



Supporting Information

for

From perfluoroalkyl aryl sulfoxides to *ortho* thioethers

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Experimental procedures, characterization data of all isolated products as well as copies of NMR spectra for novel compounds

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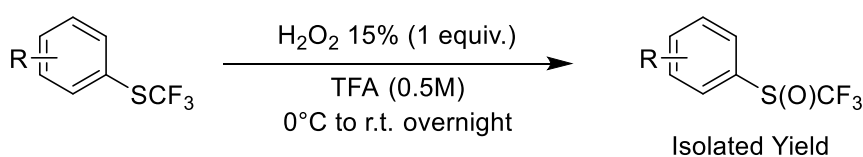
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General Information

Unless otherwise noted, all commercial reagents and solvents were purchased from commercial sources (Sigma-Aldrich, Alfa Aesar, Fluorochem, Apollo, ABCR, Carlo Erba) and used without further purification. Diisopropylethylamine (DIPEA) was distilled from KOH and stored on KOH. Dichloromethane (DCM) and acetonitrile (MeCN) were purified by distillation. Chloroform was directly drawn from Sure/Seal™ bottles. Thin-layer chromatography (TLC) analysis of reaction mixtures was performed using Merck silica gel 60 F254 TLC plates, and visualized under UV 254 nm then staining with KMnO₄. Chromatographic purification of the products was accomplished using flash chromatography on silica gel (SiO₂, 0.04–0.0063 mm) purchased from Sigma-Aldrich, and/or automated flash chromatography machine Puriflash purchased from Advion Interchim, and/or with pre-coated Merck preparative TLC plates (silica gel 60G F254, 20 × 20 cm). Nuclear magnetic resonance (NMR) spectra were recorded using Bruker 200 MHz and/or 300 MHz spectrometers. ¹H and ¹³C chemical shifts are reported in ppm downfield of tetramethylsilane and referenced to residual solvent peak (CDCl₃: δH = 7.26 and δC = 77.16). ¹⁹F{¹H} chemical shifts are reported in ppm and referenced to CFCl₃ (δF = 0.00). Multiplicities are reported using the following abbreviations: s = singlet, d = doublet, t = triplet, q = quartet, p = pentuplet, m = multiplet, b = broad. All quantitative ¹⁹F NMR spectra were decoupled with ¹H and were recorded in the presence of a known quantity of internal reference (trifluoromethoxybenzene). High-resolution mass spectrometry (HRMS) was recorded on a Mass Spectrometer XEVO-QTOF.

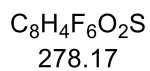
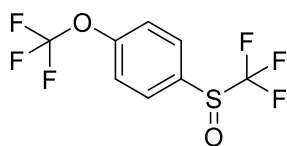
General procedure 1: Selective oxidation of trifluoromethyl aryl sulfides

We used a method previously developed by our group [1] to selectively oxidize trifluoromethyl aryl sulfides to the corresponding sulfoxides.



The sulfide (1 mmol, 1 equiv) and TFA (2 mL, 0.5 M) were added into a 5 mL round-bottomed flask equipped with a magnetic stirring bar. Then, 15 mass % aqueous solution of H₂O₂ (1 equiv) were added very slowly through an automatic injector during about 90 min at room temperature. The reaction mixture was stirred overnight at rt. The reaction mixture was poured into water, neutralized with solid NaHCO₃ to pH 6–7, then extracted with diethyl ether. The combined organic phase was dried over MgSO₄, concentrated and purified by silica gel chromatography, if necessary.

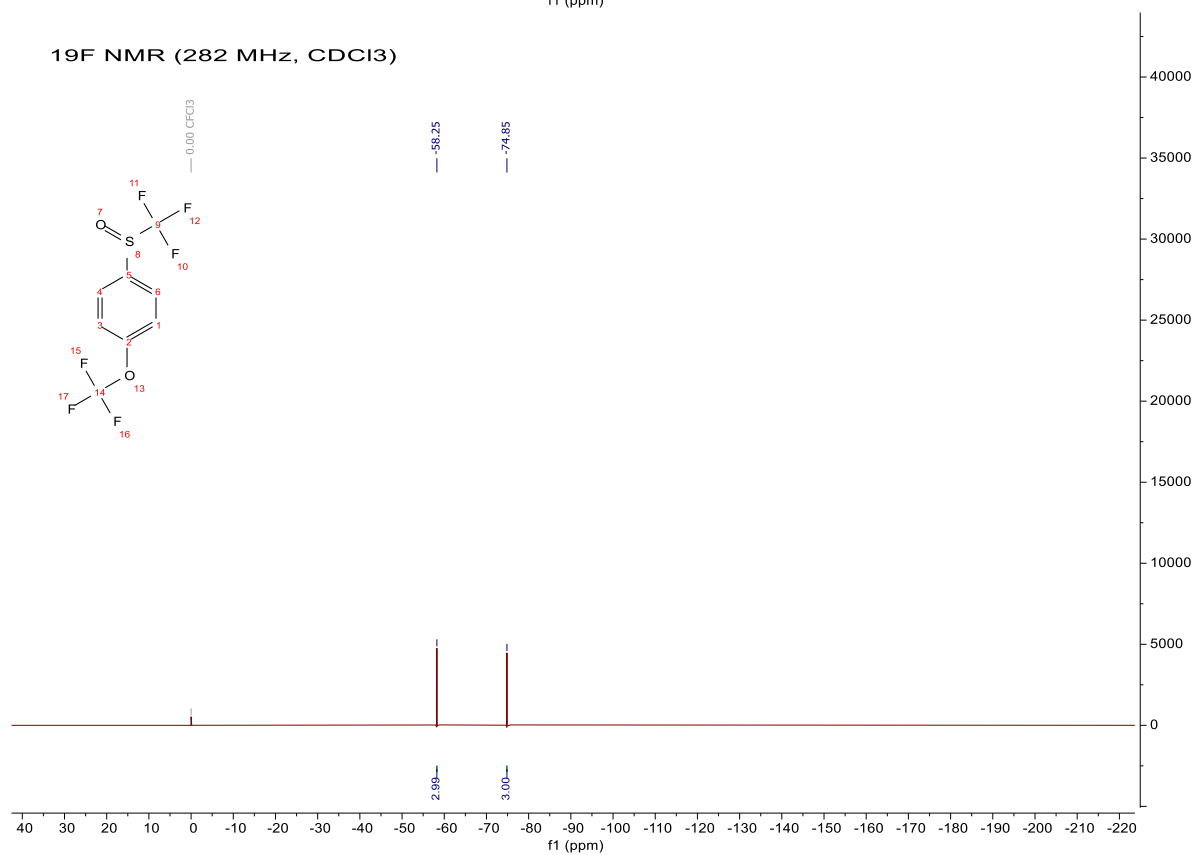
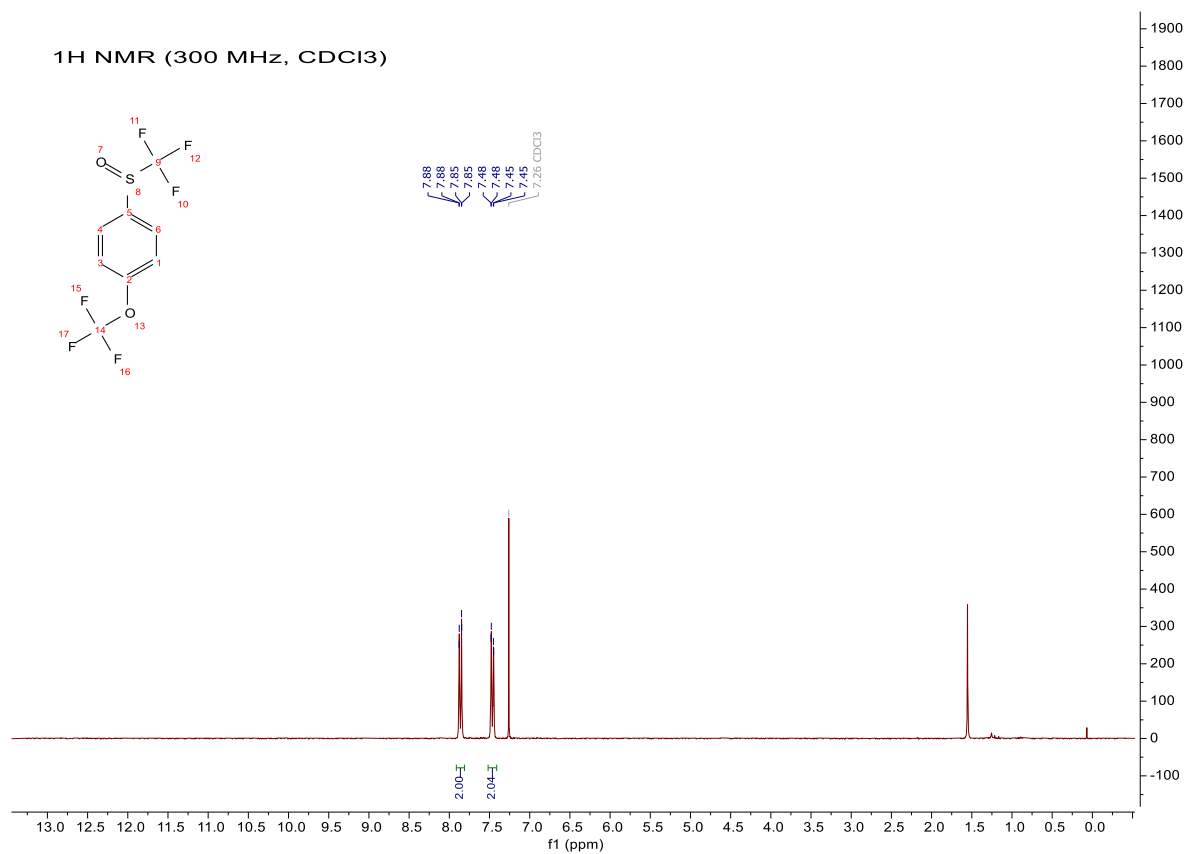
1-(Trifluoromethoxy)-4-((trifluoromethyl)sulfinyl)benzene (1b)



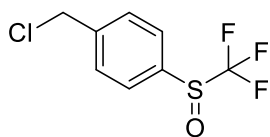
Reaction carried out following the general procedure 1 using (4-(trifluoromethoxy)phenyl)(trifluoromethyl)sulfane (524 mg, 2 mmol). Purified by flash chromatography (petroleum ether 100%), affording the product as a slightly yellow oil (261 mg, 0.94 mmol). Yield = 47%. The NMR data matched with the literature.[2]

* ^1H NMR (300 MHz, CDCl_3) δ (ppm): 7.86 (dd, $J = 9, 1$ Hz, 2H), 7.46 (dd, $J = 9, 1$ Hz, 2H).

* ^{19}F NMR (282 MHz, CDCl_3) δ (ppm): -58.25 (s, 3F), -74.85 (s, 3F).



1-(Chloromethyl)-4-((trifluoromethyl)sulfinyl)benzene (1c)



$C_8H_6ClF_3OS$
242.64

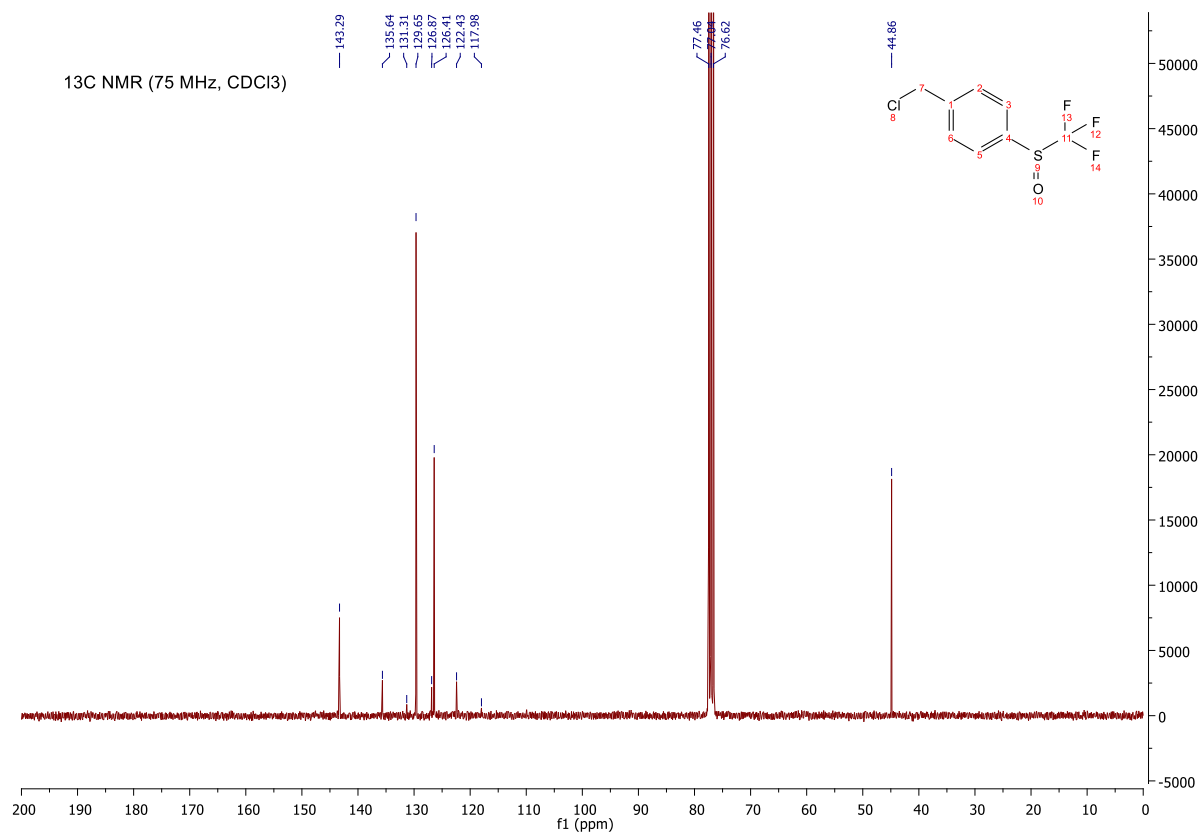
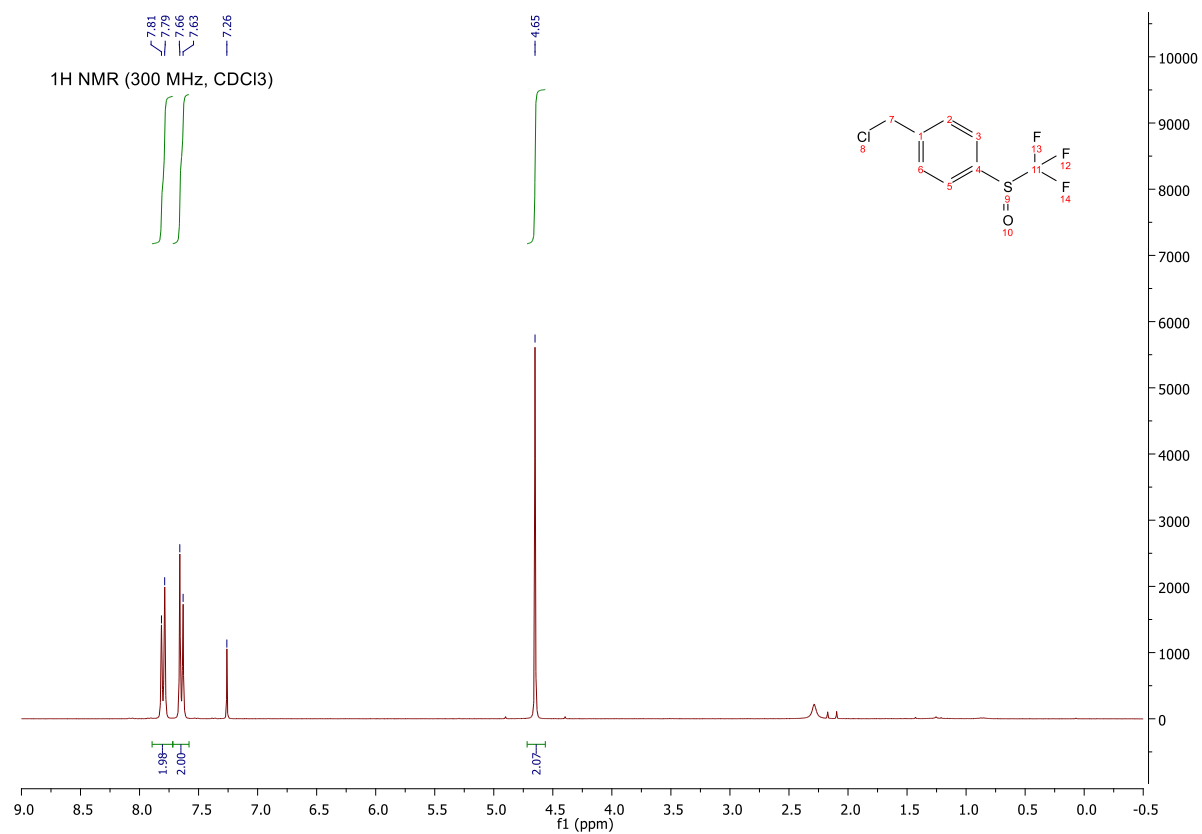
Reaction carried out following the general procedure 1 using (4-(chloromethyl)phenyl)(trifluoromethyl)sulfane (453 mg, 2 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 90:10), affording the product as an orange oil (306 mg, 1.26 mmol). Yield = 63%.

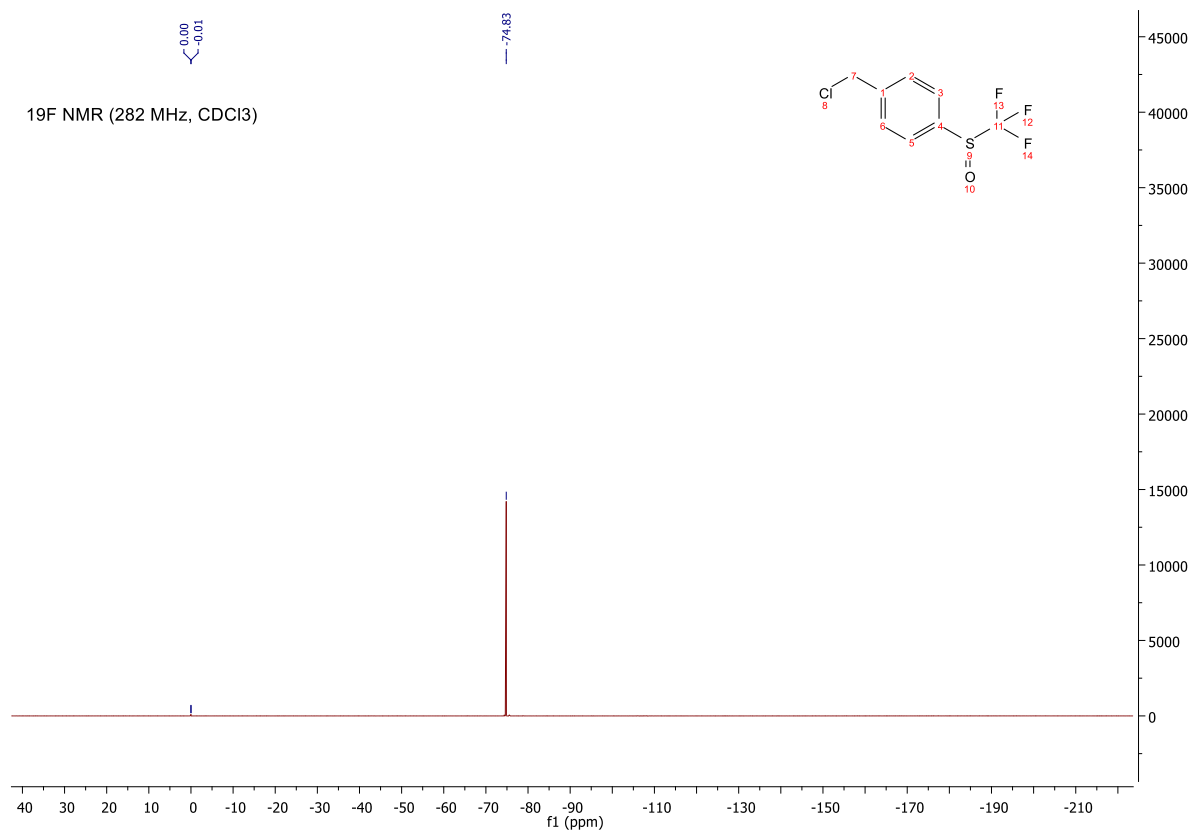
* 1H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.8 (d, $^3J = 8$ Hz, 2H); 7.64 (d, $^3J = 8$ Hz, 2H); 4.66 (s, 2H)

* ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 143.3; 135.6; 129.7; 126.4, 124.7 (q, $J = 336$ Hz), 44.9

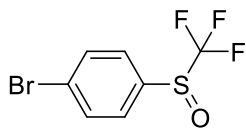
* ^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm): -74.83

* HRMS ASAP+TOF: Calculated for $C_{16}H_{13}Cl_2F_6O_2S_2[2M+H]^+$: 484.9638; Found $[2M+H]^+$: 484.9260





4-Bromo-1-((trifluoromethyl)sulfinyl)benzene (1d)

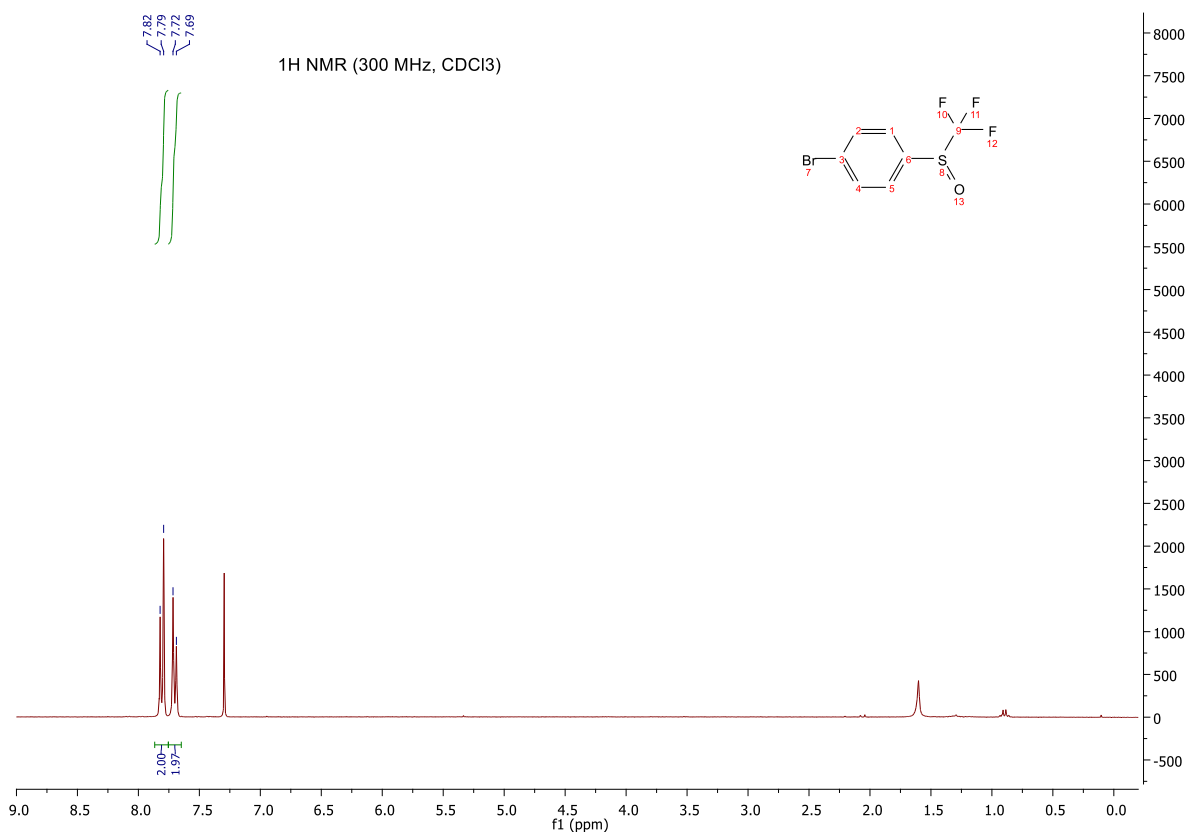


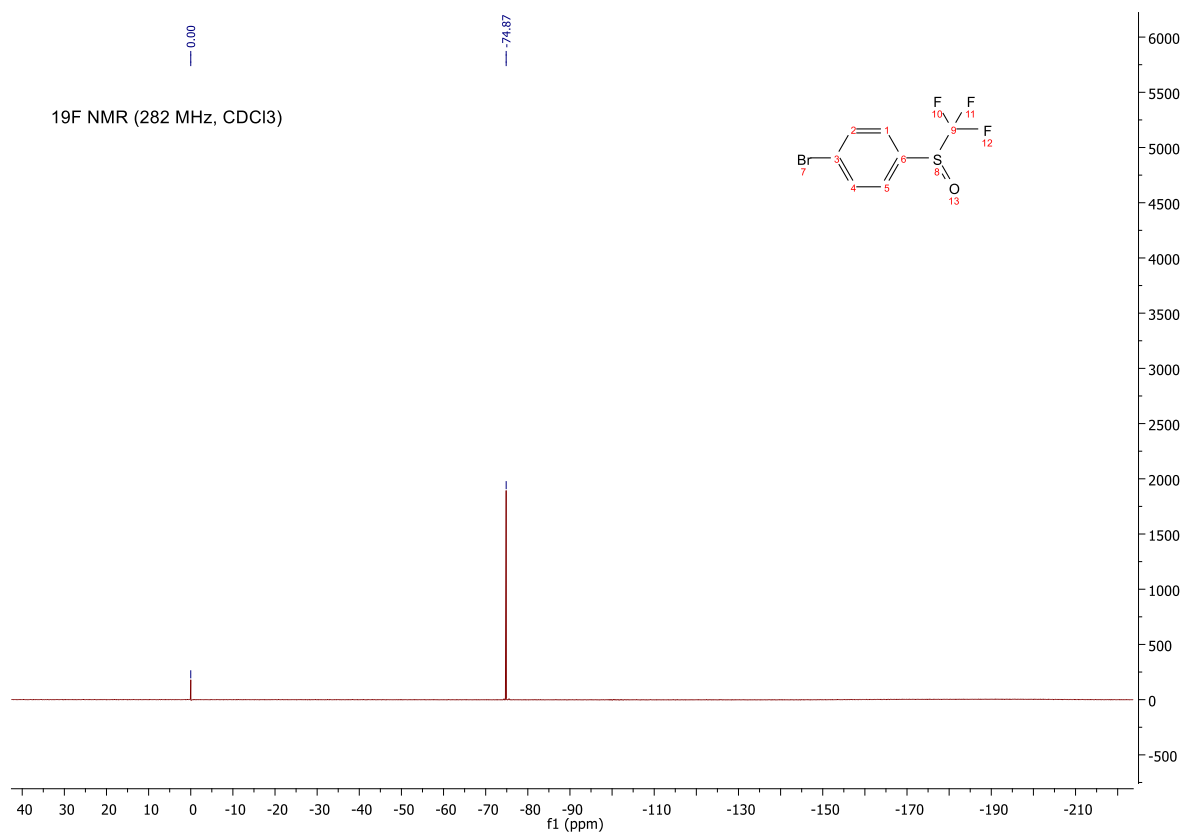
C₇H₄BrF₃OS
271,9118

Reaction carried out following the general procedure 1 using (4-bromophenyl)(trifluoromethyl)sulfane (511 mg, 2 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 90:10), affording the product as an orange oil (482 mg, 1.78 mmol). Yield = 89%. The NMR data matched with the literature.[1]

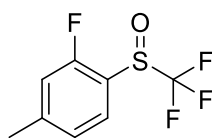
* **¹H NMR (200 MHz CDCl₃)** : d 7.81 (d, ³J = 7,5 Hz, 2H); 7.65 (d, ³J = 7,5 Hz, 2H); 4.66 (s, 2H)

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** -74.81





2-Fluoro-4-methyl-1-((trifluoromethyl)sulfinyl)benzene (1e)



C₈H₆F₄OS
226.19

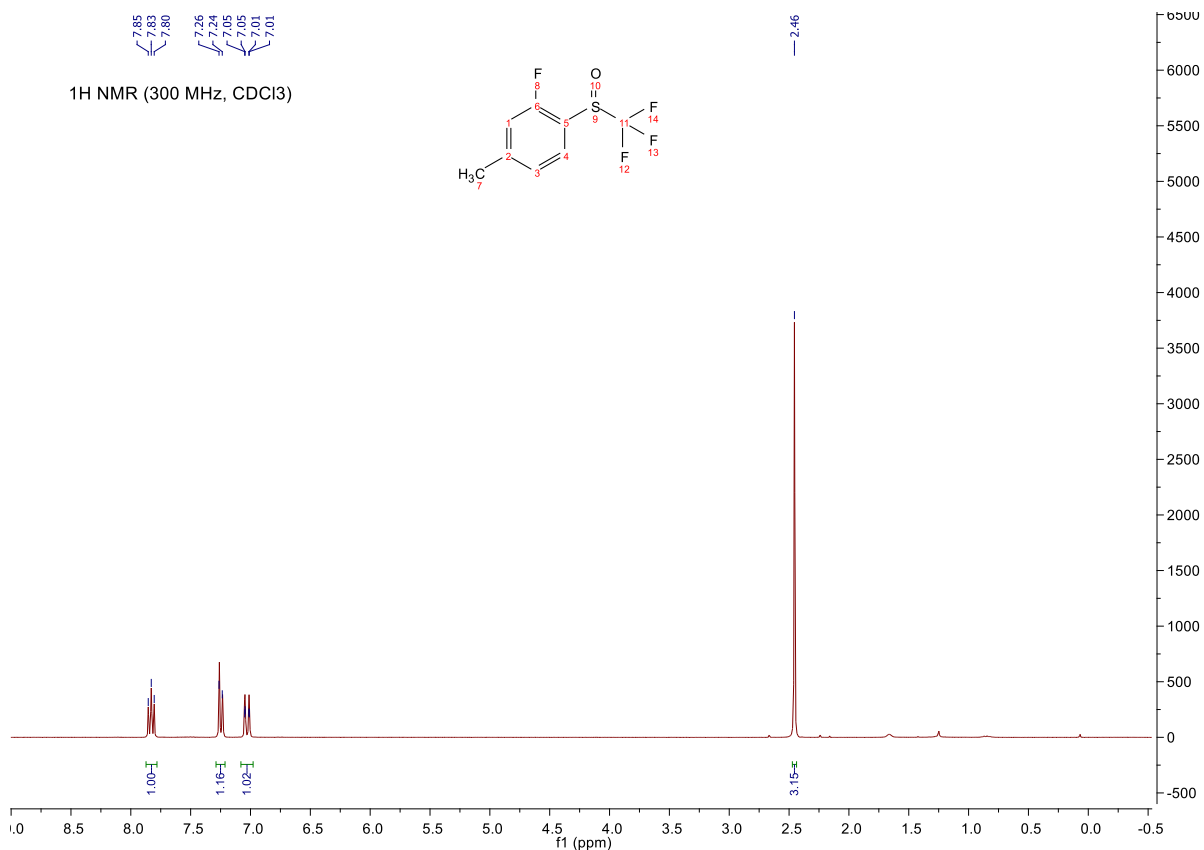
Reaction carried out following the general procedure 1 using (2-fluoro-4-methylphenyl)(trifluoromethyl)sulfane (385 mg, 1.83 mmol). Purified by flash chromatography (Petroleum ether/diethyl ether 80:20), affording the product as an orange oil (149 mg, 0.66 mmol). Yield = 36%.

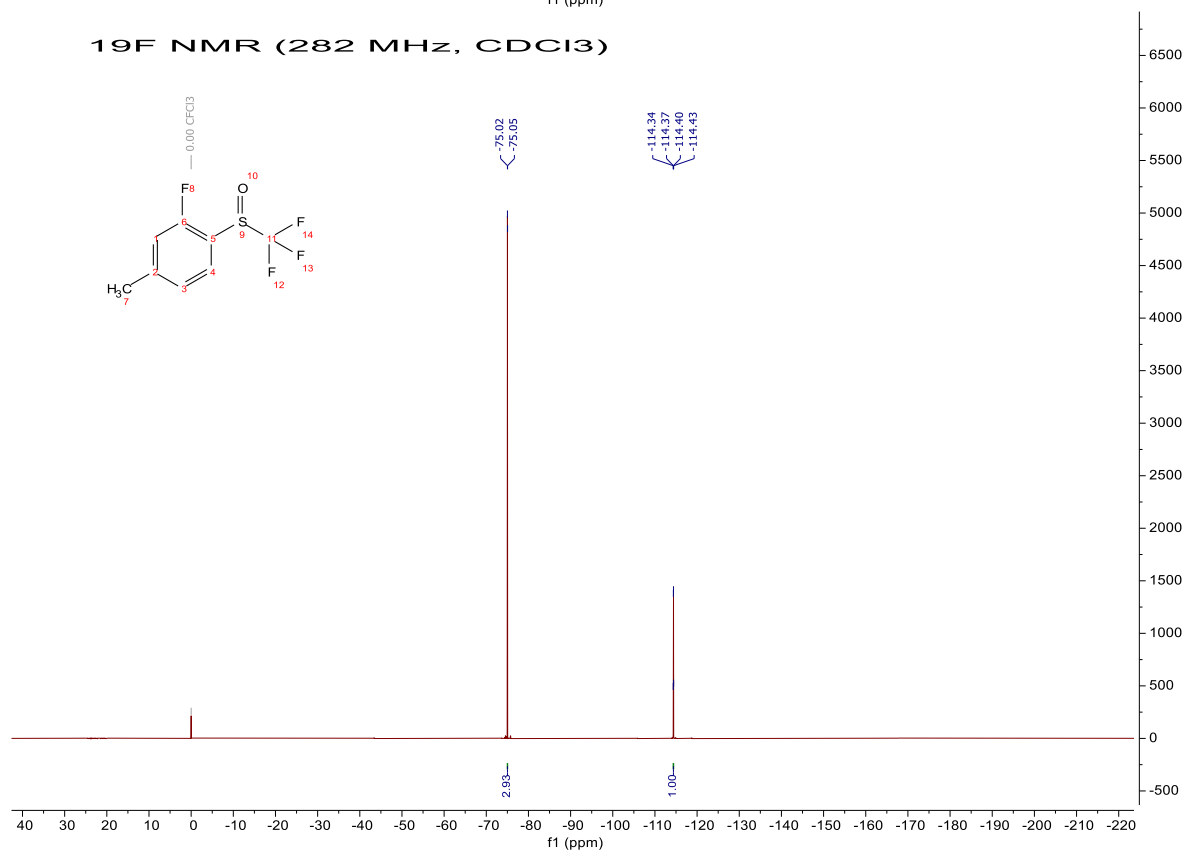
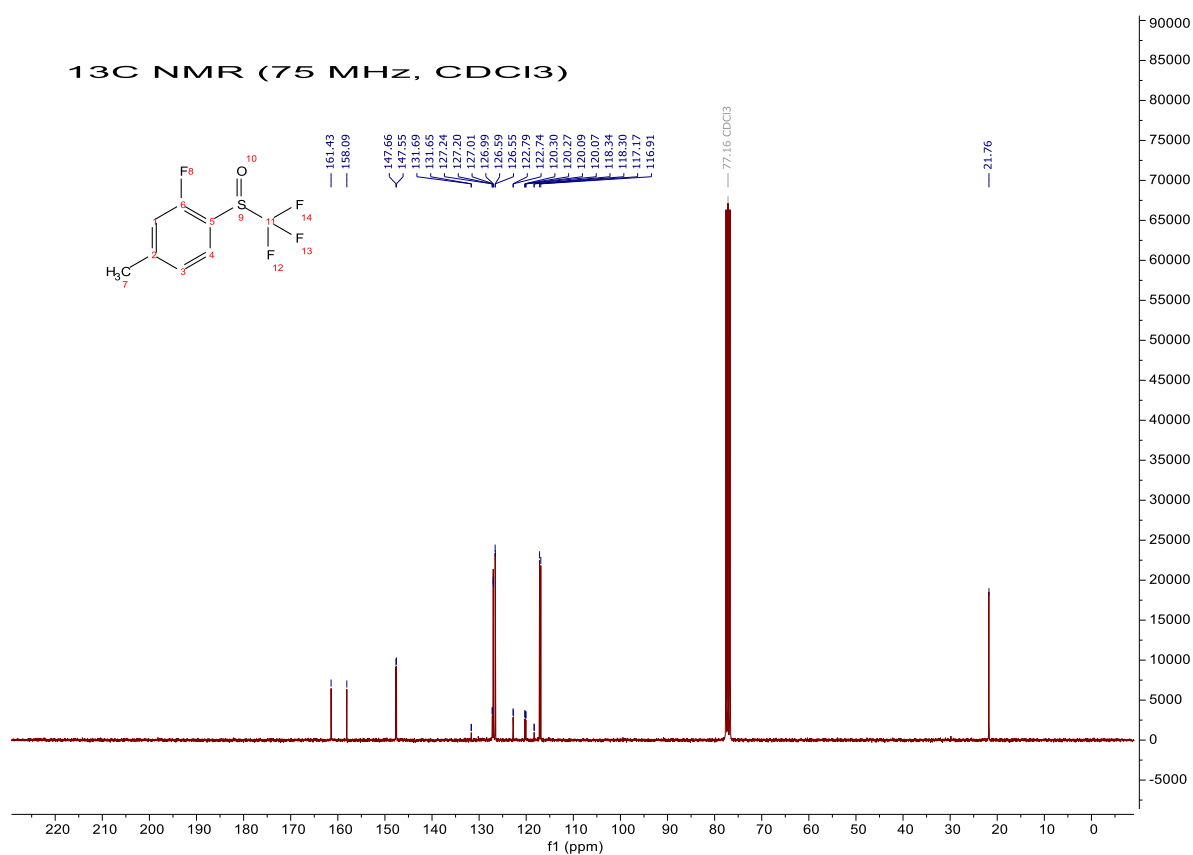
* **HRMS ASAP+TOF:** Calculated for C₈H₆F₄OS₂[2M+H]⁺: 453.0229; Found [2M+H]⁺: 453.0235

* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.83 (t, *J* = 7 Hz, 1H), 7.25 (d, *J* = 8 Hz, 1H), 7.03 (d, *J* = 12 Hz, 1H), 2.46 (s, 3H).

