Supporting Information

GENERAL CONSIDERATIONS

Reagents. Unless otherwise indicated, all reactions were carried out in resealable screw-cap test tubes under an argon atmosphere with dry solvents. Dry toluene was obtained by passing through successive alumina and Q5 reactant-packed columns on a solvent purification system. $(AllylPdCl)_2$ was purchased from Strem and used as received. Anhydrous Cs_2CO_3 was purchased from Alfa Aesar and stored in a glovebox. Small portions were removed and stored in a desiccator for up to two weeks (all reactions were set-up outside of the glovebox). Tributylamine was distilled from CaH_2 and stored under argon. Cyclohexanol was distilled from CaH_2 and stored under argon over 3Å molecular sieves. All other reagents were purchased from commercial sources and used as received. Flash chromatography was performed using Silicycle SiliaFlaP60 (230-400 mesh) silica gel.

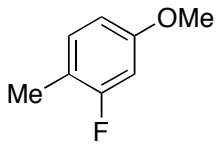
Analytical Methods. All new compounds were characterized by ^{1}H NMR, ^{13}C NMR, ^{31}P NMR (where applicable), IR spectroscopy and in most cases, elemental analysis. ^{1}H NMR and ^{13}C NMR spectra, and IR spectroscopy are included for all known compounds. NMR spectra were recorded on a Varian 300 MHz instrument and calibrated using residual solvent as an internal reference ($CDCl_3$: 7.26 ppm for ^{1}H NMR and 77.0 ppm for ^{13}C NMR). IR spectra were recorded on a Perkin-Elmer Model 2000 FT-IR using KBr

plates (thin film). Melting points were obtained on a Mel-Temp capillary melting point apparatus. Gas chromatographic analyses were performed on Agilent 6890 gas chromatography. Elemental analyses were performed by Atlantic Microlab Inc., Norcross, GA. Reactions were monitored by GC and thin-layer chromatography (TLC) carried out on 0.25 mm E. Merck silica gel plates (60F-254) using UV light as a visualizing agent. All yields stated are the average of at least two experiments.

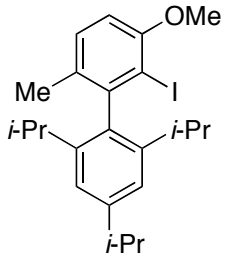
SYNTHESIS OF LIGANDS.

Ligands **L1** and **L5** were purchased from Strem. Ligand **L3** was prepared as previously described by our group.[1]

Synthesis of Ligand L4 (RockPhos).

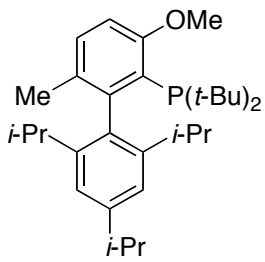


2-Fluoro-4-methoxy-1-methylbenzene: A two-necked 500 mL round bottom flask, which was equipped with a magnetic stir bar and charged with anhydrous K_2CO_3 (22.1 g, 160 mmol), was fitted with a reflux condenser and rubber septum. The flask was purged with argon and then anhydrous acetone (250 mL), 3-fluoro-4-methylphenol (10.1 g, 80 mmol), and Me_2SO_4 (10.6 mL, 112 mmol) were added via syringe. The reaction mixture was stirred at reflux for 3 h and 2 M aqueous KOH (100 mL) was added. The reaction mixture was then heated to 80 ºC for 15 min to quench the excess Me_2SO_4. The mixture was cooled to room temperature and acetone was removed by rotary evaporator. The aqueous layer was extracted with ether (3 × 150 mL) and the combined organic layers were washed with brine (100 mL), dried over $MgSO_4$, and concentrated in vacuo. The crude product was purified with flash chromatography (silica gel, hexanes) to afford 2-fluoro-4-methoxy-1-methylbenzene as a colorless oil (10.3 g, 92% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.11-7.03 (m, 1H), 6.63-6.57 (m, 2H), 3.78 (s, 3H), 2.22-2.20 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 163.2, 160.0, 158.9, 158.8, 131.45, 131.36, 116.5, 116.3, 109.4, 109.3, 101.5, 101.1, 55.4, 13.71, 13.66 (observed complexity is due to F-C splitting); ^{19}F NMR (282 MHz, $CDCl_3$) δ -112.0 (t, J = 9.2 Hz); IR (neat, cm^{-1}) 2958, 2934, 1627, 1589, 1512, 1268, 1153, 1121, 1035, 944, 834; Anal Calcd. for C_8H_9FO: C, 68.56; H, 6.47. Found: C, 68.25; H, 6.63.



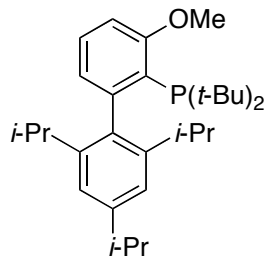
2-Iodo-2',4',6'-triisopropyl-3-methoxy-6-methyl-1,1'-biphenyl: An oven-dried three-neck 500 mL round bottom flask, which was equipped with a magnetic stir bar and charged with magnesium shavings (1.75 g, 72 mmol), was fitted with a reflux condenser, glass stopper, and rubber septum. The flask was purged with argon and then THF (120 mL) and 2,4,6-triisopropylbromobenzene (15.04 mL, 60 mmol) were added via syringe. The reaction was heated to reflux and 1,2-dibromethane (50 μL) was added via syringe. The reaction mixture was allowed to stir at reflux for 1 h and was then cooled to room temperature. A separate oven-dried 500 mL round bottom flask, which was equipped with a magnetic stir bar and fitted with a septum, was purged with argon and then THF (160 mL) and 2-fluoro-4-methoxy-1-methylbenzene (4.21 g, 30 mmol) were added to the flask via syringe. The reaction vessel was cooled via a -78 °C bath and *n*-BuLi (2.5 M in Hexane, 13.2 mL, 33 mmol) was added by a syringe pump over a 1 h period. The solution was stirred for an additional 2 h and the Grignard reagent, which was prepared in the first reaction vessel, was added via cannula over a 30 min period and the reaction mixture was allowed to stir at -78 °C for 1 h. The reaction mixture was slowly warmed to room temperature where it was stirred overnight. The mixture was then cooled to 0 °C and a solution of iodine (16.75 g, 66 mmol) in THF (66 mL) was added via syringe over a 30 min period and then the dark red solution was warmed to room temperature and stirred for 1 h. Saturated aqueous Na_2SO_3 (200 mL) was added to quench excess iodine. The two layers were separated and the aqueous layer was extracted with ether (2 × 200 mL). The combined organic layers were washed with brine, dried over $MgSO_4$, filtered, and the solvent was removed with the aid of a rotary evaporator. The crude material was purified by flash chromatography (silica gel, gradient from pure hexanes to 30:1 hexanes:EtOAc) to yield a white solid (11.05 g, 82% yield): m.p. 147 – 148 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.19 (d, 1H, J = 8.3 Hz), 7.06 (s, 2H), 6.74 (d, 1H, J = 8.3 Hz), 3.92 (s, 3H), 2.96 (septet, 1H, J = 6.9 Hz), 2.34 (septet, 2H, J = 6.9 Hz), 1.98 (s, 3H), 1.31 (d, 6H, J = 6.9 Hz), 1.19 (d, 6H, J = 6.9 Hz), 1.05 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 156.4, 148.4, 146.6, 145.1, 138.5, 130.6, 130.1, 121.1, 109.0, 94.9, 56.3, 34.1, 30.6, 24.51, 24.48, 24.1, 21.3; IR (neat, cm^{-1}): 2960, 1461, 1434, 1289, 1271, 1077, 876, 799, 755; Anal. Calcd. for $C_{23}H_{31}IO$: C, 61.33;

H, 6.94. Found: C, 61.43; H, 6.79.



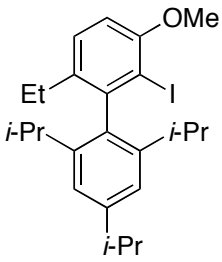
di-*tert*-Butyl-(2',4',6'-triisopropyl-3-methoxy-6-methyl-[1,1'-biphenyl]-2-yl)phosphine (L4, RockPhos): An oven-dried 200 mL round-bottom Schlenk flask, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-methoxy-6-methyl-1,1'-biphenyl (4.0 g, 8.96 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). Toluene (45 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 10.5 mL, 17.92 mmol) was added in a dropwise fashion over a 10 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk flask and anhydrous CuCl (890 mg, 8.96 mmol), which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and ClP(*t*-Bu)$_2$ (2.55 mL, 13.44 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 140 °C (bath temperature) for 20 h. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude material was recrystallized from hot methanol to afford 3.02 g (72% yield) of desired product as white crystals: m.p. 129 – 130 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.19 (d, 1H, J = 8.6 Hz), 6.98 (s, 2H), 6.79 (d, 1H, J = 8.6 Hz), 3.79 (s, 3H), 2.92 (septet, 1H, J = 6.9 Hz), 2.47 (septet, 2H, J = 6.7 Hz), 1.77 (s, 3H), 1.29 (d, 6H, J = 6.9 Hz), 1.21 (d, 6H, J = 6.7 Hz), 1.16 (s, 9H), 1.12 (s, 9H), 0.96 (d, 6H, J = 6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 160.01, 159.98, 151.0, 150.5, 147.3, 145.67, 145.65, 136.5, 136.4, 131.88, 131.86, 130.5, 130.4, 125.5, 124.9, 120.7, 108.1, 53.6, 34.2, 33.9, 33.8, 32.0, 31.8, 30.8, 30.7, 25.3, 24.63, 24.60, 24.1, 22.2, 22.1 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 35.84; IR (neat, cm^{-1}): 2960, 2925, 1564, 1459, 1427, 1360, 1263, 1168, 1024, 803; Anal. Calcd. for $C_{31}H_{49}OP$: C, 79.44; H, 10.54. Found: C, 79.44; H, 10.36.

Synthesis of Ligand L6.



di-*tert*-Butyl-(2',4',6'-triisopropyl-3-methoxy-[1,1'-biphenyl]-2-yl)phosphine (L6): An oven-dried Schlenk tube, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-methoxy-1,1'-biphenyl[2] (1.31 g, 3.0 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (15 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 4.06 mL, 6.9 mmol) was added in a dropwise fashion over a 10 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk tube and anhydrous CuCl (357 mg, 3.6 mmol), which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and $ClP(t\text{-}Bu)_2$ (0.68 mL, 3.6 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 70 °C (bath temperature) for 7 days. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude material was recrystallized from hot methanol to afford 1.02 mg (75% yield) of desired product as white crystals: m.p. 168 – 170 °C; ^1H NMR (300 MHz, $CDCl_3$) δ 7.29 (dd, 1H, J = 8.2, 7.6 Hz), 6.97 (s, 2H), 6.87 (d, 1H, J = 8.2 Hz), 6.83 (dd, 1H, J = 7.6, 3.7 Hz), 3.83 (s, 3H), 2.93 (septet, 1H, J = 6.9 Hz), 2.59 (septet, 2H, J = 6.7 Hz), 1.31 (d, 6H, J = 6.9 Hz), 1.21 (d, 6H, J = 6.8 Hz), 1.16 (s, 9H), 1.12 (s, 9H), 0.96 (d, 6H, J = 6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 161.71, 161.67, 151.4, 150.9, 147.2, 145.92, 145.90, 137.65, 137.57, 128.77, 128.75, 125.8, 125.7, 125.3, 124.7, 120.1, 108.4, 53.8, 33.94, 33.93, 33.6, 31.6, 31.4, 30.8, 30.7, 26.4, 24.1, 22.69, 22.68 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 34.10; IR (neat, cm^{-1}): 2957, 2924, 2885, 2862, 1560, 1458, 1430, 1360, 1264, 1248, 1169, 1090, 1020, 793, 740; Anal. Calcd. for $C_{30}H_{47}OP$: C, 79.25; H, 10.42. Found: C, 79.39; H, 10.21.

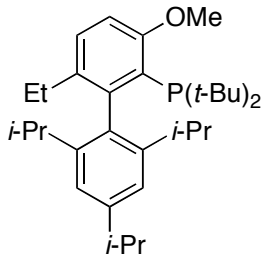
Synthesis of Ligand L7.



2-Iodo-2',4',6'-triisopropyl-3-methoxy-6-ethyl-1,1'-biphenyl: An oven-dried 500 mL round bottom flask, which was equipped with a magnetic stir bar and charged with $Pd(OAc)_2$ (336.8 mg, 1.5 mmol) and DavePhos (1.18 g, 3.0 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (100 mL) and 1-bromo-2-fluoro-4-methoxybenzene (10.26 g, 50 mmol) were added via syringe. A solution of EtMgCl (2 M in THF, 37.5 mL, 75 mmol) was added by syringe pump over 1 h at room temperature. The reaction solution was stirred at 40 °C for 5 h and allowed to cool to room temperature. Saturated aqueous NH_4Cl (80 mL) was added and THF was removed by rotary evaporator. The aqueous layer was extracted with ether (3 × 100 mL) and the combined organic layers were washed with brine (100 mL), dried over $MgSO_4$, and concentrated in vacuo. Flash chromatography (silica gel, hexanes) afforded 4.46 g (58%, ~85% pure) of 2-fluoro-4-methoxy-1-ethylbenzene contaminated with 1-fluoro-3-methoxybenzene.

An oven-dried three-neck 500 mL round bottom flask, which was equipped with a magnetic stir bar and charged with magnesium shavings (1.28 g, 52.8 mmol), was fitted with a reflux condenser, glass stopper, and rubber septum. The flask was purged with argon and then THF (90 mL) and 2,4,6-triisopropylbromobenzene (11.15 mL, 44 mmol) were added via syringe. The reaction was heated to reflux and 1,2-dibromethane (40 μL) was added via syringe. The reaction mixture was allowed to stir at reflux for 1 h and was then cooled to room temperature. A separate oven-dried 500 mL round bottom flask, which was equipped with a magnetic stir bar and fitted with a septum, was purged with argon and then THF (120 mL) and 2-fluoro-4-methoxy-1-ethylbenzene (3.4 g, 22 mmol) were added to the flask via syringe. The reaction vessel was cooled via a -78 °C bath and *n*-BuLi (2.5 M in Hexane, 9.3 mL, 23.1 mmol) was added by a syringe pump over a 1 h period. The solution was stirred for an additional 4 h and the Grignard reagent, which was prepared in the first reaction vessel, was added via cannula over a 30 min period and the reaction mixture was allowed to stir at -78 °C for 1 h. The reaction mixture was slowly warmed to room temperature where it was stirred overnight. The mixture was then cooled to 0 °C and a solution of iodine (12.29 g, 48.4 mmol) in THF (48 mL) was added via syringe over a 30 min period and then the dark red solution was warmed to room

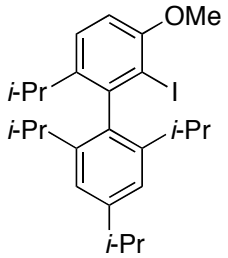
temperature and stirred for 1 h. Saturated aqueous Na_2SO_3 (100 mL) was added to quench excess iodine and THF was removed by rotary evaporator. The aqueous layer was extracted with ether (3 × 150 mL) and the combined organic layers were washed with brine, dried over $MgSO_4$, and concentrated in vacuo. Flash chromatography (silica gel, gradient from pure hexanes to 30:1 hexanes:EtOAc) afforded a light yellow solid. The yellow solid was recrystallized from hot methanol (25 mL) to yield 6.35 g (62% yield) of desired product as white solid: m.p. 125 – 126 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.29 (d, 1H, J = 8.5 Hz), 7.05 (s, 2H), 6.83 (d, 1H, J = 8.5 Hz), 3.92 (s, 3H), 2.96 (septet, 1H, J = 6.9 Hz), 2.33 (septet, 2H, J = 6.9 Hz), 2.27 (q, 2H, J = 7.6 Hz), 1.31 (d, 6H, J = 6.9 Hz), 1.19 (d, 6H, J = 6.9 Hz), 1.14 (t, 3H, J = 7.6 Hz), 1.03 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 156.2, 148.3, 146.2, 145.3, 138.3, 136.2, 127.3, 121.0, 109.2, 95.0, 56.3, 34.1, 30.5, 26.1, 24.53, 24.51, 24.1, 13.8; IR (neat, cm-1): 2961, 2931, 2869, 1555, 1461, 1433, 1287, 1269, 1054, 1018, 877, 809, 742; Anal. Calcd. for $C_{24}H_{33}IO$: C, 62.07; H, 7.16. Found: C, 61.92; H, 7.17.



di-*tert*-Butyl-(2',4',6'-triisopropyl-3-methoxy-6-ethyl-[1,1'-biphenyl]-2-yl)phosphine (L7): An oven-dried Schlenk tube, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-methoxy-6-ethyl-1,1'-biphenyl (1.39 g, 3.0 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (13 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 3.9 mL, 6.6 mmol) was added in a dropwise fashion over a 10 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk flask and anhydrous CuCl (356 mg, 3.6 mmol), which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and $ClP(t\text{-}Bu)_2$ (0.74 mL, 3.9 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 70 °C (bath temperature) for 7 d. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The

crude material was recrystallized from hot methanol to afford 862.1 mg (60% yield) of desired product as white crystals: m.p. 92 – 94 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.29 (d, 1H, J = 8.5 Hz), 6.97 (s, 2H), 6.85 (d, 1H, J = 8.5 Hz), 3.80 (s, 3H), 2.92 (septet, 1H, J = 6.9 Hz), 2.42 (septet, 2H, J = 6.7 Hz), 2.07 (q, 2H, J = 7.5 Hz), 1.29 (d, 6H, J = 6.9 Hz), 1.22 (d, 6H, J = 6.7 Hz), 1.14 (s, 9H), 1.10 (s, 9H), 1.09 (t, 3H, J = 7.5 Hz), 0.95 (d, 6H, J = 6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 159.92, 159.89, 150.7, 150.2, 147.2, 145.93, 145.91, 136.1, 136.0, 135.8, 135.7, 128.55, 128.53, 125.5, 124.9, 120.7, 108.1, 53.5, 34.1, 33.9, 33.7, 32.0, 31.8, 30.52, 30.49, 25.59, 25.55, 24.80, 24.77, 24.1, 13.8 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 35.67; IR (neat, cm-1): 2959, 2867, 1562, 1457, 1427, 1382, 1361, 1264, 1020, 877, 811; Anal. Calcd. for $C_{32}H_{51}OP$: C, 79.62; H, 10.65. Found: C, 79.44; H, 10.53.

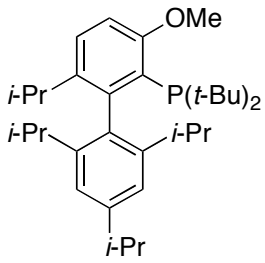
Synthesis of Ligand L8.



2-Iodo-2',4',6'-triisopropyl-3-methoxy-6-isopropyl-1,1'-biphenyl: An oven-dried 200 mL round bottom flask, which was equipped with a magnetic stir bar and charged with $Pd(OAc)_2$ (33.7 mg, 0.15 mmol) and CPhos (131.0 mg, 0.3 mmol),[3] was evacuated and backfilled with argon (this process was repeated a total of three times). THF (20 mL) and 1-bromo-2-fluoro-4-methoxybenzene (3.08 g, 15 mmol) were added via syringe. The solution was cooled to 0 °C and a solution of ^{i}PrZnBr (1.1 M in THF, 16.4 mL, 18 mmol) was added over 20 min by syringe pump. The ice bath was removed and the reaction solution was stirred at room temperature for 30 min. Brine (20 mL) was added and THF was removed by rotary evaporator. The aqueous layer was extracted with ethyl acetate (3 × 30 mL) and the combined organic layers were washed with brine (30 mL), dried over $MgSO_4$, and concentrated in vacuo. Flash chromatography (silica gel, 50:1 Hexanes/EtOAc) afforded a 7:1 mixture of 2-fluoro-1-isopropyl-4-methoxybenzene and 2-fluoro-4-methoxy-1-propylbenzene (2.28 g, 90%).

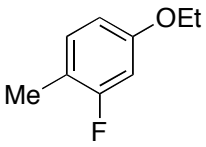
An oven-dried three-neck 300 mL round bottom flask, which was equipped with a magnetic stir bar and charged with magnesium shavings (0.73 g, 30.0 mmol), was fitted with a reflux condenser, glass stopper, and rubber septum. The flask was purged with argon and then THF (50 mL) and 2,4,6-triisopropylbromobenzene (6.33 mL, 25 mmol)

were added via syringe. The reaction was heated to reflux and 1,2-dibromethane (25 μL) was added via syringe. The reaction mixture was allowed to stir at reflux for 1 h and was then cooled to room temperature. A separate oven-dried 300 mL round bottom flask, which was equipped with a magnetic stir bar and fitted with a septum, was purged with argon and then THF (60 mL) and 2-fluoro-1-isopropyl-4-methoxybenzene (2.1 g, 12.5 mmol) were added to the flask via syringe. The reaction vessel was cooled via a -78 °C bath and *n*-BuLi (2.5 M in Hexane, 5.5 mL, 13.75 mmol) was added by a syringe pump over a 1 h period. The solution was stirred for an additional 4 h and the Grignard reagent, which was prepared in the first reaction vessel, was added via cannula over a 30 min period and the reaction mixture was allowed to stir at -78 °C for 1 h. The reaction mixture was slowly warmed to room temperature where it was stirred overnight. The mixture was then cooled to 0 °C and a solution of iodine (6.98 g, 27.5 mmol) in THF (28 mL) was added via syringe over a 30 min period and then the dark red solution was warmed to room temperature and stirred for 1 h. Saturated aqueous Na_2SO_3 (100 mL) was added to quench excess iodine and THF was removed by rotary evaporator. The aqueous layer was extracted with ether (3 × 150 mL) and the combined organic layers were washed with brine, dried over $MgSO_4$, and concentrated in vacuo. Flash chromatography (silica gel, gradient from pure hexanes to 50:1 hexanes:EtOAc) afforded a light yellow solid. The yellow solid was recrystallized from hot methanol (4 mL) to yield 3.19 g (53% yield) of desired product as white solid: m.p. 143 – 145 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.32 (d, 1H, J = 8.6 Hz), 7.05 (s, 2H), 6.87 (d, 1H, J = 8.6 Hz), 3.91 (s, 3H), 2.96 (septet, 1H, J = 6.9 Hz), 2.63 (septet, 1H, J = 6.9 Hz), 2.36 (septet, 2H, J = 6.9 Hz), 1.31 (d, 6H, J = 6.9 Hz), 1.21 (d, 6H, J = 6.9 Hz), 1.11 (d, 6H, J = 6.9 Hz), 1.09 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 156.1, 148.3, 145.8, 145.0, 141.7, 138.3, 126.2, 121.1, 109.2, 95.0, 56.4, 34.0, 30.6, 30.4, 25.0, 24.91, 24.87, 24.1; IR (neat, cm-1): 2963, 2930, 2868, 1589, 1555, 1463, 1435, 1381, 1361, 1283, 1270, 1070, 1015, 878, 808, 732; Anal. Calcd. for $C_{25}H_{35}IO$: C, 62.76; H, 7.37. Found: C, 62.99; H, 7.41.

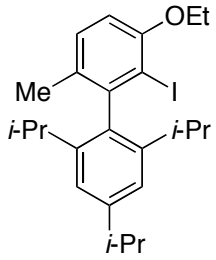


di-*tert*-Butyl-(2',4',6'-triisopropyl-3-methoxy-6-isopropyl-[1,1'-biphenyl]-2-yl)phosphine (L8): An oven-dried Schlenk tube, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-methoxy-6-isopropyl-1,1'-biphenyl (478.4 mg, 1.0 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (5 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 1.3 mL, 2.2 mmol) was added in a dropwise fashion over a 5 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk flask and anhydrous CuCl (109 mg, 1.1 mmol), which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and $ClP(t\text{-}Bu)_2$ (0.25 mL, 1.3 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 70 °C (bath temperature) for 7 d. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude material was recrystallized from hot methanol to afford 264.5 mg (53% yield) of desired product as white crystals: m.p. 100 – 101 °C; ^1H NMR (300 MHz, $CDCl_3$) δ 7.31 (d, 1H, J = 8.6 Hz), 6.93 (s, 2H), 6.85 (d, 1H, J = 8.6 Hz), 3.76 (s, 3H), 2.90 (septet, 1H, J = 6.9 Hz), 2.60 (septet, 1H, J = 6.7 Hz), 2.42 (septet, 2H, J = 6.7 Hz), 1.27 (d, 6H, J = 6.9 Hz), 1.25 (d, 6H, J = 6.7 Hz), 1.12 (d, 6H, J = 6.7 Hz), 1.04 (s, 9H), 1.02 (d, 6H, J = 6.7 Hz), 1.00 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 160.15, 160.12, 149.0, 148.5, 147.2, 147.08, 147.07, 141.7, 141.6, 134.7, 134.6, 127.03, 127.00, 126.1, 125.4, 120.3, 108.5, 53.5, 34.0, 33.8, 33.4, 31.8, 31.6, 30.20, 30.17, 29.15, 29.13, 27.0, 26.1, 24.8, 24.7, 24.1 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 37.47; IR (neat, cm-1): 2961, 2874, 1578, 1561, 1459, 1426, 1384, 1362, 1310, 1264, 1164, 1054, 1020, 876, 807; Anal. Calcd. for $C_{33}H_{53}OP$: C, 79.79; H, 10.75. Found: C, 79.49; H, 10.78.

Synthesis of Ligand L9.

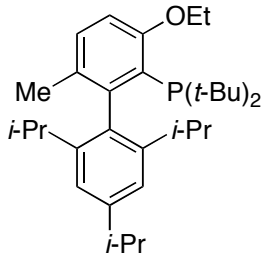


2-Fluoro-4-ethoxy-1-methylbenzene: An oven-dried 100 mL round bottom flask, which was equipped with a magnetic stir bar and charged with anhydrous K_2CO_3 (5.53 g, 40 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). Anhydrous DMF (20 mL), 3-fluoro-4-methylphenol (2.16 mL, 20 mmol), and EtI (4.8 mL, 60 mmol) were added via syringe. The reaction mixture was stirred at 80 °C overnight and was allowed to cooled to room temperature. H_2O (40 mL) was added and the mixture was extracted with ether (3 × 70 mL). The combined organic layers were washed with brine (4 × 40 mL), dried over $MgSO_4$, and concentrated in vacuo. The crude product was purified with flash chromatography (silica gel, hexanes) to afford 2-fluoro-4-ethoxy-1-methylbenzene as a colorless oil (2.74 g, 89% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.09-7.02 (m, 1H), 6.62-6.56 (m, 2H), 3.99 (q, 2H, J = 7.0), 2.22-2.19 (m, 3H), 1.41 (t, 3H, J = 7.0); ^{13}C NMR (75 MHz, $CDCl_3$) δ 163.2, 160.0, 158.3, 158.1, 131.4, 131.3, 116.4, 116.1, 109.94, 109.90, 102.0, 101.6, 63.7, 14.7, 13.72, 13.68 (observed complexity is due to F-C splitting); ^{19}F NMR (282 MHz, $CDCl_3$) δ -112.1 (t, J = 9.1 Hz); IR (neat, cm^{-1}) 2983, 2931, 1630, 1587, 1512, 1311, 1283, 1159, 1121, 1103, 1045, 847, 823; Anal Calcd. for $C_9H_{11}FO$: C, 70.11; H, 7.19. Found: C, 69.93; H, 7.40.



2-Iodo-2',4',6'-triisopropyl-3-ethoxy-6-methyl-1,1'-biphenyl: An oven-dried three-neck 250 mL round bottom flask, which was equipped with a magnetic stir bar and charged with magnesium shavings (0.95 g, 39.1 mmol), was fitted with a reflux condenser, glass stopper, and rubber septum. The flask was purged with argon and then THF (53 mL) and 2,4,6-triisopropylbromobenzene (8.26 mL, 32.6 mmol) were added via syringe. The reaction was heated to reflux and 1,2-dibromethane (27 μL) was added via syringe. The reaction mixture was allowed to stir at reflux for 1 h and was then cooled to room temperature. A separate oven-dried 500 mL round bottom flask, which was equipped with a magnetic stir bar and fitted with a septum, was purged with argon and then THF (160 mL) and 2-fluoro-4-methoxy-1-methylbenzene (2.51 g, 16.3 mmol) were added to the flask via syringe. The reaction vessel was cooled via a -78 °C bath and *n*-BuLi (2.5 M in Hexane, 6.52 mL, 16.3 mmol) was added by a syringe pump over a

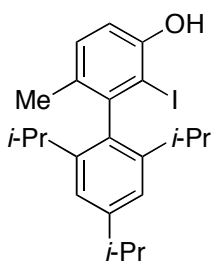
1 h period. The solution was stirred for an additional 2 h and the Grignard reagent, which was prepared in the first reaction vessel, was added via cannula over a 30 min period and the reaction mixture was allowed to stir at -78 °C for 1 h. The reaction mixture was slowly warmed to room temperature where it was stirred overnight. The mixture was then cooled to 0 °C and a solution of iodine (8.69 g, 34.2 mmol) in THF (34 mL) was added via syringe over a 30 min period and then the dark red solution was warmed to room temperature and stirred for 1 h. Saturated aqueous Na_2SO_3 (200 mL) was added to quench excess iodine. The two layers were separated and the aqueous layer was extracted with ether (2 × 200 mL). The combined organic layers were washed with brine, dried over $MgSO_4$, filtered, and the solvent was removed with the aid of a rotary evaporator. Flash chromatography (silica gel, gradient from pure hexanes to 30:1 hexanes:EtOAc) afforded a light yellow solid. The yellow solid was recrystallized from hot methanol (30 mL) to yield 2.39 g (32% yield) of desired product as white solid: m.p. 122 – 123 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.16 (d, 1H, J = 8.3 Hz), 7.06 (s, 2H), 6.71 (d, 1H, J = 8.3 Hz), 4.12 (q, 2H, J = 7.0 Hz), 2.96 (septet, 1H, J = 6.9 Hz), 2.35 (septet, 2H, J = 6.9 Hz), 1.97 (s, 3H), 1.51 (t, 3H, J = 7.0 Hz), 1.31 (d, 6H, J = 6.9 Hz), 1.19 (d, 6H, J = 6.9 Hz), 1.04 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 155.9, 148.3, 146.5, 145.1, 138.6, 130.5, 130.1, 121.1, 110.4, 95.8, 65.0, 34.1, 30.6, 24.51, 24.50, 24.1, 21.3, 14.9; IR (neat, cm^{-1}): 2961, 2928, 2868, 1457, 1428, 1289, 1268, 1256, 1069, 946, 875, 796, 761; Anal. Calcd. for $C_{24}H_{33}IO$: C, 62.07; H, 7.16. Found: C, 61.99; H, 7.18.



di-*tert*-Butyl-(2',4',6'-triisopropyl-3-ethoxy-6-methyl-[1,1'-biphenyl]-2-yl)phosphine (L9): An oven-dried Schlenk tube, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-ethoxy-6-methyl-1,1'-biphenyl (1.04 g, 2.24 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (10 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 3.03 mL, 5.15 mmol) was added in a dropwise fashion over a 10 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk tube and anhydrous CuCl (266 mg, 2.69 mmol),

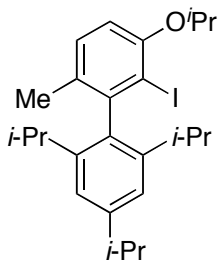
which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and ClP(*t*-Bu)$_2$ (0.51 mL, 2.69 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 70 °C (bath temperature) for 7 days. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude material was recrystallized from hot methanol to afford 484.8 mg (45% yield) of desired product as white crystals: m.p. 119 – 120 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.16 (d, 1H, J = 8.6 Hz), 6.97 (s, 2H), 6.78 (d, 1H, J = 8.6 Hz), 4.16 (q, 2H, J = 7.1 Hz), 2.92 (septet, 1H, J = 6.9 Hz), 2.47 (septet, 2H, J = 6.7 Hz), 1.76 (s, 3H), 1.51 (t, 3H, J = 7.1 Hz), 1.29 (d, 6H, J = 6.9 Hz), 1.21 (d, 6H, J = 6.7 Hz), 1.18 (s, 9H), 1.14 (s, 9H), 0.95 (d, 6H, J = 6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 159.63, 159.60, 151.3, 150.8, 147.2, 145.7, 136.8, 136.7, 131.82, 131.80, 130.2, 130.1, 125.3, 124.7, 120.7, 108.8, 62.8, 33.95, 33.93, 33.5, 32.2, 31.9, 30.8, 30.7, 25.3, 24.62, 24.60, 24.1, 22.14, 22.11, 14.7 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 35.86; IR (neat, cm^{-1}): 2959, 2891, 2868, 1561, 1461, 1382, 1362, 1253, 1145, 1036, 876, 802; Anal. Calcd. for $C_{32}H_{51}IOP$: C, 79.62; H, 10.65. Found: C, 79.77; H, 10.53.

Synthesis of Ligand L10.

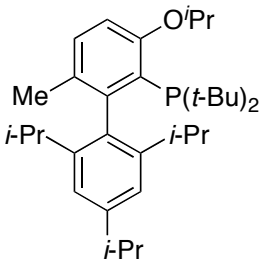


2-Iodo-2',4',6'-triisopropyl-3-hydroxy-6-methyl-1,1'-biphenyl: An oven-dried 50 mL round bottom flask, which was equipped with a magnetic stir bar and charged with 2-Iodo-2',4',6'-triisopropyl-3-methoxy-6-methyl-1,1'-biphenyl (2.25 g, 5 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). Dry CH_2Cl_2 (20 mL), was added via syringe and the solution was cooled to -78 °C. A solution of BBr_3 (1 M in Hexanes, 6.0 mL, 6 mmol) was added slowly via syringe. The reaction solution was warmed to room temperature over 2 h and stirred at room temperature for 2 h. Brine (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined organic layers were washed with brine (40 mL), dried over $MgSO_4$, and concentrated in

vacuo. The crude product was purified with flash chromatography (silica gel, 20:1 Hexanes/EtOAc) to afford 2-Iodo-2',4',6'-triisopropyl-3-hydroxy-6-methyl-1,1'-biphenyl as white solids (2.16 g, 99% yield): m.p. 164 – 165 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.14 (d, 1H, J = 8.2 Hz), 7.06 (s, 2H), 6.93 (d, 1H, J = 8.2 Hz), 5.34 (s, 1H), 2.95 (septet, 1H, J = 6.9 Hz), 2.35 (septet, 2H, J = 6.9 Hz), 1.98 (s, 3H), 1.31 (d, 6H, J = 6.9 Hz), 1.17 (d, 6H, J = 6.9 Hz), 1.05 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.0, 148.7, 145.2, 138.3, 130.9, 130.2, 121.2, 112.9, 95.6, 34.1, 30.5, 24.5, 24.4, 24.1, 21.2; IR (neat, cm^{-1}) 3466, 2963, 2924, 2868, 1588, 1453, 1194, 881, 810, 761; Anal Calcd. for $C_{22}H_{29}IO$: C, 60.55; H, 6.70. Found: C, 60.79; H, 6.72.



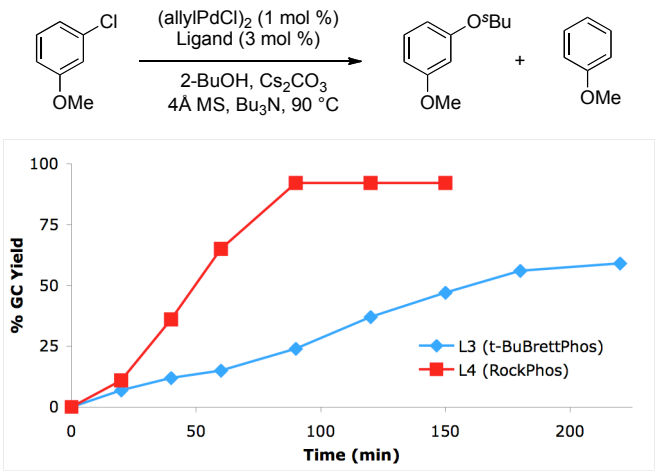
2-Iodo-2',4',6'-triisopropyl-3-isopropyloxy-6-methyl-1,1'-biphenyl: An oven-dried 50 mL round bottom flask, which was equipped with a magnetic stir bar and charged with anhydrous K_2CO_3 (1.29 g, 9.35 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). Anhydrous DMF (10 mL), 2-Iodo-2',4',6'-triisopropyl-3-hydroxy-6-methyl-1,1'-biphenyl (2.04 g, 4.67 mmol), and ^{i}PrBr (1.32 mL, 14.03 mmol) were added via syringe. The reaction mixture was stirred at 80 °C overnight and was allowed to cooled to room temperature. H_2O (20 mL) was added and the mixture was extracted with ether (3 × 50 mL). The combined organic layers were washed with brine (4 × 30 mL), dried over $MgSO_4$, and concentrated in vacuo. The crude product was purified with flash chromatography (silica gel, hexanes) to afford 2-Iodo-2',4',6'-triisopropyl-3-isopropyloxy-6-methyl-1,1'-biphenyl as a white solid (2.19 g, 98% yield): m.p. 74 – 76 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.15 (d, 1H, J = 8.3 Hz), 7.05 (s, 2H), 6.75 (d, 1H, J = 8.3 Hz), 4.56 (septet, 1H, J = 6.1 Hz), 2.95 (septet, 1H, J = 6.9 Hz), 2.35 (septet, 2H, J = 6.9 Hz), 1.97 (s, 3H), 1.42 (d, 6H, J = 6.1 Hz), 1.30 (d, 6H, J = 6.9 Hz), 1.19 (d, 6H, J = 6.9 Hz), 1.04 (d, 6H, J = 6.9 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 155.2, 148.3, 146.6, 145.0, 138.7, 130.8, 130.0, 121.0, 113.3, 98.2, 72.7, 34.0, 30.5, 24.5, 24.4, 24.1, 22.3, 21.3; IR (neat, cm^{-1}): 2963, 2924, 2863, 1607, 1590, 1567, 1462, 1383, 1288, 1267, 1205, 1177, 1138, 1111, 1050, 968, 877, 802, 758; Anal. Calcd. for $C_{25}H_{35}IO$: C, 62.76; H, 7.37. Found: C, 63.02; H, 7.42.



di-*tert*-Butyl-(2',4',6'-triisopropyl-isopropyloxy-6-methyl-[1,1'-biphenyl]-2-yl)phosphine (L10): An oven-dried Schlenk tube, which was equipped with a magnetic stir bar, fitted with a rubber septum, and charged with 2-iodo-2',4',6'-triisopropyl-3-isopropyloxy-6-methyl-1,1'-biphenyl (478.4 mg, 1 mmol), was evacuated and backfilled with argon (this process was repeated a total of three times). THF (5 mL) was added via syringe, the reaction mixture was cooled to –78 °C, and *t*-BuLi (1.7 M in pentane, 1.3 mL, 2.2 mmol) was added in a dropwise fashion over a 5 min period. The solution was stirred for 30 min and then under a positive pressure of argon the septum was removed from the Schlenk tube and anhydrous CuCl (109 mg, 1.1 mmol), which was weighed out in nitrogen filled glovebox, was added rapidly. The flask was refitted with the rubber septum and ClP(*t*-Bu)$_2$ (0.25 mL, 1.3 mmol) was added in a dropwise fashion over a 5 min period. The reaction mixture was warmed from –78 °C to room temperature at which point the flask was sealed with a Teflon screw cap and heated to 70 °C (bath temperature) for 7 days. The solution was cooled to room temperature, diluted with ethyl acetate, washed with NH_4OH 28% in water (this process was repeated a total of three times), washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude material was recrystallized from hot methanol to afford 290.9 mg (59% yield) of desired product as white crystals: m.p. 142 – 143 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.14 (d, 1H, J = 8.5 Hz), 6.96 (s, 2H), 6.77 (d, 1H, J = 8.5 Hz), 4.75 (septet, 1H, J = 6.1 Hz), 2.92 (septet, 1H, J = 6.9 Hz), 2.46 (septet, 2H, J = 6.7 Hz), 1.75 (s, 3H), 1.46 (d, 6H, J = 6.1 Hz), 1.28 (d, 6H, J = 6.9 Hz), 1.21 (d, 6H, J = 6.7 Hz), 1.19 (s, 9H), 1.15 (s, 9H), 0.95 (d, 6H, J = 6.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 158.71, 158.67, 151.8, 151.3, 147.2, 145.7, 137.1, 137.0, 131.71, 131.69, 129.6, 129.5, 125.5, 124.8, 120.6, 109.3, 68.9, 34.0, 33.8, 33.4, 32.3, 32.0, 30.81, 30.78, 25.3, 24.60, 24.57, 24.2, 22.14, 22.11, 21.9 (observed complexity is due to P-C splitting); ^{31}P NMR (121.5 Hz, $CDCl_3$) δ 36.94; IR (neat, cm^{-1}): 2958, 1578, 1559, 1456, 1383, 1274, 1254, 1117, 963, 802, 735; Anal. Calcd. for $C_{33}H_{53}OP$: C, 79.79; H, 10.75. Found: C, 79.77; H, 10.82.

Further Studies on the Effect of the Substituent in the 6-Position of the Ligand:

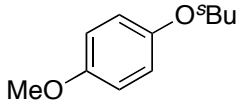
In order to gain additional insight into this effect we compared catalysts based on **L3** and **L4** for the reaction of 3-chloranisole and 2-butanol. As shown in figure 3 the reaction utilizing **L3** as the supporting ligand went to completion in ~3.5 hours and led to only 59% of the desired coupling product and 20% of the undesired reduced arene. When the same reaction was carried out employing a catalyst based on **L4** the reaction went to completion in ~1.5 hours and gave 92% of the desired product and only 7% reduction. These results indicate that replacing the 6-methoxy with a 6-methyl in the ligand not only leads to a decrease in the amount of b-H elimination but also significantly accelerates the rate of product formation.



