Supporting Information

Remarkable effect of CF_3CH_2OH for halogen induced oxidative rearrangement reaction of aminals leading to 3,4-dihydroquinazolines

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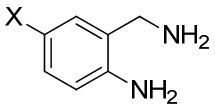
1. General

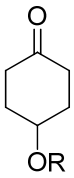
Melting points were measured by BÜCHI B-545 and all melting points were uncorrected. ^{1}H-NMR and ^{13}C-NMR spectra were measured by JEOL JNM-ECS 500, JEOL JNM-ECS 400, or JEOL JNM-ECS 300 spectrometers spectrometers with tetramethylsilane as an internal standard. IR spectra were recorded by Shimadzu FTIR 8400 using a diffuse reflectance measurement of samples ispersed in KBr powder. High resolution mass spectra and elemental analysis were performed by the Elemental Analysis Section of Osaka University. Column chromatography was performed with SiO_2 (Merck Silica Gel 60 (230-400).

2. Materials

Unless otherwise noted, materials and solvents were purchased and used without purification. Diamine **3b**, **3c**, and **3d** and ketone **4e**, **4g**, and **4h** were prepared according to the literature procedure.[1]



3b: (X= Cl)
3c: (X= Br)
3d: (X= Me)

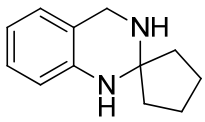


4e: (R= TBS)
4g: (R= allyl)
4h: (R= PMB)

3. Preparation of aminal 3

General Procedure: Diamine **3** (1.0 equiv) and ketone **4** (1.0 or 1.2 equiv) was dissolved in $CHCl_3$ (0.2 M) and the reaction mixture was stirred for 1 day at 60 ^{o}C. The resulting solution was cooled to rt and evaporated in vacuo to give aminal **1**.

3',4'-Dihydro-1'*H*-spiro[cyclopentane-1,2'-quinazoline] (1a)



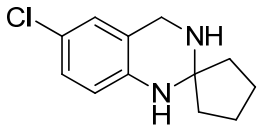
Reaction was carried out according to the general procedure with *o*-aminobenzylamine (**3a**) (273.0 mg, 2.23 mmol) and cyclopentanone (**4a**) (194.9 mg, 2.32 mmol) in $CHCl_3$ (11.0 mL) to give **1a** (420.0 mg, quant.) as a yellow solid.

Mp: 48 ^{o}C; ^{1}H NMR (300 MHz, $CDCl_3$): δ= 7.00 (ddd, *J* = 7.5, 7.5, 1.5 Hz, 1H), 6.92 (dd, *J* = 7.5, 1.5 Hz, 1H), 6.66 (ddd, *J* = 7.5, 7.5, 1.2 Hz, 1H), 6.48 (dd, *J* = 7.5, 1.2 Hz, 1H), 4.01 (s, 2H), 1.87-1.66 ppm (m, 8H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 143.0, 127.1, 126.0, 120.5, 117.3, 114.9,

[1] For **3b**: M. F. Primik; S. Göschl; M. A. Jakupec; A. Roller; B. K. Keppler; V. B. Arion *Inorganic Chemistry*, 2010, **49**, 11084.; for **3c**: R. Baharfar; H. Alinezhad; S. Azimi; S. F. From *J. Chil. Chem. Soc.*, 2011, **56**, 863.; for **3d**: A. Alexander; G. L. Claudio; K. Sabine; L. Thomas; P. Jens-Uwe; L. Steward *PCT Int. Appl.* 2006, WO 2006117305; for **4e**: S. Z. Lei; W. B. Mi; T. Y. Qiang; F. C. An; Z. S. Yu *Org. Lett.*, 2003, **5**, 2319.; for **4g**: M. Adeline; C. Anna; D. Gilles; B. J. Marie *Eur. J. Org. Chem.*, 2007, **19**, 3145.; for **4h**: W. Pablo; M. Kristian; E. Christiane *Chem Eur J.*, 2007, **13**, 4859.

76.0, 43.3, 39.7(2C), 23.7(2C) ppm; IR (KBr): 3296, 2955, 1607, 1416, 1193 cm^{-1}; HRMS (EI): calcd for $C_{12}H_{16}N_2$ [*M*]: 188.1313, found 188.1325.

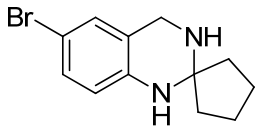
6'-Chloro-3',4'-dihydro-1'*H*-spiro[cyclopentane-1,2'-quinazoline] (1b)



Reaction was carried out according to the general procedure with **3b** (322 mg, 2.05 mmol) and cyclopentanone (**4a**) (0.22 mL, 2.49 mmol) in $CHCl_3$ (10.3 mL) to give **1b** (458 mg, quant.) as brown solid.

Mp: 98-99 ^oC; ^1H NMR (500 MHz, $CDCl_3$): δ= 6.95 (dd, *J* = 8.6, 2.5 Hz, 1H), 6.90 (d, *J* = 2.5 Hz, 1H), 6.41 (d, *J* = 8.6 Hz, 1H), 4.01 (brs, 1H), 3.98 (s, 2H), 1.86-1.65 ppm (m, 8H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 141.5, 126.9, 125.8, 121.8, 121.7, 115.9, 76.1, 43.1, 39.6, 23.6 ppm; IR (KBr): 3331, 3291, 2957, 1601, 1472 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{16}ClN_2$ $[M+H]^+$: 223.1002, found 223.1013.

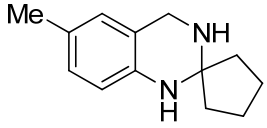
6'-Bromo-3',4'-dihydro-1'*H*-spiro[cyclopentane-1,2'-quinazoline] (1c)



Reaction was carried out according to the general procedure with **3c** (342.3 mg, 1.70 mmol) and cyclopentanone (**4a**) (251.5 mg, 2.06 mmol) in $CHCl_3$ (8.5 mL) to give **1c** (448.1 mg, 99%) as pale brown solid;

Mp: 106 ^oC; ^1H NMR (300 MHz, $CDCl_3$): δ= 7.08 (dd, *J* = 8.6, 2.1 Hz, 1H), 7.04 (d, *J* = 2.1 Hz, 1H) 6.36 (d, *J* = 8.6 Hz, 1H), 3.98 (s, 2H), 1.83-1.64 ppm (m, 8H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 142.0, 129.7, 128.6, 122.3, 116.3, 108.8, 76.0, 43.0, 39.6, 23.6 ppm; IR (KBr): 3325, 3294, 2957, 2868, 1597 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{16}BrN_2$ $[M+H]^+$: 267.0497, found 267.0504.

6'-Methyl-3',4'-dihydro-1'*H*-spiro[cyclopentane-1,2'-quinazoline] (1d)

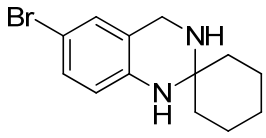


Reaction was carried out according to the general procedure with **3d** (258 mg, 1.89 mmol) and cyclopentanone (**4a**) (159 mg, 1.89 mmol) in $CHCl_3$ (9.5 mL) to give **1d** (377 mg, 98%) as pale brown solid.

Mp: 58 ^oC; ^1H NMR (300 MHz, $CDCl_3$): δ= 6.82 (d, *J* = 8.1 Hz, 1H), 6.75 (s, 1H), 6.41 (d, *J* = 8.1 Hz, 1H), 3.98 (s, 2H), 2.22 (s, 3H), 1.84-1.64 ppm (m, 8H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 140.6,

127.6, 126.7, 126.5, 120.6, 115.1, 76.1, 43.4, 39.5, 23.7, 20.5 ppm; IR (KBr): 3306, 2951, 2866, 1504, 1300, 1200 cm^{-1}; HRMS (FAB): calcd for $C_{13}H_{19}N_2$ $[M+H]^+$: 203.1548, found 203.1556.

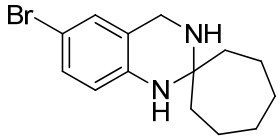
6'-Bromo-3',4'-dihydro-1'*H*-spiro[cyclohexane-1,2'-quinazoline] (1e)



Reaction was carried out according to the general procedure with **3c** (220.8 mg, 1.10 mmol) and cyclohexanone (**4b**) (128.9 mg, 1.31 mmol) in $CHCl_3$ (5.5 mL) to give **1e** (306.5 mg, 99%) as red solid.

Mp: 191 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ= 7.07 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.01 (d, *J* = 2.0 Hz, 1H), 6.37 (d, *J* = 8.4 Hz, 1H), 4.04 (brs, 1H), 3.91 (s, 2H), 1.70-1.47 ppm (m, 10H); ^{13}C NMR (126 MHz, $CDCl_3$): δ= 141.5, 129.8, 128.6, 122.4, 116.3, 108.6, 65.5, 41.4, 36.7, 25.6, 22.0 ppm; IR (KBr): 3306, 2934, 2853, 1599, 1487, 1435, 1300, 1244 cm^{-1}; HRMS (FAB): calcd for $C_{13}H_{17}BrN_2Na$ $[M+Na]^+$: 303.0473, found 303.0462.

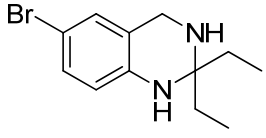
6'-Bromo-3',4'-dihydro-1'*H*-spiro[cycloheptane-1,2'-quinazoline] (1f)



Reaction was carried out according to the general procedure with **3c** (300 mg, 1.49 mmol) and cycloheptanone (**4c**) (167 mg, 1.49 mmol) in $CHCl_3$ (7.5 mL) to give **4f** (439.2 mg, 99%) as brown solid.

Mp: 100.7 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ= 7.08 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.03 (d, *J* = 2.4 Hz, 1H), 6.37 (d, *J* = 8.4 Hz, 1H), 3.92 (s, 2H), 1.74-1.48 ppm (m, 12H) ^{13}C NMR (126 MHz, $CDCl_3$) δ= 141.5, 129.8, 128.6, 122.3, 116.7, 108.8, 69.8, 41.8, 40.1, 29.9, 21.9 ppm; IR (KBr): 3305, 2926, 2852, 1778, 1694, 1597, 1435, 1300, 1179 cm^{-1}; HRMS (EI): calcd for $C_{14}H_{19}BrN_2$ [*M*]: 294.0732, found 294.0724.

6-Bromo-2,2-diethyl-1,2,3,4-tetrahydroquinazoline (1g)

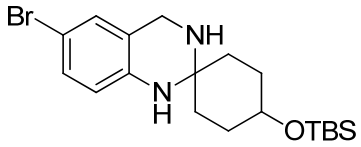


Reaction was carried out according to the general procedure with **3c** (253.5 mg, 1.26 mmol) and 3-pentanone (**4d**) (130.3 mg, 1.51 mmol) in $CHCl_3$ (6.3 mL) to give **1g** (334.2 mg, 99%) as red oil.

^1H NMR (400 MHz, $CDCl_3$): δ= 7.07 (dd, *J* = 8.2, 2.4Hz, 1H), 7.02 (d, *J* = 2.4 Hz, 1H), 6.36 (d, *J* = 8.2 Hz, 1H), 3.91 (s, 2H), 1.64-1.56 (m, 4H), 0.91 (t, *J* = 7.6 Hz, 6H); ^{13}C NMR (126 MHz, $CDCl_3$)

δ= 141.8, 129.8, 128.6, 122.1, 116.2, 108.4, 68.6, 41.6, 29.4, 7.4 ppm; IR (KBr): 3399, 3318, 2967, 1597, 1487, 1435, 1294, 1140 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{18}BrN_2$ $[M+H]^+$: 269.0653, found 269.0651.

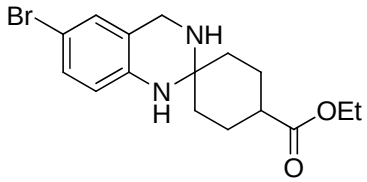
6'-Bromo-4-((*tert*-butyldimethylsilyl)oxy)-3',4'-dihydro-1'*H*-spiro[cyclohexane-1,2'-quinazoline] (1h)



Reaction was carried out according to the general procedure with **3c** (200.2 mg, 1.00 mmol) and **4e** (228.2 mg, 1.00 mmol) in $CHCl_3$ (5 mL) to give **1h** (410.0 mg, quant. 2:1 diastereomixtures) as brown solid.

Mp: 77 °C; ^{1}H NMR (500 MHz, $CDCl_3$): δ= 7.03-7.00 (m, 1H), 6.97-6.96 (m, 1H), 6.31 (d, *J* = 8.4 Hz, 1H), 6.30 (d, *J* = 8.4 Hz, 1H), 4.03 (brs, 1H), 3.86 (s, 1/3H), 3.85 (s, 2/3H), 3.77-3.73 (m, 1H), 1.87-1.36 (m, 8H), 0.84 (s, 6H), 0.83 (s, 3H), 0.00 (s, 4H), -0.01 ppm (s, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 141.5, 141.4, 129.9, 129.8, 128.7, 128.6, 122.4,122.1, 116.4, 116.3, 108.8, 108.7, 67.8, 65.30, 65.27, 41.7, 41.3, 32.4, 30.5, 30.3, 25.84, 25.81, 18.13, 18.07, -4.7, -4.8 ppm; IR (KBr): 3401, 2949, 2855, 1599, 1487, 1373, 1298, 1252, 1096 cm^{-1}; HRMS (FAB): calcd for $C_{19}H_{32}BrN_2OSi$ $[M+H]^+$: 411.1467, found 411.1440.

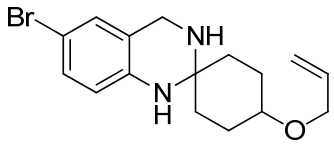
Ethyl 6'-bromo-3',4'-dihydro-1'*H*-spiro[cyclohexane-1,2'-quinazoline]-4-carboxylate (1i)



Reaction was carried out according to the general procedure with **3c** (200.6 mg, 1.00 mmol) and ethyl 4-oxocyclohexanecarboxylate (**4f**) (169.8 mg, 1.00 mmol) in $CHCl_3$ (5 mL) to give **1i** (350.0 mg, quant. 1:1 diastereomixtures) as brown solid.

Mp: 135 °C; ^{1}H NMR (300 MHz, $CDCl_3$): δ= 7.09 (dd, *J* = 9.0, 2.0 Hz, 1/2H), 7.07 (dd, *J* = 8.4, 2.0 Hz, 1/2H), 7.02 (d, *J* = 2.0 Hz, 1/2H), 7.01 (d, *J* = 2.0 Hz, 1/2H), 6.41 (d, *J* = 9.0 Hz, 1/2H), 6.35 (d, *J* = 9.0 Hz, 1/2H), 4.17-4.11 (m, 2H), 3.95 (s, 1H), 3.87 (s, 1H), 2.45-2.39 (m, 1/2H), 2.35-2.29 (m, 1/2H), 1.99-1.89 (m, 3H), 1.83-1.79 (m, 2H), 1.71-1.56 (m, 2H), 1.41-1.35 (m, 1H), 1.27 (t, *J* = 7.5 Hz, 3/2H), 1.26 ppm (t, *J* = 7.5 Hz, 3/2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 175.34, 175.28, 141.5, 141.0, 129.9, 129.8, 128.7, 128.6, 122.22, 122.17, 116.6, 116.2, 108.9, 108.7, 65.2, 64.7, 60.4, 60.3, 42.6, 41.5, 41.2, 36.0, 34.5, 24.5, 24.2, 14.2 ppm; IR (KBr): 3379, 2938, 1726, 1597, 1447, 1300, 1188 cm^{-1}; HRMS (FAB): calcd for $C_{16}H_{22}BrN_2O_2$ $[M+H]^+$: 353.0865, found 353.0867.

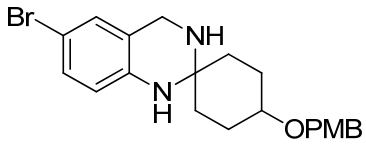
4-(Allyloxy)-6'-bromo-3',4'-dihydro-1'*H*-spiro[cyclohexane-1,2'-quinazoline] (1j)



Reaction was carried out according to the general procedure with **3c** (147.5 mg, 0.734 mmol) and **4g** (113 mg, 0.733 mmol) in $CHCl_3$ (3.7 mL) to give **1j** (245.7 mg, 99% 3:2 diastereomixtures) as brown solid.

Mp: 99 ^oC; ^1H NMR (400 MHz, $CDCl_3$): δ= 7.09-7.07 (m, 1H), 7.02 (m, 1H), 6.37-6.35 (m, 1H), 5.99-5.88 (m, 1H), 5.32-5.14 (m, 2H), 4.08 (brs, 3/5H) 4.07 (brs, 1H), 4.01 (s, 3/5H), 4.00 (s, 2/5H), 3.92 (s, 3/5H), 3.90 (m, 2/5H), 3.87 (brs, 2/5H), 3.50 (m, 3/5H), 3.44-3.42 (m, 2/5H), 1.94-1.37 ppm (m, 8H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 141.5, 141.3, 135.4, 135.3, 129.9, 129.8, 128.7, 128.6, 122.4, 122.1, 116.5, 116.4, 108.8, 99.9, 74.1, 69.0, 68.9, 65.4, 65.2, 41.7, 41.3, 33.8, 32.5, 27.1, 26.7 ppm; IR (KBr): 3318, 2938, 2853, 1645, 1597, 1487, 1300, 1088 cm^{-1}; HRMS (FAB): calcd for $C_{16}H_{22}BrN_2O$ $[M+H]^+$: 337.0916, found 337.0912.

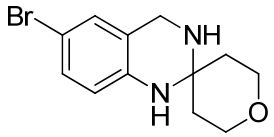
6'-Bromo-4-((4-methoxybenzyl)oxy)-3',4'-dihydro-1'*H*-spiro[cyclohexane-1,2'-quinazoline] (1k)



Reaction was carried out according to the general procedure with **3c** (236 mg, 1.17 mmol) and **4h** (275 mg, 1.17 mmol) in $CHCl_3$ (5 mL) to give **1k** (490.0 mg, quant.) as pink solid.

Mp: 127 ^oC; ^1H NMR (300 MHz, $CDCl_3$): δ= 7.29-7.26 (m, 2H), 7.09-7.02 (m, 2H), 6.90-6.86 (m, 2H), 6.37 (d, J = 8.7 Hz, 1H), 4.48 (s, 2/3H), 4.47 (s, 4/3H), 4.08 (brs, 1H), 3.91 (s, 4/3H), 3.90 (s, 2/3H), 3.55 (m, 4/3H), 3.49-3.46 (m, 2/3H), 1.96-1.37 ppm (m, 8H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 159.1, 159.0, 141.5, 141.3, 131.0, 130.9, 129.9, 129.8, 129.05, 128.98, 128.7, 128.6, 122.4, 122.1, 116.38, 116.37, 113.8, 113.7, 108.82, 108.77, 73.8, 69.7, 69.5, 65.4, 65.3, 55.3, 41.7, 41.3, 33.7, 32.5, 27.1, 26.7 ppm; IR (KBr): 3379, 2938, 1726, 1597, 1447, 1300, 1188 cm^{-1}; HRMS (FAB): calcd for $C_{21}H_{26}BrN_2O_2$ $[M+H]^+$: 417.1178, found 417.1178.

6'-Bromo-2,3,3',4',5,6-hexahydro-1'*H*-spiro[pyran-4,2'-quinazoline] (1l)



Reaction was carried out according to the general procedure with **3c** (402 mg, 2.00 mmol) and tetrahydro pyran-4-one (**4i)** (200 mg, 2.00 mmol) in $CHCl_3$ (10 mL) to give **1l** (573 mg, quant.) as

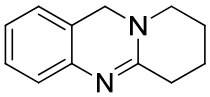
pink solid.

Mp: 133 °C; ^{1}H NMR (500 MHz, $CDCl_3$): δ= 7.09 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.03 (d, *J* = 2.5 Hz, 1H), 6.40 (d, *J* = 8.5 Hz, 1H), 3.91 (s, 2H), 3.87-3.82 (m, 2H), 3.75-3.71 (m, 2H), 1.82-1.78 (m, 2H), 1.70-1.64 ppm (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 141.0, 130.0, 128.6, 122.1, 116.5, 109.1, 64.0, 63.6, 41.2, 37.4 ppm; IR (KBr): 3318, 2949, 2866, 1599, 1454, 1356, 1302, 1277, 1238, 1161 cm^{-1}; HRMS (EI): calcd for $C_{12}H_{15}BrN_2O$ [*M*]: 282.0368, found 282.0322.

4. Synthesis of amidine 2

General Procedure: To the solution of aminal **1** (1.0 equiv) in CF_3CH_2OH (0.02 M) was added NCS (1.1 equiv) at 0 °C and the mixture was stirred for 30 min. The resulting solution was allowed to warm to rt and stirred for 1 day. The reaction was quenched with sat. $Na_2S_2O_3$ aq. and CF_3CH_2OH was evaporated in vacuo. The residue was added 0.5*N* NaOH aq. and extracted with CH_2Cl_2. The organic layer was dried over Na_2SO_4 and evaporated in vacuo. The residue was purified by column chromatography to give amidine **2**.

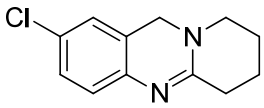
7,8,9,11-Tetrahydro-6*H*-pyrido[2,1-*b*]quinazoline (2a) [2]



Reaction was carried out according to the general procedure with **1a** (41.9 mg, 0.223 mmol) and NCS (32.8 mg, 0.246 mmol) in CF_3CH_2OH (11.0 mL) to give **2a** (29.5 mg, 71%) as red oil.; Column chromatography: AcOEt/MeOH/triethylamine = 20/2/1.

^{1}H NMR (300 MHz, $CDCl_3$): δ= 7.13 (ddd, *J* = 8.4, 8.4, 2.4 Hz, 1H), 7.05-6.98 (m, 2H), 6.71 (d, *J* = 8.4 Hz, 1H), 4.53 (s, 2H), 3.54 (t, *J* = 6.0 Hz, 2H), 2.59 (t, *J* = 6.8 Hz 2H), 2.02-1.94 (m, 2H), 1.83-1.74 ppm (m, 2H).

2-Chloro-7,8,9,11-tetrahydro-6*H*-pyrido[2,1-*b*]quinazoline (2b)



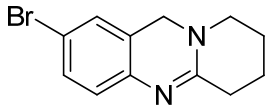
Reaction was carried out according to the general procedure with **1b** (26.7 mg, 0.120 mmol) and NCS (18.0 mg, 0.135 mmol) in CF_3CH_2OH (6.0 mL) to give **2b** (20.0 mg, 76%) as red oil.; Column chromatography: AcOEt/MeOH/triethylamine = 20/2/1.

^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.13 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.95 (d, *J* = 2.4 Hz, 1H), 6.81 (d, *J* = 8.8 Hz, 1H), 4.50 (s, 2H), 3.50 (t, *J* = 6.0 Hz, 2H), 2.57 (t, *J* = 6.8 Hz 2H), 2.01-1.94 (m, 2H), 1.81-1.75 ppm (m, 2H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 154.2, 138.1, 128.0, 126.9, 125.6, 123.2,

[2] J. S. Fitzgerald; S. R. Johns; J. A. Lamberton; A. H. Redcliffe *Aust. J. Chem*., 1966, **19**, 151.

111.8, 47.7, 44.8, 31.3, 23.0, 20.0 ppm; IR (KBr): 3289, 2945, 2868,1634, 1476, 1423, 1398, 1312, 1279, 1202 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{14}ClN_2$ $[M+H]^+$: 221.0846, found 221.0859.

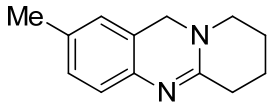
2-Bromo-7,8,9,11-tetrahydro-6*H*-pyrido[2,1-*b*]quinazoline (2c) [3]



Reaction was carried out according to the general procedure with **1c** (61.5 mg, 0.230 mmol) and NCS (34.2 mg, 0.256 mmol) in CF_3CH_2OH (11.5 mL) to give **2c** (48.4 mg, 79%) as red oil.; Column chromatography: AcOEt/MeOH/triethylamine = 20/2/1.

^1H NMR (400 MHz, $CDCl_3$): δ= 7.27 (d, *J* = 8.4 Hz, 1H), 7.10 (s, 1H), 6.65 (d, *J* = 8.4 Hz, 1H), 4.50 (s, 2H), 3.49 (t, *J* = 6.0 Hz, 2H), 2.56 (t, *J* = 6.4 Hz, 2H), 1.99 (m, 2H), 1.78 ppm (m, 2H).

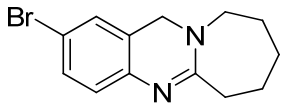
2-Methyl-7,8,9,11-tetrahydro-6*H*-pyrido[2,1-*b*]quinazoline (2d)



Reaction was carried out according to the general procedure with **1d** (42.6 mg, 0.211 mmol) and NCS (31.4 mg, 0.235 mmol) in CF_3CH_2OH (10.5 mL) to give **2d** (36.3 mg, 86%) as pale yellow solid.; Column chromatography: AcOEt/MeOH/triethylamine = 20/2/1.

Mp: 171 ^oC; ^1H NMR (300 MHz, $CDCl_3$): δ= 6.98 (d, *J* = 8.4 Hz, 1H), 6.80 (s, 1H), 6.69 (d, *J* = 8.4 Hz, 1H), 4.51 (s, 2H), 3.51 (t, *J* = 6.0 Hz, 2H), 2.56 (t, *J* = 6.6 Hz, 2H), 2.57 (s, 3H), 2.00-1.92 (m, 2H), 1.81-1.72 ppm (m, 2H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 154.3, 137.0, 132.6, 127.5, 126.4, 121.3, 110.5, 47.8, 44.6, 31.3, 23.1, 20.5, 20.2 ppm; IR (KBr): 3281, 2941, 2864, 1614, 1504, 1402, 1288 cm^{-1}; HRMS (FAB): calcd for $C_{13}H_{17}N_2$ $[M+H]^+$: 201.1392, found 201.1386.

2-Bromo-6,7,8,9,10,12-hexahydroazepino[2,1-*b*]quinazoline (2e)



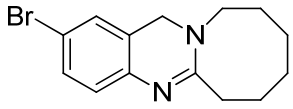
Reaction was carried out according to the general procedure with **1e** (50.8 mg, 0.181 mmol) and NCS (26.6 mg, 0.199 mmol) in CF_3CH_2OH (9.0 mL) to give **2e** (36.7 mg, 73%) as pale yellow solid.; Column chromatography: AcOEt/MeOH/triethylamine = 20/2/1.

