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Supporting Information

for

Controlling alkyne reactivity by means of a copper-catalyzed radical reaction system for the synthesis of functionalized quaternary carbons

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Experimental procedures, compound characterization data, and NMR spectra

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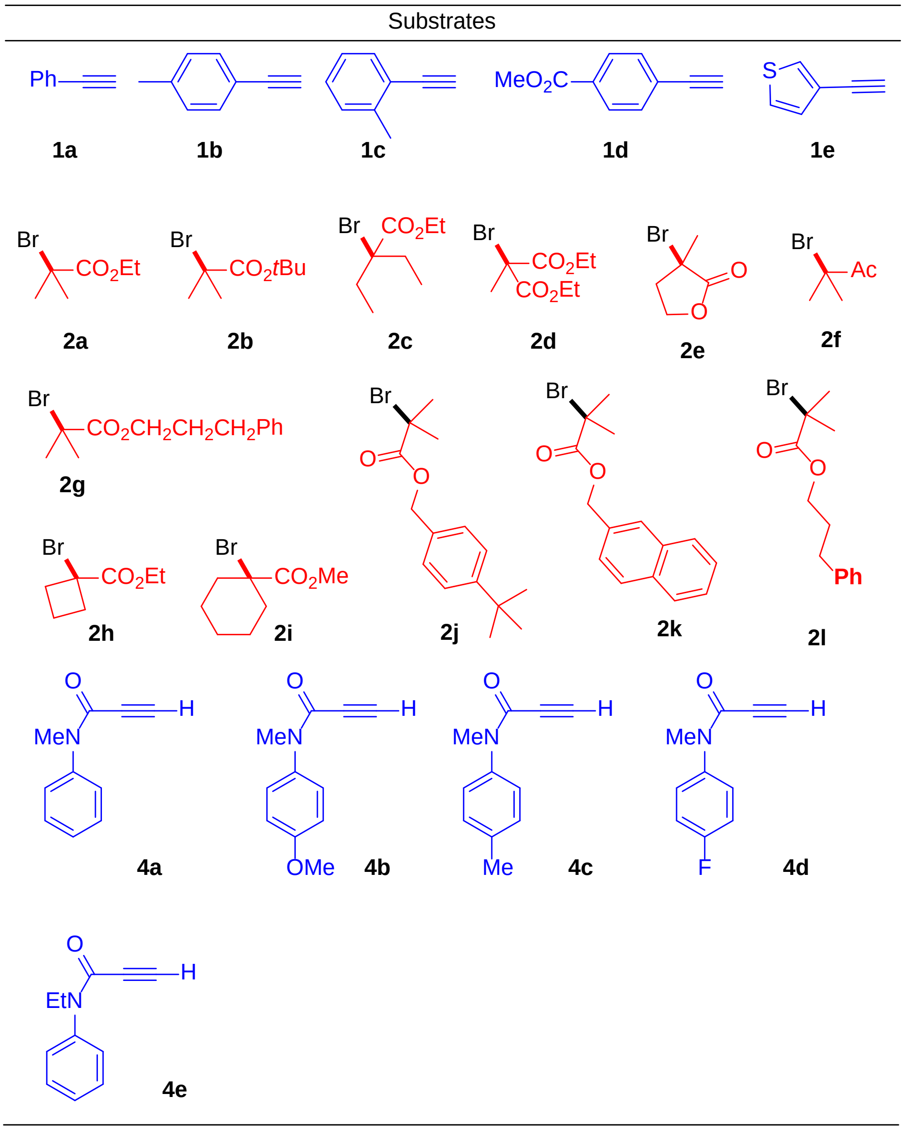
1. General information.

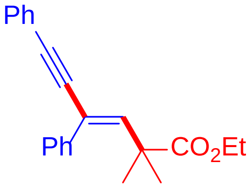
All reactions were carried out under nitrogen (99.95%) atmosphere. For TLC analyses precoated Kieselgel 60 F254 plates (Merck, 0.25 mm thick) were used; for column chromatography silica gel 60 (Kanto chemical, 63–210 μm) was used. Visualization was accomplished by UV light (254 nm), ^{1}H and ^{13}C NMR spectra were obtained using a JEOL 500 MHz NMR spectrometer. ^{1}H NMR and ^{13}C NMR spectra were obtained in $CDCl_3$ by using $CHCl_3$ (for ^{1}H, $\delta = 7.26$ ppm) and $CDCl_3$ (for ^{13}C, $\delta = 77.16$ ppm) as an internal standard. High resolution mass analyses were obtained using a ACQUITY UPLC/ TOF-MS for EI. Anhydrous toluene and THF were purchased from Kanto Chemical Co., Ltd. Other chemicals obtained from TCI, Sigma-Aldrich and Wako and Copper salts obtained from Sigma-Aldrich and Wako were used directly as supplied.

Table S1. Substrates



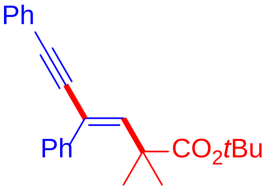
2. Synthesis and analytical data of 3

General Procedure for the reaction: CuBr (0.050 mmol), 1,10-Phen (0.10 mmol), NaI (1.0 mmol) and Cs_2CO_3 (2.0 mmol) were sequentially added to the dram vial equipped with a stir bar and a screw cap. MeCN (1.0 mL), **1** (1.5 mmol) and **2** (0.50 mmol) were added to a dram vial. The resulting mixture vigorously stirred under nitrogen atmosphere (purity 99.95%) for 24 h at 80 °C. After this time, the contents of the flask were filtered through the plug of silica gel with EtOAc as an eluent, and then concentrated by rotary evaporation. The crude residue was purified by flash chromatography and GPC, eluting with EtOAc/hexane to afford the product. The yield was checked by ^{1}H NMR analysis. **3a**, **3d,** **3f** and **3i** are reported compounds[1].



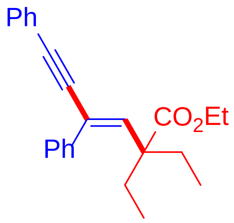
3a

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3a** with inseparable side products. The yield was determined by ^{1}H NMR analysis (66%) and purified by GPC (52%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41-7.39 (m, 2H), 7.34-7.27 (m, 8H), 6.26 (s, 1H), 3.60 (q, J = 7.0 Hz, 2H), 1.31 (s, 6H), 1.08 (t, J = 7.0 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.6, 143.3, 137.5, 131.6, 128.8, 128.3, 128.19, 128.12, 127.8, 124.2, 123.3, 91.8, 88.0, 60.7, 44.3, 27.7, 13.9. This compound is a reported compound.[1]



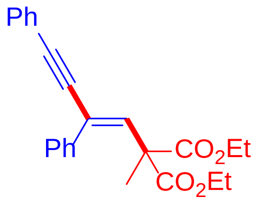
3b

Following the general procedure above, using **2b** (111 mg, 0.5 mmol), **1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3b** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (52%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.42-7.25 (m, 10H), 6.29 (s, 1H), 1.29 (s, 9H), 1.22 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.1, 143.2, 138.0, 131.6, 128.8, 128.3, 128.2, 128.1, 127.8, 92.3, 87.6, 80.6, 45.1, 27.8, 27.5; FT-IR (neat, cm^{-1}) 2974, 2930, 2869, 1722, 1488, 1366, 1132; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{24}H_{27}O_2$ 347.2011, found 347.2011.



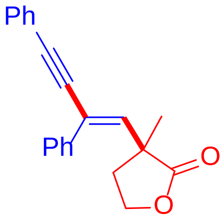
3c

Following the general procedure above, using **2c** (111 mg, 0.5 mmol), **1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3c** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (46%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41-7.39 (m, 2H), 7.34-7.26 (m, 8H), 6.33 (s, 1H), 3.74 (q, *J* = 7.1 Hz, 2H), 1.74-1.66 (m, 4H), 1.12 (t, *J* = 7.1 Hz, 3H), 0.82 (t, *J* = 7.5 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.8, 141.4, 137.9, 131.6, 128.5, 128.3, 128.1, 127.8, 124.8, 123.4, 92.3, 87.6, 60.5, 52.4, 29.2, 14.1, 8.8; FT-IR (neat, cm^{-1}) 2968, 2935, 2876, 1724, 1488, 1441, 1222, 1131; HRMS (EI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{24}H_{27}O_2$ 347.2011, found 347.2011.



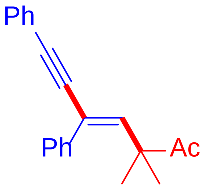
3d

Following the general procedure above, using **2d** (126 mg, 0.5 mmol), **1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3d** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (40%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41-7.39 (m, 2H), 7.35-7.27 (m, 8H), 6.74 (s, 1H), 3.99-3.92 (m, 2H), 3.89-3.83 (m, 2H), 1.55 (s, 3H), 1.16 (t, *J* = 7.2 Hz, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.5, 136.8, 136.1, 131.6, 128.8, 128.3, 128.16, 128.13, 126.1, 123.2, 91.5, 89.0, 61.7, 55.7, 23.3, 13.9. This compound is a reported compound.[1]



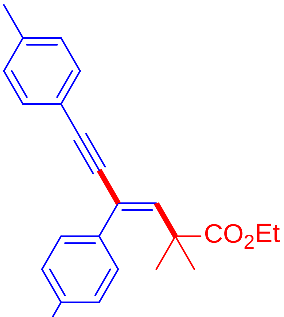
3e

Following the general procedure above, using**2e** (90 mg, 0.5 mmol),**1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3e** with inseparable side products. The yield was determined by ^1H NMR analysis and purified by GPC (53%); ^1H NMR (500 MHz, $CDCl_3$) δ 7.40-7.34 (m, 7H), 7.29-7.27 (m, 3H), 6.59 (s, 1H), 4.09-4.02 (m, 2H), 2.08-2.02 (m, 1H), 1.66-1.62 (m, 1H), 1.41 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 180.0, 139.4, 137.7, 131.6, 128.7, 128.5, 128.4, 128.3, 128.2, 126.3, 123.1, 91.0, 89.5, 65.2, 44.7, 35.3, 24.7; FT-IR (neat, cm^{-1}) 2970, 2910, 2870, 1764, 1487, 1442, 1088, 1027; HRMS (EI-MS) *m/z* $[M+H^+]$ Calcd for $C_{21}H_{19}O_2$ 303.1385, found 303.1388.



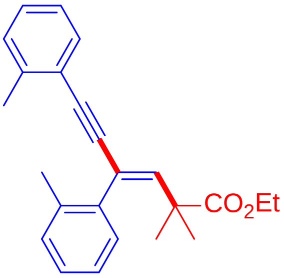
3f

Following the general procedure above, using **2f** (82 mg, 0.5 mmol), **1a** (152 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3f** with inseparable side products. The yield was determined by ^1H NMR analysis and purified by GPC (52%); ^1H NMR (500 MHz, $CDCl_3$) δ 7.42-7.40 (m, 2H), 7.35-7.25 (m, 6H), 6.34 (s, 1H), 1.93 (s, 2H), 1.22 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 210.2, 143.3, 137.1, 131.6, 128.8, 128.39, 128.35, 128.2, 91.7, 88.42, 50.8, 26.5, 26.3. This compound is a reported compound.[1]



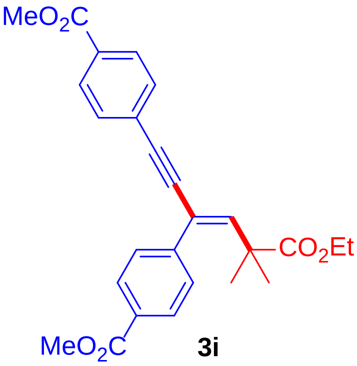
3g

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **1b** (174 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3g** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (53%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.1 Hz, 2H), 7.20 (d, *J* = 8.1 Hz, 2H), 7.14 (d, *J* = 7.9 Hz, 2H), 7.08 (d, *J* = 7.9 Hz, 2H), 6.23 (s, 1H), 3.65 (q, *J* = 7.1 Hz, 2H), 2.34 (s, 3H), 2.33 (s, 3H), 1.31 (s, 6H), 1.10 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.8, 142.7, 138.2, 137.5, 134.7, 131.5, 129.0, 128.7, 128.6, 124.4, 120.3, 91.4, 88.0, 60.6, 44.2, 27.7, 21.5, 21.3, 13.9; FT-IR (neat, cm^{-1}) 2975, 2921, 2868, 1727, 1507, 1133; HRMS (EI-MS) *m/z* [$M+H^+$] Calcd for $C_{24}H_{27}O_2$ 347.2011, found 347.2011.



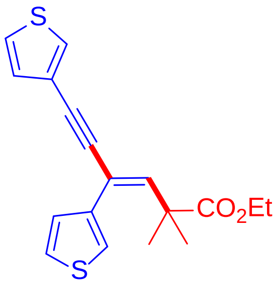
3h

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **1c** (174 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3h** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (58%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.26-7.15 (m, 4H), 7.09-7.04 (m, 4H), 6.22 (s, 1H), 3.61 (q, *J* = 7.1 Hz, 2H), 2.34 (s, 3H), 2.30 (s, 3H), 1.30 (m, 2H), 1.09 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.7, 143.1, 137.9, 137.6, 137.4, 132.2, 129.4, 129.0, 128.6, 128.5, 128.2, 128.0, 125.8, 124.4, 123.2, 91.6, 88.1, 60.6, 44.3, 27.7, 21.5, 21.2, 13.9; FT-IR (neat, cm^{-1}) 2975, 2922, 2868, 1727, 1443, 1133; HRMS (EI-MS) *m/z* [M+H$^+$] Calcd for $C_{24}H_{27}O_2$ 347.2011, found 347.2011.



3i

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **1d** (240 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3i** with inseparable side products. The yield was determined by ^{1}H NMR analysis and purified by GPC (63%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.02 (d, *J* = 7.9 Hz, 2H), 7.96 (d, *J* = 7.9 Hz, 2H), 7.45 (d, *J* = 8.0 Hz, 2H), 7.39 (d, *J* = 8.1 Hz, 2H), 6.36 (s, 1H), 3.93 (s, 3H), 3.91 (s, 3H), 3.66 (q, *J* = 7.1 Hz, 2H), 1.31 (s, 6H), (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.2, 166.7, 166.5, 145.1, 141.8, 131.4, 129.6, 129.53, 129.52, 128.8, 127.8, 123.1, 93.9, 87.9, 60.8, 52.3, 52.2, 44.4, 27.5, 13.9; FT-IR (neat, cm^{-1}) 2973, 2951, 1717, 1603, 1434, 1270, 1102; HRMS (EI-MS) *m/z* [M+H$^+$] Calcd for $C_{26}H_{27}O_6$ 435.1808, found 435.1808. This compound is a reported compound.[1]

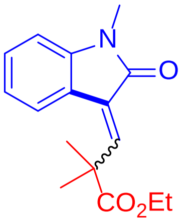


3j

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **1e** (270 mg, 1.5 mmol), CuBr (10.8 mg, 0.075 mmol), Cs_2CO_3 (656 mg, 2.00 mmol), 1,10-Phen (27.1 mg, 0.15 mmol), NaI (150 mg, 1.0 mmol) and toluene (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **3j** in 53% yield (87 mg).; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41 (dd, *J* = 1.2 and 2.9 Hz, 1H), 7.27-7.24 (m, 2H), 7.18 (dd, *J* = 1.3 and 2.9 Hz, 1H), 7.09 (dd, *J* = 1.2 and 5.0 Hz, 1H), 6.20 (s, 1H), 3.73 (q, *J* = 7.1 Hz, 2H), 1.34 (s, 6H), 1.09 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.8, 143.7, 137.1, 129.9, 128.5, 125.3, 125.1, 124.1, 122.3, 119.1, 90.7, 82.7, 60.8, 44.2, 27.6, 14.0; FT-IR (neat, cm^{-1}) 3104, 2975, 2932, 2868, 1723, 1466, 1132; HRMS (EI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{18}H_{19}O_2S_2$ 331.0826, found 331.0822.

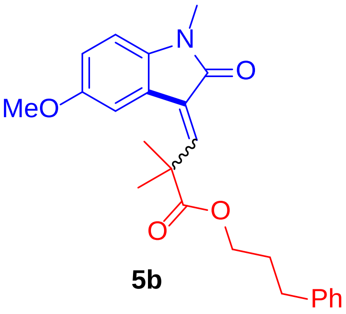
3. Synthesis and analytical data of 5

General Procedure for the reaction: CuI (10 mol %), 1,10-Phen (10 mol %), Cy_2NMe (1.0 equiv), **2** (1.0 equiv) and **4** (3.0 equiv) were sequentially added to the dram vial equipped with a stir bar and a screw cap. 1,4-dioxane (1.0 mL) was added to a dram vial. The resulting mixture vigorously stirred under nitrogen atmosphere (purity 99.95%) for 20 h at 100 °C. After this time, the contents of the flask were filtered through the plug of silica gel with EtOAc as an eluent, and then concentrated by rotary evaporation. The crude residue was purified by flash chromatography and GPC, eluting with EtOAc/hexane to afford the product. The yield was checked by ^{1}H NMR analysis.



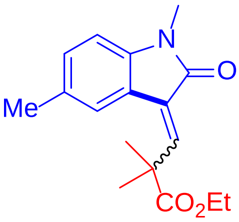
5a

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **4a** (238.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy_2NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5a** with isomers (95 mg, 70%). The desired product yield was determined by ^{1}H NMR analysis (69%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.30 (d, *J* = 7.6 Hz, 1H), 7.25 (t, *J* = 7.7 Hz, 1H), 7.04 (s, 1H), 6.99 (t, *J* = 7.7 Hz, 1H), 6.80 (d, *J* = 7.7 Hz, 1H), 4.07 (q, *J* = 7.1 Hz, 2H), 3.23 (s, 3H), 1.56 (s, 6H), 1.06 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 176.0, 168.4, 144.6, 144.2, 129.5, 128.1, 125.2, 122.2, 120.6, 108.1, 61.4, 43.4, 26.3, 26.2, 14.0; FT-IR (neat, cm^{-1}) 2976, 1707, 1607, 1467, 1229, 1137; HRMS (EI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{16}H_{20}O_3N$ 274.1443, found 274.1443.



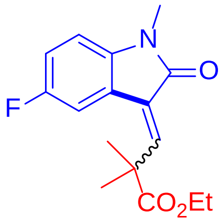
5b

Following the general procedure above, using **2l** (142 mg, 0.5 mmol), **4b** (283.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5b** with isomers (121 mg, 62%). The desired product yield was determined by ^{1}H NMR analysis (63%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.19 (t, *J* = 7.5 Hz, 2H), 7.13 (t, *J* = 7.4 Hz, 1H), 7.08 (s, 1H), 6.99 (d, *J* = 2.4 Hz, 1H), 6.94 (d, *J* = 6.9 Hz, 2H), 6.82 (dd, *J* = 2.4 and 8.5 Hz, 1H), 6.69 (d, *J* = 8.5 Hz, 1H), 4.04 (q, *J* = 6.3 Hz, 2H), 3.71 (s, 3H), 3.20 (s, 3H), 2.41 (t, *J* = 8.0 Hz, 2H), 1.80-1.74 (m, 2H), 1.59 (s, 6H); ^{13}C NMR (125 MHz, CDCl$_3$) δ 176.1, 168.1, 155.7, 144.7, 141.0, 138.0, 128.6, 128.4, 128.3, 126.0, 121.3, 114.9, 111.7, 108.5, 64.7, 55.9, 43.5, 31.9, 30.0, 26.36, 26.34; FT-IR (neat, cm^{-1}) 2935, 1703, 1592, 1469, 1222, 1129; HRMS (ESI-MS) *m/z* [M+H$^+$] Calcd for $C_{24}H_{28}O_4N$ 394.2018, found 394.2017.



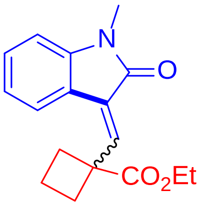
5c

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **4c** (259.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5c** with isomers (91 mg, 63%). The desired product yield was determined by ^{1}H NMR analysis (64%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.05 (s, 1H), 7.00 (d, *J* = 7.9 Hz, 1H), 6.94 (s, 1H), 6.62 (d, *J* = 7.9 Hz, 1H), 4.01 (q, *J* = 7.1 Hz, 2H), 3.15 (s, 3H), 2.25 (s, 3H), 1.50 (s, 6H), 1.02 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, CDCl$_3$) δ 176.0, 168.4, 144.3, 142.0, 131.5, 129.7, 128.3, 126.0, 120.7, 107.8, 61.4, 43.5, 26.4, 26.3, 21.3, 14.1; FT-IR (neat, cm^{-1}) 2977, 1706, 1616, 1488, 1365, 1338, 1255, 1133; HRMS (ESI-MS) *m/z* [M+H$^+$] Calcd for $C_{17}H_{22}O_3N$ 288.1600, found 288.1600.



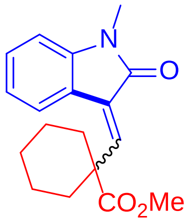
5d

Following the general procedure above, using **2a** (97 mg, 0.5 mmol), **4d** (265.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy_2NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5d** with isomers (84 mg, 58%). The desired product yield was determined by ^{1}H NMR analysis (54%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.09 (dd, *J* = 2.5 and 8.9 Hz, 1H), 7.08 (s, 1H), 6.96 (dt, *J* = 2.5 and 8.8 Hz, 1H), 6.70 (dd, *J* = 4.3 and 8.6 Hz, 1H), 4.10 (q, *J* = 7.1 Hz, 2H), 3.21 (s, 3H), 1.55 (s, 6H), 1.10 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.5, 168.1, 158 (d, *J* = 239 Hz), 140.3, 127 (d, *J* = 2.8 Hz), 121 (d, *J* = 8.9 Hz), 115 (d, *J* = 23.7 Hz), 113 (d, *J* = 27 Hz), 108 (d, *J* = 8.3 Hz), 61.5, 43.5, 26.3, 26.2, 14.0; FT-IR (neat, cm^{-1}) 2978, 1708, 1618, 1467, 1138; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{16}H_{19}O_3NF$ 292.1349, found 292.1349.



