Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Waste Corn-cob Cellulose Supported Bio-Heterogeneous Copper Nanoparticles for Aza-Michael Reactions

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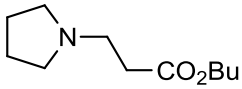
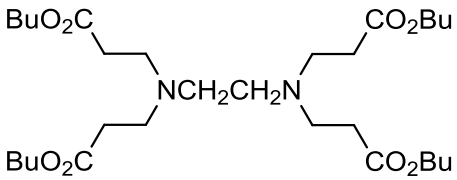
Supporting information

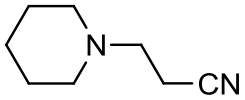
Characterization of Aza-Michael Products



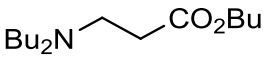
^{1}H NMR ($CDCl_3$, 500 MHz) δ 408 (t, *J* = 5.0 Hz, 2 H), 2.77 (t, *J* = 5.0 Hz, 2 H), 2055-2.48 (m, 6 H), 1.80-1.62 (m, 4 H), 1.64-1.57 (m, 2 H), 1.42-1.35 (m, 2 H), 0.94 (t, *J* = 5.0 Hz, 3 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.38, 64.08, 53.84, 51.28, 34.05, 30.53, 23.32, 18.98, 13.55. MS-EI, m/z 199 (M^+).



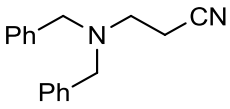
^{1}H NMR ($CDCl_3$, 500 MHz) δ 4.06 (t, *J* = 7.0 Hz, 8 H), 2.77 (t, *J* = 7.0 Hz, 8 H), 2.52 (m, 4 H, 2.27-2.40 (m, 8 H), 1.67-1.57 (m, 8 H)1.43-1.34 (m, 8 H), 0.93 (t, *J* = 7. 0 Hz, 12 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.03, 63.72, 51.97, 49.52, 32.43, 30.37, 18.80, 13.32. MS-EI, m/z 572 (M^+).



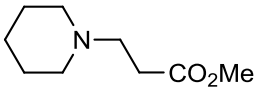
^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.68 (t, *J* = 7. 0 Hz, 2 H), 2.50 (t, *J* = 7.0 Hz, 2 H), 2.45-2.39 (m, 4 H), 1.62-1.56 (m, 4 H), 1.44-1.41 (m, 2 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 119.13, 54.19, 25.86, 24.13, 15.69. MS-EI, m/z 138 (M^+).



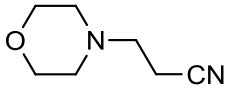
^{1}H NMR ($CDCl_3$, 500 MHz) δ 4.07 (t, *J* = 7.0 Hz, 2 H), 2.78 (t, *J* = 7.0 Hz, 2 H0, 2.45-2.37 (m, 6 H), 1.63-1.57 (m, 2 H), 1.45-1.41 (m, 6 H), 1.35-1.26 (m, 4 H), 0.93 (t, *J* = 7.0 Hz, 9 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.89, 53.65, 49.49, 32.48, 30.71, 29.34, 20.60, 19.15, 13.99, 13.65. MS-EI, m/z 157 (M^+).



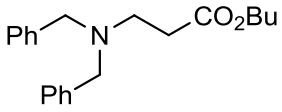
^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.38 (dd, *J* = 7.5 Hz, 4 H), 7.32 (dd, *J* = 7.5 Hz, 4 H), 7.24 (dd, *J* = 7.5 Hz, 2 H), 2.77 (t, *J* = 7.0 Hz, 2 H), 2.37 (t, *J* = 7.0 Hz, 2 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 138.48, 128.60, 128.48, 128.30, 127.16, 118.75, 57.99, 48.56, 16.12. MS-EI, m/z 250 (M^+).



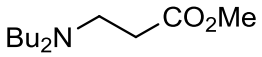
^{1}H NMR ($CDCl_3$, 500 MHz) δ 3.67 (s, 3 H), 2.66 (t, J = 7.0 Hz, 2 H), 2.54-2.50 (m, 2 H), 2.43-2.36 (m, 4 H), 1.61-1.54 (m, 4 H), 1.41-1.40 (m, 2 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 173.28, 54.35, 53.30, 51.71, 32.08, 25.97, 24.35. MS-EI, m/z 171 (M^+).



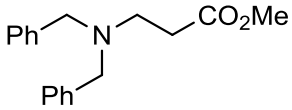
^{1}H NMR ($CDCl_3$, 500 MHz) δ 3.71 (t, *J* = 7.0 Hz, 4 H), 2.67 (t, *J* = 7.0 Hz, 2 H), 2.55-2.47 (m, 6 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 118.61, 66.52, 53.42, 52.86, 15.48. MS-EI, m/z 140 (M^+).



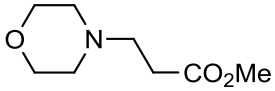
^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.32 (dd, *J* = 7.5 Hz, 4 H), 7.28 (dd, *J* = 7.5 Hz, 4 H), 7.20 (dd, *J* 7.5 Hz, 2 H), 4.00 (t, *J* = 7.0 Hz, 2 H), 3.54 (s, 4 H), 2.79 (t, *J* = 7.0 Hz, 2 H), 2.47 (t, *J* = 7.0 Hz, 2 H), 1.54-1.47 (m, 2 H), 1.34-1.28 (m, 2 H), 0.89 (t, *J* = 7.0 Hz, 3 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.30, 139.19, 128.68, 128.09, 126.84, 64.02, 57.95, 49.17, 32.71, 30.53, 19.04, 13.64. MS-EI, m/z 325 (M^+).



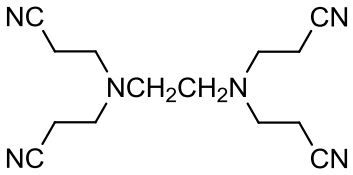
^{1}H NMR ($CDCl_3$, 500 MHz) δ 3.66 (s, 3 H), 2.77 (t, *J* = 7.0 Hz, 2 H), 2.42 (t, *J* = 7.0 Hz, 2 H), 2.39 (t, *J* = 7.0 Hz, 4 H), 1.44-1.38 (m, 4 H), 1.32-1.28 (m, 4 H), 0.90 (t, *J* = 7.0 Hz, 6 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 173.16, 53.60, 51.29, 49.36, 32.24, 29.26, 20.53, 13.98. MS-EI, m/z 215 (M^+).



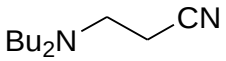
^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.33-7.27 (m, 8 H), 7.21 (dd, *J* = 7.5 Hz, 2 H), 3.59 (s, 3 H), 3.55 (s, 4 H), 2.78 (t, *J* = 7.0 Hz, 2 H), 2.48 (t, *J* = 7.0 Hz, 2 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.48, 139.14, 128.62, 128.05, 126.81, 57.91, 51.10, 48.99, 32.47. MS-EI, m/z 283 (M^+).



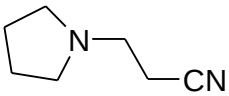
^{1}H NMR ($CDCl_3$, 500 MHz) δ 3.66 (s, 7 H), 2.68 (t, *J* = 7.0 Hz, 2 H), 2.51 (t, *J* = 7.0 Hz, 2 H), 2.47-2.44 (m, 4 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.50, 66.62, 53.73, 53.20, 51.36, 31.64. MS-EI, m/z 173 (M^+).



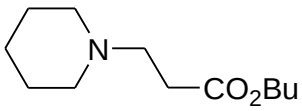
^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.92 (t, *J* =7.0 Hz, 4 H), 2.85 (t, *J* = 7.0 Hz, 4 H), 2.70 (s, 4 H), 2.53 (t, *J* = 7.0 Hz, 8 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 118.93, 52.92, 52.31, 49.27, 48.00, 46.38, 44.85, 44.62, 18.46, 16.82. MS-EI, m/z 272 (M^+).



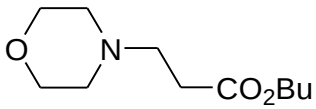
^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.77 (t, *J* = 7.0 Hz, 2 H), 2.44-2.40 (m, 6 H), 1.44-1.39 (m, 4 H), 1.38-1.29 (m, 4 H), 0.91 (t, *J* = 7.0 Hz, 6 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 119.05, 53.45, 49.57, 29.44, 20.38, 16.12, 13.90. MS-EI, m/z 182 (M^+).



^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.78 (t, *J* = 7.0 Hz, 2 H), 2.58-2.52 (m, 6 H), 1.80-1.77 (m, 4 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 119.02, 53.97, 51.45, 23.69, 17.74. MS-EI, m/z 124 (M^+).

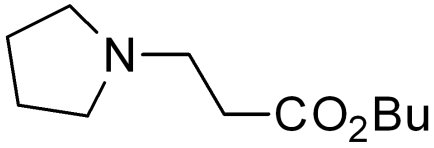


^{1}H NMR ($CDCl_3$, 500 MHz) δ 4.08 (t, *J* = 7.0 Hz, 2 H), 2.65 (t, *J* = 7.0 Hz, 2 H), 2.50 (t, *J* =7.0 Hz, 2 H), 2.45-2.33 (m, 4 H), 1.62-1.55 (m, 6 H), 1.42-1.36 (m, 4 H), 0.91 (t, *J* = 7.0 Hz, 3 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 172.18, 63.31, 53.44, 31.4429.82, 25.03, 23.42, 18.25, 12.80. MS-EI, m/z 213 (M^+).

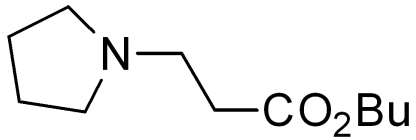


^{1}H NMR ($CDCl_3$, 500 MHz) δ 4.09 (t, *J* = 7.0 Hz, 2 H), 3.69 (t, *J* = 7.0 Hz, 4 H), 2.68 (t, *J* = 7.0 Hz, 2 H), 2.52-2.44 (m, 6 H), 1.63-1.57 (m, 2 H), 1.42-1.36 (m, 2 H), 0.93 (t, *J* = 7.0 Hz, 3 H). ^{13}C NMR ($CDCl_3$, 125 MHz) δ 171.96, 66.52, 63.86, 53.73, 53.12, 31.85, 30.40, 18.81, 13.38. MS-EI, m/z 215 (M^+).

