Supporting Information

Electrooxidative C–N Coupling of Seven-Membered Cyclic Sulfonylimines with Piperazines

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General information

Unless otherwise noted, materials were obtained from commercial suppliers and used without further purification. The instrument for electrolysis was dual display potentiostat (DJS-292B) (made in China). The anodic electrode was graphite rod (ϕ 6 mm) and cathodic electrode was platinum plate (15 mm×15 mm×0.3 mm). Thin layer chromatography (TLC) employed glass 0.25 mm silica gel plates. Flash chromatography columns were packed with 200-300 mesh silica gel in petroleum (boiling point was between 60-90 ^{o}C). Gradient flash chromatography was conducted eluting with a continuous gradient from petroleum to the indicated solvent, and they were listed as volume/volume ratios. NMR spectra were recorded on a Bruker spectrometer at 400 MHz (^{1}H NMR), 101 MHz (^{13}C NMR), 376 MHz (^{19}F NMR) , 600 MHz (^{1}H NMR), 151 MHz (^{13}C NMR), 565 MHz (^{19}F NMR) Chemical shifts were reported relative to tetramethylsilane, dimethyl sulfoxide (2.50 ppm for 1H, 39.6 ppm for 13C), deuterated chloroform (7.26 ppm for 1H, 77.16 ppm for 13C), deuterated methanol (3.31 ppm for ^{1}H, 49.0 ppm for ^{13}C) respectively. And all ^{1}H, ^{13}C and ^{19}F NMR data spectra were reported in delta (δ) units, parts per million (ppm) downfield from the internal standard. Coupling constants were reported in Hertz (Hz). The melting point of solid compounds is measured by SGW X-5 melting point apparatus with microscope (Shanghai INESA Physico optiacal instrument Co., Ltd). LC-MS spectra were recorded on a AB SCIEX TripleTOF 5600^{+}. Fluorescence measurements were performed on a BioTek Synergy H1 microplate reader (Winooski, VT, USA). Real-Time PCR Thermal Cycler were performed on ANALYTIKJENA qTOWER3 G (Germany).

Experimental procedure

General procedure for the preparation of 3:

In an oven-dried undivided three-necked bottle (20 mL) equipped with a stir bar, seven-membered cyclic *N*-sulfonylimine **1** (0.75 mmol), piperazines **2** (0.5 mmol), KI (0.50 mmol, 83.0 mg), MeCN (11 mL) was added. The bottle was equipped with graphite rod (ϕ 6 mm, about 15 mm immersion depth in solution) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a constant current of 3 mA under Ar atmosphere at room temperature for 20 h. After completion of the reaction, as indicated by TLC and LC-MS, the crude mixture product was obtained by flash column chromatography on silica gel (petroleum ether: ethyl acetate = 1: 5).

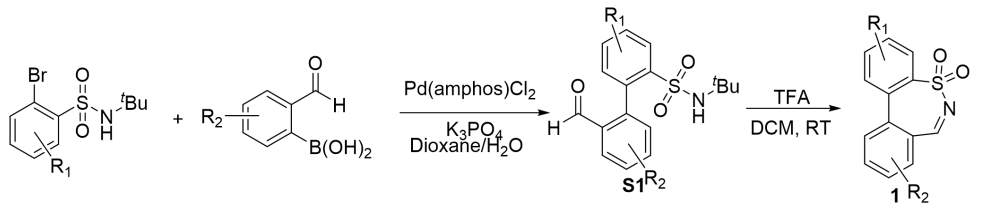
A **B** **C**

Fig. S1 The experimental setup for electrolysis. (**A**: The electrodes used in the reaction. **B** and **C**: The electrochemical reaction apparatus used.)

Procedure for gram scale synthesis of 3a:

In an oven-dried undivided three-necked bottle (120 mL) equipped with a stir bar, seven-membered cyclic *N*-sulfonylimine **1** (7.5 mmol, 1.82 g), methylpiperazin **2** (5 mmol, 0.50 g), KI (5 mmol, 0.83 g), MeCN (100 mL) was added. The bottle was equipped with graphite rod (ϕ 6 mm, about 15 mm immersion depth in solution) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a constant current of 3 mA under Ar atmosphere at room temperature for 200 h. After completion of the reaction, as indicated by TLC and LC-MS, the crude mixture product was obtained by flash column chromatography on silica gel (petroleum ether: ethyl acetate = 1: 5).

General procedure for the preparation of 1



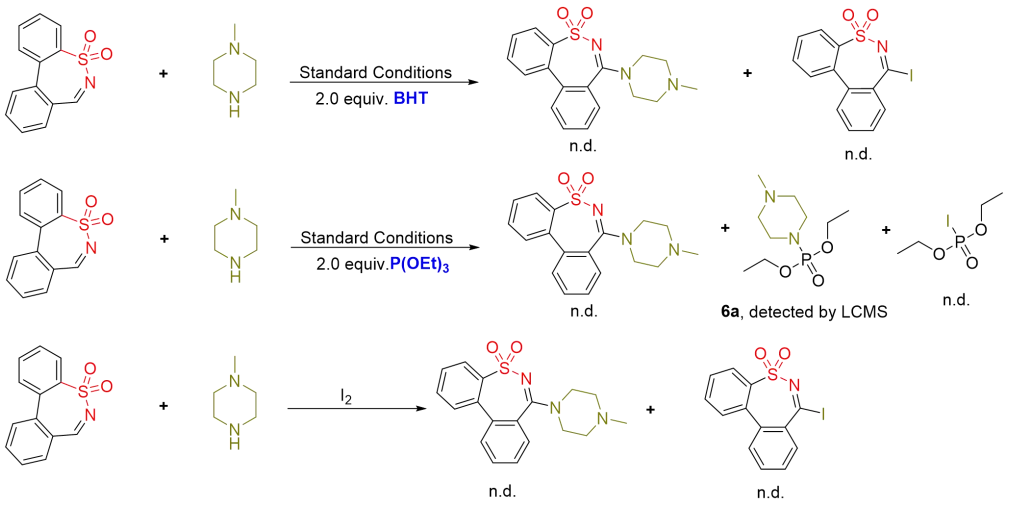
Scheme S1. Seven-membered cyclic *N*-sulfonylimine **1** were conveniently prepared from readily available 2-bromobenzenesulfonamide and 2-formylbenzeneboronic acid, following a slightly modified literature procedure. [1-3]

Step 1: 2-Formylbenzeneboronic acid (20 mmol), Pd(amphos)Cl_2 (0.3 mmol), 2-bromo-*N*-(tert-butyl)benzenesulfonamide (10.0 mmol), and potassium phosphate (30.0 mmol) were combined in 1,4-dioxane (50 mL) and water (30 mL). The mixture was stirred under reflux for 16 h, then cooled to room temperature. The solvent was removed under reduced pressure, and the residue was diluted with water (10 mL) and extracted with dichloromethane (3 × 30 mL). The combined organic layers were dried over anhydrous sodium sulfate. After filtration, the solvent was concentrated in vacuo, and the residue was purified by flash chromatography to afford product **S1**.

Step 2: Subsequently, the obtained product **S1** (3.0 mmol) was dissolved in dichloromethane (45 mL), and trifluoroacetic acid (7 mL per gram of coupling product) was added. The mixture was stirred at room temperature for 20 min, then adjusted to pH 7 with saturated aqueous sodium bicarbonate solution. The organic layer was separated, and the aqueous layer was extracted with dichloromethane (3 × 30 mL). The combined organic layers were dried over anhydrous sodium sulfate. After filtration, the solvent was removed under reduced pressure, and the crude product was recrystallized from ethyl acetate to afford the cyclic *N*-sulfonylimine **1**.

Mechanism research

In an effort to elucidate the underlying reaction mechanism, we conducted control experiments and cyclic voltammetry (CV) studies. The addition of stoichiometric amounts of the radical scavenger butylated hydroxytoluene (BHT, 2.05 V vs. Ag|AgCl) significantly suppressed the reaction, suggesting the involvement of radical intermediates. When I_2 was employed as the oxidant, no desired product was formed, indicating that the oxidative pathway does not proceed under these conditions. To further verify our proposed mechanism, we conducted radical trapping experiments using triethyl phosphite as a radical scavenger. Notably, the piperazine-derived radical was successfully captured and detected, providing direct evidence for the involvement of a piperazine radical intermediate in the reaction pathway. In contrast, no iodine radical species were detected under the same conditions.



Scheme S2. Control experiments.

To elucidate the mechanism, cyclic voltammetry was performed (see Fig. 2 and Fig. 3). KI exhibited two oxidation peaks at 1.00 V and 1.25 V, corresponding to stepwise I^- to I^+ oxidation. Piperazine alone showed no oxidation below 3.0 V; however, upon addition to KI, a new peak emerged at 1.88 V, suggesting iodide-facilitated activation of piperazine. In contrast, sulfonylimine **1a** displayed an oxidation wave at 2.65 V when measured alone, which remained essentially unchanged (2.78 V) in the presence of KI, indicating that **1a** is not electrochemically activated by iodide and serves solely as an electrophile. These results support a mechanism wherein iodide is preferentially oxidized to generate I^+ species that activate piperazine, while **1a** does not directly participate in the electrode process.

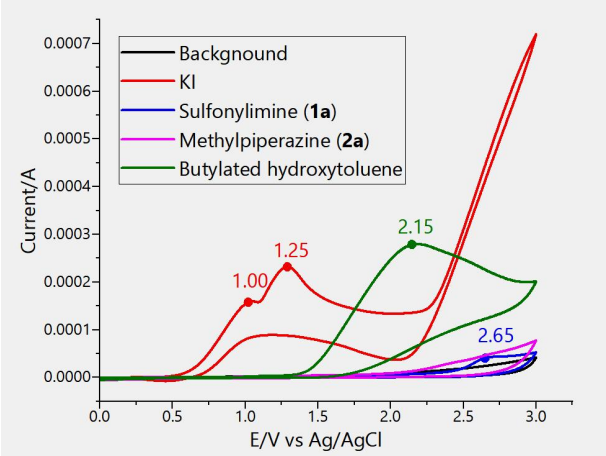


Fig. S2 CVs obtained in MeCN with 0.01 M ^{n}Bu$_4$NBF$_4$, the scan rate is 0.1 V/s, ranging from 0 V to 3.0 V. The working electrode was a glassy carbon electrode,the counter electrode a platinum wire. The reference was an Ag|AgCl electrode submerged in saturated aqueous KCl solution.

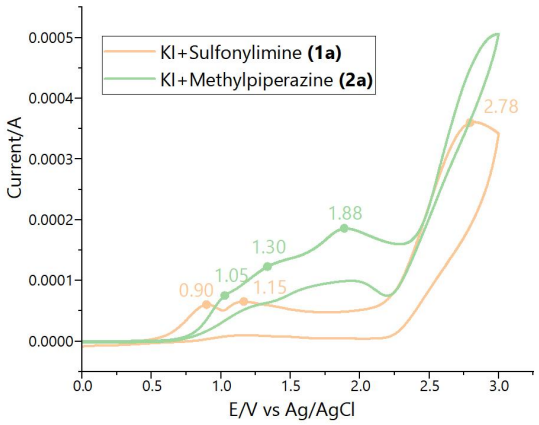


Fig. S3 CVs obtained in MeCN with 0.01 M $^{n}Bu_4NBF_4$, the scan rate is 0.1 V/s, ranging from 0 V to 3.0 V. The working electrode was a glassy carbon electrode,the counter electrode a platinum wire. The reference was an Ag|AgCl electrode submerged in saturated aqueous KCl solution.

To gain further insight into the electrocatalytic process, cyclic voltammetry was performed. In accordance with the IUPAC convention (anodic current plotted positively), all cyclic voltammetry measurements were performed using a CHI760E electrochemical workstation (CH Instruments, Shanghai). Prior to use, both electrodes were polished sequentially with 0.05 μm alu-mina slurries on a microcloth pad, followed by thorough rinsing with deionized water. Cyclic voltammetry was performed in a three-electrode cell connected to a schlenk line under air at room temperature. The working electrode was a glassy carbon electrode, the counter electrode a platinum wire. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution. The specification of the glassy carbon electrode : the length of the electrode tail is 3mm, art.No. GSRL-GZDJ-09 and the manufacturer is Gaossunion (Tian jin, People's Republic of China, this product is imported from Japan). The specification of the platinum wire: the size of the platinum wire is 1mm*5mm, art.No. GSRL-FZDJ002 and the manufacturer is Gaossunion (Tian jin, People's Republic of China) . The specification of the Silver / Silver chloride (Ag/AgCl) reference electrode: the length of the electrode glass tube is 60 mm, with a diameter of 3.8 mm; the length of thepolytetrafluoroethylene (PTFE) housing is 20 mm, with a diameter of 6 mm; the length of the electrode tail is 15 mm, art.No. RE-AgCl-1038 and the manufacturer is Gaossunion (Tian jin, People's Republic of China). 10 mL of CH_3CN containing 0.01 M $^{n}Bu_4NBF_4$ were poured into the electrochemical cell in all experiments. The scan rate is 0.1 V/s, ranging from 0 V to 3.0 V. The peak potentials vs. Ag/AgCl for used.

Procedure for anti-inflammatory effects of compounds:

Experimental results are expressed as mean ± standard deviation (SD). Statistical analyses were conducted using GraphPad version 9.5 software. For comparisons among multiple groups (exceeding two), a one-way analysis of variance (ANOVA) was employed, supplemented by Dunnett's test for multiple comparisons. A p-value $\leqslant 0.05$ was considered statistically significant.

Cell Counting Kit-8(CCK-8) assay for cytotoxicity

The effects of seven-membered ring sulfonamide derivatives containing piperazine on the viability of RAW264.7 cells were evaluated by CCK-8 assay.Calculate cell viability according to the formula: Cell Viability (%) = (OD of treatment group / OD of blank control group) × 100%.

Table **S1** Relative cell viability (%) of compound **3a-3zf** on CCK-8 kitat a concentration of 40 μM

Compound	cell viability (mean±SD)	Compound	cell viability (mean±SD)	Compound	cell viability (mean±SD)
con	100.0±2.641	**3k**	97.26±5.26	**3v**	102.4±1.735
3a	89.46±2.738**	**3l**	95.31±0.848	**3w**	103.1±5.629
3b	102.5±7.189	**3m**	91.39±4.802	**3x**	108.1±0.8234
3c	107.9±5.759	**3n**	95.55±3.384	**3y**	98.49±1.581
3d	98.24±4.669	**3o**	93.71±2.774	**3z**	90.68±2.066*
3e	107.0±3.398	**3p**	85.34±2.118	**3za**	111.4±4.033
3f	99.07±3.378	**3q**	96.27±2.403	**3zb**	86.29±3.653***
3g	102.6±7.456	**3r**	114.1±6.407	**3zc**	103.4±4.006
3h	89.97±6.223	**3s**	79.86±11.24*	**3zd**	73.33±7.966****
3i	96.8±6.115	**3t**	92.98±2.522	**3ze**	95.95±7.124
3j	102.3±4.158	**3u**	111.6±3.904	**3zf**	98.71±4.624

Nitric oxide (NO) production measurement

NO production in cells was measured by the Griess method, as indicated on the NO assay kit (Beyotime Biotech Inc., Jiangsu, China.).

Table **S2** Relative NO release (%) of compound **3a-3zf** on NO kit at a concentration of 40 μM

Compound	NO Release (mean±SD)	Compound	NO Release (mean±SD)	Compound	NO Release (mean±SD)
Con	21.86±1.186	**3j**	73.47±8.892***	**3v**	65.31±3.539***
LPS	100.0±1.657###	**3k**	65.31±2.04***	**3w**	72.33±0.306***
DEX	65.25±0.7101***	**3l**	95.89±1.440	**3x**	61.70±0.2367***
3a	94.94±1.707	**3m**	90.37±0.525	**3y**	99.48±0.306
3b	84.27±0.626***	**3n**	53.69±0.346***	**3z**	63.61±1.085***
3c	89.74±1.713***	**3o**	95.35±0.626	**3za**	52.12±0.710***
3d	54.42±7.729***	**3p**	97.55±1.092	**3zb**	90.84±0.236***
3e	77.84±0.631***	**3q**	99.32±0.820	**3zc**	76.36±0.236***
3f	69.50±0.236***	**3r**	81.12±1.318***	**3zd**	55.26±0.236***
3g	90.72±0.606***	**3s**	26.13±0.242***	**3ze**	67.35±4.08***
3h	31.29±3.116***	**3t**	61.15±0.710***	**3zf**	85.03±3.121***
3i	7.48±2.356***	**3u**	52.69±1.195***		

Quantitative Real-Time Polymerase Chain Reaction (qPCR) Analysis

Total RNA was extracted from cells and tissues by means of an RNA extraction kit. RNA was reverse-transcribed to cDNA with the aid of the Evo M-MLV Reverse Transcriptase Premix Kit. qPCR reactions were carried out using the SYBR Green Pro Taq HS Premix qPCR Kit.

Table **S3** Relative mRNA expression of compound **3n, 3t, 3x, 3z, 3za** at a concentration of 40 μM

Compound	**Relative *Il6* mRNA expression (mean±SD) (pg/mL)**	**Relative *Il1b* mRNA expression (mean±SD) (pg/mL)**
Con	1.105±0.6644	1.007±0.1520
LPS	4873±669.3$^{###}$	532.5±20.65$^{###}$
DEX	4039±182.0	269.3±3.244***
3n	4048±688.6	362.4±25.73***
3t	1420±166.2***	227.4±18.14***
3x	686.5±34.63***	47.14±3.308***
3z	2482±267.3***	138.1±26.38***
3za	6105±797.4	78.51±5.723***

Table **S4** Relative mRNA expression of compound **3d, 3h, 3i, 3u** at a concentration of 40 μM

Compound	**Relative *Il6* mRNA expression (mean±SD) (pg/mL)**	**Relative *Il1b* mRNA expression (mean±SD) (pg/mL)**
Con	1.073±0.4910	1.426±1.495
LPS	628.6±45.81$^{###}$	42.72±0.6144$^{###}$
DEX	110.8±14.09***	14.23±1.759
3d	453.7±31.39***	62.11±1.144
3h	323.3±7.857***	26.76±3.600***
3i	689.9±12.05	19.41±1.169***
3u	526.8±25.88***	33.70±3.348***

Products that failed to obtain NMR verification

We also obtained a portion of compounds that were not eligible for nuclear magnetic resonance (NMR) analysis. The main reason is that these compounds are very poor solubility in a variety of deuterated reagents.

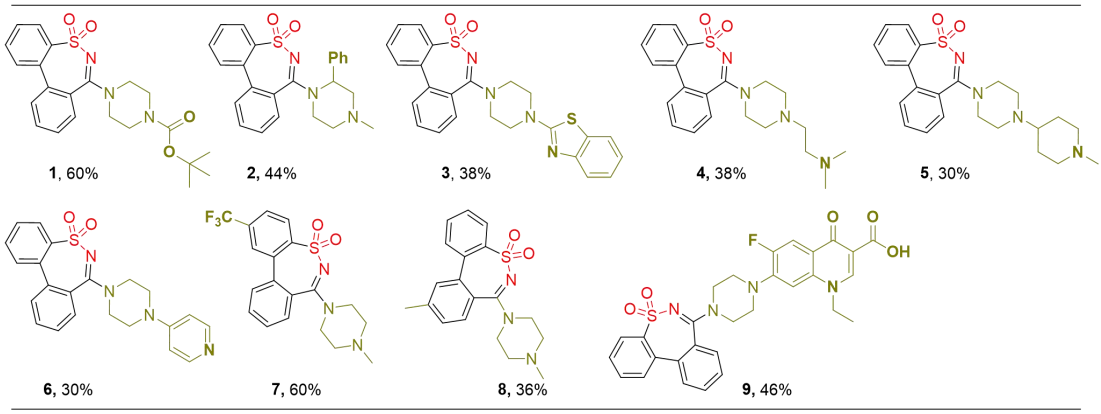


Fig. S4 Extended unacquired NMR data substrate

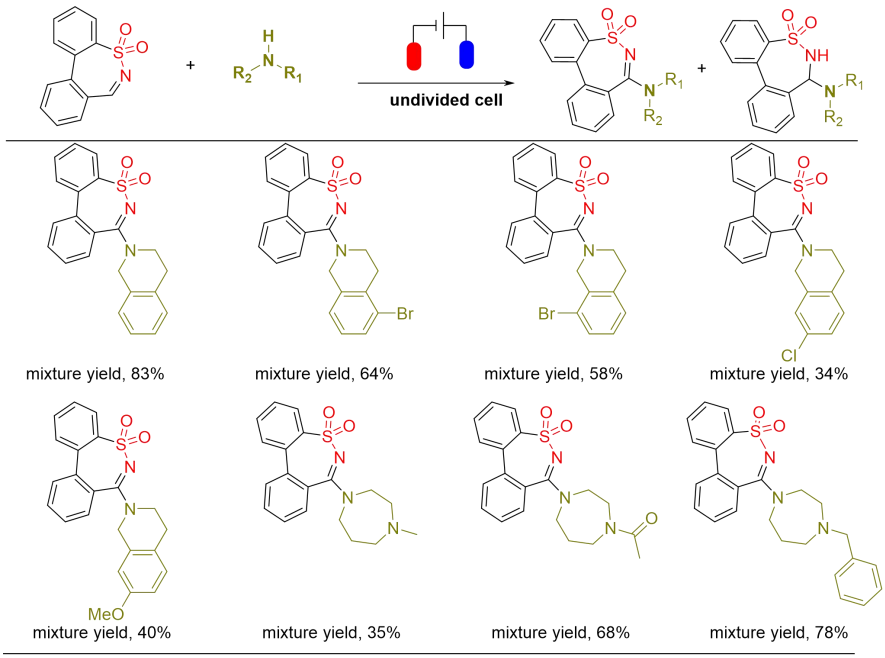
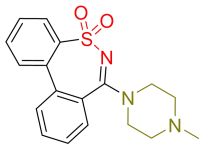


Fig. S5 Mixture

References

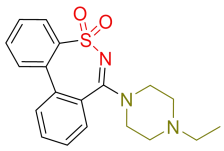
1. Burlein, C.; Wang, C.; Xu, M.; Bhatt, T.; Stahlhut, M.; Ou, Y.; Adam, G. C.; Heath, J.; Klein, D. J.; Sanders, J.; Narayan, K.; Abeywickrema, P.; Heo, M. R.; Carroll, S. S.; Grobler, J. A.; Sharma, S.; Diamond, T. L.; Converso, A.; Krosky, D. J. *ACS Chem. Biol.*, **2017**, *12*, 2858.
2. France, S. P.; Aleku, G. A.; Sharma, M.; Mangas-Sanchez, J.; Howard, R. M.; Steflik, J.; Kumar, R.; Adams, R. W.; Slabu, I.; Crook, R.; Grogan, G.; Wallace, T. W.; Turner, N. J. *Angew. Chem. Int. Ed.*, **2017**, 56, 15589.
3. Ni, C.; Zha, D.; Ye, H.; Hai, Y.; Zhou, Y.; Anslyn, E. V.; You, L. *Angew. Chem. Int. Ed.*, **2018**, *57*, 1300.

Detail descriptions for products



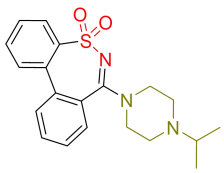
7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3a). (White solid was obtained in 92% isolated yield, 156.8 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, J = 8.0 Hz, 1H), 7.67-7.60 (m, 4H), 7.54-7.44 (m, 3H), 3.99-3.83 (m, 2H), 3.57-3.52 (m, 1H), 3.26-3.21 (m, 1H), 2.49-2.38 (m, 3H), 2.26 (s, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.24, 144.04, 139.46, 135.47, 132.12, 131.57, 131.04, 129.93, 129.78, 129.12, 128.48, 127.91, 125.86, 55.22, 54.21, 49.70, 45.66, 45.56.

HRMS (ESI) calcd for $C_{18}H_{19}N_3O_2S$: 342.1271 ($M+H^+$), found: 342.1274.



7-(4-ethylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3b). (White solid was obtained in 83% isolated yield, 147.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.67-7.62 (m, 4H), 7.55-7.45 (m, 3H), 4.02-3.83 (m, 2H), 3.59-3.54 (m, 1H), 3.28-3.23 (m, 1H), 2.56-2.42 (m, 5H), 2.35-2.30 (m, 1H), 1.06 (t, J = 8.0 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 160.35, 139.37, 134.81, 130.73, 127.28, 126.78, 126.33, 125.24, 124.94, 124.37, 123.76, 123.09, 121.23, 48.35, 47.24, 47.19, 44.99, 40.90, 7.12.

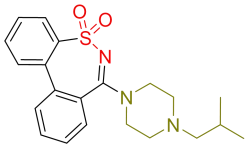
HRMS (ESI) calcd for $C_{19}H_{21}N_3O_2S$: 356.1427 ($M+H^+$), found: 356.1430.



7-(4-isopropylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3c). (White solid was obtained in 72% isolated yield, 133.1 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, J = 8.0 Hz, 1H), 7.68-7.60 (m, 4H), 7.55-7.47 (m, 3H), 4.03-3.98 (m, 1H), 3.88-3.83 (m, 1H), 3.60-3.55 (m, 1H), 3.29-3.25 (m, 1H), 2.80-2.75 (m, 1H), 2.64-2.62 (m, 3H), 2.46-2.40 (m, 1H),1.02 (d, J = 4.0 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.07, 143.95, 139.43, 135.46, 132.18, 131.59, 131.03,

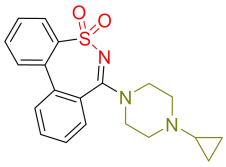
129.87, 129.82, 129.21, 128.52, 127.94, 125.81, 54.87, 49.61, 48.90, 47.84, 45.45, 18.20.

HRMS (ESI) calcd for $C_{20}H_{23}N_3O_2S$: 370.1584 ($M+H^+$), found: 370.1577.



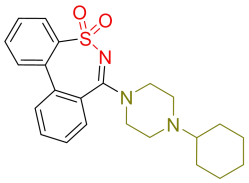
7-(4-isobutylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3d). (White solid was obtained in 82% isolated yield, 156.9 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.91 (d, J = 12.0 Hz, 1H), 7.82 (d, J = 6.0 Hz, 1H), 7.74 (t, J = 12.0 Hz, 3H), 7.63-7.58 (m, 3H), 3.83 (s, 2H), 3.49-3.46 (m, 1H), 3.23-3.16 (m, 1H), 2.48-2.43 (m, 2H), 2.31 (s, 1H), 2.10-2.01(m, 3H), 1.70 (s, 1H), 0.83 (s, 6H). ^{13}C NMR (151 MHz, DMSO-d_6)) δ 164.64, 144.27, 139.08, 135.62, 132.86, 131.91, 131.13, 130.69, 130.24, 129.75, 129.08, 128.40, 125.11, 65.99, 53.70, 52.68, 49.87, 45.65, 25.24, 21.11.

HRMS (ESI) calcd for $C_{21}H_{25}N_3O_2S$: 384.1740 ($M+H^+$), found: 384.1741.



7-(4-cyclopropylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3e). (White solid was obtained in 55% isolated yield, 100.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.68-7.62 (m, 4H), 7.55-7.46 (m, 3H), 3.97-3.79 (m, 2H), 3.52-3.47 (m, 1H), 3.21-3.17 (m, 1H), 2.68-2.61 (m, 3H), 2.49-2.43 (m, 1H), 1.63 (s, 1H), 0.46-0.40 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.13, 144.11, 139.52, 135.50, 132.05, 131.53, 131.07, 130.03, 129.70, 129.13, 128.50, 127.85, 125.95, 53.51, 52.46, 49.75, 45.66, 38.00, 5.91.

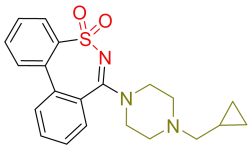
HRMS (ESI) calcd for $C_{20}H_{21}N_3O_2S$: 368.1427($M+H^+$), found: 368.1430.



7-(4-cyclohexylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3f). (White solid was obtained in 73% isolated yield, 149.6 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.67-7.61 (m, 4H), 7.55-7.44 (m, 3H), 4.04-3.82 (m, 2H), 3.57-3.52 (m, 1H), 3.22-3.19 (m, 1H), 2.62-2.57 (m, 3H), 2.44-2.39 (m, 1H), 2.29-2.24 (m, 1H), 1.79-1.76 (m, 4H), 1.32-1.06 (m, 5H),

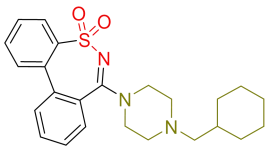
0.94-0.86 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.90, 144.15, 139.55, 135.50, 131.97, 131.46, 131.05, 130.03, 129.66, 129.17, 128.48, 127.78, 125.97, 63.36, 50.21, 49.47, 48.37, 46.09, 28.84 (d, J = 3.0 Hz), 26.12, 25.67.

HRMS (ESI) calcd for $C_{23}H_{27}N_3O_2S$: 410.1897 ($M+H^+$), found: 410.1901.



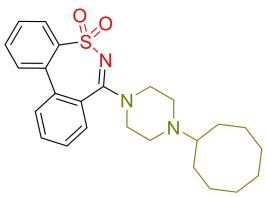
7-(4-(cyclopropylmethyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3g). (White solid was obtained in 46% isolated yield, 88.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.67-7.62 (m, 4H), 7.55-7.45 (m, 3H), 4.02-3.86 (m, 2H), 3.61-3.55 (m, 1H), 3.29-3.25 (m, 1H), 2.61-2.53 (m, 3H), 2.43-2.38 (m, 1H), 2.26 (d, J = 8.0 Hz, 2H), 0.88-0.79 (m,1H), 0. 51(d, J = 8.0 Hz, 2H) , 0.08 (d, J = 8.0 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.09, 144.10, 139.54, 135.48, 132.04, 131.53, 131.08, 129.98, 129.70, 129.14, 128.51, 127.87, 125.97, 63.13, 53.38, 52.38, 49.69, 45.57, 8.10, 3.94, 3.88.

HRMS (ESI) calcd for $C_{21}H_{23}N_3O_2S$: 382.1584 ($M+H^+$), found: 382.1581.



7-(4-(cyclohexylmethyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3h). (White solid was obtained in 76% isolated yield, 160.8 mg). ^{1}H NMR (600 Mz, DMSO-d_6) δ 7.91 (d, J = 6.0 Hz, 1H), 7.83 (d, J = 6.0 Hz, 1H), 7.76-7.71 (m, 3H), 7.63-7.58 (m, 3H), 3.81-3.75 (m, 2H), 3.48-3.45 (m, 1H), 3.18-3.14 (m, 1H), 2.48-2.43 (m, 2H), 2.32-2.29 (m, 1H), 2.12-2.04 (m, 3H), 1.70-1.61 (m, 5H), 1.44-1.41 (m, 1H), 1.18-1.09 (m, 3H), 0.81 (d, J = 12.0 Hz, 2H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.61, 144.27, 139.09, 135.63, 132.86, 131.90, 131.13, 130.68, 130.24, 129.75, 129.07, 128.38, 125.11, 64.66, 53.84, 52.74, 49.85, 45.65, 34.72, 31.63, 26.79, 25.94.

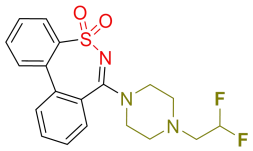
HRMS (ESI) calcd for $C_{24}H_{29}N_3O_2S$: 424.2053 ($M+H^+$), found: 424.2056.



7-(4-(cyclooctylmethyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3i). (White

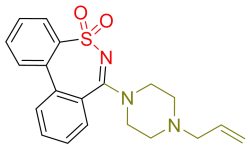
solid was obtained in 47% isolated yield, 102.5 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.90 (d, J = 6.0 Hz, 1H), 7.83 (d, J = 6.0 Hz, 1H), 7.76-7.71 (m, 3H), 7.64-7.58 (m, 3H), 3.82-3.79 (m, 1H), 3.71-3.67 (m, 1H), 3.45-3.43 (m, 1H), 3.13-3.10 (m, 1H), 2.59-2.52 (m, 3H), 2.44-2.41 (m, 1H), 2.24-2.21 (m, 1H), 1.63-1.61 (m, 5H), 1.53-1.52 (m, 3H), 1.42-1.35 (m, 8H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.65, 144.31, 139.07, 135.64, 132.83, 131.86, 131.09, 130.68, 130.29, 129.83, 129.05, 128.38, 125.09, 63.22, 50.37, 49.00, 47.87, 46.16, 29.14, 29.08, 26.73, 26.35, 25.32, 25.26.

HRMS (ESI) calcd for $C_{25}H_{31}N_3O_2S$: 438.2210 ($M+H^+$), found: 438.2212.



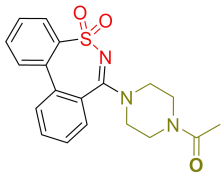
7-(4-(2,2-difluoroethyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3j). (White solid was obtained in 56% isolated yield, 110.2 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.91 (d, J = 12.0 Hz, 1H), 7.84 (d, J = 6.0 Hz, 1H), 7.77-7.72 (m, 3H), 7.64-7.58 (m, 3H), 6.21-6.01 (m, 1H), 3.85-3.82 (m, 1H), 3.77-3.74 (m, 1H), 3.50-3.46 (m, 1H), 3.20-3.17 (m, 1H), 2.78-2.66 (m, 4H), 2.58-2.55 (m, 1H), 2.38-2.35 (m, 1H). ^{13}C NMR (151 MHz, DMSO) δ 164.80, 144.21, 139.12, 135.62, 132.92, 131.98, 131.18, 130.74, 130.12, 129.78, 129.11, 128.42, 125.14, 116.15 (t, J = 240.1 Hz), 58.82, 53.54, 52.65, 49.64, 45.44. ^{19}F NMR (565 MHz, DMSO-d_6) δ -118.87, (dt, J =11.3, 56.5)

HRMS (ESI) calcd for $C_{19}H_{19}F_2N_3O_2S$: 392.1239 ($M+H^+$), found: 392.1238.



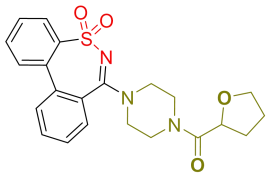
7-(4-allylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3k). (White solid was obtained in 53% isolated yield, 97.5 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.93 (d, J = 6.0 Hz, 1H), 7.83 (d, J = 6.0 Hz, 1H), 7.76-7.71 (m, 3H), 7.63-7.57 (m, 3H), 5.80-5.73 (m, 1H), 5.17-5.10 (m, 2H), 3.84-3.73 (m, 2H), 3.50-3.46 (m, 1H), 3.23-3.15 (m, 1H), 2.93 (d, J = 12.0 Hz, 2H), 2.51-2.46 (m, 2H), 2.38-2.35 (m, 1H), 2.18-2.16 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.82, 144.28, 139.10, 135.64, 135.32, 132.87, 131.92, 131.13, 130.69, 130.24, 129.77, 129.07, 128.42, 125.14, 118.80, 60.61, 52.97, 52.04, 49.81, 45.59.

HRMS (ESI) calcd for $C_{20}H_{21}N_3O_2S$: 368.1427 ($M+H^+$), found: 368.1429.



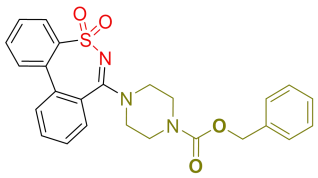
1-(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazin-1-yl)ethan-1-one (3l). (White solid was obtained in 72% isolated yield, 132.9 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.70-7.65 (m, 4H), 7.58-7.47 (m, 3H), 3.98-3.85 (m, 2H), 3.73-3.65 (m, 1H), 3.59-3.46 (m, 3H), 3.35-3.22 (m, 2H), 2.10 (s, 2H), 2.03 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.42, 165.86, 143.81, 139.63, 135.34, 132.35, 131.94, 131.24, 129.91, 129.56, 129.05, 128.68, 128.15, 126.02, 49.46, 45.68, 45.10, 41.62, 21.30.

HRMS (ESI) calcd for $C_{19}H_{19}N_3O_3S$: 370.1220 ($M+H^+$), found: 370.1217.



(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazin-1-yl)(tetrahydrofuran-2-yl) meth anone (3m). (White solid was obtained in 46% isolated yield, 98.2 mg). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.91 (d, J = 8.0 Hz, 1H), 7.84 (d, J = 4.0 Hz, 1H), 7.78-7.71 (m, 4H), 7.64-7.57 (m, 2H), 4.70-4.55 (m, 1H), 3.99-3.86 (m, 1H), 3.77-3.63 (m, 5H), 3.57-3.45 (m, 3H), 3.22-3.12 (m, 1H), 2.04-1.98 (m, 2H), 1.83-1.75 (m, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 170.26, 165.21, 144.08, 139.13, 135.64, 132.98, 132.09, 131.23, 130.86, 129.93, 129.14, 128.43, 125.17, 75.31, 68.69, 49.62, 45.88, 45.40, 41.87, 28.48, 25.67.

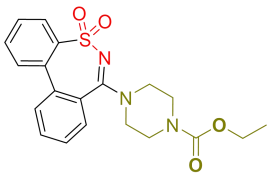
HRMS (ESI) calcd for $C_{22}H_{23}N_3O_4S$:426.1482 ($M+H^+$), found: 426.1474.



benzyl 4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazine-1-carboxylate (3n). (White solid was obtained in 91% isolated yield, 210.1 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, J = 8.0 Hz, 1H), 7.66-7.62 (m, 4H), 7.56-7.44 (m, 3H), 7.32 (s, 5H), 5.11 (s, 2H), 3.88-3.84 (m, 2H), 3.59-3.48 (m, 4H), 3.30-3.22 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.77, 154.99, 143.90,

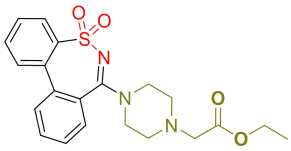
139.62, 136.15, 135.33, 132.26, 131.83, 131.20, 129.80, 129.72, 129.02, 128.66, 128.60, 128.30, 128.06, 126.08, 67.63, 49.47, 45.54, 44.09, 42.96.

HRMS (ESI) calcd for $C_{25}H_{23}N_3O_4S$: 462.1482 ($M+H^+$), found: 462.1489.



