Supporting Information

For

A general approach to biocompatible branched fluorous tags for increased solubility in perfluorocarbon solvents

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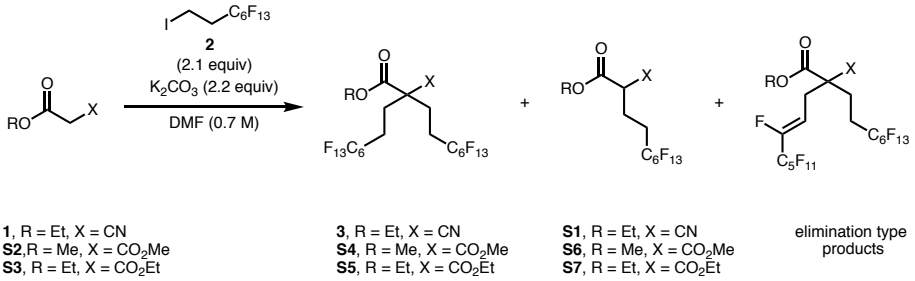
Supporting Tables, Schemes, and Figures.

Scheme S1.



1, R = Et, X = CN
S2,R = Me, X = CO_2Me
S3, R = Et, X = CO_2Et

3, R = Et, X = CN
S4, R = Me, X = CO_2Me
S5, R = Et, X = CO_2Et

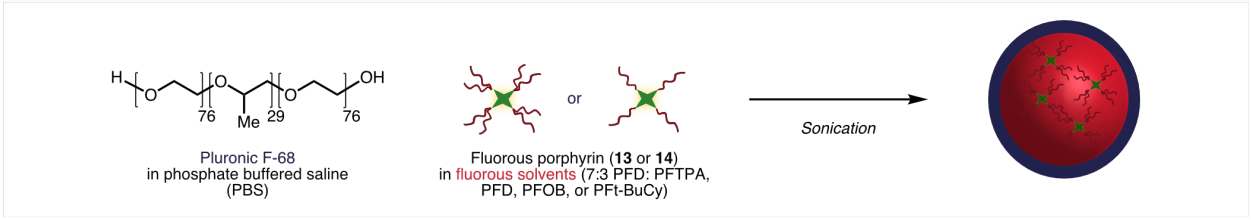
S1, R = Et, X = CN
S6, R = Me, X = CO_2Me
S7, R = Et, X = CO_2Et

elimination type products

Table S1. Dialkylation and monoalkylation of different nucleophiles: ethyl cyanoacetate **1**, dimethylmalonate **S2**, and diethylmalonate **S3**. Percent conversion to alkylated products and elimination side products were determined by crude NMR using 1,3,5-trimethoxybenzene as an external standard for ^{1}H NMR. [a] Determined by ^{19}F NMR.

SM	time (h)	temp	di-alkylation	mono-alkylation	elimination
1	24	rt	**3**, 97%	**S1**, <2%	<1%
1	48	rt	**3**, 97%	**S1**, <2%	<1%
S2	72	rt	**S4**, 26%	**S6**, 74%	--
S3	72	rt	**S5**, 30-40%[a]	**S7**, 60-70%[a]	--

Scheme S2. Perfluorocarbon nanoemulsion formation using Pluronic F-68 as a surfactant.



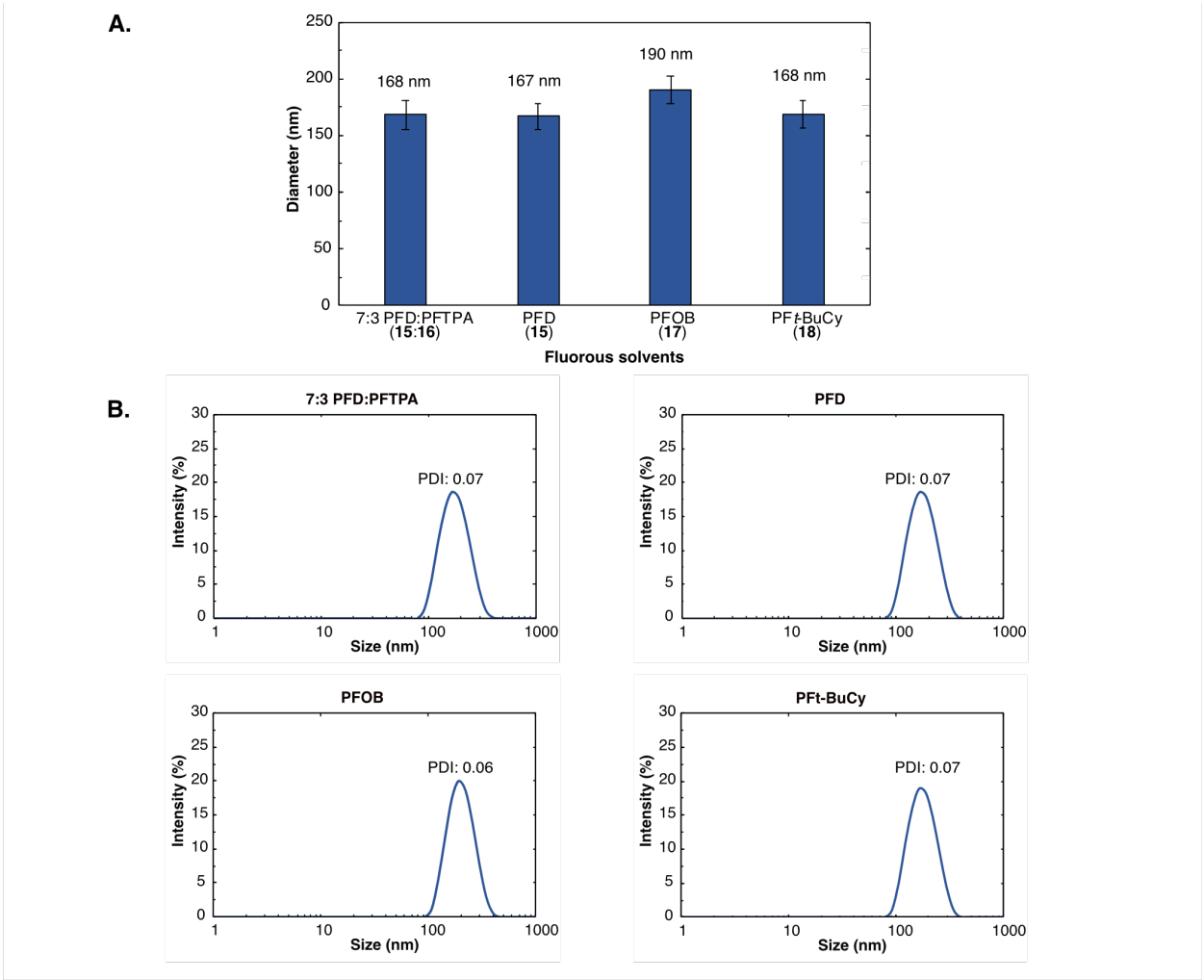


Figure S1. (A) Initial size distribution of PFC nanoemulsions composed of different fluorous solvents. Emulsions were prepared by sonicating a solution of 2.8 wt% Pluronic F-68 in phosphate buffered saline (PBS) with 10 vol% fluorous solvent (7:3 PFD **15**:PFTPA **16**, PFD **15**, PFOB **17**, or PF*t*-BuCy **18**). (B) Dynamic light scattering data for the PFC nanoemulsions stabilized by Pluronic F-68. Data is an average of three replicate measurements.

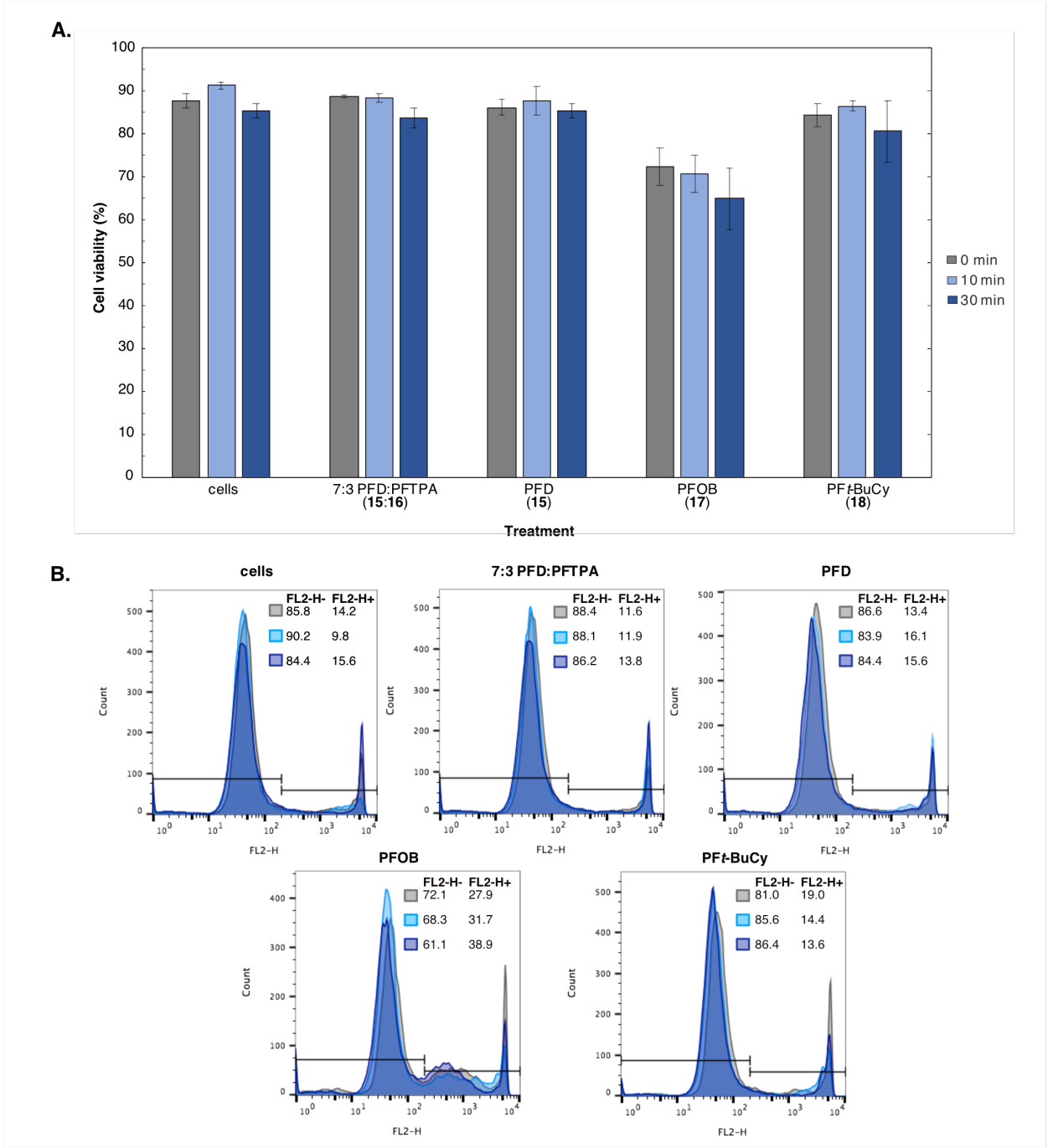


Figure S2. Photodynamic therapy with empty perfluorocarbon nanoemulsions composed of different fluorous solvents without photosensitizer **13**. Light treatment (420 nm LED, 8.5 mW/cm^2) is indicated as follows: grey = 0 min, light blue = 10 min, dark blue = 30 min. (A) Cell viability with emulsions composed of different fluorous solvents (7:3 PFD **15**: PFTPA **16**, PFD **15**, PFOB **17**, PF*t*-BuCy **18**) and no photosensitizer. Error bars represent the standard deviation of 3 replicate samples. (B) Histograms for A375 cell viability flow cytometry data.

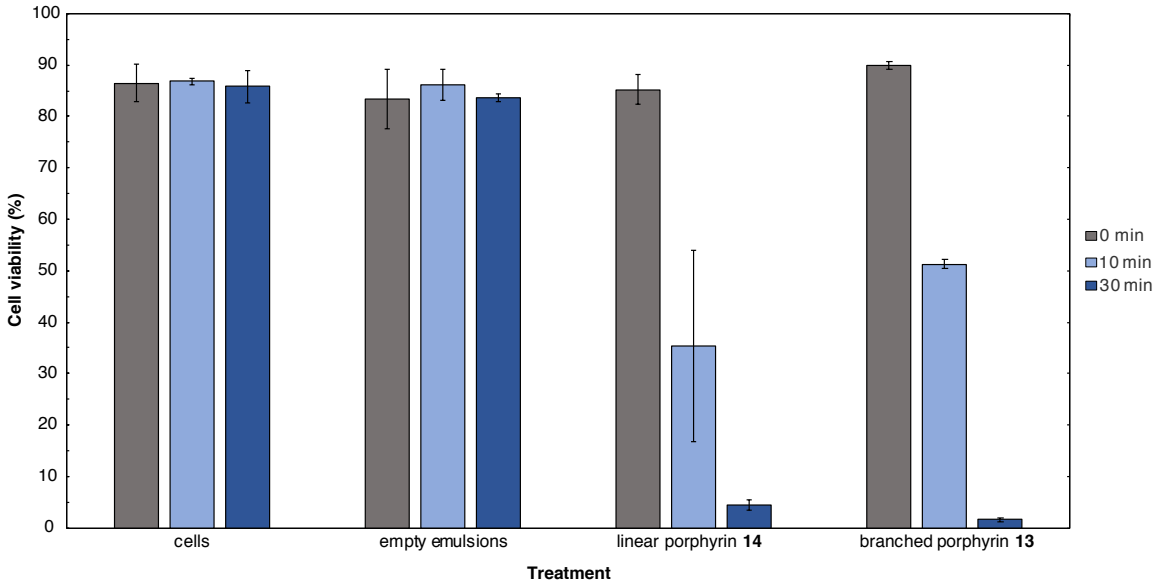


Figure S3. Cell viability comparison of photodynamic therapy efficiency of linear porphyrin **14** and branched porphyrin **13**. For comparison, emulsions composed of 7:3 PFD **15**: PFTPA **16** were employed as linear porphyrin **14** was not readily soluble in the other fluorous solvents. We found that linear porphyrin **14** and branched porphyrin **13** were similarly effective at inducing cell death when irradiated, suggesting that the branched tags do not affect the ability of porphyrin **13** to sensitize oxygen. Light treatment (420 nm LED, 8.5 mW/cm^2) is indicated as follows: grey = 0 min, light blue = 10 min, dark blue = 30 min. Error bars represent the standard deviation of 2 replicate samples.

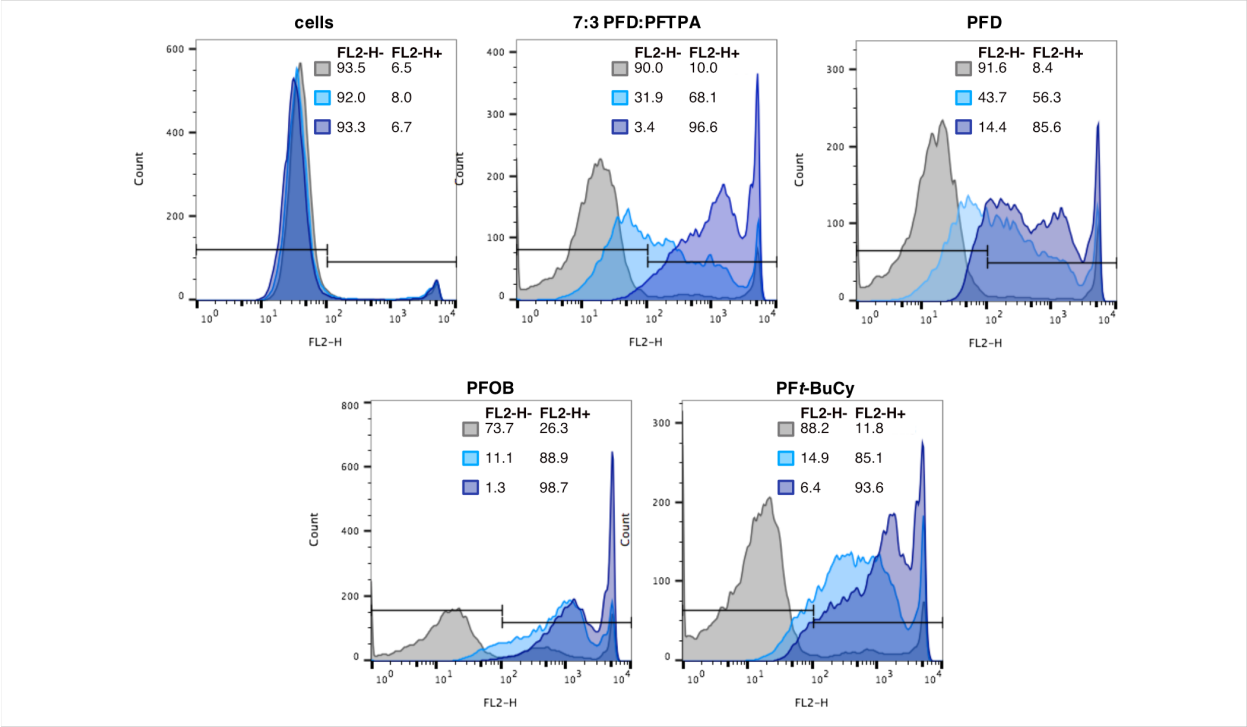


Figure S4. Histograms for flow cytometry data in Figure 3B. Light treatment (420 nm LED, 8.5 mW/cm^2) is indicated as follows: grey = 0 min, light blue = 10 min, dark blue = 30 min.

General Experimental Procedures.

Chemical reagents were purchased from Sigma-Aldrich, Alfa Aesar, Fisher Scientific, Acros Organics, Synquest, or TCI and used without purification unless noted otherwise. Anhydrous DMSO was obtained from a Sure-Seal™ bottle (Aldrich). Anhydrous and deoxygenated solvents DCM, MeOH, THF, and DMF were dispensed from a Grubb's-type Phoenix Solvent Drying System. Anhydrous, but oxygenated Et_2O was prepared by drying over 4 Å molecular sieves for at least 3 days. Thin layer chromatography was performed using Silica Gel 60 F_{254} (EMD Millipore) plates. Flash chromatography was executed with technical grade silica gel with 60 Å pores and 40 – 63 μm mesh particle size (Sorbtech Technologies). Solvent was removed under reduced pressure with a Büchi Rotovapor with a Welch self-cleaning dry vacuum pump and further dried with a Welch DuoSeal pump. Bath sonication was performed using a Branson 3800 ultrasonic cleaner. Emulsions were prepared using a QSonica (Q125) sonicator. Masses for analytical measurements were taken on a Sartorius MSE6.6S-000-DM Cubis Micro Balance. Size and surface charge were measured with Malvern Zetasizer Nano instrument. All ^{1}H, ^{13}C, and ^{19}F NMR spectra are reported in ppm and relative to residual solvent signals (^{1}H and ^{13}C). Spectra were obtained on Bruker AV-300, AV-400, DRX-500, or AV-500 instruments and processed with MestReNova software. Mass spectra (electron impact (EI), electrospray ionization (ESI), and matrix assisted laser desorption ionization (MALDI)) were collected on either an Agilent 7890B-7250 Quadrupole Time-of-Flight GC/MS, Thermo Scientific Q Exactive™ Plus Hybrid Quadrupole-Orbitrap™ with Dionex UltiMate 3000 RSLCnano System, or Bruker Ultraflex MALDI TOF-TOF.

General photophysics procedures. Absorbance spectra were collected on a JASCO V-770 UV-Visible/NIR spectrophotometer with a 4000 nm/min scan rate after blanking with the appropriate solvent. Photoluminescence spectra were obtained on a Horiba Instruments PTI QuantaMaster Series fluorometer. Quartz cuvettes (1 cm) were used for absorbance and photoluminescence measurements unless otherwise noted.

All irradiation was performed with THORLabs M420L3 (420 nm) LED with SM1P25-A lens. Power was supplied with a KORAD KD3005D Digital-control DC Power Supply: 0-30V, 0-5A. Samples were placed 18 cm from the lens and kept in the center of the light. Power densities were measured with a FieldMate Laser Power Meter + Iris.

General nanoemulsions formation procedures.
Emulsions were prepared by predissolving **13** or **14** (for amounts see individual figure procedures) in fluorous solvent (10 vol%, 20 μL) in an S33 Eppendorf tube. Pluronic F-68 was predissolved in PBS pH 7.4 (28 mg/mL), and this solution (200 μL, 2.8 wt%) was added to the fluorous solvent. The mixture was sonicated at 35% amplitude for 90 seconds at 0 °C on a QSonica (Q125) sonicator. Sonication was performed by lowering the probe directly at the liquid-liquid interface of the two immiscible solvents, resulting in emulsions of sizes shown in Figure S1A without filtration.