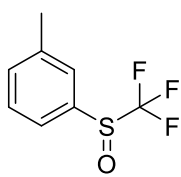
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm):** 159.8 (d, *J* = 252 Hz), 147.6 (d, *J* = 8 Hz), 127.0 (d, *J* = 2 Hz), 126.6 (d, *J* = 3 Hz), 125.0 (qd, *J* = 336, 3 Hz), 120.2 (qd, *J* = 16, 2 Hz), 117.0 (d, *J* = 20 Hz), 21.8

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** -75.03 (d, *J* = 9 Hz), -114.39 (q, *J* = 9 Hz).





3-Methyl-1-((trifluoromethyl)sulfinyl)benzene (1f)

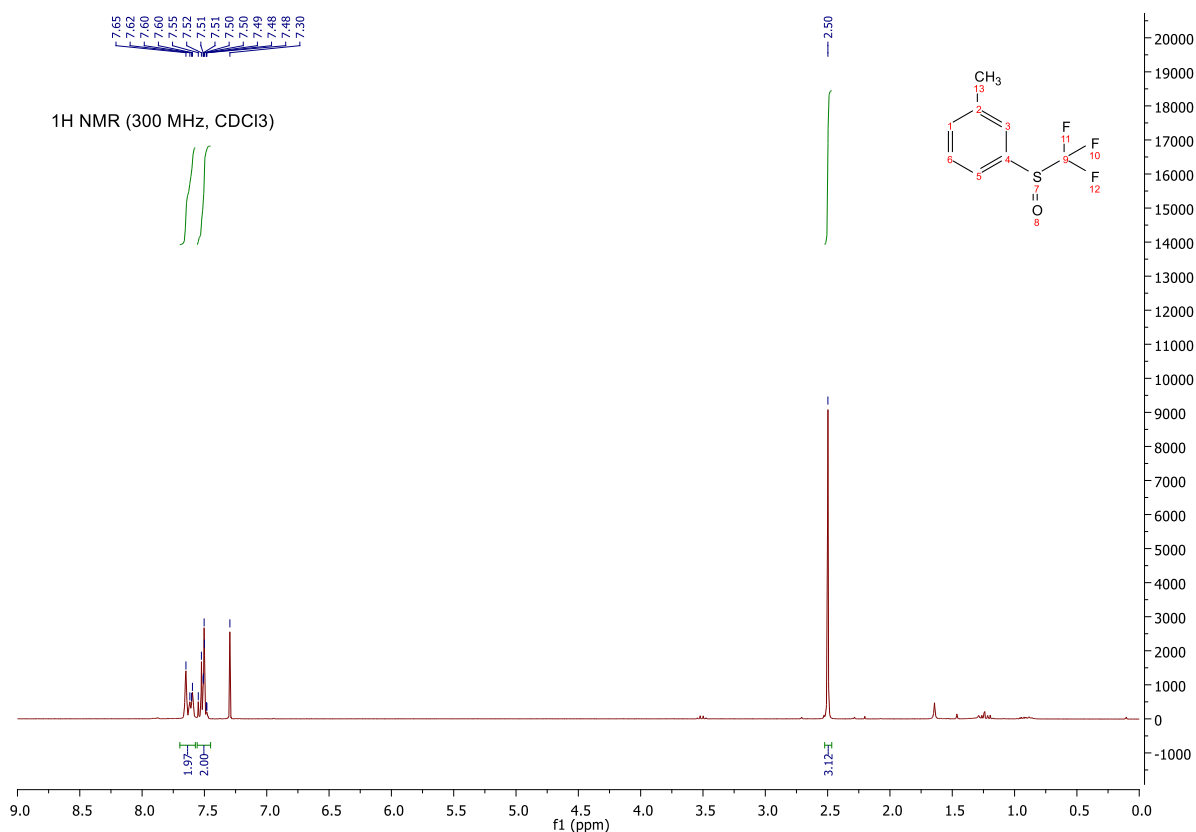


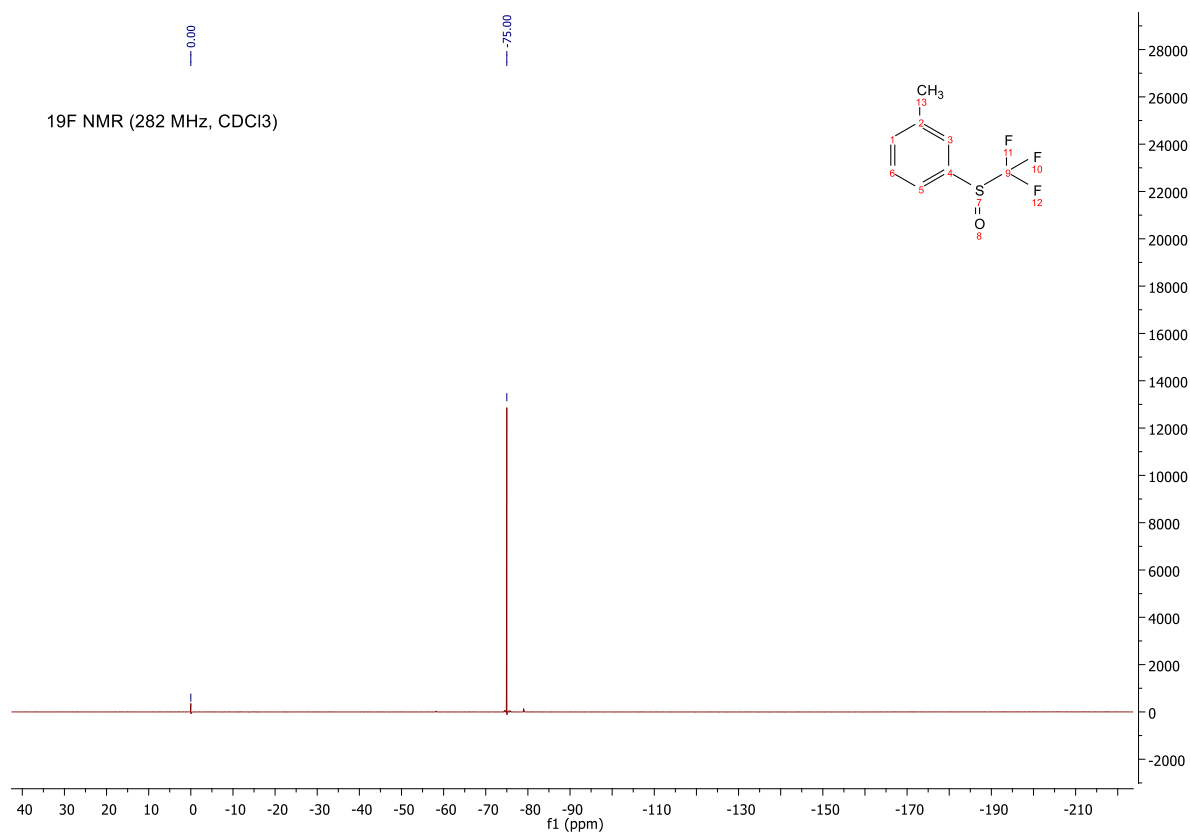
C₈H₇F₃OS
208,017

Reaction carried out following the general procedure 1 using (3-methylphenyl)(trifluoromethyl)sulfane (210 mg, 1.15 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 80:20), affording the product as an orange oil (58 mg, 0.28 mmol). Yield = 25%. The NMR data matched with the literature.[7]

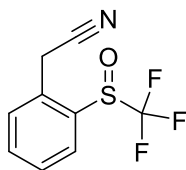
* ¹H NMR (300 MHz, CDCl₃) δ (ppm): 7.66 – 7.60 (m, 2H), 7.55 – 7.47 (m, 2H), 7.69 – 7.62 (m, 1H), 4.06 (d, *J* = 1 Hz, 2H).

* ¹⁹F NMR (282 MHz, CDCl₃) δ (ppm): -75.00 (s, 3F)





2-(2-((Trifluoromethyl)sulfinyl)phenyl)acetonitrile (1g)



$C_9H_6F_3NOS$
233.21

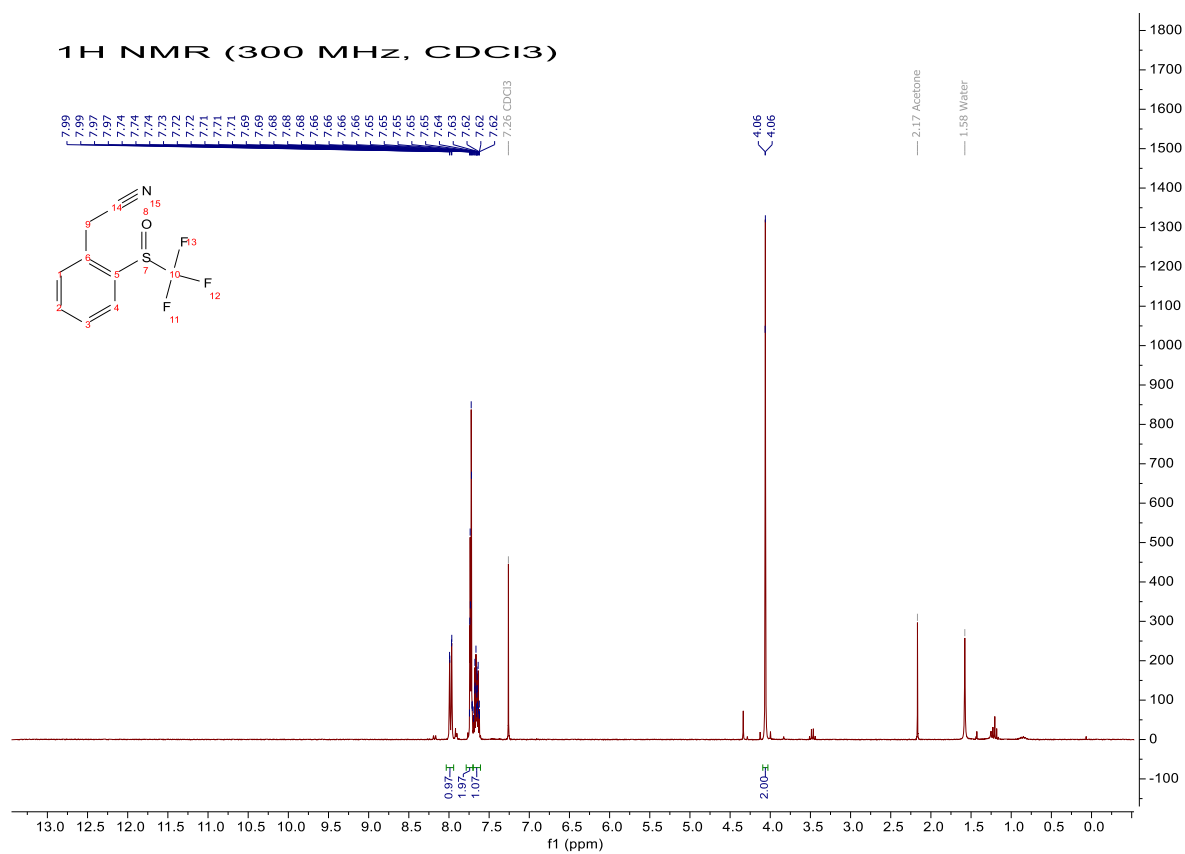
Reaction carried out following the general procedure 1 using (2-fluoro-4-methylphenyl)(trifluoromethyl)sulfane (457 mg, 2.10 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 33:67), affording the product as an orange oil (343 mg, 1.47 mmol). Yield = 70%. Purity = 96%. The impurity was the corresponding sulfone.

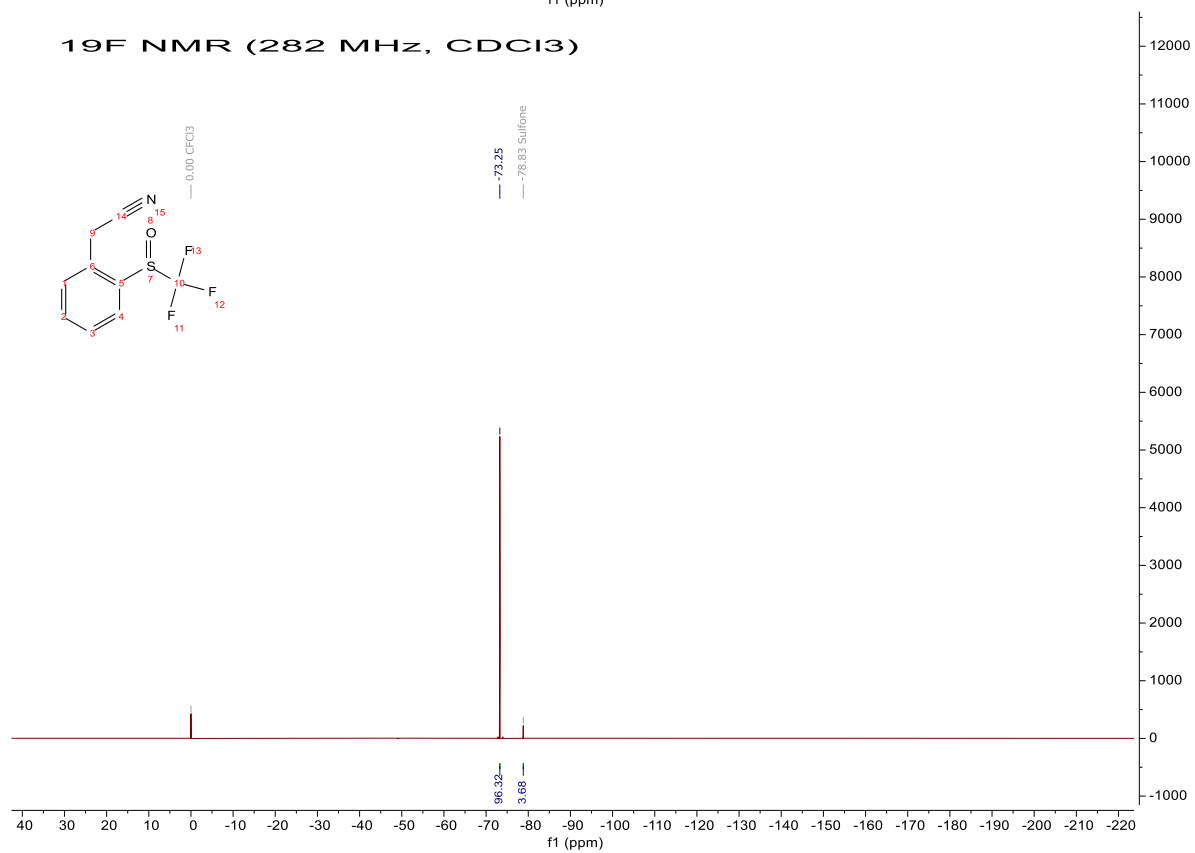
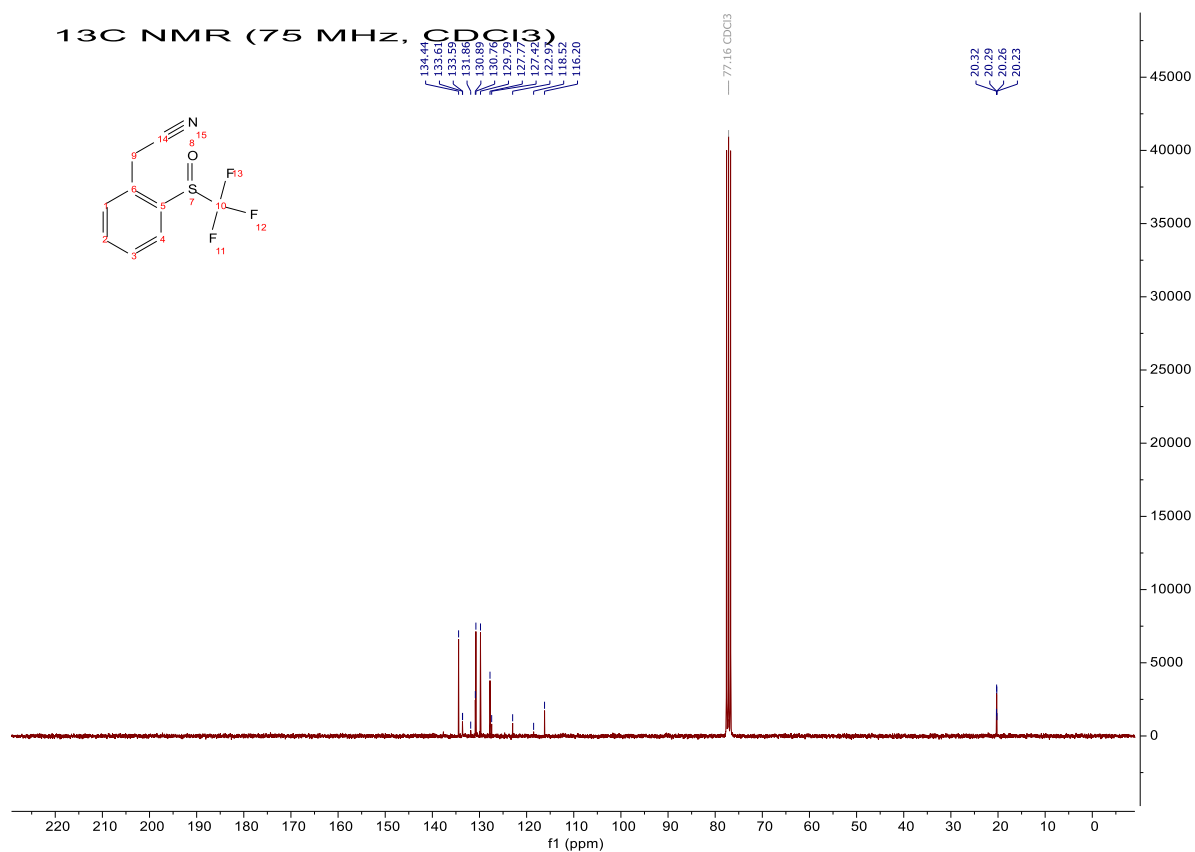
* **HRMS ASAP+TOF:** Calculated for $C_9H_6F_3NOS[M+H]^+$: 234.0200; Found $[M+H]^+$: 234.0190

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 8.02 – 7.94 (m, 1H), 7.75 – 7.71 (m, 2H), 7.69 – 7.62 (m, 1H), 4.06 (d, J = 1 Hz, 2H).

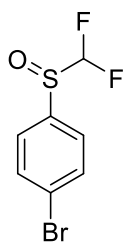
* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 134.4, 133.6 (q, J = 2 Hz), 130.9, 130.8, 129.8, 127.8, 125.2 (q, J = 336 Hz), 116.2, 20.3 (q, J = 2 Hz).

* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm):** -73.25 (s, 3F)





1-Bromo-4-((difluoromethyl)sulfinyl)benzene (1h)



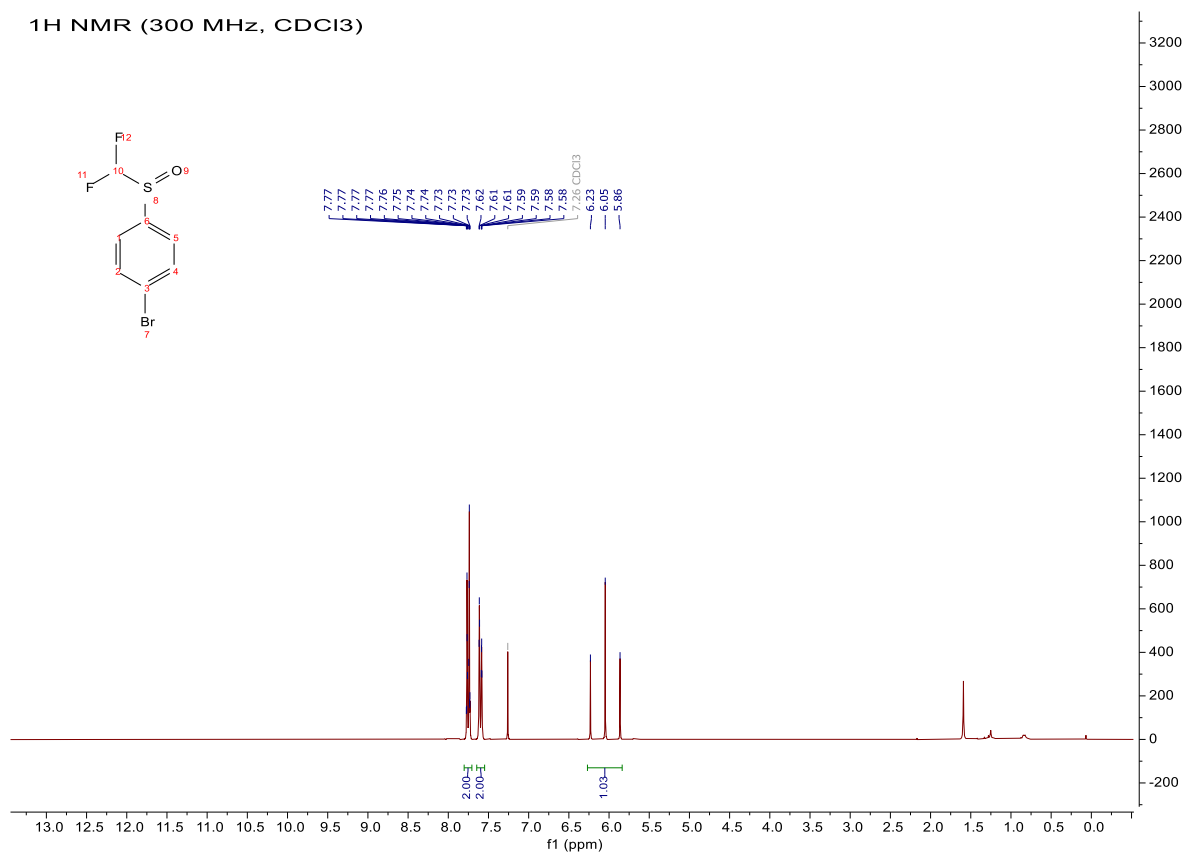
C₇H₅BrF₂OS
255.08

Reaction carried out following the general procedure 1 using (4-bromophenyl)(difluoromethyl)sulfane (478 mg, 2 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 92:8), affording the product as a slightly yellow oil (281 mg, 1.1 mmol). Yield = 55%. The NMR data matched with the literature.[4]

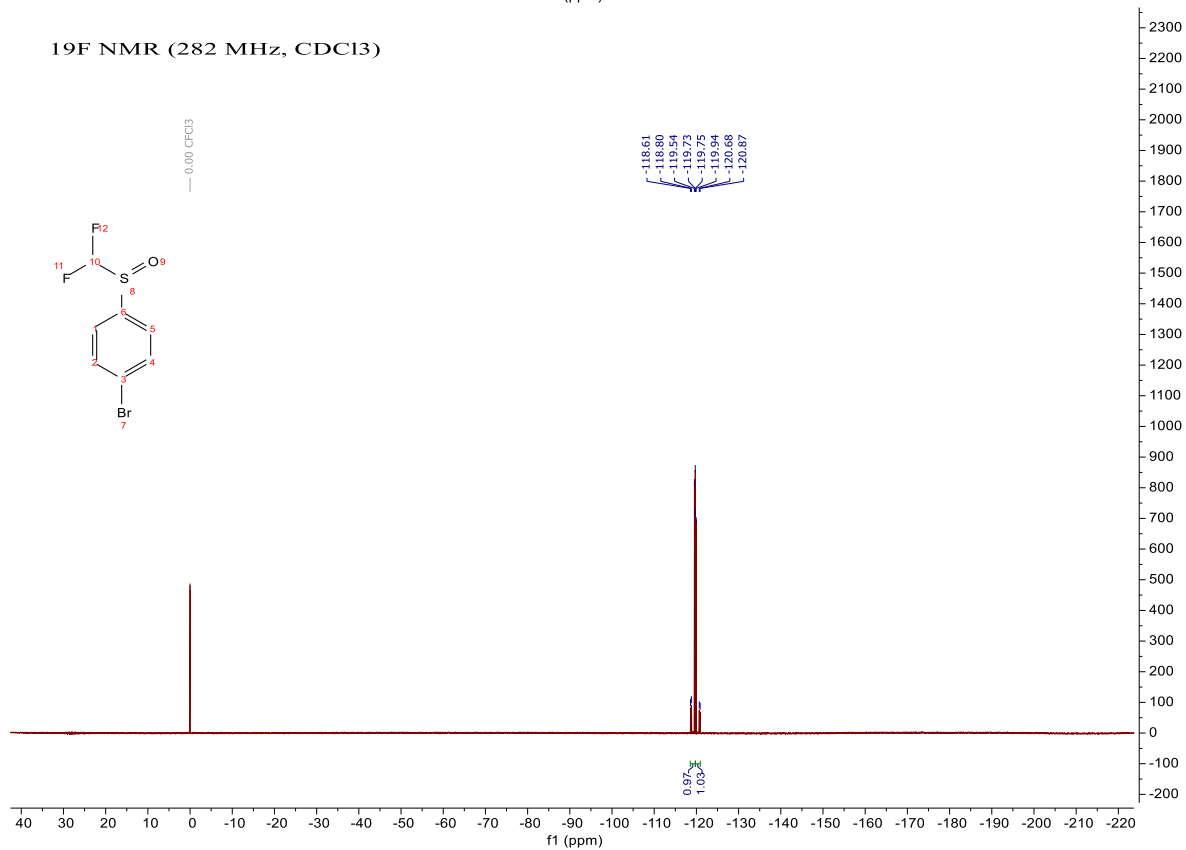
* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.78 – 7.72 (m, 2H), 7.63 – 7.56 (m, 2H), 6.05 (t, *J* = 55 Hz, 1H).

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** -119.17 (dd, *J* = 262, 55 Hz, 1F), -120.31 (dd, *J* = 262, 55 Hz, 1F).

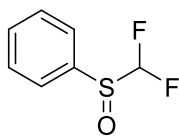
¹H NMR (300 MHz, CDCl₃)



¹⁹F NMR (282 MHz, CDCl₃)



((Difluoromethyl)sulfinyl)benzene (1i)

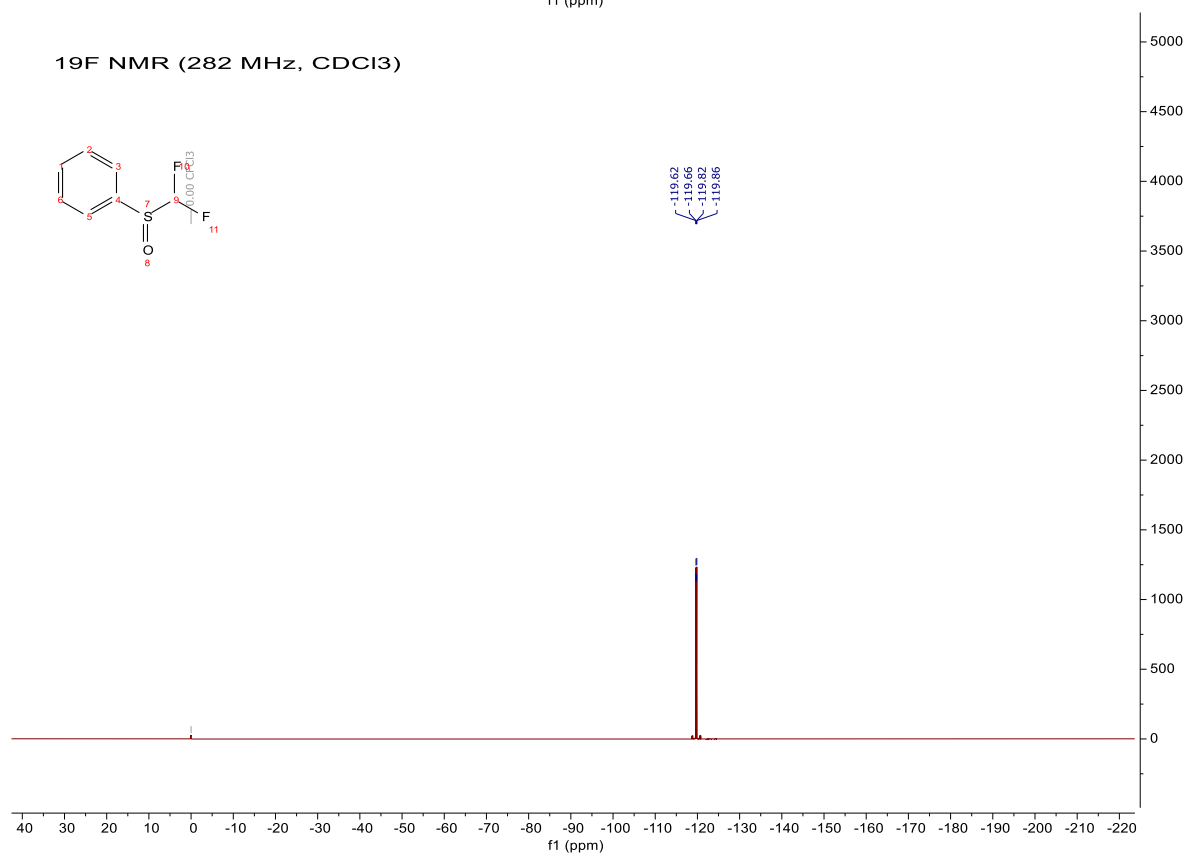
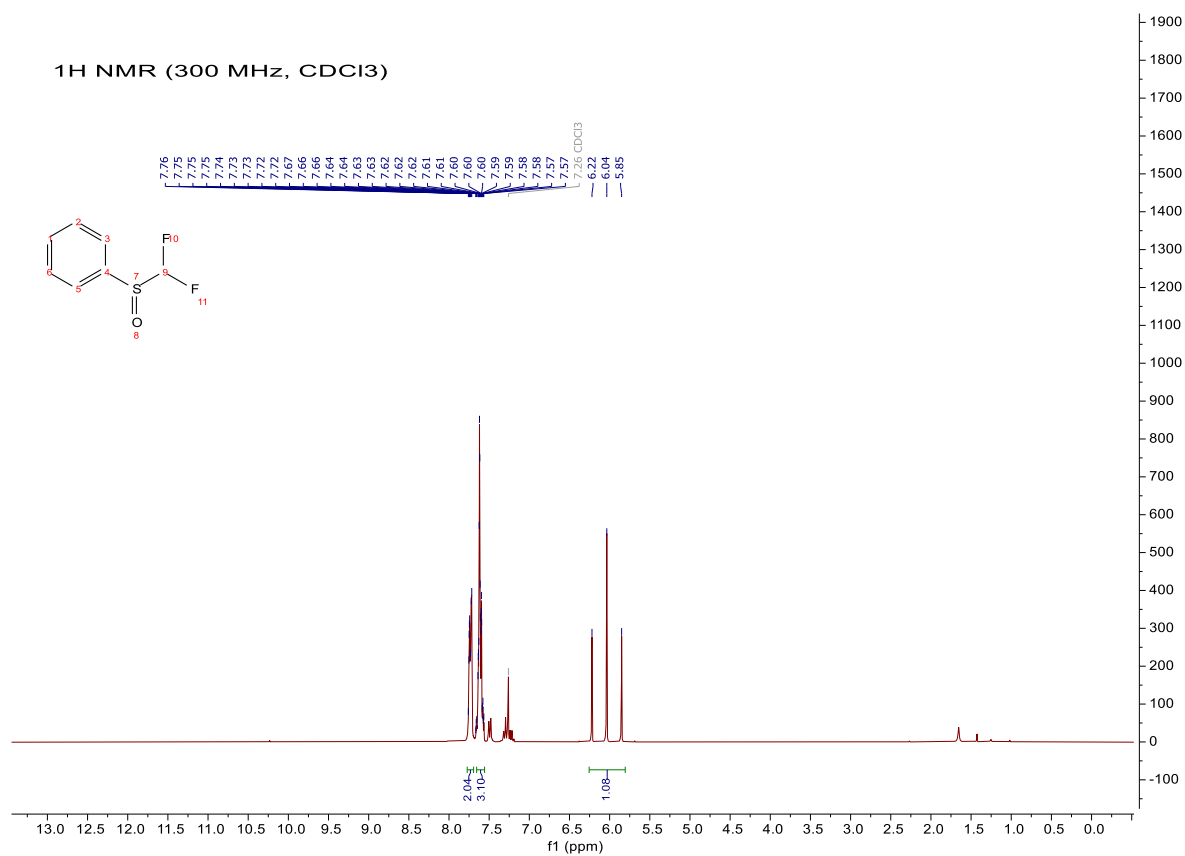


C₇H₆F₂OS
176.18

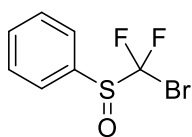
Reaction carried out following the general procedure 1 using (difluoromethyl)(phenyl)sulfane (320 mg, 2 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 92:8), affording the product as a slightly yellow oil (127 mg, 1.1 mmol). Yield = 36%. The NMR data matched with the literature.[5]

* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.77 – 7.69 (m, 2H), 7.67 – 7.56 (m, 3H), 6.04 (t, *J* = 55 Hz, 1H).

