# Supporting Information

## Synthesis of oxindoles through trifluoromethylation of *N*-aryl acrylamides by photoredox catalysis

Maojian Lu,[a] Zhiji Liu,[a] Jinwang Zhang,[a] Yu Tian,[a] Honggui Qin,[a] Mingqiang Huang,[a] Shirong Hu,[a] Shunyou Cai,*[a,b]

[a]*Key Laboratory of Modern Analytical Science and Separation Technology of Fujian Province, School of Chemistry, Chemical Engineering and Environment, Minnan Normal University, Zhangzhou, 363000, China.*

[b]*Key Laboratory of Chemical Genomics, School of Chemical Biology and Biotechnology, Shenzhen Graduate School, Peking University, Shenzhen, 518055, China.*

*E-mail: caishy05@mnnu.edu.cn*

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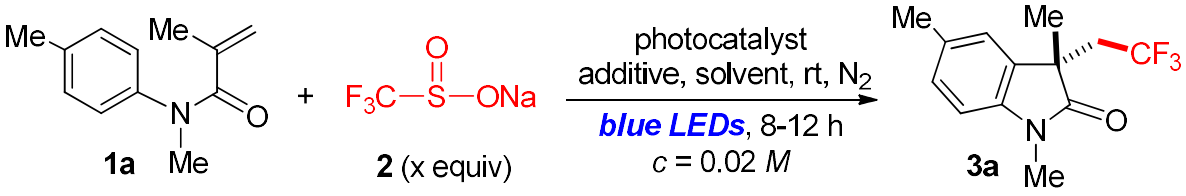
## Materials and methods

All the chemicals were purchased commercially, and used without further purification. Thin-layer chromatography (TLC) was conducted with 0.25 mm Tsingdao silica gel plates (60F-254) and visualized by exposure to UV light (254 nm) or stained with potassium permanganate. Flash column chromatography was performed using Tsingdao silica gel (60, particle size 0.040–0.063 mm). Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated. $^{1}$H NMR spectra were recorded on JEOL spectrometers (400 MHz) and were reported relative to deuterated solvent signals. Data for $^{1}$H NMR spectra were reported as follows: chemical shift (δ ppm), multiplicity, coupling constant (Hz) and integration. $^{13}$C NMR spectra were recorded on JEOL Spectrometers (100 MHz). $^{19}$F NMR spectra were recorded on JEOL Spectrometers (376 MHz). Data for $^{13}$C NMR and $^{19}$F NMR spectra were reported in terms of chemical shift. Mass spectrometric data were obtained using Bruker Apex IV RTMS. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad.

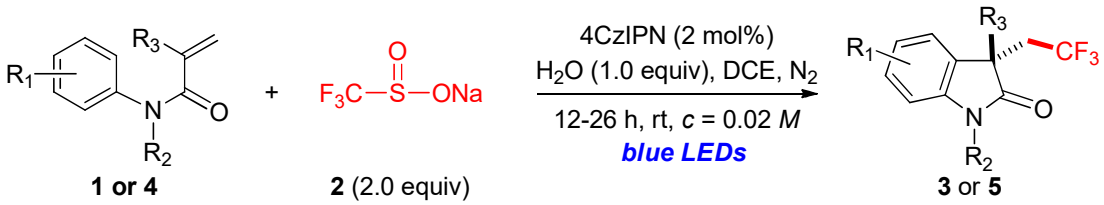
## Screenings of reaction conditions




| entry | **2a** (equiv) | PC (x mol%)[h] | additive (equiv) | solvent | yield (%)[g] |
|---|---|---|---|---|---|
| 1[a] | 1.5 | eosin Y (2) | / | DCE | trace |
| 2[a] | 1.5 | 4CzIPN (2) | / | DCE | 18 |
| 3[b] | 1.5 | 4CzIPN (2) | / | DCE | 47 |
| 4[b] | 1.5 | 4CzIPN (2) | NaOAc (1.0) | DCE | decomp |
| 5[b] | 1.5 | 4CzIPN (2) | HOAc (1.0) | DCE | 21 |
| 6[b] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | DCE | 62 |
| 7[b] | 1.5 | 4CzIPN (2) | MeOH (1.0) | DCE | 33 |
| 8[b,c] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | DCE | 72 |
| 9[b,c] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | DCM | 34 |
| 10[b,c] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | ACN | 26 |
| 11[b,c] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | DMSO | decomp |
| 12[b,c] | 1.5 | 4CzIPN (2) | $H_2O$ (1.0) | $C_6H_5Cl$ | 47 |
| **13[b,c]** | **2.0** | **4CzIPN (2)** | **$H_2O$ (1.0)** | **DCE** | **83** |
| 14[b,c,d] | 2.0 | [Ir-cat. 1] (2) | $H_2O$ (1.0) | DCE | 64 |
| 15[b,c,e] | 2.0 | [Ir-cat. 2] (2) | $H_2O$ (1.0) | DCE | 71 |
| 16[b,c] | 2.0 | $[Ru(bpy)_3Cl_2]$ (2) | $H_2O$ (1.0) | DCE | trace |

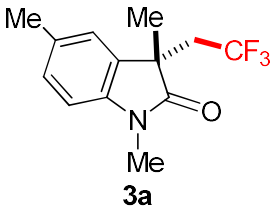
[a]Irradiation with white LEDs. [b]Irradiation with blue LEDs. [c]Reaction mixture was purged thoroughly with nitrogen for 10 mins. [d][Ir-cat. 1] = $Ir(ppy)_2(dtbpy)PF_6$. [e][Ir-cat. 2] = $Ir[dF(CF_3)ppy]_2(dtbpy)]PF_6$. [f]No light. [g]Yield of isolated product. [h]4CzIPN = 1,2,3,5-tetra-kis(carbazol-9-yl)-4,6-dicyanobenzene.

## General procedure for $CF_3$-containing oxindoles synthesis




A flame-dried flask (15 mL) was equipped with magnetic stir bar and charged with *N*-aryl-acrylamides **1** (0.145 mmol, 1.0 equiv), $CF_3SO_2Na$ **2** (0.29 mmol, 2.0 equiv), 1,2,3,5-tetrakis(carbazol-9-yl)-4,6-dicyanobenzene (4CzIPN) (0.00290 mmol, 0.02 equiv), $H_2O$ (0.145 mmol, 1.0 equiv) and DCE (8.0 mL). The reaction mixture was degassed by purging thoroughly with nitrogen (with 0.5 mol % of oxygen) for 10 minutes, then irradiated by blue LED (18 *W*) under a balloon nitrogen atmosphere (with 0.5 mol % of oxygen) at room temperature until the starting material disappeared from the TLC. After that the reaction mixture was directly concentrated under reduced pressure and the crude product was purified by silica gel column chromatography using hexane/EtOAc (10/1 to 4/1) to afford the desired pure product **3** or **5** in 41-91% yield.

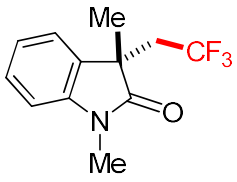
## $^1$H NMR, $^{13}$C NMR, and $^{19}$F NMR spectra data of compounds 3a-3p, 5a-5l



**3a**

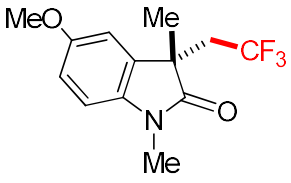
**1,3,5-trimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3a):** $^1$H NMR (400 MHz,

$CDCl_3$) δ 7.12-7.08 (m, 2H), 6.78-6.76 (d, $J$ = 7.6 Hz, 1H), 3.22 (s, 3H), 2.84-2.77 (m, 2H), 2.66-2.60 (m, 2H), 2.35 (s, 3H), 1.39 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.5, 140.5, 132.3, 131.1, 128.8, 125.6 (q, $J$ = 276.6 Hz), 124.4, 108.2, 44.5, 40.7 (q, $J$ = 27.8 Hz), 26.5, 25.1, 21.2; These data are consistent with literature values, see: Zhang, L.; Li, Z.; Liu, Z.-Q. *Org. Lett.* **2014**, *16*, 3688.



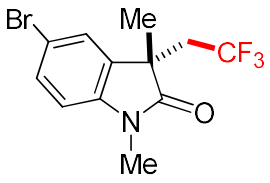

**3b**

**1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3b):** $^1$H NMR (400 MHz, $CDCl_3$) δ 7.32-7.26 (m, 2H), 7.12-7.10 (m, 1H), 6.90-6.88 (d, $J$ = 7.6 Hz, 1H), 3.24(s, 3H), 2.83-2.80 (m, 1H), 2.69-2.62 (m, 1H), 1.41(s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.6, 142.9, 131.1, 128.6, 125.2 (q, $J$ = 277.0 Hz), 123.6, 122.7, 108.5, 44.5, 40.6 (q, $J$ = 27.8 Hz), 26.5, 25.1.These data are consistent with literature values, see: Zhang, L.; Li, Z.; Liu, Z.-Q. *Org. Lett.* **2014**, *16*, 3688.



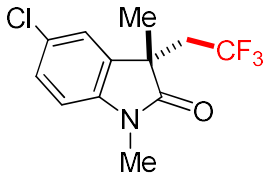

**3c**

**5-methoxy-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3c):** $^1$H NMR (400 MHz, $CDCl_3$) δ 6.88-6.78 (m, 3H), 3.80 (s, 3H), 3.22 (s, 3H), 2.82-2.78 (m, 1H), 2.66-2.62 (m, 1H), 1.40 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 156.1, 136.4, 132.5, 125.2 (q, $J$ = 279.9 Hz), 112.6, 111.3, 108.8, 55.9, 44.9, 40.6 (q, $J$ = 28.2 Hz), 26.6, 25.1. These data are consistent with literature values, see: Tang, X.-J.; Thomoson, C. S.; Dolbier, Jr., W. R. *Org.Lett.* **2014**, *16*, 4594.



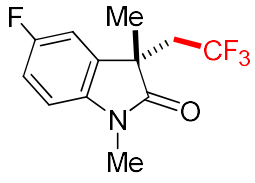

**3d**

**5-bromo-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3d):** $^{1}$HNMR (400 MHz, $CDCl_3$) δ 7.44-7.37 (m, 2H), 6.77-6.75 (d, *J* = 8.4 Hz, 1H), 3.22 (s, 3H), 2.86-2.80 (m, 1H), 2.66-2.59 (m, 1H), 1.40 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 177.9, 141.9, 133.2 (d, *J* = 2.0 Hz), 131.5, 126.9, 125.1 (q, *J* = 277.0 Hz), 115.5, 110.0, 44.6, 40.6 (q, *J* = 28.7 Hz), 26.6, 25.0. These data are consistent with literature values, see: Zhang, L.; Li, Z.; Liu, Z.-Q. *Org. Lett.* **2014**, *16*, 3688.



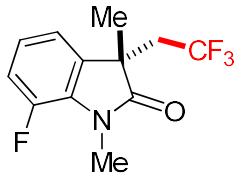

**3e**

**5-chloro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3e):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.30-7.25 (m, 2H), 6.83-6.80 (m, 1H), 3.22 (s, 3H), 2.84-2.80 (m, 1H), 2.67-2.63 (m, 1H), 1.41 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.1, 141.5, 132.7, 128.7, 128.6, 128.2, 125.1 (q, *J* = 275.9 Hz), 124.2, 109.5, 44.7, 40.6 (q, *J* = 27.7 Hz), 26.6, 25.0. These data are consistent with literature values, see: Zhang, L.; Li, Z.; Liu, Z.-Q. *Org. Lett.* **2014**, *16*, 3688.



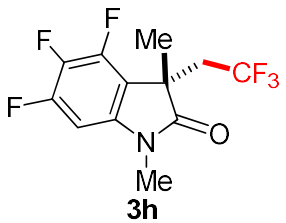

**3f**

**5-fluoro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3f)：** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.03-7.00 (m, 2H), 6.83-6.80 (m, 1H), 3.23 (s, 3H), 2.84-2.80 (m, 1H), 2.67-2.63 (m, 1H), 1.41 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 160.6 (d, $J$ = 239.6 Hz), 138.9, 129 (d, $J$ = 8.6 Hz), 125.1 (d, $J$ = 275.9 Hz), 123.8, 115.0 (d, $J$ = 23.0 Hz), 111.8 (d, $J$ = 24.5 Hz), 109.1 (d, $J$ = 7.7 Hz), 44.9, 40.6 (q, $J$ = 27.8 Hz), 26.7, 25.0. These data are consistent with literature values, see: L. Zhang, Z. Li and Z.-Q. Liu, *Org. Lett.*, 2014, **16**, 3688.



**3g**

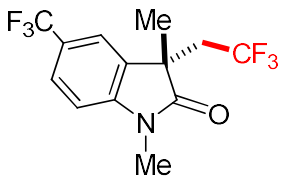
**7-fluoro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3g):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.04-7.02 (m, 3H), 3.45 (s, 3H), 2.91-2.78 (m, 1H), 2.67-2.60 (m, 1H), 1.41 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 148.0 (d, $J$ = 242.5 Hz), 133.9, 130.0, 125.1 (q, $J$ = 276.9 Hz), 123.3 (d, $J$ = 6.7 Hz), 119.4, 116.5 (d, $J$ = 19.2 Hz), 44.7, 40.9 (d, $J$ = 27.8 Hz), 29.0 (d, $J$ = 5.7 Hz), 25.4; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.9, -65.1; HRMS calculated for $C_{12}H_{12}F_4NO$ ($M + H^+$): 262.0855, found: 262.0853.



**3h**

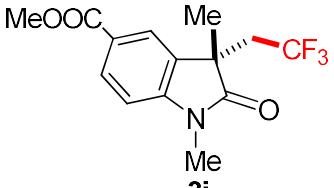
**4,5,6-trifluoro-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3h):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 6.57-6.53 (m, 1H), 3.20 (s, 3H)，2.96-2.87 (m, 1H), 2.84-2.78 (m, 1H), 1.49 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 177.5, 151.9 (d, $J$ = 248.2 Hz),

148.6 (d, $J$ = 246.3 Hz), 138.2 (d, $J$ = 95.9 Hz), 124.8 (q, $J$ = 277.0 Hz), 135.4 (t, $J$ = 15.3 Hz), 112.9 (d, $J$ = 17.3 Hz), 44.2, 39.8 (d, $J$ = 27.8 Hz), 26.9, 23.8; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -64.2, -132.9, -140.5, -168.8; HRMS calculated for $C_{12}H_{10}F_6NO$ ($M + H^+$): 298.0667, found: 298.0660.




**3i**

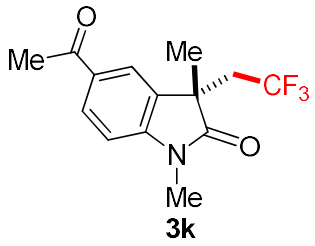
**1,3-dimethyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (3i):** $^1$H NMR (400 MHz, $CDCl_3$) δ 7.62-7.60 (m, 1H), 7.50 (s, 1H), 6.98-6.96 (d, $J$ = 8.4 Hz, 1H), 3.28 (s, 3H), 2.90-2.84 (m, 1H), 2.72-2.66 (m, 1H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.5, 146.0, 131.6, 126.5, 126.4, 125.0 (q, $J$ = 277.0 Hz), 120.7, 108.4, 44.4, 40.6 (q, $J$ = 27.8 Hz), 26.7, 25.0. These data are consistent with literature values, see: Tang, X.-J.; Thomoson, C. S.; Dolbier, Jr., W. R. *Org.Lett.* **2014**, *16*, 4594.




**3j**

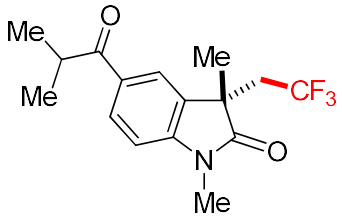
**methyl 1,3-dimethyl-2-oxo-3-(2,2,2-trifluoroethyl)indoline-5-carboxylate (3j):** $^1$H NMR (400 MHz, $CDCl_3$) δ 8.08-8.06 (d, $J$ = 8.4 Hz, 1H), 7.95-7.94 (d, $J$ = 1.2 Hz, 1H), 6.94-6.92 (d, $J$ = 8.0 Hz, 1H), 3.92 (s, 3H), 3.28 (s, 3H), 2.90-2.84 (m, 1H), 2.73-2.69 (m, 1H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.8, 166.8, 147.0, 131.3, 131.0, 125.1(q, $J$ = 276.9 Hz), 124.9, 124.8, 108.1, 52.2, 44.3, 40.7 (d, $J$ = 27.8 Hz), 26.7, 25.1. These data are consistent with literature values, see: Tang, X.-J.;

Thomoson, C. S.; Dolbier, Jr., W. R. *Org.Lett.* **2014**, *16*, 4594.



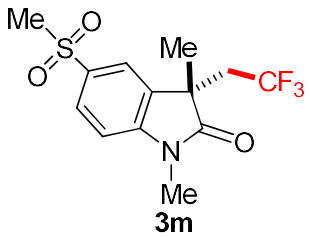

**3k**

**5-acetyl-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3k):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.99-7.97 (dd, *J* = 8.4, 1.2 Hz 1H), 7.92 (d, *J* = 1.2 Hz, 1H), 6.95-6.93 (d, *J* = 8.4 Hz, 1H), 3.29 (s, 3H), 2.88-2.85 (m, 1H), 2.74-2.65 (m, 1H), 2.60 (s, 3H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 196.9, 178.8, 147.2, 132.3，131.4, 130.7, 125.1 (q, *J* = 276.9 Hz), 123.5, 108.0, 44.2, 40.7 (q, *J* = 27.8 Hz), 26.8, 26.5, 25.1. These data are consistent with literature values, see: Liu, C.; Zhao, W.; Huang, Y.; Wang, H.; Zhang, B.*Tetrahedron* **2015**, *71*, 4344.



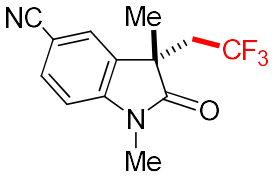

**3l**

**5-isobutyryl-1,3-dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3l):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.98-7.96 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.88 (d, *J* = 1.2 Hz, 1H), 6.93-6.91 (d, *J* = 8.0 Hz, 1H), 3.53-3.50 (m, 1H), 3.26(s, 3H), 2.86-2.82 (m, 1H), 2.72-2.69 (m, 1H), 1.41 (s, 3H), 1.21-1.19 (m, 6H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 203.1, 178.9, 147.0, 131.3, 130.3, 125.1 (q, *J* = 276.0 Hz), 123.8, 108.1, 44.3, 40.6 (q, *J* = 28.8 Hz), 35.2, 26.8, 25.1, 19.5, 19.2; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.9; HRMS calculated for $C_{16}H_{19}F_3NO_2$ ($M + H^+$): 314.1368, found: 314.1372.



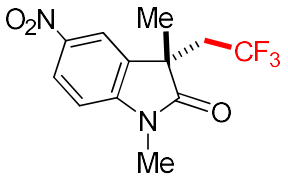

**3m**

**1,3-dimethyl-5-(methylsulfonyl)-3-(2,2,2-trifluoroethyl)indolin-2-one (3m):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.97-7.94 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.84-7.83 (d, *J* = 1.6 Hz, 1H), 7.06-7.04 (d, *J* = 8.4 Hz, 1H), 3.30 (s, 3H), 3.06 (s, 3H), 2.95-2.89 (m, 1H), 2.75-2.69 (m, 1H), 1.46 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.4, 147.8, 134.6, 132.1, 129.4, 125.0 (q, *J* = 277.0 Hz), 123.0, 108.8, 45.1, 40.6 (q, *J* = 27.8 Hz), 26.9, 25.0; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.0; HRMS calculated for $C_{13}H_{15}F_3NO_3S$ (M + $H^+$): 322.0725, found: 322.0716.



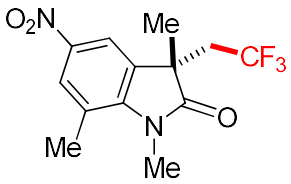

**3n**

**1,3-dimethyl-2-oxo-3-(2,2,2-trifluoroethyl)indoline-5-carbonitrile (3n):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.67 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.65 (d, *J* = 1.6 Hz, 1H), 6.98 (d, *J* = 8.0 Hz, 1H), 3.74 (s, 3H), 2.95-2.82 (m, 1H), 2.75-2.61 (m, 1H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 146.8, 134.0, 132.0, 131.0, 127.1, 125.1 (q, *J* = 276.9 Hz), 119.1, 109.1, 106.0, 44.2, 43.5, 40.6 (q, *J* = 27.8 Hz), 26.8, 24.9. These data are consistent with literature values, see: Liu, C.; Zhao, W.; Huang, Y.; Wang, H.; Zhang, B.*Tetrahedron* **2015**, *71*, 4344.



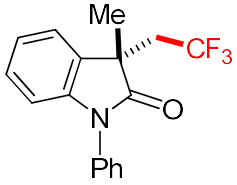

**3o**

**1,3-dimethyl-5-nitro-3-(2,2,2-trifluoroethyl)indolin-2-one (3o):** $^{1}$H NMR (400 MHz, $CDCl_3$), δ 8.33-8.30 (dd, *J* = 8.4, 1.2 Hz, 1H), 8.17 (d, *J* = 2.4 Hz, 1H), 7.00-6.98 (d, *J* = 8.4 Hz, 1H), 3.32 (s, 3H), 2.95-2.89 (m, 1H), 2.77-2.70 (m, 3H), 1.48 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.5, 148.6, 143.6, 131.8, 125.9, 125.1 (q, *J* = 276.9 Hz), 119.6, 108.2, 44.4, 40.6 (q, *J* = 27.8 Hz), 27.0, 25.0. These data are consistent with literature values, see: Tang, X.-J.; Thomoson, C. S.; Dolbier, Jr., W. R. *Org.Lett.* **2014**, *16*, 4594.



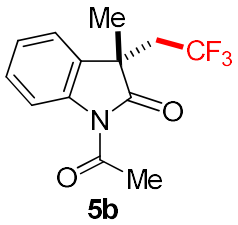

**3p**

**1,3,7-trimethyl-5-nitro-3-(2,2,2-trifluoroethyl)indolin-2-one (3p):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 2.0 Hz, 1H), 7.97 (d, *J* = 2.0 Hz, 1H), 3.58 (s, 3H), 2.98-2.88 (m, 1H), 2.78-2.62 (m, 4H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 179.4, 146.6, 143.0, 132.5, 128.7, 125.0 (q, *J* = 276.9 Hz), 120.8, 117.2, 43.8, 40.6 (q, *J* = 28.7 Hz), 30.0, 25.5, 19.3. $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.0.



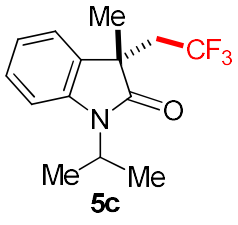

**5a**

**3-methyl-1-phenyl-3-(2,2,2-trifluoroethyl)indolin-2-one (5a):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.55-7.51 (m, 2H), 7.45-7.32 (m, 5H), 7.26-7.10 (m, 2H), 6.85-6.83 (d, *J* = 7.6 Hz, 1H), 3.00-2.94 (m, 1H), 2.76-2.70 (m, 1H), 1.53 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.1, 143.0, 134.4, 129.8, 128.5, 128.4, 126.7, 125.1 (q, *J* = 276.9 Hz), 123.9, 123.2, 109.8, 44.6, 41.1 (q, *J* = 27.8 Hz), 25.5. These data are consistent with literature values, see: Tang, X.-J.; Thomoson, C. S.; Dolbier, Jr., W. R. *Org.Lett.* **2014**, *16*, 4594.



**5b**

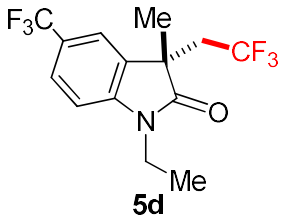
**acetyl-3-methyl-3-(2,2,2-trifluoroethyl)indolin-2-one (5b):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, *J* = 8.4 Hz, 1H), 7.36-7.34 (m, 1H), 7.27-7.24 (m, 2H), 2.96-2.89 (m, 1H), 2.72-2.66 (m, 4H), 1.48 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 179.5, 171.0, 139.2, 129.9, 129.1, 125.4, 125.0 (q, *J* = 276.9 Hz), 123.1, 116.9, 45.1, 41.5 (q, *J* = 28.8 Hz), 26.7, 26.4; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.9; HRMS calculated for $C_{13}H_{12}F_3NNaO_2$ ($M + Na^+$): 294.0718, found: 294.0697.



**5c**

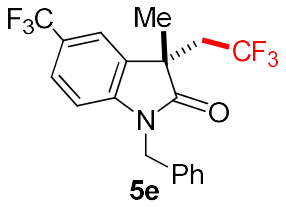
**1-isopropyl-3-methyl-3-(2,2,2-trifluoroethyl)indolin-2-one (5c):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.28-7.24 (m, 2H), 7.06-7.03 (m, 2H), 4.65-4.60 (m, 1H), 2.88-2.80 (m, 1H), 1.49-1.46 (m, 6H), 1.38 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 141.6, 131.5, 128.3, 125.0 (q, *J* = 277.0 Hz), 123.9, 122.1, 110.2, 44.1, 40.8 (q, *J* =

27.8 Hz), 25.4, 19.3, 19.1. These data are consistent with literature values, see: Xu, P.; Xie, J.; Xue, Q.; Pan, C.; Cheng, Y.; Zhu, C. *Chem. – Eur. J.* **2013**, *19*, 14039.



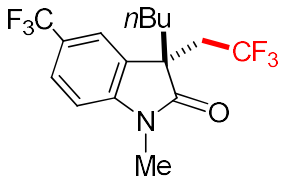

**5d**

**1-ethyl-3-methyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (5d):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.65-7.60 (d, *J* = 8.4 Hz, 1H), 7.50 (s, 1H), 6.98 (d, *J* = 8.4 Hz, 1H), 3.94-3.89 (m, 1H), 3.74-3.68 (m, 1H), 2.92-2.86 (m, 1H), 2.71-2.64 (m, 1H), 1.43 (s, 3H), 1.28-1.24 (t, *J* = 7.6 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.1, 145.0, 131.8, 126.5, 126.4, 120.9, 108.5, 44.3, 40.8 (q, *J* = 27.8 Hz), 35.1, 25.1, 12.2; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.4, -61.9; HRMS calculated for $C_{14}H_{14}F_6NO$ ($M + H^+$): 326.0980, found: 326.0982.



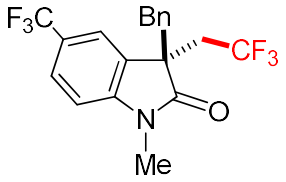

**5e**

**1-benzyl-3-methyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (5e):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.52-7.41 (m, 2H), 7.29-7.20 (m, 5H), 6.84 (d, *J* = 7.6 Hz, 1H), 5.03 (d, *J* = 15.6 Hz, 1H), 4.93 (d, *J* = 15.6 Hz, 1H), 2.99-2.93 (m, 1H), 2.77-2.71 (m, 1H), 1.49 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.5, 145.0, 135.0, 131.6, 129.0, 128.1, 127.3, 126.3, 125.4 (q, *J* = 32.5 Hz), 125.1 (q, *J* = 276.9 Hz), 120.8, 109.5, 44.5, 44.3, 40.4 (q, *J* = 27.8 Hz), 25.7; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.5, -61.7; HRMS calculated for $C_{19}H_{16}F_6NO$ ($M + H^+$): 388.1136, found: 388.1132.



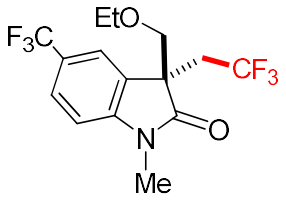

**5f**

**3-butyl-1-methyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (5f):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, $J$ = 8.4 Hz, 1H), 7.45 (s, 1H), 7.97 (d, $J$ = 8.4 Hz, 1H), 3.27 (s, 3H), 2.95-2.82 (m, 1H), 2.75-2.62 (m, 1H), 1.95-1.85 (m, 1H), 1.81-1.72 (m, 1H), 1.30-1.12 (m, 2H), 1.00-0.86 (m, 1H), 0.79-0.77 (m, 3H), 0.77-0.76 (m, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.0, 146.7, 129.9, 126.5, 124.8 (q, $J$ = 32.6 Hz), 124.4 (q, $J$ = 270.3 Hz), 120.7, 108.2, 48.5, 40.4 (q, $J$ = 28.7 Hz), 38.5, 26.6, 25.2, 22.5, 13.8; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.3, -61.6; HRMS calculated for $C_{16}H_{18}F_6NO$ ($M + H^+$): 354.1293, found: 354.1288.



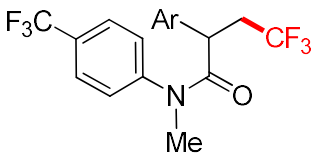

**5g**

**3-benzyl-1-methyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (5g):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.52-7.50 (m, 1H), 7.40 (s, 1H), 7.14-7.05 (m, 3H), 6.75-6.73 (m, 2H), 3.10-2.99 (m, 5H), 2.85-2.78 (m, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 177.1, 146.4, 133.4, 130.0, 128.7, 127.9, 127.4, 126.4, 125.1 (q, $J$ = 270.0 Hz), 108.0, 50.1, 44.7, 39.3 (q, $J$ = 28.8 Hz), 26.3; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.2, -61.5; HRMS calculated for $C_{19}H_{15}F_6NNaO$ ($M + H^+$): 410.0956, found: 410.0951.



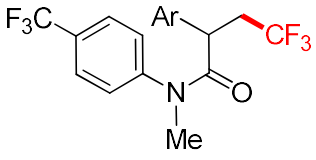

**5h**

**3-(ethoxymethyl)-1-methyl-3-(2,2,2-trifluoroethyl)-5-(trifluoromethyl)indolin-2-one (5h):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.64-7.63 (m, 2H), 6.96-6.94 (d, *J* = 8.8 Hz, 1H), 3.68-3.66 (d, *J* = 9.2 Hz, 1H), 3.46-3.32 (m, 3H), 3.26 (s, 3H), 3.10-3.01 (m, 1H), 2.90-2.82 (m, 1H), 1.17-1.11 (t, *J* = 8.4 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 176.0, 146.4, 129.1, 126.5, 125.5 (q, *J* = 276.9 Hz), 124.8 (q, *J* = 33.6 Hz), 122.5, 108.1, 74.0, 67.4, 49.5, 36.7 (q, *J* = 28.8 Hz), 26.7, 14.8; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.5; -61.6; HRMS calculated for $C_{15}H_{16}F_6NO_2$ (M + $H^+$): 356.1085, found: 356.1083.



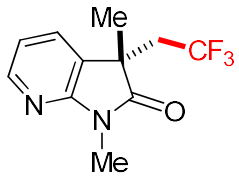

**5i**: (Ar = Ph)

**4,4,4-trifluoro-*N*-methyl-2-phenyl-*N*-(4-(trifluoromethyl)phenyl)butanamide (5i):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.66-7.64 (d, *J* = 8.0 Hz, 2H), 7.26-7.24 (m, 2H), 7.10-6.98 (m, 2H), 6.98-6.97 (m, 2H), 3.76-3.73 (m, 1H), 3.26 (s, 4H), 2.29-2.22 (m, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 170.6, 146.3, 137.7, 129.0, 128.5, 127.9, 127.7, 126.3, 126.2 (q, *J* = 276.0 Hz), 43.1, 38.4 (q, *J* = 27.8 Hz), 37.9; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.5, -65.1; HRMS calculated for $C_{18}H_{16}F_6NO$ (M + $H^+$): 376.1136, found: 376.1131.



