

Synthesis and antimicrobial activity of some new substituted quinoxalines

Mohamed A. El-Atawy*^{a,b}, Ezzat A. Hamed^b, Mahjoba Alhadi^b and Alaa Z. Omar^b

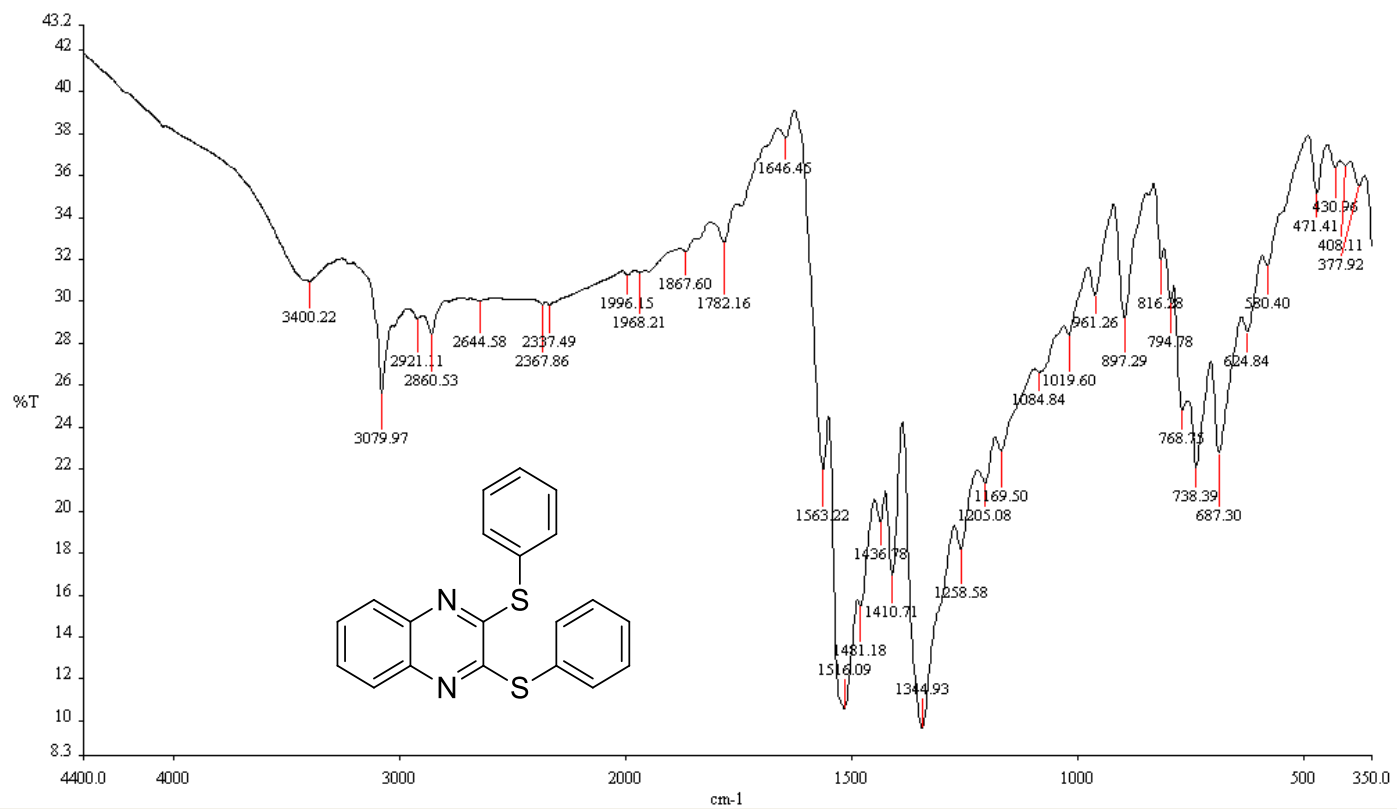
^aChemistry Department, Faculty of Science, Taibah University, Yanbu 46423 Saudi Arabia.

^bChemistry Department, Faculty of Science, Alexandria University, P.O. 426 Ibrahemia, Alexandria 21321, Egypt.

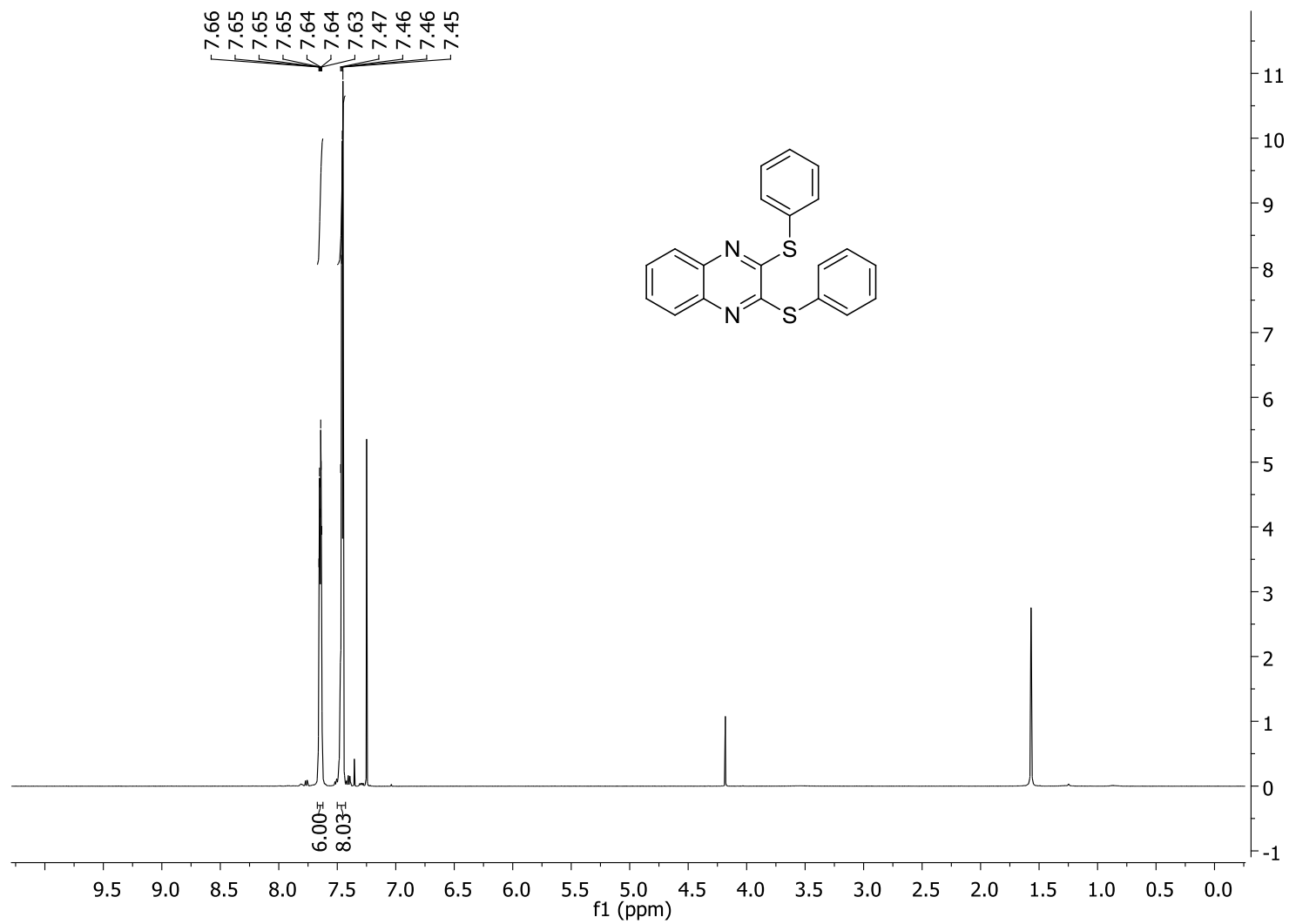
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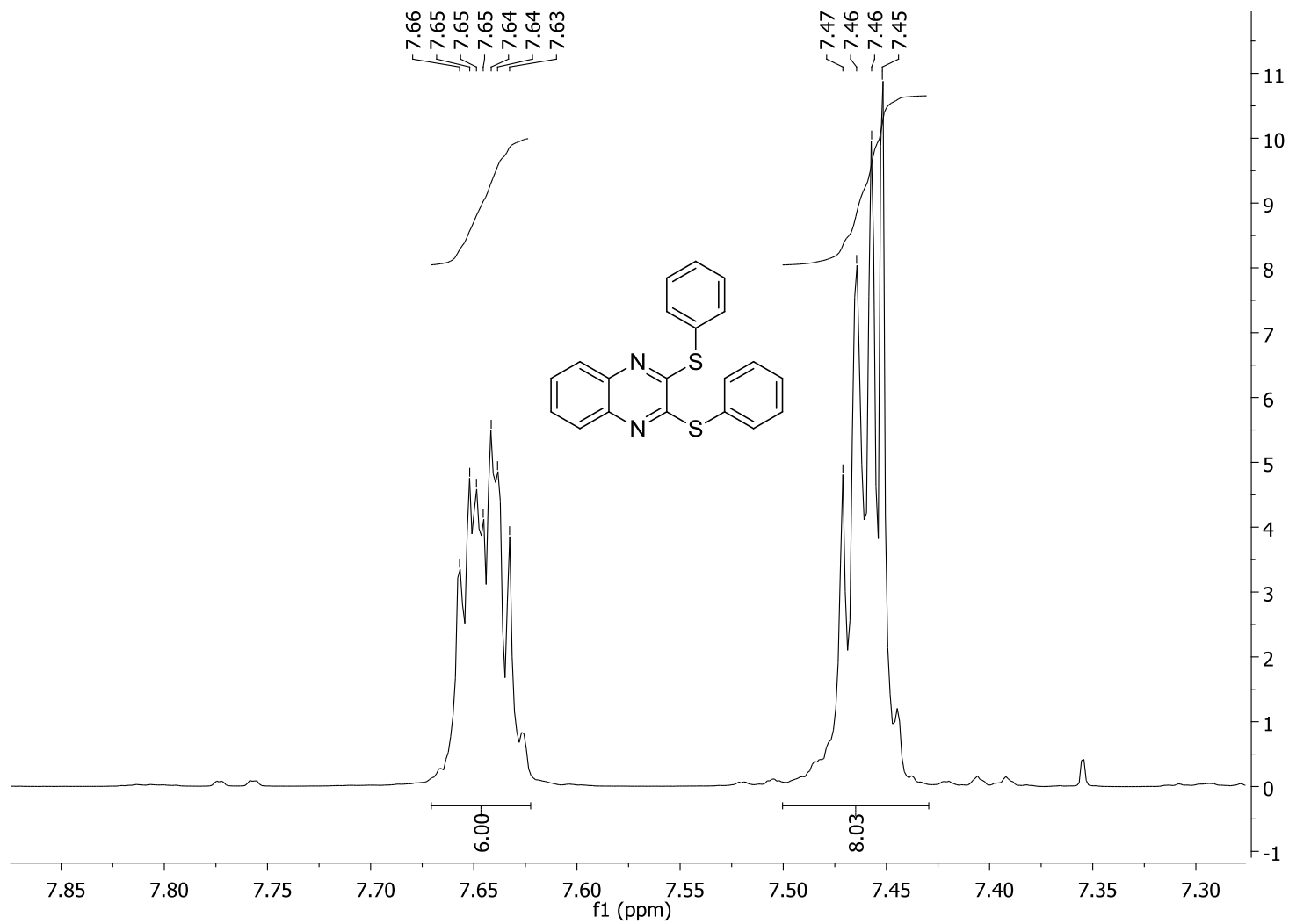
Supplementary Data



IR (KBr) of 2,3-dithiophenylquinoxaline (2a).



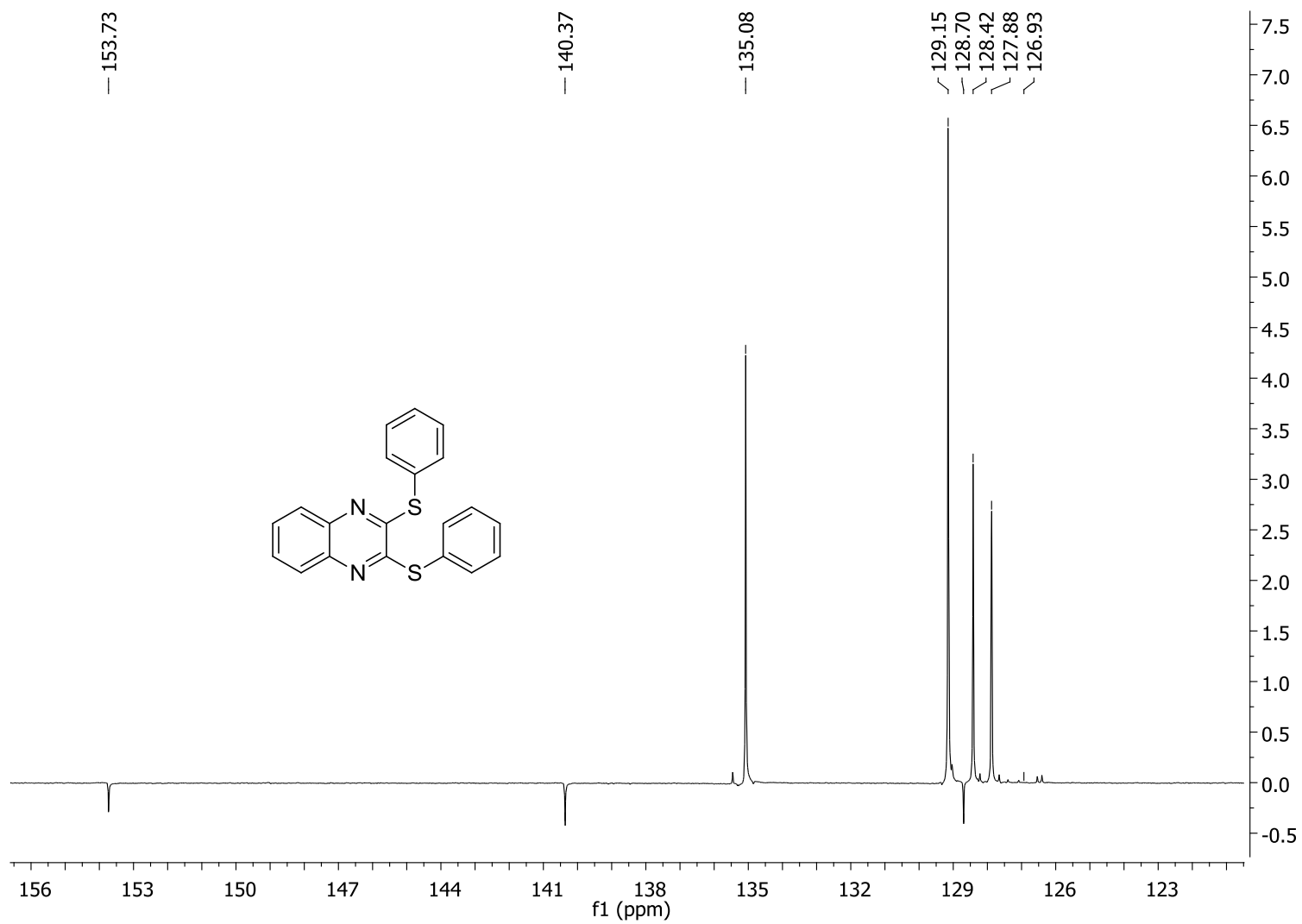
^1H NMR (CDCl_3) of 2,3-dithiophenylquinoxaline (2a).



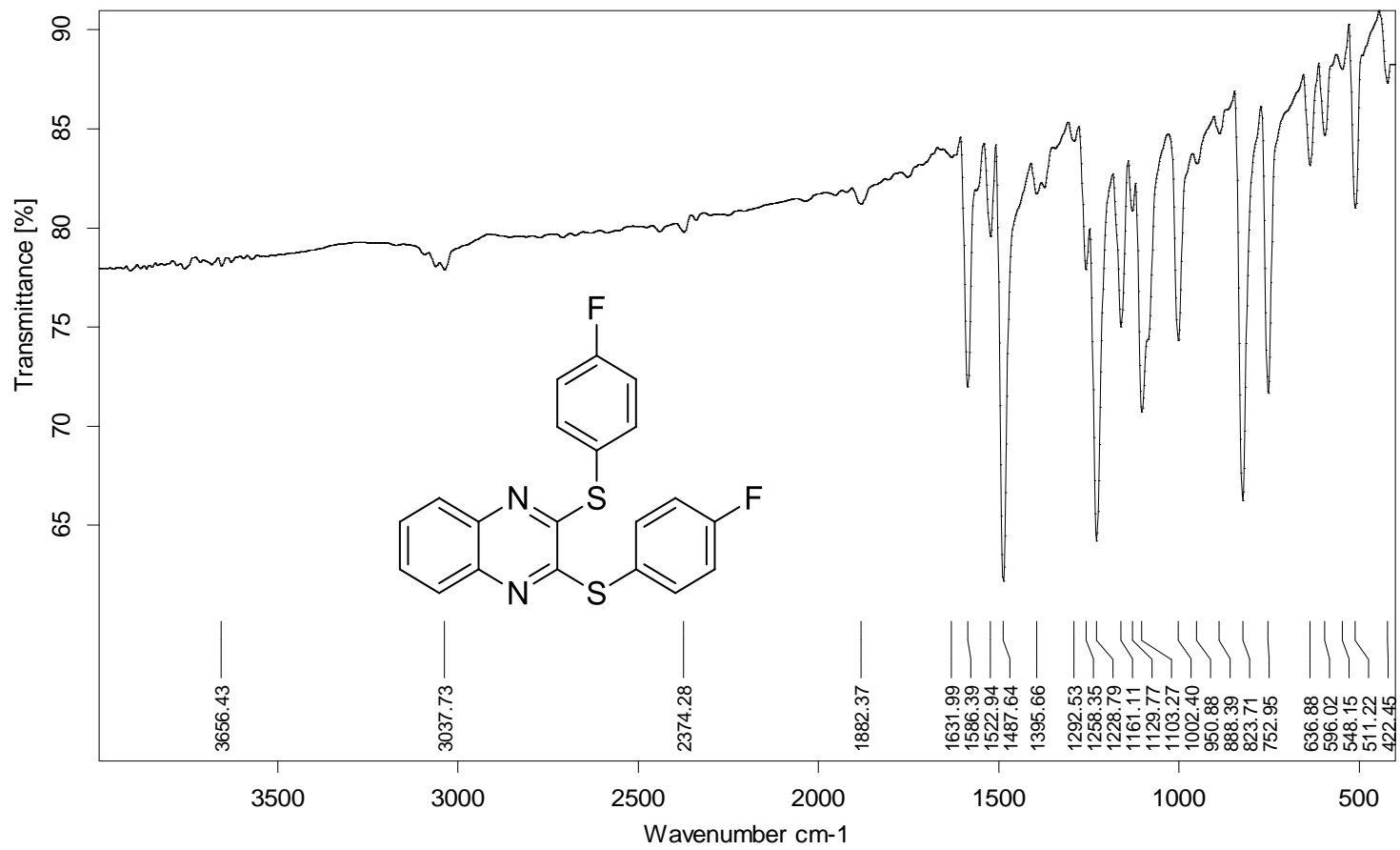
^1H NMR (CDCl_3) of 2,3-dithiophenylquinoxaline (2a).



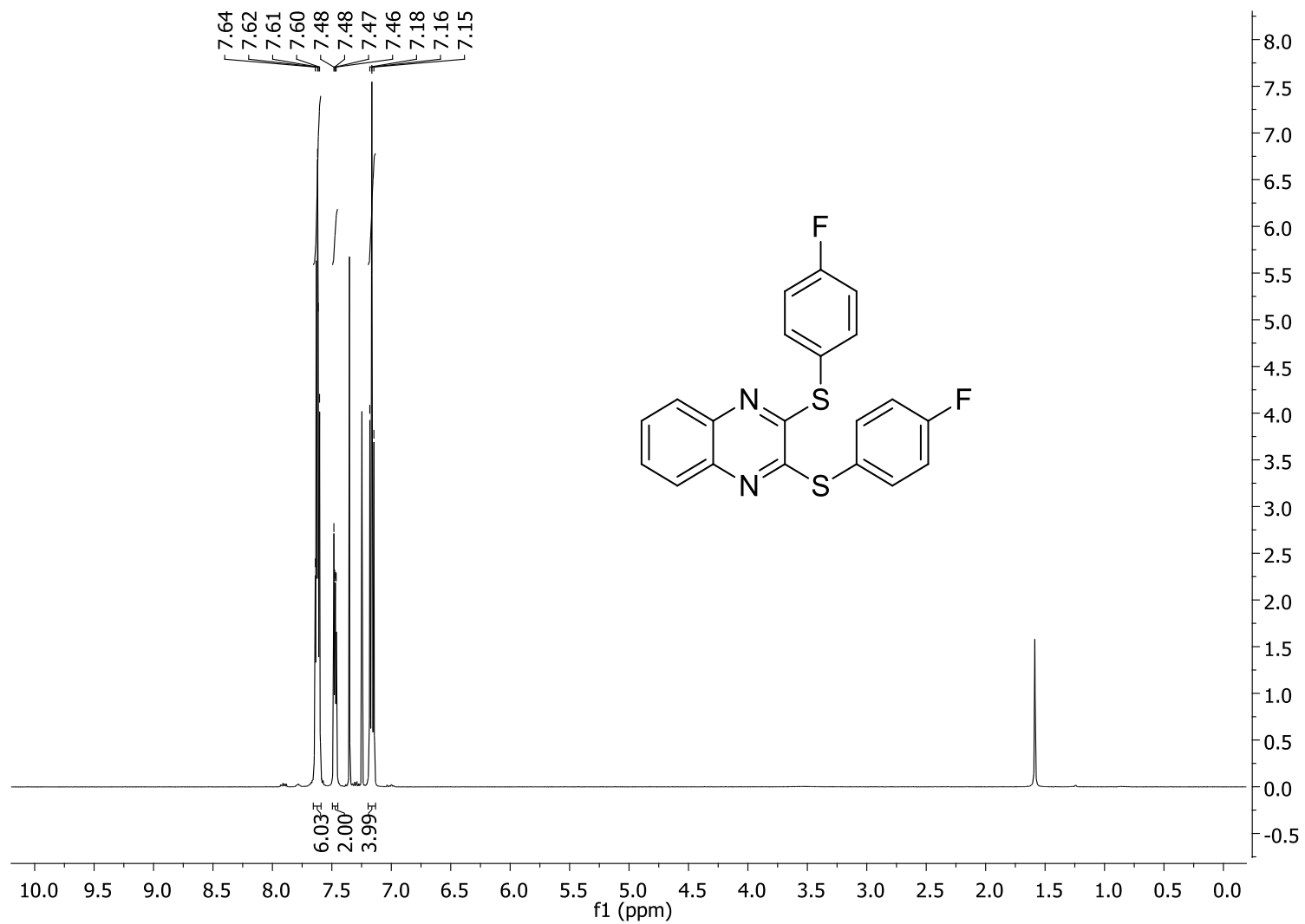
^{13}C APT NMR (CDCl_3) of 2,3-dithiophenylquinoxaline (2a).



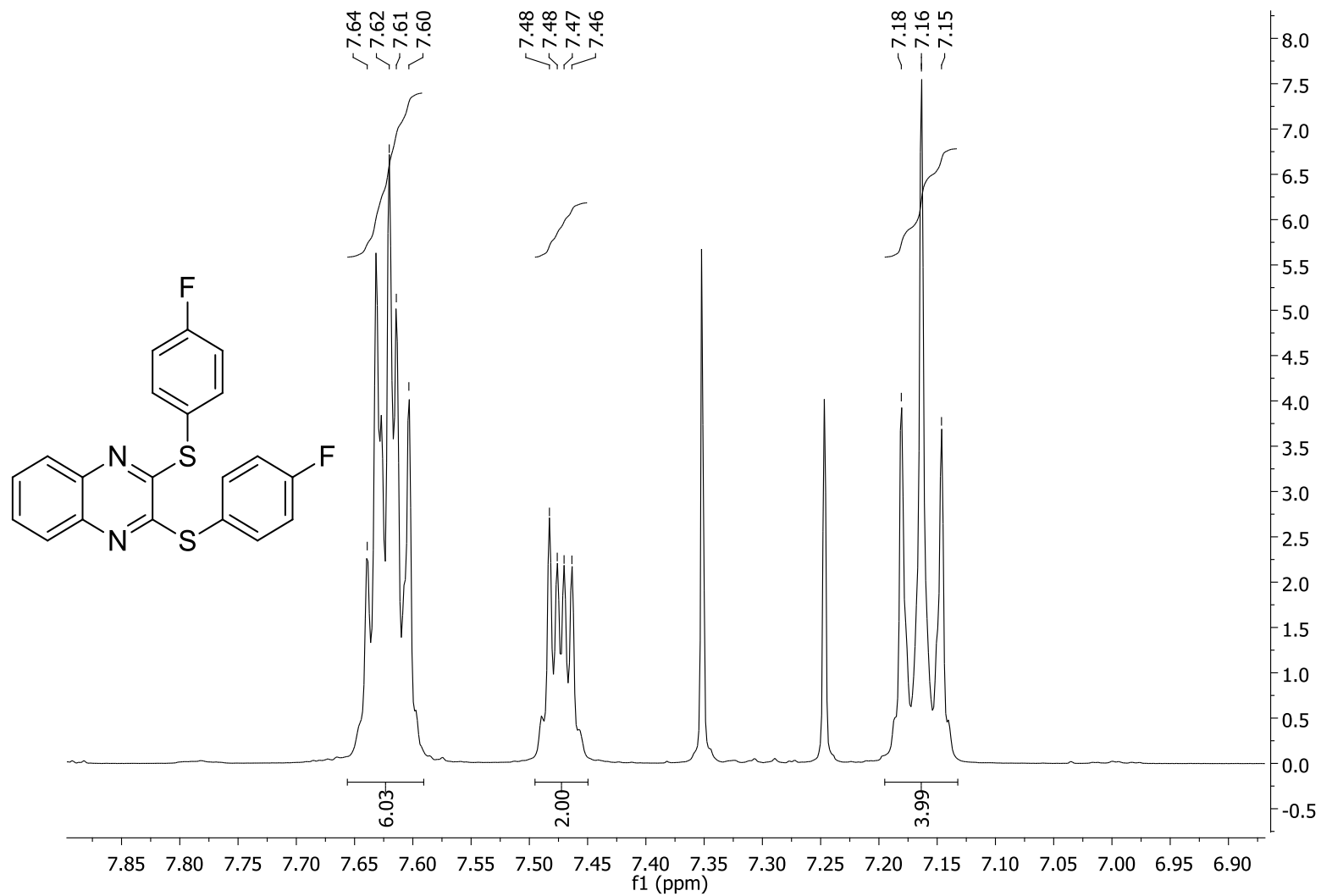
^{13}C APT NMR (CDCl_3) of 2,3-dithiophenylquinoxaline (2a).



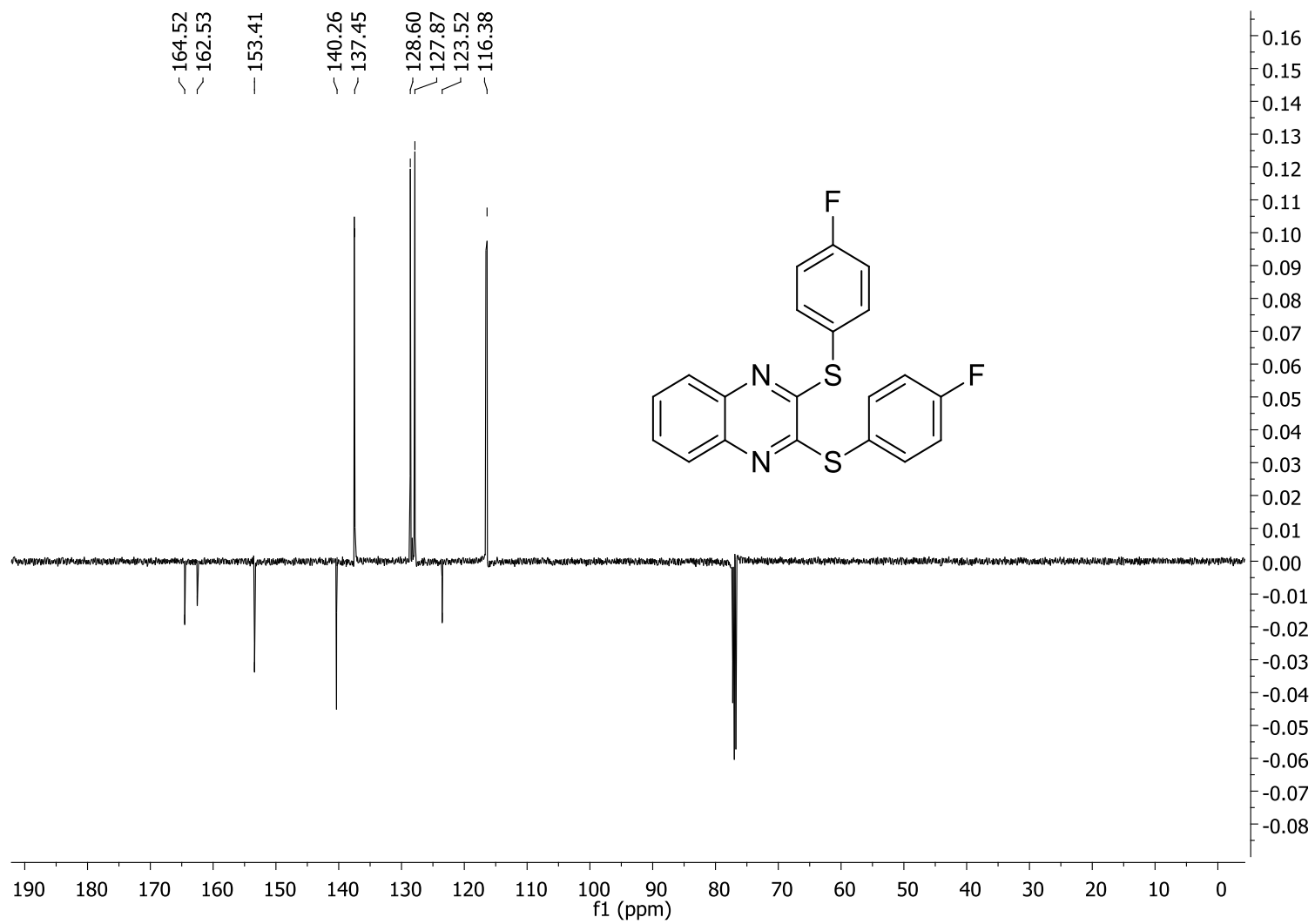
IR (KBr) of 2,3-di(thio-4-fluorophenyl)quinoxaline (2b).



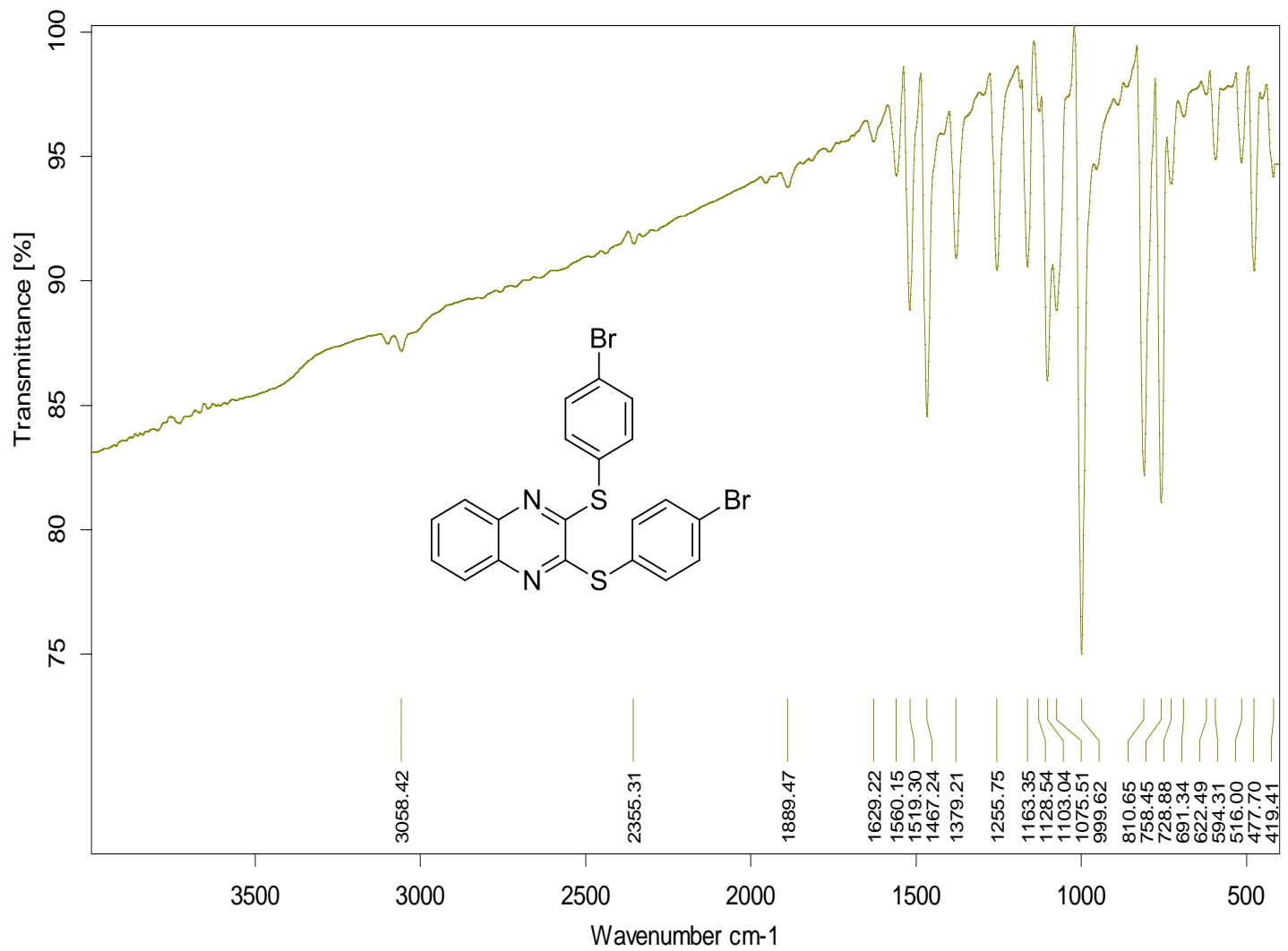
^1H NMR (CDCl_3) of 2,3-di(thio-4-fluorophenyl)quinoxaline (2b).



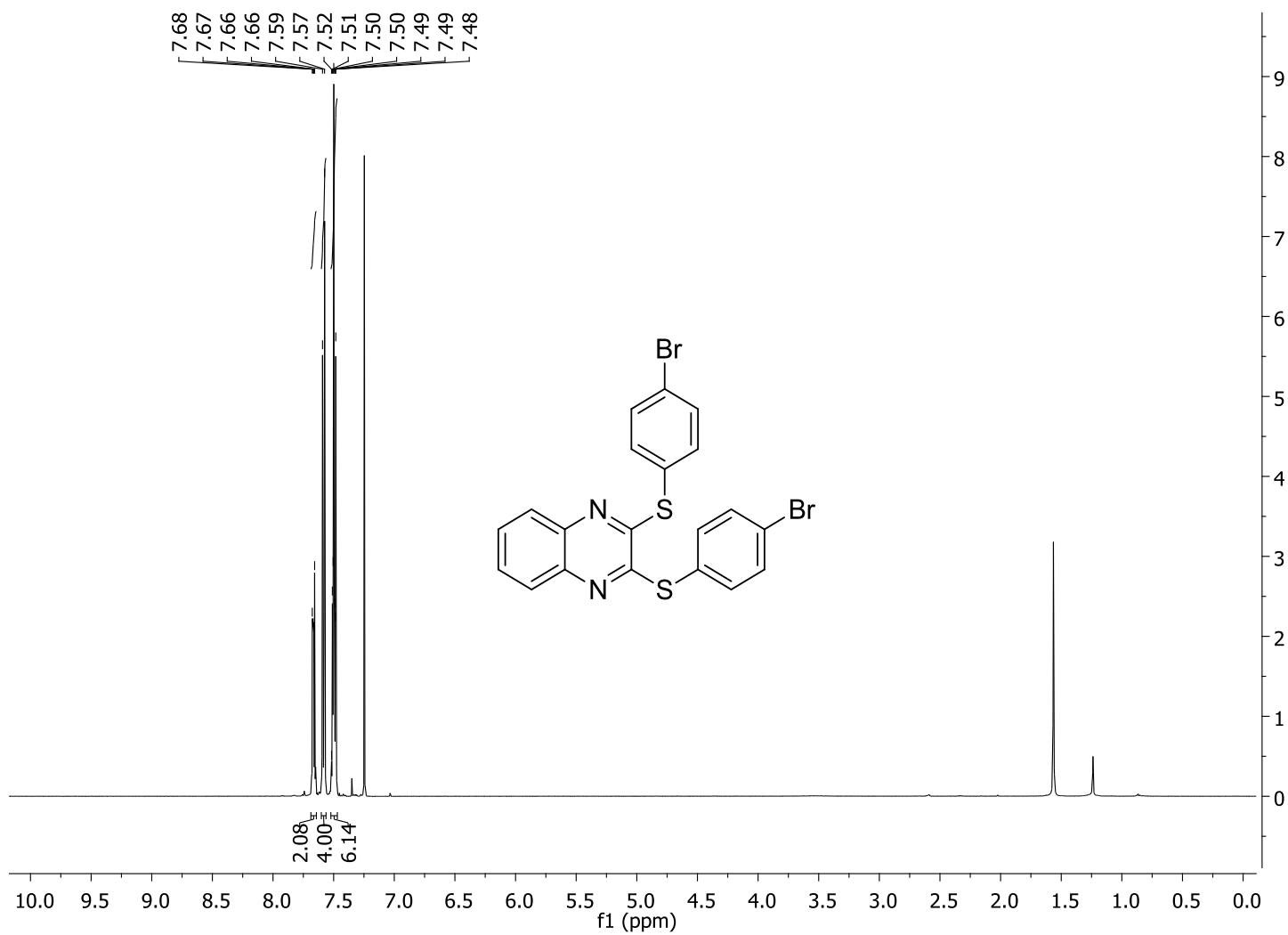
^1H NMR (CDCl_3) of 2,3-di(thio-4-fluorophenyl)quinoxaline (2b).



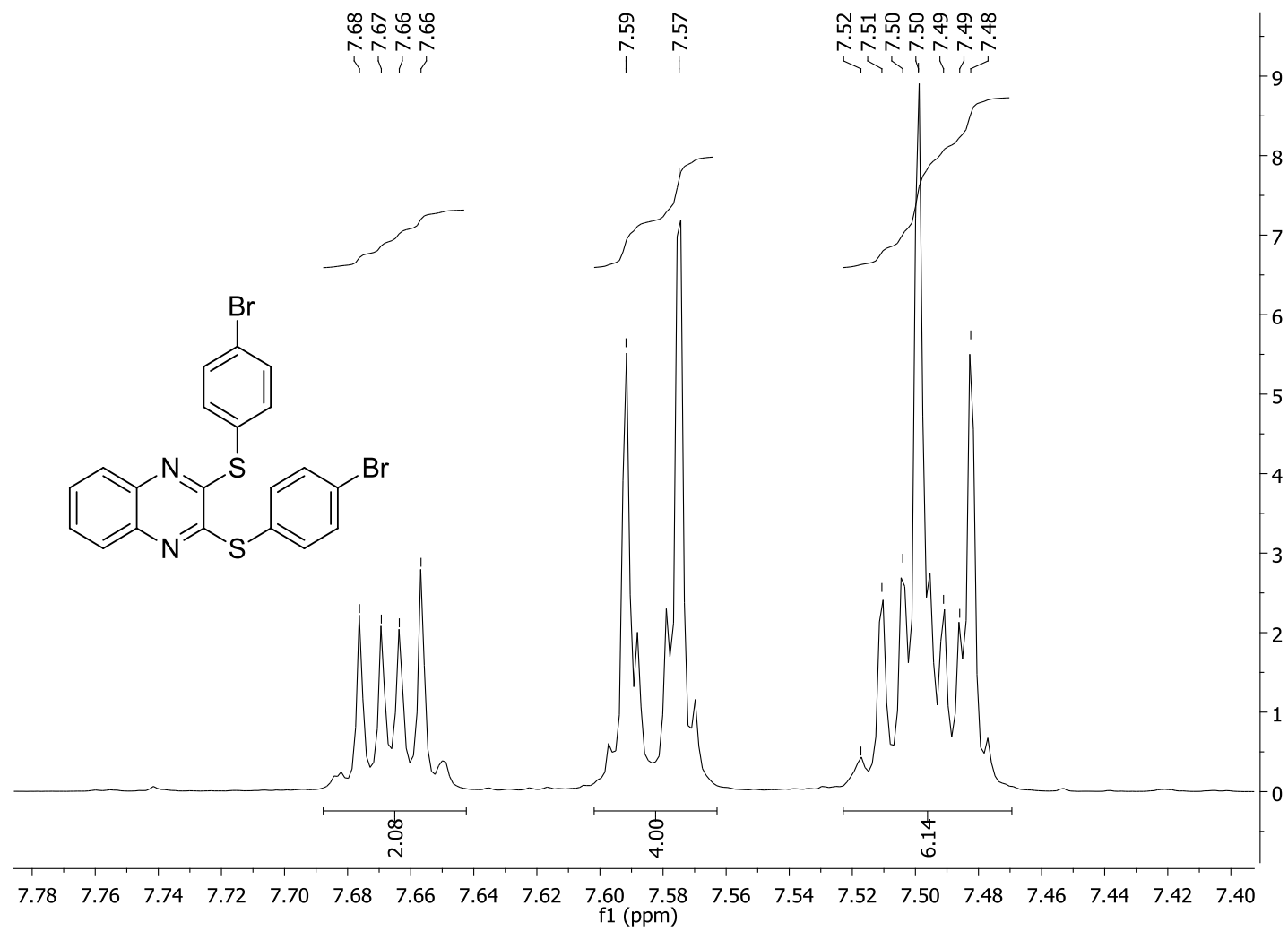
^{13}C APT NMR (CDCl_3) of 2,3-di(thio-4-fluorophenyl)quinoxaline (2b).



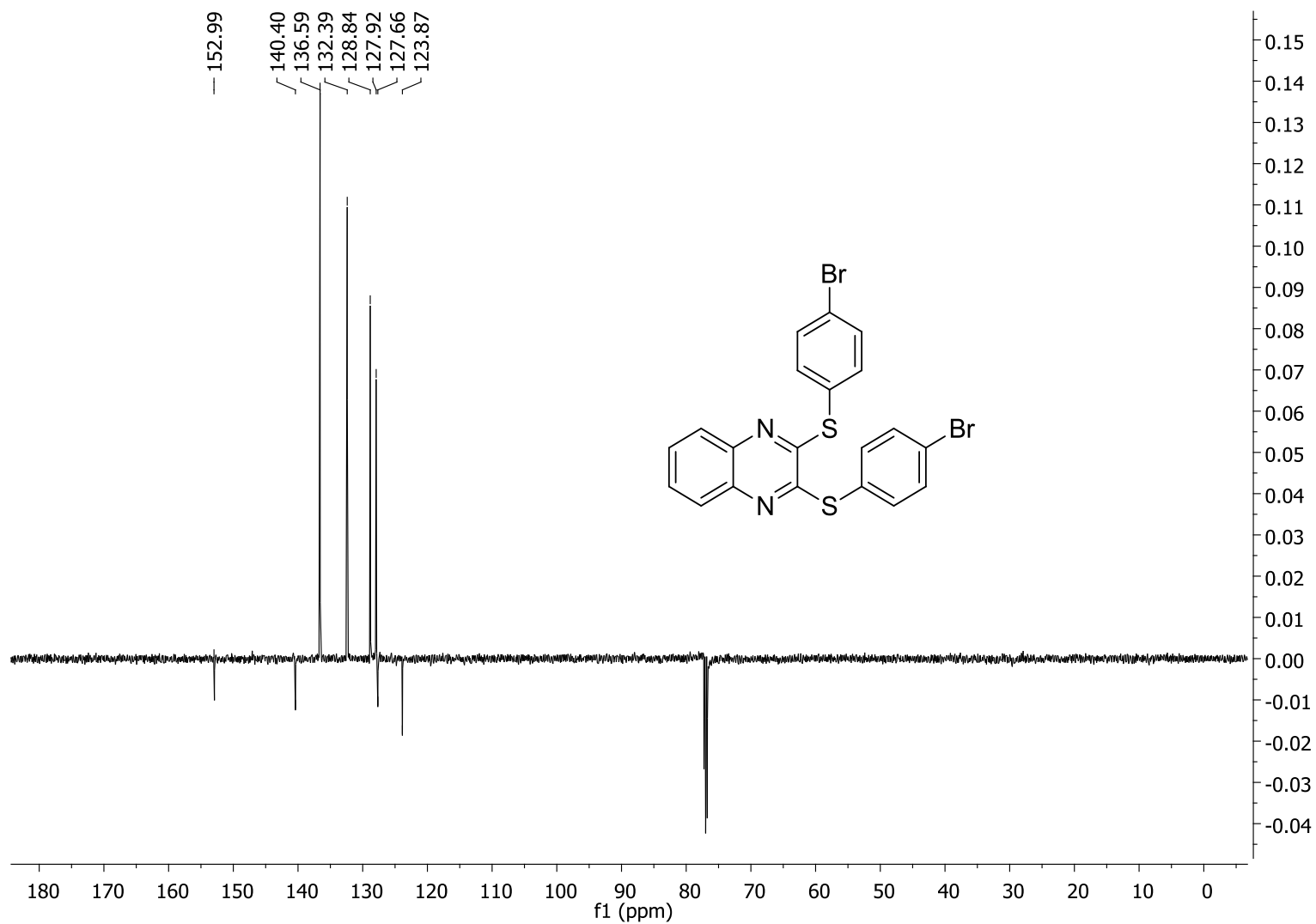
IR (KBr) of 2,3-di(thio-4-bromophenyl)quinoxaline (2c).



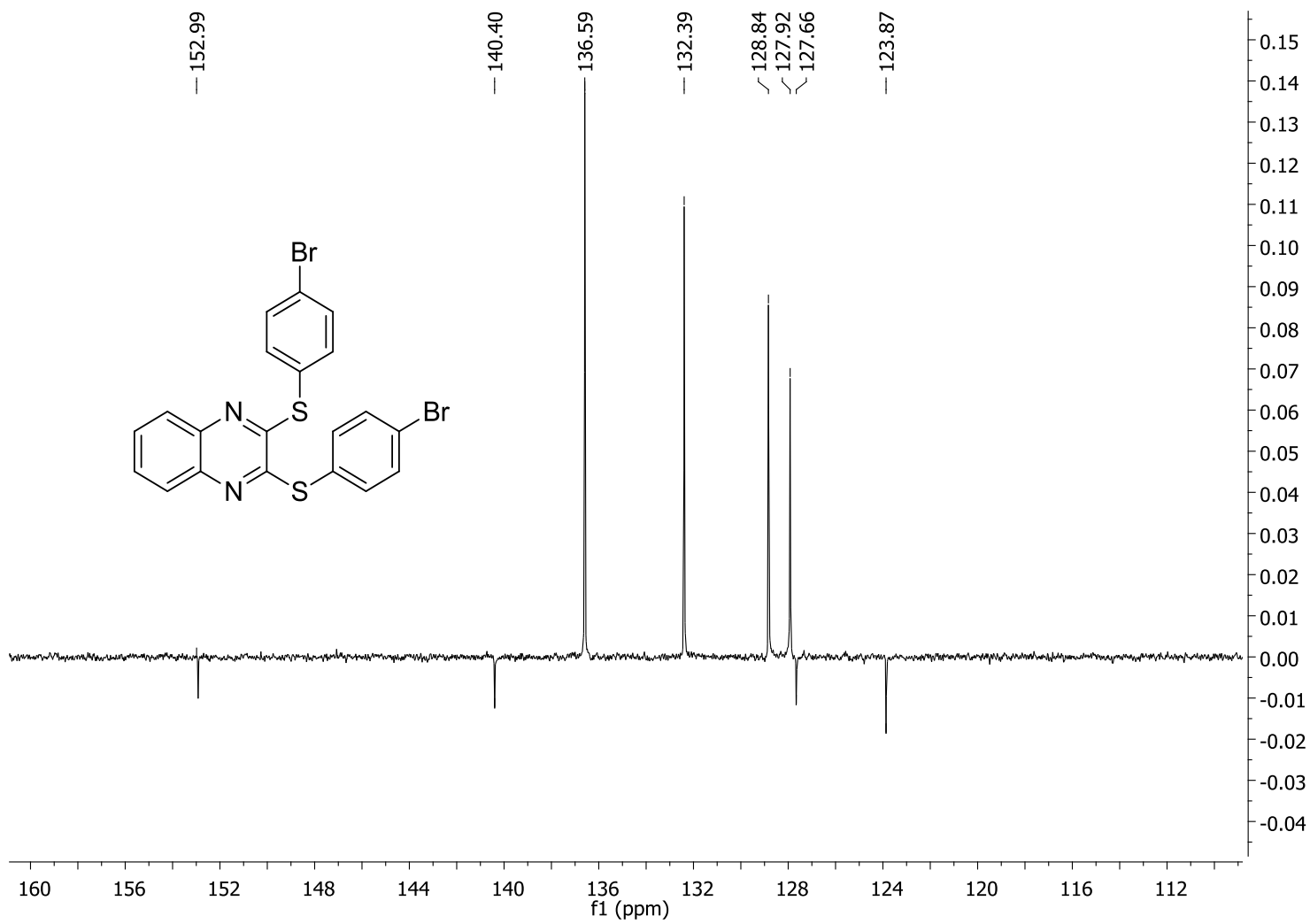
¹H NMR (CDCl₃) of 2,3-di(thio-4-bromophenyl)quinoxaline (2c).



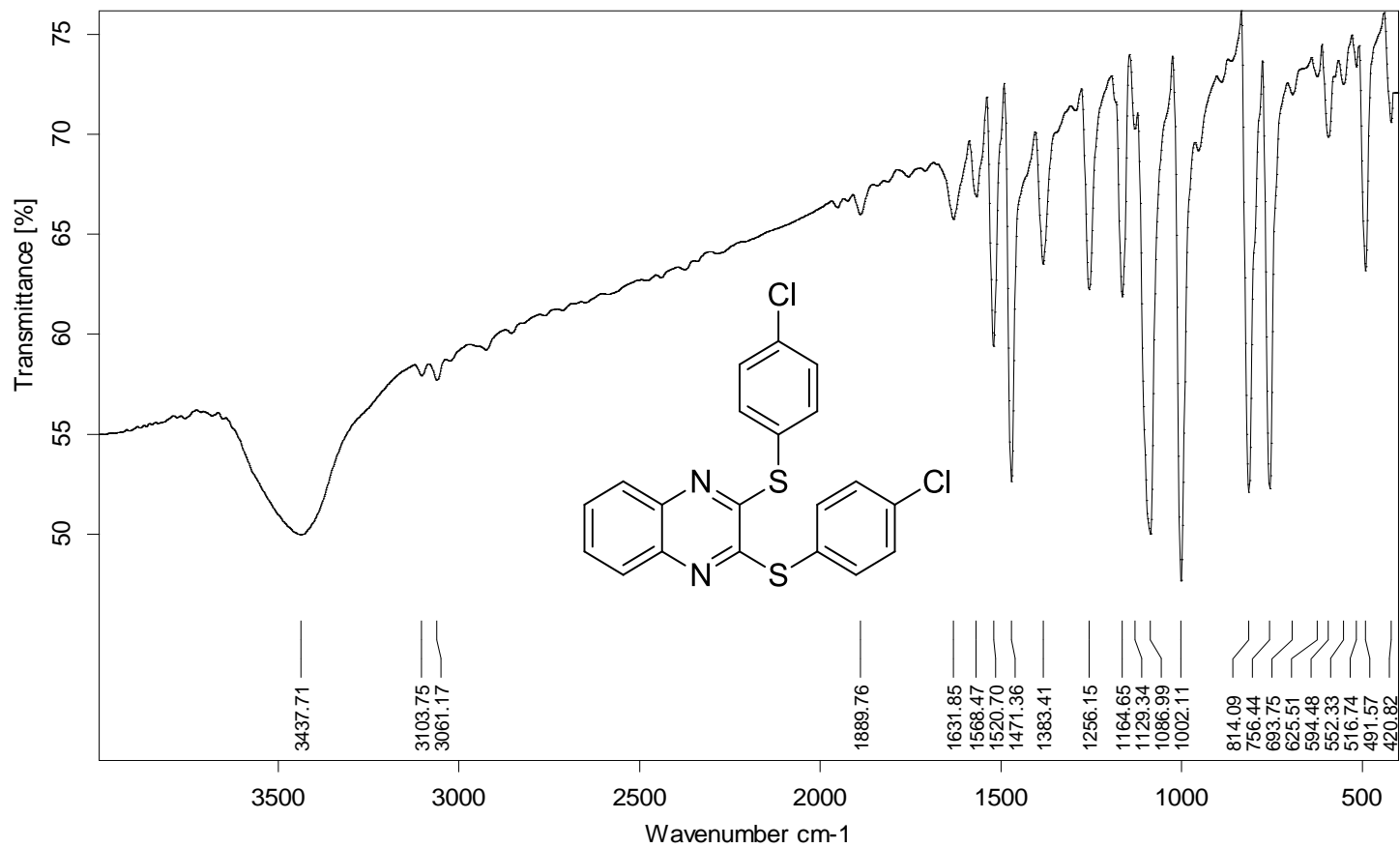
^1H NMR (CDCl_3) of 2,3-di(thio-4-bromophenyl)quinoxaline (2c).



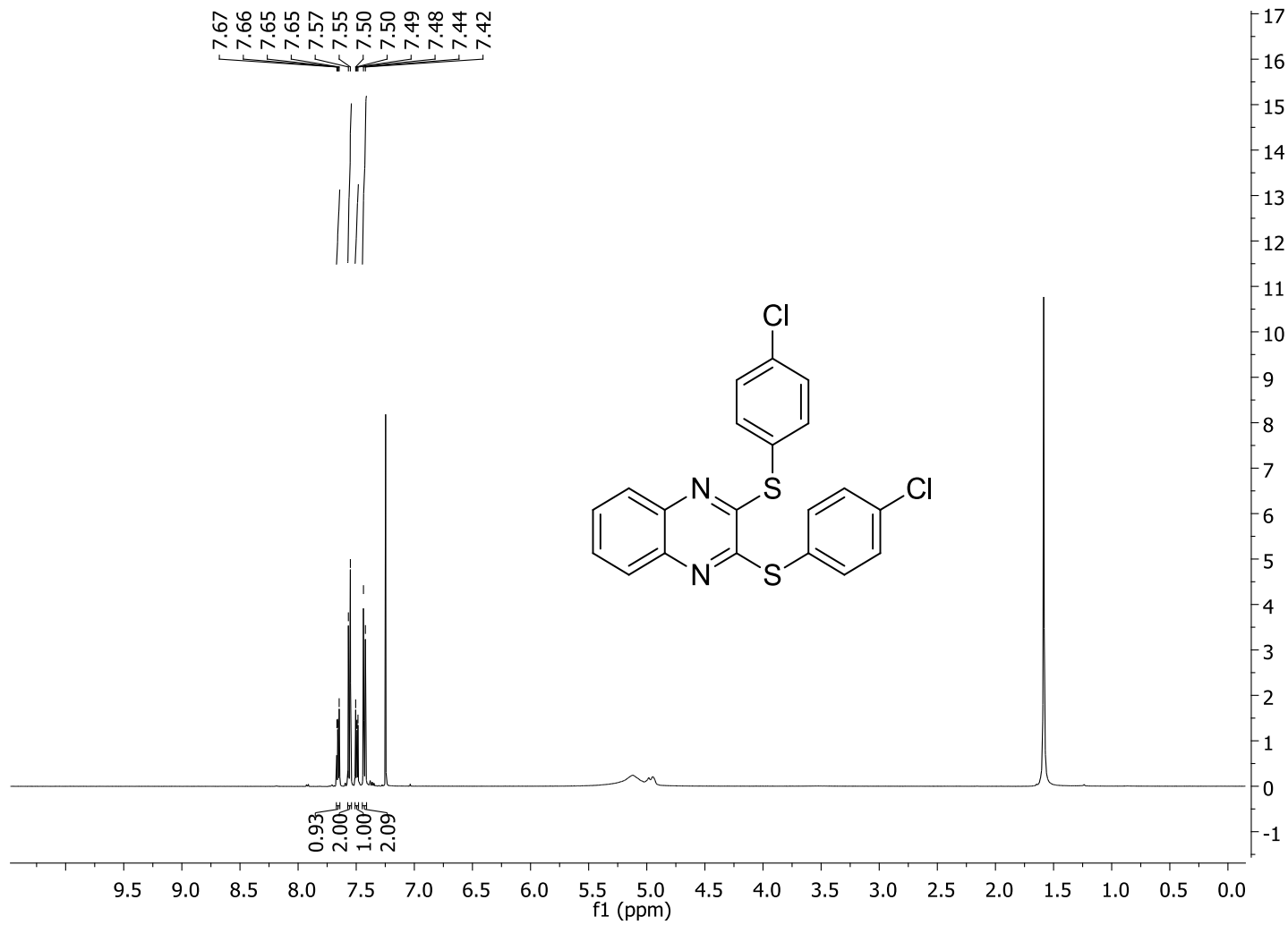
¹³C APT NMR (CDCl₃) of 2,3-di(thio-4-bromophenyl)quinoxaline (2c).