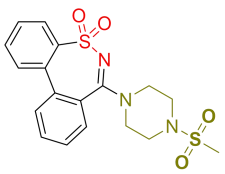
ethyl 4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazine-1-carboxylate (3o). (White solid was obtained in 89% isolated yield, 177.3 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, J = 8.0 Hz, 1H), 7.68-7.64 (m, 4H), 7.57-7.50 (m, 2H), 7.46 (d, J = 8.0 Hz, 1H), 4.16-4.11 (m, 2H), 3.90-3.87 (m, 2H), 3.56-3.49 (m, 4H), 3.29-3.22 (m, 2H), 1.26-1.18 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.21, 155.21, 143.94, 139.65, 135.34, 132.21, 131.80, 131.20, 129.76, 128.99, 128.64, 128.03, 126.11, 61.92, 49.52, 45.56, 43.95, 42.87, 14.59.

HRMS (ESI) calcd for $C_{20}H_{21}N_3O_4S$: 400.1326 ($M+H^+$), found: 400.1324.



ethyl 2-(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazin-1-yl)acetate (3p). (White solid was obtained in 84% isolated yield, 173.5 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, J = 8.0 Hz, 1H), 7.68-7.62 (m, 4H), 7.56-7.45 (m, 3H), 4.15 (q, J = 8.0 Hz, 2H), 4.04-4.00 (m, 1H), 3.91-3.87 (m, 1H), 3.61-3.55 (m, 1H), 3.31-3.25 (m, 1H), 3.23 (s, 2H), 2.69-2.64 (m, 3H), 2.49-2.46 (m, 1H), 1.24 (t, J = 8.0 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.80, 165.20, 143.94, 139.47, 135.40, 132.12, 131.59, 131.06, 129.78, 129.76, 129.09, 128.50, 127.89, 125.88, 60.81, 58.55, 52.83, 51.88, 49.60, 45.47, 14.17.

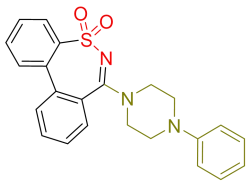
HRMS (ESI) calcd for $C_{21}H_{23}N_3O_4S$: 414.1482 ($M+H^+$), found: 414.1483.



7-(4-(methylsulfonyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3q). (White solid was obtained in 33% isolated yield, 67.1 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, J = 4.0 Hz,

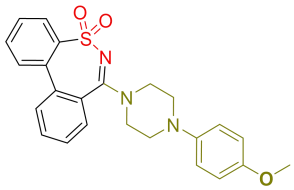
1H), 7.85 (d, *J* = 8.0 Hz, 1H), 7.78-7.71 (m, 4H), 7.64-7.58 (m, 2H), 4.07-4.02 (m, 1H), 3.75-3.70 (m, 1H), 3.62-3.56 (m, 1H), 3.30-3.26 (m, 4H), 3.11-3.05 (m, 1H), 2.89 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.20, 144.01, 139.23, 135.61, 133.07, 132.20, 131.32, 130.88, 129.96, 129.86, 129.20, 128.50, 125.23, 49.12, 45.66, 45.06, 44.99, 34.83.

HRMS (ESI) calcd for $C_{18}H_{19}N_3O_4S_2$: 406.0890 ($M+H^+$), found: 406.0891.



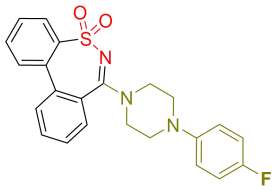
7-(4-phenylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3r). (White solid was obtained in 95% isolated yield, 191.6 mg). ^{1}H NMR (400 MHz, DMSO-d_6) *δ* 7.93 (d, *J* = 8.0 Hz, 1H), 7.84 (d, *J* = 8.0 Hz, 1H), 7.77-7.71 (m, 4H),7.62 (t, *J* = 8.0 Hz, 2H), 7.20 (t, *J* = 8.0 Hz, 2H), 6.95-6.88 (m, 2H), 6.79 (t, *J* = 8.0 Hz, 1H), 4.04-3.97 (m, 1H), 3.86-3.80 (m, 1H), 3.66-3.61 (m, 1H), 3.32-3.23 (m, 4H), 2.99-2.95 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 164.92, 150.62, 144.14, 139.13, 135.63, 132.98, 132.07, 131.21, 130.82, 130.11, 129.94, 129.48, 129.15, 128.49, 125.16, 119.88, 116.12, 49.43, 48.78, 47.95. 45.09.

HRMS (ESI) calcd for $C_{23}H_{21}N_3O_2S$: 404.1427 ($M+H^+$), found: 404.1425.



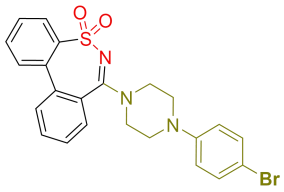
7-(4-(4-methoxyphenyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3s). (White solid was obtained in 60% isolated yield, 130.1 mg). ^{1}H NMR (600 MHz, DMSO-d_6) *δ* 7.91 (d, *J* = 6.0 Hz, 1H), 7.84 (d, *J* = 6.0 Hz, 1H), 7.76-7.70 (m, 4H), 7.63-7.59 (m, 2H), 6.88 (d, *J* = 6.0 Hz, 2H), 6.81 (d, *J* = 12.0 Hz, 2H), 4.03-3.96 (m, 1H), 3.88-3.84 (m, 1H), 3.67 (s, 3H), 3.64-3.60 (m, 1H), 3.32 (d, *J* = 6.0 Hz, 1H), 3.18-3.14 (m, 2H), 3.09-3.05 (m, 1H), 2.86-2.82 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.90, 153.90, 145.00, 144.23, 139.15, 135.64, 132.91, 132.00, 131.18, 130.77, 130.20, 129.89, 129.10, 128.45, 125.14, 118.40, 114.81, 55.69, 50.36, 49.66, 45.57, 40.61.

HRMS (ESI) calcd for $C_{24}H_{23}N_3O_3S$: 434.1533 ($M+H^+$), found: 434.1538.



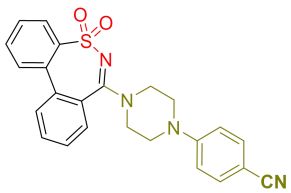
7-(4-(4-fluorophenyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3t). (White solid was obtained in 95% isolated yield, 200.2 mg). ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.12 (d, J = 6.0 Hz, 1H), 7.67-7.62 (m, 4H), 7.54-7.50 (m, 3H), 6.95-6.92 (m, 2H), 6.83-6.81 (m, 2H), 4.07-4.01 (m, 2H), 3.69-3.67 (m, 1H), 3.40-3.37 (m, 1H), 3.15-3.09 (m, 3H), 2.90-2.88 (m, 1H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 165.42, 157.76 (d, J = 361.2 Hz), 146.93, 144.07, 139.63, 135.44, 132.18, 131.70, 131.13, 129.88, 129.78, 129.17, 128.58, 127.99, 125.99, 118.57 (d, J = 11.2 Hz), 115.76 (d, J = 33.6 Hz), 50.97, 49.88, 49.69, 45.61. ^{19}F NMR (565 MHz, $CDCl_3$) δ -122.89.

HRMS (ESI) calcd for $C_{23}H_{20}FN_3O_2S$: 422.1333 ($M+H^+$), found: 422.1337.



7-(4-(4-bromophenyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3u). (White solid was obtained in 92% isolated yield, 143.2 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.92 (d, J = 6.0 Hz, 1H), 7.83 (d, J = 6.0 Hz, 1H), 7.75-7.71 (m, 4H), 7.63-7.60(m, 2H), 7.34 (d, J = 12.0 Hz, 2H), 6.85 (d, J = 12.0 Hz, 2H), 4.01-3.97 (m, 1H), 3.83-3.80 (m, 1H), 3.66-3.62 (m, 1H), 3.31-3.25 (m, 4H), 3.03-3.00 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.97, 149.79, 144.17, 139.16, 135.64, 132.94, 132.05, 132.03, 131.20, 130.81, 130.12, 129.92, 129.12, 128.45, 125.16, 117.91, 110.95, 49.20, 48.36, 47.47, 45.30.

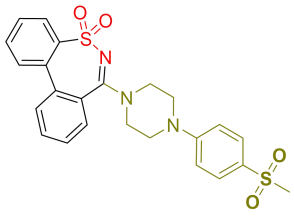
HRMS (ESI) calcd for $C_{23}H_{20}BrN_3O_2S$: 482.0532 ($M+H^+$), found: 482.0537.



4-(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazin-1-yl)benzonitrile (3v). (White solid was obtained in 38% isolated yield, 82.3 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.92 (d, J = 6.0 Hz, 1H), 7.85 (d, J = 6.0 Hz, 1H), 7.77-7.73 (m, 4H), 7.64-7.58 (m, 4H), 6.95 (d, J = 6.0 Hz, 2H),

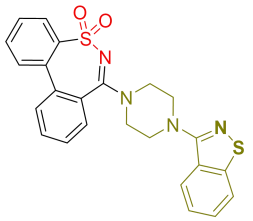
4.02-3.99 (m, 1H), 3.80-3.76 (m, 1H), 3.74-3.70 (m, 1H), 3.59-3.47 (m, 3H), 3.30-3.26 (m, 2H). ^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 165.03, 152.78, 144.15, 139.16, 135.66, 133.83, 132.93, 132.08, 131.21, 130.85, 130.10, 129.94, 129.12, 128.41, 125.17, 120.38, 114.23, 98.96, 48.76, 46.49, 45.29, 40.59.

HRMS (ESI) calcd for $C_{24}H_{20}N_4O_2S$: 429.1380 ($M+H^+$), found: 429.1382.



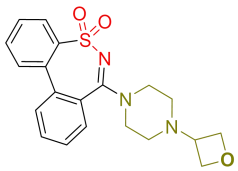
7-(4-(4-(methylsulfonyl)phenyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3w). (White solid was obtained in 25% isolated yield, 60.2 mg). ^{1}H NMR (400 MHz, DMSO-*d*$_6$) *δ* 7.91 (d, *J* = 4.0 Hz, 1H), 7.85 (d, *J* = 8.0 Hz, 1H), 7.77-7.74 (m, 4H), 7.68 (d, *J* = 12.0 Hz, 2H), 7.61 (t, *J* = 8.0 Hz, 2H), 7.00 (d, *J* = 8.0 Hz, 2H), 4.05-3.99 (m, 1H), 3.81-3.70 (m, 2H), 3.57-3.47 (m, 3H), 3.32-3.26 (m, 2H), 3.08 (s, 3H). ^{13}C NMR (101 MHz, DMSO-*d*$_6$) δ 164.99, 153.39, 144.11, 139.16, 135.66, 132.97, 132.11, 131.25, 130.89, 130.08, 129.98, 129.16, 129.05, 128.43, 125.18, 113.81, 48.81, 46.77, 45.63, 45.31, 44.68.

HRMS (ESI) calcd for $C_{24}H_{23}N_3O_4S_2$: 482.1203 ($M+H^+$), found: 482.1206.

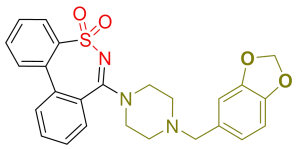


7-(4-(benzo[d]isothiazol-3-yl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3x). (White solid was obtained in 78% isolated yield, 180.3 mg). ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 8.14 (d, *J* = 8.0 Hz, 1H), 7.82 (t, *J* = 8.0 Hz, 2H), 7.69-7.63 (m, 4H), 7.56-7.46 (m, 4H), 7.36 (t, *J* = 8.0 Hz, 1H), 4.12 (d, *J* = 8.0 Hz, 2H), 3.81-3.76 (m, 1H), 3.60-3.55 (m, 3H), 3.50-3.45 (m, 1H), 3.36-3.32 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.61, 162.89, 152.86, 143.98, 139.63, 135.43, 132.25, 131.76, 131.15, 129.85, 129.83, 129.18, 128.62, 128.05, 127.92, 127.61, 126.00, 124.37, 123.51, 120.71, 50.05, 49.79, 49.52, 45.44.

HRMS (ESI) calcd for $C_{24}H_{20}N_4O_2S_2$: 461.1100 ($M+H^+$), found: 461.1102.

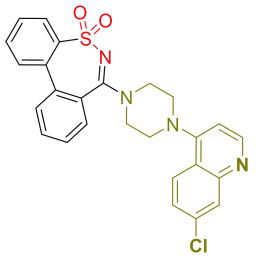


7-(4-(oxetan-3-yl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3y). (White solid was obtained in 93% isolated yield, 178.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, J = 8.0 Hz, 1H), 7.68-7.60 (m, 4H), 7.53 (t, J = 8.0 Hz, 1H), 7.49-7.43 (m, 2H), 4.63-4.51 (m, 4H), 3.99-3.84 (m, 2H), 3.59-3.53 (m, 1H), 3.49-3.44 (m, 1H), 3.28-3.22 (m, 1H), 2.37-2.32 (m, 3H),2.15 (t, J = 8.0 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.28, 143.93, 139.44, 135.43, 132.22, 131.65, 131.06, 129.85, 129.78, 129.13, 128.55, 127.96, 125.83, 75.13, 75.11, 58.64, 49.82, 49.47, 48.86, 45.29. HRMS (ESI) calcd for $C_{20}H_{21}N_3O_3S$: 384.1376 ($M+H^+$), found: 384.1377.



7-(4-(benzo[d][1,3]dioxol-5-ylmethyl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3z). (White solid was obtained in 72% isolated yield, 166.3 mg).^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.0 Hz, 1H), 7.69-7.60 (m, 4H), 7.56-7.44 (m, 3H), 6.80 (s, 1H), 6.73-6.67 (m, 2H), 5.93 (s, 2H), 4.00-3.84 (m, 2H), 3.55-3.50 (m, 1H), 3.41 (s, 2H), 3.26-3.21 (m, 1H), 2.53-2.42 (m, 3H), 2.29-2.26 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.16, 147.81, 147.02, 144.05, 139.51, 135.46, 132.09, 131.55, 131.07, 129.94, 129.72, 129.12, 128.54, 127.86, 125.97, 122.43, 109.42, 108.01, 101.02, 62.11, 52.92, 52.06, 49.59, 45.49, 30.44.

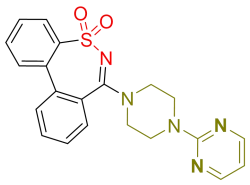
HRMS (ESI) calcd for $C_{25}H_{23}N_3O_4S$: 462.1482 ($M+H^+$), found: 462.1484.



7-(4-(7-chloroquinolin-4-yl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3za). (White solid was obtained in 43% isolated yield, 104.7 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.72 (d, J = 4.0 Hz, 1H), 8.16 (d, J = 8.0 Hz, 1H), 8.04 (s, 1H), 7.87 (d, J = 12.0 Hz, 1H), 7.69-7.65 (m, 4H), 7.58-7.54 (m, 3H), 7.43 (d, J = 8.0 Hz, 1H), 6.81 (d, J = 4.0 Hz, 1H), 4.26-4.23 (m, 2H),

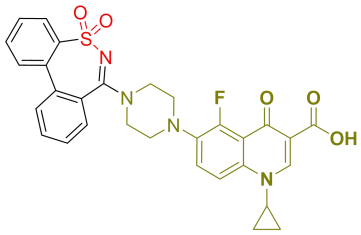
3.86-3.81 (m, 1H), 3.57-3.50 (m, 1H), 3.28-3.21 (m, 3H), 3.04-2.97 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.76, 155.75, 151.89, 150.11, 143.95, 139.76, 135.38, 135.31, 132.28, 131.86, 131.26, 129.79, 129.72, 129.15, 129.13, 128.71, 128.07, 126.81, 126.17, 124.51, 121.64, 109.44, 52.56, 51.34, 49.83, 45.57.

HRMS (ESI) calcd for $C_{26}H_{21}ClN_4O_2S$: 489.1147 ($M+H^+$), found: 489.1149.



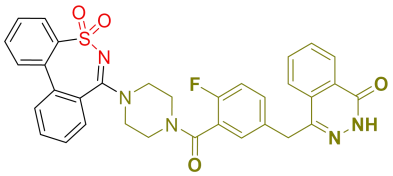
7-(4-(pyrimidin-2-yl)piperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zb). (White solid was obtained in 96% isolated yield, 195.9 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, J = 8.0 Hz, 2H), 8.14 (d, J = 8.0 Hz, 1H), 7.69-7.62 (m, 4H), 7.56-7.51 (m, 3H), 6.55 (t, J = 4.0 Hz, 1H), 4.03-3.84 (m, 5H), 3.67-3.59 (m, 2H), 3.36-3.30 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.60, 161.29, 157.80, 144.00, 139.56, 135.45, 132.19, 131.74, 131.15, 129.93, 129.83, 129.13, 128.57, 128.03, 125.95, 110.89, 49.52, 45.67, 44.09, 42.90.

HRMS (ESI) calcd for $C_{21}H_{19}N_5O_2S$: 406.1332 ($M+H^+$), found: 406.1336.



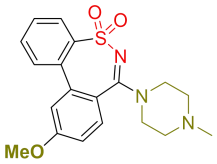
1-cyclopropyl-6-(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazin-1-yl)-5-fluoro-4-oxo-1,4-dihydroquinoline-3-carboxylic acid (3zc). (Yellow solid was obtained in 50% isolated yield, 143.7 mg).^{1}H NMR (400 MHz, DMSO-d_6) δ15.12 (s, 1H), 8.64-8.61 (m, 1H), 7.92 (d, J = 8.0 Hz, 1H), 7.89-7.82 (m, 2H),7.79-7.75 (m, 4H),7.65-7.58 (m, 2H), 7.49 (d, J = 8.0 Hz, 1H),4.07-3.98 (m, 2H), 3.82-3.71 (m, 2H), 3.62-3.40 (m,4H), 3.23-3.18(m, 1H), 1.35-1.30 (m, 2H), 1.25-1.14 (m, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 176.75, 166.32, 164.99, 153.59 (d, J = 263.6 Hz), 148.43, 144.76 (d, J = 10.1 Hz), 144.09, 139.51, 139.24, 135.65, 132.99, 132.12, 131.28, 130.85, 129.99, 129.16, 128.47, 125.20, 119.17 (d, J = 8.1 Hz), 111.44 (d, J = 23.2 Hz), 107.57, 107.19, 106.84, 49.61, 49.18, 48.97, 48.64, 45.24, 36.82, 8.07.

HRMS (ESI) calcd for $C_{30}H_{25}FN_4O_5S$: 573.1602 ($M+H^+$), found: 573.1604.



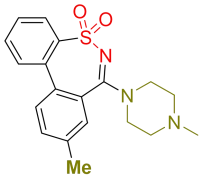
4-(3-(4-(5,5-dioxidodibenzo[d,f][1,2]thiazepin-7-yl)piperazine-1-carbonyl)-4-fluorobenzyl) phthalazin-1(2H)-one (3zd). (White solid was obtained in 56% isolated yield, 170.2 mg). ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.5 (s, 1H), 8.44 (t, J = 8.0 Hz, 1H), 8.12 (t, J = 8.0 Hz, 1H), 7.76-7.61 (m, 7H), 7.55-7.43 (m, 3H), 7.35-7.27 (m, 2H), 7.06-6.92 (m, 1H), 4.28-4.23 (m, 2H), 3.89-3.58 (m, 4H), 3.51-3.22 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.88, 165.72, 165.31, 165.01, 160.95, 157.21 (d, J = 289.9 Hz), 145.6, 143.75 (d, J = 3.0 Hz), 139.56 (d, J = 9.1Hz), 135.28 (d, J = 7.1 Hz), 134.52 (d, J = 4.0 Hz), 133.75, 132.41, 131.97, 131.69, 131.22, 129.98, 129.51, 129.12, 128.69, 128.20, 127.08, 126.01, 125.04, 123.20, 123.17 (d, J = 30.3 Hz), 116.14, 116.03 (d, J = 44.4 Hz), 48.68, 47.17, 45.86, 42.32, 38.18. ^{19}F NMR (565 MHz, $CDCl_3$) δ -117.74.

HRMS (ESI) calcd for $C_{33}H_{26}FN_5O_4S$: 608.1762 ($M+H^+$), found: 608.1763.



10-methoxy-7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3ze). (White solid was obtained in 62% isolated yield, 114.5 mg). ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.12 (d, J = 6.0 Hz, 1H), 7.61 (d, J = 6.0 Hz, 2H), 7.57 (d, J = 12.0 Hz, 1H), 7.50-7.47 (m, 1H), 7.17-7.15 (m, 1H), 6.96 (d, J = 6.0 Hz, 1H), 3.99-3.97 (m, 1H), 3.88 (s, 3H), 3.84-3.81 (m, 1H), 3.60-3.57 (m, 1H), 3.28-3.24 (m, 1H), 2.51-2.48 (m, 1H), 2.45-2.38 (m, 2H), 2.30-2.27 (m, 4H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 165.09, 158.60, 143.63, 135.44, 132.59, 131.99, 131.04, 129.41, 127.89, 126.10, 117.21, 114.38, 55.61, 55.32, 54.26, 49.73, 45.69, 45.66.

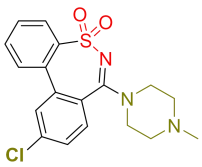
HRMS (ESI) calcd for $C_{19}H_{21}N_3O_3S$: 372.1376 ($M+H^+$), found: 372.1379.



10-methyl-7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zf). (Yellow solid was obtained in 46% isolated yield, 81.7 mg). ^{1}H NMR (600 MHz, CD_3OD) δ 7.97 (d, J =

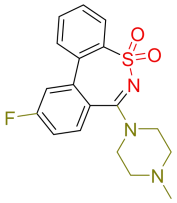
6.0 Hz, 1H), 7.77 (d, *J* = 12.0 Hz, 1H), 7.71 (t, *J* = 12.0 Hz, 1H), 7.59 (d, *J* = 12.0 Hz, 1H), 7.56 (t, *J* = 12.0 Hz, 1H), 7.52 (d, *J* = 12.0 Hz, 1H), 7.39 (s, 1H), 4.05-4.02 (m, 1H), 3.78-3.75 (m, 1H), 3.59-3.55 (m, 1H), 3.34-3.32 (m, 1H), 2.63-2.61 (m, 1H), 2.56-2.54 (m, 1H), 2.46 (s, 3H), 2.36-2.34 (m, 1H), 2.24 (s, 3H), 2.13-2.10 (m, 1H). ^{13}C NMR (151 MHz, CD_3OD) δ 166.06, 143.38, 138.45, 136.72, 135.68, 132.35, 132.29, 130.64, 129.86, 129.59, 129.29, 128.02, 124.75, 54.71, 53.59, 49.26, 44.90, 44.24, 19.75.

HRMS (ESI) calcd for $C_{19}H_{21}N_3O_2S$: 356.1427 ($M+H^+$), found: 356.1426.



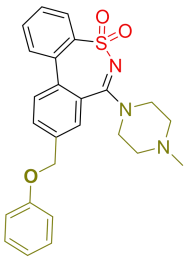
10-methyl-7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zg). (Yellow solid was obtained in 45% isolated yield, 84.5 mg). ^{1}H NMR (600 MHz, CD_3OD) δ 7.89 (d, *J* = 6.0 Hz, 1H), 7.73 (d, *J* = 12.0 Hz, 1H), 7.67 (t, *J* = 18.0 Hz, 1H), 7.64 (d, *J* = 6.0 Hz, 1H), 7.55-7.48 (m, 3H), 3.92-3.90 (m, 1H), 3.74-3.70 (m, 1H), 3.52-3.49 (m, 1H), 3.26-3.24 (m, 1H), 2.59-2.54 (m, 2H), 2.34-2.31 (m, 1H), 2.20 (s, 3H), 2.13-2.10 (m, 1H). ^{13}C NMR (151 MHz, CD_3OD) δ 165.78, 143.51, 140.39, 136.91, 134.82, 132.67, 131.10, 130.36, 130.18, 128.99, 128.40, 128.11, 124.82, 54.56, 53.45, 49.11, 44.82, 44.16.

HRMS (ESI) calcd for $C_{19}H_{21}N_3O_2S$: 376.0881 ($M+H^+$), found: 376.0887.



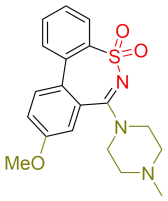
10-fluoro-7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zh). (White solid was obtained in 57% isolated yield, 102.3 mg). ^{1}H NMR (600 MHz, DMSO-*d*$_6$) δ 7.93 (d, *J* = 12.0 Hz, 1H), 7.86 (d, *J* = 12.0 Hz, 1H), 7.77-7.70 (m, 2H), 7.66-7.61 (m, 2H), 7.47-7.42 (m, 1H), 3.82-3.74 (m, 2H), 3.49-3.44 (m, 1H), 3.22-3.16 (m, 1H), 2.51-2.40 (m, 2H), 2.28-2.22 (m, 1H), 2.13 (s, 3H), 2.07-2.03 (m, 1H). ^{13}C NMR (151 MHz, DMSO-*d*$_6$) δ 164.70, 164.13, 162.21, 144.08, 142.05 (d, *J* = 13.6 Hz), 134.42 (d, *J* = 1.5 Hz), 132.95, 130.99, 129.68, 126.91 (d, *J* = 4.5 Hz), 125.11, 118.01 (d, *J* = 98.2 Hz), 115.72 (d, *J* = 34.1 Hz), 54.97, 54.05, 49.75, 49.08, 45.57. ^{19}F NMR (565 MHz, DMSO-*d*$_6$) δ -107.99.

HRMS (ESI) calcd for $C_{18}H_{18}FN_3O_2S$: 360.1177 ($M+H^+$), found: 360.1175.



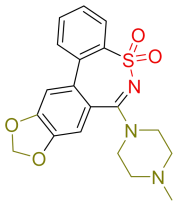
7-(4-methylpiperazin-1-yl)-9-(phenoxymethyl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zi). (White solid was obtained in 83% isolated yield, 184.6 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ1 7.91 (d, J = 12.0 Hz, 1H), 7.78 (d, J = 12.0 Hz, 1H), 7.70 (t, J = 12.0 Hz, 1H), 7.65 (d, J = 12.0 Hz, 1H), 7.56 (t, J = 12.0 Hz, 1H), 7.51-7.49 (m, 2H), 7.44-7.33 (m, 4H), 7.22 (d, J = 6.0 Hz, 1H), 5.29-5.22 (m, 2H), 3.83-3.79 (m, 1H), 3.74-3.69 (m, 1H), 3.43-3.37 (m, 1H), 3.13-3.07 (m, 1H), 2.51-2.45 (m, 1H), 2.33-2.28 (m, 1H), 2.23-2.19 (m, 1H), 2.11 (s, 3H), 1.97-1.91 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.43, 157.76, 143.72, 136.94, 135.53, 132.86, 131.72, 131.37, 130.45, 129.04, 128.51, 128.20, 125.21, 119.05, 115.12, 70.17, 54.80, 53.91, 49.51, 45.49, 45.36.

HRMS (ESI) calcd for $C_{25}H_{25}N_3O_3S$: 448.1689 ($M+H^+$), found: 448.1687.



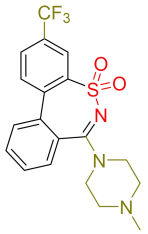
9-methoxy-7-(4-methylpiperazin-1-yl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zj). (Yellow solid was obtained in 74% isolated yield, 136.1 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.88 (d, J = 12.0 Hz, 1H), 7.78 (d, J = 12.0 Hz, 1H), 7.72 (t, J = 12.0 Hz, 1H), 7.65 (d, J = 12.0 Hz, 1H), 7.57 (t, J = 12.0 Hz, 1H), 7.30 (dd, J = 12.0, 6.0 Hz, 1H), 7.17 (d, J = 6.0 Hz, 1H), 3.88 (s, 3H), 3.80-3.72 (m, 2H), 3.55-3.50 (m, 2H), 3.23-3.17 (m, 1H), 2.47-2.43 (m, 1H), 2.28-2.23 (m, 1H), 2.15 (s, 3H), 2.09-2.05 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.45, 157.84, 143.23, 135.54, 132.89, 132.81, 131.41, 131.34, 130.44, 128.83, 125.17, 117.56, 113.88, 56.98, 54.93, 53.96, 49.65, 45.54, 45.38.

HRMS (ESI) calcd for $C_{19}H_{21}N_3O_3S$: 372.1376 ($M+H^+$), found: 372.1387.



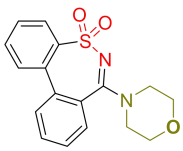
7-(4-methylpiperazin-1-yl)-[1,3]dioxolo[4',5':4,5]benzo[1,2-d]benzo[f][1,2]thiazepine 5,5-dioxide (3zk). (White solid was obtained in 80% isolated yield, 154.1mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.86 (d, J = 12.0 Hz, 1H), 7.77 (d, J = 12.0 Hz, 1H), 7.71 (t, J = 12.0 Hz, 1H), 7.58 (t, J = 12.0 Hz, 1H), 7.28 (s, 1H),7.22 (s, 1H), , 6.24 (d, J = 18.0 Hz, 2H), 3.81-3.78 (m, 1H),3.68-3.62 (m, 1H), 3.51-3.48 (m, 2H), 3.23-3.18 (m, 1H), 2.48-2.43 (m, 1H), 2.23-2.18 (m, 1H), 2.14 (s, 3H), 2.03-1.99 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.10, 150.22, 146.43, 143.02, 135.39, 134.29, 132.79, 130.89, 128.82, 124.92, 124.33, 110.90, 109.71, 103.02, 54.85, 53.95, 49.69, 45.55, 45.46.

HRMS (ESI) calcd for C19H19N3O4S: 386.1169 (M+H$^+$), found: 386.1188.



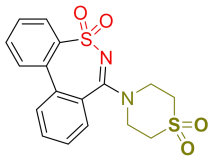
7-(4-methylpiperazin-1-yl)-3-(trifluoromethyl)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (3zl). (White solid was obtained in 71% isolated yield, 145.2 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 8.18 (s, 1H), 8.11 (d, J = 12.0 Hz, 1H), 8.00 (d, J = 12.0 Hz, 1H), 7.85 (d, J = 12.0 Hz, 1H), 7.78-7.74 (m, 1H), 7.70-7.63 (m, 2H), 3.88-3.74 (m, 2H), 3.52-3.39 (m, 2H), 3.23-3.17 (m, 1H), 2.49-2.41 (m, 2H), 2.35-2.30 (m, 1H), 2.16 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 164.68, 147.80, 137.67, 136.69, 132.8 (q, J = 48.3 Hz), 132.14, 131.56, 130.21, 129.88, 129.16, 127.64(q, J = 6 Hz), 126.29, 126.14 (q, J = 4.5 Hz), 124.12 (q, J = 339.8 Hz), 54.89, 54.04, 49.80, 45.61, 45.56. ^{19}F NMR (565 MHz, DMSO-d_6) δ -61.28.

HRMS (ESI) calcd for $C_{19}H_{18}F_3N_3O_2S$: 410.1145 (M+H$^+$), found: 410.1145.



7-morpholinodibenzo[d,f][1,2]thiazepine 5,5-dioxide (4a). (White solid was obtained in 90% isolated yield, 147.6 mg). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.90 (d, J = 8.0 Hz, 1H), 7.84 (d, J = 8.0 Hz, 1H), 7.78-7.72 (m, 3H), 7.68 (d, J = 8.0 Hz, 1H), 7.64-7.58 (m, 2H), 3.84-3.69 (m, 4H), 3.61-3.49 (m, 2H), 3.36 (s, 1H), 3.20-3.14 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 164.92, 144.07, 139.15, 135.61, 132.98, 132.04, 131.22, 130.82, 129.93, 129.86, 129.14, 128.45, 125.14, 66.43, 65.85, 50.16, 46.02.

HRMS (ESI) calcd for $C_{17}H_{16}N_2O_3S$: 329.0954 ($M+H^+$), found: 329.0947.

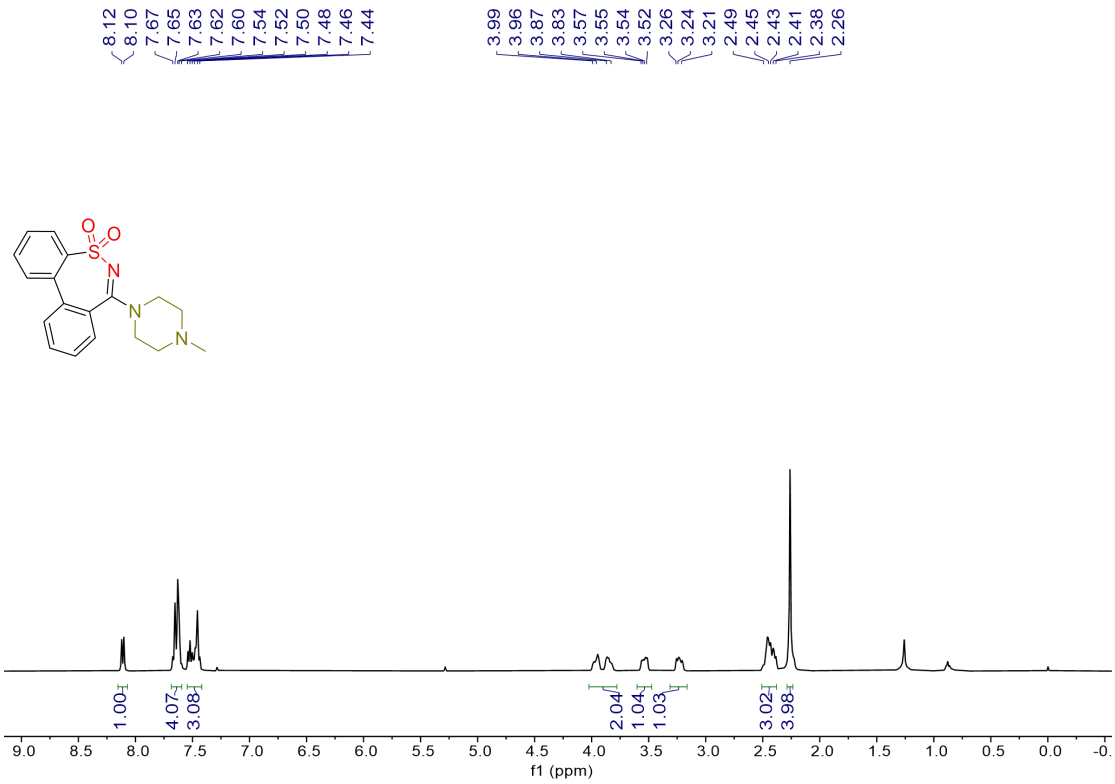


7-(1,1-dioxidothiomorpholino)dibenzo[d,f][1,2]thiazepine 5,5-dioxide (5a). (White solid was obtained in 41% isolated yield, 71 mg). ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.92-7.85 (m, 3H), 7.80-7.75 (m, 3H), 7.65-7.59 (m, 2H), 4.63 (d, J = 6.0 Hz, 1H), 3.76-3.68 (m, 2H), 3.62-3.51 (m, 3H), 3.28-3.22 (m, 1H), 3.14-3.11 (m, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 165.93, 143.72, 139.16, 135.70, 134.98, 133.22, 132.38, 131.36, 131.02, 129.78, 129.21, 128.58, 125.13, 50.94, 50.56, 48.30, 43.89.

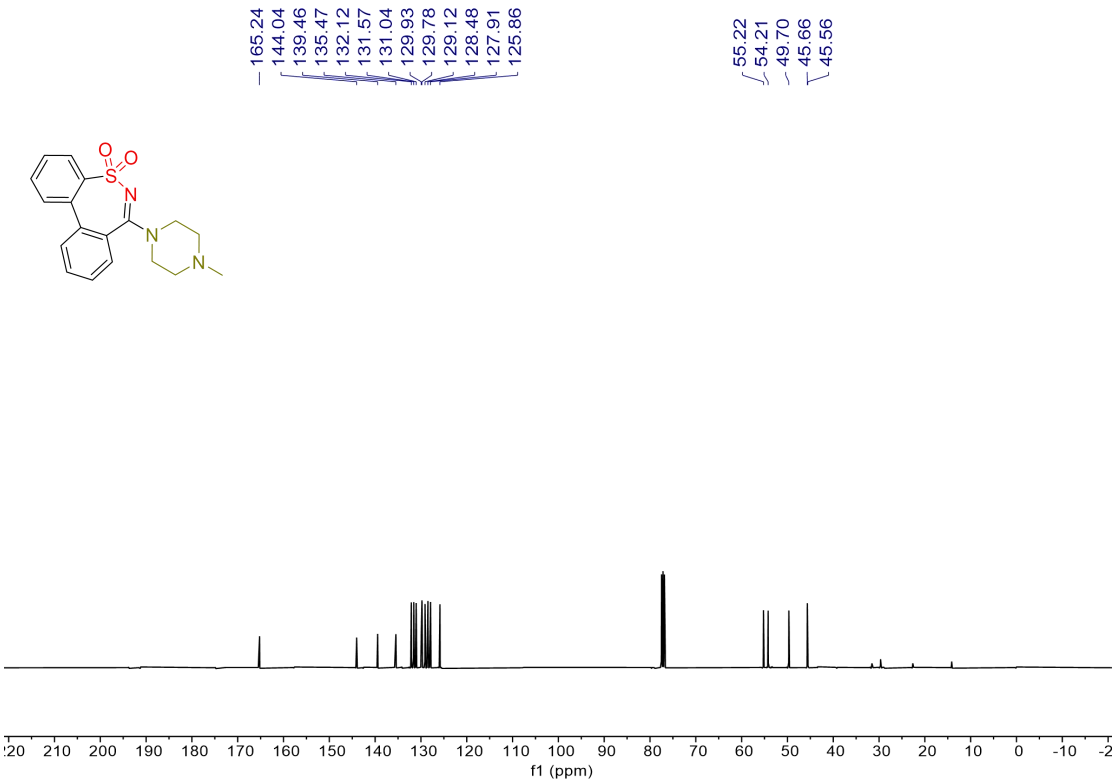
HRMS (ESI) calcd for $C_{17}H_{16}N_2O_4S_2$: 377.6024 ($M+H^+$), found: 377.0617.