General cell culture procedures. A375 cells were purchased from ATCC. A375 cells were cultured in Dulbecco's Modified Eagle Media (Life Technologies, cat# 11995073) supplemented with 10% fetal bovine serum (Corning, lot# 35016109) and 1% penicillin-streptomycin (Life

Technologies, cat# 15070063). Cells were washed with PBS, or PBS supplemented with 1% fetal bovine serum (FACS buffer). Cells were incubated at 37 ˚C, 5% CO_2, during treatments and throughout culturing, in HERACell 150i CO_2 incubators. Cells were pelleted through use of Sorvall ST 40R centrifuge. All cell work was performed in 1300 Series A2 biosafety cabinets.

For cell viability experiments: following incubation, cells were washed three times by centrifugation (526xg, 3 min, 4 ˚C). Propidium iodide solution (1 μL of 0.25 mg/mL in DI H_2O) was added to each well. Cells were transferred to FACS tubes with a final volume of 300 μL FACS buffer (PBS + 1% FBS). Cells were incubated on ice for 15 minutes prior to flow cytometry measurement. Propidium iodide fluorescence was measured on FL2 channel. Data was analyzed by splitting the population at 10^2 as a live/dead line. Flow cytometry was performed on a BDBiosciences FACSCalibur equipped with 488 nm and 635 nm lasers.

Abbreviations:
DCM = dichloromethane; DMF = dimethylformamide; DMSO = dimethylsulfoxide; EtOH = ethanol; EtOAc = ethyl acetate; Et_2O = diethyl ether; FACS = phosphate buffered saline supplemented with 1% fetal bovine serum; MeOH = methanol; PBS = phosphate buffered saline; PFD = perfluorodecalin; PFTPA = perfluorotripropylamine; PFOB = perfluorooctylbromide; PF*t*-BuCy = perfluoro(*tert*-butylcyclohexane); TEA = triethylamine.

Synthetic experimental procedures

2,2-bis((perfluorohexyl)ethyl) ethyl cyanoacetate (3). To perfluorohexyl ethyl iodide (0.65 mL, 2.6 mmol, 2.1 equiv), was added ethyl cyanoacetate (135 μL, 1.27 mmol, 1.0 equiv), freshly powdered and flame dried K_2CO_3 (388 mg, 2.80 mmol, 2.2 equiv), and anhydrous DMF (1.8 mL, 0.70 M). The vial was sealed under nitrogen and stirred at rt. Note: if the reactants begin to solidify, the mixture can be warmed to 30 °C without formation of significant byproducts. After 72 h, the reaction mixture was evaporated to dryness. The resulting solids were dissolved in acetone and absorbed onto SiO_2. The crude product was purified by column chromatography (silica gel, 98% → 95% → 90% pentane/Et_2O) to afford **3** as a white solid (922 mg, 1.14 mmol, 90%). R_f = 0.8 in 20% EtOAc/hexanes. ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.36 (q, J = 7.1 Hz, 2H), 2.49 – 2.08 (m, 8H), 1.36 (t, J = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 167.0, 117.1, 64.1, 47.7, 28.3, 27.6 (t, J_{CF} = 22.1 Hz), 14.1. ^{19}F NMR (376 MHz, $CDCl_3$): δ -80.7 (t, J = 9.8 Hz, 6F), -114.2 (m, 4F), -122.0 (m, 4F), -122.7 (m, 4F), -123.2 (m, 4F), -126.1 (m, 4F). HRMS (ESI) calcd. for $C_{21}H_{13}F_{26}NO_2Cl^-$ $[M + Cl]^-$: 840.0225; found 840.0221.

2,2-bis((perfluorohexyl)ethyl)ethylnitrile (4). To **3** (307 mg, 0.382 mmol, 1.0 equiv), was added lithium chloride (56 mg, 1.3 mmol, 3.5 equiv), DMSO (3.0 mL, 0.13 M), and H_2O (1.0 mL). The reaction mixture was heated to 160 °C and stirred for 12 h. The reaction mixture was allowed to cool to room temperature, and product crashes out of solution. The crude product was rinsed with water, dissolved in EtOAc, and evaporated to dryness. The crude product was dissolved in EtOAc, absorbed onto SiO_2, and purified by column chromatography (silica gel, 97% → 95% hexanes/EtOAc) to afford **4** as a white solid (201 mg, 0.274 mmol, 72%). R_f = 0.3 in 10% DCM/hexanes. ^{1}H NMR (500 MHz, $CDCl_3$): δ 2.78 (sep, J = 5.0 Hz, 1H), 2.52 – 2.18 (m, 4H), 2.07 – 1.91 (m, 4H). ^{13}C NMR (126 MHz, $CDCl_3$): δ 119.8–108.0 (m, CF_n peaks), 119.3 (CN), 30.8, 28.7 (t, J_{CF} = 22.6 Hz), 23.6. ^{19}F NMR (376 MHz, $CDCl_3$): δ -80.8 (t, J = 9.9 Hz, 6F), -112.7 – -115.9 (m, 4F), -121.8 (bs, 4F), -122.8 (bs, 4F), -123.3 (bs, 4F), -126.1 (bs, 4F). HRMS (EI) calcd. for $C_{18}H_8F_{25}N^+$ $[M – HF]^+$: 713.0252; found 713.0256.

2,2-bis(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)ethylamine (5). To nitrile **4** (96 mg, 0.13 mmol, 1.0 equiv) was added dry Et_2O (5.5 mL, 0.02 M) under nitrogen. Nitrile **4** was stirred until it was fully dissolved, and then cooled to 0 °C. Lithium aluminum hydride (1.0 M in THF, 0.26 mmol, 2.0 equiv) was added. After 1 h, the reaction was let warm to room temperature and stirred for 5 h. The reaction was quenched by dropwise addition of H_2O with stirring, and then extracted with EtOAc, dried ($MgSO_4$), filtered, and evaporated to dryness. The crude mixture was evaporated onto SiO_2 from EtOAc and purified by column chromatography (silica gel, 100% DCM→1% MeOH/DCM→ 5% MeOH/DCM (all with 1% TEA)) to provide the product **5** as a yellow oil (29 mg, 0.04 mmol, 30%). R_f = 0.5 in 10% MeOH/DCM. ^{1}H NMR (500 MHz, MeOD-d_4): δ 2.65 (d, J = 5.5 Hz, 2H), 2.28 – 2.15 (m, 4H), 1.79 – 1.48 (m, 5H). ^{13}C NMR (126 MHz, MeOD-d_4): δ 122.2 – 109.8 (CF_n), 44.6, 40.3, 29.02 (t, J_{CF} = 22.1 Hz), 22.42. ^{19}F NMR (282 MHz, MeOD-d4): δ -83.9 – -84.1 (m, 6F), -116.7 – -117.4 (m, 4F), -124.5 (bs, 4F), -125.4 (bs, 4F), -126.0 (bs, 4F), -127.9 – -130.4 (m, 4F). HRMS (ESI) calcd. for $C_{18}H_{14}F_{26}N^+$ $[M + H]^+$: 738.0706; found 738.0684.

2,2-bis(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)-1-ethanal (6). To nitrile **4** (30 mg, 0.04 mmol, 1.0 equiv) dissolved in dry Et_2O (2.0 mL, 0.02 M) at -78 °C, DIBAL-H (1.0 M in Hexanes, 0.09 mmol, 2.3 equiv) was added dropwise. After 2 h, additional DIBAL-H (45 μL, 1.2 equiv) was added, and the reaction was stirred for 2 h more at -78 °C. EtOAc (2 mL) was added slowly, then a saturated aq Rochelle salt solution (2 mL) was added, and the mixture was stirred at room temperature until there were two clear layers (~ 1 h). The aqueous layer was extracted with additional EtOAc (2 x 3 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated. The crude mixture was dissolved in EtOAc (2 mL) and stirred with 1 M HCl (2 mL) to hydrolyze any remaining imine. The organic layer was separated, evaporated onto SiO_2, and purified by column chromatography (silica gel, 3% DCM/hexanes→ 5% DCM/hexanes → 10% DCM/hexanes). This procedure yielded the aldehyde **6** as a white solid (14 mg, 0.02 mmol, 47% yield). R_f = 0.5 in 20% DCM/hexanes. ^{1}H NMR (500 MHz, $CDCl_3$): δ 9.68 (d, J = 1.6 Hz, 1H), 2.56 – 2.42 (m, 1H), 2.24 – 1.99 (m, 6H), 1.86 – 1.73 (m, 2H). ^{13}C NMR (126 MHz, $CDCl_3$): δ 201.6, 49.6, 28.2 (t, J_{CF} = 22.4 Hz), 19.2. ^{19}F NMR (376 MHz, $CDCl_3$) δ -80.8 (t, J = 10.0 Hz, 6F), -114.6 (bs, 4F), -121.9 (bs, 4F), -122.8 (bs, 4F), -123.4 (bs, 4F), -126.0 – -126.3 (m, 4F). HRMS (ESI) calcd. for $C_{18}H_9F_{26}O^-$ $(M - H)^-$: 735.0244; found 735.0239.

2,2-bis((perfluorohexyl)ethyl)-1-carboxylic acid (7). To ethyl cyanoacetate **3** (1.39 g, 1.73 mmol, 1.00 equiv.) and powdered KOH (297 mg, 5.29 mmol, 3.1 equiv), absolute ethanol (21 mL, 0.08 M) and H_2O (21 mL, 0.08 M) were added. The reaction was heated to 80 °C. After 3 h, 1 M HCl (~20 mL) was added, and the mixture was extracted with Et_2O (3 x 60 mL). The organics were washed with brine, dried ($MgSO_4$), and evaporated to dryness to yield branched fluorous cyanoacid as a white solid (1.26 g, 1.61 mmol, 93% crude yield). Branched fluorous cyanoacid (938 mg, 1.20 mmol) suspended in conc. HCl (27 mL, 0.04 M) was stirred and heated to 100 °C for 2 h, then cooled to 0 °C, and conc. H_2SO_4 (27 mL, 0.04 M) was added slowly. The reaction mixture was heated to 160 °C. Note: reaction is connected to a base trap before venting into a fume hood. After 14 h, the reaction was stopped, diluted with H_2O, and extracted with Et_2O (4 x 50 mL). The organics were dried ($MgSO_4$), filtered, and concentrated to yield **7** as an off-white solid (832 mg, 1.11 mmol, 92%). From **3**, the two step yield is 89%. R_f = 0.05 in 30% Et_2O/pentane (streaks). ^{1}H NMR (500 MHz, MeOD-d_4): δ 2.55 (sep, J = 5.0 Hz, 1H), 2.32 – 2.17 (m, 4H), 1.99 – 1.79 (m, 4H). ^{13}C NMR (101 MHz, MeOD-d_4): δ 177.2, 44.5, 29.6 (t, J_{CF} = 22.6 Hz), 23.7. ^{19}F NMR (376 MHz, MeOD-d_4): δ -82.5 (tt, J = 10.2, 2.7 Hz, 6F), -114.9 – -116.4 (m, 4F), -123.0 (bs, 4F), -123.9 (bs, 4F), -124.6 (bs, 4F), -127.3 – -127.4 (m, 4F). HRMS (ESI) calcd. for $C_{18}H_9F_{26}O_2^-$ $[M - H]^-$: 751.0193; found 751.0183.

2,2-bis((perfluorohexyl)ethyl)-1-ethanol (8). To lithium aluminum hydride (1.0 M in THF, 3.6 mmol, 2.4 equiv) in Et_2O (15 mL), was added branched fluorous carboxylic acid **7** (1.11 g, 1.47 mmol, 1.00 equiv) in Et_2O (15 mL) slowly under nitrogen. After 3.5 h, the reaction was quenched by slow addition of H_2O and saturated $NaHCO_3$, and then extracted with Et_2O (4 x 20 mL). The organics were dried ($MgSO_4$), filtered, and concentrated. Crude reaction mixture was absorbed onto SiO_2 and purified by flash column chromatography (silica gel, 15% Et_2O/pentane) to provide the product **8** as a colorless oil (981 mg, 1.33 mmol, 90%). R_f = 0.4 in 30% Et_2O/pentane. ^{1}H NMR (500 MHz, $CDCl_3$): δ 3.64 (apparent t, J = 4.3 Hz, 2H), 2.29 – 1.99 (m, 4H), 1.78 – 1.62 (m, 5H), 1.44 (t, J = 4.6 Hz, 1H). ^{13}C NMR (126 MHz, $CDCl_3$): δ 120.8 – 106.3

(CF_n), 64.4, 39.1, 28.6 (t, J_{CF} = 22.4 Hz), 21.6. ^{19}F NMR (376 MHz, $CDCl_3$): δ -80.9 (tt, J = 10.0, 5.2 Hz, 6F), -114.6 – -114.7 (m, 4F), -122.0 (bs, 4F), -122.9 (bs, 4F), -123.5 (bs, 4F), -126.2 – -126.3 (m, 4F). HRMS (ESI) calcd. for $C_{18}H_{12}F_{26}OCl^-$ $[M + Cl]^-$: 773.0167; found 773.0165.

2,2-bis((perfluorohexyl)ethyl)-1-ethyl tosylate (9). Tosylate **9** was synthesized using a procedure adapted from Yoshida, et. al.[1] To alcohol **8** (453 mg, 0.614 mmol, 1.00 equiv), was added DCM (3 mL, 0.2 M), triethylamine (0.21 mL, 1.53 mmol, 2.49 equiv), and trimethylamine hydrochloride (60 mg, 0.61 mmol, 1.0 equiv). The reaction mixture was stirred vigorously, cooled to 0 °C, and tosyl chloride (175 mg, 0.921 mmol, 1.50 equiv) was added in DCM (1.9 mL). The reaction was let warm to room temperature and stirred for 12 h. The organics were washed with H_2O (2x) and brine (2x), dried ($MgSO_4$), filtered, and evaporated to dryness. The crude product was evaporated onto silica from DCM and purified by column chromatography (silica gel, 50% toluene/hexanes) to afford **9** as a white solid (481 mg, 0.539 mmol, 88%). R_f = 0.2 in 10% EtOAc/hexanes.^{1}H NMR (500 MHz, $CDCl_3$): δ 7.79 (d, J = 8.0 Hz, 2H), 7.37 (d, J = 8.0 Hz, 2H), 3.98 (d, J = 4.5 Hz, 2H), 2.45 (s, 3H), 2.04 – 1.95 (m, 4H), 1.83 – 1.76 (m, 1H), 1.66 – 1.62 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 145.5, 132.5, 130.2, 128.0, 70.3, 36.7, 28.1 (t, J_{CF} = 22.4 Hz), 21.7, 21.5. ^{19}F NMR (376 MHz, $CDCl_3$) δ -80.8 (t, J = 10.0 Hz, 6F), -114.5 – -114.6 (m, 4F), -121.9 (bs, 4F), -122.8 (bs, 4F), -123.4 (bs, 4F), -126.0 – -126.2 (m, 4F). HRMS (EI) calcd. for $C_{25}H_{18}F_{26}O_3S^+$ $[M]^+$: 892.0561; found 892.0560.

2,2-bis((perfluorohexyl)ethyl)-1-ethyl azide (10). To tosylate **9** (60 mg, 0.07 mmol, 1.0 equiv.) was added sodium azide (11 mg, 0.17 mmol, 2.5 equiv) and DMF (3 mL, 0.02 M). The mixture was heated to 80 °C. After 12 h, the reaction mixture was evaporated to dryness. The crude product was taken up in DCM and filtered, to provide the product **10** as a colorless oil (47 mg, 0.060 mmol, 92%). R_f = 0.6 in 10% EtOAc/hexanes. ^{1}H NMR (500 MHz, $CDCl_3$): δ 3.38 (d, J = 4.2 Hz, 2H), 2.19 – 2.05 (m, 4H), 1.74 – 1.64 (m, 5H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 54.1, 37.1, 28.3 (t, J_{CF} = 22.6 Hz), 22.3.^{19}F NMR (282 MHz, $CDCl_3$): δ -80.7 – -80.8 (m, 6F), -114.4 – -114.6 (m, 4F), -121.9 (bs, 4F), -122.9 (bs, 4F), -123.4 (bs, 4F), -126.1 – -126.2 (m, 4F). HRMS (EI) calcd. for $C_{18}H_{11}F_{26}N^+$ $[M - N_2]^+$: 735.0471; found 735.0491.

2,2-bis((perfluorohexyl)ethyl)-1-ethanethiol (11). To tosylate **9** (169 mg, 0.190 mmol, 1.00 equiv), was added DMF (5.6 mL, 0.03 M) and potassium thioacetate (38 mg, 0.33 mmol, 1.7 equiv). The reaction was heated to 80 °C and stirred for 4 h. The reaction mixture was evaporated to dryness, taken up in DCM, filtered, and concentrated to yield an off-white solid (135 mg, 0.169 mmol, 90% crude yield). Branched fluorous thioacetate **(**122 mg, 0.150 mmol) was dissolved in MeOH (1.0 mL, 0.2 M) and under nitrogen, acetyl chloride (80 µL, 1.0 mmol, 7.5 equiv) was added dropwise. The reaction mixture was stirred at 65 °C for 5.5 h, and then evaporated to dryness. The crude product was absorbed onto silica and purified by column chromatography (silica gel, 1% Et_2O/pentane → 5% Et_2O/pentane) to afford the product **11** as a colorless oil (105 mg, 0.139 mmol, 91%). The two step yield from **9** is 82%. R_f = 0.6 in 10% EtOAc/hexanes. ^{1}H NMR (500 MHz, $CDCl_3$): δ 2.60 (dd, J = 8.2, 4.7 Hz, 2H), 2.17 – 1.99 (m, 4H), 1.82 – 1.65 (m, 5H), 1.26 (t, J = 8.2 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$): δ 39.0, 28.3 (t, J_{CF} = 22.3 Hz), 27.5, 22.7. ^{19}F NMR (376 MHz, $CDCl_3$): δ -80.8 (t, J = 10.0 Hz, 6F), -114.4 – -114.5 (m, 4F), -121.9 (bs, 4F), -122.9 (bs, 4F), -123.4 (bs, 4F), -126.1 – -126.2 (m, 4F). HRMS

(EI) calcd. for $C_{18}H_{12}F_{26}S^+$ $[M]^+$: 754.0245; found 754.0262.

5,10,15,20-tetrakis(4-(2,2-bis(perfluorohexylethyl)ethyl-thio)-2,3,5,6-tetrafluorophenyl)porpyrin (13). Procedure was adapted from Tüxen, et. al.[2] Branched thiol **11** (104 mg, 0.138 mmol, 10.0 equiv) was dissolved in DMF (2.0 mL), EtOAc (0.5 mL), and diethylamine (41 μL, 0.40 mmol, 28.5 equiv). To this mixture, 5,10,15,20-tetrakis(pentafluorophenyl)porphyrin **12** (13.4 mg, 0.0140 mmol, 1.0 equiv) dissolved in DMF (1.4 mL) was added. The reaction mixture was stirred for 17 h at room temperature, at which point the product had precipitated from solution. The mixture was filtered, and the precipitate was dissolved in chloroform. The crude product was evaporated onto silica from acetone and purified by column chromatography (silica gel, 3% → 4% → 5% → 10% acetone/pentane) to afford the product **13** as a dark purple solid (46 mg, 0.12 mmol, 85%). R_f = 0.4 in 20% in acetone/hexanes. ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.87 (s, 8H), 3.29 (d, J = 4.7 Hz, 8H), 2.27 – 2.17 (m, 16H), 2.07 – 1.89 (m, 20H), -2.89 (s, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -80.9 (t, J = 9.8 Hz, 24F), -114.2 – -114.4 (m, 16F), -121.8 (bs, 16F), -122.9 (bs, 16F), -123.3 (bs, 16F), -126.1 – -126.3 (m, 16F), -134.0 (dd, J = 24.9, 12.3 Hz, 8F), -136.5 (dd, J = 24.8, 12.2 Hz, 8F). HRMS (MALDI): calcd for $C_{116}H_{54}F_{120}N_4S_4^+$ $(M + H)^+$: 3911.1388; found 3911.2753. Absorbance (7:3 PFD **15**:PFTPA **16**): 408, 502, 584 nm. Emission (7:3 PFD **15**:PFTPA **16**, Ex 410 nm): 651, 709 nm.

Figure experimental procedures.