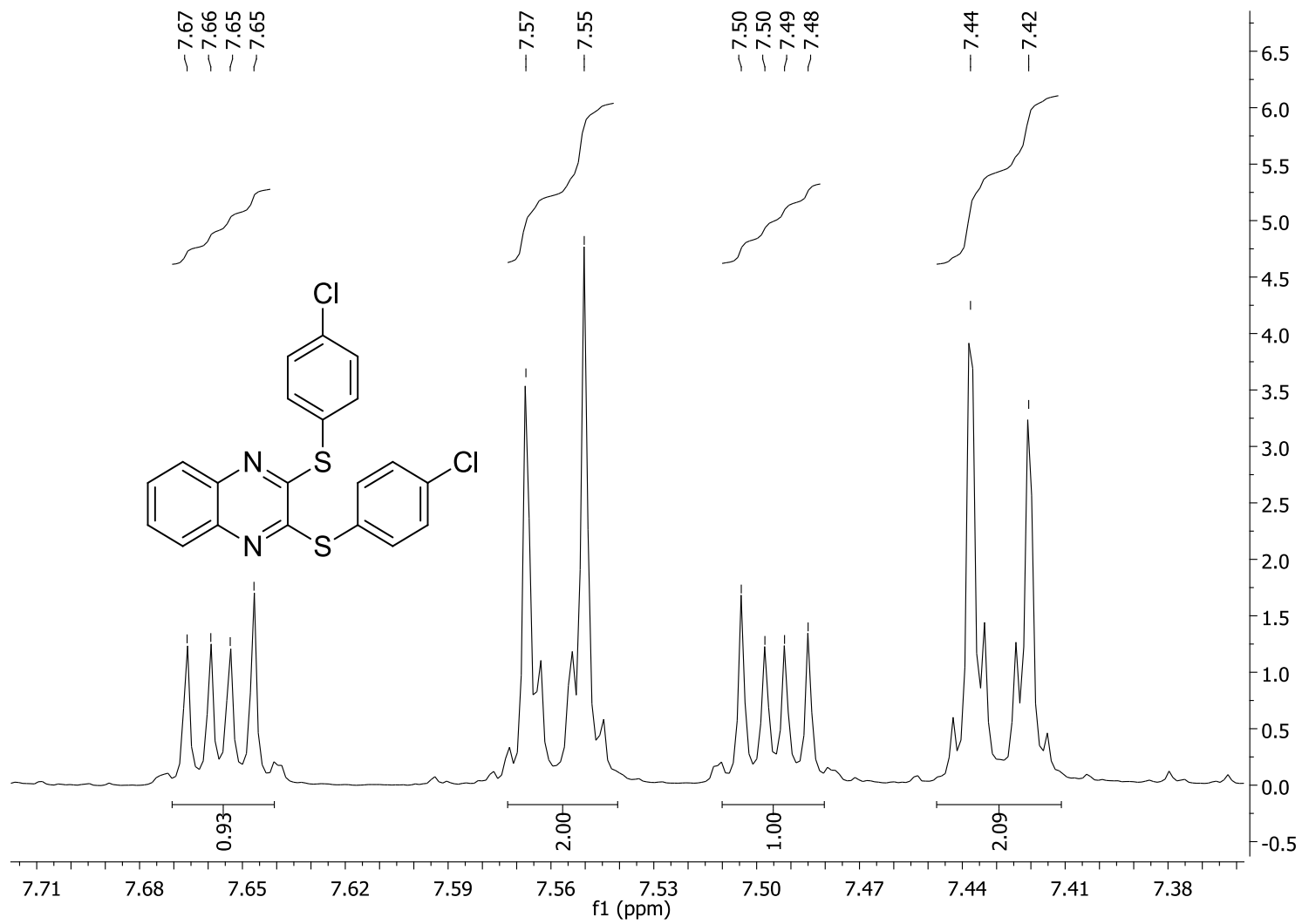


¹³C APT NMR (CDCl₃) of 2,3-di(thio-4-bromophenyl)quinoxaline (2c).

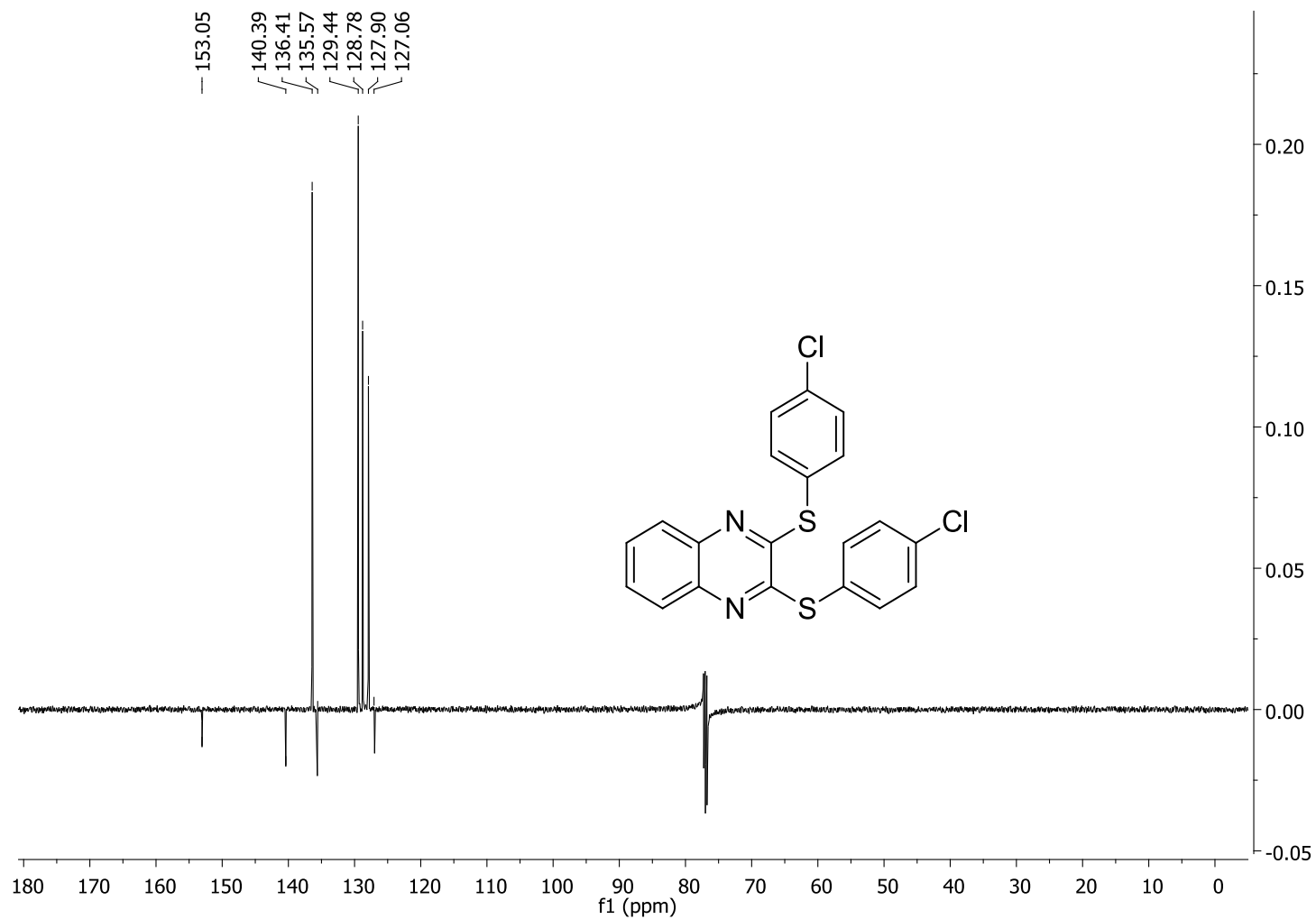


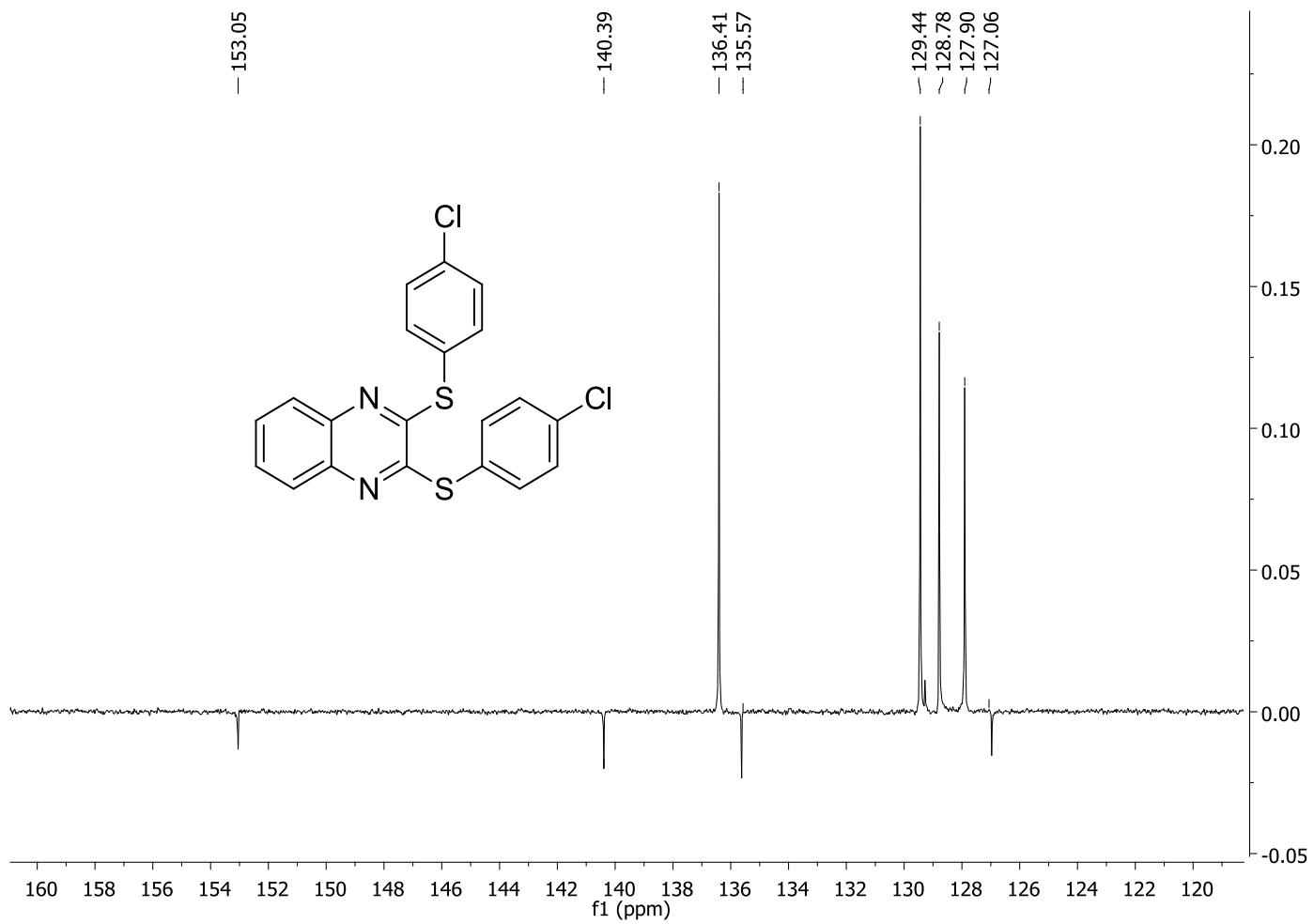
IR (KBr) of 2,3-di(thio-4-chlorophenyl)quinoxaline (2d).



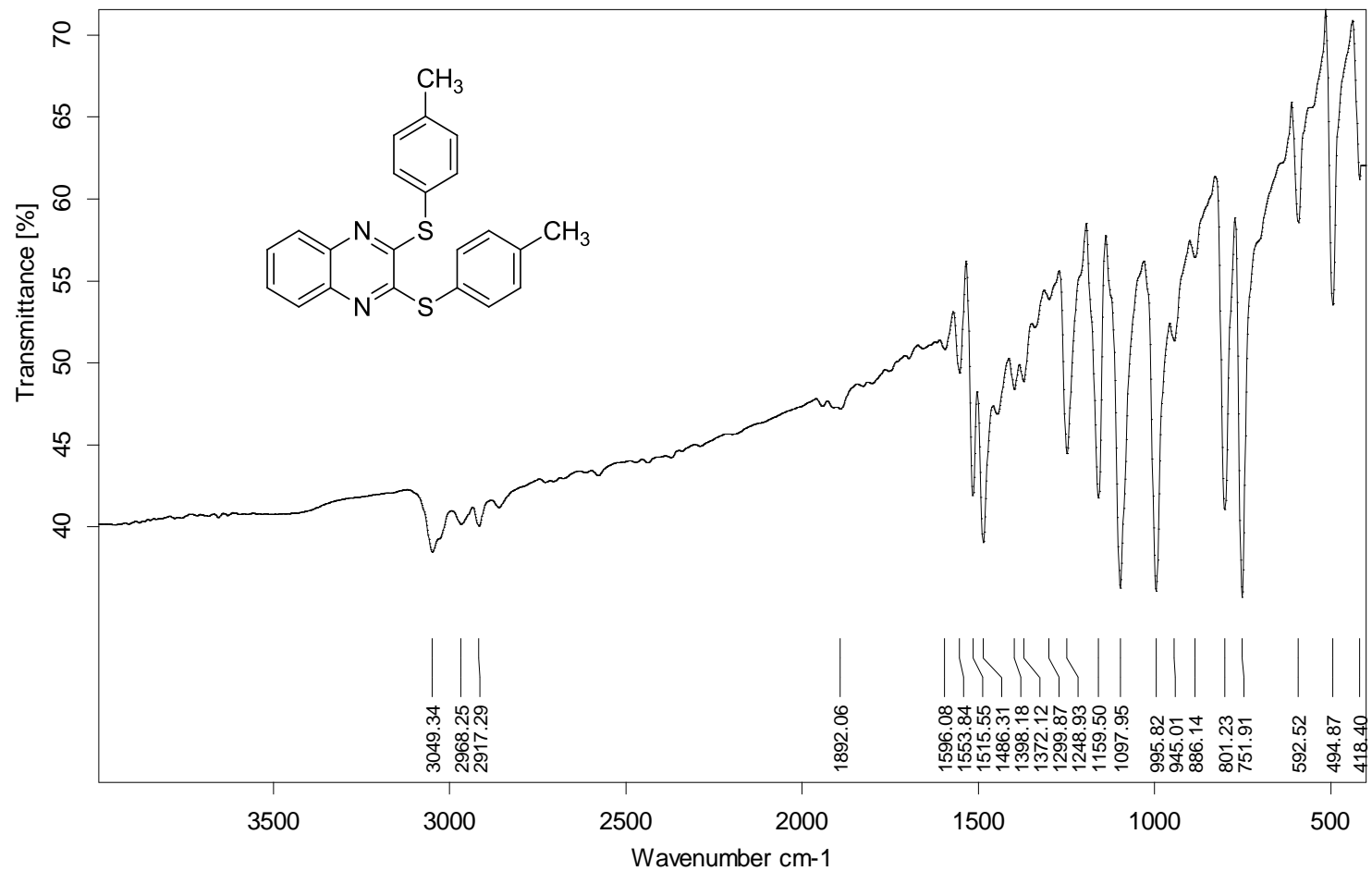


^1H NMR (CDCl_3) of 2,3-di(thio-4-chlorophenyl)quinoxaline (2d).

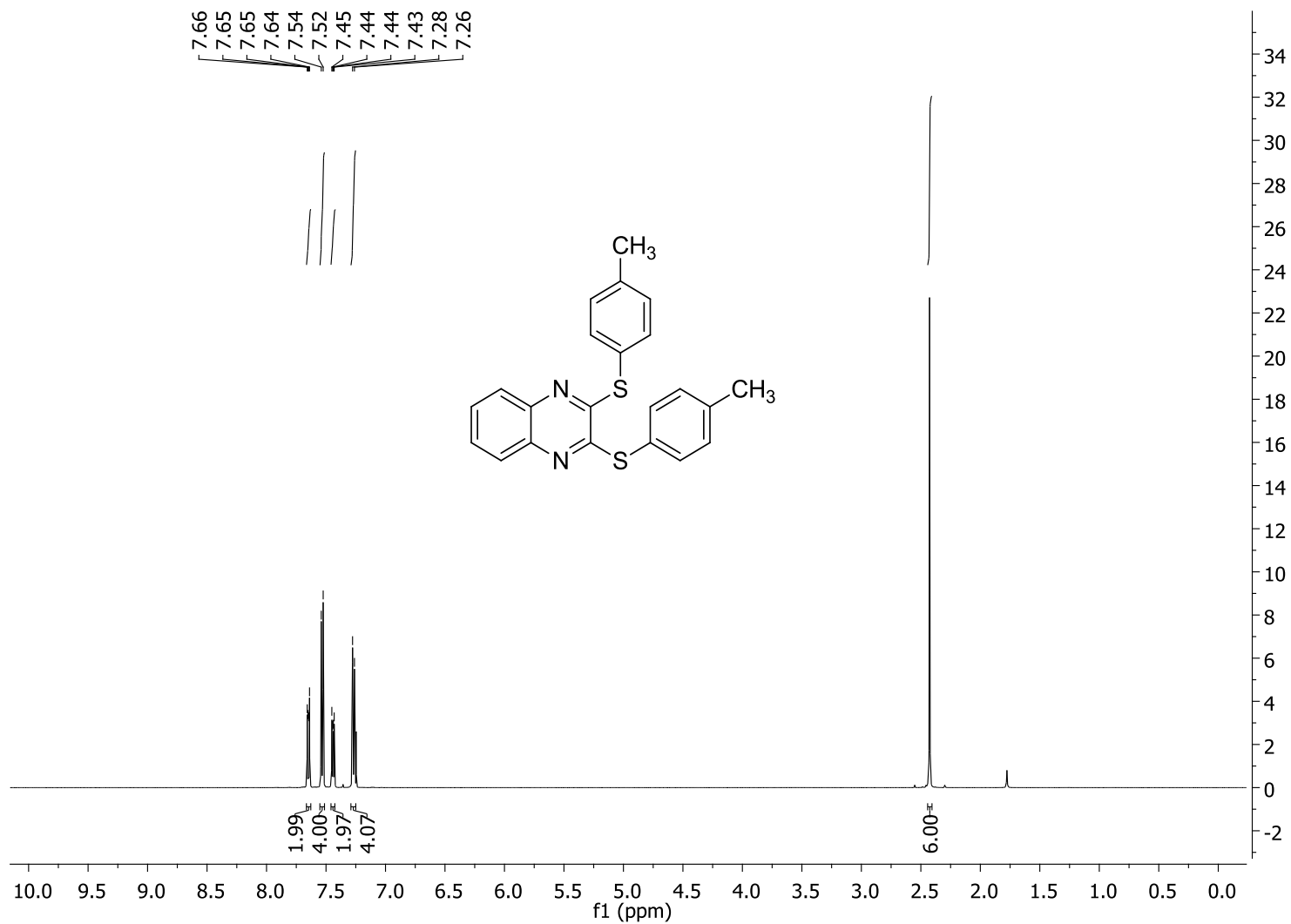




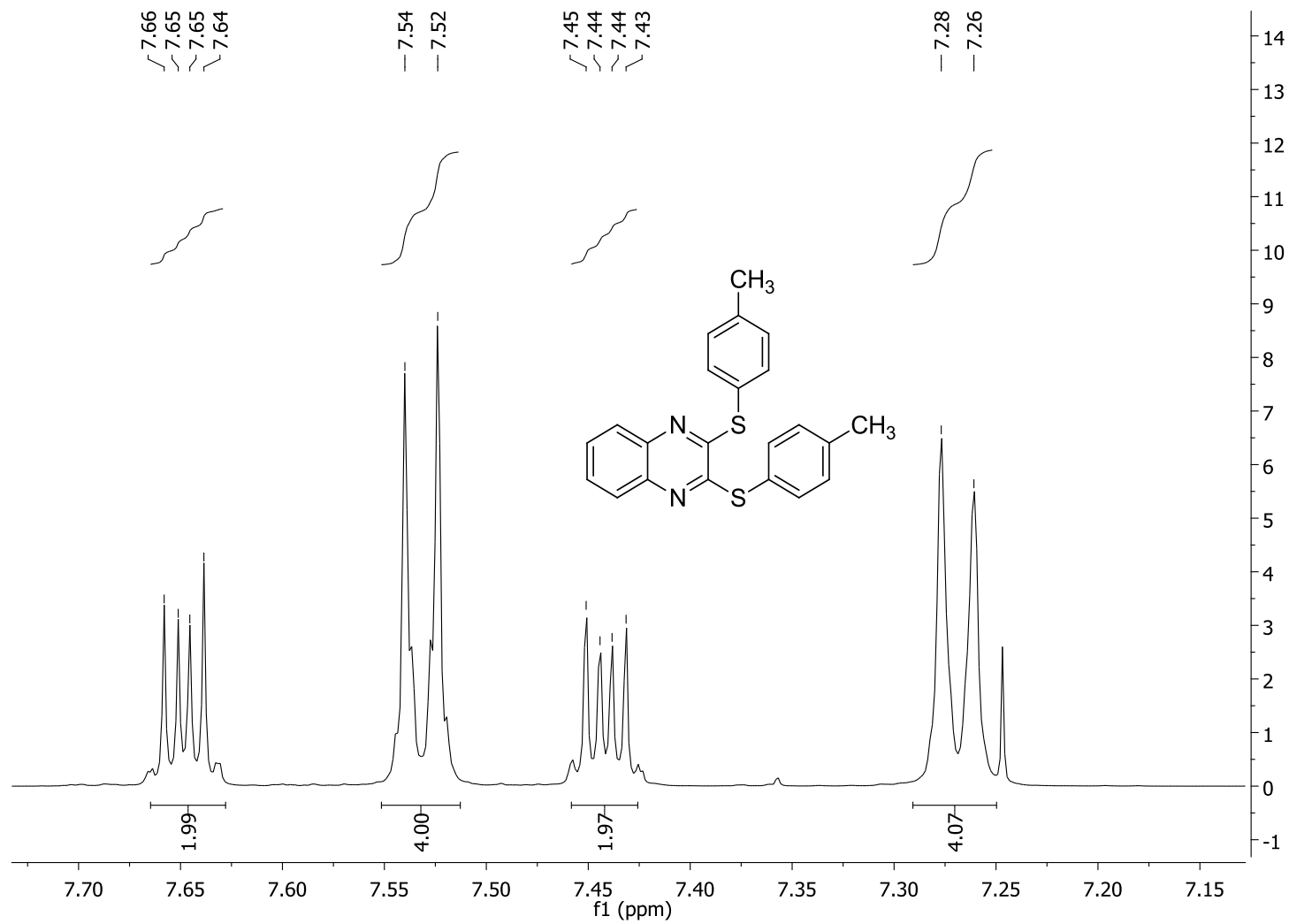
^{13}C APT NMR (CDCl_3) of 2,3-di(thio-4-chlorophenyl)quinoxaline (2d).



IR (KBr) of 2,3-di(thio-4-methylphenyl)quinoxaline (2e).



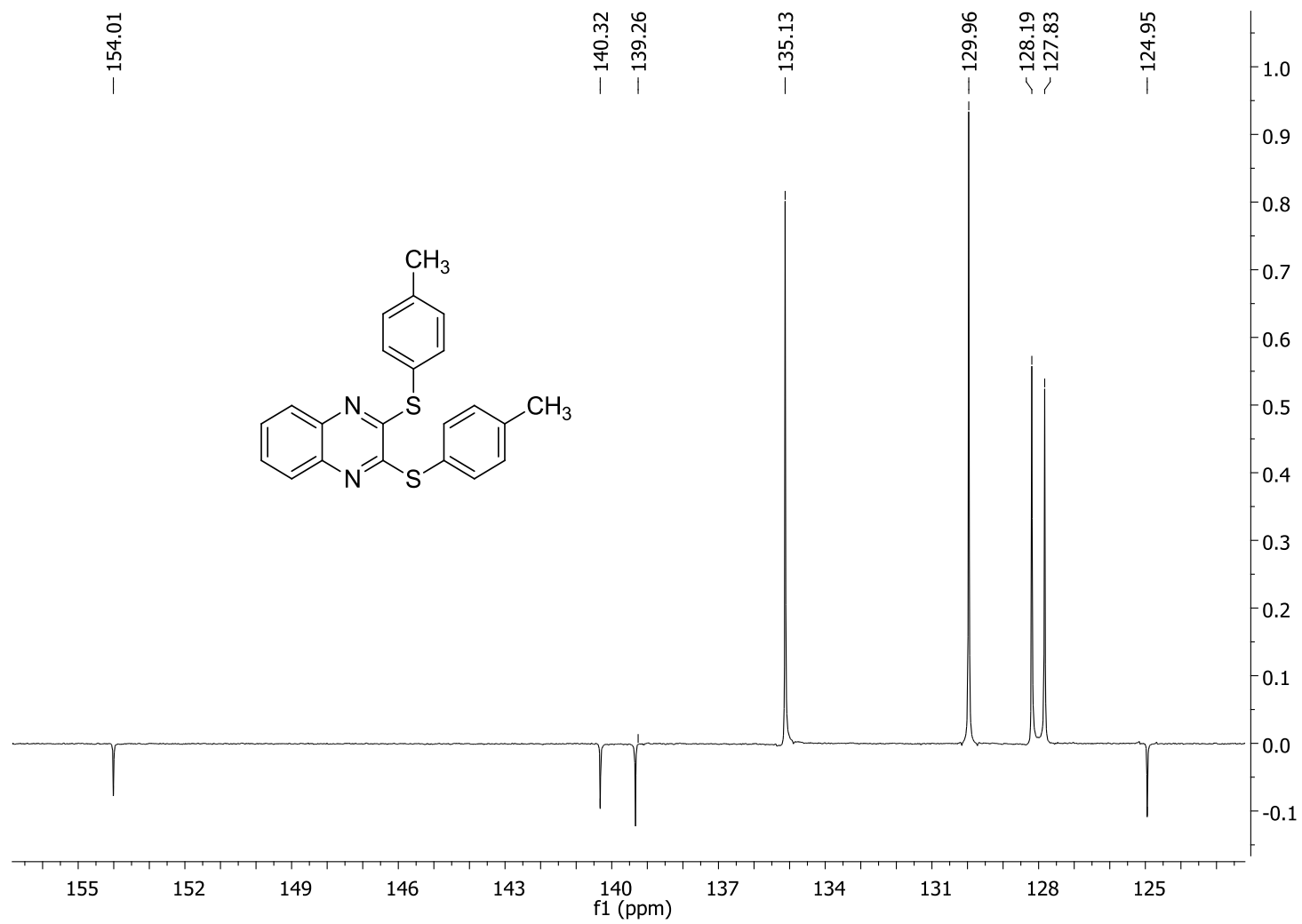
^1H NMR (CDCl_3) of 2,3-di(thio-4-methylphenyl)quinoxaline (2e).



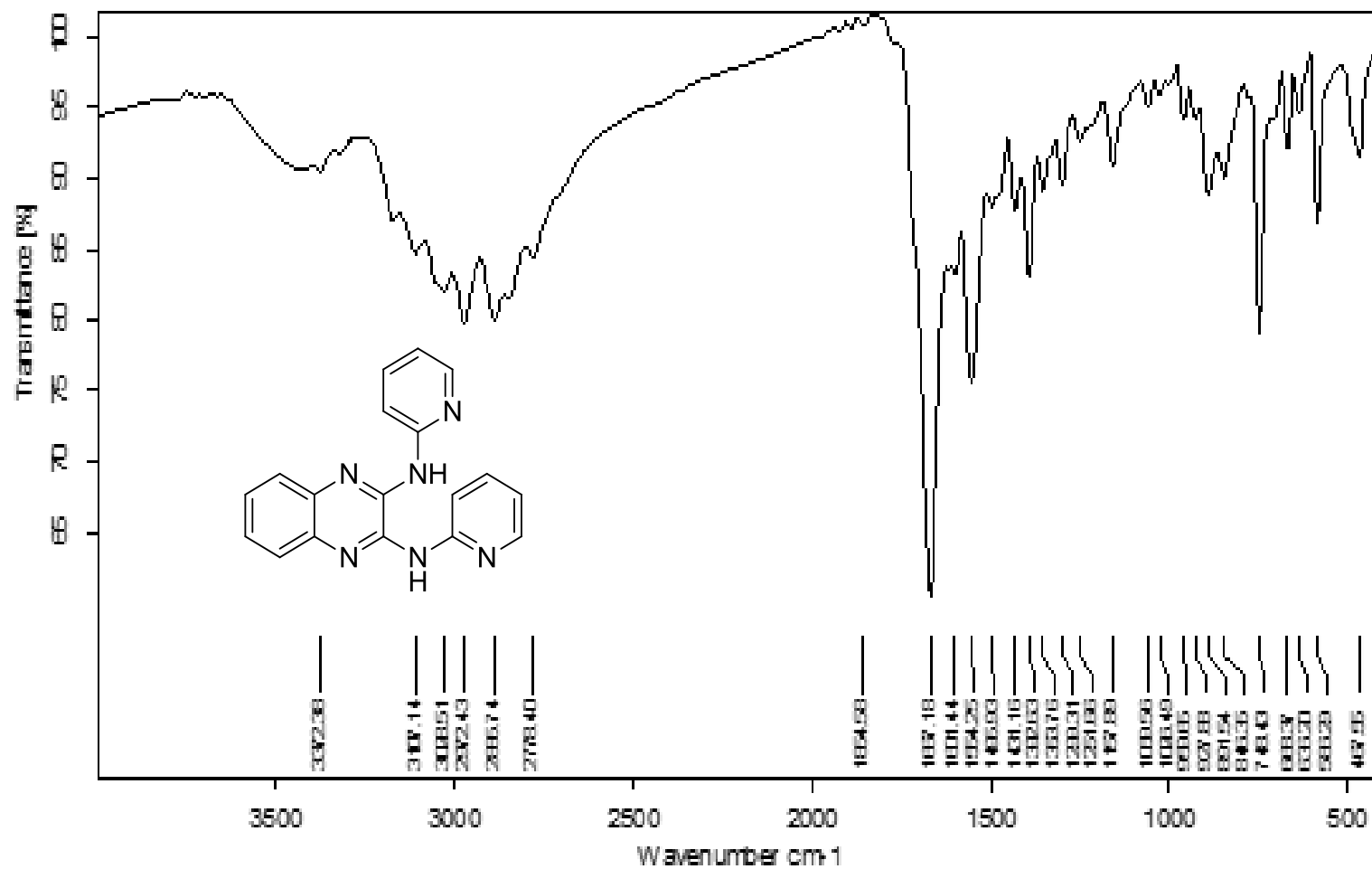
¹H NMR (CDCl₃) of 2,3-di(thio-4-methylphenyl)quinoxaline (2e).



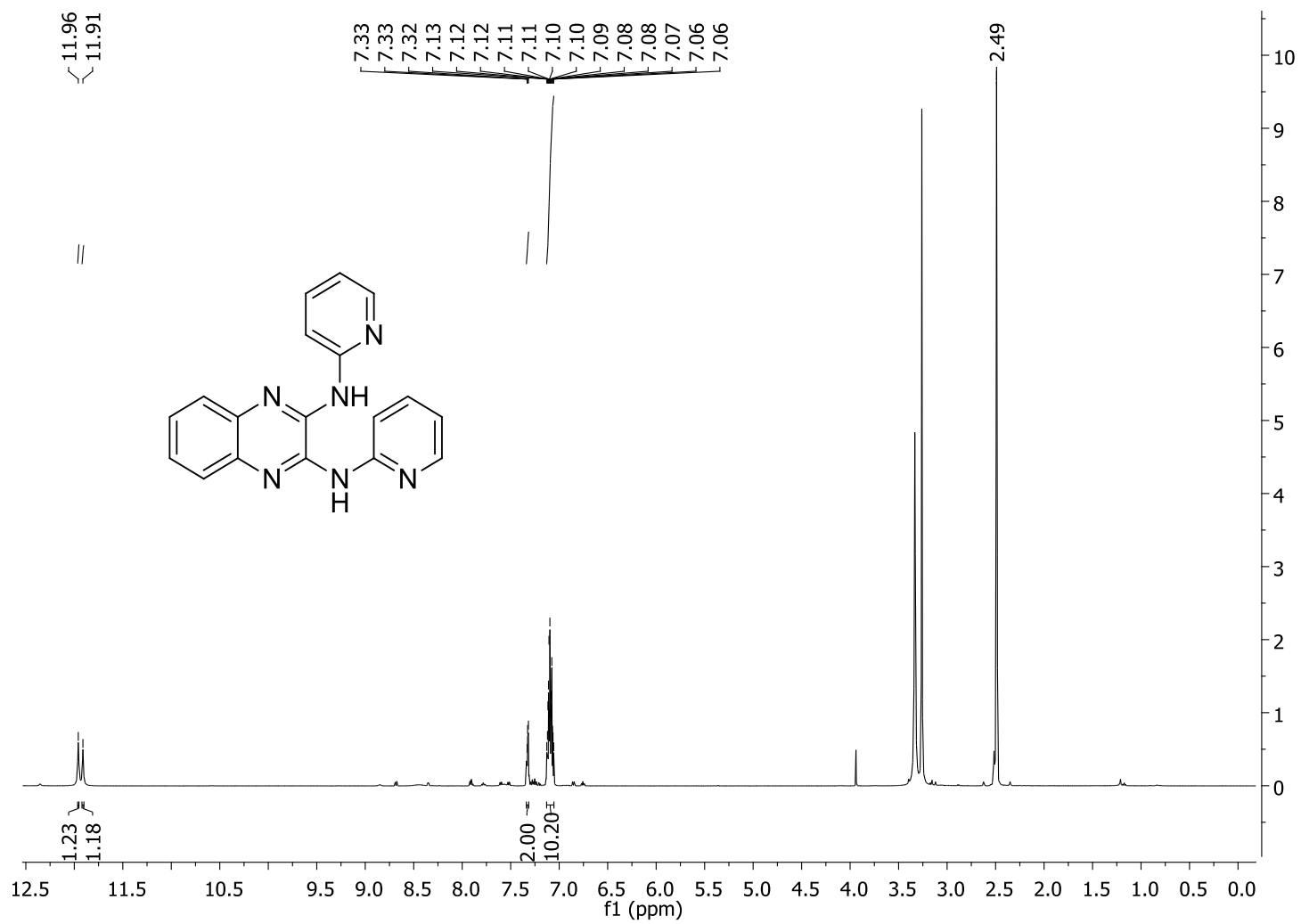
^{13}C APT NMR (CDCl_3) of 2,3-di(thio-4-methylphenyl)quinoxaline (2e).



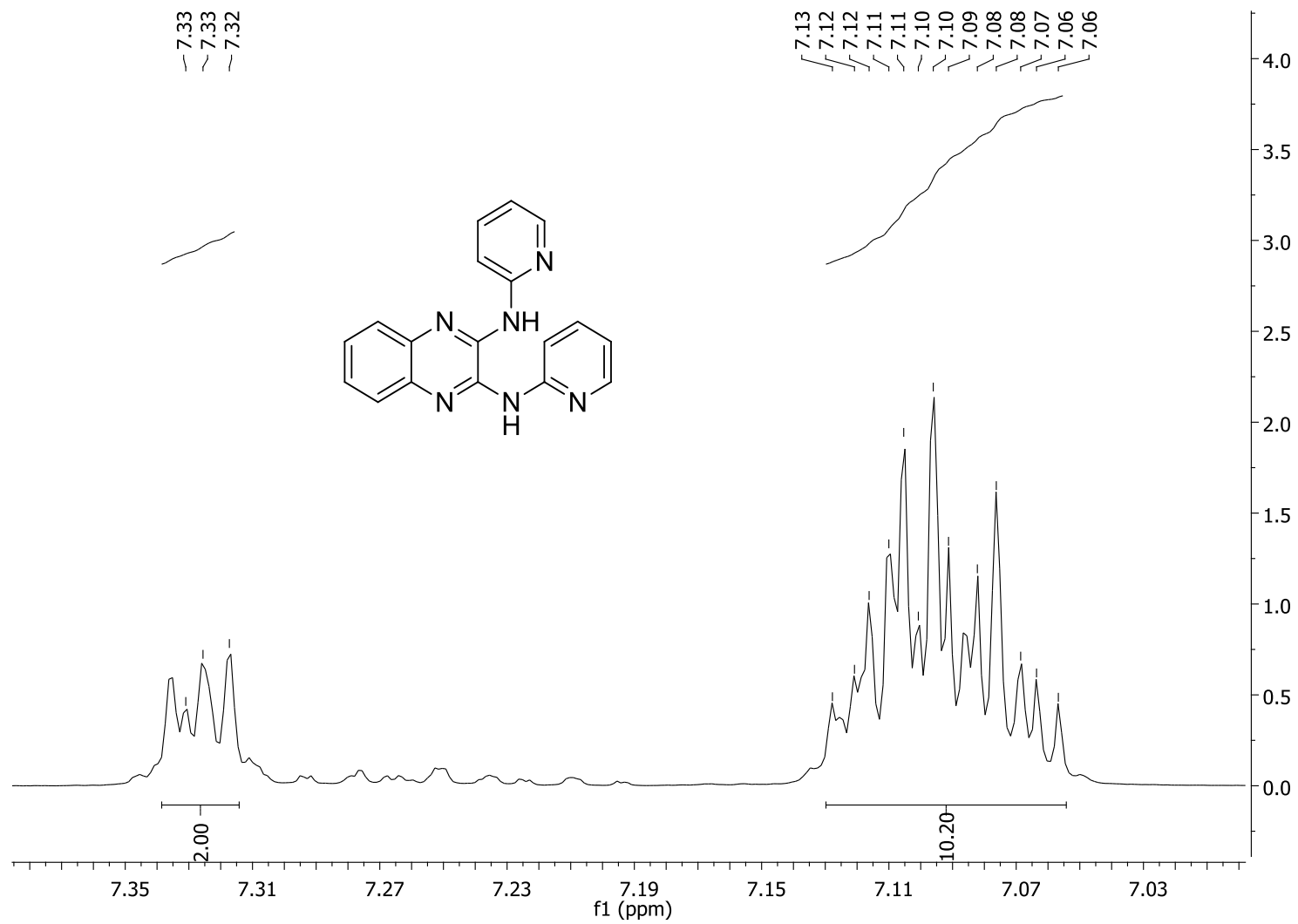
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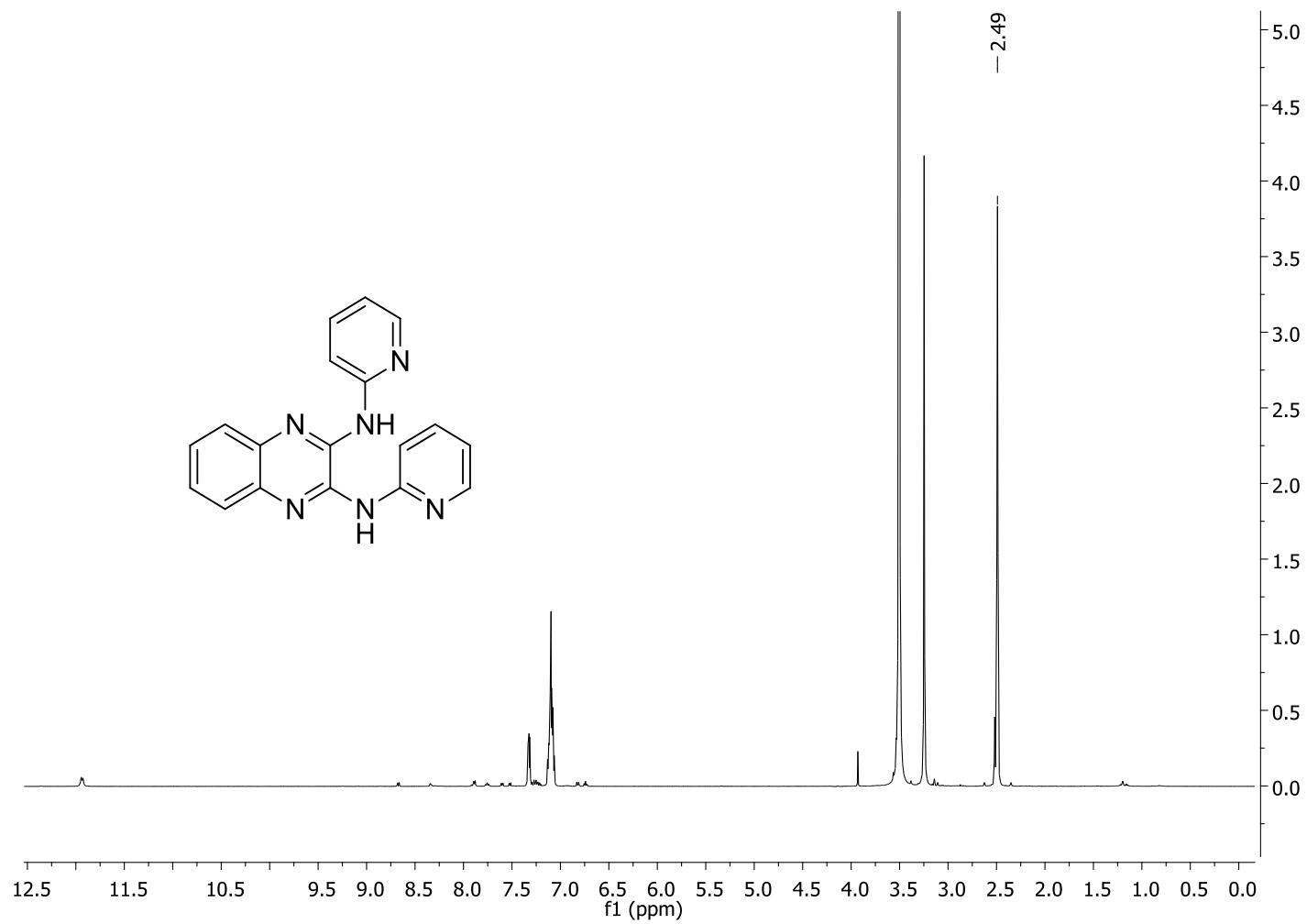
IR (KBr) of N²,N³-di(pyridin-2-yl)quinoxaline-2,3-diamine (3a).



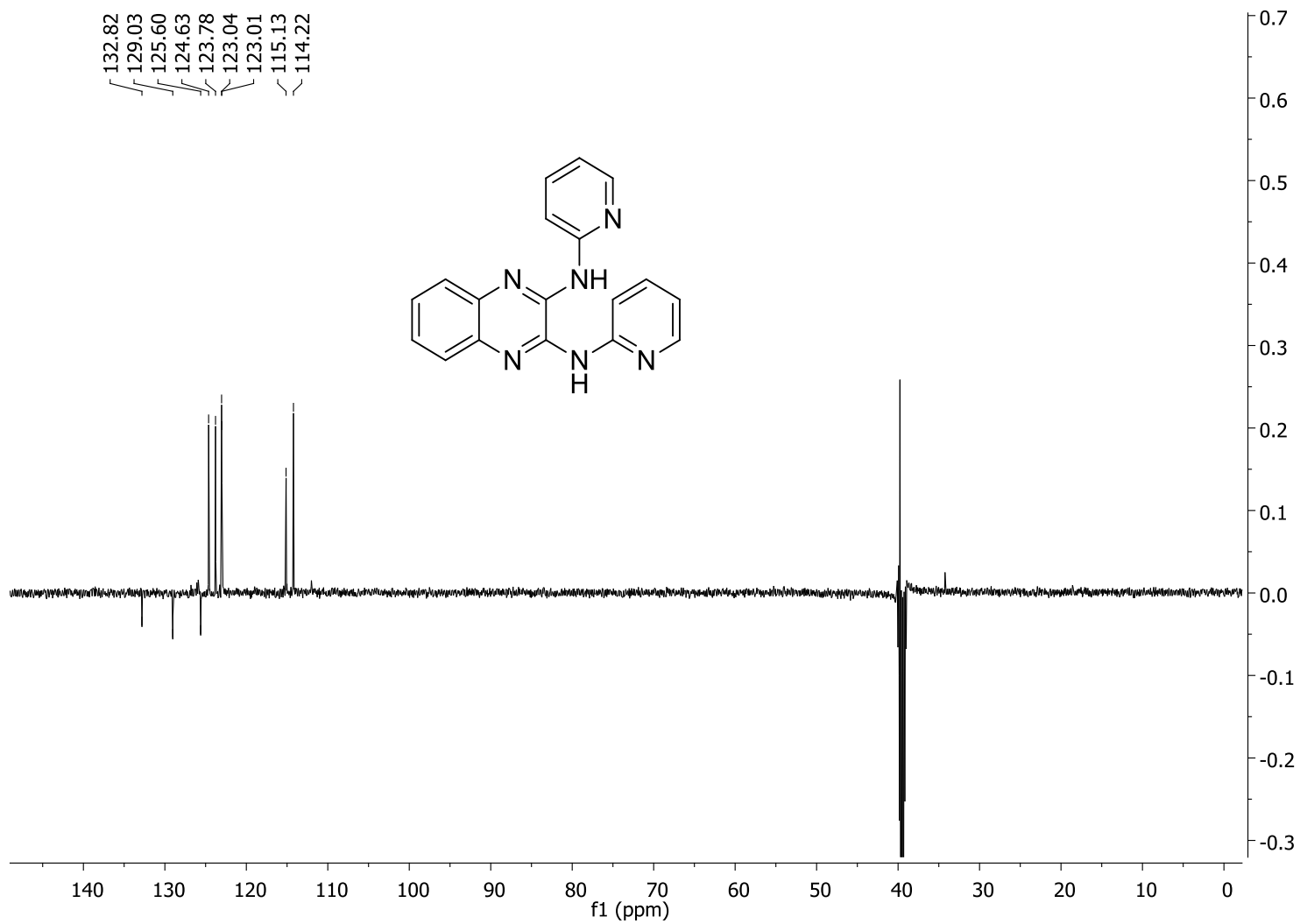
^1H NMR (DMSO) of N^2, N^3 -di(pyridin-2-yl)quinoxaline-2,3-diamine (3a).



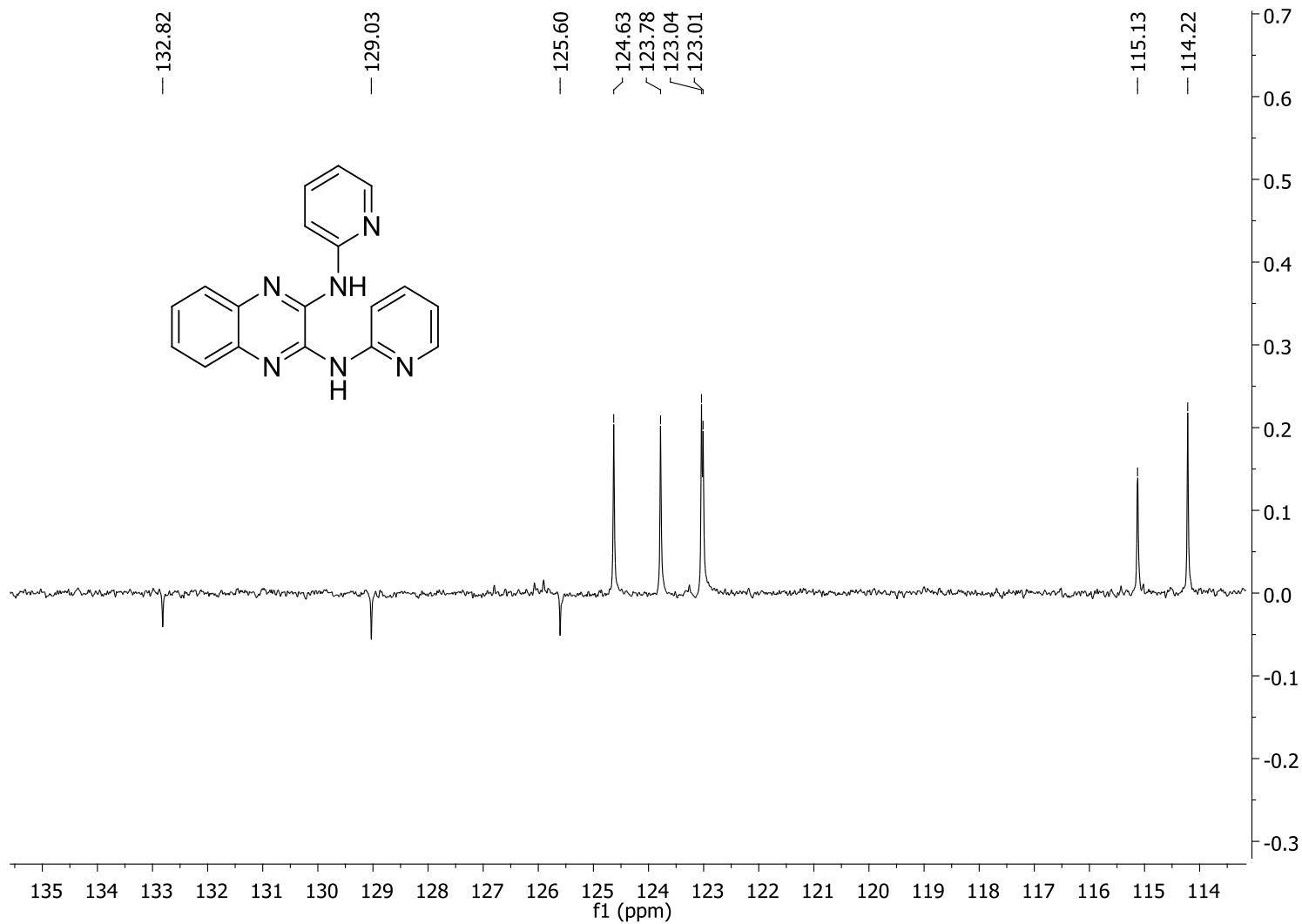
^1H NMR (DMSO) of N^2, N^3 -di(pyridin-2-yl)quinoxaline-2,3-diamine (3a).



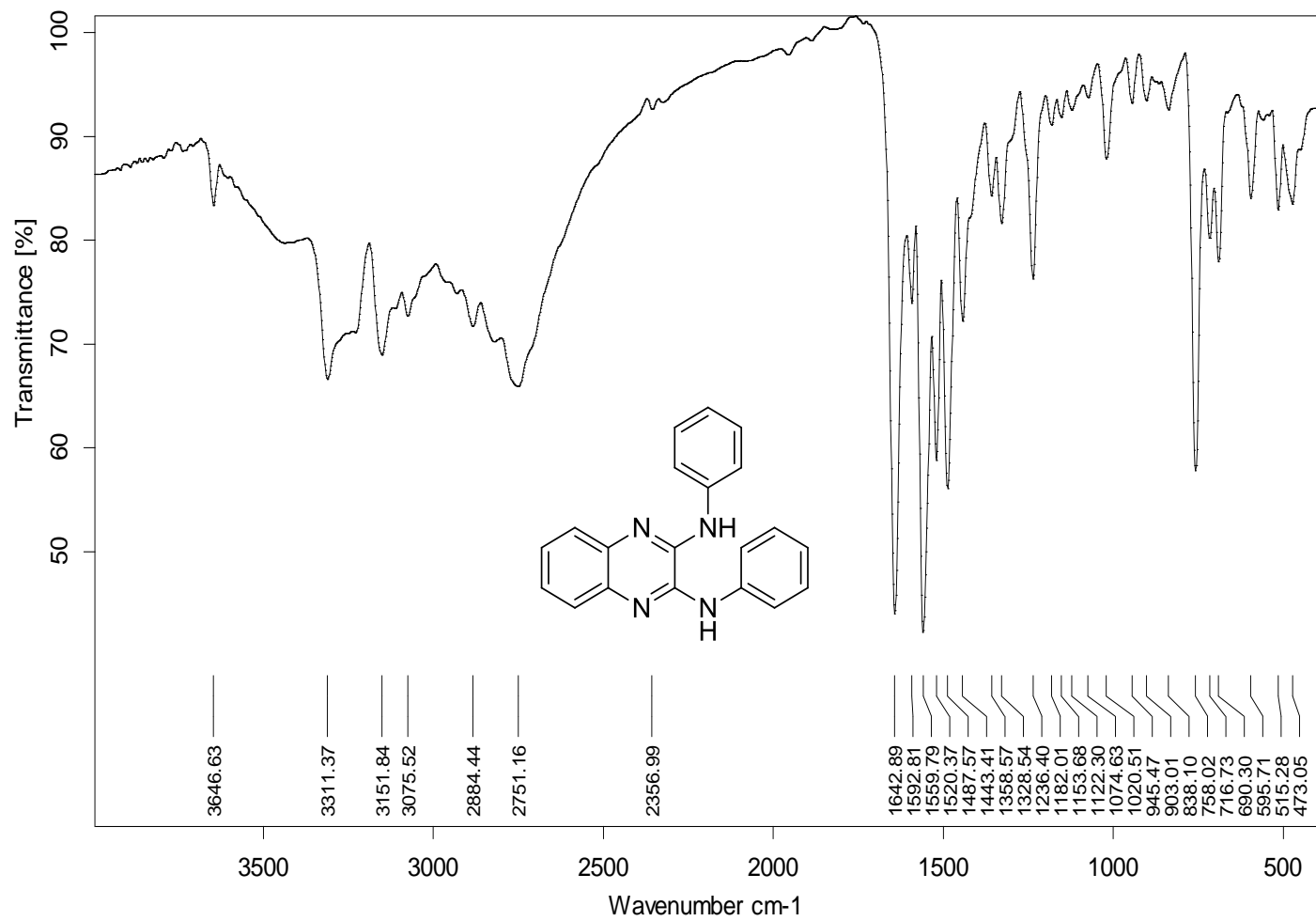
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of N^2,N^3 -di(pyridin-2-yl)quinoxaline-2,3-diamine (3a).