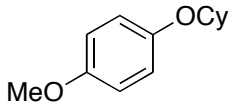
General Procedure A: Cs_2CO_3 (489 mg, 1.5 mmol, 1.5 equiv.) and 4Å Molecular sieves (200 mg, where applicable) were added to an oven-dried resealable screw-cap test tube and dried with flame under vacuum. The Pd source (1 – 4 mol%), Ligand (1.5 – 4.8 mol%), and aryl halide (if it is a solid) (1.0 mmol, 1.0 equiv.) were added under a positive pressure of argon. The tube was evacuated and backfilled with argon (this process was repeated a total of 3 times). The aryl halide (if it is a liquid) (1.0 mmol, 1.0 equiv.) and alcohol (2.0 mmol, 2.0 equiv.) were added through the septum via syringe, followed by solvent (1 mL). The sealed tube was placed into a pre-heated 90 °C oil bath and the mixture was stirred vigorously for the indicated time. After the reaction was allowed to cool to room temperature, it was filtered through a layer of Celite eluting with EtOAc. In the cases where toluene or NEt_3 was used as the solvent, the filtrate was concentrated *in vacuo* and the crude product was purified by flash chromatography. In

the cases where NBu_3 was used as the solvent, the filtrate was washed with 10% aqueous HCl. The organic layer was seperated and the aqueous layer was back extracted with EtOAc twice. The combined organic extracts were dried over $MgSO_4$ and concetranted. The crude product was purified via flash chromatography.

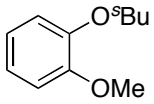
General Procedure B: Cs_2CO_3 (489 mg, 1.5 mmol, 1.5 equiv.) was added to an oven-dried resealable screw-cap test tube and dried with flame under vacuum. To the tube were added $(allylPdCl)_2$ (1 – 2.5 mol%) and RockPhos (2.4 – 6 mol%) under argon. The tube was evacuated and backfilled with argon (this process was repeated a total of 3 times). Toluene and the alcohol were added through the septum via syringe and the mixture was stirred at 90 °C in a pre-heated oil bath for 3 min. Aryl halide was added and the mixture was stirred vigorously for the indicated time. After the reaction was allowed to cool to room temperature, it was filtered through a layer of Celite eluting with EtOAc. The filtrate was concentrated *in vacuo* and the crude product was purified by flash chromatography.



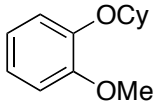
1-*sec*-Butoxy-4-methoxybenzene: Following general procedure A, 4-chloroanisole (122 μL, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and 4Å molecular sieves (200 mg), with NBu_3 as solvent were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 100:1 to 50:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (119.1 mg, 66% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.87-6.79 (m, 4H), 4.17 (sextet, 1H, J = 6.1 Hz), 3.77 (s, 3H), 1.81-1.66 (m, 1H), 1.66-1.52 (m, 1H), 1.27 (d, 3H, J = 6.1 Hz), 0.98 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.7, 152.2, 117.4, 114.6, 76.2, 55.7, 29.2, 19.3, 9.8; IR (neat, cm^{-1}) 2971, 2935, 1507, 1465, 1230, 1040, 825; Anal. Calcd. for $C_{11}H_{16}O_2$: C, 73.30; H, 8.95. Found: C, 73.40; H, 9.10. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[4]



1-Cyclohexyloxy-4-methoxybenzene: Following general procedure A, 4-chloroanisole (122 μL, 1 mmol), cyclohexanol (190 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and 4Å molecular sieves (200 mg) with NBu_3 as solvent were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 100:1 to 50:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (131.5 mg, 64% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.88-6.79 (m, 4H), 4.11 (septet, 1H, J = 4.2 Hz), 3.77 (s, 3H), 2.03-1.91 (m, 2H), 1.86-1.72 (m, 2H), 1.64-1.22 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.8, 151.7, 117.6, 114.5, 76.6, 55.6, 31.9, 25.6, 23.8; IR (neat, cm^{-1}) 2935, 2858, 1505, 1465, 1450, 1229, 1040, 968, 825, 747; Anal. Calcd. for $C_{13}H_{18}O_2$: C, 75.69; H, 8.80. Found: C, 75.84; H, 8.74. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[5]

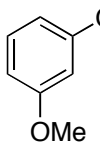


1-*sec*-Butoxy-2-methoxybenzene: Following procedure A, 4-chloroanisole (127 μL, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and NBu_3 were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 100:1 to 20:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (77.7 mg, 43% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.93-6.87 (m, 4H), 4.27 (sextet, 1H, J = 6.1 Hz), 3.85 (s, 3H), 1.90-1.75 (m, 1H), 1.71-1.56 (m, 1H), 1.33 (d, 3H, J = 6.1 Hz), 0.99 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 150.5, 147.7, 121.1, 120.7, 116.0, 112.1, 76.7, 55.9, 29.2, 19.3, 9.9; IR (neat, cm^{-1}) 2970, 2930, 1592, 1505, 1456, 1253, 1226, 1126, 1030, 743.

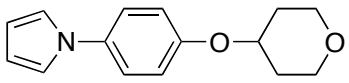


1-Cyclohexyloxy-2-methoxybenzene: Following procedure A, 4-chloroanisole (127 μL, 1 mmol), cyclohexanol (190 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and NBu_3 were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from

100:1 to 20:1 hexanes:EtOAc) to afford the title compound as a colorless oil (80.9 mg, 39% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.96-6.85 (m, 4H), 4.18 (septet, 1H, J = 4.5 Hz), 3.85 (s, 3H), 2.11-2.00 (m, 2H), 1.90-1.78 (m, 2H), 1.66-1.48 (m, 3H), 1.42-1.20 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 150.5, 147.1, 121.3, 120.6, 116.4, 112.1, 77.2, 55.9, 32.0, 25.6, 24.1; IR (neat, cm^{-1}) 2936, 2857, 1592, 1505, 1455, 1252, 1224, 1179, 1124, 1046, 1029, 964, 745; Anal. Calcd. for $C_{13}H_{18}O_2$: C, 75.69; H, 8.80. Found: C, 75.48; H, 8.78.

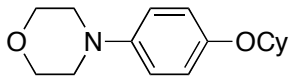


1-*sec*-Butoxy-3-methoxybenzene: Following procedure A, 3-chloroanisole (123 μL, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and NBu_3 were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 50:1 hexanes:EtOAc) to afford the title compound as a colorless oil (155.1 mg, 86% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.17 (t, 1H, J = 7.9 Hz), 6.53-6.45 (m, 3H), 4.29 (sextet, 1H, J = 6.1 Hz), 3.79 (s, 3H), 1.83-1.68 (m, 1H), 1.68-1.54 (m, 1H), 1.30 (d, 3H, J = 6.1 Hz), 0.98 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 160.8, 159.4, 129.8, 107.9, 105.9, 102.2, 75.0, 55.2, 29.2, 19.3, 9.8; IR (neat, cm^{-1}) 2972, 2937, 1600, 1492, 1455, 1286, 1265, 1201, 1150, 1043, 1001, 837, 763, 688. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[6]

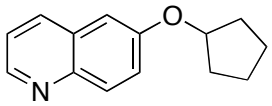


1-(4-((Tetrahydro-2*H*-pyran-4-yl)oxy)phenyl)-1*H*-pyrrole: Following procedure A, 1-(4-chlorophenyl)-1*H*-pyrrole (177.6 mg, 1 mmol), tetrahydro-4-pyranol (191 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and NBu_3 were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 10:1 hexanes:EtOAc) to afford the title compound as a off-white solid (173.9 mg, 72% yield): m.p. 80 –81 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.34-7.28 (m, 2H), 7.03-6.99 (m, 2H), 7.00-6.94 (m, 2H), 6.35-6.31 (m, 2H), 4.49 (septet, 1H), 4.06-3.96 (m, 2H), 3.65-3.55 (m, 2H), 2.10-1.99 (m, 2H), 1.88-1.75 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 155.1, 134.7, 122.2, 119.6, 116.9, 109.9,

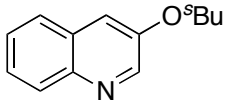
72.1, 65.1, 31.7; IR (neat, cm^{-1}) 2955, 2865, 1520, 1260, 1239, 1152, 1092, 1071, 989, 836, 730; Anal Calcd. for $C_{15}H_{17}NO_2$: C, 74.05; H, 7.04. Found: C, 73.78; H, 7.05.



4-(4-Cyclohexyloxyphenyl)morpholine: Following procedure A, 4-(4-bromophenyl)morpholine (242.1 mg, 1 mmol), cyclohexanol (159 μL, 1.5 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 15:1 hexanes:EtOAc) to afford the title compound as a white solid (136.4 mg, 52% yield): m.p. 68 –69 °C; ^1H NMR (300 MHz, $CDCl_3$) δ 6.86 (s, 4H), 4.12 (septet, 1H, J = 4.2), 3.88-3.82 (m, 4H), 3.08-3.02 (m, 4H), 2.03-1.90 (m, 2H), 1.86-1.70 (m, 2H), 1.63-1.20 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 151.9, 145.5, 117.6, 117.2, 76.2, 67.0, 50.7, 31.9, 25.6, 23.8; IR (neat, cm^{-1}) 2934, 2855, 2812, 1511, 1450, 1259, 1236, 1122, 1048, 969, 929, 825; Anal Calcd. for $C_{16}H_{23}NO_2$: C, 73.53; H, 8.87. Found: C, 73.69; H, 8.69.

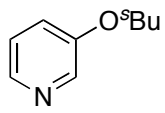


6-Cyclopentyloxyquinoline: Following procedure A, 6-chloroquinoline (163.6 mg, 1 mmol), cyclopentanol (182 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (11.25 mg, 2.4 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and Et_3N were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, 5:1 hexanes:EtOAc) to afford the title compound as a colorless oil (131.4 mg, 62% yield): ^1H NMR (300 MHz, $CDCl_3$) δ 8.74 (dd, 1H, J = 1.5, 4.3 Hz), 8.01 (d, 1H, J = 8.1 Hz), 7.97 (d, 1H, J = 9.1 Hz), 7.32 (dd, 1H, J = 2.7, 9.1 Hz), 7.31 (dd, 1H, J = 8.1, 4.3 Hz), 7.16 (d, 1H, J = 2.7 Hz), 4.88 (septet, 1H), 2.05-1.54 (m, 8H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 156.1, 147.7, 144.1, 134.6, 130.7, 129.2, 123.1, 121.2, 107.0, 79.5, 32.8, 24.1; IR (neat, cm^{-1}) 2961, 2874, 1616, 1594, 1496, 1465, 1435, 1378, 1325, 1226, 1167, 1114, 1035, 988, 833, 789, 771, 617.

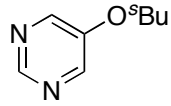


3-*sec*-Butoxyquinoline: Following procedure A, 3-bromoquinoline (136 μL, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg,

1 mol%), RockPhos (11.25 mg, 2.4 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 10:1 hexanes:EtOAc) to afford the title compound as a colorless oil (164.7 mg, 82% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.65 (d, 1H, J = 2.8 Hz), 8.05-8.00 (m, 1H), 7.72-7.67 (m, 1H), 7.58-7.45 (m, 2H), 7.36 (br d, 1H, J = 2.8 Hz), 4.45 (sextet, 1H, J = 6.1 Hz), 1.91-1.63 (m, 2H), 1.38 (d, 3H, J = 6.1 Hz), 1.02 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 151.5, 145.6, 143.3, 129.0, 128.8, 126.9, 126.5, 126.4, 114.2, 75.5, 28.9, 18.8, 9.7; IR (neat, cm^{-1}) 2973, 2935, 1603, 1496, 1464, 1423, 1379, 1345, 1274, 1211, 1189, 1140, 1121, 995, 924, 782, 751, 615; Anal Calcd. for $C_{13}H_{15}NO$: C, 77.58; H, 7.51. Found: C, 77.05; H, 7.61.

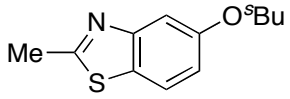


3-*sec*-Butoxypyridine: Following procedure B, 3-chloropyridine (94 μL, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (7.32 mg, 2 mol%), RockPhos (22.50 mg, 4.8 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a colorless oil (105.2 mg, 70% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.27 (dd, 1H, J = 2.3, 1.1 Hz), 8.16 (dd, 1H, J = 2.3, 3.9 Hz), 7.20-7.15 (m, 2H), 4.31 (sextet, 1H, J = 6.1 Hz), 1.81-1.54 (m, 2H), 1.29 (d, 3H, J = 6.1 Hz), 0.96 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 154.3, 141.7, 139.3, 123.8, 122.3, 75.6, 29.0, 19.0, 9.7; IR (neat, cm^{-1}) 2974, 2936, 1583, 1573, 1475, 1424, 1379, 1279, 1228, 1124, 1094, 988, 921, 800, 709, 601.

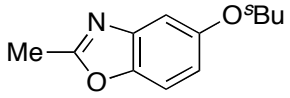


5-*sec*-Butoxypyrimidine: Following procedure B, 5-bromopyrimidine (159.0 mg, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (9.15 mg, 2 mol%), RockPhos (28.12 mg, 6.0 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 24 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a colorless oil (115.7 mg, 76% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.76 (s, 1H), 8.34 (s, 2H), 4.35 (sextet, 1H, J = 6.1 Hz), 1.82-1.55 (m, 2H), 1.30 (d, 3H, J = 6.1 Hz), 0.95 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 152.3, 151.0, 144.6, 76.2, 28.9, 18.8, 9.5;

IR (neat, cm^{-1}) 2975, 2937, 1573, 1557, 1419, 1382, 1275, 1182, 1114, 1096, 919, 887, 723, 630, 615; Anal Calcd. for $C_8H_{12}N_2O$: C, 63.13; H, 7.95. Found: C, 62.86; H, 8.14.

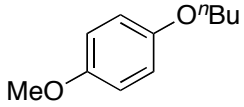


5-(*sec*-Butoxy)-2-methylbenzothiazole: Following procedure A, 5-chloro-2-methylbenzothiazole (183.7 mg, 1 mmol), 2-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (11.25 mg, 2.4 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 4:1 CH_2Cl_2:hexanes to CH_2Cl_2) to afford the desired prodcut, proceeded a mixture of 2-methylbenzothiazole and the product. The mixture was further purified by flash column chromatography (silica gel, gradient from 4:1 CH_2Cl_2:hexanes to CH_2Cl_2) to afford a total 138.6 mg (63% yield) of the desired product: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.63 (d, 1H, J = 8.8 Hz), 7.44 (d, 1H, J = 2.4 Hz), 6.96 (dd, 1H, J = 8.8, 2.4 Hz), 4.34 (sextet, 1H, J = 6.1 Hz), 2.80 (s, 3H), 1.89-1.56 (m, 2H), 1.33 (d, 3H, J = 6.1 Hz), 0.99 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 168.0, 157.3, 154.6, 127.1, 121.6, 116.2, 107.4, 75.6, 29.0, 20.1, 19.1, 9.8; IR (neat, cm^{-1}) 2972, 2933, 1601, 1557, 1524, 1456, 1376, 1320, 1276, 1163, 988, 806, 645; Anal Calcd. for $C_{12}H_{15}NOS$: C, 65.12; H, 6.83. Found: C, 64.96; H, 6.94.

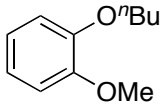


5-(*sec*-Butoxy)-2-methylbenzoxazole: Following procedure A, 5-chloro-2-methylbenzoxazole (167.6 mg, 1 mmol), 2-butanol (184 μL, 2 mmol), $(allylPdCl)_2$ (7.32 mg, 2 mol%), RockPhos (28.12 mg, 6 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 4:1 CH_2Cl_2:hexanes to CH_2Cl_2) to afford the desired prodcut, proceeded a mixture of 2-methylbenzoxazole and the product. The mixture was further purified by flash column chromatography (silica gel, gradient from 4:1 CH_2Cl_2:hexanes to CH_2Cl_2) to afford a total 124.4 mg (61% yield) of the desired product: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.32 (d, 1H, J = 8.8 Hz), 7.14 (d, 1H, J = 2.5 Hz), 6.86 (dd, 1H, J = 8.8, 2.5 Hz), 4.26 (sextet, 1H, J = 6.1 Hz), 2.60 (s, 3H), 1.84-1.54 (m, 2H), 1.30 (d, 3H, J = 6.1 Hz), 0.98 (t, 3H, J = 7.5 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 164.5, 155.4, 145.5, 142.2, 114.7,

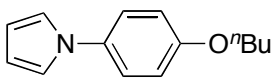
110.2, 105.5, 76.3, 29.0, 19.1, 14.6, 9.8; IR (neat, cm^{-1}) 2973, 2934, 2880, 1576, 1476, 1438, 1381, 1272, 1178, 1151, 989, 952, 928, 908, 847, 805, 664; Anal Calcd. for $C_{12}H_{15}NO_2$: C, 70.22; H, 7.37. Found: C, 70.03; H, 7.37.



1-Butoxy-4-methoxybenzene: Following procedure A, 4-bromoanisole (125 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 100:1 to 50:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (144.0 mg, 80% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.84 (s, 4H), 3.91 (t, 2H, J = 6.5 Hz), 3.77 (s, 3H), 1.80-1.69 (m, 2H), 1.55-1.42 (m, 2H), 0.97 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.6, 153.3, 115.4, 114.6, 68.3, 55.7, 31.4, 19.2, 13.9; IR (neat, cm^{-1}) 2958, 2935, 2873, 1508, 1466, 1231, 1042, 825, 744. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[7]

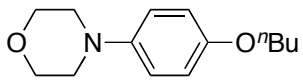


1-Butoxy-2-methoxybenzene: Following procedure A, 2-bromoanisole (125 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, gradient from 100:1 to 20:1 hexanes:EtOAc) to afford the title compound as a colorless oil (150.9 mg, 84% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.90 (s, 4H), 4.03 (t, 2H, J = 6.5 Hz), 3.87 (s, 3H), 1.89-1.78 (m, 2H), 1.57-1.43 (m, 2H), 0.98 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 149.4, 148.6, 120.8, 120.7, 112.9, 111.7, 68.6, 55.9, 31.2, 19.2, 13.9; IR (neat, cm^{-1}) 2958, 2935, 2873, 1593, 1506, 1456, 1253, 1228, 1180, 1125, 1030, 740. The ^{1}H NMR and ^{13}C NMR spectral data is in agreement with those reported in the literature.[8]

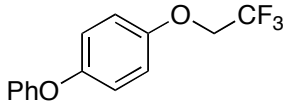


1-(4-Butoxyphenyl)-1*H*-pyrrole: Following procedure A, 1-(4-

chlorophenyl)-1*H*-pyrrole (177.6 mg, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (7.32 mg, 2 mol%), RockPhos (22.50 mg, 4.8 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 21 h. The crude product was purified by flash column chromatography (silica gel, 50:1 hexanes:EtOAc) to afford the title compound as a off-white solid (187.7 mg, 87% yield): m.p. 75 –76 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.35-7.28 (m, 2H), 7.04-7.01 (m, 2H), 6.99-6.92 (m, 2H), 6.37-6.32 (m, 2H), 4.00 (t, 2H, J = 6.5 Hz), 1.81 (pentet, 2H, J = 7.0 Hz), 1.54 (sextet, 2H, J = 6.2 Hz), 1.02 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 157.2, 134.2, 122.1, 119.6, 115.1, 109.7, 68.0, 31.3, 19.2, 13.8; IR (neat, cm^{-1}) 2956, 2937, 1527, 1260, 1129, 827, 718; Anal Calcd. for $C_{14}H_{17}NO$: C, 78.10; H, 7.96. Found: C, 77.82; H, 7.93.

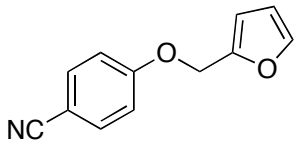


4-(4-Butoxyphenyl)morpholine: Following procedure A, 4-(4-bromophenyl)morpholine (242.1 mg, 1 mmol), cyclohexanol (159 μL, 1.5 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 15 h. The crude product was purified by flash column chromatography (silica gel, gradient from 10:1 hexanes:EtOAc) to afford the title compound as a white solid (169.1 mg, 72% yield): m.p. 59 –60 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.91-6.83 (m, 4H), 3.92 (t, 2H, J = 6.5 Hz), 3.89-3.83 (m, 4H), 3.09-3.02 (m, 4H), 1.80-1.69 (m, 2H), 1.55-1.41 (m, 2H), 0.97 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.5, 145.5, 117.8, 115.2, 68.1, 67.0, 50.8, 31.4, 19.2, 13.9; IR (neat, cm^{-1}) 2915, 2857, 1514, 1466, 1449, 1261, 1225, 1124, 1070, 1029, 975, 919, 828; Anal Calcd. for $C_{14}H_{21}NO_2$: C, 71.46; H, 8.99. Found: C, 71.47; H, 9.08.

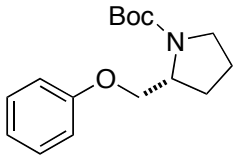


1-Phenoxy-4-(2,2,2-trifluoroethoxy)benzene: Following procedure A, 4-chlorodiphenyl ether (172 μL, 1 mmol), 2,2,2-trifluoroethanol (144 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 5 h. The crude product was purified by flash column chromatography (silica gel, 50:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (223.2 mg, 83% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.36-7.29 (m, 2H), 7.12-7.05 (m, 1H), 7.04-6.90 (m, 6H),

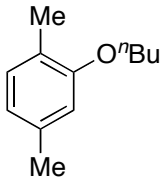
4.34 (q, 2H, J = 8.2 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 157.9, 153.5, 151.9, 129.7, 123.4 (q, J = 278.0 Hz), 122.9, 120.6, 118.0, 116.3, 66.5 (q, J = 35.5 Hz); ^{19}F NMR (282 MHz, $CDCl_3$) δ -74.3 (t, J = 8.0 Hz); IR (neat, cm^{-1}) 3045, 2945, 1592, 1504, 1488, 1459, 1285, 1217, 1165, 1079, 974, 860, 842, 692; Anal Calcd. for $C_{14}H_{11}F_3O_2$: C, 62.69; H, 4.13. Found: C, 62.40; H, 4.23.



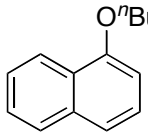
2-((4-Cyanophenoxy)methyl)furan: Following procedure A, 4-bromobenzonitrile (182.0 mg, 1 mmol), furfuryl alcohol (173 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 5 h. The crude product was purified by flash column chromatography (silica gel, 5:1 hexanes:EtOAc) to afford the title compound as a white solid (152.0 mg, 76% yield): m.p. 71 –72 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.62-7.56 (m, 2H), 7.46 (dd, 1H, J = 1.8, 0.7 Hz), 7.6-7.01 (d, 2H, J =9.0 Hz), 6.47 (br d, 1H, J = 3.3 Hz), 6.40 (dd, 1H, J = 3.3, 1.8 Hz), 5.05 (s, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 161.5, 148.9, 143.5, 134.0, 119.1, 115.5, 110.7, 110.6, 104.4, 62.4; IR (neat, cm^{-1}) 2221, 1605, 1506, 1254, 1176, 994, 926, 834, 770; Anal Calcd. for $C_{12}H_9NO_2$: C, 72.35; H, 4.55. Found: C, 72.26; H, 4.44.



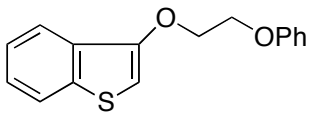
(*R*)-*tert*-Butyl 2-(Phenoxymethyl)pyrrolidine-1-carboxylate: Following procedure A, bromobenzene (107 μL, 1 mmol), *N*-Boc-D-prolinol (250 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 10 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a colorless liquid (237.8 mg, 86% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27 (br t, 2H, J = 8.0 Hz), 6.93 (br d, 3H, J = 8.0 Hz), 4.24-4.04 (m, 2H), 4.00-3.70 (m, 1H), 3.48-3.24 (m, 2H), 2.14-1.72 (m, 4H), 1.48 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 158.7, 154.6, 154.4, 129.3, 120.7, 120.5, 114.4, 79.6, 79.2, 68.0, 67.7, 55.9, 55.8 46.9, 46.5, 28.6, 28.5, 27.9, 23.7, 22.7 (observed complexity is due to the presence of two rotamers); IR (neat, cm^{-1}) 2975, 1695, 1497, 1394, 1245, 1171, 1107, 755; Anal Calcd. for $C_{16}H_{23}NO_3$: C, 69.29; H, 8.36. Found: C, 69.16; H, 8.45.



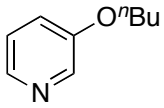
1-Butoxy-2,5-dimethylbenzene: Following procedure A, 1-bromo-2,5-dimethylbenzene (138 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $Pd(OAc)_2$ (4.49 mg, 2 mol%), *t*-BuBrettPhos (11.63 mg, 2.4 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, 100:1 hexanes:EtOAc) to afford the title compound as a colorless oil (144.8 mg, 81% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.02 (d, 1H, J = 7.7 Hz); 6.67 (d, 1H, J = 7.7 Hz); 6.66 (s, 1H), 3.96 (t, 2H, J = 6.5 Hz), 2.33 (s, 3H), 2.20 (s, 3H), 1.85-1.74 (m, 2H), 1.60-1.44 (m, 2H), 1.00 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 157.1, 136.4, 130.2, 123.6, 120.5, 111.9, 67.5, 31.5, 21.4, 19.4, 15.8, 13.9; IR (neat, cm^{-1}) 2959, 2933, 2872, 1614, 1586, 1509, 1459, 1414, 1266, 1159, 1132, 1041, 1030, 802. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[6]



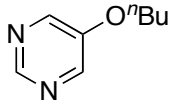
1-Butoxynaphthalene: Following procedure A, 1-bromo-naphthalene (139 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $Pd(OAc)_2$ (4.49 mg, 2 mol%), *t*-BuBrettPhos (11.63 mg, 2.4 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, 100:1 hexanes:EtOAc) to afford the title compound as a colorless oil (173.1 mg, 86% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.38-8.30 (m, 1H), 7.87-7.79 (m, 1H), 7.56-7.37 (m, 4H), 6.83 (dd, 1H, J = 7.1, 1.5 Hz); 4.17 (t, 2H, J = 6.5 Hz), 2.01-1.90 (m, 2H), 1.72-1.58 (m, 2H), 1.07 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 154.9, 134.4, 127.4, 126.3, 125.9, 125.7, 125.0, 122.1, 119.9, 104.4, 67.7, 31.4, 19.5, 13.9; IR (neat, cm^{-1}) 3053, 2958, 2933, 2872, 1596, 1581, 1509, 1460, 1405, 1390, 1271, 1240, 1156, 1100, 1073, 1020, 962, 790, 770. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[6]



3-(2-Phenoxyethoxy)benzo[*b*]thiophene: Following procedure A, 3-bromothiophene (131 μL, 1 mmol), 2-phenoxyethanol (250 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 10 h. The crude product was purified by flash column chromatography (silica gel, 15:1 hexanes:EtOAc) to afford the title compound as a off-white solid (220.4 mg, 82% yield): m.p. 91 –93 °C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.89-7.81 (m, 1H), 7.81-7.74 (m, 1H), 7.42-7.30 (m, 4H), 7.06-7.98 (m, 3H), 6.37 (s, 1H), 4.51-4.45 (m, 2H), 4.45-4.39 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 158.6, 150.6, 137.6, 132.0, 129.5, 125.2, 123.7, 122.7, 121.12, 121.10, 114.7, 96.6, 68.5, 66.3; IR (neat, cm^{-1}) 2934, 1600, 1572, 1530, 1498, 1455, 1355, 1251, 1189, 934, 758, 716; Anal Calcd. for $C_{16}H_{14}O_2S$: C, 71.08; H, 5.22. Found: C, 70.96; H, 5.07.

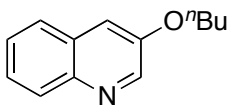


3-Butoxypyridine: Following procedure B, 3-chloropyridine (94 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 5 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a colorless oil (136.9 mg, 91% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.31-8.26 (m, 1H), 8.18 (dd, 1H, J = 2.3, 3.9 Hz), 7.21-7.12 (m, 2H), 3.98 (t, 2H, J = 6.5 Hz), 1.82-1.70 (m, 2H), 1.55-1.40 (m, 2H), 0.96 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 155.2, 141.8, 138.0, 123.7, 120.9, 67.9, 31.1, 19.1, 13.7; IR (neat, cm^{-1}) 2960, 2935, 2874, 1583, 1576, 1473, 1426, 1280, 1264, 1231, 1049, 798, 707; Anal Calcd. for $C_9H_{13}NO$: C, 71.49; H, 8.67. Found: C, 71.26; H, 8.79. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[9]

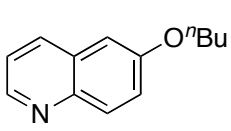


5-Butoxypyrimidine: Following procedure B, 5-bromopyrimidine (159.0 mg, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 °C for 10 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a

colorless oil (140.1 mg, 92% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.79 (s, 1H), 8.35 (s, 2H), 4.03 (t, 2H, J = 6.5 Hz), 1.82-1.70 (m, 2H), 1.54-1.39 (m, 2H), 0.94 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.0, 151.2, 143.4, 68.3, 30.9, 18.9, 13.6; IR (neat, cm^{-1}) 2960, 2936, 2875, 1569, 1560, 1419, 1387, 1276, 1182, 1113, 966, 886, 722, 615; Anal Calcd. for $C_8H_{12}N_2O$: C, 63.13; H, 7.95. Found: C, 62.86; H, 8.16.

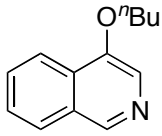


3-Butoxyquinoline: Following procedure A, 3-bromoquinoline (136 μL, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 5 h. The crude product was purified by flash column chromatography (silica gel, 10:1 hexanes:EtOAc) to afford the title compound as a colorless oil (188.5 mg, 94% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.67 (d, 1H, J = 2.8 Hz), 8.06-8.01 (m, 1H), 7.73-7.68 (m, 1H), 7.57-7.46 (m, 2H), 7.37 (br d, 1H, J = 2.8 Hz), 4.08 (t, 2H, J = 6.5 Hz), 1.91-1.79 (m, 2H), 1.62-1.48 (m, 2H), 1.01 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 152.5, 144.9, 143.3, 129.1, 128.8, 126.9, 126.6, 126.5, 112.8, 68.0, 31.0, 19.2, 13.8; IR (neat, cm^{-1}) 2960, 2873, 1604, 1496, 1464, 1427, 1380, 1347, 1275, 1213, 1184, 1141, 1067, 1026, 874, 851, 781, 750, 615; Anal Calcd. for $C_{13}H_{15}NO$: C, 77.58; H, 7.51. Found: C, 77.45; H, 7.59.

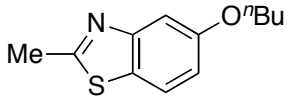


6-Butoxyquinoline: Following procedure A, 6-chloroquinoline (163.6 mg, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 5 h. The crude product was purified by flash column chromatography (silica gel, 5:1 hexanes:EtOAc) to afford the title compound as a colorless oil (188.4 mg, 94% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.74 (dd, 1H, J = 1.5, 4.3 Hz), 8.01 (d, 1H, J = 8.1 Hz), 7.98 (d, 1H, J = 9.1 Hz), 7.36 (dd, 1H, J = 2.7, 9.1 Hz), 7.32 (dd, 1H, J = 8.1, 4.3 Hz), 7.04 (d, 1H, J = 2.7 Hz), 4.06 (t, 2H, J = 6.5 Hz), 1.88-1.77 (m, 2H), 1.60-1.46 (m, 2H), 0.99 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 157.2, 147.8, 144.3, 134.7, 130.8, 129.3, 122.5, 121.3, 105.7, 67.9, 31.2, 19.3, 13.8; IR (neat, cm^{-1}) 2959, 2936, 2873, 1623, 1596, 1501, 1464, 1379, 1324,

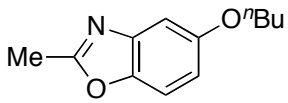
1262, 1226, 1171, 1113, 1035, 977, 923, 834, 618; Anal Calcd. for $C_{13}H_{15}NO$: C, 77.58; H, 7.51. Found: C, 77.33; H, 7.58.



4-Butoxyisoquinoline: Following procedure A, 4-bromoisoquinoline (208.1 mg, 1 mmol), *n*-BuOH (275 μL, 3 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 10 h. The crude product was purified by flash column chromatography (silica gel, 4:1 hexanes:EtOAc) to afford the title compound as a yellow liquid (161.8 mg, 80% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 8.88 (s, 1H), 8.22 (d, 1H, J = 8.4 Hz), 8.07 (s, 1H), 7.92 (d, 1H, J = 7.0 Hz), 7.72-7.57 (m, 2H), 4.22 (t, 2H, J = 6.5 Hz), 1.92 (pentet, 2H, J = 7.0 Hz), 1.60 (sextet, 2H, J = 6.2 Hz), 1.03 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 149.9, 144.9, 129.3, 129.0, 128.2, 127.4, 126.7, 123.6, 121.1, 68.2, 31.3, 19.3, 13.8; IR (neat, cm^{-1}) 2959, 2935, 2872, 1580, 1502, 1459, 1400, 1327, 1283, 1158, 1123, 1093, 962, 852, 781, 754, 591.

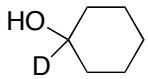


5-Butoxy-2-methylbenzothiazole: Following procedure A, 5-chloro-2-methylbenzothiazole (183.7 mg, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (1.83 mg, 0.5 mol%), RockPhos (7.03 mg, 1.5 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 15 h. The crude product was purified by flash column chromatography (silica gel, 7:1 hexanes:EtOAc) to afford the title compound as brown solids (193.1 mg, 87% yield): m.p. 40 –42 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.64 (d, 1H, J = 8.8 Hz), 7.43 (d, 1H, J = 2.4 Hz), 6.98 (dd, 1H, J = 8.8, 2.4 Hz), 4.02 (t, 2H, J = 6.5 Hz), 2.80 (s, 3H), 1.85-1.74 (m, 2H), 1.58-1.44 (m, 2H), 0.98 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 168.0, 158.2, 154.6, 127.1, 121.5, 115.0, 105.8, 68.0, 31.2, 20.1, 19.2, 13.8; IR (neat, cm^{-1}) 2957, 2930, 2868, 1602, 1558, 1521, 1457, 1323, 1279, 1169, 1068, 1009, 840, 643; Anal Calcd. for $C_{12}H_{15}NOS$: C, 65.12; H, 6.83. Found: C, 65.32; H, 6.75.



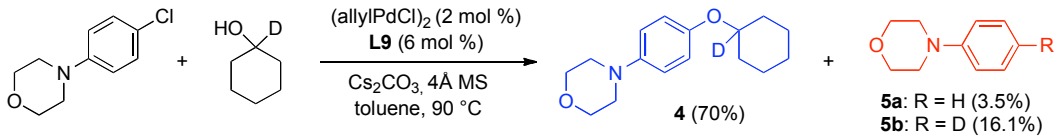
5-Butoxy-2-methylbenzoxazole: Following procedure A, 5-chloro-2-methylbenzoxazole (167.6 mg, 1 mmol), 1-butanol (183 μL, 2 mmol), $(allylPdCl)_2$ (3.66 mg, 1 mol%), RockPhos (11.25 mg, 2.4 mol%),

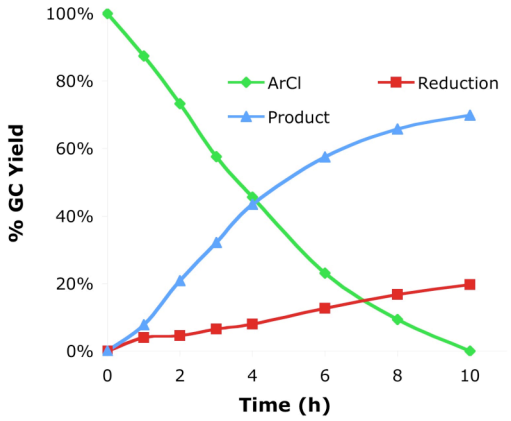
Cs_2CO_3 (489 mg, 1.5 mmol), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, 5:1 hexanes:EtOAc) to afford the title compound as a colorless oil (180.2 mg, 88% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.32 (d, 1H, J = 8.9 Hz), 7.12(d, 1H, J = 2.5 Hz), 6.87 (dd, 1H, J = 8.9, 2.5 Hz), 3.98 (t, 2H, J = 6.5 Hz), 2.60 (s, 3H), 1.83-1.72 (m, 2H), 1.57-1.43 (m, 2H), 0.98 (t, 3H, J = 7.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 164.5, 156.5, 145.5, 142.3, 113.2, 110.2, 103.5, 68.5, 31.3, 19.2, 14.6, 13.8; IR (neat, cm^{-1}) 2960, 2930, 2873, 1576, 1472, 1438, 1382, 1283, 1172, 1158, 927, 846, 804, 664; Anal Calcd. for $C_{12}H_{15}NO_2$: C, 70.22; H, 7.37. Found: C, 70.06; H, 7.45.

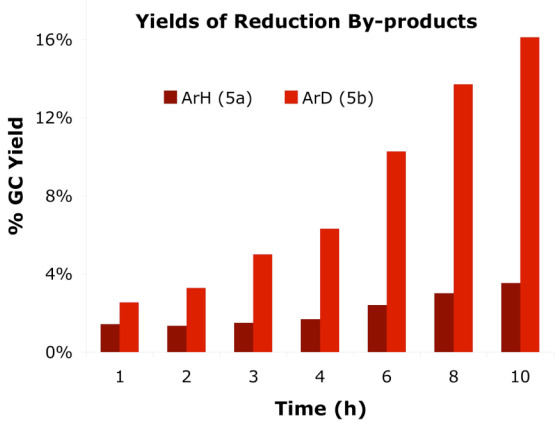


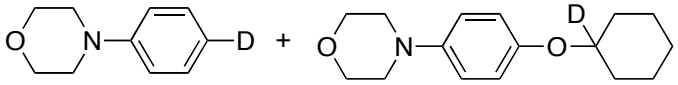
1-Deuteriocyclohexanol was prepared according the literature procedure.[10] To a suspension of $LiAlD_4$ (4.20 g, 100 mmol) in ether (250 mL) was added a solution of cyclohexanone (10.36 mL, 100 mmol) in ether (50 mL) by syringe pump over 1 h at room temperature under argon. The reaction mixture was stirred at room temperature overnight and quenched by sequentially adding H_2O (4.2 mL), 15% aqueous NaOH (4.2 mL), and then H_2O (12.6 mL) at 0 °C with caution. The mixture was stirred at room temperature for 1 h. The white precipitate was filtered off and rinsed with hot $CHCl_3$ (4 × 150 mL). H_2O (100 mL) was added and the two layers were separated. The organic layer was washed with brine, dried over $MgSO_4$, and concentrated in vacuo. The crude product was purified by distillation (bp 79-82 °C/35 torr) to give the deuterio alcohol as a colorless oil (7.8 g, 77% yield): ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.05-1.05 (m, 10H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 69.7 (t, J = 21.5 Hz), 35.3, 25.4, 24.1. The ^{1}H NMR and ^{13}C NMR spectral data were consistent with those of the previously reported compound.[11]

Deuterium Labeling Studies.









4-(4-Deuteriophenyl)morpholine and

4-(4-((1-deuteriocyclohexyl)oxy)phenyl)morpholine: Following procedure A, 4-(4-bromophenyl)morpholine (242.1 mg, 1 mmol), 1-deuteriocyclohexanol (160 μL, 1.5 mmol), $(allylPdCl)_2$, (3.66 mg, 1 mol%), RockPhos (14.06 mg, 3 mol%), Cs_2CO_3 (489 mg, 1.5 mmol), 4Å molecular sieves (200 mg), and toluene were heated at 90 ºC for 21 h. The crude product was purified by flash column chromatography (silica gel, 15:1 hexanes:EtOAc) to afford 4-(4-deuteriophenyl)morpholine (35.2 mg, 17% yield) as a white solid, followed by 4-(4-((1-deuteriocyclohexyl)oxy)phenyl)morpholine (166.8 mg, 64% yield) as a white solid.

Data for 4-(4-deuteriophenyl)morpholine: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.29 (br d, 2H, J = 8.7 Hz), 6.96-6.91 (m, 2H), 3.90-3.85 (m, 4H), 3.19-3.14 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 151.2, 129.0, 120.0 (s, from H-incorporated), 119.7 (t, J = 24.5 Hz, from D-incorporated), 115.7, 66.9, 49.3; IR (neat, cm^{-1}) 2962, 2855, 2826, 1596, 1496, 1449, 1259, 1232, 1116, 927; Anal Calcd. for $C_{10}H_{12}DN_2O$: C, 73.59; H, 8.03. Found: C, 73.38; H, 7.90.

Data for 4-(4-((1-deuteriocyclohexyl)oxy)phenyl)morpholine: m.p. 67-68 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.86 (s, 4H), 3.88-3.82 (m, 4H), 3.08-3.02 (m, 4H), 2.03-1.90 (m, 2H), 1.86-1.70 (m, 2H), 1.63-1.20 (m, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 151.9, 145.5, 117.6, 117.2, 75.7 (t, J = 21.5 Hz), 67.0, 50.7, 31.8, 25.6, 23.8; IR (neat, cm^{-1}) 2934, 2855, 1510, 1450, 1260, 1238, 1122, 1089, 959, 930, 824; Anal Calcd. for $C_{16}H_{22}DNO_2$: C, 73.53; H + D, 8.87. Found: C, 73.31; H + D, 8.86.