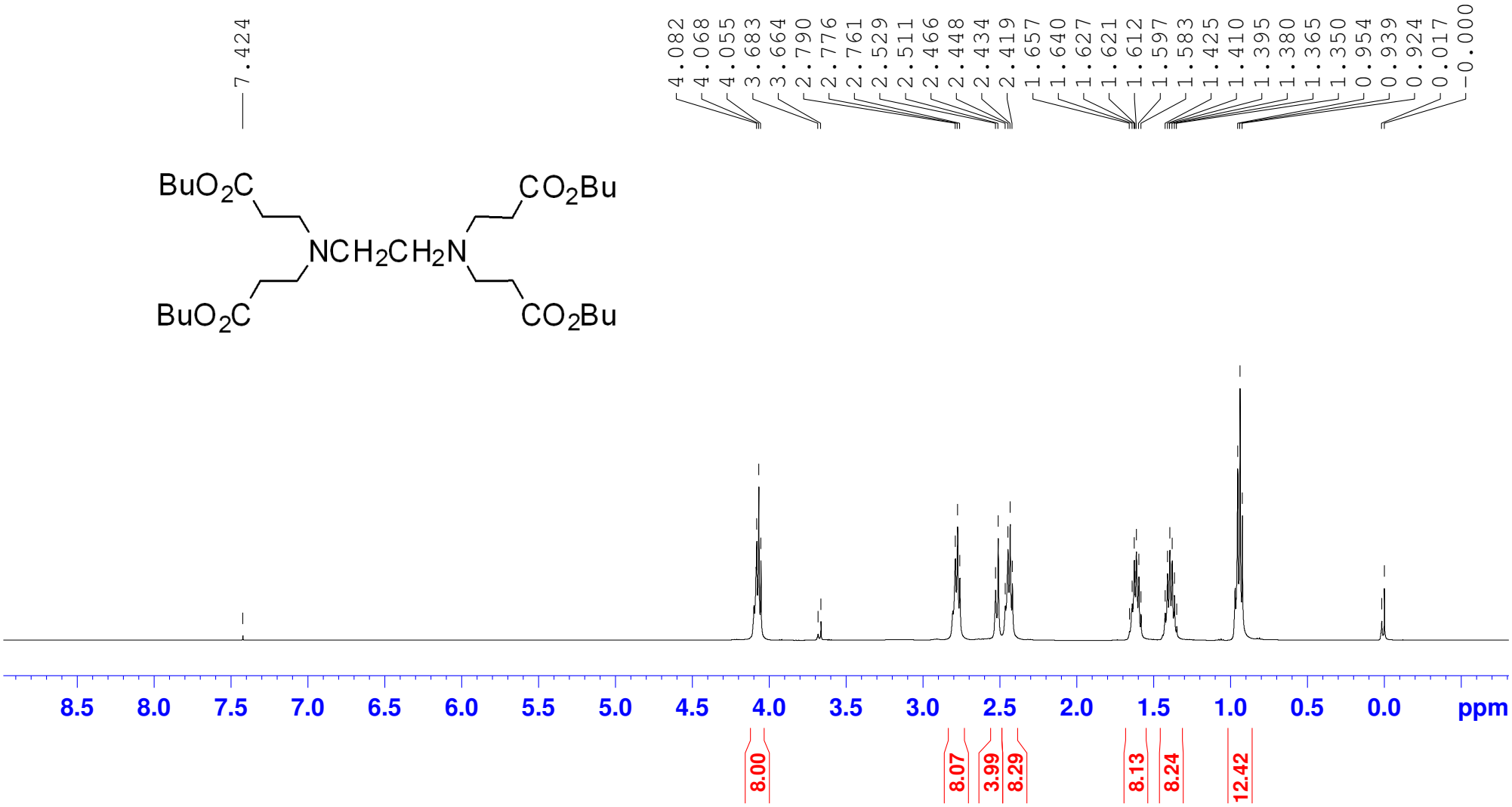
sample 1
proton
cdcl3



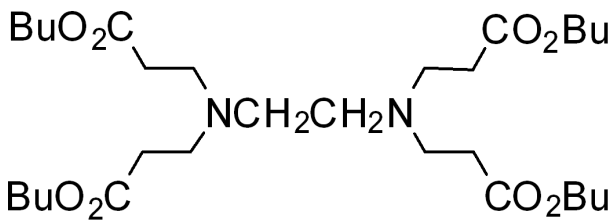
sample 1
C13
cdcl3



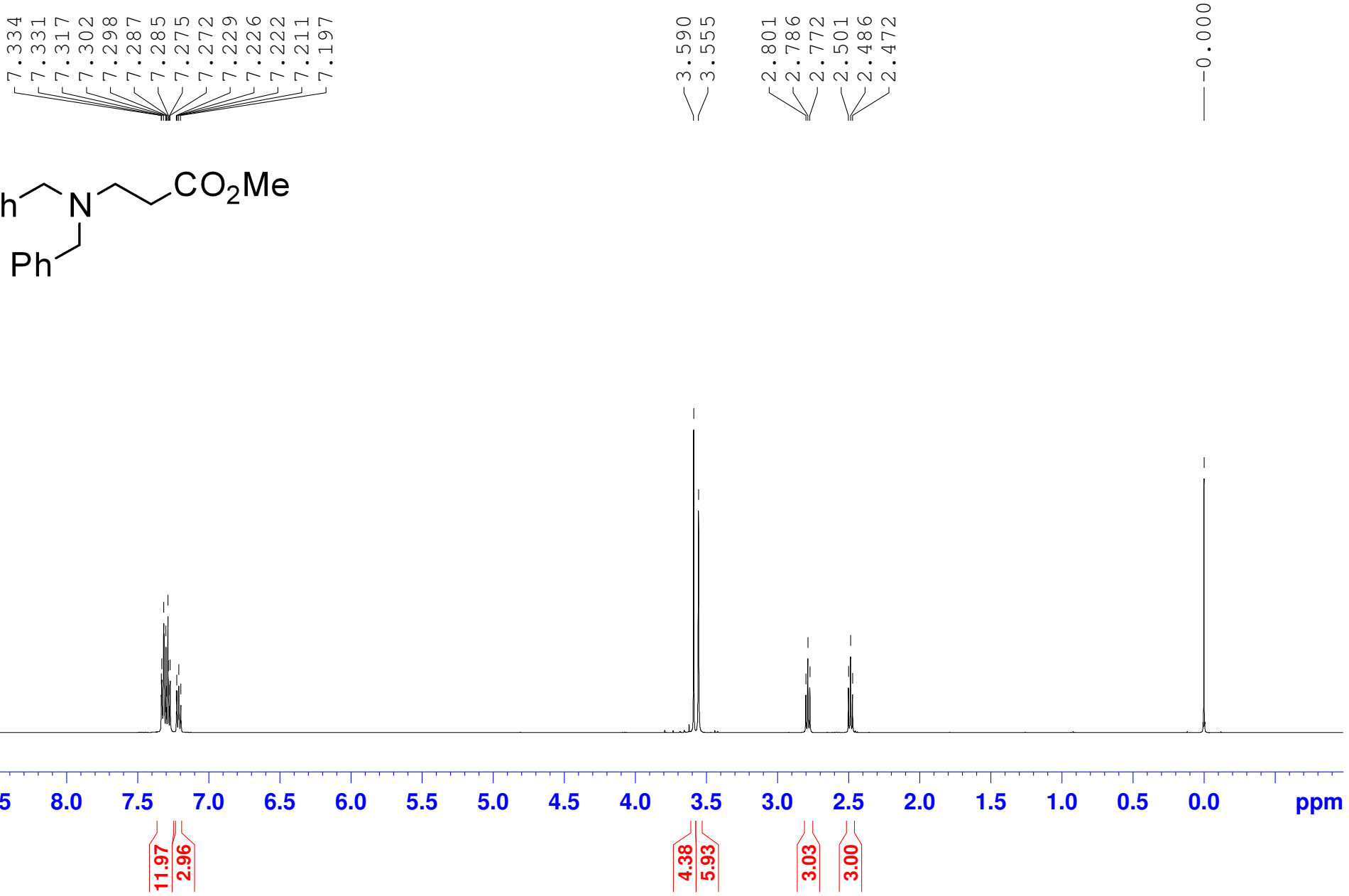
sample 2
proton
cdcl3



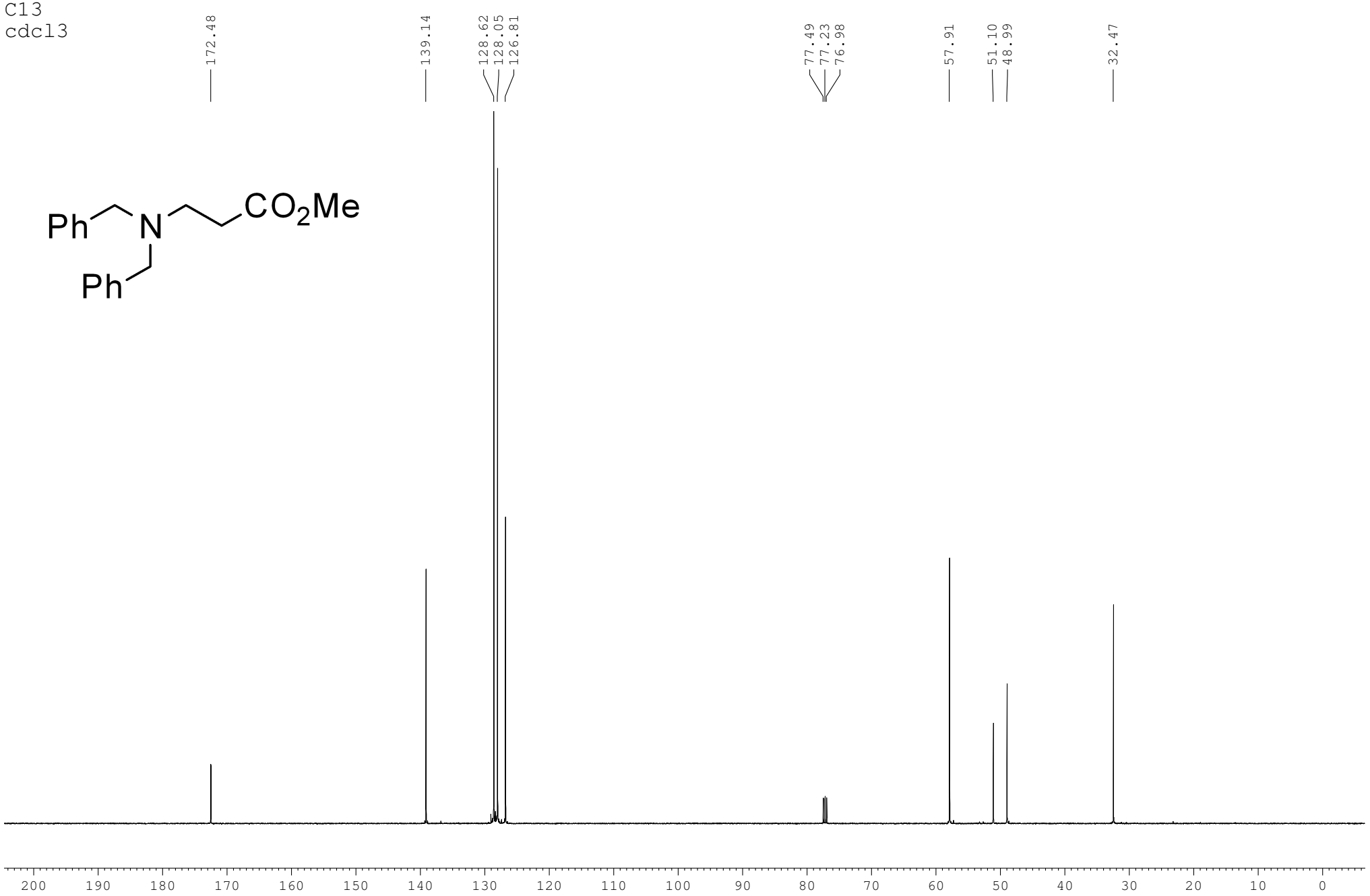
sample 2
C13
cdcl3



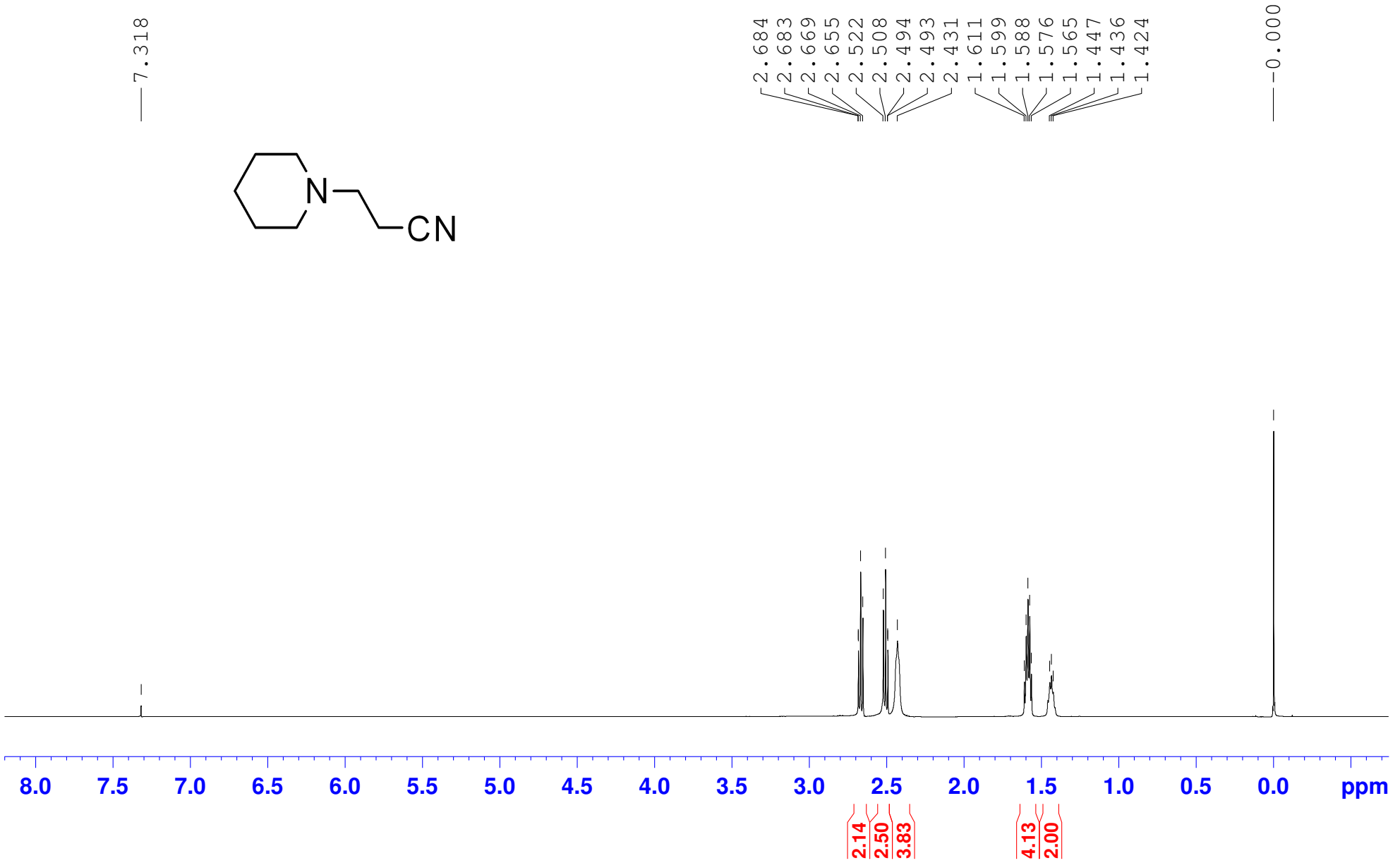
sample 3
proton
cdcl3



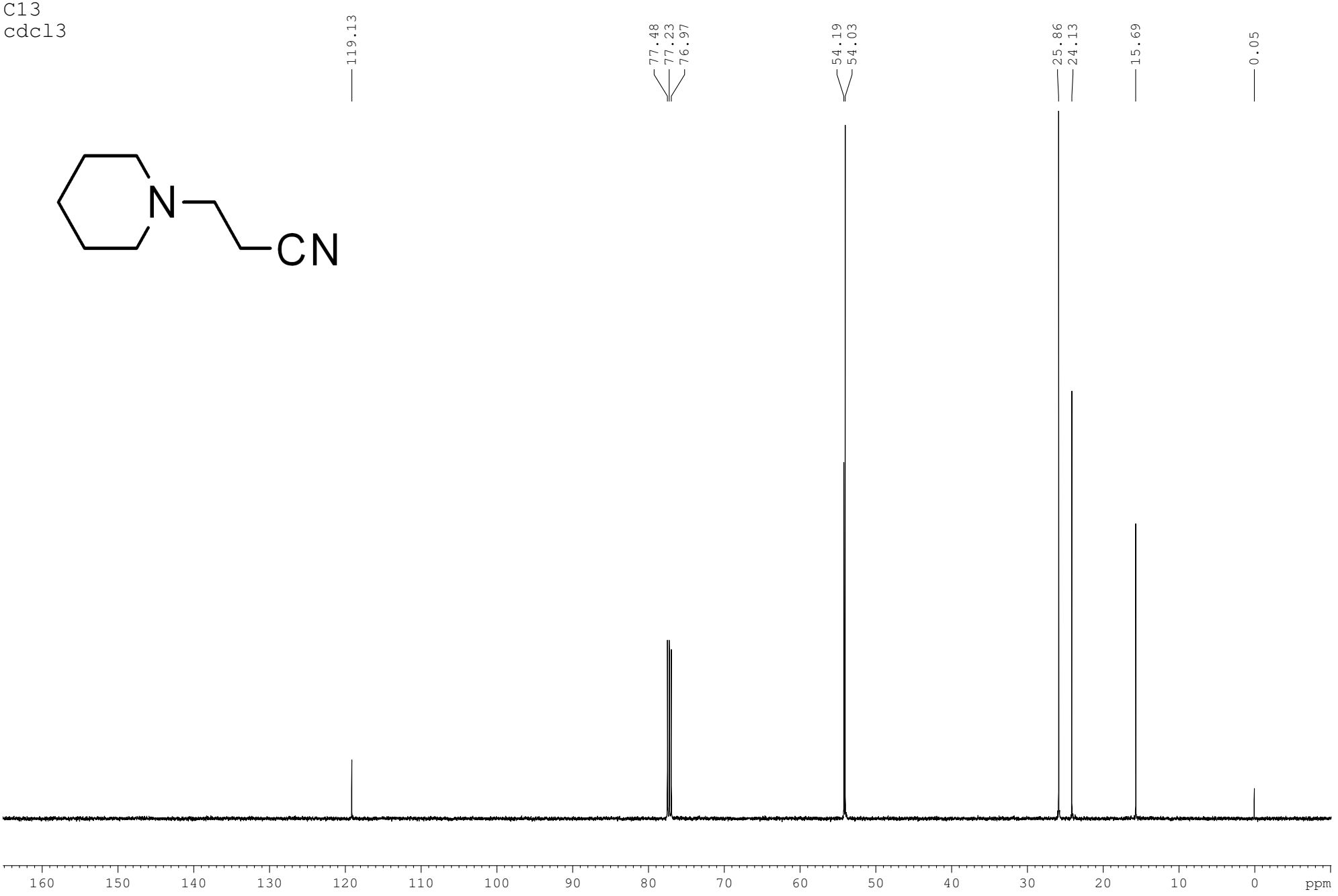
sample 3
C13
cdcl3



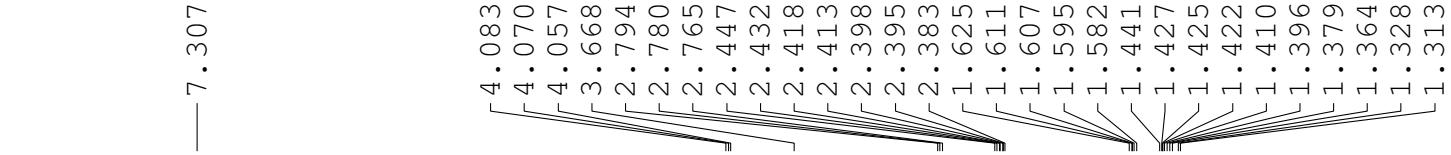
sample 4
proton
cdcl3

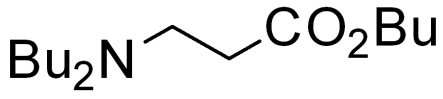


sample 4
C13
cdcl3