Figure 2B. Porphyrins **13** and **14** were added to individual dram vials from stock solutions (1.0 mg/mL) in acetone, solvent was removed, and porphyrins were dried on high vacuum (<100 mTorr). Fluorous porphryins **13** (0.02 mg, 0.07 mmol) and **14** (0.03 mg, 0.07 mmol) were dissolved in perfluoromethylcyclohexane (1.5 mL) and then sonicated for 1 min. Toluene (1.5 mL) was added. The dram vials containing each porphyrin were allowed to roll freely on a KJ-201BD Orbital shaker for 22 h. Aliquots (200 μL) from each layer (toluene and perfluoromethylcyclohexane) were dried on high vacuum to remove residual solvent. Samples were diluted in DMF (5.0 mL). Absorbance values were obtained on a JASCO V-770 UV-Visible/NIR spectrophotometer with a 2000 nm/min scan rate. The fluorous partition coefficient was determined by taking the ratio of the absorbance in perfluoromethylcyclohexane and toluene. Photographs were taken under long-wave UV light (UVGL-25, 365 nm).

Figure 2D. Emulsions were prepared as described in general nanoemulsion formation procedure with **13** (0.14 mg, 0.04 μmol) or **14** (0.13 mg, 0.04 μmol) in 7:3 PFD/PFTPA (10 vol%, 20 μL). The emulsions (200 μL) were diluted to 5 mL in PBS. A portion of these solutions (1 mL) was taken and placed in the presence of 1-octanol (0.5 mL) in an Eppendorf tube. The biphasic samples were then rocked for 2 weeks. The Eppendorf tubes containing the samples were allowed to roll freely on a KJ-201BD Orbital shaker at 20 rpm. The fluorescence of the 1-octanol layer was monitored over time to determine the amount of **13** and **14** that diffused out of the emulsions. Emission values were obtained by taking an aliquot (200 μL) of the 1-octanol in a 0.3 mL quartz cuvette and measuring the fluorescence on a Horiba Instruments PTI QuantaMaster Series fluorometer with the following settings: slits 5 nm, step size 1 nm, integration time 0.1 s (Ex 410 nm, collection 450-800 nm). The 1-octanol was returned to the sample after the measurement.

Figure 2E. Porphyrins **13** and **14** (0.36 mmol) were dissolved in the indicated fluorous solvents (1 mL) through inversion or minimal sonication (<10 min, bath sonicator). Photographs were taken under visible light.

Figure 3B/Figure S4. Emulsions with fluorous solvents (7:3 PFD **15** :PFTPA **16**, PFD **15**, PFOB **17**, or PF*t*-BuCy **18**) were prepared as described in the general nanoemulsion formation procedure with porphyrin **13** (0.04 mg, 0.01 μmol). A375 cells were placed in a 96-well plate (200,000 cells per 150 μL/well). The emulsions were diluted in FACS buffer (200 μL emulsions in 1 mL, PBS buffer + 1% FBS). Cells suspended in 150 μL media were treated with 50 μL of the diluted emulsions. Cells were incubated in the presence of emulsions (37 ˚C, 5% CO_2, 3 h). Cells were washed by centrifugation (3x, 526xg, 3 min) and resuspended in FACS buffer (PBS with 1% FBS) to a final volume of 200 μL. Cells were irradiated (30 min or 10 min, 420 nm LED, 8.5 mW/cm^2). After irradiation, the cells were diluted to 300 μL with FACS buffer and incubated (0 ˚C, 15 min) with propidium iodide (1 μL, 0.25 mg/ml solution). Cell death was analyzed by FL2 channel on FACSCalibur. 15,000 cells were collected per sample.

Figure S1. Empty emulsions were prepared as described in the general nanoemulsion formation procedure by sonicating fluorous solvent (10 vol%, 20 uL, 7:3 PFD **15**:PFTPA **16**, PFD **15**, PFOB **17**, or PF*t*-BuCy **18**) with Pluronic F-68 predissolved in PBS pH 7.4 (28 mg/mL, 2.8 wt%, 200 μL). Emulsions were diluted in MilliQ H_2O (20 μL emulsions in 2 mL MilliQ H_2O, Ω = -18 mV) in a plastic cuvette. The size was monitored by dynamic light scattering (Malvern Zetasizer Nano) and data is representative of three replicate measurements. Error bars represent the standard deviation of the product of the $Z_{average}$ and the polydispersity index of three measurements.

Figure S2. Cell viability with empty perfluorocarbon nanoemulsions was determined using the same procedure described for Figure 3B.

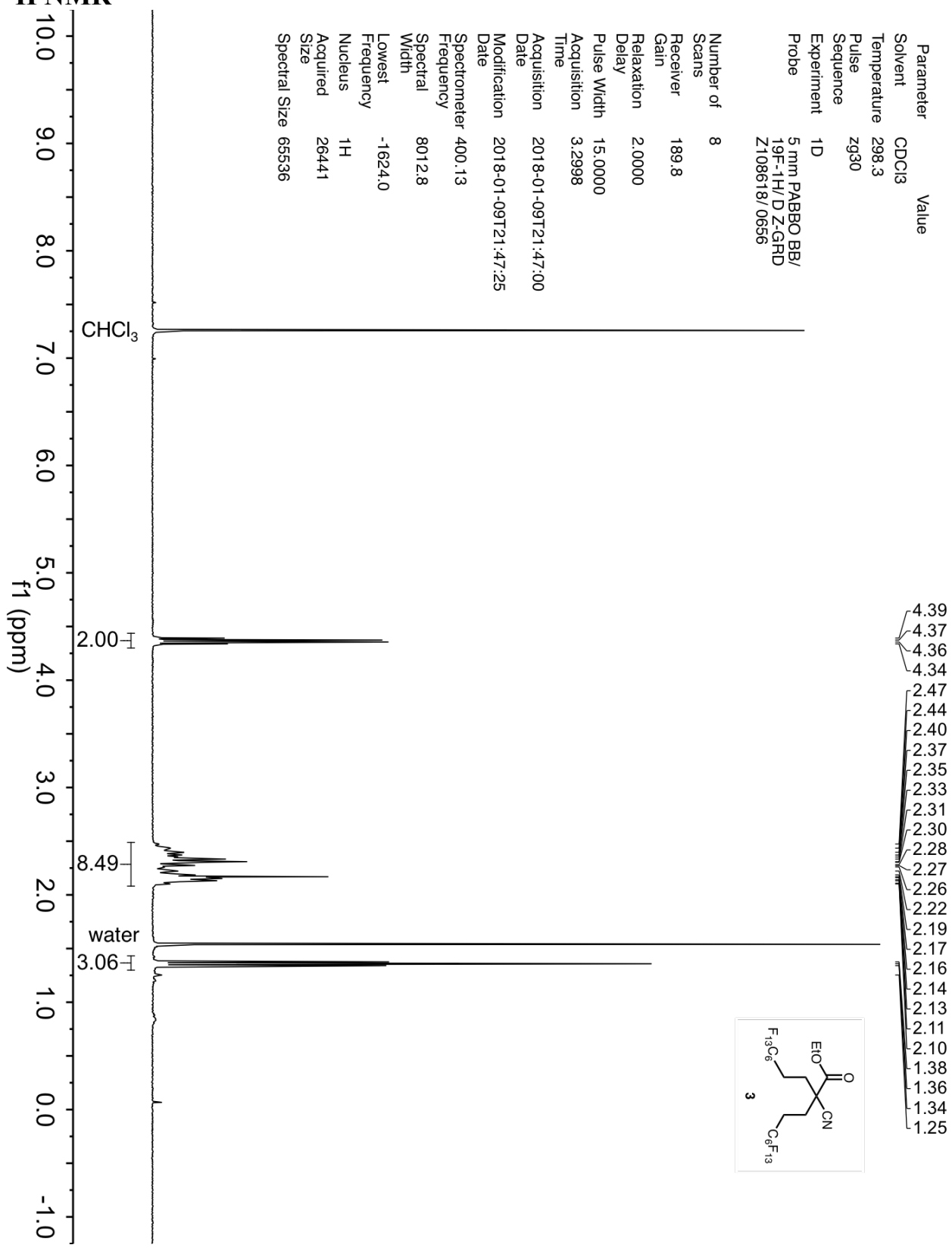
Figure S3. Cell viability comparison with **14** (7 nmol) and **13** (7 nmol) in perfluorocarbon nanoemulsions composed of 7:3 PFD **15**:PFTPA **16** was determined using the same procedure described for Figure 3B. Less porphyrin was used due to the lower solubility of **14** in 7:3 PFD:PFTPA.

Supplemental references.

(1) Yoshida, Y.; Sakakura, Y.; Aso, N.; Okada, S.; Tanabe, Y. *Tetrahedron* **1999**, *55*, 2183-2192.

(2) Tüxen, J.; Eibenberger, S.; Gerlich, S.; Arndt, M.; Mayor, M. *Eur. J. Org. Chem.* **2011**, 4823-4833.

^{1}H NMR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Receiver Gain 189.8
Relaxation Delay 2.0000
Pulse Width 15.0000
Acquisition Time 3.2998
Acquisition Date 2018-01-09T21:47:00
Modification Date 2018-01-09T21:47:25
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Spectral Width 8012.8
Lowest Frequency -1624.0
Nucleus 1H
Acquired Size 26441
Spectral Size 65536
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4.36
4.34
2.47
2.44
2.40
2.37
2.35
2.33
2.31
2.30
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2.19
2.17
2.16
2.14
2.13
2.11
2.10
1.38
1.36
1.34
1.25
EtO
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F13C6
C6F13
3
CHCl3
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8.49
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3.06
f1 (ppm)
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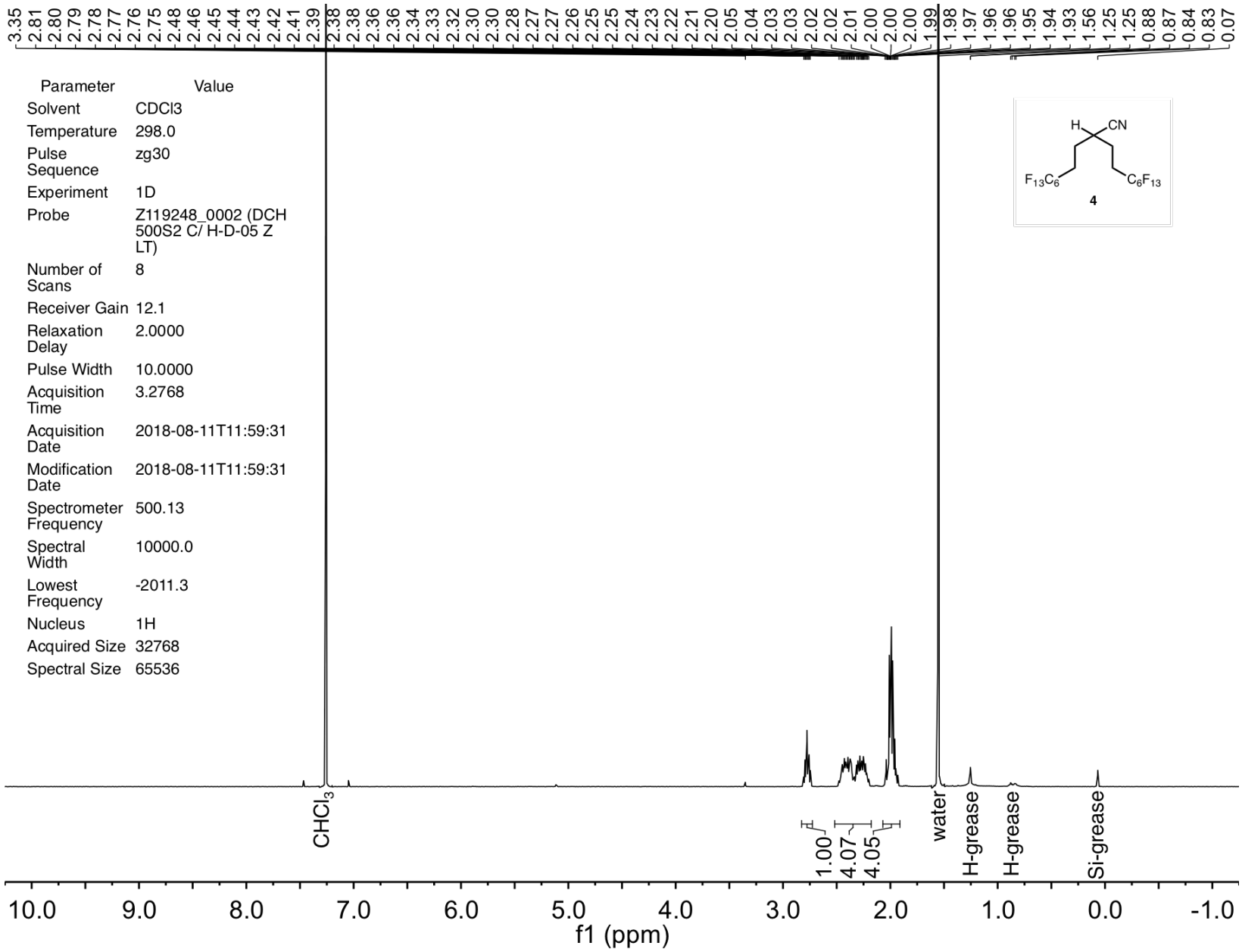
-1.0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Parameter Value
Solvent CDCl3
Temperature 298.0
Pulse Sequence zg30
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Lowest Frequency -2011.3
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Spectral Size 65536
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F13C6
C6F13
4
CHCl3
1.00
4.07
4.05
water
H-grease
H-grease
Si-grease
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)

Parameter	Value
Solvent	MeOD
Temperature	298.0
Pulse Sequence	zg30
Experiment	1D
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Number of Scans	16
Receiver Gain	12.1
Relaxation Delay	2.0000
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Acquisition Time	3.2768
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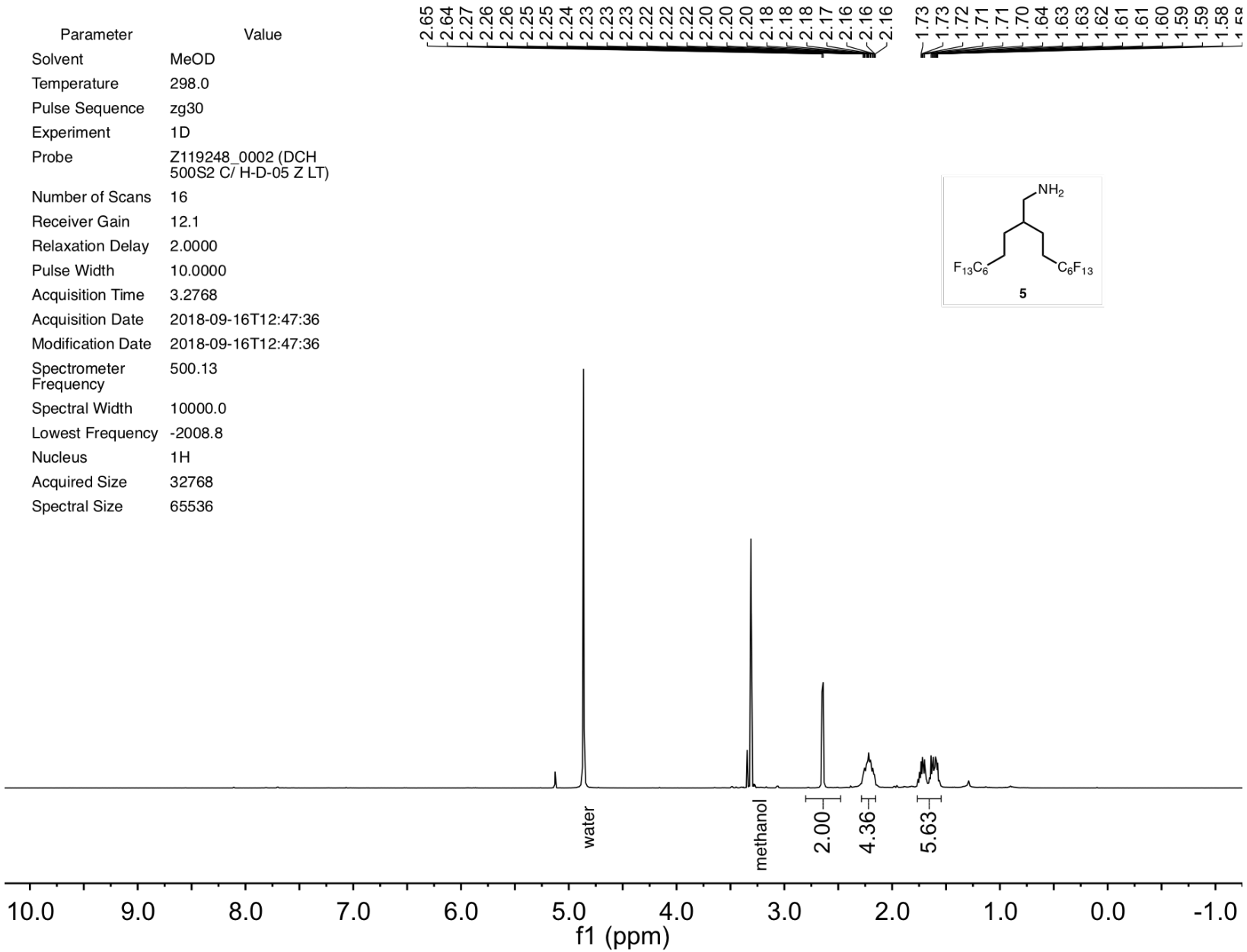

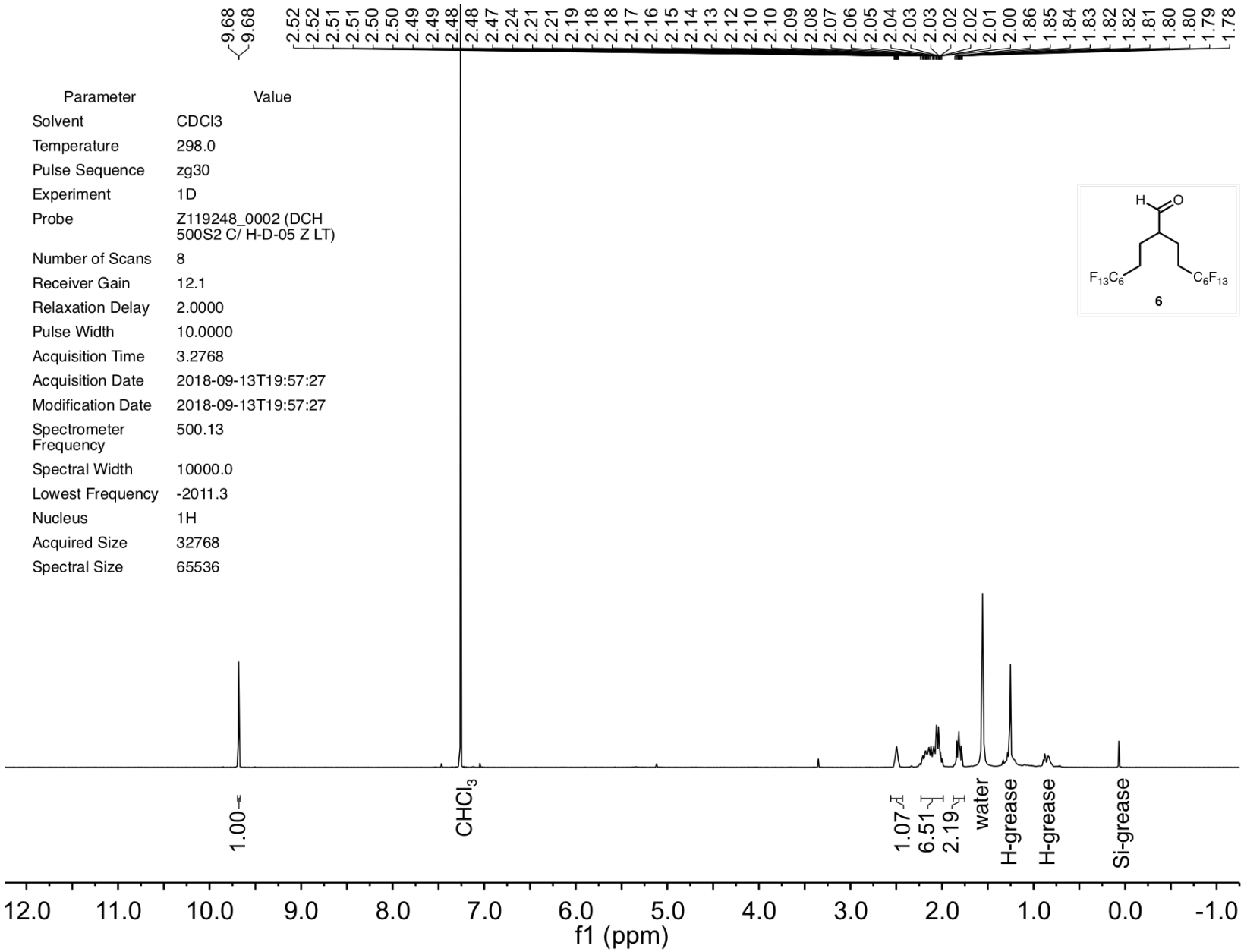
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1.78
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Spectral Size 65536
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2.19
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H-grease
Si-grease
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11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

