

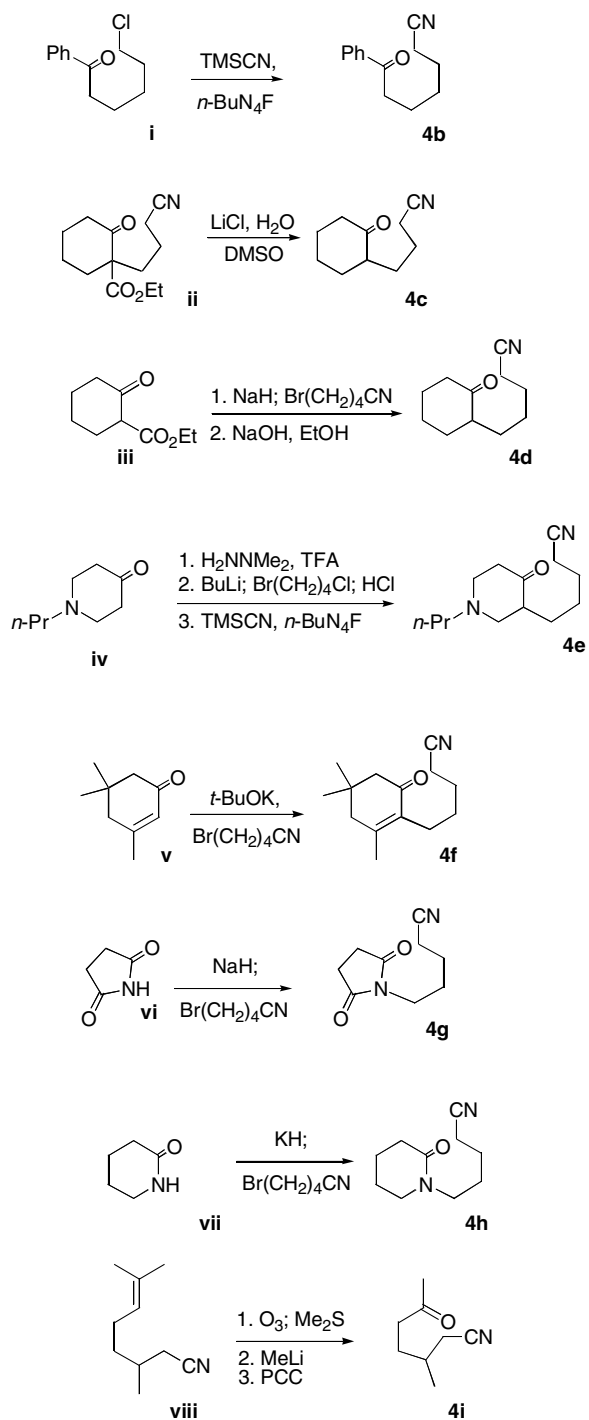
Cyclic Alkenenitriles: Chemoselective Oxonitrile Cyclizations

Fraser F. Fleming,* Lee A. Funk, Ramazan Altundas, and Vaqar Sharief.

Supporting Information Table of Contents

Compound	Procedure	¹ H NMR	¹³ C NMR
4b	S3	Reference	Reference
4c	S3	S13	S14
ethyl 1-(3-cyanopropyl)-2-oxocyclohexanecarboxylate (ii)	S4	S15	S16
4d	S4	S17	S18
1-propylpiperidin-4-one	S5	S19	S20
dimethylhydrazone			
3-(4-Chlorobutyl)-1-propylpiperidin-4-one	S5	S21	S22
4e	S5	S23	S24
4f	S5	S25	S26
4g	S6	S27	S28
4h	S6	S29	S30
3-methyl-6-oxo-hexanenitrile	S7	S31	S32
3-methyl-6-hydroxyheptane nitrile	S7	S33	S34
4i	S8	S35	S36 (CDCl ₃) S37 (DMSO-d ₆)
7a	S8	S38	S39
5-isopropenyl-2-methylcyclopent-1-ene-1-carboxamide	S9	S40	S41
7b	S9	S42	S43
7c	S9	S44	S45
7d	S9	S46	S47
6d	S9	S48	S49
7e	S10	S50	S51
7f	S10	S52	S53
7g	S11	Reference	S54
7h	S11	Reference	Reference
11i	S11	S55	S56
References	S57		

The cyclization precursors **4b – h** were prepared as outlined in the following scheme:



Preparation of Cyclization Precursors

7-Oxo-7-phenylheptanenitrile (4b): A THF solution of *n*-Bu₄NF (0.72 mmol), and neat trimethylsilyl cyanide¹ (0.72 mmol), were sequentially added to an acetonitrile solution of 6-chloro-1-phenylhexan-1-one² (100.7 mg, 0.48 mmol). After 16 h the reaction was diluted with water and CH₂Cl₂, the organic phase was separated, washed with water (3x), and then dried (Na₂SO₄). The resulting solution was concentrated under reduced pressure and then purified by radial chromatography (1:99 EtOAc/hexanes, 1 mm plate) to afford 65.2 mg (68%) of **4b** as a white solid that was spectrally identical to material previously synthesized.³

4-(2-Oxocyclohexyl)butanenitrile (4c): A DMSO (5 mL) solution of ethyl 1-(3-cyanopropyl)-2-oxocyclohexanecarboxylate (**ii**)⁴ (1.00 g, 2.88 mmol), H₂O (62mL, 3.5 mmol), and LiCl (147.0 mg, 3.5 mmol) was refluxed for 6h. After cooling aqueous, saturated NaCl was added and the mixture extracted with EtOAc. The aqueous phase was extracted with EtOAc (3x), and the organic extracts were combined. The combined extracts were dried (Na₂SO₄) and concentrated to afford 450 mg (65%) of pure **4c**⁵ as an oil: IR (film) 2245, 1710 cm⁻¹; ¹H NMR 1.25-2.60 (m, 15H); ¹³C NMR 14.0, 16.7, 22.4, 23.4, 25.6, 27.4, 33.7, 36.0, 40.9, 60.4, 61.2, 119.3, 171.7, 208.0.

5-(2-Oxocyclohexyl)pentanenitrile (4d): Neat ethyl 2-oxocyclohexanecarboxylate (400.0 mg, 2.35 mmol) was added drop wise to a 0 °C, stirred THF (10 mL) slurry of NaH (67.8 mg, 2.83 mmol). Neat bromovaleronitrile (494.2 mg, 3.05 mmol) and solid NaI (70.0 mg, 0.467 mmol) were added and then the reaction was heated at reflux. After 24 h the reaction was allowed to cool, saturated, aqueous NH₄Cl was added, the organic phase separated, and the aqueous phase

was extracted with EtOAc. The combined organic extracts were dried (Na_2SO_4), concentrated under reduced pressure, and then purified by radial chromatography (3:10 EtOAc/hexanes, 4 mm plate) to afford 439.7 mg (74%) of ethyl 1-(4-cyanobutyl)-2-oxocyclohexanecarboxylate as an oil: IR (film) 2242, 1712 cm^{-1} ; ^1H NMR 1.28 (t, $J=7.1$ Hz, 3H), 1.31-2.07 (m, 10H), 2.34 (t, $J=7$ Hz, 2H); 2.42-2.54 (m, 4H), 4.22 (q, $J=7.1$ Hz, 2H); ^{13}C NMR 14.0, 16.7, 22.4, 23.4, 25.6, 27.4, 33.7, 36.1, 60.4, 61.2, 119.3, 171.7, 207.6. Aqueous NaOH (2M, 7 mL) was added to an ethanolic solution (7 mL) of ethyl 1-(4-cyanobutyl)-2-oxocyclohexanecarboxylate (741.2 mg, 2.95 mmol) and after 60 h saturated, aqueous NaCl was added followed by 1M HCl until a pH of 2. The organic phase was separated, the aqueous phase was extracted with EtOAc (3x), and the organic extracts were combined. The combined extracts were dried (Na_2SO_4), concentrated under reduced pressure, and then purified by radial chromatography (1:5 EtOAc/hexanes, 4 mm plate) to afford 399.6 mg (76%) of **4d**⁶ as an oil: IR (film) 2245, 1709 cm^{-1} ; ^1H NMR 1.15-1.48 (m, 3H), 1.43 (pent, $J = 8$ Hz, 2H), 1.61-1.88 (m, 6H), 1.93-2.13 (m, 2H), 2.21-2.40 (m, 2H), 2.34 (t, $J = 7$ Hz, 2H); ^{13}C NMR 17.0, 25.0, 25.5, 26.3, 28.0, 26.3, 28.0, 28.5, 34.0, 42.1, 50.4, 119.7, 212.8 MS m/e 180 ($\text{M} + \text{H}$).

5-(4-Oxo-1-propylpiperidin-3-yl)pentanenitrile (4e): A benzene solution (50 mL) of 1-propyl-4-piperidone (3.67 g, 26.0 mmol), N,N-dimethylhydrazine (2.37 mL, 31.2 mmol), and trifluoroacetic acid (0.5 mL) was heated at reflux using a Dean Stark apparatus. After 5 h the mixture was cooled to room temperature, and then diluted with ether and water. The organic phase was separated, washed with brine, dried (Na_2SO_4), concentrated under reduced pressure, and distilled to afford 4.29 g (90%) of 1-propylpiperidin-4-one dimethylhydrazone as an oil: IR (film) 1642; ^1H NMR 0.87 (t, $J = 7$ Hz, 3H), 1.48 (sext, $J = 7$ Hz, 2H), 2.26-2.36 (m, 4H), 2.40

(s, 6H), 2.45-2.49 (m, 2H), 2.54 (t, $J = 6$ Hz, 2H), 2.62 (t, $J = 5.8$ Hz, 2H); ^{13}C NMR 11.7, 20.1, 28.3, 34.8, 47.2, 52.9, 53.8, 59.8, 166.8; MS m/e 184 ($M + 1$). A hexane solution of *n*-BuLi (9.26 mmol) was added to a cold (0°C) THF solution of 1-propylpiperidin-4-one dimethylhydrazone (1.54 g, 8.42 mmol). After 1h, a THF solution of 1-bromo-4-chlorobutane (1.59 g, 9.26 mmol) was added followed, after 16 h, by hydrolysis with 2 M HCl (23.2 mL, 46.3 mmol) for 1 h. The organic phase was then separated and the aqueous phase extracted with CH_2Cl_2 . The combined organic extracts were then sequentially washed with water and brine, and then dried (Na_2SO_4). The dry solution was concentrated under reduced pressure and the crude product was purified by radial chromatography (1:9 EtOAc/hexane) to provide 1.15 g (59%) of 3-(4-Chlorobutyl)-1-propylpiperidin-4-one as an oil: IR (film) 1714 cm^{-1} ; ^1H NMR 0.94 (t, $J = 7$ Hz, 3H), 1.17-1.29 (m, 2H), 1.44 (pent, $J = 8$ Hz, 2H), 1.55 (sext, $J = 7$ Hz, 2H), 1.67-1.88 (m, 2H), 2.15 (t, $J = 11$ Hz, 1H), 2.34-2.63 (m, 6H), 3.05-3.10 (m, 2H), 3.53 (t, $J = 6.6$ Hz, 2H); ^{13}C NMR 11.8, 20.6, 24.4, 26.5, 32.6, 41.0, 44.7, 49.5, 53.8, 59.1, 59.3, 210.6; MS m/e 232 ($M + 1$). 3-(4-Chlorobutyl)-1-propylpiperidin-4-one was converted to the corresponding nitrile as described for **4b** with 3-(4-chlorobutyl)-1-propylpiperidin-4-one (412.8 mg, 1.78 mmol) to afford after purification (1:5 EtOAc/hexanes, 4 mm plate) 254.0 mg (64%) of **4e** as an oil: IR (film) $2246, 1716\text{ cm}^{-1}$; ^1H NMR 0.93 (t, $J = 7$ Hz, 3H), 1.17-1.29 (m, 2H), 1.34-1.88 (m, 6H), 2.14 (t, $J = 10.9$ Hz, 2H), 2.20-2.63 (m, 7H), 3.03-3.10 (m, 1H), 3.07 (dd, $J = 11, 5$ Hz, 1H); ^{13}C NMR 11.8, 17.0, 20.6, 25.5, 26.3, 26.5, 41.0, 49.4, 53.8, 59.2, 59.3, 119.5, 210.5; MS m/e 223 ($M + 1$).

5-(2,4,4-Trimethyl-6-oxocyclohex-1-en-1-yl)pentanenitrile (4f): Solid *t*-BuOK (115.3 mg, 1.03 mmol) was added to a rt, THF solution (10 mL) of isophorone (95.0 mg, 0.688 mmol)

followed, after 30 min, by the slow addition of a THF solution (5 mL) of iodovaleronitrile (171.8 mg, 0.822 mmol). After 12 h, saturated, aqueous NH_4Cl was added, the organic phase was separated, and the aqueous phase was extracted with CH_2Cl_2 . The combined organic extracts were dried (Na_2SO_4), concentrated under reduced pressure, and then purified by radial chromatography (1:5 EtOAc/hexanes, 2mm plate) to afford 49.0 mg (77% based on recovered starting material) of **4f** as an oil: IR (film) 2245, 1661, 1632 cm^{-1} ; ^1H NMR 0.99 (s, 6H), 1.40-1.51 (m, 2H), 1.64 (pent, $J = 7$ Hz, 2H), 1.92 (s, 3H), 2.22 (s, 4H), 2.31 (t, $J = 7$ Hz, 2H), 2.36 (t, $J = 7$ Hz, 2H); ^{13}C NMR 16.8, 21.2, 23.8, 25.2, 27.9, 28.1, 32.6, 46.9, 51.2, 119.7, 133.6, 153.2, 198.8; MS m/e 220 ($\text{M} + \text{H}$).

5-(2,5-Dioxopyrrolidin-1-yl)pentanenitrile (4g): Solid NaH (57.6 mg of a 60% dispersion in mineral oil, 1.44 mmol) was added to a rt, THF solution (10 mL) of succinimide (119.6 mg, 1.21 mmol) and, after 1 h, a THF solution (5 mL) of iodovaleronitrile (302.0 mg, 1.45 mmol) was slowly added. After 16 h saturated, aqueous NaHCO_3 was added and the aqueous phase extracted with CH_2Cl_2 . The combined organic extracts were dried (Na_2SO_4), concentrated under reduced pressure, and purified by radial chromatography (1:9 EtOAc/Hexanes, 2 mm plate) to afford 111.8 mg of **4g** (51%) as an oil: IR (film) 2246, 1774, 1698 cm^{-1} ; ^1H NMR 1.60-1.80 (m, 4H), 2.39 (t, $J = 7$ Hz, 2H), 2.71 (s, 4H), 3.54 (t, $J = 7$ Hz, 2H); ^{13}C NMR 16.6 22.7 26.7 28.1 37.5 119.1 177.1 MS m/e 181 ($\text{M} + \text{H}$).

5-(2-Oxopiperidin-1-yl)pentanenitrile (4h): A THF solution (20 mL) of valerolactam (214.2 mg, 2.16 mmol) was slowly added to a THF washed slurry of KH (181.8 mg, 4.53 mmol). After 3 h, a THF solution (10 mL) of iodovaleronitrile (538.5 mg, 2.57 mmol) was added and after a

further 16 h saturated, aqueous NaHCO_3 (50 mL) was added. The organic phase was separated and then the aqueous phase was extracted with CH_2Cl_2 . The combined organic extracts were dried (Na_2SO_4), concentrated under reduced pressure, and then purified by radial chromatography (1:5 EtOAc/hexanes, 4 mm plate) to afford 229.3 mg (59%) of **4h** as an oil: IR (film) 2246, 1666 cm^{-1} ; ^1H NMR 1.57-1.83 (m, 8H), 2.32-2.36 (m, 2H), 2.40 (t, $J = 7$ Hz, 2H), 3.22-3.26 (m, 2H), 3.38 (t, $J = 7$ Hz, 2H); ^{13}C NMR 16.7, 21.3, 22.5, 23.2, 25.8, 32.2, 45.5, 47.7, 119.5, 169.8; MS m/e 181 ($\text{M} + \text{H}$).

3-Methyl-6-oxoheptanenitrile (4i): Ozonolysis of a dichloromethane solution (60 mL) of **vii**⁷ (1.47 g, 9.72 mmol), terminating the ozonolysis immediately upon observing the distinctive blue color of ozone was followed by addition of neat dimethylsulfide (2 mL) at -78 °C. The resultant mixture was allowed to warm to room temperature, stirred for 20 h, and then the solvent was removed under reduced pressure. Chromatography of the crude product (4 mm silica gel plate, 2:8 EtOAc:hexanes) and concentration of the appropriate fractions under reduced pressure gave 892 mg (73%) of 3-methyl-6-oxo-hexanenitrile as an oil: IR (film) 2246, 1726 cm^{-1} ; ^1H NMR 1.09 (d, $J = 6.6$ Hz, 3H), 1.58-1.90 (m, 3H), 2.32 (br t, $J = 6$ Hz, 2H), 2.51 (br t, $J = 7$ Hz, 2H), 9.78 (br t, $J = 1$ Hz, 1 H); ^{13}C NMR 19.1, 24.3, 27.8, 29.9, 41.1, 118.6, 201.8; GC/MS m/e 126 (MH). An ethereal solution of methyllithium (6.82 mL, 1.5 M) was added to a stirred THF solution (35 mL) of 3-methyl-6-oxo-hexanenitrile (853 mg, 6.82 mmol). After 4 h aqueous, saturated ammonium chloride was added. The crude reaction mixture was extracted with EtOAc, washed with brine, dried over magnesium sulfate, and evaporated under reduced pressure. Radial chromatography of the crude product (4 mm silica gel plate, 3:7 EtOAc:hexanes) gave 189 mg (22%) of the starting aldehyde and 552 mg (57%) of 3-methyl-6-hydroxyheptanenitrile as an oil: IR (film) 3452, 2965, 2243 cm^{-1} ; ^1H NMR : 1.02-1.45 (m, 9H), 1.81-1.93 (m, 2 H), 2.09-2.35 (m, 2H), 3.74 (br sextet, $J = 6$ Hz, 1H); ^{13}C NMR : 19.4, 23.7, 24.5, 30.6, 32.0, 36.4, 68.0,

118.7; GC/MS m/e 142 (MH). Pyridinium chlorochromate (1.04 g, 4.8 mmol) was added to a stirred, dichloromethane solution (23 mL) of 3-methyl-6-hydroxyheptane nitrile (454 mg, 3.2 mmol). After 12 h diethylether (5 mL) was added, the heterogenous mixture was sonicated (2 min) and was then passed through a plug of Florisil (elution with diethylether). Removal of the solvent under reduced pressure followed by radial chromatography (4 mm silica gel plate, 2:8 EtOAc:hexanes) afforded 370 mg (83%) of **4i** as a colorless oil. IR (film): 2970, 2245, 1715 cm^{-1} ; ^1H NMR 1.07 (d, $J = 6.7$ Hz, 3H), 1.57-1.63 (m, 1H), 1.73 (ddd, $J = 20, 14, 7$ Hz, 1H), 1.87 (ddd, $J = 20, 14, 7$ Hz, 1H), 2.16 (s, 3H), 2.25 (br dd, $J = 17, 7$ Hz, 1H), 2.33 (dd, $J = 17, 6$ Hz, 1H), 2.48 (br t, $J = 7$ Hz, 2H); ^{13}C NMR 19.2, 24.5, 29.5, 29.9, 30.4, 40.7, 118.4, 207.6; GC/MS: m/e 140 (MH).

General counter-intuitive cyclization procedure

Solid *t*-BuOK (5 equiv) was added to a refluxing, THF solution of the ketonitrile (1 equiv, 0.01-0.05 M). After 5 h the solution was cooled, saturated, aqueous, NH_4Cl was added, the organic phase was separated, and the aqueous phase was extracted with CH_2Cl_2 (3x). The combined organic extracts were dried (Na_2SO_4), concentrated under reduced pressure, and then purified by radial chromatography (EtOAc/Hexanes).

5-Isopropenyl-2-methylcyclopent-1-ene-1-carbonitrile (7a): The general procedure was employed with **4a**⁸ (108.5 mg, 0.657 mmol), except that the solution was stirred at room temperature rather than at reflux, followed, after 5 h, by addition of aqueous hydrochloric acid (2%) to afford, after chromatography (1:9 EtOAc/hexanes, 1 mm plate), 57.9 mg (60%) of **7a** as an oil: IR (film) 3078, 2211, 1728, 1638 cm^{-1} ; ^1H NMR 1.69 (s, 3H), 1.72-1.84 (m, 1H), 2.03 (s, 3H), 2.10-2.26 (m, 1H), 2.43-2.51 (m, 2H), 3.49-3.56 (m, 1H), 4.82 (d, $J = 2.7$ Hz, 2H); ^{13}C

NMR 16.7, 19.3, 29.0, 37.5, 54.4, 112.0 (resolves to 113.1 and 113.6 in CS₂), 116.5, 144.8, 161.8; MS *m/e* 148 (M + H). Repetition of the reaction at reflux generates a 1:1 mixture of **7a** and the corresponding amide 5-isopropenyl-2-methylcyclopent-1-ene-1-carboxamide: IR (film) 3377, 3289, 3181, 3082, 1634 cm⁻¹; ¹H NMR 1.74 (s, 3H), 2.05 (s, 3H), 2.46-2.55 (m, 5H), 2.76 (dd, *J* = 13, 8 Hz, 1H), 2.88 (pent, *J* = 8 Hz, 1H), 4.73-4.74 (m, 2H); ¹³C NMR 20.5, 28.1, 35.7, 39.0, 42.7, 105.2, 109.5, 147.1, 162.2; MS *m/e* 166 (M + H).

2-Phenylcyclohex-1-ene-1-carbonitrile (7b): The general procedure was employed with **4b** (20.3 mg, 0.101 mmol), using 1eq of *t*-BuOK (11.0 mg, 0.100 mmol) to provide, after chromatography (1:19 EtOAc/hexanes, 1 mm plate), 12.3 mg (66%) of **7b** as an oil: IR (Film) 3057, 2207 cm⁻¹; ¹H NMR 1.76-1.81 (m, 4H), 2.40-2.49 (m, 4H), 7.38 (s, 5H); ¹³C NMR 21.3, 21.8, 28.3, 31.3, 107.9, 119.7, 127.1, 128.5, 128.8, 140.1, 155.4; MS *m/e* 184 (M + H).

2,4,5,6,7,7a-Hexahydro-1H-indene-3-carbonitrile (7c): The general procedure was employed with **4c** (82.0 mg, 0.496 mmol) to afford, after chromatography (1:9 EtOAc/hexanes, 1 mm plate), 57.4 mg (79%) of **7c** as an oil: IR (film); 2212, 1644 cm⁻¹; ¹H NMR 1.02 (qd, *J* = 12, 3 Hz, 1H), 1.15-1.67 (m, 3H), 1.73-2.02 (m, 4H), 2.11-2.22 (m, 1H), 2.49-2.54 (m, 3H), 2.79 (d, *J* = 12.9 Hz, 1H); ¹³C NMR 25.0, 26.2, 28.3, 29.6, 32.6, 34.9, 46.6, 104.1, 116.8, 166.0.

2,3,4,4a,5,6,7,8-Octahydronaphthalene-1-carbonitrile (7d): The general procedure was employed with **4d** (56.3 mg, 0.315 mmol) to afford, after chromatography (1:9 EtOAc/hexanes, 1 mm plate), 33.8 mg (67%) of **7d**: IR (film); 2930, 2856, 2207, 1634 cm⁻¹; ¹H NMR 1.11-2.03

(m, 12H), 2.18-2.23 (m, 2H), 2.91-2.96 (m, 1H); ^{13}C NMR 28.6, 31.0, 35.1, 35.6, 38.0, 42.2, 43.2, 46.6, 112.4, 127.4, 167.8. MS m/e 161 (M). Prematurely terminating the reaction affords intermediate alcohol **6d** as a crystalline solid (mp 82-83 °C), tentatively assigned the *trans*-decalin stereochemistry: IR (film); 3546, 2236 cm^{-1} ; ^1H NMR 1.16-2.06 (m, 16H), 2.37 (dd, $J=12$, 4.5 Hz, 1H); ^{13}C NMR 21.3, 24.8, 25.7, 25.9, 27.3, 28.3, 37.6, 41.3, 43.7, 69.9, 120.5.