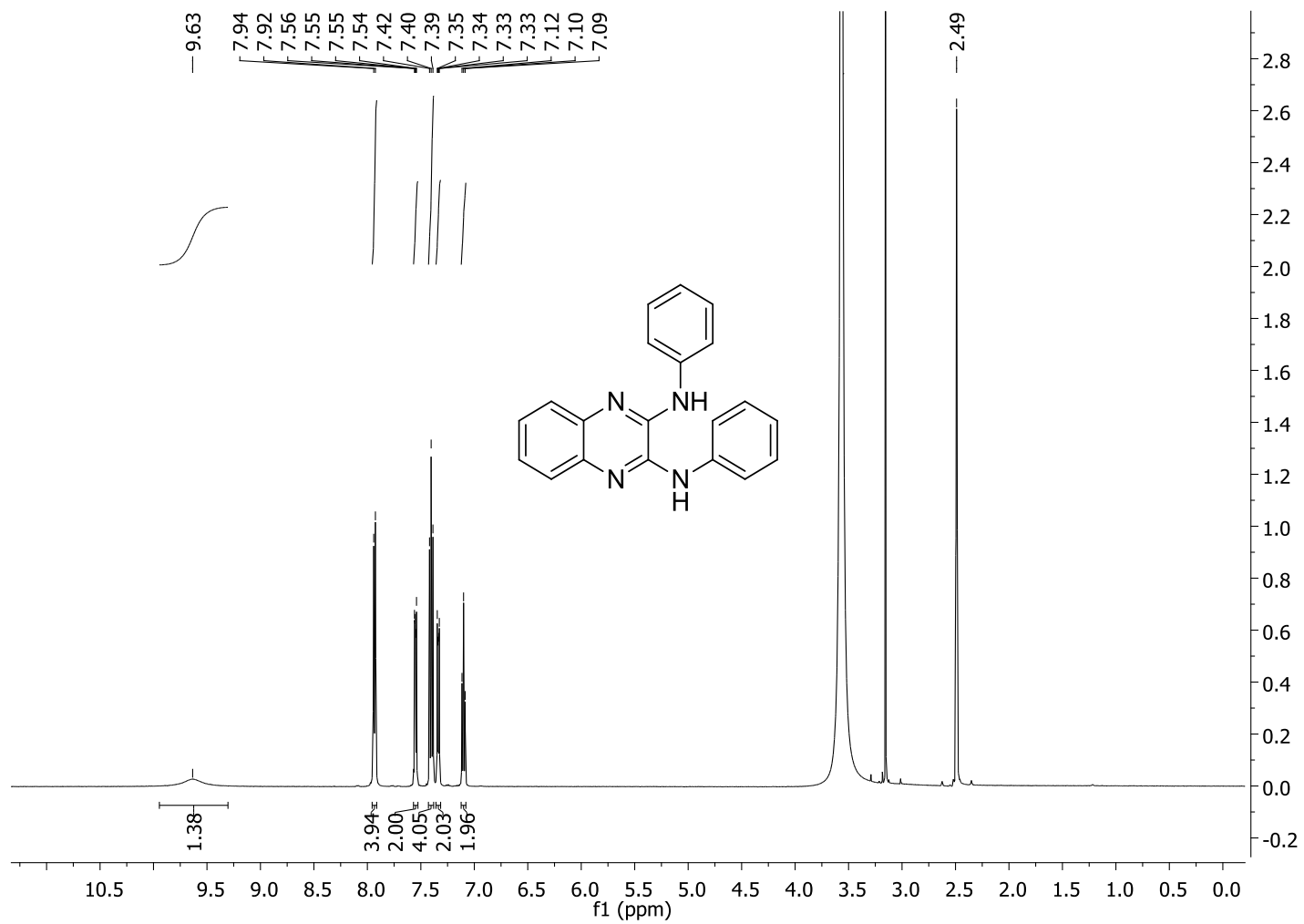
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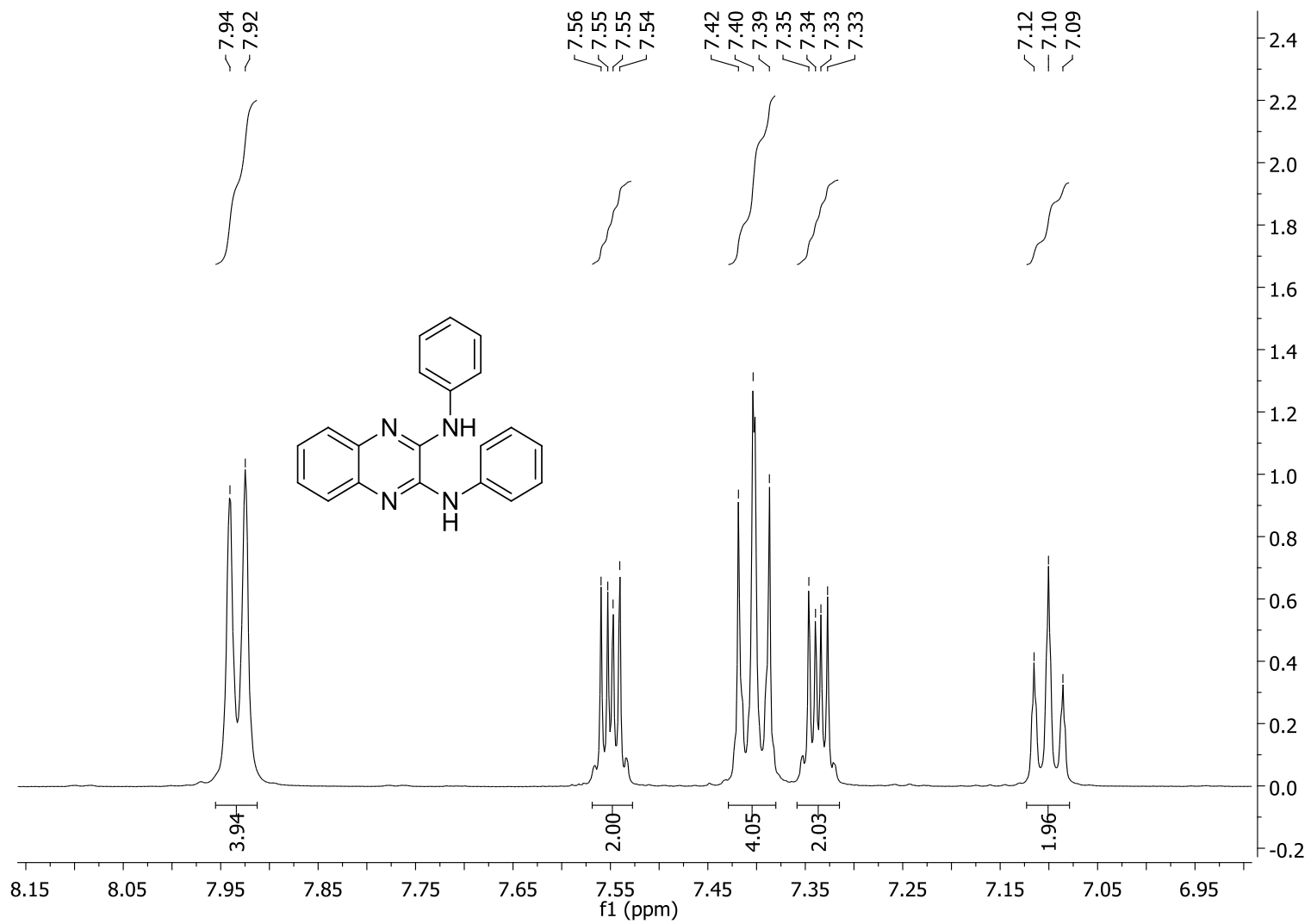
^{13}C APT NMR (DMSO) of N^2,N^3 -di(pyridin-2-yl)quinoxaline-2,3-diamine (3a).



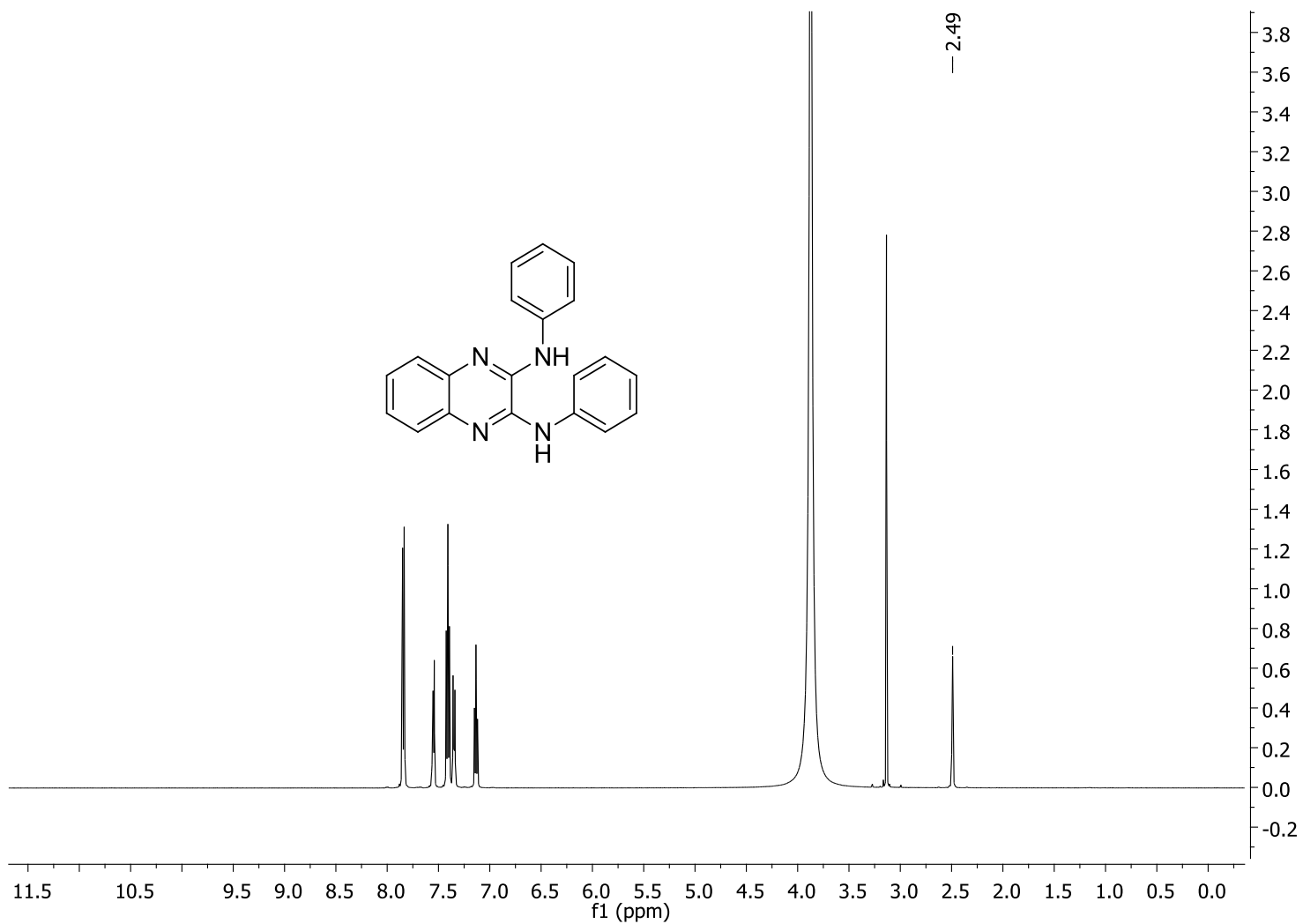
IR (KBr) of N²,N³-diphenylquinoxaline-2,3-diamine (3b).



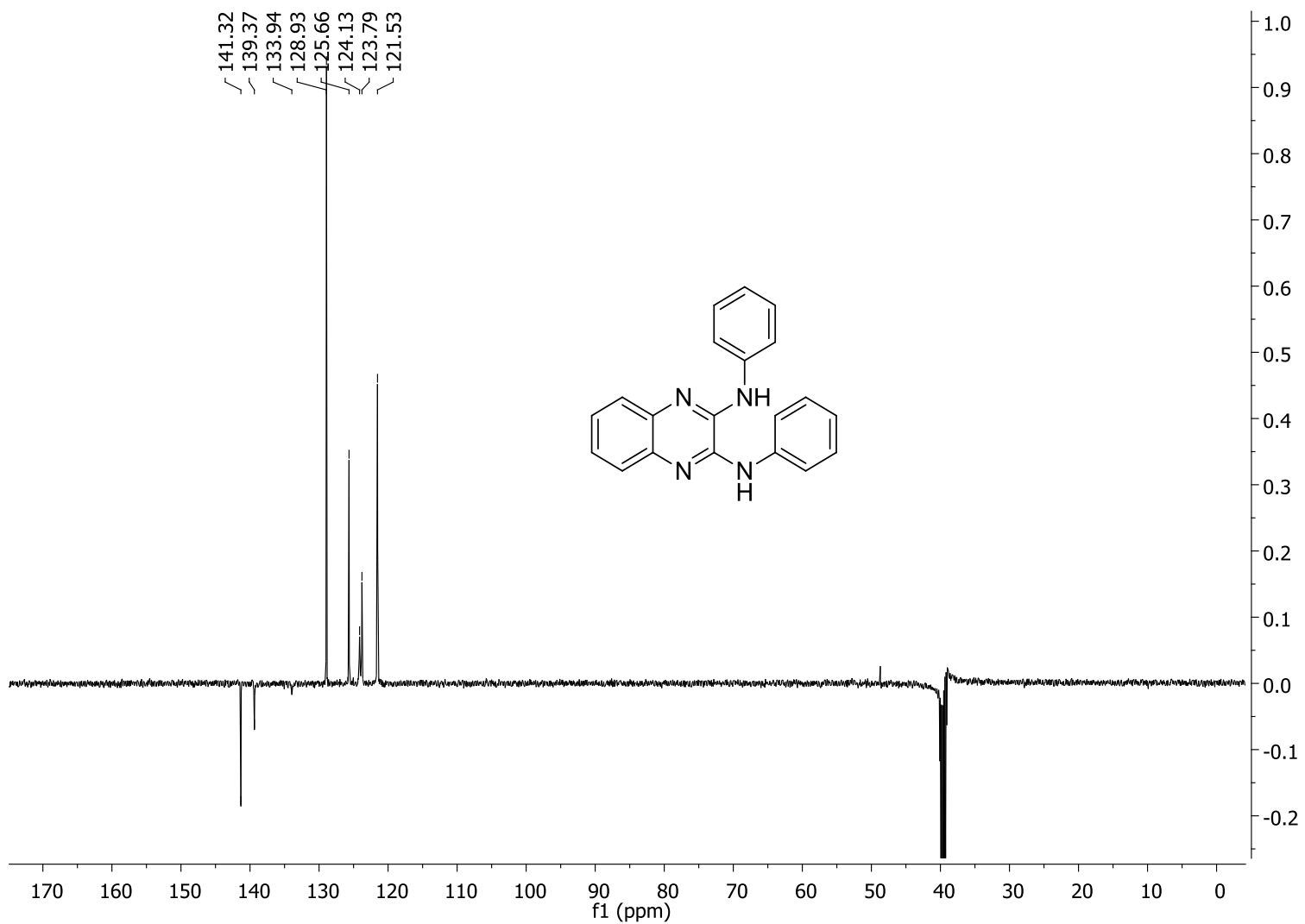
¹H NMR (DMSO) of N²,N³-diphenylquinoxaline-2,3-diamine (3b).



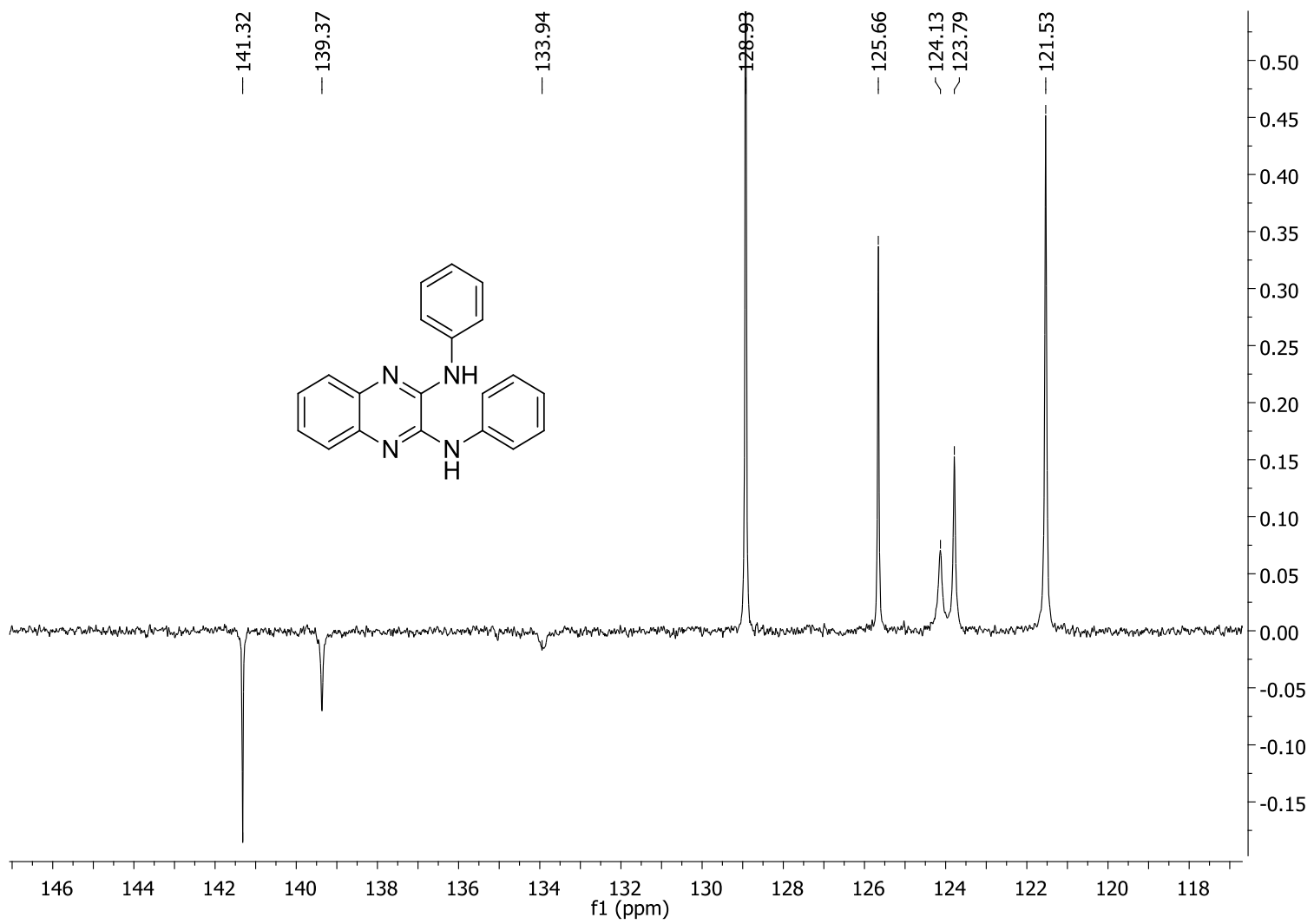
$^1\text{H NMR}$ (DMSO) of N^2,N^3 -diphenylquinoxaline-2,3-diamine (3b).



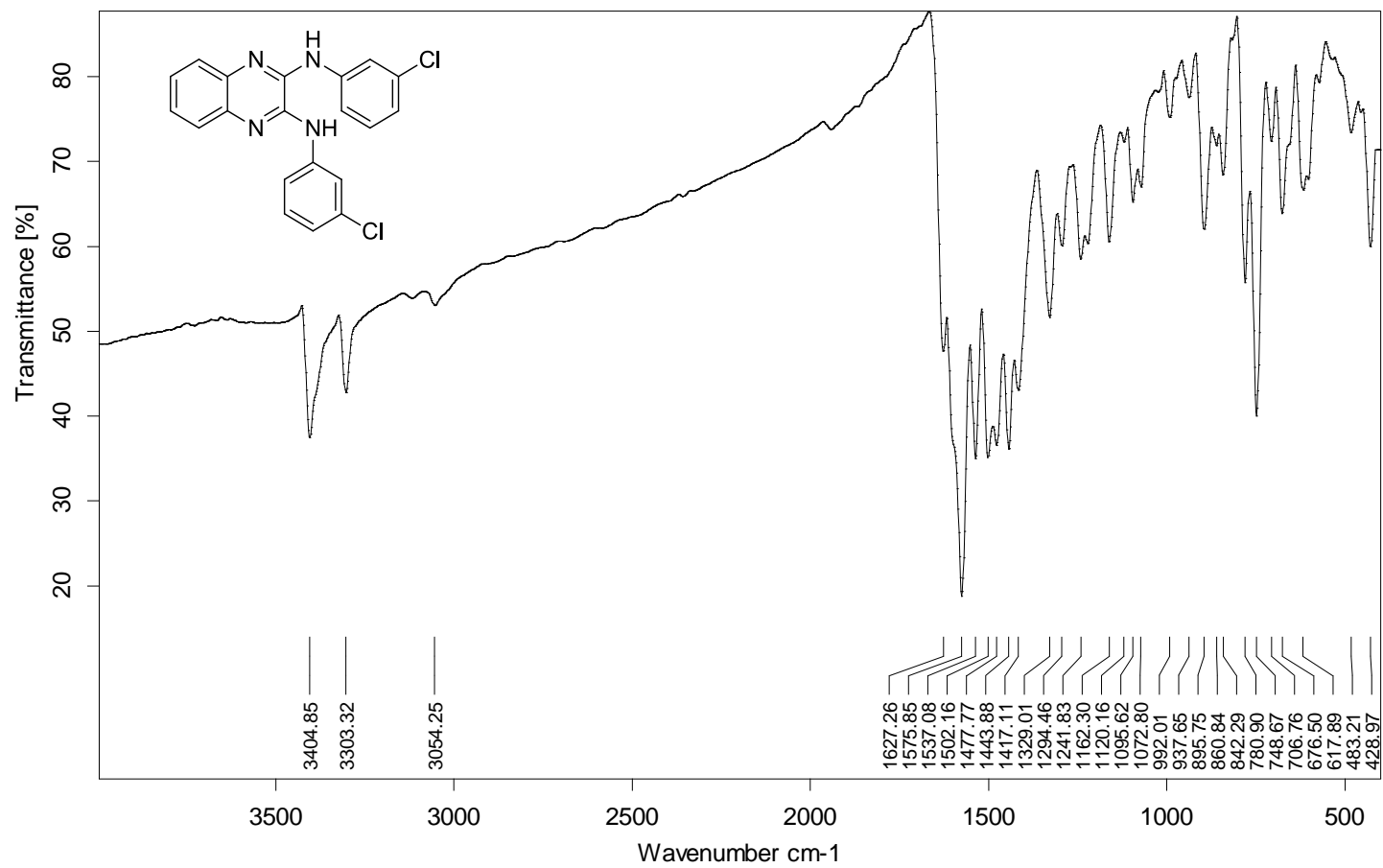
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of N^2,N^3 -diphenylquinoxaline-2,3-diamine (3b).



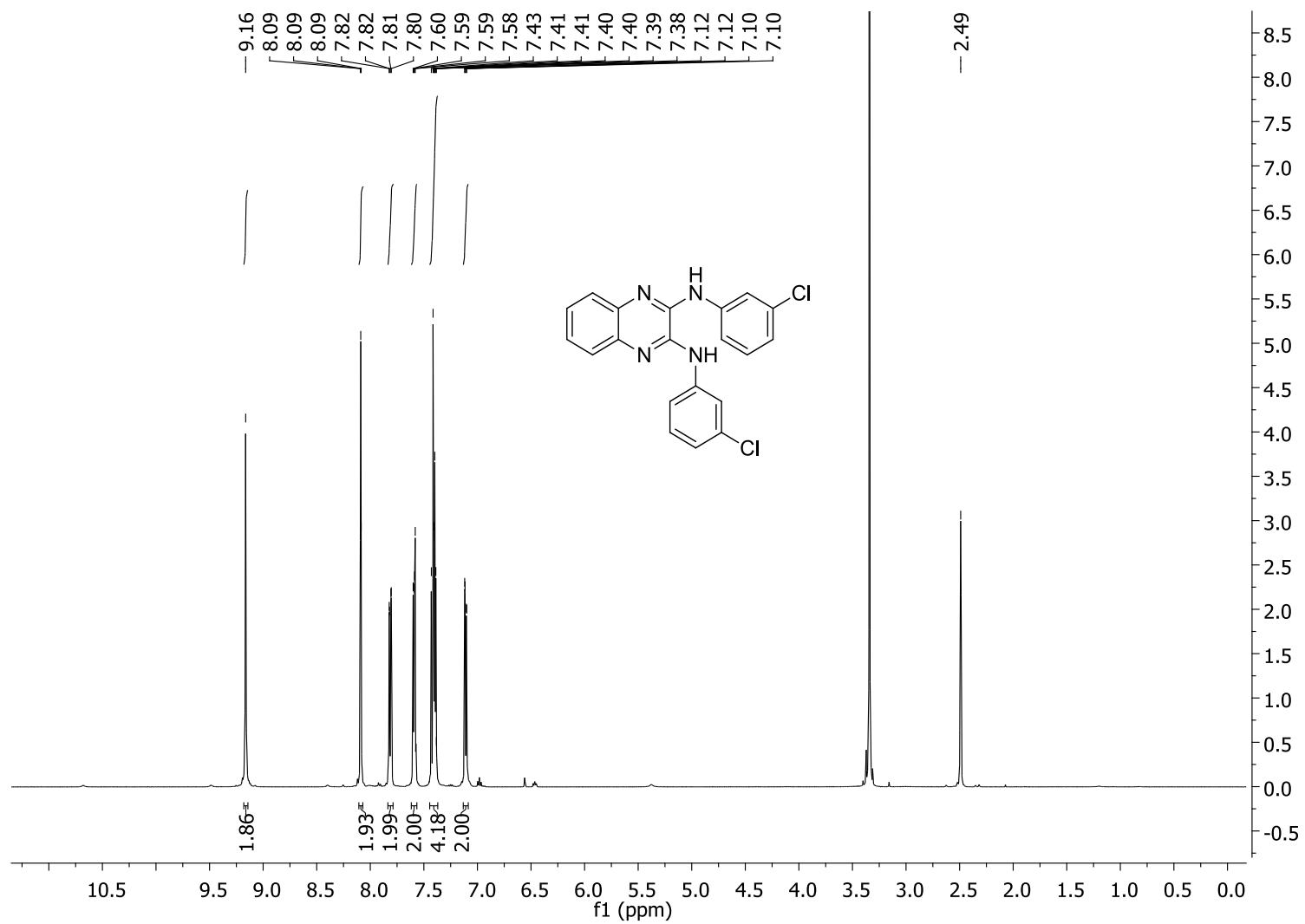
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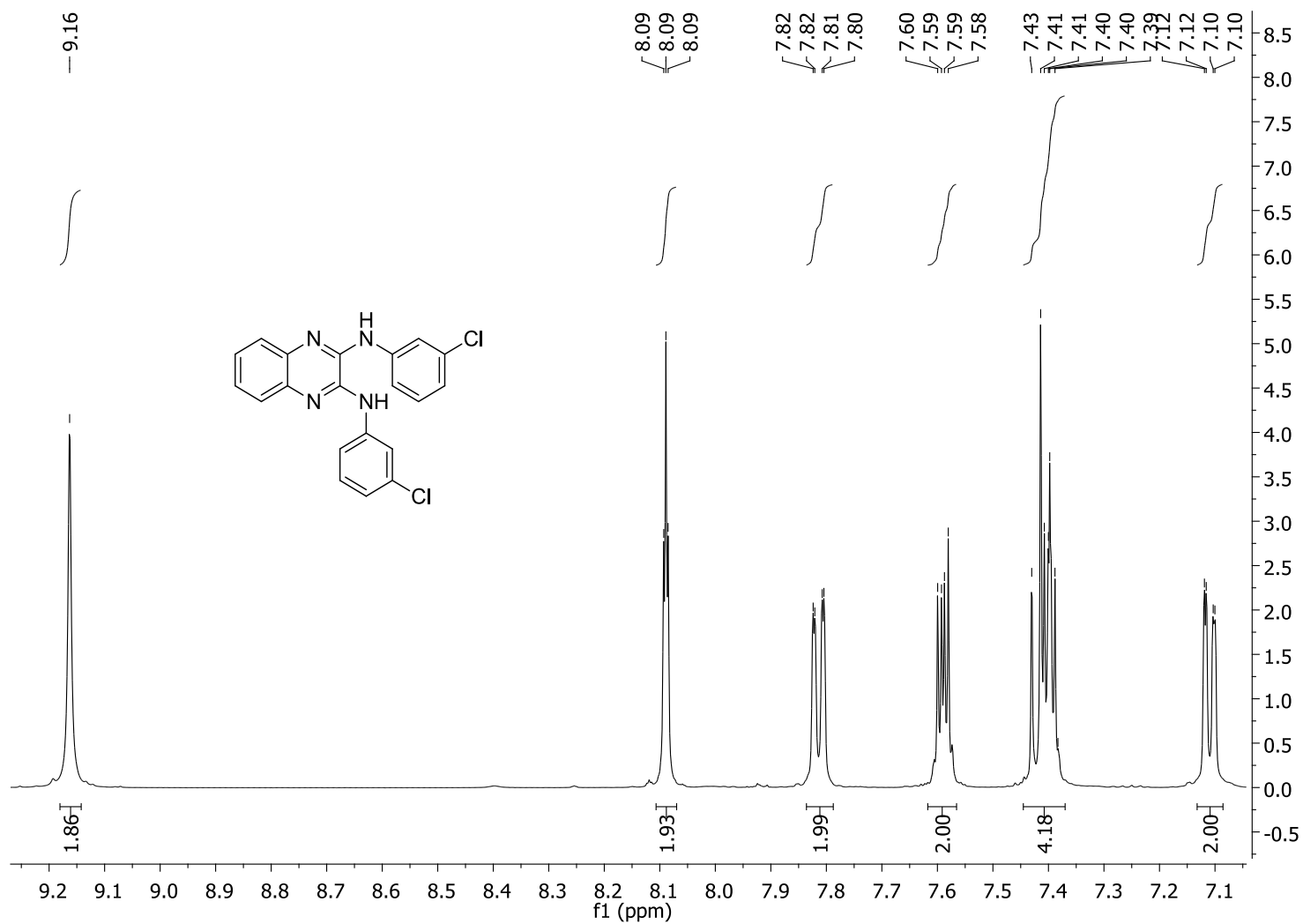
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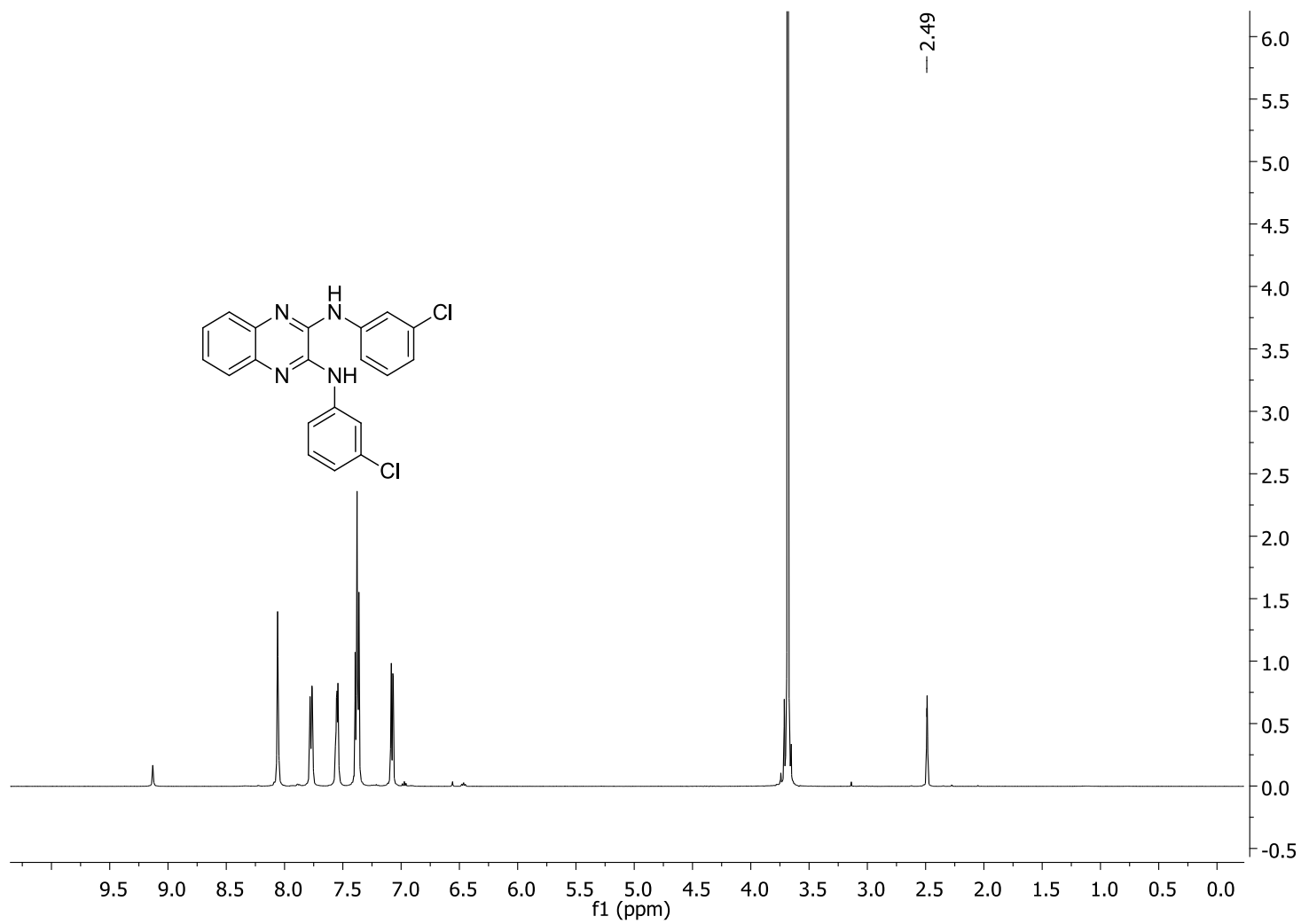
IR (KBr) of N^2,N^3 -bis(3-chlorophenyl)quinoxaline-2,3-diamine (3c).



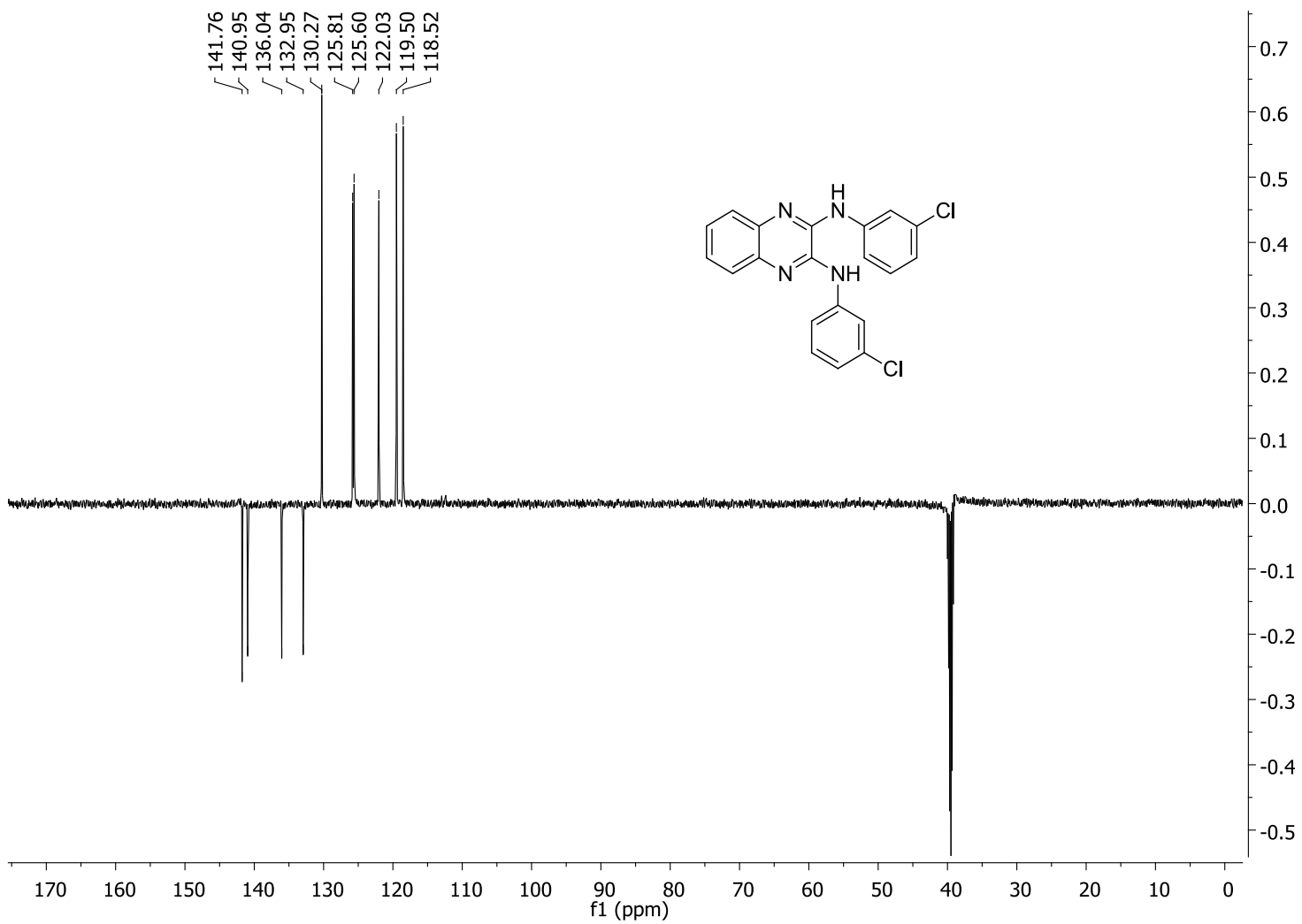
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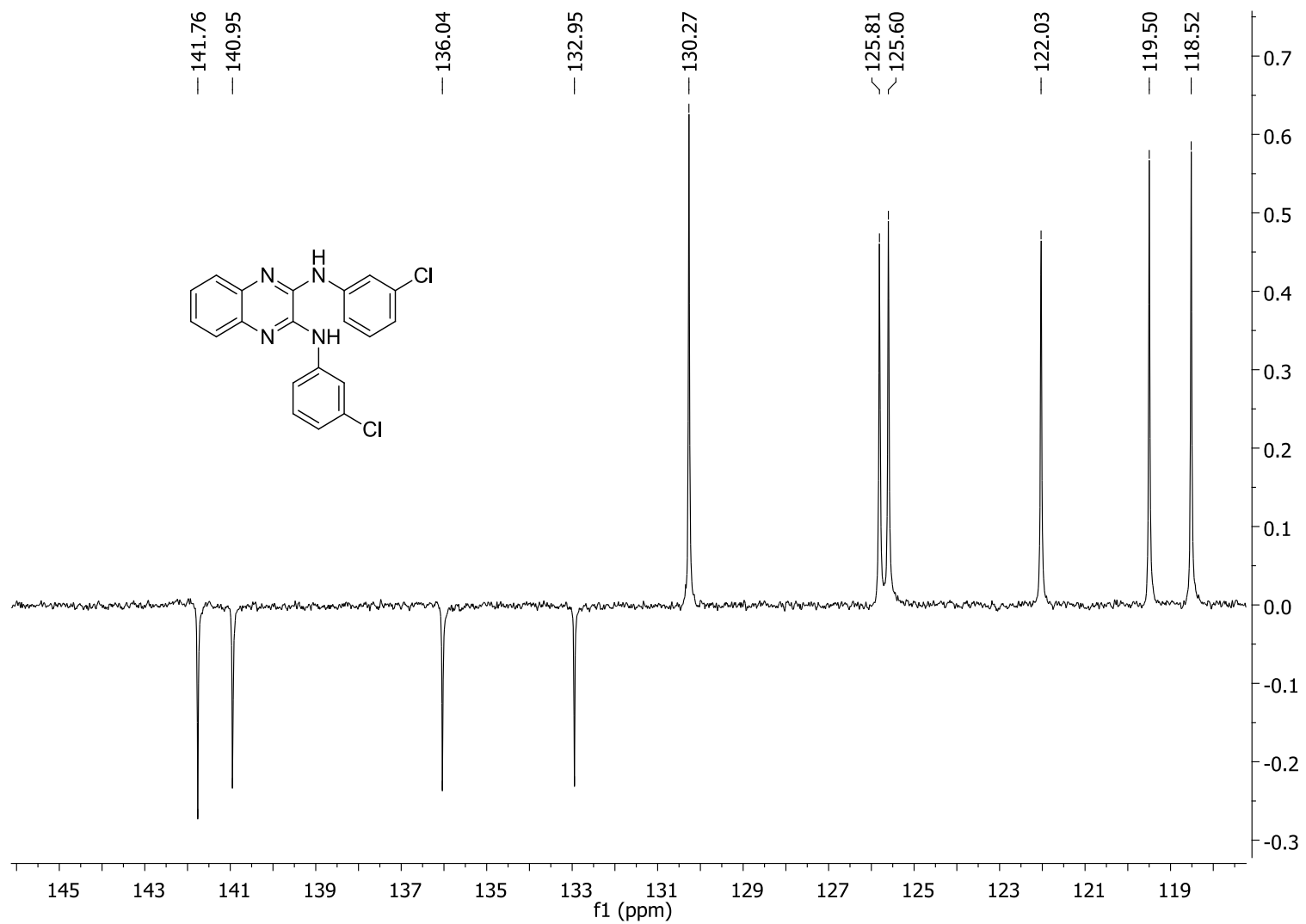
$^1\text{H NMR}$ (DMSO) of N^2,N^3 -bis(3-chlorophenyl)quinoxaline-2,3-diamine (3c).



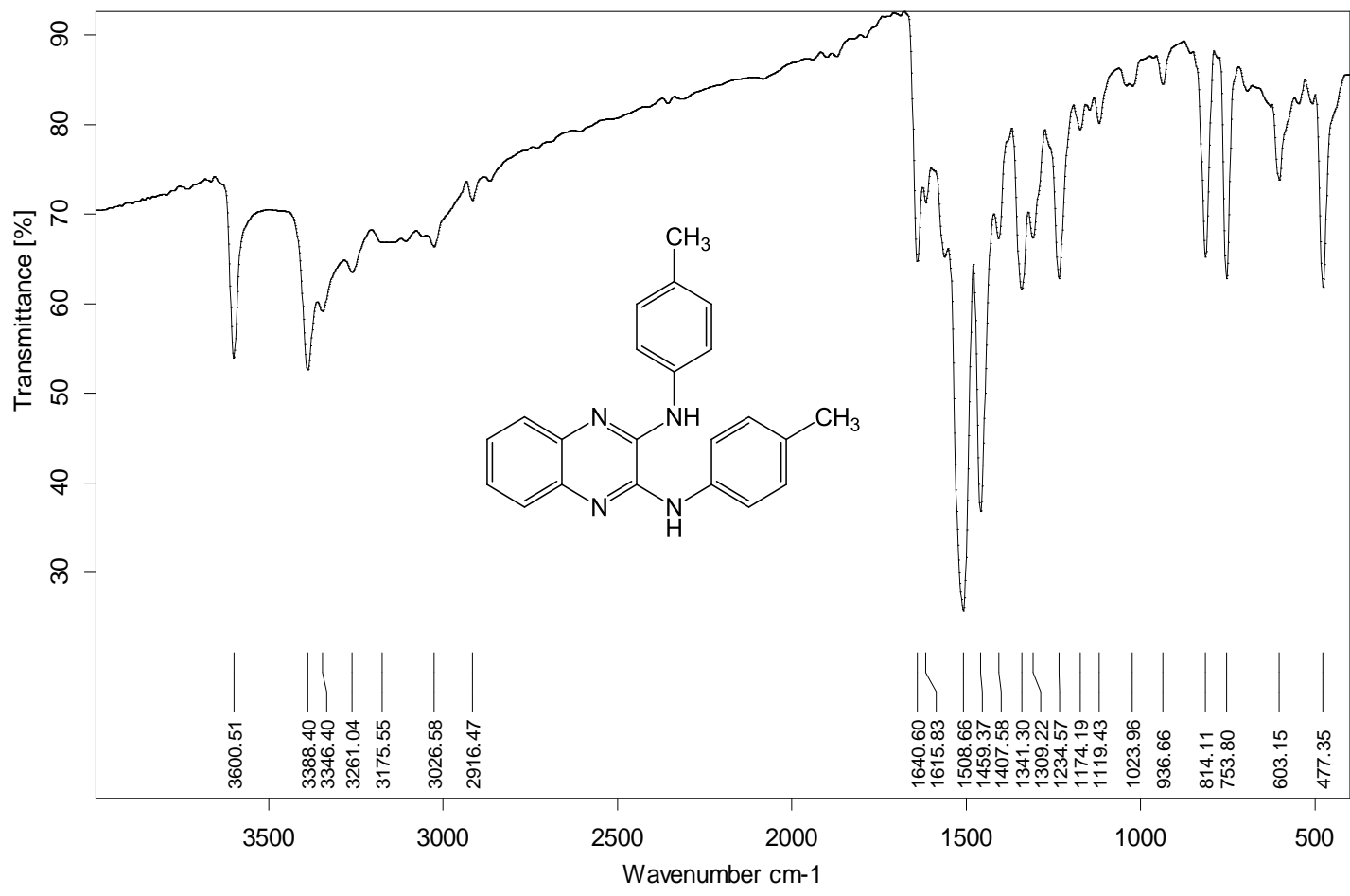
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of N^2,N^3 -bis(3-chlorophenyl)quinoxaline-2,3-diamine (3c).



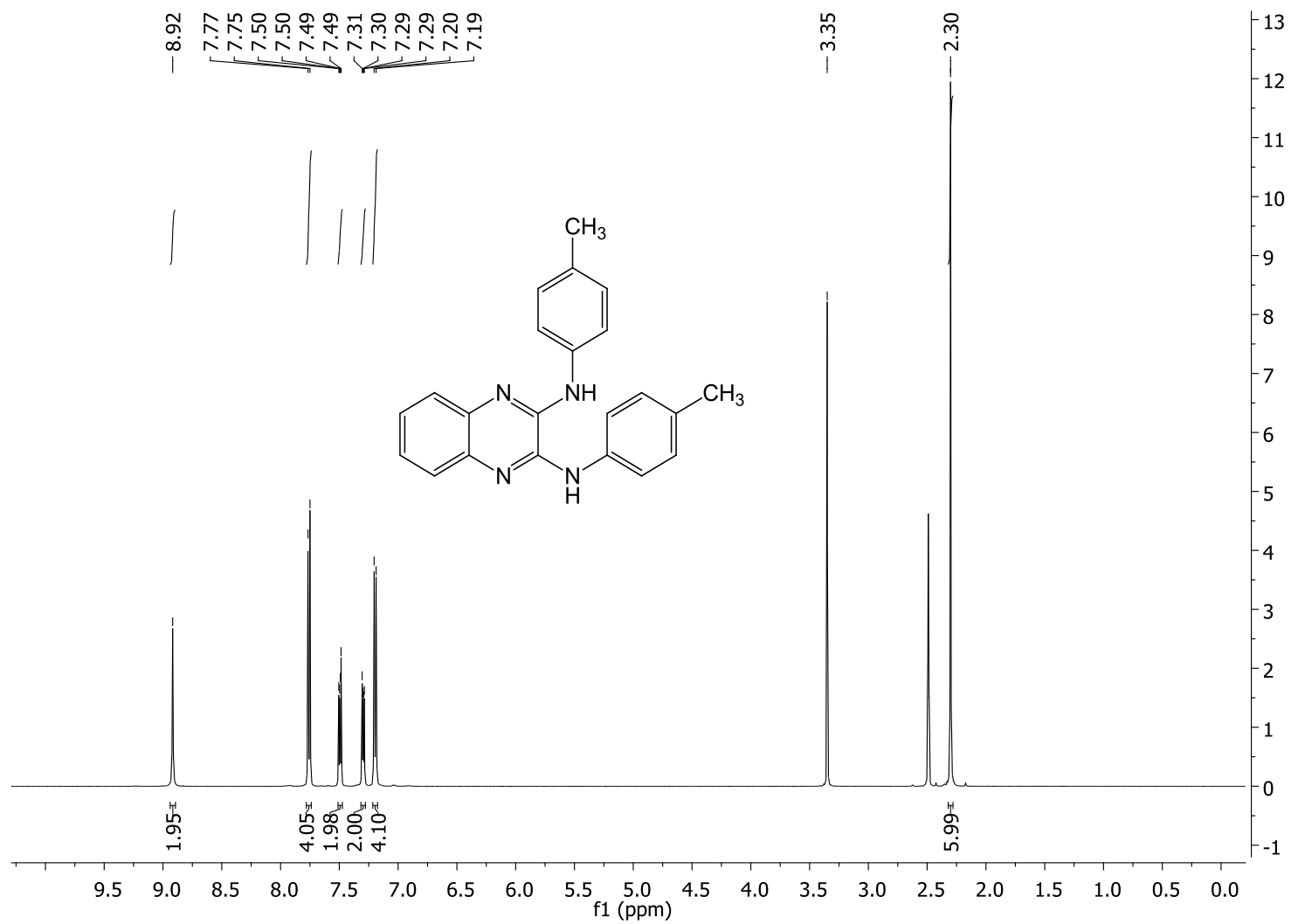
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3-chlorophenyl)quinoxaline-2,3-diamine (3c).



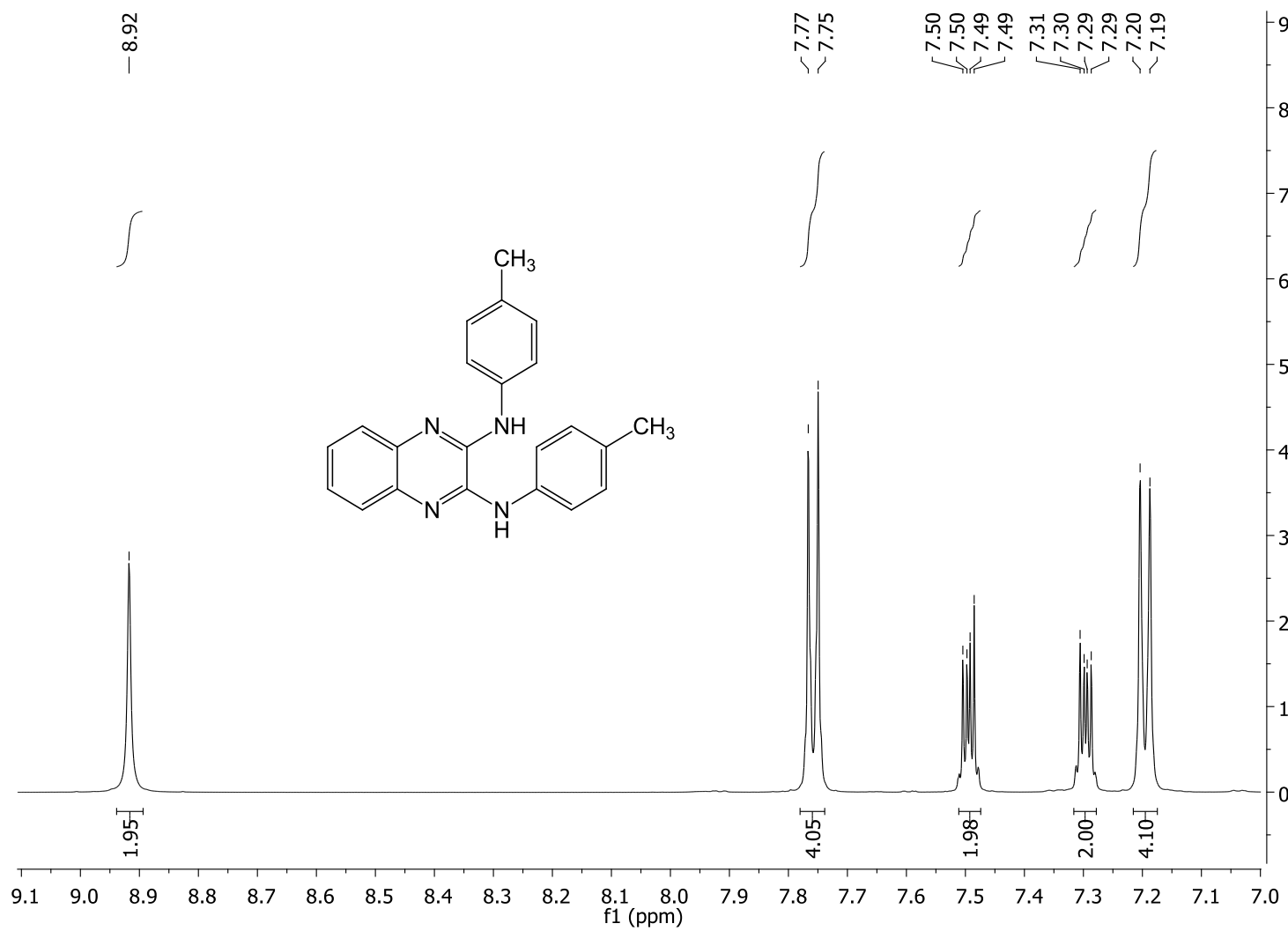
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3-chlorophenyl)quinoxaline-2,3-diamine (3c).



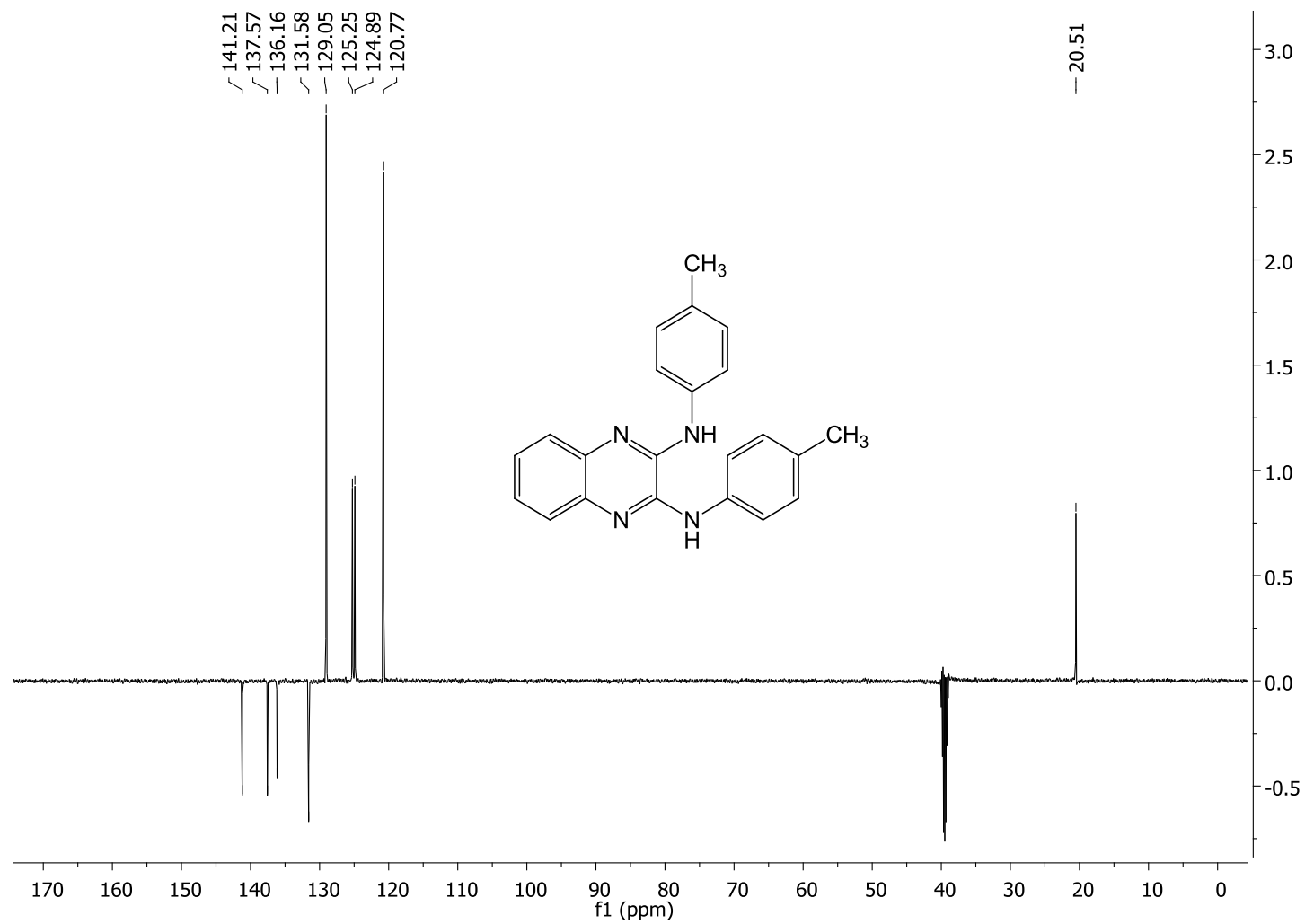
IR (KBr) of N²,N³-dip-tolylquinoxaline-2,3-diamine (3d).



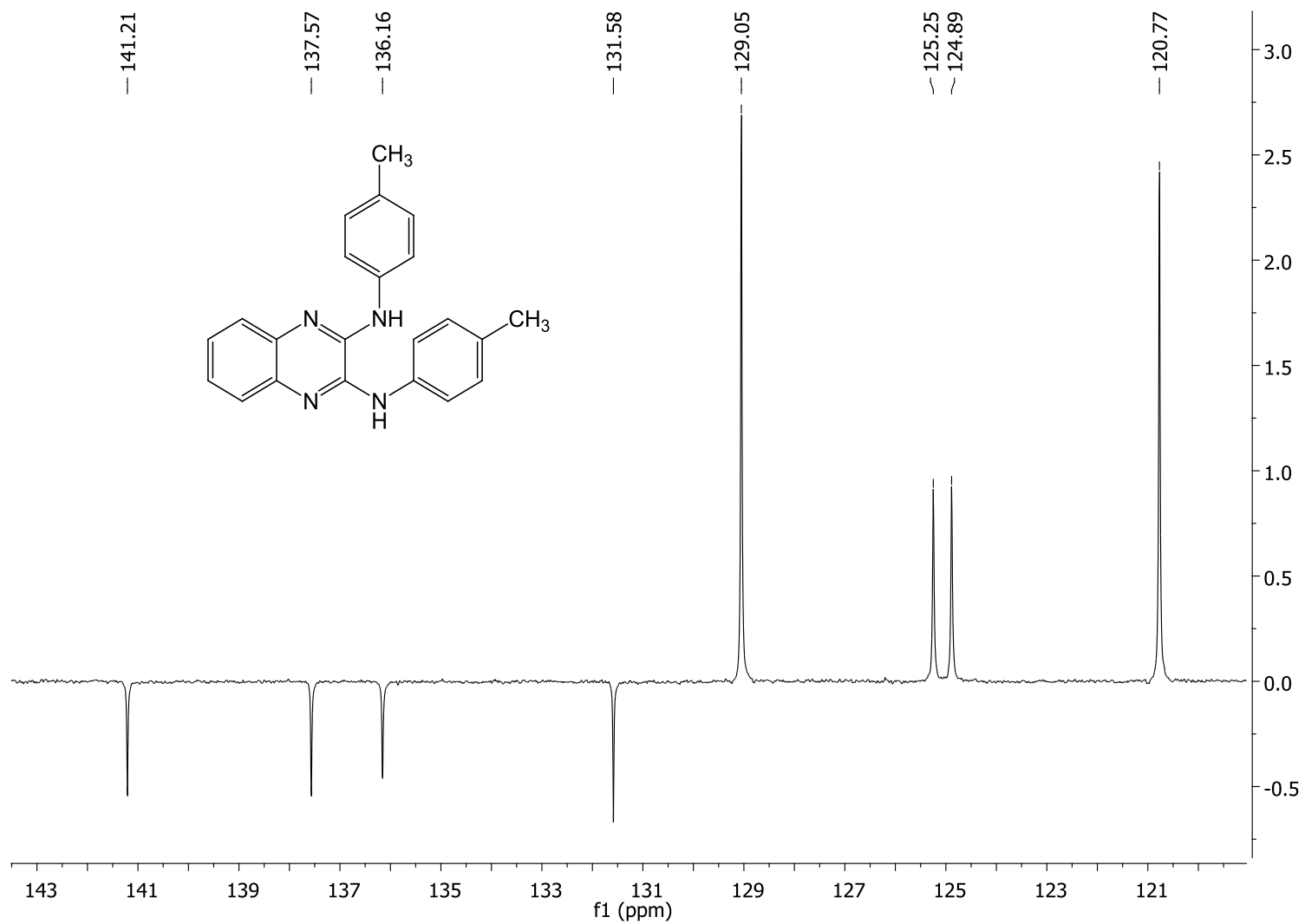
^1H NMR (DMSO) of N^2, N^3 -dip-tolylquinoxaline-2,3-diamine (3d).