Parameter	Value
Solvent	MeOD
Temperature	298.0
Pulse Sequence	zg30
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Pulse Width	10.0000
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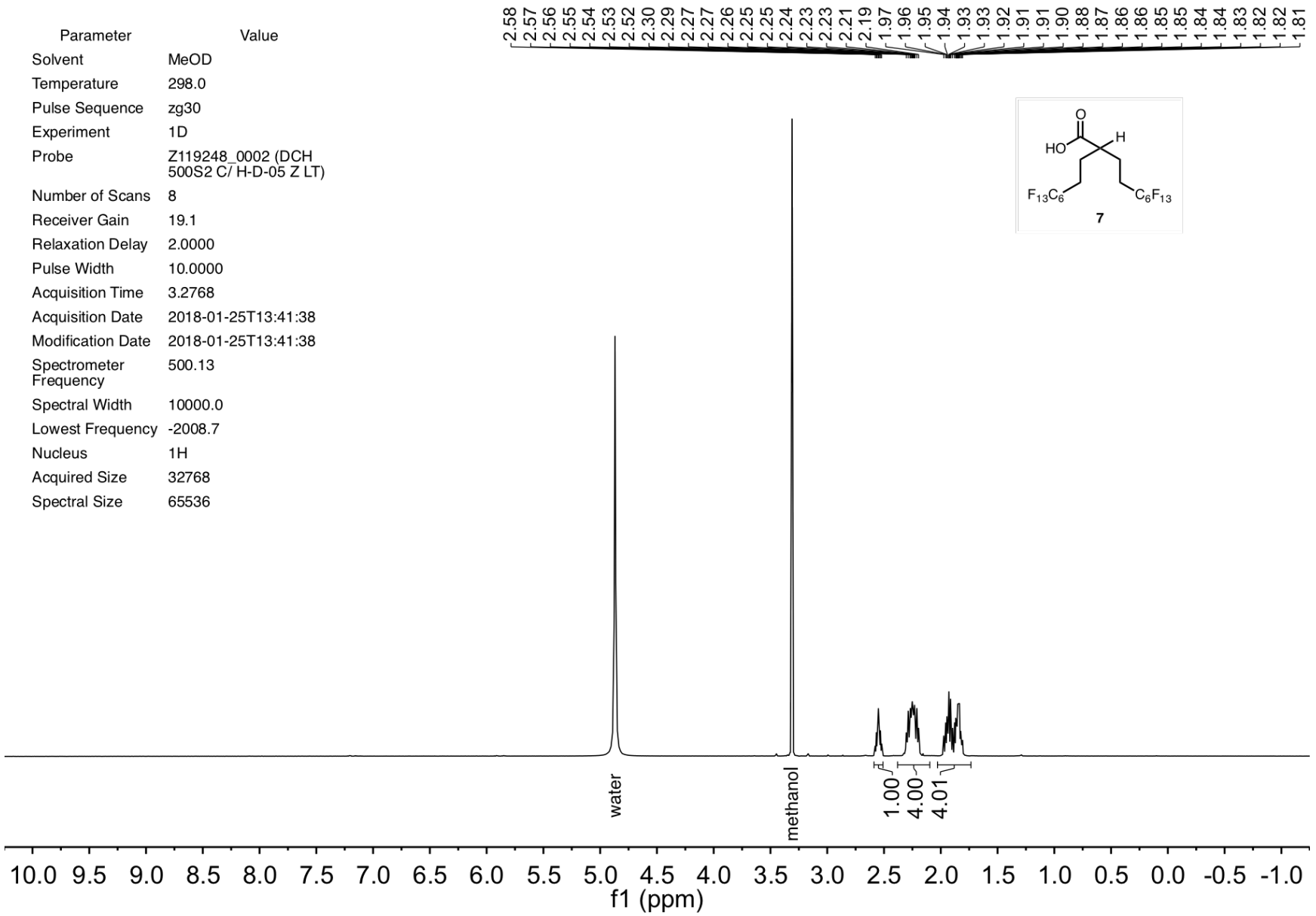
Spectral Size	65536



Parameter	Value
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Temperature	298.4
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Experiment	1D
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Number of Scans	8
Receiver Gain	155.8
Relaxation Delay	2.0000
Pulse Width	15.0000
Acquisition Time	3.2998
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Modification Date	2018-02-02T14:20:47
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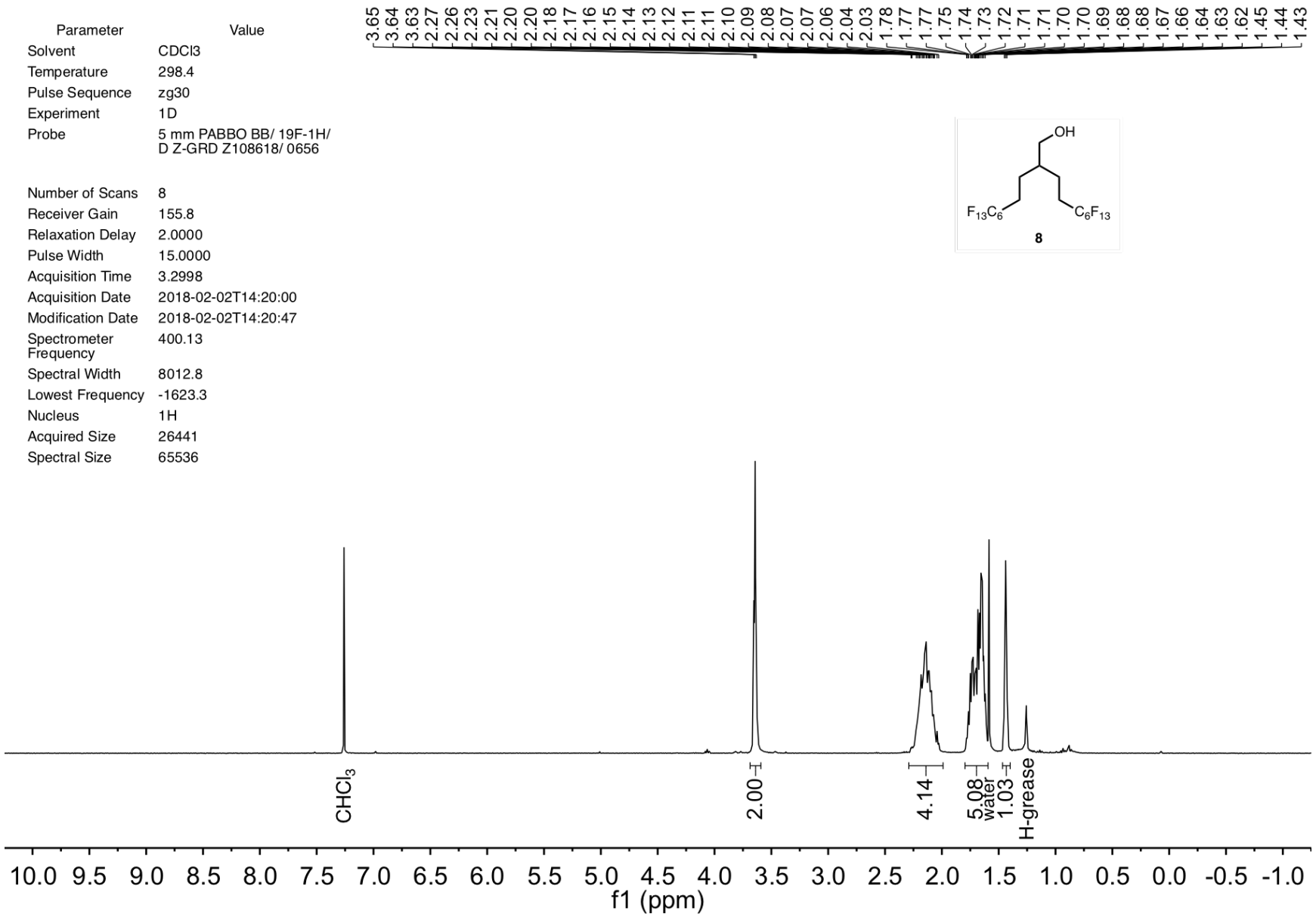
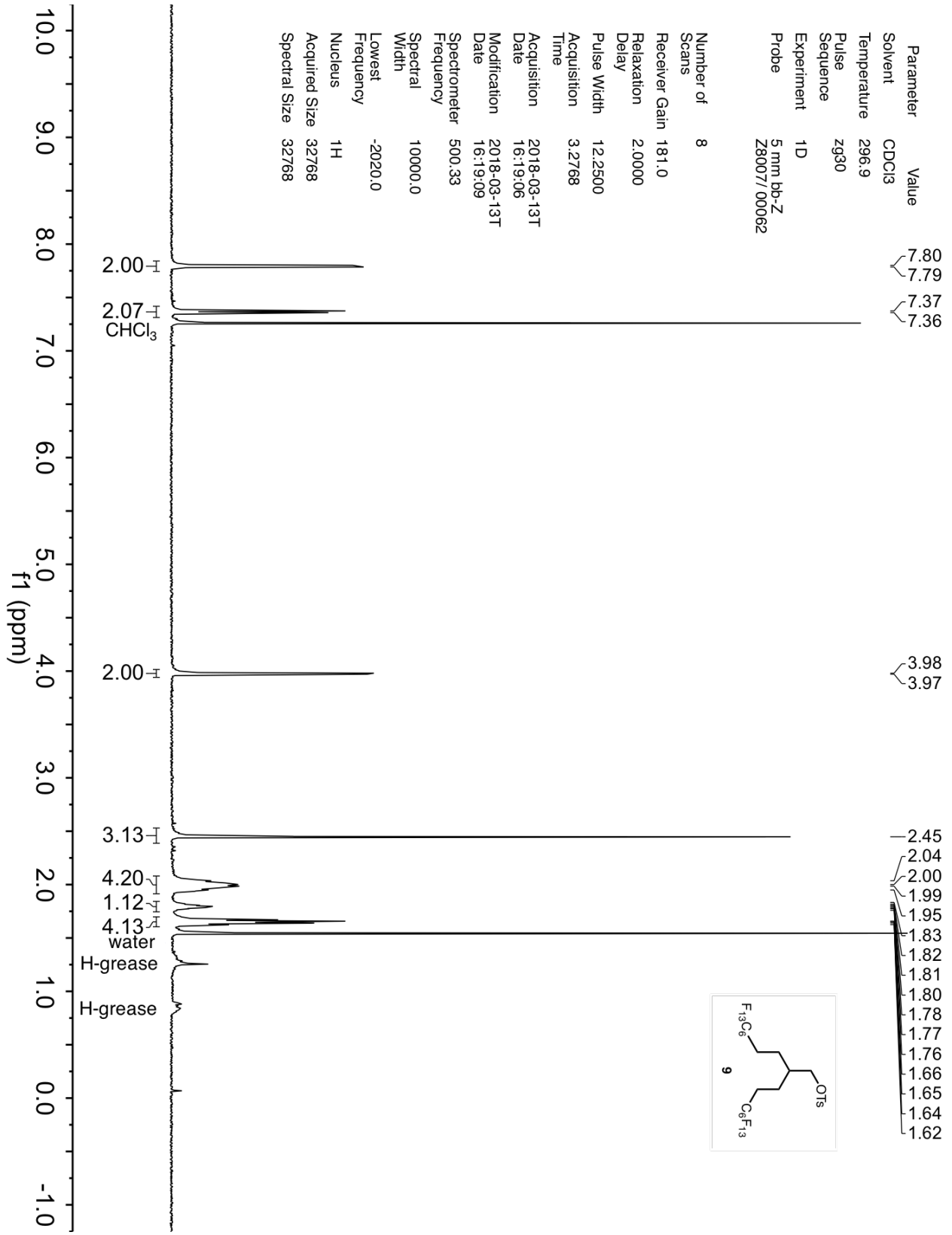
Lowest Frequency	-1623.3
Nucleus	1H
Acquired Size	26441
Spectral Size	65536

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Modification Date 2018-03-13T 16:19:09
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Spectral Size 32768
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1.65
1.64
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H-grease
F13C6
OTs
C6F13
9
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

Parameter	Value
Solvent	CDCl3
Temperature	298.0
Pulse Sequence	zg30
Experiment	1D
Probe	Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
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Receiver Gain	12.1
Relaxation Delay	2.0000
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Acquisition Time	3.2768
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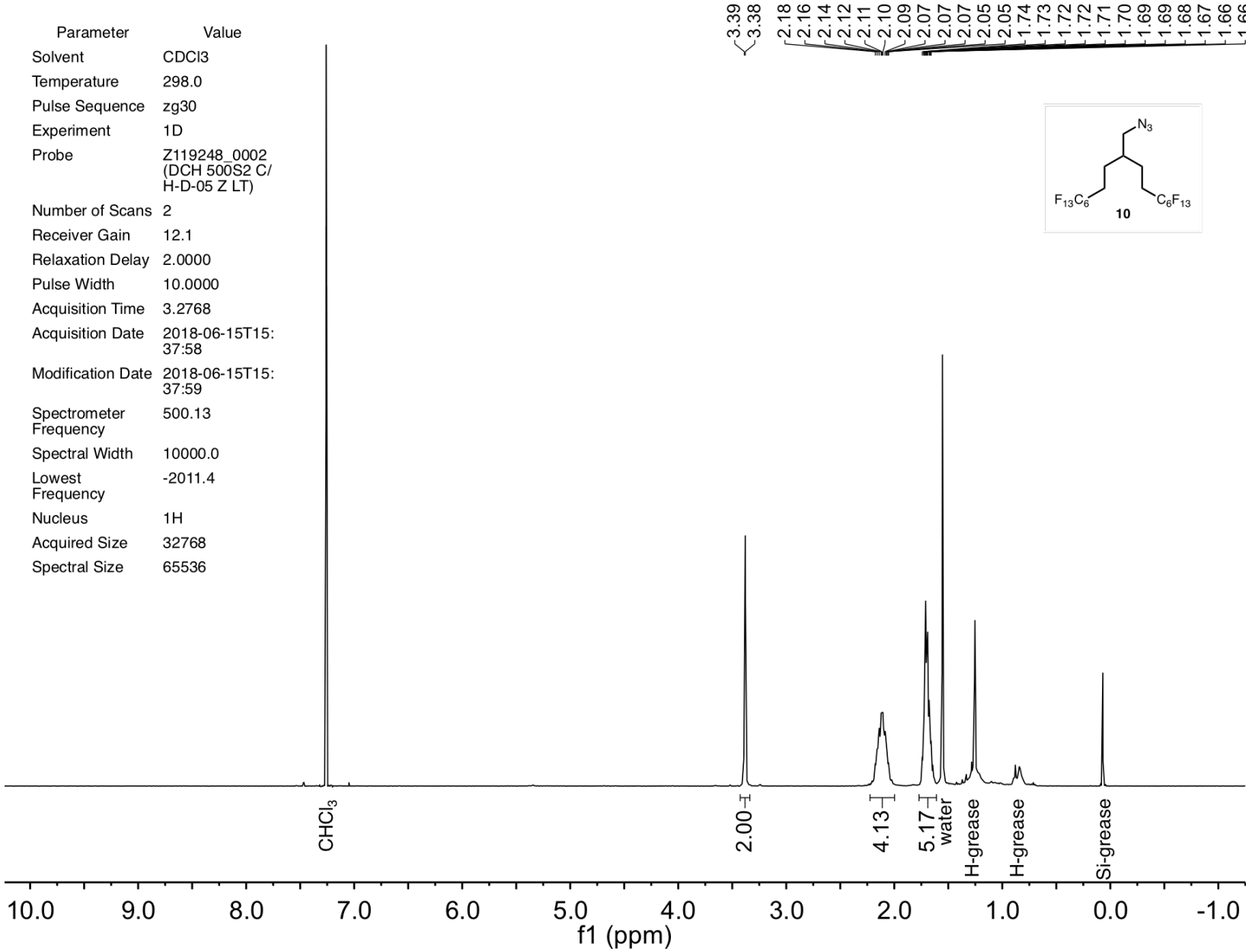
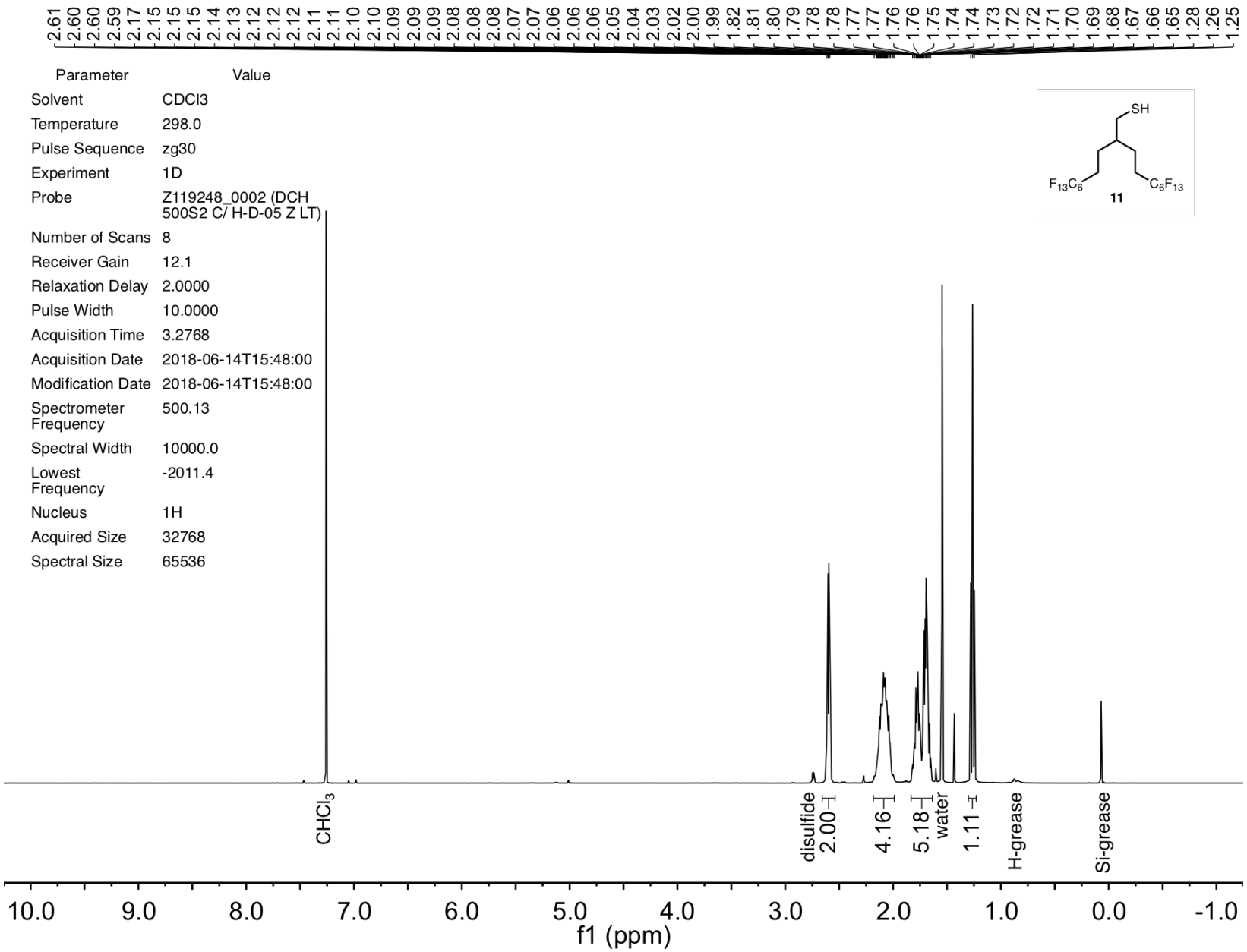
Nucleus	1H
Acquired Size	32768
Spectral Size	65536