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** -119.72 (d, *J* = 55 Hz, 1F), -119.76 (d, *J* = 55 Hz, 1F),



((Bromodifluoromethyl)sulfinyl)benzene (1j)

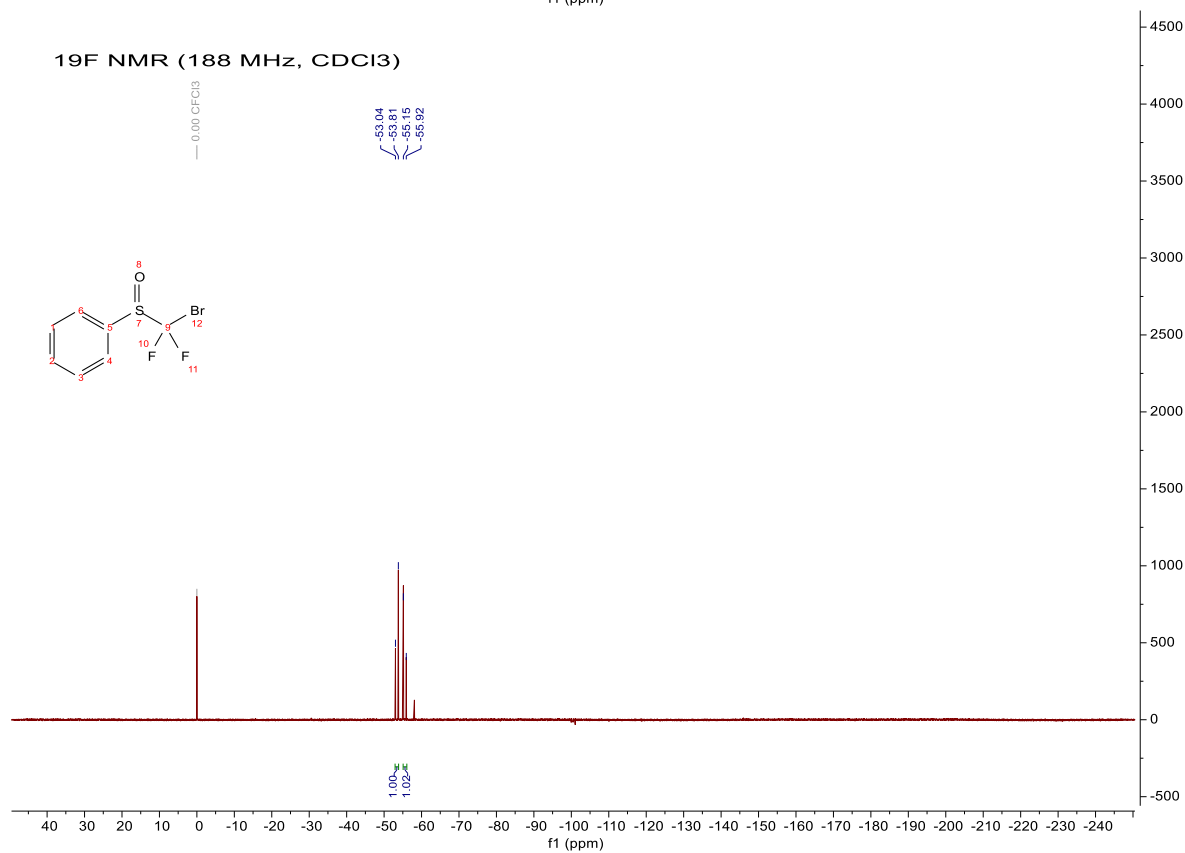
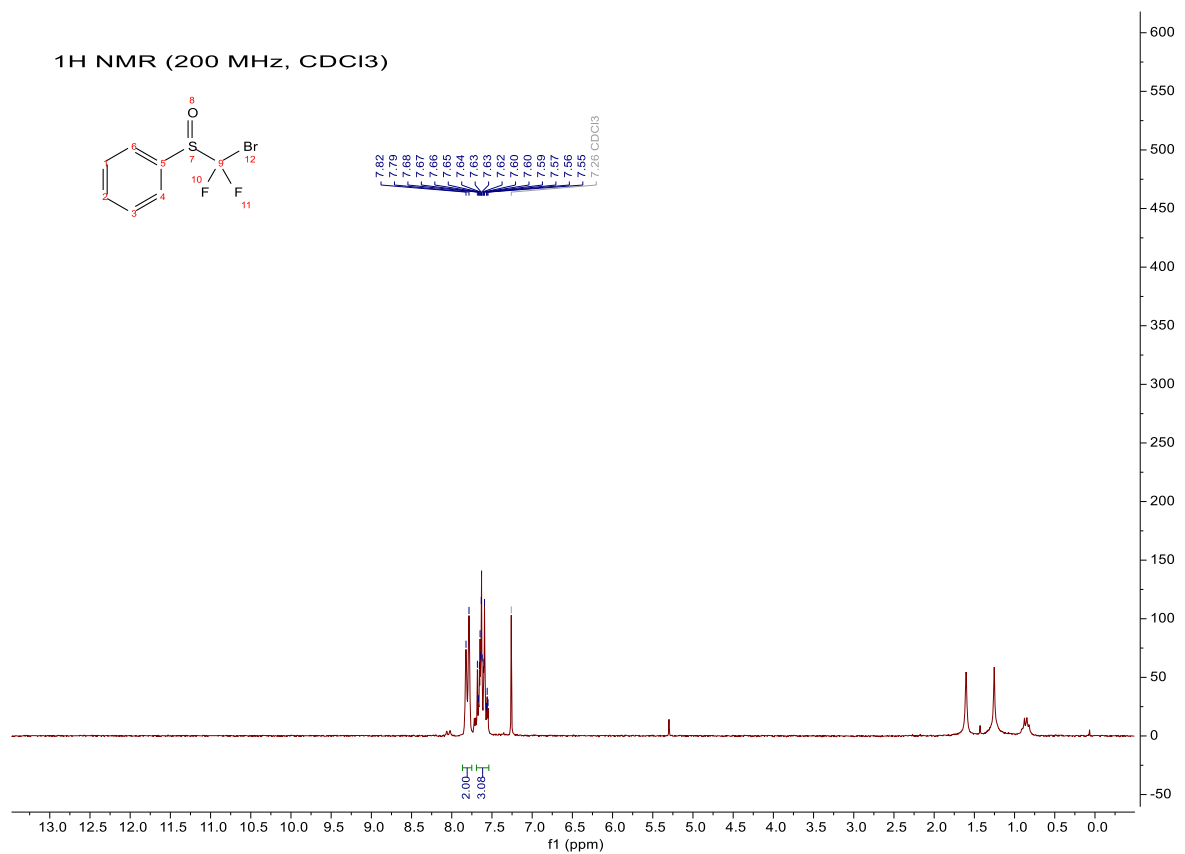


C₇H₅BrF₂OS
255.08

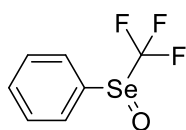
Reaction carried out following the general procedure 1 using (bromodifluoromethyl)(phenyl)sulfane (807 mg, 3.37 mmol). Purified by flash chromatography (petroleum ether/diethyl ether 92:8), affording the product as a slightly yellow oil (609 mg, 2.39 mmol). Yield = 71%. The NMR data matched with the literature.[1]

* ¹H NMR (200 MHz, CDCl₃) δ (ppm): 7.80 (d, *J* = 7 Hz, 2H), 7.68 – 7.53 (m, 3H).

* ¹⁹F NMR (188 MHz, CDCl₃) δ (ppm): -53.42 (d, *J* = 145 Hz, 1F), -55.54 (d, *J* = 145 Hz, 1F).



((Trifluoromethyl)seleninyl)benzene (**1k**)

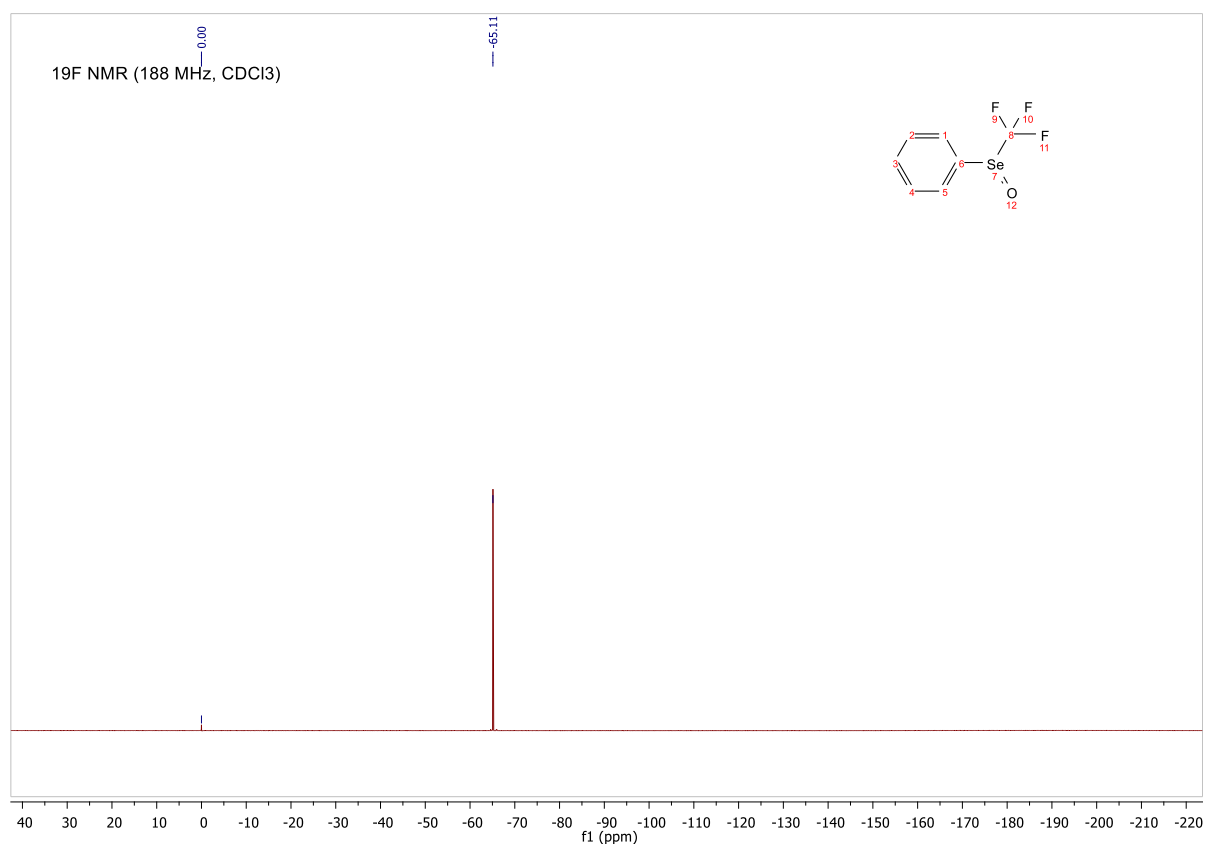
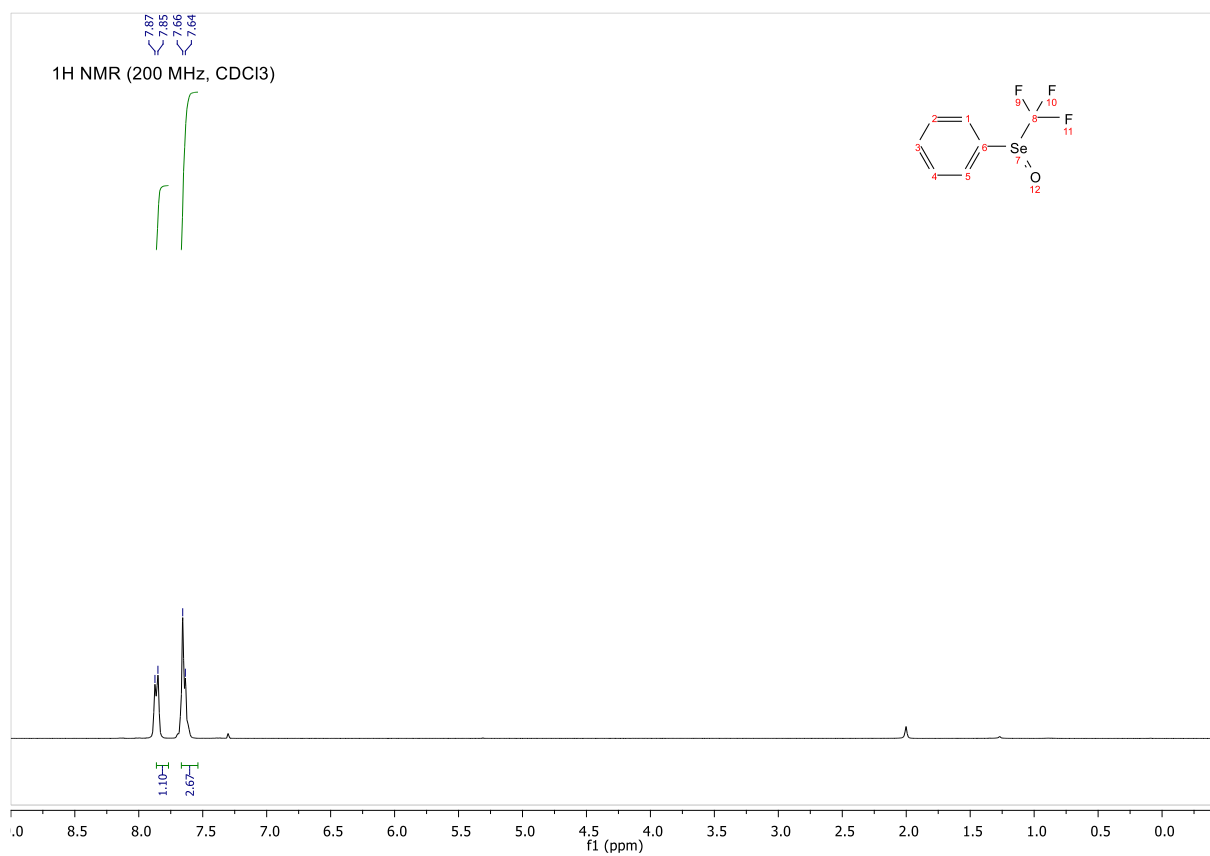


C₇H₅F₃OSe
241,9458

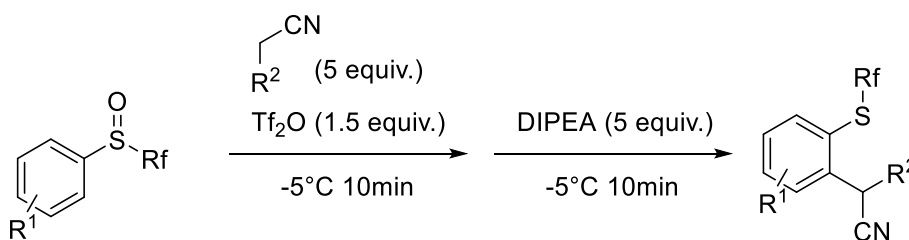
To a round-bottomed flask equipped with a magnetic stirring bar was added the phenylselenocyanate (990 mg, 5 mmol, 1 equiv) followed by 15 mL of dry THF. TMSCF₃ (10 mmol, 2 equiv) was added at 0 °C and TBAF (1 mmol, 0.2 equiv) was added dropwise. The mixture was then allowed to warm to room temperature and stirred until full conversion (the conversion was checked by ¹⁹F NMR with PhOCF₃ as internal standard). Then, Oxone[®] (10 mmol, 2 equiv) was added at 0 °C, followed by 15 mL of water. The mixture was then allowed to warm to room temperature and stirred at room temperature for 3 h (the conversion was checked by ¹⁹F NMR with PhOCF₃ as internal standard). The mixture was then filtered through a pad of silica and concentrated under vacuum. The mixture was then portioned with DCM (5 mL) and water (5 mL), the organic layer was washed with brine (10 mL) and water (10 mL), dried over MgSO₄, filtered and concentrated under vacuum. The crude residue was purified by column chromatography (*n*-pentane/EtOAc 70:30) to afford **1k** as a yellow solid (943.4 mg, 3.9 mmol, 78%). The NMR data matched with the literature.[1]

* ¹H NMR (200 MHz, CDCl₃) δ (ppm): 7.82 (d, J = 6 Hz, 2H), 7.64 – 7.56 (m, 3H).

* ¹⁹F NMR (188 MHz, CDCl₃) δ (ppm): -65.11 (s, 3F).

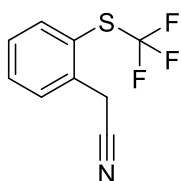


General procedure 2: Rearrangement



The sulfoxide (0.5 mmol, 1 equiv), nitrile (5 equiv) and Tf_2O (1.5 equiv) were added in the described order to a 5mL flask under an argon atmosphere, maintained at $-5^\circ C$. The reaction mixture was stirred for 10 min, then $DIPEA$ (5 equiv) was slowly added to the flask with a syringe and the reaction was stirred for another 10 min. At the end of the reaction, 1 mL of chloroform and a known amount of trifluoromethoxybenzene were added to the flask in order to determine the ^{19}F NMR yield. To purify the product, the reaction mixture was mixed with a sufficient volume of a saturated NH_4Cl solution, then extracted 3 times with diethyl ether. The combined organic layers were dried over $MgSO_4$, filtered, concentrated under reduced pressure and purified by preparative TLC or flash chromatography

2-(2-((Trifluoromethyl)thio)phenyl)acetonitrile (2a)



$C_9H_6F_3NS$
217.21

Reaction carried out following the general procedure 2 using ((trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) and acetonitrile. NMR ^{19}F yield = 95%. Purified by preparative TLC (petroleum ether/diethyl ether 7:3) affording the product as a yellow oil (87 mg, 0.4 mmol). Yield = 79%.

Gram-Scale:

An oven-dried 100 mL round-bottomed flask was charged with argon gas, then ((trifluoromethyl)sulfinyl)benzene (2 g, 10.3 mmol, 1 equiv) and acetonitrile (5.4 mL, 103 mmol, 10 equiv) were added by syringe. The flask was cooled to and maintained at $-5^\circ C$ with magnetic stirring throughout the whole process. Tf_2O (2.6 mL, 15.5 mmol, 1.5 equiv) was added to this flask through an automatic injector programmed at a debit of 0.26 mL/min. The reaction mixture was then stirred for 10 minutes and $DIPEA$ (8.9 mL, 51.5 mmol, 5 equiv) was added to this flask through an automatic injector programmed at a debit of 0.89 mL/min. The reaction mixture was then stirred for a further 10 minutes. The mixture was diluted in chloroform (20 mL) and a known quantity of

trifluoromethoxybenzene was added. ^{19}F NMR yield = 91%. The reaction was mixed with NH_4Cl (saturated solution, 30 mL), extracted with diethyl ether (20 mL \times 3), the combined organic layer was dried on MgSO_4 , concentrated, and purified by flash chromatography (petroleum ether/diethyl ether 7:3) affording the product as a yellow oil (1881mg, 8.66mmol). Yield = 84%.

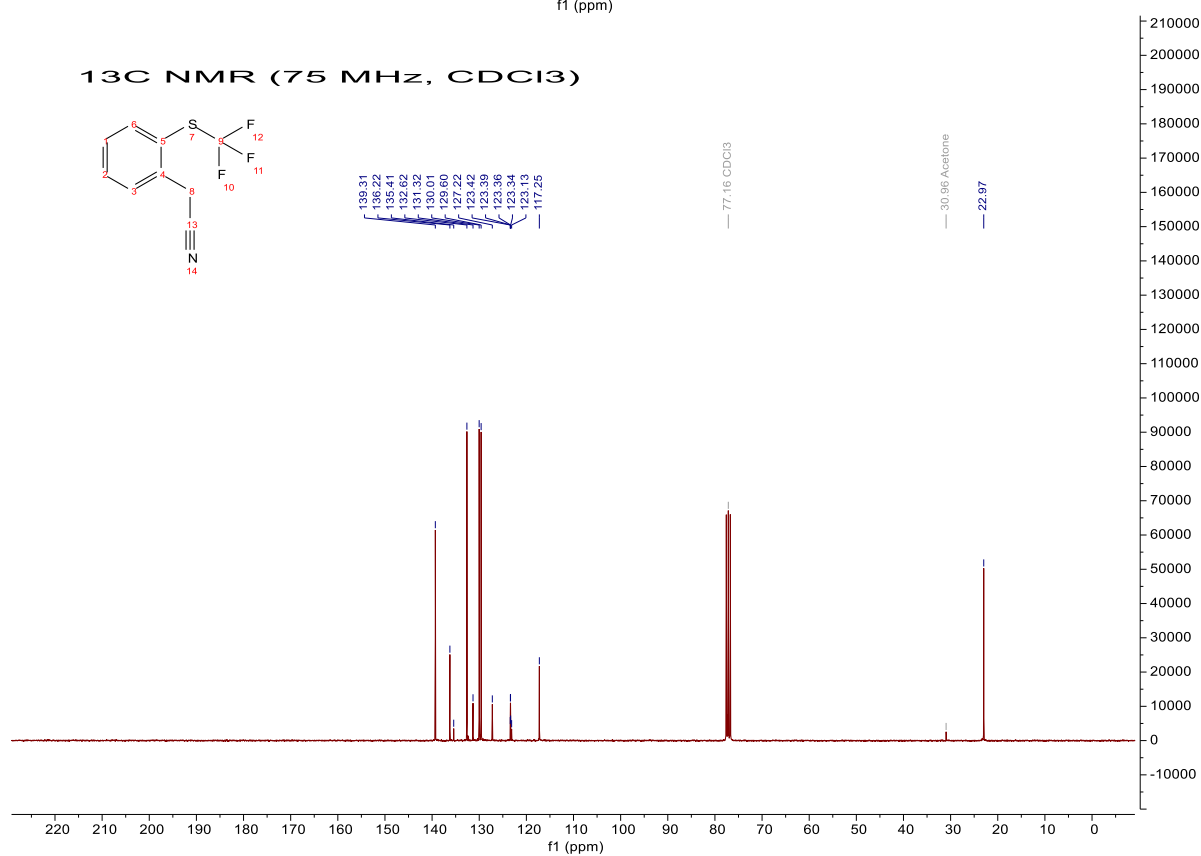
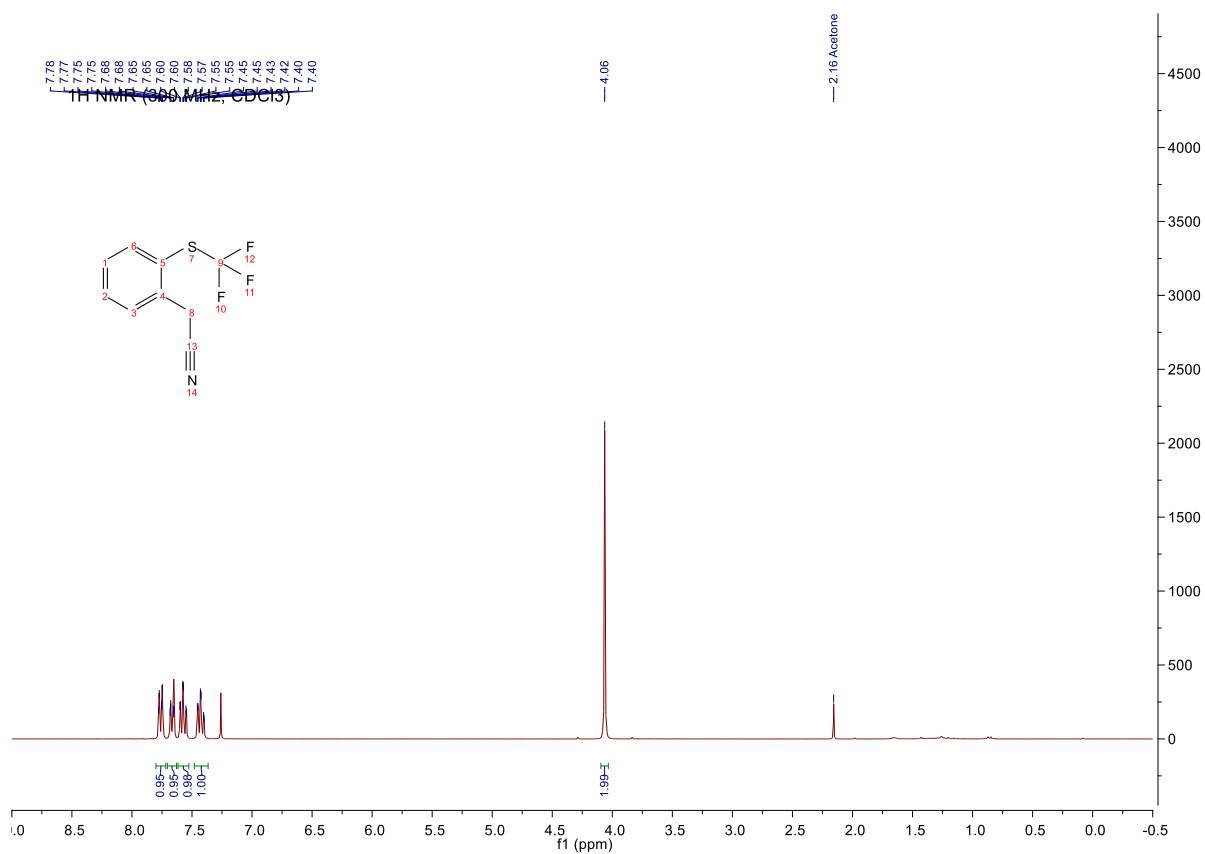
The analytical data are in accordance with the literature [7].

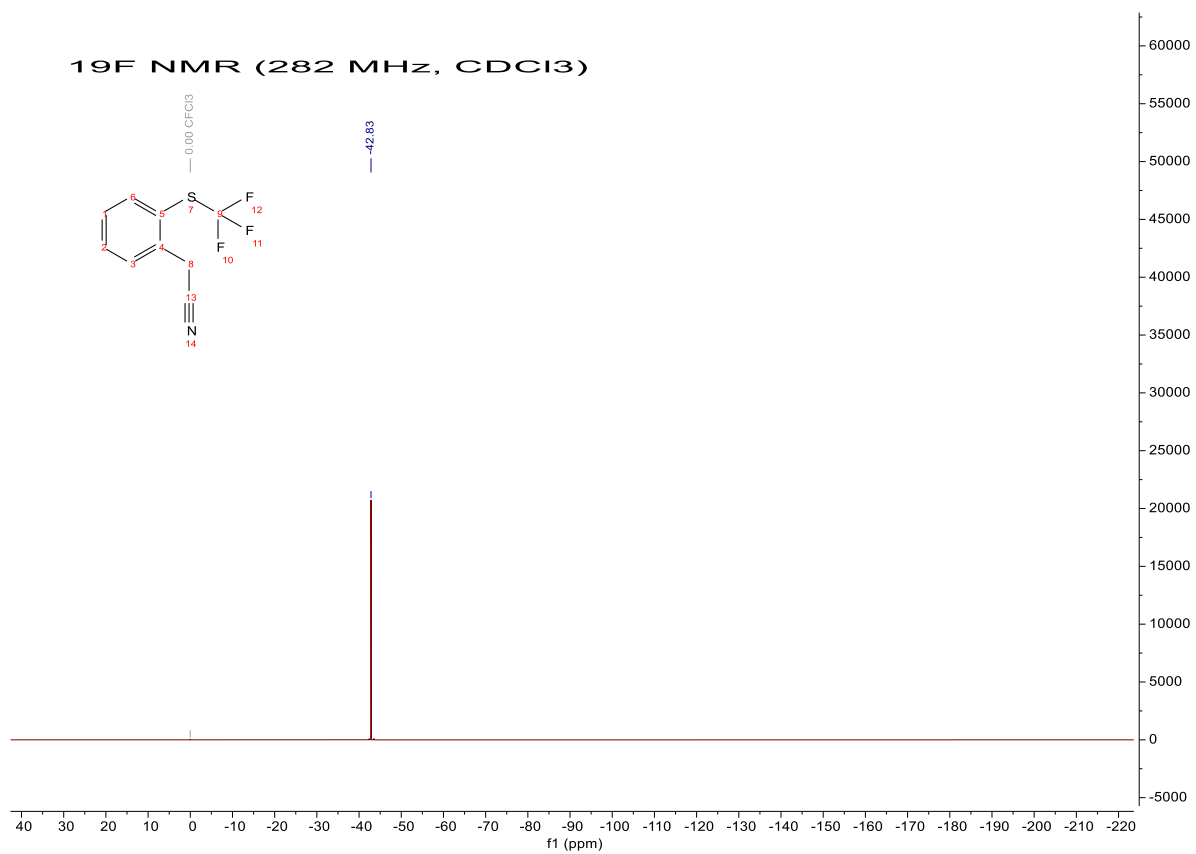
* **HRMS ASAP+TOF:** Calculated for $\text{C}_{18}\text{H}_{13}\text{F}_6\text{N}_2\text{S}_2$ $[\text{2M}+\text{H}]^+$: 435.0424, Found $[\text{2M}+\text{H}]^+$: 435.0433

* **^1H NMR (300 MHz, CDCl_3) δ (ppm):** 7.76 (dd, J = 8, 1 Hz, 1H), 7.67 (dd, J = 8, 1 Hz, 1H), 7.57 (td, J = 8, 1 Hz, 1H), 7.43 (td, J = 8, 2 Hz, 1H), 4.06 (s, 2H).

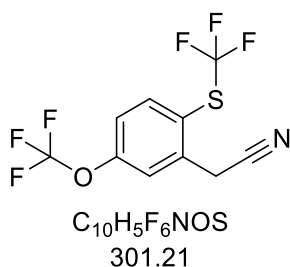
* **^{13}C NMR (75 MHz, CDCl_3) δ (ppm):** 139.3, 136.2, 132.6, 130.0, 129.6, 129.3 (q, J = 309 Hz), 123.38 (q, J = 2 Hz), 117.3, 31.0

* **^{19}F NMR (282 MHz, CDCl_3) δ (ppm):** -42.83 (s)





2-(5-(Trifluoromethoxy)-2-((trifluoromethyl)thio)phenyl)acetonitrile (2b)



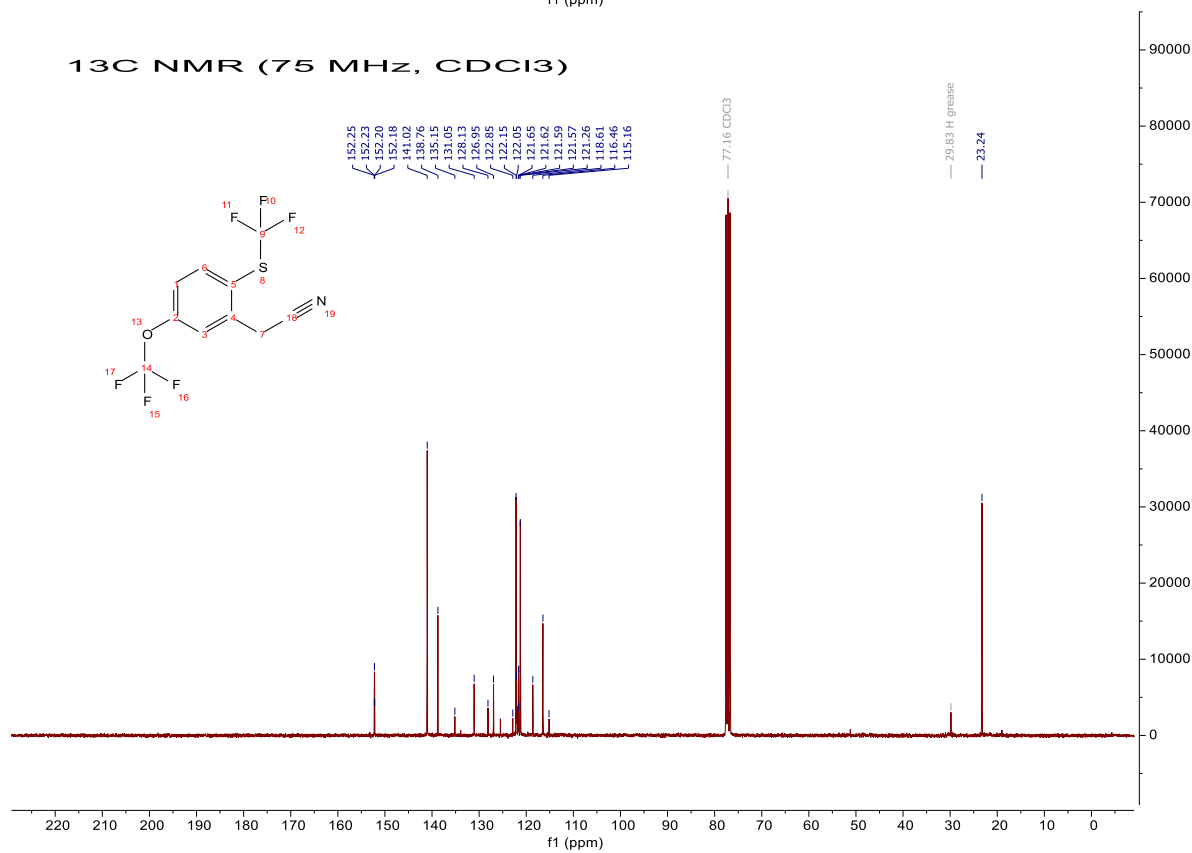
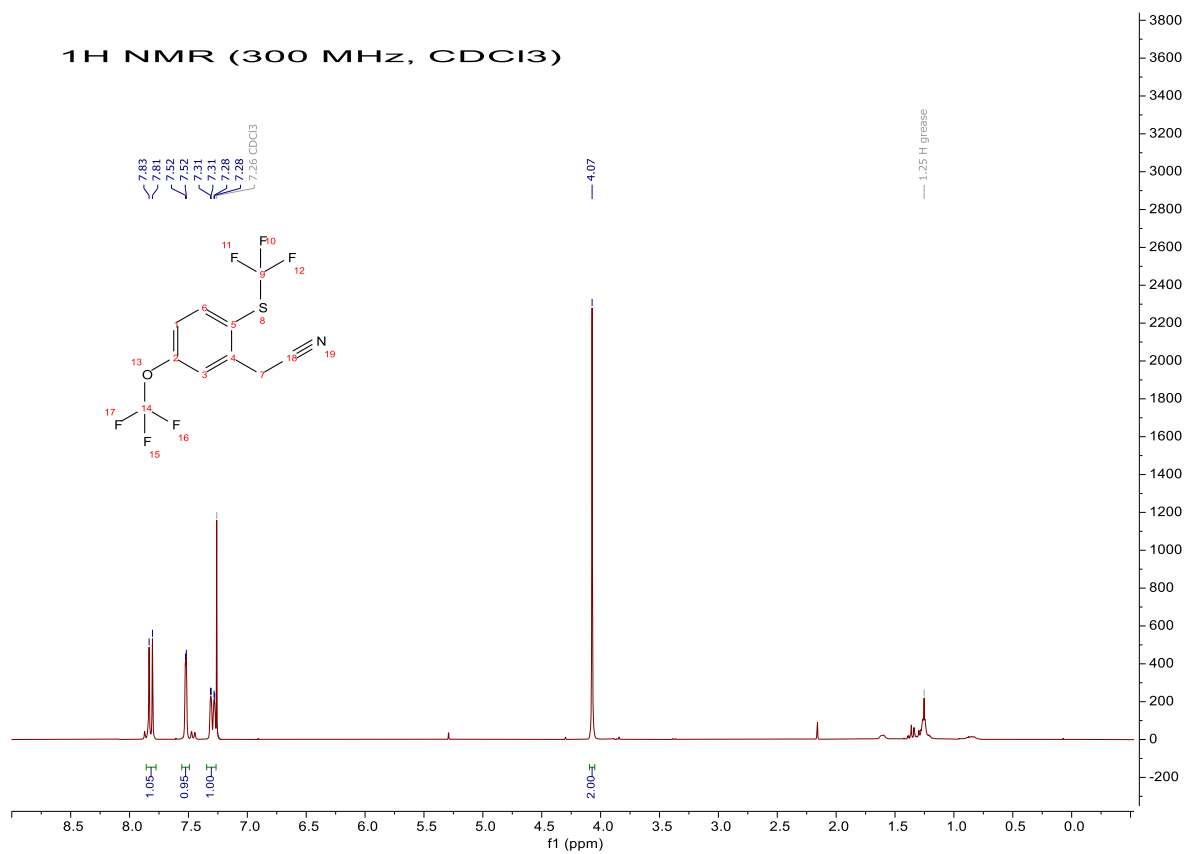
Reaction carried out following the general procedure 2 using 1-(trifluoromethoxy)-4-((trifluoromethyl)sulfinyl)benzene (138 mg, 0.49 mmol). NMR ^{19}F yield = 70%. Purified by preparative TLC (petroleum ether/diethyl ether 92:8), affording the product as a yellow oil (100 mg, 0.33 mmol). Yield = 67%.

