Electronic Supplementary Material (ESI) for ChemComm.

N-Heterocyclic carbene-catalyzed enantioselective synthesis of functionalized cyclopentenes via α,β-unsaturated acyl azoliums

Santigopal Mondal,[a] Santhivardhana Reddy Yetra,[a] Atanu Patra,[a] Sunita S. Kunte,[a] Rajesh G. Gonnade,[b] and Akkattu T. Biju*[,a]

[a]*Organic Chemistry Division, and* [b]*Center for Materials Characterization,*
CSIR-National Chemical Laboratory (CSIR-NCL),
Dr. Homi Bhabha Road, Pune - 411008, India
at.biju@ncl.res.in

Supporting Information

1. General Information

Unless otherwise specified, all reactions were carried out under an atmosphere of argon in flame-dried reaction vessels with Teflon screw caps. Dry DME was purchased from commercial sources and stored under argon over 4 Å molecular sieves. The 2-bromoenals were synthesized from the corresponding α,β-unsaturated aldehydes following the literature procedure.[1] All the malonic ester derivatives were prepared following the literature procedure.[2] The triazolium salt **4** was synthesized following the literature procedure.[3] Na_2CO_3 was dried by heating at 120 °C under vacuum and cooling under argon.

Analytical thin layer chromatography was performed on TLC Silica gel 60 F_{254}. Visualization was accomplished with short wave UV light or $KMnO_4$ staining solutions followed by heating. Flash chromatography was performed on silica gel (230-400 mesh) by standard techniques eluting with Pet. Ether-EtOAc solvent system.

All compounds were fully characterized. ^1H and ^{13}C NMR spectra were recorded on Bruker AV 400 in solvents as indicated. Chemical shifts (δ) are given in ppm. The residual solvent signals were used as references and the chemical shifts converted to the TMS scale ($CDCl_3$: δH = 7.26 ppm, δC = 77.16 ppm). Infra-red spectra were recorded on a Bruker FT-IR (ATR mode) Infra-red Spectrophotometer. The wave numbers (n) of recorded IR-signals are quoted in cm^{-1}. HRMS (ESI) data were recorded on a Thermo Scientific Q-Exactive, Accela 1250 pump. Optical rotation was measured with a JASCO P 2000 digital polarimeter at rt using 50 mm cell of 1 mL capacity. HPLC analysis was performed on Shimadzu Class-VP V6.12 SP5 with UV detector. X-ray intensity data were collected on a Bruker SMART APEX II CCD diffractometer with graphite-monochromatized (Mo Kα=0.71073 Å) radiation at ambient temperature.

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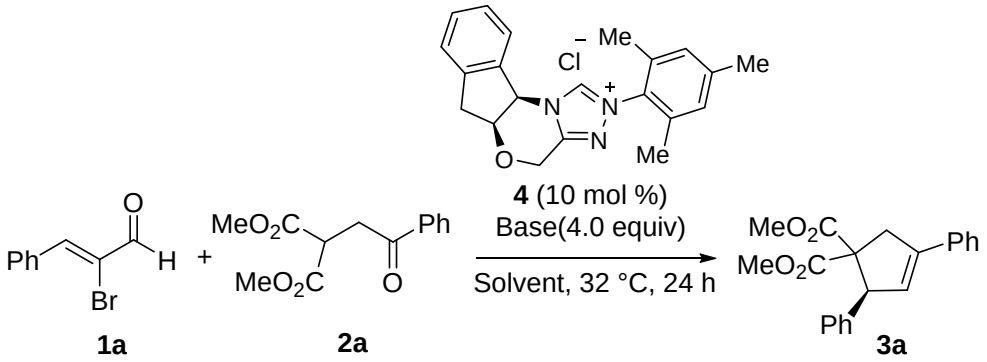
[1] (*a*) C. F. H. Allen, and C. O. Edens, Jr. *Org. Synth.,* 1945, **25**, 92; (*b*) W. Li, J. Li, Z.-K. Wan, J. Wu, and W. Massefski, *Org. Lett.,* 2007, **9**, 4607.
[2] K. Shen, X. Han, and X. Lu. *Org. Lett.,* 2013, **15**, 1732.
[3] J. R. Struble, and J. W. Bode, *Org. Synth.,* 2010, **87**, 362.

2. General Procedure for the Optimization of Reaction Conditions



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

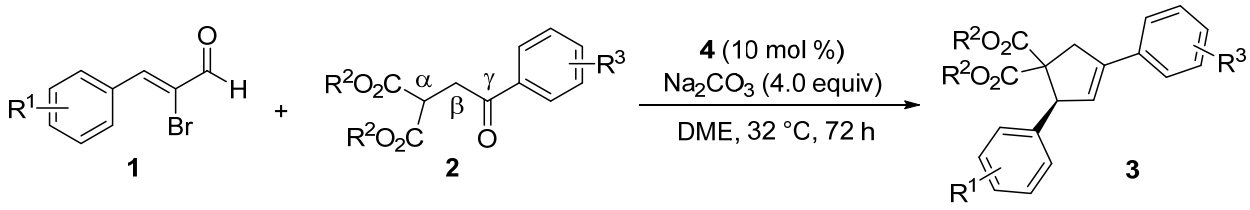
To a oven-dried Schlenk reaction vessel equipped with a magnetic stir bar was taken the (*Z*)-2-bromo-3-phenylacrylaldehyde **1a** (0.080 g, 0.38 mmol), dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (0.062 g, 0.25 mmol) and base (1.00 mmol, 4.00 equiv) was added. The mixture was kept under argon atmosphere. To this mixture was added solvent (3.0 mL) under a positive pressure of argon, and the mixture was stirred at 32 °C. To this stirring solution was added the triazolium salt **4** (9.2 mg, 0.025 mmol, 10 mol %), and the resulting mixture was stirred at 32 °C for 24 h. Evaporation of the solvent followed by silica gel flash column chromatography afforded the cyclopentene derivative **3a**. The enantiomeric excess was determined by HPLC analysis on a chiral column.