sample 5
proton
cdcl3





Current Data Parameters
NAME Tapan_2015
EXPNO 55
PROCNO 1

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PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 22.6
DW 48.400 usec
DE 6.50 usec
TE 300.0 K
D1 1.00000000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
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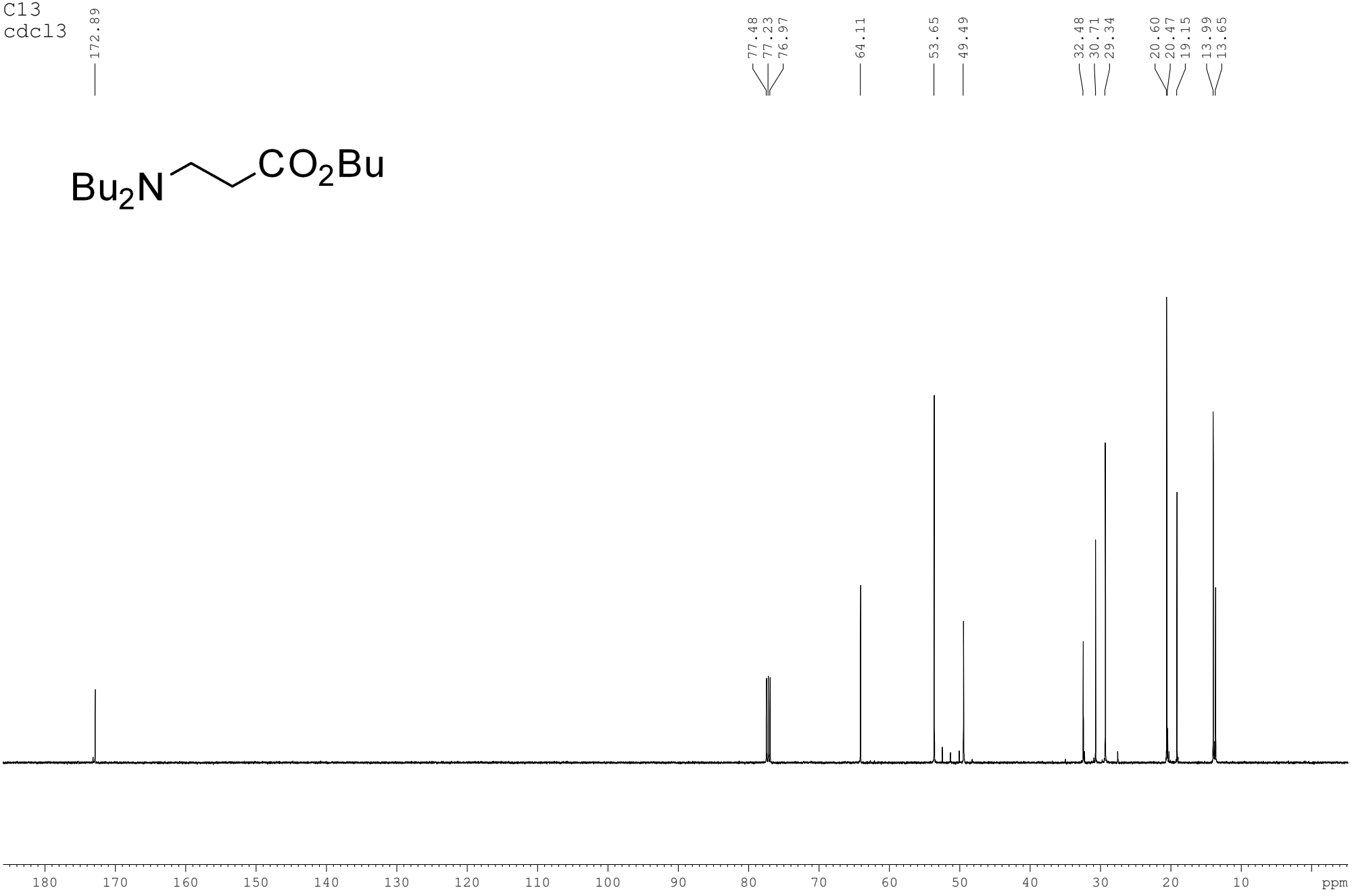
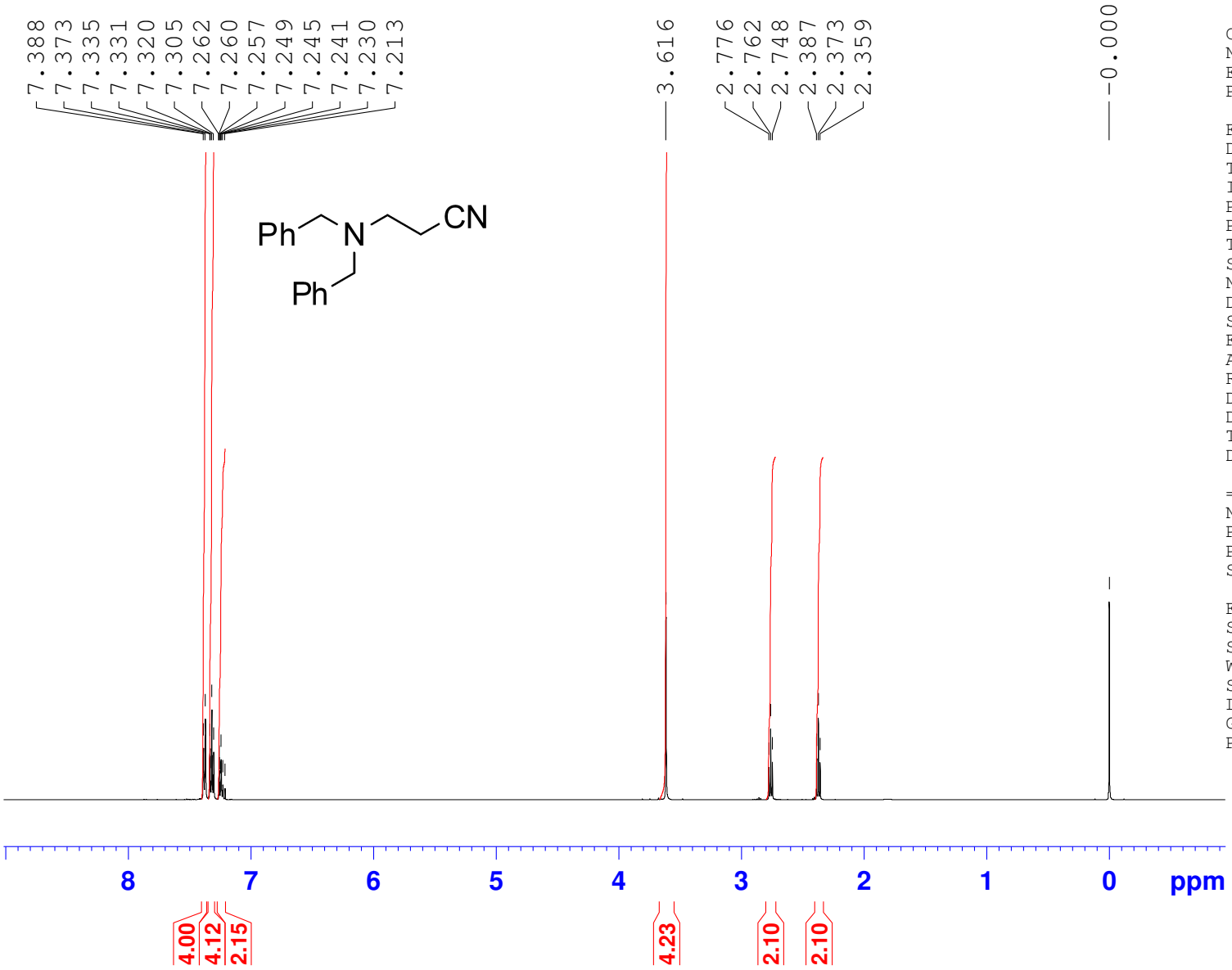
SF 500.1299897 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 5
C13
cdcl3



