Supporting Information:

Well-Defined Palladium-(II) Complexes for Ligand-Enabled C(sp^3)-Alkynylation

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1. General Information

All catalytic experiments were carried out using standard Schlenk techniques. All solvents were reagent grade or better. Deuterated solvents were used as received. Toluene was refluxed over sodium/benzophenone ketyl and distilled under argon atmosphere and stored over sodium. Metal complexes and other chemicals used in catalysis reactions were used without additional purification. Thin layer chromatography (TLC) was performed on Merck 1.05554 aluminum sheets precoated with silica gel 60 F254 and the spots visualized with UV light at 254 nm or under iodine. Column chromatography was performed with SiO_2 (Silicycle Siliaflash F60 (230-400 mesh). ^1H NMR and ^{13}C NMR spectra were recorded on a Bruker AMX-400 and AMX-500 NMR spectrometers in $CDCl_3$ with tetramethylsilane or $CHCl_3$ as an internal standard. The peaks were internally referenced to TMS (0.00 ppm) or residual undeuterated solvent signal (77.16 ppm for ^{13}C NMR). Abbreviations used in the NMR follow-up experiments: br, broad; s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. GC analysis was carried out using a HP-5 column (30 m, 0.25 mm, 0.25μ). Mass spectra were obtained on a GCMS-QP 5000 instruments with ionization voltages of 70 eV. High resolution mass spectra (HRMS) were obtained on a JEOL JMS-DX303.

2. Experimental Section

2.1 Synthesis of the Starting Materials

All substituted 8-methylquinolines (**1**) were prepared by the known procedure [S1-S2] (Bromoethynyl)triisopropylsilane (**2**, CAS 111409-79-1) was prepared by previously reported $AgNO_3$-catalyzed bromination of (triisopropylsilyl)acetylene with *N*-bromosuccinimide.[S3]

2.2 Synthesis of the Palladium Complexes

a) (Phen)$Pd(OAc)_2$ **C1** was prepared based on literature method as described below.[S4]

Palladium acetate (56 mg, 0.25 mmol) and 1,10-phenanthroline (Phen) (45 mg, 0.25 mmol) were dissolved in 3.0 mL and 1.0 mL of acetone with stirring, respectively. Then the palladium acetate solution was added dropwise to the 1,10-phenanthroline solution with stirring, forming a yellow precipitate, and the mixture was kept stirring for 2 h at room temperature. The precipitate was

separated by centrifugation, dried at 60 ºC under vacuum for 8 h to yield (Phen)$Pd(OAc)_2$ **C1** as a yellow solid, 98 mg, 97% yield.

b) (neocuproine)$Pd(OAc)_2$ **C2** was prepared according to a literature procedure as described below.[S5]

To a 100-ml round-bottom flask with stir bar was added neocuproine (0.600 g, 2.88 mmol), palladium(II) acetate (0.588 g, 2.62 mmol), and acetone (55 mL), and the reaction mixture was stirred overnight. The yellow precipitate was isolated by vacuum filtration, rinsed with acetone, and dried under vacuum to afford 0.87 g of (neocuproine)$Pd(OAc)_2$ **C2** (77% yield).

c) (BPhen)$Pd(OAc)_2$ **C3** was prepared according to a literature procedure. [S4]

Yield: 88 % (yellow solid)

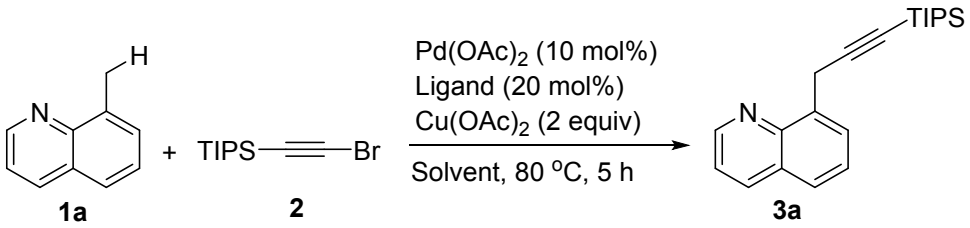
d) (bc)$Pd(OAc)_2$ **C4** was prepared based on literature method as described below.[S6]

A solution of palladium(II)acetate (449 mg, 2 mmol) in 10 mL of freshly distilled dichloromethane is stirred under argon and bathocuproine (722 mg, 2 mmol) is added in one portion. The resulting solution is stirred under argon at room temperature for 3 hours before the solvent is reduced to a volume of approximately 2 mL. Absolute diethyl ether is added until precipitation occurs and the solution is allowed to stand for 2 hours. The precipitated material is filtered and dried under vacuum to give (bc)$Pd(OAc)_2$ **C4** as a light yellow solid (1.123 g, 1.92 mmol, 96 %yield).

d) di(μ-aceto)bis[8-methylenylquinoline]dipalladium(II) **4** was synthesized according to a literature procedure.[S7]

3. Optimization of Reaction Conditions

Table S1. Screening of ligand

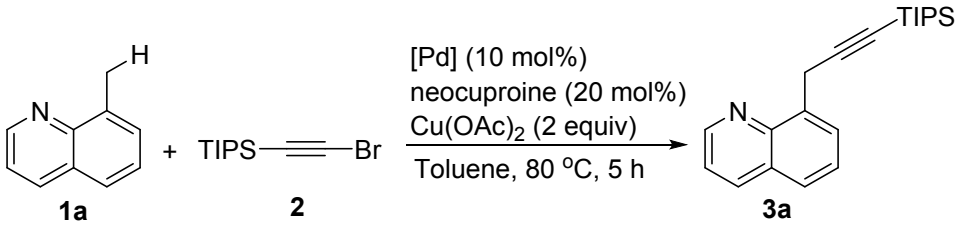


1a **2** **3a**

Entry	Ligand	Yield (%)[a,b]
1	PPh_3	NR
2	Xanthphos	NR
3	dppp	NR
4	dppb	NR
5	$PCy_3.HBF_4$	NR
6	Picolinic acid	NR
7	4,4 dimethoxy 2-2, bipyridine	5%
8	2,6-pyridinedimethanol	trace
9	Isoleucine	4%
10	BINAP	NR
11	2-Amino-4-methoxyphenol	NR

[a]Reaction conditions: **1a** (0.1 mmol), (triisopropylsilyl)ethynyl bromide **2** (0.15 mmol), $Pd(OAc)_2$ (10 mol%), ligand (20 mol%), $Cu(OAc)_2$ (2 equiv), toluene (1 mL), 80 °C, 5 h. [b]Analyzed by ^1H NMR analysis using dibromomethane as the internal standard.

Table S2. Screening of Palladium Salts



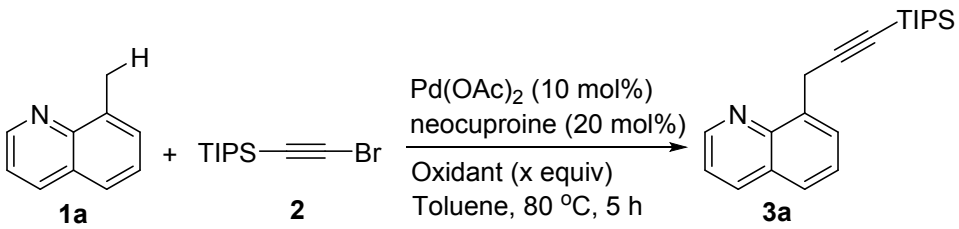
1a **2** **3a**

Entry	[Pd]	Yield (%)[a,b]
1	$PdCl_2$	NR
2	Pd(ferrocene)$(OAc)_2$	trace
3	$Pd(CH_3CN)_2(Cl)_2$	41%
4	$Pd(PPh_3)_2(Cl)_2$	NR

5	$Pd(PhCN)_2(Cl)_2$	39%
6	$Pd_2(dba)_3$	NR
7	$Pd(acac)_2$	30%
8	$Pd(TFA)_2$	NR
9	[1,2-Bis(diphenylphosphino)ethane] dichloropalladium(II)	NR
10	$Pd_2(dba)_3$	NR

[a]Reaction conditions: **1a** (0.1 mmol), (triisopropylsilyl)ethynyl bromide **2** (0.15 mmol), [Pd] (10 mol%), neocuproine (20 mol%), $Cu(OAc)_2$ (2 equiv), toluene (1 mL), 80 °C, 5 h. [b]The yield was determined by ^1H NMR analysis of the crude product using dibromomethane as the internal standard.

Table S3. Effect of Oxidants

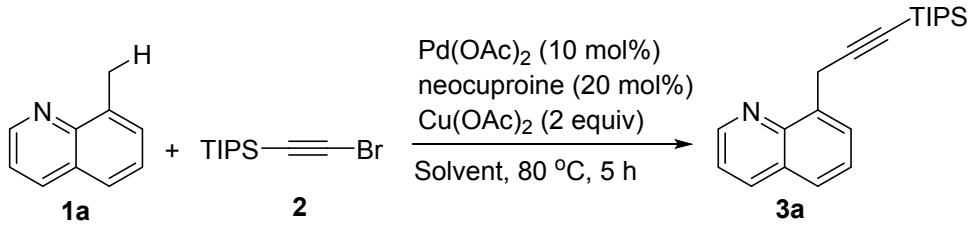


Entry	Oxidant	Equiv. of oxidant (x)	Yield of **3a** (%)[a,b]
1	$K_2S_2O_8$	2	10%
2	$PhI(OAc)_2$	2	6%
3	NFSI	2	15%
4	$Cu(OAc)_2$	1	31%
5	TBHP	1	NR
6	Cu_2O	1	10%
7	$Cu(acac)_2$	2	8%
8	Ag_2CO_3	1	12%
9	Ag_2O	1	10%
10	AgOAc	2	5%
11	$Cu(OAc)_2$	2	42%
12	$Cu(OAc)_2$	3	23%
13	$Cu(OAc)_2$	0.5	7%
14	---	---	NR
15	O_2	1 atm	NR
16	Oxone	1	trace

17	$NaNO_3$	2	NR
18	$Cu(OTf)_2$	1	8%
19	*p*-Benzoquinone	1	trace
20	V_2O_5	2	trace
21	$AgNO_3$	1	NR

[a]Reaction conditions: **1a** (0.1 mmol), (triisopropylsilyl)ethynyl bromide **2** (0.15 mmol), $Pd(OAc)_2$ (10 mol%), neocuproine (20 mol%), oxidant (x equiv), toluene (1 mL), 80 °C, 5 h. [b]The yield was determined by ^1H NMR analysis of the crude product using dibromomethane as the internal standard.

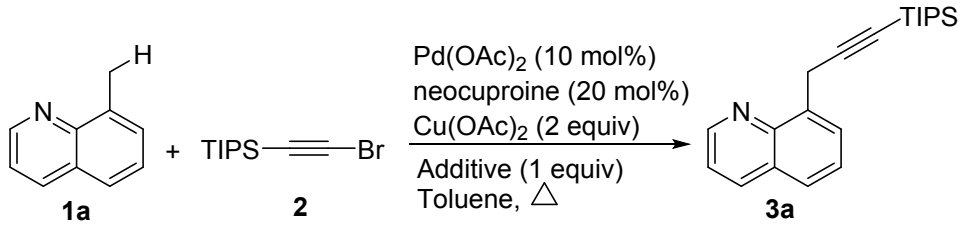
Table S4. Effect of Solvent

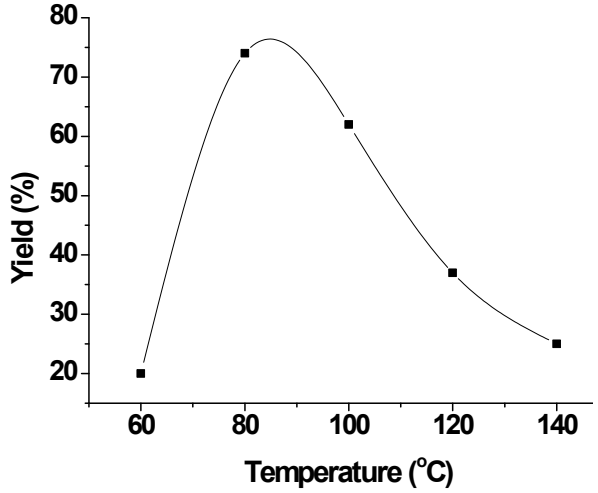


Entry	Solvent	Yield of **3a** (%)[a,b]
1	Toluene	42%
2	DCE	8%
3	DMSO	NR
4	DMF	NR
5	THF	12%
6	1,4-Dioxane	10%
7	Toluene + DMSO (1:1)	NR
8	*m*-Xylene	37%
9	Acetic acid	trace
10	C_6F_6	trace
11	*t*-Amyl alcohol	NR
12	CH_3CN	28%
13	MeOH	12%

[a]Reaction conditions: **1a** (0.1 mmol), (triisopropylsilyl)ethynyl bromide **2** (0.15 mmol), $Pd(OAc)_2$ (10 mol%), neocuproine (20 mol%), $Cu(OAc)_2$ (2 equiv), solvent (1 mL), 80 °C, 5 h. [b]The yield was determined by ^1H NMR analysis of the crude product using dibromomethane as the internal standard.

Effect of Temperature, Time and mol% of the catalyst





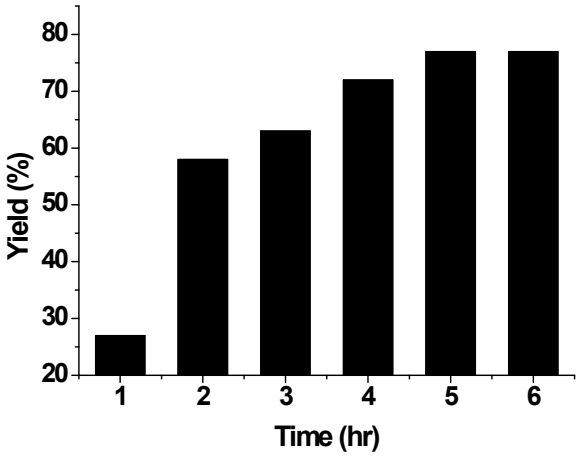


Figure 1a. Effect of Temperature

Figure 1b. Effect of Reaction Time

Reaction conditions: **1a** (0.1 mmol), **2** (0.15 mmol), complex **C2** (10 mol%), $Cu(OAc)_2$ (2 equiv) and toluene (1 mL) in a 10 mL screw-capped viol were heated and the yield was determined by ^1H NMR analysis of the crude product using dibromomethane as the internal standard.
Figure 1a (left): reaction time 5 hr; Figure 1b (right): reaction at 80 °C

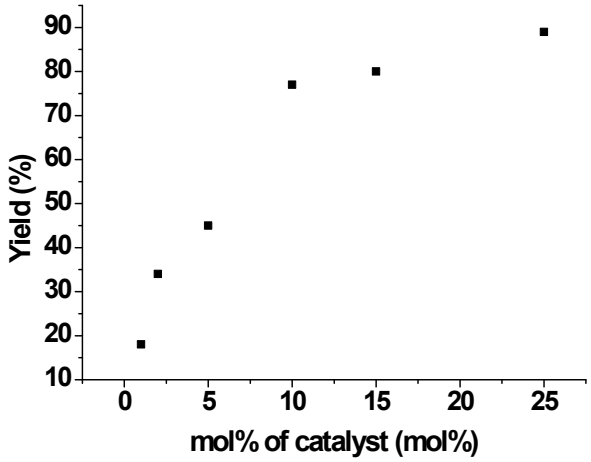
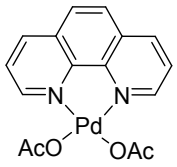


Figure 1b. Effect of mol% of catalyst (**C2**)[a,b]

[a]Reaction conditions: **1a** (0.1 mmol), **2** (0.15 mmol), complex **C2** (x mol%), $Cu(OAc)_2$ (2 equiv) and toluene (1 mL) in a 10 mL screw-capped viol were heated at 80 °C for 5 hr. [b]The yield was determined by ^1H NMR analysis of the crude product using dibromomethane as the internal standard.

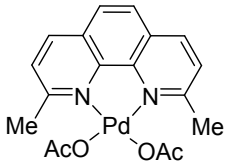
4. Characterization Data

(1,10-phenanthroline)-palladium(II) acetate (**C1**)



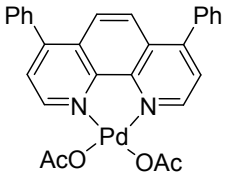
Yield = 97%. Yellow Solid. ^1H NMR ($CDCl_3$, 500 MHz) δ 2.21 (s, 6H), 7.78-7.81 (q, J = 5.4 Hz, 2H), 7.96 (s, 2H), 8.51-8.52 (d, J = 4.2 Hz, 2H), 8.61-8.62 (d, J = 8.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 23.36, 125.19, 127.19, 129.65, 138.80, 146.34, 150.52, 178.63.

(2,9-Dimethyl-1,10-phenanthroline)-palladium(II) acetate (**C2**)



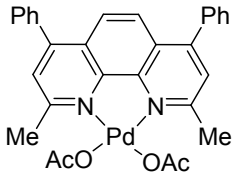
Yield = 94%. Yellow Solid. ^1H NMR ($CDCl_3$, 500 MHz) δ 2.05 (s, 6H), 2.87 (s, 6H), 7.39-7.41 (q, J = 8.5 Hz, 2H), 7.85 (s, 2H), 8.37-8.38 (d, J = 8.2 Hz, 2H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 22.88, 24.44, 126.29, 127.82, 138.42, 147.15, 165.14, 178.53.

(2,9-Dimethyl-4,7-diphenyl-1,10-phenanthroline)-palladium(II) acetate (**C3**)



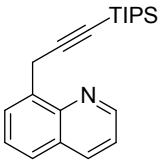
Yield = 96%. Yellow Solid. ^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.03 (s, 6H), 2.99 (s, 6H), 7.43 (s, 2H), 7.46-7.48 (m,4H), 7.55-7.57 (m, 6H), 7.80 (s, 2H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 22.90, 24.70, 124.33, 126.49, 126.81, 129.05, 129.23, 129.71, 135.37, 148.23, 150.86, 164.68, 178.45.

(4,7-diphenyl-1,10-phenanthroline)-palladium(II) acetate (**C4**)



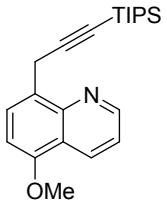
Yield = 96%. Yellow Solid. ^{1}H NMR ($CDCl_3$, 500 MHz) δ 2.21 (s, 6H), 7.51-7.52 (m, 4H), 7.59-7.60 (m, 6H), 7.74-7.76 (d, *J* = 5.4 Hz, 2H),7 .99 (s, 2H), 8.67-8.69 (d, *J* = 5.19 Hz, 2H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 23.40, 125.25, 125.37, 128.10, 129.24, 129.39, 130.09, 135.05, 147.32, 149.97, 151.76, 178.59.

8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3a**)



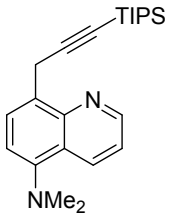
Isolated yield: 9.4 mg (66%). ^{1}H NMR ($CDCl_3$, 200 MHz) δ 1.13 (s, 21H), 4.40 (s, 2H), 7.39-7.45 (dd, *J* = 8.2 Hz, 1H), 7.52-7.60 (t, *J* = 7.0 Hz, 1H), 7.71-7.76 (d, *J* = 7.7 Hz, 1H), 8.06-8.11 (dd, *J* = 7.0 Hz, 1H), 8.14-8.19 (dd, *J* = 8.3 Hz, 1H), 8.90-8.94 (dd, *J* = 4.1 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.38, 18.69, 22.17, 83.56, 106.23, 121.04, 126.42, 126.54, 127.89, 128.18, 135.39, 136.20, 143.03, 149.30. HRMS Calcd for $C_{21}H_{30}NSi$ $[M+H]^+$: 324.2148; Found: 324.2142.

5-methoxy-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3b**)



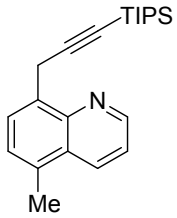
Isolated yield: 13.8 mg (80%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 4.01 (s, 3H), 4.29 (s, 2H), 6.87-6.89 (d, *J* = 7.9 Hz, 1H), 7.38-7.41 (dd, *J* = 8.5 Hz, 1H), 7.95-7.96 (d, *J* = 7.9 Hz, 1H), 8.57-8.59 (dd, *J* = 8.5 Hz, 1H), 8.90-8.91 (d, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.39, 18.71, 21.69, 55.66, 83.16, 103.91, 106.74, 120.10, 120.60, 126.88, 127.84, 103.81, 146.46, 149.58, 154.03. HRMS Calcd for $C_{22}H_{32}NOSi$ $[M+H]^+$: 354.2253; Found: 354.2248

N,N-dimethyl-8-(3-(triisopropylsilyl)prop-2-ynyl)quinolin-5-amine (**3c**)



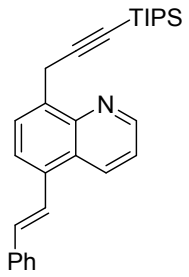
Isolated yield: 15.43 mg (83%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 2.89 (s,6H), 4.31 (s, 2H), 7.13-7.14 (d, *J* = 7.6 Hz, 1H), 7.27 (s, 1H), 7.40-7.41 (d, *J* = 4.5 Hz, 1H), 7.96-7.97 (d, *J* = 7.6 Hz, 1H), 8.56-8.57 (d, *J* = 8.2 Hz, 2H), 8.88 (s, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.40, 18.71, 21.94, 45.38, 83.25, 106.66, 114.21, 119.94, 123.72, 127.88, 129.44, 132.81, 146.99, 148.91, 149.80. HRMS Calcd for $C_{23}H_{35}N_2Si$ $[M+H]^+$: 367.2570; Found: 367.2564

5-methyl-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3d**)



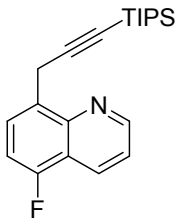
Isolated yield: 11.2 mg (71%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 2.68 (s, 3H), 4.36 (s, 2H), 7.39-7.40 (d, *J* = 7.3 Hz, 1H), 7.44-7.46 (dd, *J* = 4.2 Hz, 1H), 7.95-7.96 (d, *J* = 7.0 Hz, 1H), 8.32-8.34 (dd, *J* = 8.5 Hz, 1H), 8.92-8.92 (d, *J* =4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.38, 18.69, 18.52, 18.69, 83.31, 106.55, 120.60, 126.84, 127.37, 127.83, 132.62, 133.06, 133.28, 146.25, 148.77. HRMS Calcd for $C_{22}H_{32}NSi$ $[M+H]^+$: 338.2304; Found: 338.2299.

(E)-5-styryl-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3e**)



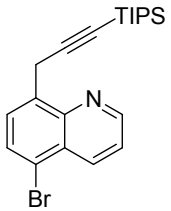
Isolated yield: 18.6 mg (76%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.15 (s, 21H), 4.41 (s, 2H), 7.18-7.21 (d, *J* = 16.1 Hz, 1H), 7.31-7.34 (t, *J* = 7.3 Hz, 1H), 7.41-7.44 (t, *J* = 7.6 Hz, 2H), 7.46-7.48 (q, *J* = 3.9 Hz, 1H), 7.60-7.62 (d, *J* = 7.6 Hz, 2H), 7.78-7.81 (d, *J* = 16.1 Hz, 1H), 7.84-7.85 (d, *J* = 7.6 Hz, 1H), 8.10-8.11 (d, *J* = 7.6 Hz, 1H), 8.56-8.58 (dd, *J* = 8.5 Hz, 1H), 8.94-8.95 (dd, *J* = 3.9 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.37, 18.71, 22.14, 83.64, 106.20, 120.85, 123.68, 124.21, 126.15, 126.67, 127.99, 128.03, 128.79, 132.28, 132.29, 133.95, 135.03, 127.27, 146.10, 129.11. HRMS Calcd for $C_{29}H_{36}NSi$ $[M+H]^+$: 426.2617; Found: 426.2612.

5-fluoro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3f**)



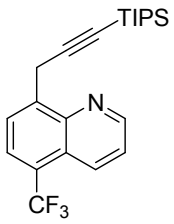
Isolated yield: 9.5 mg (59%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 4.32 (s, 2H), 7.21-7.24 (t, *J* = 8.2 Hz, 1H), 7.46-7.49 (q, *J* = 3.9 Hz, 1H), 7.97-8.00 (t, *J* = 6.7 Hz, 1H), 8.42-8.44 (dd, *J* = 8.2 Hz, 1H), 8.94-8.96 (dd, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.36, 18.67, 21.86, 83.74, 105.95, 109.63, 109.78, 118.69, 118.82, 121.06, 127.49, 127.56, 129.41, 129.44, 131.22, 146.18, 150.08, 155.77, 157.79. HRMS Calcd for $C_{21}H_{29}NSi$ $[M+H]^+$: 342.2053; Found: 342.2048.