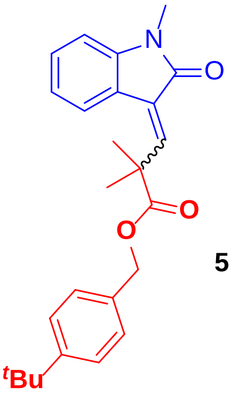
5e

Following the general procedure above, using **2h** (103 mg, 0.5 mmol), **4a** (238.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy_2NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5e** (47% pure *E*-compound). The yield was determined by ^{1}H NMR analysis (60%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.31 (d, *J* = 7.5 Hz, 1H), 7.27 (dt, *J* = 1.1 and 7.8 Hz, 1H), 7.25 (s, 1H), 7.00 (dt, *J* = 0.9 and 7.6 Hz, 1H), 6.80 (d, *J* = 7.8 Hz, 1H), 4.10 (q, *J* = 7.1 Hz, 2H), 3.25 (s, 3H), 2.95-2.90 (m, 2H), 2.45-2.40 (m, 2H), 2.08-1.97 (m, 2H), 1.13 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 173.7, 168.1, 144.0, 142.7, 129.5, 129.1, 125.0, 122.2, 120.3, 108.0, 61.4, 48.1, 33.1, 26.2, 16.2, 14.1; FT-IR (neat, cm^{-1}) 2939, 1706, 1607, 1467, 1377, 1336, 1215, 1094; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{17}H_{20}O_3N$ 286.1443, found 286.1443.



5f

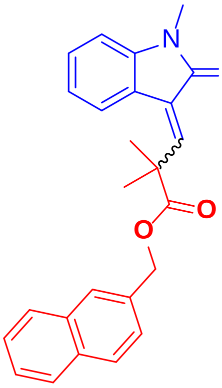
Following the general procedure above, using **2i** (110 mg, 0.5 mmol), **4a** (238.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5f** with isomers (92 mg, 62%). The desired product yield was determined by ^{1}H NMR analysis (60%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.38 (d, *J* = 7.6 Hz, 1H), 7.27 (t, *J* = 7.7 Hz, 1H), 7.15 (s, 1H), 7.01 (t, *J* = 7.7 Hz, 1H), 6.80 (d, *J* = 7.7 Hz, 1H), 3.57 (s, 3H), 3.24 (s, 3H), 2.10-2.00 (m, 4H), 1.68-1.52 (m, 5H), 0.97-0.88 (m, 1H); ^{13}C NMR (125 MHz, CDCl$_3$) δ 176.0, 168.2, 144.3, 143.0, 129.4, 128.2, 125.3, 122.3, 120.6, 108.1, 52.5, 47.4, 34.0, 26.2, 25.3, 22.3; FT-IR (neat, cm^{-1}) 2931, 1701, 1605, 1464, 1239, 1069; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{18}H_{22}O_3N$ 300.1600, found 300.1602.



5g

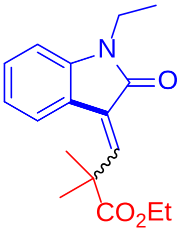
Following the general procedure above, using **2j** (156 mg, 0.5 mmol), **4a** (238.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5g** with isomers (118 mg, 60%). The desired product yield was determined by ^{1}H NMR analysis (59%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.25-7.22 (m, 4H), 7.06 (d, *J* = 8.2 Hz, 2H), 7.04 (s, 1H), 6.89 (t, *J* = 7.7 Hz, 1H), 6.79 (d, *J* = 7.7

Hz, 1H),5.02 (s, 2H), 3.23 (s, 3H), 1.59 (s, 6H), 1.28 (s, 9H); ^{13}C NMR (125 MHz, CDCl$_3$) δ 175.9, 168.3, 151.2, 144.3, 144.2, 132.5, 129.4, 128.2, 128.0, 125.4, 125.1, 122.3, 120.5, 108.1, 67.1, 43.6, 34.6, 31.3, 26.3, 26.2; FT-IR (neat, cm^{-1}) 2959, 1708, 1608, 1466, 1255, 1134; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{25}H_{30}O_3N$ 392.2226, found 392.2226.



5h

Following the general procedure above, using **4a** (153 mg, 0.5 mmol), **2k** (238.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.5 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5h** with isomers (121 mg, 62%). The desired product yield was determined by ^{1}H NMR analysis (64%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, CDCl$_3$) δ 7.76-7.74 (m, 1H), 7.67-7.63 (m, 2H), 7.57 (s, 1H), 7.46-7.42 (m, 2H), 7.19 (d, *J* = 8.1 Hz, 2H), 7.11 (t, *J* = 7.7 Hz, 1H), 7.06 (s, 1H), 6.74 (t, *J* = 7.6 Hz, 1H), 6.70 (d, *J* = 7.6 Hz, 1H), 5.21 (s, 2H), 3.21 (s, 3H), 1.60 (s, 6H); ^{13}C NMR (125 MHz, CDCl$_3$) δ 175.8, 144.1, 144.0, 133.08, 133.04, 132.84, 129.37, 128.3, 128.1, 128.0, 127.6, 127.5, 126.2, 126.1, 125.8, 125.0, 122.1, 120.4, 107.9, 67.3, 43.5, 25.3, 26.2; FT-IR (neat, cm^{-1}) 3053, 2973, 1703, 1607, 1466, 1123; HRMS (ESI-MS) *m*/*z* [M+H$^+$] Calcd for $C_{26}H_{24}O_3N$ 386.1756, found 386.1756.



5i

Following the general procedure above, using **4e** (97 mg, 0.5 mmol), **2a** (259.5 mg, 1.5 mmol), CuI (9.5 mg, 0.05 mmol), 1,10-Phen (9 mg, 0.05 mmol), Cy$_2$NMe (97.6 mg, 0.1 mmol) and 1,4-dioxane (1.0 mL), the crude residue was purified by flash Chromatography on silica gel with EtOAc/hexane to afford the desired compound **5i** with isomers (105 mg, 73%). The desired product yield was determined by ^{1}H NMR analysis (65%) and purified by GPC (*E*-isomer).; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.31 (d, *J* = 7.6 Hz, 1H), 7.25 (t, *J* = 7.7 Hz, 1H), 7.04 (s, 1H), 6.98 (t, *J* = 7.7 Hz, 1H), 6.82 (d, *J* = 7.7 Hz, 1H), 4.09 (q, *J* = 7.1 Hz, 2H), 3.79 (q, *J* = 7.2 Hz, 2H), 1.57 (s, 6H), 1.26 (t, *J* = 7.1 Hz, 3H), 1.08 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 176.0, 167.9, 144.4, 143.3, 129.4, 128.2, 125.3, 122.0, 120.8, 108.2, 61.4, 43.4, 34.7, 26.3, 14.1, 12.8; FT-IR (neat, cm^{-1}) 2976, 1704, 1606, 1466, 1344, 1221, 1138; HRMS (ESI-MS) *m/z* [M+H^{+}] Calcd for $C_{17}H_{22}O_3N$ 288.1600, found 288.1600.

4. Reference

1 C. Che, H. Zheng, G. Zhu, *Org. Lett.* **2015**, *17*, 1617-1620.

5. Spectral charts for new compounds

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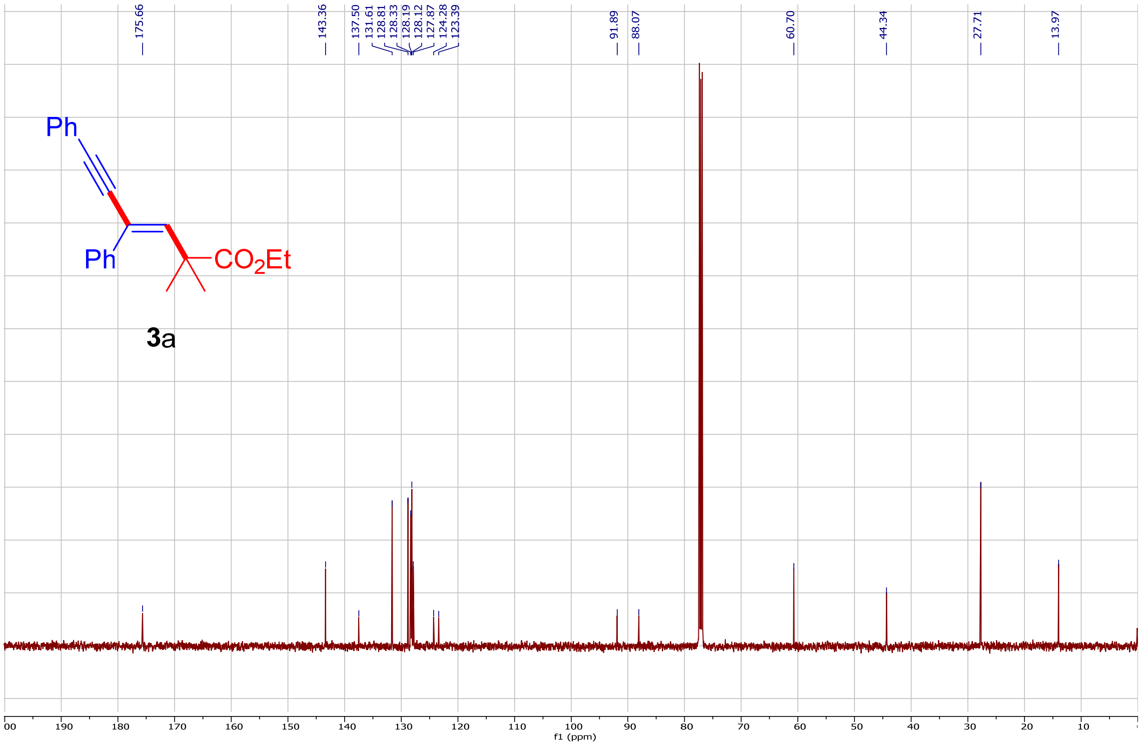

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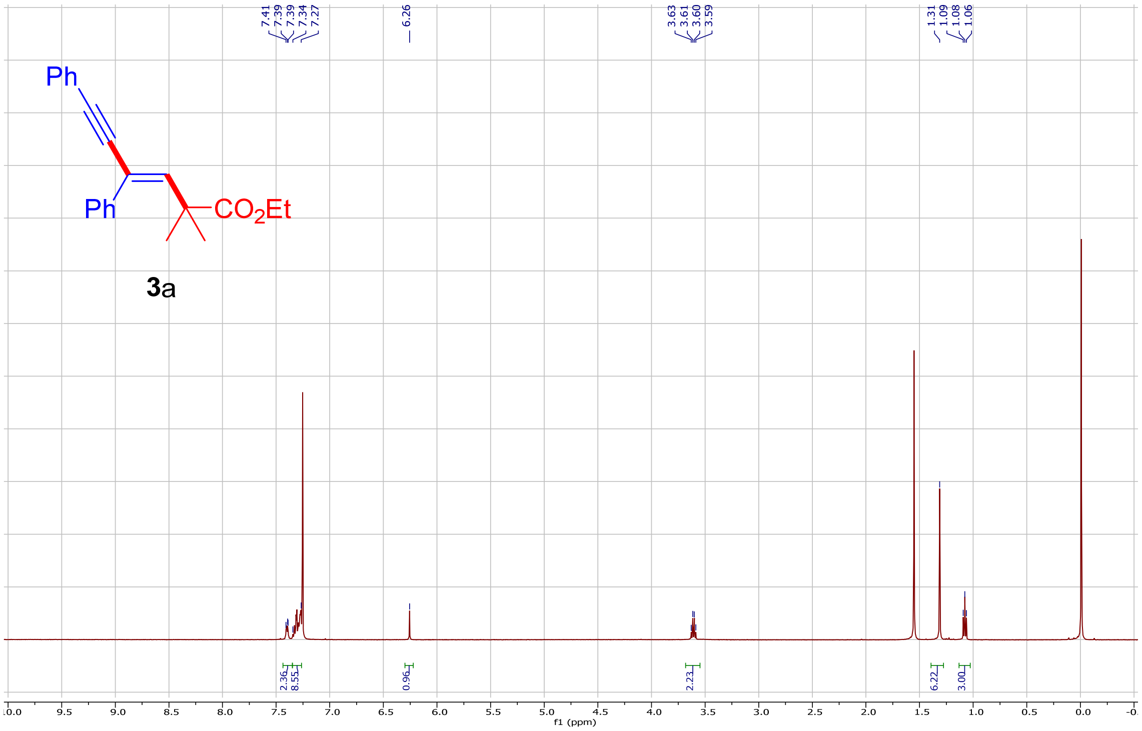

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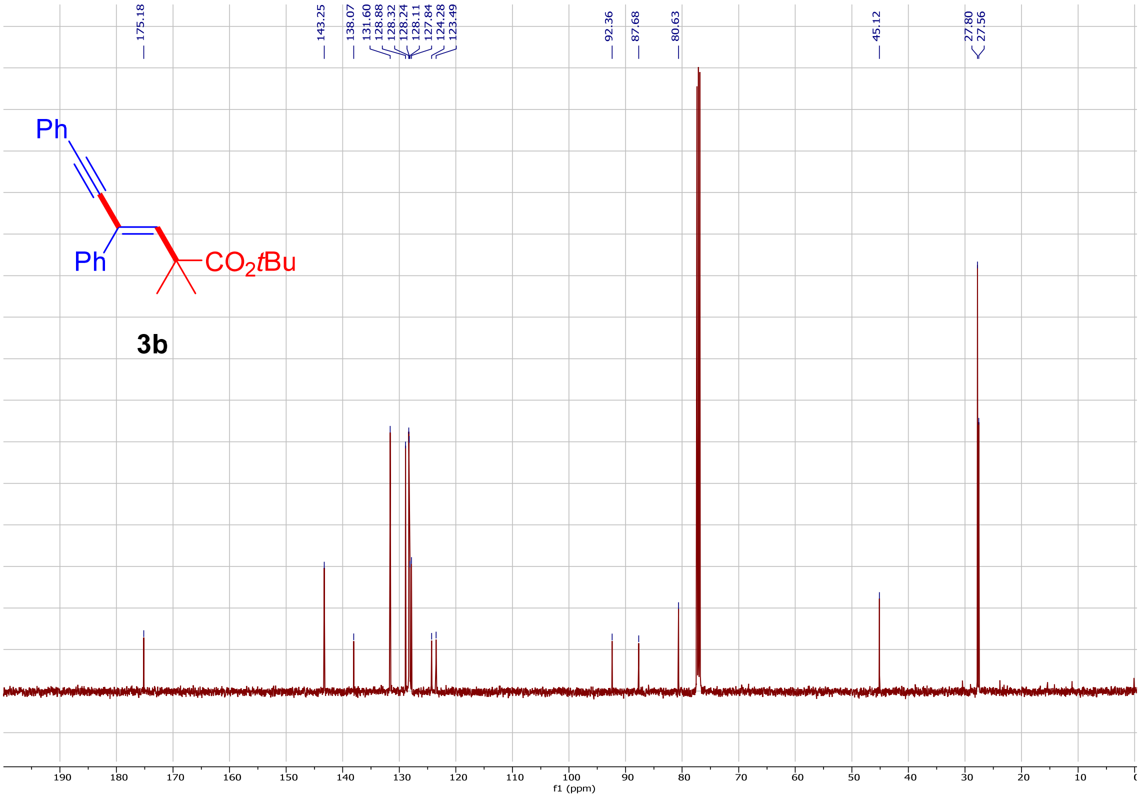

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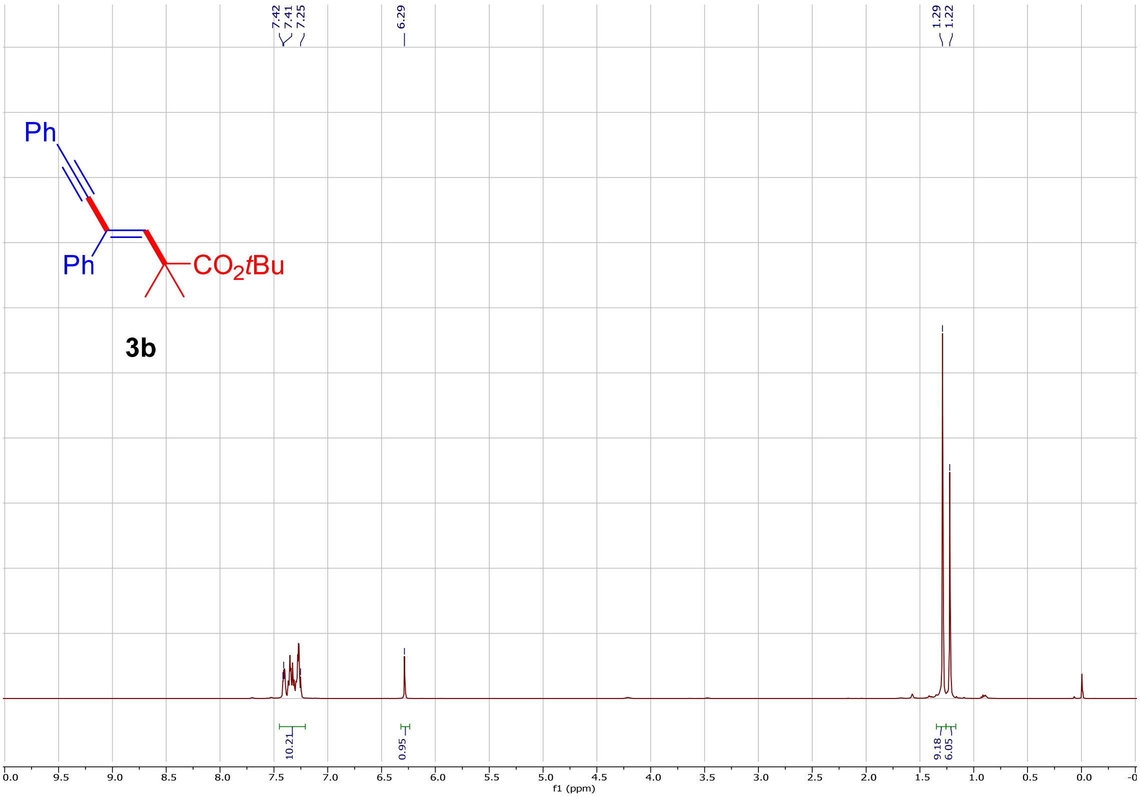

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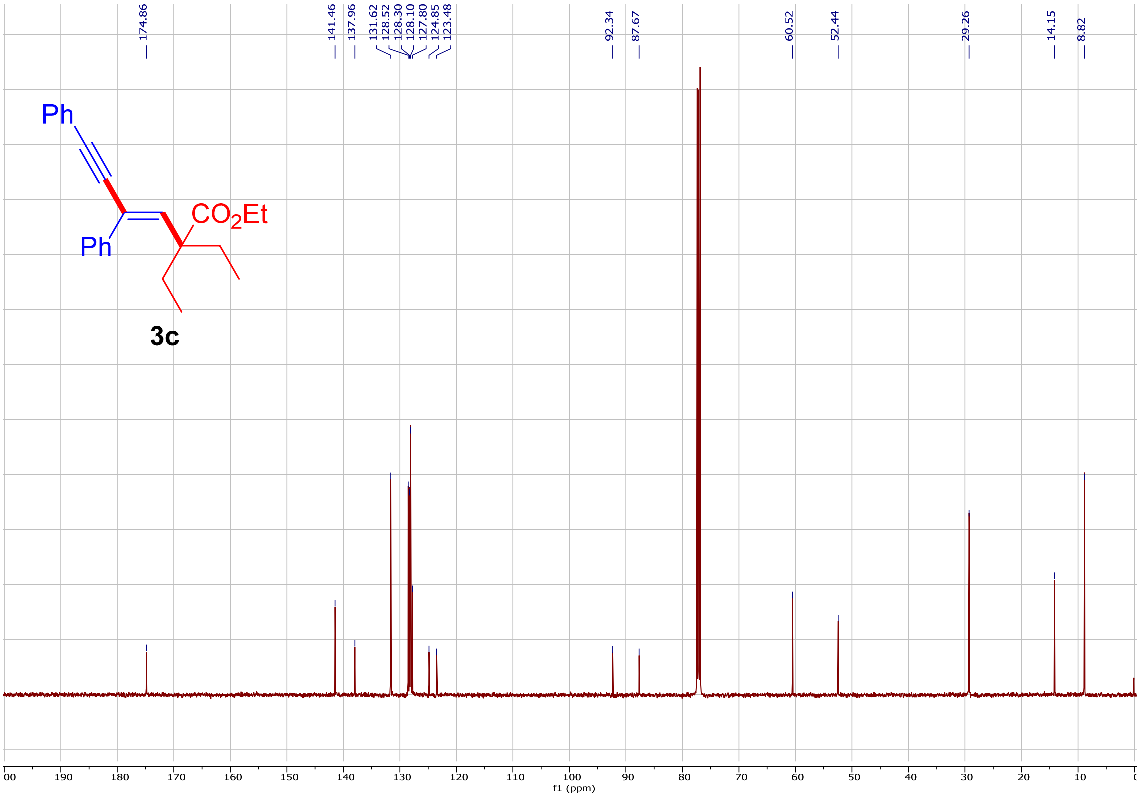