Mp: 165 ^oC; ^1H NMR (500 MHz, $CDCl_3$): δ= 7.28 (dd, *J* = 10.5, 2.5 Hz, 1H), 7.15 (d, *J* = 2.5 Hz, 1H), 6.80 (d, *J* = 10.5 Hz, 1H), 4.34 (s, 2H), 3.78 (t, *J* = 5.0 Hz, 2H), 2.66 (t, *J* = 5.5 Hz, 2H),

[3] N. I. Mukarramov; R. Ya. Okmanov; F. R. Utaeva; K. K. Turgunov; B. Tashkhodzhaev; Z. M. Khakimova; K. M. Shakhidoyatov *Chem. Nat. Compd.*, 2009, **45**, 854.

1.79-1.68 ppm (m, 6H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 160.6, 139.1, 129.8, 128.6, 124.4, 114.6, 112.3, 48.3, 46.2, 36.4, 29.4, 27.2, 25.6 ppm; IR (KBr): 3261, 2926, 2853, 1634, 1485, 1422, 1379, 1193 cm^{-1}; HRMS (FAB): calcd for $C_{13}H_{16}BrN_2$ $[M+H]^+$: 279.0497, found 279.0494.

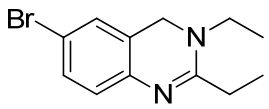
2-Bromo-7,8,9,10,11,13-hexahydro-6*H*-azocino[2,1-*b*]quinazoline (2f)



Reaction was carried out according to the general procedure with **1f** (31.9 mg, 0.108 mmol) and NCS (15.7 mg, 0.118 mmol) in CF_3CH_2OH (5.4 mL) to give **2f** (22.9 mg, 72%) as yellow oil.; Column chromatography: AcOEt/triethylamine = 20/1.

^{1}H NMR (500 MHz, $CDCl_3$): δ= 7.22 (dd, *J* = 8.5, 2.5 Hz, 1H), 7.03 (d, *J* = 2.5 Hz, 1H), 6.69 (d, *J* = 8.5 Hz, 1H), 4.60 (s, 2H), 3.87 (t, *J* = 5.5 Hz, 2H), 2.56 (t, *J* = 6.5 Hz, 2H), 1.82-1.75 (m, 4H), 1.58-1.53 ppm (m, 4H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 158.2, 137.5, 129.9, 128.7, 123.5, 114.8, 113.4, 47.9, 43.9, 34.0, 30.2, 28.4, 26.0, 24.4 ppm; IR (KBr): 3188, 2926, 2855, 1634, 1485, 1447, 1422, 1379, 1285 cm^{-1}; HRMS (FAB): calcd for $C_{14}H_{18}BrN_2$ $[M+H]^+$: 293.0653, found 293.0671.

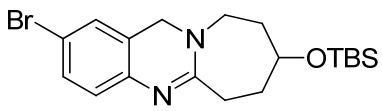
6-Bromo-2,3-diethyl-3,4-dihydroquinazoline (2g)



Reaction was carried out according to the general procedure with **1g** (54.9 mg, 0.204 mmol) and NCS (30.5 mg, 0.228 mmol) in CF_3CH_2OH (10.0 mL) to give **2g** (37.7 mg, 69%) as red solid.; Column chromatography: AcOEt/Hexane/triethylamine = 10/10/1.

Mp: 100 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.26 (dd, *J* = 8.8, 2.2 Hz, 1H), 7.10 (d, *J* = 2.2 Hz, 1H), 6.66 (d, *J* = 8.8 Hz, 1H), 4.46 (s, 2H), 3.75 (q, *J* = 6.8 Hz, 2H), 2.44 (q, *J* = 7.2 Hz, 2H) 1.28 (t, *J* = 7.2 Hz, 3H), 1.19 ppm (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 157.9, 138.0, 129.8, 128.6, 124.3, 114.7, 113.0, 48.1, 39.1, 27.1, 13.8, 11.4 ppm; IR (KBr): 3181, 2974, 2934, 1634, 1485, 1422, 1377, 1260, 1221 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{16}BrN_2$ $[M+H]^+$: 267.0497, found 267.0494.

2-Bromo-8-((*tert*-butyldimethylsilyl)oxy)-6,7,8,9,10,12-hexahydroazepino[2,1-*b*]quinazoline (2h)

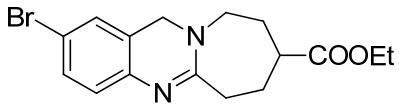


Reaction was carried out according to the general procedure with **1h** (50.2 mg, 0.122 mmol), and

NCS (17.6 mg, 0.132 mmol) in CF_3CH_2OH (6.1 mL) to give **2h** (32.7 mg, 65%) as colorless solid. Column chromatography: Hex/AcOEt/triethylamine = 65/30/5 and Hex/AcOEt/triethylamine = 20/2/1 to 10/2/1

Mp: 143 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.28 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.14 (d, *J* = 2.4 Hz, 1H) 6.66 (d, *J* = 8.8 Hz, 1H), 4.39 (A in ABq, *J* = 16.0 Hz, 1H), 4.26 (B in ABq, *J* = 16.0 Hz, 1H) 4.13-4.09 (m, 2H), 3.58 (ddd, *J* = 15.6, 4.0, 4.0 Hz, 1H), 3.07 (m, 1H), 2.42 (dd, *J* = 15.2, 8.8, Hz, 1H), 1.82-1.65 (m, 4H), 0.92 (s, 9H), 0.08 (s, 6H) ppm ; ^{13}C NMR (126 MHz, $CDCl_3$) δ= 160.6, 138.8, 129.8, 128.6, 124.3, 114.7, 112.1, 67.5, 48.1, 39.7, 35.1, 33.5, 29.1, 25.7, 18.0, -4.8, -4.9 ppm; IR (KBr): 3171, 2928, 1639, 1462, 1377, 1252 cm^{-1}; HRMS (FAB): calcd for $C_{19}H_{30}BrN_2OSi$ $[M+H]^+$: 409.1311, found 409.1301.

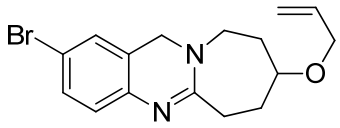
Ethyl 2-bromo-6,7,8,9,10,12-hexahydroazepino[2,1-*b*]quinazoline-8-carboxylate (2i)



Reaction was carried out according to the general procedure with **1i** (59.9 mg, 0.170 mmol), and NCS (24.9 mg, 0.186 mmol) in CF_3CH_2OH (8.5 mL) to give **2i** (36.2 mg, 61%) as pink amorphous. Column chromatography: AcOEt/triethylamine = 20/1.

^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.34 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.18 (d, *J* = 2.4 Hz, 1H), 6.74 (dd, *J* = 8.8 Hz, 1H), 4.45 (A in ABq, *J* = 16.4 Hz, 1H), 4.37 (B in ABq, *J* = 16.4 Hz, 1H), 4.15 (q, *J* = 7.0 Hz, 2H), 4.01 (dd, *J* = 15.6, 7.2 Hz, 1H), 3.79 (dd, *J* = 15.6, 9.2 Hz 1H), 2.94 (dd, *J* = 15.6, 8.6 Hz 1H), 2.79-2.67 (m, 2H), 2.15-2.11 (m, 2H), 2.02-1.93 (m, 1H), 1.89-1.80 (m, 1H), 1.26 ppm (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 174.0, 161.0, 137.6, 130.4, 129.0, 123.6, 116.1, 112.9, 60.8, 46.8, 44.5, 44.1, 33.2, 29.0, 27.4, 14.1 ppm; IR (KBr): 3197, 2961, 2926, 1726, 1634, 1483, 1379, 1261 cm^{-1}; HRMS (FAB): calcd for $C_{16}H_{20}BrN_2O_2$ $[M+H]^+$: 351.0708, found 351.0714.

8-(Allyloxy)-2-bromo-6,7,8,9,10,12-hexahydroazepino[2,1-*b*]quinazoline (2j)

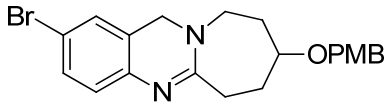


Reaction was carried out according to the general procedure with **1j** (40.2 mg, 0.119 mmol), and NCS (17.6 mg, 0.132 mmol) in CF_3CH_2OH (6.0 mL) to give **2j** (26.4 mg, 66%) as pale brown oil. Column chromatography: CH_2Cl_2/MeOH = 10:1 to CH_2Cl_2/MeOH = 5:1.

^{1}H NMR (500 MHz, $CDCl_3$): δ= 7.30 (dd, *J* = 8.5, 2.0 Hz, 1H), 7.15 (d, *J* = 2.0 Hz, 1H), 6.68 (dd, *J* = 8.5 Hz, 1H), 5.97-5.89 (m, 1H), 5.33-5,29 (m, 1H), 5.21-5.18 (m, 1H), 4.40 (A in ABq, *J* = 12.8 Hz, 1H), 4.30 (B in ABq, *J* = 12.8 Hz, 1H), 4.09-3.98 (m, 3H), 3.69 (m, 1H), 3.64-3.59 (m, 1H), 2.99 (m, 1H), 2.50 (dd, *J* = 15.0, 8.5 Hz, 1H), 2.00-1.97 (m, 2H), 1.89-1.85 (m, 1H), 1.76-1.74 ppm (m,

1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 160.5, 138.5, 134.9, 129.9, 128.7, 124.2, 116.7, 115.0, 112.2, 74.3, 69.1, 47.9, 40.4, 31.9, 29.7, 29.5 ppm; IR (KBr): 3262, 2926, 2857, 2185, 1638, 1481, 1379, 1323, 1287 cm^{-1}; HRMS (FAB): calcd for $C_{16}H_{20}BrN_2O$ [*M*+H]$^+$: 335.0759, found 335.0761.

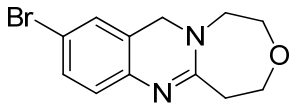
2-Bromo-8-((4-methoxybenzyl)oxy)-6,7,8,9,10,12-hexahydroazepino[2,1-*b*]quinazoline (2k)



Reaction was carried out according to the general procedure with **1k** (61.4 mg, 0.147 mmol), and NCS (21.4 mg, 0.160 mmol) in CF_3CH_2OH (7.4 mL) to give **2k** (37.6 mg, 62%) as pale brown oil. Column chromatography: CH_2Cl_2/MeOH = 10:1.

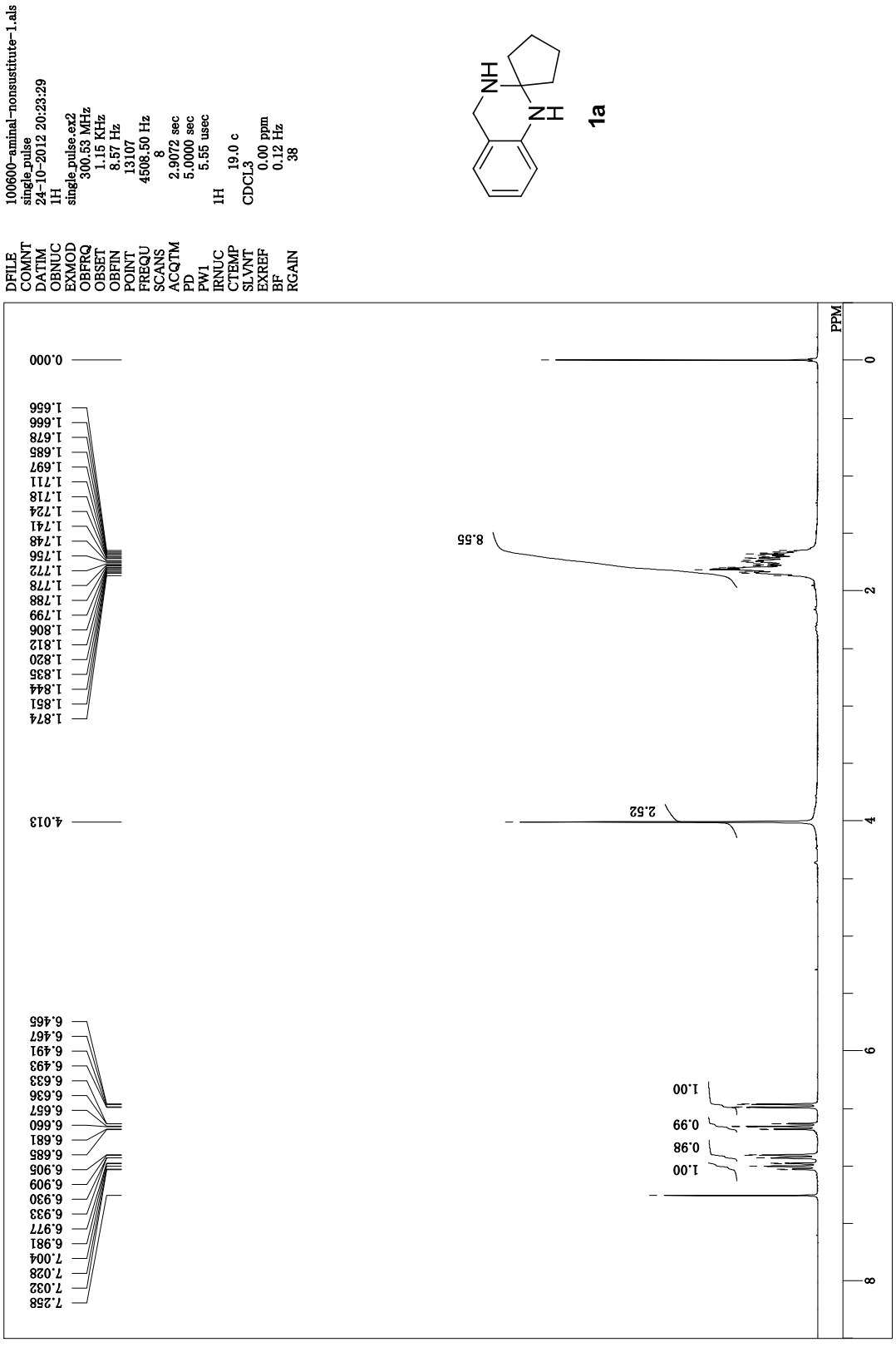
^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.35 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.27 (d, *J* = 8.6 Hz, 2H), 7.19 (d, *J* = 1.8 Hz, 1H), 6.90 (d, *J* = 8.6 Hz, 2H), 6.75 (d, *J* = 8.6 Hz, 1H), 4.54-4.35 (m, 4H), 4.15 (dd, *J* = 16.0, 10.0 Hz, 1H), 3.82 (s, 3H), 3.77 (m, 1H), 3.67 (dd, *J* = 16.0, 6.8 Hz, 1H), 3.11 (dd, *J* = 15.4, 11.2 Hz, 1H), 2.77 (dd, *J* = 15.4, 7.6 Hz, 1H), 2.08-2.02 (m, 2H), 1.87-1.72 ppm (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ= 160.3, 159.1, 138.6, 130.4, 129.8, 129.0, 128.6, 124.2, 114.8, 113.8, 112.1, 74.0, 69.7, 55.2, 48.0, 40.3, 31.9, 29.7, 29.5 ppm; IR (KBr): 3223, 2928, 2835, 1633, 1477, 1379, 1287 cm^{-1}; HRMS (FAB): calcd for $C_{21}H_{24}BrN_2O_2$ [*M*+H]$^+$: 415.1021, found 415.1048.

9-Bromo-2,4,5,11-tetrahydro-1*H*-[1,4]oxazepino[5,4-*b*]quinazoline (2l)



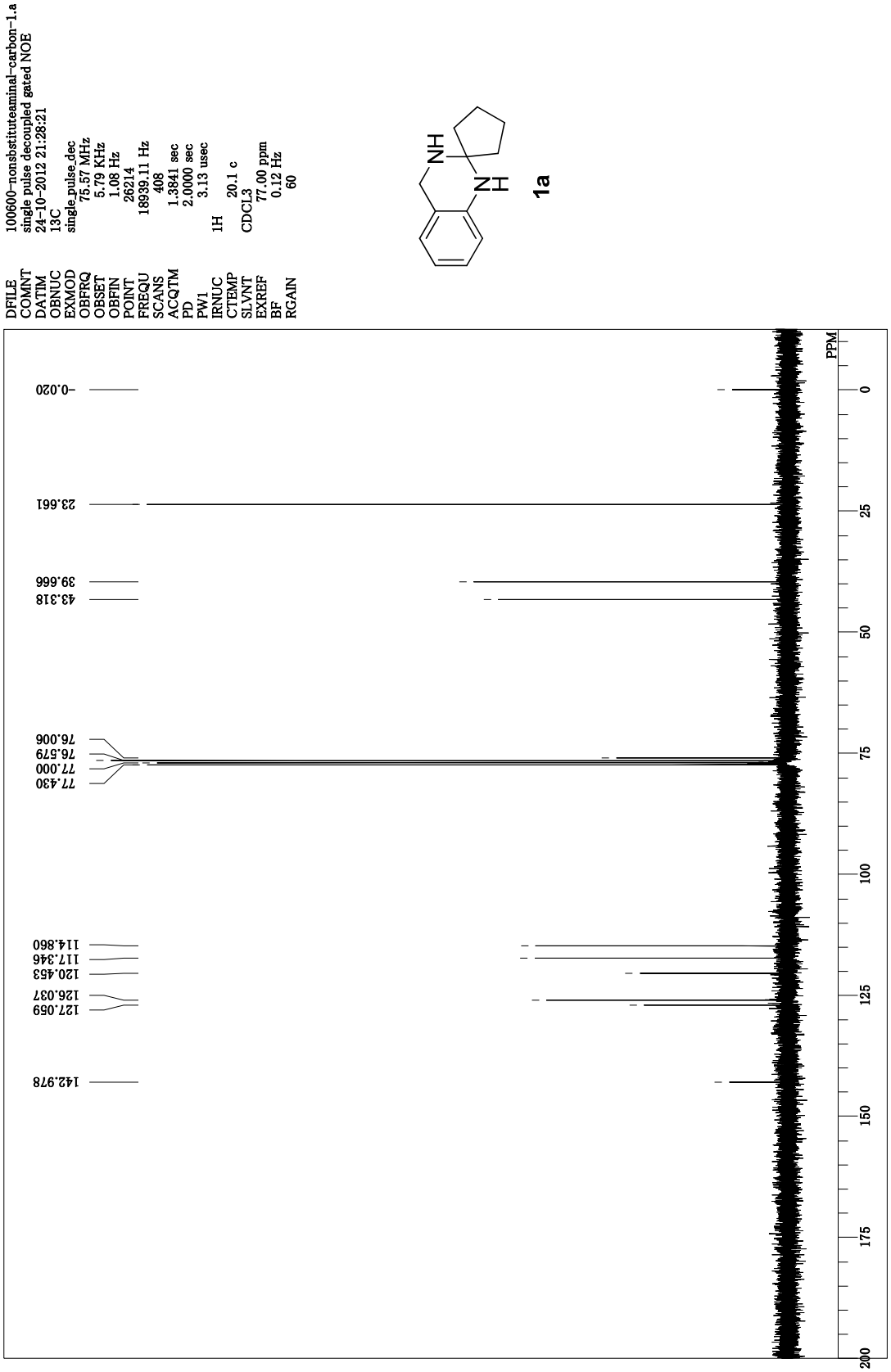
Reaction was carried out according to the general procedure with **1l** (45.7 mg, 0.161 mmol), and NCS (23.4 mg, 0.175 mmol) in CF_3CH_2OH (8.1 mL) to give **2l** (11.4 mg, 25%) as pale brown oil. Column chromatography: CH_2Cl_2/MeOH = 20/1 to 5/1.

^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.32 (dd, *J* = 8.6, 1.6 Hz, 1H), 7.20 (s, 1H), 6.63 (d, *J* = 8.6 Hz, 1H), 4.39 (s, 2H), 3.95-3.88 (m, 4H), 3.82 (m, 2H), 2.92 ppm (m, 2H); ^{13}C NMR (100.5 MHz, $CDCl_3$) δ= 159.6, 138.7, 130.1, 128.9, 124.2, 115.6, 112.3, 69.5, 67.7, 48.9, 48.0, 39.6 ppm; IR (KBr): 3059, 2953, 2853, 1634, 1485, 1377, 1331, 1273, 1186 cm^{-1}; HRMS (FAB): calcd for $C_{12}H_{14}BrN_2O$ [*M*+H]$^+$: 281.0290, found 281.0292.

