Asymmetric Synthesis of Bicyclo[4.3.1] and [3.3.2]decadienes *via* [6+3] Trimethylenemethane Cycloaddition with Tropones

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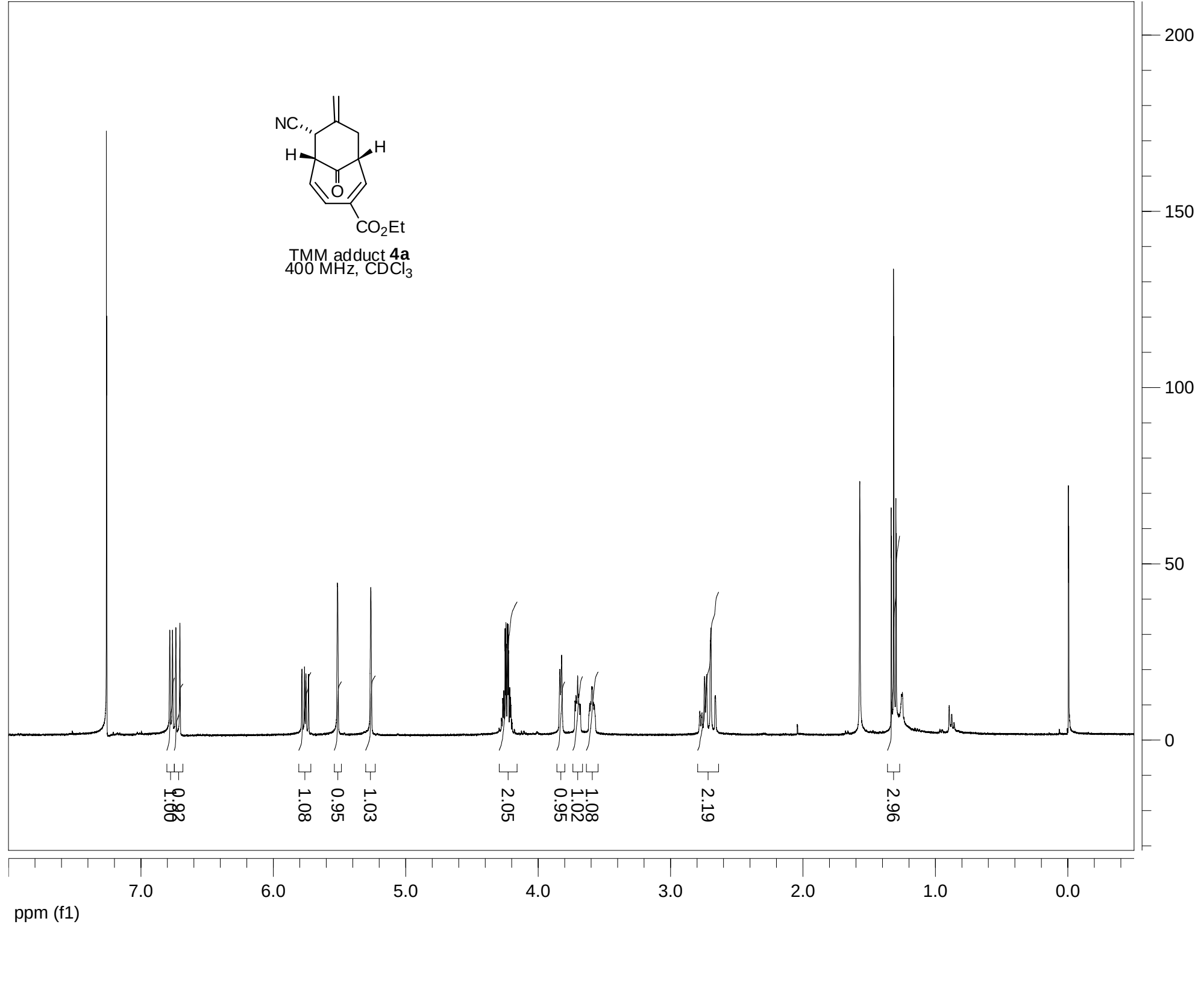
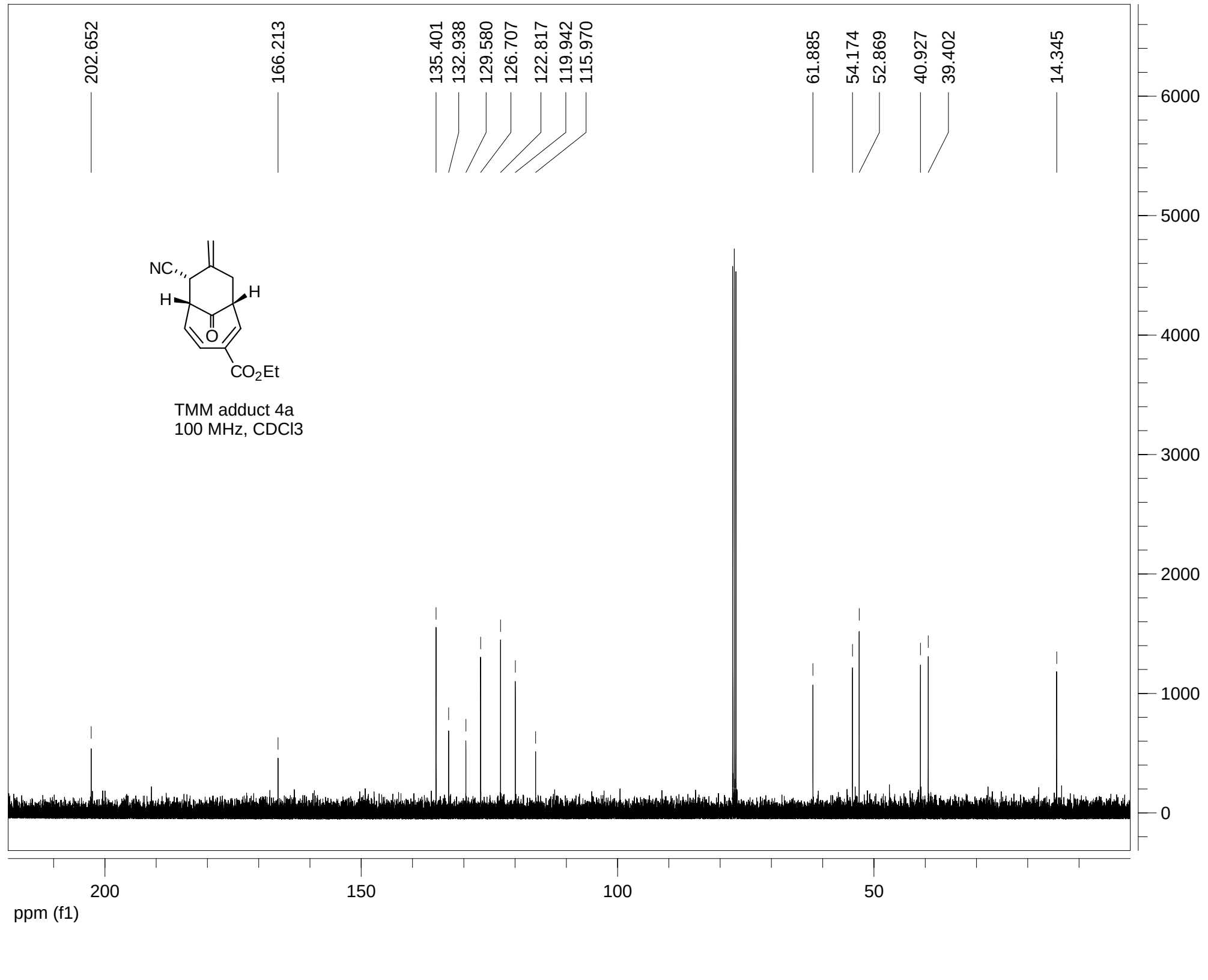
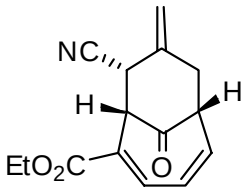
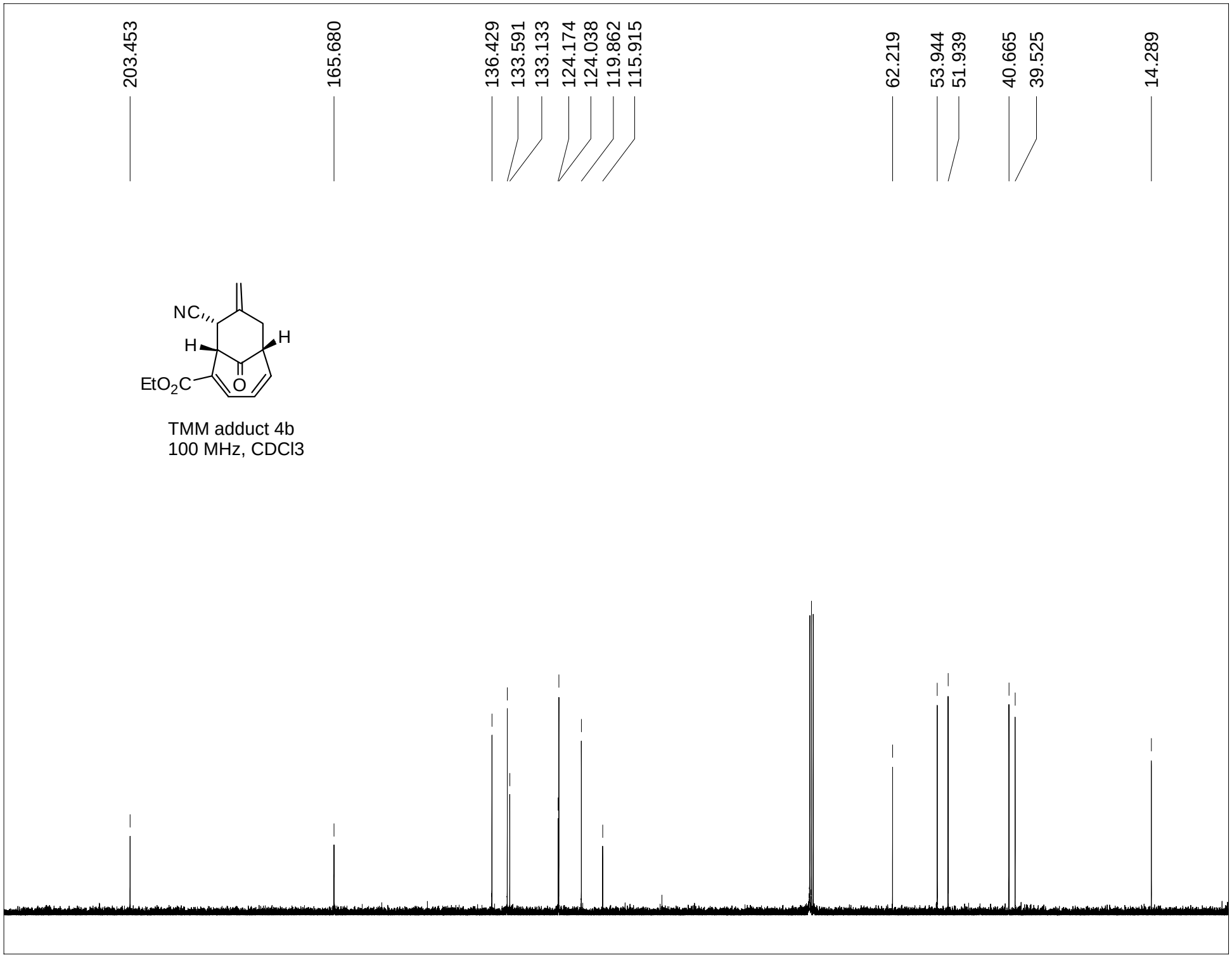
^{1}H and ^{13}C NMR Spectra for Compounds 4a-i and 5a, d, and f