Optimization Studies

entry	variation of the standard conditions[a]	yield **3a** (%)[b]	ee **3a** (%)[c]
1	none	52	99
2	reaction time 60 h instead of 24 h	65	99
3	reaction run at 60 °C instead of 32 °C	<5	n.d.
4	Cs_2CO_3 instead of Na_2CO_3	48	91
5	KO*t*-Bu instead of Na_2CO_3	<5	n.d.
6	DBU instead of Na_2CO_3	<5	n.d.
7	DABCO instead of Na_2CO_3	30	93
8	Et_3N instead of Na_2CO_3	10	86
9	1,4-dioxane instead of THF	<5	n.d.
10	toluene instead of THF	10	99
11	DME instead of THF	54	99
12	*DME instead of THF, run for 72 h*	*75*	*99*

[a] Standard conditions: **1a** (0.38 mmol), **2a** (0.25 mmol), **4** (10 mol %), Na_2CO_3 (4.0 equiv), THF (3.0 mL), 32 °C and 24 h. [b] Isolated yield after column chromatography. [f] Determined by HPLC analysis on a chiral column.

3. General Procedure for the Enantioselective Synthesis of Functionalized Cyclopentenes



To an oven-dried Schlenk reaction vessel with a teflon screw cap was taken the 2-bromoenal **1** (0.75 mmol), the malonic ester derivative **2** (0.50 mmol), and Na_2CO_3 (212 mg, 2.0 mmol, 4.0 equiv). The mixture was kept under argon atmosphere, and dry DME (6.0 mL) was then introduced into the vessel by syringe under a positive pressure of argon, and the mixture was stirred at 32 °C. To this stirring solution was added the triazolium salt **4** (18.4 mg, 0.05 mmol), and the resulting mixture was stirred at 32 °C for 72 h. Evaporation of the solvent followed by silica gel flash column chromatography afforded the cyclopentene derivatives **3** in moderate to good yields with excellent enantioselectivity. [The racemic cyclopentenes were synthesized by treating **1** and **2** with IMes.HCl in the presence of Cs_2CO_3 (1.5 equiv) and NaH (1.0 equiv) in THF for 12 h at 32 °C]

4. X-ray data of 3c and 11r

Single crystals of compound **3c**, obtained from dichloromethane. X-ray intensity data were collected on a Bruker SMART APEX II CCD diffractometer with graphite-monochromatized (Mo Kα=0.71073 Å) radiation at ambient temperature. The X-ray generator was operated at 50 kV and 30 mA. Diffraction data were collected with a ω scan width of 0.5° and at different settings of φ and 2θ. The sample-to-detector distance was fixed at 5.00 cm. The X-ray data acquisition was monitored by APEX II program suite. [4] All the data were corrected for Lorentz-polarization and absorption effects using SAINT and SADABS programs integrated in APEX II program package.[1] The structures were solved by direct method and refined by full matrix least squares, based on F^2, using SHELX-97. [5] All the H-atoms were placed in geometrically idealized position (C-H = 0.93 Å for the phenyl H-atom, C-H = 0.97 Å for the methylene H-atom, C-H = 0.98 Å for the methine H-atom and C-H = 0.96 Å for the methyl H-atom) and constrained to ride on their parent atoms [U_{iso}(H) = 1.2U_{eq}(C) for the phenyl, methylene and methine group and U_{iso}(H) = 1.5 U_{eq}(C) for the methyl group]. ORTEP was generated using ORTEP-32 program.[6]

Crystallographic data for 3c. ($C_{21}H_{19}O_4Br$): M = 415.27, Crystal dimensions 0.49 x 0.45 x 0.41 mm^3, trigonal, space group $P\,3_2$, a = 11.7082(7), b = 11.7082(7), c = 11.9217(8) Å, α = 90°, β = 90°, γ =120°, V = 1415.30(15) Å^3, Z = 3, ρ_{calcd} = 1.462 gcm^{-3}, μ (Mo-K$_\alpha$) = 2.201 mm^{-1}, *F(000)* = 636, $2\theta_{max}$ = 67.22°, T = 296(2) K, 32442 reflections collected, 7324 unique (R_{int}=0.0360), 4525 observed ($I > 2\sigma(I)$) reflections, 238 refined parameters, R value 0.0340, $wR2$ = 0.0730, (all data R = 0.0759, $wR2$ = 0.0838), S = 0.995, minimum and maximum transmission 0.412 and 0.466; maximum and minimum residual electron densities +0.44 and –0.43 e Å^{-3}. The absolute configuration was established by anomalous dispersion effect (Flack parameter of 0.0174(11)) in X-ray diffraction measurements which is caused by the presence of bromine atom in the molecule.

[4] Bruker (2006). *APEX2*, *SAINT* and *SADABS*. Bruker AXS Inc., Madison, Wisconsin, USA.
[5] G. M. Sheldrick, *Acta Crystallogr*., 2008, **A64**, 112.
[6] L. J. Farrugia, J. Appl. Crystallogr., 1997, **30**, 565.

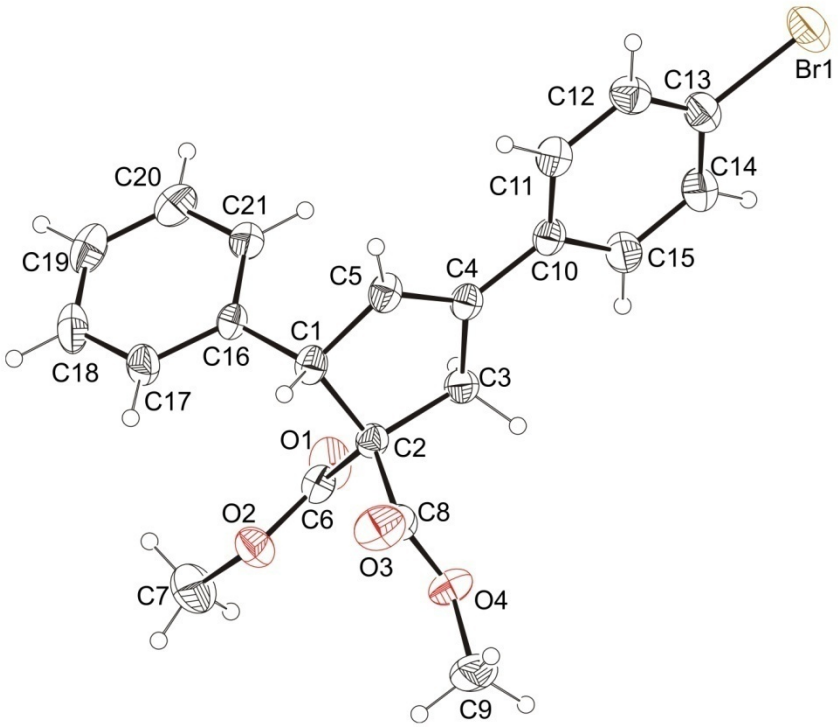


Figure 1. ORTEP of **3c** showing atom numbering scheme. Displacement ellipsoids are drawn at the 30% probability level and H atoms are shown as small spheres of arbitrary radii.