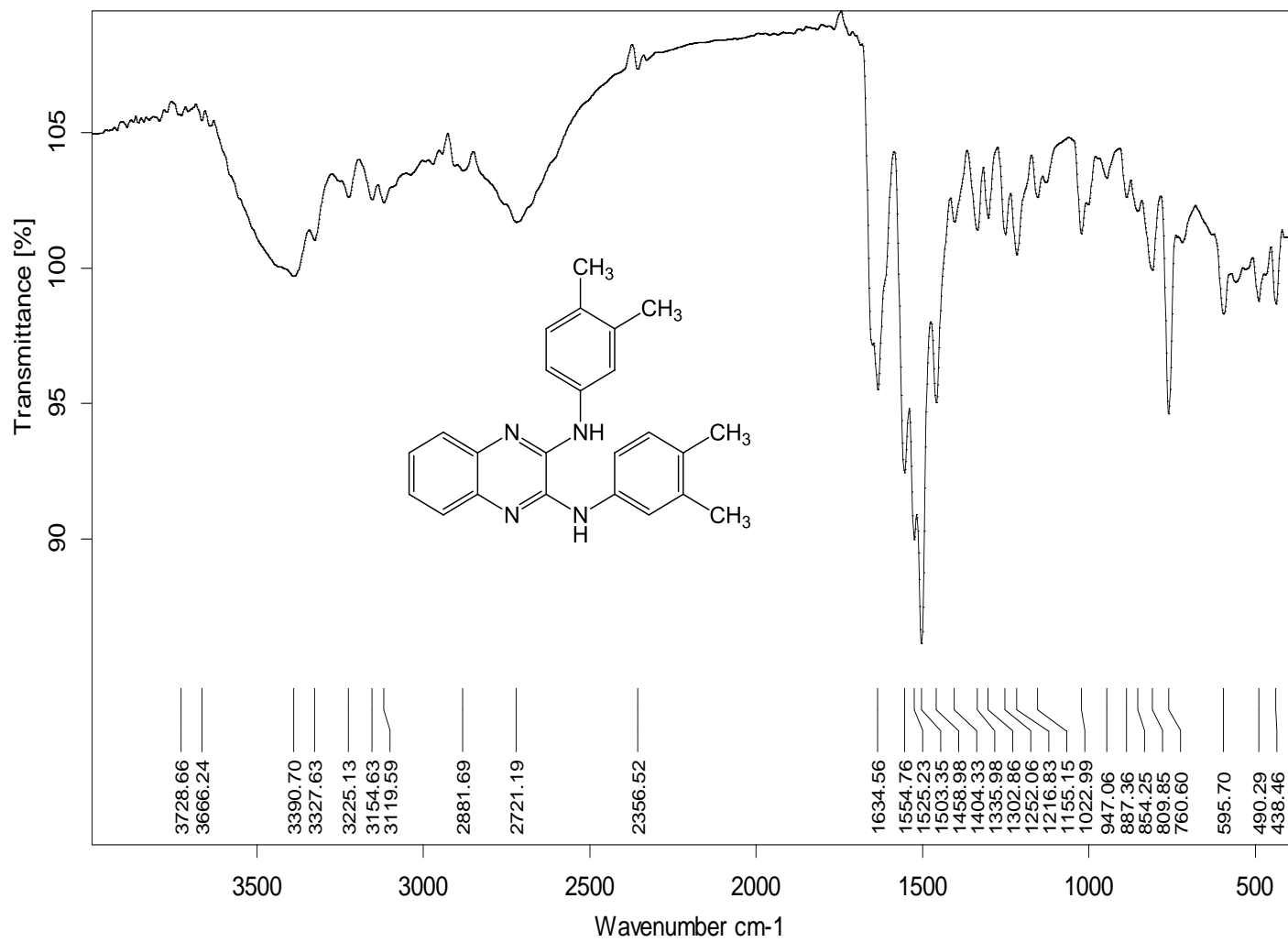
$^1\text{H NMR}$ (DMSO) of N^2,N^3 -dip-tolylquinoxaline-2,3-diamine (3d).



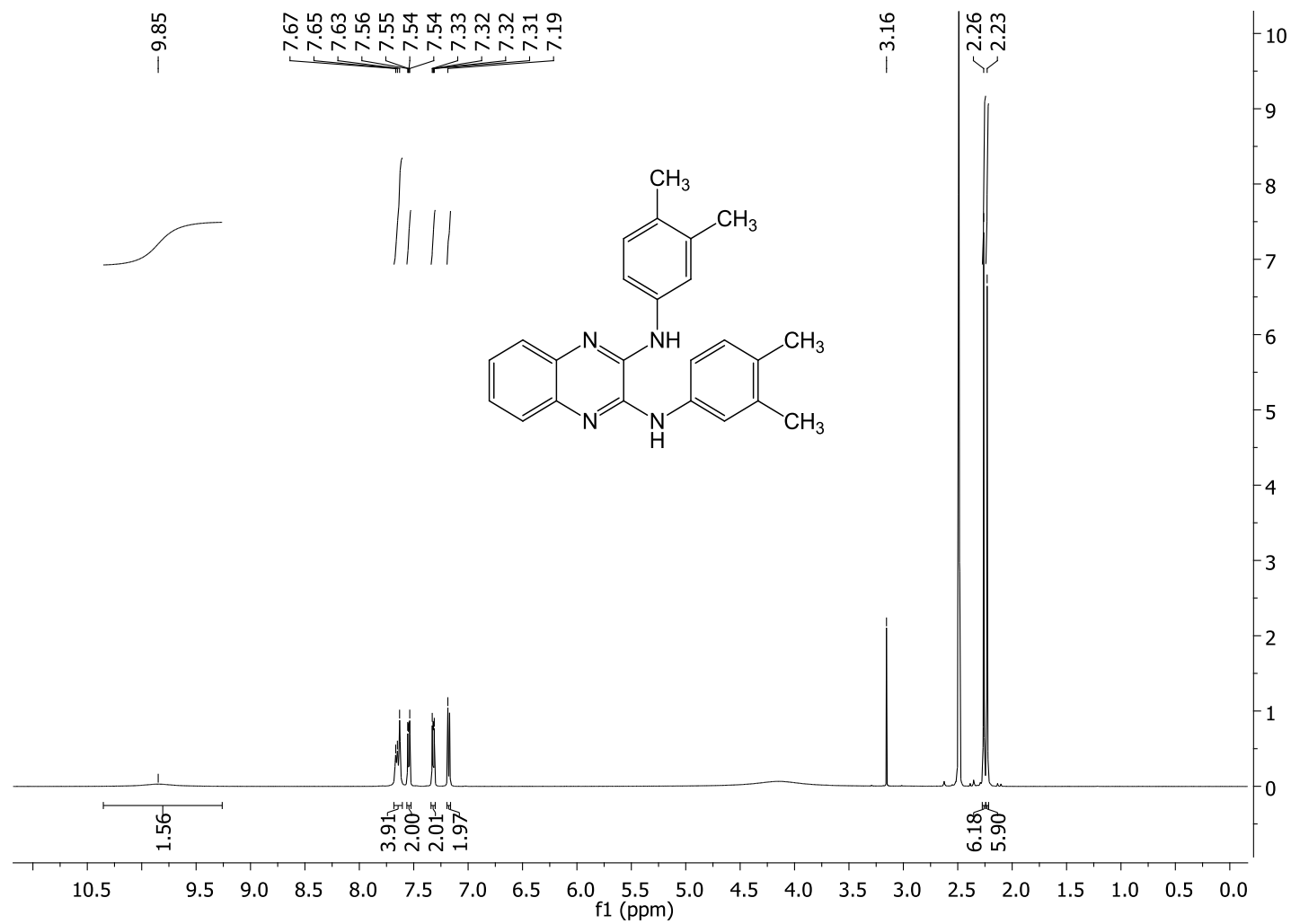
^{13}C APT NMR (DMSO) of N^2, N^3 -dip-tolylquinoxaline-2,3-diamine (3d).



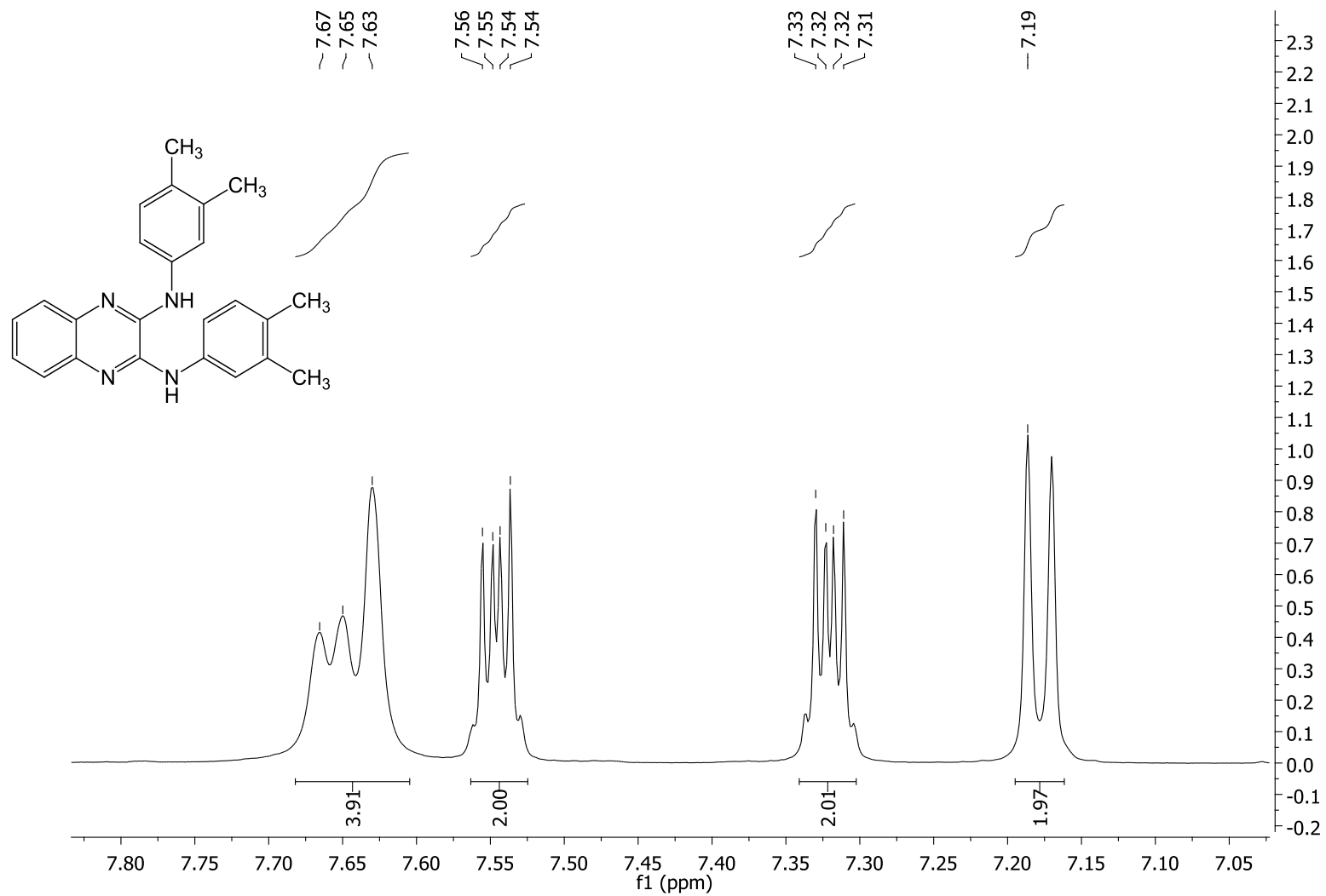
^{13}C APT NMR (DMSO) of N^2,N^3 -dip-tolylquinoxaline-2,3-diamine (3d).

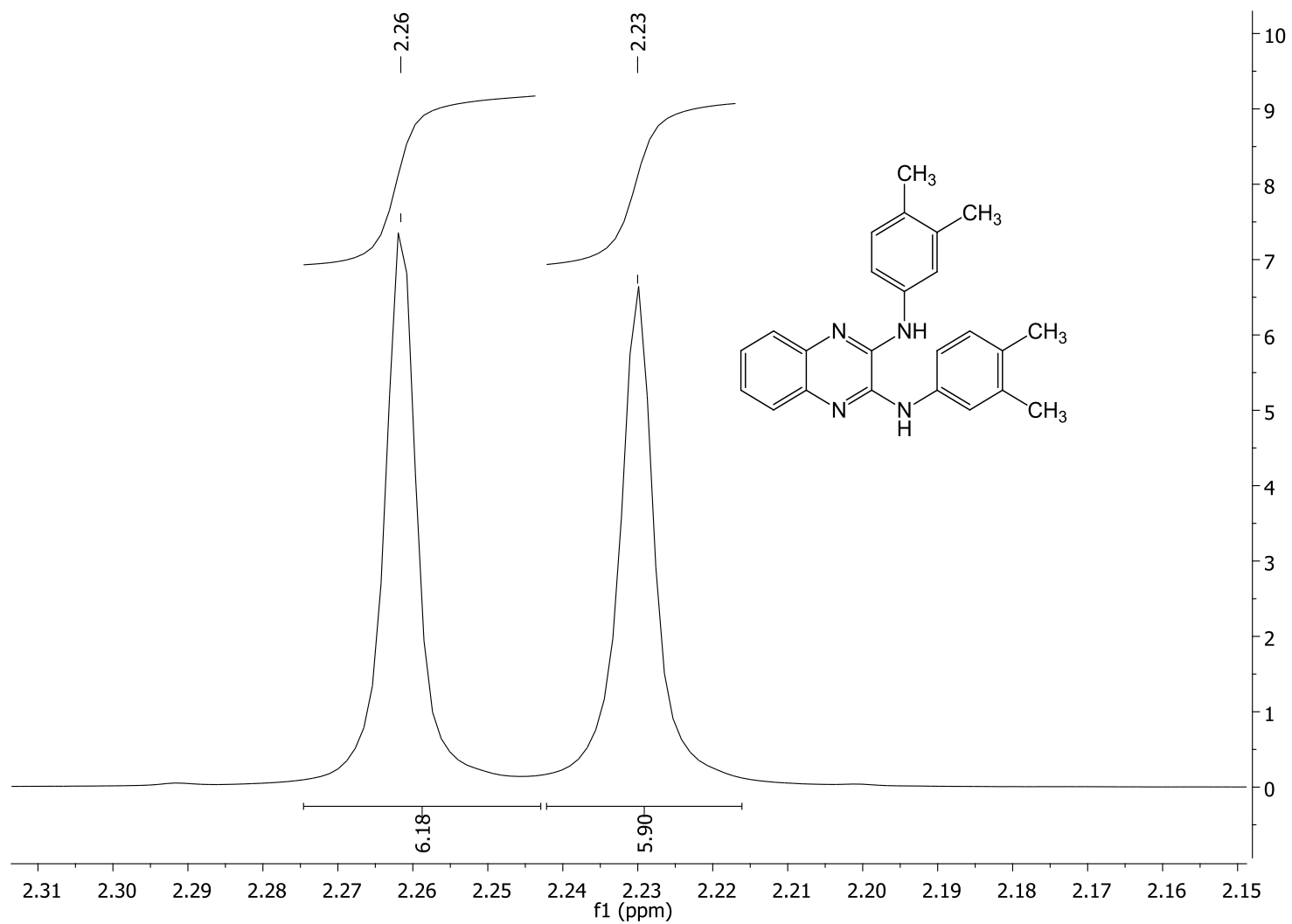


IR (KBr) of N^2,N^3 -bis(3,4-dimethylphenyl)quinoxaline-2,3-diamine (3e).

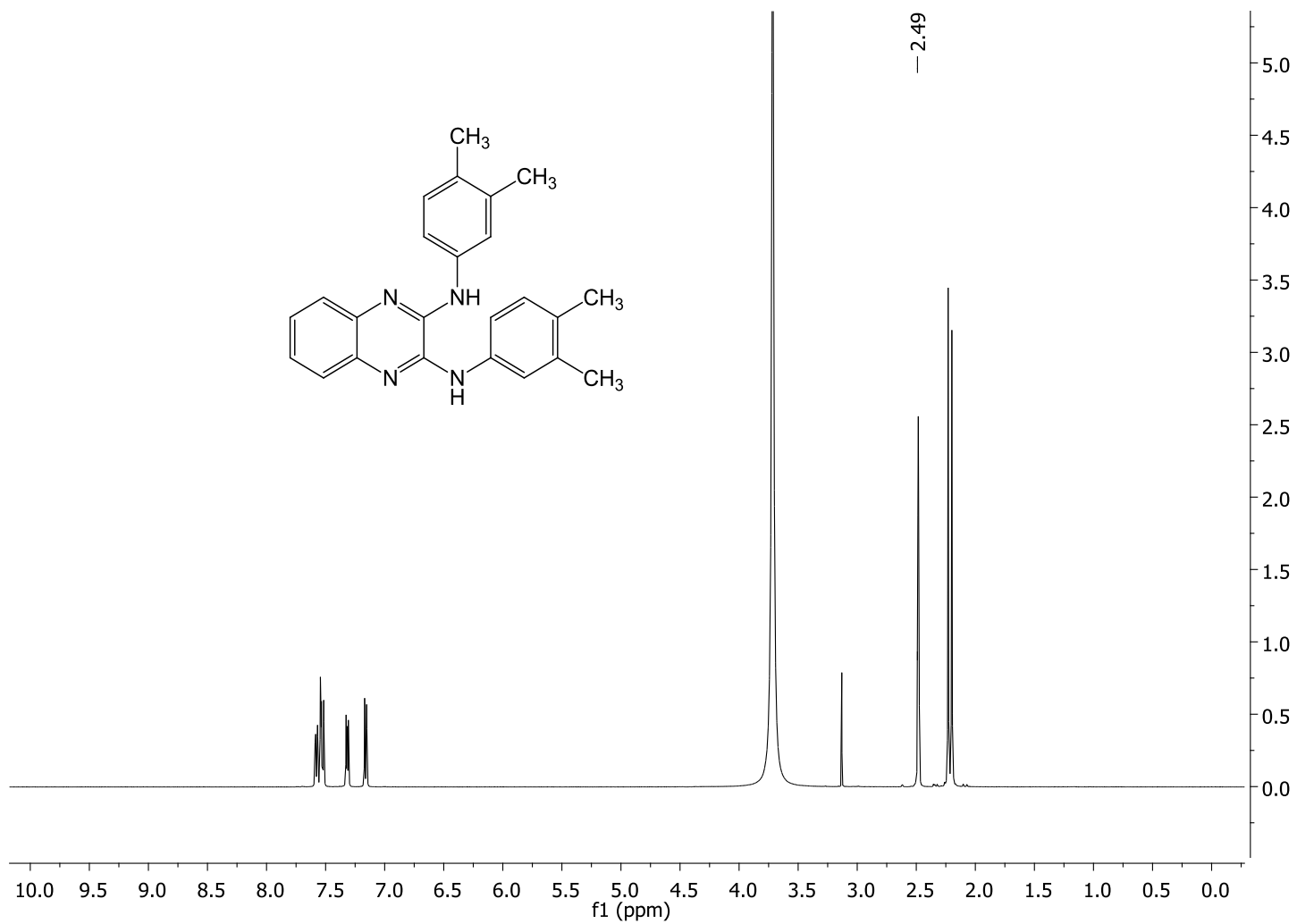


¹H NMR (DMSO) of N²,N³-bis(3,4-dimethylphenyl)quinoxaline-2,3-diamine (3e).

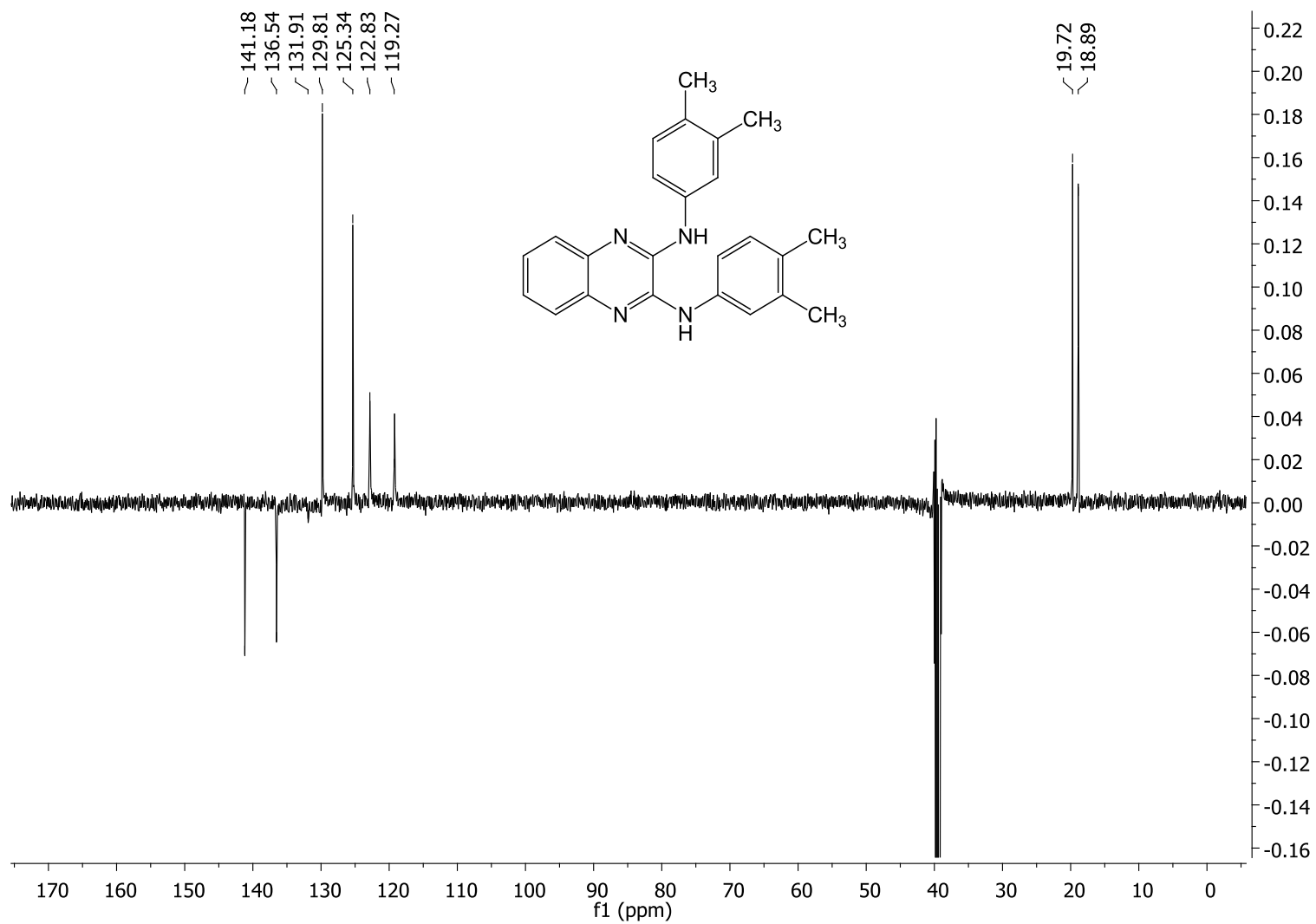




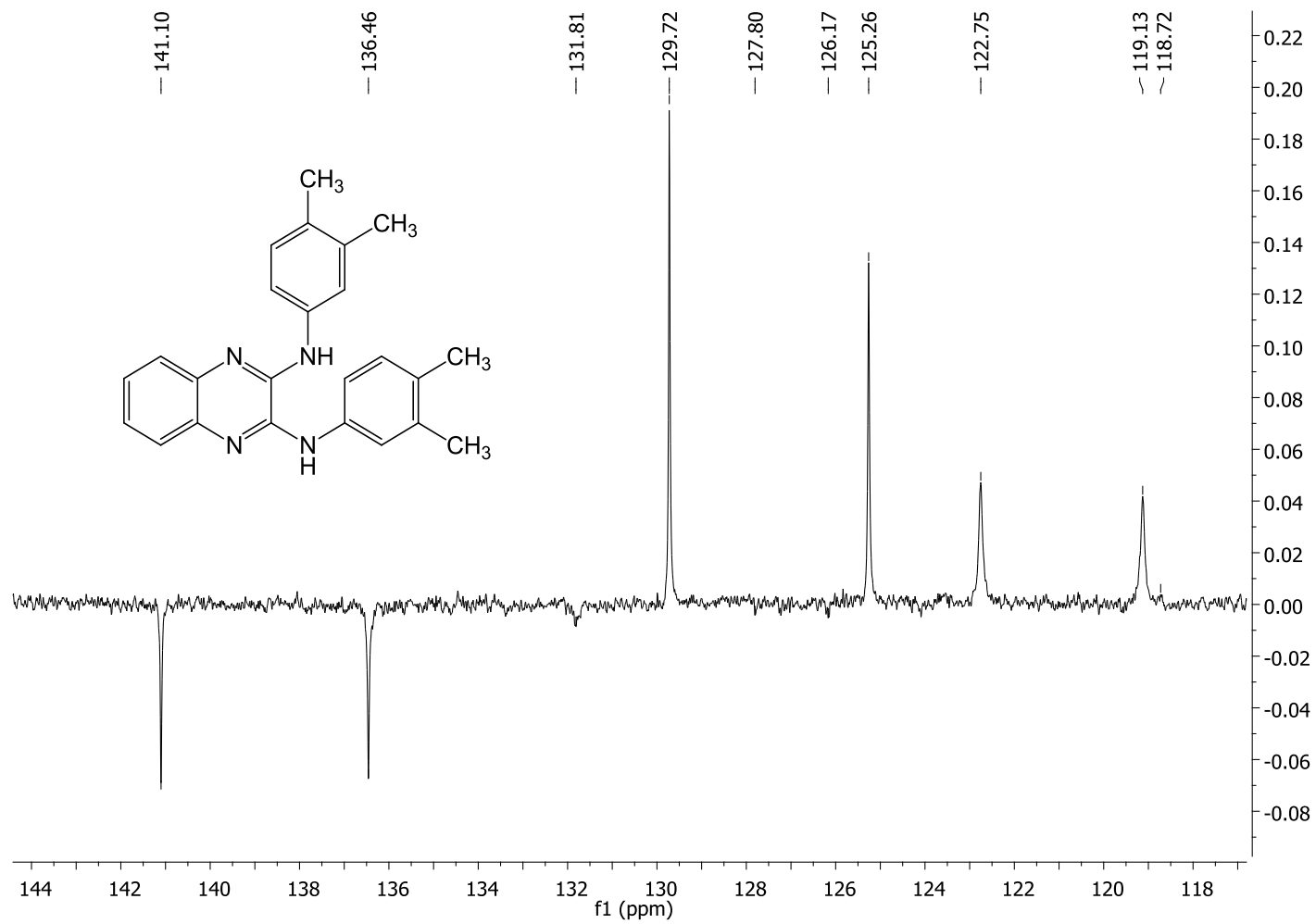
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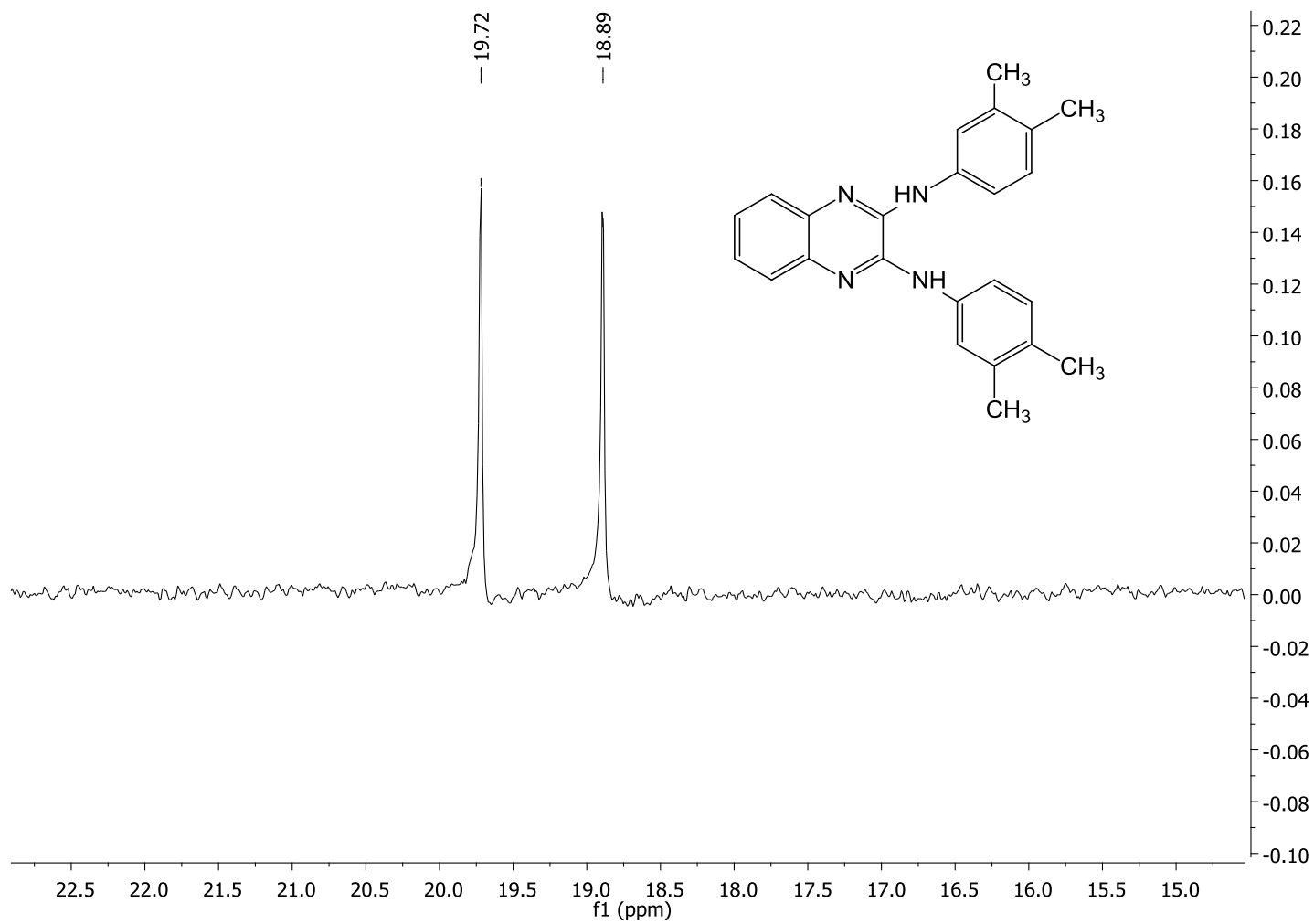
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of N^2,N^3 -bis(3,4-dimethylphenyl)quinoxaline-2,3-diamine (3e).



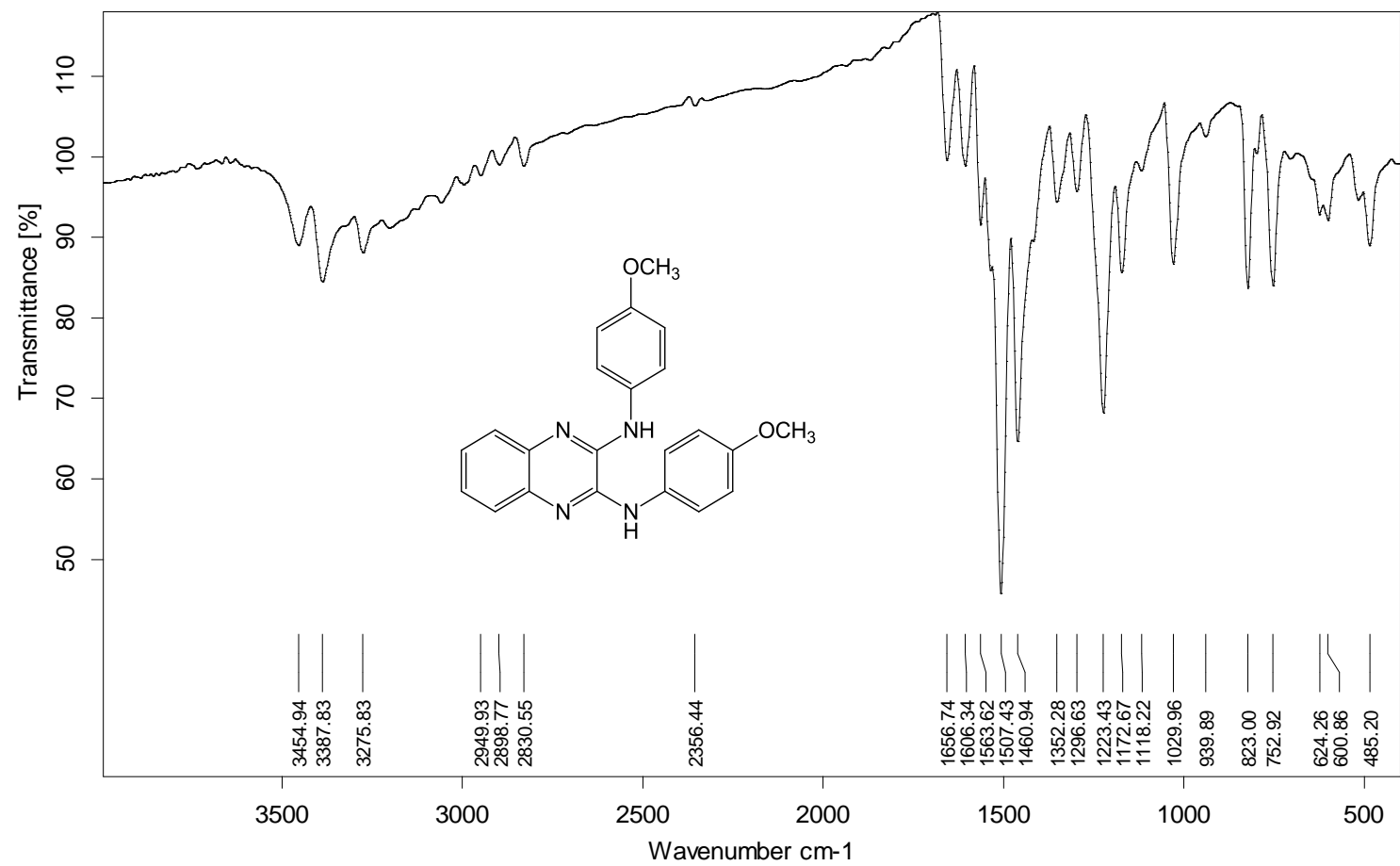
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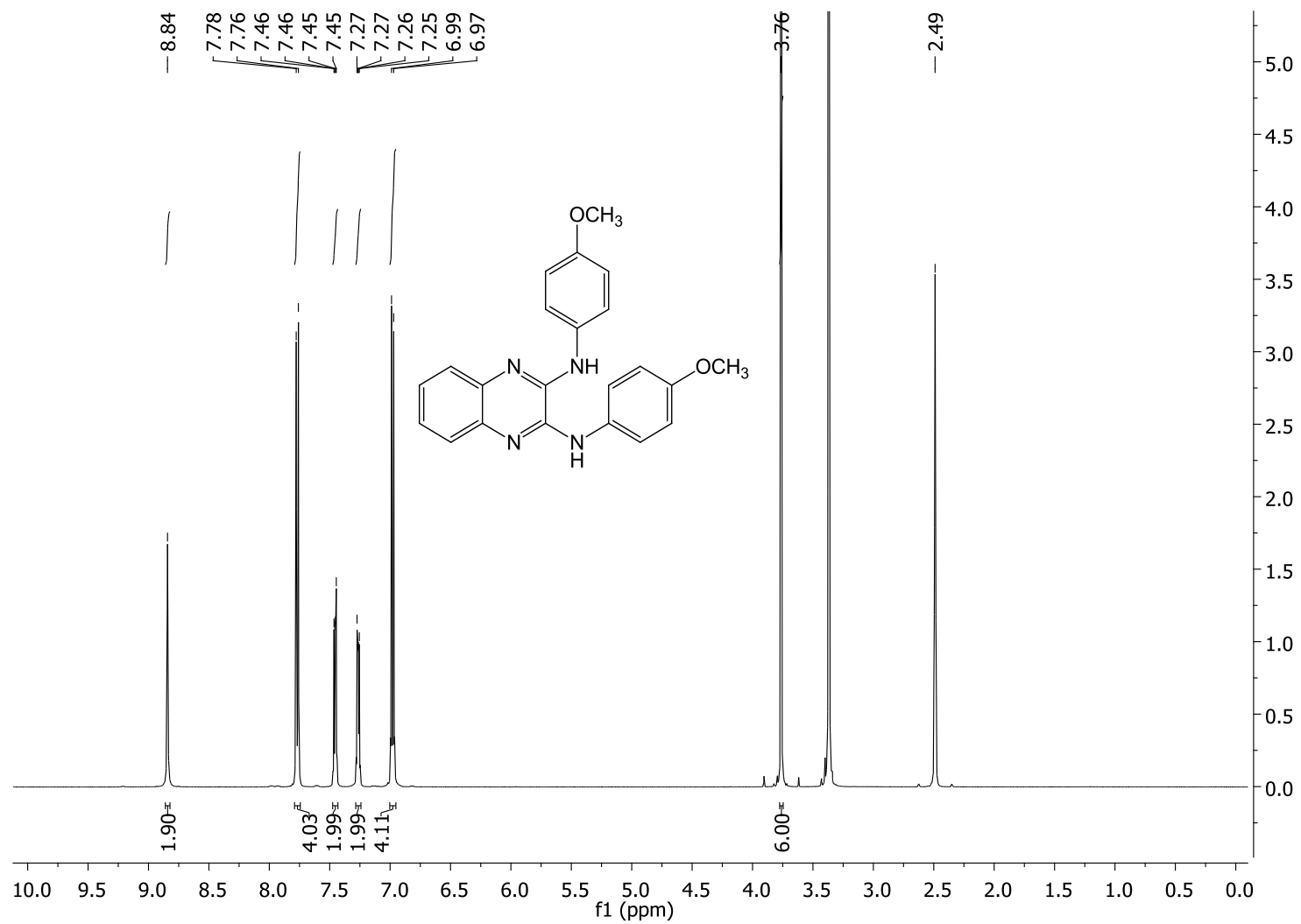
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3,4-dimethylphenyl)quinoxaline-2,3-diamine (3e).



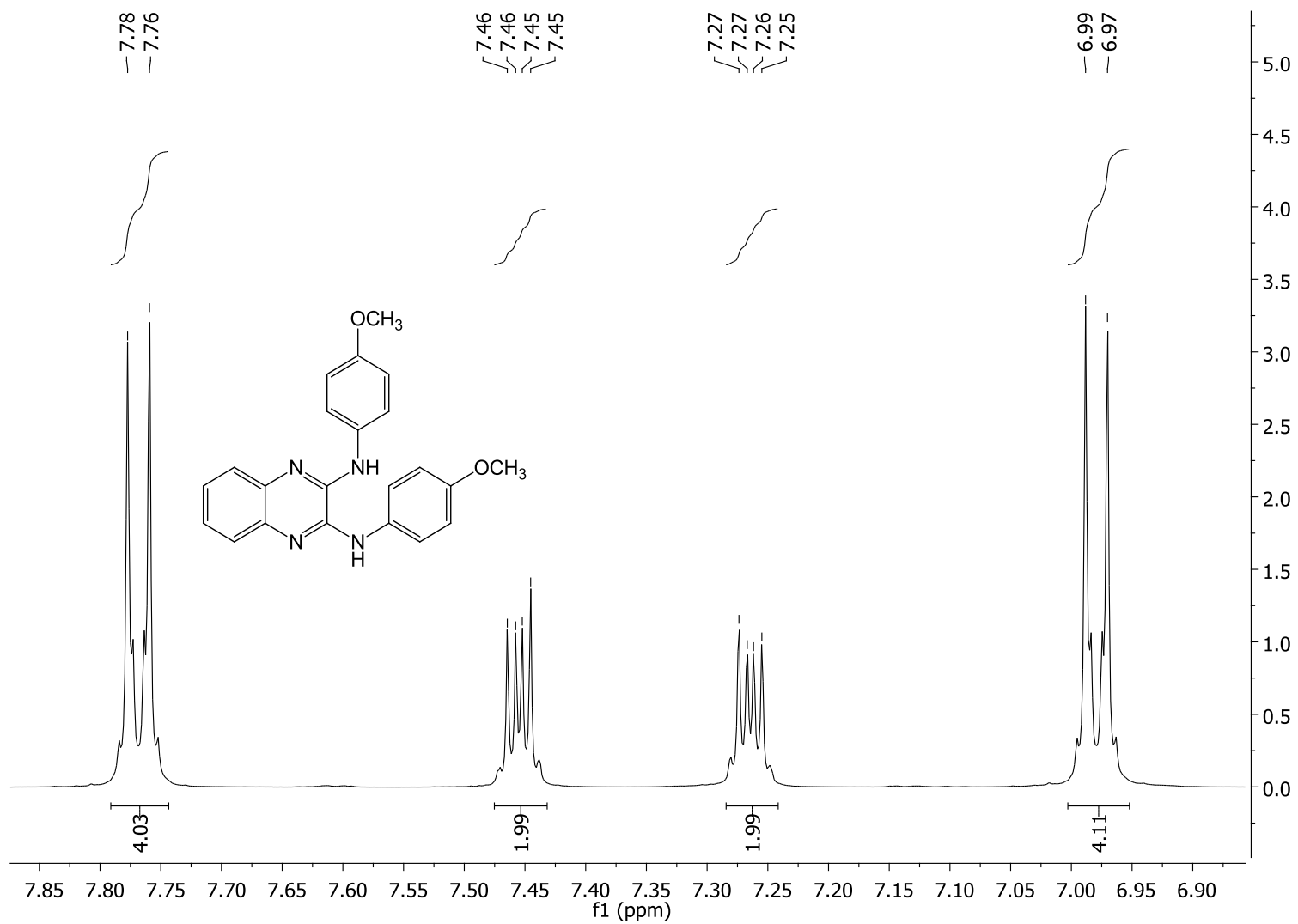
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3,4-dimethylphenyl)quinoxaline-2,3-diamine (3e).



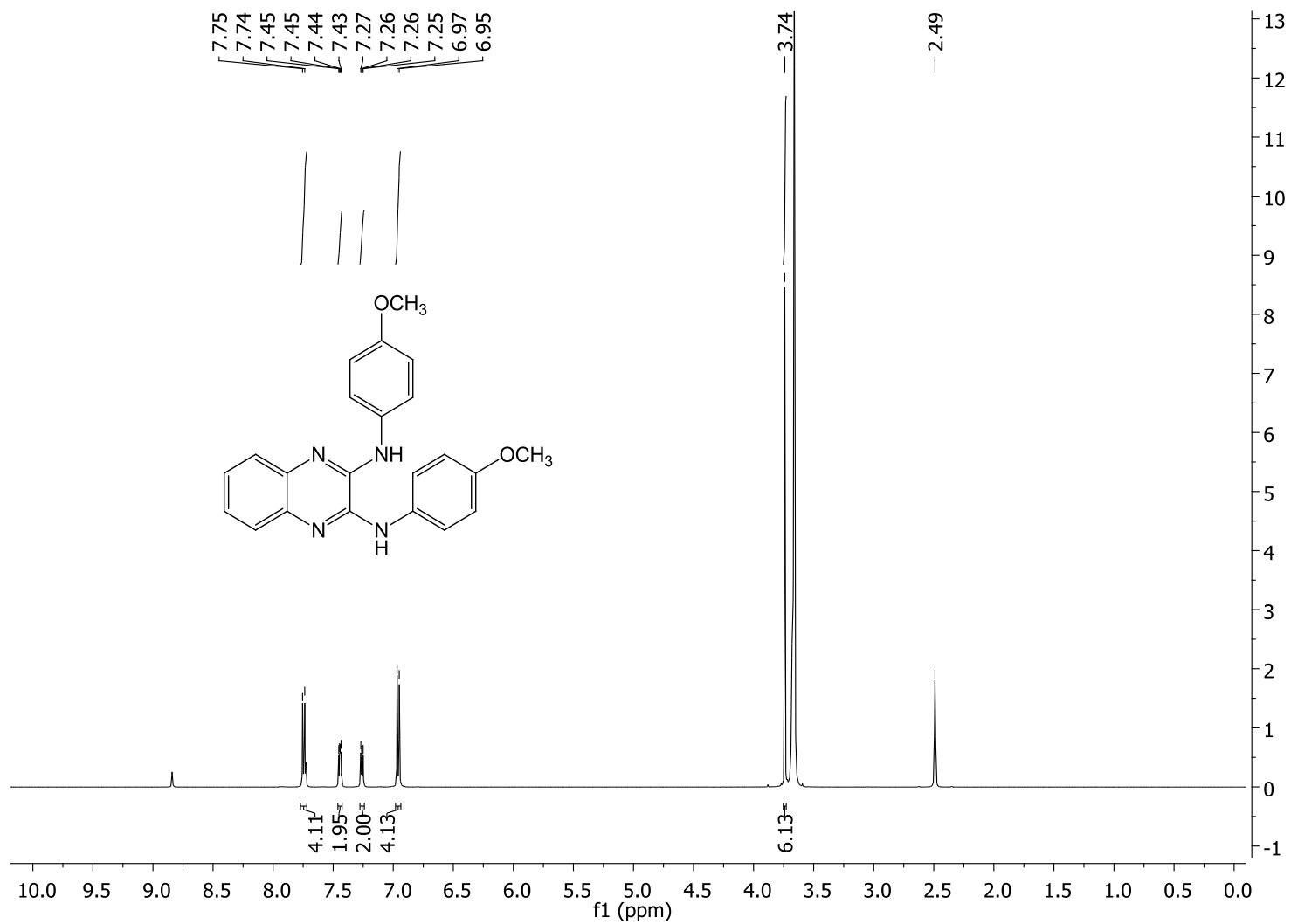
IR (KBr) of N^2,N^3 -bis(4-methoxyphenyl)quinoxaline-2,3-diamine (3f).



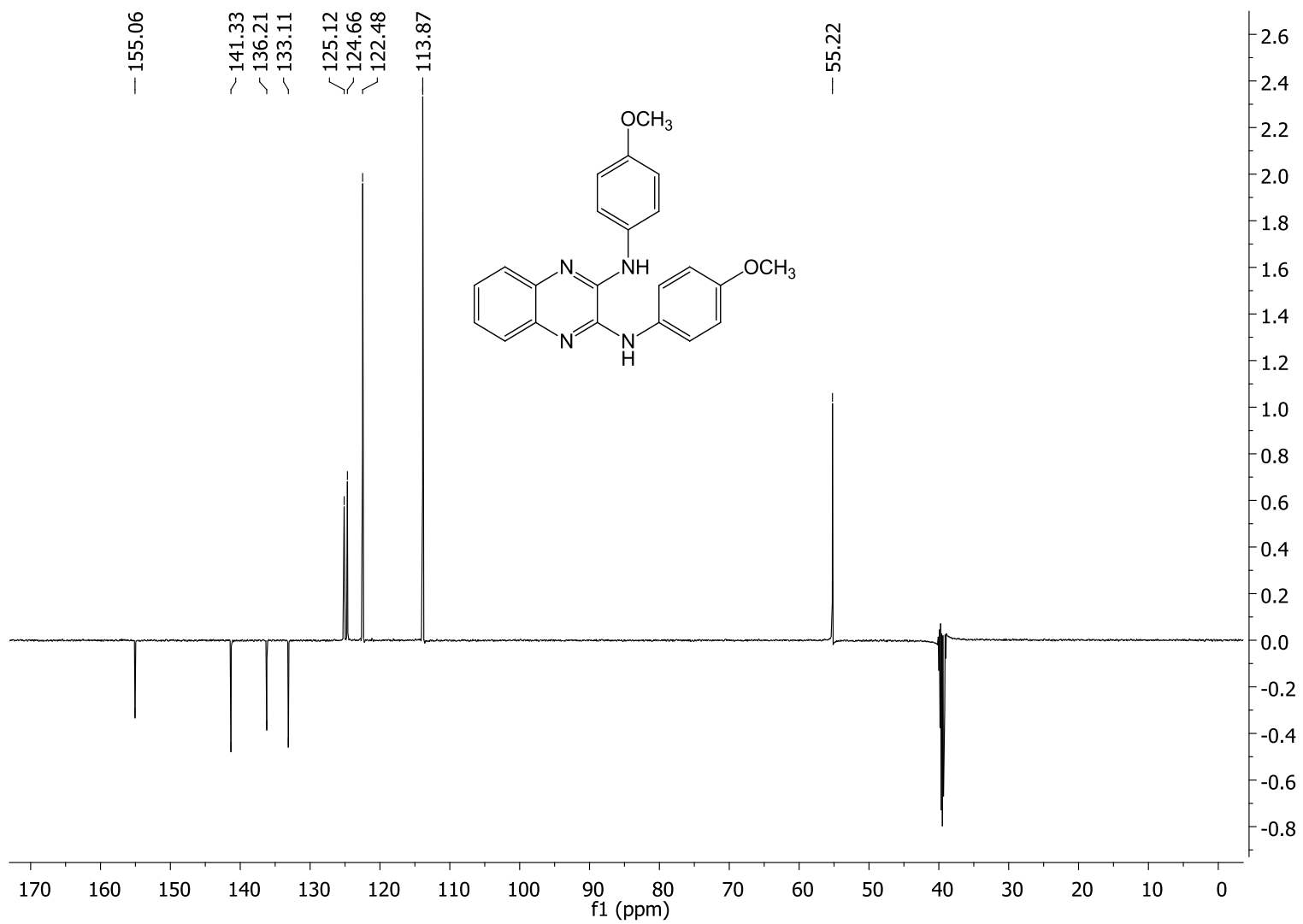
$^1\text{H NMR}$ (DMSO) of N^2,N^3 -bis(4-methoxyphenyl)quinoxaline-2,3-diamine (3f).



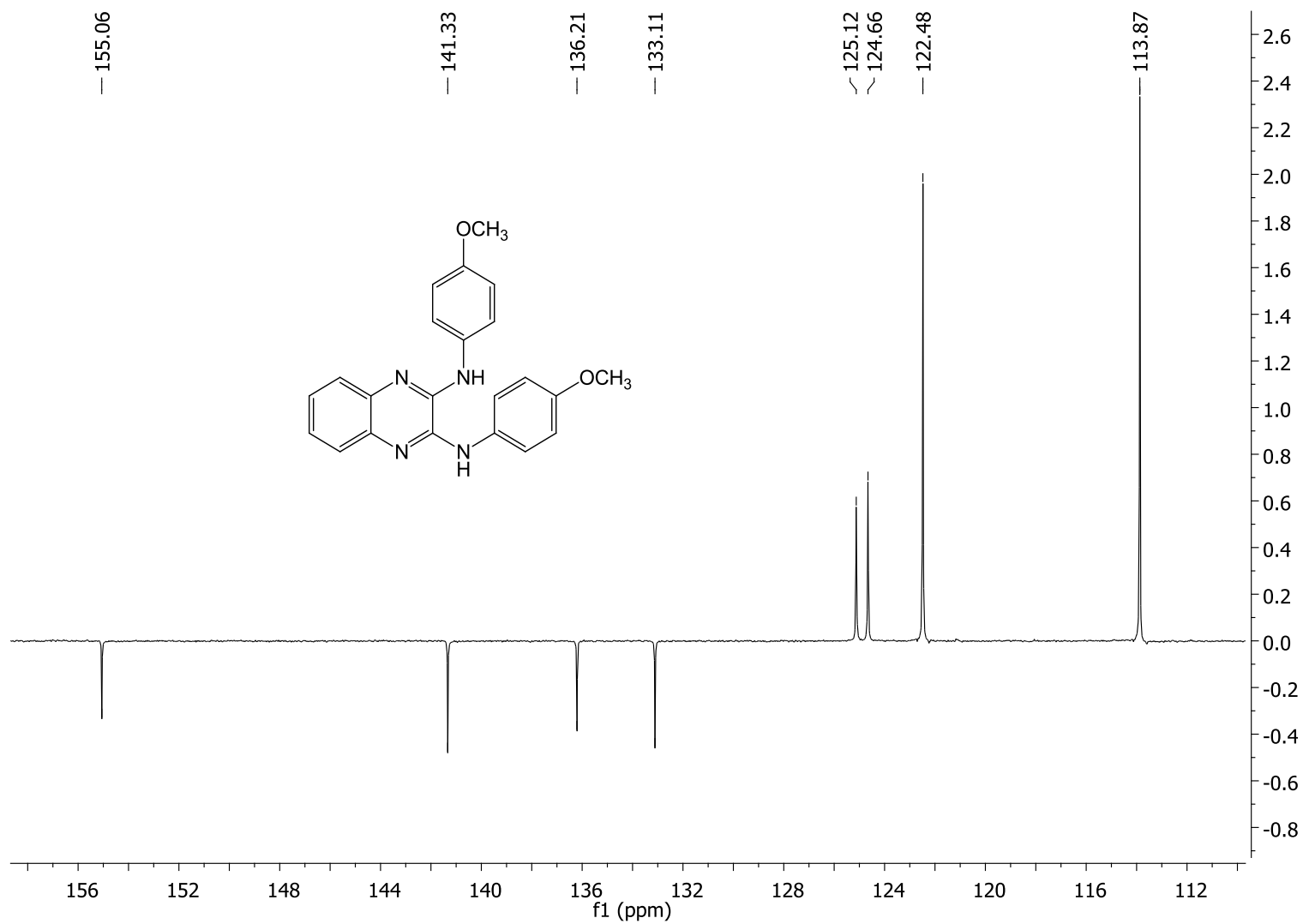
¹H NMR (DMSO) of N²,N³-bis(4-methoxyphenyl)quinoxaline-2,3-diamine (3f).



