07
179.00	81980	13.66	215.00	1393	0.23	250.80	564	0.09
180.00	220638	36.77	215.90	630	0.10	251.85	412	0.07
181.00	34940	5.82	217.05	902	0.15	252.90	263	0.04
182.00	41110.69		218.00	788	0.13	253.90	250	0.04
182.95	328	0.05	218.95	2520	0.42	254.90	148	0.02
184.00	2	0.00	220.00	815	0.14	256.00	460	0.08
185.10	129	0.02	221.05	2597	0.43	257.00	106	0.02
186.05	3826	0.64	222.05	800	0.13	258.00	81	0.01
186.95	2271	0.38	223.00	11420.19		259.00	60	0.01
188.00	2191	0.37	223.90	598	0.10	260.00	182	0.03
188.95	32843	5.47	224.90	145	0.02	261.10	114	0.02
189.95	20922	3.49	225.90	361	0.06	262.05	1392	0.23
191.00	60079	10.01	226.90	238	0.04	**263.15**	**4138**	**0.69**
192.05	33787	5.63	227.90	206	0.03	**264.05**	**215314**	**35.88**
193.00	600054	100.00	228.90	318	0.05	**265.05**	**44097**	**7.35**
194.00	104863	17.48	229.90	161	0.03	266.05	4774	0.80
194.95	8189	1.36	230.90	310	0.05	266.95	1586	0.26
196.00	836	0.14	231.90	98	0.02	268.00	215	0.04
197.00	266	0.04	232.95	452	0.08	269.00	228	0.04

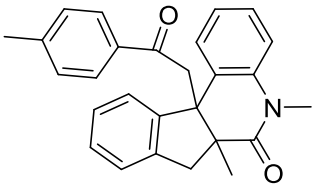
3. Characterization data for all products

11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-i



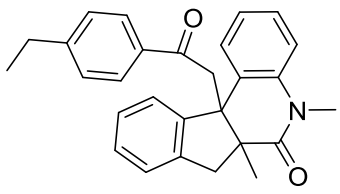
ndeno[2,1-c]quinolin-6-one (**3aa**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 49.0 mg, 74%; white solid; mp 178.0-178.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.80-7.78 (m, 2H), 7.63 (d, *J* = 7.6 Hz, 1H), 7.35-7.32 (m, 1H), 7.22-7.17 (m, 3H), 7.09-7.05 (m, 1H), 6.88-6.79 (m, 4H), 4.05 (d, *J* = 16.8 Hz, 1H), 3.81 (s, 3H), 3.49 (s, 3H), 3.44 (d, *J* = 16.9 Hz, 1H), 3.18 (d, *J* = 15.1 Hz, 1H), 2.81 (d, *J* = 15.2 Hz, 1H), 1.32 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.6, 173.5, 163.3, 148.1, 140.9, 139.9, 130.2, 129.9, 129.0, 127.5, 127.1, 126.6, 126.3, 124.9, 123.9, 122.4, 114.4, 113.4, 55.4, 54.1, 52.4, 45.4, 45.0, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{27}H_{26}NO_3$ $(M + H)^+$ calcd for 412.1908, found 412.1912.

5,6a-dimethyl-11b-(2-oxo-2-(p-tolyl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c



]quinolin-6-one (**3ab**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 61.6 mg, 78%; white solid; mp 104.0-104.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.71 (d, *J* = 8.2 Hz, 2H), 7.63 (d, *J* = 7.5 Hz, 1H), 7.36-7.32 (m, 1H), 7.21-7.19 (m, 3H), 7.14 (d, *J* = 8.0 Hz, 2H), 7.10-7.06 (m, 1H), 6.89-6.83 (m, 2H), 4.08 (d, *J* = 17.2 Hz, 1H), 3.50-3.45 (m, 4H), 3.19 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.3 Hz, 1H), 2.35 (s, 3H), 1.30 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 196.7, 173.5, 148.2, 143.7, 140.9, 140.0, 134.3, 129.0 (2C), 128.1, 127.5, 127.1, 126.7, 126.2, 124.9, 123.9, 122.4, 114.4, 54.1, 52.4, 45.7, 45.0, 30.1, 21.6, 18.9; HRMS (ESI-TOF) *m/z*: $C_{27}H_{26}NO_2$ $(M + H)^+$ calcd for 396.1958, found 396.1966.

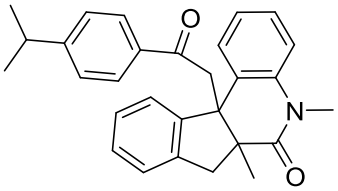
11b-(2-(4-ethylphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-inde



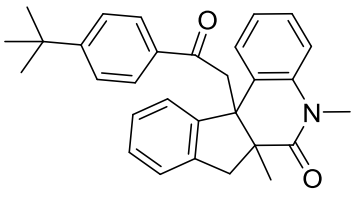
no[2,1-c]quinolin-6-one (**3ac**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 57.3 mg, 70%; white solid; mp 173.0-173.5 ^{o}C

(uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.74 (d, *J* = 8.3 Hz, 2H), 7.64 (d, *J* = 7.5 Hz, 1H), 7.36-7.32 (m, 1H), 7.22-7.15 (m, 5H), 7.09-7.05 (m, 1H), 6.88- 6.82 (m, 2H), 4.09 (d, *J* = 17.2 Hz, 1H), 3.47 (d, *J* = 19.0 Hz, 4H), 3.19 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.2 Hz, 1H), 2.67-2.61 (m, 2H), 1.31 (s, 3H), 1.20 (t, *J* = 7.6 Hz, 3H);^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ:196.7, 173.5, 149.9, 148.1, 140.8, 139.9, 134.5, 129.0, 128.2, 127.8, 127.4, 127.1, 126.6, 126.2, 124.9, 123.9, 122.4, 114.4, 54.1, 52.3, 45.8, 45.0, 30.0, 28.8, 18.8, 15.2; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_2$ (M + H)$^{+}$ calcd for 410.2115, found 410.2119.

11b-(2-(4-isopropylphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ad**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 65.2 mg, 76%; white solid; mp 127.0-127.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.76 (d, *J* = 8.3 Hz, 2H), 7.63 (d, *J* = 7.5 Hz, 1H), 7.36-7.32 (m, 1H), 7.22-7.17 (m, 5H), 7.09-7.04 (m, 1H), 6.87-6.82 (m, 2H), 4.10 (d, *J* = 17.3 Hz, 1H), 3.50-3.45 (m, 4H), 3.19 (d, *J* = 15.2 Hz, 1H), 2.93-2.87 (m, 1H), 2.81 (d, *J* = 15.3 Hz, 1H), 1.31 (s, 3H), 1.22 (d, *J* = 6.9 Hz, 6H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 196.7, 173.5, 154.4, 148.1, 140.9, 139.9, 134.6, 129.0, 128.2, 127.4, 127.1, 126.7, 126.3, 126.2, 124.9, 123.9, 122.4, 114.3, 54.1, 52.3, 45.8, 45.0, 34.1, 30.1, 23.6(2C), 18.84; HRMS (ESI-TOF) *m/z*: $C_{29}H_{30}NO_2$ (M + H)$^{+}$ calcd for 424.2271, found 424.2276.

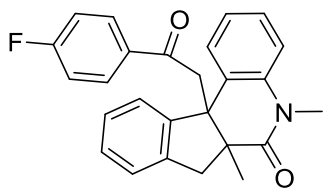


11b-(2-(4-(tert-butyl)phenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ae**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 59.4 mg, 68%; yellow solid; mp 181.0-181.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.75 (d, *J* = 8.2 Hz, 2H), 7.63 (d, *J* = 7.6 Hz, 1H), 7.37-7.32 (m, 3H), 7.23-7.17 (m, 3H), 7.07 (t, *J* = 7.7 Hz, 1H), 6.88-6.82 (m, 2H), 4.11 (d, *J* = 17.3 Hz, 1H), 3.80 (s, 3H), 3.47 (d, *J* = 21.1 Hz, 4H), 3.19 (d, *J* = 15.2 Hz, 1H), 2.82 (d, *J* = 15.2 Hz, 1H), 1.29 (s, 9H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 196.7, 173.6, 156.6, 148.2, 140.9, 140.0, 134.2,



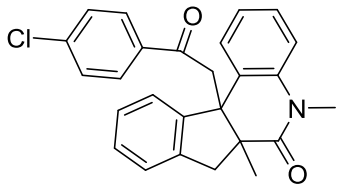
129.0, 127.9, 127.5, 127.1, 126.7, 125.2, 124.9, 123.9, 122.4, 114.4, 54.1, 52.4, 45.9, 45.1, 35.0, 31.0, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{30}H_{32}NO_2$ $(M + H)^+$ calcd for 438.2428, found 438.2423.

11b-(2-(4-fluorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-ind



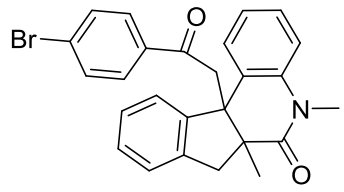
eno[2,1-c]quinolin-6-one (**3af**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 51.9 mg, 65%; white solid; mp 118.0-118.5^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.84-7.80 (m, 2H), 7.63 (d, *J* = 7.5 Hz, 1H), 7.34 (t, *J* = 6.8 Hz, 1H), 7.24-7.17 (m, 3H), 7.11-7.07 (m, 1H), 7.01 (t, *J* = 6.8 Hz, 2H), 6.88-6.84 (m, 2H), 4.06 (d, *J* = 16.9 Hz, 1H), 3.45 (d, *J* = 8.6 Hz, 4H), 3.17 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.3 Hz, 1H), 1.32 (s, 3H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -105.2 (s, 1F); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.7 , 173.4 , 166.8(d, J_{C-F} = 253.5 Hz, 1C), 147.8 , 140.9 , 139.9 , 133.2(d, J_{C-F} = 3.0 Hz, 1C), 130.7(d, J_{C-F} =9.2 Hz, 1C) , 129.0 , 127.6 , 127.2 , 126.7 , 126.1 , 125.0 , 123.9 , 122.5 , 115.5(d, J_{C-F} =21.6 Hz, 1C), 114.4, 54.1, 52.4 , 45.6, 44.9, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{26}H_{23}FNO_2$ $(M + H)^+$ calcd for 400.1707, found 400.1716.

11b-(2-(4-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-ind



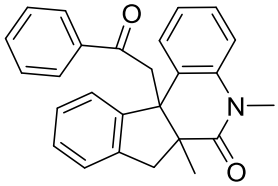
eno[2,1-c]quinolin-6-one (**3ag**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 51.4 mg, 62%; white solid; mp 133.0-133.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.72 (s, 1H), 7.65 (t, *J* = 7.0 Hz, 2H), 7.44-7.42 (m, 1H), 7.35 (t, *J* = 7.7 Hz, 1H), 7.28 (d, *J* = 7.9 Hz, 1H), 7.23-7.17 (m, 3H), 7.10-7.06 (m, 1H), 6.87-6.84 (m, 2H), 4.04 (d, *J* = 16.9 Hz, 1H), 3.46 (d, *J* = 15.2 Hz, 4H), 3.17 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.2 Hz, 1H), 1.32 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 196.2, 173.3, 147.6, 140.8, 139.7, 138.2, 132.8, 129.6, 129.0, 128.1, 127.7, 127.2, 126.7, 126.0, 125.0, 123.9, 122.6, 114.4, 54.1, 52.4, 45.6, 44.8, 30.1, 18.8; HRMS (ESI-TOF) *m/z*: $C_{26}H_{23}ClNO_2$ $(M + H)^+$ calcd for 416.1412, found 416.1417.

11b-(2-(4-bromophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-ind



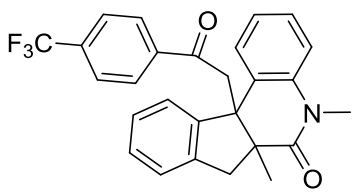
eno[2,1-c]quinolin-6-one (**3ah**) : by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 60.7 mg, 66%; white solid; mp 148.0-148.5 ^{o}C (uncorrected) ; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.66-7.61 (m, 3H), 7.48-7.46 (m, 2H), 7.36 (t, *J* = 8.0 Hz, 1H), 7.21-7.17 (m, 3H), 7.11-7.07 (m, 1H), 6.88-6.83 (m, 2H), 4.05 (d, *J* = 16.9 Hz, 1H), 3.47-3.42 (m, 4H), 3.17 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.3 Hz, 1H), 1.31 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 196.3, 173.3, 147.7, 140.8, 139.8, 135.4, 131.6, 129.5, 129.0, 128.1, 127.7, 127.2, 126.7, 126.0, 125.0, 123.8, 122.5, 114.4, 54.1, 52.3, 45.6, 44.9, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{26}H_{23}BrNO_2$ $(M + H)^+$ calcd for 460.0907, found 460.0901.

5,6a-dimethyl-11b-(2-oxo-2-phenylethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]



quinolin-6-one (**3ai**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:49.5 mg, 65%; yellow solid; mp 165.6-166.1^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.82-7.79 (m, 2H), 7.64 (d, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.35 (t, *J* = 7.8 Hz, 3H), 7.23-7.18 (m, 3H), 7.10-7.06 (m, 1H), 6.88-6.83 (m, 2H), 4.11 (d, *J* = 17.1 Hz, 1H), 3.51-3.47 (m, 4H), 3.19 (d, *J* = 15.2 Hz, 1H), 2.82 (d, *J* = 15.2 Hz, 1H), 1.32 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 197.2, 173.5, 148.0, 140.9, 139.9, 136.8, 133.0, 129.1, 128.3, 128.0, 127.6, 127.2, 126.7, 126.2, 125.0, 123.9, 122.5, 114.4, 54.1, 52.4, 45.8, 45.0, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{26}H_{24}NO_2$ $(M + H)^+$ calcd for 382.1802, found 382.1806.

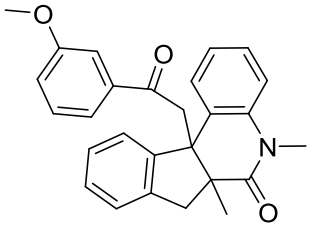
5,6a-dimethyl-11b-(2-oxo-2-(4-(trifluoromethyl)phenyl)ethyl)-5,6a,7,11b-tetrahy



dro-6H-indeno[2,1-c]quinolin-6-one (**3aj**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:54.8 mg, 61%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.87 (d, *J* = 8.1 Hz, 2H), 7.65-7.59 (m, 3H), 7.29-7.26 (m, 1H), 7.22-7.18 (m, 3H), 7.11-7.06 (m, 1H), 6.88-6.84 (m, 2H),

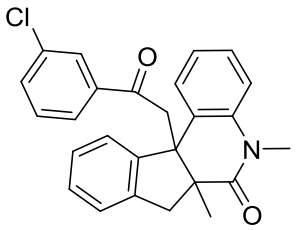
4.11 (d, *J* = 16.9 Hz, 1H), 3.49 (d, *J* = 18.1 Hz, 4H), 3.18 (d, *J* = 15.2 Hz, 1H), 2.82 (d, *J* = 15.2 Hz, 1H), 1.33 (s, 3H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -63.1 (s,3F); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 196.6, 173.3, 147.6 , 140.8 ,139.8, 139.4, 129.0 , 128.3(q, J_{C-F} = 8.1 Hz, 1C) , 127.9, 127.7, 127.3 , 126.7, 125.8 , 125.5 , 125.3(q, J_{C-F} = 3.5 Hz, 1C) , 125.0 , 123.8 , 122.6(q, J_{C-F} = 250.1 Hz, 1C) , 114.4 , 54.1, 52.3, 45.9, 44.9, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{27}H_{23}F_3NO_2(M + H)^+$ calcd for 450.1675, found 450.1679.

11b-(2-(3-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-i



ndeno[2,1-c]quinolin-6-one (**3ak**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:56.7 mg, 69%; white solid; mp 155.5-156.0^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.63 (d, *J* = 7.6 Hz, 1H), 7.42 (d, *J* = 7.8 Hz, 1H), 7.36-7.32 (m, 2H), 7.25-7.19 (m, 4H), 7.11-7.07 (m, 1H), 7.04-7.02 (m, 1H), 6.91-6.84 (m, 2H), 4.14-4.09 (m, 1H), 3.79 (s, 3H), 3.52-3.47 (m, 4H), 3.19 (d, *J* = 15.3 Hz, 1H), 2.82 (d, *J* = 15.2 Hz, 1H), 1.30 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 196.9, 173.6, 159.6, 148.0, 140.8, 140.0, 138.0, 129.2, 129.0, 127.5, 127.2, 126.7, 126.1, 124.9, 123.9, 122.5, 120.6, 119.7, 114.4, 112.0, 55.4, 54.0, 52.3, 46.1, 45.0, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{27}H_{26}NO_3(M + H)^+$ calcd for 412.1907, found 412.1901.

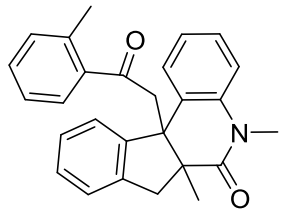
11b-(2-(3-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-ind



eno[2,1-c]quinolin-6-one (**3al**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:52.3 mg, 63%; white solid; mp 168.5-168.0^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.72 (s, 1H), 7.65 (t, *J* = 7.6 Hz, 2H), 7.44-7.42 (m, 1H), 7.37-7.33 (m, 1H), 7.29 (d, *J* = 7.9 Hz, 1H), 7.24-7.16 (m, 3H), 7.10-7.06 (m, 1H), 6.88-6.84 (m, 2H), 4.03 (d, *J* = 16.9 Hz, 1H), 3.46 (d, *J* = 15.4 Hz, 4H), 3.17 (d, *J* = 15.2 Hz, 1H), 2.81 (d, *J* = 15.2 Hz, 1H), 1.32 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 196.2, 173.3, 147.7, 140.8, 139.8, 138.2, 134.6, 132.8, 129.6, 129.0, 128.1, 127.7, 127.3, 126.7, 126.0, 125.8, 125.0, 123.9, 122.6,

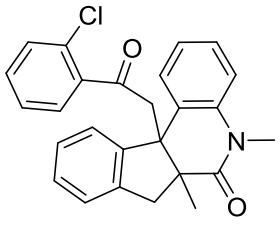
114.4, 54.1, 52.4, 45.7, 44.8, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{26}H_{23}ClNO_2$ (M + H)$^+$ calcd for 416.1412, found 416.1418.

5,6a-dimethyl-11b-(2-oxo-2-(o-tolyl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c



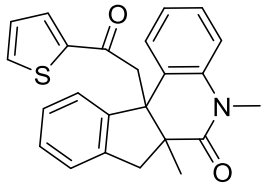
]quinolin-6-one (**3am**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:44.2 mg, 56%; white solid; mp 171.0-171.5^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.55 (d, J = 7.5 Hz, 1H), 7.34-7.31 (m, 3H), 7.28-7.24 (m, 1H), 7.20-7.18 (m, 3H), 7.13 (s, 1H), 7.11 (s, 1H), 6.91-6.85 (m, 2H), 4.03 (d, J = 17.2 Hz, 1H), 3.48 (s, 3H), 3.36 (d, J = 17.1 Hz, 1H), 3.18 (d, J = 15.3 Hz, 1H), 2.83 (d, J = 15.2 Hz, 1H), 2.21 (s, 3H), 1.37 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 201.7, 173.4, 147.8, 140.8, 139.8, 138.4, 137.4, 131.6, 130.9, 129.0, 128.2, 127.6, 127.1, 126.6, 126.1, 125.3, 124.9, 123.9, 122.4, 114.4, 54.4, 52.3, 48.8, 45.0, 30.0, 20.6, 19.0; HRMS (ESI-TOF) *m/z*: $C_{27}H_{26}NO_2$ (M + H)$^+$ calcd for 396.1958, found 396.1966.

11b-(2-(2-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-ind



eno[2,1-c]quinolin-6-one (**3an**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:44.2 mg, 49%; white solid; mp 165.0-165.5^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.53 (d, *J* = 7.6 Hz, 1H), 7.31-7.28 (m, 3H), 7.20-7.12 (m, 5H), 7.02 (t, *J* = 6.8 Hz, 1H), 6.94 (d, *J* = 8.3 Hz, 1H), 6.87 (t, *J* = 7.5 Hz, 1H), 4.15(d, *J* = 17.6 Hz, 1H), 3.52 (s, 3H), 3.43 (d, *J* = 17.5 Hz, 1H), 3.20 (d, *J* = 15.3 Hz, 1H), 2.83 (d, *J* = 15.3 Hz, 1H), 1.37 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 200.7 , 173.3, 147.5 , 140.7 , 139.7 139.6, , 131.5 , 130.3, 130.2 , 129.3 , 128.5 , 127.7 , 127.2 , 126.8 , 126.7 , 125.6 , 124.9 , 123.9 , 122.5 , 114.4 , 54.4 , 52.4 , 50.0 , 45.0 , 30.1 , 19.1 ; HRMS (ESI-TOF) *m/z*: $C_{26}H_{23}ClNO_2$ (M + H)$^+$ calcd for 416.1412, found 416.1417.

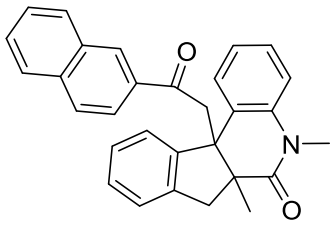
5,6a-dimethyl-11b-(2-oxo-2-(thiophen-2-yl)ethyl)-5,6a,7,11b-tetrahydro-6H-inde



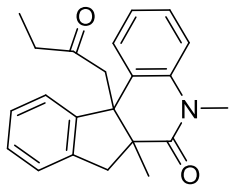
no[2,1-c]quinolin-6-one (**3ao**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:42.6 mg,

55%; white solid; mp 135.0-135.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.63 (d, *J* = 7.2 Hz, 1H), 7.52 (d, *J* = 5.2 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 1H), 7.35 (t, *J* = 6.8 Hz, 1H), 7.22-7.16 (m, 3H), 7.10-7.07 (t, *J* =7.6 Hz, 1H), 7.00-6.96 (m, 1H), 6.87 (t, *J* = 6.0 Hz, 2H), 3.96-3.92 (m, 1H), 3.45 (d, *J* = 16.8 Hz, 4H), 3.15 (d, *J* = 16.8 Hz, 1H), 2.83-2.79 (m, 1H), 1.38 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 190.0, 173.2, 147.6, 144.2, 140.9, 139.7, 133.6, 131.9, 129.1, 127.8, 127.7, 127.2, 126.7, 126.0, 125.0, 123.9, 122.6, 114.4, 54.3, 52.6, 46.1, 44.7, 30.1, 19.0; HRMS (ESI-TOF) *m/z*: $C_{24}H_{22}NO_2S$ $(M + H)^+$ calcd for 388.1366, found 388.1370.

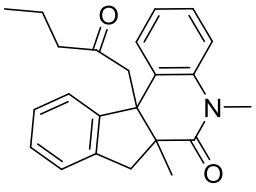
5,6a-dimethyl-11b-(2-(naphthalen-2-yl)-2-oxoethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ap**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:60.3 mg, 70%; white solid; mp 185.0-185.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.27 (s, 1H), 7.89-7.85 (m, 2H), 7.81-7.78 (m, 2H), 7.71 (d, *J* = 7.4 Hz, 1H), 7.57-7.50 (m, 3H), 7.39 (t, *J* = 6.9 Hz, 1H), 7.25-7.18 (m, 2H), 7.04-7.00 (m, 1H), 6.87-6.81 (m, 2H), 4.23 (d, *J* = 16.9 Hz, 1H), 3.62 (d, *J* = 16.8 Hz, 1H), 3.48 (s, 3H), 3.20 (d, *J* = 15.2 Hz, 1H), 2.83 (d, *J* = 15.2 Hz, 1H), 1.36 (s, 3H).; ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 197.2, 173.5, 148.0, 140.9, 139.9, 135.3, 134.0, 132.2, 129.6, 129.4, 129.1, 128.4, 128.1, 127.6, 127.6, 127.2, 126.7, 126.6, 126.2, 124.9, 124.0, 123.7, 122.5, 114.4, 54.2, 52.4, 45.8, 44.9, 30.1, 18.9; HRMS (ESI-TOF) *m/z*: $C_{30}H_{26}NO_2$ $(M + H)^+$ calcd for 432.1958, found 432.1963.



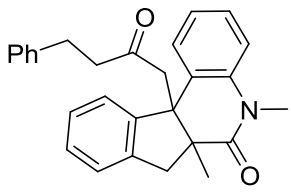
5,6a-dimethyl-11b-(2-oxobutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3aq**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:48.6 mg, 73%; white solid; mp 137.0-137.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.52 (d, *J* = 7.5 Hz, 1H), 7.31-7.27 (m, 1H), 7.20-7.13 (m, 4H), 6.96-6.88 (m, 2H), 3.48 (s, 3H), 3.41 (d, *J* = 16.5 Hz, 1H), 3.14 (d, *J* = 15.2 Hz, 1H), 2.97 (d, *J* = 16.4 Hz, 1H), 2.78 (d, *J* = 15.2 Hz, 1H), 2.31-2.21 (m, 1H), 2.07-1.99 (m, 1H), 1.28 (s, 3H), 0.84 (t, *J* = 7.3 Hz, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 208.4,



173.2, 147.6, 140.8, 139.6, 129.0, 127.6, 127.1, 126.6, 126.0, 124.9, 123.9, 122.5, 114.4, 53.91, 52.30 , 48.93 , 44.72 , 36.91 , 30.06 , 18.89 , 7.57; HRMS (ESI-TOF) *m/z*: $C_{22}H_{24}NO_2$ $(M + H)^+$ calcd for 334.1802, found 334.1806.

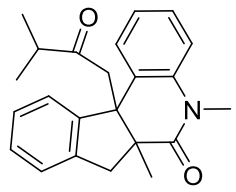
5,6a-dimethyl-11b-(2-oxopentyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ar**): 

by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:47.9 mg, 69%; white solid; mp 148.0-148.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.50 (d, *J* = 7.6 Hz, 1H), 7.31-7.29 (m, 1H), 7.19-7.14 (m, 4H), 6.96-6.88 (m, 2H), 3.48 (s, 3H), 3.44 (t, *J* = 16.6 Hz, 4H), 3.14 (d, *J* = 15.3 Hz, 1H), 2.95 (d, *J* = 16.6 Hz, 1H), 2.79 (d, *J* = 15.2 Hz, 1H), 2.24-2.16 (m, 1H), 2.05-1.98 (m, 1H), 1.40-136 (m, 2H), 1.28 (s, 3H), 0.71 (t, *J* = 7.4 Hz, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 208.1, 173.3, 147.7 , 140.8, 139.7, 129.1 ,127.7, 127.2, 126.6, 126.0, 125.0, 123.9, 122.6, 114.5, 54.0, 52.3, 49.3, 45.8, 44.9, 30.1, 19.0, 17.0, 13.5; HRMS (ESI-TOF) *m/z*: $C_{23}H_{26}NO_2$ $(M + H)^+$ calcd for 348.1958, found 348.1962.

5,6a-dimethyl-11b-(2-oxo-4-phenylbutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3as**): 

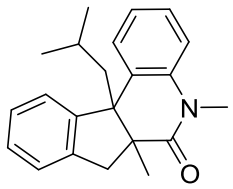
by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:54.8 mg, 67%; white solid; mp 130.7-131.2°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.46 (d, *J* = 7.5 Hz, 1H), 7.29-7.25 (m, 1H), 7.22-7.11 (m, 7H), 6.97-6.89 (m, 4H), 3.41 (t, *J* = 16.4 Hz, 4H), 3.13 (d, *J* = 15.2 Hz, 1H), 2.92 (d, *J* = 16.4 Hz, 1H), 2.77 (d, *J* = 15.2 Hz, 1H), 2.69-2.62 (m, 2H), 2.58-2.50 (m, 1H), 2.37-2.29 (m, 1H), 1.27 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 207.0 , 173.1, 147.4 , 140.7(2C) ,139.5, 129.0 , 128.3 , 128.1 , 127.7 , 127.1 , 126.6 , 125.9 , 125.8 , 124.9 , 123.8 , 122.6 , 114.5 , 53.9 , 52.3 , 49.4 , 45.3 , 44.7 , 30.0 , 29.4 , 18.9; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_2$ $(M + H)^+$ calcd for 410.2115, found 410.2119.

5,6a-dimethyl-11b-(3-methyl-2-oxobutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]



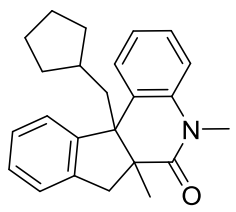
quinolin-6-one (**3au**): by silica gel column chromatography (hexane/ethyl acetate = 12 : 1), yield:6.9 mg, 10%; white solid; mp 125.0-125.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.52 (d, *J* = 7.6 Hz, 1H), 7.28 (s, 1H), 7.19-7.13 (m, 4H), 6.95-6.87 (m, 2H), 3.53 (t, *J* = 24.2 Hz, 4H), 3.14 (d, *J* = 15.2 Hz, 1H), 3.00 (d, *J* = 16.9 Hz, 1H), 2.79 (d, *J* = 15.3 Hz, 1H), 2.35-2.29 (m, 1H), 1.28 (s, 3H), 0.94 (d, *J* = 6.9 Hz, 3H), 0.79 (d, *J* = 6.9 Hz, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 211.5, 173.3, 147.8, 140.9, 139.7, 129.1, 128.2, 127.6, 127.1, 126.6, 124.9, 123.9, 122.4, 114.4, 53.9, 52.3, 47.3, 44.9, 41.4, 30.0, 18.9, 18.1, 17.6; HRMS (ESI-TOF) *m/z*: $C_{23}H_{26}NO_2$ $(M + H)^+$ calcd for 348.1958, found 348.1963.

11b-isobutyl-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-on



e (**4au**): by silica gel column chromatography (hexane/ethyl acetate = 12 : 1), yield:35.1 mg, 55%; white solid; mp 138.0-138.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.45 (d, *J* = 7.5 Hz, 1H), 7.29-7.27 (m, 1H), 7.18-7.14 (m, 3H), 7.10 (d, *J* = 7.4 Hz, 1H), 6.95-6.90 (m, 2H), 3.45 (s, 3H), 3.09 (d, *J* = 15.0 Hz, 1H), 2.71 (d, *J* = 15.0 Hz, 1H), 2.03-1,97 (m, 1H), 1.90-1.85 (m, 1H), 1.27 (s, 3H), 0.96 (s, 1H), 0.82 (d, *J* = 6.7 Hz, 3H), 0.36 (d, *J* = 6.4 Hz, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 174.0, 149.1, 141.0, 139.4, 129.6, 128.1, 127.3, 126.6, 126.4, 124.7, 124.0, 123.0, 113.9, 55.8, 52.7, 45.8, 44.4, 30.0, 25.7, 24.7, 23.3, 18.4; HRMS (ESI-TOF) *m/z*: $C_{22}H_{26}NO$ $(M + H)^+$ calcd for 320.2009, found 320.2002.

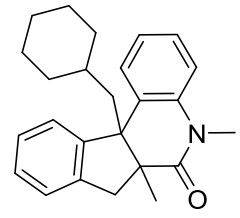
11b-(cyclopentylmethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]q



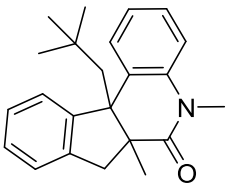
uinolin-6-one (**4av**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:54.0 mg, 78%; white solid; mp 129.0-129.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.46 (d, *J* = 7.5 Hz, 1H), 7.30-7.27 (m, 1H), 7.19-7.14 (m, 3H), 7.10-7.08 (m, 1H), 6.95-6.89 (m, 2H), 3.4 (s, 3H), 3.1 (d, *J* = 14.9 Hz, 1H), 2.7 (d, *J* = 14.9 Hz, 1H), 2.1 (d, *J* = 5.5 Hz, 2H), 1.7-1.7 (m, 2H), 1.5-1.2 (m, 10H);

$^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 174.0 , 149.0 , 141.1 , 139.5 , 129.6 , 128.2 , 127.3 , 126.6 , 126.4 , 124.7 , 124.0 , 122.9 , 113.9 , 55.9 , 52.4 , 44.4 , 43.5 , 36.3 , 35.5 , 32.5 , 30.0 , 25.6 , 24.4 , 18.3; HRMS (ESI-TOF) *m/z*: $C_{24}H_{28}NO$ $(M + H)^+$ calcd for 346.2166, found 346.2172.

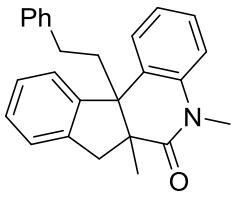
11b-(cyclohexylmethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**4aw**): by silica gel column chromatography (hexane/ethyl acetate = 12 : 1), yield:54.0 mg, 78%; white solid; mp 136.7-138.4°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.47 (d, J = 7.5 Hz, 1H), 7.32 (t, J = 7.4 Hz, 1H), 7.22-7.16 (m, 3H), 7.05 (d, J = 7.8 Hz, 1H), 6.97-6.91 (m, 2H), 3.65-3.61 (m, 1H), 3.48 (s, 3H), 3.10 (d, J = 15.0 Hz, 1H), 2.73 (d, J = 15.3 Hz, 2H), 2.57-2.31 (m, 1H), 2.37-2.31 (m, 1H), 1.93 (d, J = 13.6 Hz, 2H), 1.77 (t, J = 15.0 Hz, 2H), 1.65 (d, J = 9.6 Hz, 2H), 1.50-1.41 (m, 3H), 1.31 (s, 3H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 182.3 , 173.1, 147.8, 141.0 , 139.9 , 129.6 , 127.8 , 127.0 , 126.7 , 125.1 , 123.7 , 123.2 , 114.2 , 56.2 , 54.4, 52.5 , 49.3 , 44.2 , 42.8 , 41.7 , 30.4 , 28.7 , 25.6 , 25.3 , 18.4; HRMS (ESI-TOF) *m/z*: $C_{25}H_{30}NO$ $(M + H)^+$ calcd for 360.2322, found 360.2328.



5,6a-dimethyl-11b-neopentyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**4ax**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:45.3 mg, 68%; white solid; mp 133.0-133.5°C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.55 (d, *J* = 7.6 Hz, 1H), 7.31-7.27 (d, *J* = 7.7 Hz, 1H), 7.15 (t, *J* = 7.2 Hz, 3H), 7.06-7.04 (m, 1H), 6.95-6.93 (m, 1H), 6.90-6.86 (m, 1H), 3.47 (s, 3H), 3.08 (d, *J* = 15.0 Hz, 1H), 2.71 (d, *J* = 15.0 Hz, 1H), 2.28 (d, *J* = 15.0 Hz, 1H), 1.96 (d, *J* = 15.0 Hz, 1H), 1.33 (s, 3H), 0.68 (s, 9H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 174.1 , 150.2 , 140.7 , 139.4 , 130.5 , 127.5 , 127.3 , 126.6 , 126.3 , 124.7 , 124.0 , 122.8 , 114.1 , 56.4 , 52.9 , 48.7 , 45.4 , 31.8 , 31.4 , 30.0 , 18.9; HRMS (ESI-TOF) *m/z*: $C_{23}H_{28}NO$ $(M + H)^+$ calcd for 334.2166, found 334.2172.

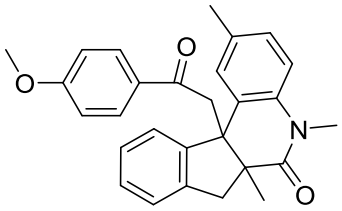


5,6a-dimethyl-11b-phenethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4ay):



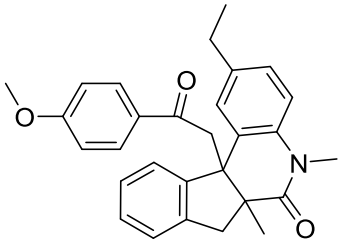
by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:49.2 mg, 67%; white solid; mp 143.0-143.5^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.45 (d, *J* = 7.5 Hz, 1H), 7.26-7.20 (m, 4H), 7.15 (d, *J* = 9.5 Hz, 4H), 7.04-6.96 (m, 4H), 3.48 (s, 3H), 3.08 (d, *J* = 14.9 Hz, 1H), 2.74 (d, *J* = 15.0 Hz, 1H), 2.59-2.50 (m, 1H), 2.41-2.33 (m, 1H), 2.24-2.14 (m, 2H), 1.39 (s, 3H).; ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 173.8 , 148.2 , 141.8 , 141.1 , 139.5 , 129.2 , 128.3 , 128.1 , 127.5 , 127.1, 126.8 , 126.5 , 125.9 , 124.8 , 123.9 , 123.3 , 113.9 , 55.8 , 52.0 , 44.4 , 39.8 , 30.1 , 29.8 , 18.2; HRMS (ESI-TOF) *m/z*: $C_{26}H_{26}NO$ $(M + H)^+$ calcd for 368.2009, found 368.2014.

11b-(2-(4-methoxyphenyl)-2-oxoethyl)-2,5,6a-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ba**):



by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 66.2 mg, 78%; white solid; mp 155.0-155.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.80 (d, *J* = 8.8 Hz, 2H), 7.64 (d, *J* = 7.6 Hz, 1H), 7.34 (t, *J* = 6.4 Hz, 1H), 7.22-7.17 (m, 2H), 6.96 (s, 1H), 6.88-6.86 (m, 1H), 6.82-6.76 (m, 3H), 4.04 (d, *J* = 16.8 Hz, 1H), 3.81 (s, 3H), 3.45 (d, *J* = 22 Hz, 4H), 3.18 (d, *J* = 15.2 Hz, 1H), 2.80 (d, *J* = 15.2 Hz, 1H), 2.13 (s, 3H), 1.29 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.5, 173.3, 163.2 , 148.2, 140.8, 137.6, 131.5, 130.2, 129.8 , 129.4, 128.1, 127.0, 126.6, 126.0, 124.8, 123.9 , 114.3 , 113.3 , 55.3, 54.0, 52.3, 45.5, 44.9, 30.1, 20.6, 18.8; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_3$ $(M + H)^+$ calcd for 426.2064, found 426.2069.

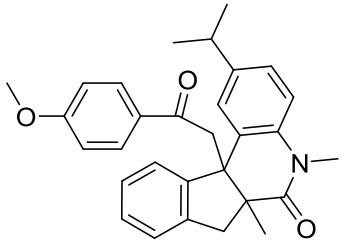
2-ethyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ca**):



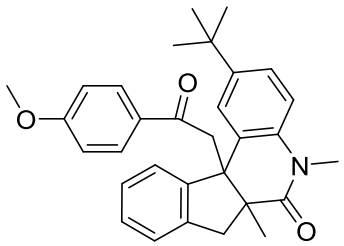
by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 60.6 mg, 69%; white solid; mp 141.0-141.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, CDCl3) δ: 7.75 (d, J = 8.8 Hz, 2H), 7.65 (d, J = 7.5 Hz, 1H), 7.36-7.32 (m, 1H), 7.21-7.16 (m, 2H), 6.95 (d,

J = 2.0 Hz, 1H), 6.90-6.88(m, 1H), 6.78 (t, J = 8.8 Hz, 3H), 4.03 (d, J = 16.8 Hz, 1H), 3.80 (s, 3H), 3.44 (t, J = 7.2 Hz, 4H), 3.16 (d, J = 15.2 Hz, 1H), 2.79 (d, J = 15.2 Hz, 1H), 2.46-2.41 (m, 2H), 1.3 (s, 3H), 1.08 (t, J = 7.6 Hz, 3H); 13C{1H}NMR (100 MHz, CDCl3) δ: 195.7, 173.3, 163.2 , 148.2, 140.9, 138.0, 137.7, 130.2, 129.9 , 128.4, 127.0, 126.8, 126.6, 126.0, 124.9, 123.9 , 114.3, 113.3, 55.4, 54.2, 52.4, 45.2, 44.9, 30.1, 27.9, 18.9, 15.3; HRMS (ESI-TOF) m/z: $C_{29}H_{30}NO_3$ $(M + H)^+$ calcd for 440.2220, found 440.2223.

2-isopropyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3da**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 58.9 mg, 65%; white solid; mp 143.0-143.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.77-7.74 (m, 2H), 7.66 (d, *J* = 7.6 Hz, 1H), 7.36-7.32 (m, 1H), 7.22-7.18 (m, 2H), 7.01 (d, *J* = 2.2 Hz, 1H), 6.93-6.90 (m, 1H), 6.80-6.75 (m, 3H), 4.01 (d, *J* = 16.4 Hz, 1H), 3.81 (s, 3H), 3.44-3.38 (m, 4H), 3.16 (d, *J* = 15.1 Hz, 1H), 2.79 (d, *J* = 15.3 Hz, 1H), 2.73-2.66 (m, 1H), 1.3 (s, 3H), 1.08 (t, *J* = 6.8 Hz, 6H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.9 , 173.3 , 163.2 , 148.1 , 142.6 , 140.9 , 137.7 , 130.2 , 130.0 , 127.2 , 127.0 , 126.5 , 125.9, 125.1 , 124.9 , 123.9 , 114.2 , 113.3 , 55.4 , 54.3 , 52.5 , 45.0 , 44.8 , 33.1 , 30.0 , 23.9 , 23.8 , 18.9; HRMS (ESI-TOF) *m/z*: $C_{30}H_{32}NO_3$ $(M + H)^+$ calcd for 454.2377, found 454.2371.

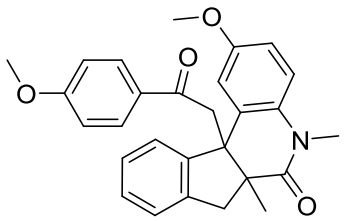


2-(tert-butyl)-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ea**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 57.9 mg, 62%; white solid; mp 123.0-123.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.74 (d, *J* = 7.4 Hz, 2H), 7.66 (d, *J* = 7.5 Hz, 1H), 7.34 (t, *J* = 7.1 Hz, 1H), 7.18 (d, *J* = 7.3 Hz, 3H), 7.05 (d, *J* = 8.7 Hz, 1H), 6.76 (m, 3H), 4.00 (d, *J* = 16.3 Hz, 1H), 3.80 (s, 3H), 3.44-3.38 (m, 4H), 3.16 (d, *J* = 15.3 Hz, 1H), 2.80 (d, *J* = 15.2 Hz, 1H), 1.35 (s, 3H), 1.14 (s, 9H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 196.0 , 173.3 ,



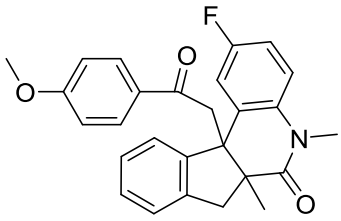
163.1 , 148.2 , 144.8 , 140.9 , 137.3 , 130.2 , 130.1 , 127.0 , 126.5 , 126.1 , 125.5, 124.9 , 124.3 , 123.8 , 113.8 , 113.3 , 55.4 , 54.5 , 52.5 , 44.8 , 34.0 , 31.2 , 29.9 , 19.0, 14.2; HRMS (ESI-TOF) *m/z*: $C_{31}H_{34}NO_3$ $(M + H)^+$ calcd for 468.2533, found 468.2539.

2-methoxy-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetra



hydro-6H-indeno[2,1-c]quinolin-6-one (**3fa**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 59.0 mg, 67%; white solid; mp 163.0-163.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.40 (d, J = 8.8 Hz, 2H), 7.24 (d, J = 8.0 Hz, 2H), 7.19 (s, 1H), 7.00 (d, J = 9.0 Hz, 1H), 6.87 (d, J = 8.8 Hz, 2H), 6.55-6.76 (m, 1H), 6.55 (t, J = 3.0 Hz, 2H), 3.87-3.80(m, 5H), 3.68 (s, 3H), 3.50 (s, 3H), 3.12-3.07 (m, 1H), 2.76 (d, J = 15.0 Hz, 1H), 1.01 (s, 3H); 13C{1H}NMR (100 MHz, CDCl3)δ: 172.7 , 159.4 , 155.4 , 142.8 , 142.3, 132.0, 131.9, 128.2, 128.1, 127.6, 127.0, 126.9, 126.8, 115.7, 115.3, 113.8 , 112.2 , 61.1 , 55.4 , 52.1 , 46.6 , 30.3 , 29.7 , 22.1 , 14.1 ; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_4$ $(M + H)^+$ calcd for 442.2013, found 442.2017.

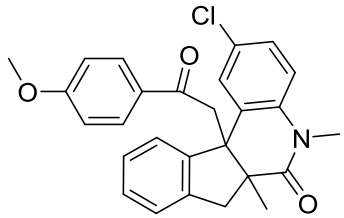
2-fluoro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahy



dro-6H-indeno[2,1-c]quinolin-6-one (**3ga**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 64.4 mg, 75%; white solid; mp 176.0-176.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.83-7.81 (m, 2H), 7.61 (d, *J* = 7.6 Hz, 1H), 7.38-7.34 (m, 1H), 7.23-7.21 (m, 2H), 6.92-6.88 (m, 1H), 6.85 (d, *J* = 2.0 Hz, 1H), 6.84-6.82 (m, 2H), 6.80-6.77 (m, 1H), 4.03 (d, *J* = 17.2 Hz, 1H), 3.82 (s, 3H), 3.49-3.44 (m, 4H), 3.17 (d, *J* = 15.3 Hz, 1H), 2.82 (d, *J* = 15.3 Hz, 1H), 1.3 (s, 3H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -120.9 (s, 1F); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.3 , 173.1 , 163.4 , 158.1 (d, J_{C-F} = 239.8 Hz, 1C), 147.5 , 140.7 , 136.3(d, *J* = 2.4 Hz, 1C) , 130.2 , 129.6 , 128.4(d, J_{C-F} = 6.1 Hz, 1C) , 127.4 , 126.9 , 124.9 , 123.7 , 115.6 (d, J_{C-F} = 6.7 Hz, 1C), 115.5(d, J_{C-F} = 8.7 Hz, 1C) , 114.1(d, J_{C-F} = 22.1 Hz, 1C) , 113.4 , 55.4 , 54.1 , 52.0 , 45.3 , 44.9 ,

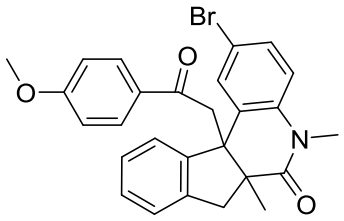
30.3 , 18.8 ; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}FNO_3$ $(M + H)^+$ calcd for 430.1813, found 430.1818.

2-chloro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahy

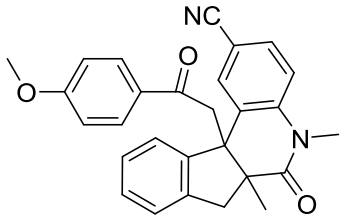


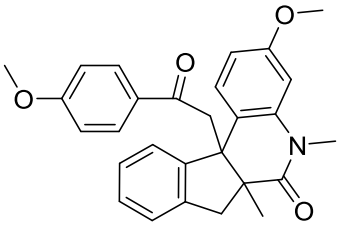
dro-6H-indeno[2,1-c]quinolin-6-one (**3ha**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 53.4 mg, 60%; white solid; mp 174.0-174.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.84-7.81 (m, 2H), 7.61 (d, *J* = 7.5 Hz, 1H), 7.38-7.34 (m, 1H), 7.25-7.21 (m, 2H), 7.12 (d, *J* = 2.4 Hz, 1H), 7.01-7.02(m, 1H), 6.86-6.81 (m, 3H), 4.03 (d, *J* = 17.3 Hz, 1H), 3.83 (s, 3H), 3.48 (d, *J* = 16.8 Hz, 4H), 3.17 (d, *J* = 15.3 Hz, 1H), 2.81 (d, *J* = 15.3 Hz, 1H), 1.28 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.2 , 173.2 , 163.4 , 147.5 , 140.7 , 138.8 , 130.3 , 129.9, 129.5 , 128.9 , 128.3, 127.4 , 127.3 , 127.0 , 125.0 , 123.8 , 115.7 , 113.5 , 55.4 , 54.0 , 52.2 , 45.7 , 45.0 , 30.2 , 18.8; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}ClNO_3$ $(M + H)^+$ calcd for 446.1517, found 446.1525.

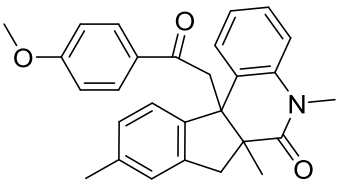
2-bromo-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahy



dro-6H-indeno[2,1-c]quinolin-6-one (**3ia**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 67.6 mg, 69%; white solid; mp 177.6-178.4 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.84-7.81 (m, 2H), 7.61 (d, *J* = 7.5 Hz, 1H), 7.37 (t, *J* = 7.4 Hz, 1H), 7.23-7.17 (m, 4H), 6.86-6.84 (m, 2H), 6.78-6.69 (m, 1H), 4.06-4.01 (m, 1H), 3.83 (d, *J* = 2.6 Hz, 3H), 3.49-3.45 (m, 4H), 3.17 (d, *J* = 15.4 Hz, 1H), 2.82 (d, *J* = 12.8 Hz, 1H), 1.27 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.3 , 173.2 , 163.4 , 147.4 , 140.7 , 139.3 , 131.7 , 130.4 , 130.3 , 129.5 , 128.7 , 127.4 , 127.0 , 125.0 , 123.8 , 116.1 , 114.8 , 113.5 , 55.4 , 54.0 , 52.2 , 45.7 , 45.0 , 30.2 , 18.8; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}BrNO_3$ $(M + H)^+$ calcd for 490.1013, found 490.1017.

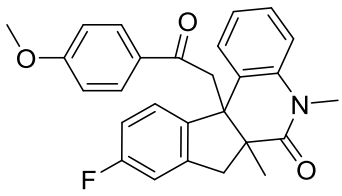
11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-6-oxo-6,6a,7,11b-tetrahydro-5H-indeno[2,1-c]quinoline-2-carbonitrile (**3ja**):  by silica gel column chromatography (hexane/ethyl acetate = 10:1), yield: 41.8 mg, 48%; white solid; mp 180.1-180.8 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ:7.79-7.76 (m, 2H), 7.59-7.56 (m, 1H), 7.14-7.07 (m, 2H), 7.02 (t, *J* = 8.8 Hz, 1H), 6.89-6.87 (d, *J* = 8.6 Hz, 3H), 6.82-6.79 (m, 2H), 3.99 (d, *J* = 17.2 Hz, 1H), 3.82 (s, 3H), 3.49-3.92(m, 4H), 3.15 (d, *J* = 14.4 Hz, 1H), 2.78 (d, *J* = 15.6 Hz, 1H), 1.32 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.4 , 173.0 , 163.3 , 160.9, 143.8, 143.2, 139.8 , 130.2 , 129.8 , 129.0 , 127.6 , 126.1 , 125.0 , 122.4 , 114.5 , 113.4 , 113.3 , 112.5 , 112.3 , 55.4 , 53.6 , 52.7 , 45.3 , 44.7 , 30.1 , 18.8 ; HRMS (ESI-TOF) *m/z*: $C_{28}H_{25}N_2O_3(M + H)^+$ calcd for 437.1860, found 437.1867.

3-methoxy-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3ka**):  by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 59.9 mg, 68%; white solid; mp 143.0-143.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.81-7.78 (m, 2H), 7.60 (d, *J* = 7.5 Hz, 1H), 7.20-7.18 (m, 2H), 7.06 (d, *J* = 8.4 Hz, 1H), 6.94 (d, *J* = 8.9 Hz, 1H), 6.83-6.81 (m, 2H), 6.42-6.38 (m, 2H), 4.04 (d, *J* = 17.0 Hz, 1H), 3.82 (s, 3H), 3.70 (s, 3H), 3.47-3.39 (m, 4H), 3.17 (d, *J* = 15.2 Hz, 1H), 2.80 (d, *J* = 15.2 Hz, 1H), 1.30 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.7 , 173.8, 163.3 , 158.8 , 148.4 , 141.0, 140.8 , 130.3 , 130.0 , 127.0 , 126.6 , 125.0 , 123.7 , 118.8 , 113.7 , 113.4 , 107.0 , 101.1 , 55.4 , 55.2 , 53.6 , 52.5 , 45.3 , 45.0 , 30.1 , 18.8; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_4$ $(M + H)^+$ calcd for 442.2013, found 442.2019.

11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,9-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3la**):  by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 49.3 mg, 58%; white solid; mp 165.0-165.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.9-7.77 (m, 2H), 7.50 (d, *J* = 7.7 Hz,

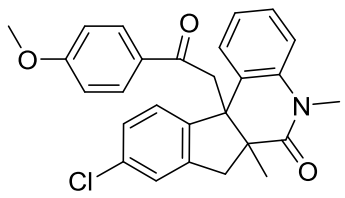
1H), 7.20-7.18 (m, 1H), 7.13 (d, *J* = 7.7 Hz, 1H), 7.08-7.04 (m, 1H), 7.00 (s, 1H), 6.87-6.79 (m, 4H), 4.04 (d, *J* = 17.0 Hz, 1H), 3.80 (s, 3H), 3.5 (s, 3H), 3.41 (d, *J* = 17.0 Hz, 1H), 3.14 (d, *J* = 15.2 Hz, 1H), 2.75 (d, *J* = 15.2 Hz, 1H), 2.32 (s, 3H), 1.31 (s, 3H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 195.7 , 173.6, 163.2 , 145.3 , 140.9 , 139.8, 136.8 , 130.2 , 129.8 , 128.9 , 127.3(2C) , 126.6 , 125.7 , 123.6 , 122.4 , 114.3 , 113.4 , 55.4 , 53.8 , 52.4 , 45.6 , 44.9 , 30.0 , 21.2 , 18.9 ; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_3$ $(M + H)^+$ calcd for 426.2064, found 426.2069.

