

## Supporting Information

### **A general strategy for the synthesis of $\alpha$ -trifluoromethylated and $\alpha$ -trifluoroalkyl- $\beta$ -lactams via palladium-catalyzed carbonylation**

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## 1 General information

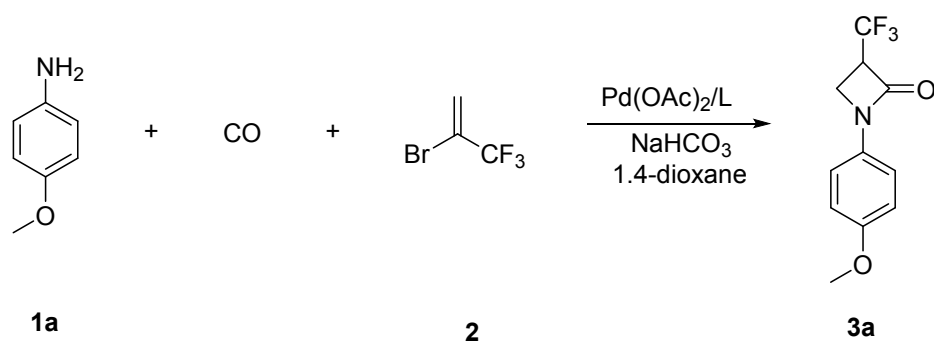
All reactions were carried out under an atmosphere of dry argon using standard autoclave technique. Chemicals were purchased from Sigma-Aldrich, TCI, Alfa Aesar, Fluorochem, or ABCR. Anilines and 2-Bromo-3,3,3-Trifluoropropane were used without any purification. Other chemicals were used as received. Multiplets of NMR were assigned as s (singlet), d (doublet), t (triplet), dd (doublet of doublet), dt (doublet of triplet), td (triplet of doublet), m (multiplet), and br. s (broad singlet).

## 2 General methods

NMR data were recorded on Bruker Avance 300 or Bruker ARX 400 spectrometers at room temperature.  $^1\text{H}$  NMR,  $^{13}\text{C}$  NMR and  $^{19}\text{F}$  NMR spectra were referenced to signals of deuterium solvents and residual protiated solvents, respectively. High resolution mass spectra (HRMS) were recorded on Agilent 6210. The data are given as mass units per charge (m/z).

## 3 General procedures

The reaction was carried out in an autoclave containing a 5.0 mL glass reaction tube.  $\text{Pd}(\text{OAc})_2$  (0.02 mmol), Ru-Phos (0.05 mmol), aniline (1.0 mmol),  $\text{NEt}_3$  (2.0 mmol), 2-bromo-3,3,3-trifluoro-1-propene (2.0 mmol) and toluene (2.0 mL) were added to the tube. The tube was placed in the autoclave. Once sealed, the autoclave was purged three times with  $\text{CO}$ , then pressurized to 8 atm at room temperature and heated in an oil bath at 100 °C for 12 h. After the reaction, the autoclave was then cooled to room temperature and vented to discharge  $\text{CO}$ . and the crude product was purified by column chromatography on silica gel using a mixture of ethyl acetate and petroleum ether as eluent to give the target compounds.

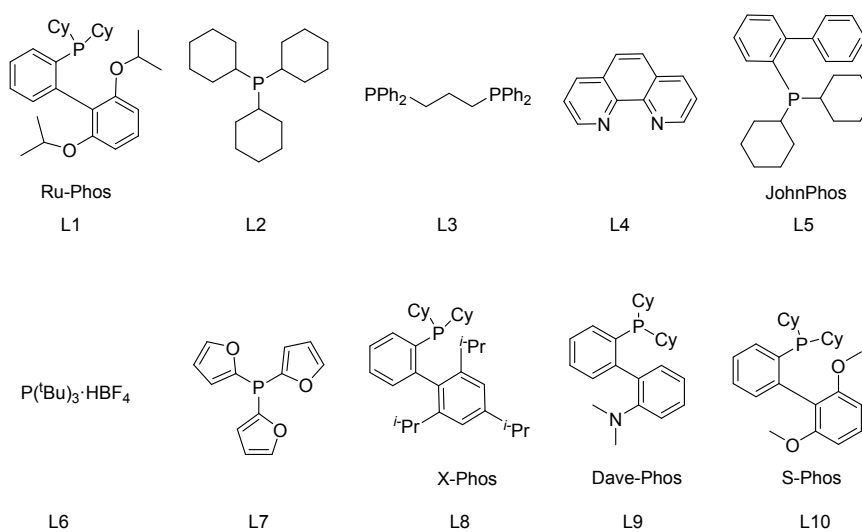
**Table-S1: Ligand optimization**

Entry	Ligand (5.0 mol%)	Yield (%) <sup>b</sup>
1	L1	72
2	L2	35
3	L3	25
4	L4	0
5	L5	41
6	L6	45
7	L7	28
8	L8	38
9	L9	51
10	L10	58

Reaction conditions: **1a** (1.0 mmol), **2** (2.0 mmol), CO (8 atm), Pd(OAc)<sub>2</sub> (2.0 mol%), Ligand (5.0 mol%), NaHCO<sub>3</sub> (2.0 mmol), 1,4-dioxane (2.0 mL), 100 °C, 12 h.

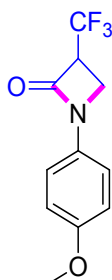
[b] Isolated Yield.

Structure of ligands:



#### 4 Characterization data of the $\alpha$ -CF<sub>3</sub>- $\beta$ -lactams

##### 1-(4-methoxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3a)



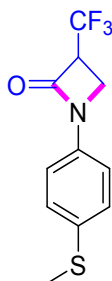
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.33 (d, 2 H,  $J$  = 9.0 Hz), 6.93 (d, 2 H,  $J$  = 9.0 Hz), 4.05-3.99 (m, 1 H), 3.87-3.82 (m, 4 H), 3.81-3.73 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.8, 155.9, 131.0, 123.6 (q,  $J$  = 274.5 Hz), 117.9, 114.5, 55.5, 51.6 (q,  $J$  = 24.0 Hz), 39.5.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>11</sub>F<sub>3</sub>NO<sub>2</sub>, 246.0742; found, 246.0744.

##### 1-(4-(methylthio)phenyl)-3-(trifluoromethyl)azetidin-2-one (3b)



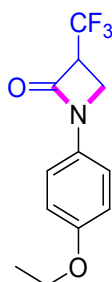
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.31 (s, 4 H), 4.10-3.98 (m, 1 H), 3.89-3.85 (m, 1 H), 3.79-3.76 (m, 1 H), 2.50 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  134.8, 133.1, 128.0, 117.1, 51.6 (q,  $J$  = 31.5 Hz), 39.4 (q,  $J$  = 3.8 Hz), 16.5.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>11</sub>F<sub>3</sub>NOS, 262.0513; found, 262.0514.

### 1-(4-ethoxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3c)



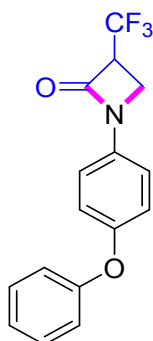
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.32 (d, 2 H,  $J$  = 9.0 Hz), 6.92 (d, 2 H,  $J$  = 9.0 Hz), 4.07-3.98 (m, 3 H), 3.86-3.73 (m, 1 H), 3.73-3.73 (m, 1 H), 1.43 (t, 3 H,  $J$  = 6.0 Hz).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.2, 155.8, 130.8, 123.6 (q,  $J$  = 275.3 Hz), 117.8, 115.1, 63.8, 51.5 (q,  $J$  = 30.8 Hz), 14.8.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>13</sub>F<sub>3</sub>NO<sub>2</sub>, 260.0898; found, 260.0886.

### 1-(4-phenoxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3d)



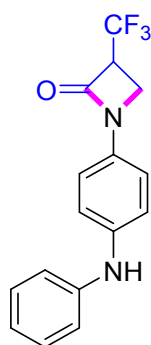
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.39-7.33 (m, 4 H), 7.15 (t, 1 H,  $J$  = 3.0 Hz), 7.13-6.99 (m, 4 H), 4.09-4.00 (m, 1 H), 3.90-3.80 (m, 1 H), 3.79-3.77 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  157.2, 156.2, 154.1, 133.0, 129.8, 123.6 (q,  $J$  = 275.3 Hz), 123.4, 119.9, 118.6, 118.0, 51.6 (q,  $J$  = 31.5 Hz), 39.5 (q,  $J$  = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>16</sub>H<sub>13</sub>F<sub>3</sub>NO<sub>2</sub>, 308.0898; found, 308.0902.

### 1-(4-(phenylamino)phenyl)-3-(trifluoromethyl)azetidin-2-one (3e)



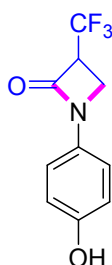
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.33-7.27 (m, 4 H), 7.11-7.04 (m, 4 H), 7.00-6.94 (m, 1 H), 5.81 (s, 1 H), 4.07-3.95 (m, 1 H), 3.84 (t, 1 H,  $J = 6.0$  Hz), 3.77-3.74 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.0 (q,  $J = 4.5$  Hz), 143.0, 140.4, 131.7, 129.5, 123.9 (q,  $J = 305.3$  Hz), 119.2, 117.8, 117.6, 51.5 (q,  $J = 31.5$  Hz), 39.4 (q,  $J = 2.3$  Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>16</sub>H<sub>14</sub>F<sub>3</sub>NO, 307.1058; found, 307.1052.

### 1-(4-hydroxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3f)



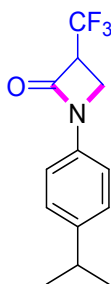
**<sup>1</sup>H NMR (300 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  8.58 (s, 1 H), 7.22 (t, 1 H,  $J = 6.0$  Hz), 7.00 (s, 1 H), 6.88-6.87 (m, 1 H), 6.68-6.65 (m, 1 H), 4.46-4.37 (m, 1 H), 4.06 (t, 1 H,  $J = 6.0$  Hz), 3.88-3.84 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  158.2, 139.0, 130.2, 111.7, 107.4, 103.7, 51.1 (q,  $J = 30.0$  Hz), 39.3 (q,  $J = 3.8$  Hz).

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  -69.3 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>10</sub>H<sub>9</sub>F<sub>3</sub>NO<sub>2</sub>, 232.0585; found, 232.0581.

### 1-(4-isopropylphenyl)-3-(trifluoromethyl)azetidin-2-one (3g)



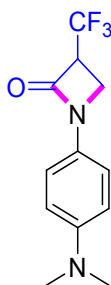
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.34-7.24 (m, 4 H), 4.05-3.96 (m, 1 H), 3.88-3.84 (m, 1 H), 3.78-3.75 (m, 1 H), 2.97-2.88 (m, 1 H), 1.27 (s, 3 H), 1.25 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.2, 145.8, 135.2, 127.2, 123.7 (q,  $J = 273.5$  Hz), 116.5, 113.4, 51.5 (q,  $J = 30.7$  Hz), 39.3 (q,  $J = 3.0$  Hz), 33.7, 24.0.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>15</sub>F<sub>3</sub>NO, 258.1106; found, 258.1102.

### 1-(4-(dimethylamino)phenyl)-3-(trifluoromethyl)azetidin-2-one (3h)



**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.28 (d, 2 H,  $J = 9.0$  Hz), 6.73 (d, 2 H,  $J = 9.0$  Hz), 4.04-3.92 (m, 1 H), 3.80 (t, 1 H,  $J = 6.0$  Hz), 3.78-3.69 (m, 1 H), 2.95 (s, 6 H).

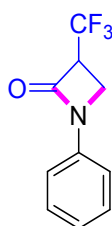
**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  155.7 (q,  $J = 3.0$  Hz), 148.2, 127.9, 124.1 (q,  $J = 247.5$  Hz), 117.8, 112.9, 51.4 (q,  $J = 30.0$  Hz), 40.7, 39.3 (q,  $J = 3.0$  Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.8 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>14</sub>F<sub>3</sub>N<sub>2</sub>O, 259.1058; found, 259.1056.



### 1-phenyl-3-(trifluoromethyl)azetidin-2-one (3i)



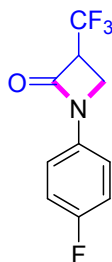
**<sup>1</sup>H NMR (300 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  7.48-7.39 (m, 4 H), 7.21-7.15 (m, 1 H), 4.51-4.38 (m, 1 H), 4.10 (t, *J* = 6.0 Hz), 3.92-3.89 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  156.8 (q, *J* = 4.5 Hz), 139.3, 129.2, 124.4, 124.6 (q, *J* = 240.8 Hz), 116.4, 51.2 (q, *J* = 30.8 Hz), 39.2 (q, *J* = 3.0 Hz).

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  -69.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>10</sub>H<sub>9</sub>F<sub>3</sub>NO, 216.0636; found, 216.0632.

### 1-(4-fluorophenyl)-3-(trifluoromethyl)azetidin-2-one (3j)



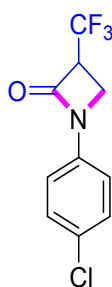
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.38-7.33 (m, 2 H), 7.11-7.06 (m, 2 H), 4.09-3.99 (m, 1 H), 3.88 (t, 1 H, *J* = 6.0 Hz), 3.79-3.76 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  161.3, 158.0, 156.3 (q, *J* = 4.5 Hz), 133.6 (d, *J* = 2.3 Hz), 123.5 (q, *J* = 261.8 Hz), 118.0 (d, *J* = 8.3 Hz), 116.2 (d, *J* = 2.3 Hz), 51.7 (q, *J* = 31.5 Hz), 39.5 (q, *J* = 3.1 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.7 (s, 3 F), -116.3 (s, 1 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>10</sub>H<sub>8</sub>F<sub>4</sub>NO, 234.0542; found, 234.0540.

### 1-(4-chlorophenyl)-3-(trifluoromethyl)azetidin-2-one (3k)



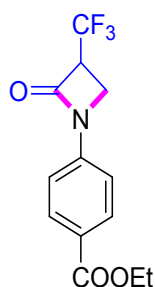
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.38-7.31 (m, 4 H), 4.12-4.00 (m, 1 H), 3.86 (t, 1 H,  $J = 6.0$  Hz), 3.80-3.77 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.4, 135.8, 130.1, 129.5, 123.4 (q,  $J = 274.5$  Hz), 117.7, 51.8 (q,  $J = 31.5$  Hz), 39.5 (q,  $J = 3.0$  Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>10</sub>H<sub>8</sub>ClF<sub>3</sub>NO, 250.0247; found, 250.0250.

### ethyl 4-(2-oxo-3-(trifluoromethyl)azetidin-1-yl)benzoate (3l)



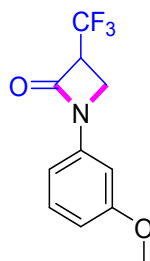
**<sup>1</sup>H NMR (300 MHz, d<sub>4</sub>-MeOD)**  $\delta$  8.06 (d, 2 H,  $J = 9.0$  Hz), 7.50 (d, 2 H,  $J = 9.0$  Hz), 4.45-4.39 (m, 3 H), 4.04 (t, 1 H,  $J = 6.0$  Hz), 3.92-3.88 (m, 1 H), 1.40 (t, 3 H,  $J = 6.0$  Hz).

**<sup>13</sup>C NMR (400 MHz NMR, 100 MHz, d<sub>4</sub>-MeOD)**  $\delta$  169.3, 161.7 (q,  $J = 4.0$  Hz), 145.1, 134.5, 130.8, 127.9 (q,  $J = 273.0$  Hz), 119.9, 64.7, 55.3 (q,  $J = 30.0$  Hz), 43.4 (q,  $J = 3.0$  Hz), 17.9.

**<sup>19</sup>F NMR (282 MHz, d<sub>4</sub>-MeOD)**  $\delta$  -70.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>13</sub>F<sub>3</sub>NO<sub>3</sub>, 288.0484; found, 288.0480.

### 1-(3-methoxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3m)



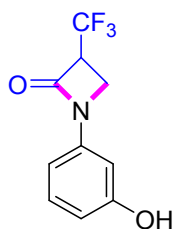
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.28 (t, 1 H,  $J$  = 6.0 Hz), 7.03 (t, 1 H,  $J$  = 3.0 Hz), 6.89- 6.86 (m, 1 H), 6.75- 6.71 (m, 1 H), 4.07-3.96 (m, 1 H), 3.86 (t, 1 H,  $J$  = 6.0 Hz), 3.83 (s, 3 H), 3.78-3.74 (m, 1 H).

**<sup>13</sup>C NMR (400 MHz NMR, 100 MHz, CDCl<sub>3</sub>)**  $\delta$  161.8, 156.6 (q,  $J$  = 5.0 Hz), 138.4, 130.2, 123.8 (q,  $J$  = 227.0 Hz), 110.8, 108.5, 102.6, 55.4, 51.5 (q,  $J$  = 31.0 Hz), 39.5 (q,  $J$  = 3.0 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.7 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>11</sub>F<sub>3</sub>NO<sub>2</sub>, 246.0742; found, 246.0744.

### 1-(3-hydroxyphenyl)-3-(trifluoromethyl)azetidin-2-one (3n)



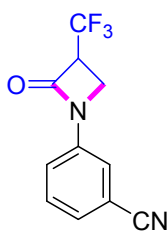
**<sup>1</sup>H NMR (300 MHz, d<sub>6</sub>-acetone)**  $\delta$  8.63 (s, 1 H), 7.22 (t, 1 H,  $J$  = 6.0 Hz), 7.01 (t, 1 H,  $J$  = 3.0 Hz), 6.88- 6.84 (m, 1 H), 6.68- 6.64 (m, 1 H), 4.49- 4.36 (m, 1 H), 4.06 (t, 1 H,  $J$  = 6.0 Hz), 3.88-3.84 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, d<sub>6</sub>-acetone)**  $\delta$  154.6, 141.0, 130.2, 111.7, 107.4, 103.8, 51.1 (q,  $J$  = 30.8 Hz), 39.4.

**<sup>19</sup>F NMR (282 MHz, d<sub>6</sub>-acetone)**  $\delta$  -69.3 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>10</sub>H<sub>9</sub>F<sub>3</sub>NO<sub>2</sub>, 232.0585; found, 232.0590.

### 3-(2-oxo-3-(trifluoromethyl)azetid-1-yl)benzonitrile (3o)



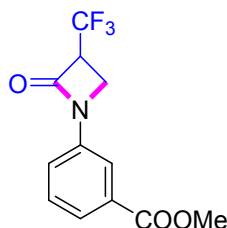
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.69-7.62 (m, 2 H), 7.55-7.47 (m, 2 H), 4.15-4.06 (m, 1 H), 3.94 (t, 1 H, *J* = 6.0 Hz), 3.86-3.83 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  137.9, 130.4, 128.4, 120.8, 119.5, 117.9, 113.6, 100.0, 52.1 (d, *J* = 35.3 Hz), 39.6 (d, *J* = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>8</sub>F<sub>3</sub>N<sub>2</sub>O, 241.0589; found, 241.0581.

### methyl 3-(2-oxo-3-(trifluoromethyl)azetid-1-yl)benzoate (3p)



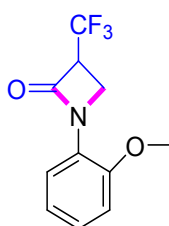
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.78-7.67 (m, 3 H), 7.38 (t, 1 H, *J* = 9.0 Hz), 4.03-3.96 (m, 1 H), 3.88-3.84 (m, 4 H), 3.77-3.74 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  167.9, 156.6 (q, *J* = 2.3 Hz), 137.5, 131.3, 129.6, 126.0, 123.4 (q, *J* = 274.5), 121.5, 116.6, 52.4, 51.7 (q, *J* = 31.5 Hz), 39.6 (q, *J* = 3.0 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>3</sub>F<sub>3</sub>NO<sub>3</sub>, 274.0691; found, 274.0685.

### 1-(2-methoxyphenyl)-3-(trifluoromethyl)azetid-2-one (3q)



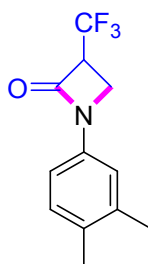
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.91 (dd, 1 H, *J* = 6.0, 3.0 Hz), 7.19-7.13 (m, 1 H), 7.00- 6.92 (m, 2 H), 4.20- 4.15 (m, 1 H), 4.09-3.96 (m, 2 H), 3.87 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 158.1, 150.3, 129.8, 126.3, 126.0, 123.8 (q, *J* = 274.5 Hz), 122.9, 121.1, 111.3, 55.6, 53.2 (q, *J* = 30.8 Hz), 44.1 (q, *J* = 3.0 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>11</sub>F<sub>3</sub>NO<sub>2</sub>, 246.0742; found, 246.0744.

### 1-(3,4-dimethylphenyl)-3-(trifluoromethyl)azetidin-2-one (3r)



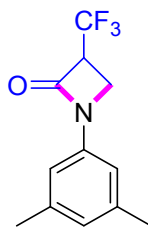
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.21 (d, 1 H, *J* = 3.0 Hz), 7.15- 7.06 (m, 2 H), 4.06- 3.94 (m, 1 H), 3.84 (t, 1 H, *J* = 6.0 Hz), 3.76- 3.73 (m, 1 H), 2.29 (s, 3 H), 2.26 (s, 3 H).

**<sup>13</sup>C NMR (400 MHz NMR, 100 MHz, CDCl<sub>3</sub>)** δ 156.3 (q, *J* = 3.0 Hz), 139.9, 135.3, 133.5, 127.8, 123.7 (q, *J* = 275.0 Hz), 117.7, 113.8, 51.4 (q, *J* = 31.0 Hz), 39.3 (q, *J* = 4.0 Hz), 19.8, 19.3.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>13</sub>F<sub>3</sub>NO, 244.0949; found, 244.0945.

### 1-(3,5-dimethylphenyl)-3-(trifluoromethyl)azetidin-2-one (3s)



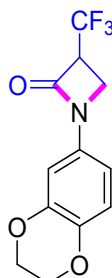
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.02 (s, 2 H), 6.85 (s, 1 H), 4.04-3.93 (m, 1 H), 3.84 (t, 1 H, *J* = 6.0 Hz), 3.77-3.73 (m, 1 H), 2.34 (s, 6 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 153.0, 135.3, 133.3, 125.1, 119.7 (q, *J* = 279.0 Hz), 110.3, 47.4 (q, *J* = 31.5 Hz), 35.4 (q, *J* = 3.8 Hz), 14.3.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>13</sub>F<sub>3</sub>NO, 244.0949; found, 244.0945.

**1-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-3-(trifluoromethyl)azetidin-2-one (3t)**



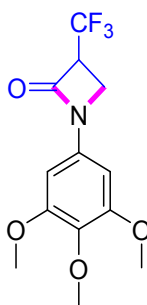
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 6.94 (s, 1 H), 6.87 (s, 2 H), 4.29-4.24 (m, 4 H), 4.04-3.97 (m, 1 H), 3.81 (t, 1 H, *J* = 6.0 Hz), 3.73-3.70 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 156.1, 143.9, 140.9, 131.4, 123.6 (q, *J* = 275.3 Hz), 117.7, 109.8, 106.0, 64.5, 64.3, 51.4 (q, *J* = 31.5 Hz), 39.5 (q, *J* = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>11</sub>F<sub>3</sub>NO<sub>2</sub>, 274.0691; found, 274.0691.

**3-(trifluoromethyl)-1-(3,4,5-trimethoxyphenyl)azetidin-2-one (3u)**



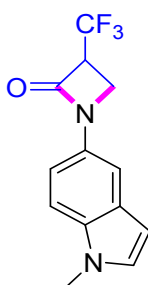
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 6.59 (s, 1 H), 4.10-3.99 (m, 1 H), 3.87-3.80 (m, 10 H), 3.76-3.73 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 156.4 (q, *J* = 4.5 Hz), 154.3, 135.3, 133.6, 123.6 (q, *J* = 274.5 Hz), 94.6, 60.9, 56.2, 51.4 (q, *J* = 30.8 Hz), 39.7 (q, *J* = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>15</sub>F<sub>3</sub>NO<sub>4</sub>, 306.0953; found, 306.0951.

### 1-(1-methyl-1H-indol-5-yl)-3-(trifluoromethyl)azetidin-2-one (3v)



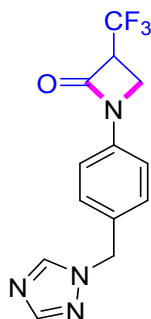
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.54 (d, 1 H, *J* = 3.0 Hz), 7.43-7.39 (m, 1 H), 7.30 (dt, 1 H, *J* = 9.0, 3.0 Hz), 7.11 (d, 1 H, *J* = 3.0 Hz), 6.49 (dd, 1 H, *J* = 3.0, 1.0 Hz), 4.03-3.97 (m, 1 H), 3.87 (t, 1 H, *J* = 6.0 Hz), 3.80-3.78 (m, 4 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 156.2 (q, *J* = 5.3 Hz), 134.3, 130.6, 130.4, 128.3, 123.9 (q, *J* = 274.5 Hz), 111.3, 109.9, 108.1, 101.5, 51.2 (q, *J* = 31.5 Hz), 39.6 (q, *J* = 3.0 Hz), 33.0.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.7 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>12</sub>F<sub>3</sub>N<sub>2</sub>O, 269.0902; found, 269.0908.

### 1-(4-((1H-1,2,4-triazol-1-yl)methyl)phenyl)-3-(trifluoromethyl)azetidin-2-one (3w)



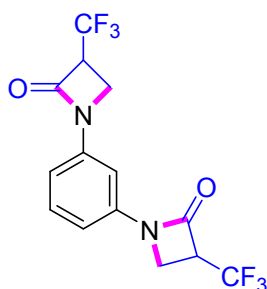
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.99 (s, 1 H), 7.89 (s, 1 H), 7.32-7.28 (m, 2 H), 7.25-7.20 (m, 2 H), 5.25 (s, 2 H), 4.03-3.91 (m, 1 H), 3.80 (t, 1 H, *J* = 6.0 Hz), 3.71-3.68 (m, 1 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 156.5 (q, *J* = 4.5 Hz), 152.3, 143.5, 137.5, 131.7, 128.7, 123.4 (q, *J* = 275.3 Hz), 117.0, 53.0, 51.7 (q, *J* = 31.5 Hz), 39.5 (q, *J* = 3.2 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.4 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>12</sub>F<sub>3</sub>N<sub>4</sub>O, 297.0963; found, 297.0961.

**1,1'-(1,3-phenylene)bis(3-(trifluoromethyl)azetidin-2-one) (3x)**



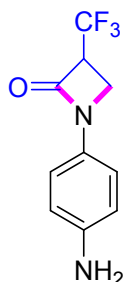
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.32-7.27 (m, 2 H), 7.71-7.08 (m, 2 H), 4.01-3.91 (m, 2 H), 3.82 (t, *J* = 6.0 Hz, 2 H), 3.74-3.71 (m, 2 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.7 (d, *J* = 4.5 Hz), 138.2, 130.5, 128.2, 123.4 (q, *J* = 274.5 Hz), 112.9, 104.6, 51.7 (q, *J* = 30.0 Hz), 39.6 (q, *J* = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.4 (s, 6 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>14</sub>H<sub>11</sub>F<sub>6</sub>N<sub>2</sub>O<sub>2</sub>, 353.0725; found, 353.0722.

**1-(4-aminophenyl)-3-(trifluoromethyl)azetidin-2-one (3y)**



**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.18 (d, 2 H, *J* = 9.0 Hz), 6.68 (d, 2 H, *J* = 9.0 Hz), 4.03-3.92 (m, 1 H), 3.79 (t, 1 H, *J* = 6.0 Hz), 3.71-3.68 (m, 3 H).

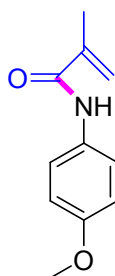
**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  158.8 (q, *J* = 3.8 Hz), 143.9, 127.9, 124.0 (q, *J* = 234.0 Hz), 118.0, 115.5, 51.3 (q, *J* = 23.3 Hz), 39.4 (q, *J* = 3.8 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>17</sub>H<sub>7</sub>F<sub>2</sub>N<sub>2</sub>O, 642.0349; found, 642.0342.



### N-(4-methoxyphenyl)methacrylamide ( 8 )

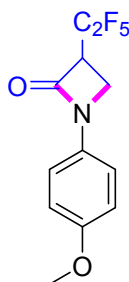


**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.50 (s, 1 H), 7.38 (d, 2 H,  $J$  = 3.0 Hz), 6.78 (d, 2 H,  $J$  = 3.0 Hz), 5.69 (t, 1 H,  $J$  = 1.0 Hz), 5.35-5.33 (m, 1 H), 3.71 (s, 3 H), 1.96 (q, 1 H,  $J$  = 1.0 Hz).

**<sup>13</sup>C NMR (400 MHz NMR, 100 MHz, CDCl<sub>3</sub>)**  $\delta$  166.6, 156.9, 140.8, 132.0, 122.0, 118.8, 114.1, 55.5, 20.7.

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>14</sub>NO<sub>2</sub>, 192.1025; found, 192.1026.

### 1-(4-methoxyphenyl)-3-(perfluoroethyl)azetidin-2-one (10a)



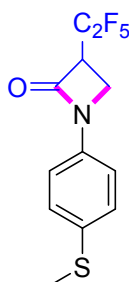
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.23 (d, 2 H,  $J$  = 9.0 Hz), 6.82 (d, 2 H,  $J$  = 9.0 Hz), 3.98-3.85 (m, 1 H), 3.76-3.67 (m, 5 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  158.1, 155.6 (t,  $J$  = 5.3 Hz), 130.9, 120.5 (t,  $J$  = 35.3 Hz), 117.9, 114.5, 112.6 (t,  $J$  = 30.8 Hz), 109.2 (t,  $J$  = 39.8 Hz), 55.5, 49.3 (t,  $J$  = 24.0 Hz), 38.9 (t,  $J$  = 4.5 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -84.2 (s, 3 F), -121.4 (t, 2 F,  $J$  = 16.3 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>11</sub>F<sub>5</sub>NO<sub>2</sub>, 296.0710; found, 296.0702.

### 1-(4-(methylthio)phenyl)-3-(perfluoroethyl)azetidin-2-one (10b)



**<sup>1</sup>H NMR (300 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  7.44-7.40 (m, 2 H), 7.37-7.33 (m, 2 H), 4.58-4.42 (m, 1 H), 4.12 (t, 1 H, *J* = 9.0 Hz), 3.97-3.94 (m, 1 H), 2.51 (s, 3 H).

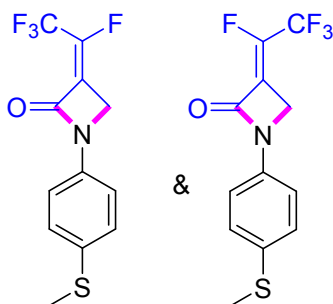
**<sup>13</sup>C NMR (75 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  156.2 (t, *J* = 5.3 Hz), 135.4, 134.4, 127.9, 120.7 (t, *J* = 36.0 Hz), 117.2, 113.5 (t, *J* = 26.3 Hz), 110.2 (t, *J* = 57.8 Hz), 49.2 (t, *J* = 23.3 Hz), 38.9 (t, *J* = 13.5 Hz), 14.6.

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  -85.3 (s, 3 F), -121.7 (dd, *J* = 16.3, 13.6 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>11</sub>F<sub>5</sub>NOS, 312.0482; found, 312.0480.

### (*Z,E*)-1-(4-(methylthio)phenyl)-3-(perfluoroethylidene)azetidin-2-one

(11, 11')



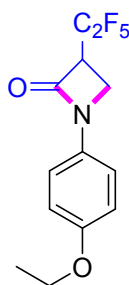
**<sup>1</sup>H NMR (300 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  7.46-7.42 (m, 2 H), 7.38-7.33 (m, 2 H), 4.59-4.57 (m, 1.6 H), 4.55-4.54 (m, 0.4 H), 2.51 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  153.3 (d, *J* = 4.5 Hz), 135.2, 134.9, 127.5, 124.0 (d, *J* = 11.3 Hz), 120.0 (d, *J* = 41.3 Hz), 117.2, 117.1, 116.4 (d, *J* = 40.5 Hz), 44.4-44.3 (m), 43.9 (d, *J* = 3.8 Hz), 15.1.

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)**  $\delta$  -70.9 (s, 0.7 H), -72.1 (s, 3.0 F), -130.2- -130.3 (m, 1 F), -133.6- -134.1 (m, 0.22 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>10</sub>F<sub>4</sub>NOS, 292.0419; found, 292.0411.

### 1-(4-ethoxyphenyl)-3-(perfluoroethyl)azetidin-2-one (10c)



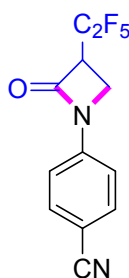
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.31 (d, 2 H,  $J$  = 6.0 Hz), 6.90 (d, 2 H,  $J$  = 9.0 Hz), 4.08-3.94 (m, 3 H), 3.85-3.77 (m, 2 H), 1.43 (t, 3 H,  $J$  = 7.5 Hz).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  156.2, 155.6 (t,  $J$  = 5.3 Hz), 131.4, 124.2 (t,  $J$  = 40.5 Hz), 120.5 (t,  $J$  = 35.3 Hz), 117.8, 115.1, 112.8 (t,  $J$  = 39.0 Hz), 109.5 (d,  $J$  = 38.3 Hz), 63.8, 49.3 (t,  $J$  = 24.0 Hz), 38.9 (t,  $J$  = 4.5 Hz), 14.8.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -84.4 (s, 3 F), -121.4 (dd,  $J$  = 16.3, 13.6 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>13</sub>F<sub>5</sub>NO<sub>2</sub>, 310.0866; found, 310.0861.

### 4-(2-oxo-3-(perfluoroethyl)azetidin-1-yl)benzonitrile (10d)



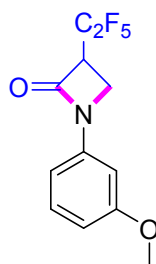
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.68 (d, 2 H,  $J$  = 9.0 Hz), 7.45 (d, 2 H,  $J$  = 9.0 Hz), 4.16-4.05 (m, 1 H), 3.96-3.86 (m, 2 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  140.5, 133.8, 118.4, 117.0, 108.3, 50.0 (t,  $J$  = 24.4 Hz), 39.3 (t,  $J$  = 4.1 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -84.2 (s, 3 F), -121.1 (d, 2 F,  $J$  = 13.6 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>8</sub>F<sub>5</sub>N<sub>2</sub>O, 291.0557; found, 291.0548.

### 1-(3-methoxyphenyl)-3-(perfluoroethyl)azetidin-2-one (10e)



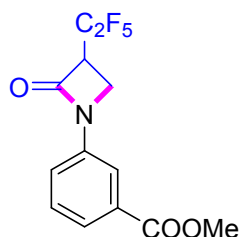
**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)**  $\delta$  7.83-7.73 (m, 3 H), 7.44 (t, 1 H, *J* = 10.4 Hz), 4.12-4.06 (m, 1 H), 4.00-3.85 (m, 5 H).

**<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)**  $\delta$  163.3, 156.4 (t, *J* = 2.1 Hz), 137.5, 131.4, 129.7, 126.0, 121.6, 116.6, 52.5, 49.6 (t, *J* = 32.3 Hz), 39.2 (t, *J* = 5.2 Hz).

**<sup>19</sup>F NMR (382 MHz, CDCl<sub>3</sub>)**  $\delta$  -84.3 (s, 3 F), -121.3 (dd, 2 F, *J* = 16.3, 13.6 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>11</sub>F<sub>5</sub>NO<sub>2</sub>, 296.0710; found, 296.0701.

### methyl 3-(2-oxo-3-(perfluoroethyl)azetidin-1-yl)benzoate (10f)



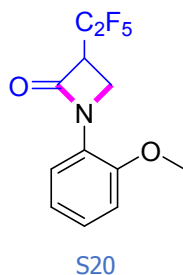
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)**  $\delta$  7.78-7.67 (m, 3 H), 7.38 (td, 1 H, *J* = 9.0, 3.0 Hz), 4.06-3.92 (m, 1 H), 3.88-3.78 (m, 5 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)**  $\delta$  167.9, 156.3 (t, *J* = 6.0 Hz), 137.4, 131.3, 129.6, 126.0, 121.5, 120.5 (t, *J* = 35.3 Hz), 116.6, 112.7 (d, *J* = 39.0 Hz), 109.3 (d, *J* = 45.8 Hz), 52.4, 49.5 (t, *J* = 24.0 Hz), 39.1 (t, *J* = 5.3 Hz).

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**  $\delta$  -84.7 (s, 3 F), -121.5 (dd, 2 F, *J* = 13.6, 5.4 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>11</sub>F<sub>5</sub>NO<sub>3</sub>, 324.0659; found, 324.0648.

### 1-(2-methoxyphenyl)-3-(perfluoroethyl)azetidin-2-one (10g)



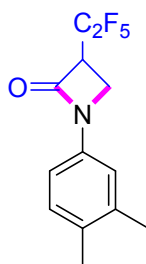
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.89 (dd, 1 H, *J* = 2.7, 0.5 Hz), 7.17-7.10 (m, 1 H), 6.98-6.90 (m, 2 H), 4.17-3.92 (m, 3 H), 3.84 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 157.8, 151.4, 126.4, 126.0, 122.4, 121.2, 111.9, 55.7, 51.0 (t, *J* = 22.5 Hz), 43.8.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -84.4 (s, 3 F), -121.5 (dd, 2 F, *J* = 13.6, 5.4 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>11</sub>F<sub>5</sub>NO<sub>2</sub>, 296.0710; found, 296.0701.

### 1-(3,4-dimethylphenyl)-3-(perfluoroethyl)azetid-2-one (10h)



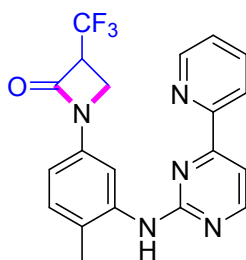
**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.18 (d, 2 H, *J* = 2.8 Hz), 7.13-7.04 (m, 2 H), 4.05-3.93 (m, 1 H), 3.84-3.78 (m, 2 H), 2.27 (s, 3 H), 2.24 (s, 3 H).

**<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 138.1, 135.4, 133.7, 130.4, 118.0, 114.0, 49.4 (t, *J* = 31.5 Hz), 39.0, 20.1, 19.5.

**<sup>19</sup>F NMR (375 MHz, CDCl<sub>3</sub>)** δ -84.3 (s, 3 F), -121.4 (dd, *J* = 22.1, 19.9 Hz).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>13</sub>H<sub>13</sub>F<sub>5</sub>NO, 294.0917; found, 294.0912.

### 1-(4-methyl-3-((4-(pyridin-2-yl)pyrimidin-2-yl)amino)phenyl)-3-(trifluoromethyl)azetid-2-one (13)



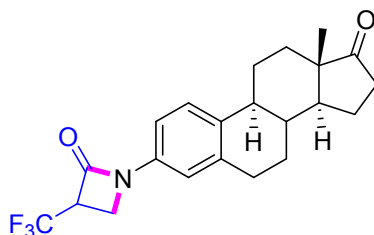
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 9.28 (dd, 1 H, *J* = 6.0, 3.0 Hz), 8.75 (dd, 1 H, *J* = 6.0, 3.0 Hz), 8.55- 8.54 (m, 1 H), 8.53- 8.50 (m, 1 H), 7.25 (d, 1 H, *J* = 3.0 Hz), 7.21 (s, 1 H), 7.11 (s, 1 H), 7.00 (dd, 1 H, *J* = 6.0, 3.0 Hz), 4.11-3.99 (m, 1 H), 3.90 (t, 1 H, *J* = 6.0 Hz), 3.81-3.78 (m, 1 H), 2.37 (s, 3 H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 163.6, 160.3, 159.2, 156.3 (q, *J* = 4.5 Hz), 151.7, 148.5, 138.2, 135.6, 134.4, 132.6, 128.2, 125.5, 124.9, 123.8, 123.7, 122.3, 112.4, 108.9, 108.7, 51.4 (q, *J* = 31.5 Hz), 39.5 (q, *J* = 3.8 Hz), 17.1.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.5 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>21</sub>H<sub>21</sub>F<sub>3</sub>N<sub>5</sub>O, 416.1698; found, 416.1692.

**1-((9S,13S,14S)-13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-6H-cyclopenta[a]phenanthren-3-yl)-3-(trifluoromethyl)azetidin-2-one (15)**



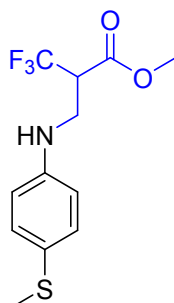
**<sup>1</sup>H NMR (400 MHz, *d*<sub>6</sub>-acetone)** δ 7.18 (d, 1 H, *J* = 8.4 Hz), 7.08-7.05 (m, 1 H), 7.01 (s, 1 H), 4.30- 4.23 (m, 1 H), 3.90 (t, 1 H, *J* = 6.0 Hz), 3.71-3.68 (m, 1 H), 2.76-2.75 (m, 2 H), 2.33-2.25 (m, 2 H), 2.10 (t, 1 H, *J* = 10.0 Hz), 1.95-1.87 (m, 3 H), 1.72-1.69 (m, 1 H), 1.53-1.30 (m, 6 H), 0.74 (s, 3 H).