5-bromo-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3g**)



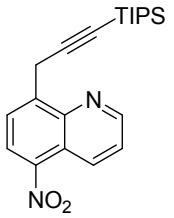
Isolated yield: 13.4 mg (61%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 4.34 (s, 2H), 7.51-7.53 (dd, *J* = 4.2 Hz, 1H), 7.84-7.86 (d, *J* = 7.3 Hz, 1H), 7.93-7.95 (d, *J* = 7.9 Hz, 1H), 8.53-8.58 (d, *J* = 8.5 Hz, 1H), 8.92-8.93 (d, *J* = 3.6 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.32, 18.67, 22.16, 84.03, 105.55, 120.25, 122.14, 127.17, 128.55, 130.14, 135.65, 146.58, 149.29, 149.85; HRMS Calcd for $C_{21}H_{29}BrNSi$ $[M+H]^+$: 402.1253 ; Found: 402.1247.

5-(trifluoromethyl)-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3h**)



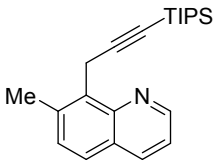
Isolated yield: 10.60 mg (48%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.14 (s, 21H), 4.44 (s, 2H), 7.54-7.57 (dd, *J* = 8.8 Hz, 1H), 7.95-7.96 (dd, *J* = 7.6 Hz, 1H), 8.13-8.14 (d, *J* = 7.3 Hz, 1H), 8.50-8.52 (d, *J* = 8.5 Hz, 1H), 8.99-9.00 (d, *J* =4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.34, 18.68, 22.74, 84.55, 105.09, 122.22, 122.67, 123.15, 124.03, 125.07, 125.03, 126.50, 128.76, 132.27, 140.76, 146.03, 149.84, 150.57. HRMS Calcd for $C_{22}H_{29}F_3NSi$ $[M+H]^+$: 392.2021; Found: 392.2016.

5-nitro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3i**)



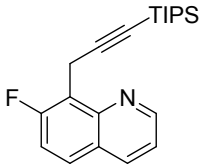
Isolated yield: 9.8 mg (52%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.14 (s, 21H), 4.47 (s, 2H), 7.66-7.68 (dd, *J* = 8.8 Hz, 1H), 8.18-8.20 (d, *J* = 7.6 Hz, 1H), 8.43-8.44 (d, *J* = 7.9 Hz, 1H), 9.01-9.03 (dd, *J* = 3.9 Hz, 1H), 9.05-9.07 (dd, *J* =8.8 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.31, 16.67, 23.20, 85.17, 104.39, 120.83, 123.86, 124.69, 126.35, 132.25, 143.98, 144.36, 150.36, 158.90. HRMS Calcd for $C_{21}H_{29}N_2O_2Si$ $[M+H]^+$: 369.1998; Found: 369.1996.

7-methyl-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3j**)



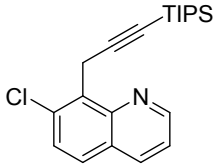
Isolated yield: 12.3 mg (78%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.98 (s, 21H), 2.69 (s, 3H), 4.42 (s, 2H), 7.34-7.35 (d, *J* = 4.2 Hz, 1H), 7.40-7.41 (q, *J* = 8.2 Hz, 1H), 7.64-7.65 (d, *J* = 8.2 Hz, 1H), 8.09-8.11 (dd, *J* = 8.2 Hz, 1H), 8.93-8.94 (d, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.28, 17.88, 18.56, 20.33, 79.90, 106.68, 120.04, 126.00, 126.67, 129.77, 133.36, 135.95, 137.96, 146.13, 149.46. HRMS Calcd for $C_{22}H_{32}NSi$ $[M+H]^+$: 338.2304; Found: 338.2299.

7-fluoro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3k**)



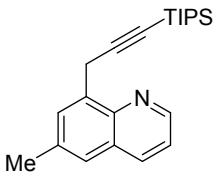
Isolated yield: 13.0 mg (81%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.98 (s, 21H), 4.29 (s, 2H), 7.34-7.36 (d, *J* = 8.8 Hz, 1H), 7.38-7.40 (q, *J* = 4.2 Hz, 1H), 7.72-7.75 (q, *J* = 6.1 Hz, 1H), 8.13-8.15 (dd, *J* = 8.2 Hz, 1H), 8.97-8.98 (dd, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.25, 18.50, 14.70, 80.03, 105.95, 116.88, 117.07, 120.20, 120.67, 120.79, 125.30, 127.96, 128.04, 136.06, 146.87, 146.93, 150.42, 159.61, 161.59. HRMS Calcd for $C_{21}H_{29}NFSi$ $[M+H]^+$: 342.2053; Found: 342.2048.

7-chloro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3l**)



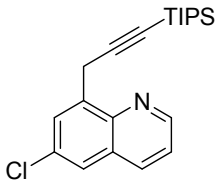
Isolated yield: 14.9 mg (84%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.97 (s, 21H), 4.46 (s, 2H), 7.41-7.43 (q, *J* = 4.2 Hz, 1H), 7.55-7.56 (d, *J* = 8.8 Hz, 1H), 7.67-7.69 (d, *J* = 8.8 Hz, 1H), 8.12-8.14 (dd, *J* = 8.2 Hz, 1H), 8.97-8.99 (d, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.24, 18.52, 19.26, 80.45, 105.47, 121.01, 126.88, 127.34, 128.20, 133.93, 135.07, 136.06, 146.61, 150.38; HRMS Calcd for $C_{21}H_{29}NClSi$ $[M+H]^+$: 358.1758 ; Found: 358.1752.

6-methyl-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3m**)



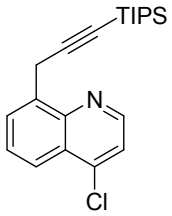
Isolated yield: 11.0 mg (70%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.15 (s, 21H), 2.54 (s, 3H), 4.36 (s, 2H), 7.36-7.39 (q, *J* = 4.2 Hz, 1H), 7.49 (s, 1H), 7.97 (s, 1H), 8.05-8.07 (dd, *J* = 8.2 Hz, 1H), 8.84-8.85 (d, *J* = 4.2 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.39, 18.69, 21.65, 22.08, 83.70, 106.39, 121.04, 125.23, 128.14, 130.70, 134.82, 135.51, 136.16, 144.67, 148.42. HRMS Calcd for $C_{22}H_{32}NSi$ $[M+H]^+$: 338.2304 ; Found: 338.2299.

6-chloro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3n**)



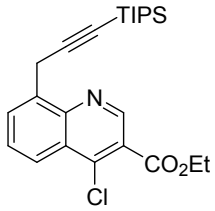
Isolated yield: 11.7 mg (66%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.15 (s, 21H), 4.35 (s, 2H), 7.42-7.44 (q, *J* = 4.2 Hz, 1H), 7.70 (d, *J* = 2.4 Hz, 1H), 8.05-8.07 (m, 2H), 8.88-8.90 (dd, *J* = 8.2 Hz, 1H); ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.34, 18.68, 22.16, 84.66, 105.19, 121.92, 124.99, 128.64, 129.36, 132.37, 135.29, 137.74, 144.45, 149.42 ; HRMS Calcd for $C_{21}H_{29}NClSi$ $[M+H]^+$: 358.1758; Found: 358.1752.

4-chloro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline (**3o**)



Isolated yield: 14.3 mg (81%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 4.39 (s, 2H), 7.50-7.51 (d, J = 4.8 Hz, 1H), 7.64-7.67 (t, J = 7.9 Hz, 1H), 8.13-8.17 (t, J = 9.1 Hz, 2H), 8.76-8.77 (t, J = 4.5 Hz, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.35, 18.68, 22.47, 83.86, 105.84, 121.25, 122.82, 126.23, 127.39, 129.14, 135.96, 142.76, 146.89, 148.63. HRMS Calcd for $C_{21}H_{29}NClSi$ $[M+H]^+$: 358.1758; Found: 358.1572.

ethyl 4-chloro-8-(3-(triisopropylsilyl)prop-2-ynyl)quinoline-3-carboxylate (**3p**)

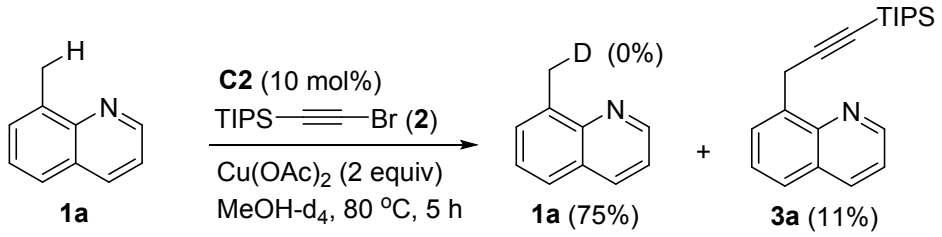


Isolated yield: 18.4 mg (74%). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.13 (s, 21H), 1.46-1.49 (t, J = 7.0 Hz, 3H), 4.39 (s, 2H), 4.50-4.52 (q, J = 7.0 Hz, 2H), 7.70-7.73 (t, J = 7.9 Hz, 1H), 8.19-8.21 (d, J = 6.7 Hz, 1H), 8.33-8.35 (d, J = 8.5 Hz, 1H), 9.20 (s, 1H). ^{13}C NMR ($CDCl_3$, 500 MHz) δ 11.35, 14.23, 18.68, 22.41, 62.05, 84.20, 105.57, 122.98, 124.09, 125.98, 128.16, 130.69, 136.20, 143.51, 147.30, 148.95, 164.65; HRMS Calcd for $C_{24}H_{31}NClO_2Si$ $[M-H]^+$: 428.1813; Found: 428.1807

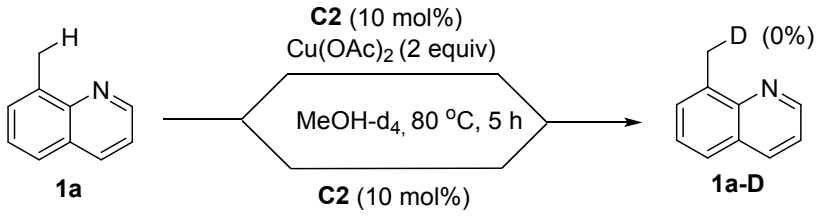
5. Mechanistic Investigation

(i). Irrversibility of C-H activation

a) To a flame dried 10 mL screw-capped vial, 8-methylquinoline **1a** (1 equiv), (bromoethynyl)triisopropylsilane **2** (0.15 mmol), (nc)$Pd(OAc)_2$ **C2** (10 mol%), $Cu(OAc)_2$ (2 equiv) and MeOH-d_4 (1 mL) were added. The mixture was stirred for 5 hr at 80 °C followed by cooling to room temperature. The residue was purified by column chromatography on silica gel (eluent: pet ether/EtOAc) to afford the alkynylated product **3a** (11%) with a recovery of **1a** (75%) and the ^{1}H NMR reveled formation of deuterated **1a** was unobserved.



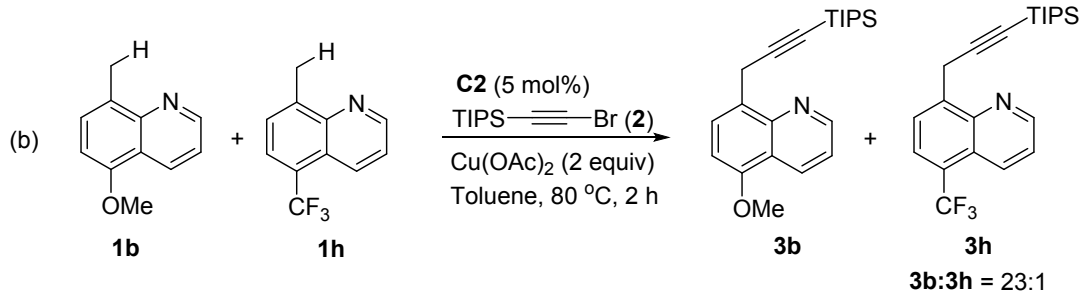
b) To a flame dried 10 mL screw-capped vial, 8-methylquinoline **1a** (1 equiv), (nc)$Pd(OAc)_2$ **C2** (10 mol%), $Cu(OAc)_2$ (2 equiv) and MeOH-d_4 (1 mL) were added. The mixture was stirred for 5 hr at 80 °C followed by cooling to room temperature. ^{1}H NMR reveled formation of deuterated **1a** was unobserved.



(ii). Competitive experiment

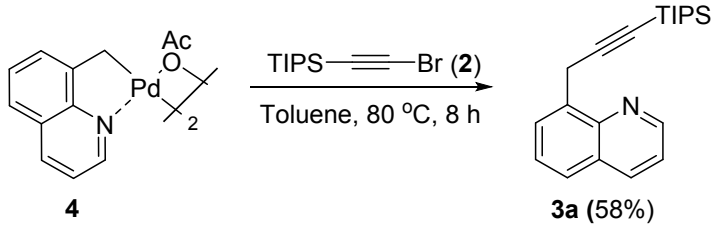
To a flame dried 10 mL screw-capped vial, 5-methoxy-8-methylquinoline **1b** (1 equiv) and 8-methyl-5-(trifluoromethyl)quinoline **1f** (1 equiv), (triisopropylsilyl)ethynyl bromide **2** (1 equiv), (nc)$Pd(OAc)_2$ (10 mol%), $Cu(OAc)_2$ (2 equiv) and toluene (1 mL) were added. The mixture was stirred for 2 hr at 80 °C followed by cooling to room temperature. The solution was filtered

through a celite pad and washed with 10-20 mL of dichloromethane. The filtrate was concentrated and the residue was analyzed by ^{1}H NMR.



(iii). Reaction of palladacycle(II) 4 with 2

To a flame dried 10 mL screw-capped vial, palladacycle(II) **4** (0.1 mmol), (triisopropylsilyl)ethynyl bromide **2** (0.25 mmol) and toluene (1 mL) were added under Ar. The mixture was stirred for 8 hr at 80 °C followed by cooling to room temperature. The solution was filtered through a celite pad and washed with 10-20 mL of dichloromethane. The filtrate was concentrated *in vacuo*. The residue was purified by column chromatography on silica gel (eluent: pet ether/EtOAc) to afford the alkynylated products **3a** with isolated yield of 58%.



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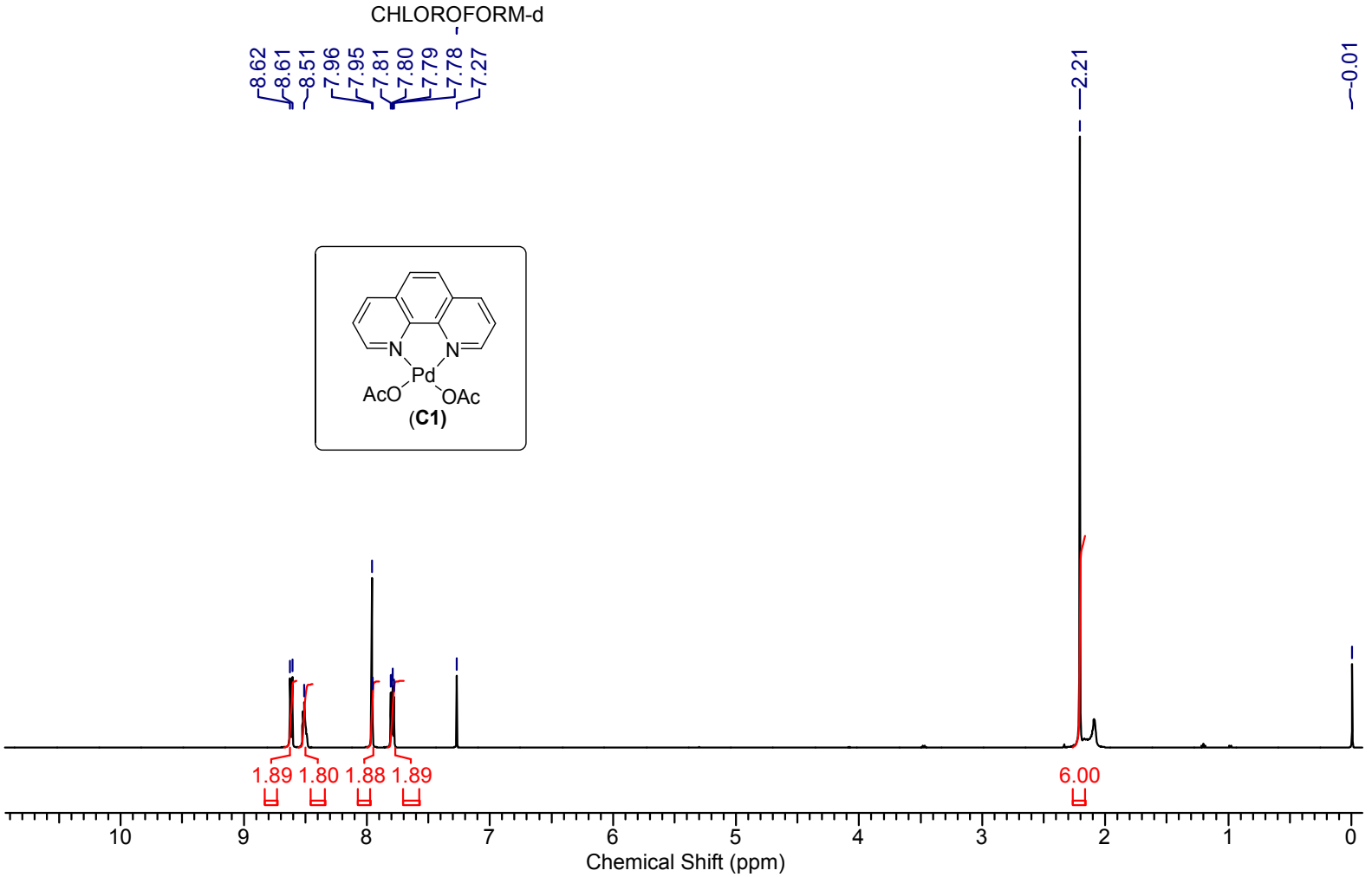
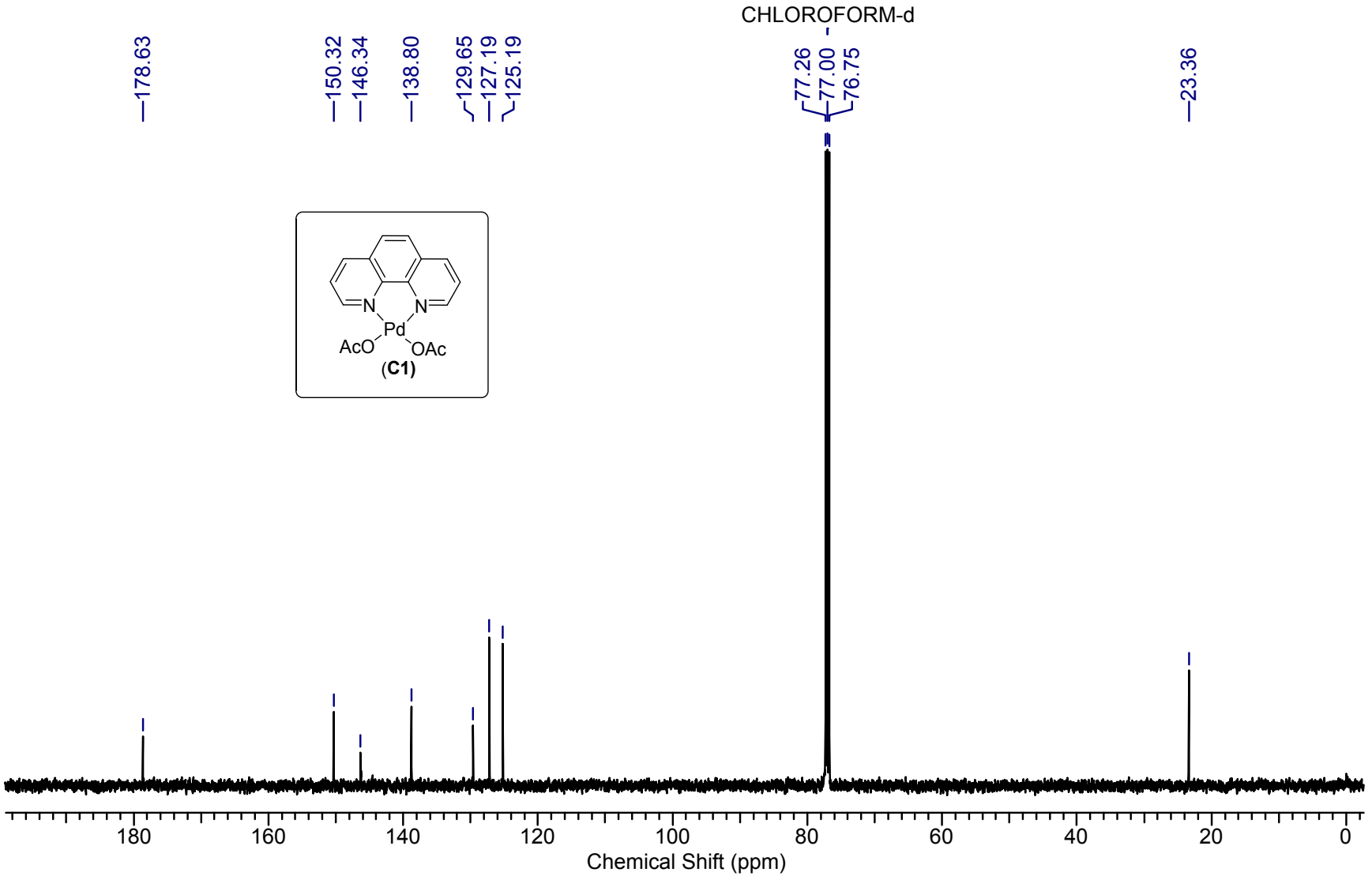

CHLOROFORM-d
8.62
8.61
8.51
7.96
7.95
7.81
7.80
7.79
7.78
7.27
2.21
0.01
N
N
Pd
AcO
OAc
(C1)
1.89
1.80
1.88
1.89
6.00
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