9-fluoro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahy



dro-6H-indeno[2,1-c]quinolin-6-one (**3ma**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 42.0 mg, 49%; white solid; mp 176.0-176.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.78-7.75 (m, 2H), 7.59-7.56 (m, 1H), 7.14-7.07 (m, 2H), 7.04-7.00 (m, 1H), 6.90-6.84 (m, 3H), 6.82-6.77 (m, 2H), 4.00 (d, *J* = 16.9 Hz, 1H), 3.82 (s, 3H), 3.49 (s, 3H), 3.44-3.38 (m, 1H), 3.14 (t, *J* = 15.5 Hz, 1H), 2.80-2.69 (m, 1H), 1.32 (s, 3H); ^{19}F NMR (282 MHz, $CDCl_3$) δ: -115.6(s,1F);$^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 195.4 , 173.1 , 163.3 , 160.9, 143.8(d, *J* = 2.4 Hz, 1C), 143.2 (d, *J* = 8.4 Hz, 1C), 139.8 , 130.2 , 129.8 , 129.0 , 127.6 , 126.1 , 125.0 (d, *J* = 8.9 Hz, 1C) , 122.5 , 114.5 , 113.5 (d, *J* = 22.3 Hz, 1C) , 113.4 , 112.5 (d, *J* = 22.2Hz, 1C), 55.4 , 53.6 , 52.8 , 45.3 , 44.7 , 30.1 , 18.8; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}FNO_3$ $(M + H)^+$ calcd for 430.1813, found 430.1818.

9-chloro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahy



dro-6H-indeno[2,1-c]quinolin-6-one (**3na**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 54.3 mg, 61%; white solid; mp 171.0-171.5 ^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.78-7.76 (m, 2H), 7.59-7.55 (m, 1H), 7.30 (d, *J* = 7.8 Hz, 1H), 7.16-7.07 (m, 3H), 6.94-6.80 (m, 4H), 4.02-3.97 (m, 1H), 3.81 (s, 3H), 3.48-3.40 (m, 4H), 3.14 (d, *J* = 15.6 Hz, 1H), 2.78 (d, *J* = 15.5 Hz, 1H), 1.30 (d, *J* = 6.1 Hz, 3H); $^{13}C\{^{1}H\}$NMR (100 MHz, $CDCl_3$) δ: 195.3 , 173.0 , 163.3 , 146.7 , 142.9 , 139.8, 132.8 , 130.2 , 129.7 ,

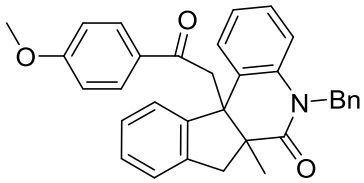
128.9 , 127.7 , 126.8 , 125.7 , 125.3 , 125.0 , 122.5 , 114.5 , 113.4 , 55.4 , 53.8 , 52.6 , 45.1 , 44.5 , 30.1 , 18.8; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}ClNO_3$ $(M + H)^+$ calcd for 446.1517, found 446.1511.

9-bromo-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (**3oa**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 67.5 mg, 69%; white solid; mp 163.0-163.5 ^oC (uncorrected); ^1H NMR (400 MHz, $CDCl_3$) δ: 7.82 (d, *J* = 9.3 Hz, 2H), 7.60 (d, *J* = 7.7 Hz, 1H), 7.37 (t, *J* = 7.3 Hz, 1H), 7.26-7.17 (m, 4H), 6.86-6.83 (m, 2H), 6.77 (d, *J* = 8.8 Hz, 1H), 4.03 (d, *J* = 17.3 Hz, 1H), 3.84 (s, 3H), 3.47 (d, *J* = 15.5 Hz, 4H), 3.17 (d, *J* = 15.3 Hz, 1H), 2.82 (d, *J* = 15.3 Hz, 1H), 1.27 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.3, 173.3, 163.5, 147.5, 140.7, 139.3, 131.7, 130.4, 130.3, 129.5, 128.8, 127.5, 127.1, 125.0, 123.8, 116.2, 114.9, 113.5, 55.4, 54.0, 52.2, 45.8, 45.1, 30.2, 18.8; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}BrNO_3$ $(M + H)^+$ calcd for 490.1013, found 490.1016.

11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,10-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3pa) and 11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,8-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3pa') mixture: Yield: 51.4 mg, 54% , and ; yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ: 7.82 (d, *J* = 9.3 Hz, 2H), 7.44 (t, *J* = 7.7 Hz, 1H), 7.25-7.18 (t, *J* = 7.3 Hz, 1.5H), 7.10-7.00 (m, 2.5H), 6.89-6.80 (m, 4H), 4.06-4.01 (m, 1H), 3.82 (s, 3H), 3.50-3.40 (m, 4H), 3.14-3.03 (m, 1H), 2.83-2.74(m, 1H), 2.47 (s, 1.4H),2.17 (s, 1.6H), 1.31 (s, 3H); $^{13}C\{^1H\}$NMR (100 MHz, $CDCl_3$) δ: 195.3, 173.3, 171.1, 163.5, 147.5, 140.7, 139.3, 131.7, 130.4, 130.3, 129.5, 128.8, 127.5, 127.1, 125.0, 123.8, 116.2, 114.9, 113.5, 60.4, 55.4, 54.2, 54.0, 52.5, 51.9, 45.6, 45.4, 44.6, 43.7, 30.1, 29.7, 21.6, 19.2, 18.9; HRMS (ESI-TOF) *m/z*: $C_{28}H_{27}NO_3$(M +

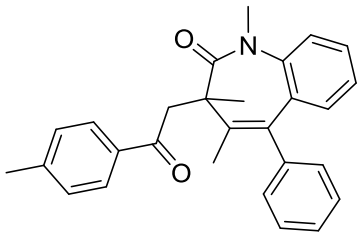
H)$^+$ calcd for 426.6024, found 426.6028.

5-benzyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-6a-methyl-5,6a,7,11b-tetrahydro



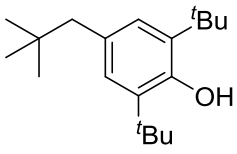
-6H-indeno[2,1-c]quinolin-6-one (**3qa**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield: 57.5 mg, 59%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.85 (d, *J* = 8.9 Hz, 2H), 7.64 (d, *J* = 7.6 Hz, 1H), 7.37-7.31 (m, 5H), 7.25-7.21 (m, 4H), 6.92-6.90 (m, 1H), 6.85-6.76 (m, 4H), 5.90 (d, *J* = 16.4 Hz, 1H), 4.76 (d, *J* = 16.4 Hz, 1H), 4.13 (d, *J* = 17.3 Hz, 1H), 3.82 (s, 3H), 3.50 (d, *J* = 17.3 Hz, 1H), 3.38 (d, *J* = 15.1 Hz, 1H), 2.94 (d, *J* = 15.1 Hz, 1H), 1.36 (s, 3H).; ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.6 , 173.9 , 163.4 , 148.2 , 140.7 , 139.5 , 138.1 , 130.3 , 129.8 , 129.0 , 128.6 , 127.4 , 127.2 , 126.8 , 126.7 , 126.3(2C) , 125.0 , 124.0 , 122.6 , 115.3 , 113.6 , 55.5 , 54.3 , 52.6 , 47.4 , 45.7 , 45.4 , 18.9; HRMS (ESI-TOF) *m/z*: $C_{33}H_{30}NO_3$ (M + H)$^+$ calcd for 488.2221, found 488.2228.

1,3,4-Trimethyl-3-(2-oxo-2-(p-tolyl)ethyl)-5-phenyl-1,3-dihydro-2H-benzo[b]azep



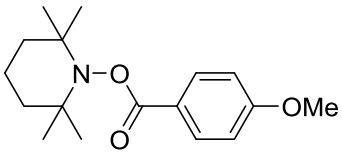
in-2-one (**3tb**): by silica gel column chromatography (hexane/ethyl acetate = 10:1), yield: 47.4 mg, 58%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.39-7.28 (m, 8H), 7.08 (d, *J* = 7.9 Hz, 3H), 6.84 (t, *J* = 7.5 Hz, 1H), 6.77 (d, *J* = 8.0 Hz, 1H), 3.54 (s, 3H), 2.97 (d, *J* = 18.5 Hz, 1H), 2.72 (d, *J* = 18.5 Hz, 1H), 2.33 (s, 3H), 1.93 (s, 3H), 1.69 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 197.0, 172.3, 143.5, 143.0, 141.3, 139.9, 135.0, 134.6, 130.5, 130.1, 129.1, 128.9, 128.2, 127.6, 127.5, 126.8, 123.5, 121.4, 47.8 , 44.0 , 38.0 , 23.8 , 21.5 , 19.9; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_2$ (M + H)$^+$ calcd for 410.2115, found 410.2120.

2,6-Di-tert-butyl-4-neopentylphenol (**7**): by silica gel column chromatography



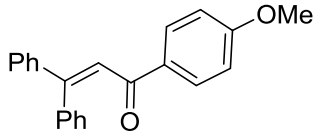
(hexane/ethyl acetate = 100:1), yield: 33.1 mg, 60%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.13 (s, 2H), 5.12 (s, 1H), 4.33 (s, 2H), 1.43 (s, 18H), 1.30 (s, 9H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 153.1, 135.6, 129.9, 124.9, 73.1, 64.7, 34.2, 30.2, 27.7; HRMS (ESI-TOF) *m/z*: $C_{19}H_{33}O$ (M + H)$^+$ calcd for 277.2526, found 277.2531.

2,2,6,6-tetramethylpiperidin-1-yl 4-methoxybenzoate (**8**): by silica gel column chromatography (hexane/ethyl acetate = 12:1), yield:45.3 mg, 68%; yellow oil; ^{1}H



NMR (400 MHz, $CDCl_3$) δ: 8.03 (d, *J* = 8.9 Hz, 2H), 6.94 (d, *J* = 8.9 Hz, 2H), 3.87 (s, 3H), 1.84-1.67 (m, 4H), 1.60-1.56 (m, 2H), 1.27(s, 6H), 1.11(s, 6H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 166.1, 163.2 , 131.5 , 121.9, 113.7, 60.3, 55.4, 39.0, 31.9, 20.8, 17.0; HRMS (ESI-TOF) *m/z*: $C_{17}H_{26}NO_3$ $(M + H)^+$ calcd for 292.1908, found 292.1913.

1-(4-Methoxyphenyl)-3,3-diphenylprop-2-en-1-one (**10**): by silica gel column



chromatography (hexane/ethyl acetate = 12:1), yield:45.3 mg, 68%; white solid; mp 110.0-110.5^{o}C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.91 (d, *J* = 8.8 Hz, 2H), 7.37 (d, *J* = 7.9 Hz, 4H), 7.30-7.20 (m, 6H), 6.86 (d, *J* = 8.9 Hz, 2H), 4.12 (s, 1H), 3.85 (s, 3H); ^{13}C{^{1}H}NMR (100 MHz, $CDCl_3$) δ: 195.6 , 163.0 , 143.7 , 131.5 , 130.7 , 127.5 , 127.4 , 127.0 , 113.2 , 86.4 , 79.7 , 55.4; HRMS (ESI-TOF) *m/z*: $C_{22}H_{19}O_2$ $(M + H)^+$ calcd for 315.1380, found 315.1385.

4. References

[1] H.-W. Wang, B.-B. Wang, S. Sun, J. Cheng, *Org. Chem. Front.*, **2018**, 5, 2547-2551.

5. X-Ray Crystallographic Data

A single crystal of **3ag** suitable for X-ray crystallography was obtained by crystallization via evaporation from its PE/DCM solution.

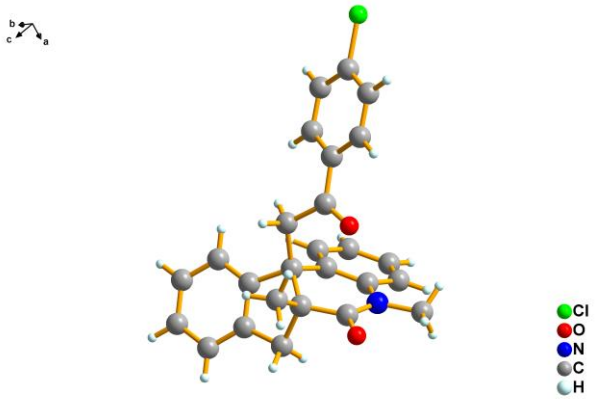


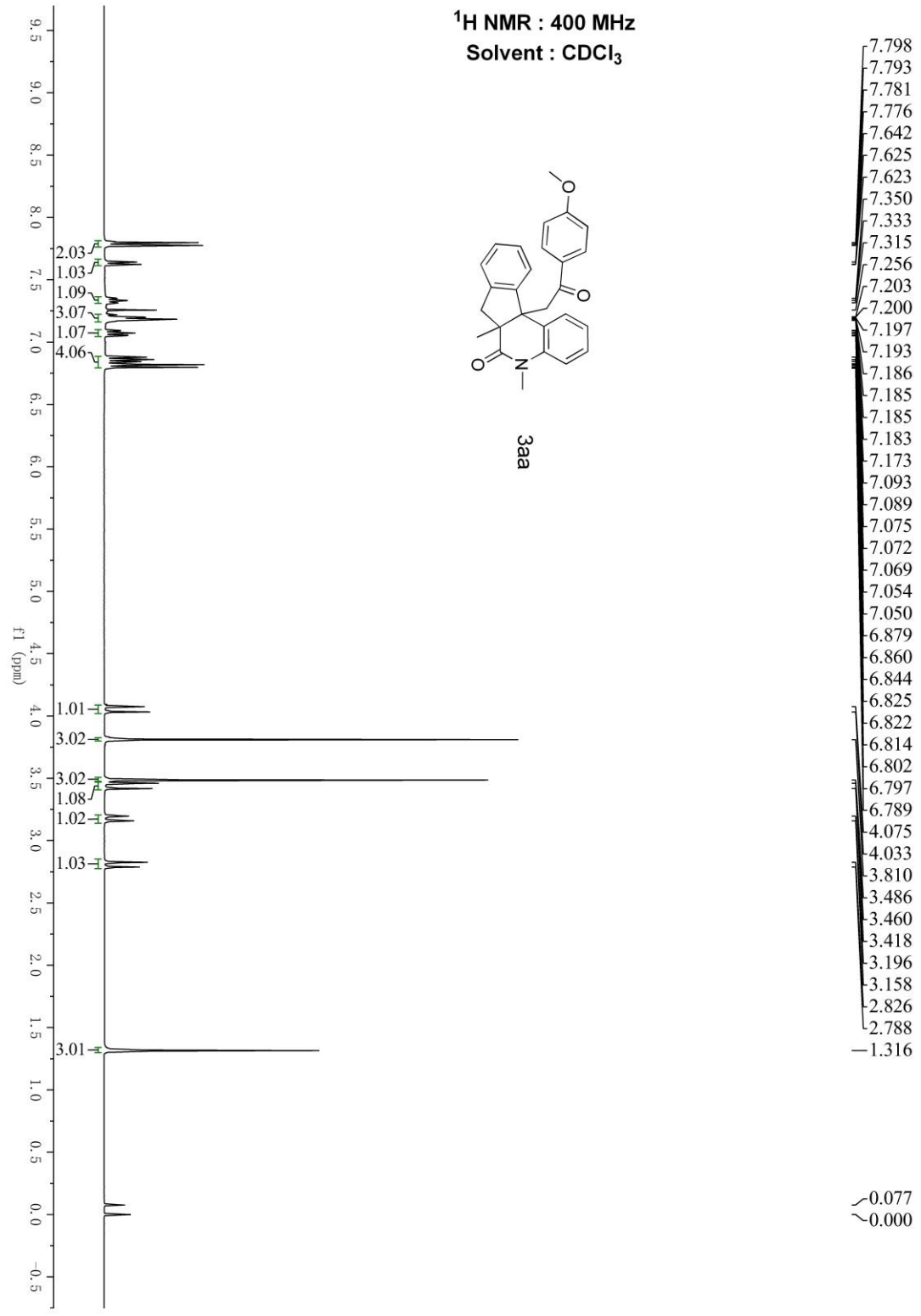
Figure S3. X-Ray crystallographic data of **3ag**. Thermal ellipsoids are shown at the 30% level.

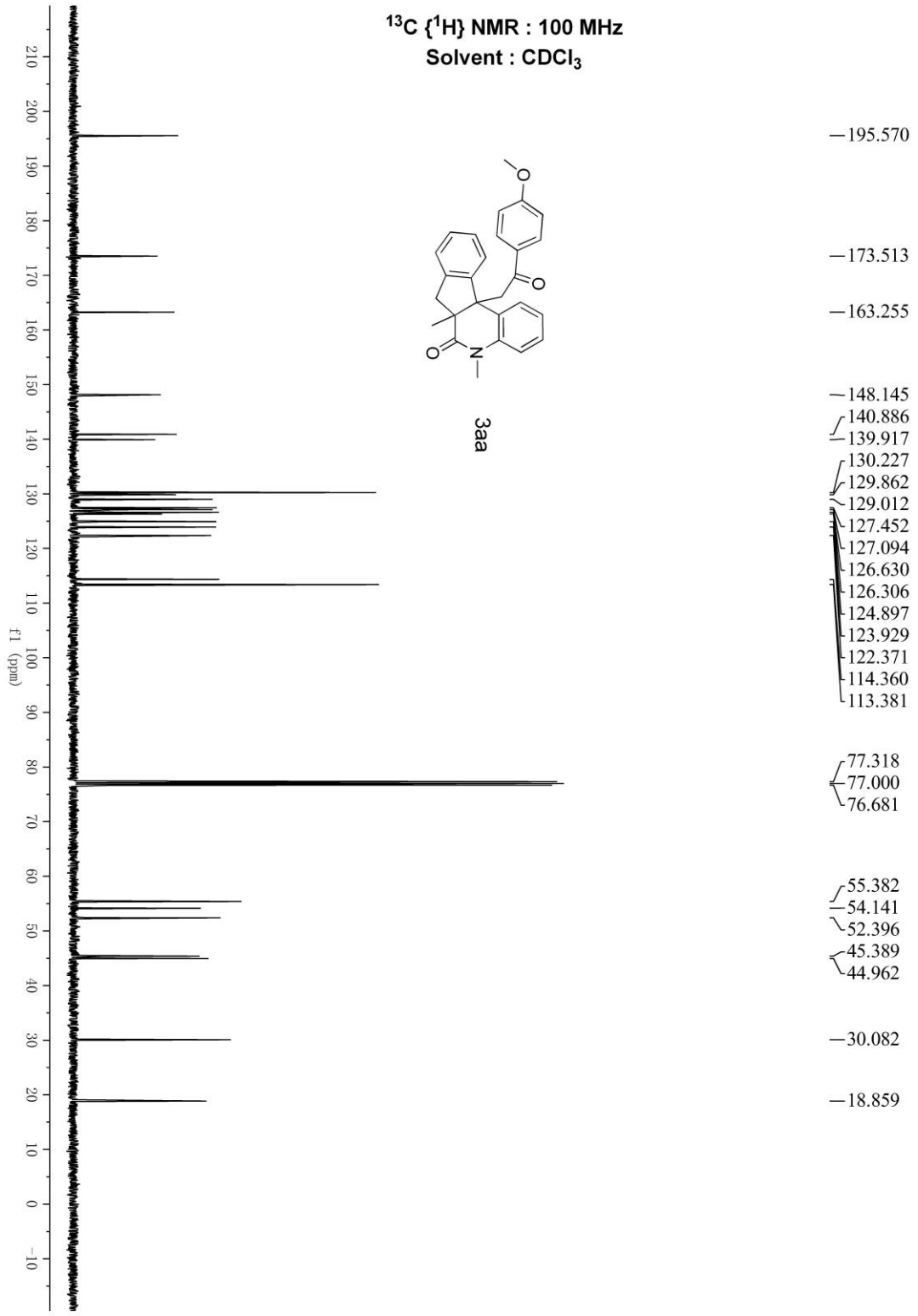
Table S2. Crystal data and structure refinement for **3ag**

Bond precision:	C-C = 0.0018 A	Wavelength=1.54184	
Cell:	a=7.7575(2)	b=11.8553(3)	c=12.4714(3)
	alpha=68.379(2)	beta=88.015(2)	gamma=75.886(2)
Temperature:	100 K		
	Calculated	Reported	
Volume	1032.14(5)	1032.13(5)	
Space group	P -1	P -1	
Hall group	-P 1	-P 1	
Moiety formula	$C_{26}H_{22}ClNO_2$	$C_{26}H_{22}ClNO_2$	
Sum formula	$C_{26}H_{22}ClNO_2$	$C_{26}H_{22}ClNO_2$	
Mr	415.90	423.97	
Dx,g cm^{-3}	1.338	1.364	
Z	2	2	
Mu (mm^{-1})	1.816	1.795	
F000	436.0	450.0	
F000’	437.88		
h,k,lmax	9,14,15	9,14,15	
Nref	4336	4123	
Tmin,Tmax	0.760,0.764	0.755,1.000	
Tmin’	0.026		
Correction method= # Reported T		Limits: Tmin=0.755	Tmax=1.000
AbsCorr = MULTI-SCAN			
Data completeness= 0.951		Theta(max)= 76.310	
R(reflections)= 0.0315(3990)		wR2(reflections) = 0.0807(4123)	
S = 1.040		Npar= 274	

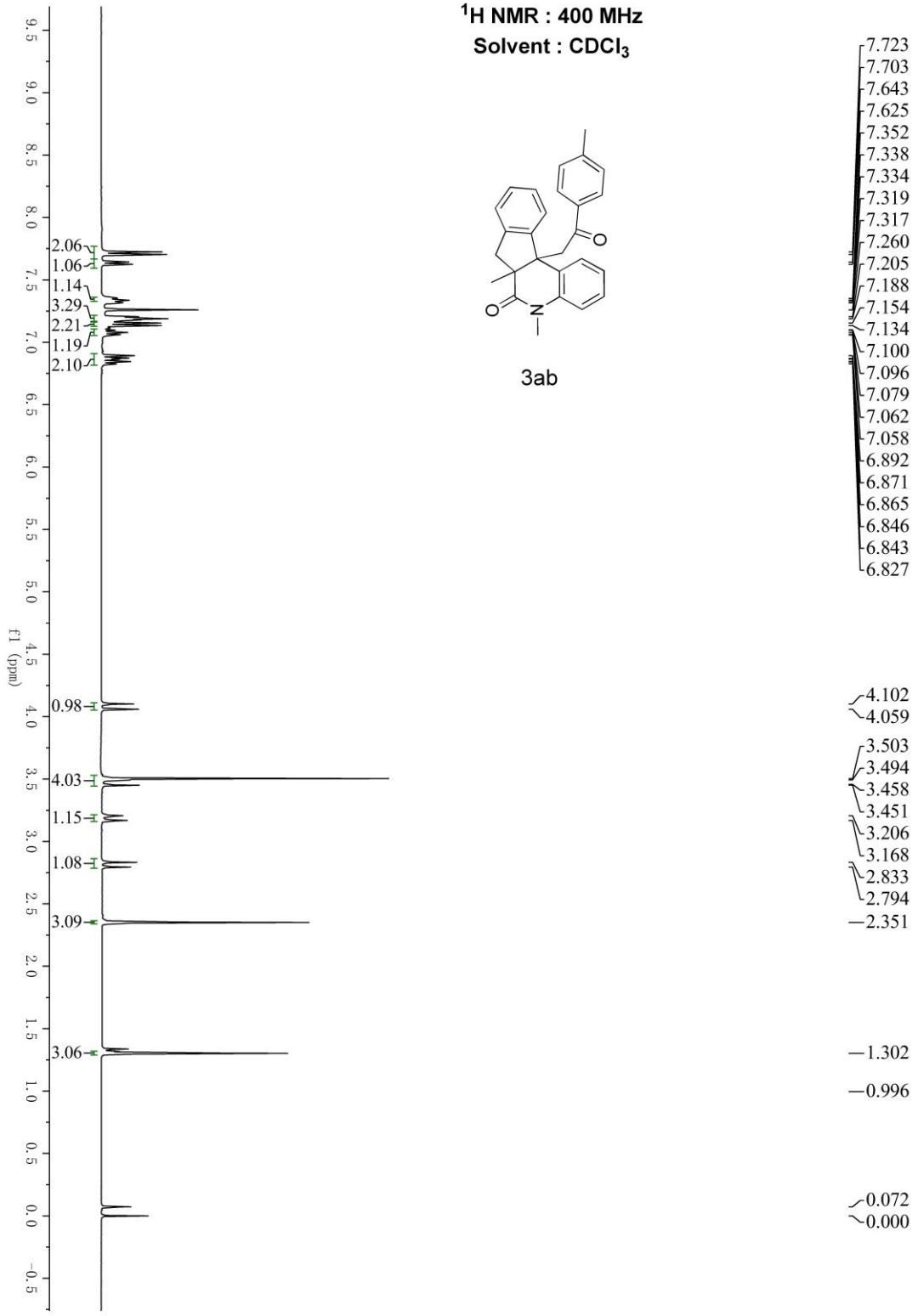
7. Copies of NMR Spectra

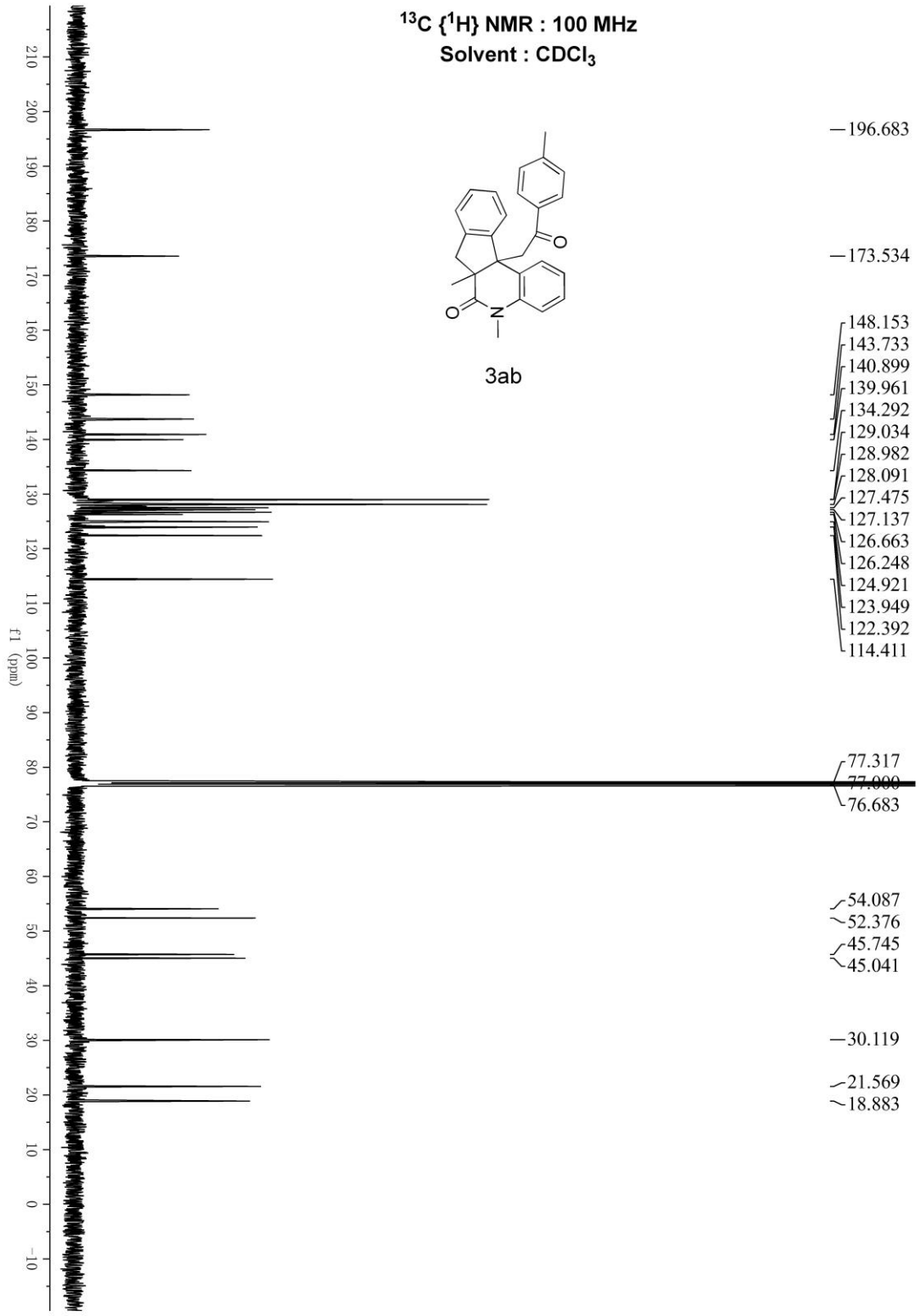
11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3aa)



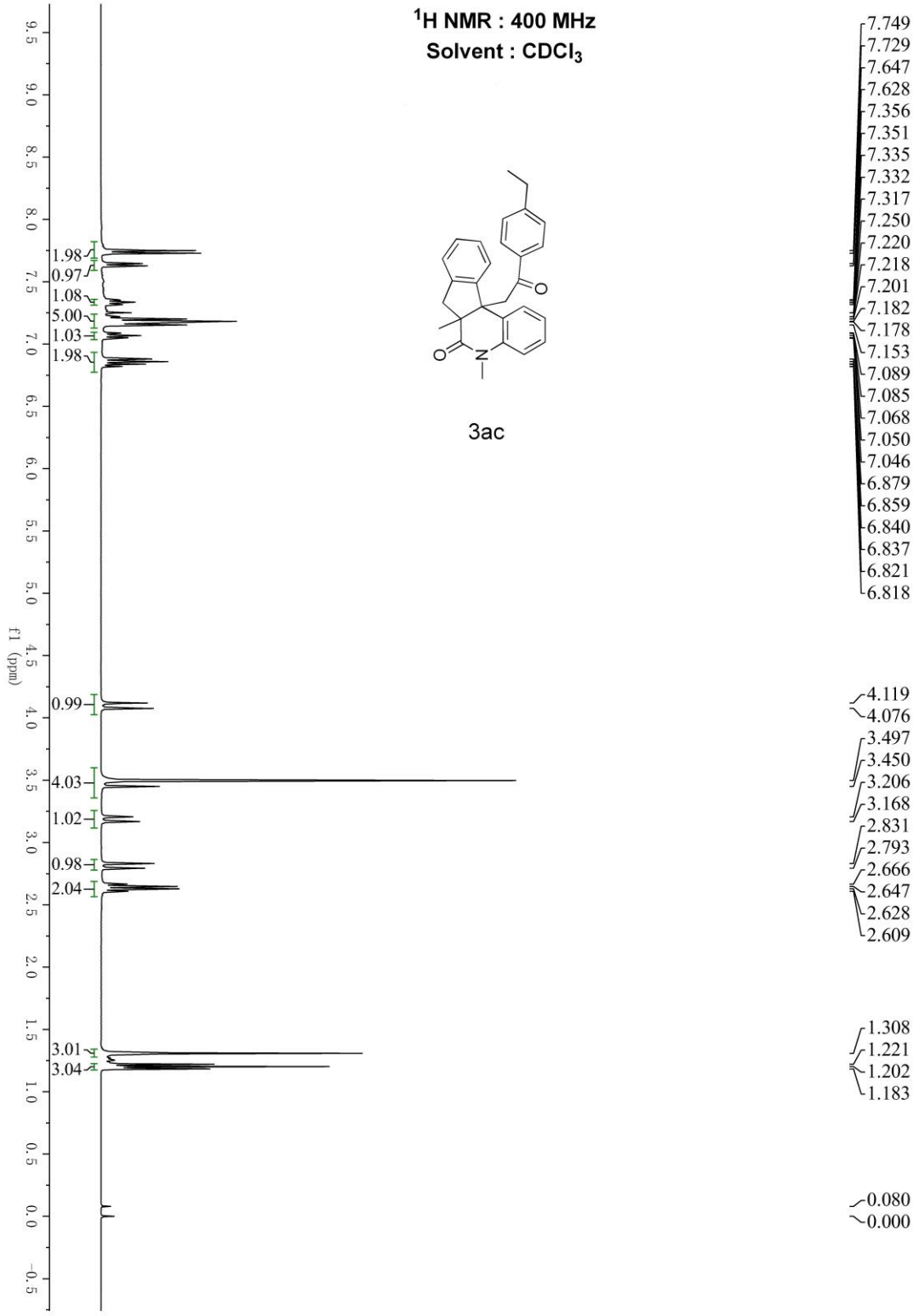

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3aa
f1 (ppm)
195.570
173.513
163.255
148.145
140.886
139.917
130.227
129.862
129.012
127.452
127.094
126.630
126.306
124.897
123.929
122.371
114.360
113.381
77.318
77.000
76.681
55.382
54.141
52.396
45.389
44.962
30.082
18.859

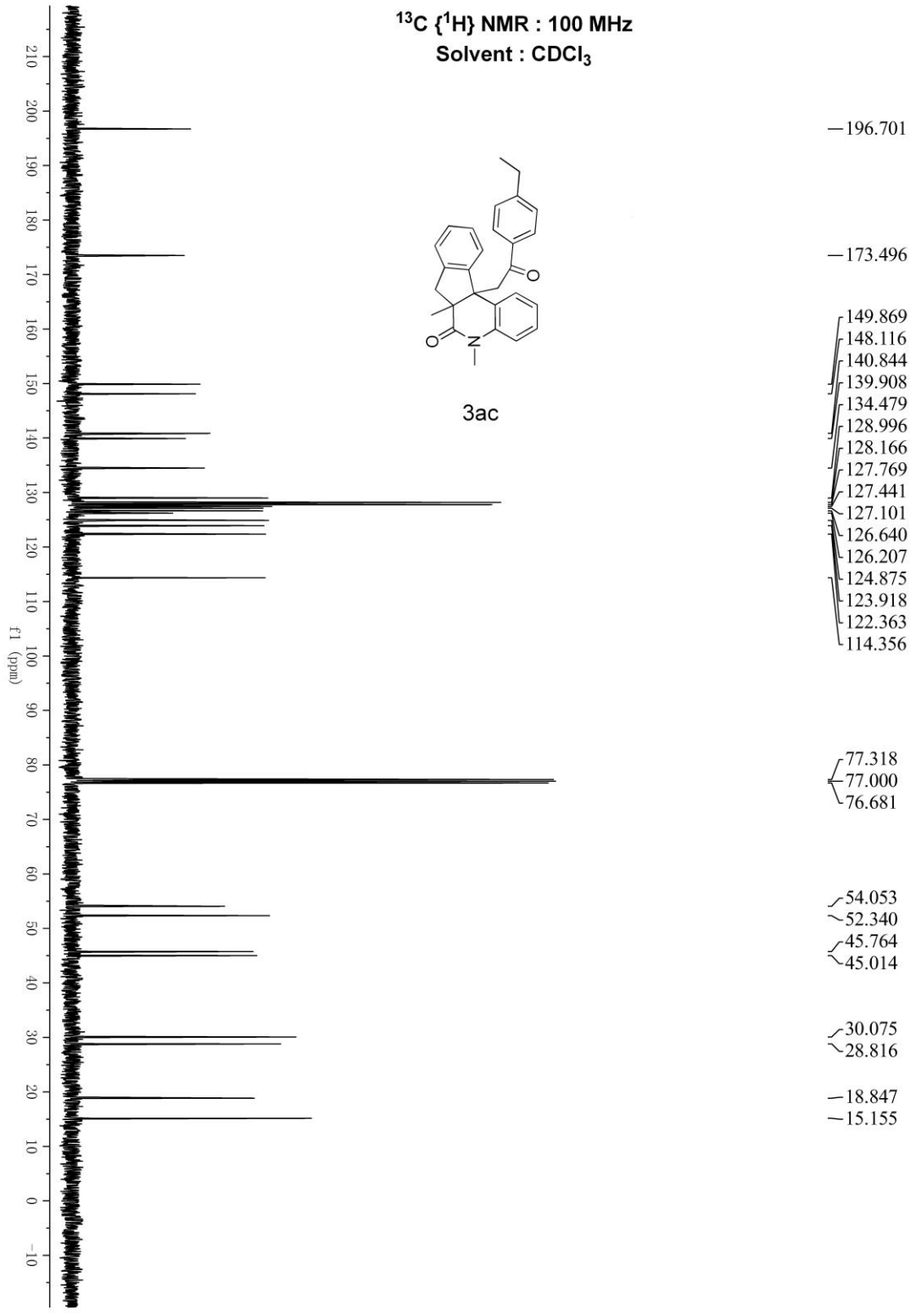
5,6a-dimethyl-11b-(2-oxo-2-(p-tolyl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ab)



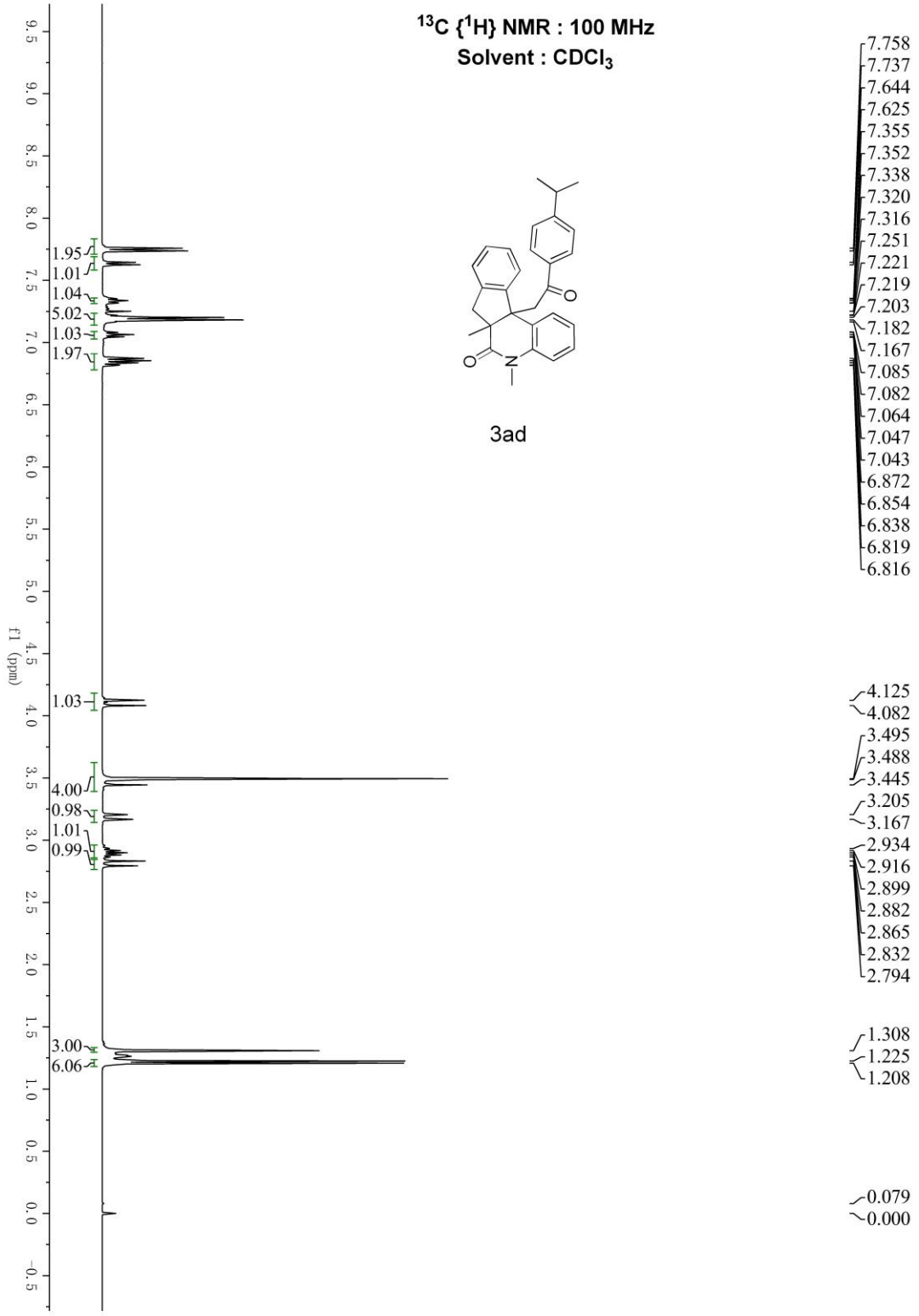

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ab
196.683
173.534
148.153
143.733
140.899
139.961
134.292
129.034
128.982
128.091
127.475
127.137
126.663
126.248
124.921
123.949
122.392
114.411
77.317
77.000
76.683
54.087
52.376
45.745
45.041
30.119
21.569
18.883
f1 (ppm)

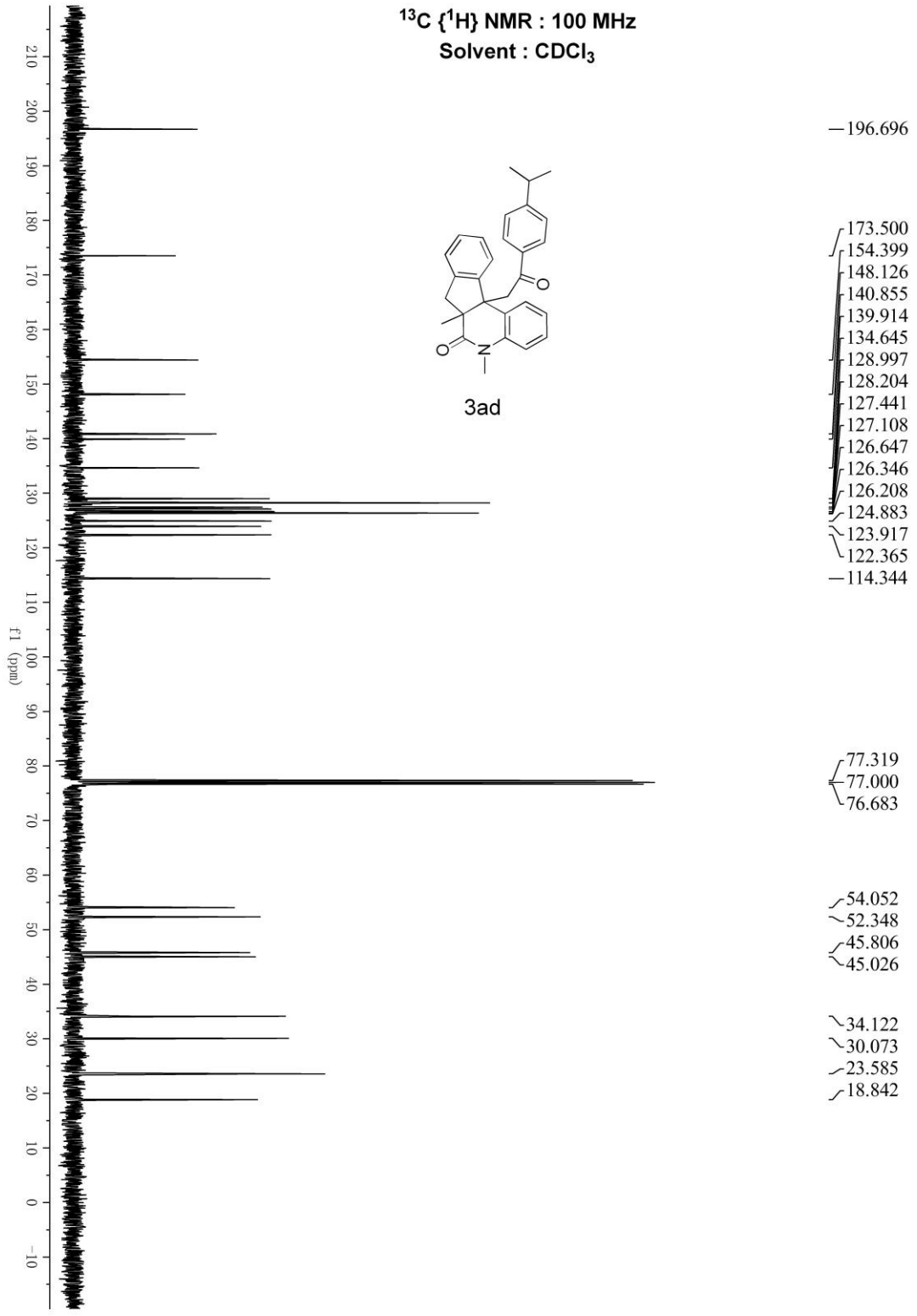
11b-(2-(4-ethylphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ac)



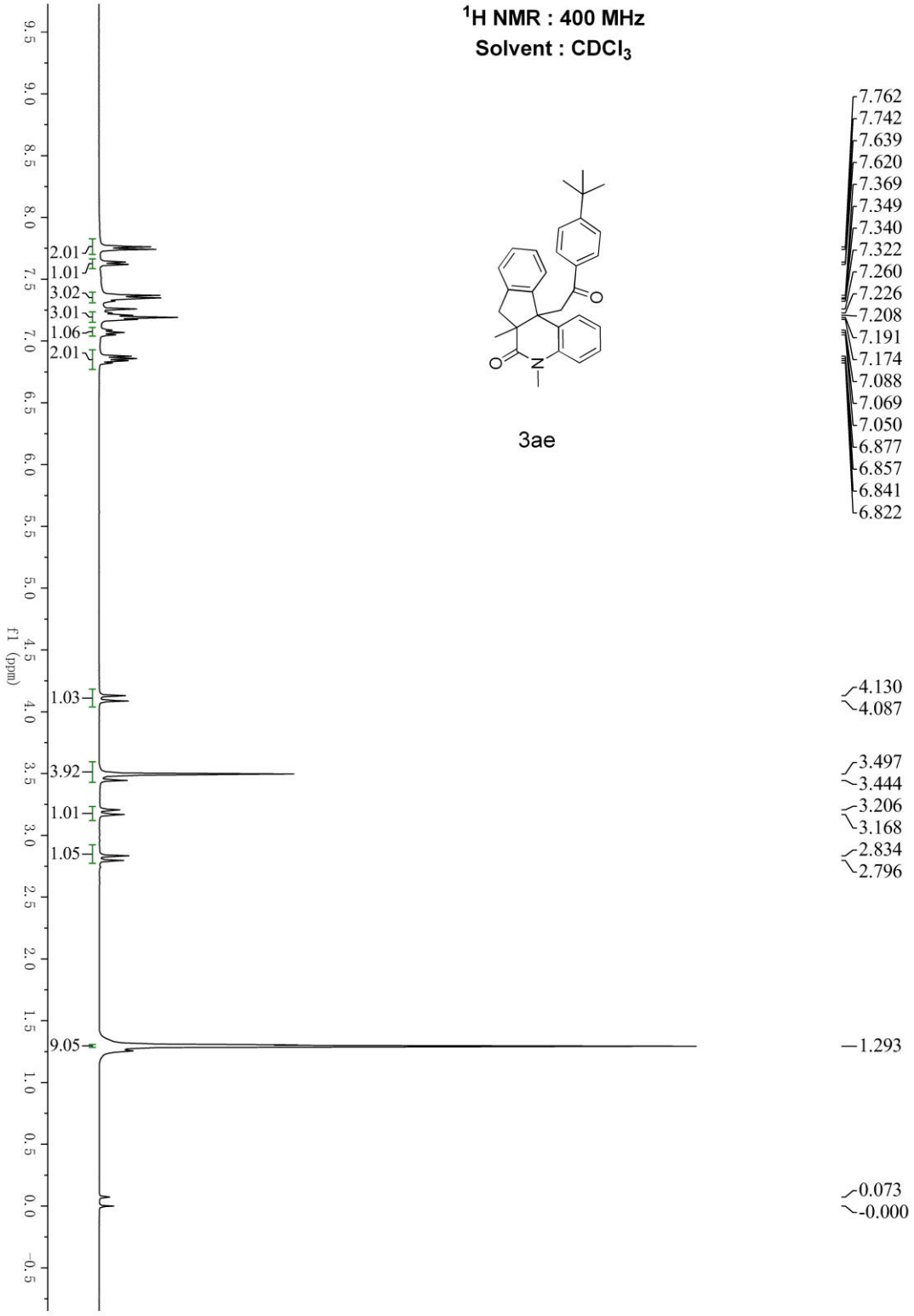

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3ac
f1 (ppm)
196.701
173.496
149.869
148.116
140.844
139.908
134.479
128.996
128.166
127.769
127.441
127.101
126.640
126.207
124.875
123.918
122.363
114.356
77.318
77.000
76.681
54.053
52.340
45.764
45.014
30.075
28.816
18.847
15.155

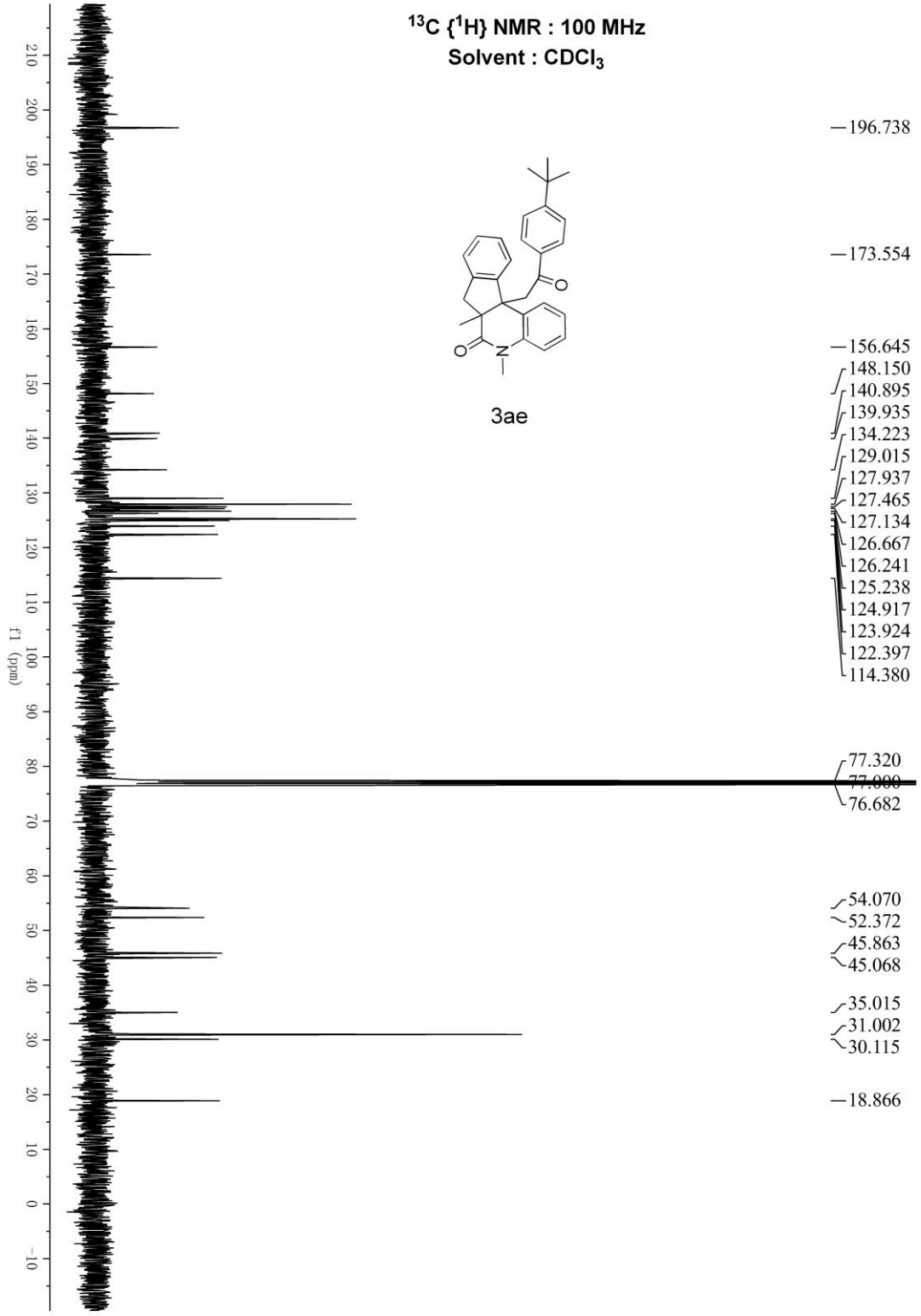
11b-(2-(4-isopropylphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ad)



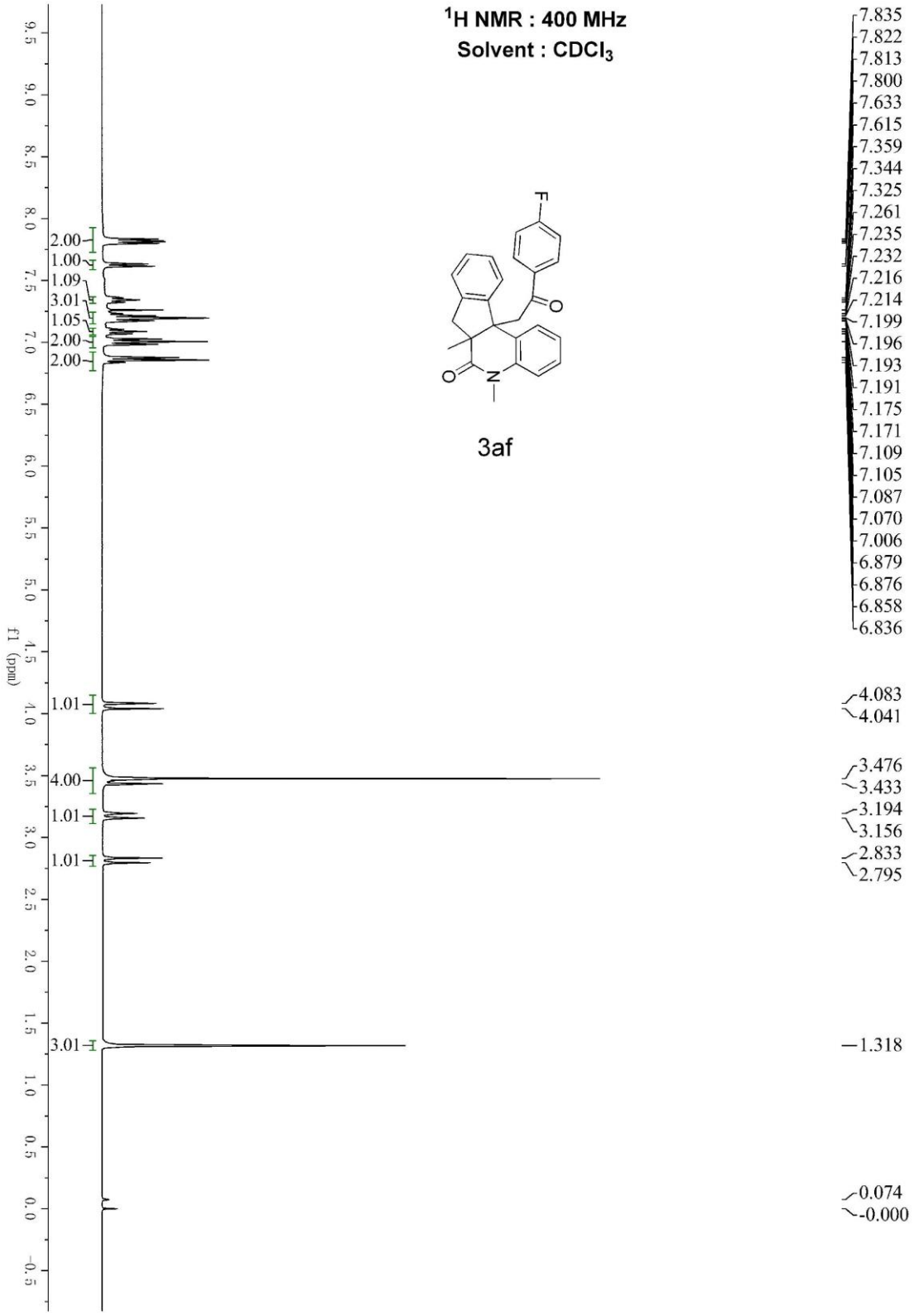

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3ad
196.696
173.500
154.399
148.126
140.855
139.914
134.645
128.997
128.204
127.441
127.108
126.647
126.346
126.208
124.883
123.917
122.365
114.344
77.319
77.000
76.683
54.052
52.348
45.806
45.026
34.122
30.073
23.585
18.842
f1 (ppm)