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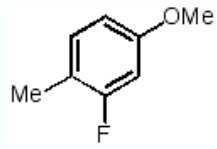
wxx-1-270-2

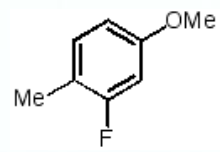
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

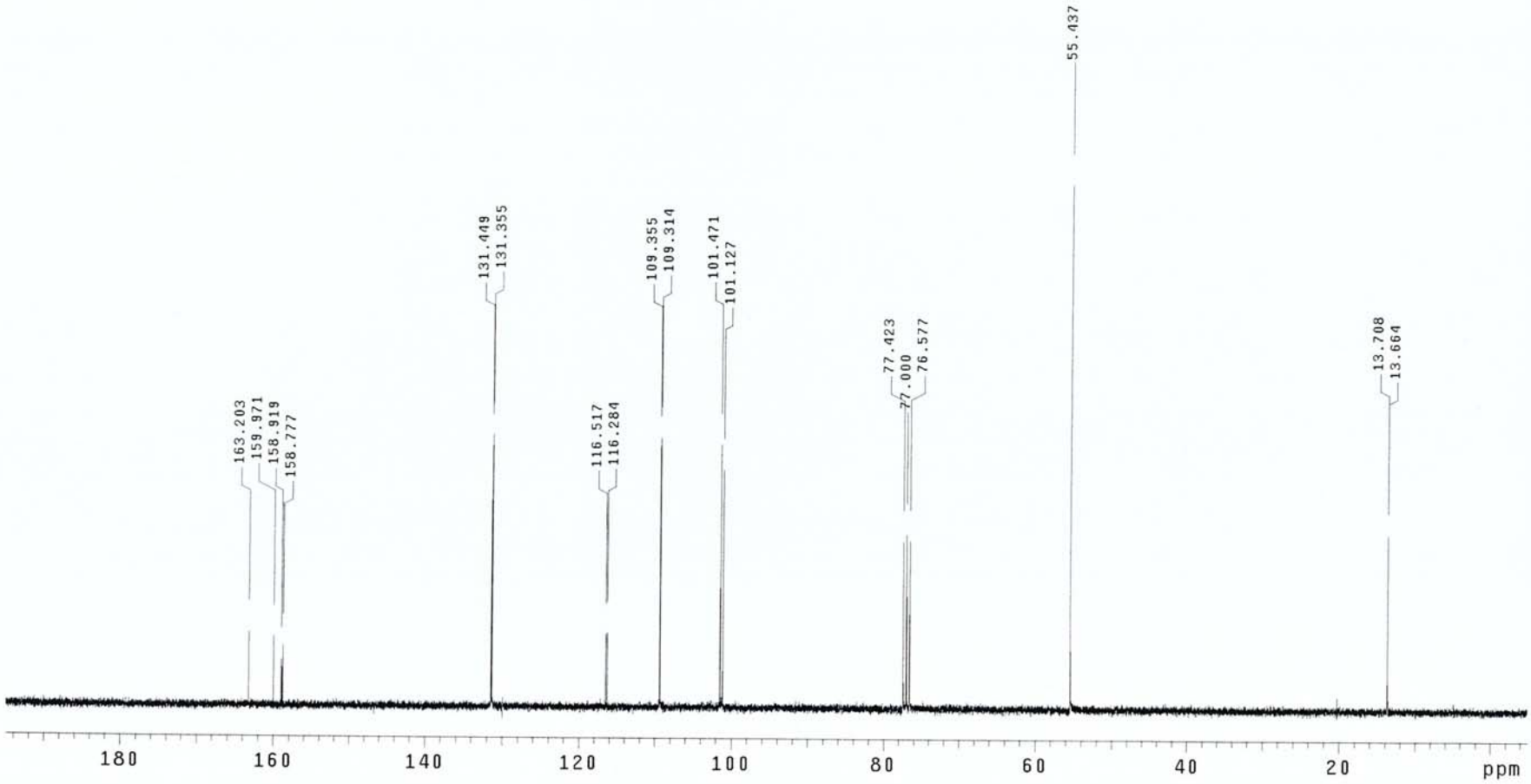
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055030 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec



wxx-1-270-2C

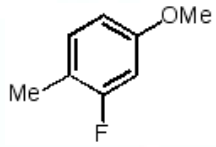
Pulse Sequence: s2pul





wxx-1-270-2F

Pulse Sequence: s2pul



wxx-1-286-3

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

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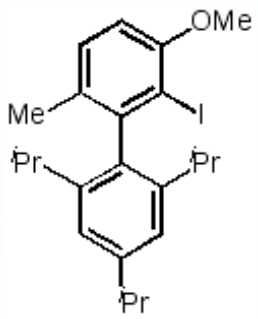
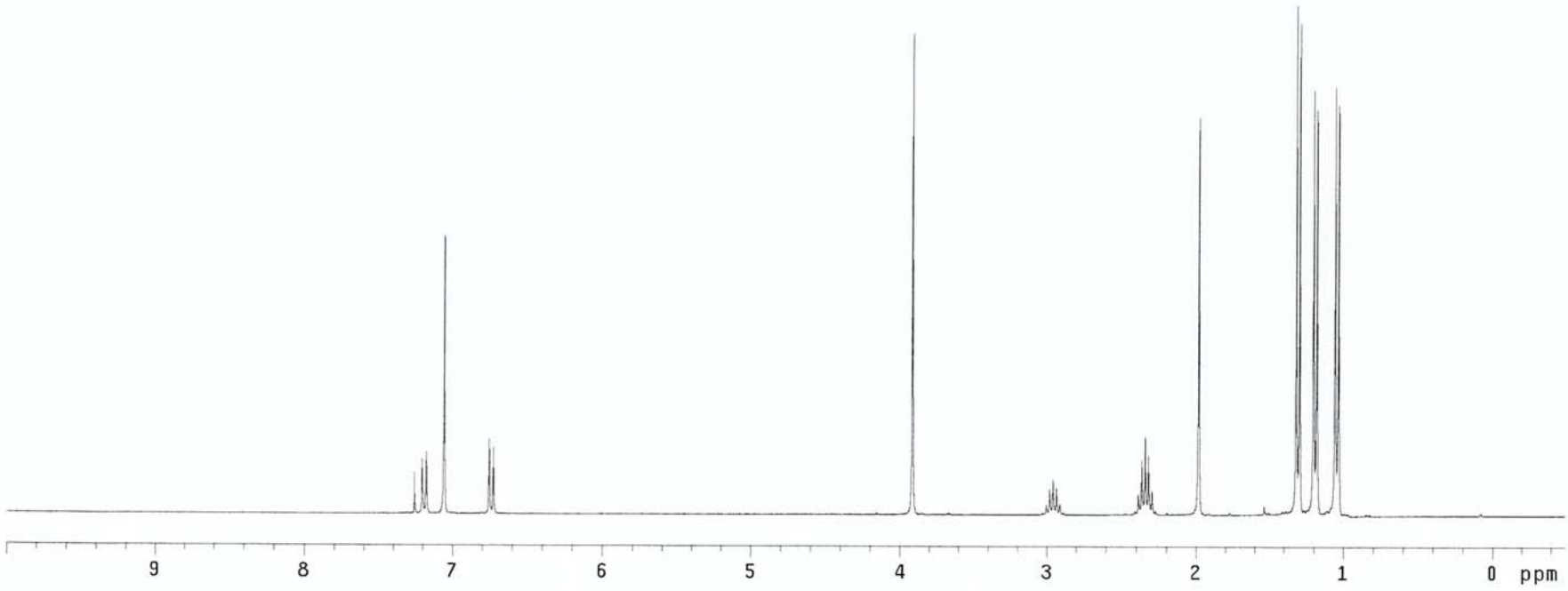
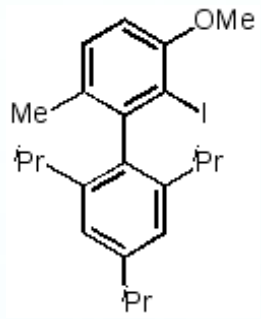
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
17 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec

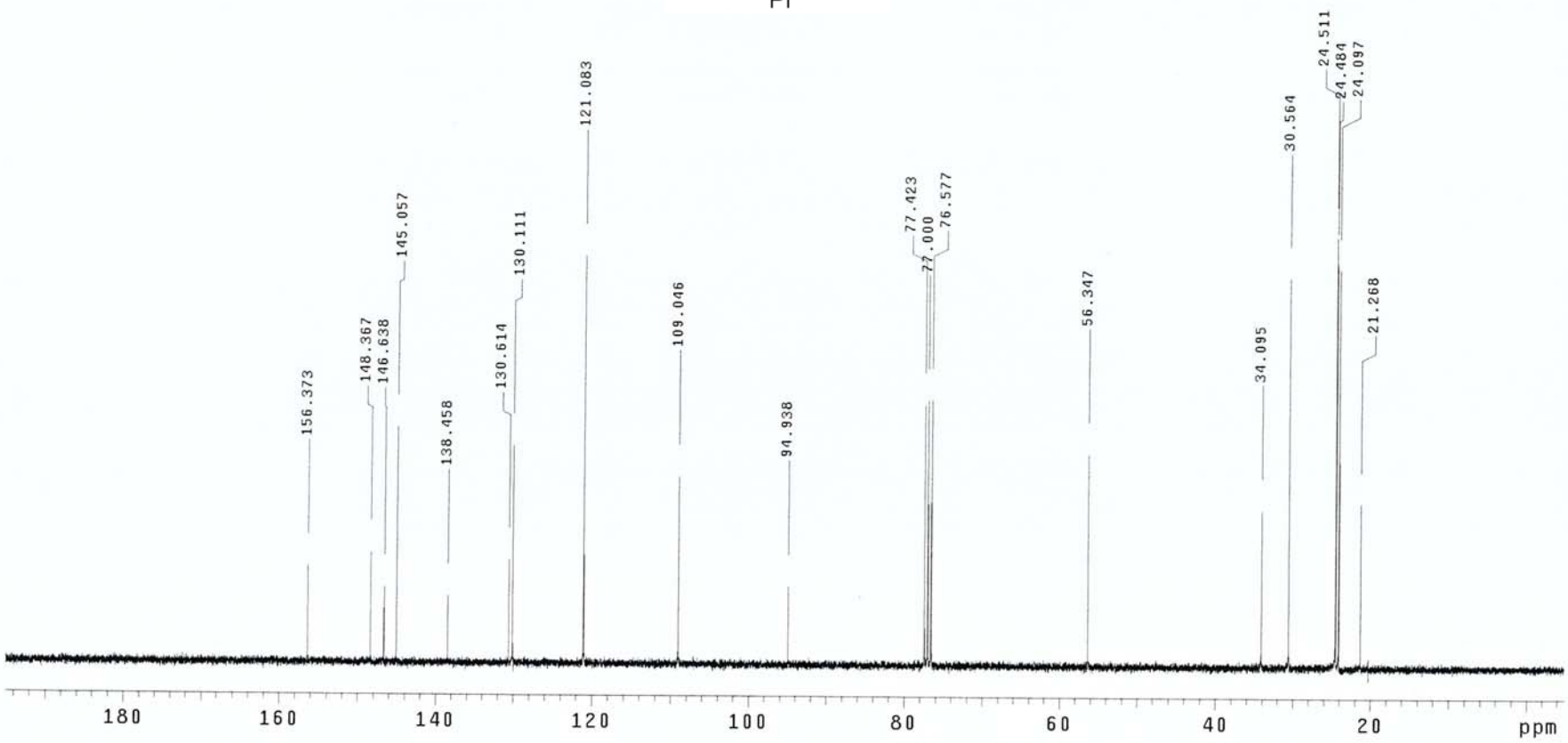




wxx-1-286-3C

Pulse Sequence: s2pul

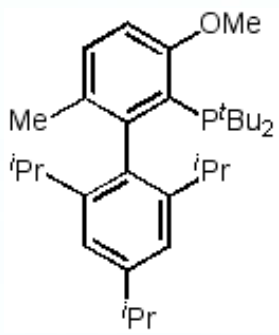




wxx-1-245-4

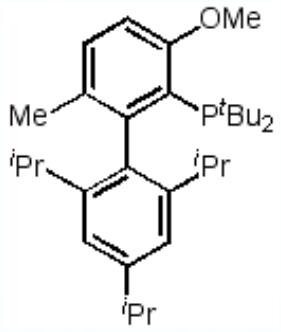
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



wxx-1-245-4C

Pulse Sequence: s2pul



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33.944
33.777
31.993
31.776
30.765
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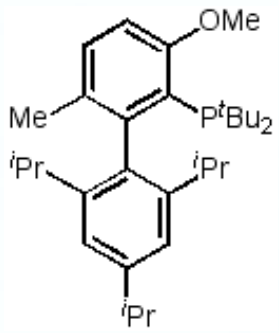
24.129
22.157
22.125

180 160 140 120 100 80 60 40 20 ppm

wxx-1-245-4P

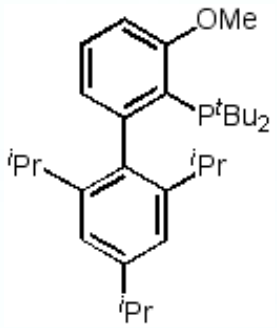
Pulse Sequence: s2pul



wxx-1-269-1

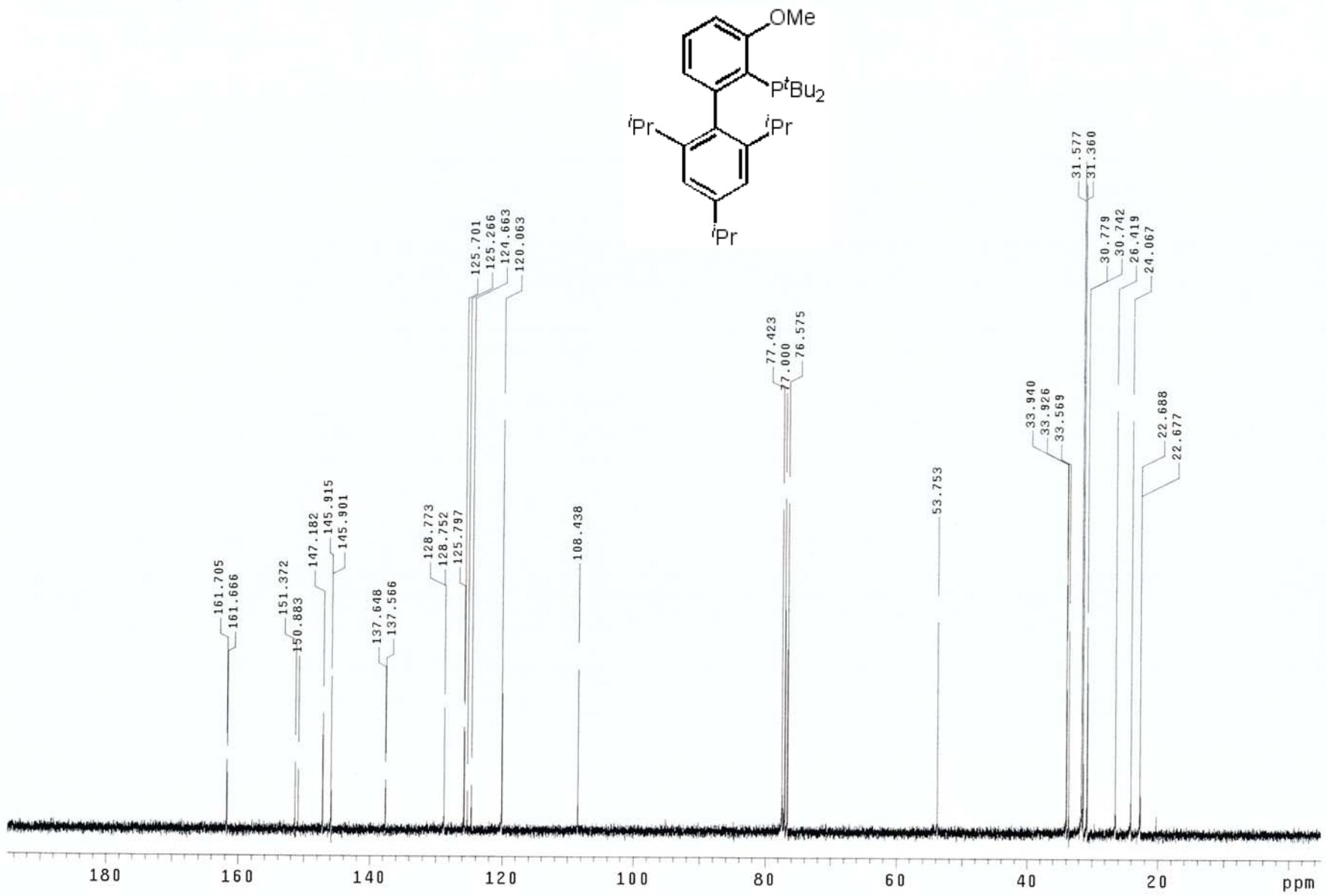
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



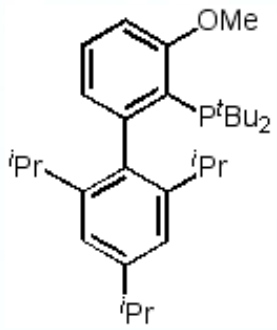
wxx-1-269-1C

Pulse Sequence: s2pul



wxx-1-269-1P

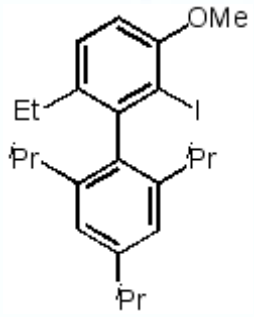
Pulse Sequence: s2pul

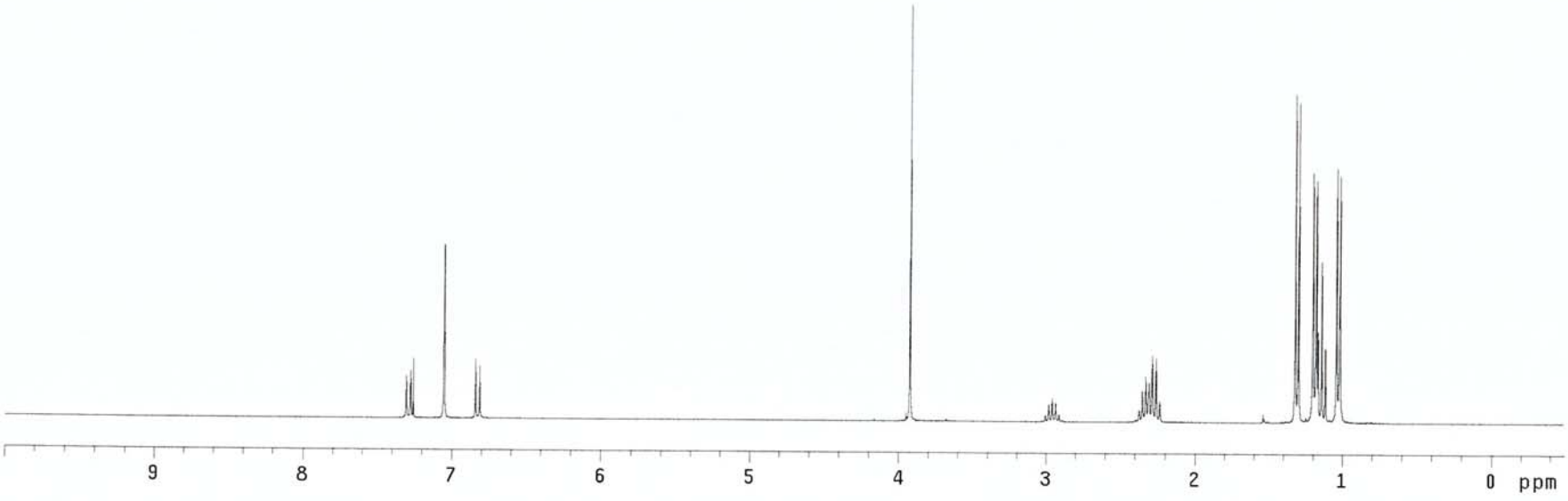


wxx-2-105-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055029 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-105-3C

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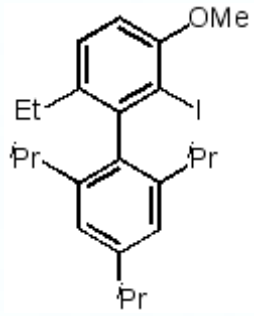

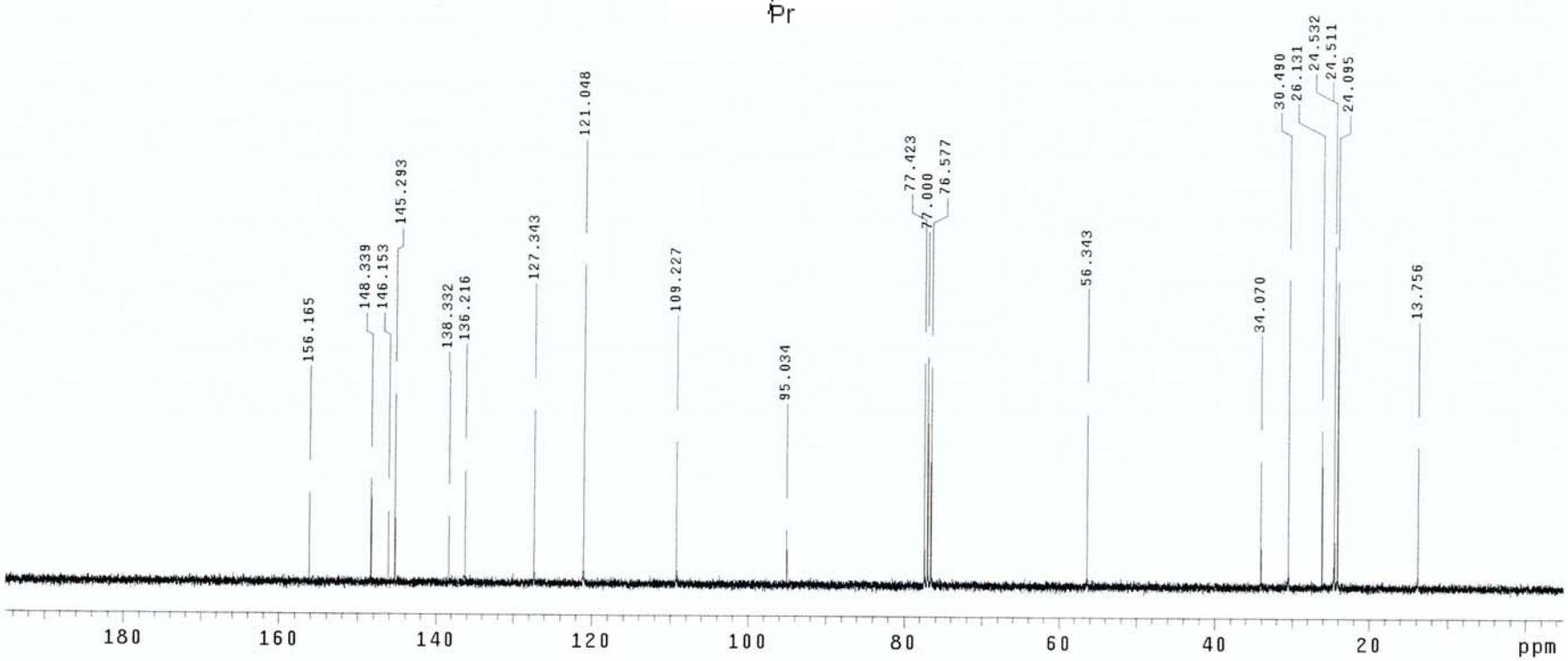

wxx-2-110-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

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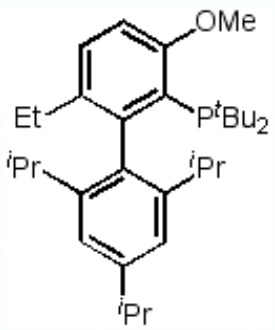
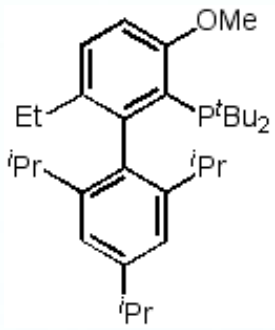
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec



wxx-2-110-1C

Pulse Sequence: s2pul



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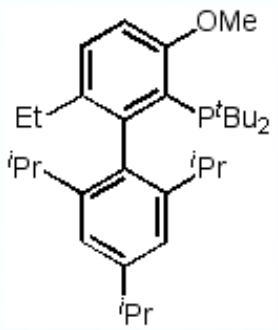
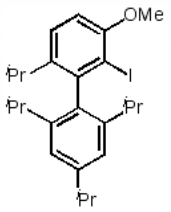
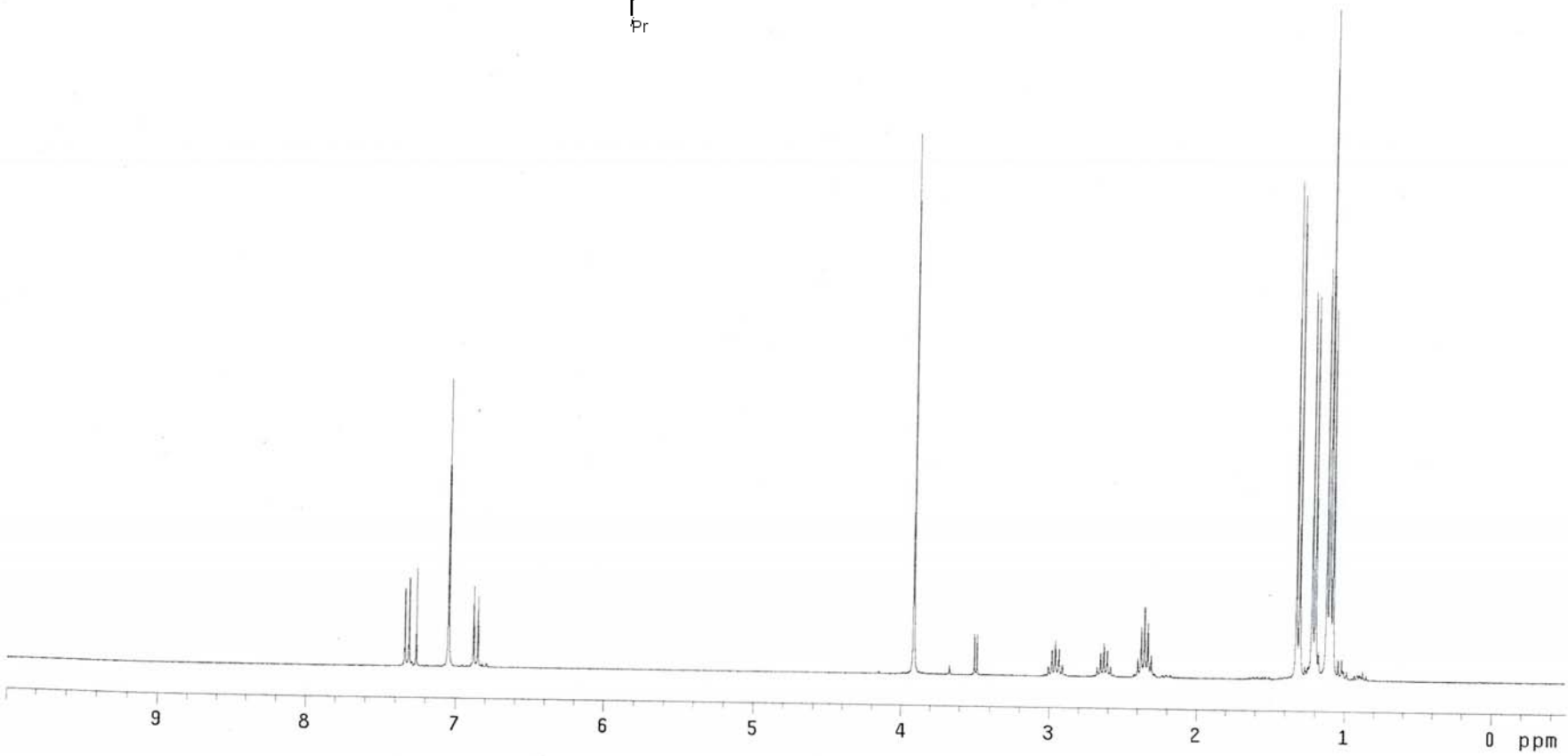


wxx-2-200-4

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

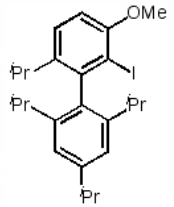
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

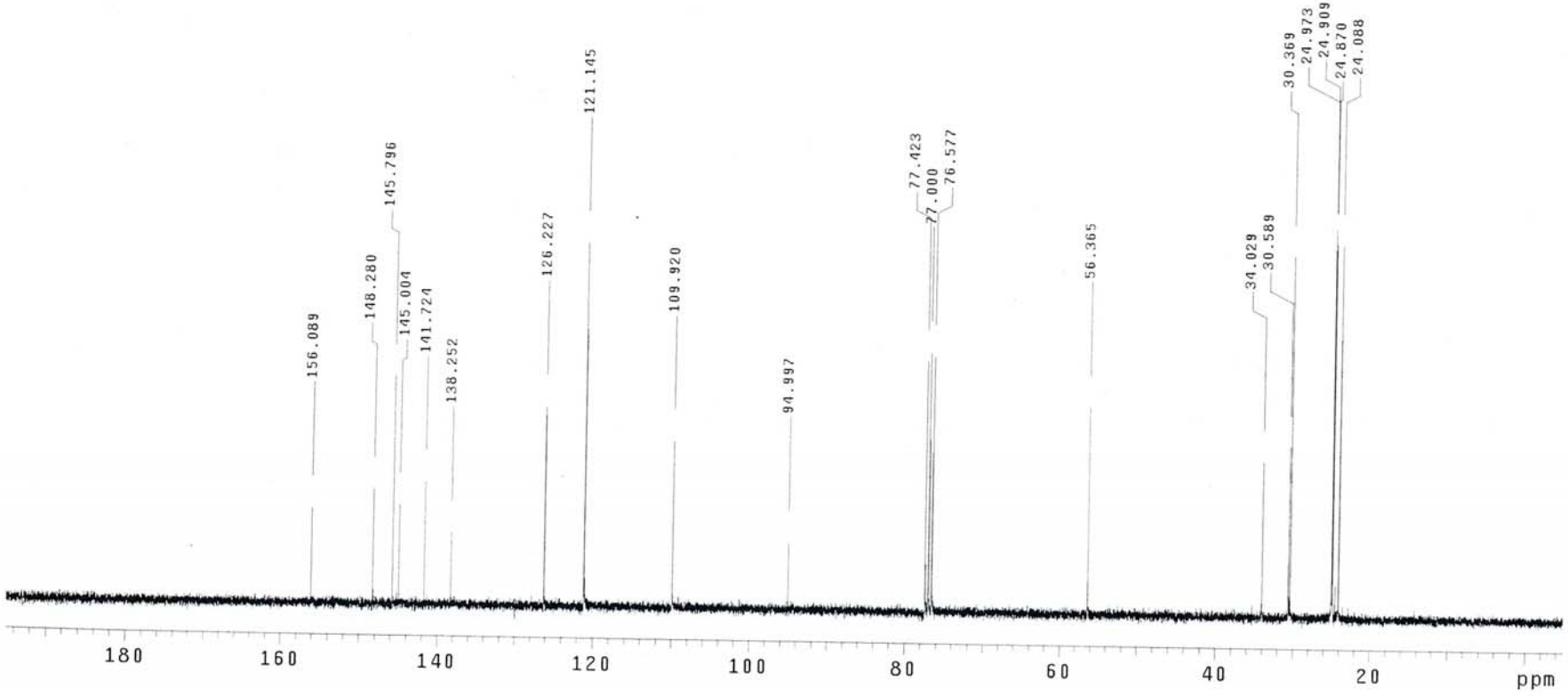




wxx-2-200-4C

Pulse Sequence: s2pul



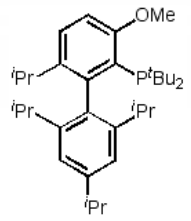


wxx-2-202-5

Pulse Sequence: s2pul

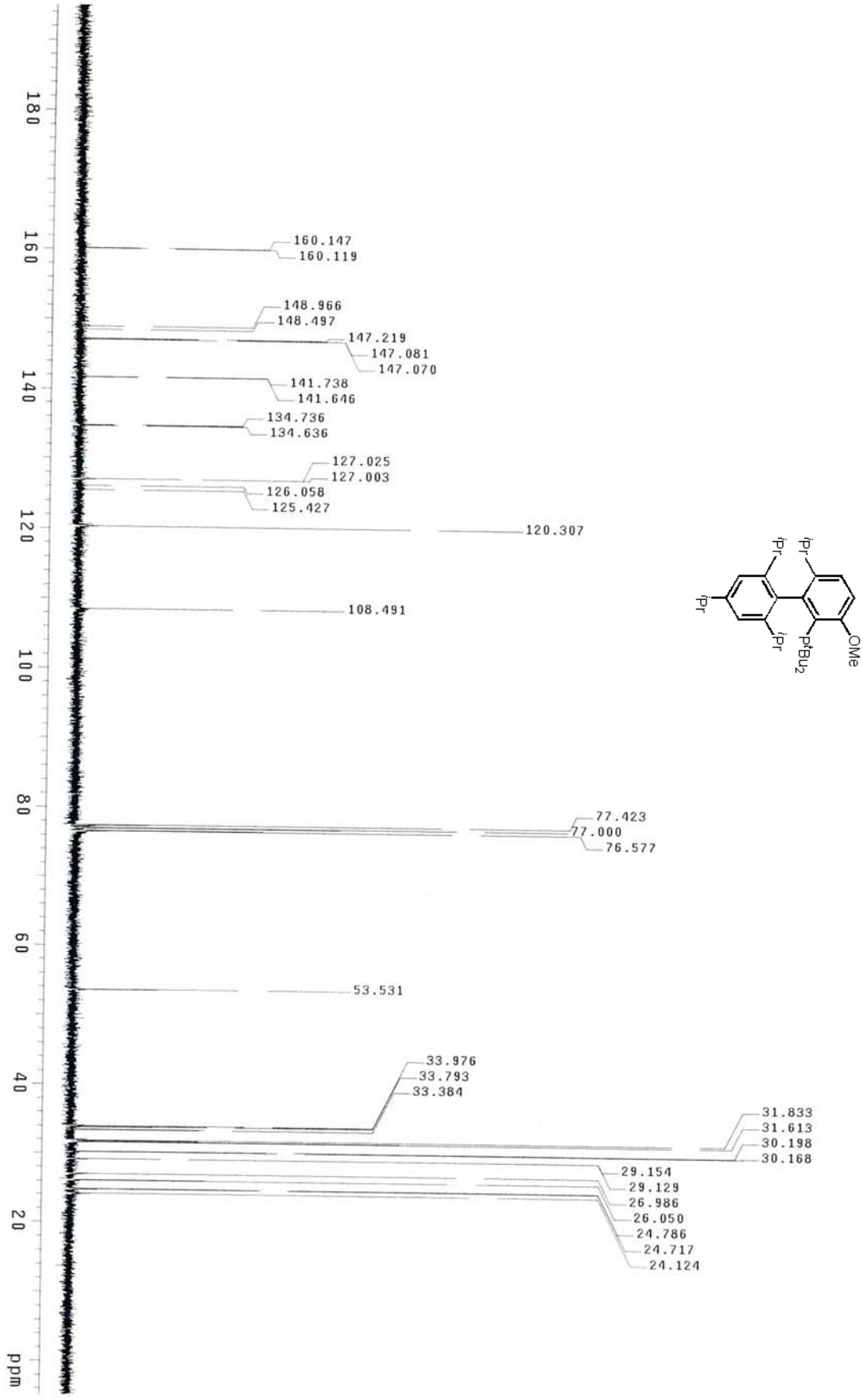
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
17 repetitions
OBSERVE H1, 300.1055030 MHz
DATA PROCESSING
FT size 131072
Total time 10 min, 20 sec



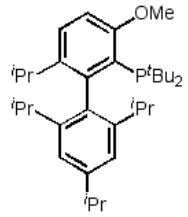
wxx-2-202-5C

Pulse Sequence: s2pul



wxx-2-202-5P

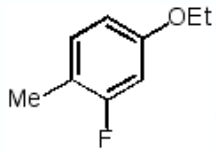
Pulse Sequence: s2pul

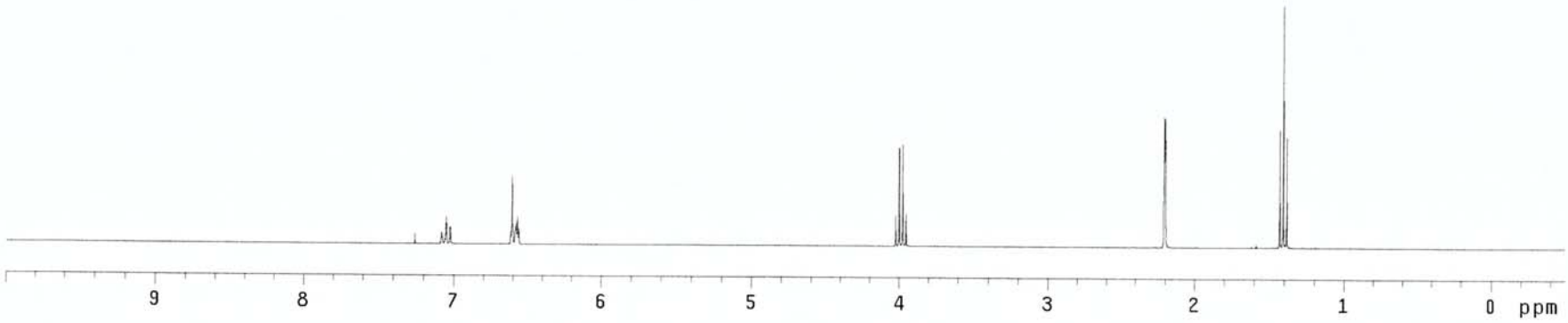


wxx-1-267-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

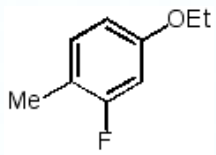
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055029 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec