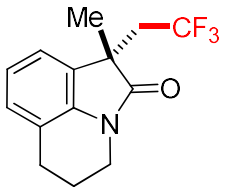

**5j**: (Ar = *p*-Cl-Ph)

**2-(4-chlorophenyl)-4,4,4-trifluoro-*N*-methyl-*N*-(4-(trifluoromethyl)phenyl)butan amide (5j):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.70-7.68 (d, *J* = 8.8 Hz, 2H), 7.25-7.23 (d, *J* = 8.8 Hz, 2H), 7.14-7.13 (m, 2H), 6.95-6.93 (d, *J* = 8.8 Hz, 2H), 3.76-3.73 (m, 1H), 3.27 (s, 3H), 3.26-3.19 (m, 1H), 2.29-2.21 (m, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 170.6, 146.1, 136.1, 133.9, 130.9, 129.2, 129.1, 128.4, 127.2, 126.4 (q, *J* = 279.9 Hz), 123.5 (q, *J* = 236.7 Hz), 42.4, 38.3 (q, *J* = 27.8 Hz), 38.0; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -62.5, -65.1; HRMS calculated for $C_{18}H_{15}ClF_6NO$ ($M + H^+$): 410.0746, found: 410.0740.



**5k**

**1,3-dimethyl-3-(2,2,2-trifluoroethyl)-1*H*-pyrrolo[2,3-*b*]pyridin-2(3*H*)-one (5k):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.24-8.23 (d, *J* = 5.6 Hz, 1H), 7.53-7.51 (d, *J* = 7.2 Hz, 1H), 7.02-6.99 (m, 1H), 3.33 (s, 3H), 2.83-2.79 (m, 1H), 2.70-2.68 (m, 1H), 1.44 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 178.2, 156.3, 147.6, 131.3, 125.5, 125.2 (q, *J* = 276.9 Hz), 118.3, 44.2, 40.2 (q, *J* = 27.8 Hz), 25.7, 24.3; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -61.6; HRMS calculated for $C_{11}H_{12}F_3N_2O$ ($M + H^+$): 245.0902, found: 245.0820.

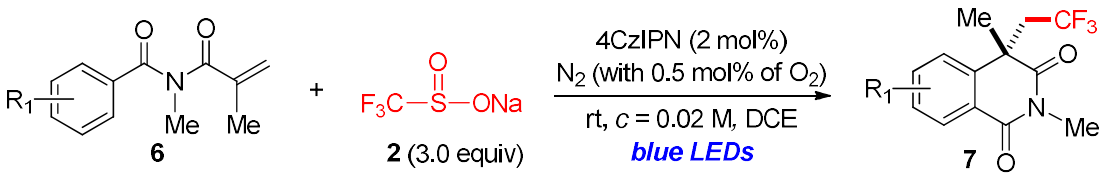


**5l**

**1-methyl-1-(2,2,2-trifluoroethyl)-5,6-dihydro-1*H*-pyrrolo[3,2,1-*ij*]quinolin-2(4*H*)-one (5l):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.11-7.10 (d, *J* = 4.0 Hz, 1H), 7.07-7.05 (d, *J*

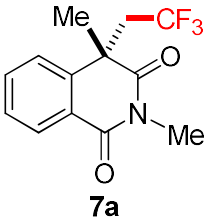
= 8.0 Hz, 1H), 6.99-6.96 (m, 1H), 3.74-3.71 (m, 2H), 2.81-2.78 (m, 3H), 2.75-2.50 (m, 1H), 2.04-2.00 (m, 2H), 1.42 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 177.4, 138.7, 129.8, 127.4, 125.5 (q, *J* = 276.9 Hz), 122.2, 121.6, 120.6, 45.7, 40.5 (q, *J* = 27.8 Hz), 39.1, 24.7, 24.6, 21.2. These data are consistent with literature values, see: Yang, F.; Klumphu, P.; Liang, Y.-M.; Lipshutz, B. H. *Chem. Commun.* **2014**, *50*, 936.

## General procedure for $CF_3$-containing isoquinolinediones synthesis




A flame-dried flask (15 mL) was equipped with magnetic stir bar and charged with *N*-acryl-acrylamides **6** (0.145 mmol, 1.0 equiv), $CF_3SO_2Na$ **2** (0.435 mmol, 3.0 equiv), 1,2,3,5-tetrakis(carbazol-9-yl)-4,6-dicyanobenzene (4CzIPN) (0.00290 mmol, 0.02 equiv), and DCE (8.0 mL). The reaction mixture was degassed by purging thoroughly with nitrogen (with 0.5 mol % of oxygen) for 10 minutes, then irradiated by blue LED (18 *W*) under a balloon nitrogen atmosphere (with 0.5 mol % of oxygen) at room temperature until the starting material disappeared from the TLC. After that the reaction mixture was directly concentrated under reduced pressure and the crude product was purified by silica gel column chromatography using hexane/EtOAc (10/1 to 4/1) to afford the desired pure product **7** in 71-85% yield.

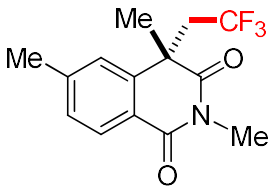
## $^1$H NMR and $^{13}$C NMR spectra data of compounds 7a-7d




**7a**

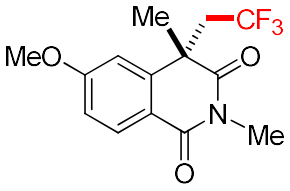
**2,4-dimethyl-4-(2,2,2-trifluoroethyl)isoquinoline-1,3(2*H*,4*H*)-dione (7a):** $^1$H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, *J* = 8.0 Hz, 1H), 7.67-7.65 (m, 1H), 7.51-7.47 (m, 1H),

7.44-7.42 (d, $J$ = 8.0 Hz, 1H), 3.41 (s, 3H), 3.40-3.33 (m, 1H), 2.84-2.77 (m, 1H), 1.66 (s , 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 174.7, 163.9, 140.4, 137.6, 133.9, 130.3, 129.4, 128.2, 125.7, 125.2 (q, $J$ = 276.9 Hz), 44.3 (q, $J$ = 27.7 Hz), 43.6, 31.3, 27.5. These data are consistent with literature values, see: Liu, C.; Zhao, W.; Huang, Y.; Wang, H.; Zhang, B. *Tetrahedron* **2015**, *71*, 4344.




**7b**

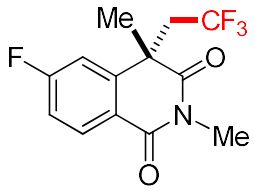
**2,4,6-trimethyl-4-(2,2,2-trifluoroethyl)isoquinoline-1,3(2*H*,4*H*)-dione (7b):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, $J$ = 8.0 Hz, 1H), 7.27 (d, $J$ = 8.0 Hz, 1H), 7.19 (s, 1H), 3.40 (s, 3H), 3.39-3.26 (m, 1H), 2.85-2.74 (m, 1H), 2.46 (s, 3H), 1.64 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 174.8, 163.9, 144.8, 140.4, 129.4, 126.1, 125.0 (q, $J$ = 277.9 Hz), 121.8, 44.3 (q, $J$ = 27.8 Hz), 43.6, 31.3, 27.4, 22.0. These data are consistent with literature values, see: Zheng, L.; Yang, C.; Xu, Z.; Gao, F.; Xia, W. *J. Org. Chem.* **2015**, *80*, 5730.




**7c**

**6-methoxy-2,4-dimethyl-4-(2,2,2-trifluoroethyl)isoquinoline-1,3(2*H*,4*H*)-dione (7c):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.25 (d, $J$ = 8.8 Hz, 1H), 7.02-6.99 (dd, $J$ = 8.8, 2.0 Hz, 1H), 6.85 (d, $J$ = 2.0 Hz, 1H), 3.90 (s, 3H), 3.38 (s, 3H), 3.38-3.31 (m, 1H), 2.79-2.73 (m, 1H), 1.65 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 174.7, 164.0, 163.5, 142.6, 131.8, 125.0 (q, $J$ = 277.0 Hz), 117.3, 113.7, 111.2, 55.7, 44.3 (q, $J$ = 26.8 Hz),

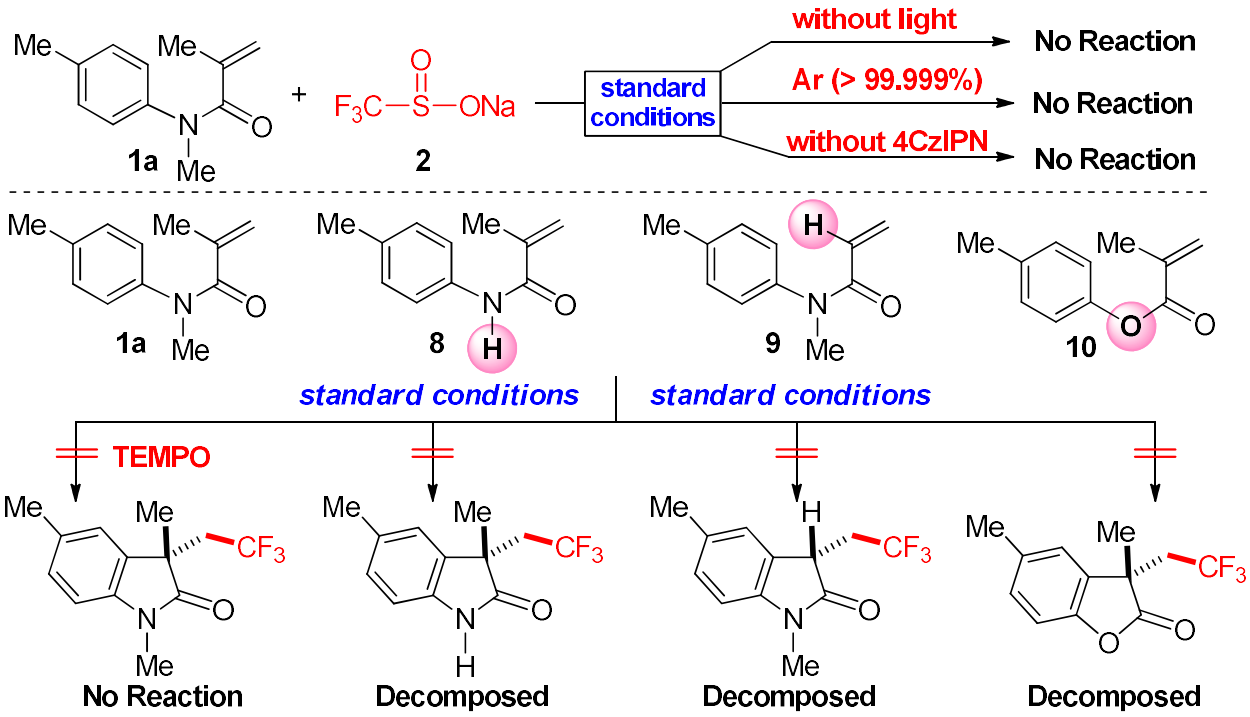
43.8, 31.4, 27.4. These data are consistent with literature values, see: Liu, C.; Zhao, W.; Huang, Y.; Wang, H.; Zhang, B. *Tetrahedron* **2015**, *71*, 4344.




**7d**

**6-fluoro-2,4-dimethyl-4-(2,2,2-trifluoroethyl)isoquinoline-1,3(2*H*,4*H*)-dione (7d):** $^{1}$H NMR (400 MHz, $CDCl_3$) δ 8.34-8.30 (m, 1H), 7.21-7.19 (m, 1H), 7.12-7.09 (m, 1H), 3.41 (s, 3H), 3.40-3.34 (m, 1H), 2.78-2.71 (m, 1H), 1.67 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 174.1, 167.5, 163.8 (d, $J$ = 207.0 Hz), 143.5, 132.5 (d, $J$ = 9.6 Hz), 124.9 (q, $J$ = 276.9 Hz), 120.8, 116.3 (d, $J$ = 22.1 Hz), 112.8 (d, $J$ = 26.0 Hz), 44.4 (q, $J$ = 27.8 Hz), 43.8, 31.1, 27.5. These data are consistent with literature values, see: Zheng, L.; Yang, C.; Xu, Z.; Gao, F.; Xia, W. *J. Org. Chem.* **2015**, *80*, 5730.

**Control experiments on reaction parameters**




It should be note that when the reaction mixture was carefully degassed by purging thoroughly with high purity argon (> 99.999%) for 45 mins, complete inhibition of the reactivity was observed under otherwise standard reaction conditions.

## On-off swithching of the visible light irradiation

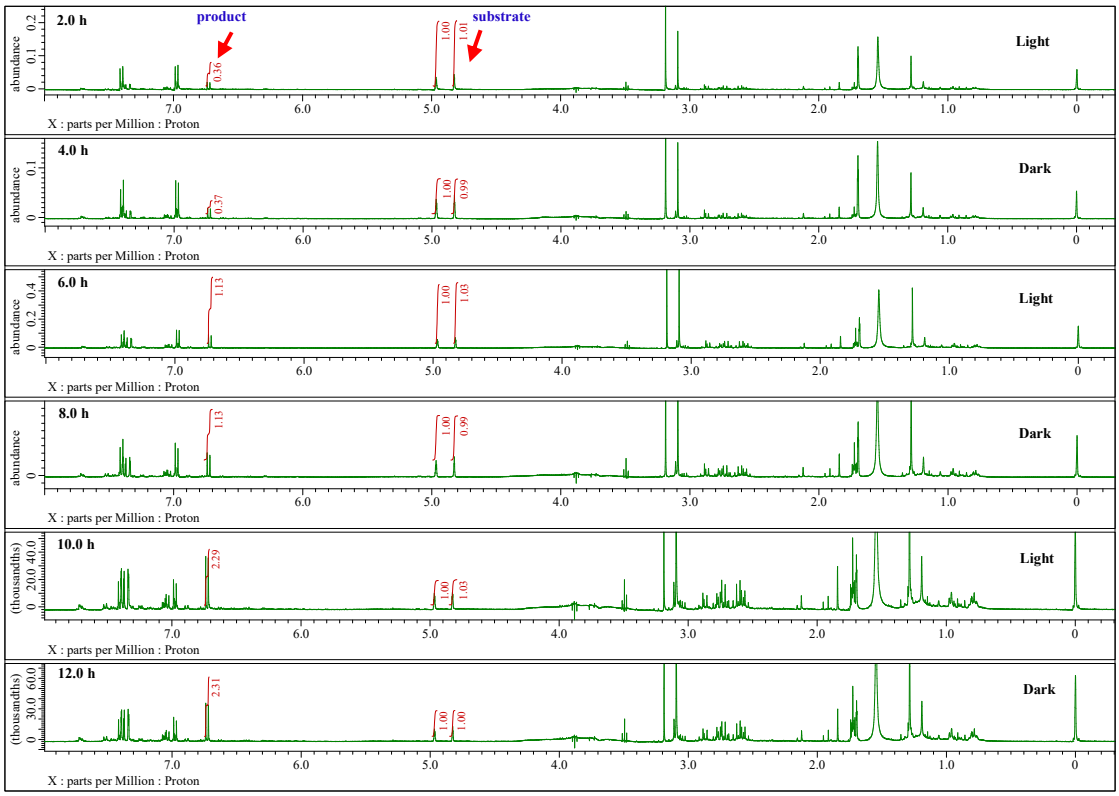



**Figure (a).** $^{1}$H NMR spectra copies of reaction of **1d** and $CF_3SO_2Na$ with different reaction time

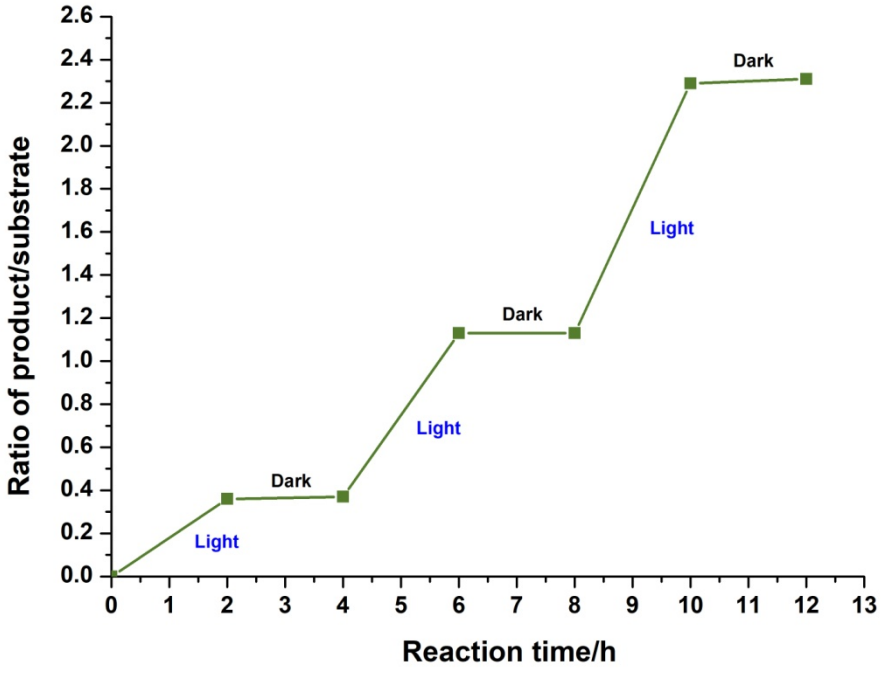



**Figure (b).** Time profile of visible-light-promoted trifluoromethylation/arylation of **1d** with $CF_3SO_2Na$

**Determination of the light intensity at 450 nm:**

The quantum yield was measured according to published procedures.[1] The photon flux of the spectrophotometer was determined by standard ferrioxalate actinometry.[1-2] A 0.15 M solution of ferrioxalate was prepared by dissolving 2.21 g of potassium ferrioxalate hydrate in 30 mL of 0.05 M $H_2SO_4$. A buffered solution of phenanthroline was prepared by dissolving 50 mg of phenanthroline and 11.25 g of sodium acetate in 50 mL of 0.5 M $H_2SO_4$. Both solutions were stored in the dark. To determine the photon flux of the spectrophotometer, 2.0 mL of the ferrioxalate solution was placed in a cuvette and irradiated for 90.0 seconds at $\lambda$ = 450 nm. After irradiation, 0.35 mL of the phenanthroline solution was added to the cuvette. The solution was then allowed to rest for 1 h to allow the ferrous ions to completely coordinate to the phenanthroline. The absorbance of the solution was measured at 510 nm. A non-irradiated sample was also prepared and the absorbance at 510 nm measured. Conversion was calculated using eq 1.

$$\text{mol } Fe^{2+} = (V*\Delta A)/(l*\varepsilon) \quad (1)$$

$$= (0.00235\text{L}*0.381)/(1.000\text{ cm}*11100\text{ L mol}^{-1}\text{ cm}^{-1})$$

$$= 8.07 \times 10^{-8}\text{ mol}$$

Where V is the total volume (0.00235 L) of the solution after addition of phenanthroline, $\Delta$A is the difference in absorbance at 510 nm between the irradiated and non-irradiated solutions, l is the path length (1.000 cm), and $\varepsilon$ is the molar absorptivity at 510 nm (11,100 L $mol^{-1}$ $cm^{-1}$).[1] The photon flux can be calculated using eq 2.

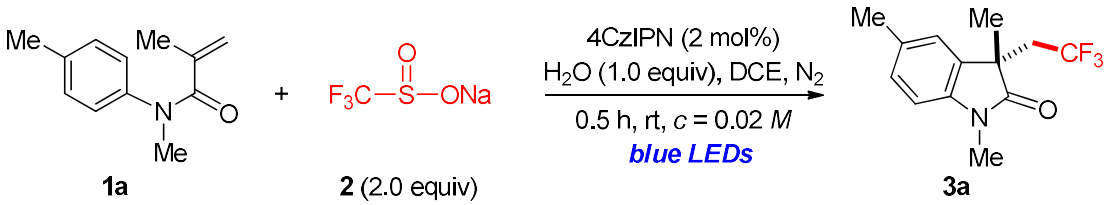
$$\text{photo flux} = (\text{mol } Fe^{2+})/(\Phi*t*f) \quad (2)$$

$$= (8.07 \times 10^{-8}\text{ mol})/(1.01*90\text{ s}*0.9553)$$

$$= 9.29 \times 10^{-10}\text{ einstein/s}$$

Where $\Phi$ is the quantum yield for the ferrioxalate actinometer (1.01 for a 0.15 M solution at $\lambda$ = 450 nm),[1] t is the time (90.0 s), and f is the fraction of light absorbed at $\lambda$ = 450 nm (0.9553, *vide infra*). The photon flux was calculated to be $9.29 \times 10^{-10}$ einstein $s^{-1}$.

**Determination of quantum yield:**




A cuvette was charged with *N*-aryl-acrylamides **1a** (0.068 mmol, 1.0 equiv), $CF_3SO_2Na$ **2** (0.136 mmol, 2.0 equiv), 4CzIPN (0.00014 mmol, 0.02 equiv), $H_2O$ (0.068 mmol, 1.0 equiv) and 3.0 mL DCE (0.022 M). The sample was stirred and irradiated (λ = 450 nm) for 1800 s (30 min). After irradiation, the solution was passed through a silica plug. The yield of product generated was determined by crude $^1H$ NMR to be 8.2% using 1,3,5-trimethoxybenzene as an internal standard. The quantum yield was determined using eq 3. Essentially all incident light (f > 0.999, *vide infra*) is absorbed by the 4CzIPN at the reaction conditions described above.

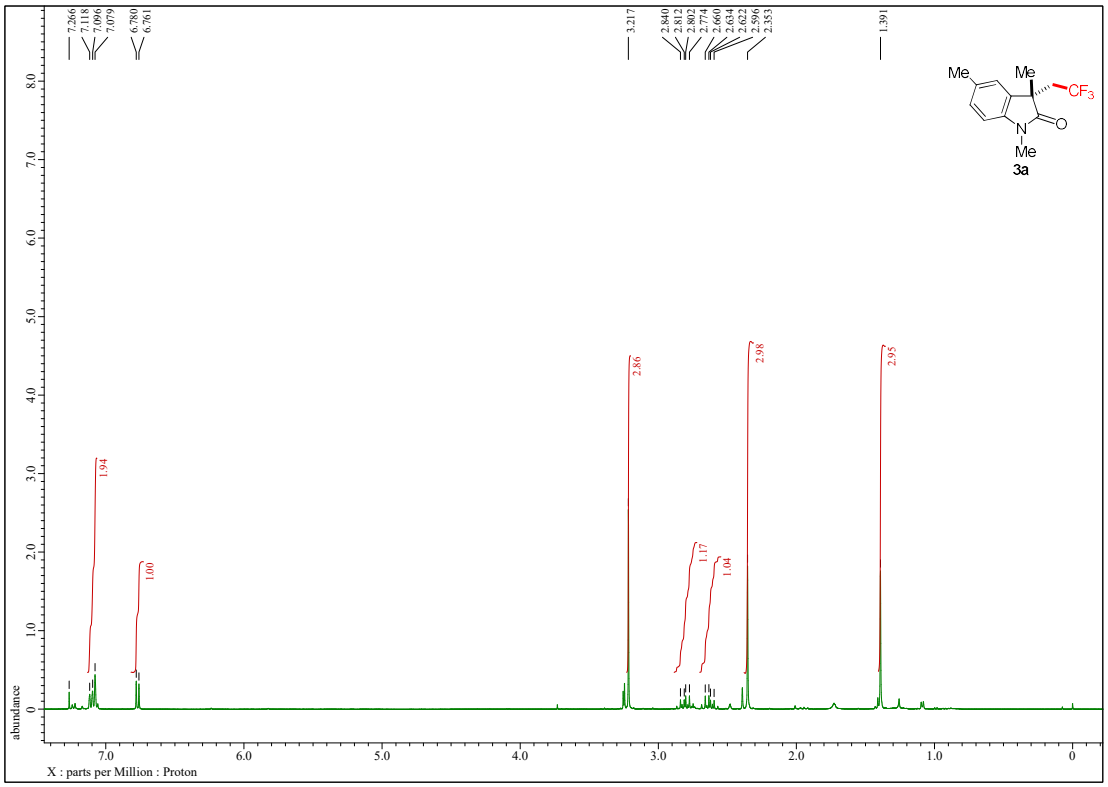
$$\Phi = (\text{mol product})/(\text{photo flux} * t * f) \qquad (3)$$

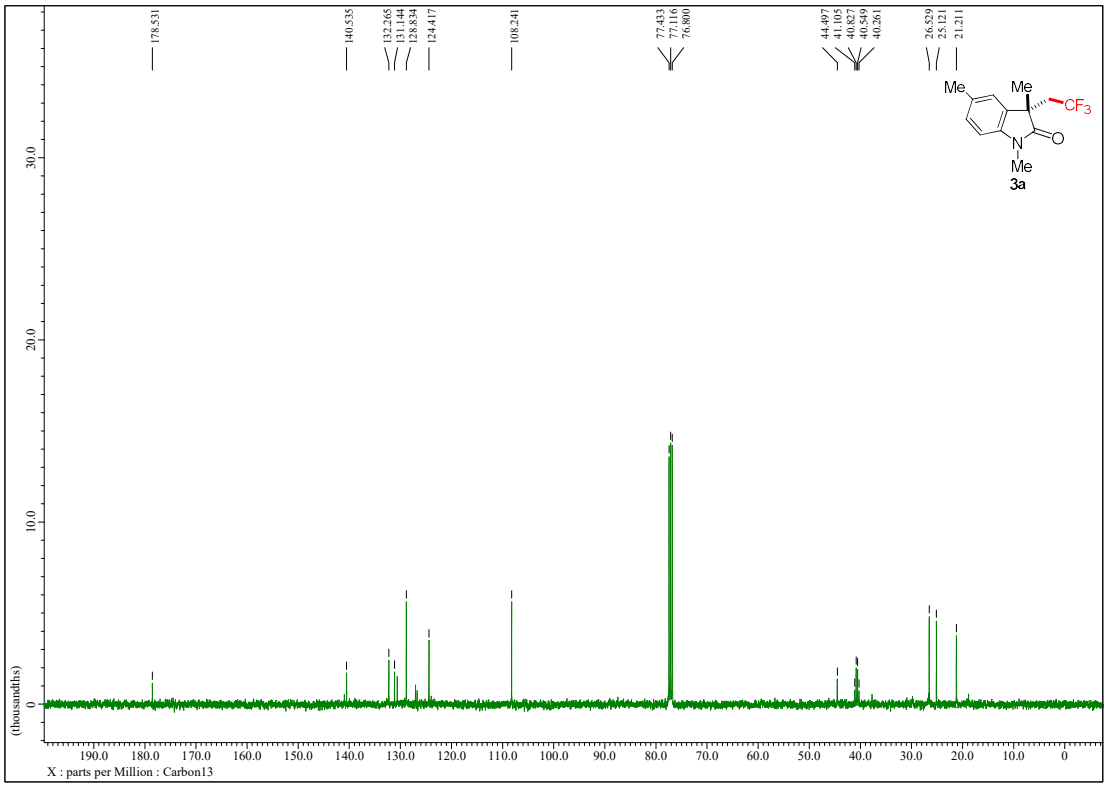
$$= (5.57 \times 10^{-6}\ \text{mol})/(9.29 \times 10^{-10}\ \text{einstein/s} * 1800\ \text{s} * 1) = 3.33$$

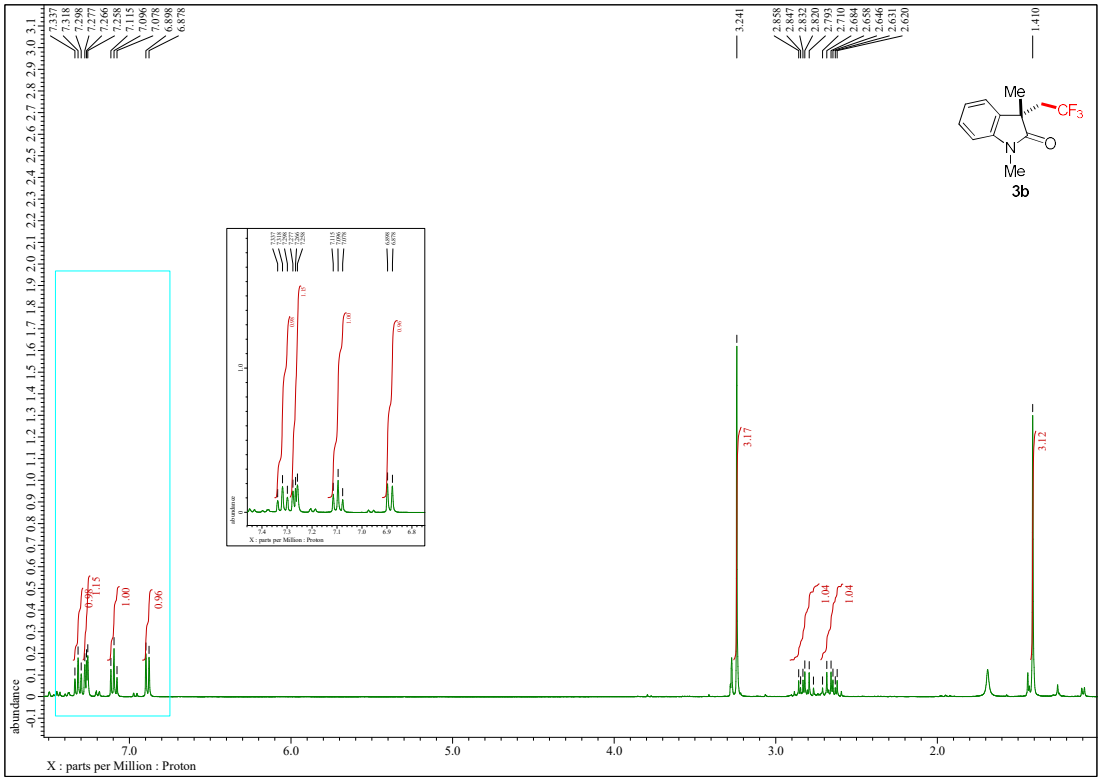

1. a) Hatchard, C. G.; Parker, C. A. *Proc. Roy. Soc. (London)* **1956**, *A235*, 518. b) Cismesia, M. A.; Yoon, T. P. *Chem. Sci.* **2015**, *6*, 5426.

2. a) Kuhn, H. J.; Braslavsky, S. E.; Schmidt, R. *Pure Appl. Chem.* **2004**, *76*, 2105. b) Monalti, M. *et. al.* Chemical Actinometry. *Handbook of Photochemistry*, 3rd Ed; Taylor & Francis Group, LLC. Boca Raton, FL, **2006**, 601.