X-ray intensity data measurements of compound **11r** was carried out on a Bruker SMART APEX II CCD diffractometer with graphite-monochromatized (MoK_α= 0.71073Å) radiation at room temperature. The X-ray generator was operated at 50 kV and 30 mA. A preliminary set of cell constants and an orientation matrix were calculated from three sets of 36 frames. Data were collected with ω scan width of 0.5° at different settings of φ and 2θ with a frame time of 15 secs keeping the sample-to-detector distance fixed at 5.00 cm. The X-ray data collection was monitored by APEX2 program (Bruker, 2006). All the data were corrected for Lorentzian, polarization and absorption effects using SAINT and SADABS programs (Bruker, 2006). SHELX-97 was used for structure solution and full matrix least-squares refinement on F^2. All the hydrogen atoms were placed in geometrically idealized position and constrained to ride on their parent atoms. ORTEP III3 views of both compounds were drawn with 30% probability displacement ellipsoids and H atoms are shown as small spheres of arbitrary radii.

Crystal data of **11r** $C_{20}H_{22}O_8$, M = 390.38, colorless block, 0.39 x 0.09 x 0.06 mm^3, monoclinic, space group *C*2, a = 20.4540(10) Å, b = 7.1698(3) Å, c = 15.6356(8) Å, β = 121.607(6) °, V = 1952.84(16) $Å^3$, Z = 4, T = 296(2) K, $2\theta_{max}$=52.00°, D_{calc} (g cm^{-3}) = 1.328, $F(000)$ = 824, μ (mm^{-1}) = 0.103, 11890 reflections collected, 3508 unique reflections (R_{int}=0.0436), 2708 observed ($I > 2\sigma(I)$) reflections, multi-scan absorption correction, T_{min} = 0.961, T_{max} = 0.994, 257 refined parameters, S = 1.095, $R1$ = 0.0515, $wR2$ = 0.0972 (all data R = 0.0722, $wR2$ = 0.1054), maximum and minimum residual electron densities; $\Delta\rho_{max}$ = 0.14, $\Delta\rho_{min}$= -0.17 ($eÅ^{-3}$).

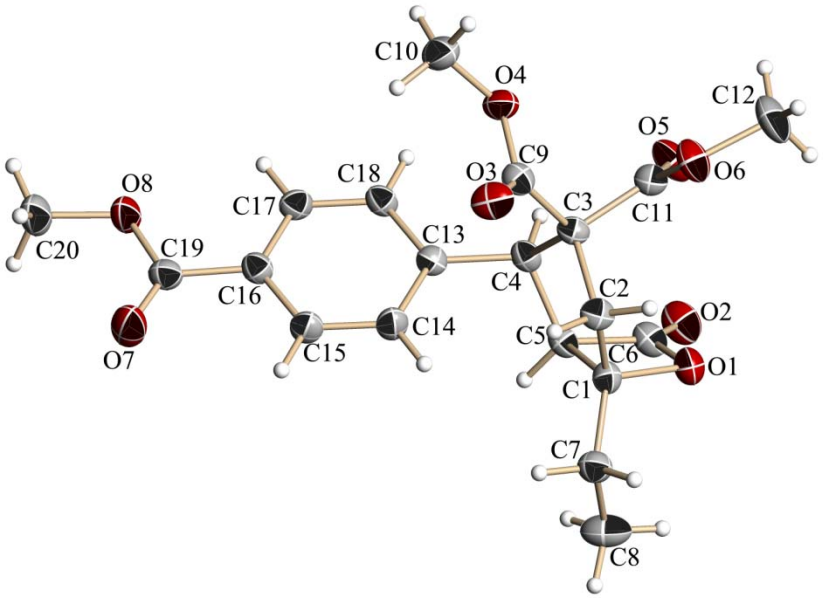
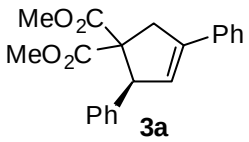


Figure 2. ORTEP of **11r** showing atom numbering scheme. Displacement ellipsoids are drawn at the 30% probability level and H atoms are shown as small spheres of arbitrary radii.

5. Synthesis and Characterization of Functionalized Cyclopentenes

Dimethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate (3a)[7]

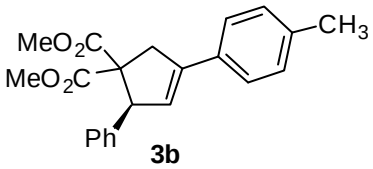


3a

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.3 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate **3a** as a light yellow solid (126.1 mg, 75%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.65; 99% ee, $[\alpha]_D^{25}$ = -279.45 (c 0.4, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 10.0 min, Minor: 13.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.54 (d, *J* = 7.4 Hz, 2H, H_{ar}), 7.39 (t, *J* = 7.7 Hz, 2H, H_{ar}), 7.33-7.22 (m, 6H, H_{ar}), 6.16 (s, 1H, $H_{olefinic}$), 5.08 (s, 1H), 3.97-3.92 (m, 1H), 3.81 (s, 3H, CH_3), 3.21(d, *J* = 17.0 Hz, 1H), 3.18 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.56, 169.86, 140.39, 139.22, 135.09, 129.19, 128.62, 128.17, 127.99, 127.50, 126.39, 125.95, 65.22, 57.35, 53.11, 52.06, 40.83. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{20}O_4Na$: 359.1254, found: 359.1247. **FTIR (cm^{-1})** 3463, 3059, 3029, 2952, 2843, 2104, 1734, 1697, 1638, 1436, 1257, 1196, 1164, 1028, 964, 863, 697.