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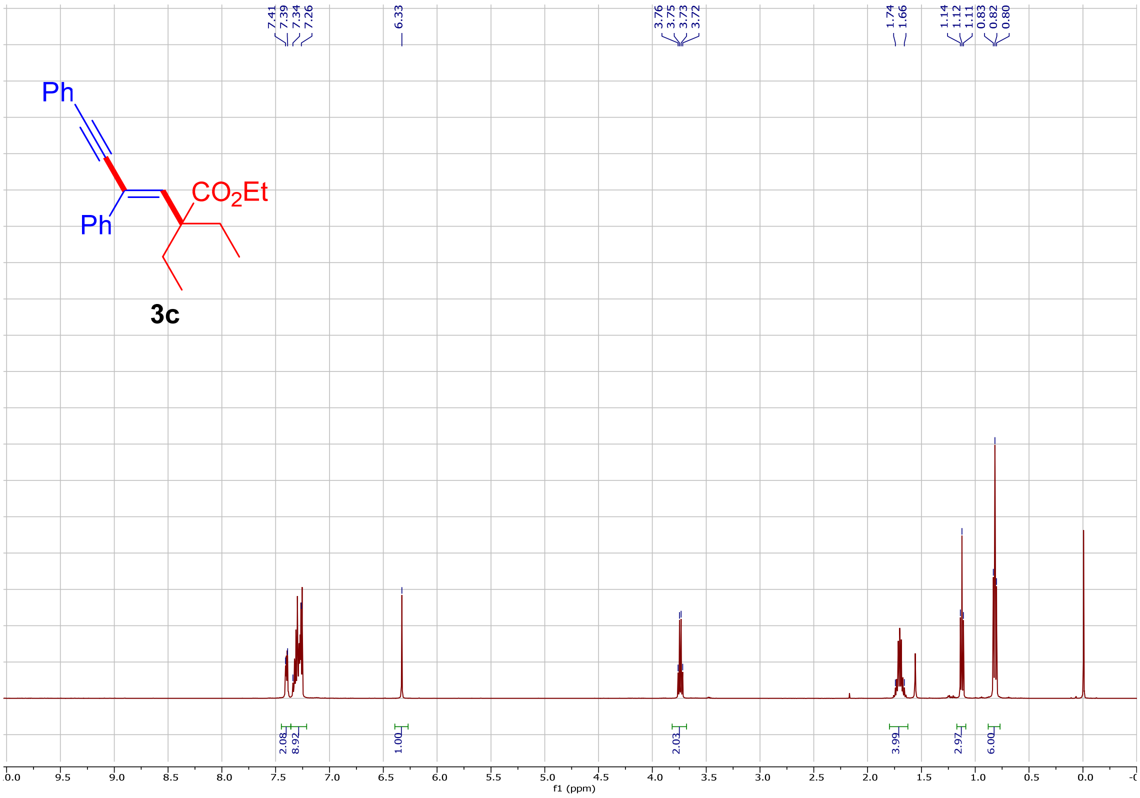

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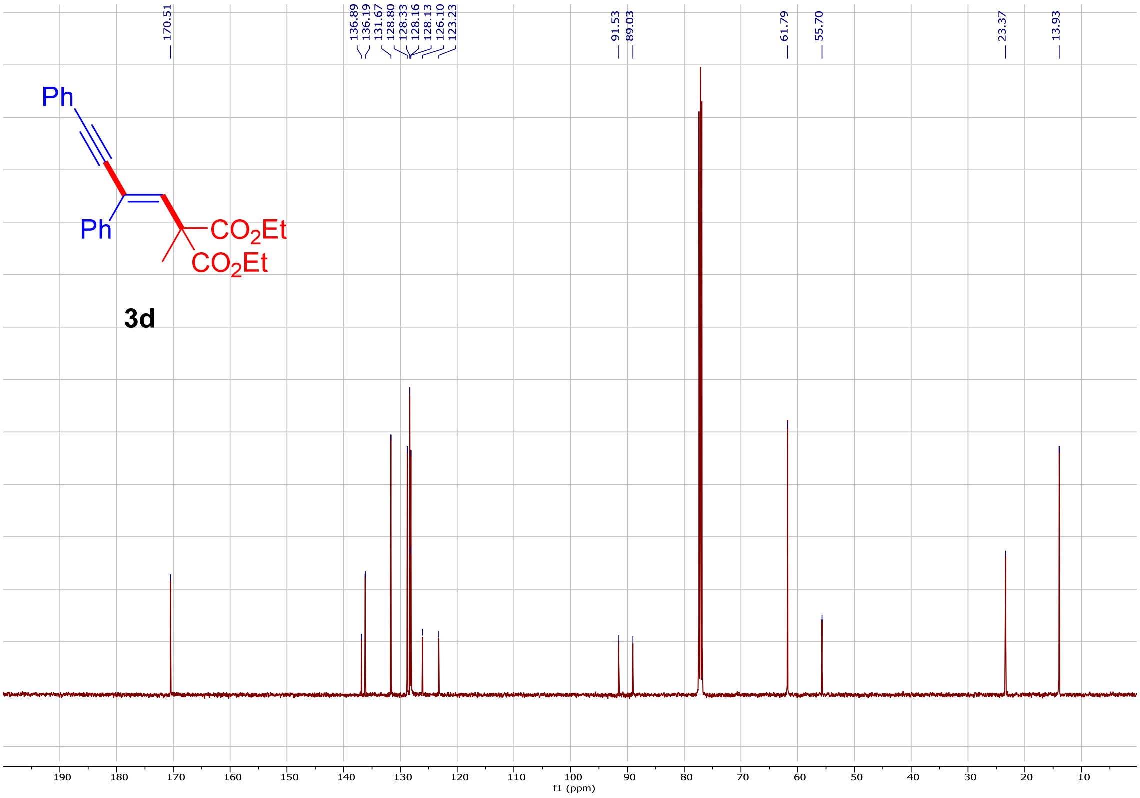

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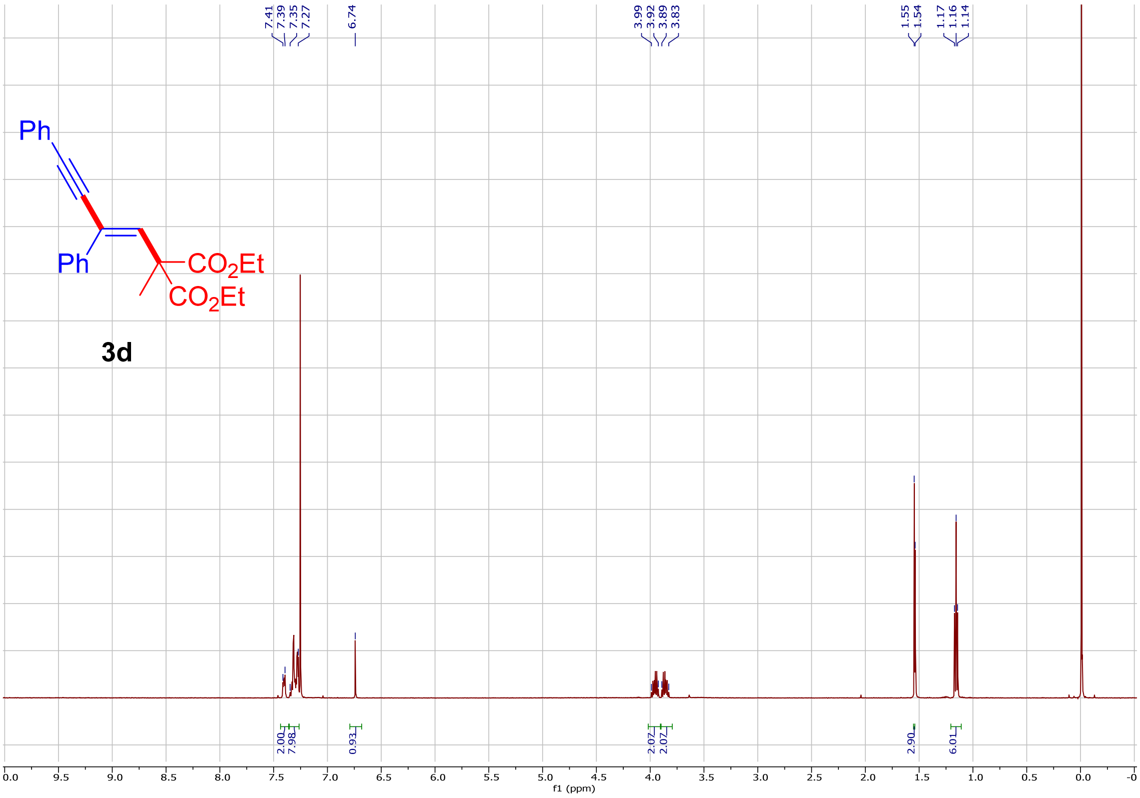

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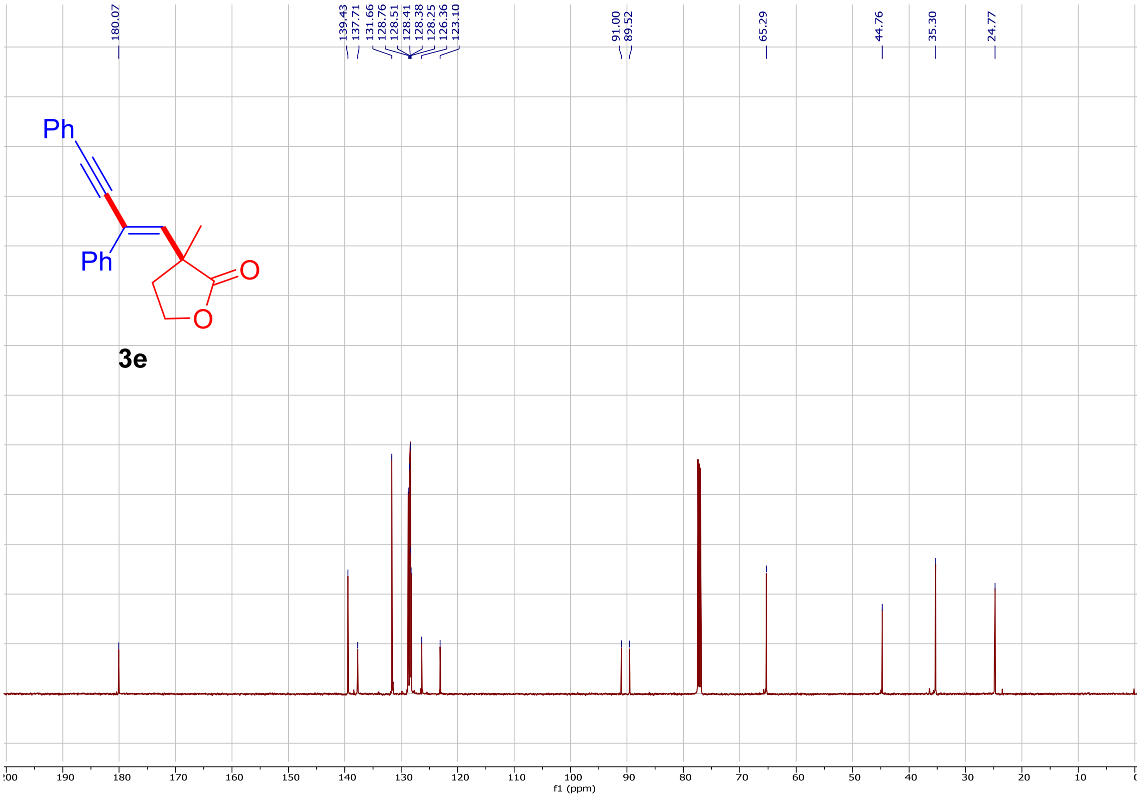

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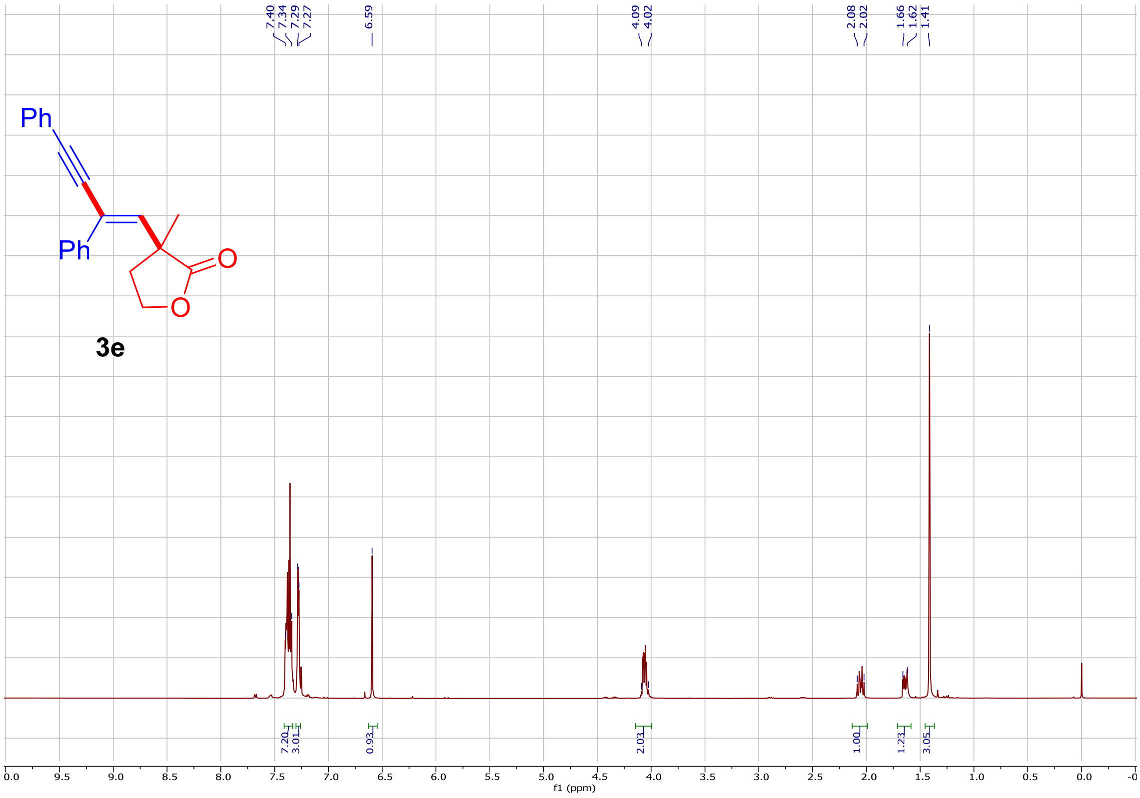
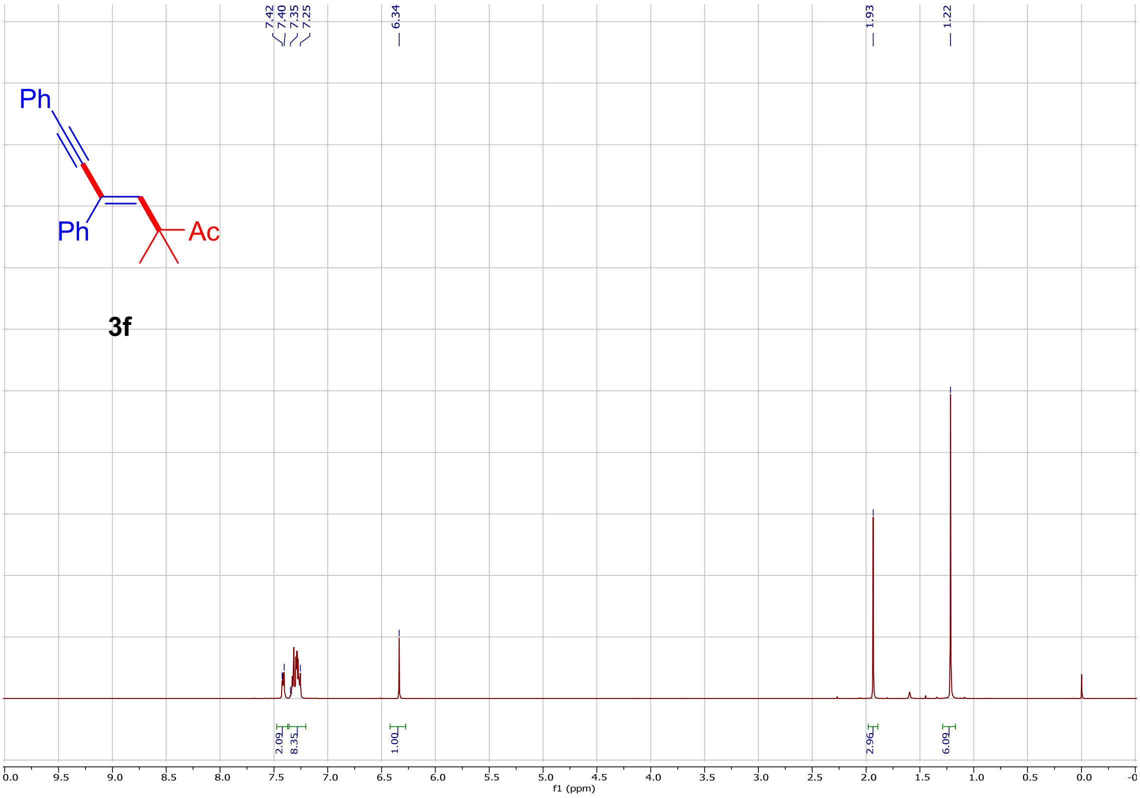


^{13}C NMR($CDCl_3$)

^{1}H NMR($CDCl_3$)



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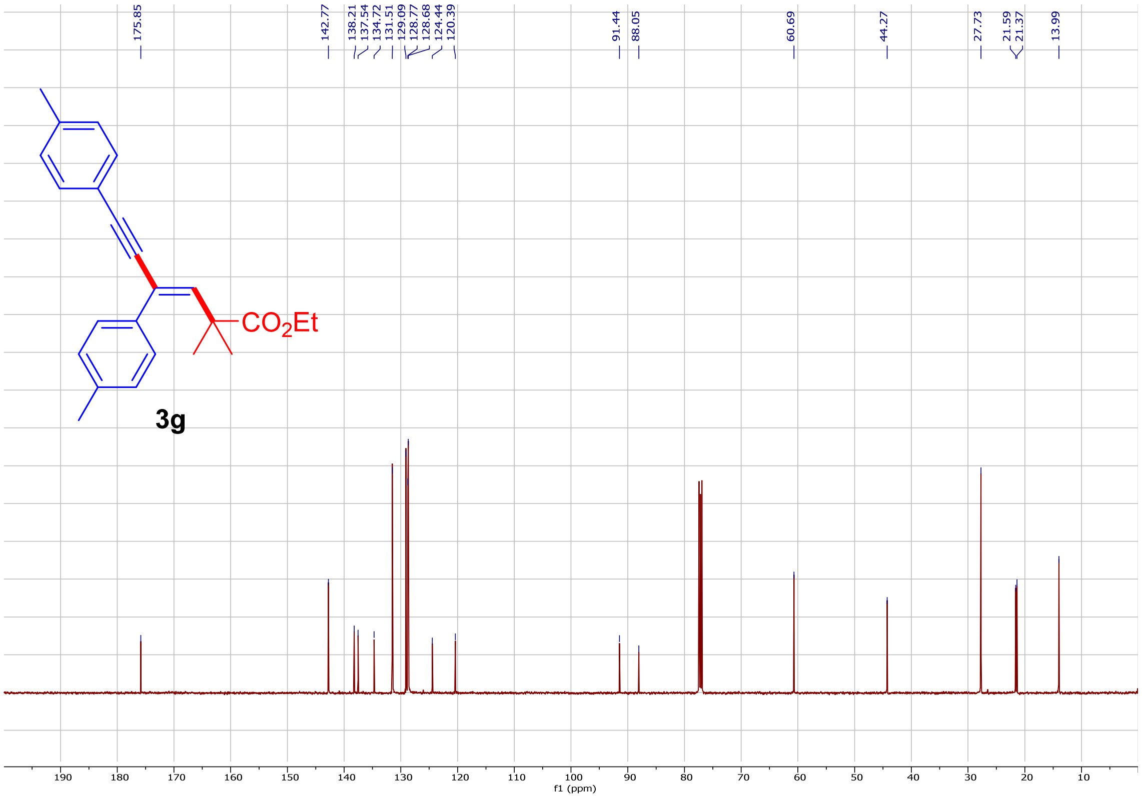

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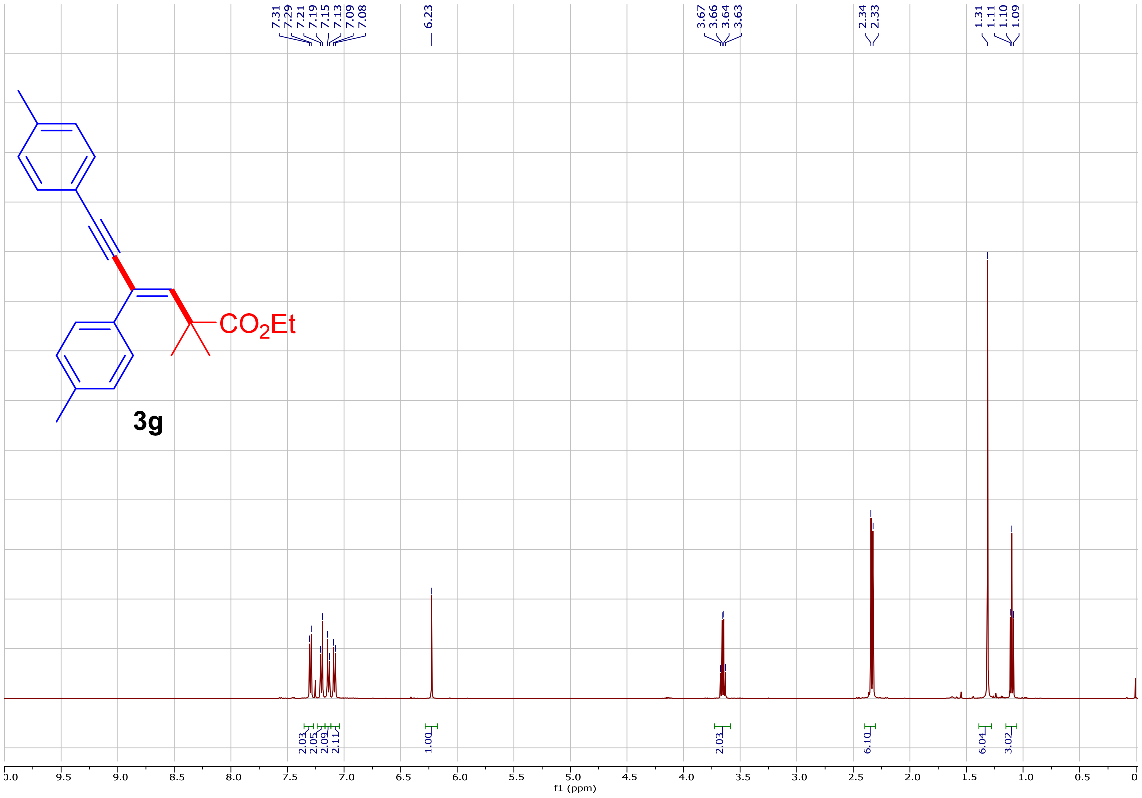