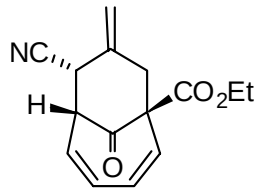

NC
H
H
O
CO2Et
TMM adduct 4a
400 MHz, CDCl3
1.00
0.82
1.08
0.95
1.03
2.05
0.95
1.02
1.08
2.19
2.96
200
150
100
50
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)


202.652
166.213
135.401
132.938
129.580
126.707
122.817
119.942
115.970
61.885
54.174
52.869
40.927
39.402
14.345
NC
H
H
O
CO2Et
TMM adduct 4a
100 MHz, CDCl3
6000
5000
4000
3000
2000
1000
0
200
150
100
50
ppm (f1)

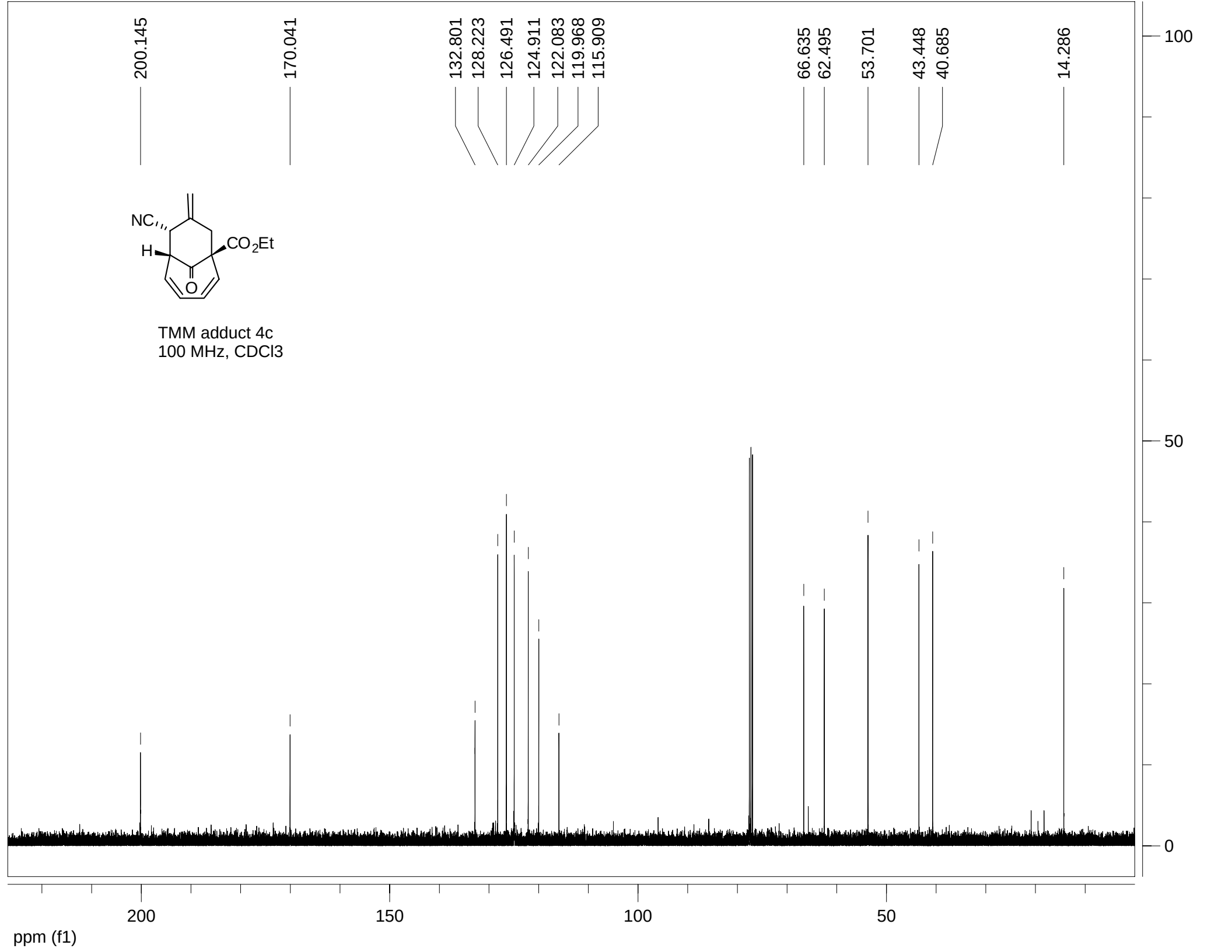


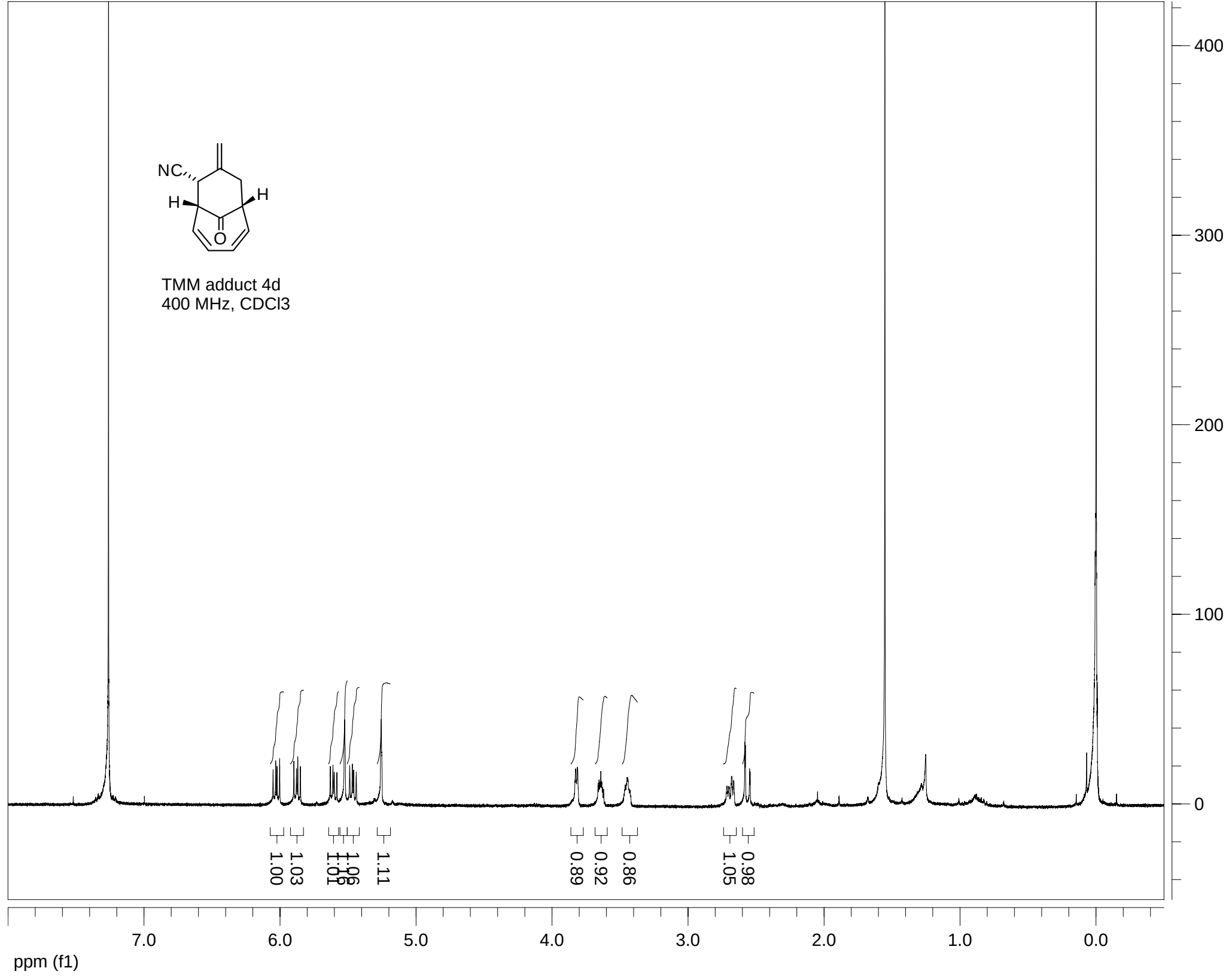
TMM adduct 4b
400 MHz, CDCl3

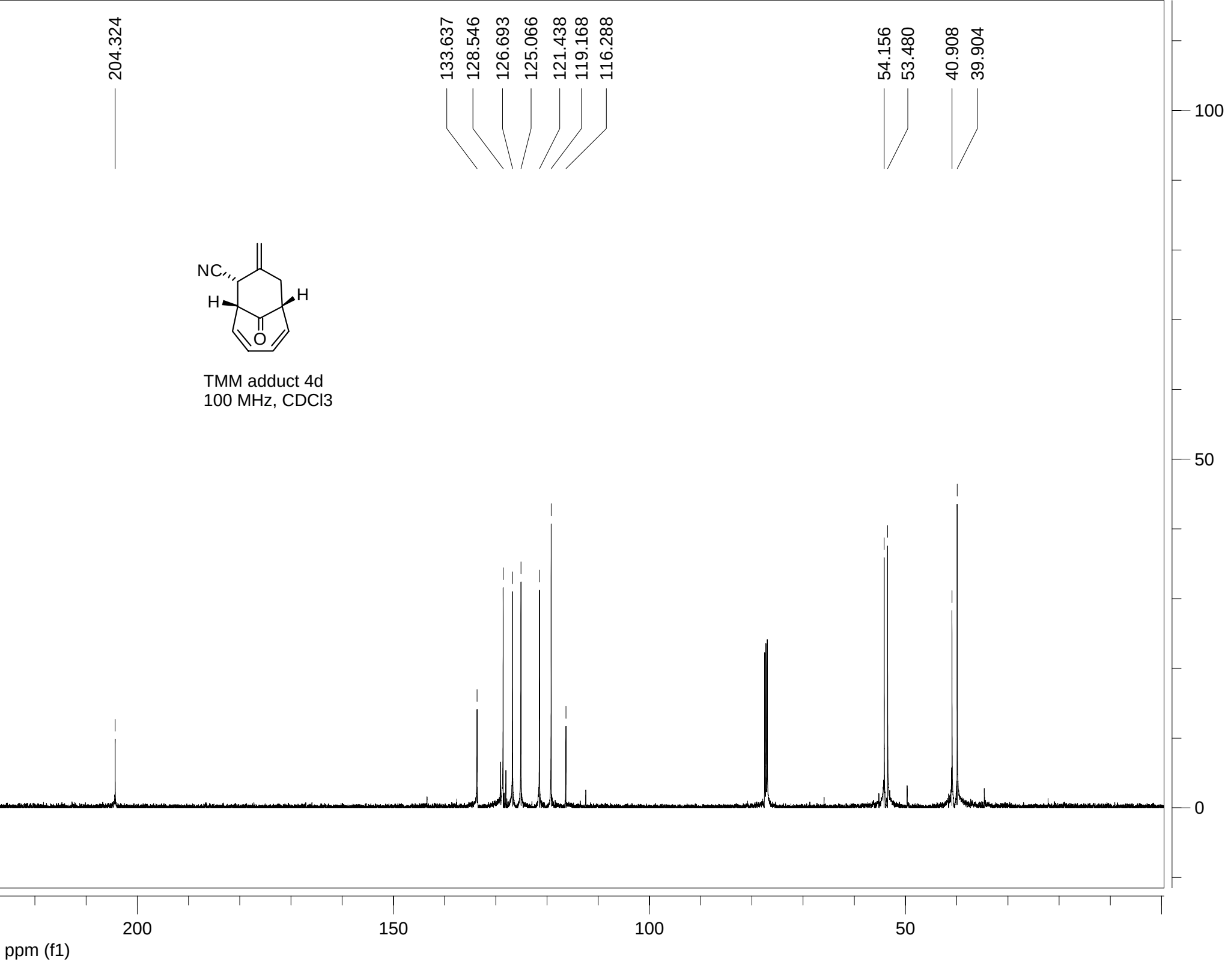

203.453
165.680
136.429
133.591
133.133
124.174
124.038
119.862
115.915
62.219
53.944
51.939
40.665
39.525
14.289
NC
H
H
EtO2C
O
TMM adduct 4b
100 MHz, CDCl3
250
200
150
100
50
0
200
150
100
50
ppm (f1)



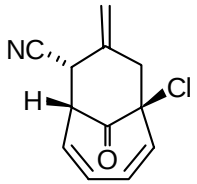