CHLOROFORM-d
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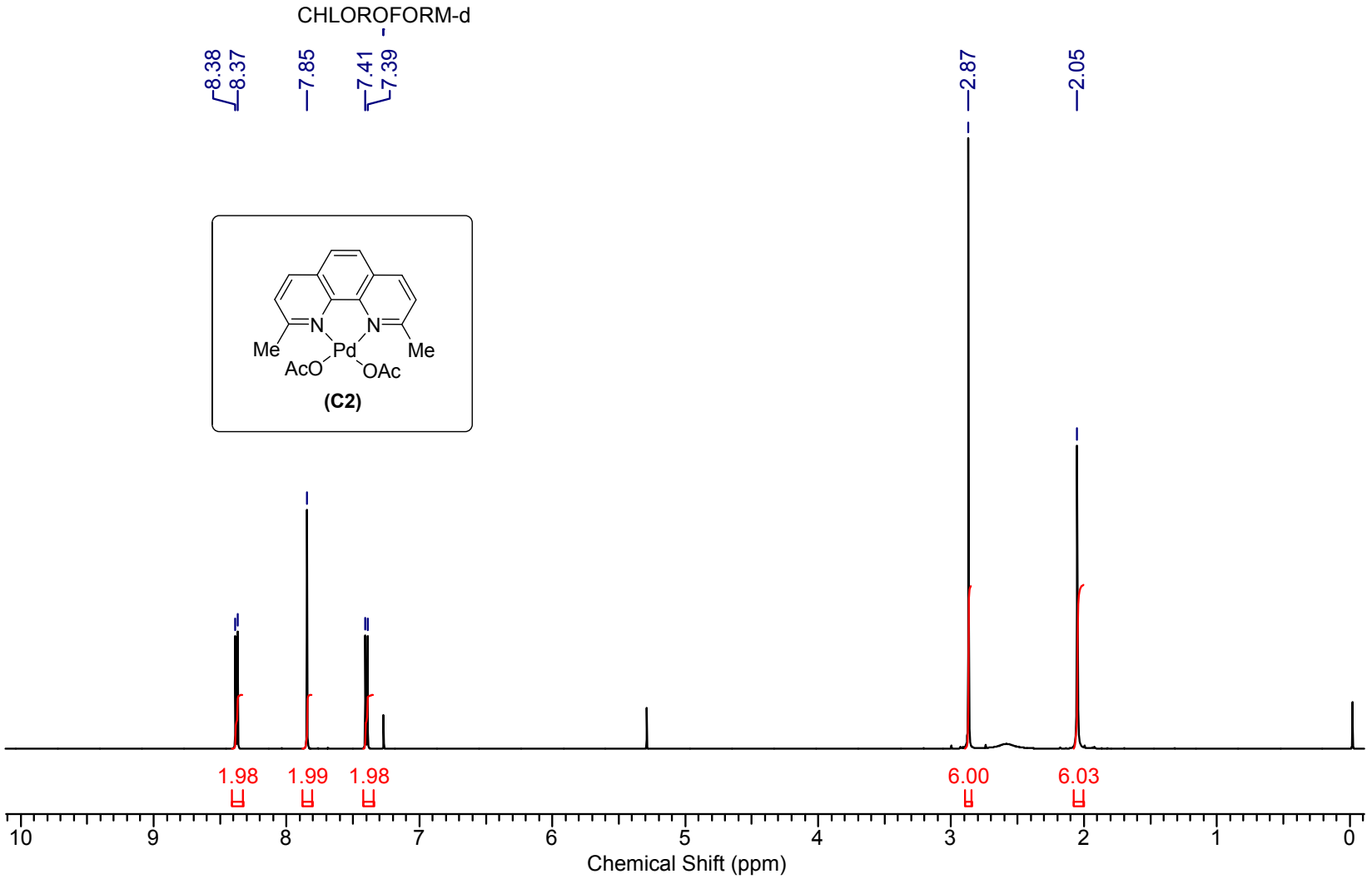
150.32
146.34
138.80
129.65
127.19
125.19
77.26
77.00
76.75
23.36
N
N
Pd
AcO
OAc
(C1)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)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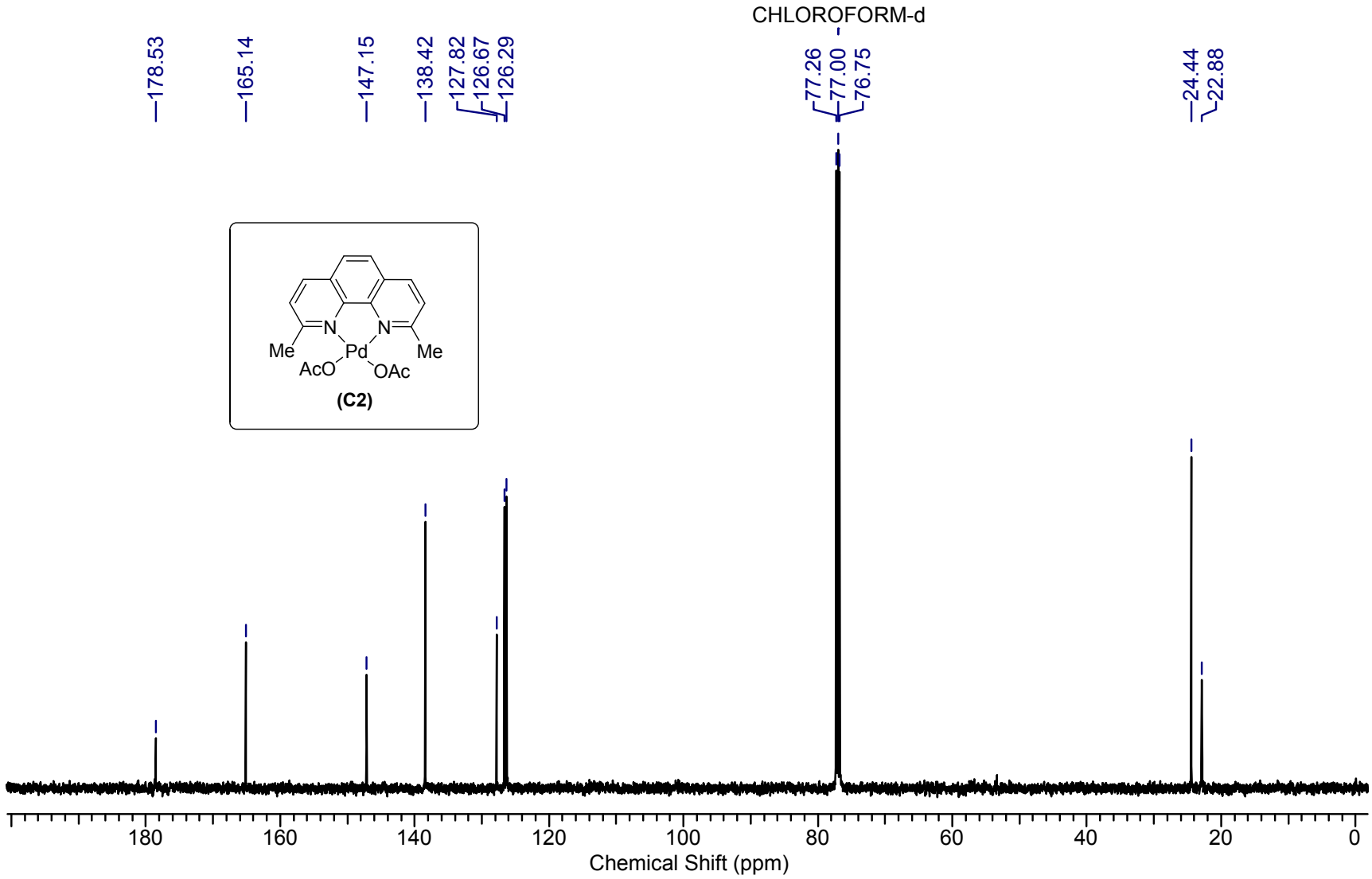
8.37
7.85
7.41
7.39
2.87
2.05
Me
N
Pd
N
Me
AcO
OAc
(C2)
1.98
1.99
1.98
6.00
6.03
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


CHLOROFORM-d
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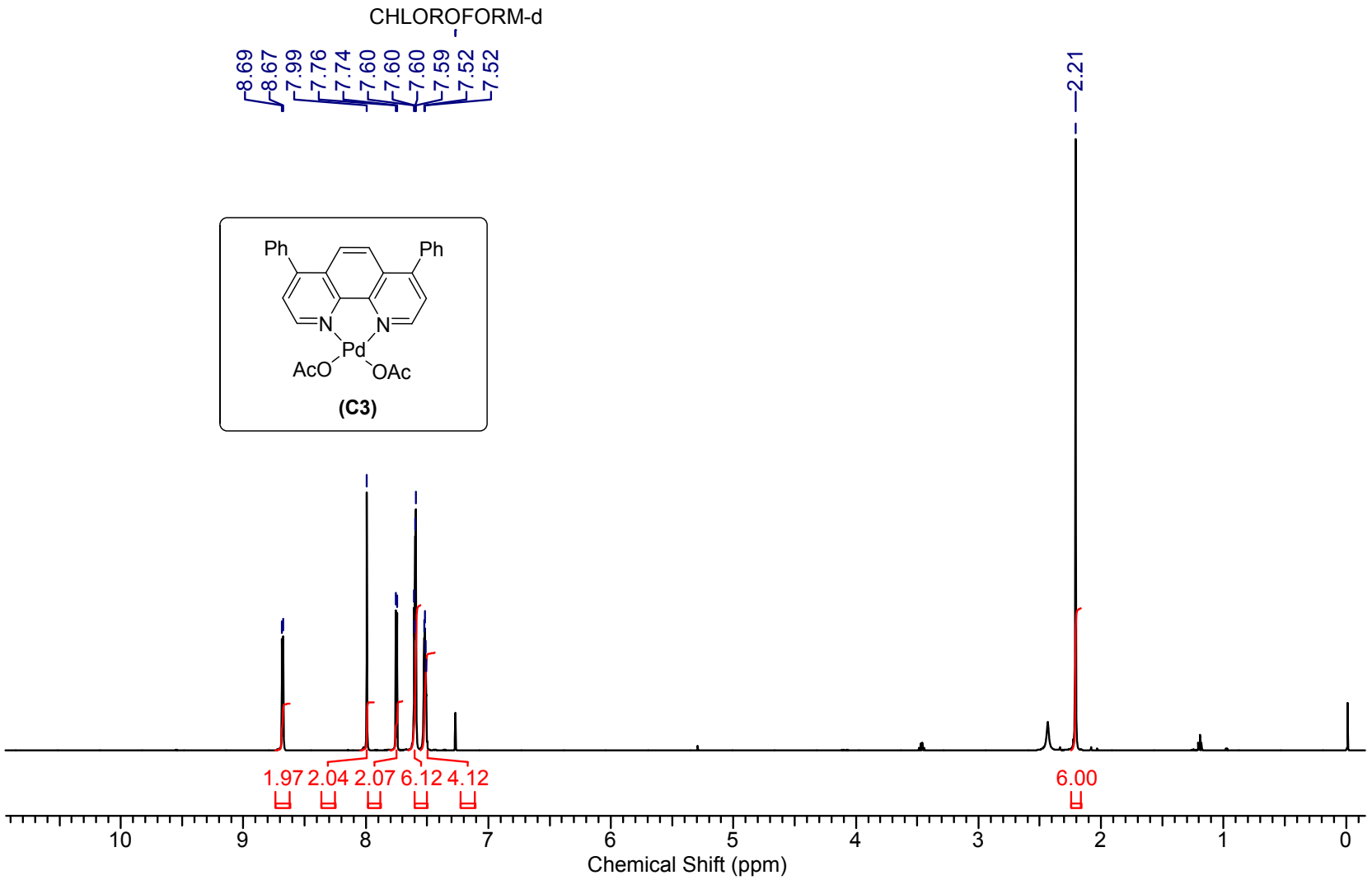
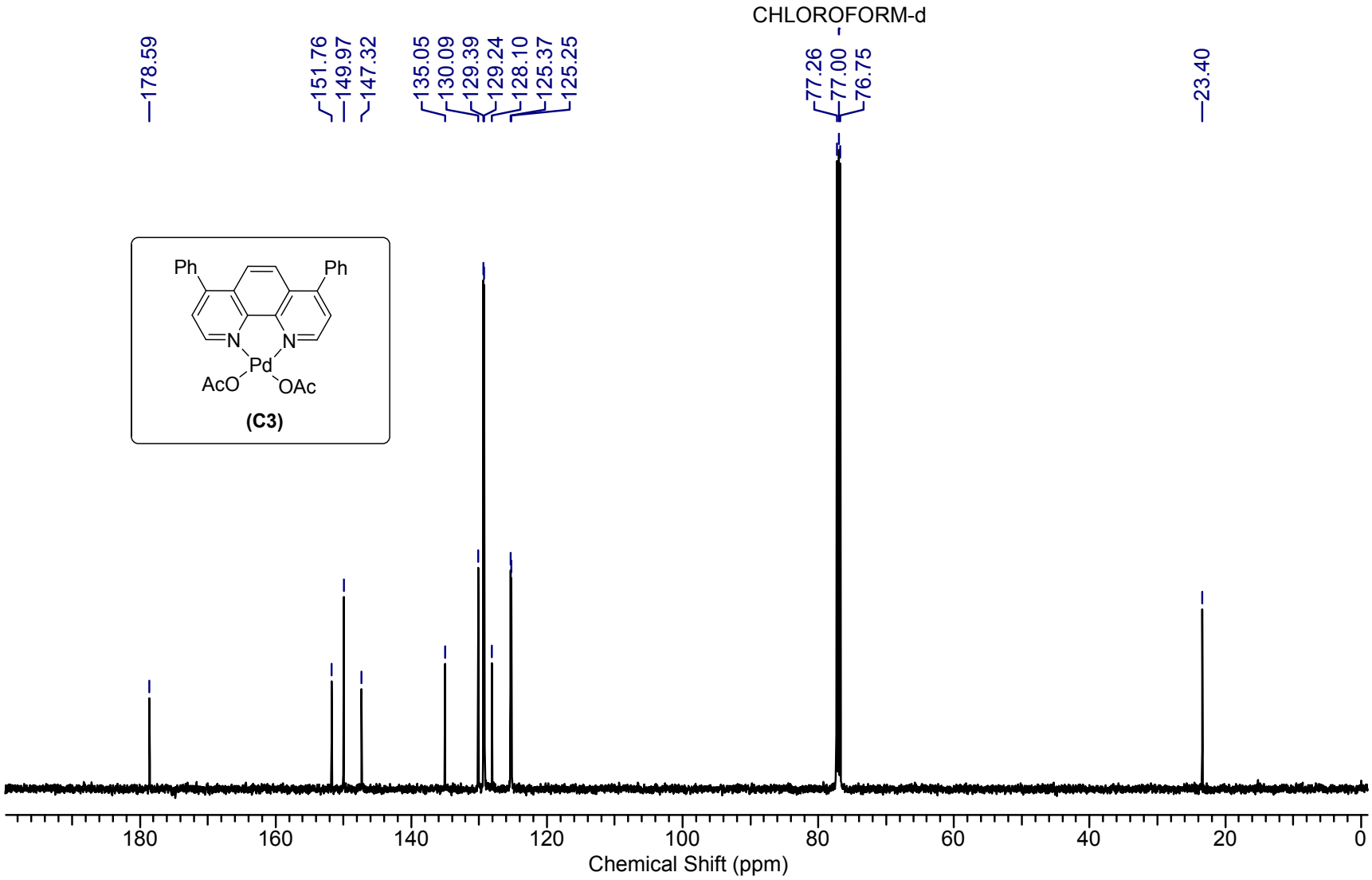
165.14
147.15
138.42
127.82
126.67
126.29
77.26
77.00
76.75
24.44
22.88
Me
Pd
AcO
OAc
Me
(C2)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)


CHLOROFORM-d
8.69
8.67
7.99
7.76
7.74
7.60
7.60
7.60
7.59
7.52
7.52
2.21
Ph
Ph
N
N
Pd
AcO
OAc
(C3)
1.97
2.04
2.07
6.12
4.12
6.00
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


CHLOROFORM-d
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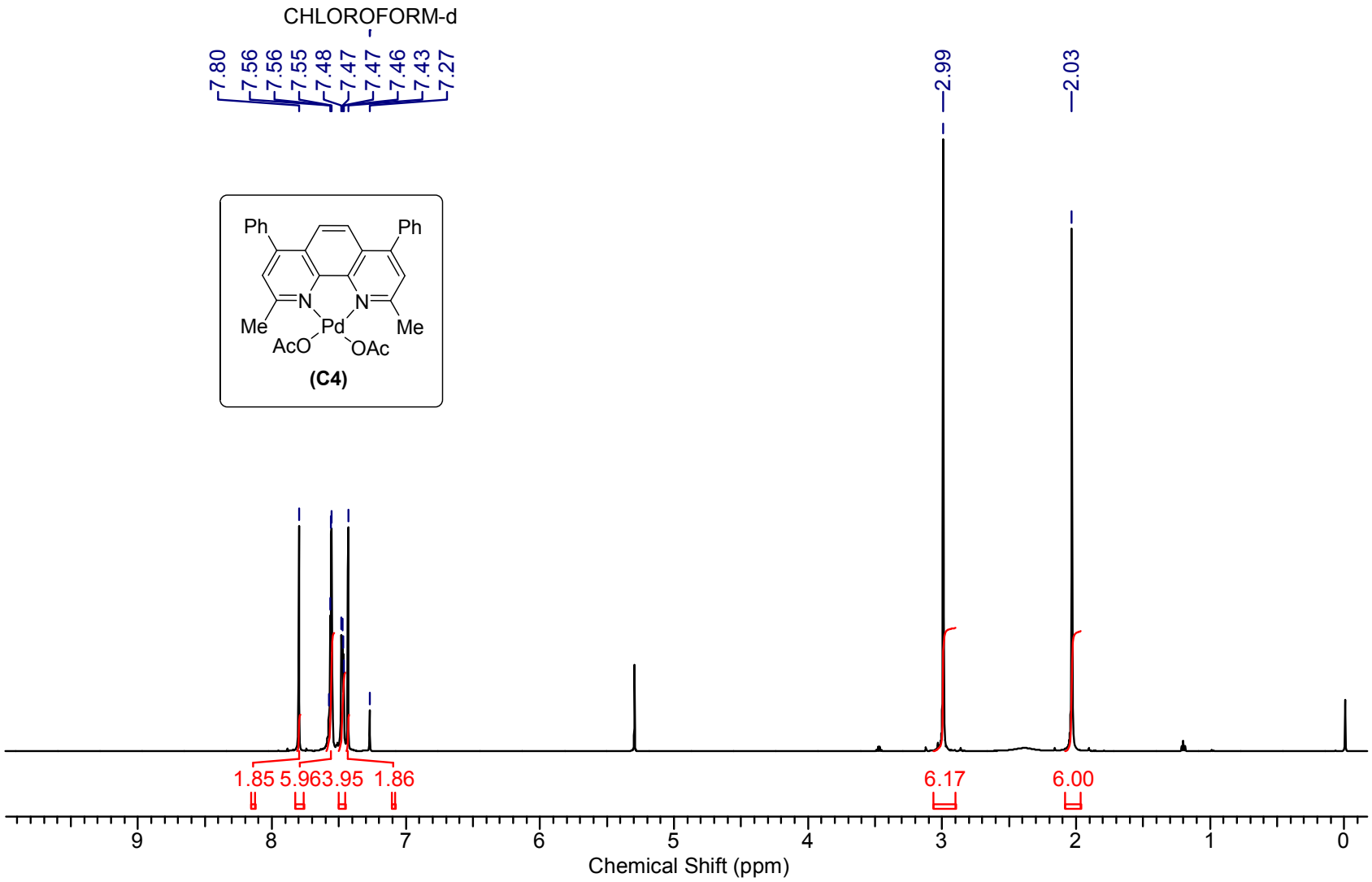
151.76
149.97
147.32
135.05
130.09
129.39
129.24
128.10
125.37
125.25
77.26
77.00
76.75
23.40
Ph
Ph
N
N
Pd
AcO
OAc
(C3)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)