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Parameter Value
Solvent CDCl3
Temperature 298.0
Pulse Sequence zg30
Experiment 1D
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Pulse Width 10.0000
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Acquired Size 32768
Spectral Size 65536
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11
CHCl3
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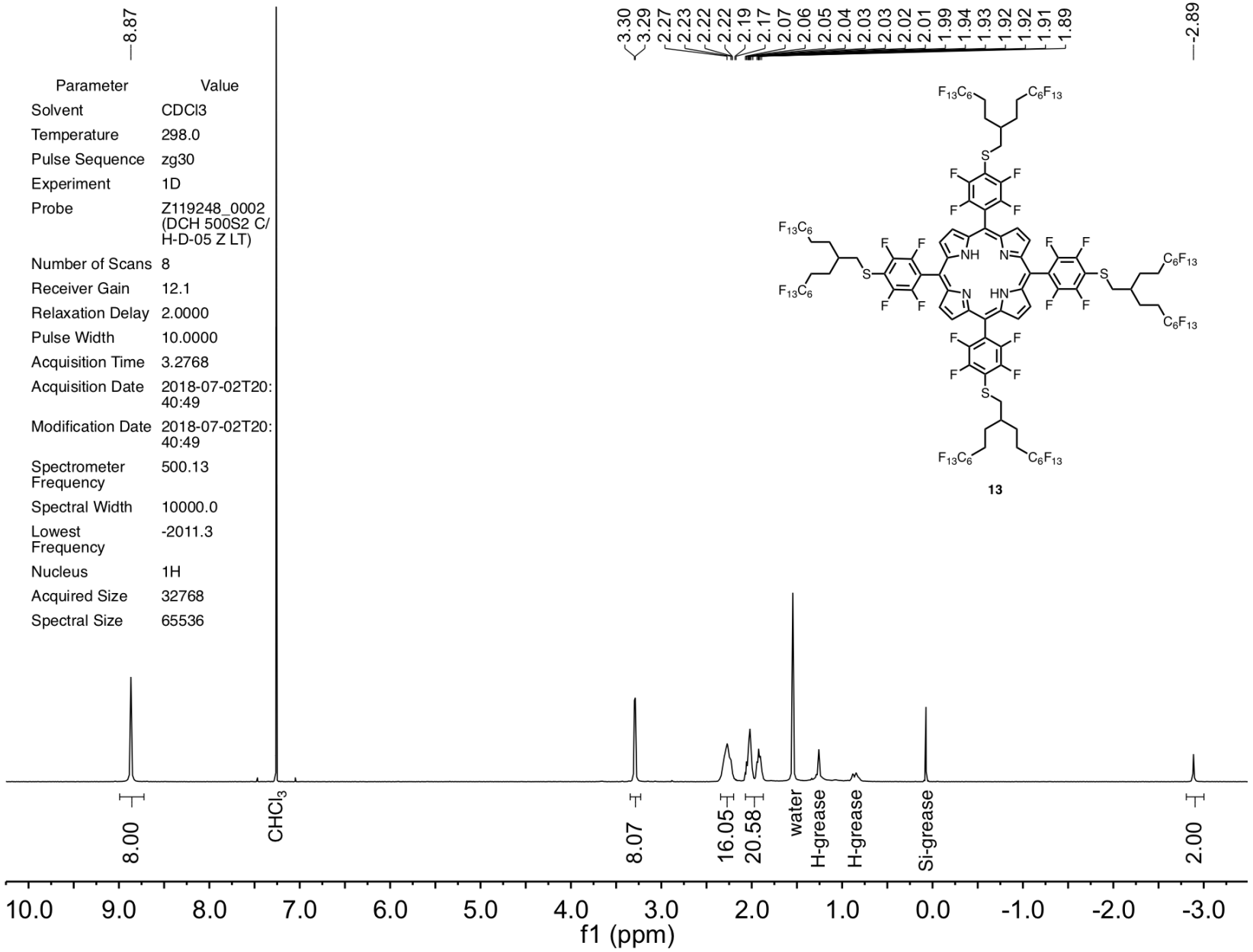
2.00
4.16
5.18
water
1.11
H-grease
Si-grease
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0 -1.0
f1 (ppm)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2.01
1.99
1.94
1.93
1.92
1.92
1.91
1.89
2.89
Parameter Value
Solvent CDCl3
Temperature 298.0
Pulse Sequence zg30
Experiment 1D
Probe Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
Number of Scans 8
Receiver Gain 12.1
Relaxation Delay 2.0000
Pulse Width 10.0000
Acquisition Time 3.2768
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Modification Date 2018-07-02T20:40:49
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Lowest Frequency -2011.3
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Acquired Size 32768
Spectral Size 65536
13
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CHCl3
8.07
16.05
20.58
water
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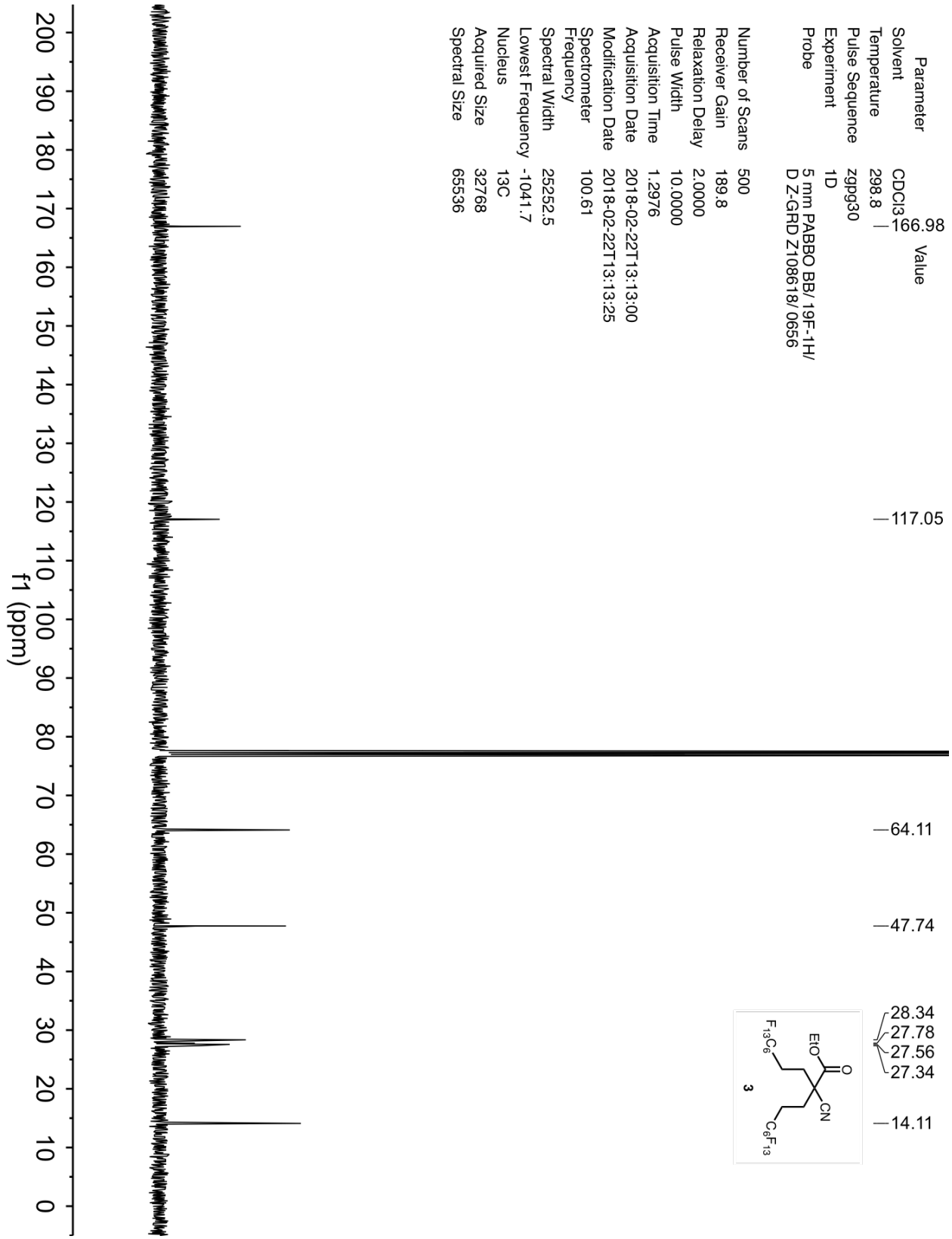
H-grease
Si-grease
2.00
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
f1 (ppm)

^{13}C NMR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Relaxation Delay 2.0000
Pulse Width 10.0000
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Modification Date 2018-02-22T13:13:25
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Spectral Width 25252.5
Lowest Frequency -1041.7
Nucleus 13C
Acquired Size 32768
Spectral Size 65536
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47.74
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27.78
27.56
27.34
14.11
EtO
O
CN
F13C6
C6F13
3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Parameter	Value
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Temperature	298.0
Pulse Sequence	zgpg30
Experiment	1D
Probe	Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
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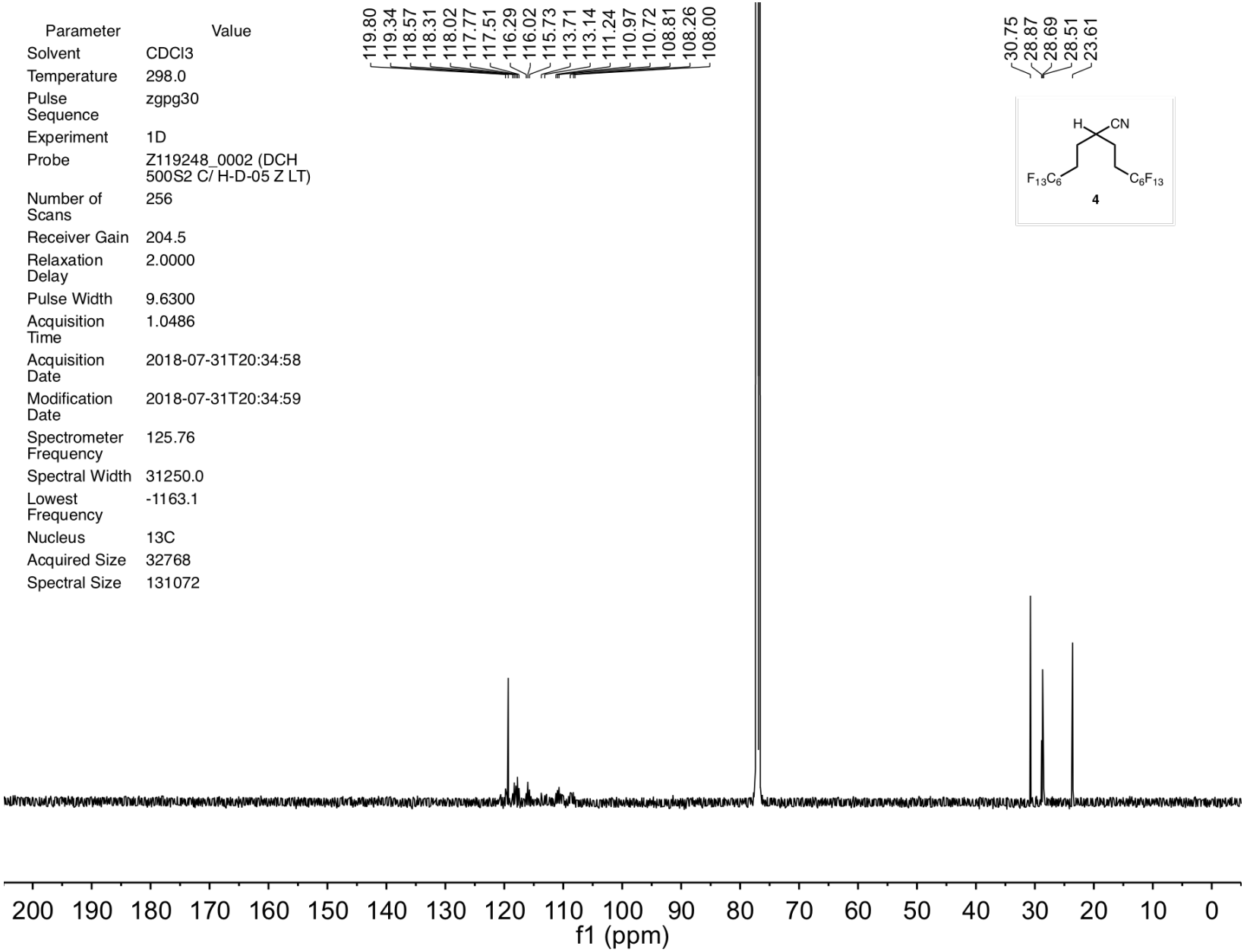
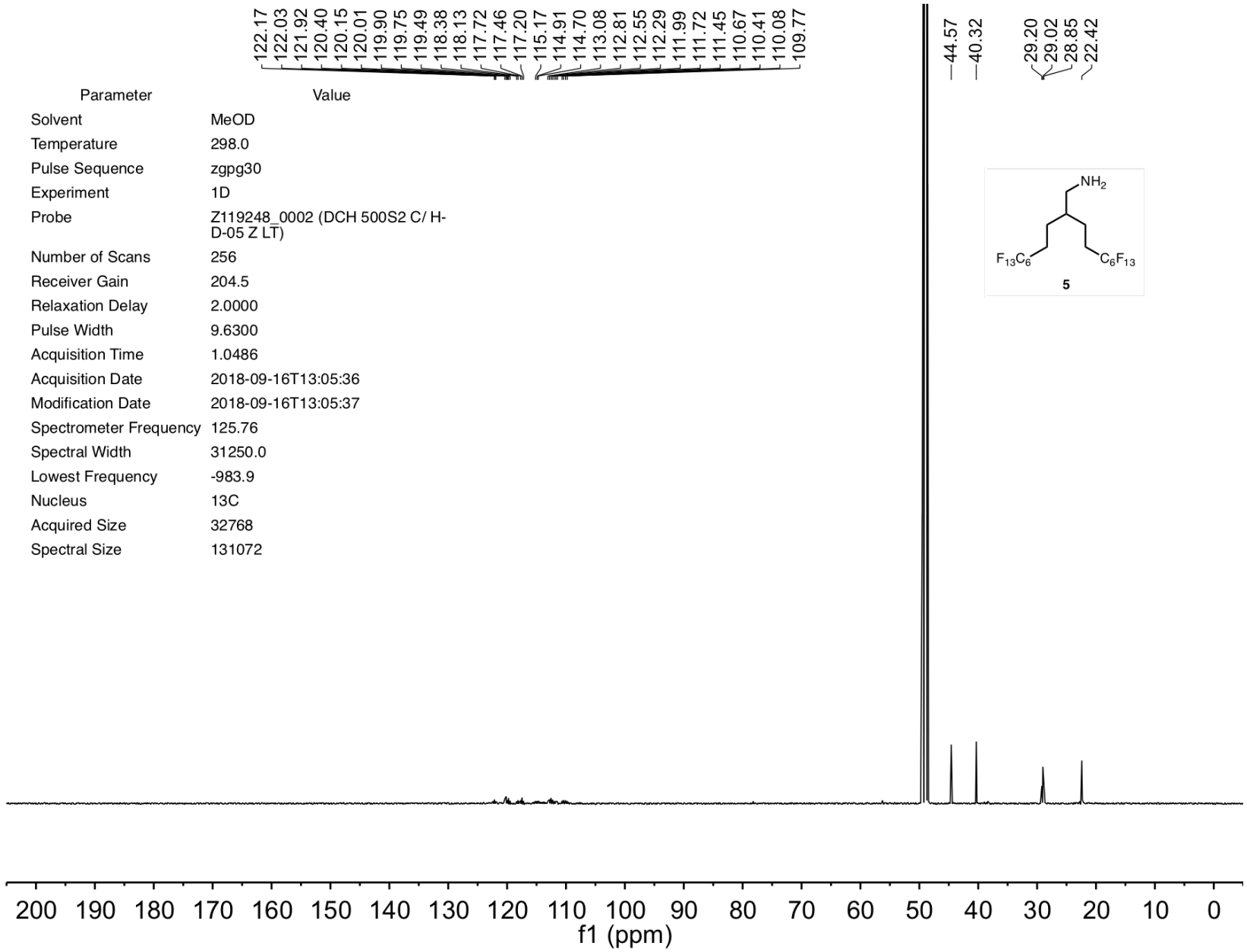
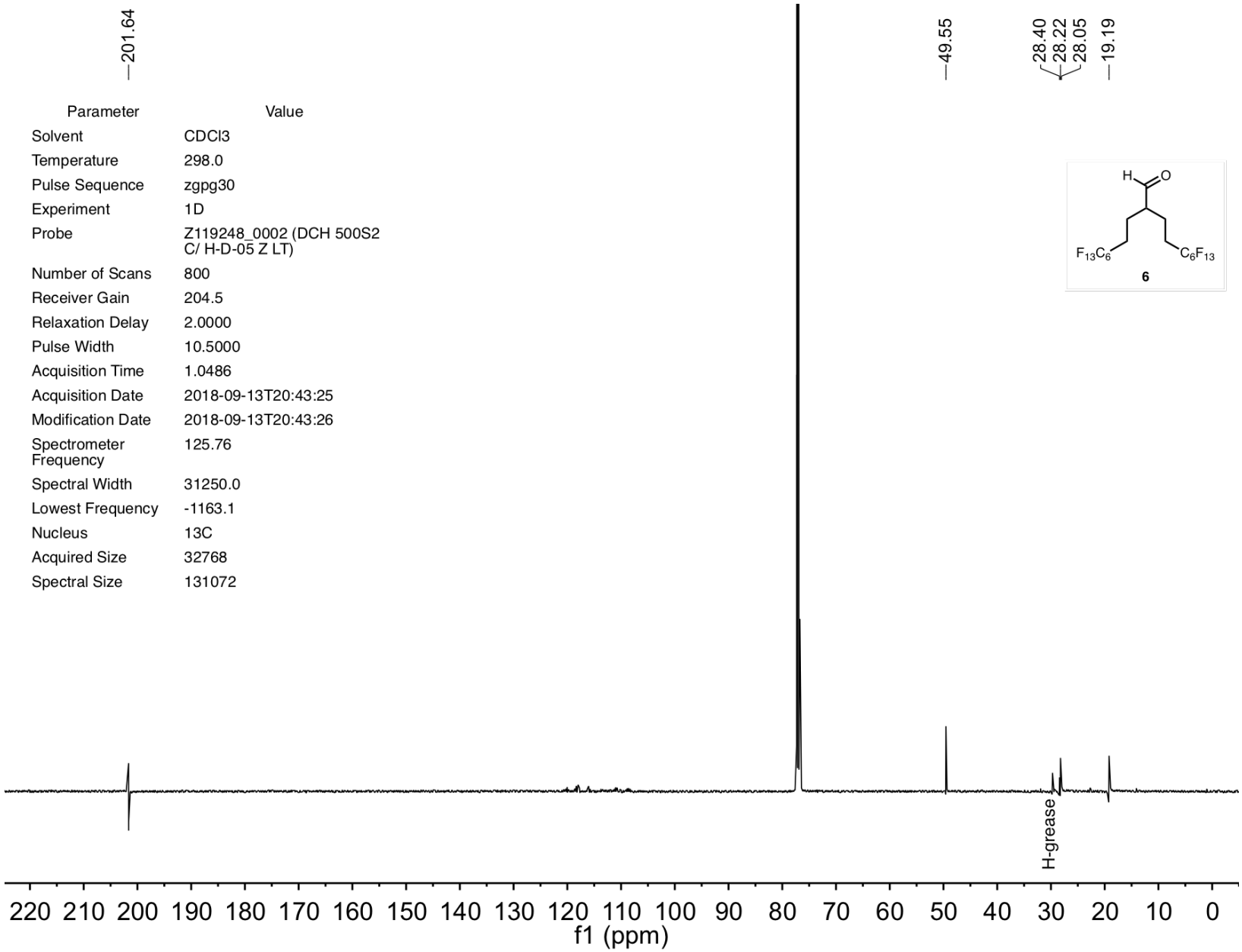
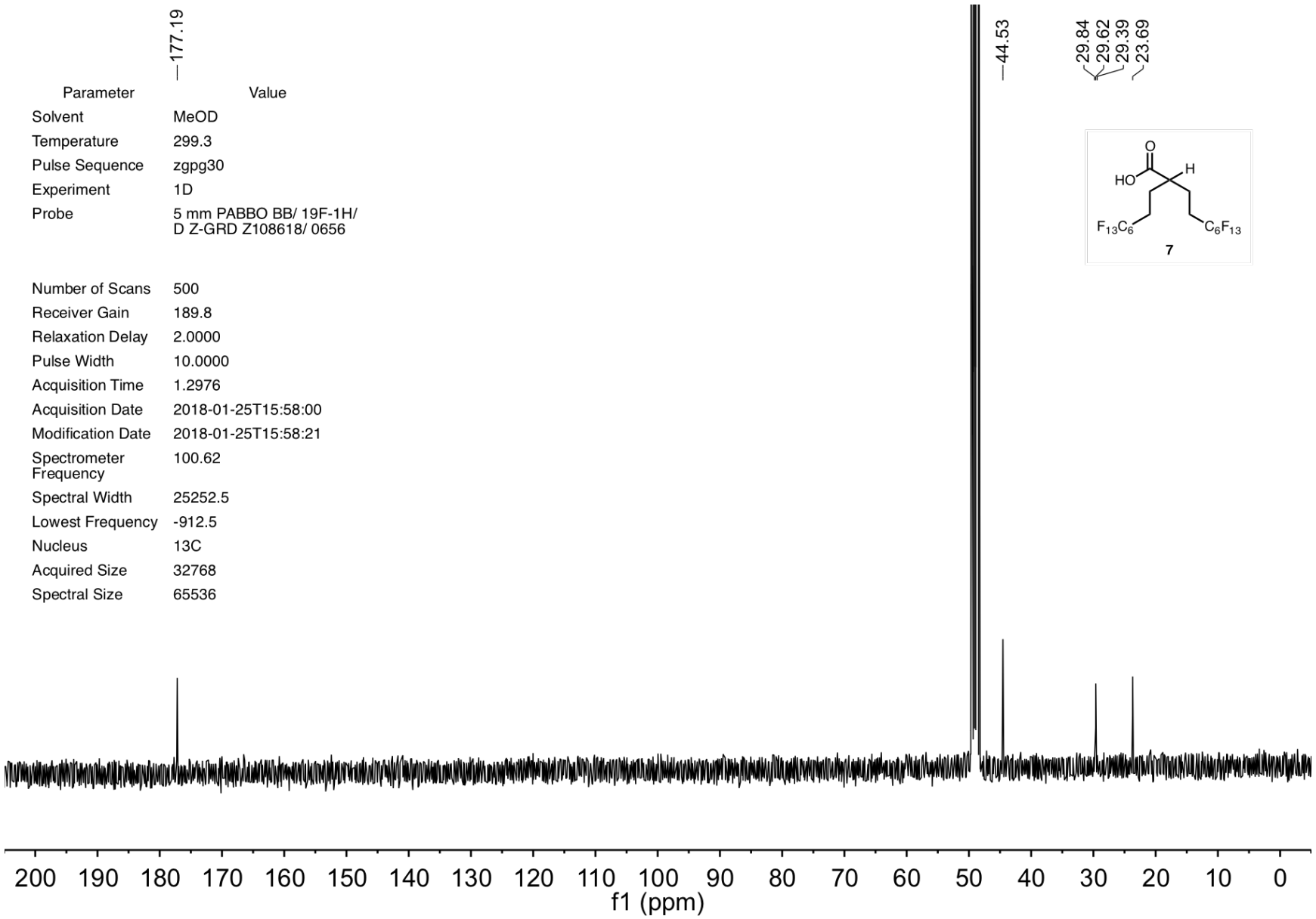
Spectral Width	31250.0
Lowest Frequency	-1163.1
Nucleus	13C
Acquired Size	32768
Spectral Size	131072