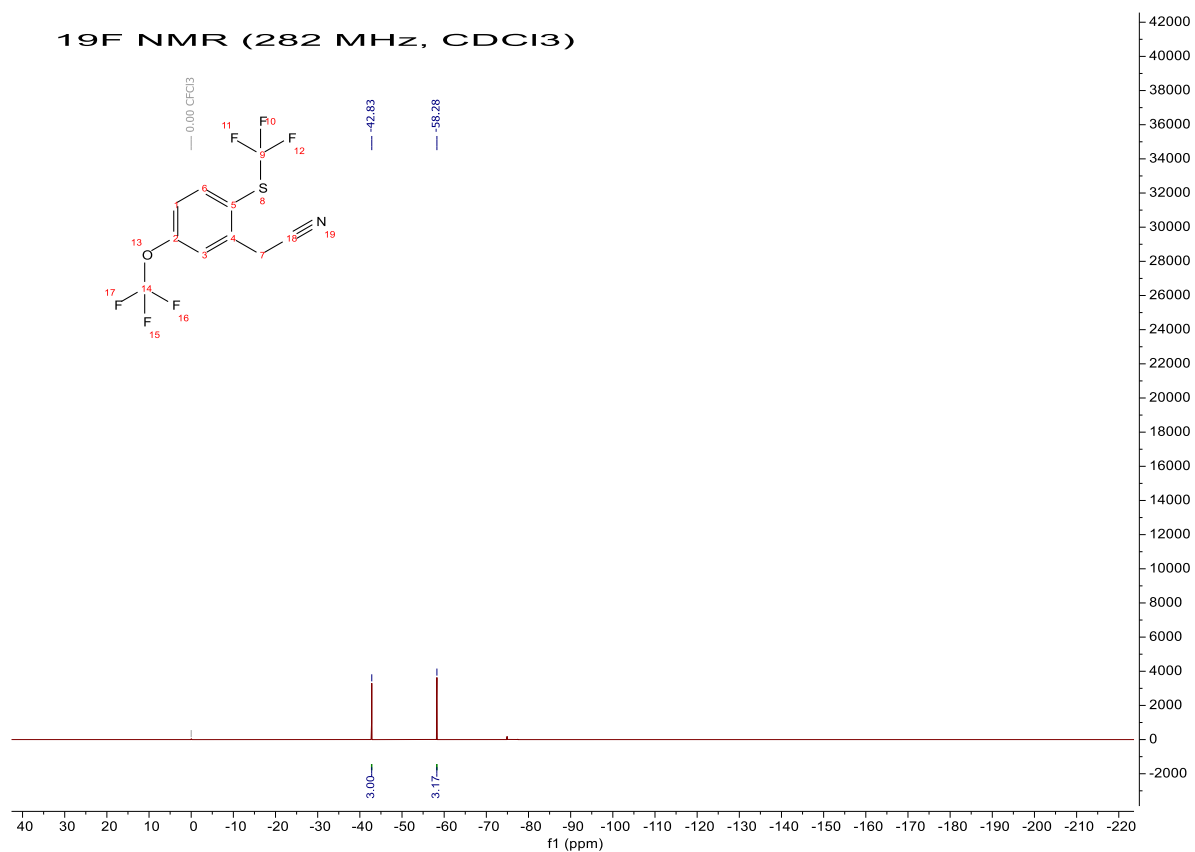
* **HRMS ASAP+TOF:** Calculated for $C_{20}H_{11}F_{12}N_2O_2S_2[2M+H]^+$: 603.0070 ; Found $[2M+H]^+$: 603.0069.

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 7.82 (d, J = 9 Hz, 1H), 7.52 (d, J = 2 Hz, 1H), 7.29 (dd, J = 9, 2 Hz, 1H), 4.07 (s, 2H).

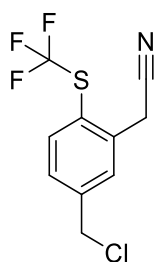
* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 152.2 (q, J = 2 Hz), 141.0, 138.8, 129.0 (q, J = 309 Hz), 122.1 (d, J = 8 Hz), 121.6 (q, J = 2 Hz), 121.3, 120.3 (q, J = 258 Hz) 116.5, 23.2

* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm):** -42.83 (s), -58.88 (s)





2-(5-(Chloromethyl)-2-((trifluoromethyl)thio)phenyl)acetonitrile (2c)



C₁₀H₇ClF₃NS
265.68

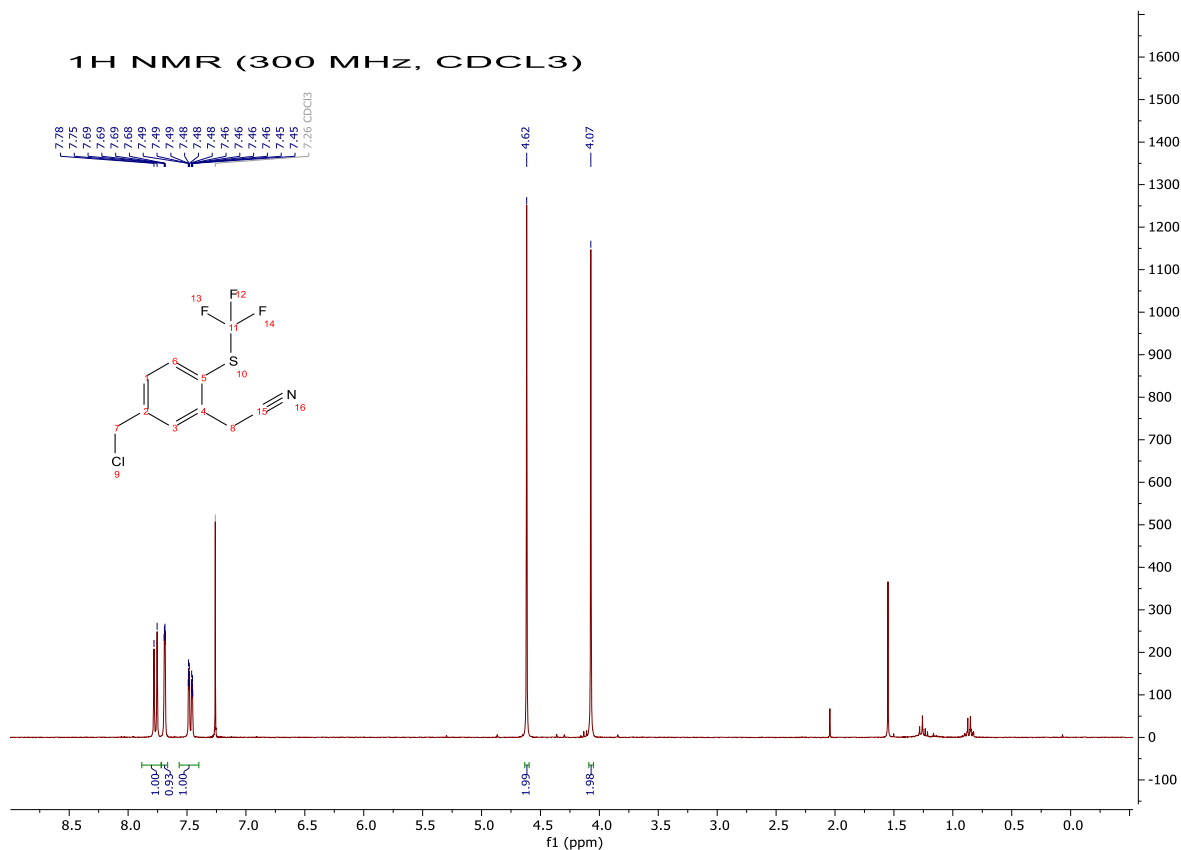
Reaction carried out following the general procedure 2 using 1-(chloromethyl)-4-((trifluoromethyl)sulfinyl)benzene (121 mg, 0.5 mmol) with acetonitrile. NMR ¹⁹F yield = 85%. Purified by preparative TLC (petroleum ether/diethyl ether 7:3) affording the product as an orange oil (98 mg, 0.37 mmol). Yield = 74%.

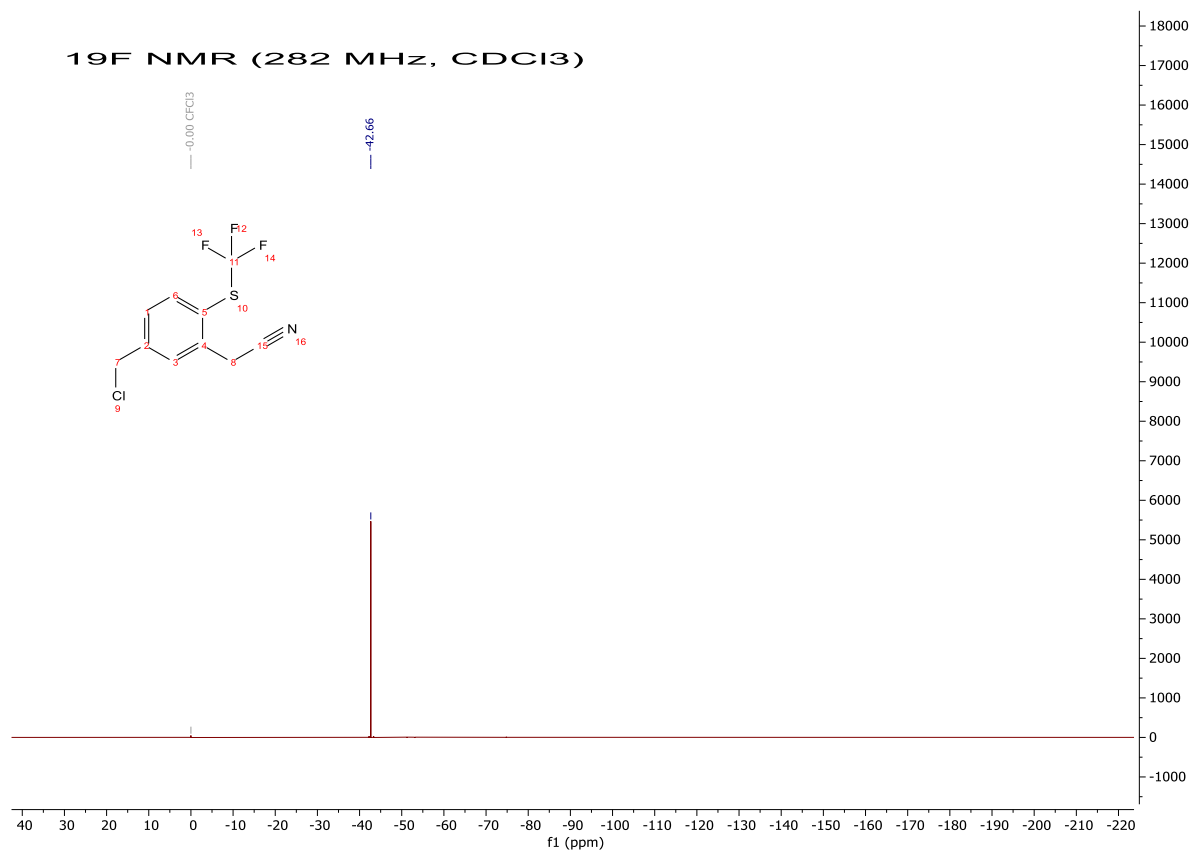
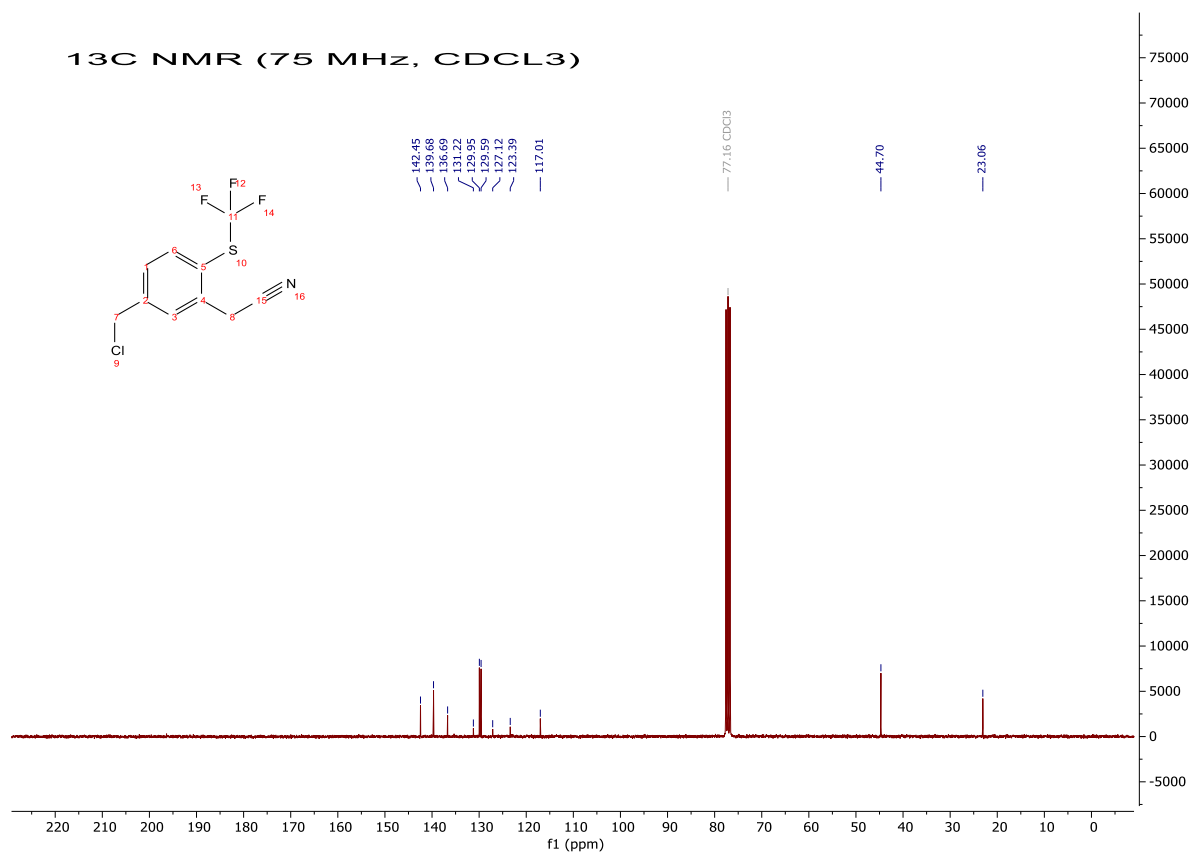
* **HRMS ASAP+TOF**: Calculated for C₁₀H₁₅ClF₃NS [2M+H]⁺: 530.9958; Found [M+H]⁺: 530.9963.

* **¹H NMR (300 MHz, CDCl₃) δ (ppm)**: 7.77 (d, *J* = 8 Hz, 1H), 7.69 (dd, *J* = 2 Hz, 1 Hz, 1H), 7.49 – 7.45 (m, 1H), 4.62 (s, 2H), 4.07 (s, 2H).

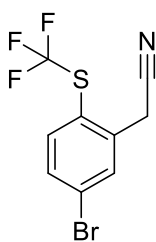
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm)**: 142.4, 139.7, 136.7, 130.0, 129.6, 129.2 (q, *J* = 307 Hz), 123.4 (q, *J* = 2 Hz), 117.0, 44.7, 23.1.

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm)**: -42.66 (s)





2-(5-Bromo-2-((trifluoromethyl)thio)phenyl)acetonitrile (2d)



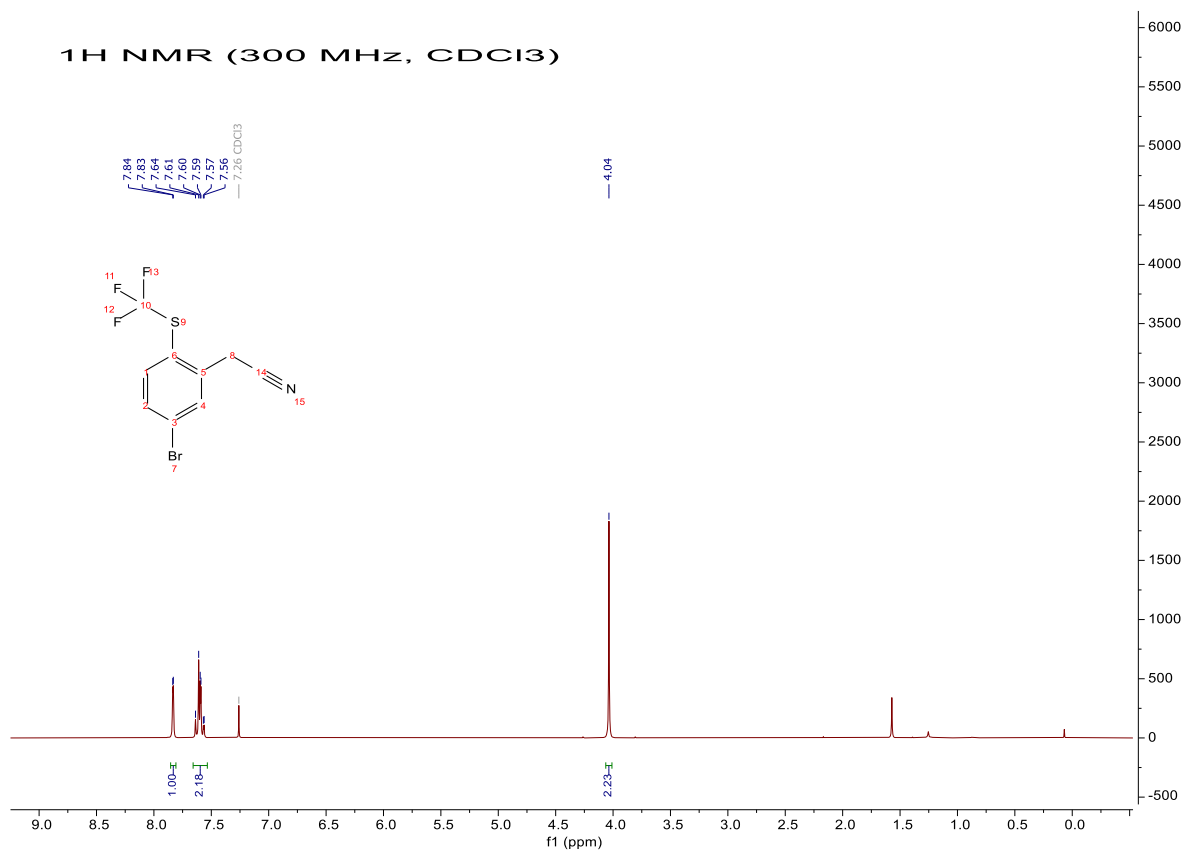
$\text{C}_9\text{H}_5\text{BrF}_3\text{NS}$
296.11

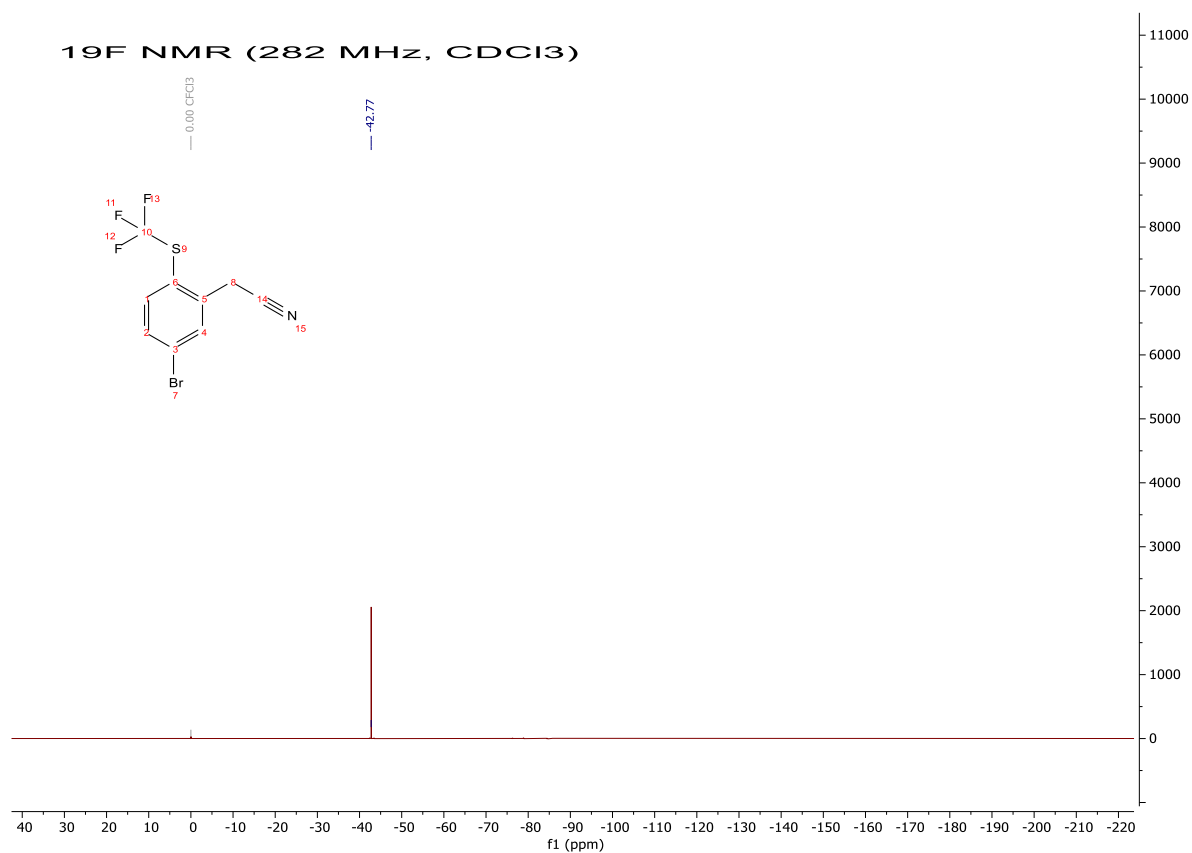
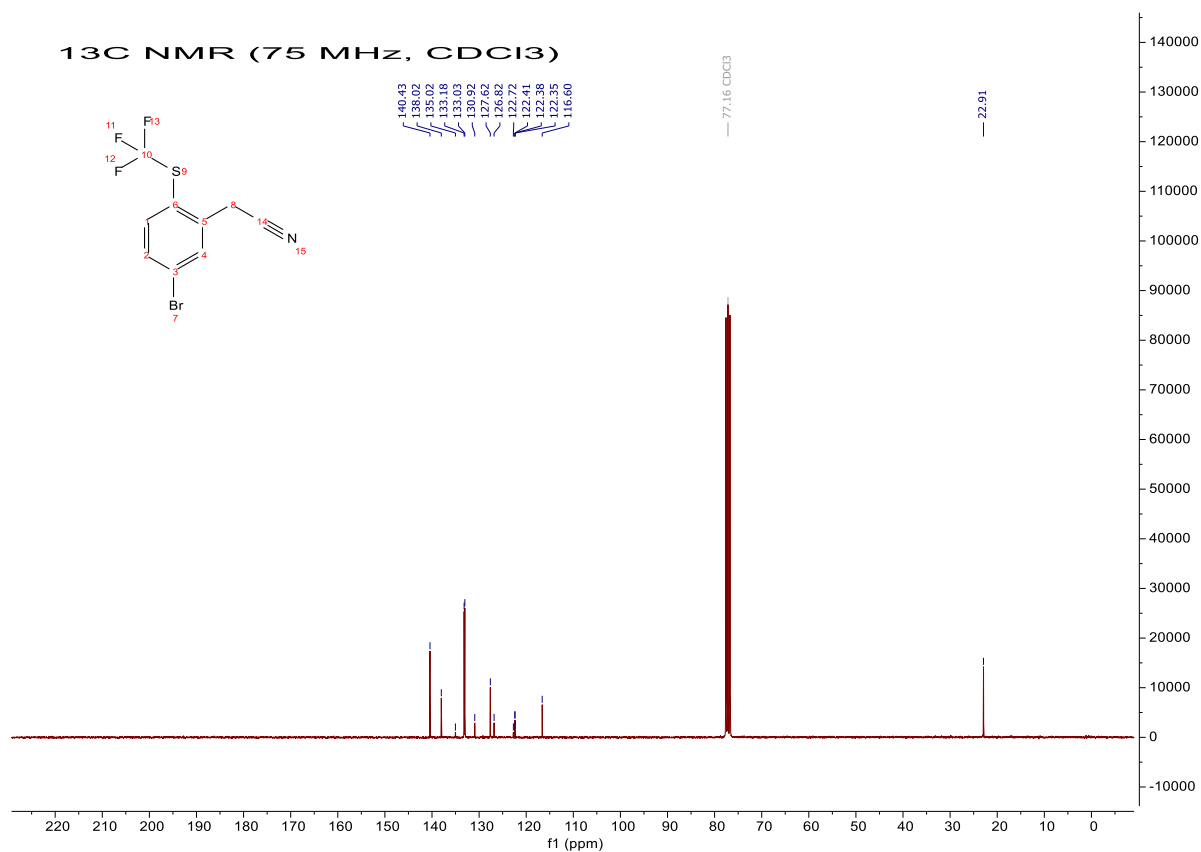
Reaction carried out following the general procedure 1 using 1-bromo-4-((trifluoromethyl)sulfinyl)benzene (137 mg, 0.5 mmol) and acetonitrile. NMR ^{19}F yield = 73%. Purified by preparative TLC (*n*-pentane/EtOAc 84:16) affording the product as an orange oil (87 mg, 0.3 mmol). Yield = 59%.

* ^1H NMR (300 MHz, CDCl_3) δ (ppm): 7.83 (d, $J = 1$ Hz, 1H), 7.67 – 7.55 (m, 2H), 4.04 (s, 2H).

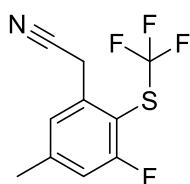
* ^{13}C NMR (75 MHz, CDCl_3) δ (ppm): 140.4, 138.0, 133.2, 133.0, 128.9 (q, $J = 309$ Hz), 122.4 (q, $J = 2$ Hz), 127.6, 116.6, 22.9

* ^{19}F NMR (282 MHz, CDCl_3) δ (ppm): -42.77 (s)





2-(3-Fluoro-5-methyl-2-((trifluoromethyl)thio)phenyl)acetonitrile (2e)



C₁₀H₇F₄NS
249.23

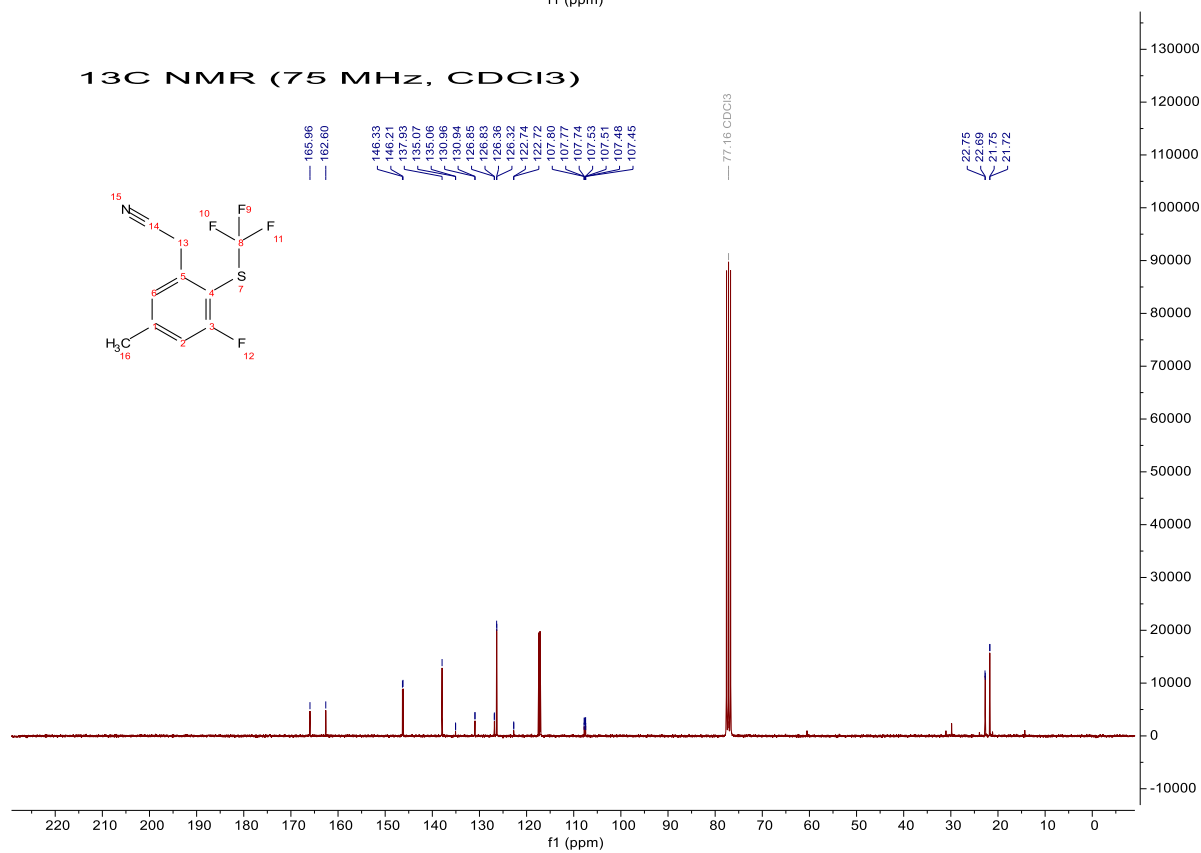
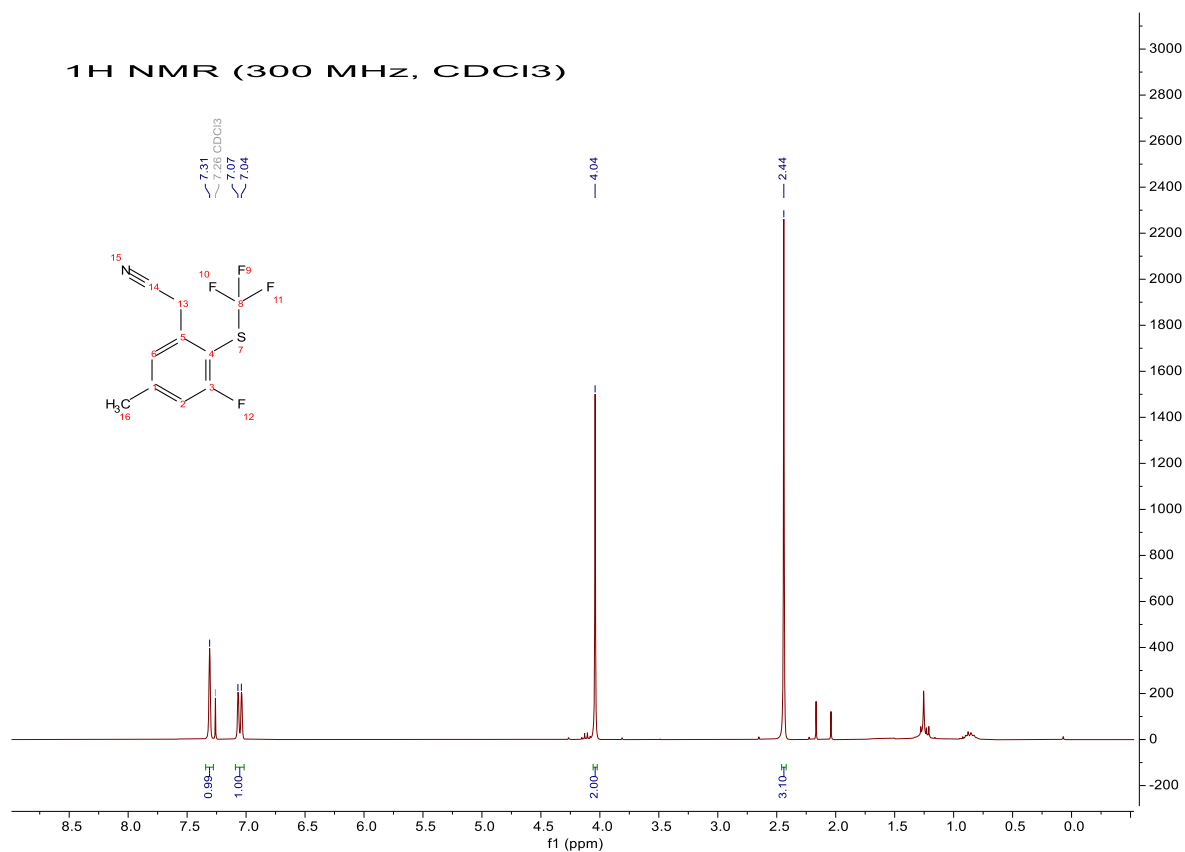
Reaction carried out following the general procedure 2 using 2-fluoro-4-methyl-1-((trifluoromethyl)sulfinyl)benzene (110 mg, 0.5 mmol) with acetonitrile. NMR ¹⁹F yield = 37%. Purified by flash chromatography (Gradient: petroleum ether/diethyl ether 100:0 to 80:20), affording the product as an orange oil (42 mg, 0.17 mmol). Yield = 35%.

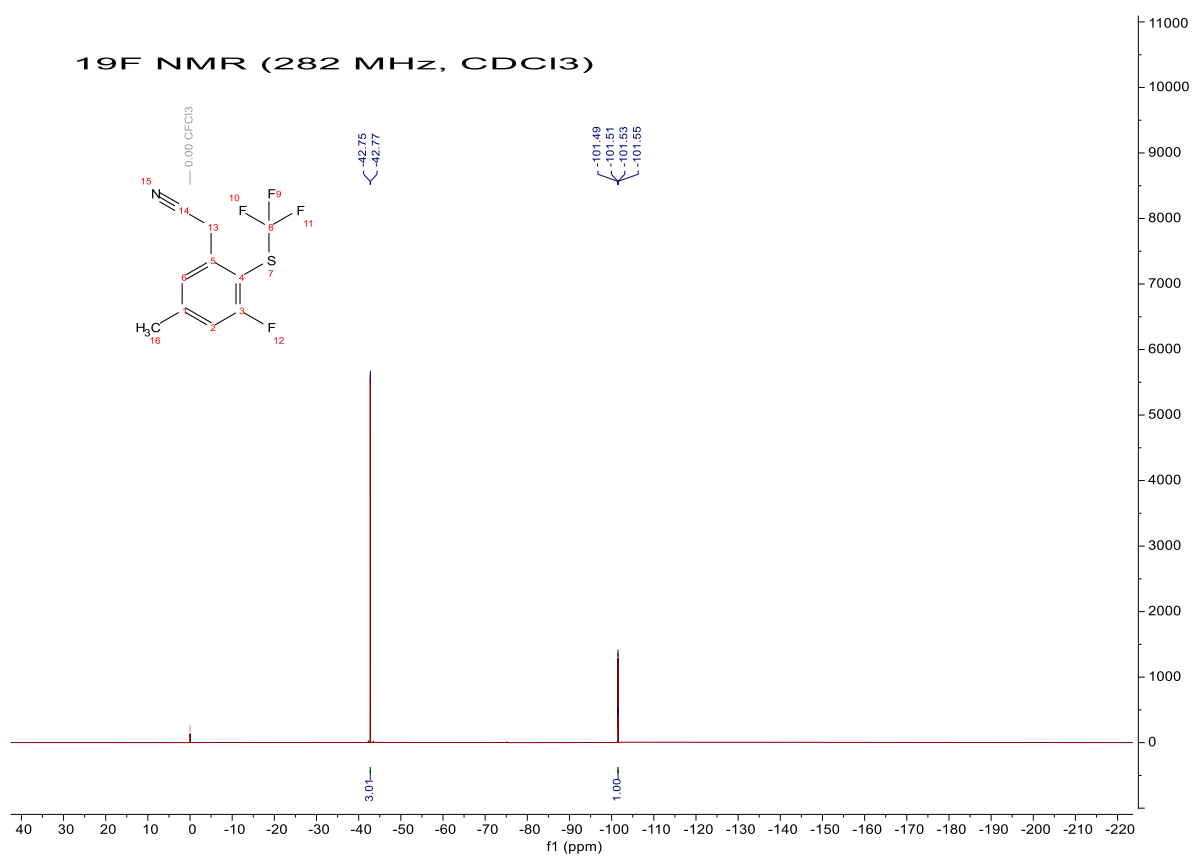
* **HRMS ASAP+TOF:** Calculated for C₁₀H₈F₄NS[M+H]⁺: 250.0314; Found [M+H]⁺: 250.0322

* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.31 (s, 1H), 7.05 (d, *J* = 9 Hz, 1H), 4.04 (s, 2H), 2.44 (s, 3H).

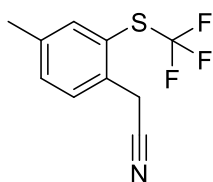
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm):** 164.3 (d, *J* = 253 Hz), 146.3 (d, *J* = 9 Hz), 137.9, 128.9 (qd, *J* = 311, 2 Hz), 126.3 (d, *J* = 3 Hz), 117.3 (d, *J* = 23 Hz), 117.0, 107.6 (qd, *J* = 20, 2 Hz), 22.7 (d, *J* = 4 Hz), 21.7 (d, *J* = 2 Hz).

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** -42.76 (d, *J* = 6 Hz), -101.52 (q, *J* = 6 Hz).