2-Propyl-1,2,3,4,6,7,8,8a-octahydroisoquinoline-5-carbonitrile (7e): The general procedure was employed with **4e** (83.2 mg, 0.374 mmol), with the modification that the solution was heated at reflux for 3h, rather than 5 h, followed by addition of NaHCO_3 rather than NH_4Cl , to afford,, after chromatography (1:5 EtOAc/hexanes, 1 mm plate), 46.9 mg (61%) of **7e** as an oil: IR (Film) 2209, 1639 cm^{-1} ; ^1H NMR 0.90 (t, $J = 7$ Hz, 3H), 1.13-1.22 (m, 1H), 1.51 (sext, $J = 7$ Hz, 2H), 1.65 (t, $J = 11$ Hz, 2H), 1.72-1.83 (m, 2H), 1.90-2.03 (m, 1H), 2.15-2.42 (m, 6H), 2.99 (d, $J = 6.6$ Hz, 1H), 3.02-3.06 (m, 2H); ^{13}C NMR 11.8, 20.1, 20.5, 26.4, 27.4, 32.9, 37.3, 53.7, 59.9, 60.4, 105.0, 118.6, 156.3; MS m/e 205 (M + H).

5,7,7-Trimethyl-2,3,4,6,7,8-hexahydronaphthalene-1-carbonitrile (7f): The general procedure was employed using potassium *iso*-butoxide, prepared by adding neat *iso*-butanol (35.9 mg, 0.484 mmol) to a rt, THF washed suspension (5 mL) of KH (16.4 mg, 0.409 mmol). After 15 minutes a THF solution (1 mL) of **4f** (17.6 mg, 0.0857 mmol) was slowly added, followed by refluxing, to afford, after chromatography (1:9 EtOAc/hexanes, 1 mm plate), 9.8 mg (61%) of **7f** as an oil: IR (film) 2199, 1624, 1590 cm^{-1} ; ^1H NMR 0.92 (s, 6H), 1.68 (pent, $J = 6.0$ Hz, 2H), 1.75 (s, 3H), 2.01 (s, 2H), 2.29-2.34 (m, 4H), s, 2H), ^{13}C NMR 20.1, 21.9, 25.2, 27.8, 27.9, 30.6, 43.4, 47.2, 103.4, 120.4, 125.5, 137.0, 149.6; MS m/e 202 ($M + 1$).

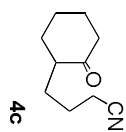
3-Oxo-1,2,3,5,6,7-hexahydroindolizine-8-carbonitrile (7g): The general procedure was employed with **4g** (53.4 mg, 0.298 mmol) and modified by adding 10% aqueous HCl, rather than NH_4Cl . After 30 min, solid K_2CO_3 was added until the solution was neutral and then saturated, aqueous NaHCO_3 was added to afford, after chromatography (1:5 EtOAc/hexanes, 1 mm plate), 29.8 mg (62%) of **7g** as an oil exhibiting IR and ^1H NMR spectra identical to that previously reported⁹: ^{13}C NMR 19.6, 23.1, 23.3, 28.1, 38.8, 80.9, 118.8, 154.2, 174.8.

3,4,6,7,8,9-Hexahydro-2H-quinolizine-1-carbonitrile (7h): The general procedure was employed with **4h** (122.6 mg, 0.680 mmol) to provide, after chromatography (1:5 EtOAc/hexanes, 1 mm plate), 66.4 mg (60%) of **7h** that was spectrally identical to material previously synthesized.¹⁰ Alternative cyclization with KH: A THF solution (100 mL) of **7h** (899.1 mg, 5.00 mmol) was slowly added to a THF-washed slurry of KH (600.1 mg, 14.98 mmol) followed by heating the resulting mixture to reflux. After 5 h, the solution was cooled, saturated, aqueous, NH_4Cl was added, the organic phase was separated, and the aqueous phase was extracted with CH_2Cl_2 . The combined organic extracts were dried (Na_2SO_4), concentrated

under reduced pressure, and then purified by radial chromatography (1:5 EtOAc/hexanes, 4 mm plate) to afford 511.1 mg (63%) of **8h** spectrally identical to material previously synthesized.¹⁰

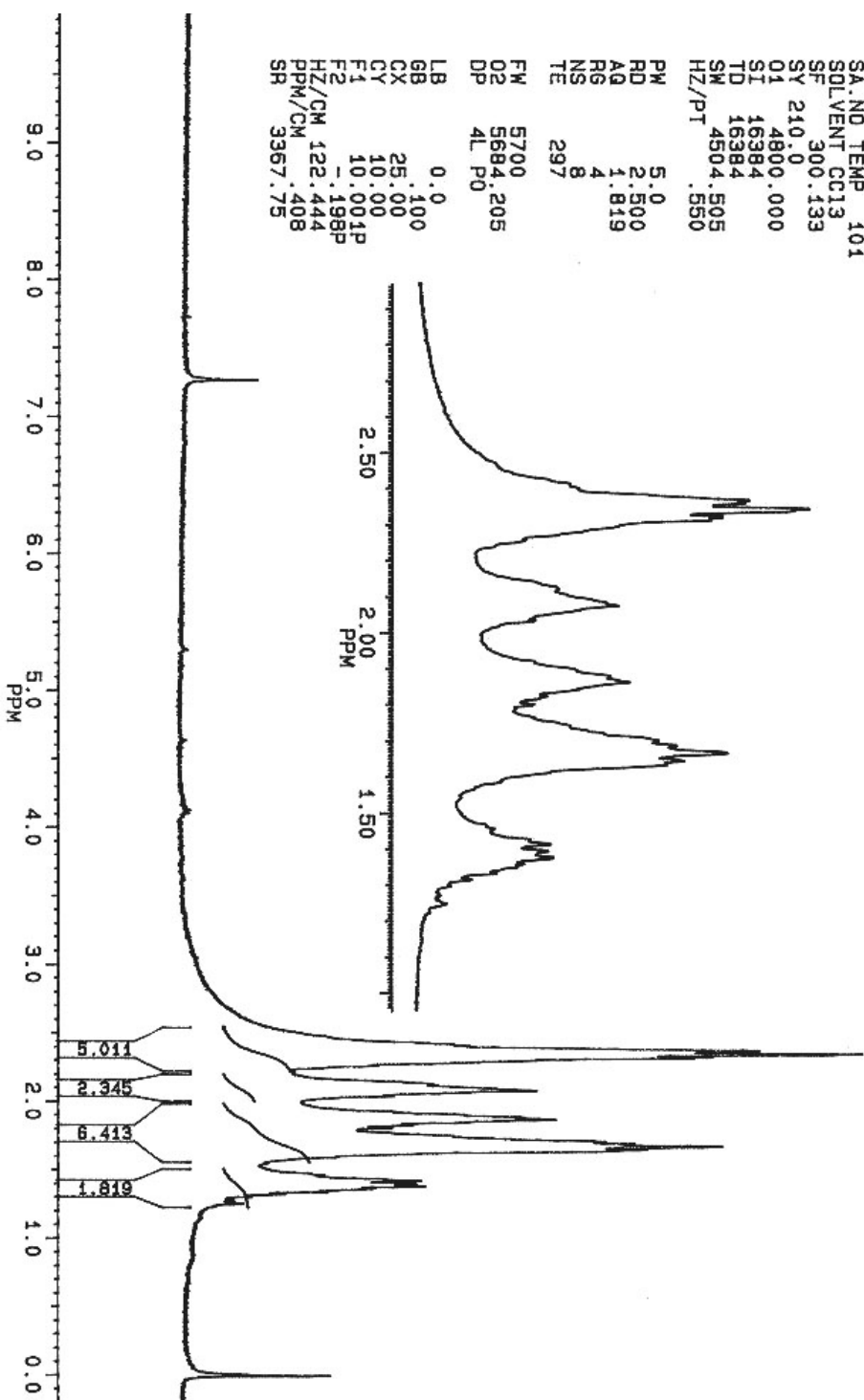
(2, 5-Dimethyl-1-cyclopentenyl)-1-carboxamide (11i): Potassium *tert*-butoxide (1.0 M in *t*-butanol, 0.55 mmol) was added to a stirred, room temperature, *t*-BuOH solution (8 mL) of **4i** (76 mg, 0.55 mmol). After 8 h aqueous saturated ammonium chloride was added. The reaction mixture was extracted with EtOAc, the extracts were washed with brine, dried over MgSO₄, and then the solvent was removed under reduced pressure. Radial chromatography of the crude product (1 mm silica gel plate, 4:6 EtOAc:hexanes) afforded 41 mg (54%) of **11j** as crystals upon concentration of the appropriate fractions under reduced pressure. M.P: 65-69 °C; IR (film): 3354, 3160, 2931, 1629, 1500 cm⁻¹; ¹H NMR 1.08 (d, *J* = 6.7 Hz, 3H), 2.04 (s, 3H), 2.07-2.25 (m, 2H), 2.33 (br ddd, *J* = 21, 14, 7 Hz, 1H), 2.61 (dd, *J* = 16, 8 Hz, 1H), 2.77 (dd, *J* = 12.9, 8 Hz, 1H); ¹³C NMR 21.1, 28.1, 30.1, 38.9, 42.7, 105.5, 162.6, 195.7; GC/MS: *m/e* 140 (MH).

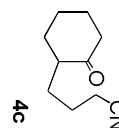
~~BRUKER~~



RAMA811.001
DATE 11-8-99
TIME 17:05

SA.NO TEMP 101
SOLVENT CC13
SF 300.133
SY 210.0
O1 4800.000
SI 16384
TD 16384
SM 4504.505
HZ/PT .550
PM 5.0
RD 2.500
AQ 1.819
RG 4
NS 8
TE 297
FW 5700
O2 5684.205
DP 4L P0
LB 0.0
GB .100
CX 25.00
CY 10.00
F1 10.001P
F2 .198P
HZ/CM 122.444
PPM/CM 408
SR 3367.75






 PPM
 RAN4811.101
 DATE 11-8-99
 TIME 16:19

SOLVENT CDCl3
 SF 75.0
 SY 75.0
 01 6147.202
 SI 16384
 TD 16384
 SM 17657.143
 HZ/PT 2.160

PM 4.0
 RD 3.000
 AG .452
 RG 160
 NS 243
 TE 237

FM 22400
 02 4004.452
 DP 20H BB

LB 0.0
 GB 0.0
 CX 25.00
 CY .50
 F1 220.015P
 F2 -48.4P
 HZ/CW 665.632
 PPM/CW 8.820
 SR -1336.64

118.723

76.850
 76.494
 76.002

48.880

41.087

39.137

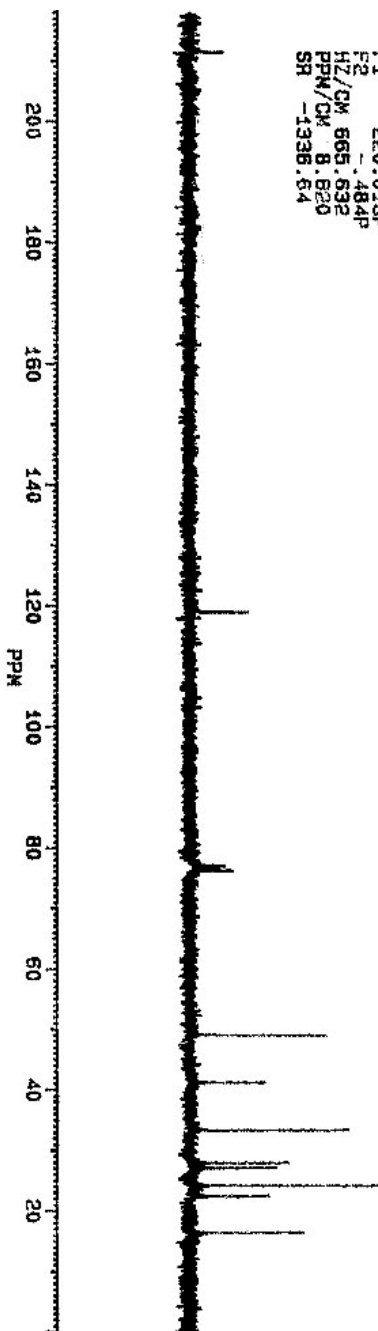
27.787

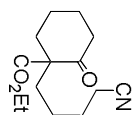
26.684

23.681

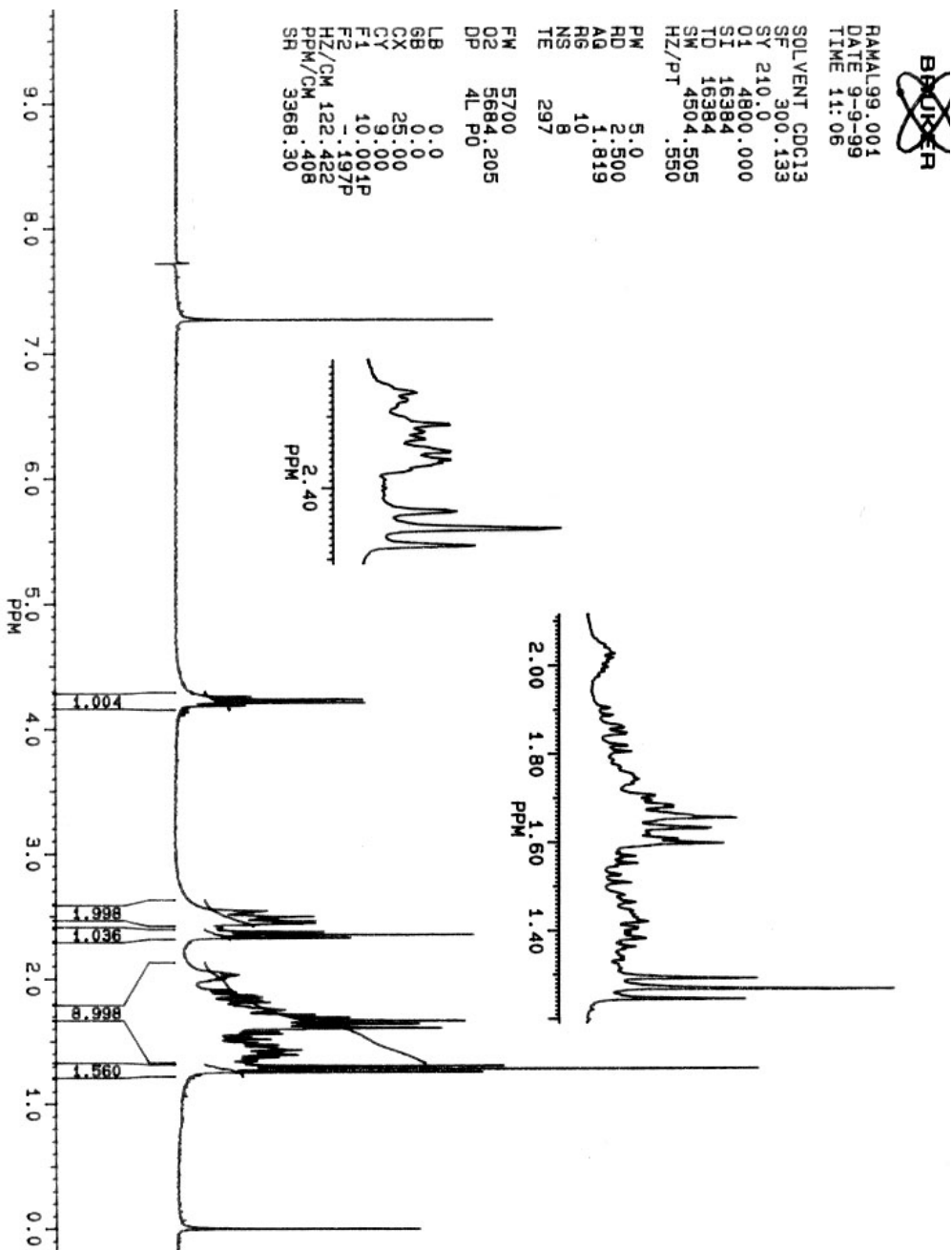
22.272

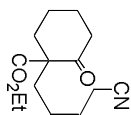
16.298





Ethyl 1-(4-cyanobutyl)-2-oxocyclohexanecarboxylate





Ethyl 1-(4-cyanobutyl)-2-oxocyclohexanecarboxylate



RAMAL99.101
DATE 11-9-99
TIME 15:18

PPM

171.653

119.345

77.433
77.001
76.571

61.172
60.449

40.897

36.072
33.675

27.406

25.559

23.363

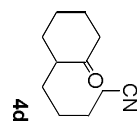
22.410

16.719

14.004

SOLVENT CDCl3
SF 75.0
SY 6147.202
O1 16384
SI 16384
TD 16384
SM 17857.143
HZ/Pt 2.180
PM 4.0
RD 3.000
AQ 459
RG 200
NS 21344
TE 297
FW 22400
U2 4004.452
DP 20H BB
LB 0.0
GB 0.0
CX 25.00
CY 220.50
F1 220.004P
F2 495P
HZ/CW 665.632
PPM/CW 8.820
SR -1396.84

200 180 160 140 120 100 80 60 40 20 PPM



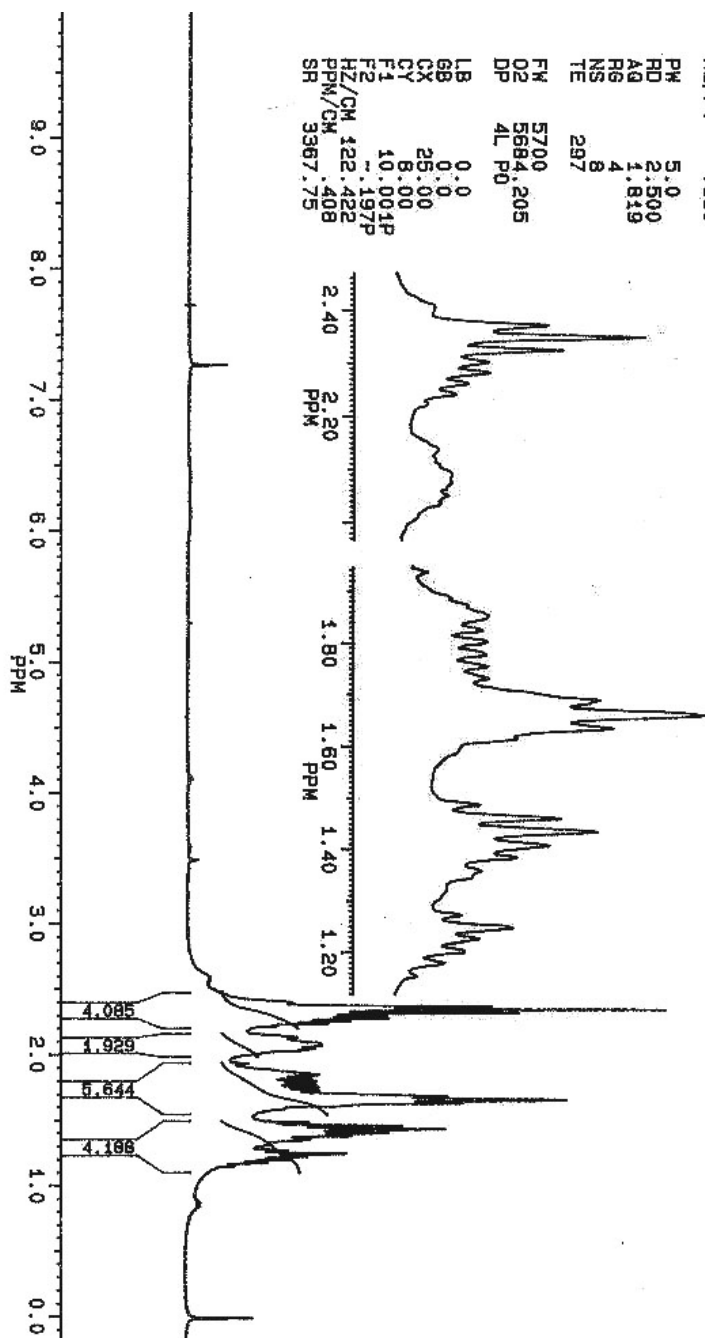
RAMAL106.001
DATE 7-10-99
TIME 11:54

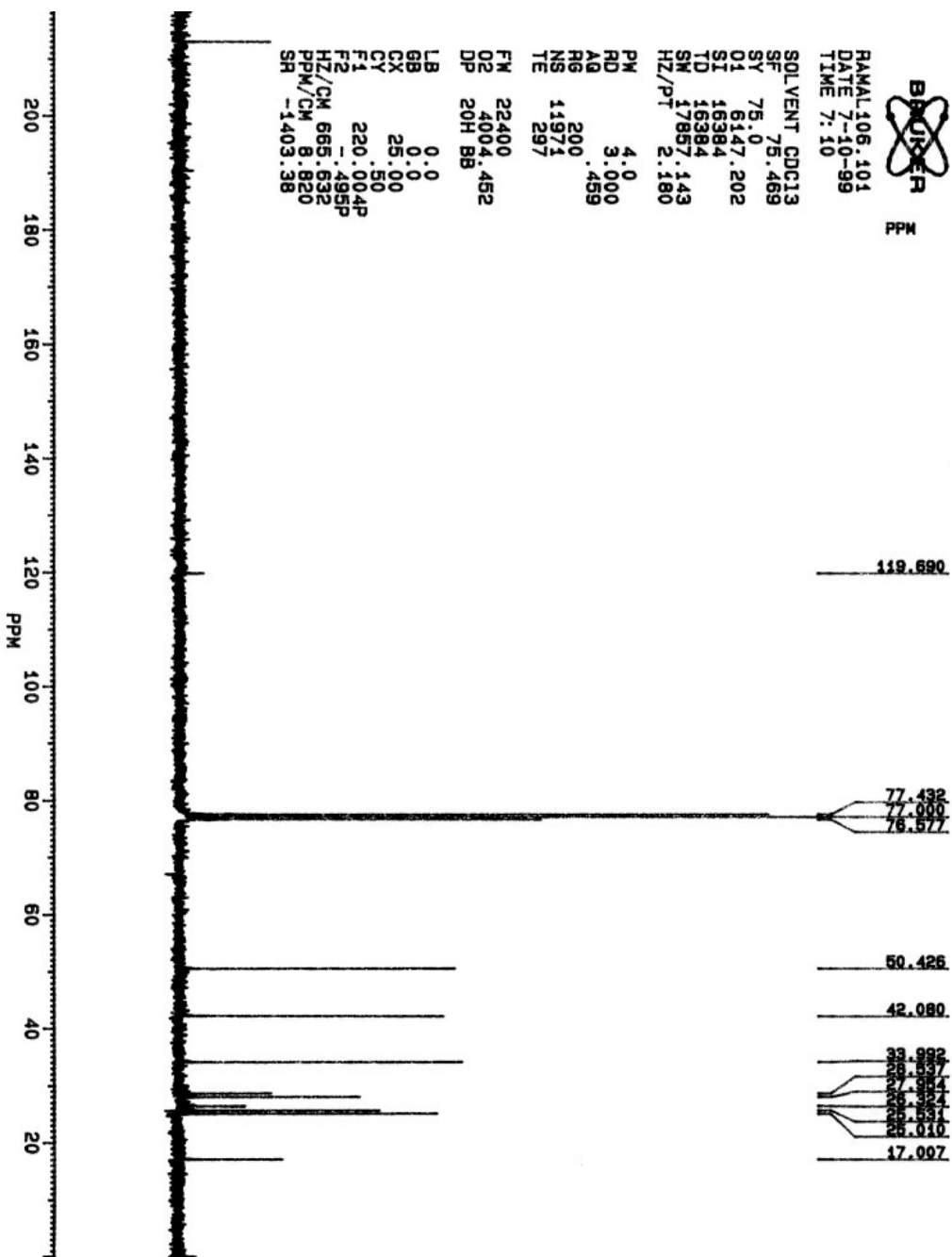
SOLVENT CDCl3
SF 300.133
SY 210.0
O1 4800.000
SI 16384
TO 16384
SM 4504.505
HZ/PT .550