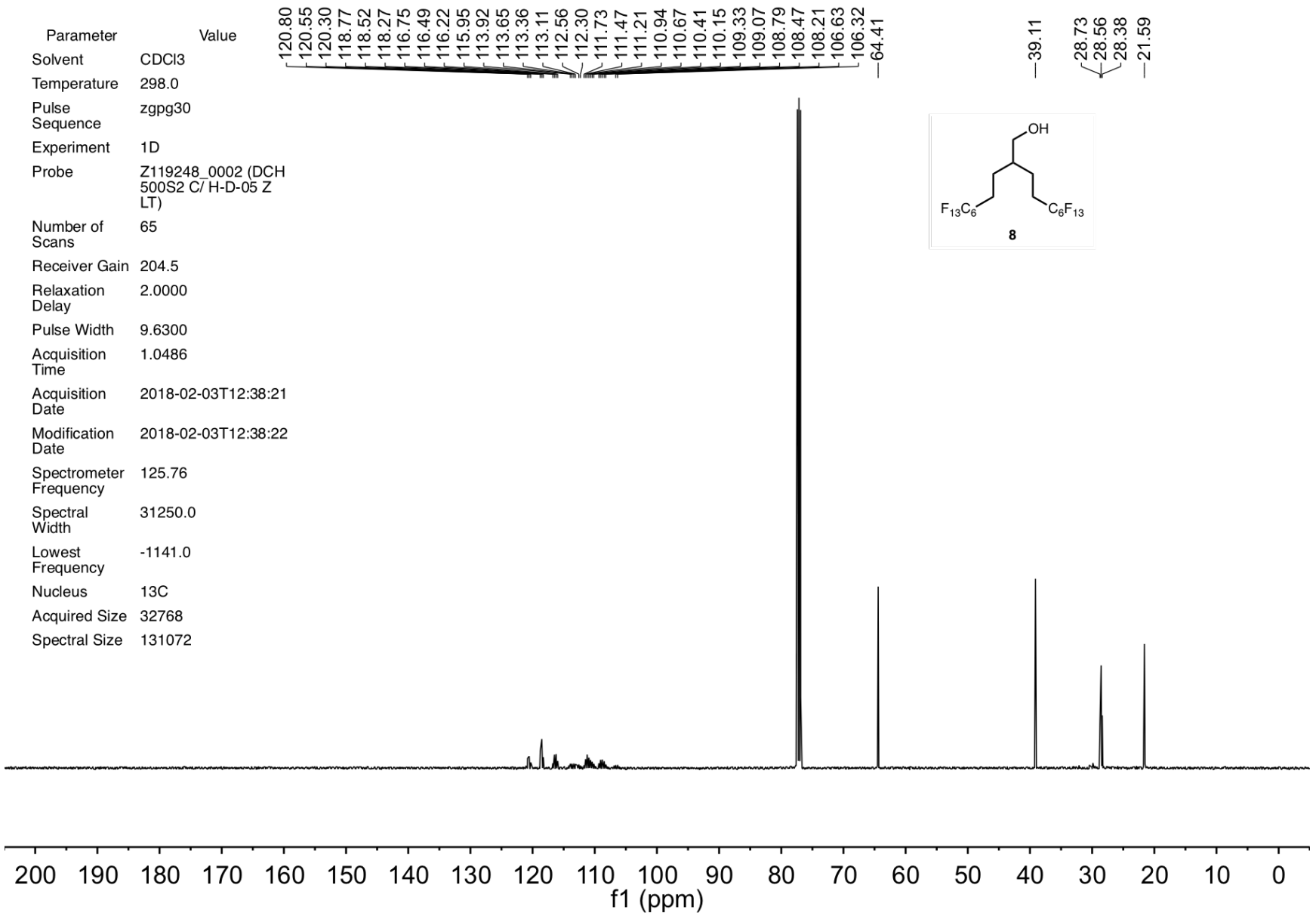




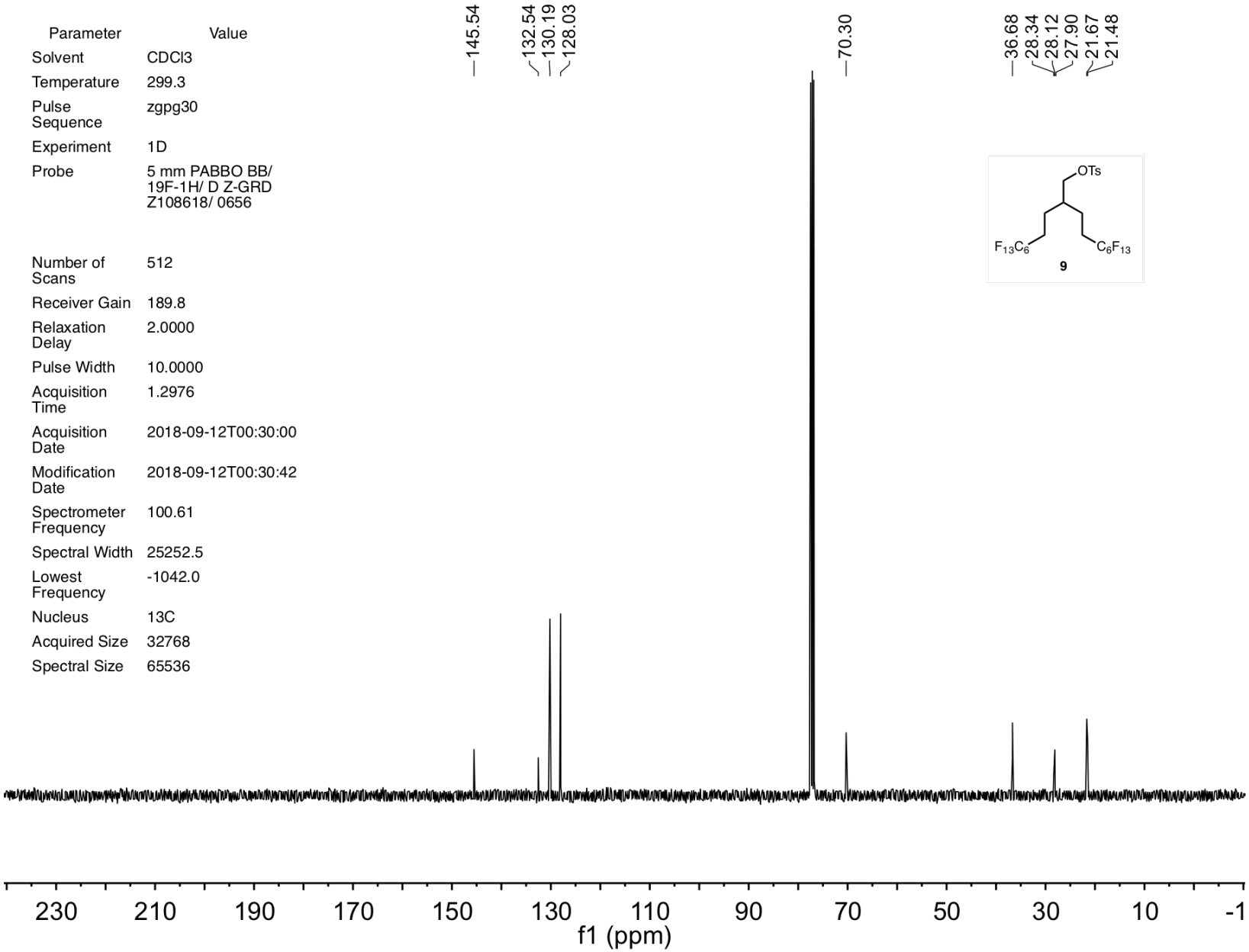
Parameter	Value
Solvent	MeOD
Temperature	298.0
Pulse Sequence	zgpg30
Experiment	1D
Probe	Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
Number of Scans	256
Receiver Gain	204.5
Relaxation Delay	2.0000
Pulse Width	9.6300
Acquisition Time	1.0486
Acquisition Date	2018-09-16T13:05:36
Modification Date	2018-09-16T13:05:37
Spectrometer Frequency	125.76
Spectral Width	31250.0
Lowest Frequency	-983.9
Nucleus	13C
Acquired Size	32768
Spectral Size	131072


201.64
49.55
28.40
28.22
28.05
19.19
Parameter Value
Solvent CDCl3
Temperature 298.0
Pulse Sequence zgpg30
Experiment 1D
Probe Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
Number of Scans 800
Receiver Gain 204.5
Relaxation Delay 2.0000
Pulse Width 10.5000
Acquisition Time 1.0486
Acquisition Date 2018-09-13T20:43:25
Modification Date 2018-09-13T20:43:26
Spectrometer Frequency 125.76
Spectral Width 31250.0
Lowest Frequency -1163.1
Nucleus 13C
Acquired Size 32768
Spectral Size 131072
H
O
F13C6
C6F13
6
H-grease
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

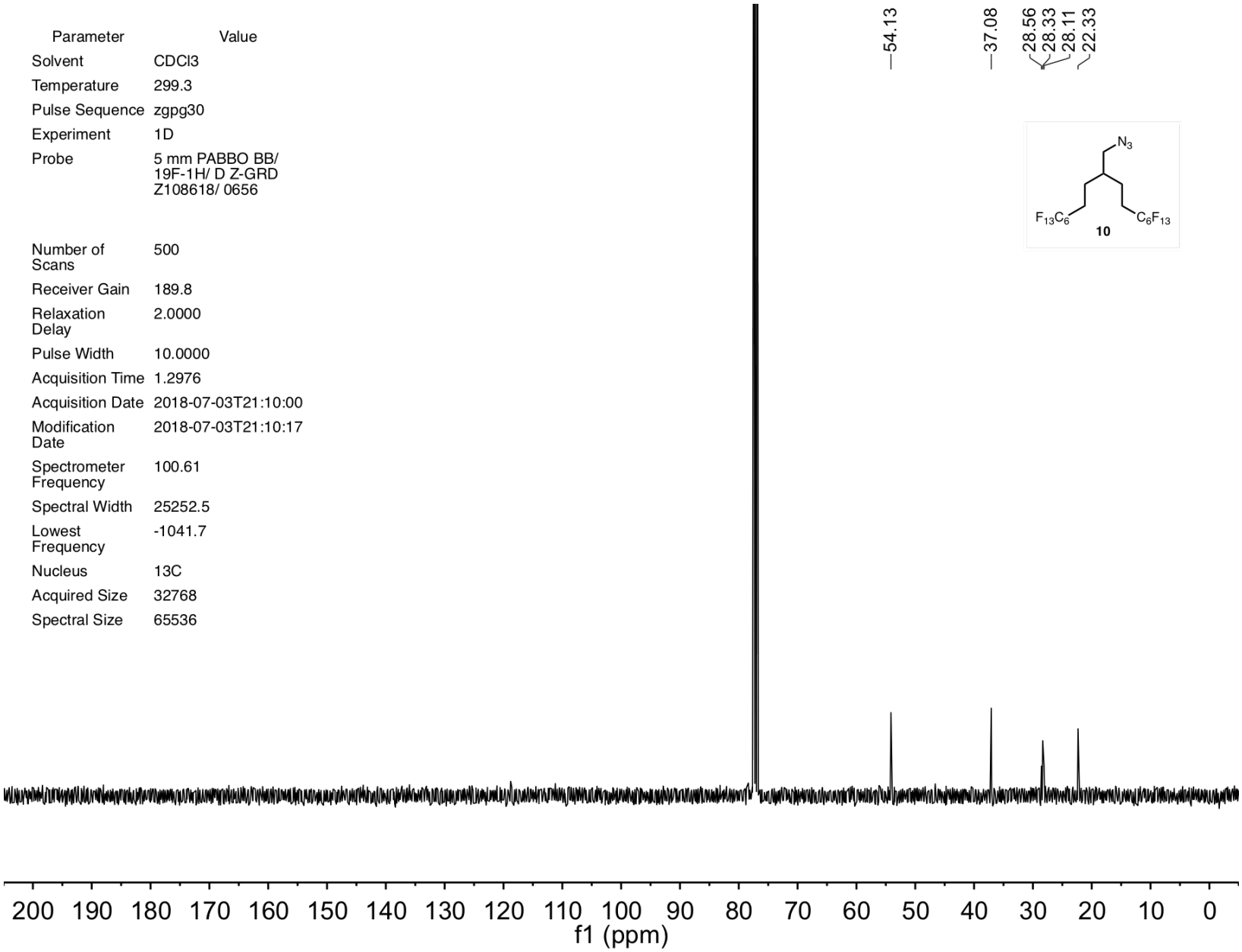

177.19
44.53
29.84
29.62
29.39
23.69
Parameter Value
Solvent MeOD
Temperature 299.3
Pulse Sequence zgpg30
Experiment 1D
Probe 5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans 500
Receiver Gain 189.8
Relaxation Delay 2.0000
Pulse Width 10.0000
Acquisition Time 1.2976
Acquisition Date 2018-01-25T15:58:00
Modification Date 2018-01-25T15:58:21
Spectrometer Frequency 100.62
Spectral Width 25252.5
Lowest Frequency -912.5
Nucleus 13C
Acquired Size 32768
Spectral Size 65536
O
HO
H
F13C6
C6F13
7
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


Parameter Value
Solvent CDCl3
Temperature 298.0
Pulse Sequence zgpg30
Experiment 1D
Probe Z119248_0002 (DCH 500S2 C/ H-D-05 Z LT)
Number of Scans 65
Receiver Gain 204.5
Relaxation Delay 2.0000
Pulse Width 9.6300
Acquisition Time 1.0486
Acquisition Date 2018-02-03T12:38:21
Modification Date 2018-02-03T12:38:22
Spectrometer Frequency 125.76
Spectral Width 31250.0
Lowest Frequency -1141.0
Nucleus 13C
Acquired Size 32768
Spectral Size 131072
120.80
120.55
120.30
118.77
118.52
118.27
116.75
116.49
116.22
115.95
113.92
113.65
113.36
113.11
112.56
112.30
111.73
111.47
111.21
110.94
110.67
110.41
110.15
109.33
109.07
108.79
108.47
108.21
106.63
106.32
64.41
39.11
28.73
28.56
28.38
21.59
OH
F13C6
C6F13
8
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

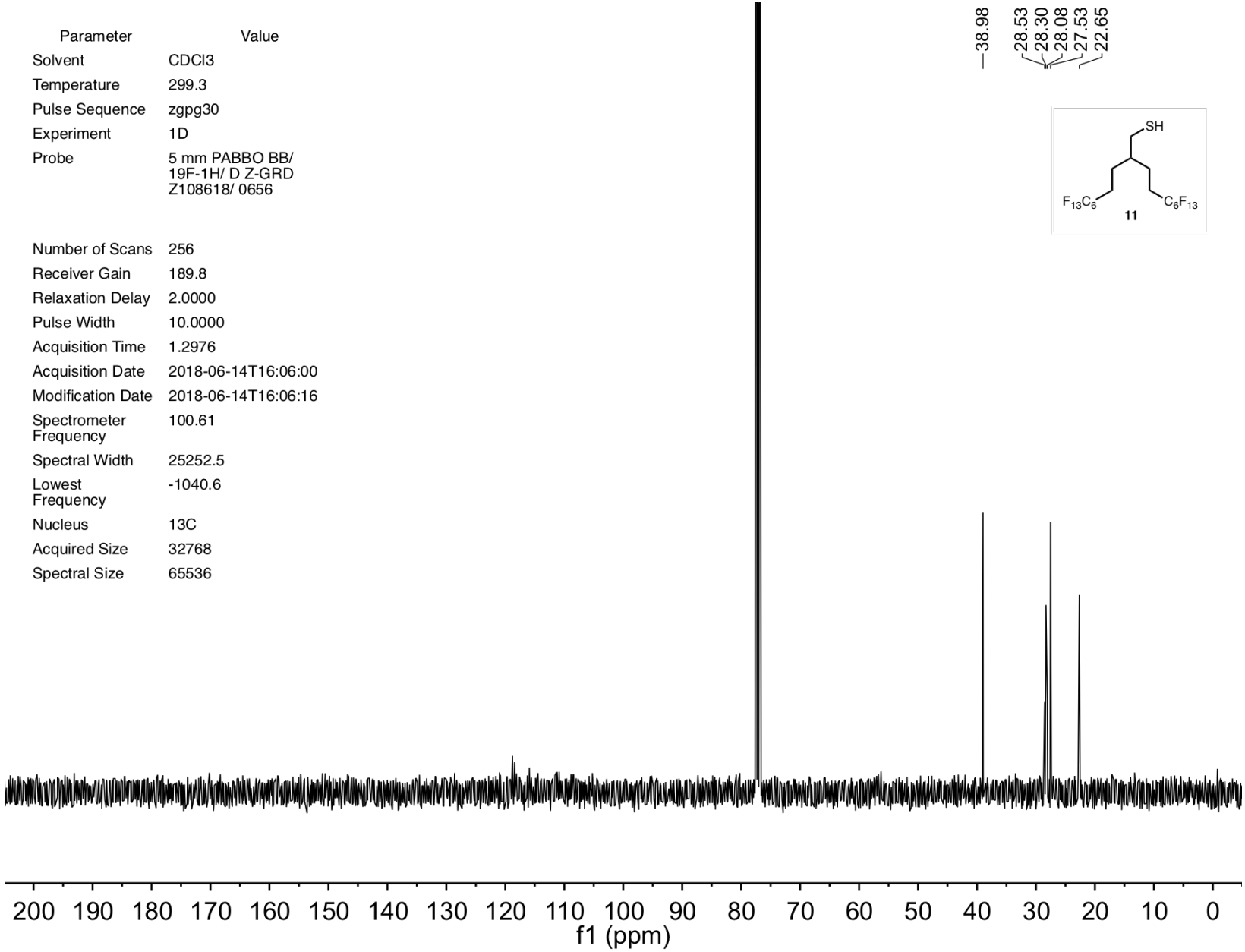
Parameter	Value
Solvent	CDCl3
Temperature	299.3
Pulse Sequence	zgpg30
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	512
Receiver Gain	189.8
Relaxation Delay	2.0000
Pulse Width	10.0000
Acquisition Time	1.2976
Acquisition Date	2018-09-12T00:30:00
Modification Date	2018-09-12T00:30:42
Spectrometer Frequency	100.61
Spectral Width	25252.5
Lowest Frequency	-1042.0
Nucleus	13C
Acquired Size	32768
Spectral Size	65536