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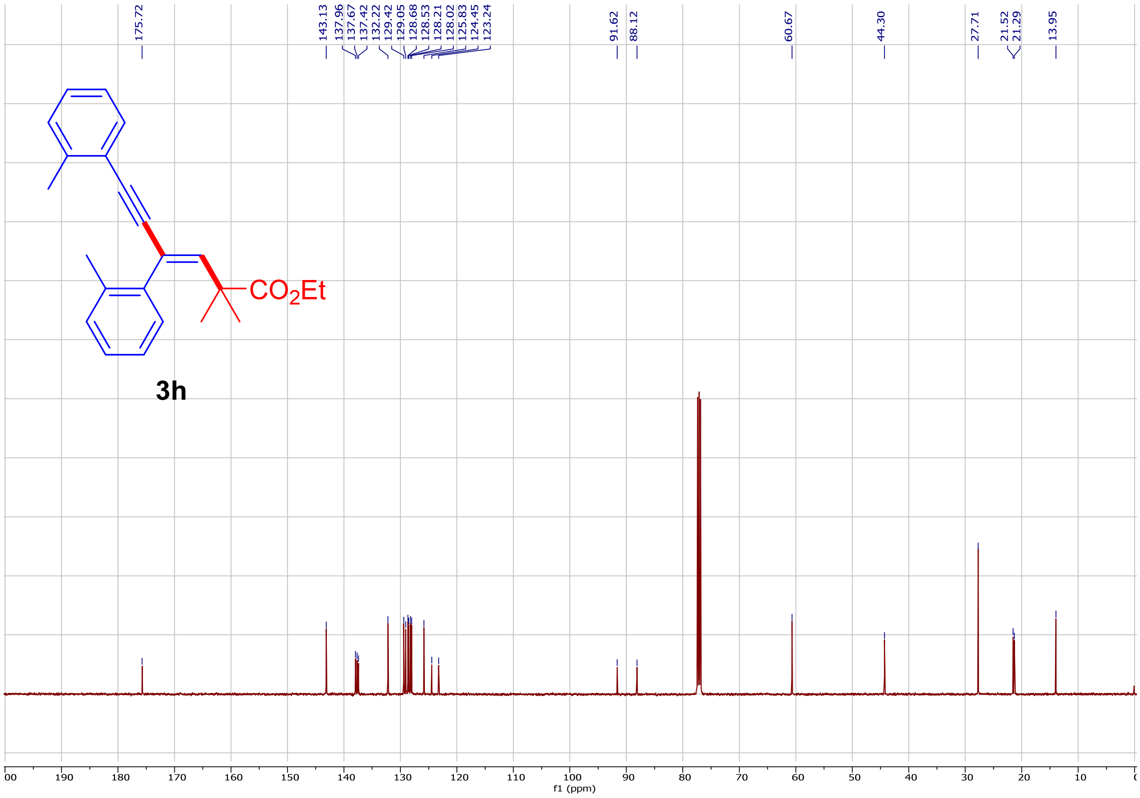

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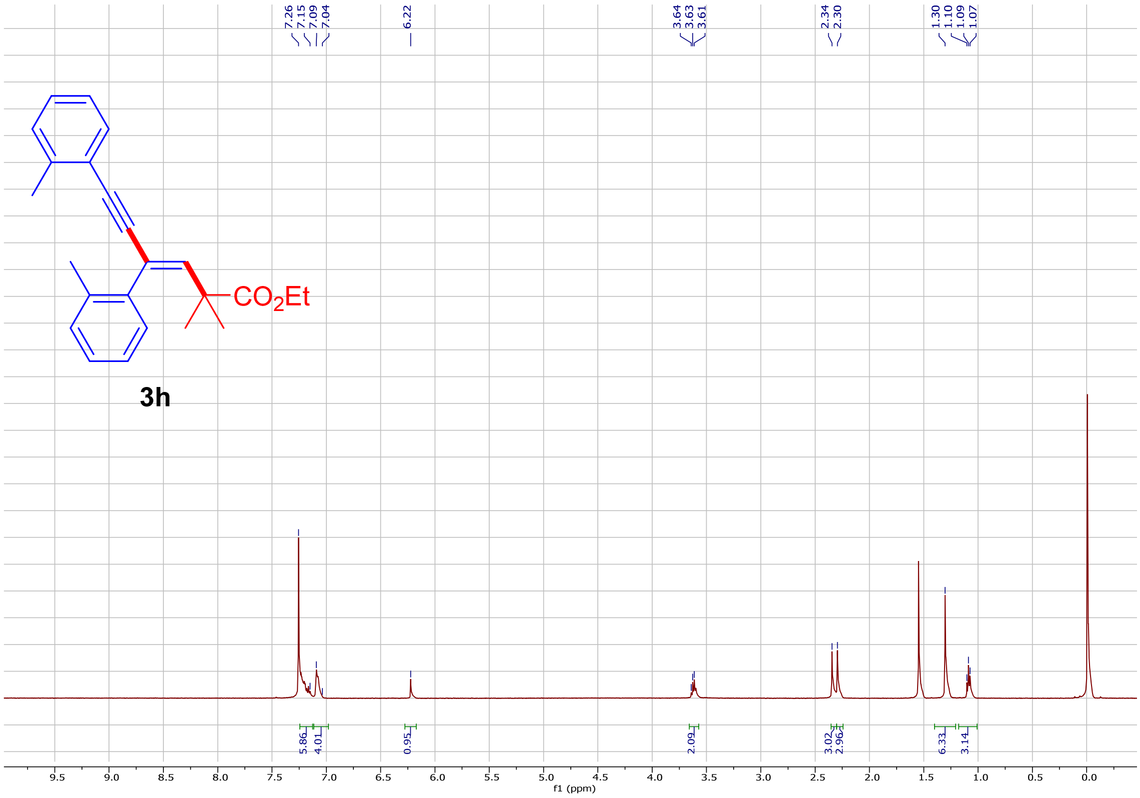

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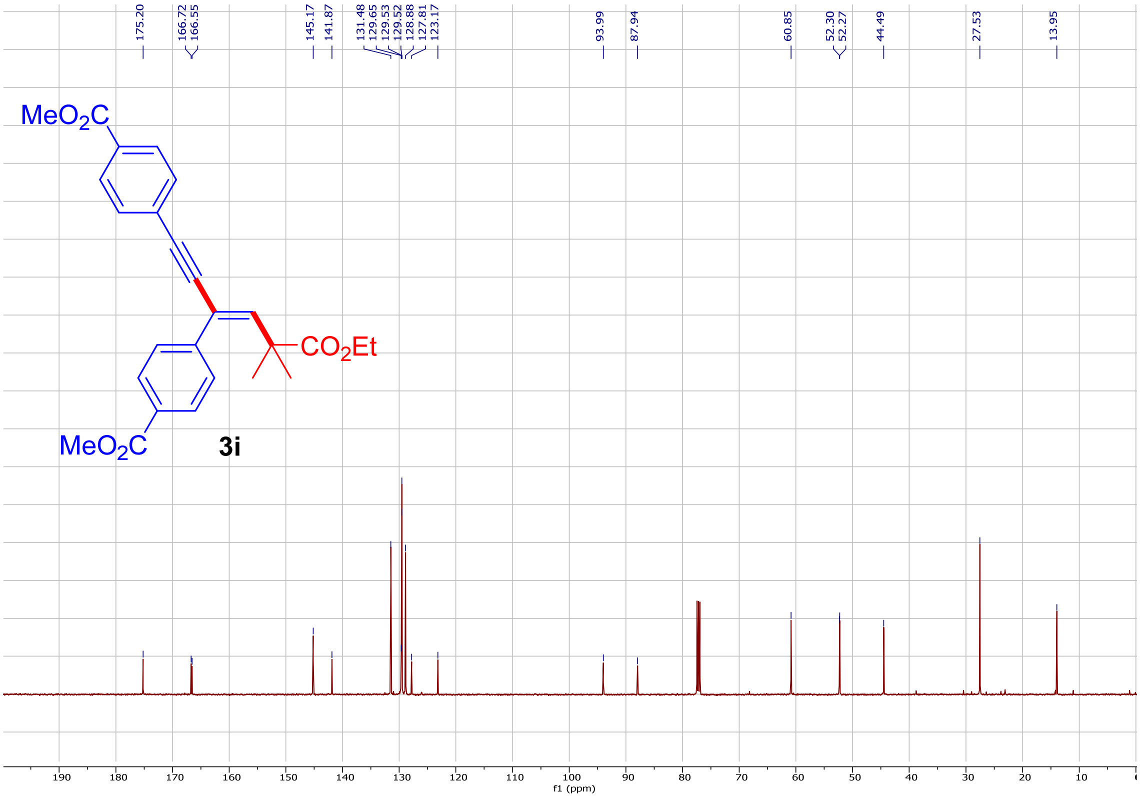

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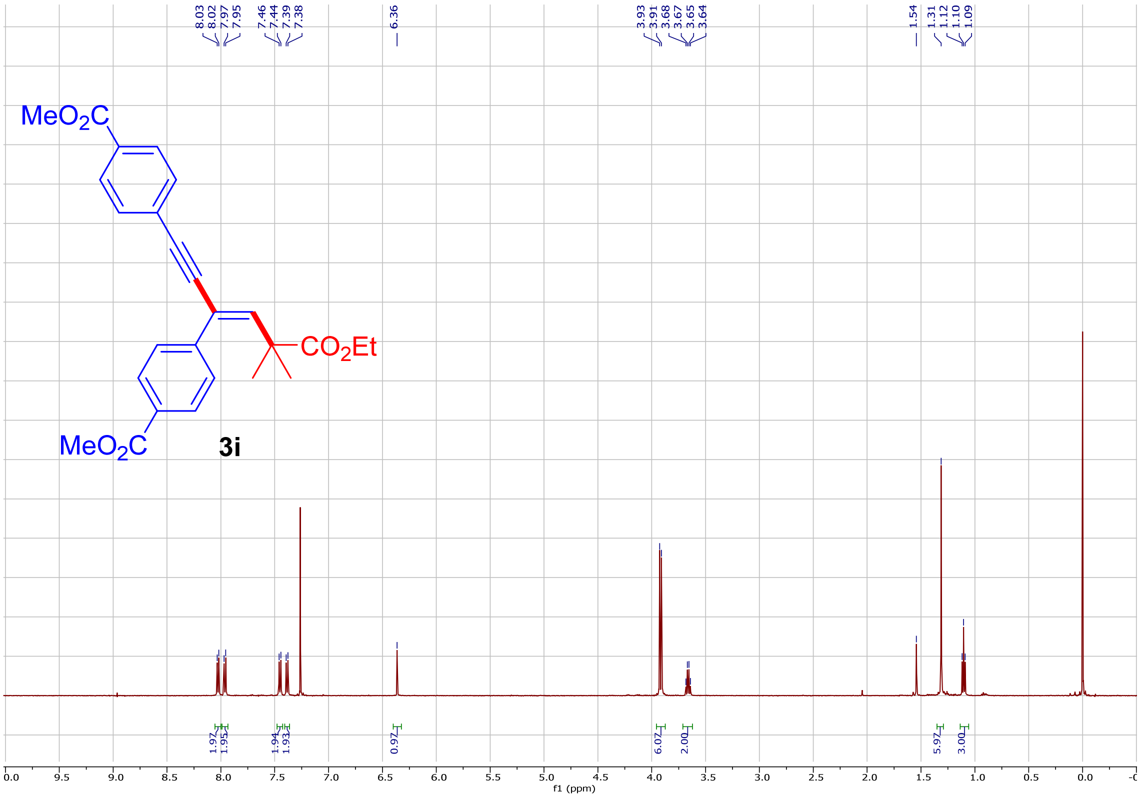

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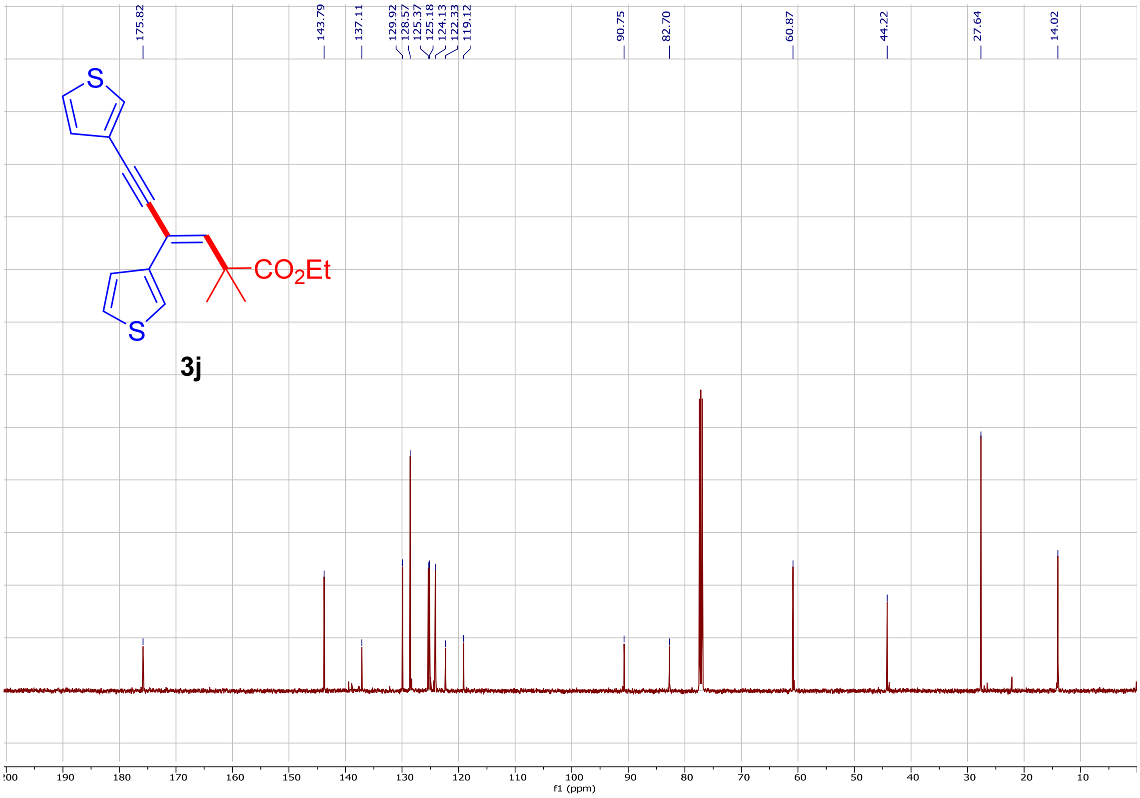

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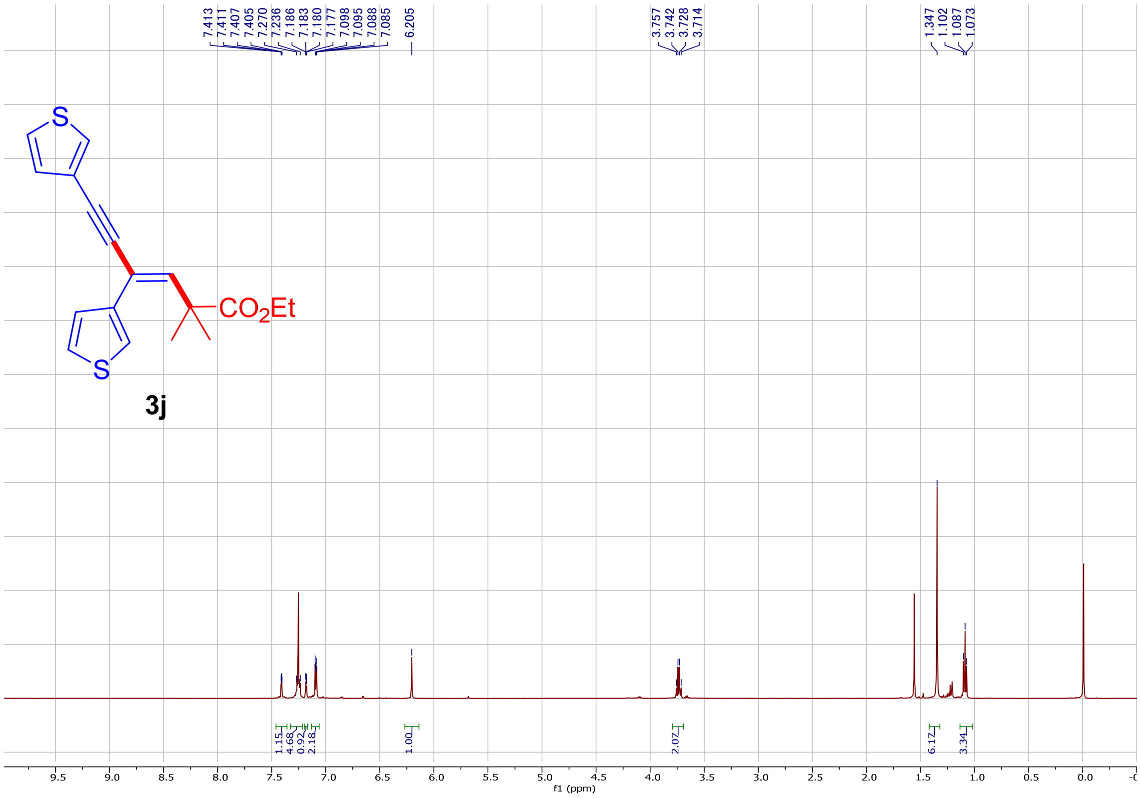

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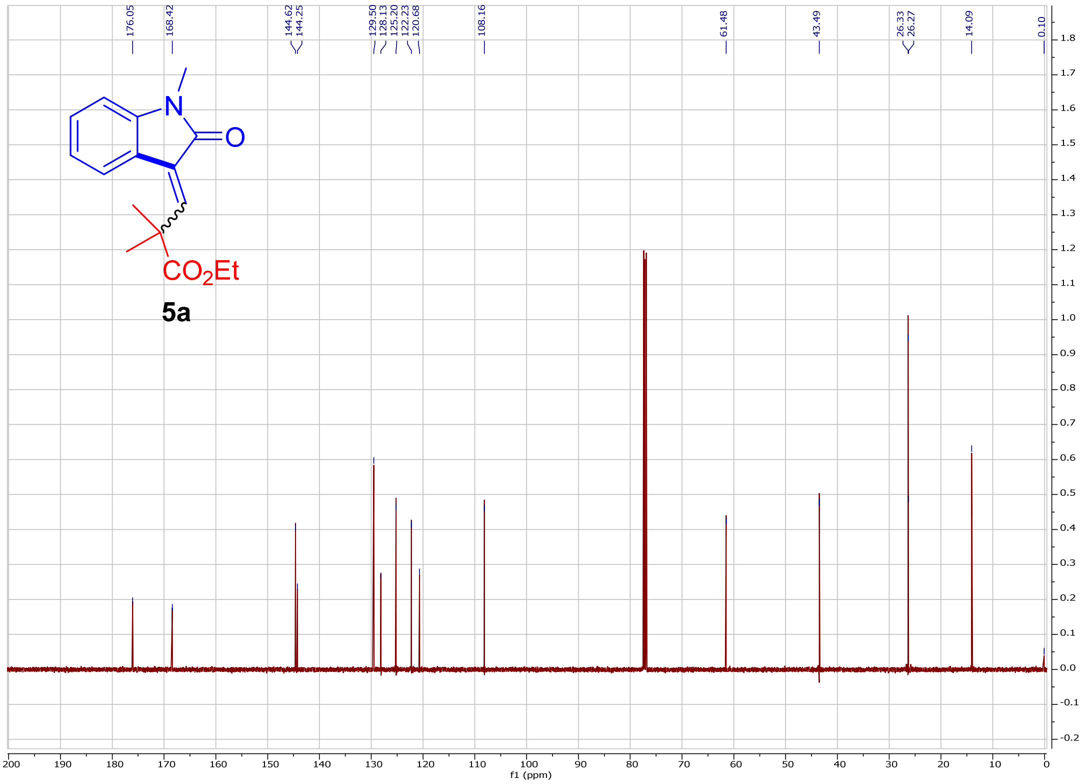