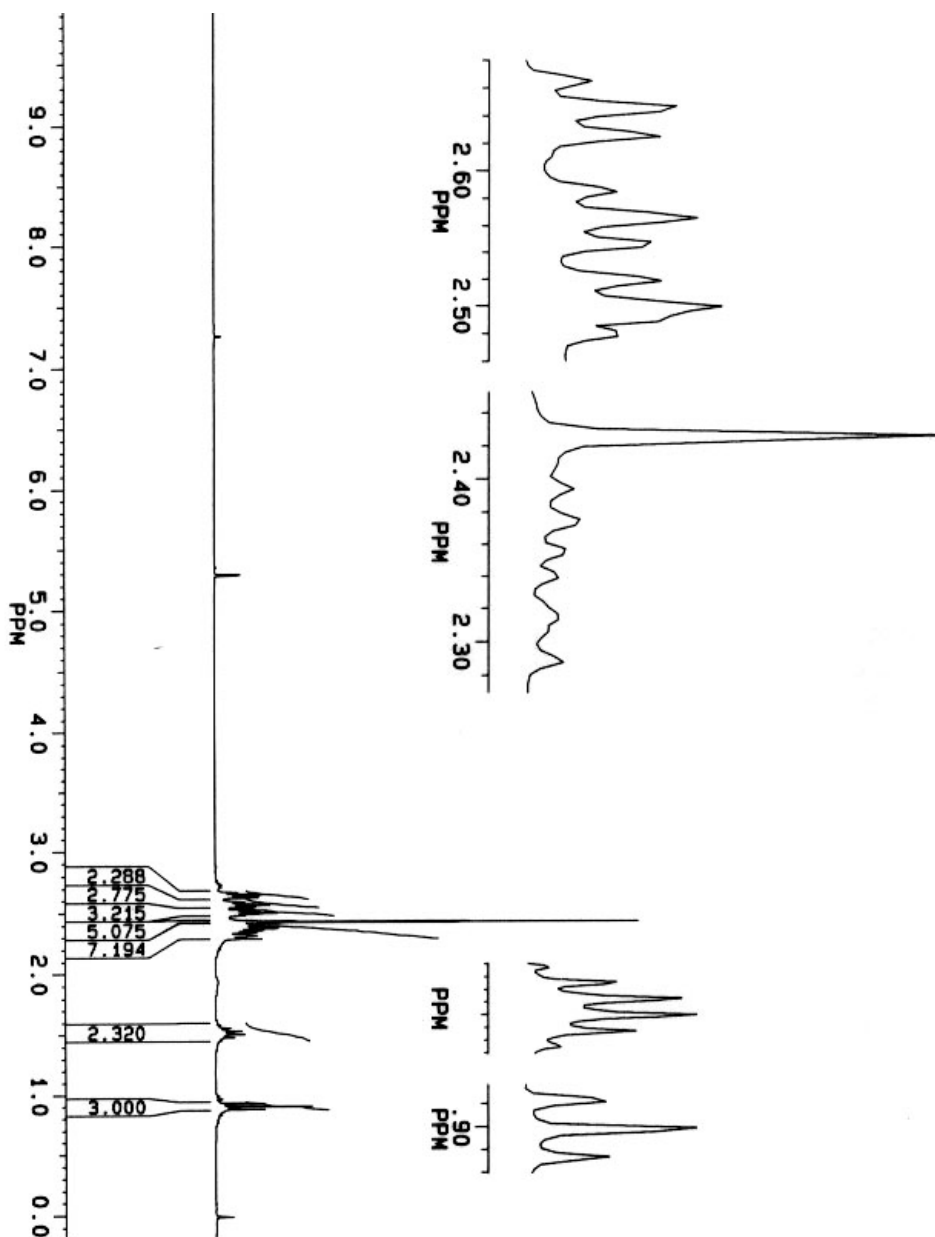
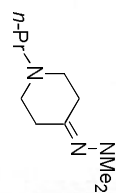
PW 5.0
RD 2.500
RG 1.819
NS 8
TE 297

FV 5700
O2 5684.205
DP 4L P0

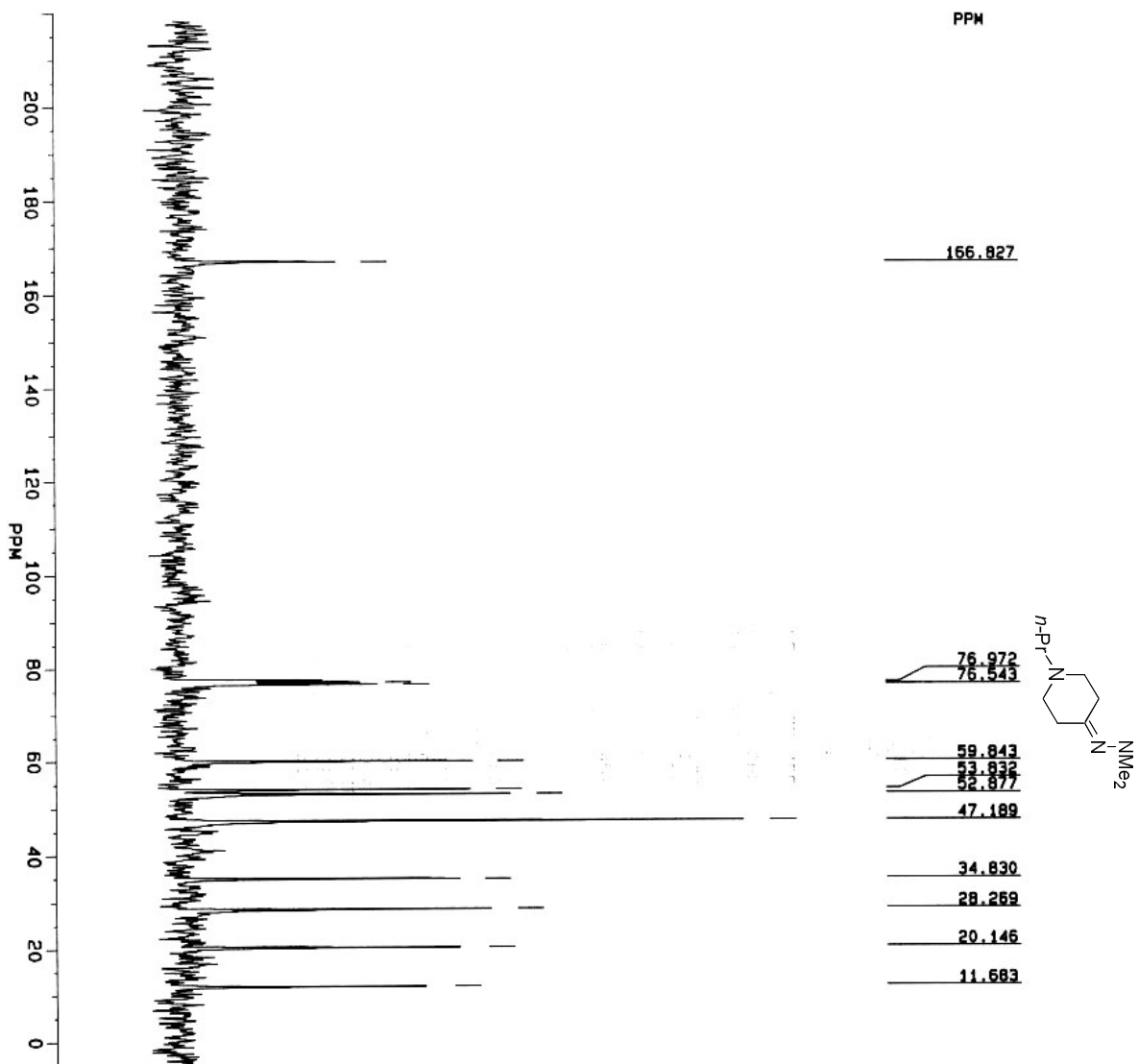
LB 0.0
GB 0.0
CX 25.00
CY 8.00
F1 10.001P
F2 ~.197P
HZ/CM 122.422
PPM/CM 3367.75
SR





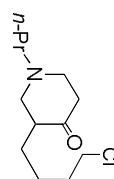


FFLF2.001
 DATE 19-10-0
 SF 300.133
 SY 210.0
 O1 4800.000
 SI 8192
 TD 8192
 SM 4504.505
 HZ/PT 1.100
 PM 5.0
 RD 2.500
 AG .909
 RG 4
 NS 8
 TE 297
 FM 5700
 O2 5684.205
 DP 4L PO
 LB 0.0
 GB 0.0
 CX 20.50
 CY 7.00
 F1 10.001P
 F2 .200P
 HZ/CM 149.349
 PPM/CM .498
 SR 3368.85



F.001
 DATE 1-3-96
 SF 75.469
 SY 75.0
 O1 6147.202
 SI 16384
 TD 16384
 SM 17857.143
 HZ/PT 2.180
 PM 4.0
 RD 3.000
 AG .459
 RG 200
 NS 74
 TE 297
 FM 22400
 O2 4004.452
 DP 20H BB
 LB 10.000
 GB 0.0
 CX 20.50
 CY 10.00
 F1 220.004P
 F2 -5.001P
 HZ/CM 828.334
 PPM/CM 10.976
 SR -1394.66





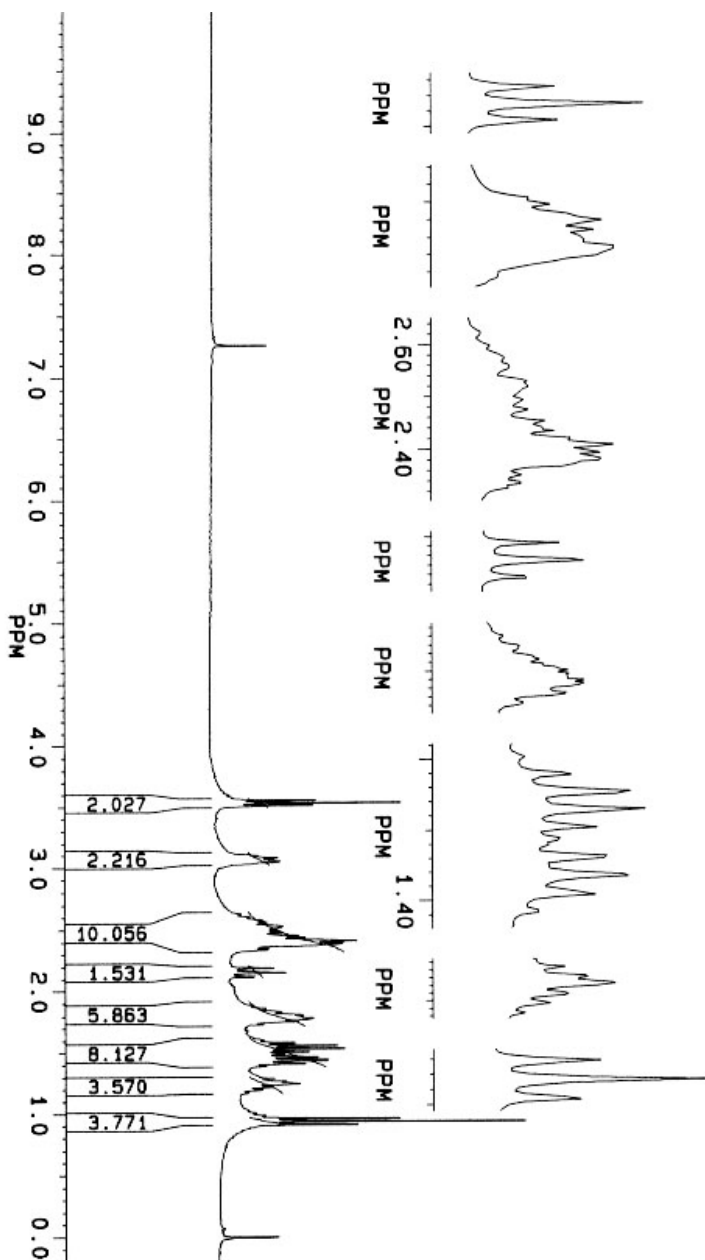
FFLE33.001
DATE 24-10-0

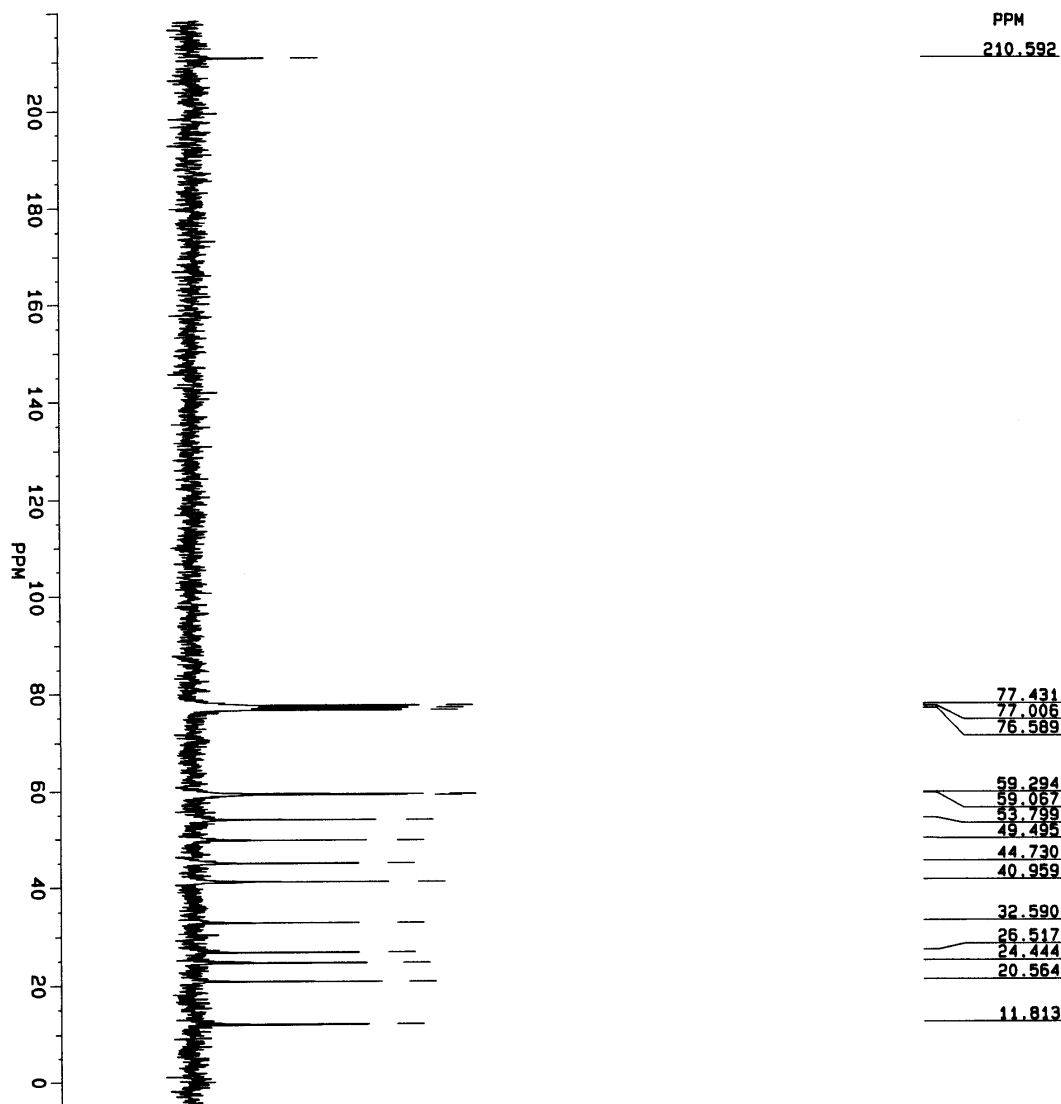
SF 300.133
SY 210.0
O1 4800.000
SI 8192
TD 8192
SM 4504.505
HZ/PT 1.100

PM 5.0
RD 2.500
AQ .909
RG 4
NS 8
TE 297

FM 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 20.50
CY 5.00
F1 10.001P
F2 -200P
HZ/CM 149.349
PPM/CM .498
SR 3367.75





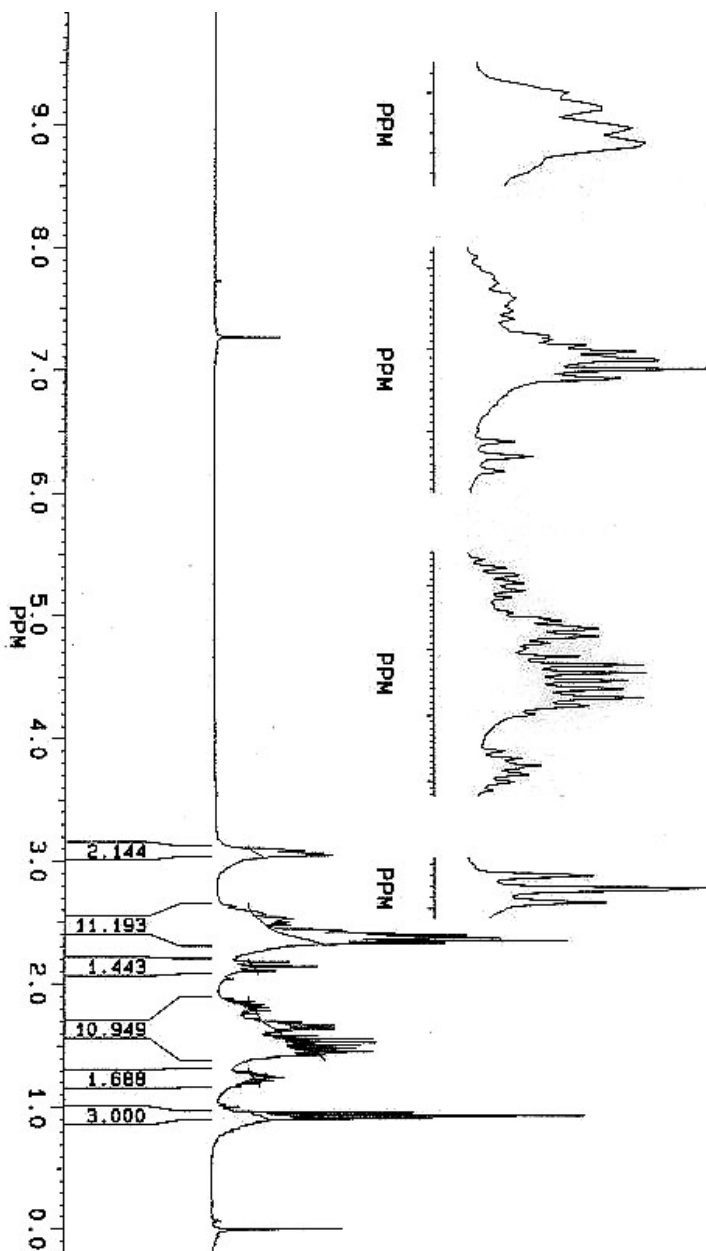
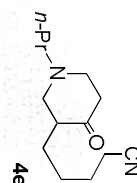
FFLF100.001
DATE 1-3-96

SF 75.469
SY 75.0
O1 6147.202
SI 16384
TD 16384
SW 17857.143
HZ/PT 2.180

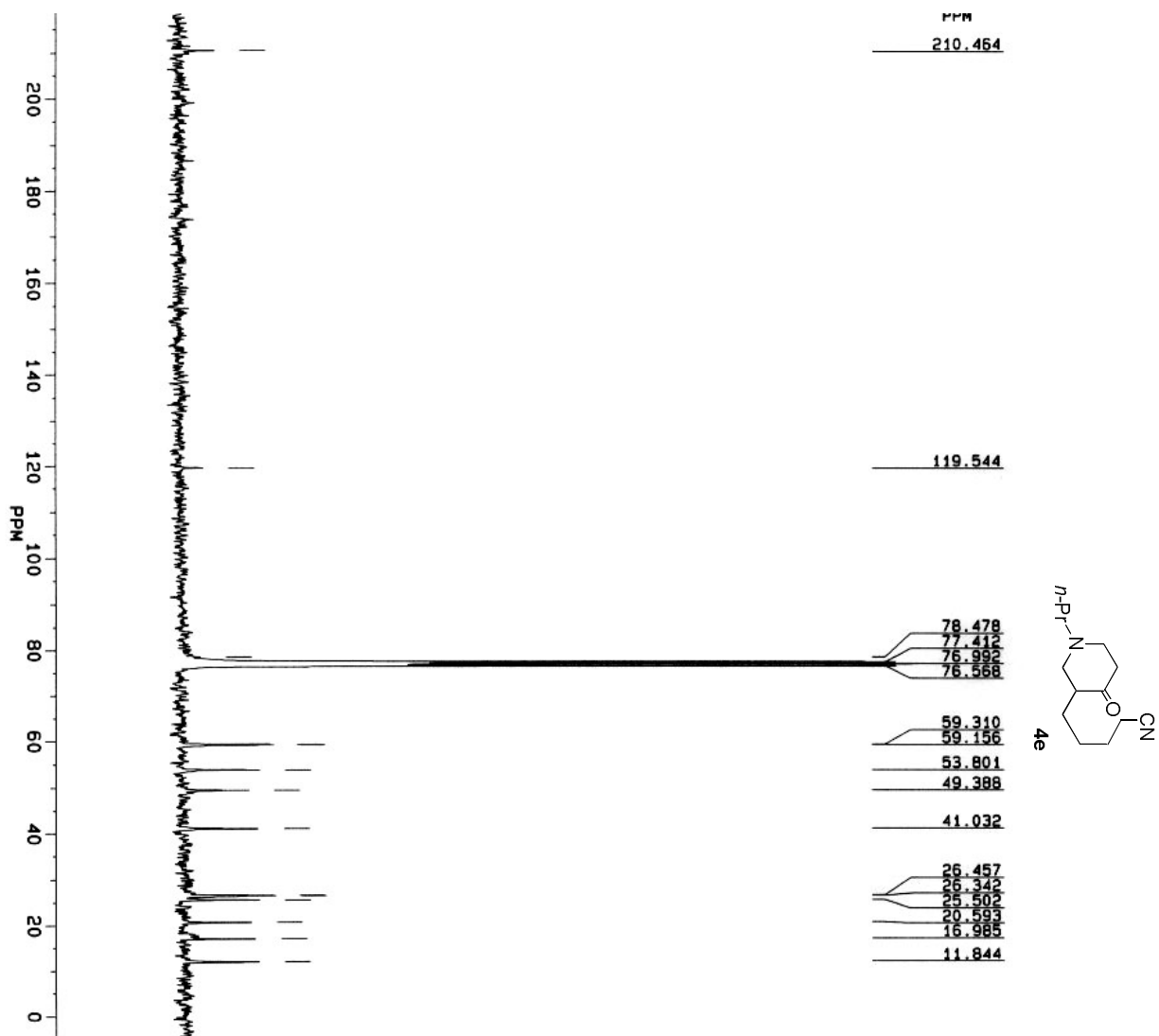
PM 4.0
RD 3.000
AQ .459
RG 200
NS 564
TE 297

FM 22400
O2 4004.452
DP 20H 88

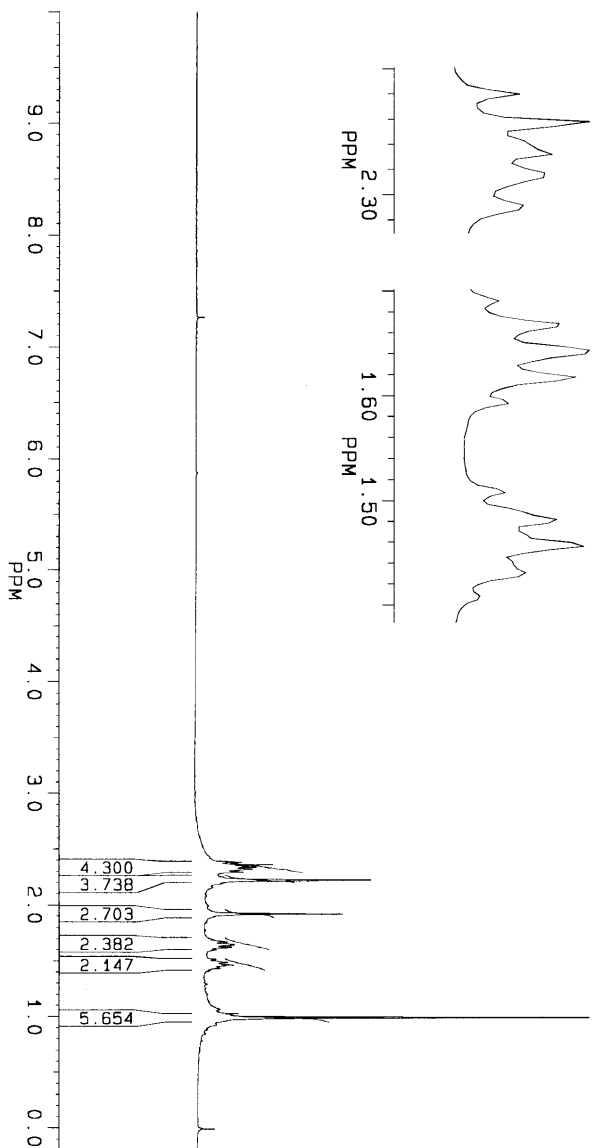
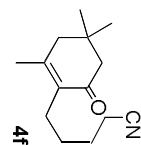
LB 4.000
GB 0.0
CX 20.50
CY 4.00
F1 220.004P
F2 -5.001P
HZ/CM 828.334
PPM/CM 10.976
SR -1403.38