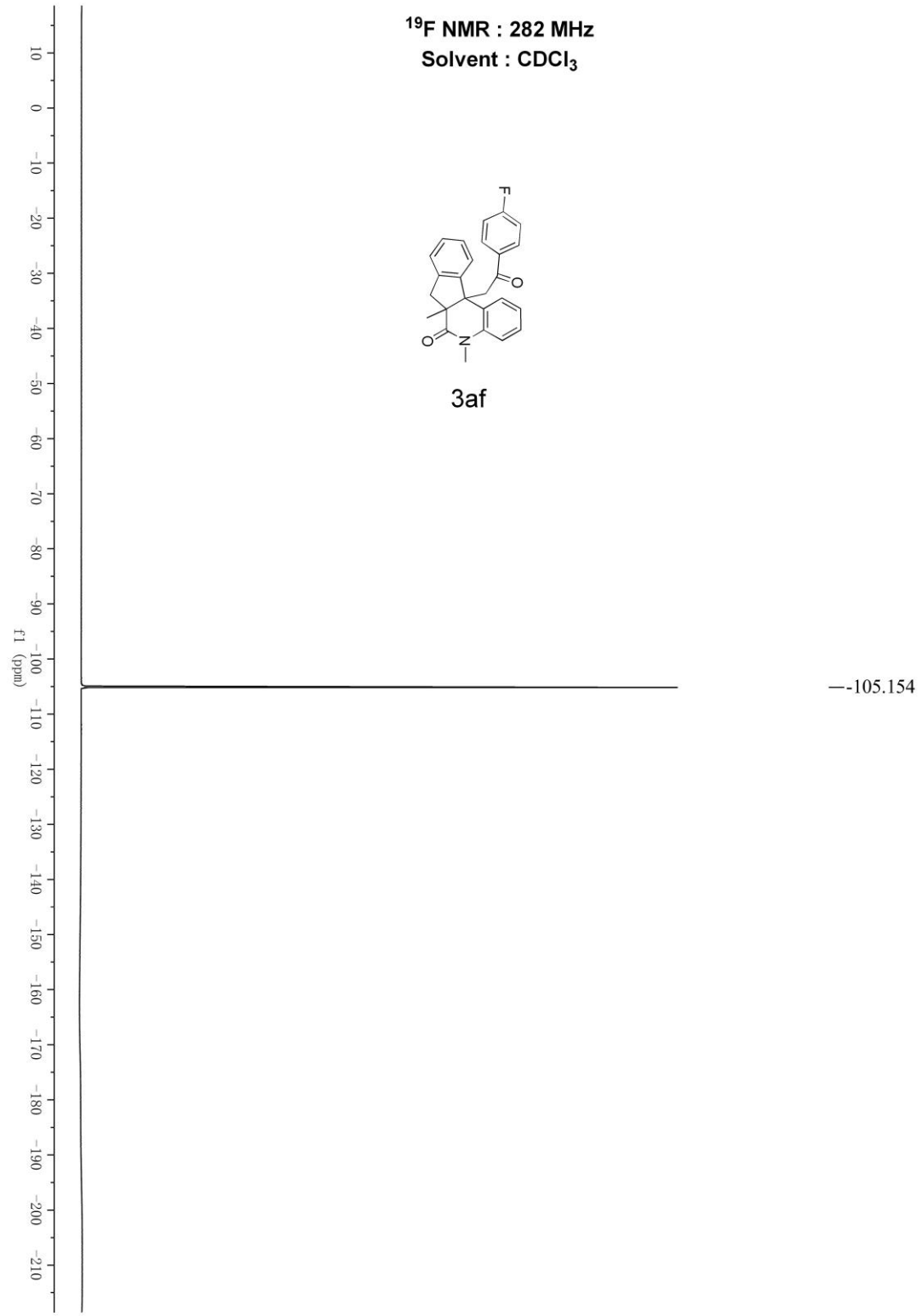
11b-(2-(4-(tert-butyl)phenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ae)

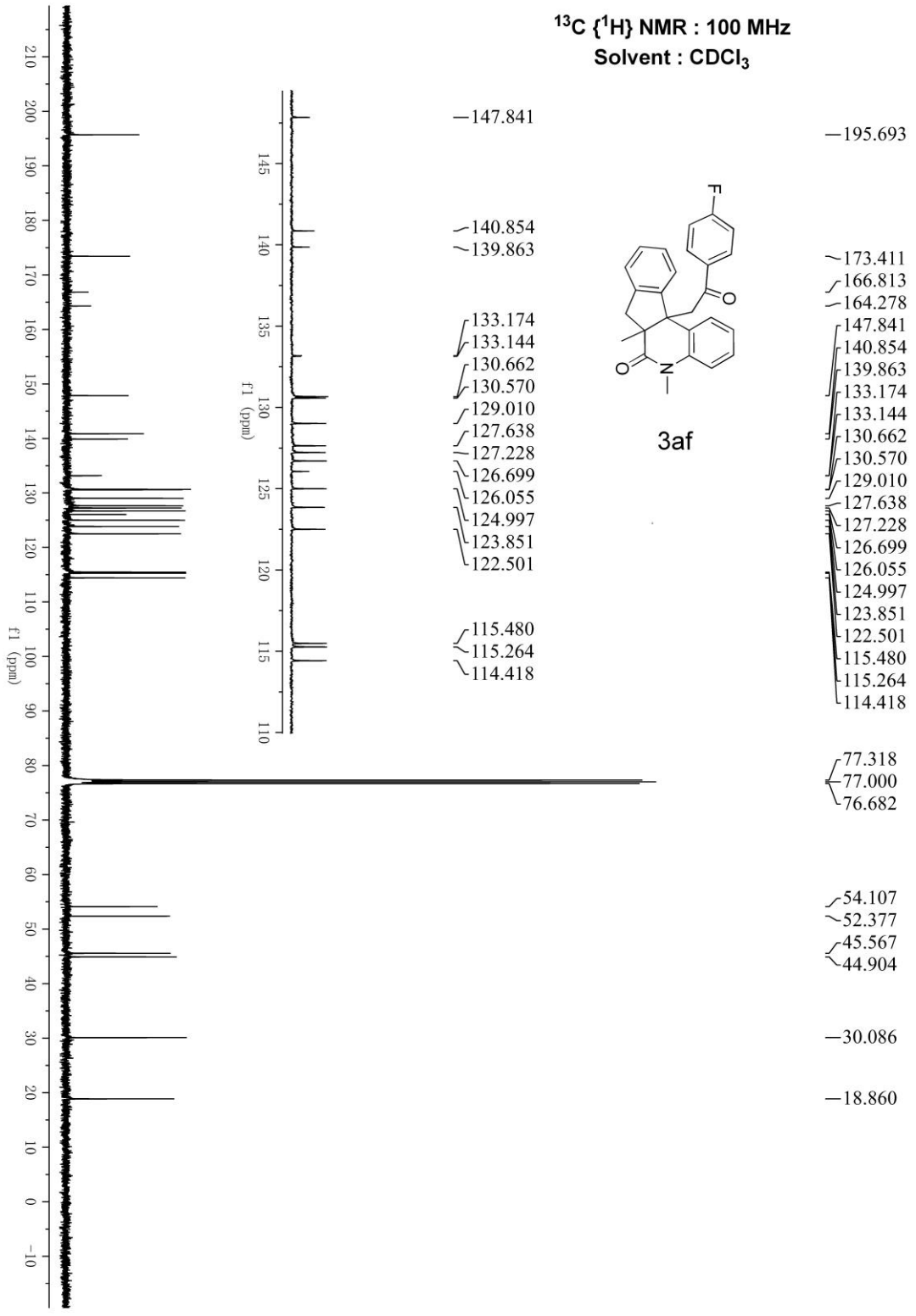



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ae
196.738
173.554
156.645
148.150
140.895
139.935
134.223
129.015
127.937
127.465
127.134
126.667
126.241
125.238
124.917
123.924
122.397
114.380
77.320
77.000
76.682
54.070
52.372
45.863
45.068
35.015
31.002
30.115
18.866
f1 (ppm)

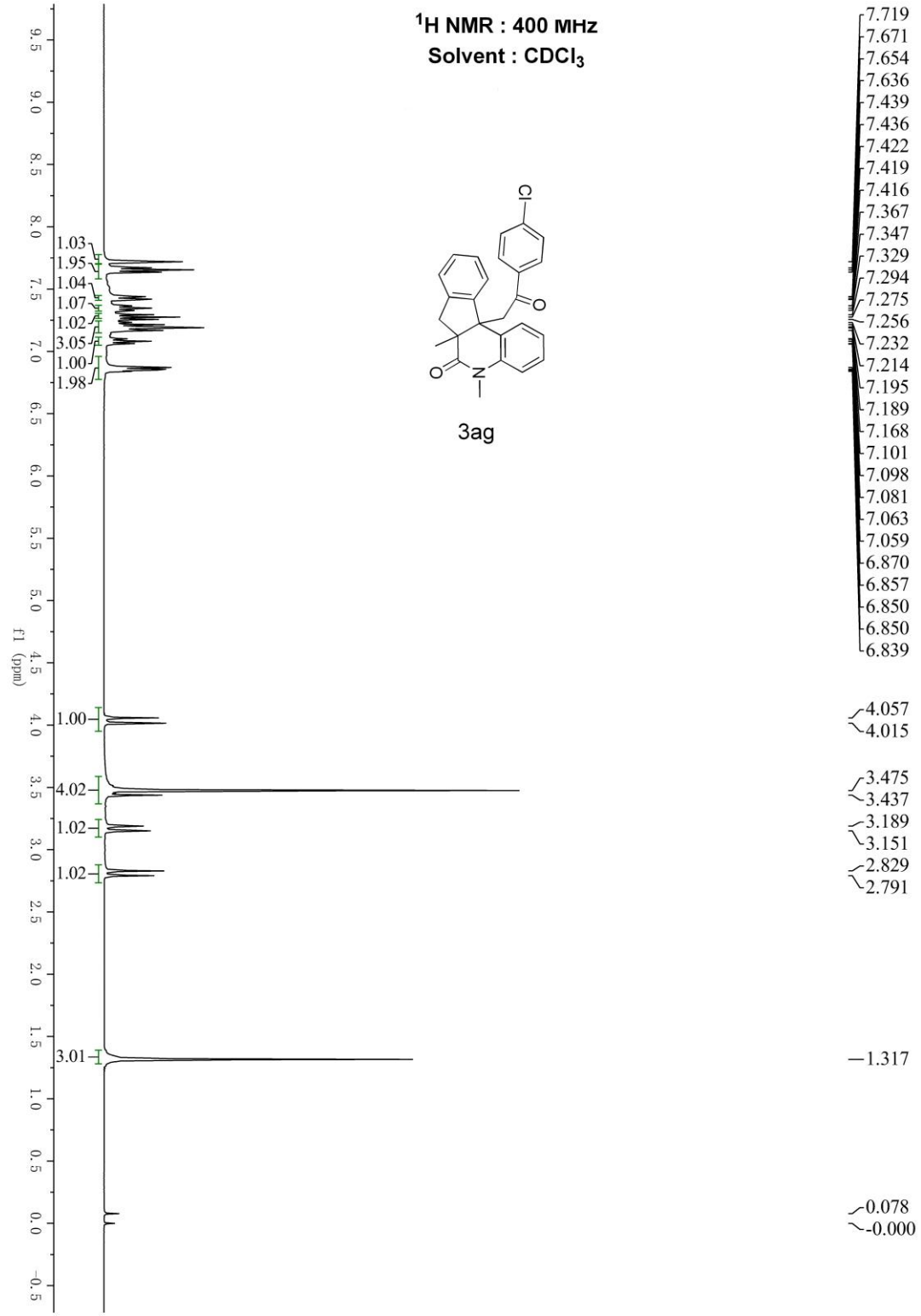
11b-(2-(4-fluorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3af)

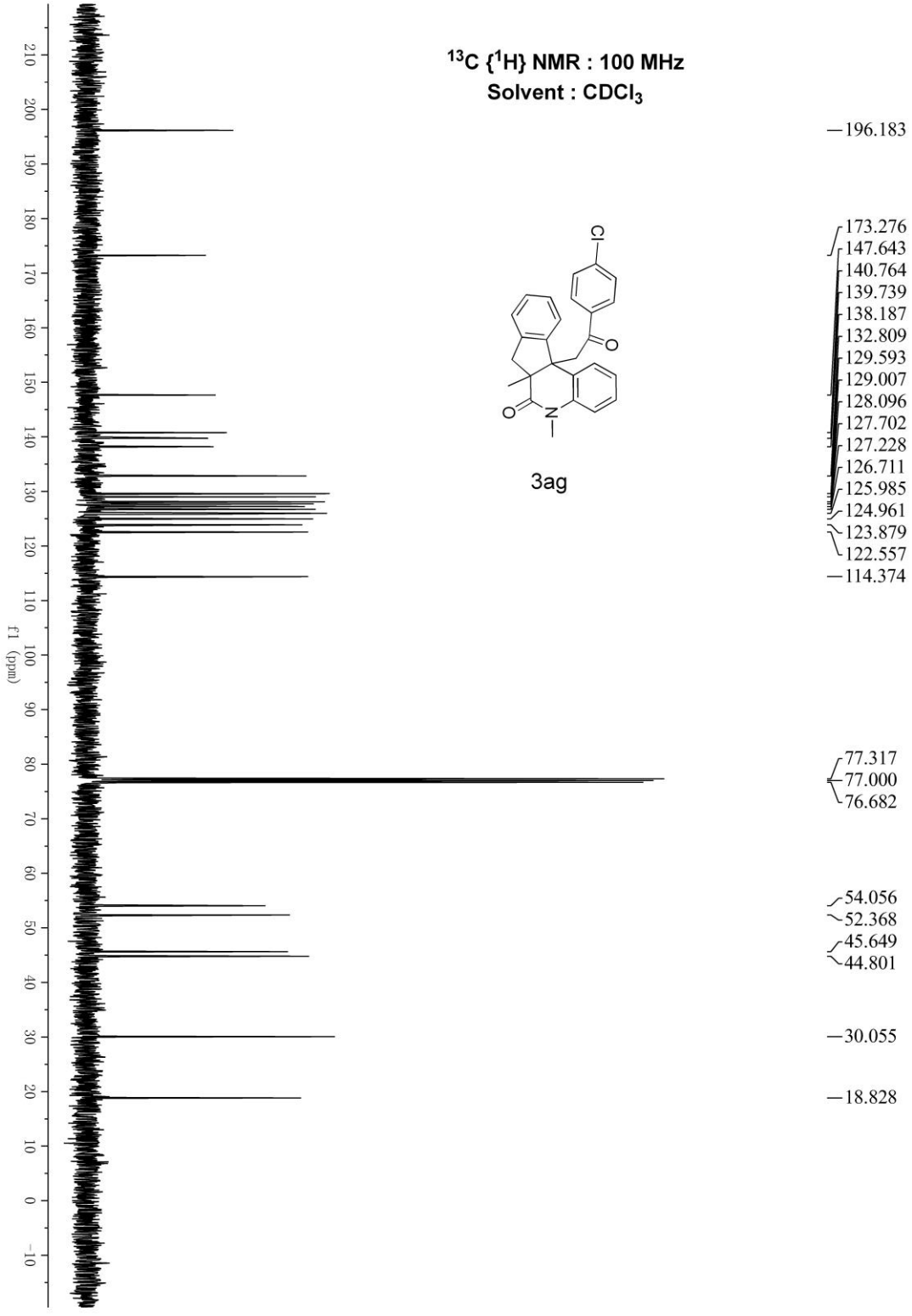



19F NMR : 282 MHz
Solvent : CDCl3
F
O
O
N
3af
—-105.154
f1 (ppm)
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
−210

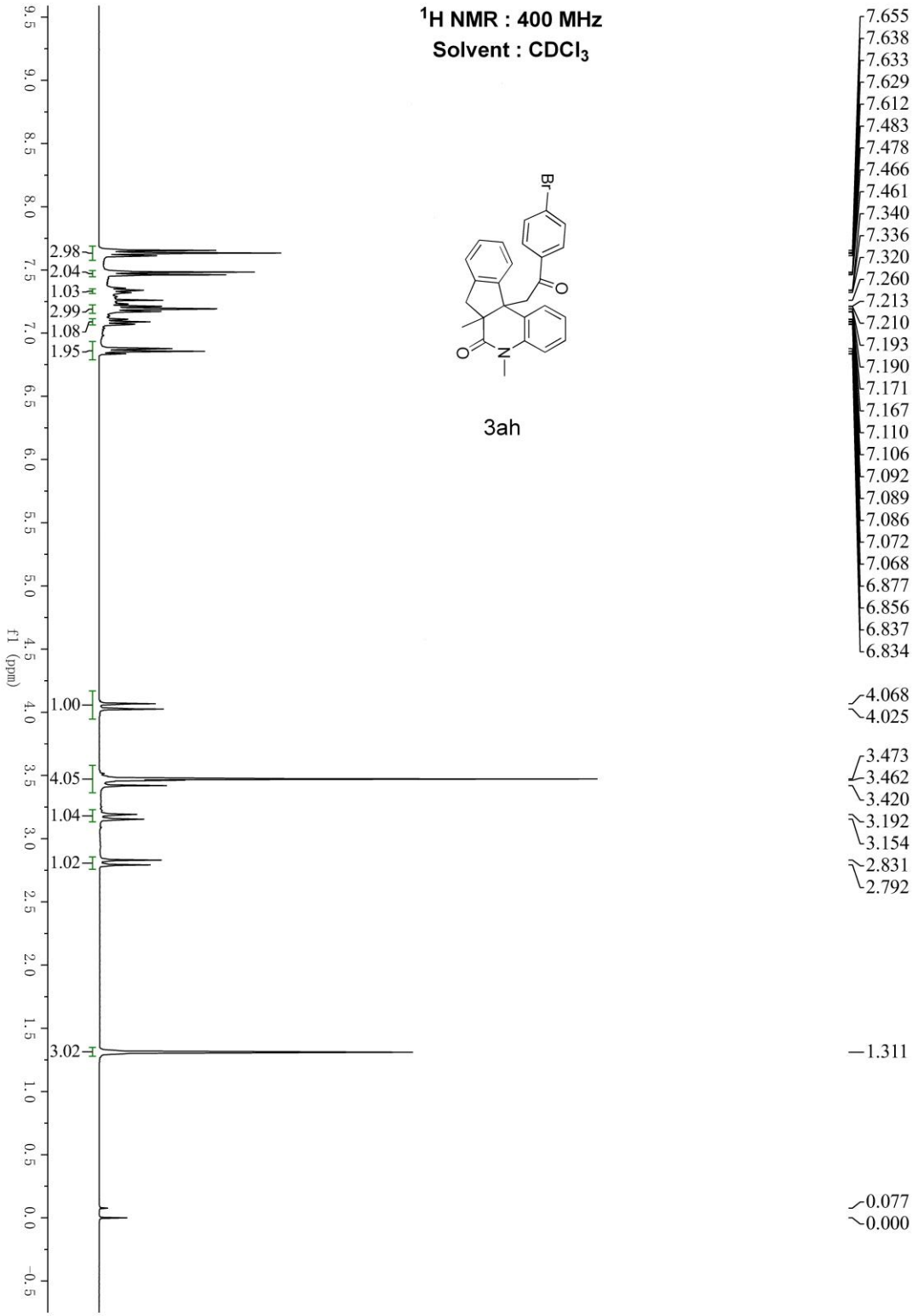

^{13}C {^{1}H} NMR : 100 MHz
Solvent : CDCl$_3$
147.841
140.854
139.863
133.174
133.144
130.662
130.570
129.010
127.638
127.228
126.699
126.055
124.997
123.851
122.501
115.480
115.264
114.418
195.693
173.411
166.813
164.278
147.841
140.854
139.863
133.174
133.144
130.662
130.570
129.010
127.638
127.228
126.699
126.055
124.997
123.851
122.501
115.480
115.264
114.418
77.318
77.000
76.682
54.107
52.377
45.567
44.904
30.086
18.860
3af
f1 (ppm)

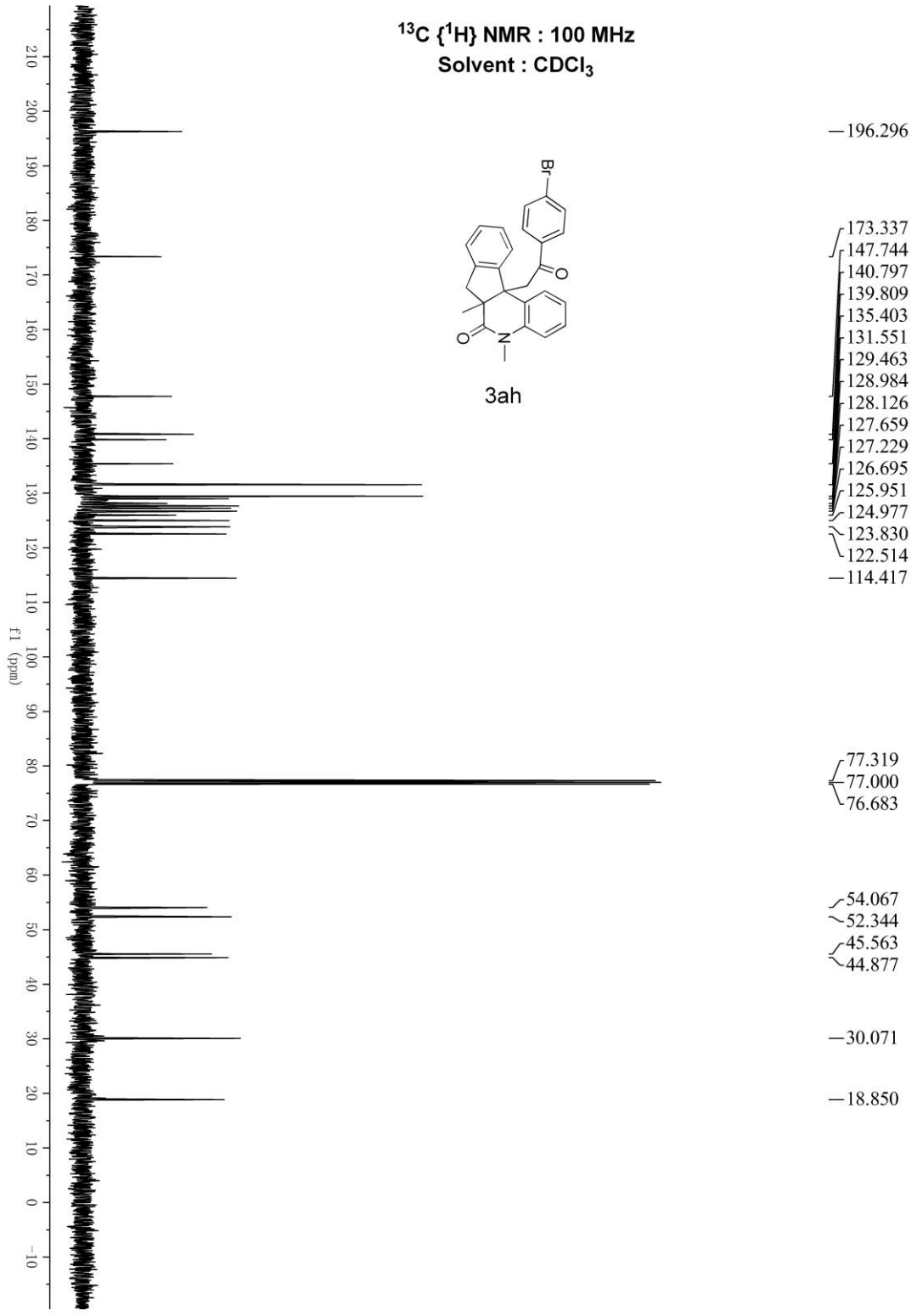
11b-(2-(4-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ag)



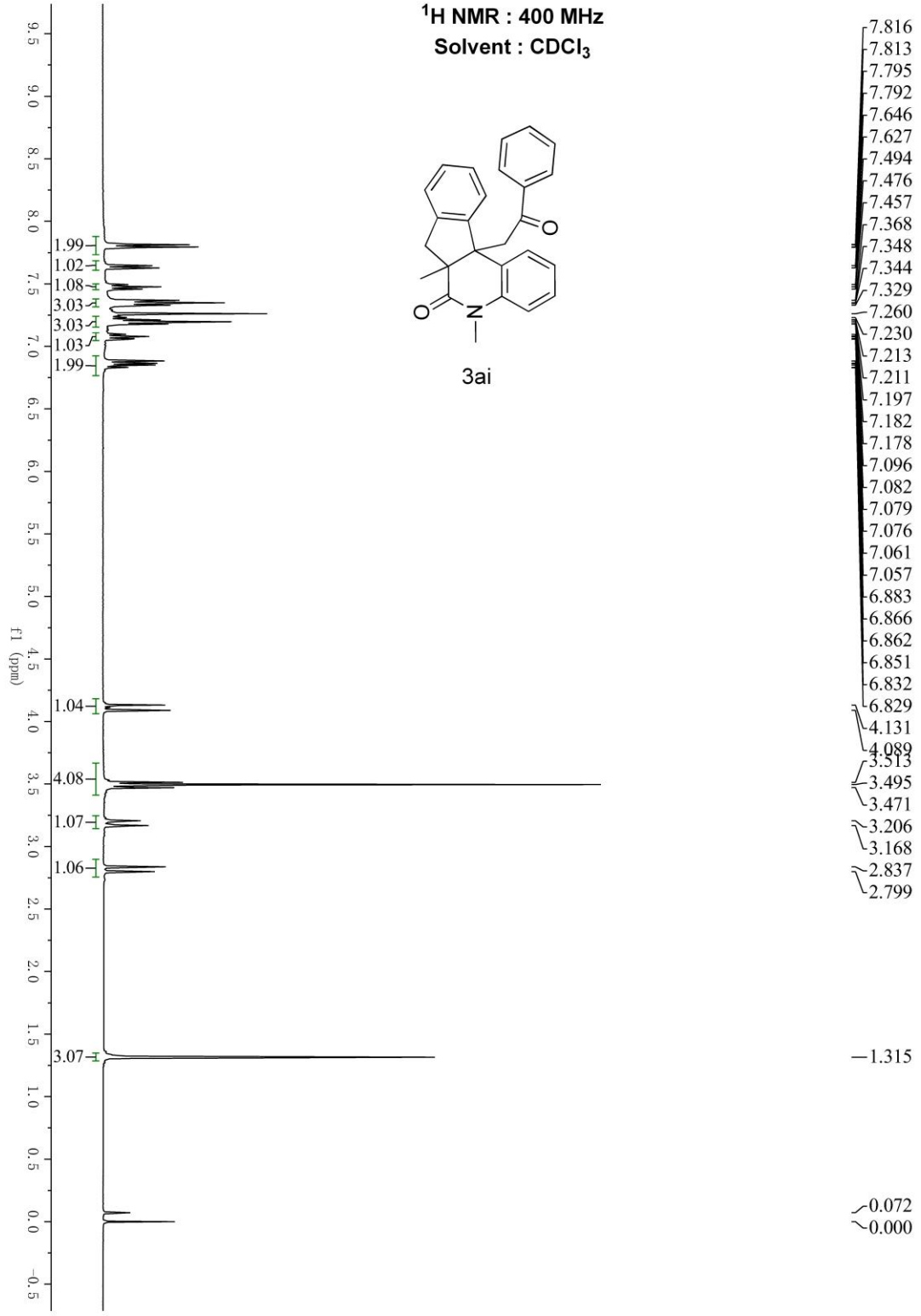

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ag
196.183
173.276
147.643
140.764
139.739
138.187
132.809
129.593
129.007
128.096
127.702
127.228
126.711
125.985
124.961
123.879
122.557
114.374
77.317
77.000
76.682
54.056
52.368
45.649
44.801
30.055
18.828
f1 (ppm)

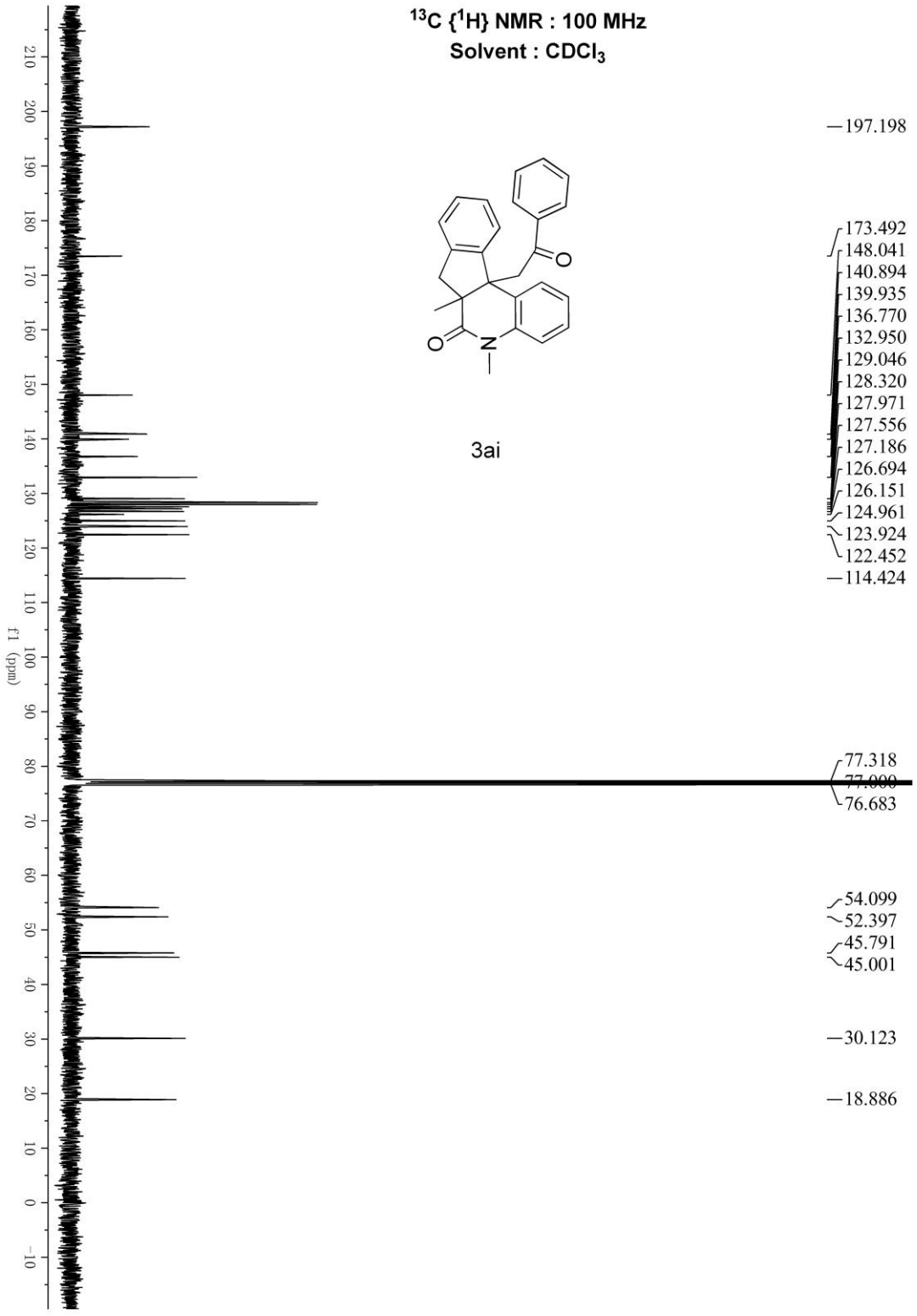
11b-(2-(4-bromophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ah)



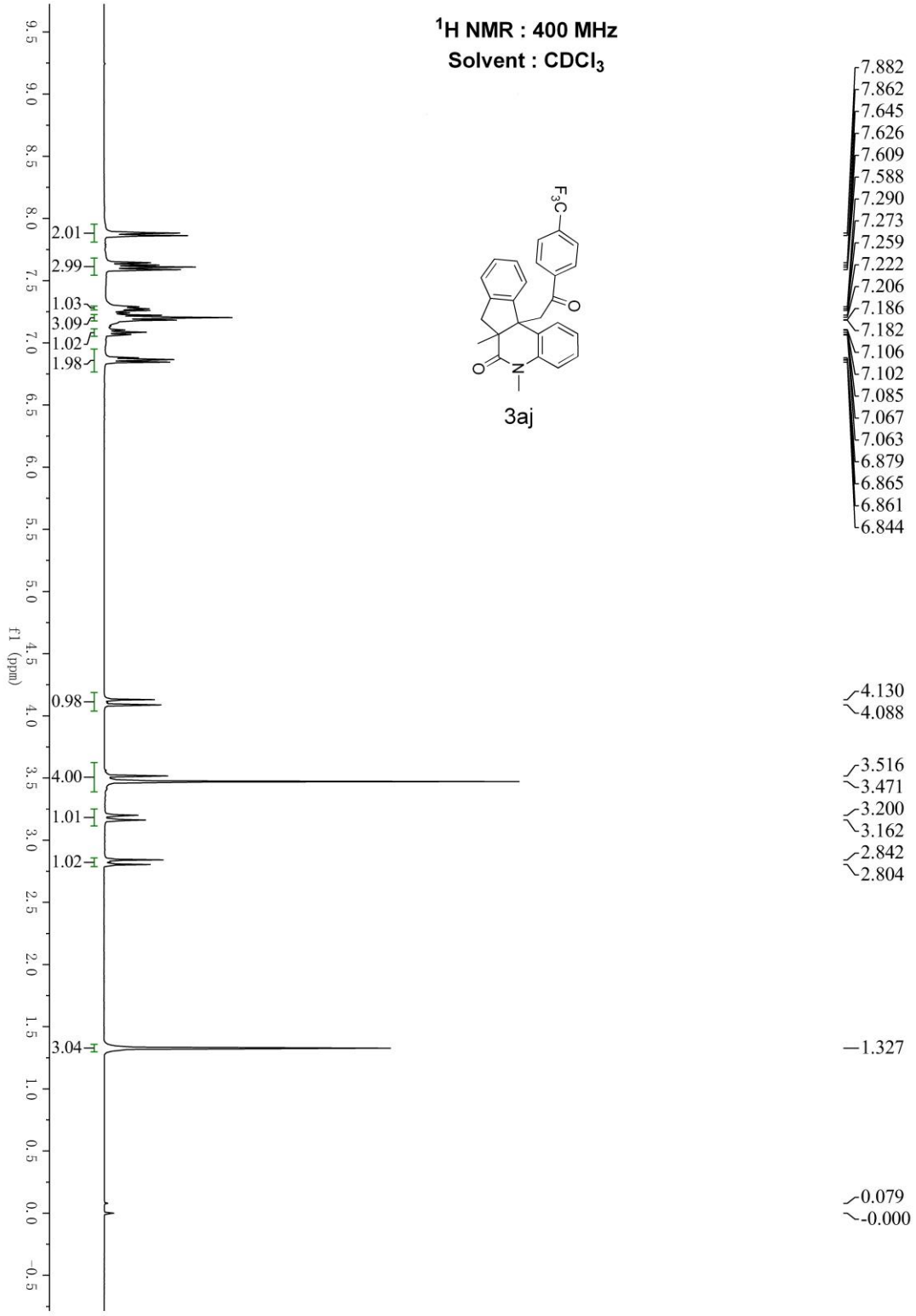

^{13}C {^{1}H} NMR : 100 MHz
Solvent : CDCl$_3$
Br
O
O
N
3ah
f1 (ppm)
196.296
173.337
147.744
140.797
139.809
135.403
131.551
129.463
128.984
128.126
127.659
127.229
126.695
125.951
124.977
123.830
122.514
114.417
77.319
77.000
76.683
54.067
52.344
45.563
44.877
30.071
18.850

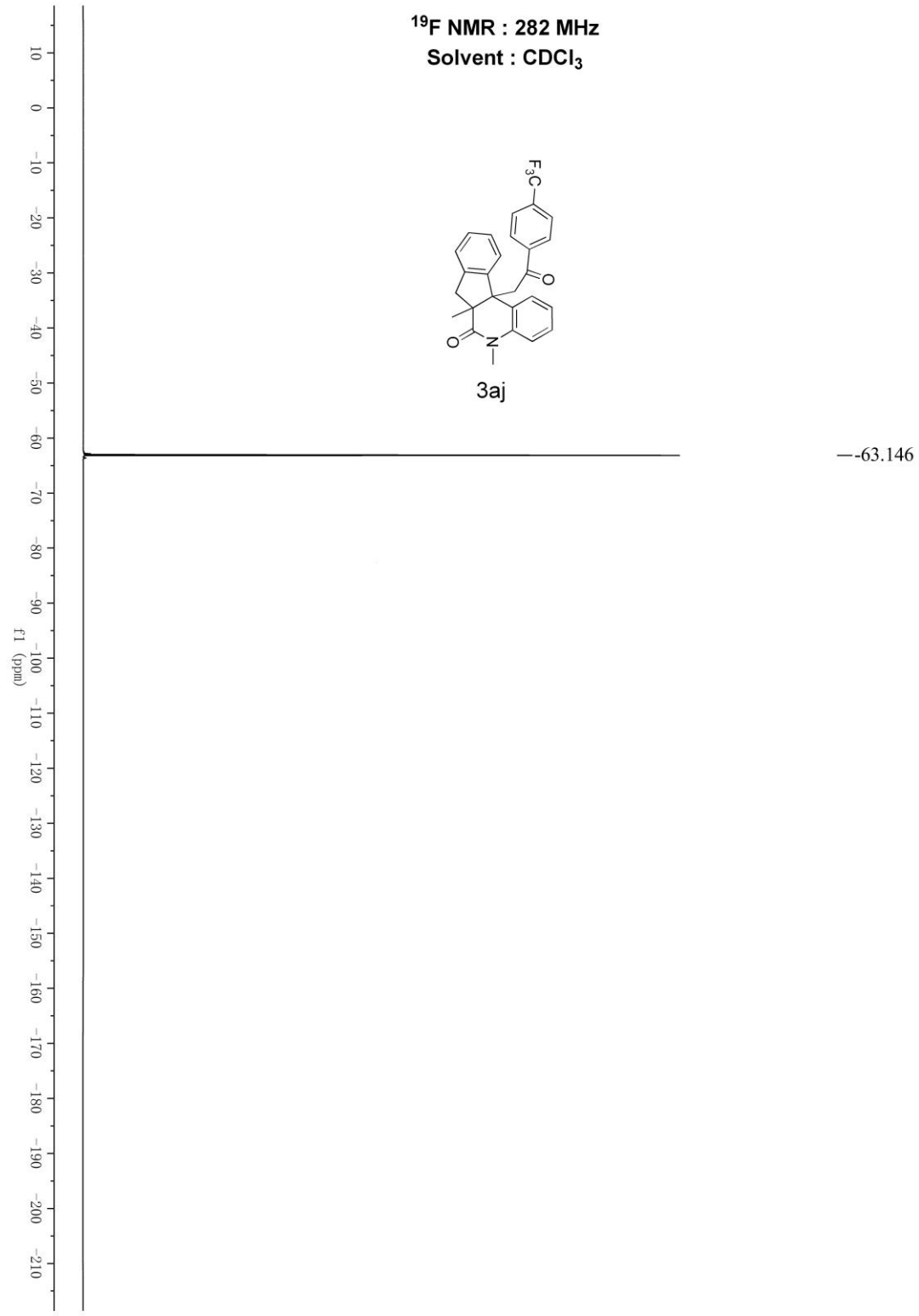
5,6a-dimethyl-11b-(2-oxo-2-phenylethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c] quinolin-6-one (3ai)

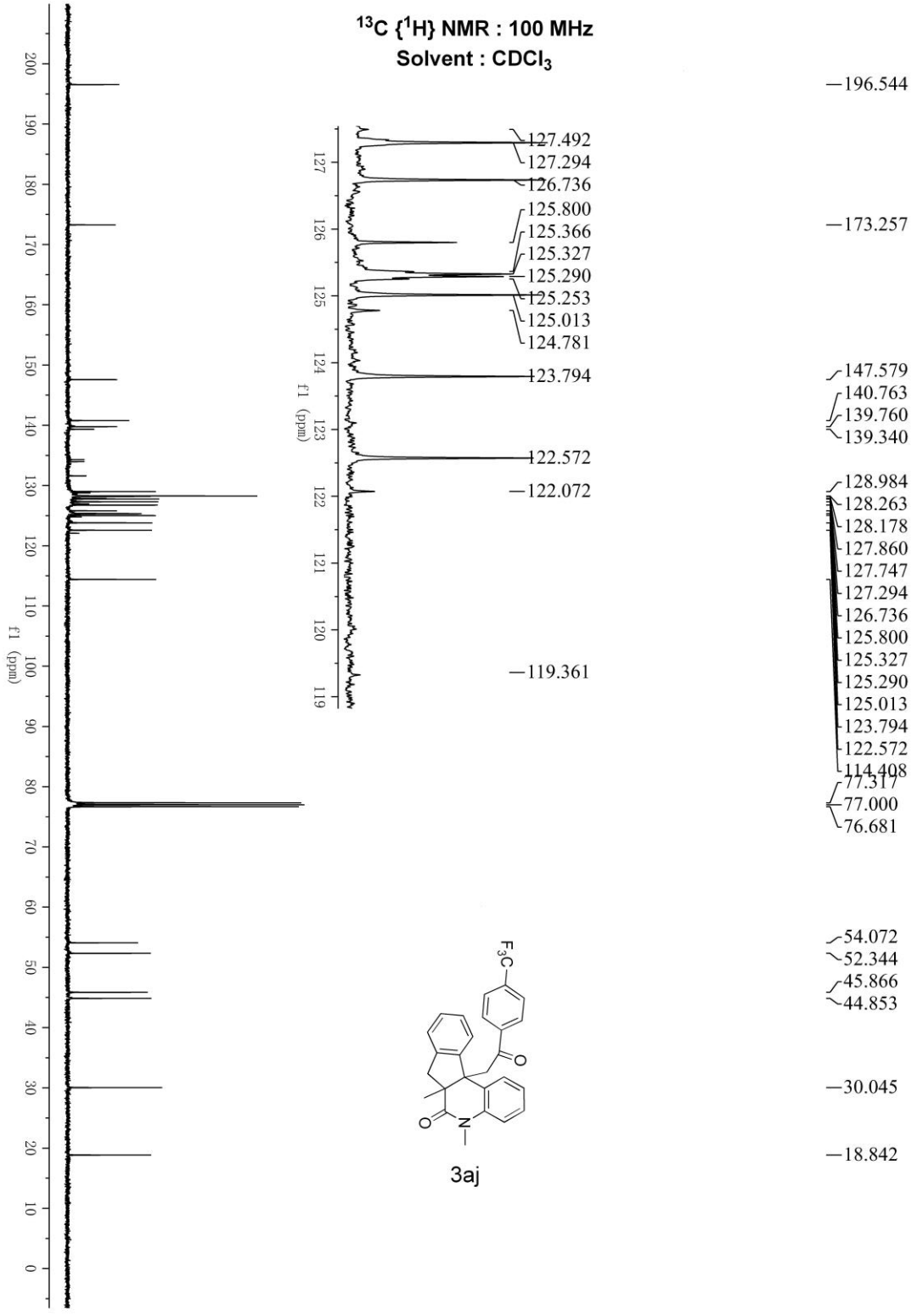



^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ai
197.198
173.492
148.041
140.894
139.935
136.770
132.950
129.046
128.320
127.971
127.556
127.186
126.694
126.151
124.961
123.924
122.452
114.424
77.318
77.000
76.683
54.099
52.397
45.791
45.001
30.123
18.886
f1 (ppm)

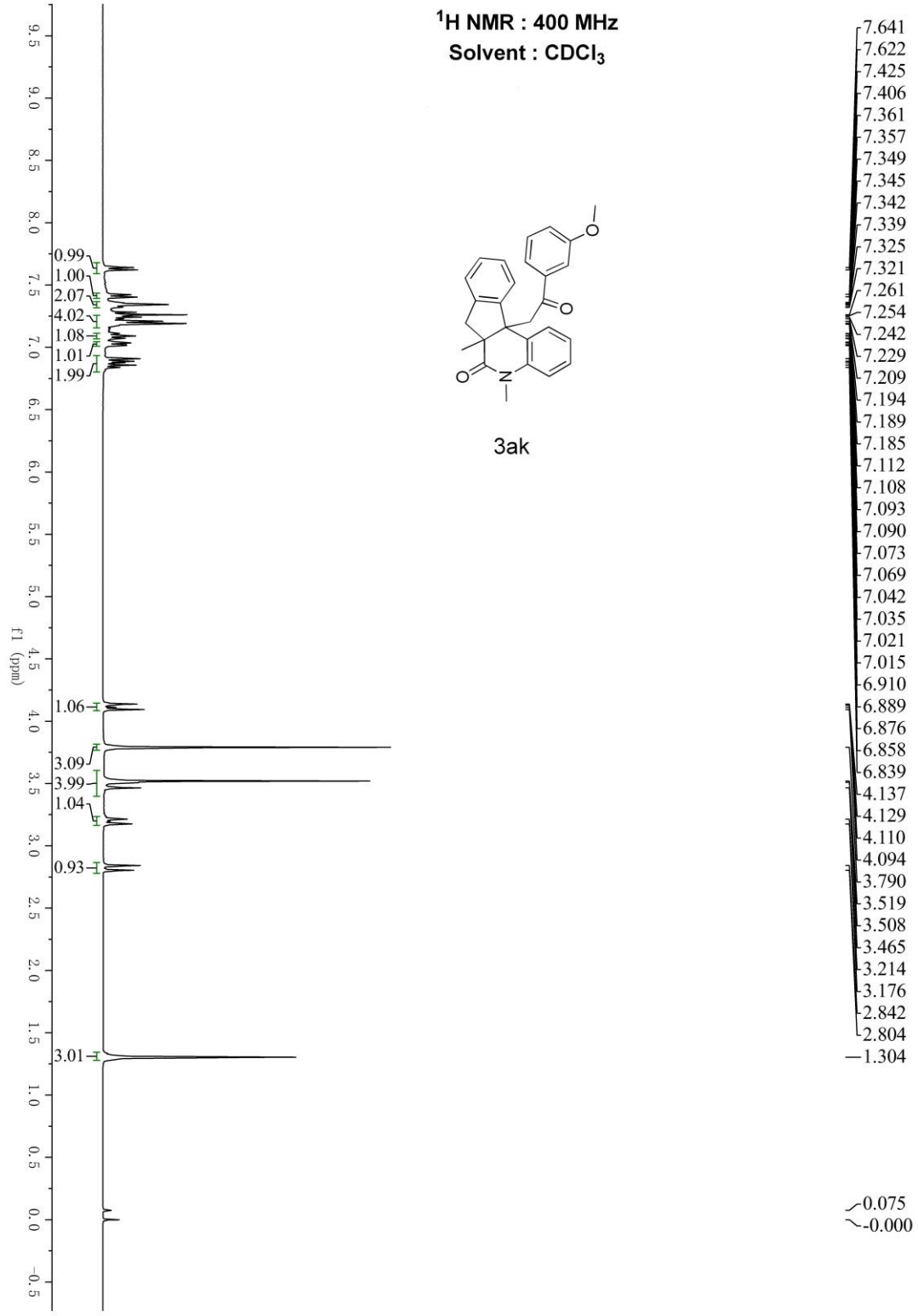
5,6a-dimethyl-11b-(2-oxo-2-(4-(trifluoromethyl)phenyl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3aj)

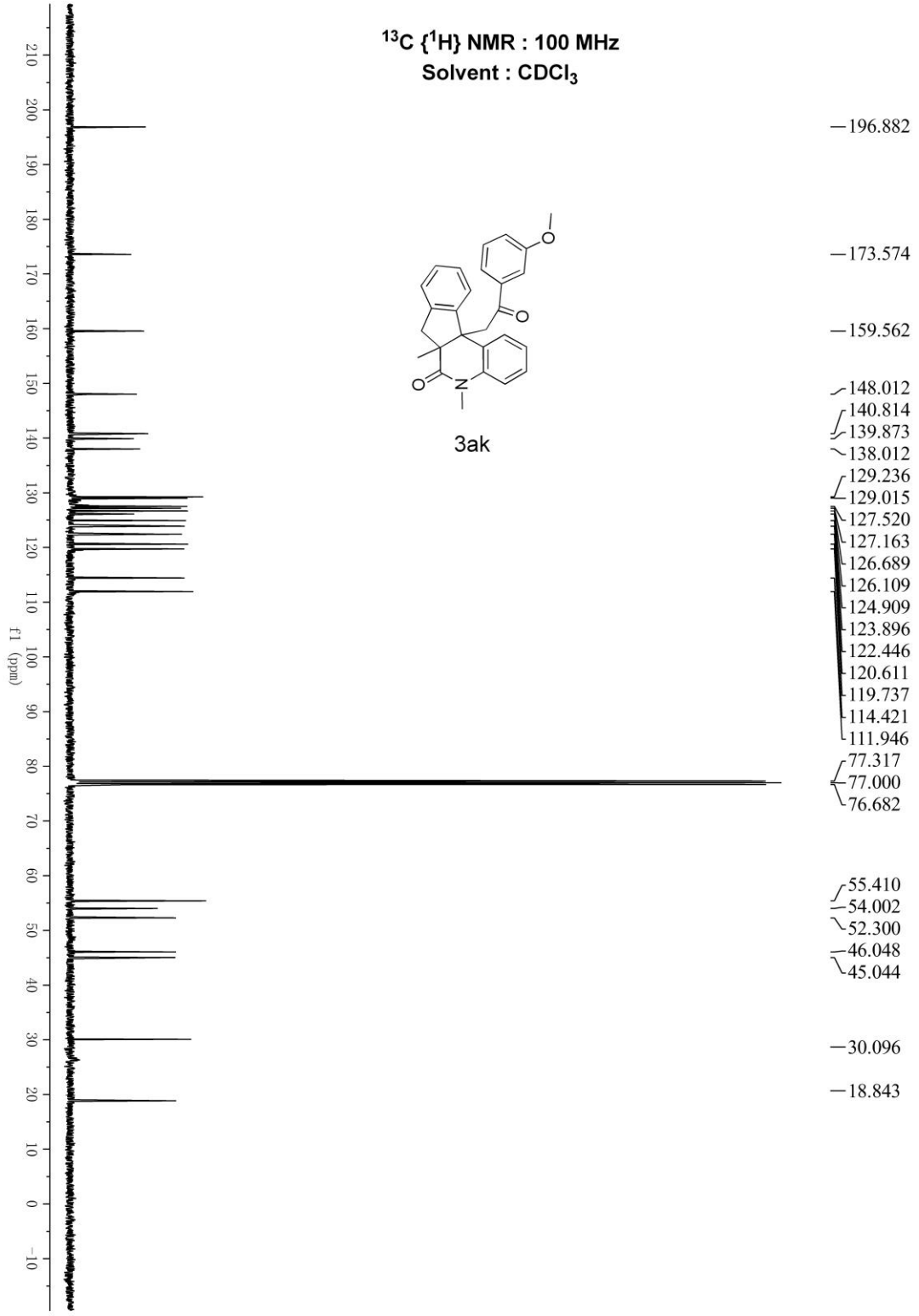



19F NMR : 282 MHz
Solvent : CDCl3
F3C
O
O
N
3aj
—-63.146
f1 (ppm)