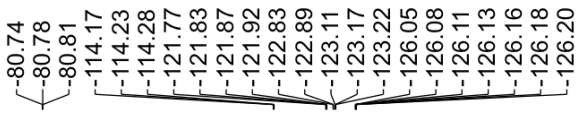
Parameter	Value
Solvent	CDCl3
Temperature	299.3
Pulse Sequence	zgpg30
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	500
Receiver Gain	189.8
Relaxation Delay	2.0000
Pulse Width	10.0000
Acquisition Time	1.2976
Acquisition Date	2018-07-03T21:10:00
Modification Date	2018-07-03T21:10:17
Spectrometer Frequency	100.61
Spectral Width	25252.5
Lowest Frequency	-1041.7
Nucleus	13C
Acquired Size	32768
Spectral Size	65536

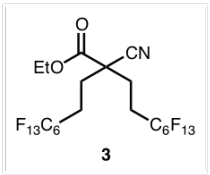


Parameter	Value
Solvent	CDCl3
Temperature	299.3
Pulse Sequence	zgpg30
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	256
Receiver Gain	189.8
Relaxation Delay	2.0000
Pulse Width	10.0000
Acquisition Time	1.2976
Acquisition Date	2018-06-14T16:06:00
Modification Date	2018-06-14T16:06:16
Spectrometer Frequency	100.61
Spectral Width	25252.5
Lowest Frequency	-1040.6
Nucleus	13C
Acquired Size	32768
Spectral Size	65536

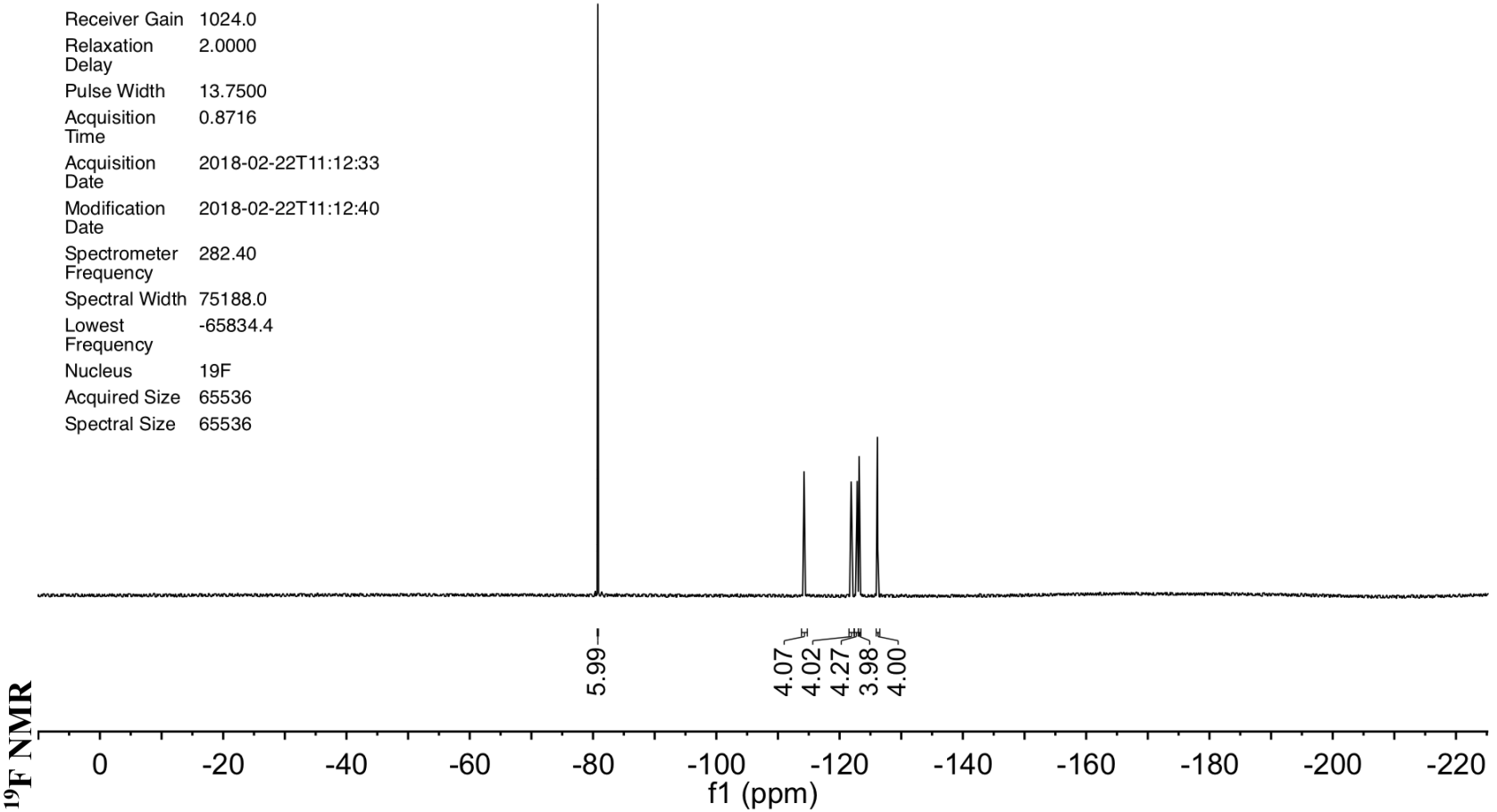


Parameter	Value
Solvent	CDCl3
Temperature	297.2
Pulse Sequence	zg30
Experiment	1D
Probe	5 mm PABBO BB-1H/D Z-GRD Z862701/0016
Number of Scans	8
Receiver Gain	1024.0
Relaxation Delay	2.0000
Pulse Width	13.7500
Acquisition Time	0.8716
Acquisition Date	2018-02-22T11:12:33
Modification Date	2018-02-22T11:12:40
Spectrometer Frequency	282.40
Spectral Width	75188.0
Lowest Frequency	-65834.4
Nucleus	19F
Acquired Size	65536
Spectral Size	65536

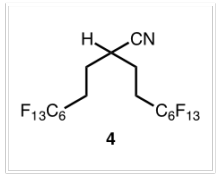


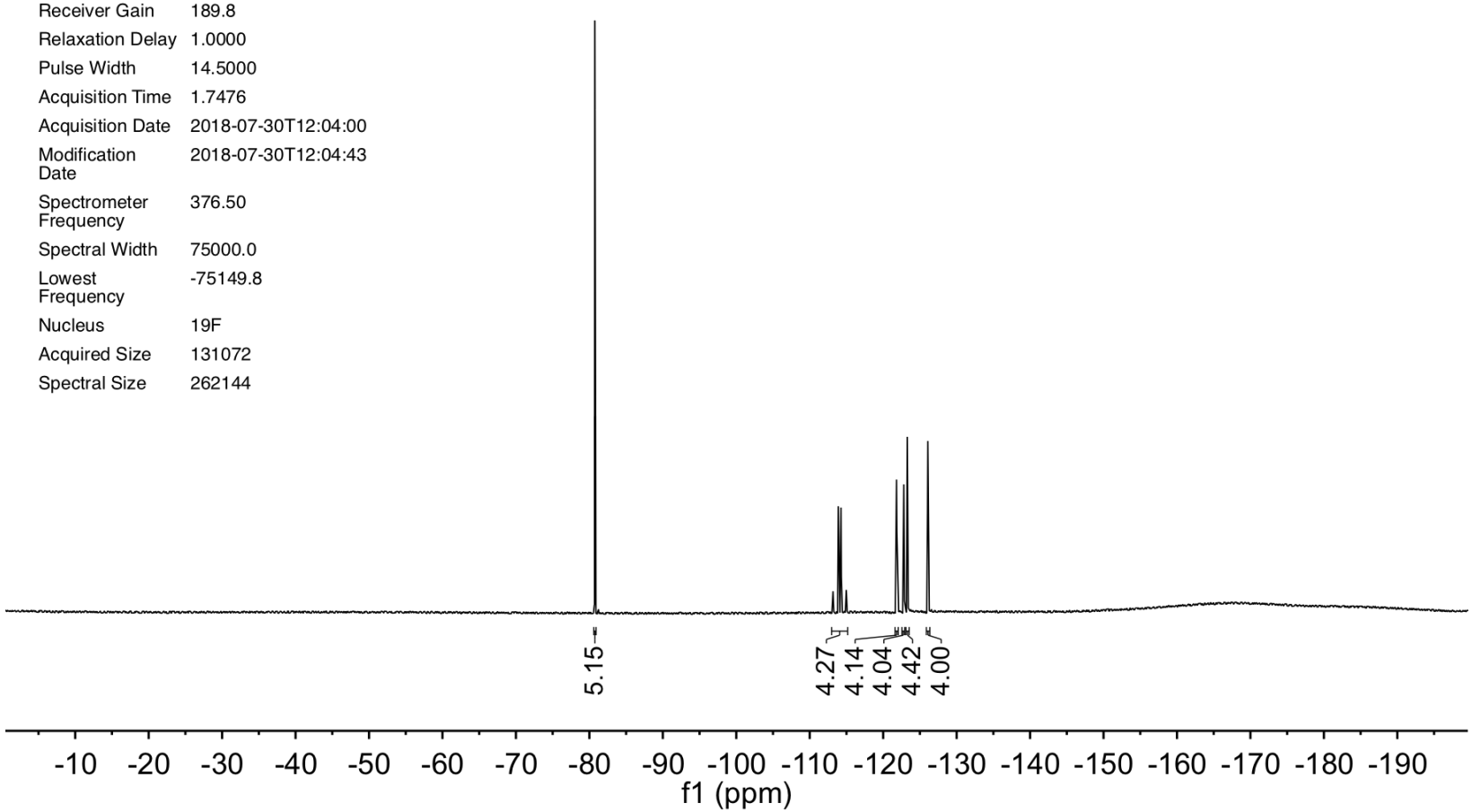


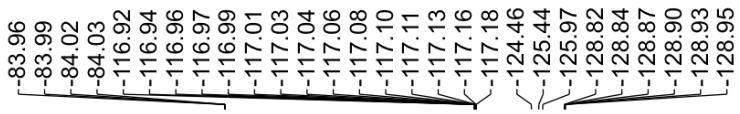
3



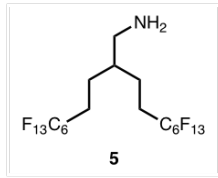
Parameter	Value
Solvent	CDCl3
Temperature	0.0
Pulse Sequence	zgfhigqn.2
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	16
Receiver Gain	189.8
Relaxation Delay	1.0000
Pulse Width	14.5000
Acquisition Time	1.7476
Acquisition Date	2018-07-30T12:04:00
Modification Date	2018-07-30T12:04:43
Spectrometer Frequency	376.50
Spectral Width	75000.0
Lowest Frequency	-75149.8
Nucleus	19F
Acquired Size	131072
Spectral Size	262144



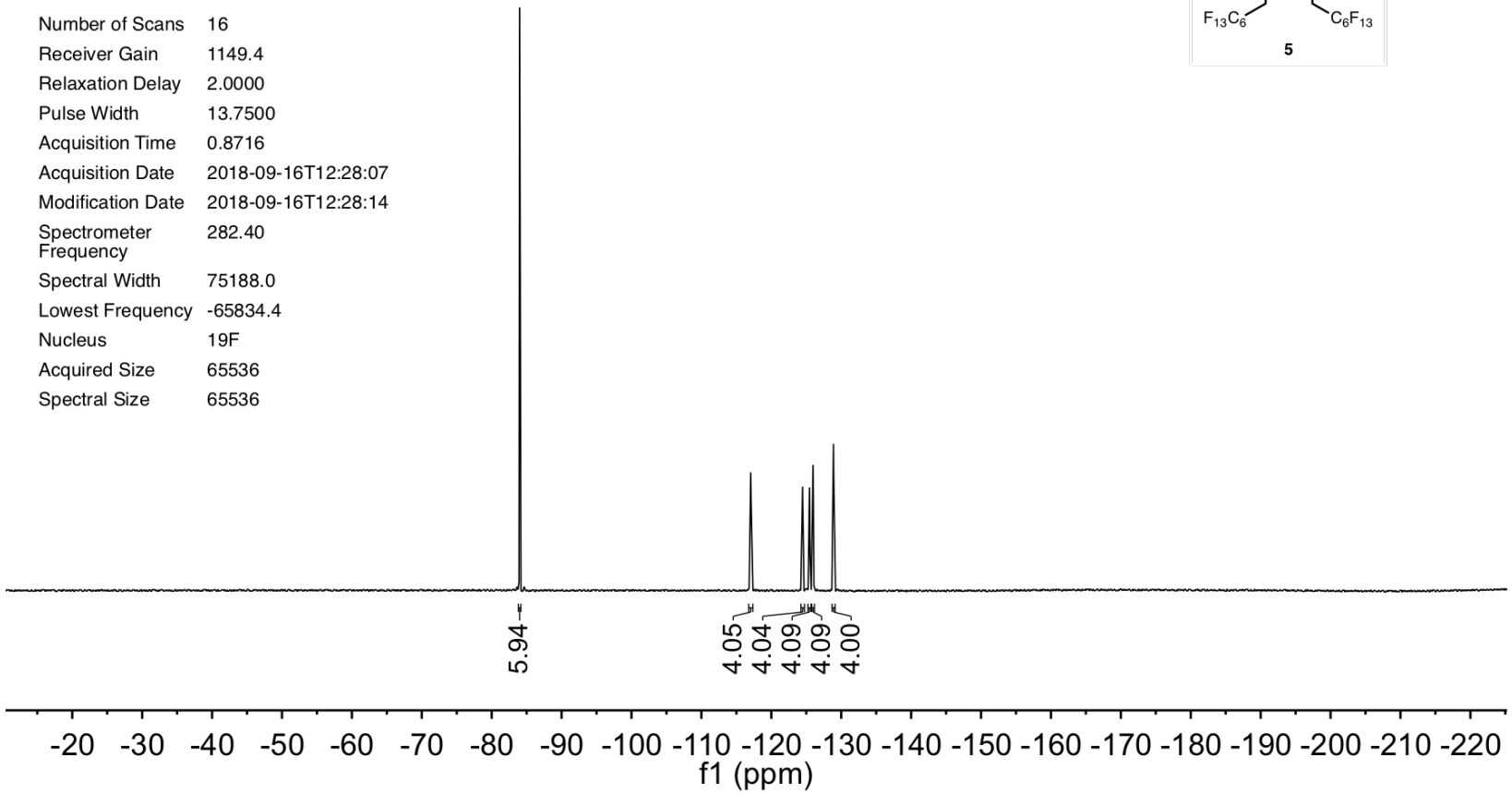




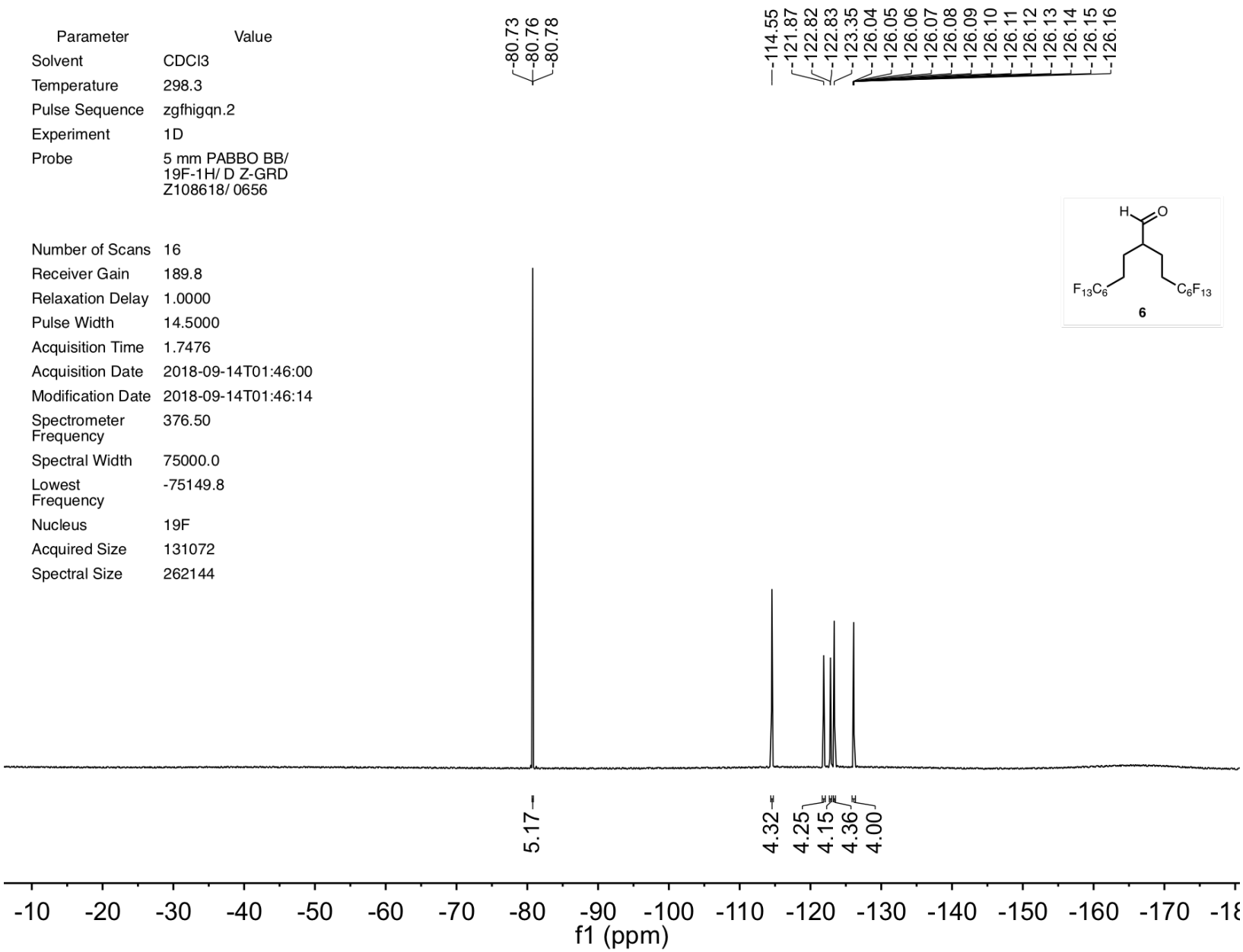
Parameter	Value
Solvent	MeOD
Temperature	298.3
Pulse Sequence	zg30
Experiment	1D
Probe	5 mm PABBO BB-1H/ D Z-GRD Z862701/ 0016
Number of Scans	16
Receiver Gain	1149.4
Relaxation Delay	2.0000
Pulse Width	13.7500
Acquisition Time	0.8716
Acquisition Date	2018-09-16T12:28:07
Modification Date	2018-09-16T12:28:14
Spectrometer Frequency	282.40
Spectral Width	75188.0
Lowest Frequency	-65834.4
Nucleus	19F
Acquired Size	65536
Spectral Size	65536