sample 7
proton
cdcl3



Current Data Parameters
NAME Tapan_2015
EXPNO 57
PROCNO 1

F2 - Acquisition Parameters
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Time 15.42
INSTRUM spect
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PULPROG zg30
TD 65536
SOLVENT CDCl3
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DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 40.3
DW 48.400 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
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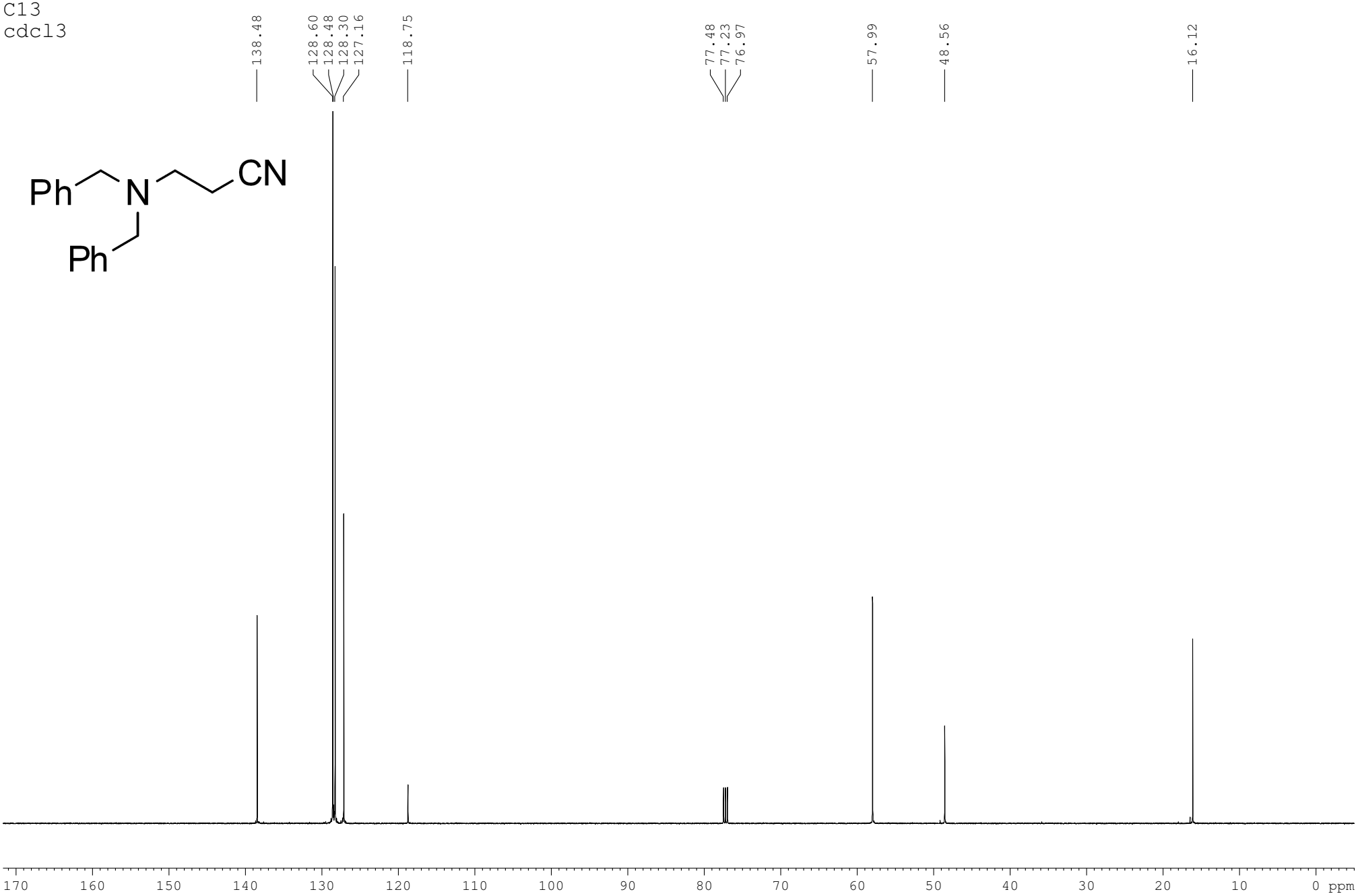
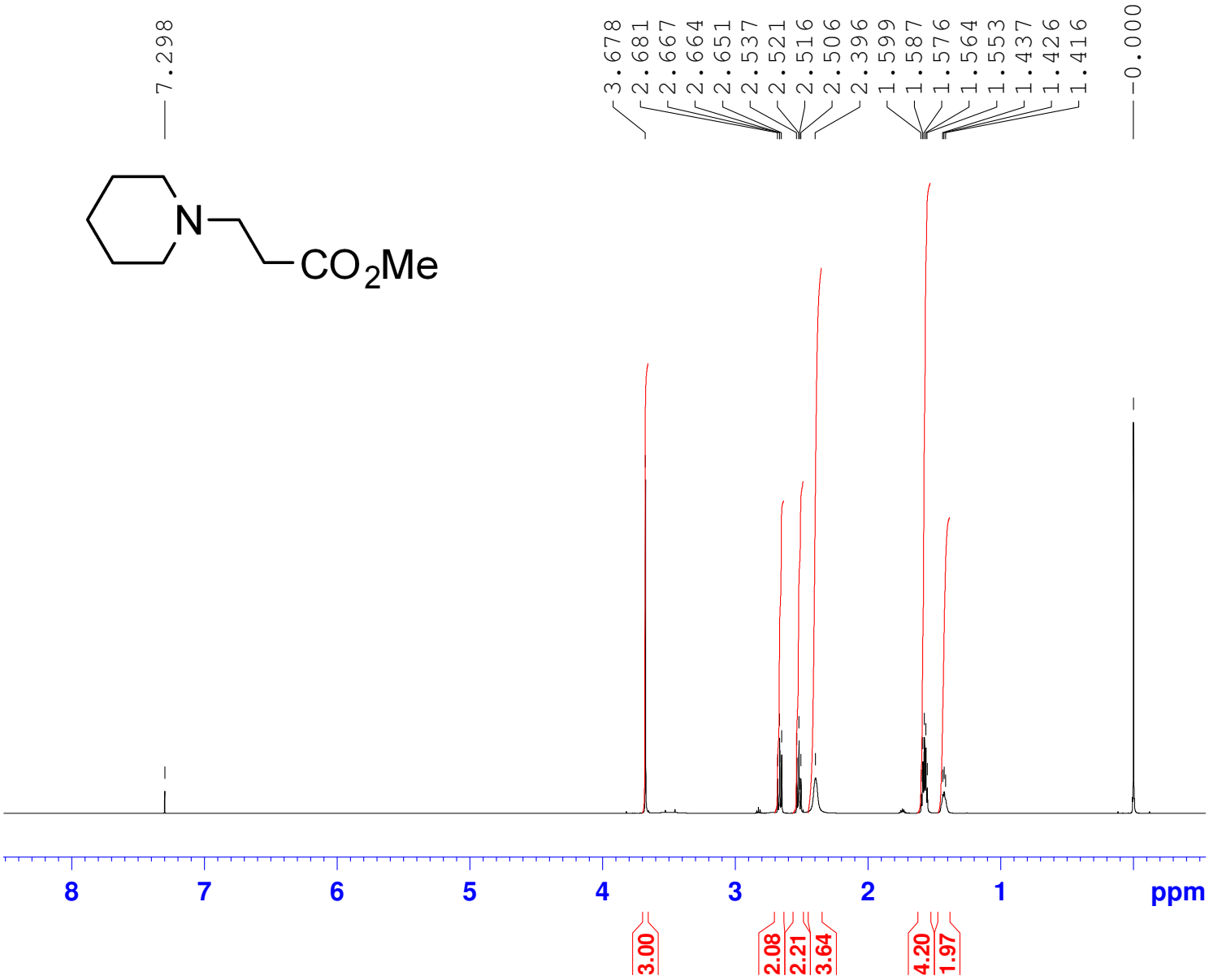
SF 500.1300372 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 7
C13
cdcl3



sample 9
proton
cdcl3



Current Data Parameters
NAME Tapan_2015
EXPNO 59
PROCNO 1

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INSTRUM spect
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PULPROG zg30
TD 65536
SOLVENT CDCl3
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DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 50.8
DW 48.400 usec
DE 6.50 usec
TE 293.4 K
D1 1.00000000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
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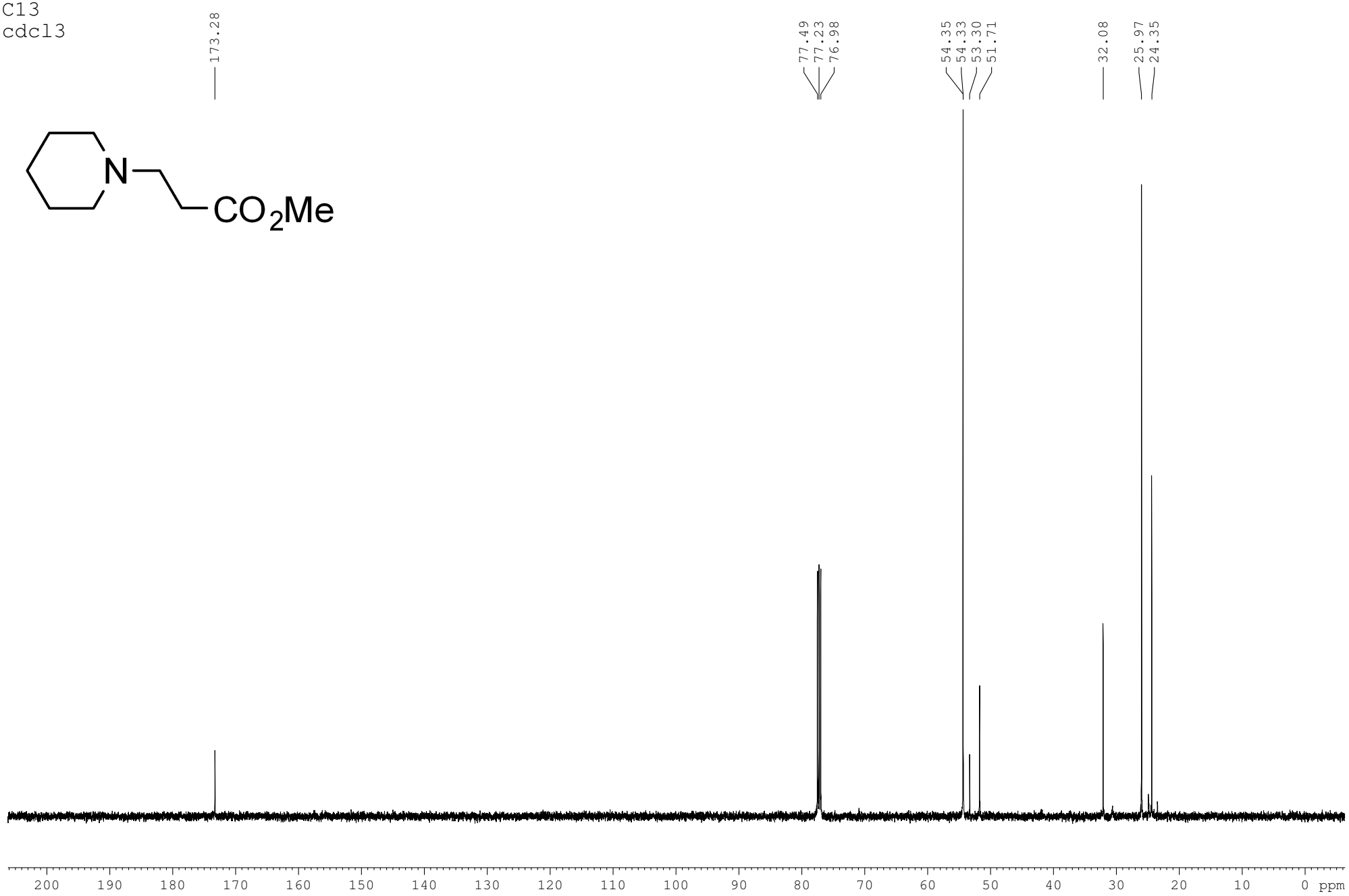
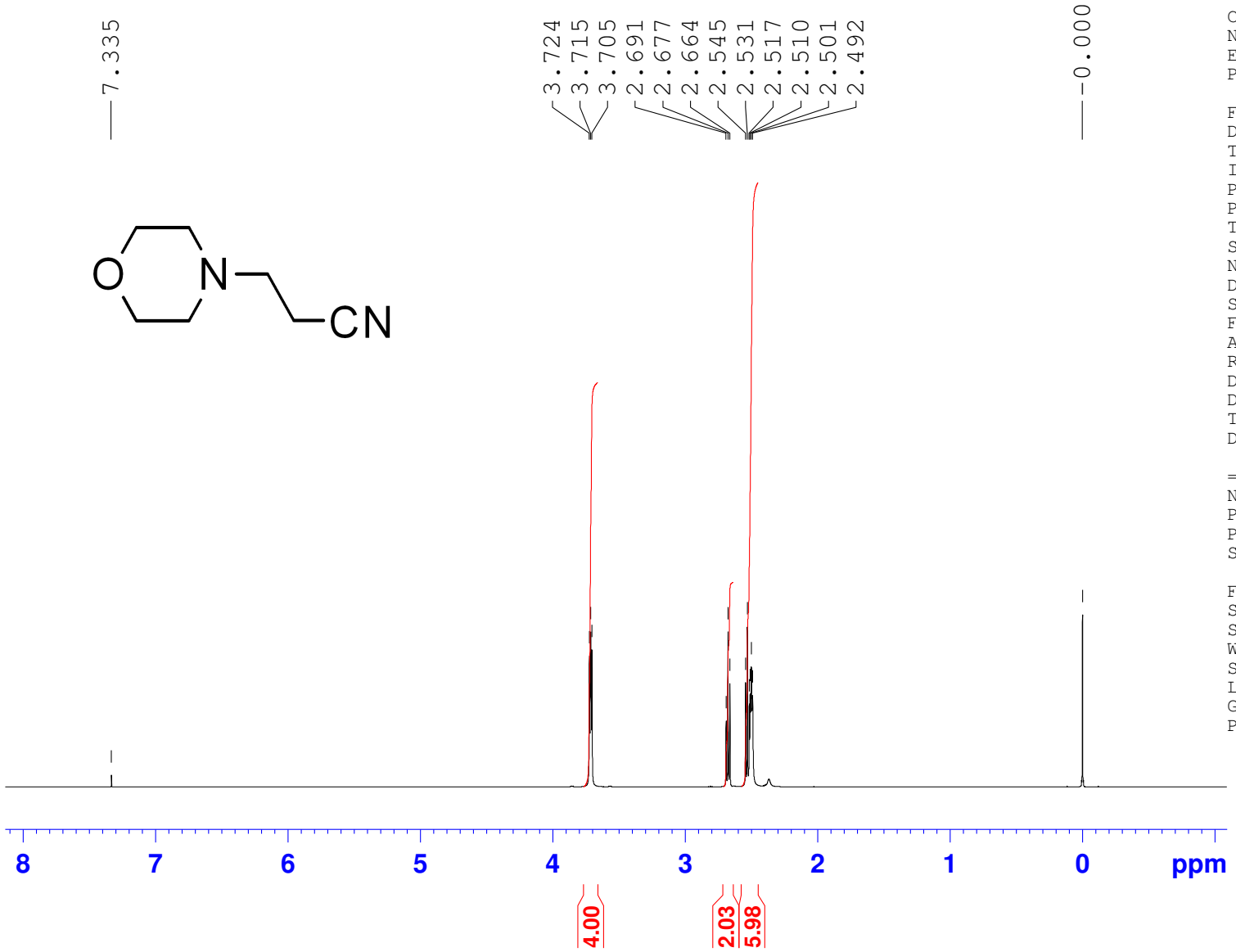
SF 500.1299945 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 9
C13
cdcl3