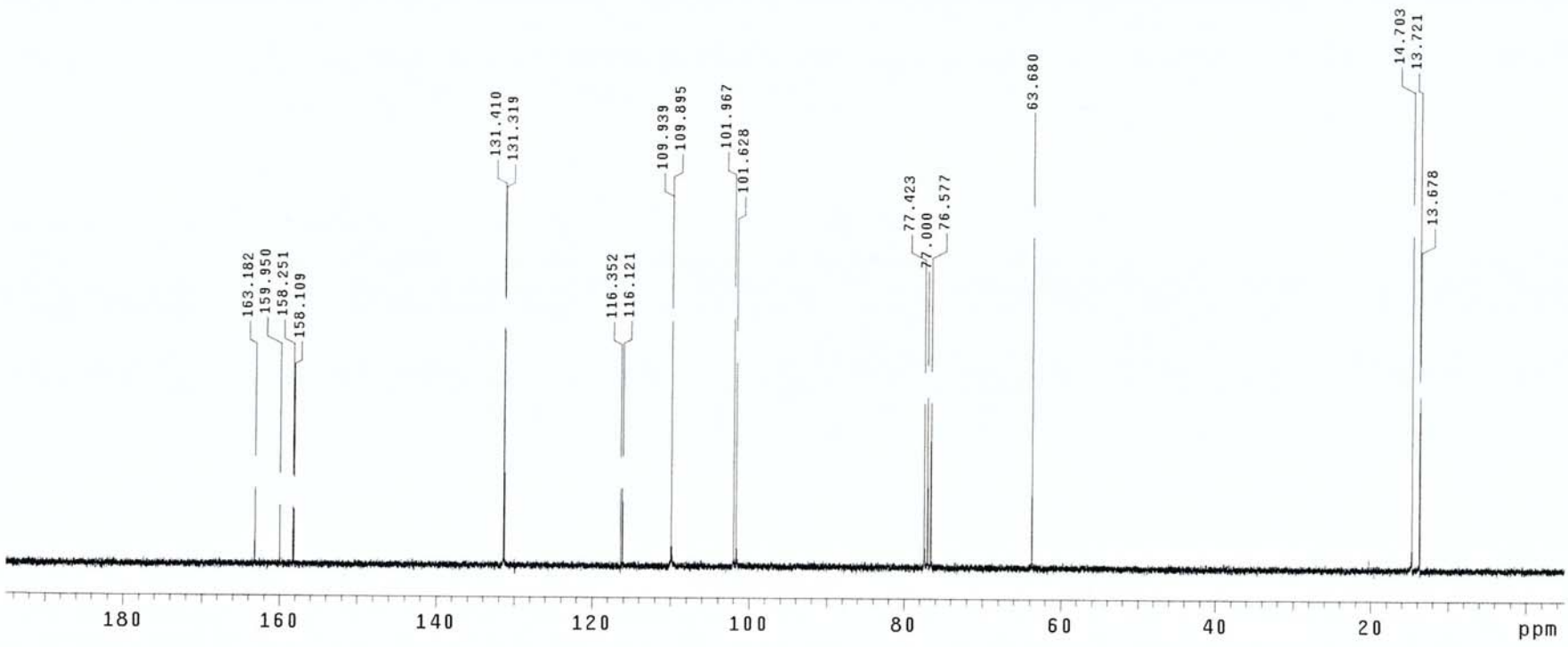




wxx-1-267-2C

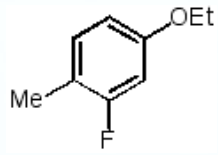
Pulse Sequence: s2pul





wxx-1-267-2F

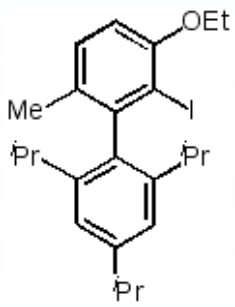
Pulse Sequence: s2pul

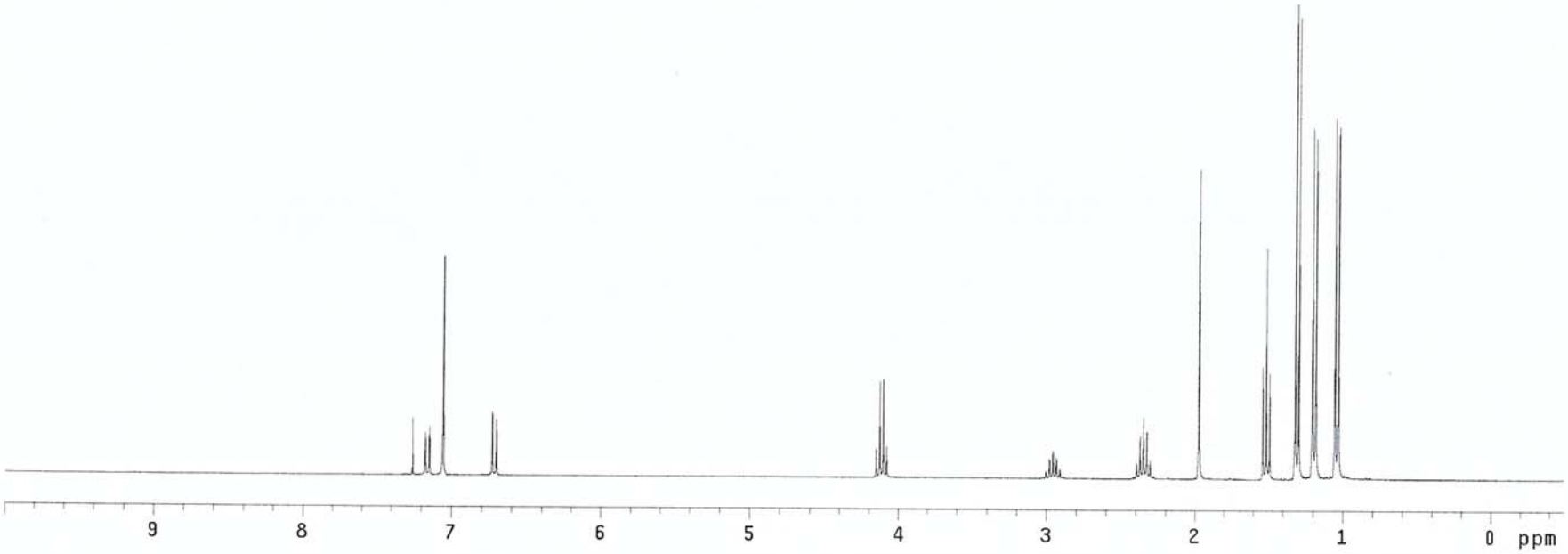


wxx-1-274-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

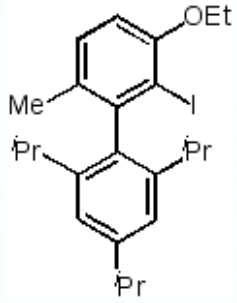
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

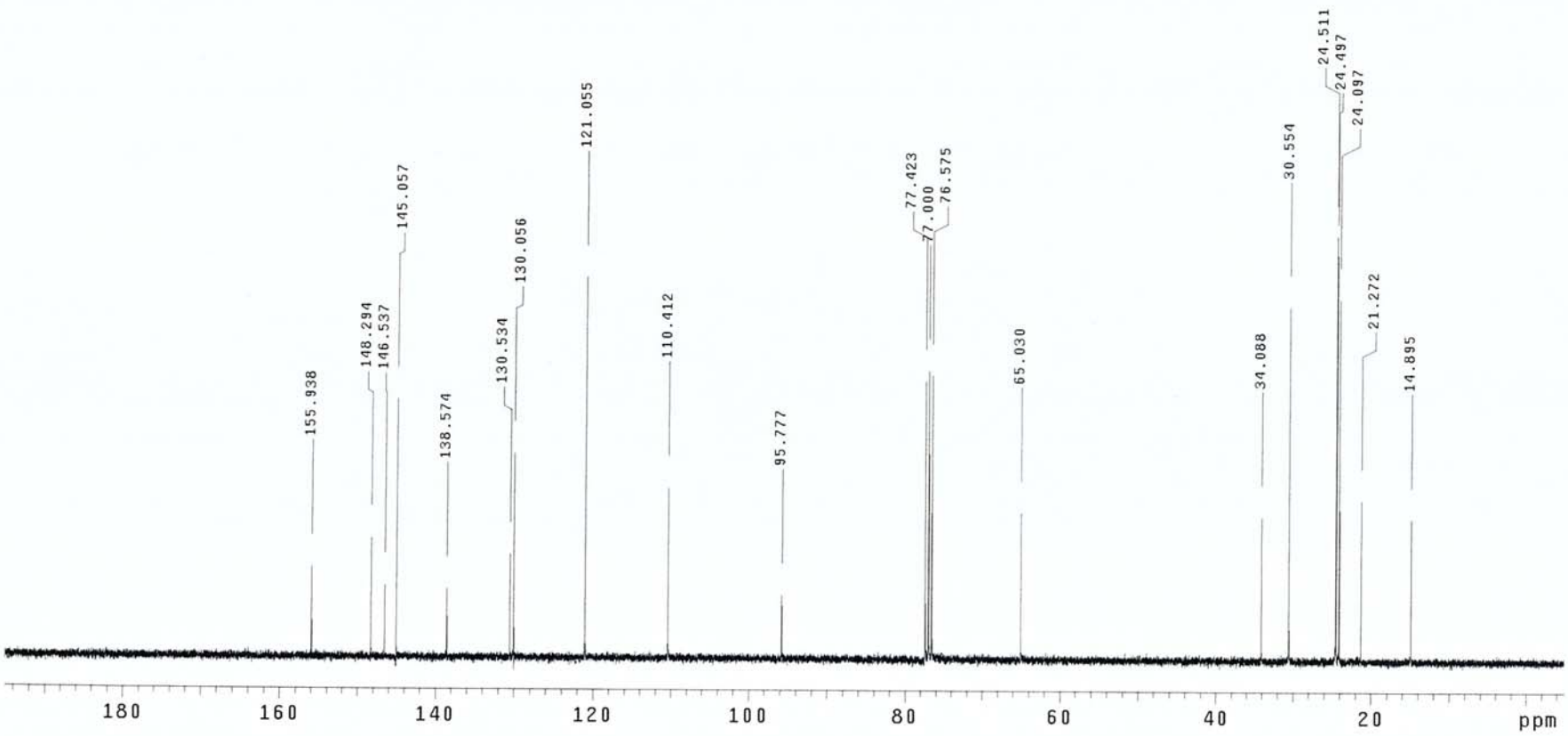




wxx-1-274-3C

Pulse Sequence: s2pul

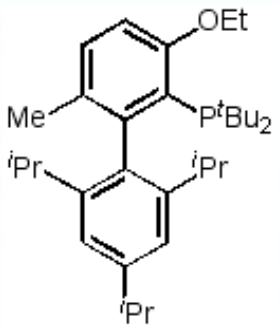




wxx-1-275-2

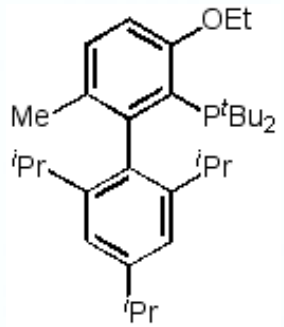
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



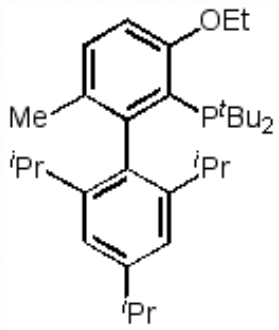
wxx-1-275-2C

Pulse Sequence: s2pul



wxx-1-275-2P

Pulse Sequence: s2pul

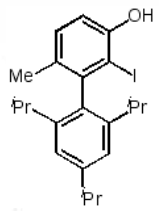


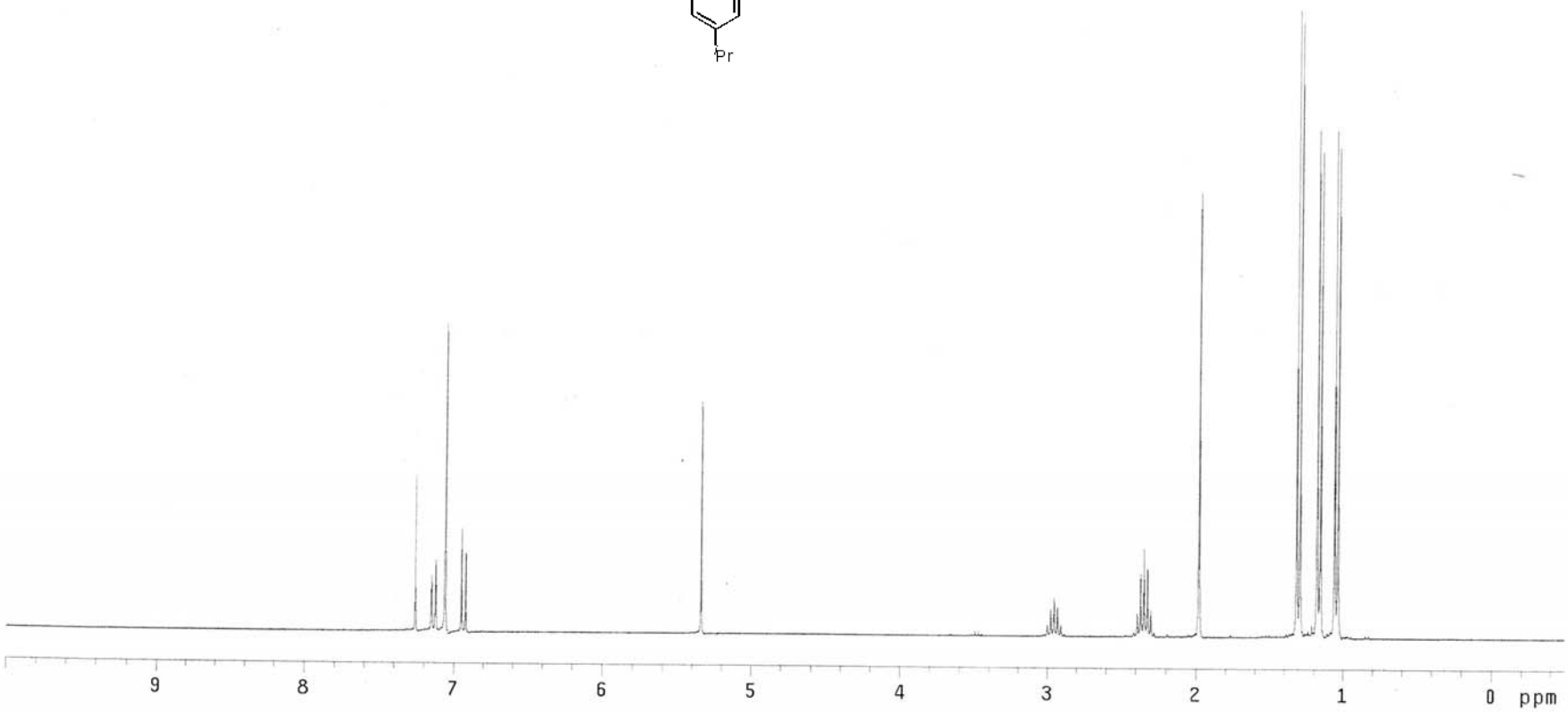
wxx-2-195-2

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

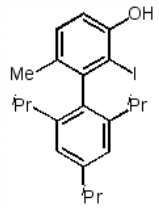
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055035 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

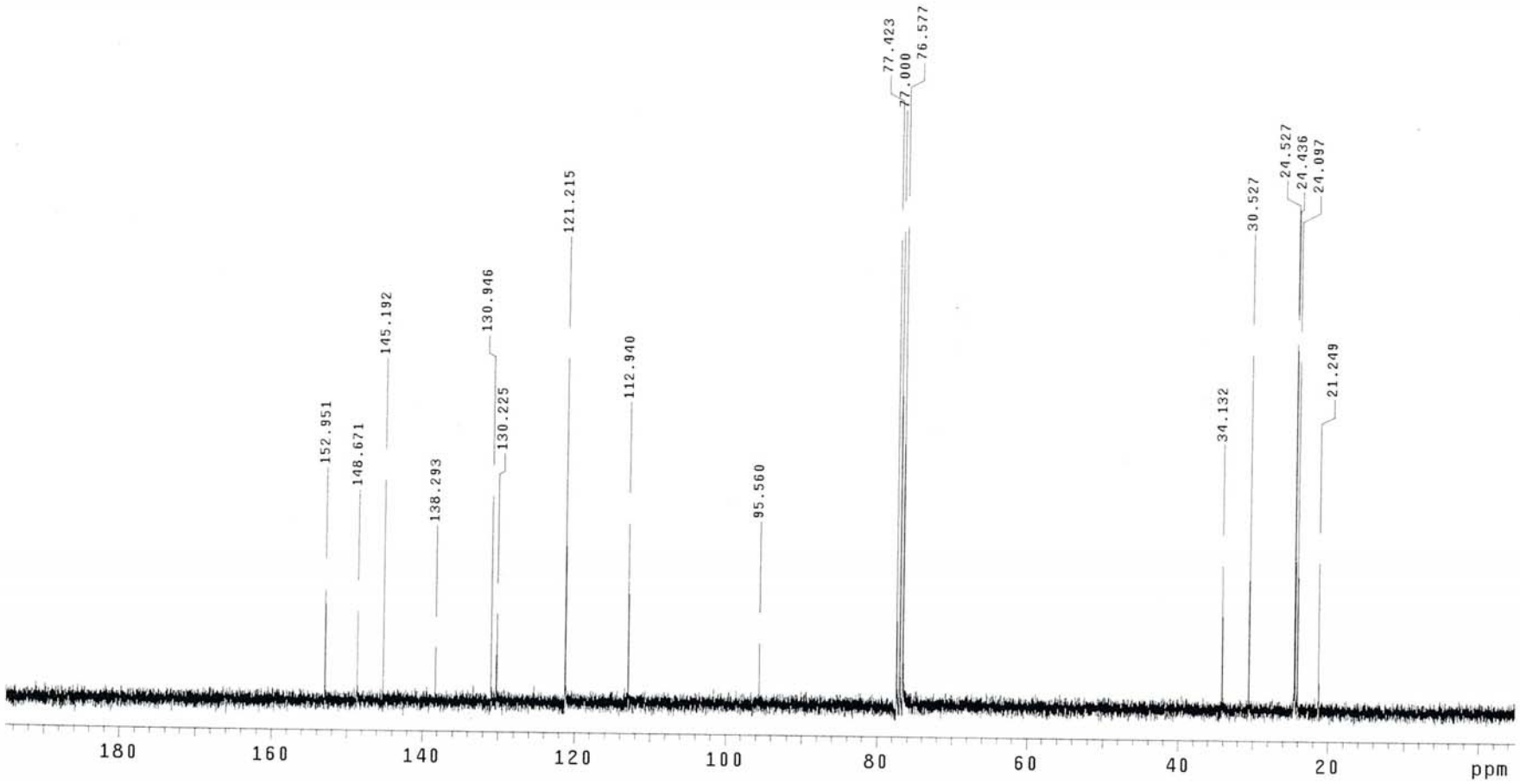




wxx-2-195-2C

Pulse Sequence: s2pul

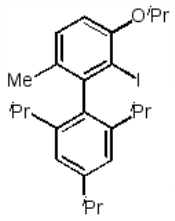


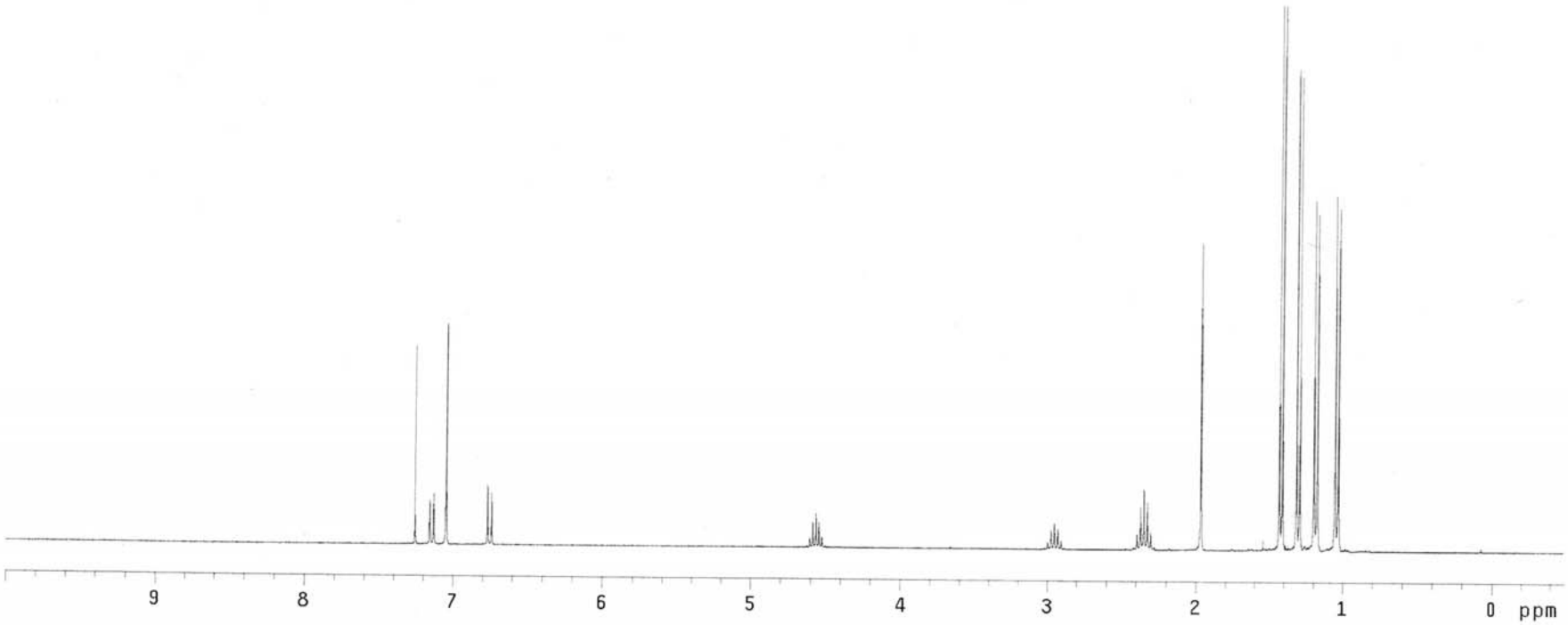


wxx-2-197-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

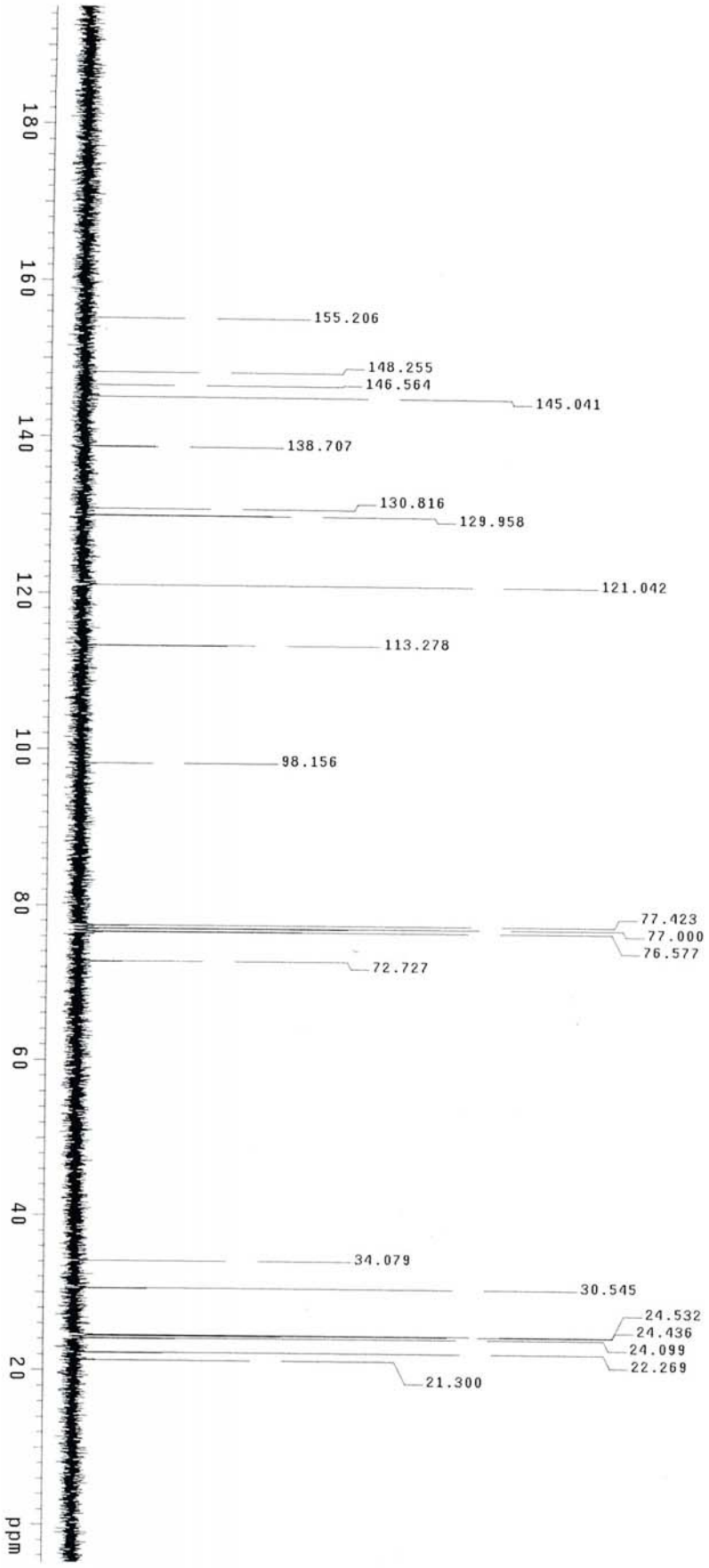
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
17 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec

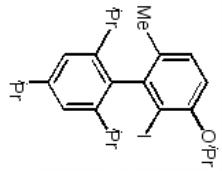




wxx-2-197-1C

Pulse Sequence: s2pul



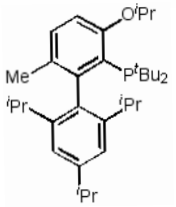


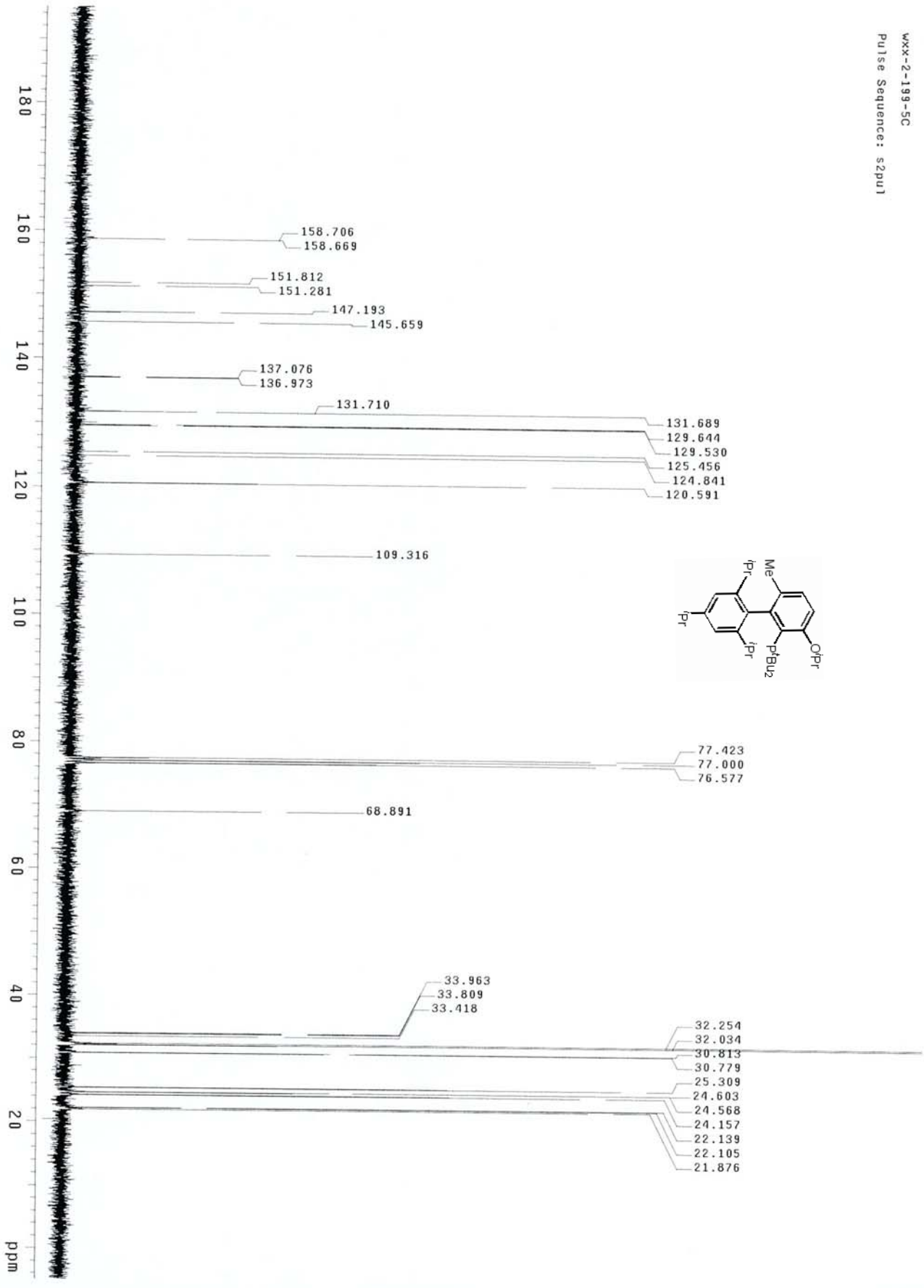
wxx-2-199-5

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

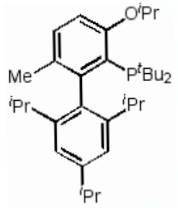
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
17 repetitions
OBSERVE H1, 300.1055031 MHz
DATA PROCESSING
FT size 131072
Total time 10 min, 20 sec




wxx-2-199-5C
Pulse Sequence: s2pul
158.706
158.669
151.812
151.281
147.193
145.659
137.076
136.973
131.710
131.689
129.644
129.530
125.456
124.841
120.591
109.316
77.423
77.000
76.577
68.891
33.963
33.809
33.418
32.254
32.034
30.813
30.779
25.309
24.603
24.568
24.157
22.139
22.105
21.876
ppm
180
160
140
120
100
80
60
40
20
Me
iPr
iPr
iPr
PtBu2
OiPr

wxx-2-199-5P

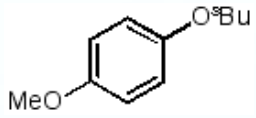
Pulse Sequence: s2pul



wxx-2-34-D-2

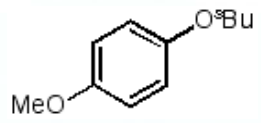
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

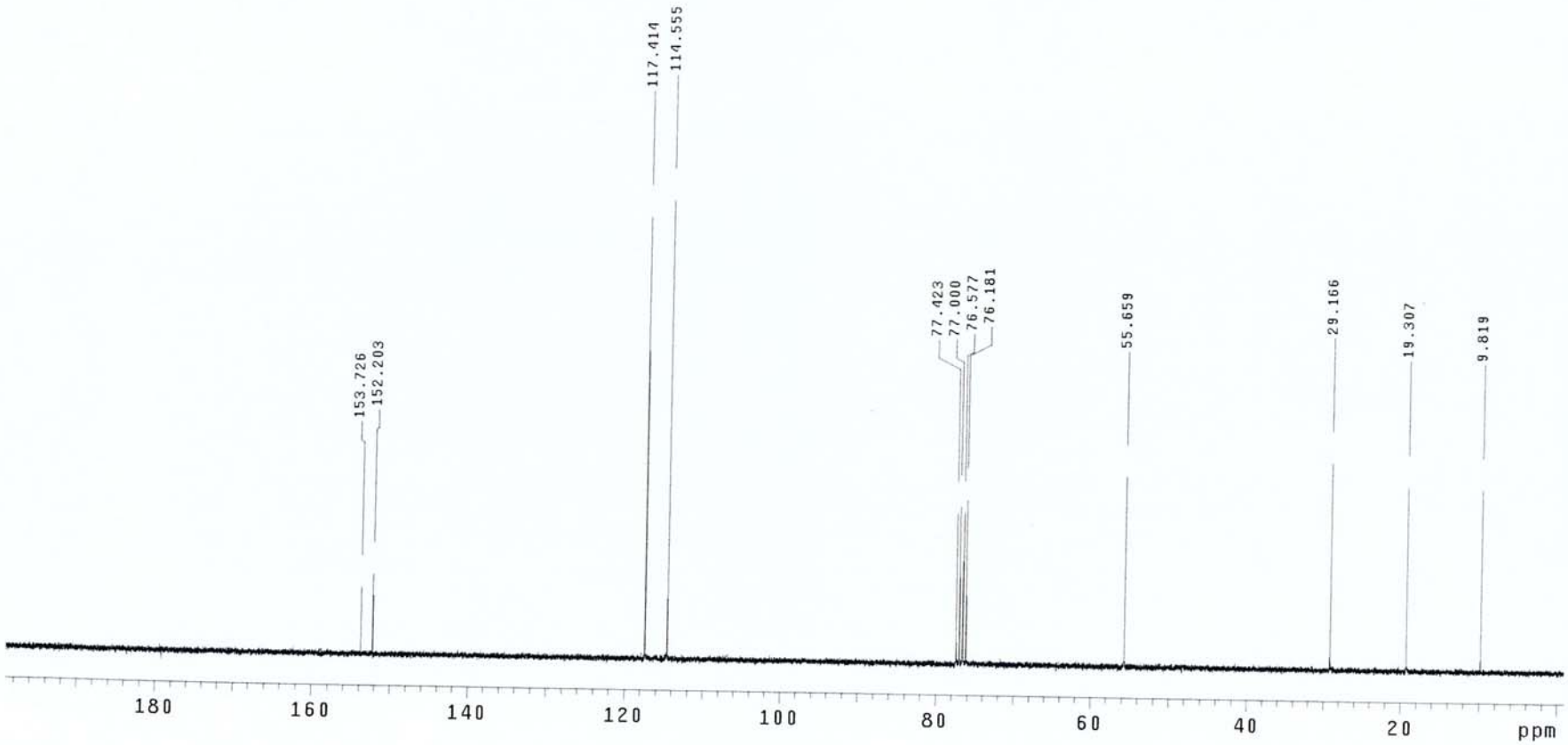
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
32 repetitions
OBSERVE H1, 300.1055039 MHz
DATA PROCESSING
FT size 131072
Total time 2 min, 35 sec



wxx-2-34-D-2C

Pulse Sequence: s2pul

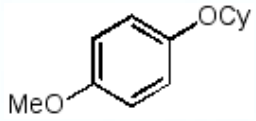




wxx-2-59-A-2

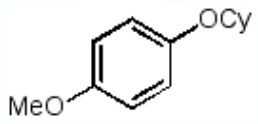
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

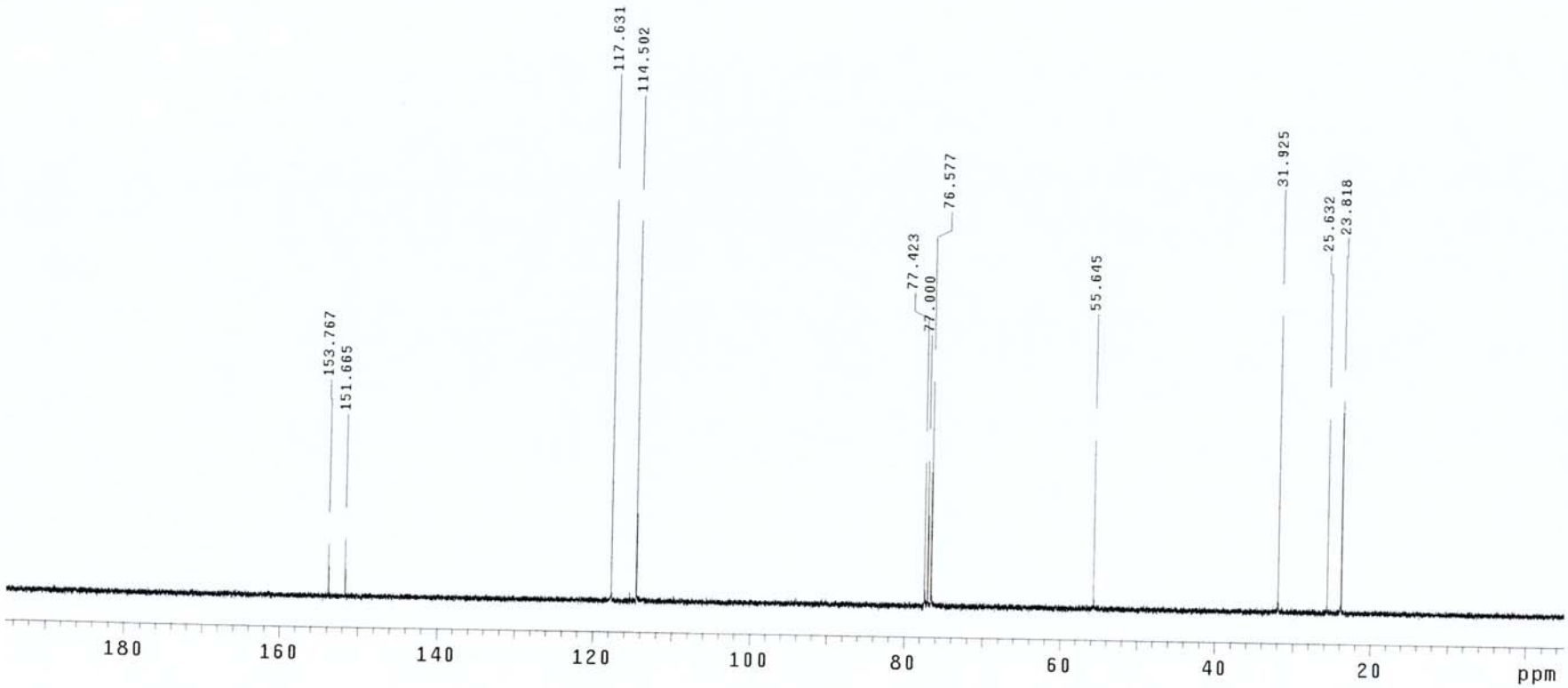
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



wxx-2-59-A-2C

Pulse Sequence: s2pul

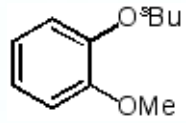


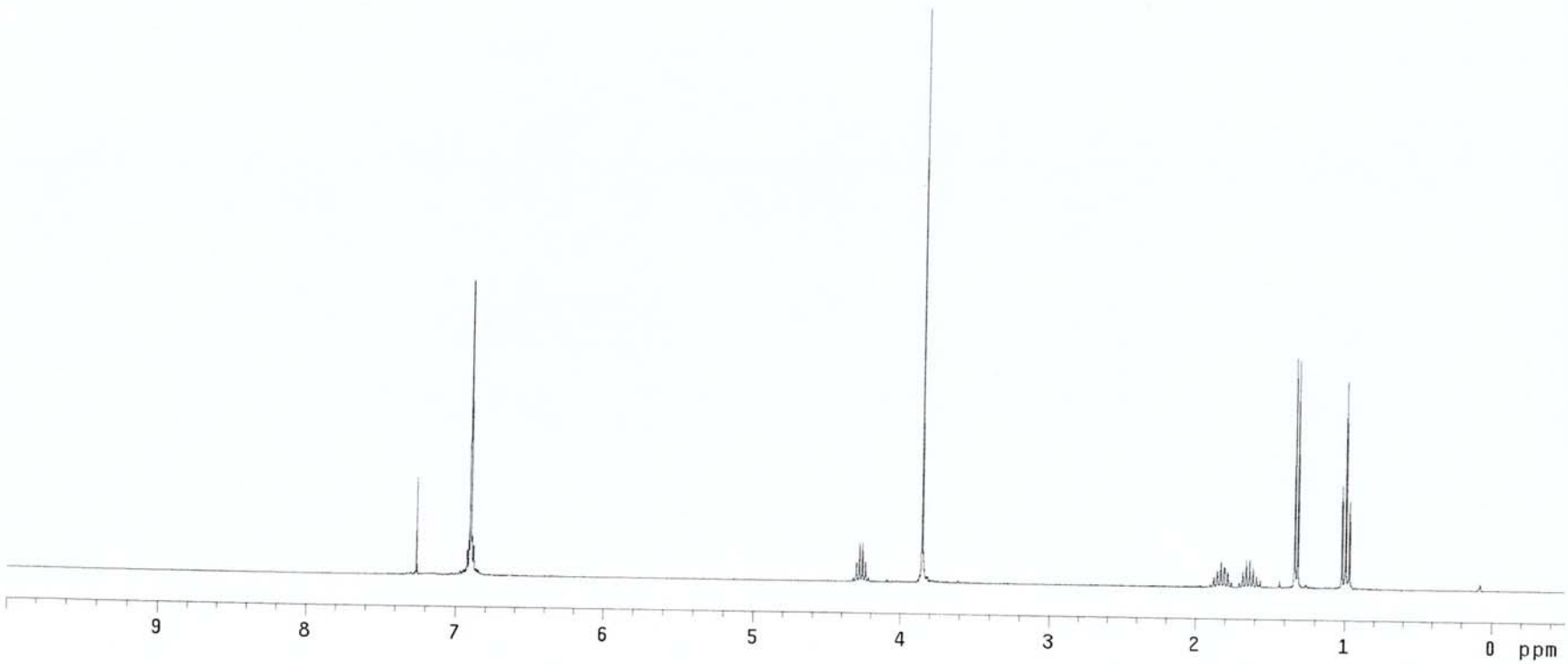


wxx-2-32-D-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

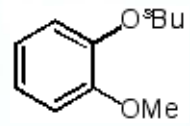
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
32 repetitions
OBSERVE H1, 300.1055040 MHz
DATA PROCESSING
FT size 131072
Total time 2 min, 35 sec

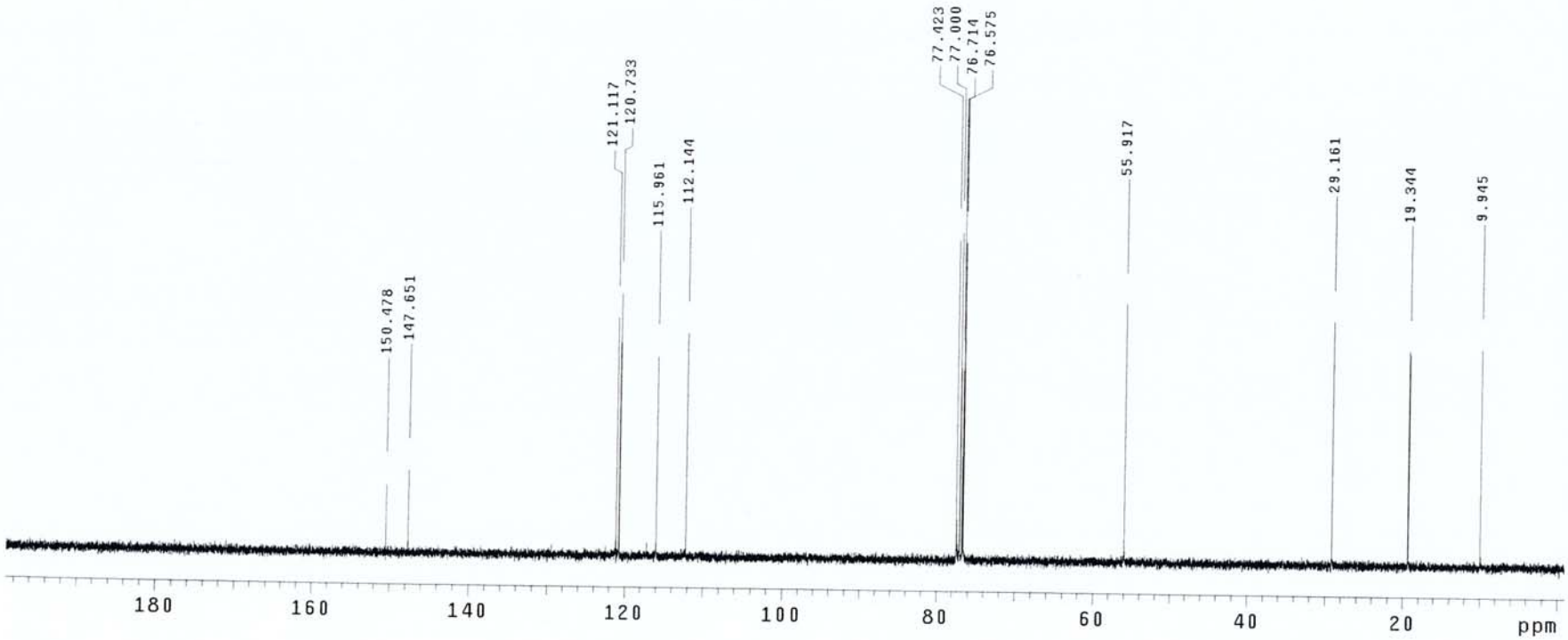




wxx-2-32-D-2C

Pulse Sequence: s2pul

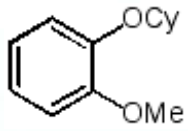




wxx-2-62-A-2

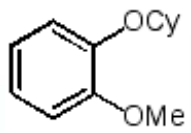
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