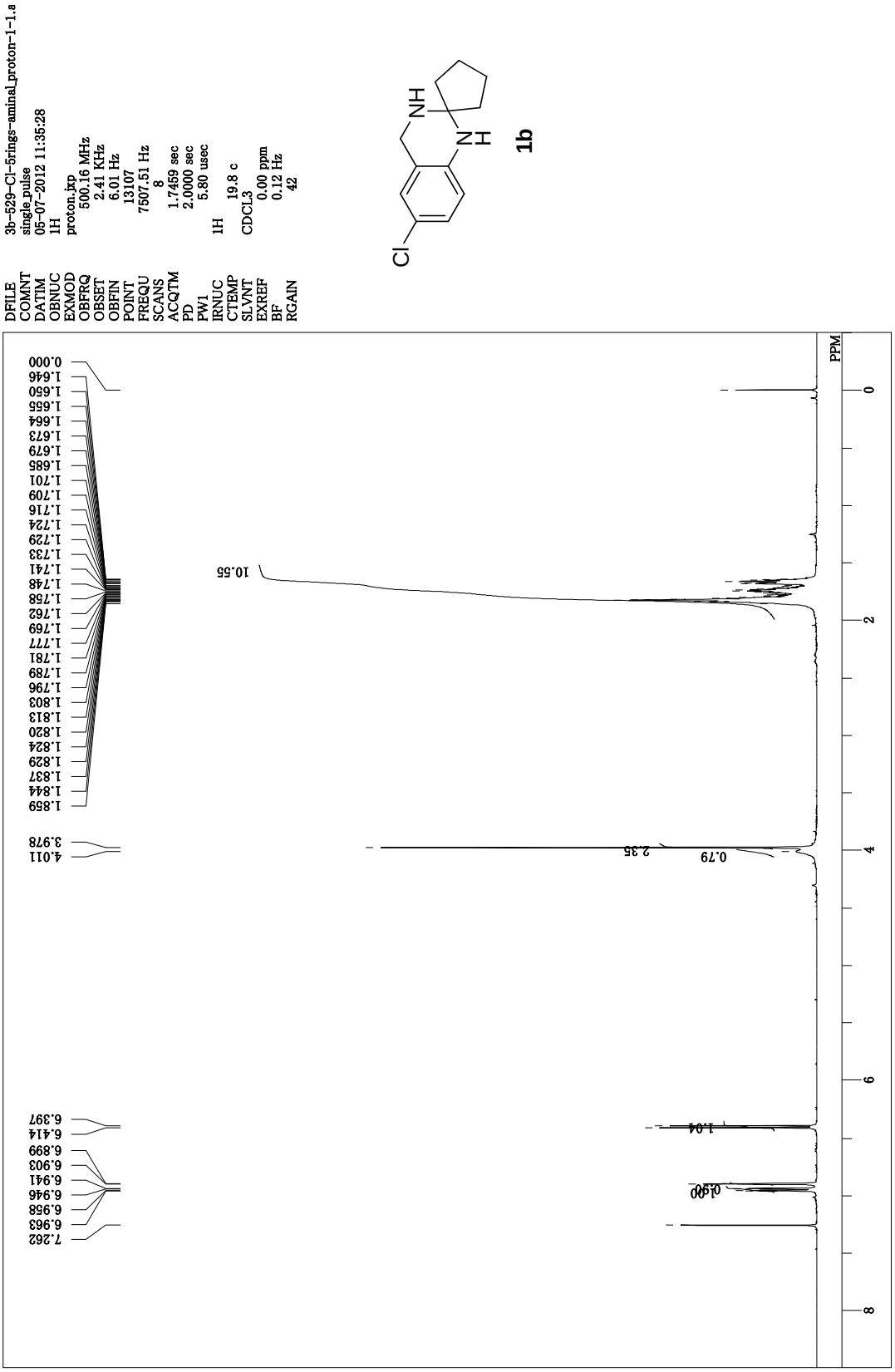


^{1}H NMR spectrum of **1a**

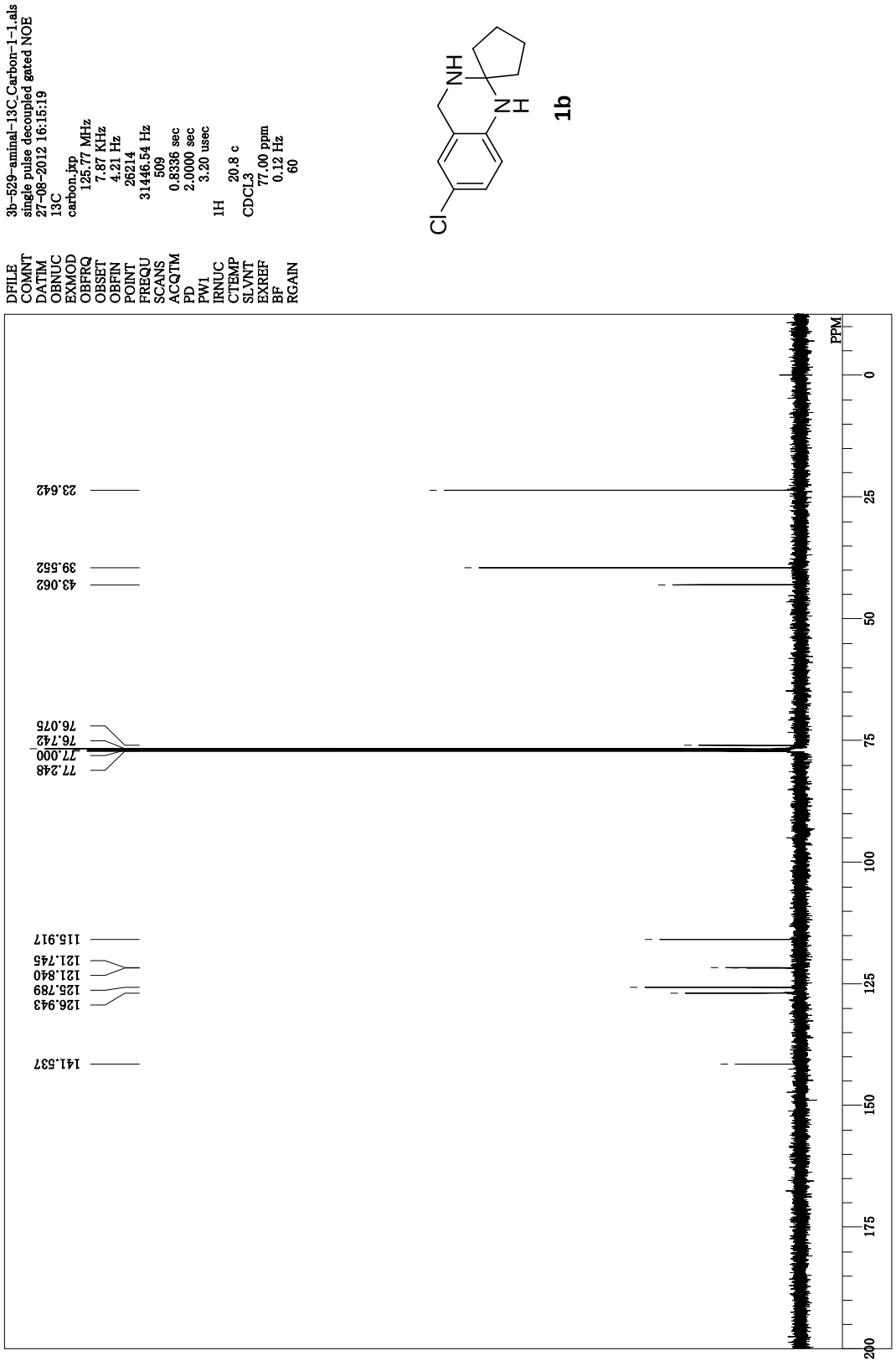
^{13}C NMR spectrum of **1a**

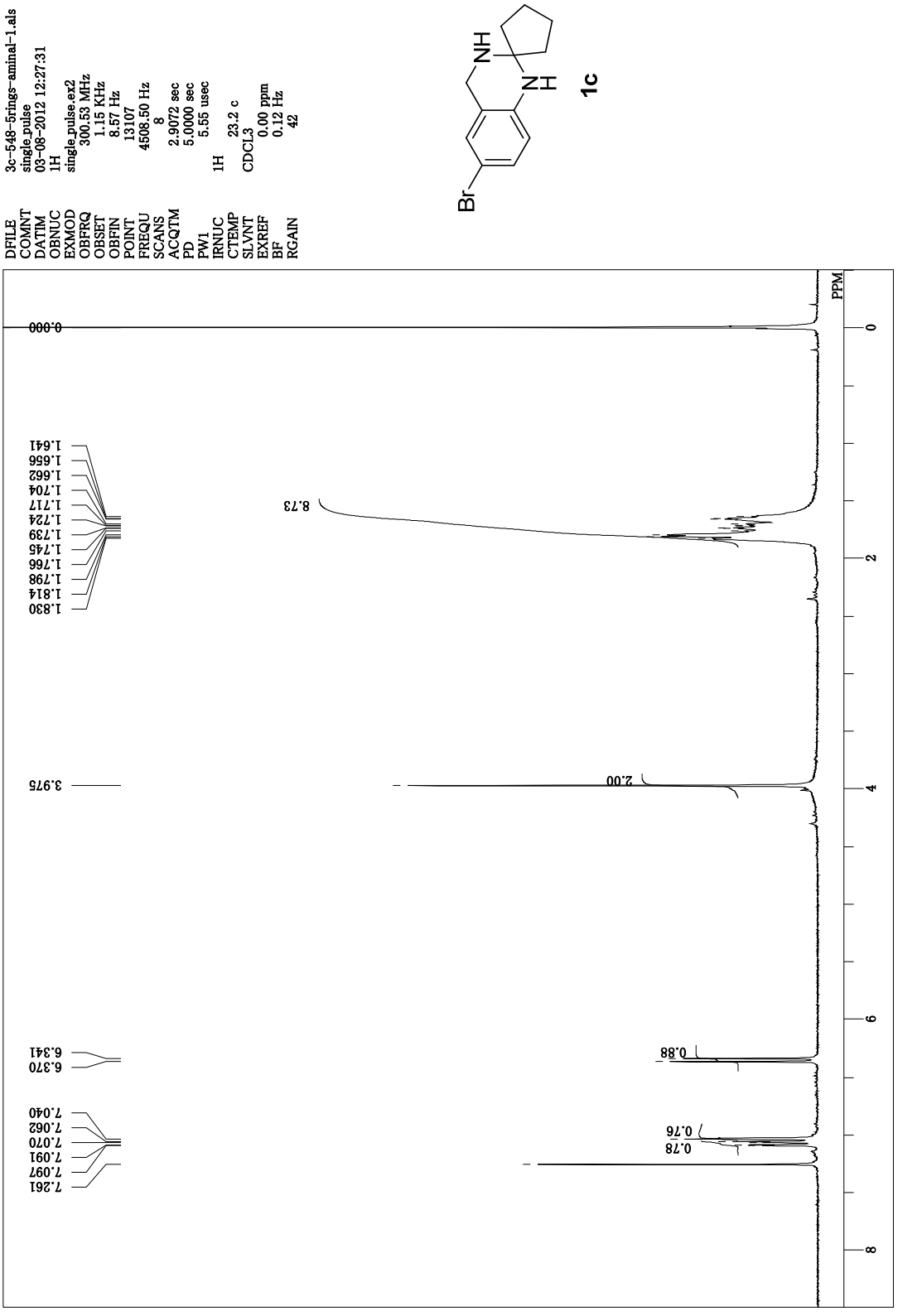


^{1}H NMR spectrum of **1b**



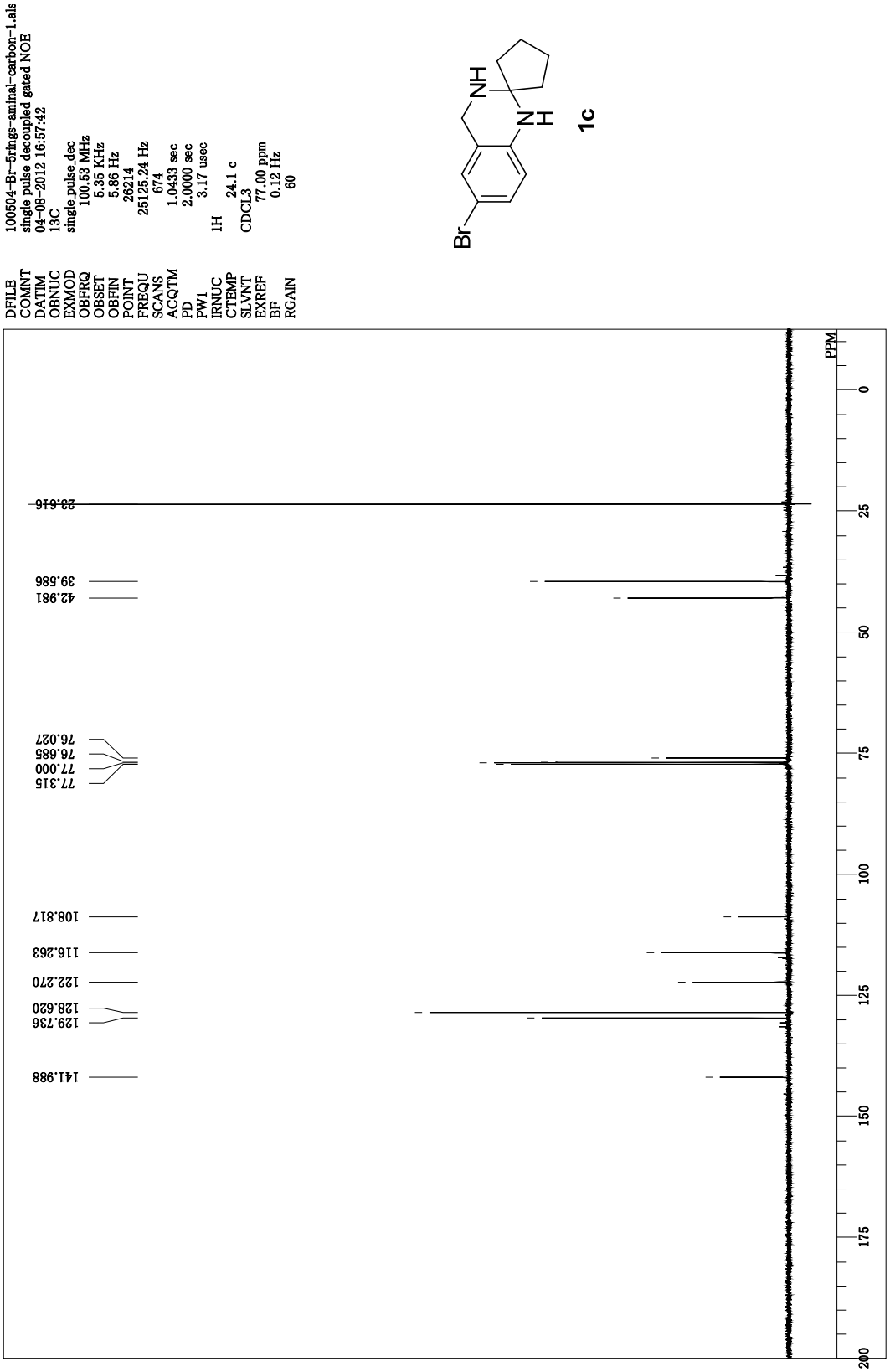
^{13}C NMR spectrum of **1b**

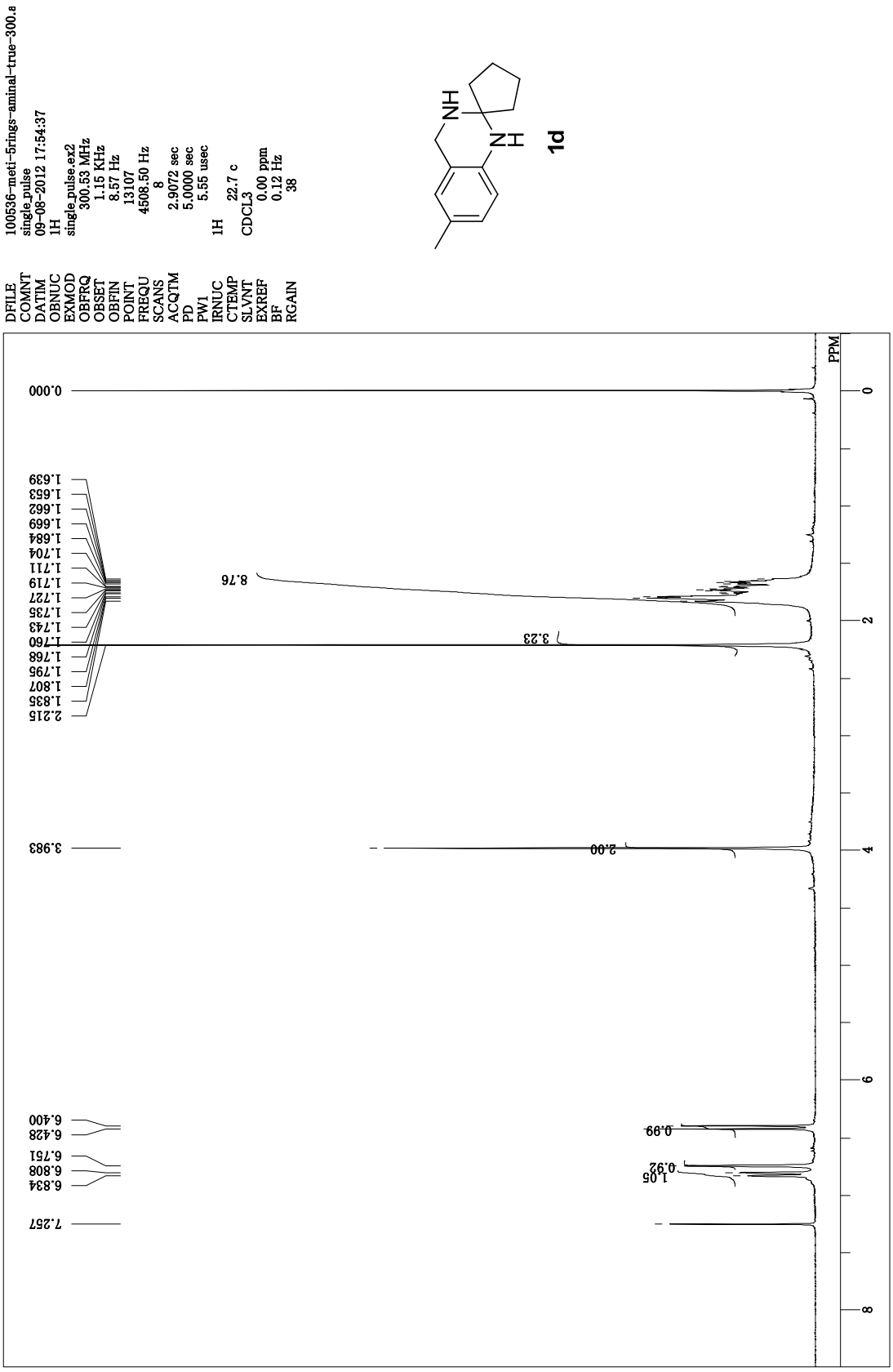




^{1}H NMR spectrum of **1c**

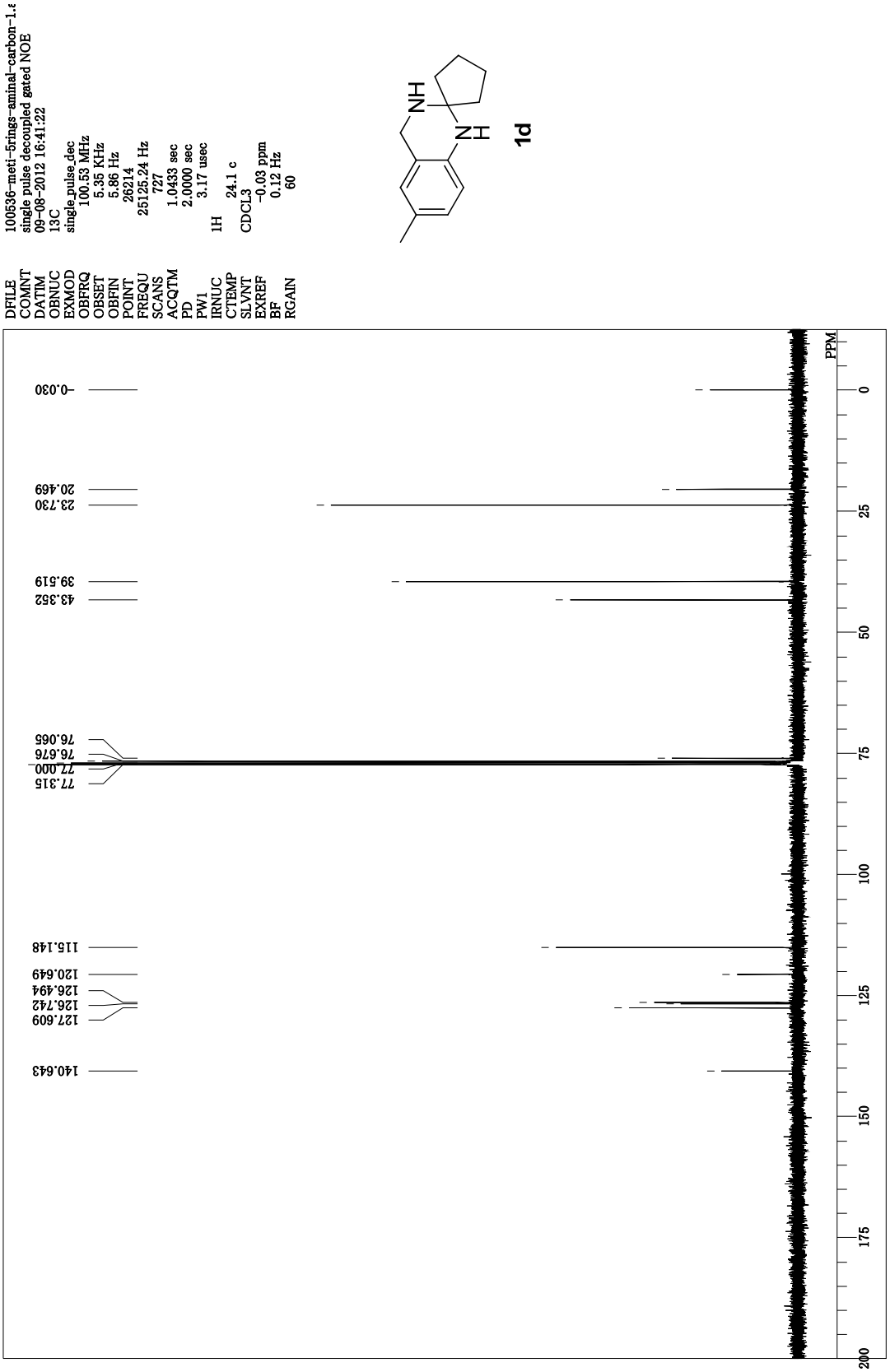
^{13}C NMR spectrum of **1c**

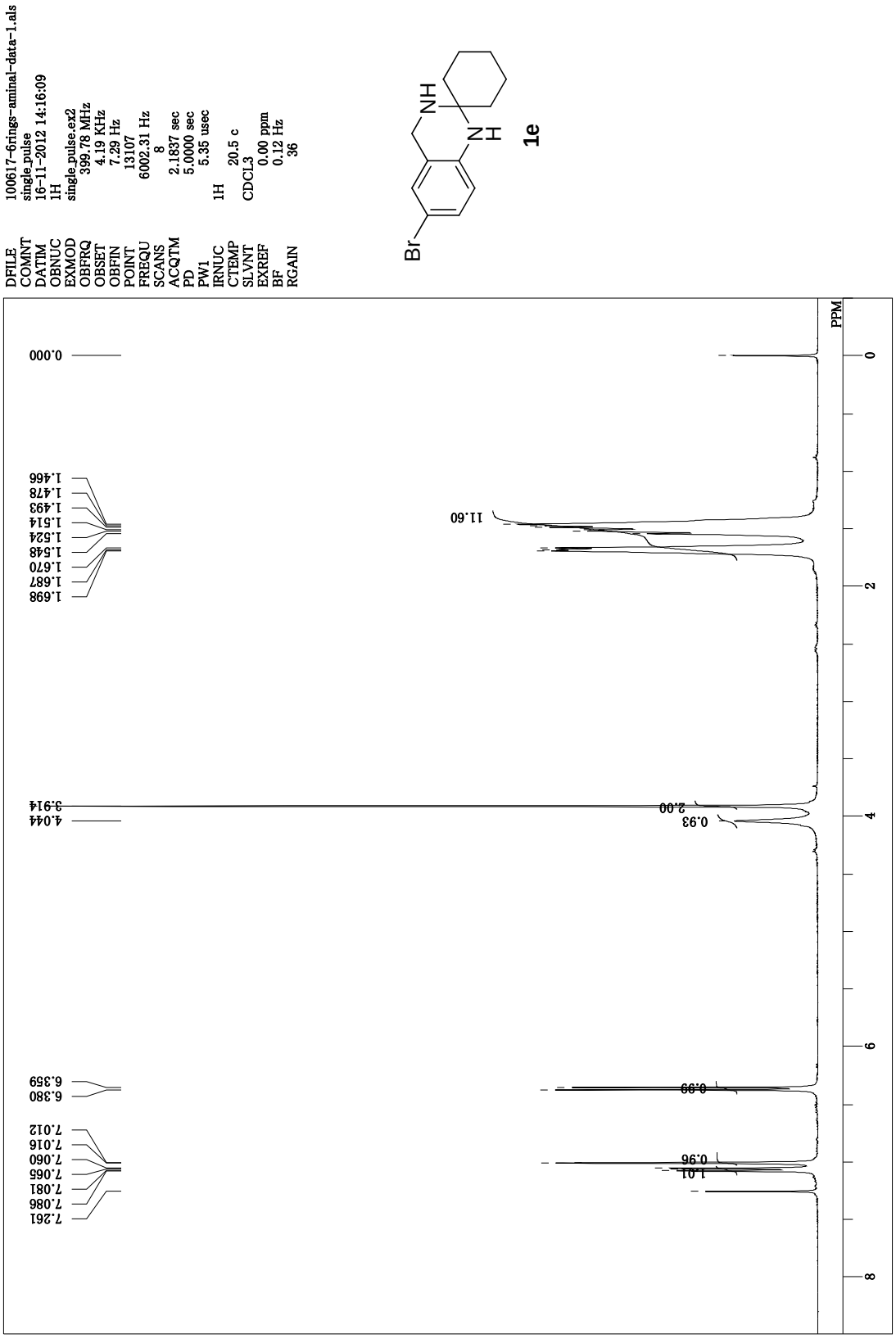




^{1}H NMR spectrum of **1d**

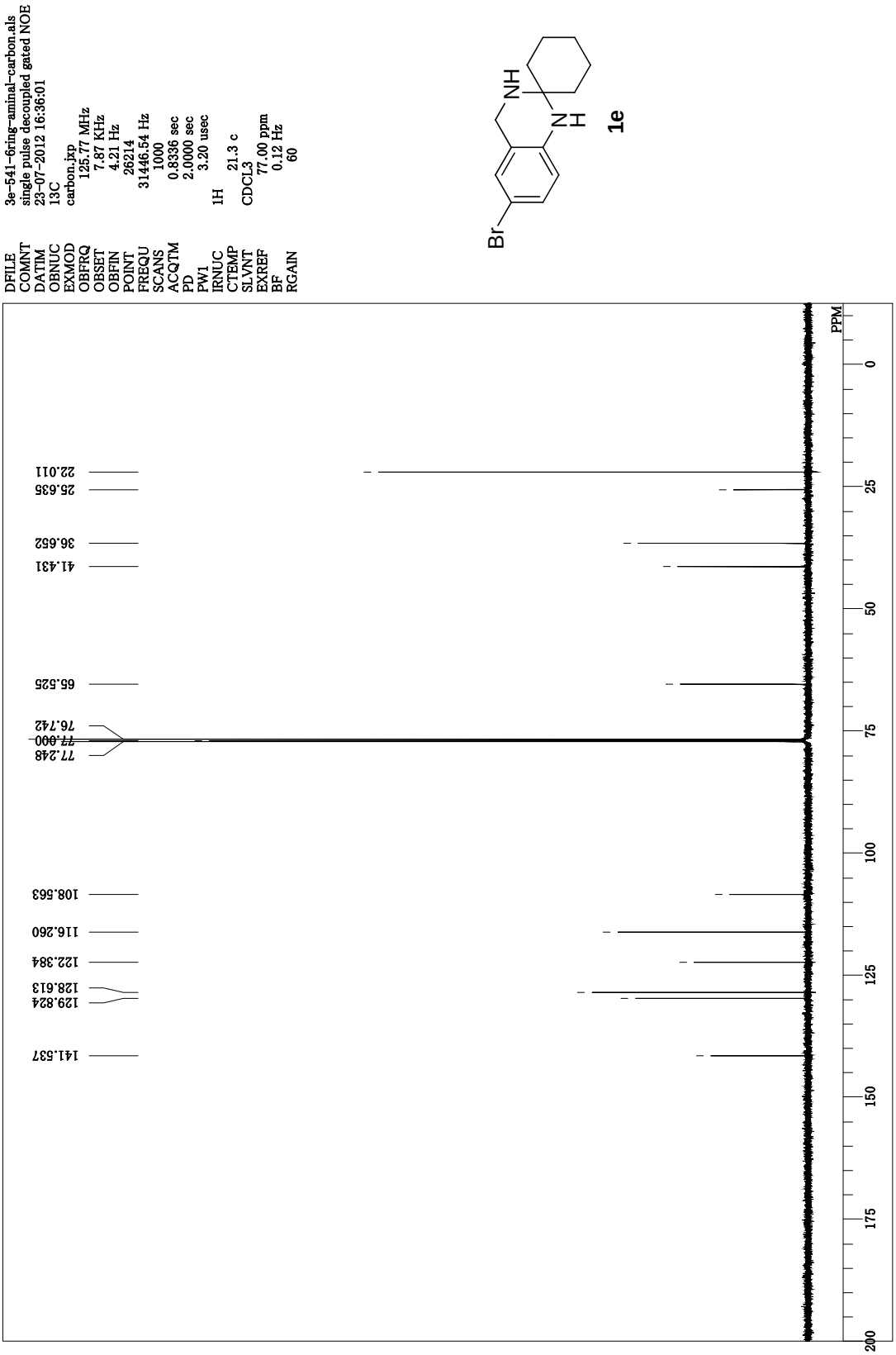