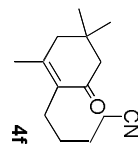
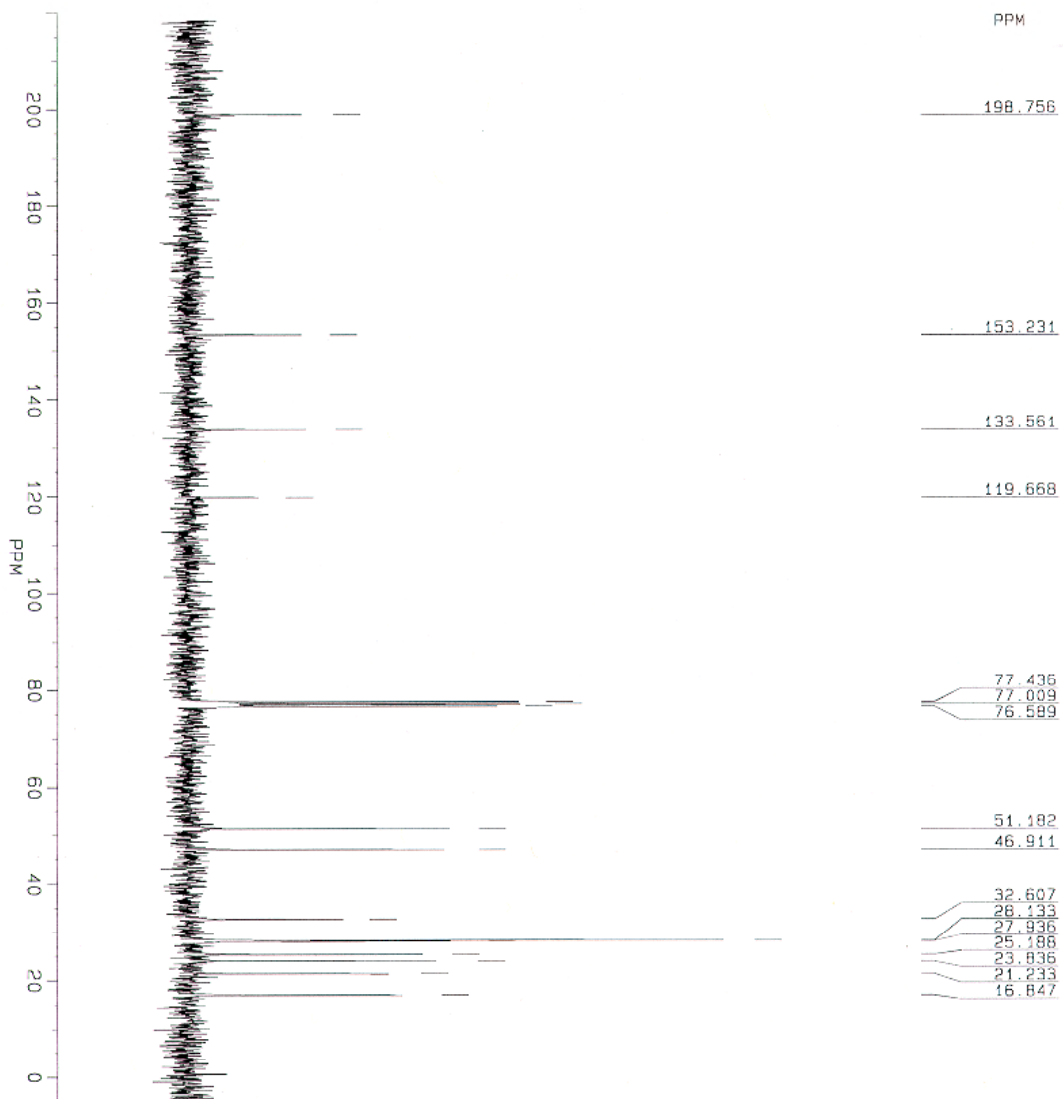
FFLEB.001
 DATE 21-11-0
 SF 300.133
 SY 210.0
 O1 4800.000
 S1 8192
 T0 8192
 SM 4504.505
 HZ/PT 1.100
 PM 5.0
 RD 2.500
 AG 4.909
 RG 8
 NS 8
 TE 297
 FM 5700
 O2 5684.205
 DP 4L P0
 LB 0.0
 GB 0.0
 CX 20.50
 CY 6.00
 F1 10.003P
 F2 -200P
 HZ/CM 149.349
 PPM/CM 498
 SR 3367.75



BF₃·OEt₂
 FFLFB.002
 DATE 22-11-0
 SF 75.469
 SY 75.0
 O1 6147.202
 S1 16384
 TD 16384
 SM 17857.143
 HZ/Pt 2.180
 PW 4.0
 RD 3.000
 AG .459
 RG 200
 NS 9190
 TE 297
 FW 22400
 O2 4004.452
 DP 20H BB
 LB 8.000
 GB 0.0
 CX 20.50
 CY 14.50
 F1 220.004P
 F2 -5.001P
 HZ/CM 828.334
 PPM/CM 10.976
 SR -1405.56

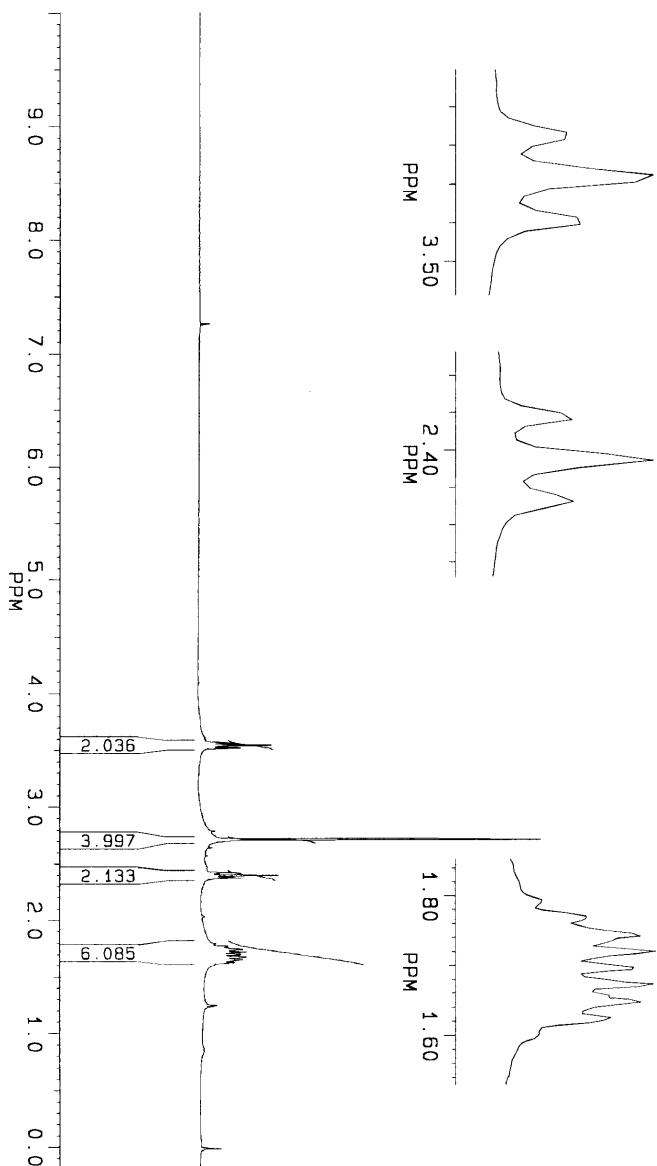
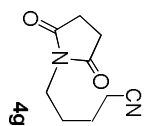


~~BRUKER~~
 FFL17.001
 DATE 2-2-1
 SF 300.133
 SY 210.0
 O1 4800.000
 SI 8192
 TD 8192
 SW 4504.505
 HZ/PT 1.100
 PM 5.0
 RD 2.500
 AG .909
 RG 2
 NS 8
 TE 297
 FW 5700
 O2 5684.205
 DP 4L P0
 LB 0.0
 GB 0.0
 CX 20.50
 CY 7.00
 F1 10.001P
 F2 .200P
 HZ/CM 149.349
 PM/CM .498
 SR 3367.75

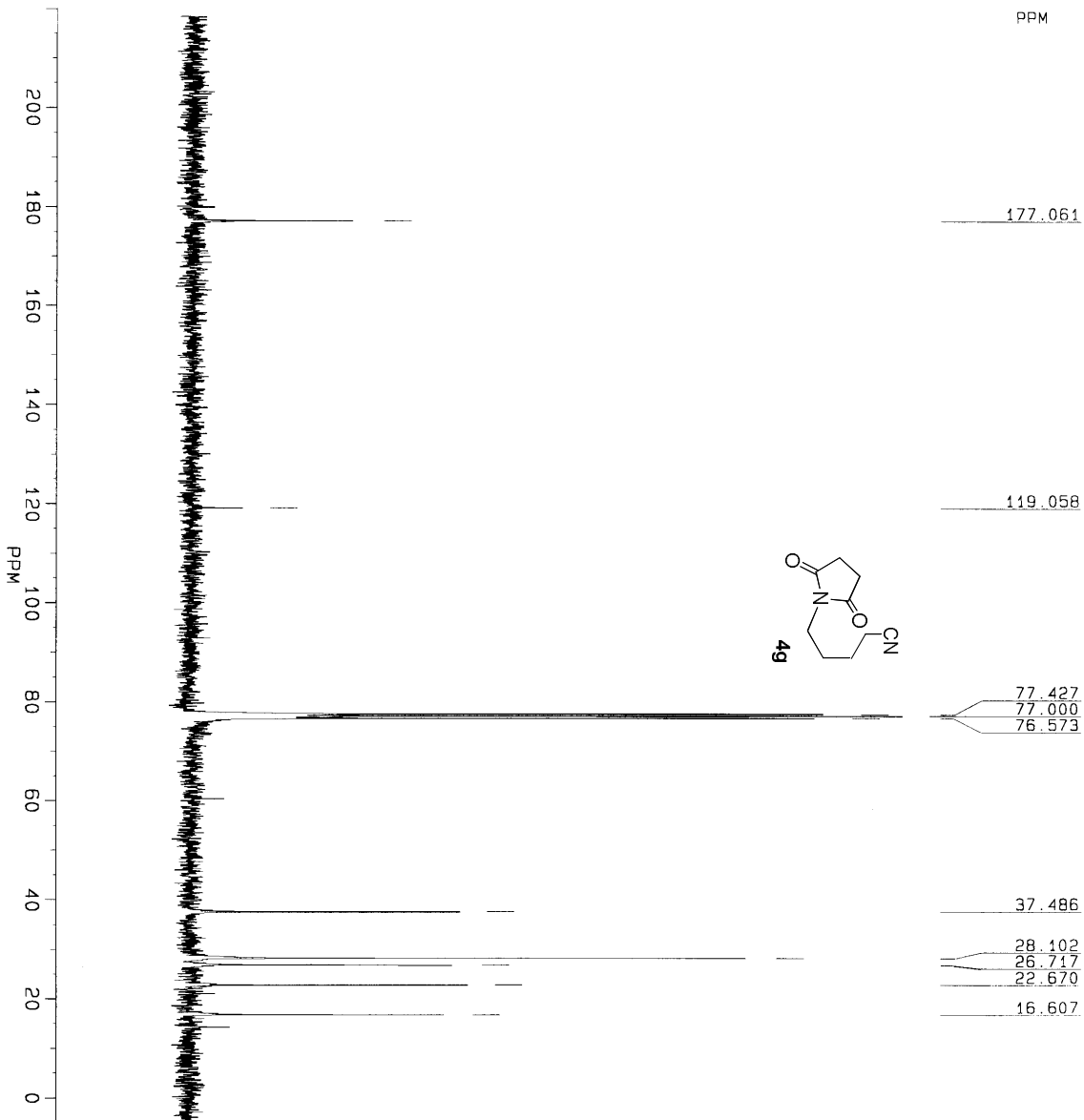


FFLF20.002
DATE 22-1-1

SF 75.469
SY 75.0
O1 6147.202
SI 16384
TD 16384
SW 17857.143
HZ/PT 2.180
PW 4.0
RD 3.000
AG 459
RG 200
NS 706
TE 297
FW 22400
O2 4004.452
DP 20H BB
LB 2.000
GB 0.0
CX 20.50
CY 10.00
F1 220.004P
F2 5.001P
HZ/CM 828.334
PPM/CM 10.976
SR -1401.20



BMR
 FFLF16.001
 DATE 1-2-1
 SF 300.133
 SY 210.0
 O1 4800.000
 SI 8192
 TD 8192
 SW 4504.505
 HZ/Pt 1.100
 PM 5.0
 RD 2.500
 AG .909
 RG 4
 NS 8
 TE 297
 FM 5700
 O2 5684.205
 DP 4L P0
 LB 0.0
 GB 0.0
 CX 20.50
 CY 6.00
 F1 10.004P
 F2 .200P
 HZ/CM 149.349
 PPM/CM .498
 SR 3367.75



FFLF16.002
DATE 26-1-1

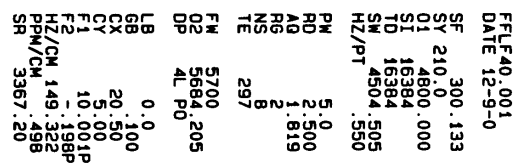
SF 75.469
SY 75.0
O1 8147.202
S1 16384
TD 16384
SW 17857.143
HZ/PT 2.180

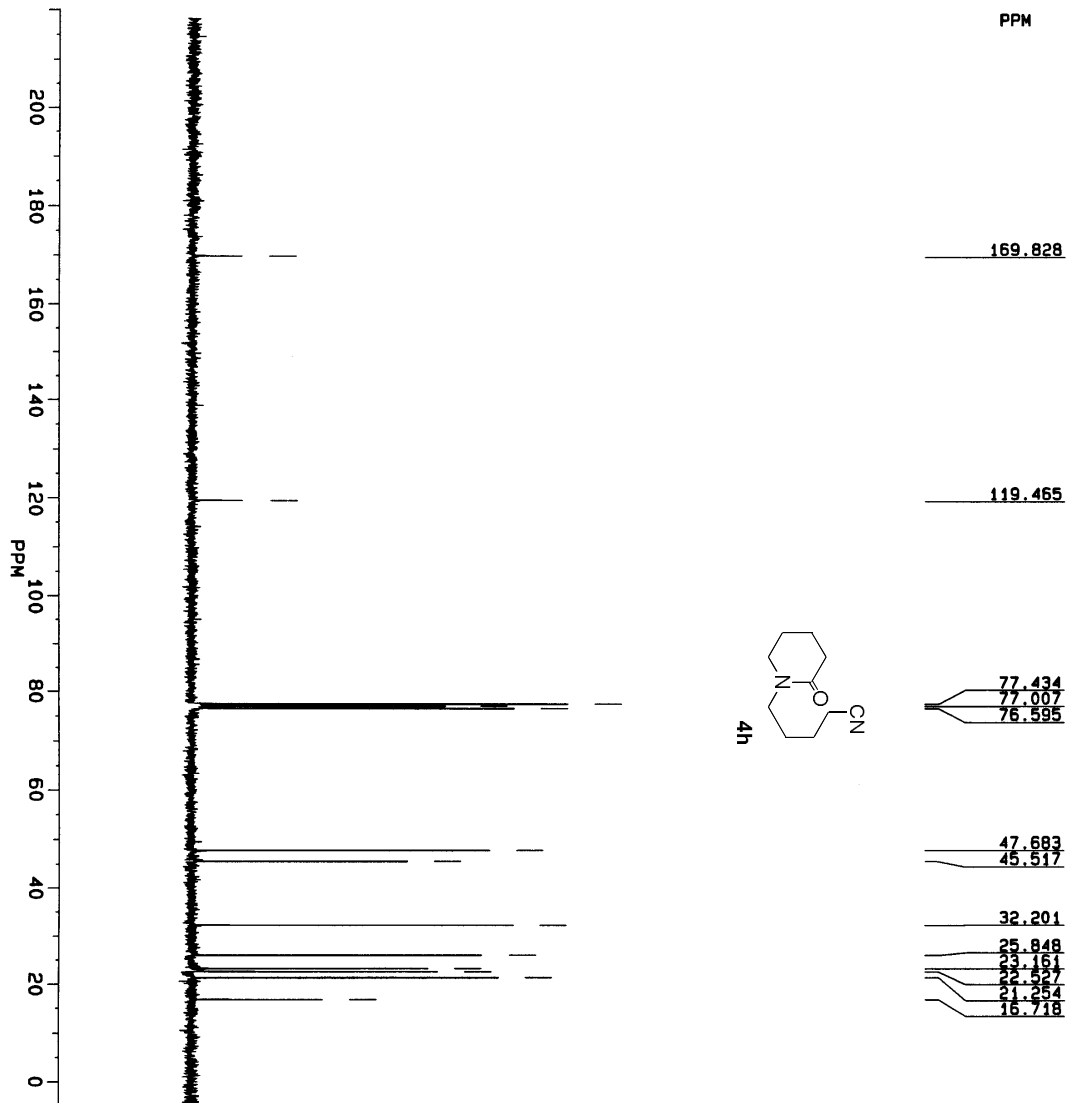
PM 4.0
RD 3.000
AQ .459
RG 200
NS 5367
TE 297

FW 22400
O2 4004.452
DP 20H BB

LB 2.000
GB 0.0
CX 20.50
CY 13.00
F1 220.004P
F2 -5.001P
HZ/CM 828.334
PPM/CM 10.976
SR -1403.38

B
X
R





FFLF40.002
DATE 12-9-0

SF 75.469
SY 75.0
O1 6147.202
S1 16384
TD 16384
SW 17857.143
HZ/PT 2.180

PM 4.0
RD 3.000
AQ .459
RG 200
NS 2922
TE 297

FW 22400
O2 4004.452
DP 20H BB

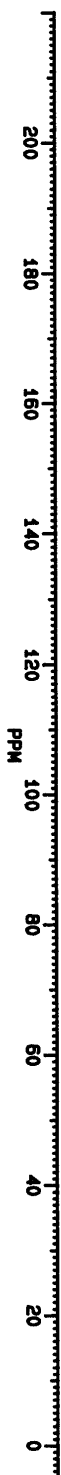
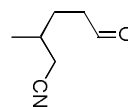
LB .400
GB 0.0
CX 20.50
CY 6.00
F1 220.004P
F2 -5.001P
HZ/CM 828.334
PPM/CM 10.976
SR -1401.20





V06ARC13.012
DATE 27-1-98
TIME 17:26

SA NO TEMP 101
SOLVENT CDCl3
SF 78.0
SI 8147.202
SI 16384
TD 16384
SM 17857.143
HZ/PT 2.180
PM 4.0
RD 3.000
AB .459
RG 200
NS 1984
TE 297
FM 22400
O2 4003.452
DP 20H 9B
LB 2.000
GB .100
CX 25.00
CY 15.00
F1 220.004P
F2 -8.001P
HZ/CM 678.234
PPM/CM 9.000
SR -1401.20



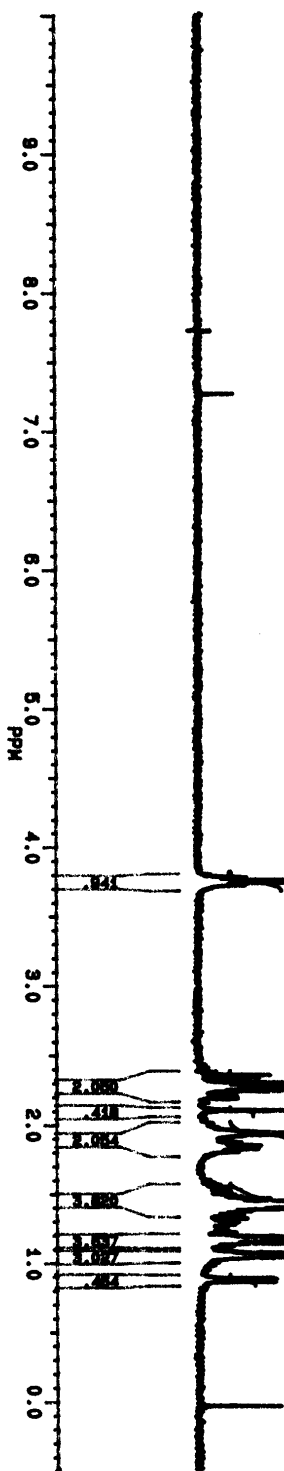
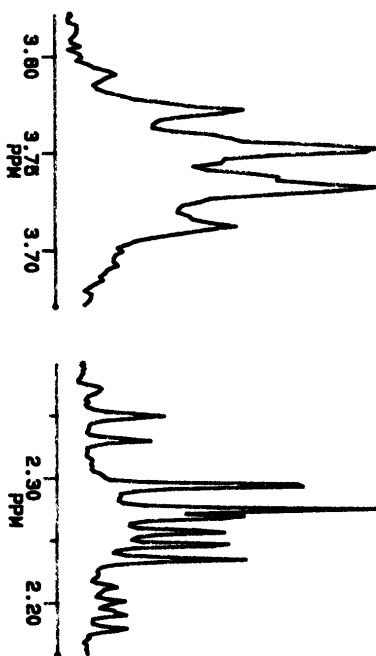
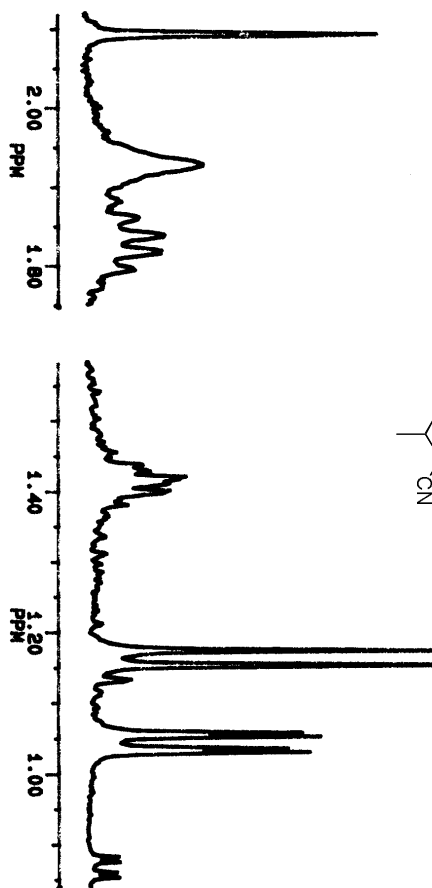
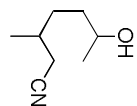
~~BUNEF~~