**<sup>13</sup>C NMR (100 MHz, *d*<sub>6</sub>-acetone)** δ 218.5, 156.5 (q, *J* = 4.6 Hz), 137.7, 136.4, 135.7, 126.1, 124.4 (q, *J* = 273.9 Hz), 116.5 (d, *J* = 2.9 Hz), 113.9 (d, *J* = 3.2 Hz), 51.2 (q, *J* = 30.0 Hz), 50.2, 47.5, 44.1, 39.2, 38.1, 35.2, 31.7, 29.2, 26.2, 25.6, 21.2, 13.2.

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)** δ -69.2 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>22</sub>H<sub>25</sub>F<sub>3</sub>NO<sub>2</sub>, 392.1837; found, 392.1831.

**methyl 3,3,3-trifluoro-2-(((4-(methylthio)phenyl)amino)methyl)propanoate (16)**



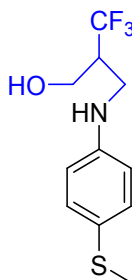
**<sup>1</sup>H NMR (400 MHz, *d*<sub>6</sub>-acetone)** δ 7.05 (d, 2 H, *J* = 2.2 Hz), 6.55 (d, 2 H, *J* = 2.1 Hz), 5.17 (s, 1 H), 3.67-3.53 (m, 6 H), 2.24 (s, 3 H).

**<sup>13</sup>C NMR (100 MHz, *d*<sub>6</sub>-acetone)** δ 166.6, 146.3, 130.1, 124.7 (t, *J* = 116.0 Hz), 113.4, 52.2, 49.3 (q, *J* = 25.5 Hz), 40.5 (q, *J* = 2.9 Hz), 17.8.

**<sup>19</sup>F NMR (282 MHz, *d*<sub>6</sub>-acetone)** δ -67.7 (s, 3 F).

**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>12</sub>H<sub>15</sub>F<sub>3</sub>NO<sub>2</sub>S, 294.0776; found, 294.0768.

**3,3,3-trifluoro-2-(((4-(methylthio)phenyl)amino)methyl)propan-1-ol (17)**



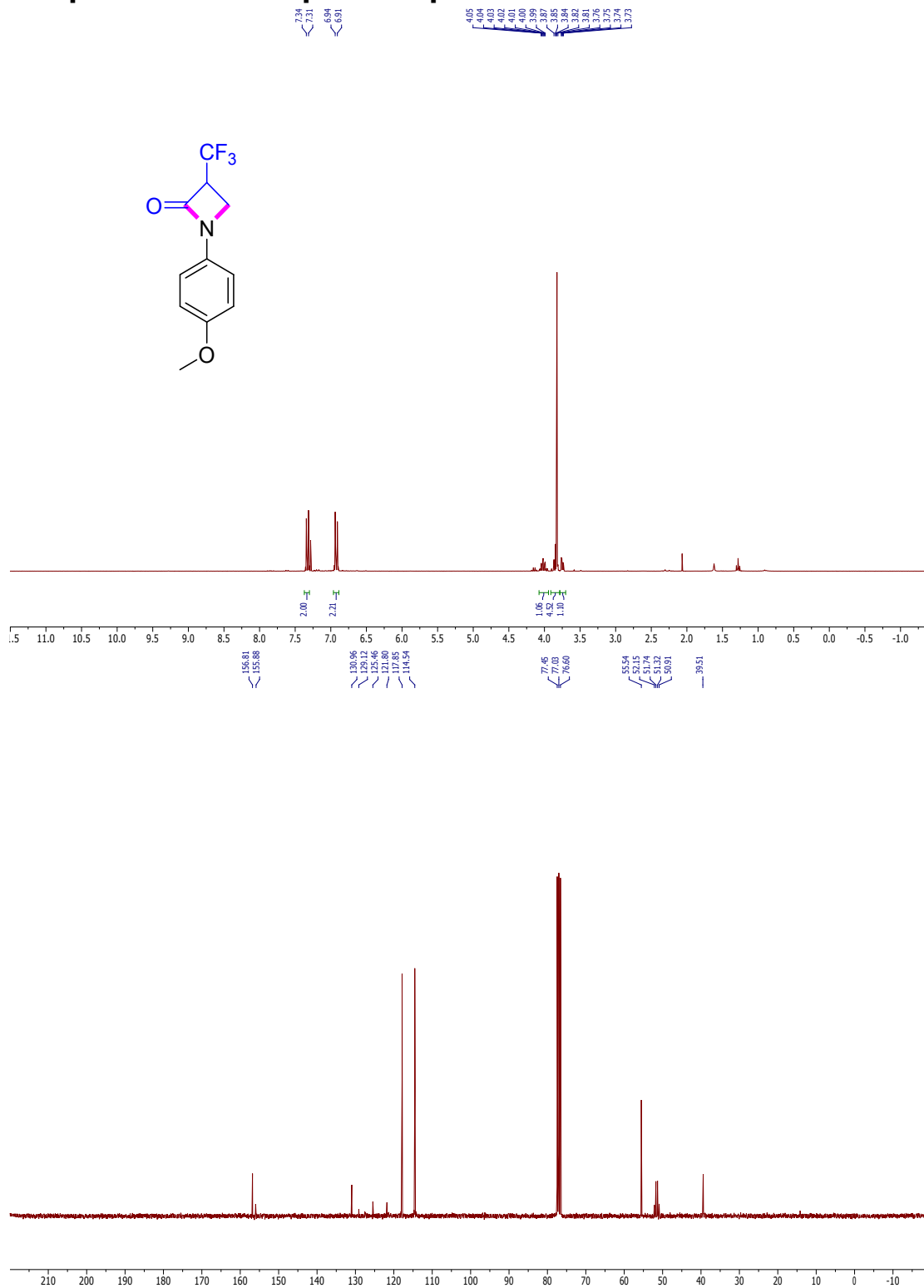
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.16 (d, 2 H, *J* = 9.0 Hz), 6.55 (d, 2 H, *J* = 9.0 Hz), 3.91-3.78 (m, 2 H), 3.50-3.43 (m, 2 H), 2.57-2.50 (m, 1 H), 2.34 (s, 3 H).

**<sup>13</sup>C NMR (400 MHz NMR, 100 MHz, CDCl<sub>3</sub>)** δ 144.8, 131.0, 127.0, 126.8 (q, *J* = 131.2 Hz), 114.5, 58.9 (q, *J* = 3.0 Hz), 44.3 (q, *J* = 23.4 Hz), 40.8, 18.6.

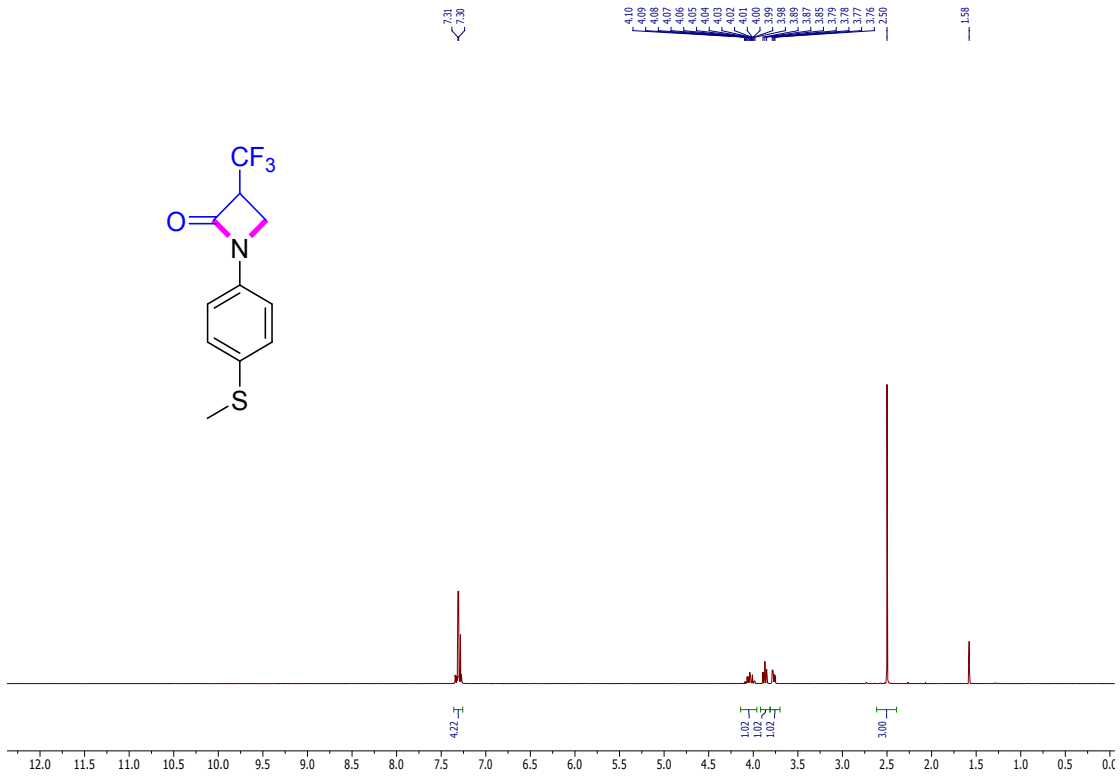
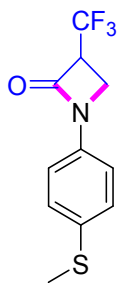
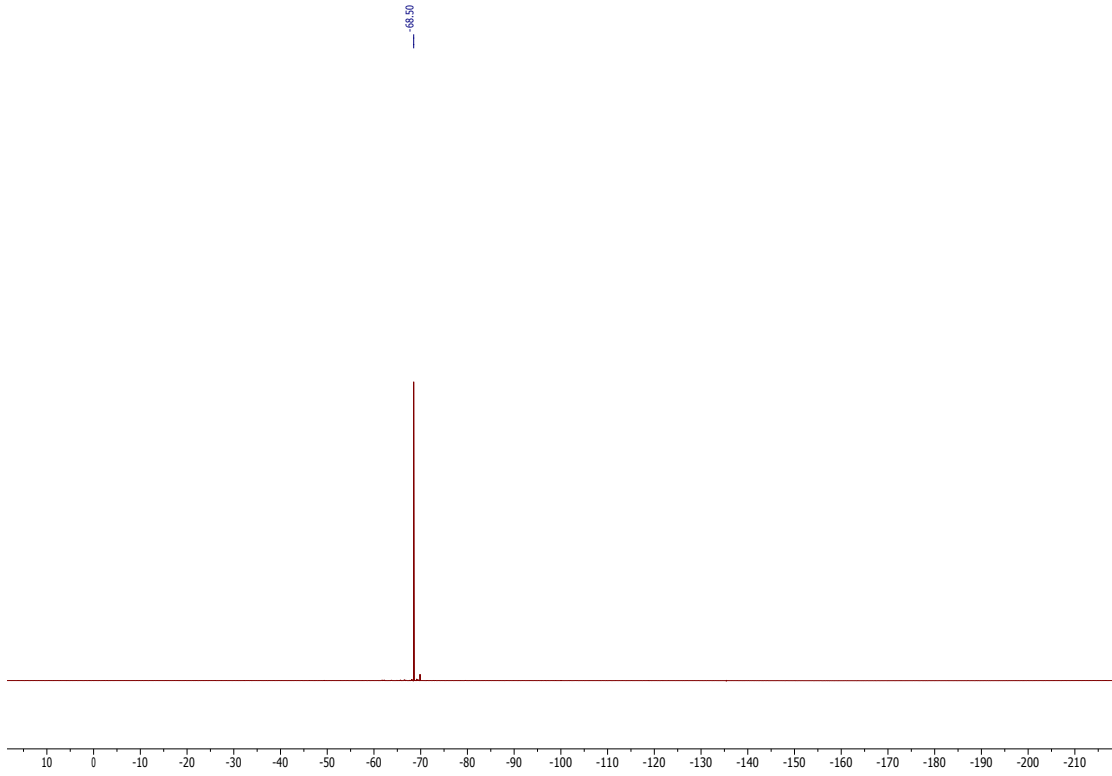
**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -68.1 (s, 3 F).

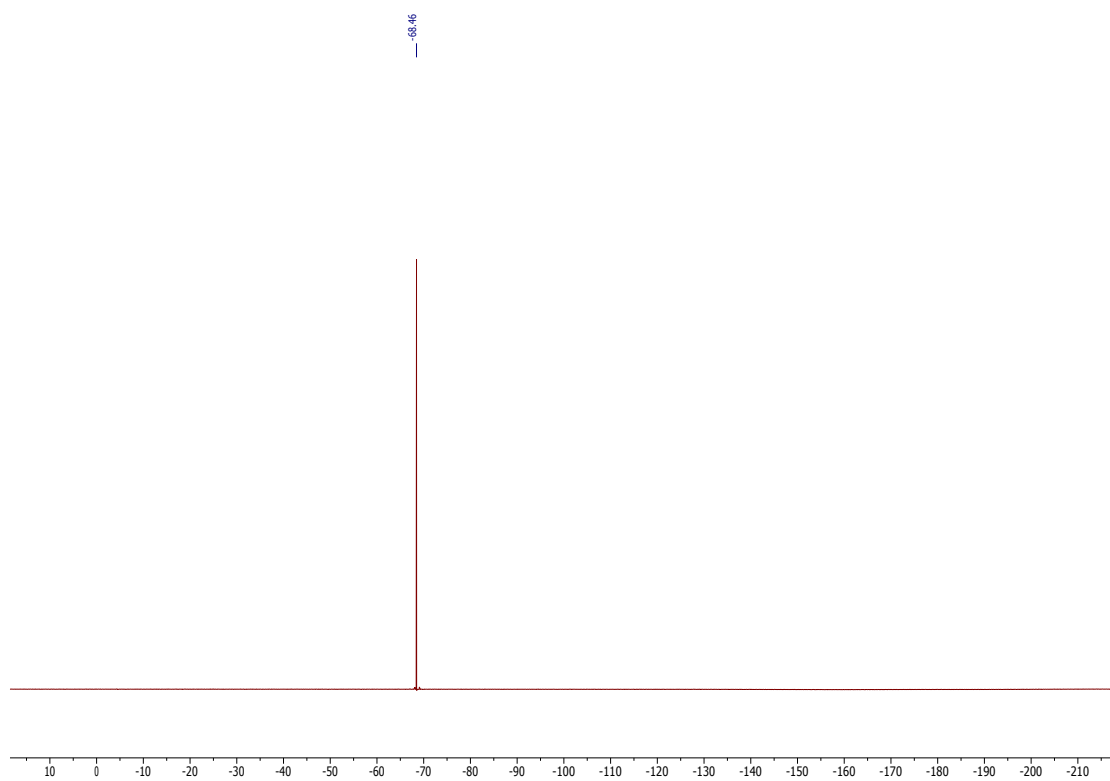
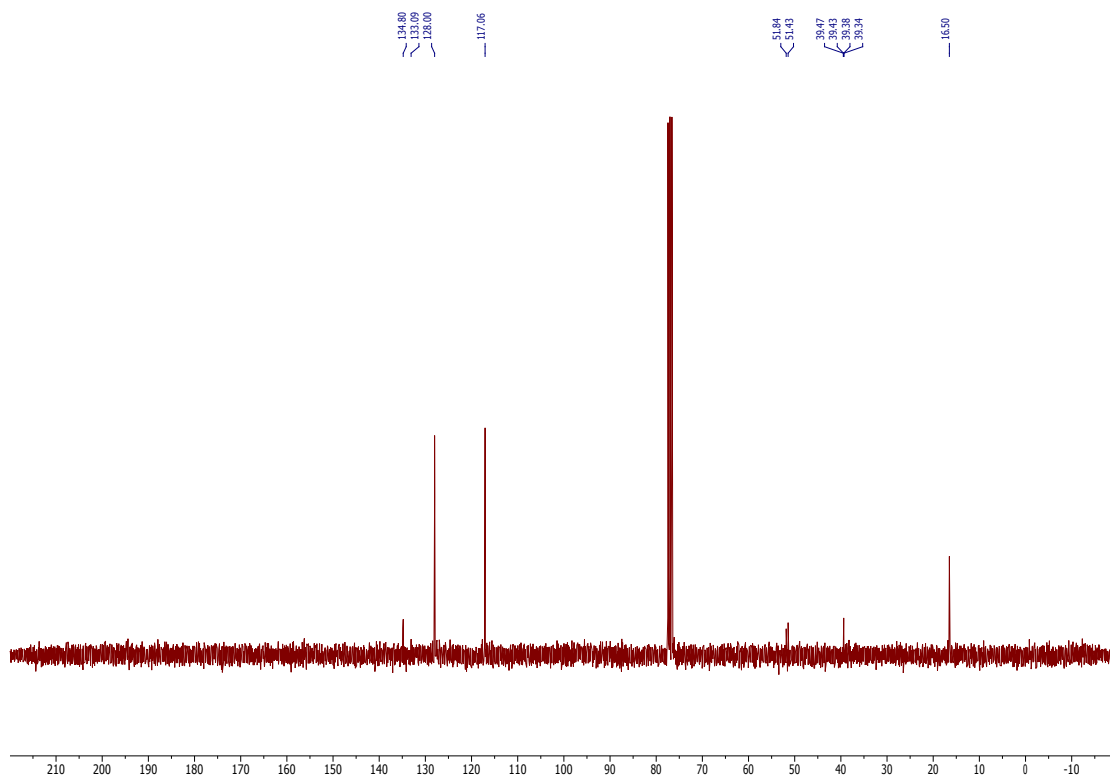
**HRMS (EI)** [M+H]<sup>+</sup> calcd for C<sub>11</sub>H<sub>15</sub>F<sub>3</sub>NOS, 266.0826; found, 266.0820.

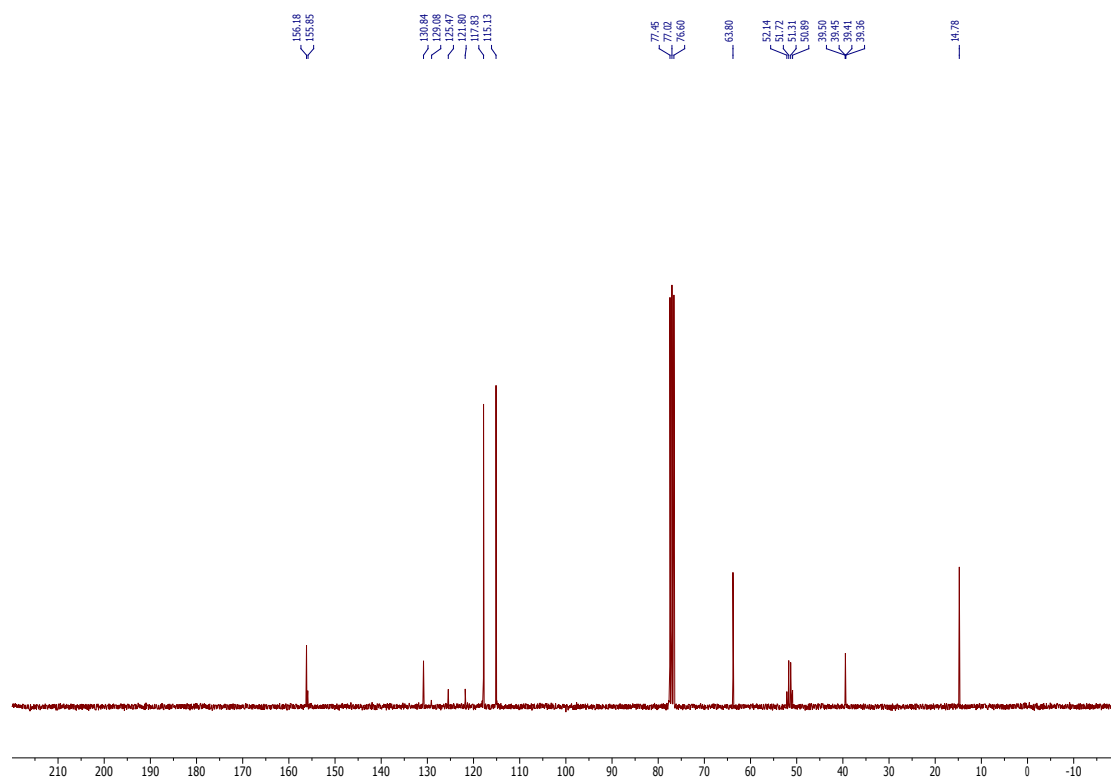
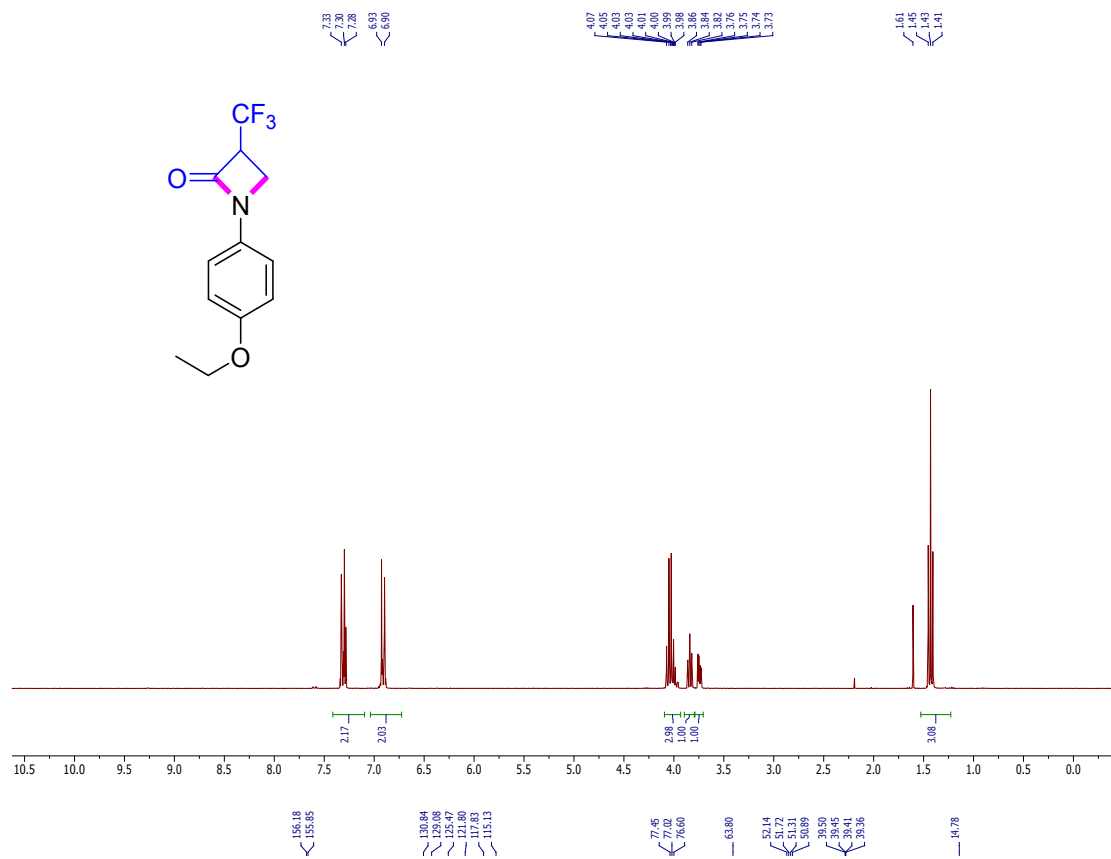
# 5 Copies of the NMR spectra of products

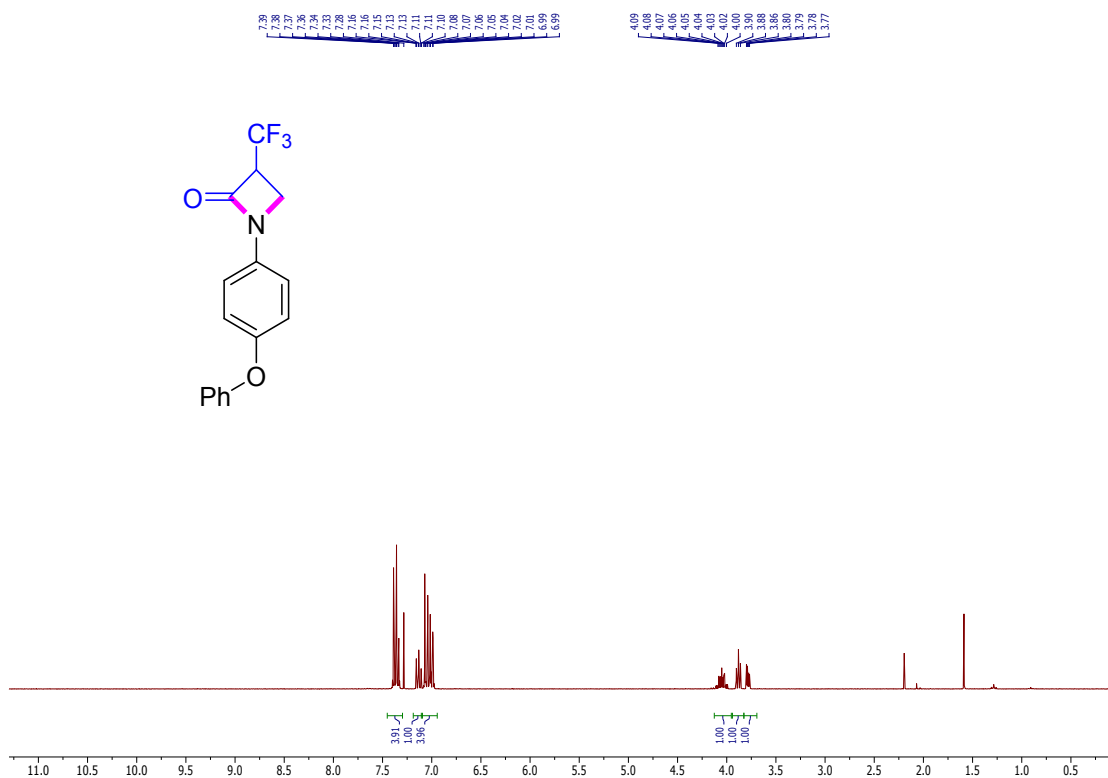
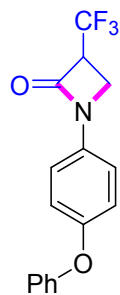
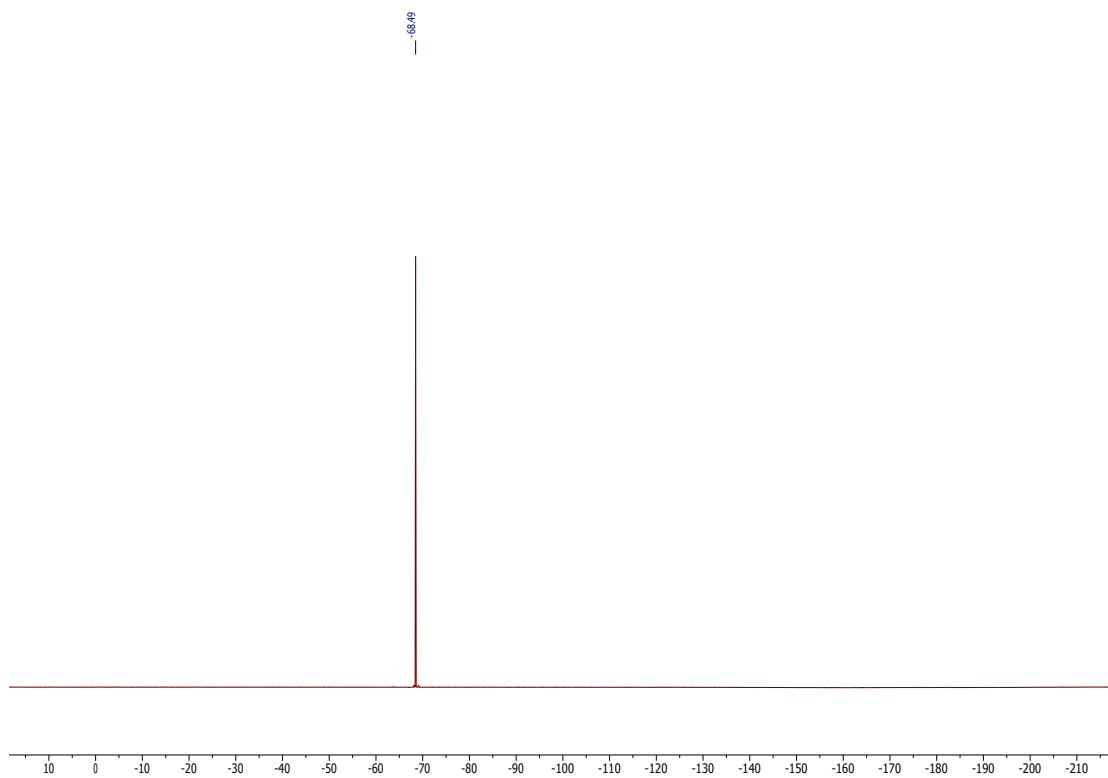


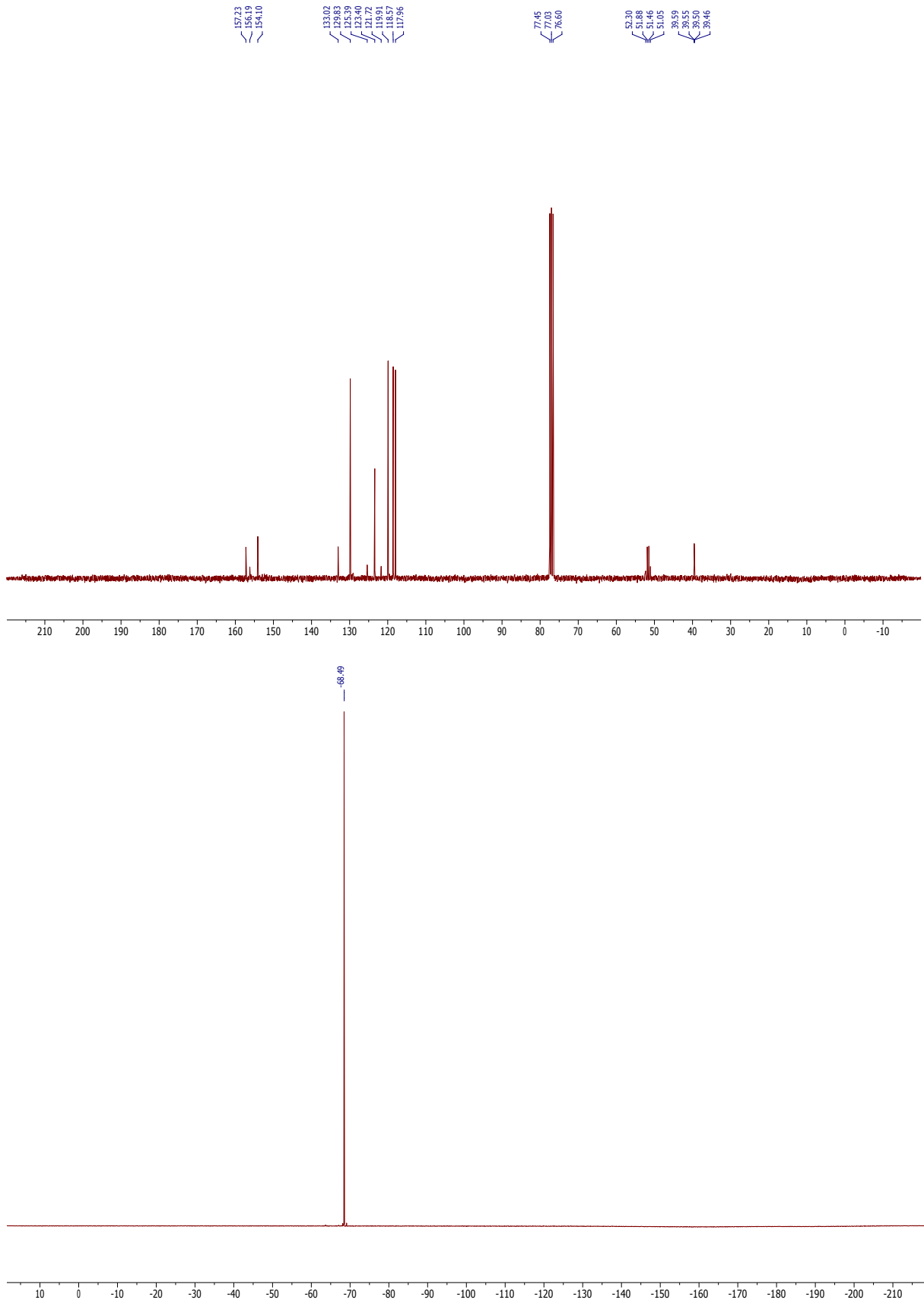


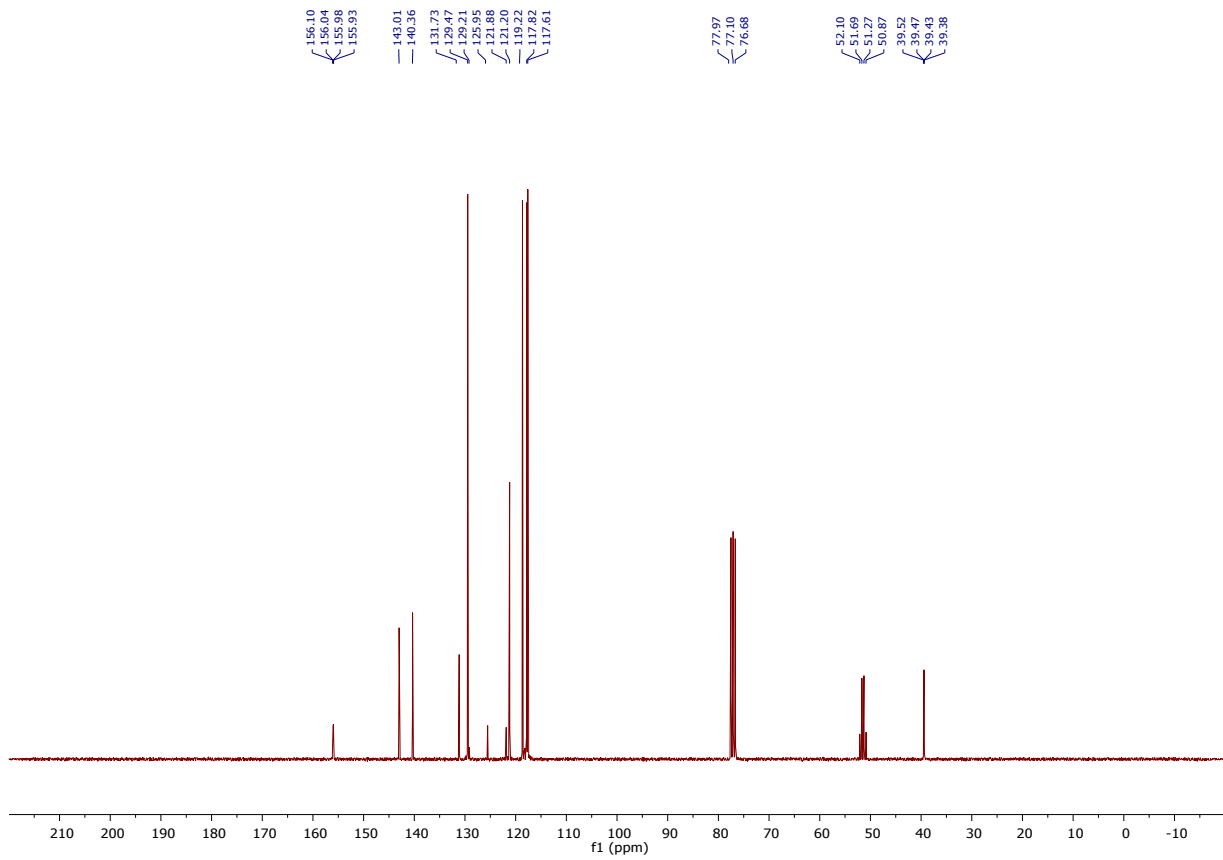
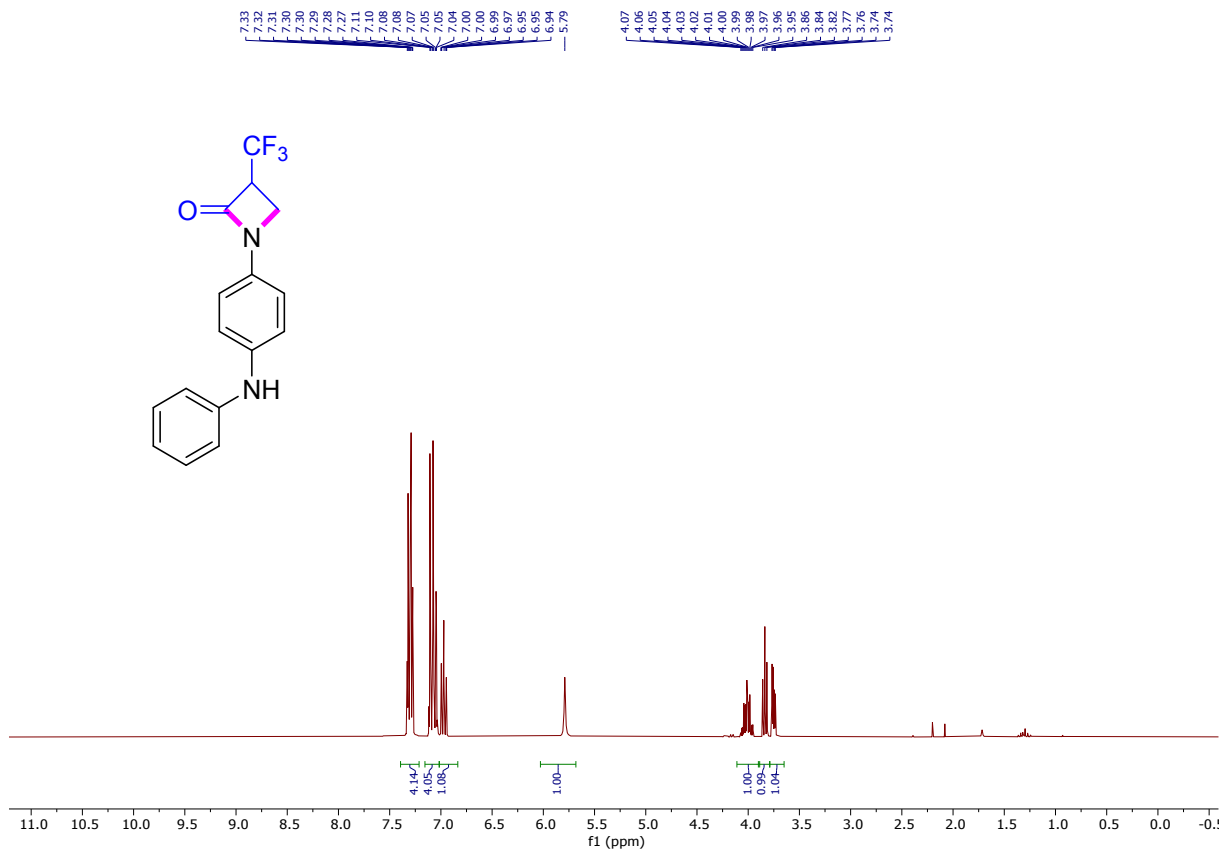