Copies of ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra

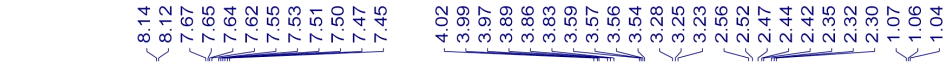
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3a**

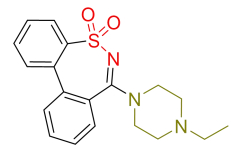


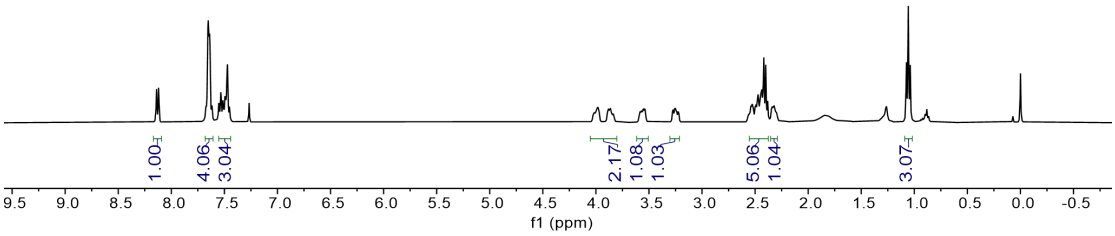
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3a**



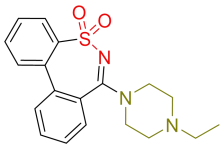
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3b**

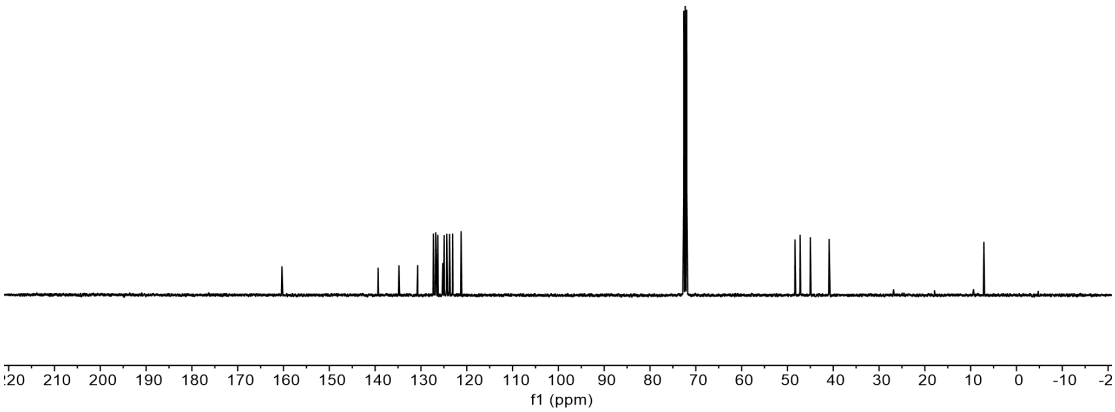




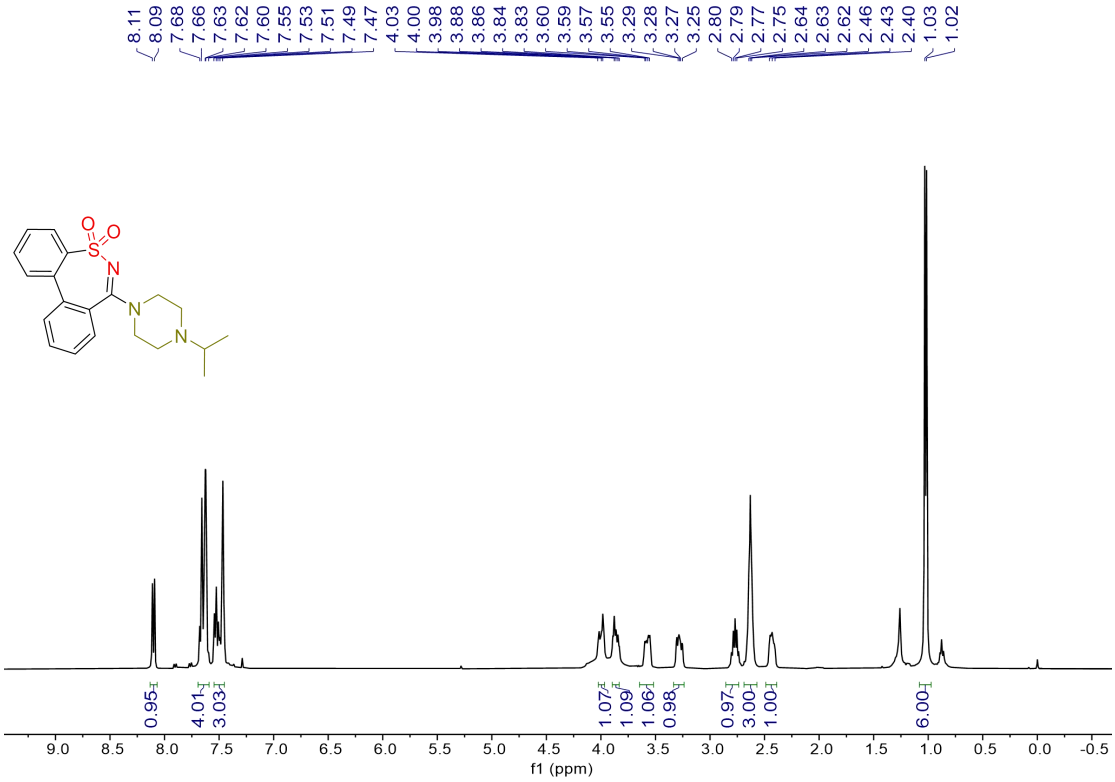


^{13}C NMR (101 MHz, $CDCl_3$) of compound **3b**

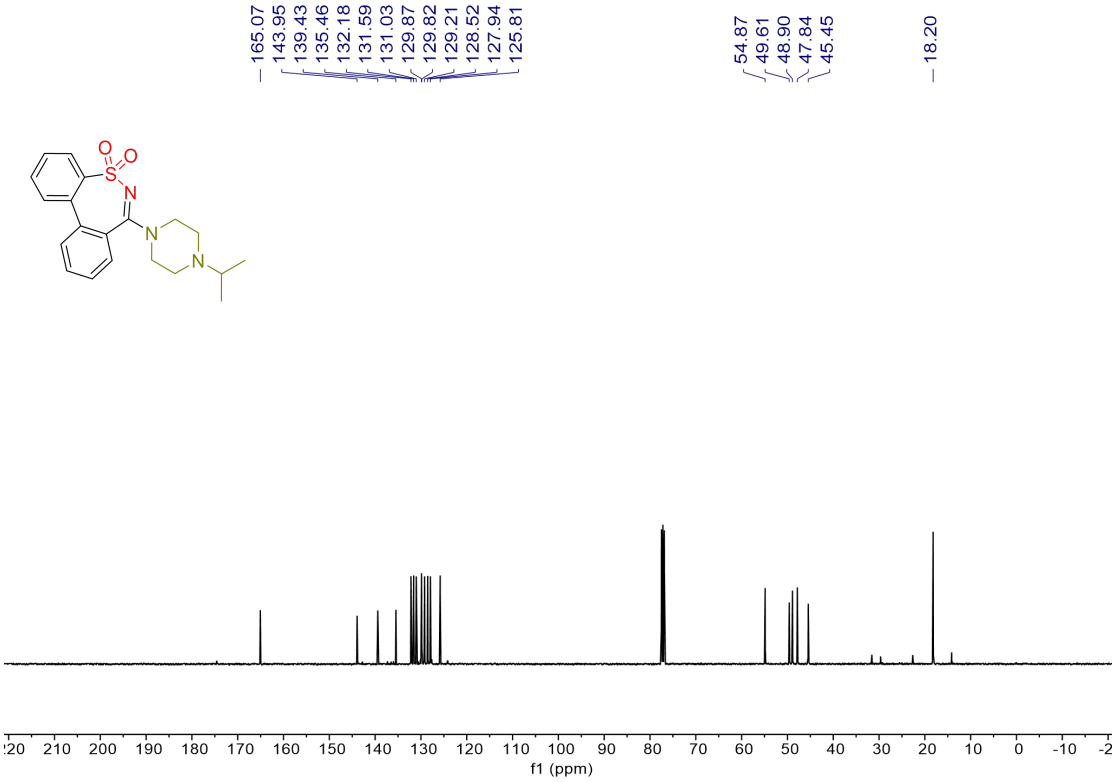




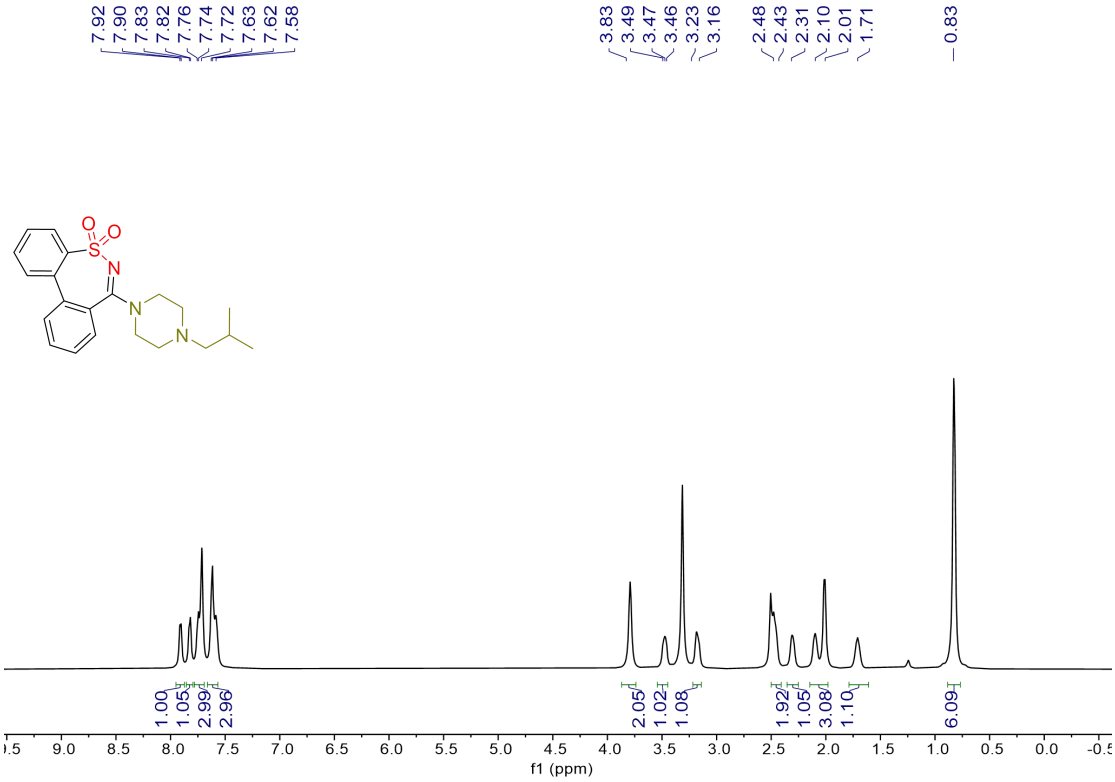
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3c**



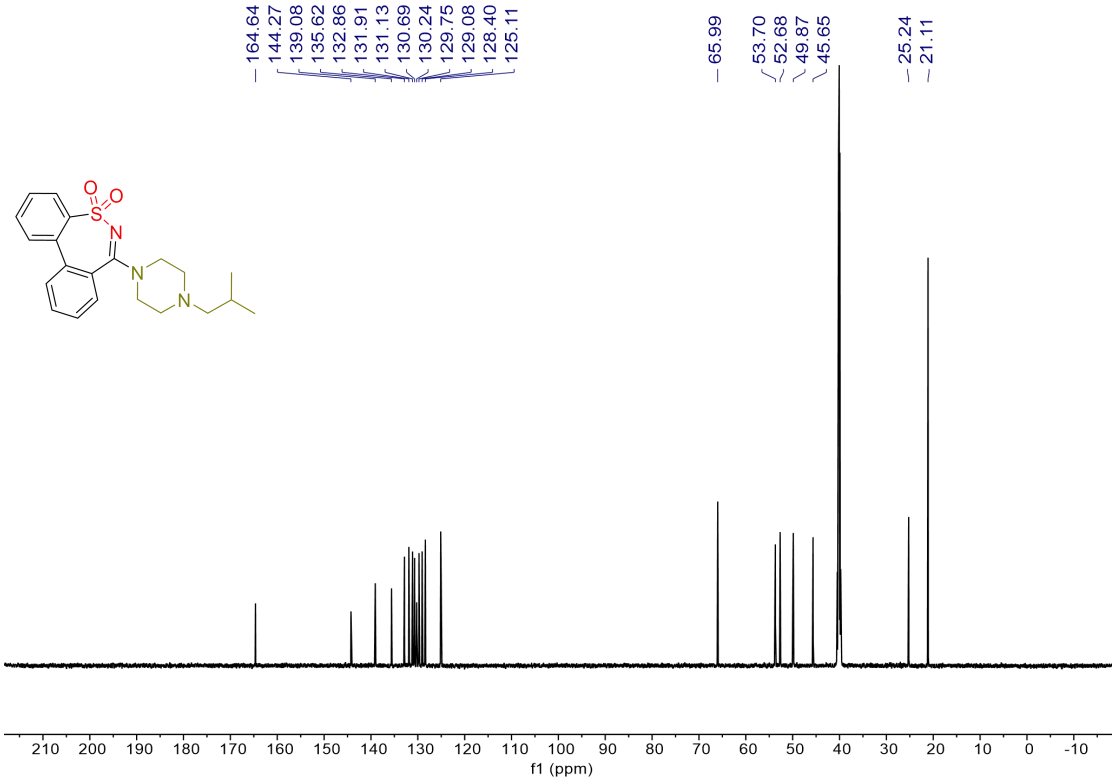
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3c**



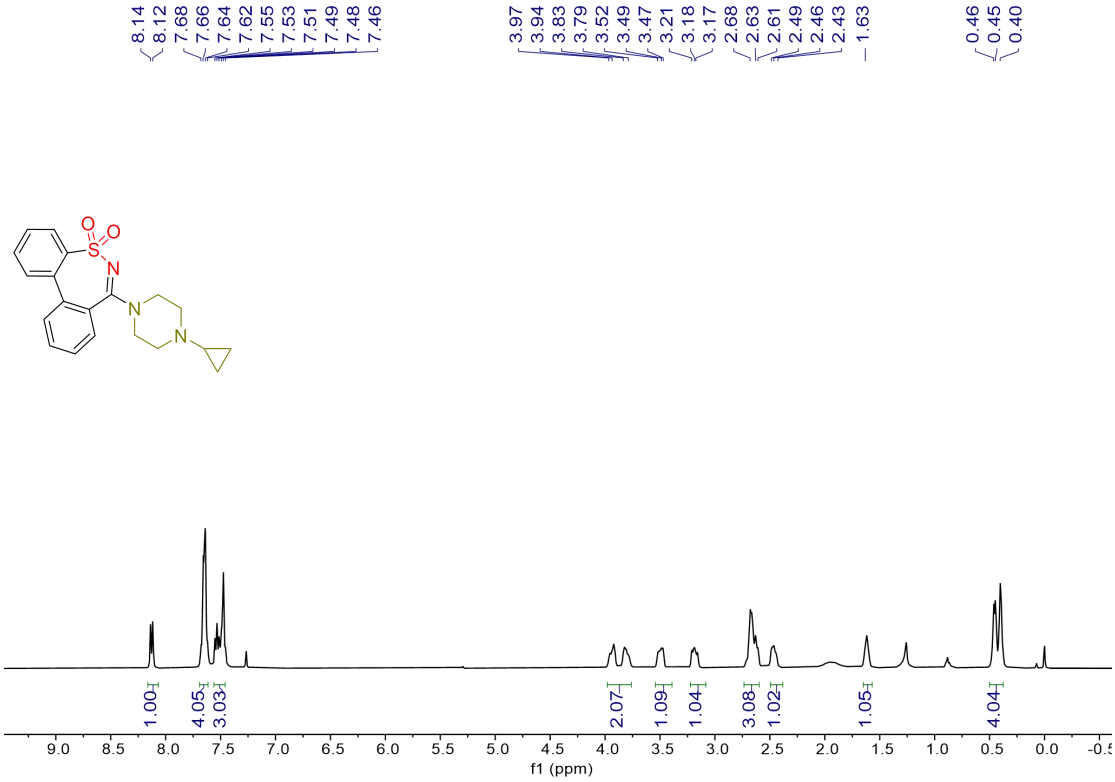
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3d**



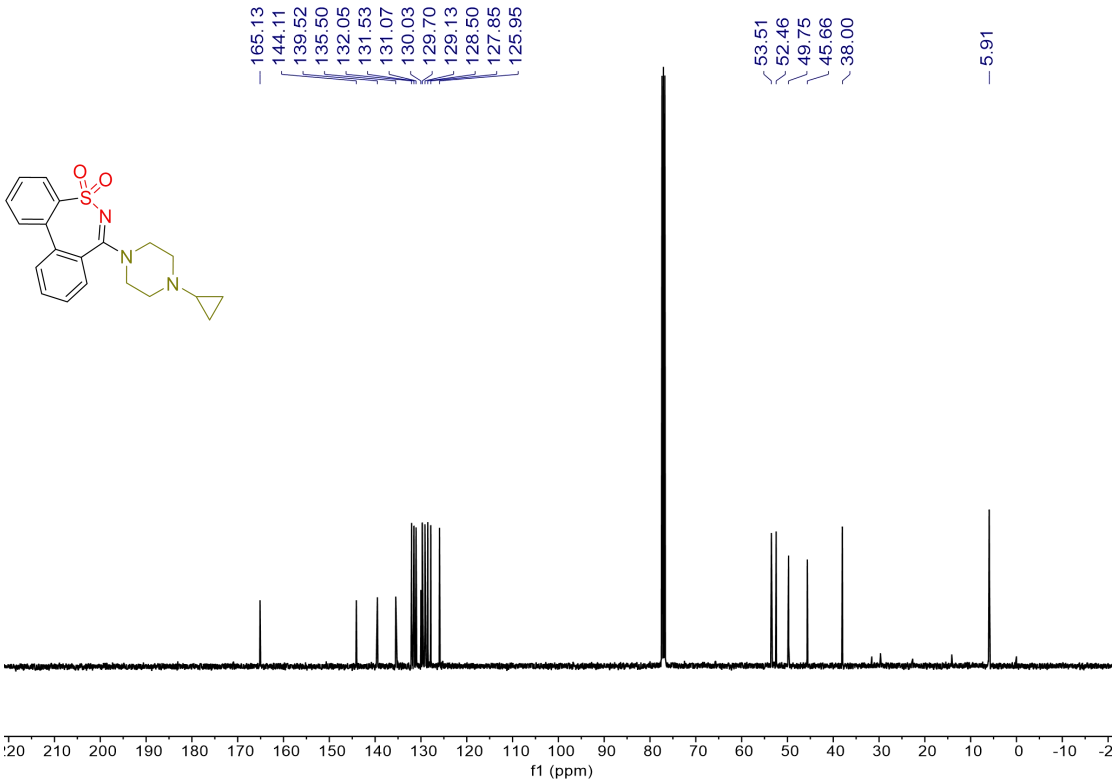
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3d**



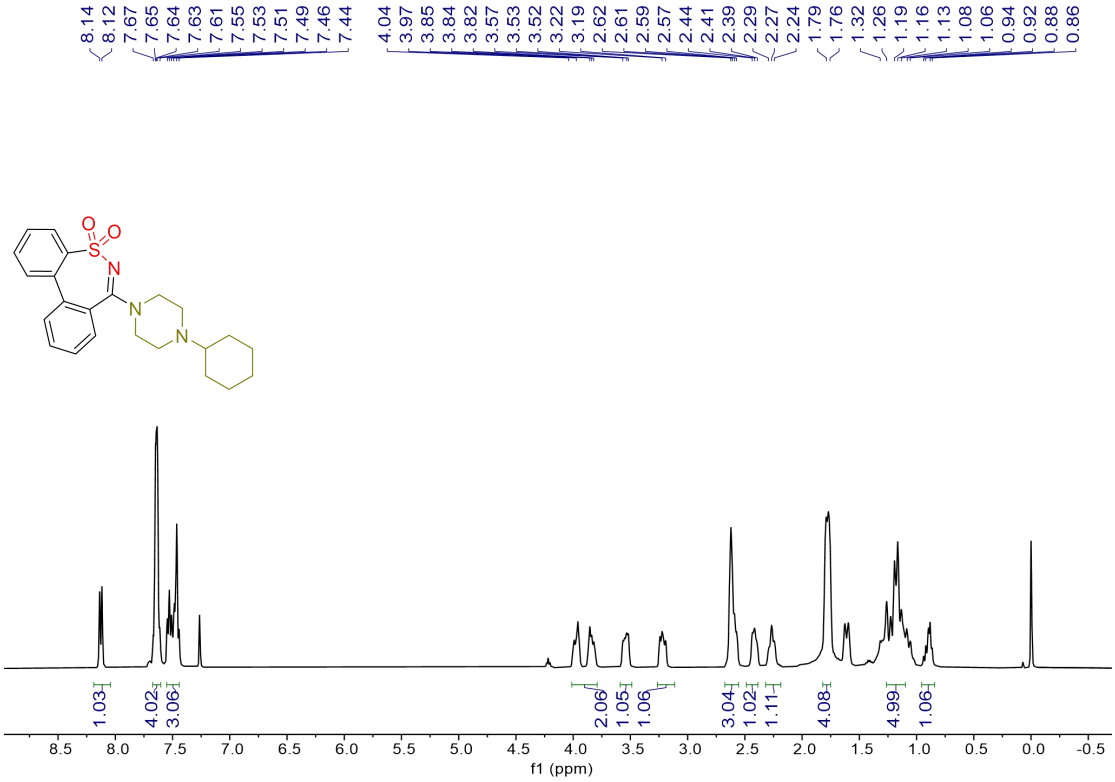
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3e**



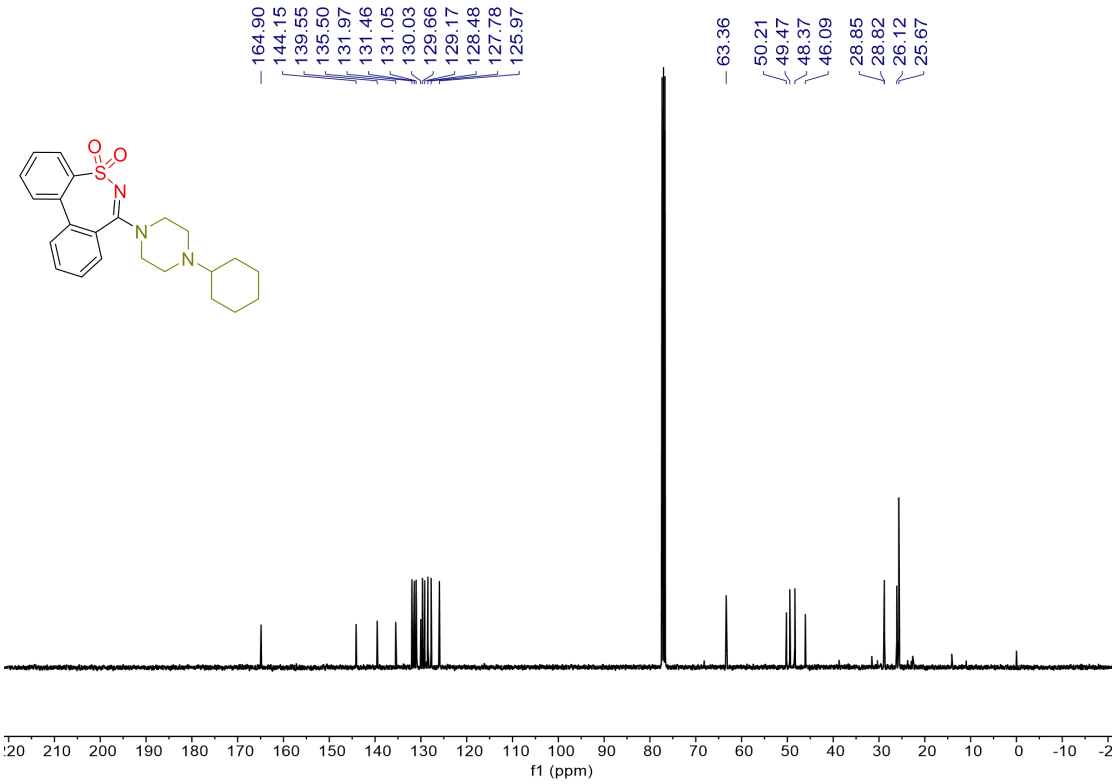
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3e**



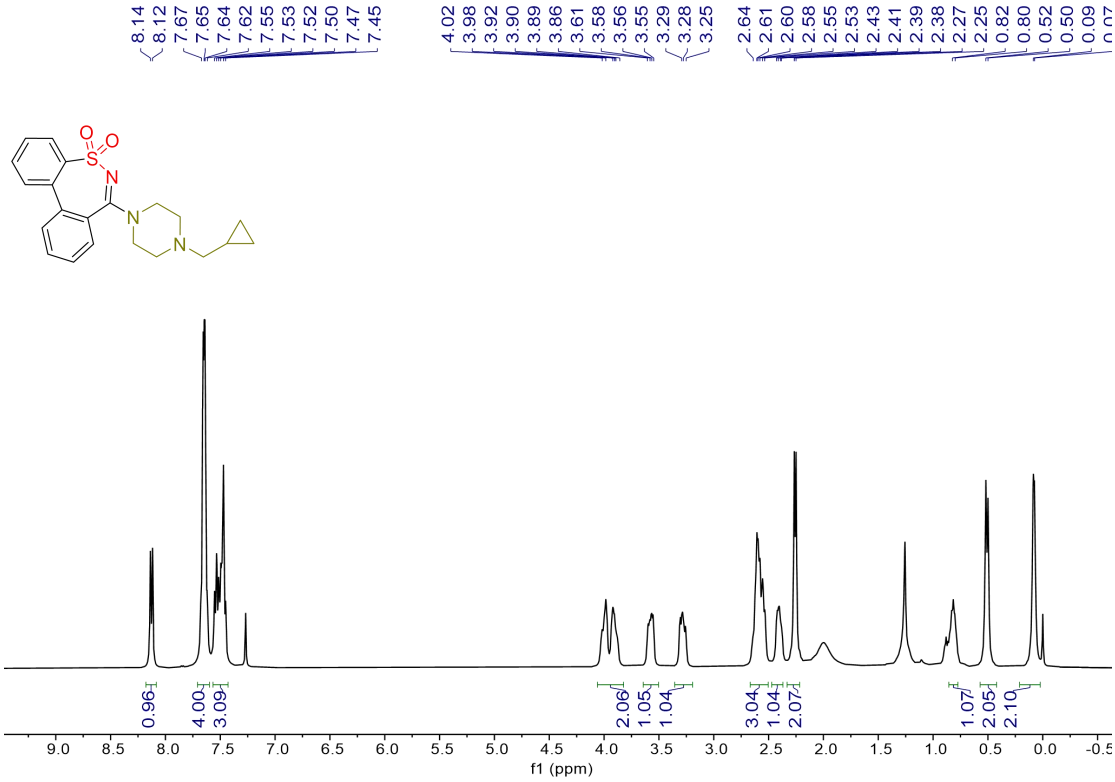
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3f**



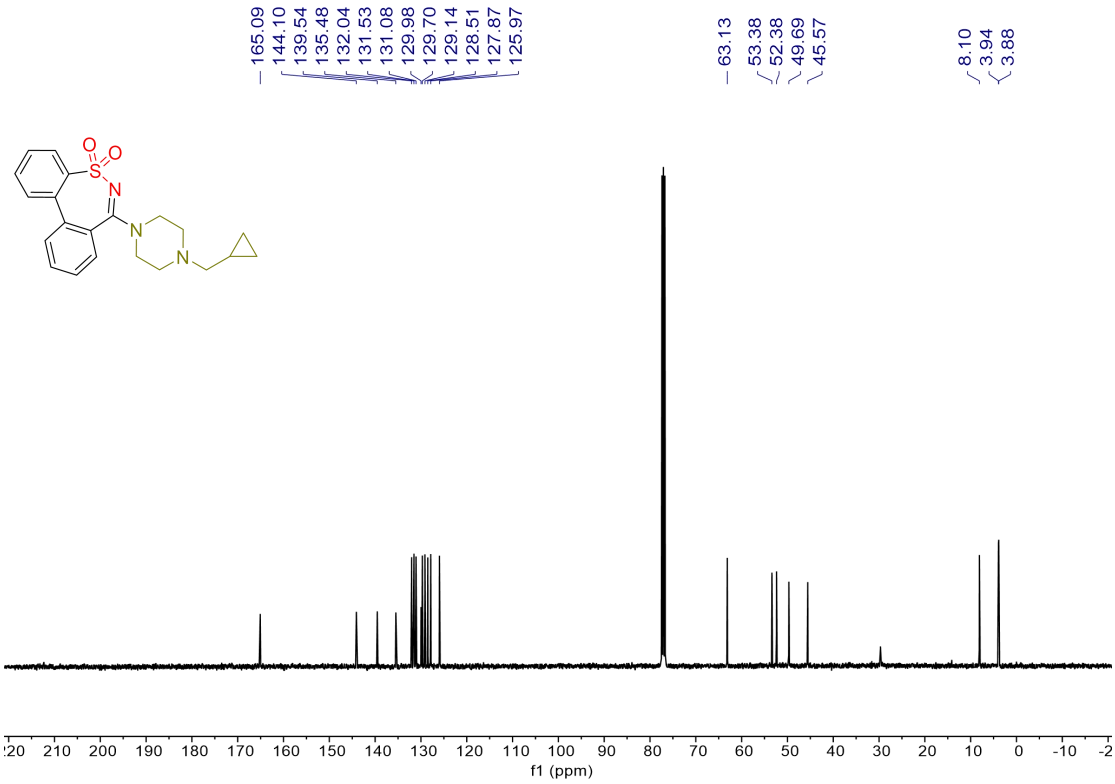
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3f**



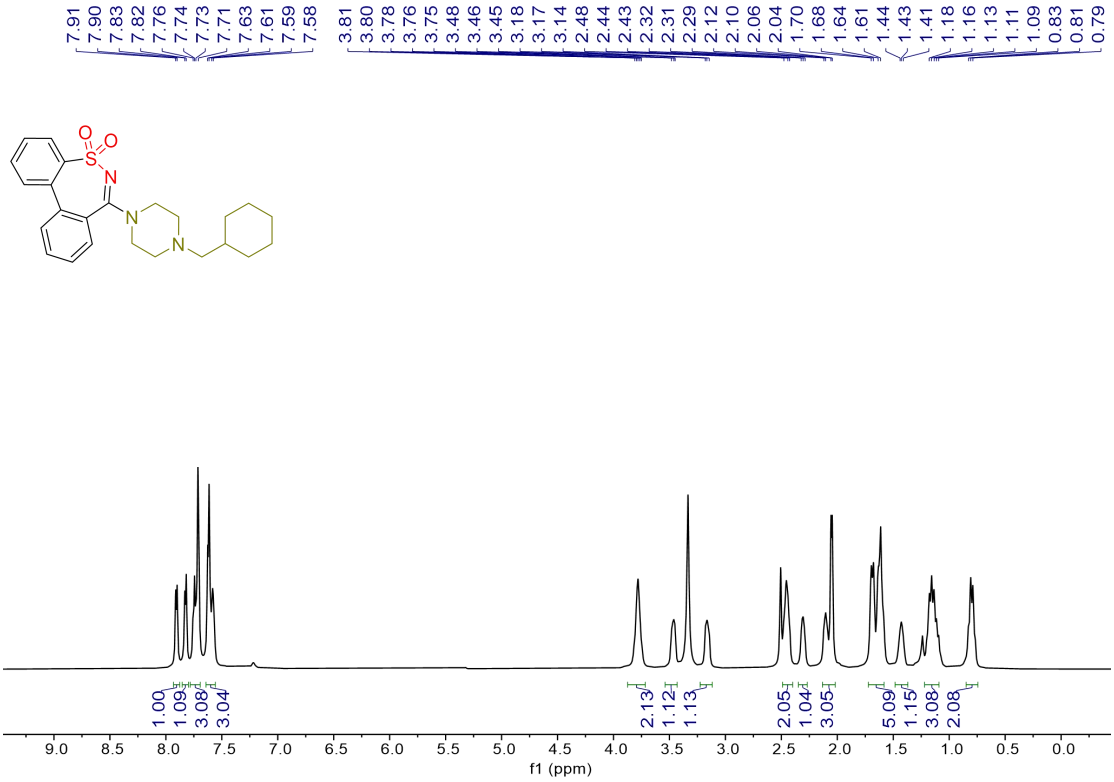
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3g**



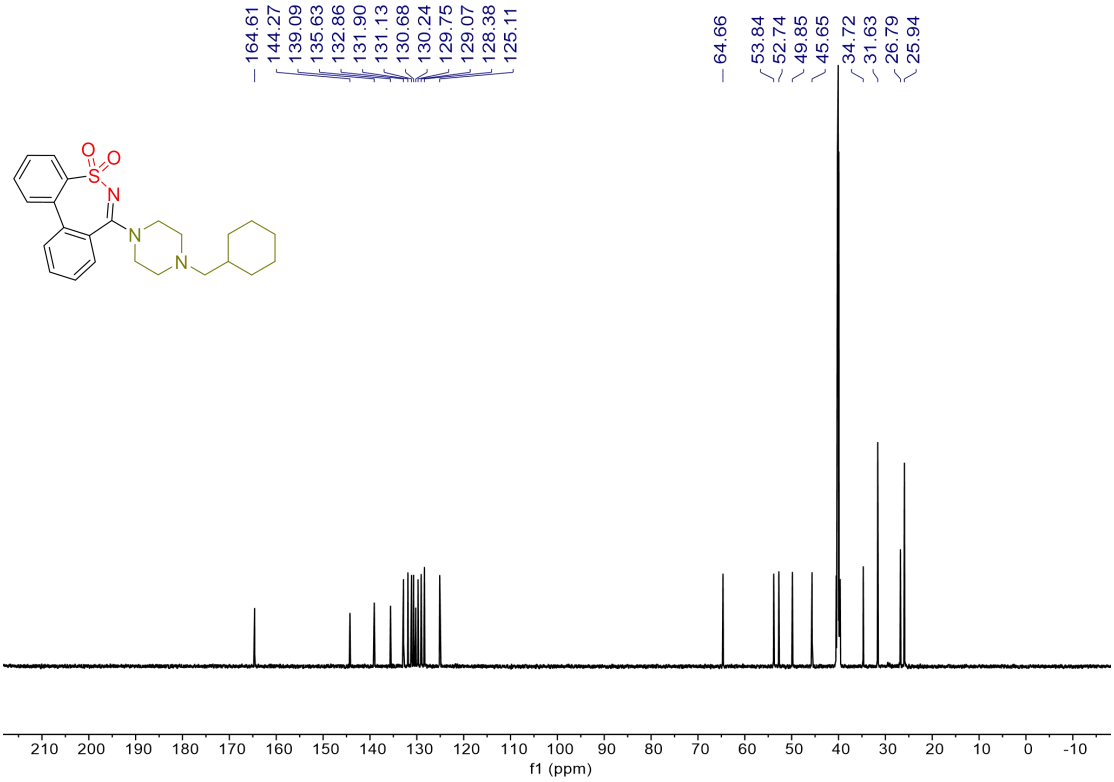
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3g**



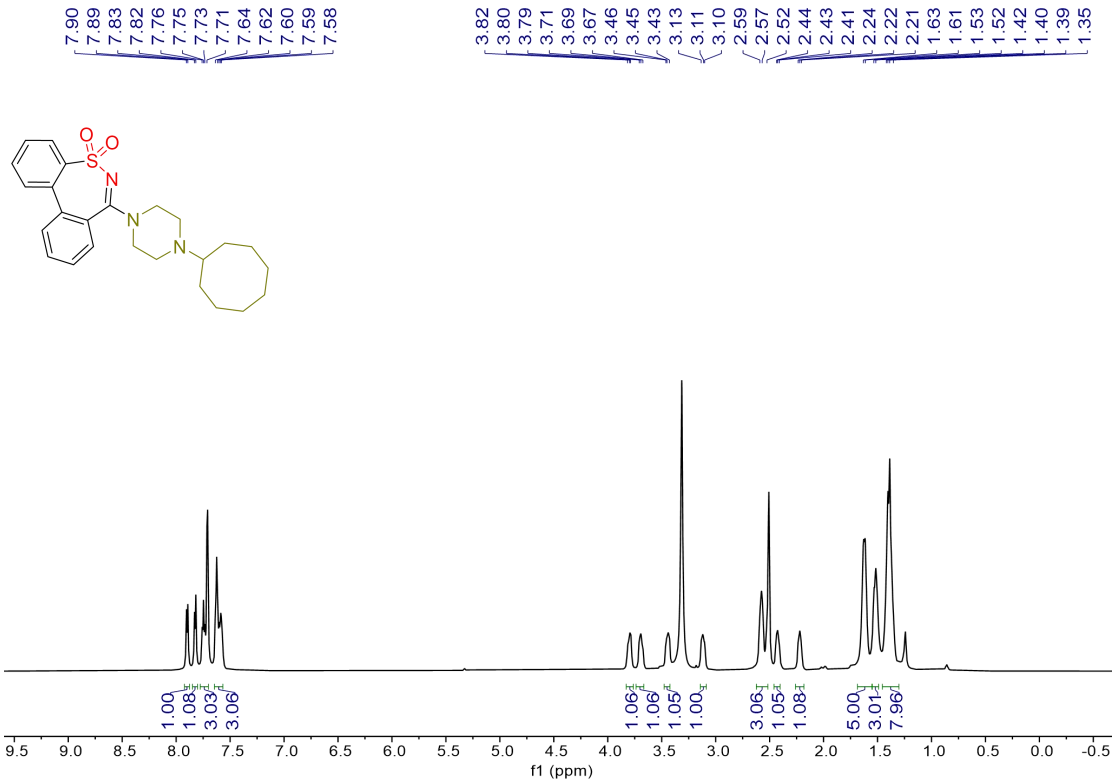
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3h**