Dimethyl (*S*)-2-phenyl-4-(p-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3b)



3b

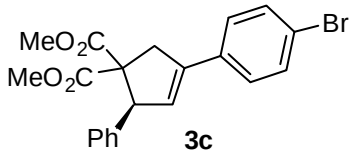
Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-(p-tolyl)ethyl)malonate **2b** (132.0 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-phenyl-4-(p-tolyl)cyclopent-3-ene-1,1-dicarboxylate **3b** as a white solid (96.4 mg, 55%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.67; 99% ee, $[\alpha]_D^{25}$ = -250.61 (c 0.3, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 11.4 min, Minor: 20.0 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.45 (d, *J* = 8.1 Hz, 2H, H_{ar}), 7.32-7.25 (m, 5H, H_{ar}), 7.22 (d, *J* = 8.0, 2H,

[7] K. Mochizuki, K. Sakai, T. Kochi, and F. Kakiuchi, *Synthesis*, 2013, 2088.

H_{ar}) 6.12 (s, 1H, $H_{olefinic}$), 5.09 (s, 1H), 3.97-3.93 (m, 1H), 3.82 (s, 3H, CH_3), 3.23-3.19 (m.4H), 2.41 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.57, 169.90, 140.25, 139.34, 137.84, 132.28, 129.28, 129.18, 128.13, 127.44, 125.86, 125.39, 65.21, 57.31, 53.08, 52.03, 40.83, 21.31. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_4Na$: 373.1410, found: 373.1401. **FTIR (cm^{-1})** 3427, 3028,2951,1734, 1634, 1514, 1492, 1435, 1262, 1222, 1196, 1164, 1058, 964, 903, 763, 668.

Dimethyl (*S*)-4-(4-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3c)

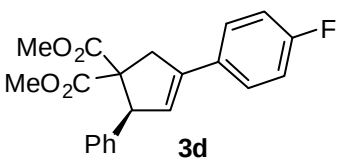


3c

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(4-bromophenyl)-2-oxoethyl)malonate **2c** (164.5 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford Dimethyl (*S*)-4-(4-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3c** as a white solid (176.0 mg, 85%).

R_f (Pet. ether /EtOAc = 80/20): 0.64; 99% ee, $[\alpha]_D^{25}$ = -203.02 (c 0.25, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 13.8 min, Minor: 27.6 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.52–7.49 (m, 2H, H_{ar}), 7.40–7.38 (m, 2H, H_{ar}), 7.31–7.21(m, 5H, H_{ar}), 6.16–6.14 (m, 1H, $H_{olefinic}$), 5.07 (s, 1H), 3.93-3.88 (m, 1H), 3.81 (s, 3H, CH_3), 3.18 3.14 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.43, 169.78, 139.41, 138.99, 134.02, 131.75, 129.16, 128.24, 127.61, 127.54, 127.24, 121.91, 65.22, 57.42, 53.19, 52.14, 40.83. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4BrNa$: 437.0359, found: 437.0349. **FTIR (cm^{-1})** 3685, 3432, 3021, 2401, 2357, 1713, 1602, 1521, 1490, 1433, 1266, 1216, 1075, 929, 772, 670.

Dimethyl (*S*)-4-(4-fluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3d)



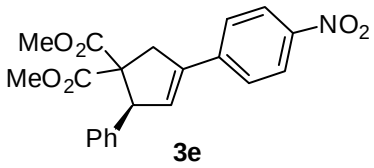
3d

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(4-fluorophenyl)-2-oxoethyl)malonate **2d** (134.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol)

in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-4-(4-fluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3d** as a white solid (110.0 mg, 62%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.62; >99% ee, $[\alpha]_D^{25}$ = -234.52 (c 0.5, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 12.6 min, Minor: 20.9 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51-7.48 (m, 2H, H_{ar}), 7.31-7.23 (m, 5H, H_{ar}), 7.09-7.05 (m. 2H, H_{ar}), 6.08 (s, 1H, $H_{olefinic}$), 5.08 (s, 1H), 3.94-3.89 (m, 1H), 3.81 (s, 3H, CH3), 3.19-3.15 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.45, 169.80, 162.54 (d, *J* = 248.6 Hz), 139.22 (d, *J* = 18.7 Hz), 131.27 (d, *J* = 3.2 Hz), 129.12, 128.18, 127.62, 127.53, 126.07, 115.50 (d, *J* = 21.6 Hz), 65.20, 57.32, 53.13, 52.08, 40.97. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4FNa$: 377.1160, found: 377.1150. **FTIR (cm^{-1})** 3466, 3027, 2953, 2845, 1732, 1638, 1603, 1511, 1436. 1224, 1099, 1059, 1023, 939, 834, 759.

Dimethyl (*S*)-4-(4-nitrophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3e)

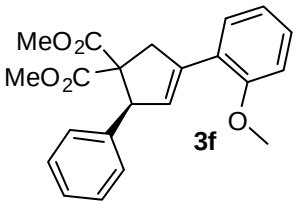


3e

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(4-nitrophenyl)-2-oxoethyl)malonate **2e** (147.6 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 120 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford Dimethyl (*S*)-4-(4-nitrophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3e** as a yellow oil (134.0 mg, 70%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.48; 99% ee, $[\alpha]_D^{25}$ = -217.42 (c 0.2, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 19.6 min, Minor: 40.7 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 8.23 (d, *J* = 8.5 Hz, 2H, H_{ar}), 7.64 (d, *J* = 8.8 Hz, 2H, H_{ar}), 7.29–7.20 (m, 5H, H_{ar}), 6.36 (s, 1H, $H_{olefine}$), 5.12 (s, 1H), 3.98–3.92 (m, 1H), 3.82 (s, 3H, CH_3), 3.21 (d, *J* = 16.7, 1H), 3.16 (s, 3H,CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.15, 169.53, 147.15, 141.26, 138.18, 138.36, 131.33, 129.07, 28.31, 127.77, 126.54, 123.98, 65.10, 57.51, 53.25, 52.20, 40.80. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_6NNa$: 404.1105, found: 404.1097. **FTIR (cm^{-1})** 3444, 3021, 2401, 2357, 1731, 1635, 1520, 1434, 1345, 1268, 1216, 1107, 929, 848, 771, 670.