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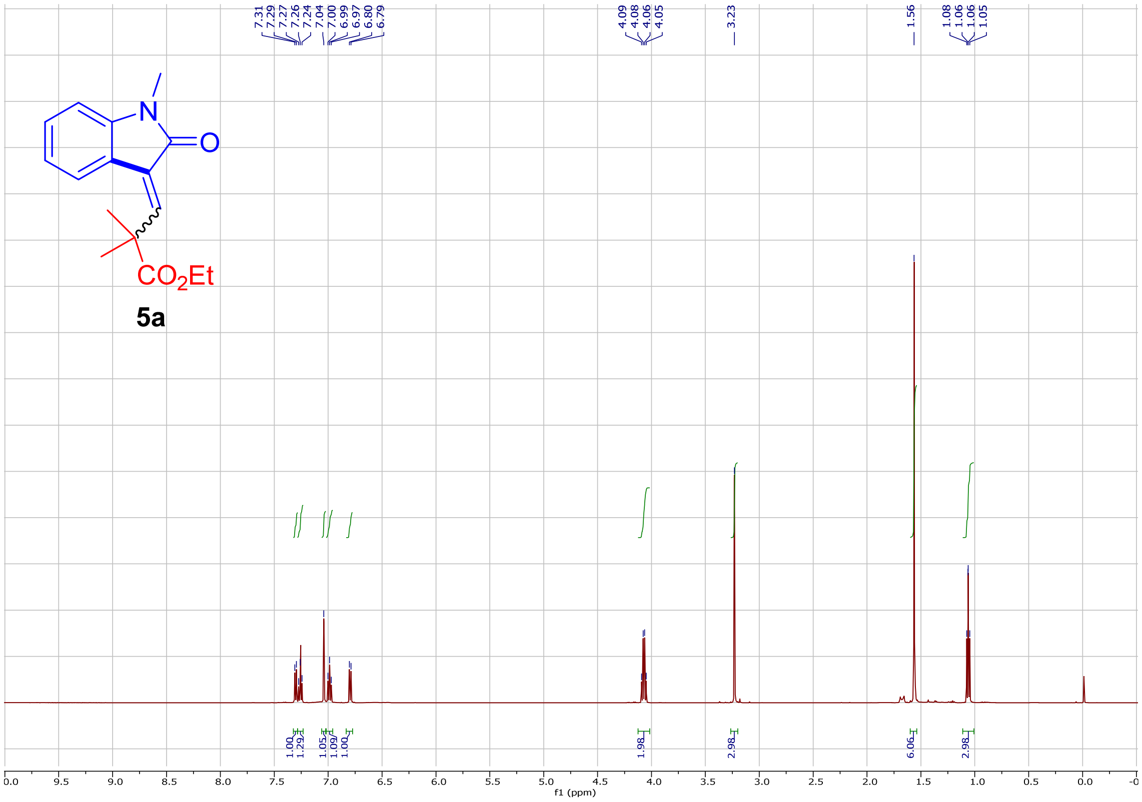

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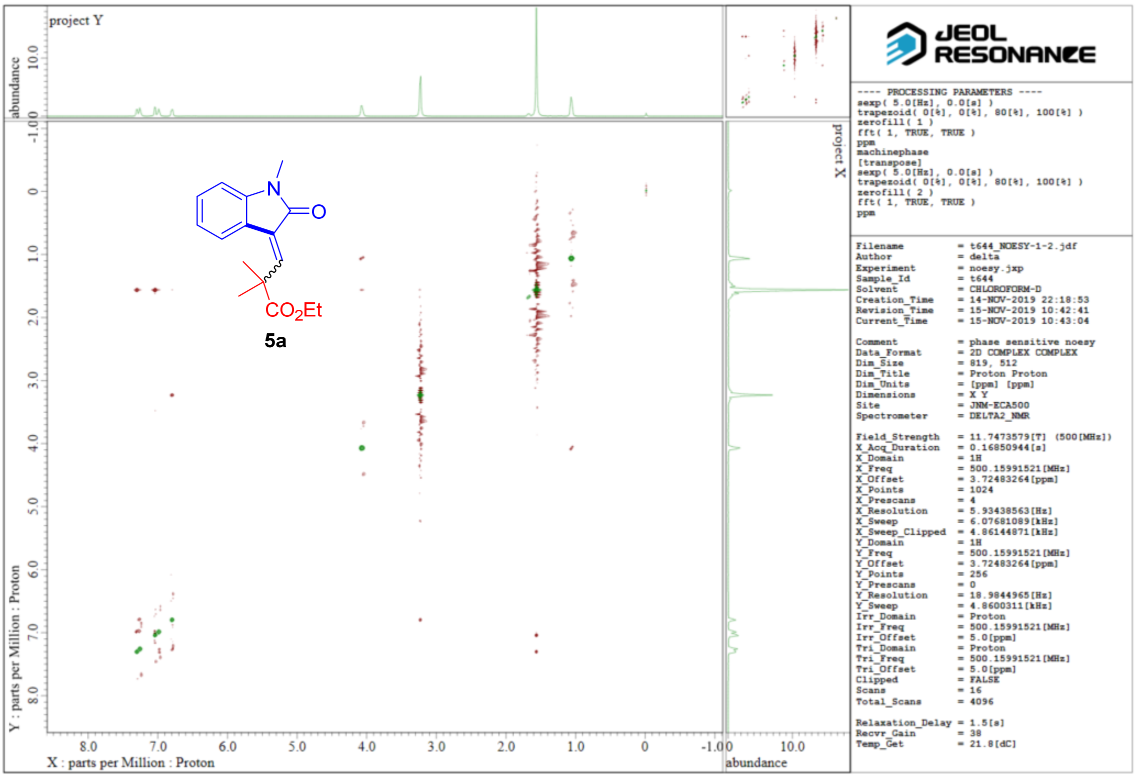

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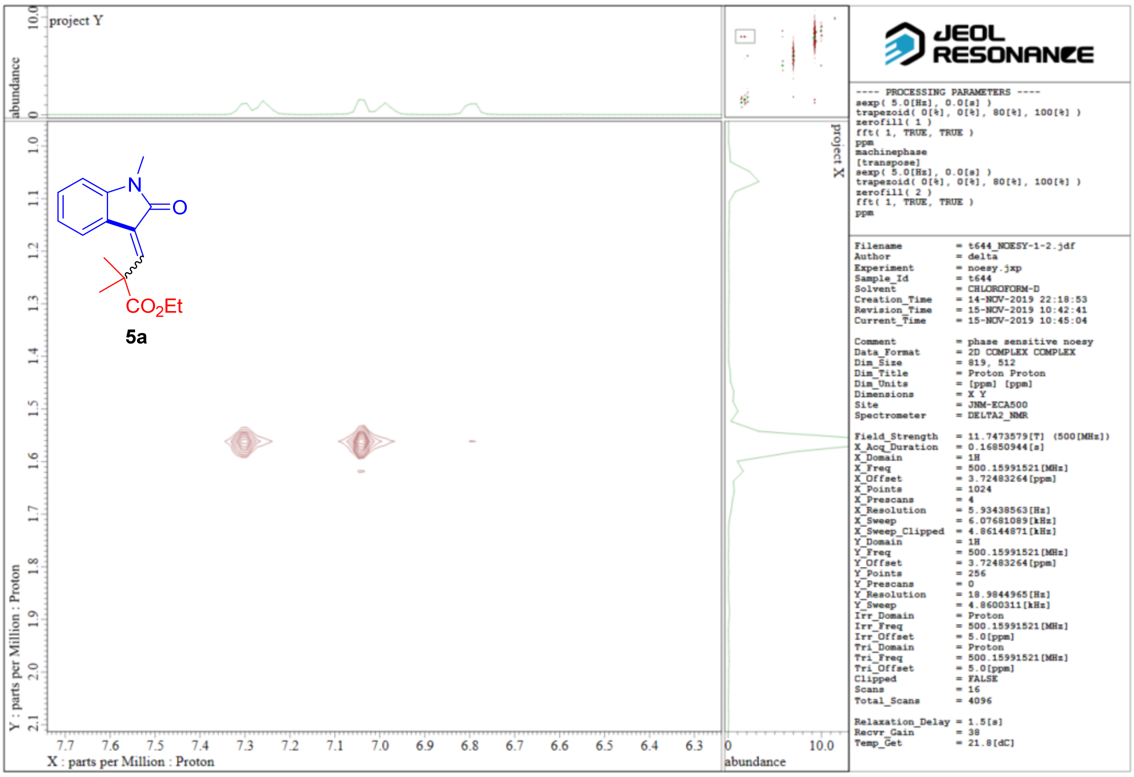

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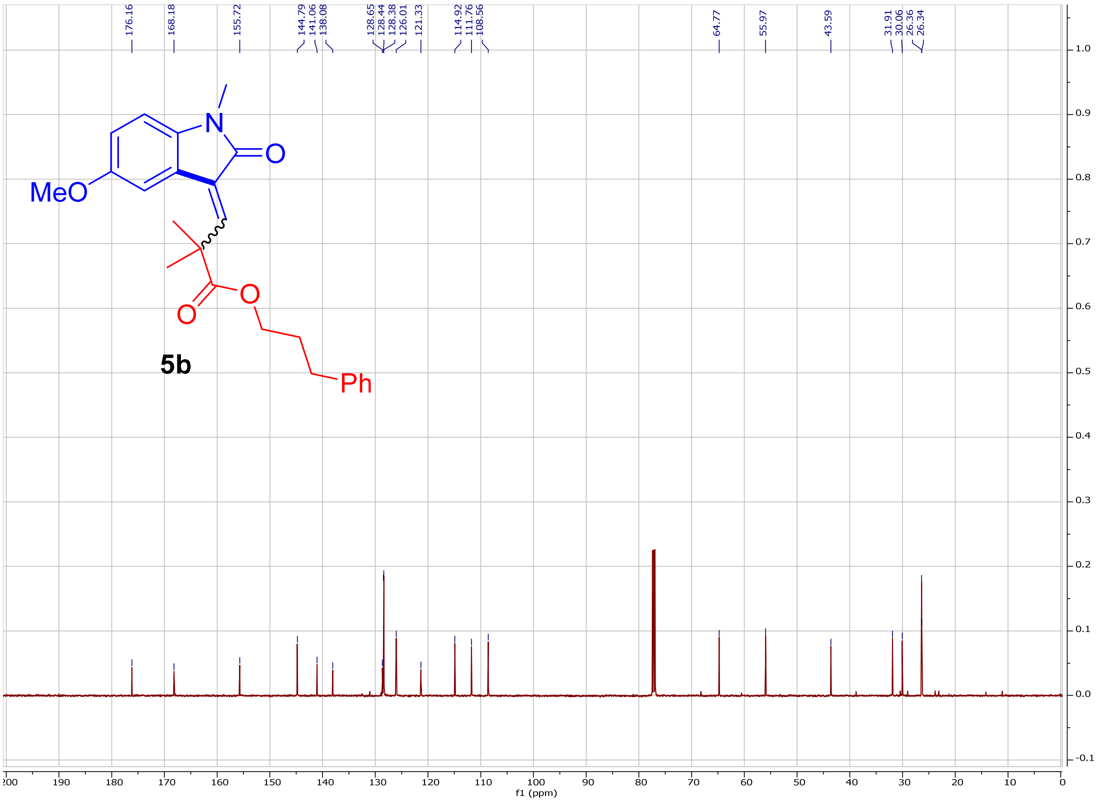

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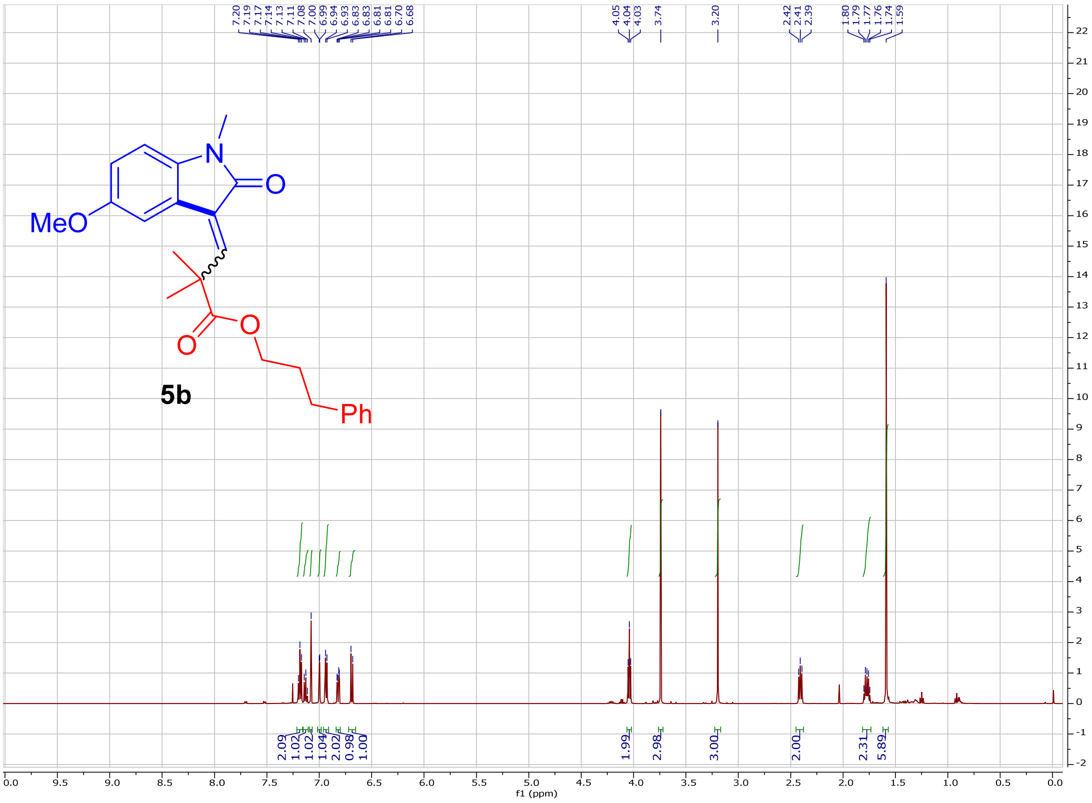
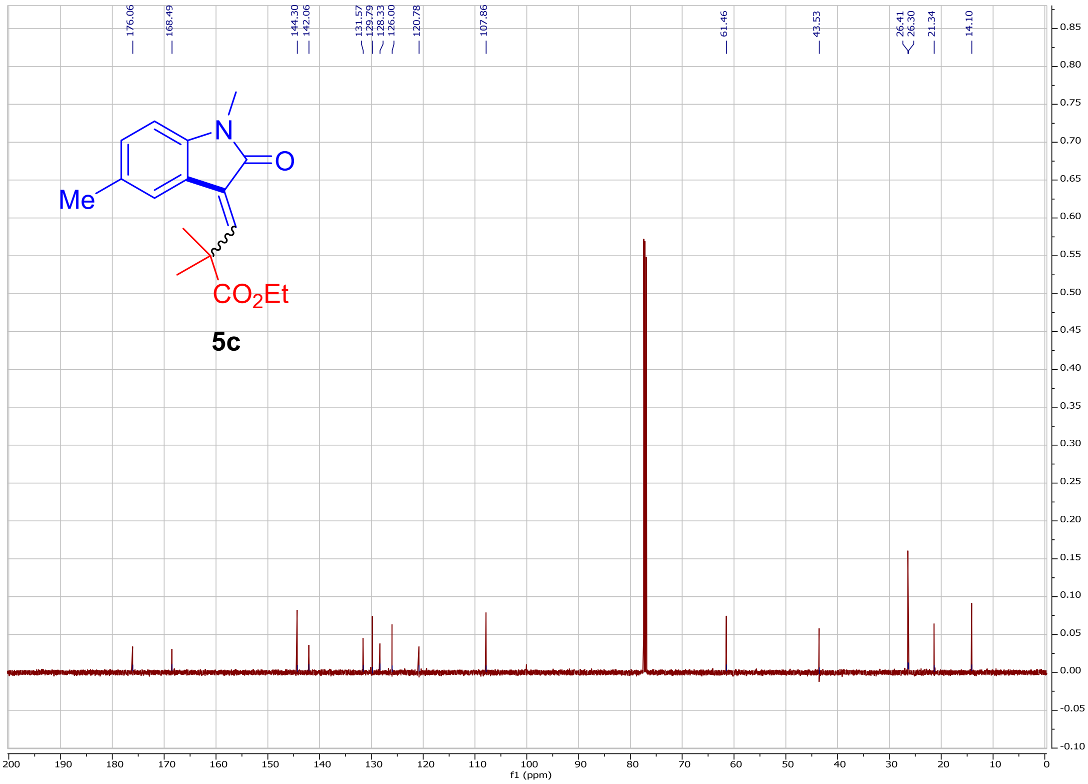
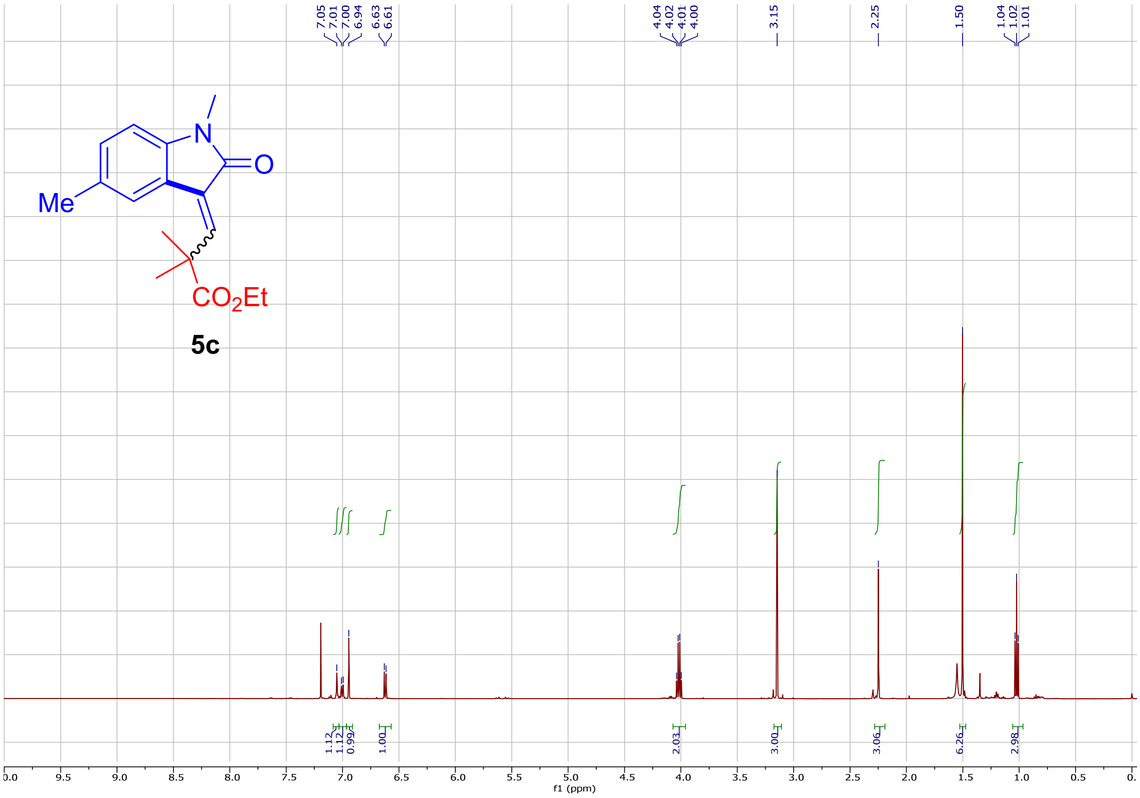


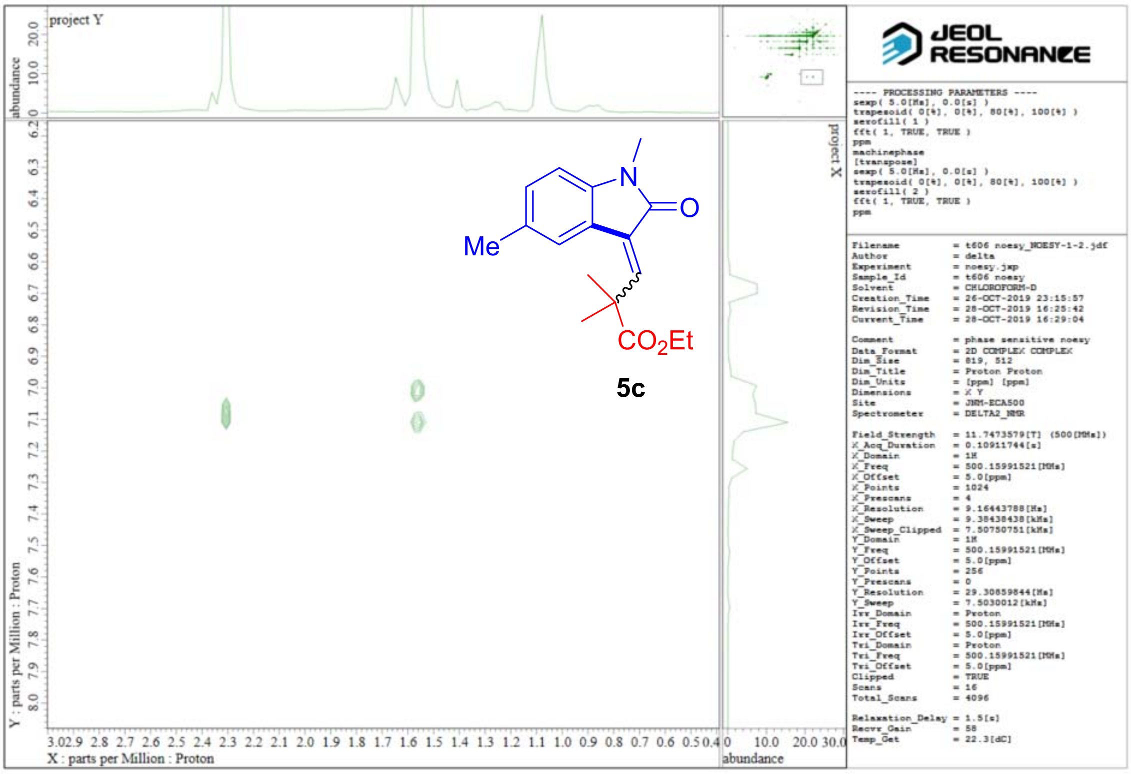
^{13}C NMR(CDCl$_3$)



^{1}H NMR(CDCl$_3$)