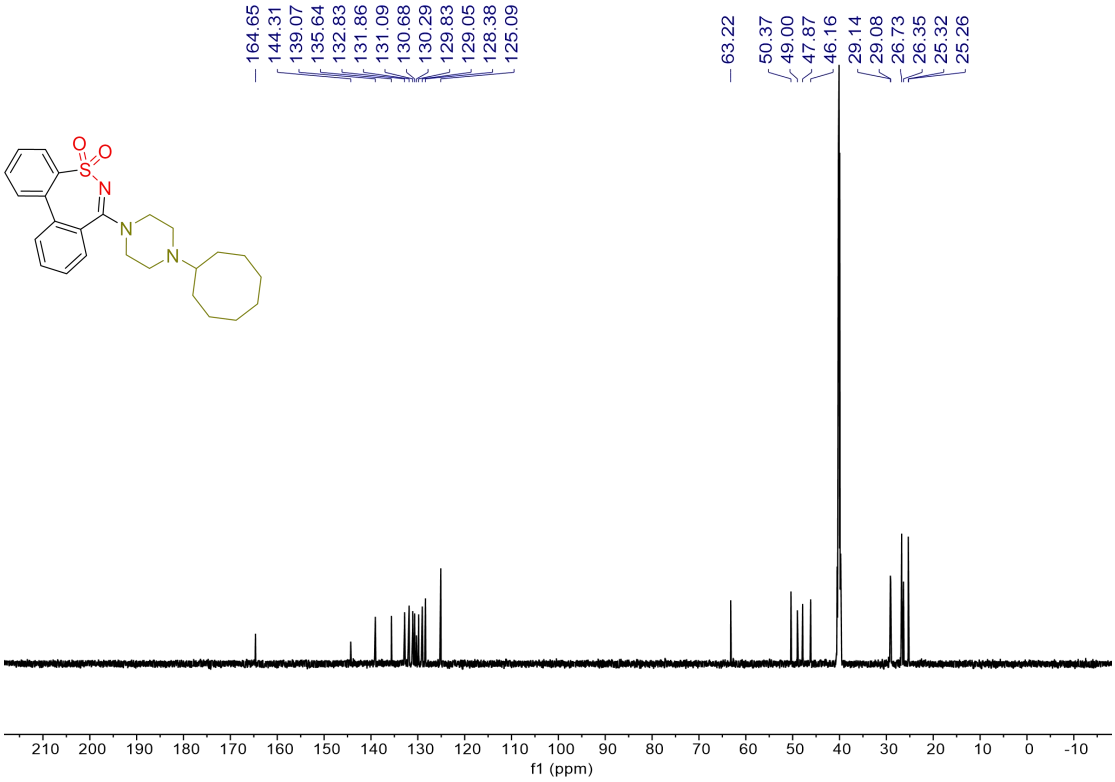
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3h**



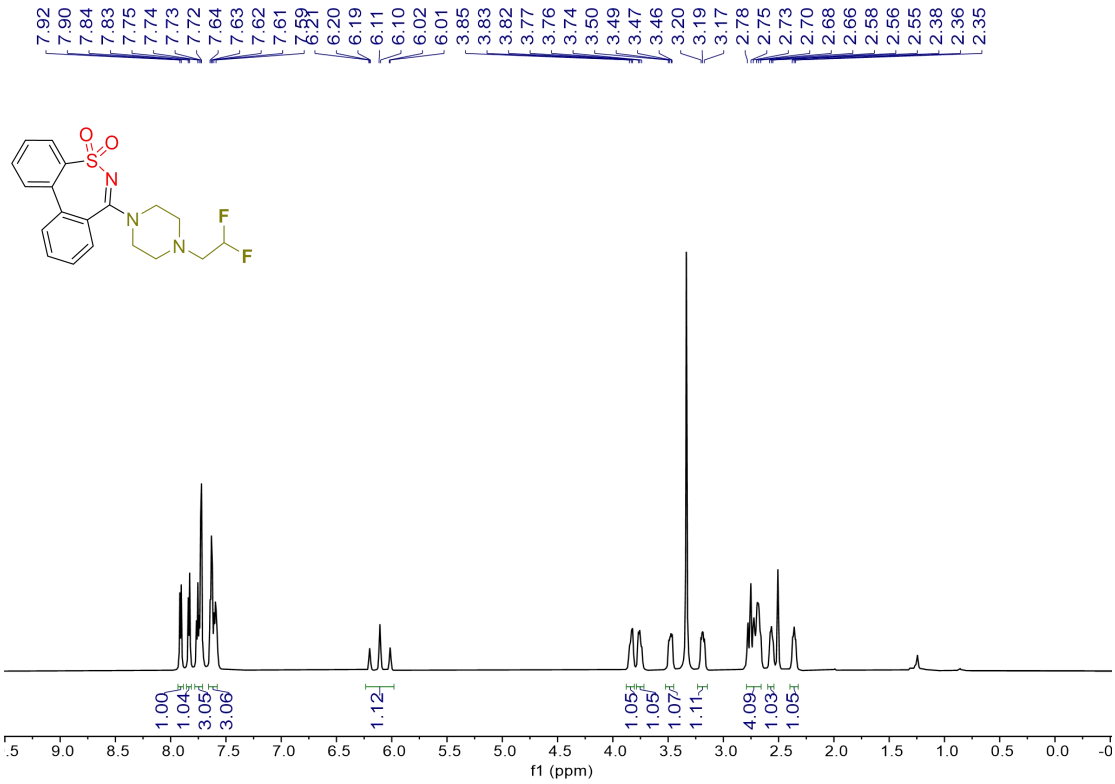
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3i**



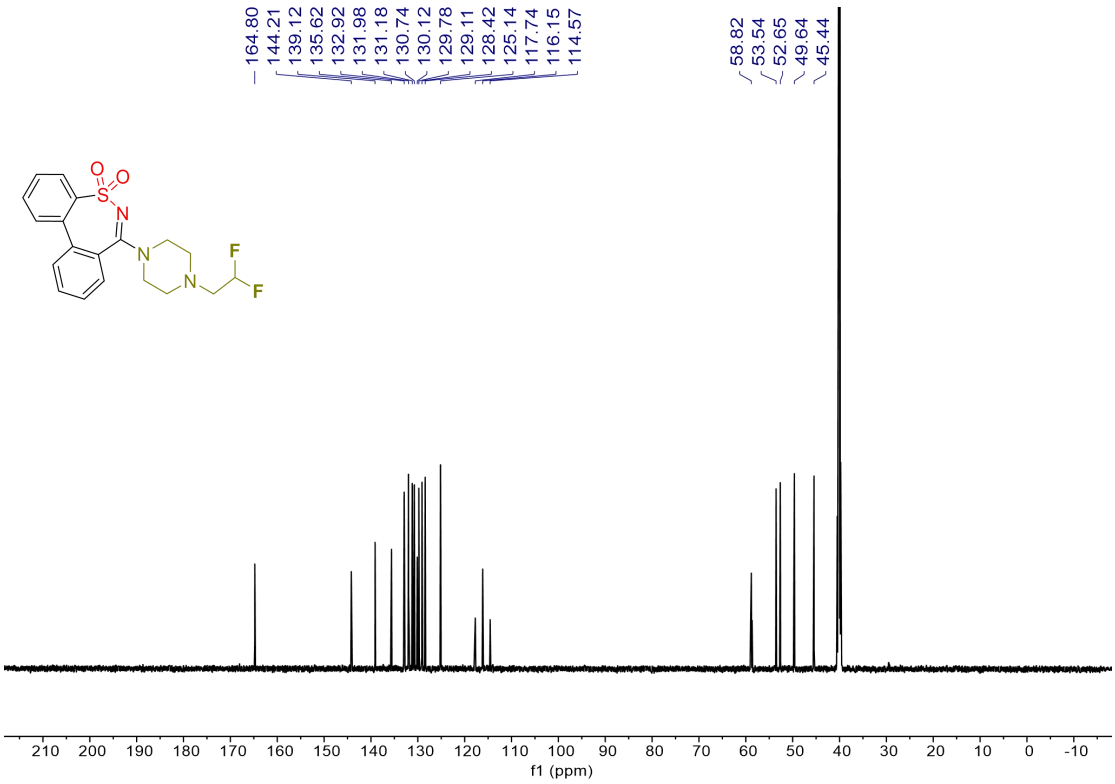
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3i**



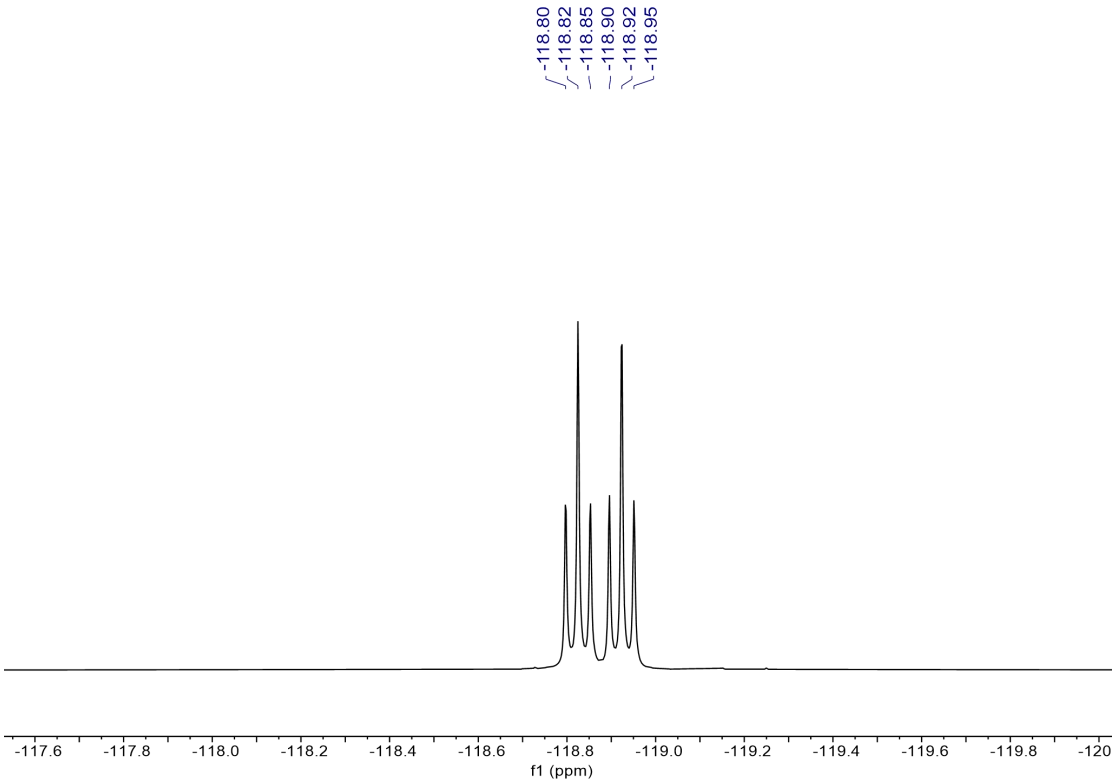
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3j**



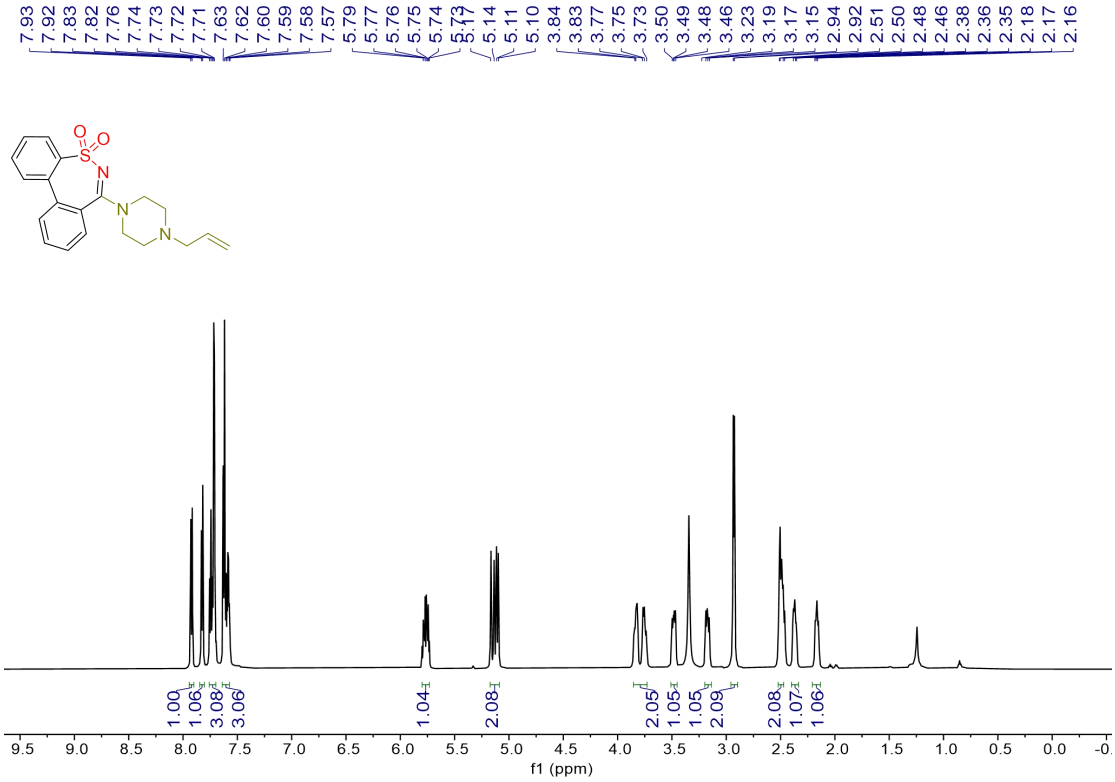
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3j**



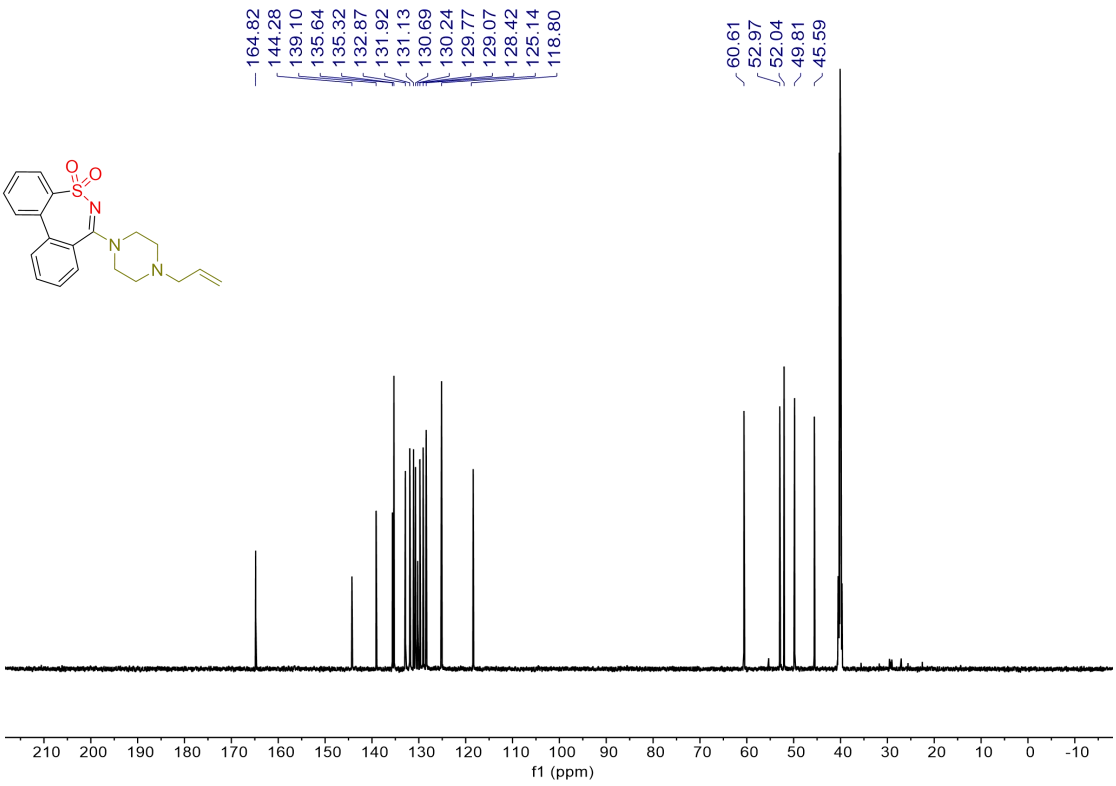
^{19}F NMR (565 MHz, DMSO-d_6) of compound **3j**



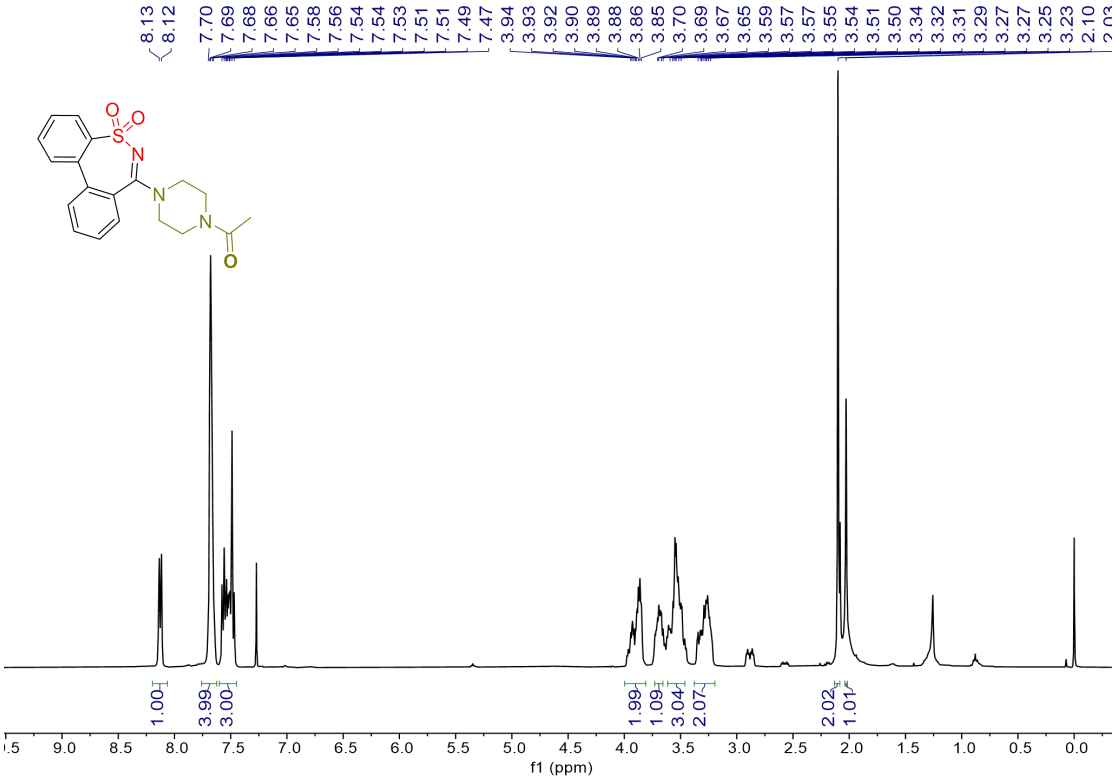
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3k**



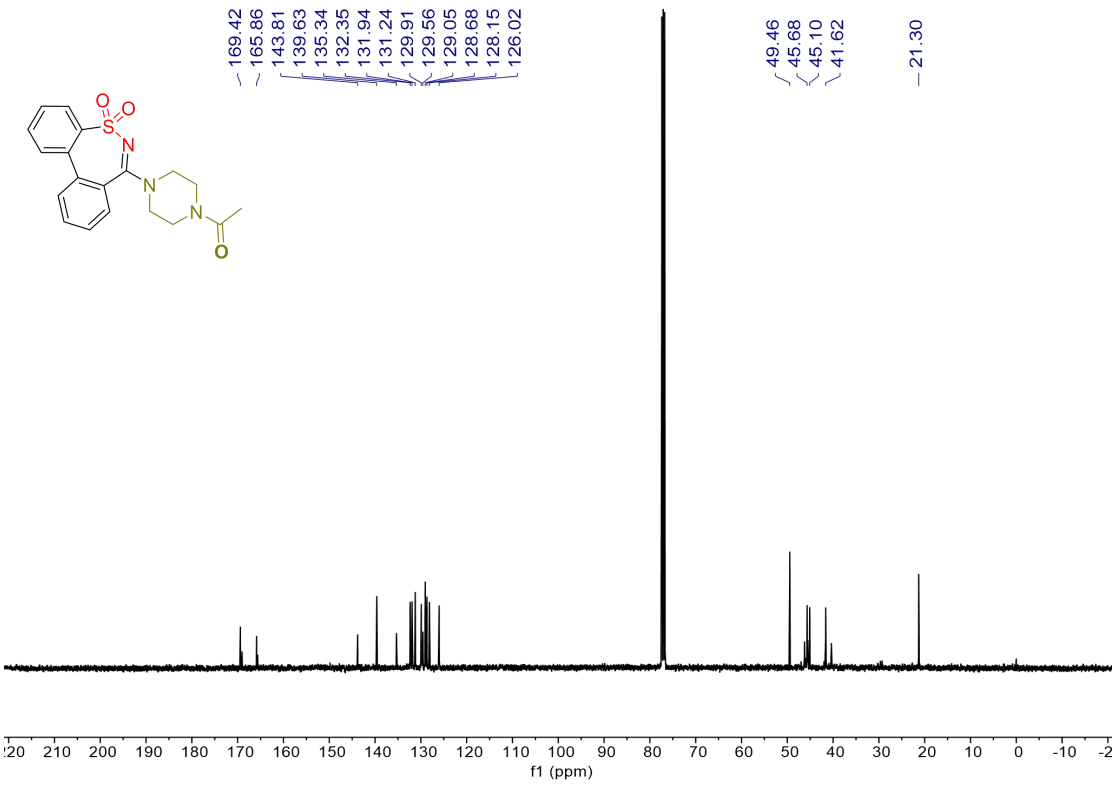
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3k**



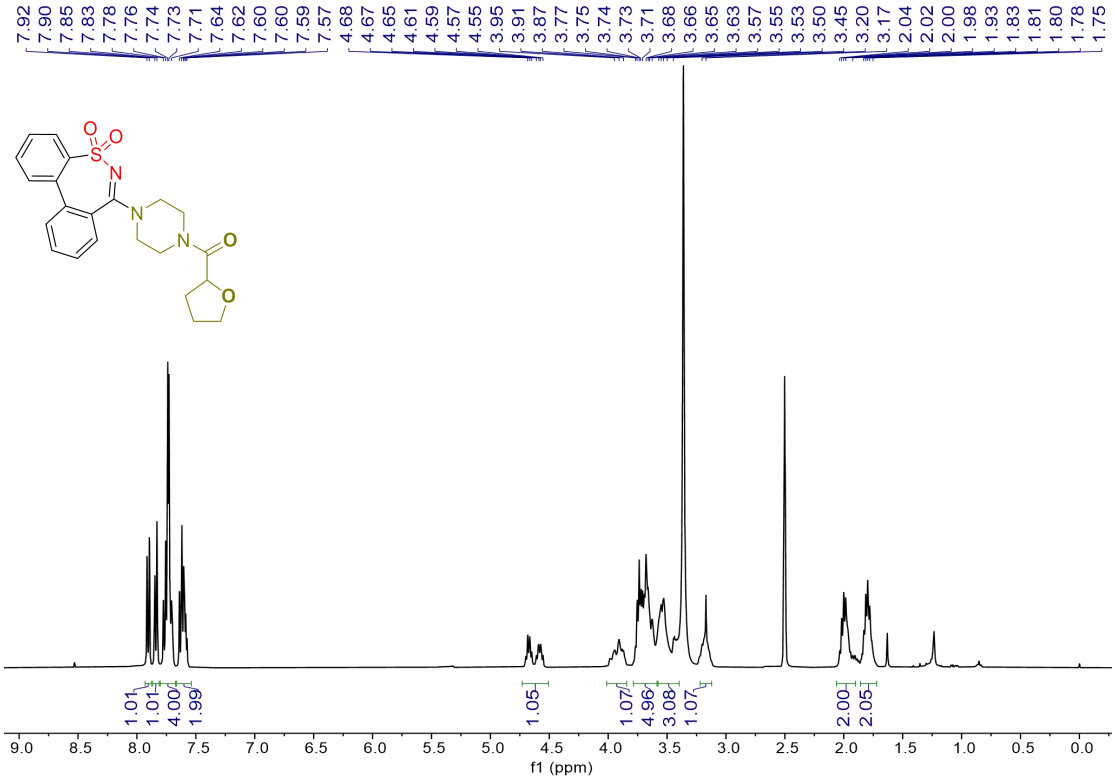
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3l**



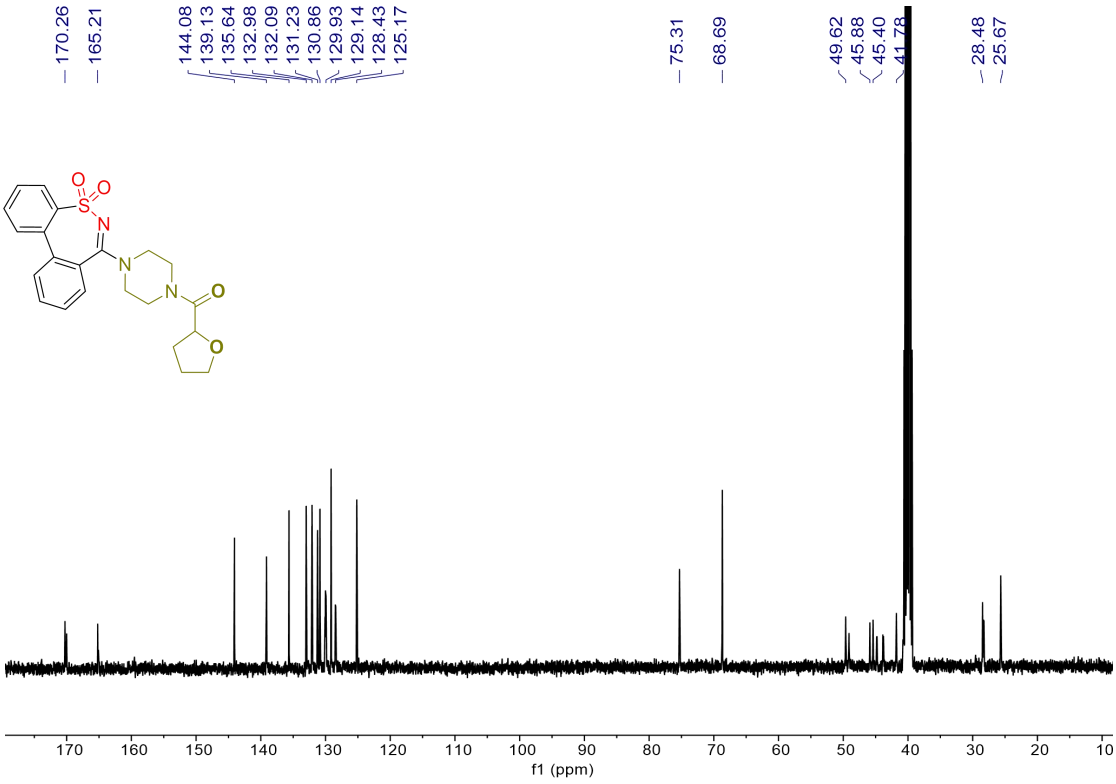
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3l**



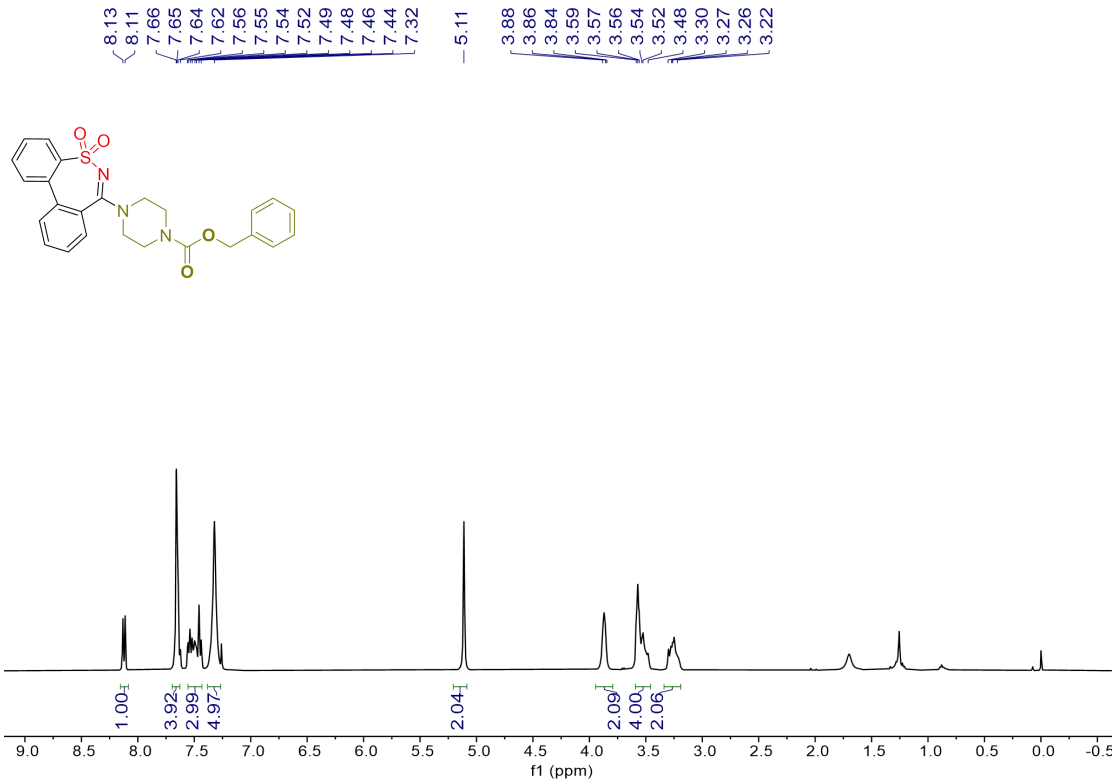
^{1}H NMR (400 MHz, DMSO-d_6) of compound **3m**



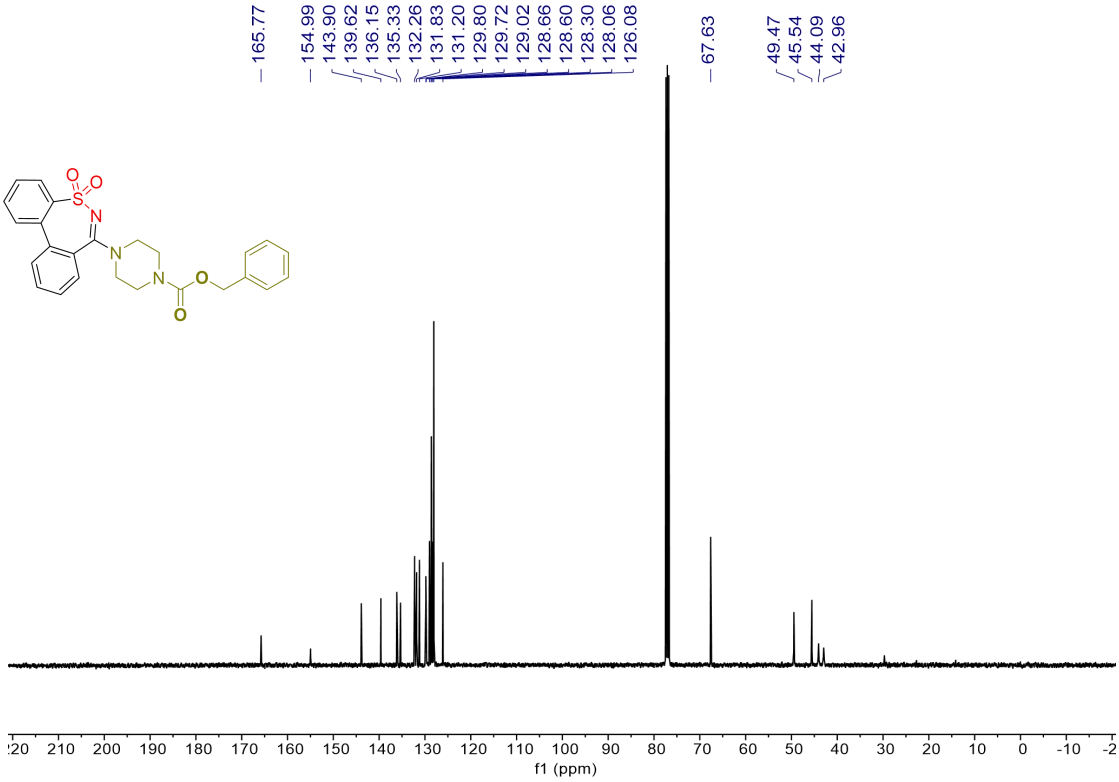
^{13}C NMR (101 MHz, DMSO-d_6) of compound **3m**



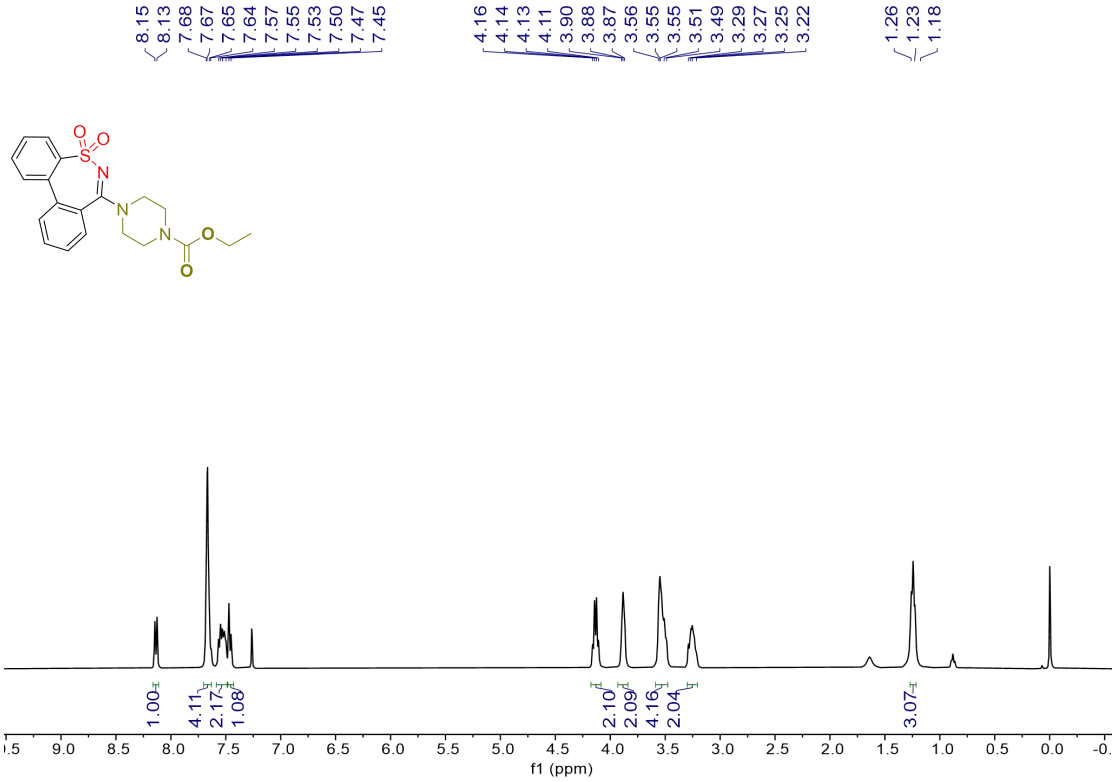
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3n**



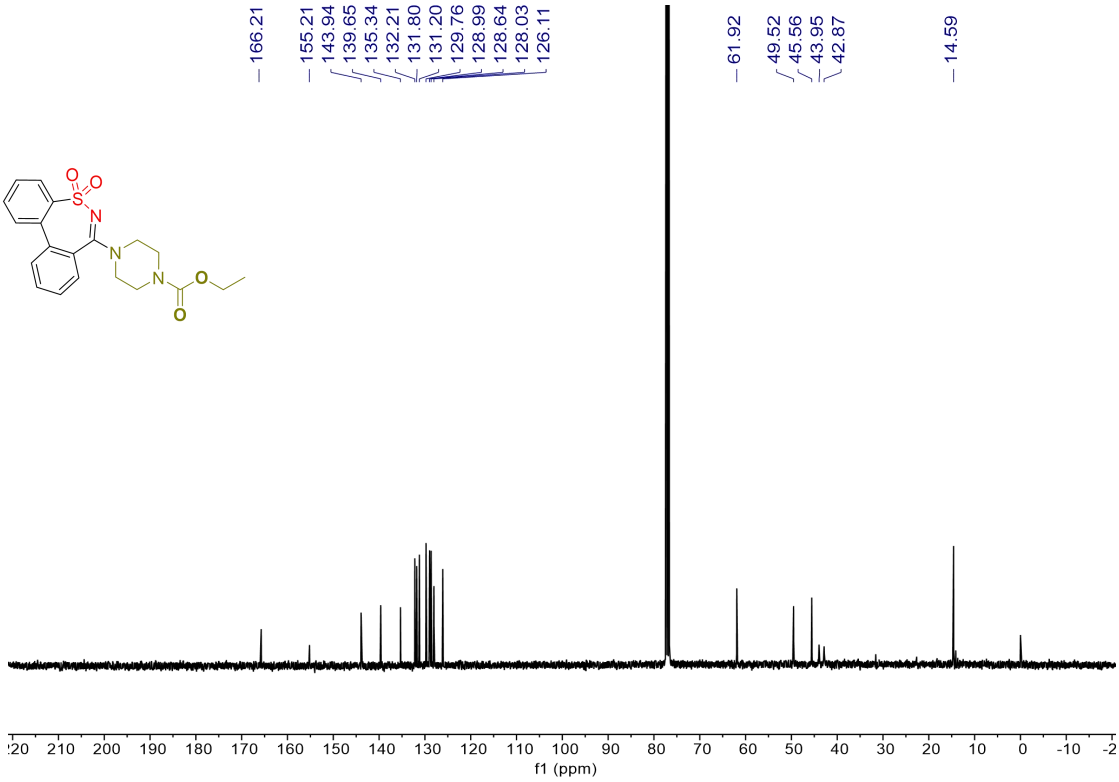
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3n**