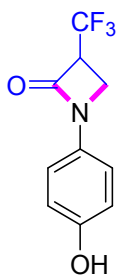
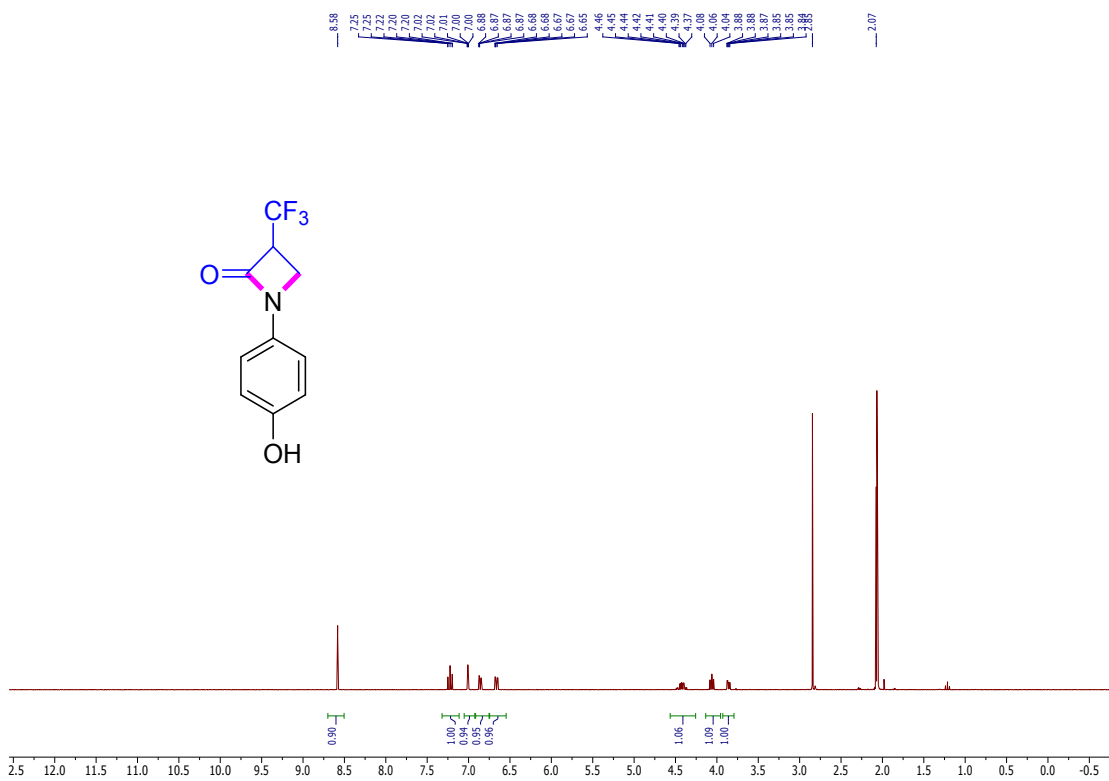
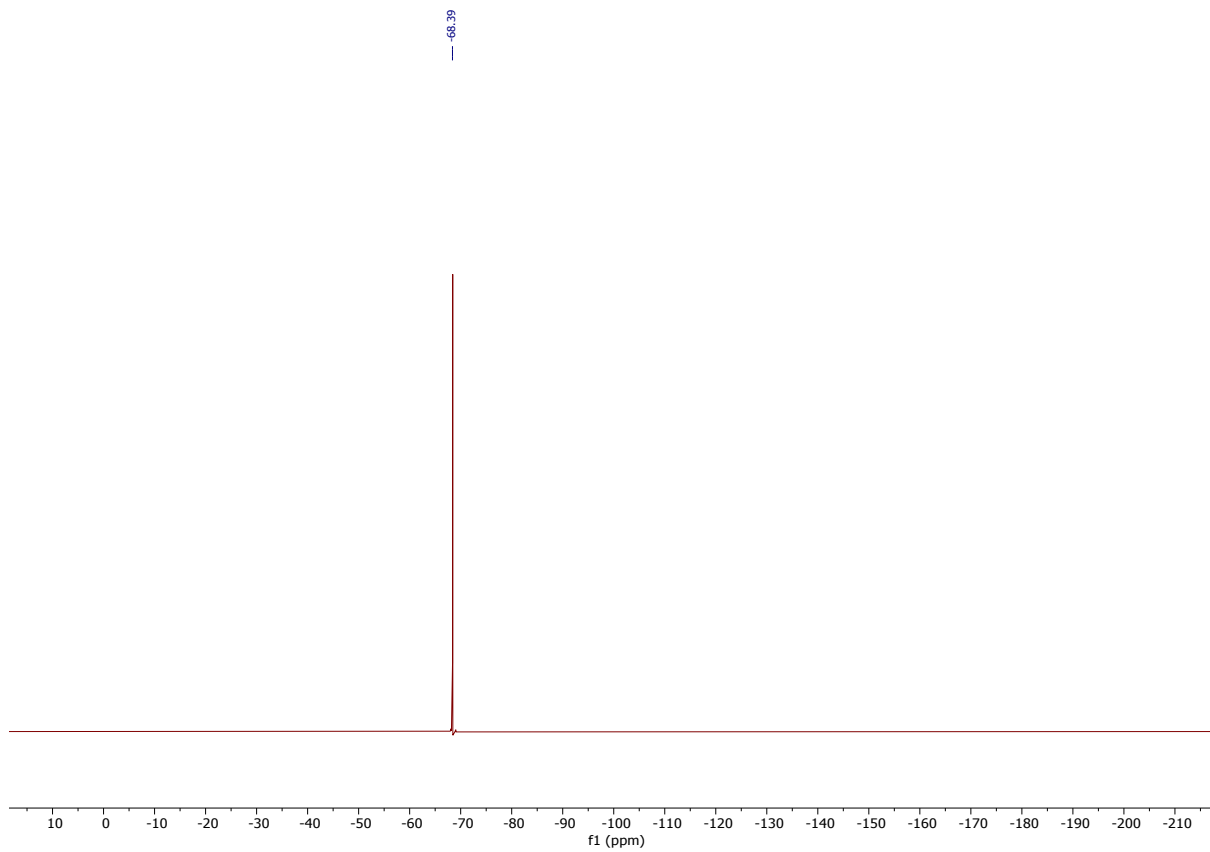


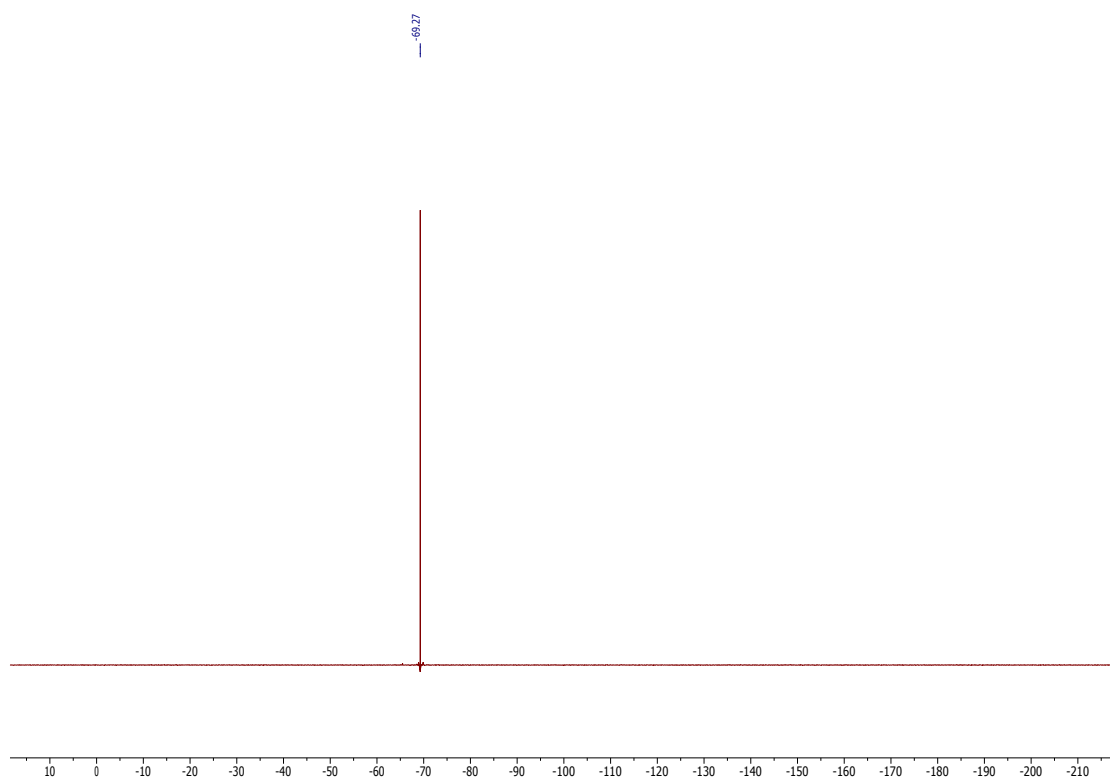
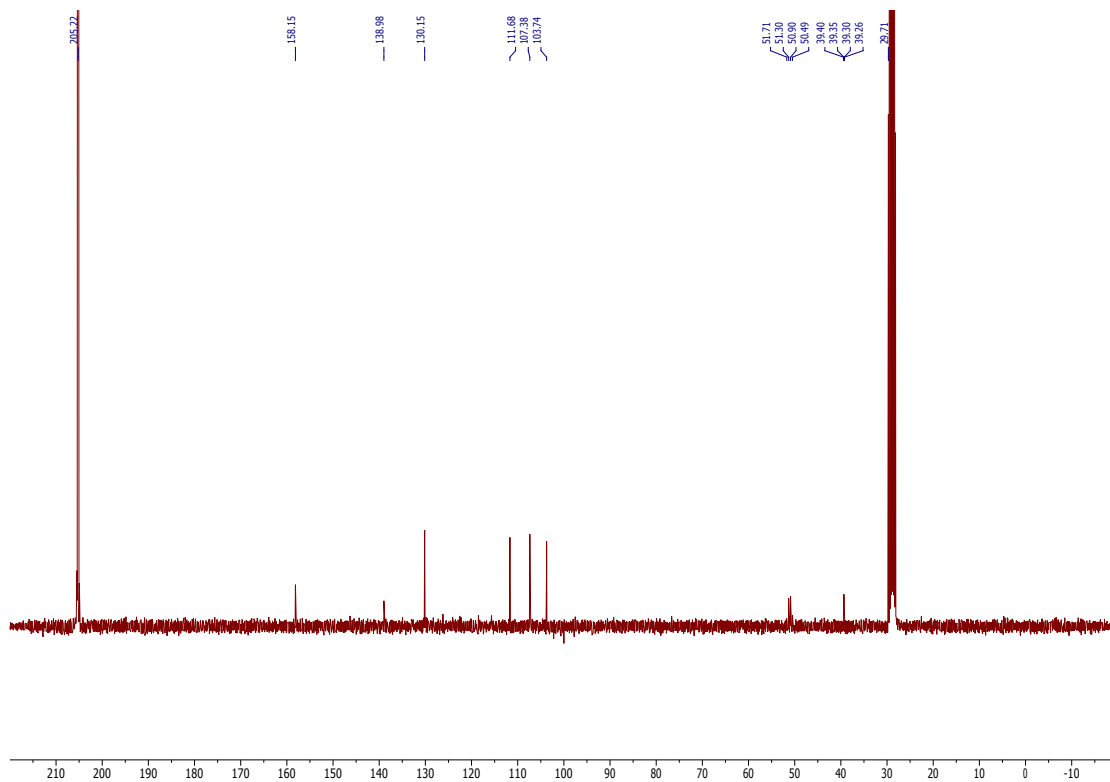




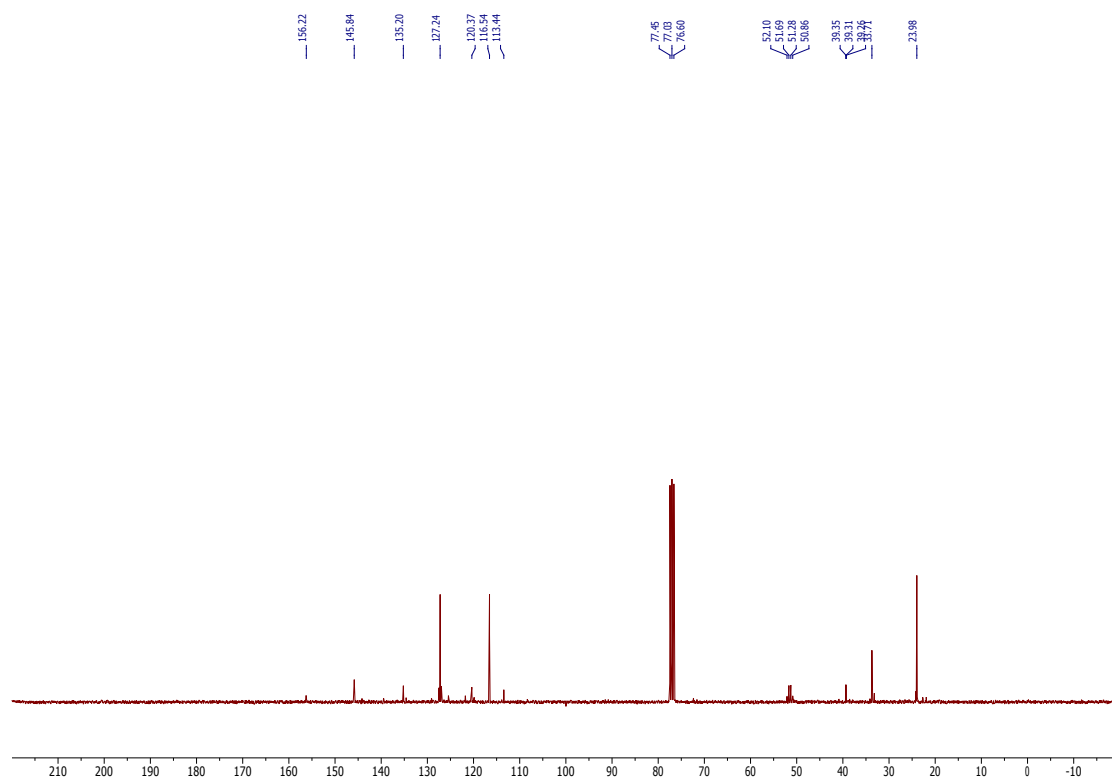
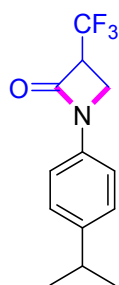
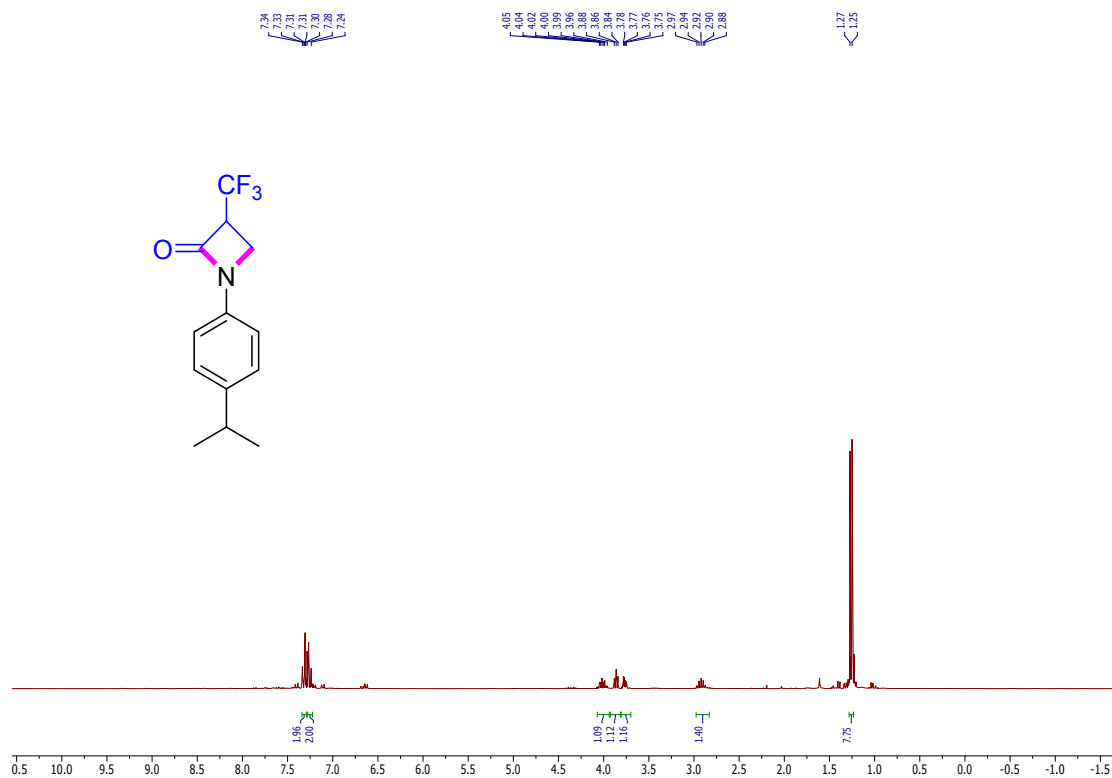


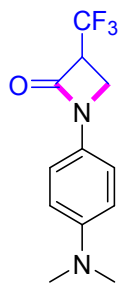
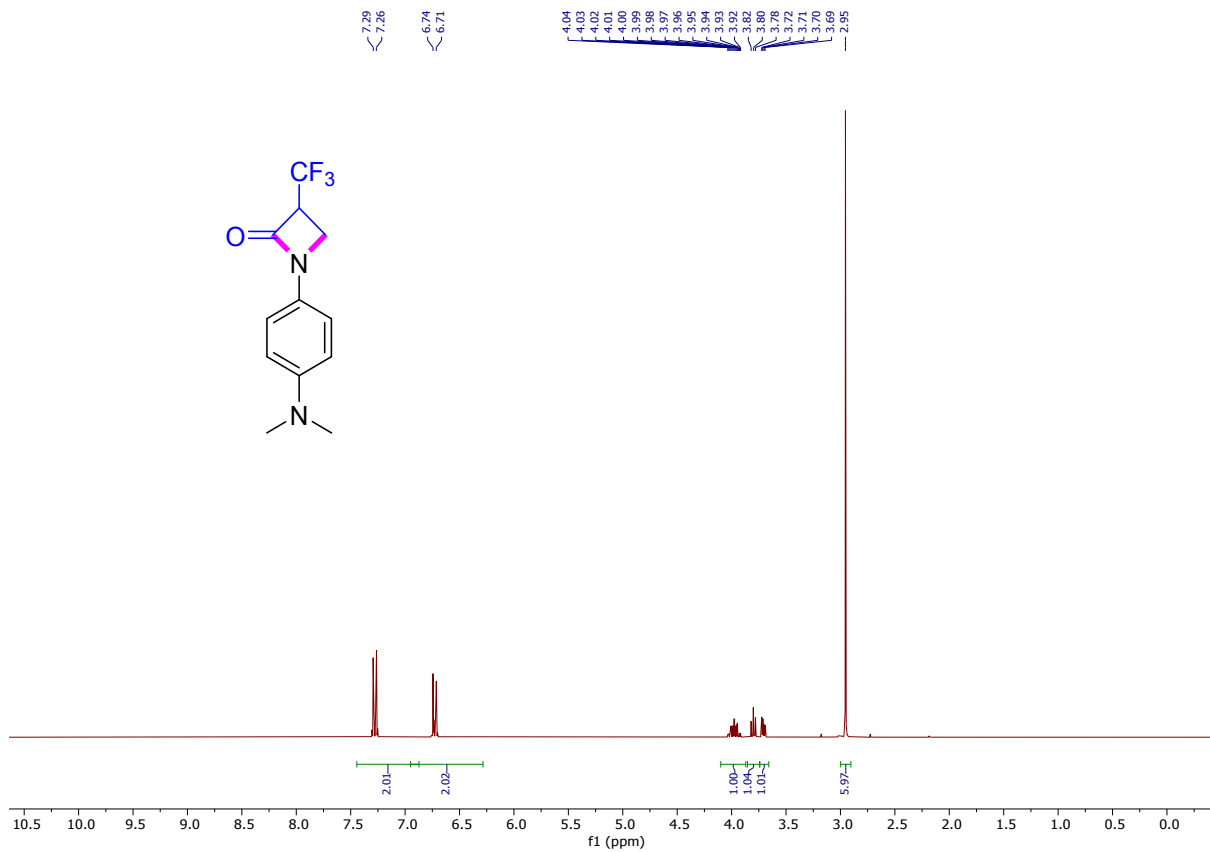
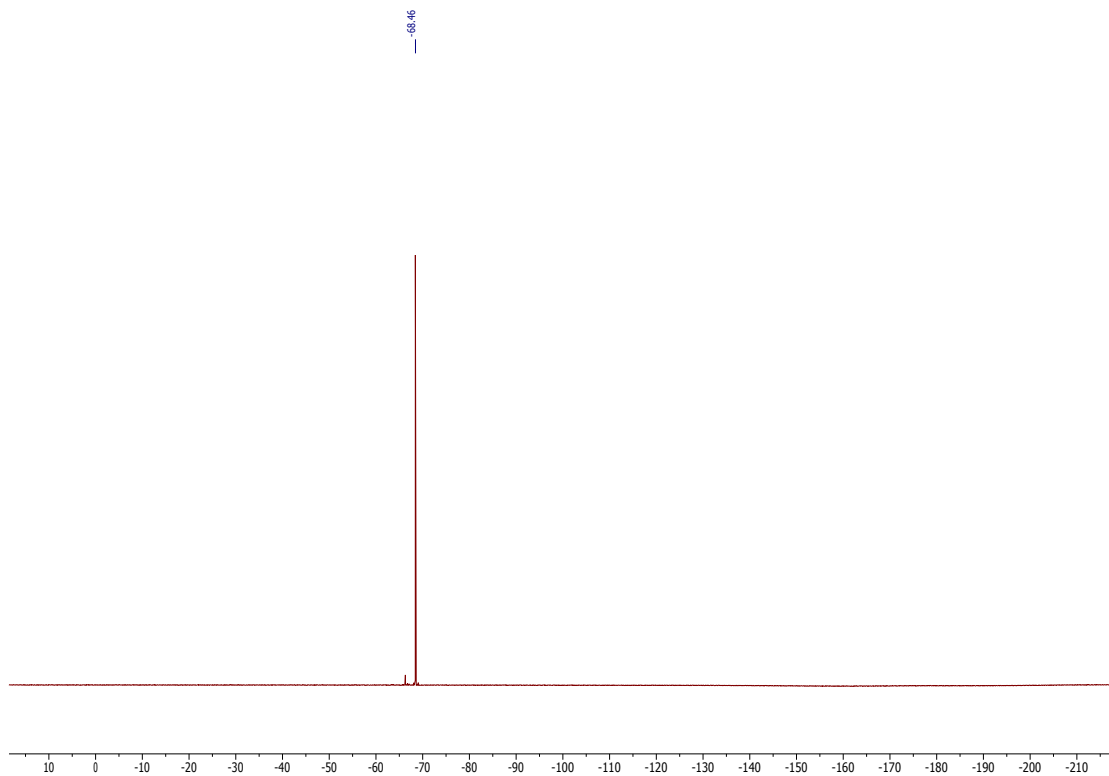


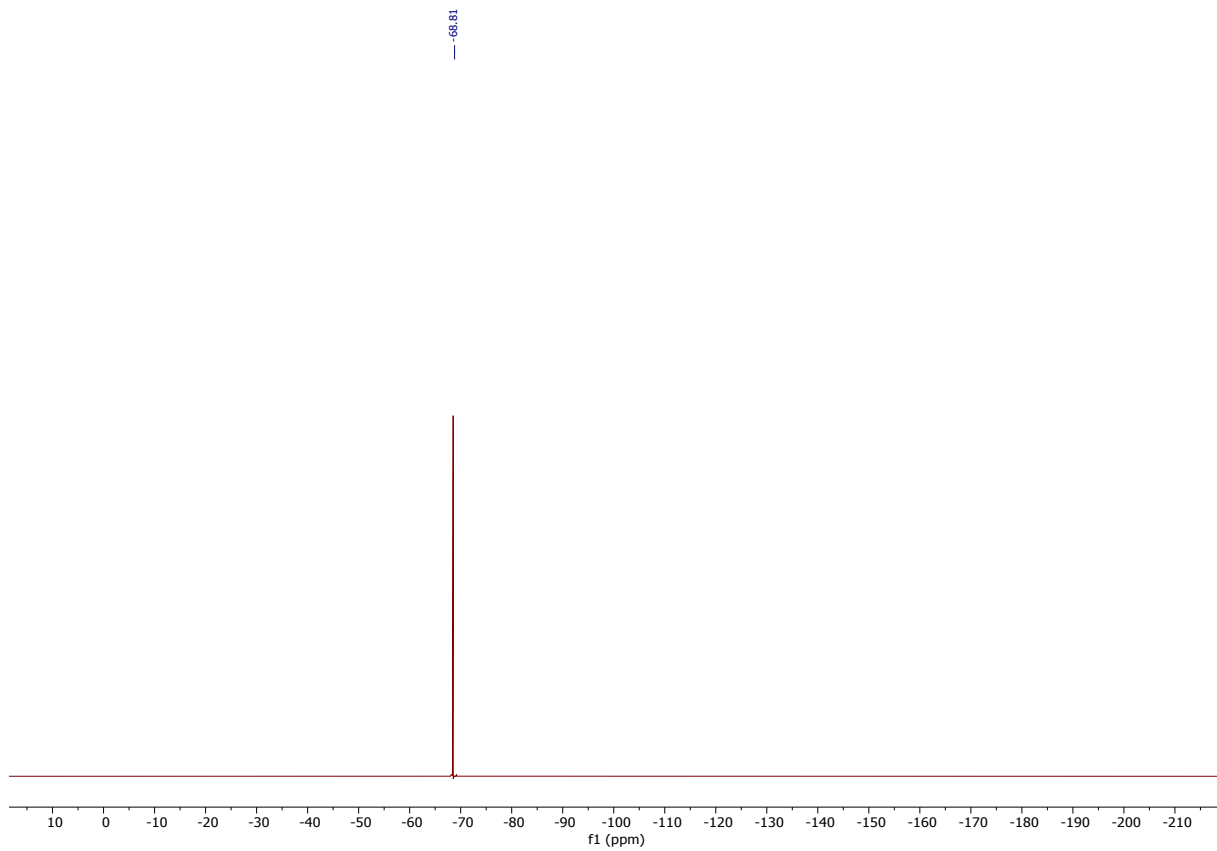
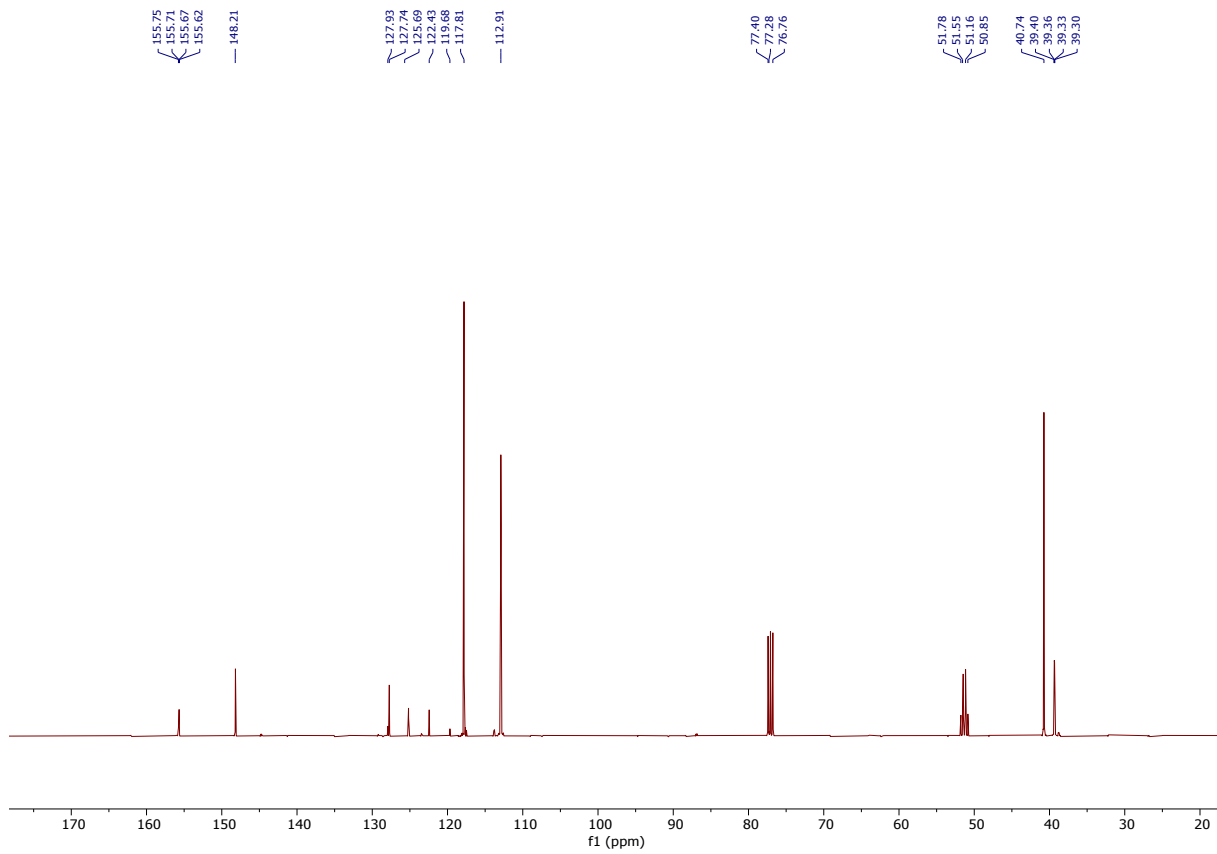


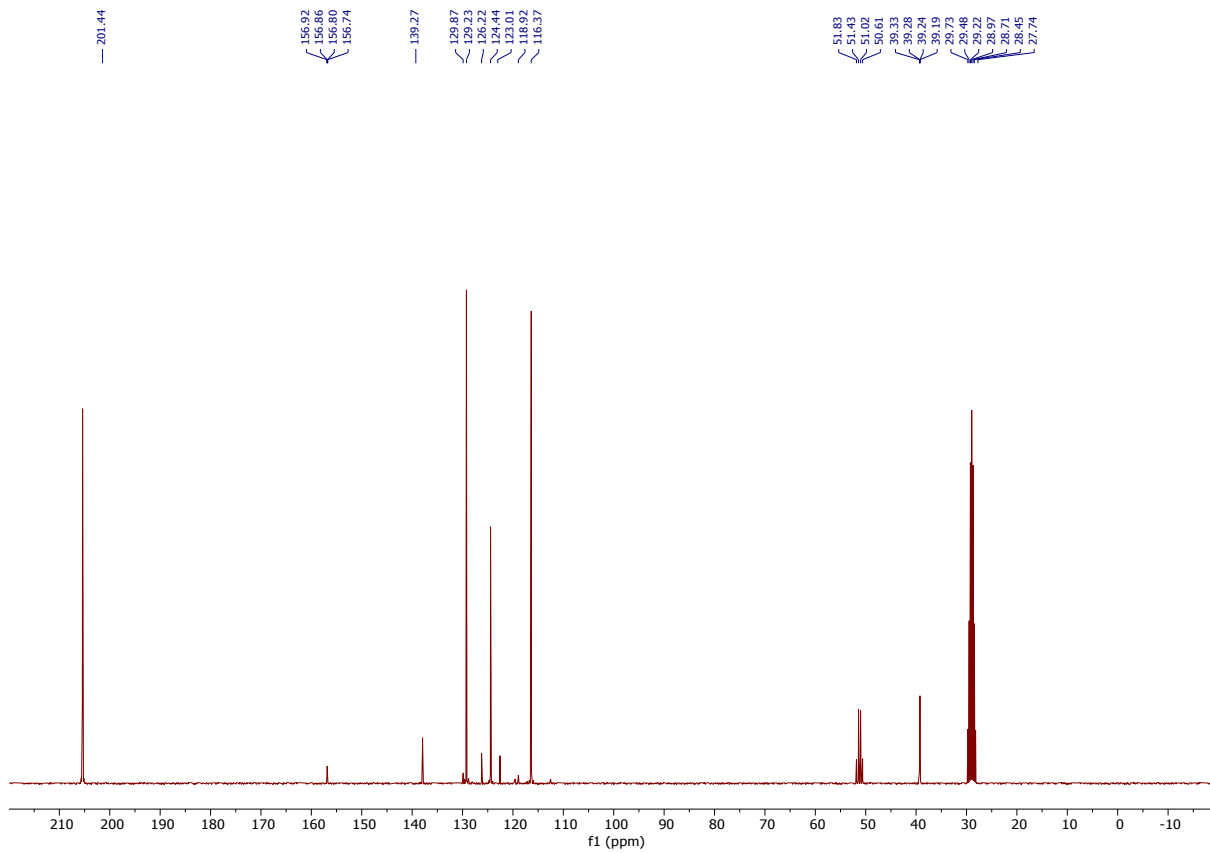
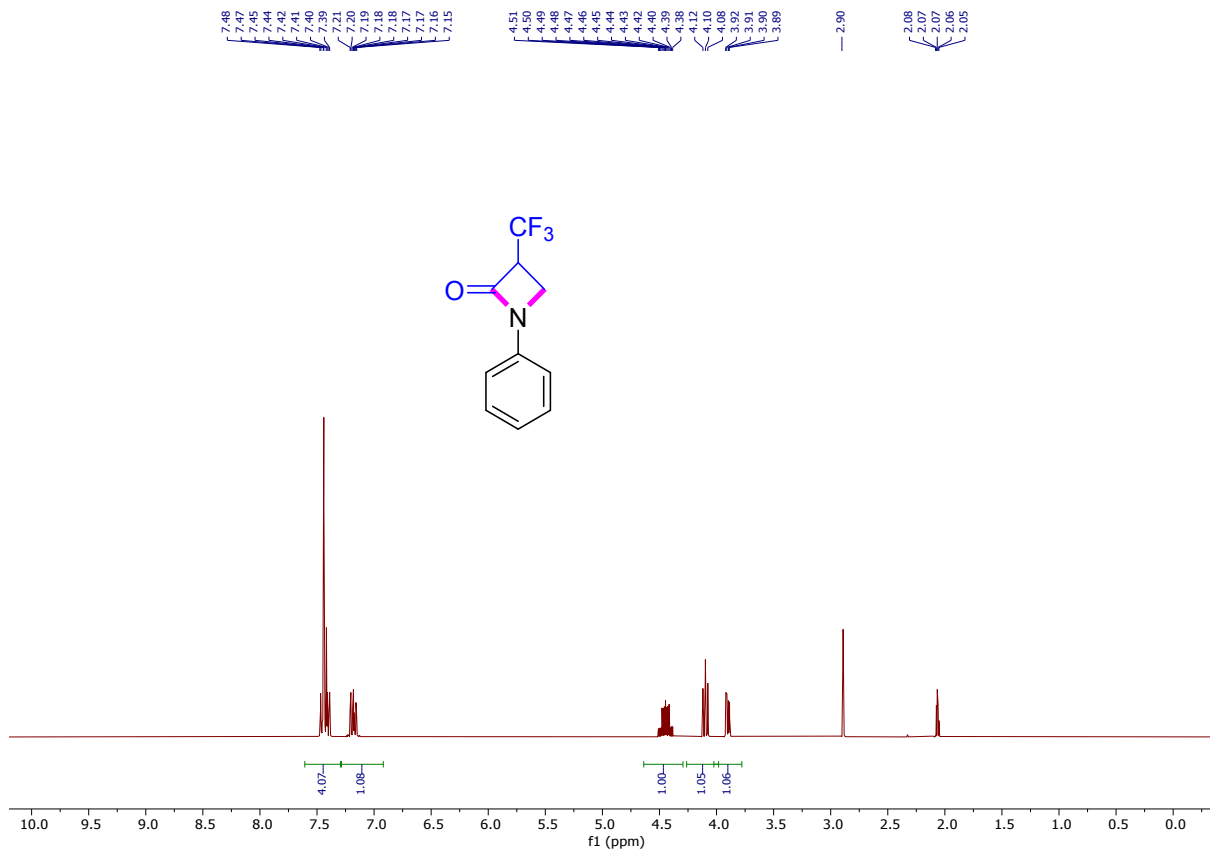


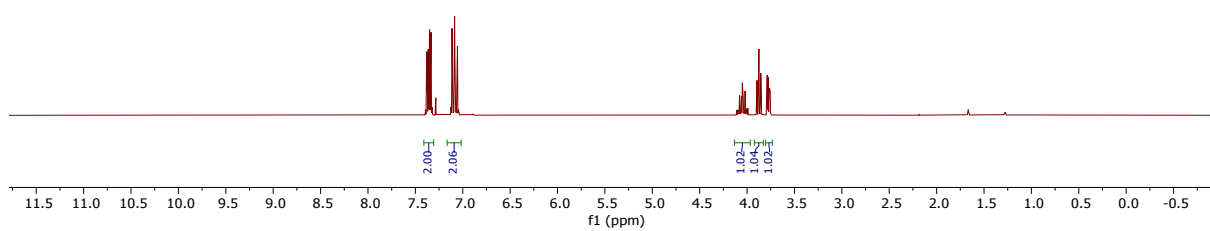
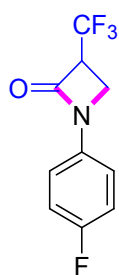
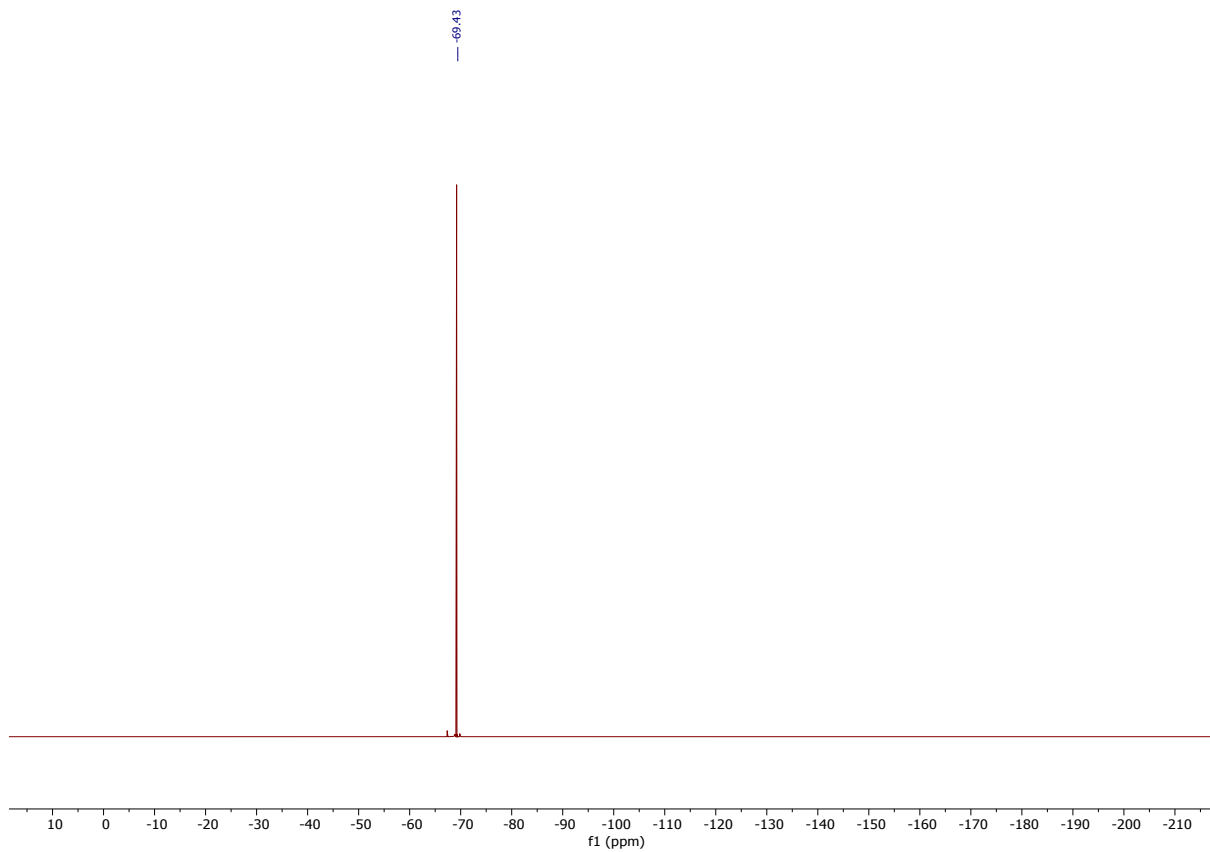