^{13}C NMR spectrum of **1d**



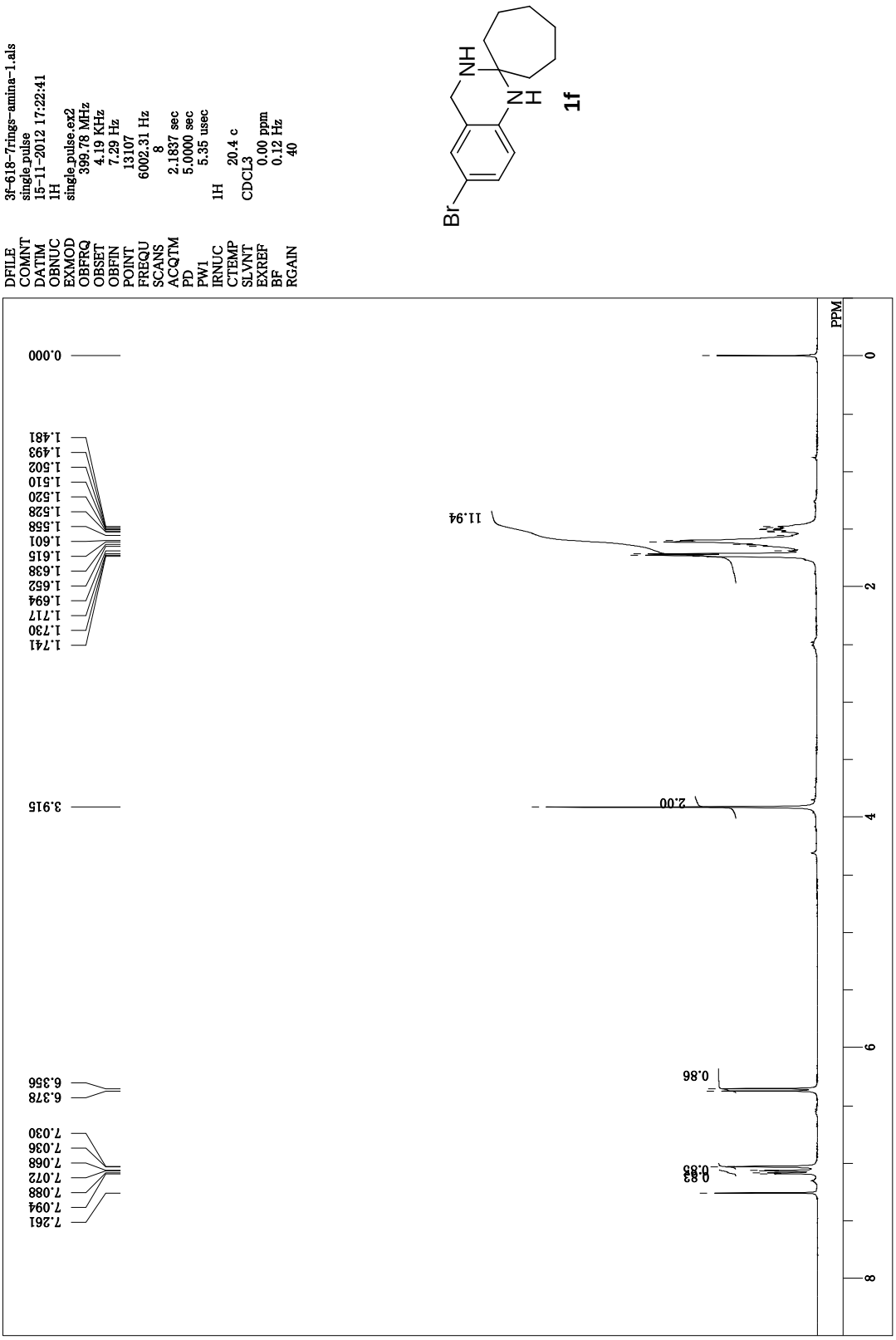


^{1}H NMR spectrum of **1e**

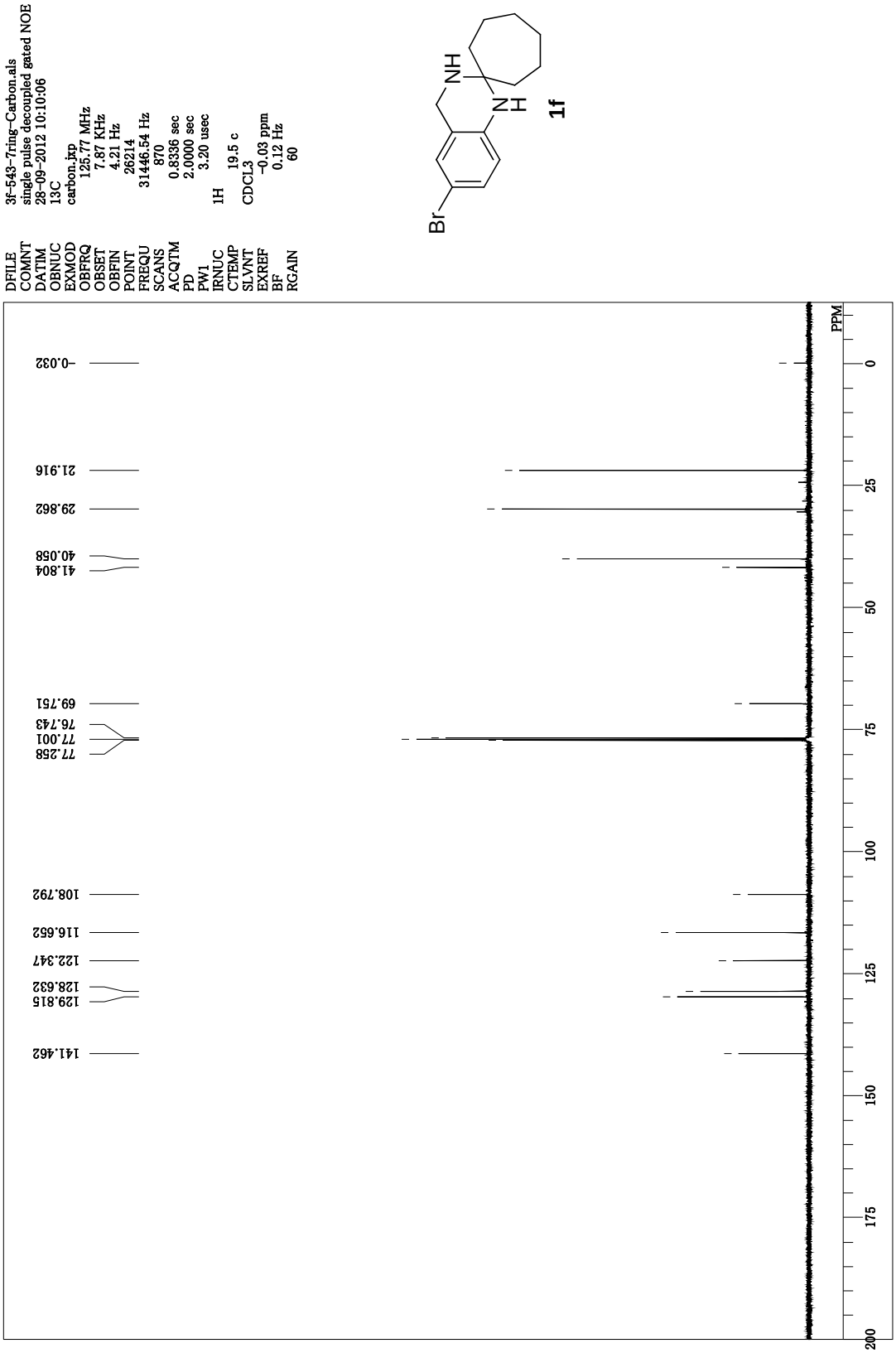
^{13}C NMR spectrum of **1e**



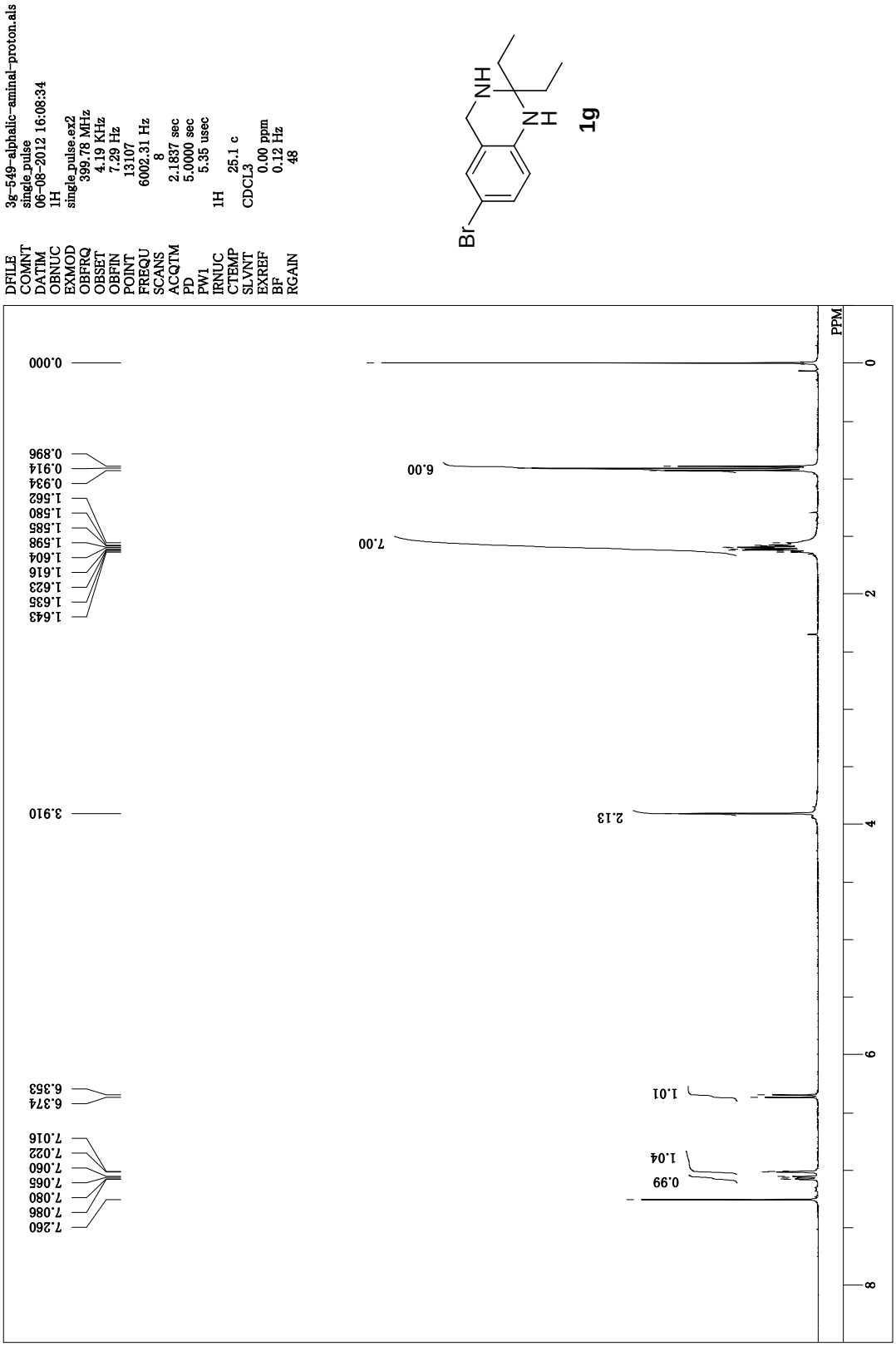
^{1}H NMR spectrum of **1f**



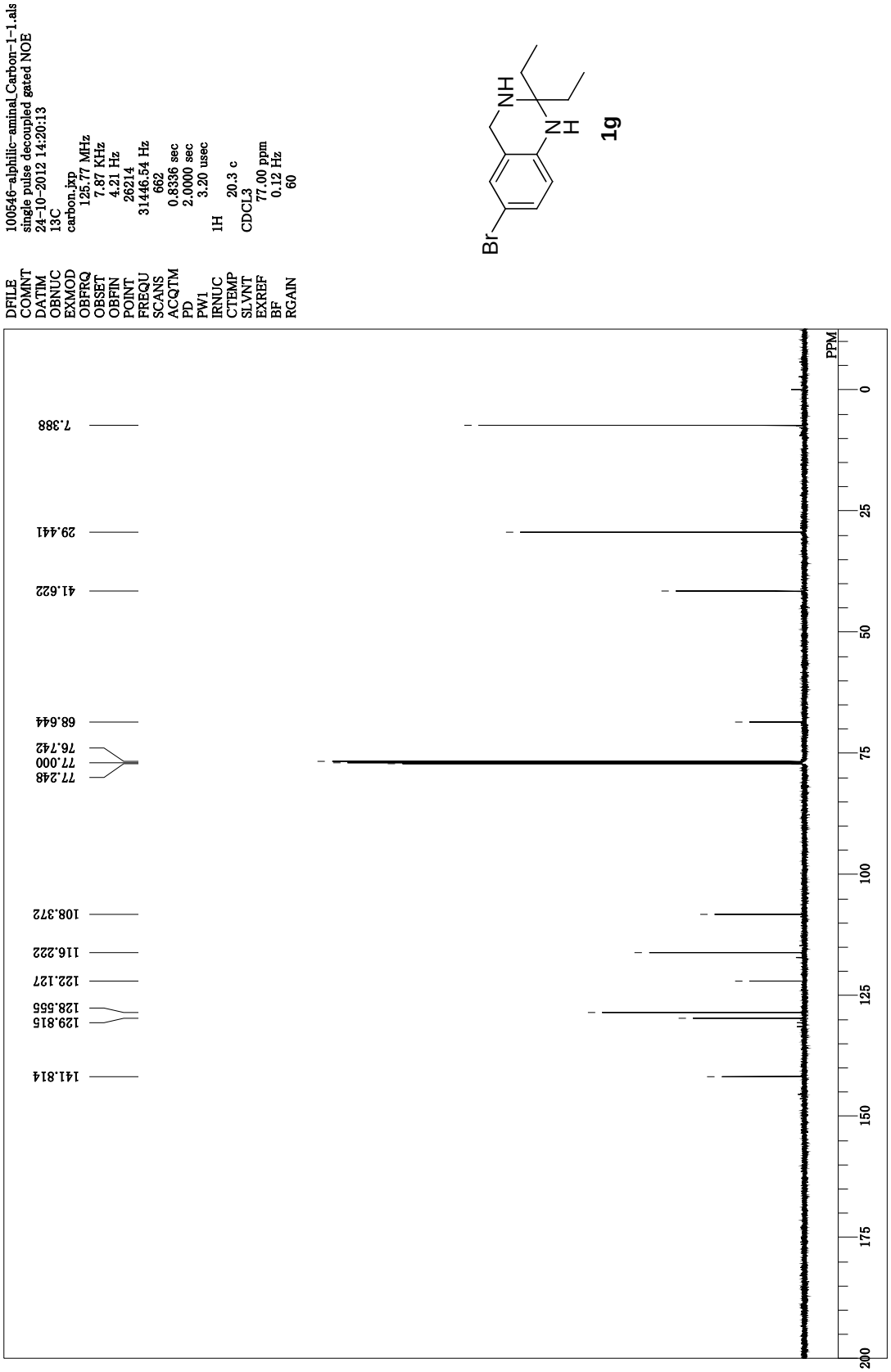
^{13}C NMR spectrum of **1f**

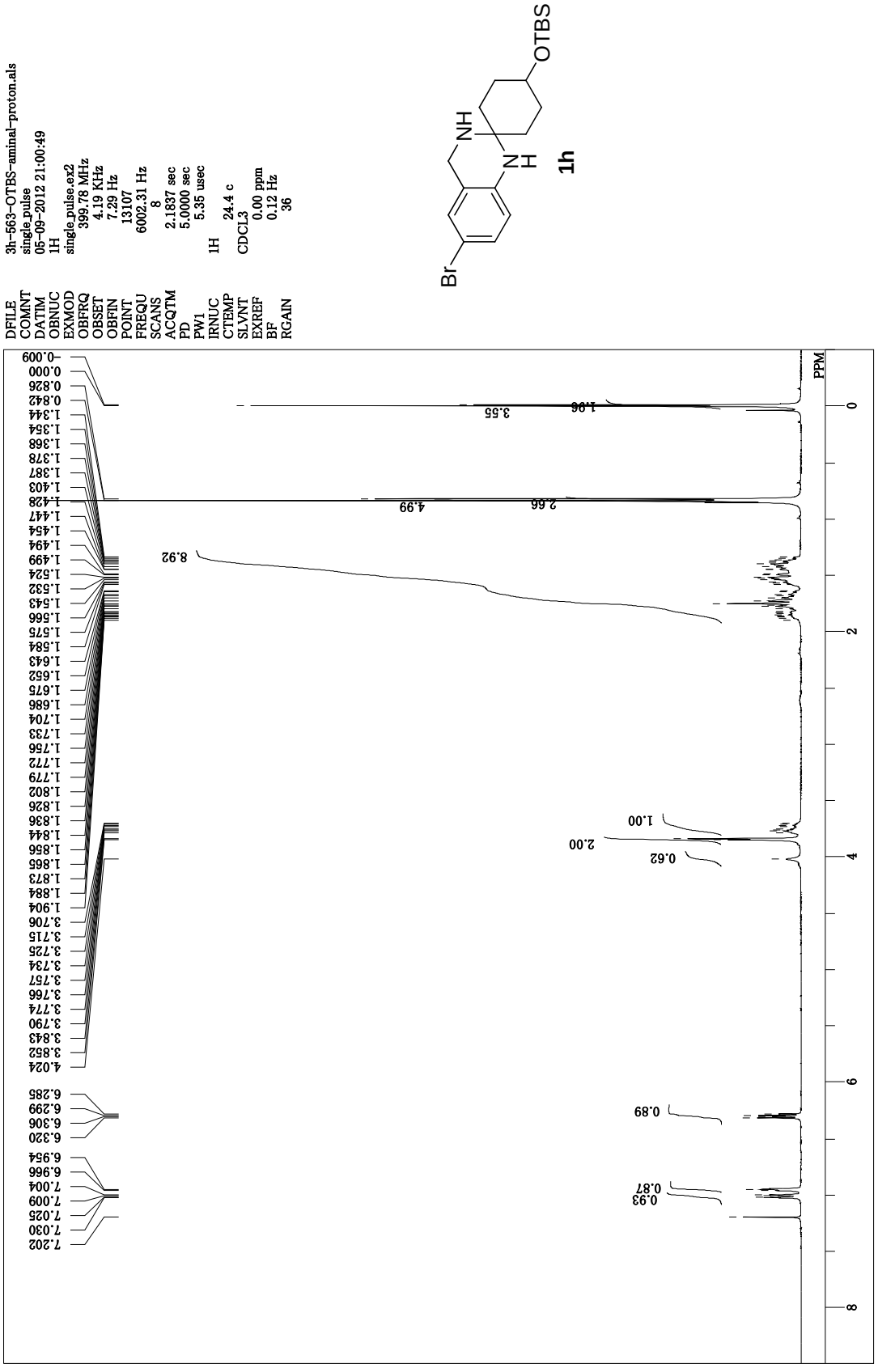


^{1}H NMR spectrum of **1g**



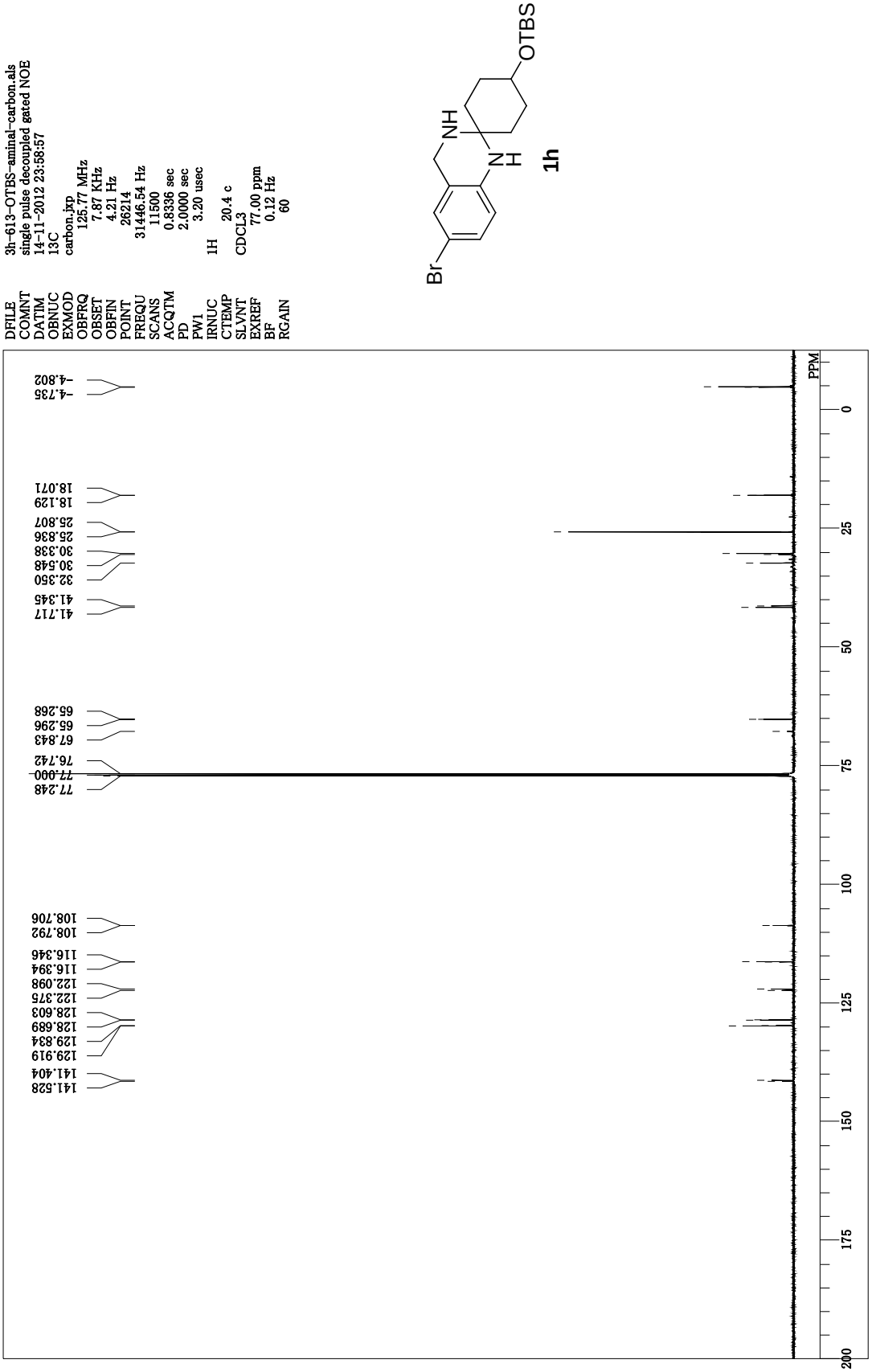
^{13}C NMR spectrum of **1g**



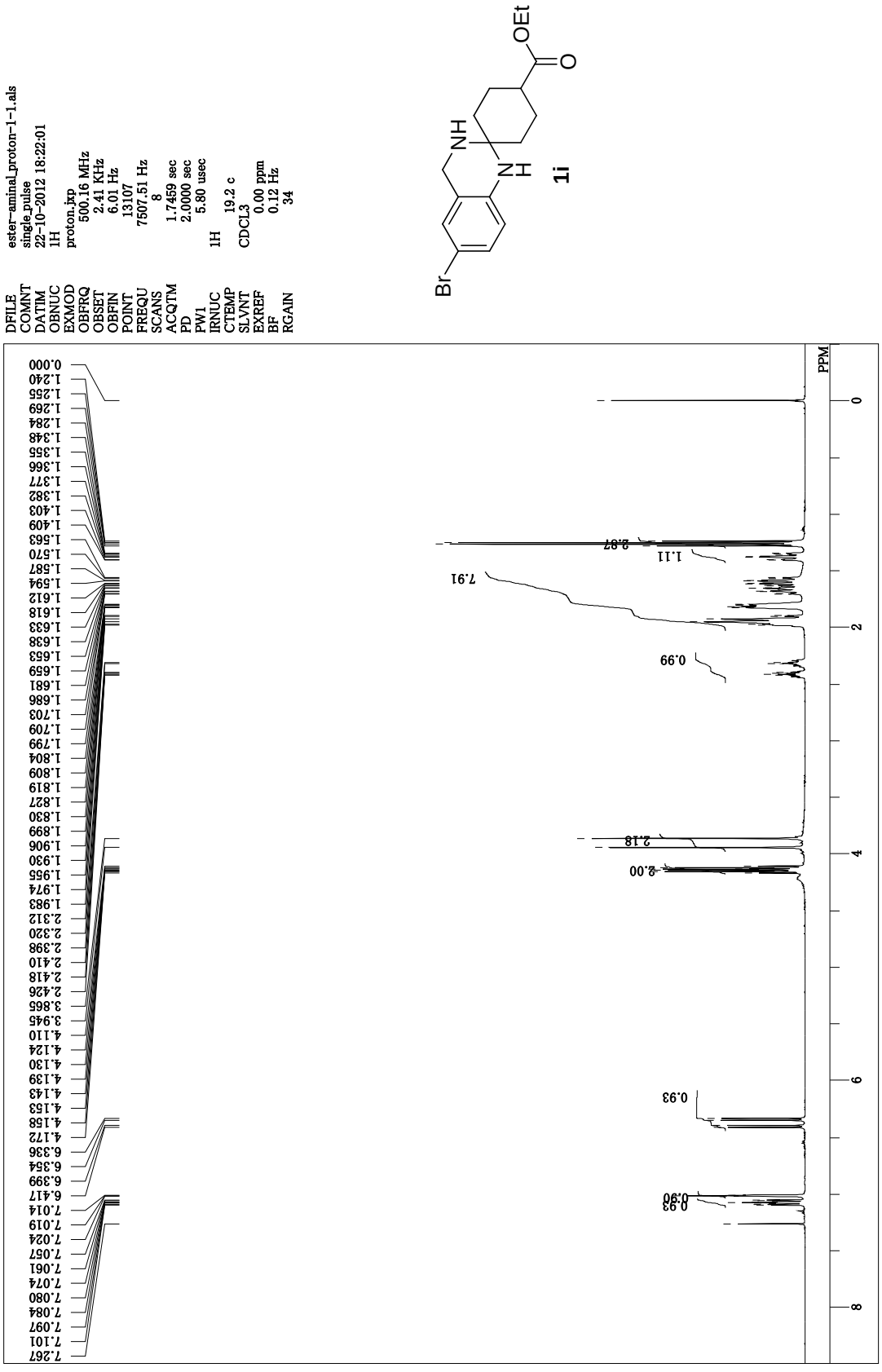