TMM adduct 4c
400 MHz, CDCl3


200.145
170.041
132.801
128.223
126.491
124.911
122.083
119.968
115.909
66.635
62.495
53.701
43.448
40.685
14.286
NC
H
CO2Et
O
TMM adduct 4c
100 MHz, CDCl3
100
50
0
200
150
100
50
ppm (f1)


NC
H
H
O
TMM adduct 4d
400 MHz, CDCl3
400
300
200
100
0
1.00
1.03
1.01
1.11
0.89
0.92
0.86
1.05
0.98
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)



TMM adduct 4d
100 MHz, CDCl3



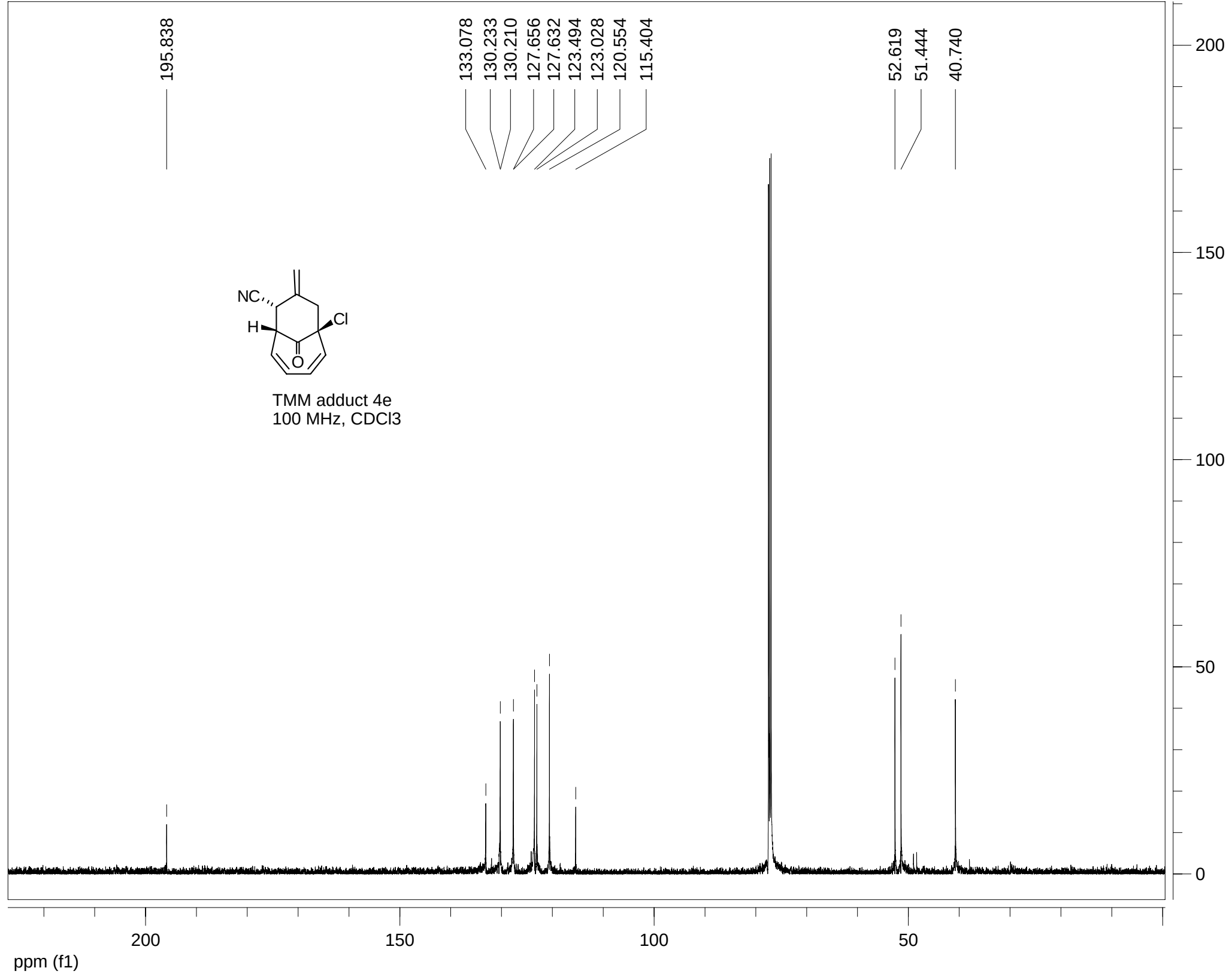
TMM adduct 4e
400 MHz, CDCl3

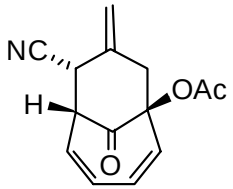
1.00
1.01
1.01
1.02
0.85
1.07
1.82
1.05
1.05

1500
1000
500
0

7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

ppm (f1)


195.838
133.078
130.233
130.210
127.656
127.632
123.494
123.028
120.554
115.404
52.619
51.444
40.740
NC
H
Cl
O
TMM adduct 4e
100 MHz, CDCl3
200
150
100
50
0
200
150
100
50
ppm (f1)