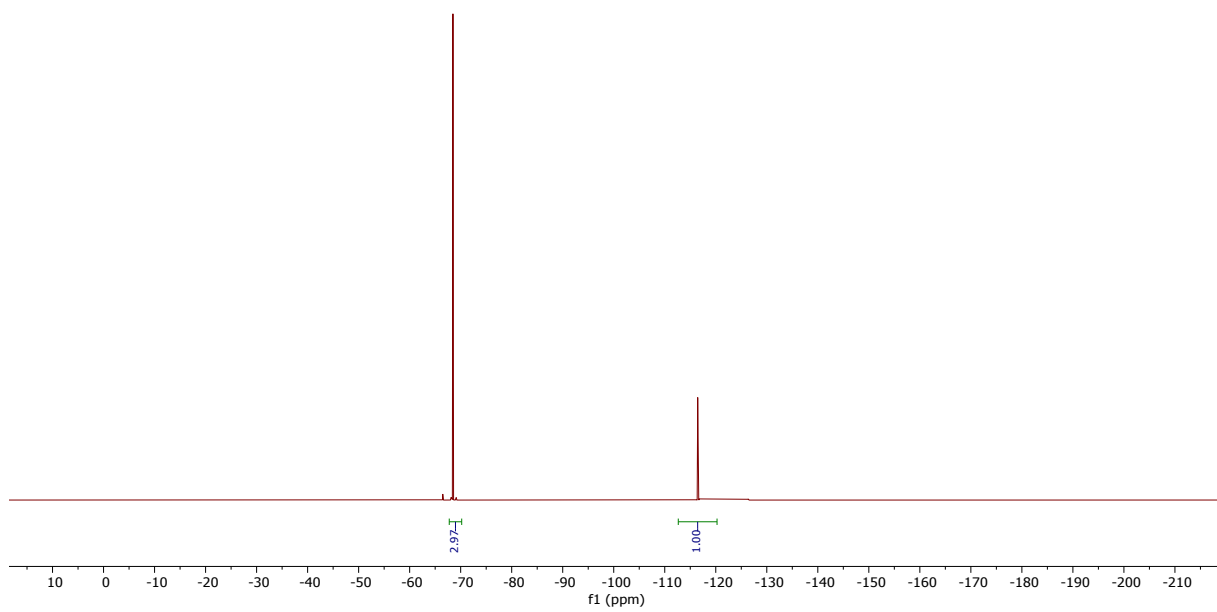
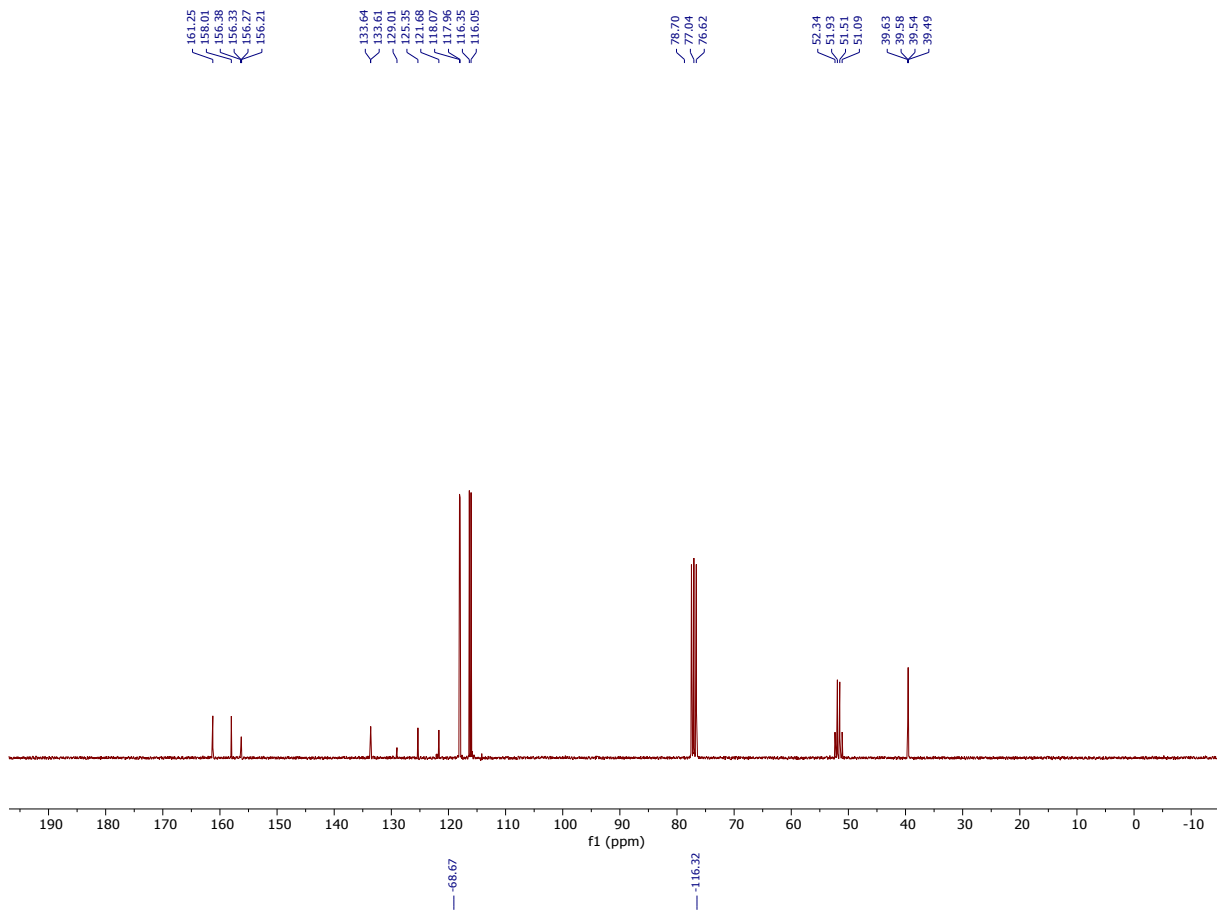


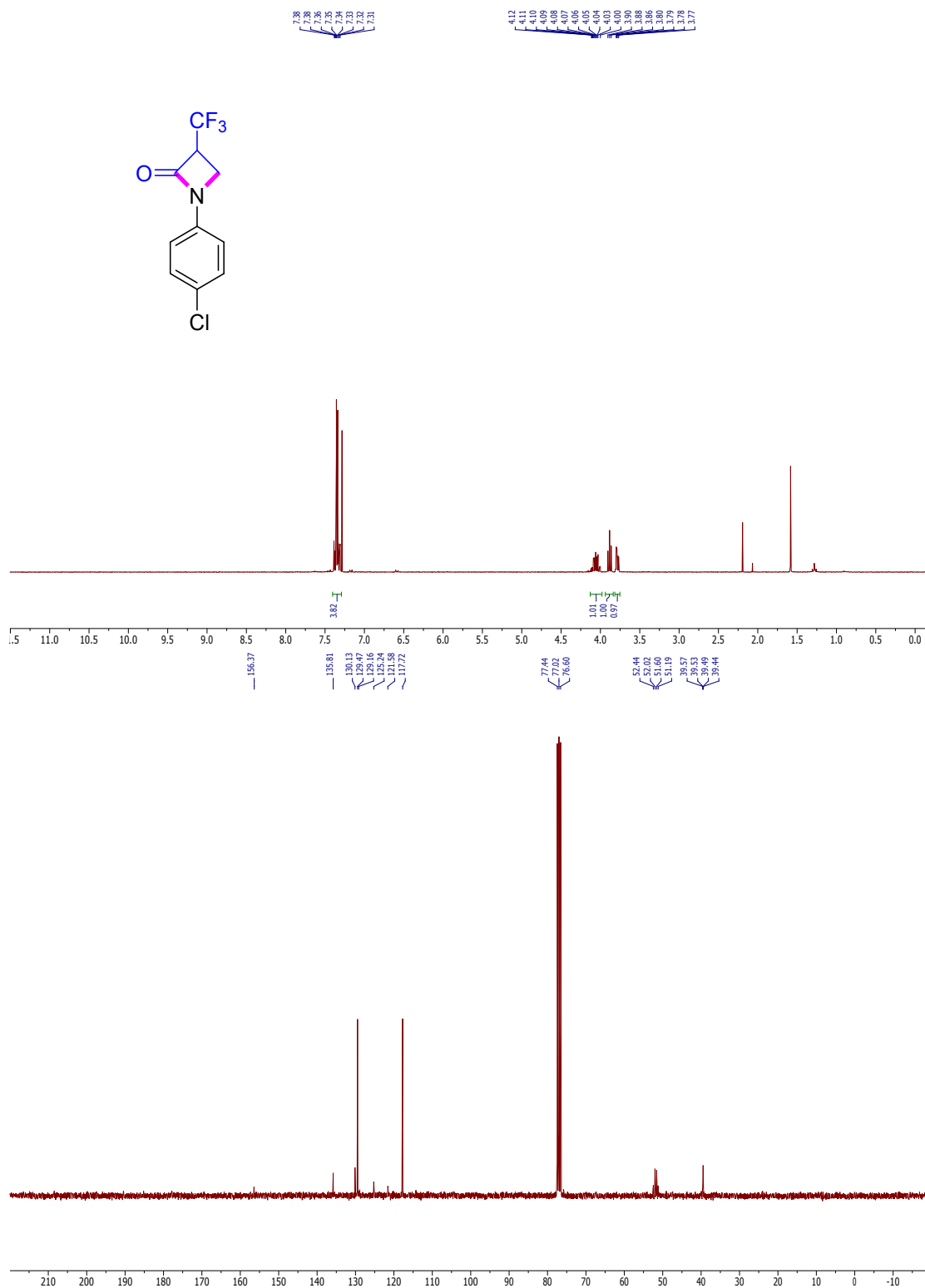
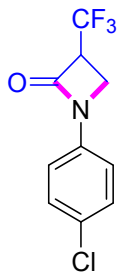


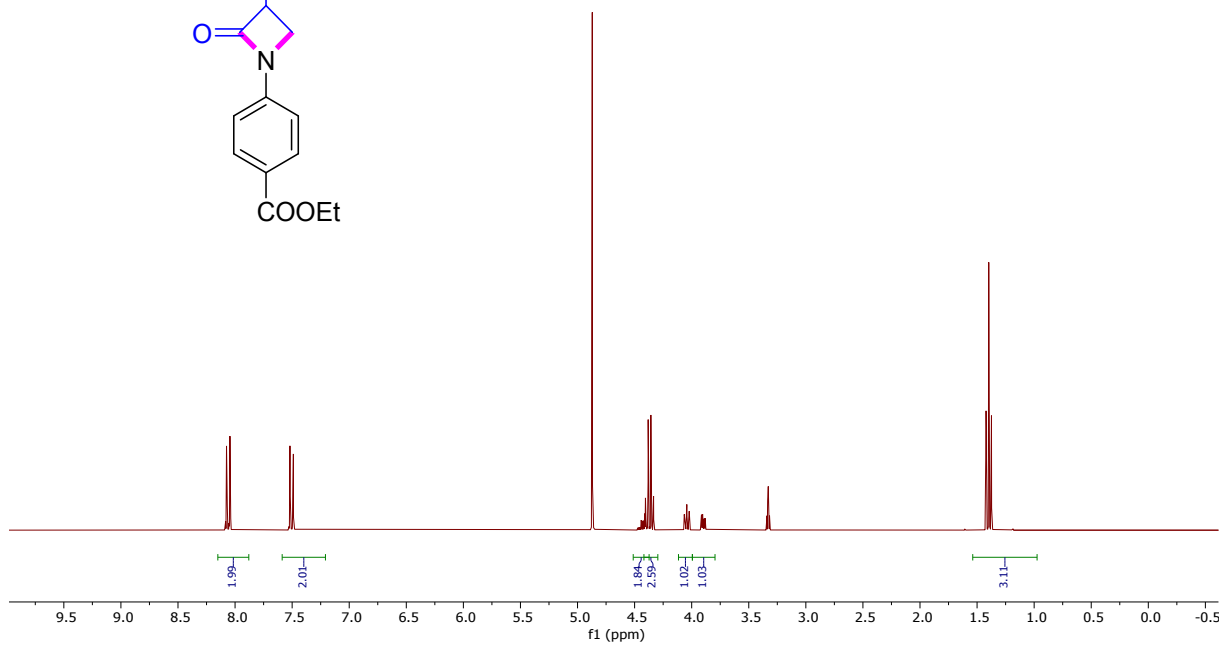
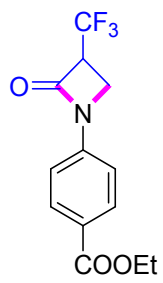
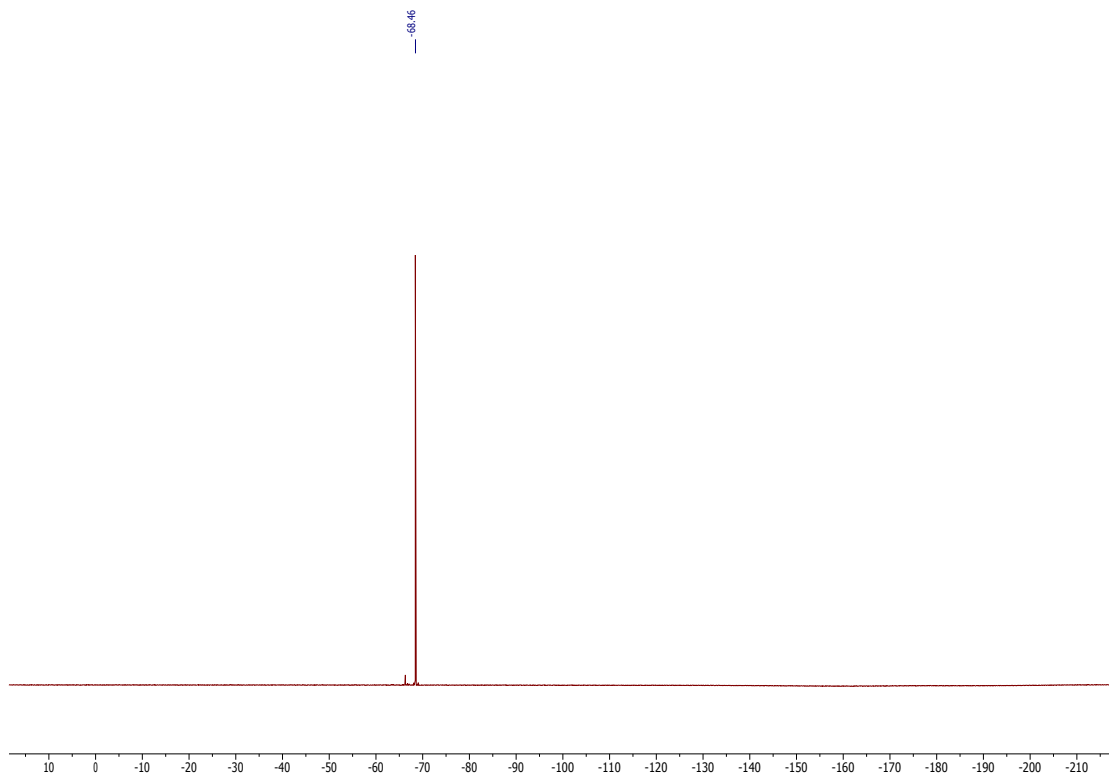




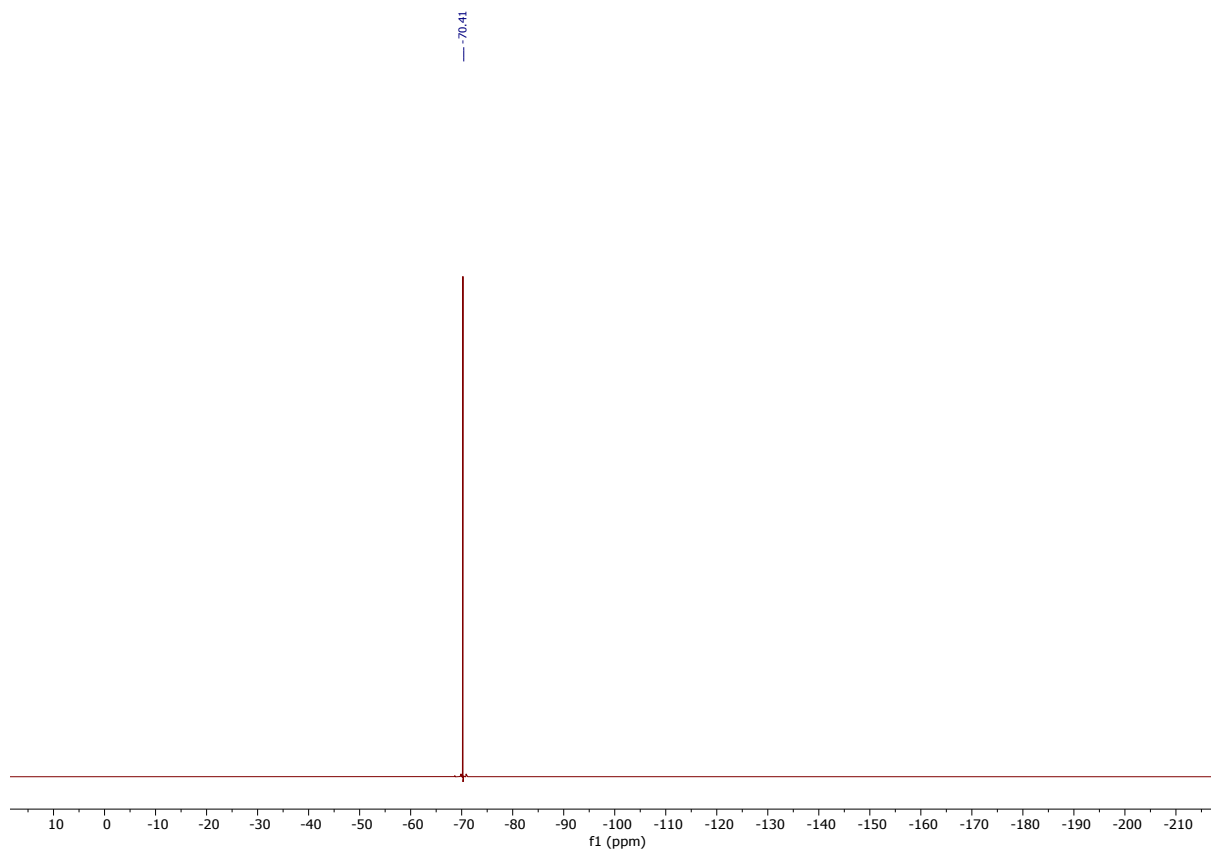
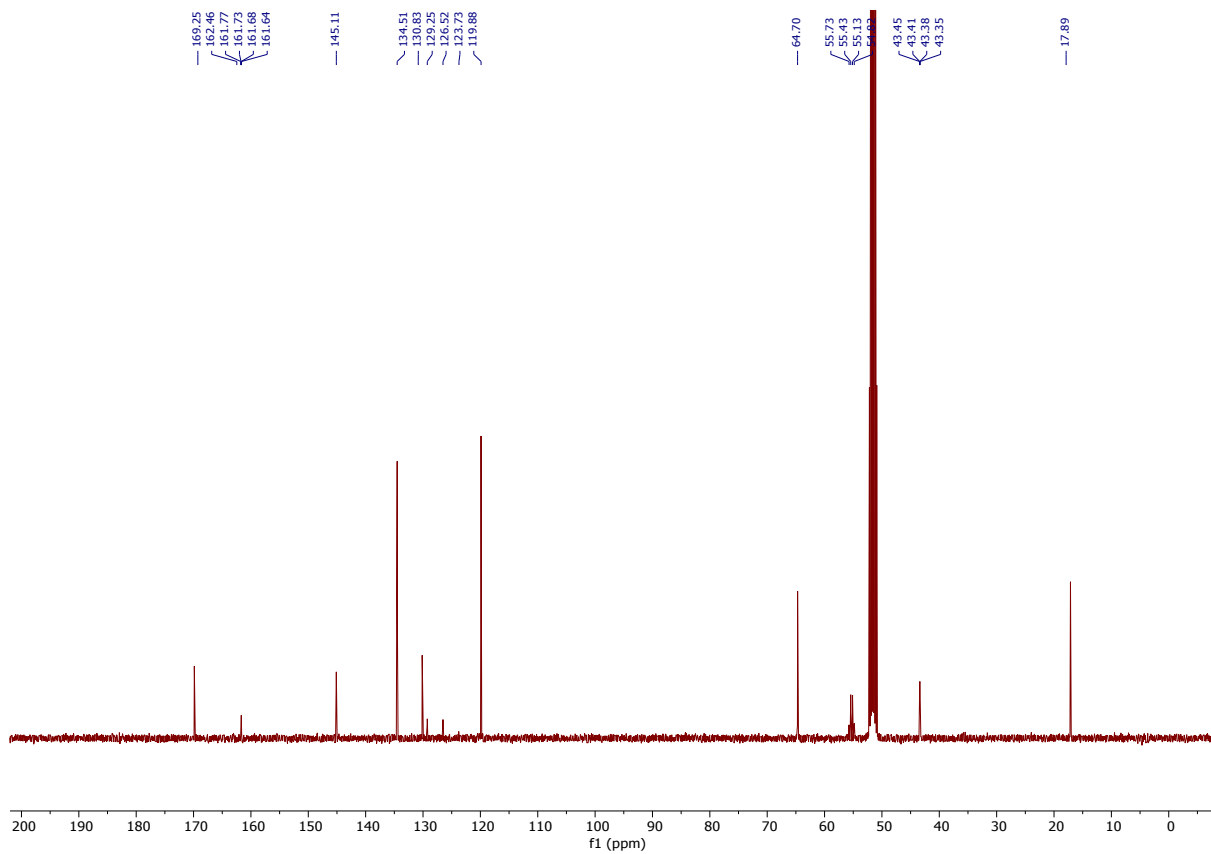


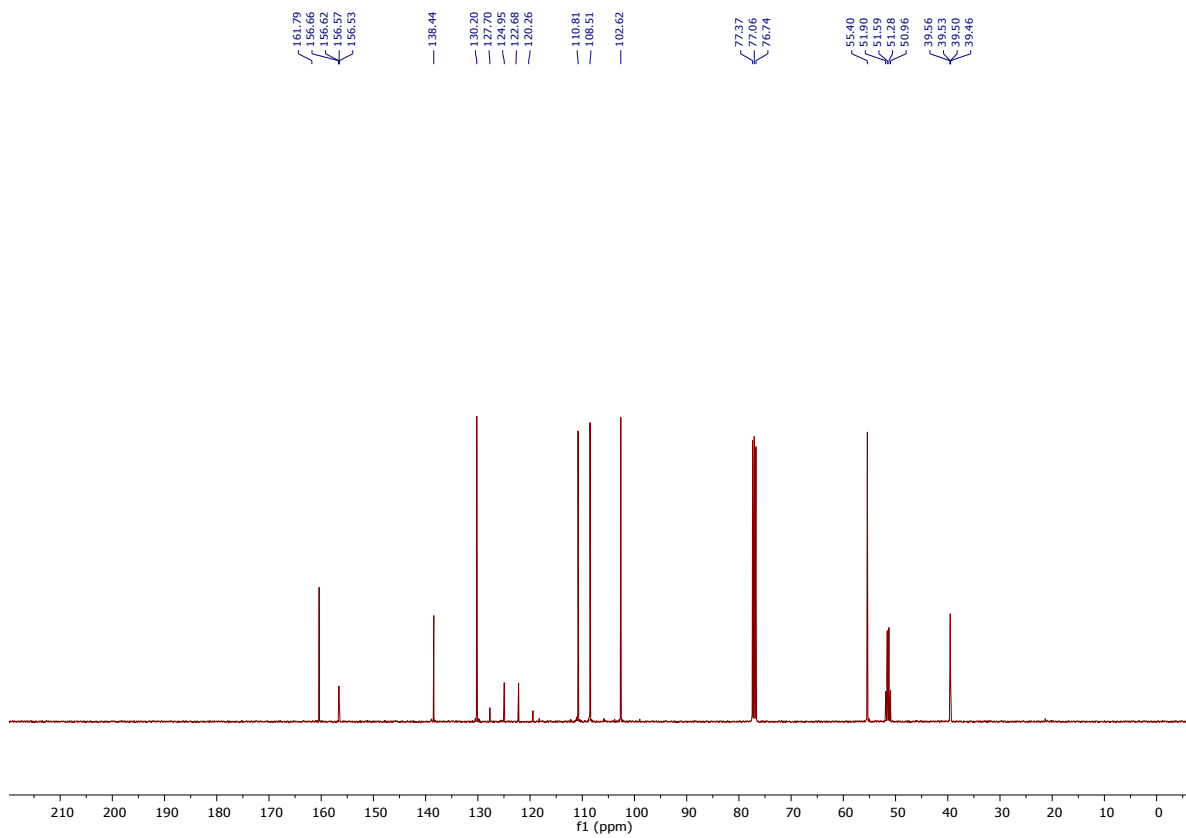
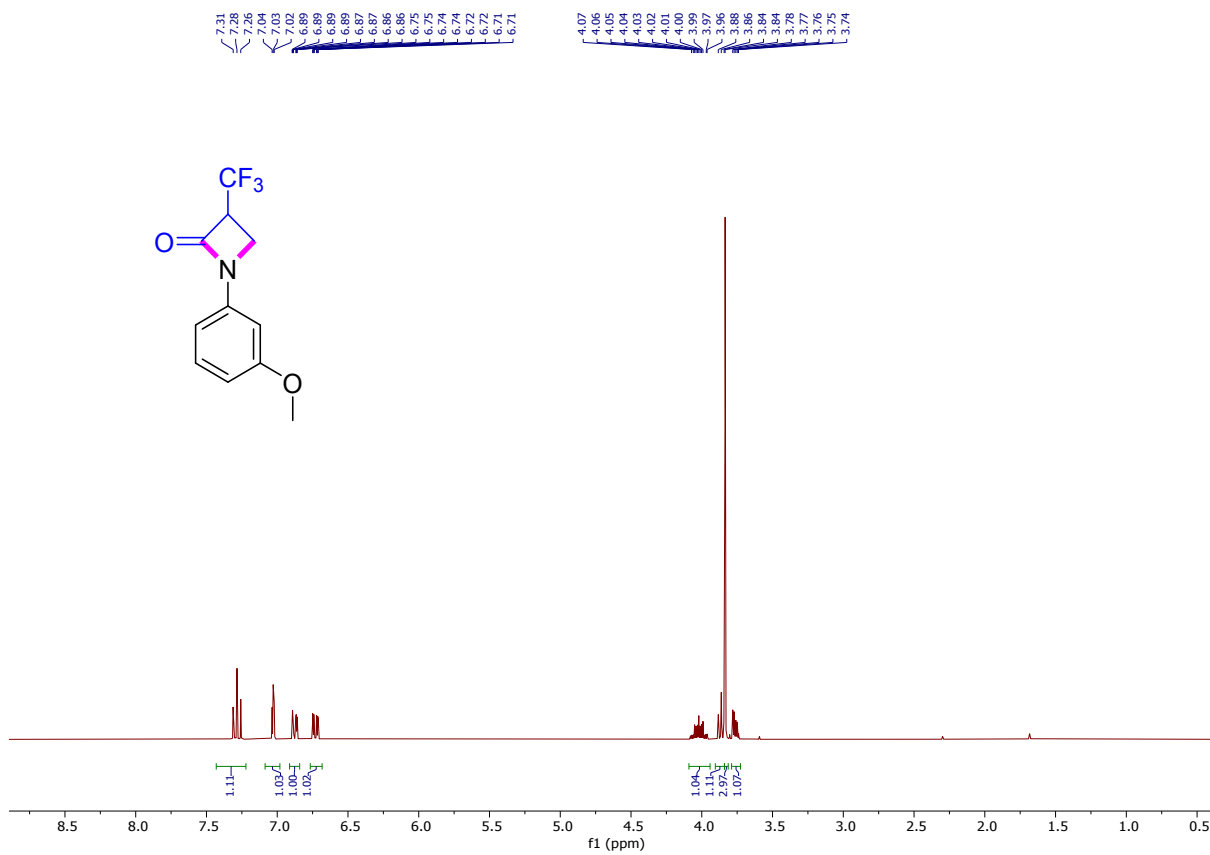


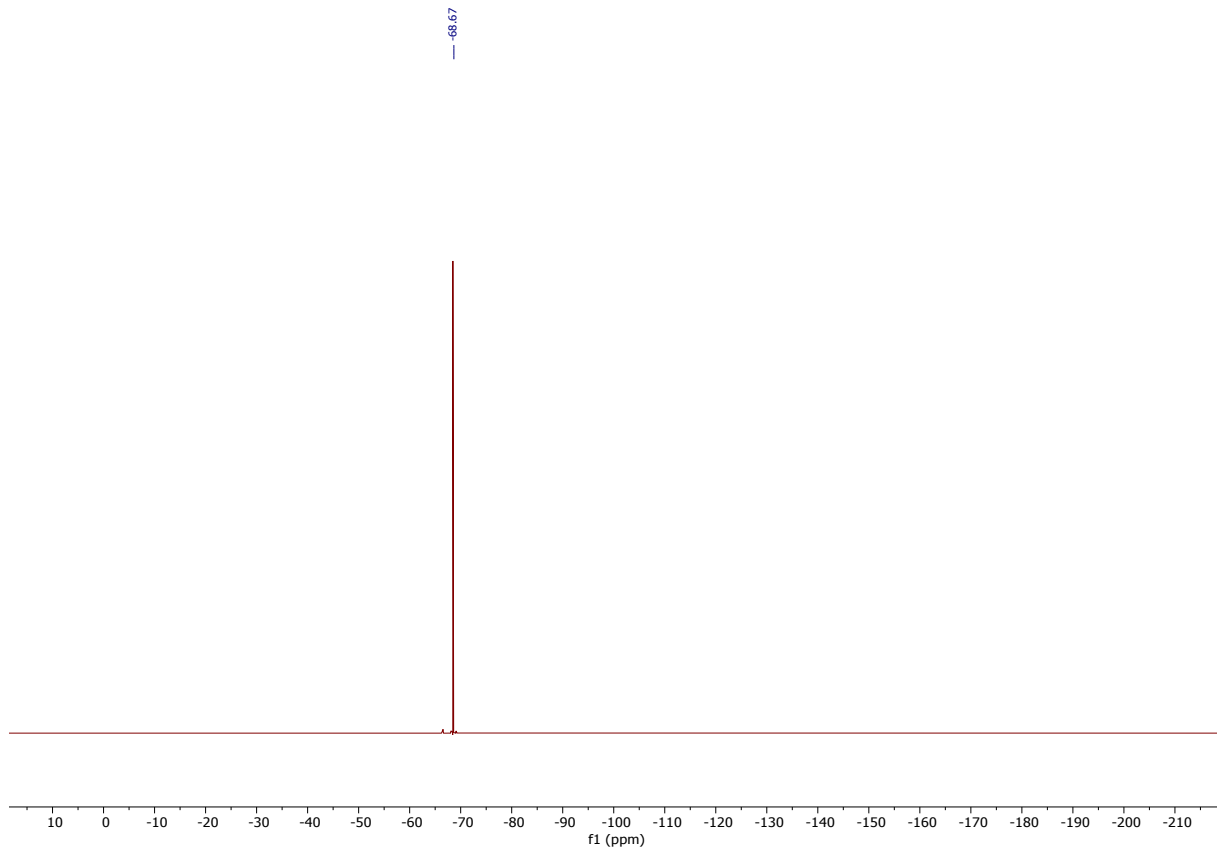




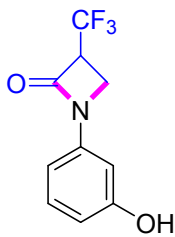
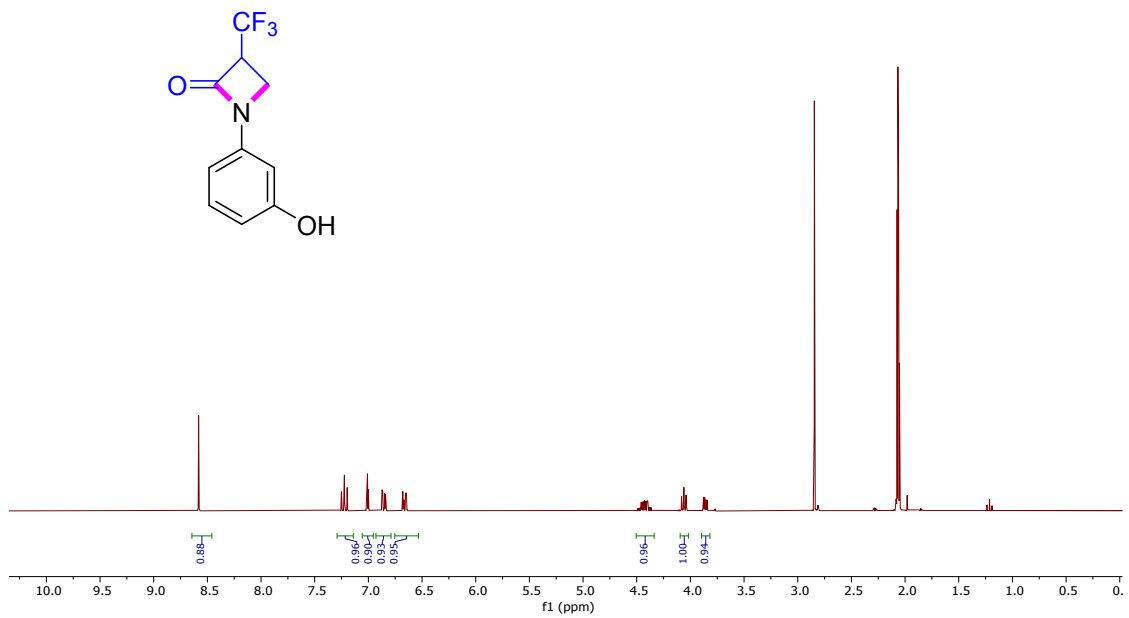


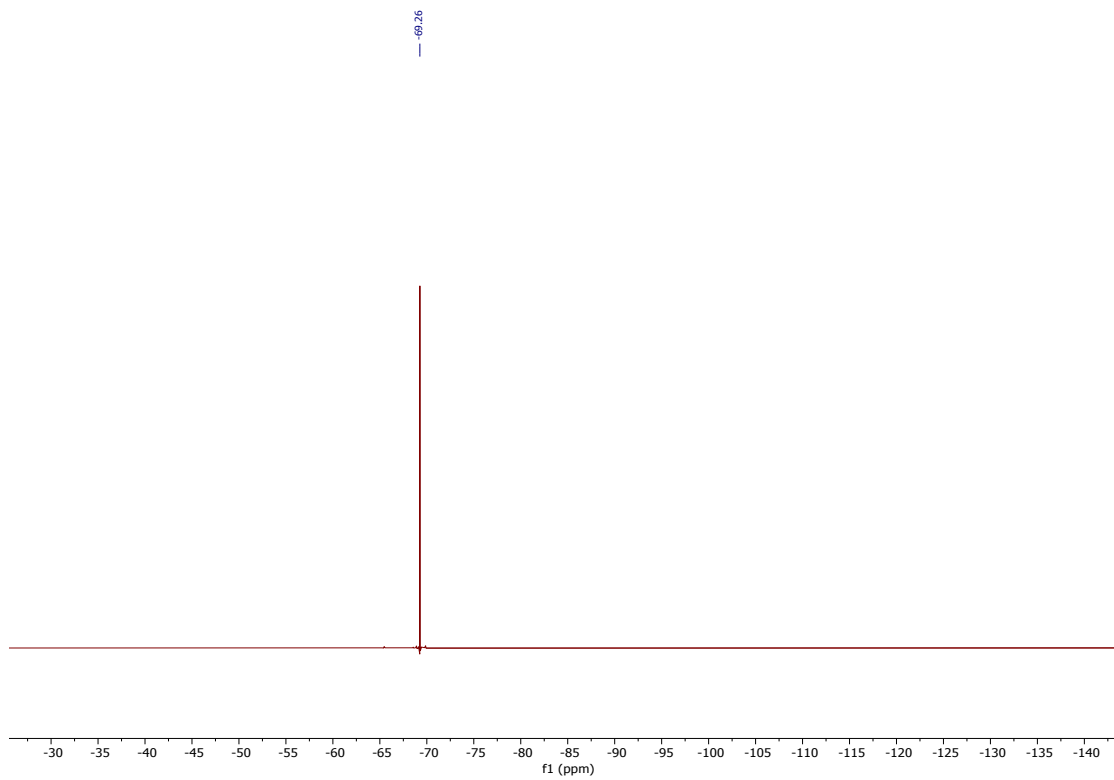
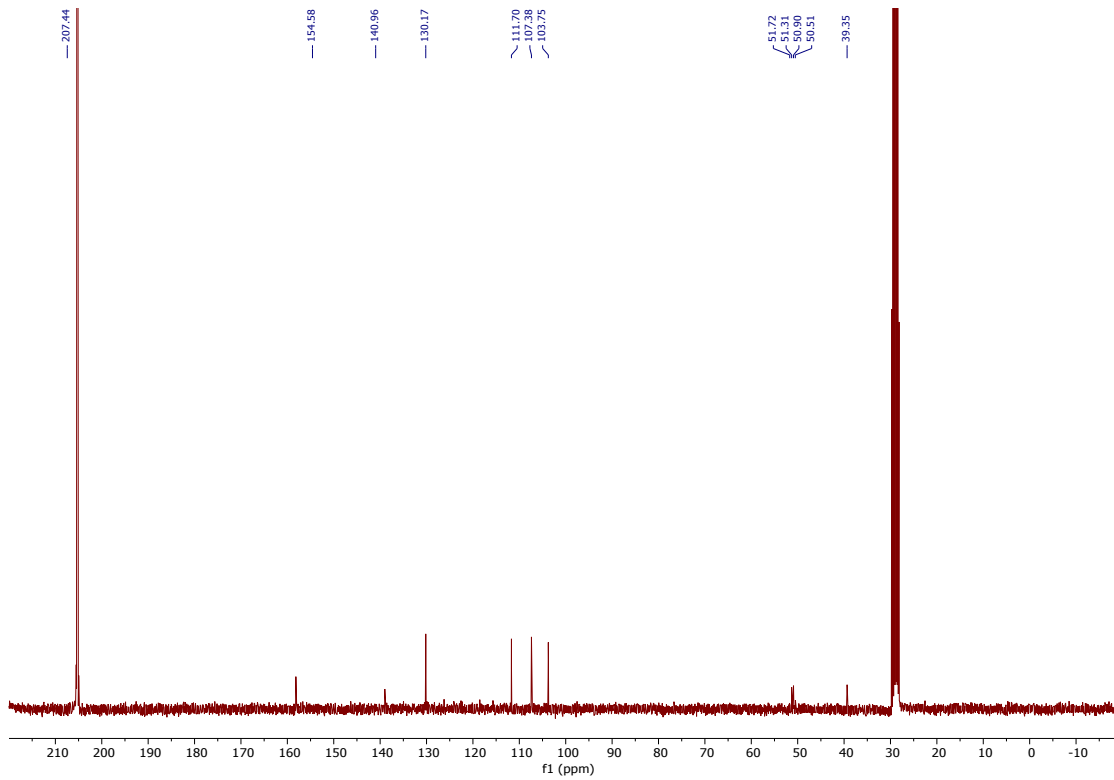