CHLOROFORM-d
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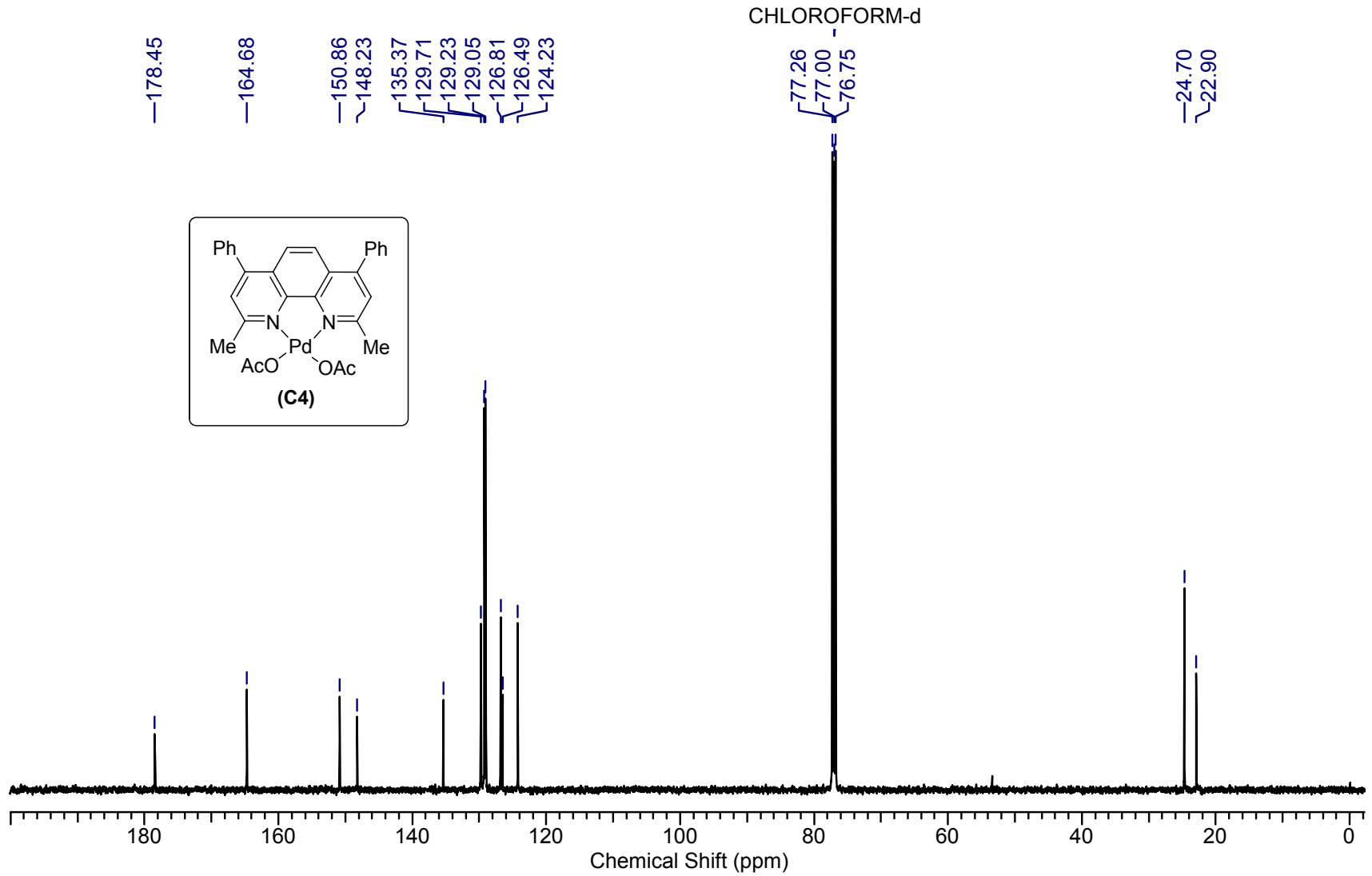
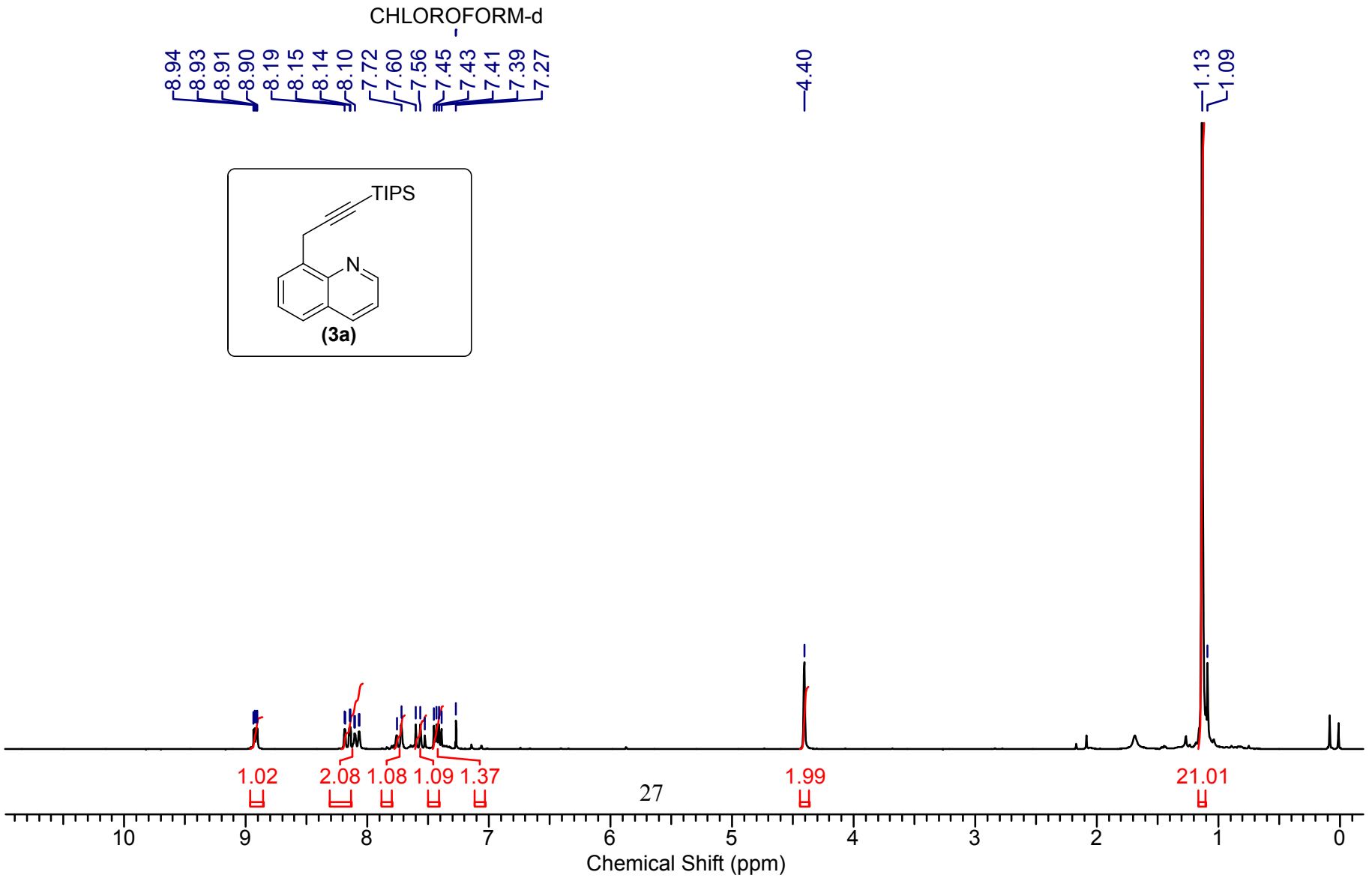
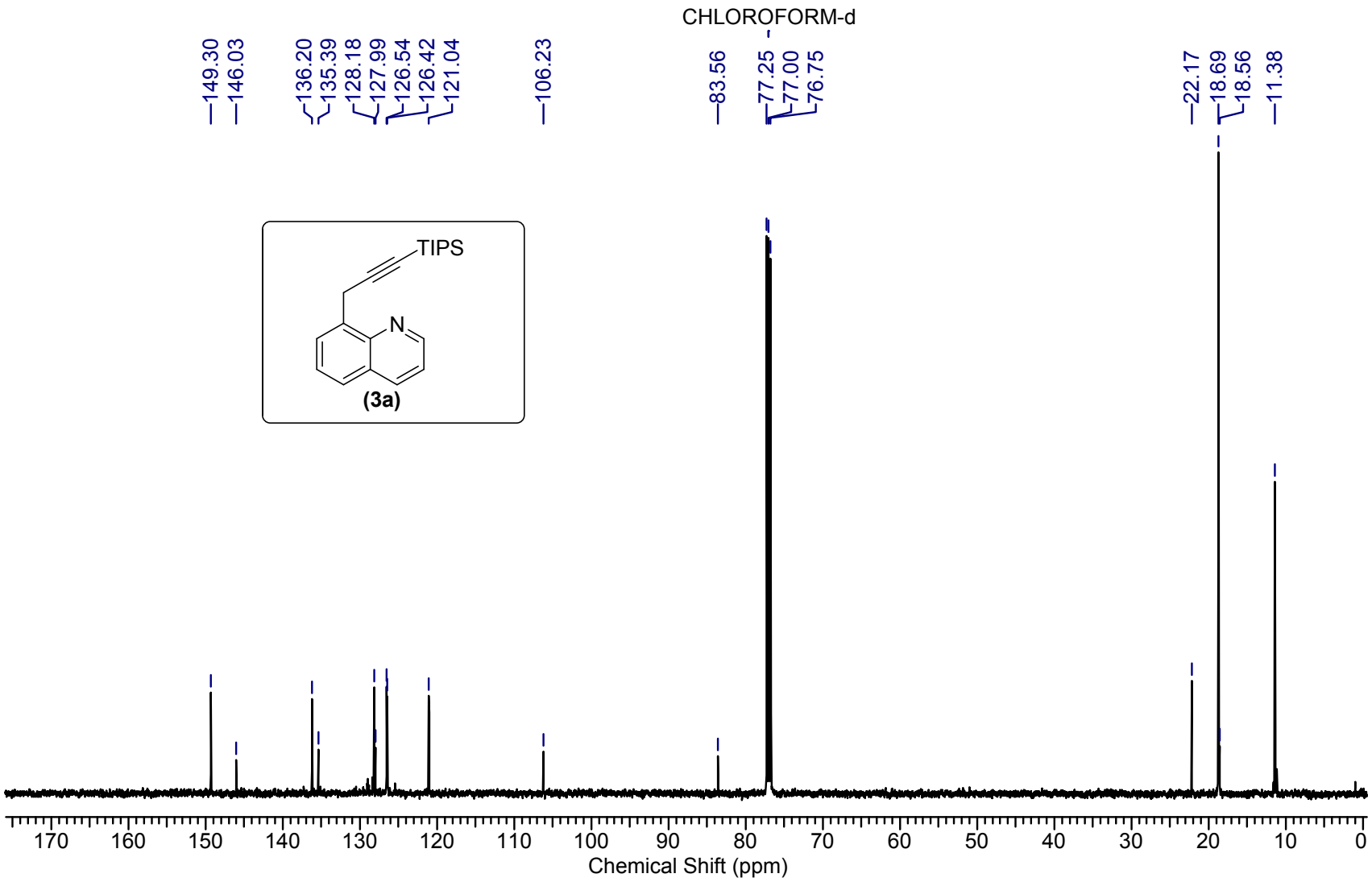
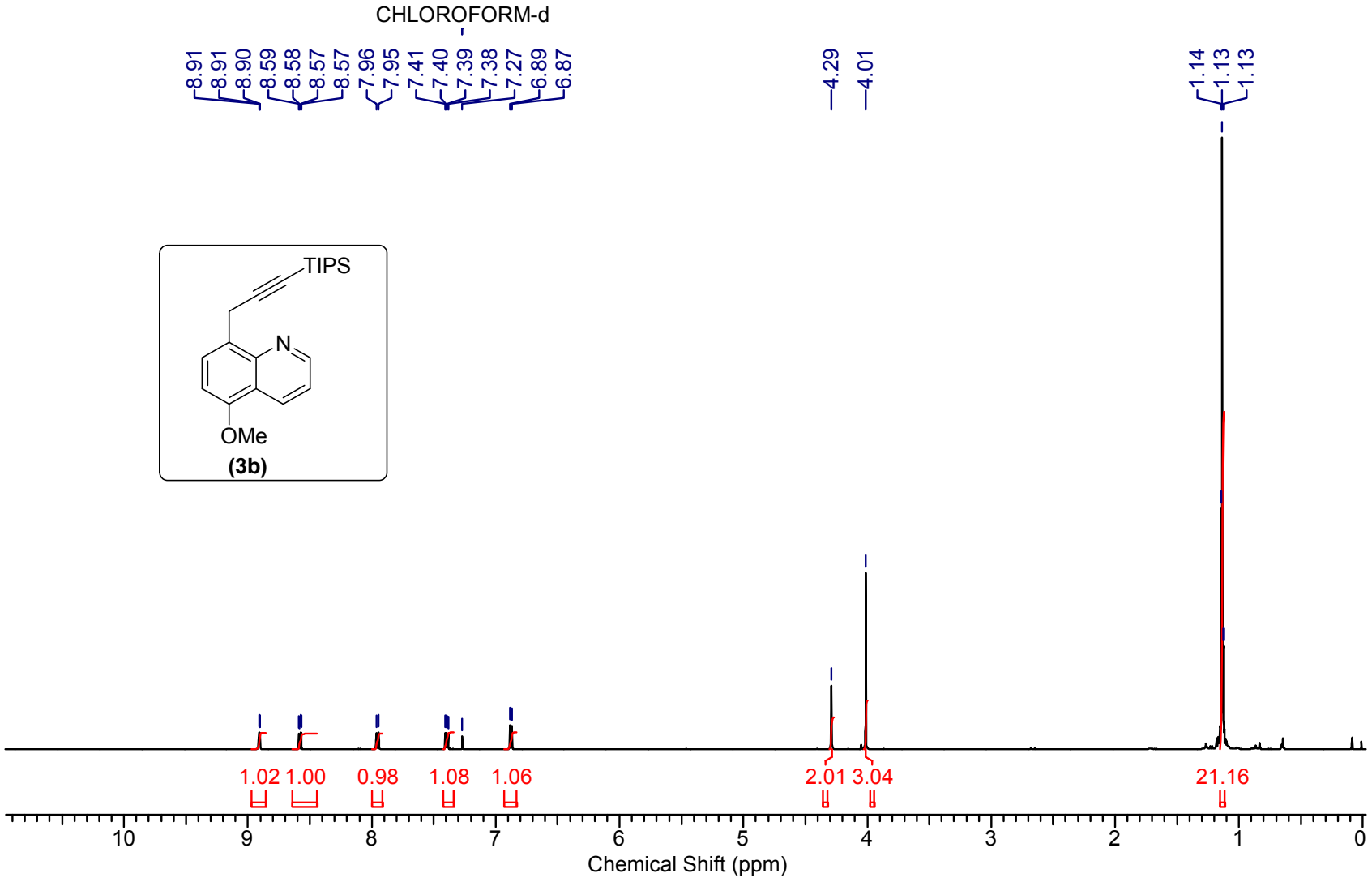
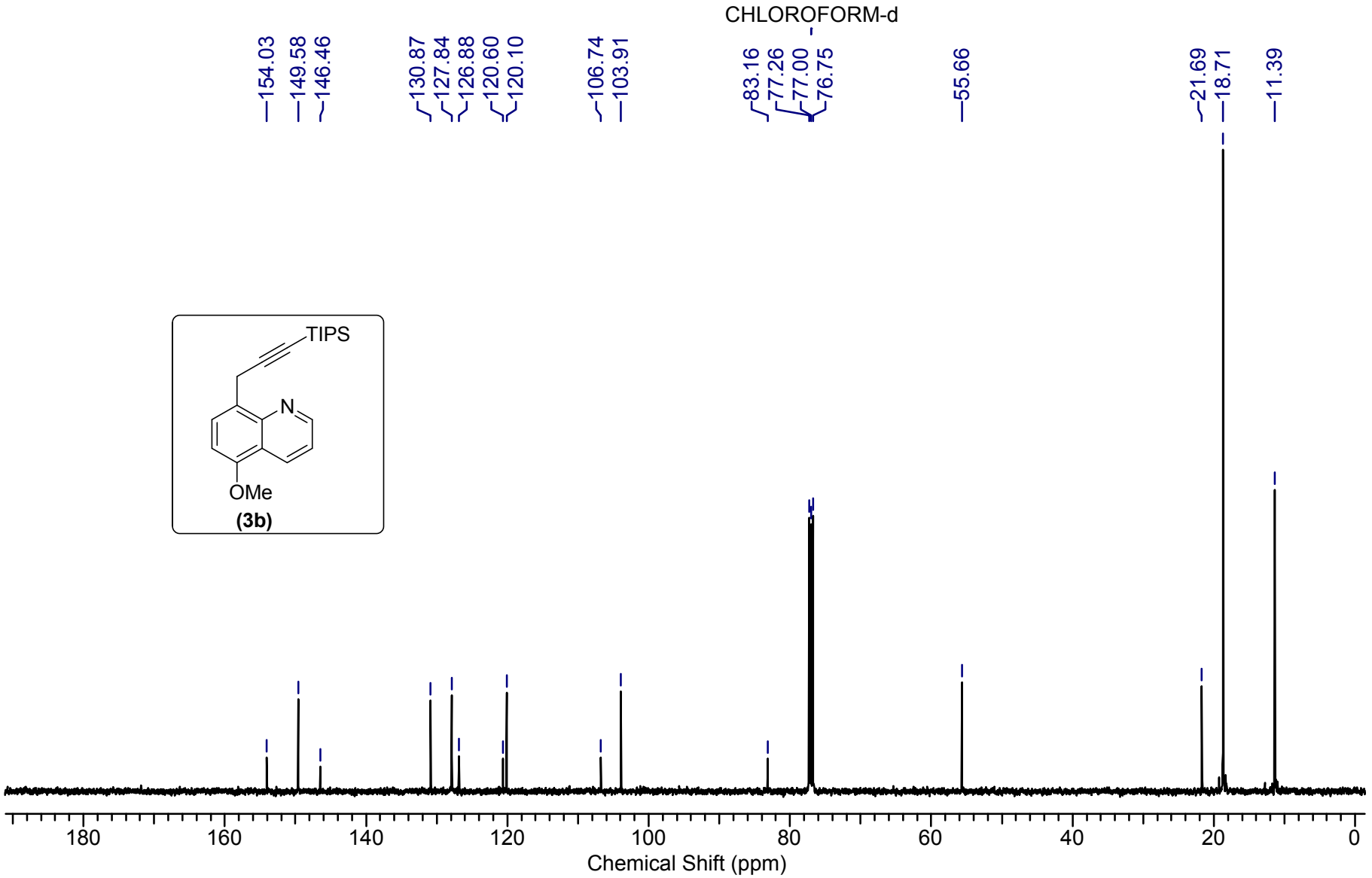
7.56
7.56
7.55
7.48
7.47
7.47
7.46
7.43
7.27
2.99
2.03
Ph
Ph
N
N
Me
Pd
Me
AcO
OAc
(C4)
1.85
5.96
3.95
1.86
6.17
6.00
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

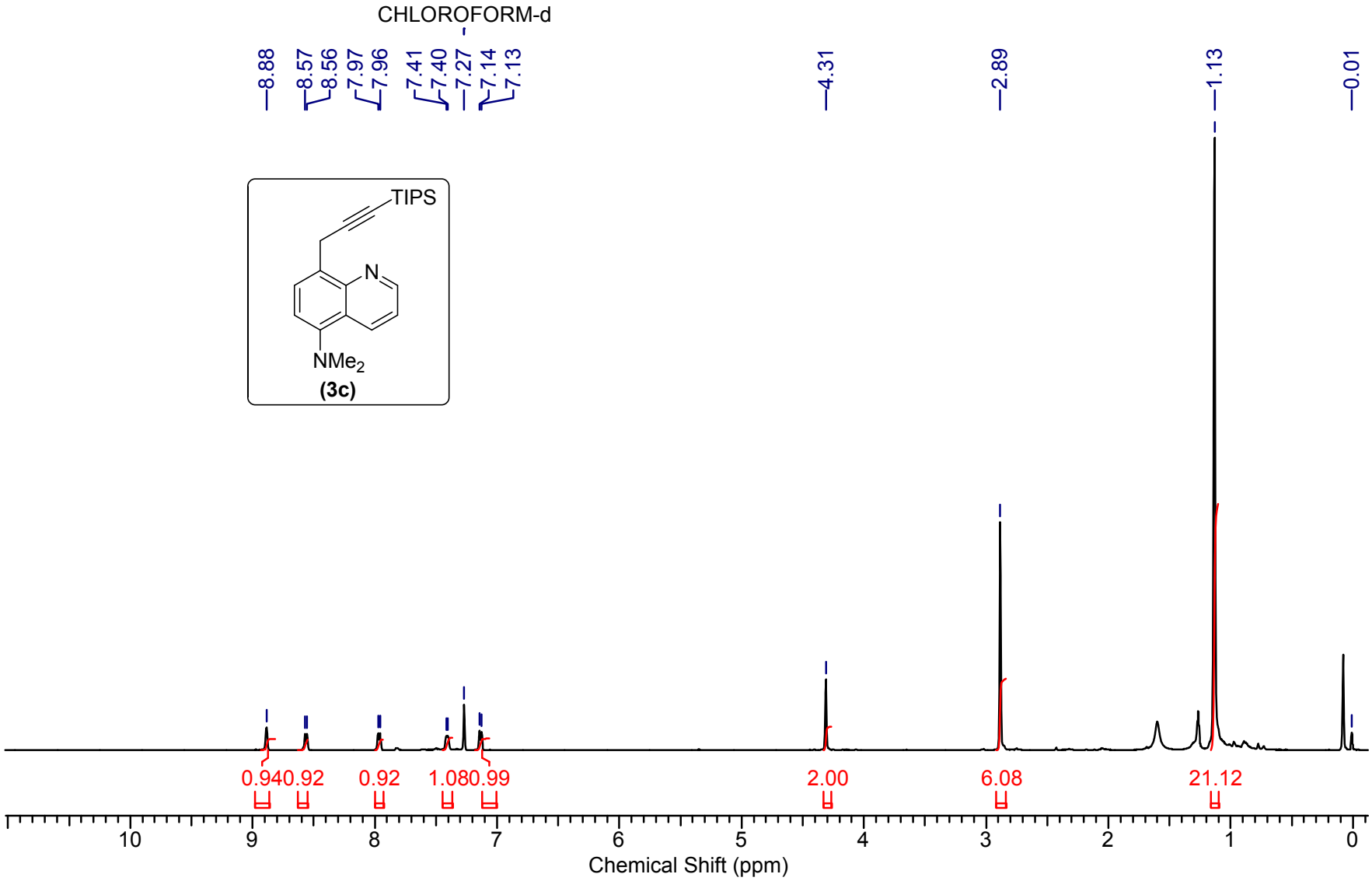

CHLOROFORM-d
178.45
164.68
150.86
148.23
135.37
129.71
129.23
129.05
126.81
126.49
124.23
77.26
77.00
76.75
24.70
22.90
Ph
Ph
N
N
Me
Pd
Me
AcO
OAc
(C4)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

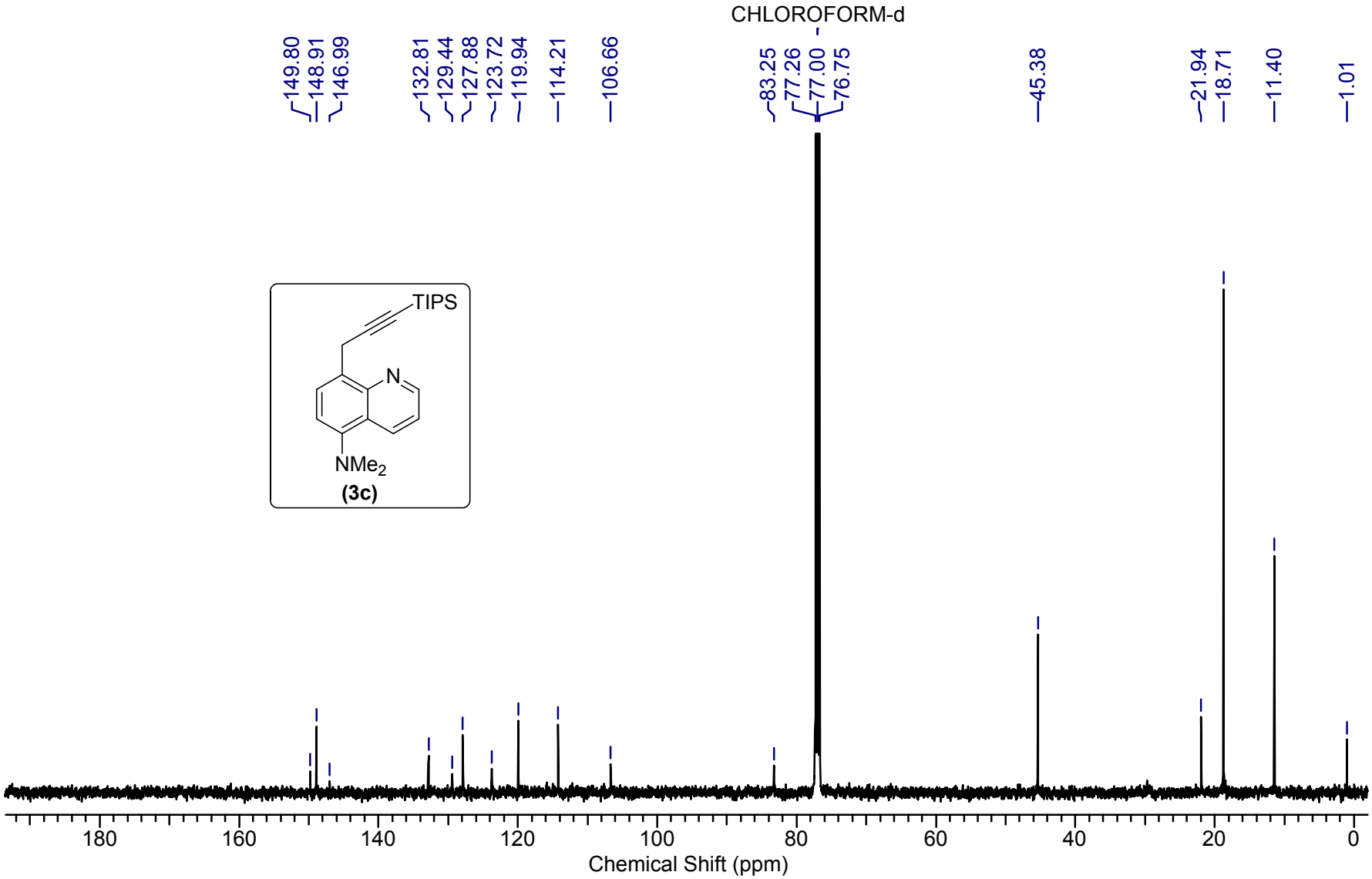

CHLOROFORM-d
8.94
8.93
8.91
8.90
8.19
8.15
8.14
8.10
7.72
7.60
7.56
7.45
7.43
7.41
7.39
7.27
4.40
1.13
1.09
TIPS
N
(3a)
1.02
2.08
1.08
1.09
1.37
1.99
21.01
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

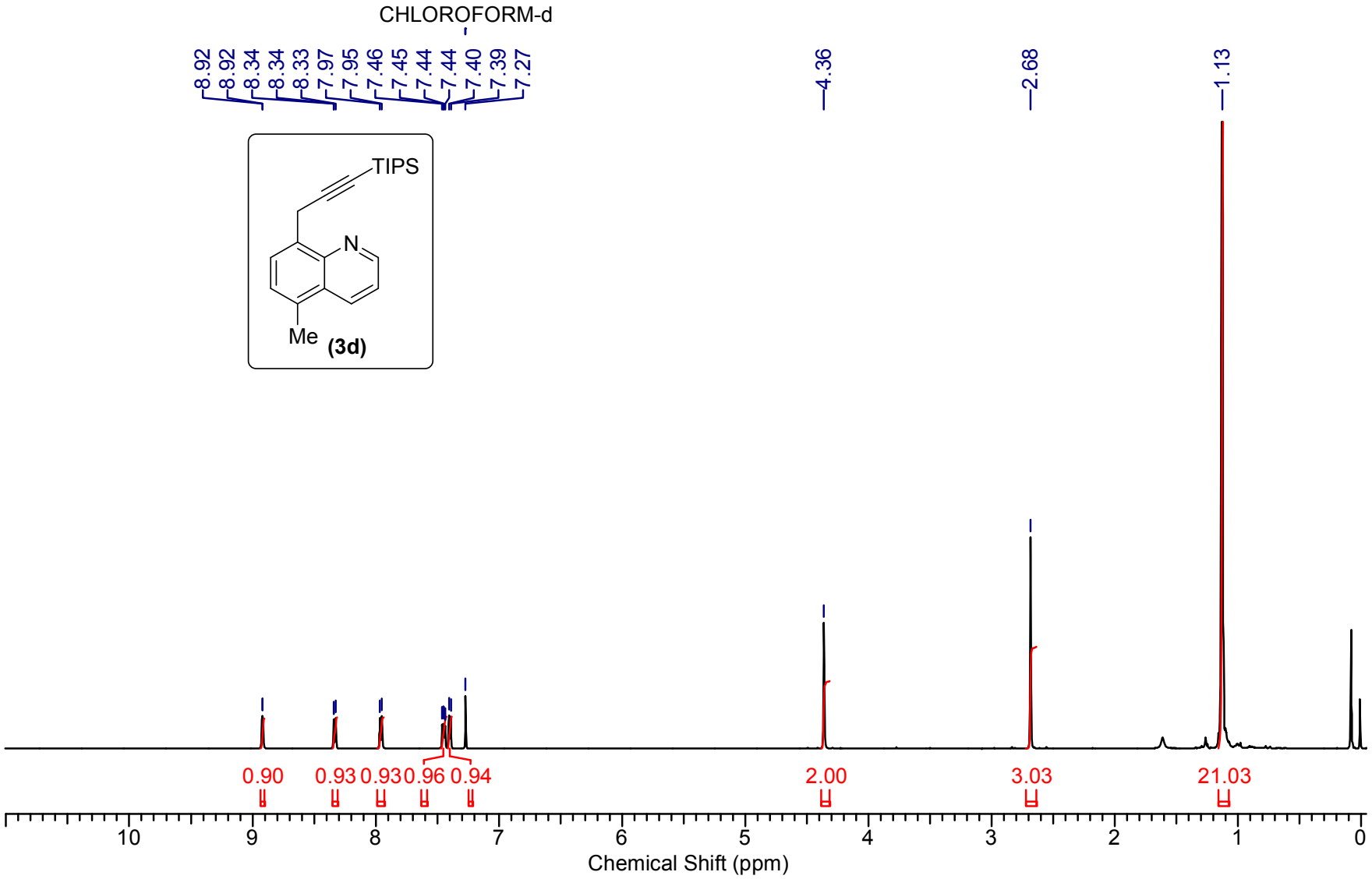

CHLOROFORM-d
149.30
146.03
136.20
135.39
128.18
127.99
126.54
126.42
121.04
106.23
83.56
77.25
77.00
76.75
22.17
18.69
18.56
11.38
TIPS
N
(3a)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Chemical Shift (ppm)

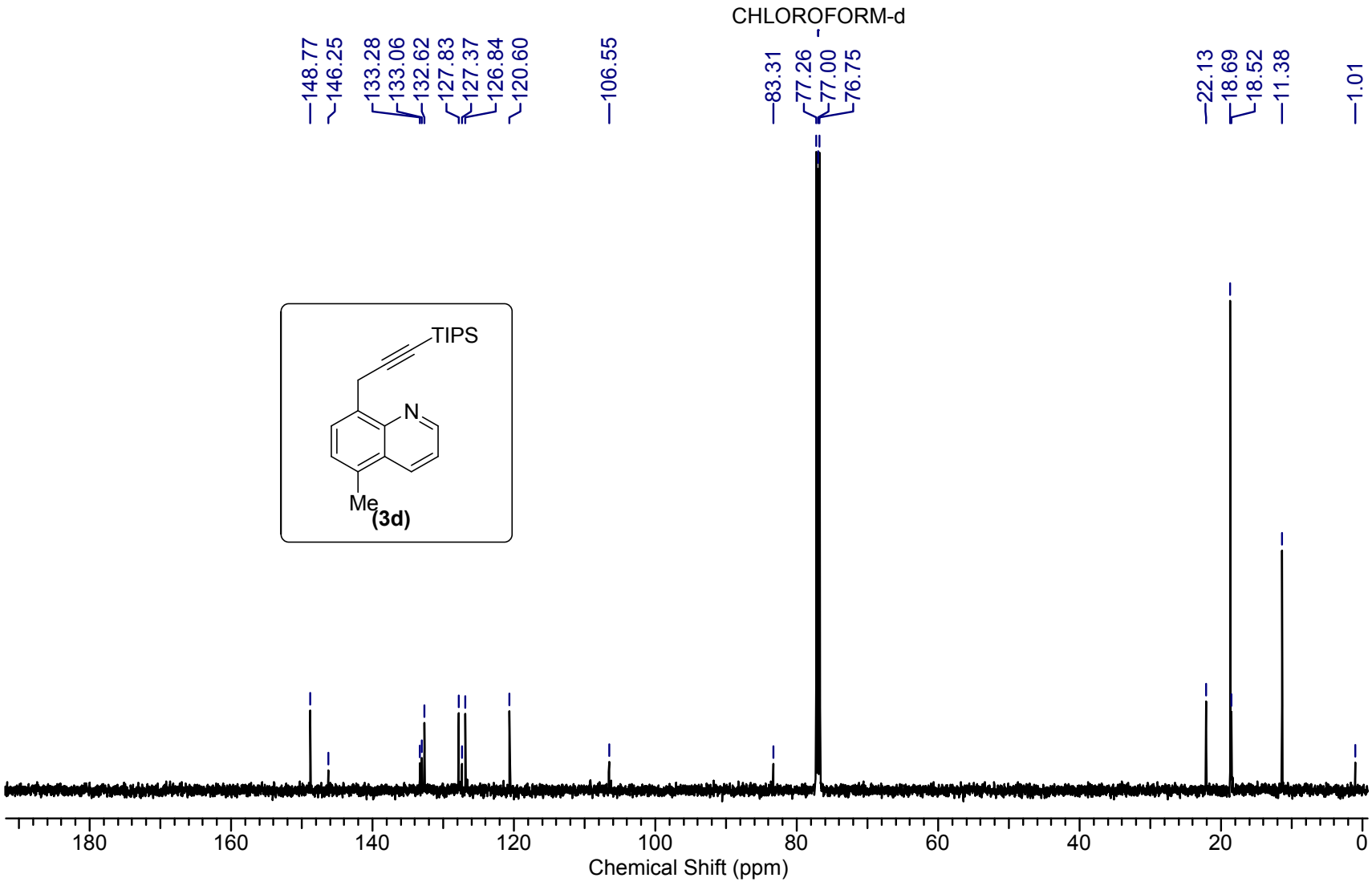

CHLOROFORM-d
8.91
8.91
8.90
8.59
8.58
8.57
8.57
7.96
7.95
7.41
7.40
7.39
7.38
7.27
6.89
6.87
4.29
4.01
1.14
1.13
1.13
TIPS
N
OMe
(3b)
1.02
1.00
0.98
1.08
1.06
2.01
3.04
21.16
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