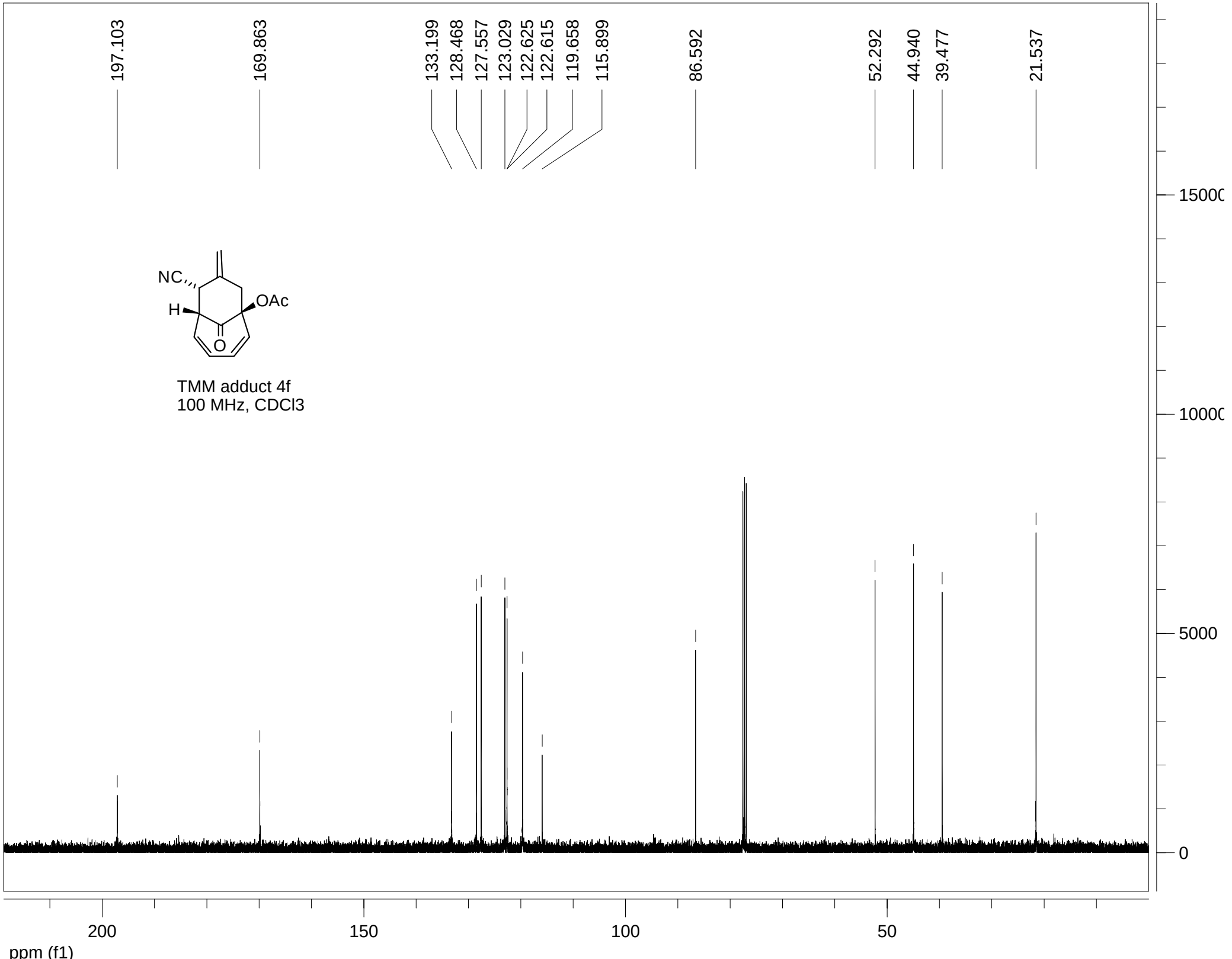
TMM adduct 4f
400 MHZ, CDCl3

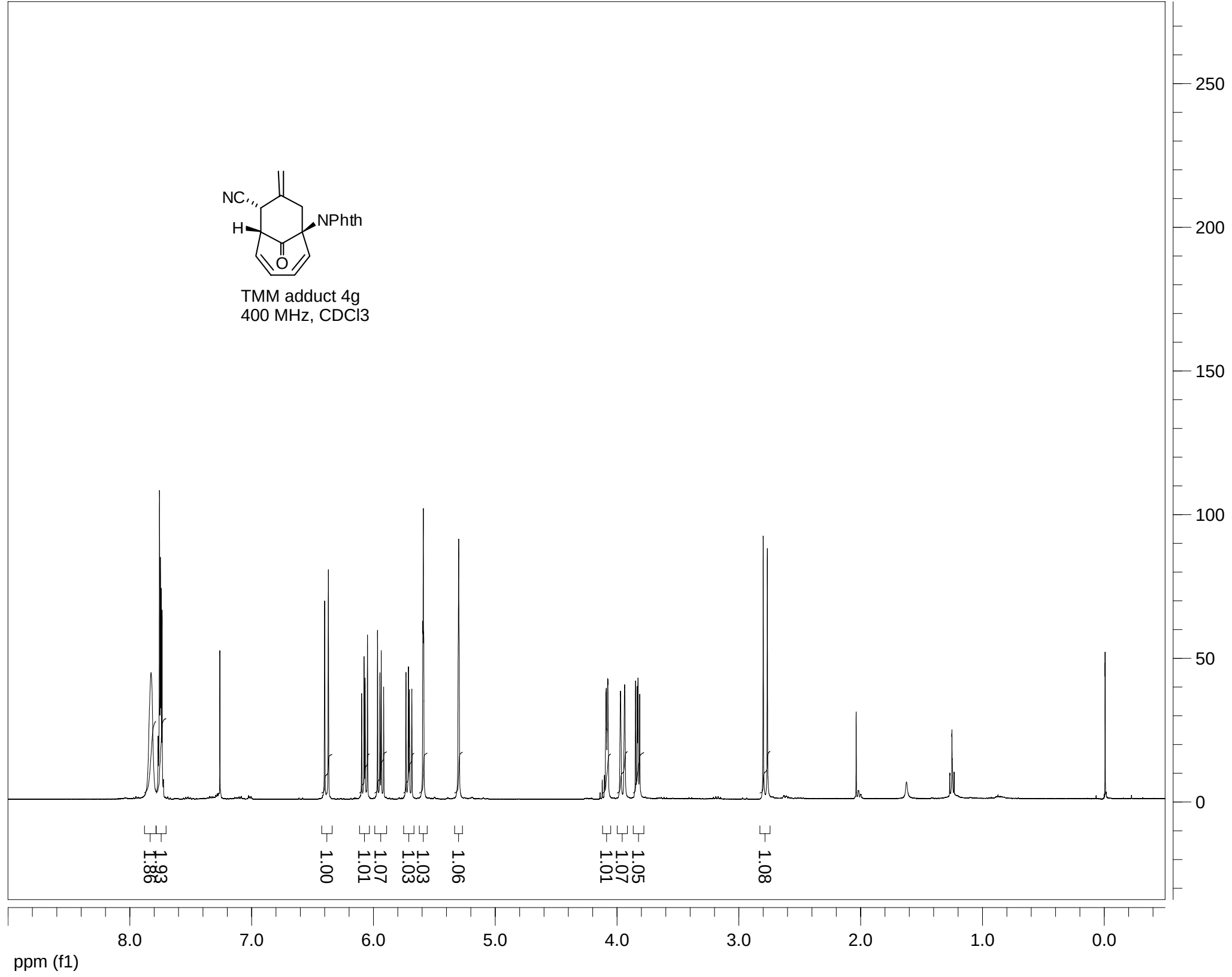
1.00 0.99 0.99 1.06 0.89 0.93 1.04 1.09 2.90