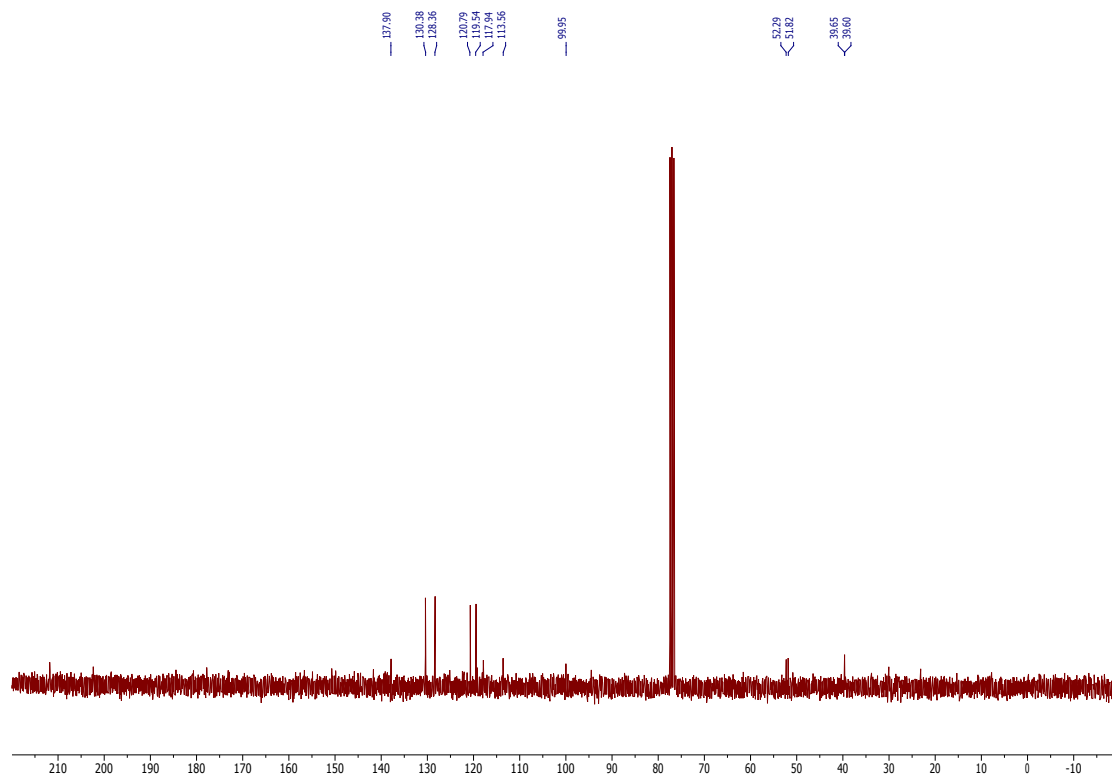
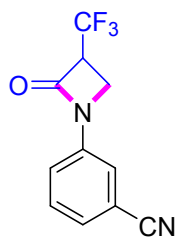
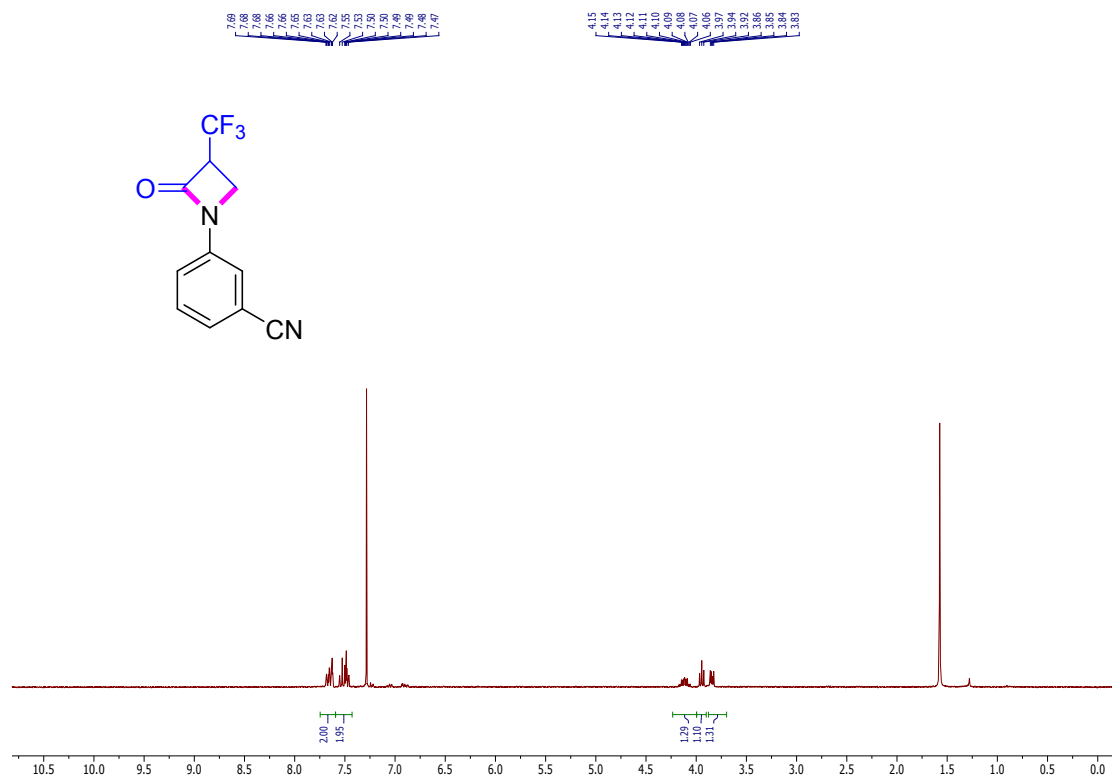


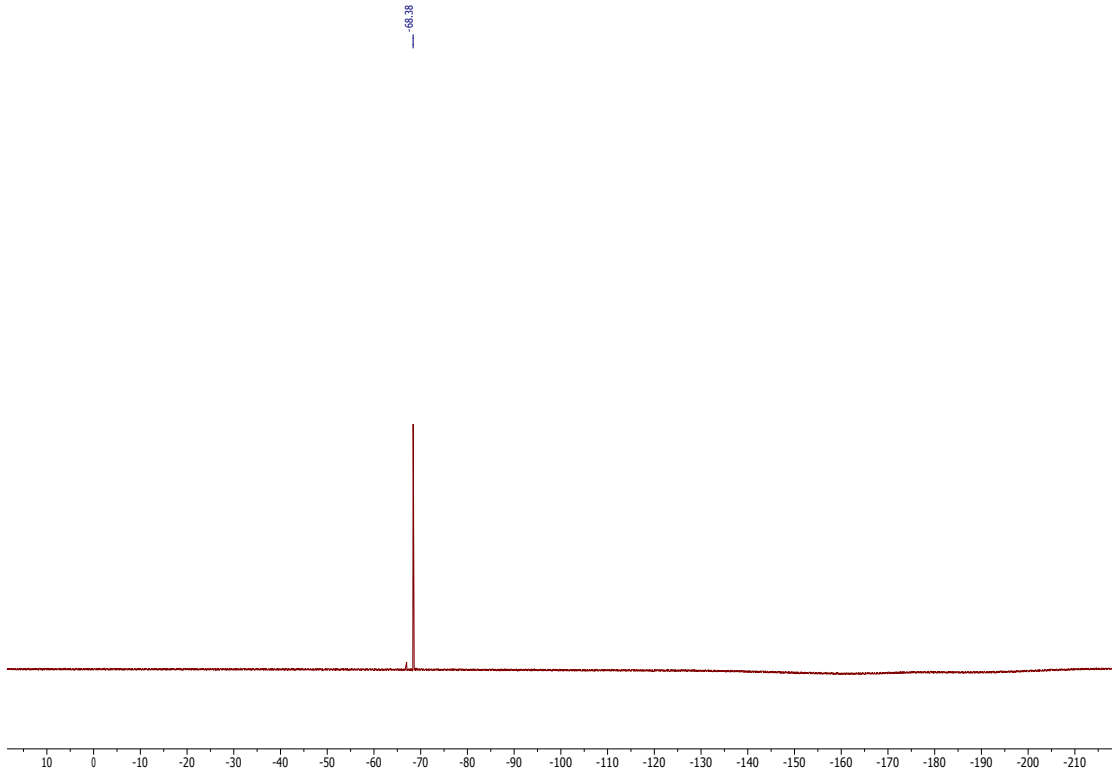


8.63, 7.725, 7.722, 7.720, 7.702, 7.701, 7.701, 7.700, 6.688, 6.687, 6.687, 6.687, 6.687, 6.685, 6.685, 6.684, 6.684, 6.683, 6.668, 6.667, 6.667, 6.665, 6.665, 6.655, 6.655, 6.654, 6.644, 4.498, 4.497, 4.477, 4.466, 4.465, 4.445, 4.444, 4.442, 4.441, 4.441, 4.440, 4.438, 4.436, 4.436, 4.088, 4.088, 4.066, 4.066, 4.064, 4.064, 3.388, 3.387, 3.386, 3.385, 3.384, 3.384, 3.384, 3.384, 2.855, 2.085, 2.085, 2.077, 2.077, 2.065, 2.065

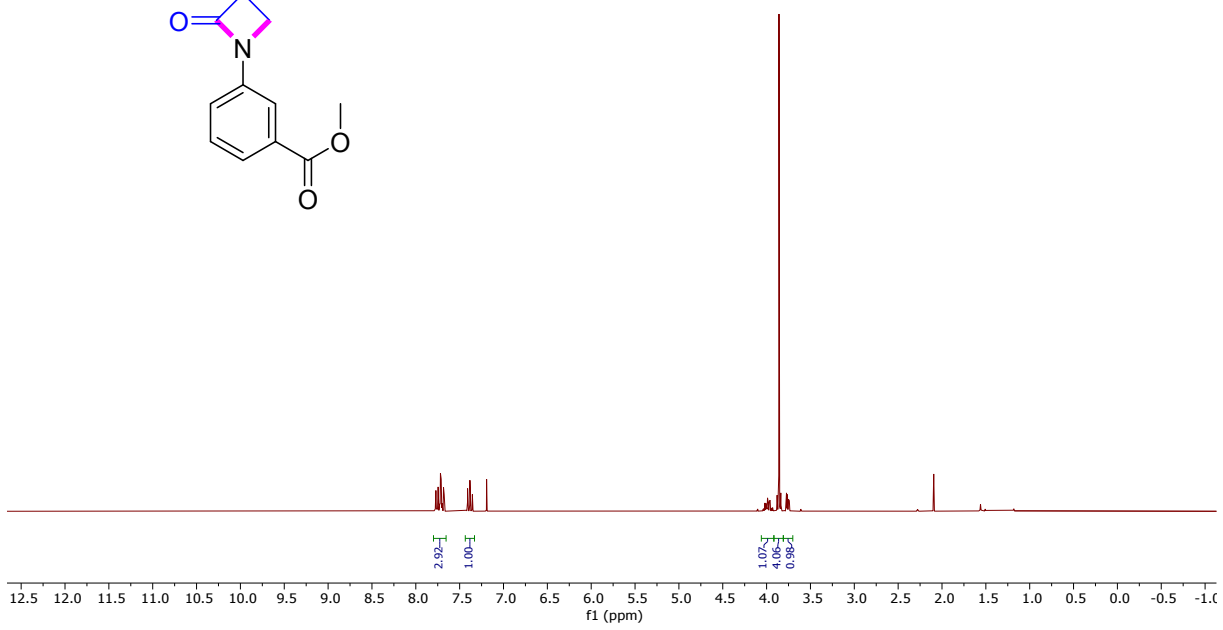
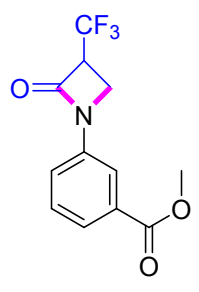


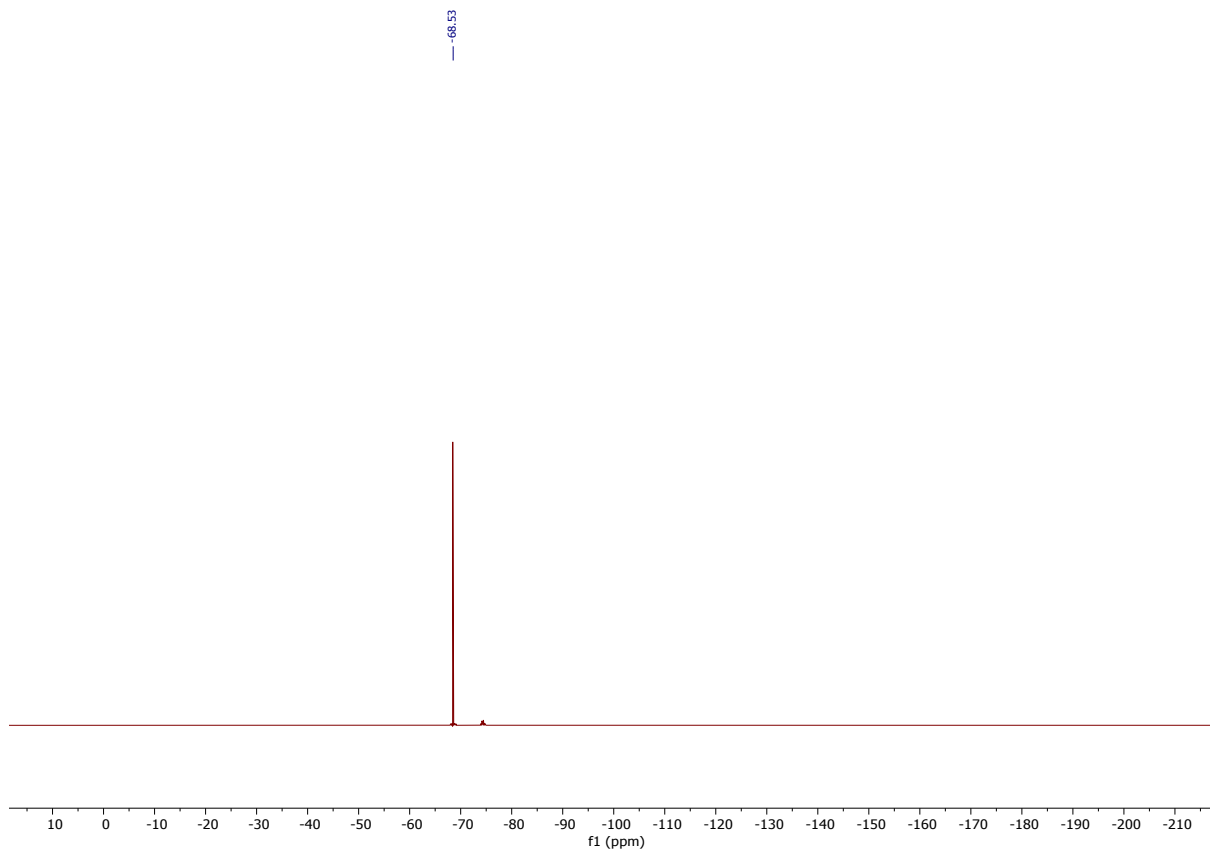
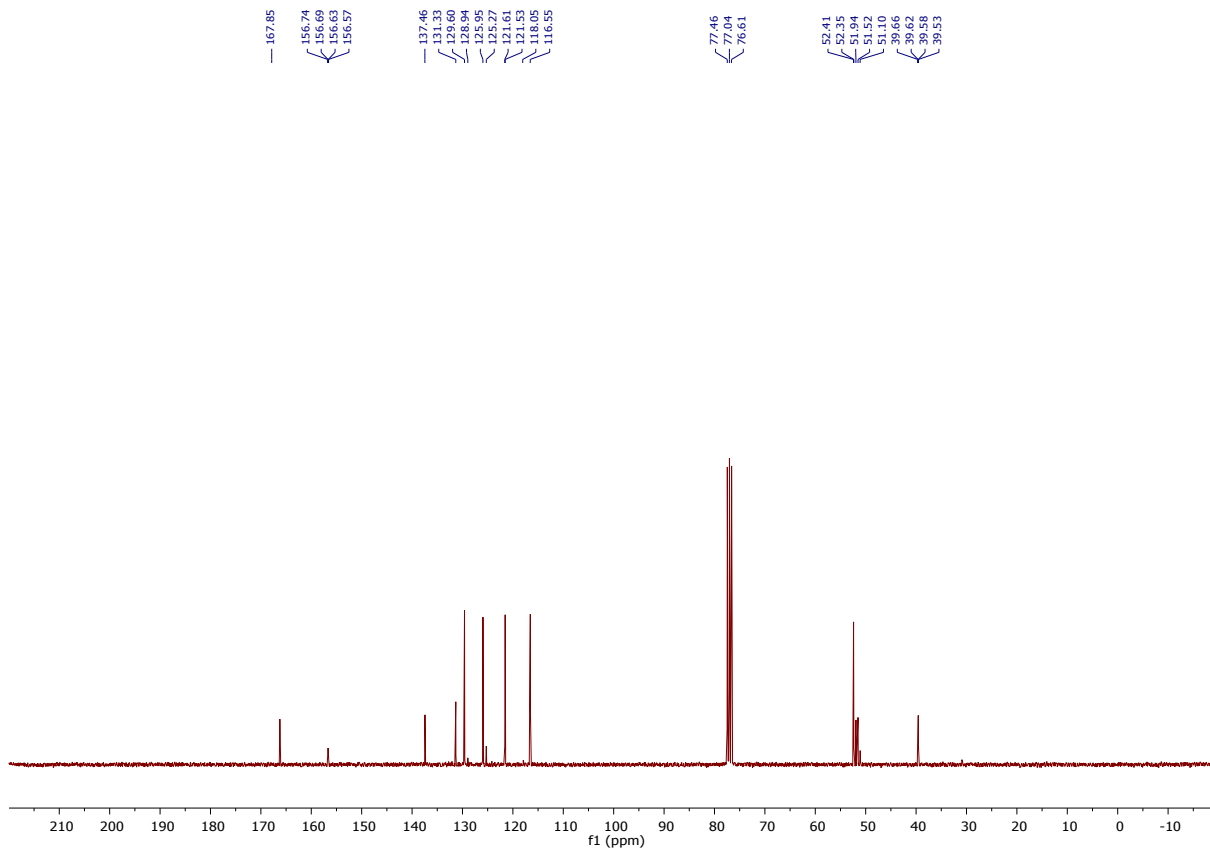


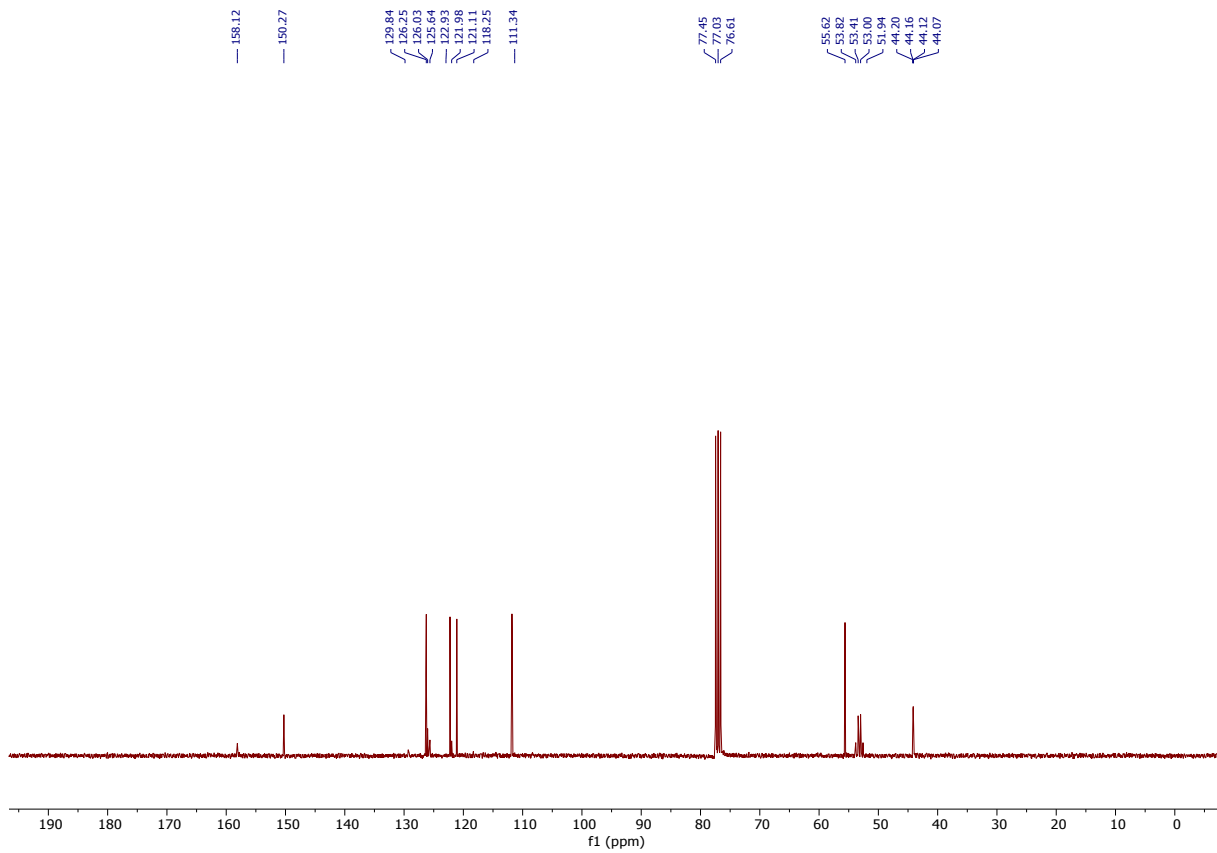
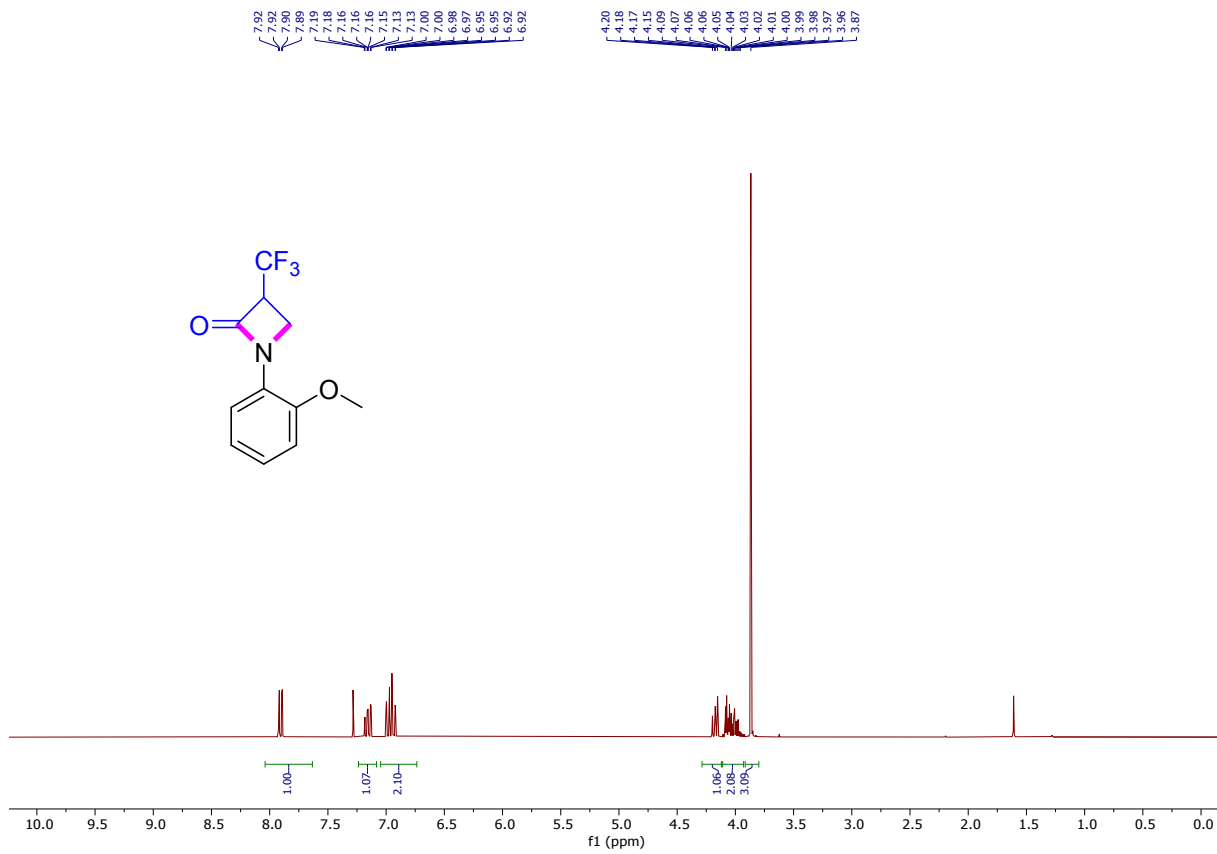




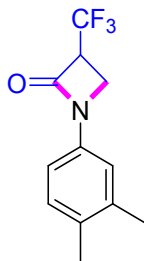
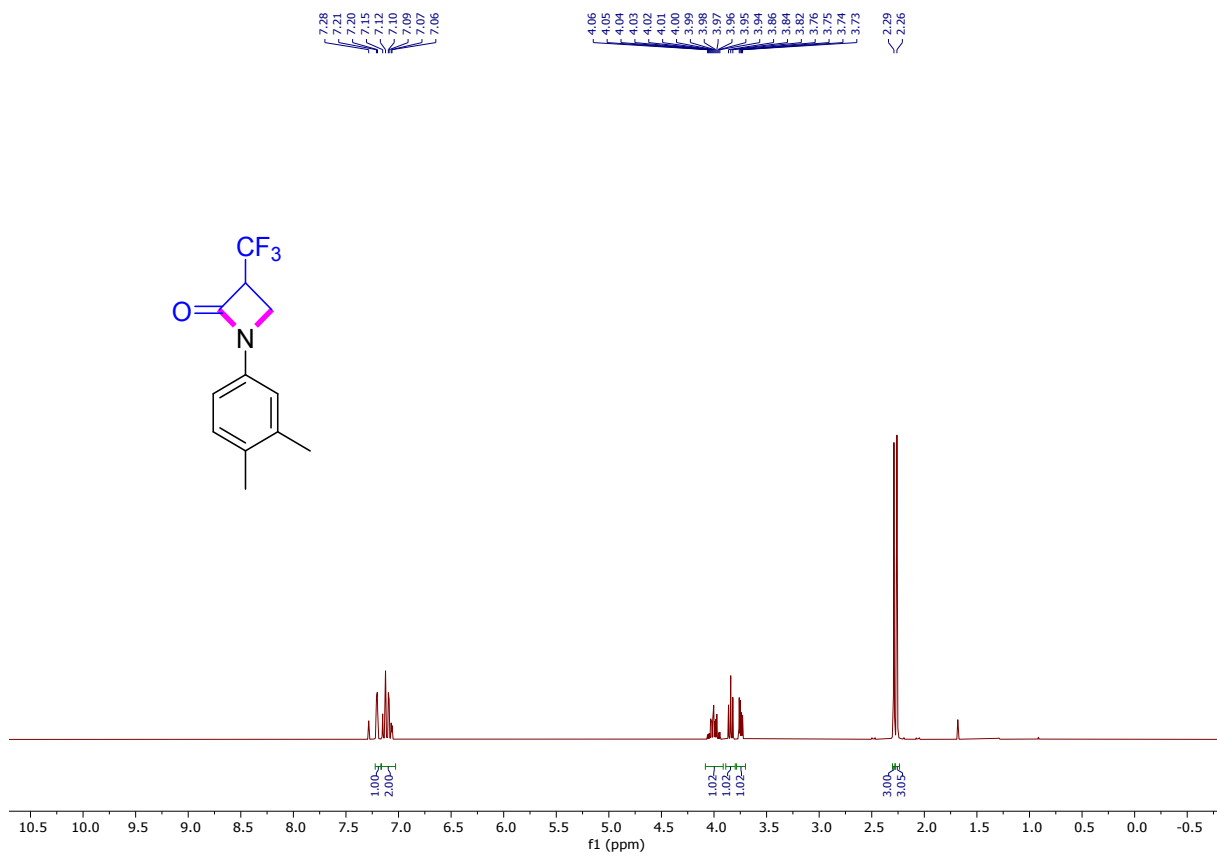
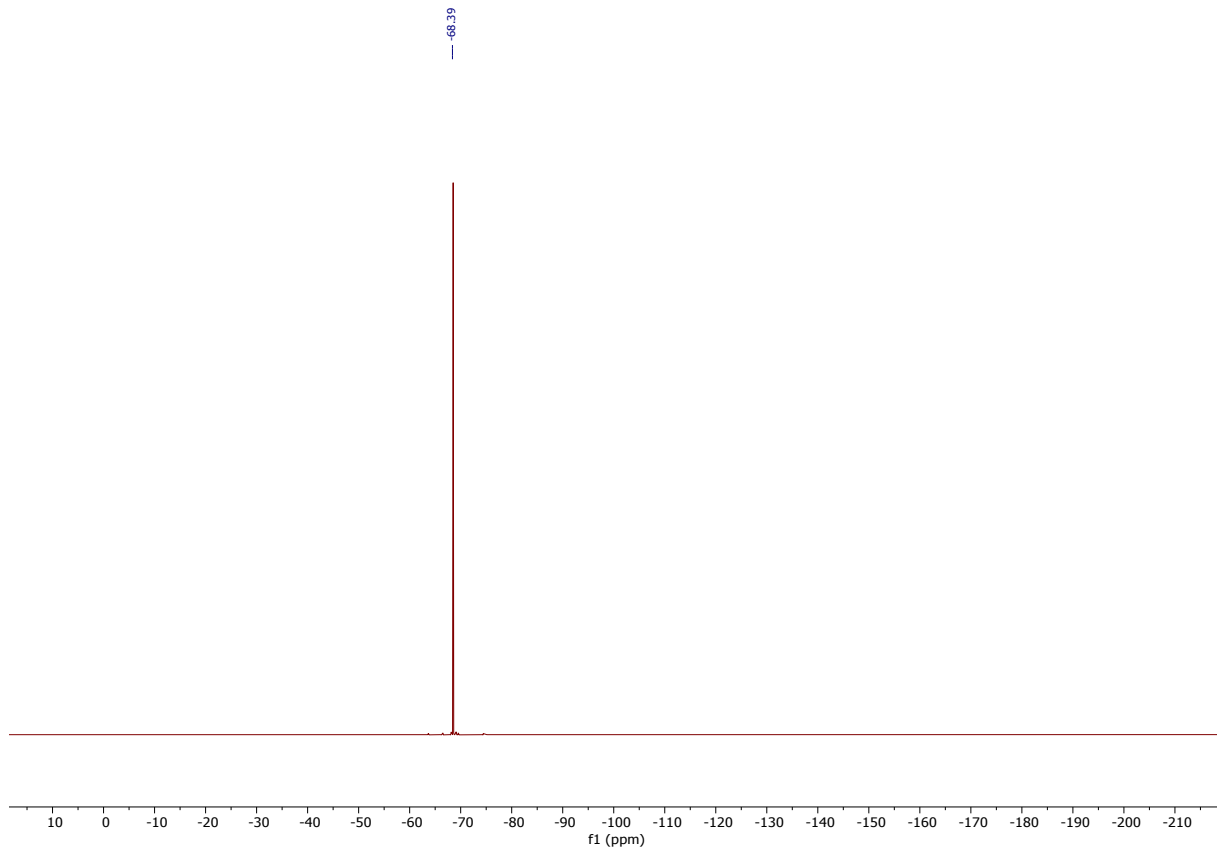
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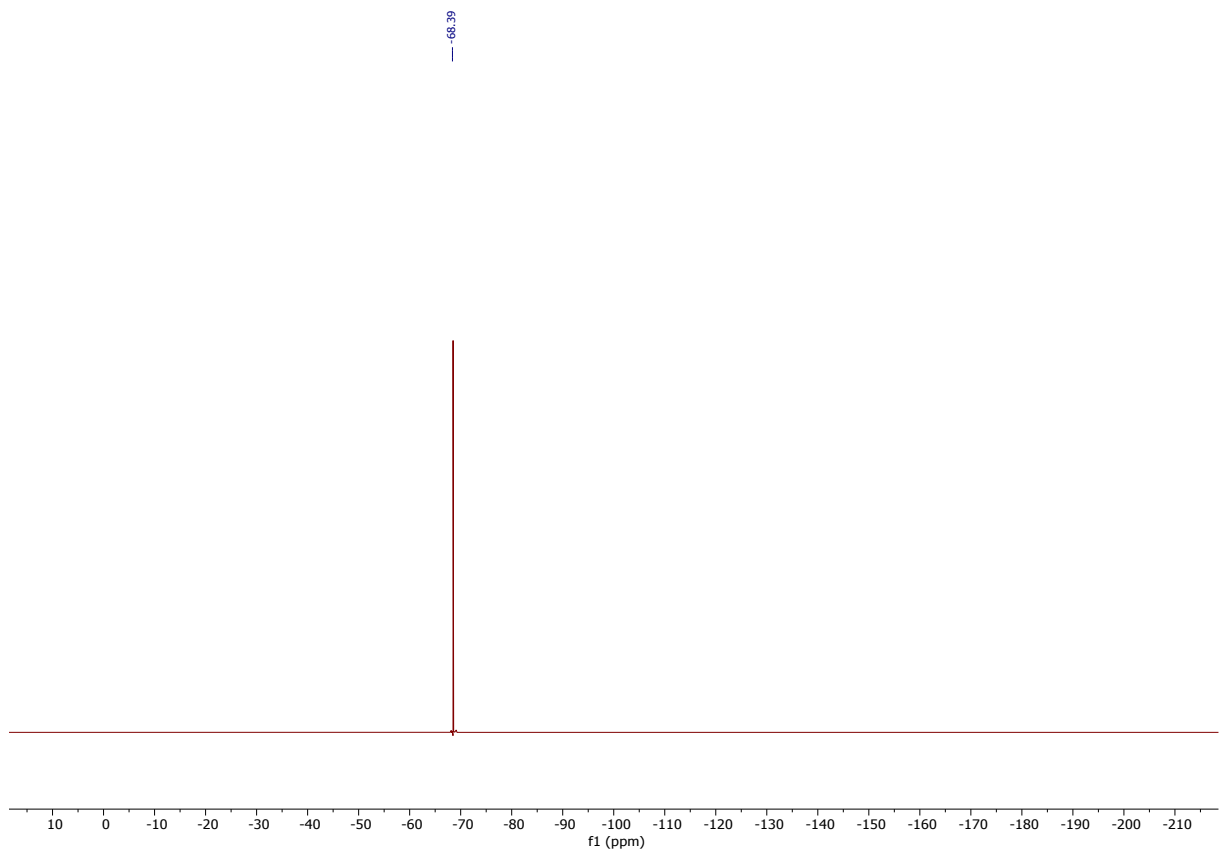
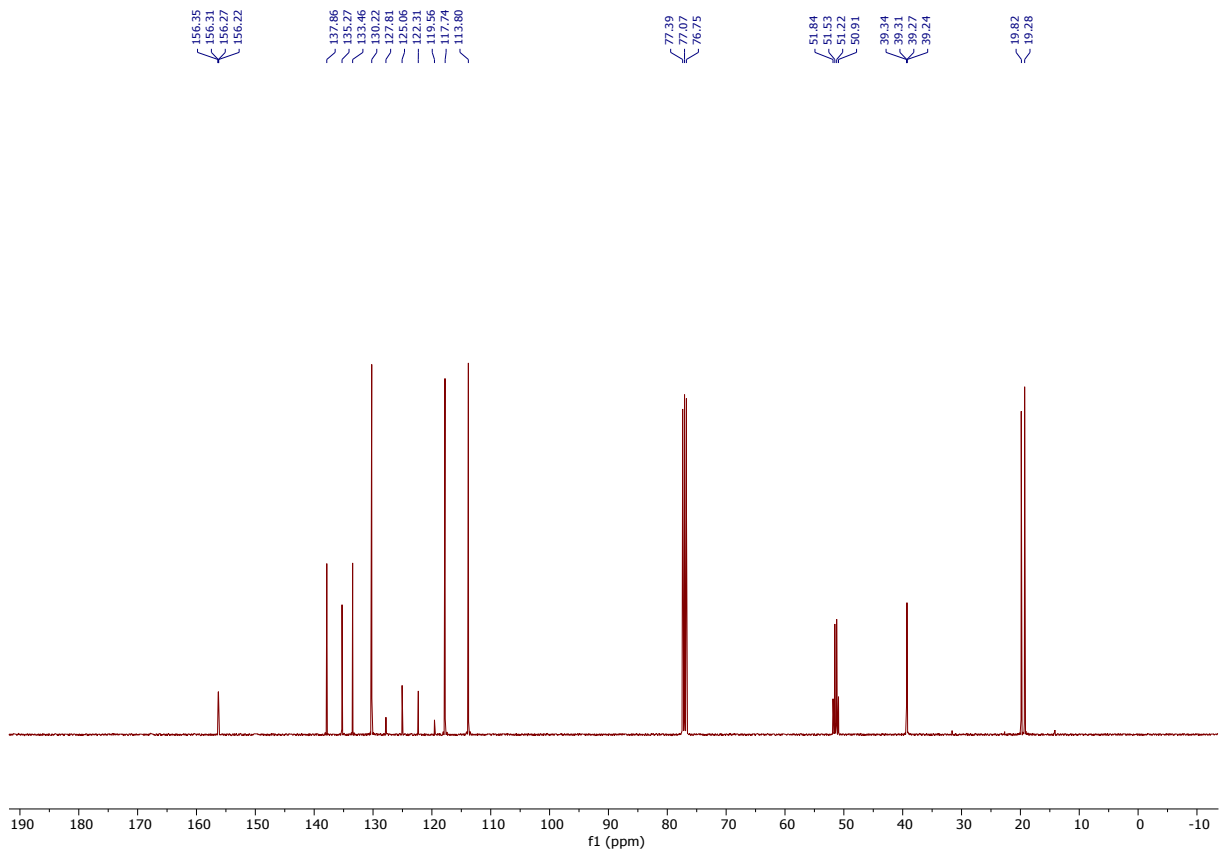


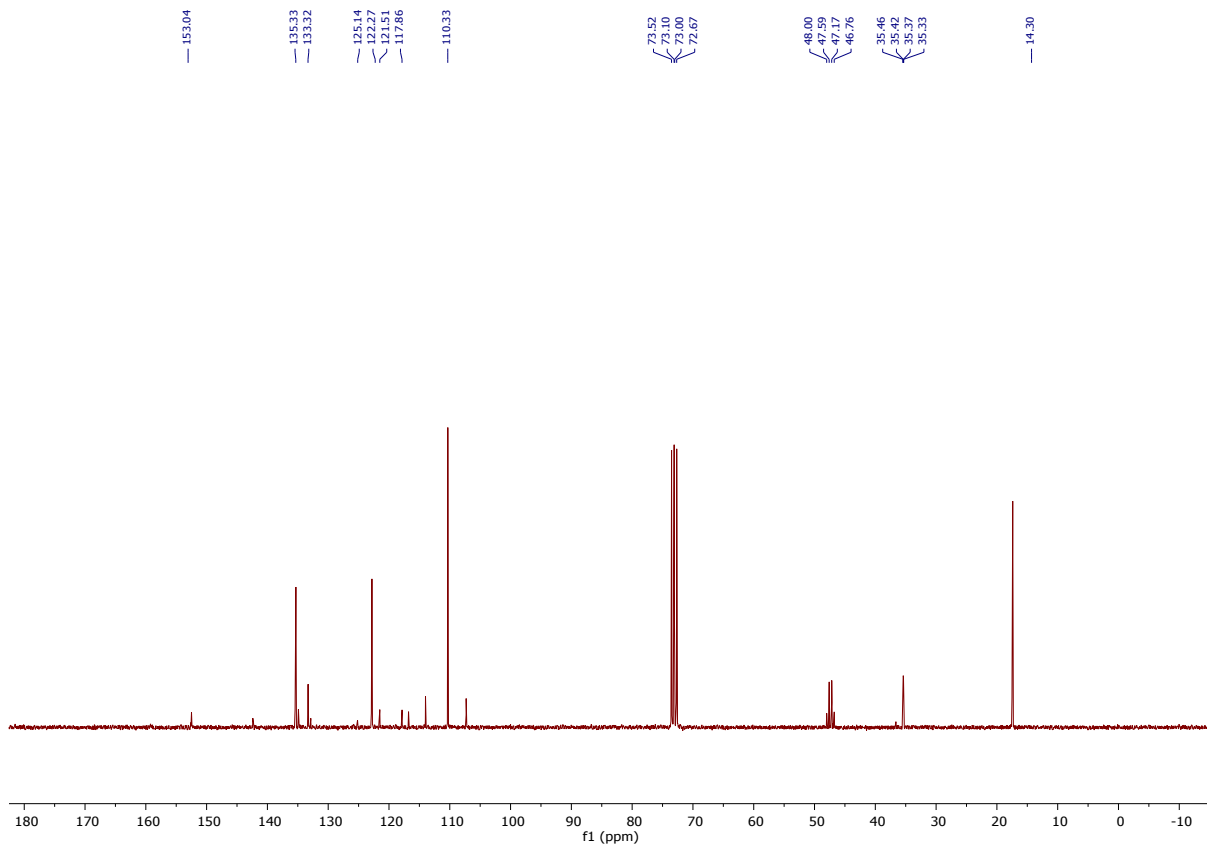
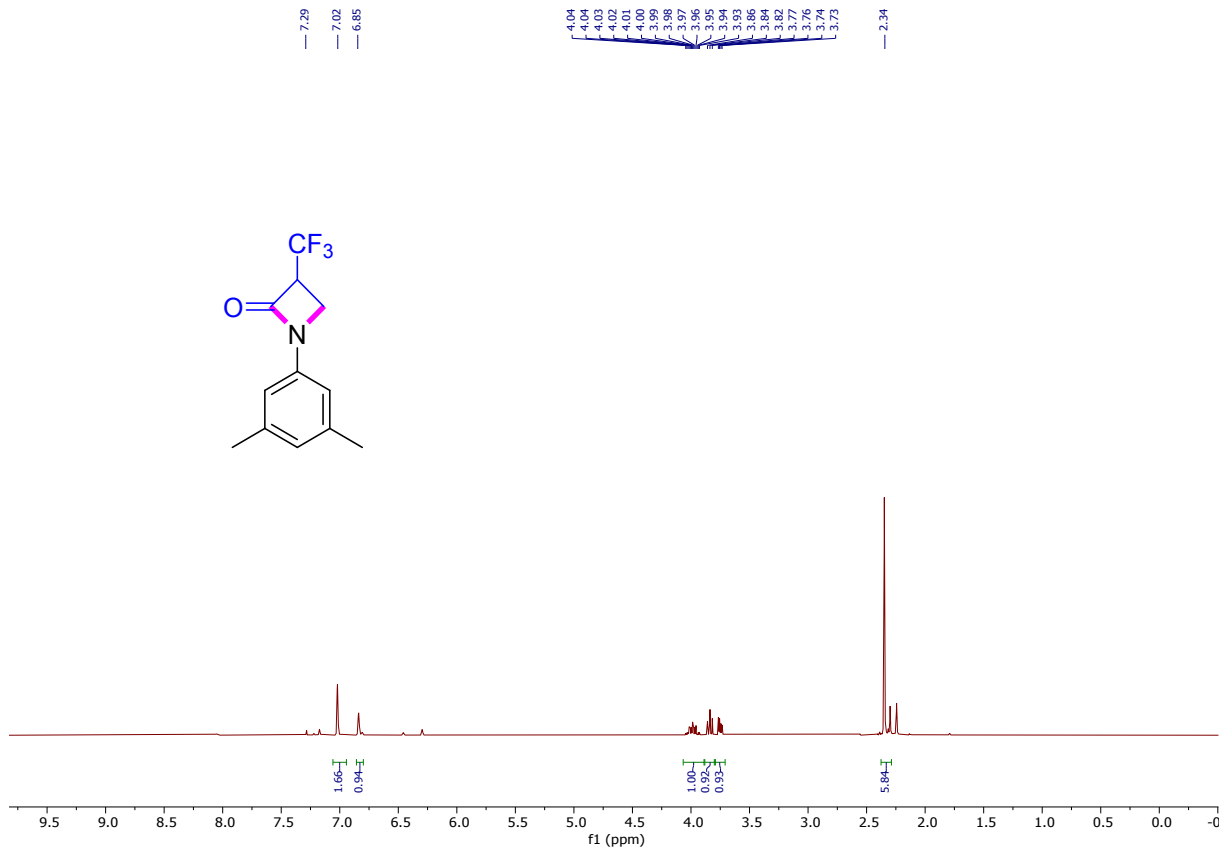