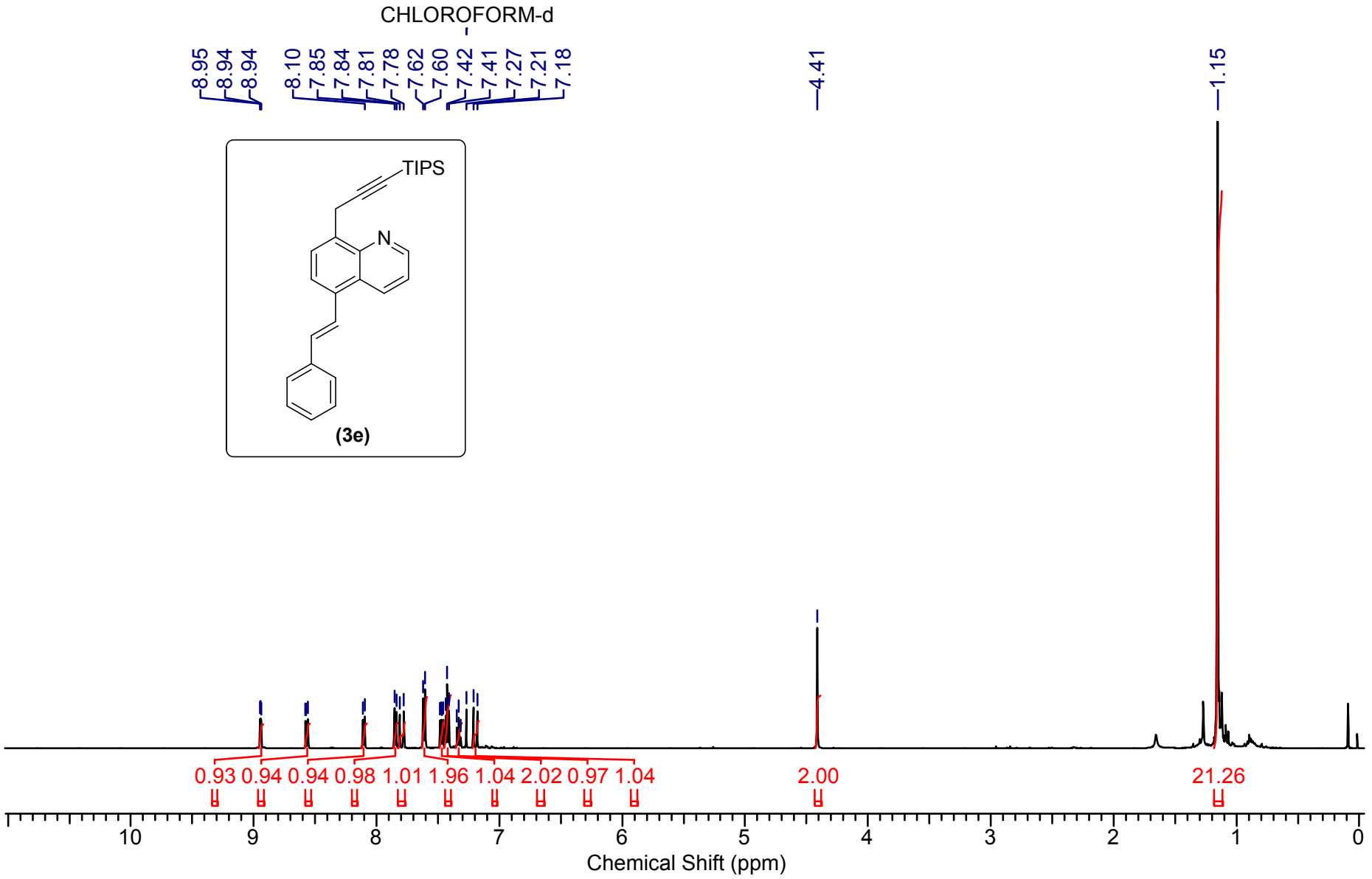

CHLOROFORM-d
154.03
149.58
146.46
130.87
127.84
126.88
120.60
120.10
106.74
103.91
83.16
77.26
77.00
76.75
55.66
21.69
18.71
11.39
TIPS
N
OMe
(3b)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

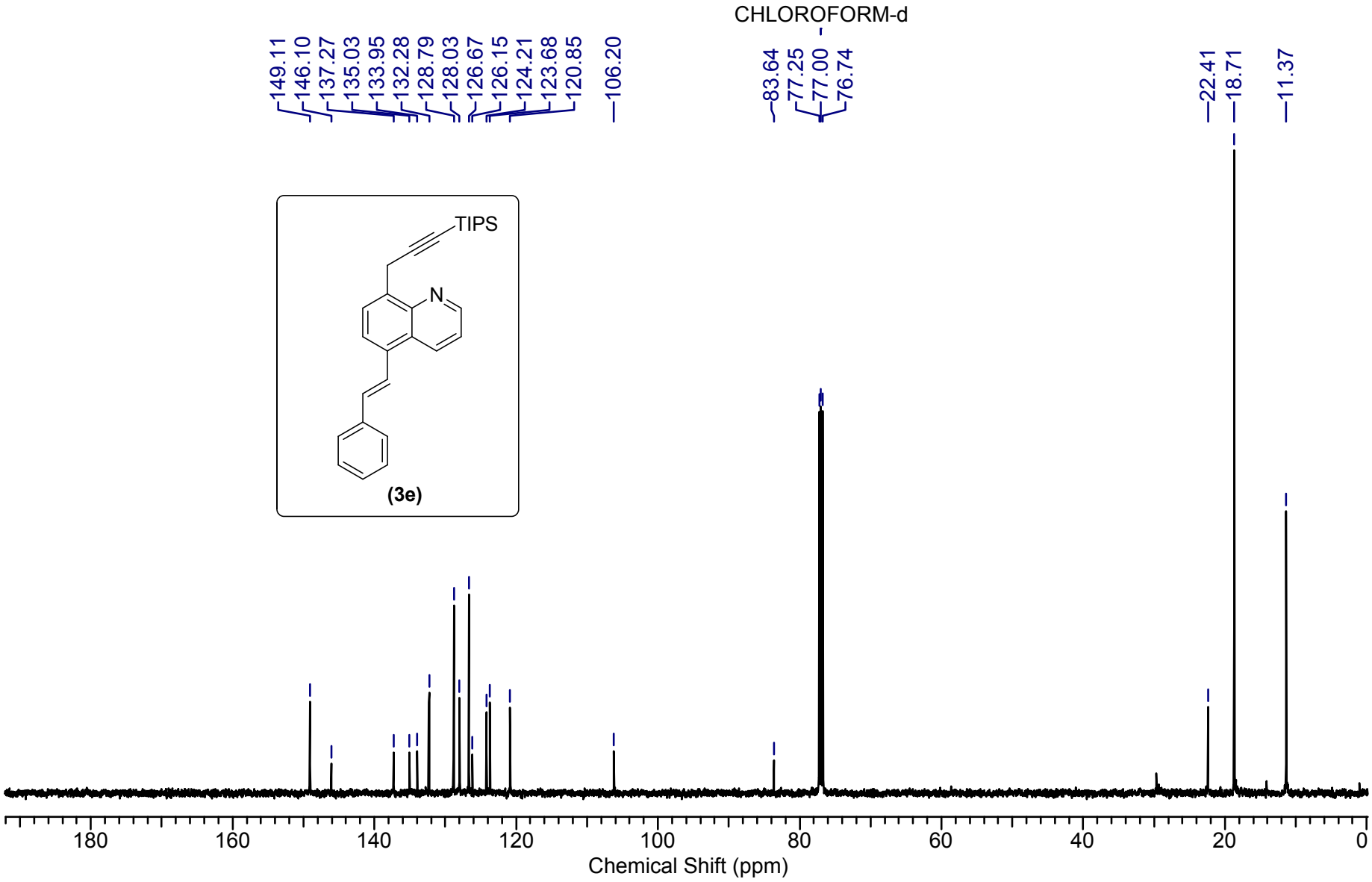

CHLOROFORM-d
8.88
8.57
8.56
7.97
7.96
7.41
7.40
7.27
7.14
7.13
4.31
2.89
1.13
0.01
TIPS
N
NMe2
(3c)
0.94
0.92
0.92
1.08
0.99
2.00
6.08
21.12
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

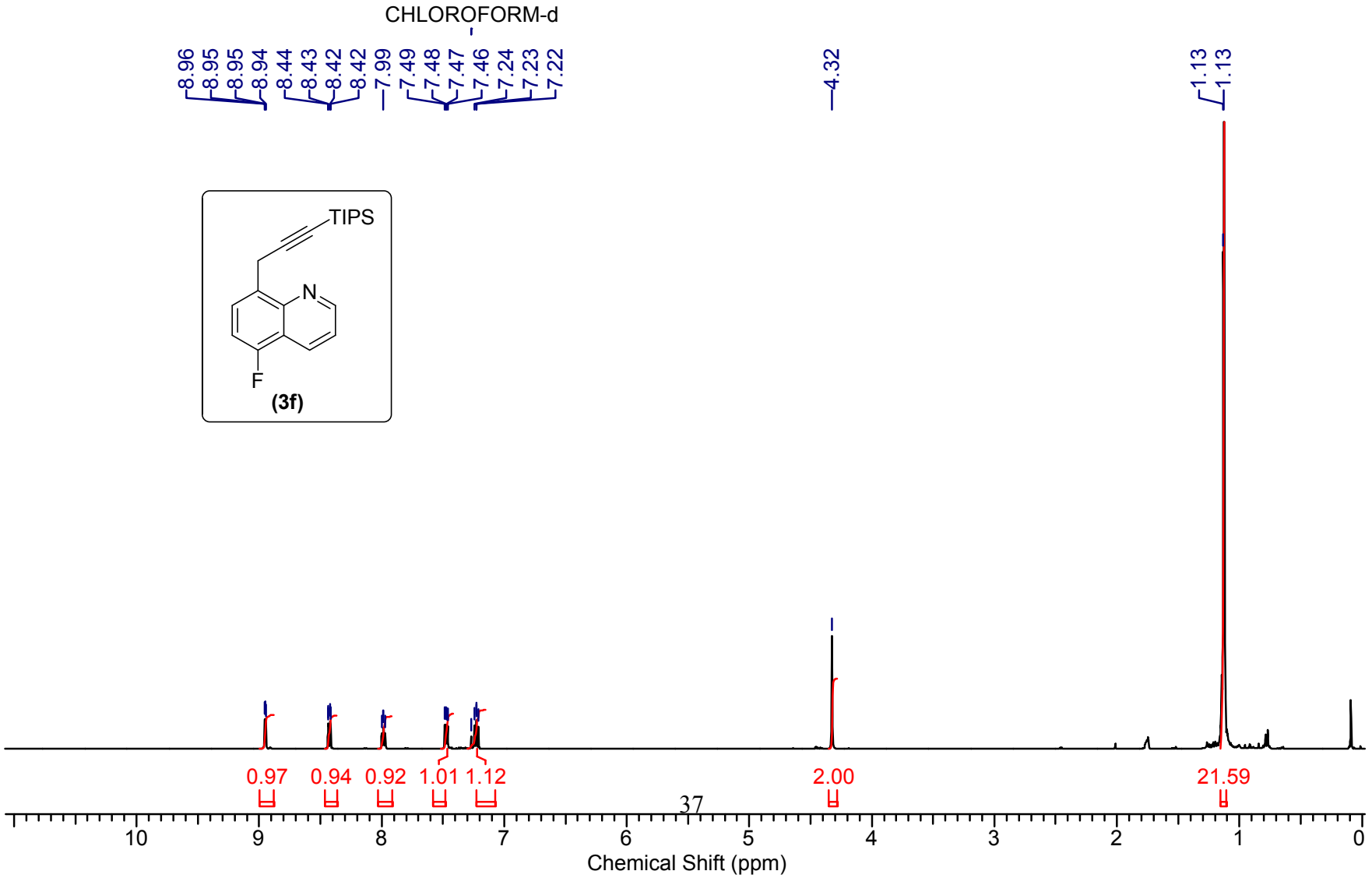

CHLOROFORM-d
149.80
148.91
146.99
132.81
129.44
127.88
123.72
119.94
114.21
106.66
83.25
77.26
77.00
76.75
45.38
21.94
18.71
11.40
1.01
TIPS
N
NMe2
(3c)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

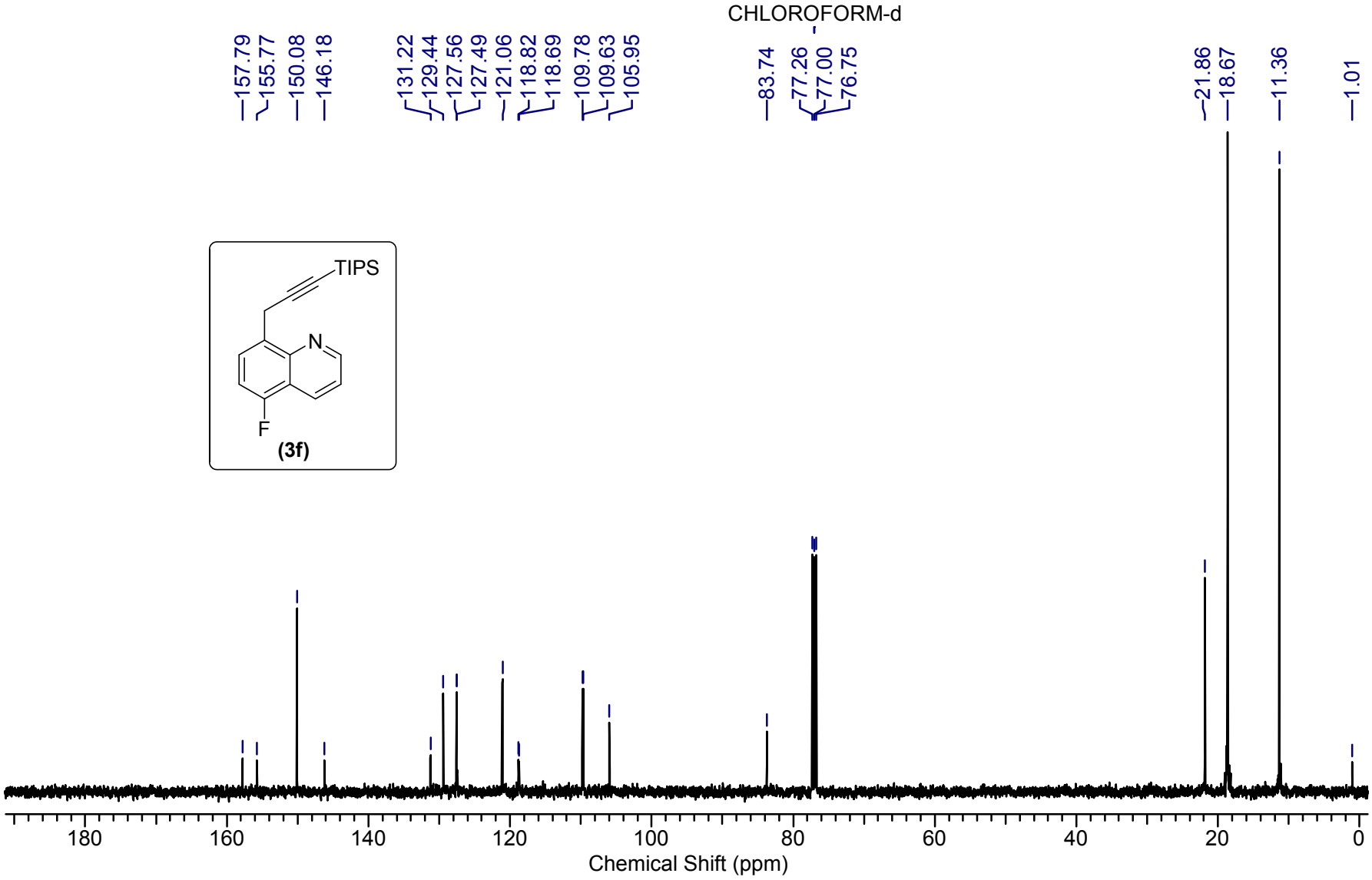

CHLOROFORM-d
8.92
8.92
8.34
8.34
8.33
7.97
7.95
7.46
7.45
7.44
7.44
7.40
7.39
7.27
4.36
2.68
1.13
TIPS
N
Me
(3d)
0.90
0.93
0.93
0.96
0.94
2.00
3.03
21.03
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

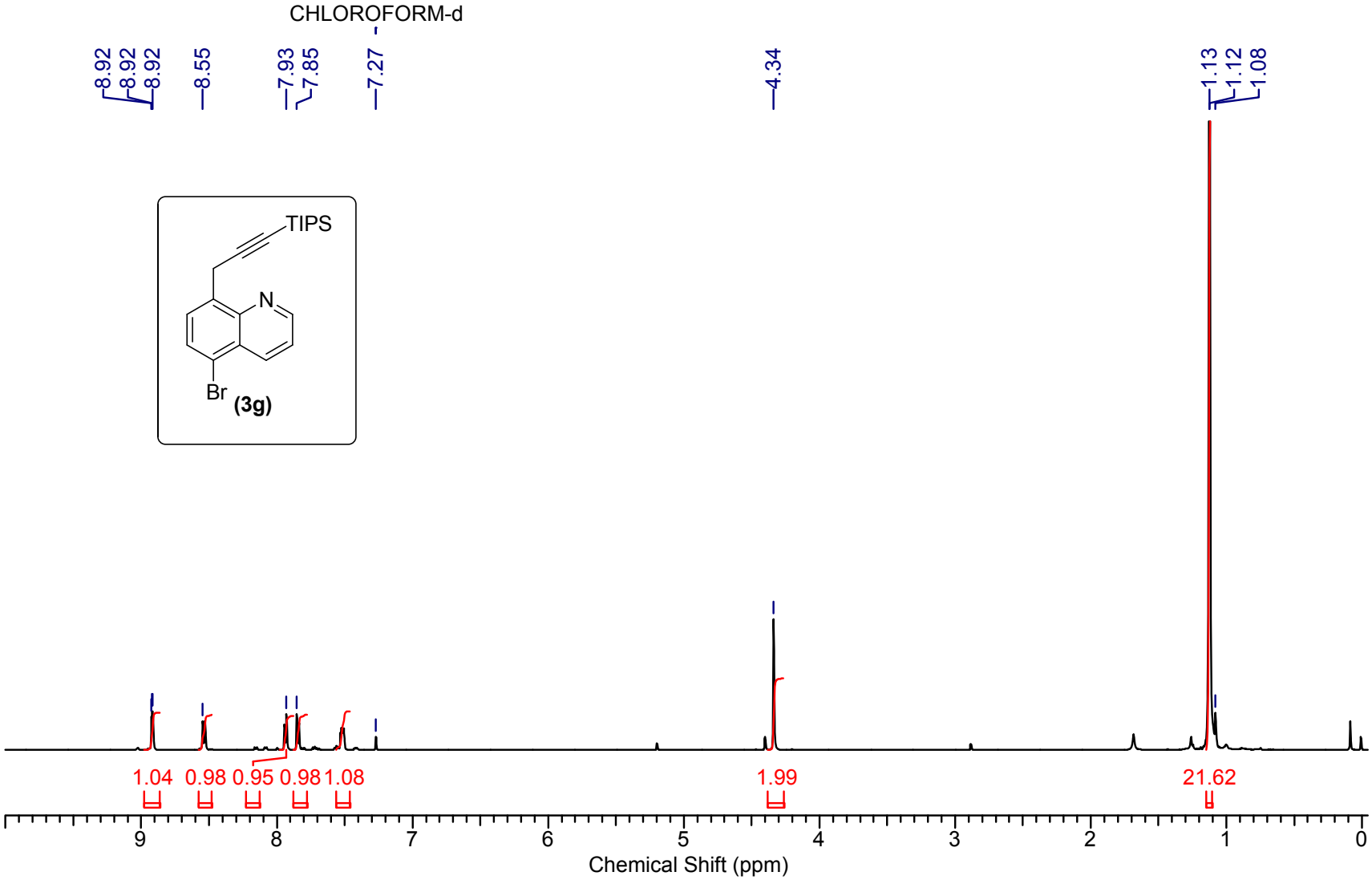

CHLOROFORM-d
148.77
146.25
133.28
133.06
132.62
127.83
127.37
126.84
120.60
106.55
83.31
77.26
77.00
76.75
22.13
18.69
18.52
11.38
1.01
TIPS
N
Me
(3d)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

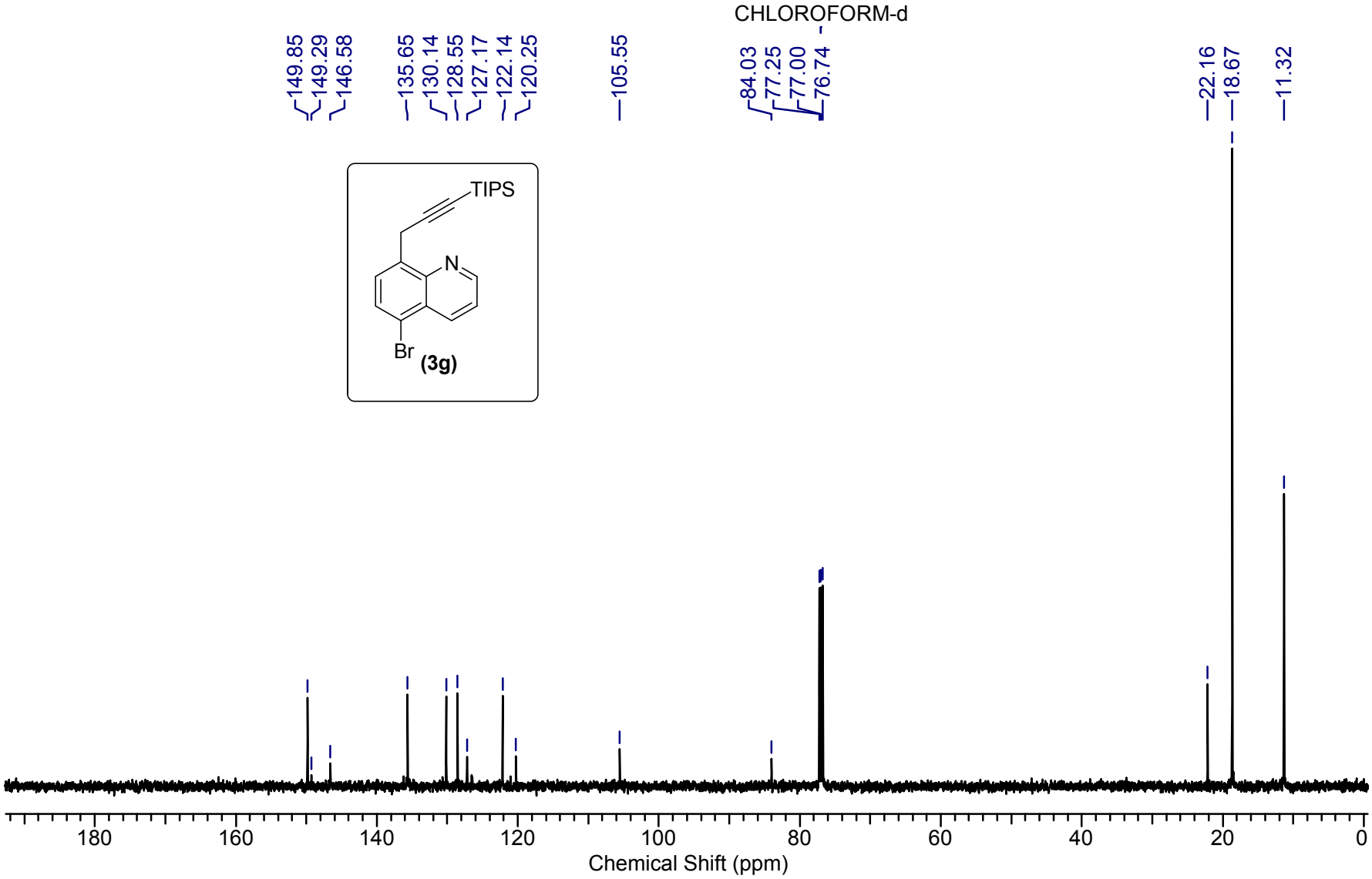

CHLOROFORM-d
8.95
8.94
8.94
8.10
7.85
7.84
7.81
7.78
7.62
7.60
7.42
7.41
7.27
7.21
7.18
4.41
1.15
TIPS
N
(3e)
0.93 0.94 0.94 0.98 1.01 1.96 1.04 2.02 0.97 1.04
2.00
21.26
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