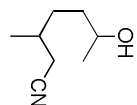
FLYA.004
DATE 10-5-98
TIME 11:42

SA, NO TEMP 101
SOLVENT CDCl3
SF 300.133
SY 210.0
O1 4800.000
S1 16384
TD 16384
SH 4804.505
HZ/PT .880

PM 5.0
RD 2.800
AG 1.819
R8 200
NS 16
TE 287
FW 5700
O2 5684.205
DP 4L P0

LB .200
GB .100
CX 25.00
CY 15.00
F1 10.004P
F2 -488P
HZ/CM 126.051
PPM/CM 420
SR 3367.75





PPM

VACA.002
DATE 11-5-98
TIME 16:34

SA. NO TEMP 101

SOLVENT CCl3

SF 75.0

SI 61.47.202

TD 16384

SW 17867.143

HZ/PT 2.180

PM 4.0

RD 3.000

RS 200.459

NS 1425

TE 287

FV 22400

O2 4004.452

DP 20H BB

LB 3.000

CB 25.100

CY 15.00

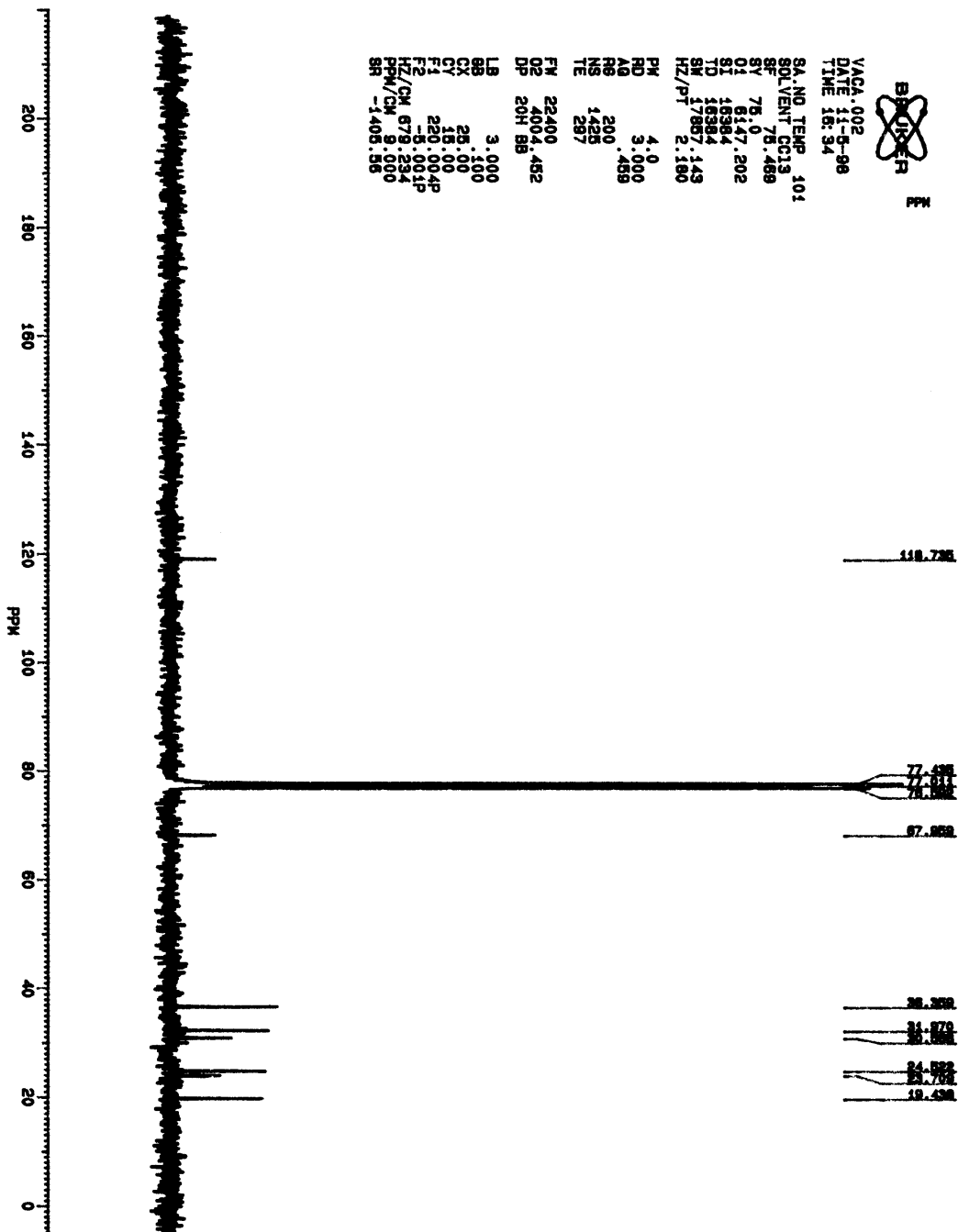
F1 220.004P

F2 -5.001P

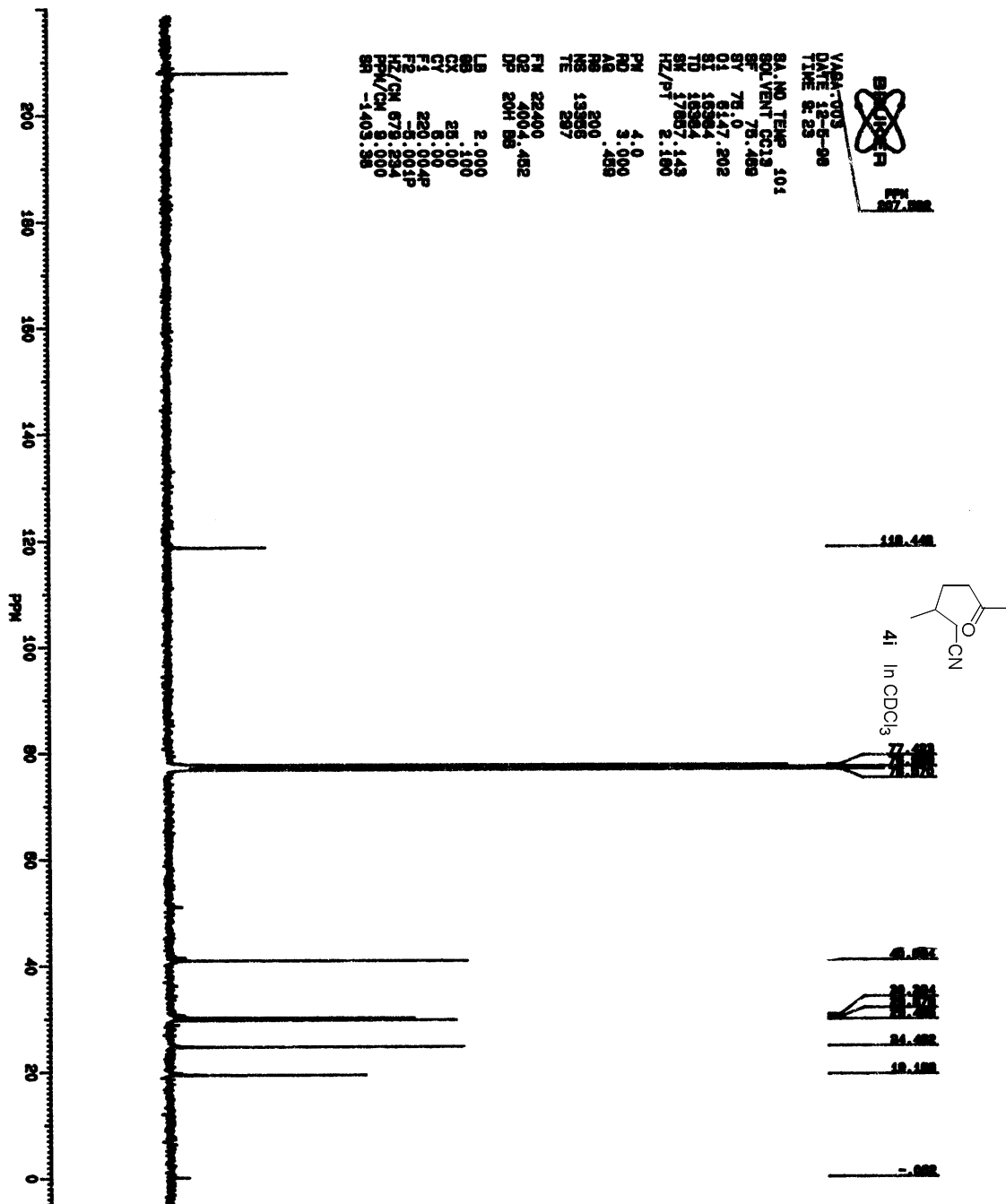
HZ/CM 678.234

PPM/CM 9.000

SR -1405.56

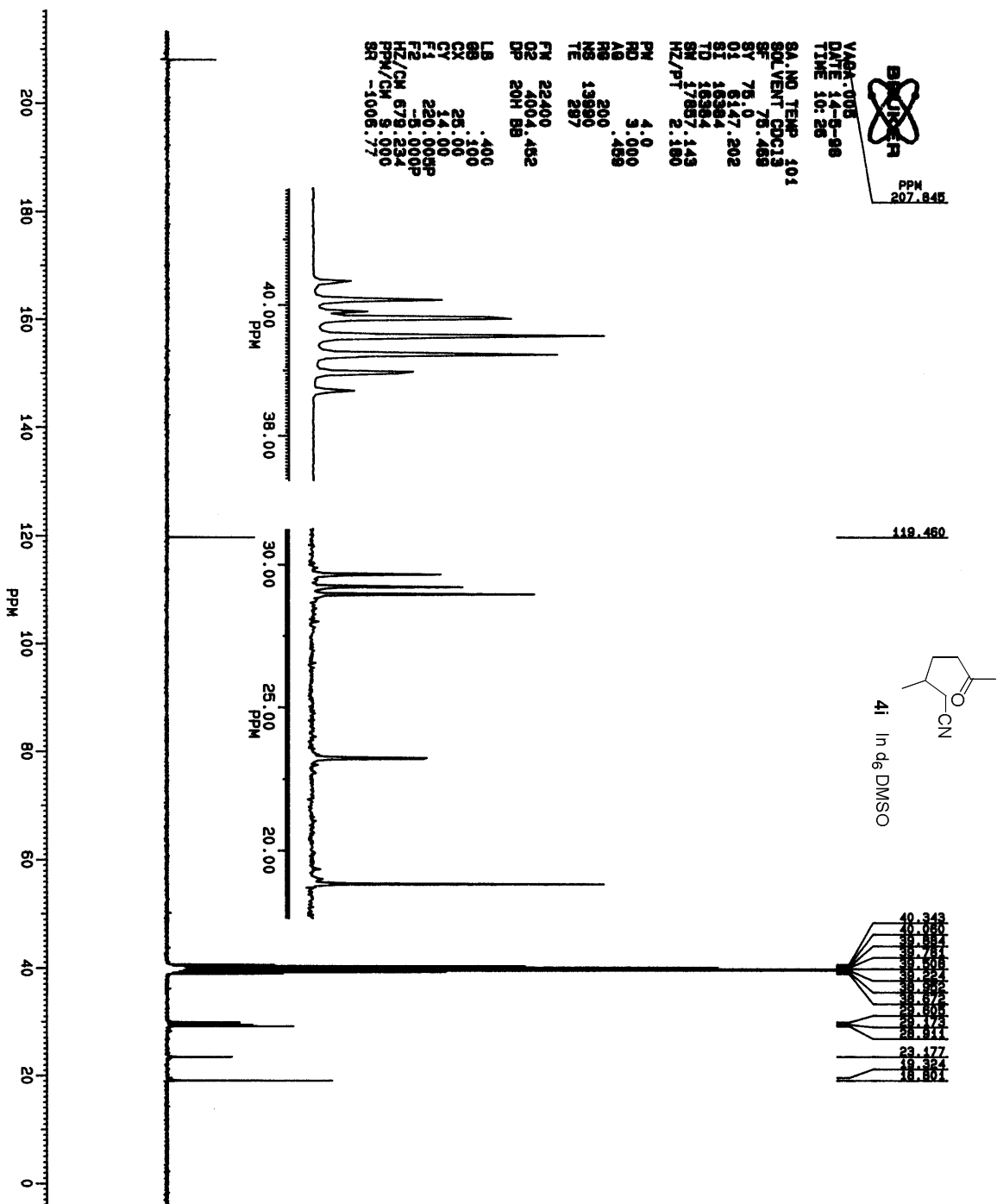






PPM
207.845

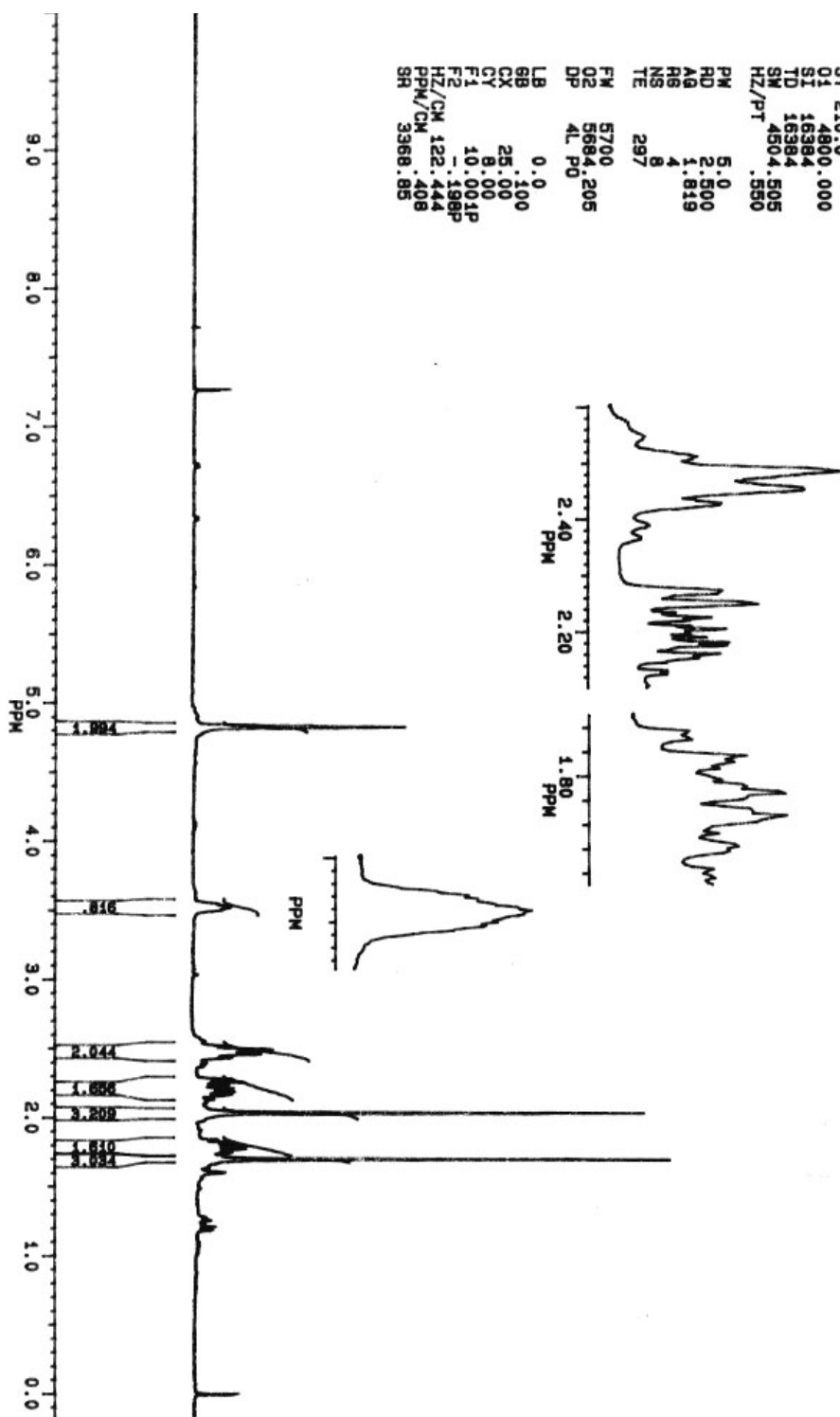
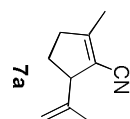
SA, ND TEMP	10.1
SOLVENT	CDCl ₃
BF	75.468
CF	75.0
CI	81.7
OT	81.7
91	168.4
92	168.4
10	168.4
11	168.4
HZ/PT	143
	2.160
PM	4.0
RD	5.000
AB	.468
NS	200
NR	13980
TE	287
FM	22400
02	400.4
DP	201 BB
LB	.400
CY	25.100
CI	41.00
F1	225.000P
F2	225.000P
HZ/CM	678.224
PM/CM	5.000
PR-1000	.77

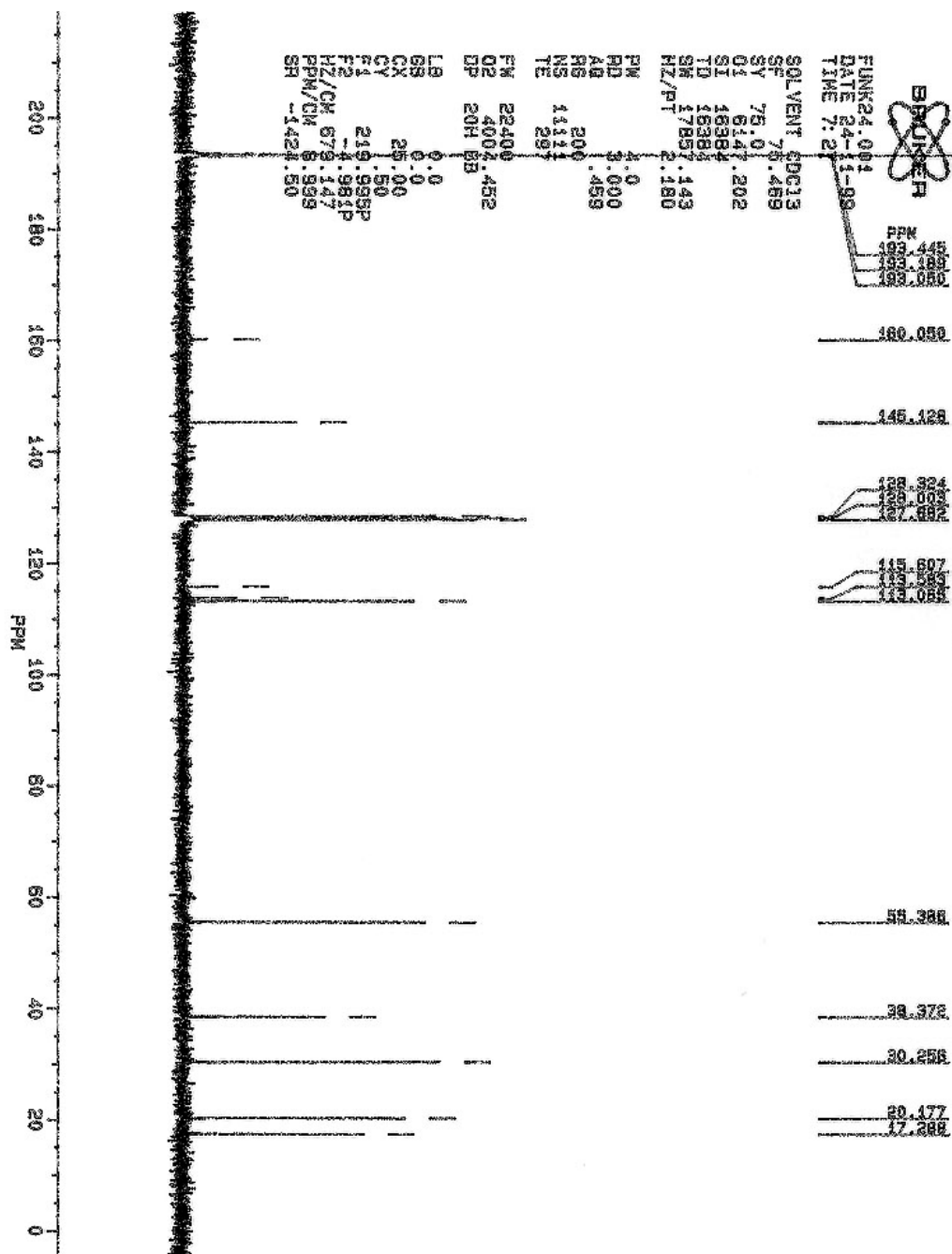
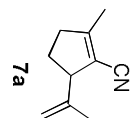




F. 002
DATE 29-10-99
TIME 6:37

SA. NO. TEMP. 101
SOLVENT CDCl₃
SF 210.0
SY 210.0
O1 4800.000
SI 16384
TD 16384
SW 4504.505
HZ/PT .550
PM 5.0
RD 2.500
AG 1.819
RG 4
NS 8
TE 297
FW 5700
O2 5684.205
DP 4L P0
LB 0.0
GB 0.100
CX 25.00
CY 8.00
F1 10.001P
F2 -198P
HZ/CN 122.444
PM/CN .408
SR 3368.85







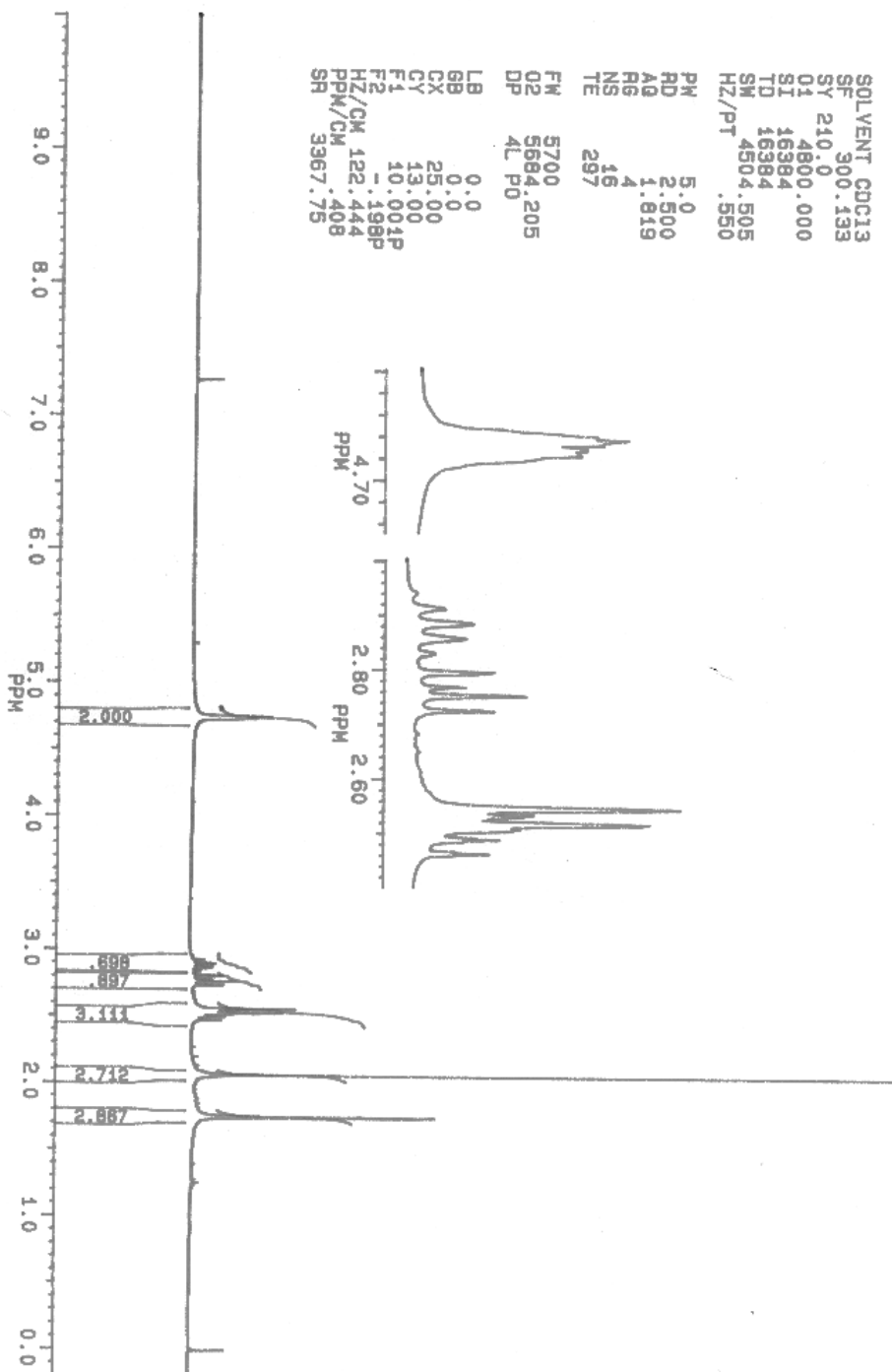
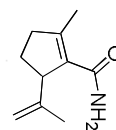
FUNK14.004
DATE 28-10-99
TIME 21:32