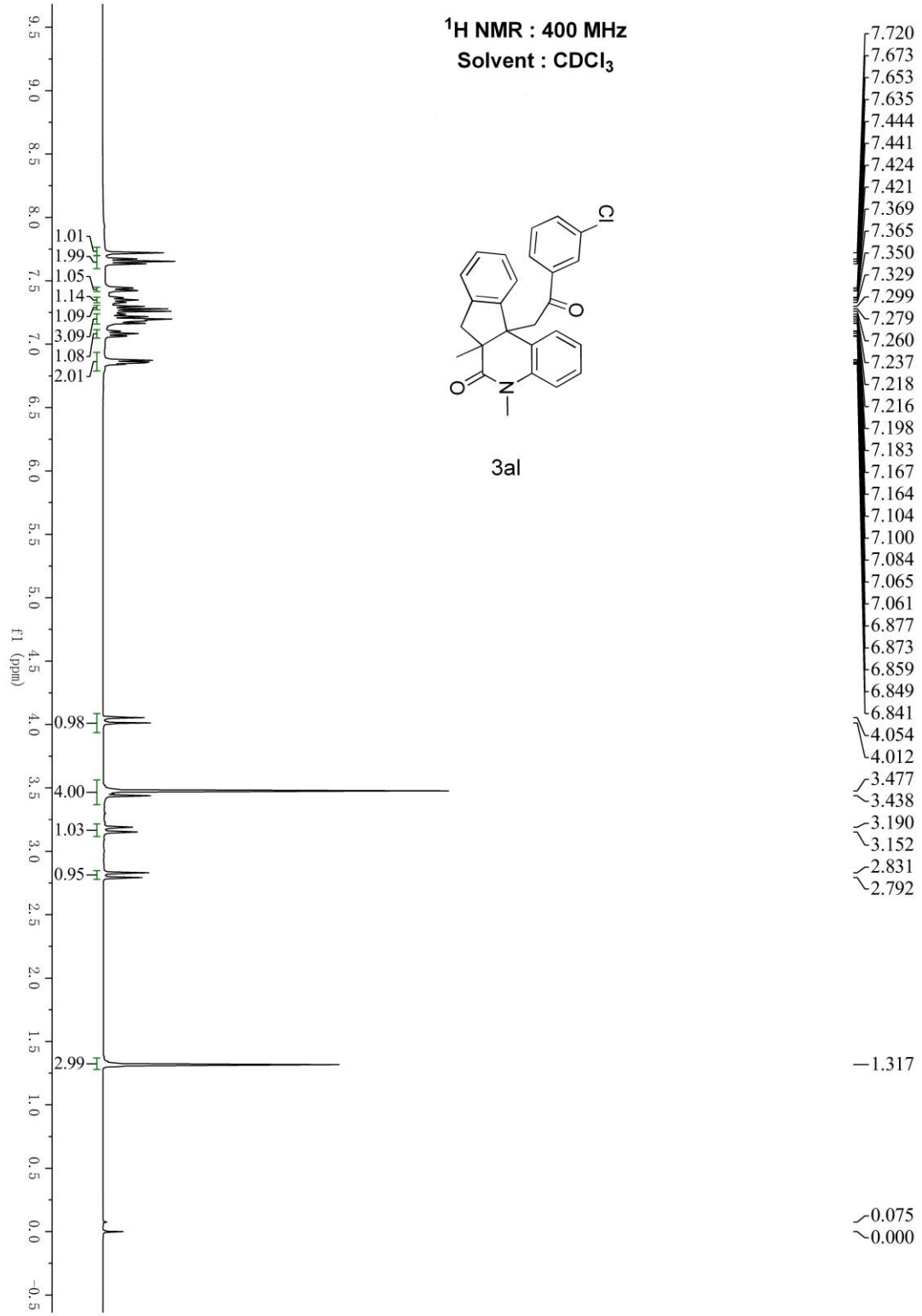

13C {1H} NMR : 100 MHz
Solvent : CDCl3
196.544
173.257
147.579
140.763
139.760
139.340
128.984
128.263
128.178
127.860
127.747
127.294
126.736
125.800
125.327
125.290
125.013
123.794
122.572
114.408
77.317
77.000
76.681
54.072
52.344
45.866
44.853
30.045
18.842
127.492
127.294
126.736
125.800
125.366
125.327
125.290
125.253
125.013
124.781
123.794
122.572
122.072
119.361
f1 (ppm)
F3C
O
O
N
3aj

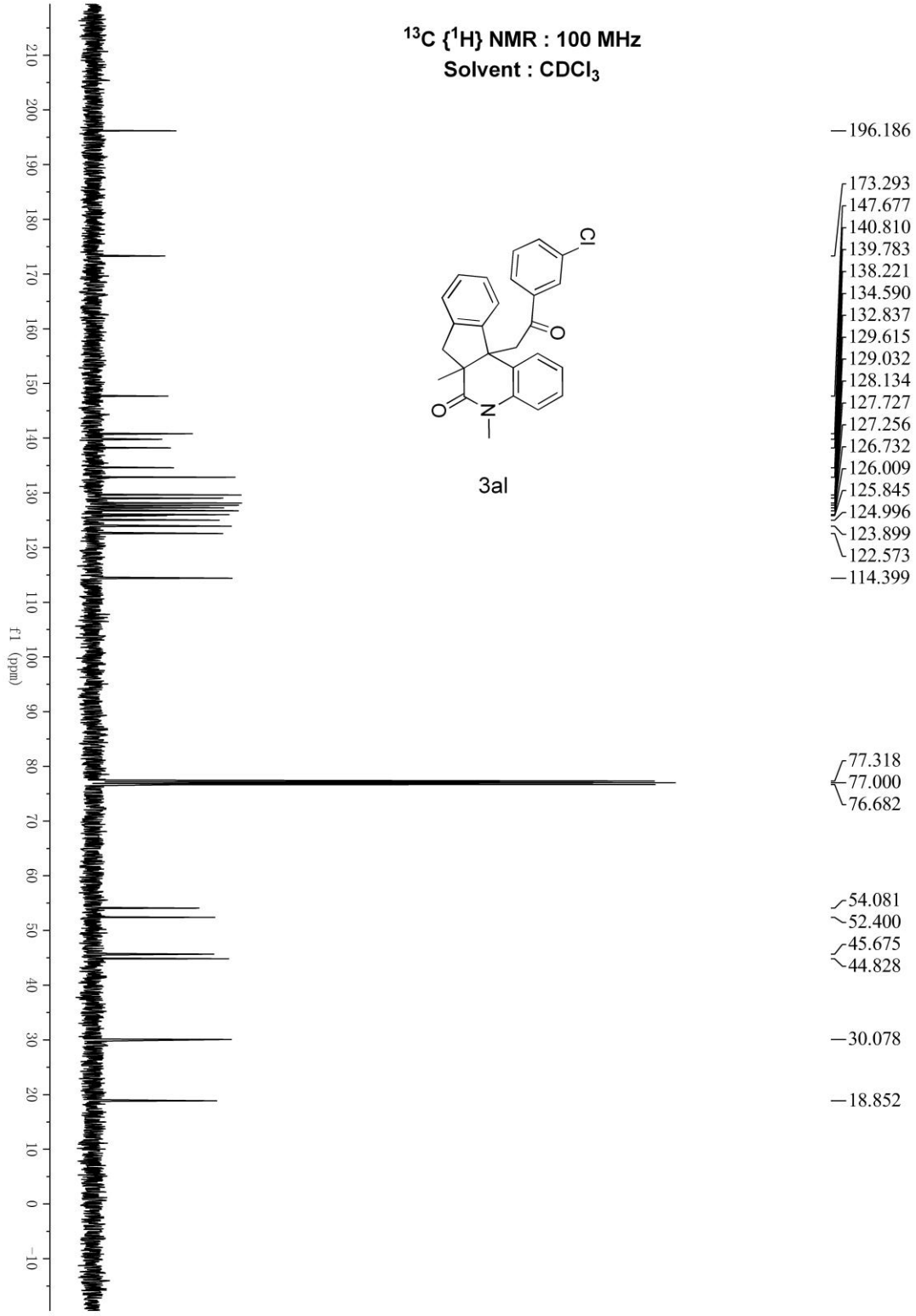
11b-(2-(3-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ak)



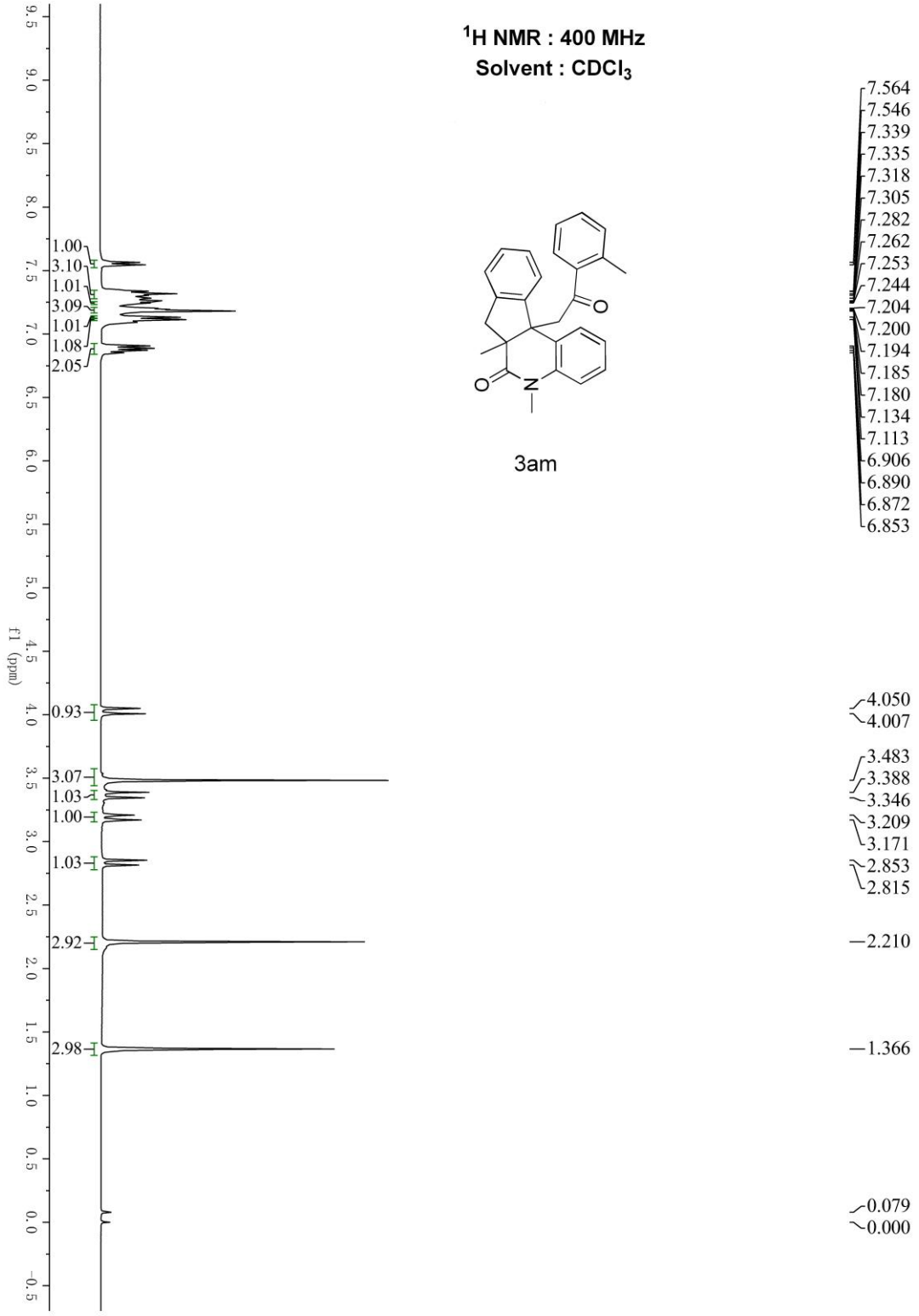

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ak
f1 (ppm)
196.882
173.574
159.562
148.012
140.814
139.873
138.012
129.236
129.015
127.520
127.163
126.689
126.109
124.909
123.896
122.446
120.611
119.737
114.421
111.946
77.317
77.000
76.682
55.410
54.002
52.300
46.048
45.044
30.096
18.843

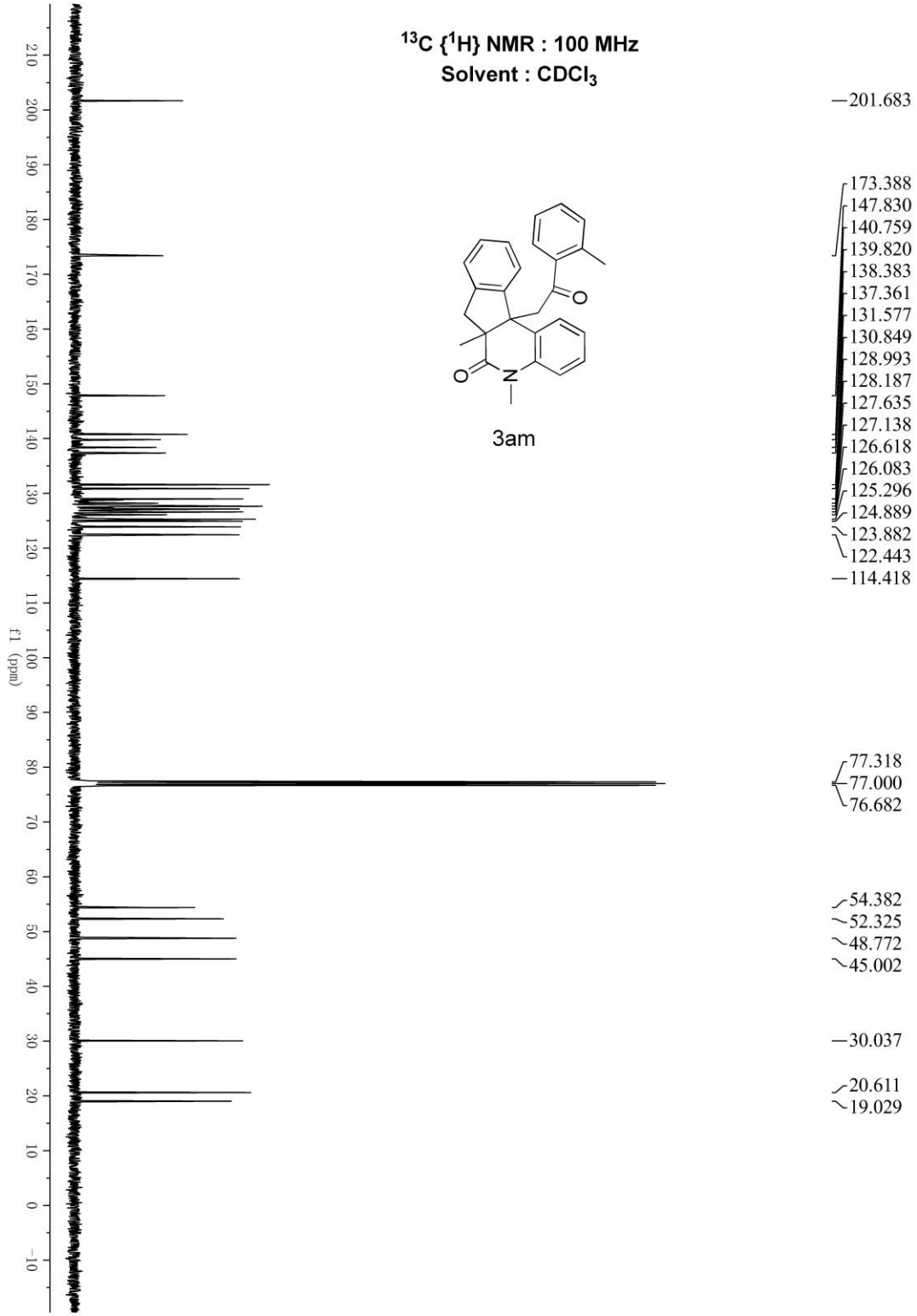
11b-(2-(3-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3al)



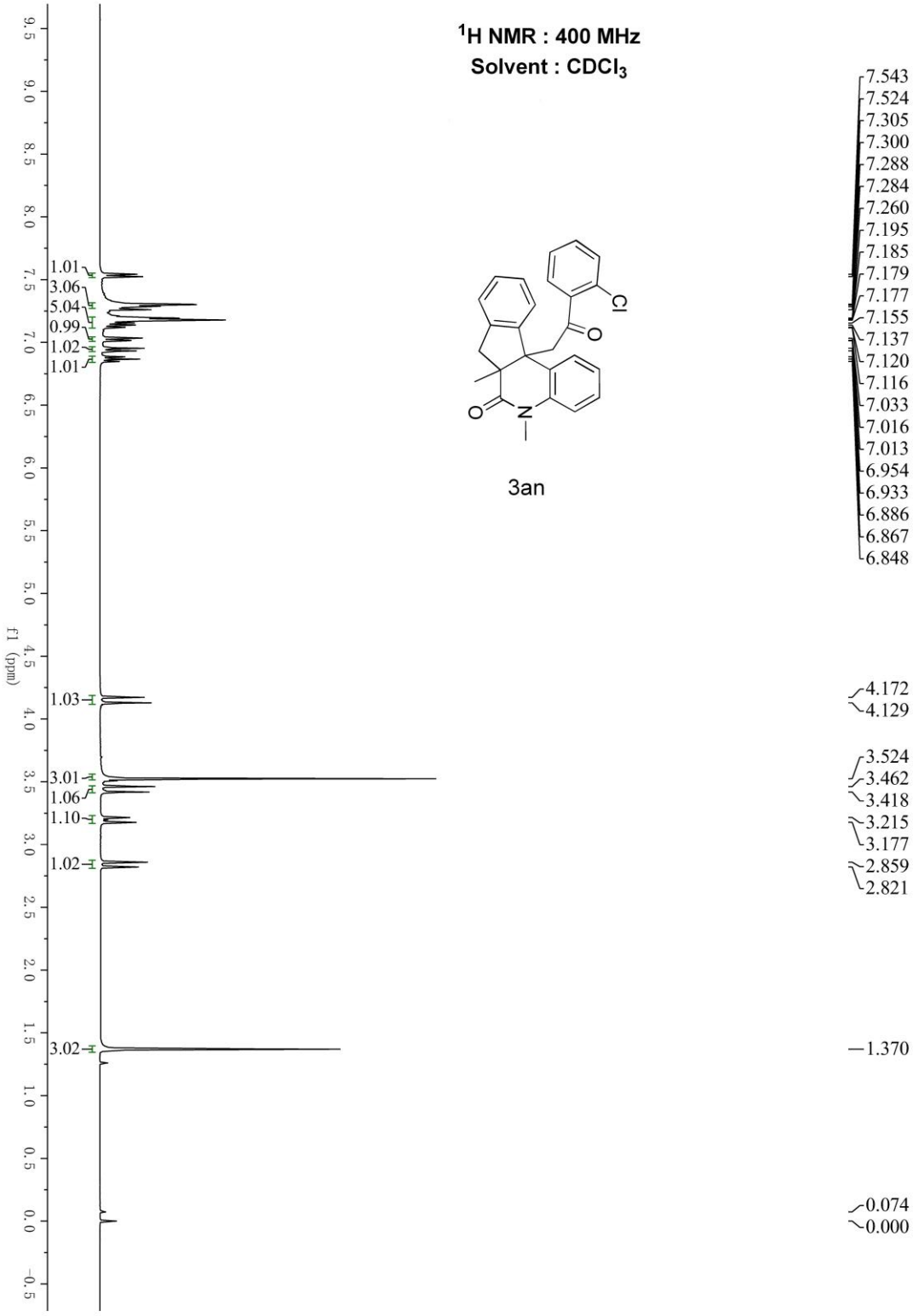

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3al
f1 (ppm)
196.186
173.293
147.677
140.810
139.783
138.221
134.590
132.837
129.615
129.032
128.134
127.727
127.256
126.732
126.009
125.845
124.996
123.899
122.573
114.399
77.318
77.000
76.682
54.081
52.400
45.675
44.828
30.078
18.852

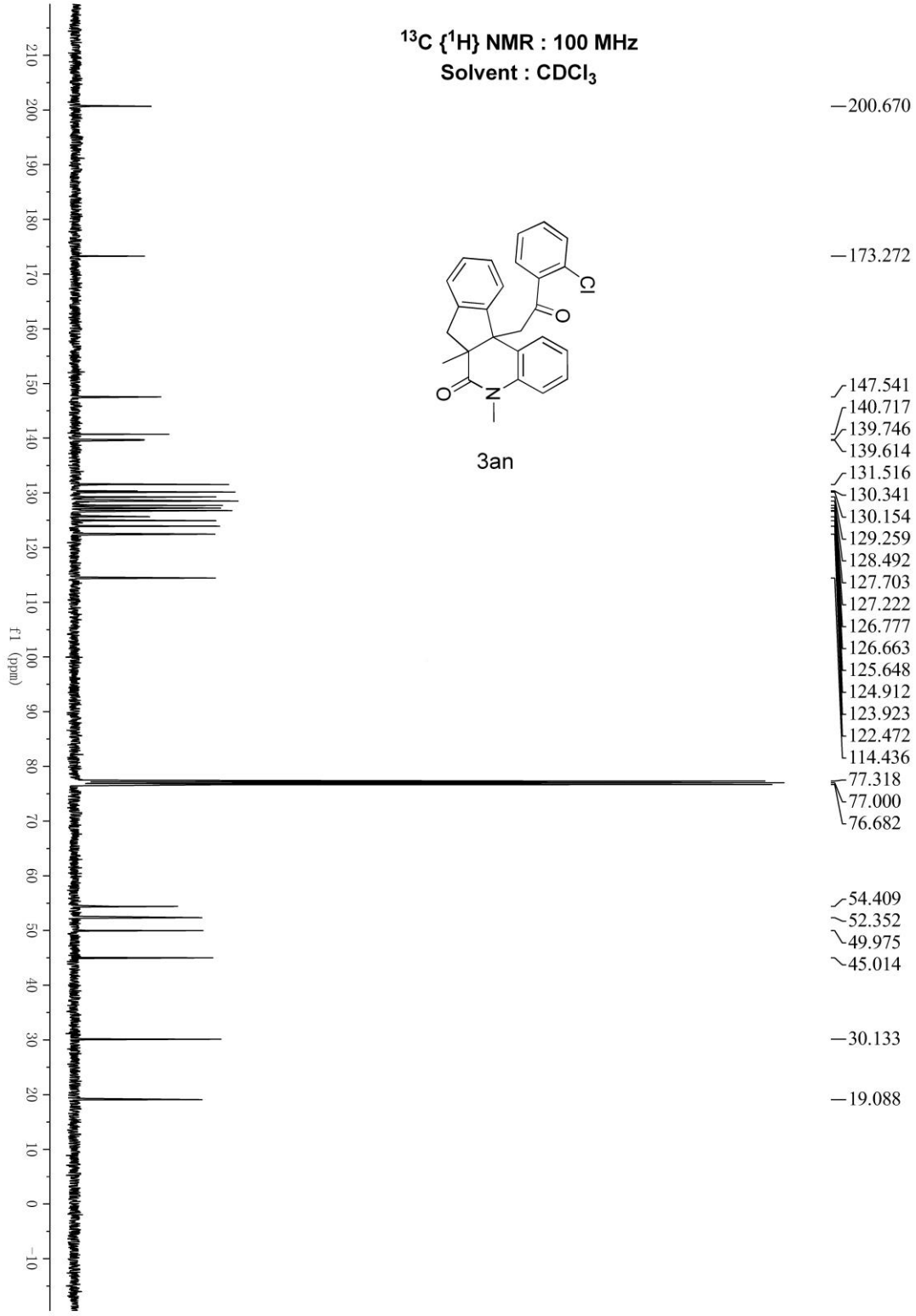
5,6a-dimethyl-11b-(2-oxo-2-(o-tolyl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3am)



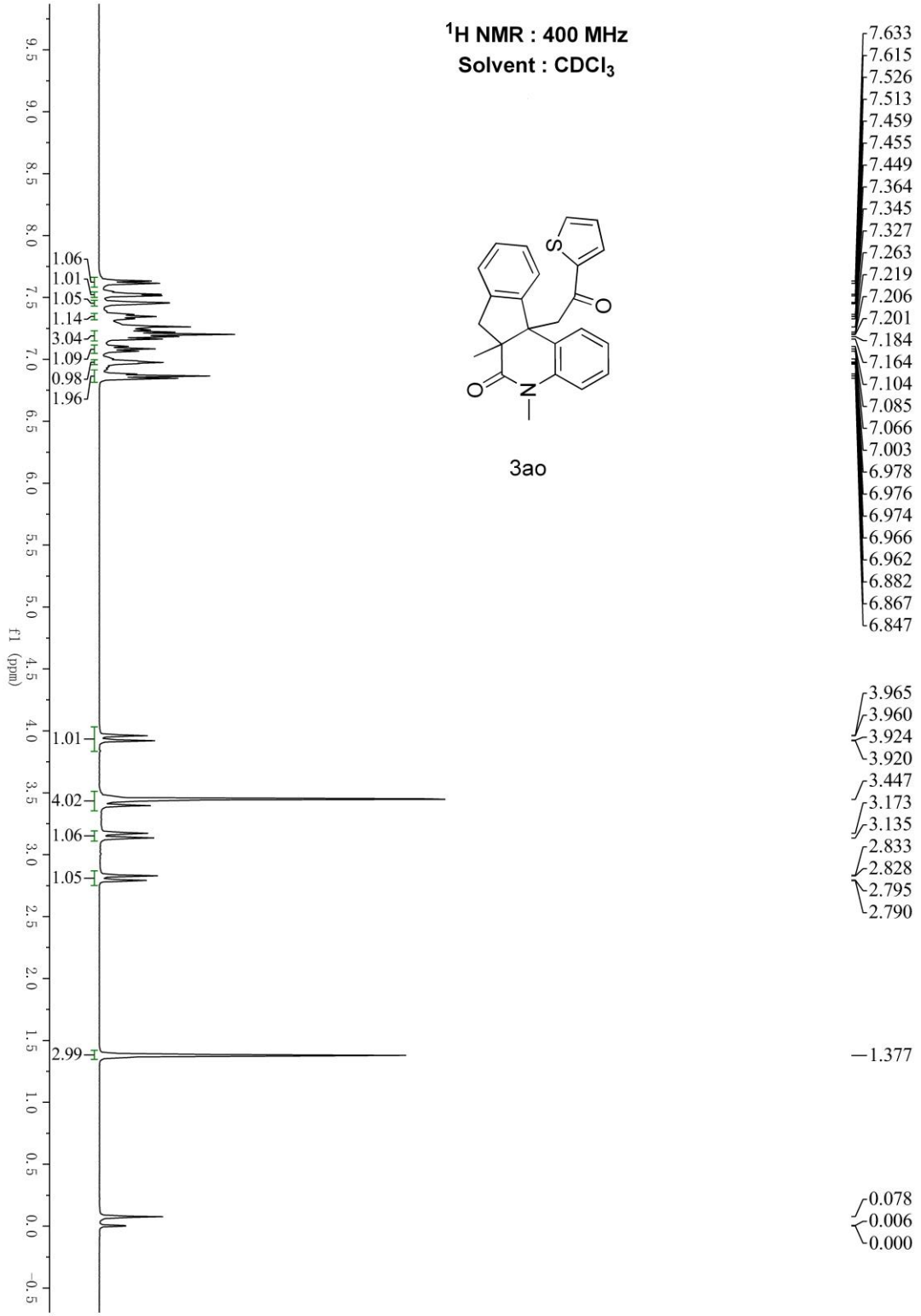

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3am
f1 (ppm)
201.683
173.388
147.830
140.759
139.820
138.383
137.361
131.577
130.849
128.993
128.187
127.635
127.138
126.618
126.083
125.296
124.889
123.882
122.443
114.418
77.318
77.000
76.682
54.382
52.325
48.772
45.002
30.037
20.611
19.029

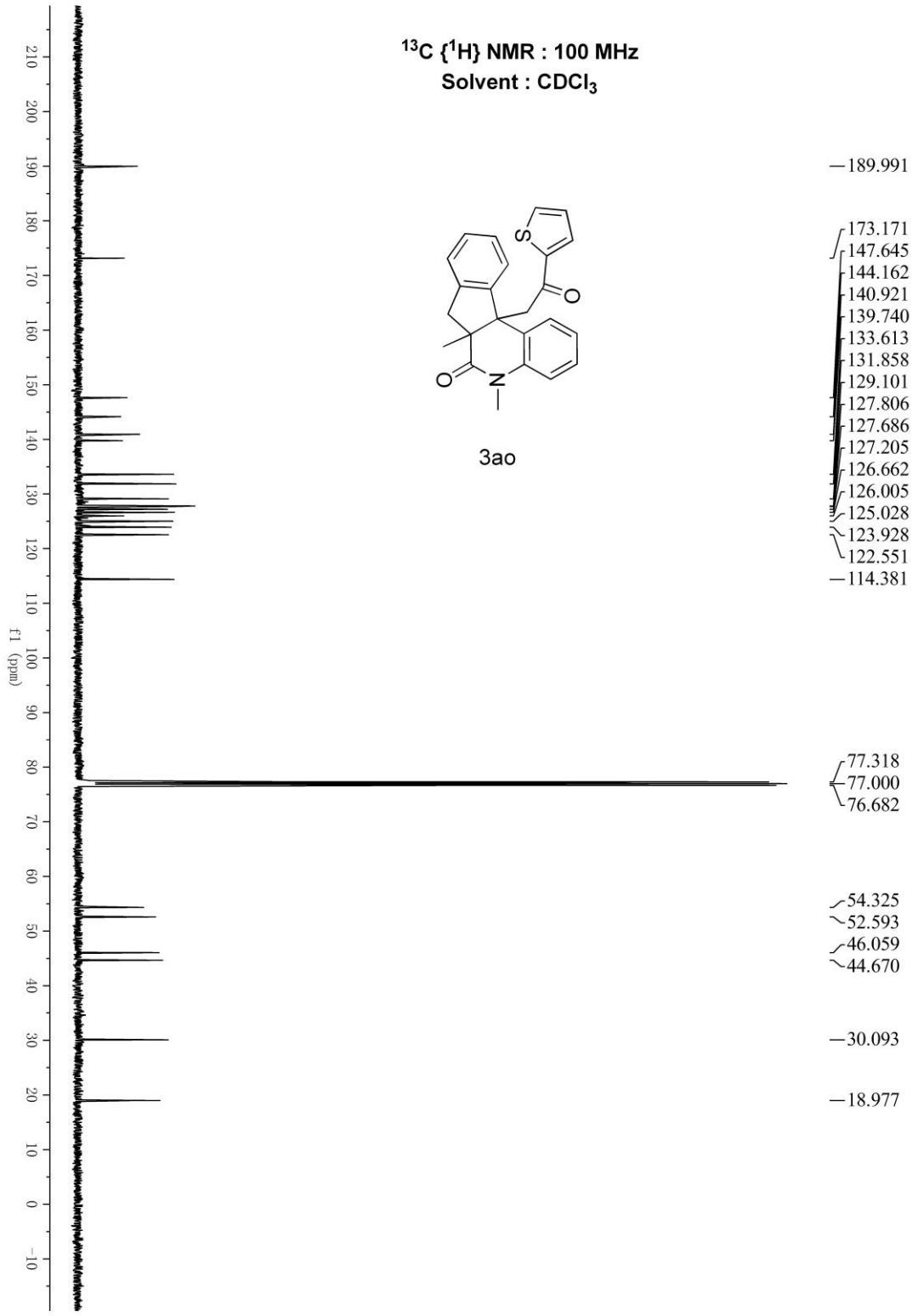
11b-(2-(2-chlorophenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3an)



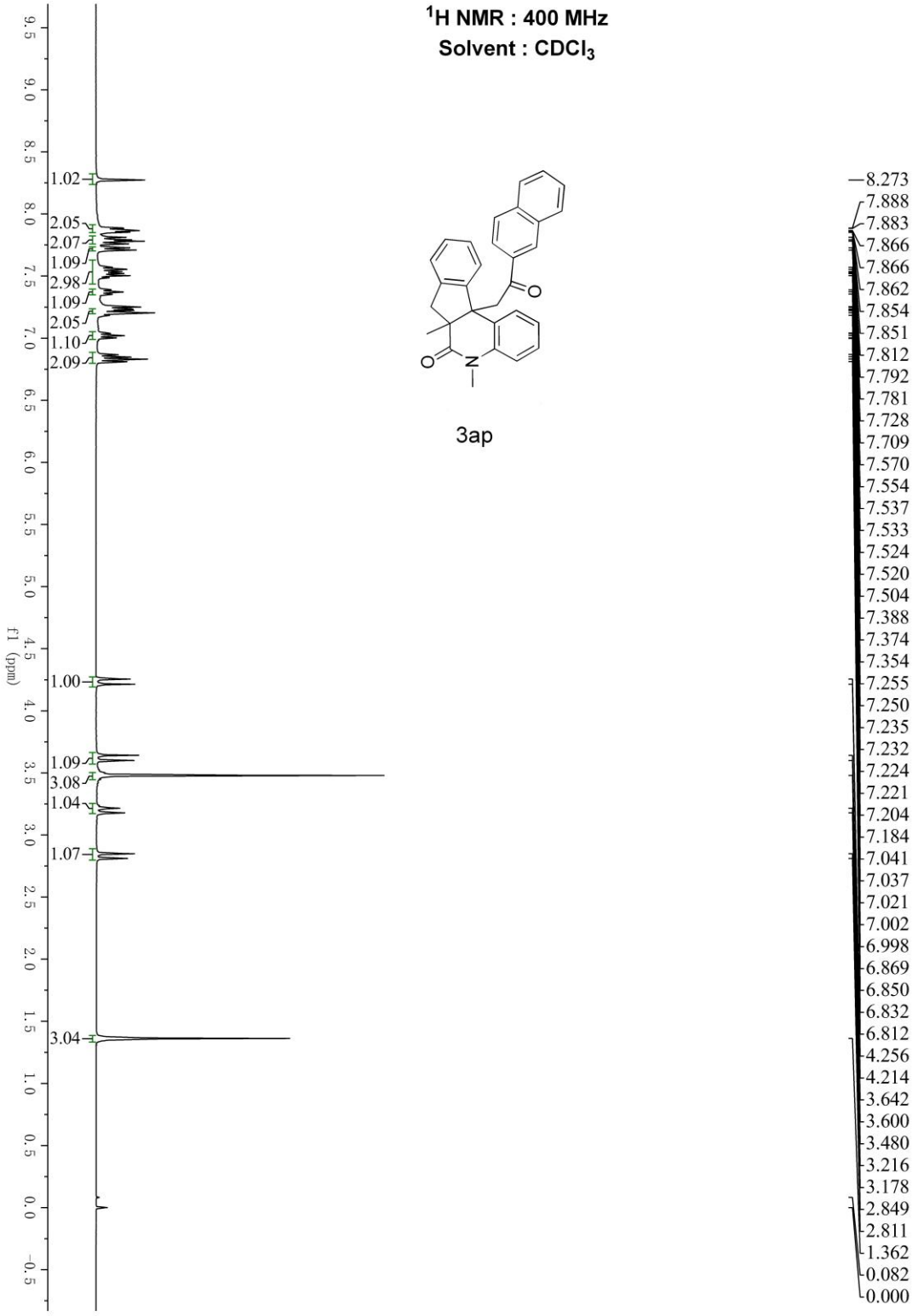

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3an
f1 (ppm)
200.670
173.272
147.541
140.717
139.746
139.614
131.516
130.341
130.154
129.259
128.492
127.703
127.222
126.777
126.663
125.648
124.912
123.923
122.472
114.436
77.318
77.000
76.682
54.409
52.352
49.975
45.014
30.133
19.088

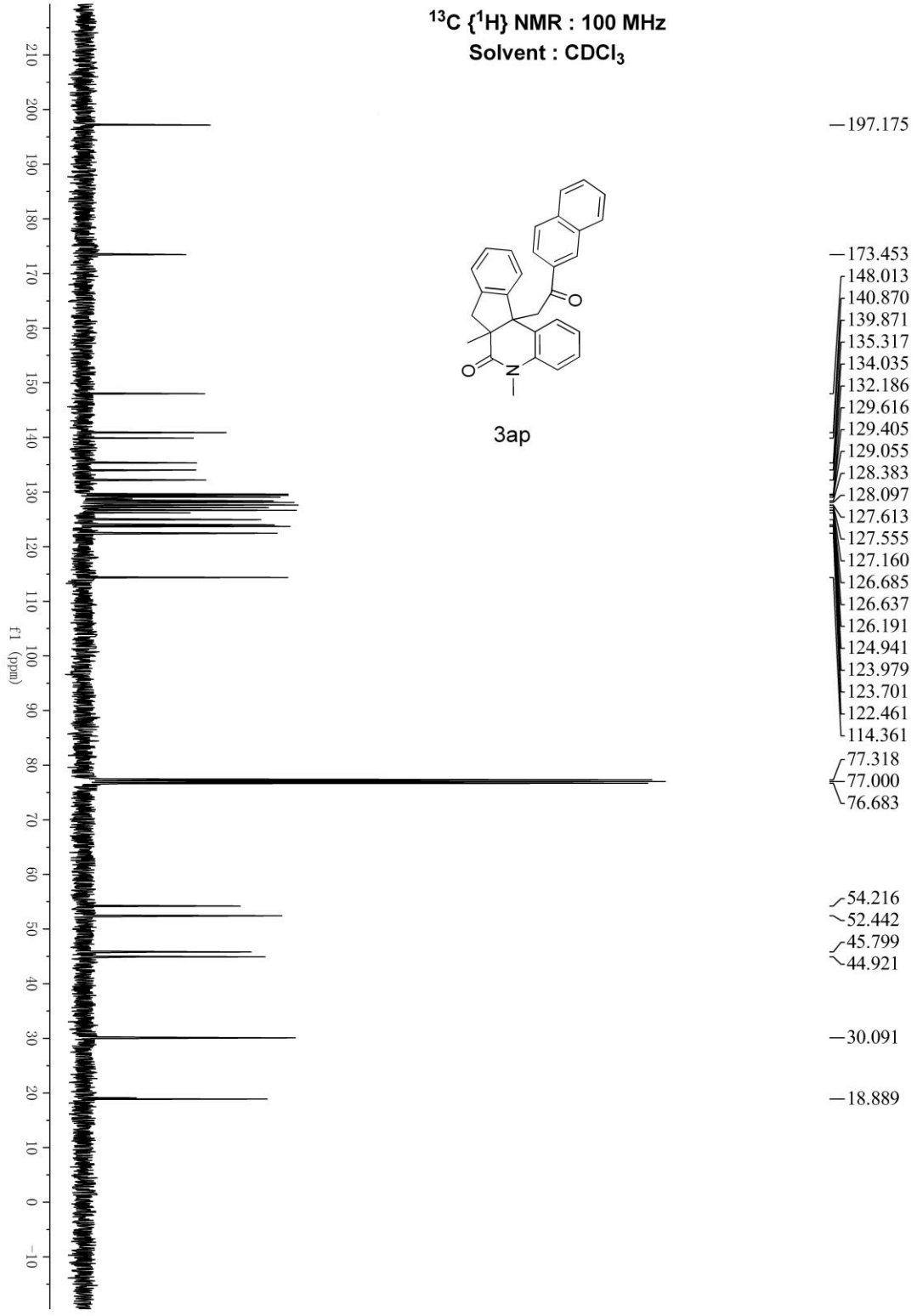
5,6a-dimethyl-11b-(2-oxo-2-(thiophen-2-yl)ethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ao)



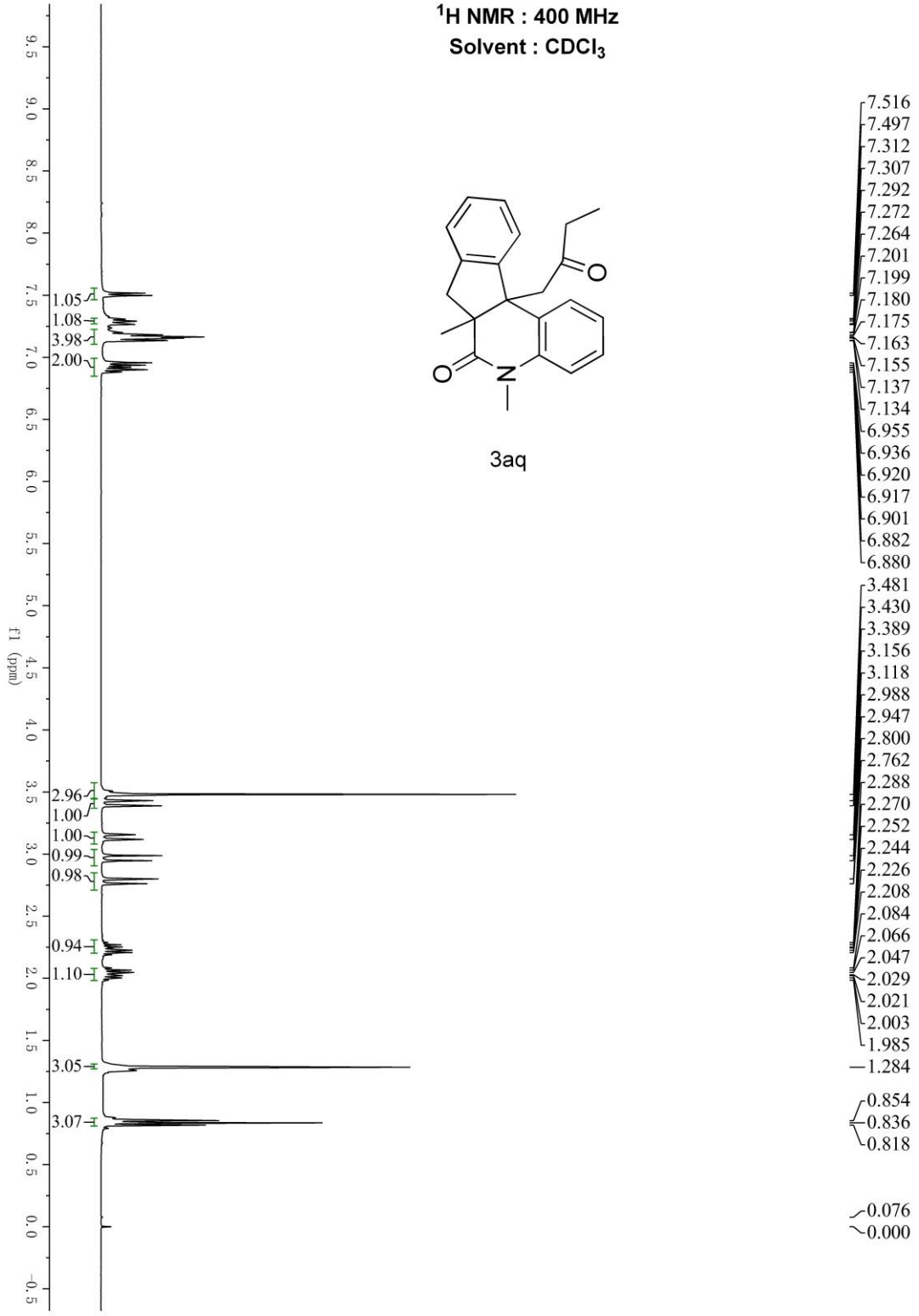

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ao
f1 (ppm)
189.991
173.171
147.645
144.162
140.921
139.740
133.613
131.858
129.101
127.806
127.686
127.205
126.662
126.005
125.028
123.928
122.551
114.381
77.318
77.000
76.682
54.325
52.593
46.059
44.670
30.093
18.977

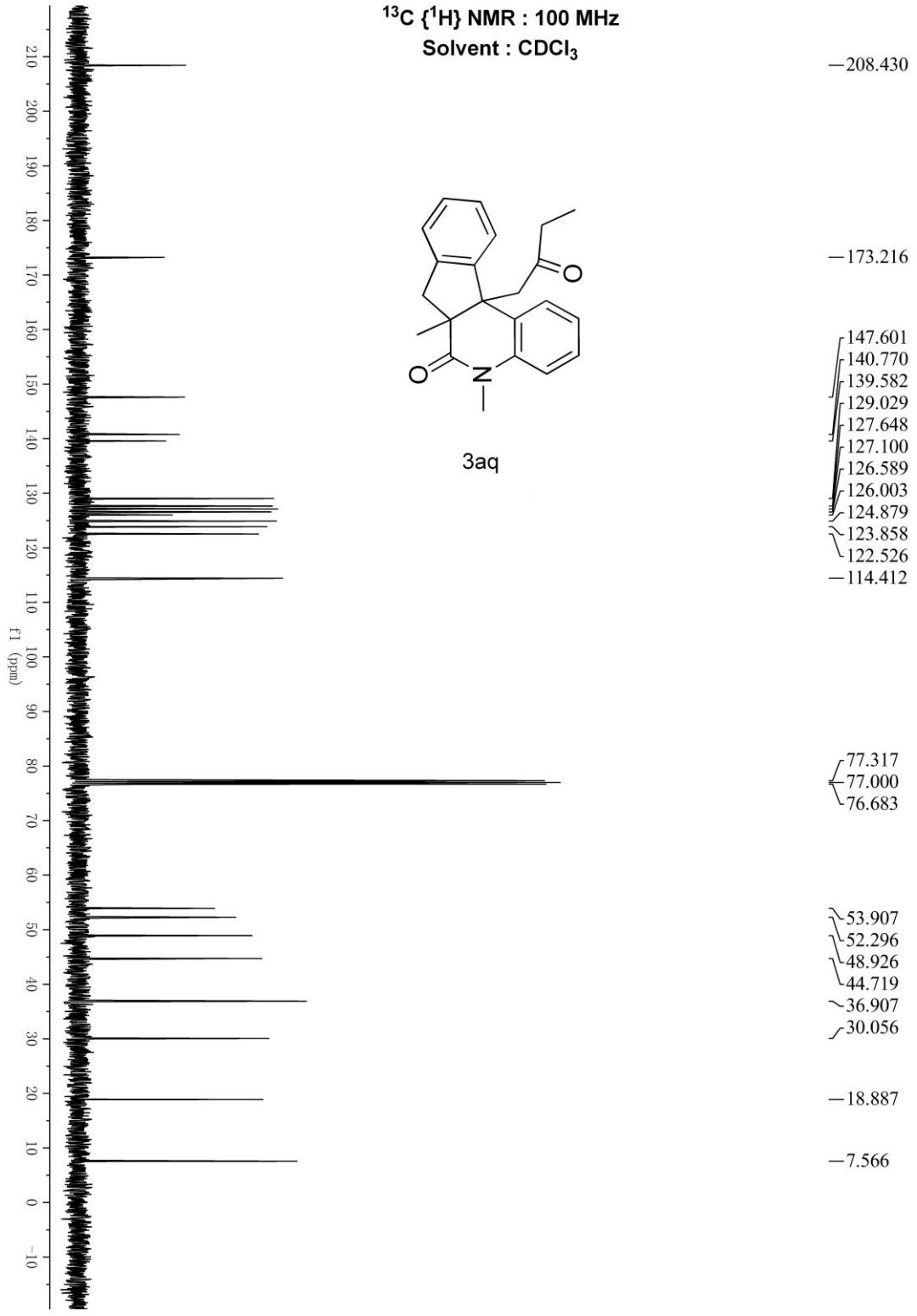
5,6a-dimethyl-11b-(2-(naphthalen-2-yl)-2-oxoethyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ap)



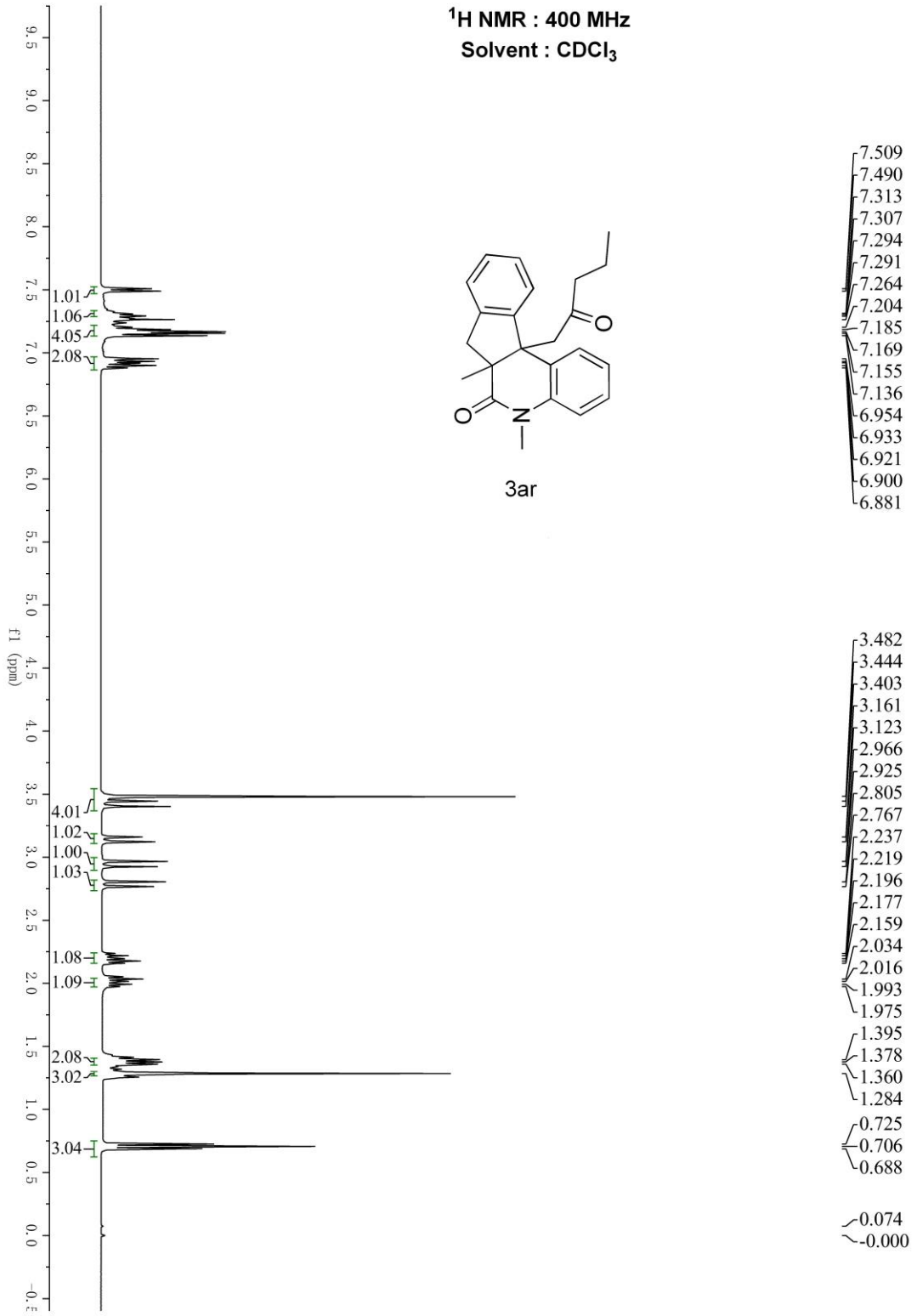

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3ap
f1 (ppm)
197.175
173.453
148.013
140.870
139.871
135.317
134.035
132.186
129.616
129.405
129.055
128.383
128.097
127.613
127.555
127.160
126.685
126.637
126.191
124.941
123.979
123.701
122.461
114.361
77.318
77.000
76.683
54.216
52.442
45.799
44.921
30.091
18.889

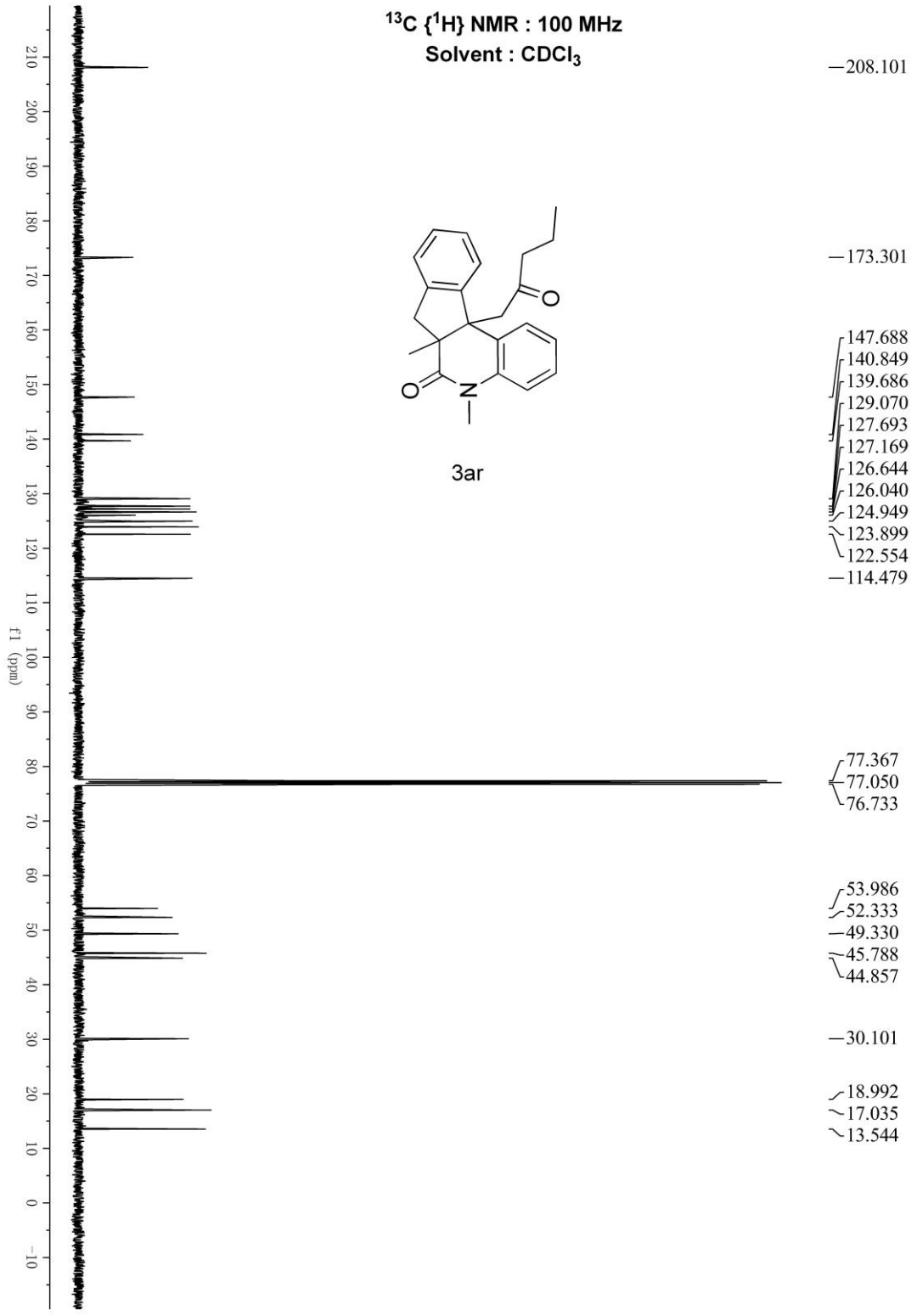
5,6a-dimethyl-11b-(2-oxobutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3aq)