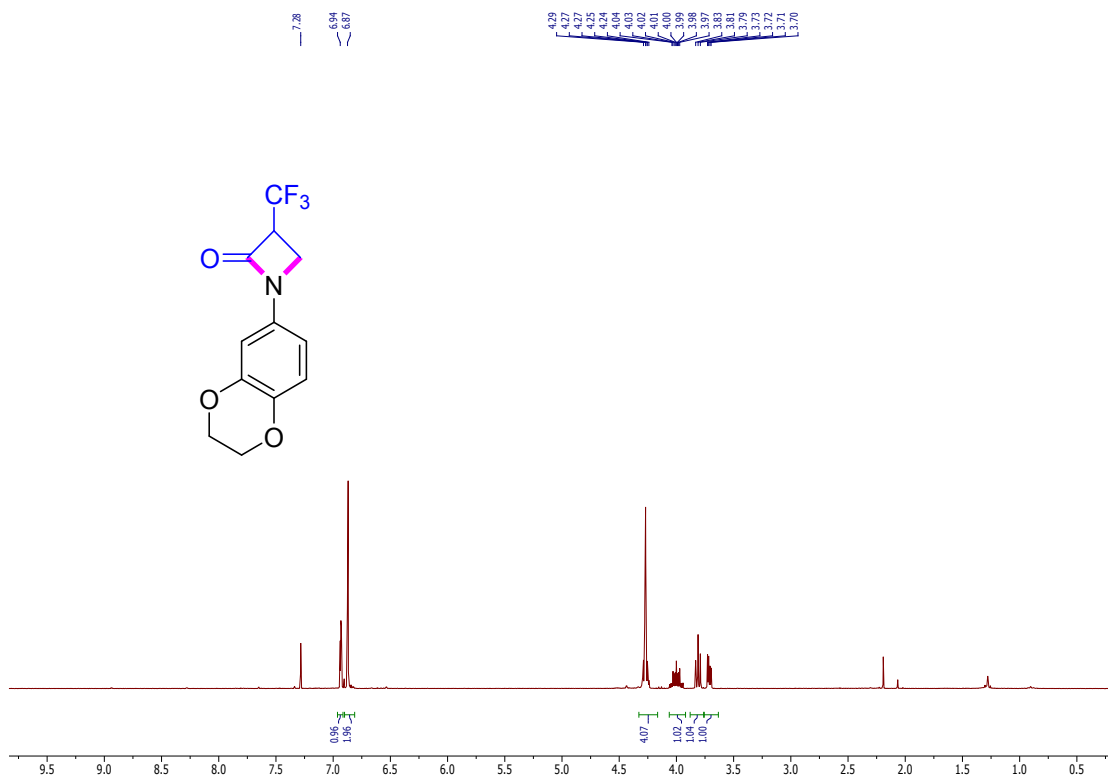
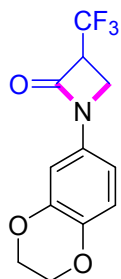
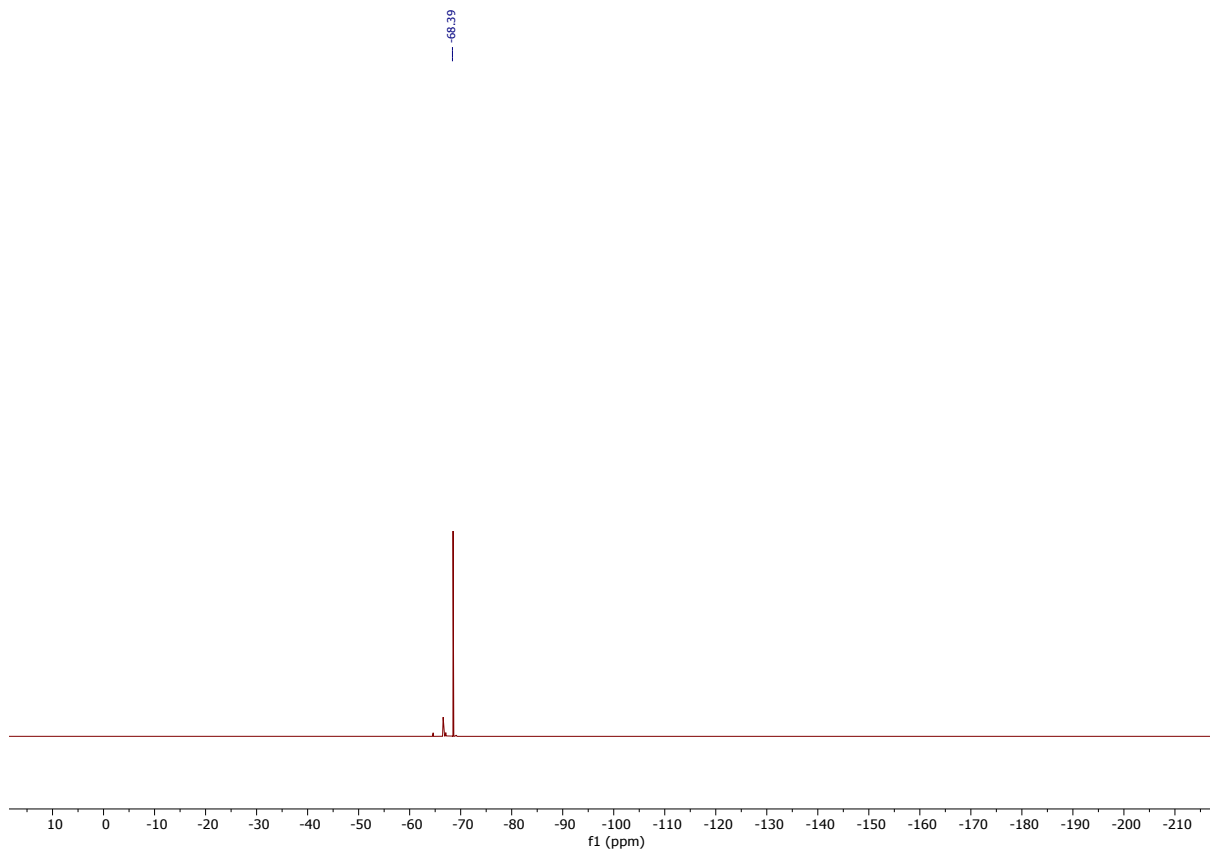


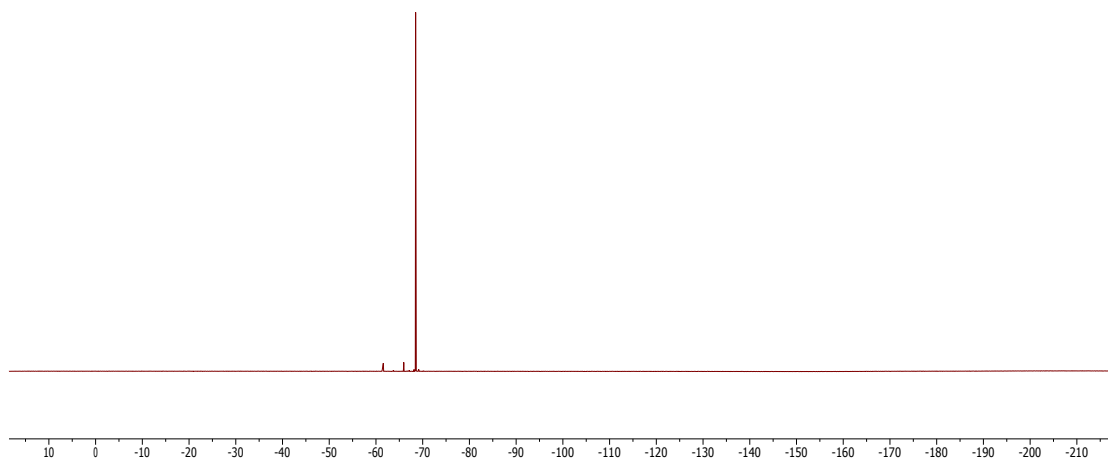
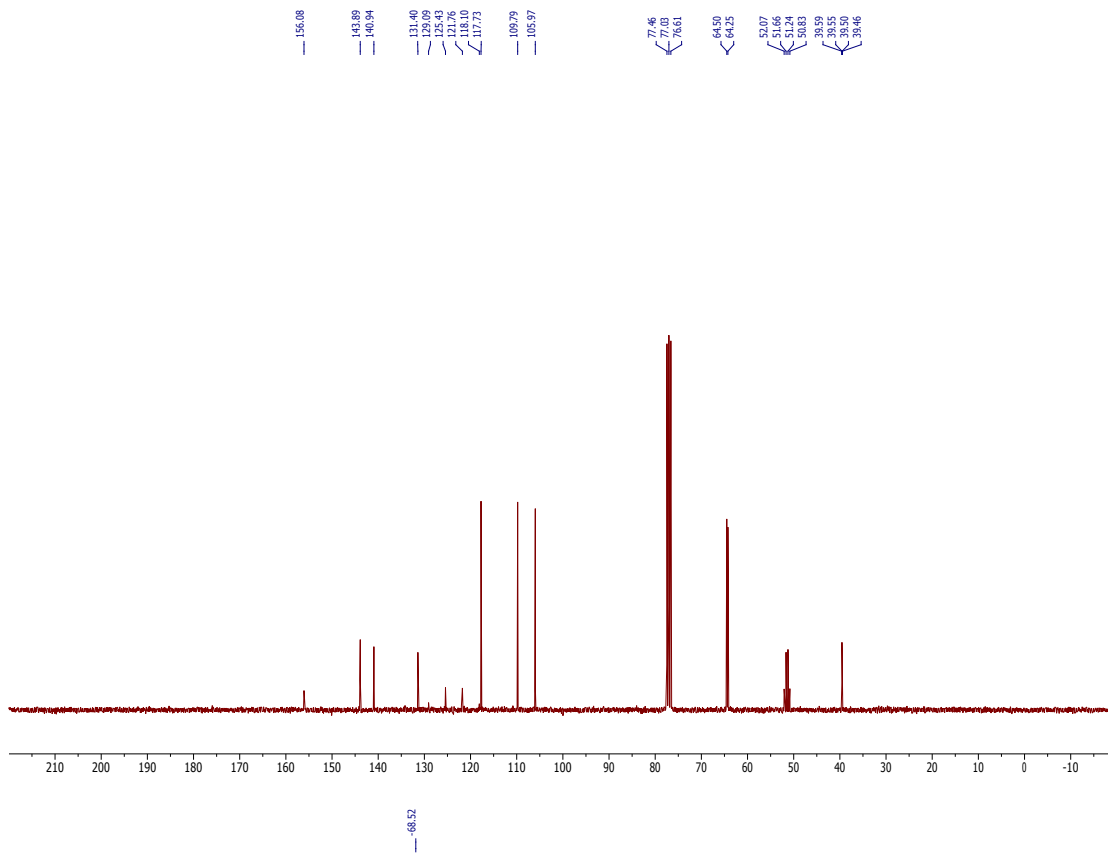


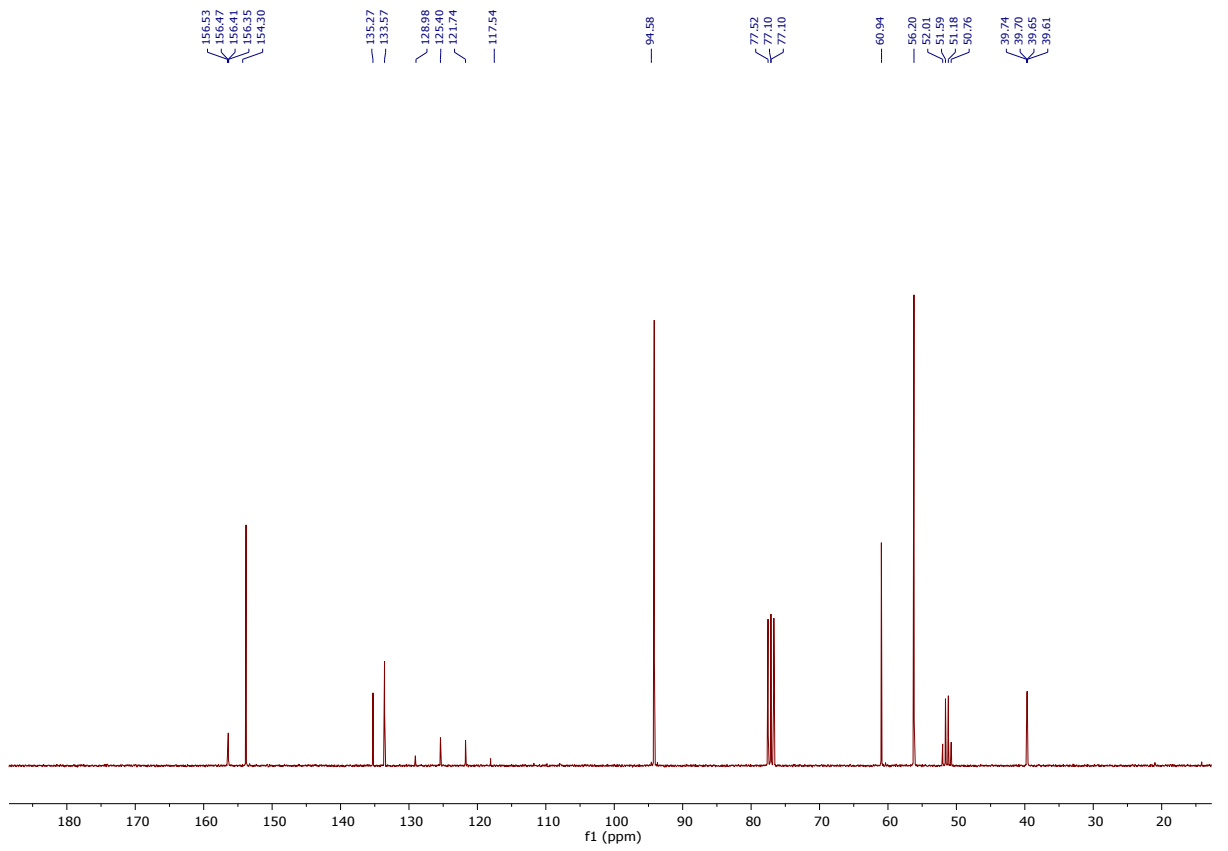
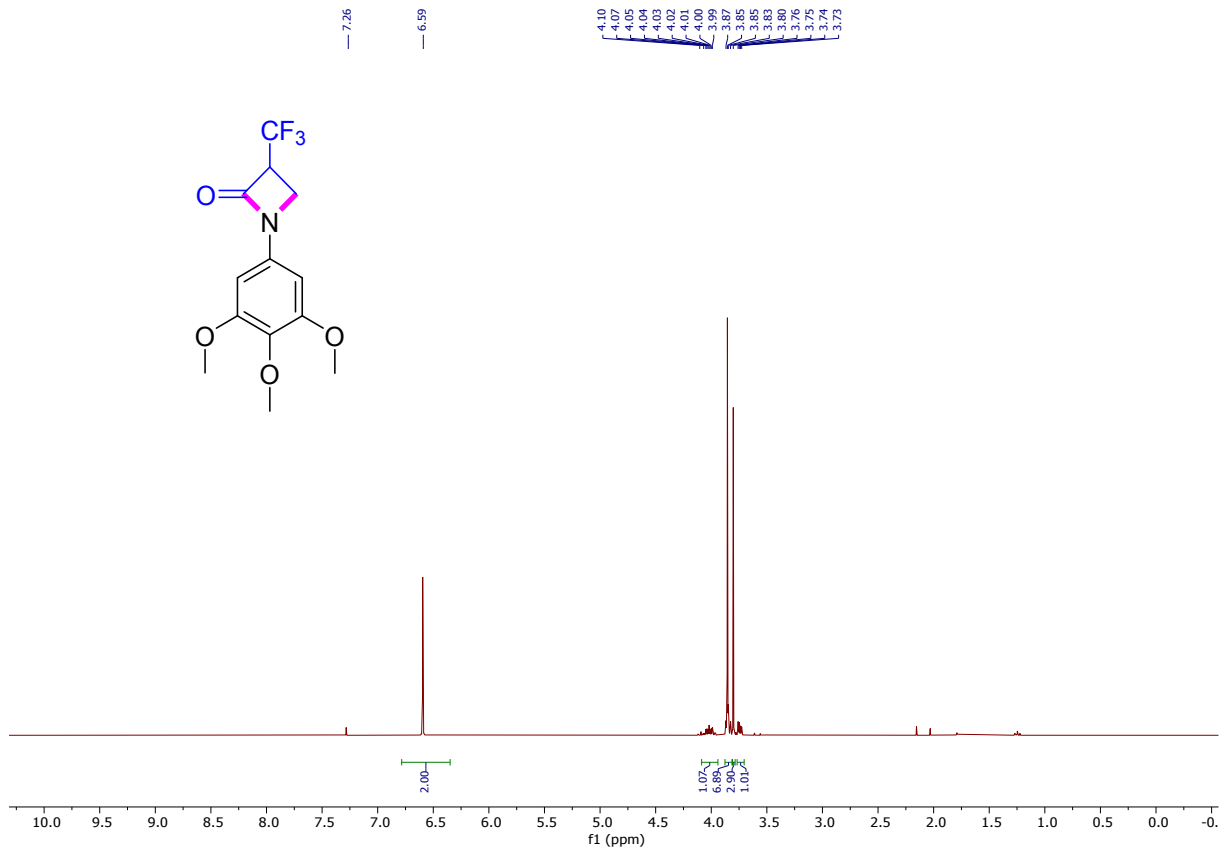


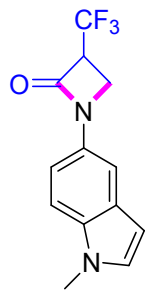
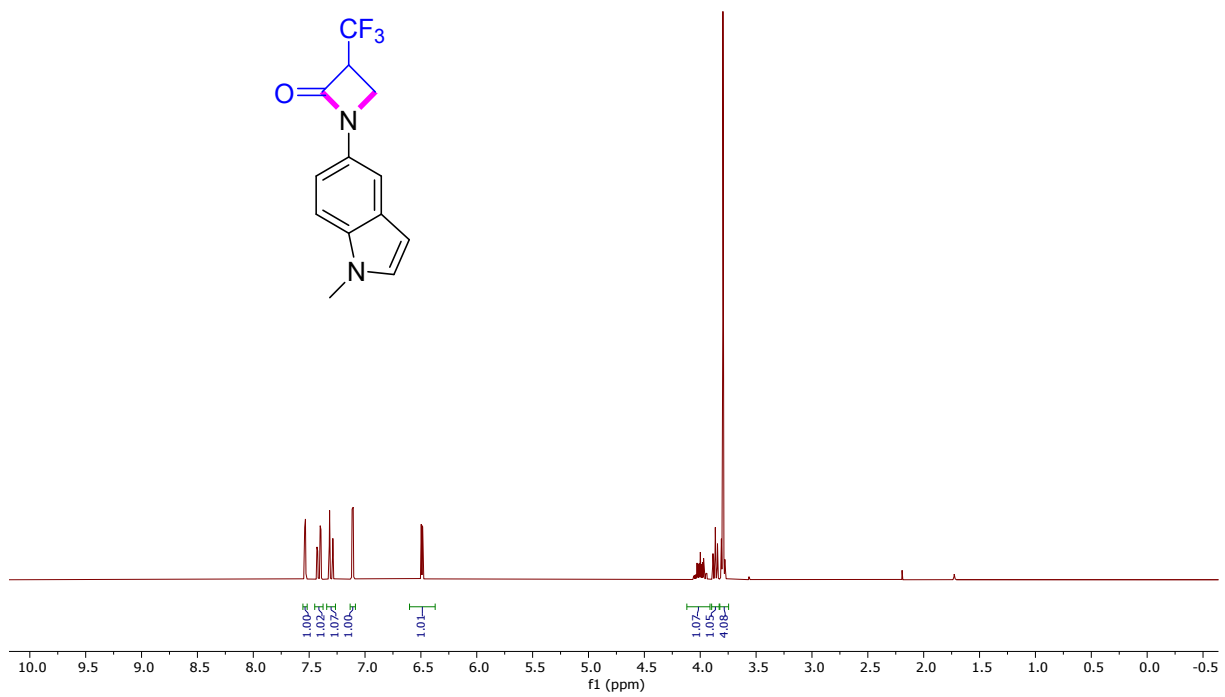
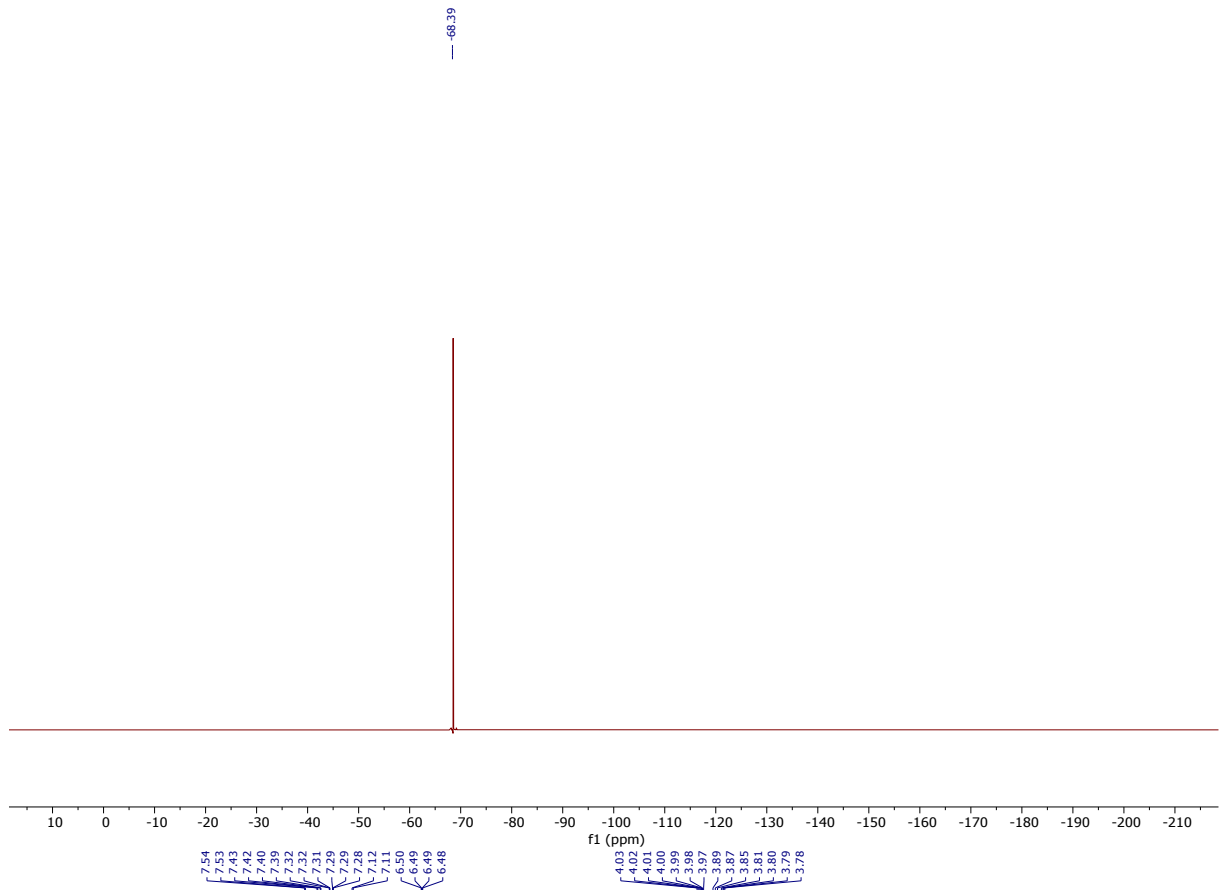


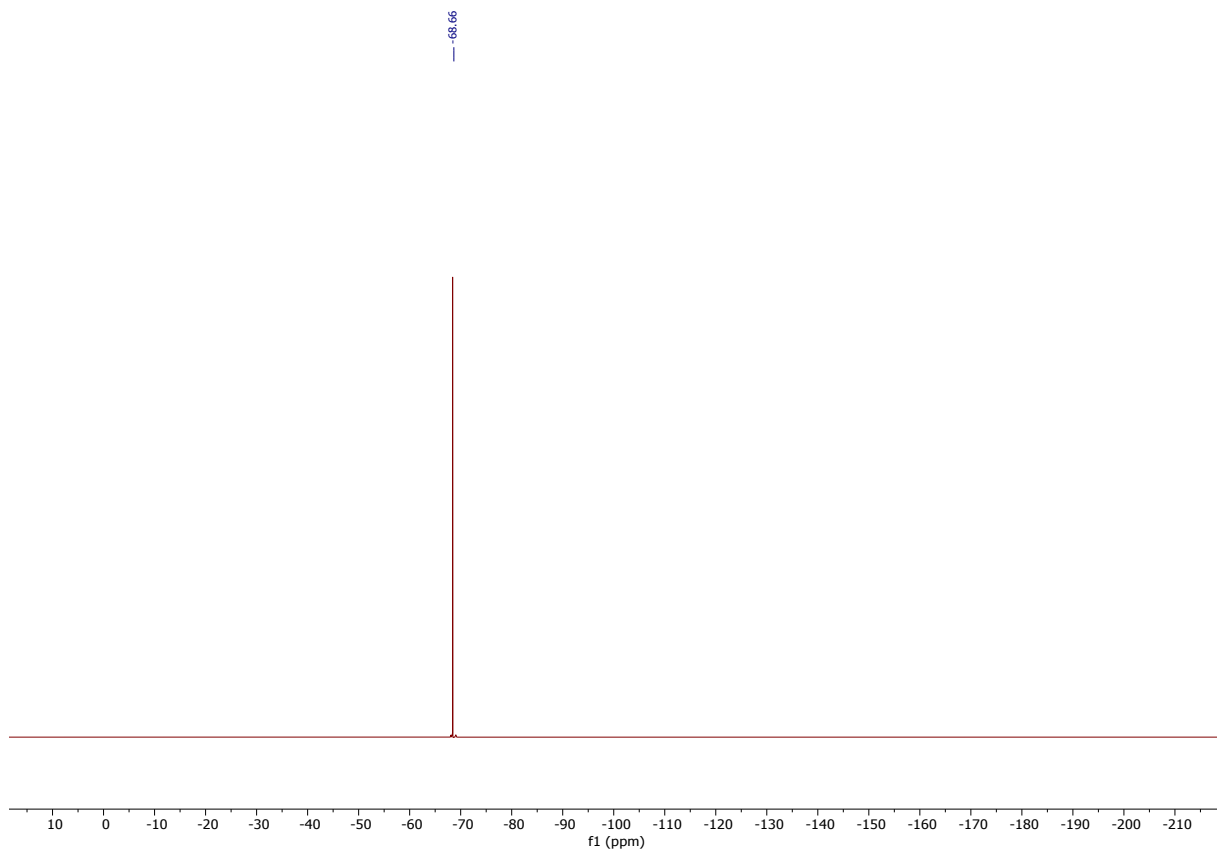
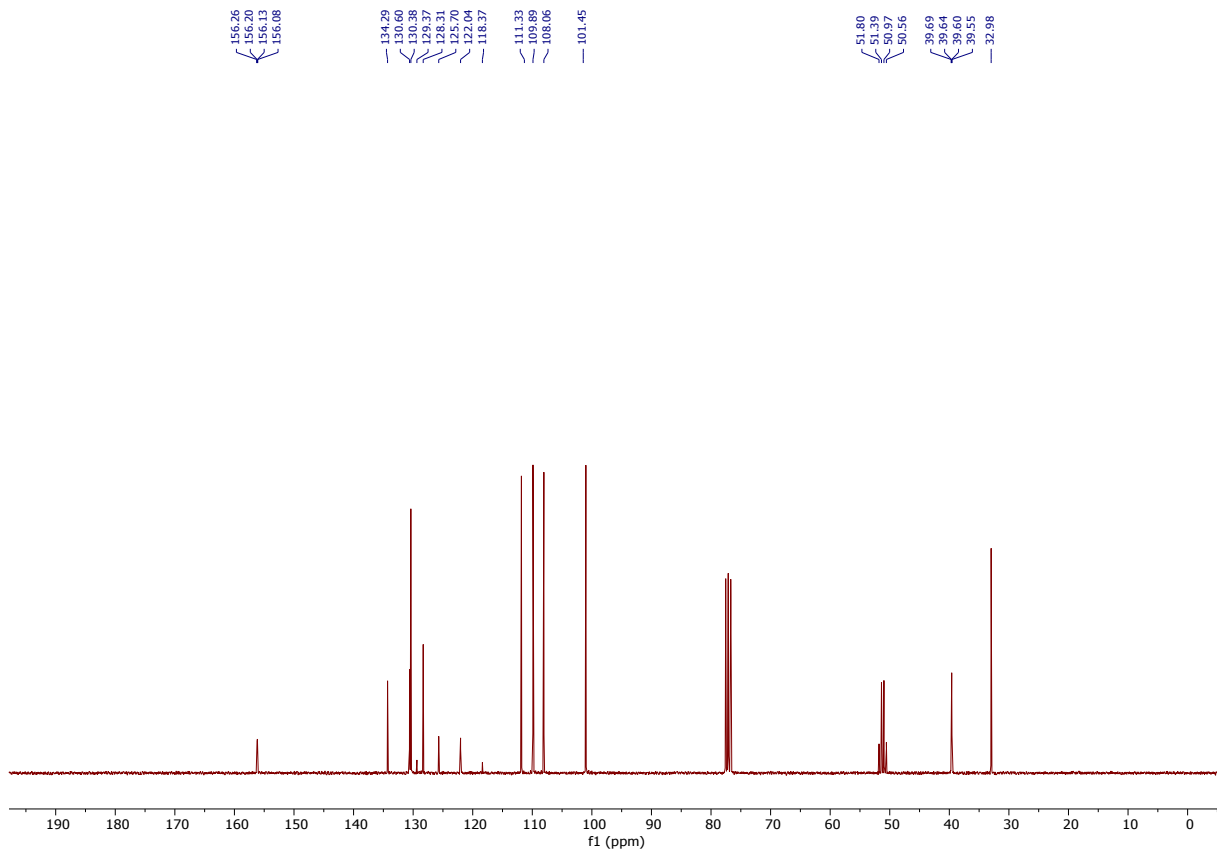




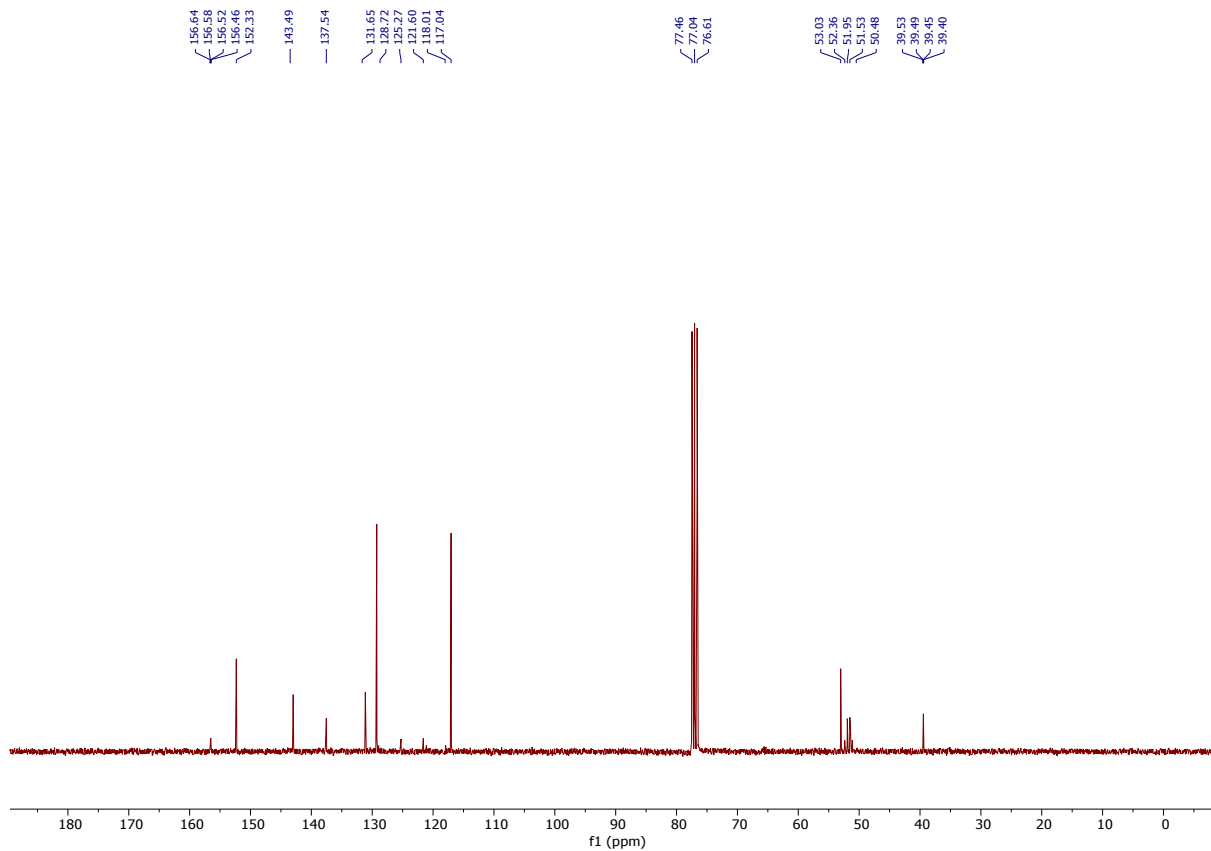
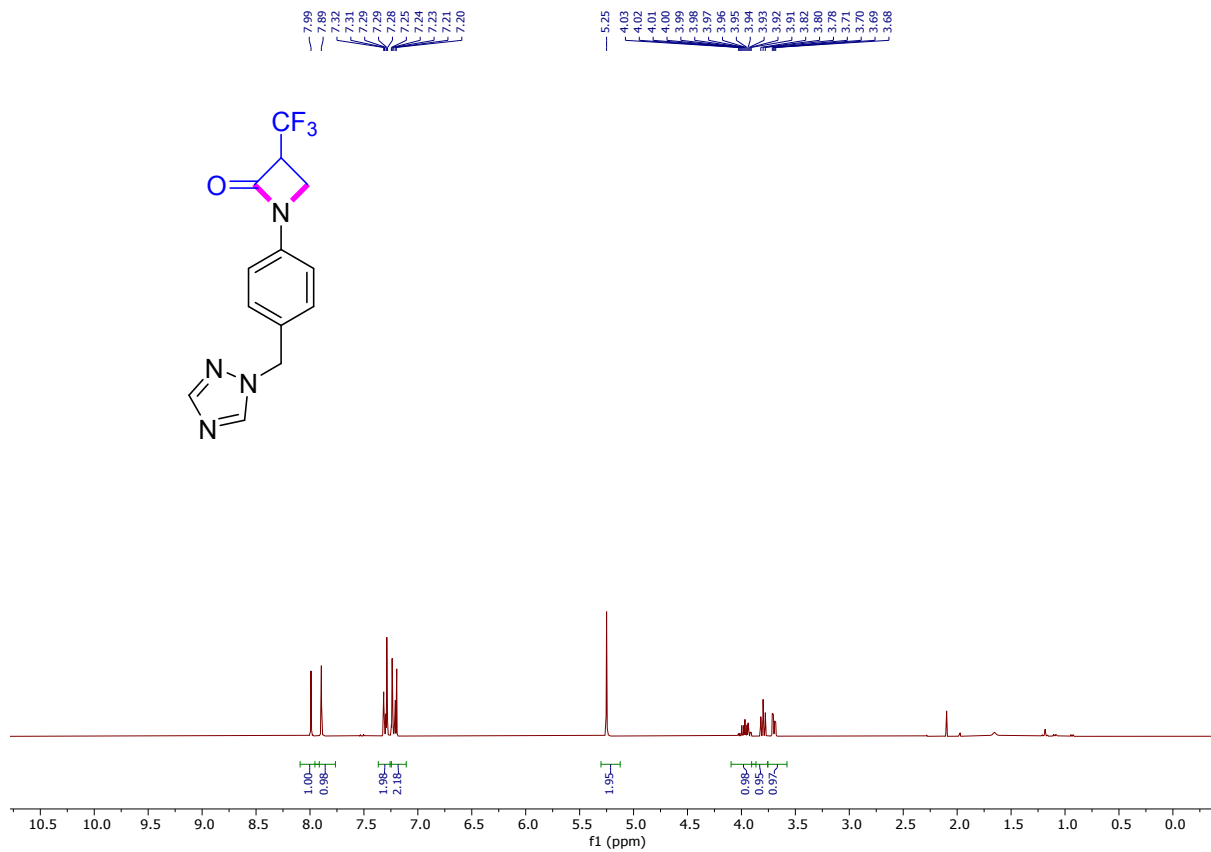


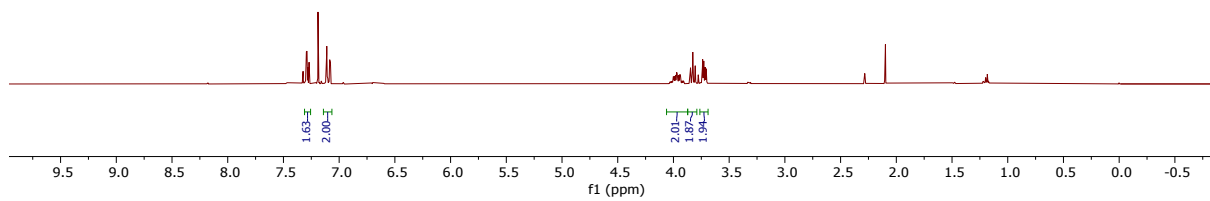
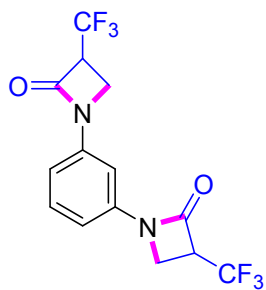
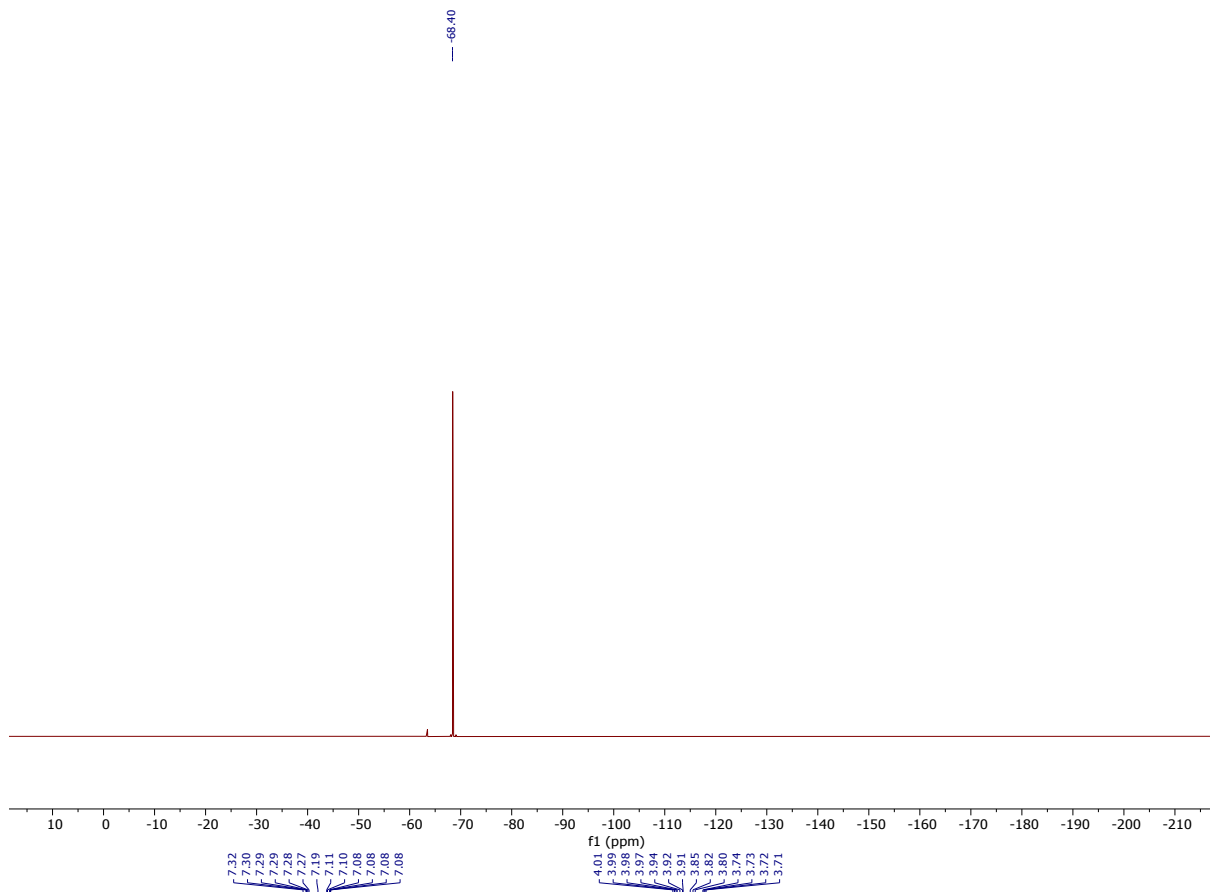