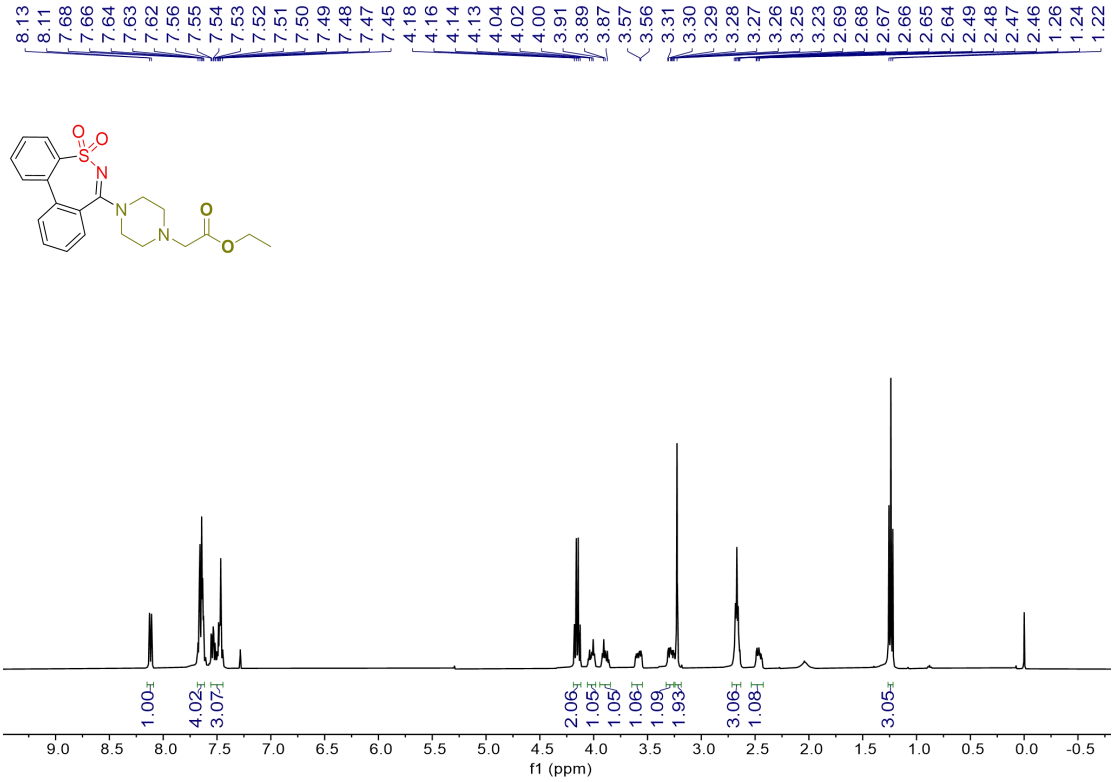
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3o**



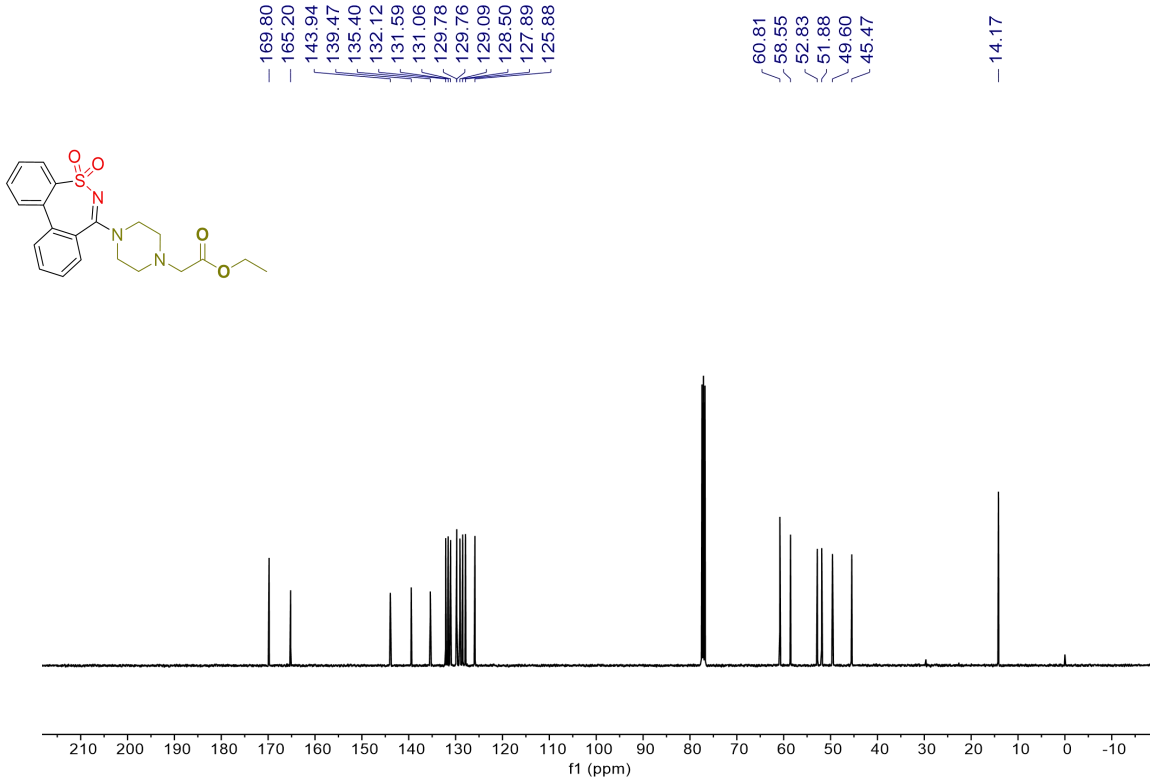
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3o**



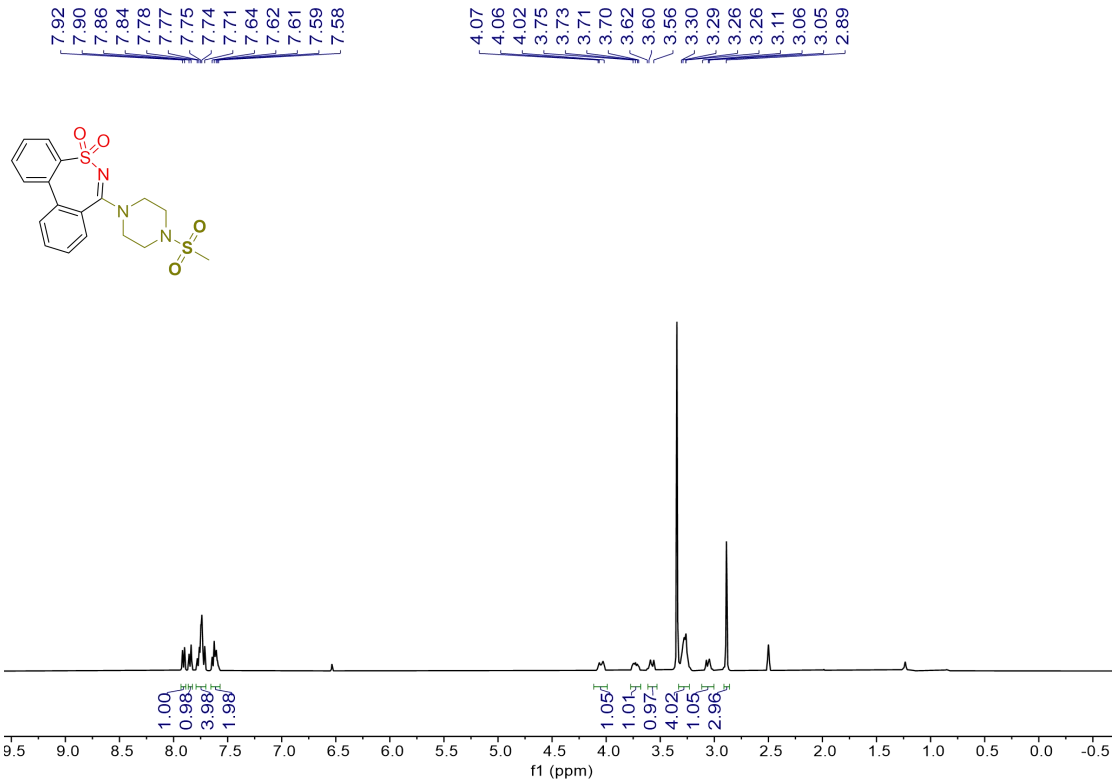
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3p**



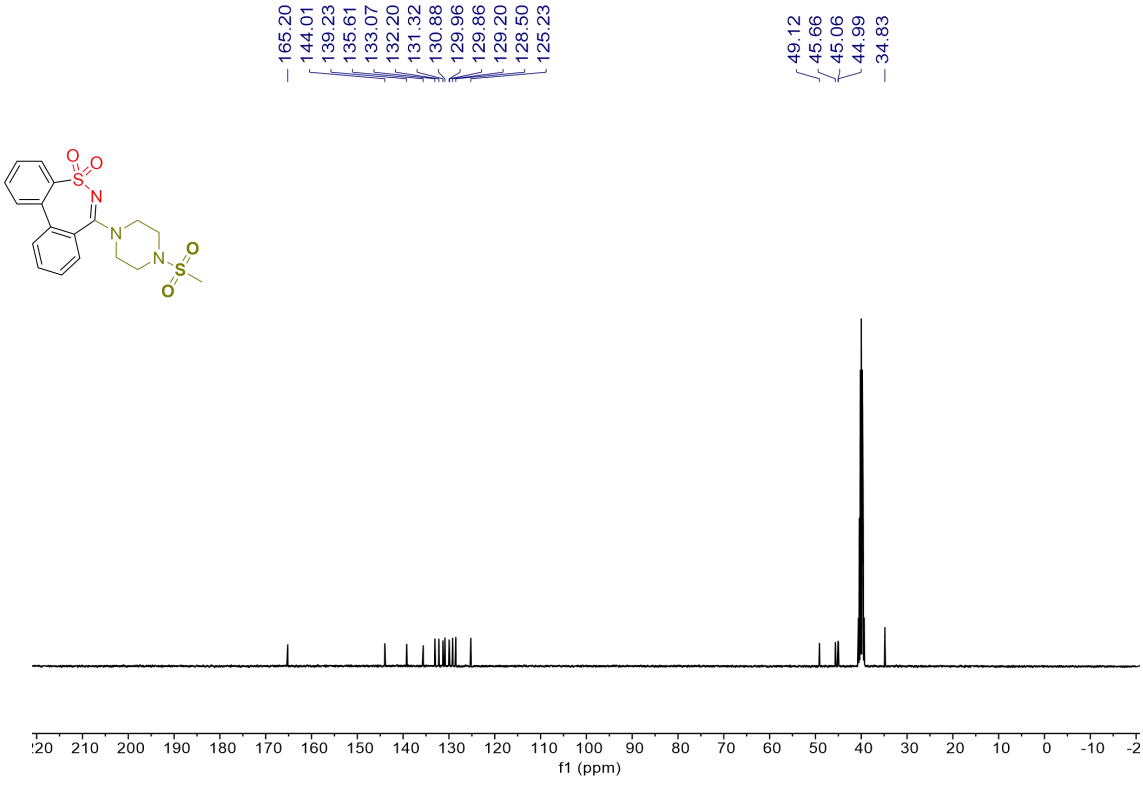
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3p**



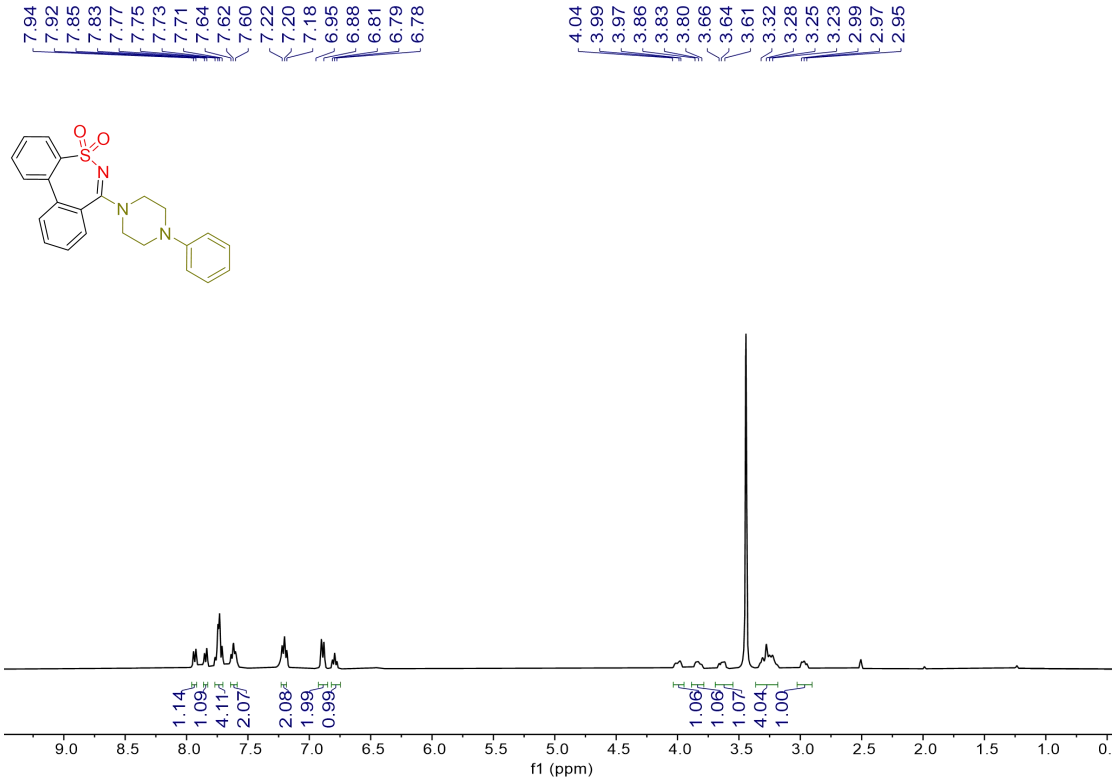
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3q**



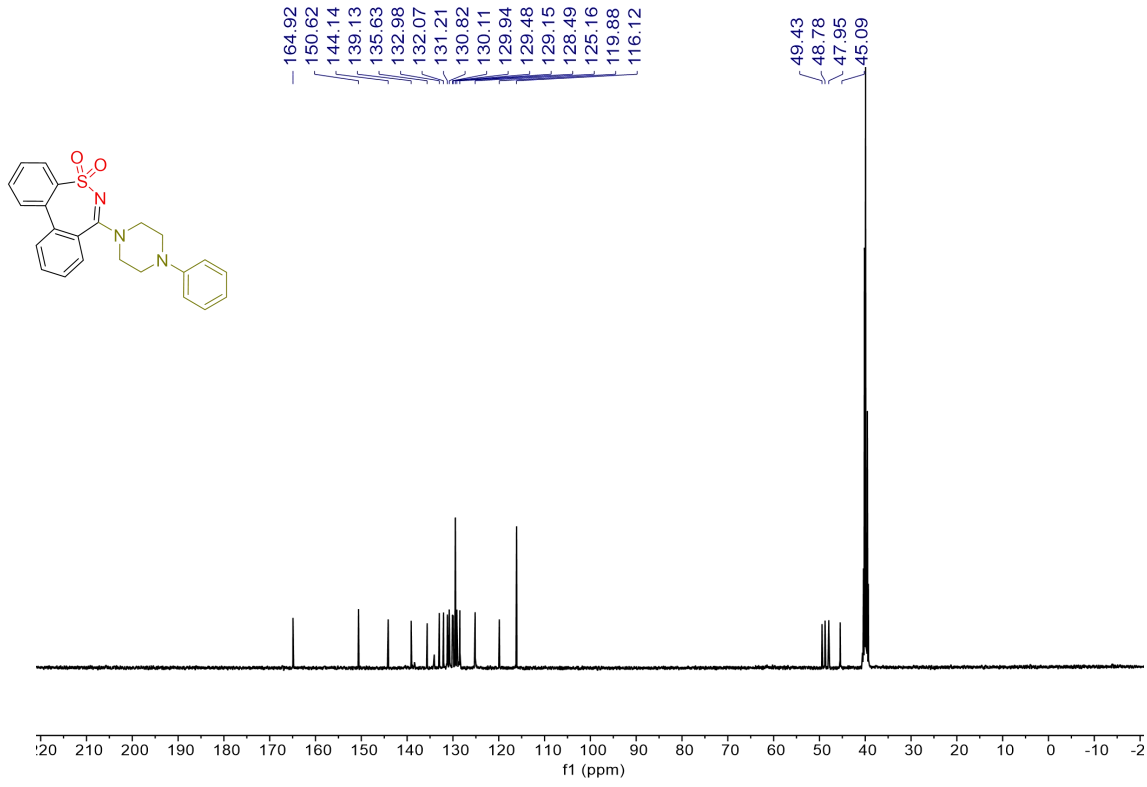
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3q**



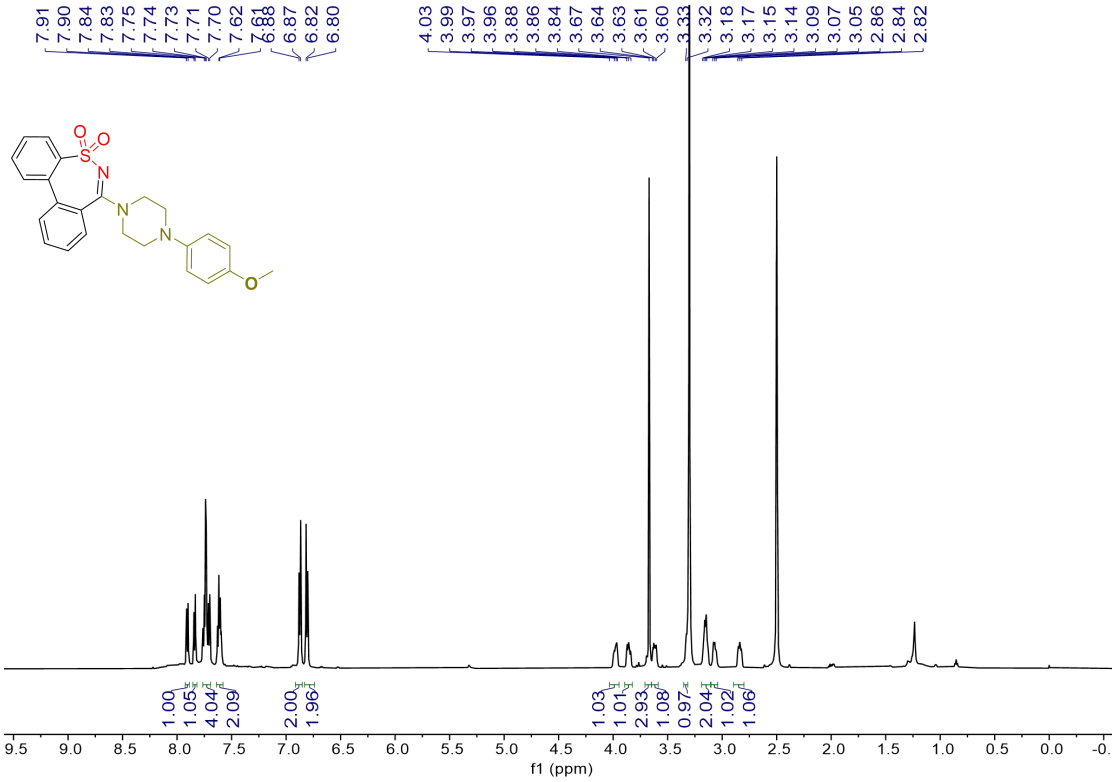
^{1}H NMR (400 MHz, DMSO-d_6) of compound **3r**



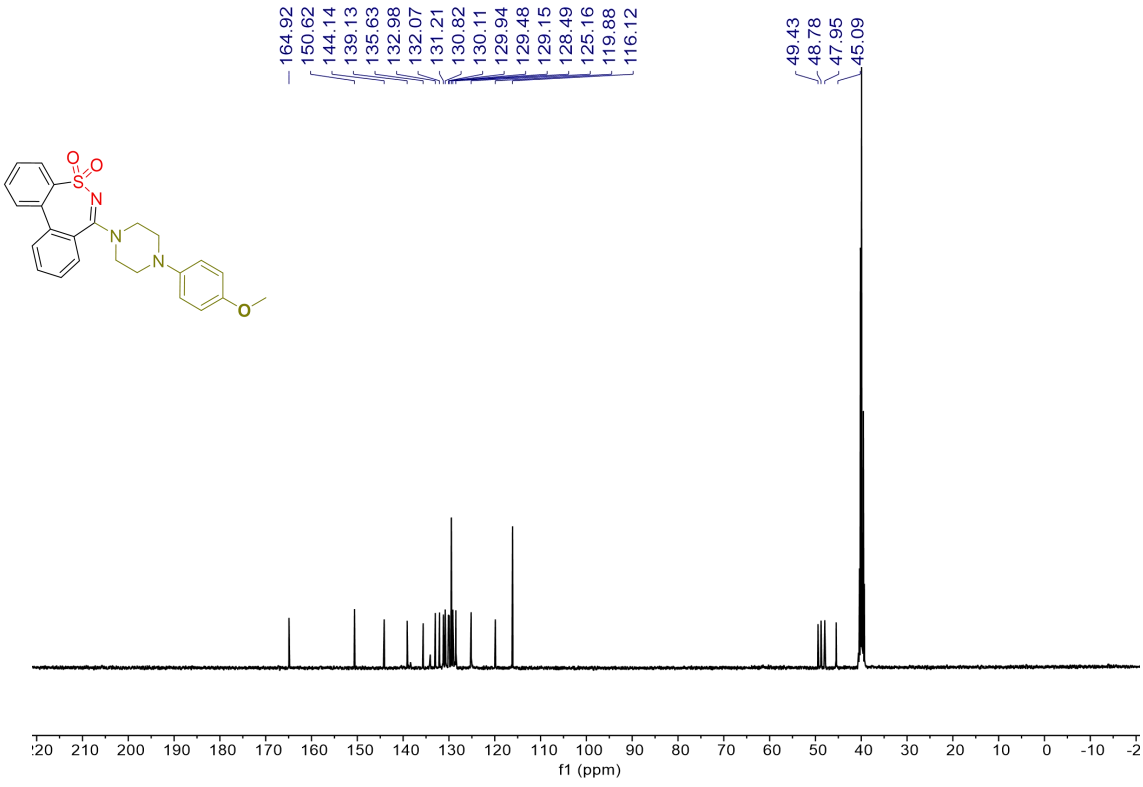
^{13}C NMR (101 MHz, DMSO-d_6) of compound **3r**



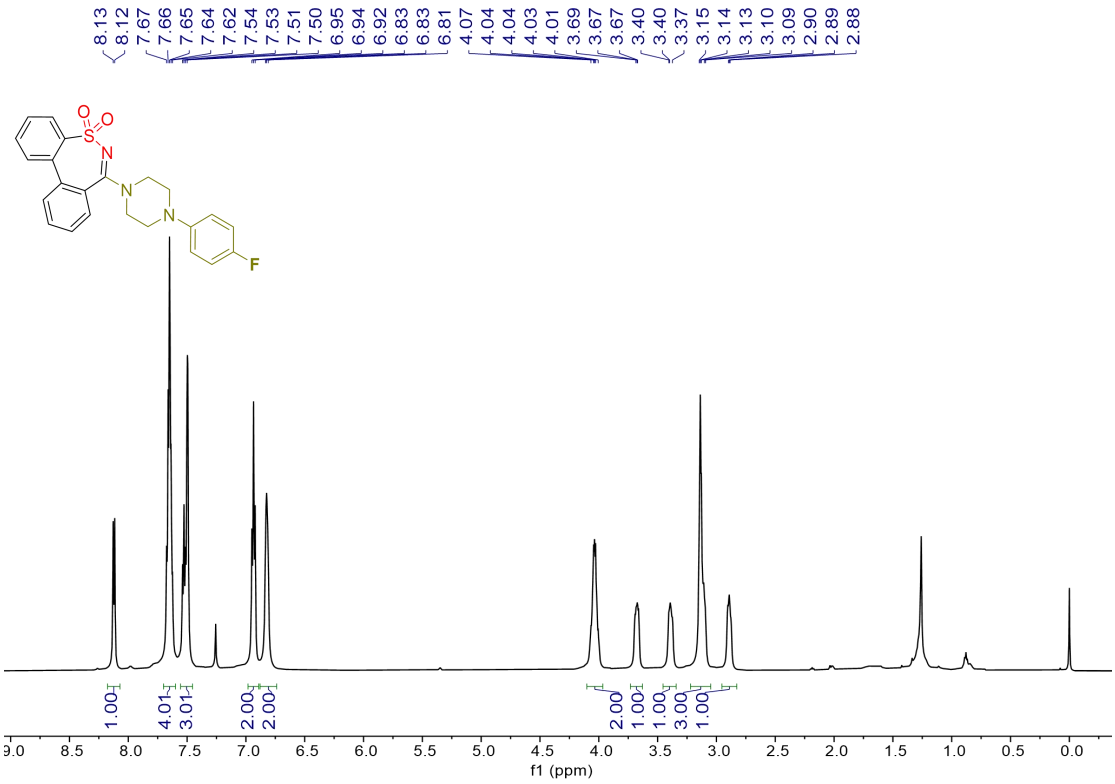
^{1}H NMR (600 MHz, $CDCl_3$) of compound **3s**



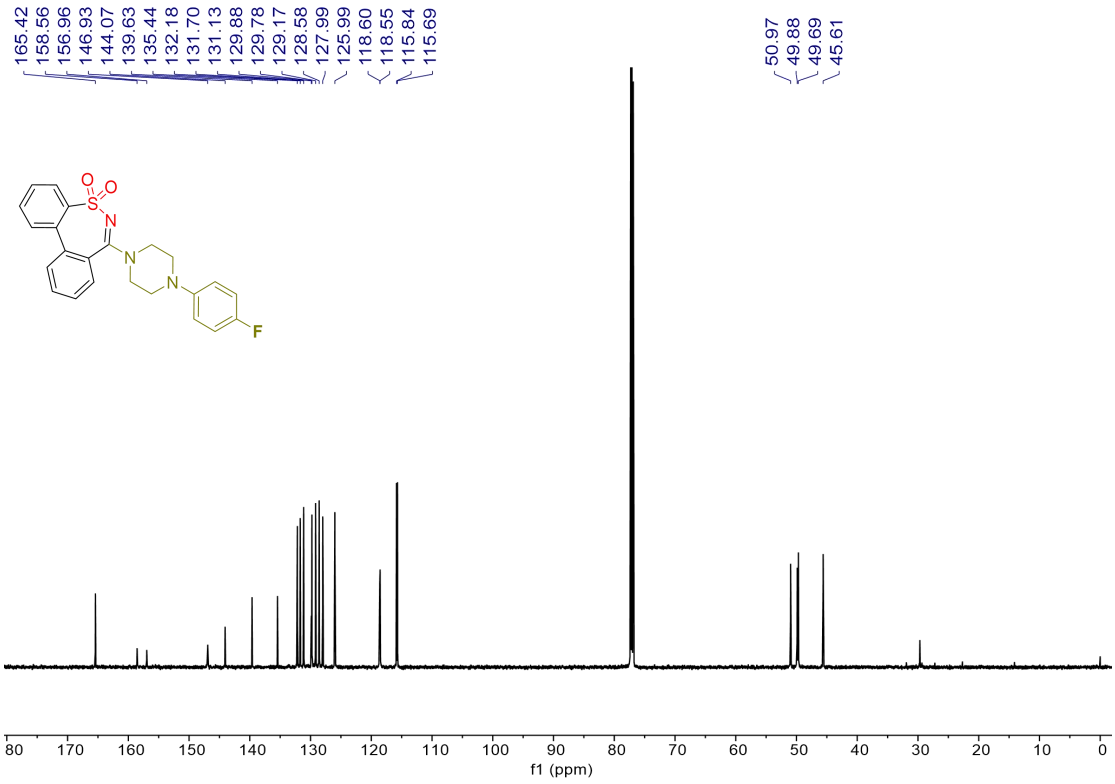
^{13}C NMR (151 MHz, $CDCl_3$) of compound **3s**



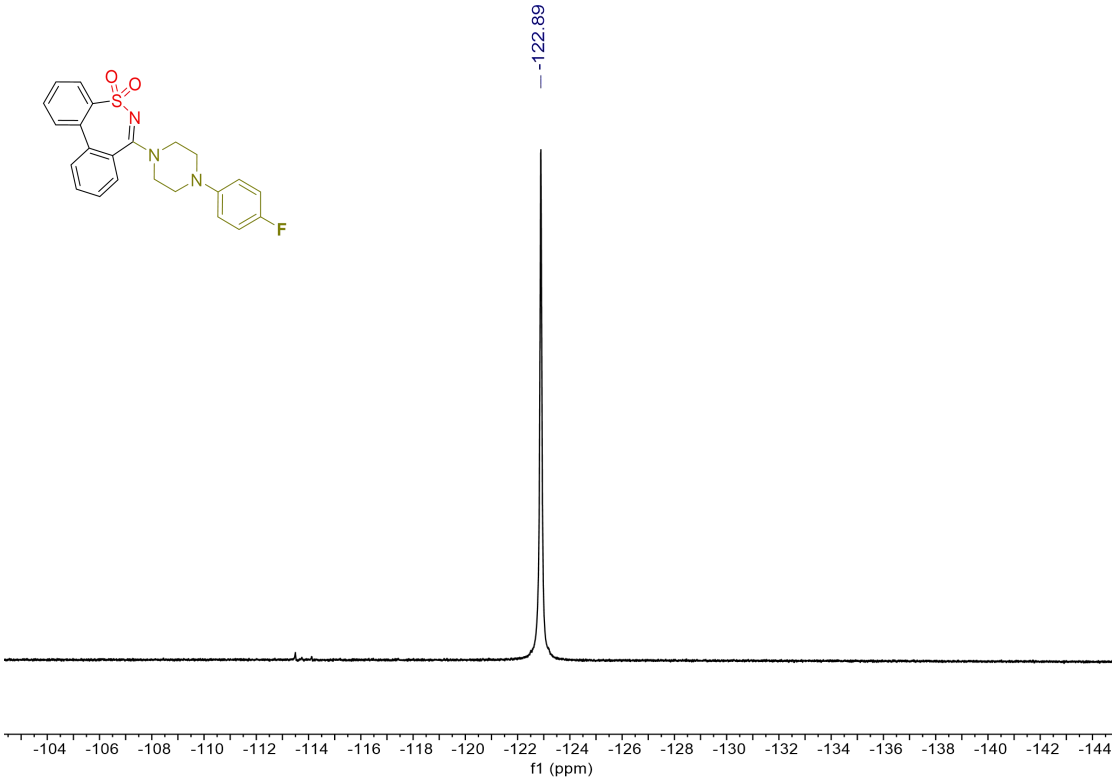
^{1}H NMR (600 MHz, $CDCl_3$) of compound **3t**



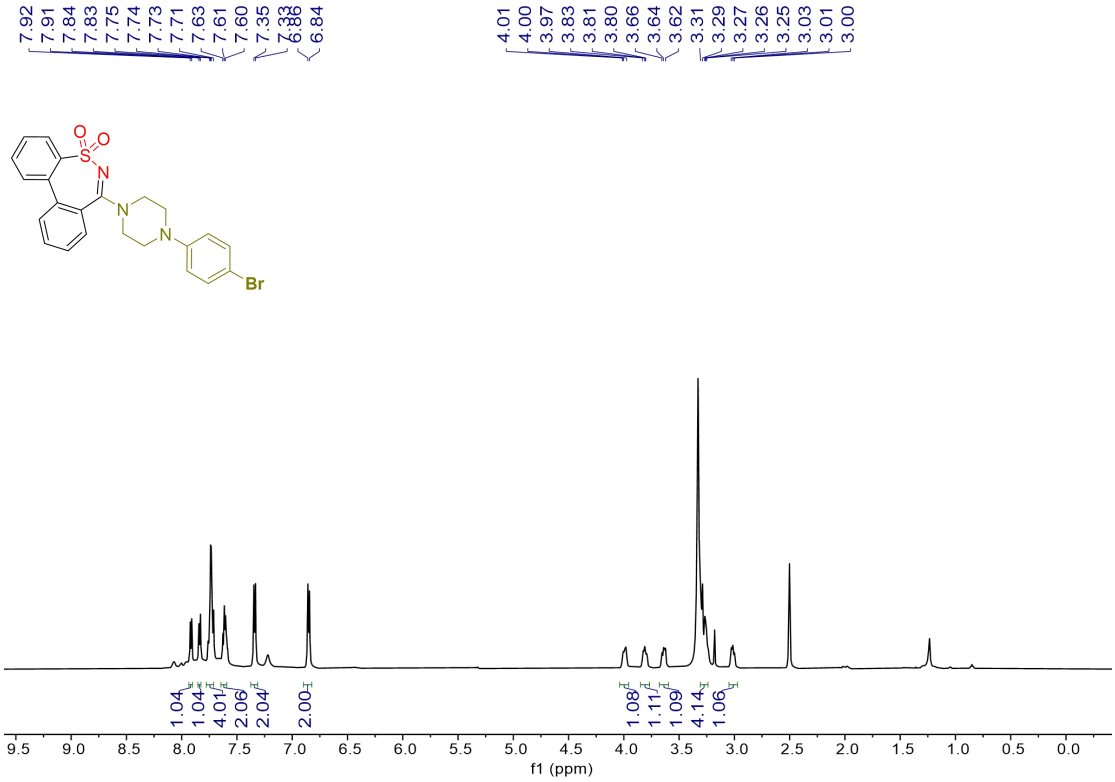
^{13}C NMR (151 MHz, $CDCl_3$) of compound **3t**



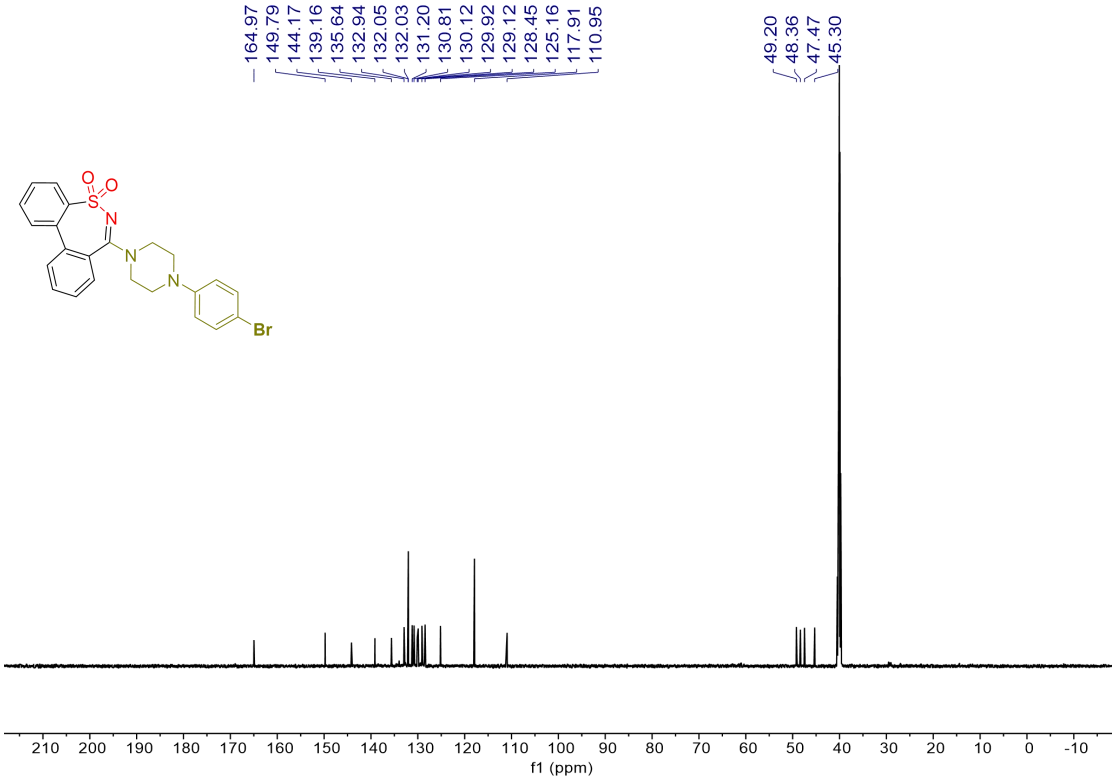
^{19}F NMR (565 MHz, $CDCl_3$) of compound **3t**



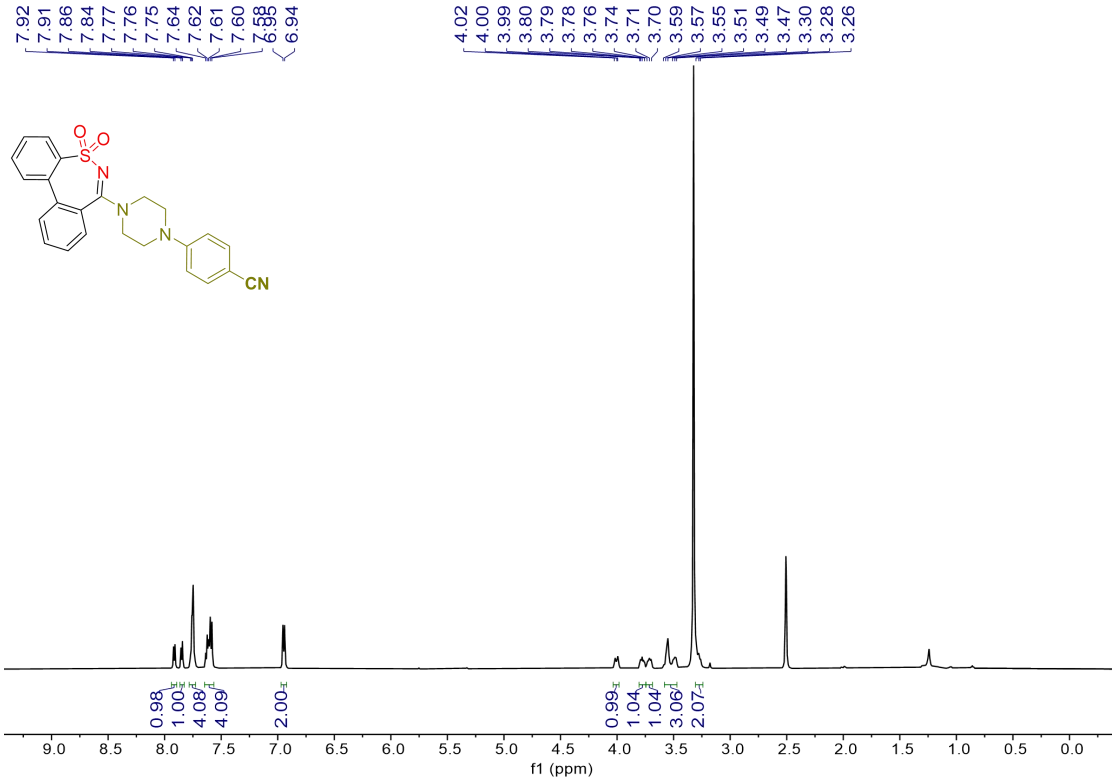
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3u**