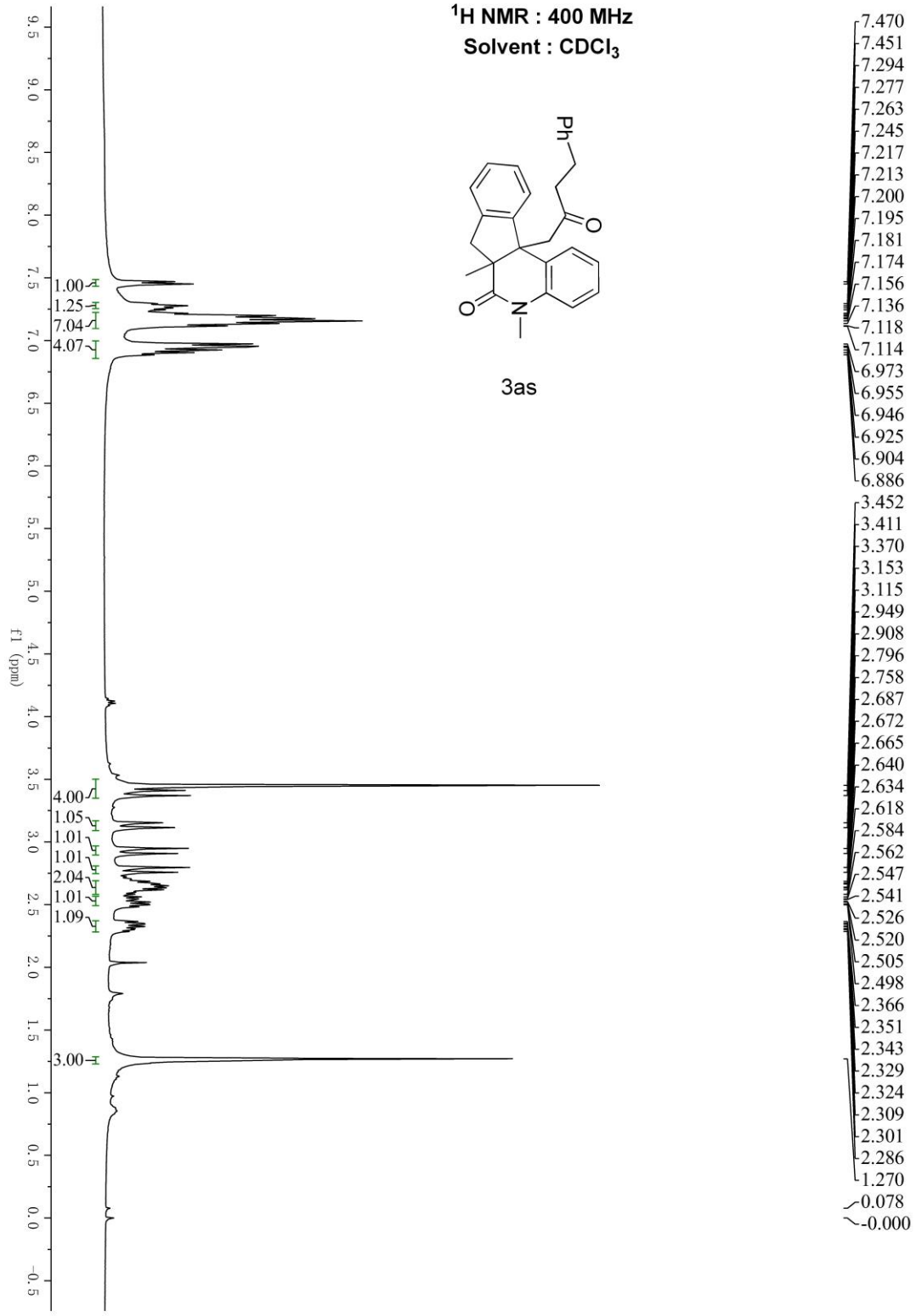

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3aq
f1 (ppm)
208.430
173.216
147.601
140.770
139.582
129.029
127.648
127.100
126.589
126.003
124.879
123.858
122.526
114.412
77.317
77.000
76.683
53.907
52.296
48.926
44.719
36.907
30.056
18.887
7.566

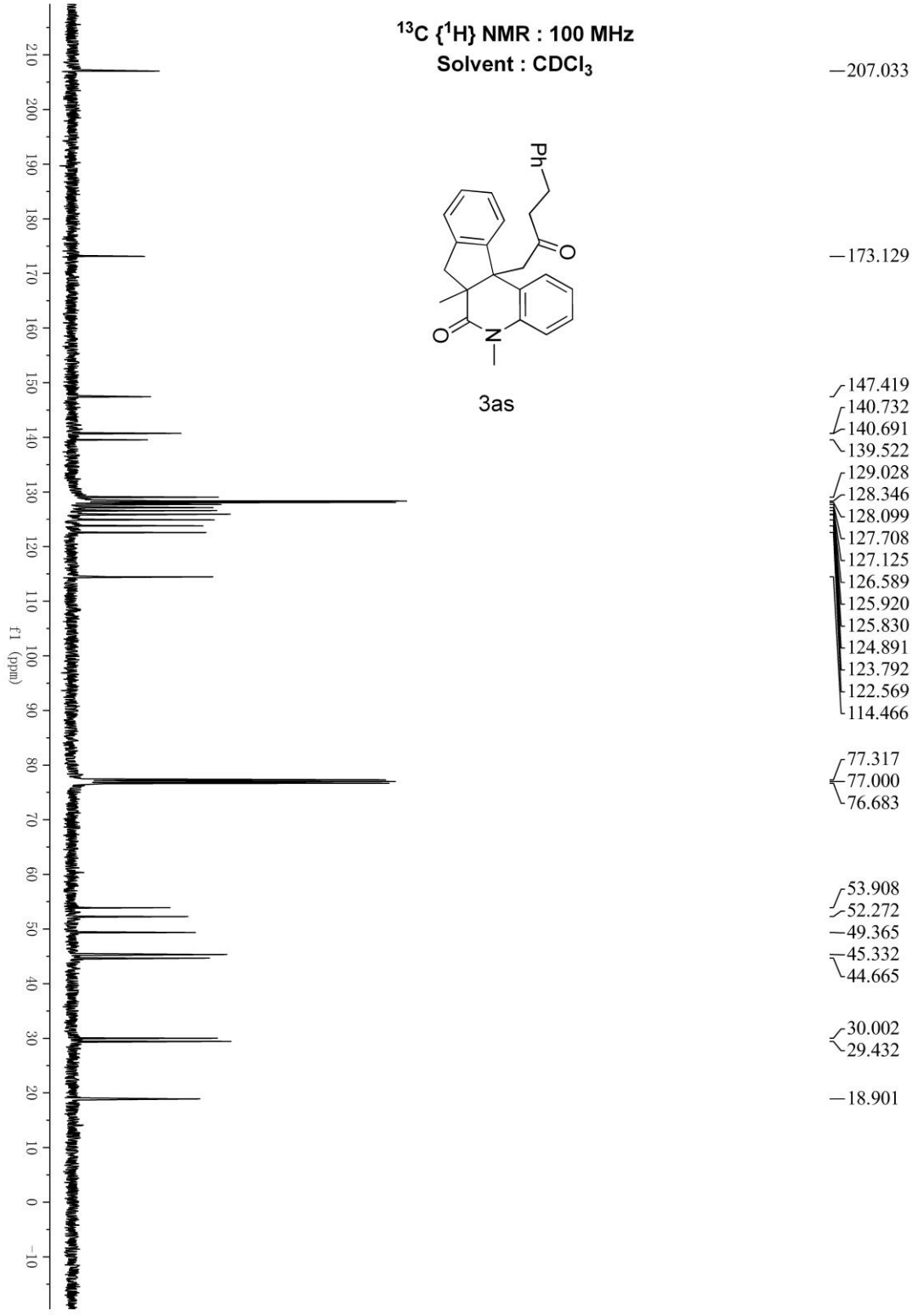
5,6a-dimethyl-11b-(2-oxopentyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ar)



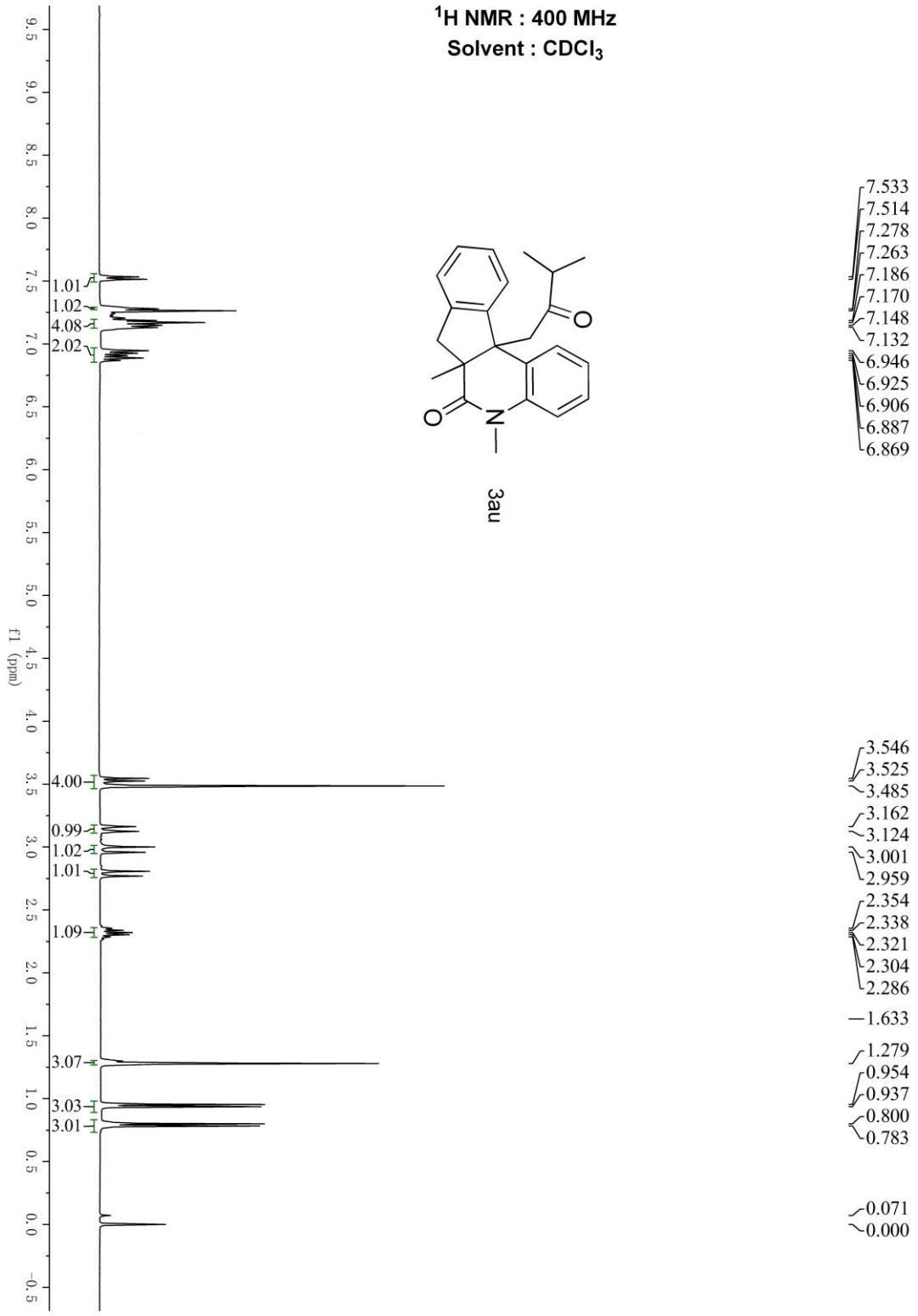

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ar
f1 (ppm)
208.101
173.301
147.688
140.849
139.686
129.070
127.693
127.169
126.644
126.040
124.949
123.899
122.554
114.479
77.367
77.050
76.733
53.986
52.333
49.330
45.788
44.857
30.101
18.992
17.035
13.544

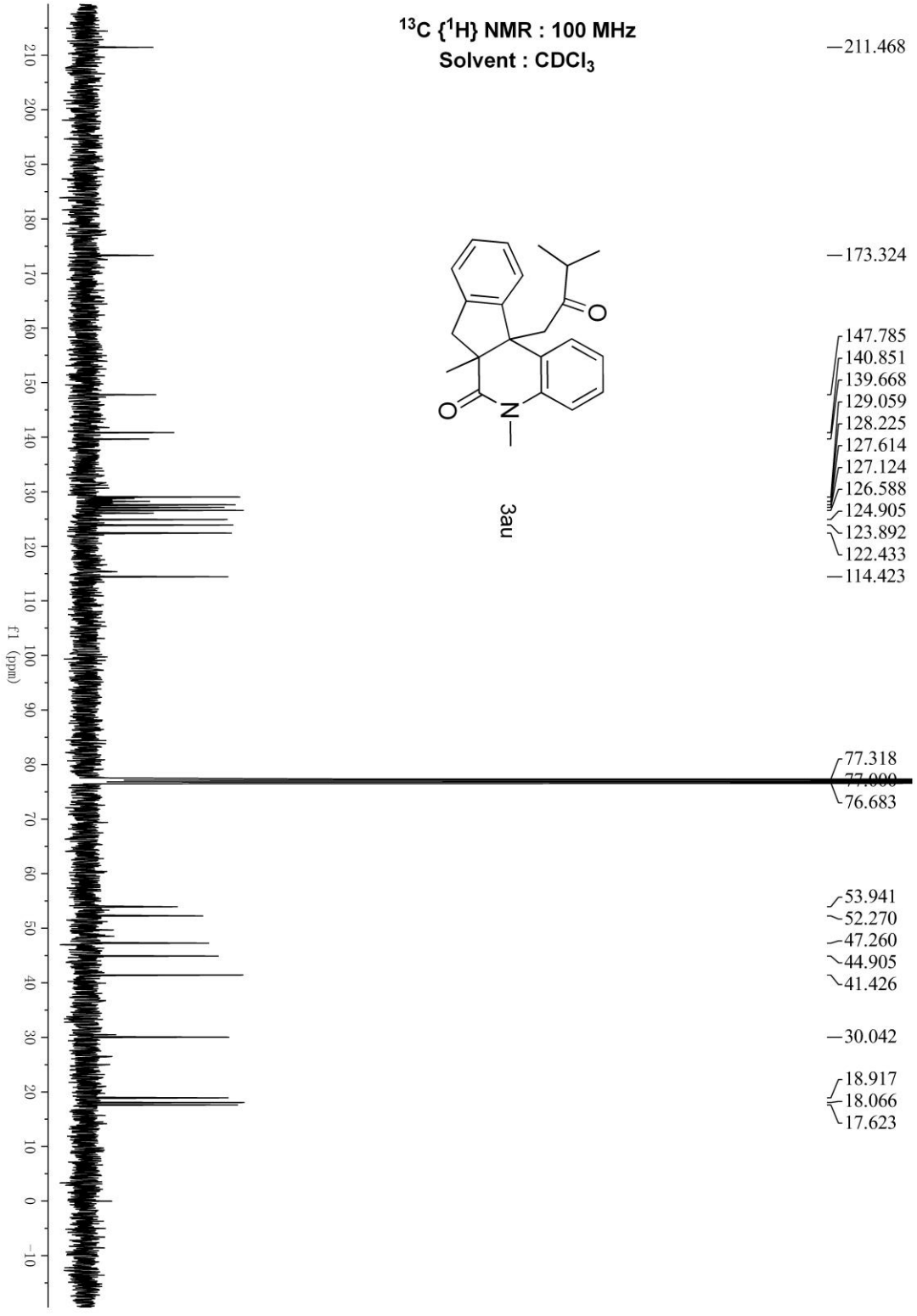
5,6a-dimethyl-11b-(2-oxo-4-phenylbutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c] quinolin-6-one (3as)



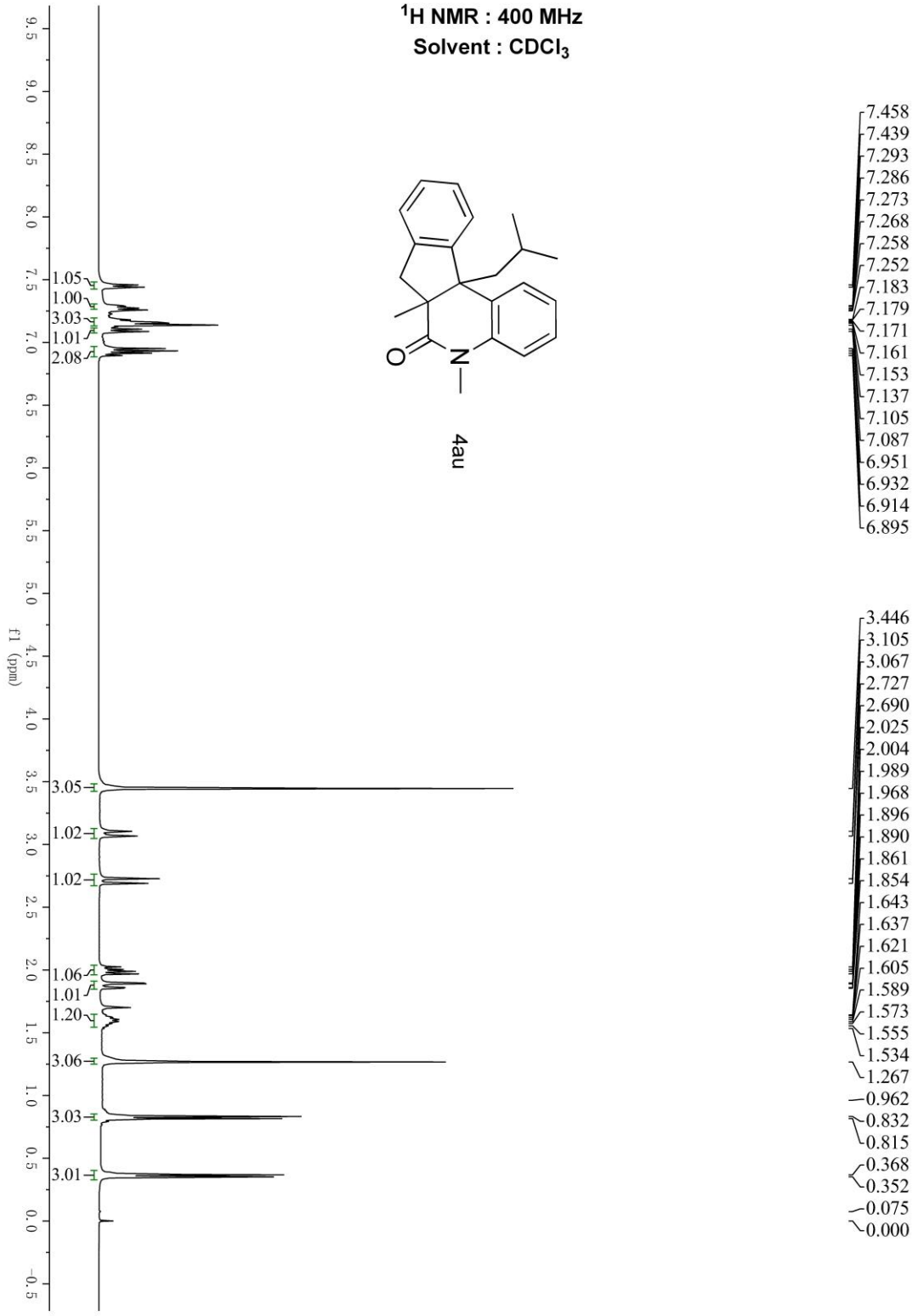

13C {1H} NMR : 100 MHz
Solvent : CDCl3
Ph
O
O
N
3as
f1 (ppm)
207.033
173.129
147.419
140.732
140.691
139.522
129.028
128.346
128.099
127.708
127.125
126.589
125.920
125.830
124.891
123.792
122.569
114.466
77.317
77.000
76.683
53.908
52.272
49.365
45.332
44.665
30.002
29.432
18.901

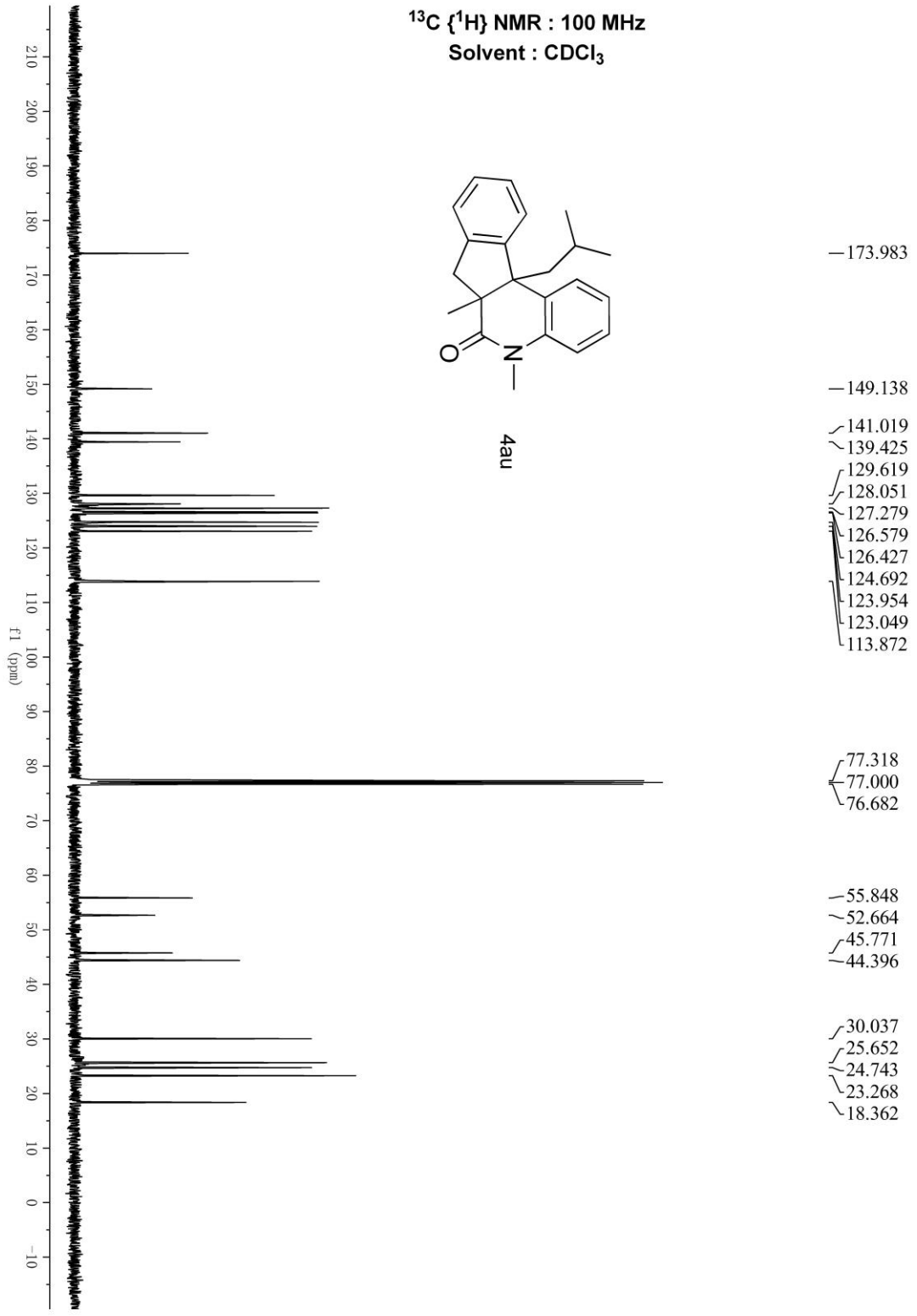
5,6a-dimethyl-11b-(3-methyl-2-oxobutyl)-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c] quinolin-6-one (3au)



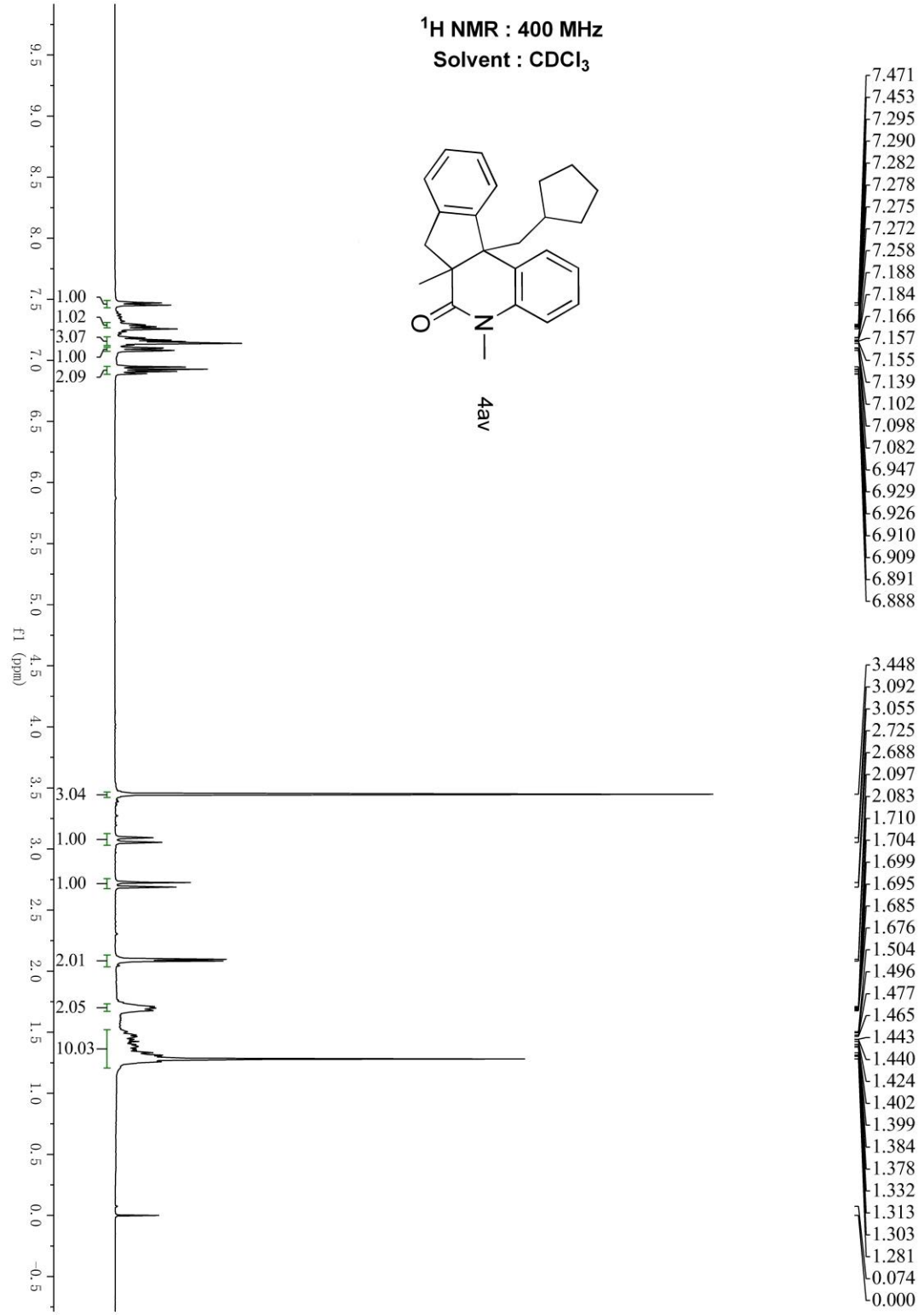

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3au
211.468
173.324
147.785
140.851
139.668
129.059
128.225
127.614
127.124
126.588
124.905
123.892
122.433
114.423
77.318
77.000
76.683
53.941
52.270
47.260
44.905
41.426
30.042
18.917
18.066
17.623
f1 (ppm)

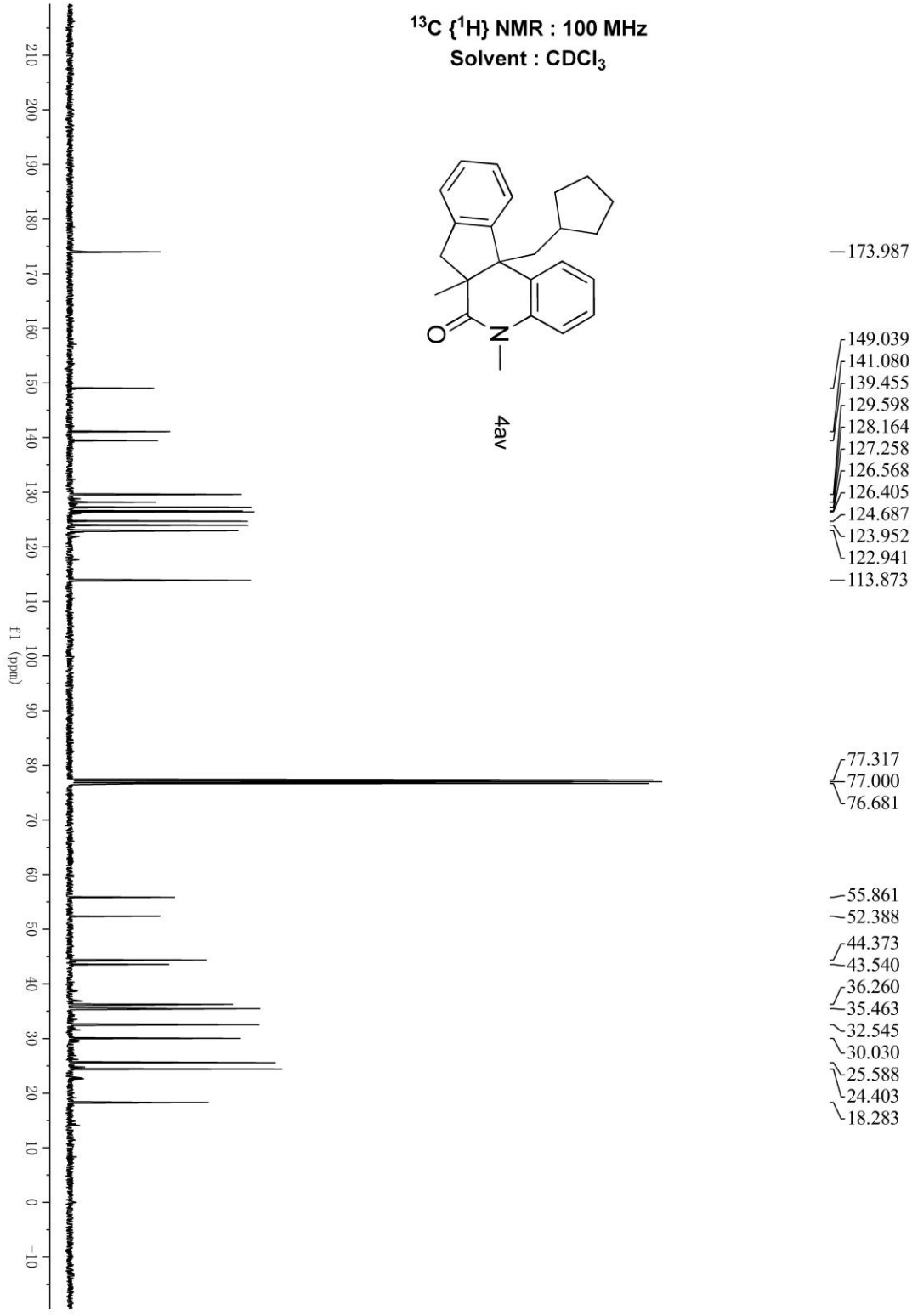
11b-isobutyl-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4au)



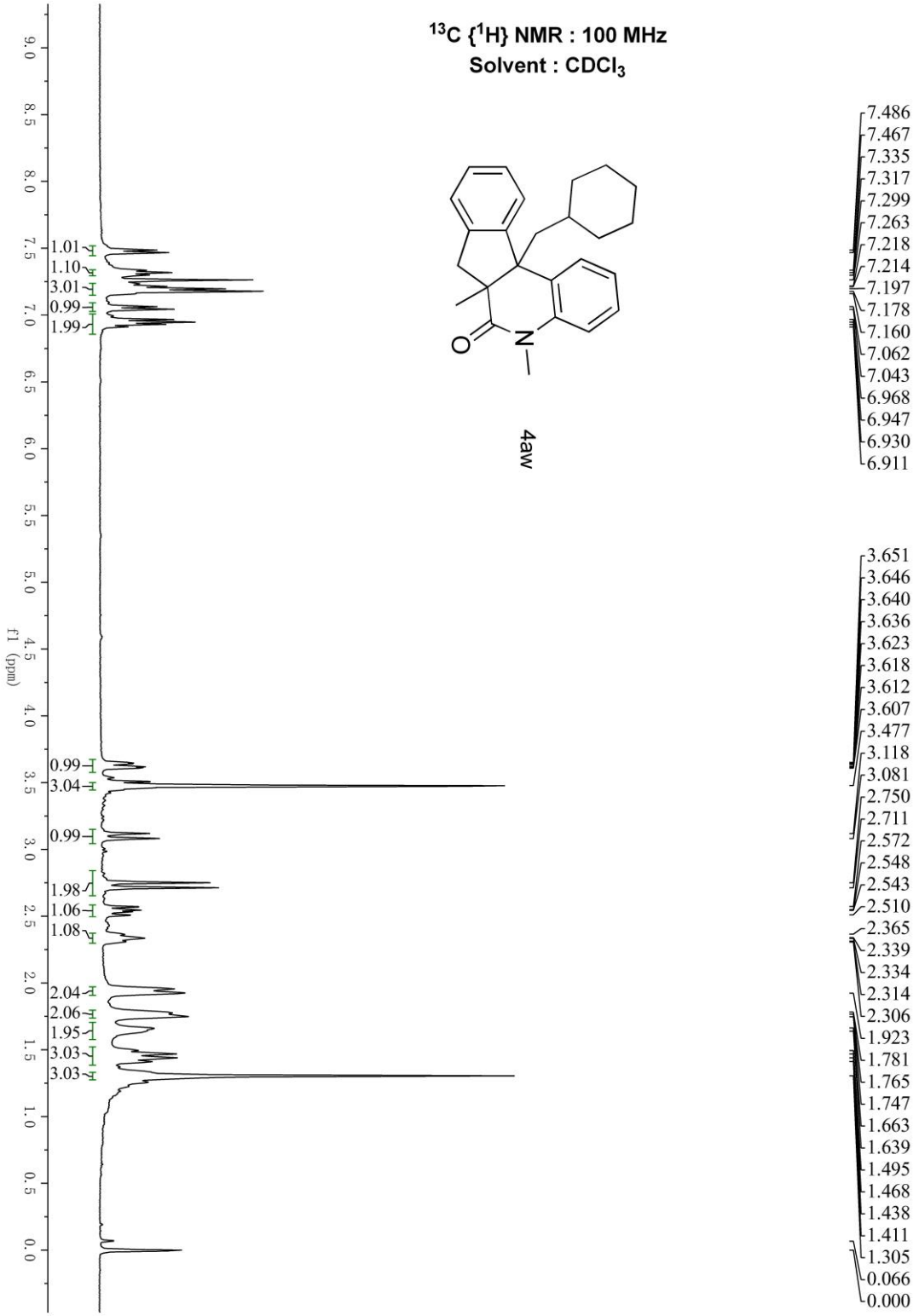

^{13}C {^{1}H} NMR : 100 MHz
Solvent : CDCl$_3$
4au
f1 (ppm)
173.983
149.138
141.019
139.425
129.619
128.051
127.279
126.579
126.427
124.692
123.954
123.049
113.872
77.318
77.000
76.682
55.848
52.664
45.771
44.396
30.037
25.652
24.743
23.268
18.362

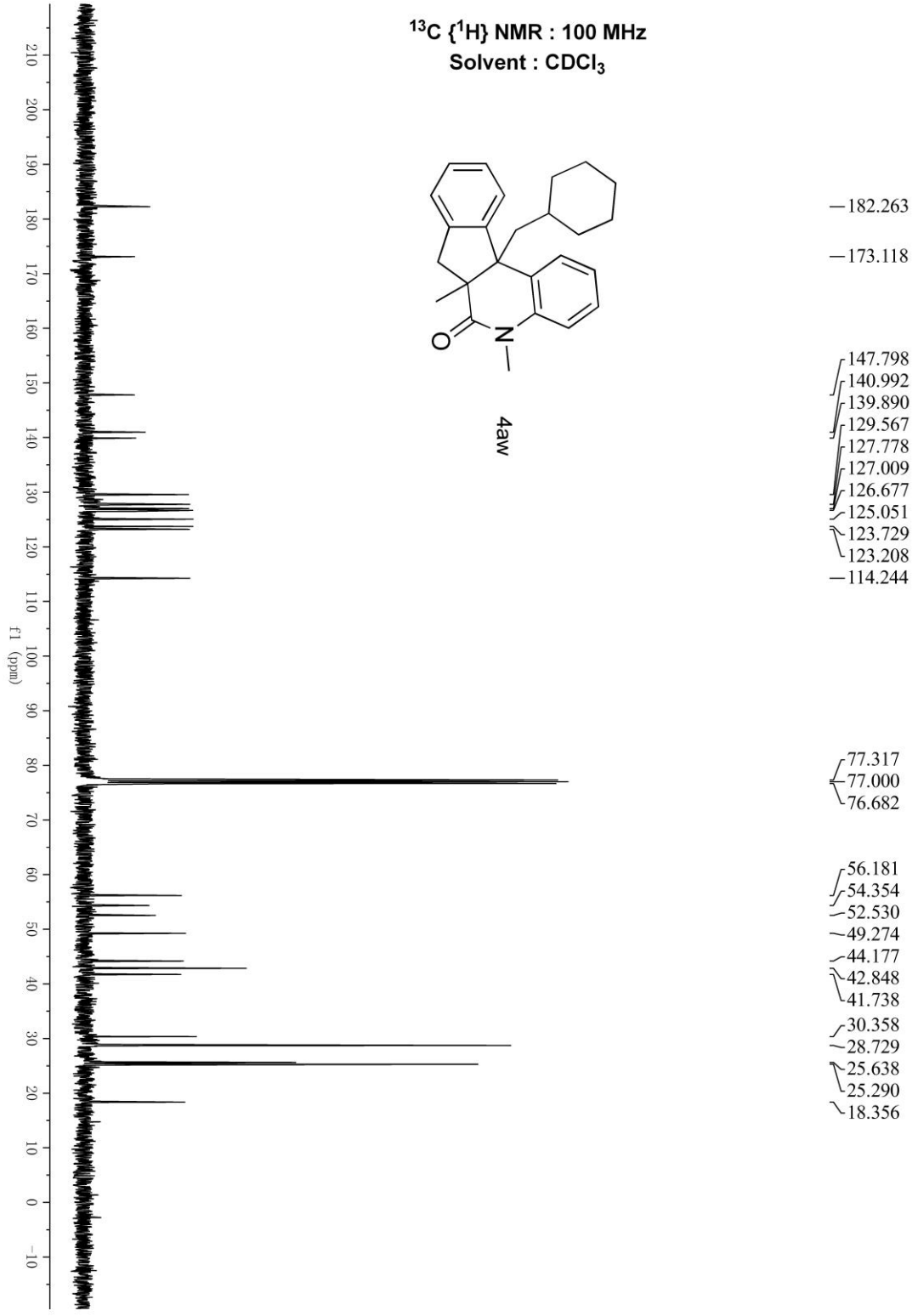
11b-(cyclopentylmethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4av)



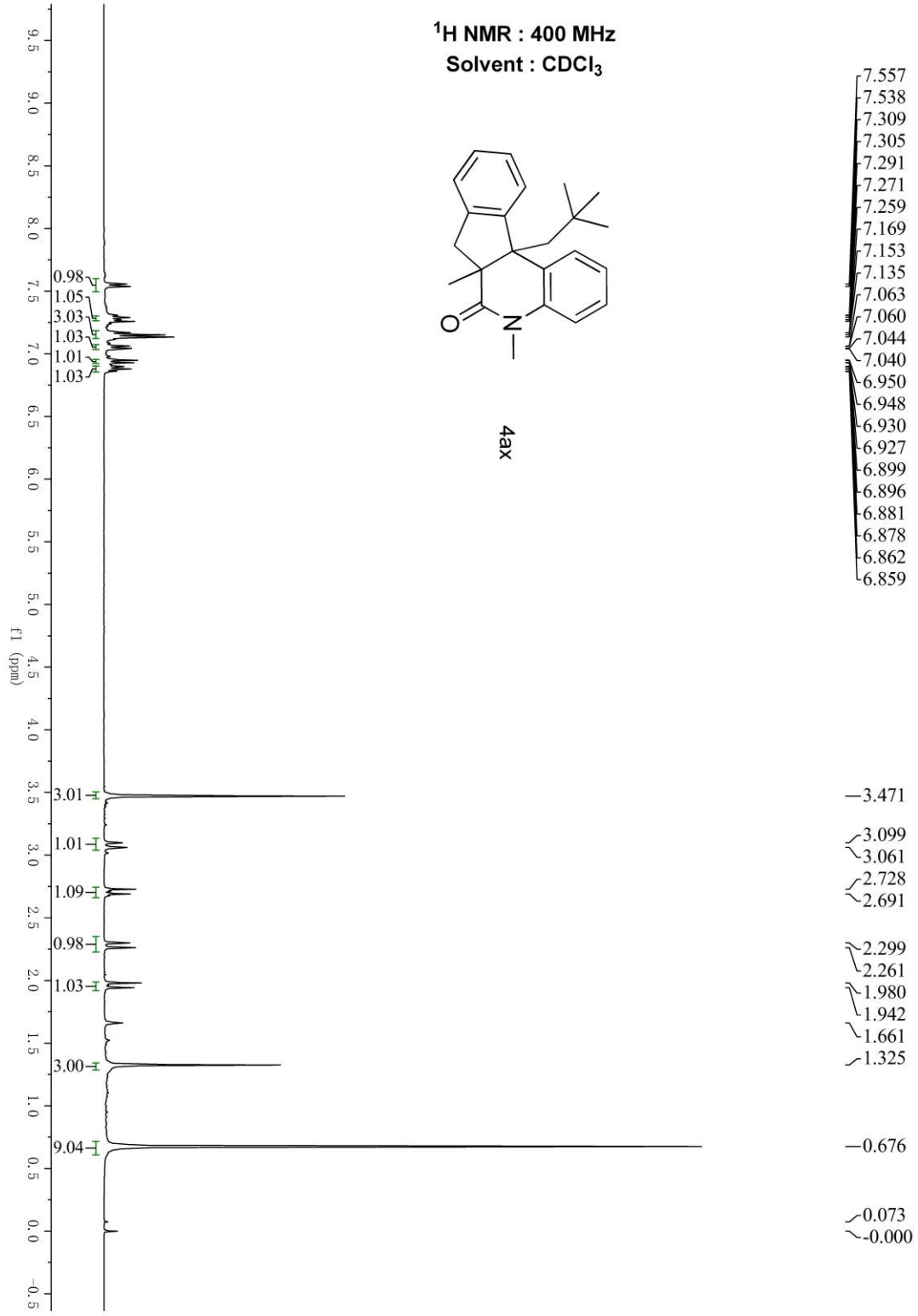

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
4av
f1 (ppm)
173.987
149.039
141.080
139.455
129.598
128.164
127.258
126.568
126.405
124.687
123.952
122.941
113.873
77.317
77.000
76.681
55.861
52.388
44.373
43.540
36.260
35.463
32.545
30.030
25.588
24.403
18.283

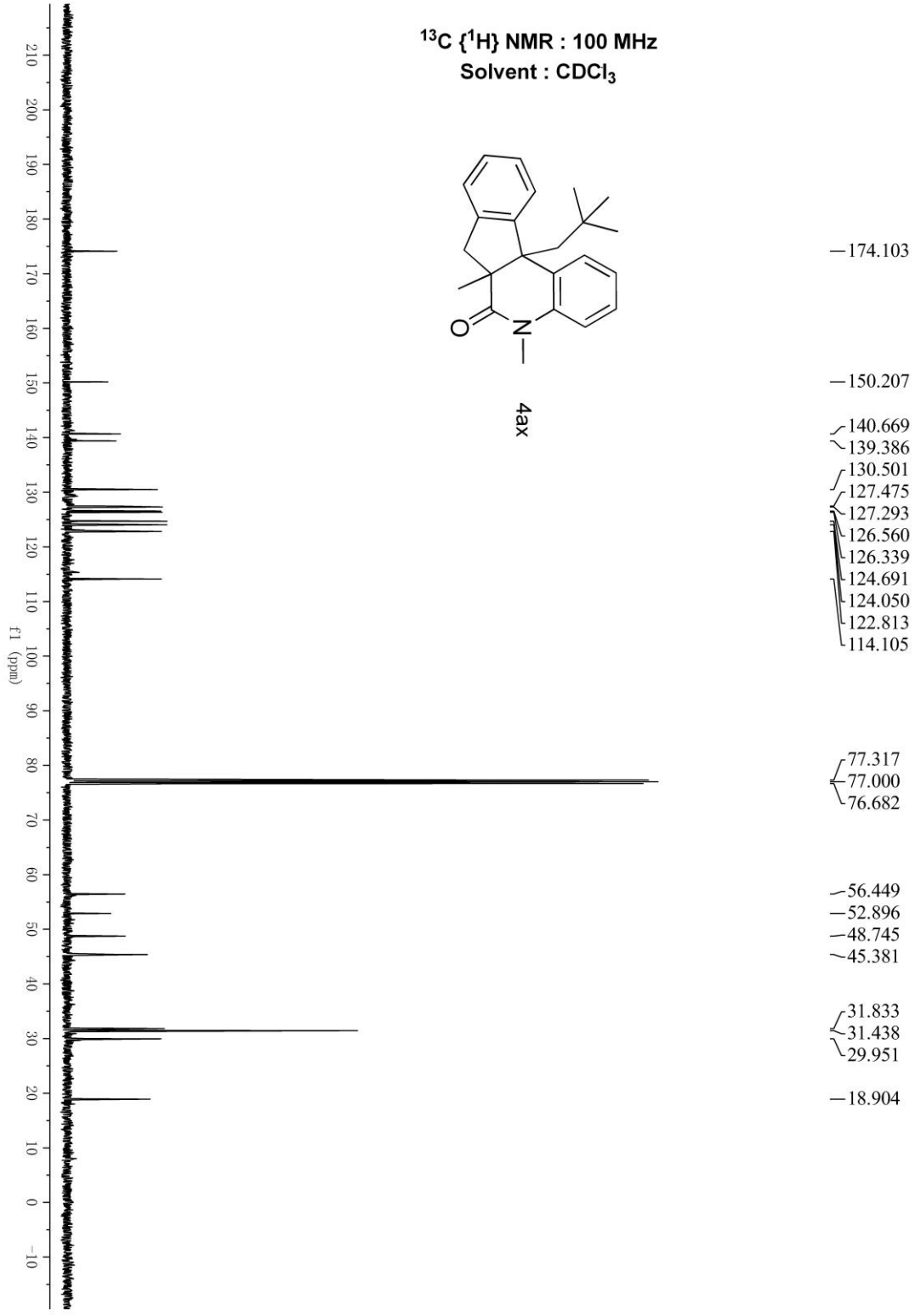
11b-(cyclohexylmethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4aw)



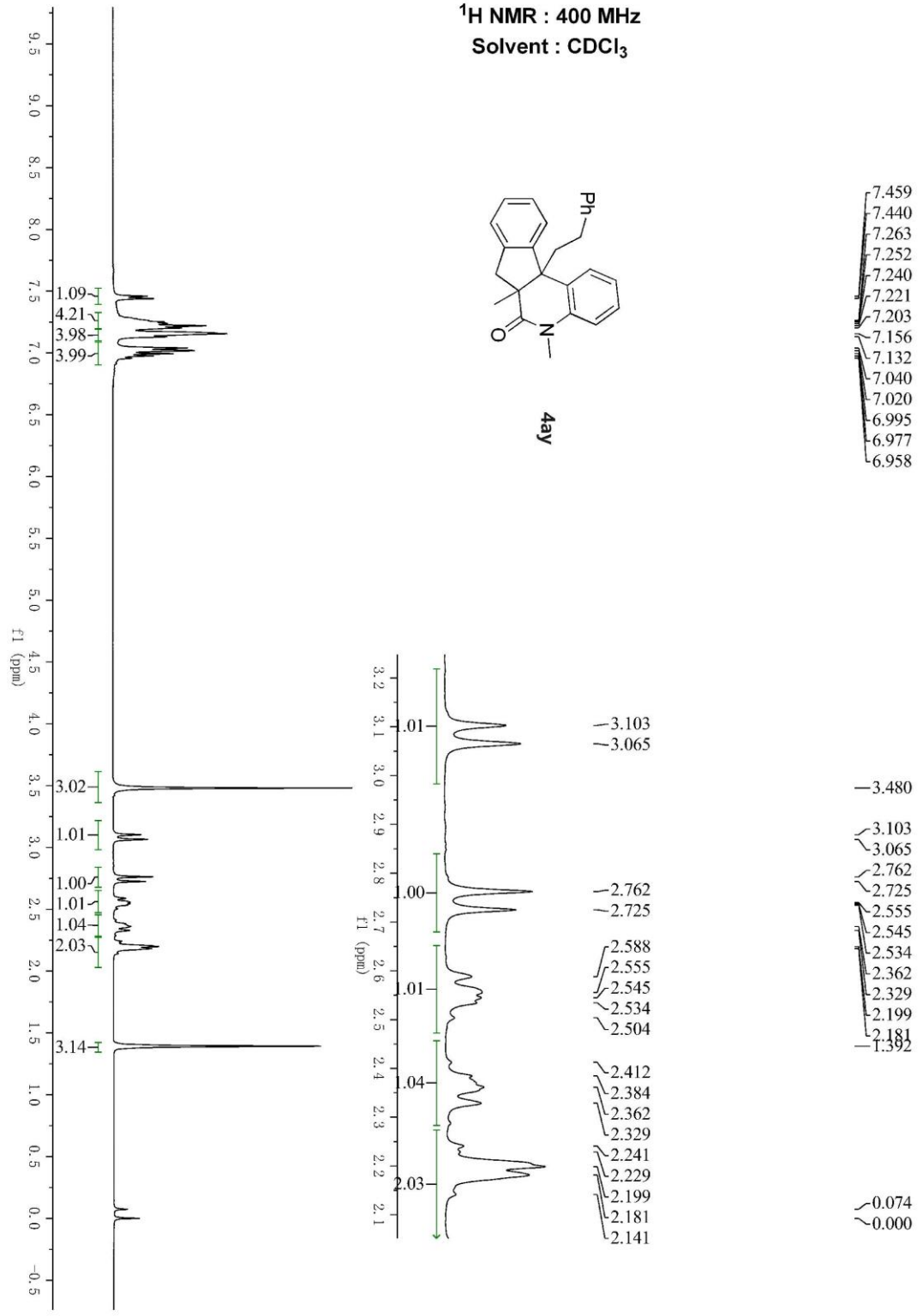

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
4aw
f1 (ppm)
182.263
173.118
147.798
140.992
139.890
129.567
127.778
127.009
126.677
125.051
123.729
123.208
114.244
77.317
77.000
76.682
56.181
54.354
52.530
49.274
44.177
42.848
41.738
30.358
28.729
25.638
25.290
18.356

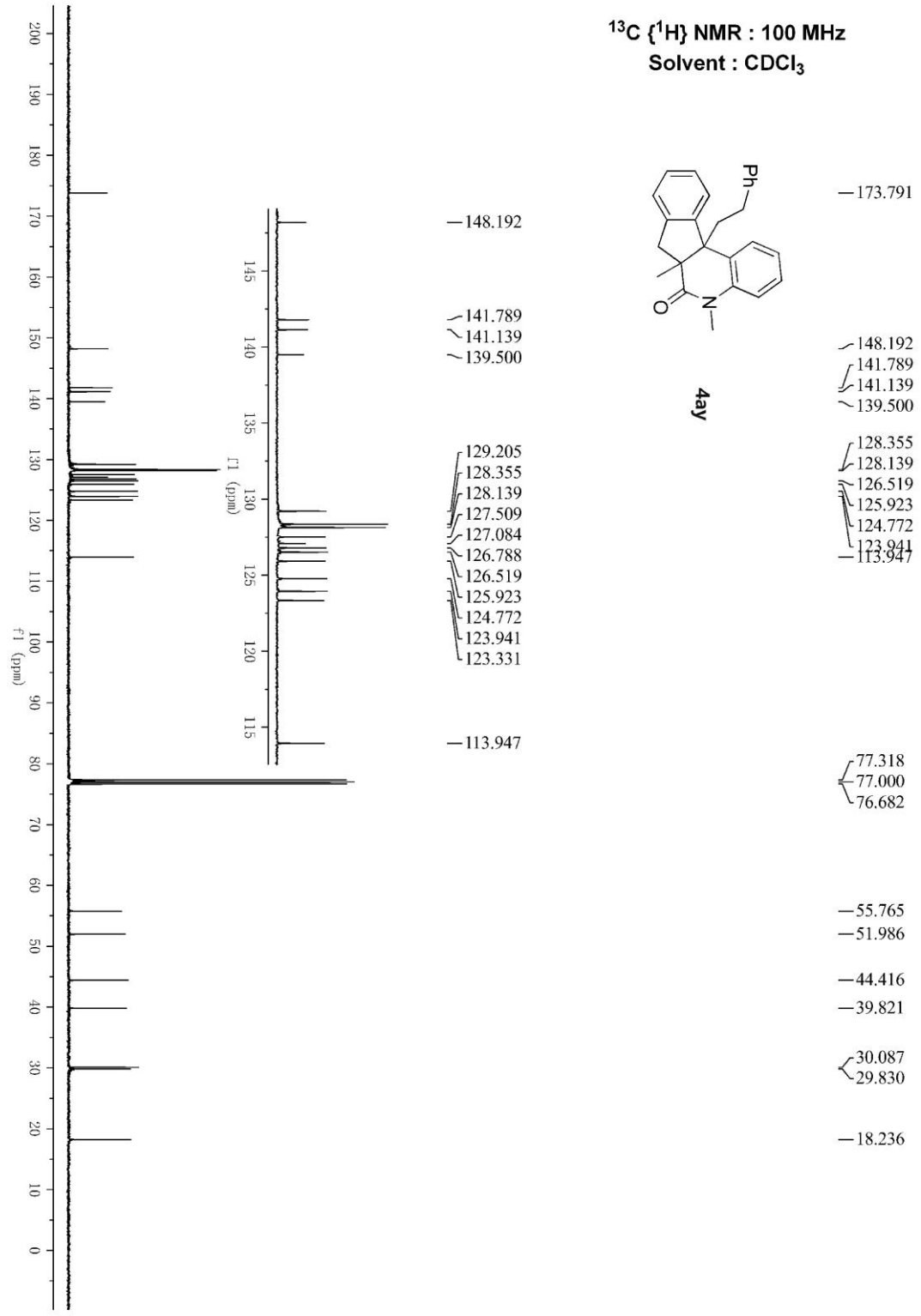
5,6a-dimethyl-11b-neopentyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4ax)