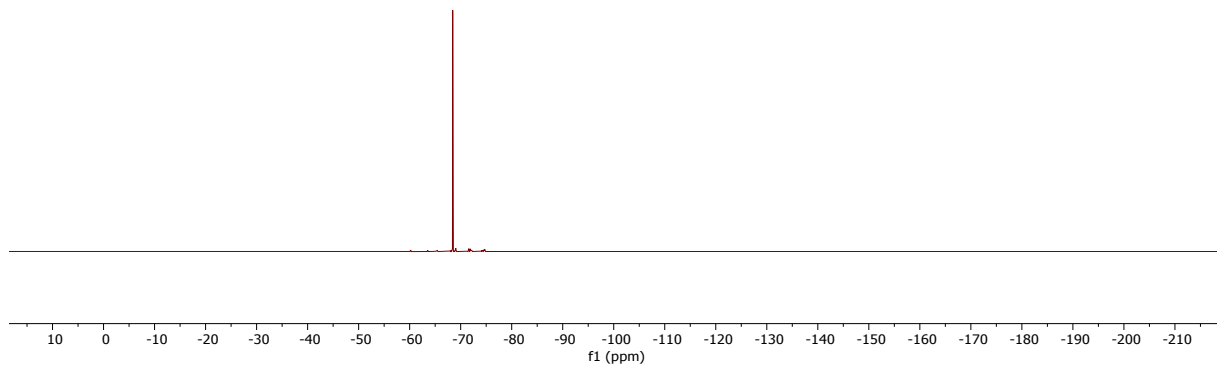
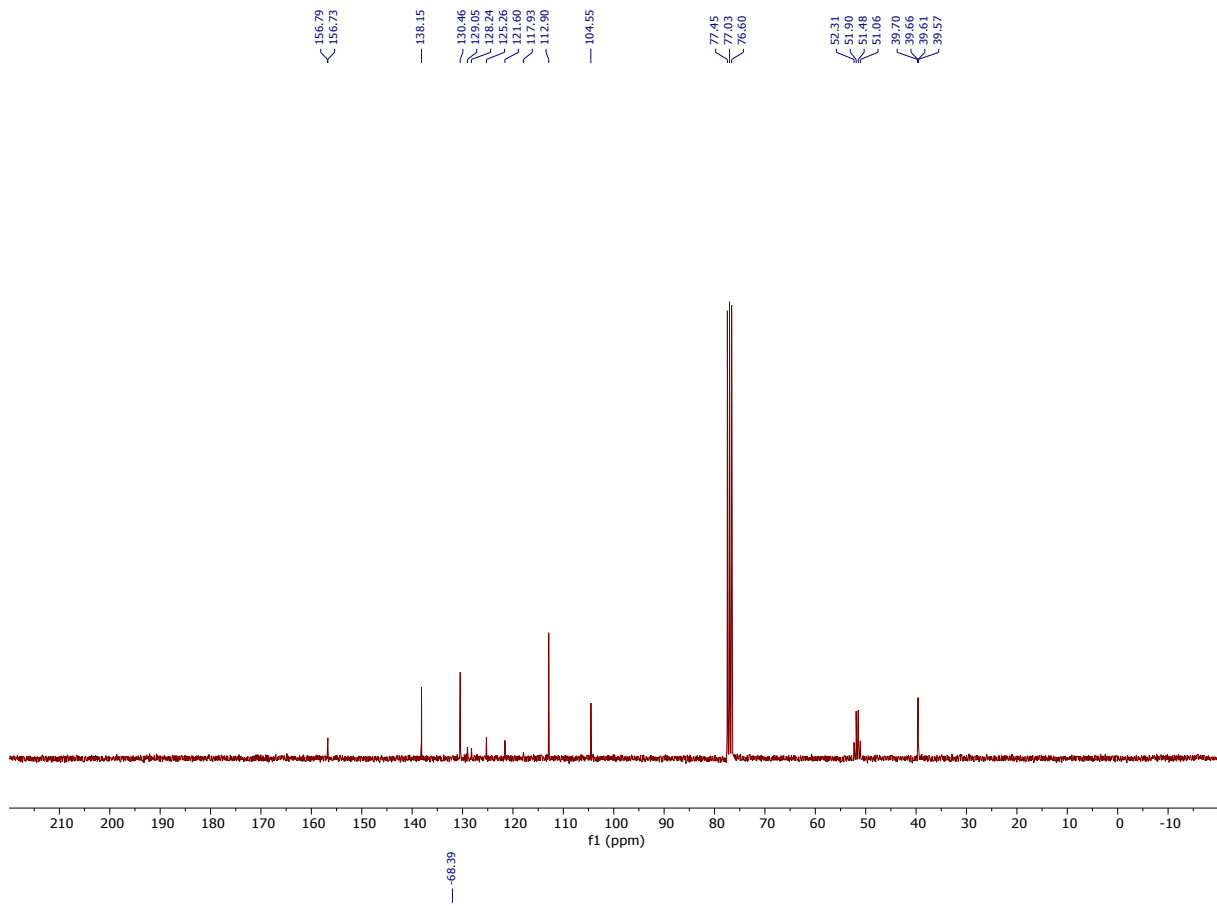


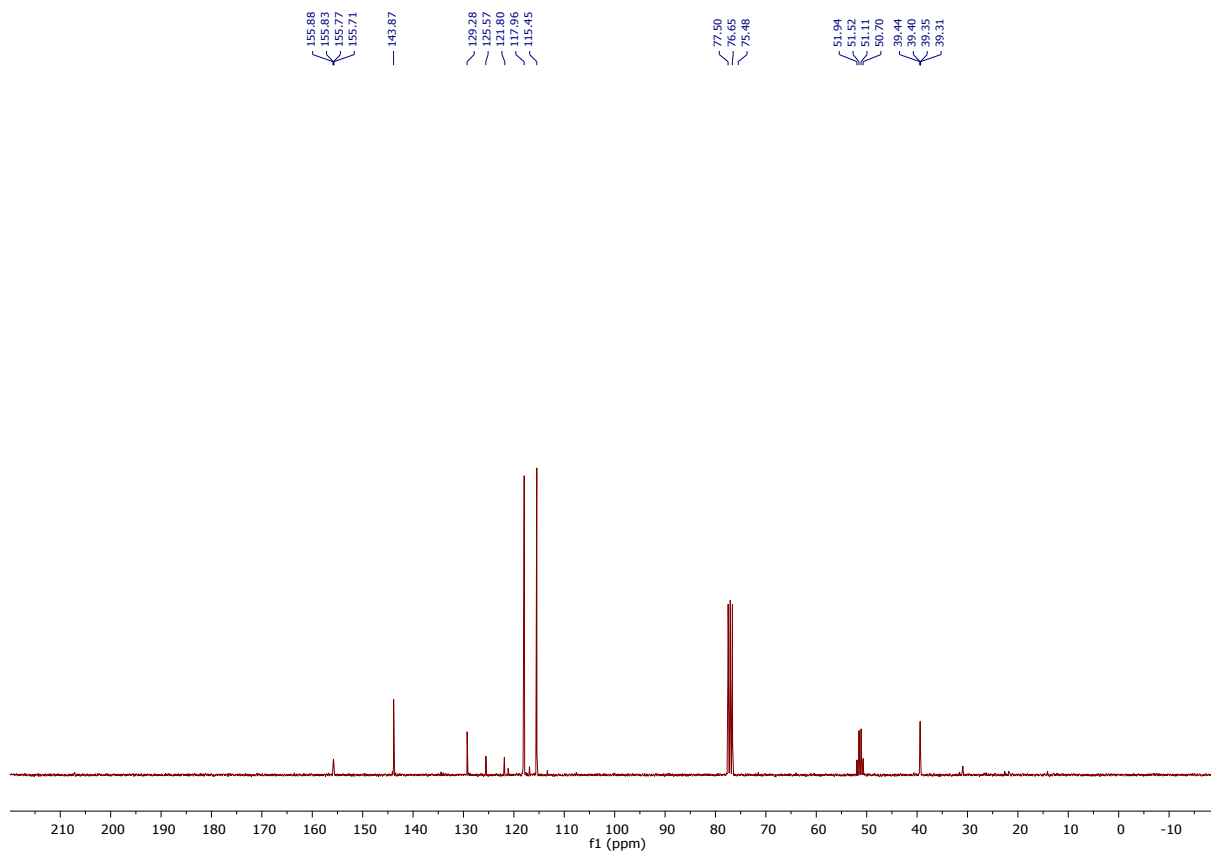
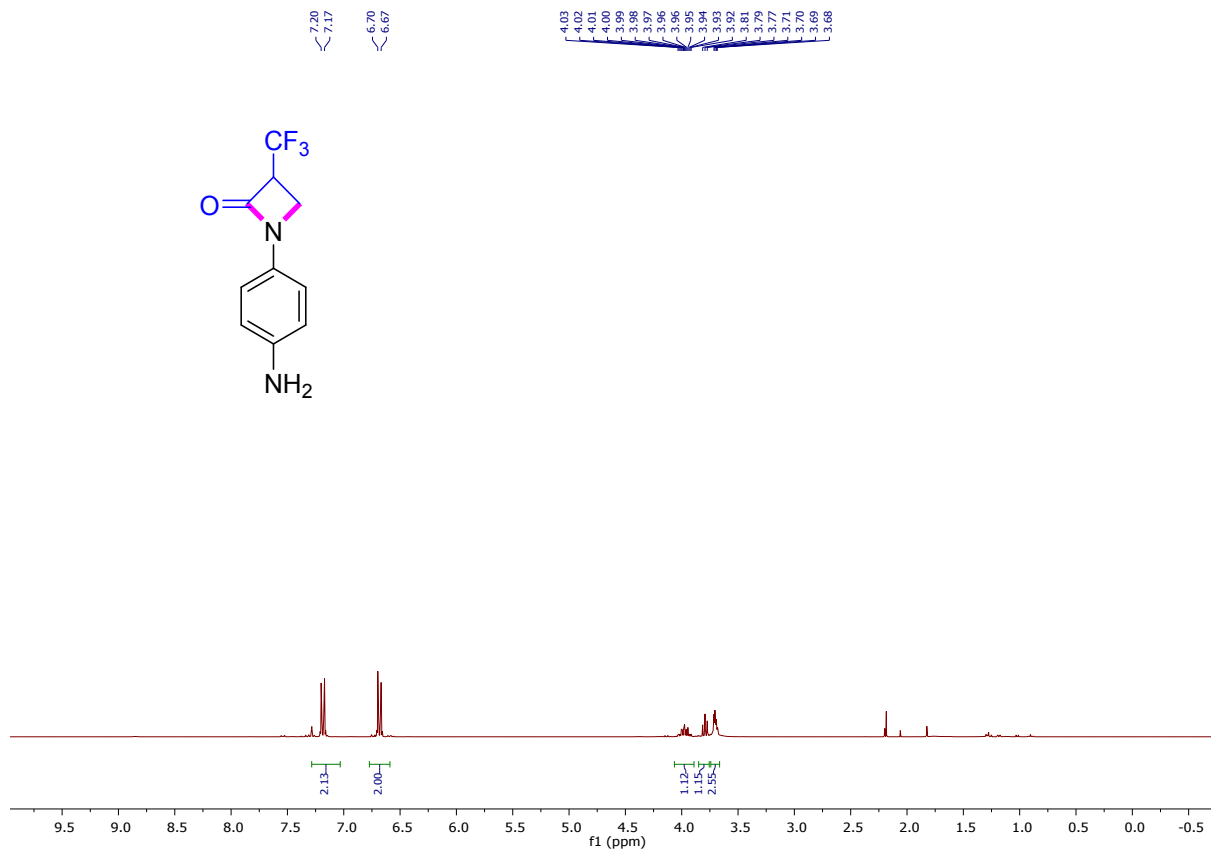
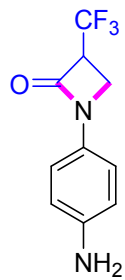


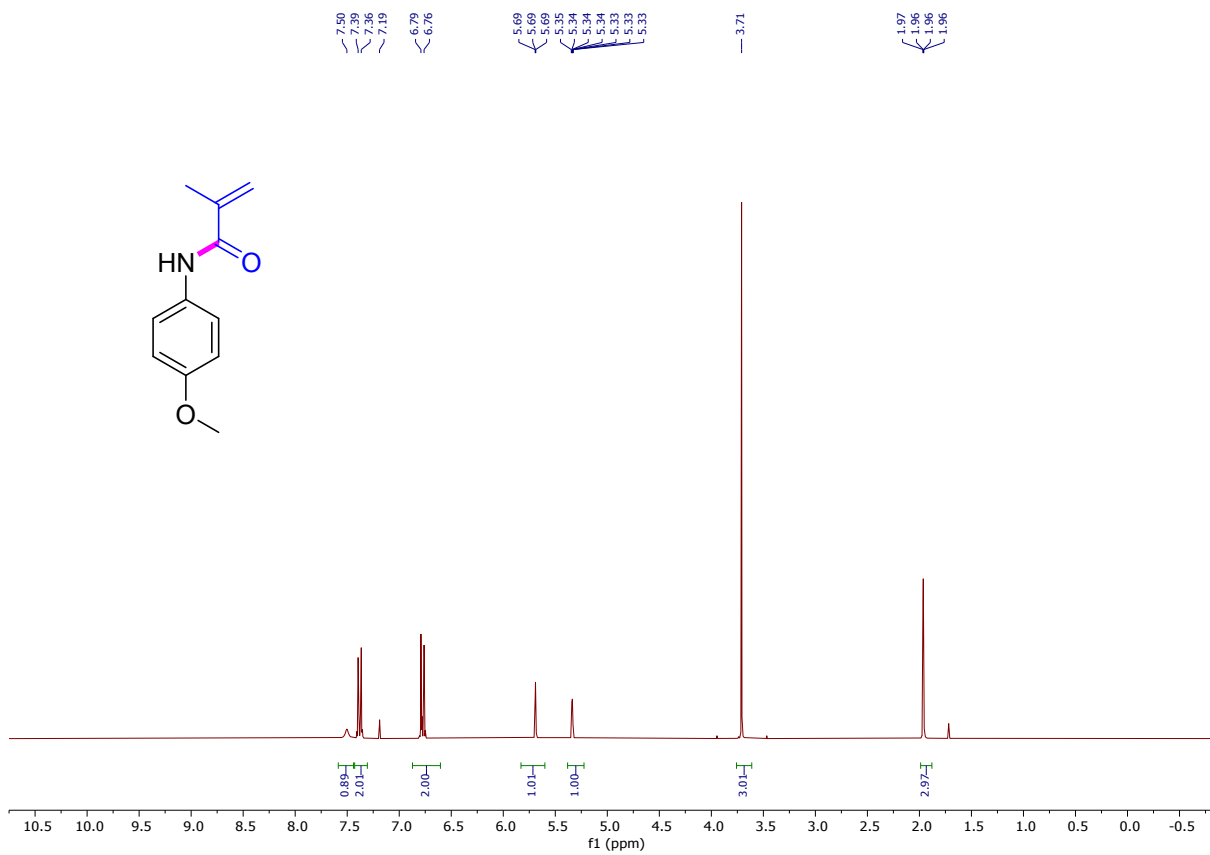
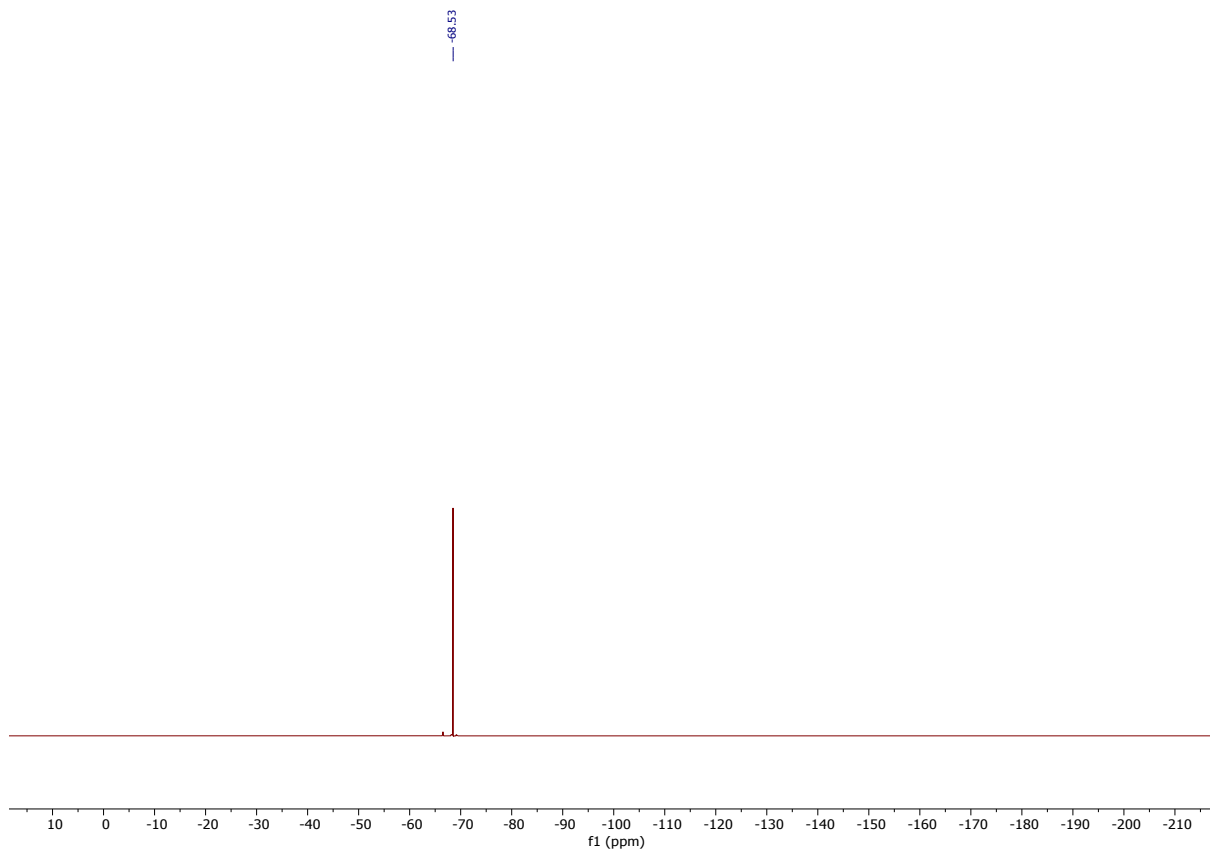


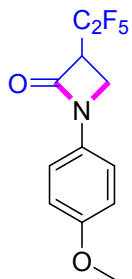
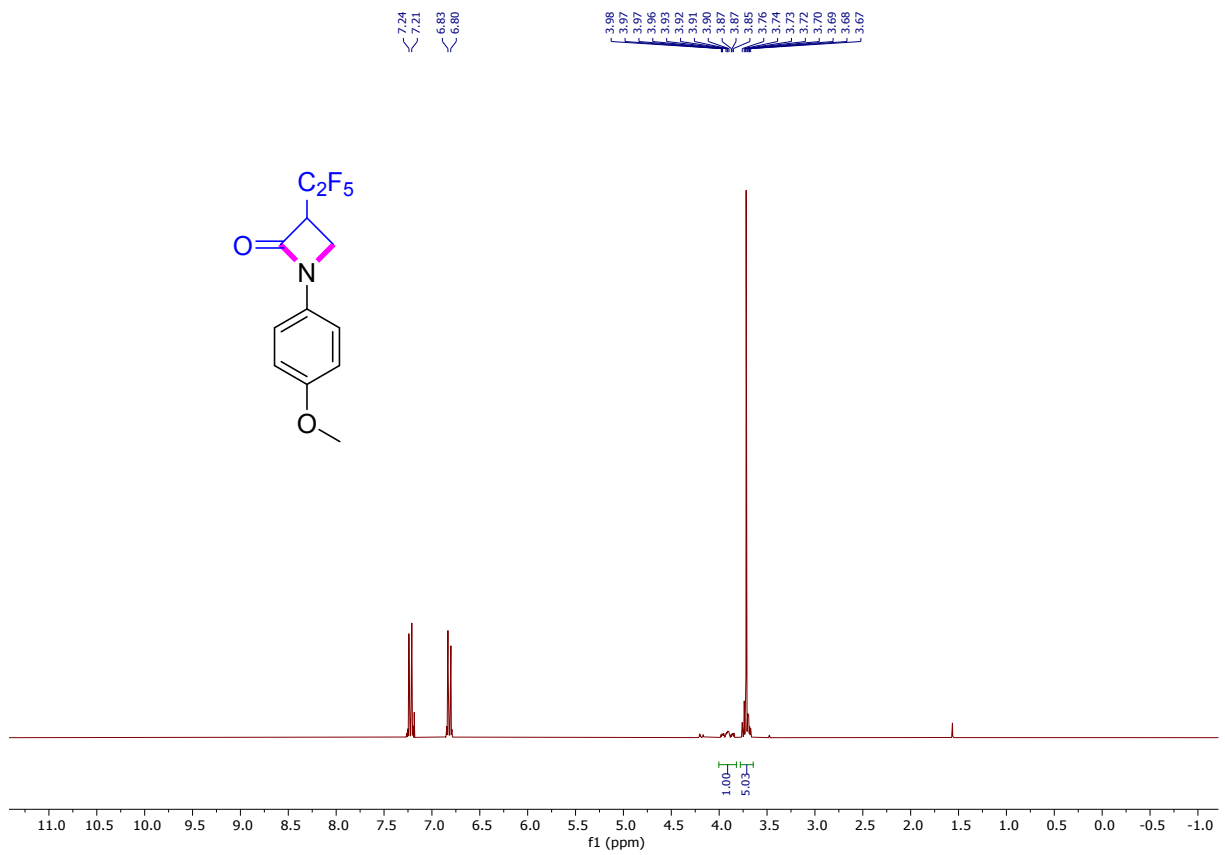
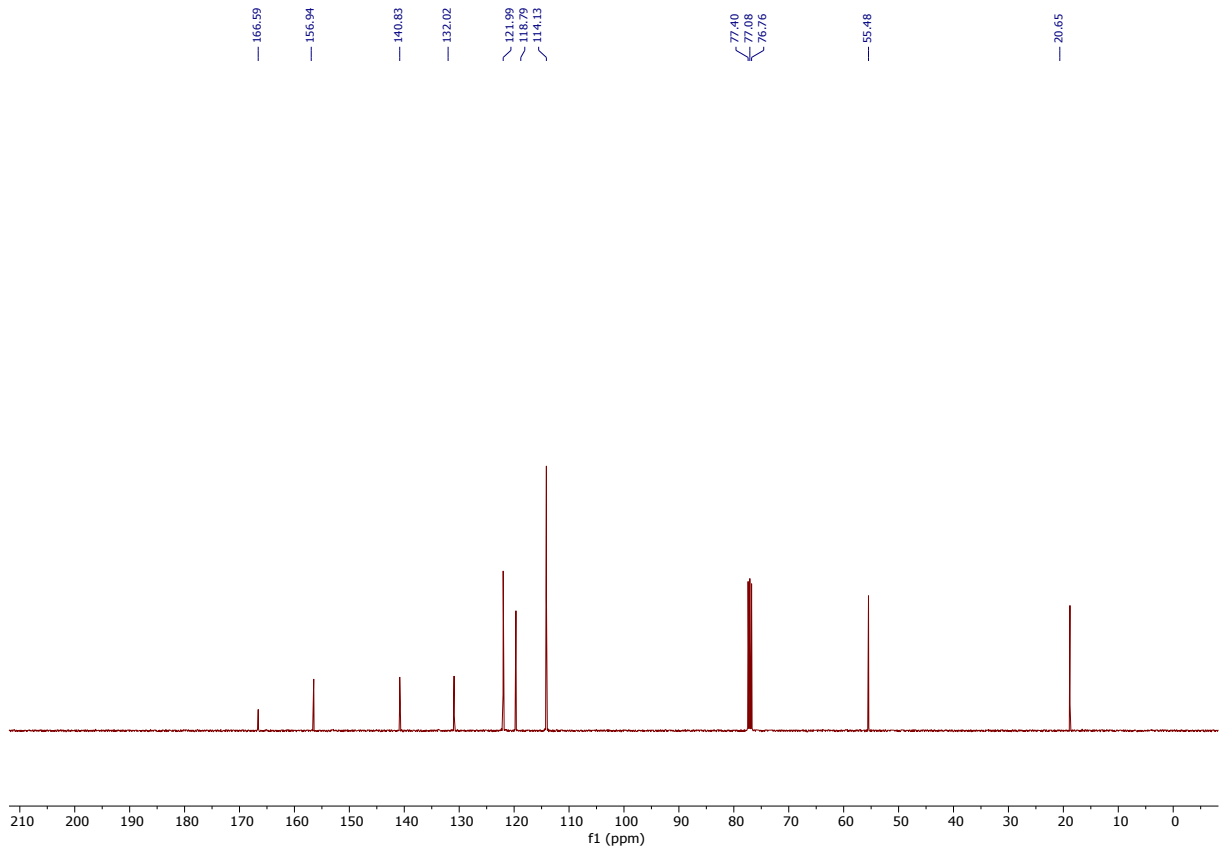


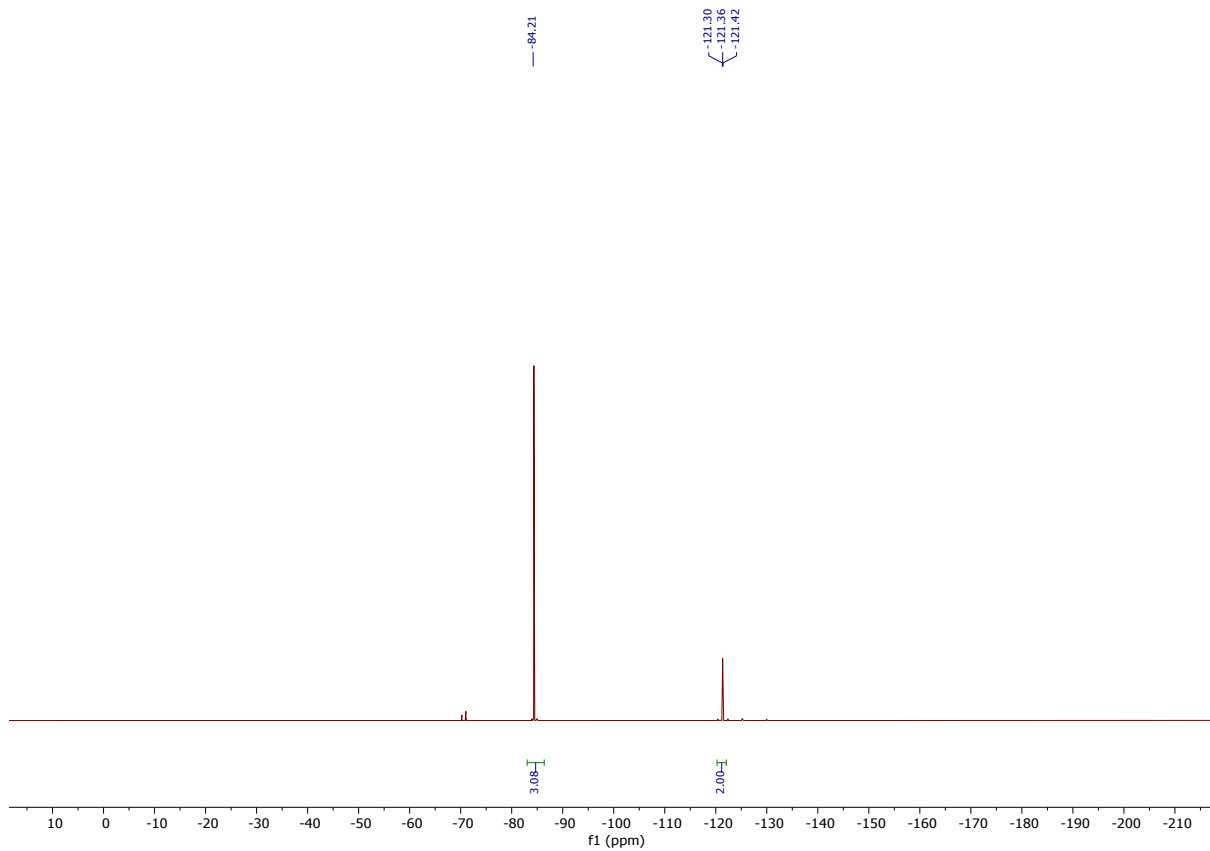
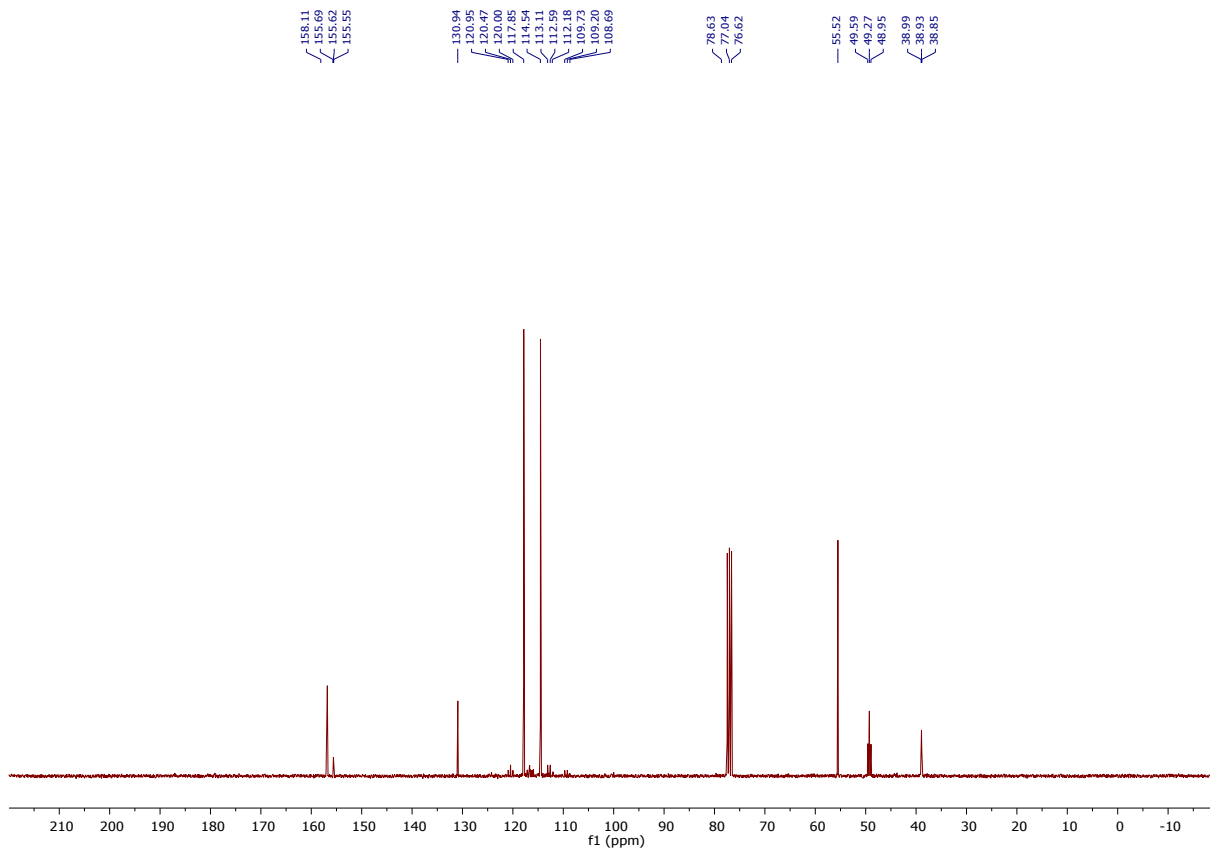


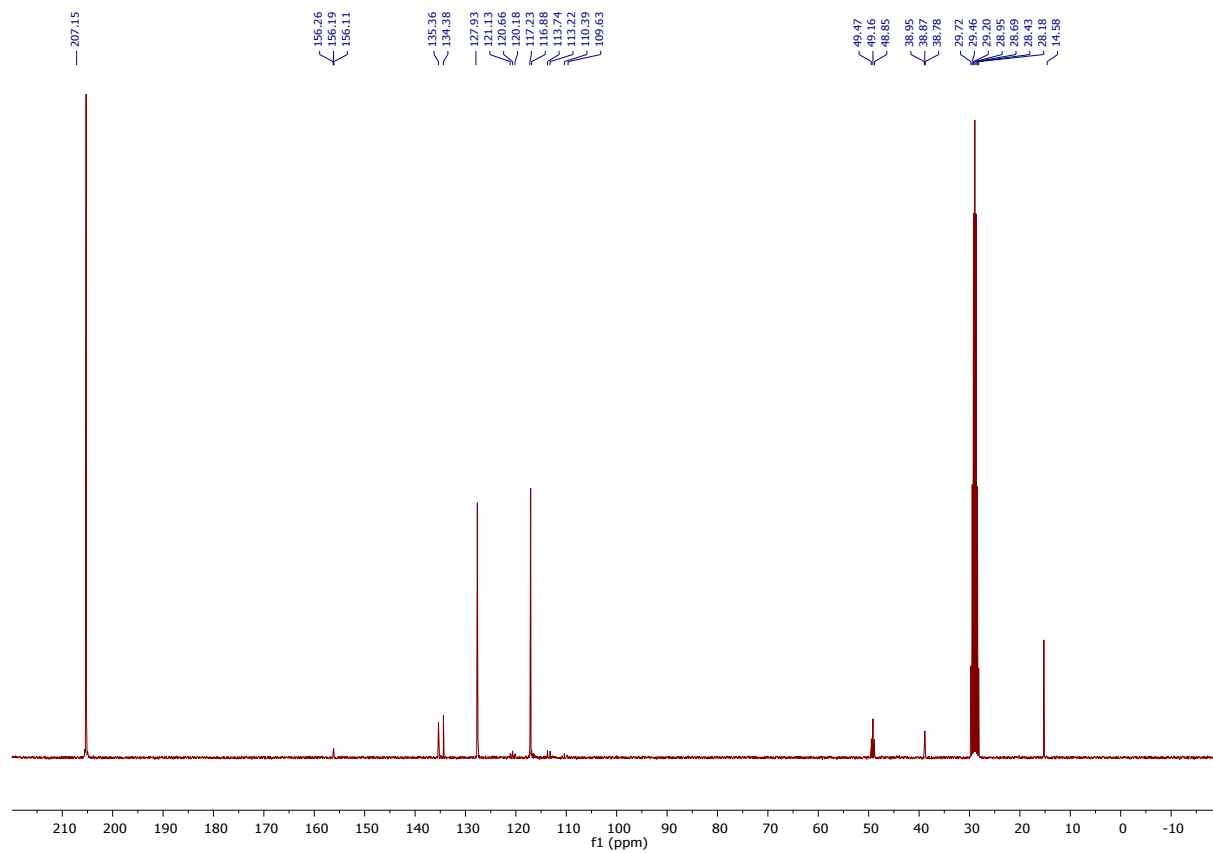
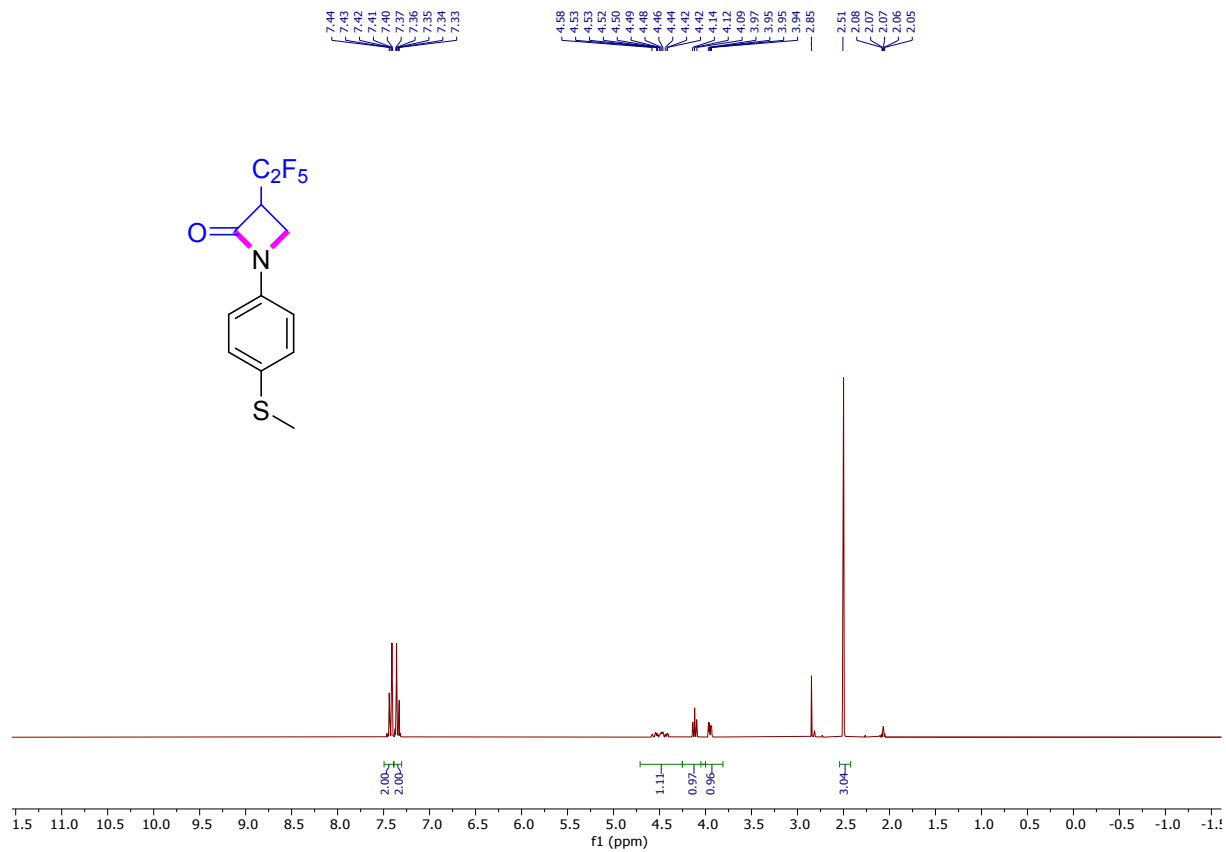