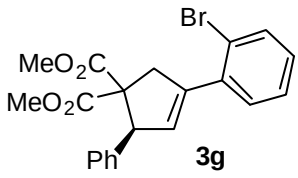
Dimethyl (*S*)-4-(2-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3f)



Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(2-methoxyphenyl)-2-oxoethyl)malonate **2f** (104.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (DCM-Pet. ether 40:60) to afford dimethyl (*S*)-4-(2-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3f** as a white solid (124.5 mg, 68%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.57; >99% ee, $[\alpha]_D^{25}$ = -218.22 (c 0.25, $CHCl_3$). **HPLC** (Chiralcel OJ-H, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 17.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.39 (dd, J_1 = 1.56 Hz, J_2 = 7.56 Hz, 1H, H_{ar}), 7.29-7.20 (m, 6H, Har), 7.00-6.93 (m, 2H, H_{ar}), 6.40-6.39 (m, 1H, $H_{olefinic}$), 5.06 (s, 1H), 4.00-3.96 (m, 1H), 3.87 (s, 3H, CH_3), 3.79 (s, 3H, CH_3), 3.23 (d, *J* = 17.1 Hz, 1H), 3.17 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.14, 170.12, 157.97, 139.51, 137.32, 130.62, 129.26, 128.94, 128.75, 128.13, 127.36, 124.55, 120.55, 111.08, 64.65, 57.60, 55.38, 53.05, 52.03, 42.51. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_5Na$: 389.1359, found: 389.1348. **FTIR (cm^{-1})** 3433, 3022, 2953, 2839, 2402, 2108, 1730, 1629, 1601, 1458, 1437, 1218, 1166, 1057, 968, 870, 702.

Dimethyl (*S*)-4-(2-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3g)

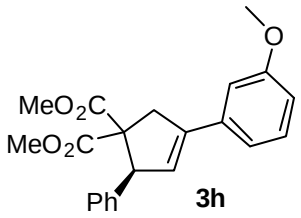


Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(2-bromophenyl)-2-oxoethyl)malonate **2g** (164.5 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (DCM-Pet. ether 40:90) to afford dimethyl (*S*)-4-(2-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3g** as a colourless oil (135.0 mg, 65%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.62; >99% ee, $[\alpha]_D^{25}$ = -202.26 (c 0.2, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 6.5 min, Minor: 8.0 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.63 (d, *J* = 7.9 Hz, 1H, H_{ar}), 7.39-7.26 (m, 7H, H_{ar}), 7.18 (t, *J* = 7.4 Hz, 1H, H_{ar}), 5.96 (s, 1H, $H_{olefinic}$), 5.07 (s, 1H), 3.96 (d, *J* = 17.1 Hz, 1H), 3.83 (s, 3H, CH_3), 3.25-3.19 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.44, 169.76, 141.32, 138.82, 137.82,

133.43, 131.68, 130.35, 129.24, 129.04, 128.25, 127.57, 127.41, 122.30, 65.52, 57.18, 53.13, 52.09, 43.14. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4BrNa$: 437.0359, found: 437.0353. **FTIR (cm^{-1})** 3685, 3619, 3435, 3021, 2975, 2401, 2357, 1731, 1603, 1521, 1432, 1216, 1051, 929, 774, 670.

Dimethyl (*S*)-4-(3-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3h)

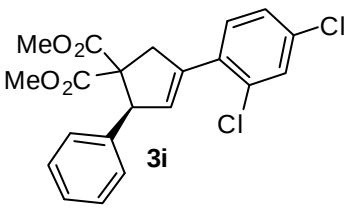


3h

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(3-methoxyphenyl)-2-oxoethyl)malonate **2h** (140.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-4-(3-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3h** as a light yellow oil (97 mg, 53%).

R_f (Pet. ether /EtOAc = 80/20): 0.64; 99% ee, $[\alpha]_D^{25}$ = -195.5 (c 0.1, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 8.2 min, Minor: 10.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.33 (m, 6H, H_{ar}), 7.14 (d, *J* = 7.7 Hz, 1H, H_{ar}), 7.06 (s, 1H, H_{ar}), 6.89-6.87 (m, 1H, H_{ar}), 6.16 (s, 1H, $H_{olefinic}$), 5.07 (s, 1H), 3.93 (d, *J* = 16.9 Hz, 1H), 3.86 (s, 3H, CH_3), 3.81 (s, 3H, CH_3), 3.21-3.18 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.55, 169.88, 159.87, 140.33, 139.14, 136.52, 129.62, 129.20, 128.21, 127.55, 126.83, 118.57, 113.63, 111.54, 65.19, 57.31, 55.41, 53.17, 52.12, 40.88. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_5Na$: 389.1359, found: 389.1353. **FTIR (cm^{-1})** 3021, 1731, 1599, 1433, 1264, 1214, 1170, 1052, 742, 668.

Dimethyl (*S*)-4-(2,4-dichlorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3i)

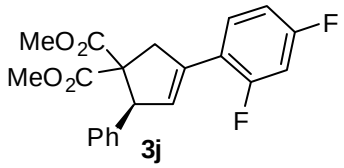


3i

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(2,4-dichlorophenyl)-2-oxoethyl)malonate **2i** (158.2 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (dcm-Pet. ether 40:60) to afford dimethyl (*S*)-4-(2,4-dichlorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3i** as a colourless oil (117.0 mg, 58%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.78; >99% ee, $[\alpha]_D^{25}$ = -191.90 (c 0.3, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 8.5 min, Minor: 9.9 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.43 (d, *J* = 2.1 Hz, 1H, H_{ar}), 7.33-7.24 (m, 7H, H_{ar}), 6.09-6.07 (m, 1H, $H_{olefinic}$), 5.07 (s, 1H), 3.95-3.90 (m, 1H), 3.81 (s, 3H, CH_3), 3.20-3.16 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.29, 169.64, 138.59, 138.42, 133.85, 133.45, 132.58, 130.81, 130.12, 129.12, 128.26, 127.62, 127.14, 65.28, 57.26, 53.13, 52.11, 42.96. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{18}O_4Cl_2Na$: 427.0474, found: 427.0465. **FTIR (cm^{-1})** 3428, 3021, 2401, 2313, 1731, 1635, 1437, 1217, 1057, 769, 670.