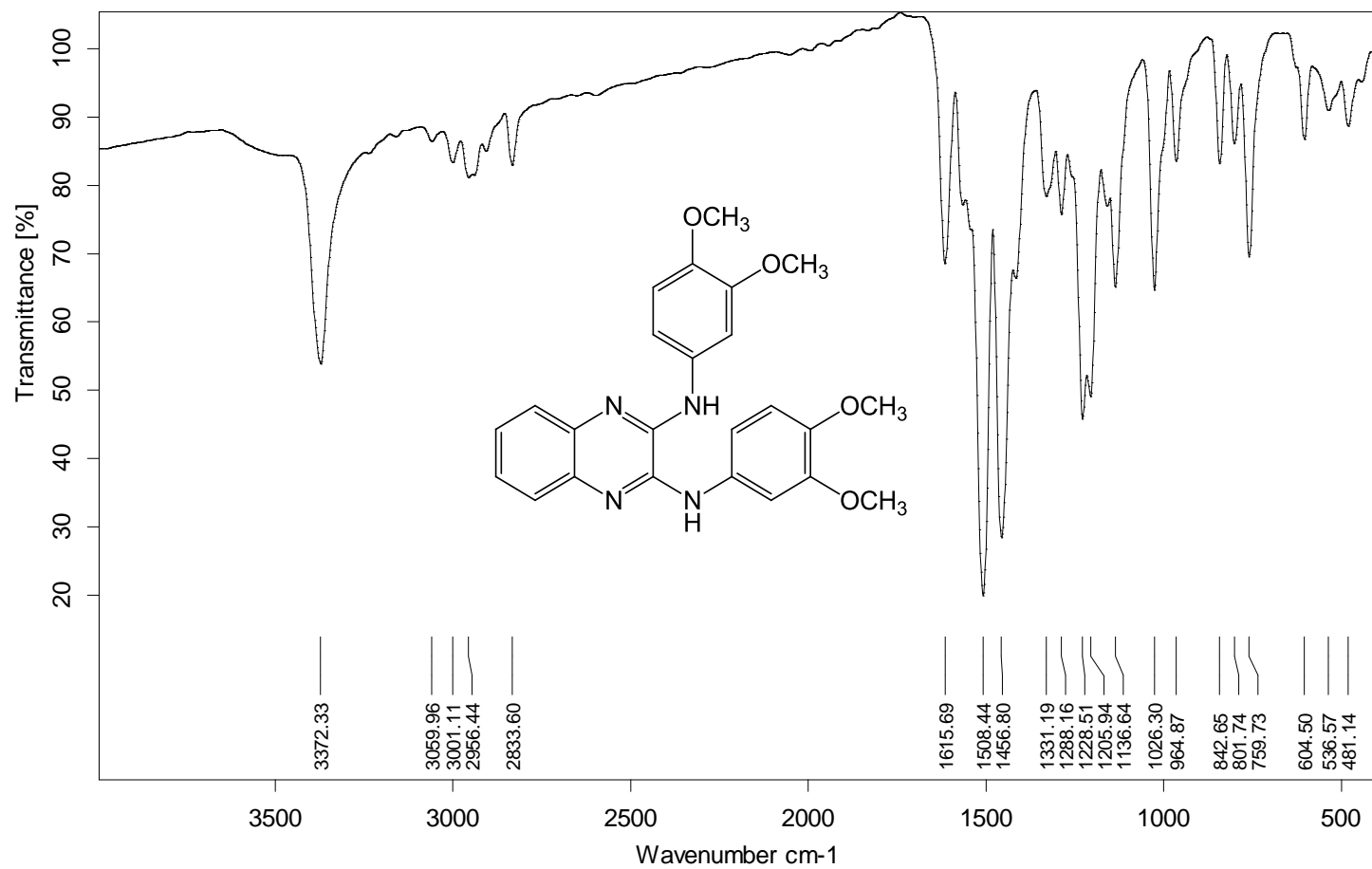
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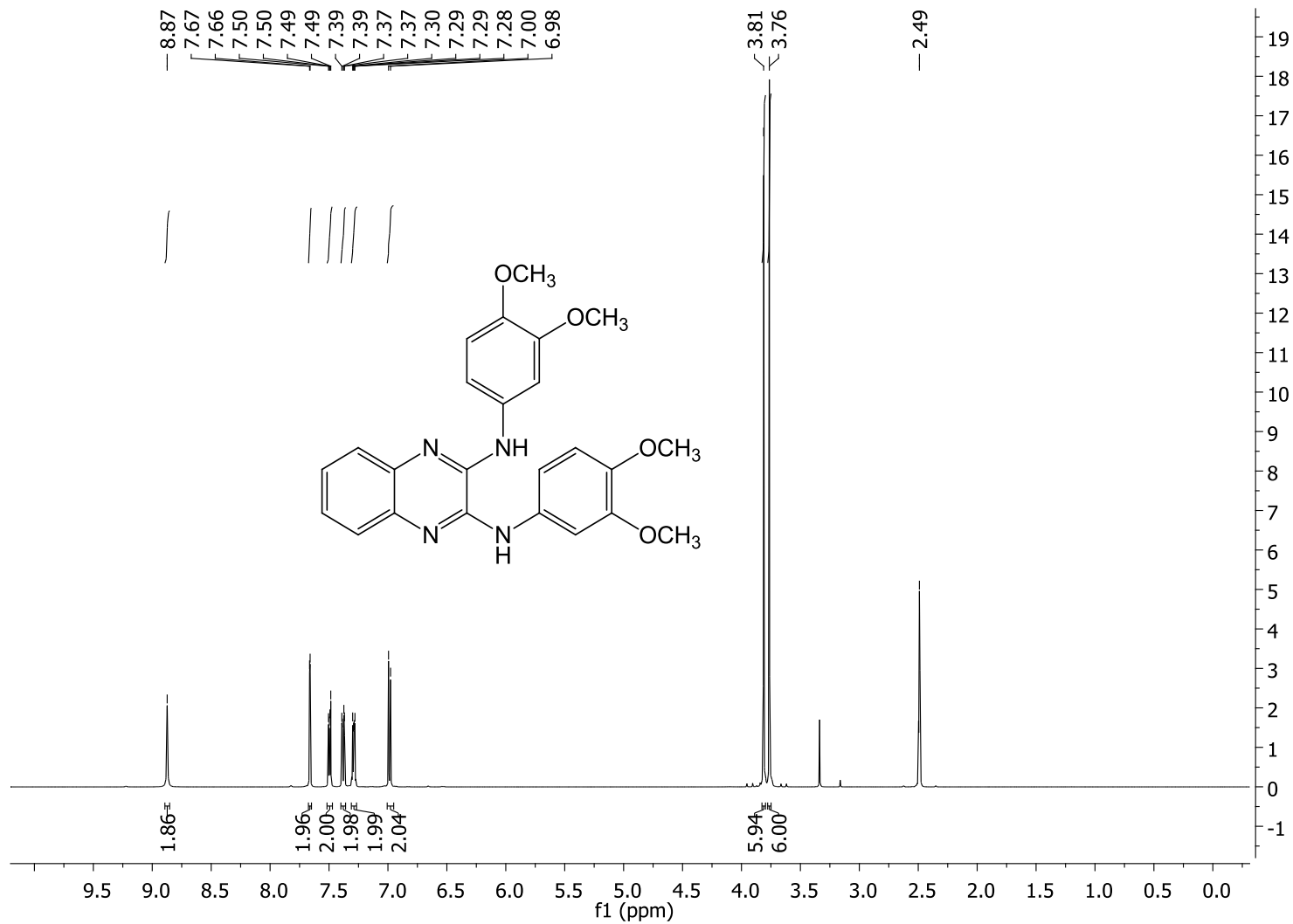
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(4-methoxyphenyl)quinoxaline-2,3-diamine (3f).



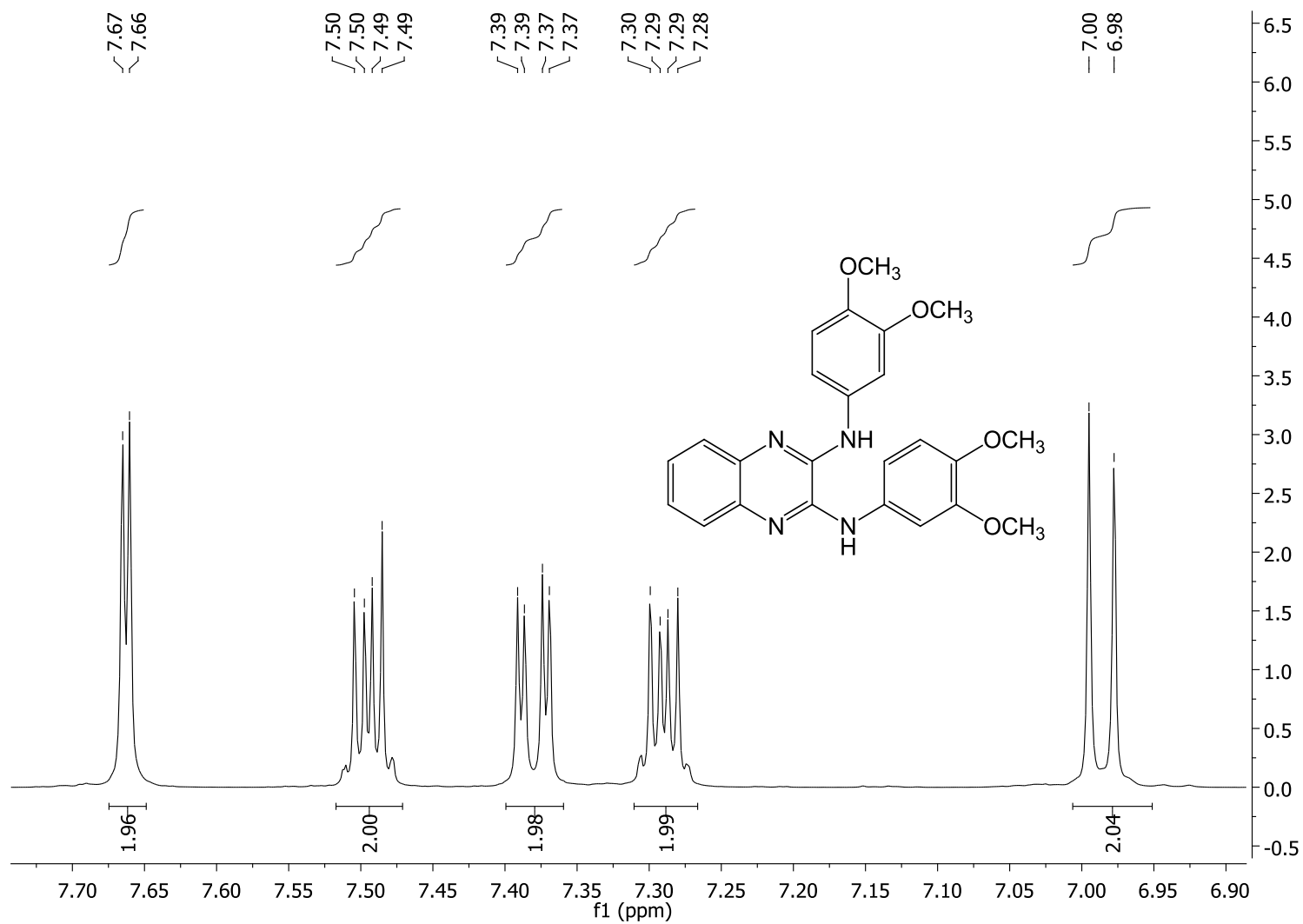
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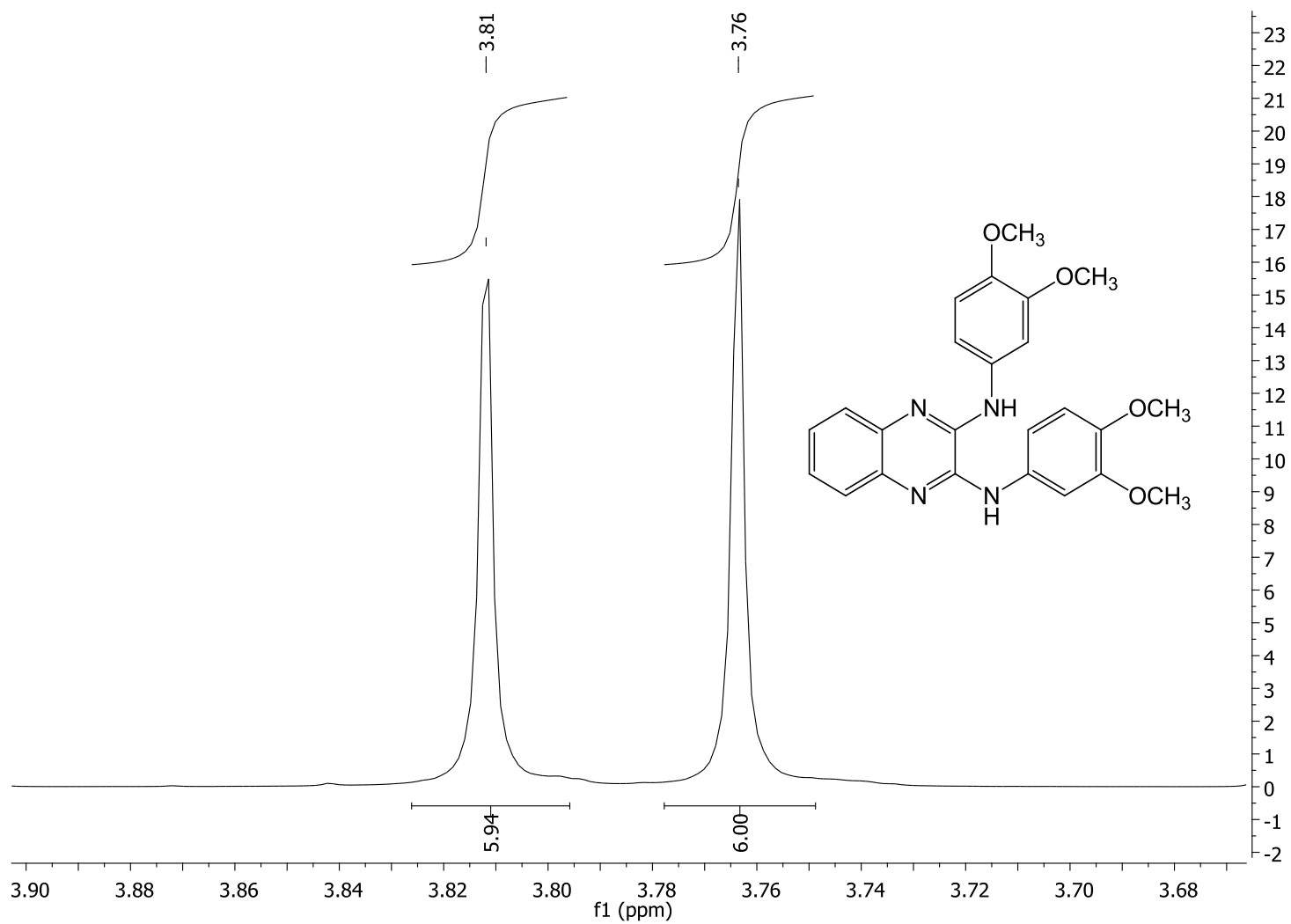
IR (KBr) of N²,N³-bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



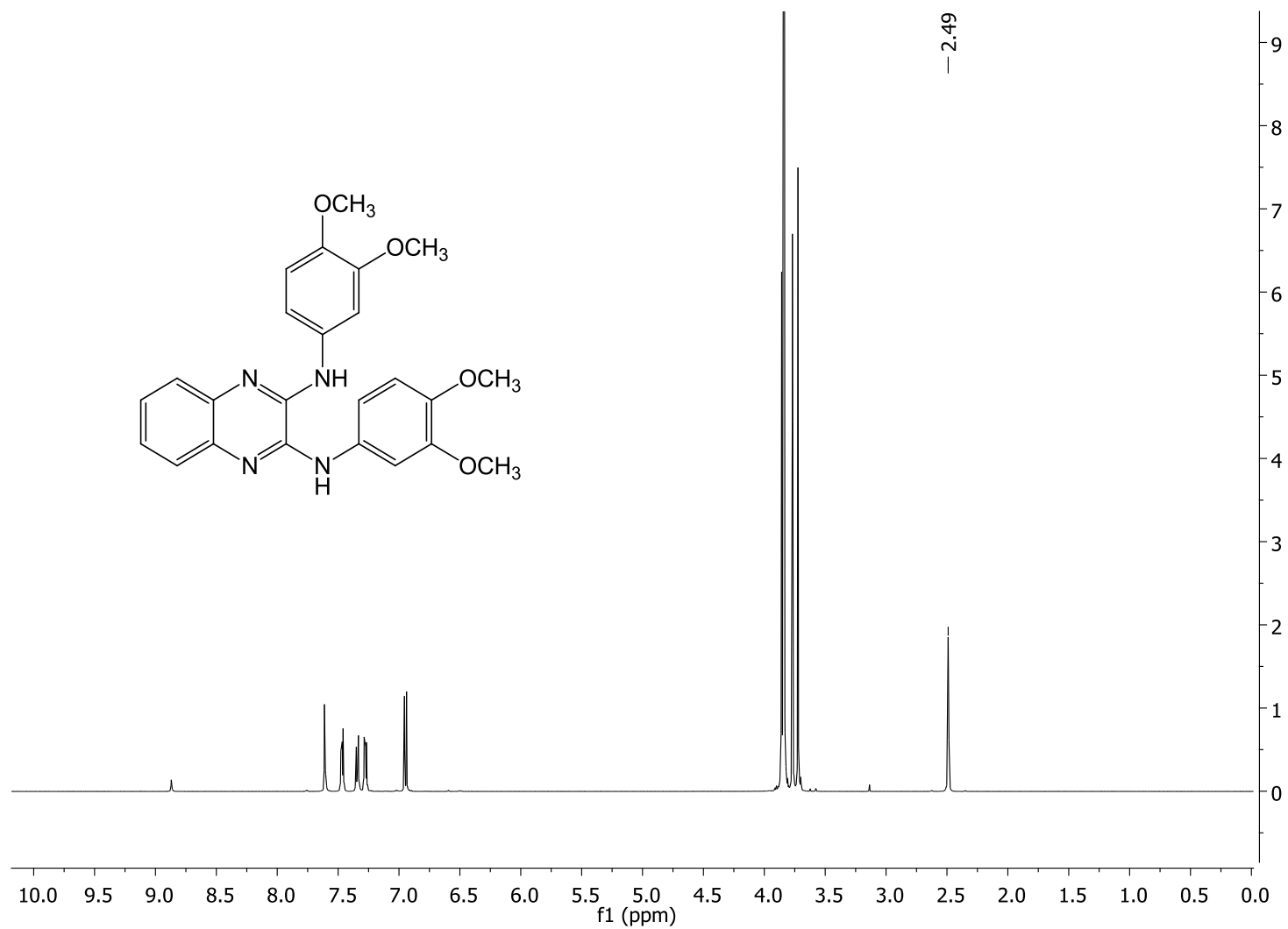
$^1\text{H NMR}$ (DMSO) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



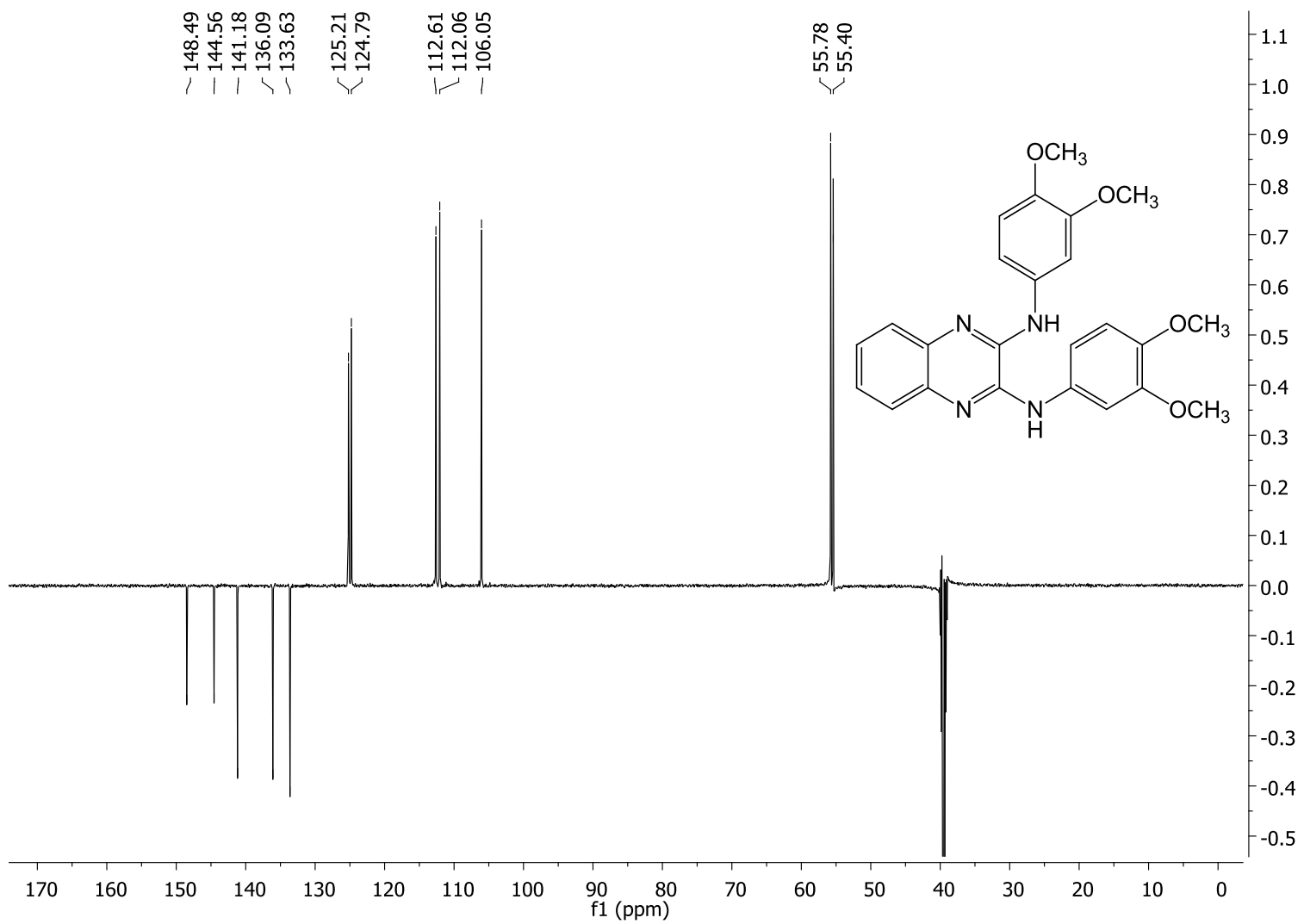
¹H NMR (DMSO) of N²,N³-bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



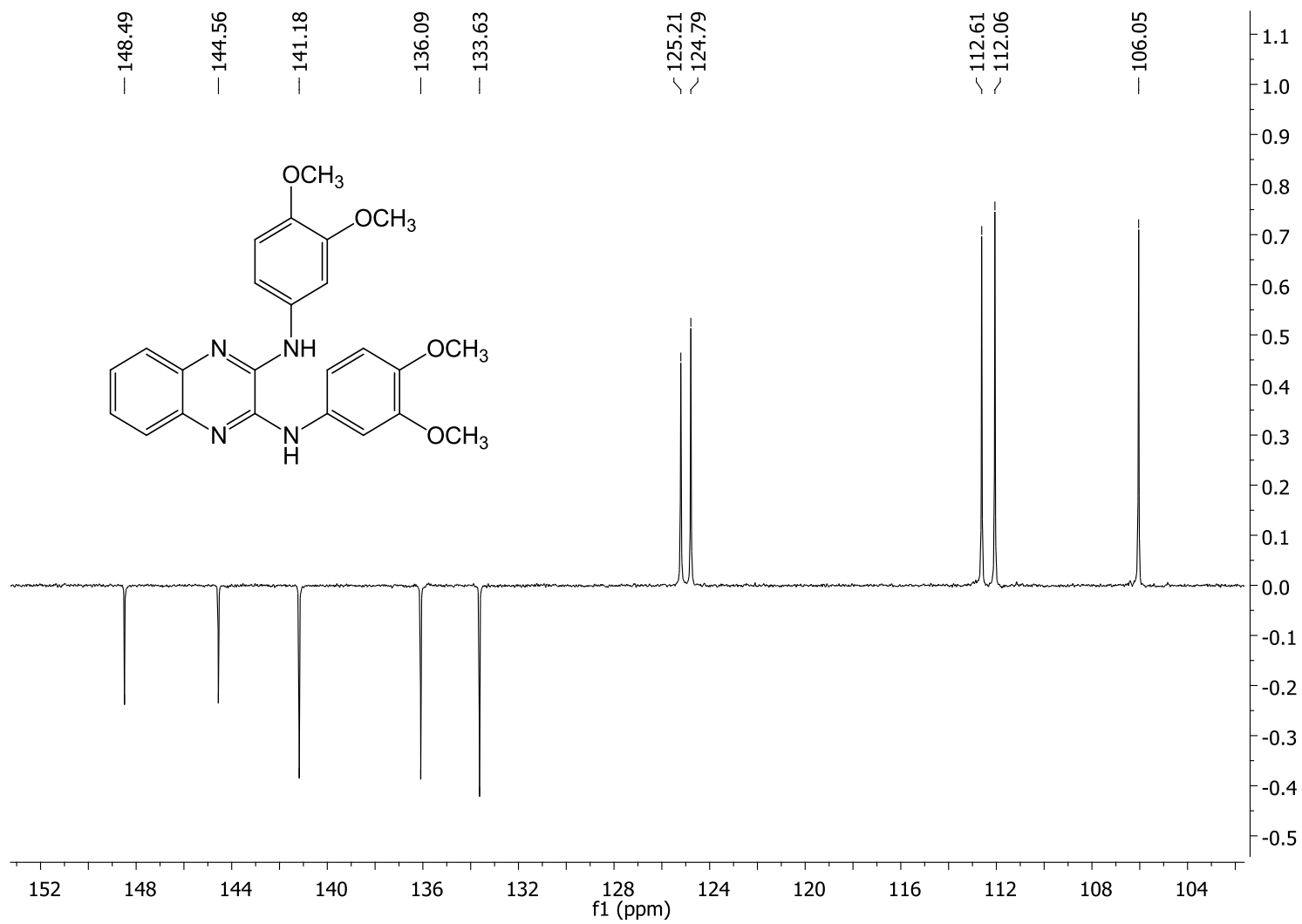
^1H NMR (DMSO) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



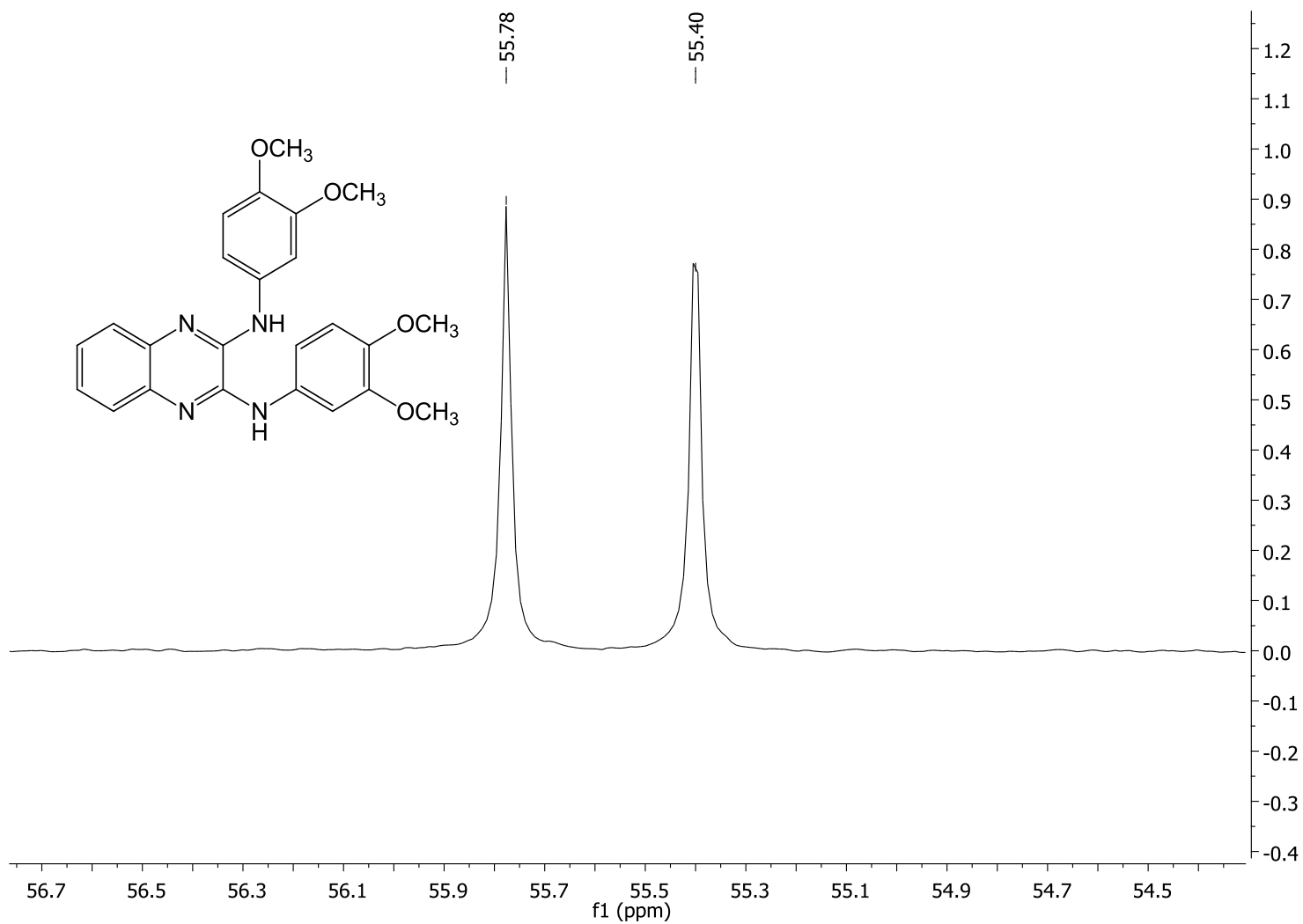
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



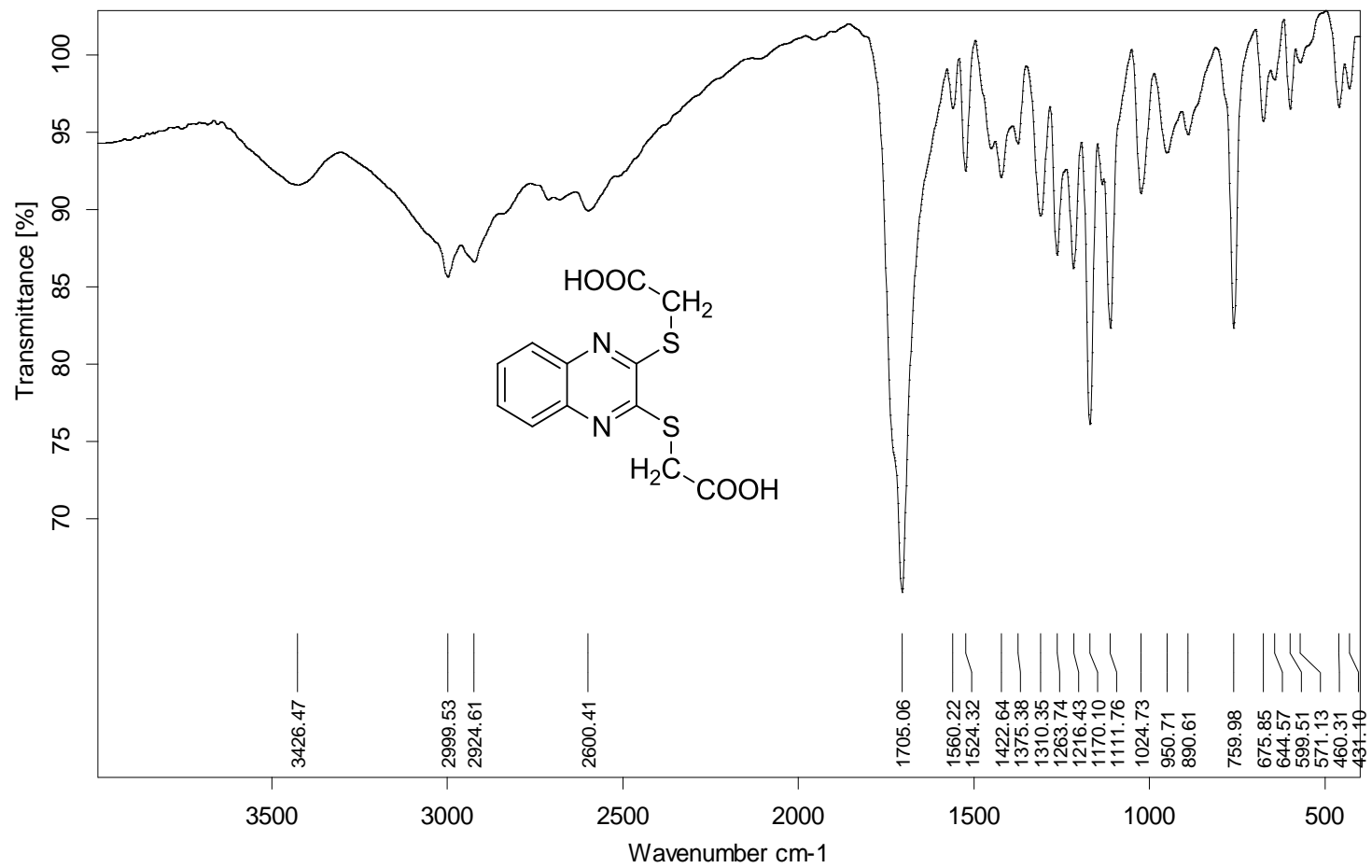
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



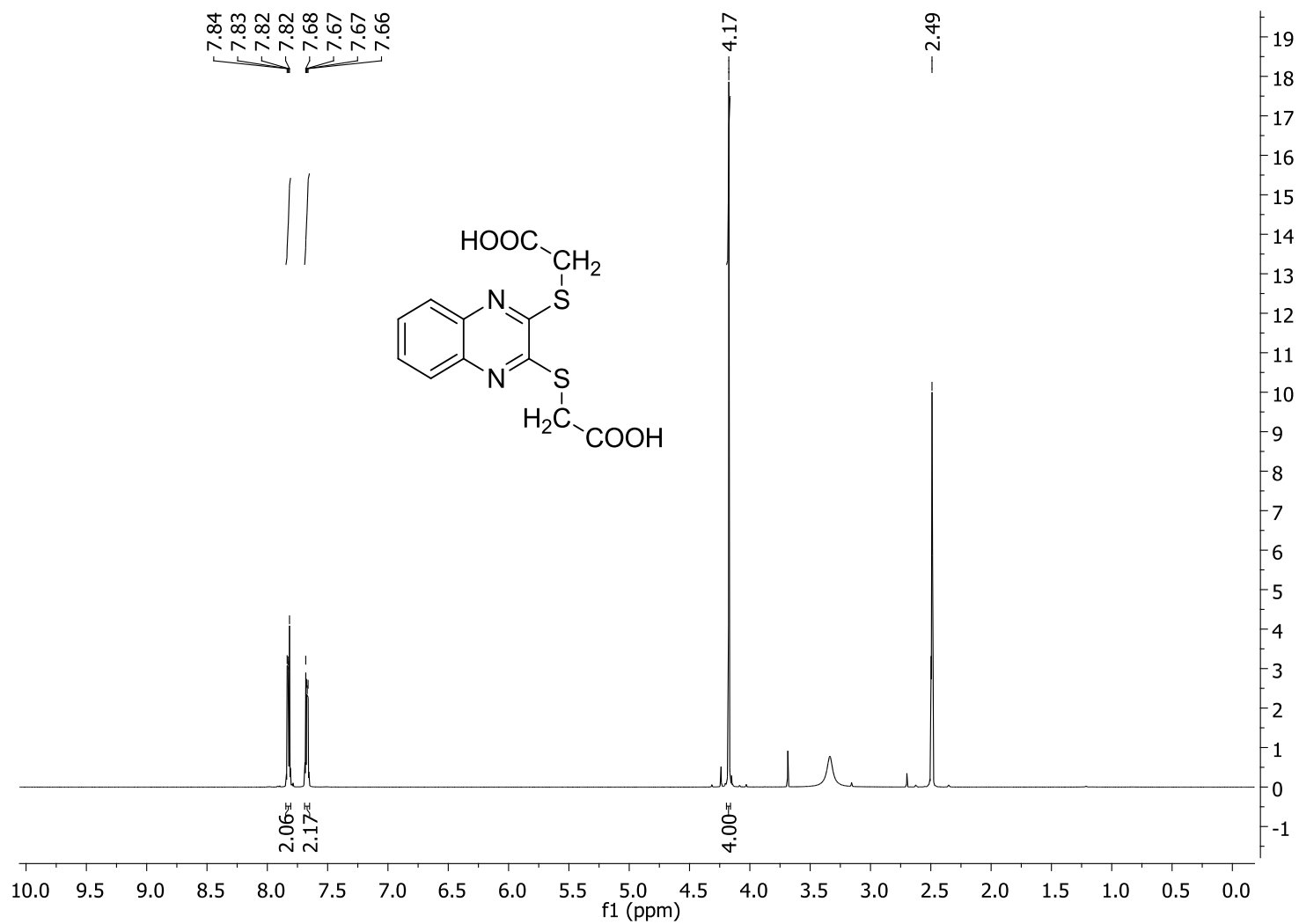
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



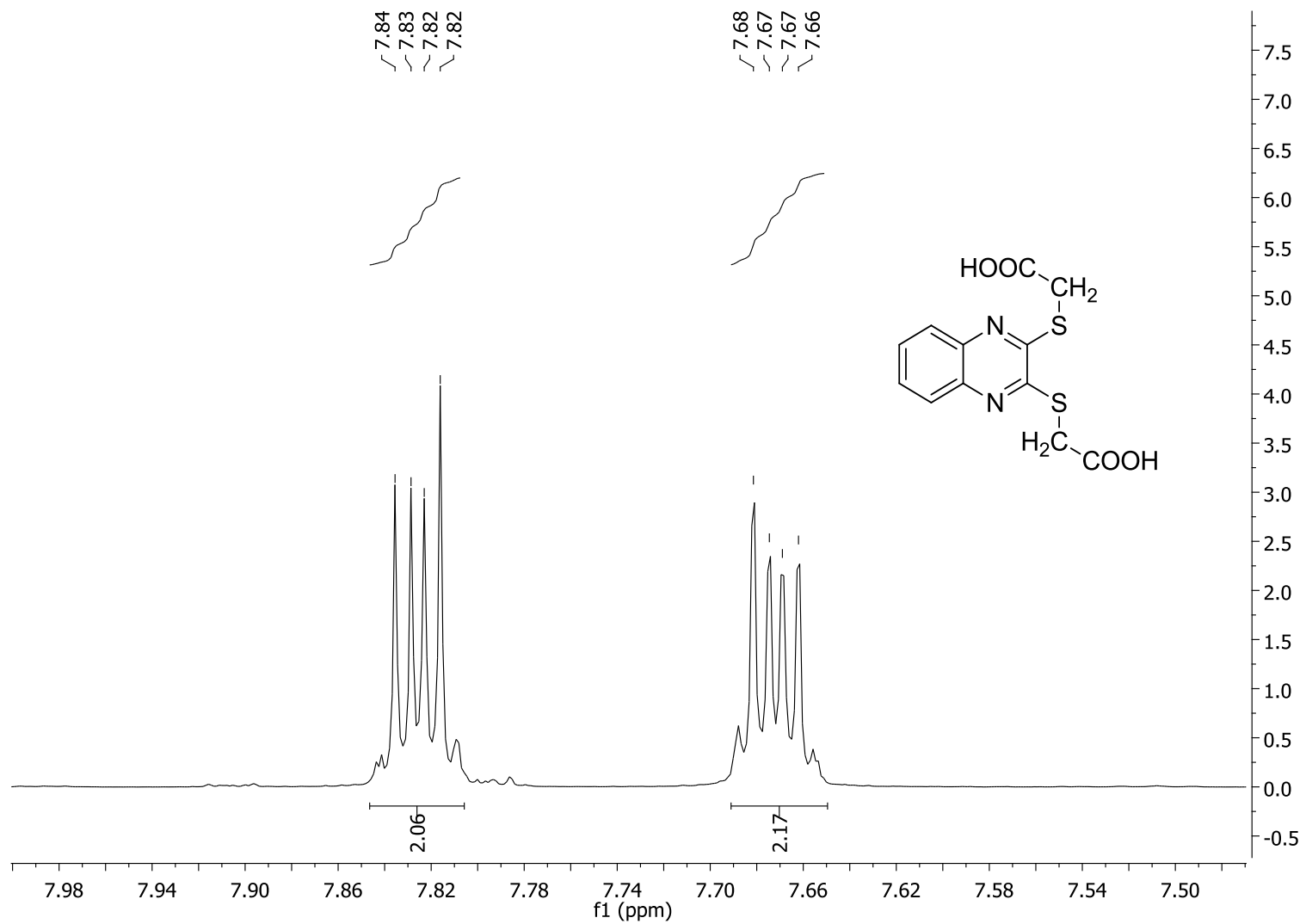
^{13}C APT NMR (DMSO) of N^2,N^3 -bis(3,4-dimethoxyphenyl)quinoxaline-2,3-diamine (3g).



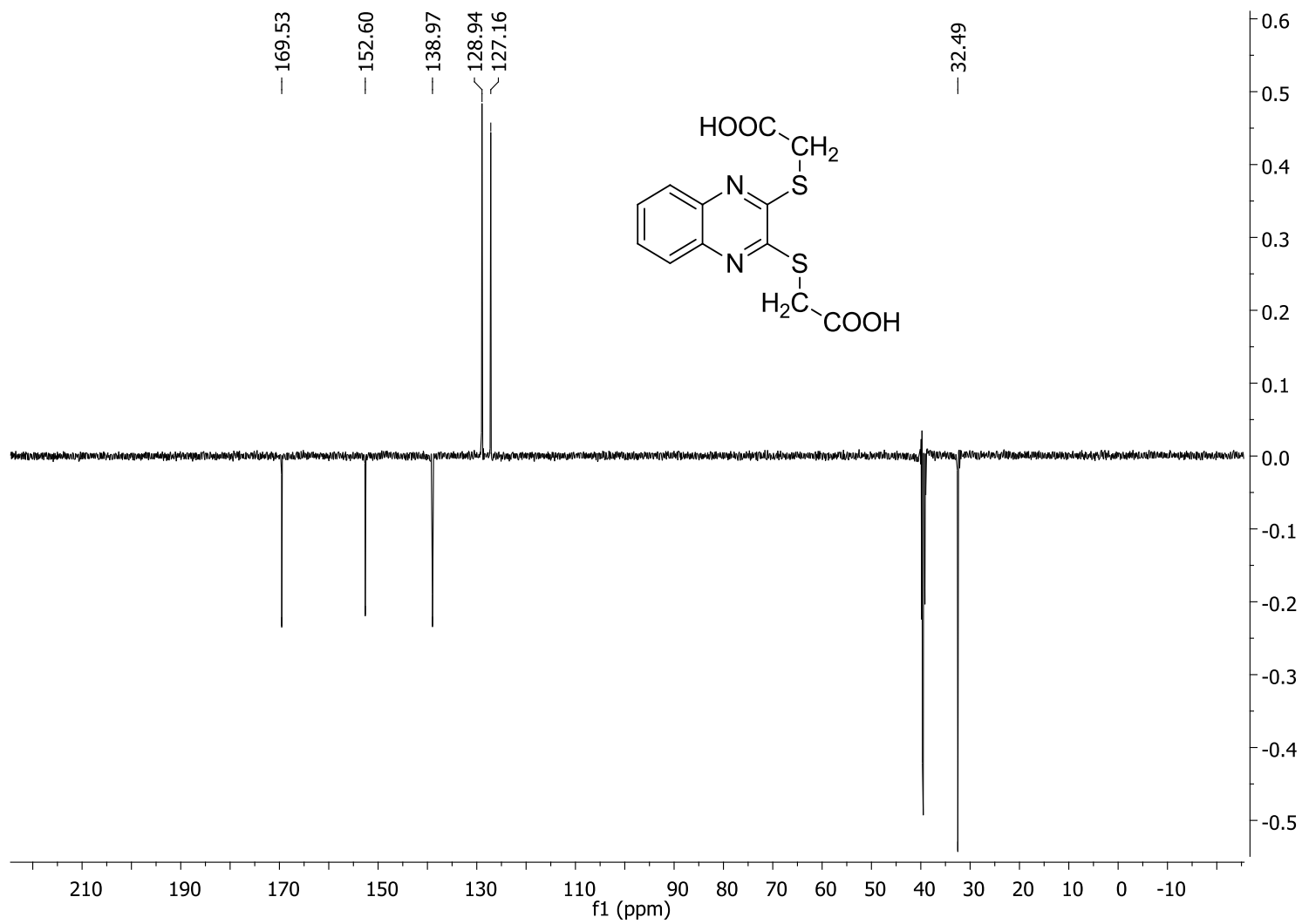
IR (KBr) of 2,2'-(quinoxaline-2,3-diylbis(sulfaneydiyl))diacetic acid (4).



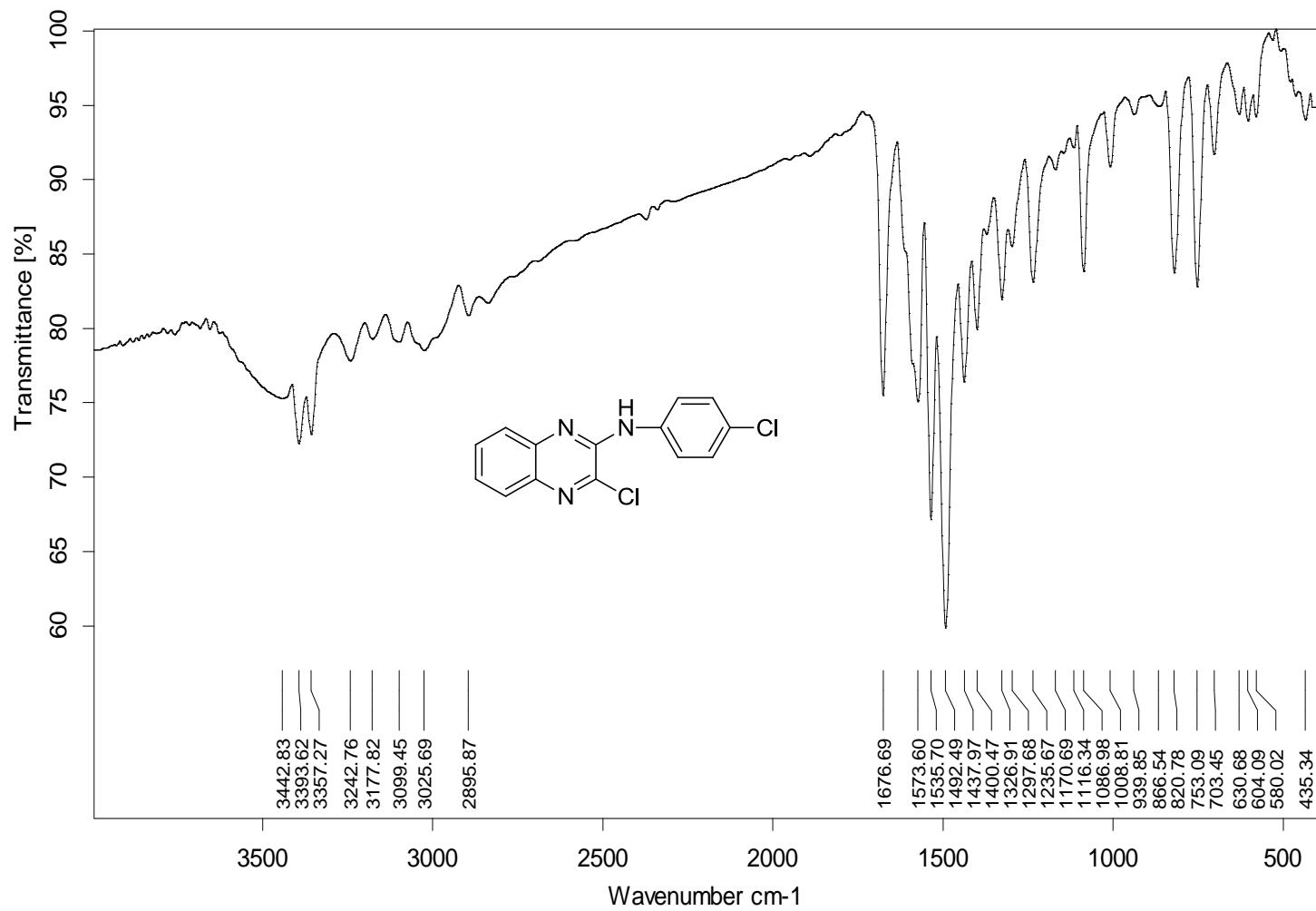
¹H NMR (DMSO) of 2,2'-(quinoxaline-2,3-diylbis(sulfaneydiyl))diacetic acid (4).



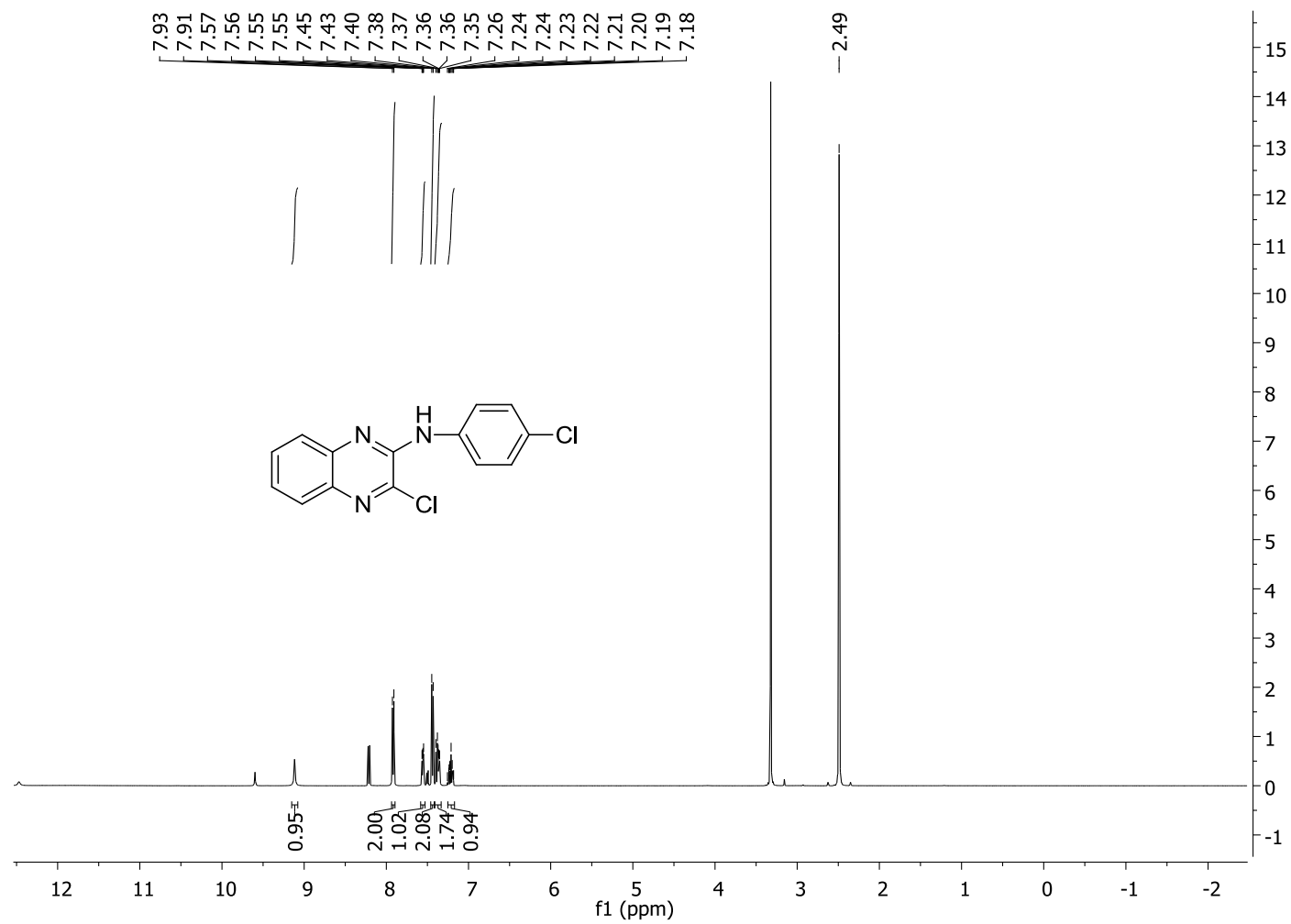
¹H NMR (DMSO) of 2,2'-(quinoxaline-2,3-diylbis(sulfaneydiyl))diacetic acid (4).



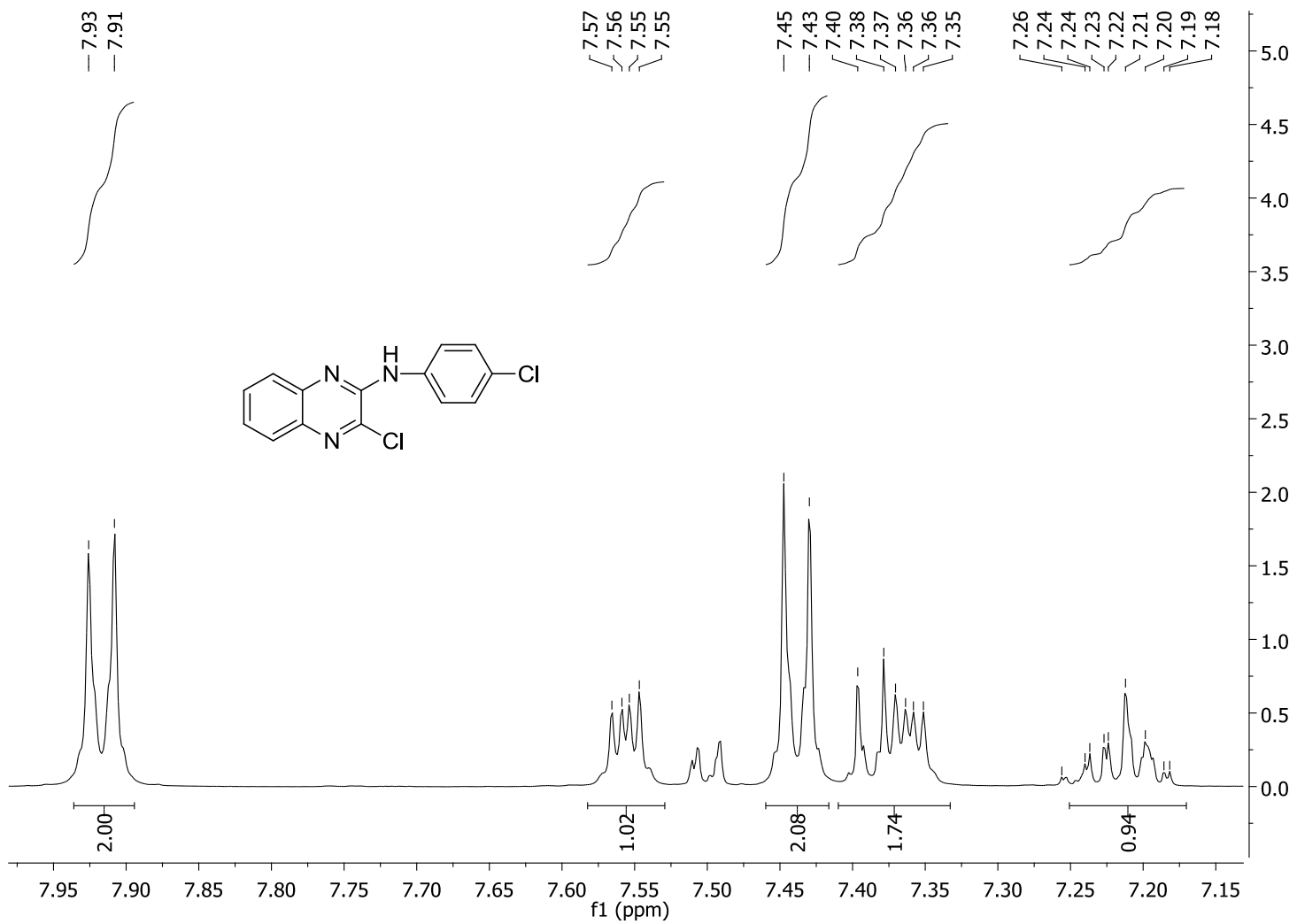
^{13}C APT NMR (DMSO) of 2,2'-(quinoxaline-2,3-diylbis(sulfaneydiyl))diacetic acid (4).



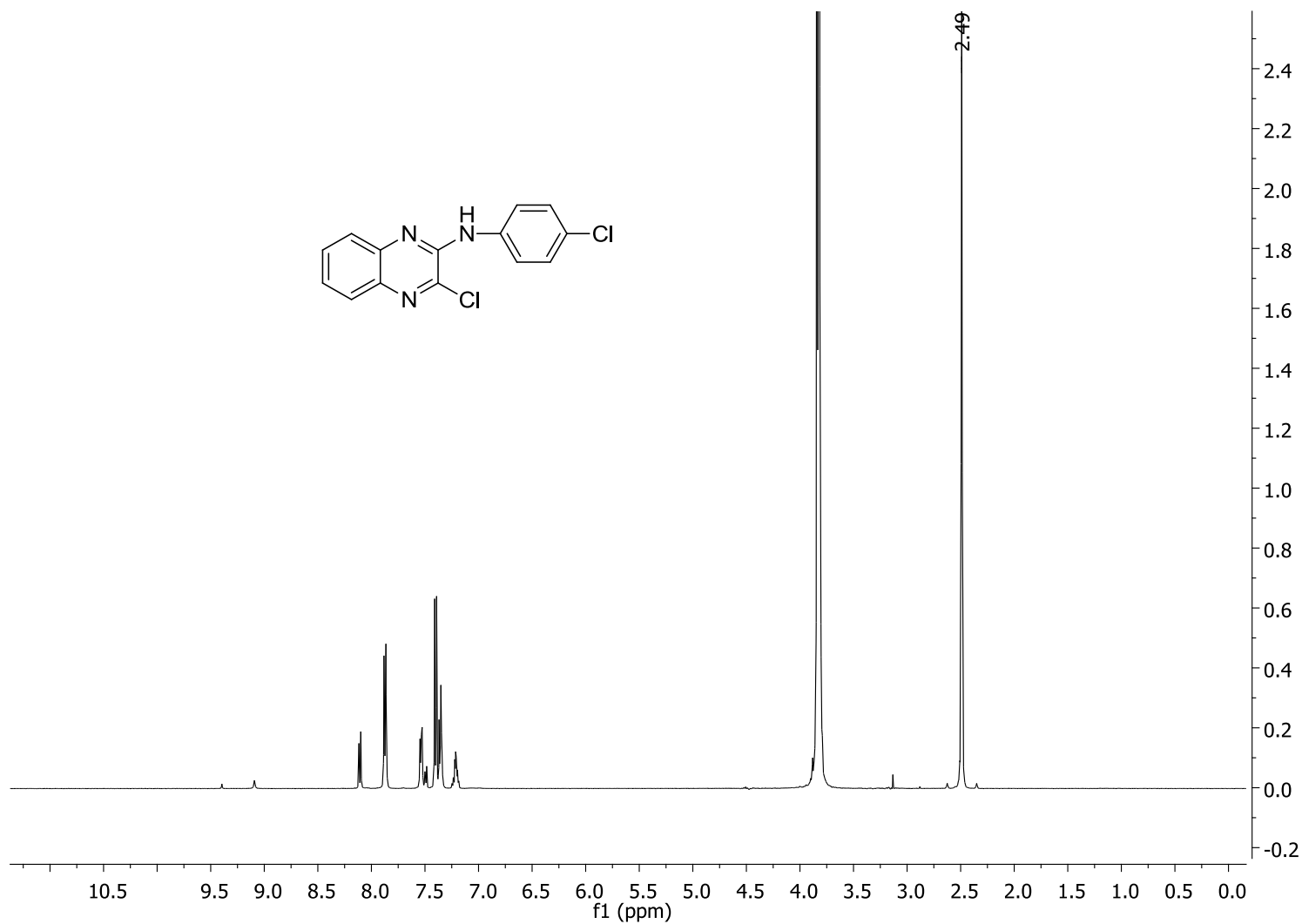
IR (KBr) of 3-chloro-N-(4-chlorophenyl)quinoxalin-2-amine (5).