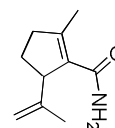
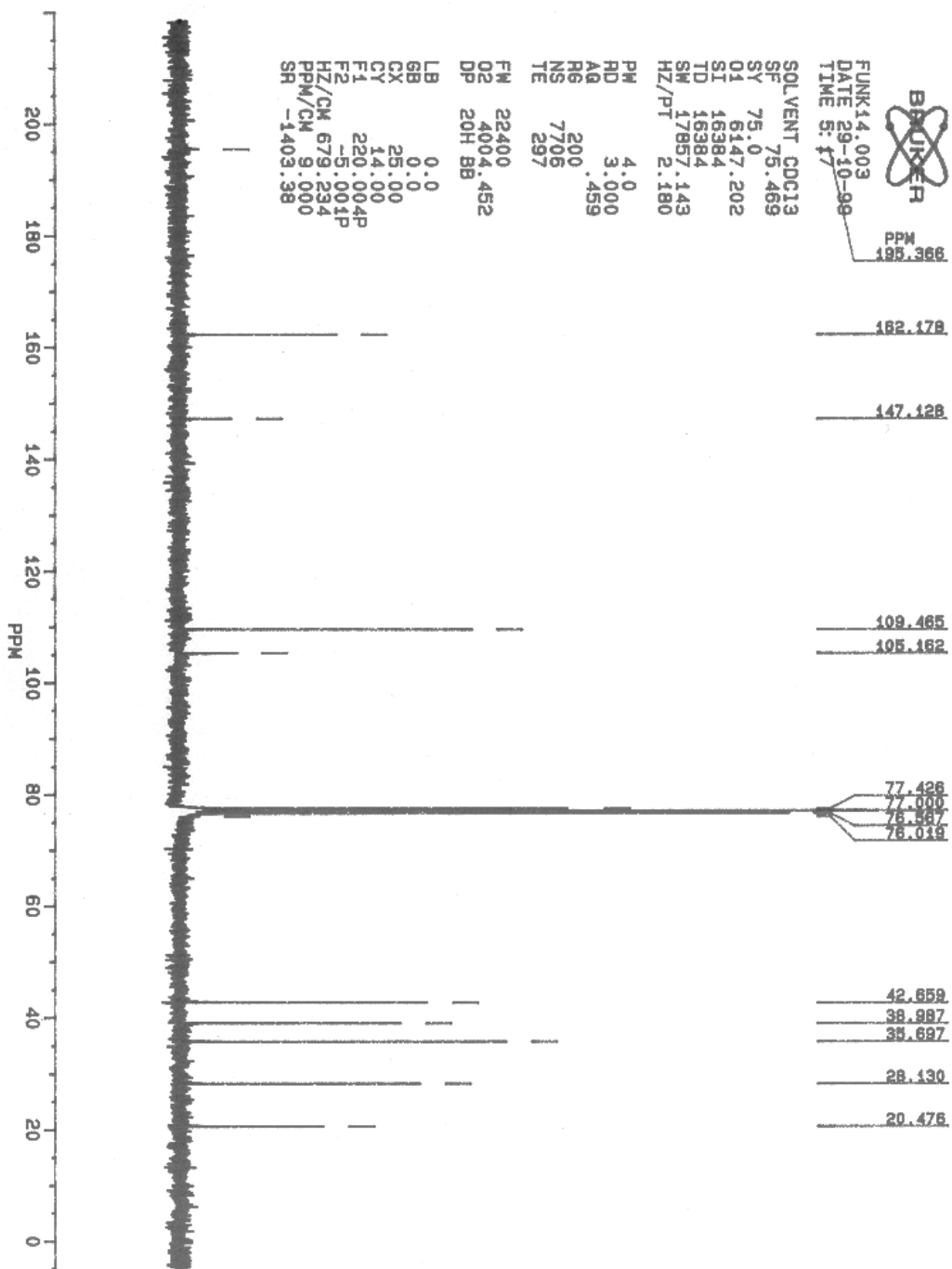
SOLVENT CDCl3
SF 210.0
SY 210.0
O1 4800.000
SI 16384
TD 16384
SM 4504.505
HZ/PT .550

PM 5.0
RD 2.500
AG 1.819
RG 4
NS 16
TE 297

FM 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 25.00
CY 13.00
F1 10.004P
F2 -198P
HZ/CM 122.444
PPM/CM 3367.75
SR 3367.75

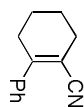




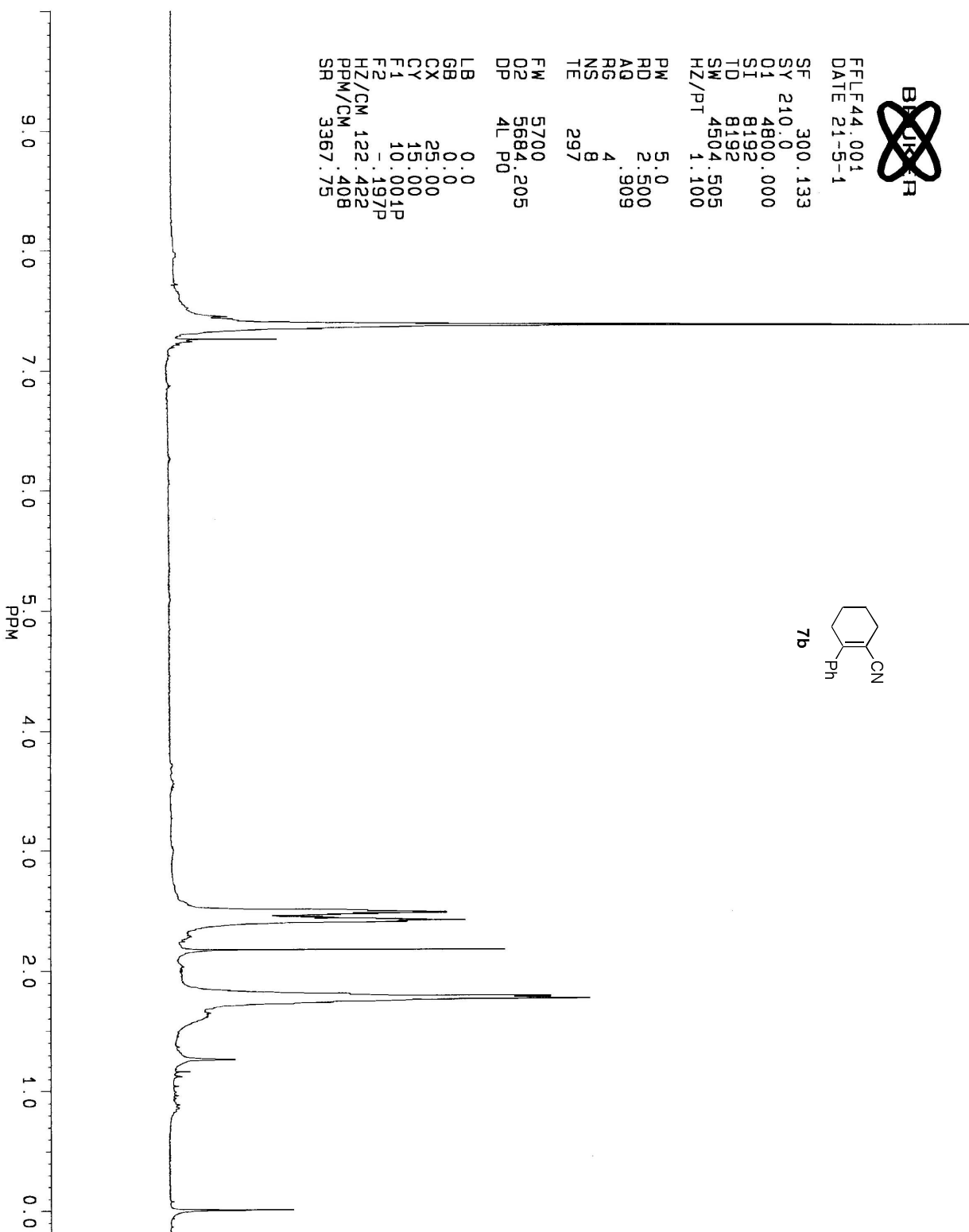


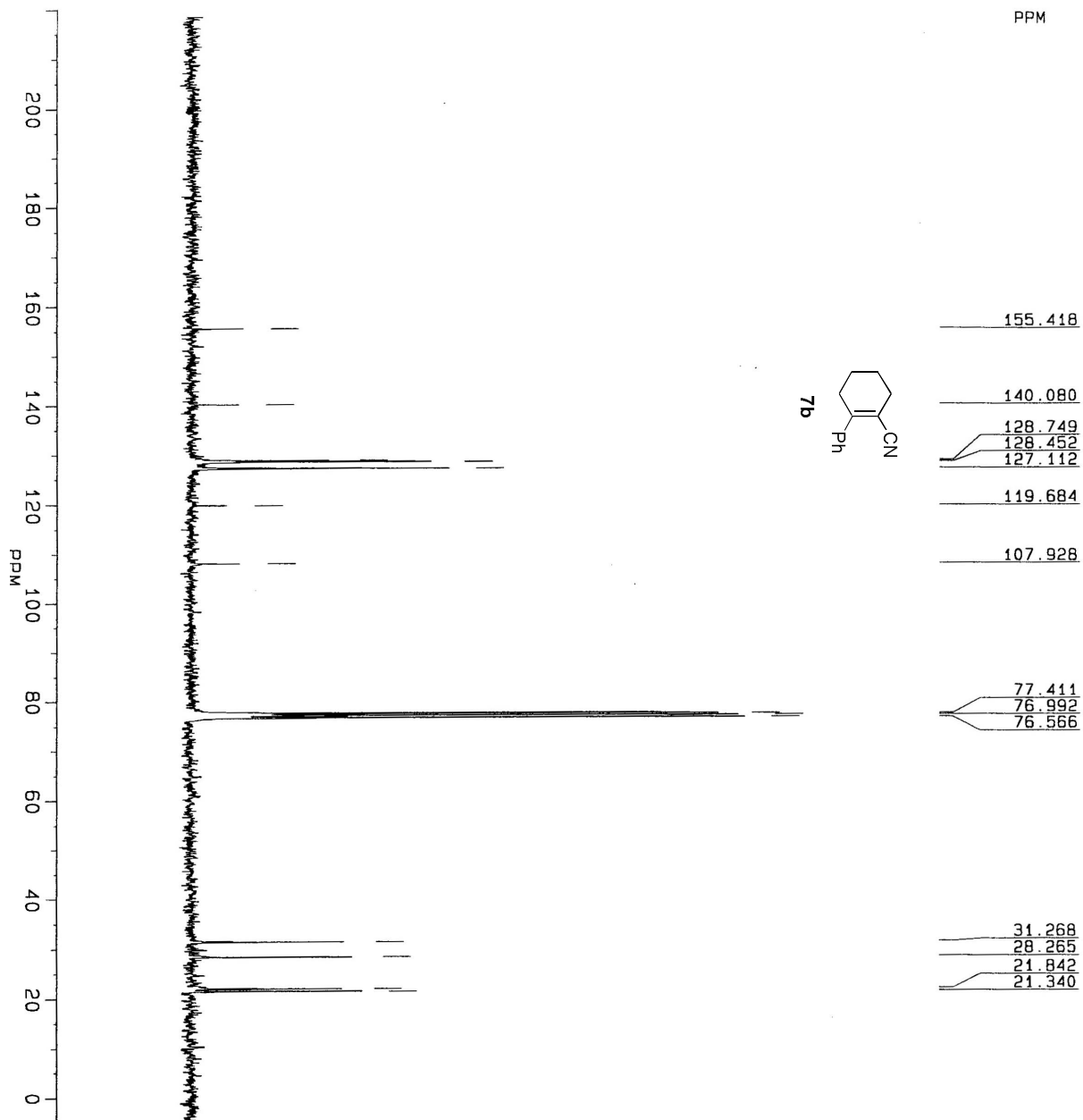
FFLF44.001
DATE 21-5-1

SF	300.133
SY	210.0
O1	4800.000
SI	8192
TD	8192
SW	4504.505
HZ/PT	1.100
PW	5.0
RD	2.500
AG	.909
RG	4
NS	8
TE	297
FW	5700
O2	5684.205
DP	4L P0
LB	0.0
GB	0.0
CX	25.00
CY	15.00
F1	10.001P
F2	-197P
HZ/CM	122.422
PPM/CM	.408
SR	3367.75



7b





FFLF119.002
DATE 29-5-1

SF 75.469
SY 75.0
O1 6147.202
S1 16384
TD 16384
SW 17857.143
HZ/PT 2.180

PW 4.0
RD 3.000
AQ .459
RG 200
NS 4208
TE 297

FW 22400
O2 4004.452
DP 20H BB

LB 4.000
GB 0 0
CX 20.50
CY 10.00
F1 220.004P
F2 -5.001P
HZ/CM 828.334
PM/CM 10.976
SR -1403.38



~~BRUKER~~

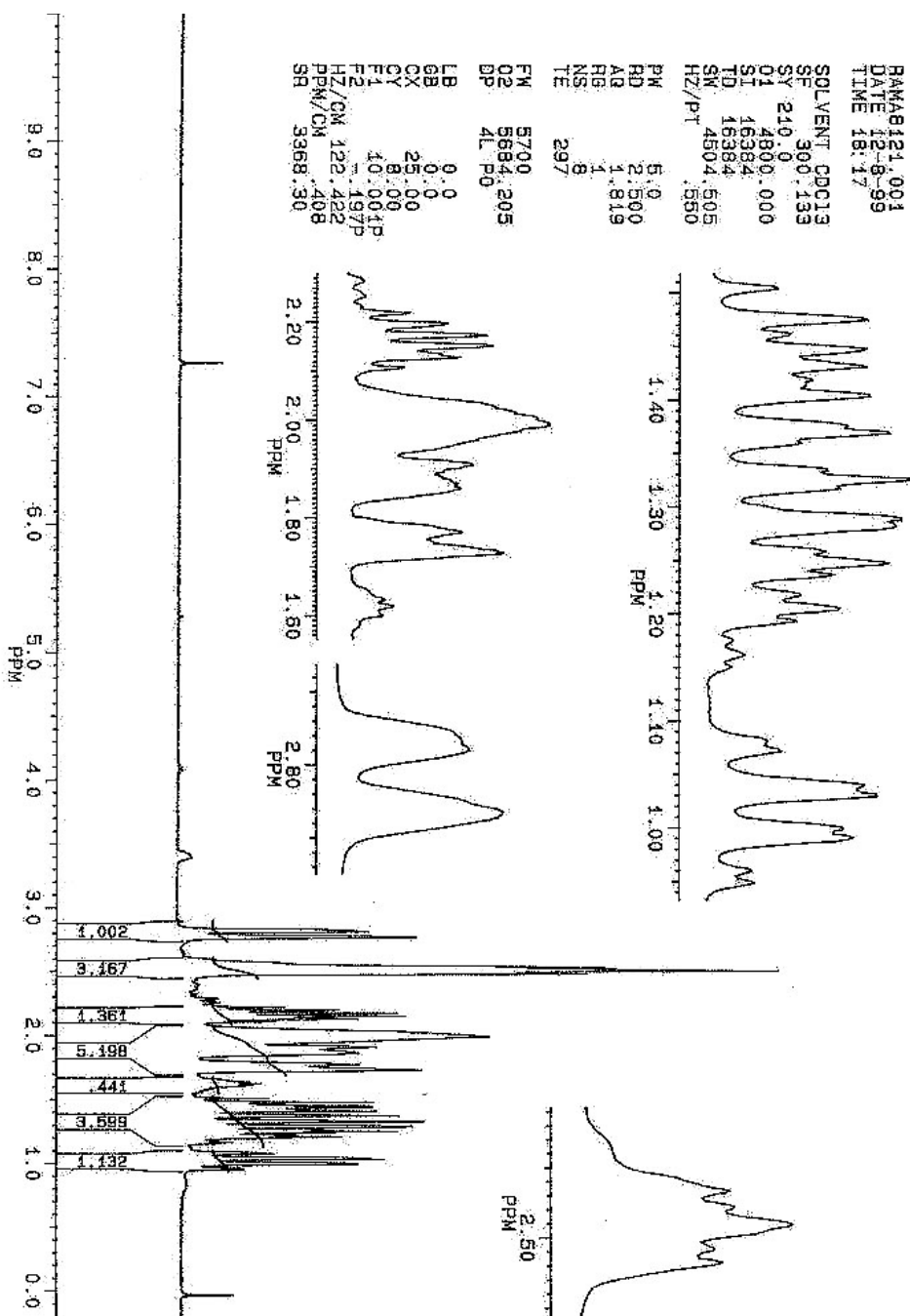
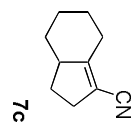
RAMA8121.001
DATE 12-8-99
TIME 18:17

SOLVENT CDCl3
SC 300.133
SY 210.0
O1 4800.000
SI 16384
TD 16384
SN 4504.505
HZ/PT .560

PM 5.0
RD 2.500
AG 1.819
RG 1
NS 8
TE 297

FW 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 25.00
CY 8.00
F1 10.001P
F2 197P
HZ/CM 122.422
PPM/CM 3368.30
SR





PPM

RAMA8121.101
DATE 12-8-99
TIME 22:34

SOLVENT CDCl₃
SF 75.0
O1 6147.202
SI 16384
TD 16384
SM 17857.143
HZ/PT 2.180

PM 4.0
RD 3.000
RG 200
NS 4107
TE 297

FM 22400
O2 4004.452
DP 20H BB

LB 0.0
GB 0.0
CX 25.00
CY .50
F1 220.004P
F2 -.495P
HZ/CM 665.632
PPM/CM 8.820
SR -1396.84

166.018

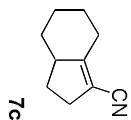
116.773

104.095

77.410
76.999
76.567

46.612

34.857
32.633
29.574
28.331
26.195
25.040





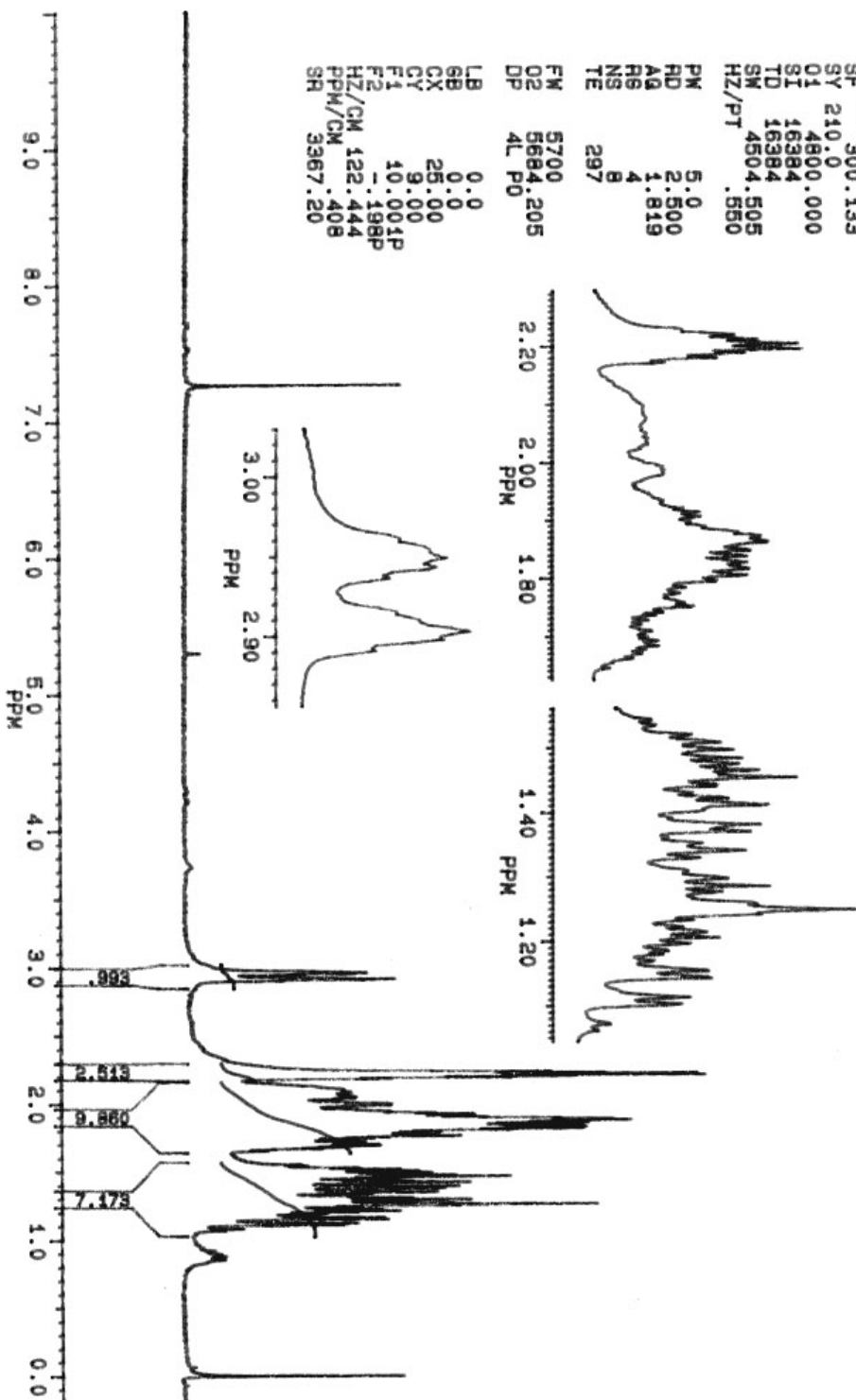
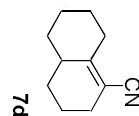
RAMA1112.001
DATE 12-11-99
TIME 13:17

SOLVENT CDCl₃
SF 300.133
SY 210.0
O1 4800.000
SI 16384
TD 16384
SM 4504.505
HZ/PT .550

PM 5.0
RD 2.500
AG 1.819
RS 4
NS 8
TE 297

FM 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 25.00
CY 9.00
F1 10.004P
F2 -1.198P
HZ/CM 122.444
PPM/CM 408
SR 3367.20