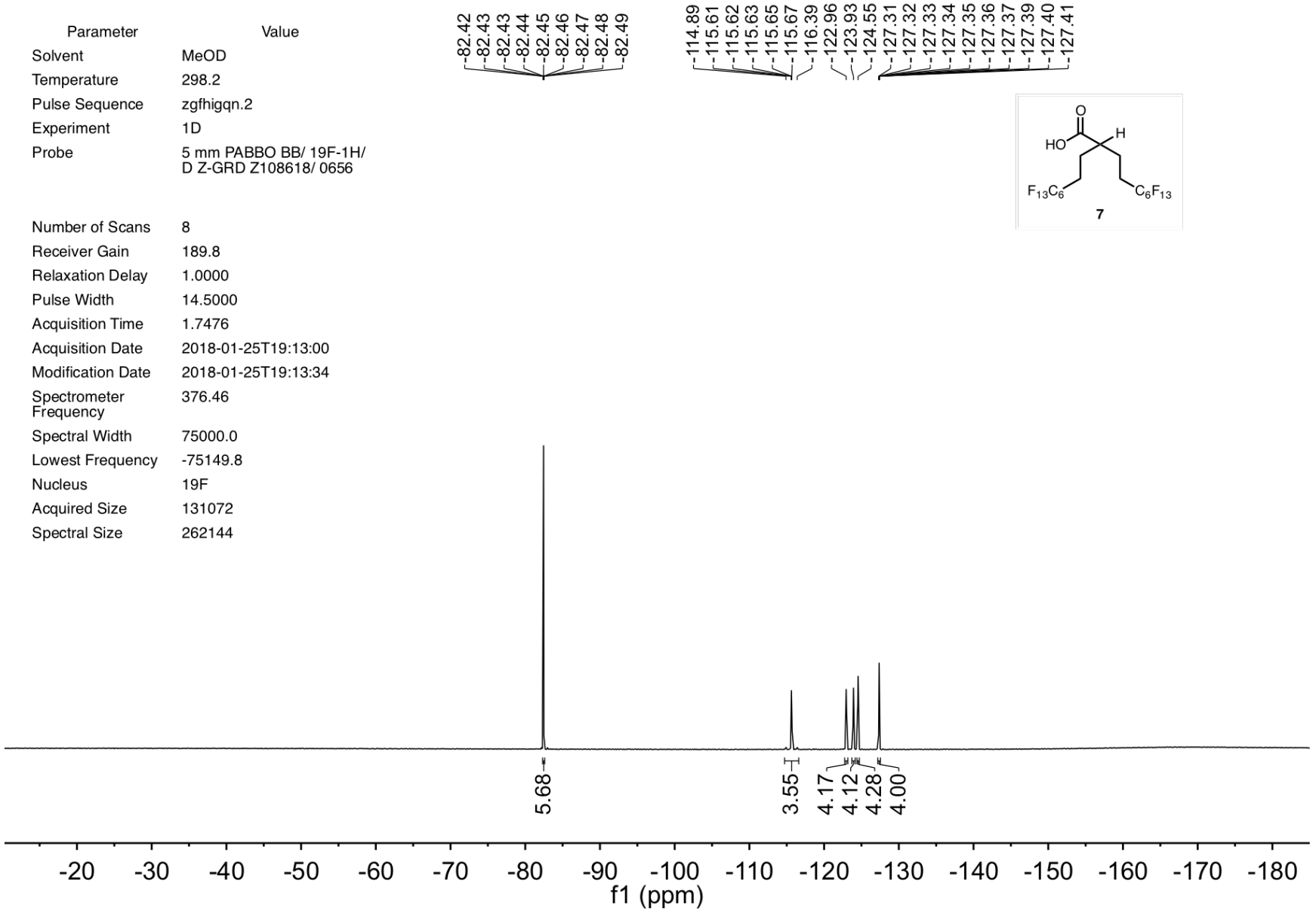
5



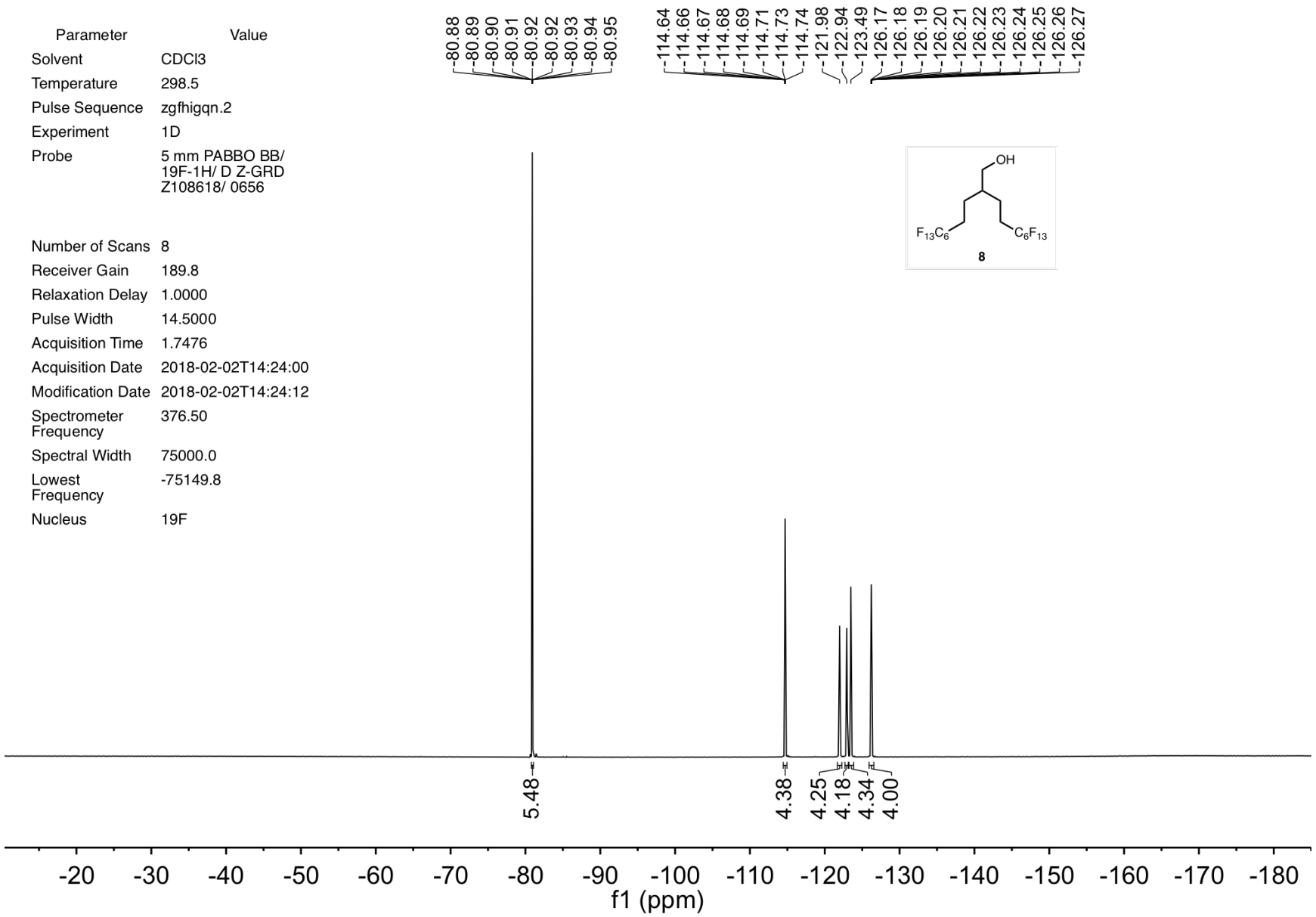
Parameter	Value
Solvent	CDCl3
Temperature	298.3
Pulse Sequence	zgfhigqn.2
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	16
Receiver Gain	189.8
Relaxation Delay	1.0000
Pulse Width	14.5000
Acquisition Time	1.7476
Acquisition Date	2018-09-14T01:46:00
Modification Date	2018-09-14T01:46:14
Spectrometer Frequency	376.50
Spectral Width	75000.0
Lowest Frequency	-75149.8
Nucleus	19F
Acquired Size	131072
Spectral Size	262144



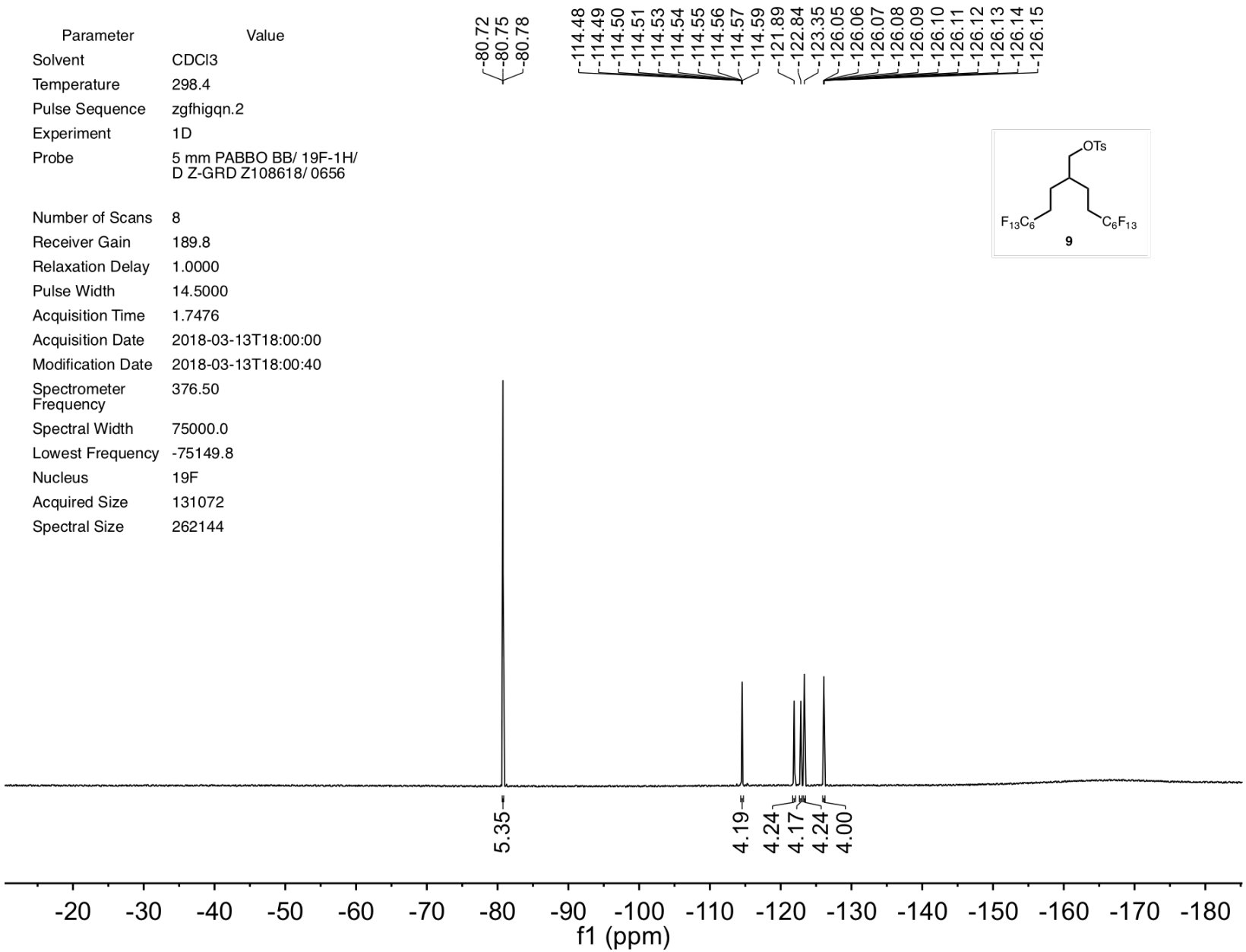
Parameter	Value
Solvent	MeOD
Temperature	298.2
Pulse Sequence	zgfhigqn.2
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	8
Receiver Gain	189.8
Relaxation Delay	1.0000
Pulse Width	14.5000
Acquisition Time	1.7476
Acquisition Date	2018-01-25T19:13:00
Modification Date	2018-01-25T19:13:34
Spectrometer Frequency	376.46
Spectral Width	75000.0
Lowest Frequency	-75149.8
Nucleus	19F
Acquired Size	131072
Spectral Size	262144



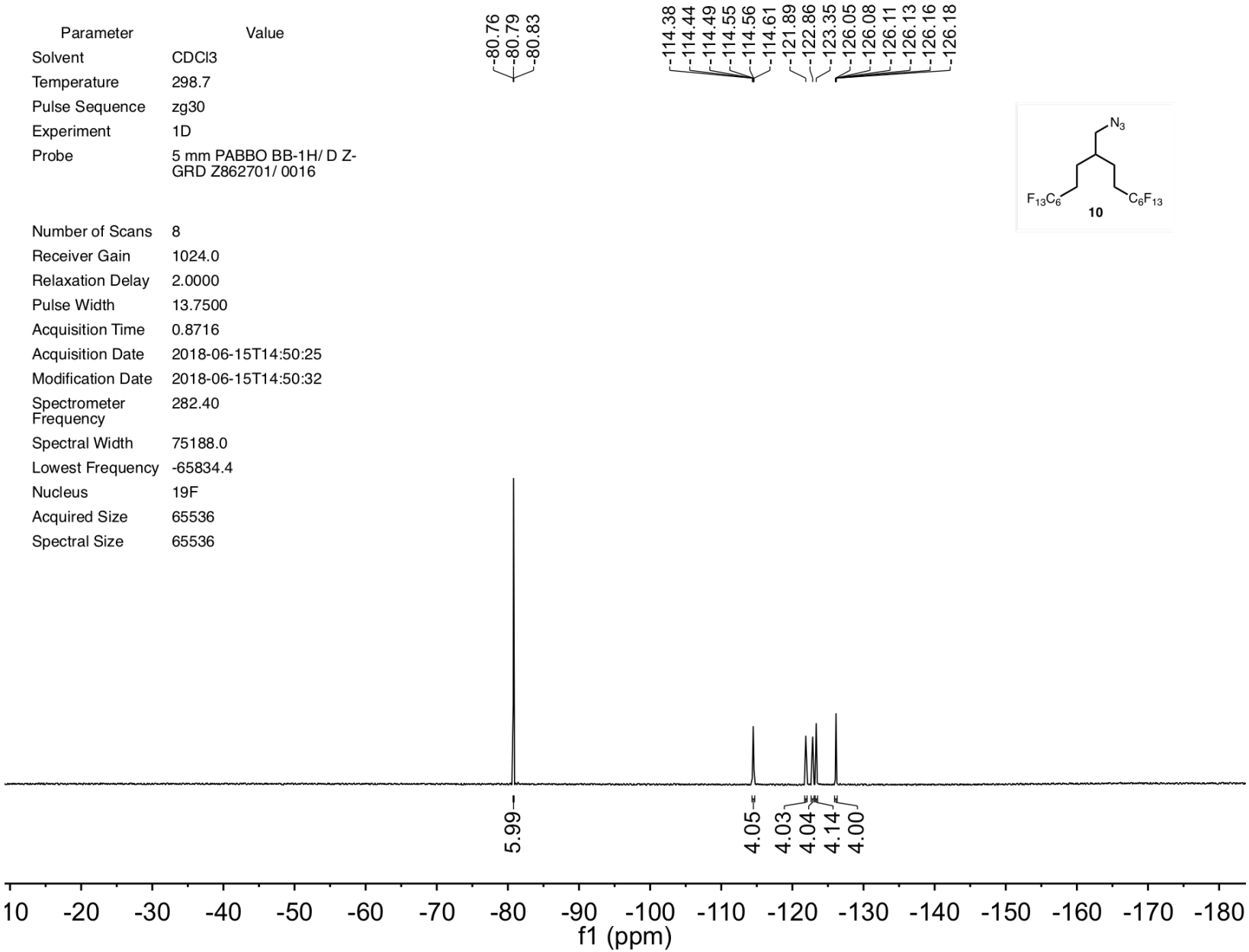
Parameter	Value
Solvent	CDCl3
Temperature	298.5
Pulse Sequence	zgfhigqn.2
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	8
Receiver Gain	189.8
Relaxation Delay	1.0000
Pulse Width	14.5000
Acquisition Time	1.7476
Acquisition Date	2018-02-02T14:24:00
Modification Date	2018-02-02T14:24:12
Spectrometer Frequency	376.50
Spectral Width	75000.0
Lowest Frequency	-75149.8
Nucleus	19F

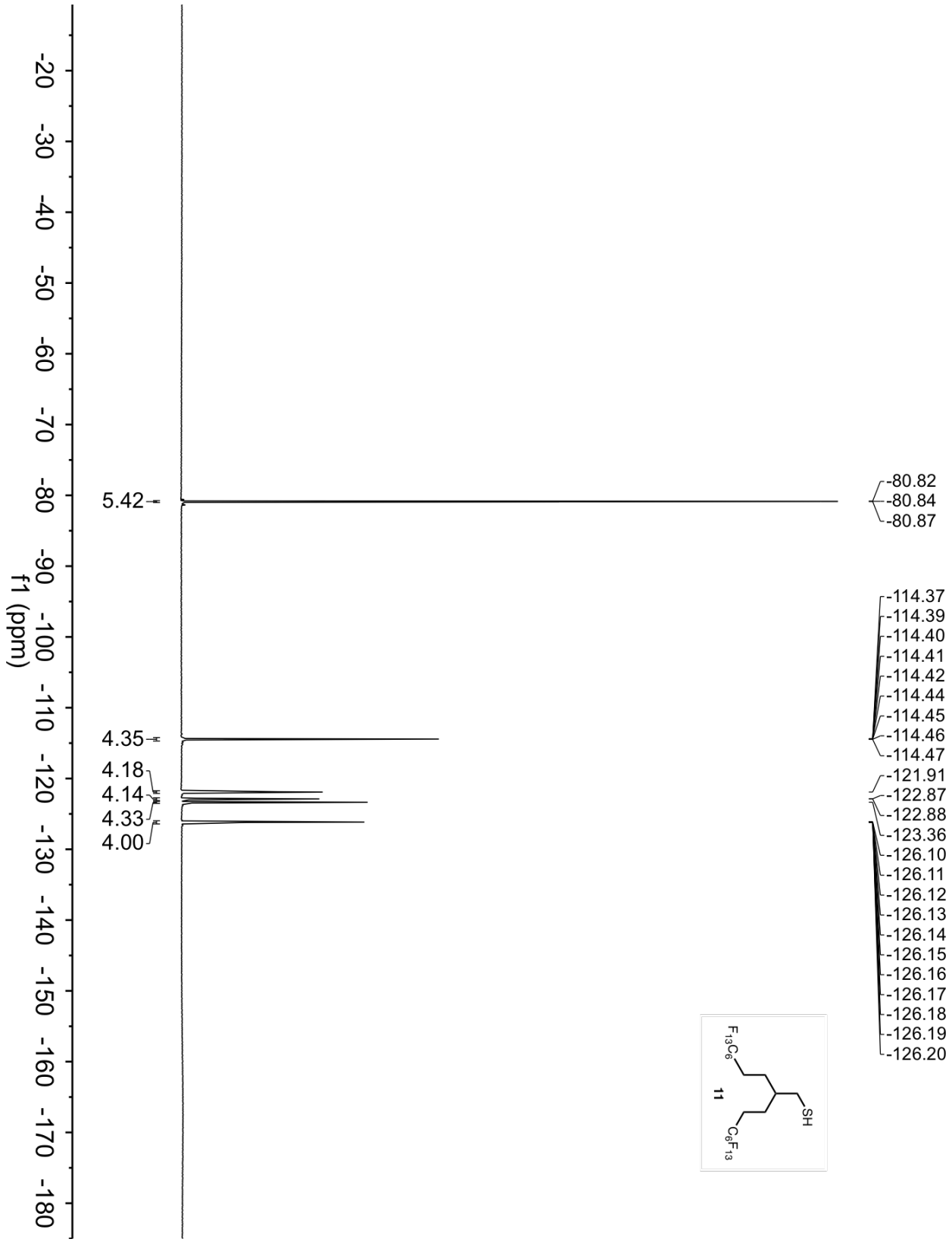


Parameter	Value
Solvent	CDCl3
Temperature	298.4
Pulse Sequence	zgfhigqn.2
Experiment	1D
Probe	5 mm PABBO BB/ 19F-1H/ D Z-GRD Z108618/ 0656
Number of Scans	8
Receiver Gain	189.8
Relaxation Delay	1.0000
Pulse Width	14.5000
Acquisition Time	1.7476
Acquisition Date	2018-03-13T18:00:00
Modification Date	2018-03-13T18:00:40
Spectrometer Frequency	376.50
Spectral Width	75000.0
Lowest Frequency	-75149.8
Nucleus	19F
Acquired Size	131072
Spectral Size	262144



Parameter	Value
Solvent	CDCl3
Temperature	298.7
Pulse Sequence	zg30
Experiment	1D
Probe	5 mm PABBO BB-1H/ D Z-GRD Z862701/ 0016
Number of Scans	8
Receiver Gain	1024.0
Relaxation Delay	2.0000
Pulse Width	13.7500
Acquisition Time	0.8716
Acquisition Date	2018-06-15T14:50:25
Modification Date	2018-06-15T14:50:32
Spectrometer Frequency	282.40
Spectral Width	75188.0
Lowest Frequency	-65834.4
Nucleus	19F
Acquired Size	65536
Spectral Size	65536




f1 (ppm)
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
5.42
4.35
4.18
4.14
4.33
4.00
-80.82
-80.84
-80.87
-114.37
-114.39
-114.40
-114.41
-114.42
-114.44
-114.45
-114.46
-114.47
-121.91
-122.87
-122.88
-123.36
-126.10
-126.11
-126.12
-126.13
-126.14
-126.15
-126.16
-126.17
-126.18
-126.19
-126.20
F13C6
11
SH
C6F13

-80.84
-80.87
-80.91
-114.15
-114.20
-114.26
-114.32
-114.38
-121.84
-122.88
-123.29
-126.12
-126.14
-126.17
-126.20
-126.23
-126.25
-126.26
-133.97
-134.01
-134.06
-134.10
-136.43
-136.47
-136.52
-136.56
21.01
15.64
16.40
16.29
15.23
16.00
8.09
8.03
f1 (ppm)
-20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
13