# Copies of $^{1}$H NMR and $^{13}$C NMR spectra

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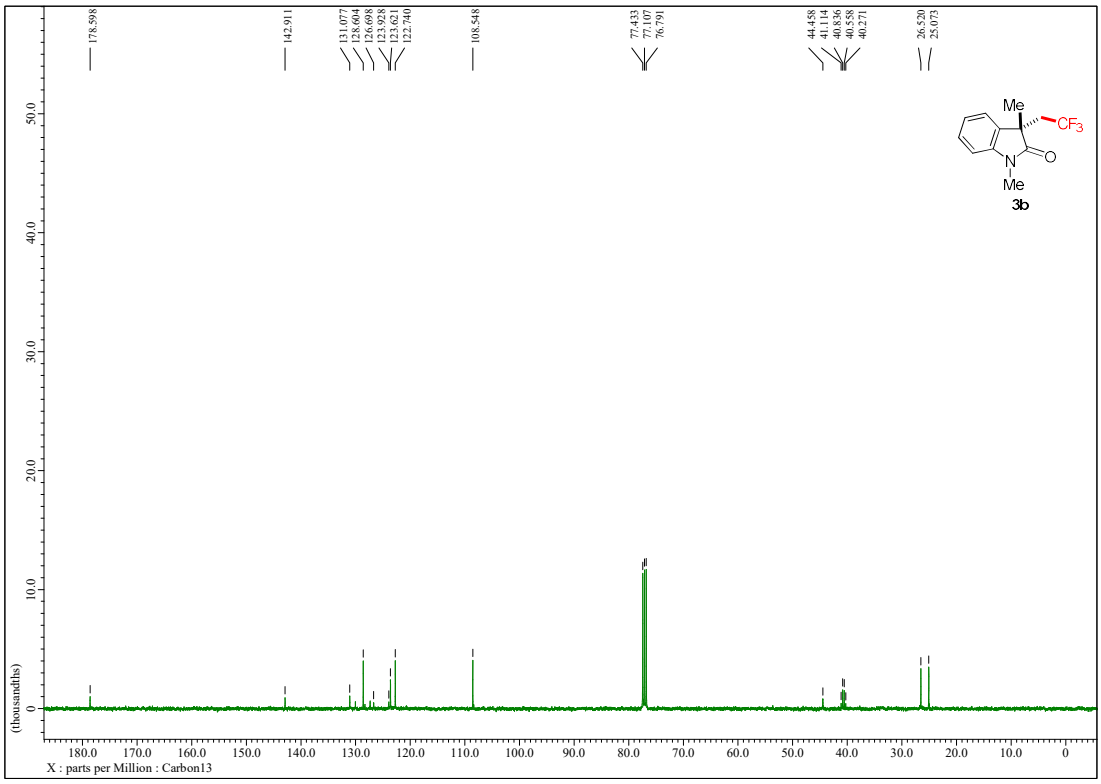
2.847
2.833
2.820
2.793
2.710
2.684
2.658
2.646
2.631
2.620
1.410
Me
CF3
N
O
Me
3b
0.98
1.15
1.00
0.96
3.17
1.04
1.04
3.12
abundance
X : parts per Million : Proton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77.433
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76.791
44.458
41.114
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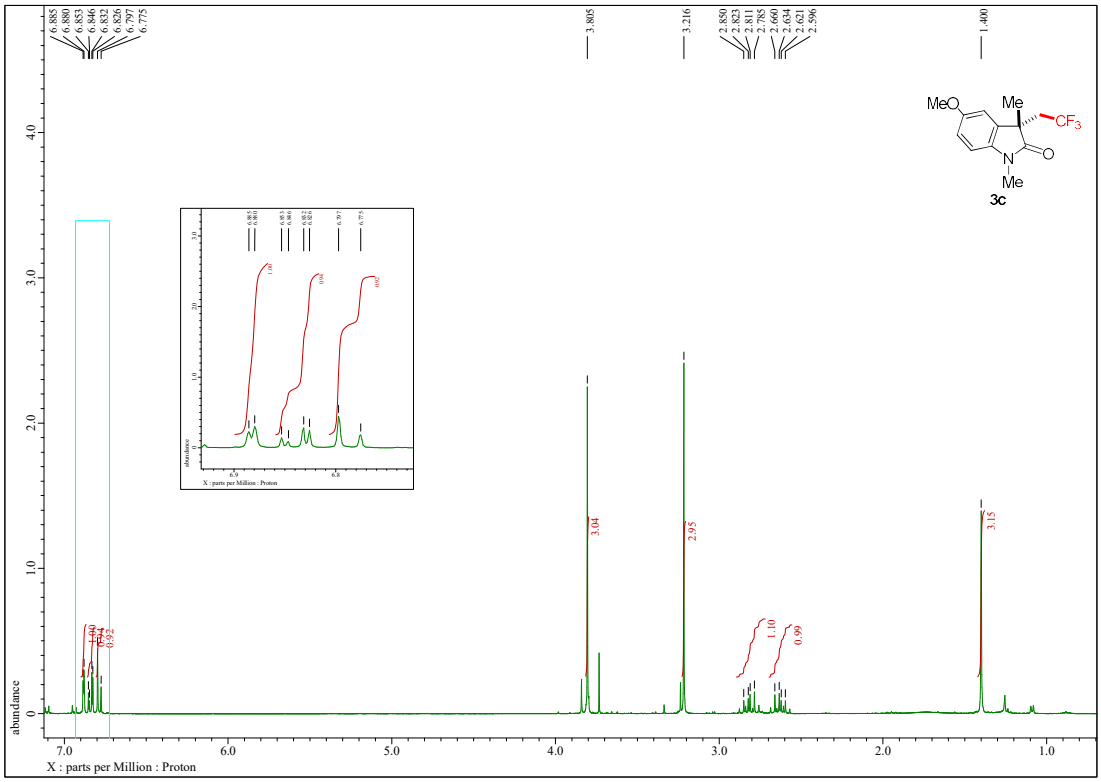
Me
CF3
N
O
Me
3b
(thousandths)
X : parts per Million : Carbon13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6.880
6.853
6.846
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6.826
6.797
6.775
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3.216
2.850
2.823
2.811
2.785
2.660
2.634
2.621
2.596
1.400
MeO
Me
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N
O
Me
3c
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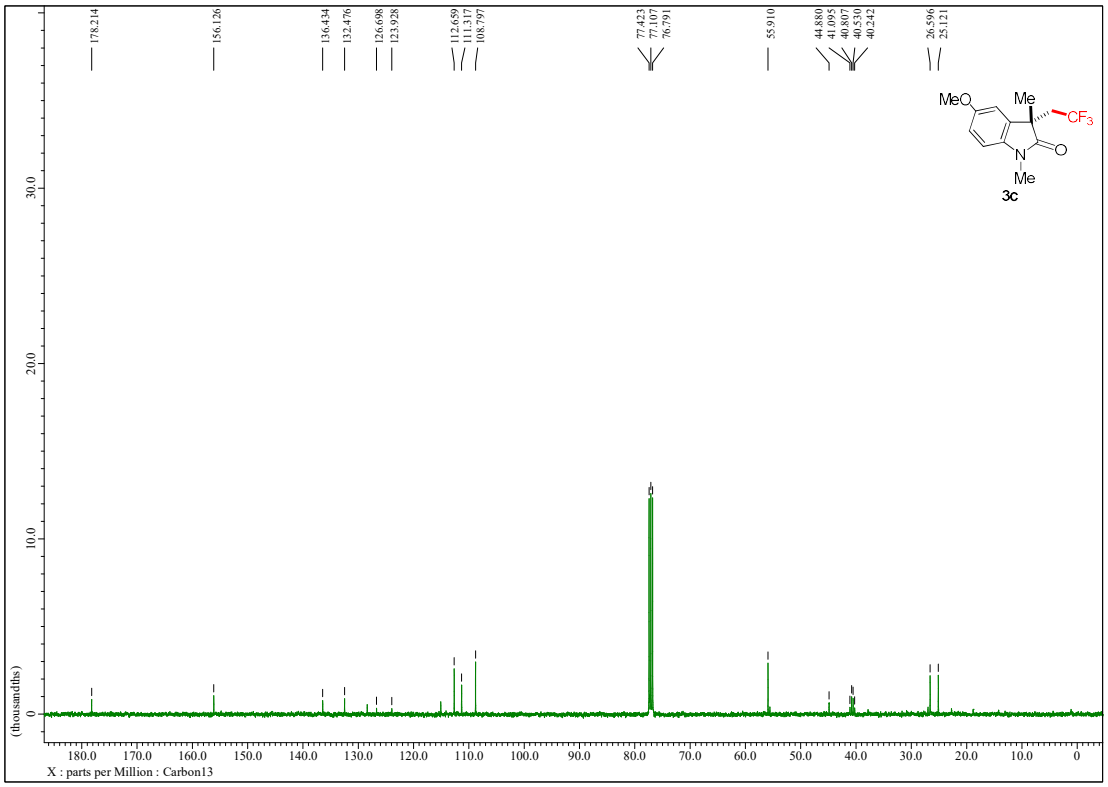
1.10
0.99
3.15
0.92
abundance
X : parts per Million : Proton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111.377
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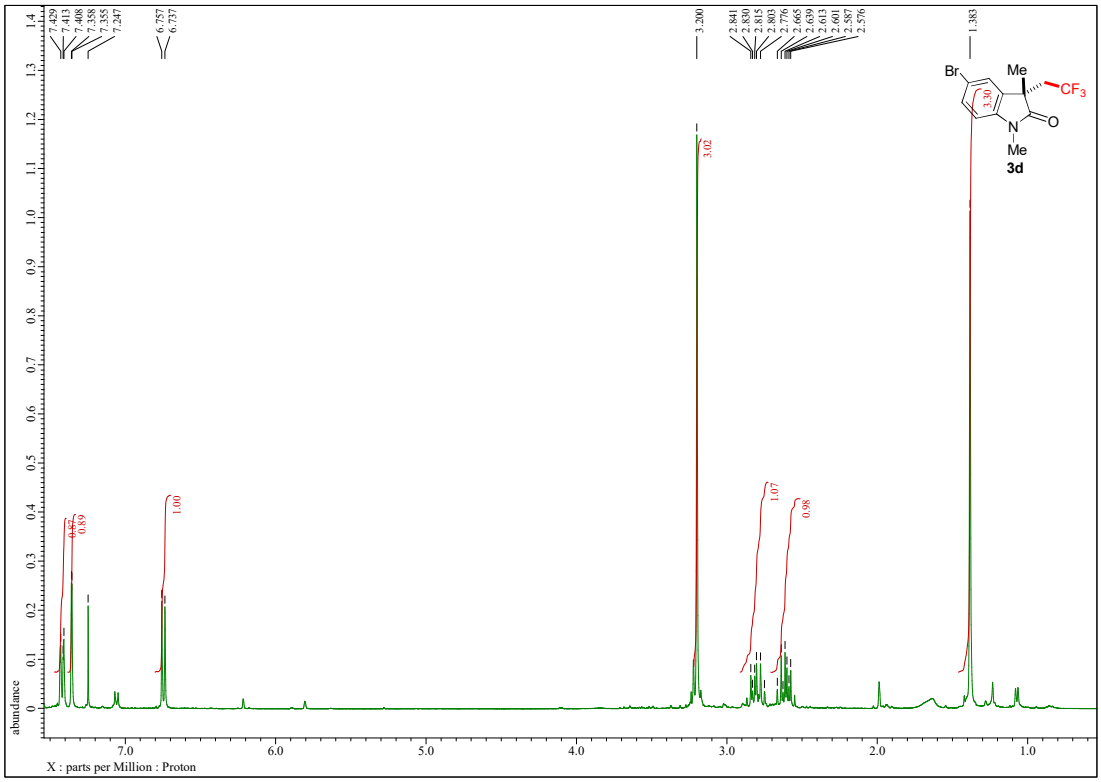
77.423
77.107
76.791
55.910
44.880
41.095
40.897
40.530
40.242
26.596
25.121
MeO
Me
CF3
N
O
Me
3c
(thousandths)
X : parts per Million : Carbon13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7.358
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6.737
3.200
2.841
2.830
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2.803
2.776
2.665
2.639
2.613
2.601
2.587
2.576
1.383
Br
Me
CF3
O
N
Me
3d
3.30
3.02
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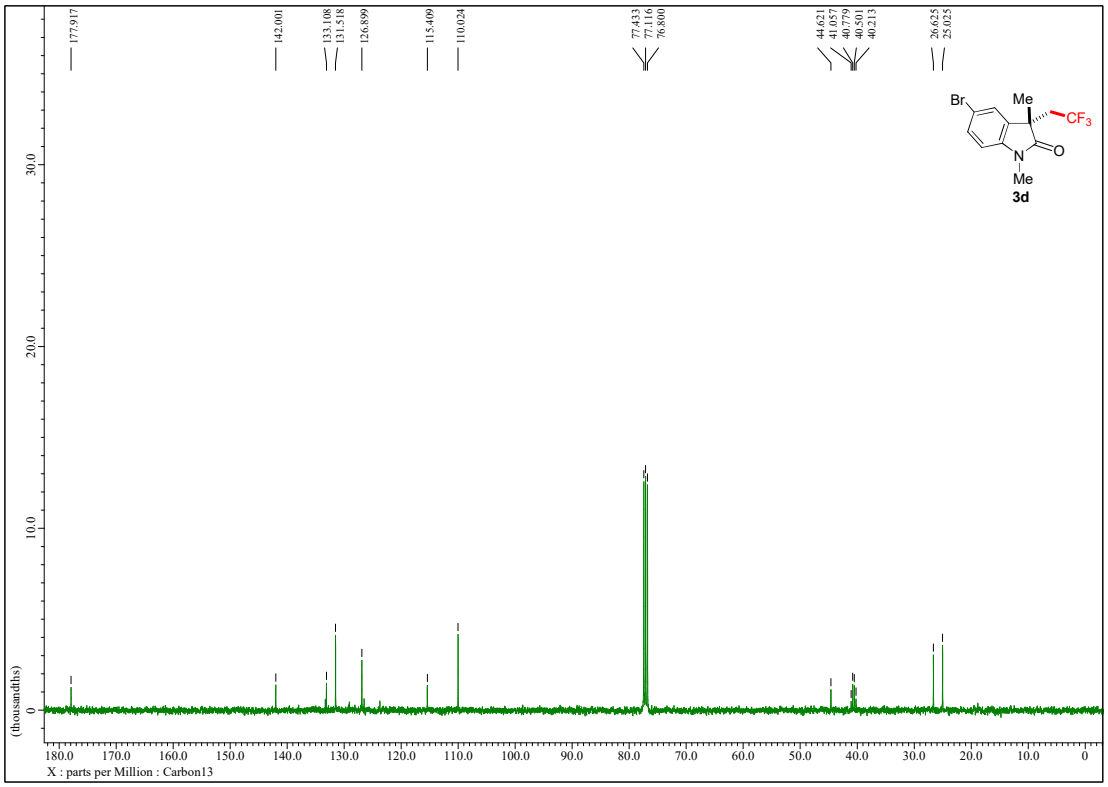
0.87
0.89
abundance
X : parts per Million : Proton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Me
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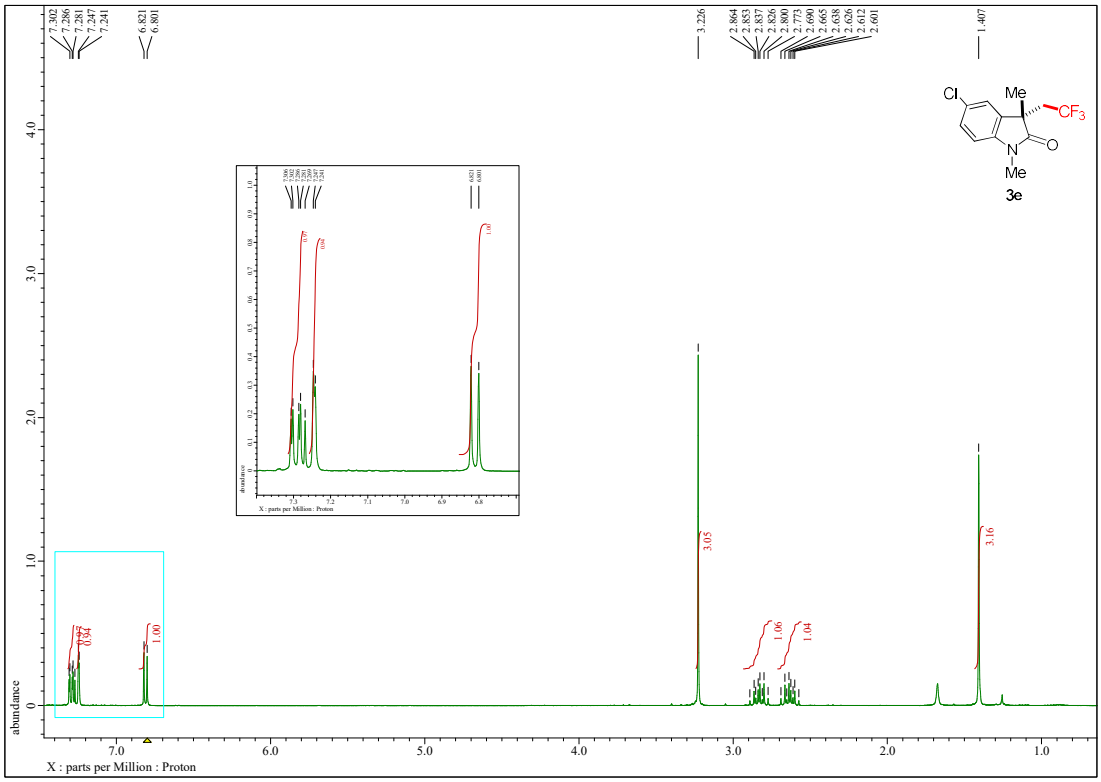
O
N
Me
3d
(thousandths)
X : parts per Million : Carbon13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2.826
2.800
2.773
2.690
2.665
2.638
2.626
2.612
2.601
1.407
Cl
Me
CF3
N
O
Me
3e
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3.16
1.06
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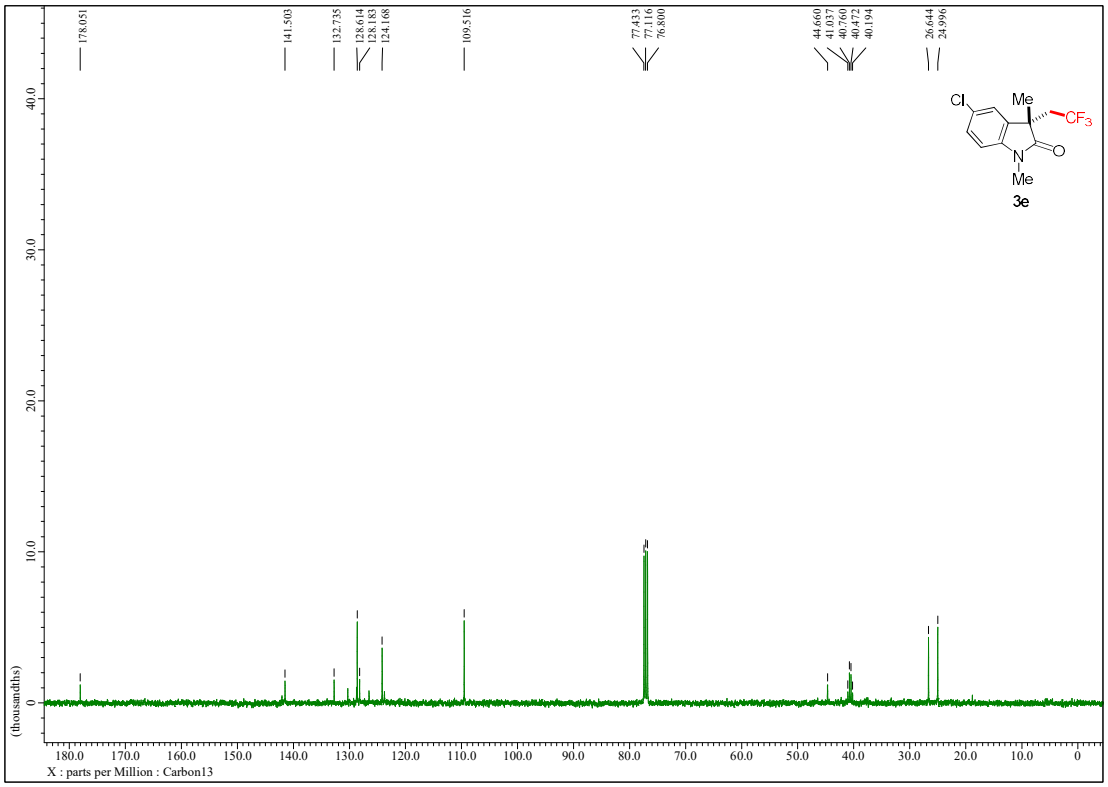
0.97
0.94
1.00
abundance
X : parts per Million : Proton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Cl
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CF3
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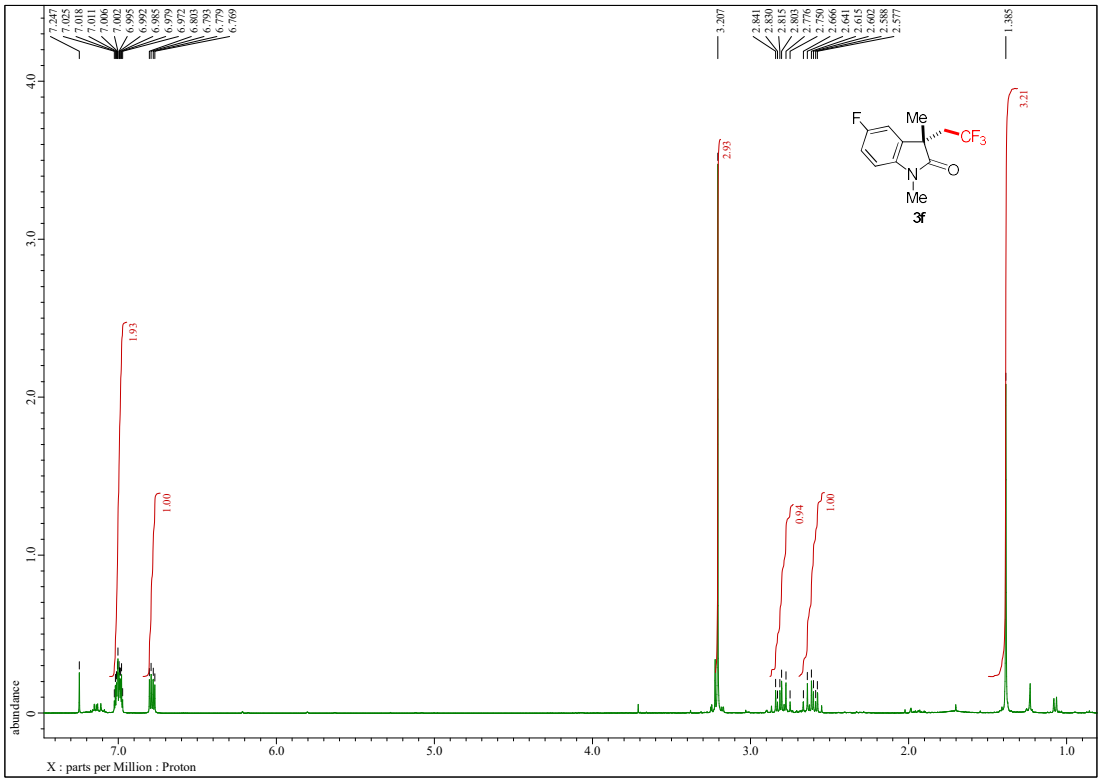
O
Me
3e
(thousandths)
X : parts per Million : Carbon13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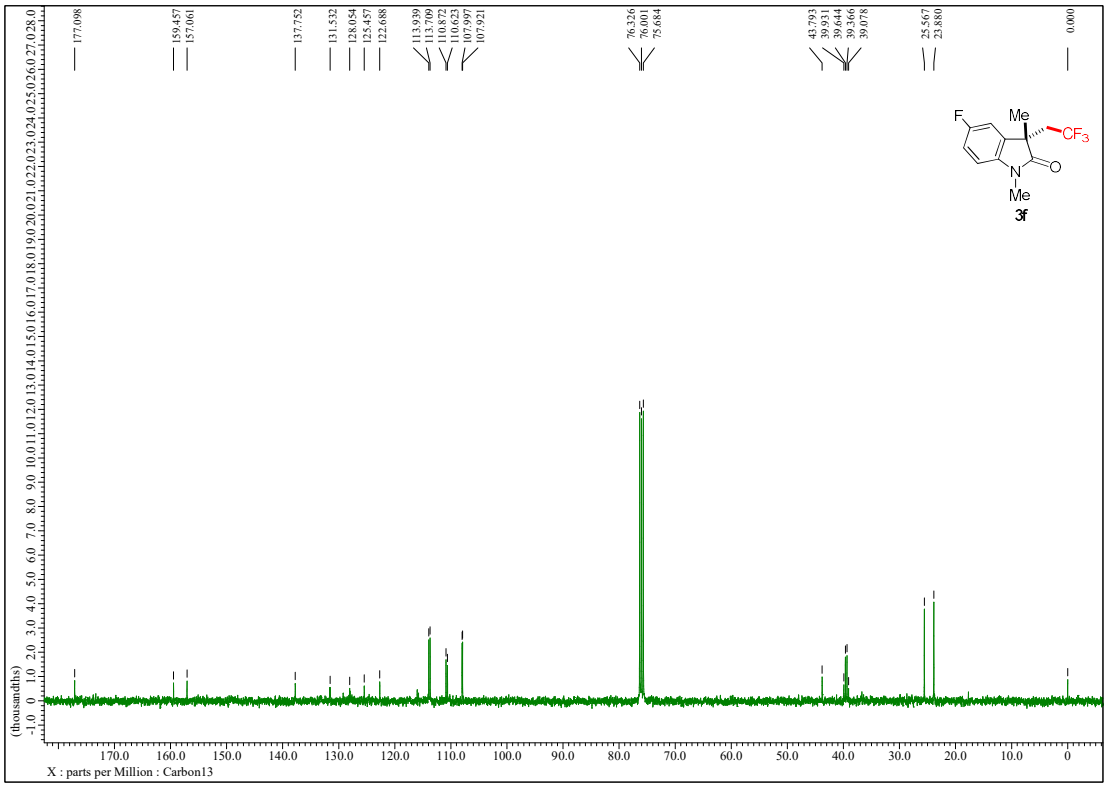
abundance
X : parts per Million : Proton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107.921
76.326
76.001
75.684
43.793
39.931
39.644
39.366
39.078
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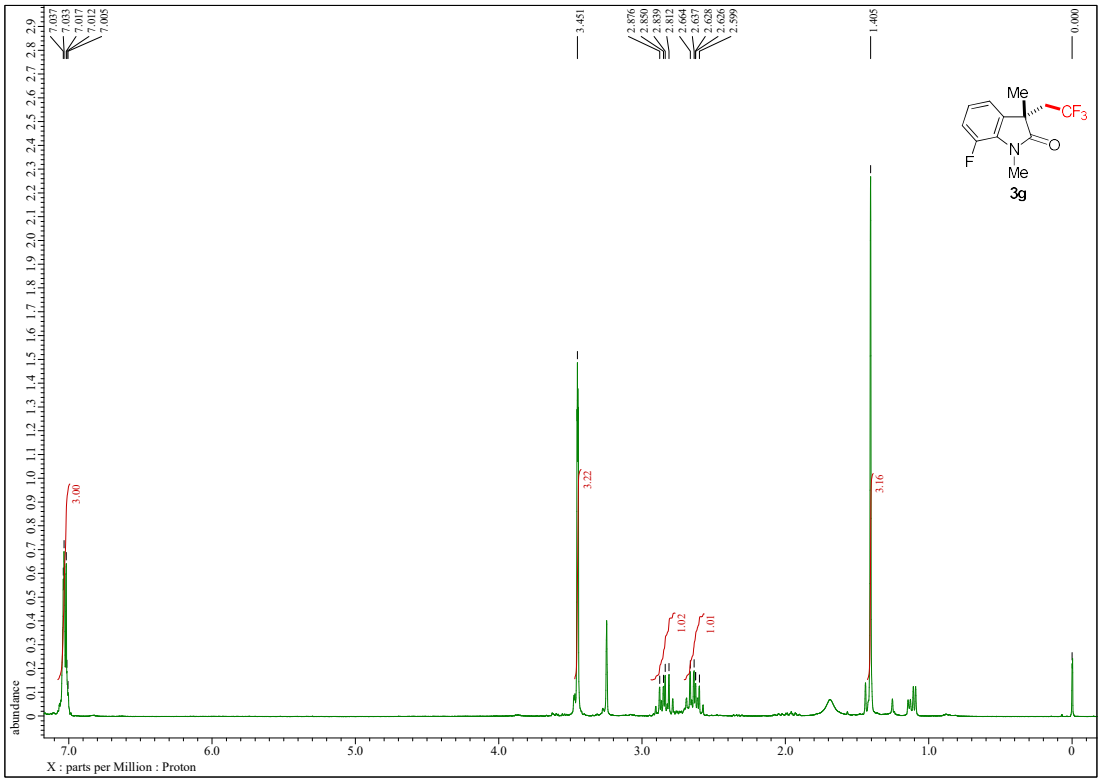
0.000
F
Me
CF3
N
O
Me
3f
(thousandths)
X : parts per Million : Carbon13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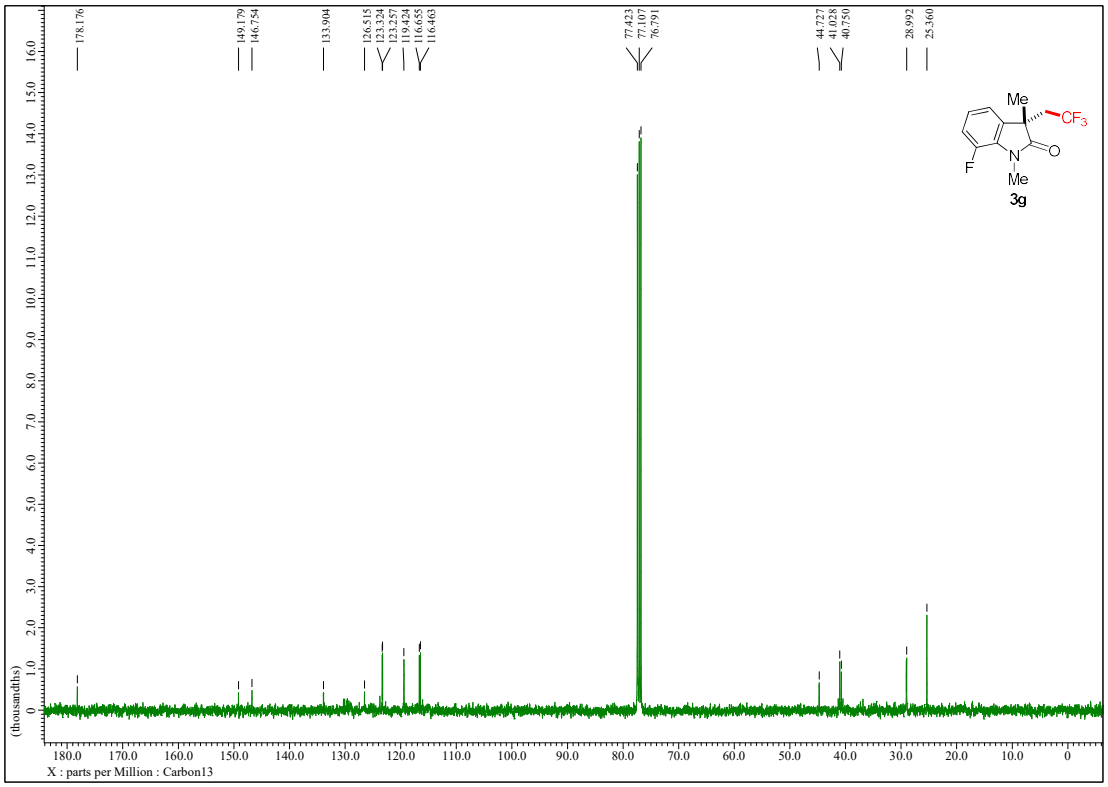
2.850
2.839
2.812
2.664
2.637
2.628
2.626
2.599
1.405
0.000
3.00
3.22
1.02
1.01
3.16
abundance
X : parts per Million : Proton
Me
CF3
F
N
O
Me
3g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76.791
44.727
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28.992
25.360
(thousandths)
X : parts per Million : Carbon13
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CF3
F
N
O
Me
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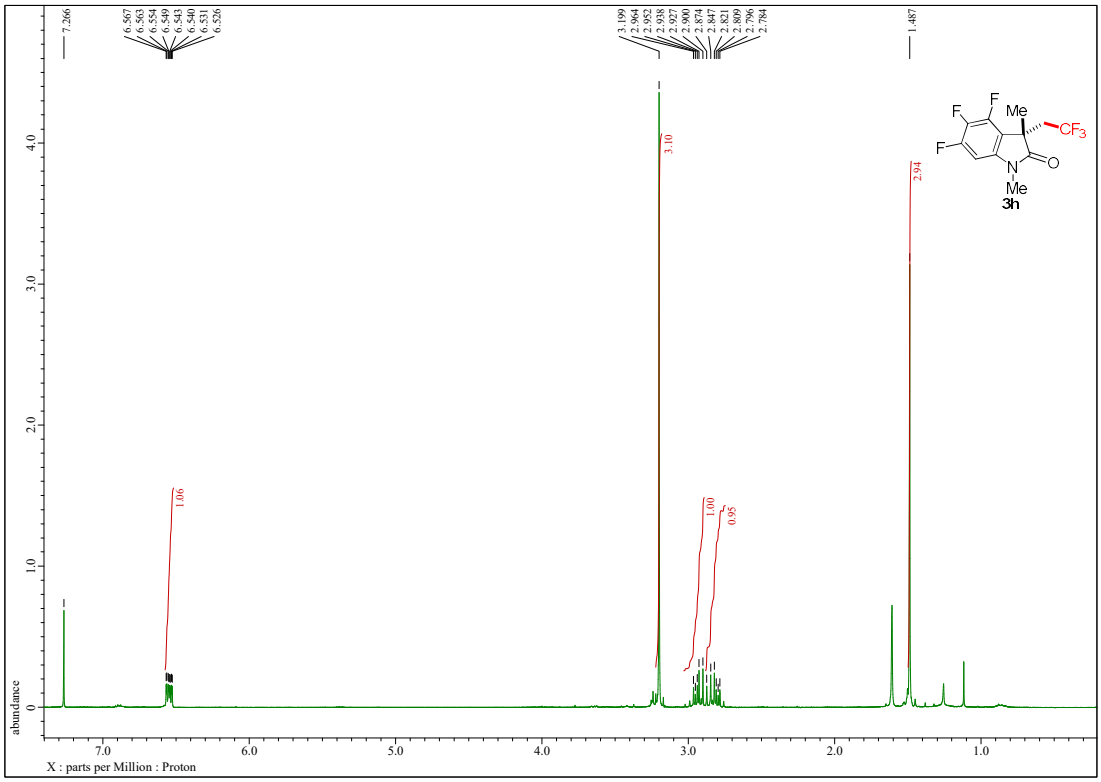
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2.900
2.874
2.847
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2.809
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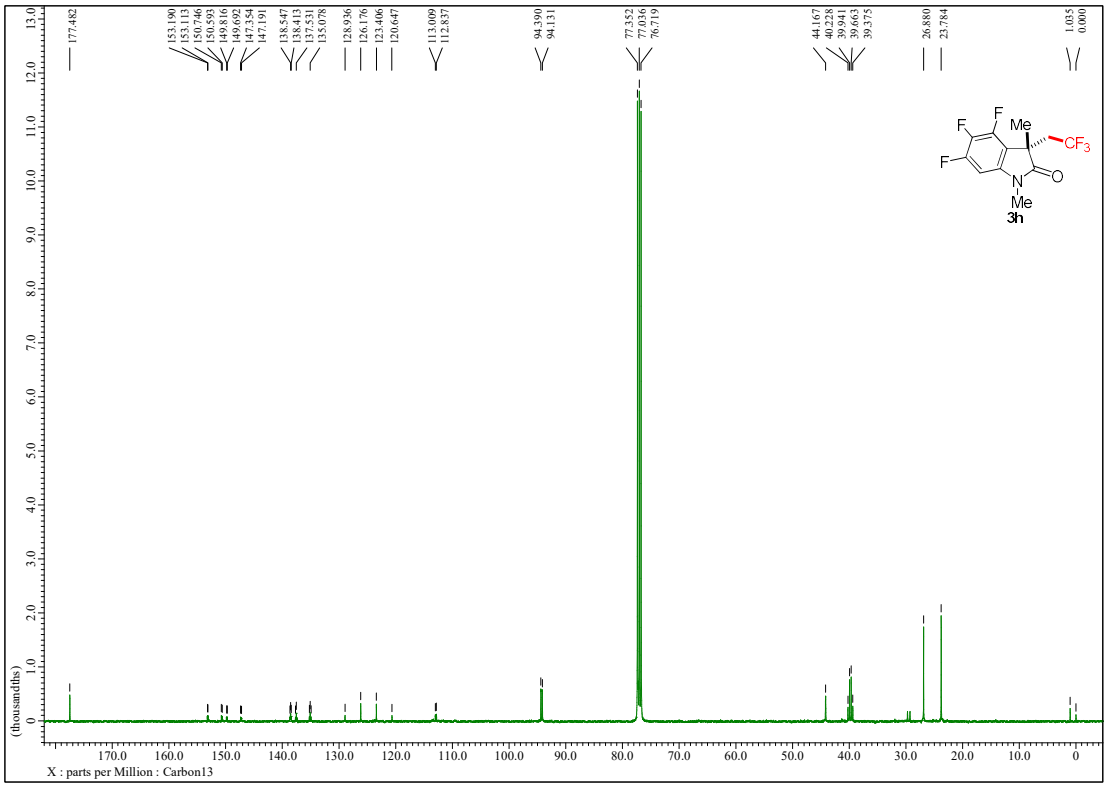
0.95
abundance
X : parts per Million : Proton
3h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44.167
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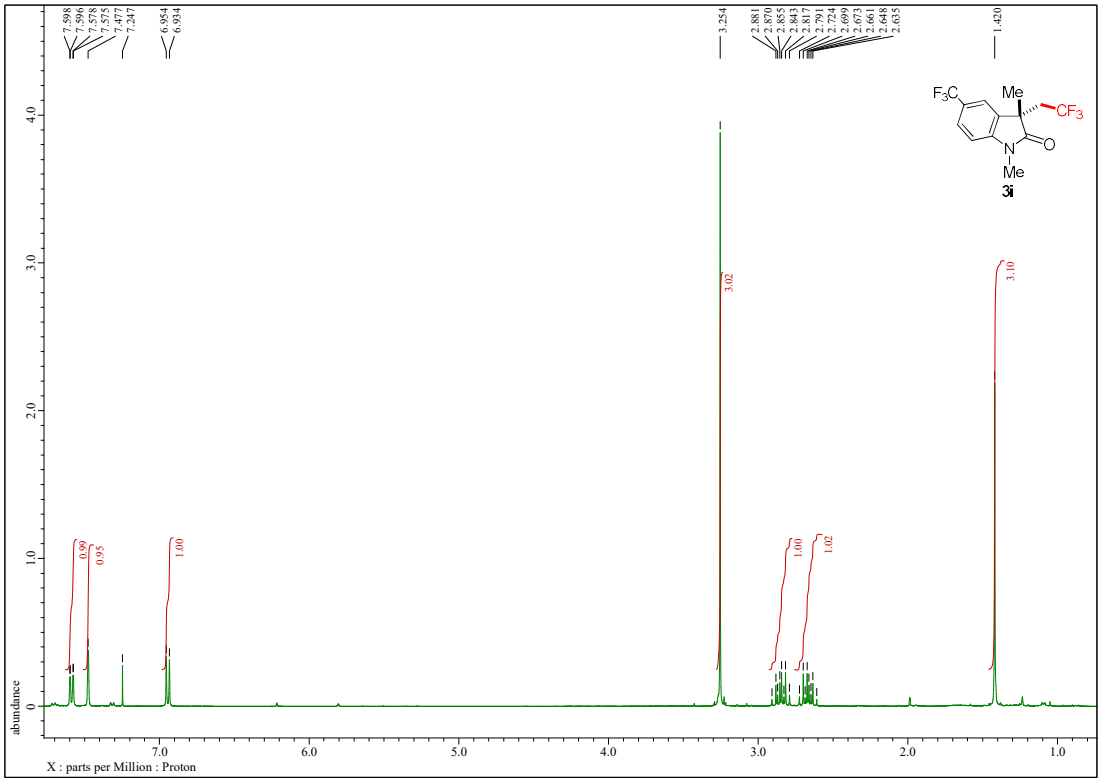
(thousandths)
X : parts per Million : Carbon13
3h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F3C
Me
CF3
N
O
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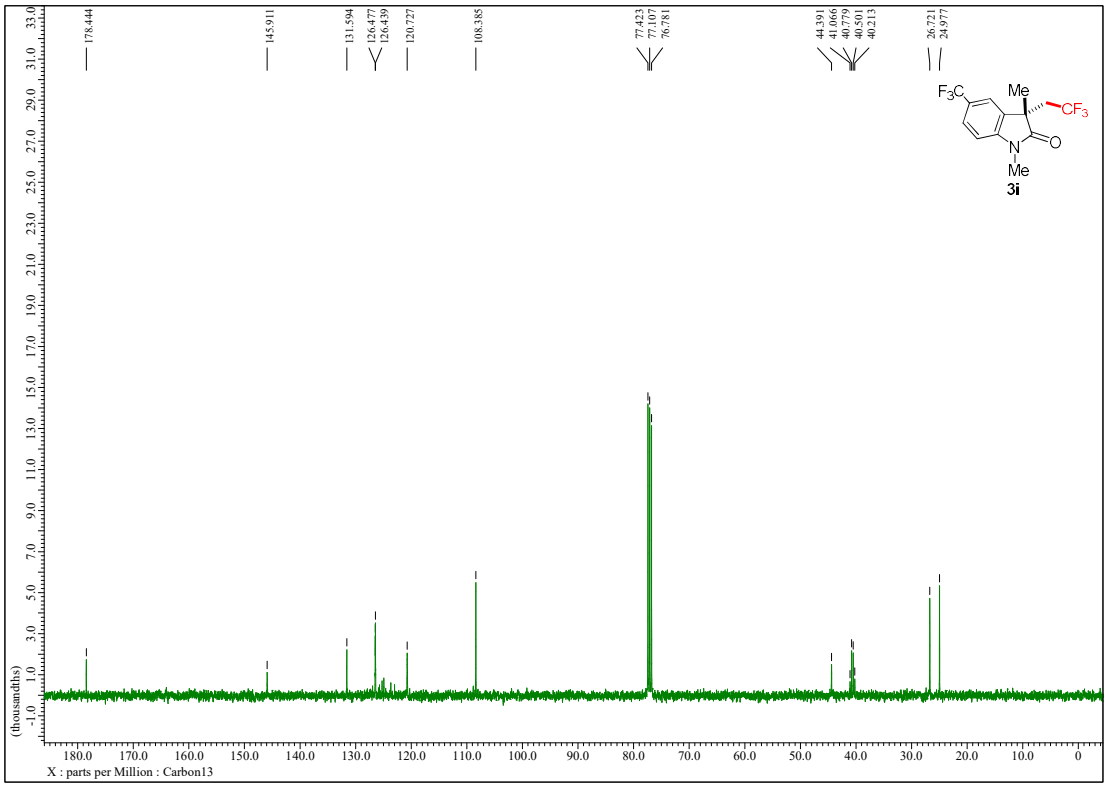
1.00
1.02
3.10
abundance
X : parts per Million : Proton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76.781
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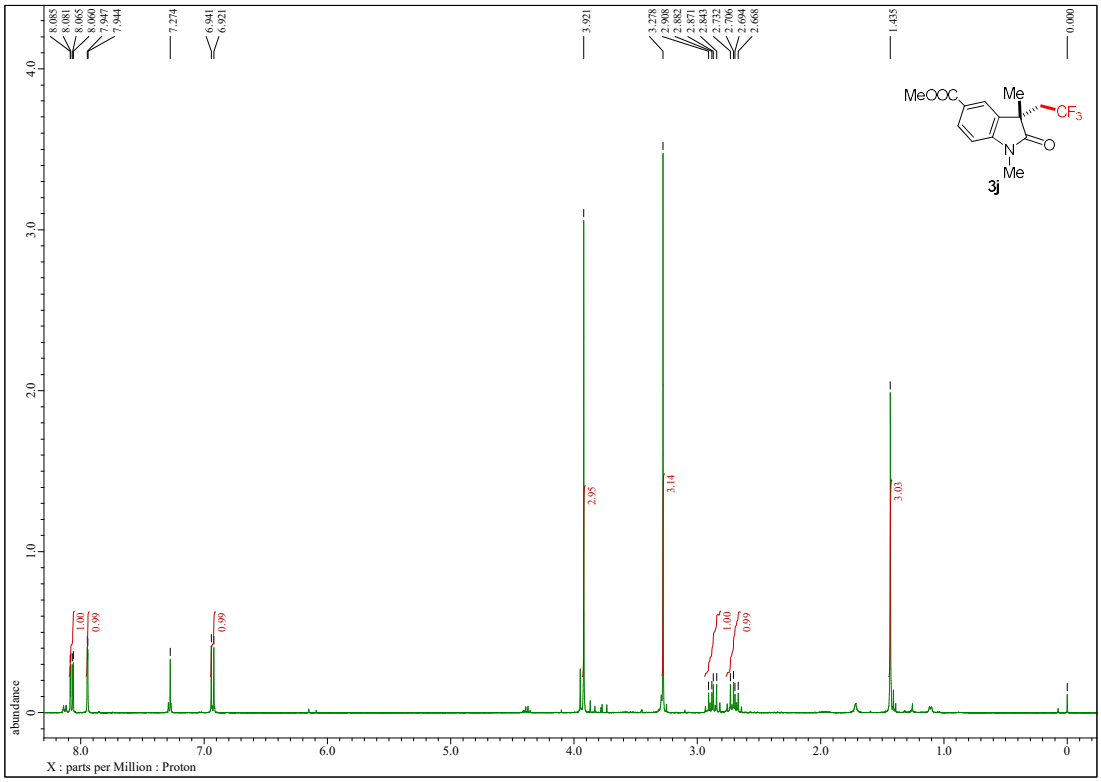
41.066
40.779
40.493
40.213
26.721
24.977
F3C
Me
CF3
N
O
Me
3i
(thousandths)
X : parts per Million : Carbon13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O
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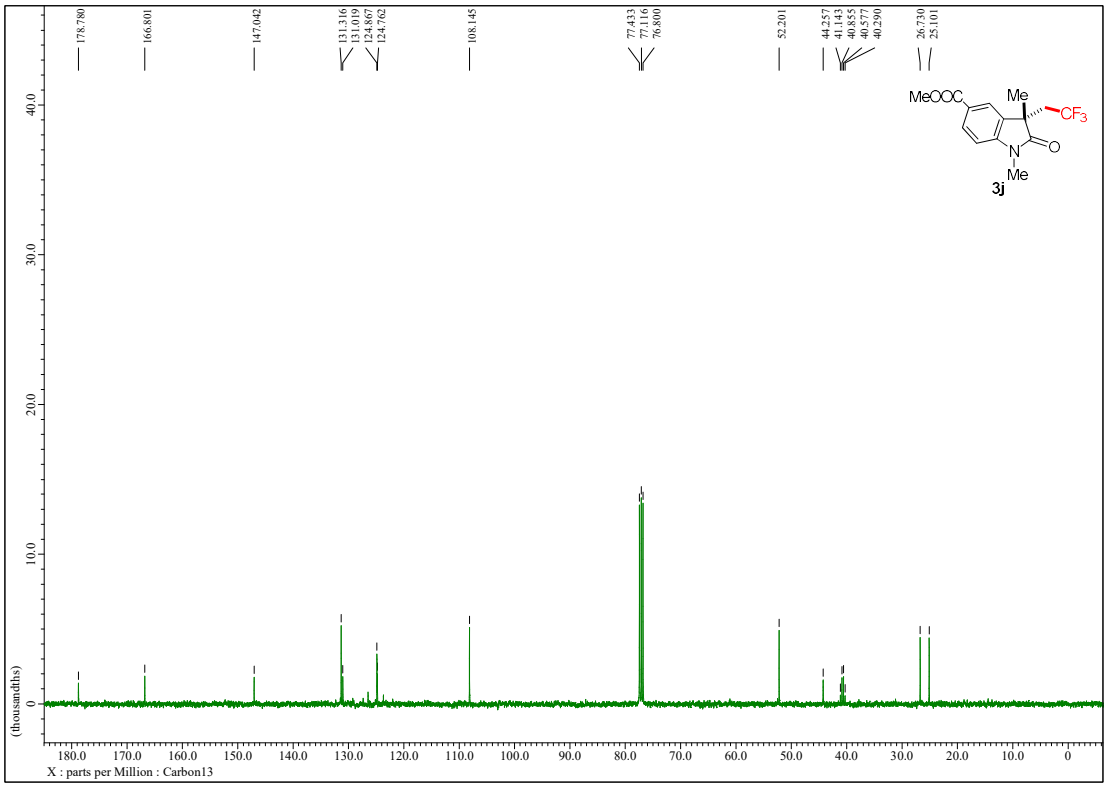
abundance
X : parts per Million : Proton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40.577
40.290
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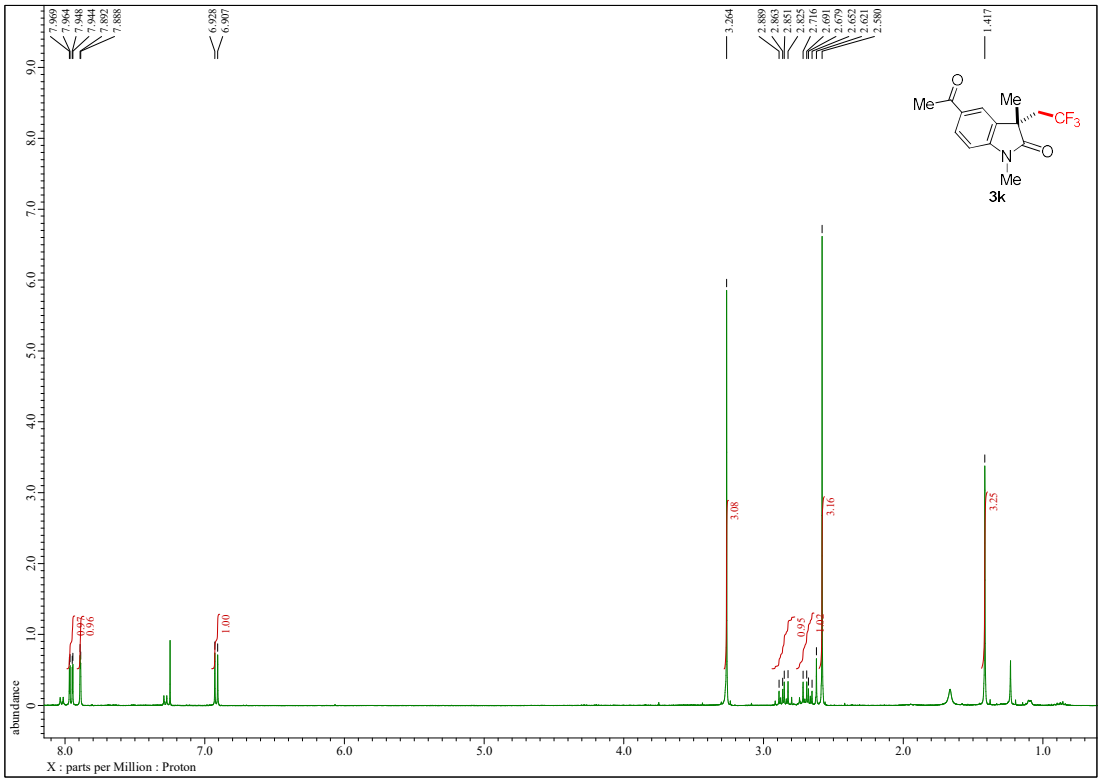