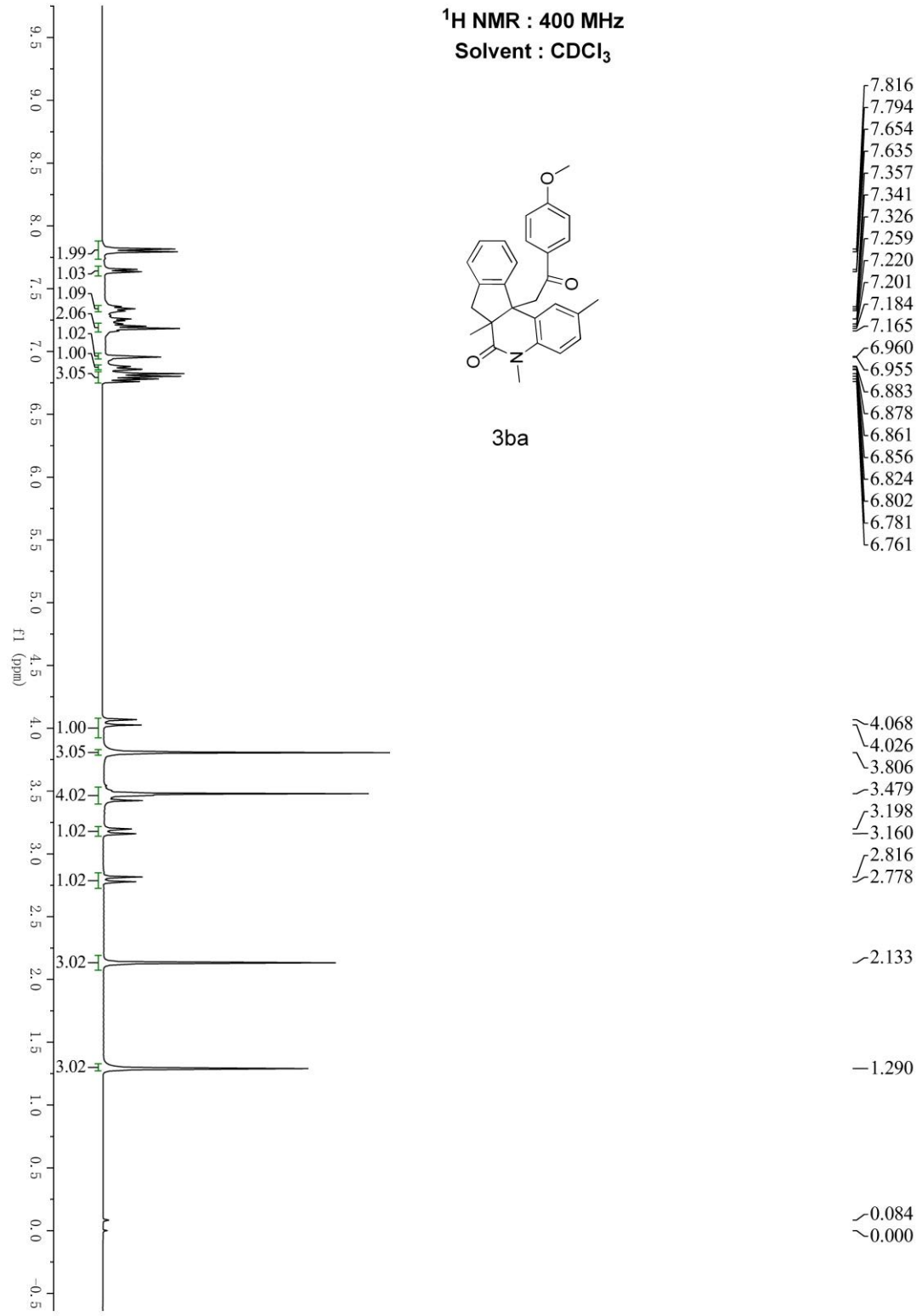

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
4ax
f1 (ppm)
174.103
150.207
140.669
139.386
130.501
127.475
127.293
126.560
126.339
124.691
124.050
122.813
114.105
77.317
77.000
76.682
56.449
52.896
48.745
45.381
31.833
31.438
29.951
18.904

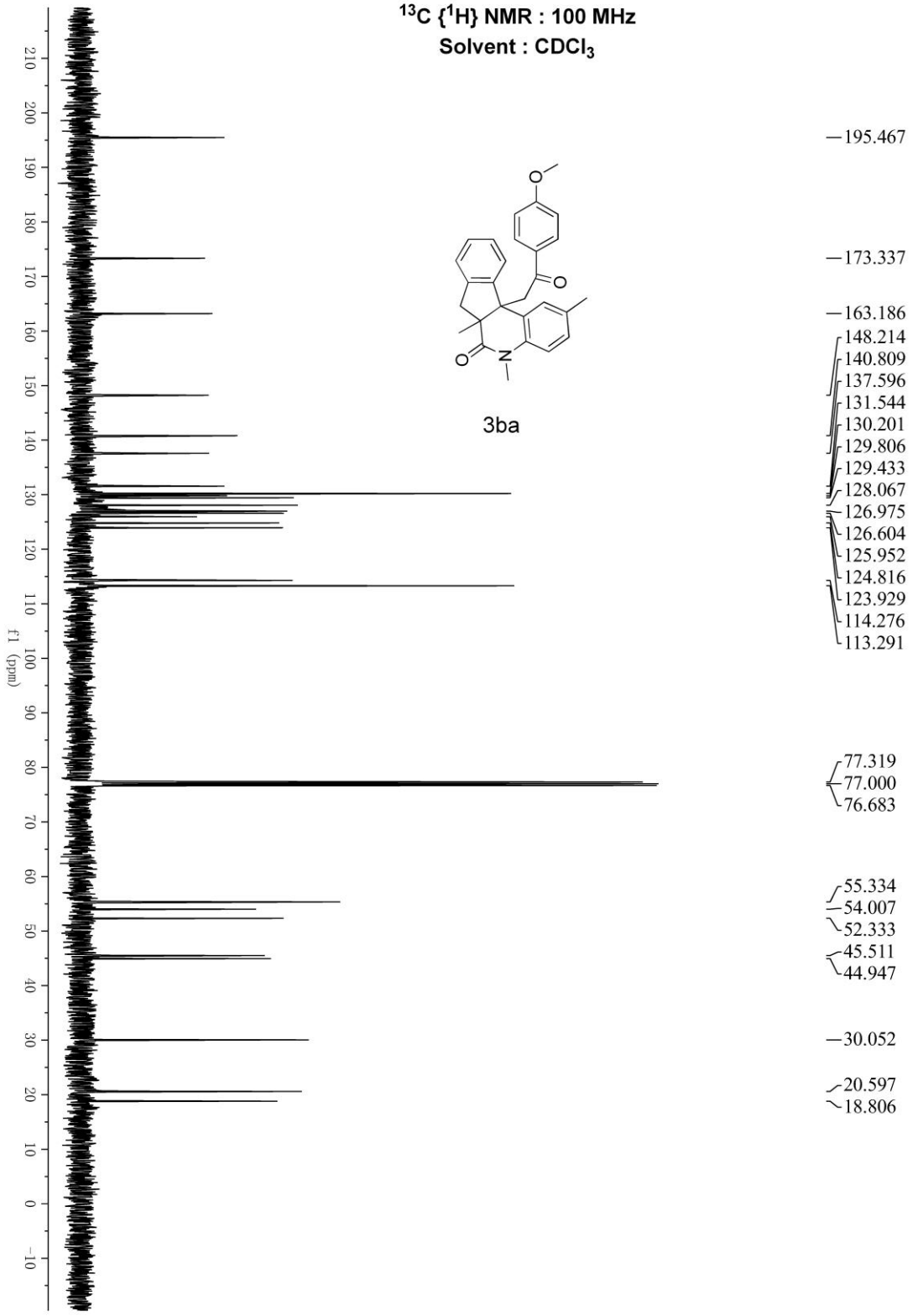
5,6a-dimethyl-11b-phenethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (4ay)



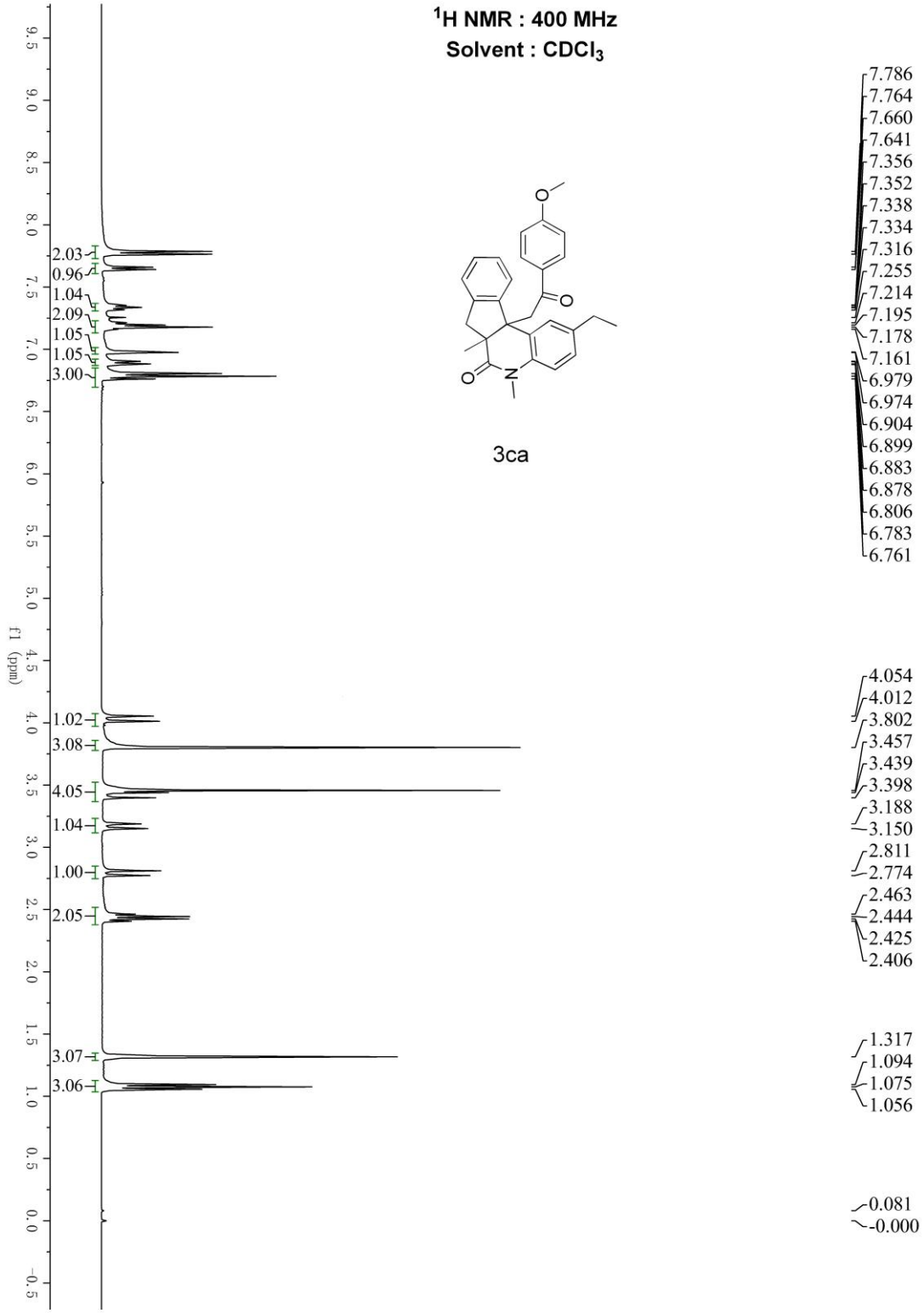

^{13}C {^{1}H} NMR : 100 MHz
Solvent : CDCl$_3$
Ph
O
N
4ay
173.791
148.192
141.789
141.139
139.500
129.205
128.355
128.139
127.509
127.084
126.788
126.519
125.923
124.772
123.941
123.331
113.947
77.318
77.000
76.682
55.765
51.986
44.416
39.821
30.087
29.830
18.236
f1 (ppm)

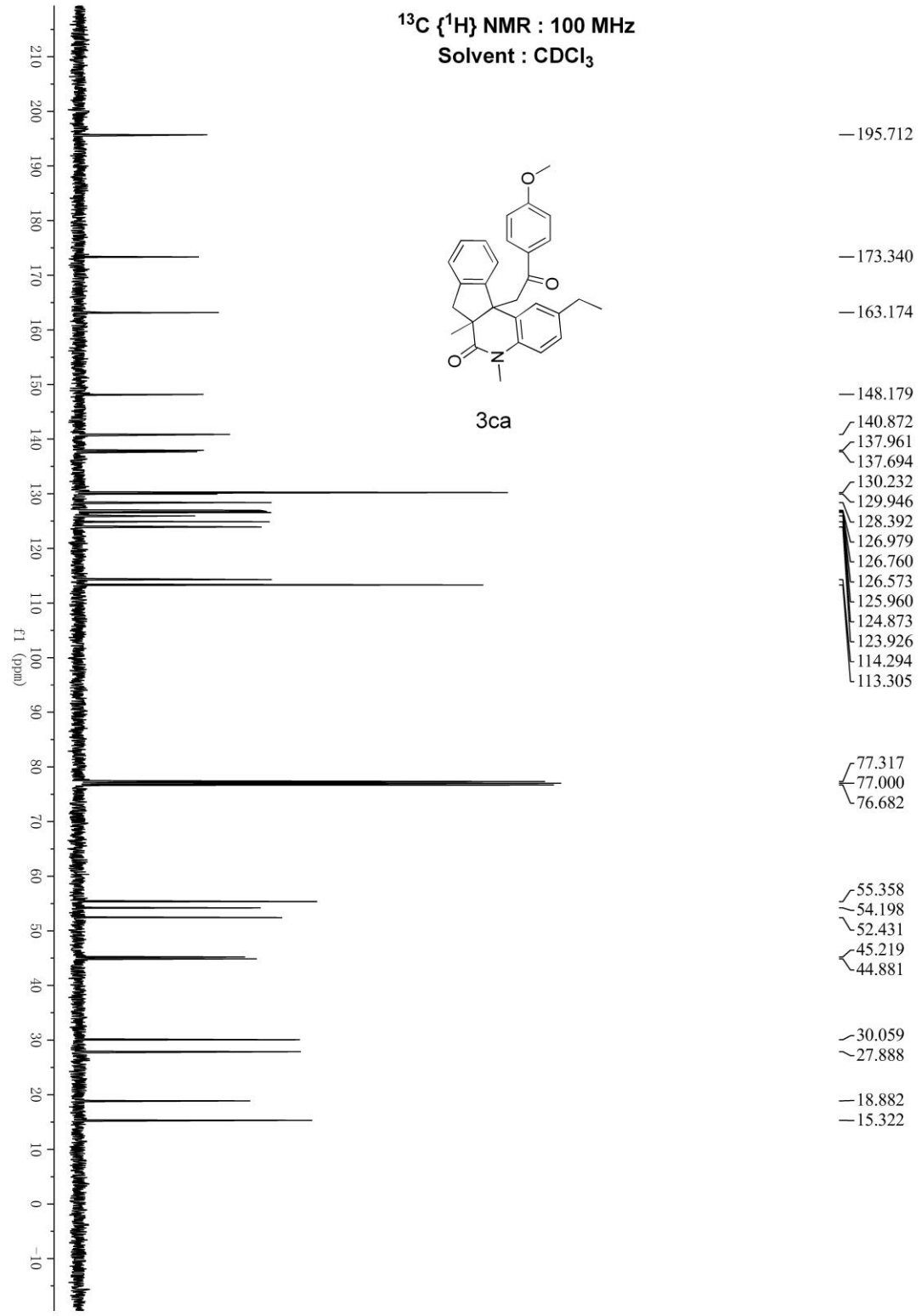
11b-(2-(4-methoxyphenyl)-2-oxoethyl)-2,5,6a-trimethyl-5,6a,7,11b-tetrahydro-6H -indeno[2,1-c]quinolin-6-one (3ba)



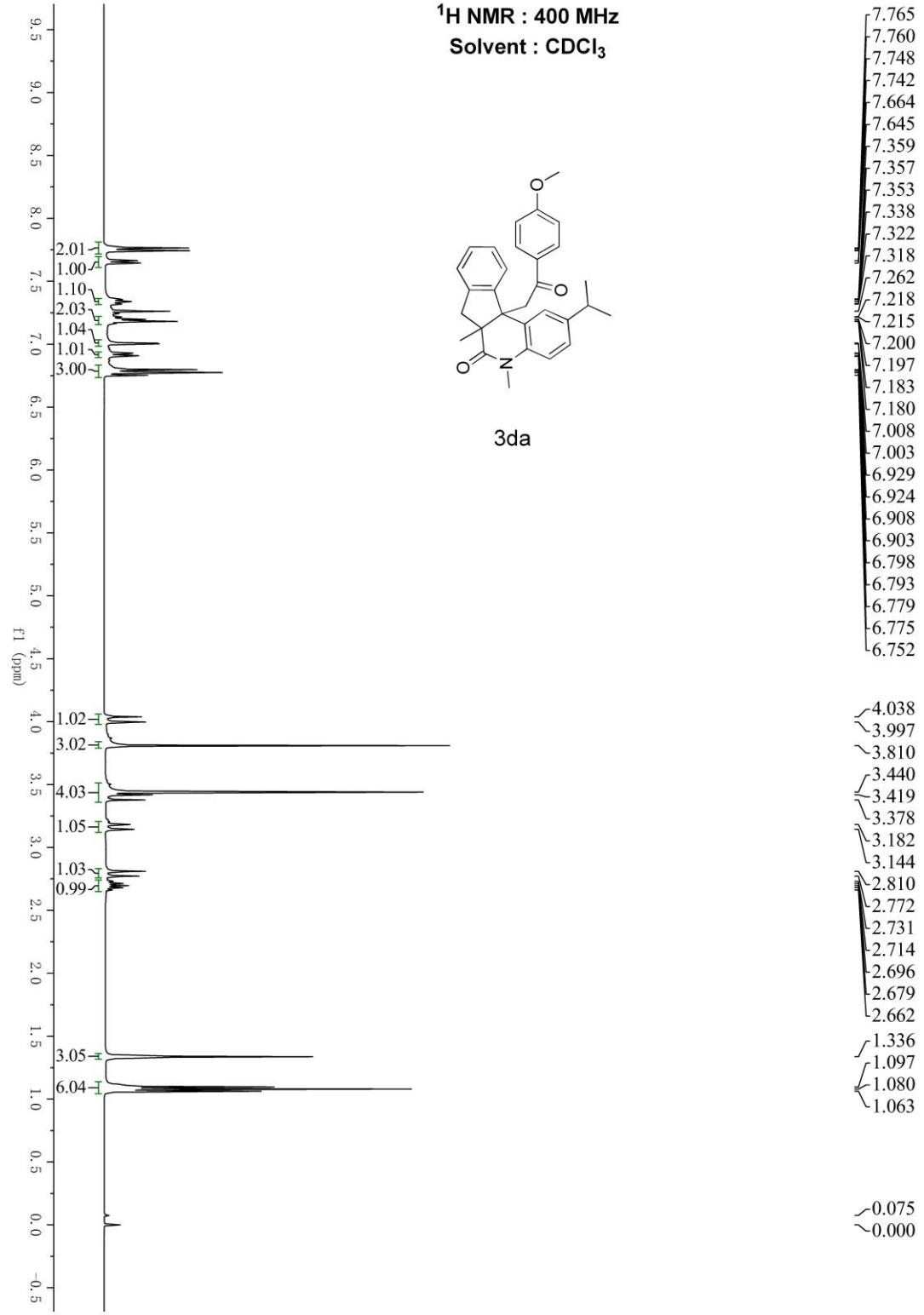

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ba
f1 (ppm)
195.467
173.337
163.186
148.214
140.809
137.596
131.544
130.201
129.806
129.433
128.067
126.975
126.604
125.952
124.816
123.929
114.276
113.291
77.319
77.000
76.683
55.334
54.007
52.333
45.511
44.947
30.052
20.597
18.806

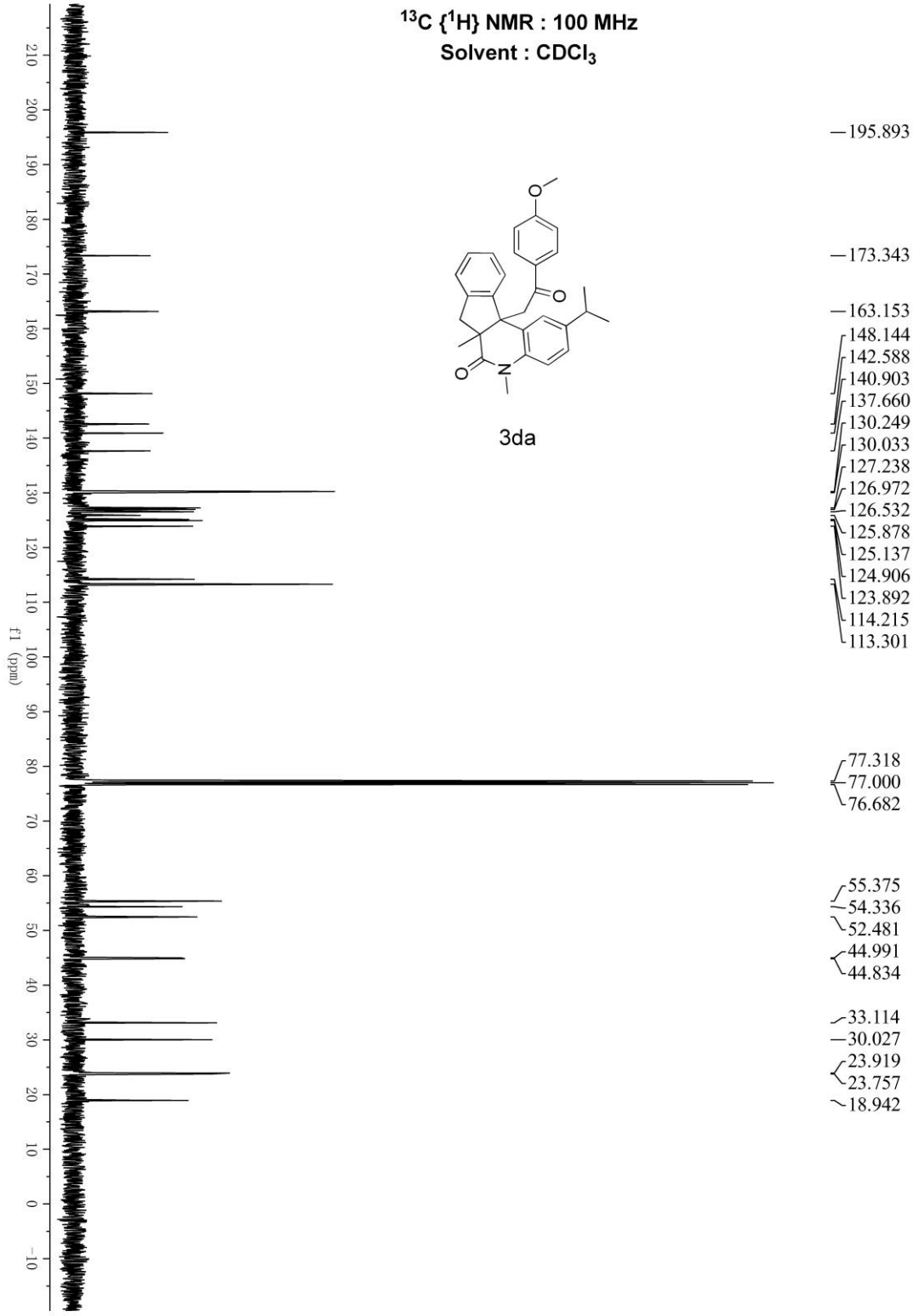
2-ethyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ca)



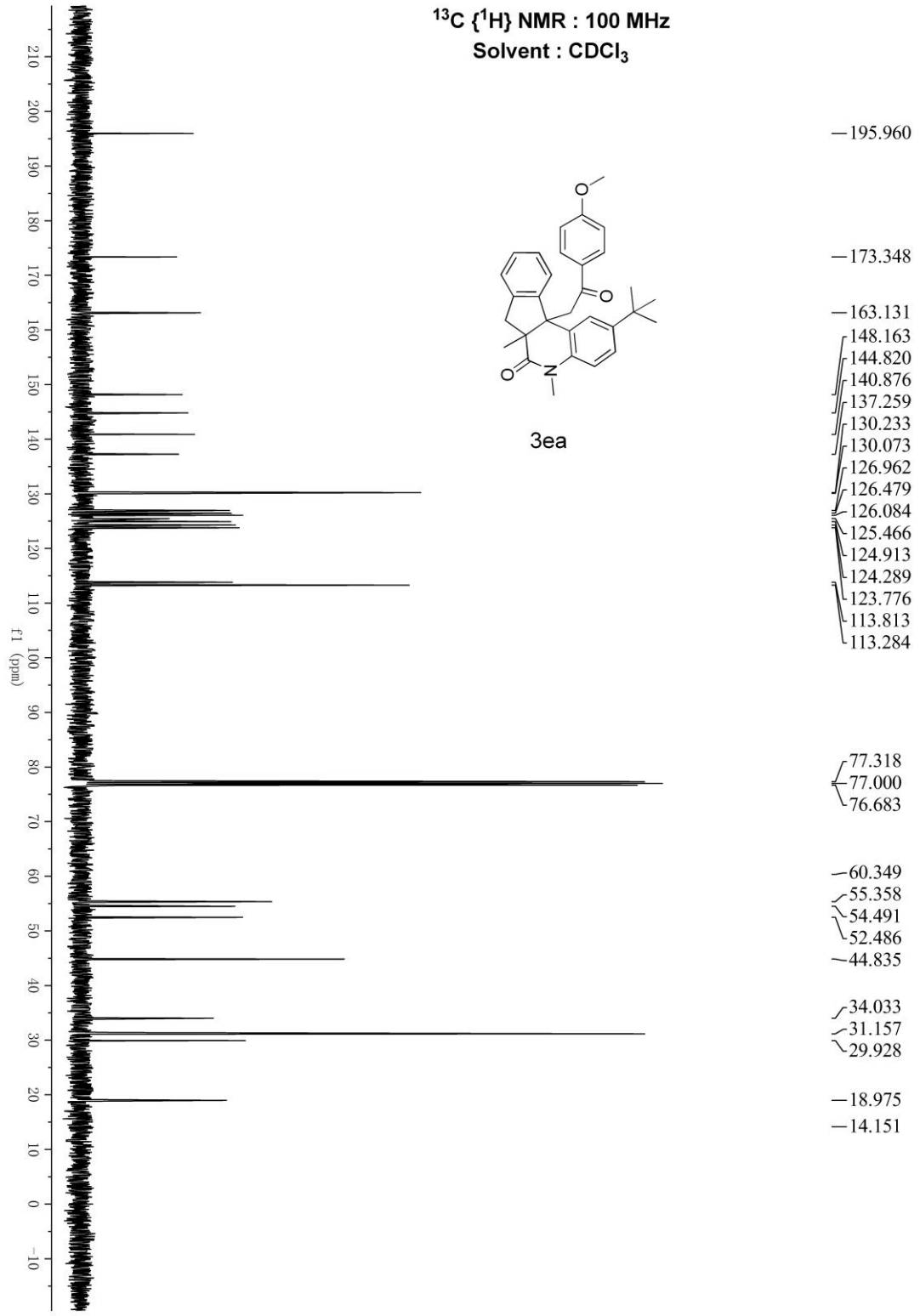

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ca
f1 (ppm)
195.712
173.340
163.174
148.179
140.872
137.961
137.694
130.232
129.946
128.392
126.979
126.760
126.573
125.960
124.873
123.926
114.294
113.305
77.317
77.000
76.682
55.358
54.198
52.431
45.219
44.881
30.059
27.888
18.882
15.322

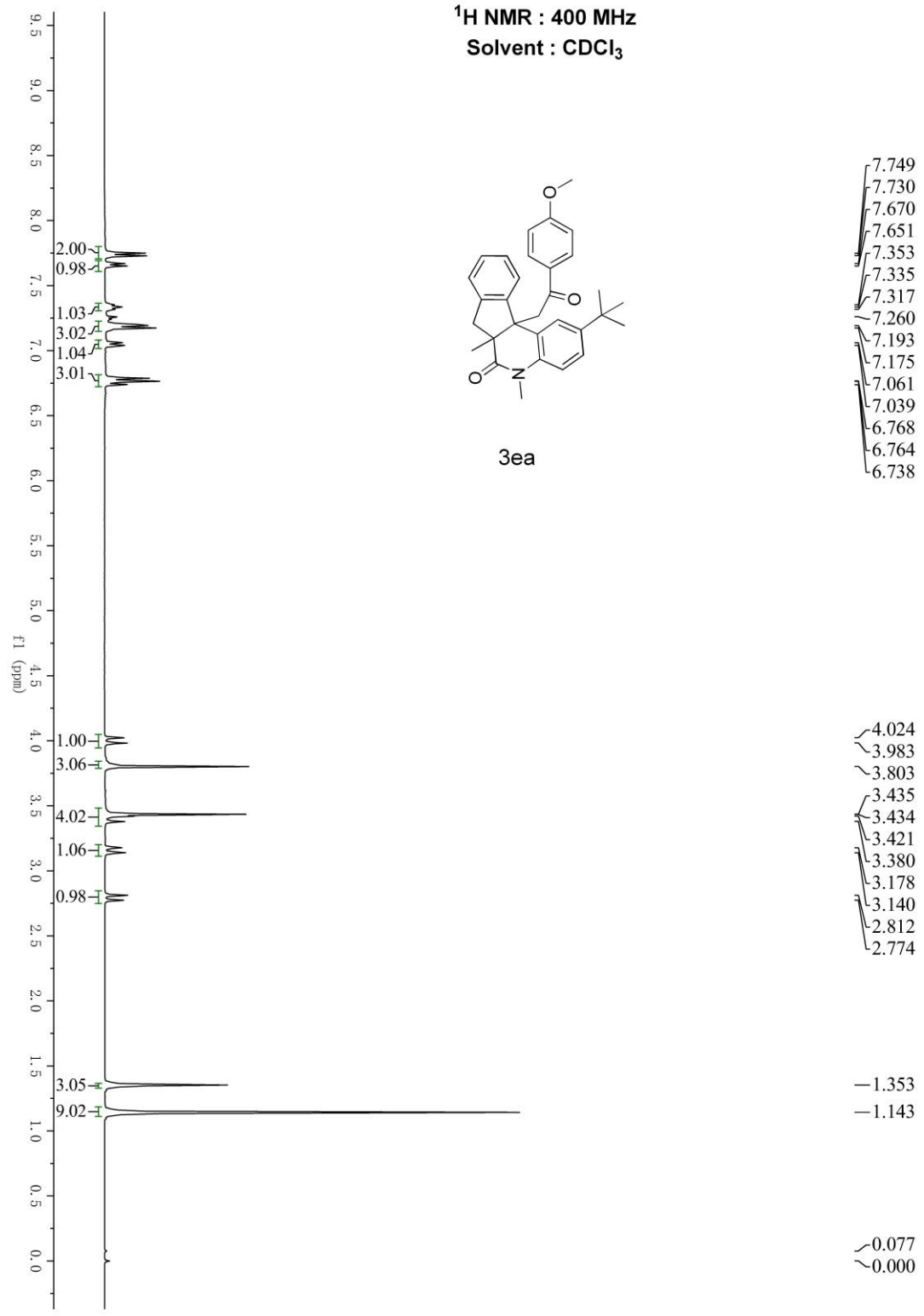
2-isopropyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetra hydro-6H-indeno[2,1-c]quinolin-6-one (3da)



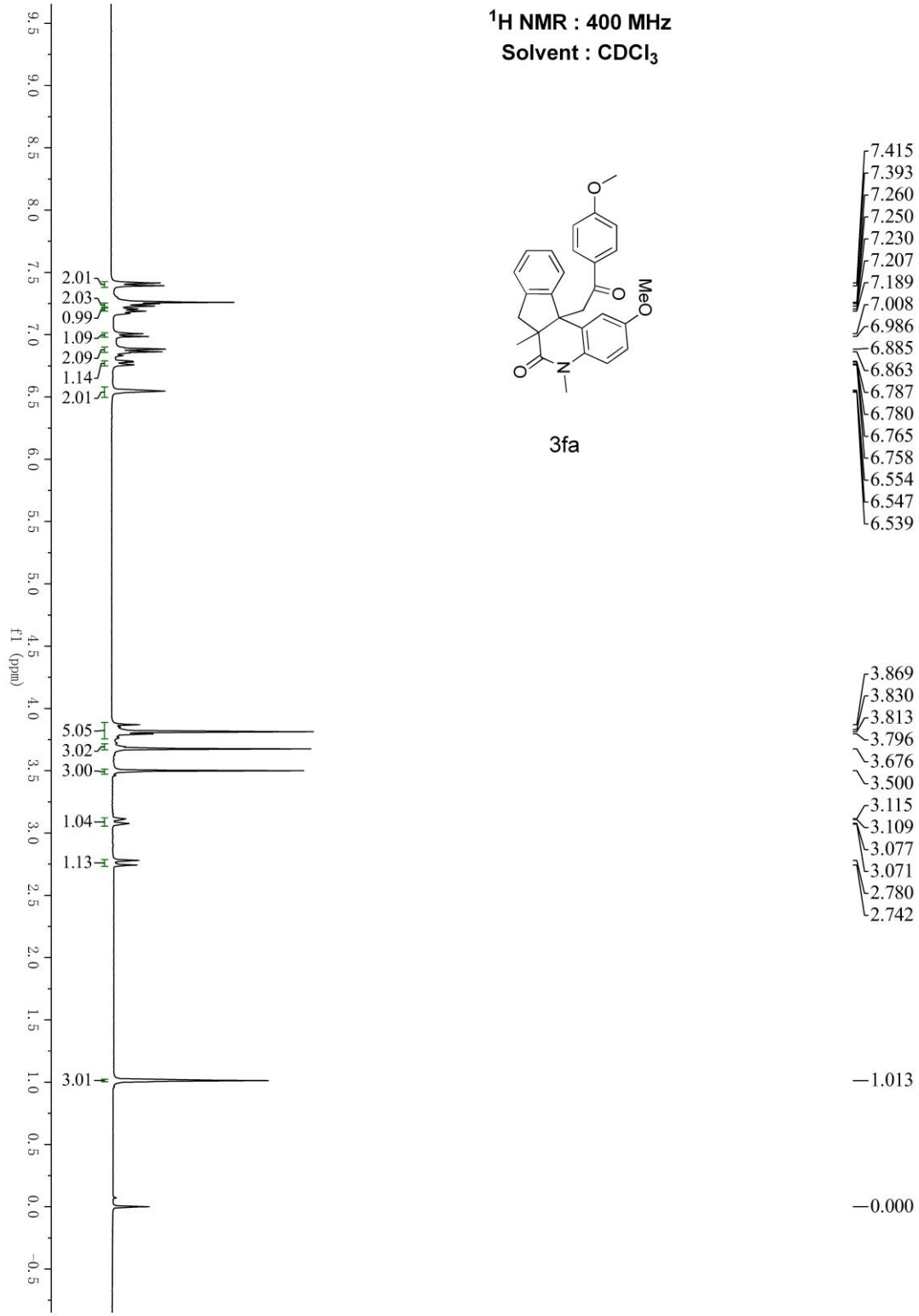

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3da
f1 (ppm)
195.893
173.343
163.153
148.144
142.588
140.903
137.660
130.249
130.033
127.238
126.972
126.532
125.878
125.137
124.906
123.892
114.215
113.301
77.318
77.000
76.682
55.375
54.336
52.481
44.991
44.834
33.114
30.027
23.919
23.757
18.942

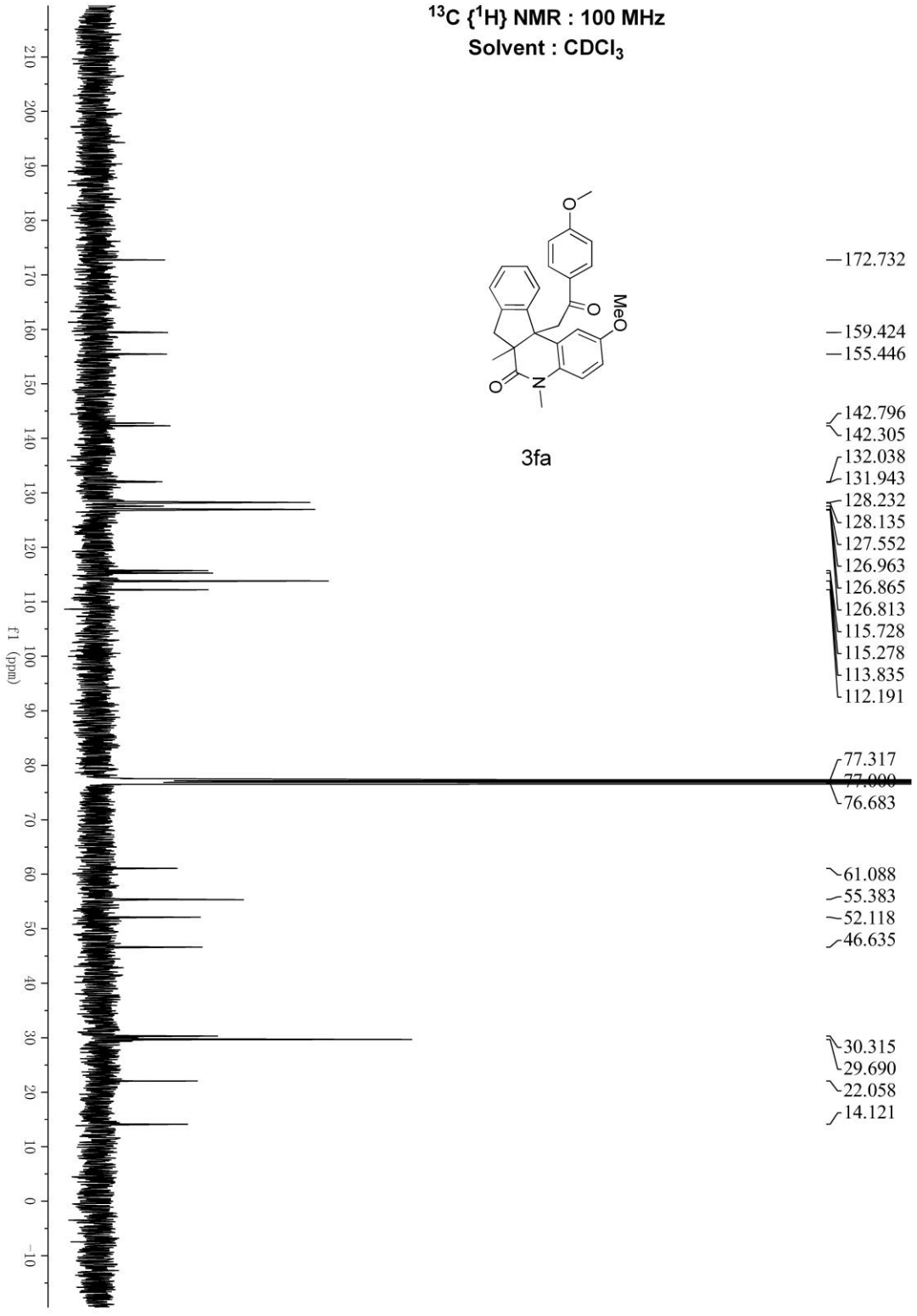
2-(tert-butyl)-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ea)



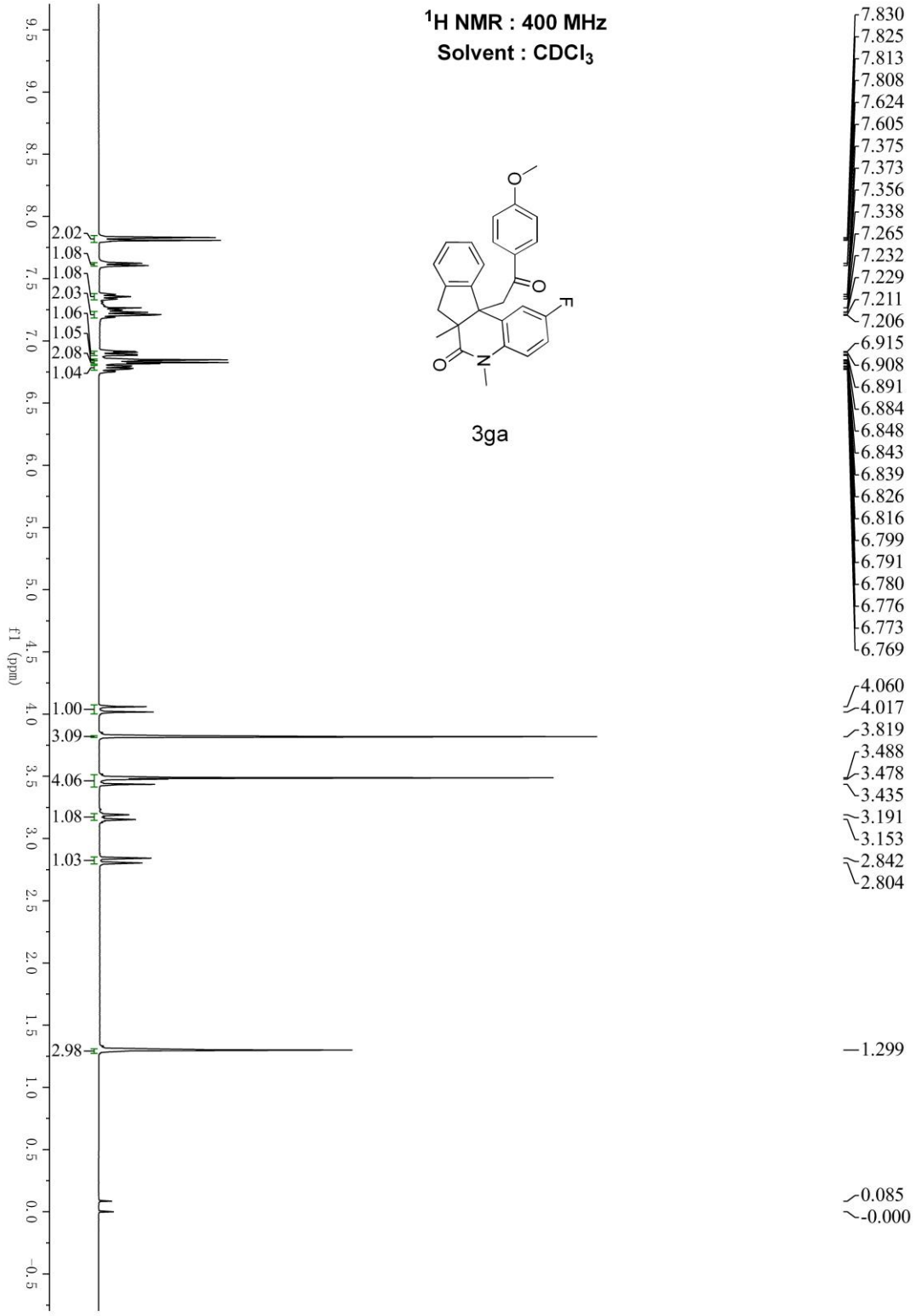

^{1}H NMR : 400 MHz
Solvent : $CDCl_3$
3ea
f1 (ppm)
2.00
0.98
1.03
3.02
1.04
3.01
1.00
3.06
4.02
1.06
0.98
3.05
9.02
7.749
7.730
7.670
7.651
7.353
7.335
7.317
7.260
7.193
7.175
7.061
7.039
6.768
6.764
6.738
4.024
3.983
3.803
3.435
3.434
3.421
3.380
3.178
3.140
2.812
2.774
1.353
1.143
0.077
0.000

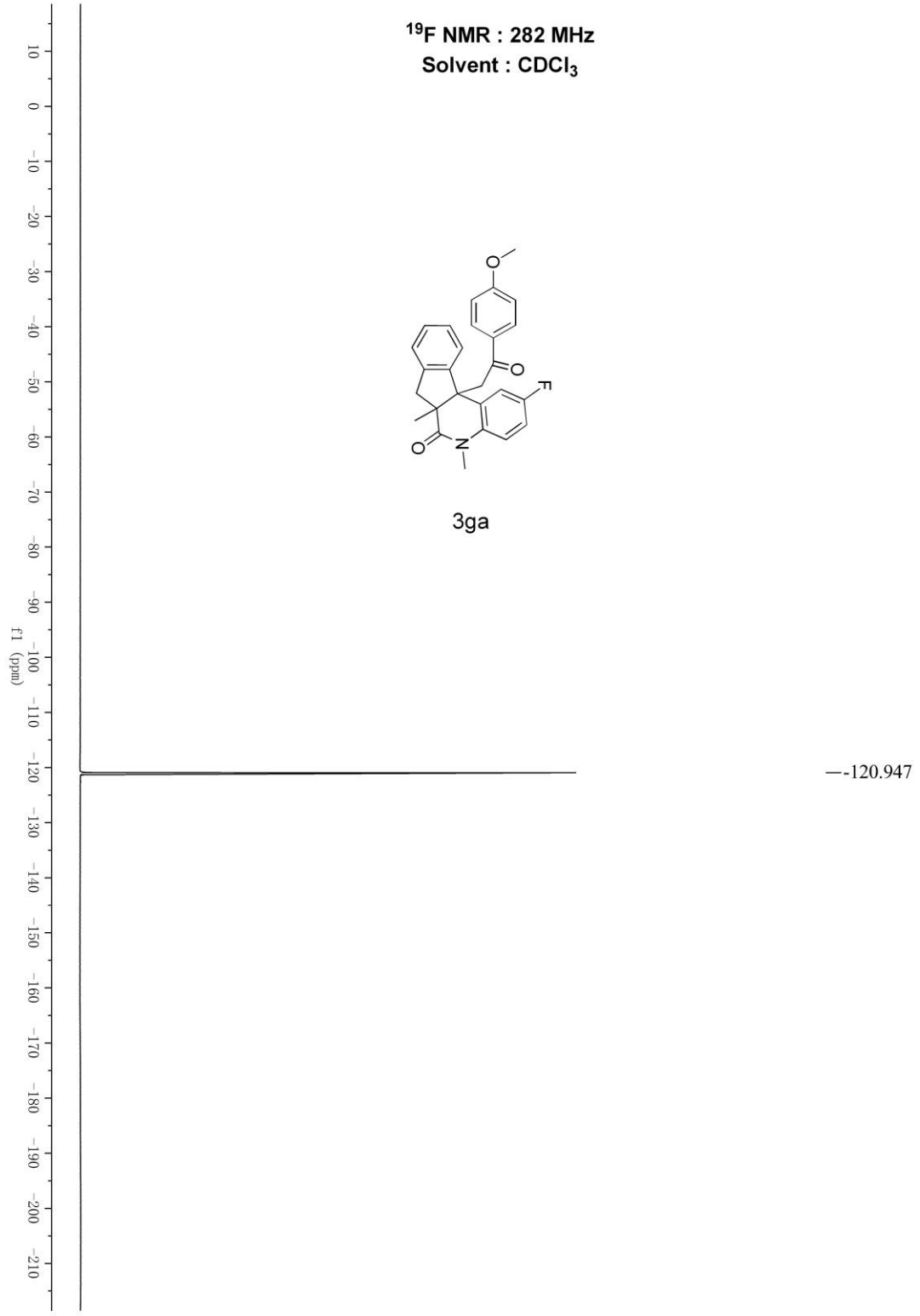
2-methoxy-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetra hydro-6H-indeno[2,1-c]quinolin-6-one (3fa)

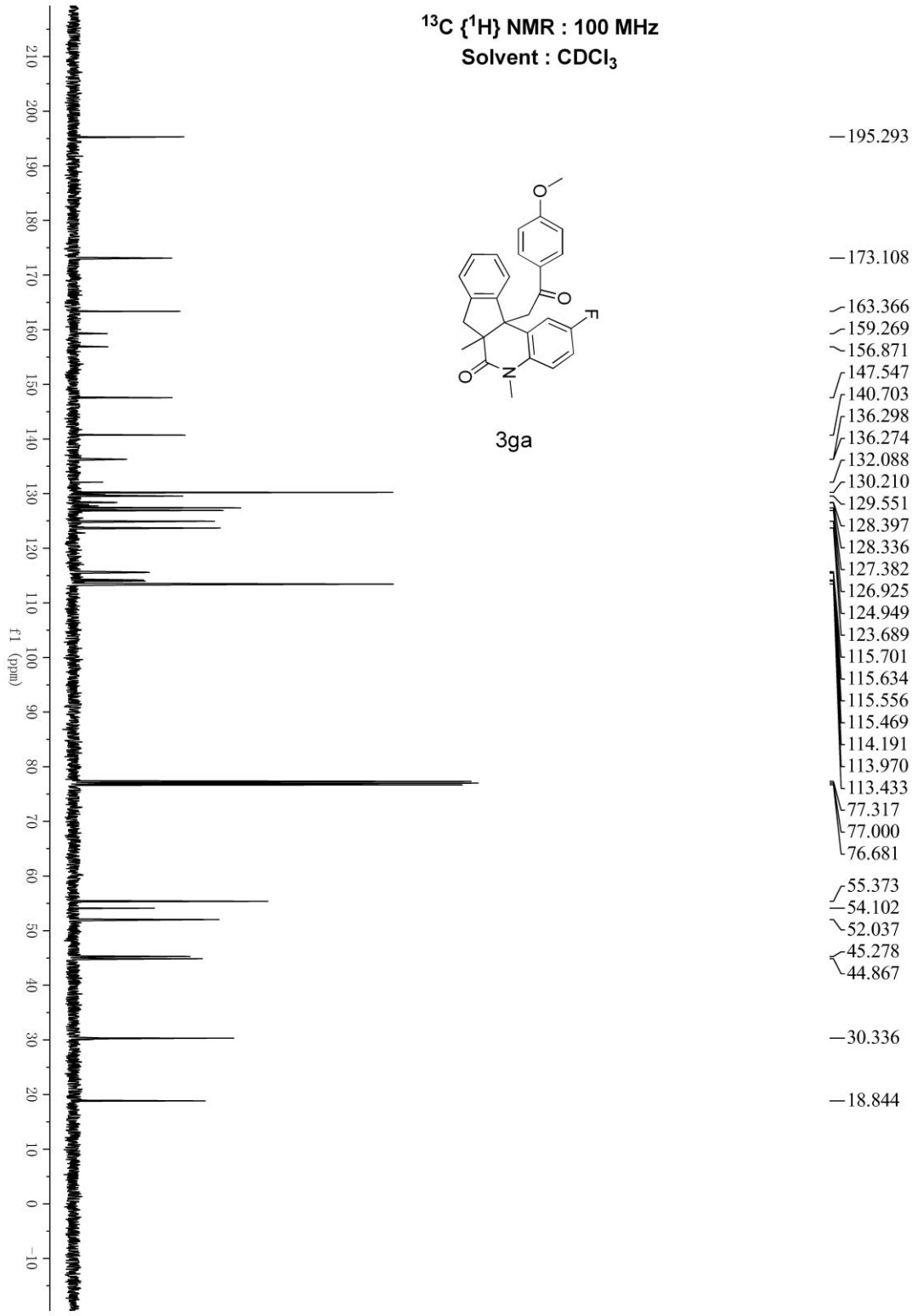



13C {1H} NMR : 100 MHz
Solvent : CDCl3
MeO
3fa
f1 (ppm)
172.732
159.424
155.446
142.796
142.305
132.038
131.943
128.232
128.135
127.552
126.963
126.865
126.813
115.728
115.278
113.835
112.191
77.317
77.000
76.683
61.088
55.383
52.118
46.635
30.315
29.690
22.058
14.121

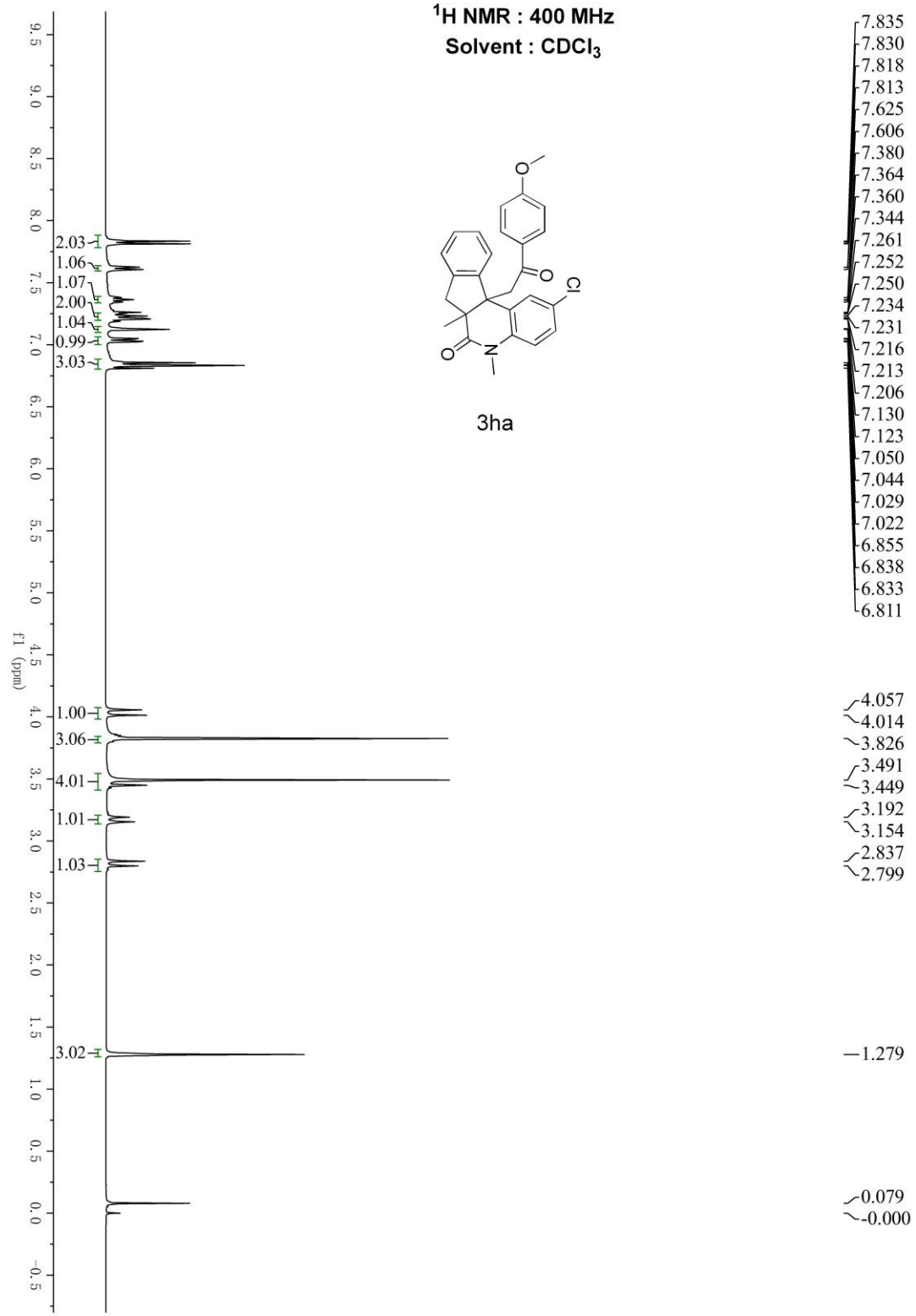
2-fluoro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ga)