sample 10
proton
cdcl3



Current Data Parameters
NAME Tapan_2015
EXPNO 60
PROCNO 1

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INSTRUM spect
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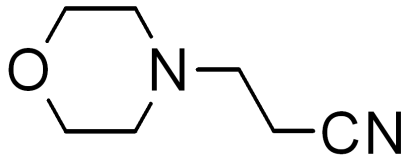
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 22.6
DW 48.400 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec

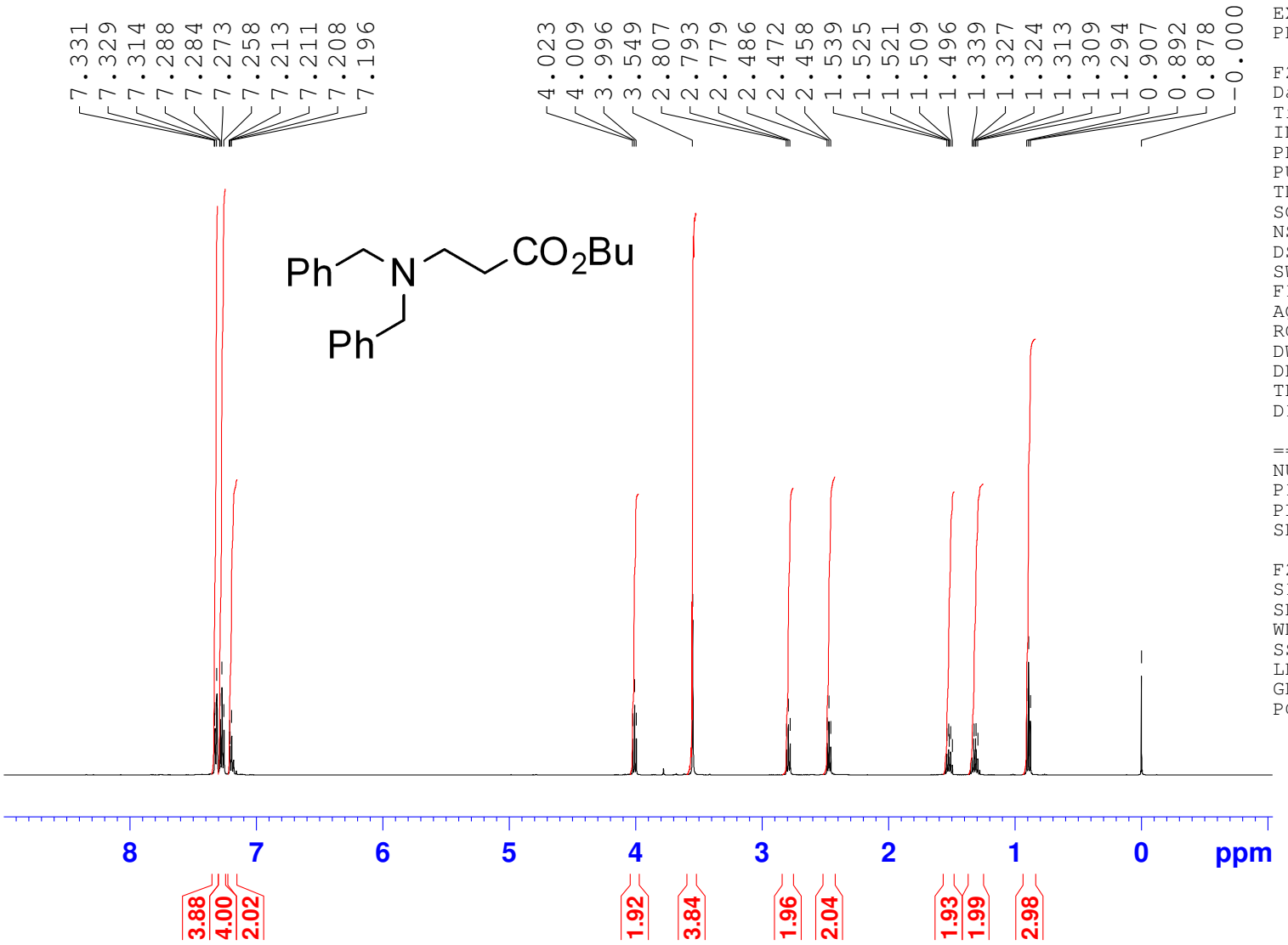
======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1299762 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 10
C13
cdcl3



sample 11
proton
cdcl3



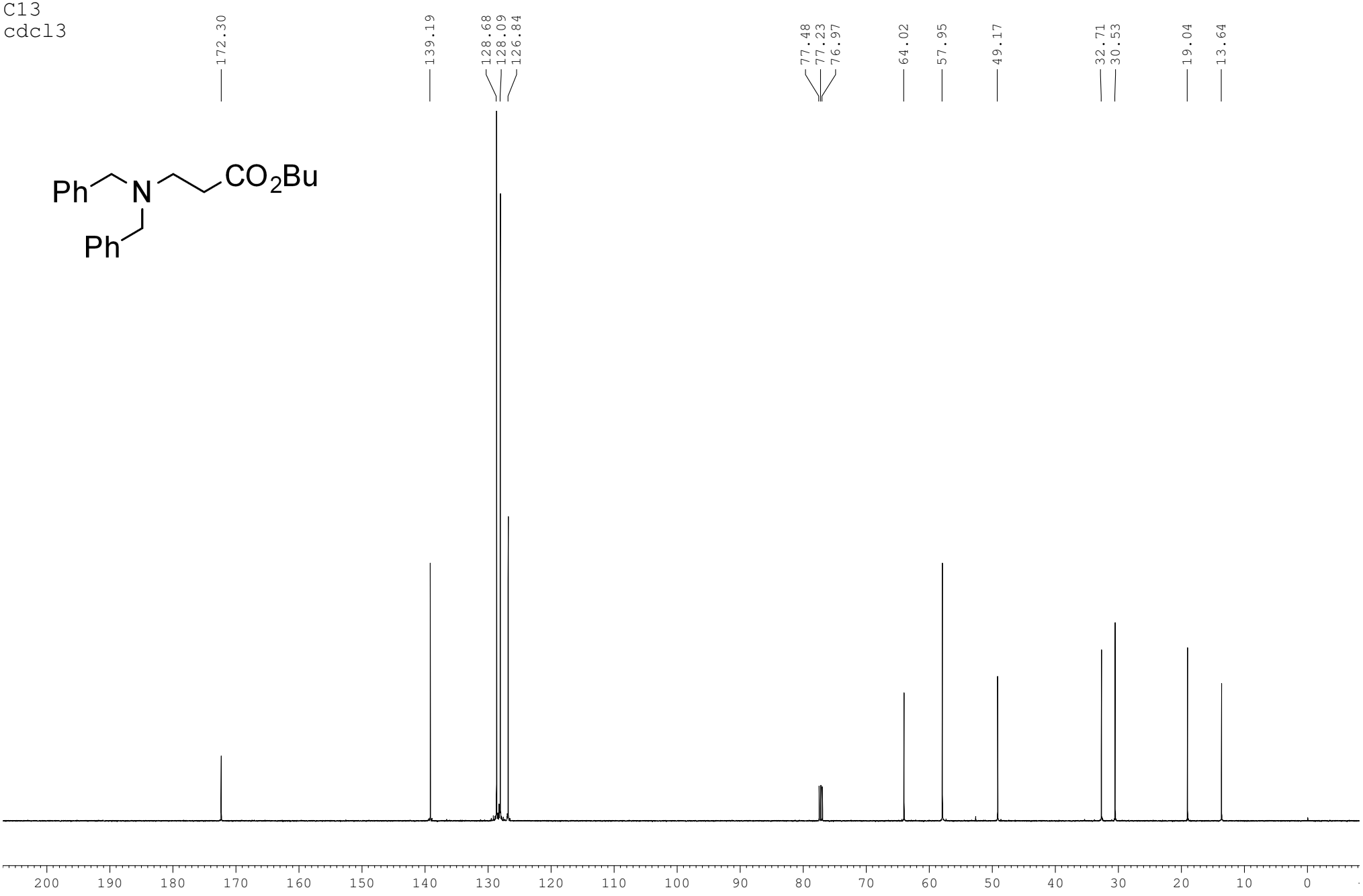
Current Data Parameters
NAME Tapan_2015
EXPNO 61
PROCNO 1

F2 - Acquisition Parameters
Date_ 20150706
Time 15.02
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 14.2
DW 48.400 usec
DE 6.50 usec
TE 293.3 K
D1 1.00000000 sec

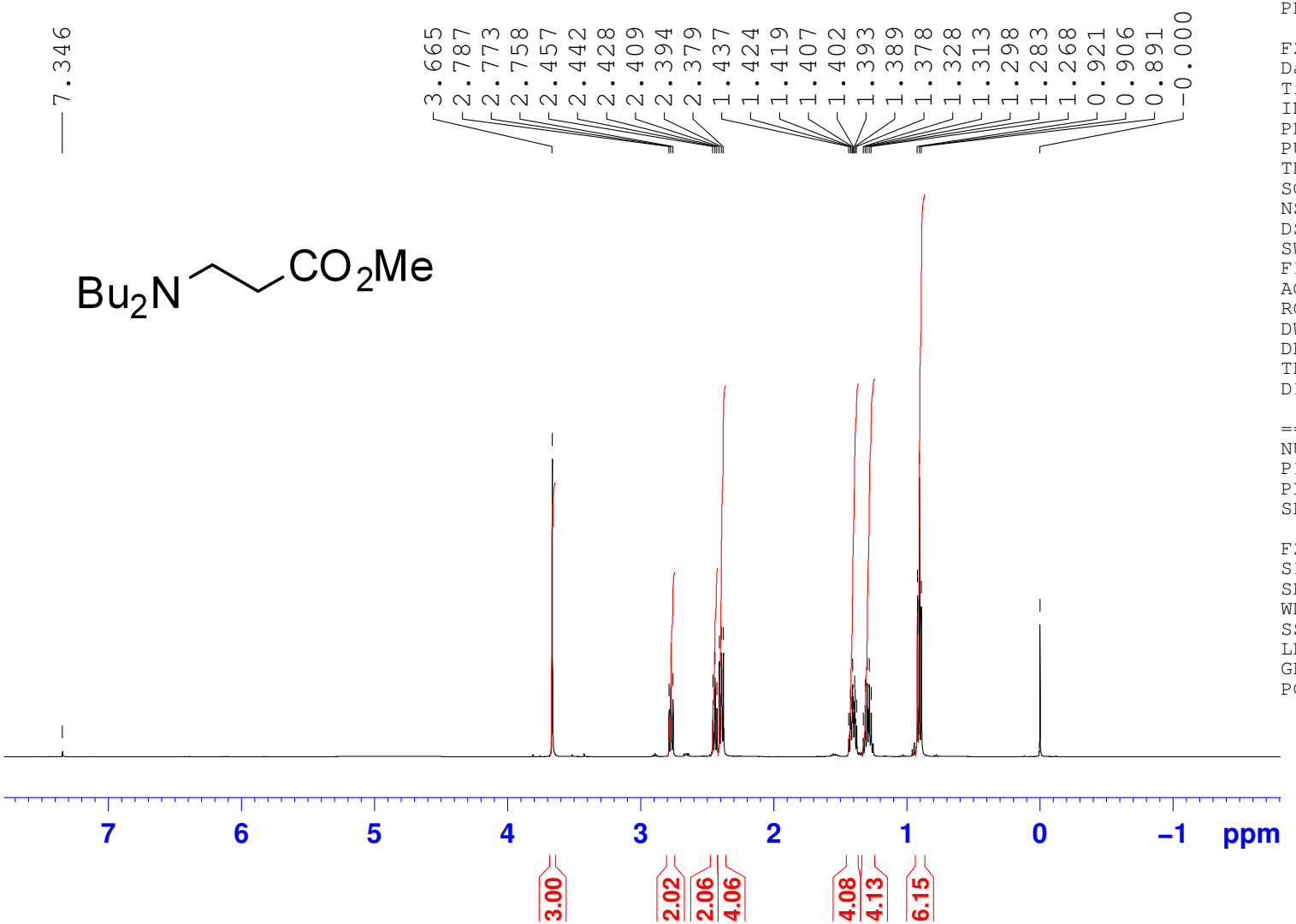
======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1300624 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 11
C13
cdcl3