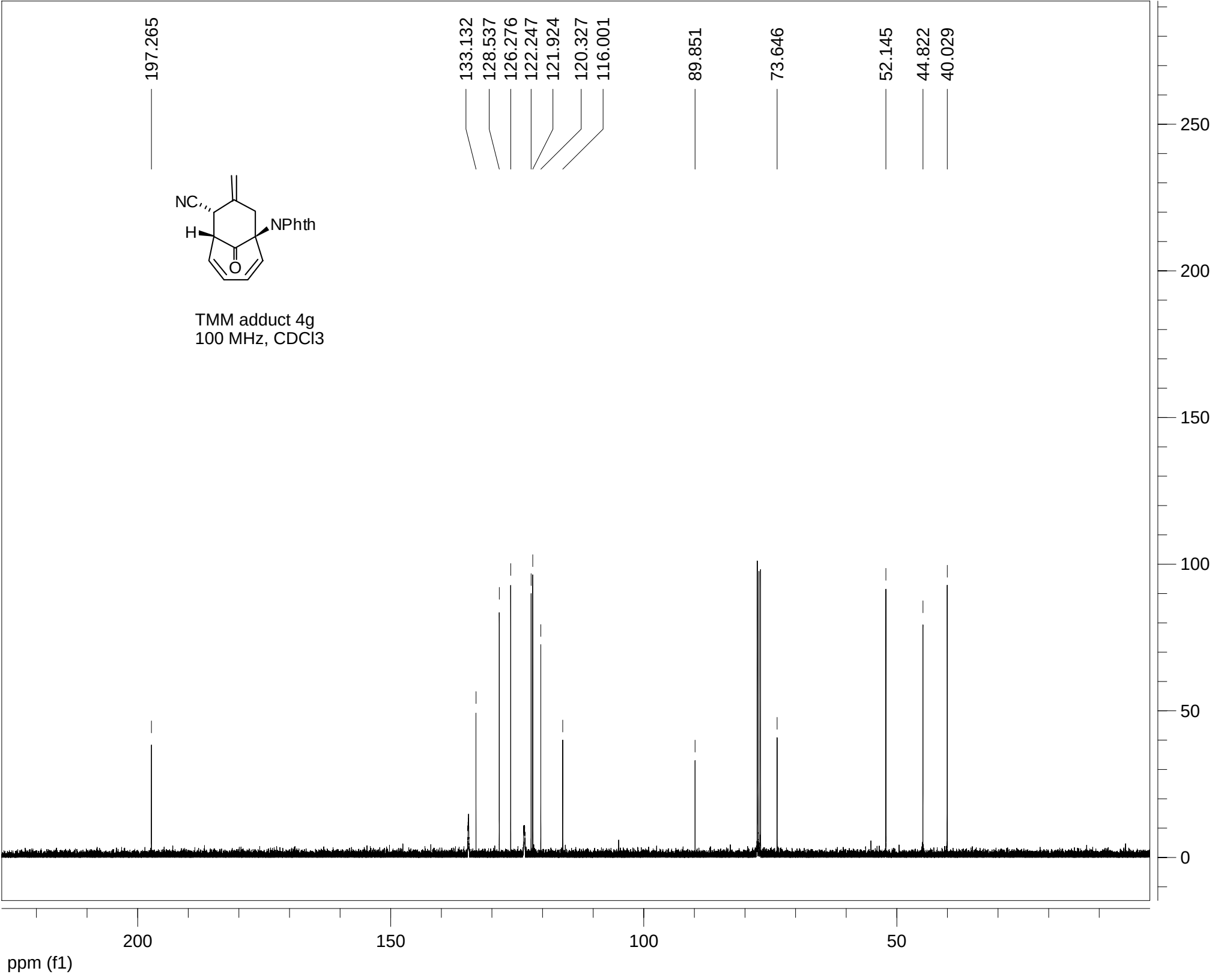
1500
1000
500
0

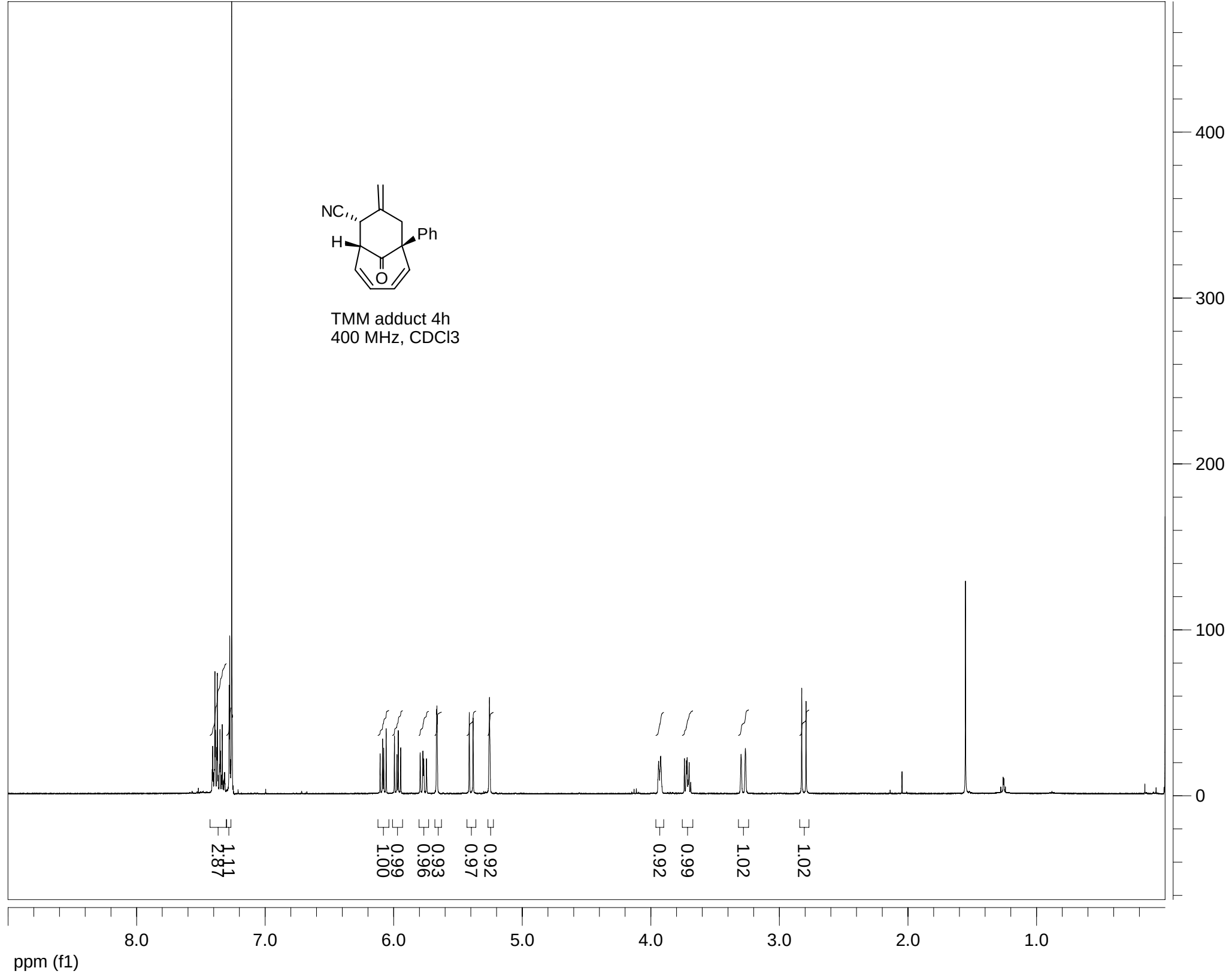
8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

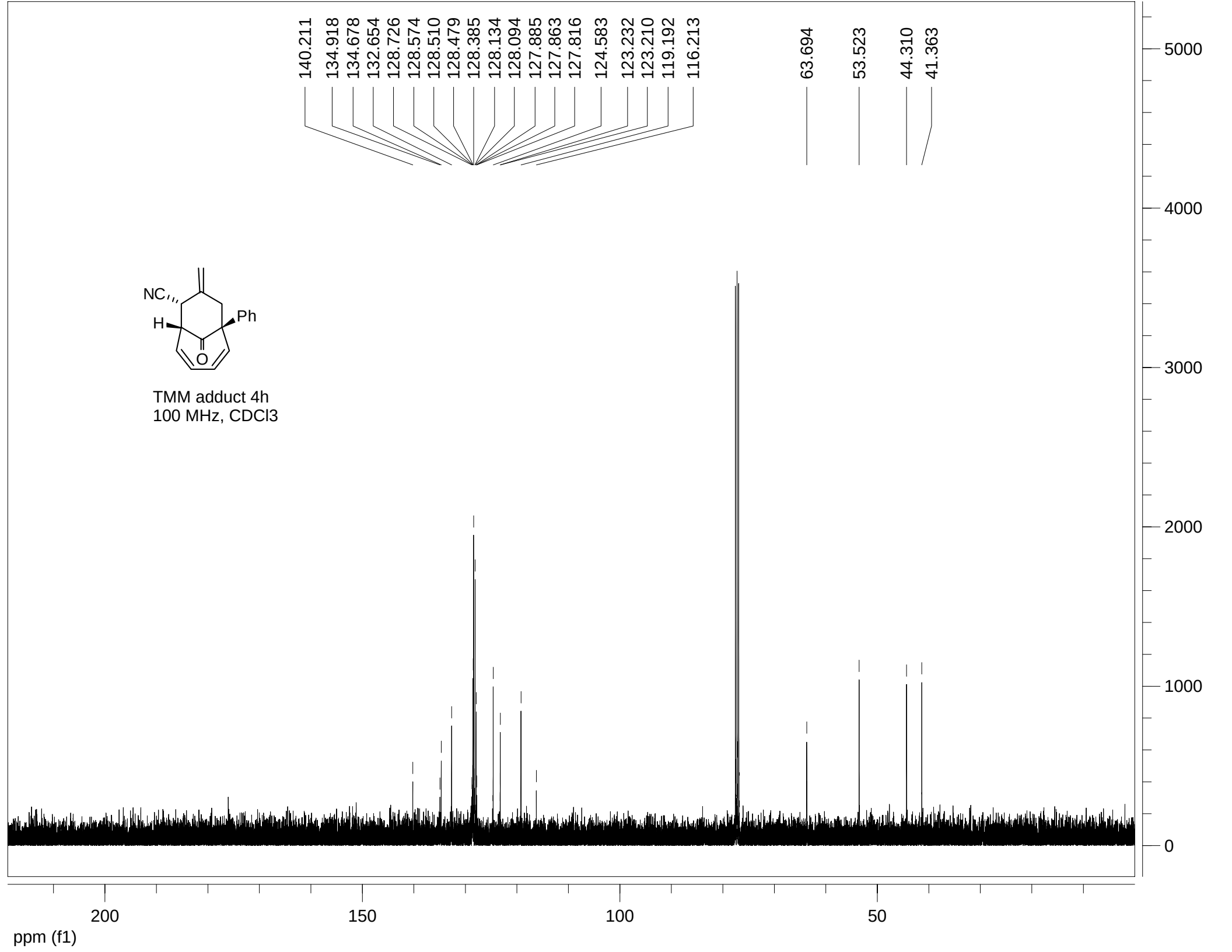
ppm (f1)

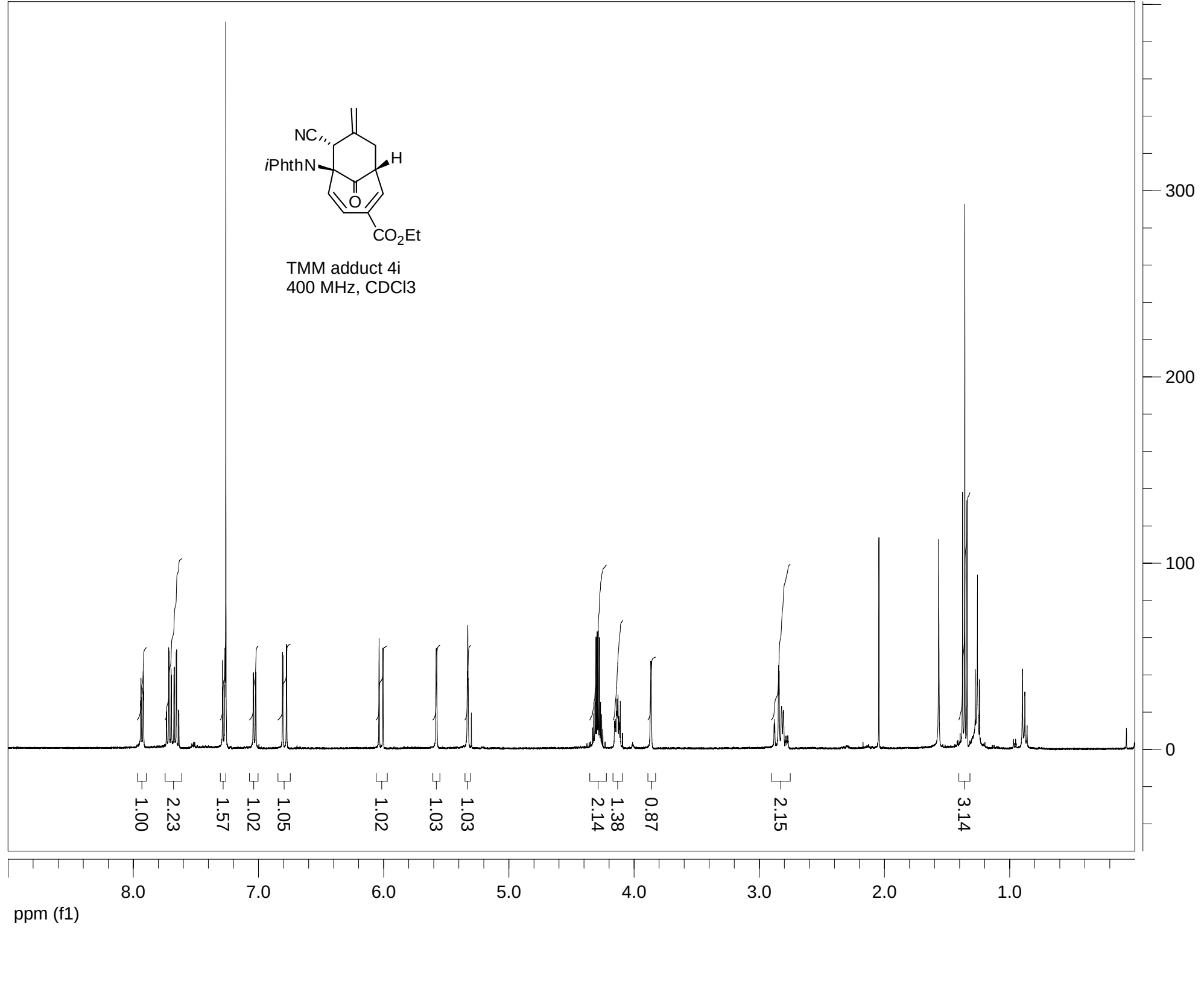

197.103
169.863
133.199
128.468
127.557
123.029
122.625
122.615
119.658
115.899
86.592
52.292
44.940
39.477
21.537
NC
H
OAc
O
TMM adduct 4f
100 MHz, CDCl3
15000
10000
5000
0
200
150
100
50
ppm (f1)