25.101
MeOOC
Me
CF3
N
O
Me
3j
(thousandths)
X : parts per Million : Carbon13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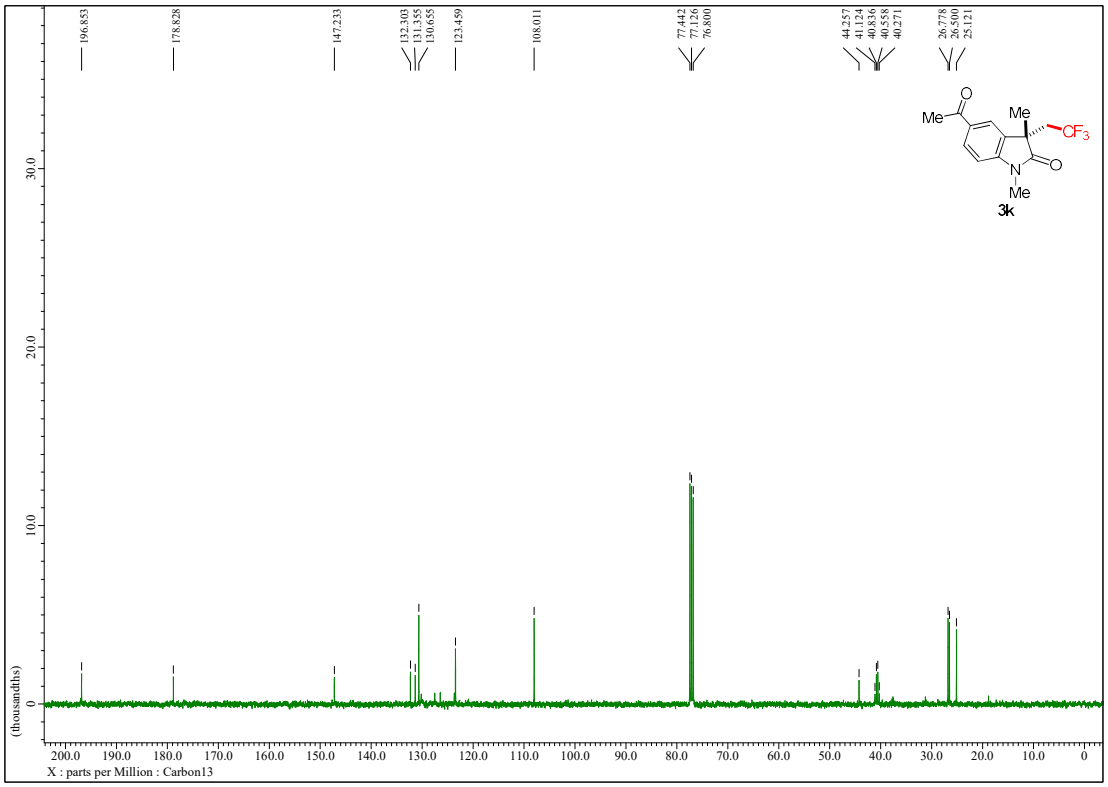
7.944
7.892
7.888
6.928
6.907
3.264
2.889
2.865
2.851
2.825
2.716
2.691
2.679
2.652
2.621
2.580
1.417
Me
Me
CF3
N
Me
3k
abundance
0.95
0.96
1.00
3.08
0.95
1.02
3.16
3.25
X : parts per Million : Proton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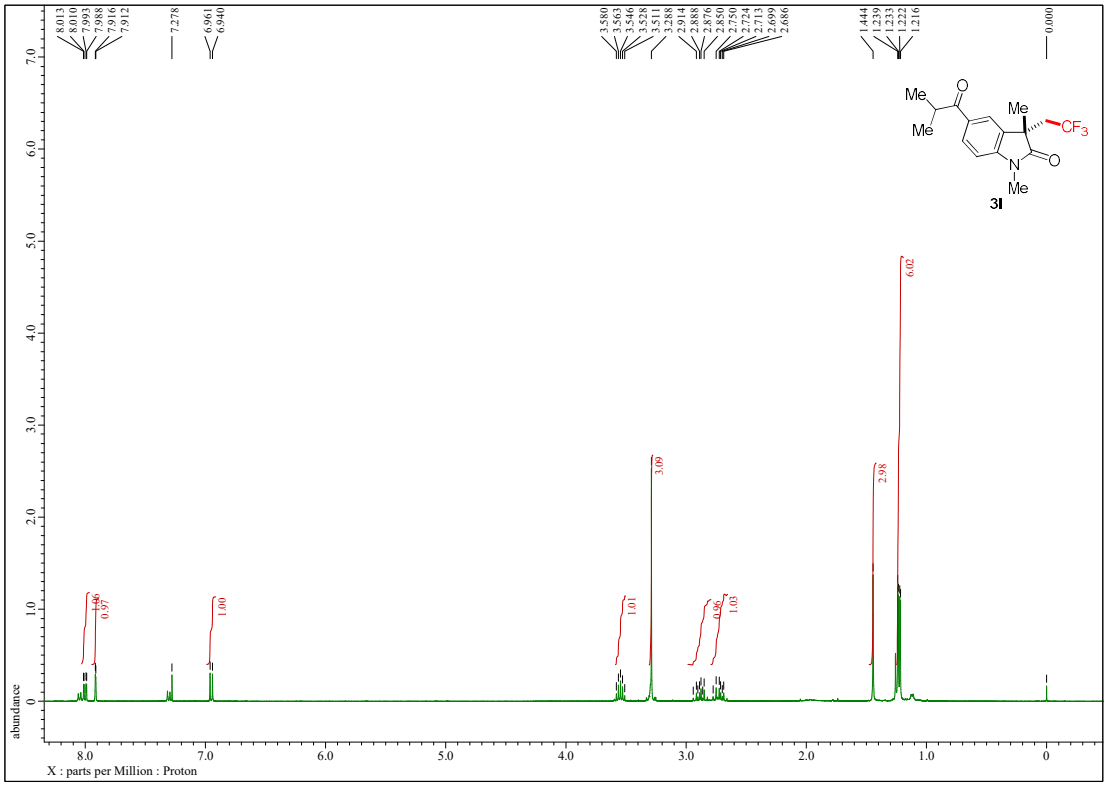
178.828
147.233
132.303
131.355
130.655
123.459
108.011
77.442
77.126
76.800
44.257
41.124
40.834
40.558
40.271
26.778
26.500
25.121
Me
Me
CF3
N
Me
3k
(thousandths)
X : parts per Million : Carbon13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8.010
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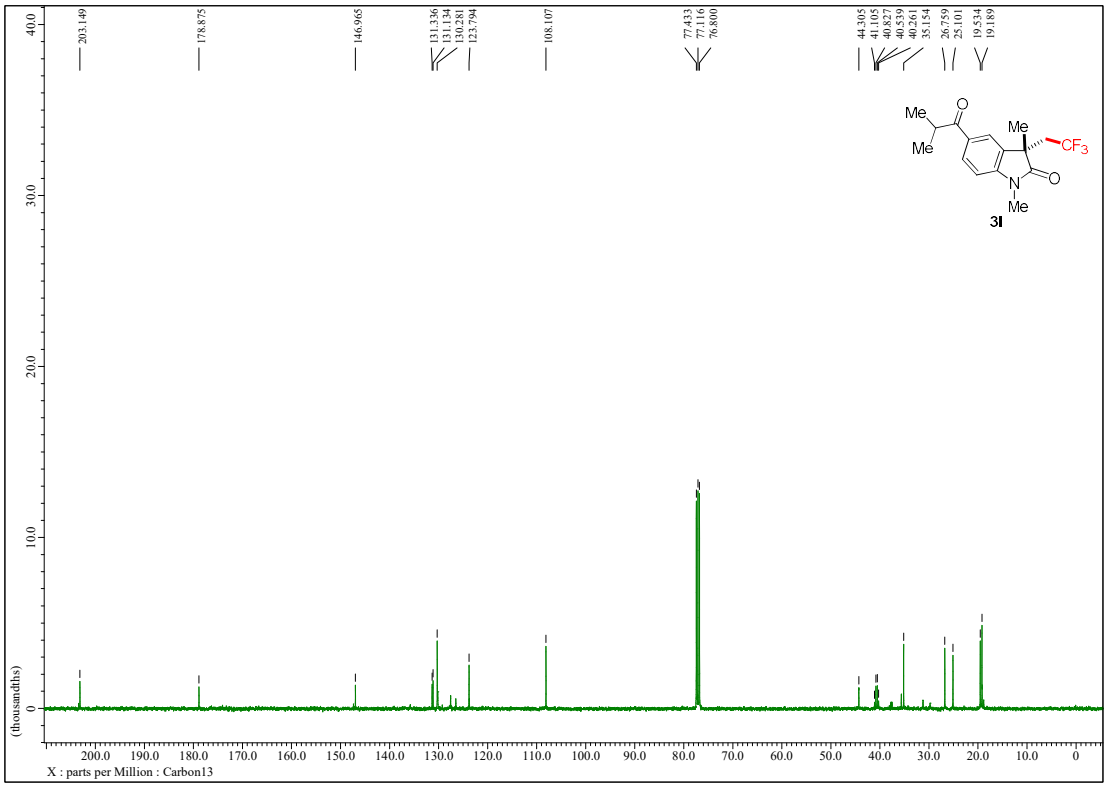
7.912
7.278
6.961
6.940
3.580
3.563
3.546
3.528
3.511
3.288
2.914
2.888
2.876
2.850
2.750
2.724
2.713
2.699
2.686
1.444
1.239
1.233
1.222
1.216
0.000
Me
Me
Me
CF3
N
Me
O
O
3l
6.02
3.09
2.98
1.01
1.00
0.98
0.97
1.03
abundance
X : parts per Million : Proton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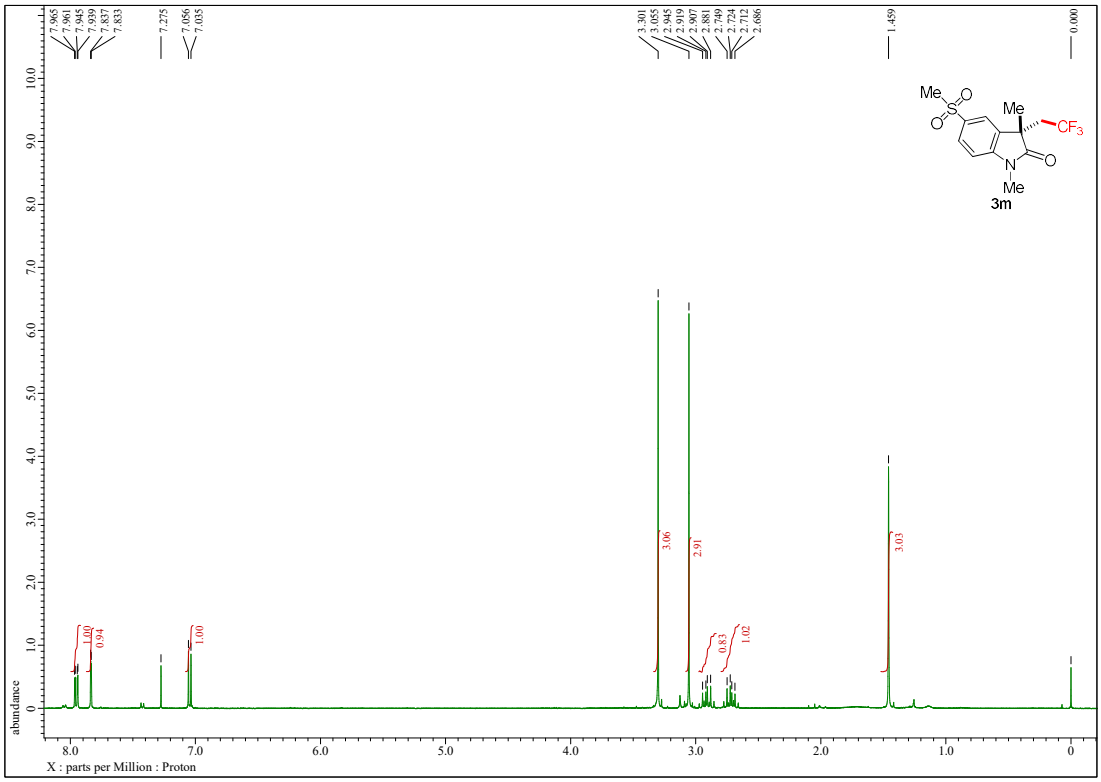
146.965
131.336
131.134
130.281
123.794
108.107
77.433
77.116
76.800
44.305
41.105
40.837
40.570
40.261
35.154
26.759
25.101
19.534
19.189
Me
Me
Me
CF3
N
Me
O
O
3l
(thousandths)
X : parts per Million : Carbon13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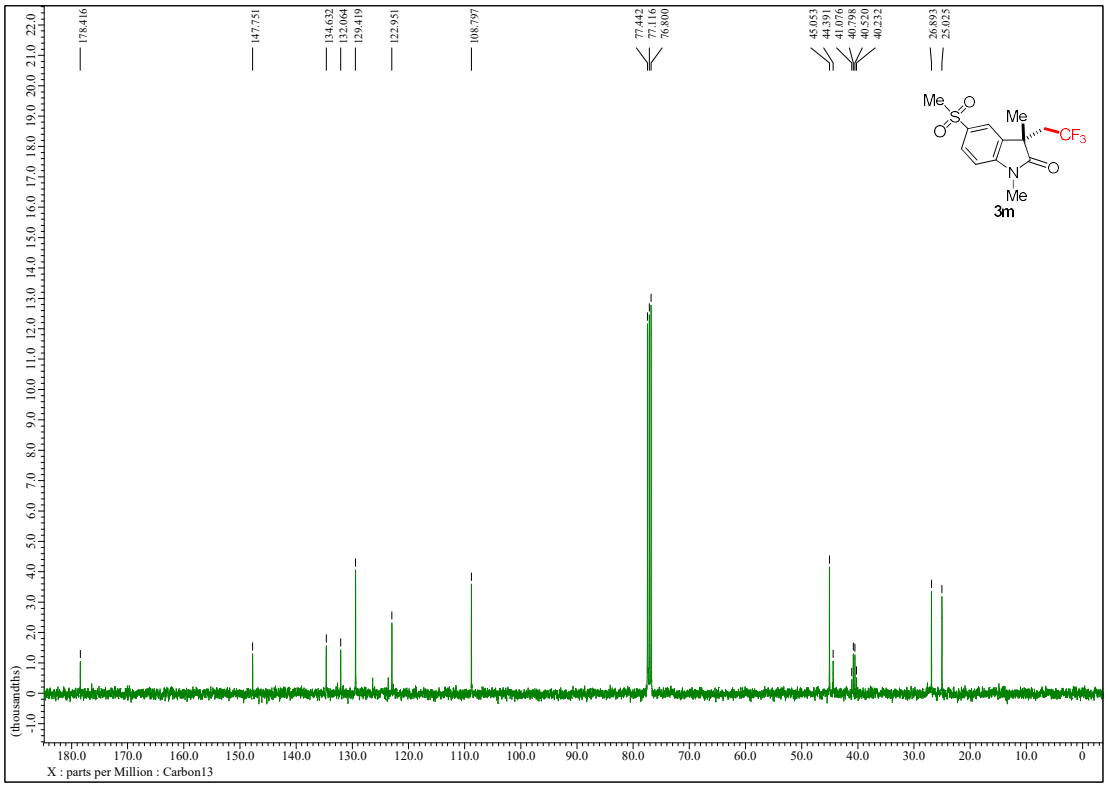
7.961
7.945
7.939
7.837
7.833
7.275
7.056
7.035
3.301
3.055
2.945
2.919
2.907
2.881
2.749
2.724
2.712
2.686
1.459
0.000
Me
Me
CF3
N
O
Me
3m
3.06
2.91
3.03
1.00
0.94
1.00
0.83
1.02
abundance
X : parts per Million : Proton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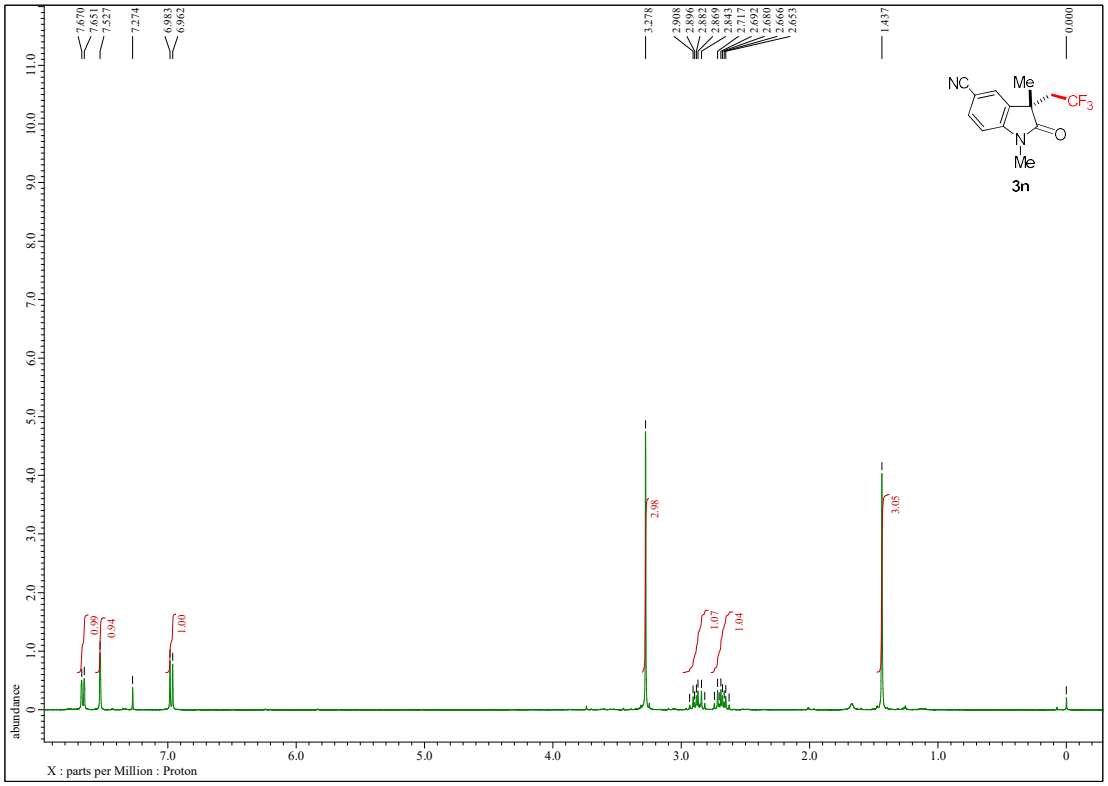
129.419
122.951
108.797
77.442
77.116
76.800
45.053
44.391
41.076
40.798
40.520
40.232
26.893
25.025
Me
Me
CF3
N
O
Me
3m
(thousandths)
X : parts per Million : Carbon13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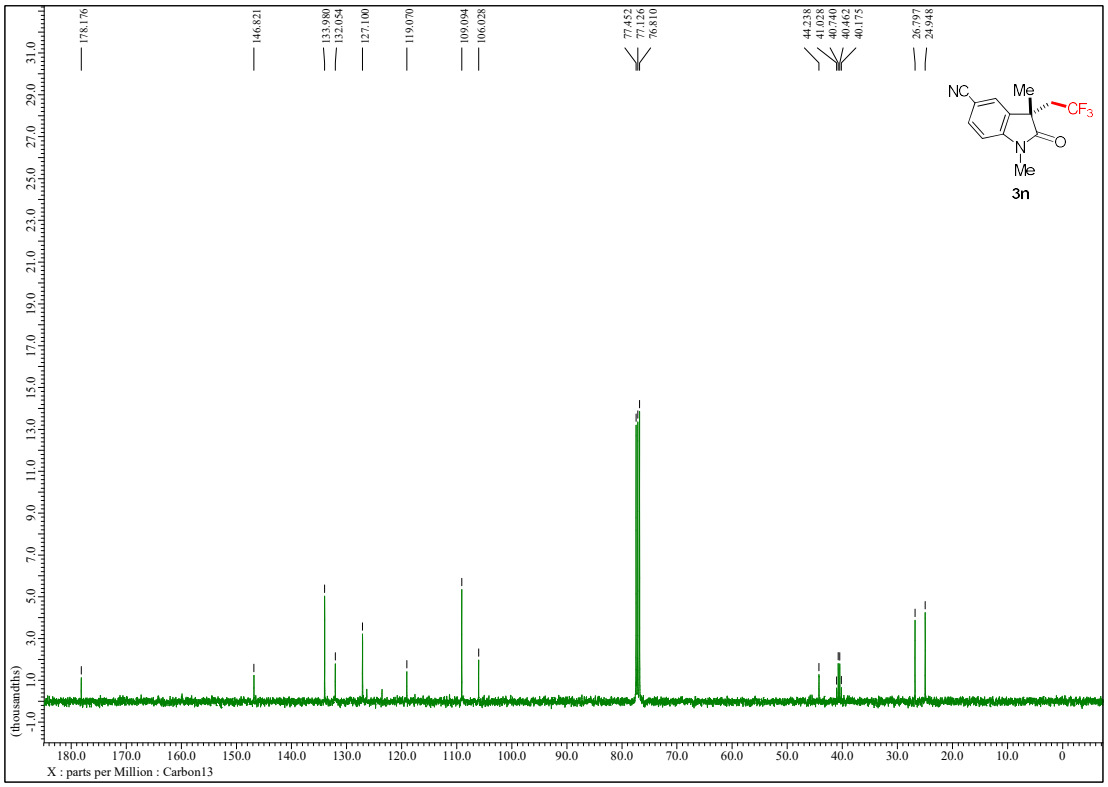
7.651
7.527
7.274
6.983
6.962
3.278
2.908
2.896
2.882
2.869
2.843
2.717
2.692
2.680
2.666
2.653
1.437
0.000
NC
Me
CF3
N
O
Me
3n
abundance
0.99
0.94
1.00
2.98
1.07
1.04
3.05
X : parts per Million : Proton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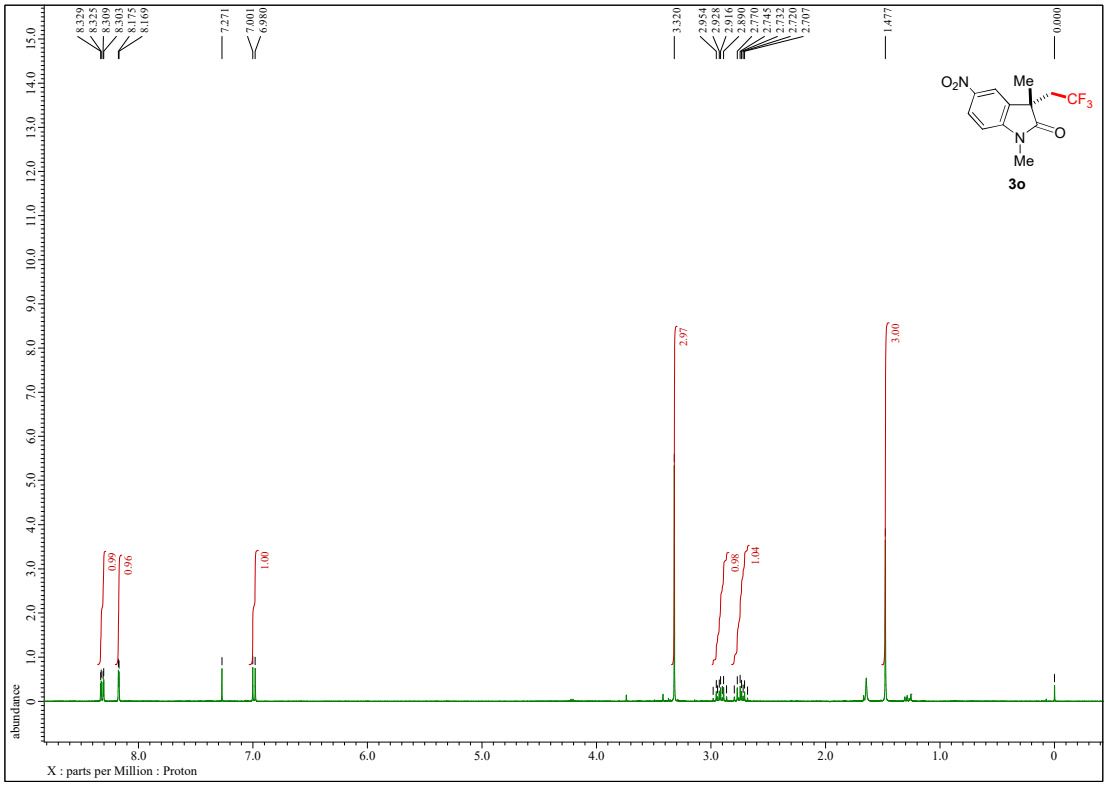
132.054
127.100
119.070
109.094
106.028
77.452
77.126
76.810
44.238
41.028
40.740
40.462
40.175
26.797
24.948
NC
Me
CF3
N
O
Me
3n
(thousandths)
X : parts per Million : Carbon13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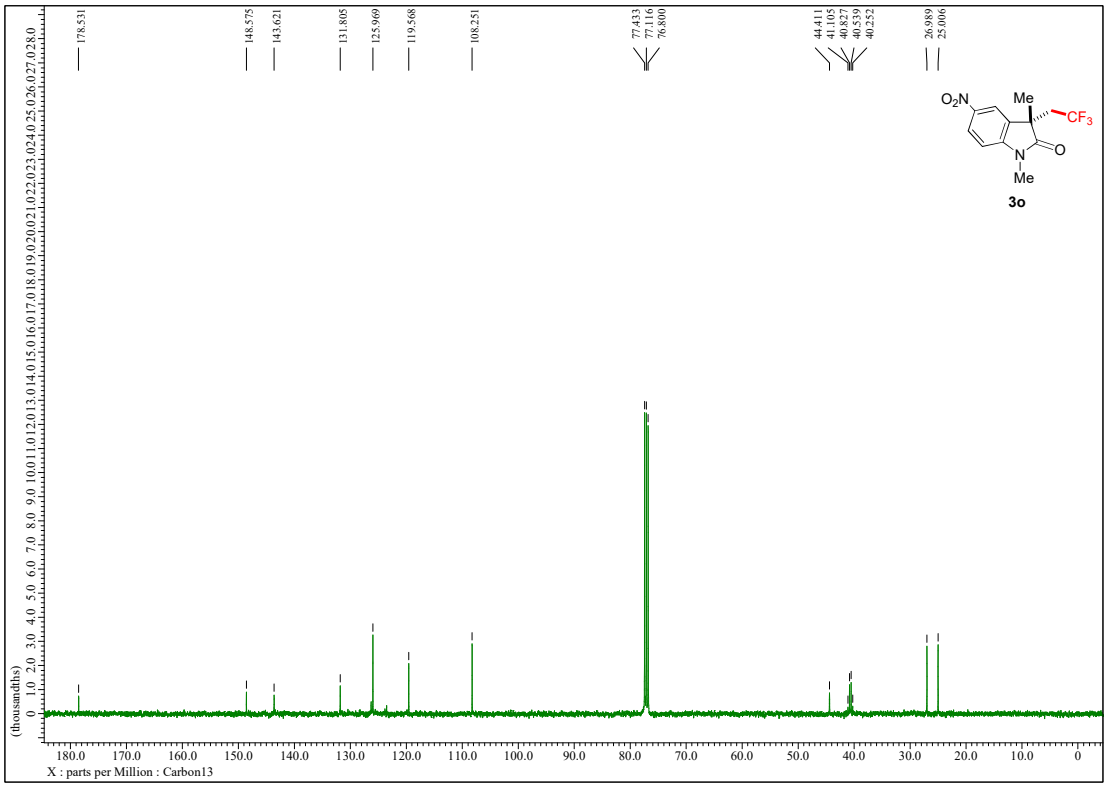
8.325
8.309
8.303
8.175
8.169
7.271
7.001
6.980
3.320
2.954
2.928
2.916
2.890
2.770
2.745
2.732
2.720
2.707
1.477
0.000
2.97
3.00
0.99
0.96
1.00
0.98
1.04
abundance
X : parts per Million : Proton
Me
CF3
O2N
N
O
Me
3o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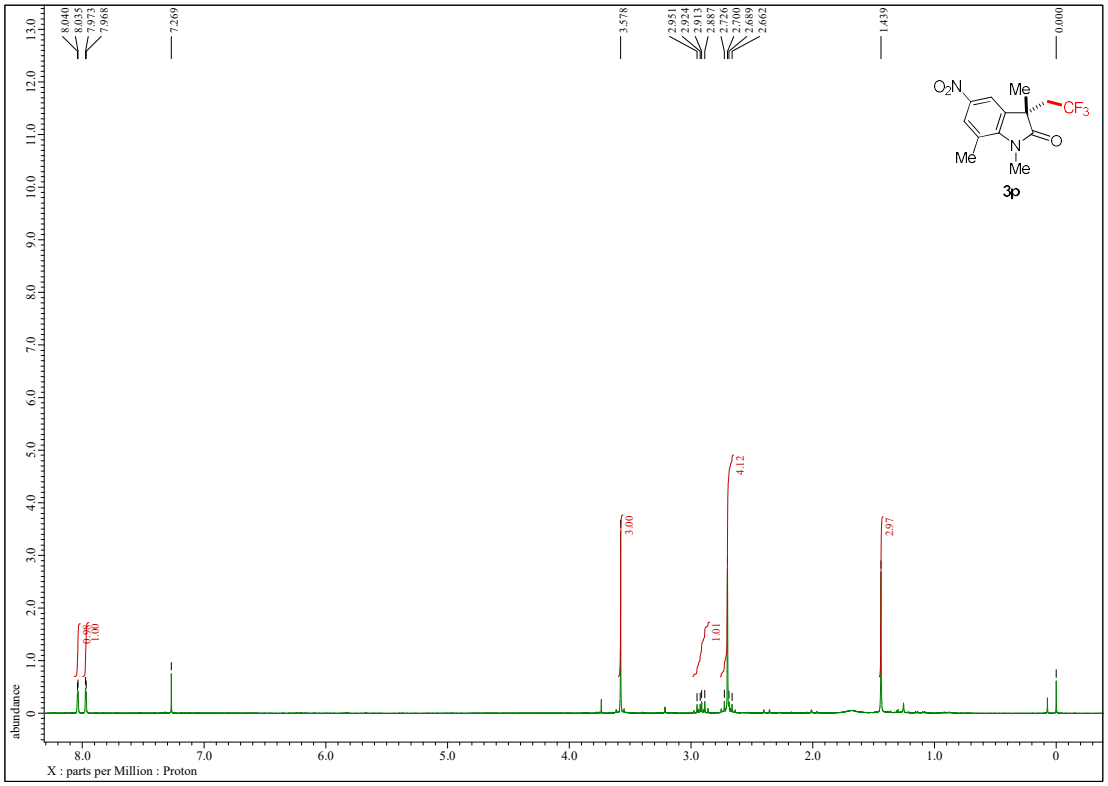
143.621
131.805
125.969
119.568
108.251
77.433
77.116
76.800
44.411
41.105
40.827
40.539
40.252
26.989
25.006
(thousandths)
X : parts per Million : Carbon13
Me
CF3
O2N
N
O
Me
3o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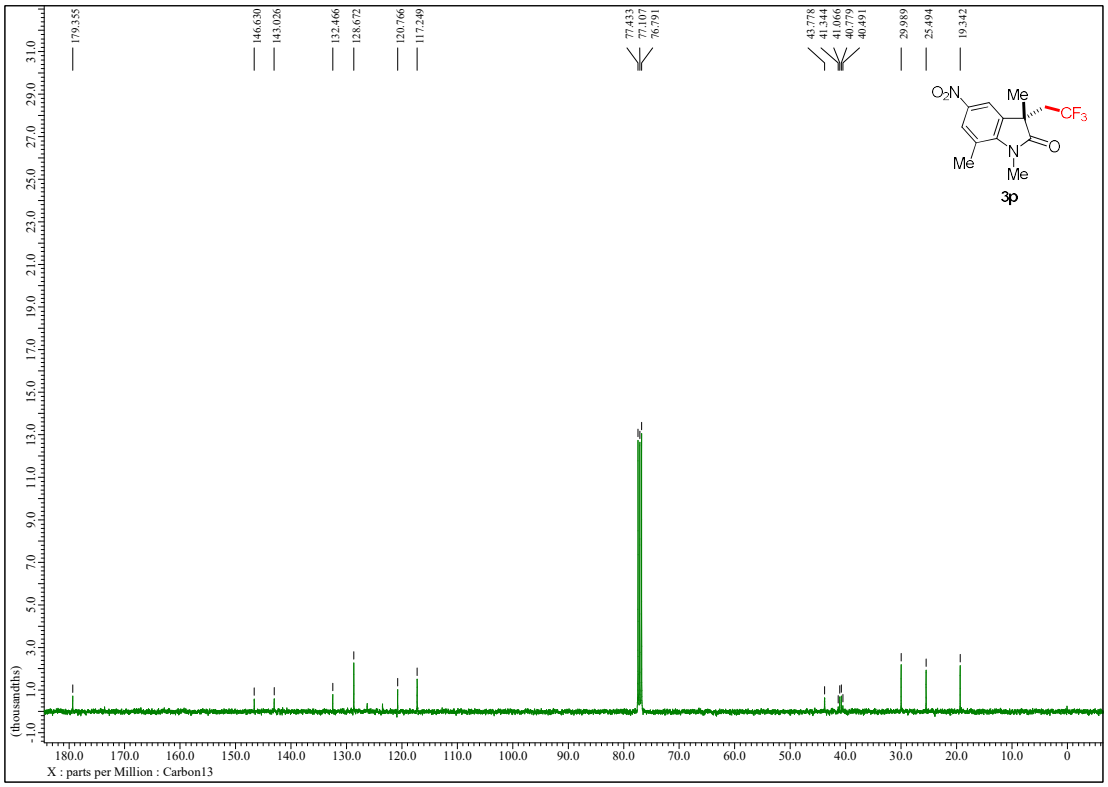
8.035
7.973
7.968
7.269
3.578
2.951
2.924
2.913
2.887
2.726
2.700
2.689
2.662
1.439
0.000
4.12
3.00
2.97
1.01
1.00
abundance
X : parts per Million : Proton
O2N
Me
CF3
Me
N
Me
O
3p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120.766
117.249
77.433
77.107
76.791
43.778
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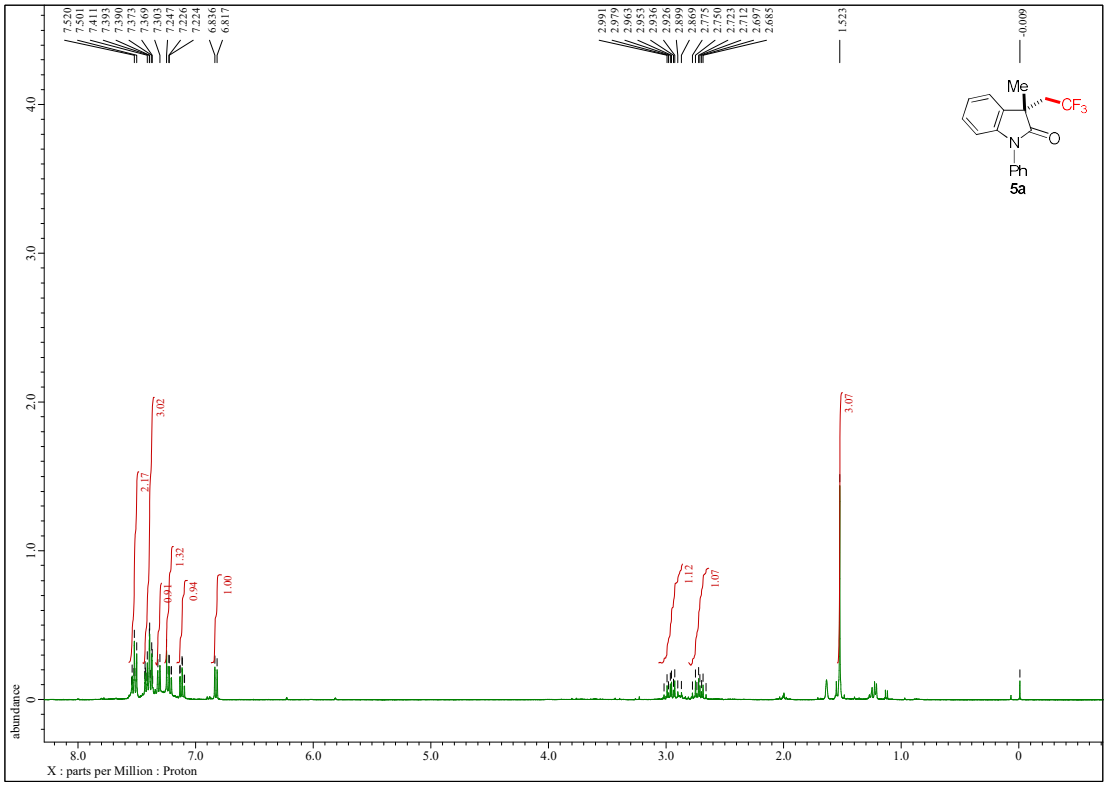
41.066
40.779
40.491
29.989
25.494
19.342
(thousandths)
X : parts per Million : Carbon13
O2N
Me
CF3
Me
N
Me
O
3p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7.390
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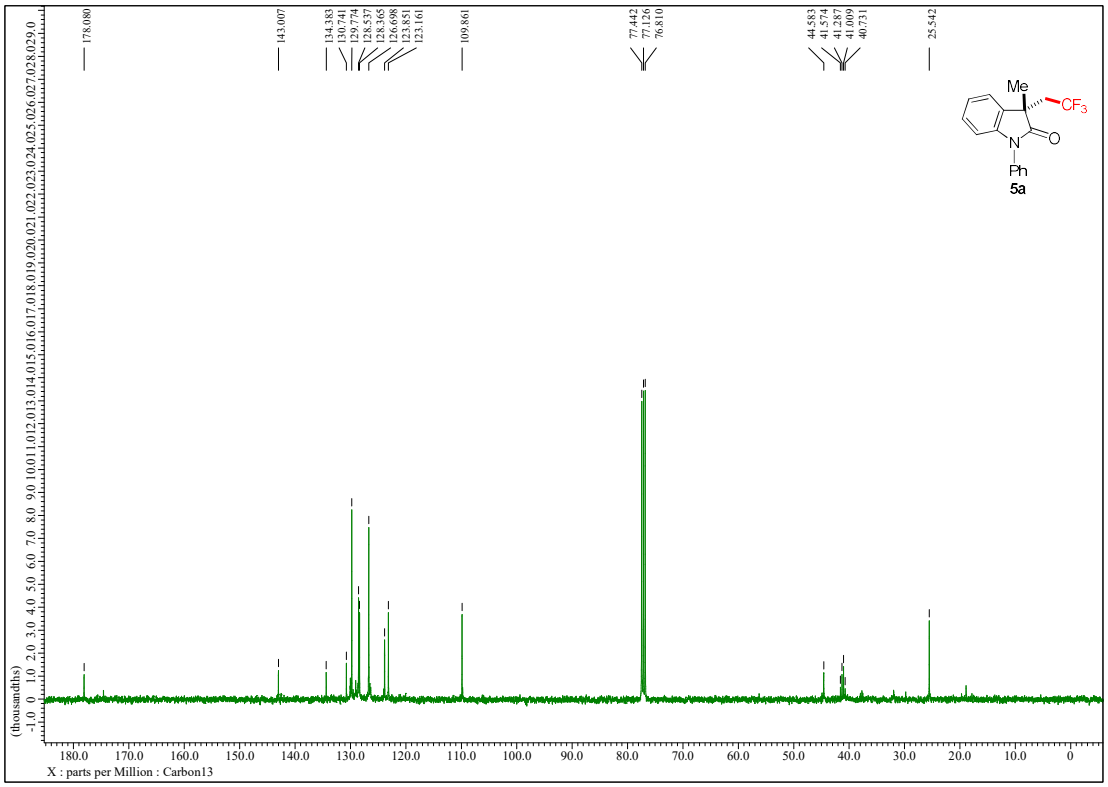
7.369
7.303
7.247
7.226
7.224
6.836
6.817
2.991
2.979
2.963
2.953
2.936
2.926
2.899
2.869
2.755
2.750
2.723
2.712
2.697
2.685
1.523
-0.009
3.02
2.17
1.32
0.94
1.00
1.12
1.07
3.07
Me
CF3
N
O
Ph
5a
abundance
X : parts per Million : Proton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128.537
128.365
126.698
123.851
123.161
109.861
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77.126
76.810
44.583
41.574
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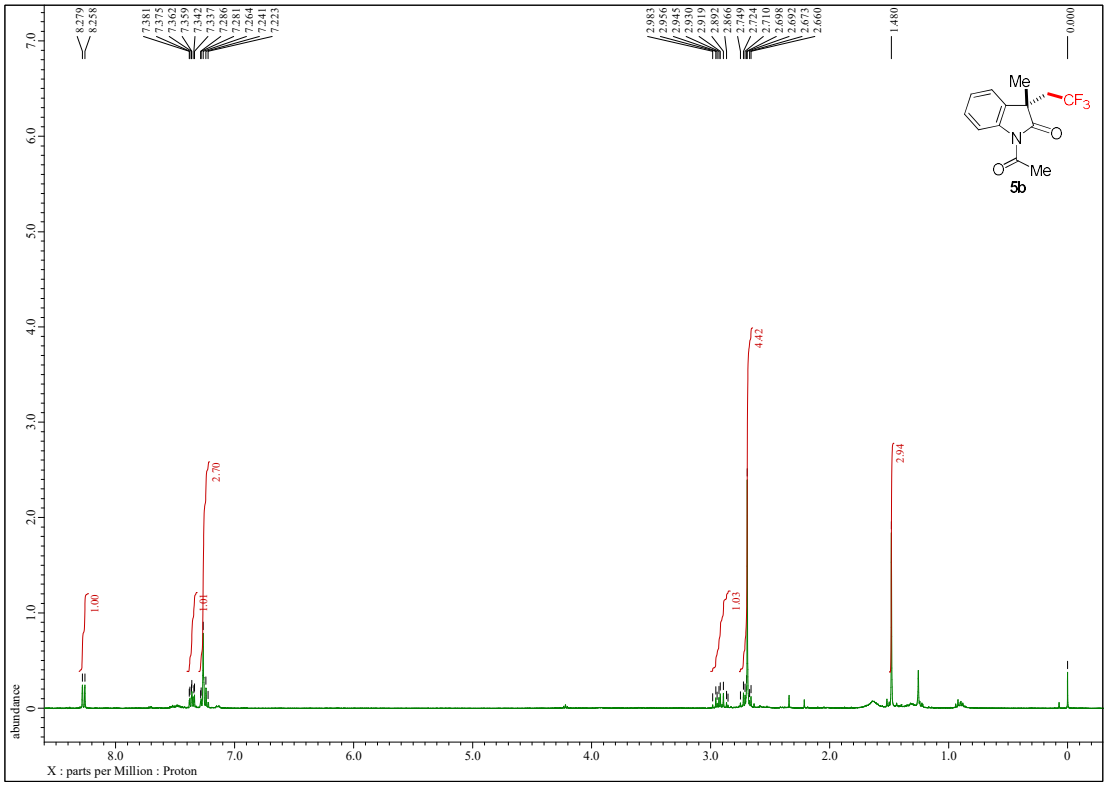
41.009
40.731
25.542
Me
CF3
N
O
Ph
5a
(thousandths)
X : parts per Million : Carbon13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7.365
7.359
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7.337
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7.281
7.264
7.241
7.223
2.983
2.966
2.945
2.930
2.919
2.892
2.866
2.749
2.724
2.710
2.698
2.692
2.673
2.660
1.480
0.000
Me
CF3
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O
O
Me
5b
4.42