sample 13
proton
cdcl3



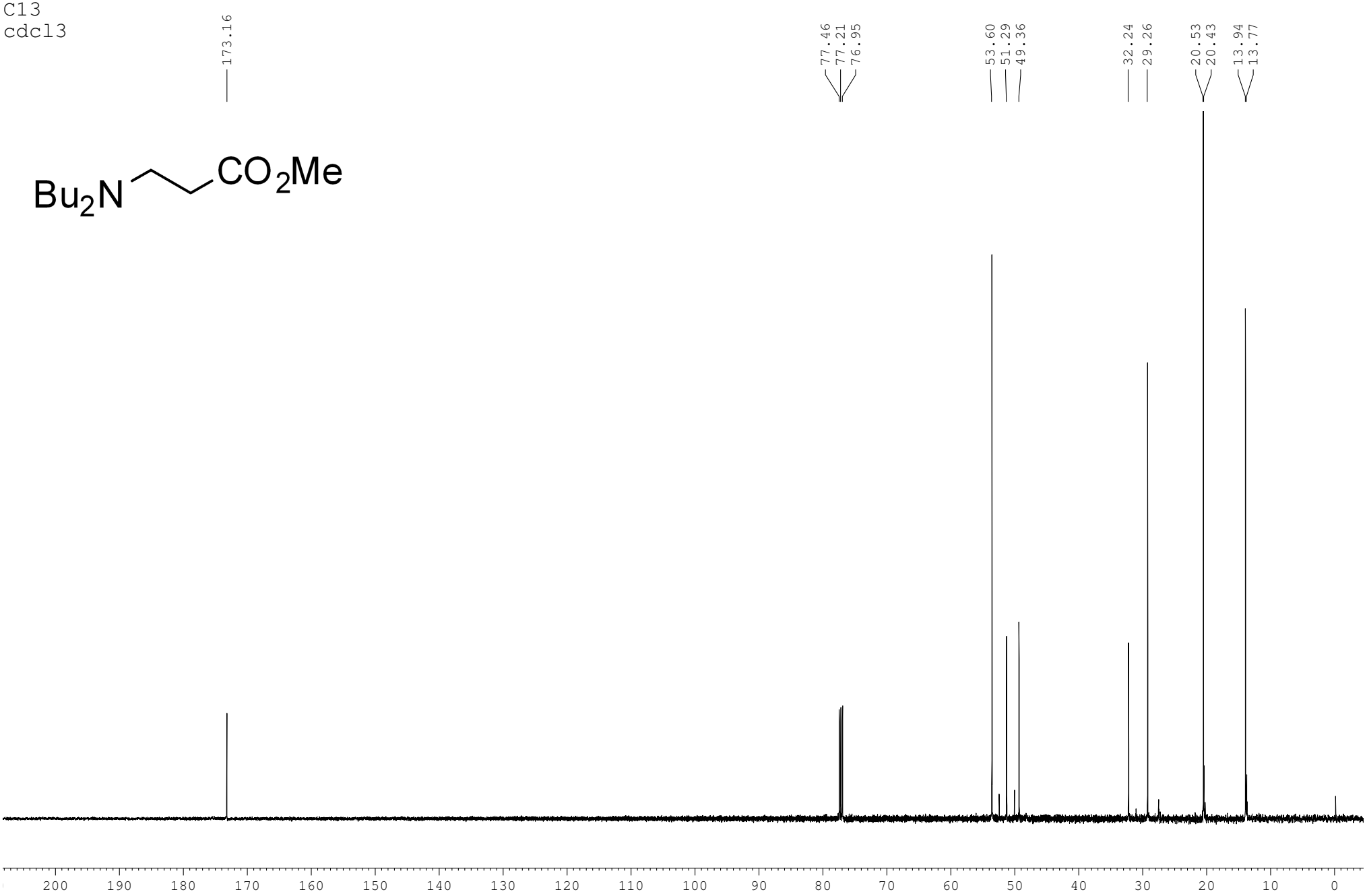
Current Data Parameters
NAME Tapan_2015
EXPNO 63
PROCNO 1

F2 - Acquisition Parameters
Date_ 20150706
Time 15.16
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 12.7
DW 48.400 usec
DE 6.50 usec
TE 293.2 K
D1 1.00000000 sec

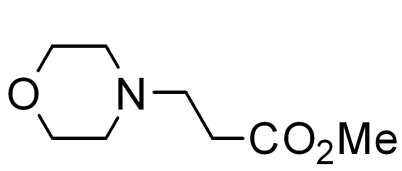
======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1299704 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 13
C13
cdcl3

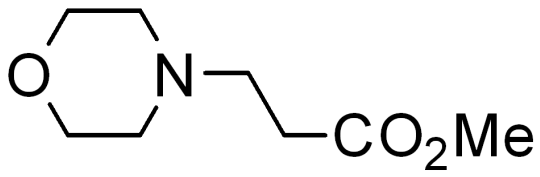


sample 15
proton
cdcl3

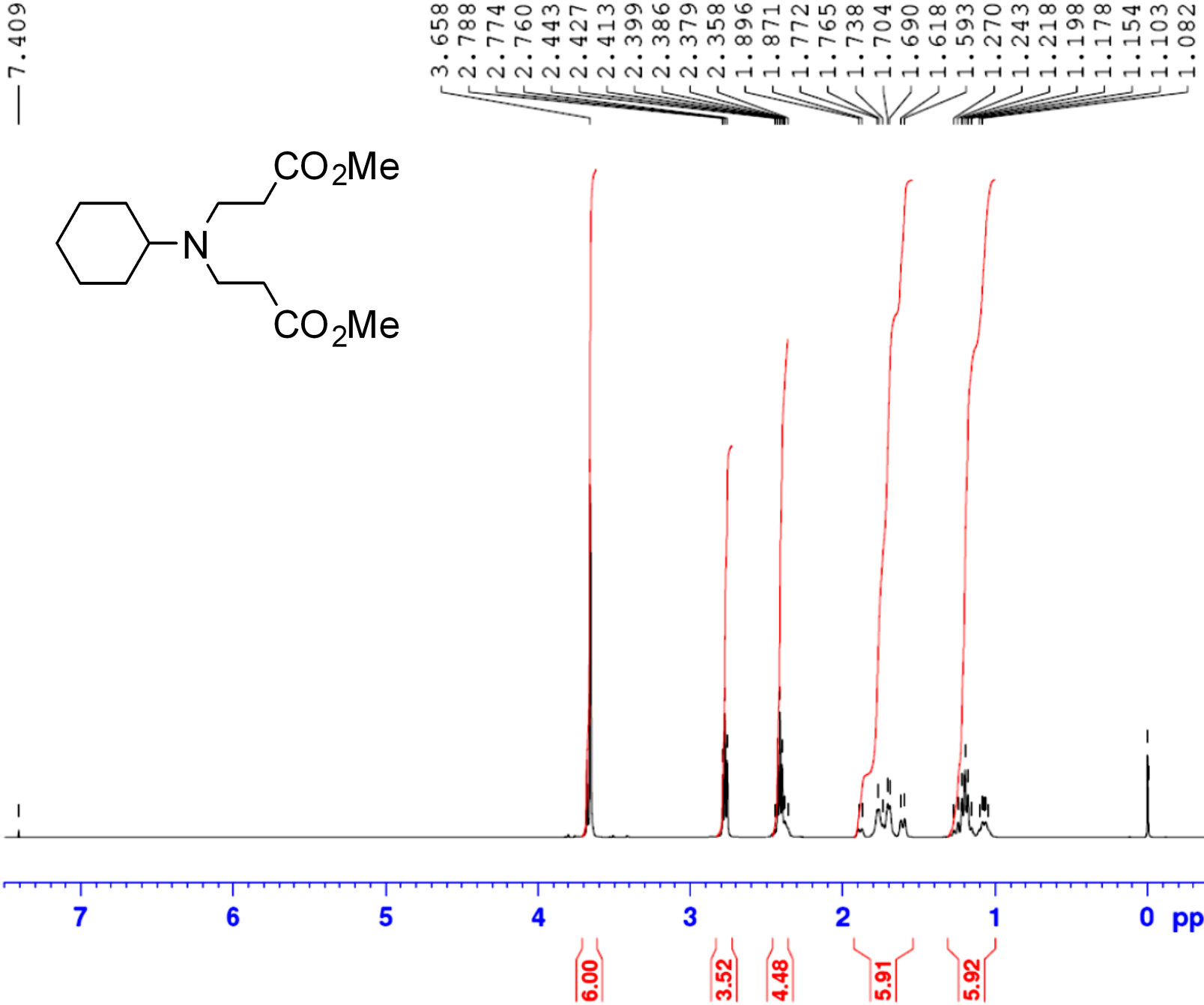



```
Current Data Parameters
NAME          Tapan_2015
EXPNO                 65
PROCNO                 1

F2 - Acquisition Parameters
Date_           20150707
Time               10.08
INSTRUM            spect
PROBHD   5 mm PABBO BB-
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                    16
DS                     2
SWH           10330.578 Hz
FIDRES         0.157632 Hz
AQ            3.1719923 sec
RG                    16
DW               48.400 usec
DE                6.50 usec
TE                292.5 K
D1           1.00000000 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                16.00 usec
PLW1        13.00000000 W
SFO1        500.1330885 MHz

F2 - Processing parameters
SI                 65536
SF          500.1299418 MHz
WDW                   EM
SSB       0
LB                0.30 Hz
GB        0
PC                1.00
```