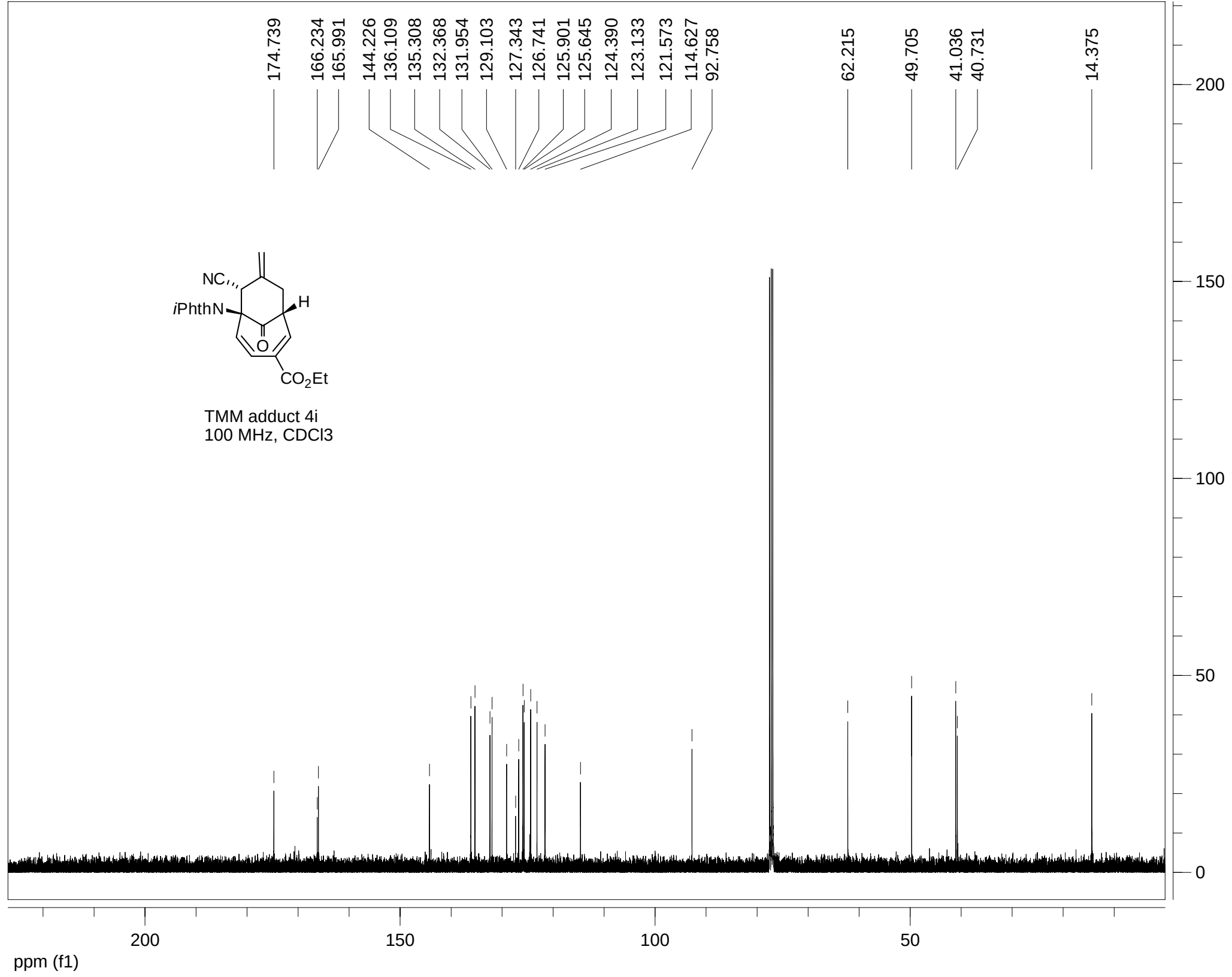

NC
H
NPhth
O
TMM adduct 4g
400 MHz, CDCl3
1.86
1.93
1.00
1.01
1.07
1.03
1.03
1.06
1.01
1.07
1.05
1.08
250
200
150
100
50
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)

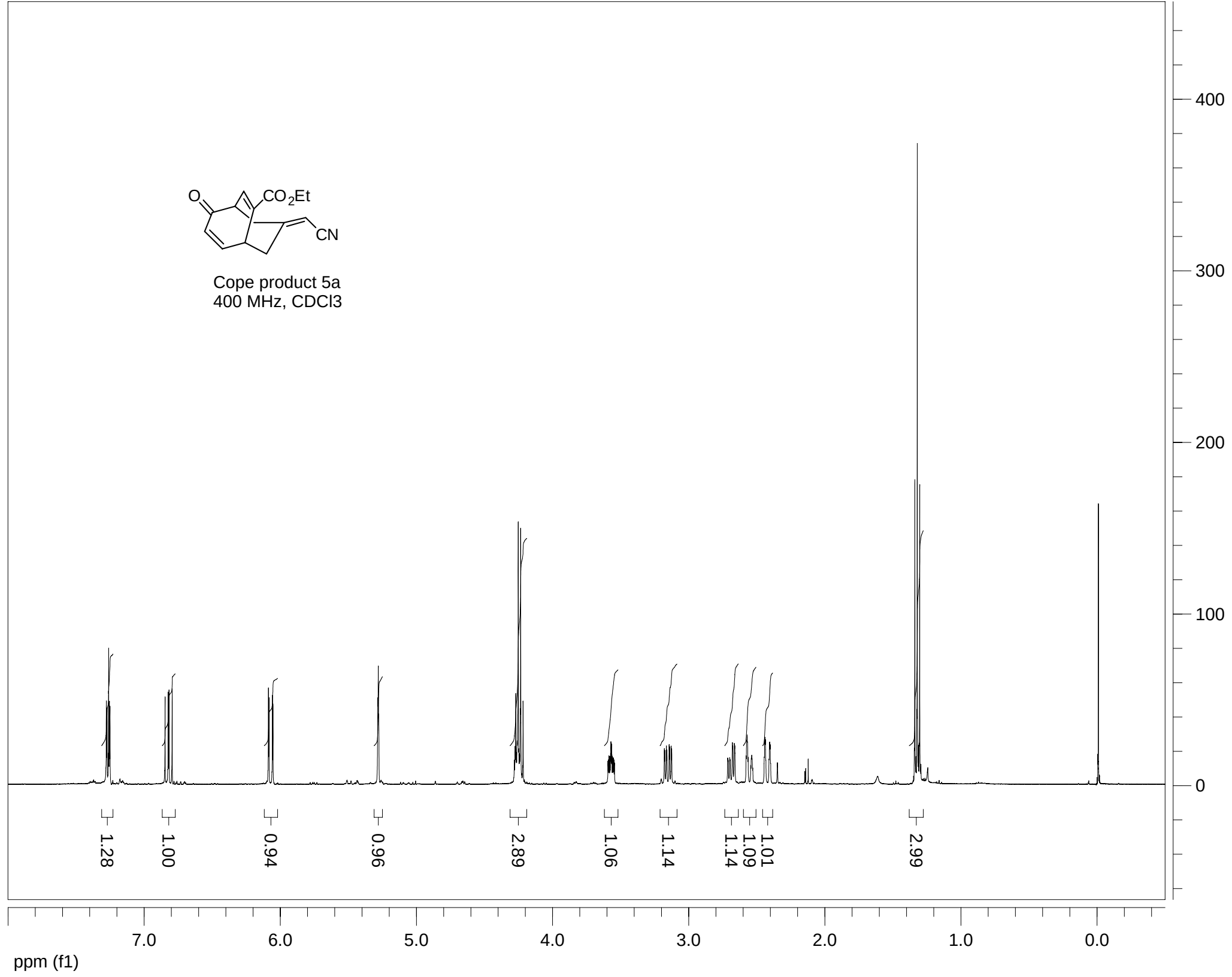

197.265
133.132
128.537
126.276
122.247
121.924
120.327
116.001
89.851
73.646
52.145
44.822
40.029
NC
H
NPhth
O
TMM adduct 4g
100 MHz, CDCl3
250
200
150
100
50
0
200
150
100
50
ppm (f1)