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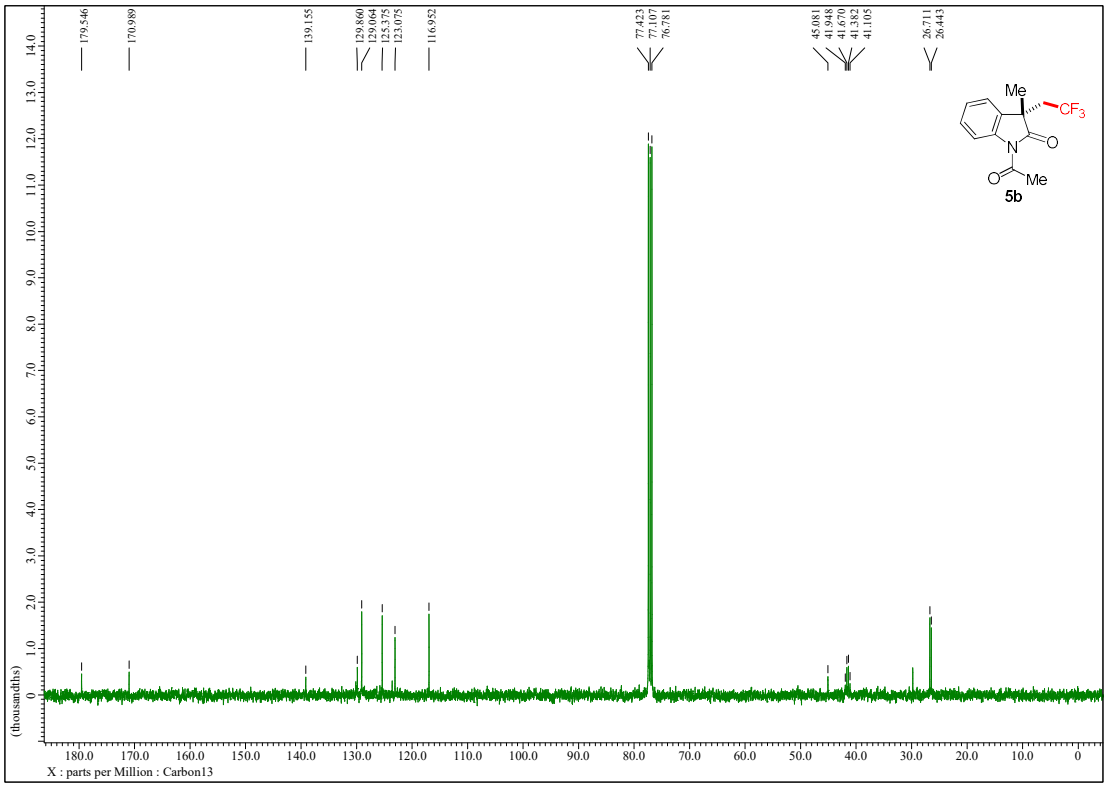
1.00
1.40
1.03
abundance
X : parts per Million : Proton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123.075
116.952
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77.107
76.781
45.081
41.948
41.670
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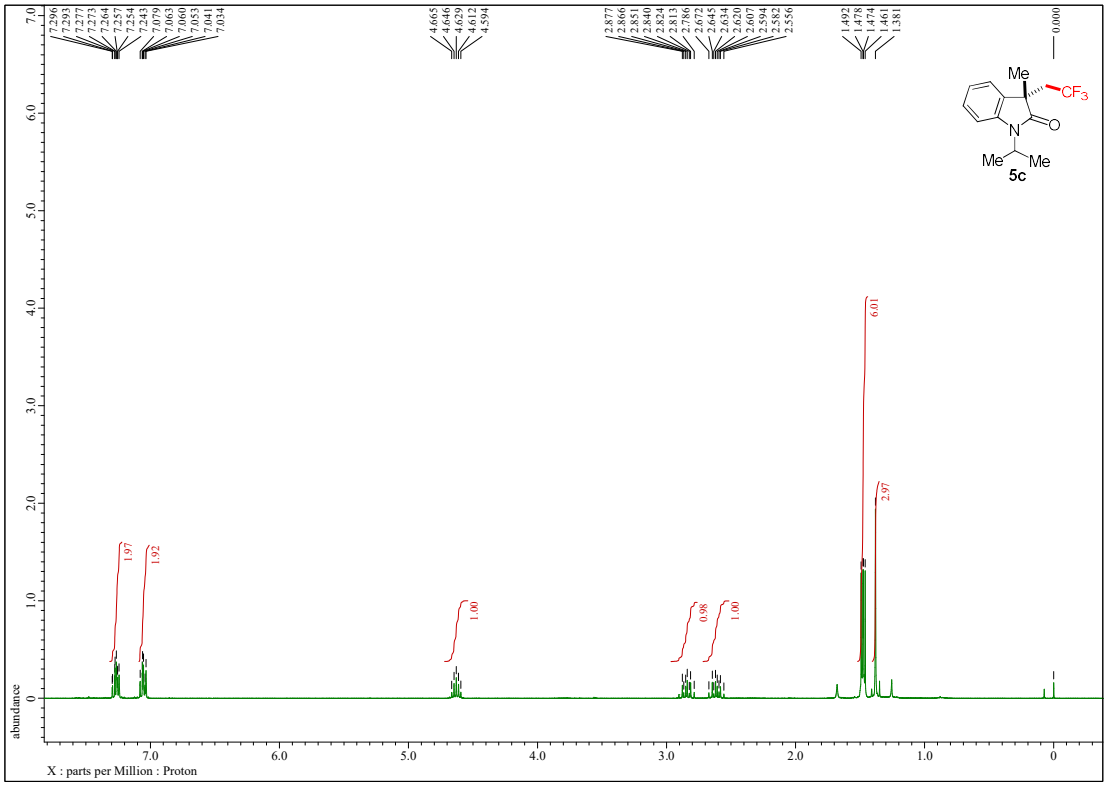
26.711
26.443
Me
CF3
N
O
O
Me
5b
(thousandths)
X : parts per Million : Carbon13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7.243
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7.060
7.053
7.041
7.034
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4.646
4.629
4.612
4.594
2.877
2.866
2.851
2.840
2.824
2.813
2.786
2.672
2.645
2.634
2.620
2.607
2.594
2.582
2.556
1.492
1.478
1.474
1.461
1.381
0.000
Me
CF3
N
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1.92
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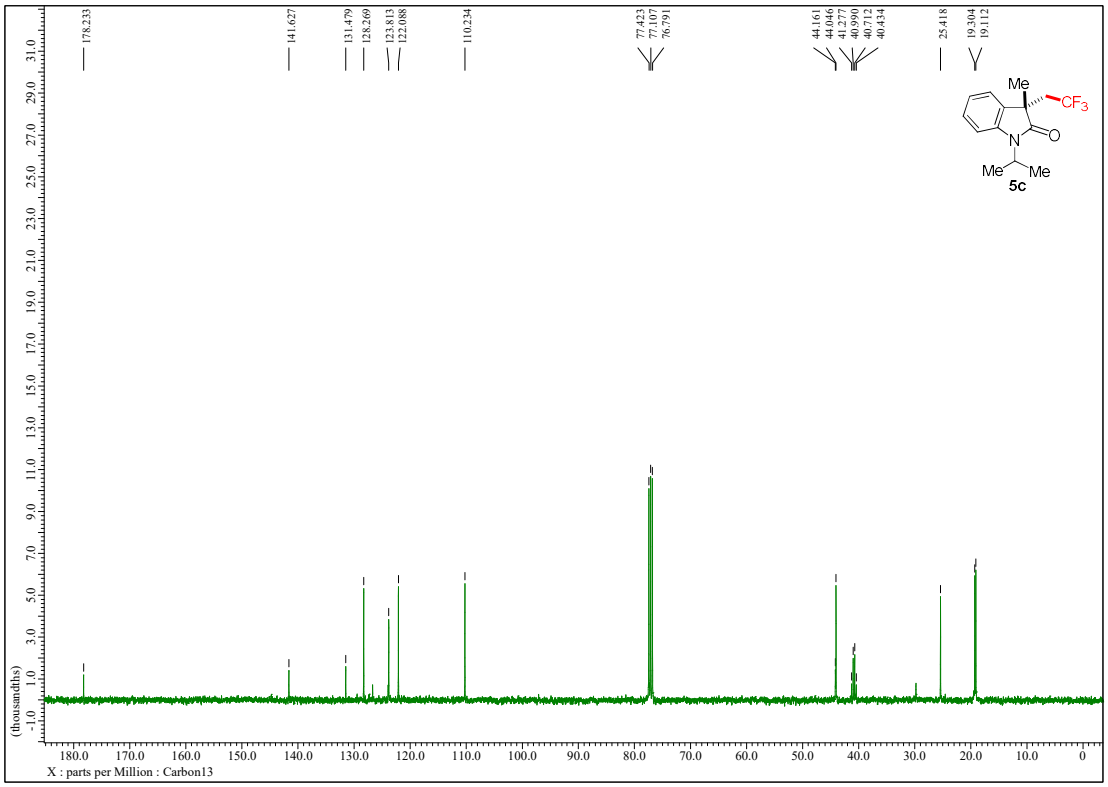
6.01
2.97
abundance
X : parts per Million : Proton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122.088
110.234
77.423
77.107
76.791
44.161
44.046
41.277
40.990
40.712
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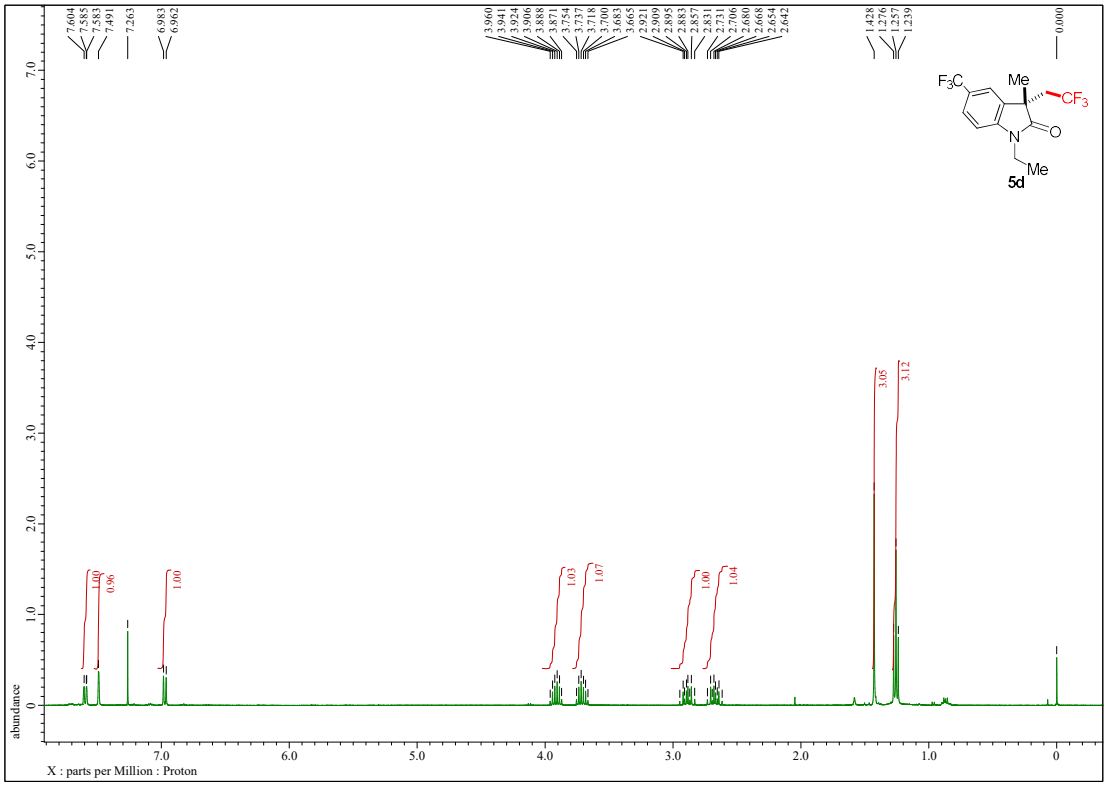
19.112
Me
CF3
N
O
Me
Me
5c
(thousandths)
X : parts per Million : Carbon13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3.924
3.906
3.888
3.871
3.754
3.737
3.718
3.700
3.683
3.665
2.921
2.909
2.895
2.883
2.857
2.831
2.731
2.706
2.690
2.668
2.654
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1.428
1.276
1.257
1.239
0.000
F3C
Me
CF3
N
O
Me
5d
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1.00
1.04
3.05
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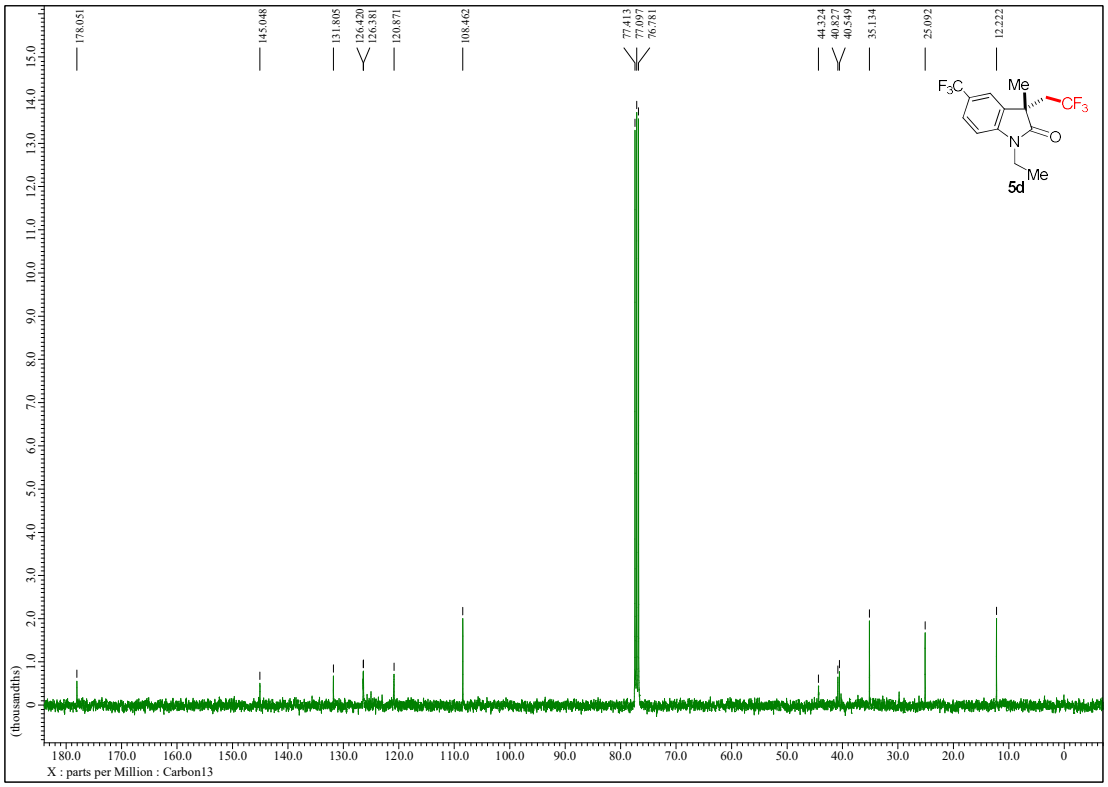
abundance
X : parts per Million : Proton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108.462
77.413
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76.781
44.324
40.827
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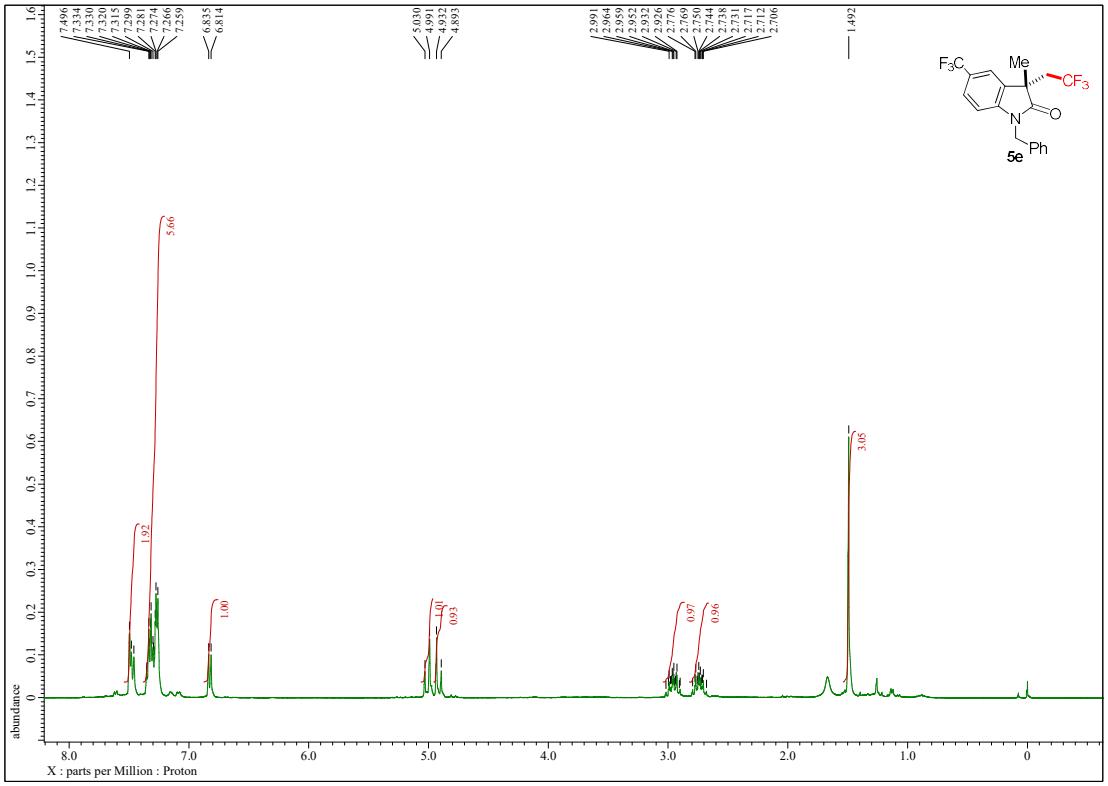
35.134
25.092
12.222
F3C
Me
CF3
N
O
Me
5d
(thousandths)
X : parts per Million : Carbon13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7.259
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6.814
5.030
4.991
4.932
4.893
3.991
3.964
3.959
3.952
3.932
2.926
2.776
2.769
2.750
2.744
2.738
2.731
2.717
2.712
2.706
1.492
5.66
1.92
1.00
1.01
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3.06
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Me
CF3
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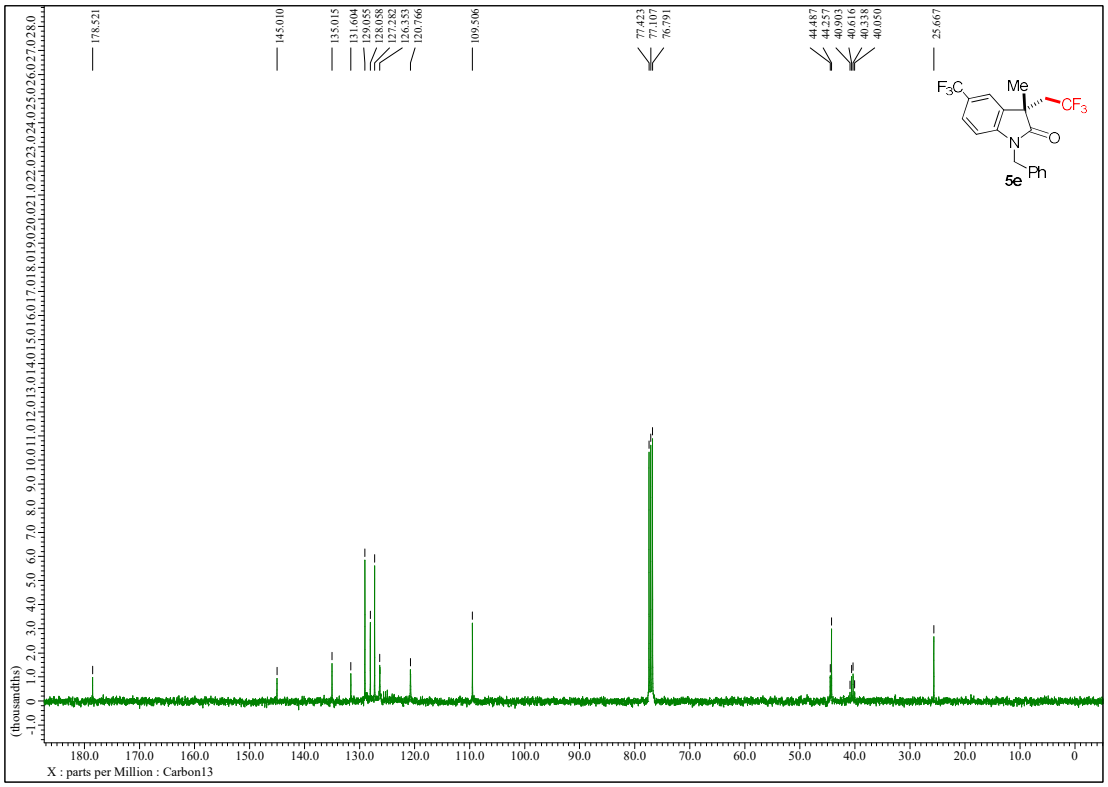
N
Ph
5e
abundance
X : parts per Million : Proton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128.058
127.282
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109.506
77.423
77.107
76.791
44.487
44.257
40.903
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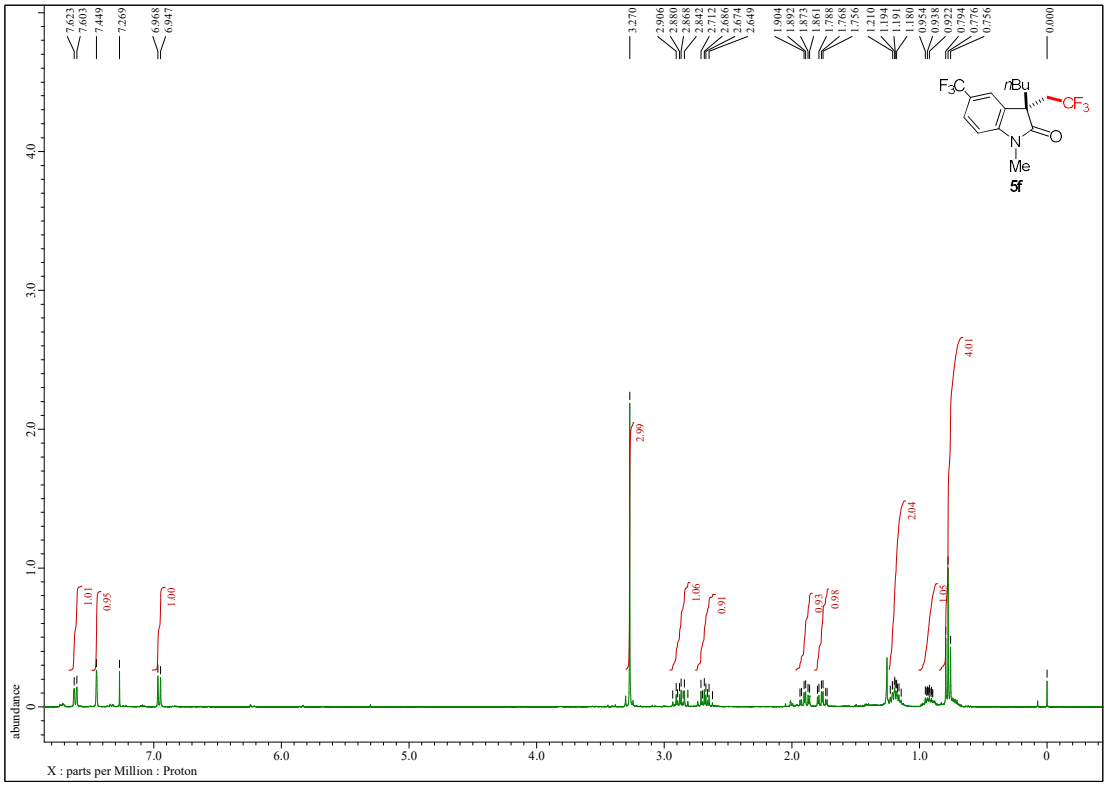
40.050
25.667
F3C
Me
CF3
O
N
Ph
5e
(thousandths)
X : parts per Million : Carbon13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2.712
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2.674
2.649
1.904
1.892
1.873
1.857
1.788
1.768
1.756
1.210
1.194
1.191
1.180
0.954
0.938
0.922
0.794
0.776
0.756
0.000
F3C
nBu
CF3
N
Me
O
5f
1.01
0.95
1.00
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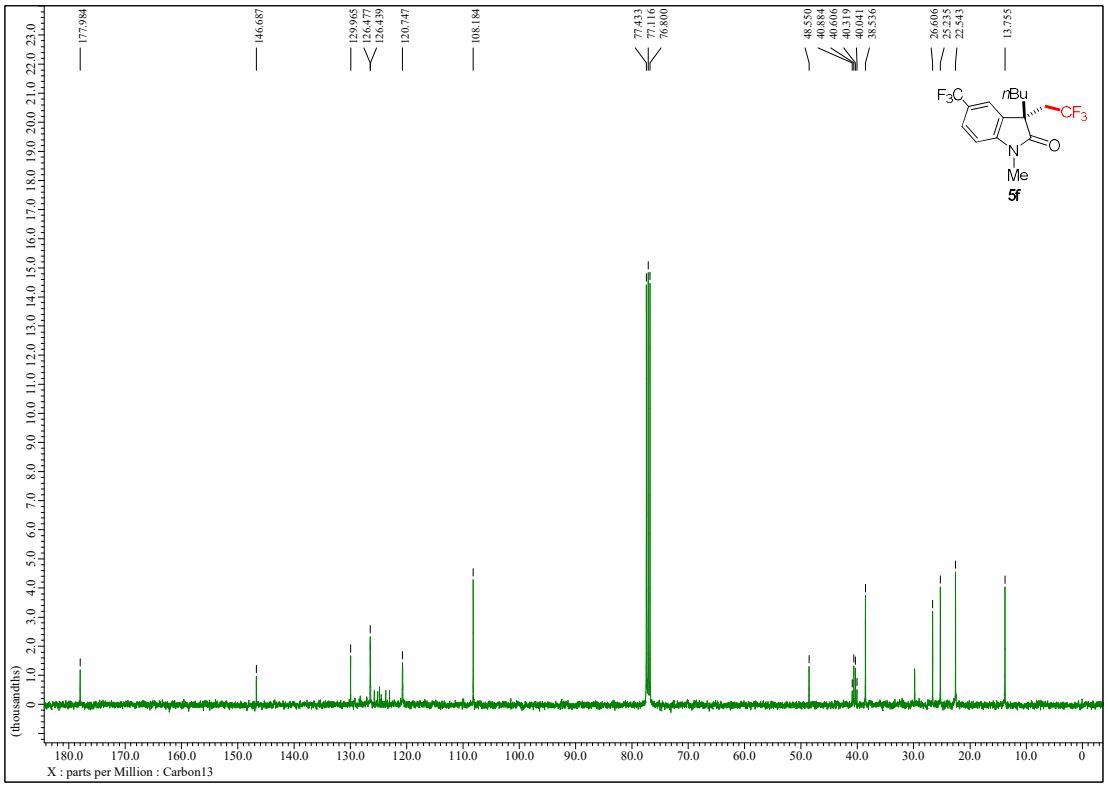
0.91
0.93
0.98
2.04
1.05
4.01
abundance
X : parts per Million : Proton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120.747
108.184
77.433
77.116
76.800
48.550
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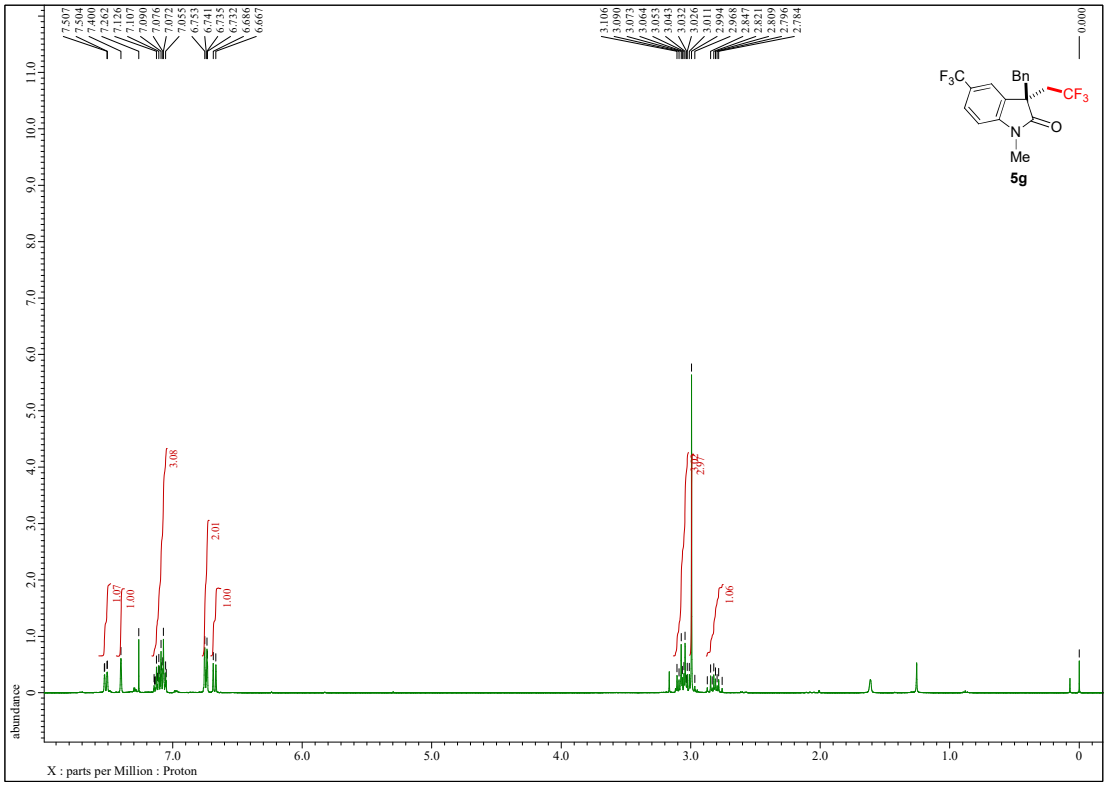
40.606
40.319
40.041
38.536
26.606
25.235
22.543
13.755
F3C
nBu
CF3
N
Me
O
5f
(thousandths)
X : parts per Million : Carbon13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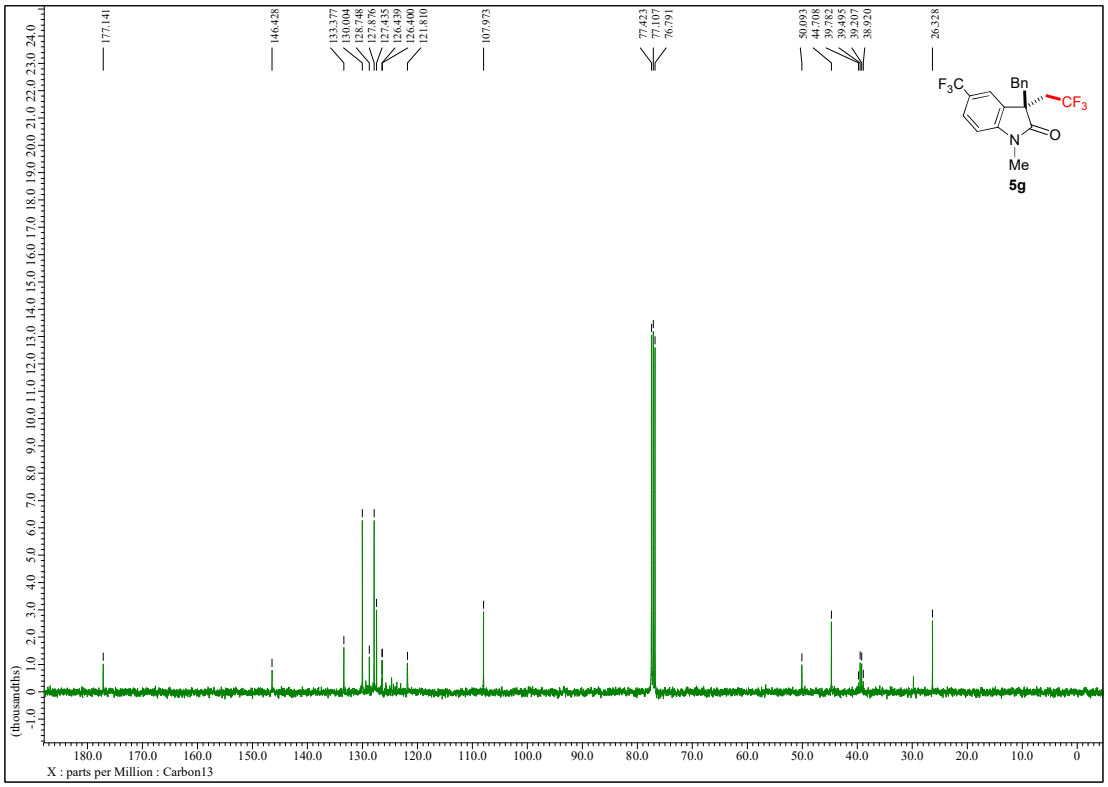
7.262
7.156
7.107
7.090
7.076
7.072
7.055
6.753
6.741
6.735
6.732
6.686
6.667
3.106
3.090
3.073
3.064
3.053
3.043
3.032
3.026
3.011
2.994
2.968
2.847
2.821
2.809
2.796
2.784
0.000
3.08
2.01
1.07
1.00
1.00
2.07
1.06
abundance
X : parts per Million : Proton
F3C
Bn
CF3
N
O
Me
5g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133.377
130.004
128.748
127.876
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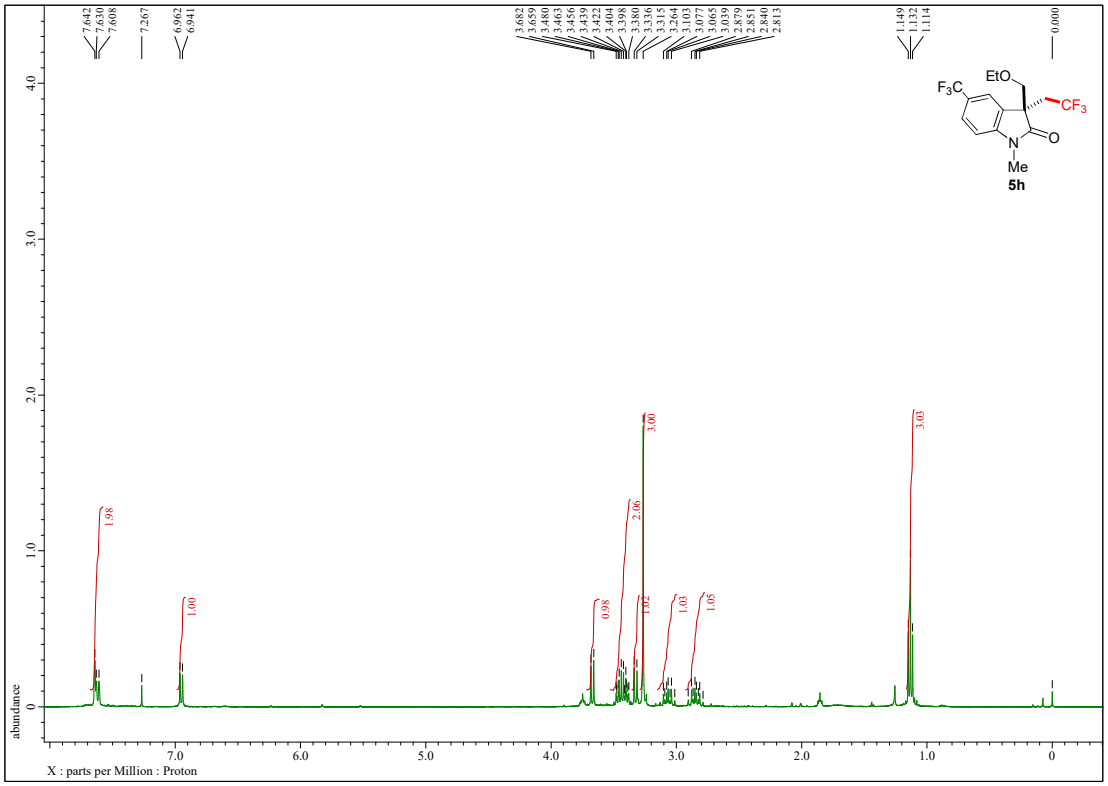
126.400
121.810
107.973
77.423
77.107
76.791
50.093
44.708
39.782
39.495
39.207
38.920
26.328
(thousandths)
X : parts per Million : Carbon13
F3C
Bn
CF3
N
O
Me
5g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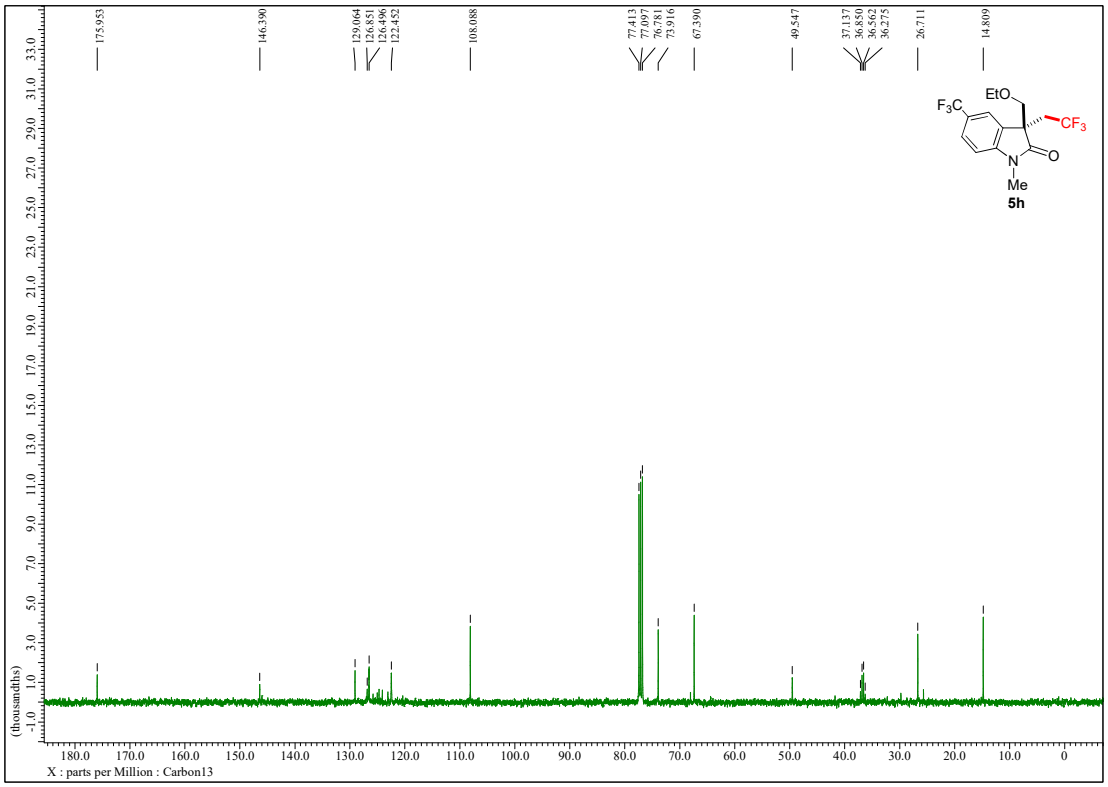
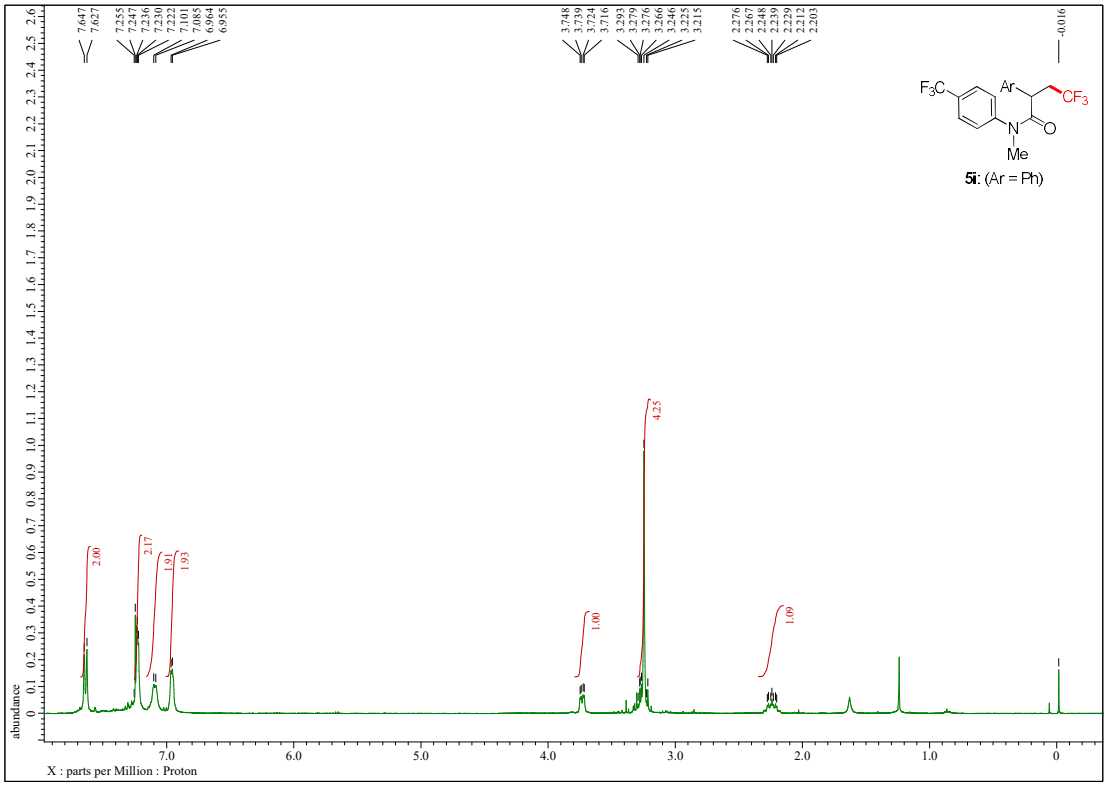
7.630
7.608
7.267
6.962
6.941
3.682
3.659
3.480
3.463
3.456
3.439
3.422
3.404
3.398
3.380
3.336
3.315
3.264
3.103
3.077
3.065
3.039
2.879
2.851
2.840
2.813
1.149
1.132
1.114
0.000
EtO
F3C
CF3
O
N
Me
5h
1.98
1.00
0.98
2.06
3.00
1.72
1.03
1.05
3.03
abundance
X : parts per Million : Proton