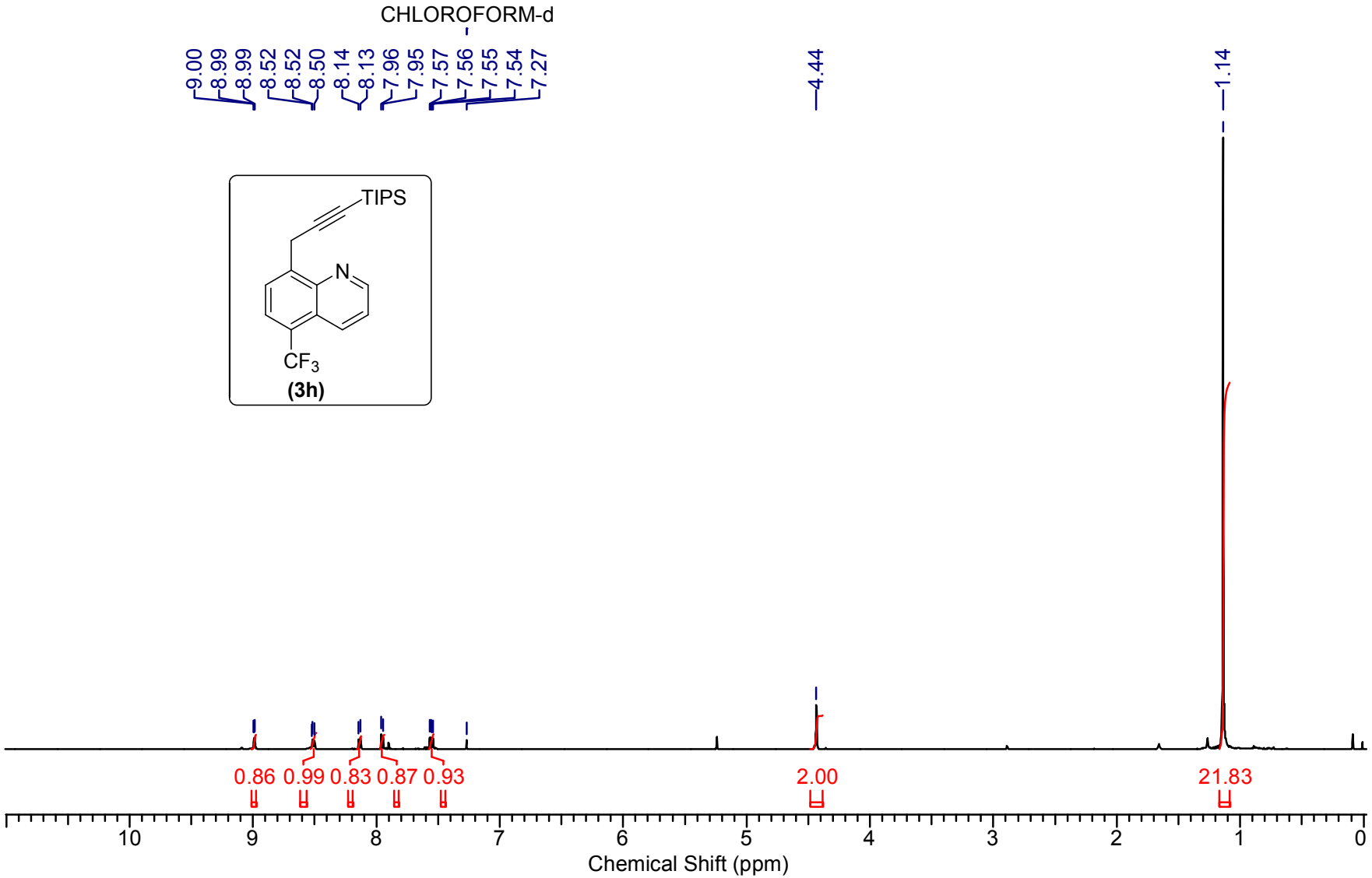

CHLOROFORM-d
149.11
146.10
137.27
135.03
133.95
132.28
128.79
128.03
126.67
126.15
124.21
123.68
120.85
106.20
83.64
77.25
77.00
76.74
22.41
18.71
11.37
TIPS
N
(3e)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

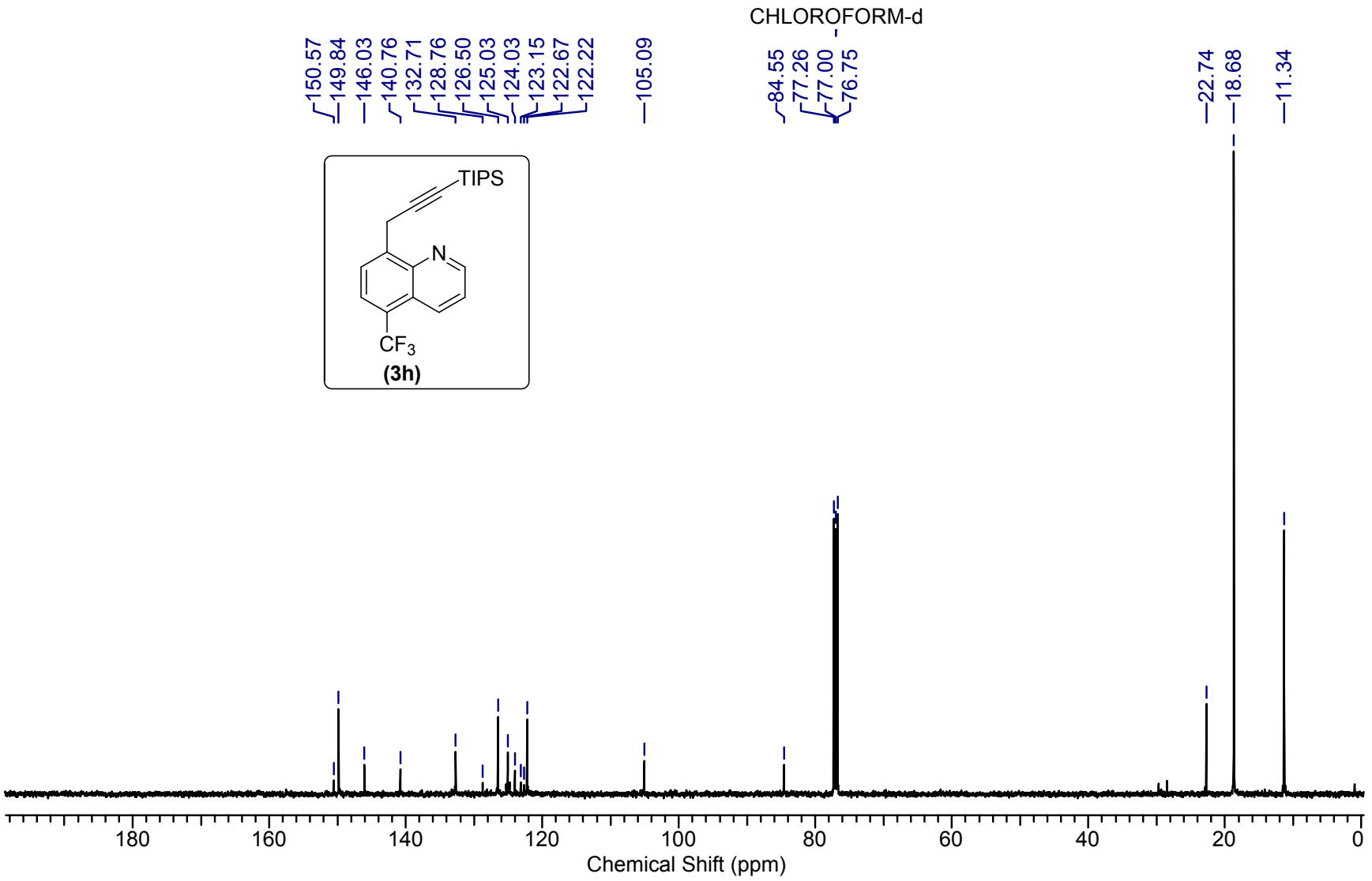

CHLOROFORM-d
8.96
8.95
8.95
8.94
8.44
8.43
8.42
8.42
7.99
7.49
7.48
7.47
7.46
7.24
7.23
7.22
4.32
1.13
1.13
TIPS
N
F
(3f)
0.97
0.94
0.92
1.01
1.12
2.00
21.59
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

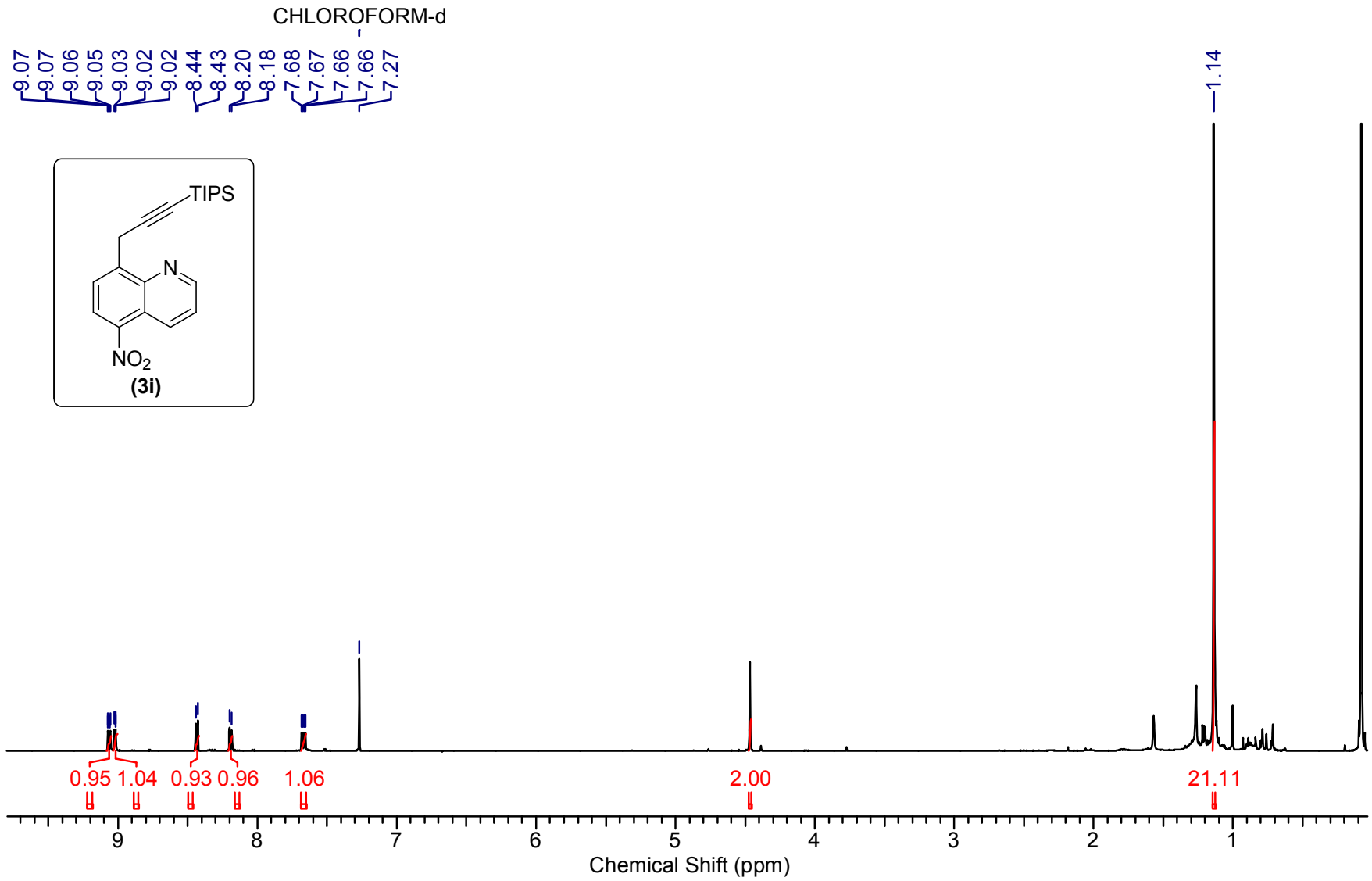

CHLOROFORM-d
157.79
155.77
150.08
146.18
131.22
129.44
127.56
127.49
121.06
118.82
118.69
109.78
109.63
105.95
83.74
77.26
77.00
76.75
21.86
18.67
11.36
1.01
TIPS
N
F
(3f)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

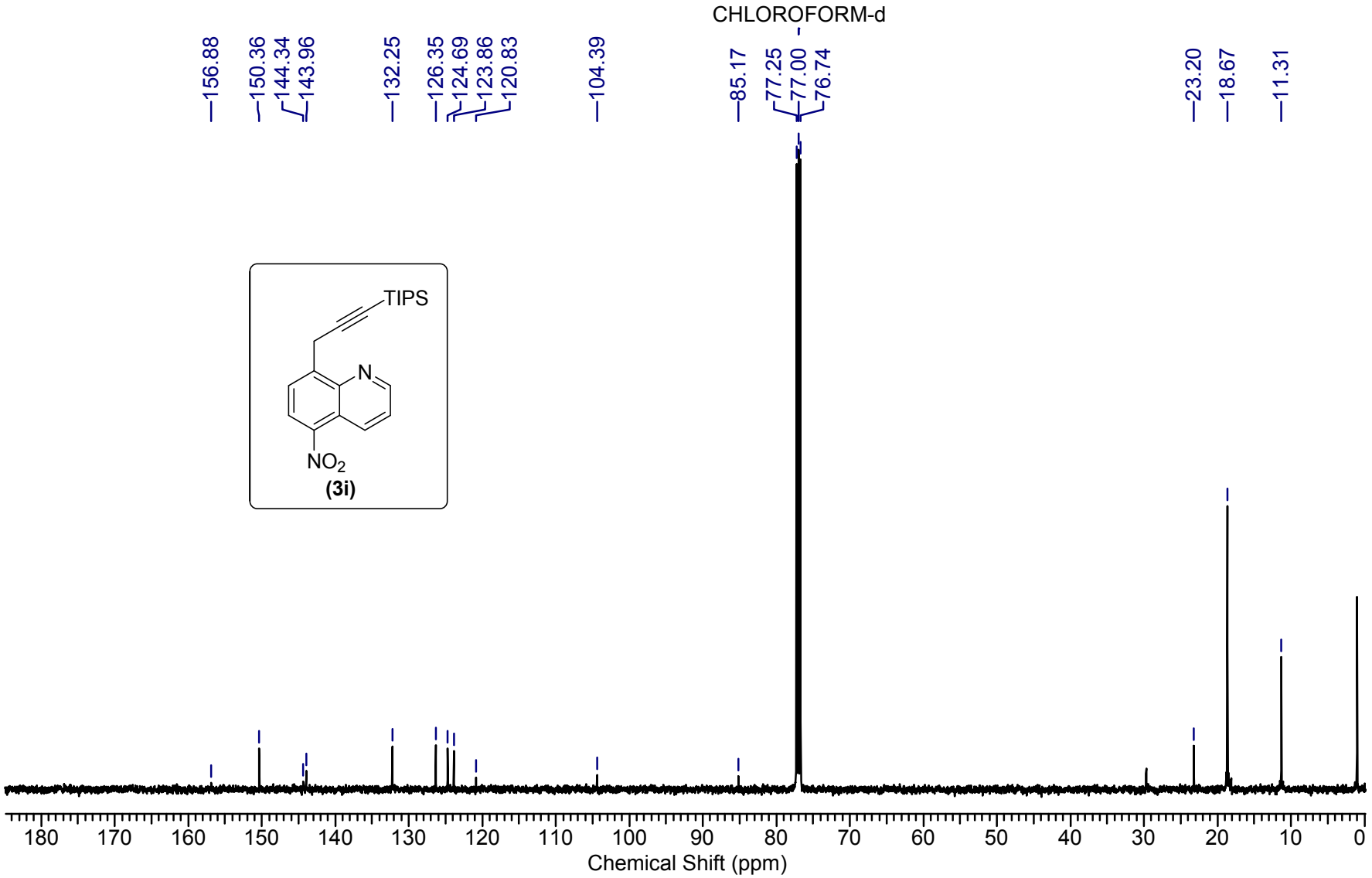

CHLOROFORM-d
8.92
8.92
8.92
8.55
7.93
7.85
7.27
4.34
1.13
1.12
1.08
TIPS
N
Br
(3g)
1.04
0.98
0.95
0.98
1.08
1.99
21.62
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

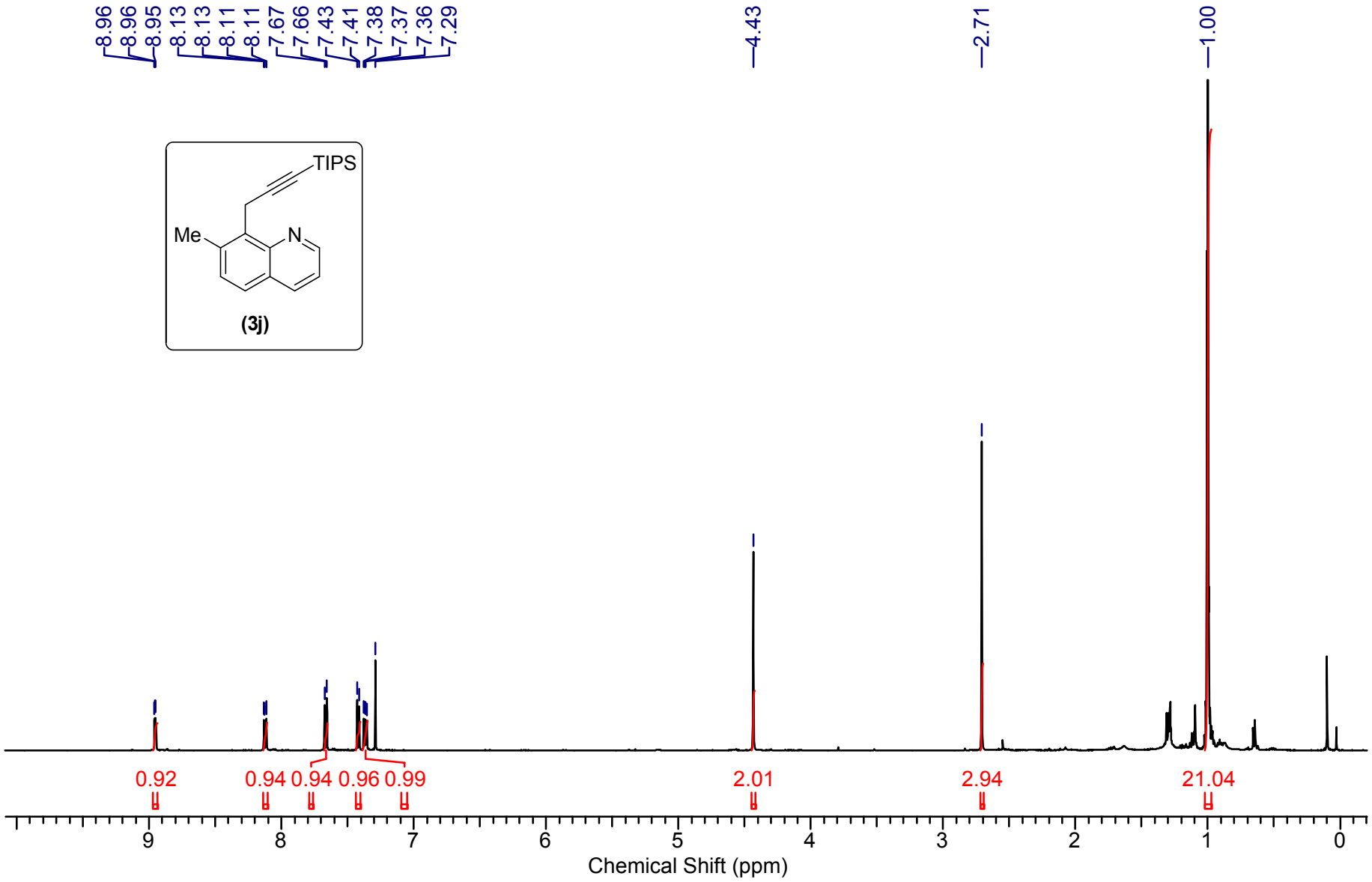

CHLOROFORM-d
149.85
149.29
146.58
135.65
130.14
128.55
127.17
122.14
120.25
105.55
84.03
77.25
77.00
76.74
22.16
18.67
11.32
TIPS
N
Br
(3g)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

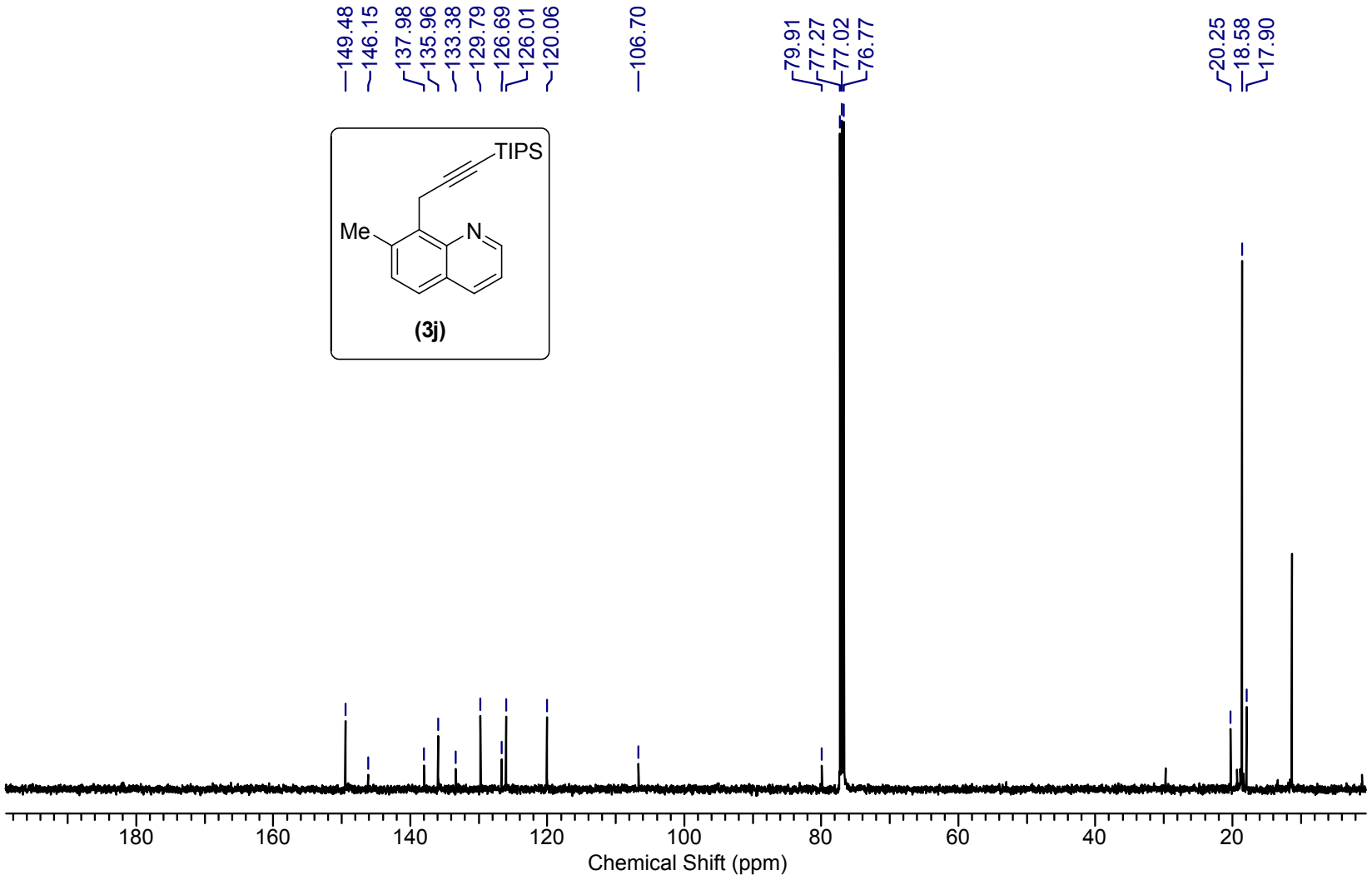

CHLOROFORM-d
9.00
8.99
8.99
8.52
8.52
8.50
8.14
8.13
7.96
7.95
7.57
7.56
7.55
7.54
7.27
4.44
1.14
TIPS
N
CF3
(3h)
0.86
0.99
0.83
0.87
0.93
2.00
21.83
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