PPM

RAMAZI.101
DATE 12-11-99
TIME 5:57

SA. NO TEMP 101
SOLVENT CDCl3

SF 75.0
O1 6147.202
SI 16384
TD 16384
SM 17857.143
HZ/PT 2.180

PM 4.0
RD 3.000
AG 459
HS 200
NS 12274
TE 297

FM 22400
O2 4004.452
DP 20H BB

LB 0.0
GB 0.100
CX 25.00
CY .50
F1 220.004P
F2 -495P
HZ/CM 665.632
PPM/CM 8.820
SR -1403.38

159.651

119.187

104.238

77.406
76.848
76.867

86.142
85.113
84.084
82.954
81.824
80.694
79.564
78.434
77.304
76.174
75.044
73.914
72.784
71.654
70.524
69.394
68.264
67.134
66.004
64.874
63.744
62.614
61.484
60.354
59.224
58.094
56.964
55.834
54.704
53.574
52.444
51.314
50.184
49.054
47.924
46.794
45.664
44.534
43.404
42.274
41.144
40.014
38.884
37.754
36.624
35.494
34.364
33.234
32.104
30.974
29.844
28.714
27.584
26.454
25.324
24.194
23.064
21.934
20.804
19.674
18.544
17.414
16.284
15.154
14.024
12.894
11.764
10.634
9.504
8.374
7.244
6.114
4.984
3.854
2.724
1.594
0.464
-0.674
-1.804
-2.934
-4.064
-5.194
-6.324
-7.454
-8.584
-9.714
-10.844
-11.974
-13.104
-14.234
-15.364
-16.494
-17.624
-18.754
-19.884
-21.014
-22.144
-23.274
-24.404
-25.534
-26.664
-27.794
-28.924
-30.054
-31.184
-32.314
-33.444
-34.574
-35.704
-36.834
-37.964
-39.094
-40.224
-41.354
-42.484
-43.614
-44.744
-45.874
-47.004
-48.134
-49.264
-50.394
-51.524
-52.654
-53.784
-54.914
-56.044
-57.174
-58.304
-59.434
-60.564
-61.694
-62.824
-63.954
-65.084
-66.214
-67.344
-68.474
-69.604
-70.734
-71.864
-72.994
-74.124
-75.254
-76.384
-77.514
-78.644
-79.774
-80.904
-82.034
-83.164
-84.294
-85.424
-86.554
-87.684
-88.814
-89.944
-91.074
-92.204
-93.334
-94.464
-95.594
-96.724
-97.854
-98.984
-100.114
-101.244
-102.374
-103.504
-104.634
-105.764
-106.894
-108.024
-109.154
-110.284
-111.414
-112.544
-113.674
-114.804
-115.934
-117.064
-118.194
-119.324
-120.454
-121.584
-122.714
-123.844
-124.974
-126.104
-127.234
-128.364
-129.494
-130.624
-131.754
-132.884
-134.014
-135.144
-136.274
-137.404
-138.534
-139.664
-140.794
-141.924
-143.054
-144.184
-145.314
-146.444
-147.574
-148.704
-149.834
-150.964
-152.094
-153.224
-154.354
-155.484
-156.614
-157.744
-158.874
-160.004
-161.134
-162.264
-163.394
-164.524
-165.654
-166.784
-167.914
-169.044
-170.174
-171.304
-172.434
-173.564
-174.694
-175.824
-176.954
-178.084
-179.214
-180.344
-181.474
-182.604
-183.734
-184.864
-185.994
-187.124
-188.254
-189.384
-190.514
-191.644
-192.774
-193.904
-195.034
-196.164
-197.294
-198.424
-199.554
-200.684
-201.814
-202.944
-204.074
-205.204
-206.334
-207.464
-208.594
-209.724
-210.854
-211.984
-213.114
-214.244
-215.374
-216.504
-217.634
-218.764
-219.894
-221.024
-222.154
-223.284
-224.414
-225.544
-226.674
-227.804
-228.934
-230.064
-231.194
-232.324
-233.454
-234.584
-235.714
-236.844
-237.974
-239.104
-240.234
-241.364
-242.494
-243.624
-244.754
-245.884
-247.014
-248.144
-249.274
-250.404
-251.534
-252.664
-253.794
-254.924
-256.054
-257.184
-258.314
-259.444
-260.574
-261.704
-262.834
-263.964
-265.094
-266.224
-267.354
-268.484
-269.614
-270.744
-271.874
-273.004
-274.134
-275.264
-276.394
-277.524
-278.654
-279.784
-280.914
-282.044
-283.174
-284.304
-285.434
-286.564
-287.694
-288.824
-289.954
-291.084
-292.214
-293.344
-294.474
-295.604
-296.734
-297.864
-298.994
-300.124
-301.254
-302.384
-303.514
-304.644
-305.774
-306.904
-308.034
-309.164
-310.294
-311.424
-312.554
-313.684
-314.814
-315.944
-317.074
-318.204
-319.334
-320.464
-321.594
-322.724
-323.854
-324.984
-326.114
-327.244
-328.374
-329.504
-330.634
-331.764
-332.894
-334.024
-335.154
-336.284
-337.414
-338.544
-339.674
-340.804
-341.934
-343.064
-344.194
-345.324
-346.454
-347.584
-348.714
-349.844
-350.974
-352.104
-353.234
-354.364
-355.494
-356.624
-357.754
-358.884
-360.014
-361.144
-362.274
-363.404
-364.534
-365.664
-366.794
-367.924
-369.054
-370.184
-371.314
-372.444
-373.574
-374.704
-375.834
-376.964
-378.094
-379.224
-380.354
-381.484
-382.614
-383.744
-384.874
-386.004
-387.134
-388.264
-389.394
-390.524
-391.654
-392.784
-393.914
-395.044
-396.174
-397.304
-398.434
-399.564
-400.694
-401.824
-402.954
-404.084
-405.214
-406.344
-407.474
-408.604
-409.734
-410.864
-411.994
-413.124
-414.254
-415.384
-416.514
-417.644
-418.774
-419.904
-421.034
-422.164
-423.294
-424.424
-425.554
-426.684
-427.814
-428.944
-430.074
-431.204
-432.334
-433.464
-434.594
-435.724
-436.854
-437.984
-439.114
-440.244
-441.374
-442.504
-443.634
-444.764
-445.894
-447.024
-448.154
-449.284
-450.414
-451.544
-452.674
-453.804
-454.934
-456.064
-457.194
-458.324
-459.454
-460.584
-461.714
-462.844
-463.974
-465.104
-466.234
-467.364
-468.494
-469.624
-470.754
-471.884
-473.014
-474.144
-475.274
-476.404
-477.534
-478.664
-479.794
-480.924
-482.054
-483.184
-484.314
-485.444
-486.574
-487.704
-488.834
-489.964
-491.094
-492.224
-493.354
-494.484
-495.614
-496.744
-497.874
-499.004
-500.134
-501.264
-502.394
-503.524
-504.654
-505.784
-506.914
-508.044
-509.174
-510.304
-511.434
-512.564
-513.694
-514.824
-515.954
-517.084
-518.214
-519.344
-520.474
-521.604
-522.734
-523.864
-524.994
-526.124
-527.254
-528.384
-529.514
-530.644
-531.774
-532.904
-534.034
-535.164
-536.294
-537.424
-538.554
-539.684
-540.814
-541.944
-543.074
-544.204
-545.334
-546.464
-547.594
-548.724
-549.854
-550.984
-552.114
-553.244
-554.374
-555.504
-556.634
-557.764
-558.894
-560.024
-561.154
-562.284
-563.414
-564.544
-565.674
-566.804
-567.934
-569.064
-570.194
-571.324
-572.454
-573.584
-574.714
-575.844
-576.974
-578.104
-579.234
-580.364
-581.494
-582.624
-583.754
-584.884
-586.014
-587.144
-588.274
-589.404
-590.534
-591.664
-592.794
-593.924
-595.054
-596.184
-597.314
-598.444
-599.574
-600.704
-601.834
-602.964
-604.094
-605.224
-606.354
-607.484
-608.614
-609.744
-610.874
-612.004
-613.134
-614.264
-615.394
-616.524
-617.654
-618.784
-619.914
-621.044
-622.174
-623.304
-624.434
-625.564
-626.694
-627.824
-628.954
-630.084
-631.214
-632.344
-633.474
-634.604
-635.734
-636.864
-637.994
-639.124
-640.254
-641.384
-642.514
-643.644
-644.774
-645.904
-647.034
-648.164
-649.294
-650.424
-651.554
-652.684
-653.814
-654.944
-656.074
-657.204
-658.334
-659.464
-660.594
-661.724
-662.854
-663.984
-665.114
-666.244
-667.374
-668.504
-669.634
-670.764
-671.894
-673.024
-674.154
-675.284
-676.414
-677.544
-678.674
-679.804
-680.934
-682.064
-683.194
-684.324
-685.454
-686.584
-687.714
-688.844
-689.974
-691.104
-692.234
-693.364
-694.494
-695.624
-696.754
-697.884
-699.014
-700.144
-701.274
-702.404
-703.534
-704.664
-705.794
-706.924
-708.054
-709.184
-710.314
-711.444
-712.574
-713.704
-714.834
-715.964
-717.094
-718.224
-719.354
-720.484
-721.614
-722.744
-723.874
-725.004
-726.134
-727.264
-728.394
-729.524
-730.654
-731.784
-732.914
-734.044
-735.174
-736.304
-737.434
-738.564
-739.694
-740.824
-741.954
-743.084
-744.214
-745.344
-746.474
-747.604
-748.734
-749.864
-750.994
-752.124
-753.254
-754.384
-755.514
-756.644
-757.774
-758.904
-760.034
-761.164
-762.294
-763.424
-764.554
-765.684
-766.814
-767.944
-769.074
-770.204
-771.334
-772.464
-773.594
-774.724
-775.854
-776.984
-778.114
-779.244
-780.374
-781.504
-782.634
-783.764
-784.894
-786.024
-787.154
-788.284
-789.414
-790.544
-791.674
-792.804
-793.934
-795.064
-796.194
-797.324
-798.454
-799.584
-800.714
-801.844
-802.974
-804.104
-805.234
-806.364
-807.494
-808.624
-809.754
-810.884
-812.014
-813.144
-814.274
-815.404
-816.534
-817.664
-818.794
-819.924
-821.054
-822.184
-823.314
-824.444
-825.574
-826.704
-827.834
-828.964
-830.094
-831.224
-832.354
-833.484
-834.614
-835.744
-836.874
-838.004
-839.134
-840.264
-841.394
-842.524
-843.654
-844.784
-845.914
-847.044
-848.174
-849.304
-850.434
-851.564
-852.694
-853.824
-854.954
-856.084
-857.214
-858.344
-859.474
-860.604
-861.734
-862.864
-863.994
-865.124
-866.254
-867.384
-868.514
-869.644
-870.774
-871.904
-873.034
-874.164
-875.294
-876.424
-877.554
-878.684
-879.814
-880.944
-882.074
-883.204
-884.334
-885.464
-886.594
-887.724
-888.854
-890.084
-891.214
-892.344
-893.474
-894.604
-895.734
-896.864
-897.994
-899.124
-900.254
-901.384
-902.514
-903.644
-904.774
-905.904
-907.034
-908.164
-909.294
-910.424
-911.554
-912.684
-913.814
-914.944
-916.074
-917.204
-918.334
-919.464
-920.594
-921.724
-922.854
-923.984
-925.114
-926.244
-927.374
-928.504
-929.634
-930.764
-931.894
-933.024
-934.154
-935.284
-936.414
-937.544
-938.674
-939.804
-940.934
-942.064
-943.194
-944.324
-945.454
-946.584
-947.714
-948.844
-949.974
-951.104
-952.234
-953.364
-954.494
-955.624
-956.754
-957.884
-959.014
-960.144
-961.274
-962.404
-963.534
-964.664
-965.794
-966.924
-968.054
-969.184
-970.314
-971.444
-972.574
-973.704
-974.834
-975.964
-977.094
-978.224
-979.354
-980.484
-981.614
-982.744
-983.874
-985.004
-986.134
-987.264
-988.394
-989.524
-990.654
-991.784
-992.914
-994.044
-995.174
-996.304
-997.434
-998.564
-999.694
-1000.824
-1001.954
-1003.084
-1004.214
-1005.344
-1006.474
-1007.604
-1008.734
-1009.864
-1010.994
-1012.124
-1013.254
-1014.384
-1015.514
-1016.644
-1017.774
-1018.904
-1020.034
-1021.164
-1022.294
-1023.424
-1024.554
-1025.684
-1026.814
-1027.944
-1029.074
-1030.204
-1031.334
-1032.464
-1033.594
-1034.724
-1035.854
-1036.984
-1038.114
-1039.244
-1040.374
-1041.504
-1042.634
-1043.764
-1044.894
-1046.024
-1047.154
-1048.284
-1049.414
-1050.544
-1051.674
-1052.804
-1053.934
-1055.064
-1056.194
-1057.324
-1058.454
-1059.584
-1060.714
-1061.844
-1062.974
-1064.104
-1065.234
-1066.364
-1067.494
-1068.624
-1069.754
-1070.884
-1072.014
-1073.144
-1074.274
-1075.404
-1076.534
-1077.664
-1078.794
-1079.924
-1081.054
-1082.184
-1083.314
-1084.444
-1085.574
-1086.704
-1087.834
-1088.964
-1090.094
-1091.224
-1092.354
-1093.484
-1094.614
-1095.744
-1096.874
-1098.004
-1099.134
-1100.264
-1101.394
-1102.524
-1103.654
-1104.784
-1105.914
-1107.044
-1108.174
-1109.304
-1110.434
-1111.564
-1112.694
-1113.824
-1114.954
-1116.084
-1117.214
-1118.344
-1119.474
-1120.604
-1121.734
-1122.864
-1123.994
-1125.124
-1126.254
-1127.384
-1128.514
-1129.644
-1130.774
-1131.904
-1133.034
-1134.164
-1135.294
-1136.424
-1137.554
-1138.684
-1139.814
-1140.944
-1142.074
-1143.204
-1144.334
-1145.464
-1146.594
-1147.724
-1148.854
-1149.984
-1151.114
-1152.244
-1153.374
-1154.504
-1155.634
-1156.764
-1157.894
-1159.024
-1160.154
-1161.284
-1162.414
-1163.544
-1164.674
-1165.804
-1166.934
-1168.064
-1169.194
-1170.324
-1171.454
-1172.584
-1173.714
-1174.844
-1175.974
-1177.104
-1178.234
-1179.364
-1180.494
-1181.624
-1182.754
-1183.884
-1185.014
-1186.144
-1187.274
-1188.404
-1189.534
-1190.664
-1191.794
-1192.924
-1194.054
-1195.184
-1196.314
-1197.444
-1198.574
-1199.704
-1200.834
-1201.964
-1203.094
-1204.224
-1205.354
-1206.484
-1207.614
-1208.744
-1209.874
-1211.004
-1212.134
-1213.264
-1214.394
-1215.524
-1216.654
-1217.784
-1218.914
-1220.044
-1221.174
-1222.304
-1223.434
-1224.564
-1225.694
-1226.824
-1227.954
-1229.084
-1230.214
-1231.344
-1232.474
-1233.604
-1234.734
-1



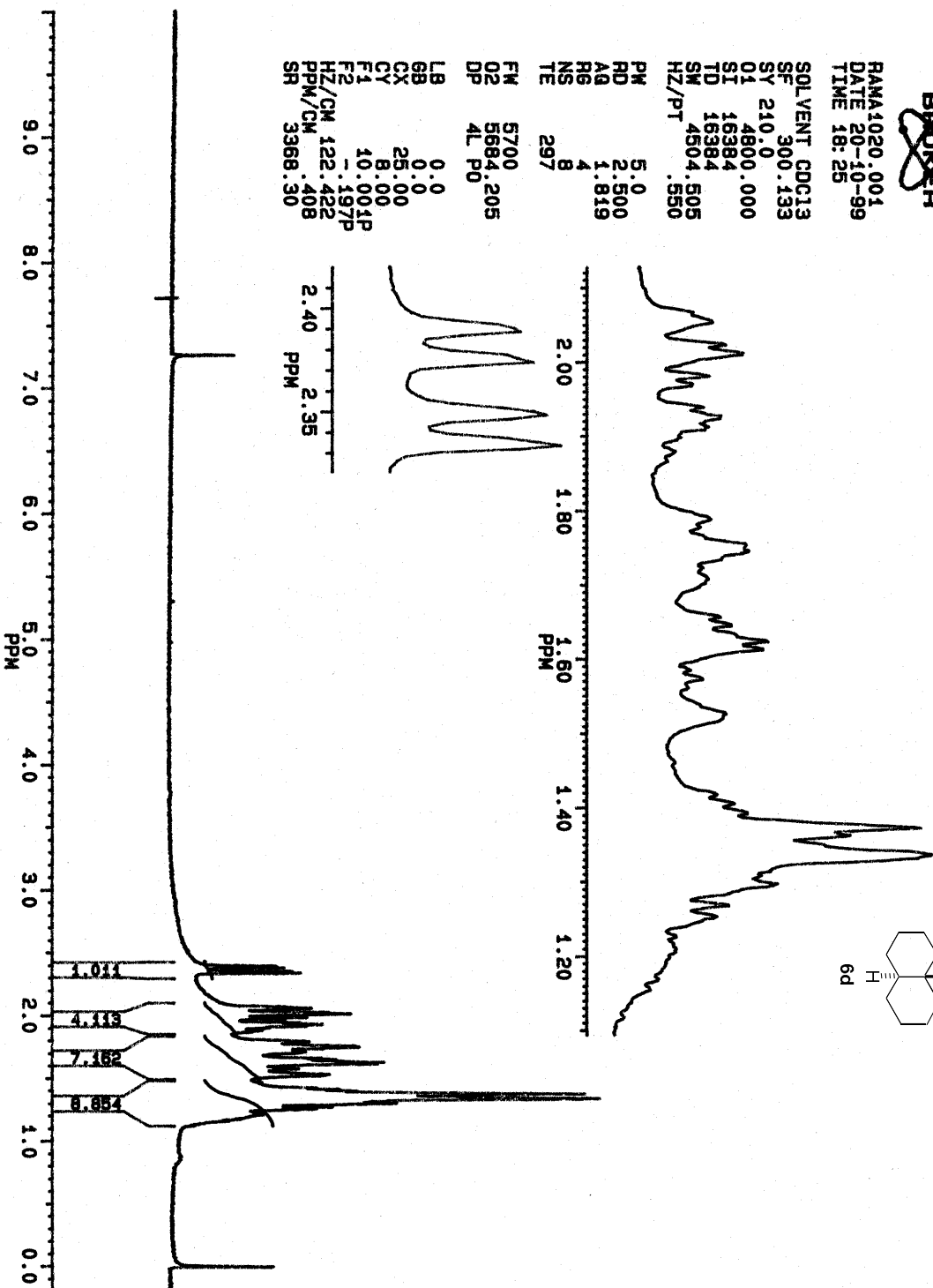
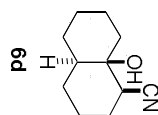
RAMA1020.001
DATE 20-10-99
TIME 18:25

SOLVENT CDCl₃
SF 300.133
SY 210.0
O1 4800.000
SI 16384
TD 16384
SM 4804.505
HZ/PT .550

PM 5.0
RD 2.500
AG 1.819
RG 4
NS 8
TE 297

FM 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 25.00
CY 8.00
F1 10.001P
F2 -197P
HZ/CM 122.422
PPM/CM .408
SR 3368.30





PPM

F.001
DATE 21-10-99
TIME 8:05

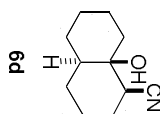
SOLVENT CDCl₃
SF 75.0
SY 75.0
O1 6147.202
SI 16384
TD 16384
SM 17867.143
HZ/PT 2.180

PM 4.0
RD 3.000
AG 200
NS 13278
TE 297

FM 22400
O2 4004.452
DP 20H BB

LB 0.0
GB 0.0
GX 25.00
CY 50
F1 220.004P
F2 -486P
HZ/CN 665.632
PPM/CN 8.820
SR -1401.20

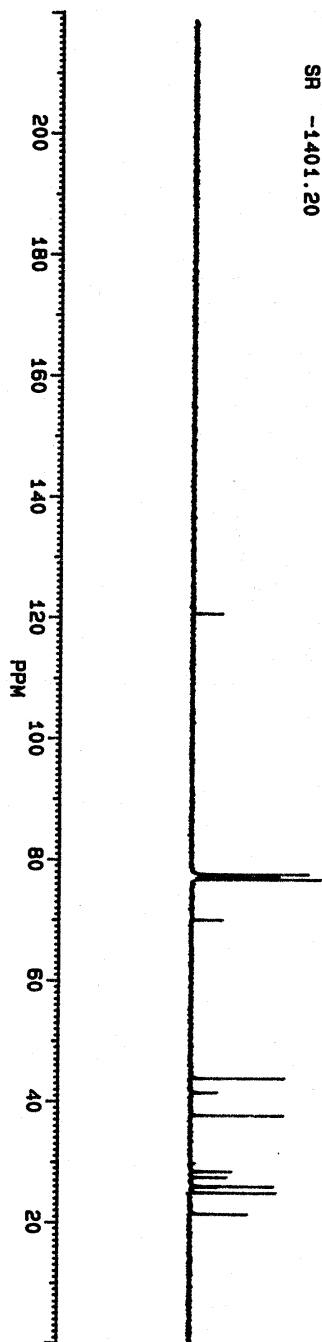
120.501

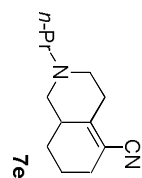


77.407
76.996
76.568
69.888

43.699
41.337
37.575

28.302
27.345
25.878
25.745
24.780
21.285





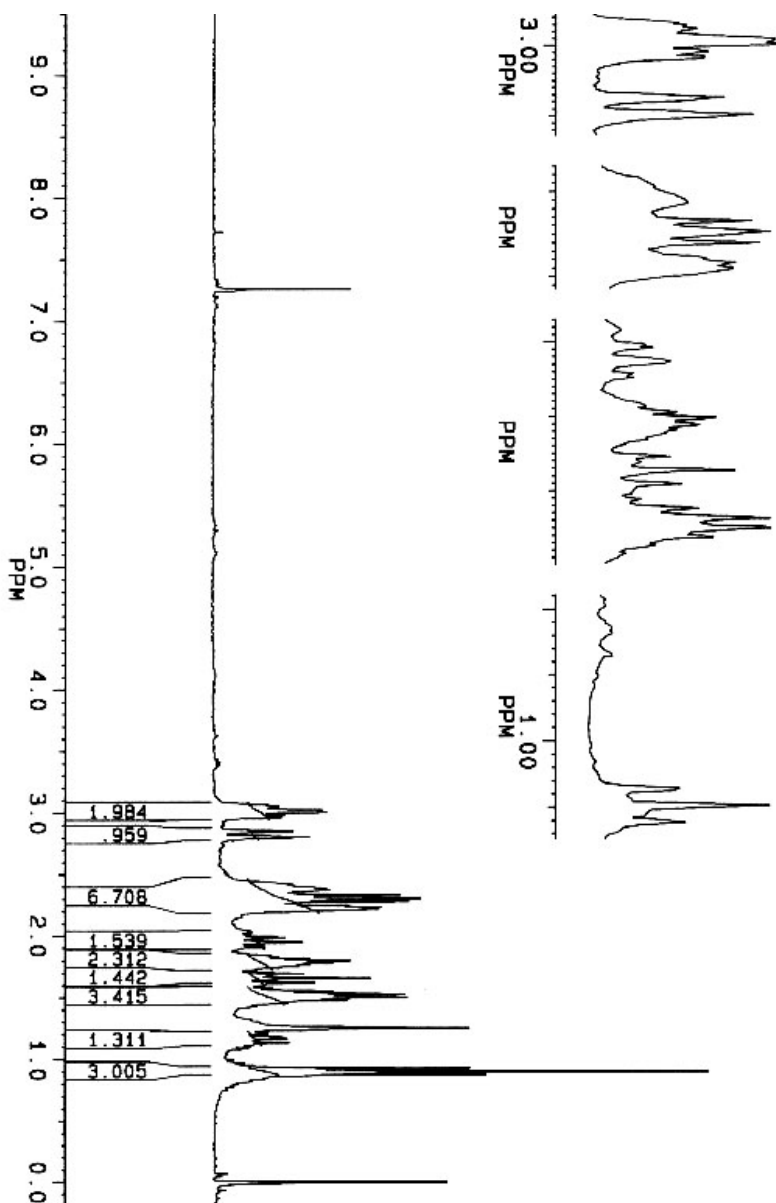
FFLF10.001
DATE 22-11-0

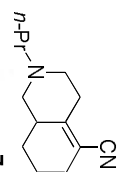
SF 300.133
SY 210.0
O1 4800.000
SI 8192
TD 8192
SM 4504.505
HZ/PT 1.100