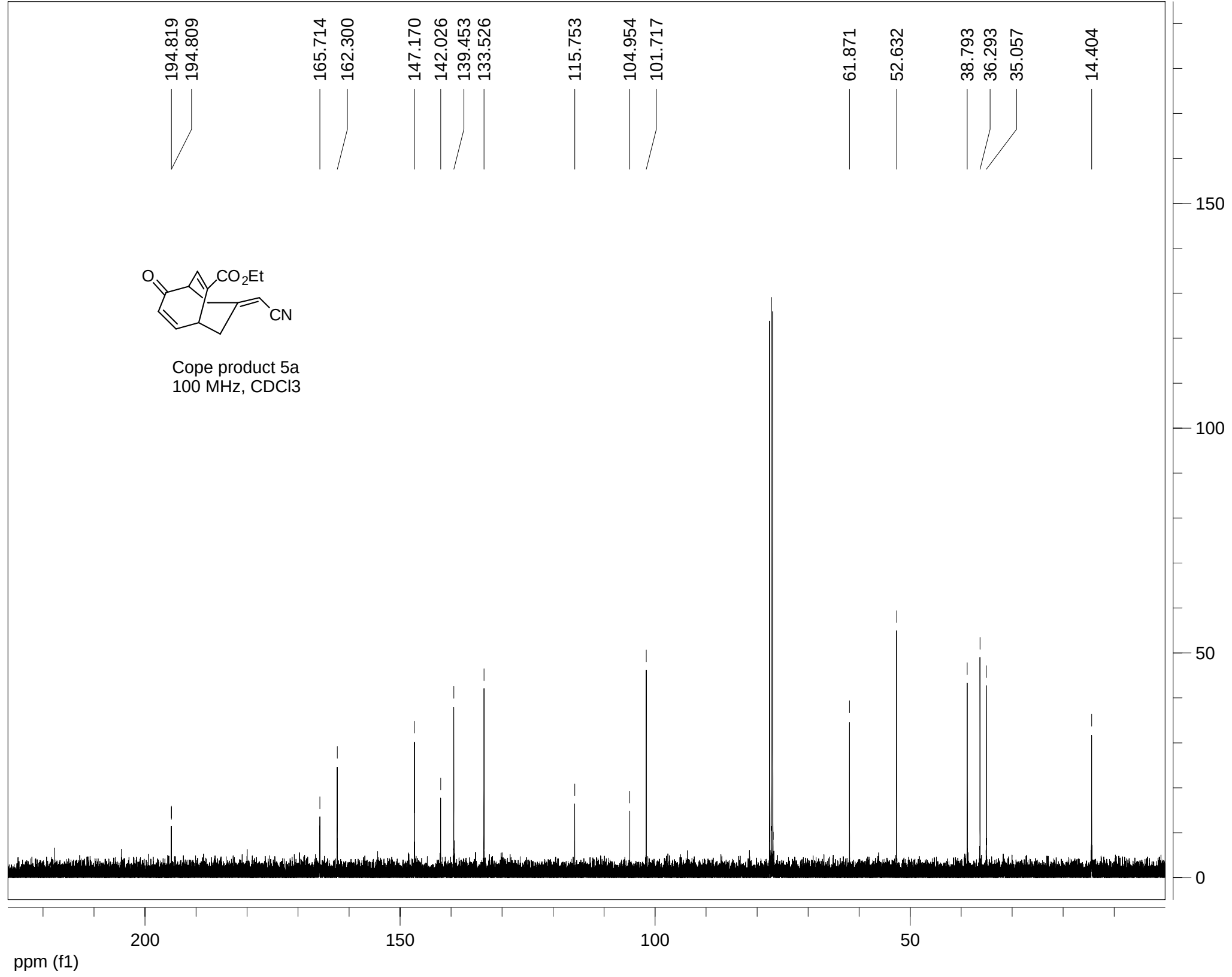

NC
H
Ph
O
TMM adduct 4h
400 MHz, CDCl3
2.87
1.11
1.00
0.99
0.96
0.93
0.97
0.92
0.92
0.99
1.02
1.02
400
300
200
100
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
ppm (f1)

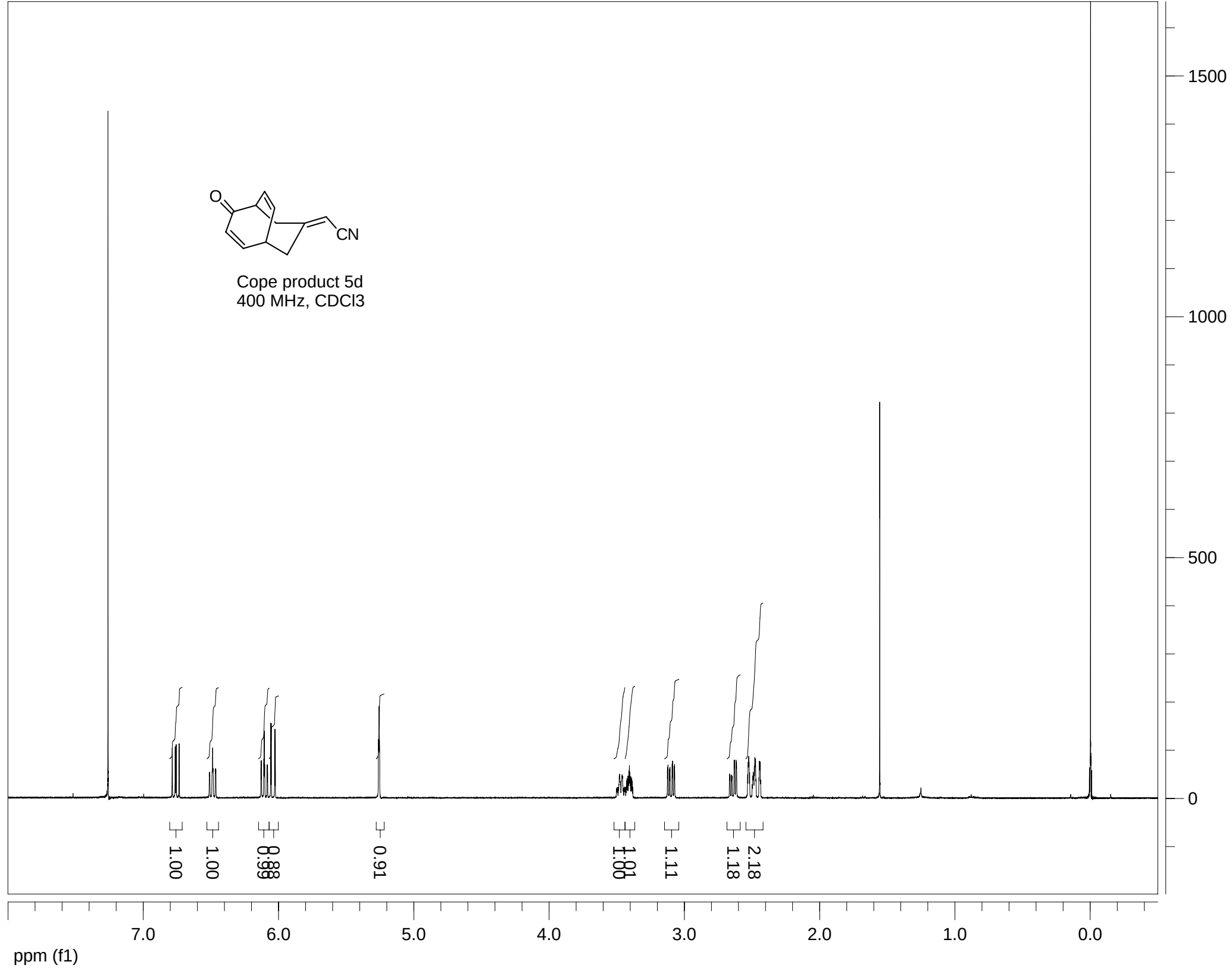

140.211
134.918
134.678
132.654
128.726
128.574
128.510
128.479
128.385
128.134
128.094
127.885
127.863
127.816
124.583
123.232
123.210
119.192
116.213
63.694
53.523
44.310
41.363
NC
H
Ph
O
TMM adduct 4h
100 MHz, CDCl3
5000
4000
3000
2000
1000
0
200
150
100
50
ppm (f1)

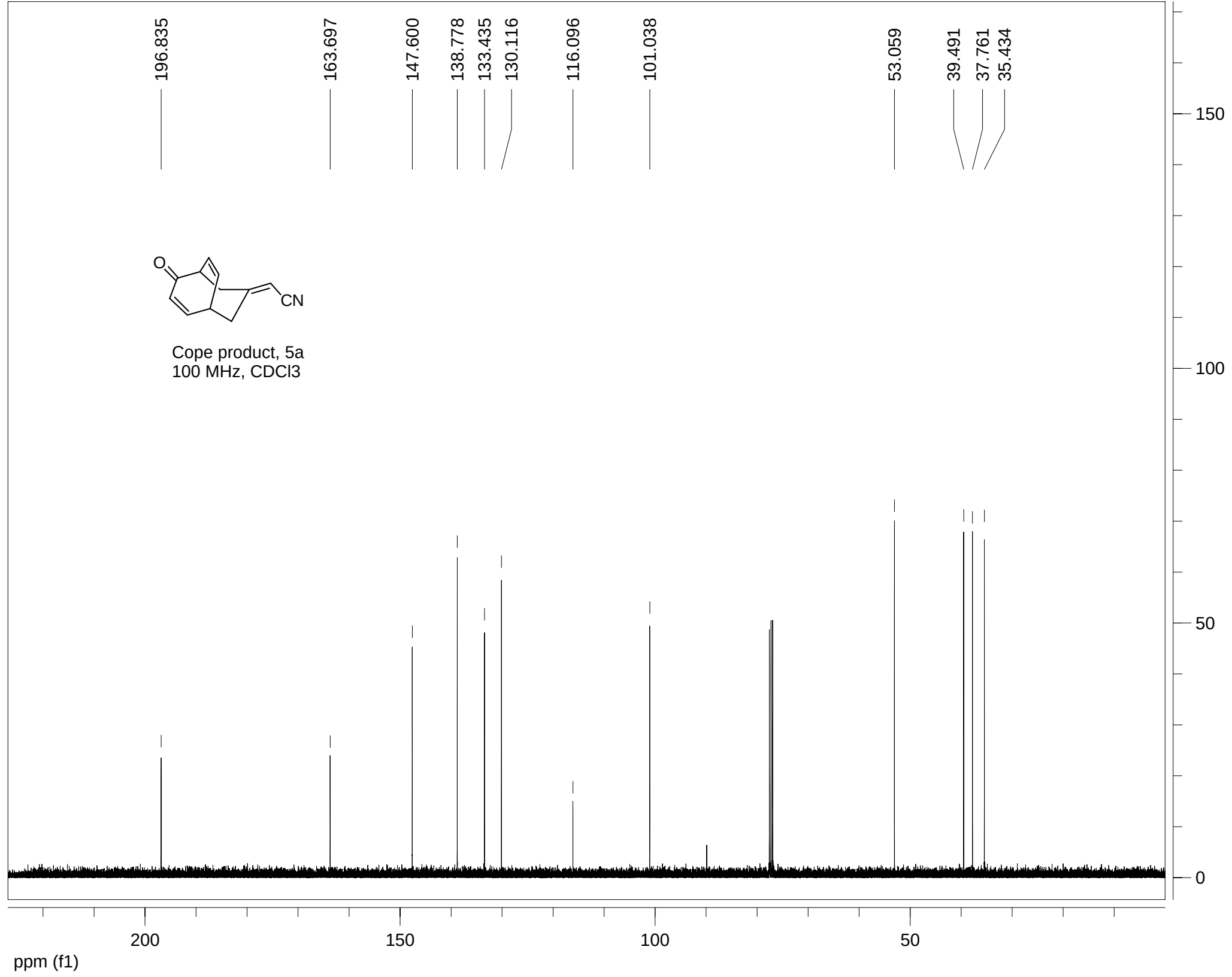

NC
iPhthN
H
O
CO2Et
TMM adduct 4i
400 MHz, CDCl3
300
200
100
0
1.00
2.23
1.57
1.02
1.05
1.02
1.03
1.03
2.14
1.38
0.87
2.15
3.14
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
ppm (f1)