^{1}H NMR spectrum of **1h**

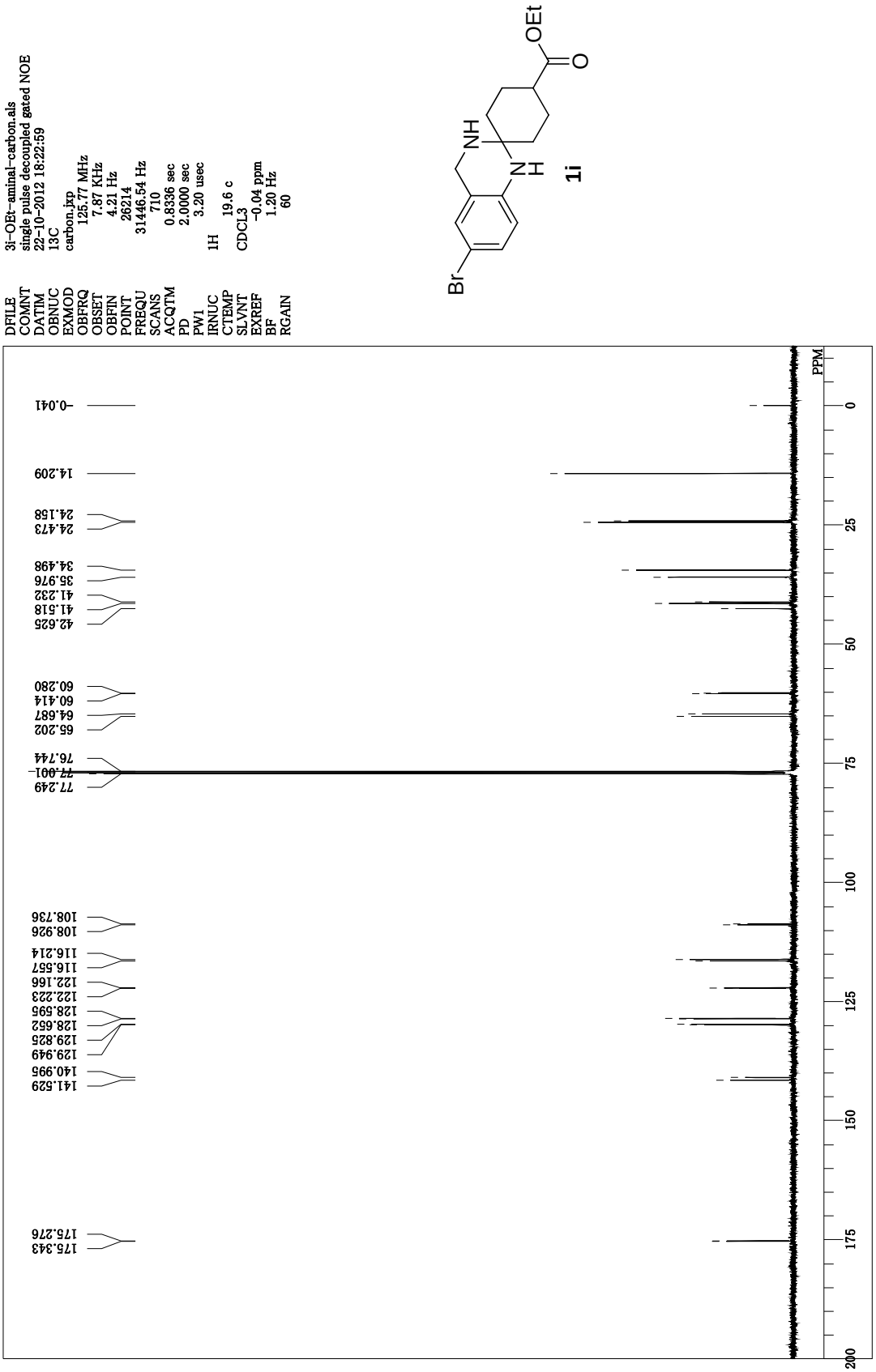
^{13}C NMR spectrum of **1h**



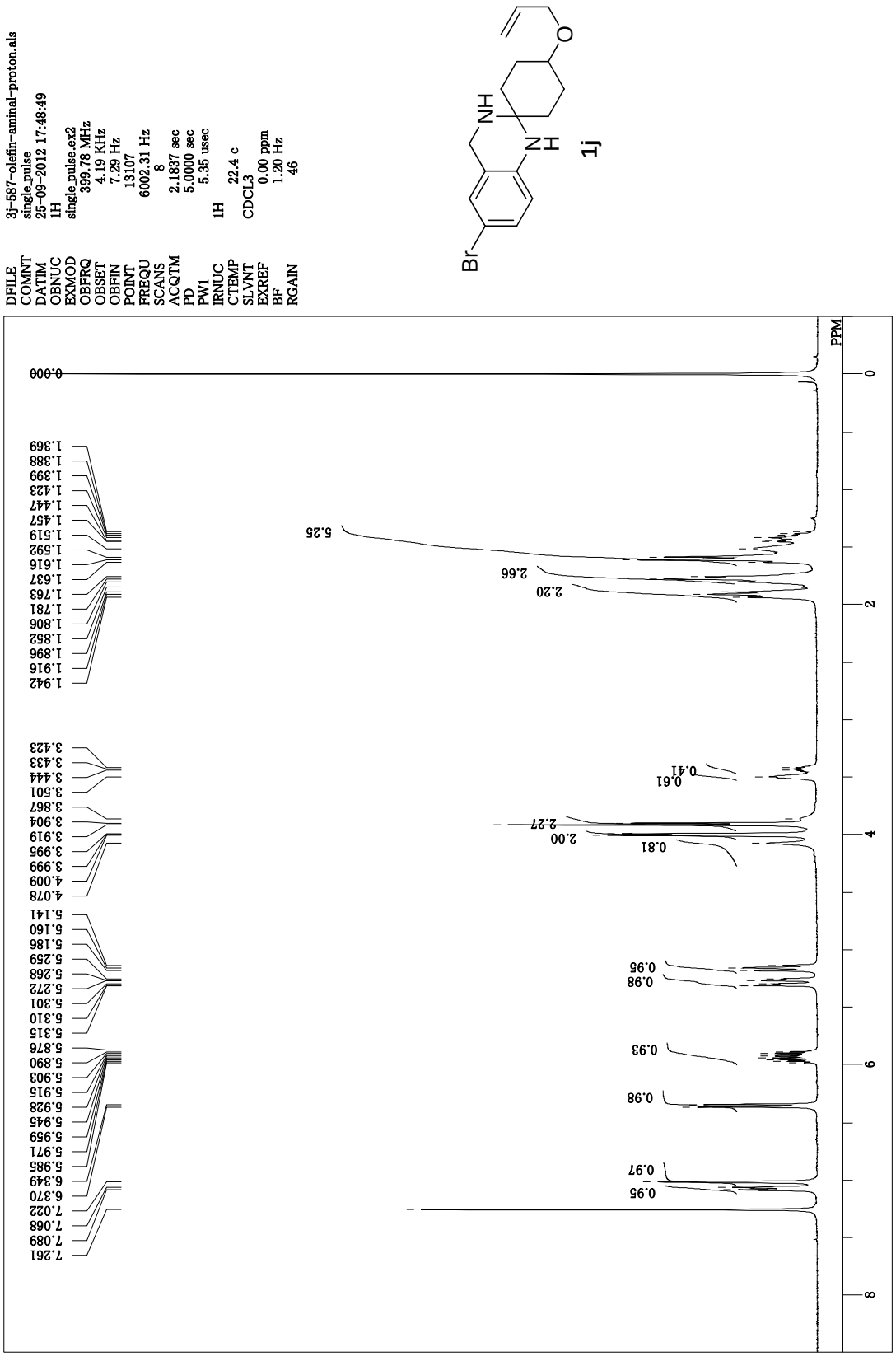
^{1}H NMR spectrum of **1i**



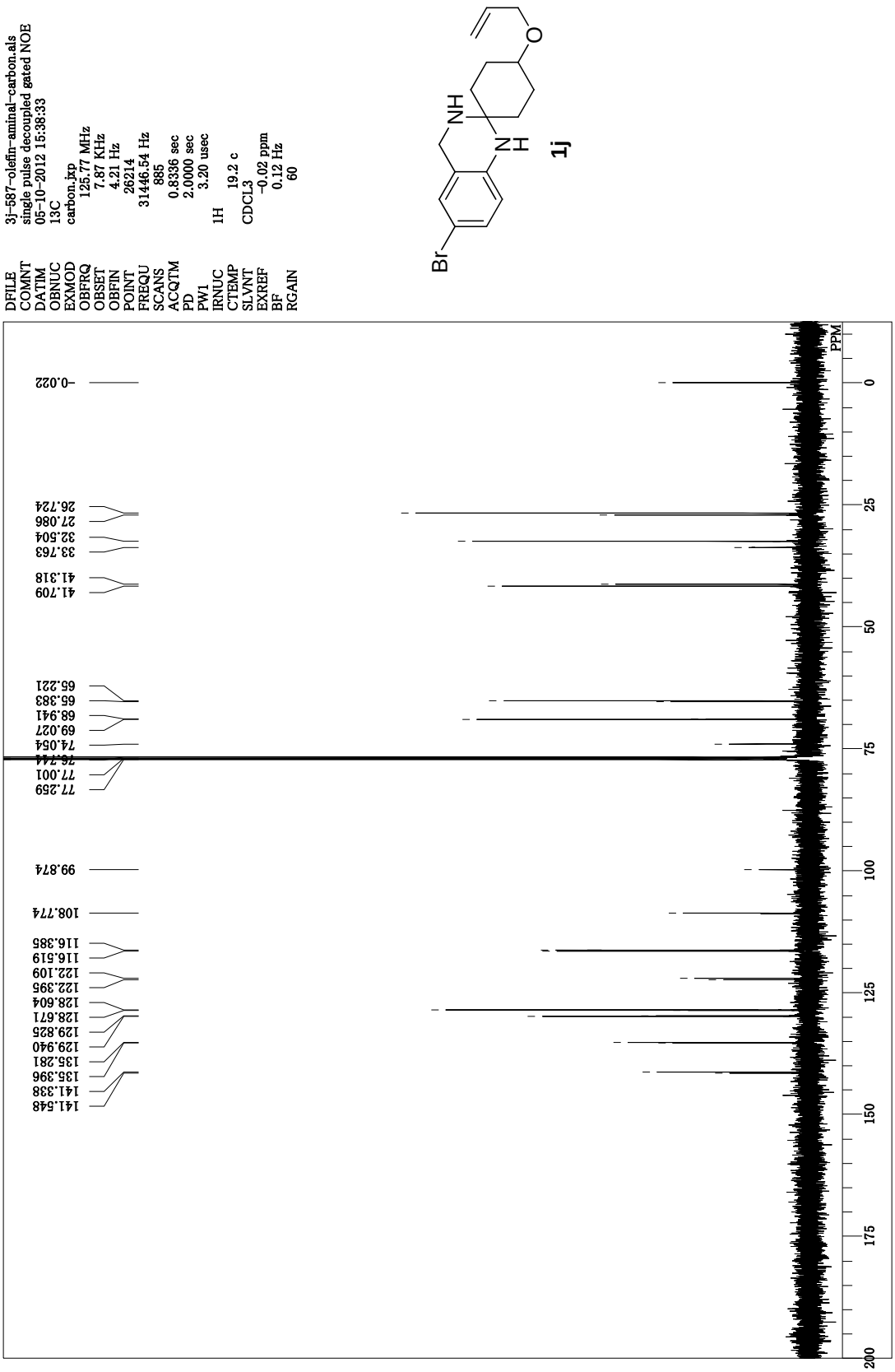
^{13}C NMR spectrum of **1i**



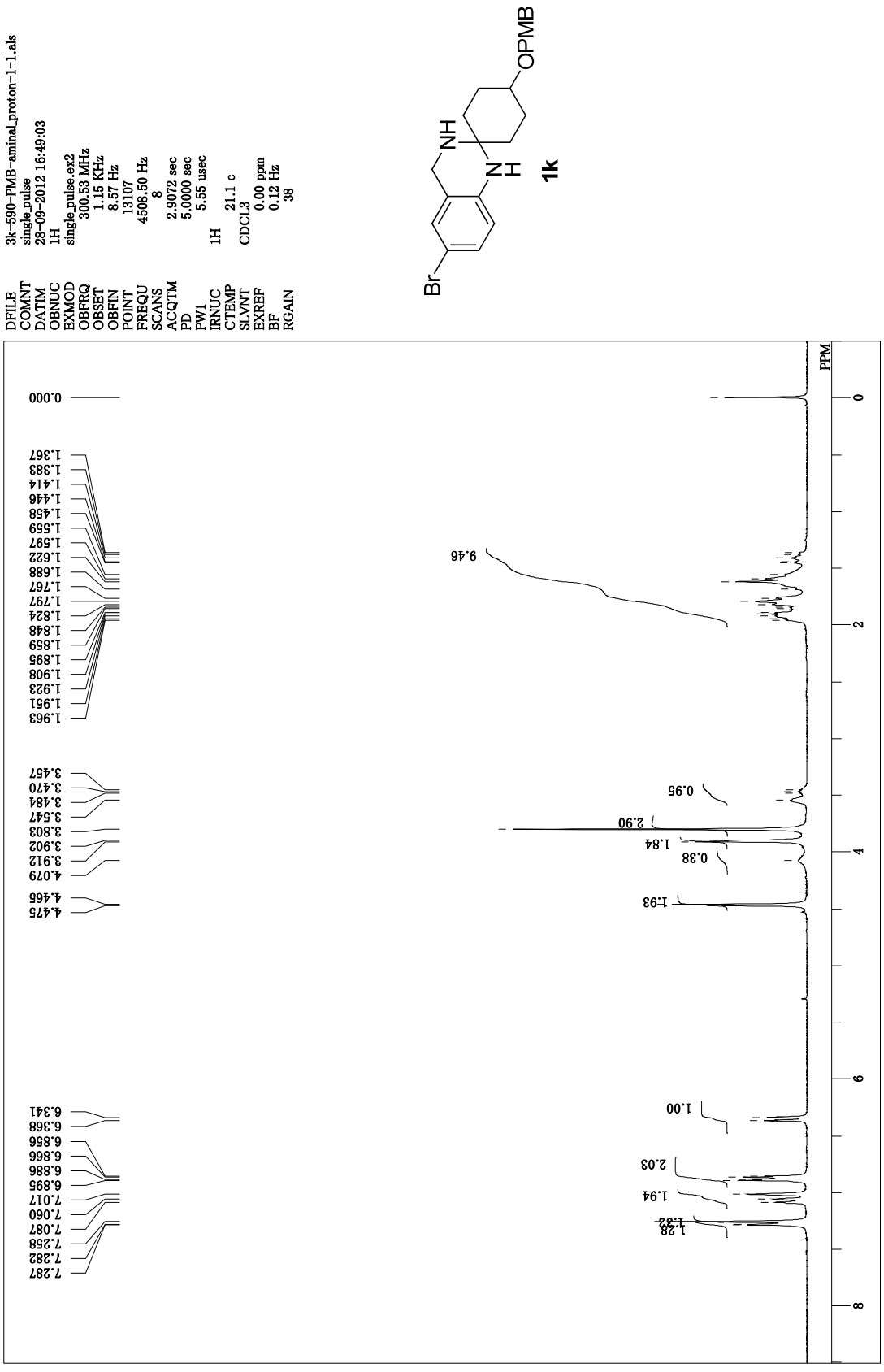
^{1}H NMR spectrum of **1j**



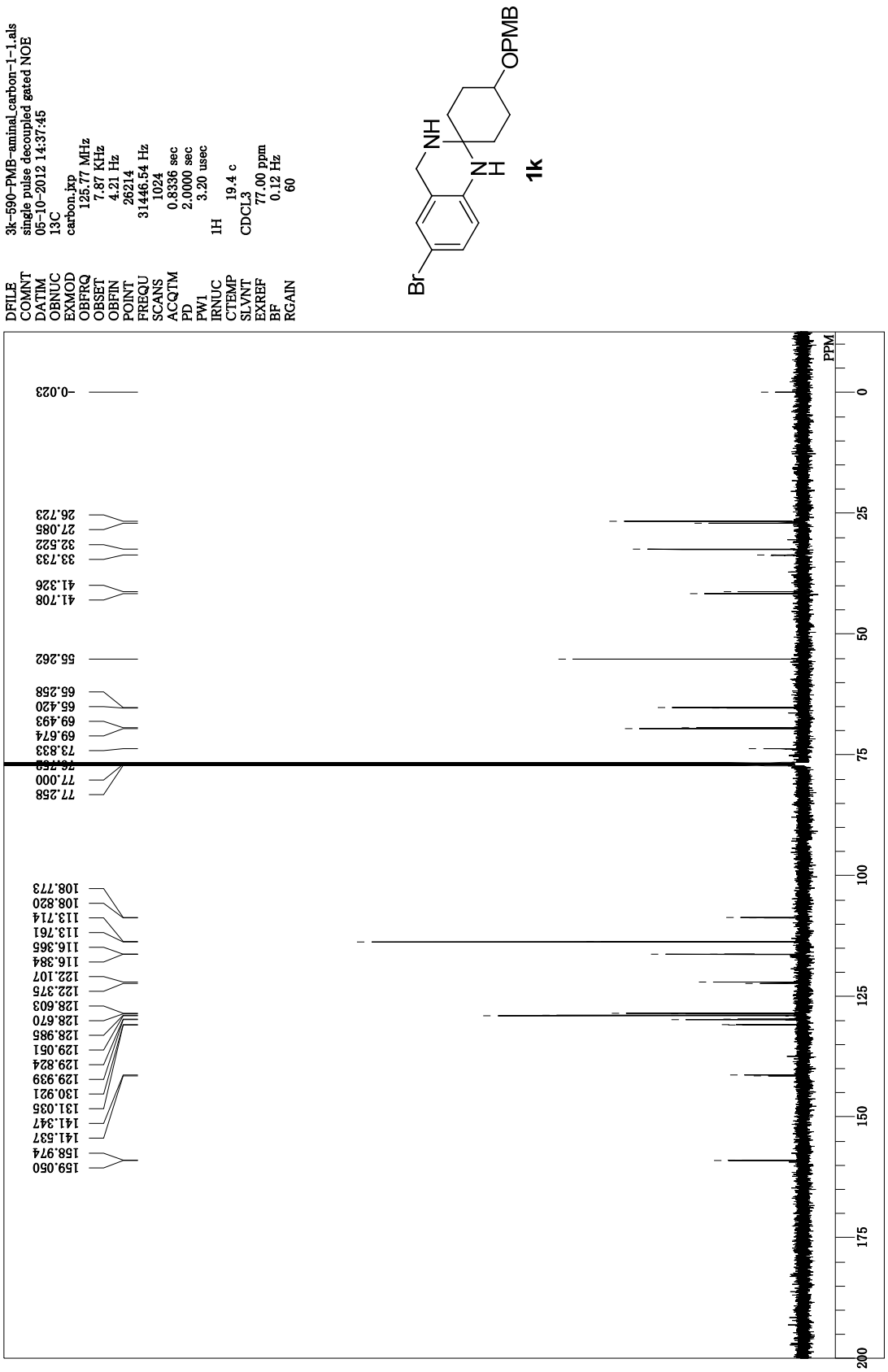
^{13}C NMR spectrum of **1j**



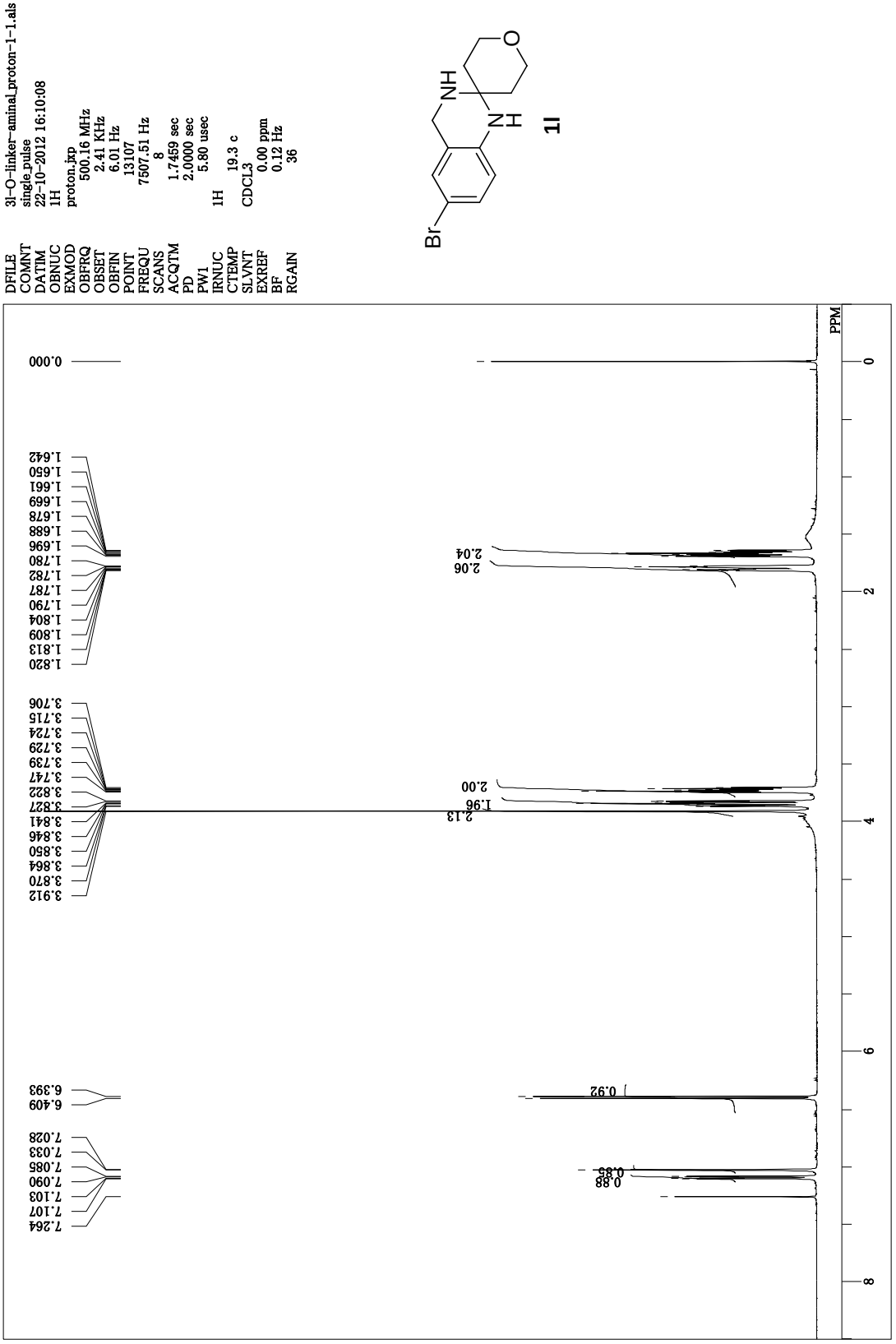
^{1}H NMR spectrum of **1k**



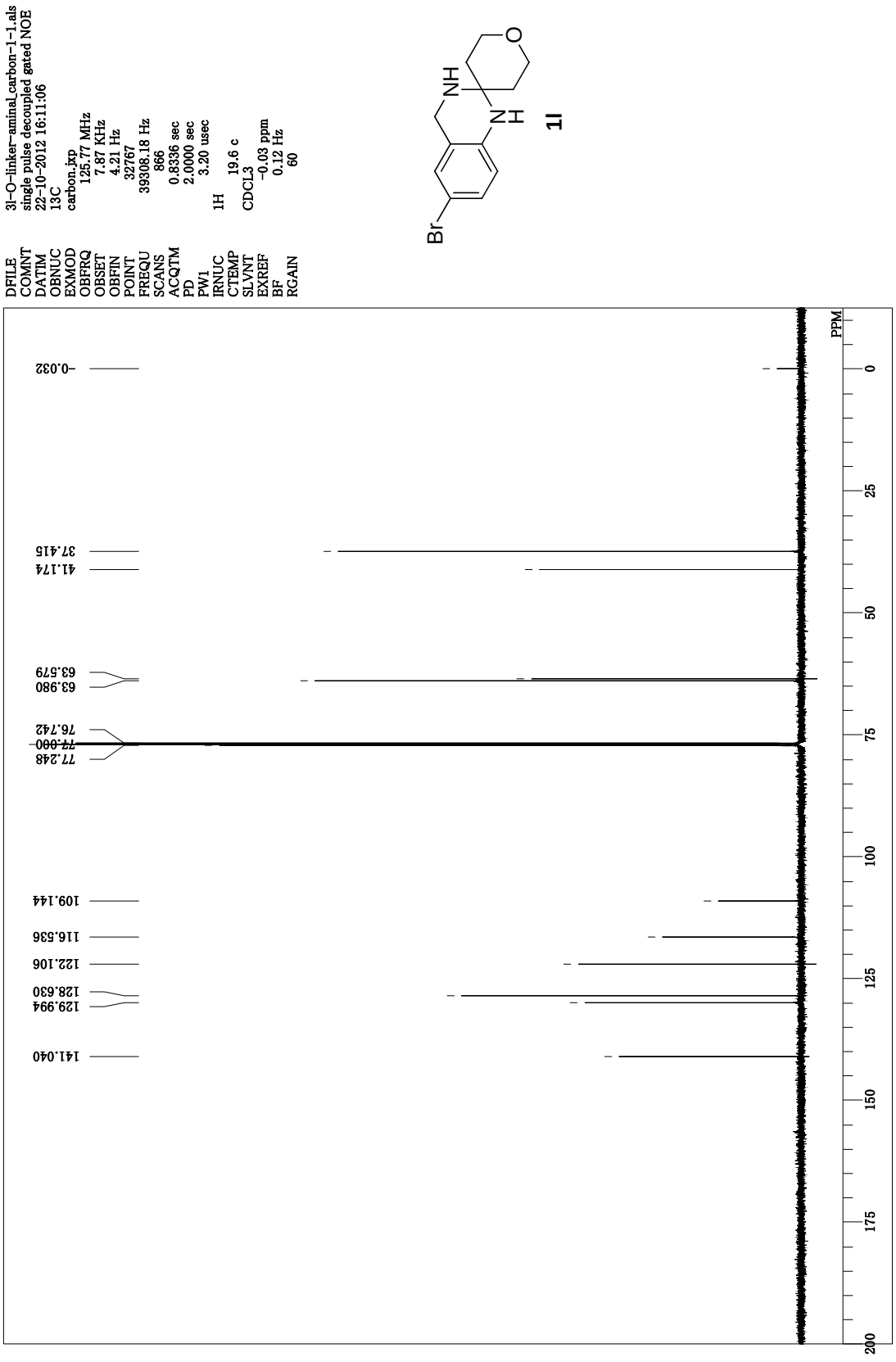
^{13}C NMR spectrum of **1k**