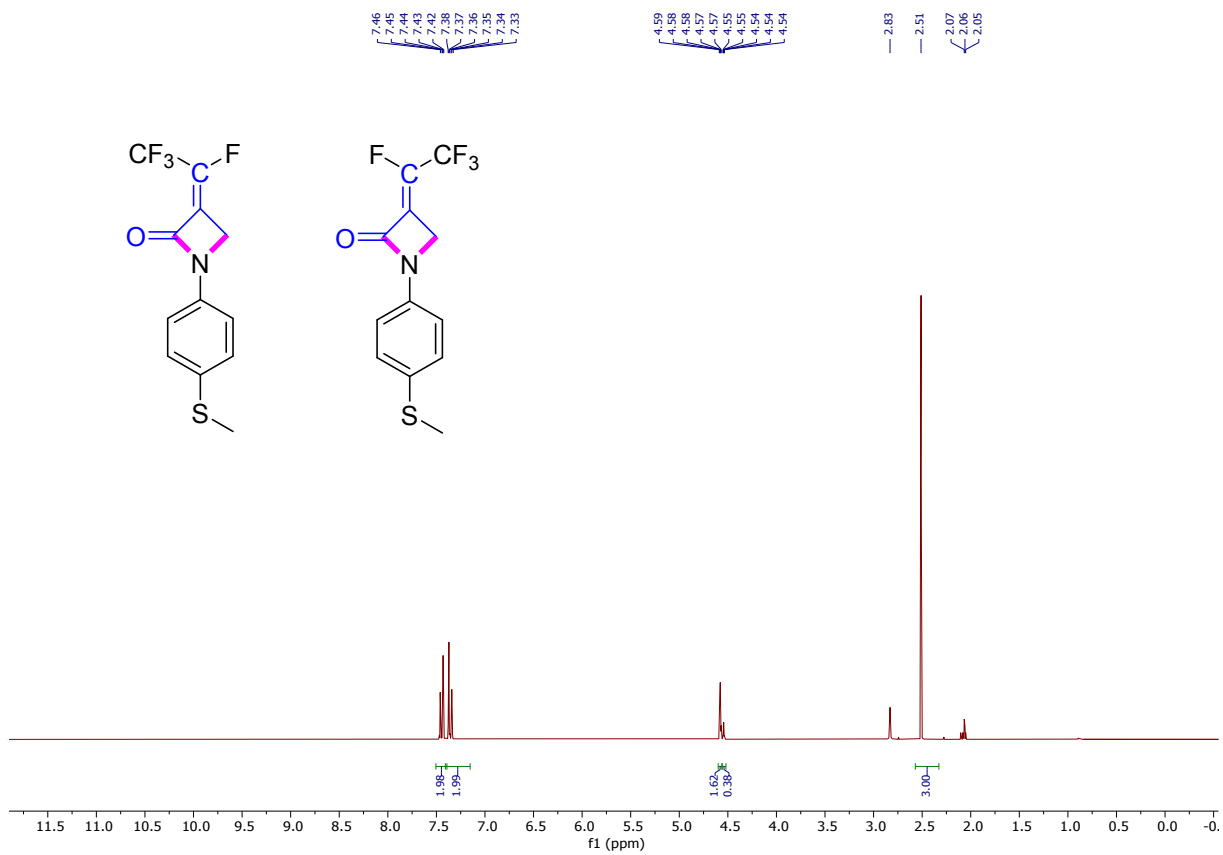
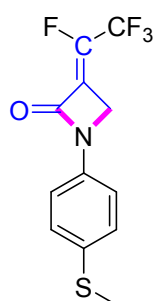
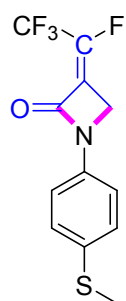
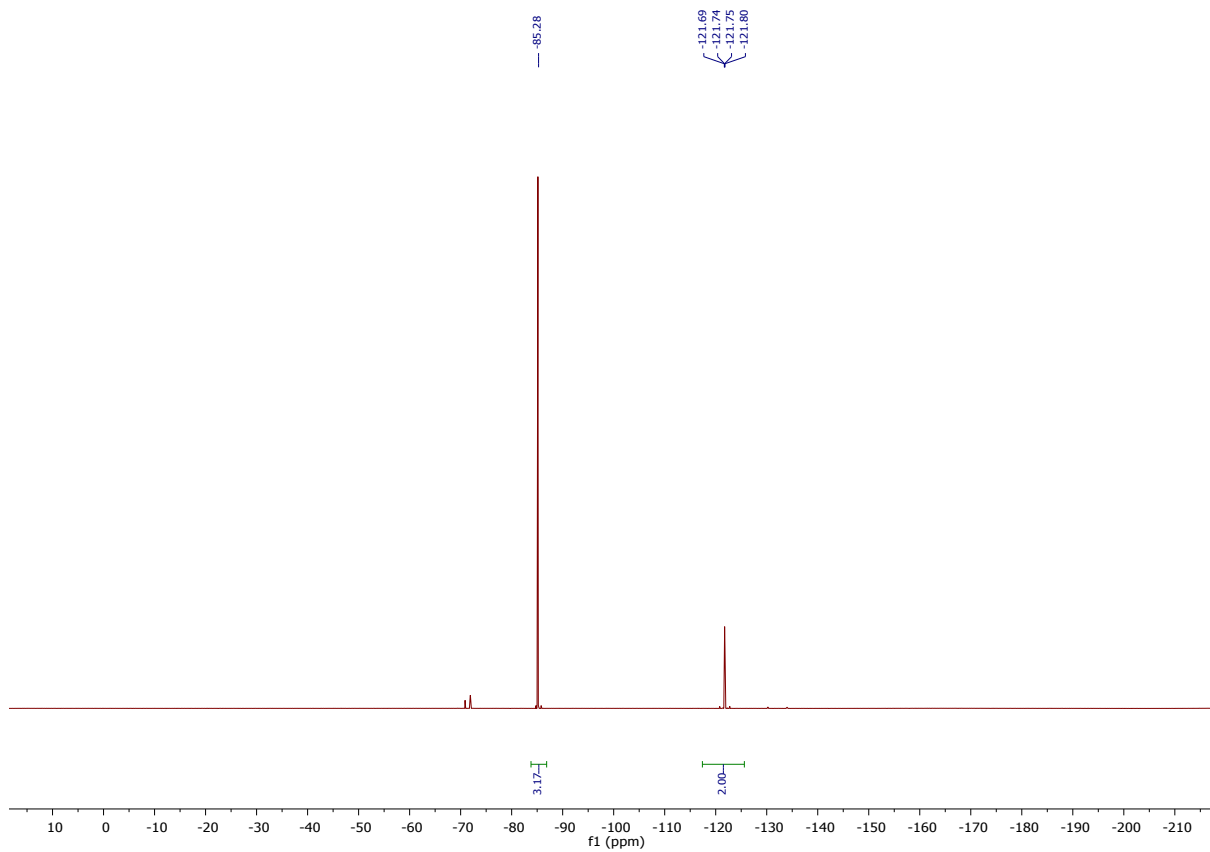


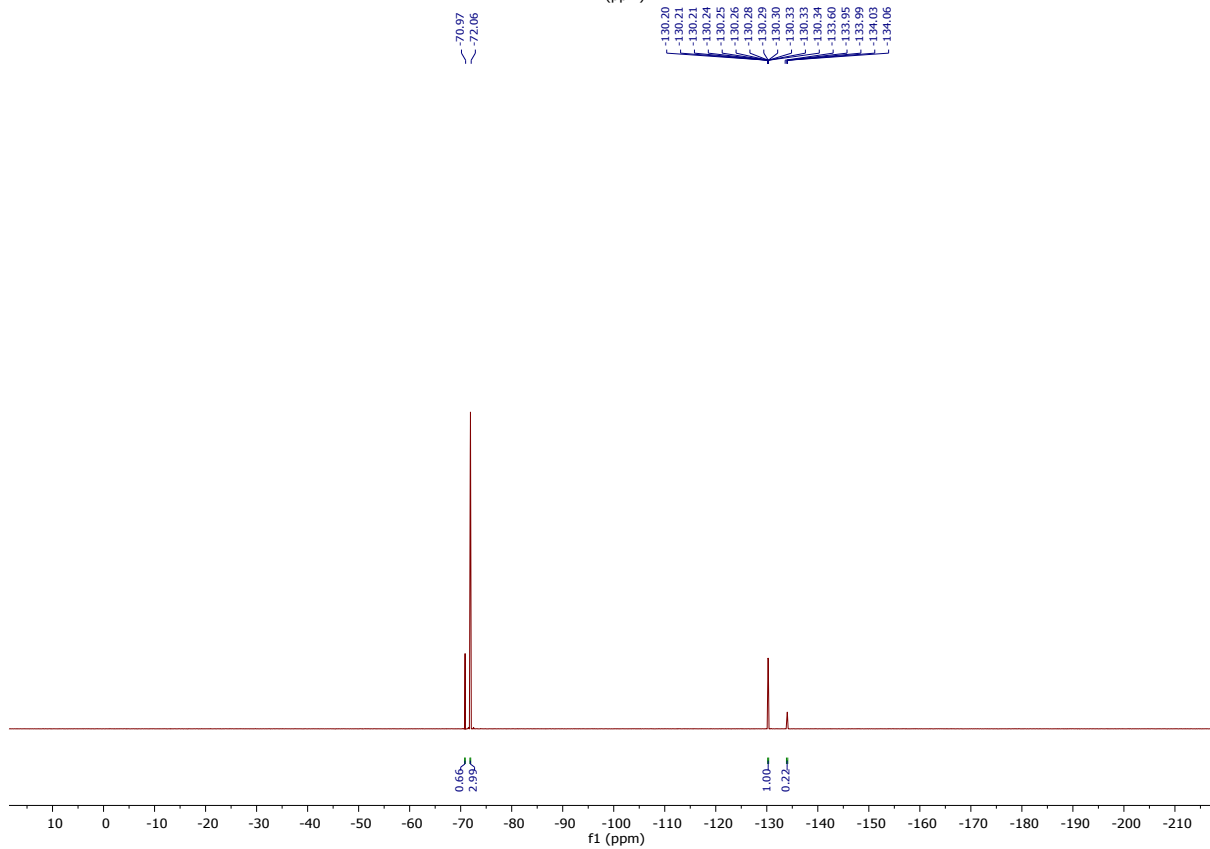
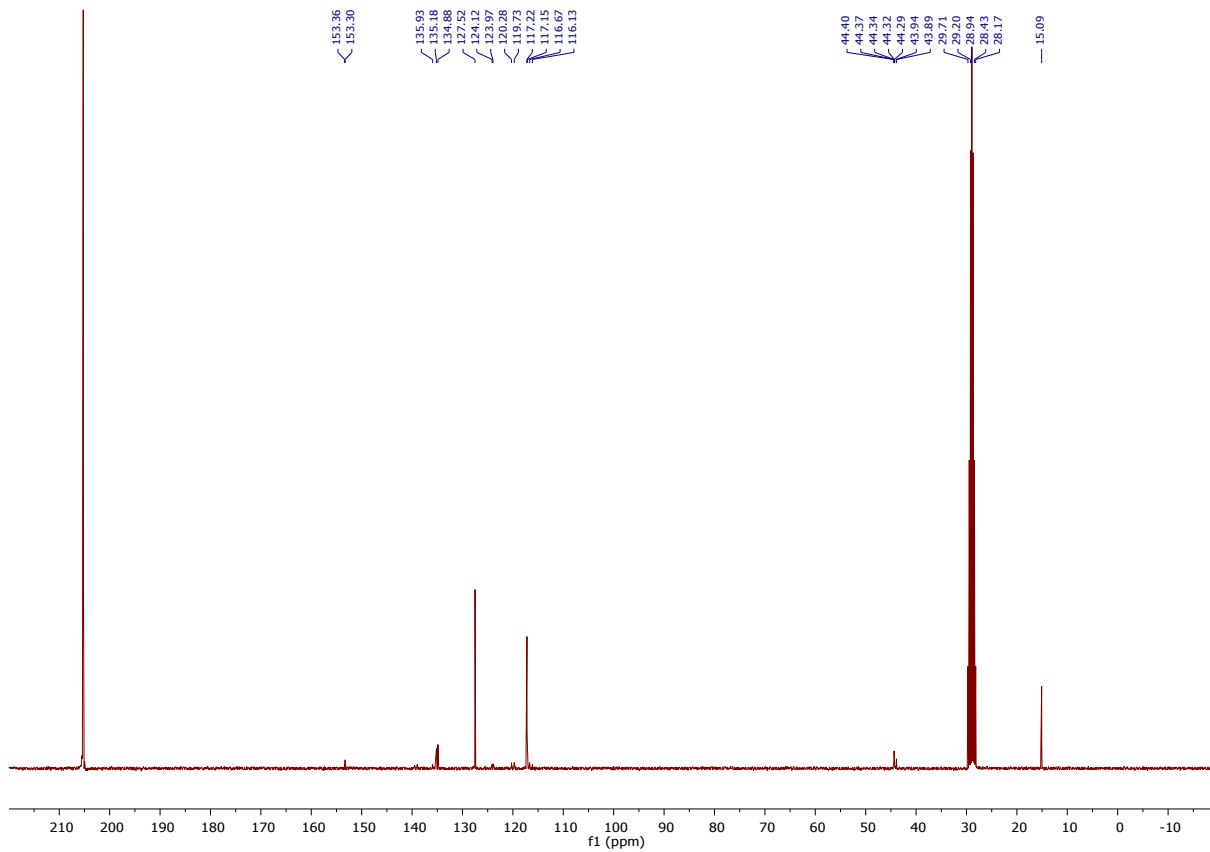


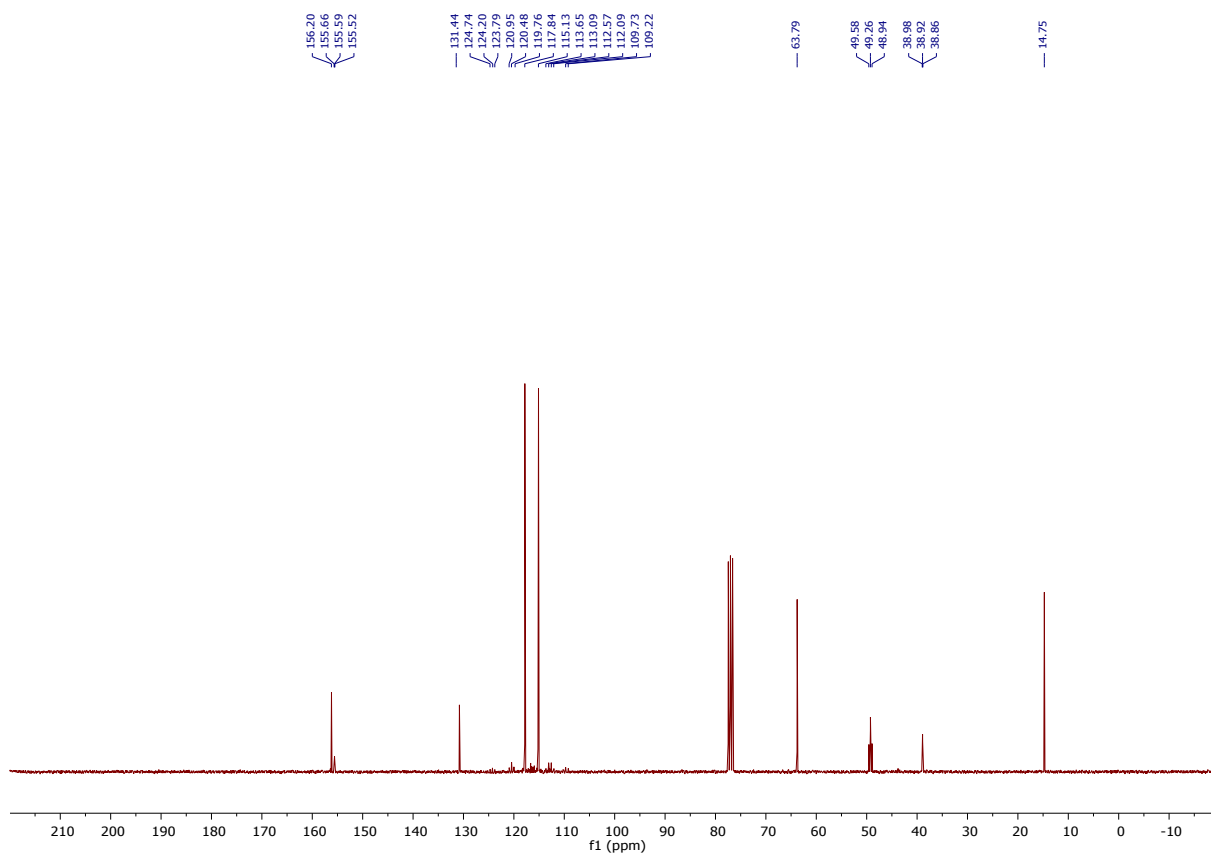
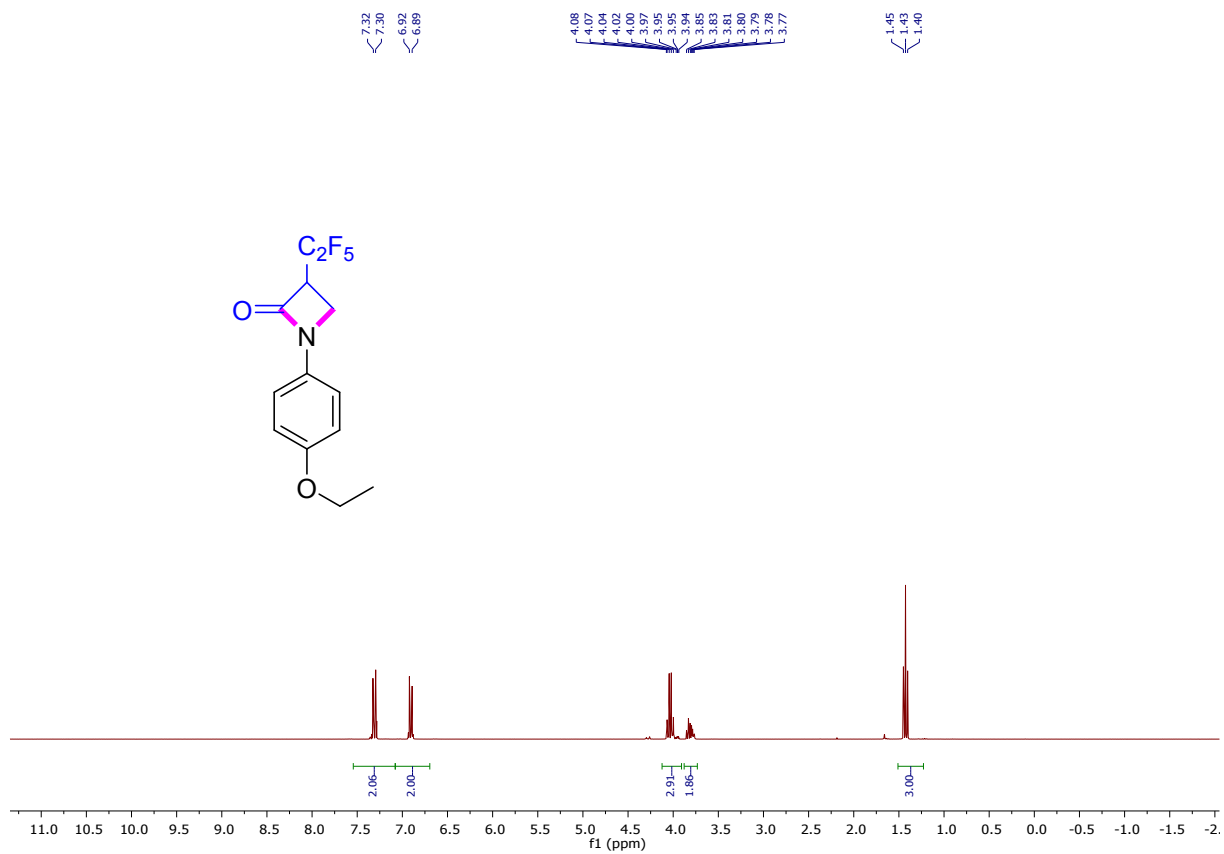
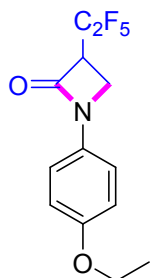


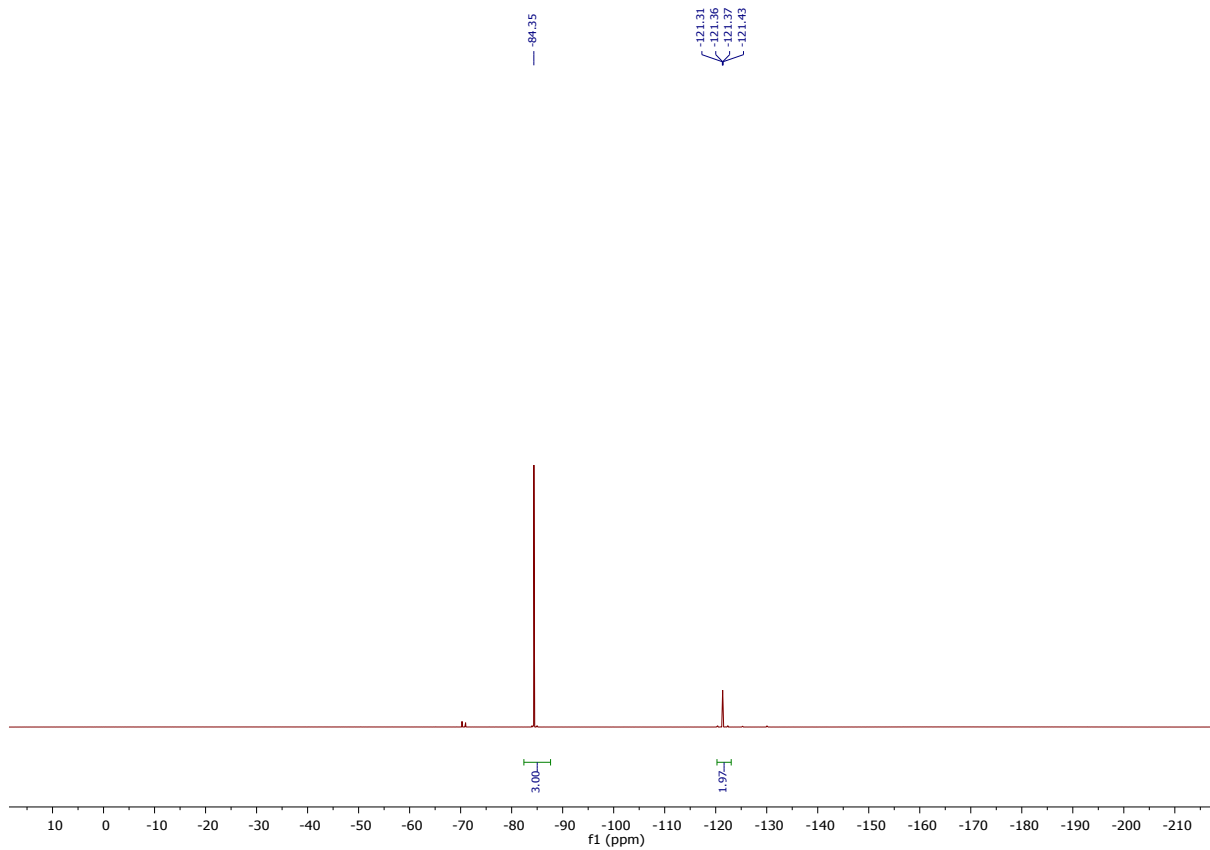






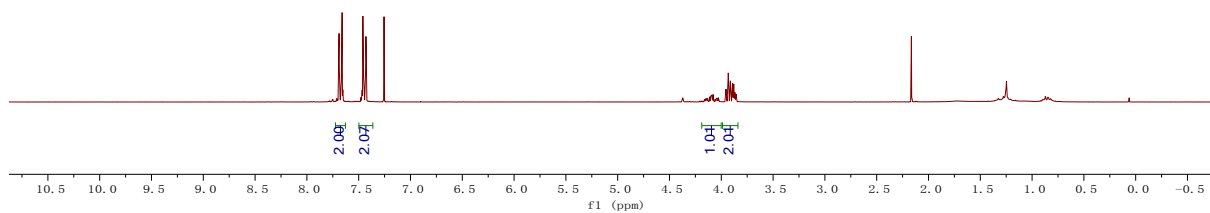
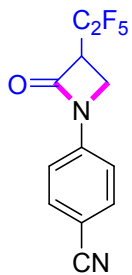


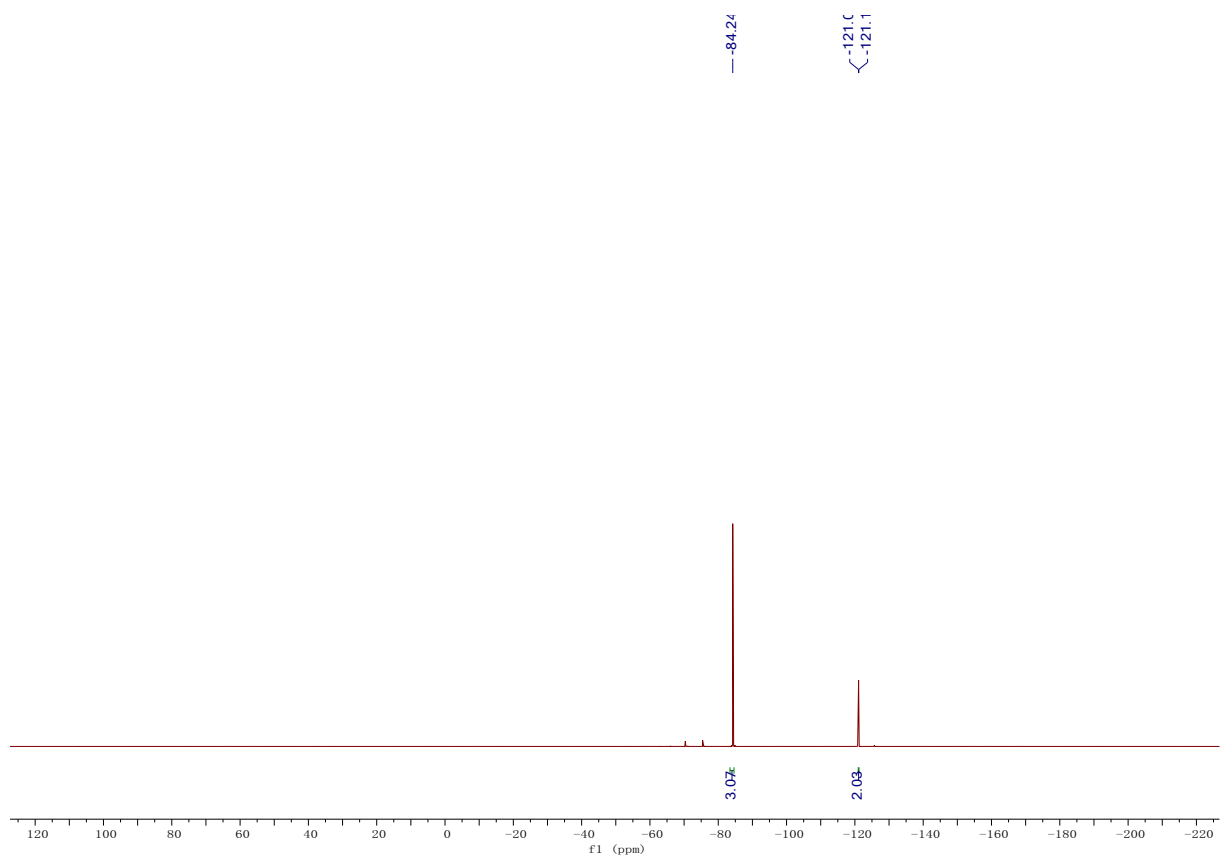
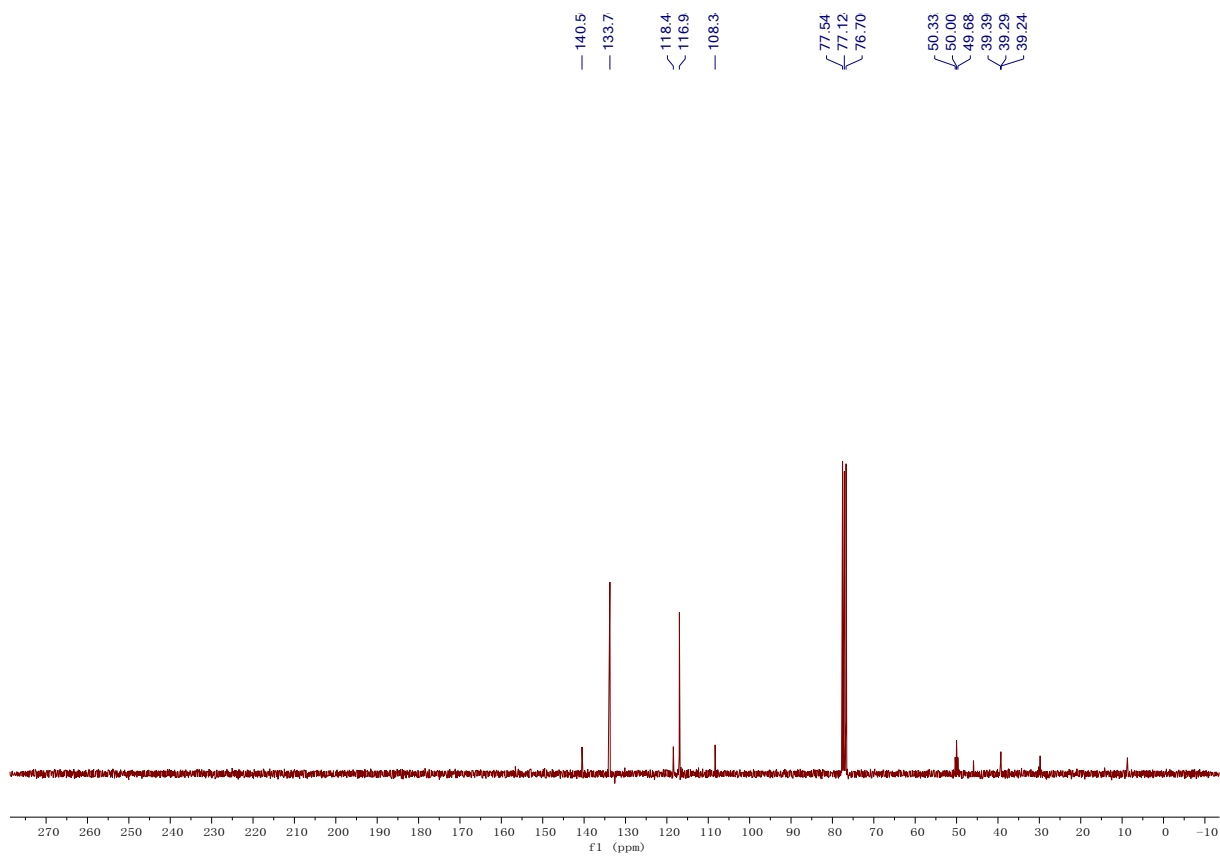


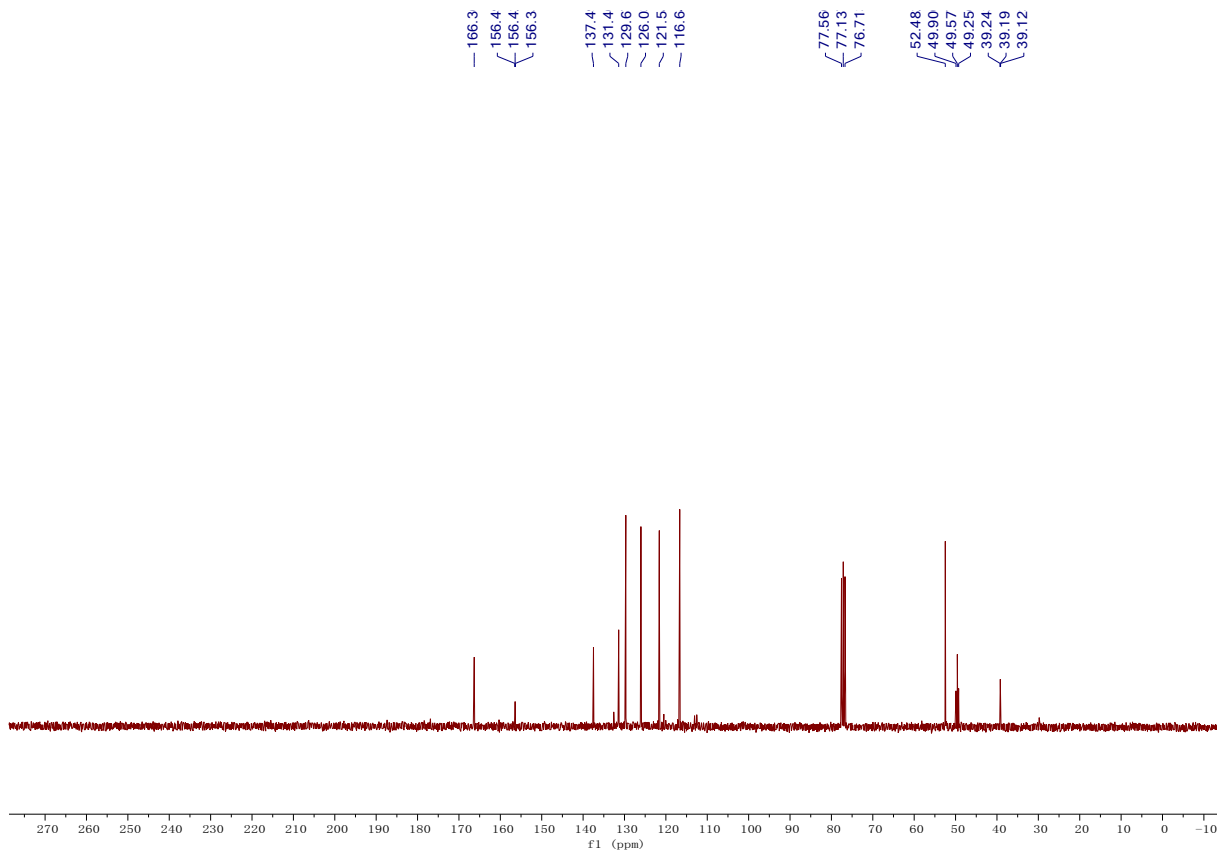
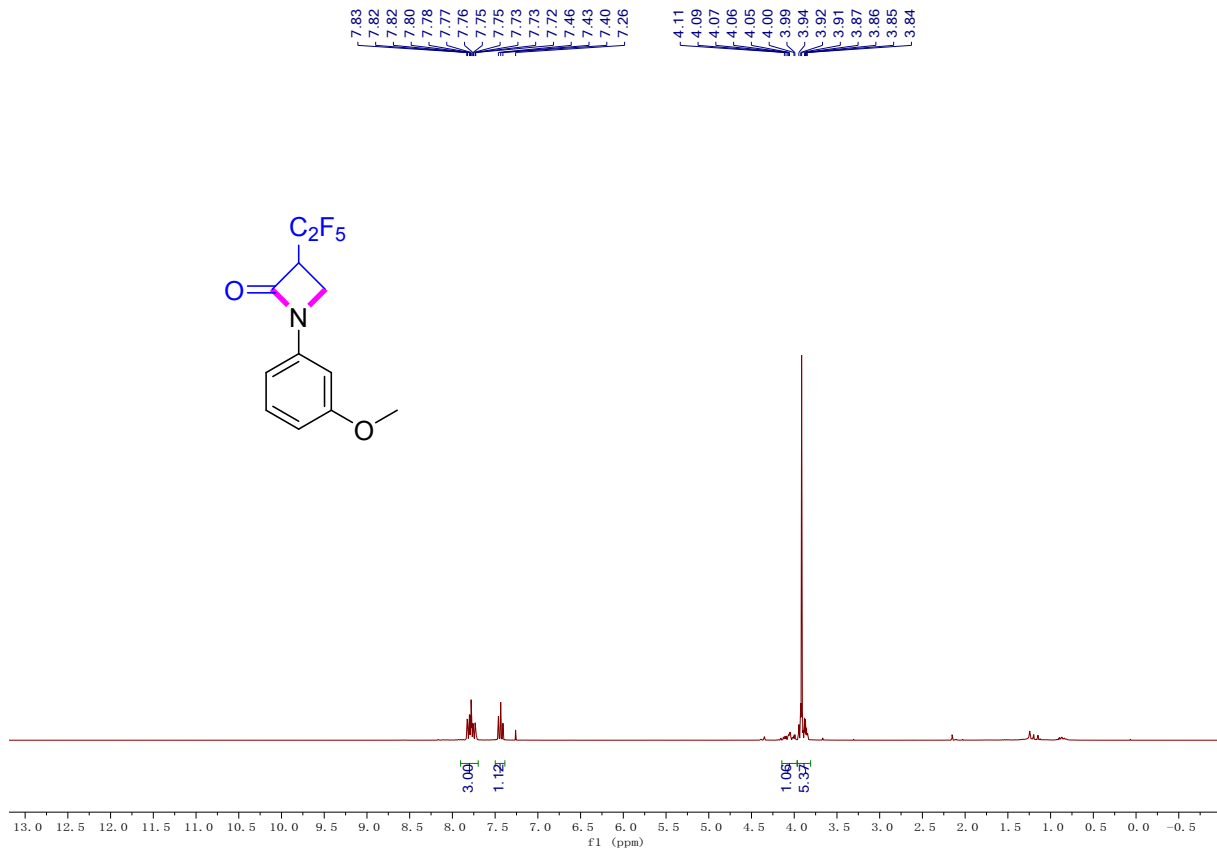


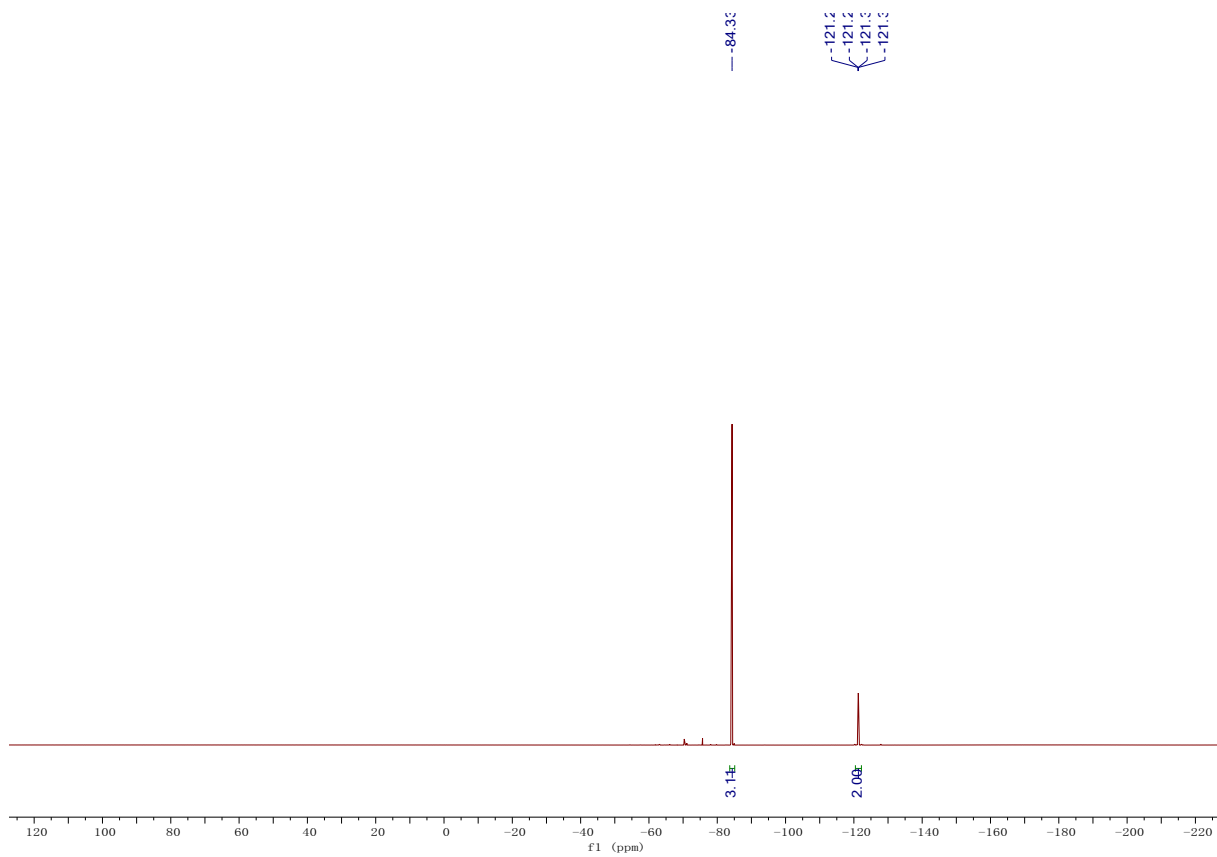
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