2-(4-Methyl-2-((trifluoromethyl)thio)phenyl)acetonitrile (2f)



C₁₀H₈F₃NS
231.24

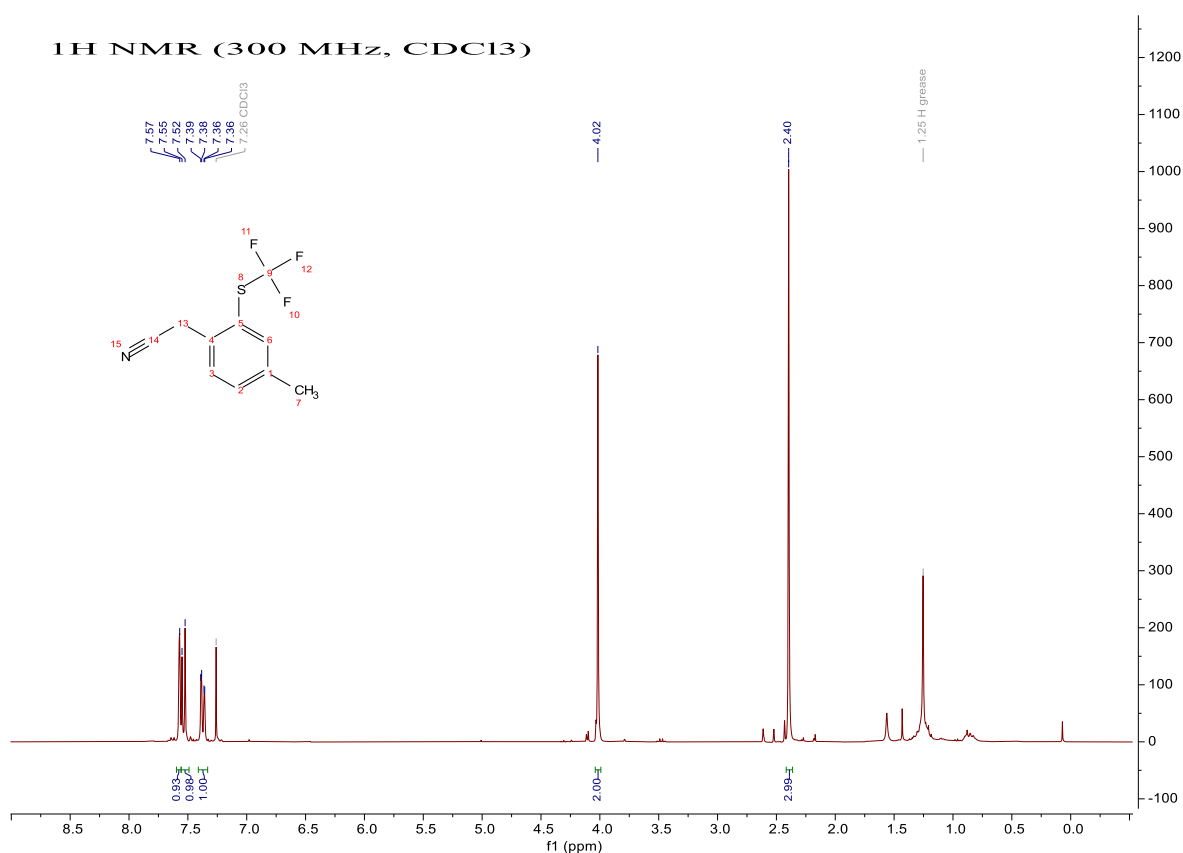
Reaction carried out following the general procedure 2 using 1-methyl-3-((trifluoromethyl)sulfinyl)benzene (58 mg, 0.28 mmol). NMR ¹⁹F yield = 23%. Purified by preparative TLC (petroleum ether/diethyl ether 8:2), affording the product as a yellow oil (12 mg, 0.05 mmol). Yield = 18%.

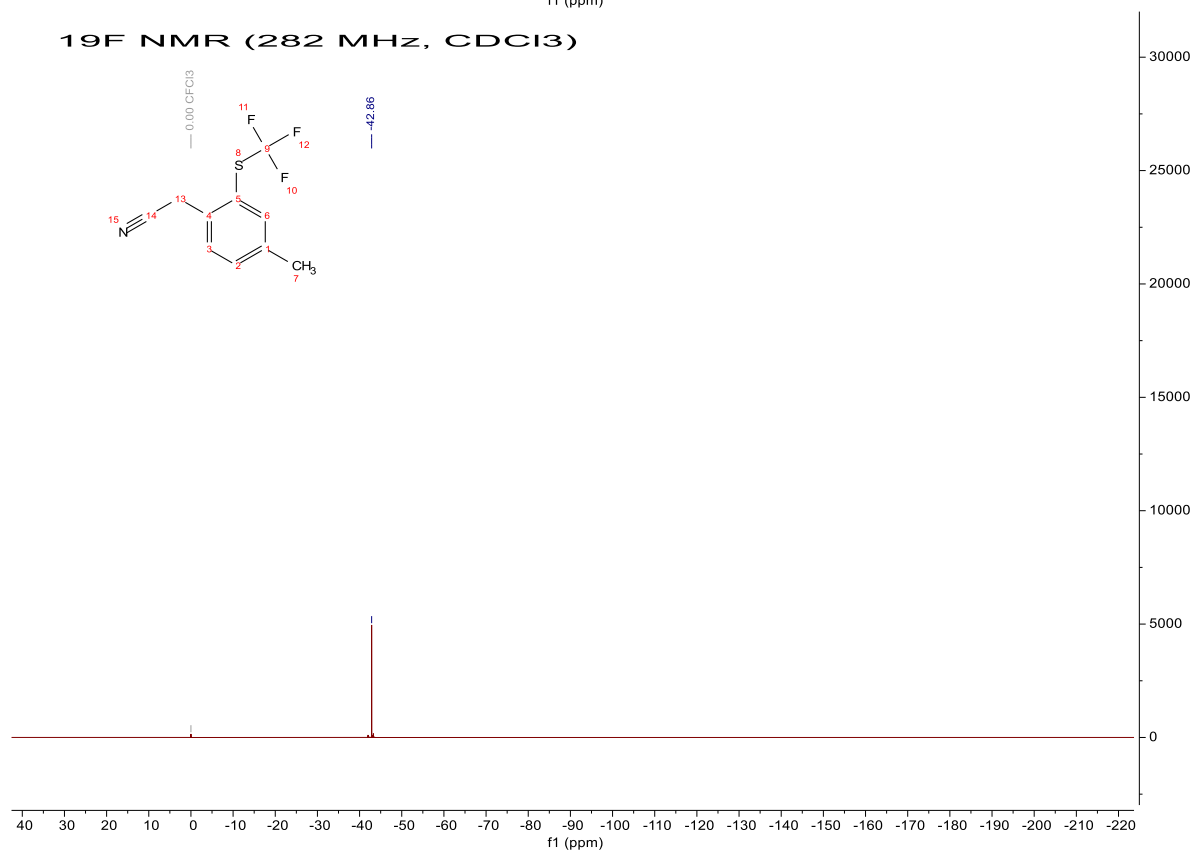
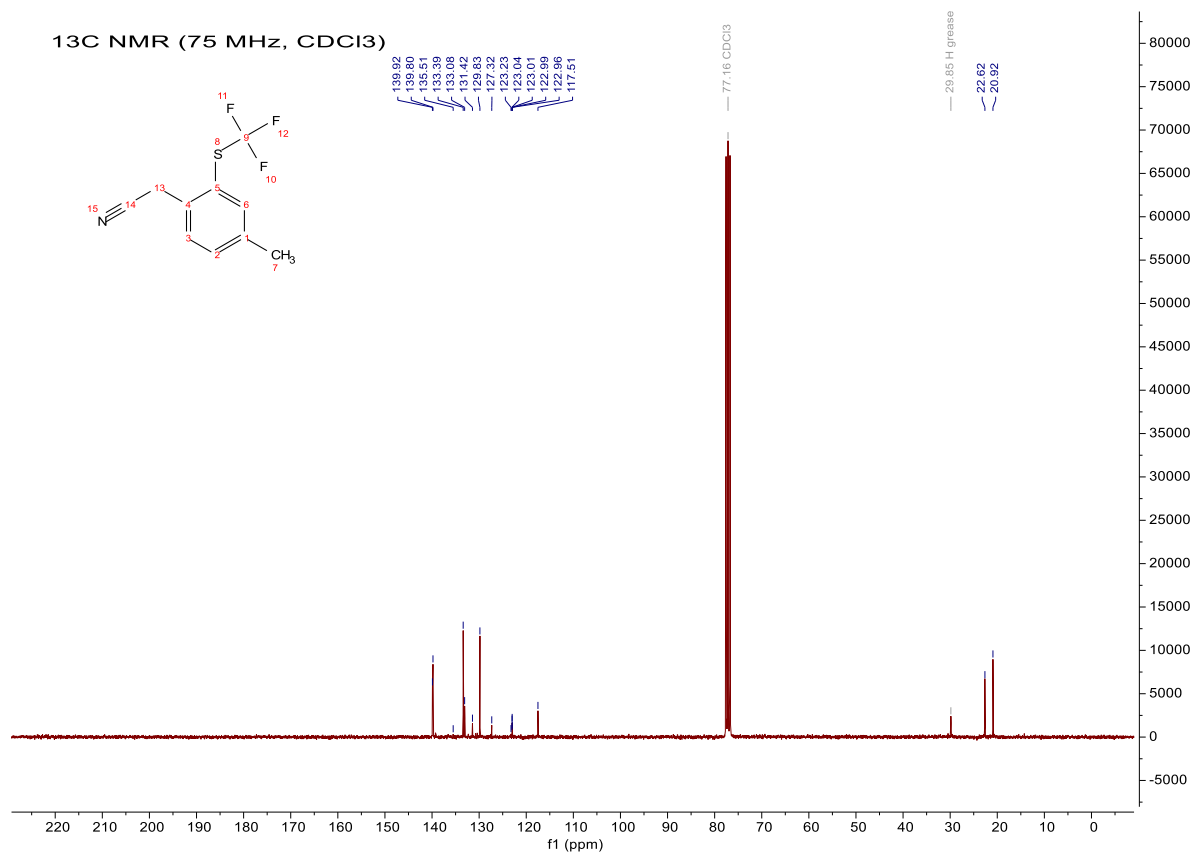
* **HRMS ASAP+TOF**: Calculated for C₁₀H₉F₃NS[M+H]⁺:232.0408 ; Found [M+H]⁺: 232.0408

* **¹H NMR (300 MHz, CDCl₃) δ (ppm)**: 7.57 (s, 1H), 7.54 (d, *J* = 8 Hz, 1H), 7.37 (dd, *J* = 8 Hz, 2 Hz, 1H), 4.02 (s, 2H), 2.40 (s, 3H).

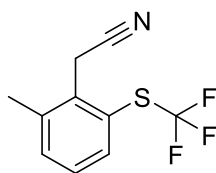
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm)**: 139.9, 139.8, 133.4, 133.1, 129.8, 117.5, 129.4 (q, *J* = 309 Hz), 123.0 (q, *J* = 2 Hz), 22.6, 20.9

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm)**: - 42.86 (s)





2-(2-Methyl-6-((trifluoromethyl)thio)phenyl)acetonitrile (2f')



$C_{10}H_8F_3NS$
231.24

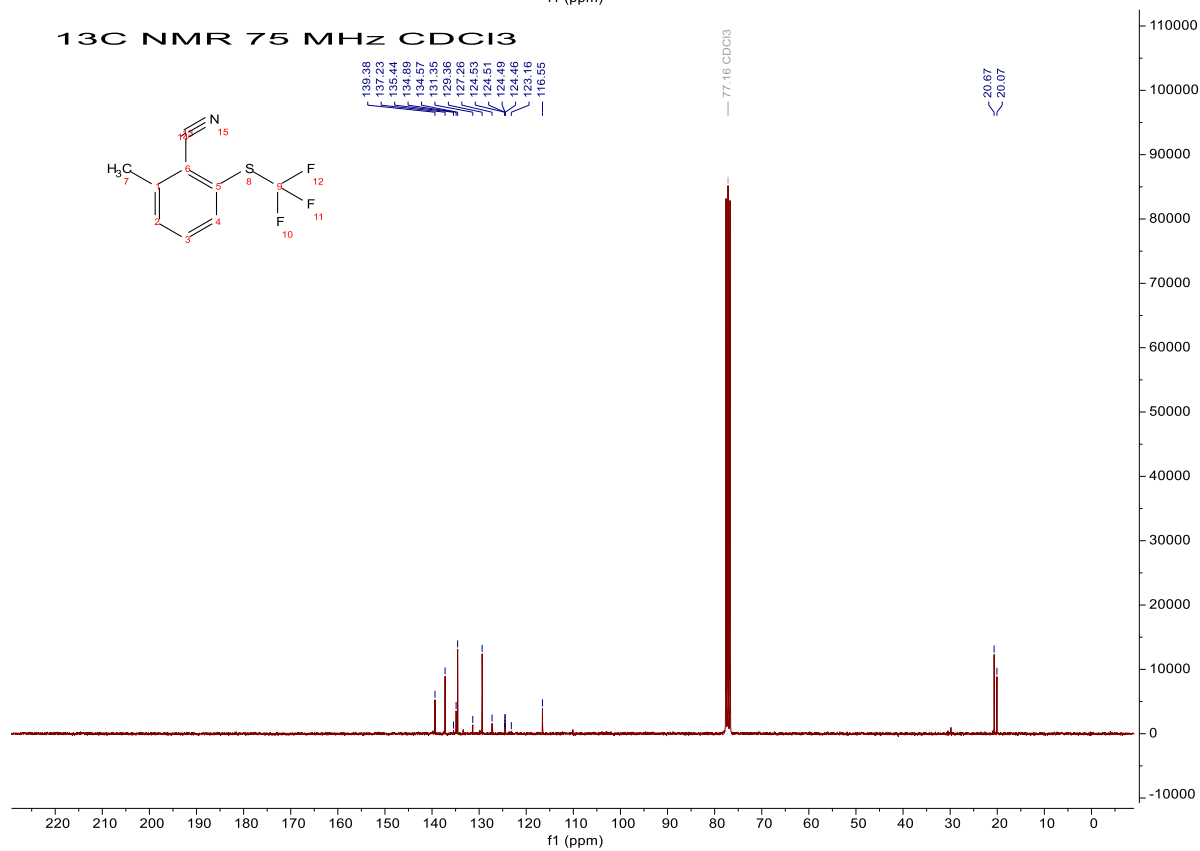
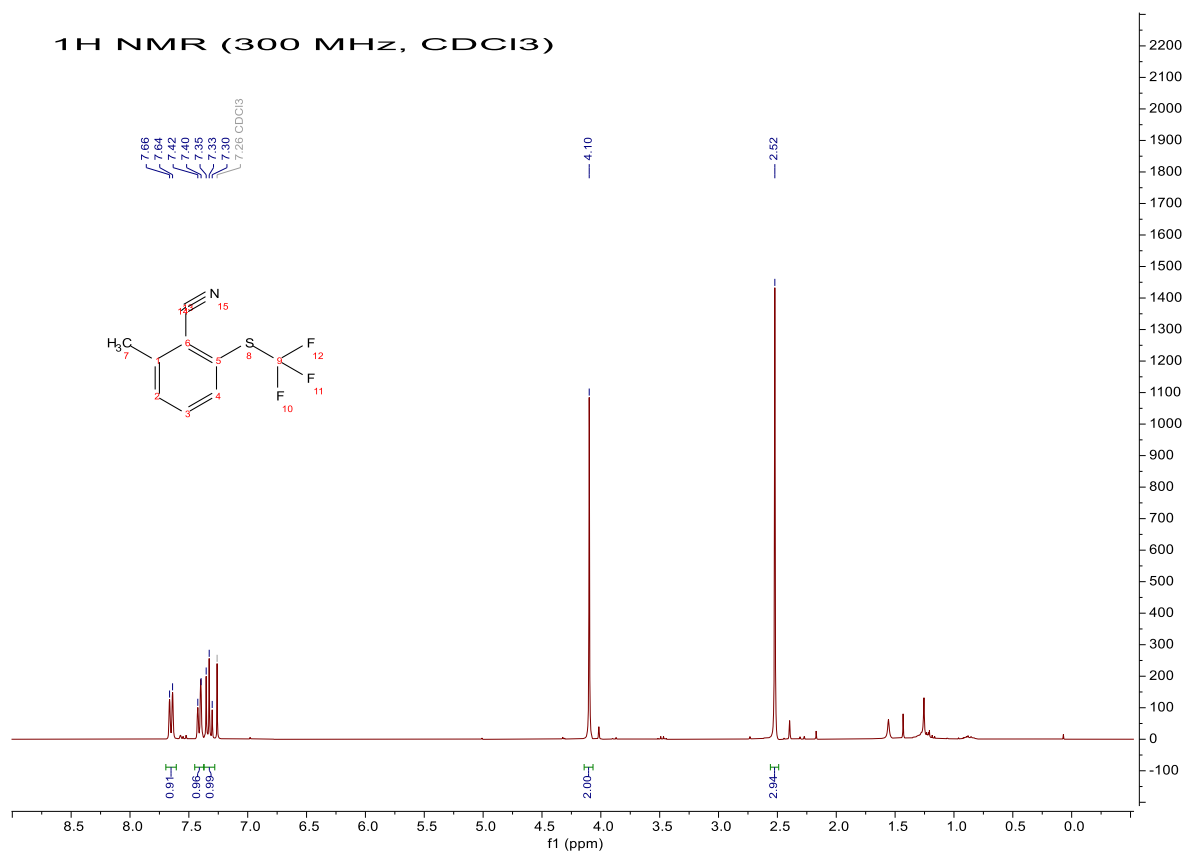
Reaction carried out following the general procedure 2 using 1-methyl-3-((trifluoromethyl)sulfinyl)benzene (58 mg, 0.28 mmol). NMR ^{19}F yield = 29%. Purified by preparative TLC (petroleum ether/diethyl ether 8:2), affording the product as a yellow oil (12 mg, 0.05 mmol). Yield = 19%.

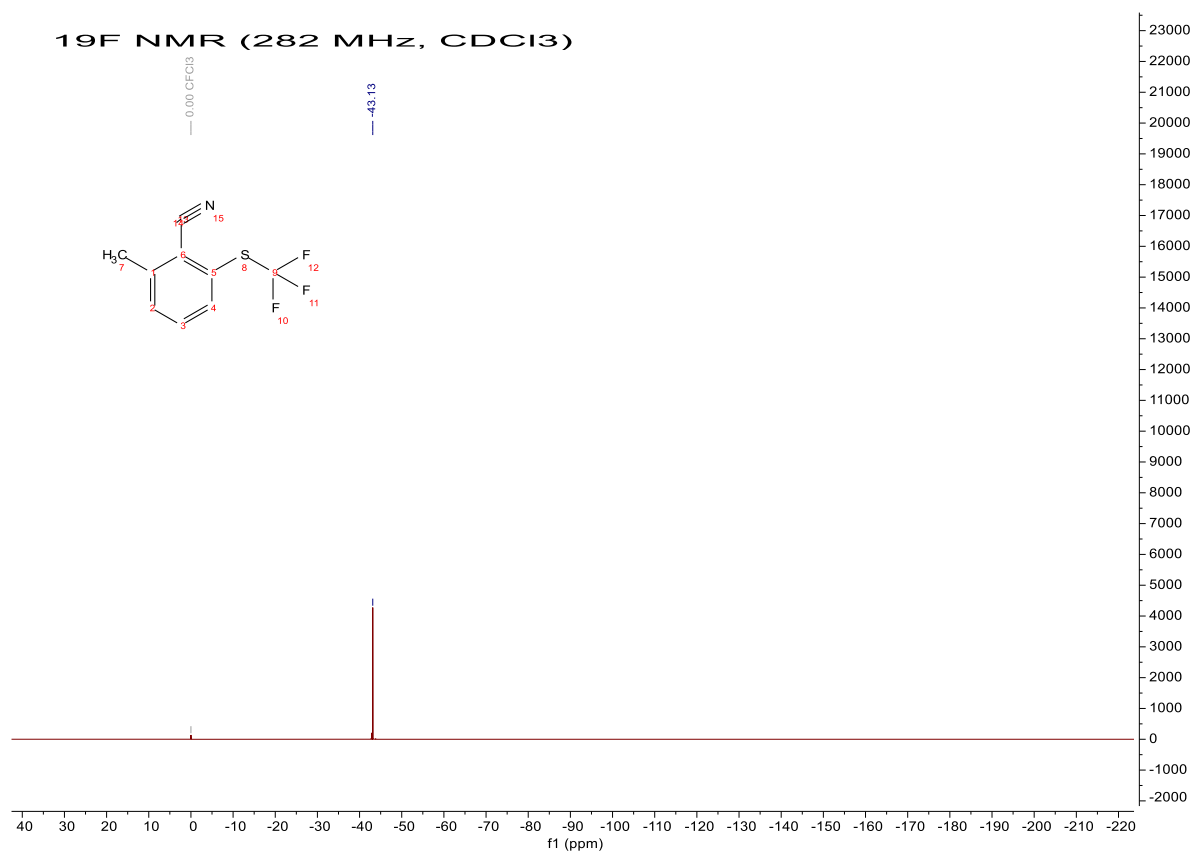
* **HRMS ASAP+TOF:** Calculated for $C_{10}H_9F_3NS[M+H]^+$: 232.0408 ; Found $[M+H]^+$: 232.0408.

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 7.65 (d, J = 8 Hz, 1H), 7.41 (d, J = 8 Hz, 1H), 7.33 (t, J = 8 Hz, 1H), 4.10 (s, 2H), 2.52 (s, 3H).

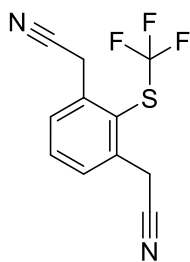
* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 139.4, 137.2, 134.9, 134.6, 129.4, 129.3 (q, J = 309 Hz), 124.50 (q, J = 2 Hz), 116.6, 20.7, 20.1

* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm):** - 43.13 (s)





2,2'-(2-((Trifluoromethyl)thio)-1,3-phenylene)diacetonitrile (2g)



$C_{11}H_7F_3N_2S$
256.25

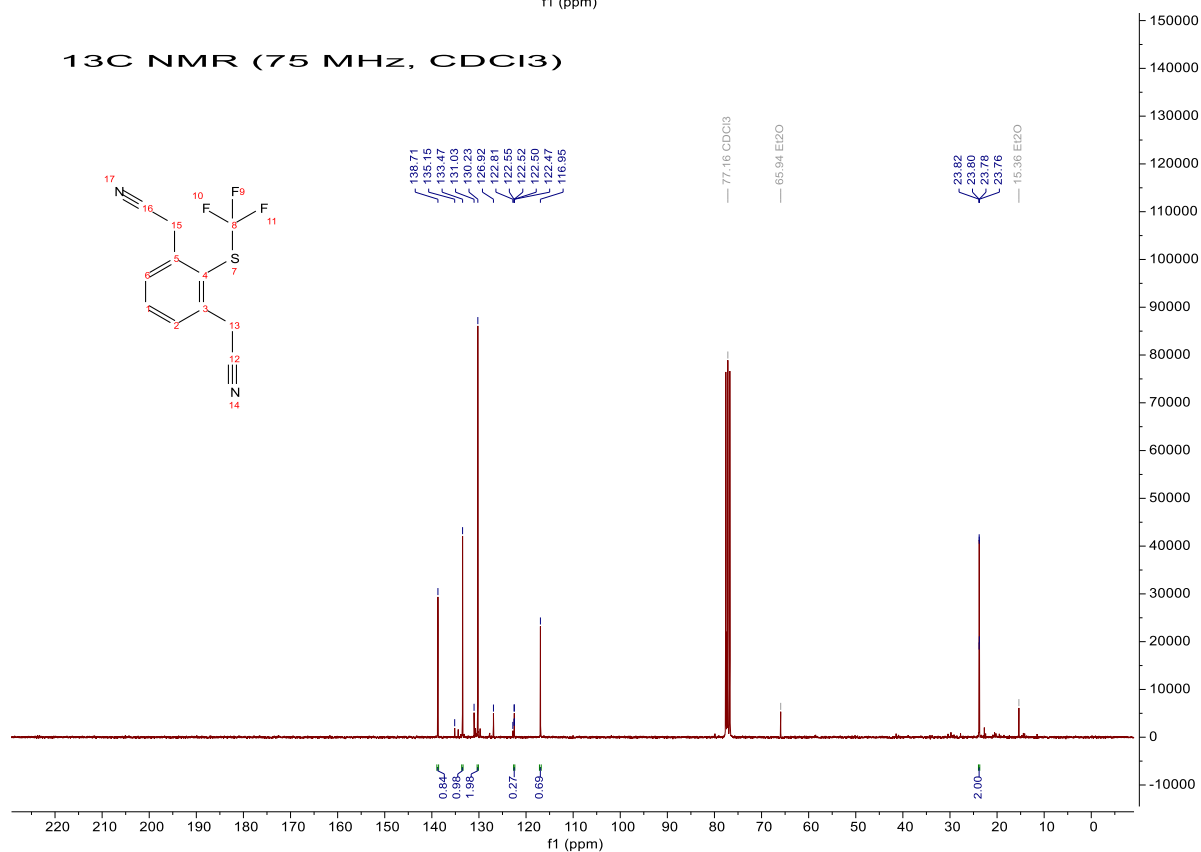
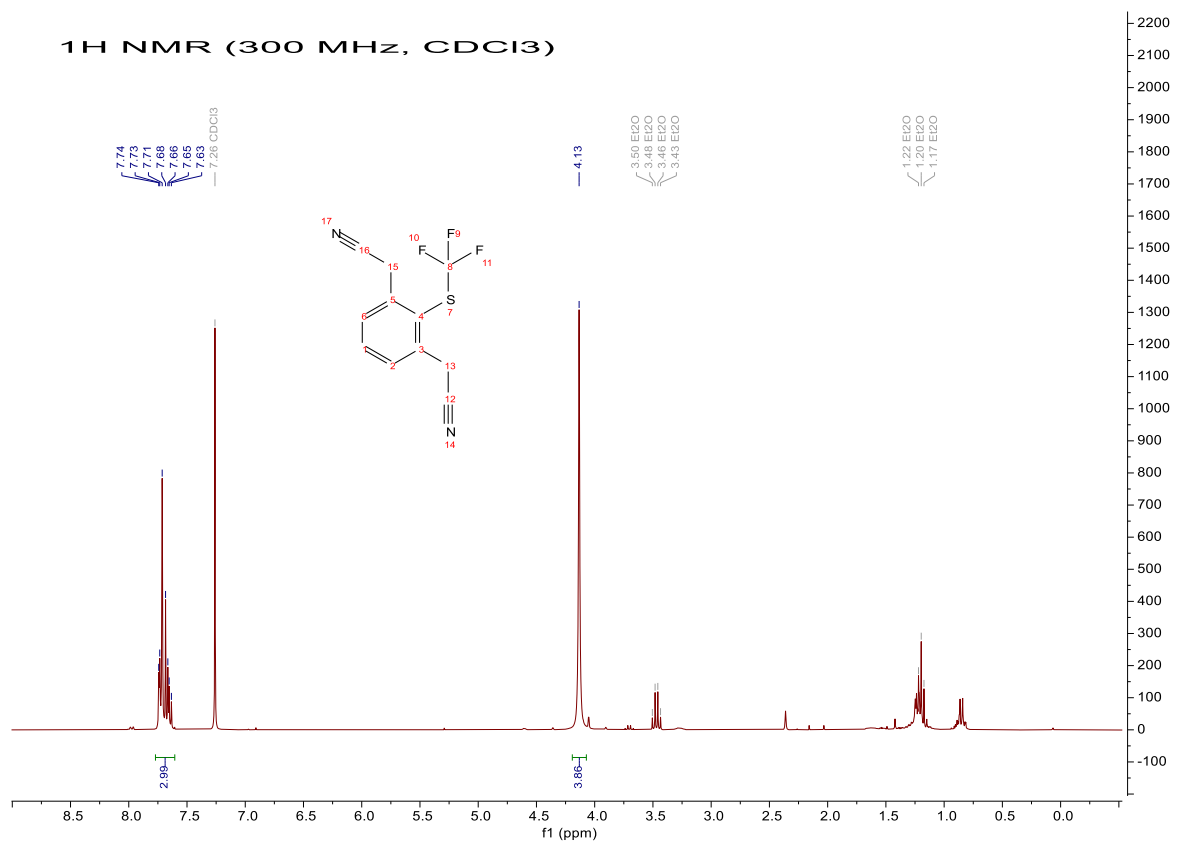
Reaction carried out following the general procedure 2 using 2-(2-((trifluoromethyl)sulfinyl)phenyl)acetonitrile (116 mg, 0.5 mmol) with acetonitrile. NMR ^{19}F yield = 62%. Purified by flash chromatography (Gradient: petroleum ether/diethyl ether 100:0 to 60:40), affording the product as an orange oil (63 mg, 0.25 mmol). Yield = 49%.

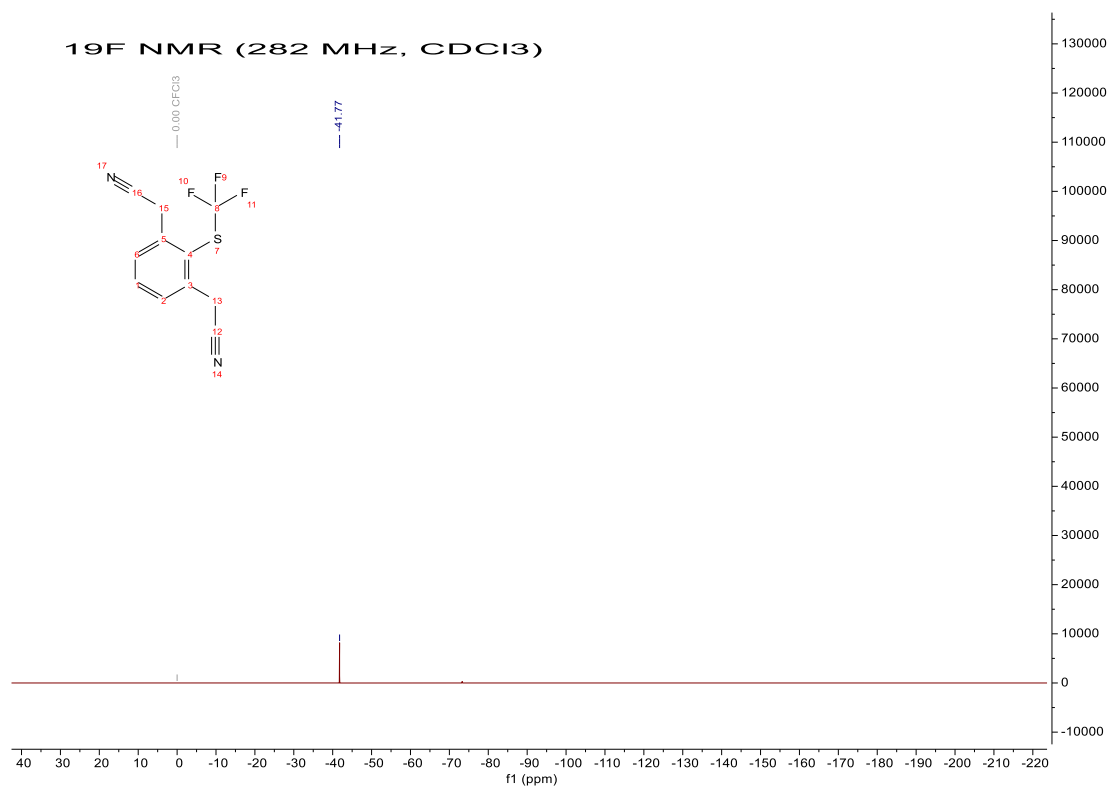
* **HRMS ASAP+TOF:** Calculated for $C_{11}H_8F_3N_2S[M+H]^+$: 257.0360; Found $[M+H]^+$: 257.0368

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 7.76 – 7.62 (m, 3H), 4.13 (s, 4H).

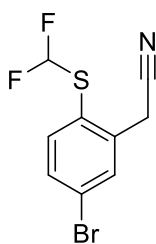
* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 138.1, 135.2, 130.2 (2C), 129.0 (q, J = 311 Hz), 122.5 (q, J = 2 Hz, 2C), 117.0 (2C), 23.8 (q, J = 2 Hz, 2C)

* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm):** -41.77 (s)





2-(5-Bromo-2-((difluoromethyl)thio)phenyl)acetonitrile (2h)



C₉H₆BrF₂NS
278.11

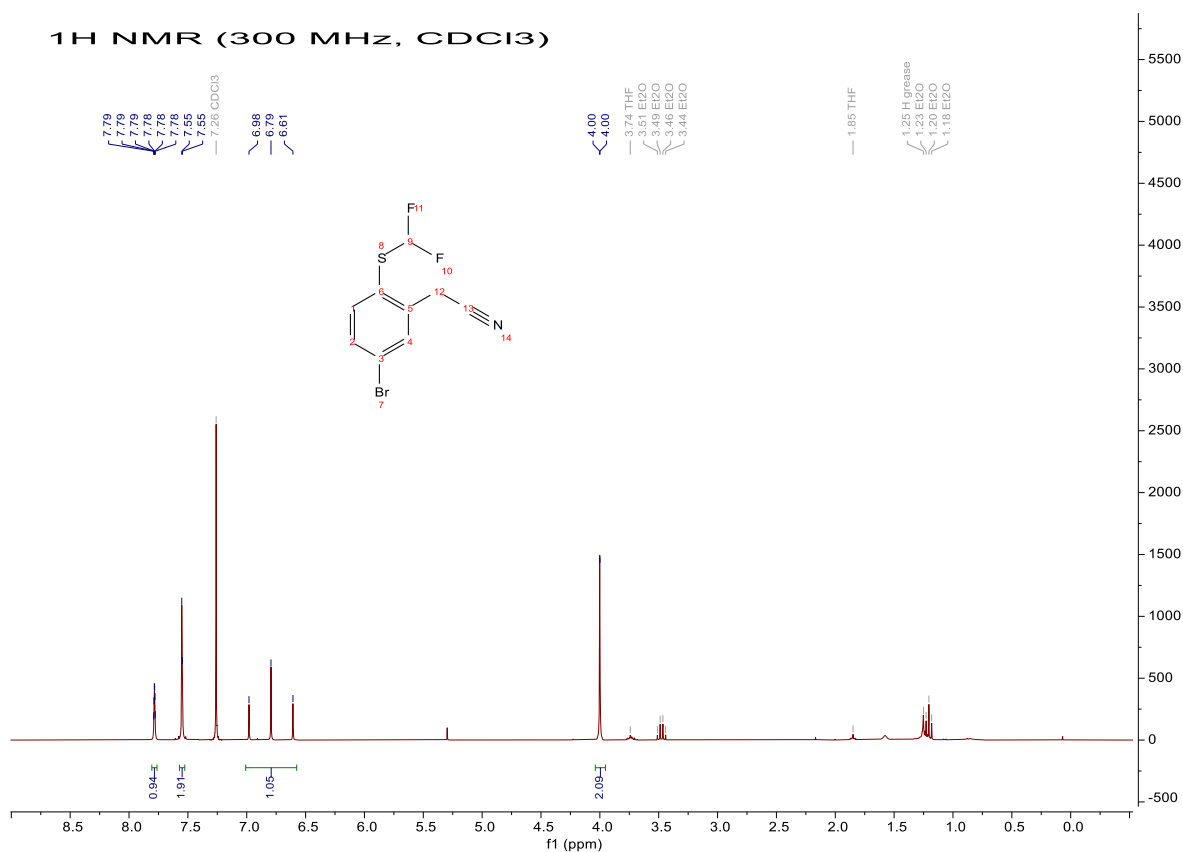
Reaction carried out following the general procedure 2 using 1-bromo-4-((difluoromethyl)sulfinyl)benzene (144 mg, 0.57 mmol). NMR ¹⁹F yield = 51%. Purified by preparative TLC (petroleum ether/diethyl ether 7:3), affording the product as a yellow oil (71 mg, 0.26 mmol). Yield = 45%.