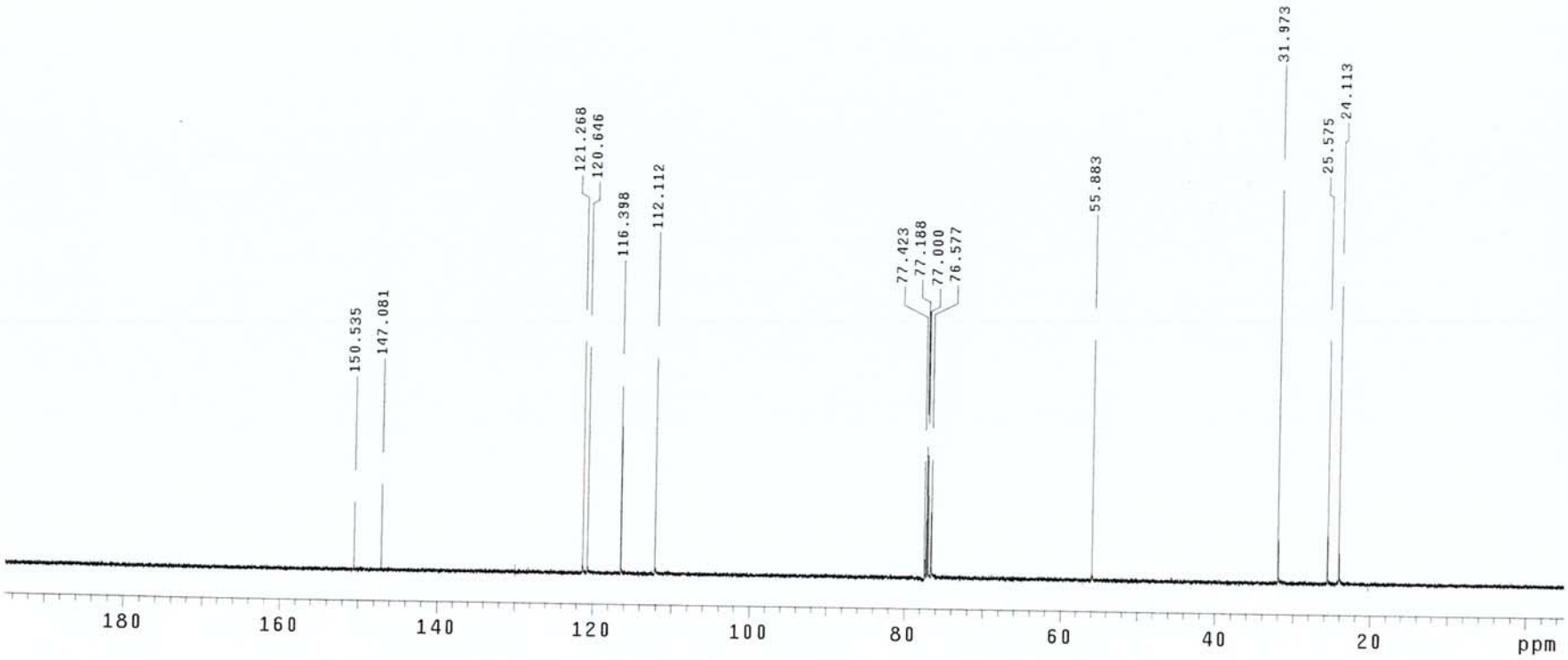
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec



wxx-2-62-A-2C

Pulse Sequence: s2pul

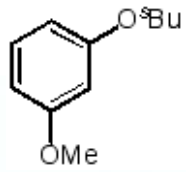


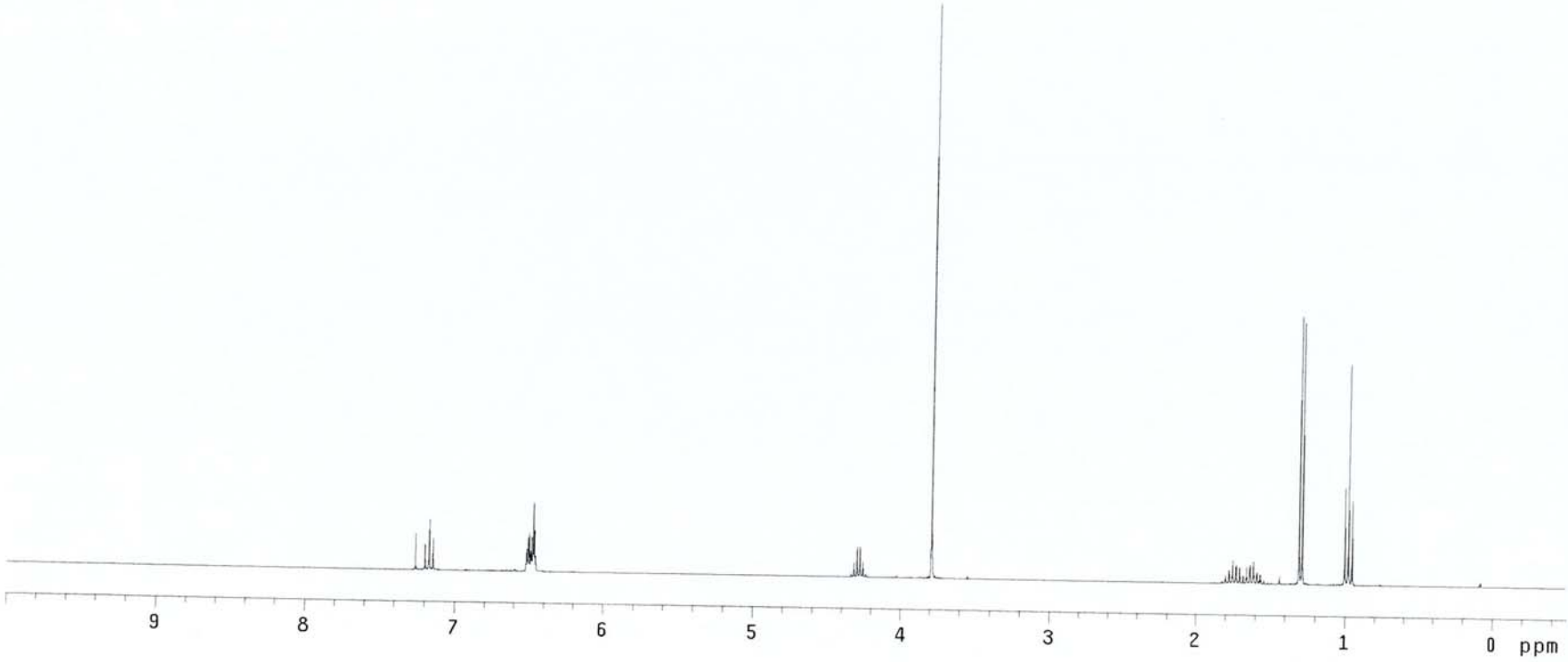


wxx-1-253-A-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

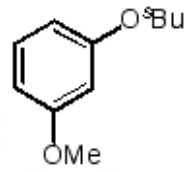
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055035 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

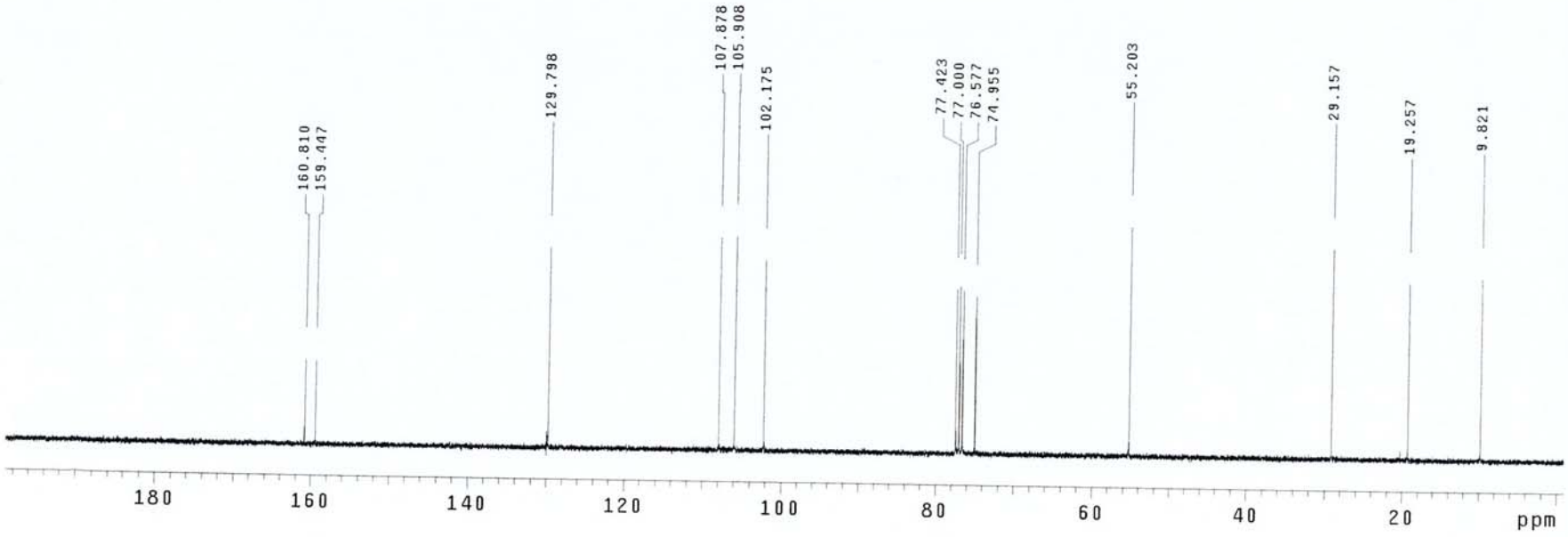




wxx-[illegible]-253-A-2C

Pulse Sequence: s2pul

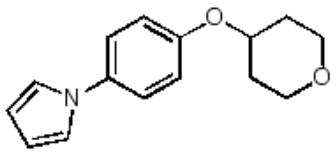


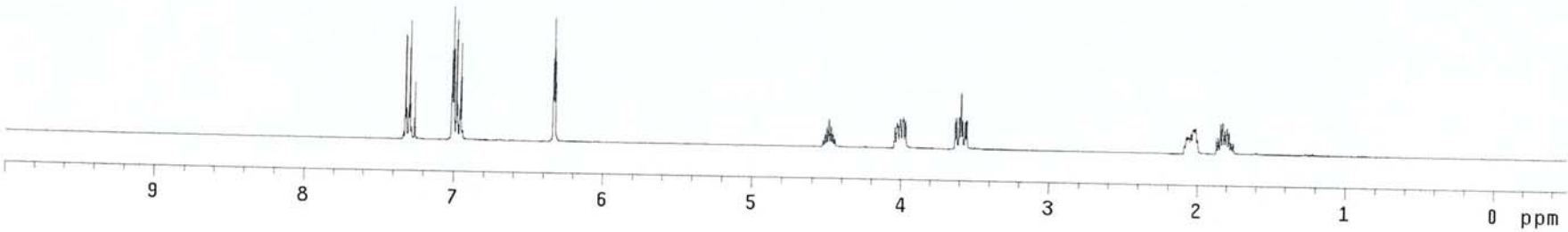


wxx-2-50-C-2a

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

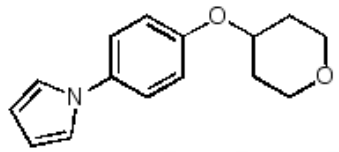
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

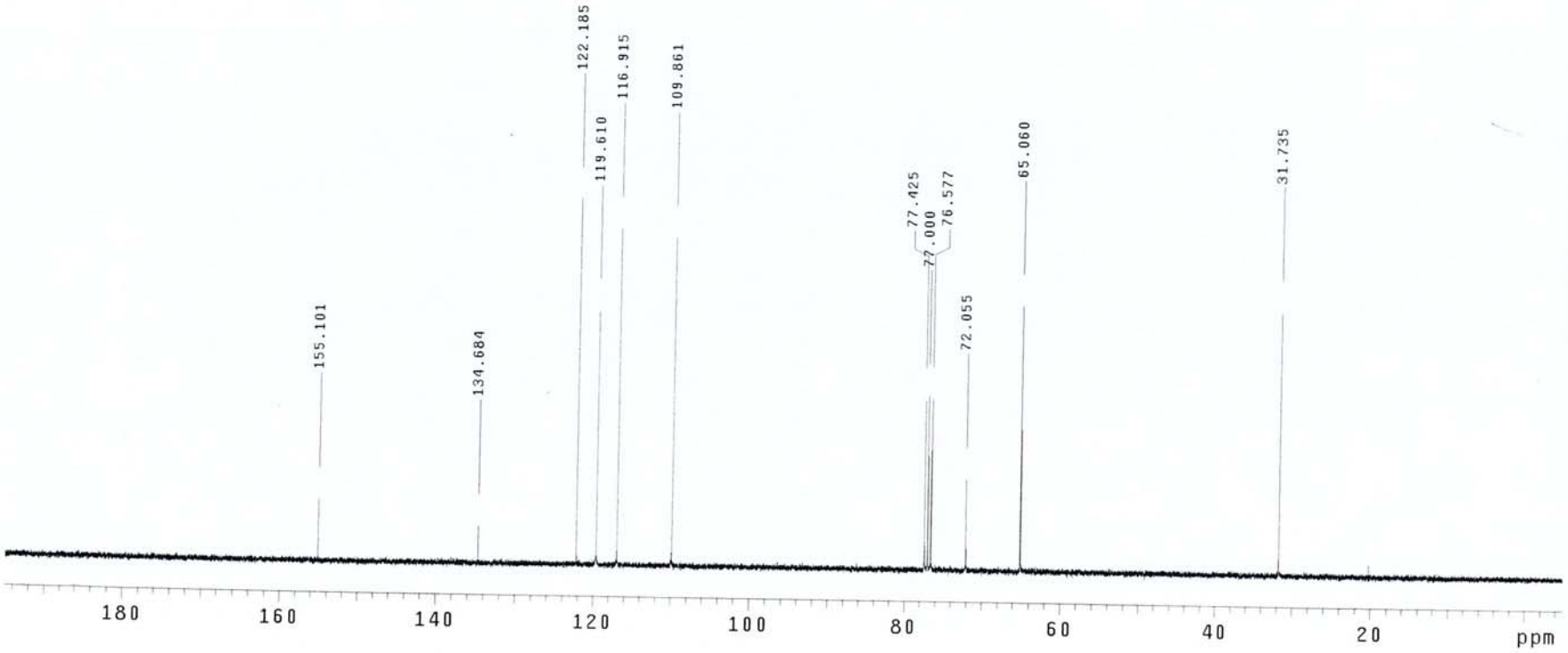




wxx-2-50-C-2C

Pulse Sequence: s2pul

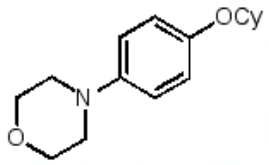




wxx-2-81-A-1b

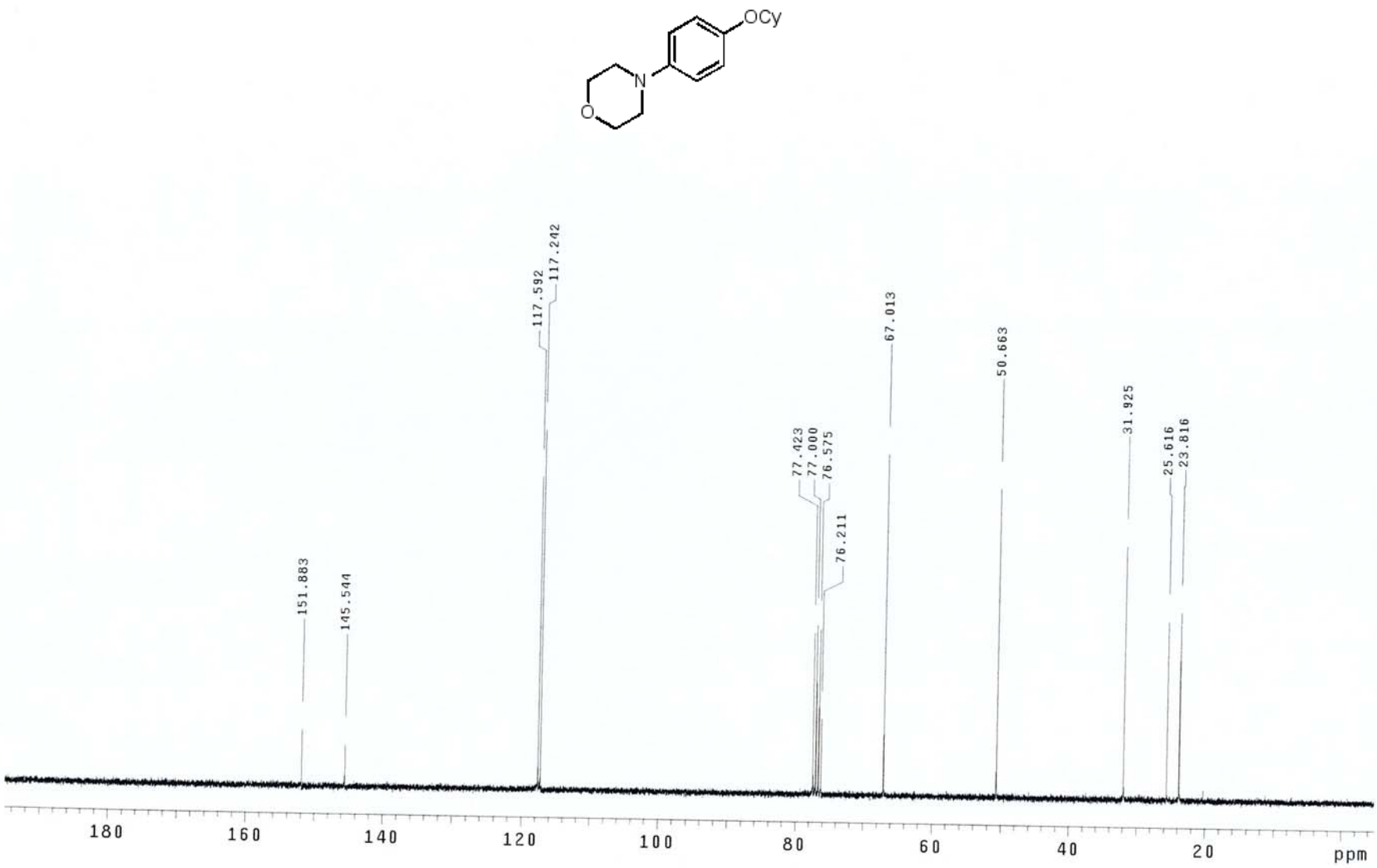
Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



wxx-2-81-A-1b_C

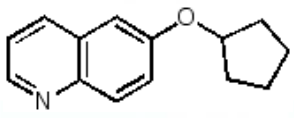
Pulse Sequence: s2pul

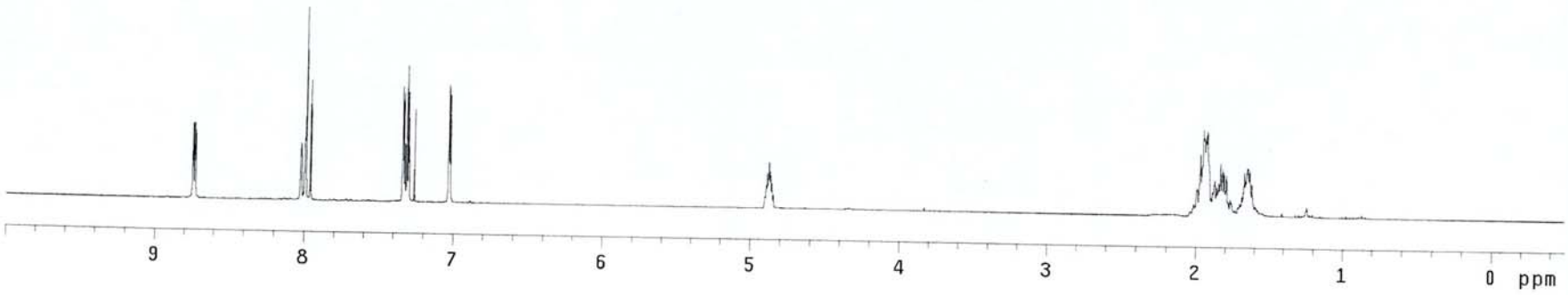


wxx-2-42-C-2_040710

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

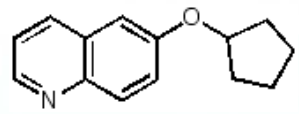
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

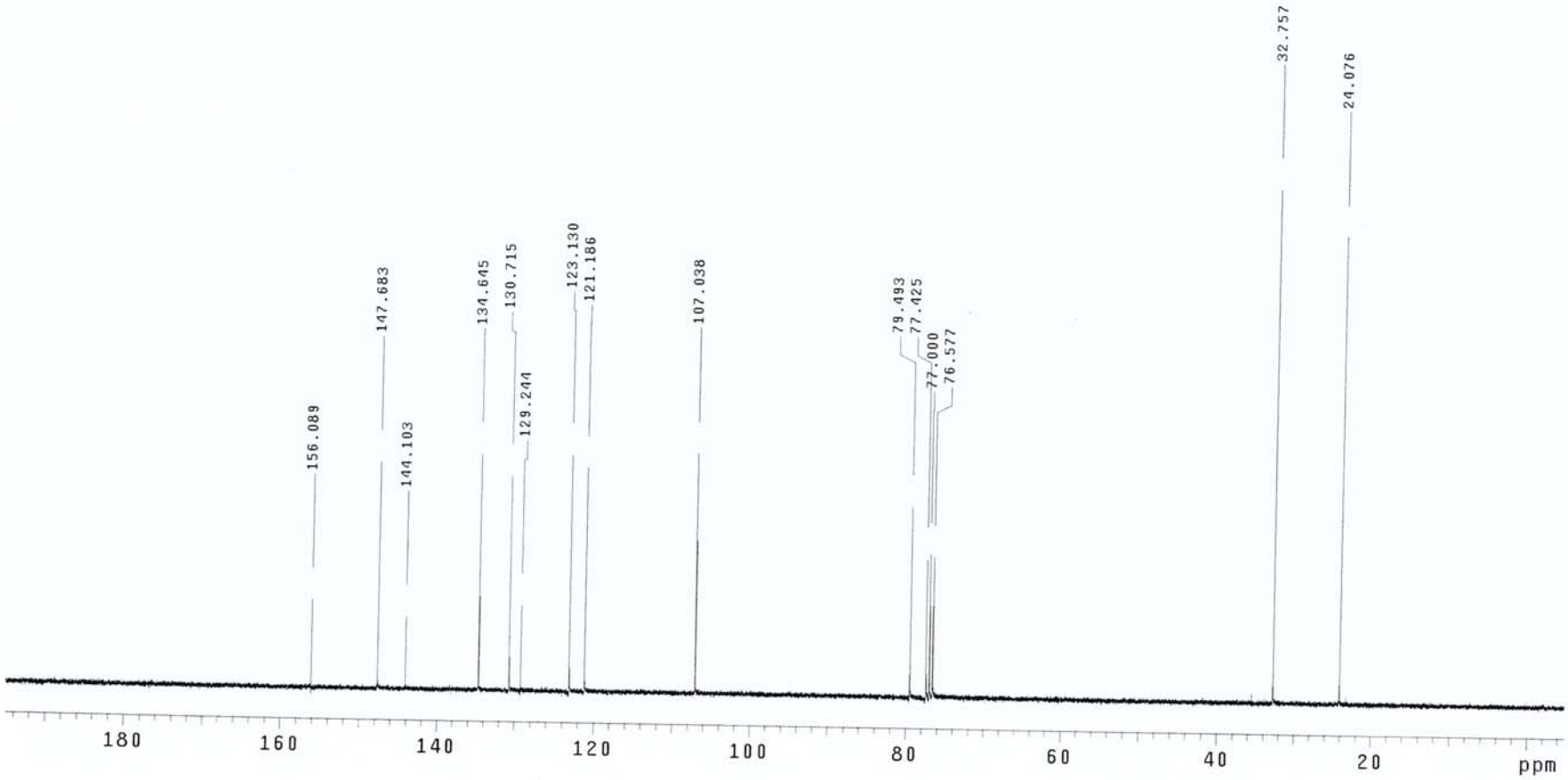




wxx-2-42-C-2C
13C OBSERVE

Pulse Sequence: s2pul

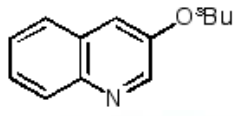


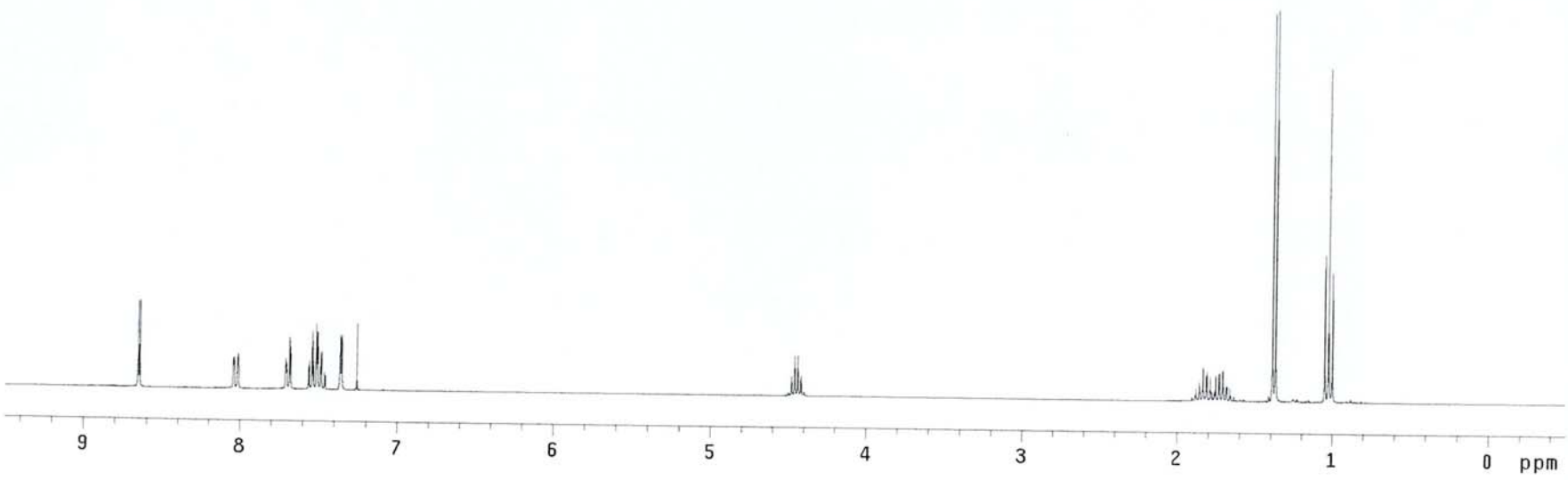


wxx-2-27-C-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

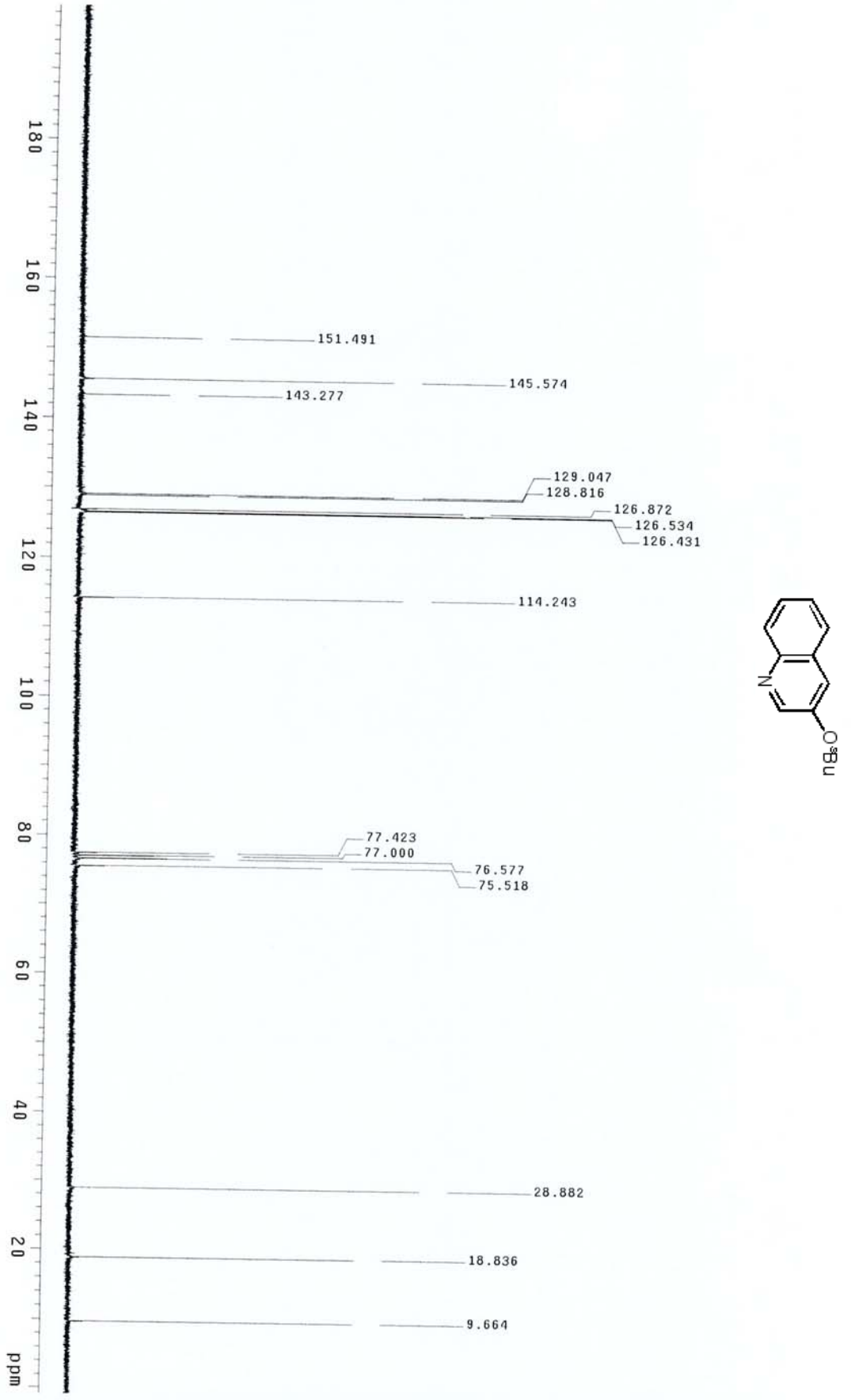
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-27-A-2C

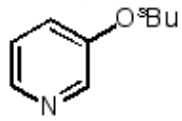
Pulse Sequence: s2pul

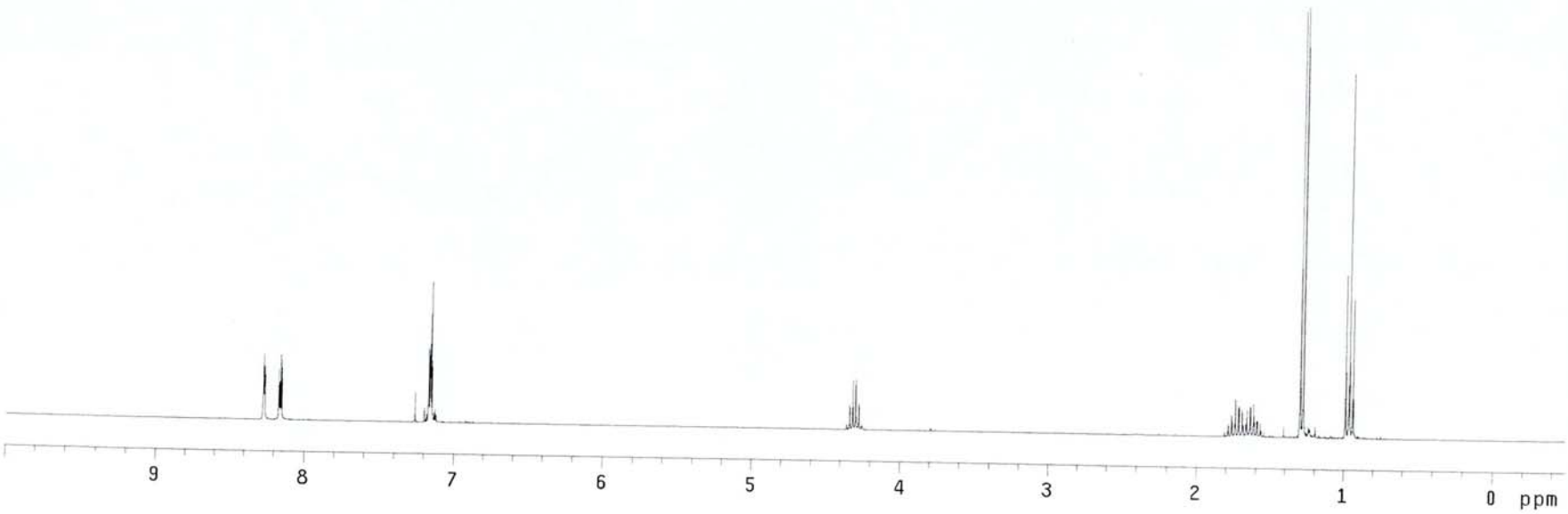


wxx-16-C-4

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

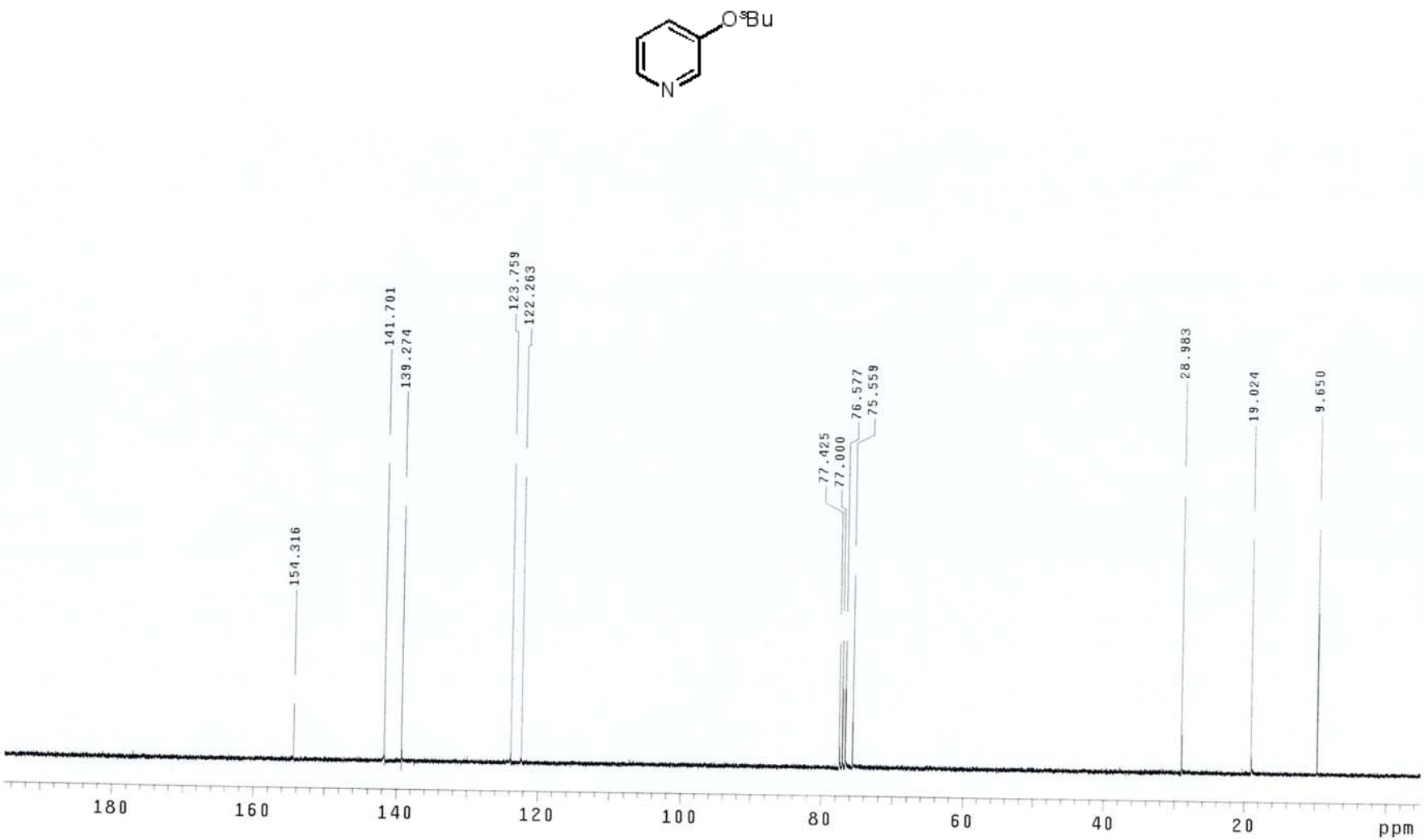
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec





wxx-2-16-C-6C

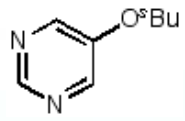
Pulse Sequence: s2pul

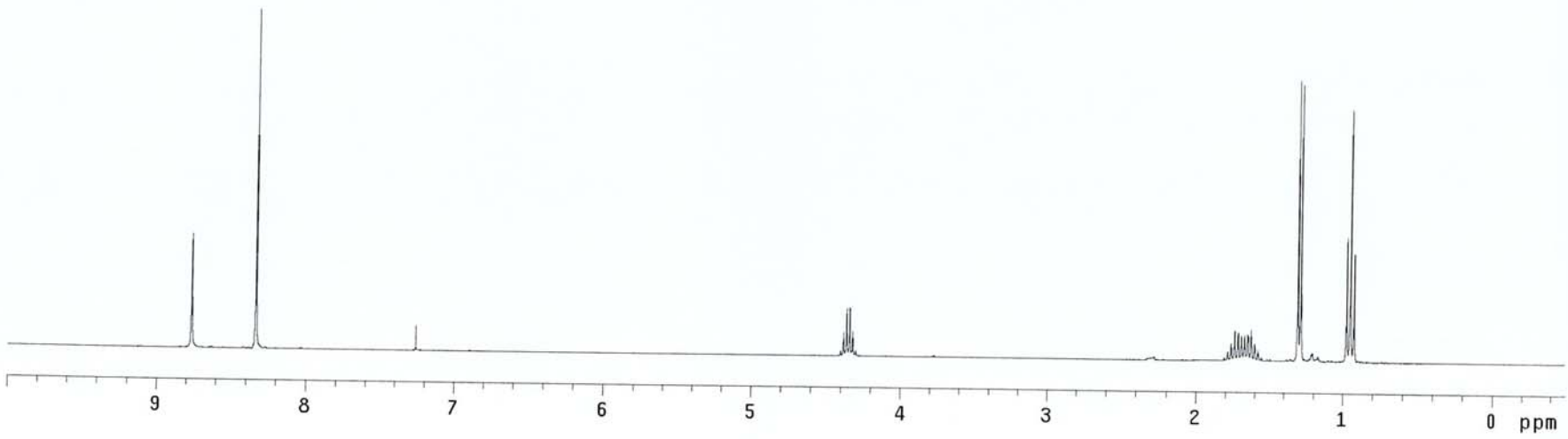


wxx-2-41-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
File: wxx-2-41-B-2
INOVA-500 "zippy"