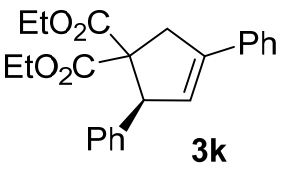
Dimethyl (*S*)-4-(2,4-difluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3j)



3j

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and dimethyl 2-(2-(2,4-difluorophenyl)-2-oxoethyl)malonate **2j** (143.0 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-4-(2,4-difluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate **3j** as a white solid (143.0 mg, 77%).
***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.62; 99% ee, $[\alpha]_D^{25}$ = -249.26 (c 0.35, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 99.3:0.7:0.1 Hexane / IPA/TFA, 0.5 mL/min.) Major: 20.2 min, Minor: 22.6 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.41–7.35 (m, 1H, H_{ar}), 7.30–7.22 (m, 5H, H_{ar}), 6.92–6.83 (m, 2H, H_{ar}), 6.25 (s, 1H, $H_{olefinic}$), 5.09 (s, 1H), 3.92 (d, *J* = 16.7 Hz, 1H), 3.80 (s, 3H, CH_3), 3.21-3.15 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.42, 169.83, 163.23 (dd, J_1 = 12.2 Hz, J_2 = 250.1 Hz), 161.58 (dd, J_1 = 11.7 Hz, J_2 = 254.5 Hz), 138.93, 134.08, 130.94 (d, *J* = 10.2 Hz), 129.66-129.51 (m), 129.15, 128.22, 127.57, 119.70 (dd, J_1 = 3.8 Hz, J_2 = 12.6 Hz), 111.33 (dd, J_1 = 3.4 Hz, J_2 = 21.2 Hz), 104.61 (t, *J* = 25.8 Hz), 64.57, 57.55, 53.17, 52.13, 42.08. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{18}O_4F_2Na$: 395.1065, found: 395.1058. **FTIR (cm^{-1})** 3430, 3023, 2954, 1731, 1619, 1502, 1271, 1217, 1162, 1141, 1105, 965, 854, 761, 702.

Diethyl (*S*) 2, 4-diphenylcyclopent-3-ene-1, 1-dicarboxylate (3k)

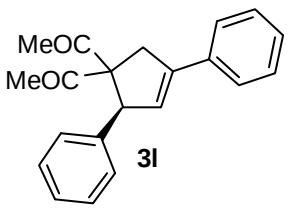


3k

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and diethyl 2-(2-oxo-2-phenylethyl)malonate **2k** (208.7 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford diethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate **3k** as a colourlass oil (110 mg, 61%).

R_f (Pet. ether /EtOAc = 80/20): 0.69; >99% ee, $[\alpha]_D^{25}$ = -265.10 (c 0.45, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 10.5 min, Minor: 12.0 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.55 (d, *J* = 7.4 Hz, 2H, H_{ar}), 7.40 (t, *J* = 7.4 Hz, 2H, H_{ar}), 7.33 (d, *J* = 7.4 Hz, 1H, H_{ar}), 7.31-7.22 (m, 5H, H_{ar}), 6.17 (s, 1H, $H_{olefinic}$), 5.09 (s, 1H), 4.38-4.30 (m, 1H), 4.27-4.19 (m, 1H), 3.81-3.73 (m, 1H), 3.55-3.47 (m, 1H), 3.21(d, *J* = 16.9 Hz, 1H), 1.31 (t, *J* = 7.1 Hz, 3H, CH_3), 0.89 (t, *J* = 7.1 Hz, 3H, CH_3) **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.09, 169.53, 140.18, 139.44, 135.19, 129.34, 128.59, 128.13, 127.91, 127.43, 126.72, 125.95, 65.01, 61.85, 61.25, 57.18, 40.94, 14.14, 13.61. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{23}H_{24}O_4Na$: 387.1567, found: 387.1555. **FTIR (cm^{-1})** 3430, 3021, 2401, 1726, 1636, 1449, 1261, 1216, 1097, 928, 760, 669

(*S*)-1,1'-(2,4-Diphenylcyclopent-3-ene-1,1-diyl)bis(ethan-1-one) (3l)



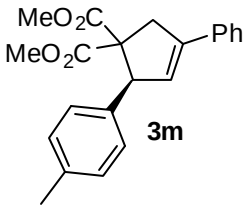
3l

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and 3-acetyl-1-phenylpentane-1,4-dione **2l** (109.0 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford (*S*)-1,1'-(2,4-diphenylcyclopent-3-ene-1,1-diyl)bis(ethan-1-one) **3l** as a white solid (76 mg, 50%).

R_f (Pet. ether /EtOAc = 80/20): 0.53; >99% ee, $[\alpha]_D^{25}$ = -406.95 (c 0.4, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 11.1 min, Minor: 12.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.52-7.50 (m, 2H, H_{ar}), 7.37 (t, *J* = 7.1 Hz, 2H, H_{ar}), 7.32-7.18 (m, 6H, H_{ar}), 6.13 (s, 1H, $H_{olefinic}$), 5.06 (s, 1H), 4.06-4.00 (m, 1H), 2.94 (d, *J* = 17.0 Hz, 1H), 2.25 (s,

3H, CH_3), 1.63 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 204.43, 204.18, 139.68, 138.97, 135.10, 129.36, 128.74, 128.67, 128.06, 127.85, 127.62, 125.89, 79.24, 55.11, 38.22, 28.54, 26.81. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{20}O_2Na$: 327.1356, found: 327.1346. **FTIR (cm^{-1})** 3411, 3021, 2928, 2401, 1697, 1492, 1216, 1144, 1029, 760, 669, 622.