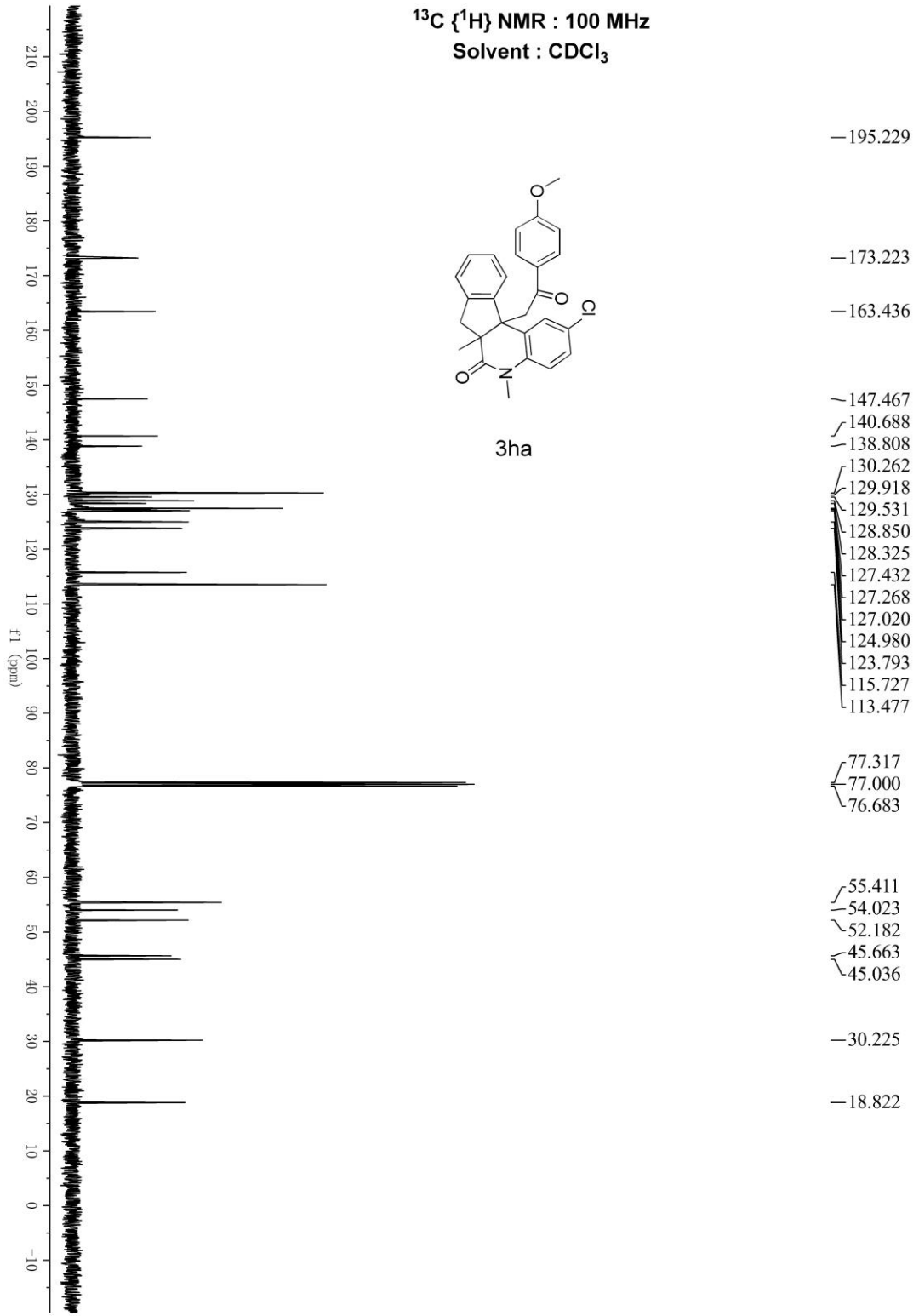



19F NMR : 282 MHz
Solvent : CDCl3
3ga
-120.947
f1 (ppm)

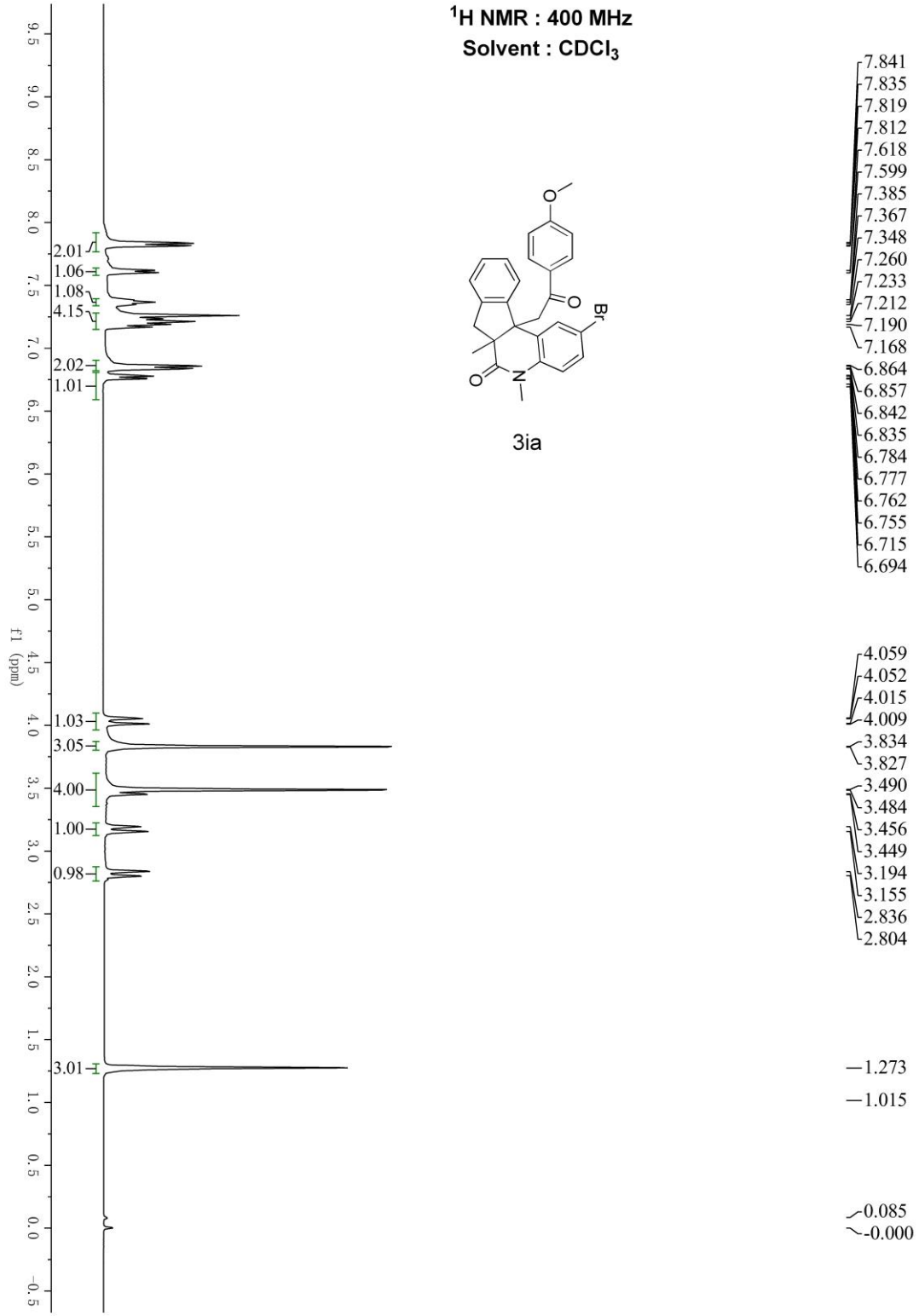

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ga
f1 (ppm)
195.293
173.108
163.366
159.269
156.871
147.547
140.703
136.298
136.274
132.088
130.210
129.551
128.397
128.336
127.382
126.925
124.949
123.689
115.701
115.634
115.556
115.469
114.191
113.970
113.433
77.317
77.000
76.681
55.373
54.102
52.037
45.278
44.867
30.336
18.844

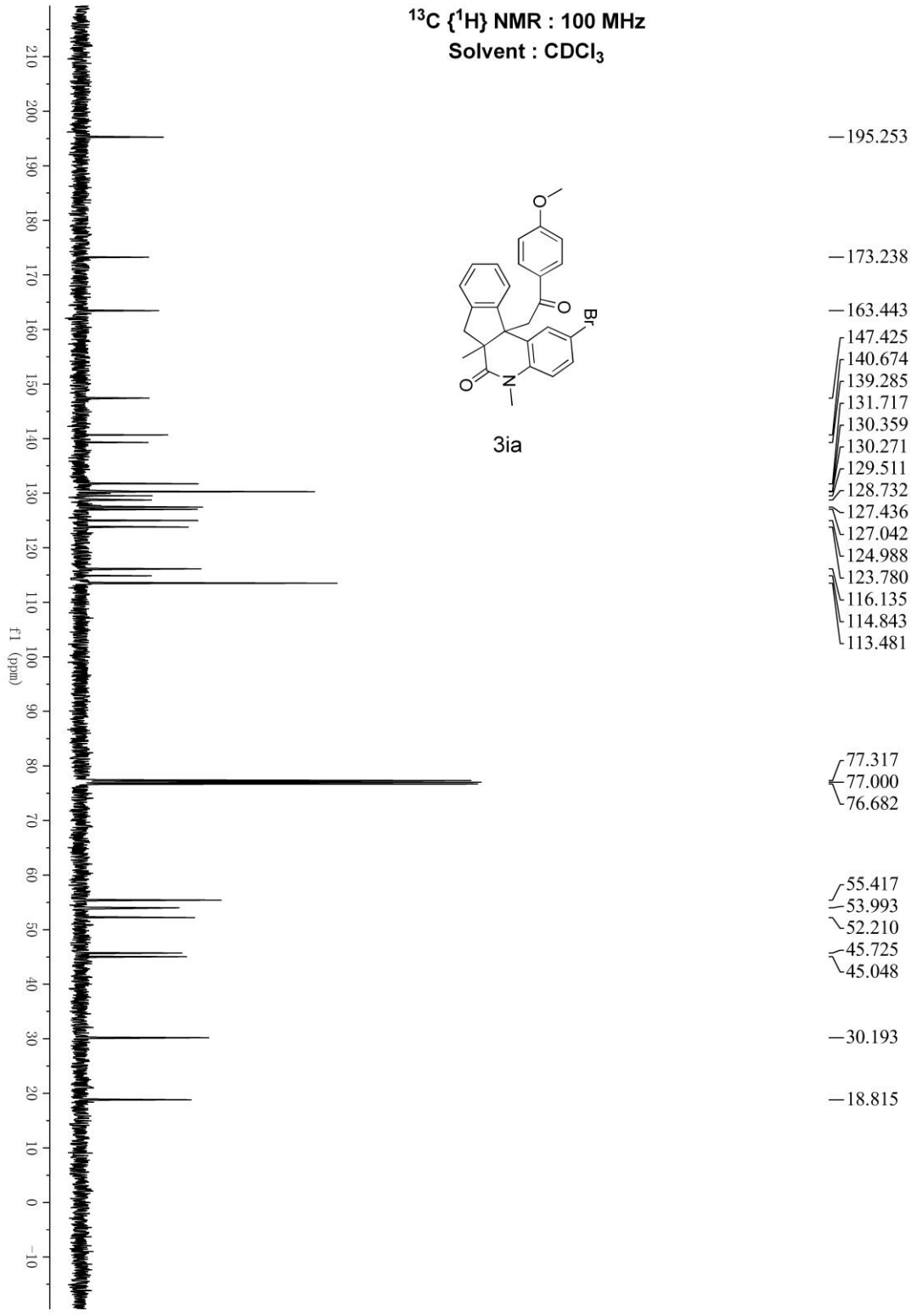
2-chloro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ha)



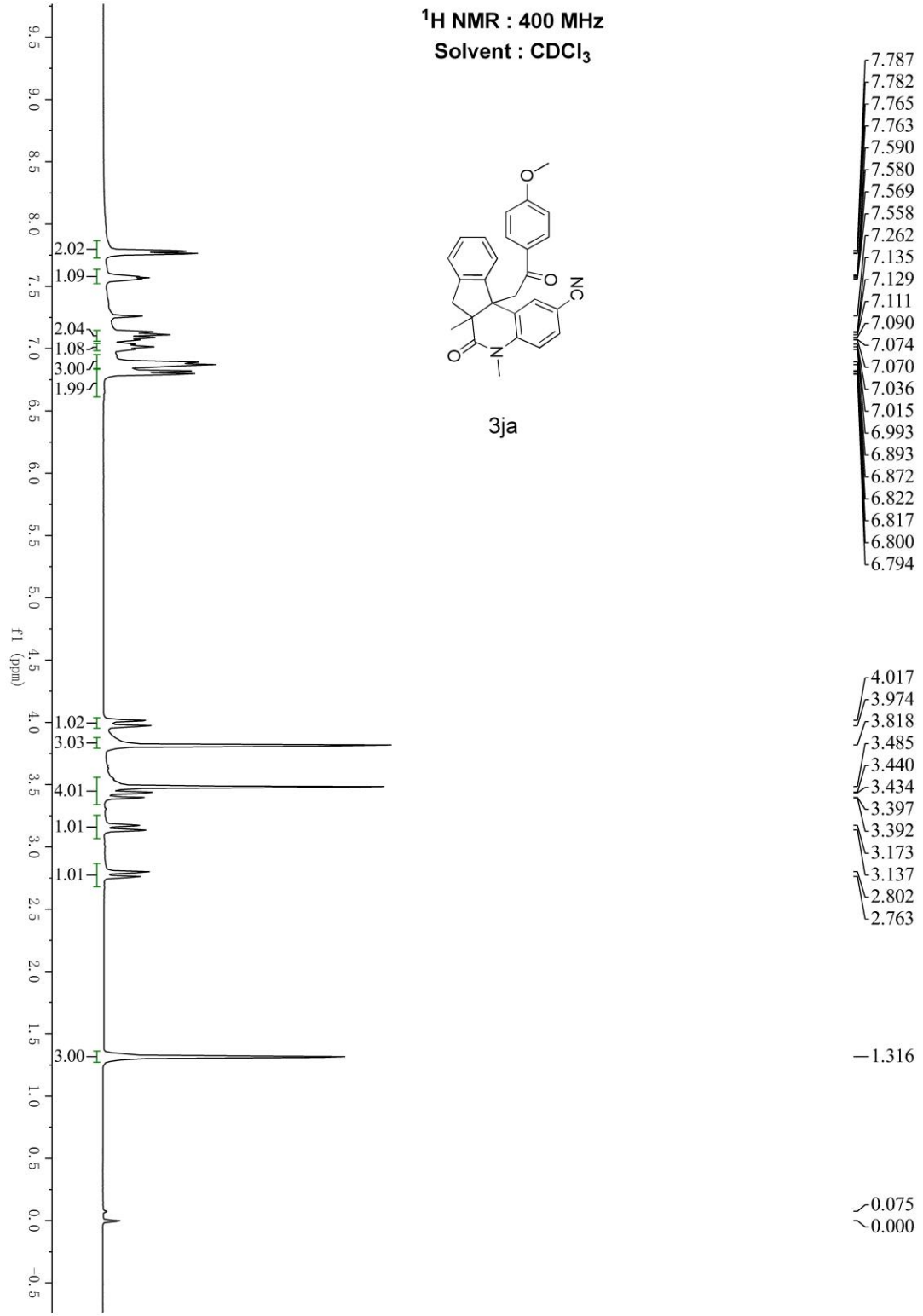

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ha
195.229
173.223
163.436
147.467
140.688
138.808
130.262
129.918
129.531
128.850
128.325
127.432
127.268
127.020
124.980
123.793
115.727
113.477
77.317
77.000
76.683
55.411
54.023
52.182
45.663
45.036
30.225
18.822
f1 (ppm)

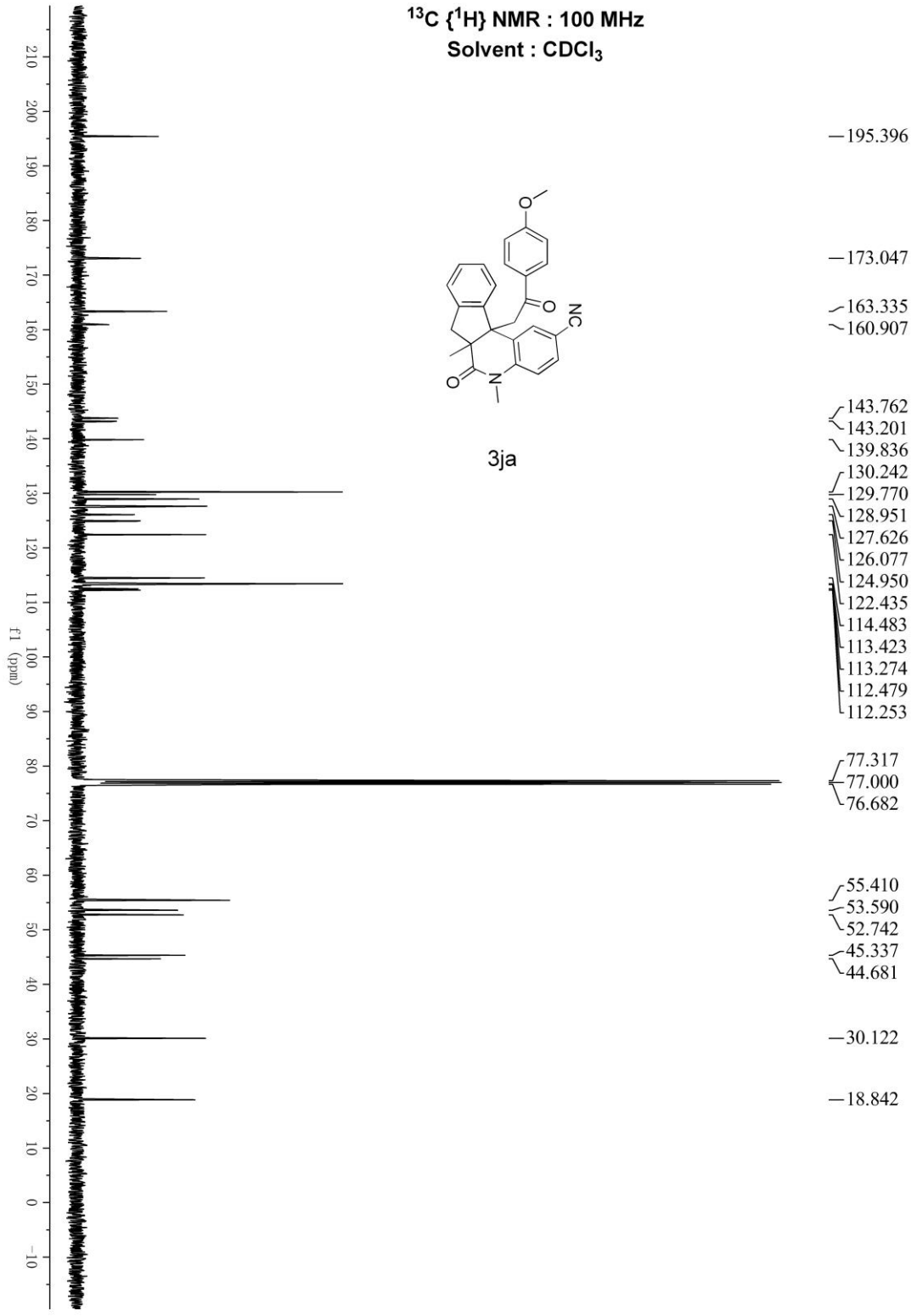
2-bromo-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ia)



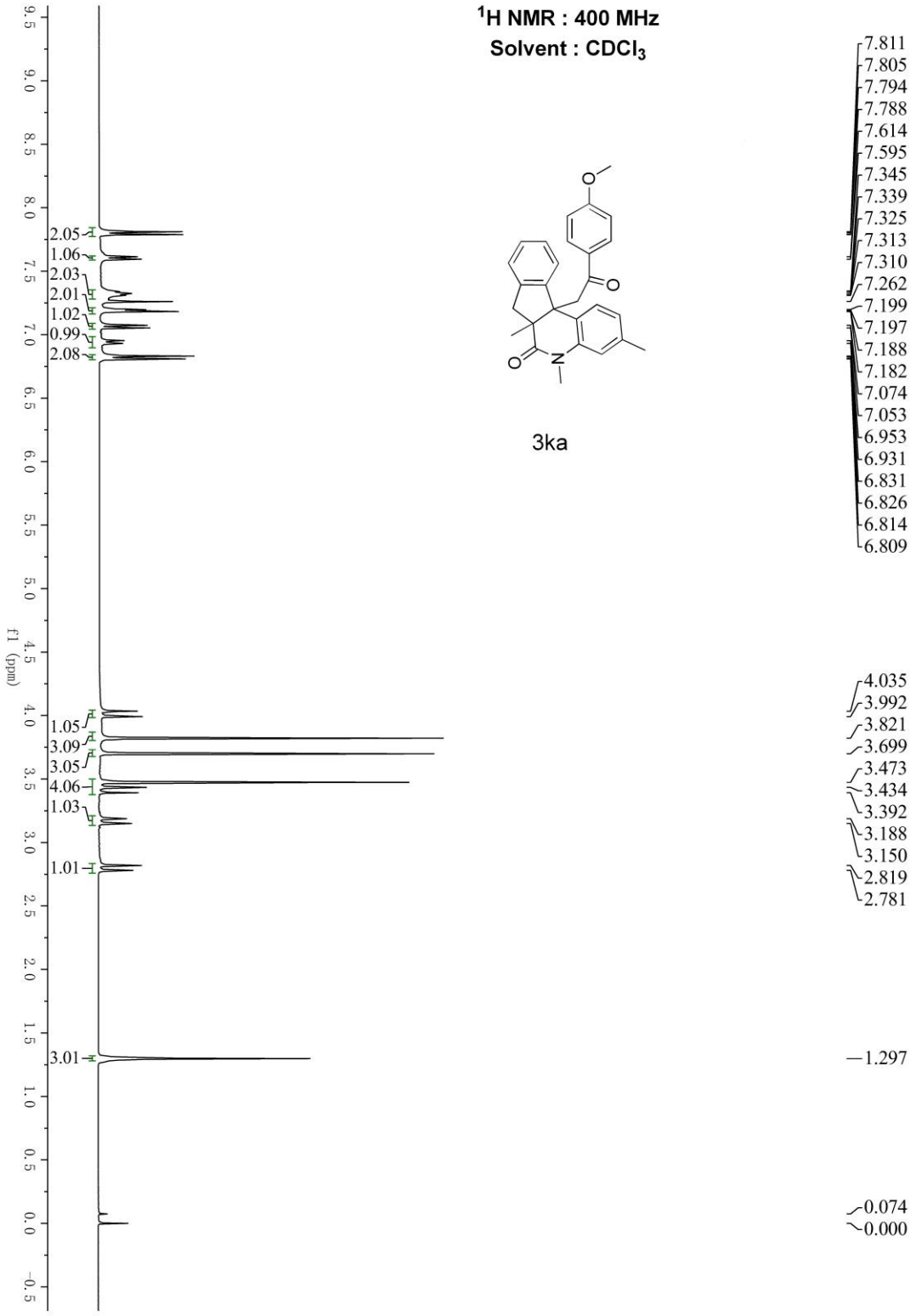

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ia
195.253
173.238
163.443
147.425
140.674
139.285
131.717
130.359
130.271
129.511
128.732
127.436
127.042
124.988
123.780
116.135
114.843
113.481
77.317
77.000
76.682
55.417
53.993
52.210
45.725
45.048
30.193
18.815
f1 (ppm)

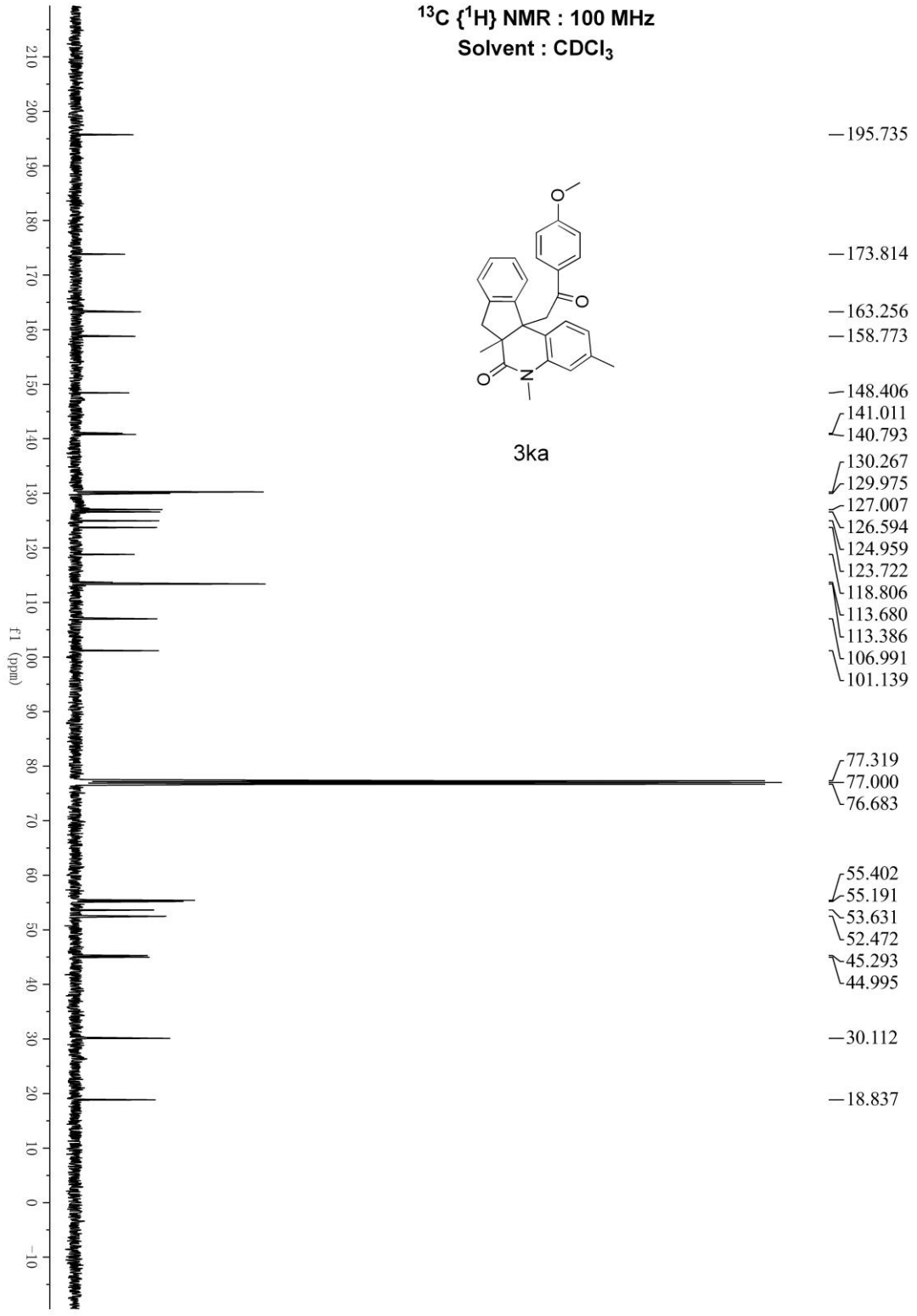
11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-6-oxo-6,6a,7,11b-tetrahydro-5H-indeno[2,1-c]quinoline-2-carbonitrile (3ja)



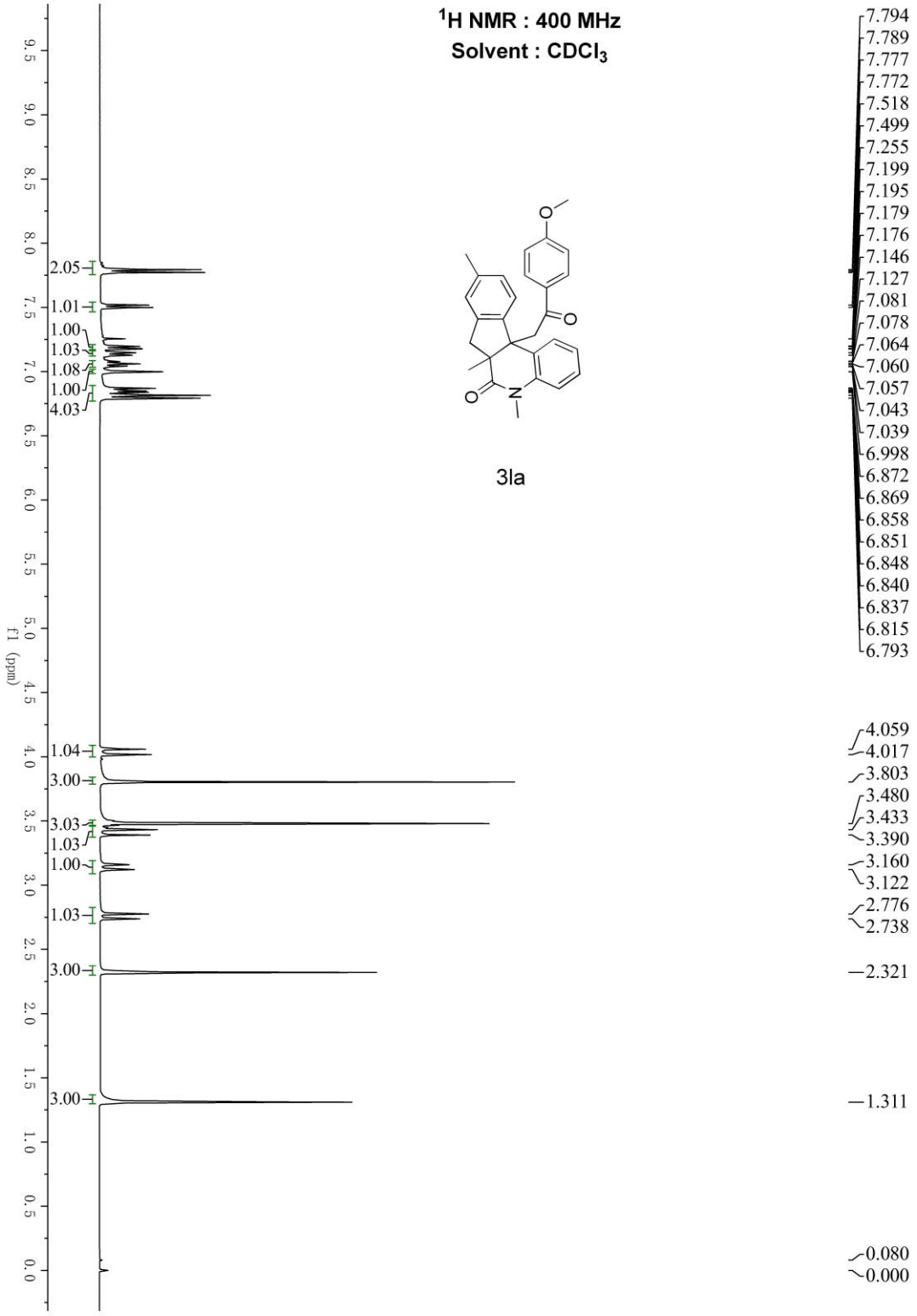

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ja
195.396
173.047
163.335
160.907
143.762
143.201
139.836
130.242
129.770
128.951
127.626
126.077
124.950
122.435
114.483
113.423
113.274
112.479
112.253
77.317
77.000
76.682
55.410
53.590
52.742
45.337
44.681
30.122
18.842
f1 (ppm)

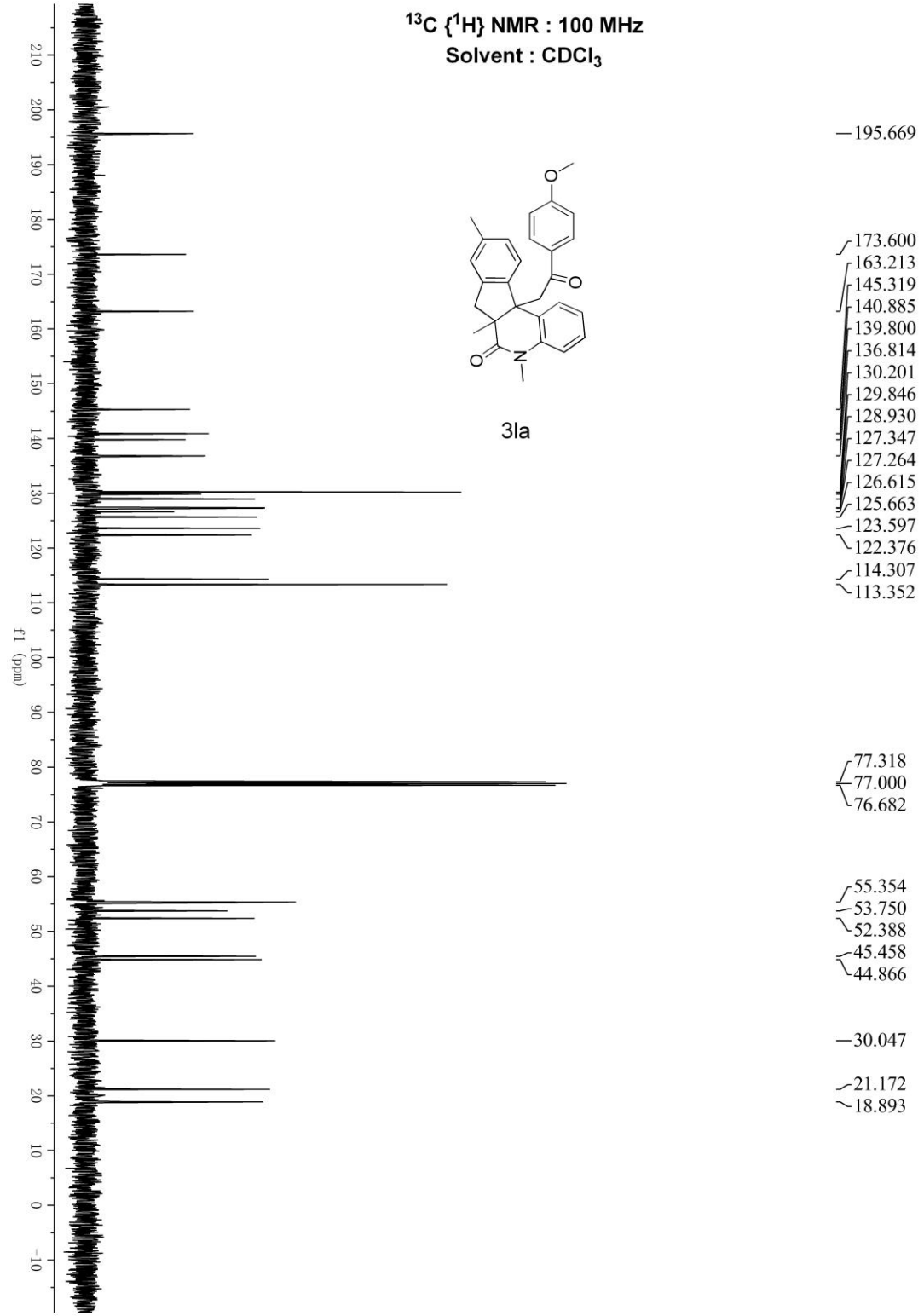
3-methoxy-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetra hydro-6H-indeno[2,1-c]quinolin-6-one (3ka)



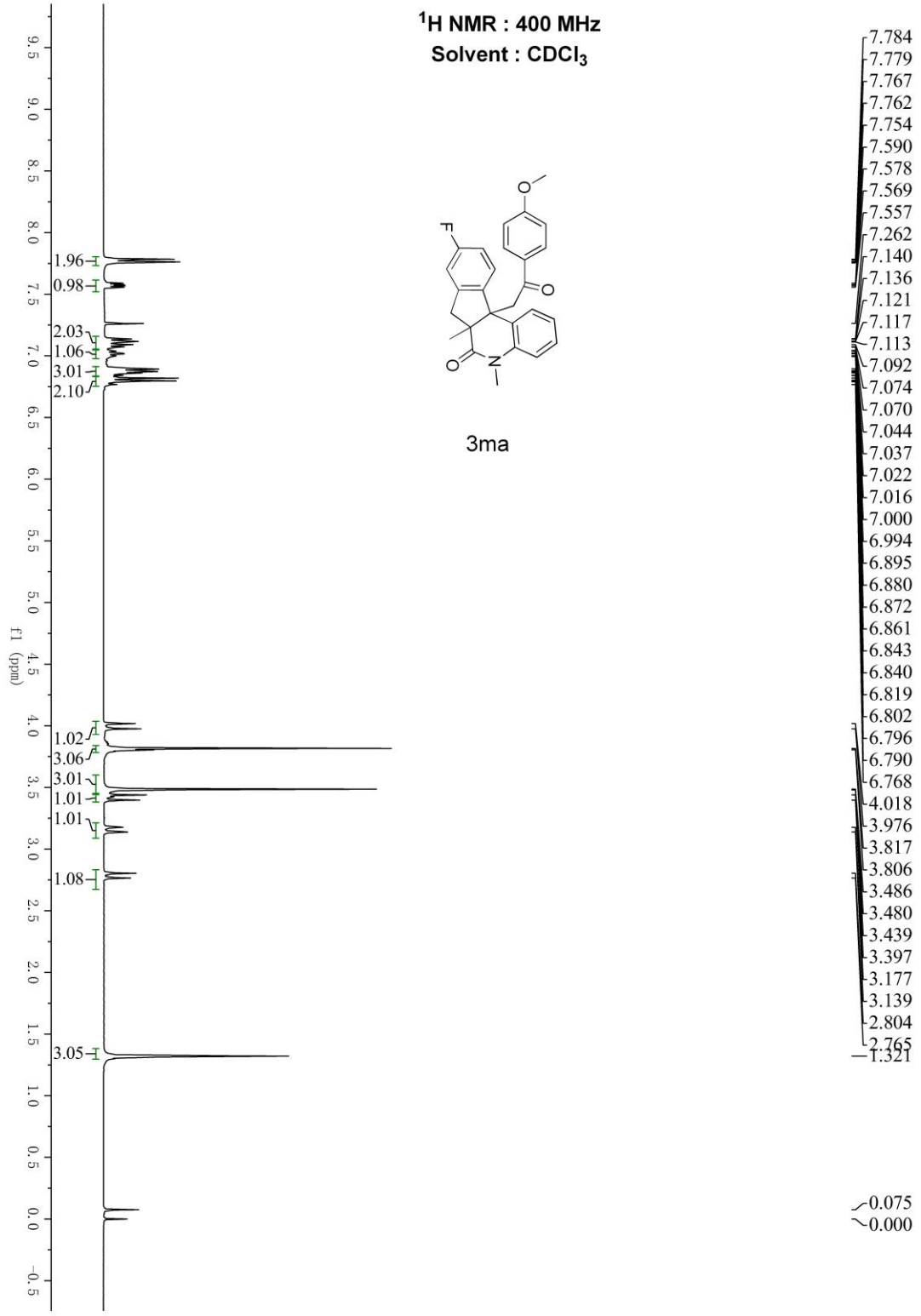

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ka
f1 (ppm)
195.735
173.814
163.256
158.773
148.406
141.011
140.793
130.267
129.975
127.007
126.594
124.959
123.722
118.806
113.680
113.386
106.991
101.139
77.319
77.000
76.683
55.402
55.191
53.631
52.472
45.293
44.995
30.112
18.837

11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,9-trimethyl-5,6a,7,11b-tetrahydro-6H -indeno[2,1-c]quinolin-6-one (3la)

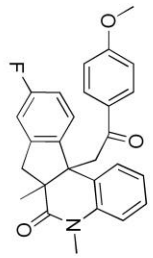



13C {1H} NMR : 100 MHz
Solvent : CDCl3
3la
f1 (ppm)
195.669
173.600
163.213
145.319
140.885
139.800
136.814
130.201
129.846
128.930
127.347
127.264
126.615
125.663
123.597
122.376
114.307
113.352
77.318
77.000
76.682
55.354
53.750
52.388
45.458
44.866
30.047
21.172
18.893

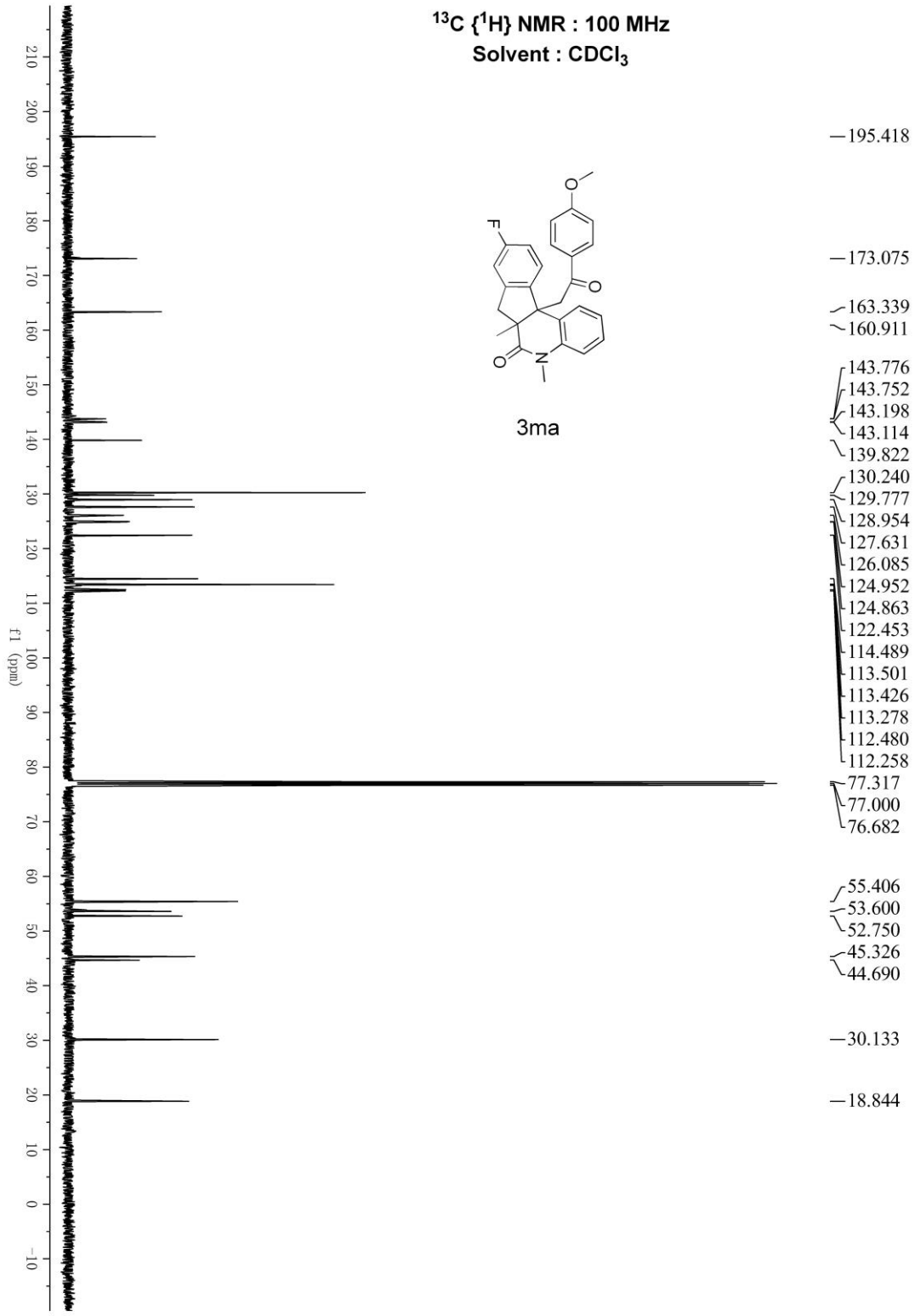
9-fluoro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3ma)



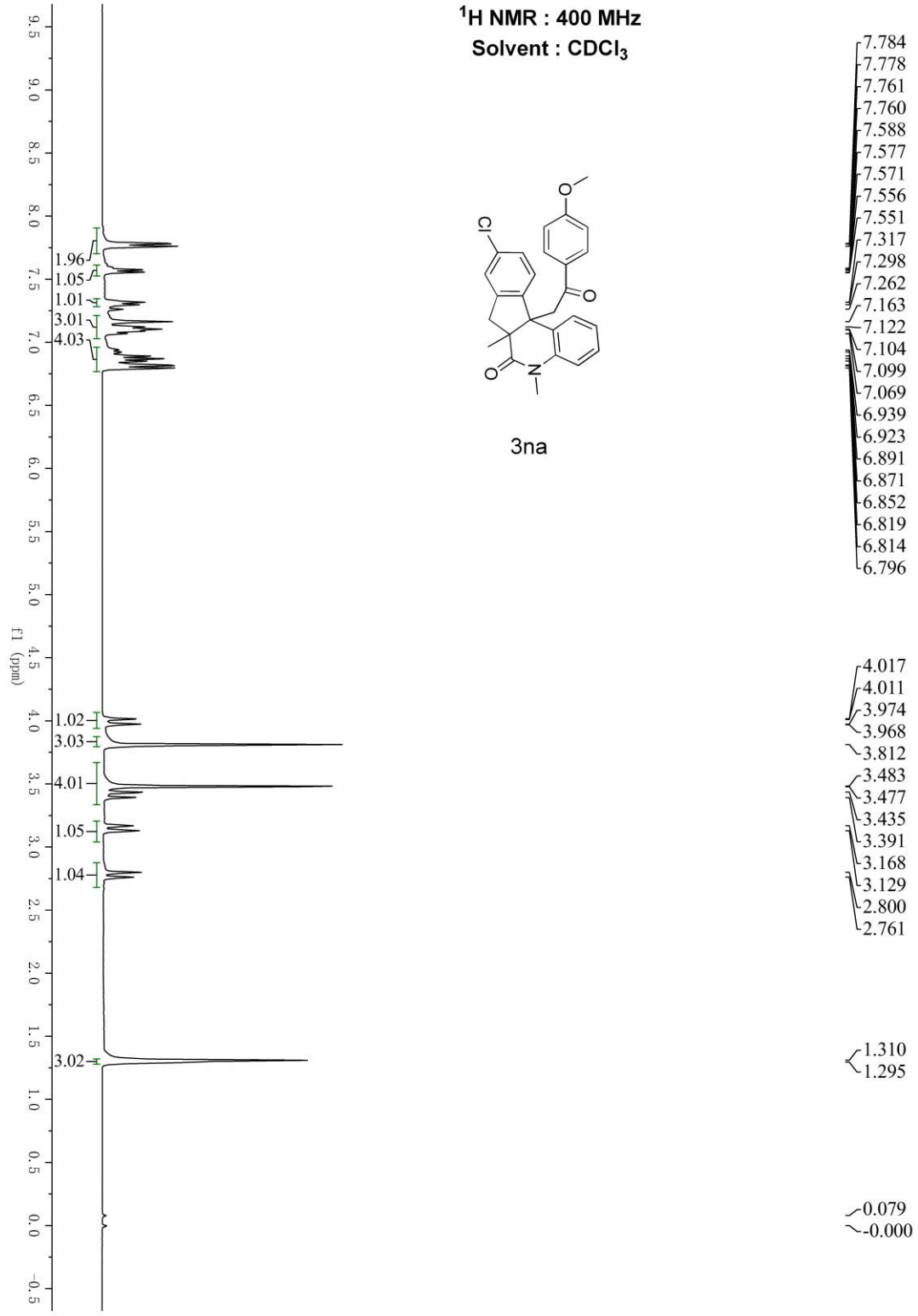
^{19}F NMR : 282 MHz
Solvent : $CDCl_3$

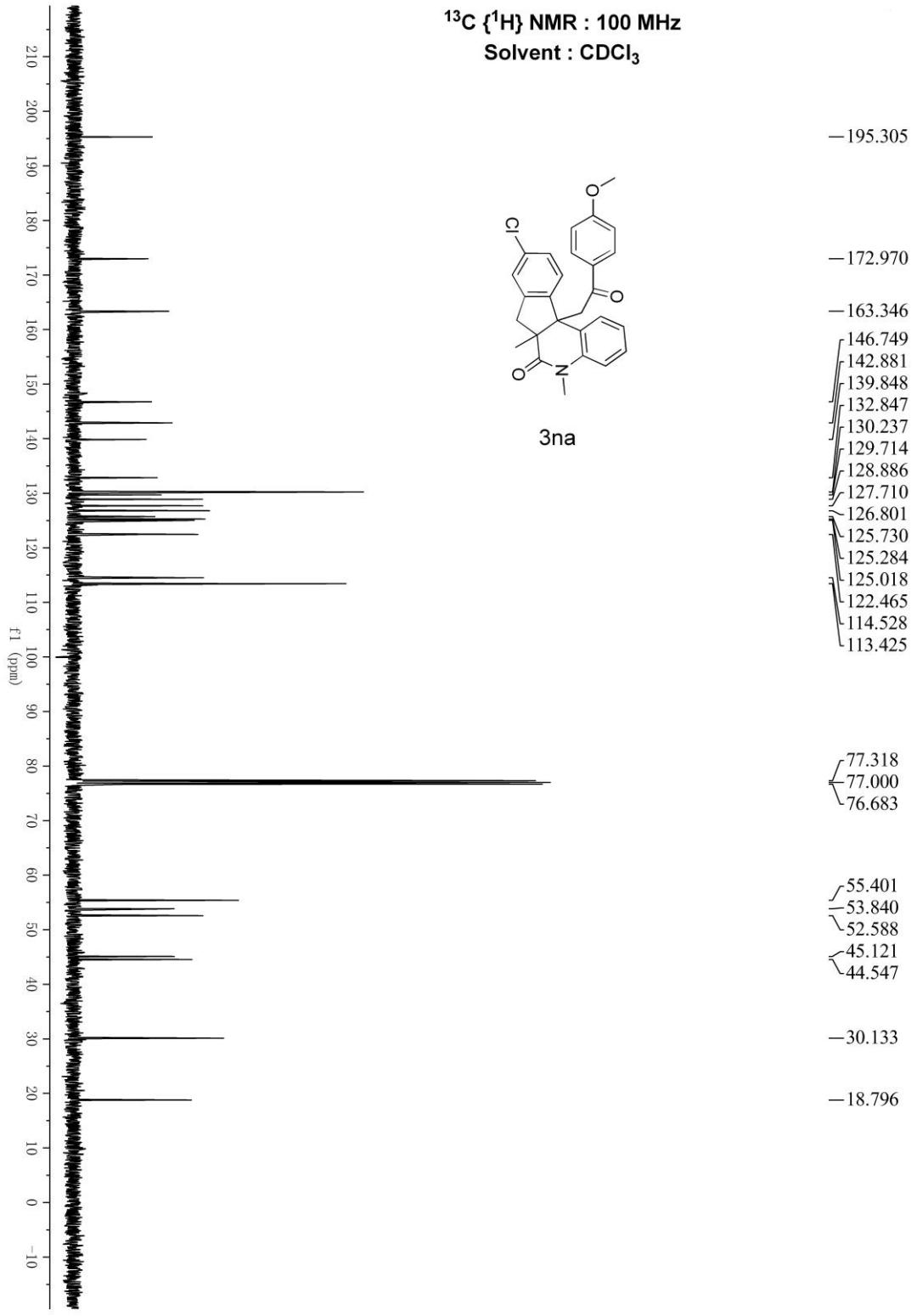


3ma

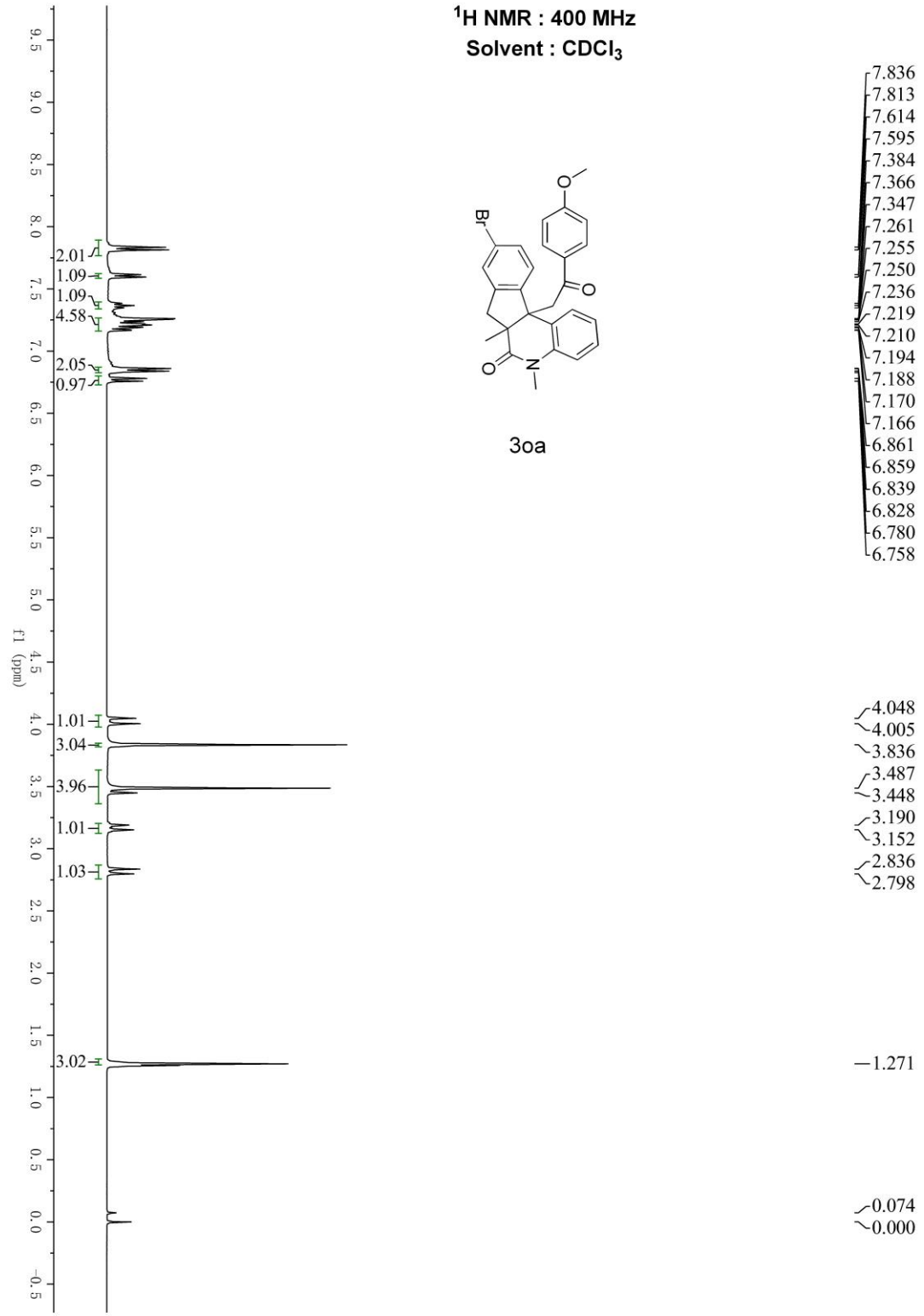

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3ma
f1 (ppm)
195.418
173.075
163.339
160.911
143.776
143.752
143.198
143.114
139.822
130.240
129.777
128.954
127.631
126.085
124.952
124.863
122.453
114.489
113.501
113.426
113.278
112.480
112.258
77.317
77.000
76.682
55.406
53.600
52.750
45.326
44.690
30.133
18.844