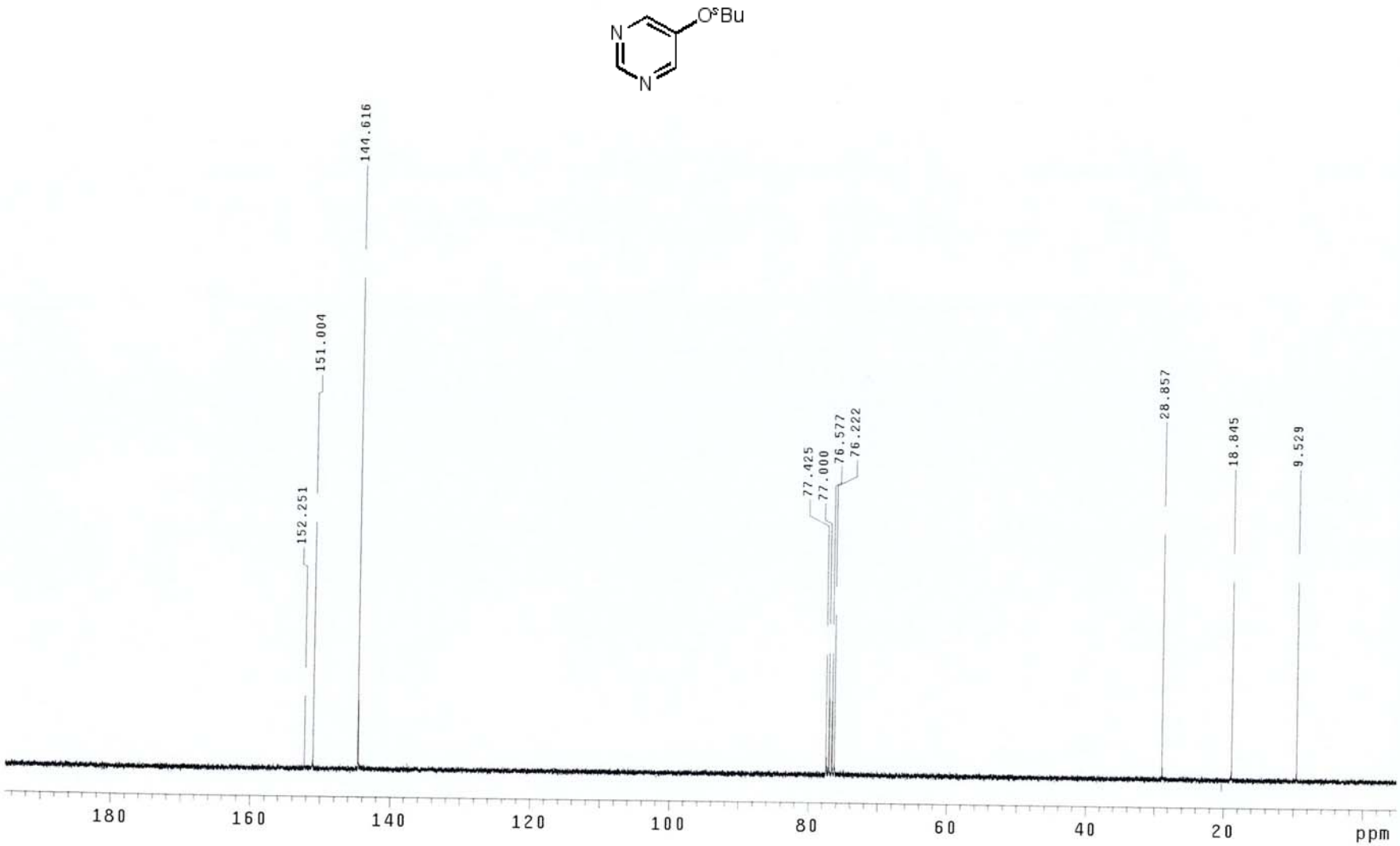
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 4 sec





wxx-2-41-C-3C

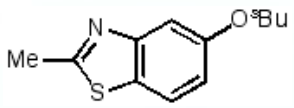
Pulse Sequence: s2pul

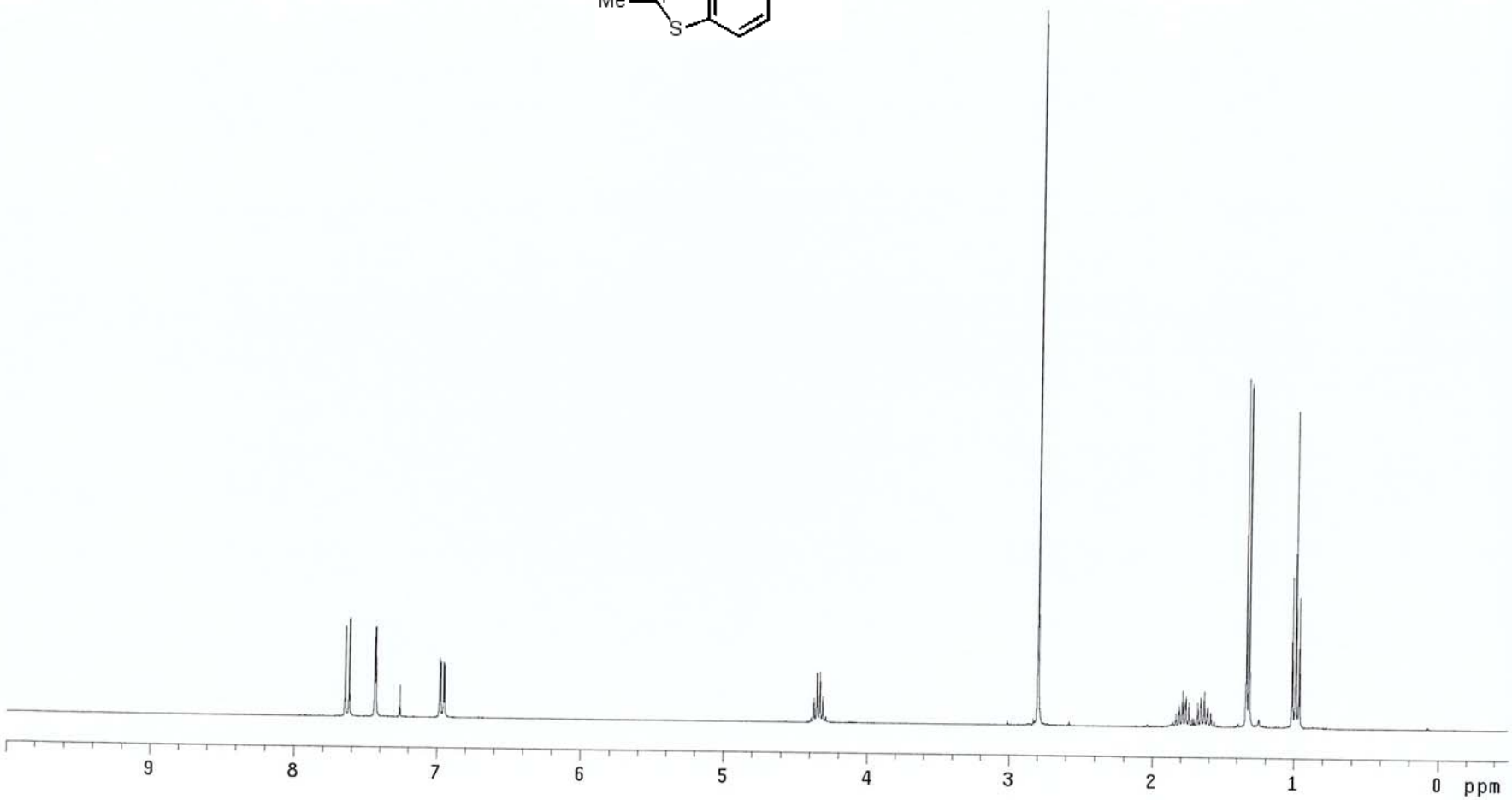


wxx-2-36-B-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
File: wxx-2-36-B-3
INOVA-500 "zippy"

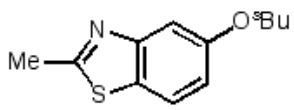
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055031 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 4 sec

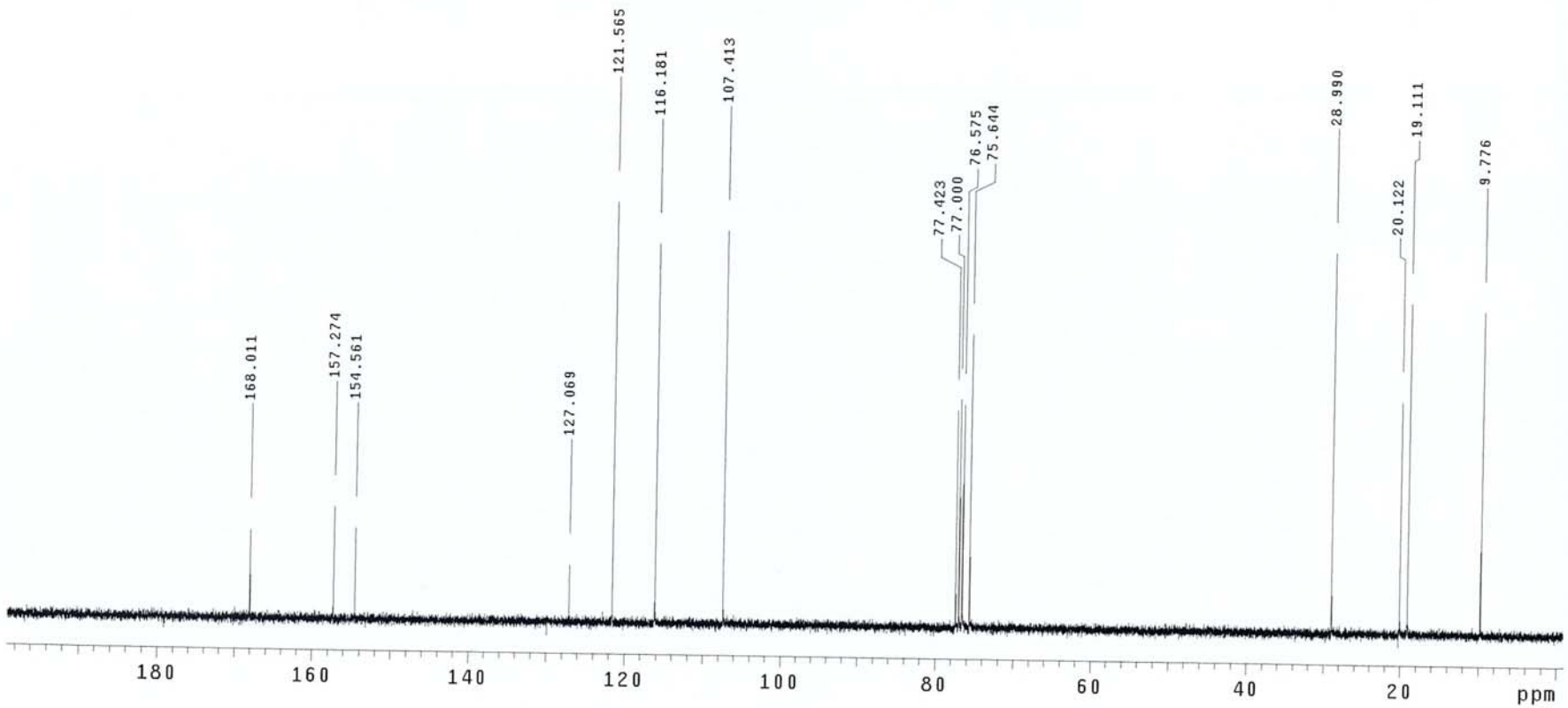




wxx-2-36-B-3C

Pulse Sequence: s2pul



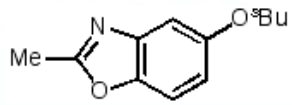


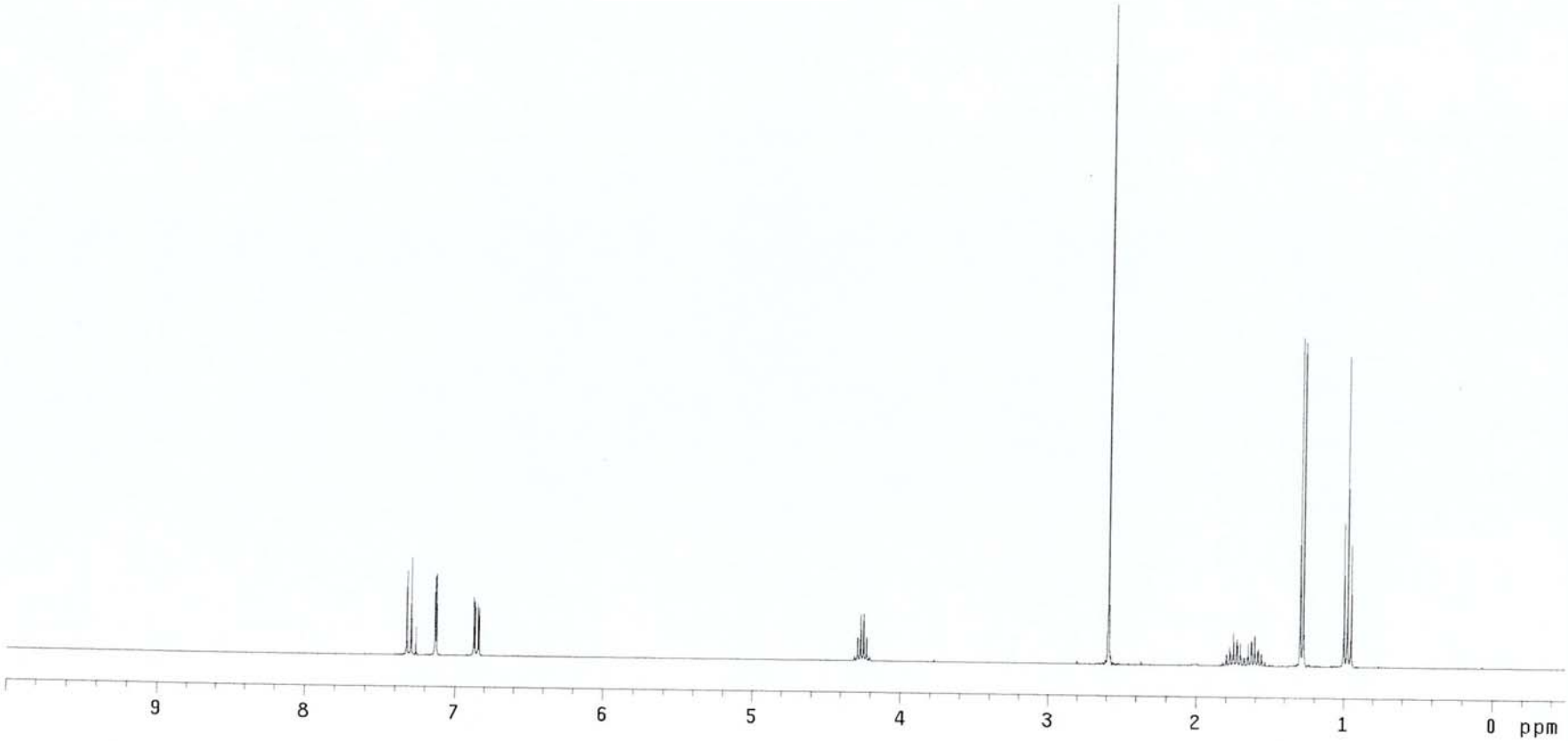
wxx-2-35-D-2

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

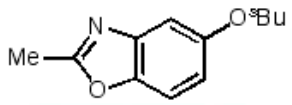
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec

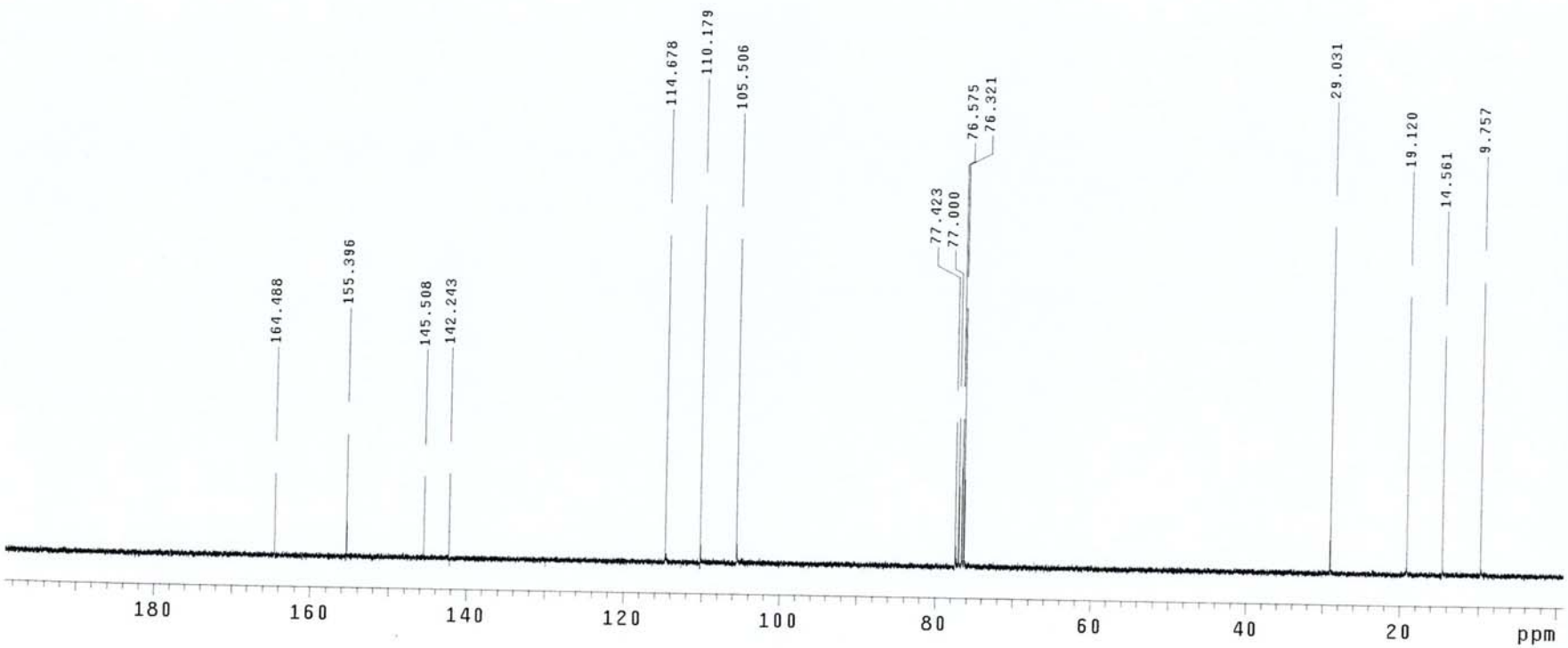




wxx-2-35-D-2C

Pulse Sequence: s2pul



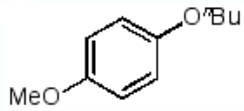


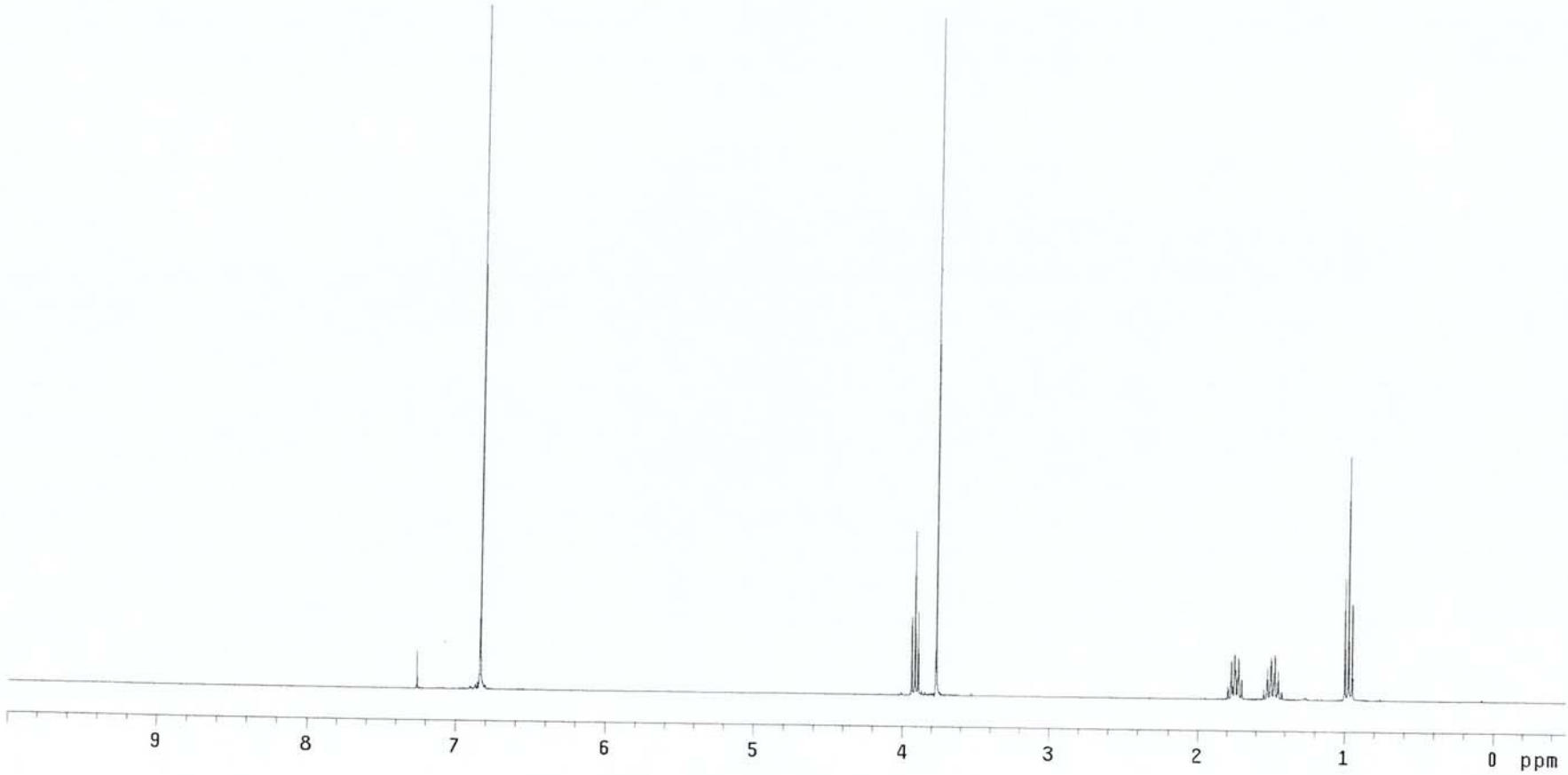
wxx-2-6-A-1-a

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

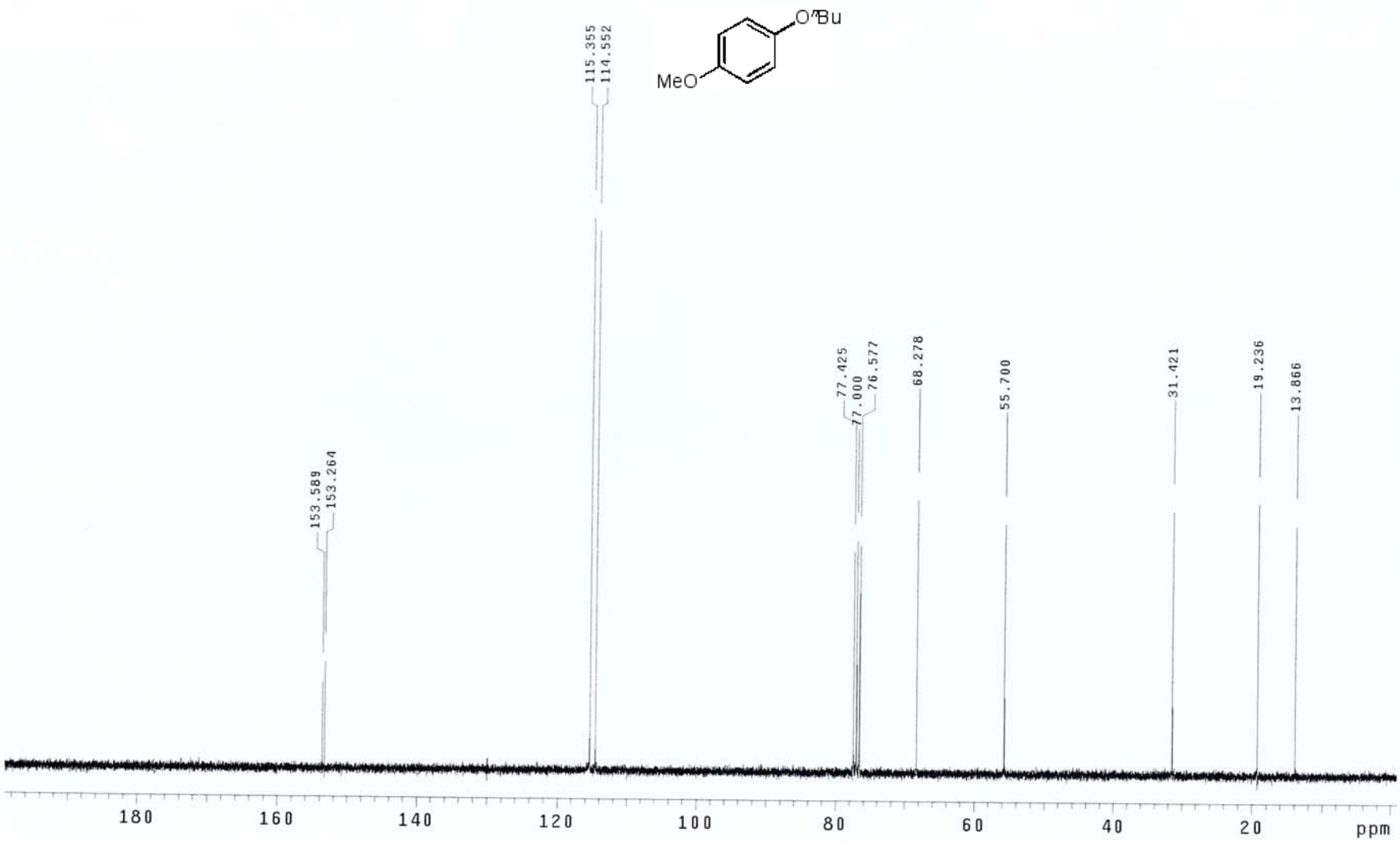
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055031 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-6-A-2C

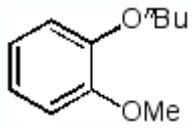
Pulse Sequence: s2pul

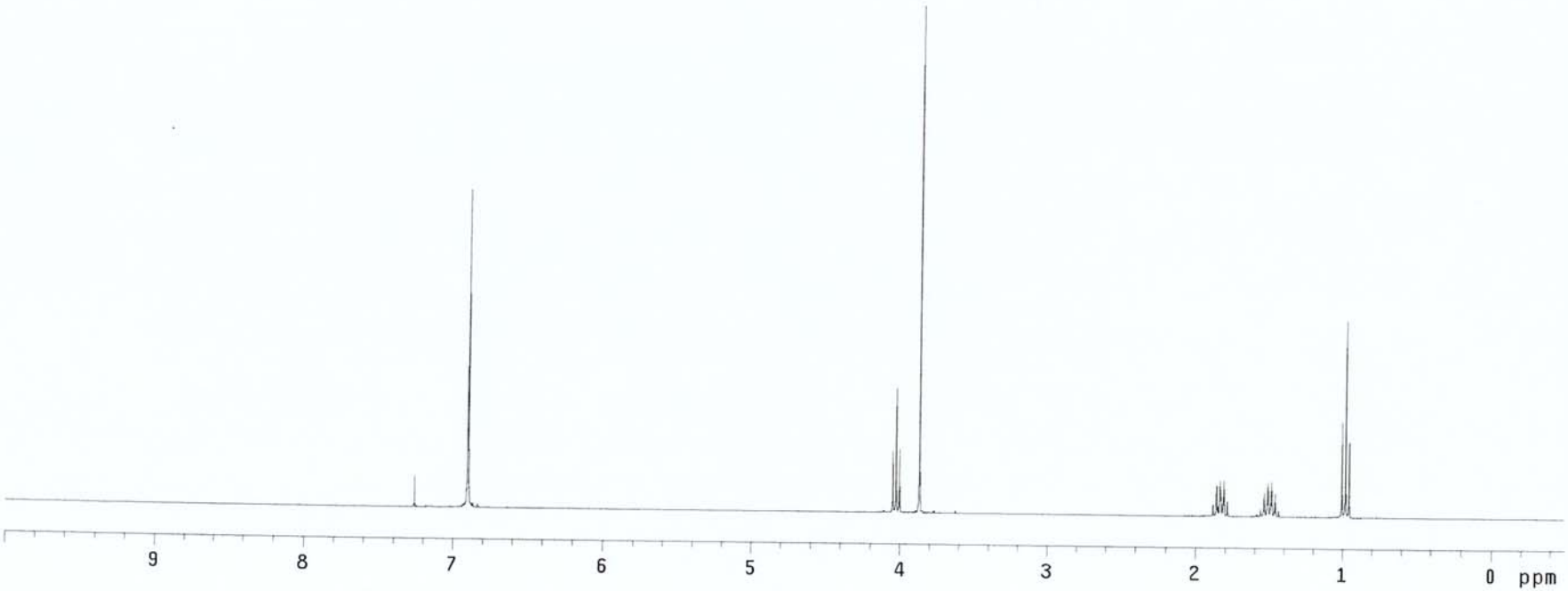


wxx-2-19-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

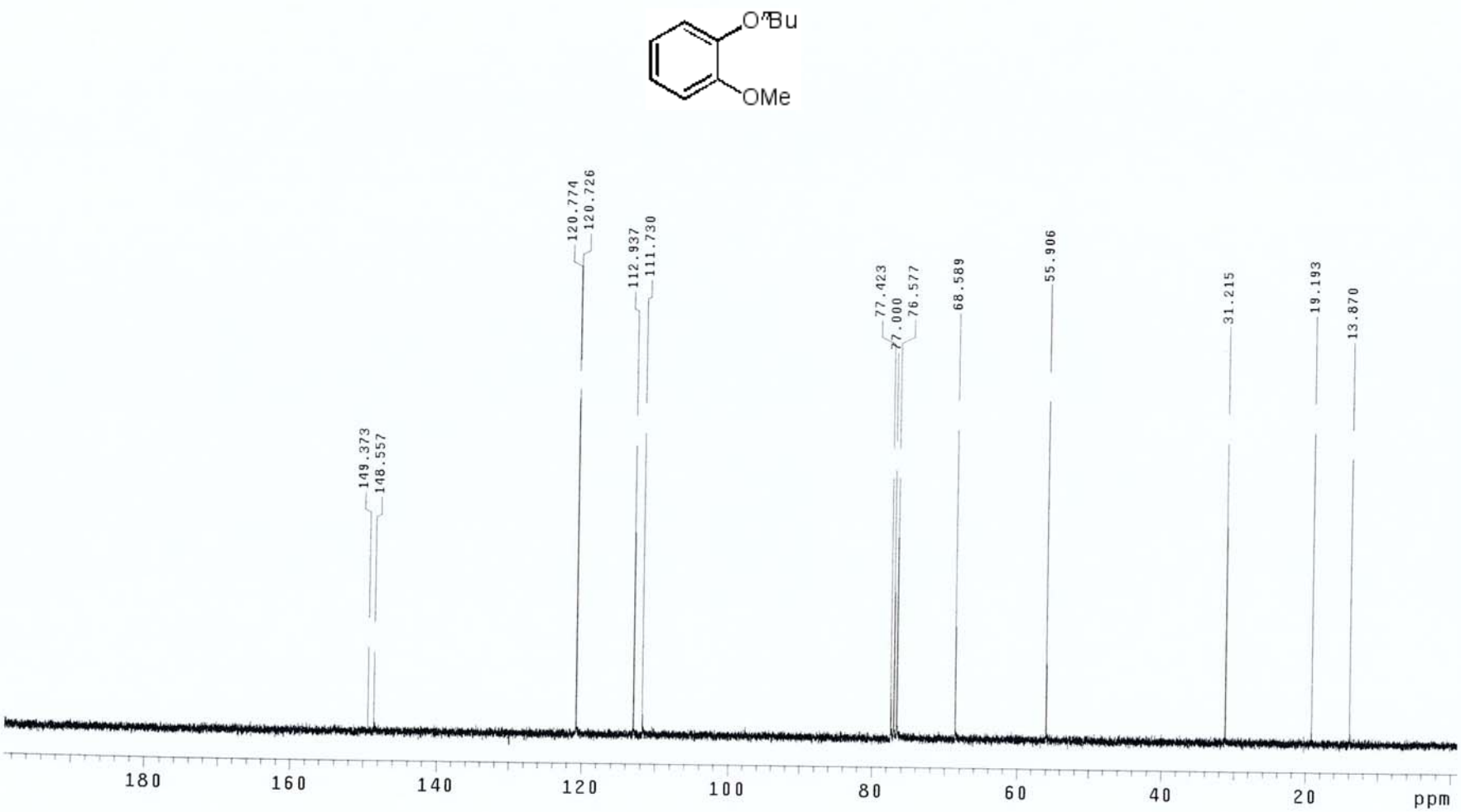
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-19-B-2C

Pulse Sequence: s2pul

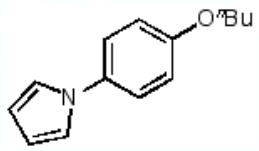


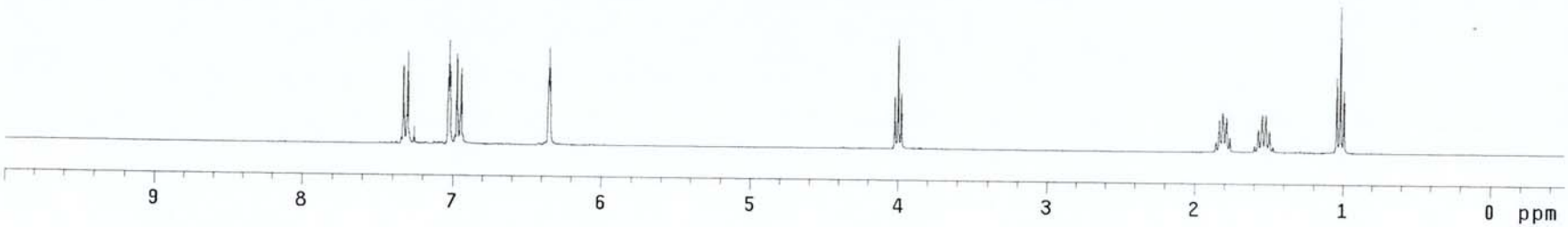
wxx-2-22-C-2

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
File: wxx-2-22-C-2
Mercury-300 "mrhat"

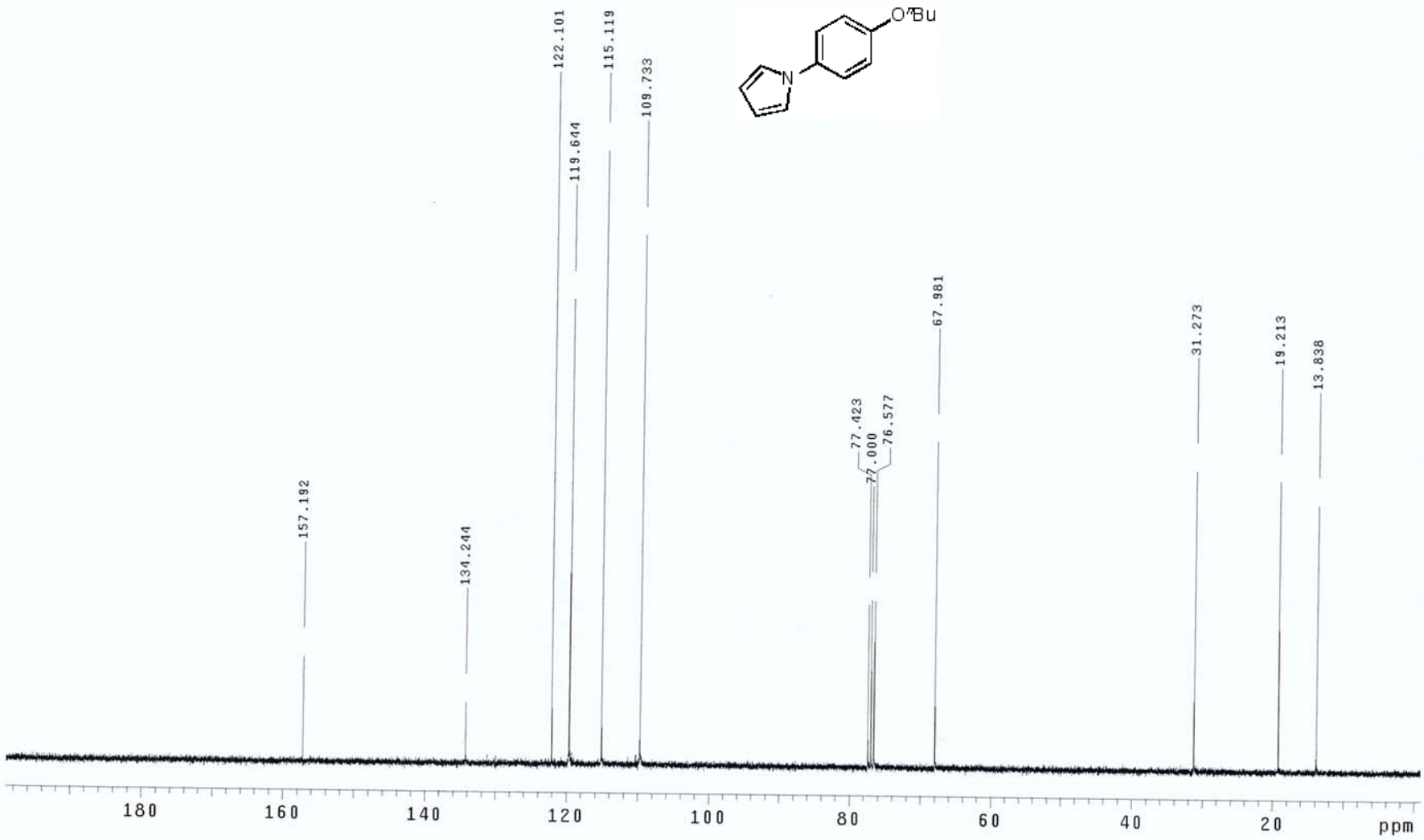
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-22-C-2C

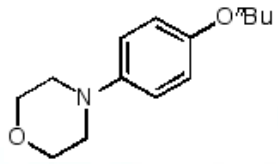
Pulse Sequence: s2pul

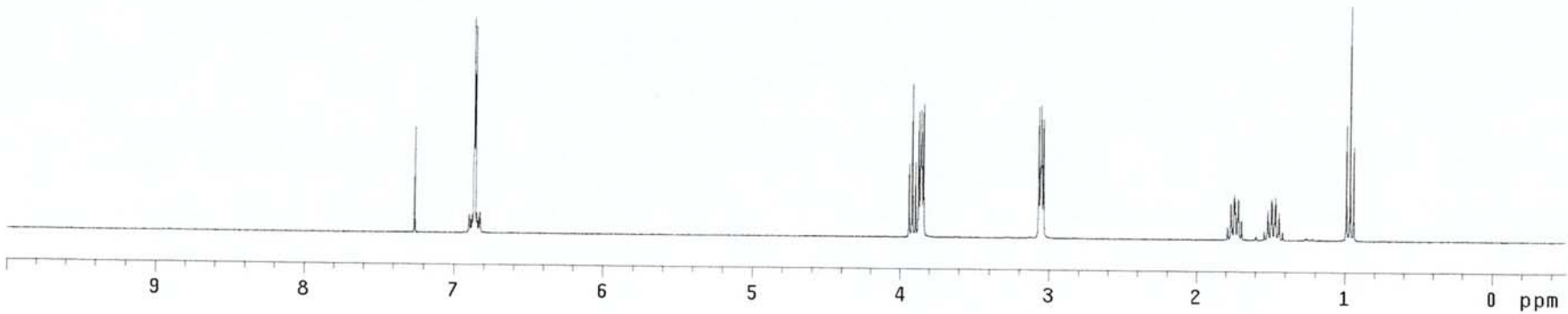


wxx-2-15-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

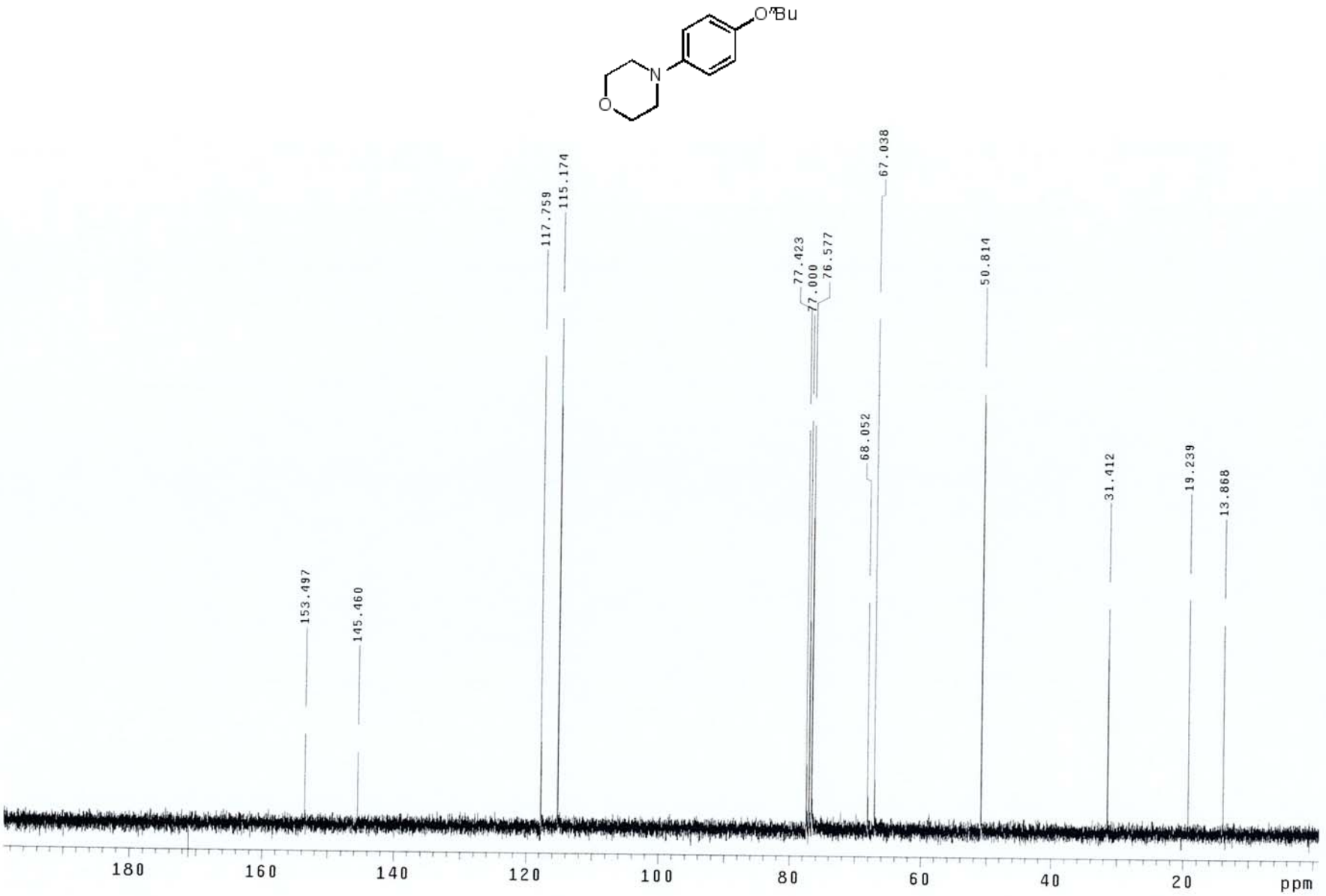
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-15-A-2C