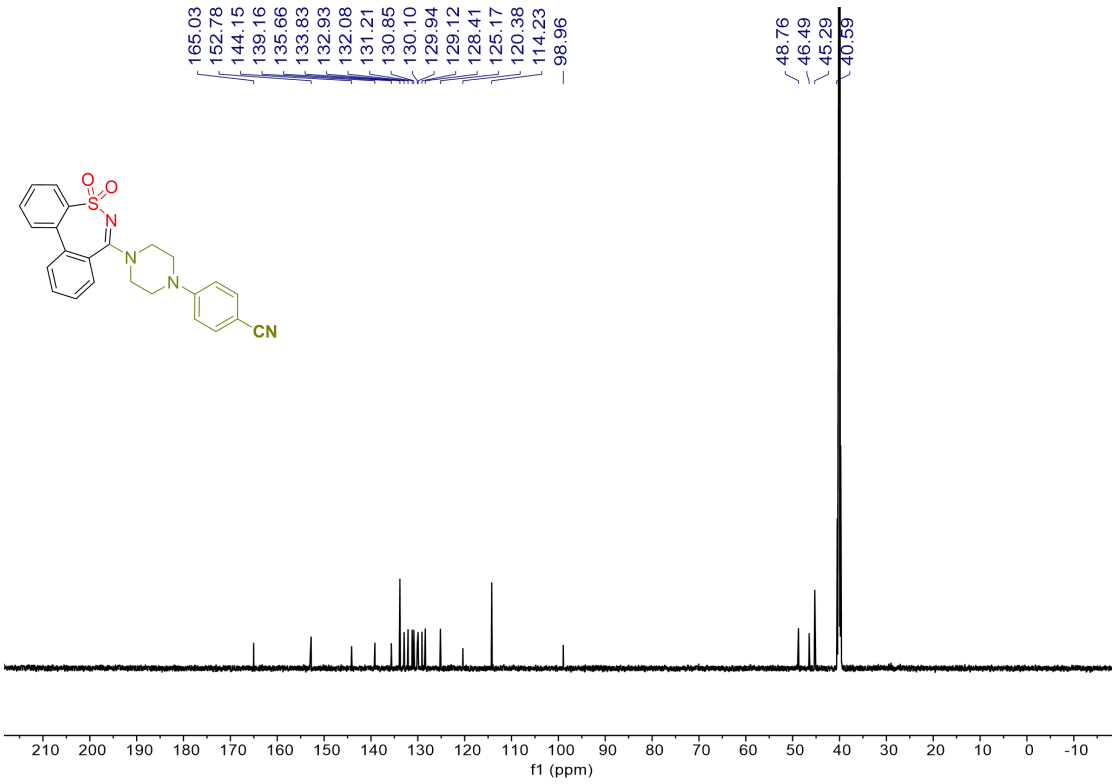
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3u**



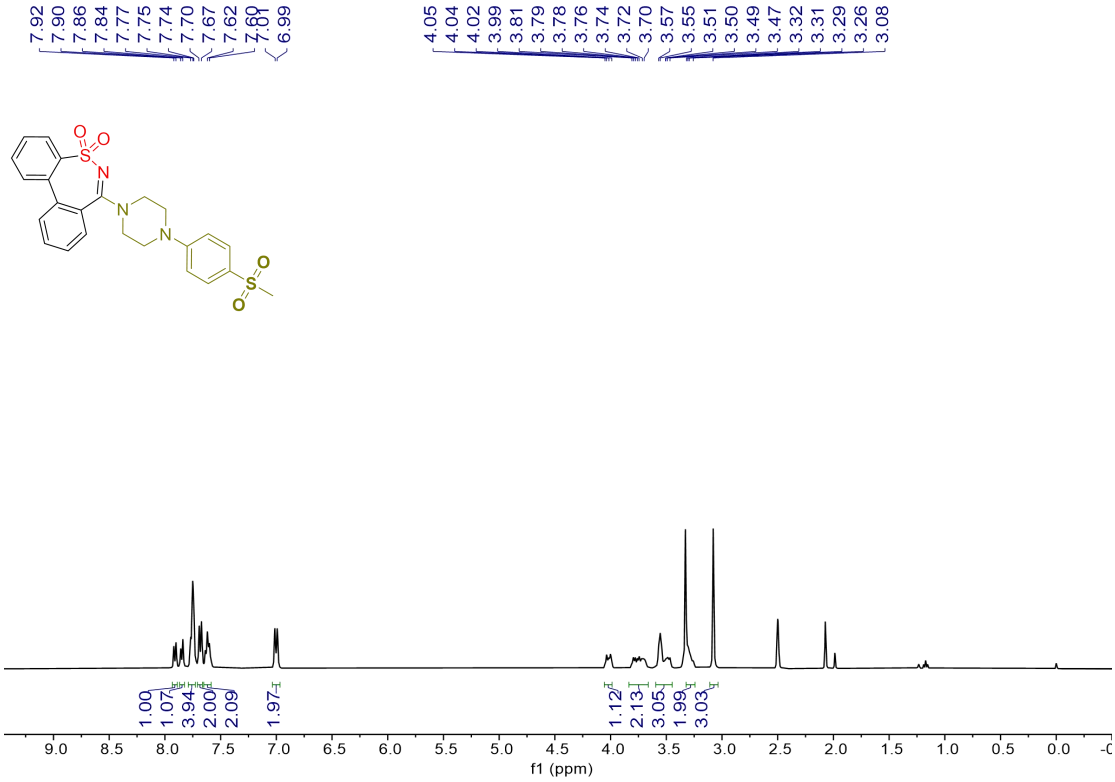
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3v**



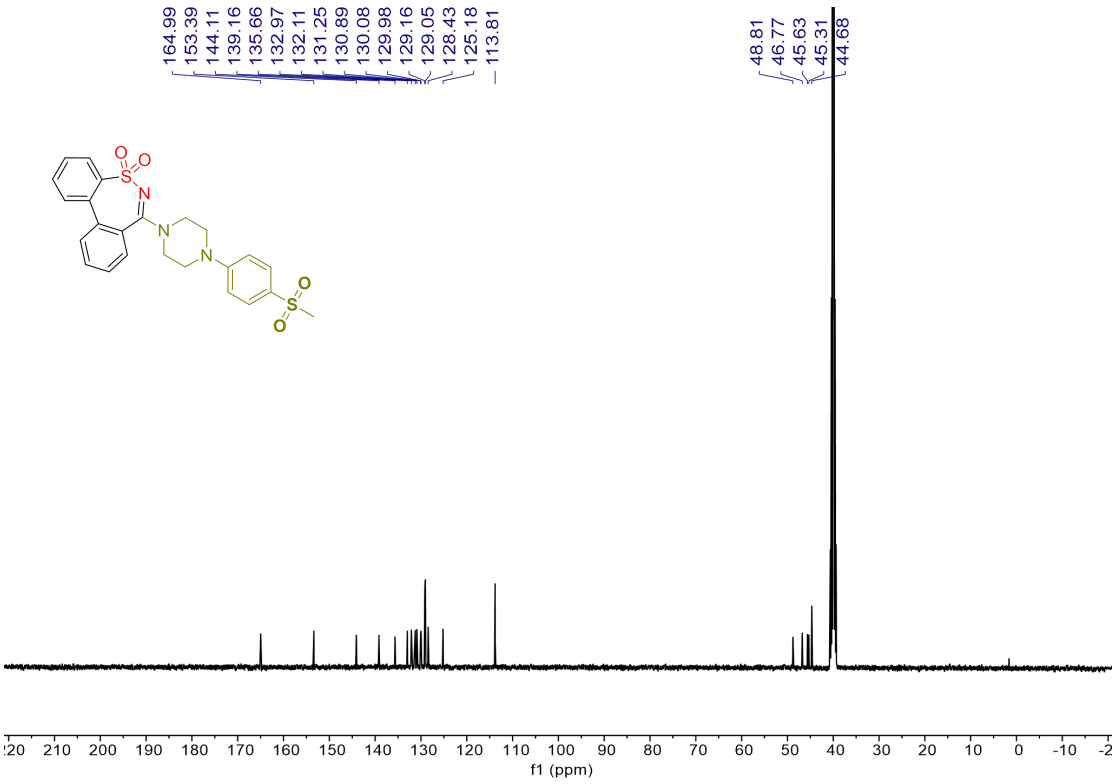
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3v**



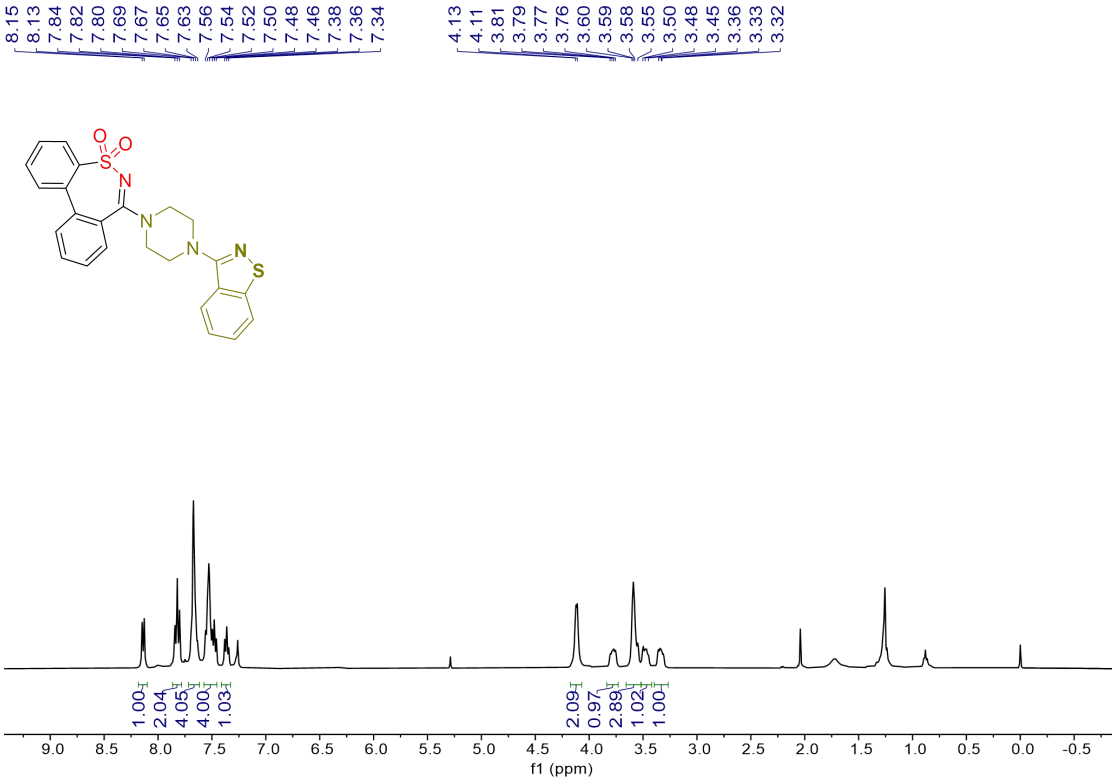
^{1}H NMR (400 MHz, DMSO-d_6) of compound **3w**



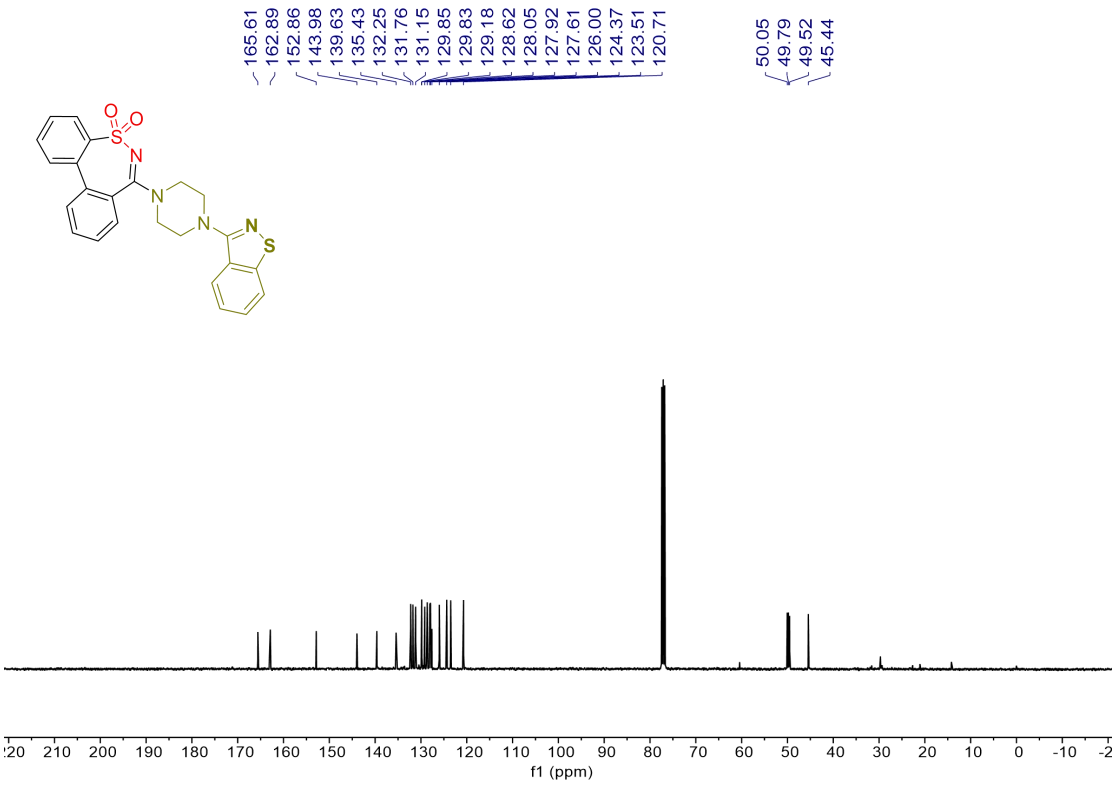
^{13}C NMR (101 MHz, DMSO-d_6) of compound **3w**



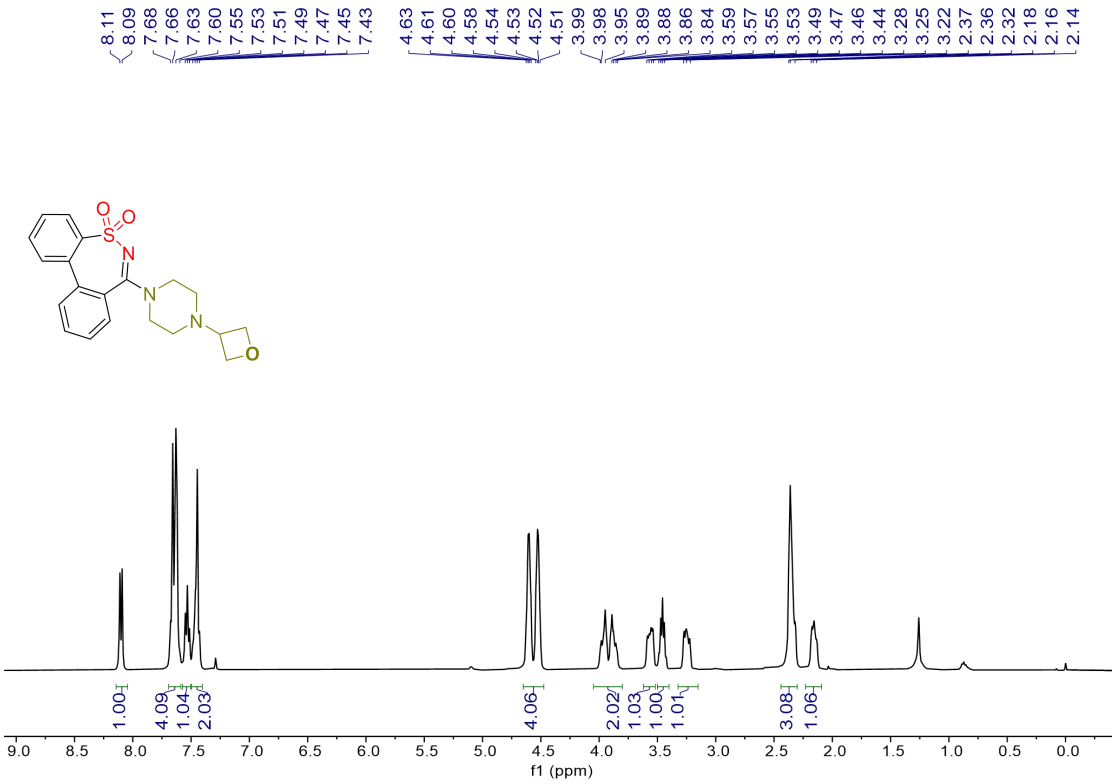
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3x**



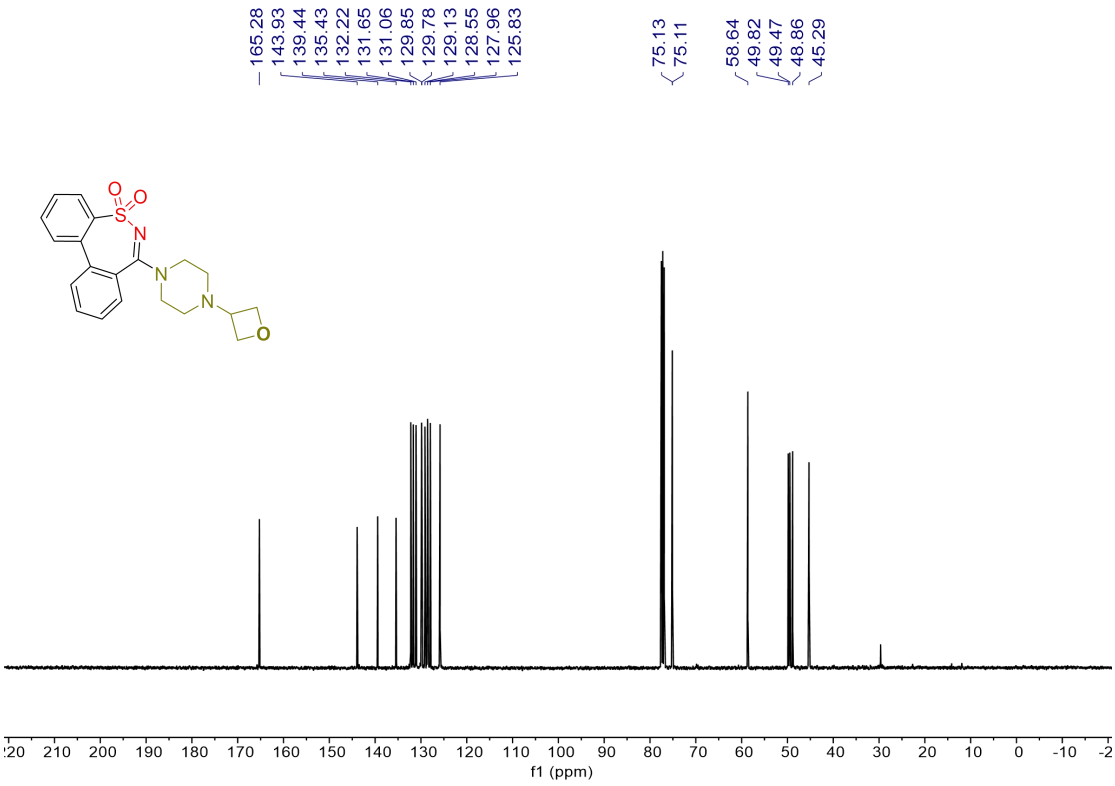
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3x**



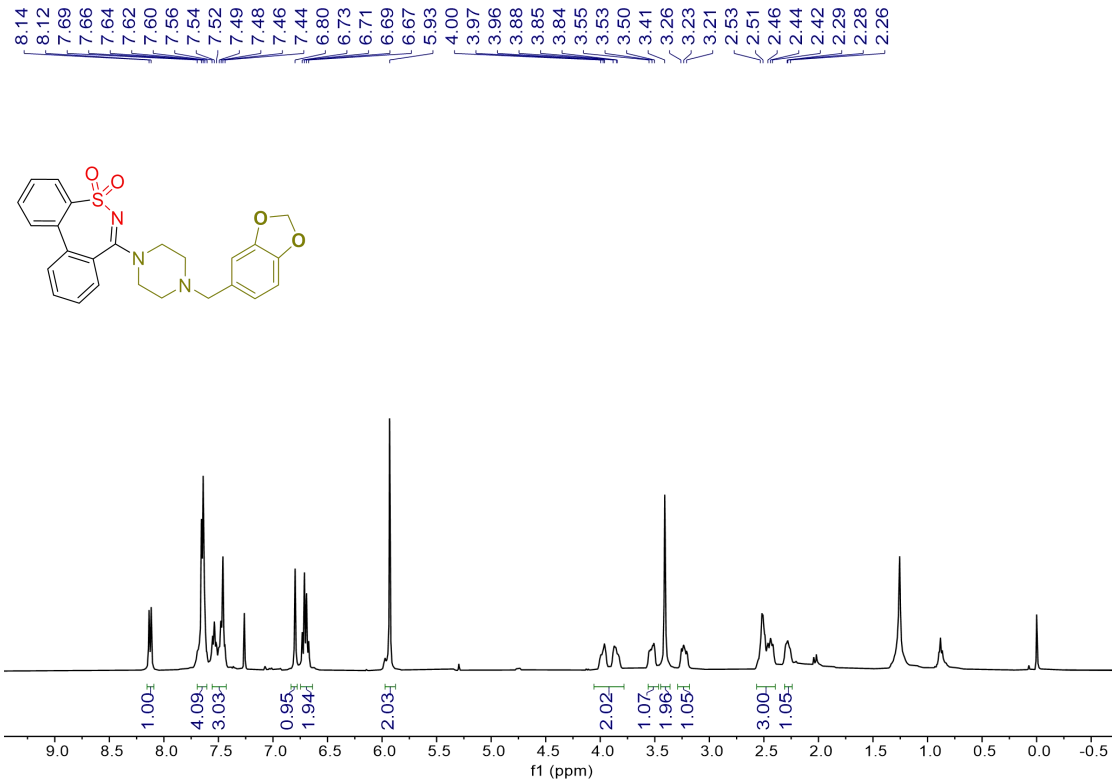
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3y**



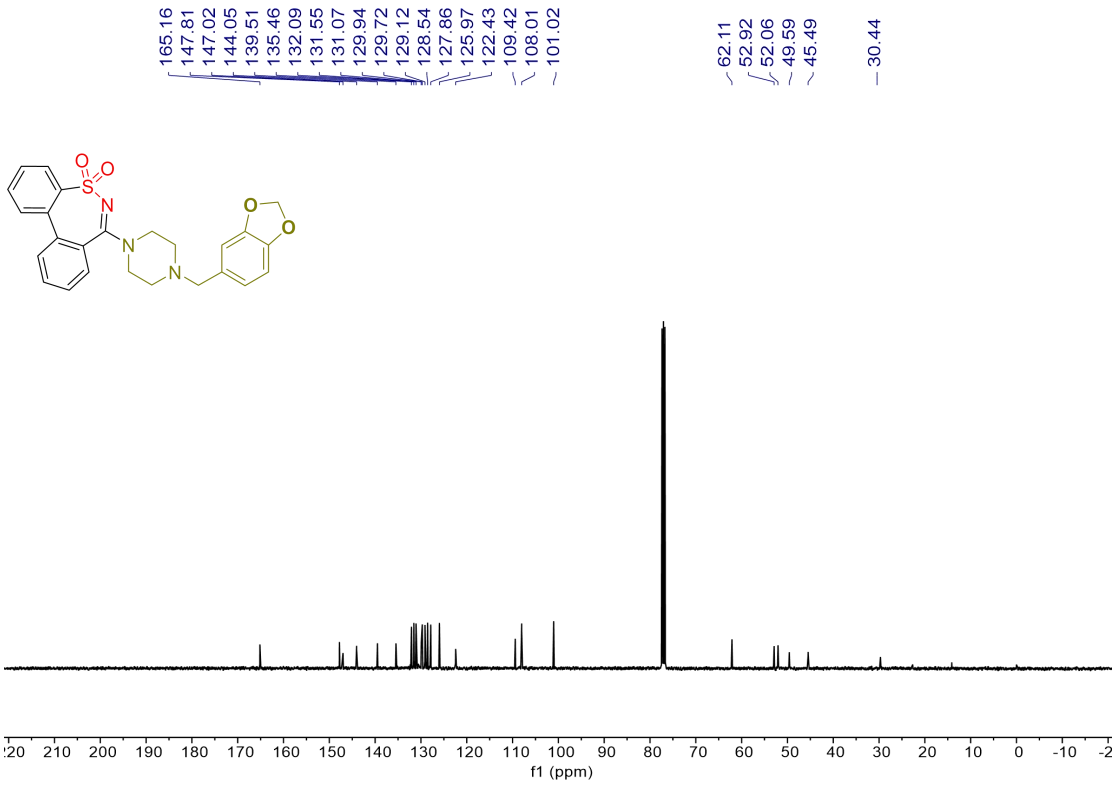
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3y**



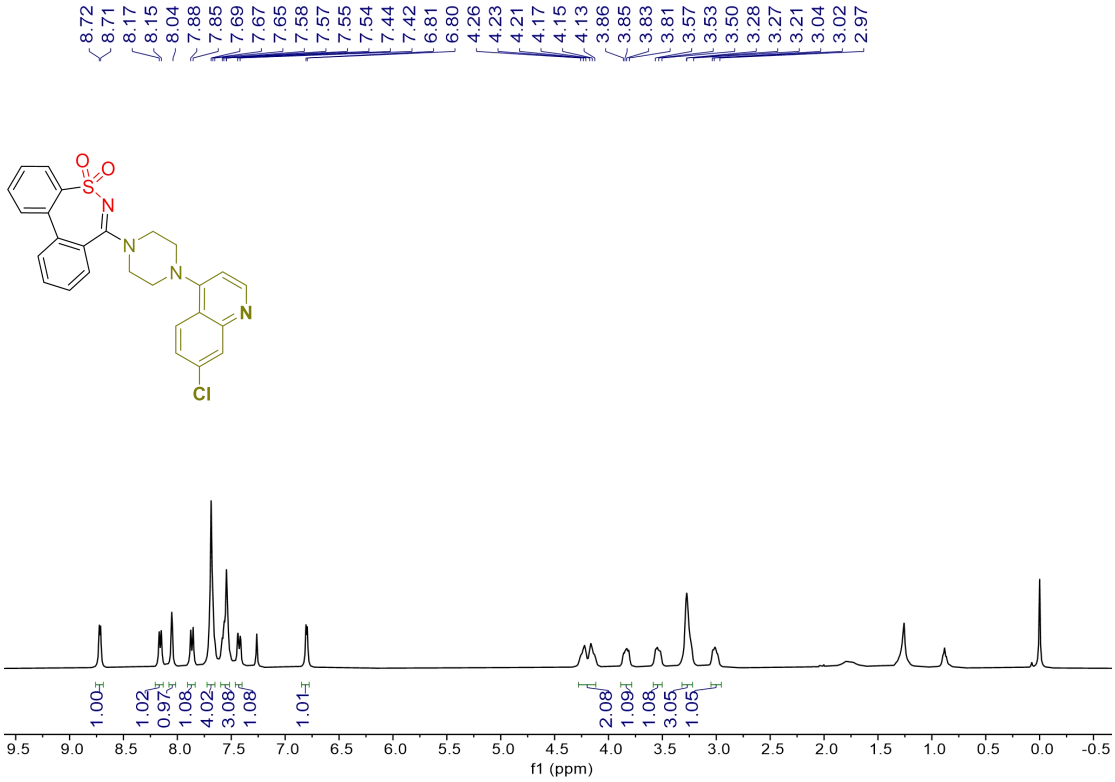
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3z**



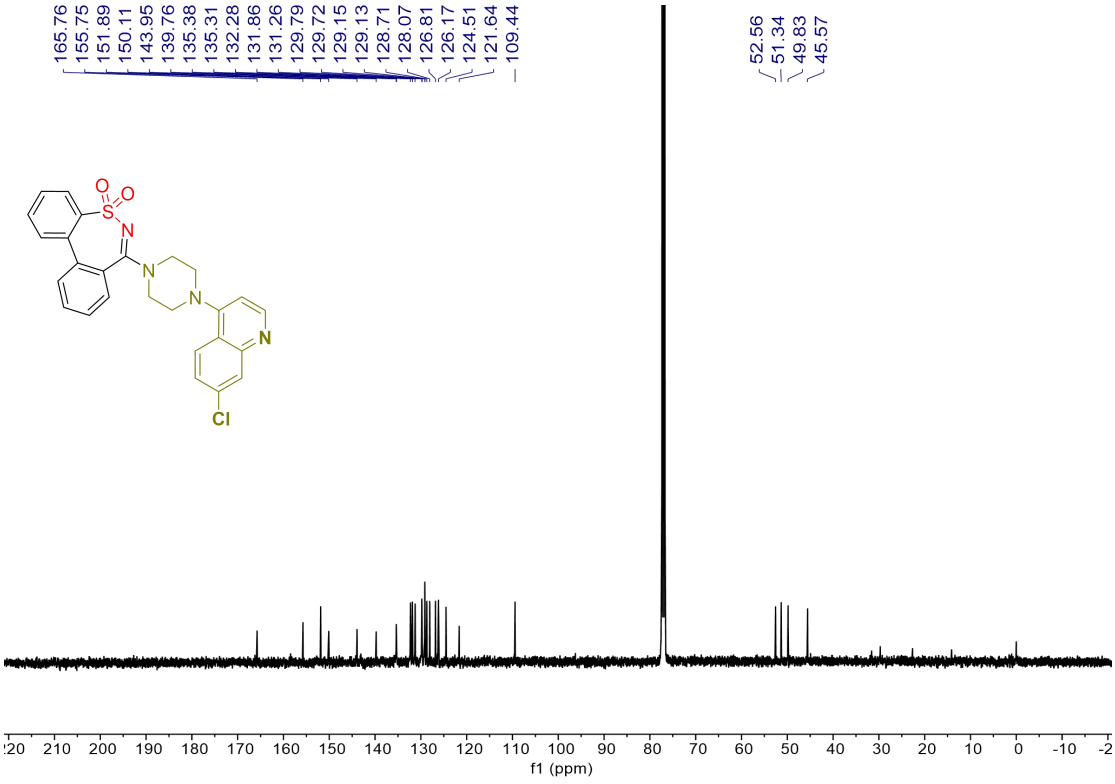
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3z**



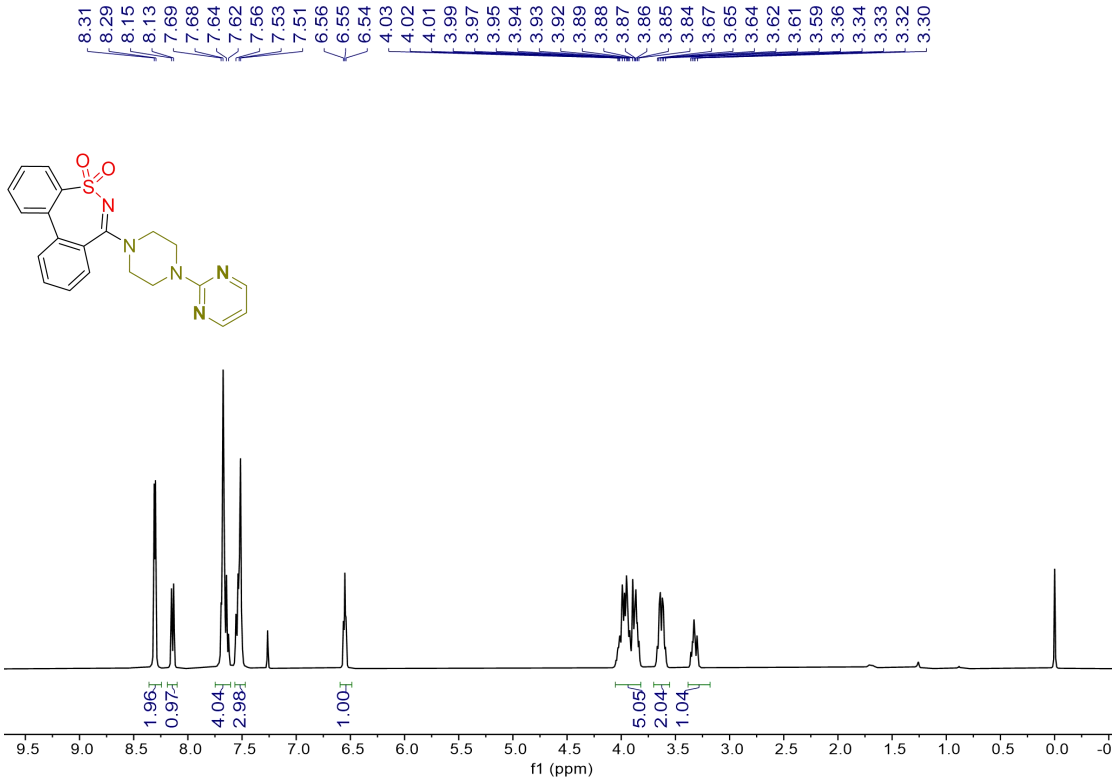
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3za**



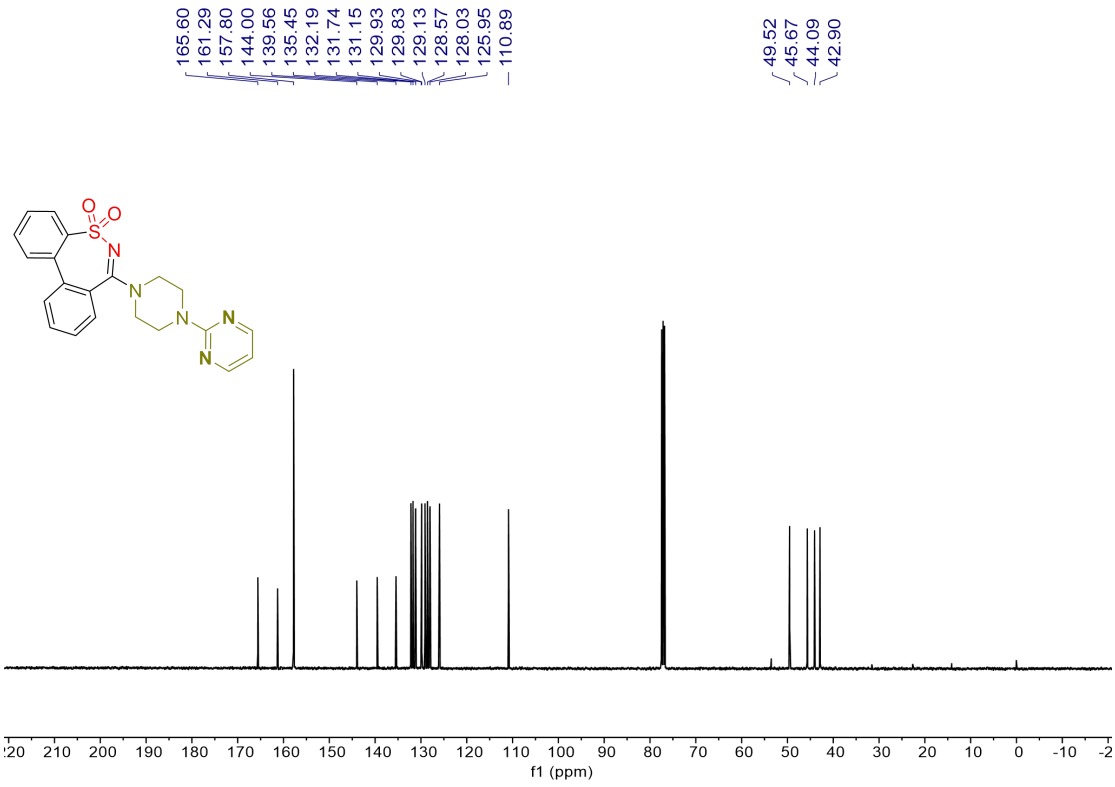
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3za**



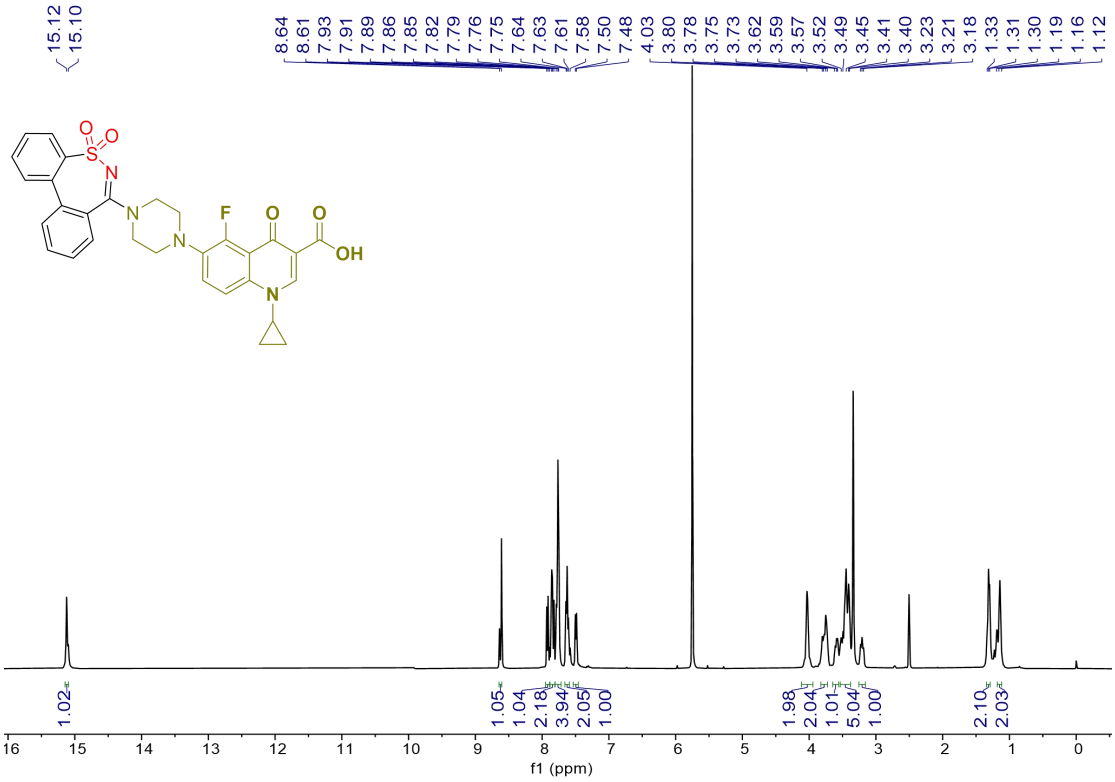
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3zb**