NOESY



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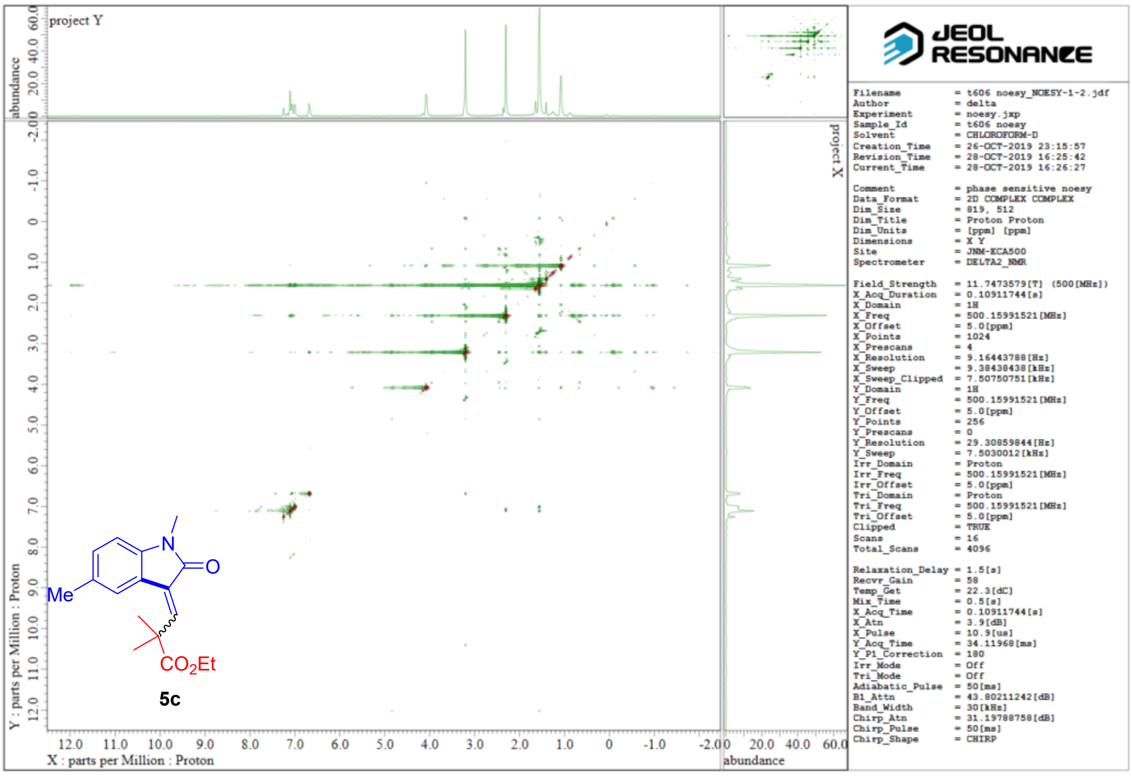
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm
```

```
Filename           = t606 noesy_NOESY-1-2.jdf
Author             = delta
Experiment         = noesy.jxp
Sample_Id          = t606 noesy
Solvent            = CHLOROFORM-D
Creation_Time      = 26-OCT-2019 23:15:57
Revision_Time      = 28-OCT-2019 16:25:42
Current_Time       = 28-OCT-2019 16:29:04

Comment            = phase sensitive noesy
Data_Format        = 2D COMPLEX COMPLEX
Dim_Size           = 819, 512
Dim_Title          = Proton Proton
Dim_Units          = [ppm] [ppm]
Dimensions         = X Y
Site               = JNM-ECA500
Spectrometer       = DELTA2_NMR

Field_Strength     = 11.7473579[T] (500[MHz])
X_Acq_Duration     = 0.10911744[s]
X_Domain           = 1H
X_Freq             = 500.15991521[MHz]
X_Offset           = 5.0[ppm]
X_Points           = 1024
X_Prescans         = 4
X_Resolution       = 9.16443788[Hz]
X_Sweep            = 9.38438438[kHz]
X_Sweep_Clipped    = 7.50750751[kHz]
Y_Domain           = 1H
Y_Freq             = 500.15991521[MHz]
Y_Offset           = 5.0[ppm]
Y_Points           = 256
Y_Prescans         = 0
Y_Resolution       = 29.30859844[Hz]
Y_Sweep            = 7.5030012[kHz]
Irr_Domain         = Proton
Irr_Freq           = 500.15991521[MHz]
Irr_Offset         = 5.0[ppm]
Tri_Domain         = Proton
Tri_Freq           = 500.15991521[MHz]
Tri_Offset         = 5.0[ppm]
Clipped            = TRUE
Scans              = 16
Total_Scans        = 4096

Relaxation_Delay = 1.5[s]
Recvr_Gain         = 58
Temp_Get           = 22.3[dC]
```



```
Filename           = t606 noesy_NOESY-1-2.jdf
Author             = delta
Experiment         = noesy.jxp
Sample_Id          = t606 noesy
Solvent            = CHLOROFORM-D
Creation_Time      = 26-OCT-2019 23:15:57
Revision_Time      = 28-OCT-2019 16:25:42
Current_Time       = 28-OCT-2019 16:26:27

Comment            = phase sensitive noesy
Data_Format        = 2D COMPLEX COMPLEX
Dim_Size           = 819, 512
Dim_Title          = Proton Proton
Dim_Units          = [ppm] [ppm]
Dimensions         = X Y
Site               = JNM-ECA500
Spectrometer       = DELTA2_NMR

Field_Strength     = 11.7473579[T] (500[MHz])
X_Acq_Duration     = 0.10911744[s]
X_Domain           = 1H
X_Freq             = 500.15991521[MHz]
X_Offset           = 5.0[ppm]
X_Points           = 1024
X_Prescans         = 4
X_Resolution       = 9.16443788[Hz]
X_Sweep            = 9.38438438[kHz]
X_Sweep_Clipped    = 7.50750751[kHz]
Y_Domain           = 1H
Y_Freq             = 500.15991521[MHz]
Y_Offset           = 5.0[ppm]
Y_Points           = 256
Y_Prescans         = 0
Y_Resolution       = 29.30859844[Hz]
Y_Sweep            = 7.5030012[kHz]
Irr_Domain         = Proton
Irr_Freq           = 500.15991521[MHz]
Irr_Offset         = 5.0[ppm]
Tri_Domain         = Proton
Tri_Freq           = 500.15991521[MHz]
Tri_Offset         = 5.0[ppm]
Clipped            = TRUE
Scans              = 16
Total_Scans        = 4096

Relaxation_Delay = 1.5[s]
Recvr_Gain         = 58
Temp_Get           = 22.3[dC]
Mix_Time           = 0.5[s]
X_Acq_Time         = 0.10911744[s]
X_Atn              = 3.9[dB]
X_Pulse            = 10.9[us]
Y_Acq_Time         = 34.11968[ms]
Y_P1_Correction    = 180
Irr_Mode           = Off
Tri_Mode           = Off
Adiabatic_Pulse    = 50[ms]
B1_Attn            = 43.80211242[dB]
Band_Width         = 30[kHz]
Chirp_Atn          = 31.19788758[dB]
Chirp_Pulse        = 50[ms]
Chirp_Shape        = CHIRP
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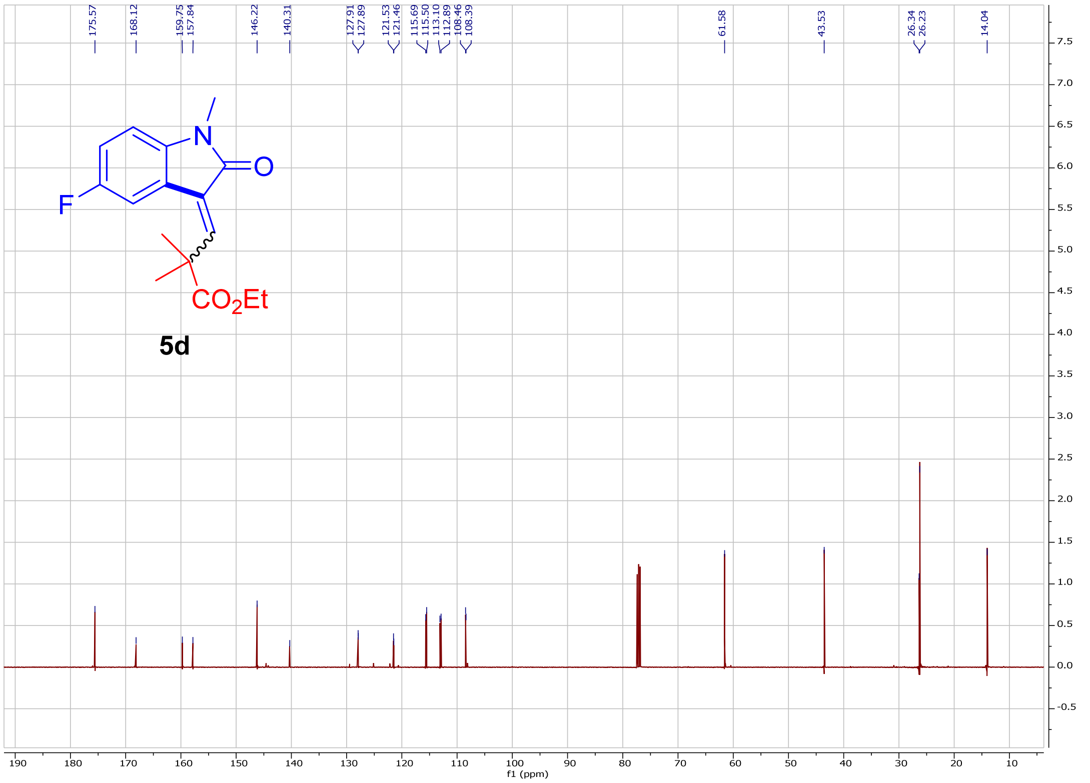
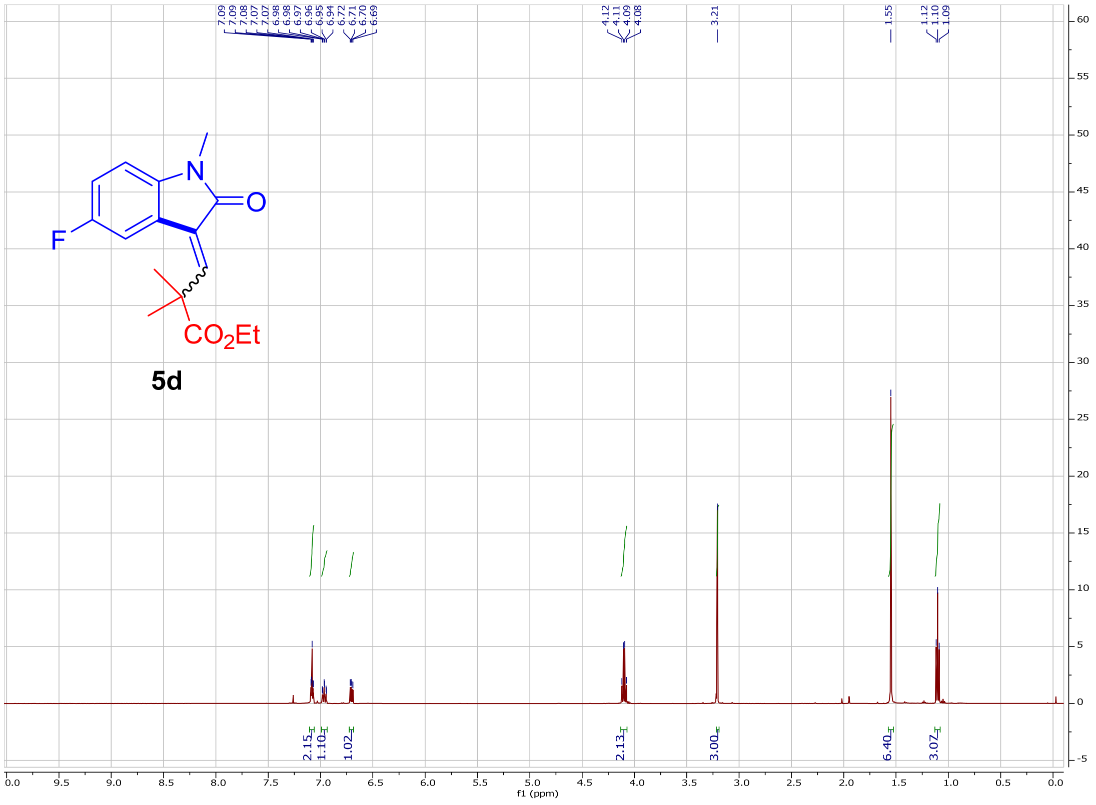
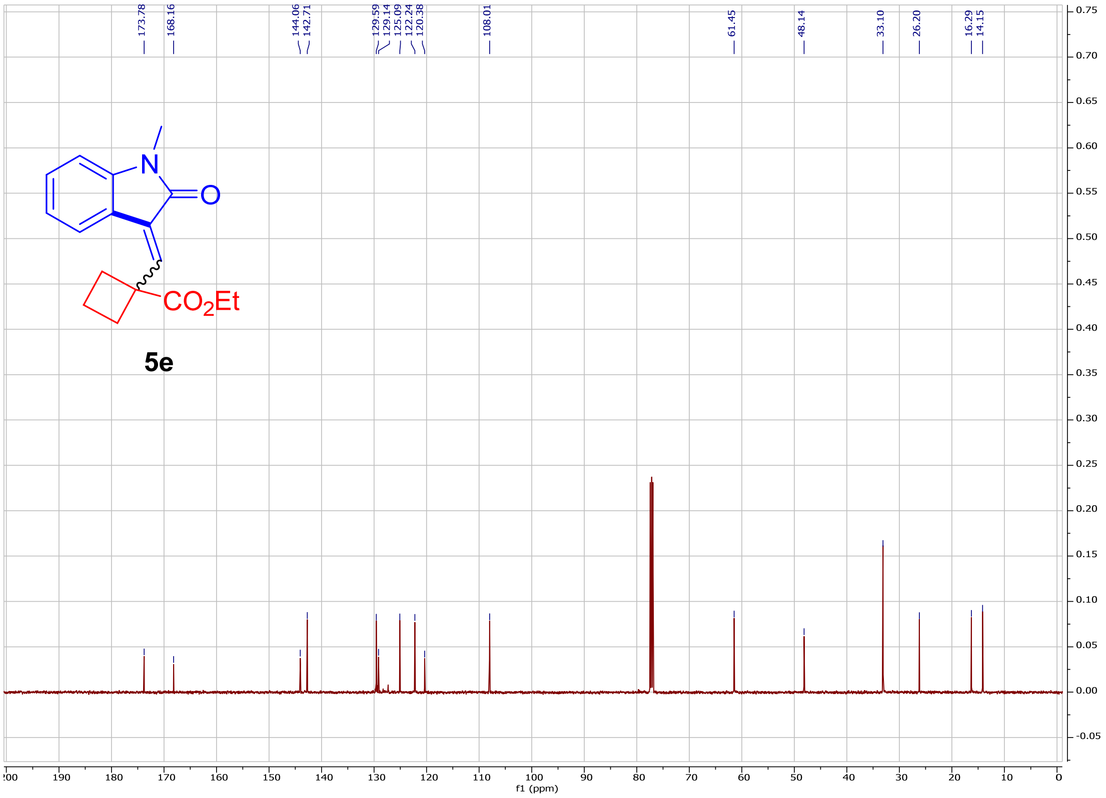
^{13}C NMR(CDCl$_3$)



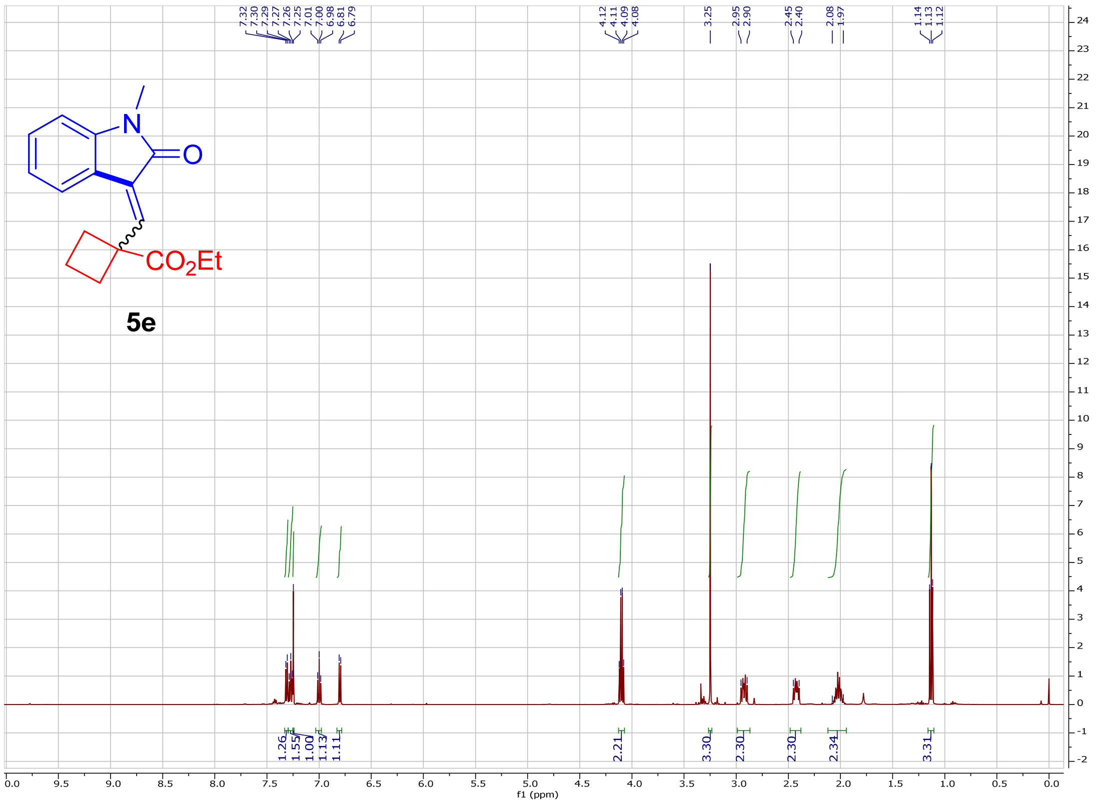
^{1}H NMR(CDCl$_3$)



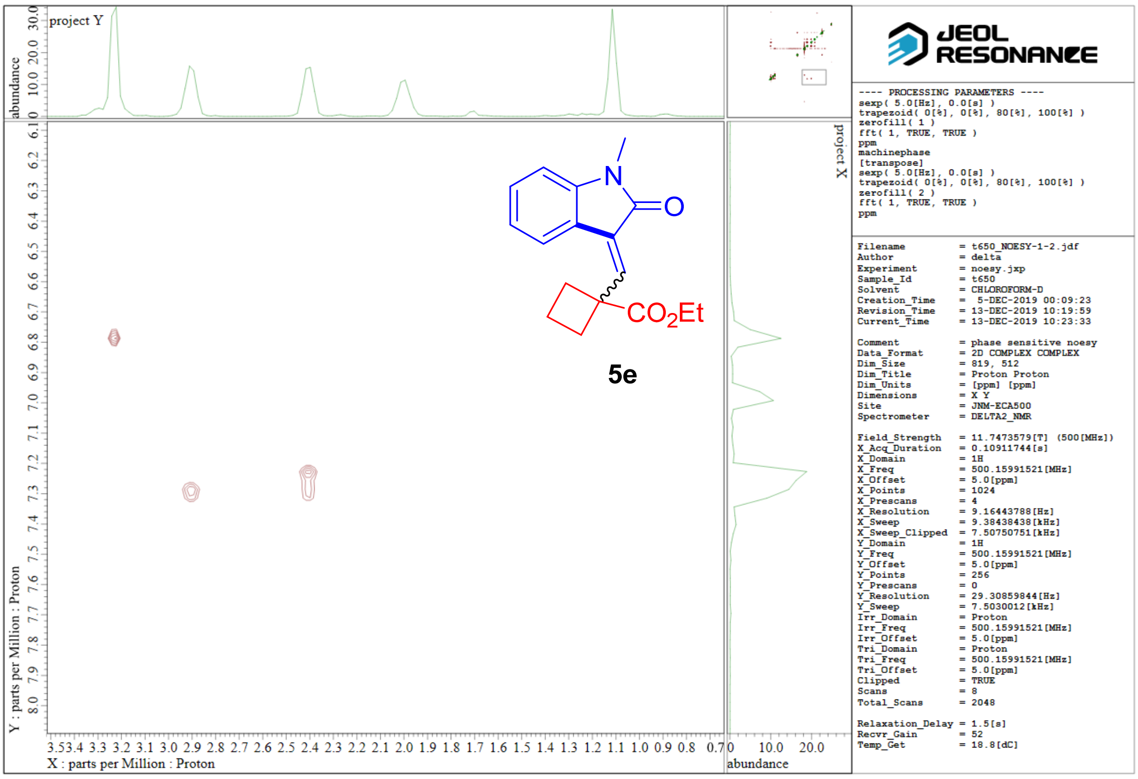
^{13}C NMR($CDCl_3$)



^{1}H NMR($CDCl_3$)