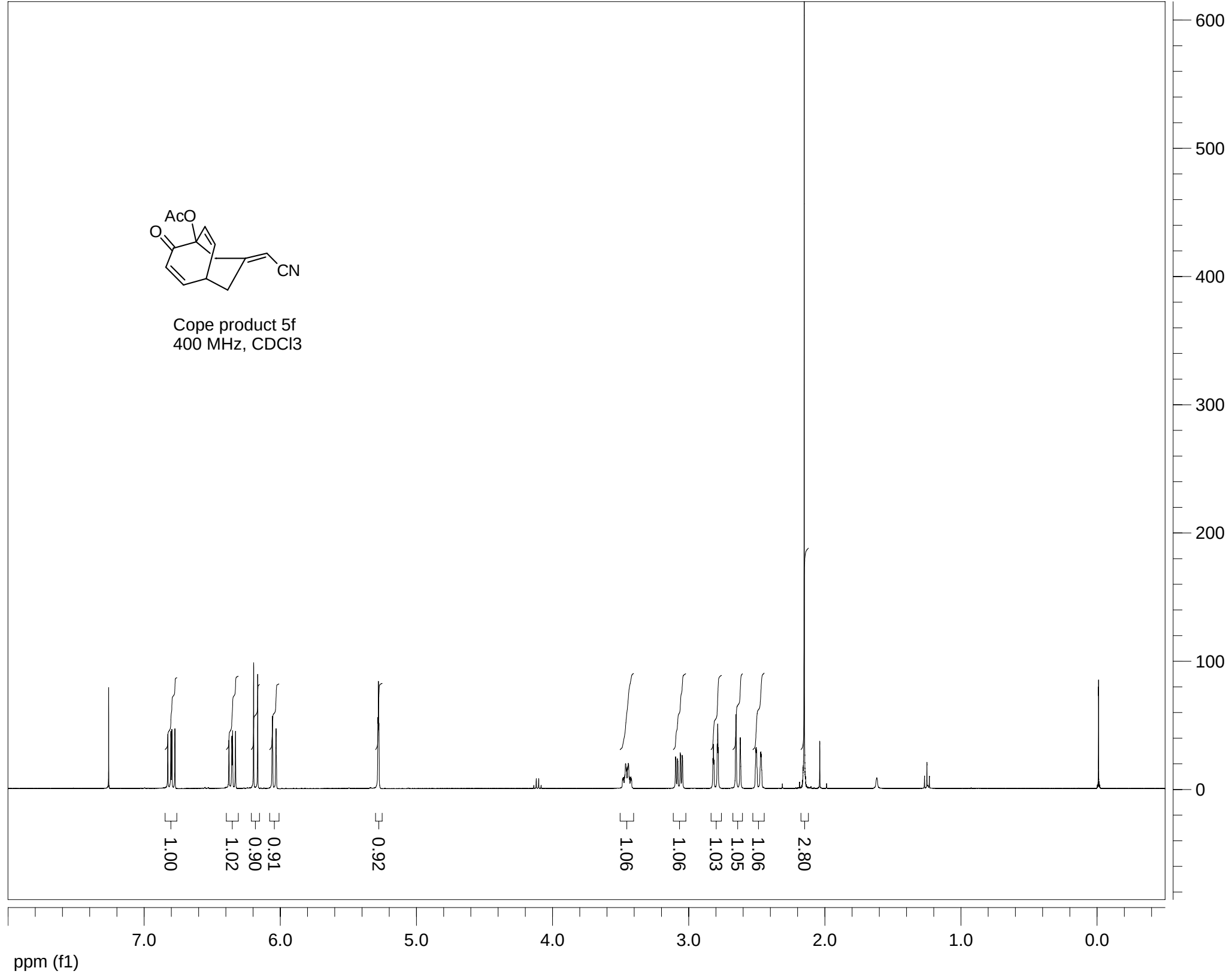

174.739
166.234
165.991
144.226
136.109
135.308
132.368
131.954
129.103
127.343
126.741
125.901
125.645
124.390
123.133
121.573
114.627
92.758
62.215
49.705
41.036
40.731
14.375
NC
iPhthN
H
O
CO2Et
TMM adduct 4i
100 MHz, CDCl3
200
150
100
50
0
200
150
100
50
ppm (f1)

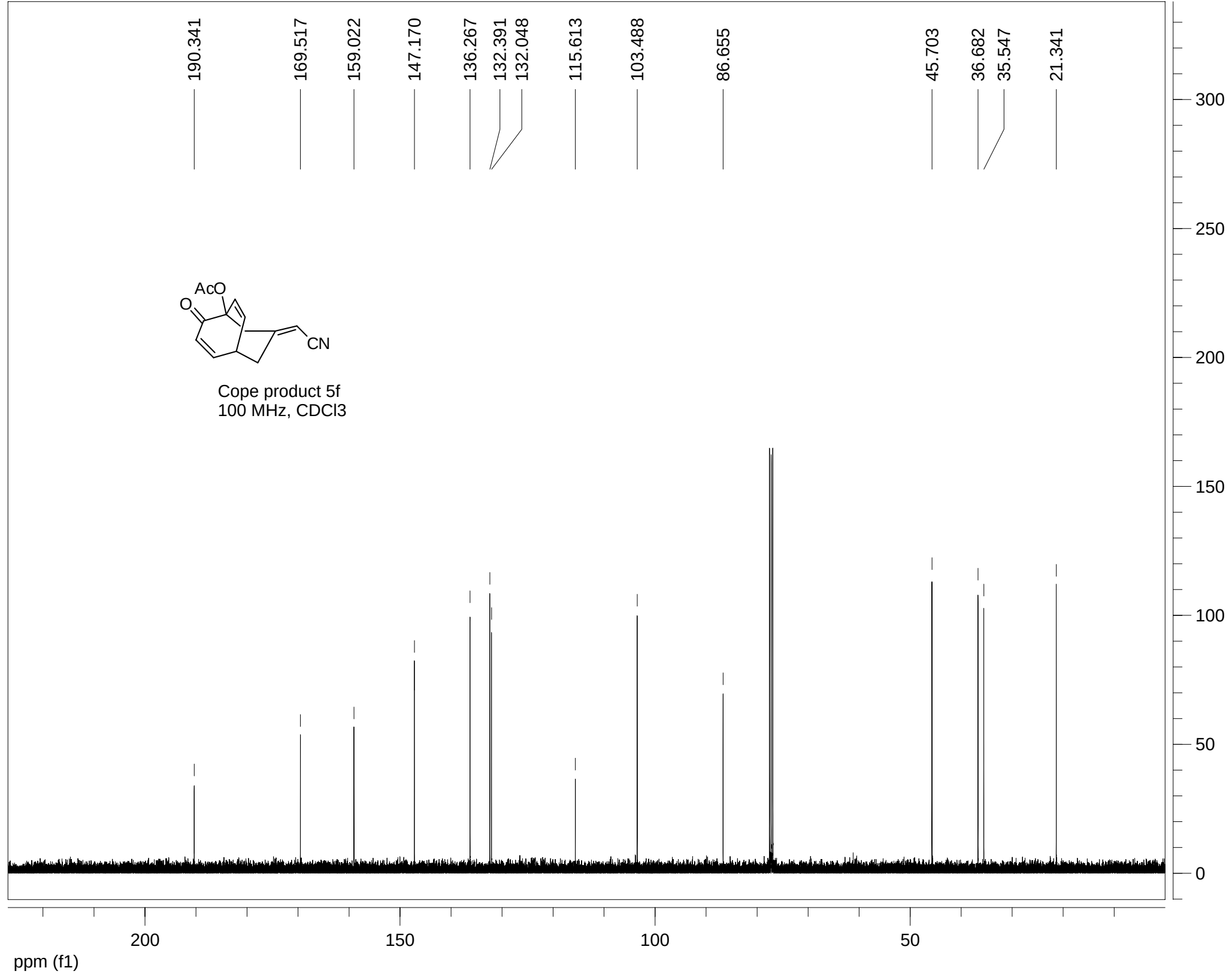

O
CO2Et
CN
Cope product 5a
400 MHz, CDCl3
400
300
200
100
0
1.28
1.00
0.94
0.96
2.89
1.06
1.14
1.14
1.09
1.01
2.99
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)


194.819
194.809
165.714
162.300
147.170
142.026
139.453
133.526
115.753
104.954
101.717
61.871
52.632
38.793
36.293
35.057
14.404
O
CO2Et
CN
Cope product 5a
100 MHz, CDCl3
150
100
50
0
200
150
100
50
ppm (f1)


O
CN
Cope product 5d
400 MHz, CDCl3
1500
1000
500
0
1.00
1.00
0.99
0.88
0.91
1.00
1.01
1.11
1.18
2.18
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)


196.835
163.697
147.600
138.778
133.435
130.116
116.096
101.038
53.059
39.491
37.761
35.434
O
CN
Cope product, 5a
100 MHz, CDCl3
150
100
50
0
200
150
100
50
ppm (f1)


AcO
O
CN
Cope product 5f
400 MHz, CDCl3
1.00
1.02
0.90
0.91
0.92
1.06
1.06
1.03
1.05
1.06
2.80
600
500
400
300
200
100
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
ppm (f1)


190.341
169.517
159.022
147.170
136.267
132.391
132.048
115.613
103.488
86.655
45.703
36.682
35.547
21.341
AcO
O
CN
Cope product 5f
100 MHz, CDCl3
300
250
200
150
100
50
0
200
150
100
50
ppm (f1)