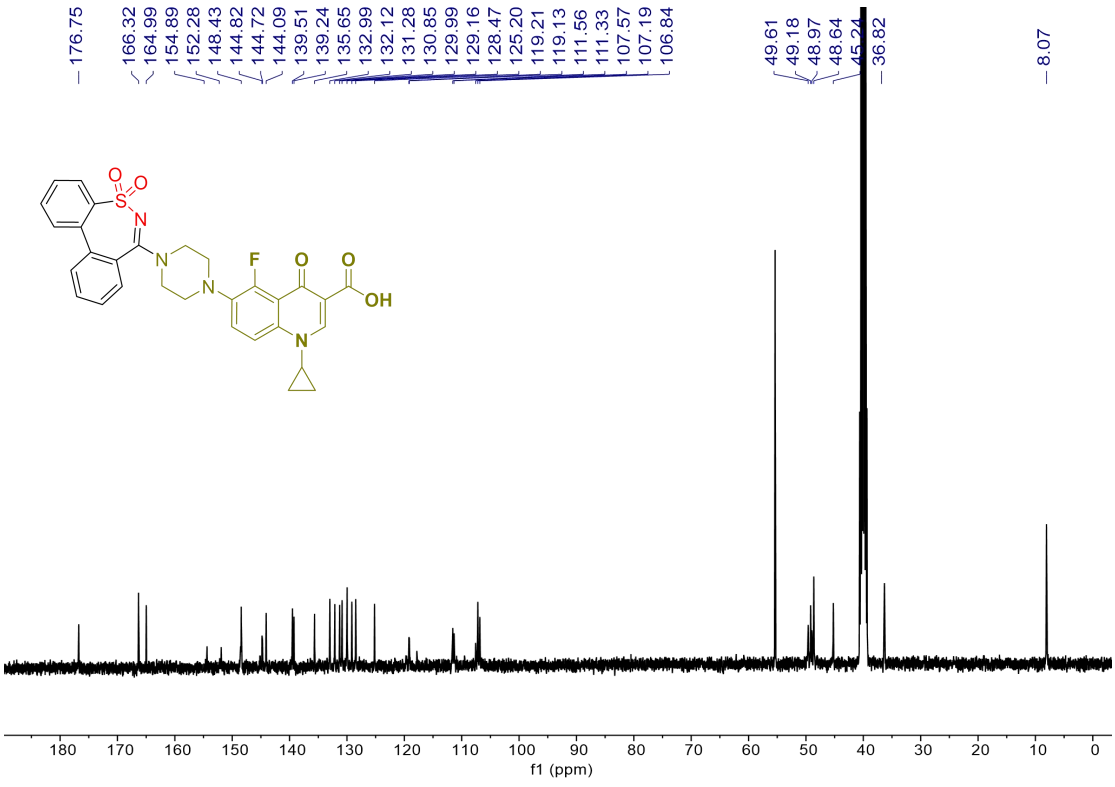
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3zb**



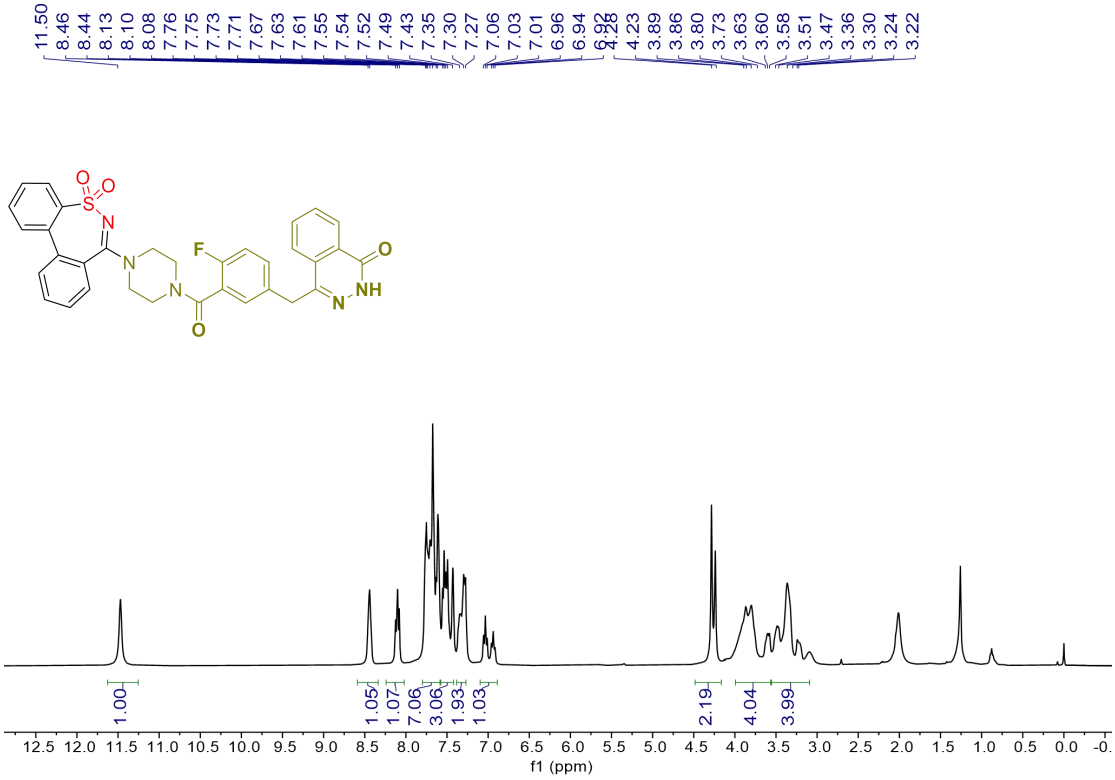
^{1}H NMR (400 MHz, DMSO-d_6) of compound **3zc**



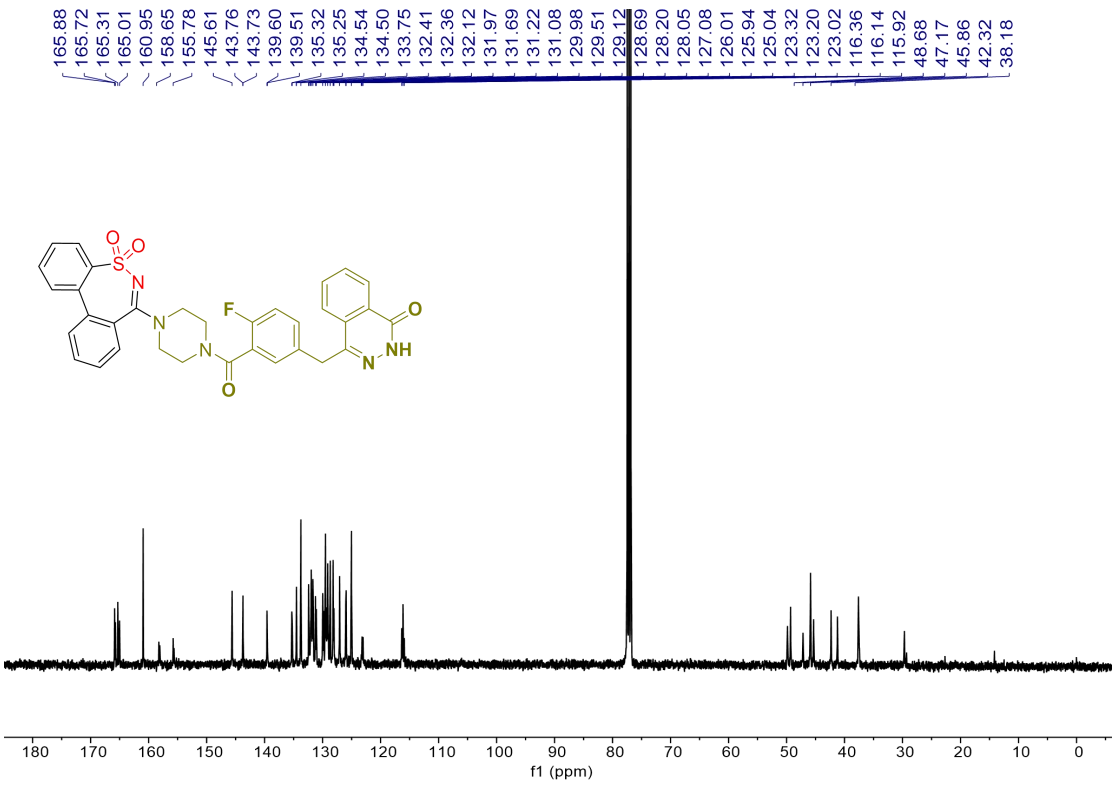
^{13}C NMR (101 MHz, DMSO-d_6) of compound **3zc**



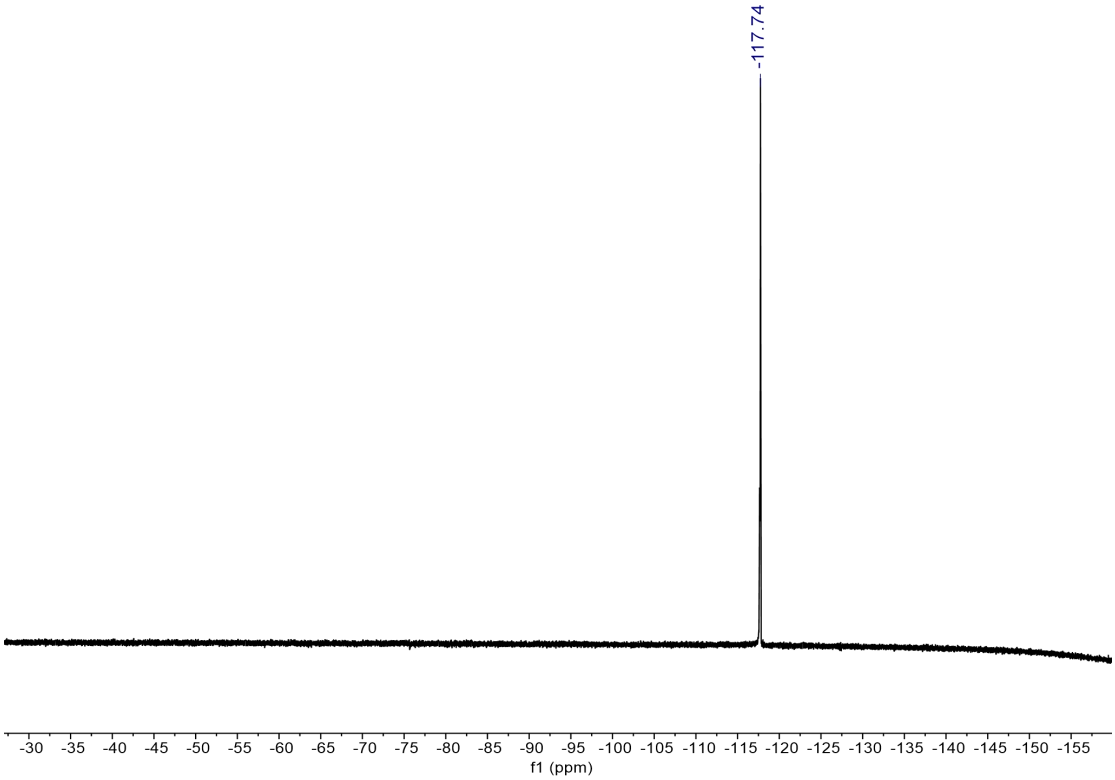
^{1}H NMR (400 MHz, $CDCl_3$) of compound **3zd**



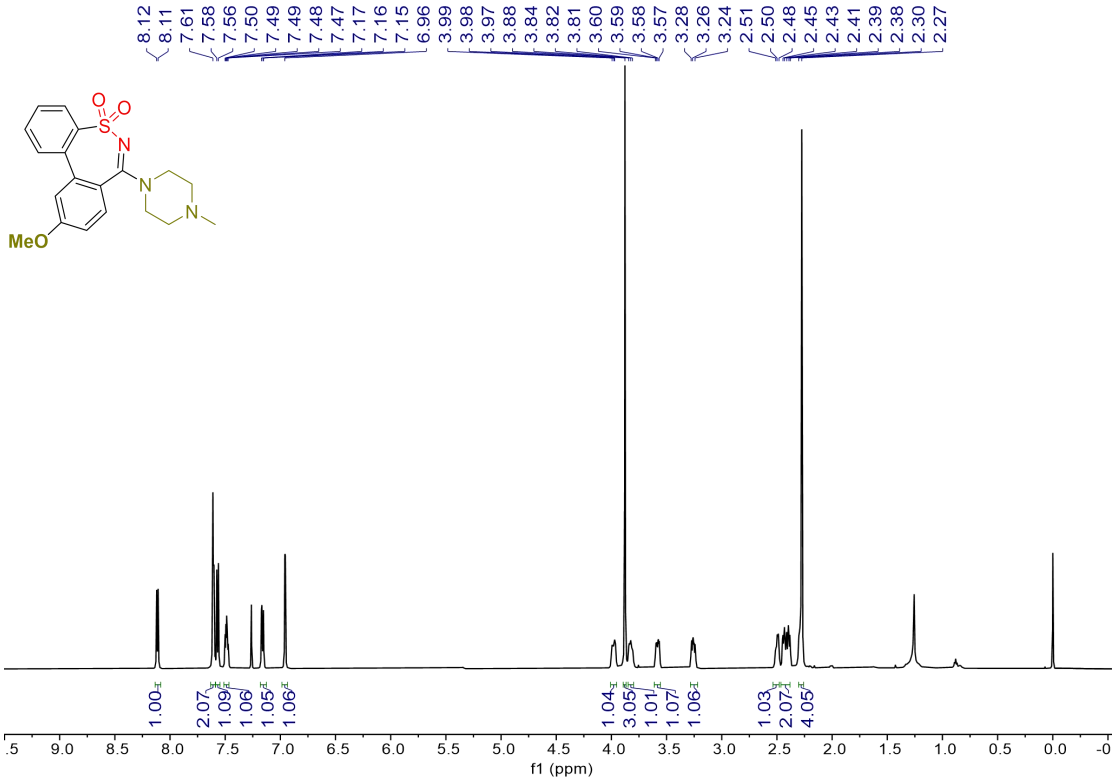
^{13}C NMR (101 MHz, $CDCl_3$) of compound **3zd**



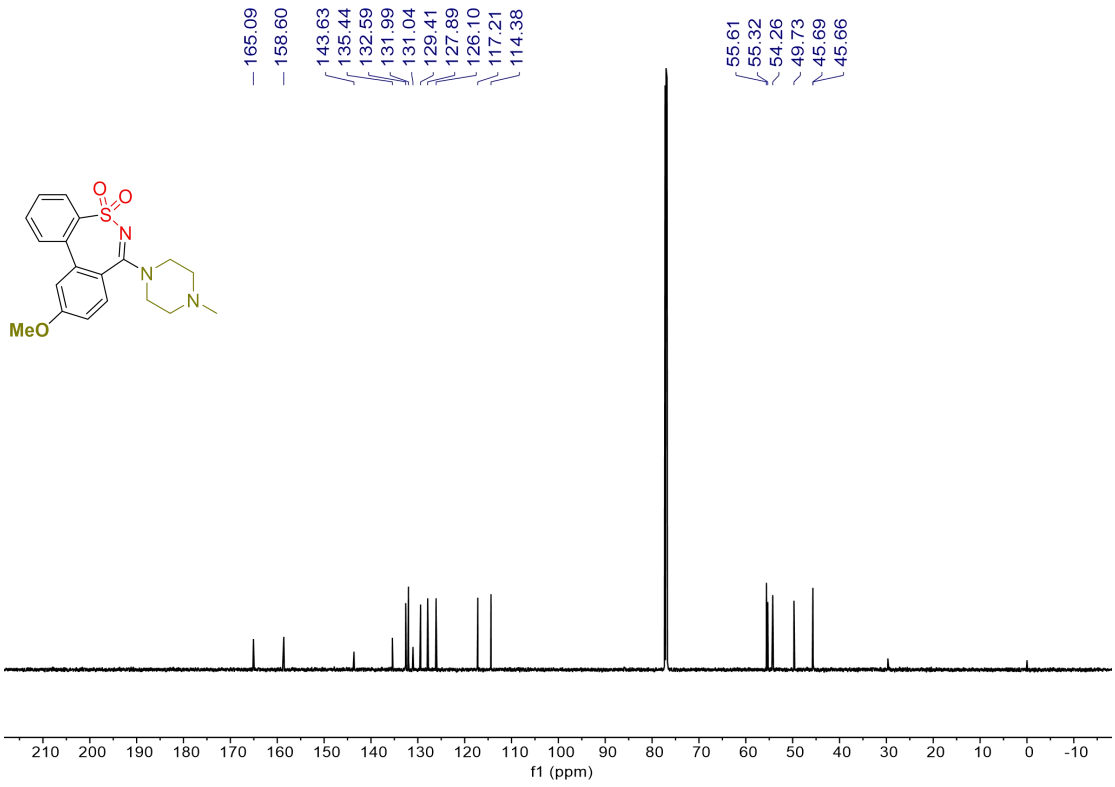
^{19}F NMR (565 MHz, $CDCl_3$) of compound **3zd**



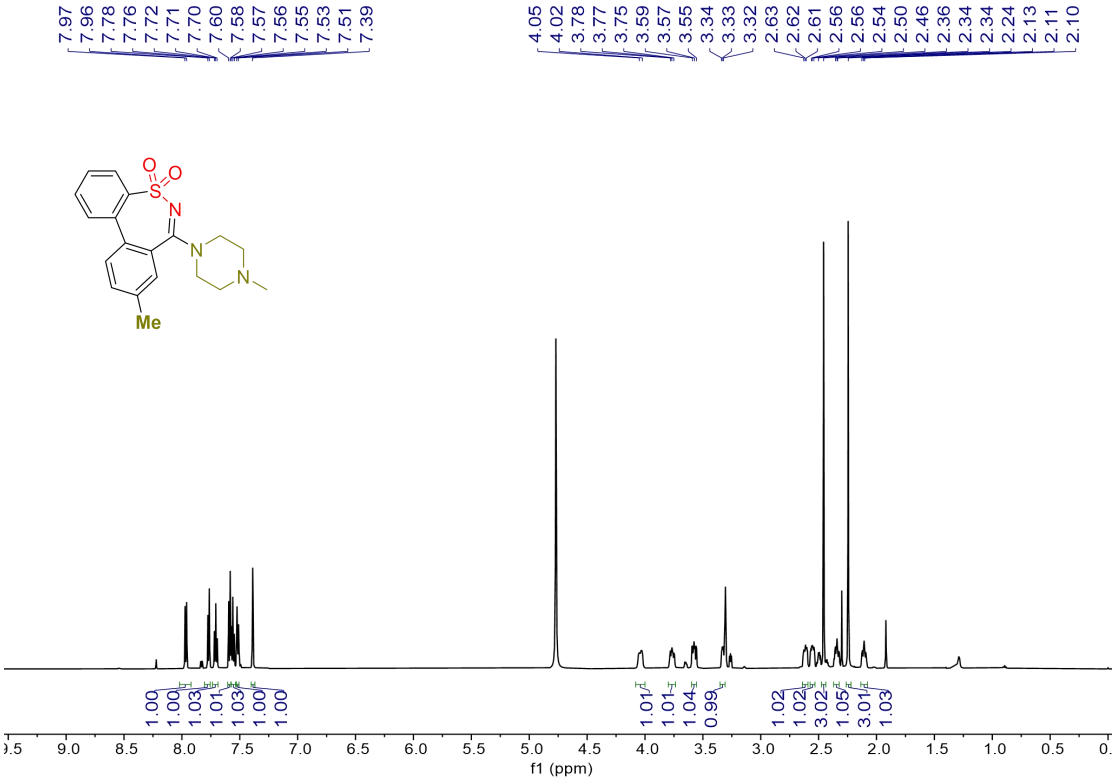
^{1}H NMR (600 MHz, $CDCl_3$) of compound **3ze**



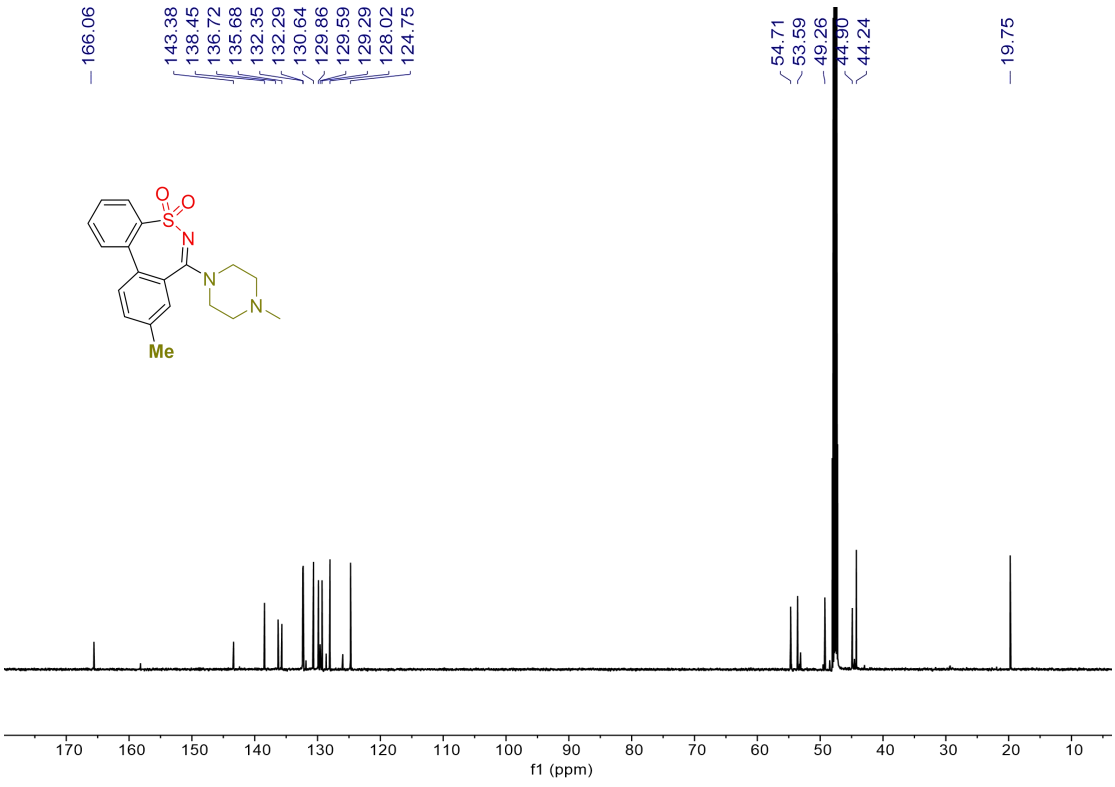
^{13}C NMR (151 MHz, $CDCl_3$) of compound **3ze**



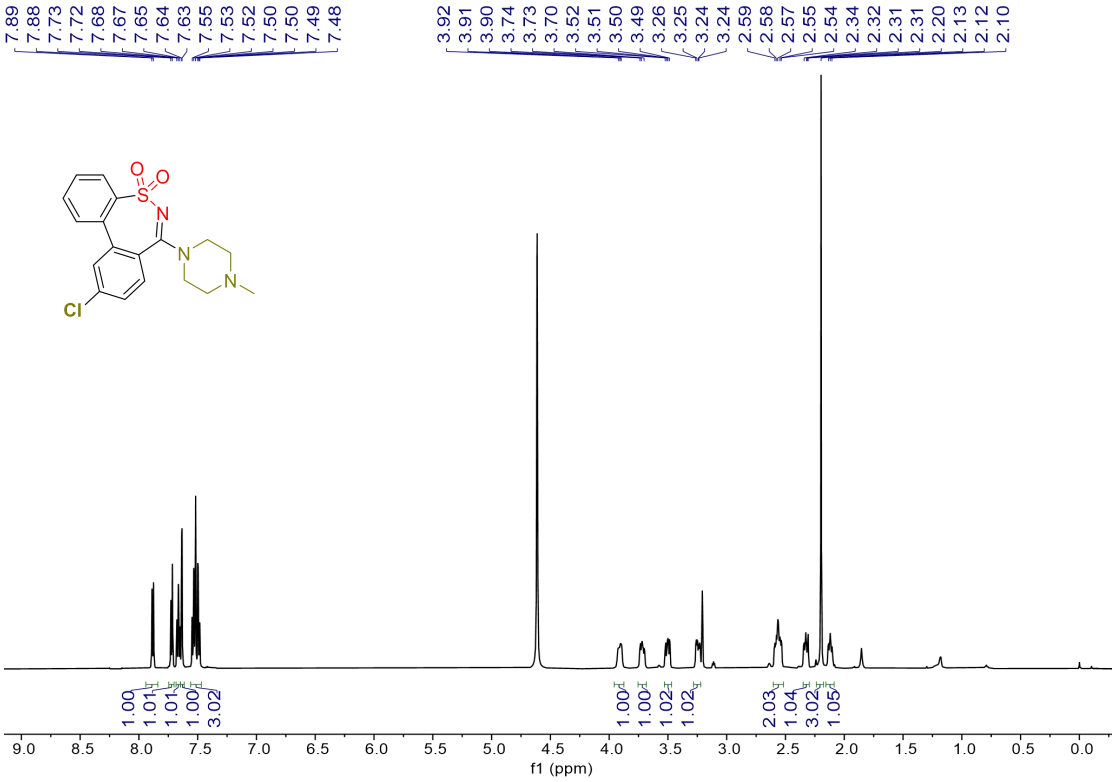
^{1}H NMR (600 MHz, CD_3OD) of compound **3zf**



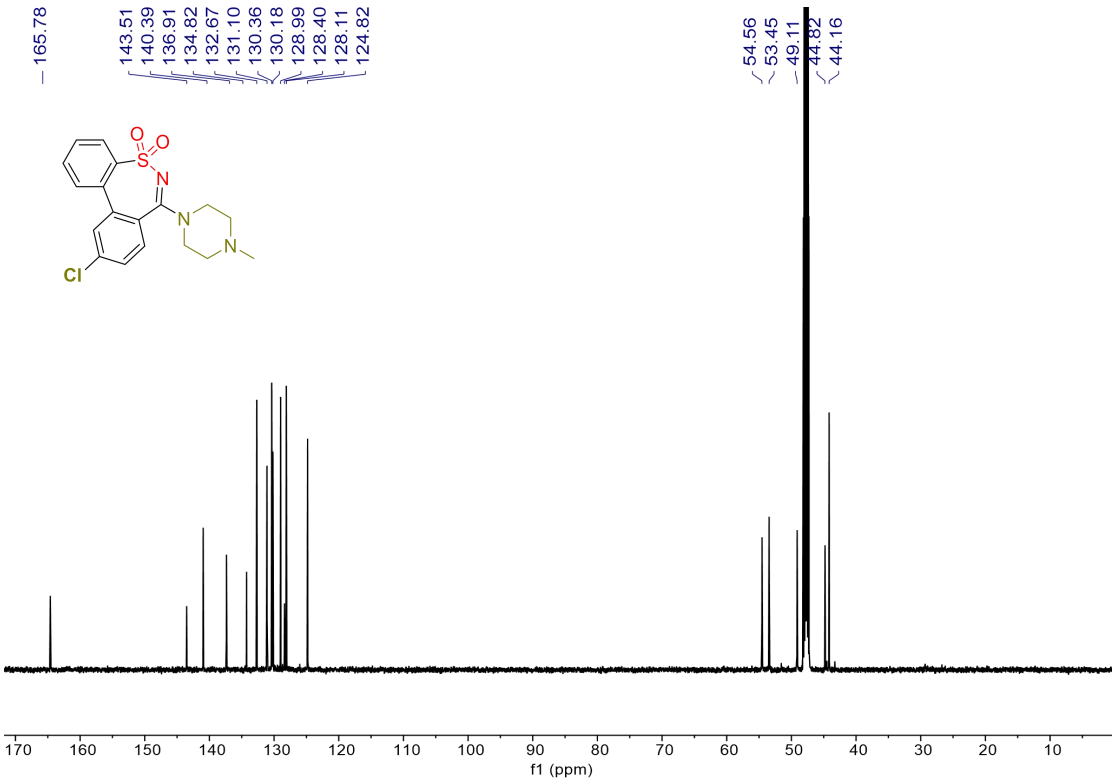
^{13}C NMR (151 MHz, CD_3OD) of compound **3zf**



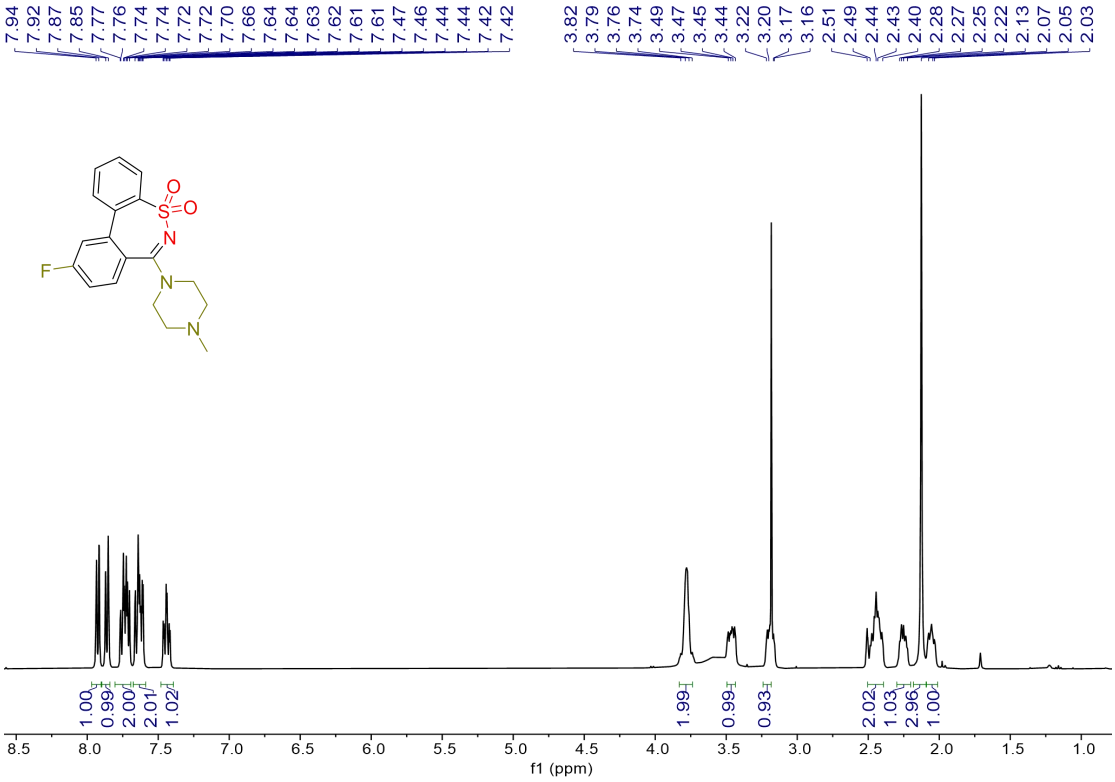
^{1}H NMR (600 MHz, CD_3OD) of compound **3zg**



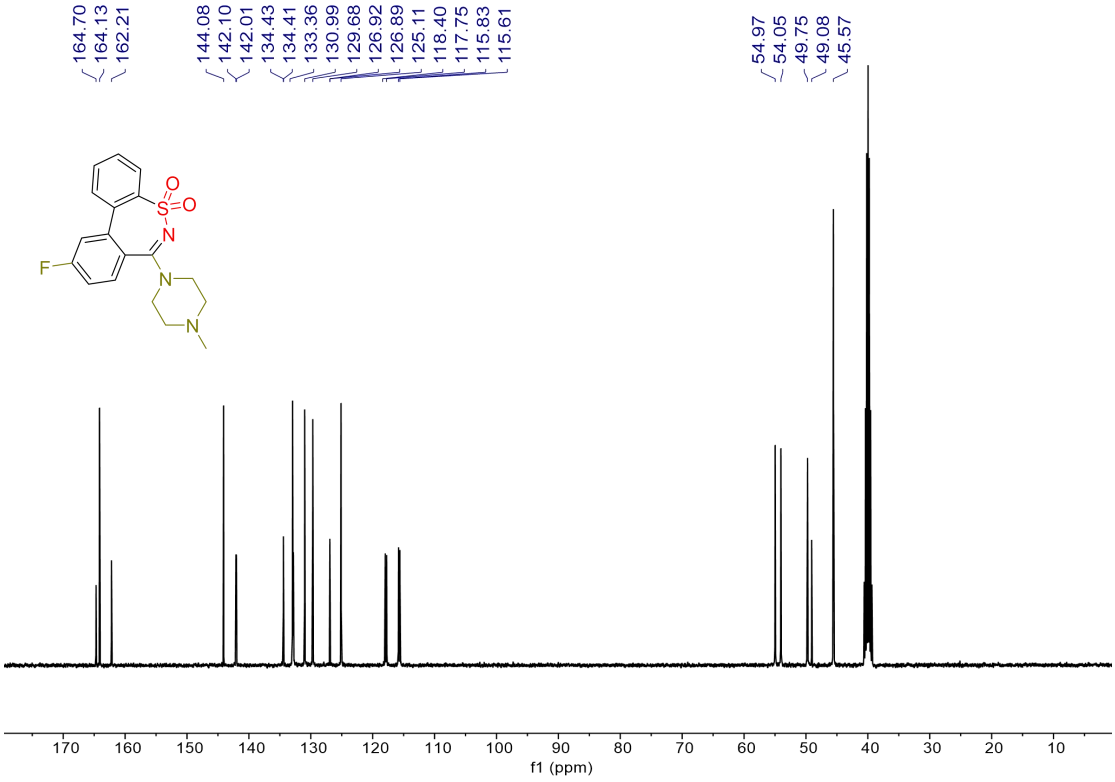
^{13}C NMR (151 MHz, CD_3OD) of compound **3zg**



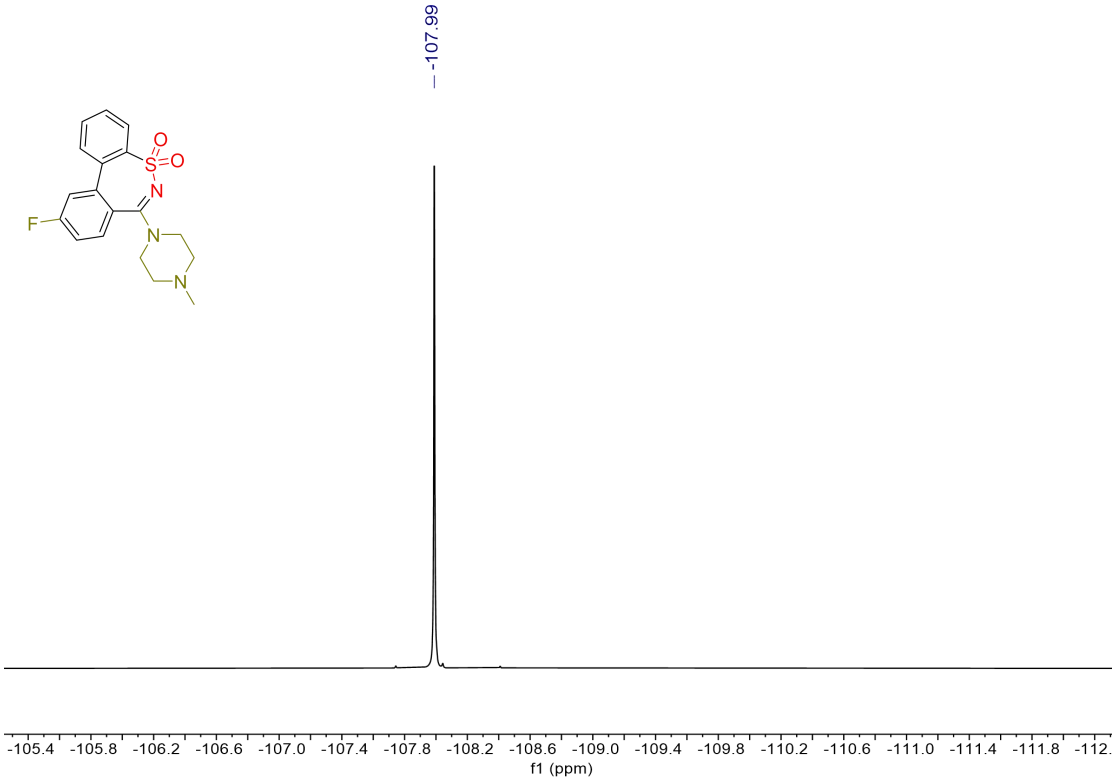
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3zh**