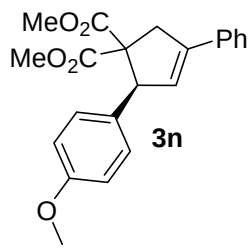
Dimethyl (*S*)-4-phenyl-2-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3m)



Following the general procedure, treatment of (Z)-2-bromo-3-(*p*-tolyl)acrylaldehyde **1m** (168.8 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-4-phenyl-2-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate **3m** as a colourless oil (105.0 mg, 60%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.64; >99% ee, $[\alpha]_D^{25}$ = -235.55 (c 0.25, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 12.5 min, Minor: 24.4 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.52 (d, *J* = 7.4 Hz, 2H, H_{ar}), 7.37 (t, *J* = 7.2 Hz, 2H, H_{ar}), 7.30 (t, *J* = 7.3 Hz, 1H, H_{ar}), 7.12-7.06 (m, 4H, H_{ar}), 6.13 (s, 1H, $H_{olefinic}$), 5.02 (s, 1H), 3.94-3.89 (m, 1H), 3.79 (s, 3H, CH_3), 3.20-3.16 (m, 4H), 2.31 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.63, 169.95, 140.14, 137.12, 135.94, 135.15, 129.06, 128.89, 128.62, 127.95, 126.65, 125.95, 65.16, 56.97, 53.12, 52.12, 40.69, 21.19. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_4Na$: 373.1410, found: 373.1400. **FTIR (cm^{-1})** 3427, 3021, 2954, 1731, 1635, 1439, 1267, 1217, 768, 670

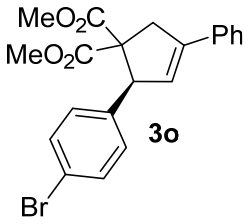
Dimethyl (*S*)-2-(4-methoxyphenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3n)



Following the general procedure, treatment of (*Z*)-2-bromo-3-(4-methoxyphenyl)acrylaldehyde **1n** (180.8 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(4-methoxyphenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3n** as a light yellow oil (110 mg, 60%).

R_f (Pet. ether /EtOAc = 80/20): 0.63; 95% ee, $[\alpha]_D^{25}$ = -217.4 (c 0.25, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 14.9 min, Minor: 28.8 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51 (d, *J* = 7.3 Hz, 2H, H_{ar}), 7.37 (t, *J* = 7.1 Hz, 2H, H_{ar}), 7.30 (d, *J* = 7.2 Hz, 1H, H_{ar}), 7.13 (d, *J* = 8.7 Hz, 2H, H_{ar}), 6.80 (d, *J* = 8.7 Hz, 2H, H_{ar}), 6.11 (s, 1H, $H_{olefinic}$), 5.00 (s, 1H), 3.92-3.87 (m, 1H), 3.78-3.77 (m, 6H, $2CH_3$), 3.21 (s, 3H, CH_3), 3.16 (d, *J* = 16.9 Hz, 1H),. **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.66, 170.00, 159.03, 140.03, 135.15, 131.00, 130.25, 128.64, 127.97, 126.69, 125.95, 113.57, 65.11, 56.60, 55.35, 53.13, 52.21, 40.64. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_5Na$: 389.1359, found: 389.1346. **FTIR (cm^{-1})** 3021, 1733, 1215, 908, 742, 669.

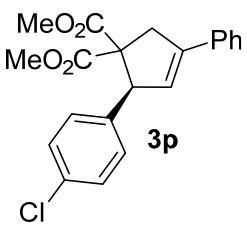
Dimethyl (*S*)-2-(4-bromophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3o)



Following the general procedure, treatment of (*Z*)-2-bromo-3-(4-bromophenyl)acrylaldehyde **1o** (108.7 mg, 0.38 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (62.5 mg, 0.25 mmol) with triazolium salt **4** (9.2 mg, 0.025 mmol), Na_2CO_3 (106 mg, 1.0 mmol) in DME (3.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(4-bromophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3o** as a light yellow oil (65.4 mg, 63%).

R_f (Pet. ether /EtOAc = 80/20): 0.64; >99% ee, $[\alpha]_D^{25}$ = -200.97 (c 0.45, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 10.5 min, Minor: 16.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51 (d, *J* = 7.3 Hz, 2H, H_{ar}), 7.41-7.36 (m, 4H, H_{ar}), 7.33-7.29 (m, 1H, H_{ar}), 7.11 (d, *J* = 8.4 Hz, 2H, H_{ar}), 6.08 (d, *J* = 1.5 Hz, 1H, $H_{olefinic}$), 5.03 (s, 1H), 3.92-3.88 (m, 1H), 3.79 (s, 3H, CH_3), 3.22-3.17 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.31, 169.70, 140.93, 138.31, 134.81, 131.28, 130.89, 128.66, 128.17, 125.97, 125.68, 121.47, 65.02, 56.67, 53.21, 52.26, 40.78. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4BrNa$: 437.0359, found: 437.0355. **FTIR (cm^{-1})** 3436, 3022, 2954, 2401, 1732, 1636, 1437, 1267, 1216, 1167, 1073, 932, 758.

Dimethyl (*S*)-2-(4-chlorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3p)

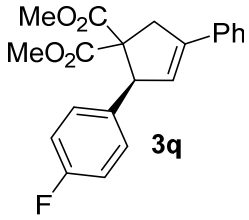


Following the general procedure, treatment of (*Z*)-2-bromo-3-(4-chlorophenyl)acrylaldehyde **1p** (92.0 mg, 0.38 mmol) and dimethyl 2-(2-

oxo-2-phenylethyl)malonate **2a** (62.5 mg, 0.25 mmol) with triazolium salt **4** (9.2 mg, 0.025 mmol), Na_2CO_3 (106.0 mg, 1.0 mmol) in THF (3.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(4-chlorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3p** as a light yellow oil (37.0 mg, 40%).

R_f (Pet. ether /EtOAc = 80/20): 0.65; 99% ee, $[\alpha]_D^{25}$ = -334.60 (c 0.1, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 10.1 min, Minor: 14.8 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.53 (d, *J* = 7.2 Hz, 2H, H_{ar}), 7.40 (t, *J* = 7.1 Hz, 2H, H_{ar}), 7.33 (t, *J* = 7.2 Hz, 1H, H_{ar}), 7.26 (d, *J* = 8.5 Hz, 2H, H_{ar}), 7.18 (d, *J* = 8.5 Hz, 2H, H_{ar}) 6.11 (s, 1H, $H_{olefinic}$), 5.06 (s, 1H), 3.94-3.89 (m, 1H), 3.81 (s, 3H, CH_3), 3.24 (s, 3H, CH_3), 3.21(d, *J* = 17.3 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.37, 169.75, 140.90, 137.79, 134.86, 133.36, 130.55, 128.68, 128.34, 128.19, 125.99, 125.79, 65.09, 56.63, 53.23, 52.26, 40.79. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4ClNa$: 393.0864, found: 393.0859. **FTIR (cm^{-1})** 3435, 3021, 2955, 2401, 1732, 1635, 1489, 1437, 1267, 1216, 1169, 1091, 1017, 930, 770, 672.