175.953
146.390
129.064
126.451
126.406
122.452
108.088
77.413
77.097
76.781
73.916
67.390
49.547
37.137
36.450
36.562
36.275
26.711
14.809
EtO
F3C
CF3
O
N
Me
5h
(thousandths)
X : parts per Million : Carbon13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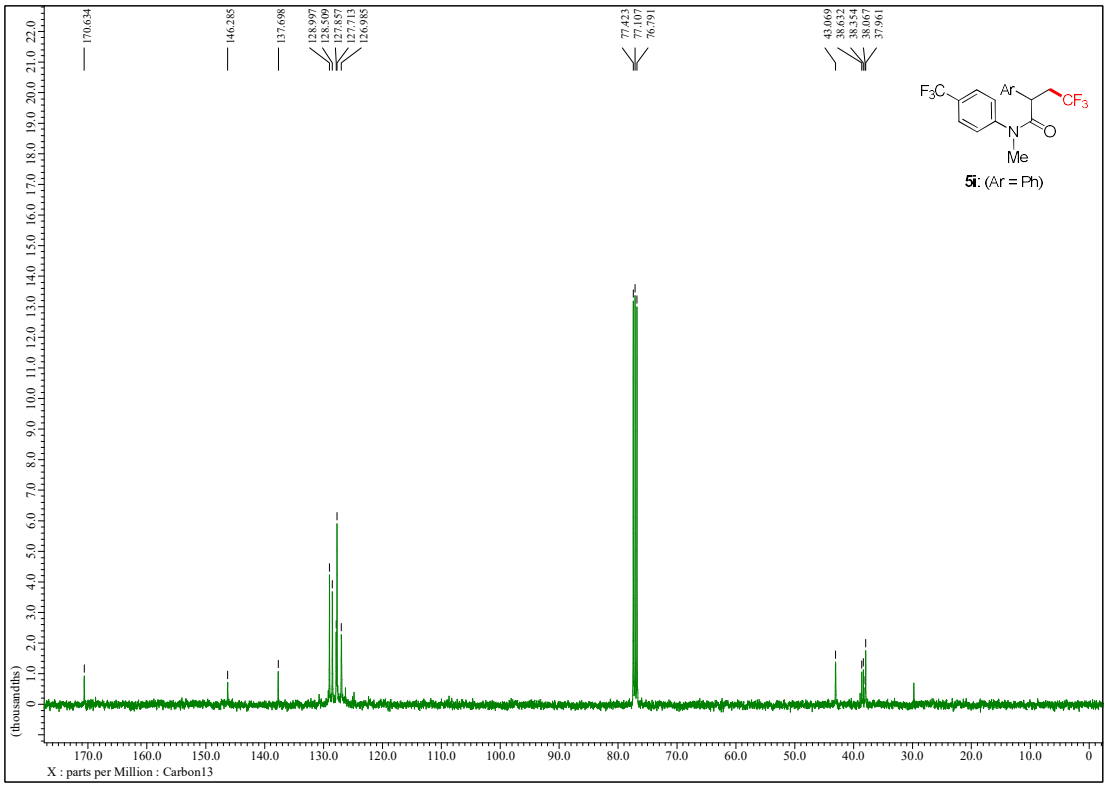
7.627
7.255
7.247
7.236
7.230
7.222
7.101
7.085
6.964
6.955
3.748
3.739
3.724
3.716
3.293
3.279
3.276
3.266
3.246
3.225
3.215
2.276
2.267
2.248
2.239
2.212
2.203
-0.016
2.00
2.17
1.91
1.93
1.00
4.25
1.09
abundance
X : parts per Million : Proton
F3C
Ar
CF3
N
O
Me
5i: (Ar = Ph)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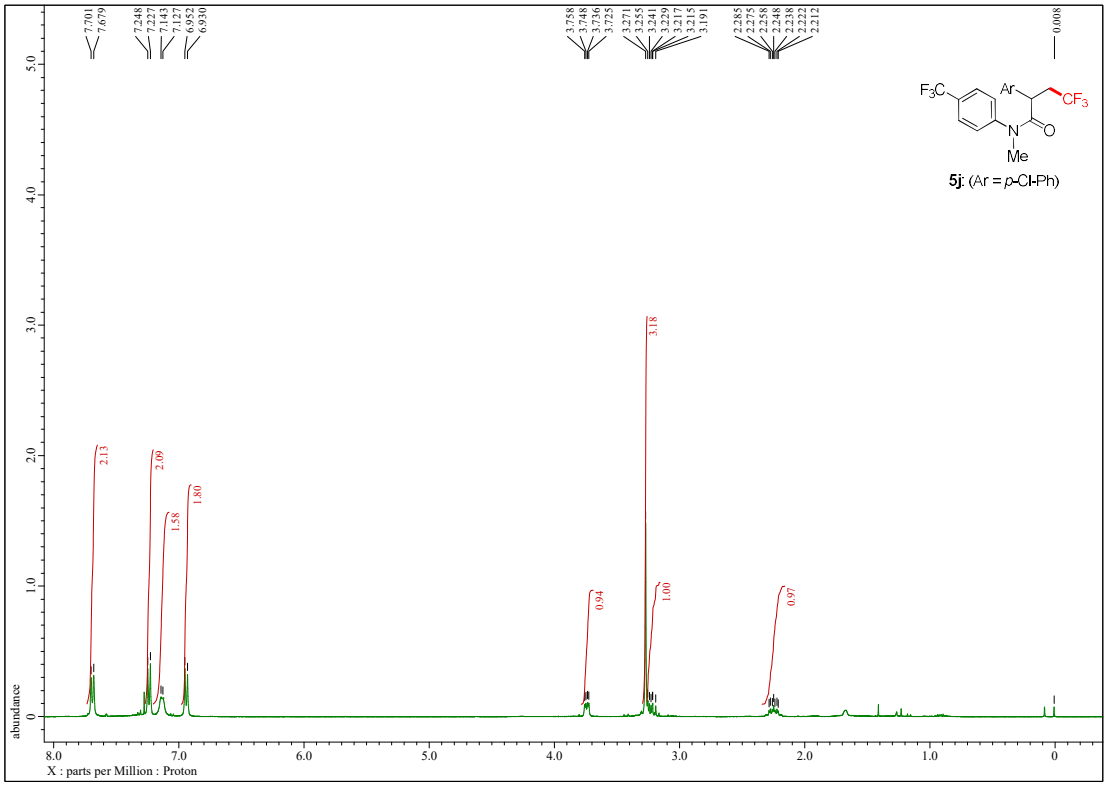
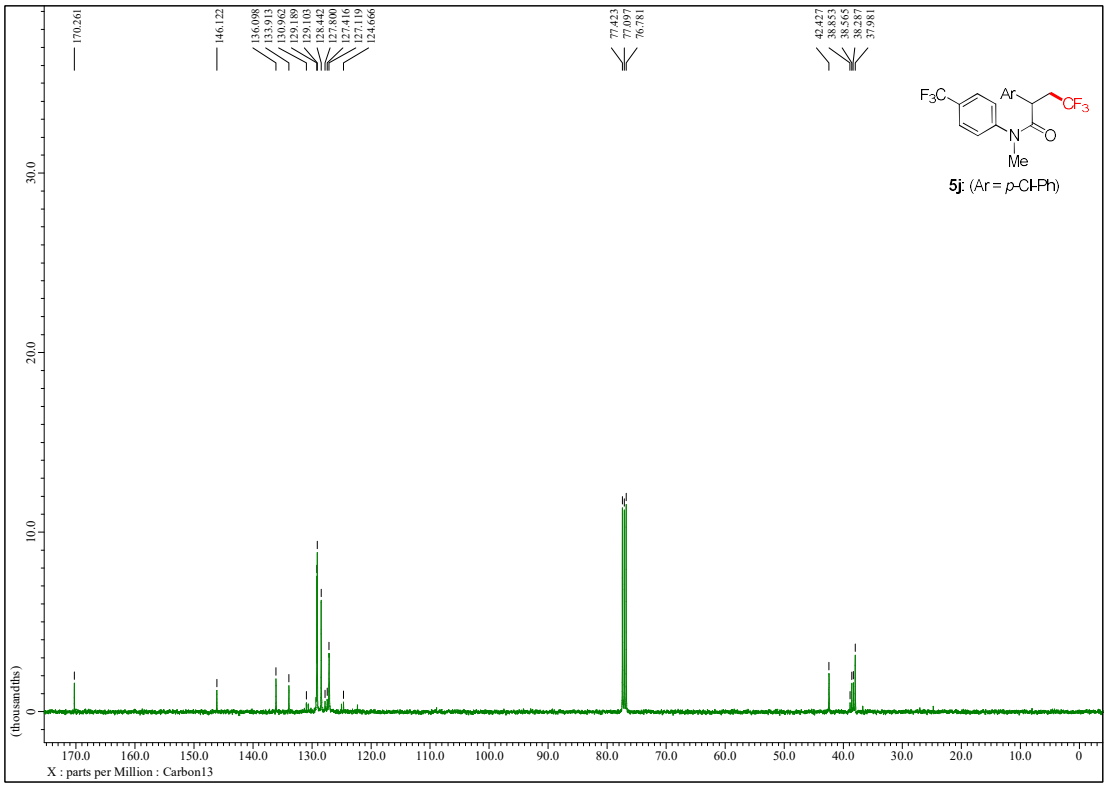
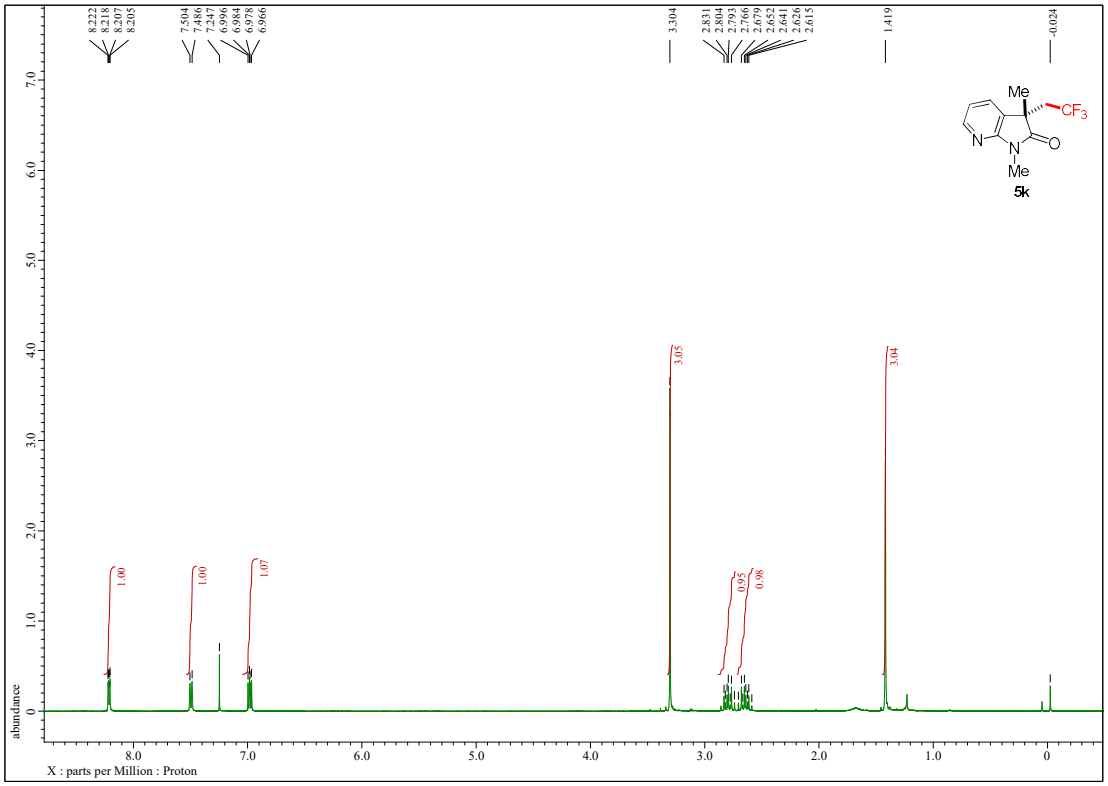
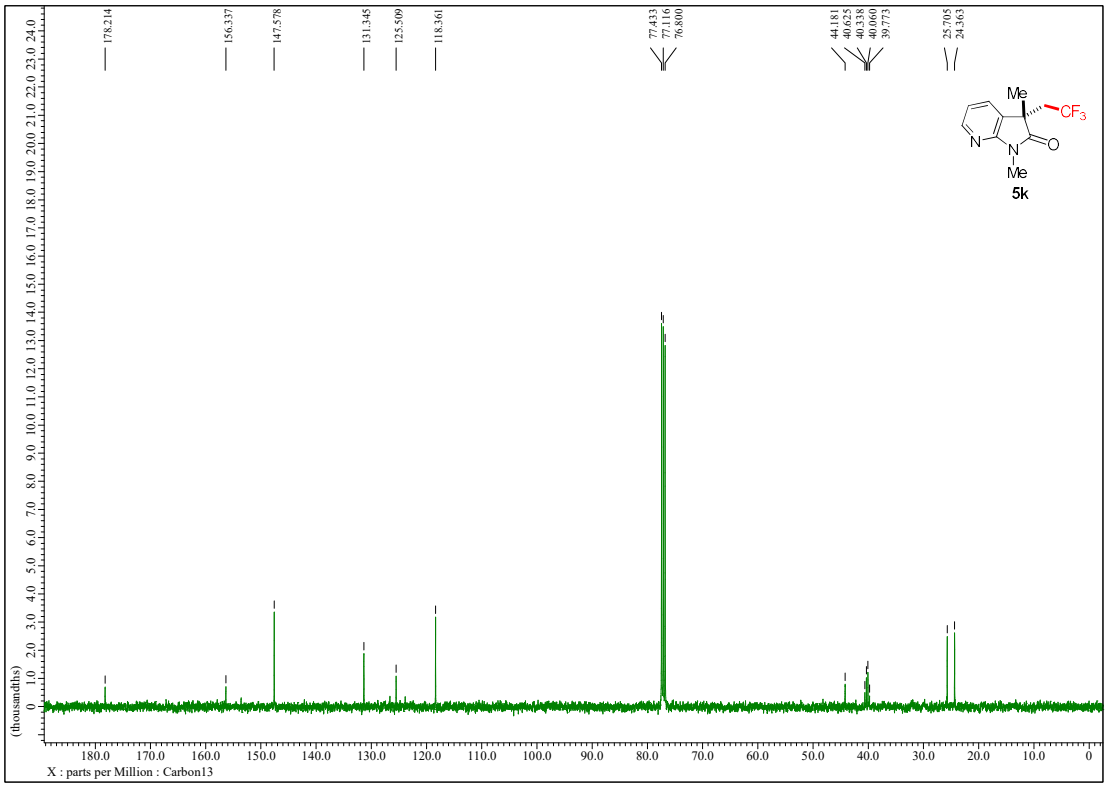
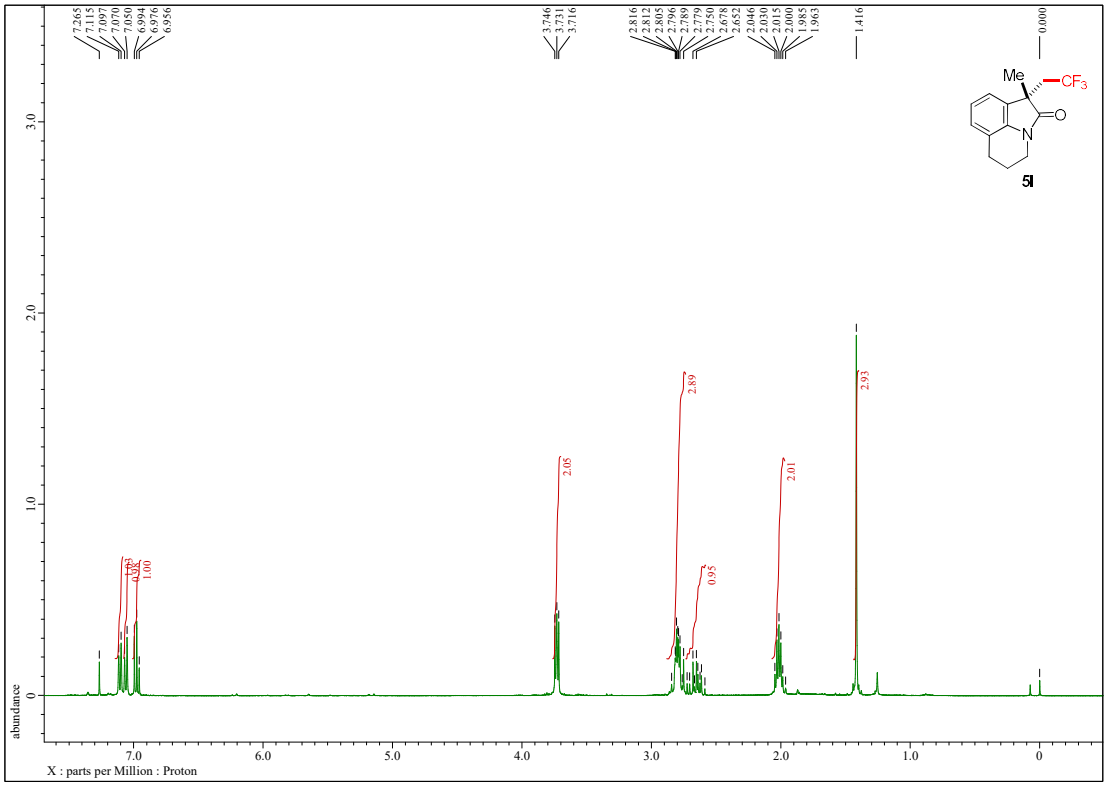
146.285
137.698
128.997
128.509
127.857
127.713
126.985
77.423
77.107
76.791
43.069
38.632
38.354
38.067
37.961
(thousandths)
X : parts per Million : Carbon13
F3C
Ar
CF3
N
O
Me
5i: (Ar = Ph)