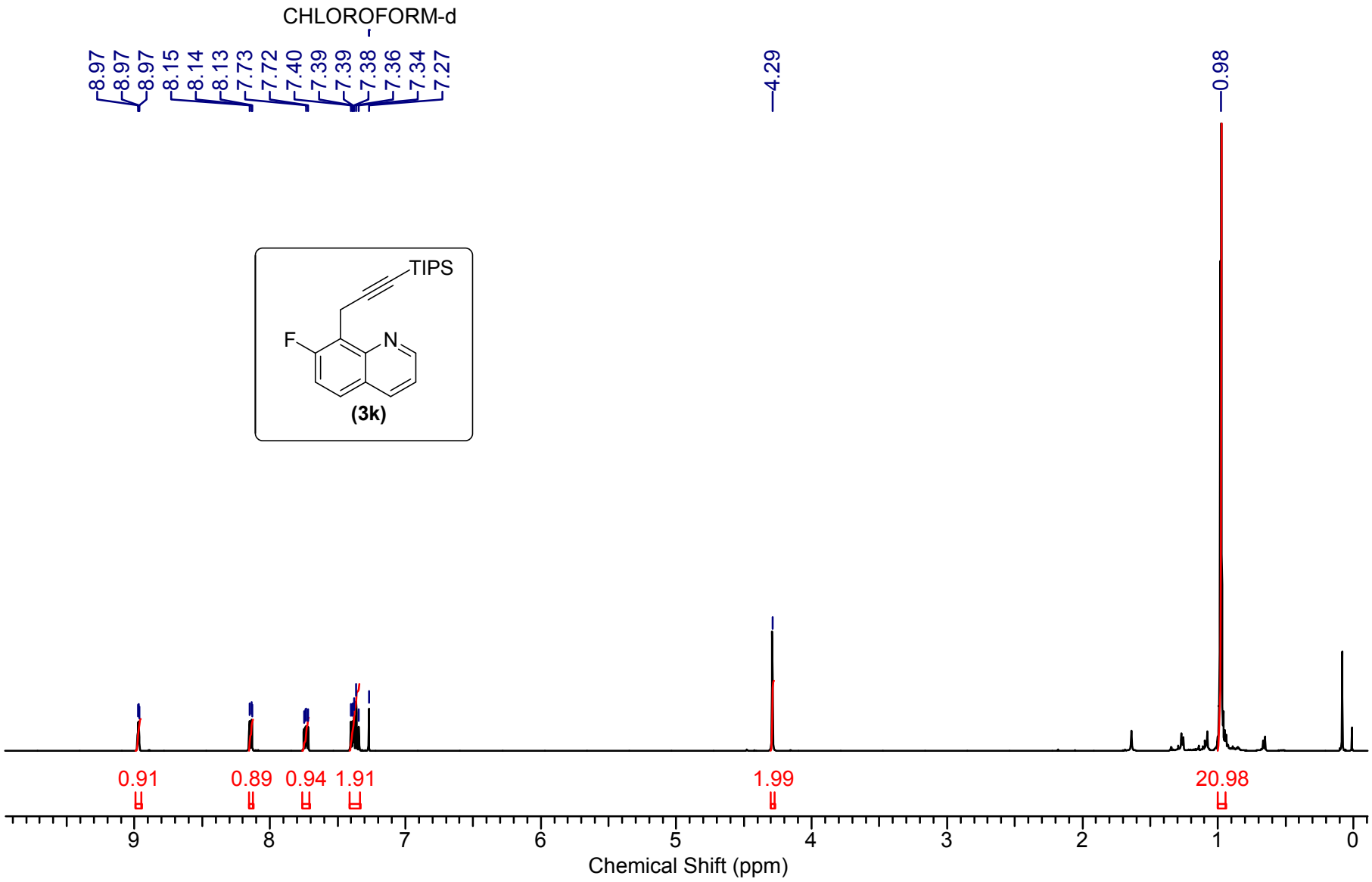

CHLOROFORM-d
150.57
149.84
146.03
140.76
132.71
128.76
126.50
125.03
124.03
123.15
122.67
122.22
105.09
84.55
77.26
77.00
76.75
22.74
18.68
11.34
TIPS
N
CF3
(3h)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

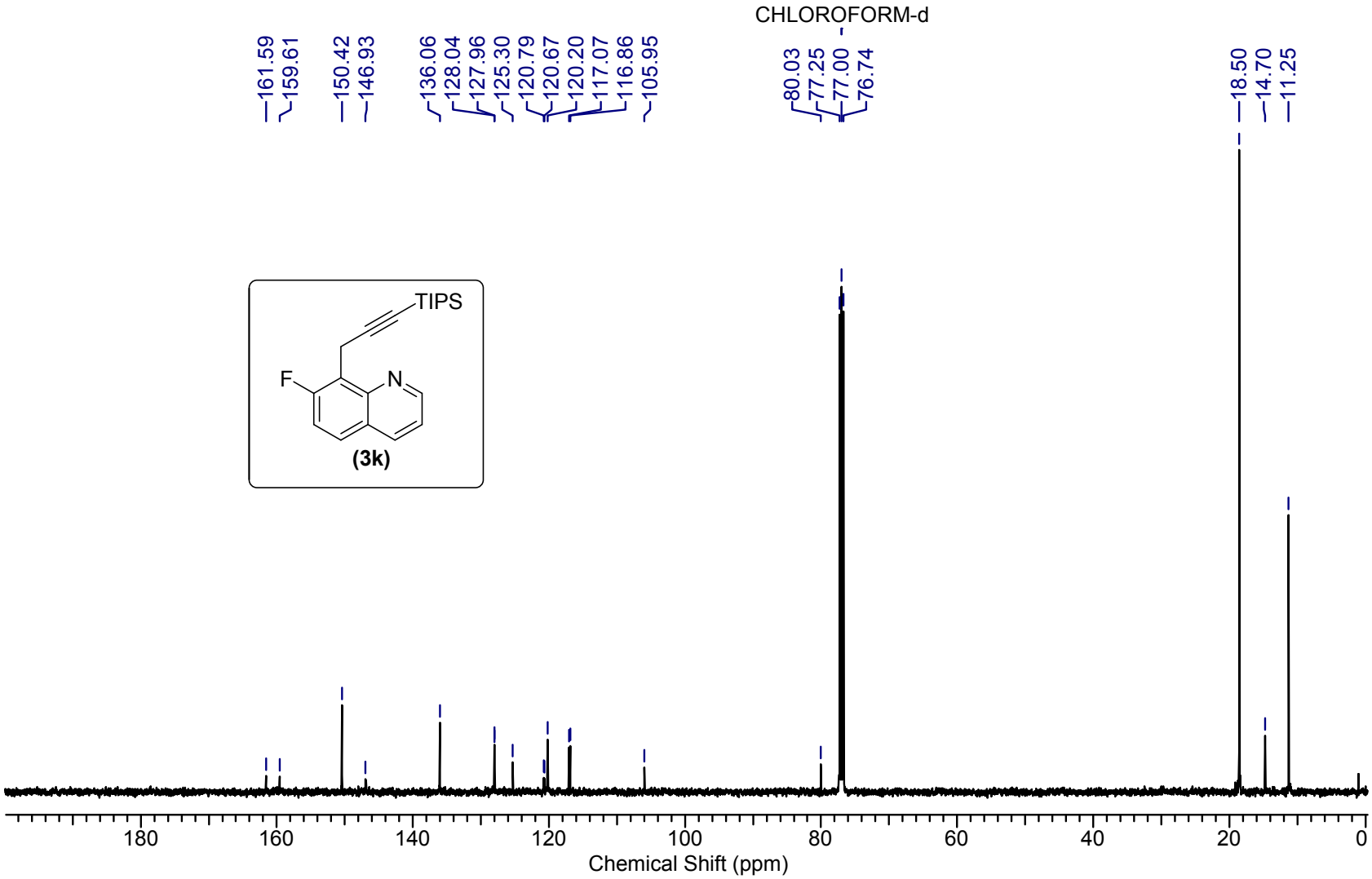

CHLOROFORM-d
9.07
9.07
9.06
9.05
9.03
9.02
9.02
8.44
8.43
8.20
8.18
7.68
7.67
7.66
7.66
7.27
1.14
TIPS
N
NO2
(3i)
0.95
1.04
0.93
0.96
1.06
2.00
21.11
9
8
7
6
5
4
3
2
1
Chemical Shift (ppm)

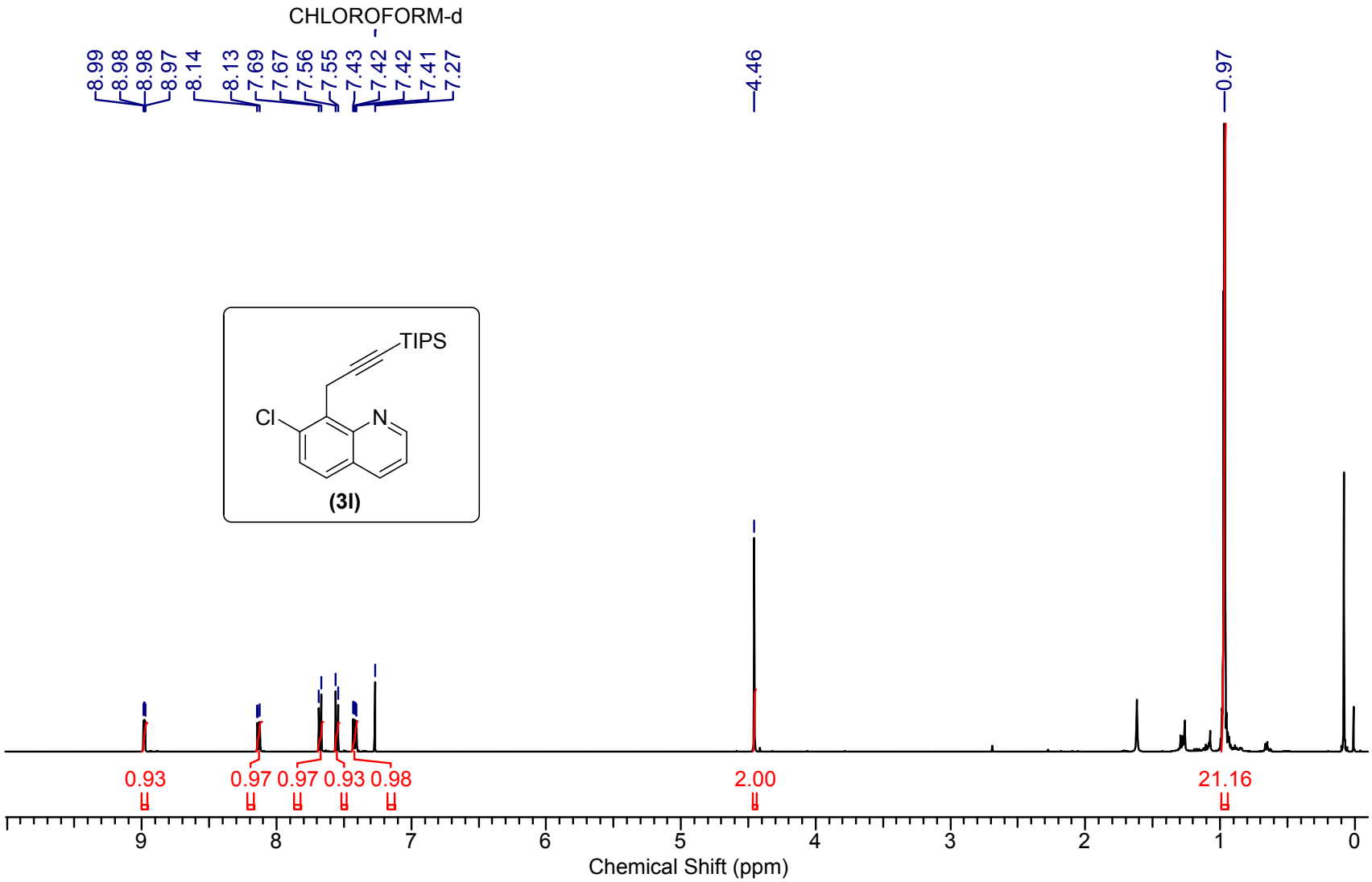

CHLOROFORM-d
156.88
150.36
144.34
143.96
132.25
126.35
124.69
123.86
120.83
104.39
85.17
77.25
77.00
76.74
23.20
18.67
11.31
TIPS
N
NO2
(3i)
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
Chemical Shift (ppm)

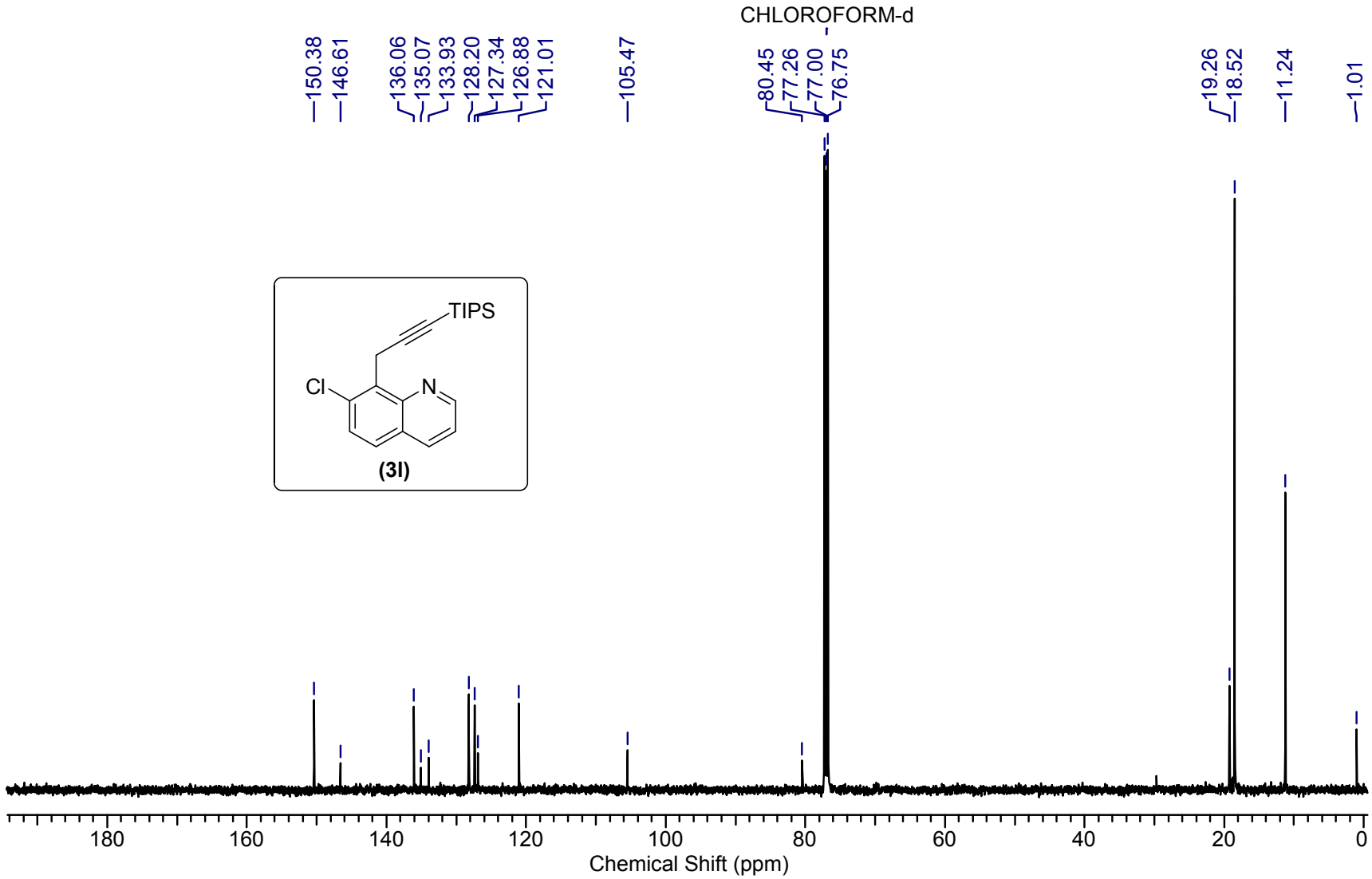

8.96
8.96
8.95
8.13
8.13
8.11
8.11
7.67
7.66
7.43
7.41
7.38
7.37
7.36
7.29
4.43
2.71
1.00
TIPS
Me
N
(3j)
0.92
0.94
0.94
0.96
0.99
2.01
2.94
21.04
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

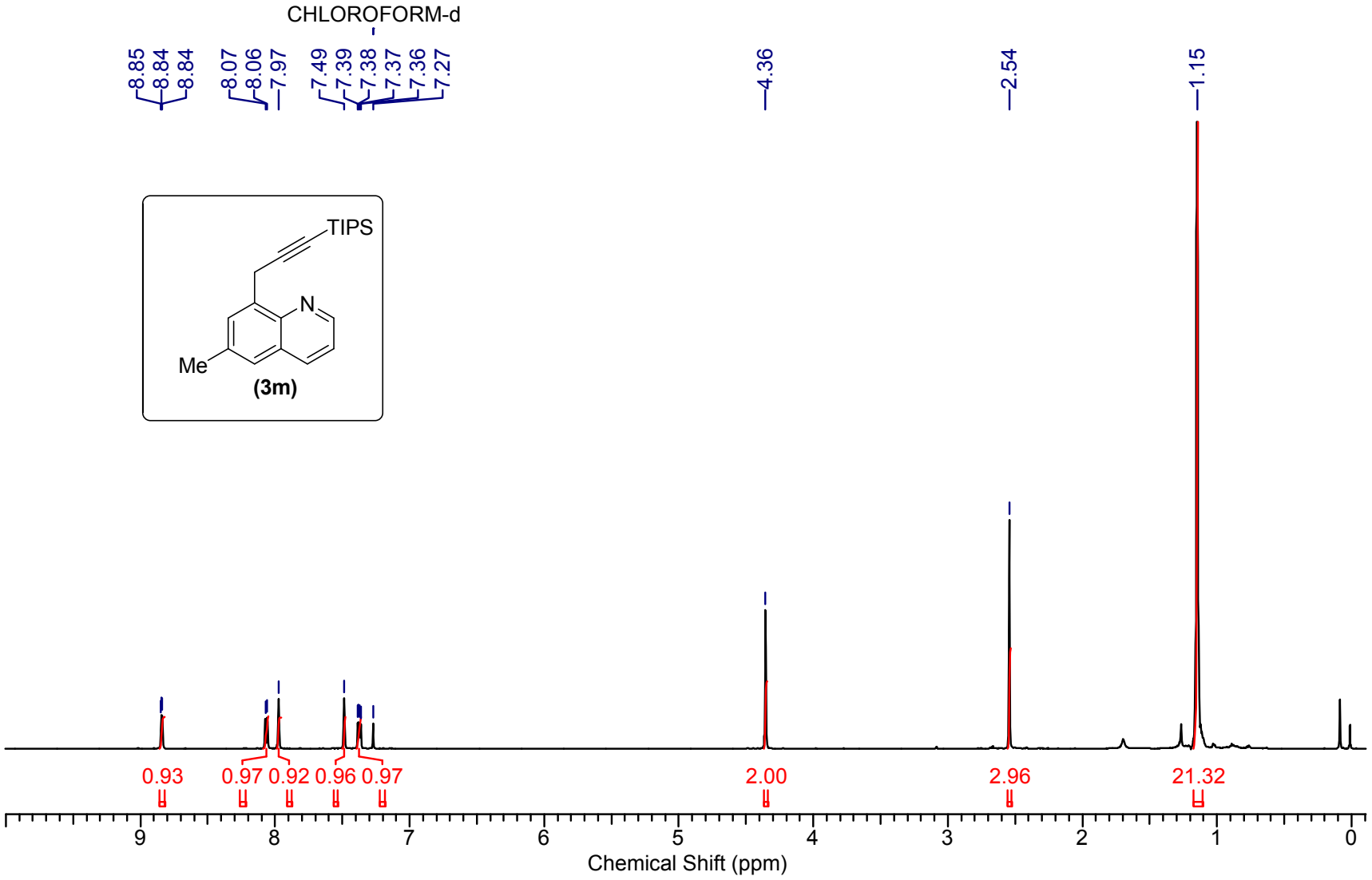

149.48
146.15
137.98
135.96
133.38
129.79
126.69
126.01
120.06
106.70
79.91
77.27
77.02
76.77
20.25
18.58
17.90
TIPS
Me
N
(3j)
180
160
140
120
100
80
60
40
20
Chemical Shift (ppm)

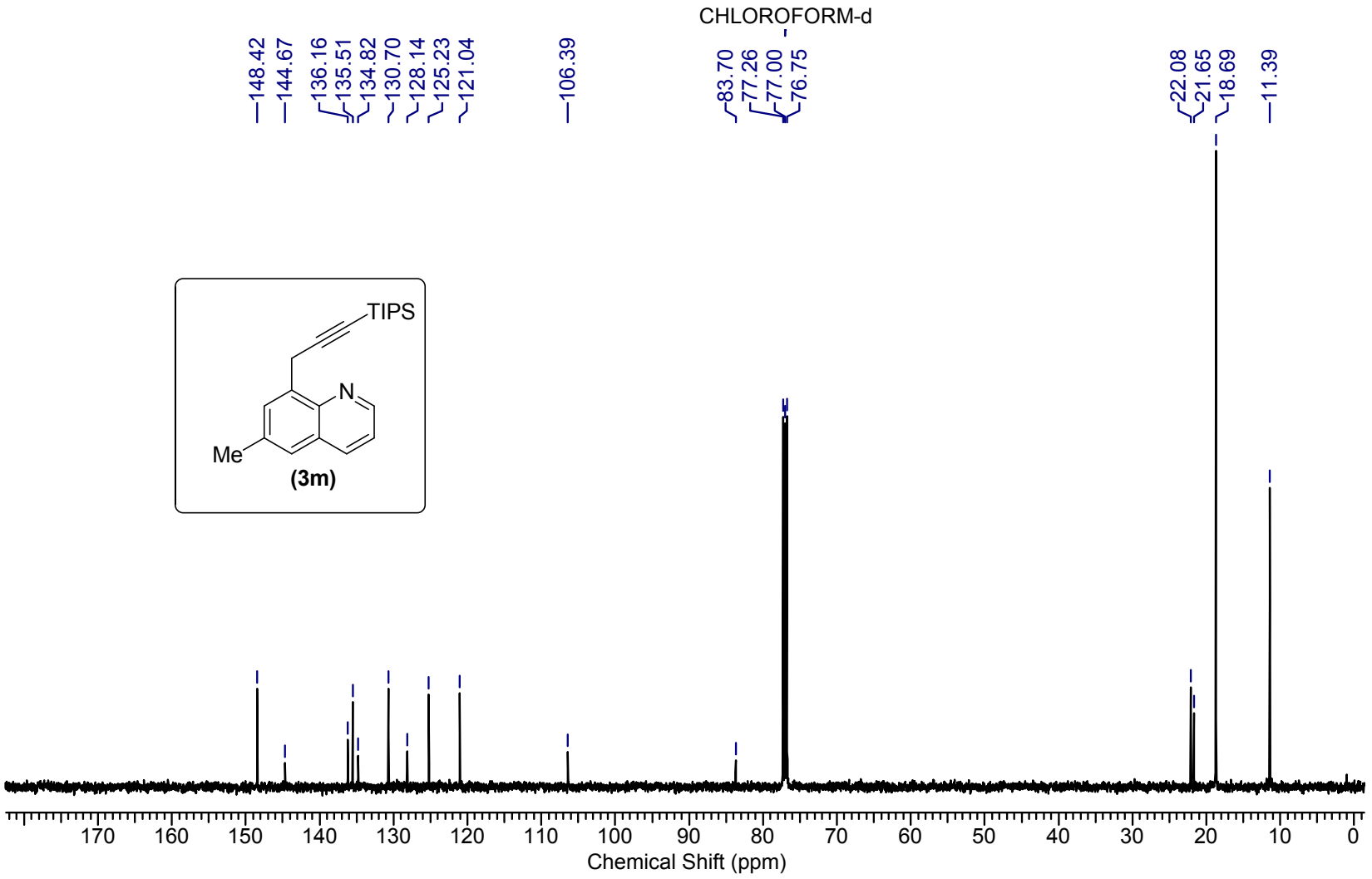

CHLOROFORM-d
8.97
8.97
8.97
8.15
8.14
8.13
7.73
7.72
7.40
7.39
7.39
7.38
7.36
7.34
7.27
4.29
0.98
TIPS
F
N
(3k)
0.91
0.89
0.94
1.91
1.99
20.98
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