PM 5.0
RD 2.500
AQ .909
RG 8
NS 8
TE 297

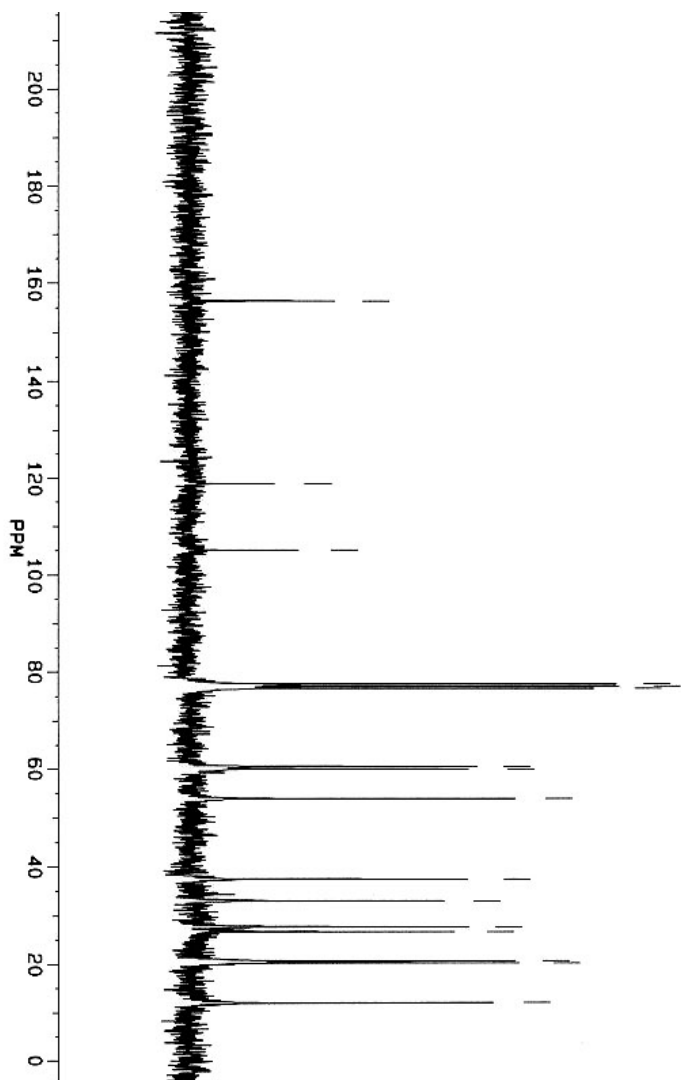
FM 5700
O2 5684.205
DP 4L P0

LB 0.0
GB 0.0
CX 20.50
CY 8.00
F1 10.001P
F2 -.200P
HZ/GM 149.349
PPM/GM .498
SR 3367.75

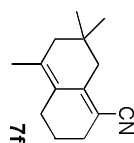




156.313
118.630
104.999
77.431
77.008
76.583
60.363
59.853
53.725
37.322
32.858
27.436
26.441
20.472
20.108
11.815



F 001
 DATE 1-3-96
 SF 75.469
 SY 75.0
 O1 6147.202
 S1 16384
 TD 16384
 SW 17857.143
 HZ/PT 2.180
 PM 4.0
 RD 3.000
 AQ .459
 RG 200
 NS 1311
 TE 297
 FW 22400
 O2 4004.452
 DP 20H BB
 LB 2.000
 GB 0.0
 CX 20.50
 CY 8.00
 F1 220.004P
 F2 -5.001P
 HZ/CW 828.334
 PPM/CW 10.976
 SR -1399.02



~~SECRET~~

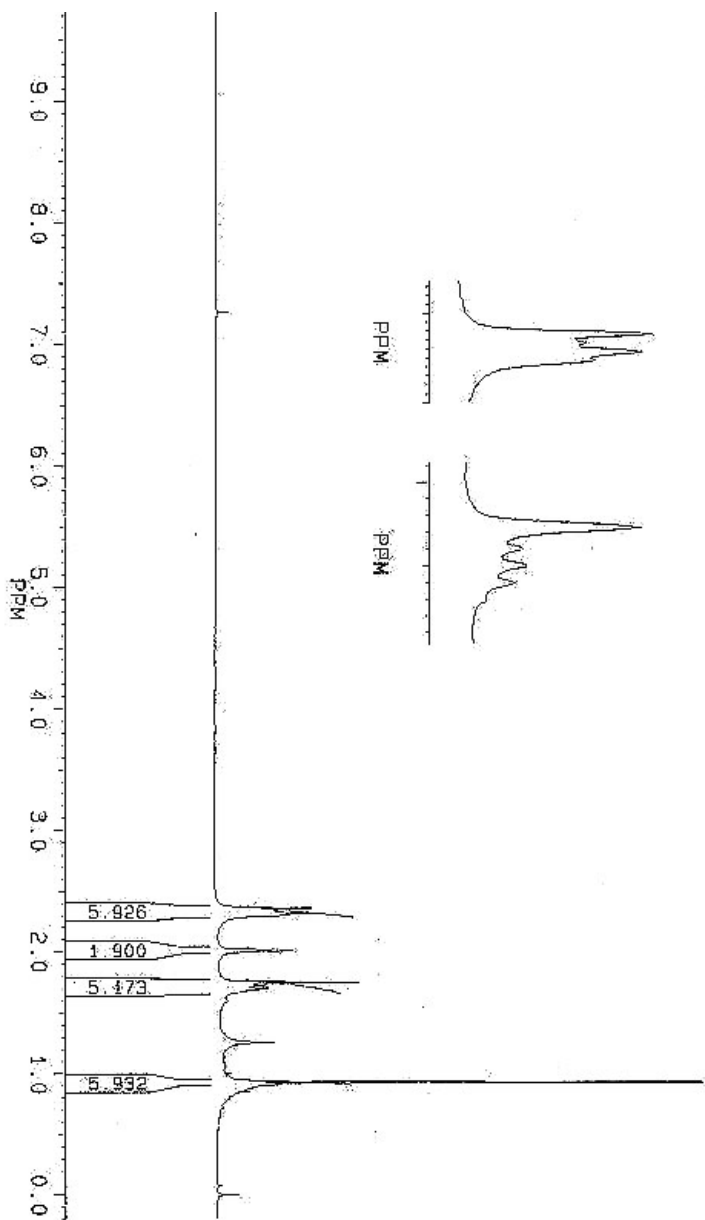
FELF50.001
DATE 5-3-1

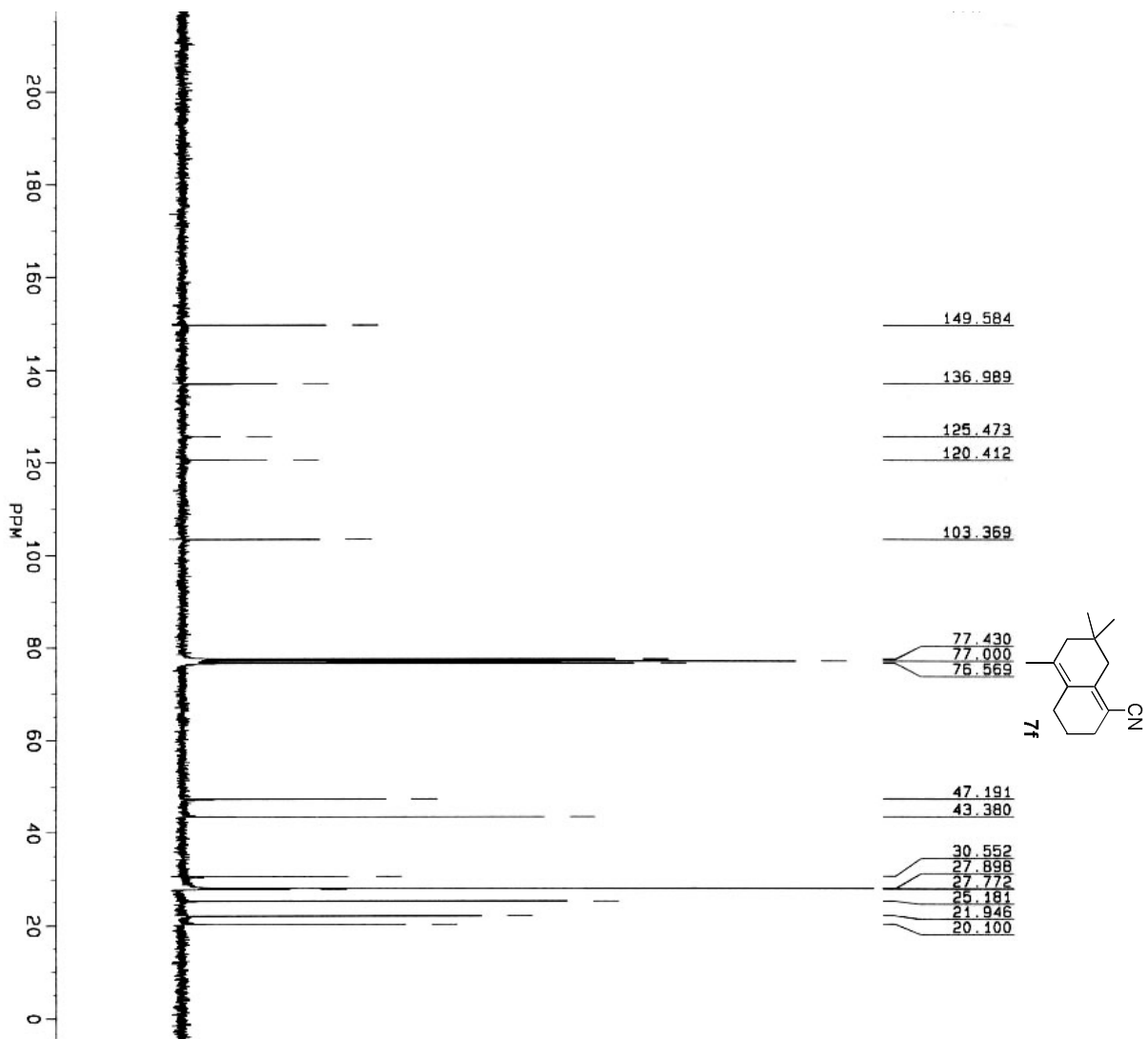
SF 300.133
SY 210.0
Q1 4800.000
S1 8192
T0 8192
SW 4504.505
HZ/P1 1.100

PM 5.0
RD 2.500
AQ 909
RG 4
NS 32
TE 297

FM 5700
O2 5684.205
OP 4L PG

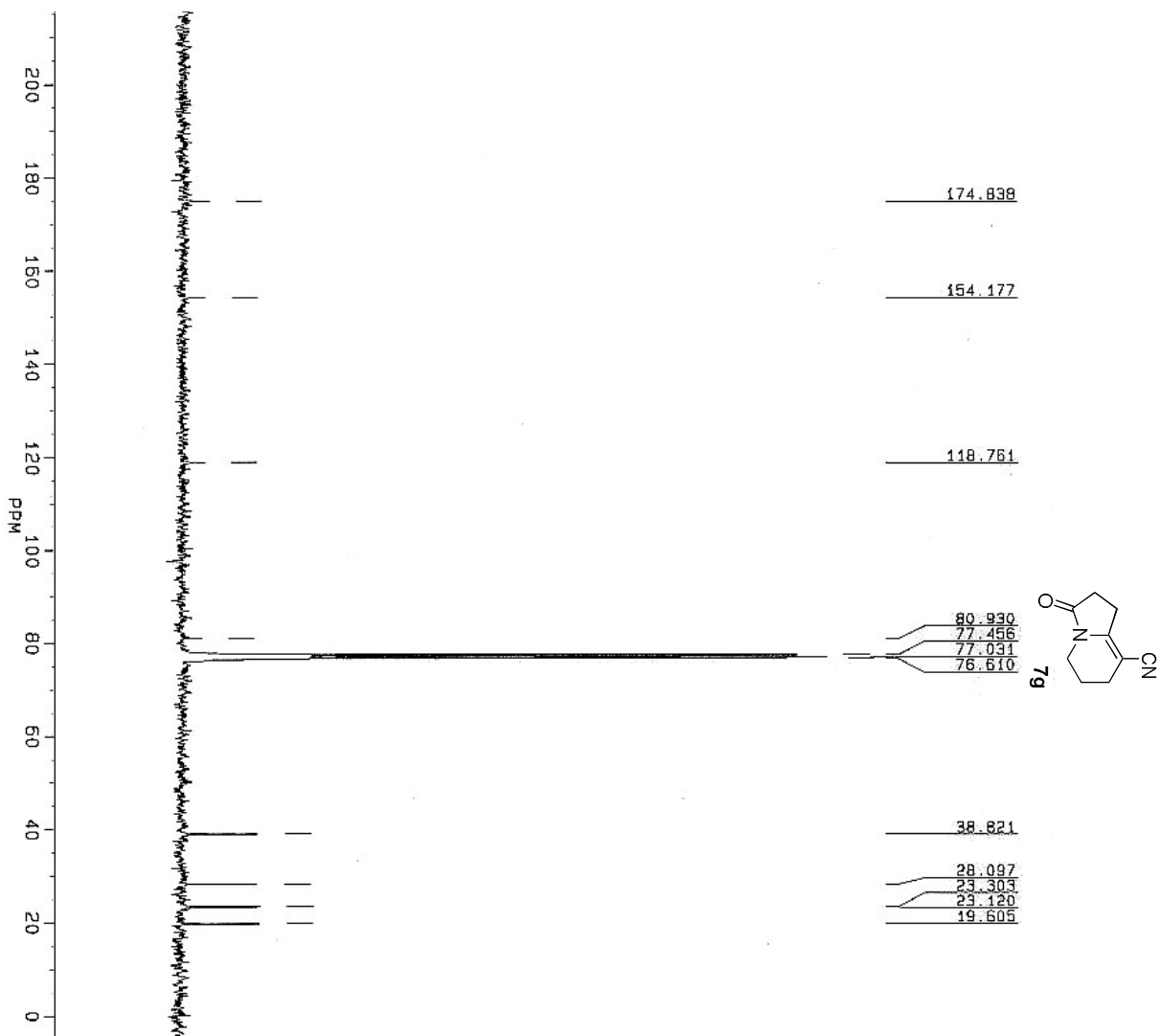
LB 0.0
GB 0.0
CX 20.50
CY 8.00
F1 10.001P
F2 200P
HZ/CM 149.349
RPM/CM 498
SR 3367.75





FILE 99.001
 DATE 29-3-1
 SF 75.469
 SY 75.0
 O1 6147.202
 SI 16384
 TD 16384
 SW 17857.143
 HZ/PT 2.180
 PM 4.0
 RD 3.000
 AG .459
 RG 200
 NS 13191
 TE 297
 FM 22400
 O2 4004.452
 DP 20H BB
 LB 0.0
 GB 0.0
 CX 20.50
 CY 12.00
 F1 220.004P
 F2 -5.001P
 HZ/CW 828.334
 PPM/CW 10.976
 SR -1403.38





FFLF21.002
DATE 25-3-1

SF 75.469
 SY 75.0
 O1 6447.202
 S1 16384
 TD 16384
 SM 17857.143
 HZ/PT 2.180

PM 4.0
 RD 3.000
 AG 459
 RG 200
 NS 7918
 TE 297

FM 22400
 D2 4004.452
 DP 20H BB

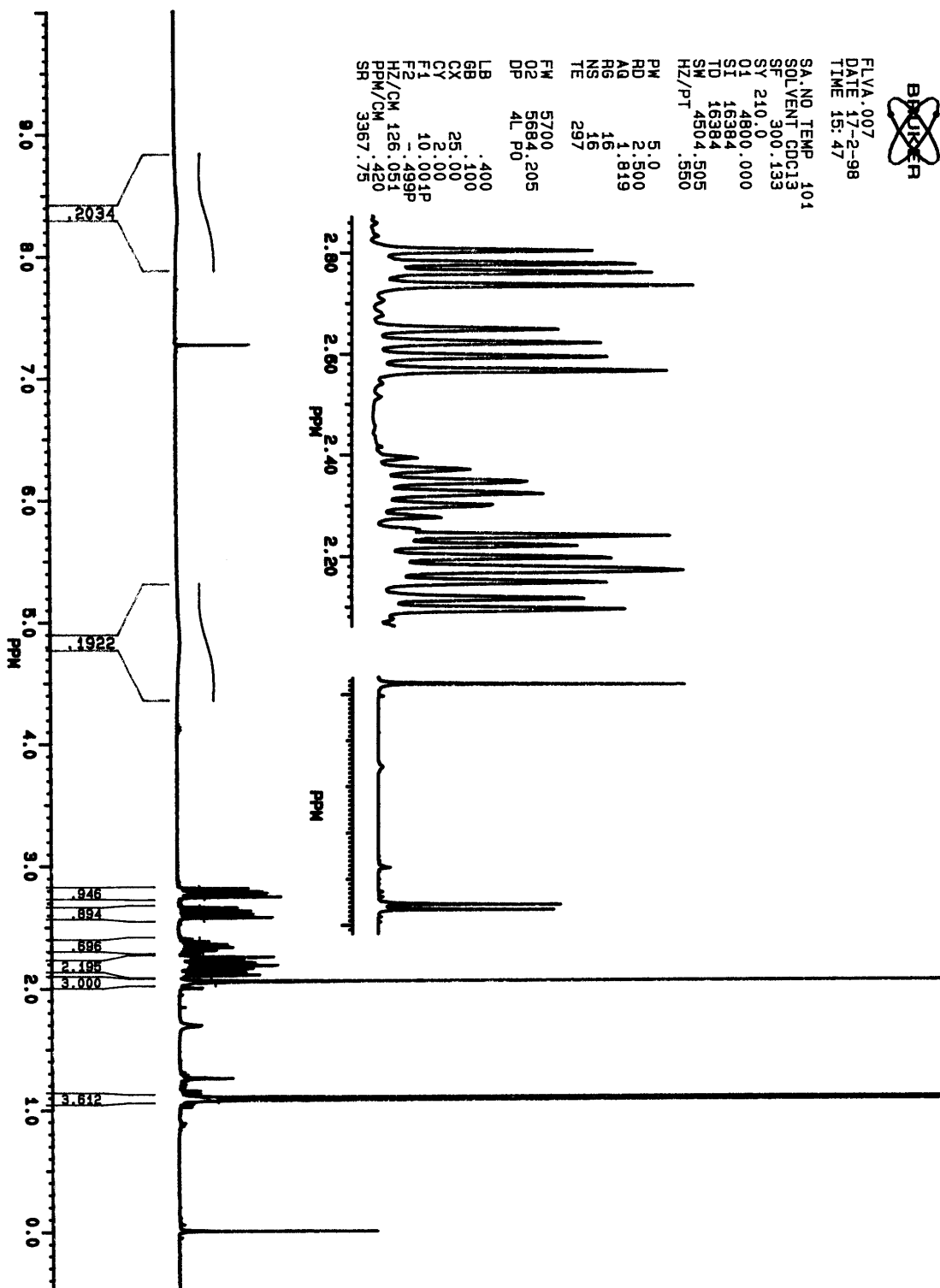
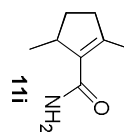
LB 6.000
 GB 0.0
 CX 20.50
 CY 40
 F1 220.004P
 F2 -5.001P
 HZ/CM 828.334
 PPM/CM 10.976
 SR -1407.74

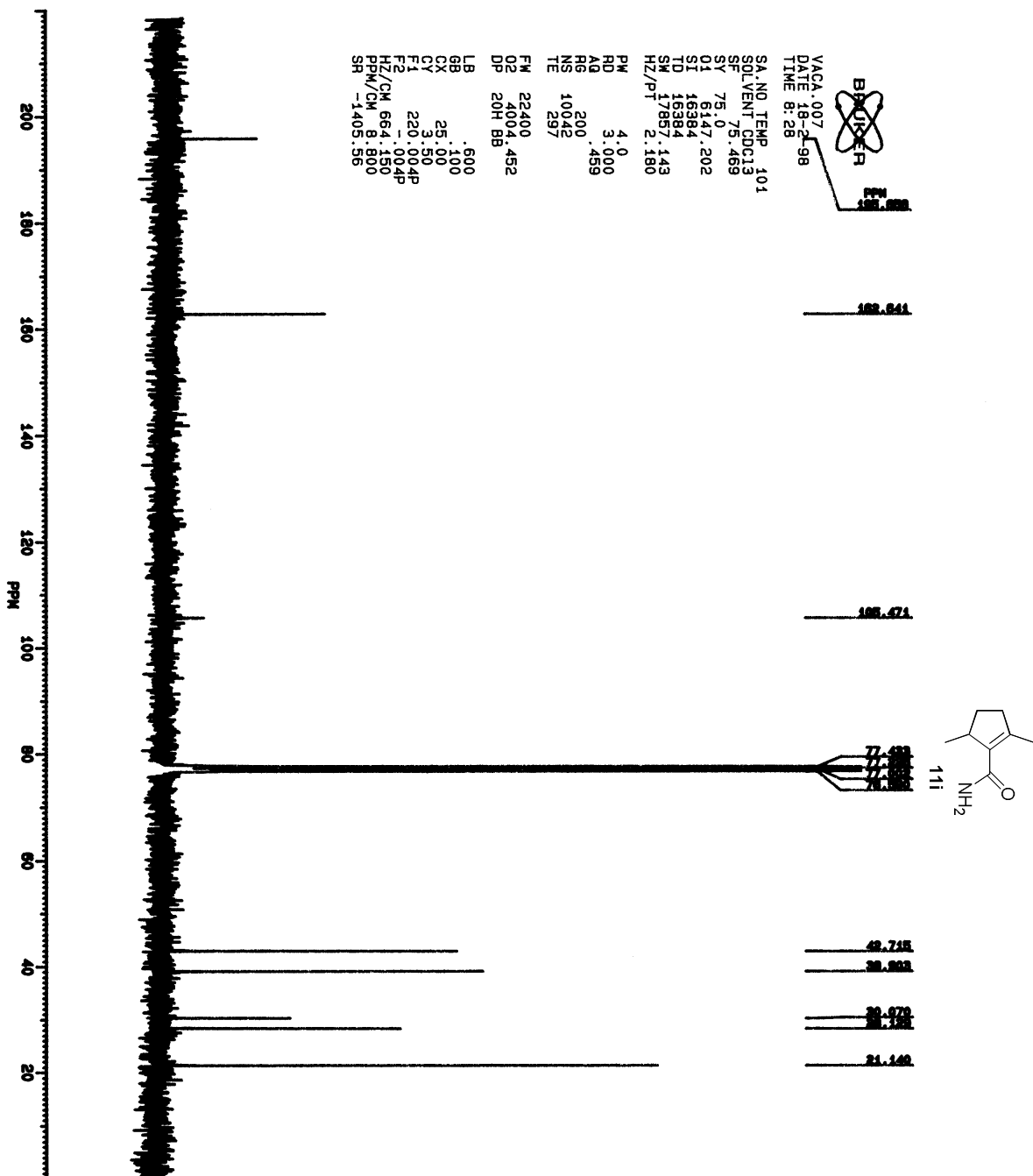




FLYA.007
DATE 17-2-98
TIME 15:47

SA.NO TEMP 101
SOLVENT CDCl3
SF 300.133
SY 210.0
O1 4800.000
S1 16384
TD 16384
SM 4504.505
HZ/PT .550
PM 5.0
PD 2.500
AQ 1.819
RG 16
NS 16
TE 297
FM 5700
O2 5684.205
DP 4L PD
LB .400
GB 25.100
CX 25.00
CY 2.00
F1 10.001P
F2 -499P
HZ/CM 126.051
PPM/CM 3367.73
SR 3367.73





References

- ¹ Soli, E. D.; Manoso, A. S.; Patterson M. C.; DeShong, P.; Favor, D. A.; Hirschmann, R.; Smith, A. B. *J. Org. Chem.* **1999**, *64*, 3171.
- ² Vaultier, M.; Lambert, P.H.; Carrie, R. *Bull. Soc. Chim. Fr.* **1986**, 83.
- ³ Montgomery, J.; Oblinger, E.; Savchenko, A. V. *J. Am. Chem. Soc.* **1997**, *119*, 4911.
- ⁴ Molander, Gary A.; Wolfe, Chad N. *J. Org. Chem.* **1998**, *63*, 9031.
- ⁵ Previously synthesized although no spectral data was reported: Shono, T.; Kise, N.; Fujimoto, T.; Tominaga, N.; Morita, H. *J. Org. Chem.* **1992**, *57*, 7175.
- ⁶ Previously synthesized although no spectral data was reported: Shono, T.; Kise, N.; Fujimoto, T.; Tominaga, N.; Morita, H. *J. Org. Chem.* **1992**, *57*, 7175.
- ⁷ Proffit, J. A.; Watt, D. S.; Corey, E. J. *J. Org. Chem.* **1975**, *40*, 127.
- ⁸ Commercially available from Acros.
- ⁹ Minor discrepancies exist with the ¹³C NMR data reported for **7g** prepared previously: Gourves, J.-P.; Copulhon, H.; Sturtz, G. *Eur. J. Org. Chem.* **1999**, 3489.
- ¹⁰ Michael, J. P.; Jungmann, C. M. *Tetrahedron* **1992**, *48*, 10211.