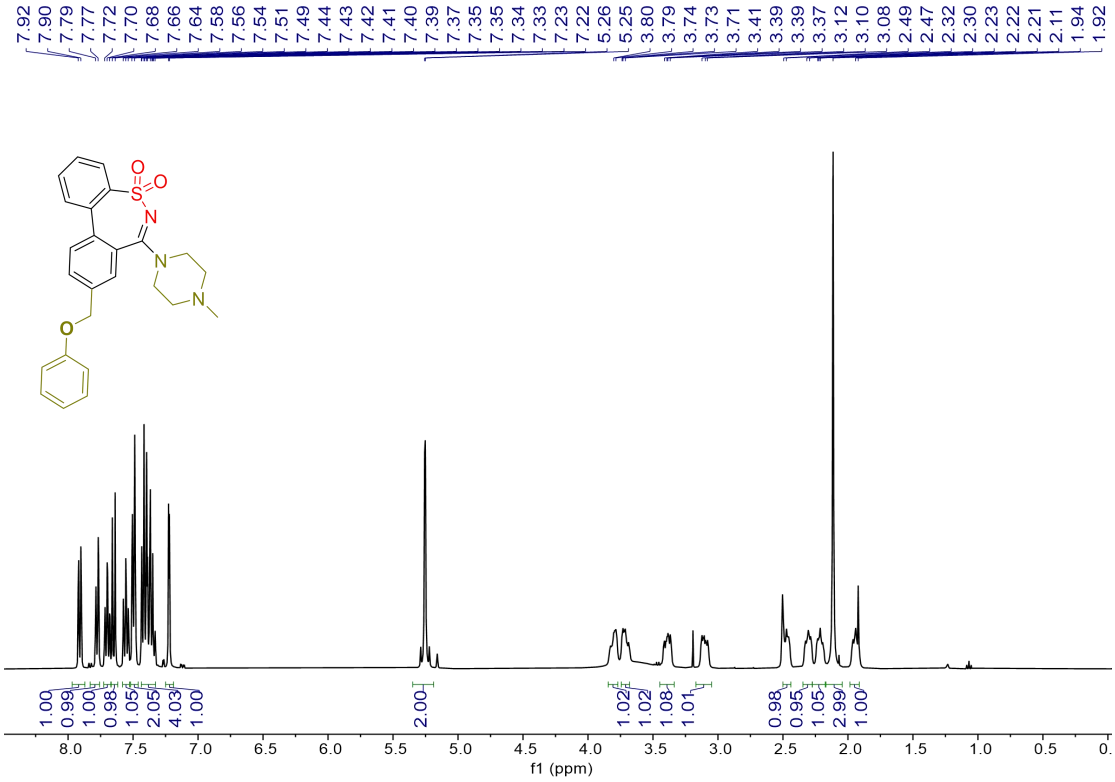
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3zh**



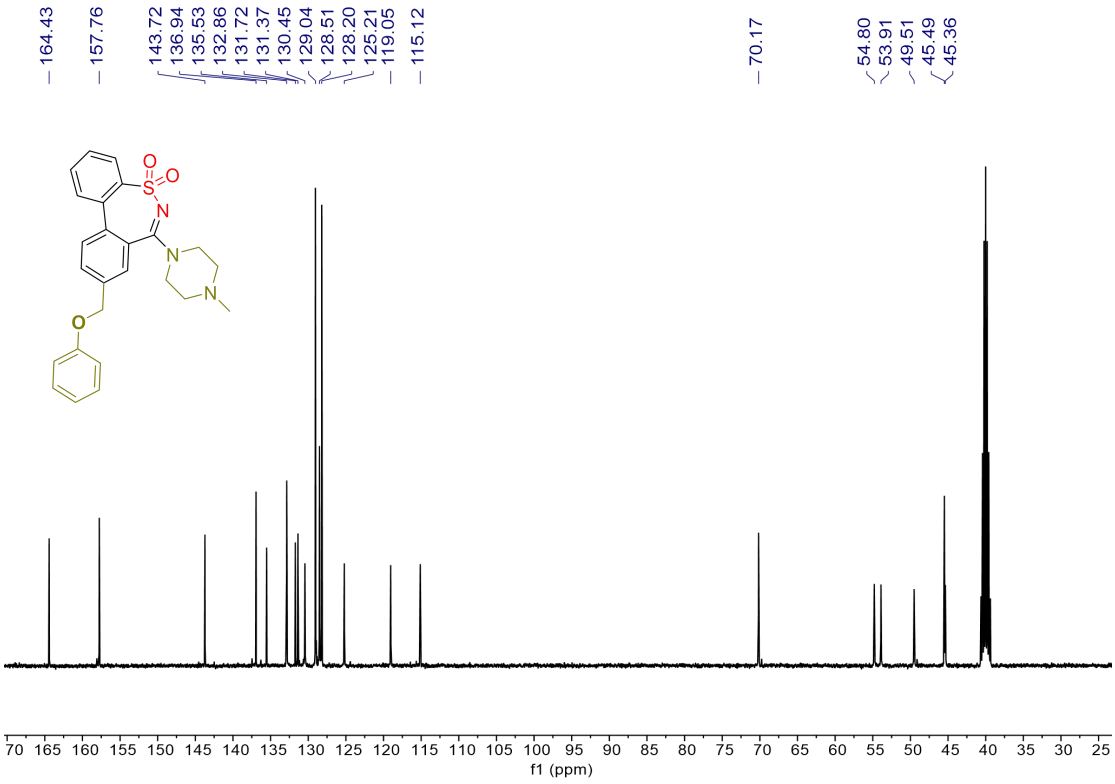
^{19}F NMR (565 MHz, $CDCl_3$) of compound **3zh**



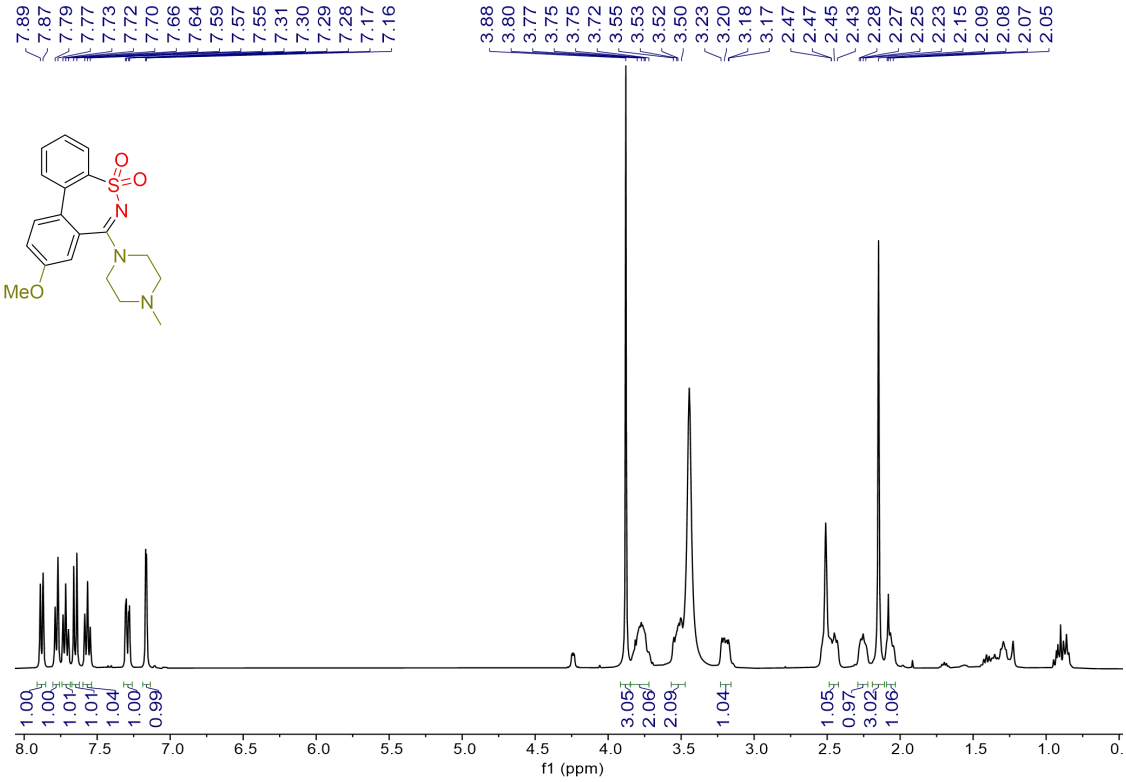
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3zi**



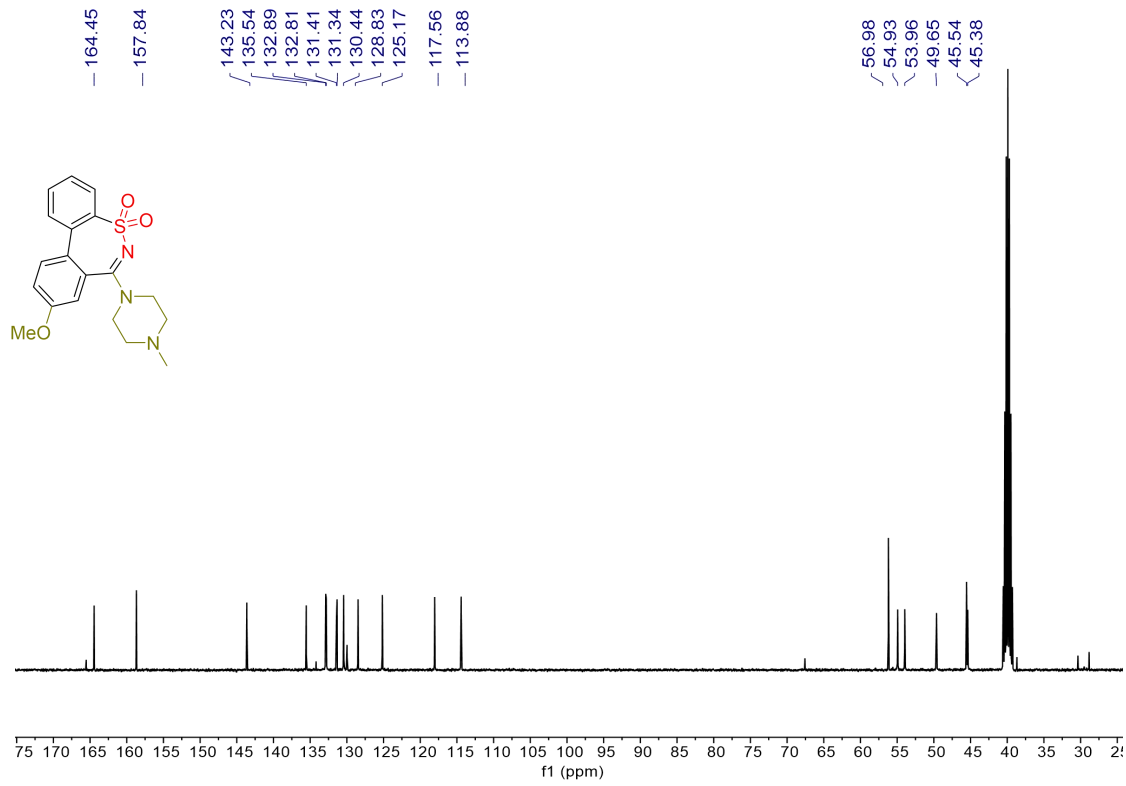
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3zi**



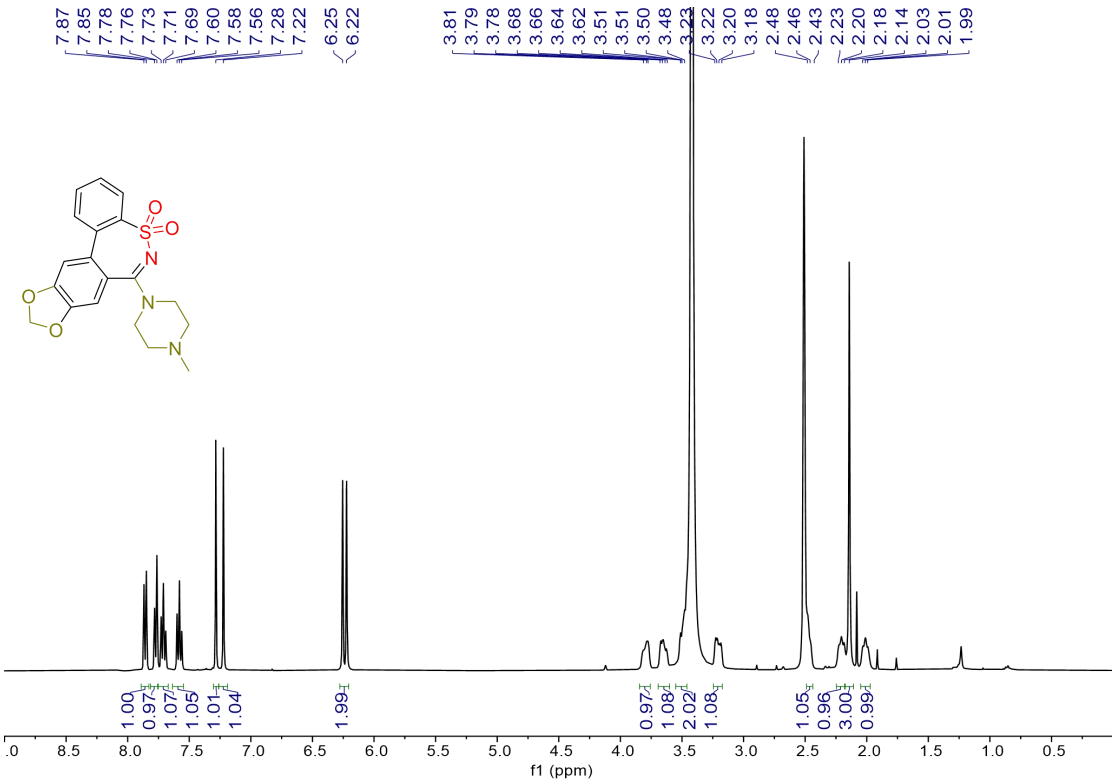
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3zj**



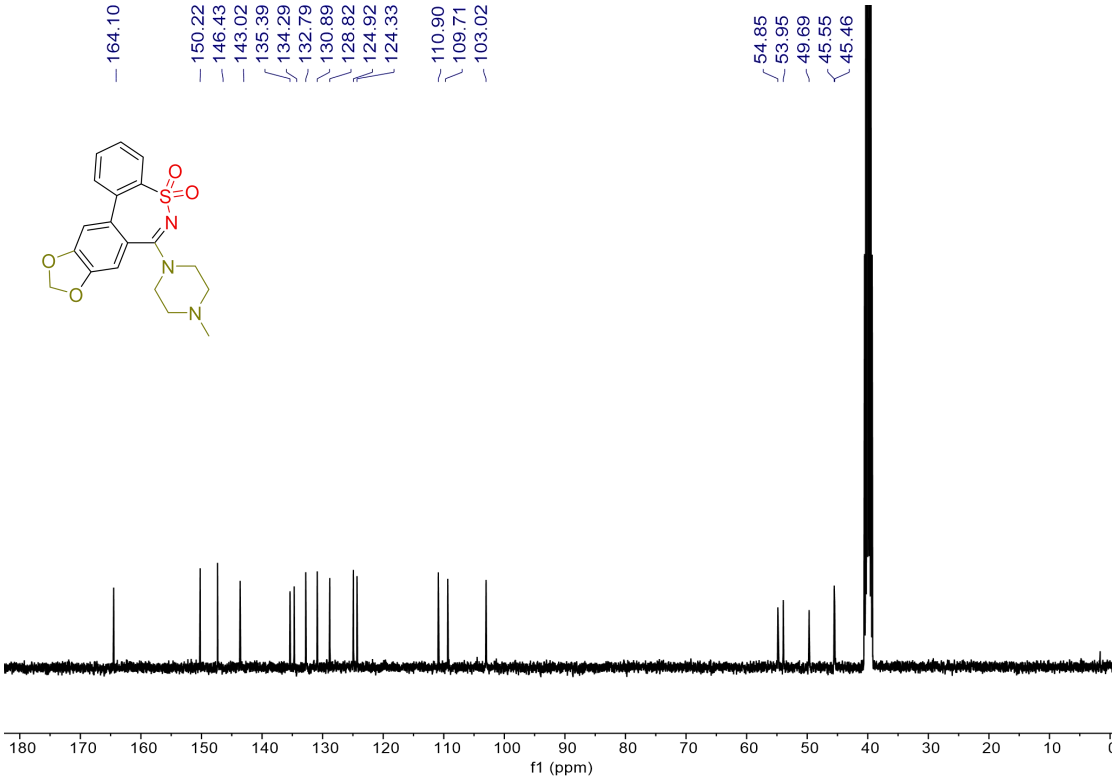
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3zj**



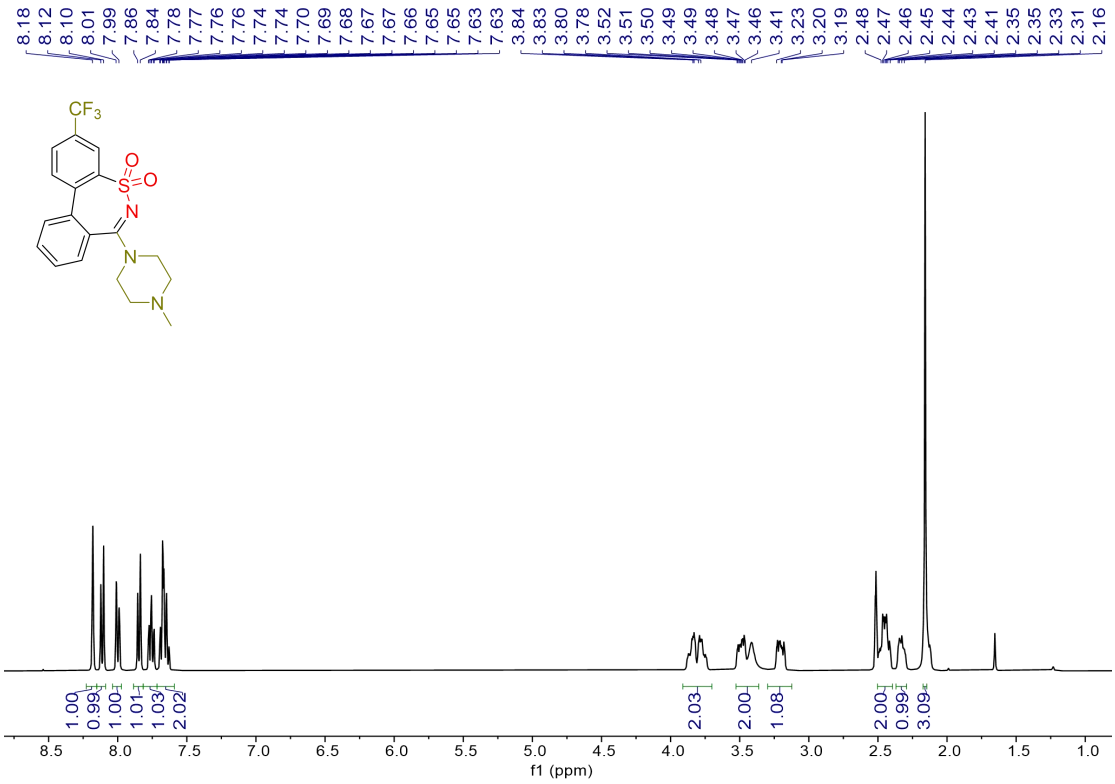
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3zk**



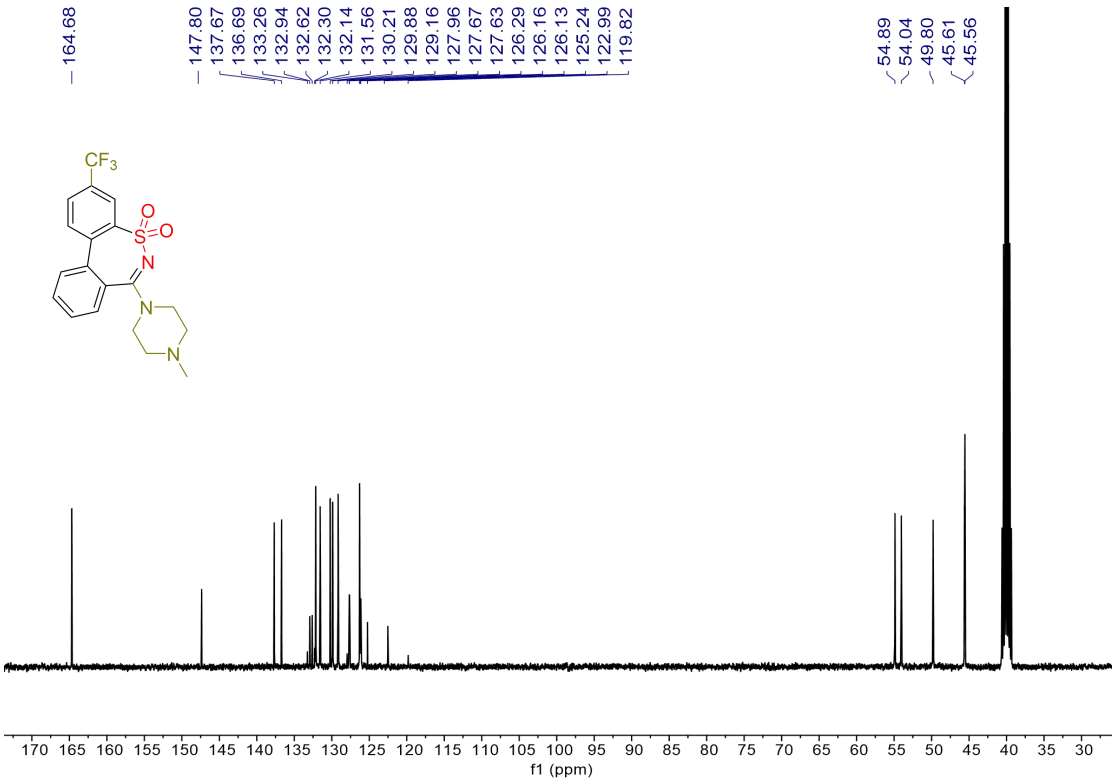
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3zk**



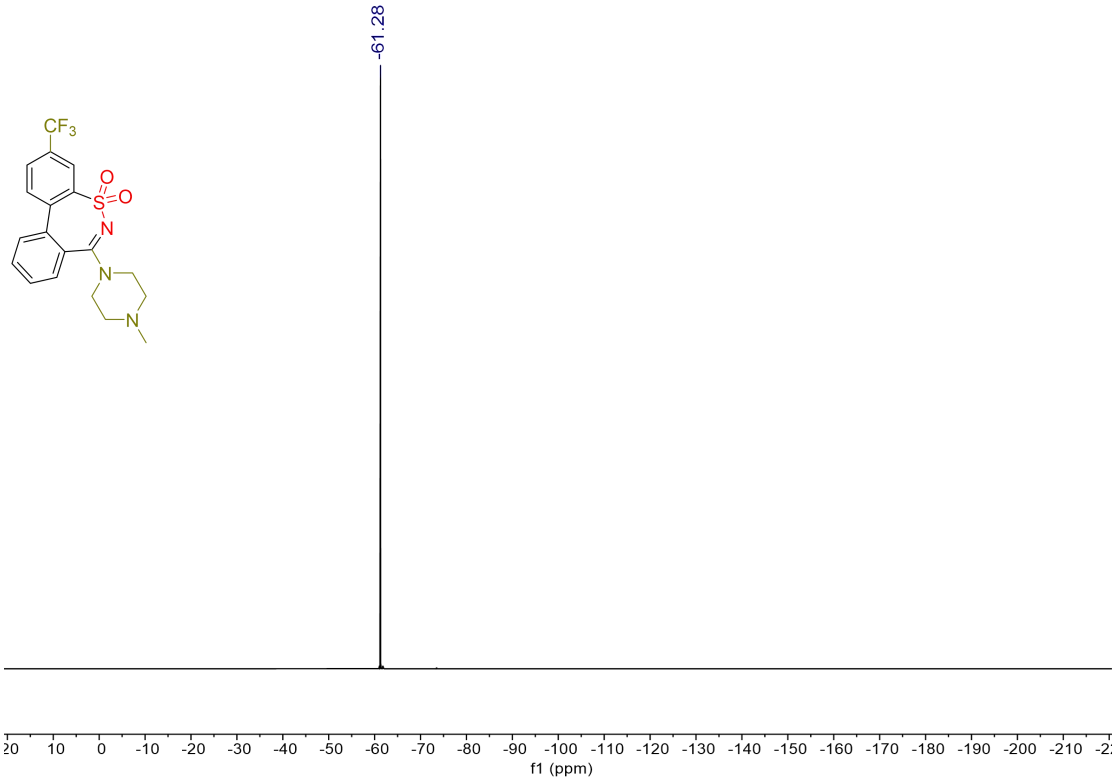
^{1}H NMR (600 MHz, DMSO-d_6) of compound **3zl**



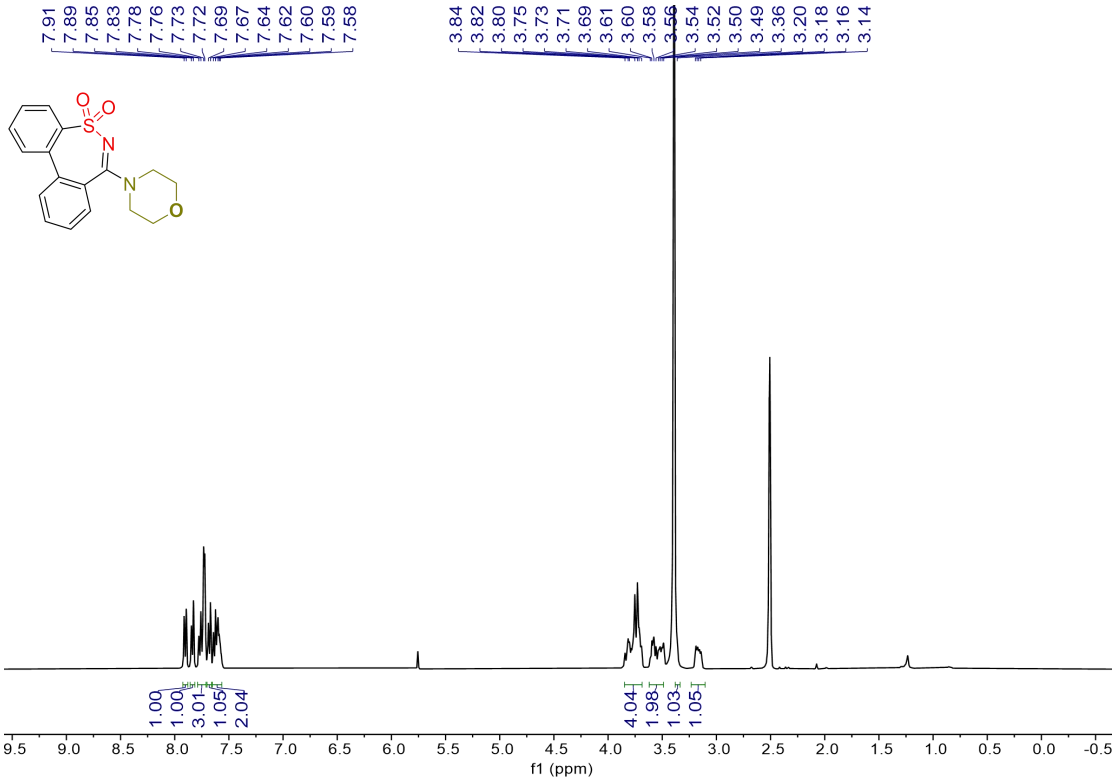
^{13}C NMR (151 MHz, DMSO-d_6) of compound **3zl**



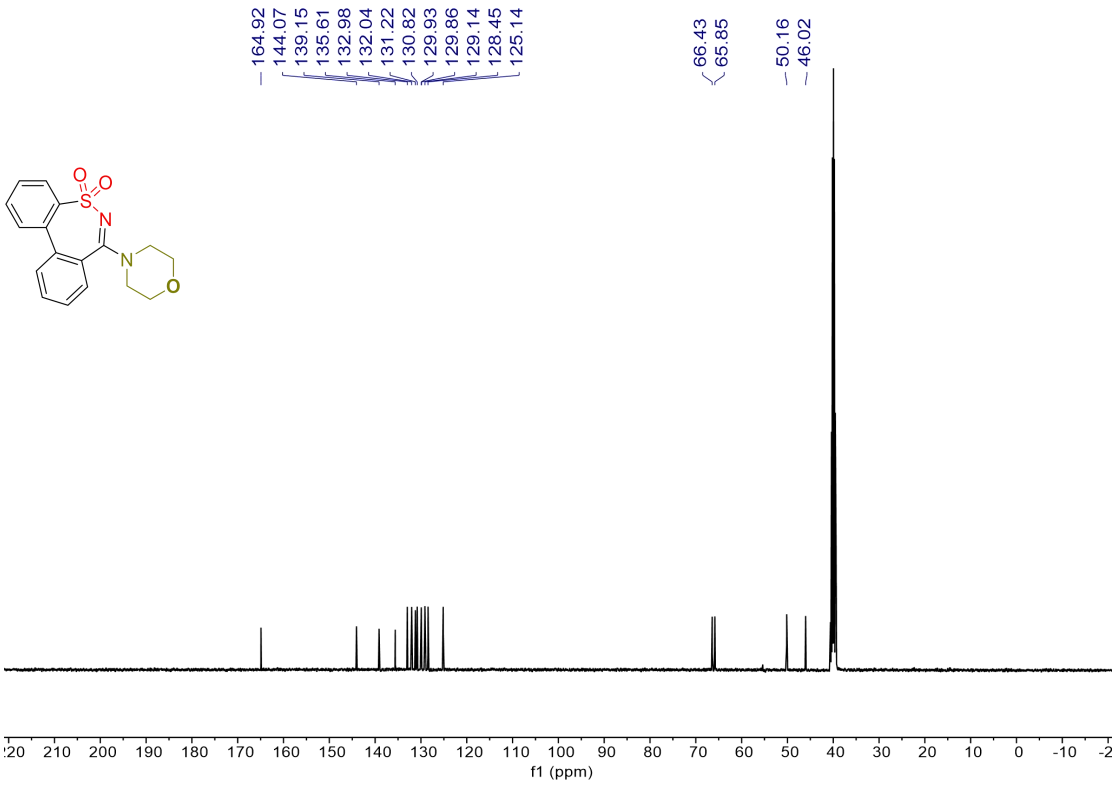
^{19}F NMR (565 MHz, $CDCl_3$) of compound **3zl**



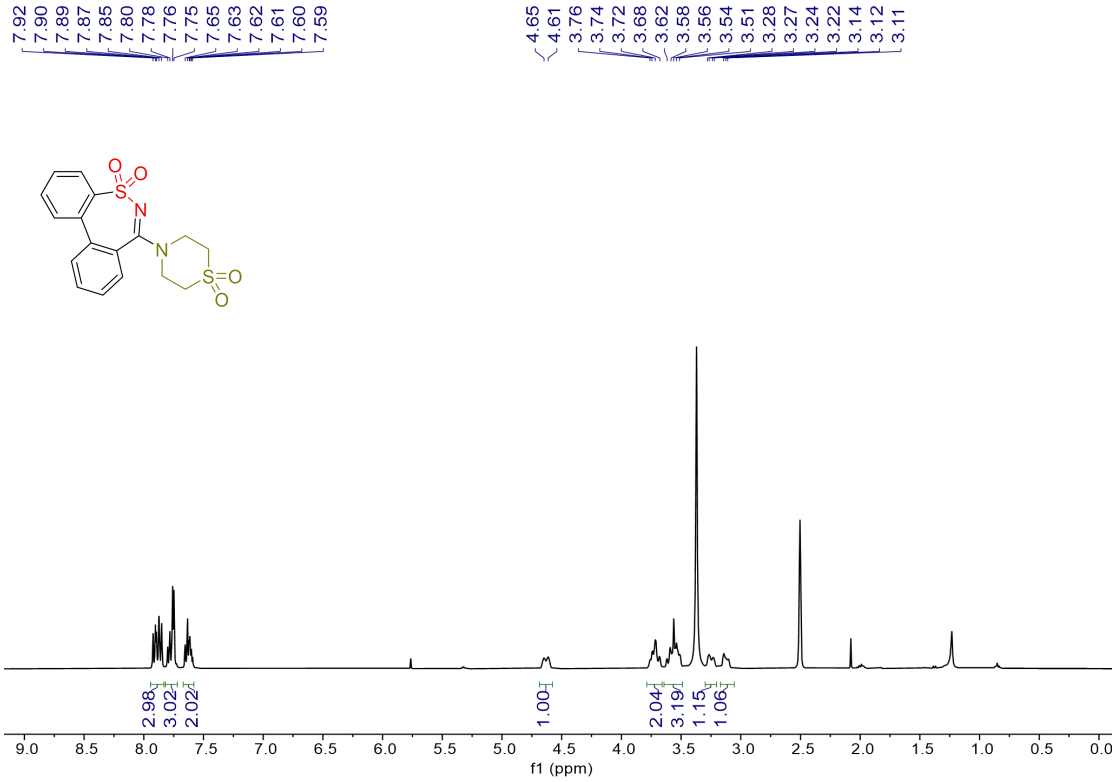
^{1}H NMR (400 MHz, DMSO-d_6) of compound **4a**



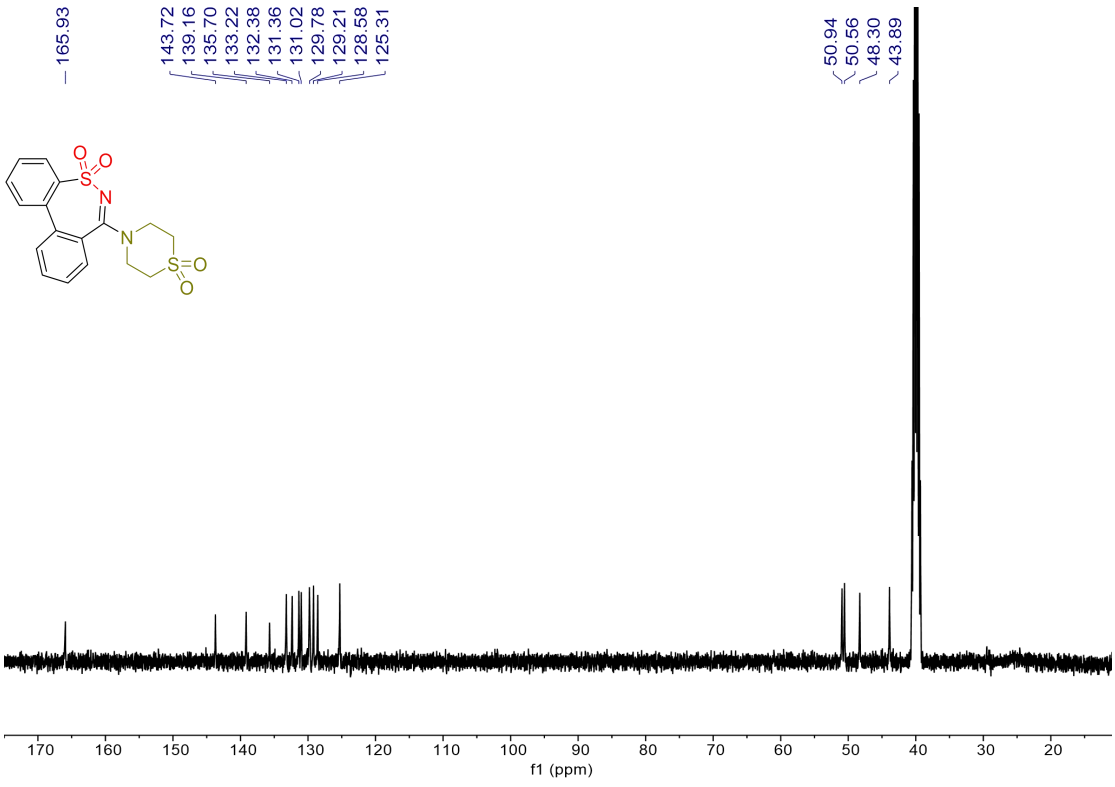
^{13}C NMR (101 MHz, DMSO-d_6) of compound **4a**



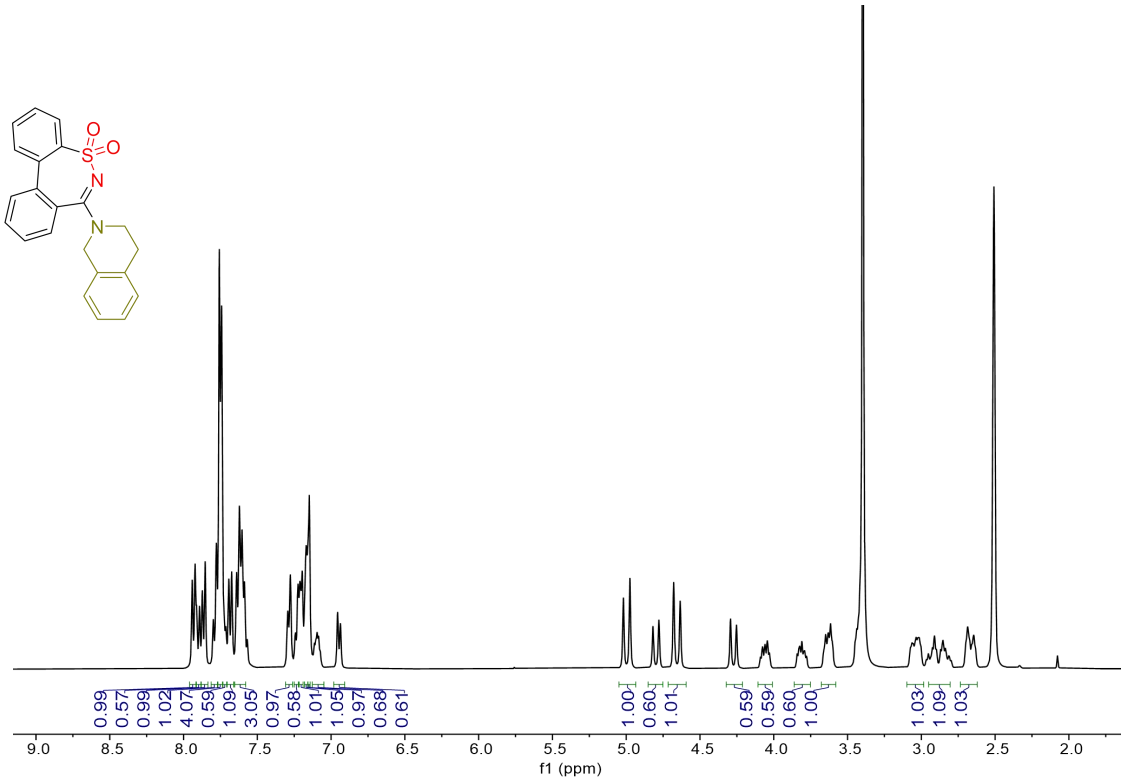
^{1}H NMR (600 MHz, DMSO-d_6) of compound **5a**



^{13}C NMR (151 MHz, DMSO-d_6) of compound **5a**



^{1}H NMR (600 MHz, DMSO-d_6) of compound **Mixture**



^{13}C NMR (151 MHz, DMSO-d_6) of compound **Mixture**