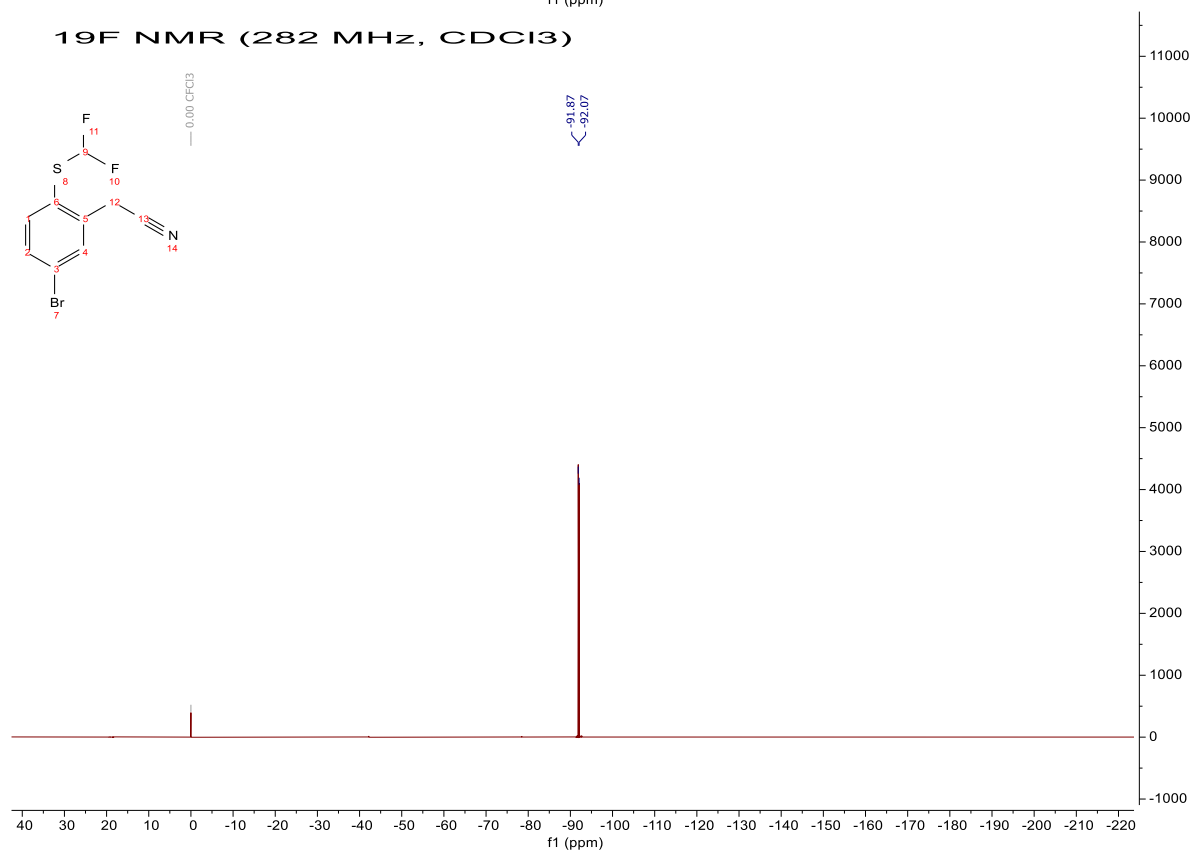
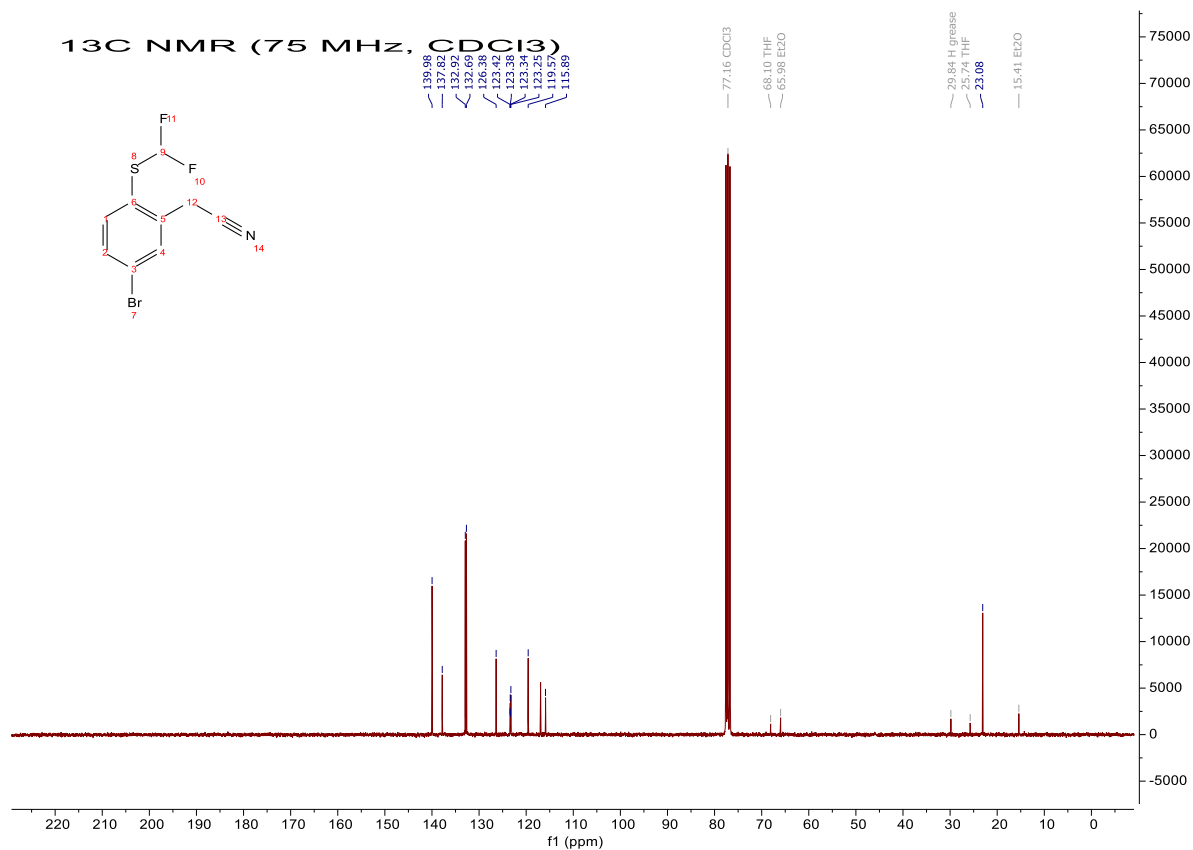
* **HRMS ASAP+TOF:** Calculated for C₉H₇BrF₂NS[M+H]⁺; Found [M+H]⁺: 276.9361

* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.79 – 7.78 (m, 1H), 7.56 – 7.54 (m, 2H), 6.79 (t, *J* = 56 Hz, 1H), 4.00 (d, *J* = 1 Hz, 2H).

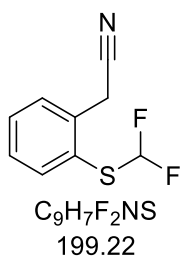
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm):** 140.0, 137.8, 132.9, 132.7, 126.4, 123.4 (t, *J* = 3 Hz), 119.6 (t, *J* = 278 Hz), 115.9, 23.1

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm):** - 91.97 (d, *J* = 56 Hz)





2-(2-((Difluoromethyl)thio)phenyl)acetonitrile (2i)



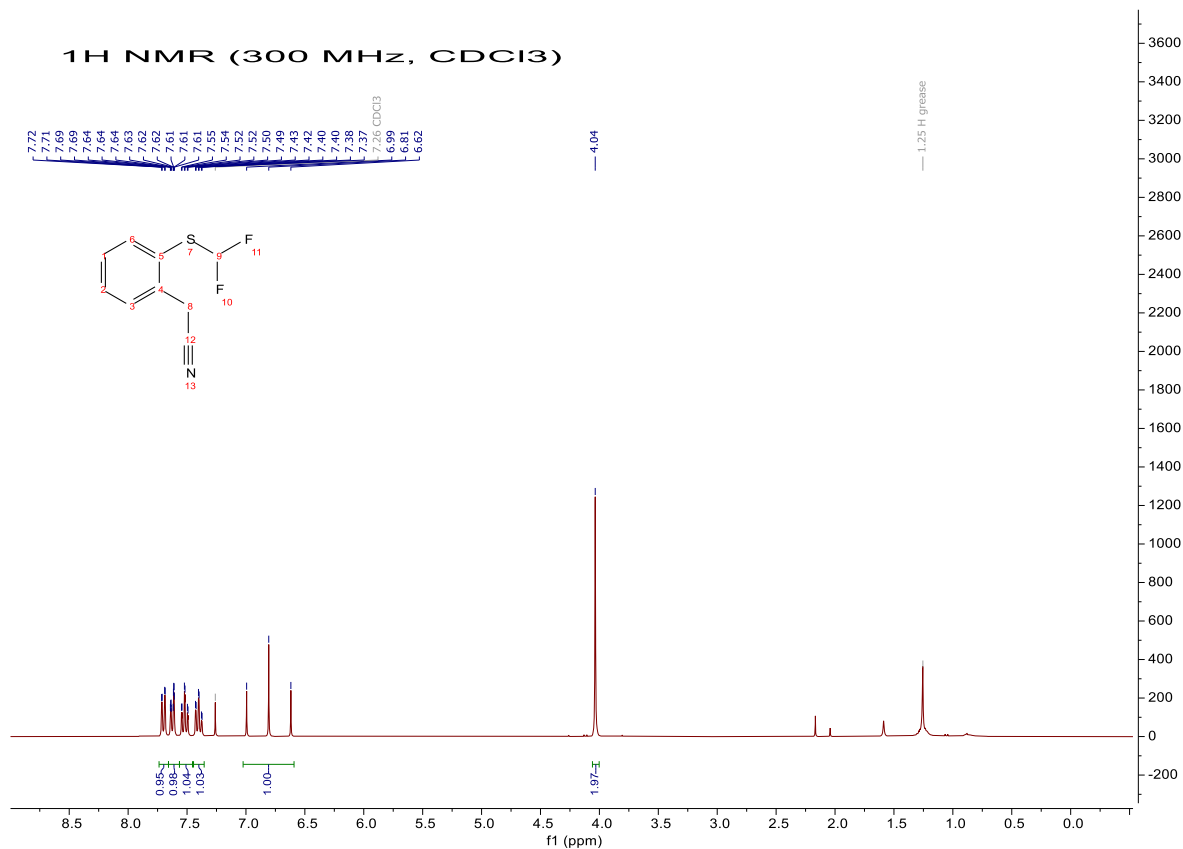
Reaction carried out following the general procedure 2 using ((difluoromethyl)sulfinyl)benzene (98 mg, 0.56 mmol). NMR ^{19}F yield = 60%. Purified by preparative TLC (*n*-pentane/EtOAc 84:16) affording the product as an orange oil (28 mg, 0.14 mmol). Yield = 25%. Highly volatile product.

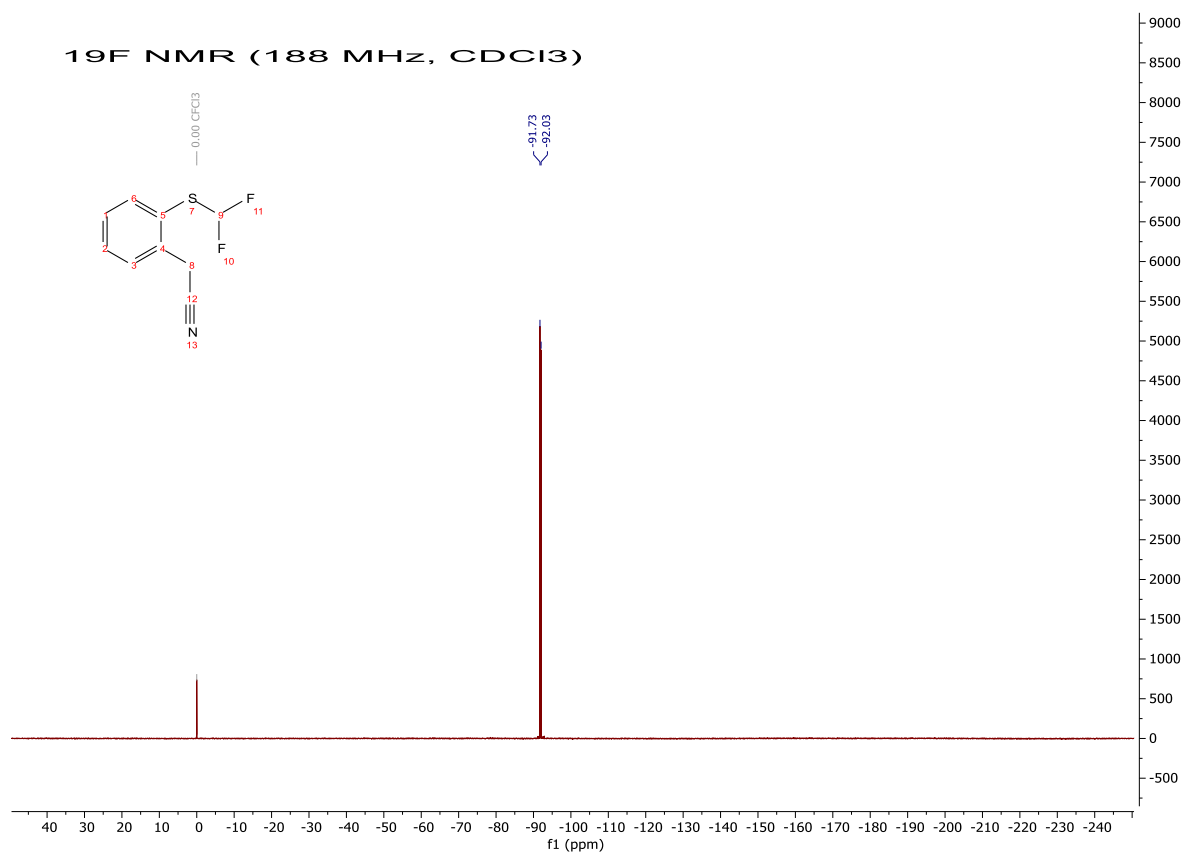
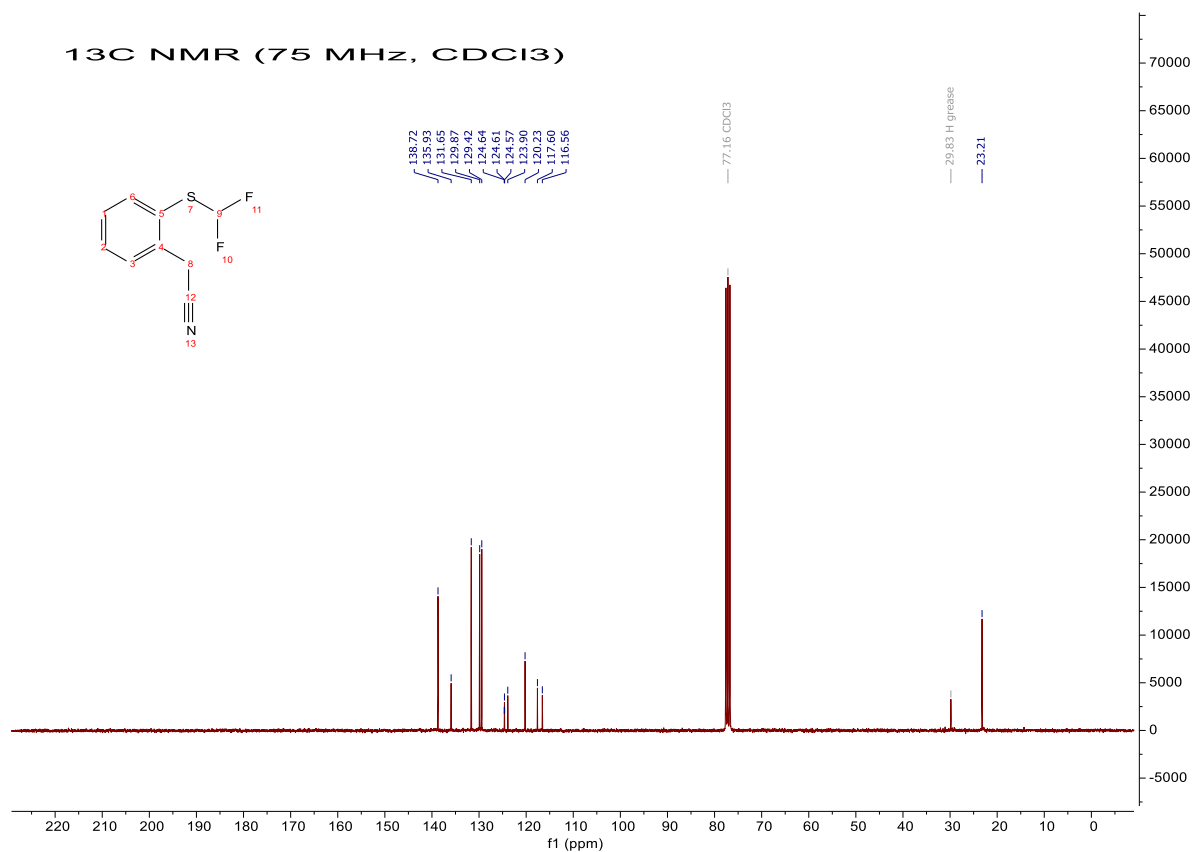
* **HRMS ASAP+TOF:** Calculated for $\text{C}_9\text{H}_8\text{F}_2\text{NS}$ $[\text{M}+\text{H}]^+$: 200.0346; Found $[\text{M}+\text{H}]^+$: 200.0353.

* **^1H NMR (300 MHz, CDCl_3) δ (ppm):** 7.70 (dd, $J = 8$ Hz, 2 Hz, 1H), 7.63 (dd, $J = 8$ Hz, 2 Hz, 1H), 7.52 (td, $J = 8$ Hz, 2 Hz, 1H), 7.40 (td, $J = 8$ Hz, 2 Hz, 1H), 6.81 (t, $J = 56$ Hz, 1H), 4.04 (s, 2H).

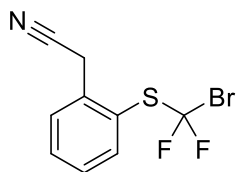
* **^{13}C NMR (75 MHz, CDCl_3) δ (ppm):** 138.7, 135.9, 131.6, 129.9, 129.4, 124.6 (t, $J = 3$ Hz), 120.2 (t, $J = 277$ Hz), 117.6, 23.2.

* **^{19}F NMR (188 MHz, CDCl_3) δ (ppm):** -91.88 (d, $J = 56$ Hz).





2-(2-((Bromodifluoromethyl)thio)phenyl)acetonitrile (2j)



C₉H₆BrF₂NS
278.11

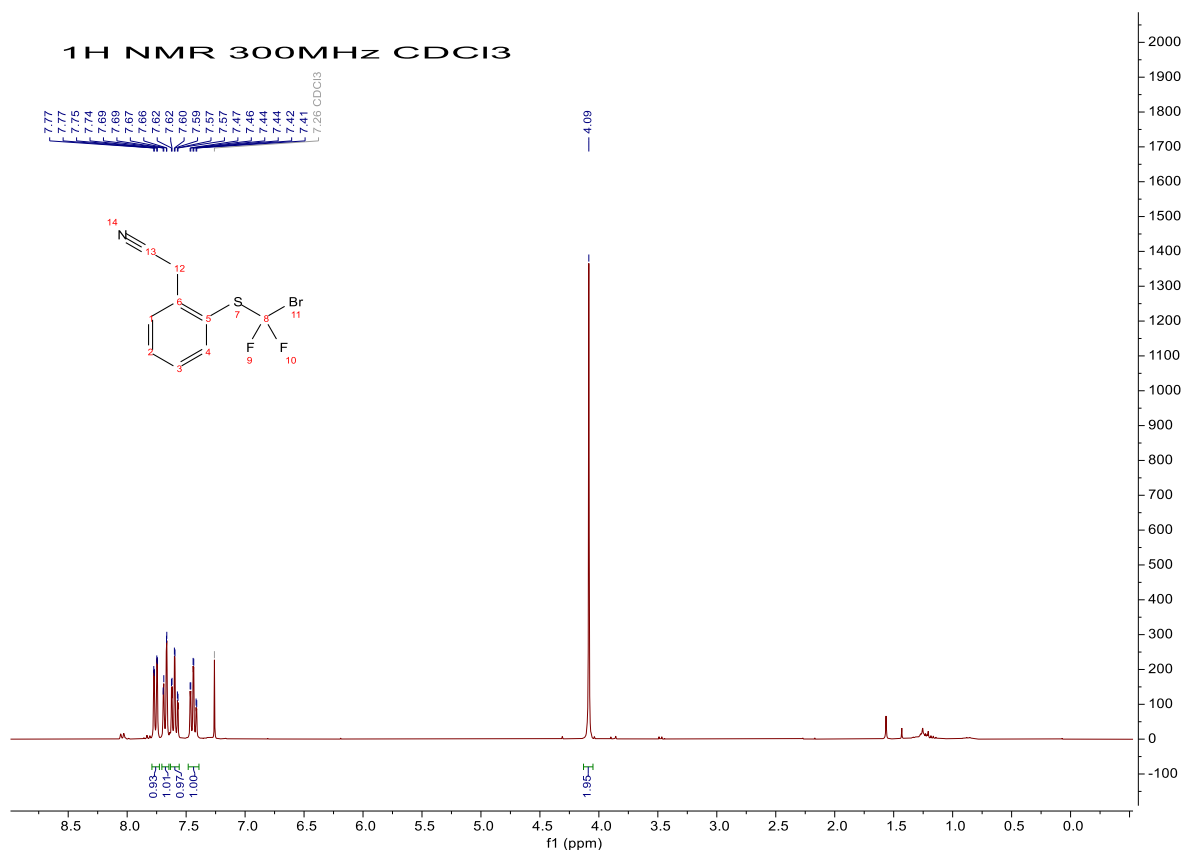
Reaction carried out following the general procedure 2 using ((bromodifluoromethyl)sulfinyl)benzene (128 mg, 0.50 mmol). NMR ¹⁹F yield = 71%. Purified by preparative TLC (petroleum ether/diethyl ether 8:2), affording the product as an orange oil (92 mg, 0.33 mmol). Yield = 67%.

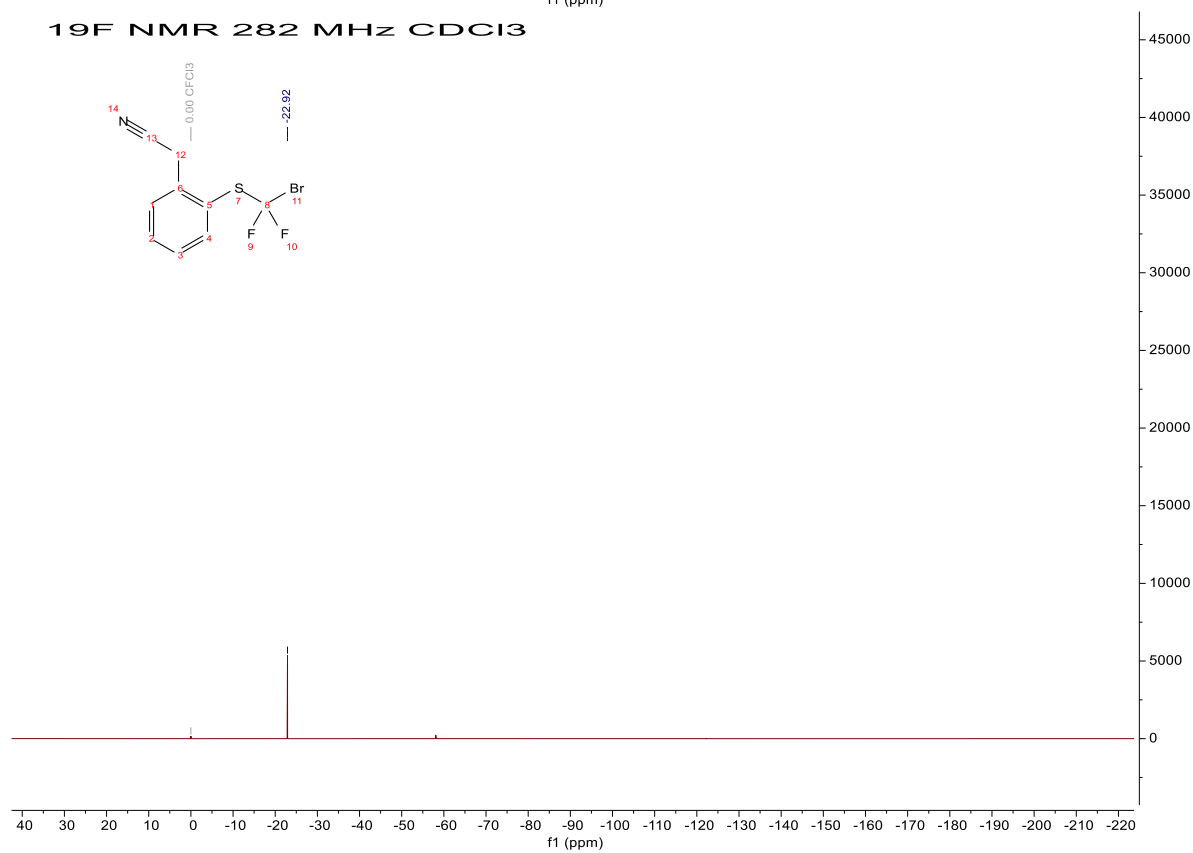
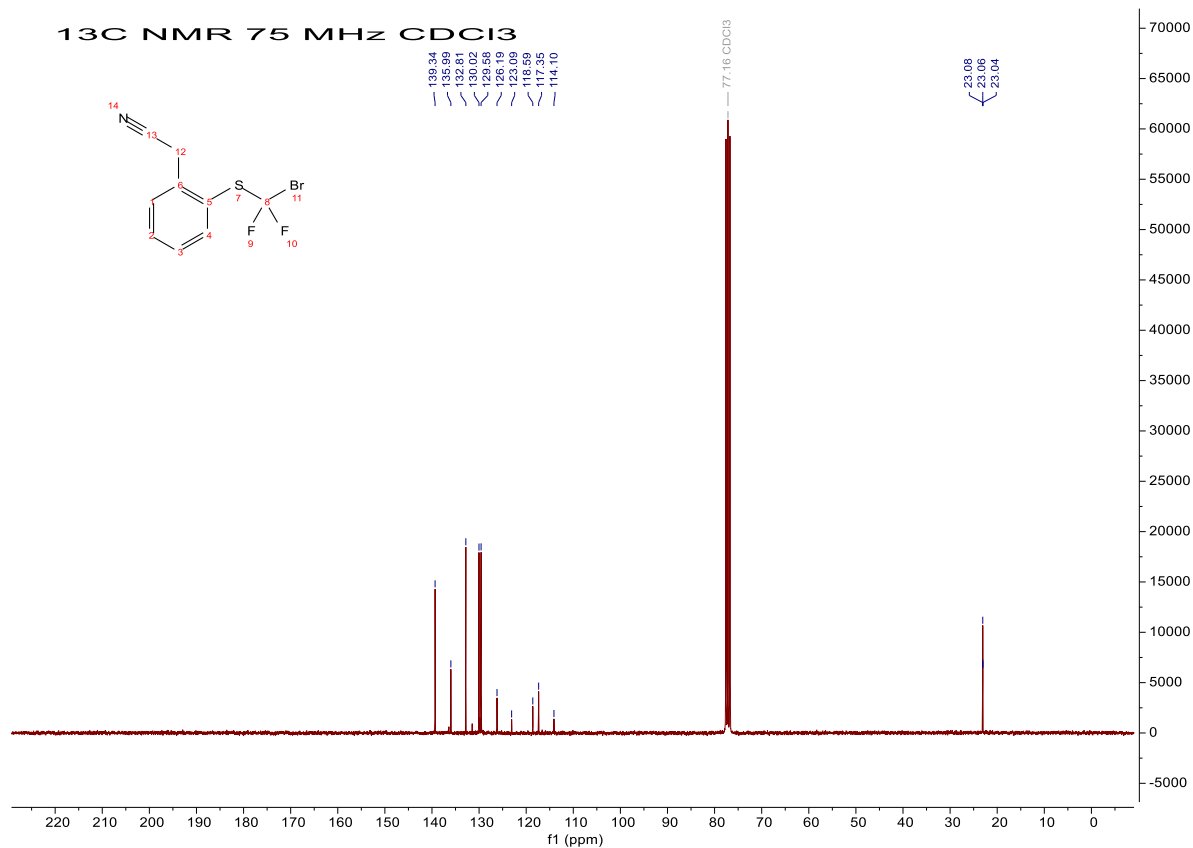
* **HRMS ASAP+TOF**: Calculated for C₉H₆BrF₂N₂S₂[2M+H]⁺:554.8823 ; Found [2M+H]⁺: 554.8822

* **¹H NMR (300 MHz, CDCl₃) δ (ppm)**: 7.76 (dd, *J* = 8 Hz, 1 Hz, 1H), 7.68 (dd, *J* = 8 Hz, 1 Hz, 1H), 7.60 (td, *J* = 8 Hz, 1 Hz, 1H), 7.44 (td, *J* = 8 Hz, 1 Hz, 1H), 4.09 (s, 2H).

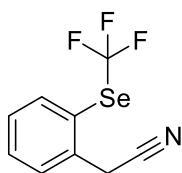
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm)**: 139.3, 136.0, 132.8, 130.0, 129.6, 126.2, 118.6 (t, *J* = 339 Hz), 117.4, 23.1 (t, *J* = 1 Hz)

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm)**: - 22.92 (s)





2-(2-((Trifluoromethyl)selenanyl)phenyl)acetonitrile (2k)



$C_9H_6F_3NSe$
264.12

Reaction carried out following the general procedure 2 using ((trifluoromethyl)seleninyl)benzene (93 mg, 0.39 mmol) with acetonitrile. NMR ^{19}F yield = 16%. Purified by flash chromatography (gradient: *n*-pentane/EtOAc 100:0 to 90:10), affording the product as an orange oil (15 mg, 0.06 mmol). Yield = 15%.

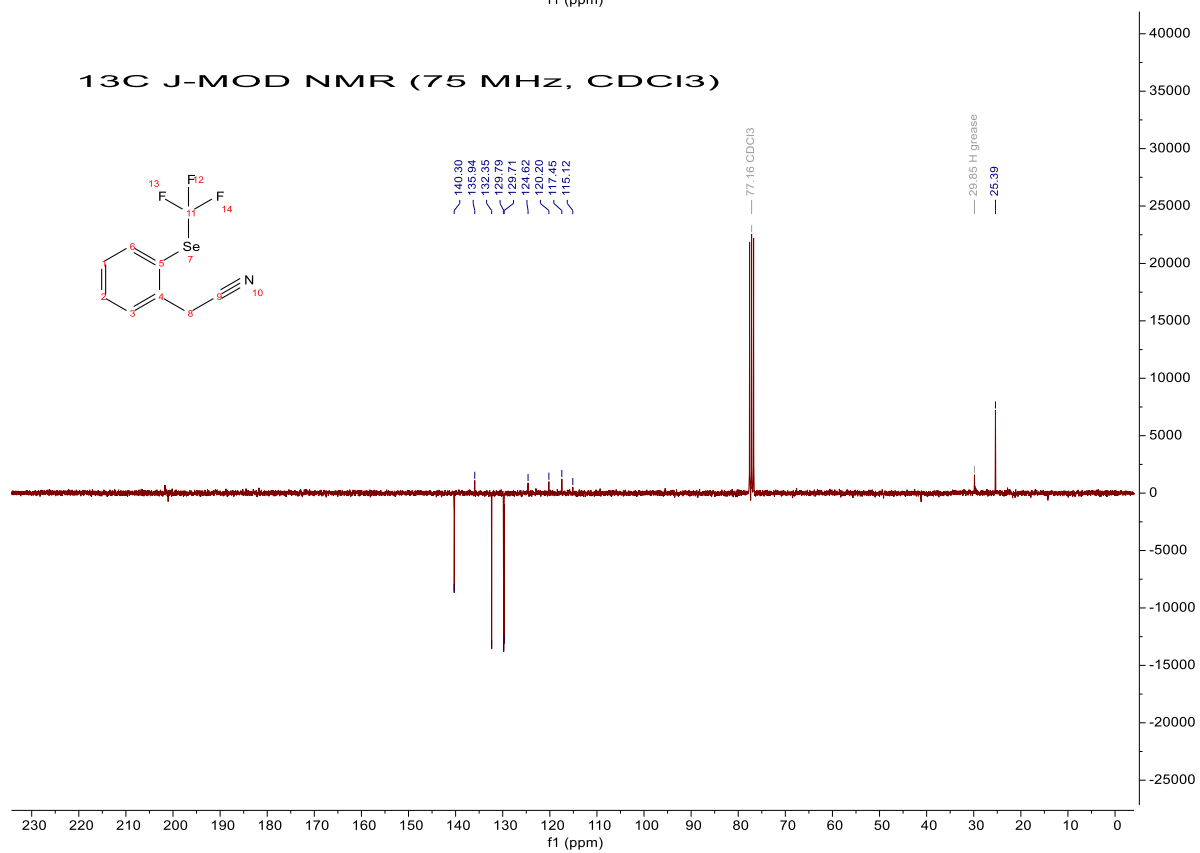
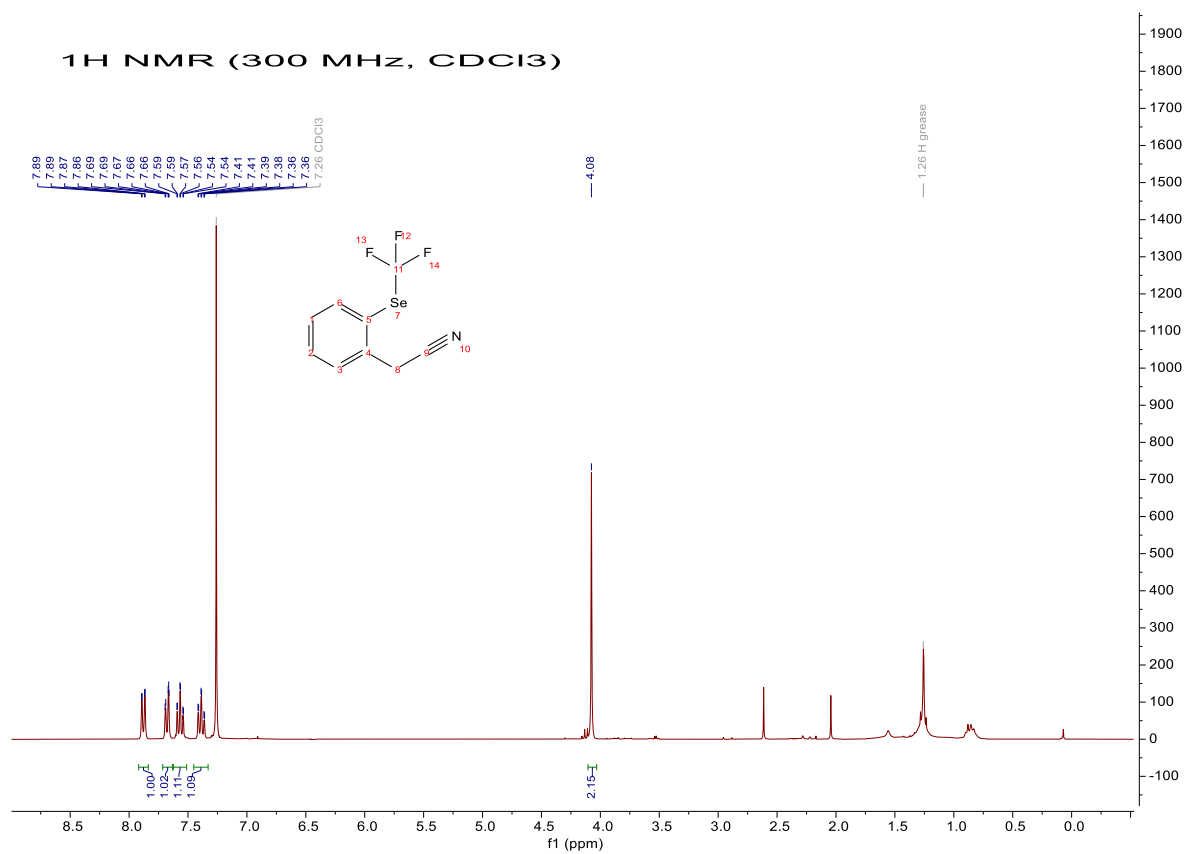
* **HRMS ASAP+TOF**: Calculated for $C_9H_7F_3NSe[M+H]^+$: pending; Found $[M+H]^+$: pending

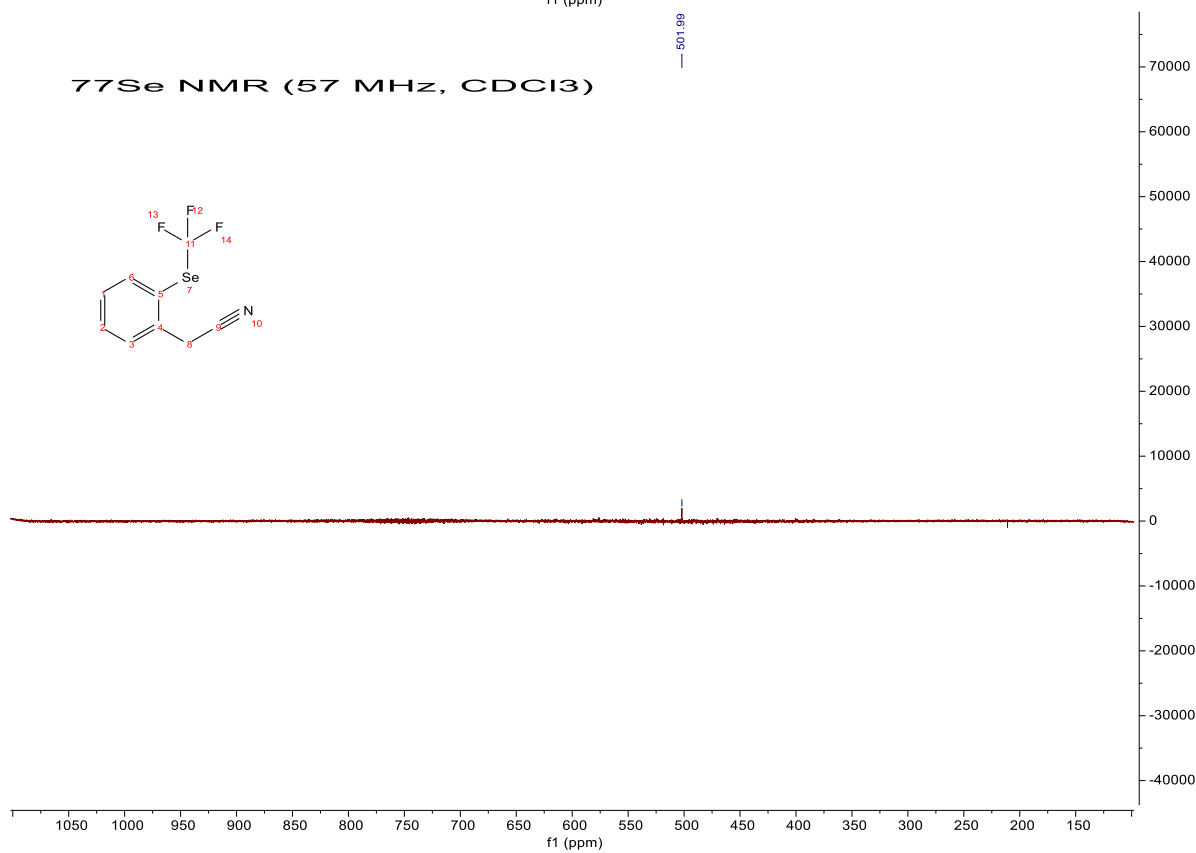
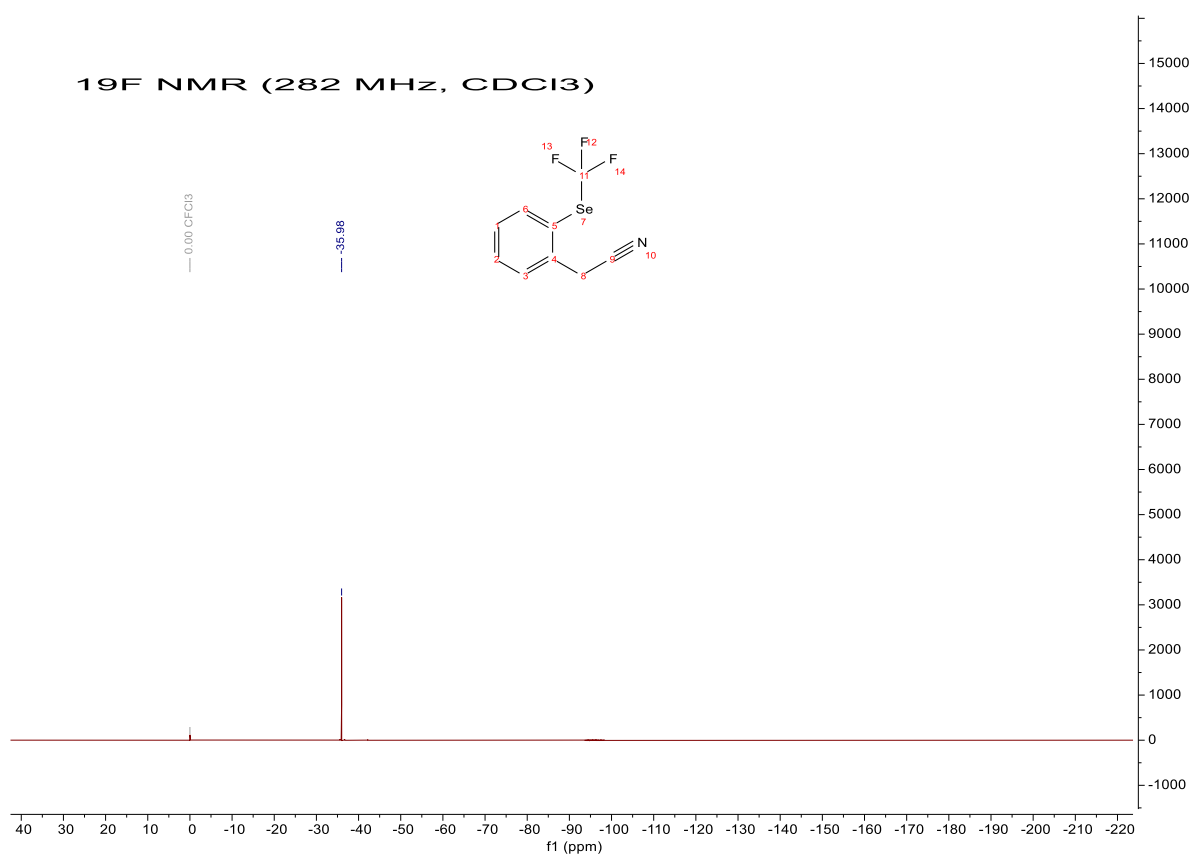
* **1H NMR (300 MHz, $CDCl_3$) δ (ppm)**: 7.88 (dd, $J = 8$, 1 Hz, 1H), 7.68 (dd, $J = 8$, 1 Hz, 1H), 7.57 (td, $J = 8$, 1 Hz, 1H), 7.39 (td, $J = 8$, 1 Hz, 1H), 4.08 (s, 2H).

* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm)**: 140.3, 135.9, 132.4, 129.8, 129.7, 122.4 (d, $J = 334$ Hz), 117.5, 115.1, 25.4

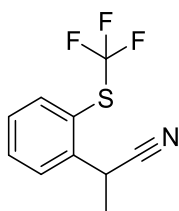
* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm)**: -35.98 (s)

* **^{77}Se NMR (57 MHz, $CDCl_3$) δ (ppm)**: 501.99 (s)





2-(2-((Trifluoromethyl)thio)phenyl)propanenitrile (3a)



C₁₀H₈F₃NS
231.24

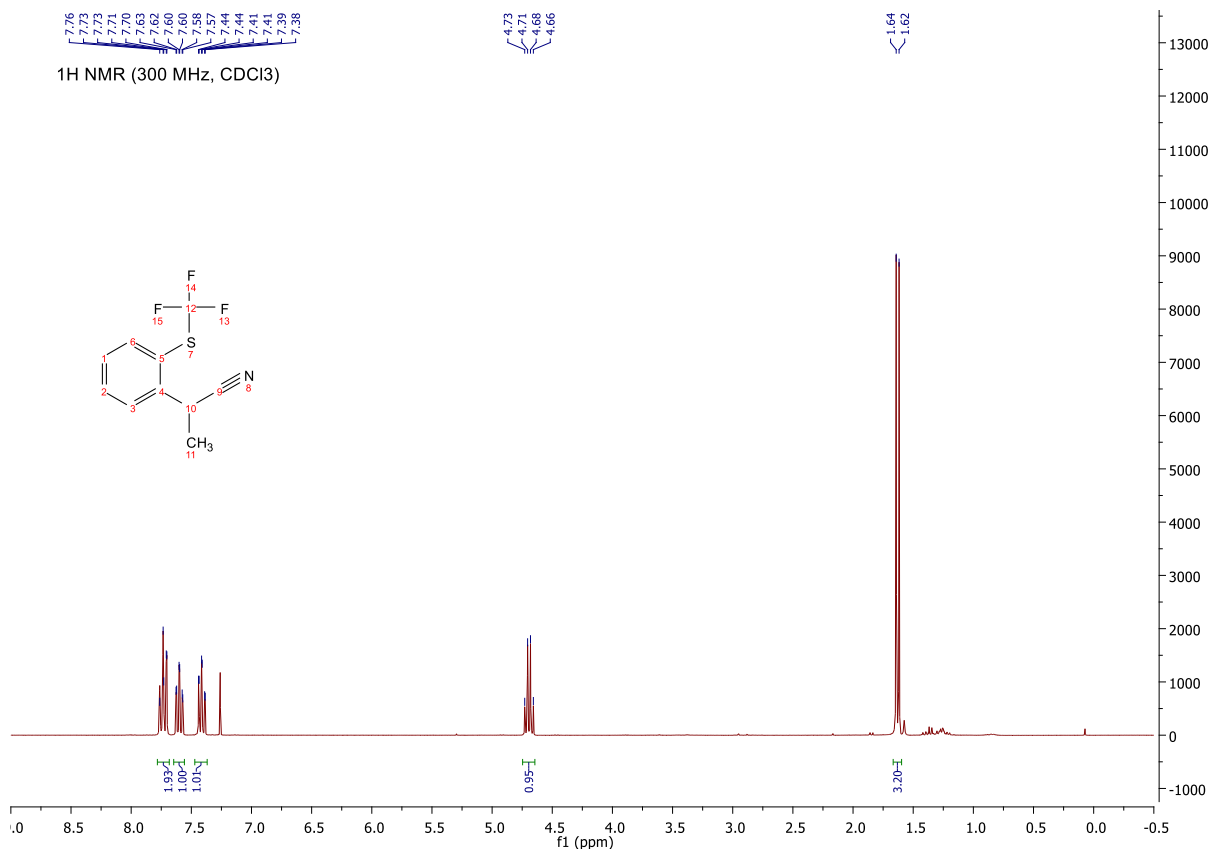
Reaction carried out following the general procedure 2 using propionitrile and ((trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) and propionitrile. NMR ¹⁹F yield = 87%. Purified by preparative TLC (petroleum ether/diethyl ether 7:3) affording the product as a yellow oil (83 mg, 0.36 mmol). Yield = 72%.

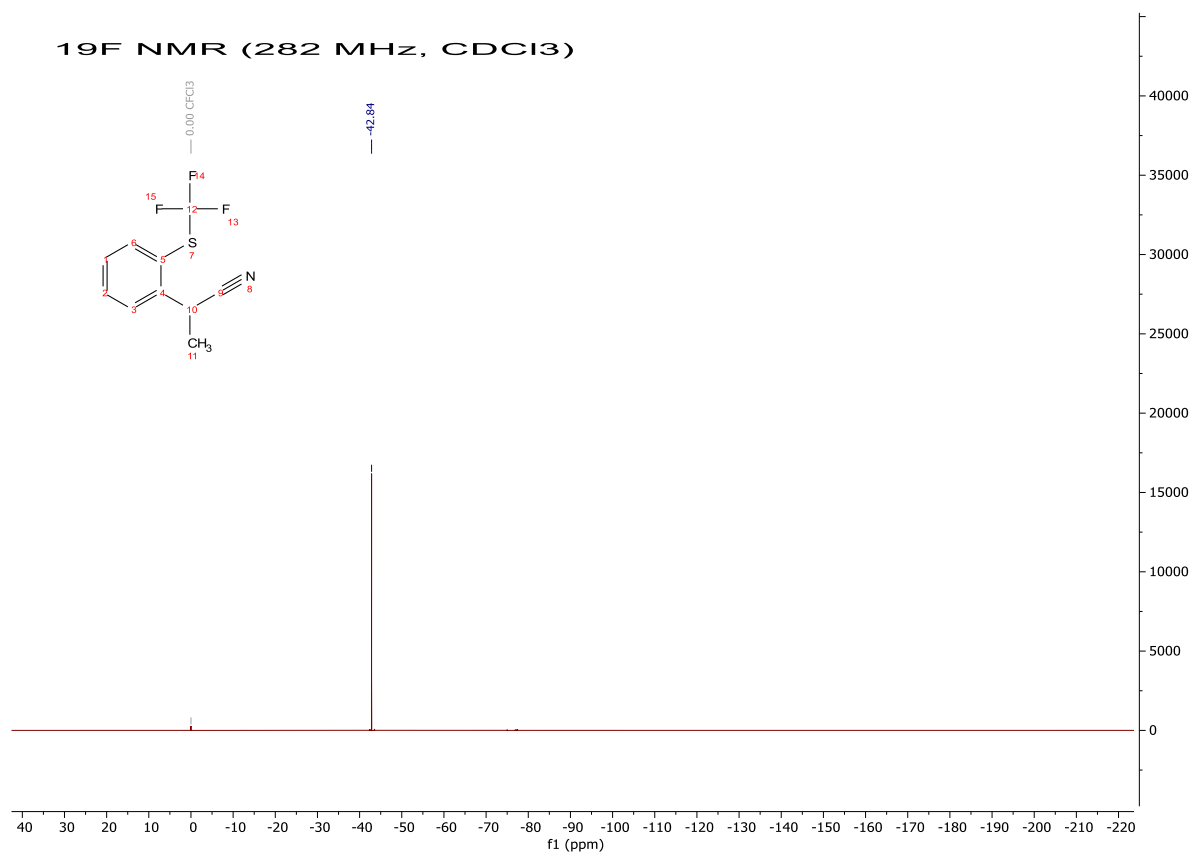
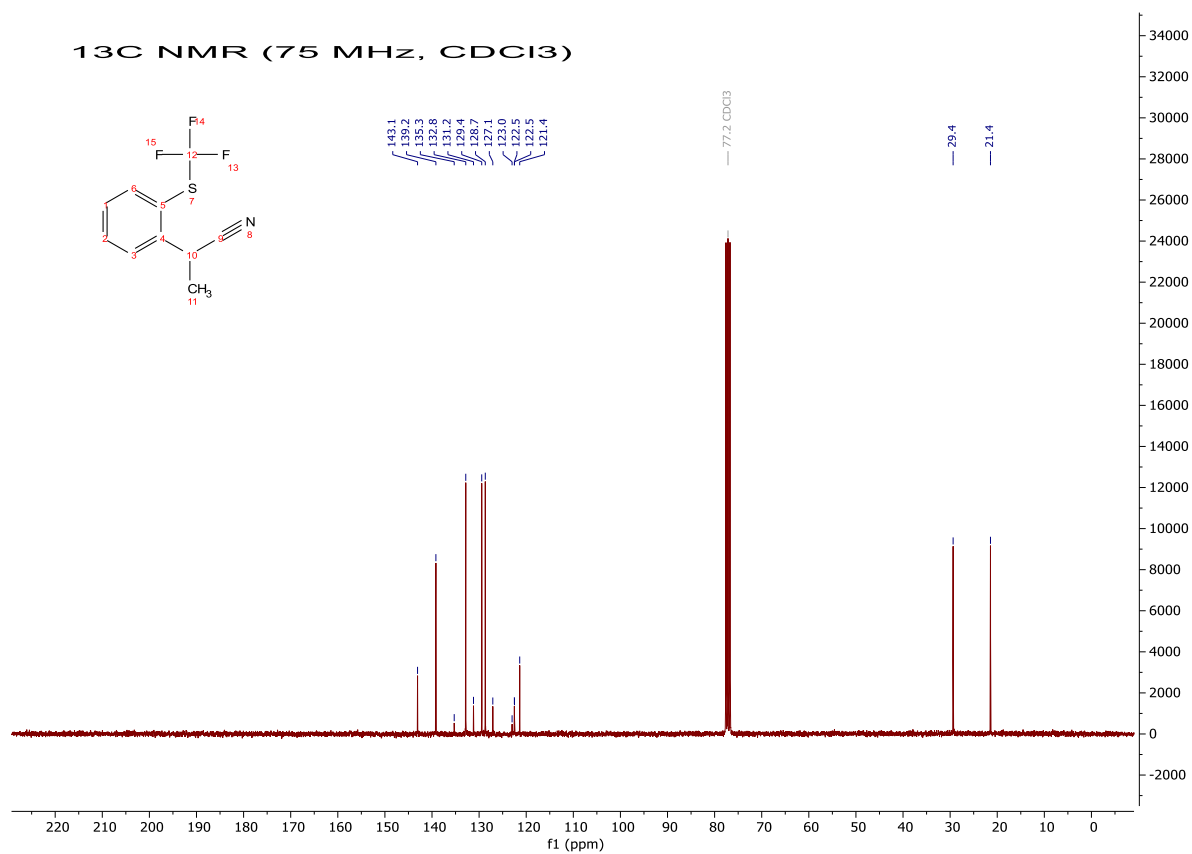
* **HRMS ASAP+TOF**: Calculated for C₁₀H₉F₃NS[M+H]⁺: 232.0408 ; Found [M+H]⁺: 232.0412.

* **¹H NMR (300 MHz, CDCl₃) δ (ppm)**: 7.76 – 7.70 (m, 2H), 7.60 (td, *J* = 8 Hz, 2 Hz, 1H), 7.41 (td, *J* = 8 Hz, 2 Hz, 1H), 4.69 (q, *J* = 7 Hz, 1H), 1.63 (d, *J* = 7 Hz, 3H).

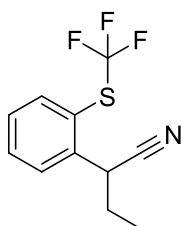
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm)**: 143.1, 139.2, 132.8, 129.4, 129.1 (q, *J* = 309 Hz), 128.7, 122.5 (q, *J* = 2 Hz), 121.4, 29.4, 21.4

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm)**: -42.89 (s)





2-(2-((Trifluoromethyl)thio)phenyl)butanenitrile (3b)



C₁₁H₁₀F₃NS
MW: 245.26

Reaction carried out following the general procedure 2 using ((trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) and butyronitrile. NMR ¹⁹F yield = 80%. Purified by : firstly, preparative TLC (petroleum ether/diethyl ether 7:3), secondly, flash chromatography (*n*-pentane/EtOAc 100:0 to 88:12 gradient) affording the product as a yellow oil (73 mg, 0.3 mmol). Yield = 60%.

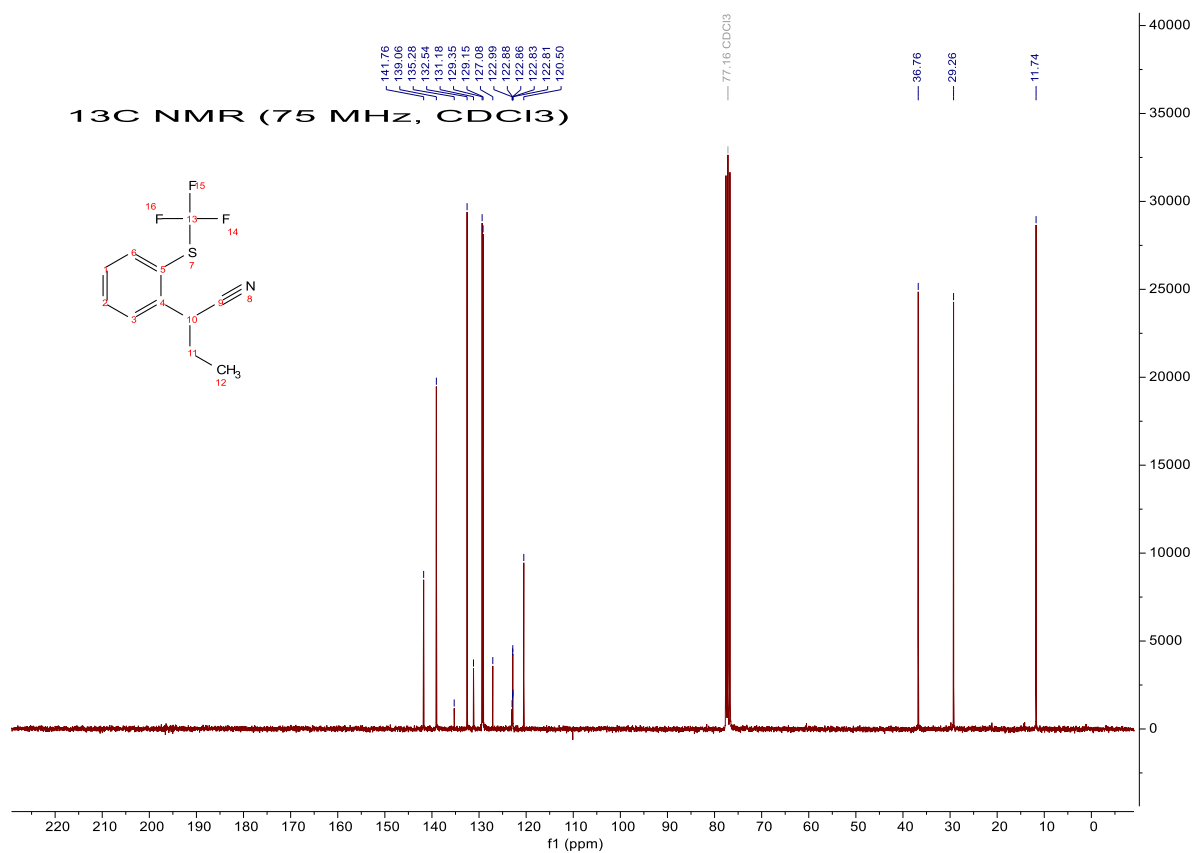
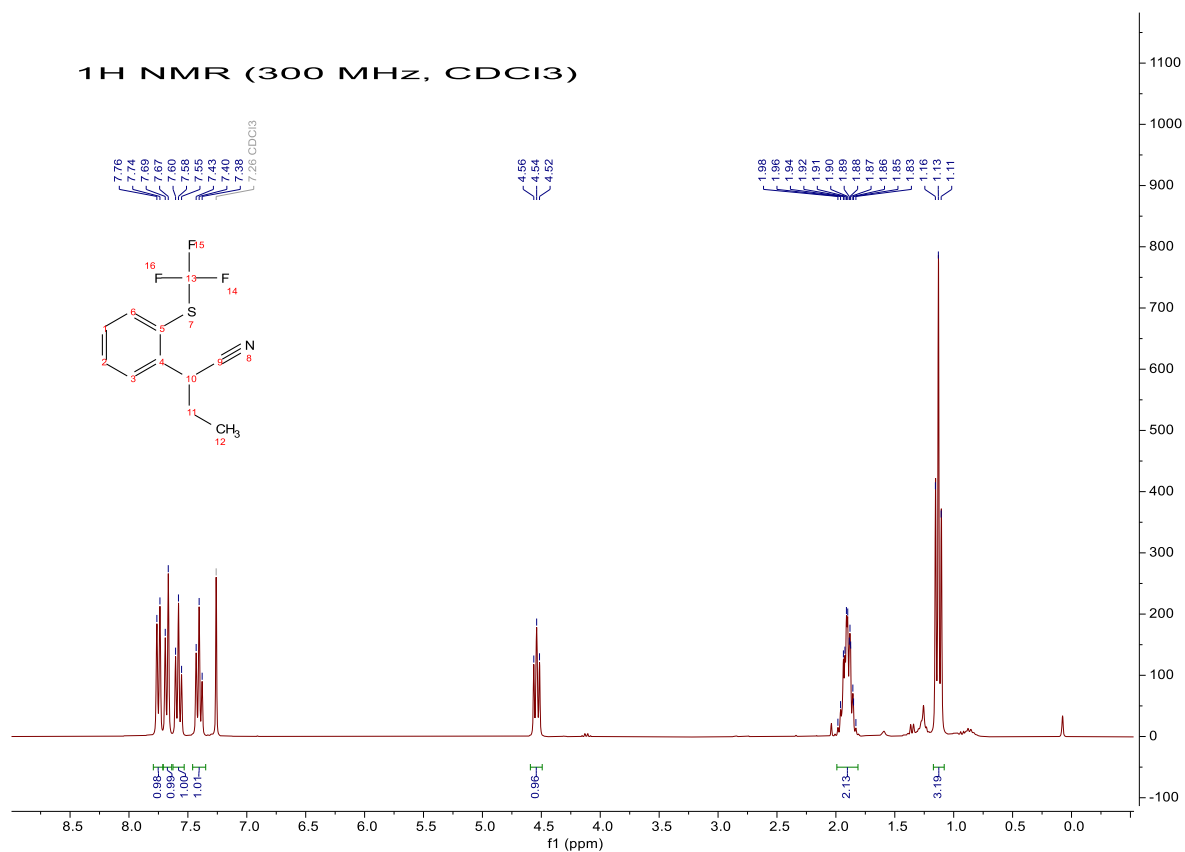
* **HRMS ASAP+TOF**: Calculated for C₂₂H₂₁F₆N₂S₂ [2M+H]⁺:491.1050; Found [2M+H]⁺: 491.1049.

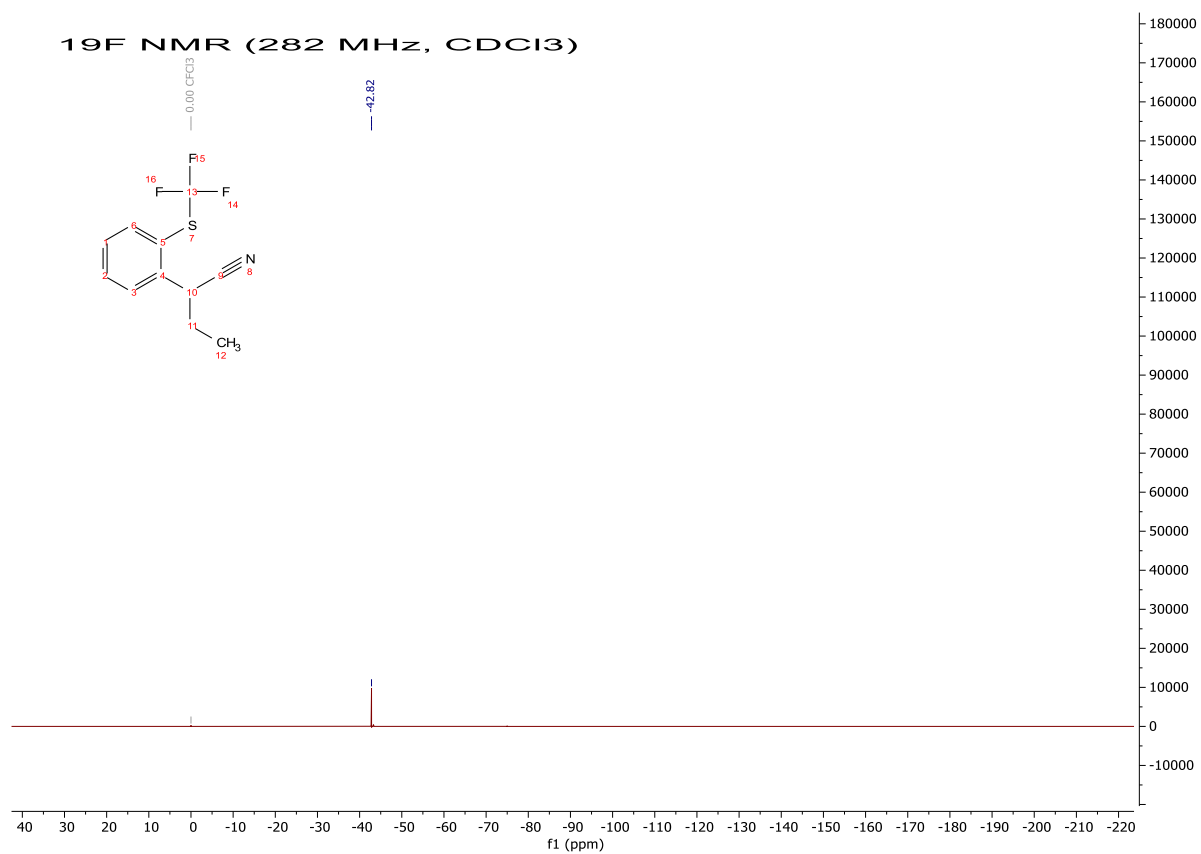
* **¹H NMR (300 MHz, CDCl₃) δ (ppm)**: 7.75 (d, *J* = 8 Hz, 1H), 7.68 (d, *J* = 8 Hz, 1H), 7.58 (t, *J* = 8 Hz, 1H), 7.40 (t, *J* = 8 Hz, 1H), 4.54 (t, *J* = 7 Hz, 1H), 1.98 – 1.93 (m, 2H), 1.13 (t, *J* = 7 Hz, 3H).

* **¹³C NMR (75 MHz, CDCl₃) δ (ppm)**:

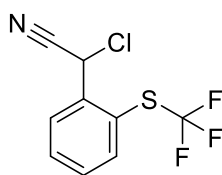
141.8, 139.1, 132.5, 129.3, 129.1 (q, *J* = 309 Hz), 122.9 (q, *J* = 2 Hz), 120.5, 36.8, 29.3, 11.7

* **¹⁹F NMR (282 MHz, CDCl₃) δ (ppm)**: -42.82 (s)





2-Chloro-2-(2-((trifluoromethyl)thio)phenyl)acetonitrile (3d)



$\text{C}_9\text{H}_5\text{ClF}_3\text{NS}$
251.65

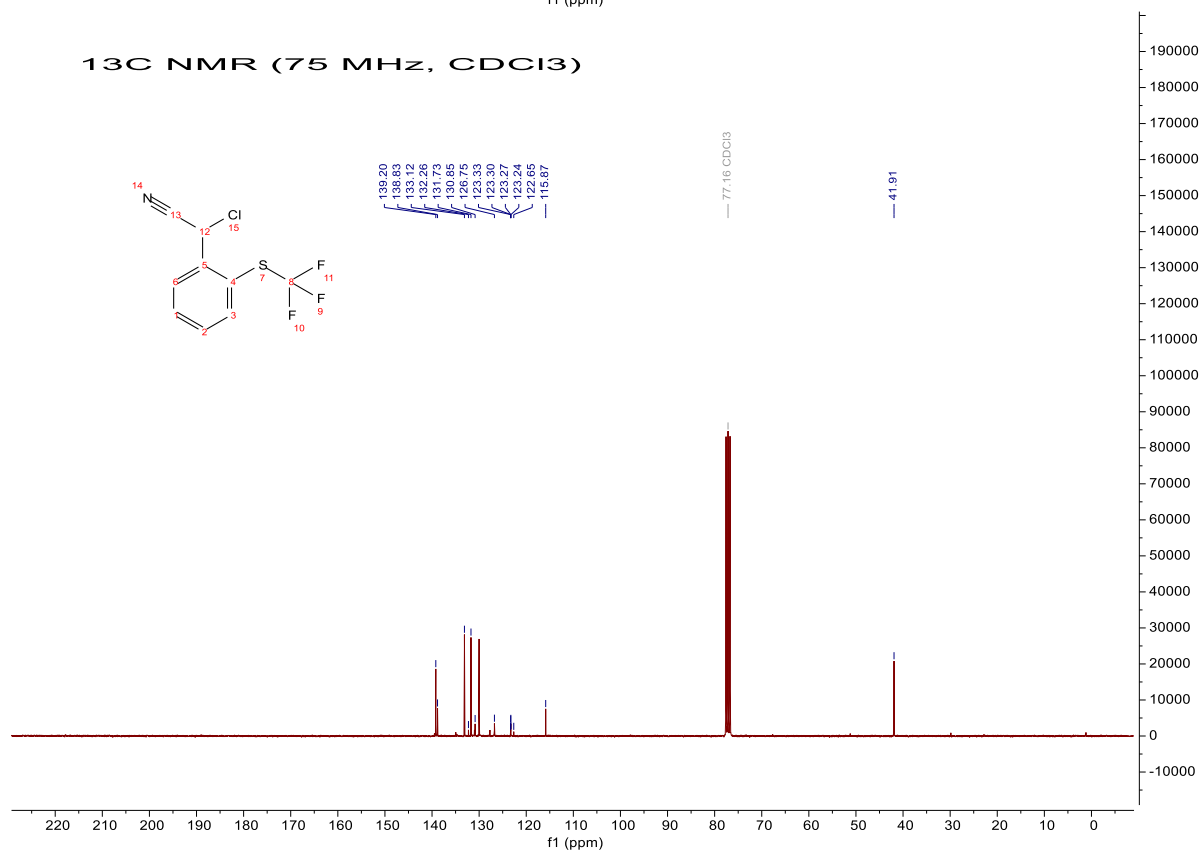
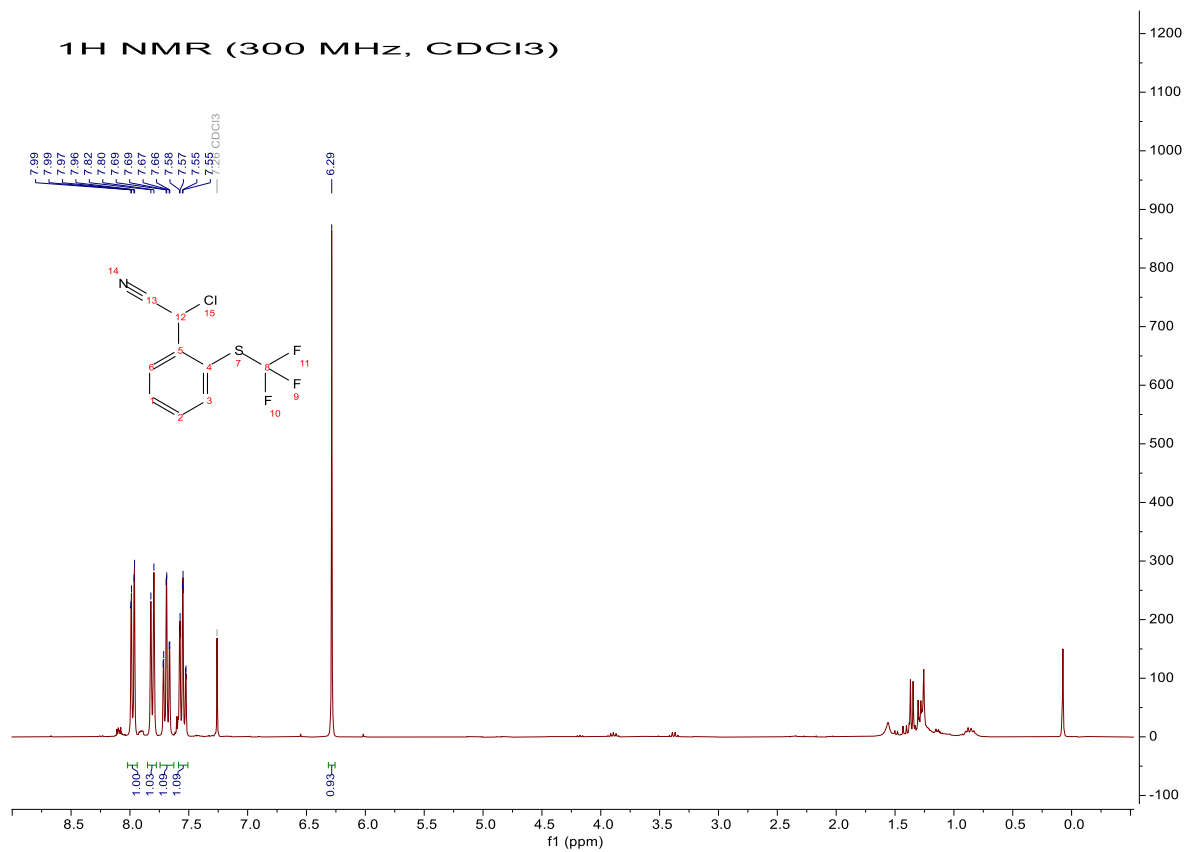
Reaction carried out following the general procedure 2 using ((trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) with chloroacetonitrile. NMR ^{19}F yield = 28%. Purified by flash chromatography (gradient: petroleum ether/diethyl ether 100:0 to 90:10), affording the product as an orange oil (34 mg, 0.14 mmol). Yield = 27%.