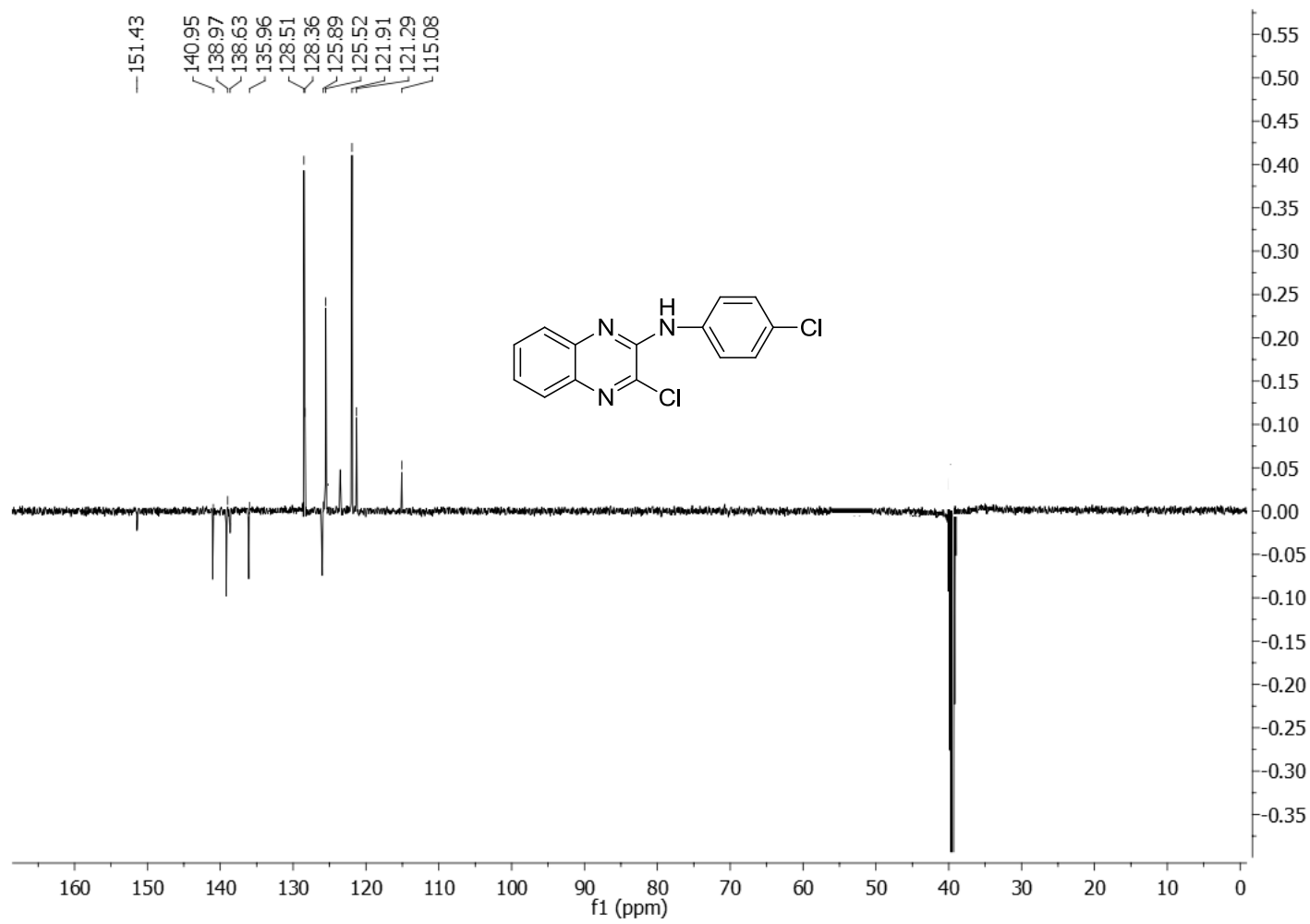
¹H NMR (DMSO) of 3-chloro-N-(4-chlorophenyl)quinoxalin-2-amine (5).



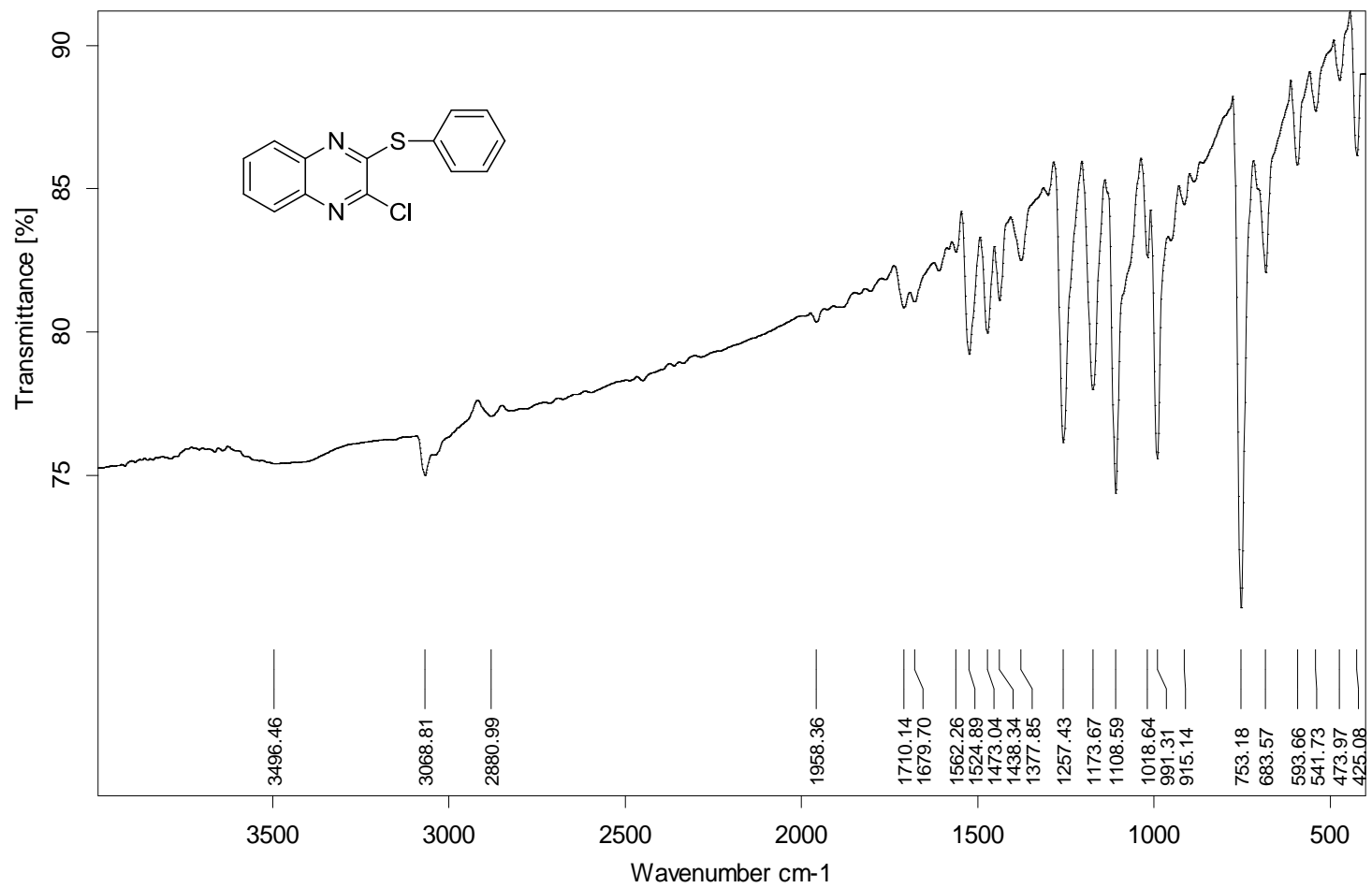
¹H NMR (DMSO) of 3-chloro-N-(4-chlorophenyl)quinoxalin-2-amine (5).



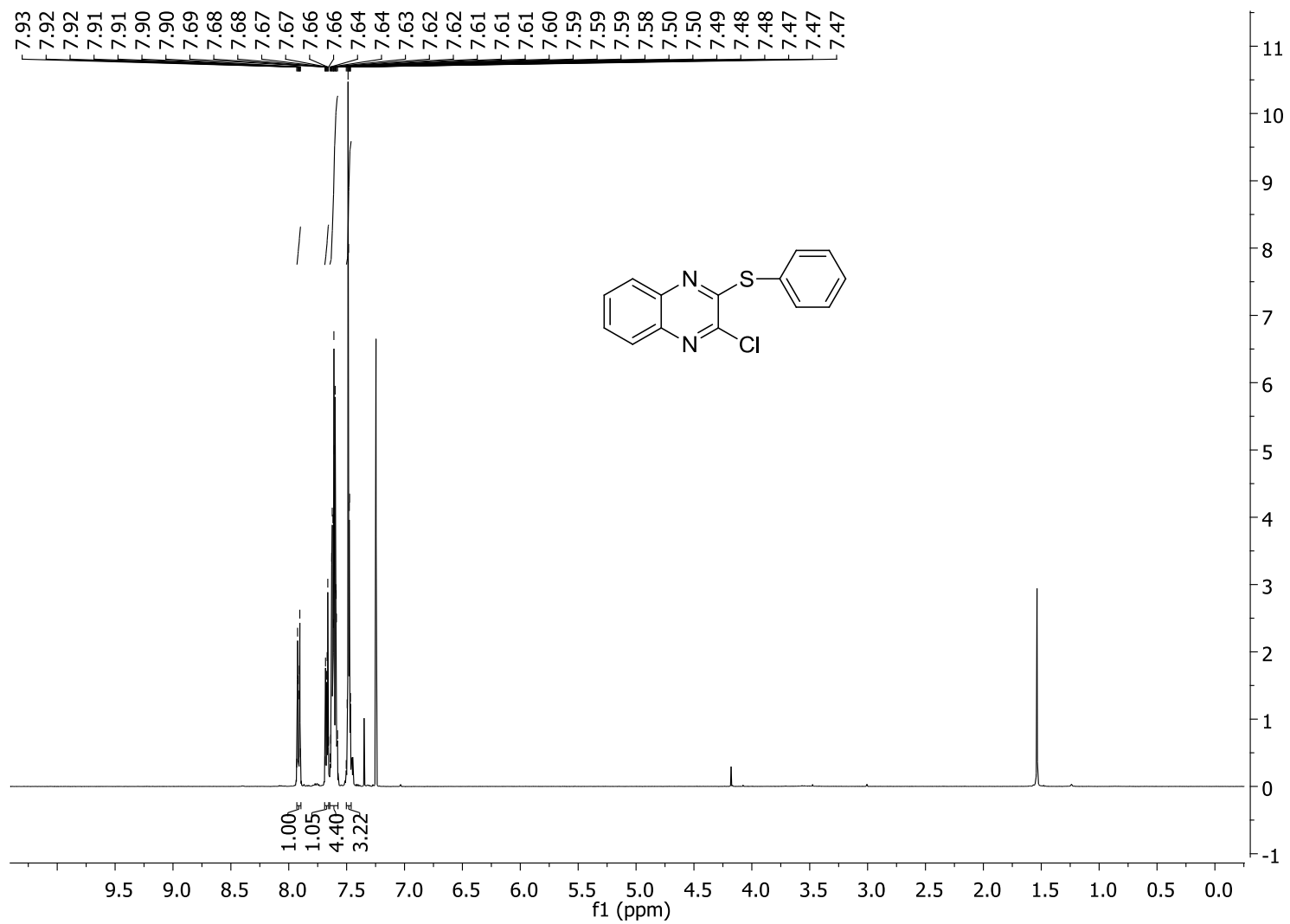
^1H NMR (DMSO, D_2O) of 3-chloro-N-(4-chlorophenyl)quinoxalin-2-amine (5).



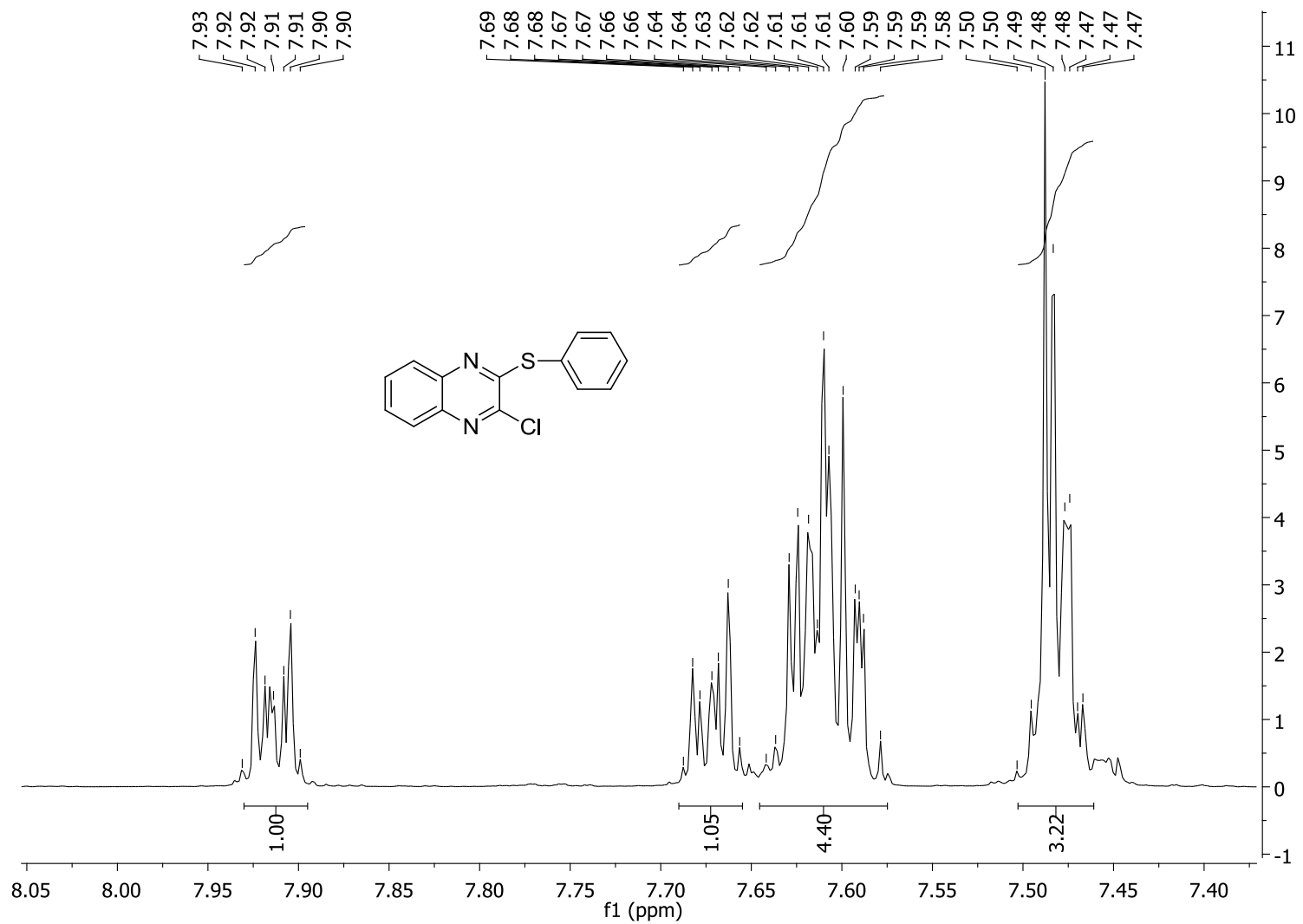
¹³C APT NMR (DMSO) spectrum of 3-chloro-N-(4-chlorophenyl)quinoxalin-2-amine (5).



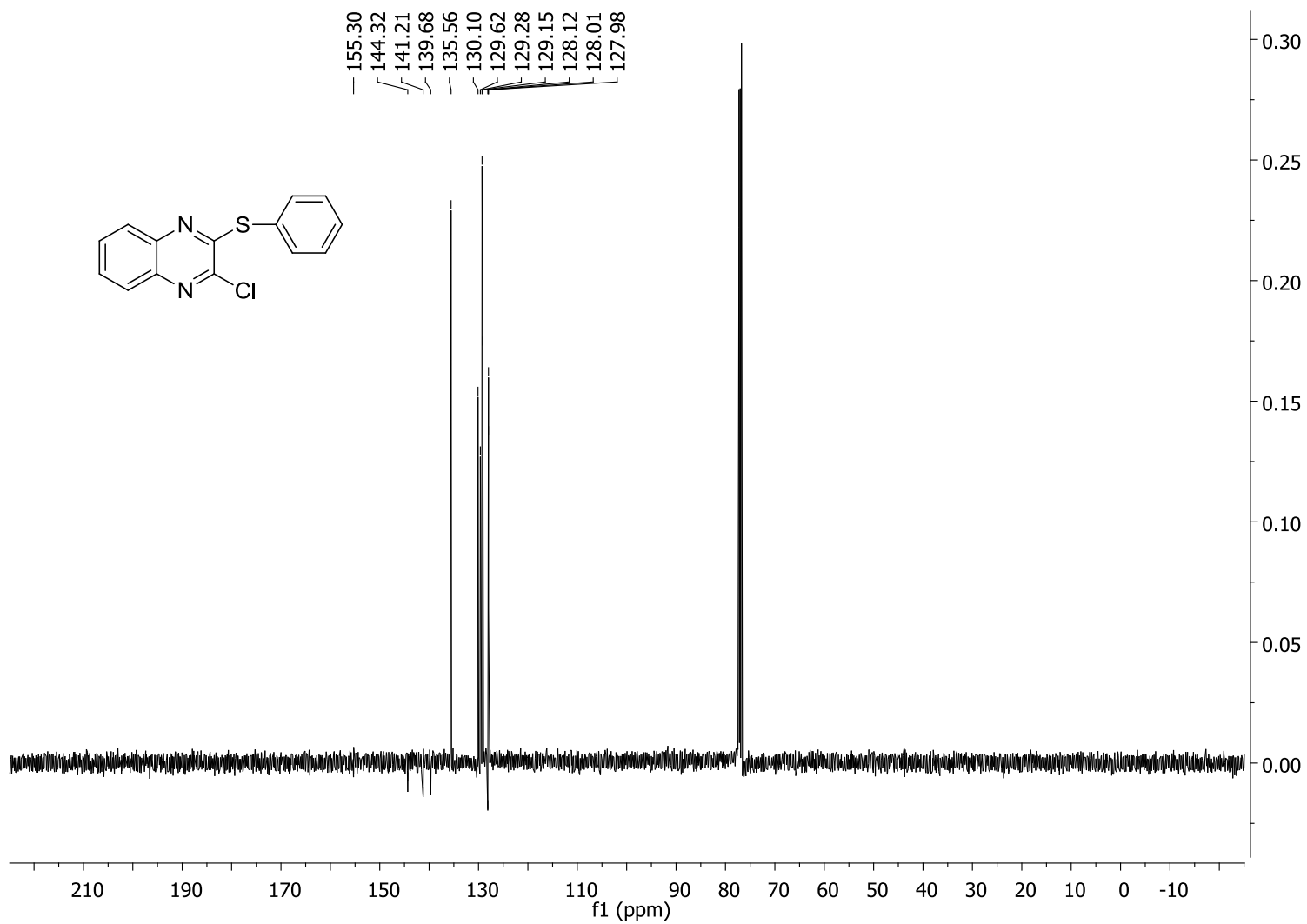
IR (KBr) of 2-chloro-3-(phenylthio)quinoxaline (6a).

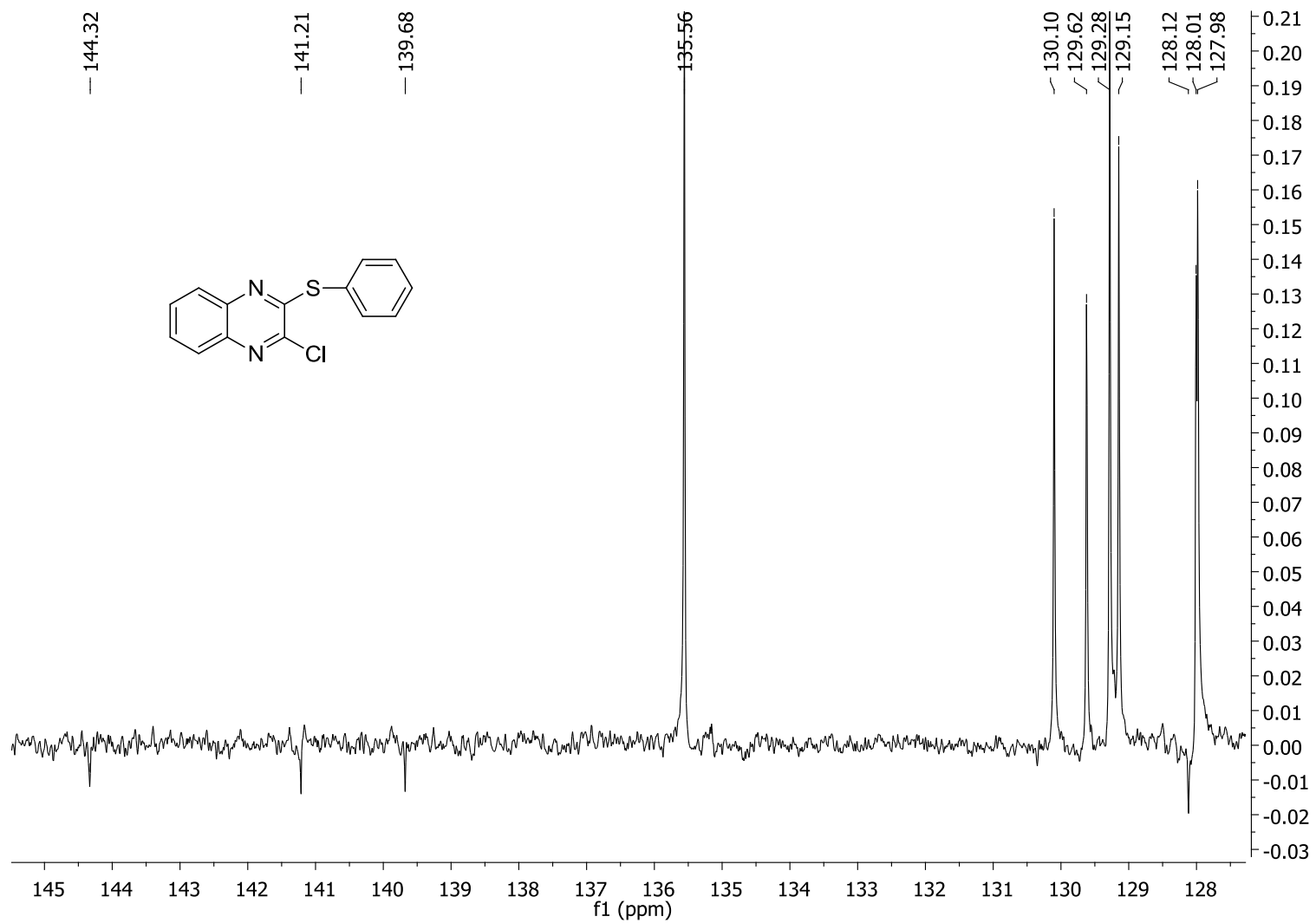


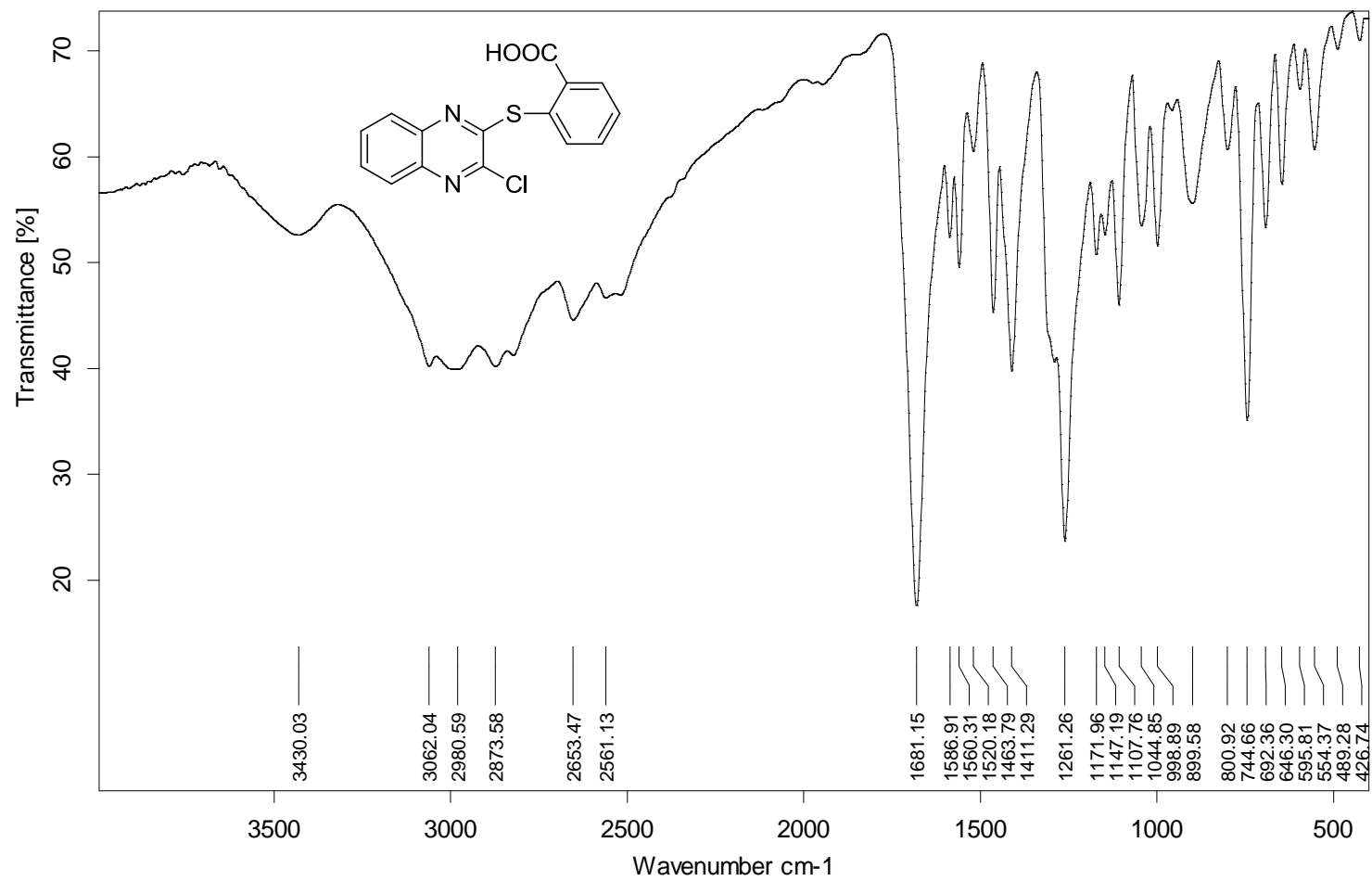
^1H NMR (CDCl_3) of 2-chloro-3-(phenylthio)quinoxaline (6a).



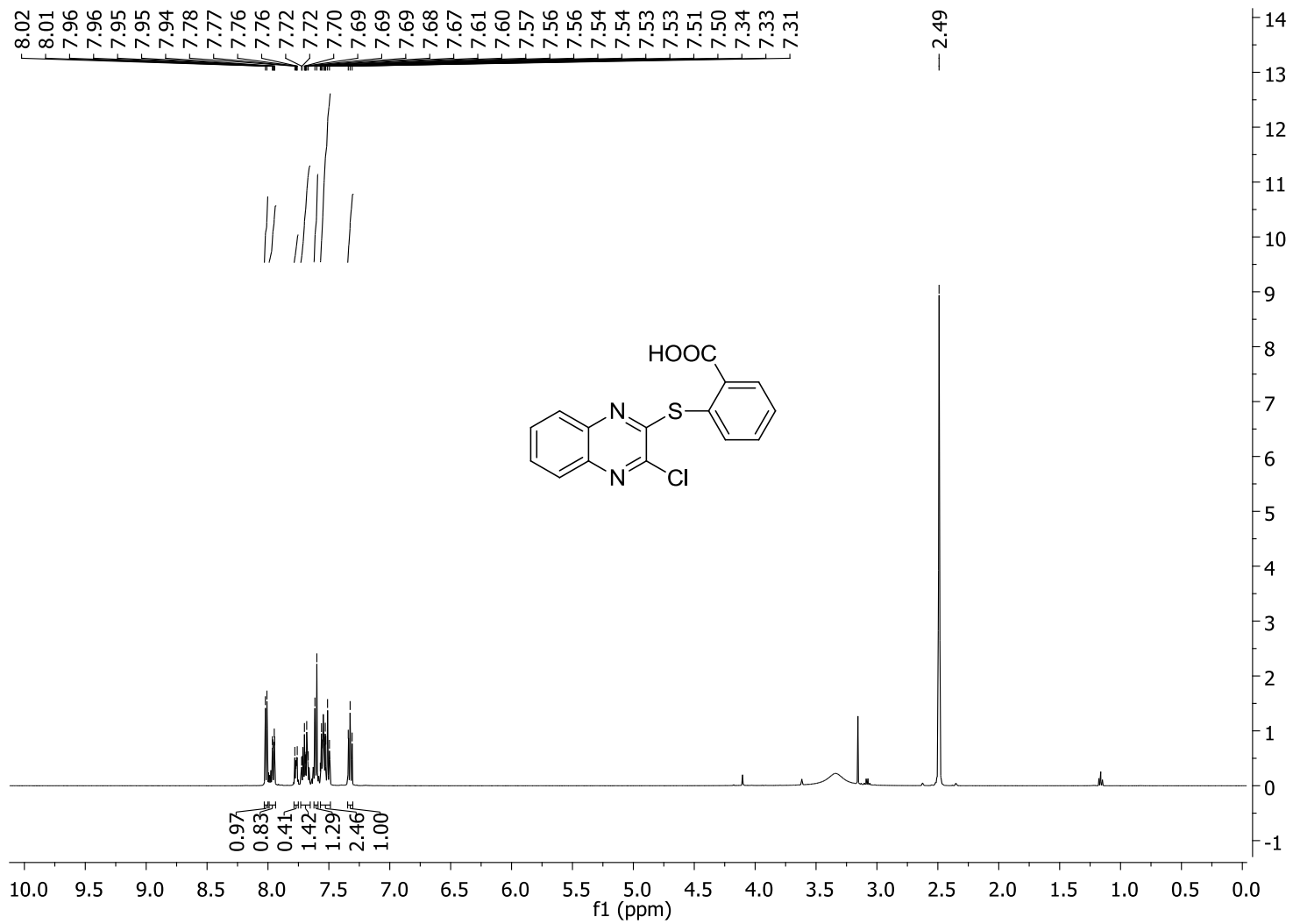
¹H NMR (CDCl₃) of 2-chloro-3-(phenylthio)quinoxaline (6a).



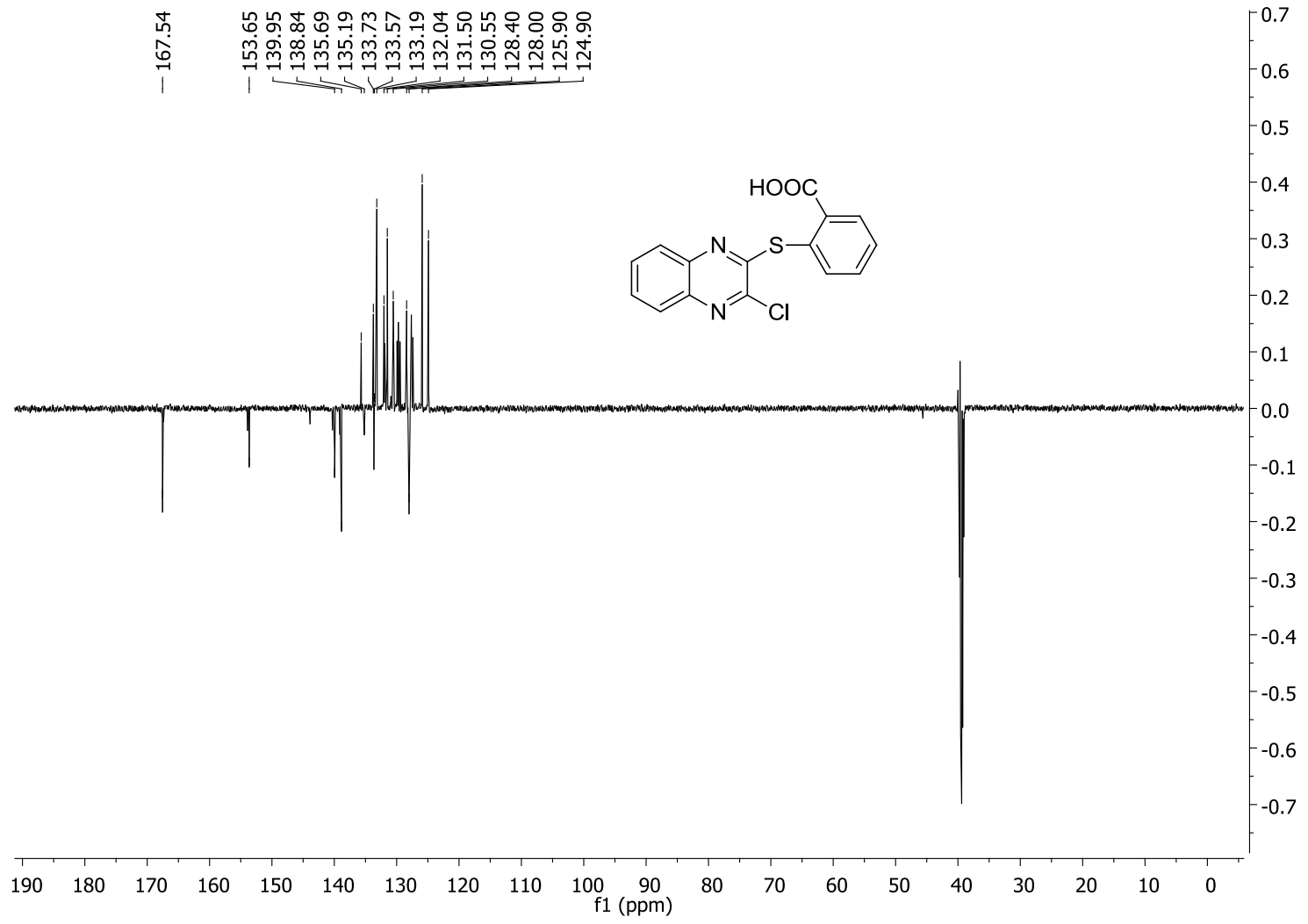




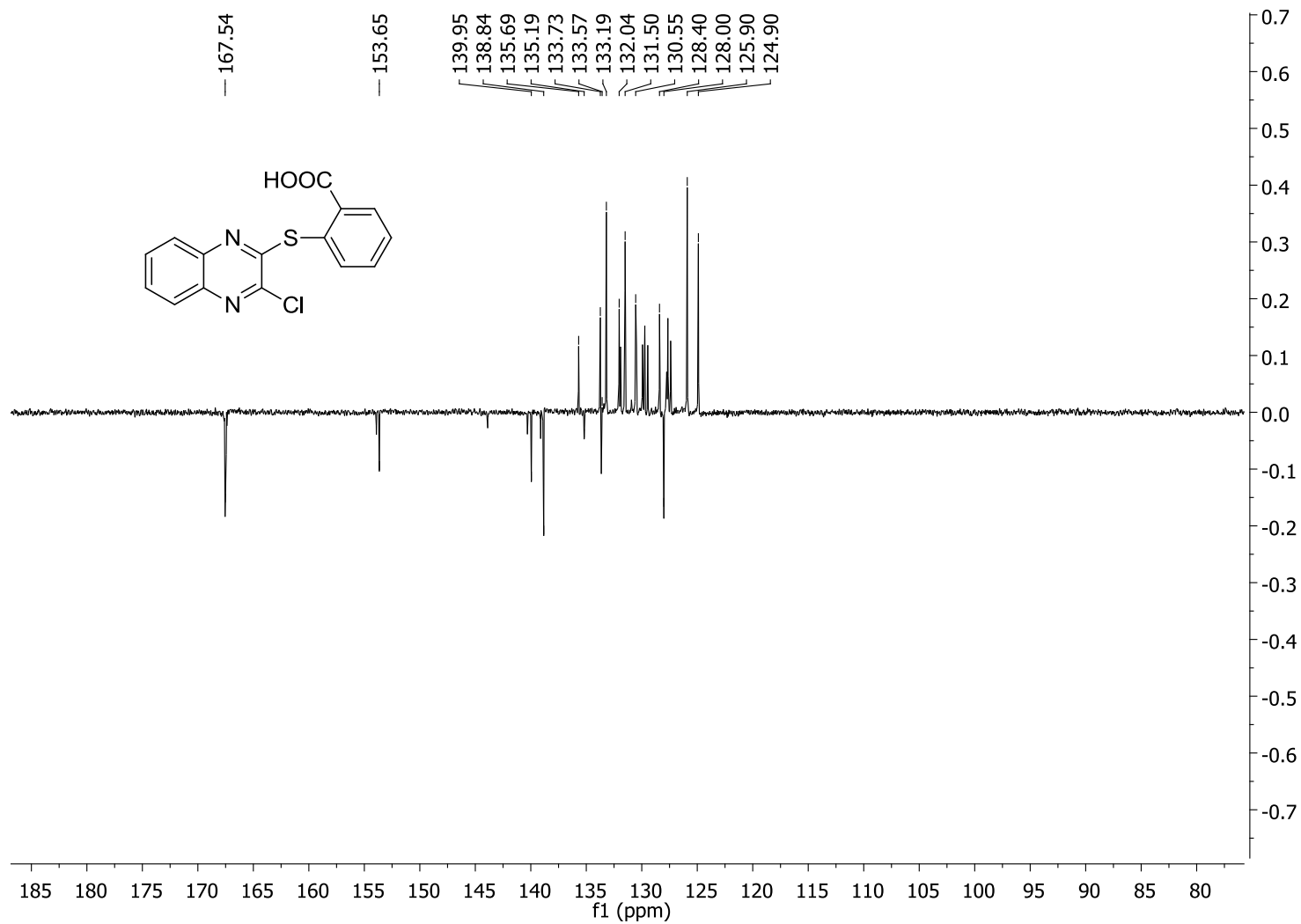
IR (KBr) of 2-(3-chloroquinoxalin-2-ylthio)benzoic acid (6b).



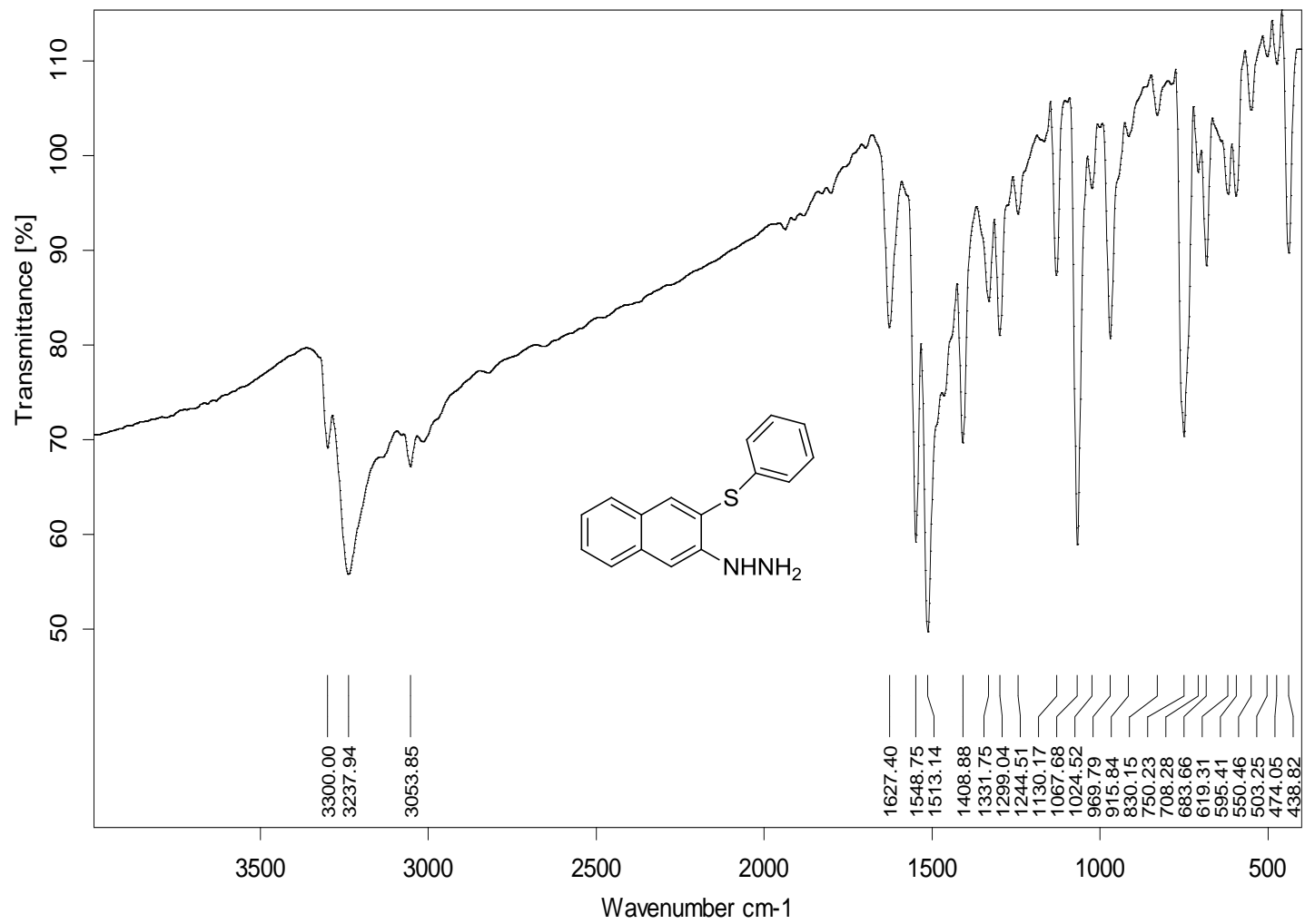
¹H NMR (DMSO) of 2-(3-chloroquinoxalin-2-ylthio)benzoic acid (6b).



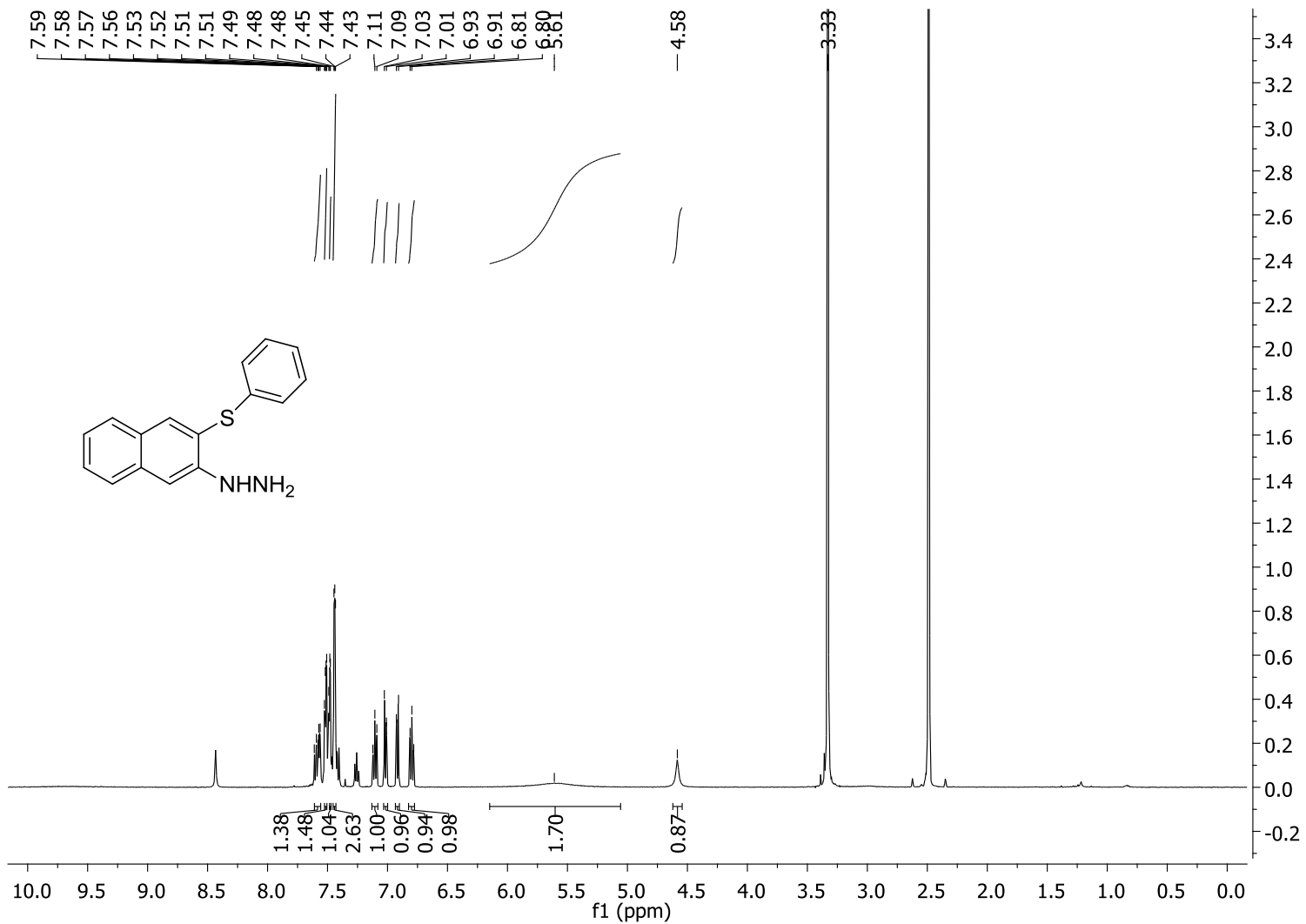
^{13}C APT NMR (DMSO) of 2-(3-chloroquinoxalin-2-ylthio)benzoic acid (6b).



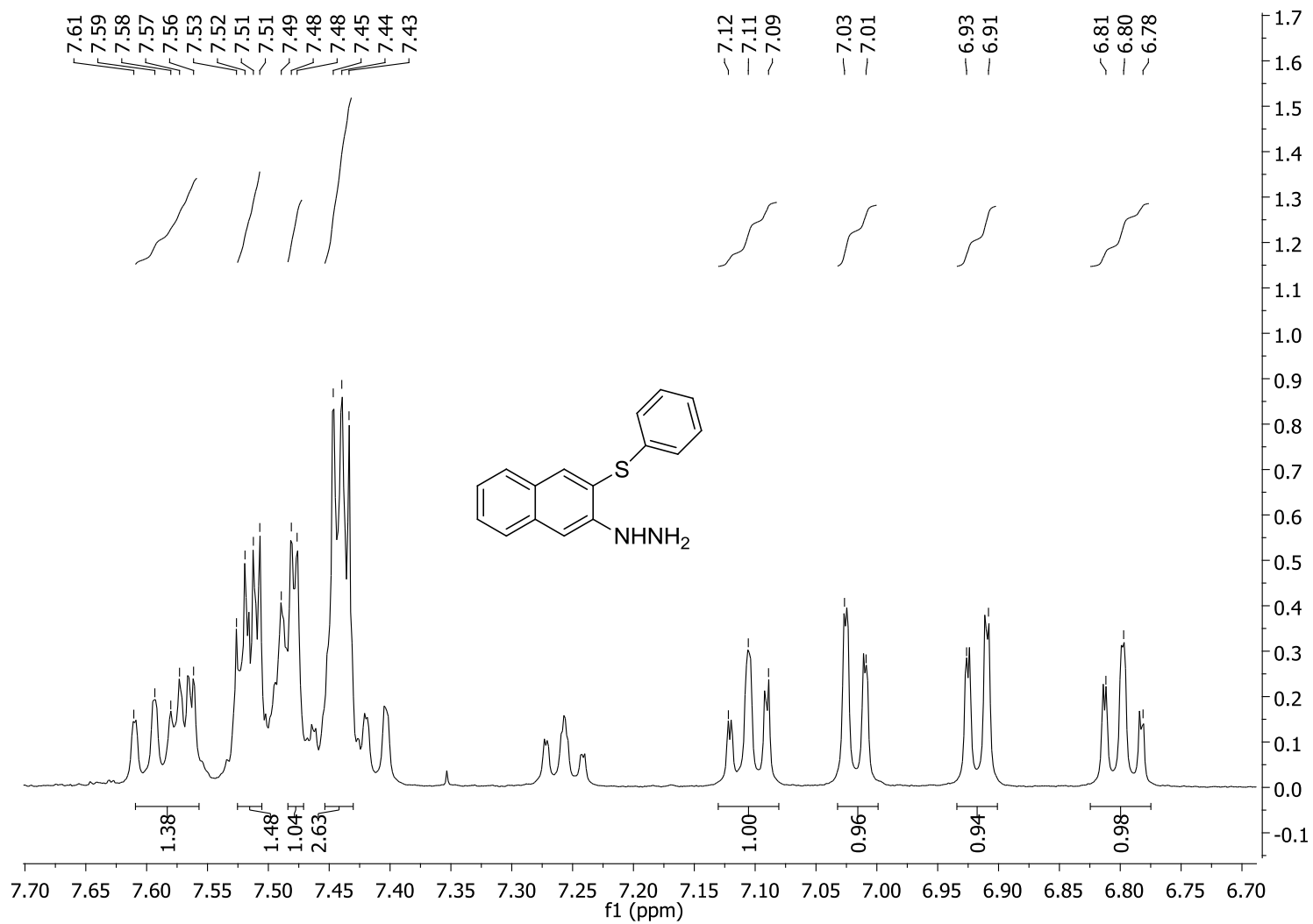
¹³C APT NMR (DMSO) of 2-(3-chloroquinoxalin-2-ylthio)benzoic acid (6b).



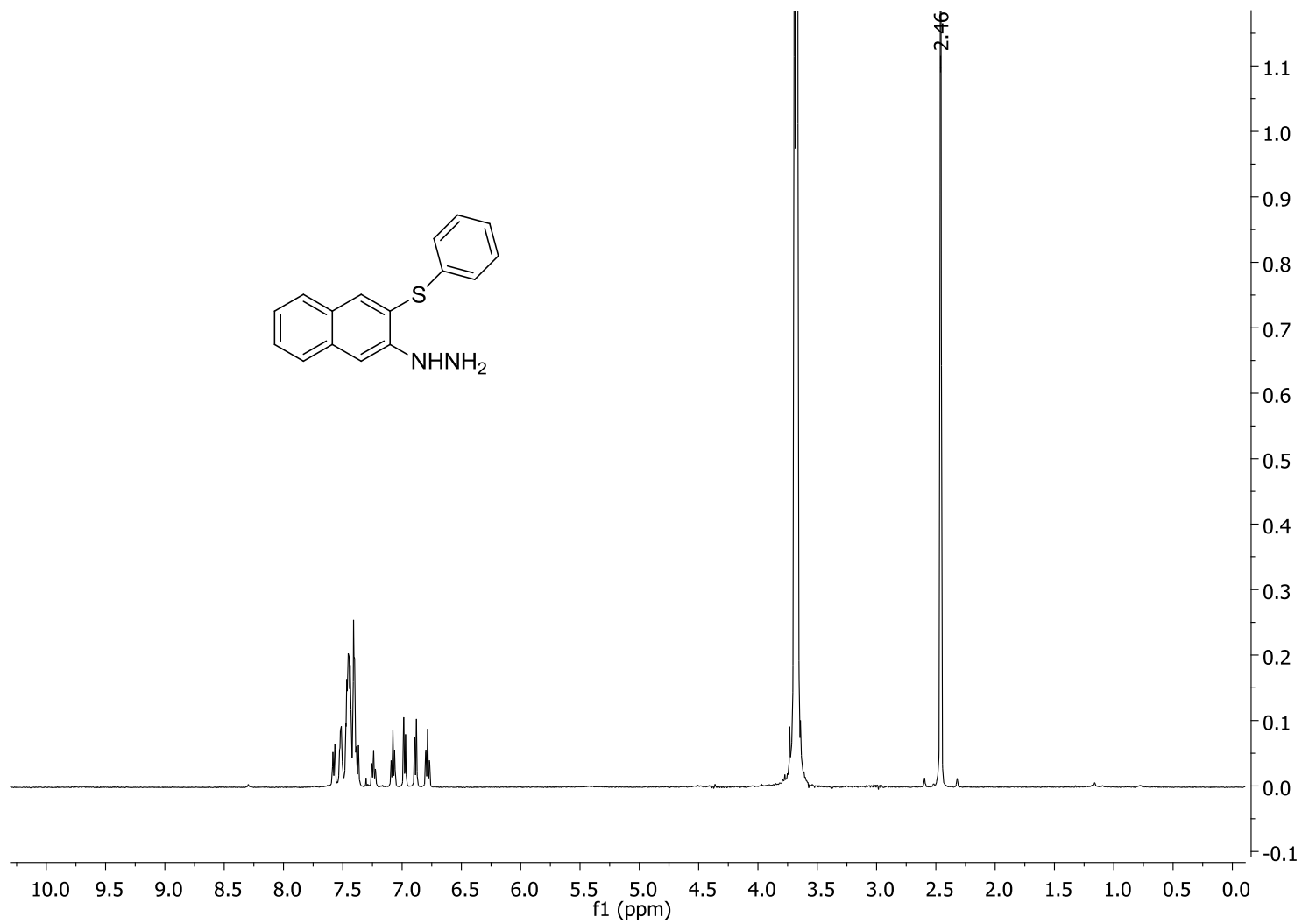
IR (KBr) spectrum of 2-hydrazinyl-3-(phenylthio)quinoxaline (8).



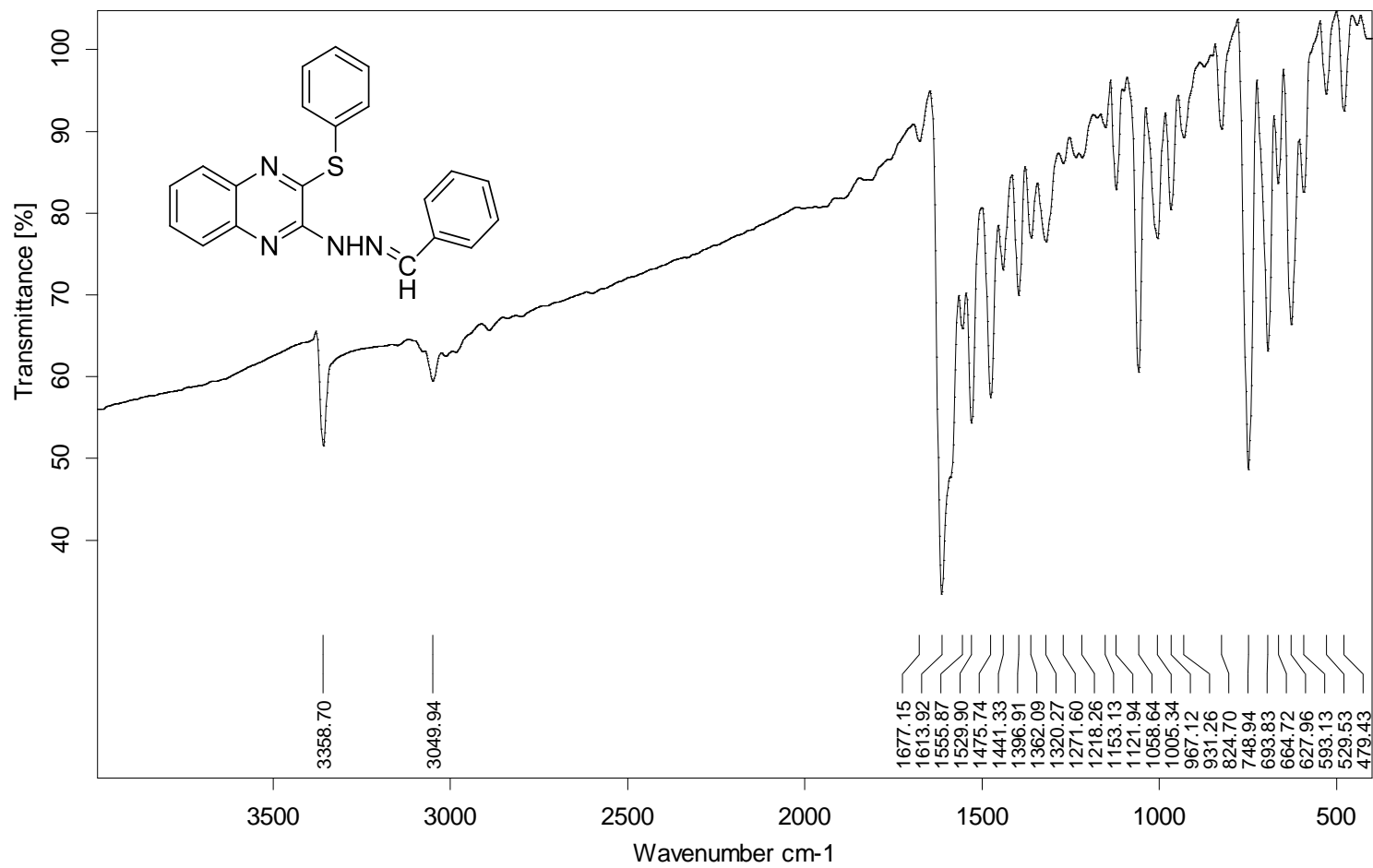
¹H NMR (DMSO) of 2-hydrazinyl-3-(phenylthio)quinoxaline (8).