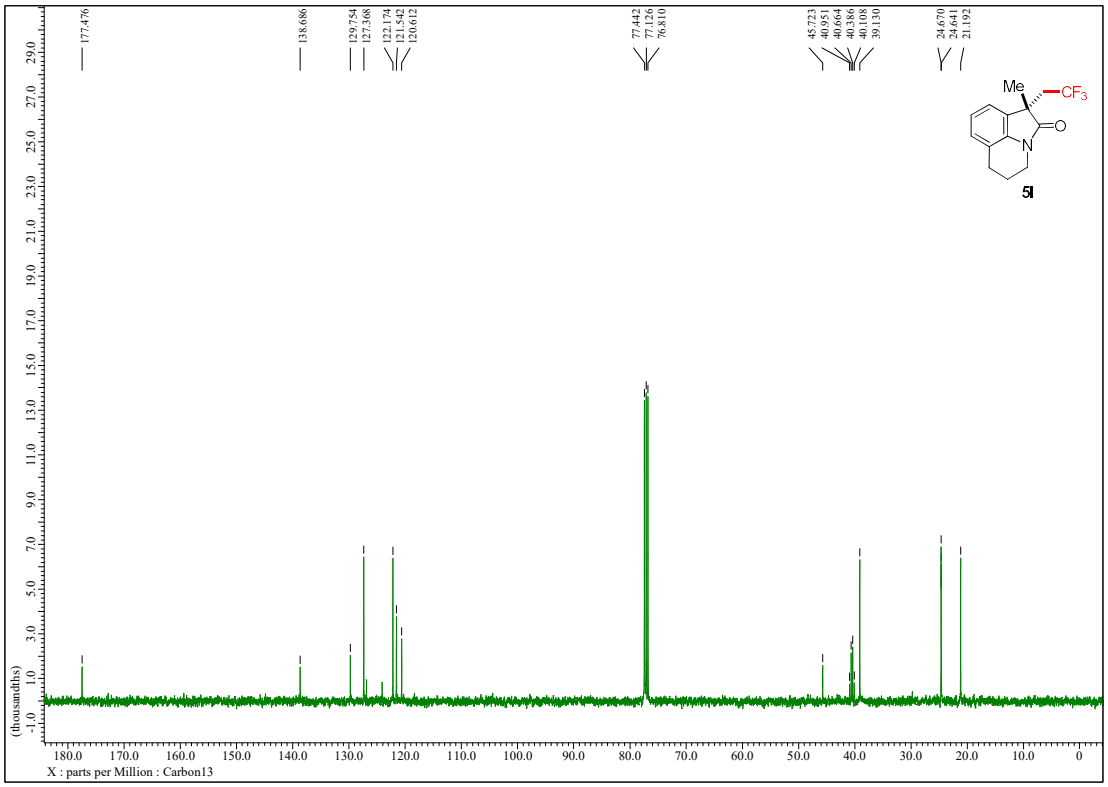

7.701
7.679
7.248
7.227
7.143
7.127
6.952
6.930
3.758
3.748
3.736
3.725
3.271
3.255
3.241
3.229
3.217
3.201
3.191
2.285
2.275
2.258
2.248
2.238
2.221
2.212
0.008
2.13
2.09
1.58
1.80
0.94
3.18
1.00
0.97
abundance
X : parts per Million : Proton
F3C
Ar
CF3
N
O
Me
5j: (Ar = p-Cl-Ph)