* **HRMS ASAP+TOF**: Calculated for $\text{C}_9\text{H}_5\text{ClF}_3\text{NS}[\text{M}+\text{H}]^+$: 251.9862; Found $[\text{M}+\text{H}]^+$: 251.9850

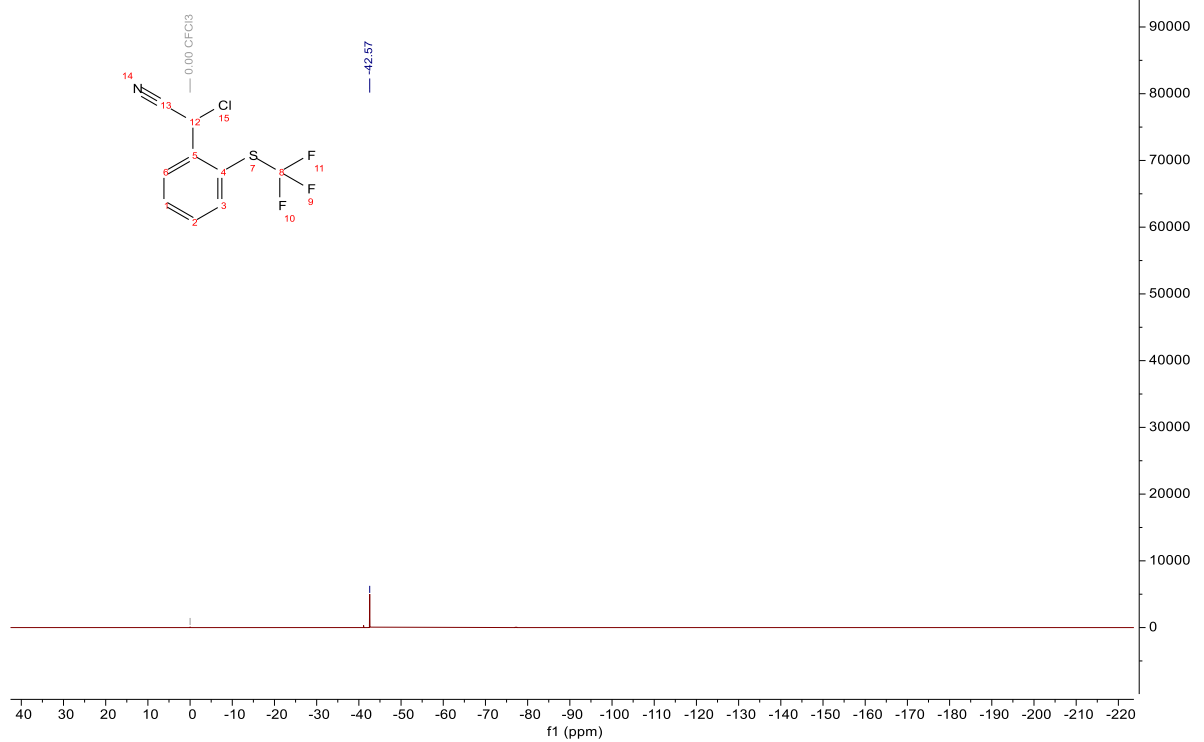
* **^1H NMR (300 MHz, CDCl_3) δ (ppm)**: 7.98 (dd, $J = 8$, 1 Hz, 1H), 7.81 (d, $J = 8$ Hz, 1H), 7.69 (td, $J = 8$, 1 Hz, 1H), 7.55 (td, $J = 8$, 2 Hz, 1H), 6.29 (s, 1H).

* **^{13}C NMR (75 MHz, CDCl_3) δ (ppm)**: 139.2, 138.8, 133.1, 131.7, 130.0, 128.8 (q, $J = 310$ Hz), 123.3 (q, $J = 2$ Hz), 115.9, 41.9

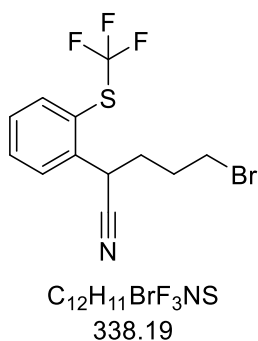
* **^{19}F NMR (282 MHz, CDCl_3) δ (ppm)**: -42.57 (s)



¹⁹F NMR (282 MHz, CDCl₃)



5-Bromo-2-(2-((trifluoromethyl)thio)phenyl)pentanenitrile (3e)



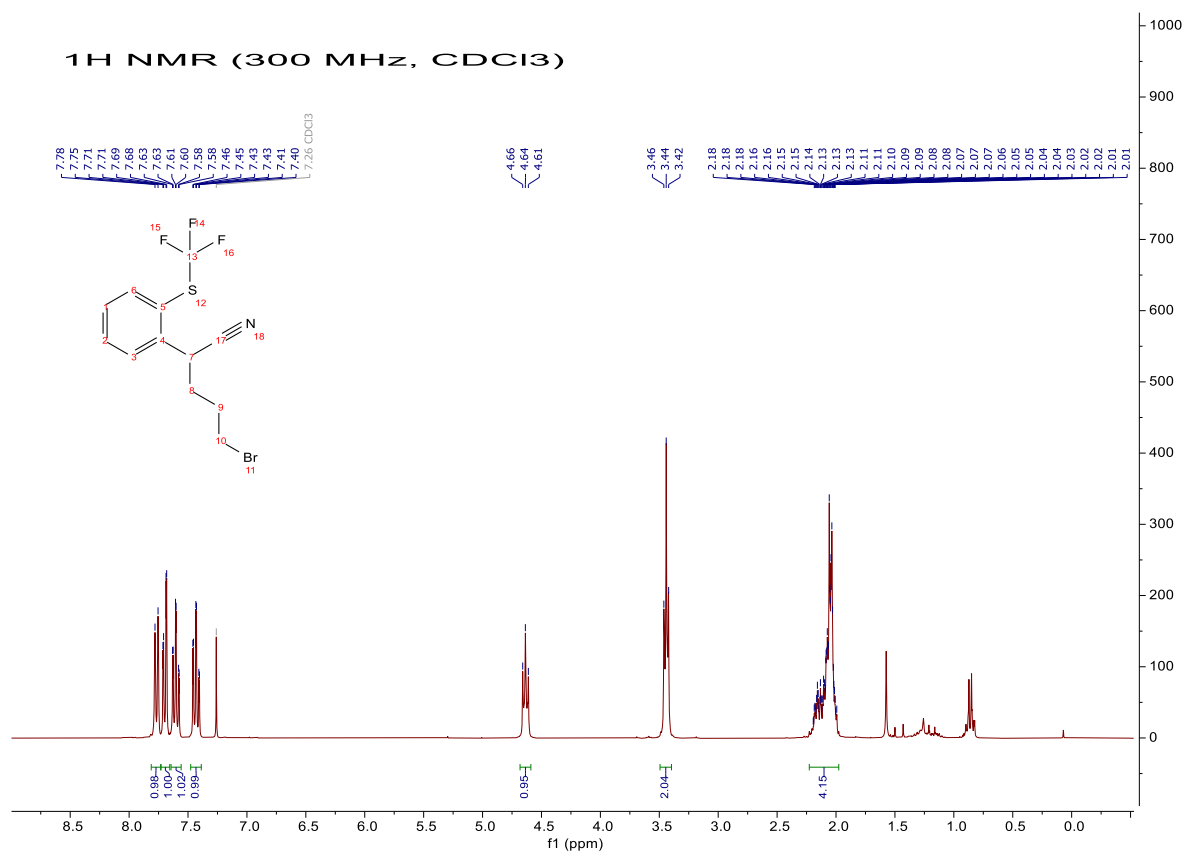
Reaction carried out following the general procedure 2 using (trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) and 5-bromopentanenitrile. NMR ^{19}F yield = 52%. Purified by preparative TLC (petroleum ether/diethyl ether 8:2) affording the product as an orange oil (54 mg, 0.16 mmol). Yield = 32%.

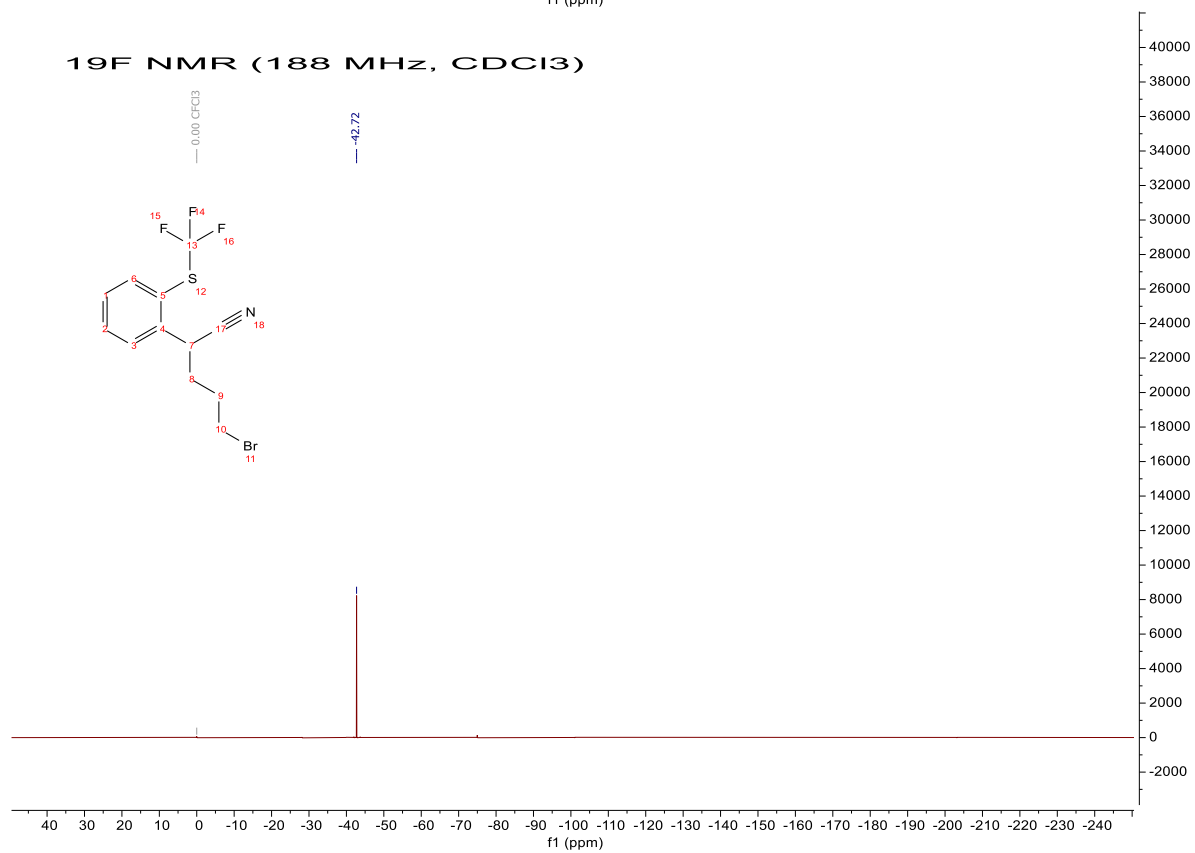
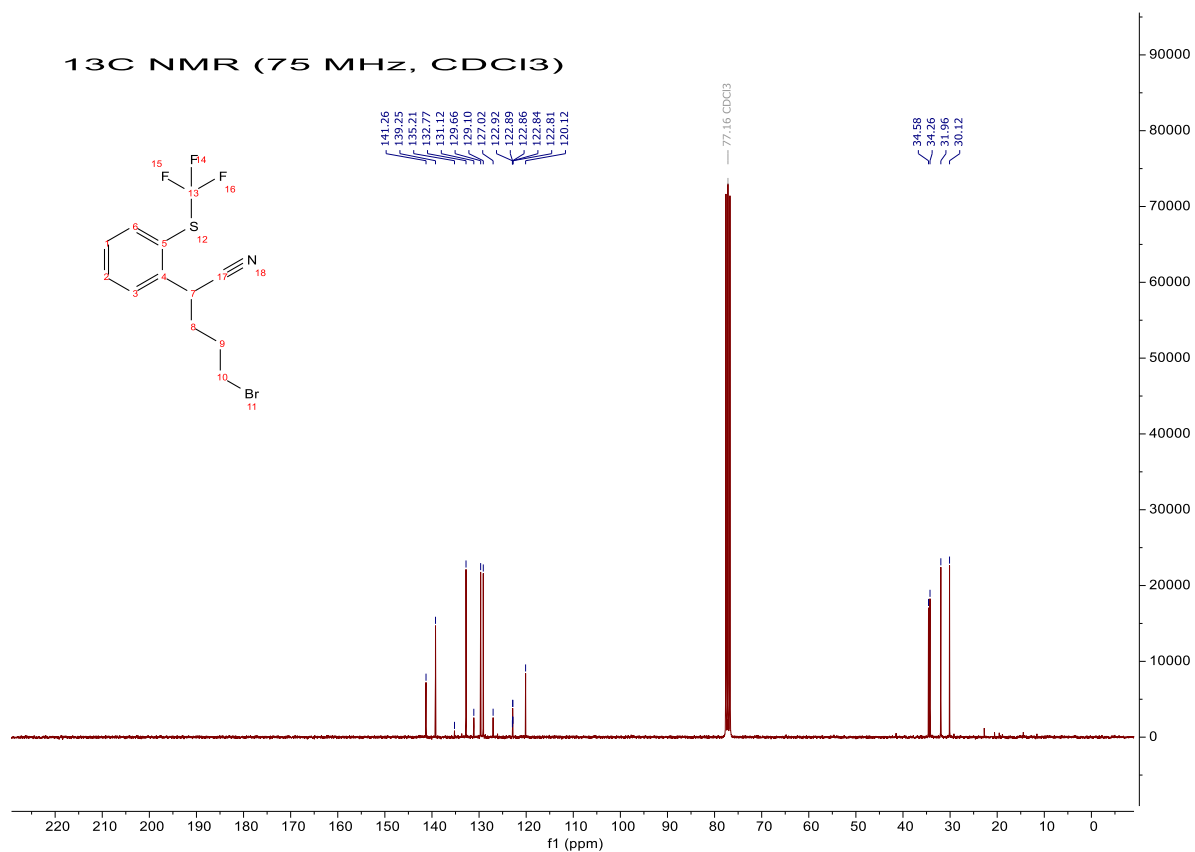
* **HRMS ASAP+TOF:** Calculated for $C_{12}H_{12}BrF_3NS$ $[M+H]^+$: 337.9826 ; Found $[M+H]^+$: 337.9838.

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 7.77 (d, J = 8 Hz, 1H), 7.70 (dd, J = 8, 2 Hz, 1H), 7.60 (td, J = 8, 2 Hz, 1H), 7.43 (td, J = 8, 2 Hz, 1H), 4.64 (t, J = 7 Hz, 1H), 3.44 (t, J = 6 Hz, 2H), 2.24 – 1.98 (m, 4H).

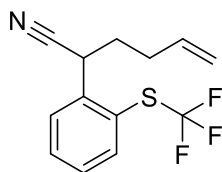
* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 141.3, 139.2, 132.8, 129.7, 129.1, 129.0 (q, J = 309 Hz), 122.9 (q, J = 2 Hz), 120.1, 34.6, 34.3, 32.0, 30.1

* **^{19}F NMR (188 MHz, $CDCl_3$) δ (ppm):** -42.72 (s)





2-(2-((Trifluoromethyl)thio)phenyl)hex-5-enenitrile (3f)



C₁₃H₁₂F₃NS
271.30

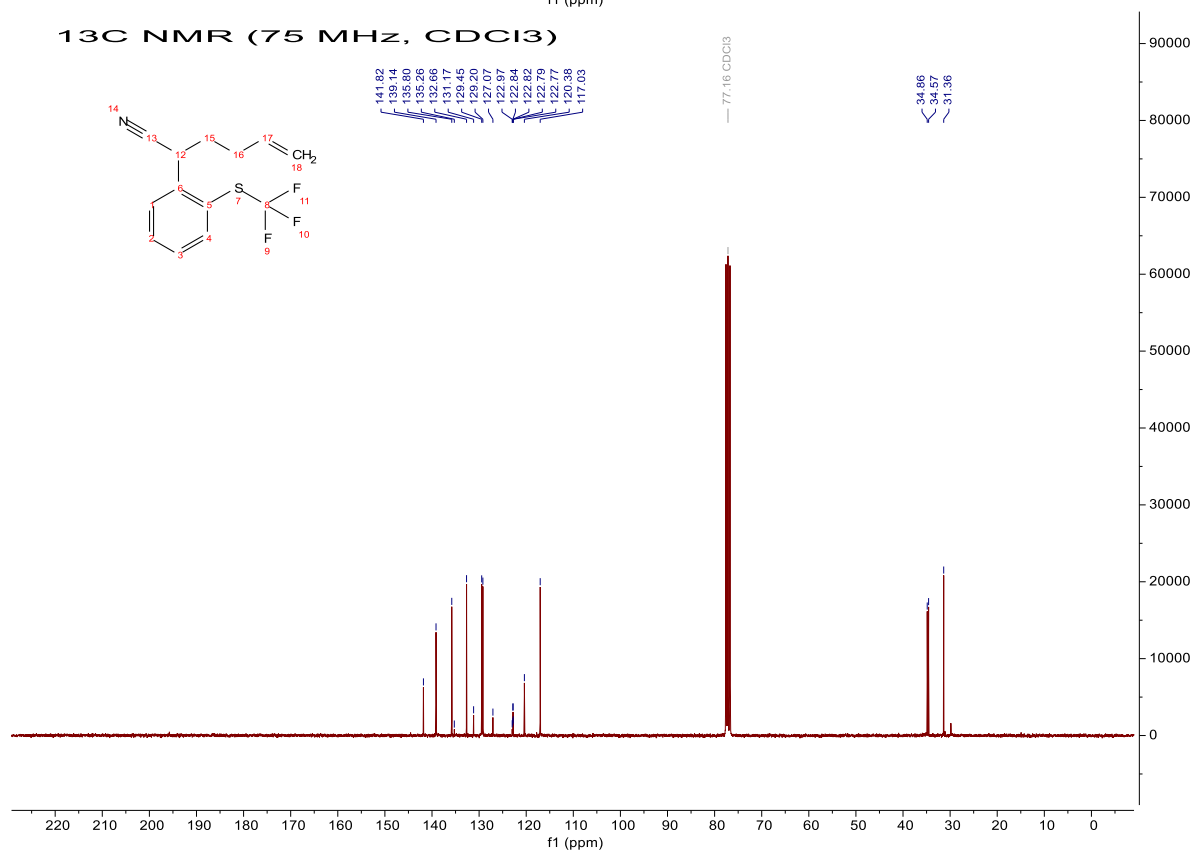
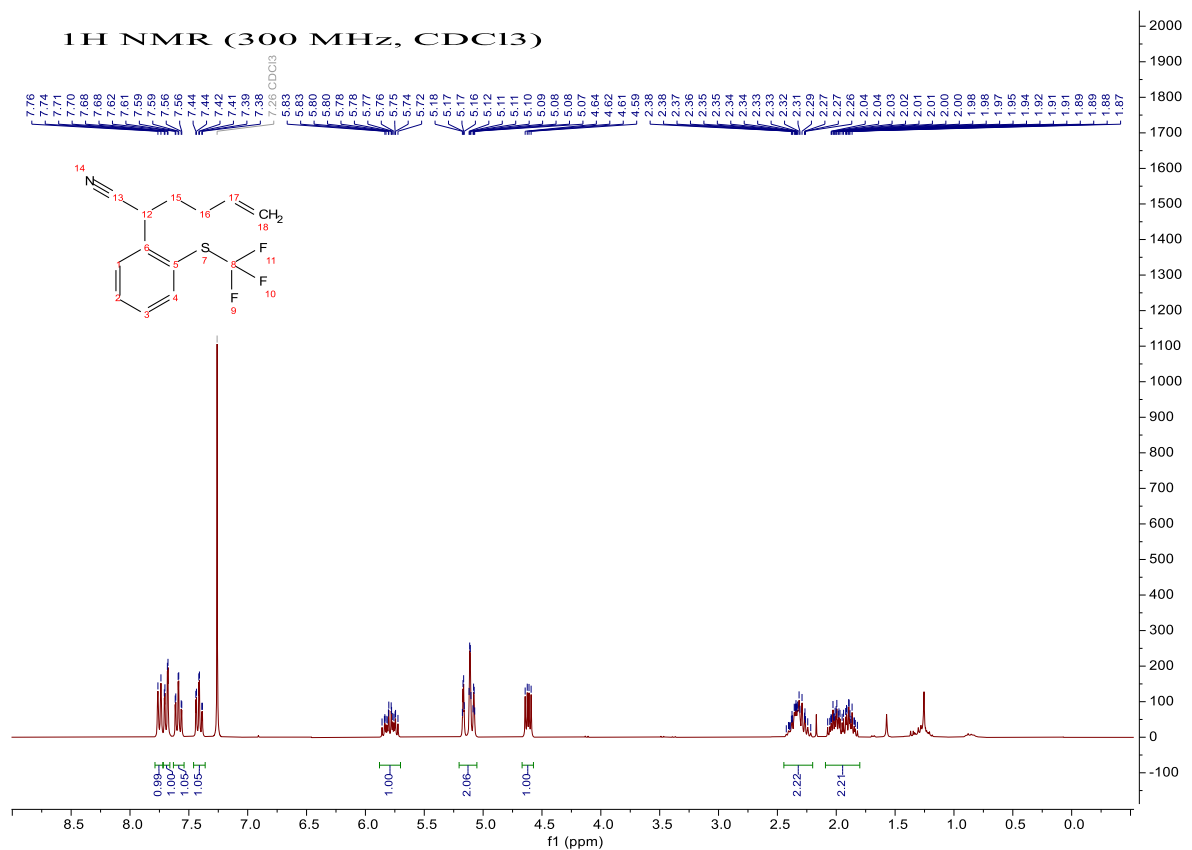
Reaction carried out following the general procedure 2 using ((Trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) with hex-5-enenitrile. 0.3 mL of dichloromethane was used as solvent. NMR ¹⁹F yield = 63%. Purified by preparative TLC (1st elution: petroleum ether/diethyl ether 7:3; 2nd elution: petroleum ether/diethyl ether 8:2; 3rd elution *n*-pentane/diethyl ether 9:1), affording the product as a yellow oil (79 mg, 0.29 mmol). Yield = 58%.

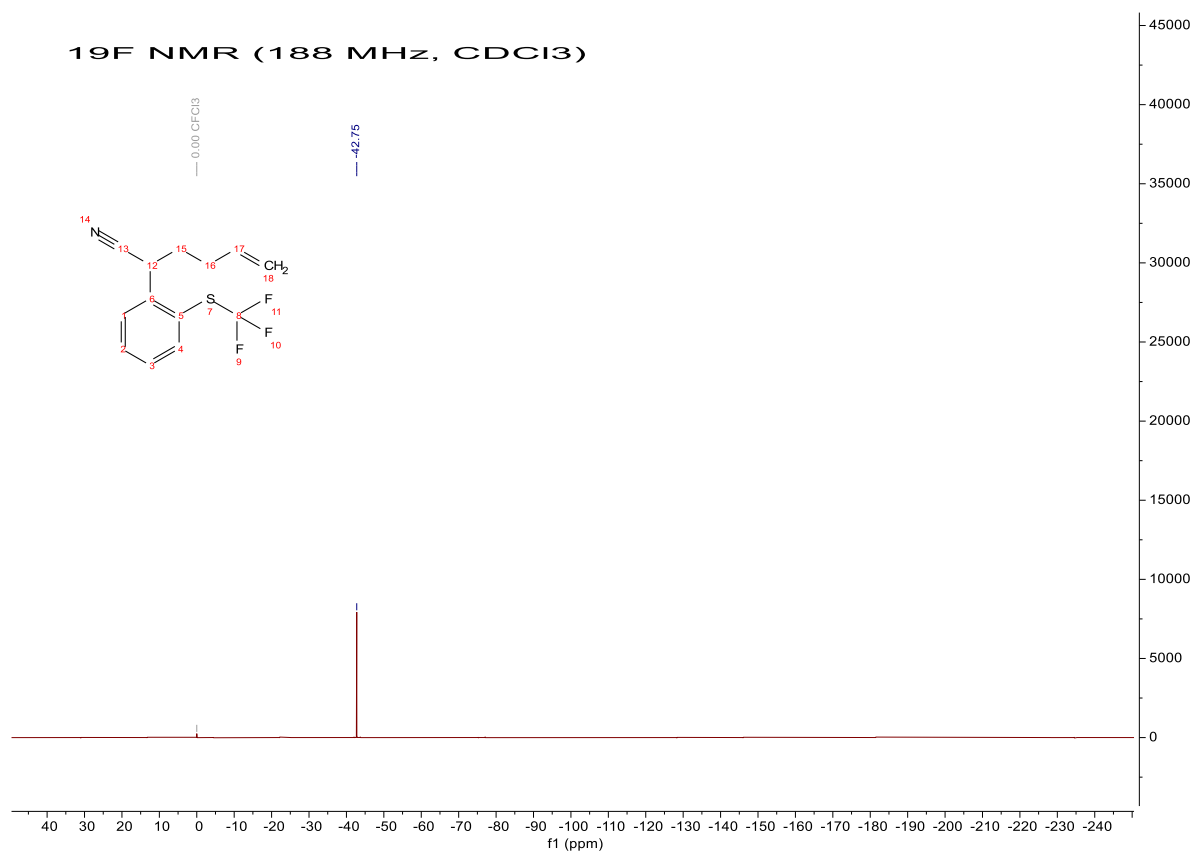
* **HRMS ASAP+TOF:** Calculated for C₂₃H₂₅F₆N₂S₂[2M+H]⁺: 543.1363; Found [2M+H]⁺: 543.1343

* **¹H NMR (300 MHz, CDCl₃) δ (ppm):** 7.75 (d, *J* = 8 Hz, 1H), 7.69 (dd, *J* = 8, 2 Hz, 1H), 7.59 (td, *J* = 8, 2 Hz, 1H), 7.41 (td, *J* = 8, 2 Hz, 1H), 5.86 – 5.72 (m, 1H), 5.18 – 5.06 (m, 2H), 4.62 (dd, *J* = 10, 5 Hz, 1H), 2.44 – 2.19 (m, 2H), 2.10 – 1.81 (m, 2H).

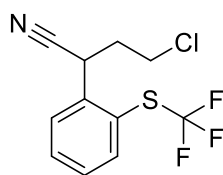
* **¹³C NMR (75 MHz, CDCl₃) δ (ppm):** 141.8, 139.1, 135.8, 132.7, 129.4, 129.2, 129.1 (q, *J* = 308 Hz), 122.81 (q, *J* = 2 Hz), 120.4, 117.0, 34.9, 34.6, 31.4

* **¹⁹F NMR (188 MHz, CDCl₃) δ (ppm):** -42.75 (s)





4-Chloro-2-((trifluoromethyl)thio)phenyl)butanenitrile (3g)



$C_{11}H_9ClF_3NS$
279.71

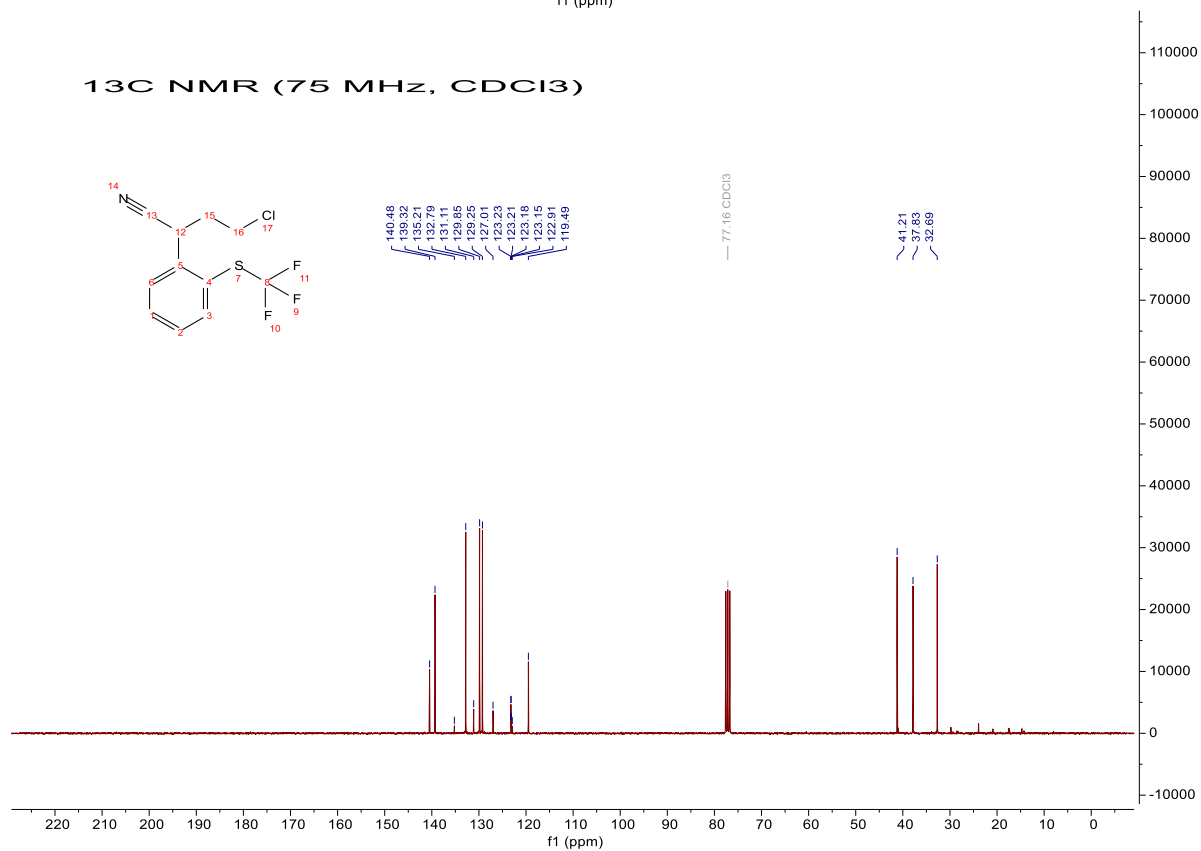
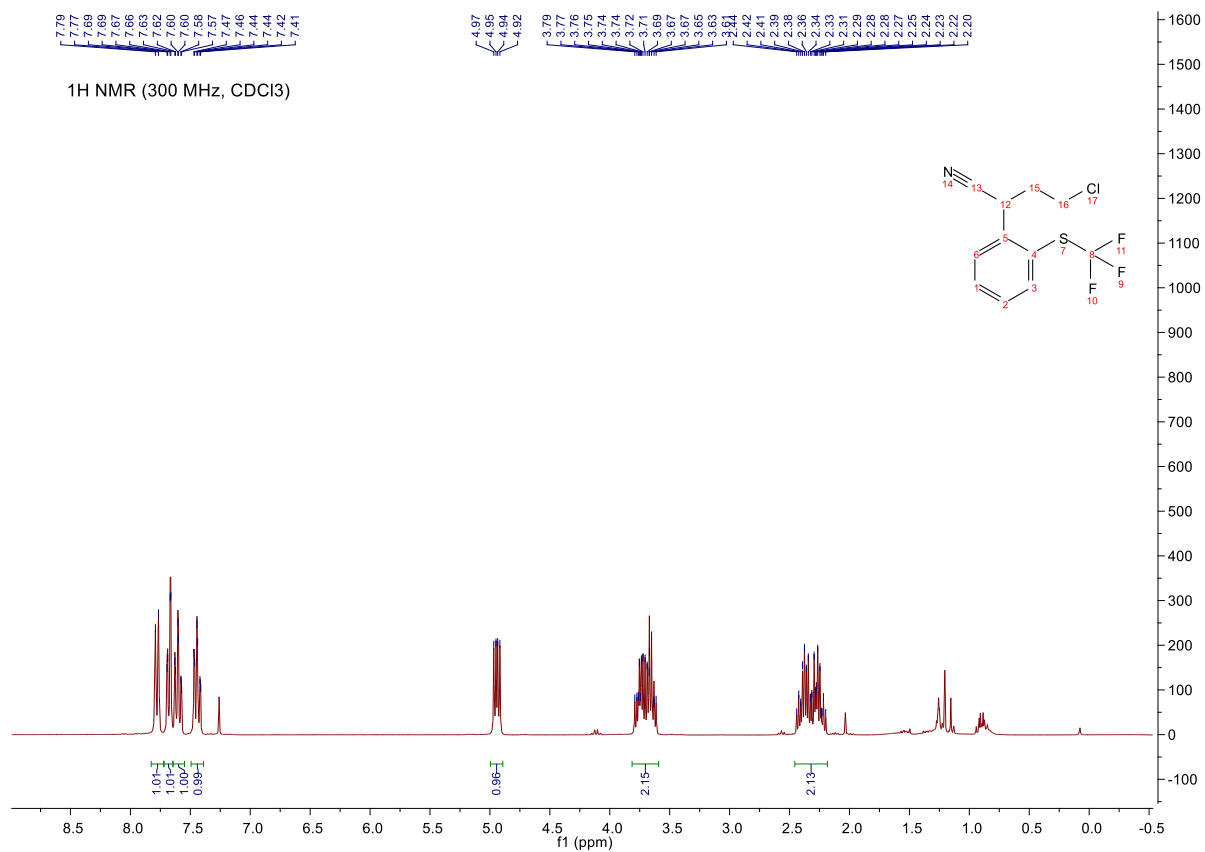
Reaction carried out following the general procedure 2 using ((trifluoromethyl)sulfinyl)benzene (97 mg, 0.5 mmol) with chlorobutyronitrile. NMR ^{19}F yield = 95%. Purified by flash chromatography (1st elution: gradient: petroleum ether/diethyl ether 100:0 to 80:20; 2nd elution: gradient: *n*-pentane/EtOAc 100:0 to 88:12), affording the product as an orange oil (131 mg, 0.47 mmol). Yield = 94%.

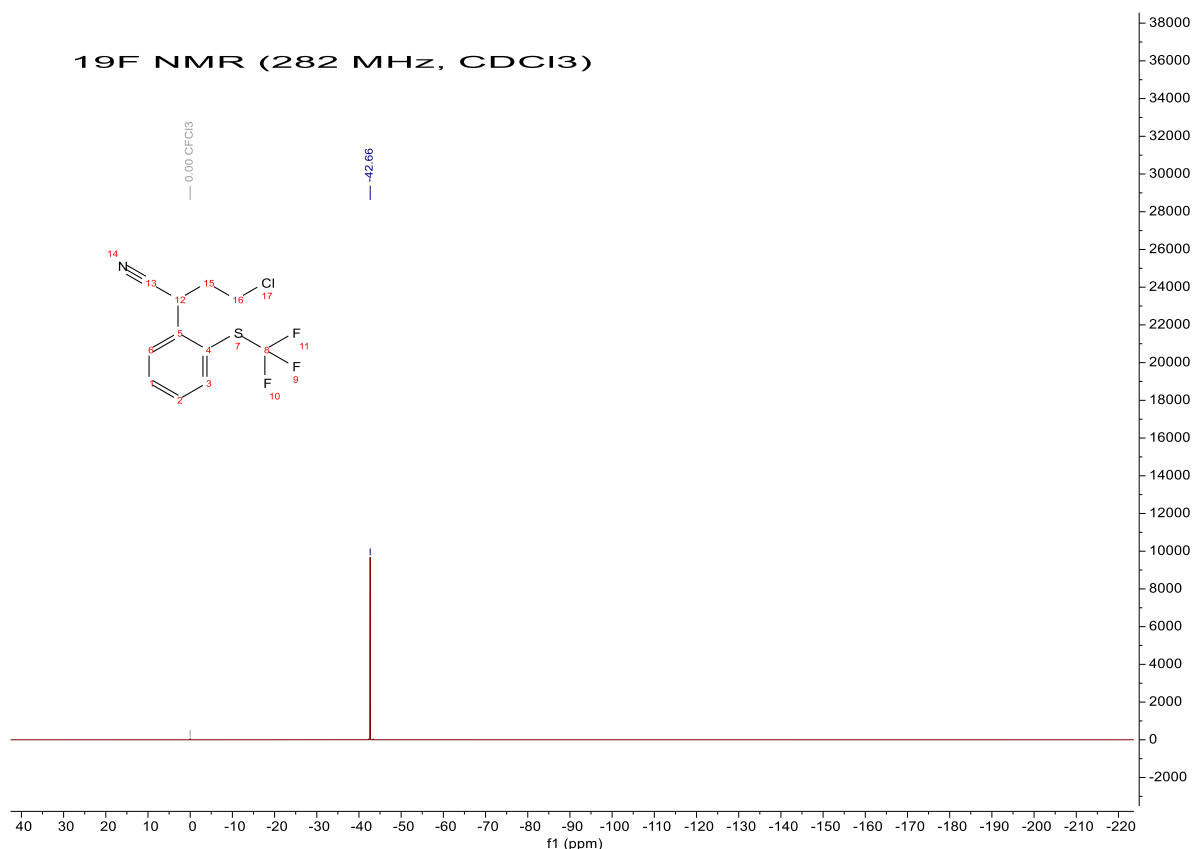
* **HRMS ASAP+TOF:** Calculated for $C_{11}H_{10}ClF_3NS[M+H]^+$: 280.0175; Found $[M+H]^+$: 280.0183

* **1H NMR (300 MHz, $CDCl_3$) δ (ppm):** 7.78 (d, J = 8 Hz, 1H), 7.68 (dd, J = 8, 2 Hz, 1H), 7.60 (td, J = 8, 1 Hz, 1H), 7.44 (td, J = 8, 2 Hz, 1H), 4.94 (dd, J = 10, 6 Hz, 1H), 3.81 – 3.60 (m, 2H), 2.46 – 2.18 (m, 2H).

* **^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm):** 140.5, 139.3, 132.8, 129.9, 129.2, 129.1 (q, J = 309 Hz), 123.2 (q, J = 2 Hz), 119.5, 41.2, 37.8, 32.7

* **^{19}F NMR (282 MHz, $CDCl_3$) δ (ppm):** -42.86 (s)





References

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