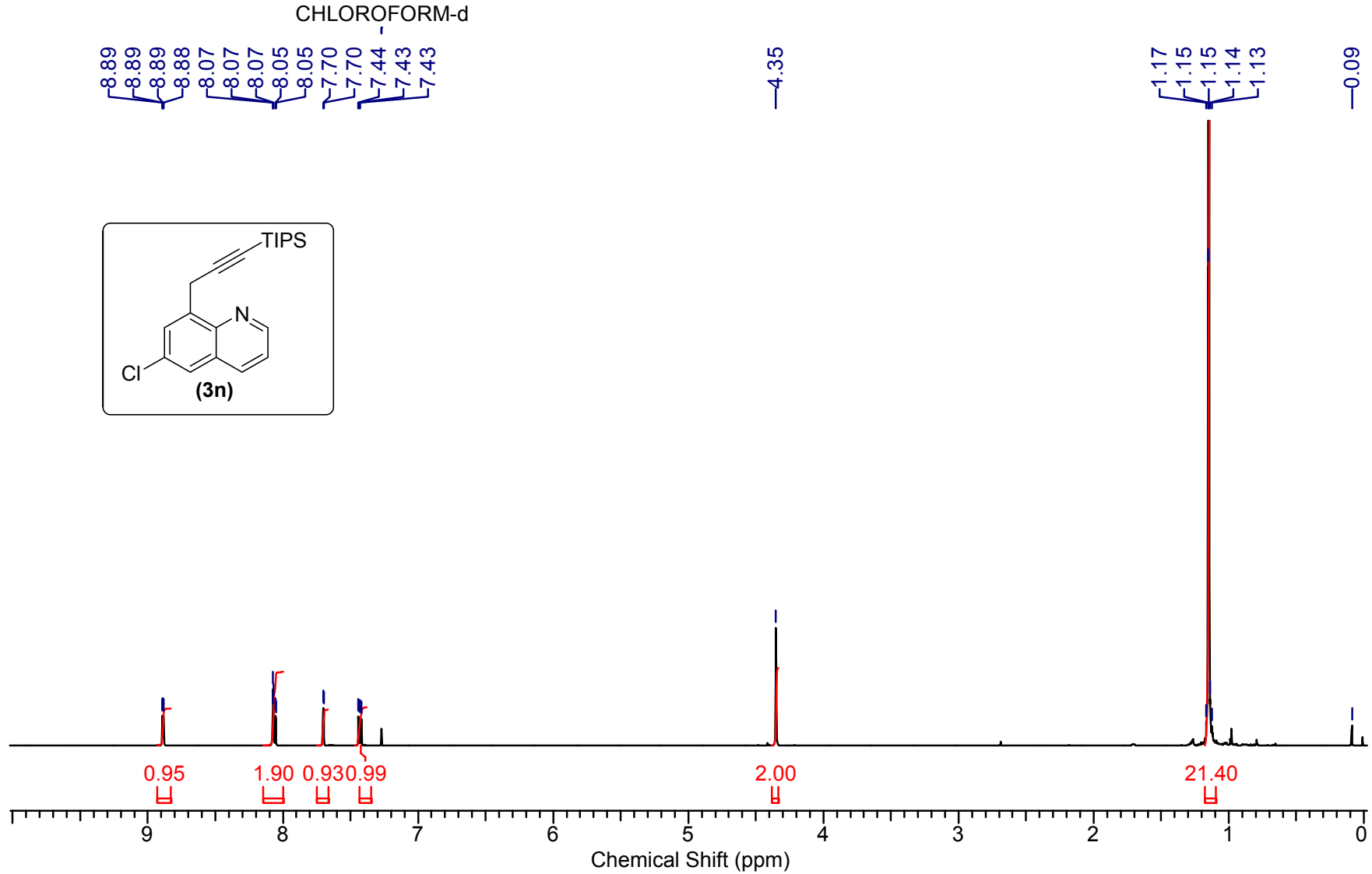

CHLOROFORM-d
161.59
159.61
150.42
146.93
136.06
128.04
127.96
125.30
120.79
120.67
120.20
117.07
116.86
105.95
80.03
77.25
77.00
76.74
18.50
14.70
11.25
TIPS
F
N
(3k)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

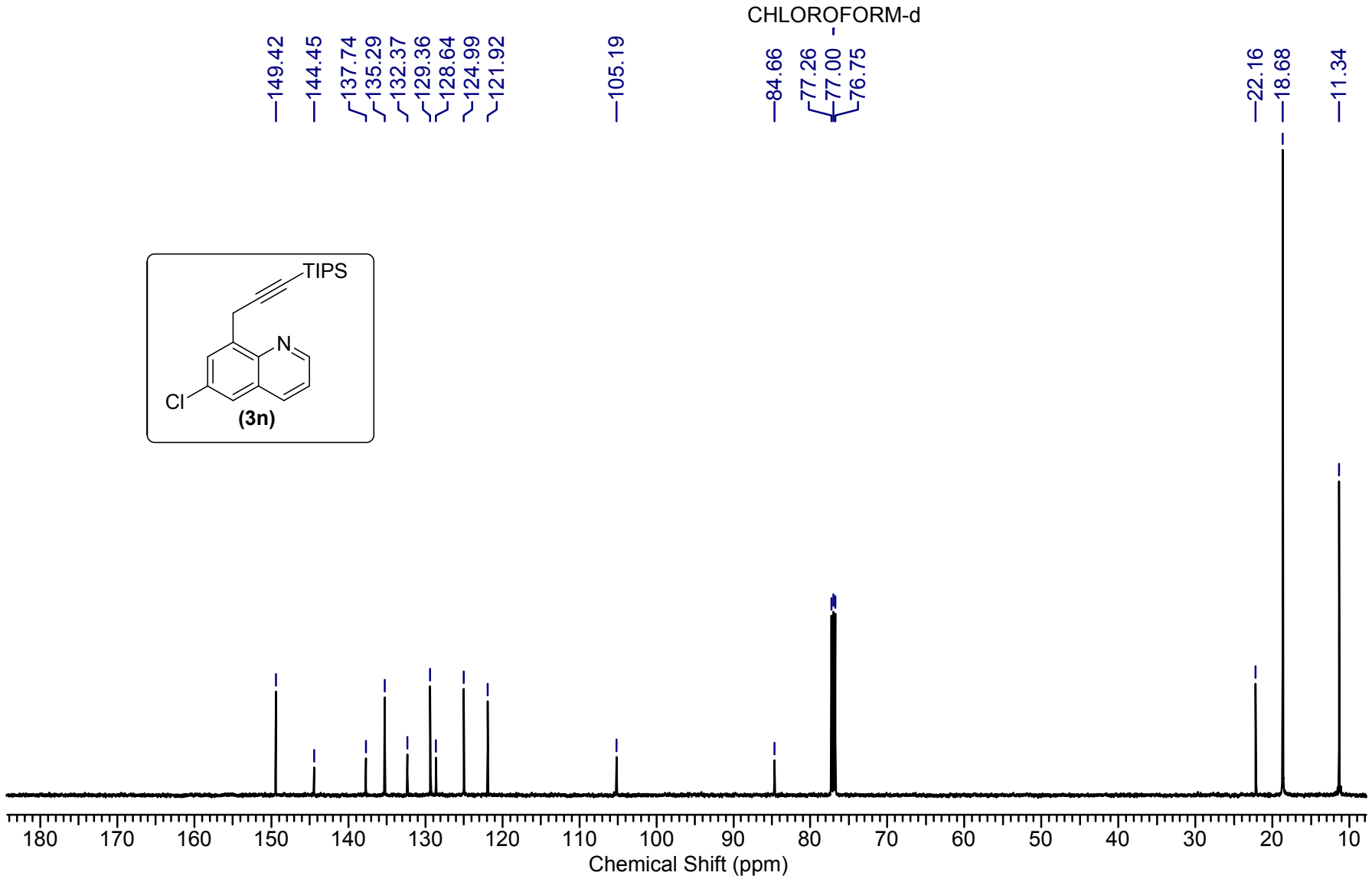

CHLOROFORM-d
8.99
8.98
8.98
8.97
8.14
8.13
7.69
7.67
7.56
7.55
7.43
7.42
7.42
7.41
7.27
4.46
0.97
TIPS
Cl
N
(3l)
0.93
0.97
0.97
0.93
0.98
2.00
21.16
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

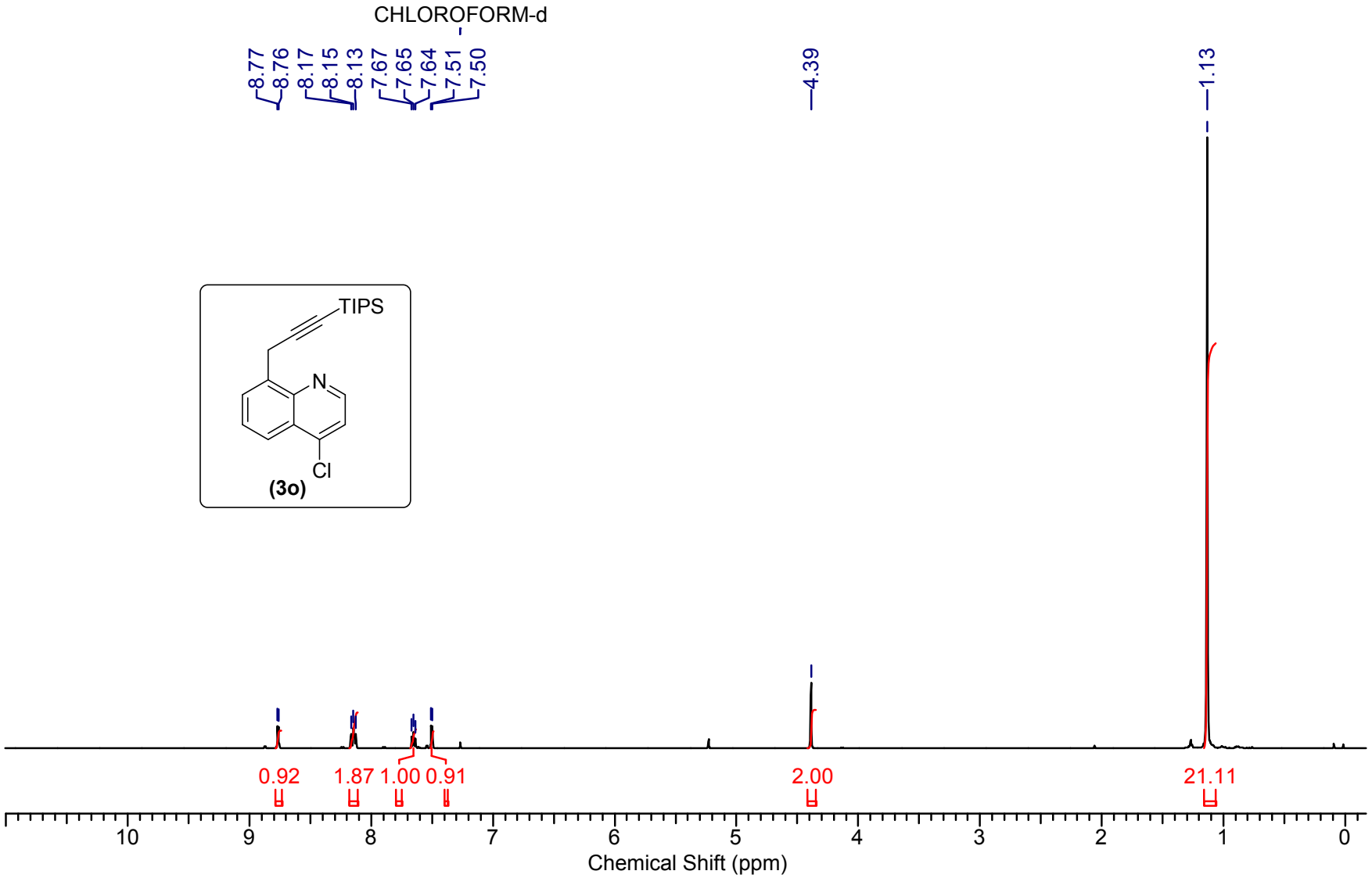

CHLOROFORM-d
150.38
146.61
136.06
135.07
133.93
128.20
127.34
126.88
121.01
105.47
80.45
77.26
77.00
76.75
19.26
18.52
11.24
1.01
TIPS
Cl
N
(3l)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)

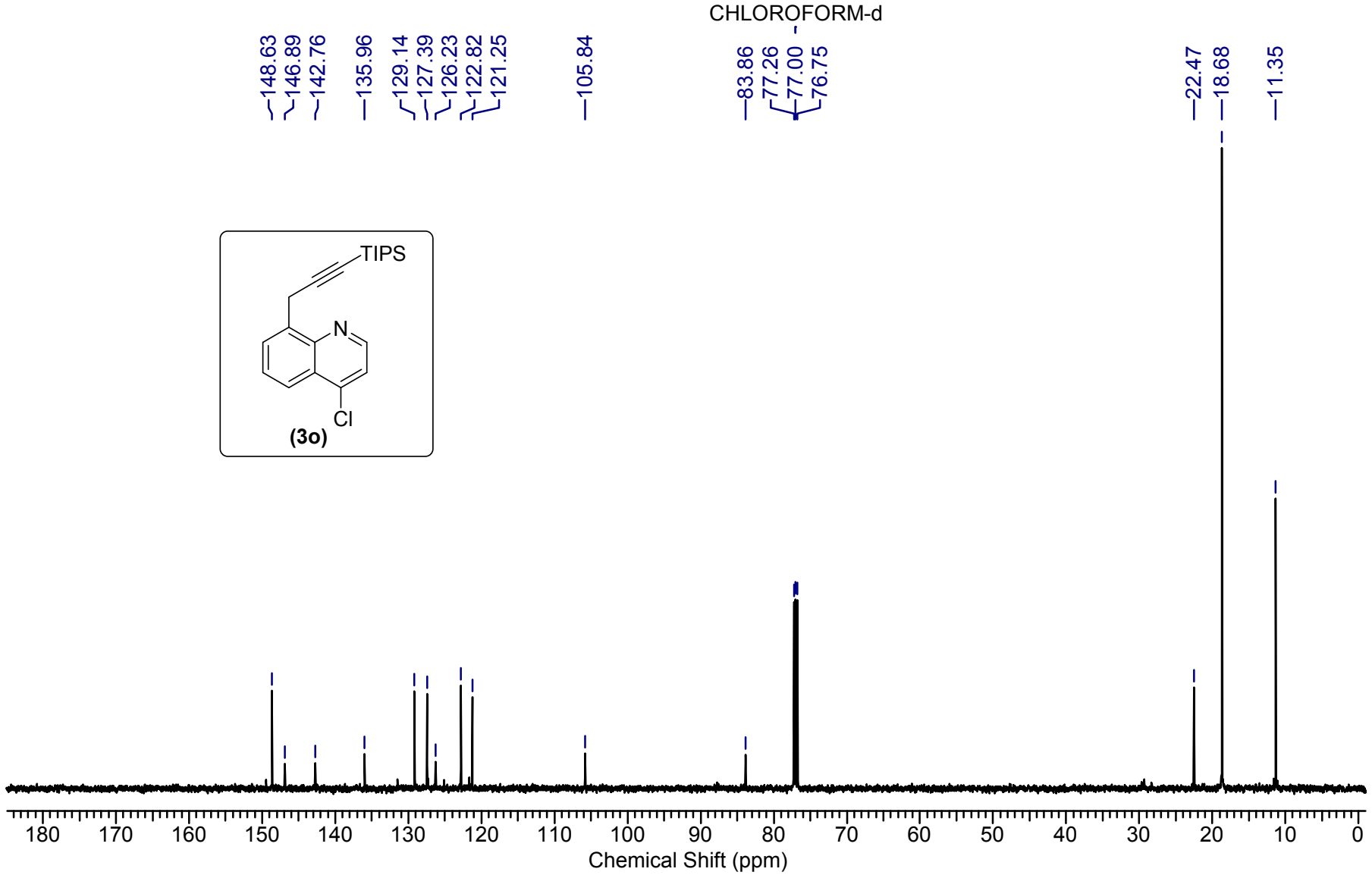

CHLOROFORM-d
8.85
8.84
8.84
8.07
8.06
7.97
7.49
7.39
7.38
7.37
7.36
7.27
4.36
2.54
1.15
TIPS
N
Me
(3m)
0.93
0.97
0.92
0.96
0.97
2.00
2.96
21.32
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)

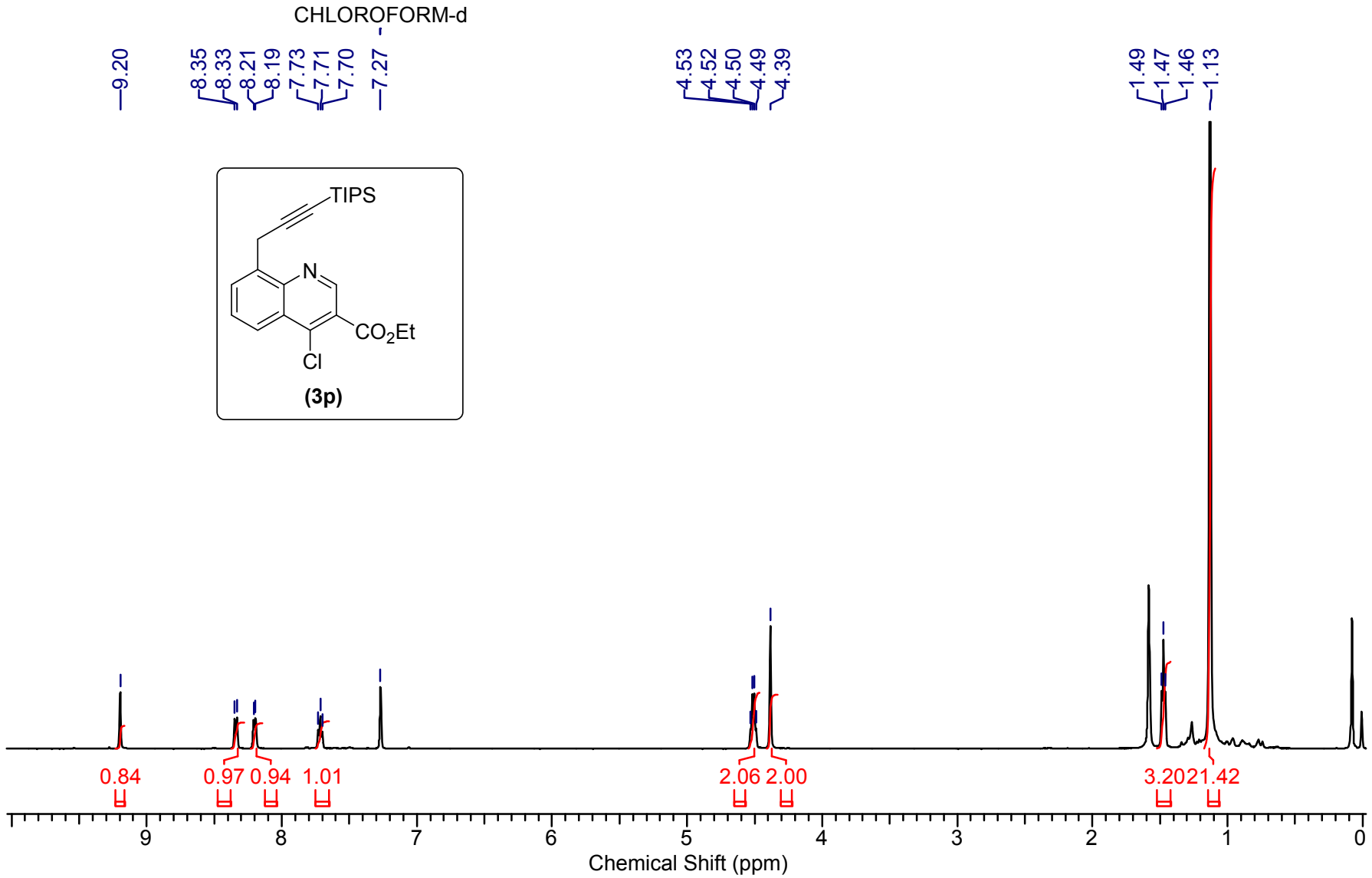

CHLOROFORM-d
148.42
144.67
136.16
135.51
134.82
130.70
128.14
125.23
121.04
106.39
83.70
77.26
77.00
76.75
22.08
21.65
18.69
11.39
TIPS
N
Me
(3m)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Chemical Shift (ppm)

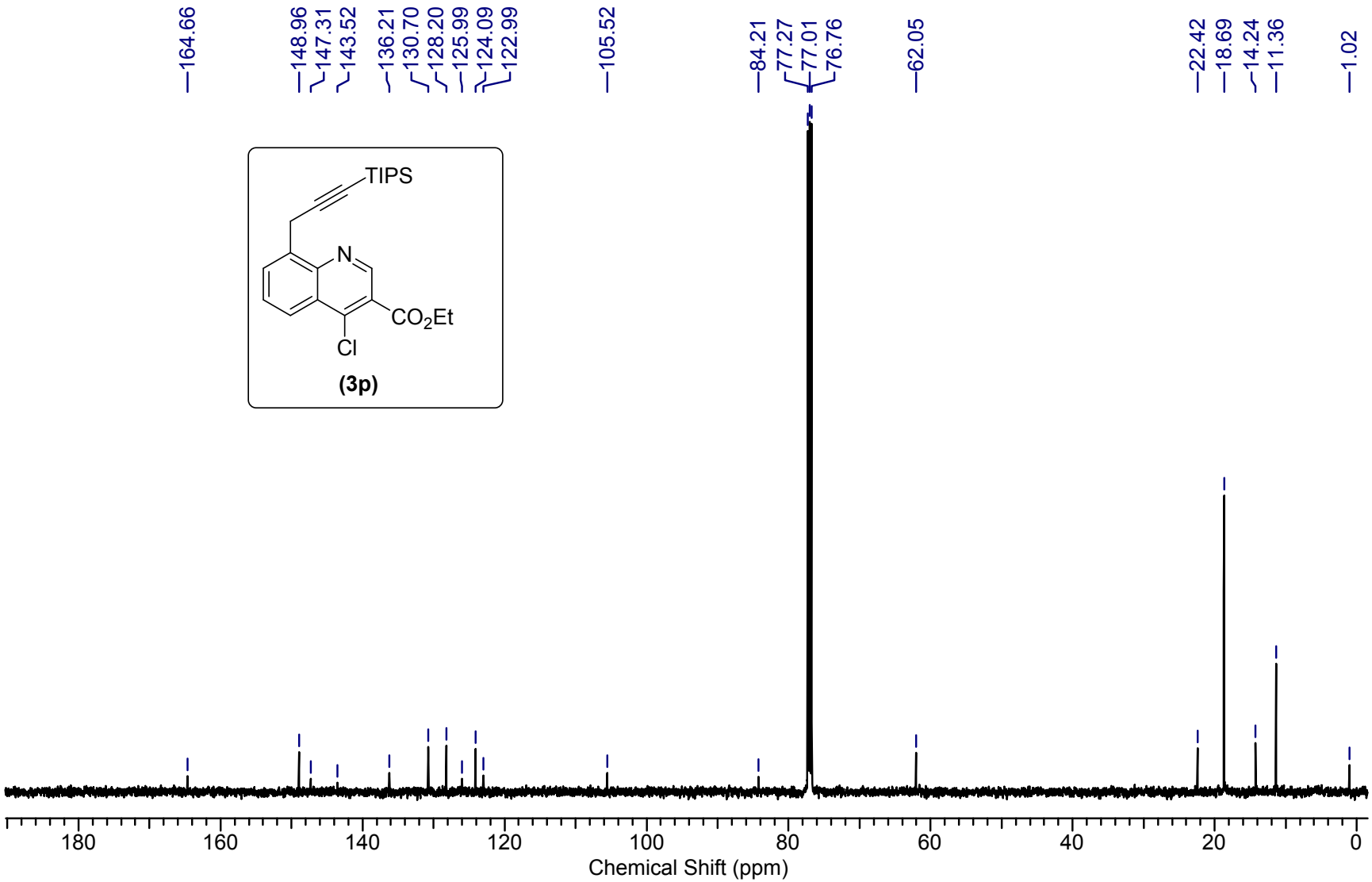

CHLOROFORM-d
8.89
8.89
8.89
8.88
8.07
8.07
8.07
8.05
8.05
7.70
7.70
7.44
7.43
7.43
4.35
1.17
1.15
1.15
1.14
1.13
0.09
TIPS
N
Cl
(3n)
0.95
1.90
0.93
0.99
2.00
21.40
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


CHLOROFORM-d
149.42
144.45
137.74
135.29
132.37
129.36
128.64
124.99
121.92
105.19
84.66
77.26
77.00
76.75
22.16
18.68
11.34
TIPS
N
Cl
(3n)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


CHLOROFORM-d
8.77
8.76
8.17
8.15
8.13
7.67
7.65
7.64
7.51
7.50
4.39
1.13
TIPS
N
Cl
(3o)
0.92
1.87
1.00
0.91
2.00
21.11
10
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


CHLOROFORM-d
148.63
146.89
142.76
135.96
129.14
127.39
126.23
122.82
121.25
105.84
83.86
77.26
77.00
76.75
22.47
18.68
11.35
TIPS
N
Cl
(3o)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Chemical Shift (ppm)


CHLOROFORM-d
9.20
8.35
8.33
8.21
8.19
7.73
7.71
7.70
7.27
4.53
4.52
4.50
4.49
4.39
1.49
1.47
1.46
1.13
TIPS
N
CO2Et
Cl
(3p)
0.84
0.97
0.94
1.01
2.06
2.00
3.20
21.42
9
8
7
6
5
4
3
2
1
0
Chemical Shift (ppm)


164.66
148.96
147.31
143.52
136.21
130.70
128.20
125.99
124.09
122.99
105.52
84.21
77.27
77.01
76.76
62.05
22.42
18.69
14.24
11.36
1.02
TIPS
N
CO2Et
Cl
(3p)
180
160
140
120
100
80
60
40
20
0
Chemical Shift (ppm)