NOESY



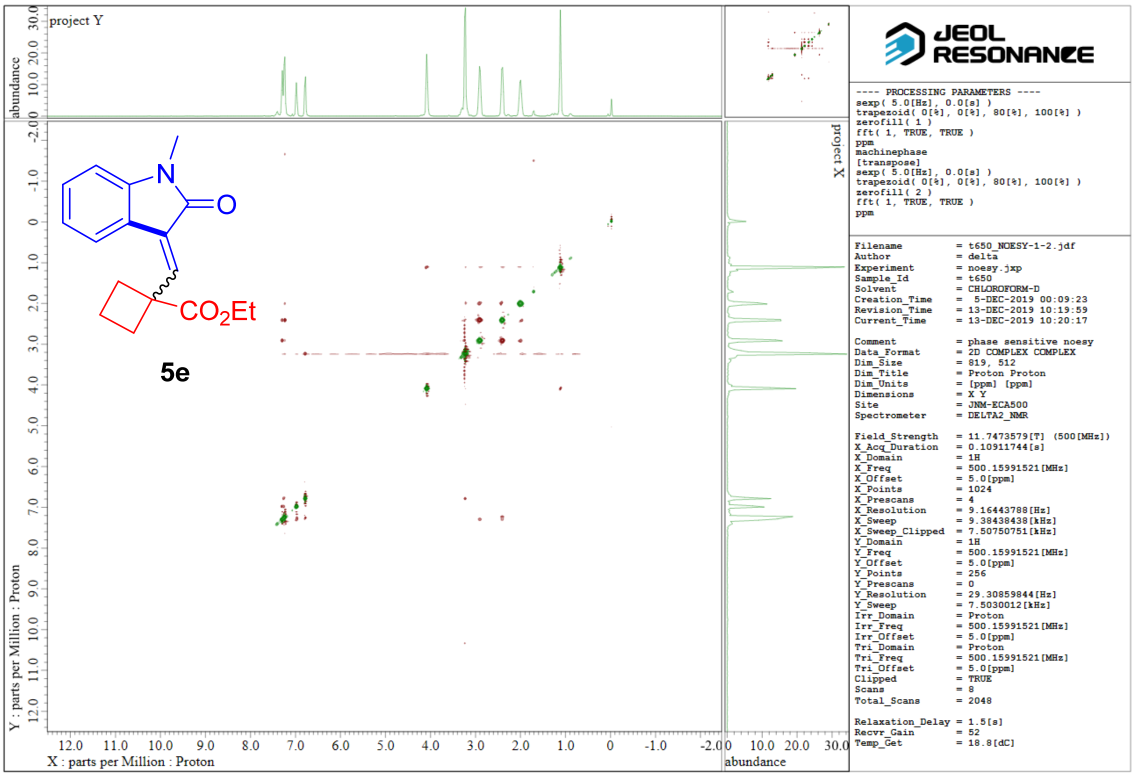
```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm

Filename          = t650_NOESY-1-2.jdf
Author            = delta
Experiment        = noesy.jxp
Sample_Id         = t650
Solvent           = CHLOROFORM-D
Creation_Time     =  5-DEC-2019 00:09:23
Revision_Time     = 13-DEC-2019 10:19:59
Current_Time      = 13-DEC-2019 10:23:33

Comment           = phase sensitive noesy
Data_Format       = 2D COMPLEX COMPLEX
Dim_Size          = 819, 512
Dim_Title         = Proton Proton
Dim_Units         = [ppm] [ppm]
Dimensions        = X Y
Site              = JNM-ECA500
Spectrometer      = DELTA2_NMR

Field_Strength    = 11.7473579[T] (500[MHz])
X_Acq_Duration    = 0.10911744[s]
X_Domain          = 1H
X_Freq            = 500.15991521[MHz]
X_Offset          = 5.0[ppm]
X_Points          = 1024
X_Prescans        = 4
X_Resolution      = 9.16443788[Hz]
X_Sweep           = 9.38438438[kHz]
X_Sweep_Clipped   = 7.50750751[kHz]
Y_Domain          = 1H
Y_Freq            = 500.15991521[MHz]
Y_Offset          = 5.0[ppm]
Y_Points          = 256
Y_Prescans        = 0
Y_Resolution      = 29.30859844[Hz]
Y_Sweep           = 7.5030012[kHz]
Irr_Domain        = Proton
Irr_Freq          = 500.15991521[MHz]
Irr_Offset        = 5.0[ppm]
Tri_Domain        = Proton
Tri_Freq          = 500.15991521[MHz]
Tri_Offset        = 5.0[ppm]
Clipped           = TRUE
Scans             = 8
Total_Scans       = 2048

Relaxation_Delay = 1.5[s]
Recvr_Gain        = 52
Temp_Get          = 18.8[dC]
```



```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm

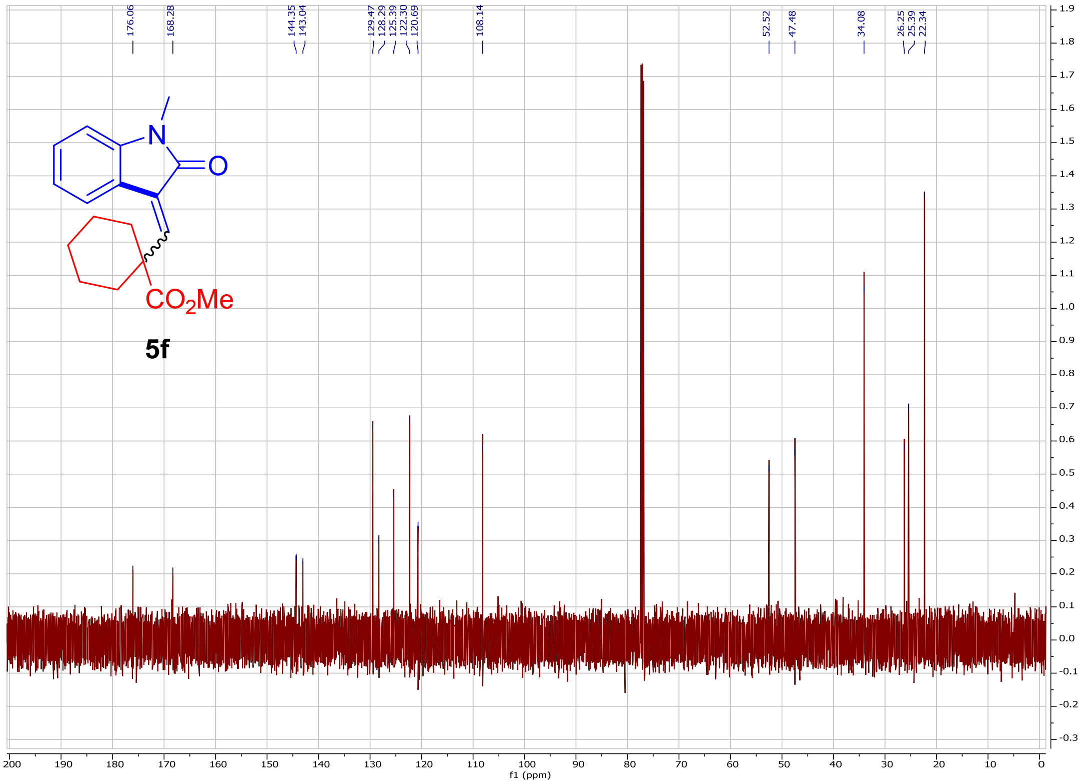
Filename          = t650_NOESY-1-2.jdf
Author            = delta
Experiment        = noesy.jxp
Sample_Id         = t650
Solvent           = CHLOROFORM-D
Creation_Time     =  5-DEC-2019 00:09:23
Revision_Time     = 13-DEC-2019 10:19:59
Current_Time      = 13-DEC-2019 10:20:17

Comment           = phase sensitive noesy
Data_Format       = 2D COMPLEX COMPLEX
Dim_Size          = 819, 512
Dim_Title         = Proton Proton
Dim_Units         = [ppm] [ppm]
Dimensions        = X Y
Site              = JNM-ECA500
Spectrometer      = DELTA2_NMR

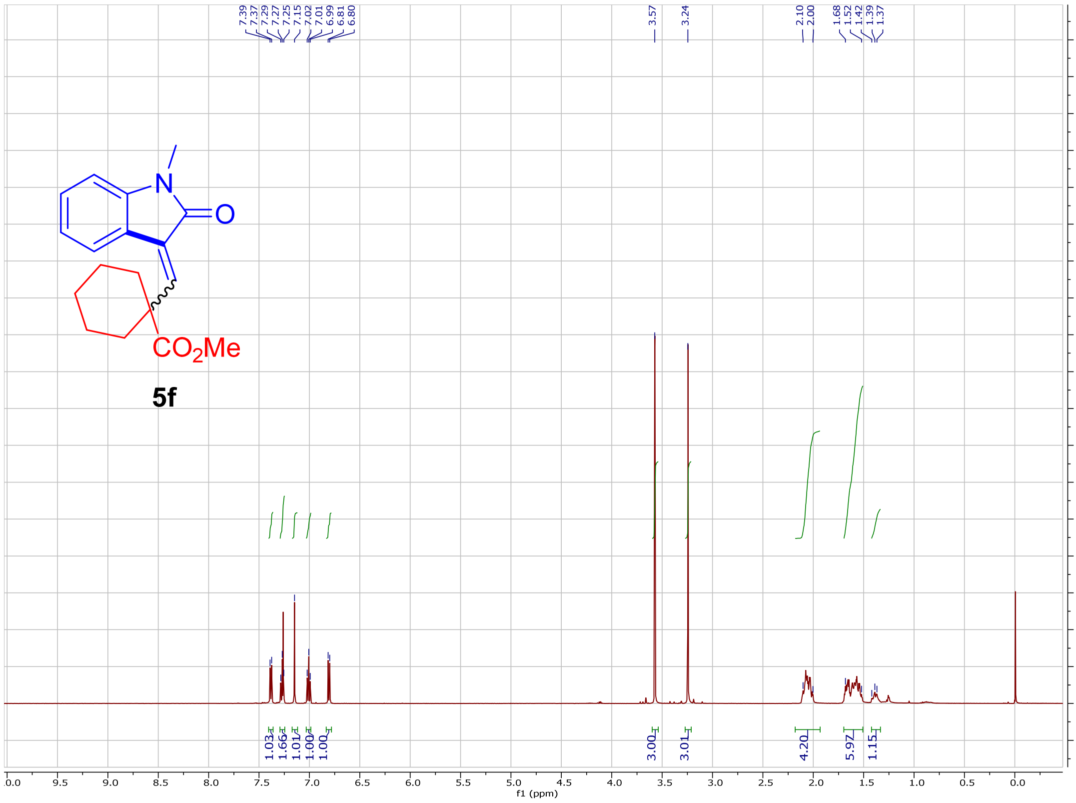
Field_Strength    = 11.7473579[T] (500[MHz])
X_Acq_Duration    = 0.10911744[s]
X_Domain          = 1H
X_Freq            = 500.15991521[MHz]
X_Offset          = 5.0[ppm]
X_Points          = 1024
X_Prescans        = 4
X_Resolution      = 9.16443788[Hz]
X_Sweep           = 9.38438438[kHz]
X_Sweep_Clipped   = 7.50750751[kHz]
Y_Domain          = 1H
Y_Freq            = 500.15991521[MHz]
Y_Offset          = 5.0[ppm]
Y_Points          = 256
Y_Prescans        = 0
Y_Resolution      = 29.30859844[Hz]
Y_Sweep           = 7.5030012[kHz]
Irr_Domain        = Proton
Irr_Freq          = 500.15991521[MHz]
Irr_Offset        = 5.0[ppm]
Tri_Domain        = Proton
Tri_Freq          = 500.15991521[MHz]
Tri_Offset        = 5.0[ppm]
Clipped           = TRUE
Scans             = 8
Total_Scans       = 2048

Relaxation_Delay = 1.5[s]
Recvr_Gain        = 52
Temp_Get          = 18.8[dC]
```

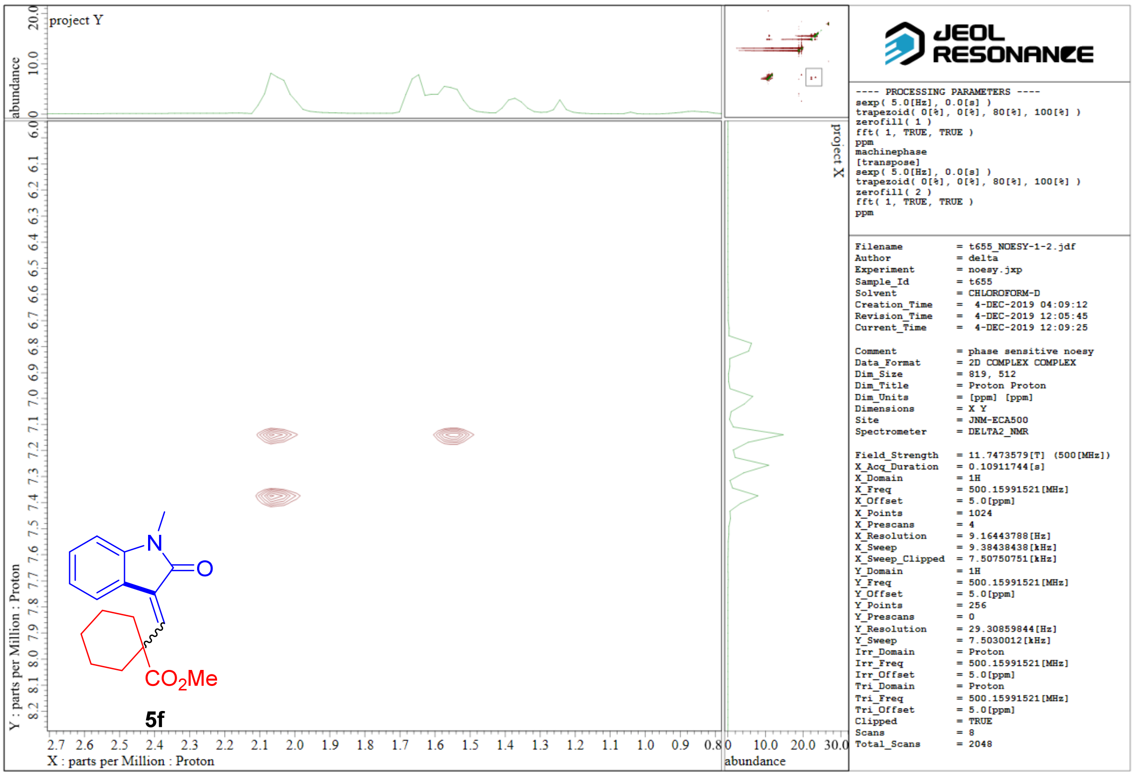
^{13}C NMR($CDCl_3$)



^{1}H NMR($CDCl_3$)



NOESY

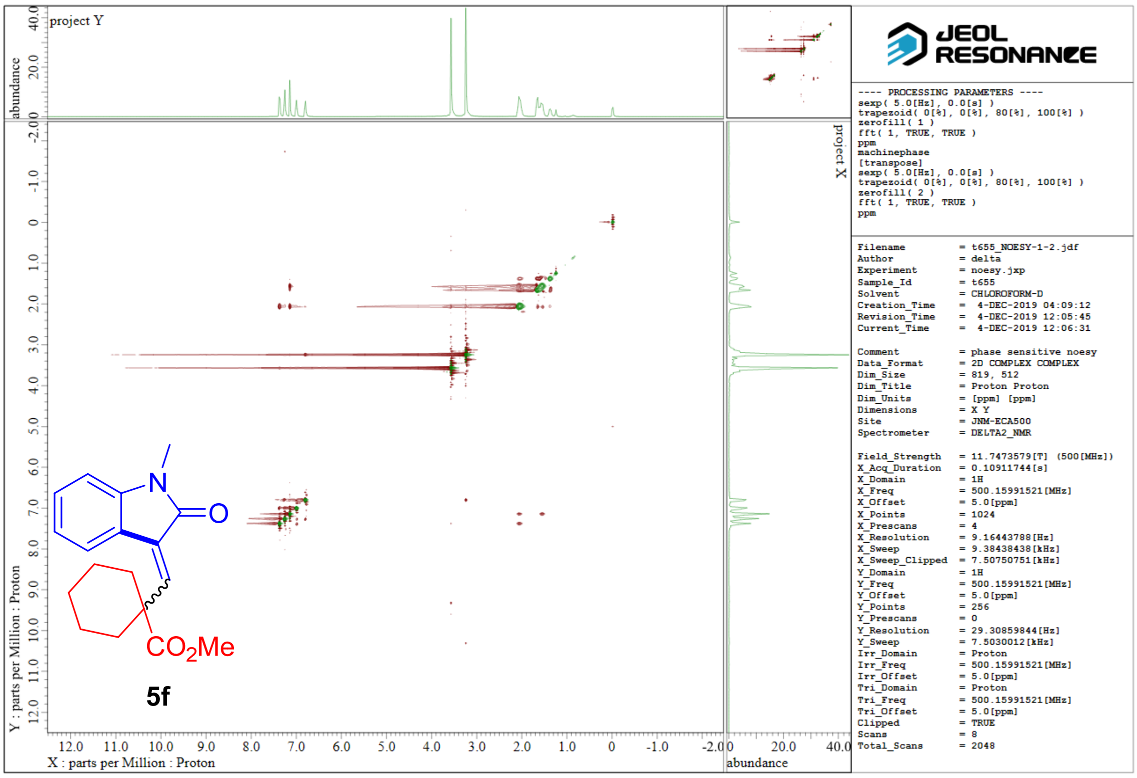


```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm
```

```
Filename          = t655_NOESY-1-2.jdf
Author            = delta
Experiment        = noesy.jxp
Sample_Id         = t655
Solvent           = CHLOROFORM-D
Creation_Time     =  4-DEC-2019 04:09:12
Revision_Time     =  4-DEC-2019 12:05:45
Current_Time      =  4-DEC-2019 12:09:25

Comment           = phase sensitive noesy
Data_Format       = 2D COMPLEX COMPLEX
Dim_Size          = 819, 512
Dim_Title         = Proton Proton
Dim_Units         = [ppm] [ppm]
Dimensions        = X Y
Site              = JNM-ECA500
Spectrometer      = DELTA2_NMR

Field_Strength    = 11.7473579[T] (500[MHz])
X_Acq_Duration    = 0.10911744[s]
X_Domain          = 1H
X_Freq            = 500.15991521[MHz]
X_Offset          = 5.0[ppm]
X_Points          = 1024
X_Prescans        = 4
X_Resolution      = 9.16443788[Hz]
X_Sweep           = 9.38438438[kHz]
X_Sweep_Clipped   = 7.50750751[kHz]
Y_Domain          = 1H
Y_Freq            = 500.15991521[MHz]
Y_Offset          = 5.0[ppm]
Y_Points          = 256
Y_Prescans        = 0
Y_Resolution      = 29.30859844[Hz]
Y_Sweep           = 7.5030012[kHz]
Irr_Domain        = Proton
Irr_Freq          = 500.15991521[MHz]
Irr_Offset        = 5.0[ppm]
Tri_Domain        = Proton
Tri_Freq          = 500.15991521[MHz]
Tri_Offset        = 5.0[ppm]
Clipped           = TRUE
Scans             = 8
Total_Scans       = 2048
```



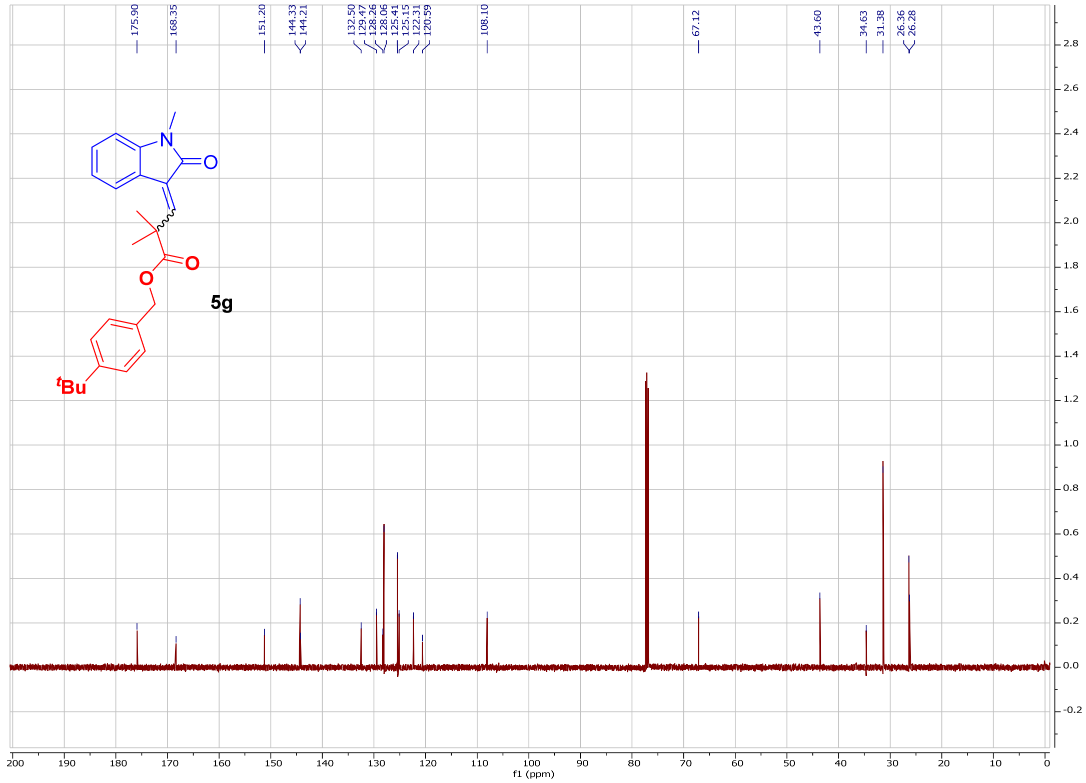
```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm
```

```
Filename          = t655_NOESY-1-2.jdf
Author            = delta
Experiment        = noesy.jxp
Sample_Id         = t655
Solvent           = CHLOROFORM-D
Creation_Time     =  4-DEC-2019 04:09:12
Revision_Time     =  4-DEC-2019 12:05:45
Current_Time      =  4-DEC-2019 12:06:31

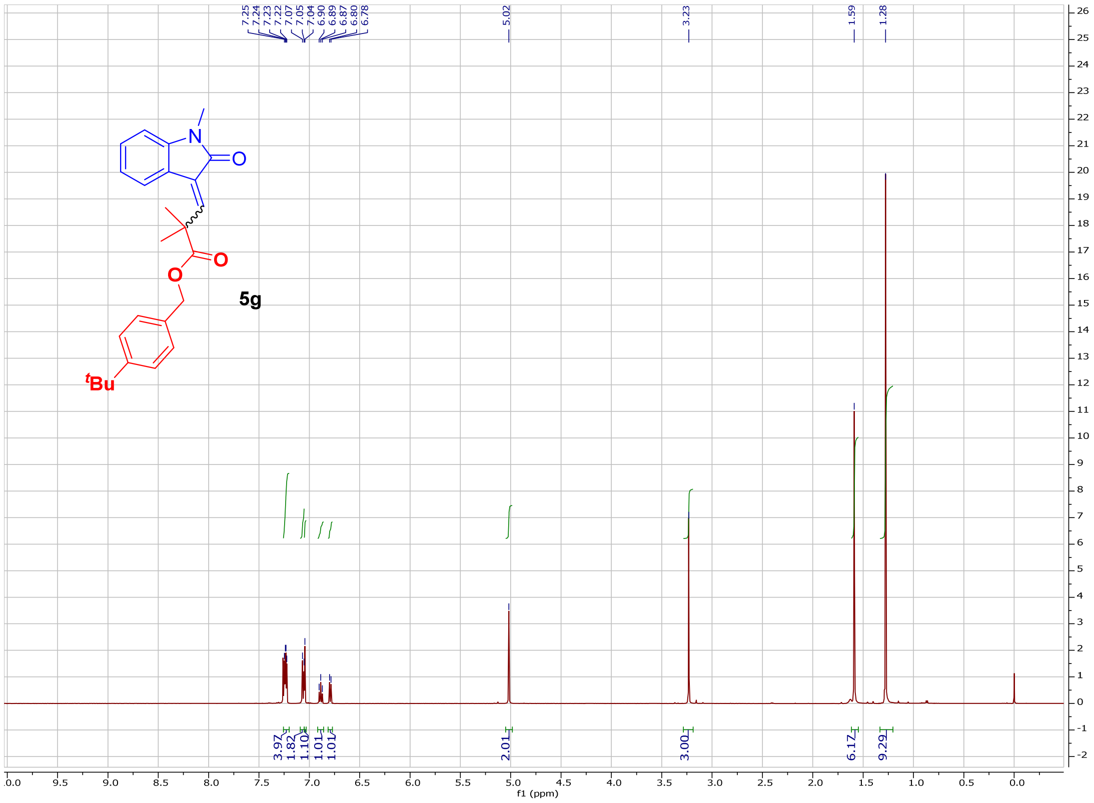
Comment           = phase sensitive noesy
Data_Format       = 2D COMPLEX COMPLEX
Dim_Size          = 819, 512
Dim_Title         = Proton Proton
Dim_Units         = [ppm] [ppm]
Dimensions        = X Y
Site              = JNM-ECA500
Spectrometer      = DELTA2_NMR

Field_Strength    = 11.7473579[T] (500[MHz])
X_Acq_Duration    = 0.10911744[s]
X_Domain          = 1H
X_Freq            = 500.15991521[MHz]
X_Offset          = 5.0[ppm]
X_Points          = 1024
X_Prescans        = 4
X_Resolution      = 9.16443788[Hz]
X_Sweep           = 9.38438438[kHz]
X_Sweep_Clipped   = 7.50750751[kHz]
Y_Domain          = 1H
Y_Freq            = 500.15991521[MHz]
Y_Offset          = 5.0[ppm]
Y_Points          = 256
Y_Prescans        = 0
Y_Resolution      = 29.30859844[Hz]
Y_Sweep           = 7.5030012[kHz]
Irr_Domain        = Proton
Irr_Freq          = 500.15991521[MHz]
Irr_Offset        = 5.0[ppm]
Tri_Domain        = Proton
Tri_Freq          = 500.15991521[MHz]
Tri_Offset        = 5.0[ppm]
Clipped           = TRUE
Scans             = 8
Total_Scans       = 2048
```