sample 15
C13
cdcl3



sample 16
proton
cdcl3



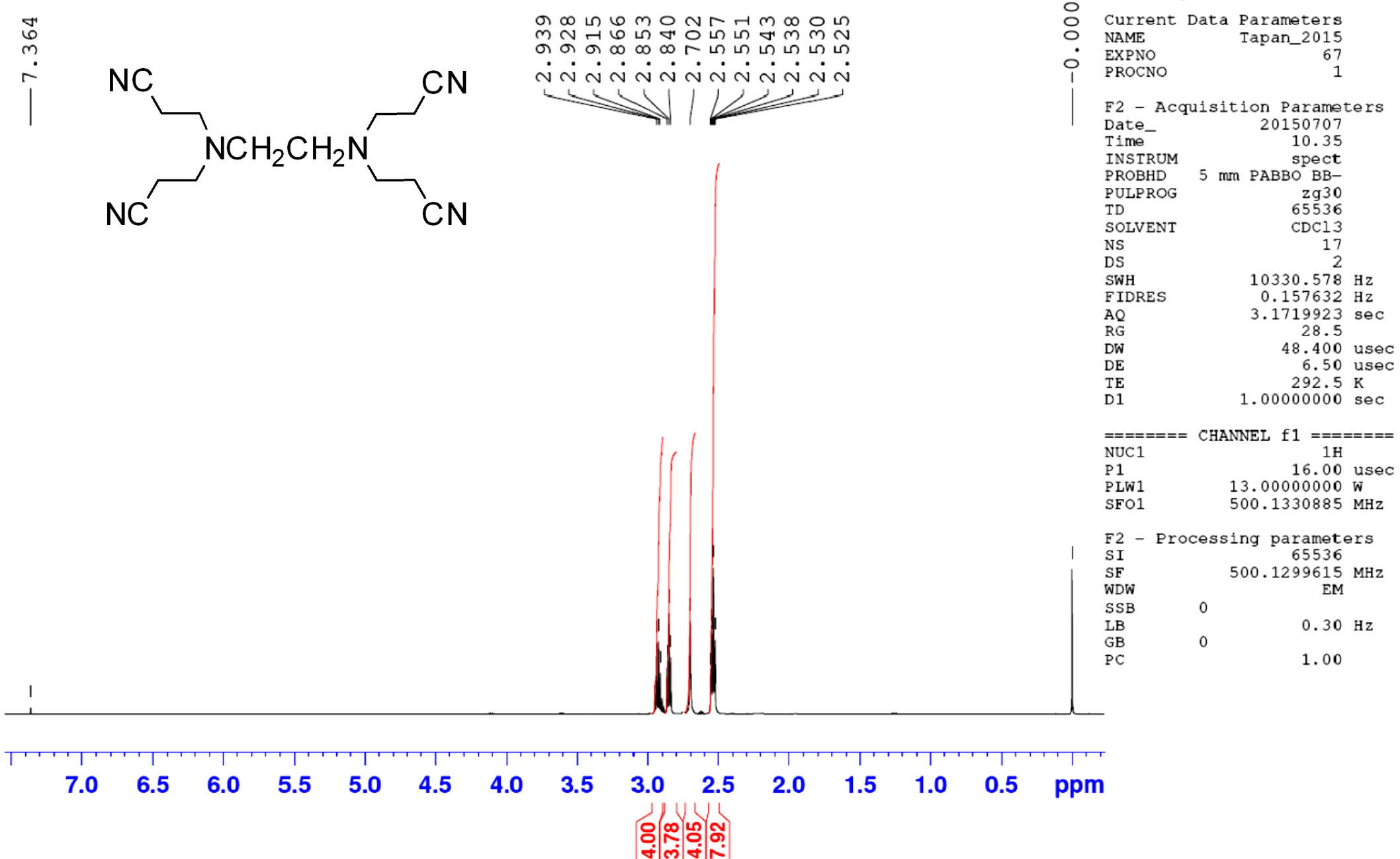
Current Data Parameters
NAME Tapan_2015
EXPNO 66
PROCNO 1

F2 - Acquisition Parameters
Date_ 20150707
Time 10.28
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDC13
NS 16
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 16
DW 48.400 usec
DE 6.50 usec
TE 292.5 K
D1 1.00000000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1299383 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 17
proton
cdcl3



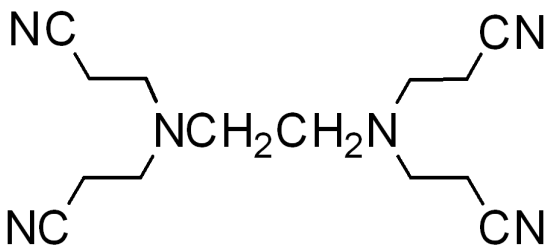
Current Data Parameters
NAME Tapan_2015
EXPNO 67
PROCNO 1

F2 - Acquisition Parameters
Date_ 20150707
Time 10.35
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 17
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 28.5
DW 48.400 usec
DE 6.50 usec
TE 292.5 K
D1 1.00000000 sec

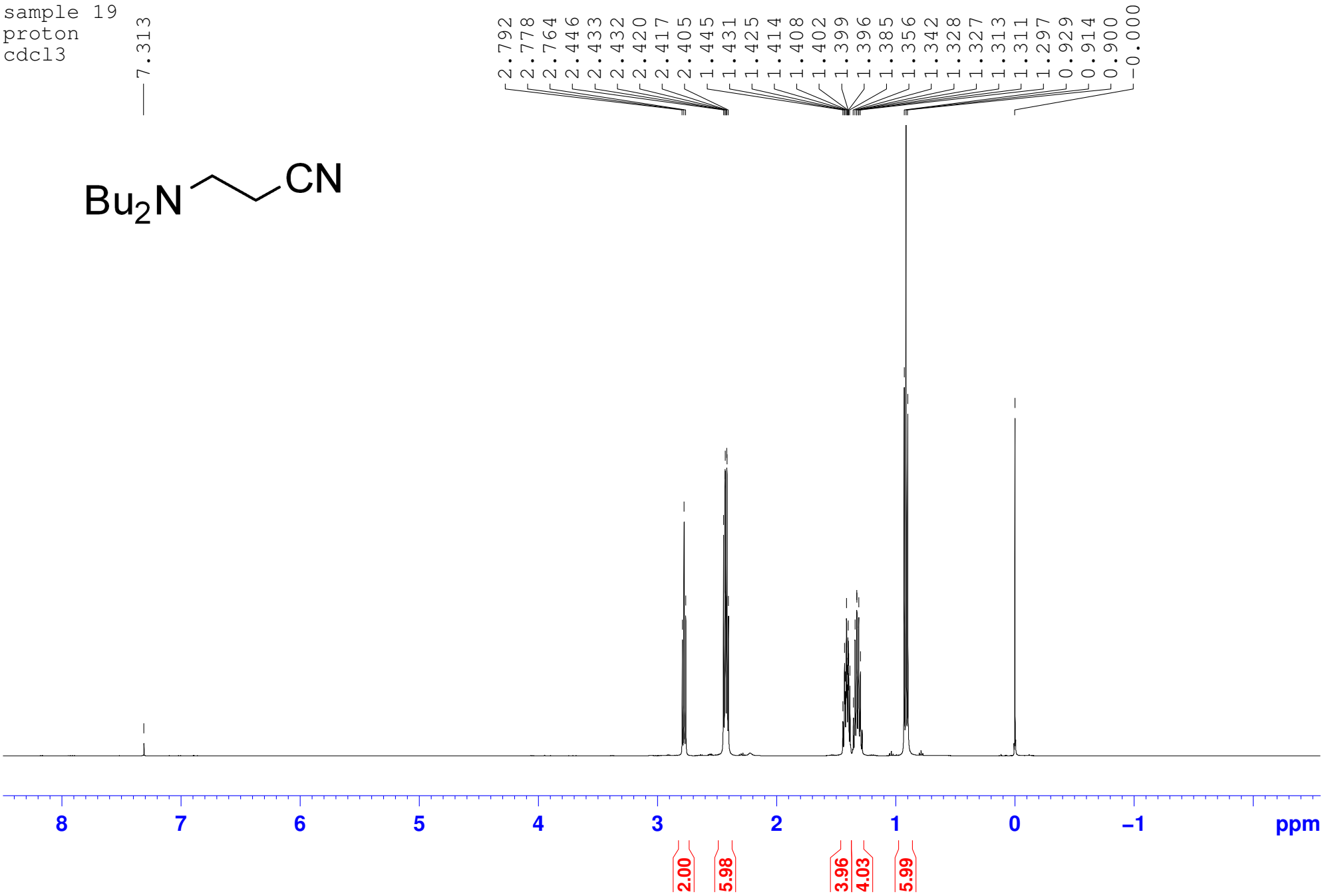
======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1299615 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