170.261
146.122
136.098
133.913
130.962
129.189
129.103
128.442
127.800
127.416
127.119
124.666
77.423
77.097
76.781
42.427
38.853
38.653
38.287
37.981
(thousandths)
X : parts per Million : Carbon13
F3C
Ar
CF3
N
O
Me
5j: (Ar = p-Cl-Ph)


8.222
8.218
8.207
8.205
7.504
7.486
7.247
6.996
6.984
6.978
6.966
3.304
2.831
2.804
2.793
2.766
2.679
2.652
2.641
2.626
2.615
1.419
-0.024
Me
CF3
N
N
O
Me
5k
3.05
3.04
1.00
1.00
1.07
0.95
0.98
abundance
X : parts per Million : Proton


178.214
156.337
147.578
131.345
125.509
118.361
77.433
77.116
76.800
44.181
40.625
40.338
40.060
39.773
25.705
24.363
Me
CF3
N
N
O
Me
5k
(thousandths)
X : parts per Million : Carbon13


7.265
7.145
7.097
7.070
7.050
6.994
6.976
6.956
3.746
3.731
3.716
2.816
2.812
2.805
2.796
2.789
2.779
2.750
2.678
2.652
2.046
2.030
2.015
2.000
1.985
1.963
1.416
0.000
Me
CF3
O
N
5l
2.89
2.93
2.05
2.01
0.95
1.00
abundance
X : parts per Million : Proton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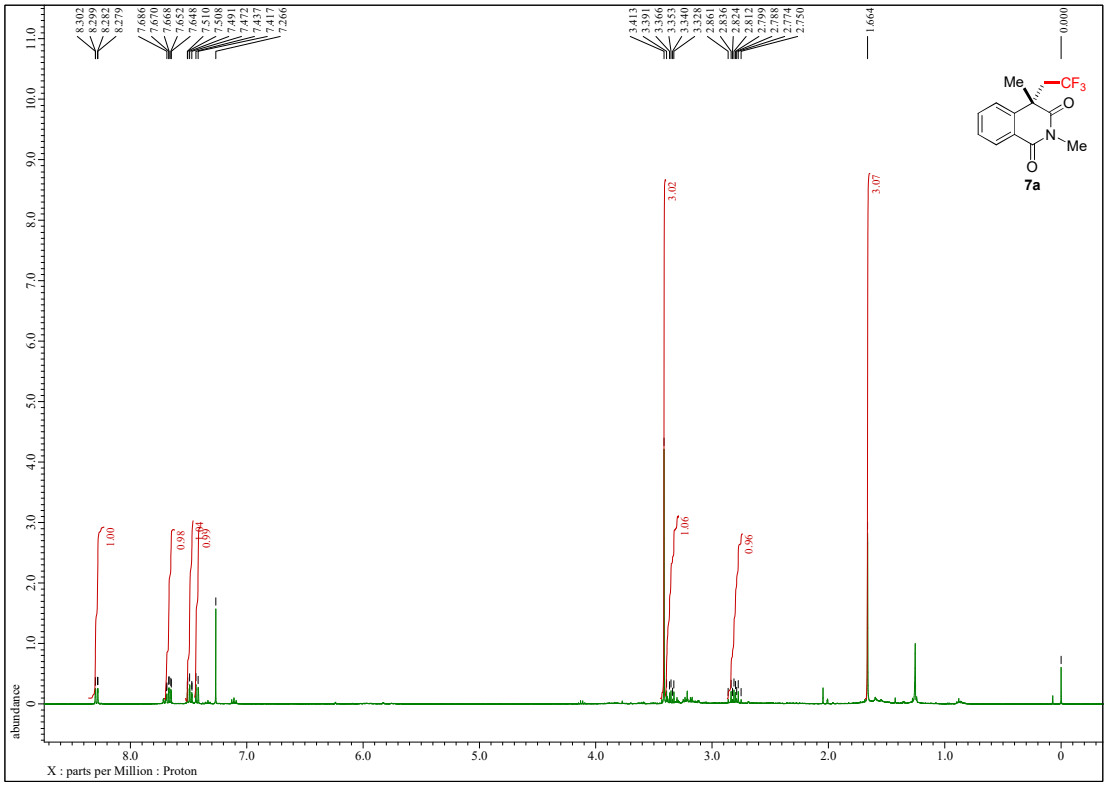
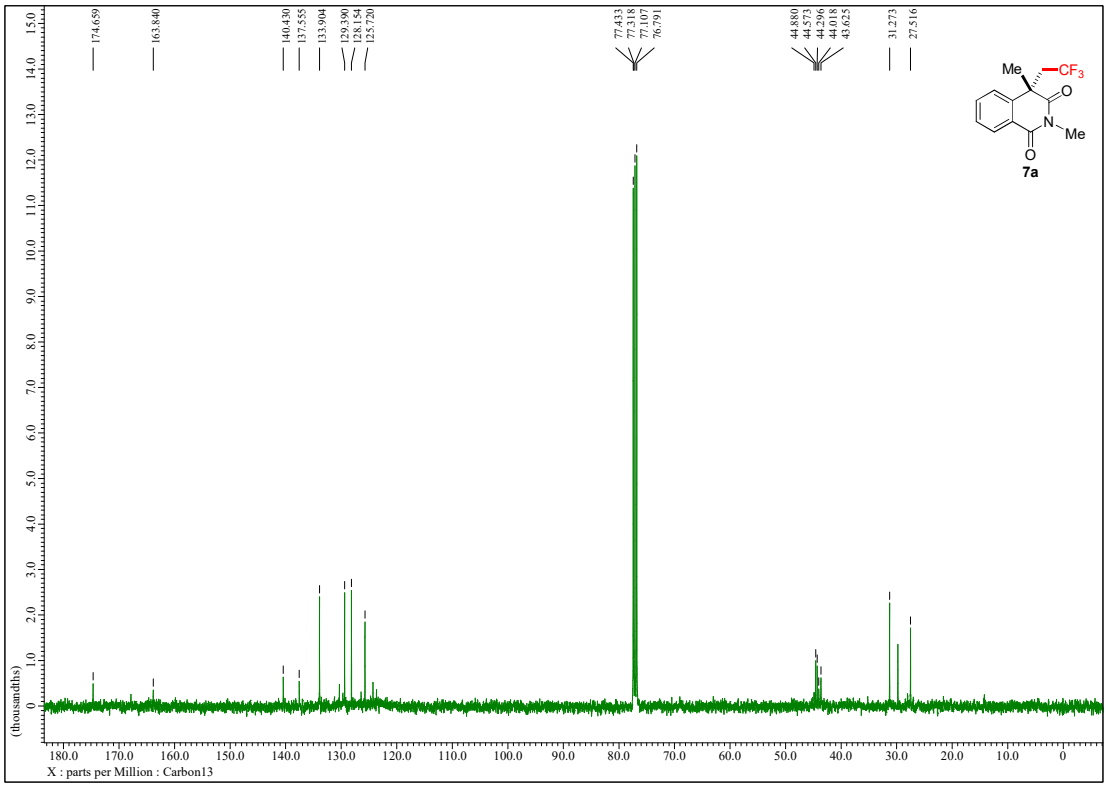
138.686
129.754
127.368
122.174
121.542
120.612
77.442
77.216
76.810
45.723
40.951
40.664
40.386
40.108
39.130
24.670
24.641
21.192
Me
CF3
O
N
5l
(thousandths)
X : parts per Million : Carbon13


8.302
8.299
8.282
8.279
7.686
7.670
7.668
7.652
7.648
7.510
7.508
7.491
7.472
7.437
7.417
7.266
3.413
3.391
3.366
3.353
3.340
3.328
2.861
2.836
2.824
2.812
2.799
2.786
2.774
2.750
1.664
0.000
1.00
0.98
1.04
0.99
3.02
1.06
0.96
3.07
abundance
X : parts per Million : Proton
Me
CF3
O
N
Me
O
7a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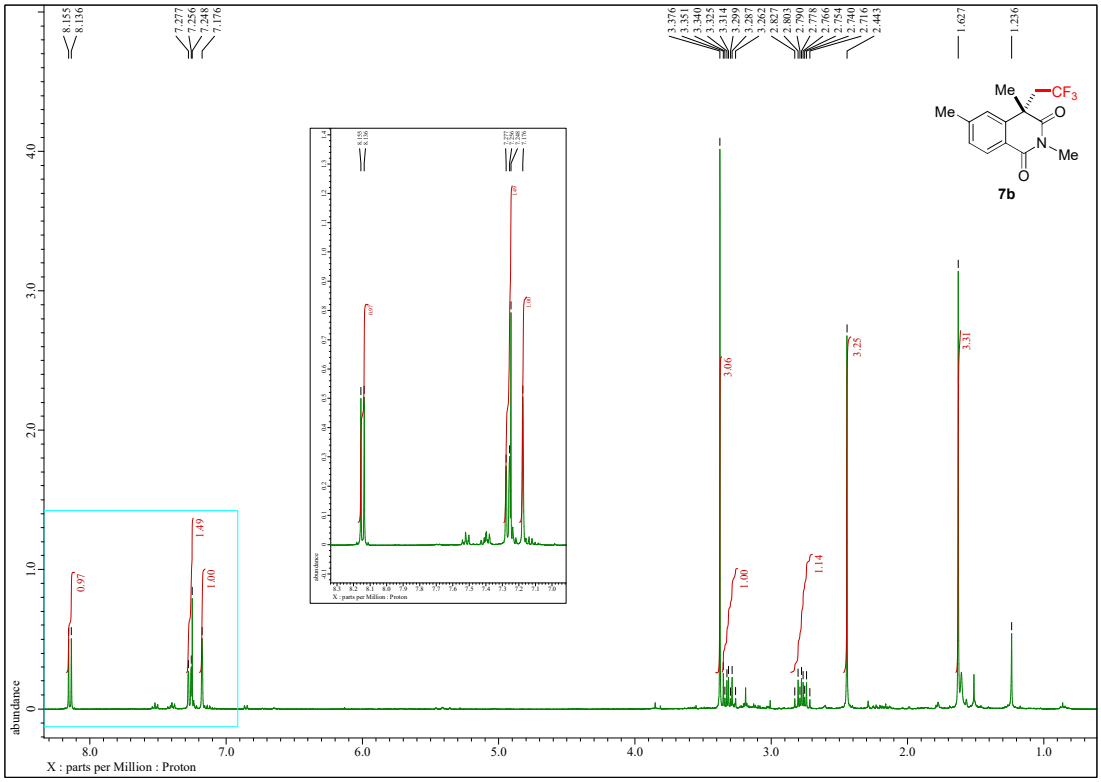
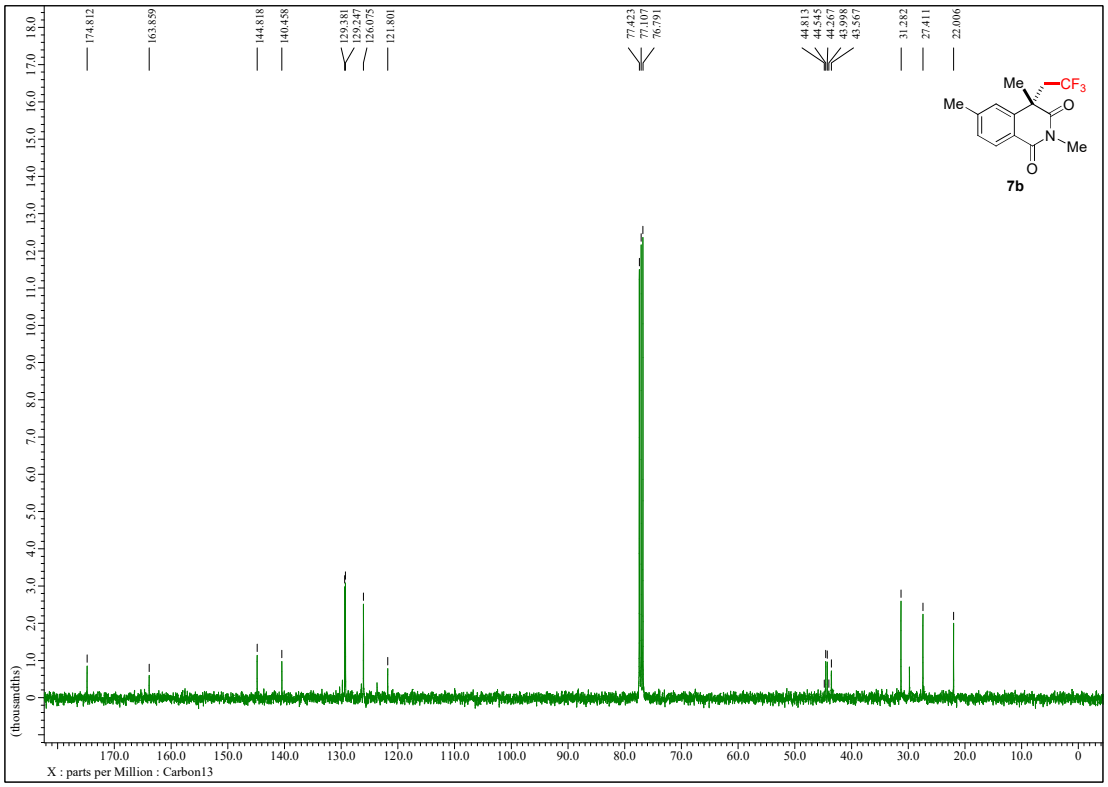
163.840
140.430
137.555
133.904
129.390
128.154
125.720
77.433
77.318
77.107
76.791
44.880
44.573
44.296
44.018
43.625
31.273
27.516
(thousandths)
X : parts per Million : Carbon13
Me
CF3
O
N
Me
O
7a


8.155
8.136
7.277
7.256
7.248
7.176
3.376
3.351
3.340
3.325
3.314
3.299
3.287
3.262
3.257
2.803
2.790
2.778
2.766
2.754
2.740
2.716
2.443
1.627
1.236
Me
CF3
Me
O
N
Me
O
7b
0.97
1.49
1.00
3.06
1.00
1.14
3.25
3.31
abundance
X : parts per Million : Proton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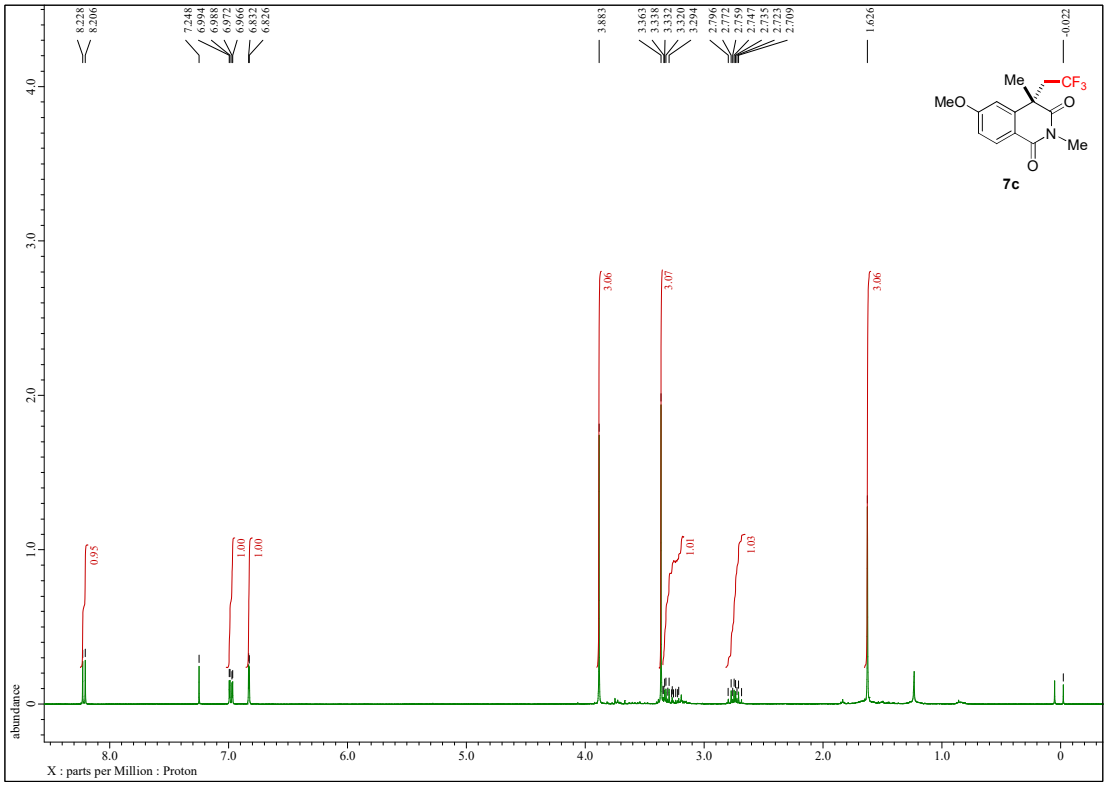
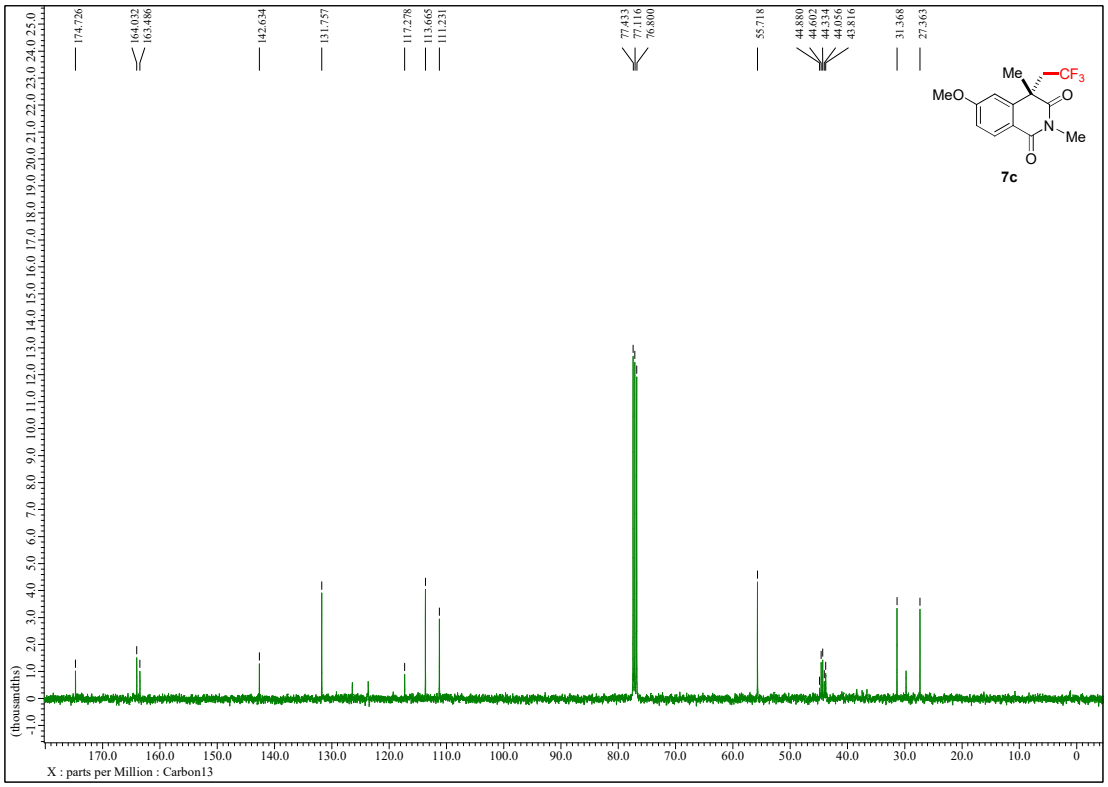
163.859
144.818
140.458
129.381
129.247
126.075
121.801
77.423
77.107
76.791
44.813
44.545
44.267
43.998
43.567
31.282
27.411
22.006
Me
CF3
Me
O
N
Me
O
7b
(thousandths)
X : parts per Million : Carbon13


8.228
8.206
7.248
6.984
6.978
6.972
6.966
6.832
6.826
3.883
3.363
3.338
3.332
3.320
3.294
2.796
2.772
2.759
2.747
2.735
2.723
2.709
1.626
-0.022
Me
CF3
MeO
O
N
Me
O
7c
3.06
3.07
3.06
0.95
1.00
1.00
1.01
1.03
abundance
X : parts per Million : Proton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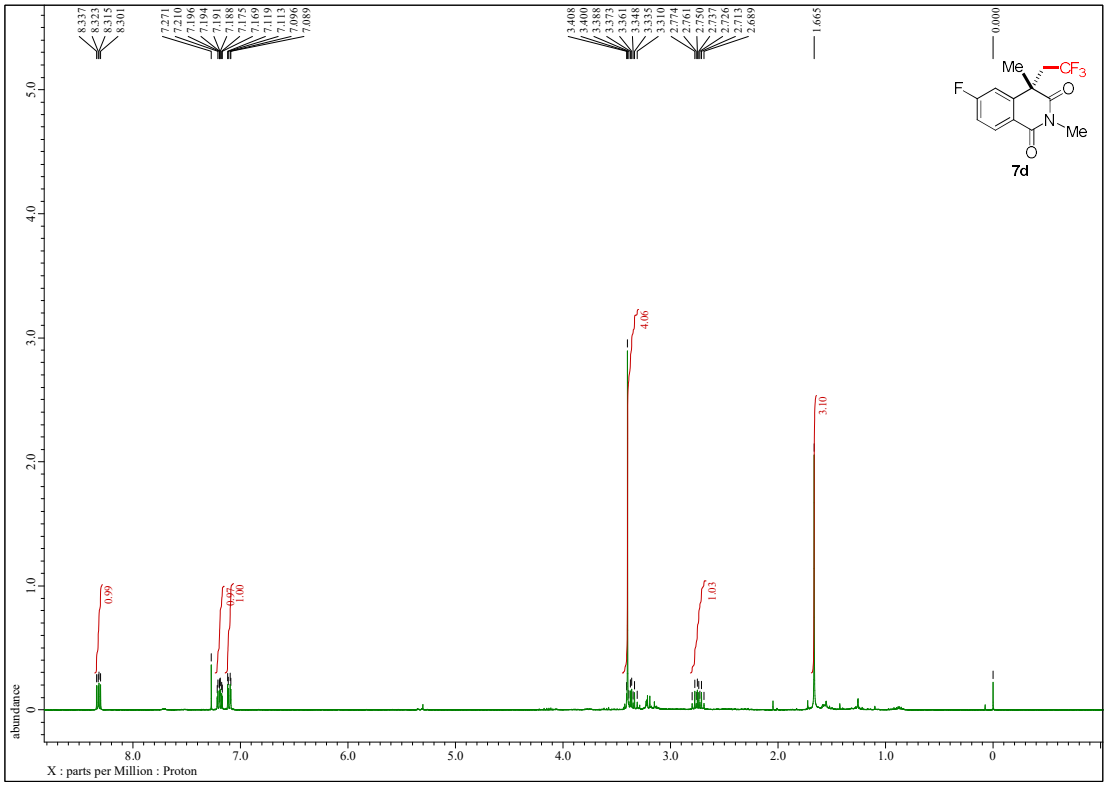
164.032
163.486
142.634
131.757
117.278
113.665
111.231
77.433
77.116
76.800
55.718
44.880
44.602
44.334
44.056
43.816
31.368
27.363
Me
CF3
MeO
O
N
Me
O
7c
(thousandths)
X : parts per Million : Carbon13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8.315
8.301
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7.210
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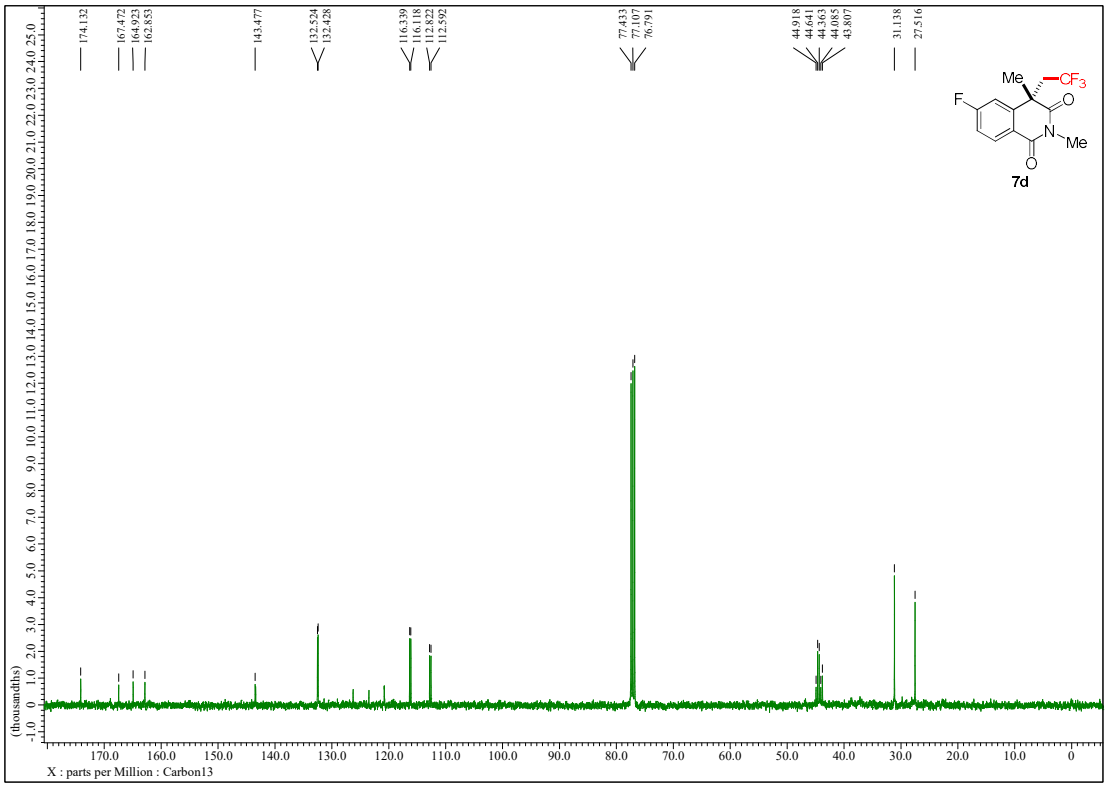
7.194
7.191
7.188
7.175
7.169
7.119
7.113
7.096
7.089
3.408
3.400
3.388
3.373
3.361
3.348
3.335
3.310
2.774
2.761
2.750
2.737
2.726
2.713
2.689
1.665
0.000
4.06
3.10
1.03
0.99
0.96
1.00
abundance
X : parts per Million : Proton
Me
CF3
F
O
N
Me
O
7d


174.132
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164.923
162.853
143.477
132.524
132.428
116.339
116.118
112.822
112.592
77.433
77.107
76.791
44.918
44.641
44.363
44.085
43.807
31.138
27.516
(thousandths)
X : parts per Million : Carbon13
Me
CF3
F
O
N
Me
O
7d