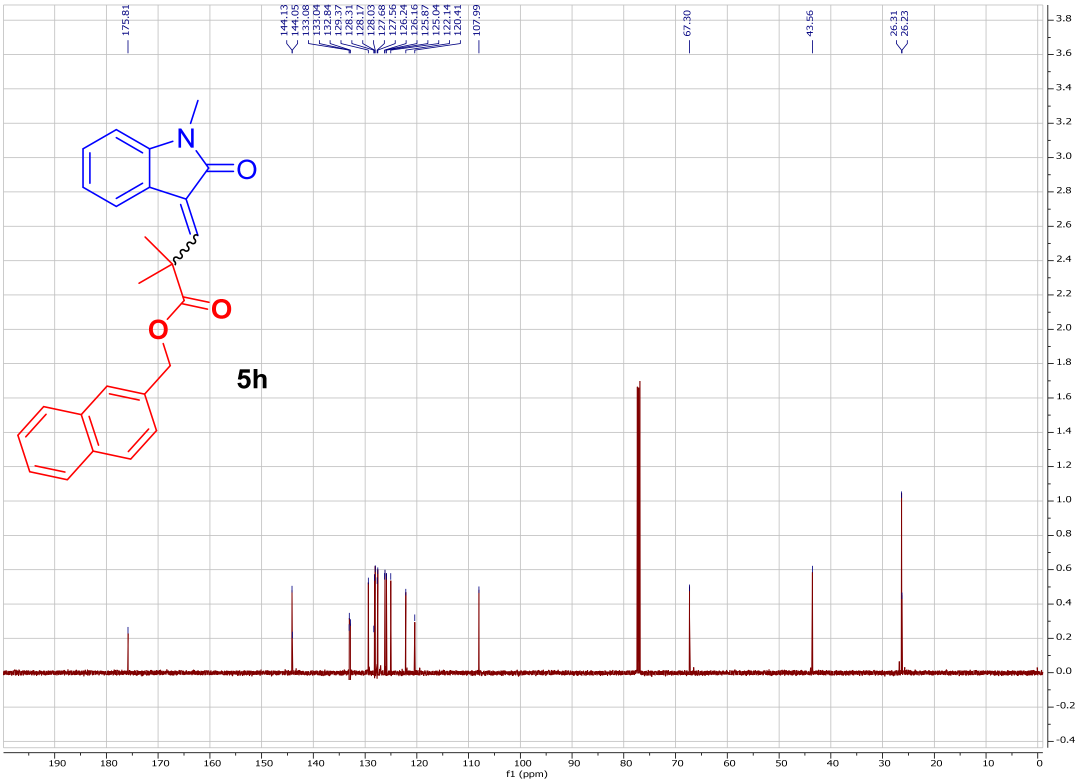
^{13}C NMR($CDCl_3$)



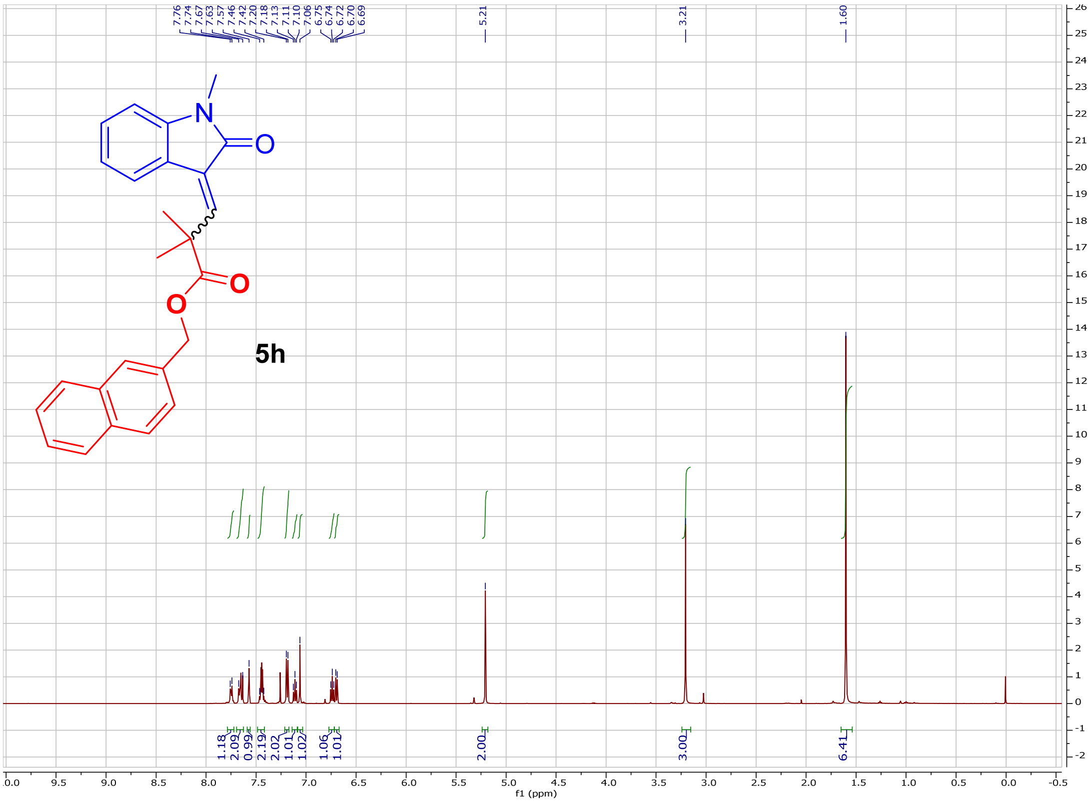
^{1}H NMR($CDCl_3$)



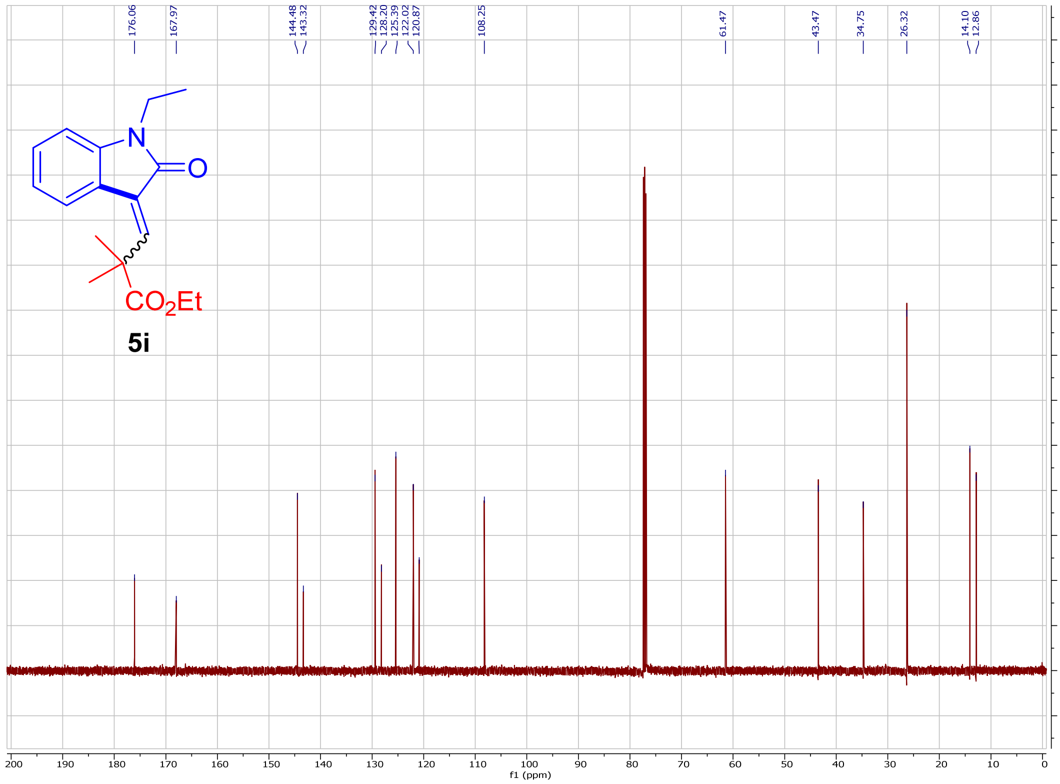
^{13}C NMR(CDCl$_3$)



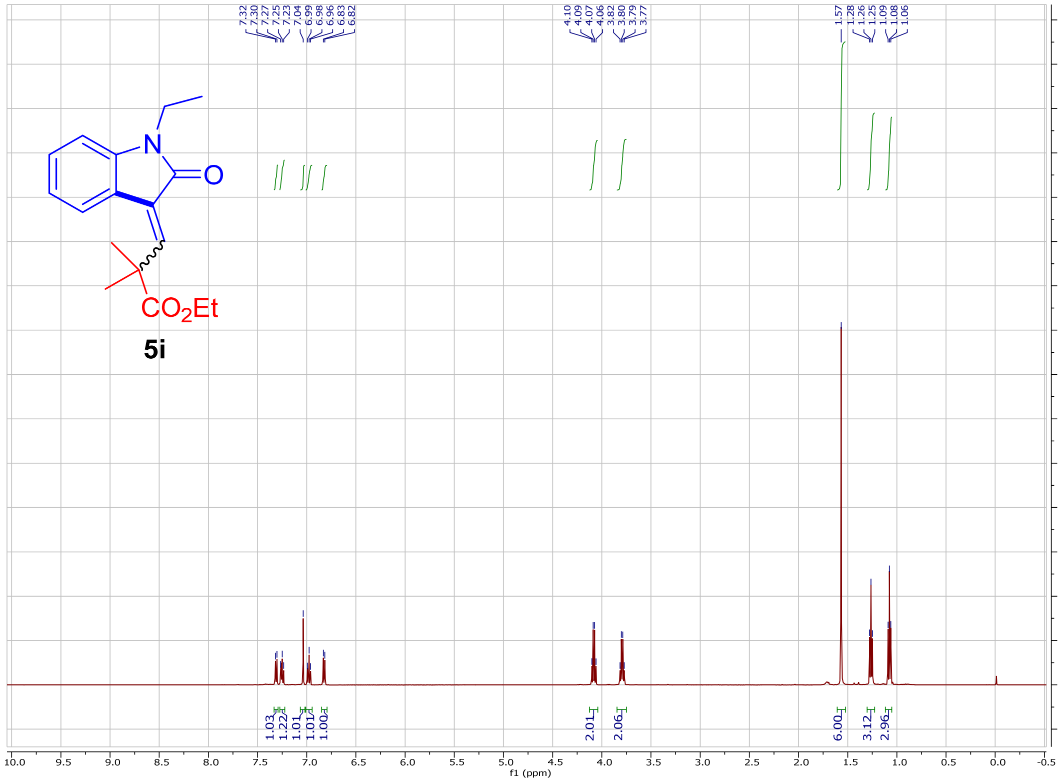
^{1}H NMR(CDCl$_3$)



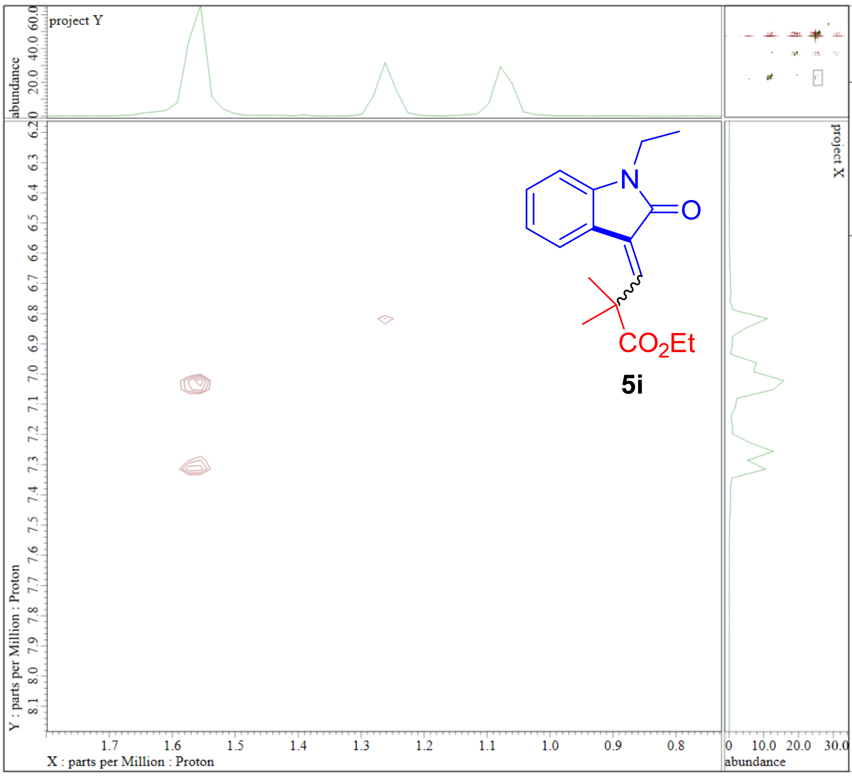
^{13}C NMR(CDCl$_3$)



^{1}H NMR(CDCl$_3$)



NOESY



```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm

Filename           = t652_NOESY-1-2.jdf
Author             = delta
Experiment         = noesy.jxp
Sample_Id          = t652
Solvent            = CHLOROFORM-D
Creation_Time      =  5-DEC-2019 02:43:04
Revision_Time      = 13-DEC-2019 10:25:05
Current_Time       = 13-DEC-2019 10:27:26

Comment            = phase sensitive noesy
Data_Format        = 2D COMPLEX COMPLEX
Dim_Size           = 819, 512
Dim_Title          = Proton Proton
Dim_Units          = [ppm] [ppm]
Dimensions         = X Y
Site               = JNM-ECA500
Spectrometer       = DELTA2_NMR

Field_Strength     = 11.7473579[T] (500[MHz])
X_Acq_Duration     = 0.10911744[s]
X_Domain           = 1H
X_Freq             = 500.15991521[MHz]
X_Offset           = 5.0[ppm]
X_Points           = 1024
X_Prescans         = 4
X_Resolution       = 9.16443788[Hz]
X_Sweep            = 9.38438438[kHz]
X_Sweep_Clipped    = 7.50750751[kHz]
Y_Domain           = 1H
Y_Freq             = 500.15991521[MHz]
Y_Offset           = 5.0[ppm]
Y_Points           = 256
Y_Prescans         = 0
Y_Resolution       = 29.30859844[Hz]
Y_Sweep            = 7.5030012[kHz]
Irr_Domain         = Proton
Irr_Freq           = 500.15991521[MHz]
Irr_Offset         = 5.0[ppm]
Tri_Domain         = Proton
Tri_Freq           = 500.15991521[MHz]
Tri_Offset         = 5.0[ppm]
Clipped            = TRUE
Scans              = 8
Total_Scans        = 2048

Relaxation_Delay = 1.5[s]
Recvr_Gain         = 54
Temp_Get           = 18.1[dC]
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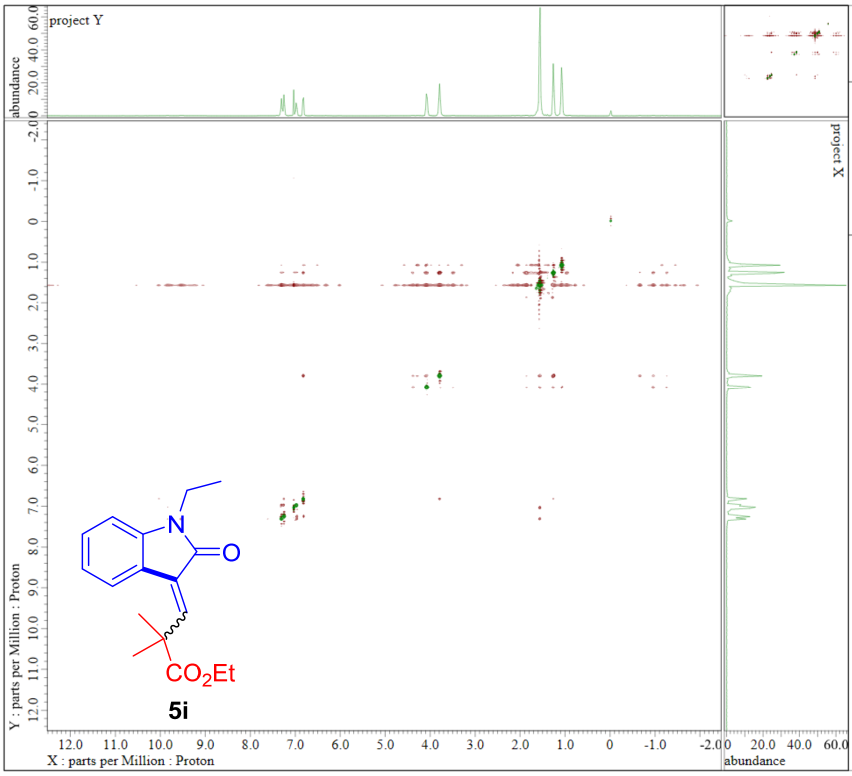

```
---- PROCESSING PARAMETERS ----
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
ppm
machinephase
[transpose]
sexp( 5.0[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 2 )
fft( 1, TRUE, TRUE )
ppm

Filename           = t652_NOESY-1-2.jdf
Author             = delta
Experiment         = noesy.jxp
Sample_Id          = t652
Solvent            = CHLOROFORM-D
Creation_Time      =  5-DEC-2019 02:43:04
Revision_Time      = 13-DEC-2019 10:25:05
Current_Time       = 13-DEC-2019 10:26:52

Comment            = phase sensitive noesy
Data_Format        = 2D COMPLEX COMPLEX
Dim_Size           = 819, 512
Dim_Title          = Proton Proton
Dim_Units          = [ppm] [ppm]
Dimensions         = X Y
Site               = JNM-ECA500
Spectrometer       = DELTA2_NMR

Field_Strength     = 11.7473579[T] (500[MHz])
X_Acq_Duration     = 0.10911744[s]
X_Domain           = 1H
X_Freq             = 500.15991521[MHz]
X_Offset           = 5.0[ppm]
X_Points           = 1024
X_Prescans         = 4
X_Resolution       = 9.16443788[Hz]
X_Sweep            = 9.38438438[kHz]
X_Sweep_Clipped    = 7.50750751[kHz]
Y_Domain           = 1H
Y_Freq             = 500.15991521[MHz]
Y_Offset           = 5.0[ppm]
Y_Points           = 256
Y_Prescans         = 0
Y_Resolution       = 29.30859844[Hz]
Y_Sweep            = 7.5030012[kHz]
Irr_Domain         = Proton
Irr_Freq           = 500.15991521[MHz]
Irr_Offset         = 5.0[ppm]
Tri_Domain         = Proton
Tri_Freq           = 500.15991521[MHz]
Tri_Offset         = 5.0[ppm]
Clipped            = TRUE
Scans              = 8
Total_Scans        = 2048

Relaxation_Delay = 1.5[s]
Recvr_Gain         = 54
Temp_Get           = 18.1[dC]
```