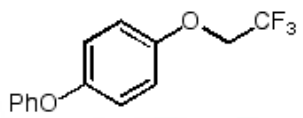
Pulse Sequence: s2pul

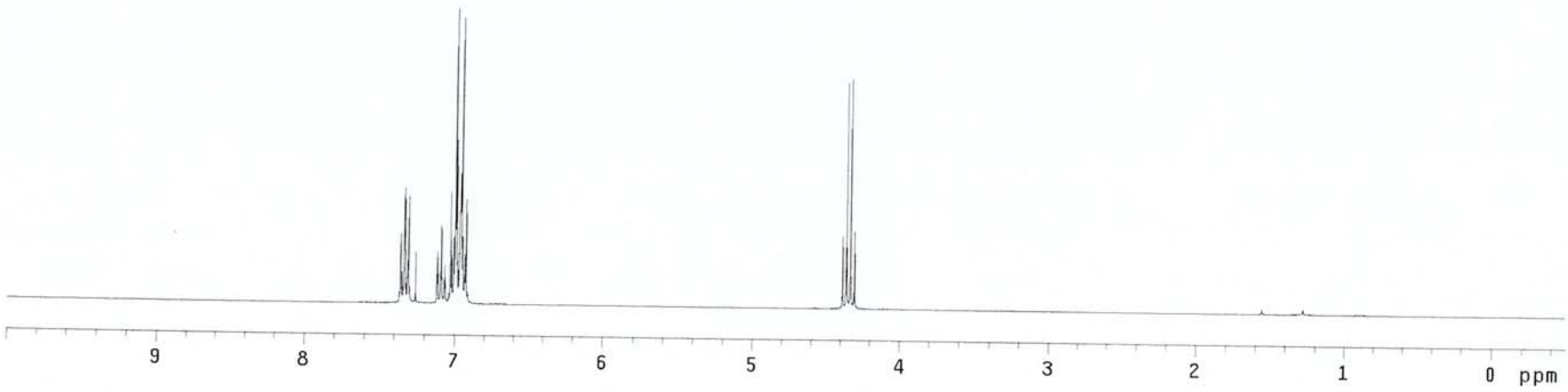


wxx-2-120-B-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

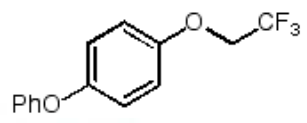
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055035 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-120-A-2C

Pulse Sequence: s2pul



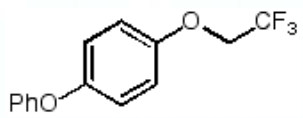
WXX-2-120-B-3F

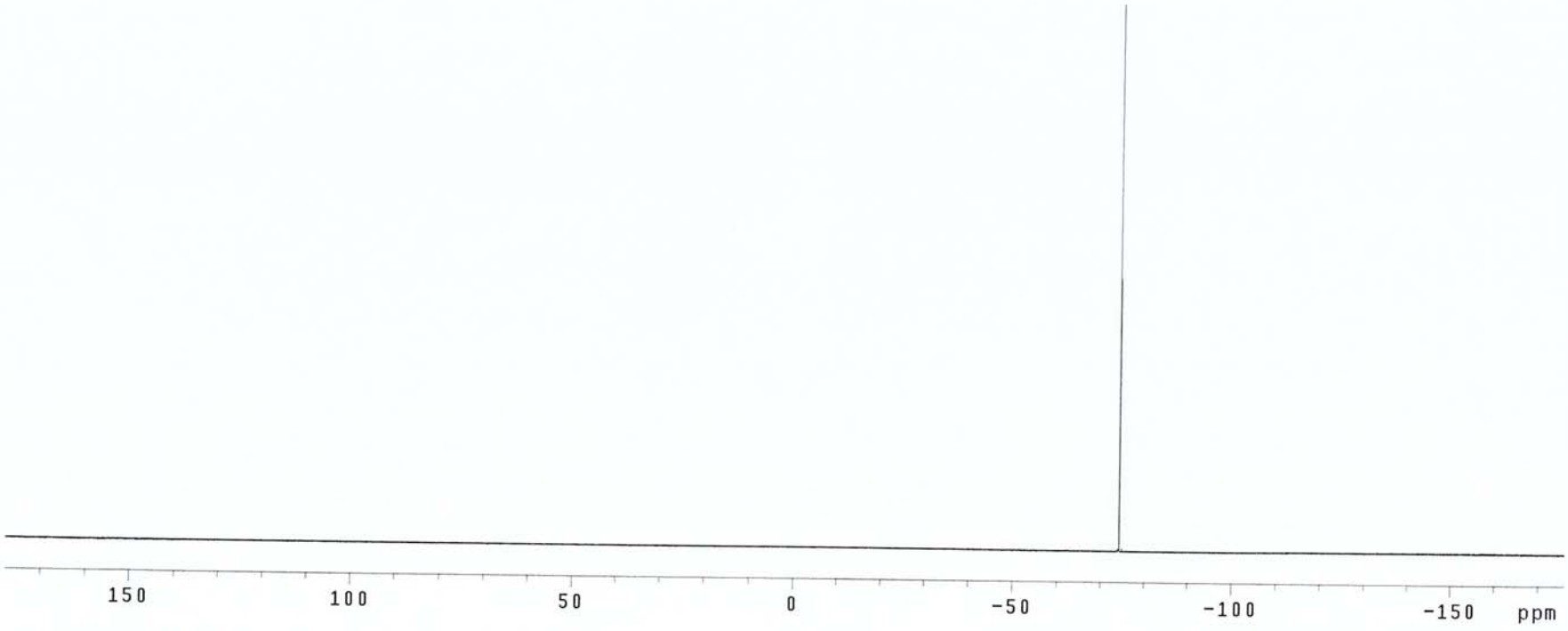
19F OBSERVE
STANDARD PARAMETERS

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 4.000 sec
Pulse 45.0 degrees
Acq. time 0.300 sec
Width 100.0 kHz
16 repetitions
OBSERVE F19, 282.3814158 MHz
DATA PROCESSING
Line broadening 0.3 Hz
FT size 262144
Total time 1 min, 24 sec

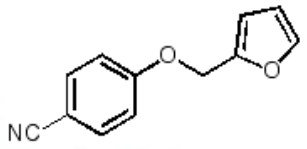


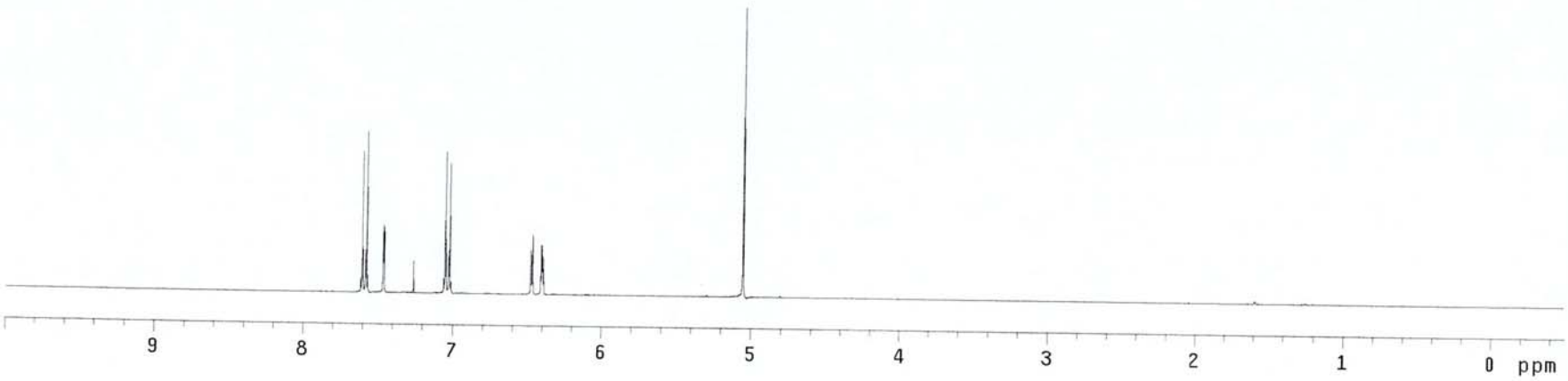


wxx-2-126-A-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

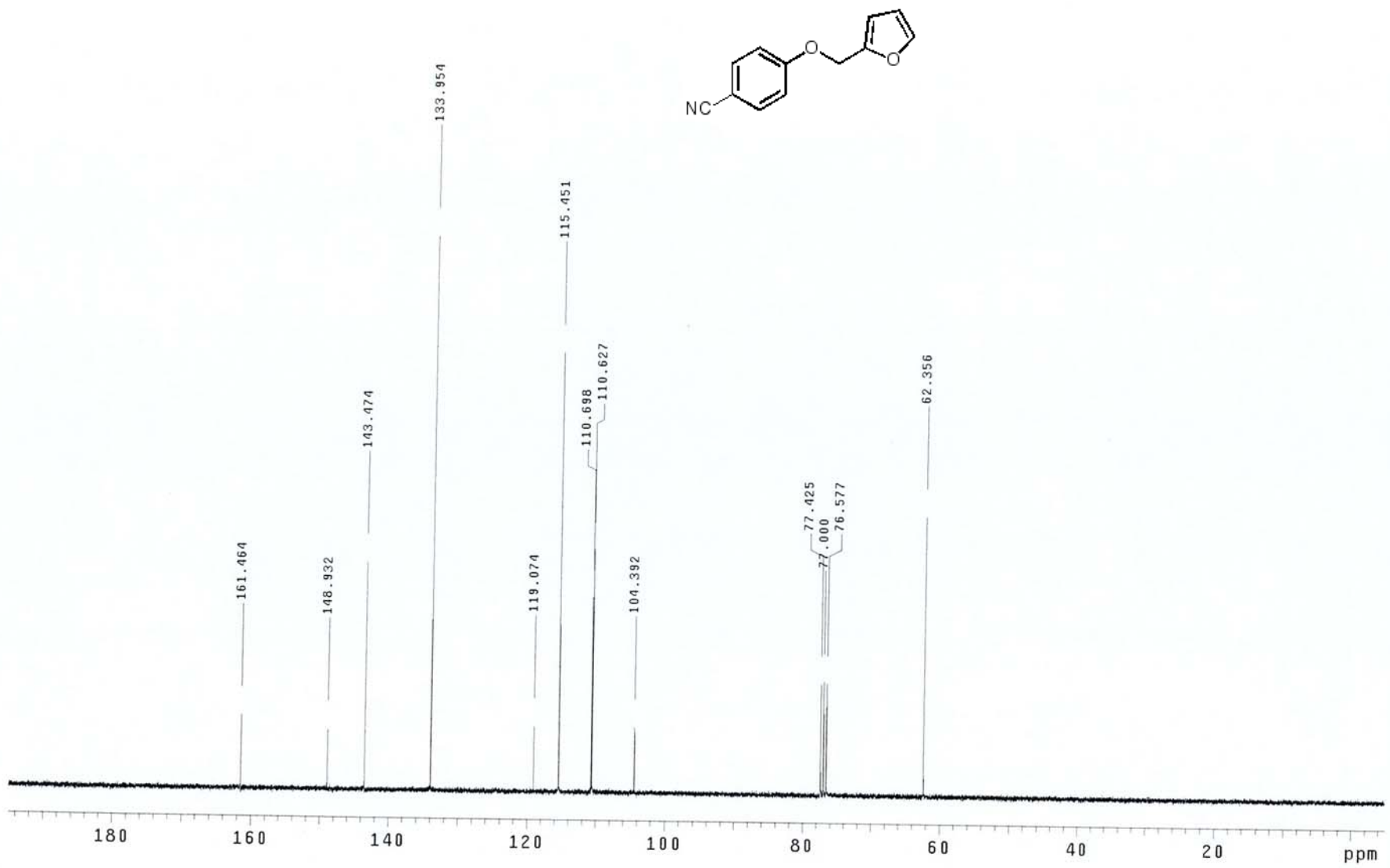
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055029 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





wxx-2-126-A-2C

Pulse Sequence: s2pul

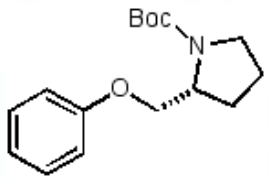


wxx-2-119-A-2

Pulse Sequence: s2pul

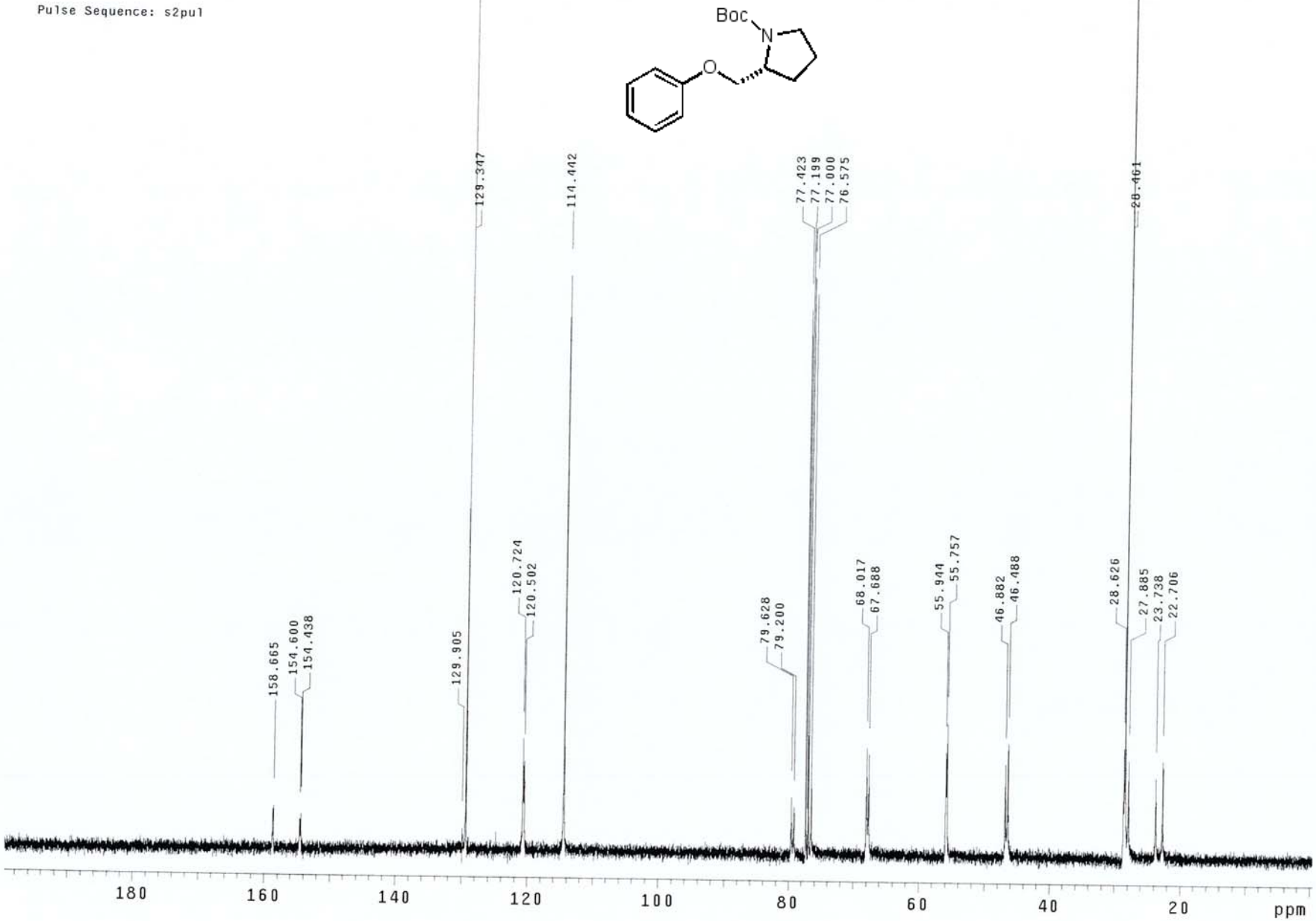
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055029 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



wxx-2-119-A-2C

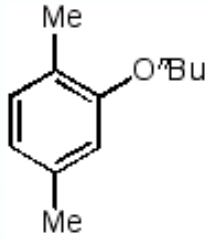
Pulse Sequence: s2pul

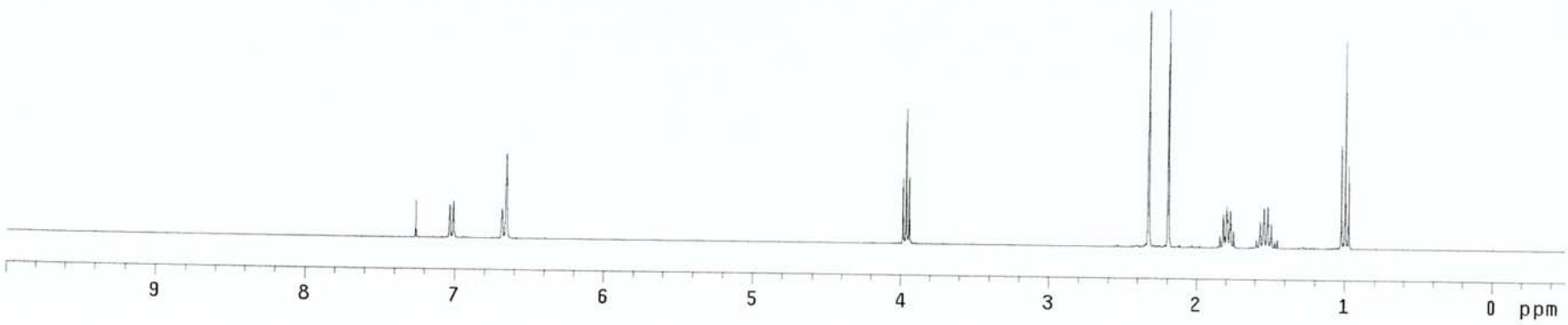


wxx-2-17-D-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

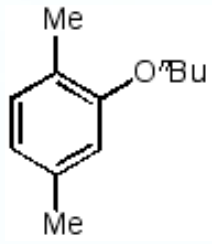
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

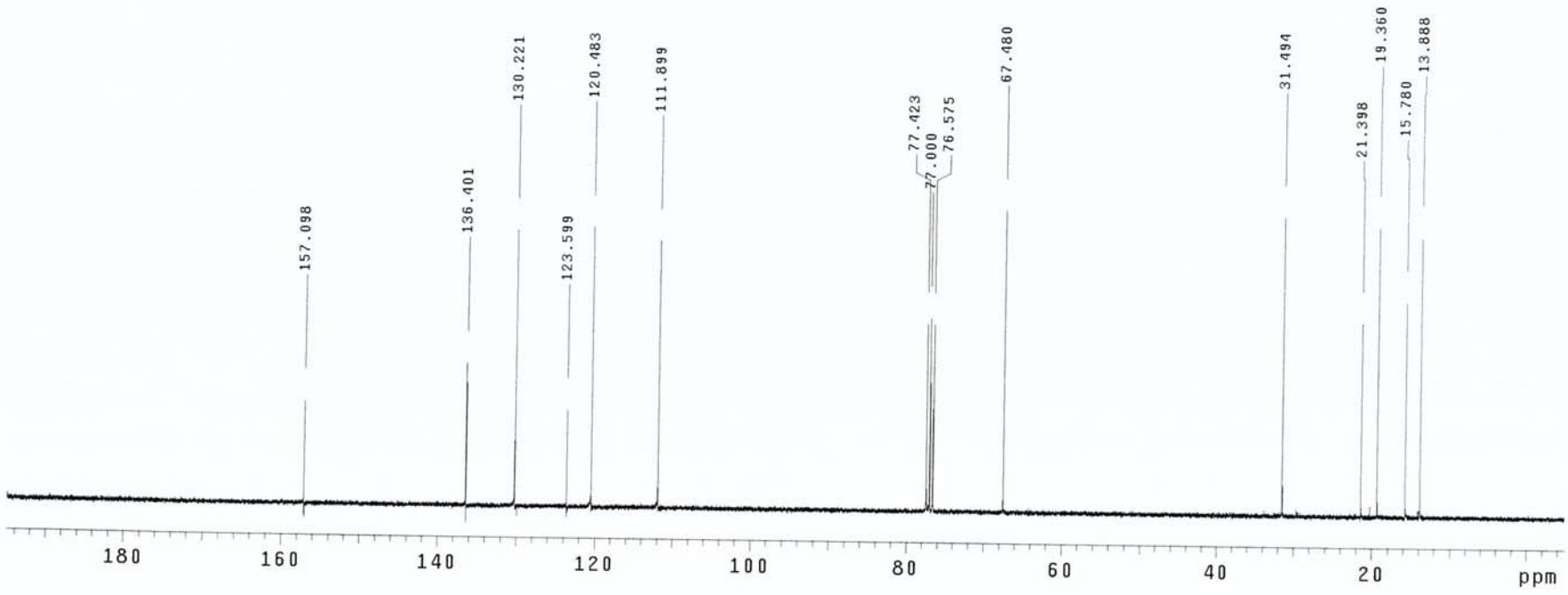




wxx-2-17-B-2C

Pulse Sequence: s2pul

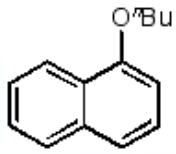


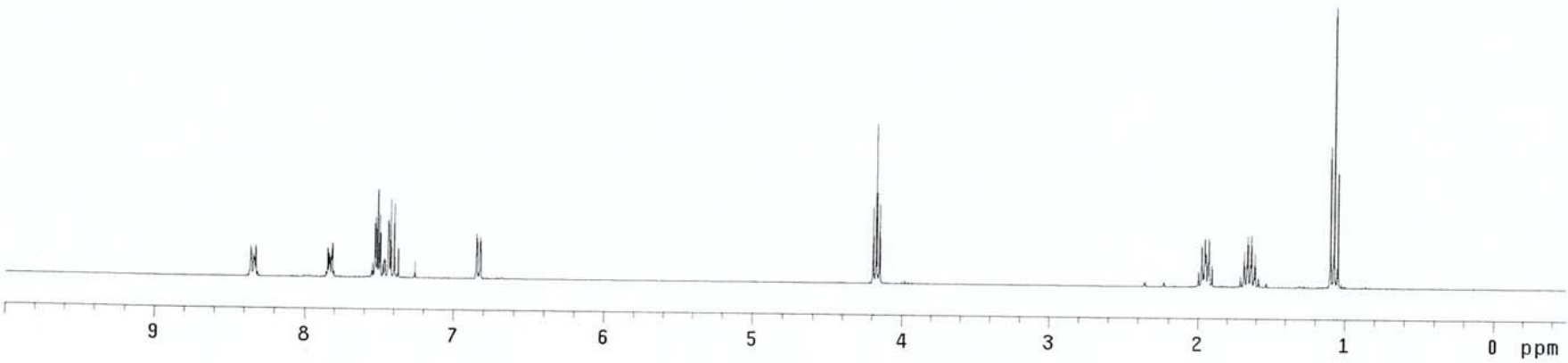


wxx-2-8-C-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

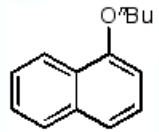
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

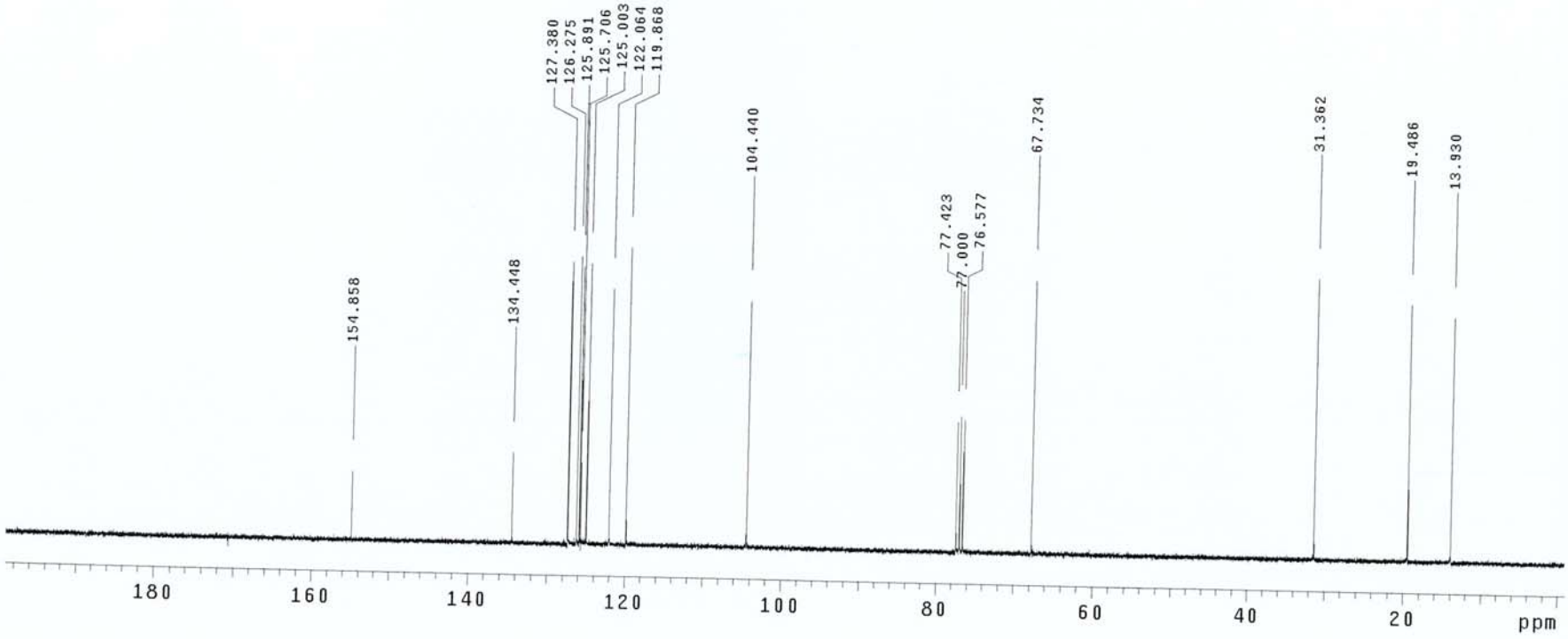




wxx-2-8-C-2C

Pulse Sequence: s2pul

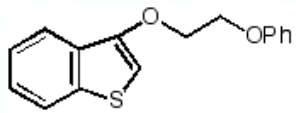


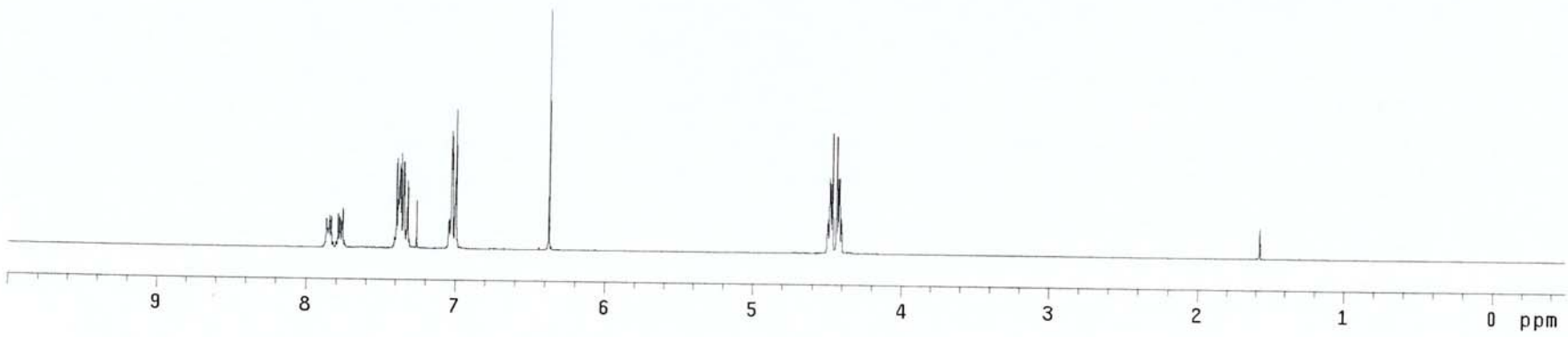


wxx-2-93-A-3

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

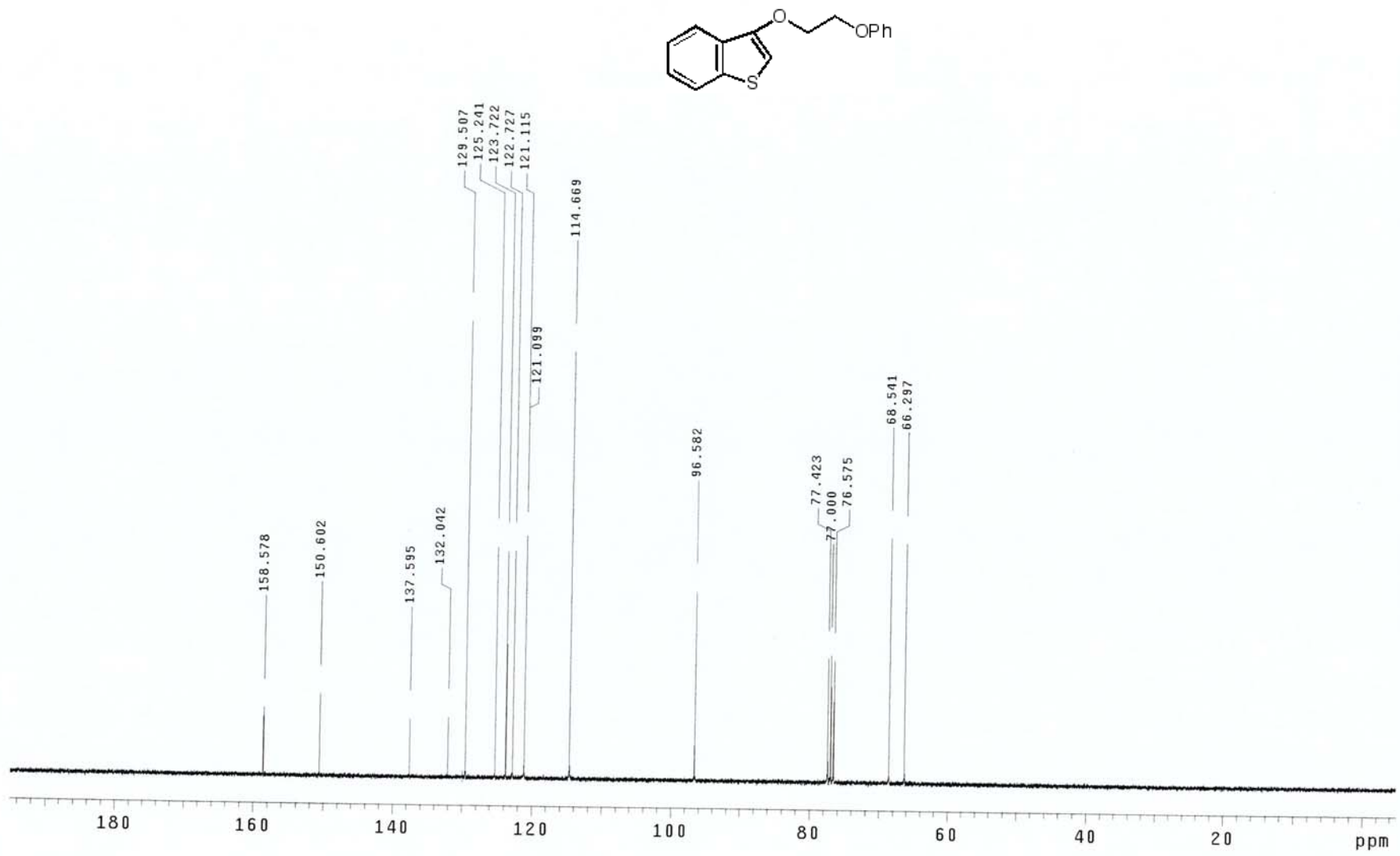
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec





wxx-2-93-A-3_C

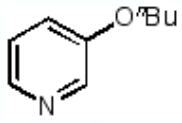
Pulse Sequence: s2pul

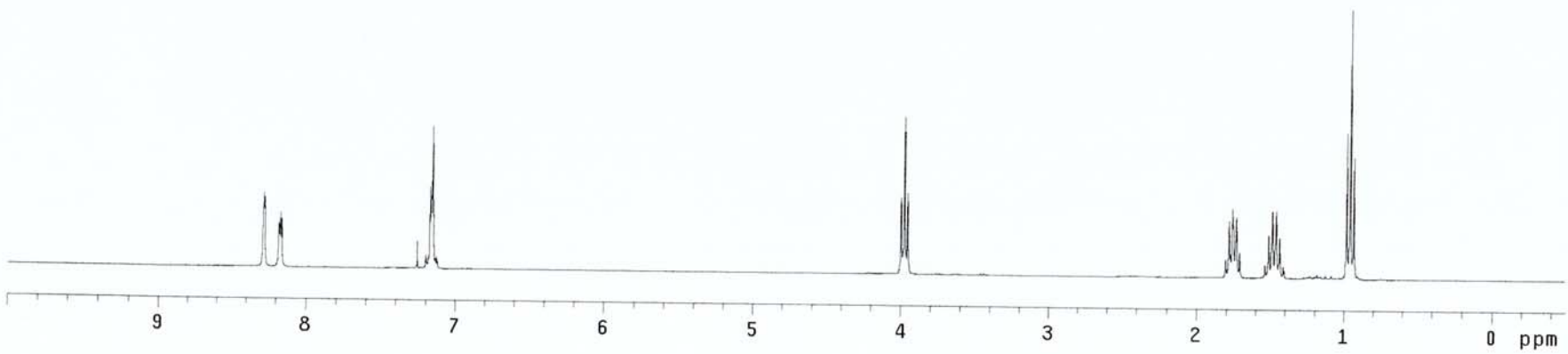


wxx-2-12-E-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

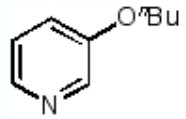
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055035 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

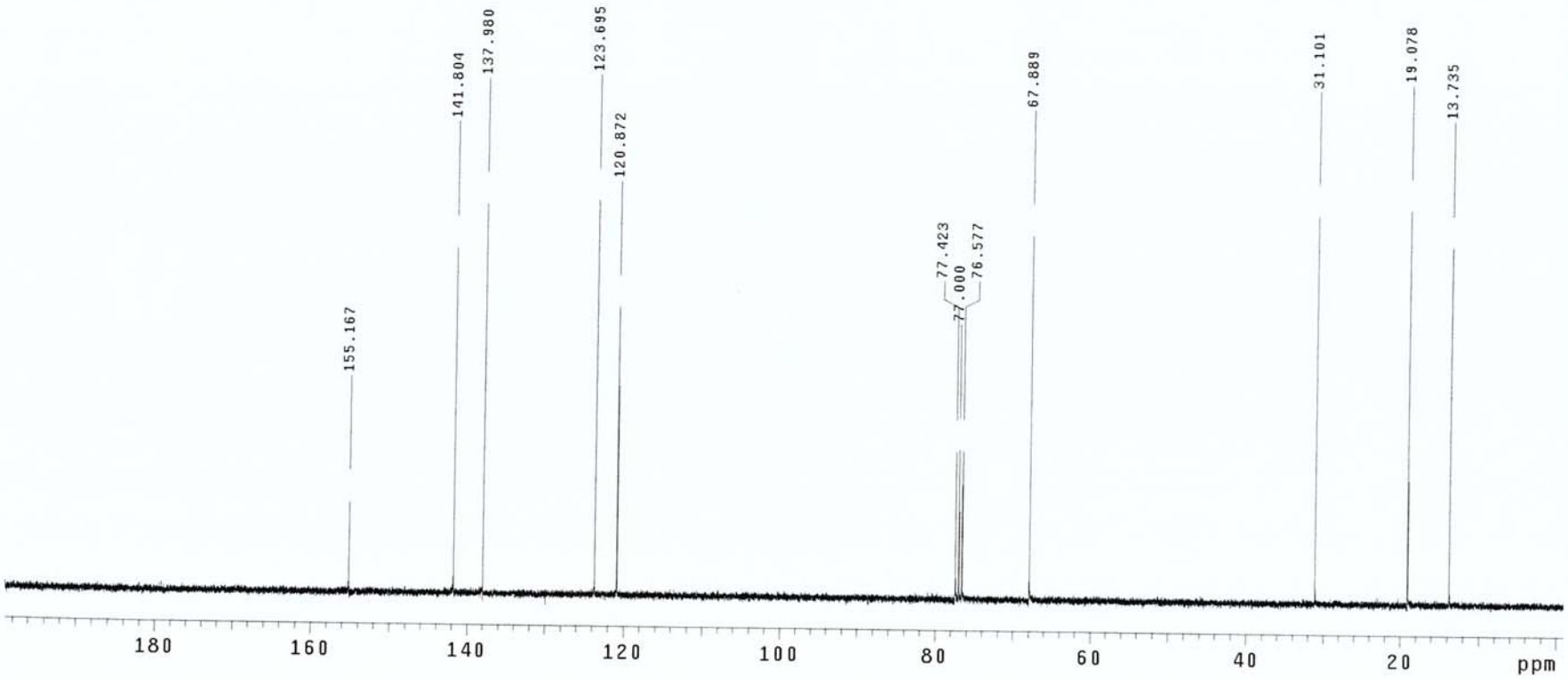




wxx-2-12-E-2C

Pulse Sequence: s2pul

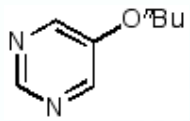


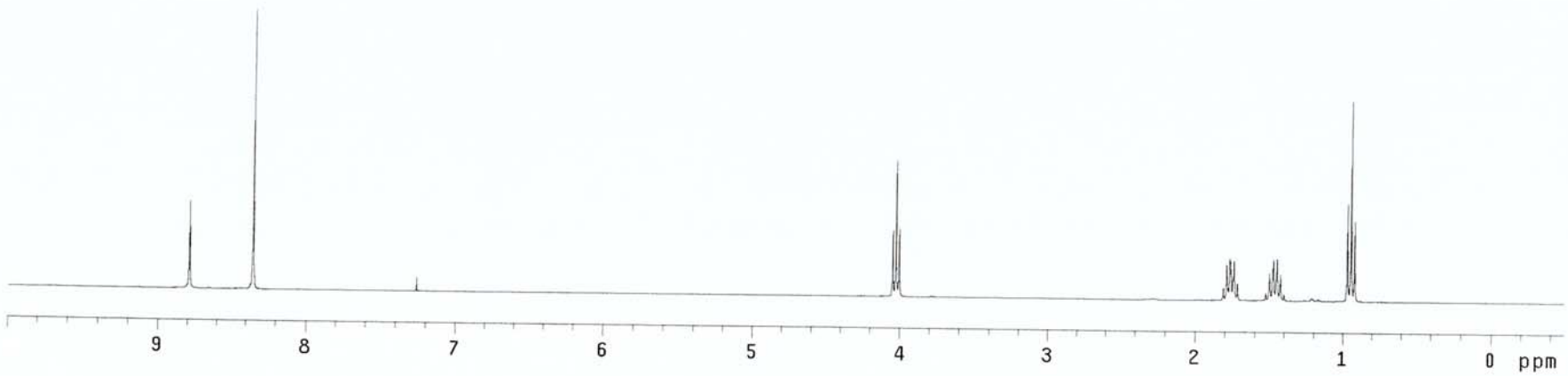


wxx-2-23-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
File: wxx-2-23-A-2
Mercury-300 "mrhat"

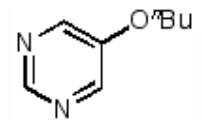
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055032 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