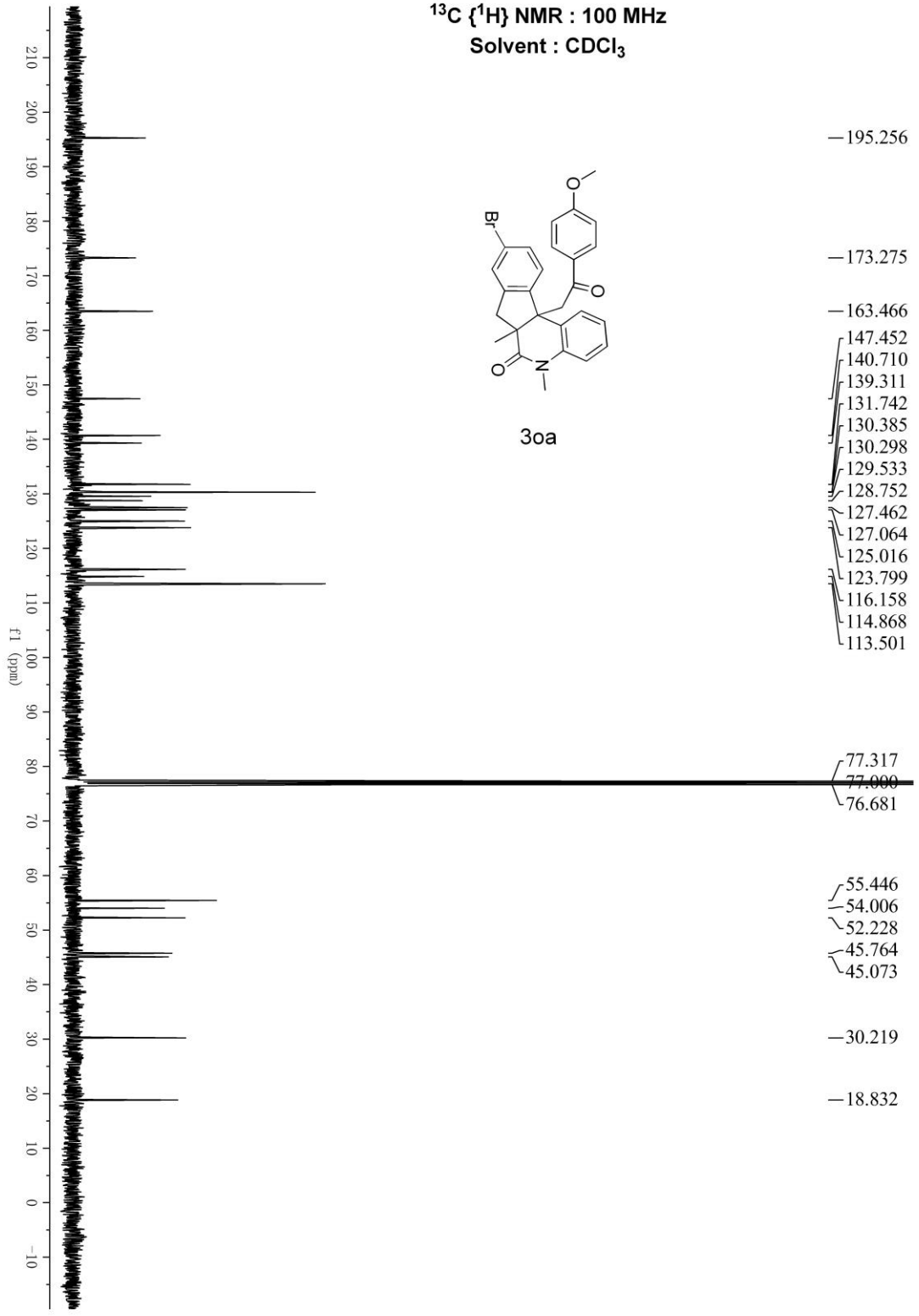
9-chloro-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3na)



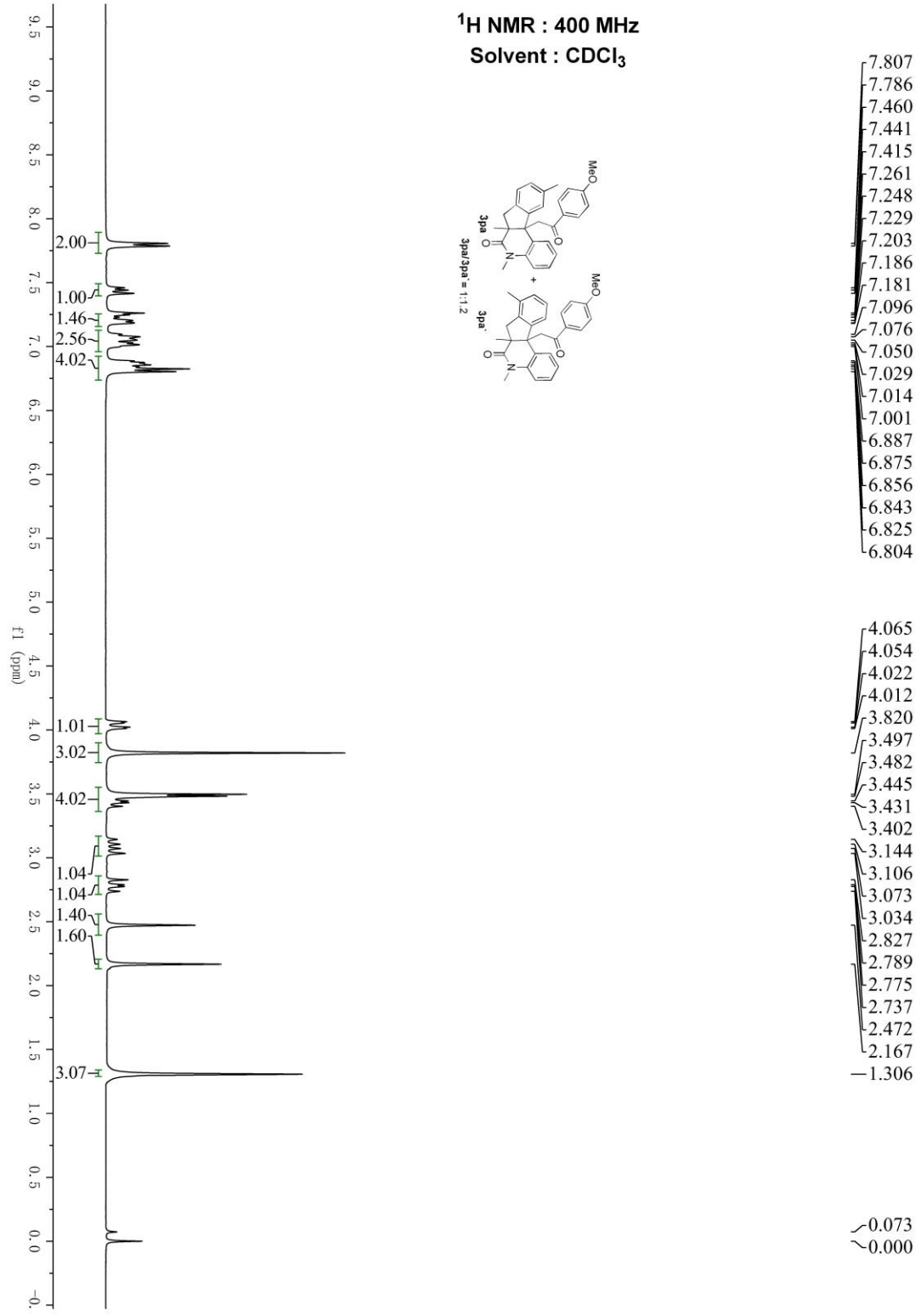

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3na
195.305
172.970
163.346
146.749
142.881
139.848
132.847
130.237
129.714
128.886
127.710
126.801
125.730
125.284
125.018
122.465
114.528
113.425
77.318
77.000
76.683
55.401
53.840
52.588
45.121
44.547
30.133
18.796
f1 (ppm)

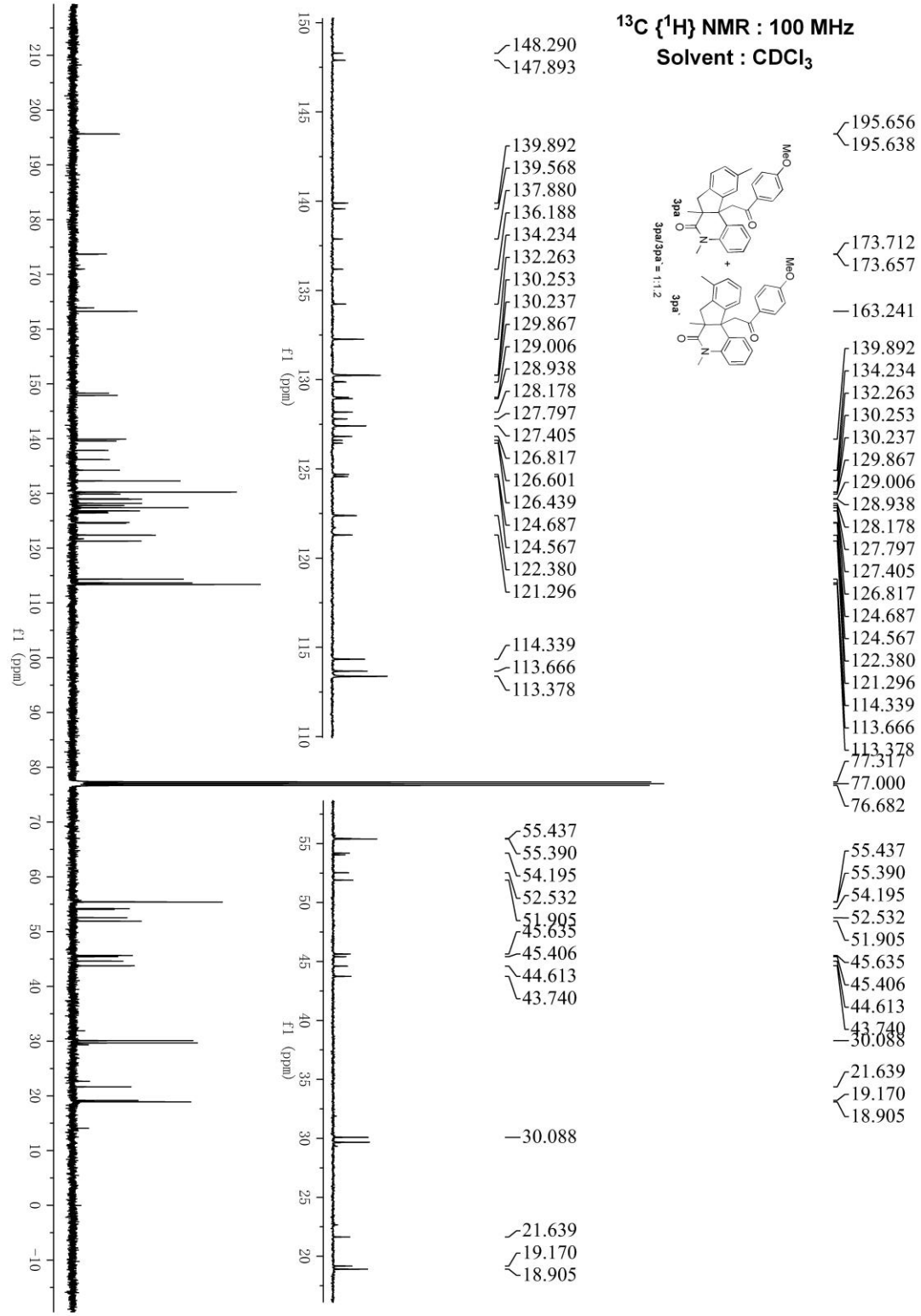
9-bromo-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a-dimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3oa)



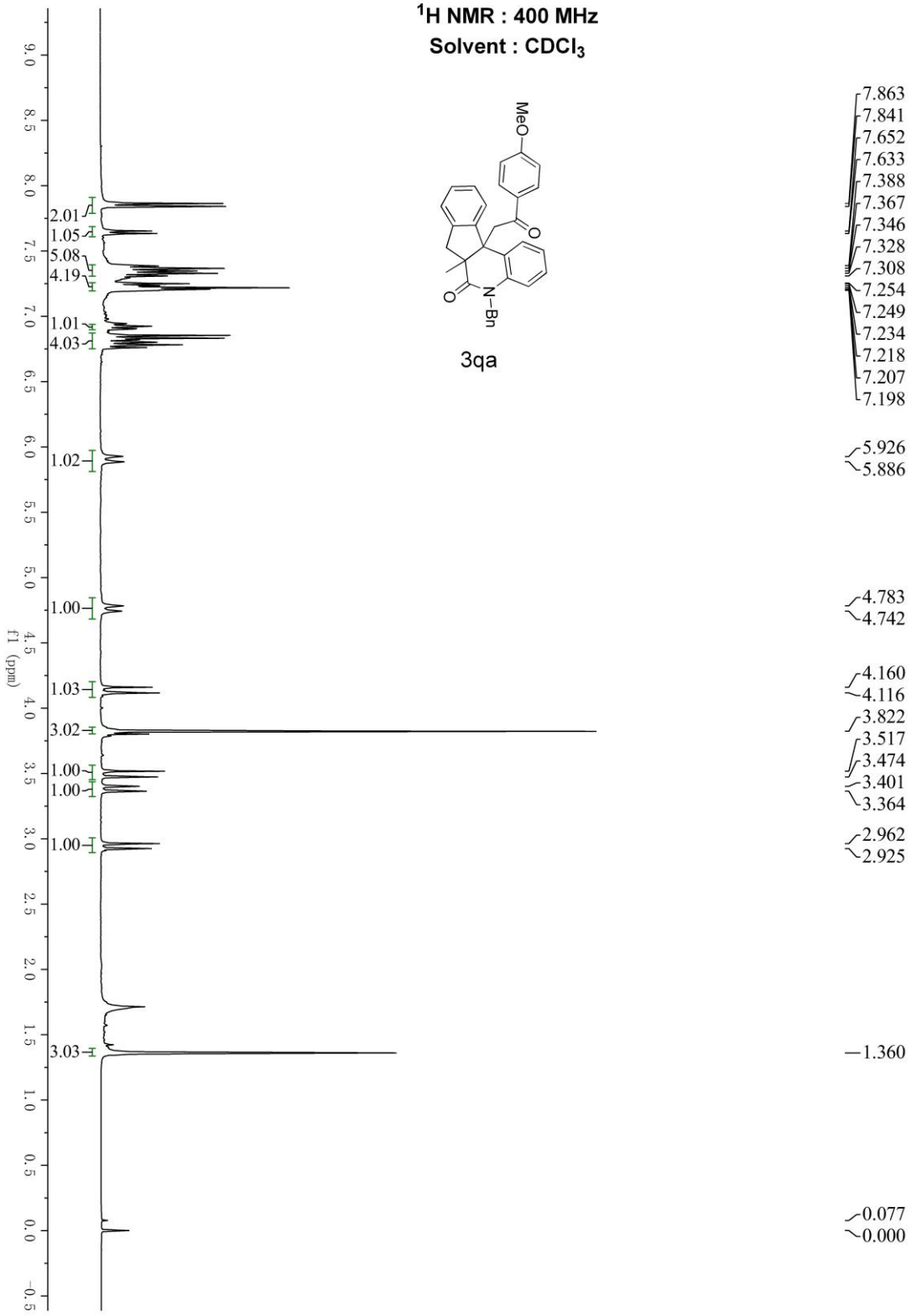

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
3oa
195.256
173.275
163.466
147.452
140.710
139.311
131.742
130.385
130.298
129.533
128.752
127.462
127.064
125.016
123.799
116.158
114.868
113.501
77.317
77.000
76.681
55.446
54.006
52.228
45.764
45.073
30.219
18.832
f1 (ppm)

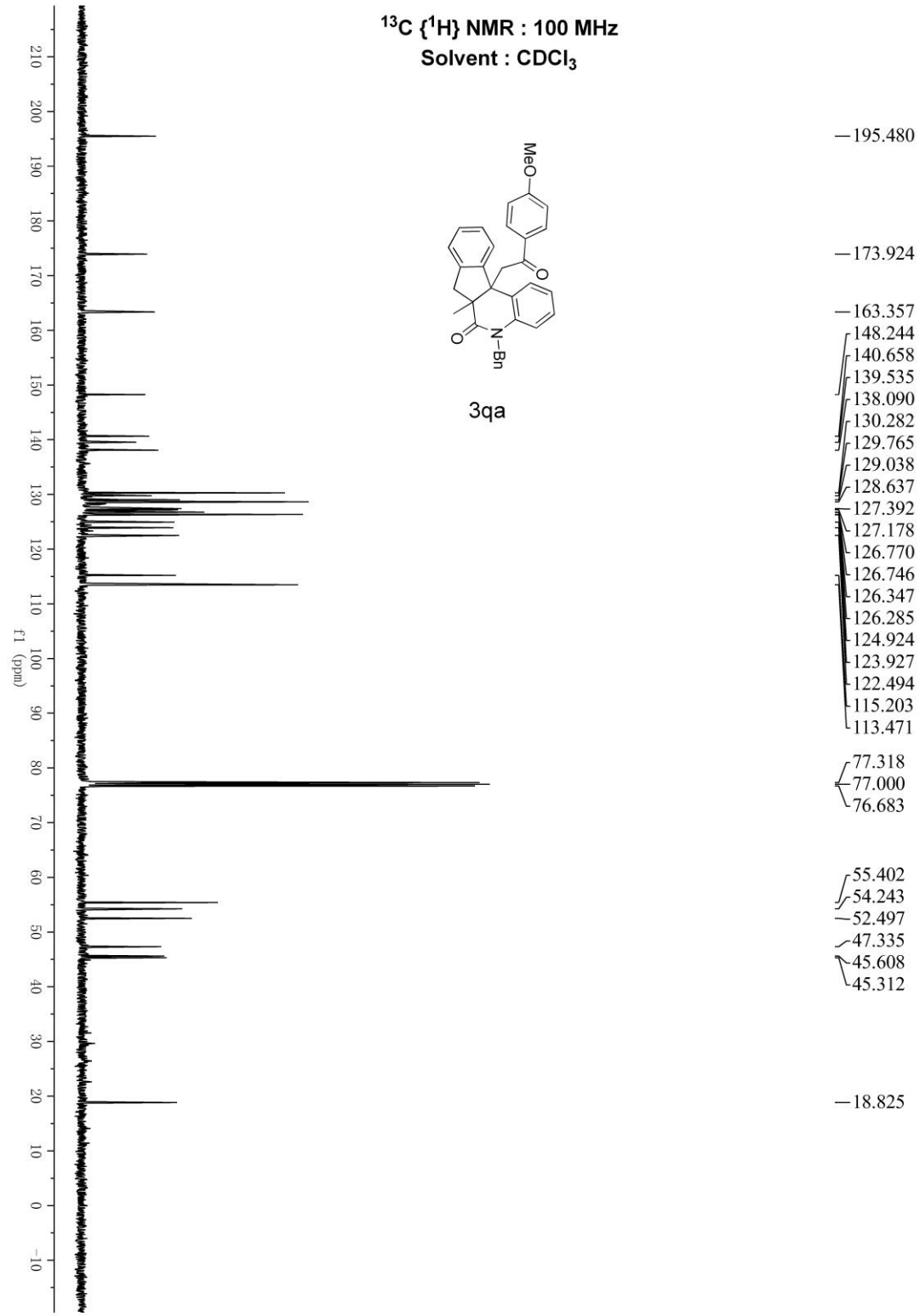
11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,10-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3pa) and 11b-(2-(4-methoxyphenyl)-2-oxoethyl)-5,6a,8-trimethyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3pa') mixture



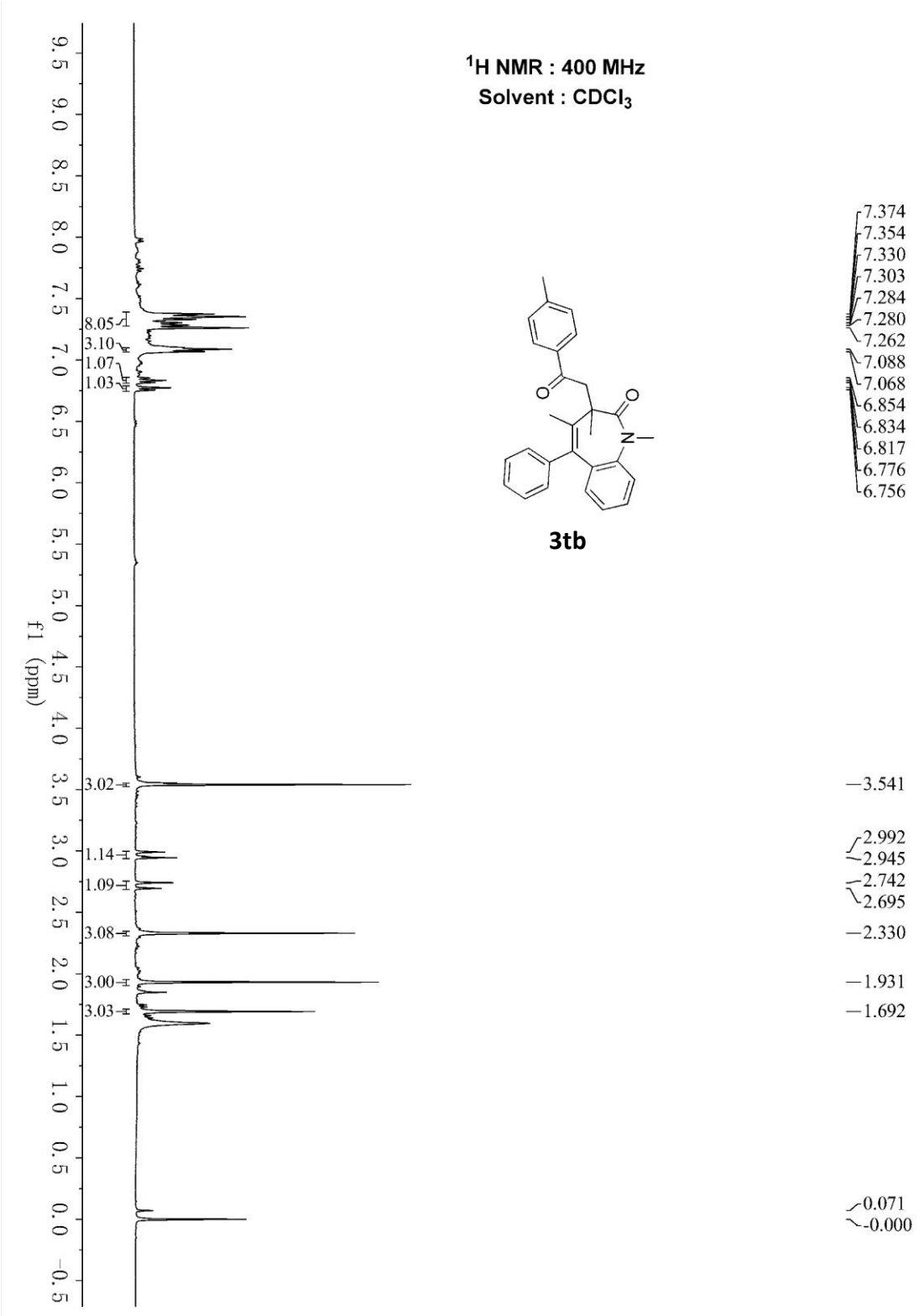

13C {1H} NMR : 100 MHz
Solvent : CDCl3
3pa
3pa/3pa` = 1:1.2
3pa`
MeO
MeO
148.290
147.893
139.892
139.568
137.880
136.188
134.234
132.263
130.253
130.237
129.867
129.006
128.938
128.178
127.797
127.405
126.817
126.601
126.439
124.687
124.567
122.380
121.296
114.339
113.666
113.378
55.437
55.390
54.195
52.532
51.905
45.635
45.406
44.613
43.740
30.088
21.639
19.170
18.905
195.656
195.638
173.712
173.657
163.241
139.892
134.234
132.263
130.253
130.237
129.867
129.006
128.938
128.178
127.797
127.405
126.817
124.687
124.567
122.380
121.296
114.339
113.666
113.378
77.317
77.000
76.682
55.437
55.390
54.195
52.532
51.905
45.635
45.406
44.613
43.740
30.088
21.639
19.170
18.905
f1 (ppm)

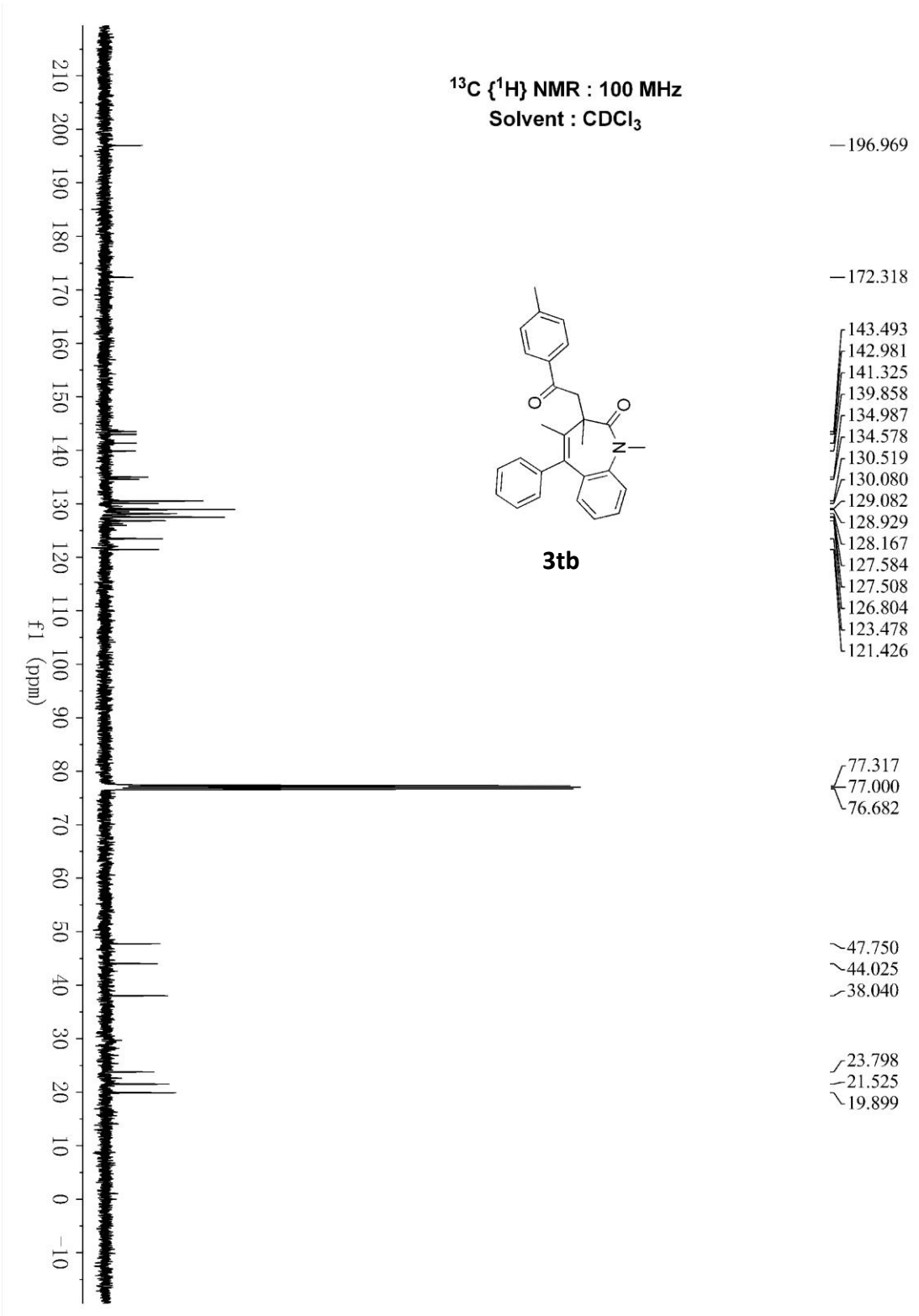
5-benzyl-11b-(2-(4-methoxyphenyl)-2-oxoethyl)-6a-methyl-5,6a,7,11b-tetrahydro-6H-indeno[2,1-c]quinolin-6-one (3qa)



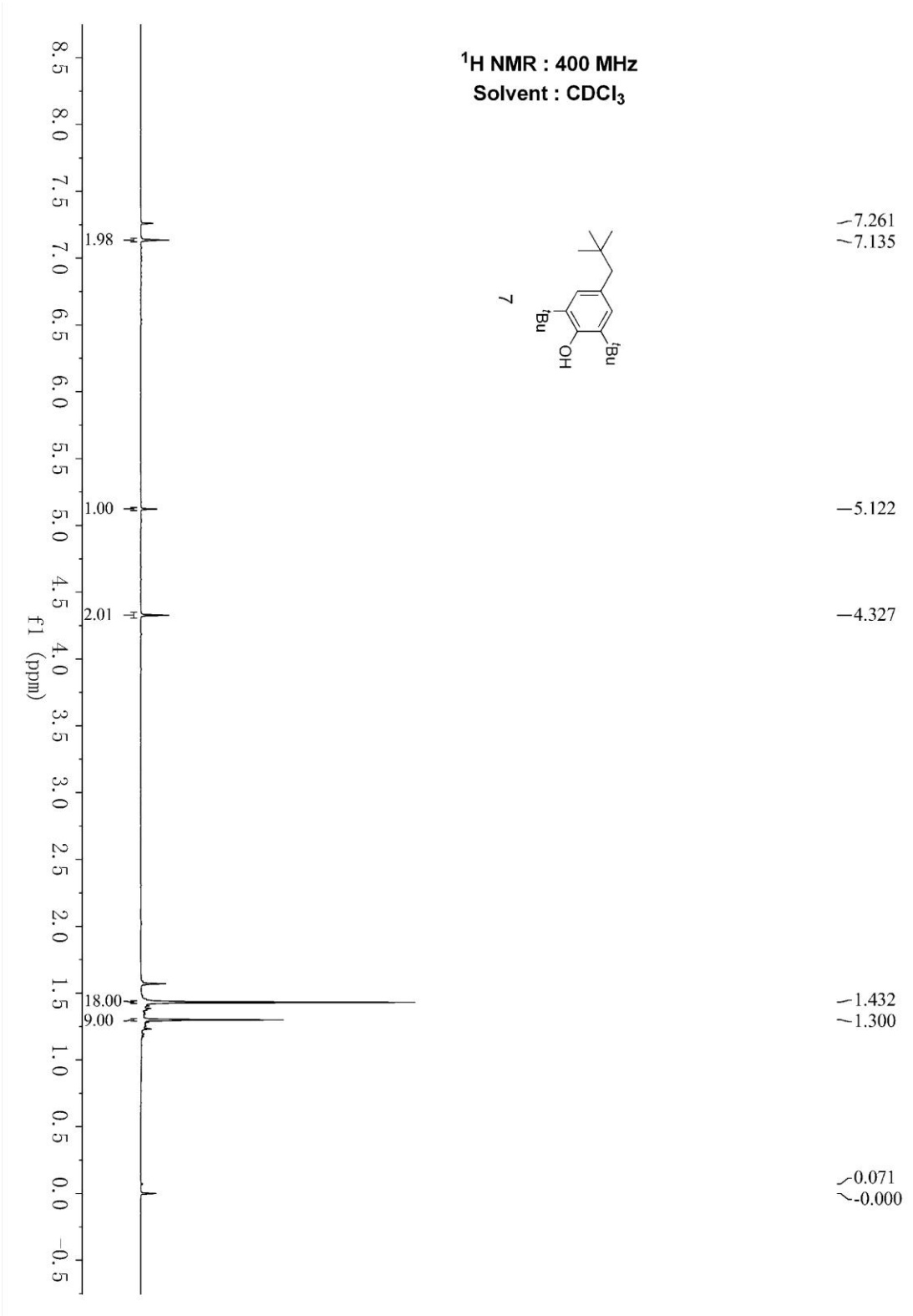

13C {1H} NMR : 100 MHz
Solvent : CDCl3
MeO
O
O
N–Bn
3qa
195.480
173.924
163.357
148.244
140.658
139.535
138.090
130.282
129.765
129.038
128.637
127.392
127.178
126.770
126.746
126.347
126.285
124.924
123.927
122.494
115.203
113.471
77.318
77.000
76.683
55.402
54.243
52.497
47.335
45.608
45.312
18.825
f1 (ppm)

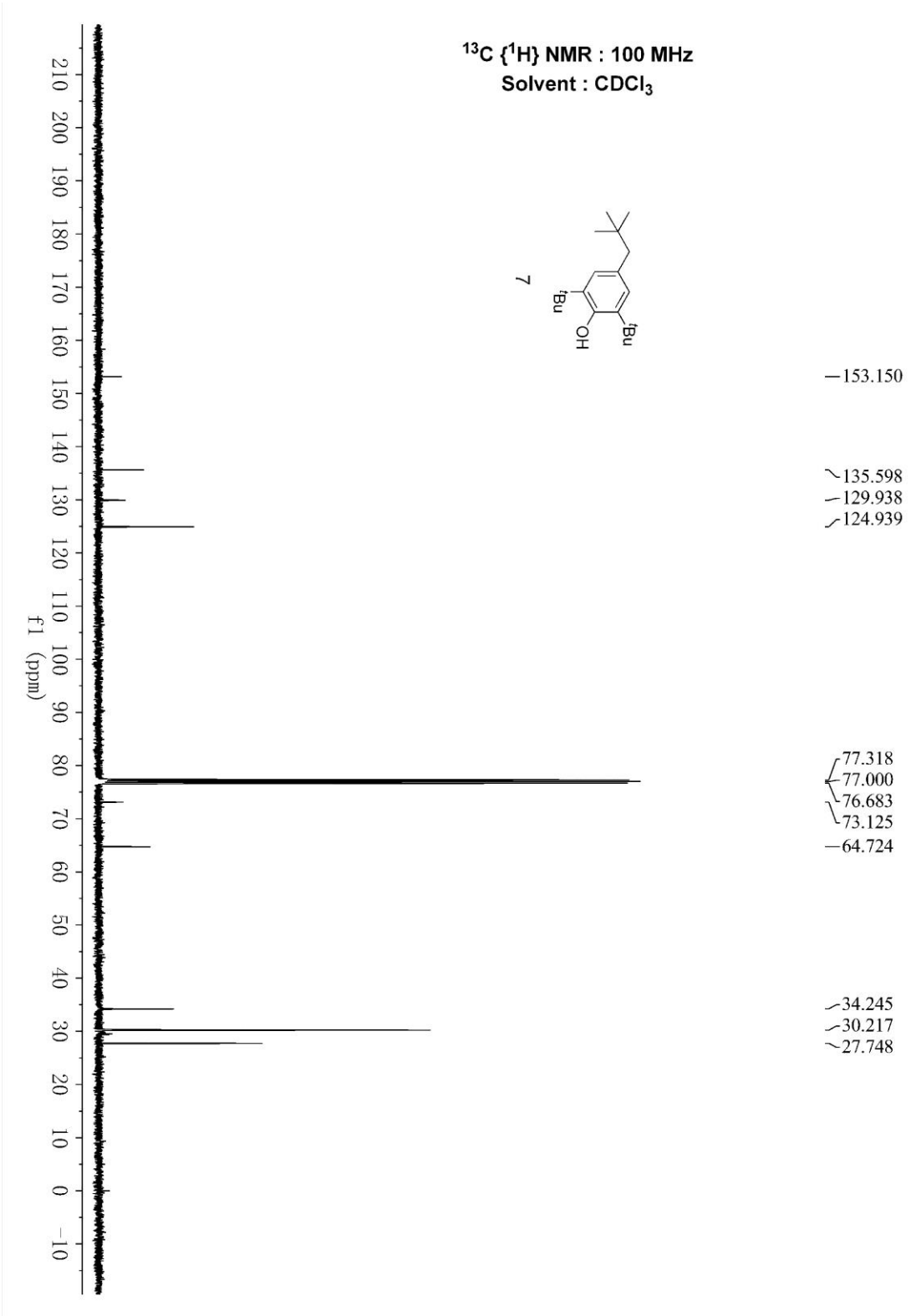
1,3,4-Trimethyl-3-(2-oxo-2-(p-tolyl)ethyl)-5-phenyl-1,3-dihydro-2H-benzo[b]azepin-2-one (3tb)



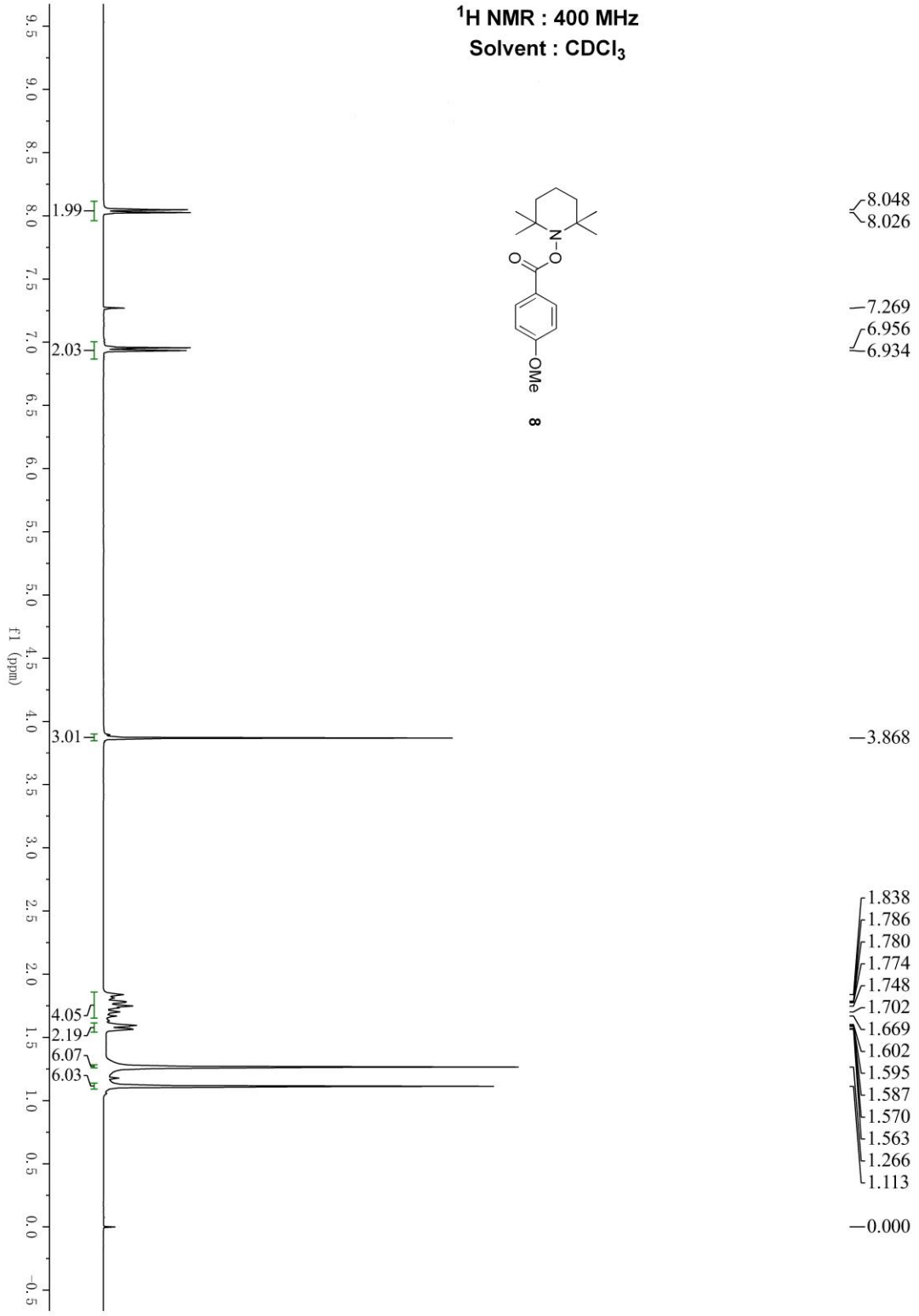

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
196.969
172.318
143.493
142.981
141.325
139.858
134.987
134.578
130.519
130.080
129.082
128.929
128.167
127.584
127.508
126.804
123.478
121.426
77.317
77.000
76.682
47.750
44.025
38.040
23.798
21.525
19.899
3tb
f1 (ppm)

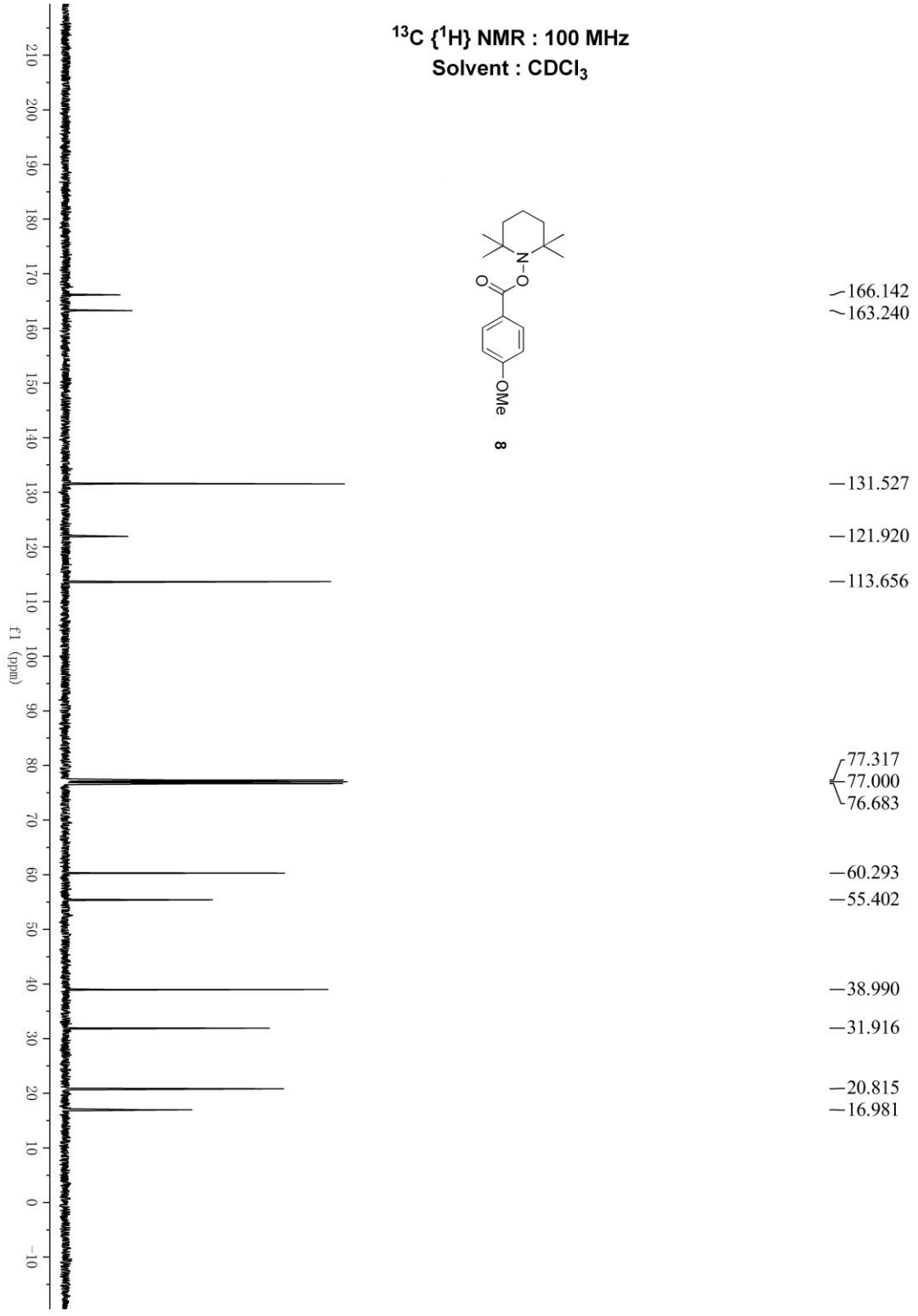
2,6-Di-tert-butyl-4-neopentylphenol (**7**)



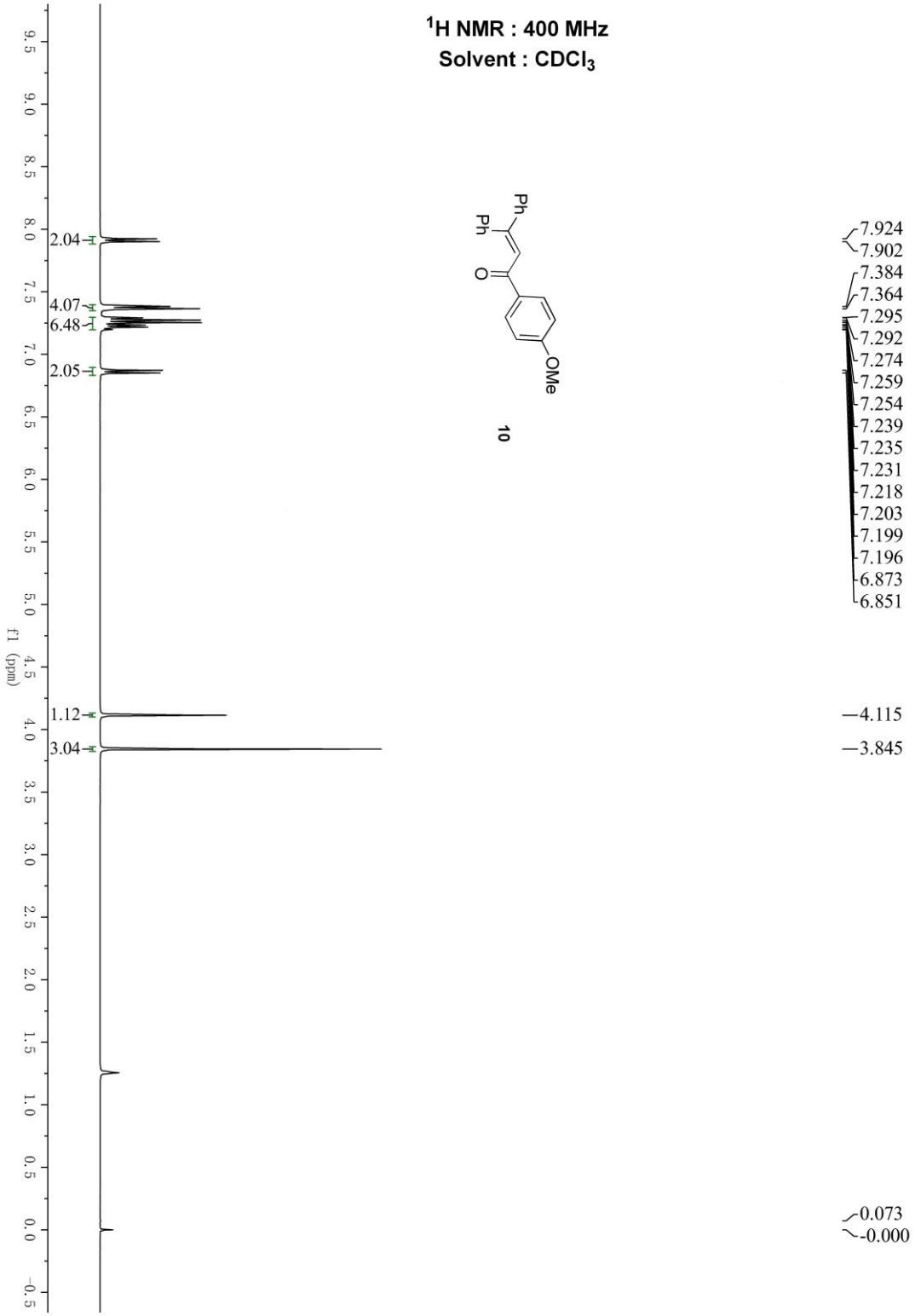

^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
7
OH
tBu
tBu
f1 (ppm)
153.150
135.598
129.938
124.939
77.318
77.000
76.683
73.125
64.724
34.245
30.217
27.748

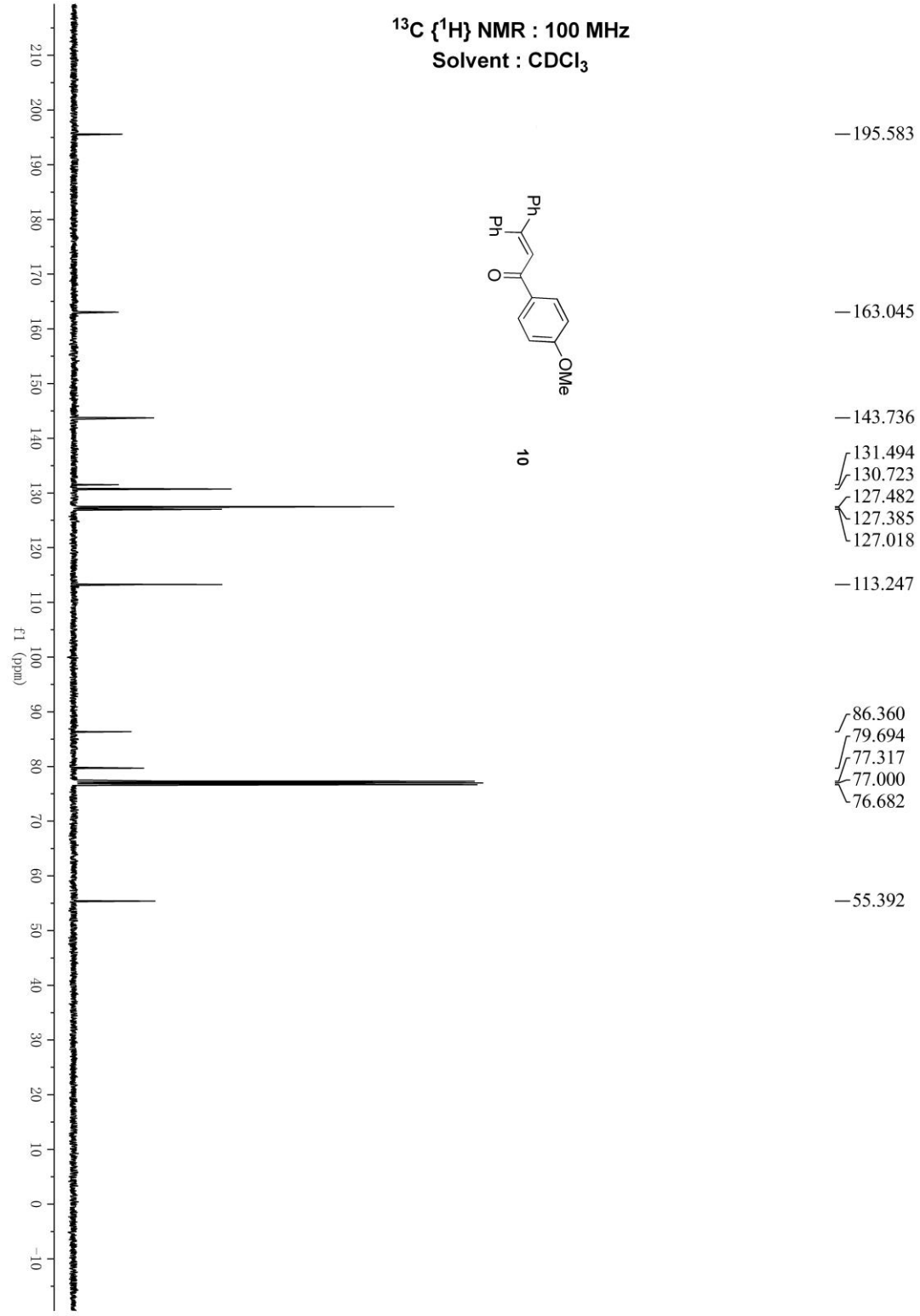
2,2,6,6-tetramethylpiperidin-1-yl-4-methoxybenzoate (8)




^{13}C {^{1}H} NMR : 100 MHz
Solvent : $CDCl_3$
N
O
O
OMe
8
166.142
163.240
131.527
121.920
113.656
77.317
77.000
76.683
60.293
55.402
38.990
31.916
20.815
16.981
f1 (ppm)

1-(4-Methoxyphenyl)-3,3-diphenylprop-2-en-1-one (10)




^{13}C {^{1}H} NMR : 100 MHz
Solvent : CDCl$_3$
Ph
Ph
O
OMe
10
195.583
163.045
143.736
131.494
130.723
127.482
127.385
127.018
113.247
86.360
79.694
77.317
77.000
76.682
55.392
f1 (ppm)