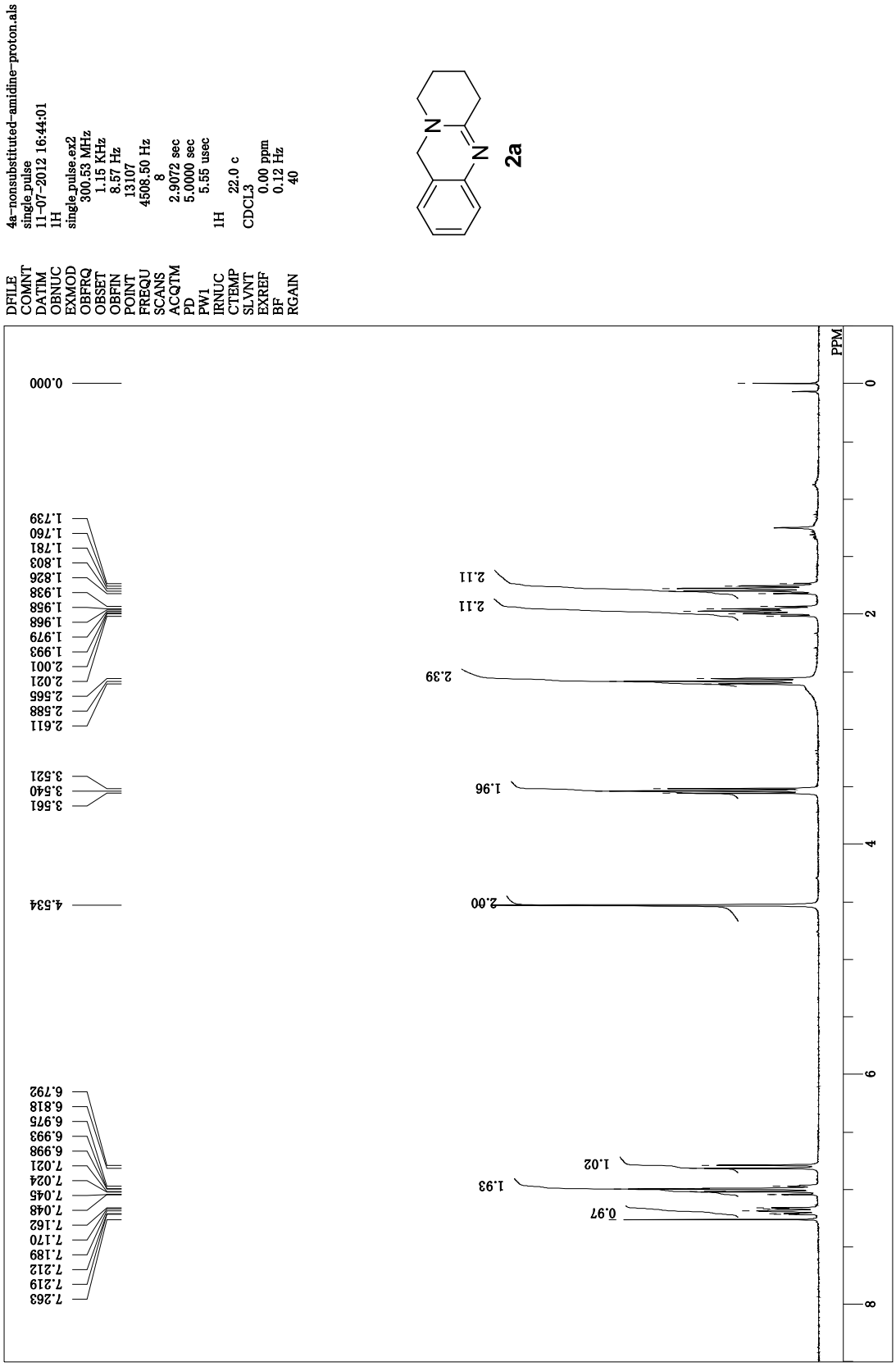


^{1}H NMR spectrum of **11**



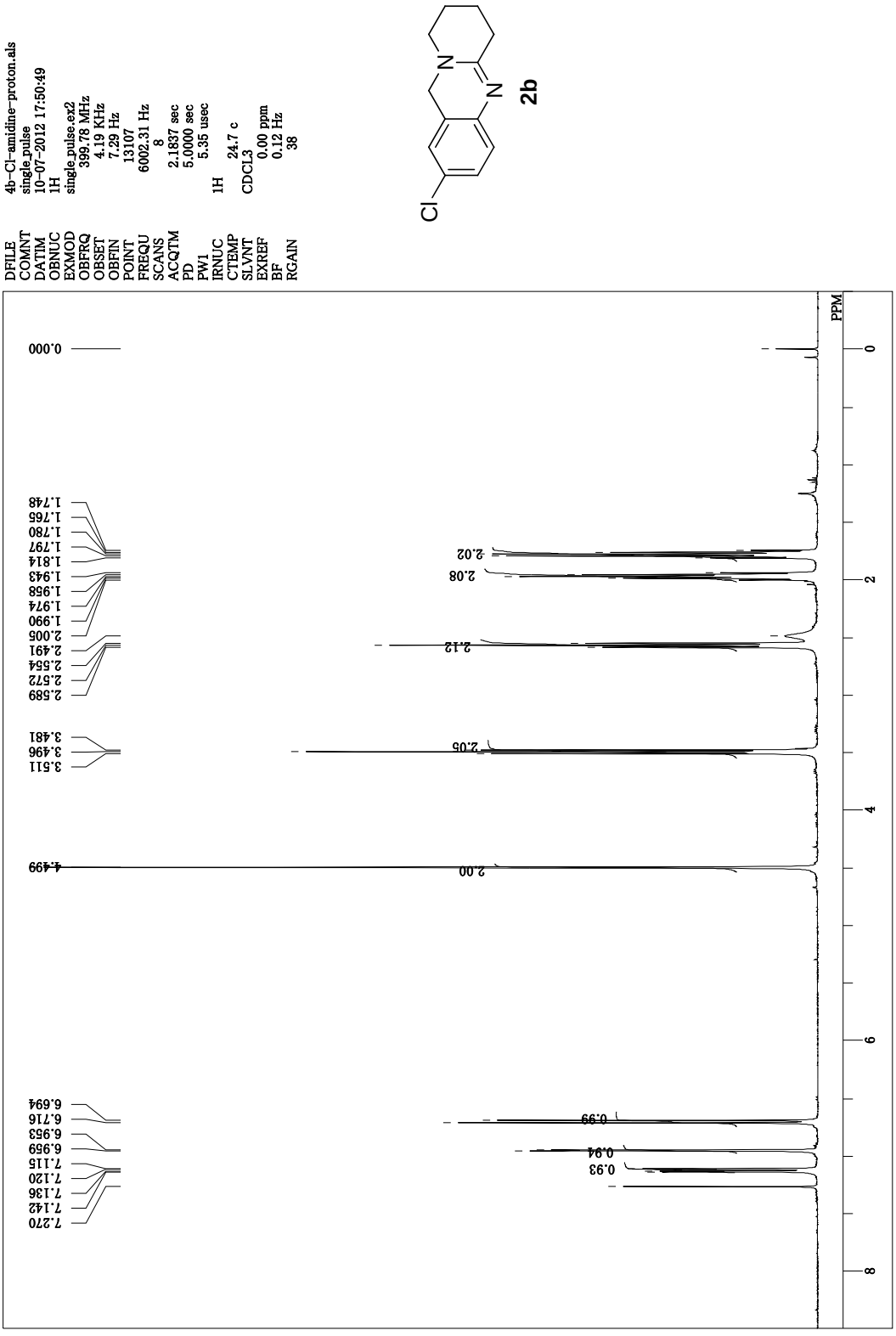
^{13}C NMR spectrum of **1l**



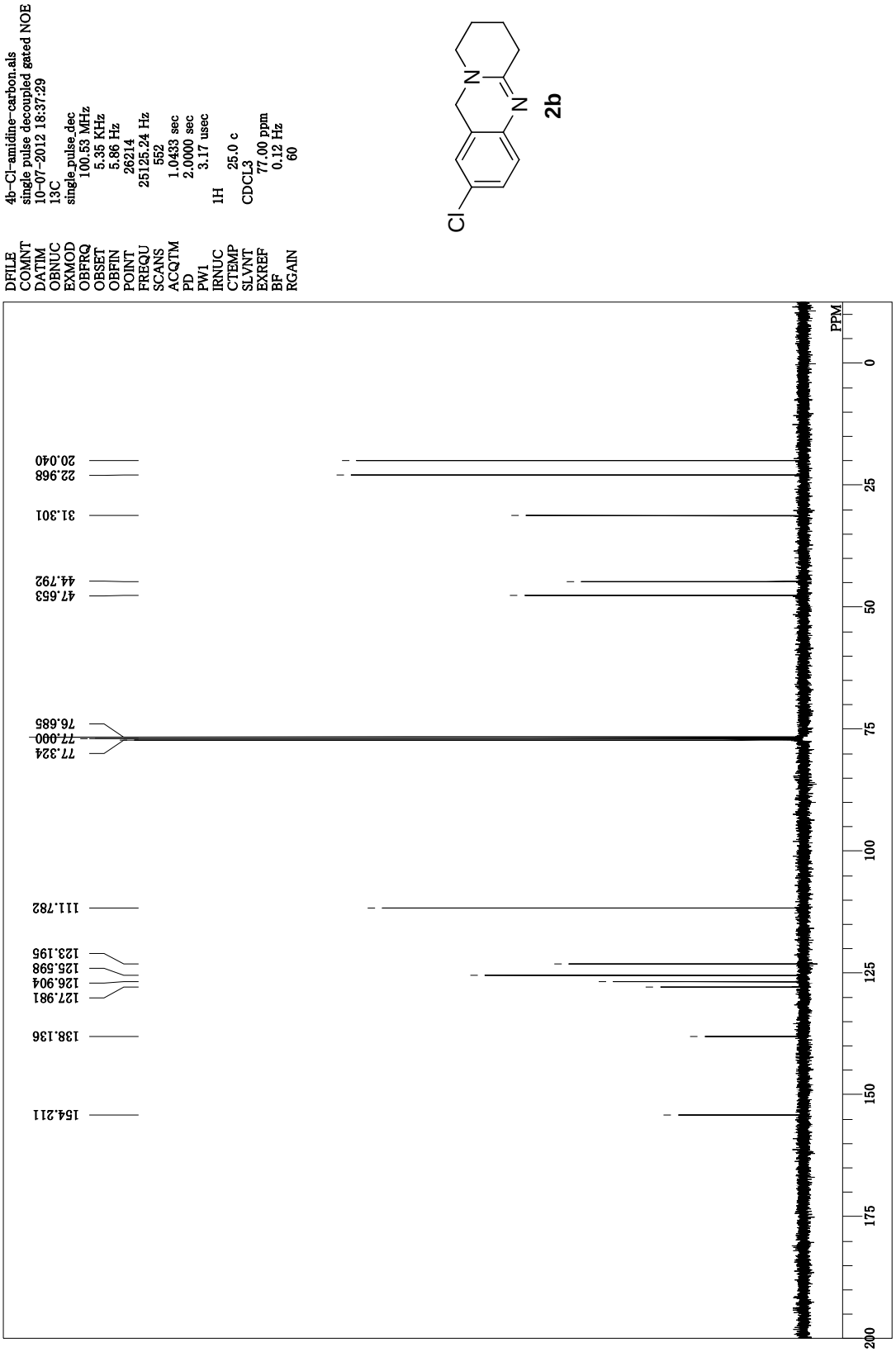


^{1}H NMR spectrum of **2a**

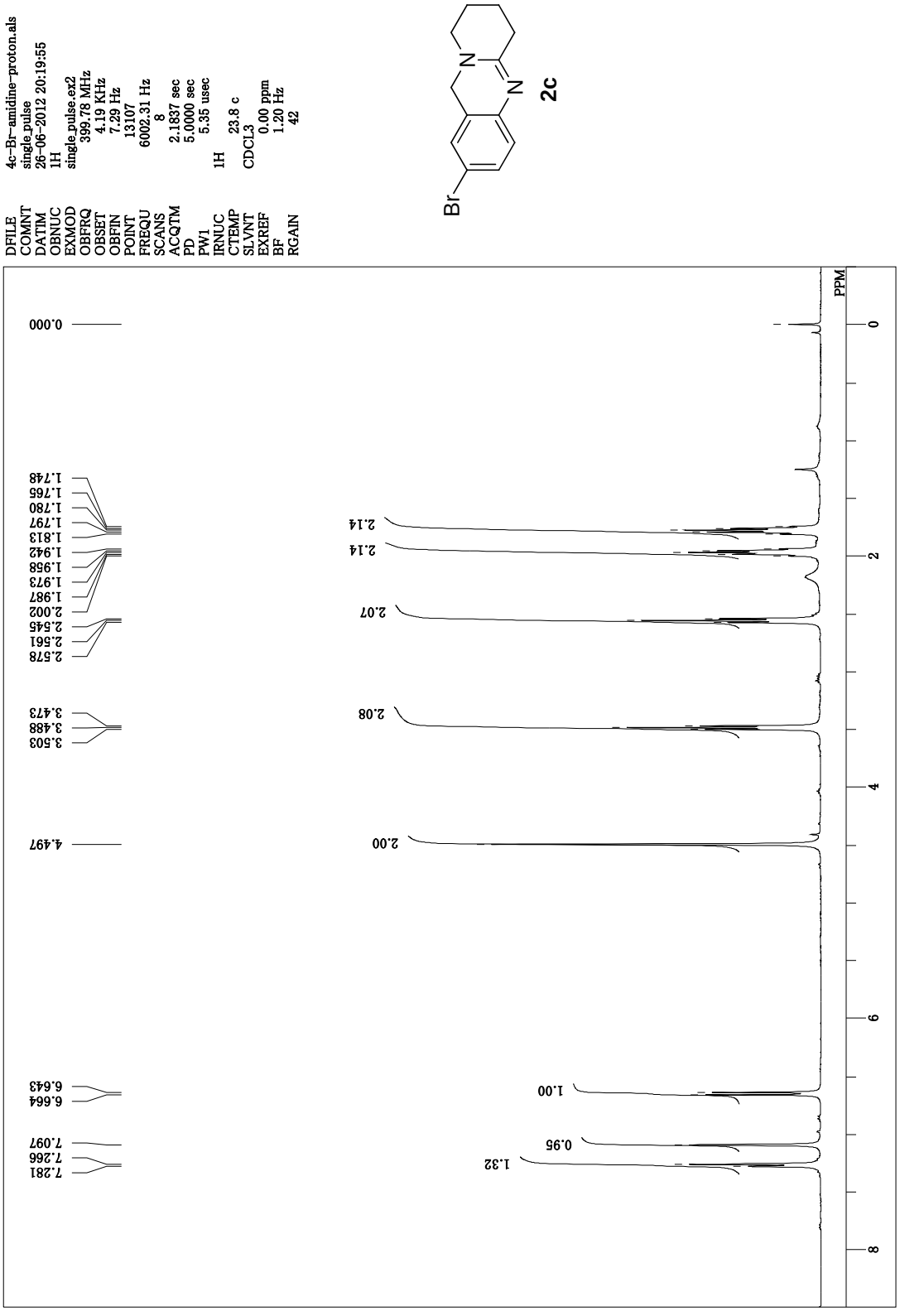
^{1}H NMR spectrum of **2b**



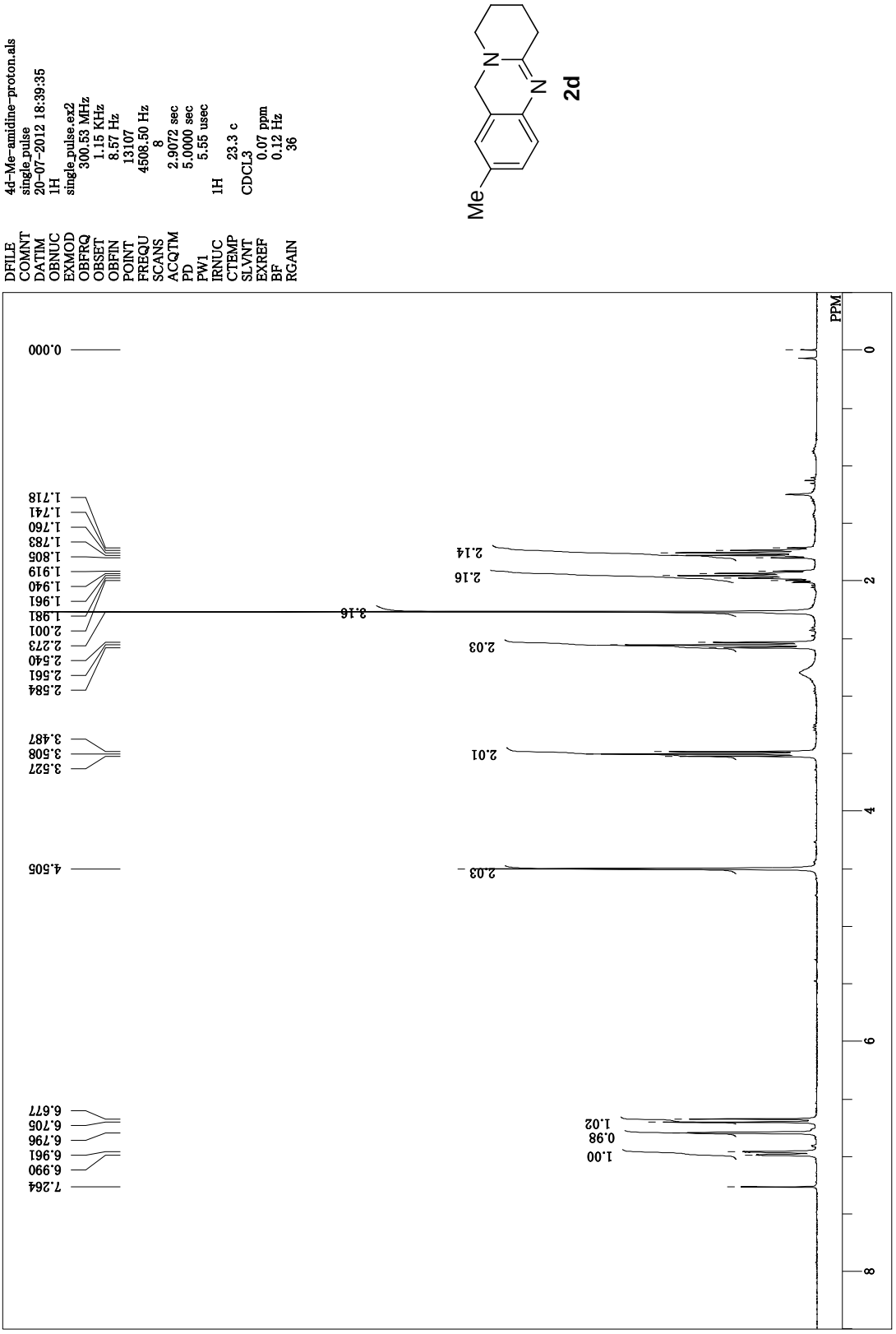
^{13}C NMR spectrum of **2b**



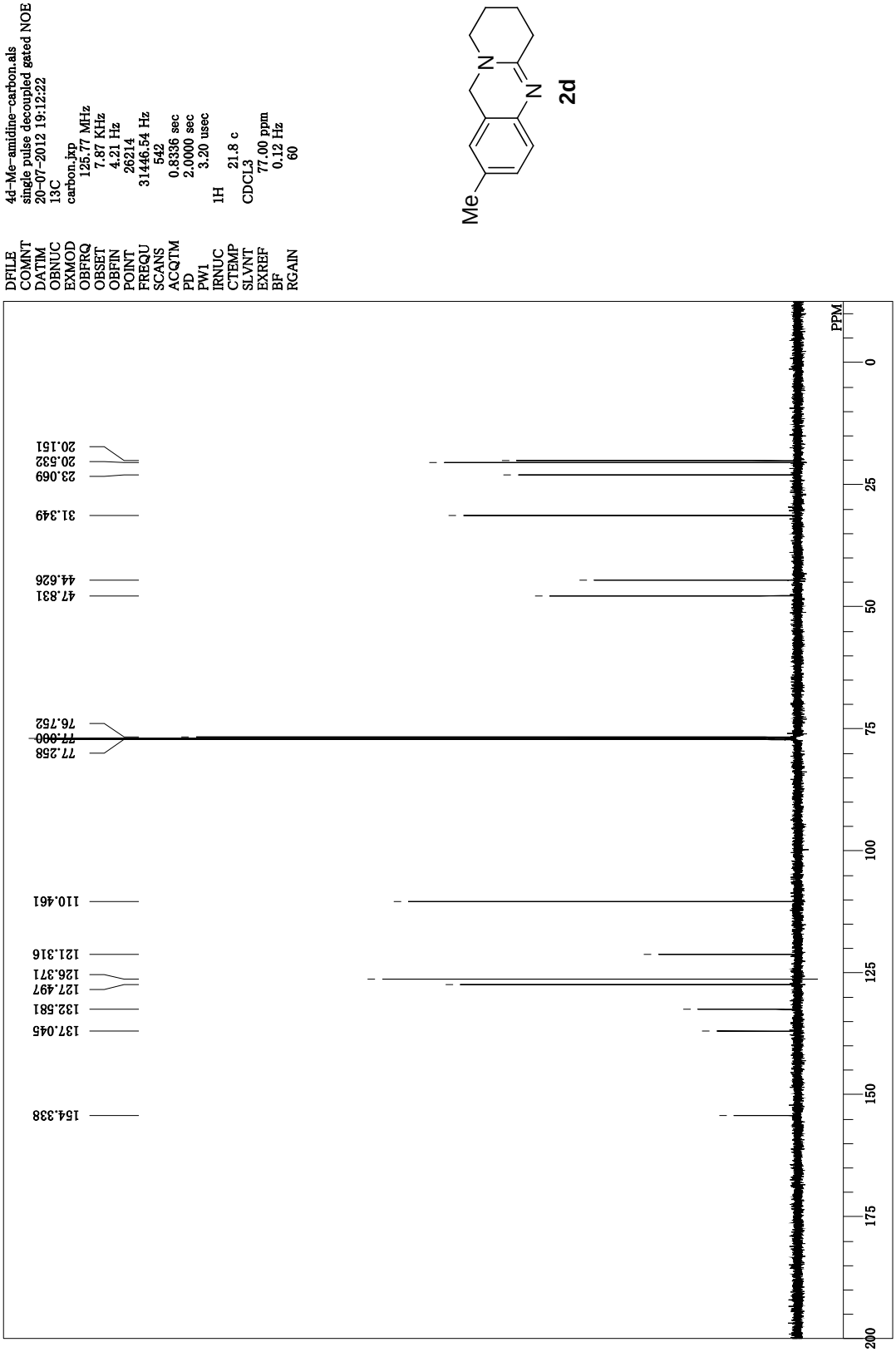
^{1}H NMR spectrum of **2c**



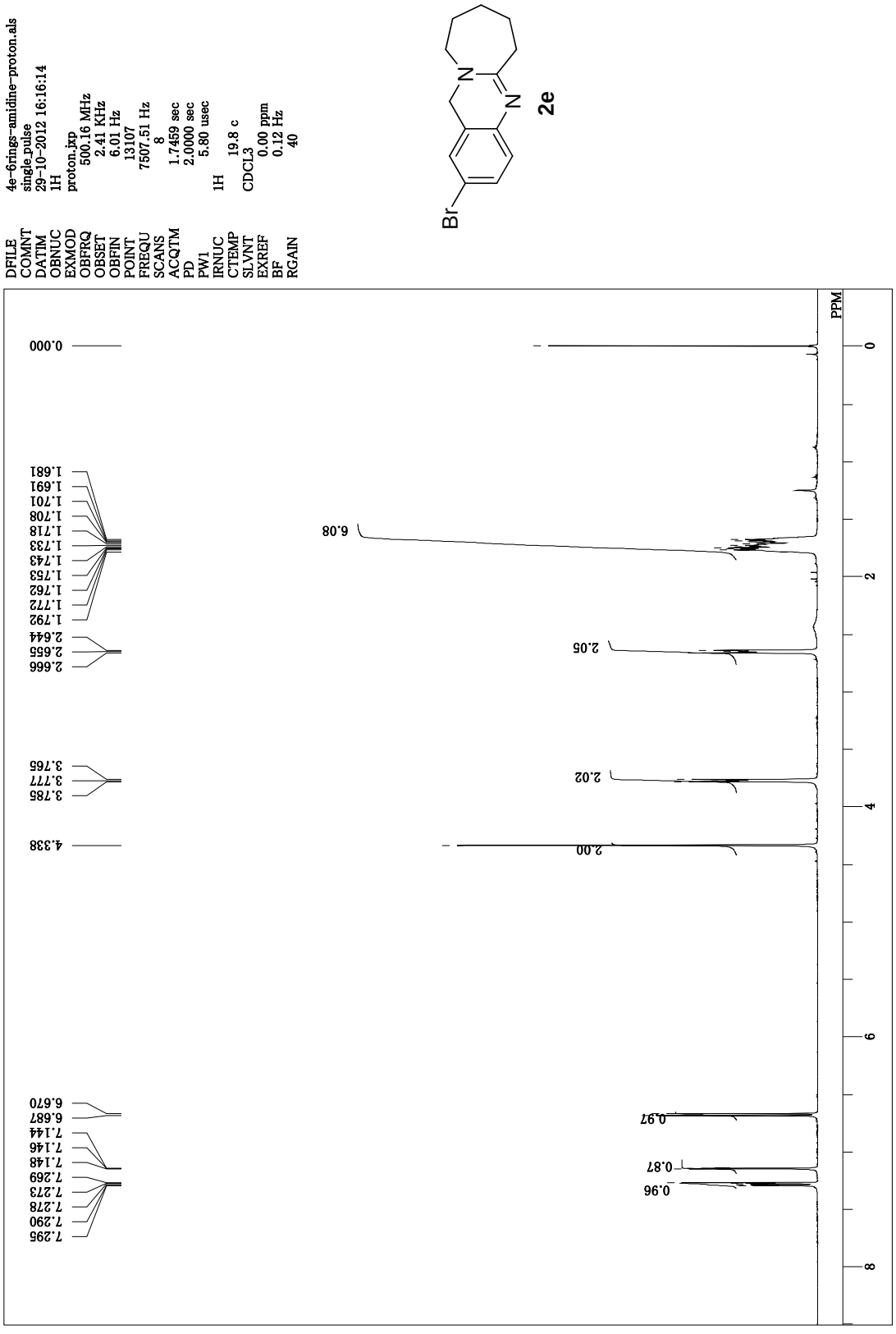
^{1}H NMR spectrum of **2d**



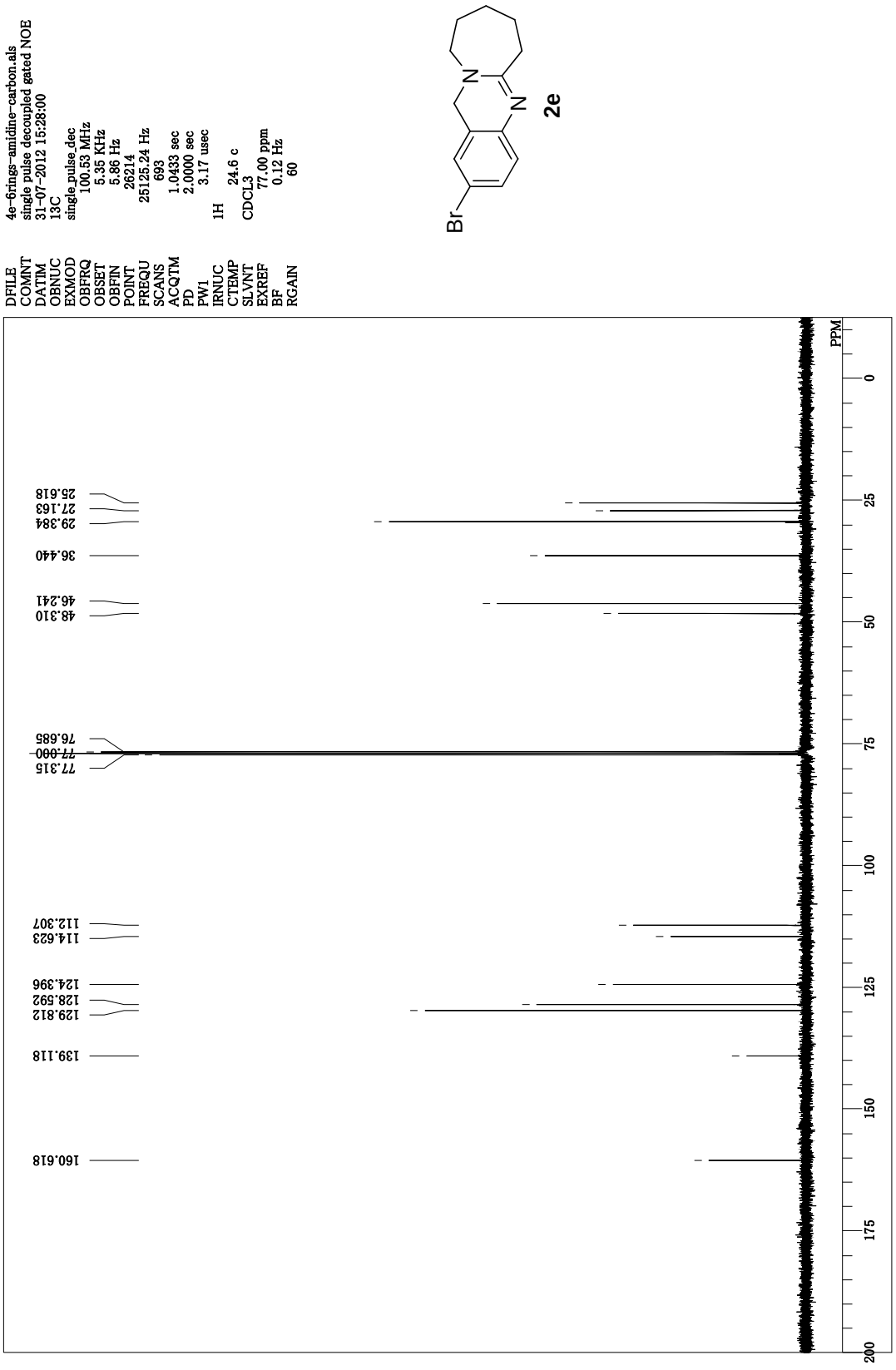