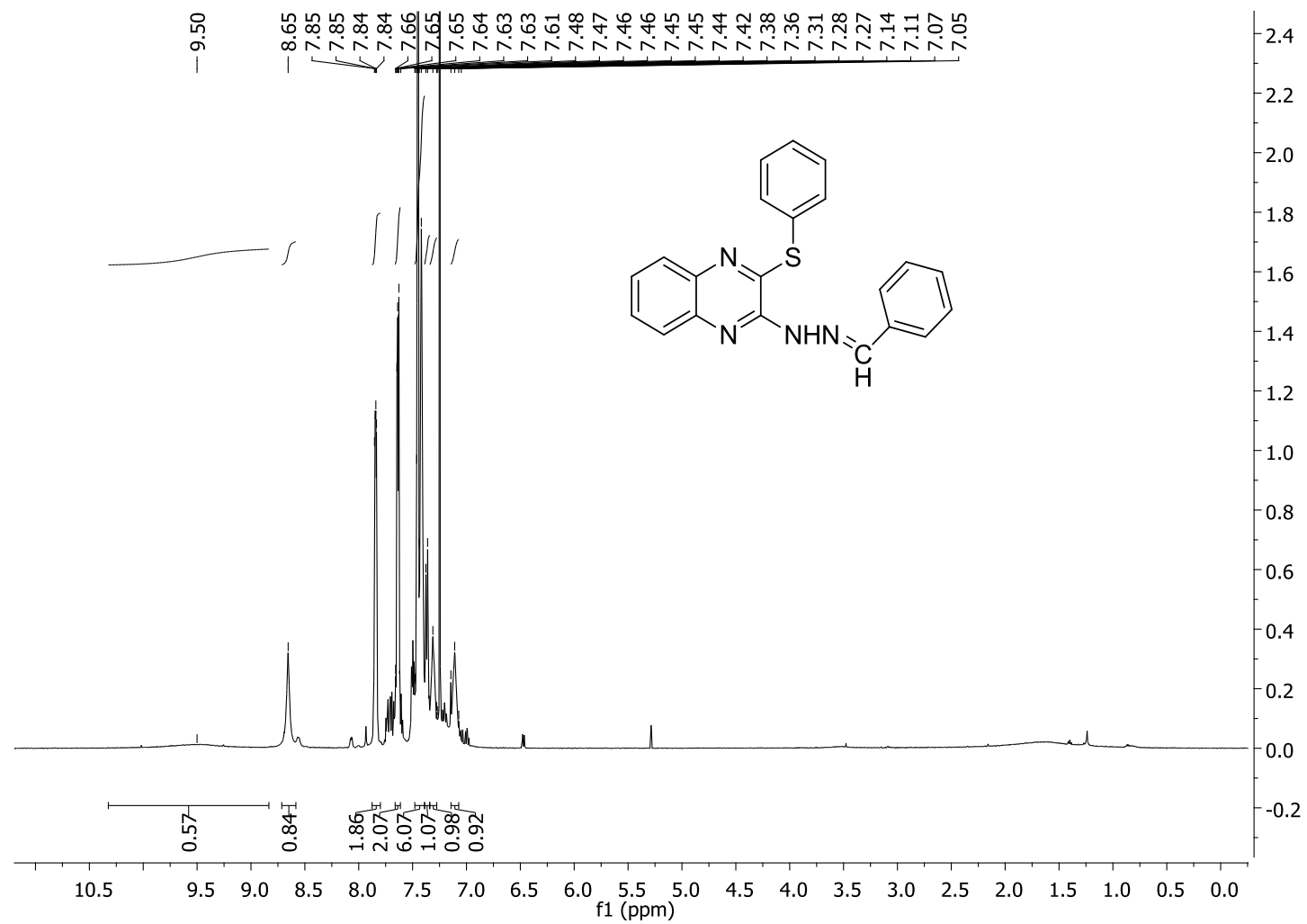
^1H NMR (DMSO) of 2-hydrazinyl-3-(phenylthio)quinoxaline (8).



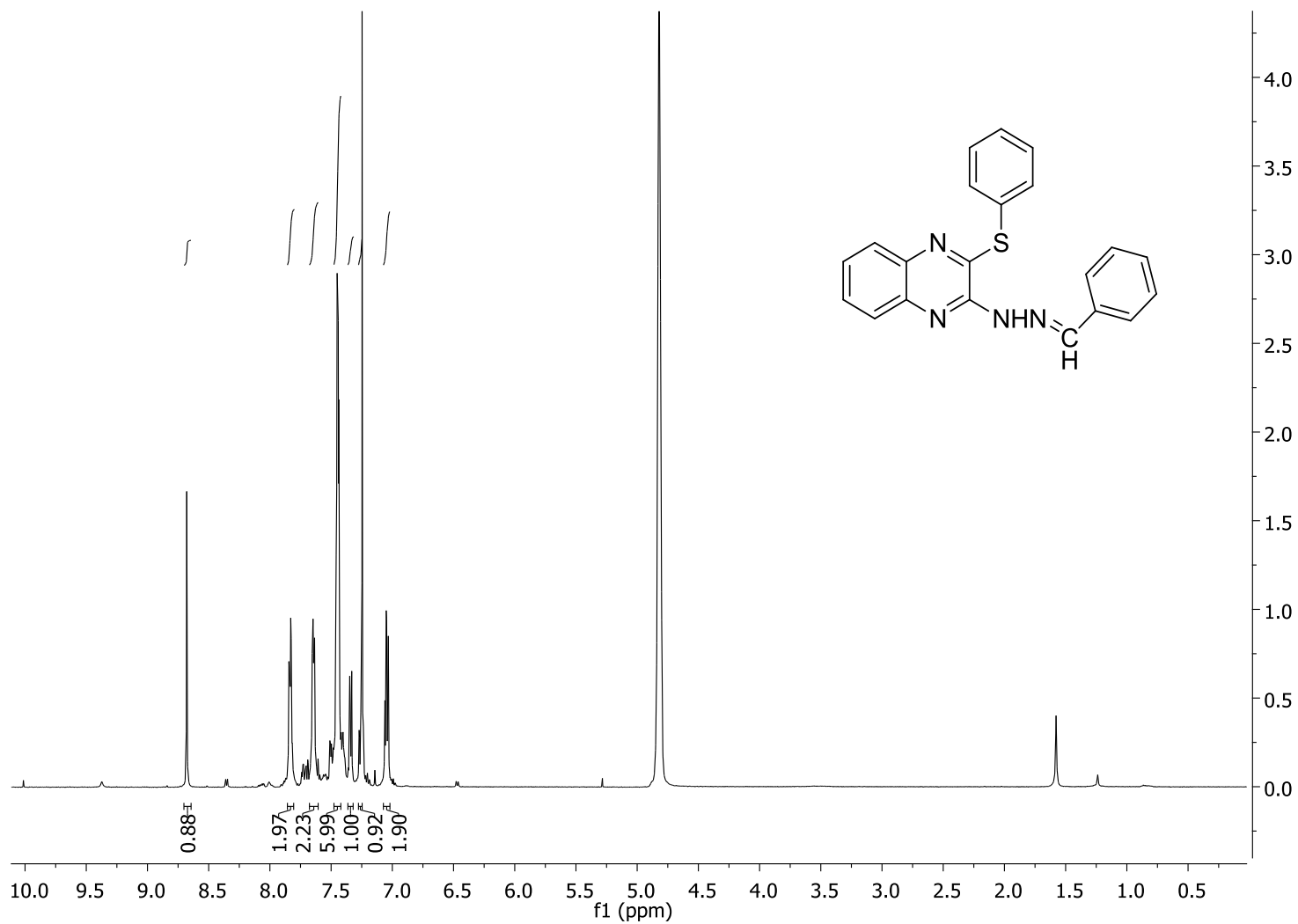
¹H NMR (DMSO, D₂O) of 2-hydrazinyl-3-(phenylthio)quinoxaline (8).



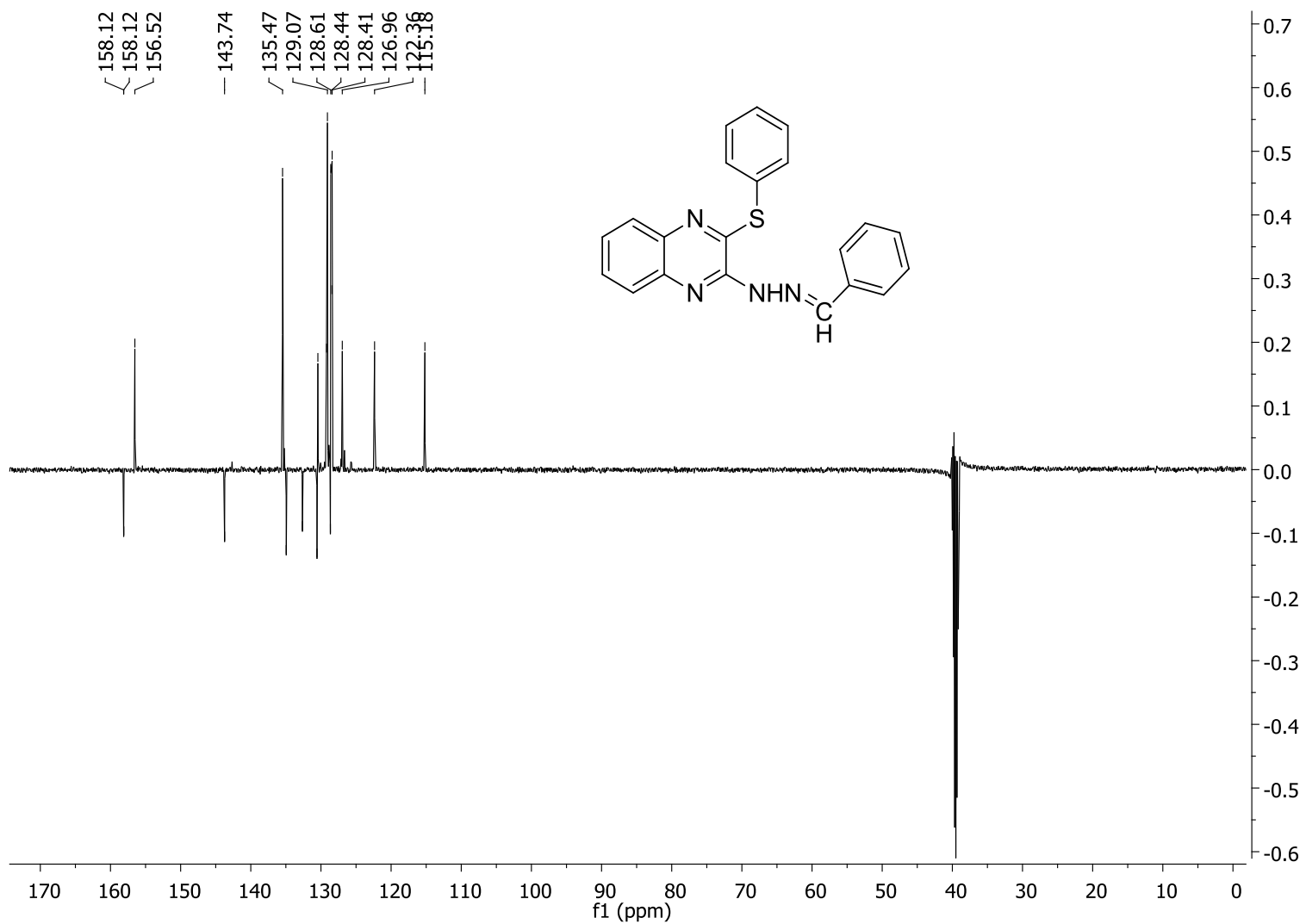
IR (KBr) of 2-(2-benzylidenehydrazinyl)-3-(thiophenyl)quinoxaline (9a).



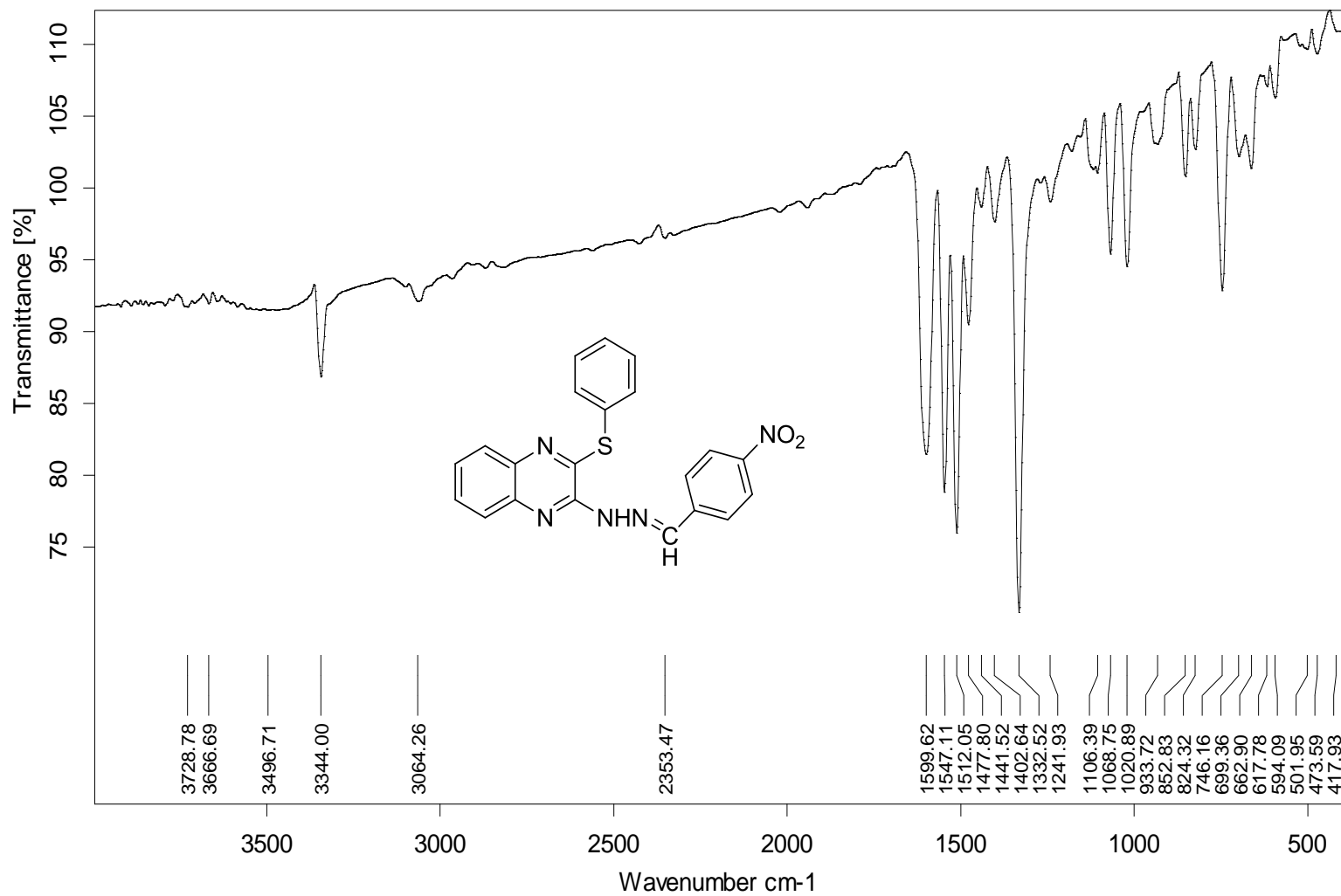
¹H NMR (DMSO) of 2-(2-benzylidenehydrazinyl)-3-(thiophenyl)quinoxaline (9a).



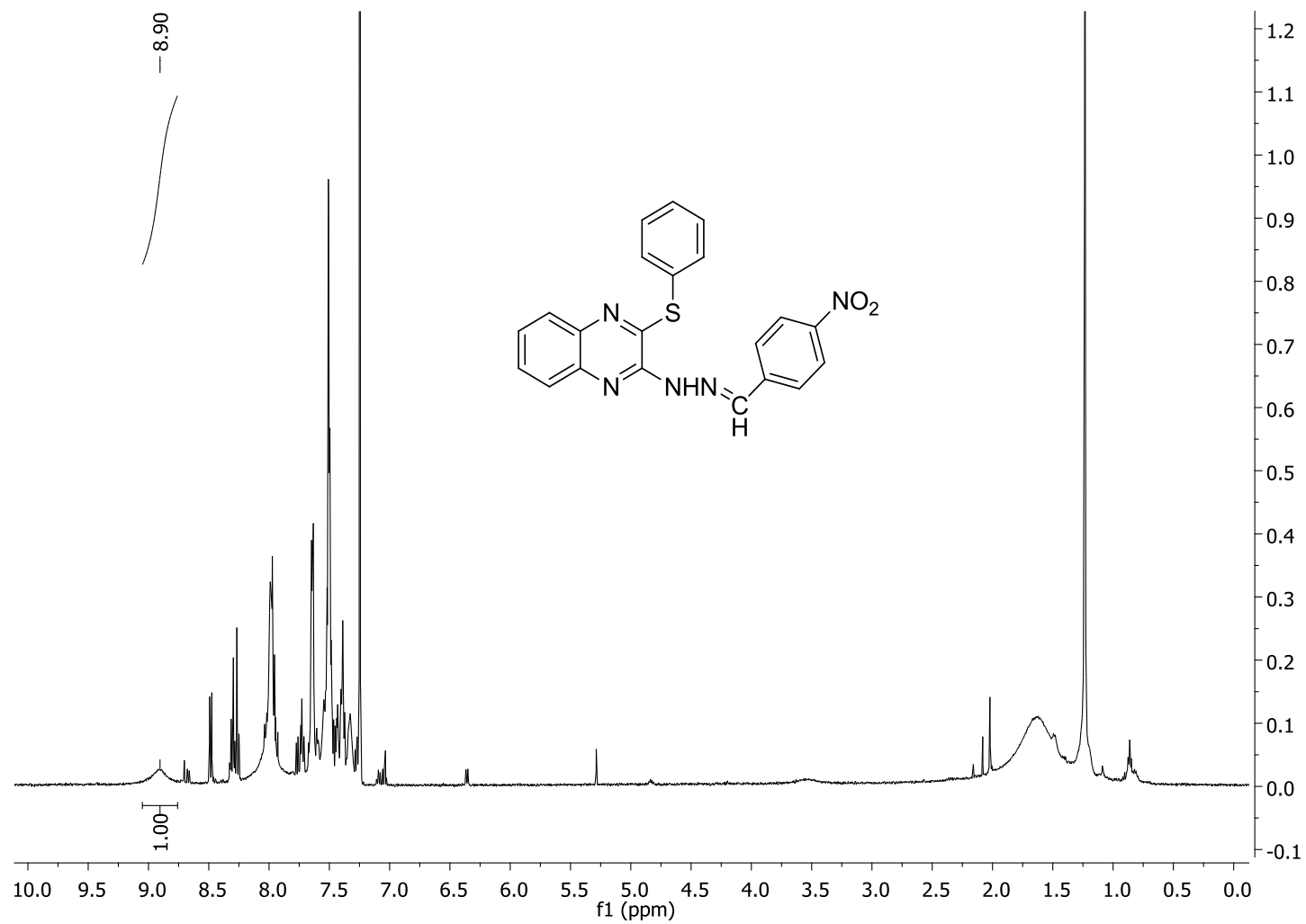
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of 2-(2-benzylidenehydrazinyl)-3-(phenylthio)quinoxaline (9a).



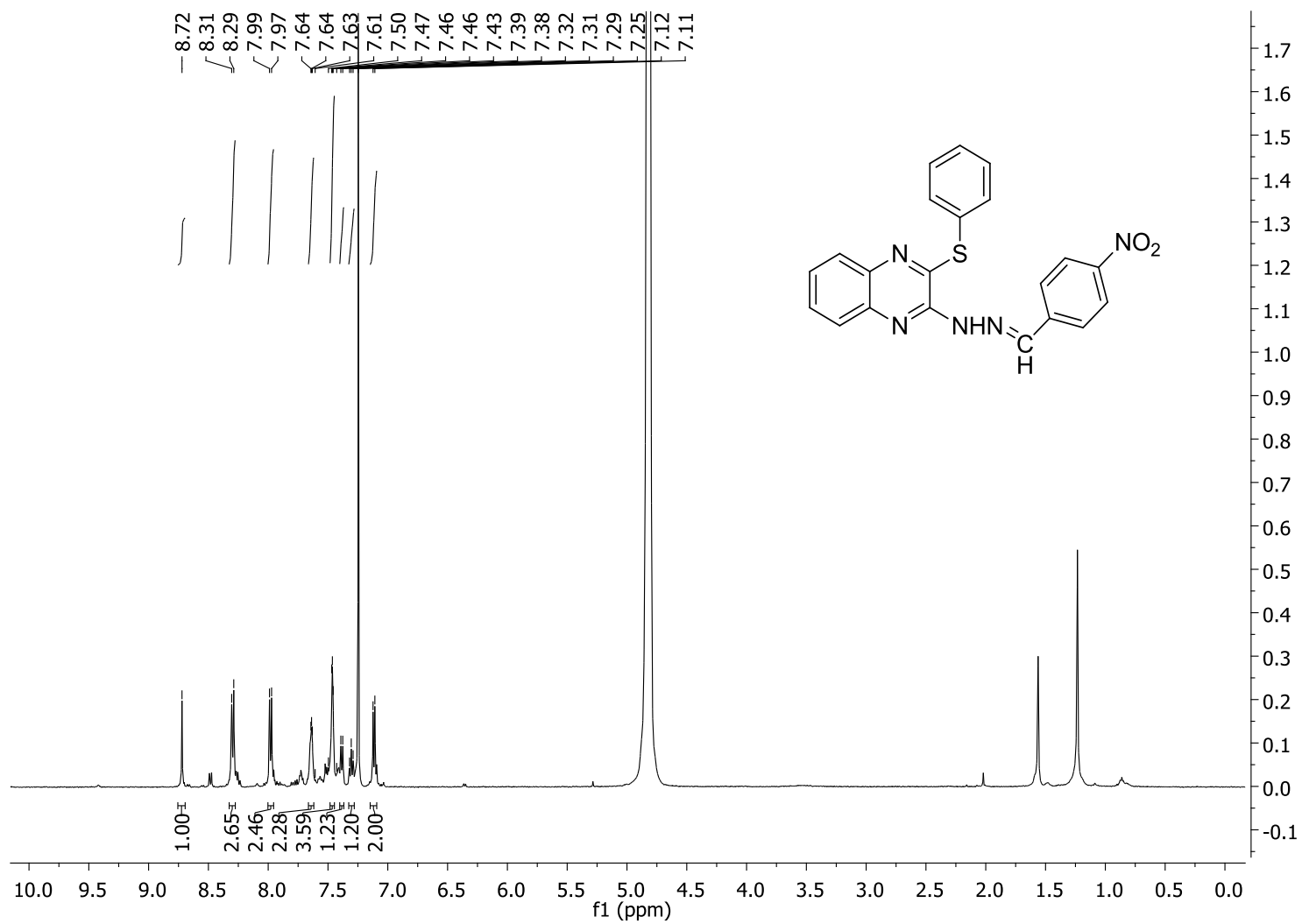
^{13}C APT NMR (DMSO) of 2-(2-benzylidenehydrazinyl)-3-(phenylthio)quinoxaline (9a).



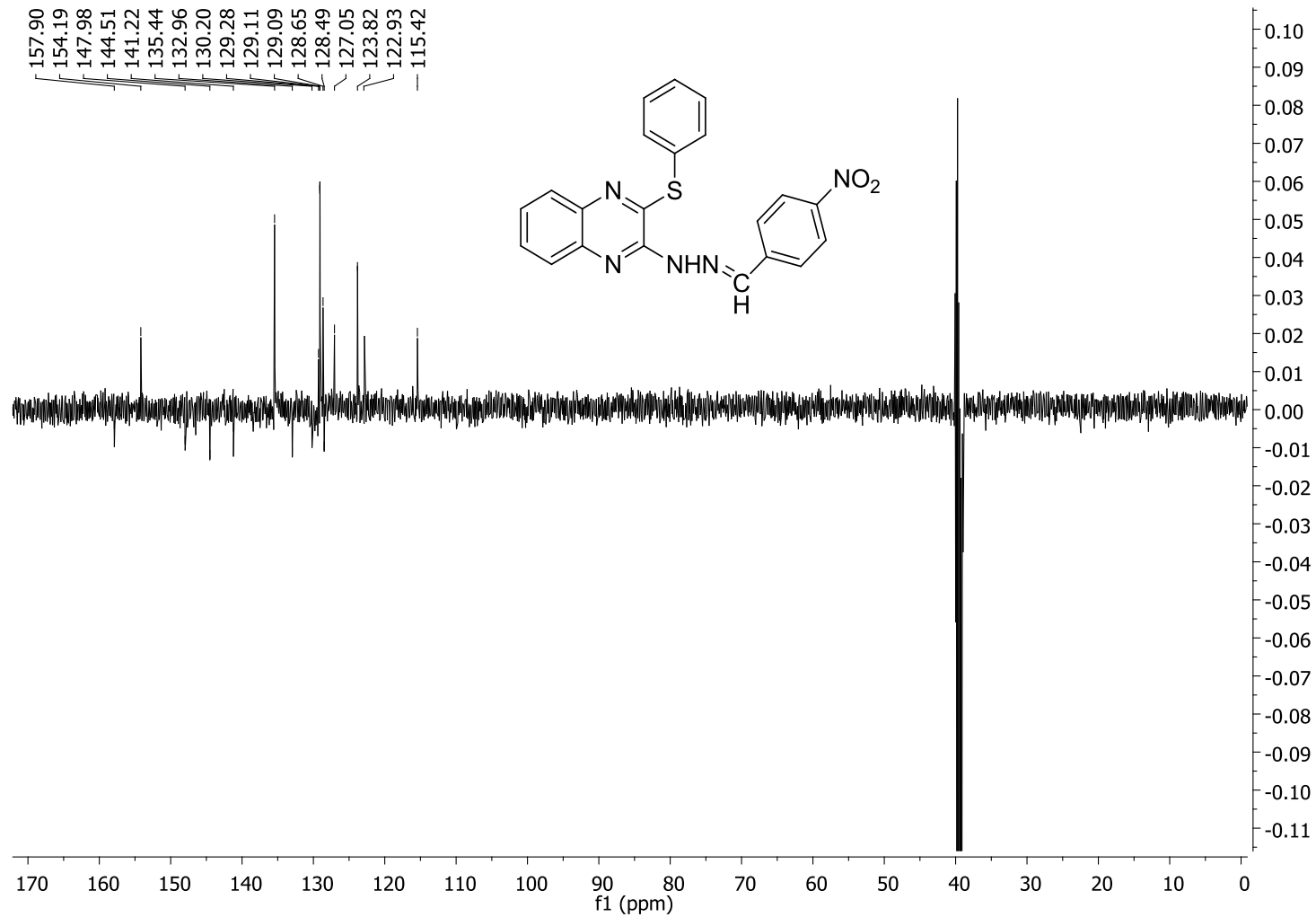
IR (KBr) of 2-(2-(4-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline(9b).



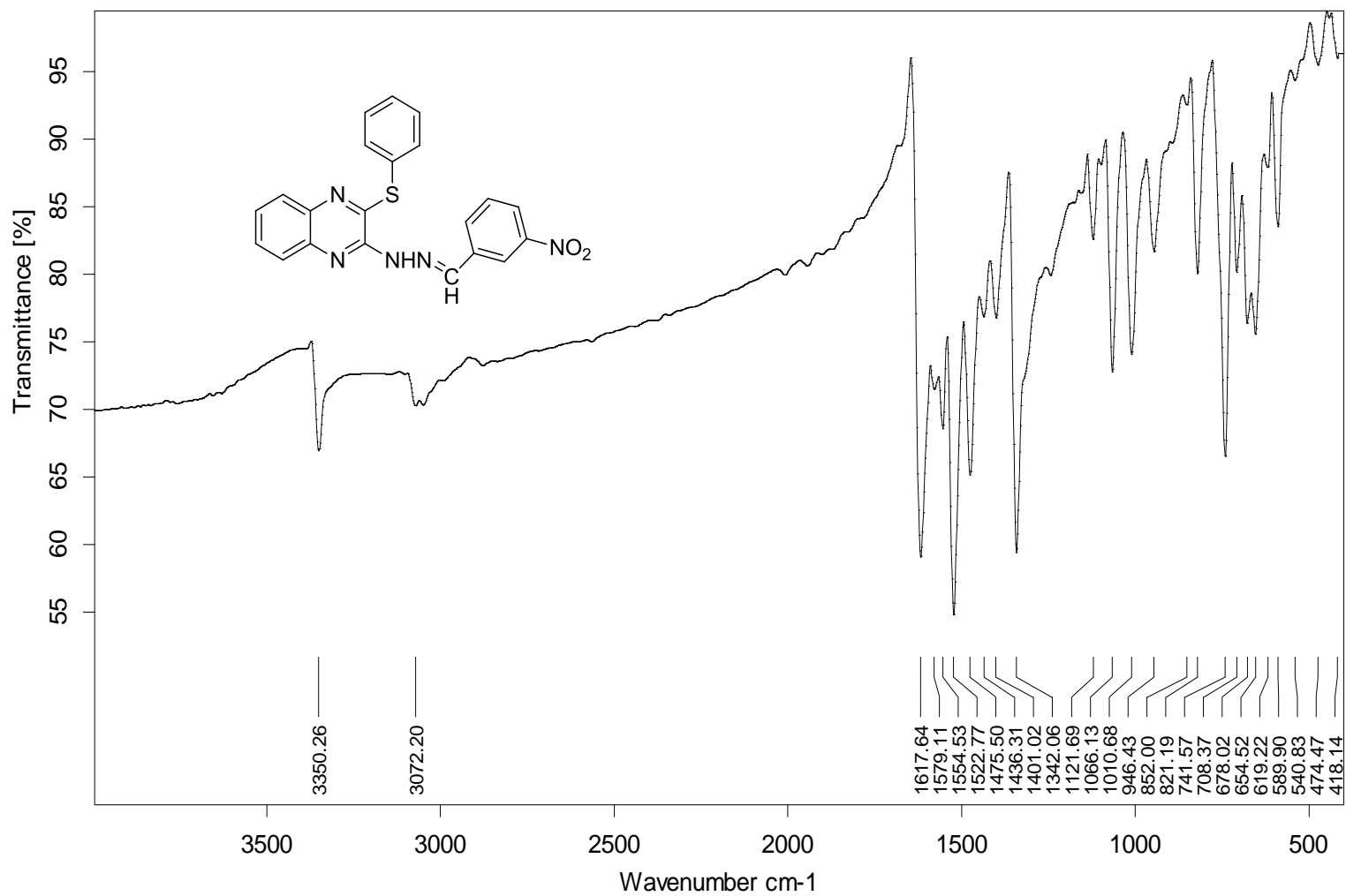
^1H NMR (DMSO) of 2-(2-(4-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (**9b**).



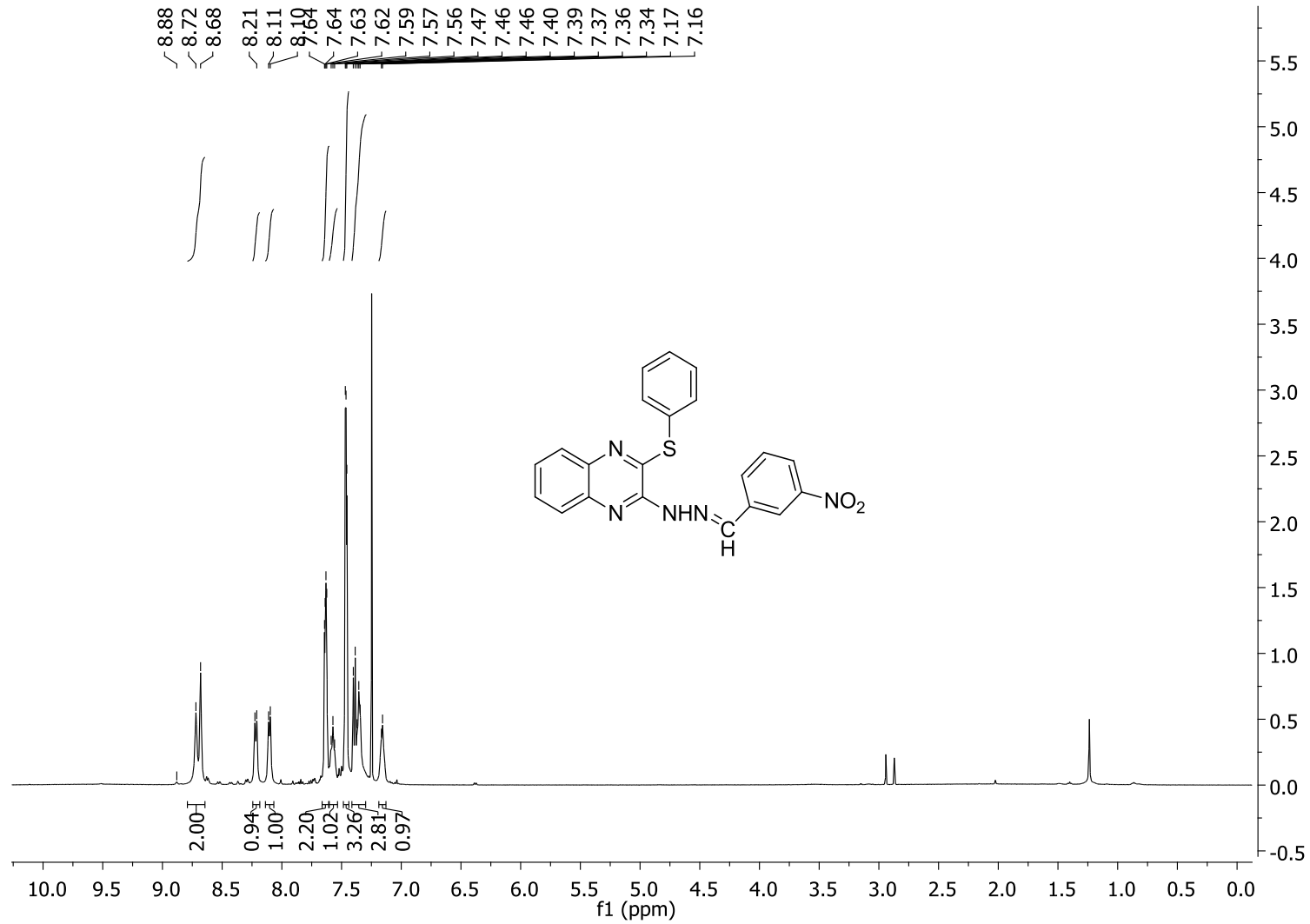
^1H NMR ($\text{DMSO}, \text{D}_2\text{O}$) of 2-(2-(4-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline(**9b**).



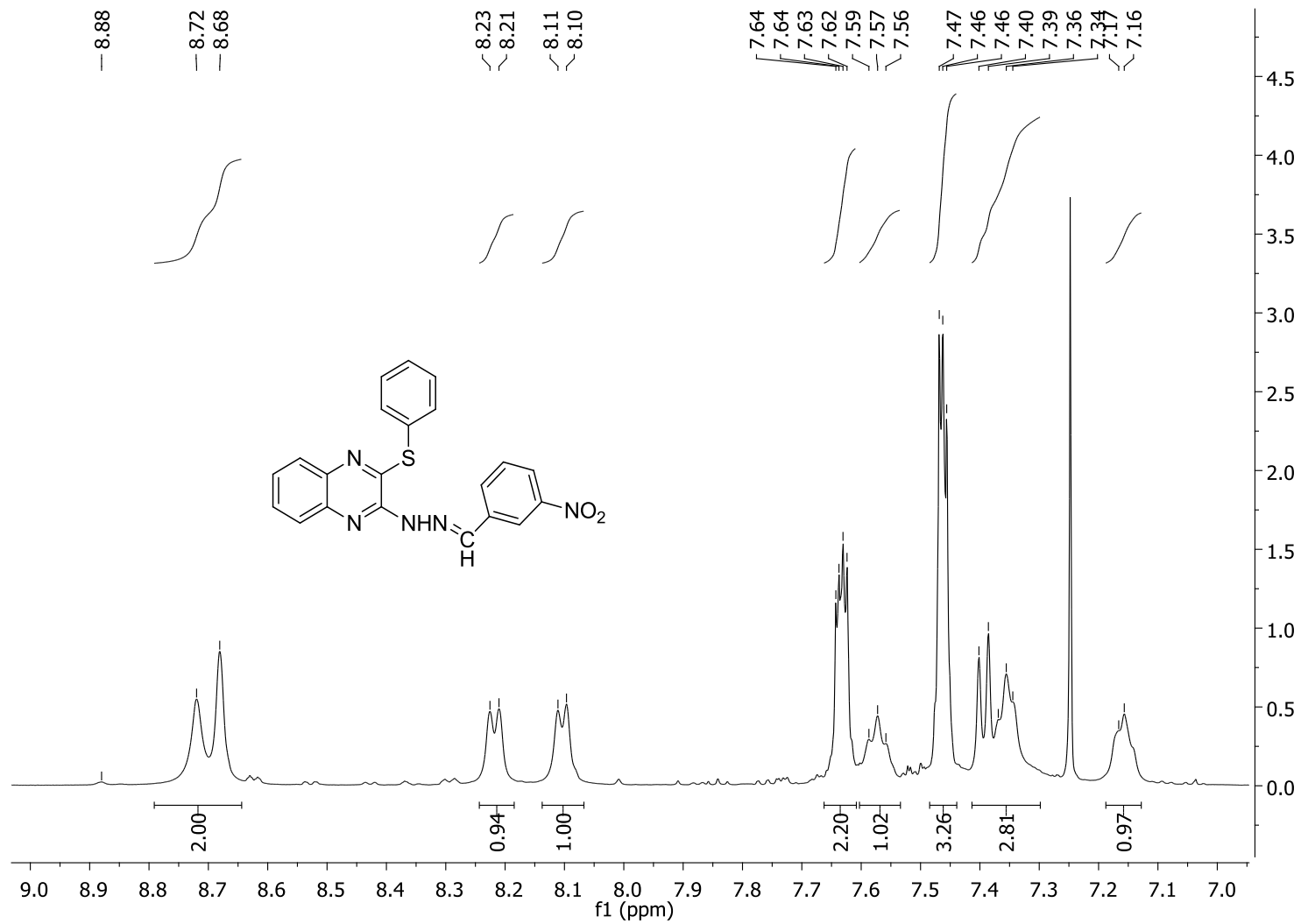
¹³C APT NMR (DMSO) of 2-(2-(4-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline(9b).



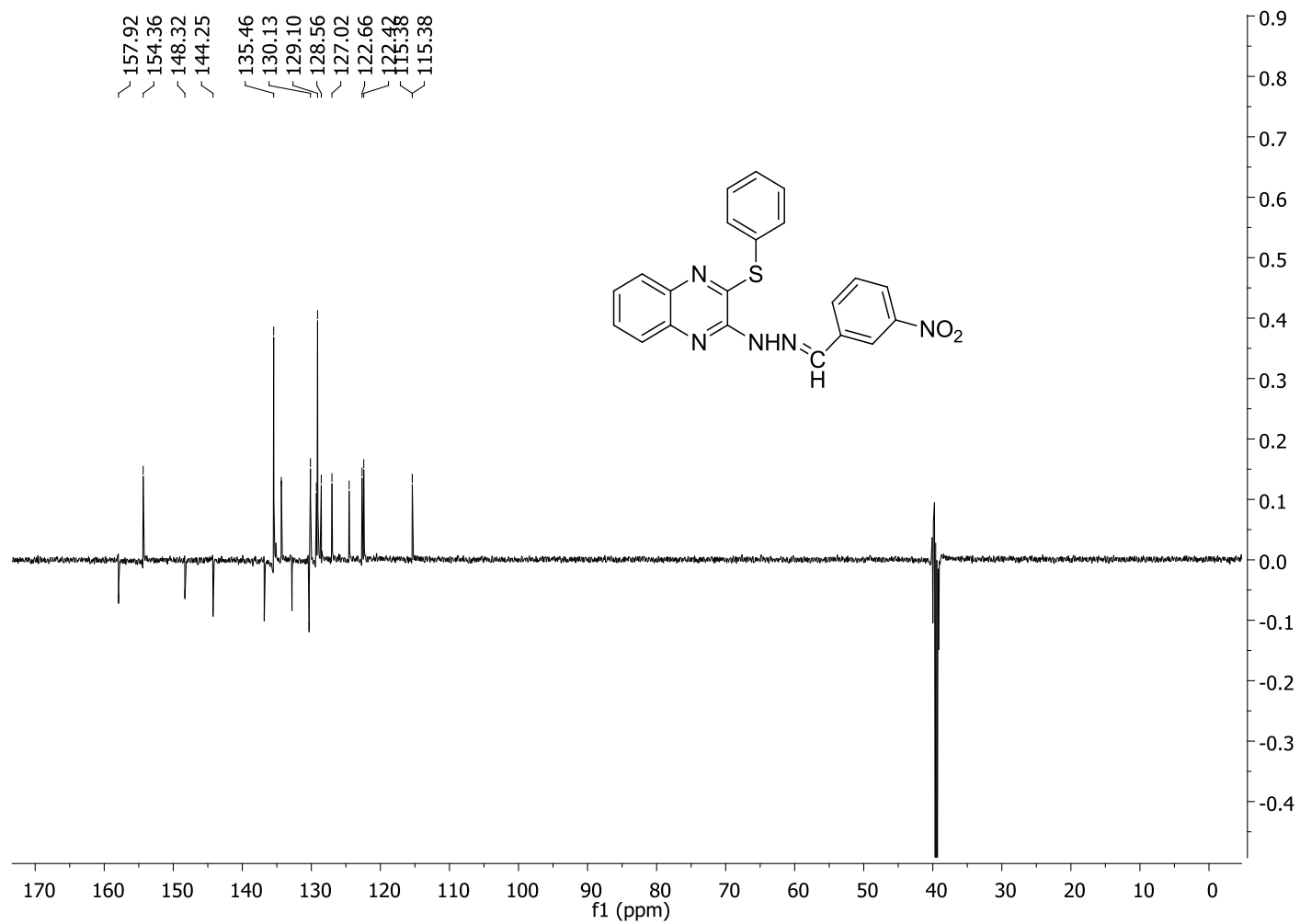
IR (KBr) of 2-(2-(3-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9c).



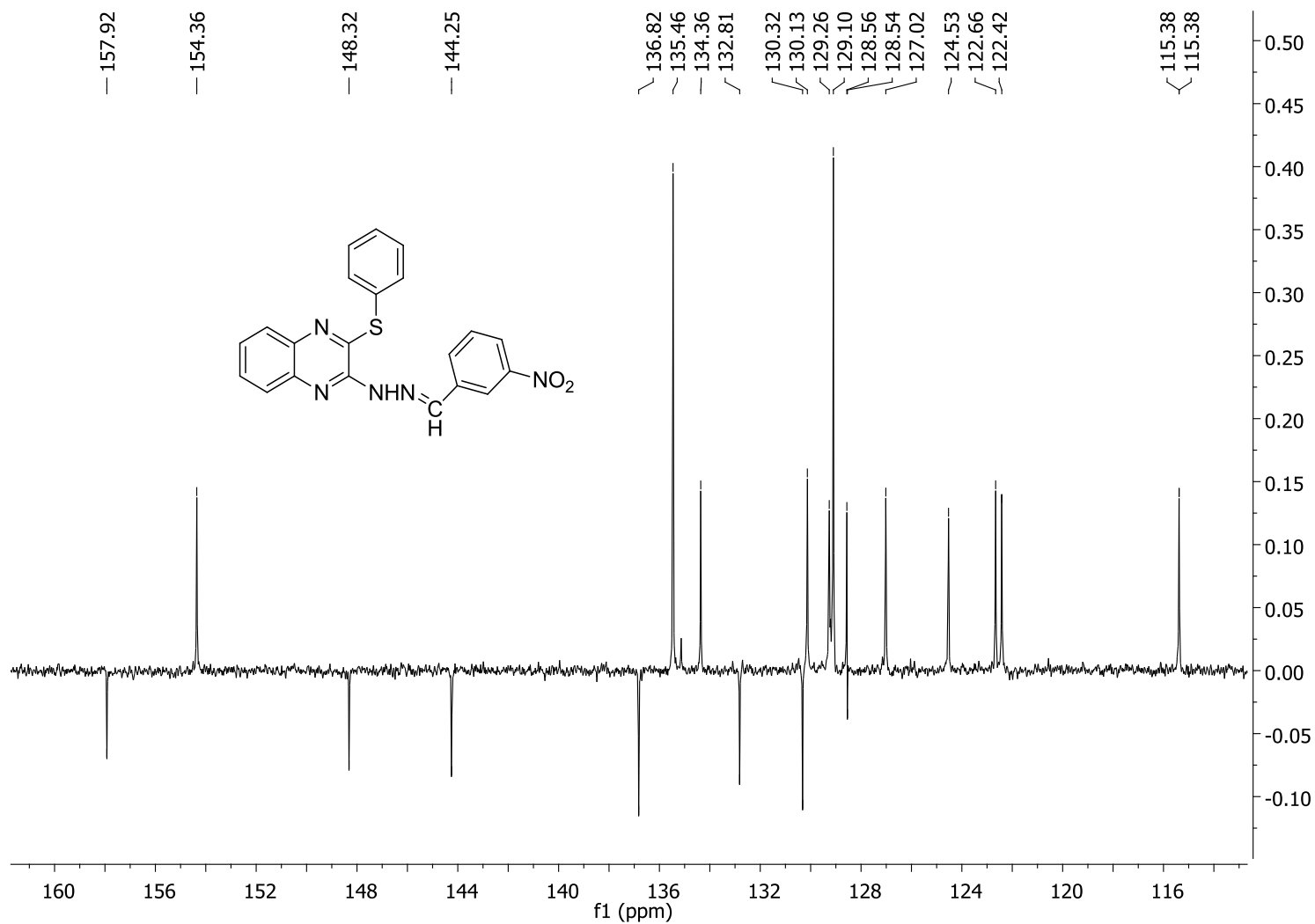
¹H NMR (DMSO) of 2-(2-(3-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9c).



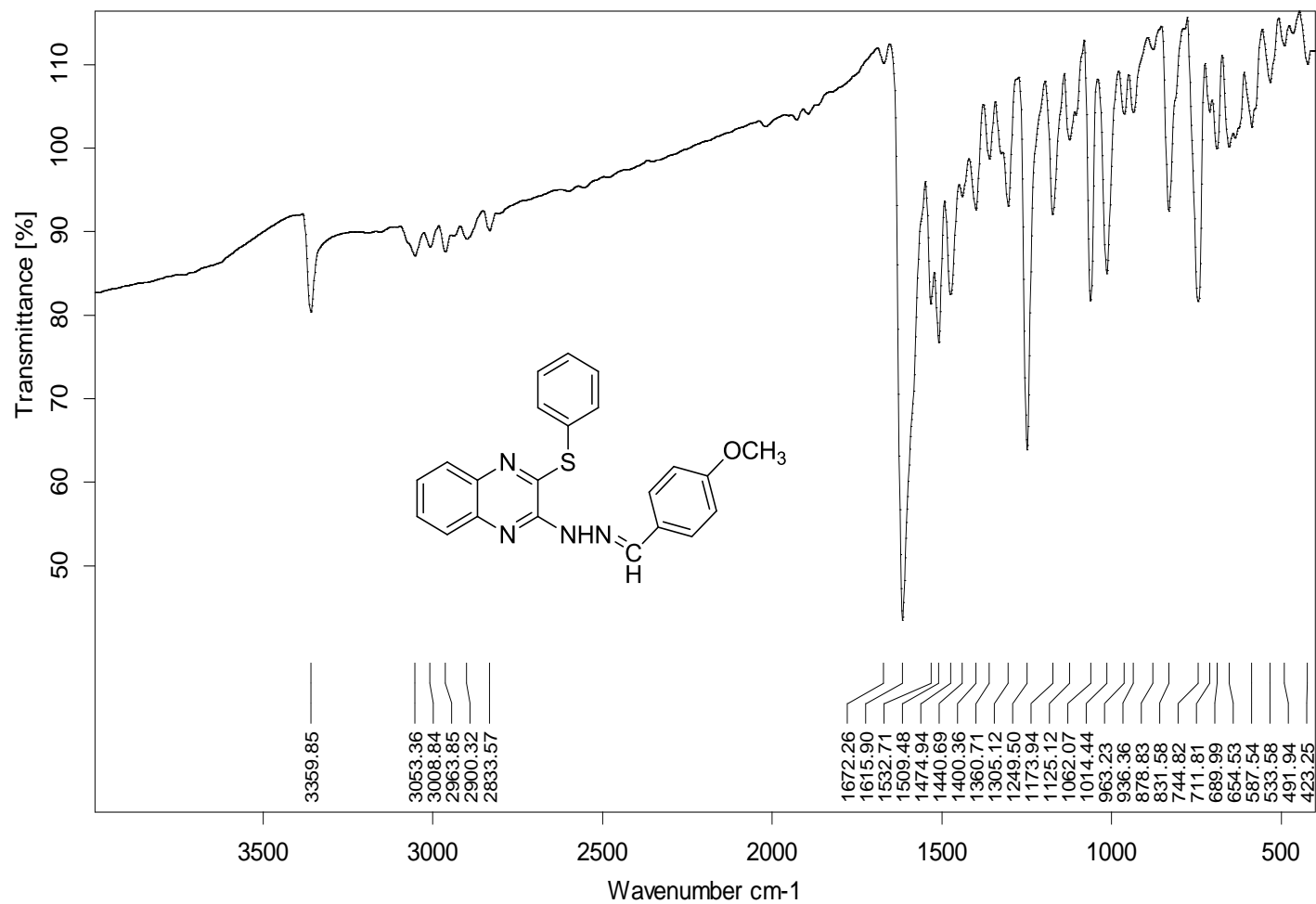
¹H NMR (DMSO) of 2-(2-(3-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9c).



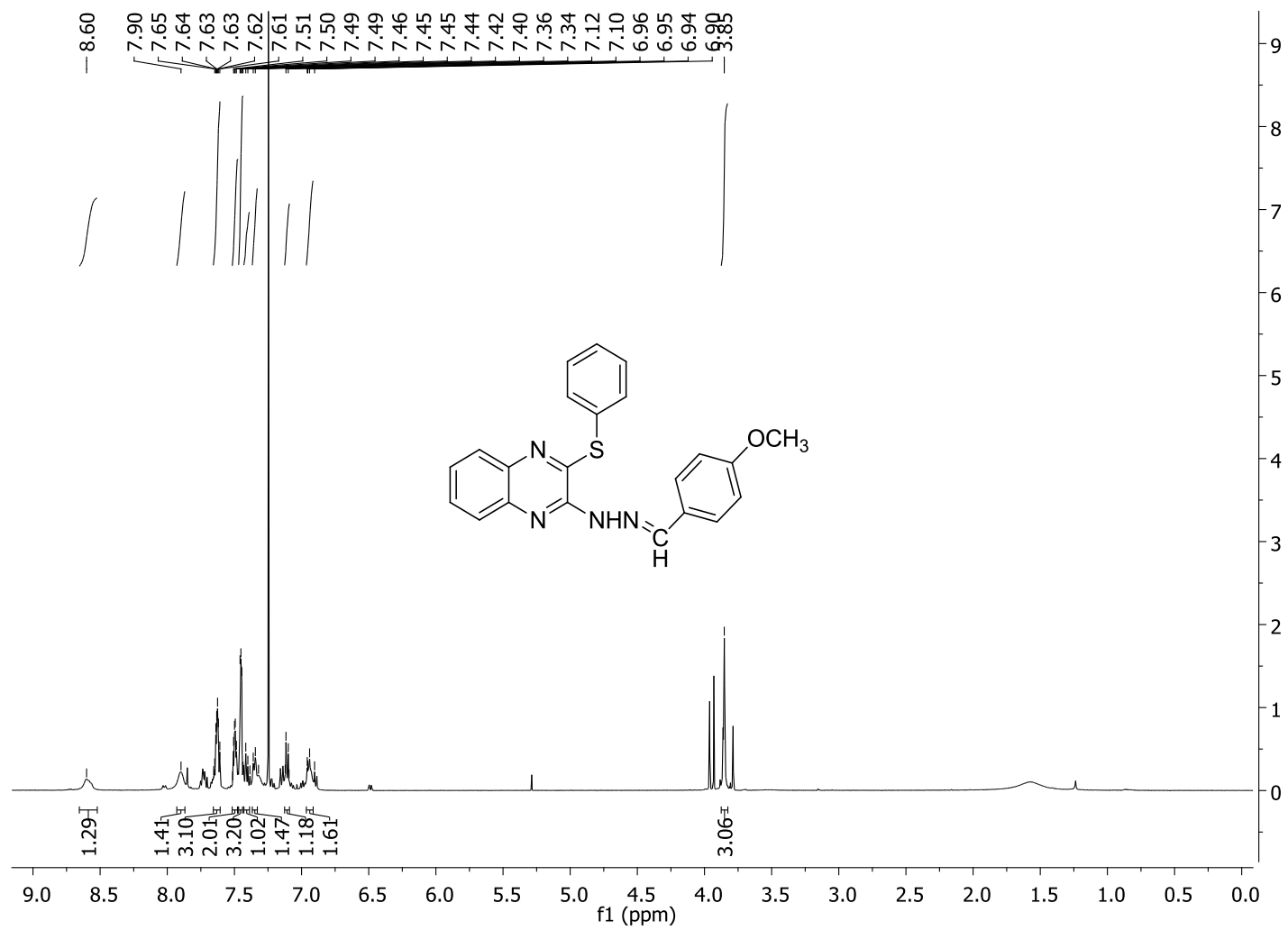
¹³C APT NMR (DMSO) of 2-(2-(3-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9c).



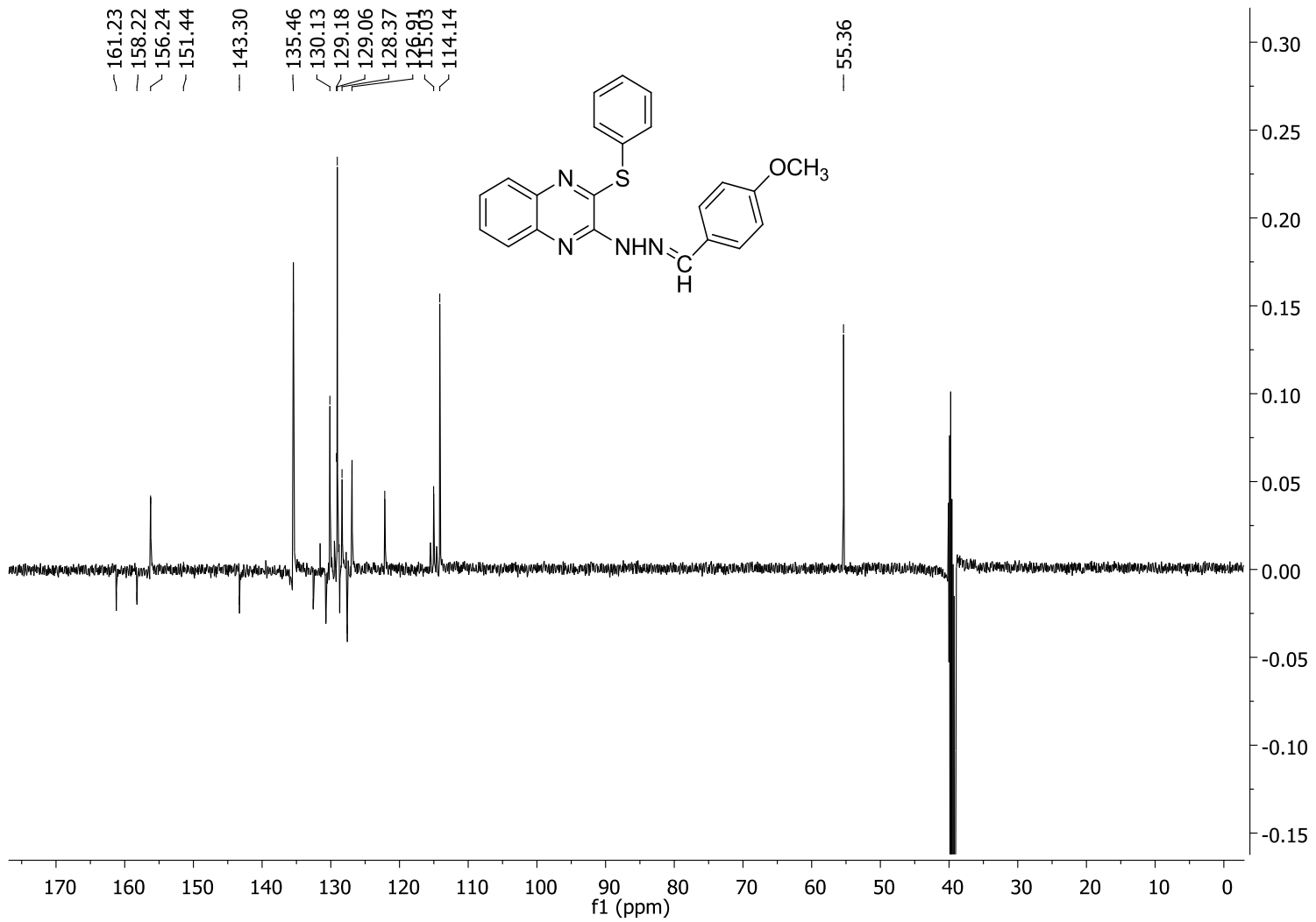
^{13}C APT NMR (DMSO) of 2-(2-(3-nitrobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9c).