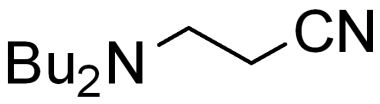
sample 17
C13
cdcl3



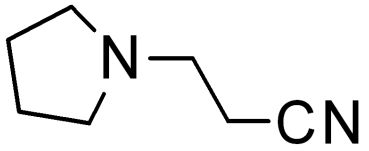
sample 19
proton
cdcl3



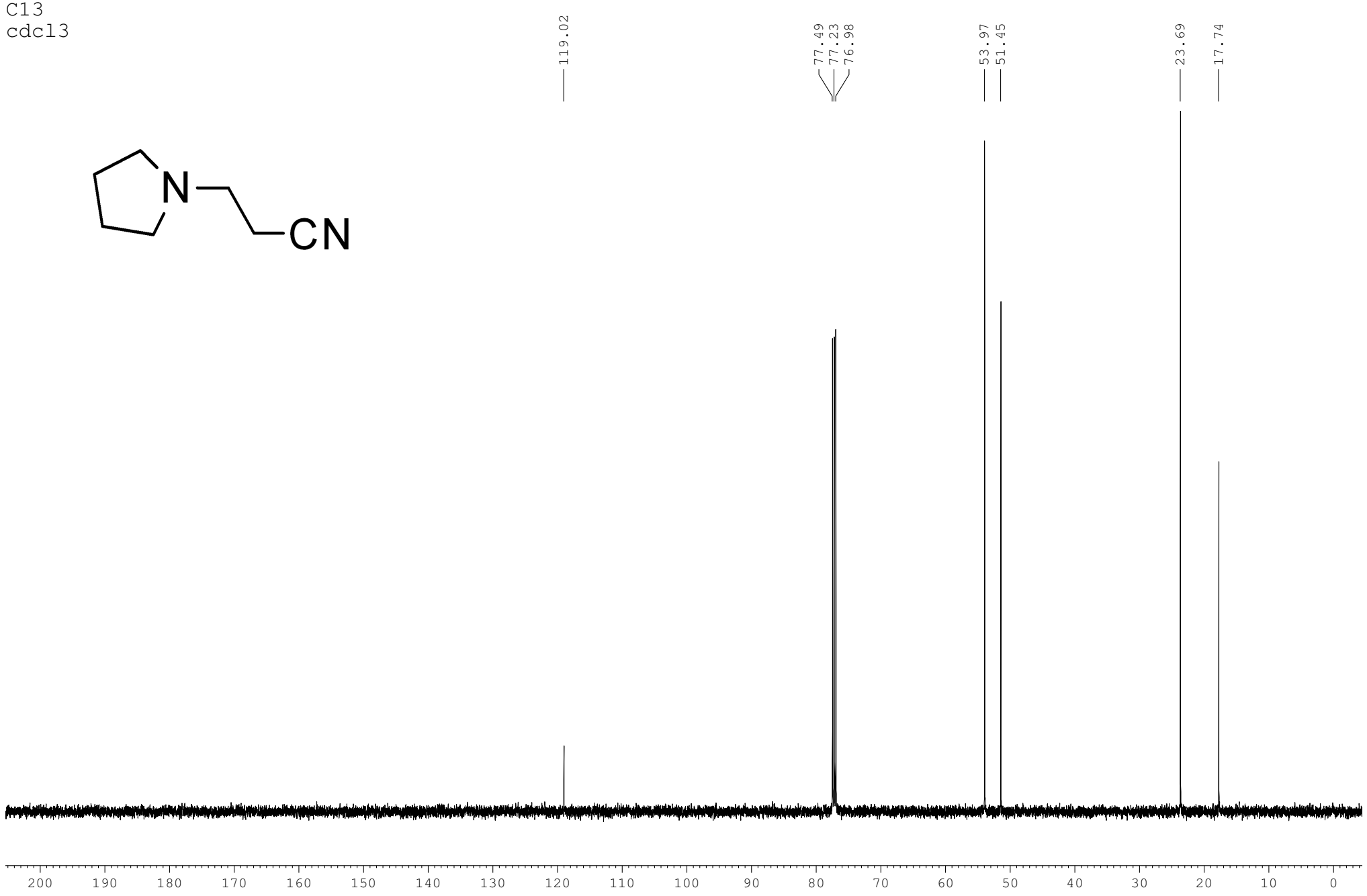
sample 19
C13
cdcl3



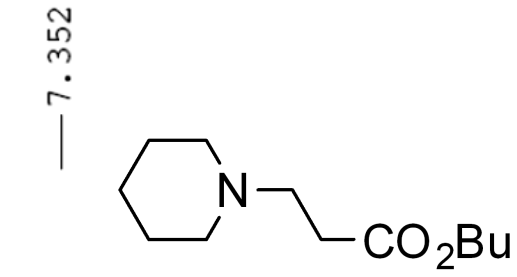
sample 20
proton
cdcl3

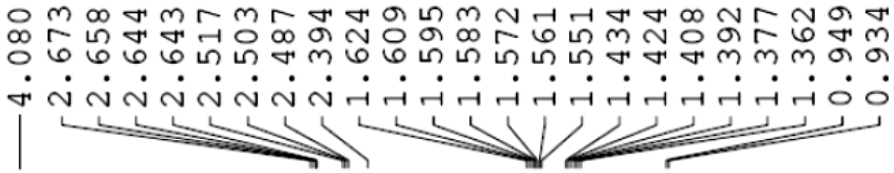


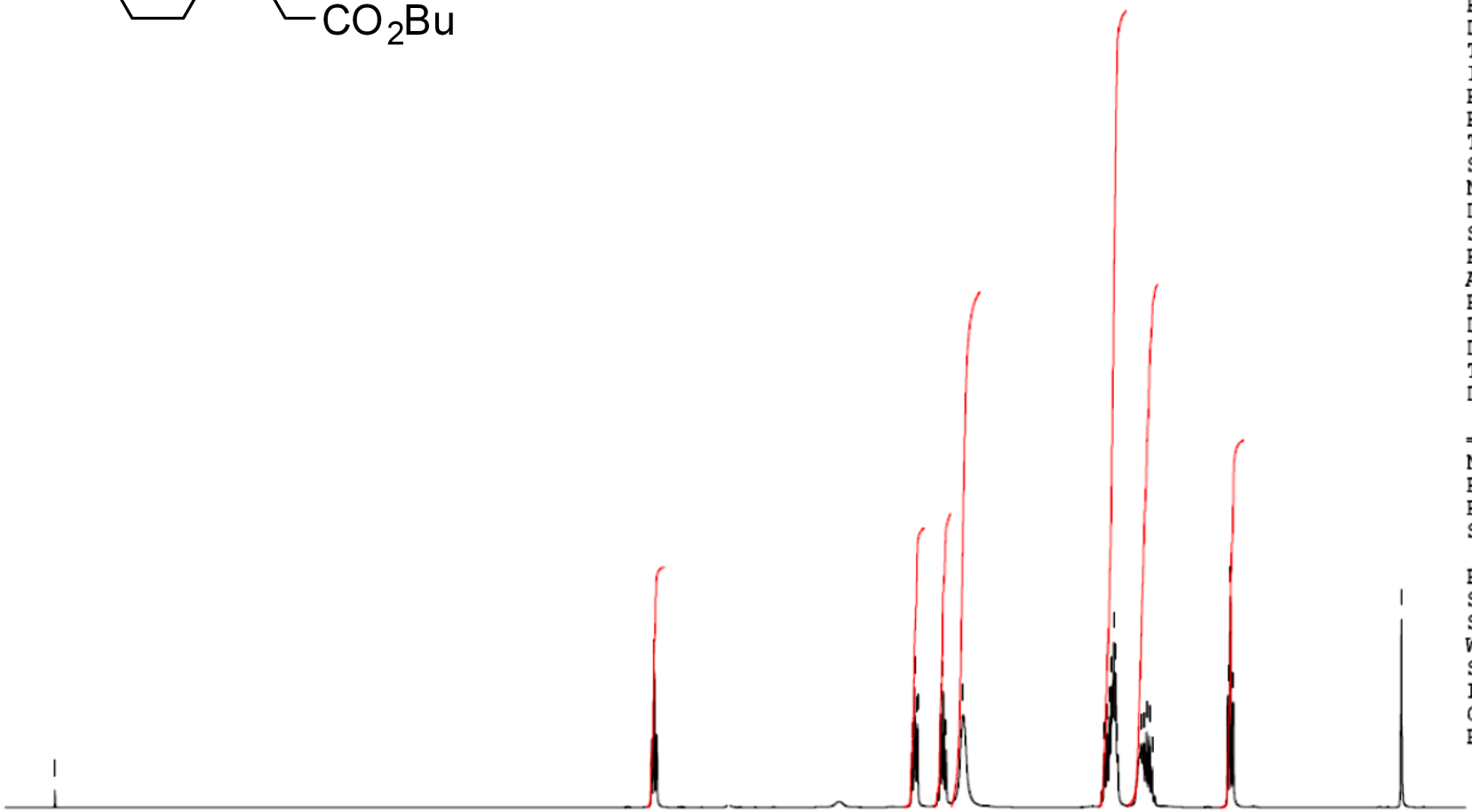
sample 20
C13
cdcl3

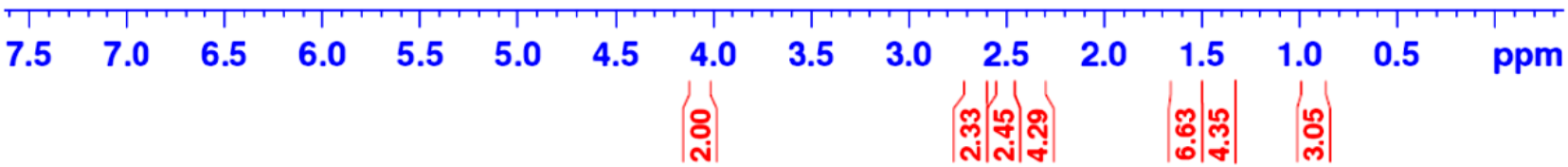


sample 21
proton
cdcl3





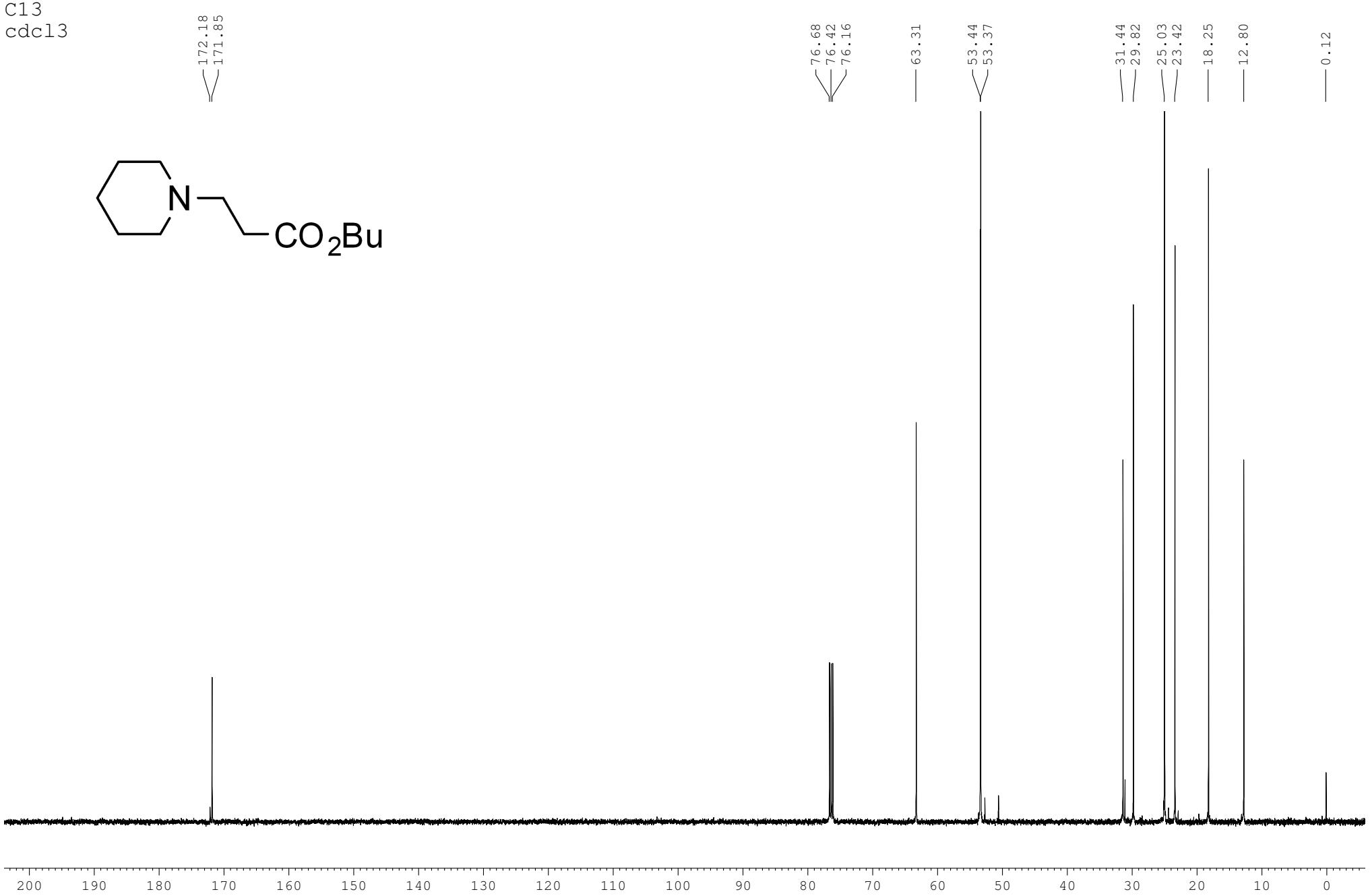




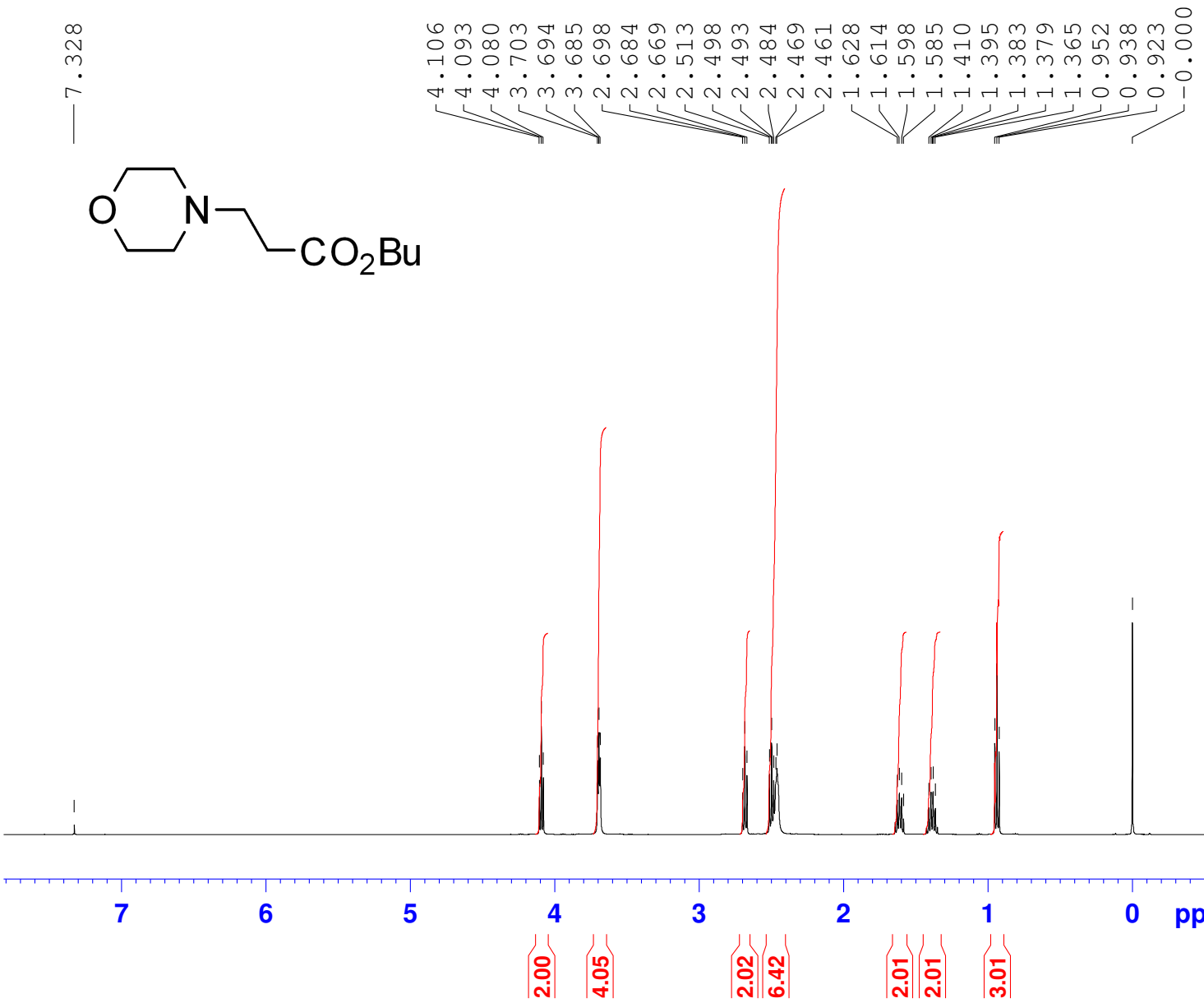
BRUKER

```
Current Data Parameters
NAME                  Tapan_2015
EXPNO                         70
PROCNO                         1

F2 - Acquisition Parameters
Date_                   20150707
Time                       10.50
INSTRUM                    spect
PROBHD    5 mm PABBO BB-
PULPROG                     zg30
TD                         65536
SOLVENT                    CDCl3
NS                            32
DS                             2
SWH                 10330.578 Hz
FIDRES               0.157632 Hz
AQ                  3.1719923 sec
RG                            18
DW                     48.400 usec
DE                      6.50 usec
TE                      292.5 K
D1                  1.00000000 sec

======== CHANNEL f1 ========
NUC1                          1H
P1                     16.00 usec
PLW1          13.00000000 W
SFO1          500.1330885 MHz

F2 - Processing parameters
SI                         65536
SF                500.1299676 MHz
WDW                           EM
SSB                0
LB                      0.30 Hz
GB                 0
PC                         1.00
```

sample 21
C13
cdcl3



sample 24
proton
cdcl3



Current Data Parameters
NAME Tapan_2015
EXPNO 74
PROCNO 1

F2 - Acquisition Parameters
Date_ 20150706
Time 11.56
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 32
DS 2
SWH 10330.578 Hz
FIDRES 0.157632 Hz
AQ 3.1719923 sec
RG 20.2
DW 48.400 usec
DE 6.50 usec
TE 292.8 K
D1 1.00000000 sec

======== CHANNEL f1 ========
NUC1 1H
P1 16.00 usec
PLW1 13.00000000 W
SFO1 500.1330885 MHz

F2 - Processing parameters
SI 65536
SF 500.1299791 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

sample 24
C13
cdcl3