^{13}C NMR spectrum of **2d**



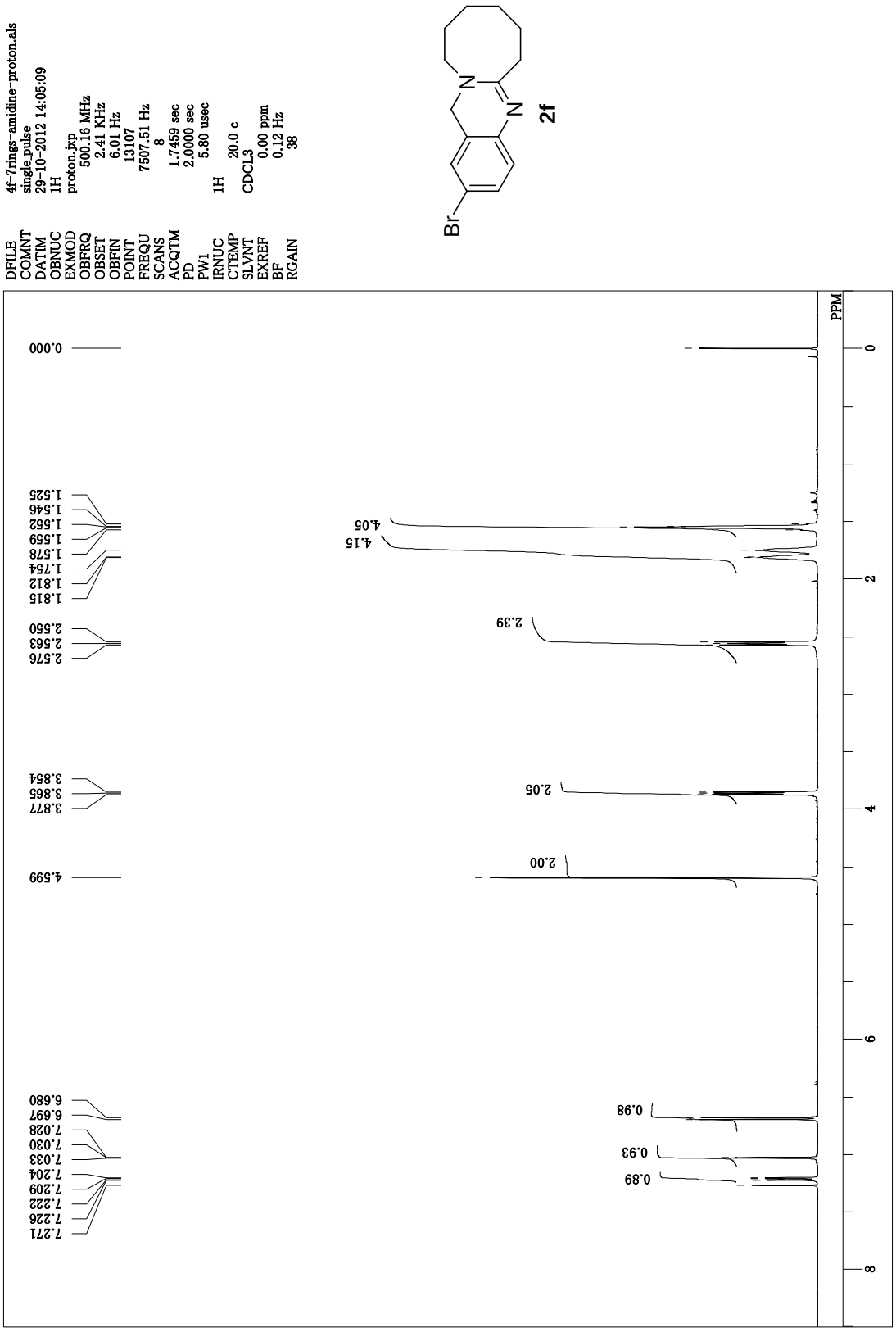
^{1}H NMR spectrum of **2e**



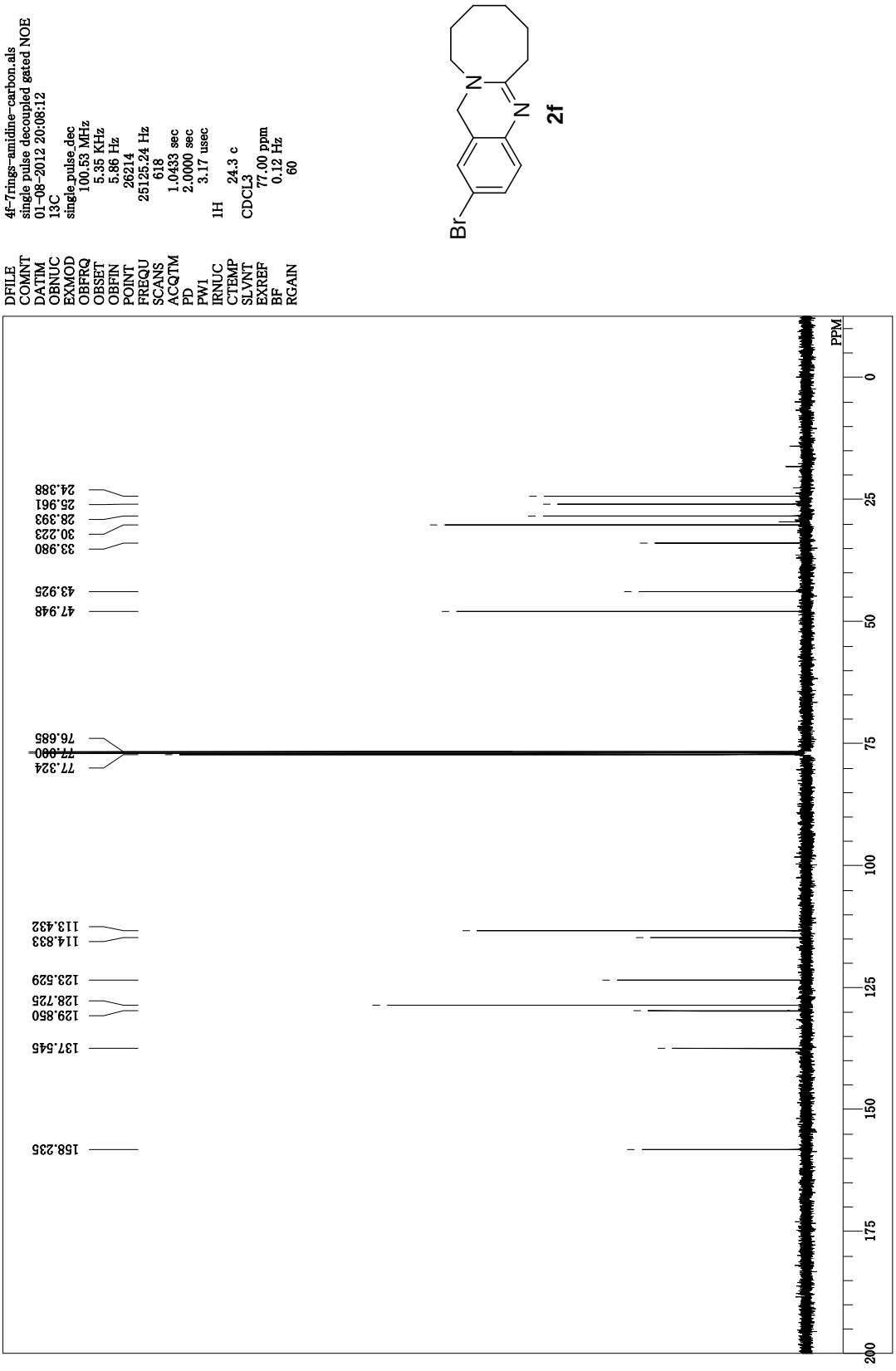
^{13}C NMR spectrum of **2e**



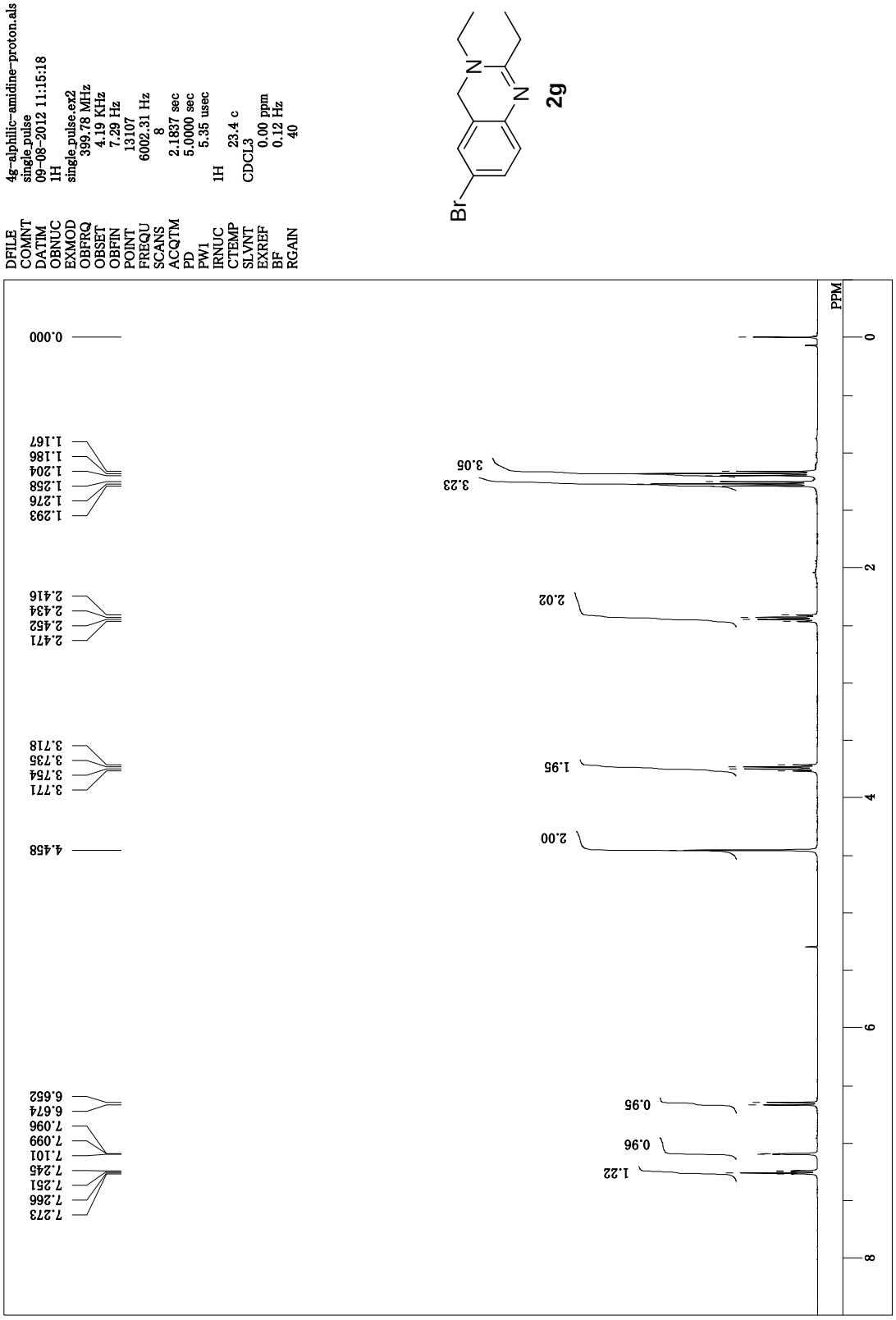
^{1}H NMR spectrum of **2f**



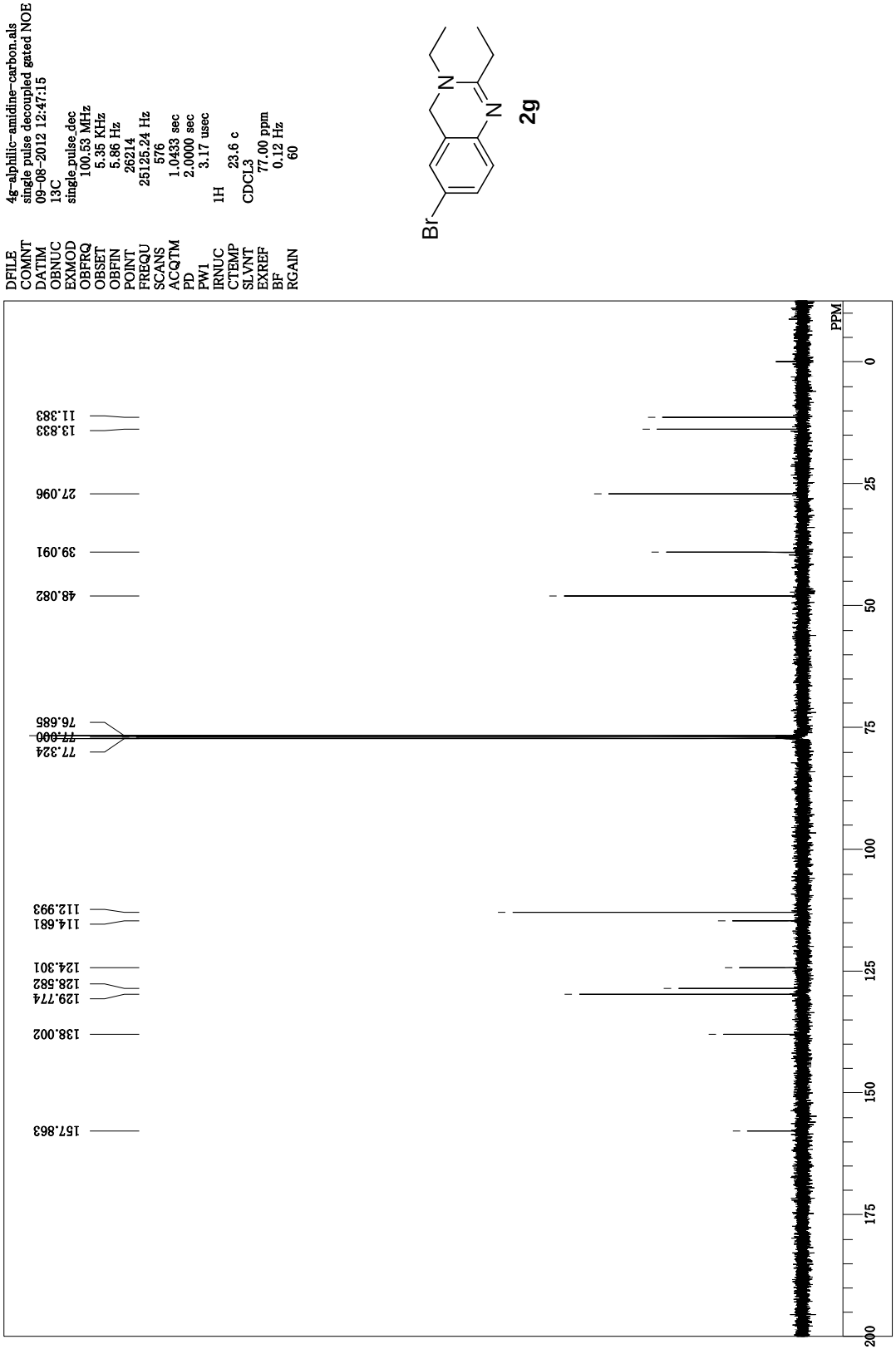
^{13}C NMR spectrum of **2f**



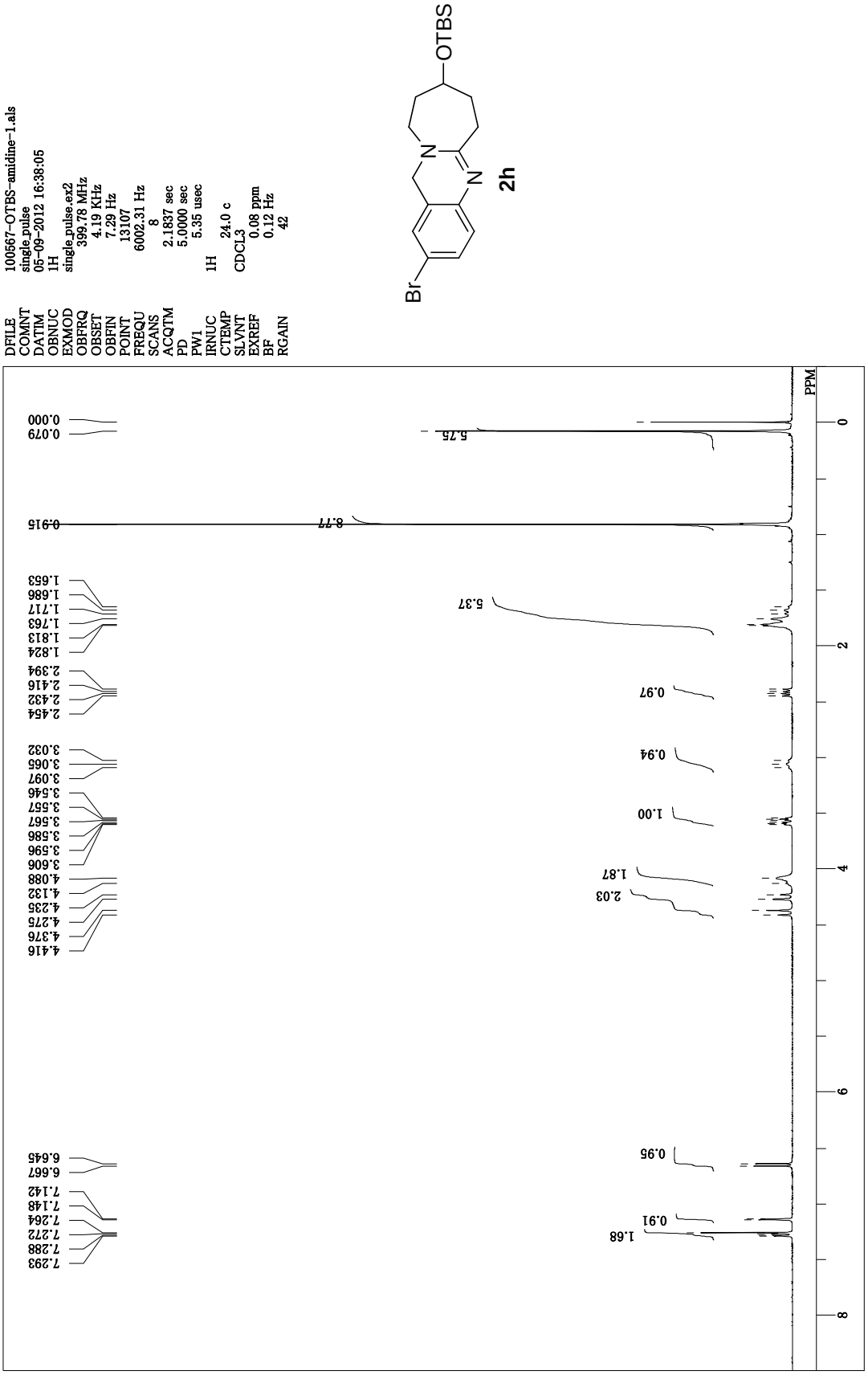
^{1}H NMR spectrum of **2g**



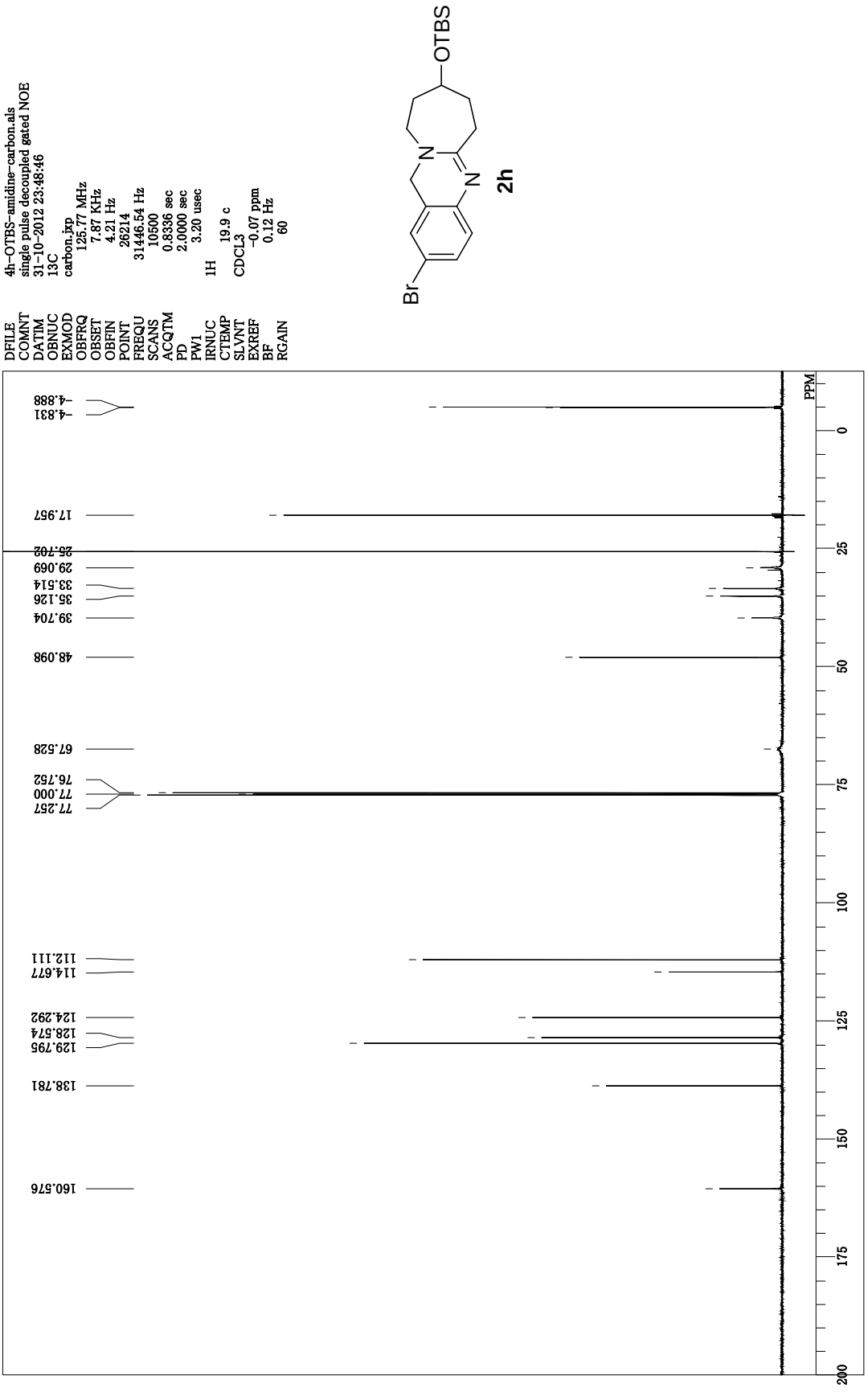
^{13}C NMR spectrum of **2g**



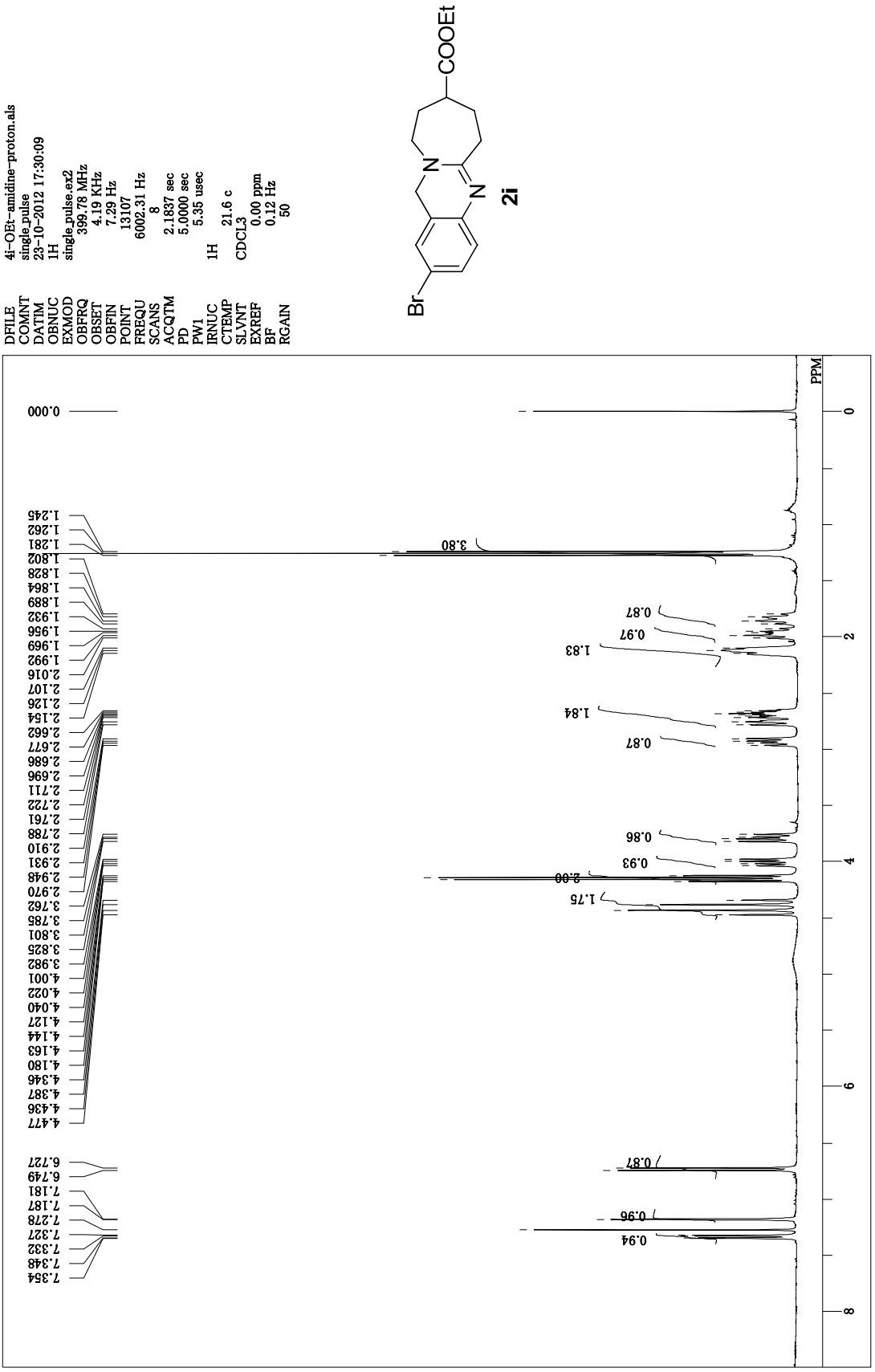
^{1}H NMR spectrum of **2h**