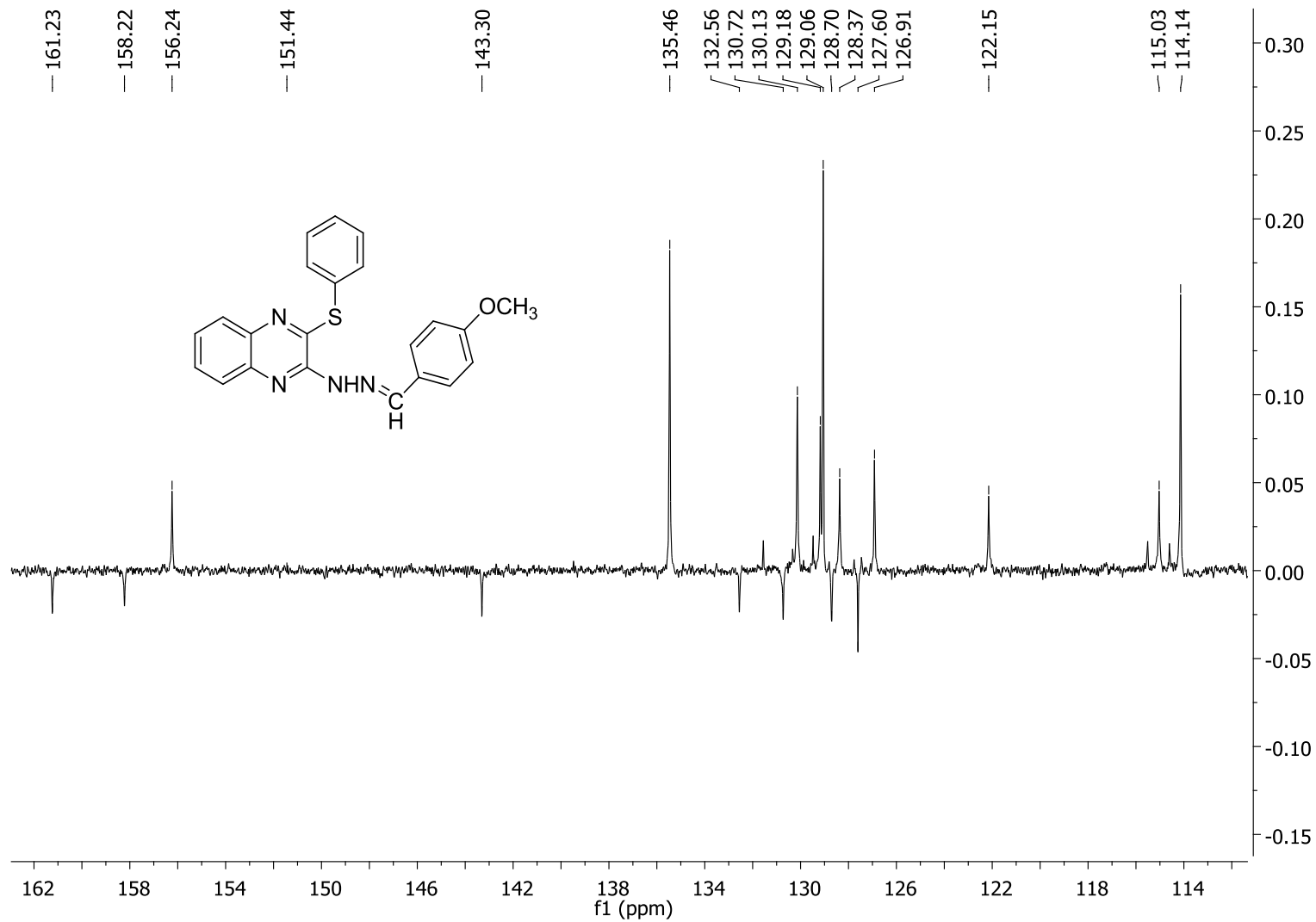
IR (KBr) spectrum of 2-(2-(4-methoxybenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9d).



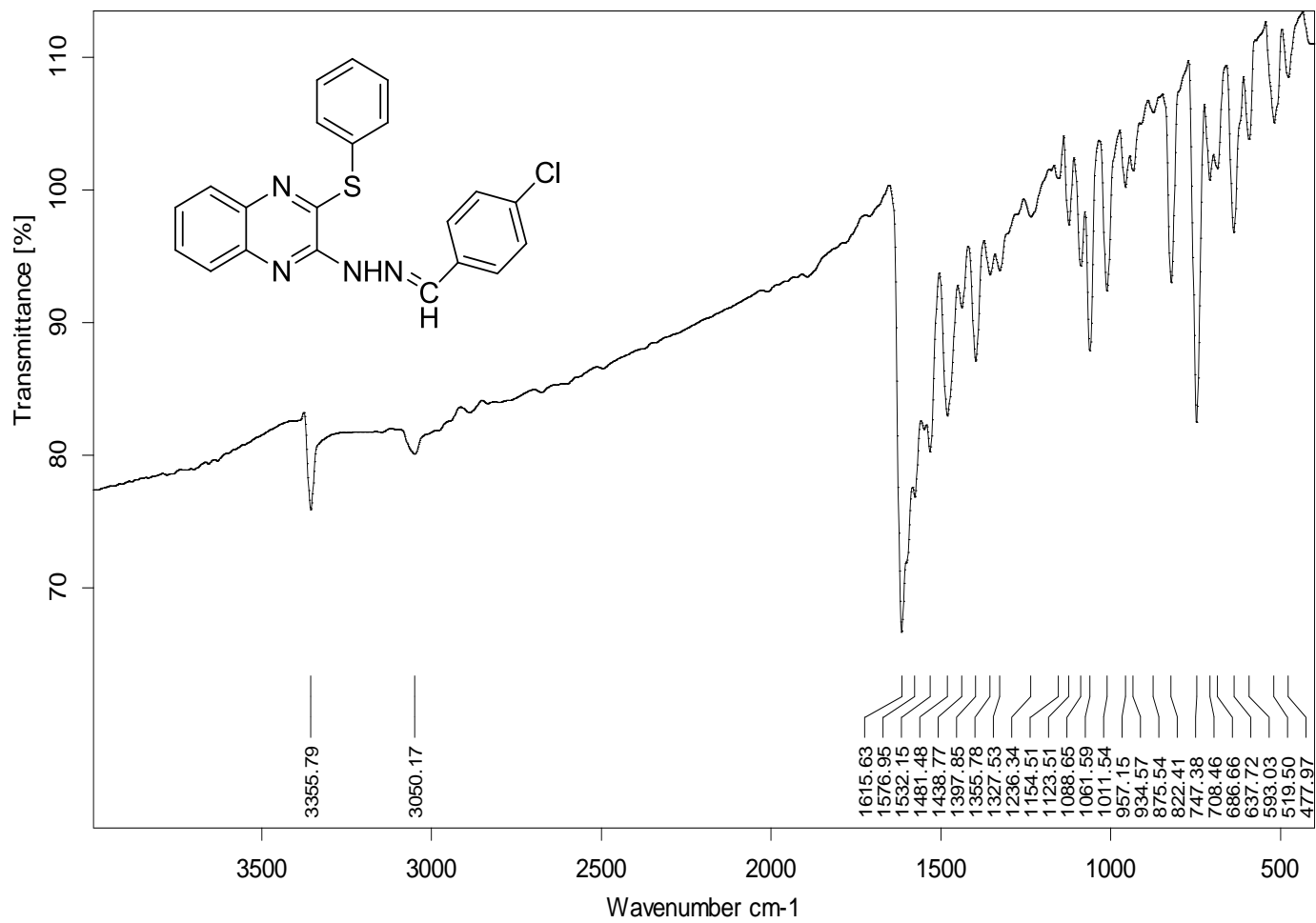
¹H NMR (DMSO) of 2-(2-(4-methoxybenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9d).



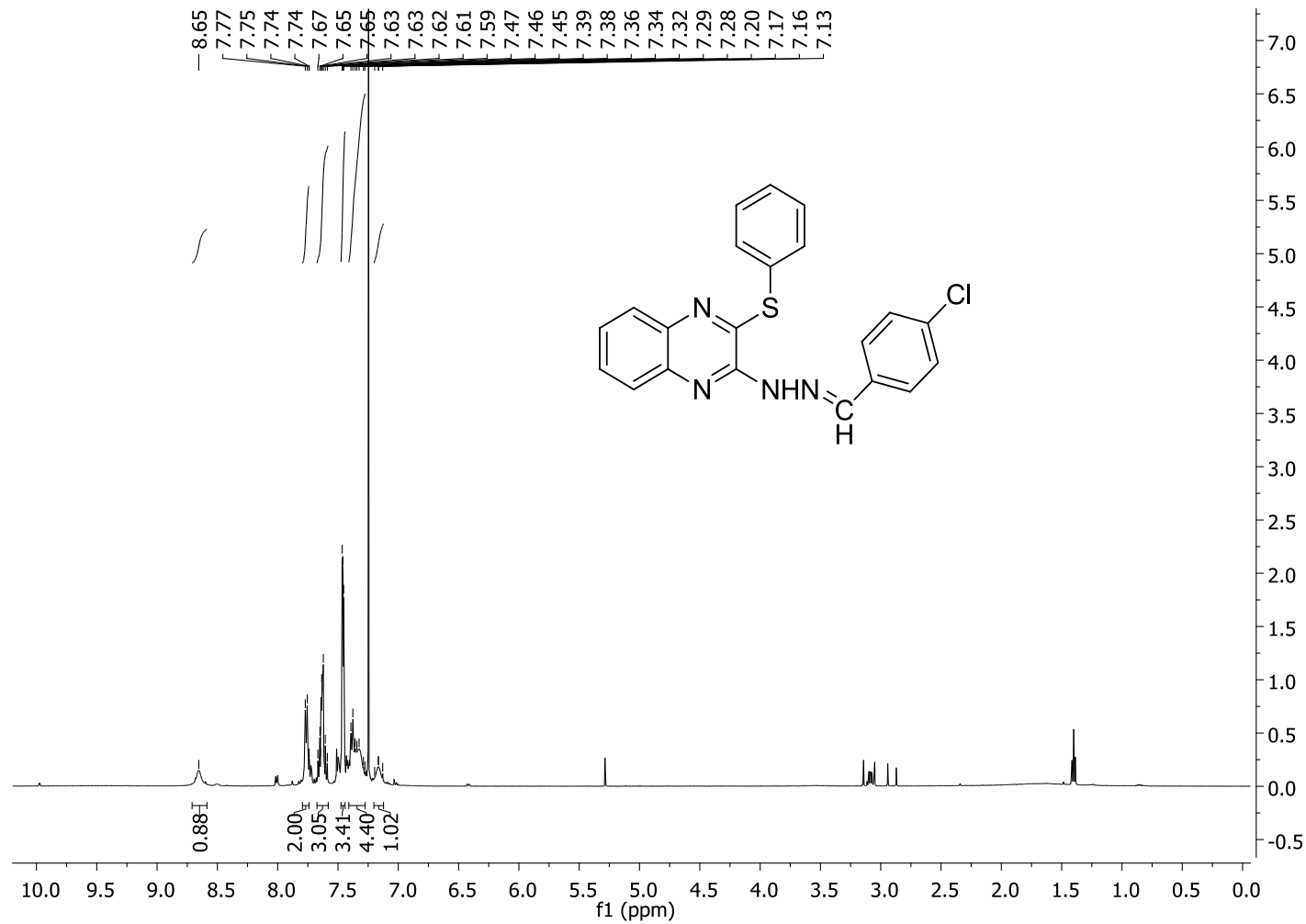
¹³C APT NMR (DMSO) of 2-(2-(4-methoxybenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9e).



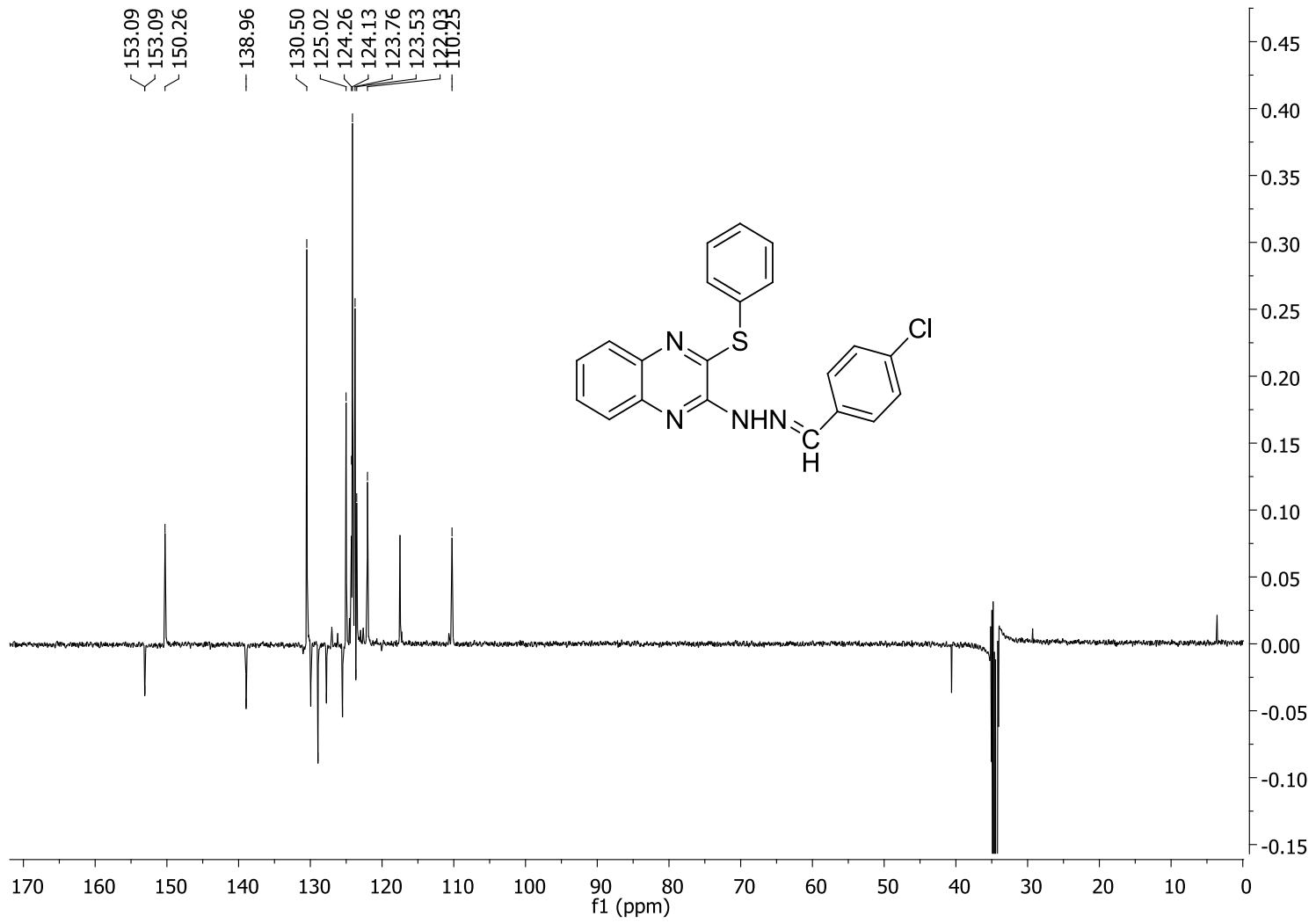
¹³C APT NMR (DMSO) of 2-(2-(4-methoxybenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9d)



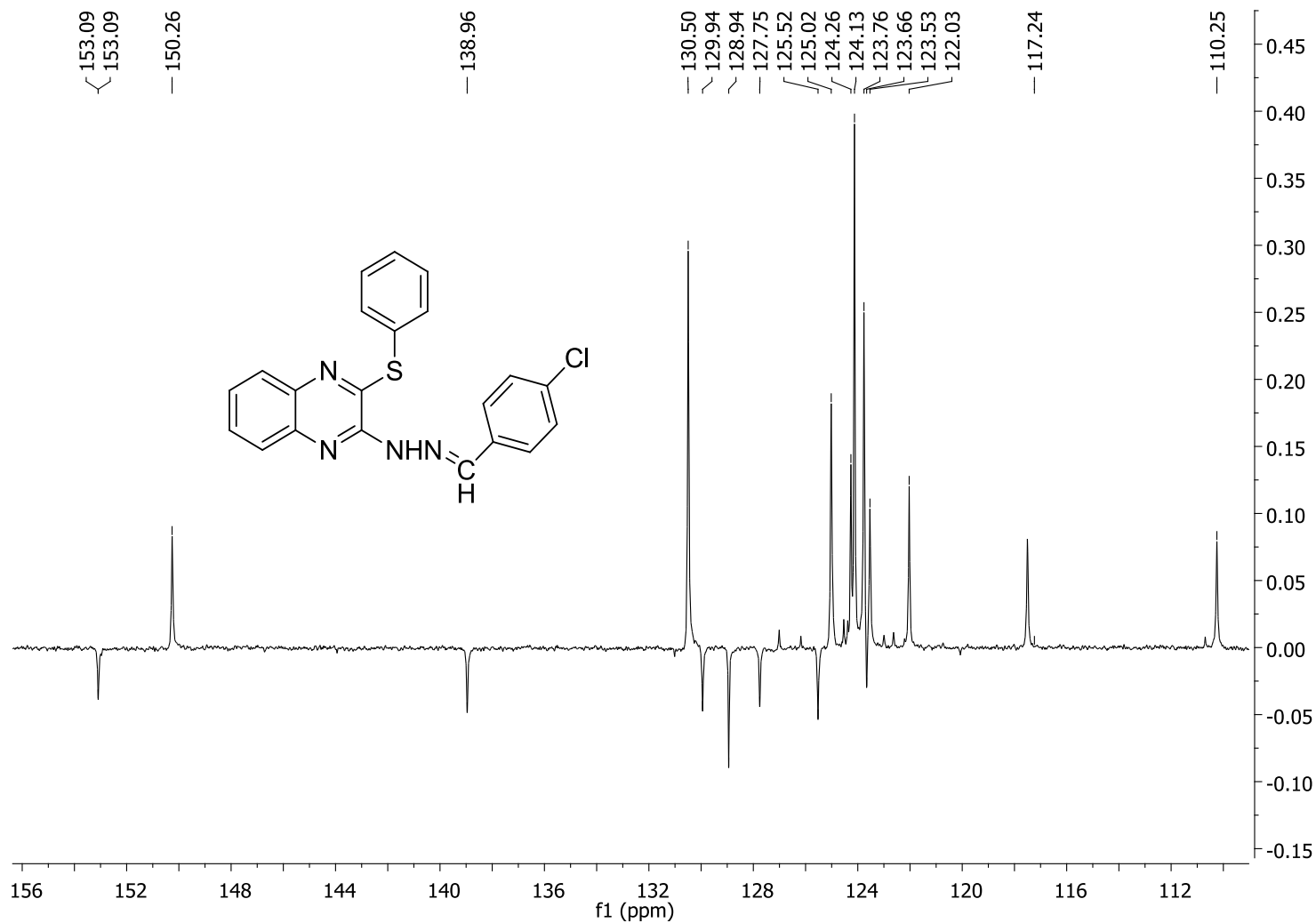
IR (KBr) of 2-(2-(4-chlorobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9e).



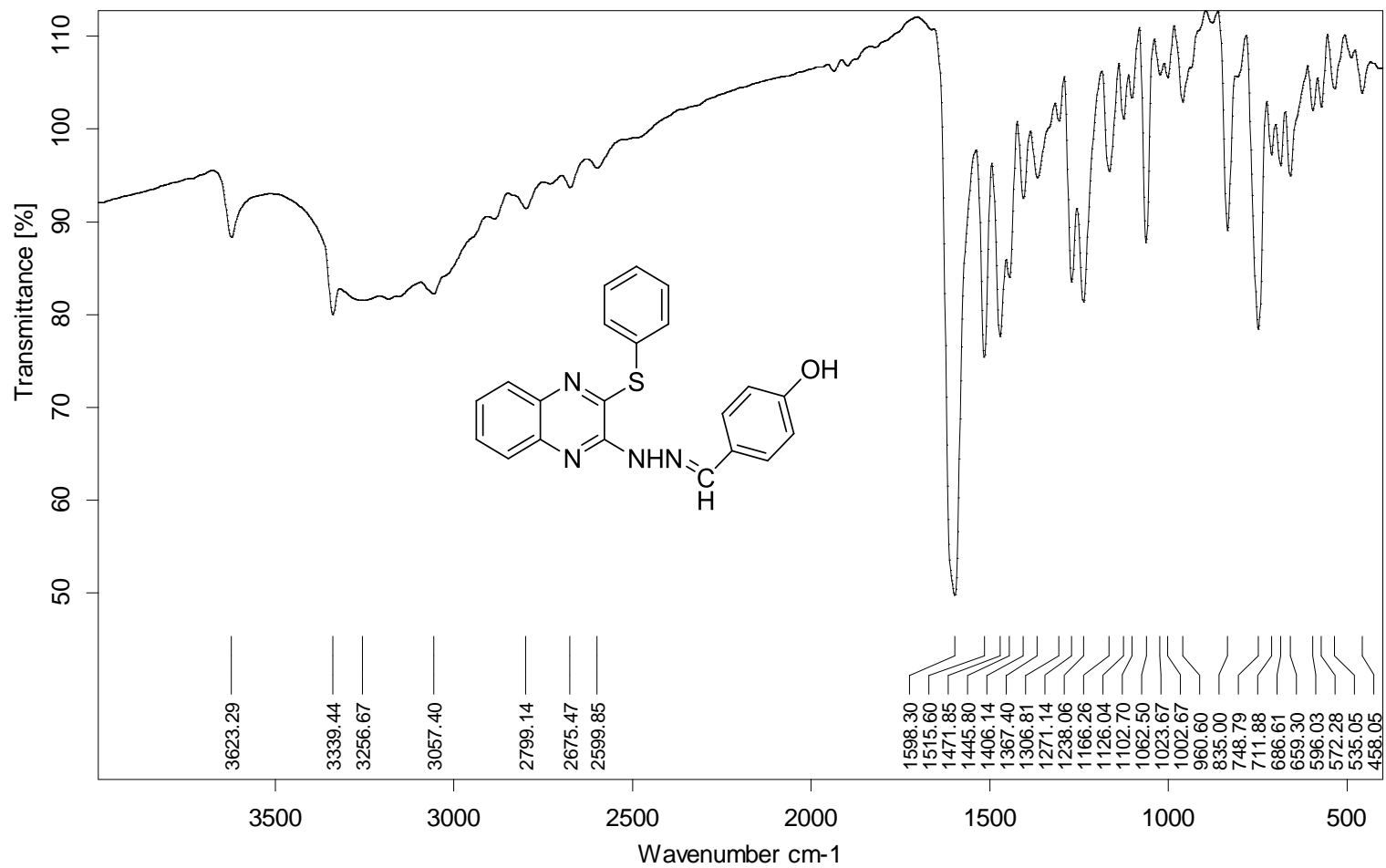
¹H NMR (DMSO) of 2-(2-(4-chlorobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9e).



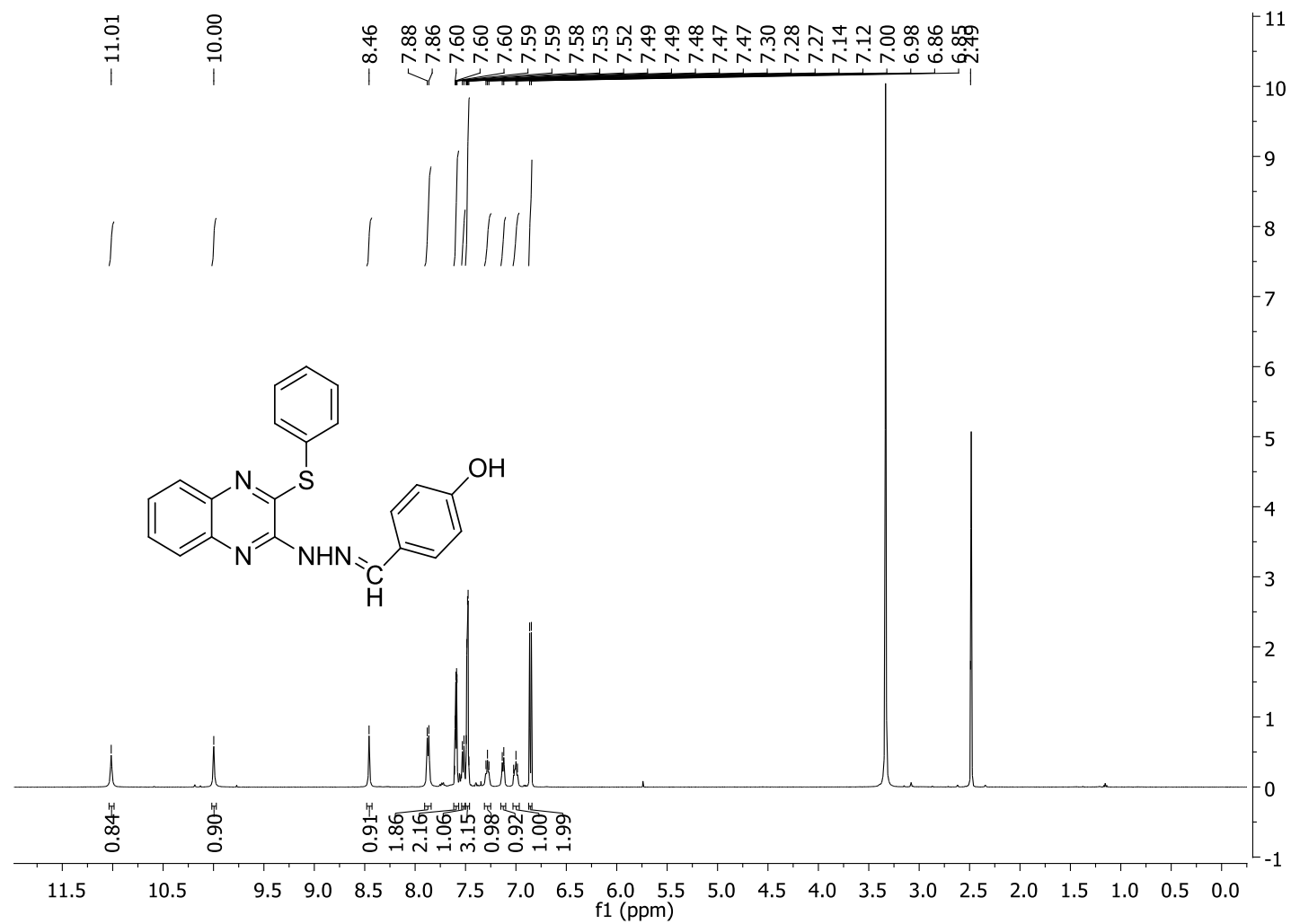
¹³C APT NMR (DMSO) of 2-(2-(4-chlorobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9e).



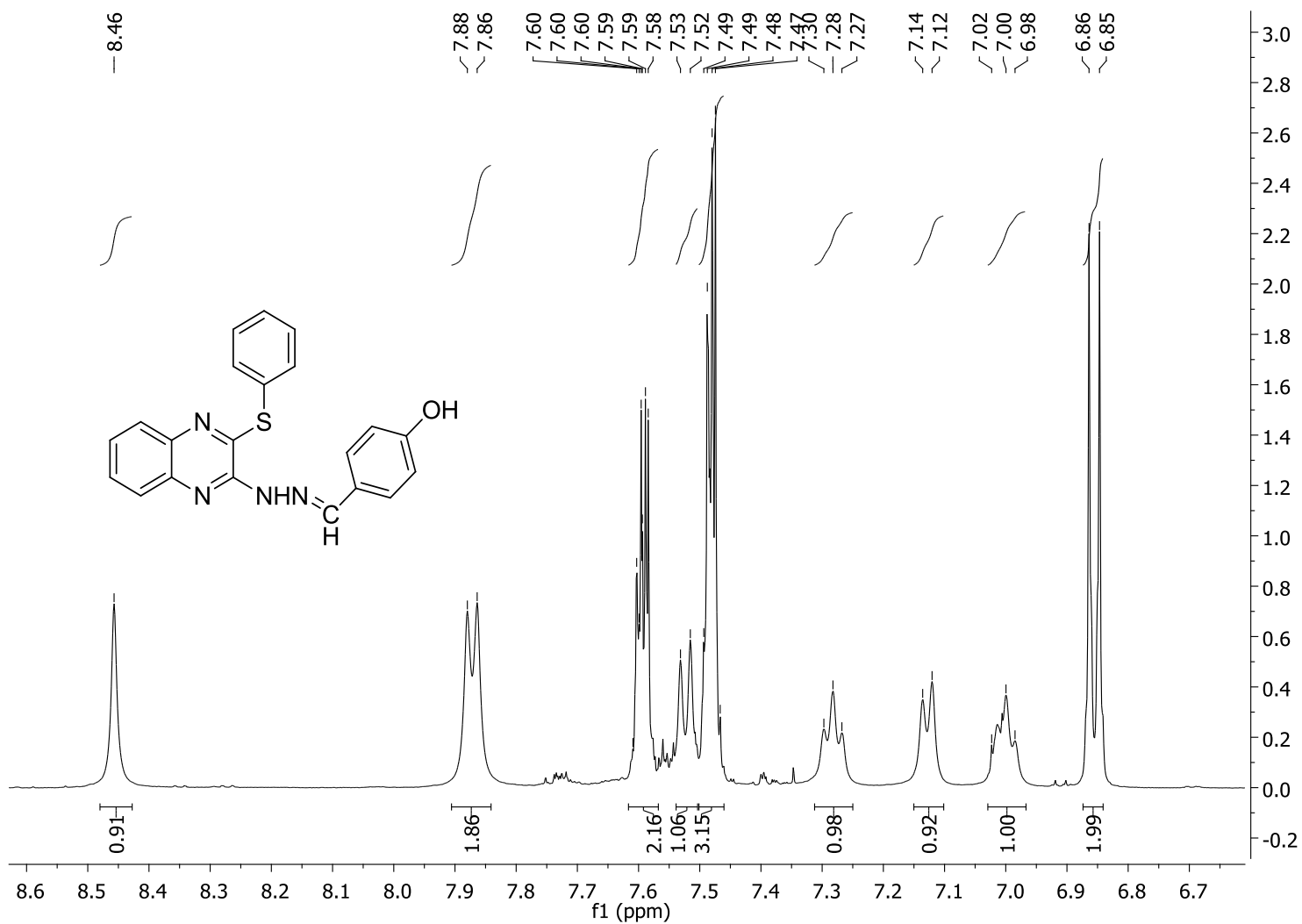
¹³C APT NMR (DMSO) of 2-(2-(4-chlorobenzylidene)hydrazinyl)-3-(phenylthio)quinoxaline (9e).



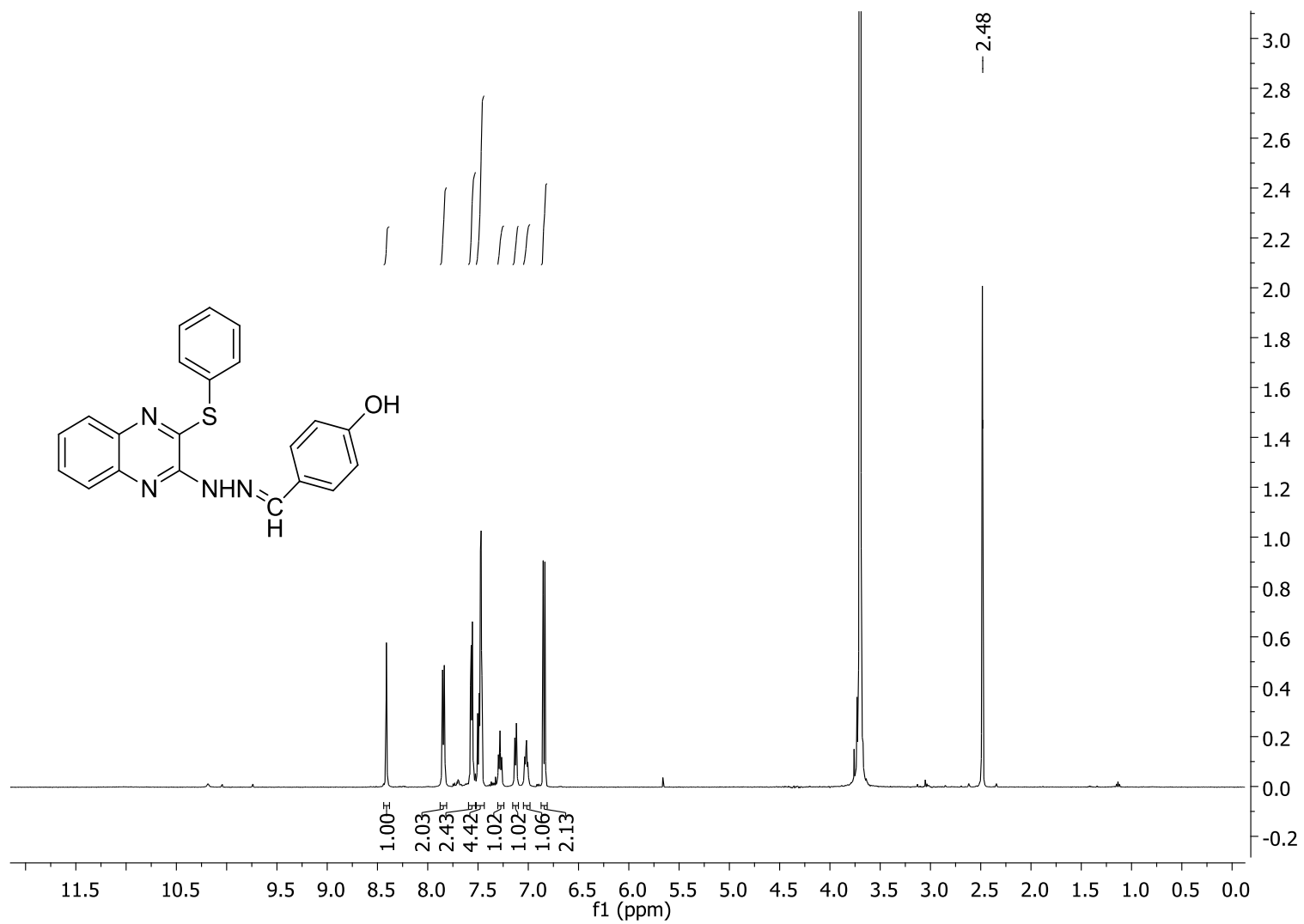
IR (KBr) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



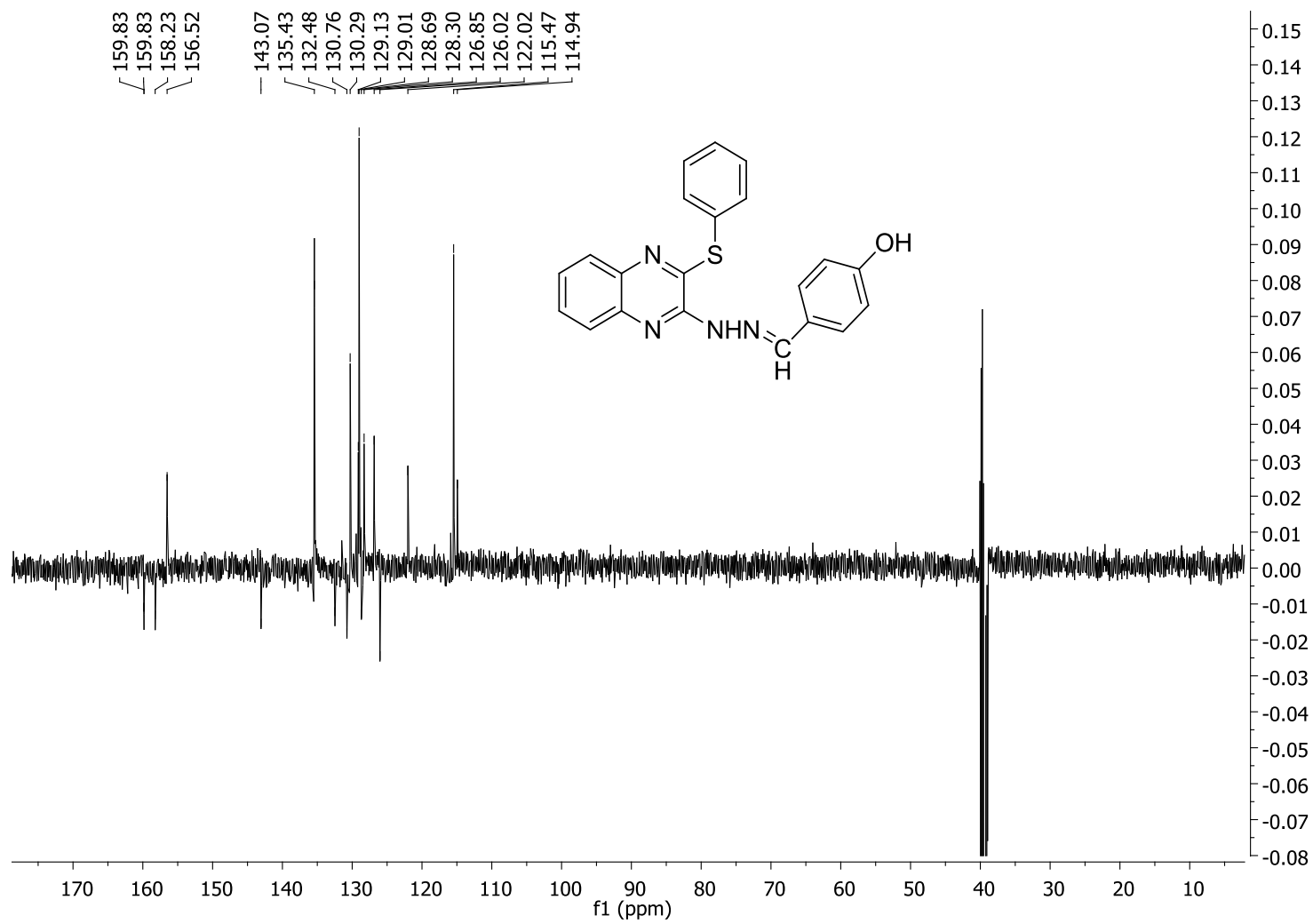
¹H NMR (DMSO) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



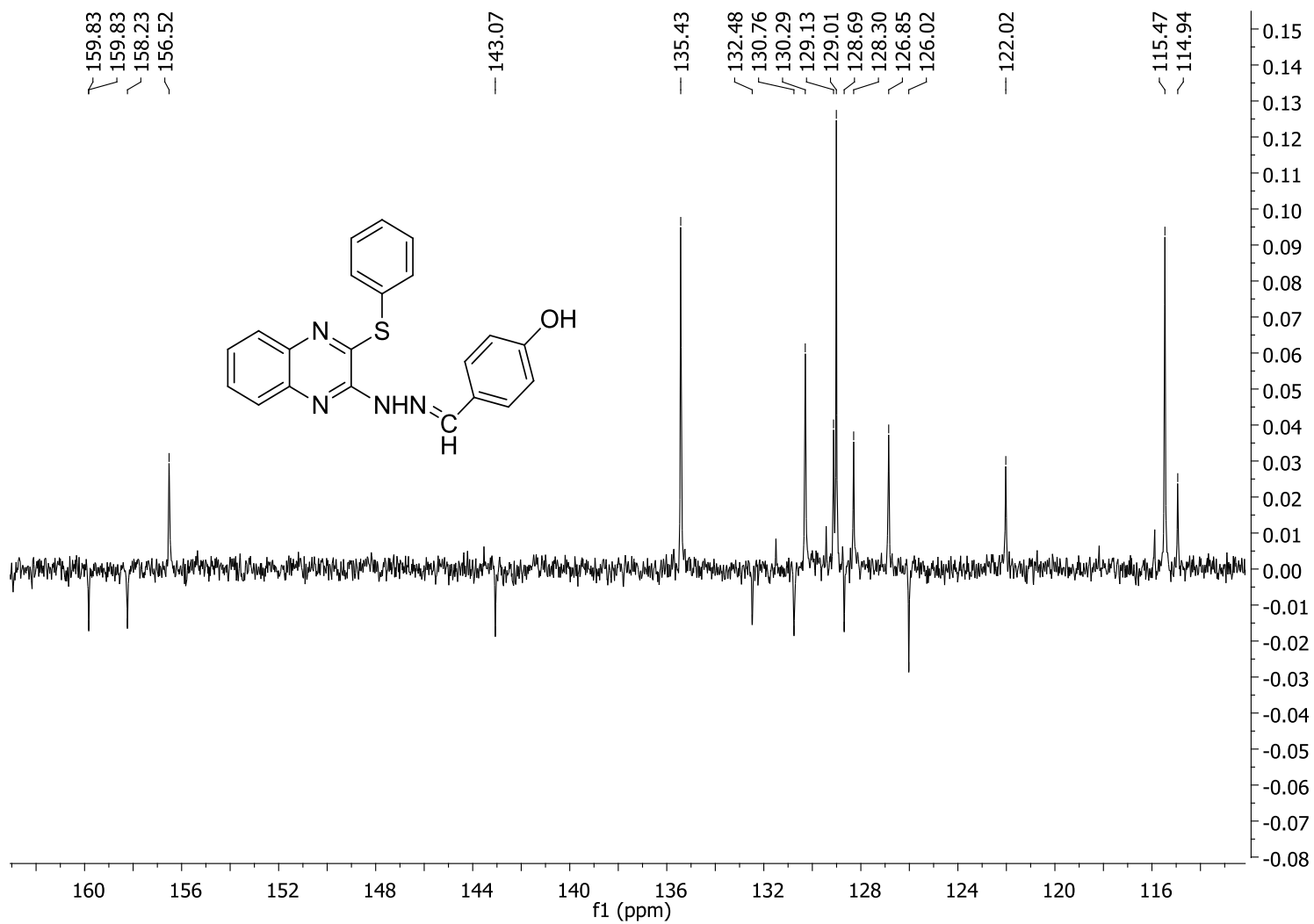
¹H NMR (DMSO) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



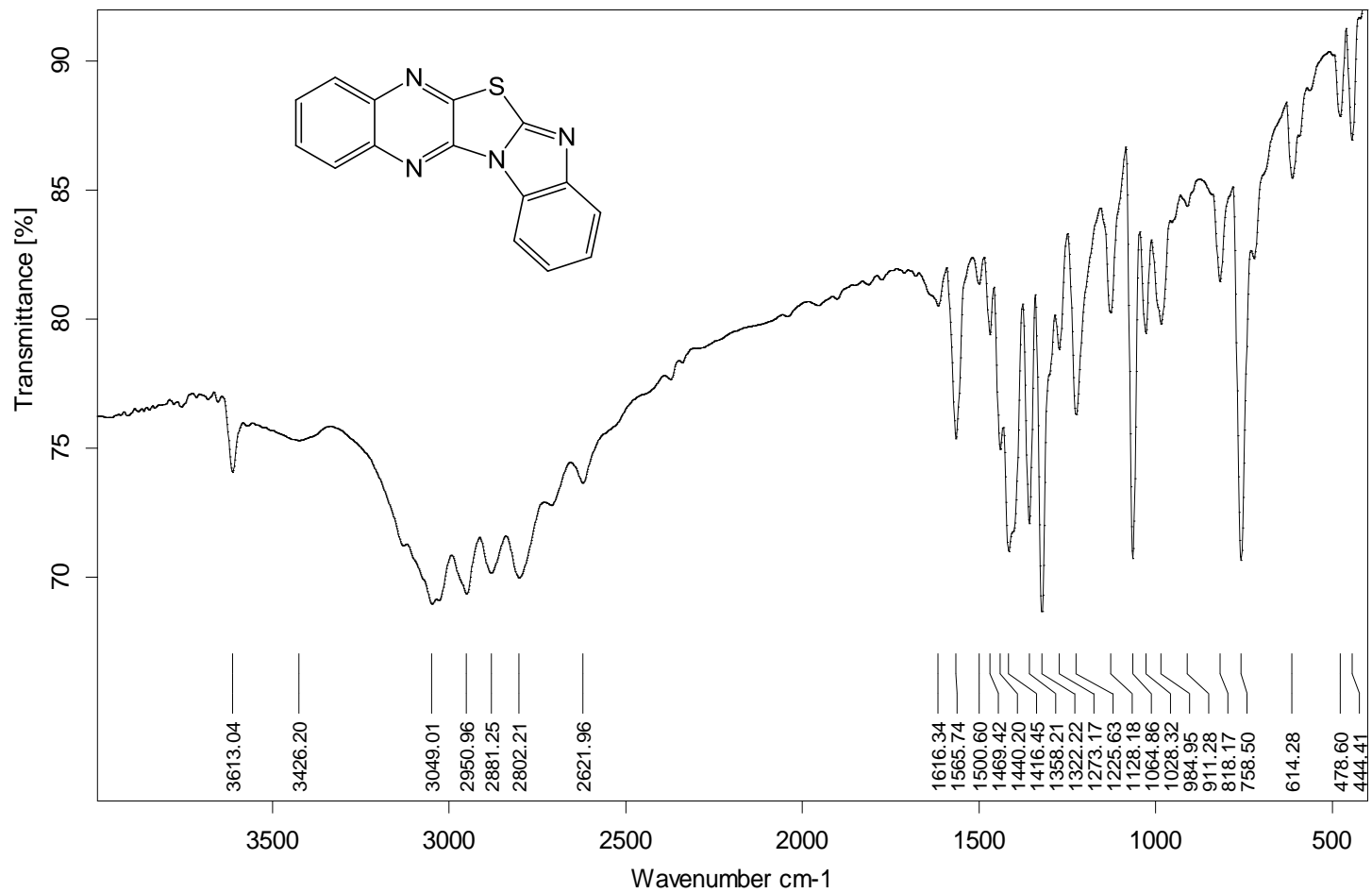
¹H NMR (DMSO, D₂O) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



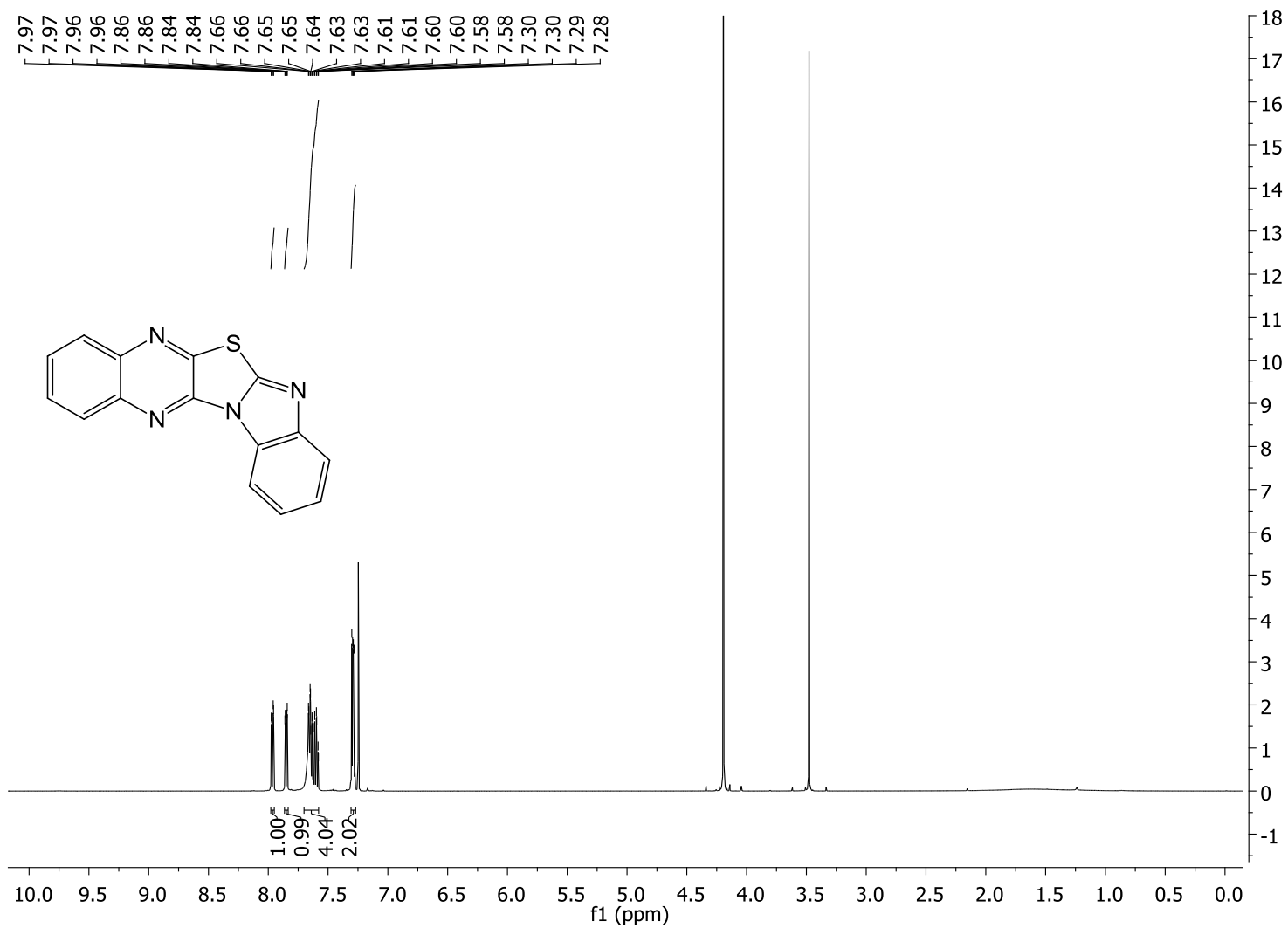
¹³C APT NMR (DMSO) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



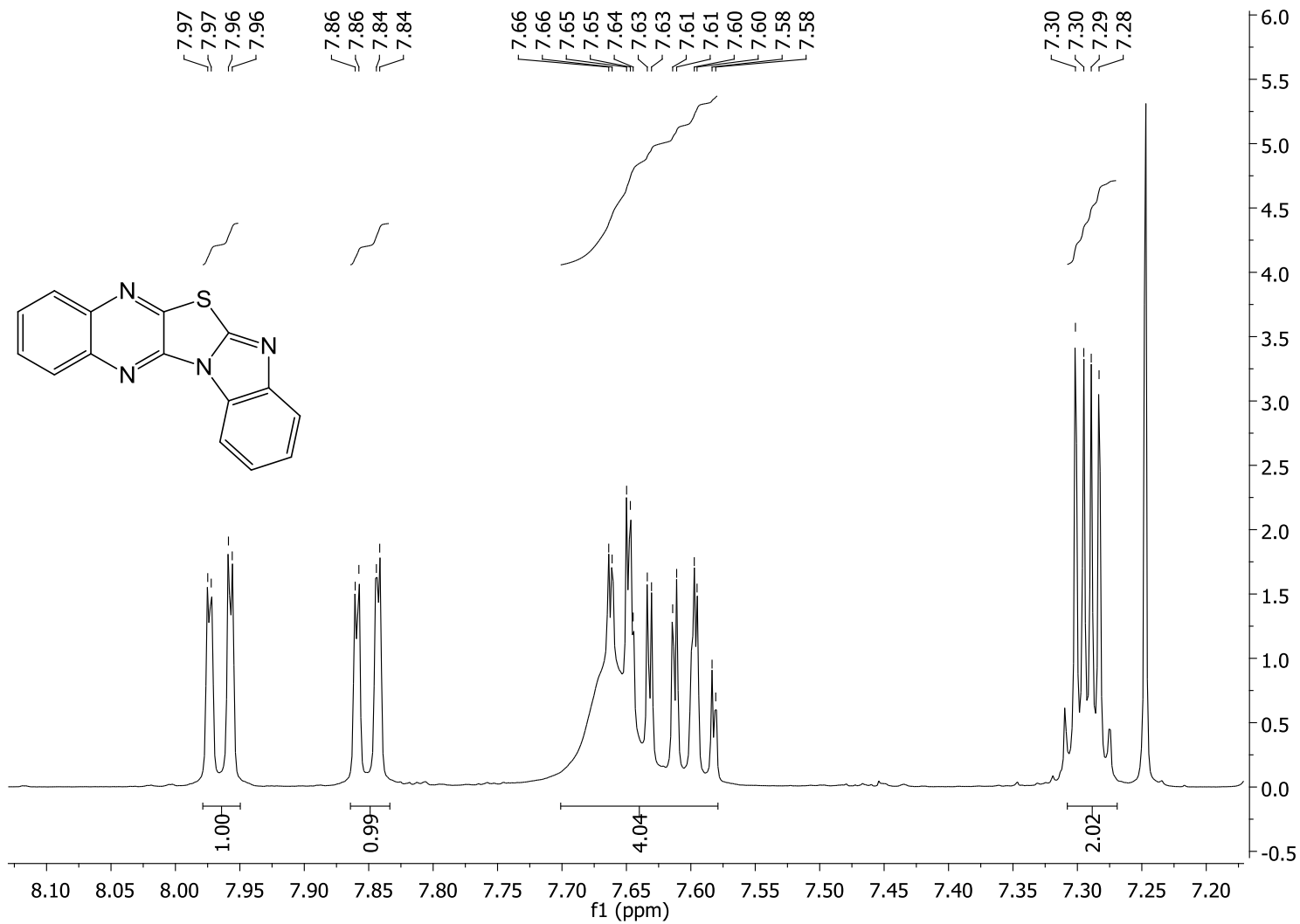
¹³C APT NMR (DMSO) of 4-((2-(3-(phenylthio)quinoxalin-2-yl)hydrazono)methyl)phenol (9f).



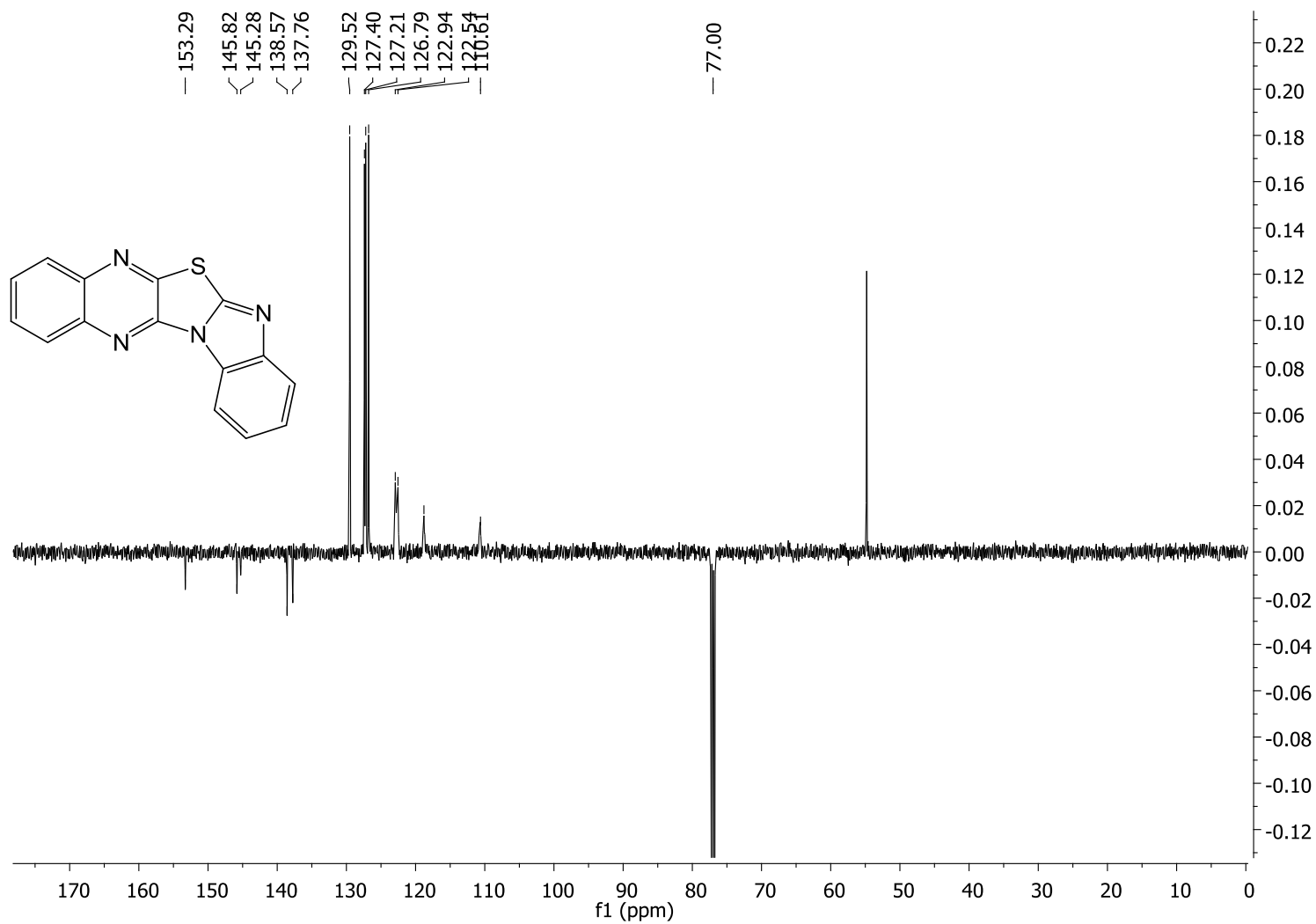
IR (KBr) of benzimidazo[2',1':2,3]thiazolo[4,5-b]quinoxaline (10).



¹H NMR (CDCl₃) of benzimidazo[2',1':2,3]thiazolo[4,5-b]quinoxaline (10).



^1H NMR (CDCl_3) of benzimidazo[2',1':2,3]thiazolo[4,5-b]quinoxaline (10).



¹³C APT NMR (CDCl₃) of benzimidazo[2',1':2,3]thiazolo[4,5-b]quinoxaline (10).