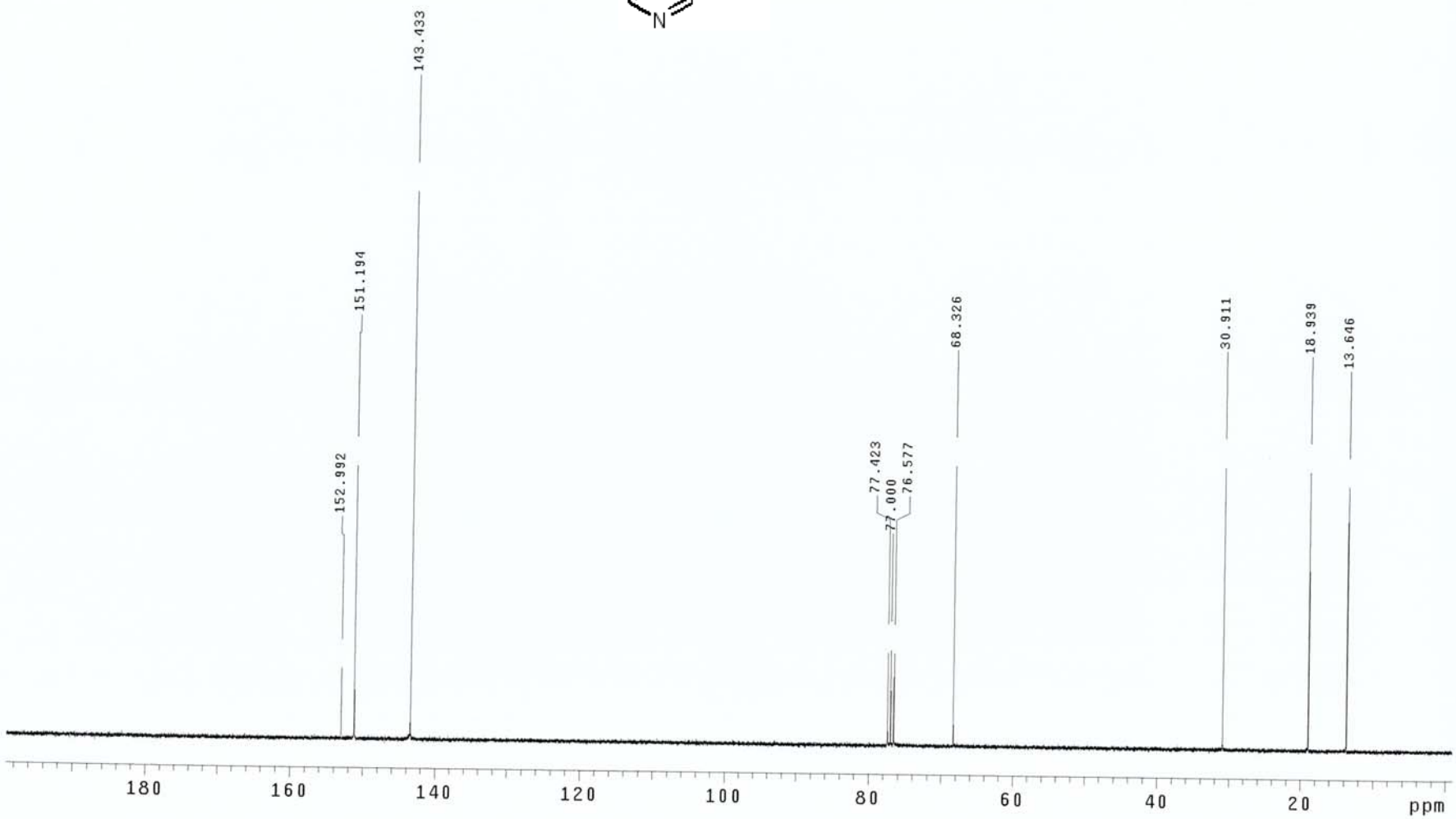




wxx-2-23-A-2C

Pulse Sequence: s2pul

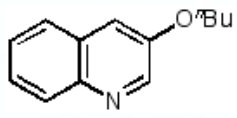


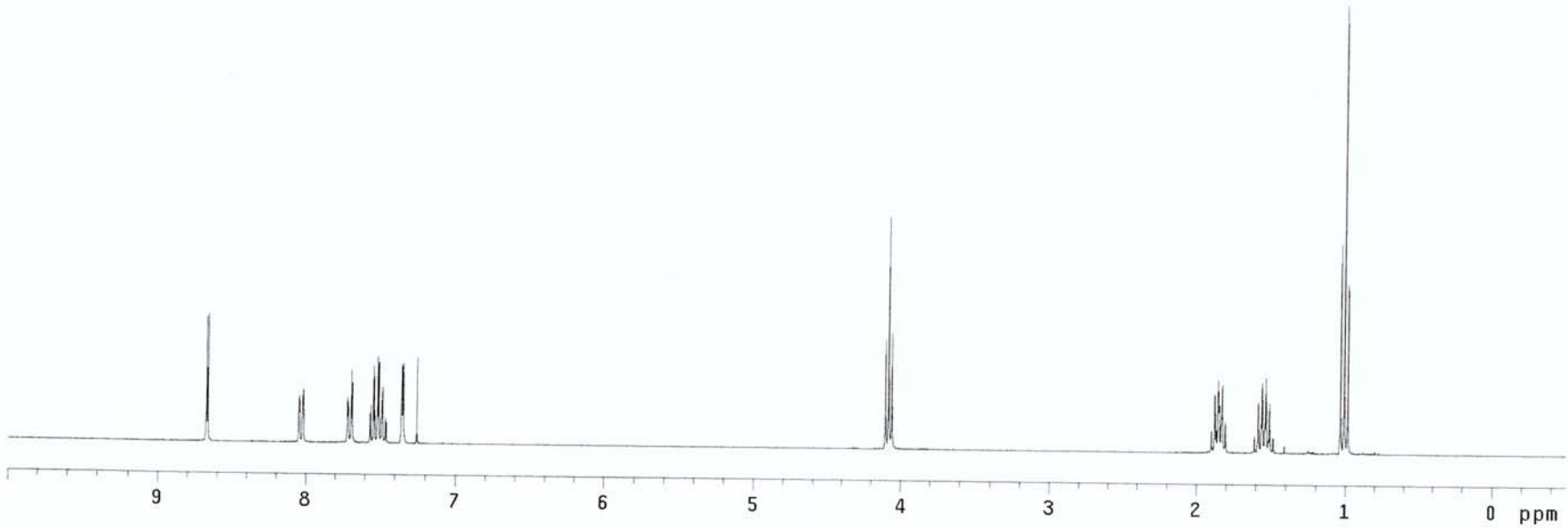


wxx-2-13-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

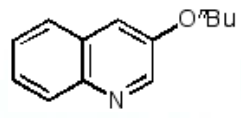
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

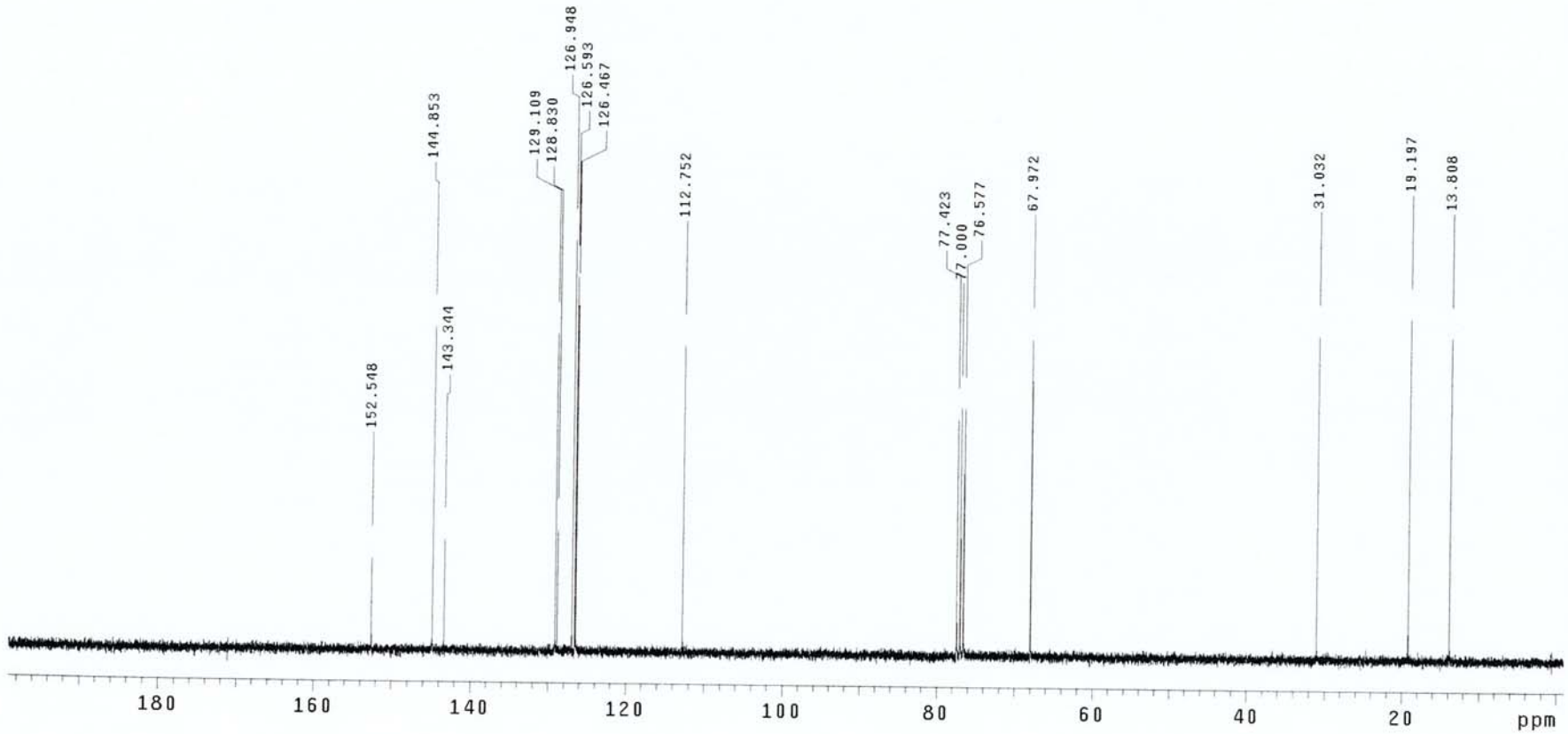




wxx-2-13-A-2C

Pulse Sequence: s2pul

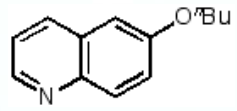


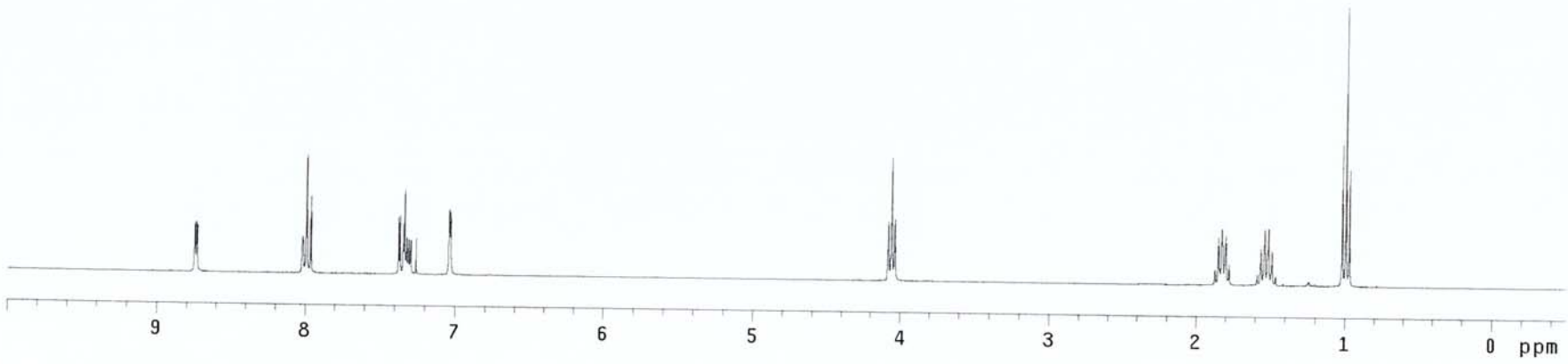


wxx-2-14-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

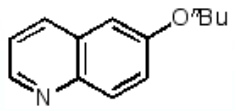
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055033 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

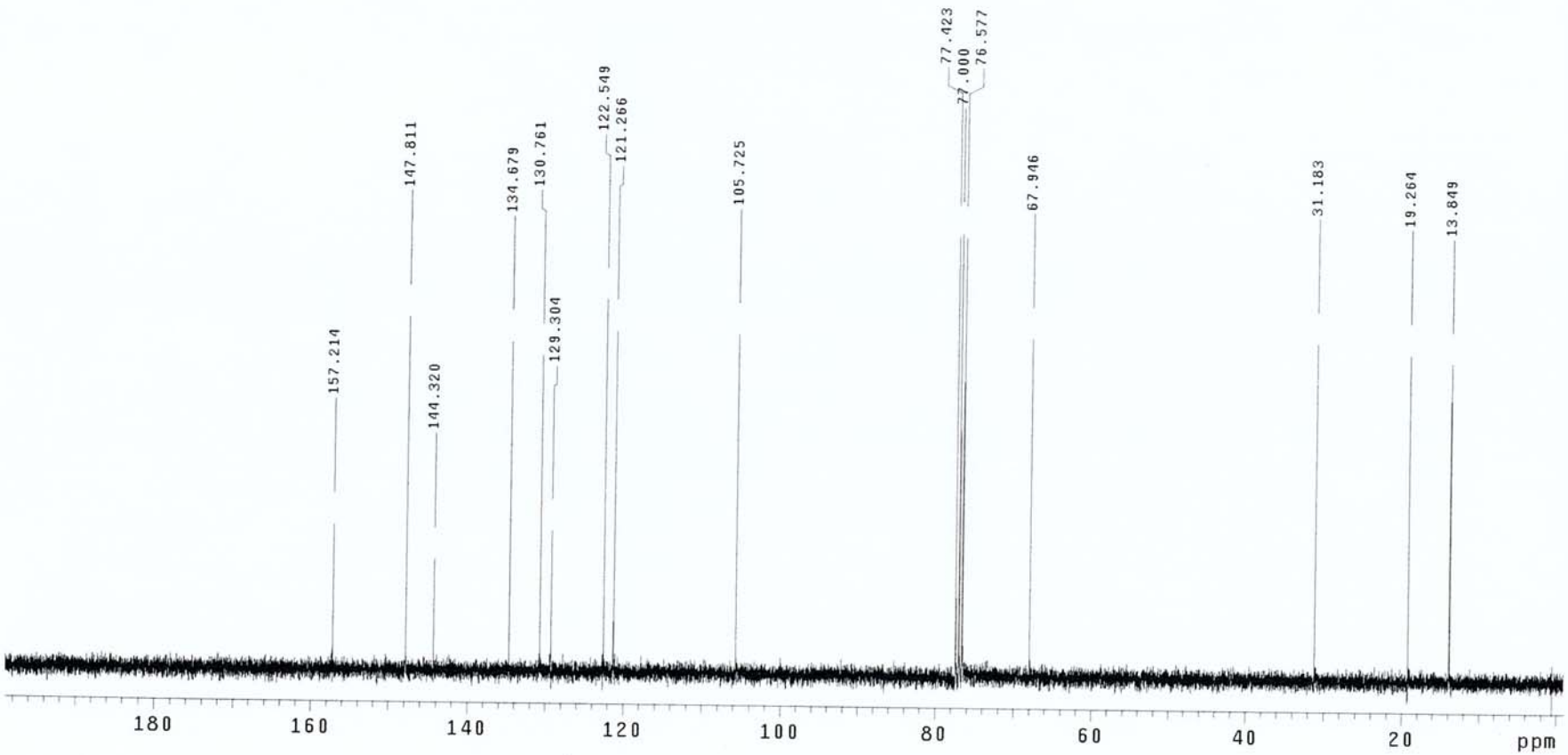




wxx-2-14-A-2C

Pulse Sequence: s2pul

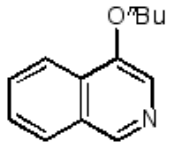


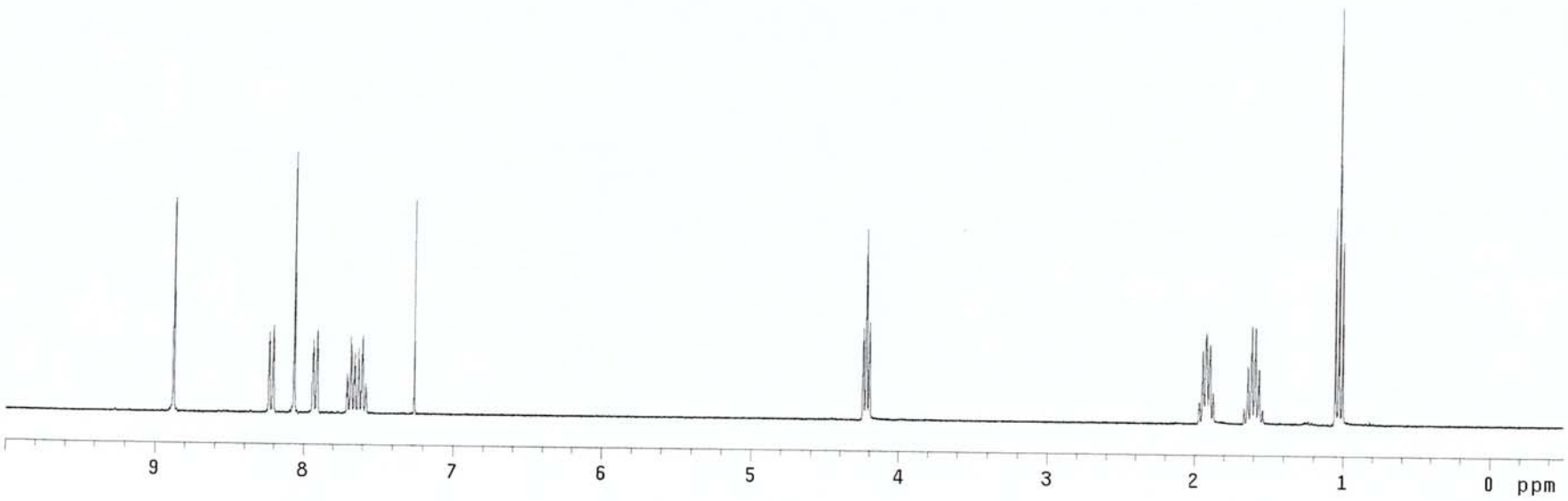


wxx-2-128-J-1

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

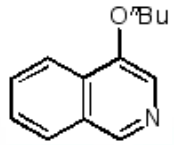
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
8 repetitions
OBSERVE H1, 300.1055040 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

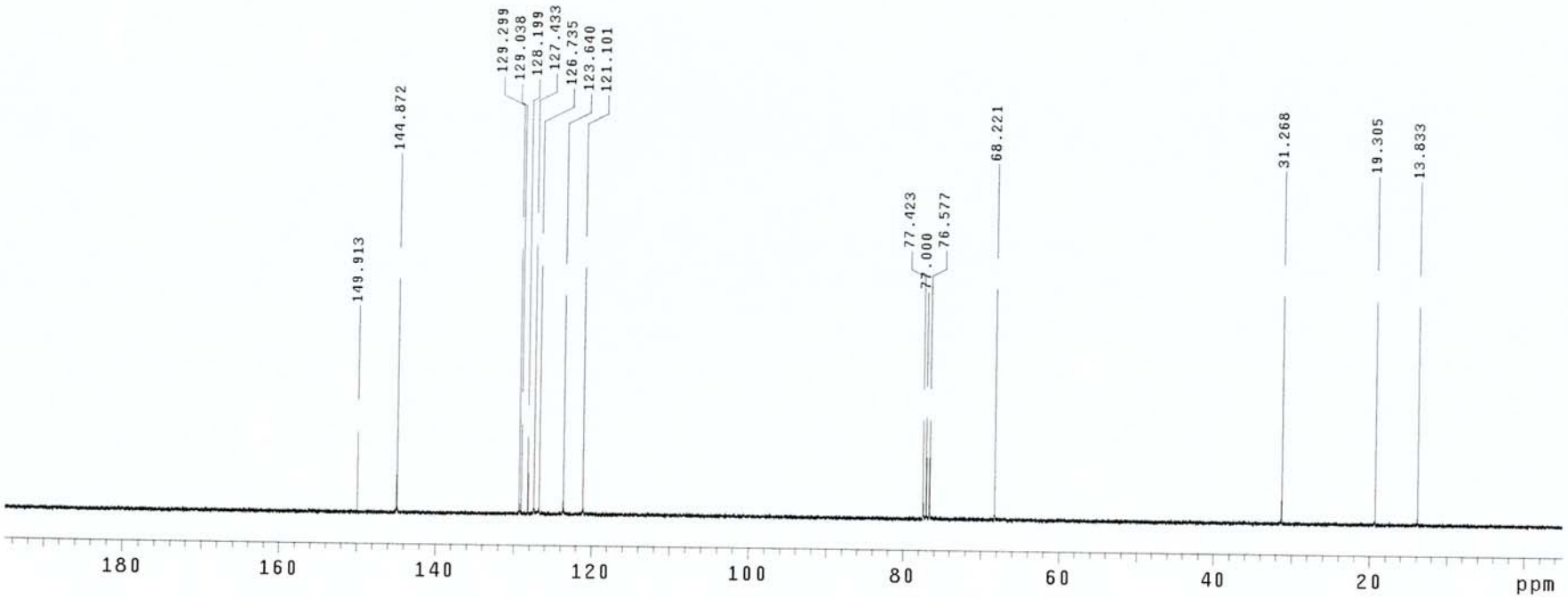




wxx-2-128-D-2C

Pulse Sequence: s2pul

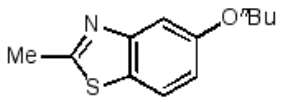


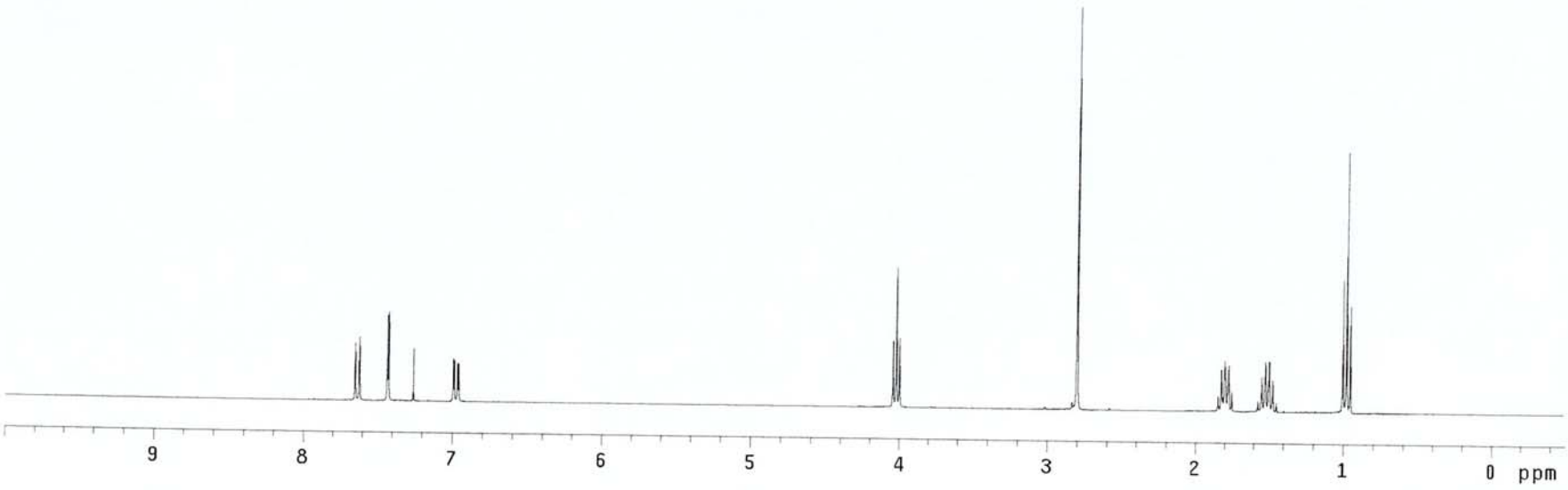


wxx-2-21-B-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

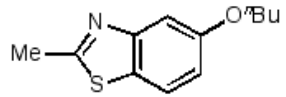
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 0 min, 0 sec

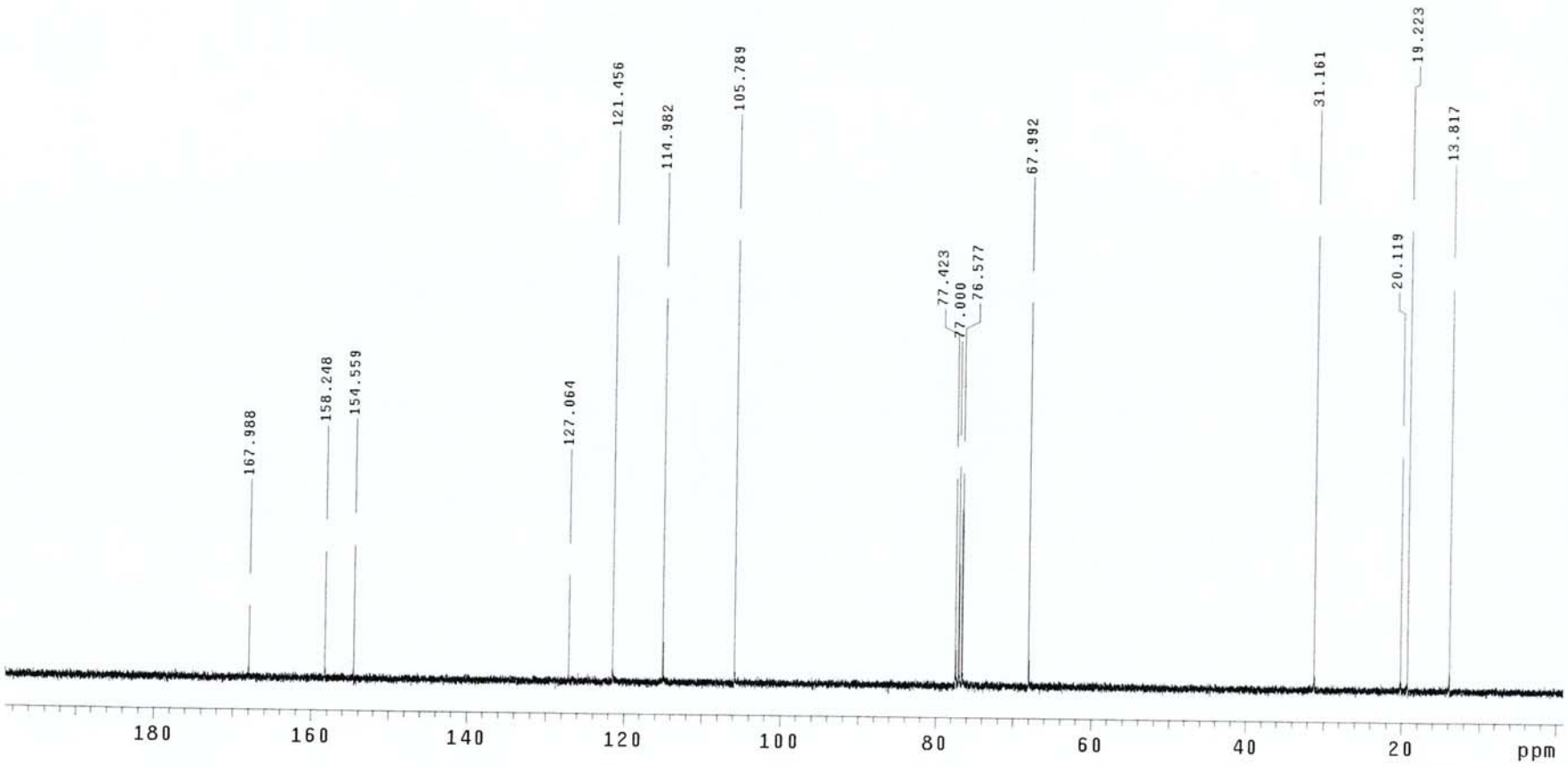




wxx-2-21-A-2C

Pulse Sequence: s2pul

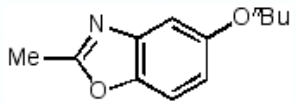


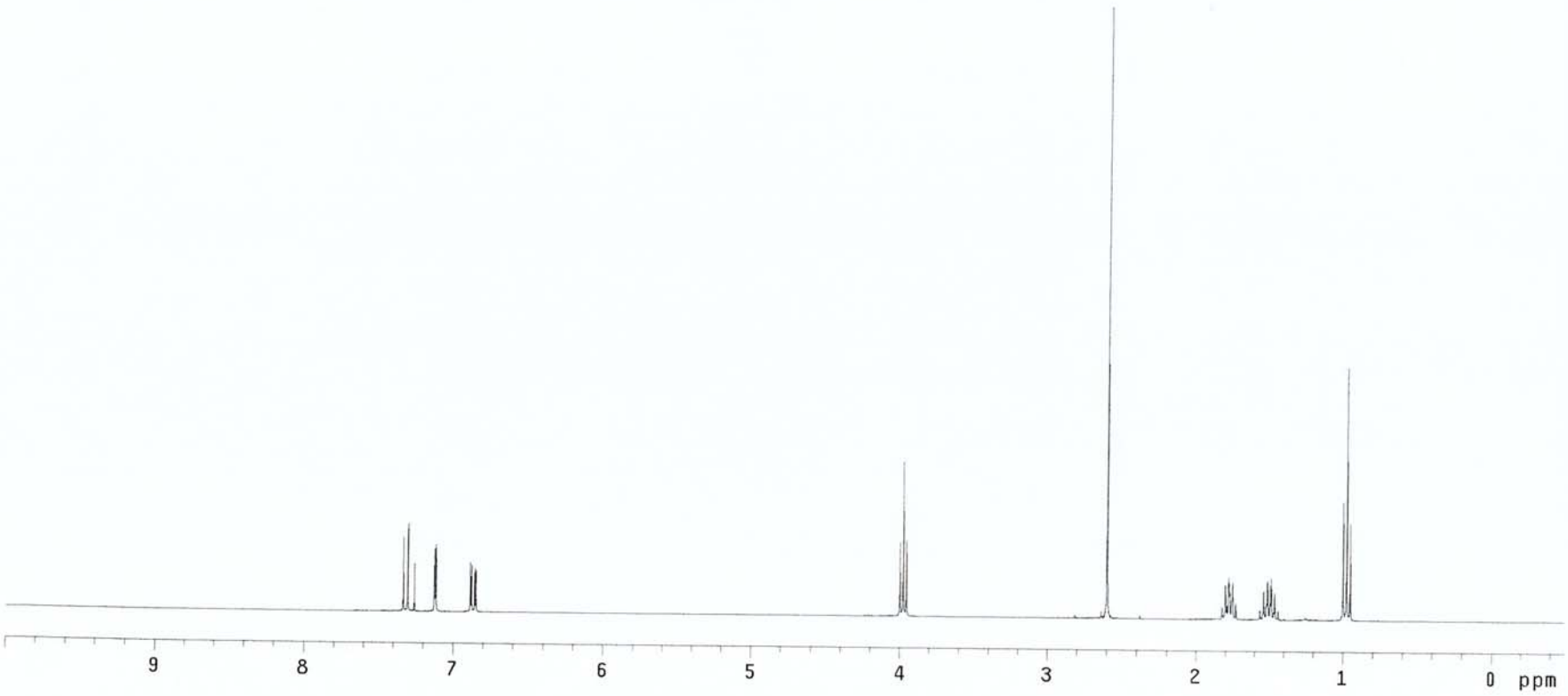


wxx-2-20-A-2

Pulse Sequence: s2pul
Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

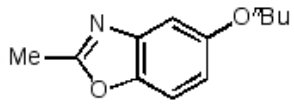
Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec

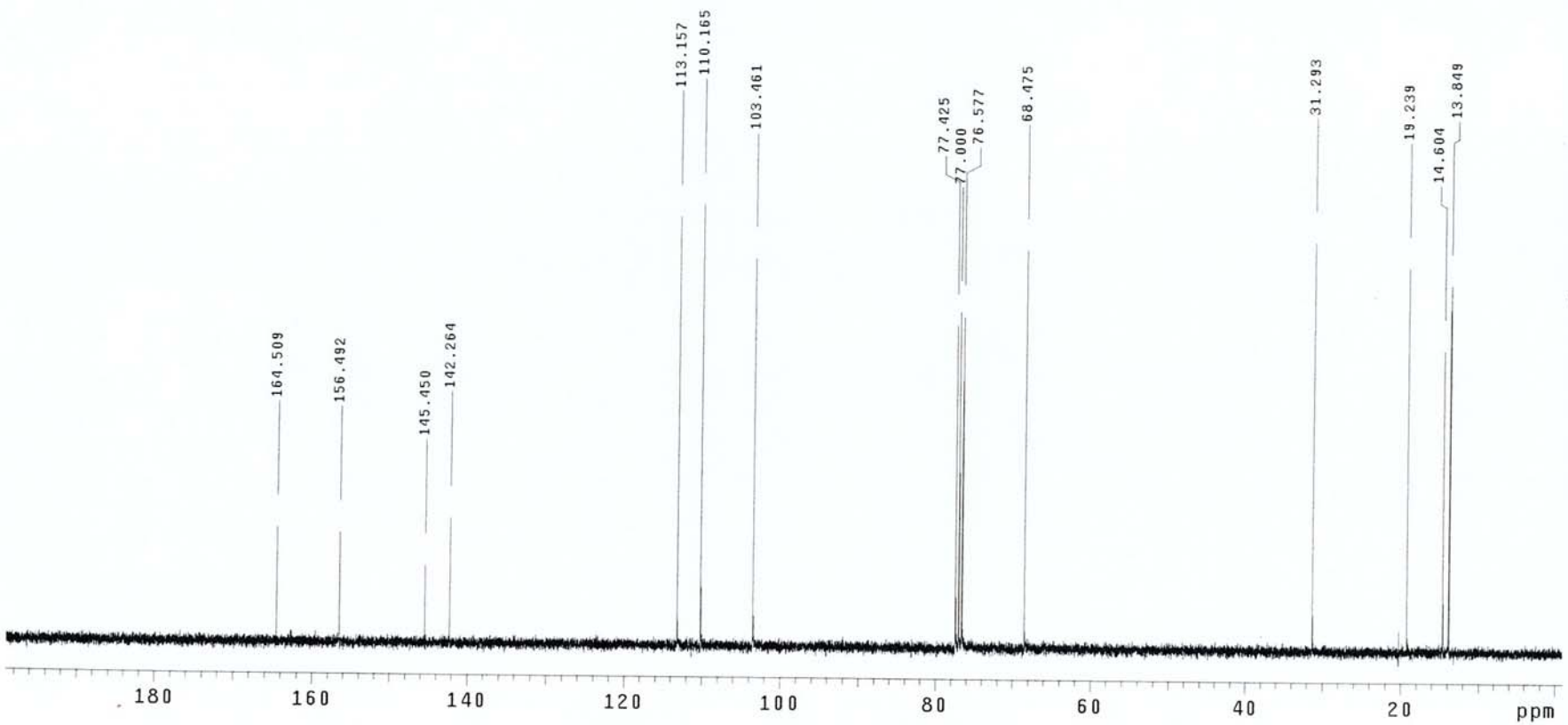




wxx-2-20-A-2C

Pulse Sequence: s2pul



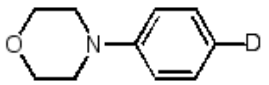


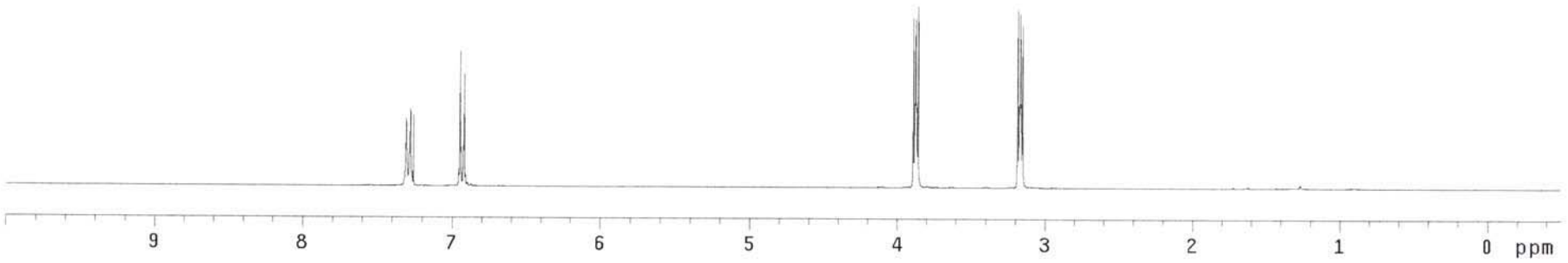
wxx-2-76-C-1a

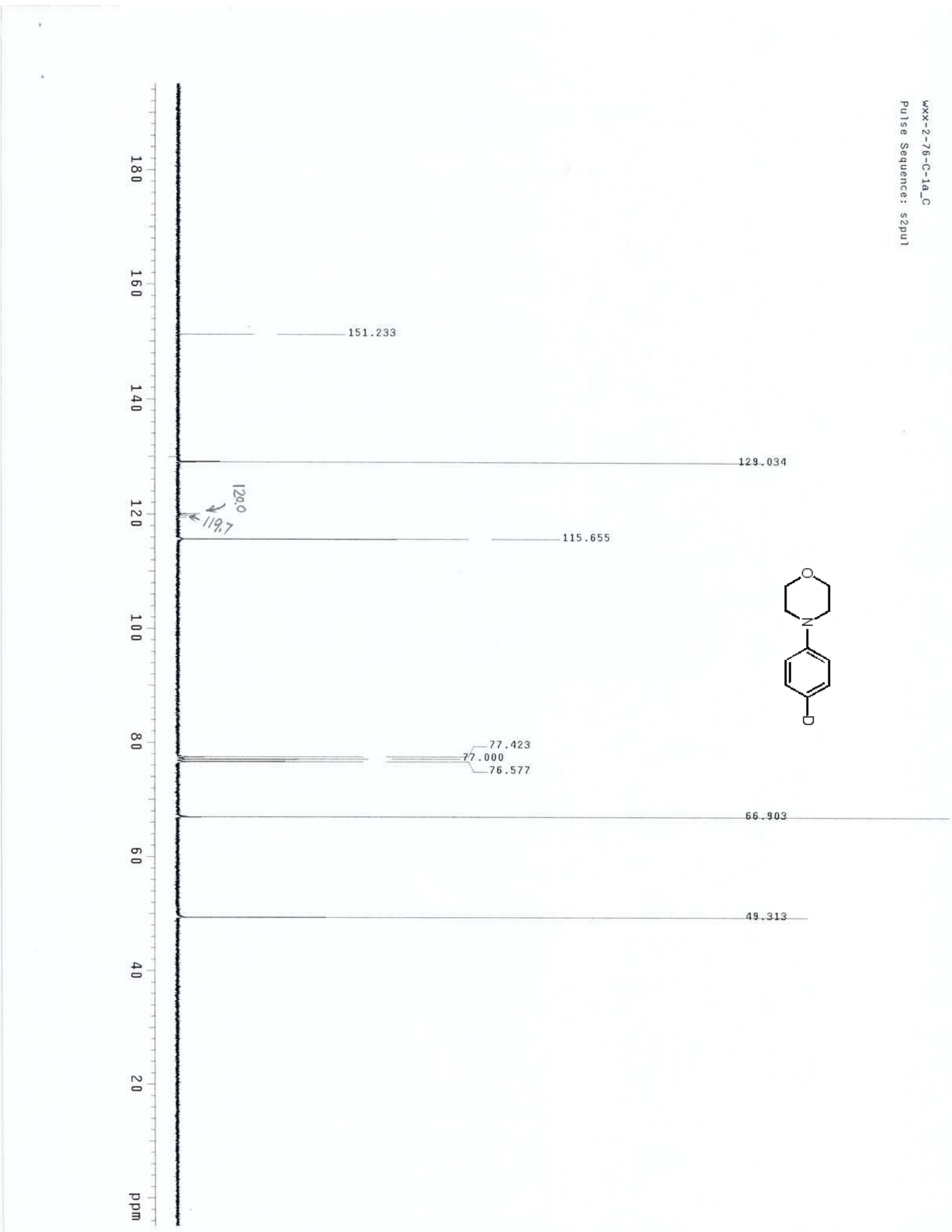
Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
16 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec





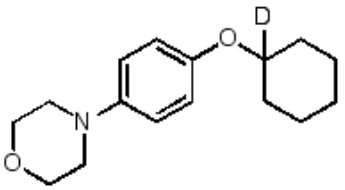

wxx-2-76-C-1a_C
Pulse Sequence: s2pul
151.233
129.034
120.0
119.7
115.655
77.423
77.000
76.577
66.903
49.313
180
160
140
120
100
80
60
40
20
ppm

wxx-2-88-B-8b_070510

Pulse Sequence: s2pul

Solvent: CDCl3
Temp. 20.0 C / 293.1 K
Mercury-300 "mrhat"

Relax. delay 0.050 sec
Pulse 33.9 degrees
Acq. time 4.003 sec
Width 6002.4 Hz
12 repetitions
OBSERVE H1, 300.1055034 MHz
DATA PROCESSING
FT size 131072
Total time 1 min, 17 sec



wxx-2-88-B-8b_C

Pulse Sequence: s2pul