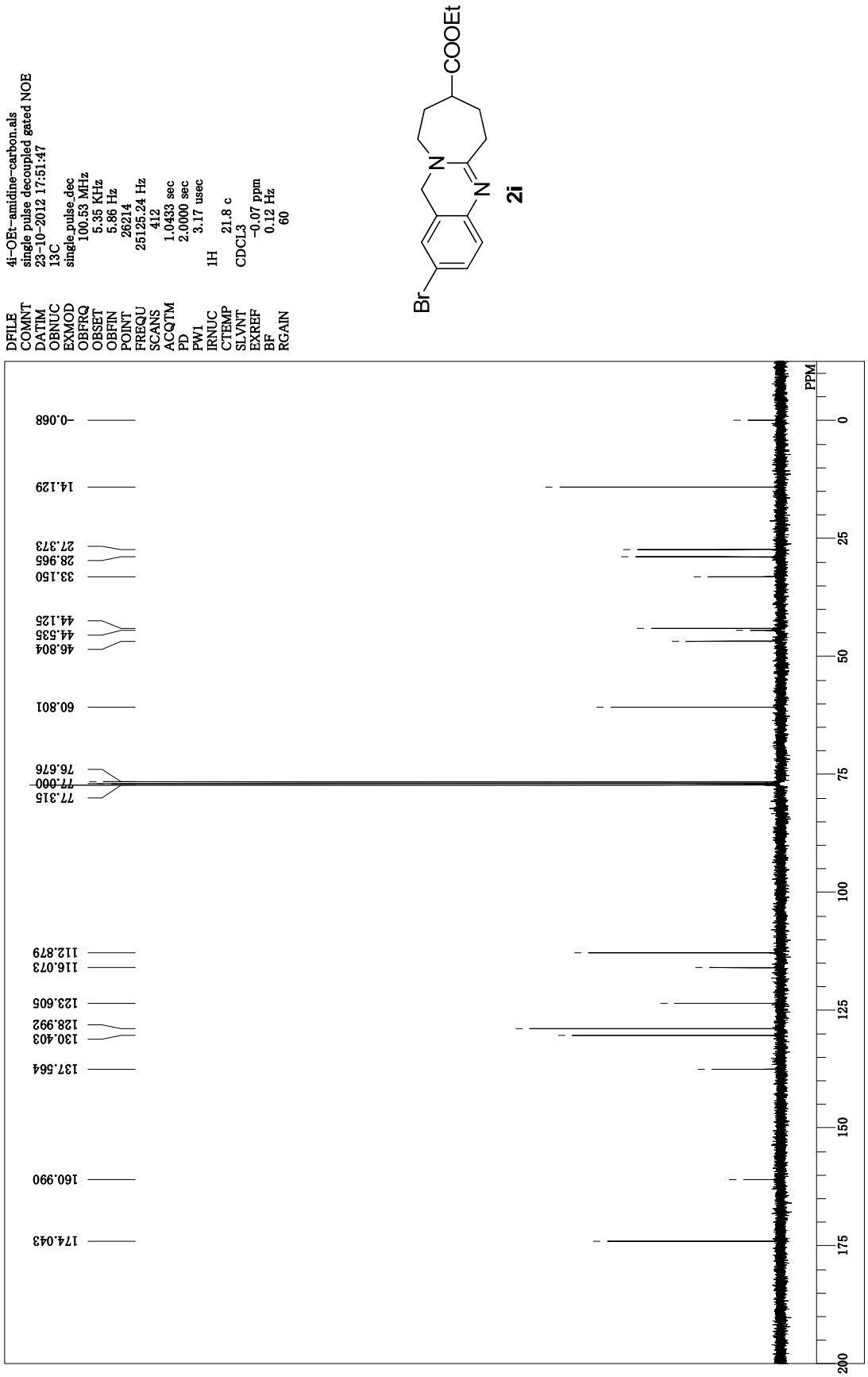
^{13}C NMR spectrum of **2h**



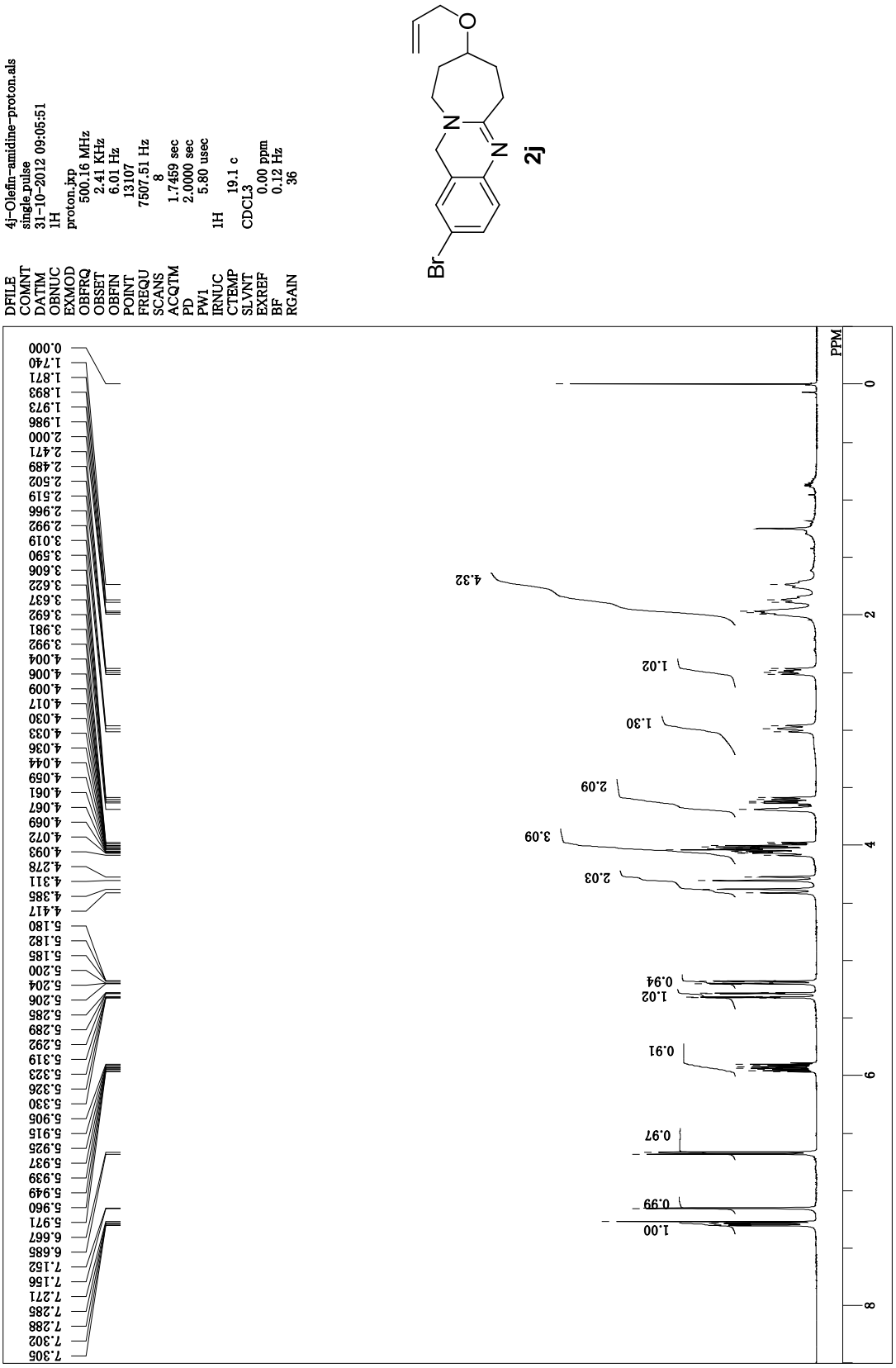
^{1}H NMR spectrum of **2i**



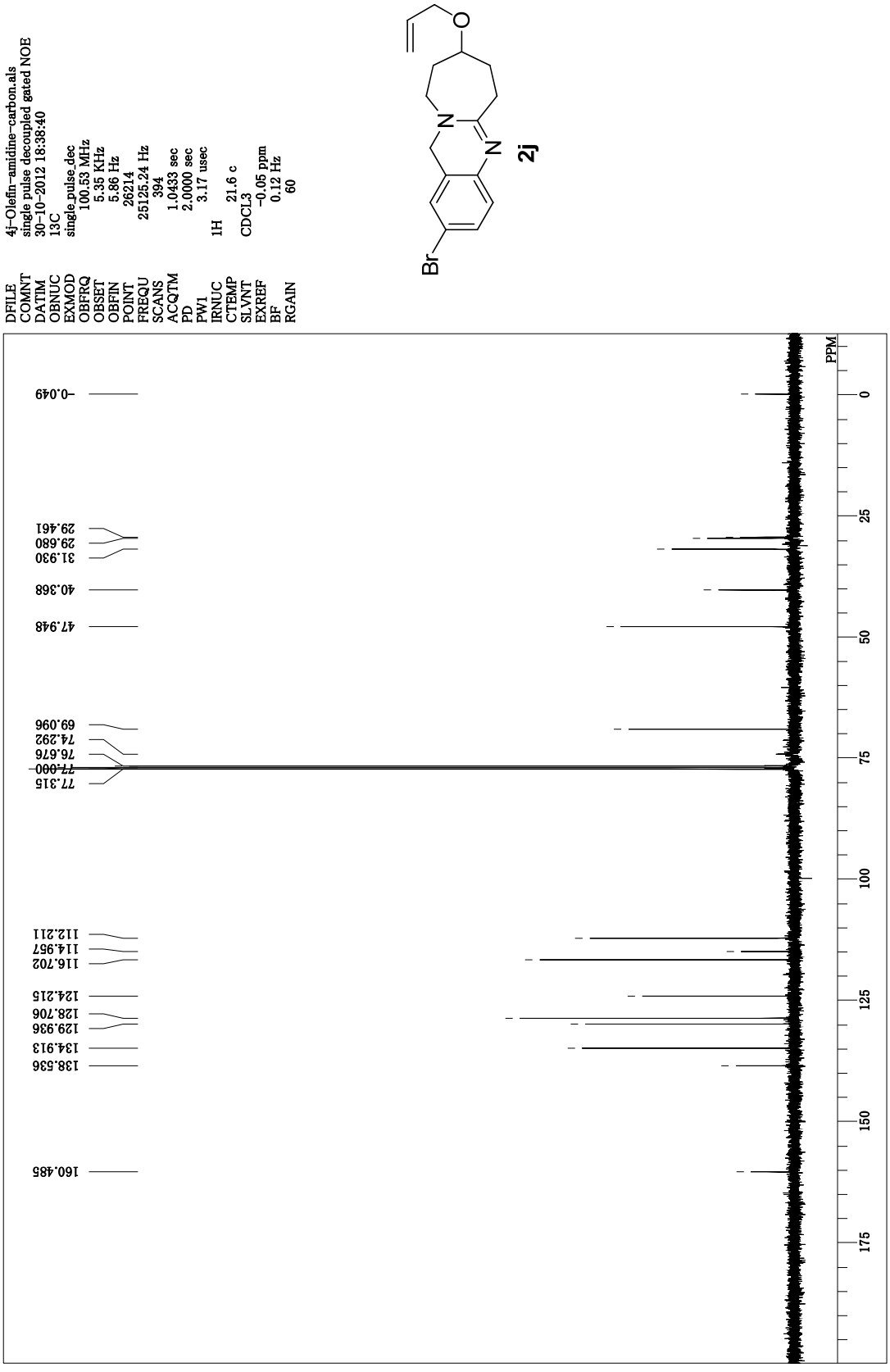
^{13}C NMR spectrum of **2i**



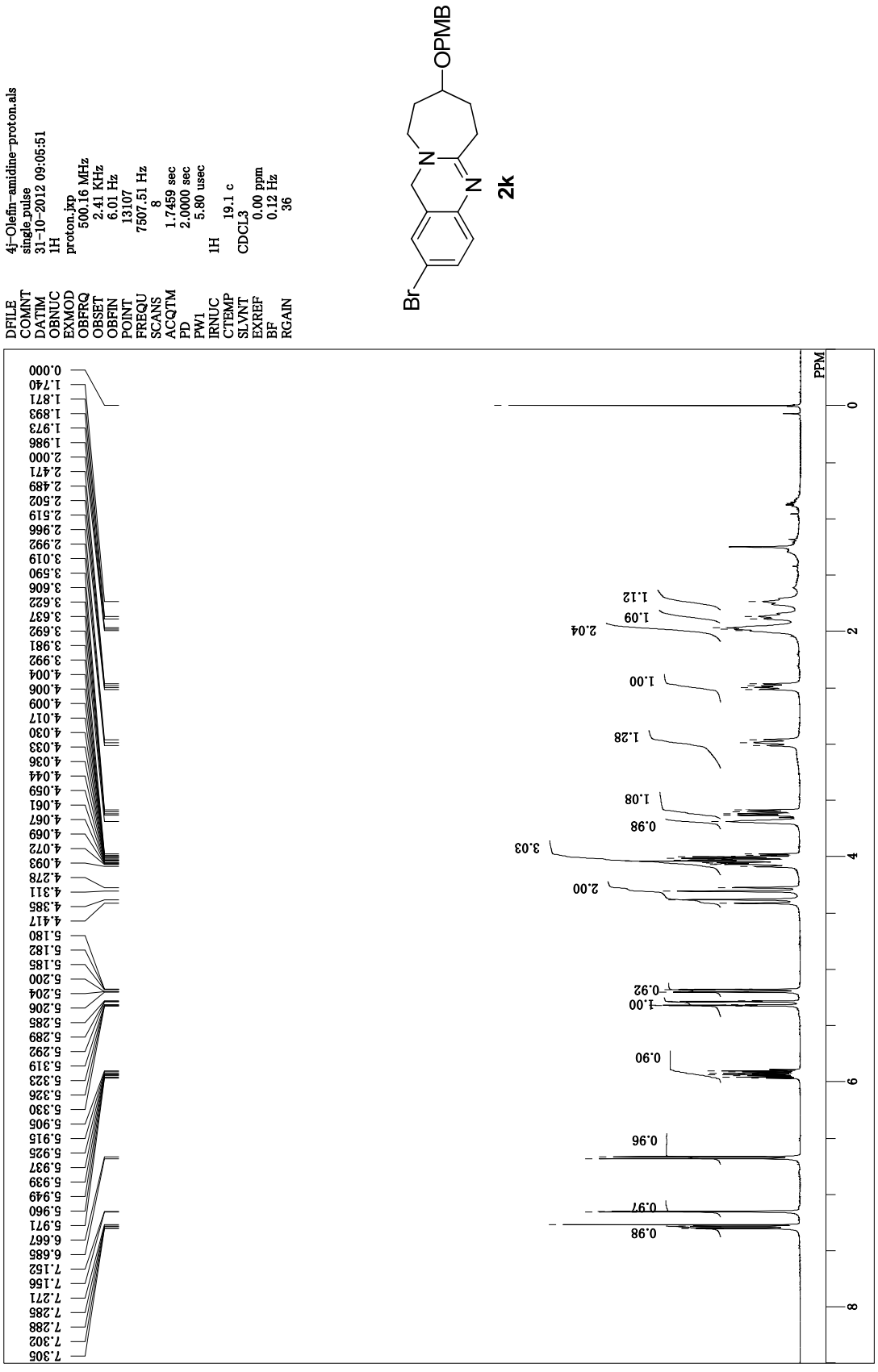
^{1}H NMR spectrum of **2j**



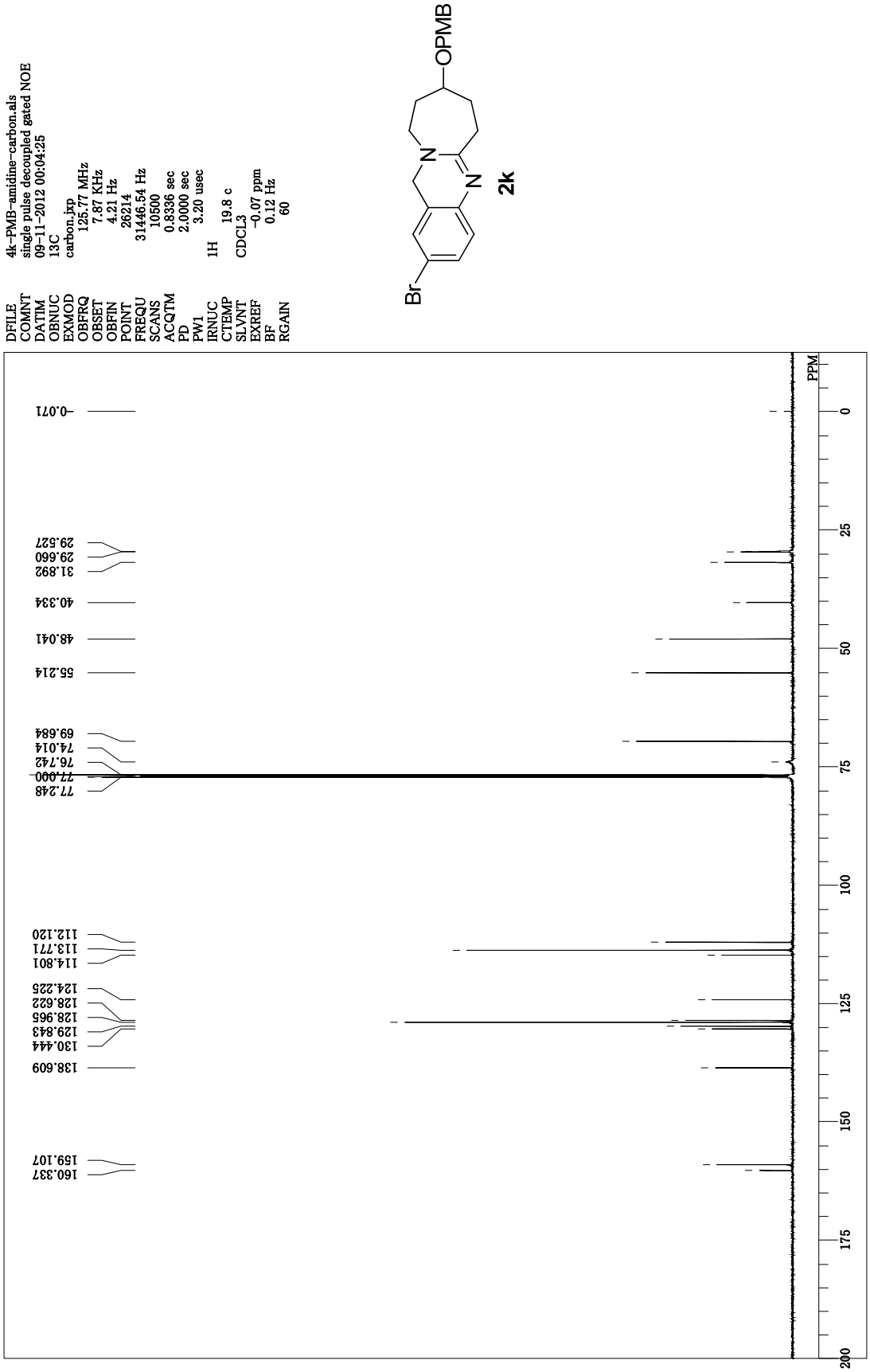
^{13}C NMR spectrum of **2i**



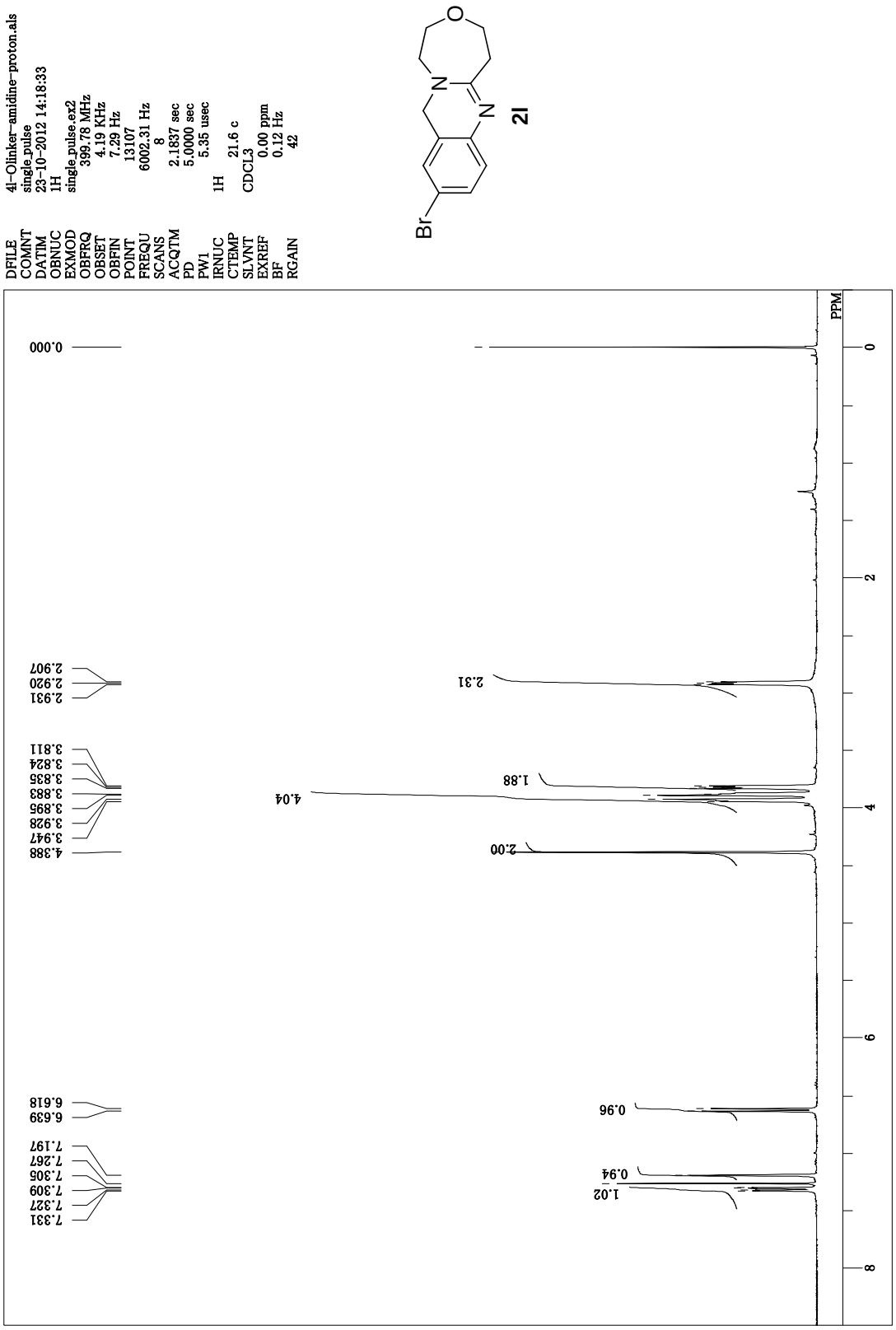
^{1}H NMR spectrum of **2k**



^{13}C NMR spectrum of **2k**



^{1}H NMR spectrum of **2l**



^{13}C NMR spectrum of **2l**