Dimethyl (*S*)-2-(4-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3q)

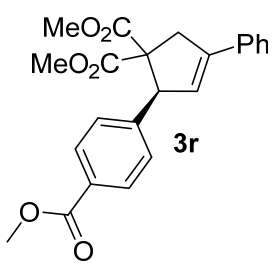


Following the general procedure, treatment of (*Z*)-2-bromo-3-(4-fluorophenyl)acrylaldehyde **1q** (171.7 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(4-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3q** as a light yellow oil (133.0 mg, 75%).

R_f (Pet. ether /EtOAc = 80/20): 0.60; 99% ee, $[\alpha]_D^{25}$ = -232.72 (c 0.15, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 11.4 min, Minor: 17.4 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.52 (d, *J* = 8.5 Hz, 2H, H_{ar}), 7.38 (t, *J* = 7.1 Hz, 2H, H_{ar}), 7.31 (t, *J* = 7.3 Hz, 1H, H_{ar}), 7.22-7.18 (m, 2H, H_{ar}), 6.98-6.94 (m, 2H, H_{ar}), 6.11 (s, 1H, $H_{olefinic}$), 5.06 (s, 1H), 3.93-3.88 (m, 1H), 3.79 (s, 3H, CH_3), 3.21-3.17(m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.41, 169.80, 162.27 (d, *J* = 246.1 Hz), 140.61, 134.92, 130.74 (d, *J* = 8.0 Hz), 128.65, 128.11, 126.07, 125.96, 114.99 (d, *J* = 21.3 Hz), 65.09, 56.52, 53.15, 52.16, 40.74. **HRMS (ESI)**

calculated $[M+Na]^+$ for $C_{21}H_{19}O_4FNa$: 377.1160, found: 377.1154. **FTIR (cm^{-1})** 3441, 3028, 2053, 1734, 1636, 1604, 1507, 1438, 1265, 1224, 1098, 1018, 901, 841, 759.

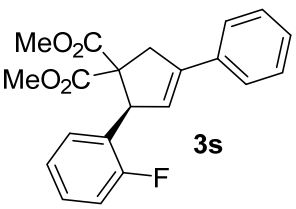
Dimethyl (*S*)-2-(4-(methoxycarbonyl)phenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3r)



Following the general procedure, treatment of methyl (*Z*)-4-(2-bromo-3-oxoprop-1-en-1-yl)benzoate **1r** (201.8 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(4-(methoxycarbonyl)phenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3r** as a light yellow solid (110.4 mg, 56%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.44; >99% ee, $[\alpha]_D^{25}$ = -224.45 (c 0.55, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 27.3 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.94 (d, *J* = 8.2 Hz, 2H, H_{ar}), 7.50 (d, *J* = 7.4 Hz, 2H, H_{ar}), 7.37 (t, *J* = 7.3 Hz, 2H, H_{ar}), 7.31 (t, *J* = 6.9 Hz, 3H, H_{ar}), 6.10 (d, *J* = 1.5 Hz, 1H, $H_{olefinic}$), 5.11 (s, 1H), 3.94-3.89 (m, 4H), 3.79 (s, 3H, CH_3), 3.21(d, *J* = 16.9 Hz, 1H), 3.15 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.28, 169.63, 167.03, 144.79, 141.17, 134.80, 129.47, 129.34, 129.24, 128.68, 128.22, 126.00, 125.53, 65.21, 57.12, 53.27, 52.24, 52.19, 40.91. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{23}H_{22}O_6Na$: 417.1309, found: 417.1300. **FTIR (cm^{-1})** 3426, 3021, 2401, 1729, 1617, 1439, 1281, 1217, 1113, 969, 766, 670.

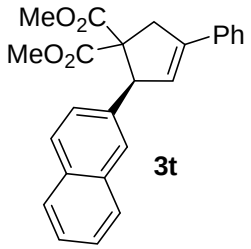
Dimethyl (*R*)-2-(2-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3s)



Following the general procedure, treatment of (*Z*)-2-bromo-3-(2-fluorophenyl)acrylaldehyde **1s** (171.7 mg, 0.75 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (125.1 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*R*)-2-(2-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3s** as a colourless solid (90.3 mg, 51%).

R_f (Pet. ether /EtOAc = 80/20): 0.59; 94% ee, $[\alpha]_D^{25}$ = -167.96 (c 0.1, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 10.5 min, Minor: 12.9 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.51 (d, *J* = 7.3 Hz, 2H, H_{ar}), 7.37 (t, *J* = 7.1 Hz, 2H, H_{ar}), 7.32-7.28 (m, 1H, H_{ar}), 7.22-7.17 (m, 1H, H_{ar}), 7.10 (t, *J* = 6.2 Hz, 1H, H_{ar}), 7.02 (t, *J* = 8.6 Hz, 2H, H_{ar}), 6.05 (s, 1H, $H_{olefinic}$), 5.46 (s, 1H), 4.02-3.97 (m, 1H), 3.79 (s, 3H, CH_3), 3.22 (s, 3H, CH_3) 3.18 (d, *J* = 17.2 Hz, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.18, 169.90, 160.87 (d, *J* = 248.7 Hz), 140.86, 134.92, 130.38 (d, *J* = 3.4 Hz), 129.19 (d, *J* = 8.2 Hz), 128.67, 128.13, 126.52, 126.37, 126.00, 125.43, 123.96 (d, *J* = 3.3 Hz), 115.29 (d, *J* = 22.4 Hz), 64.54, 53.26, 52.24, 49.19 (d, *J* = 3.3 Hz), 41.01. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_4FNa$: 377.1160, found: 377.1152. **FTIR (cm^{-1})** 3685, 3619, 3434, 3021, 2401, 2358, 1733, 1605, 1521, 1491, 1435, 1216, 1049, 929,773, 670.

Dimethyl (*S*)-2-(naphthalen-2-yl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3t)

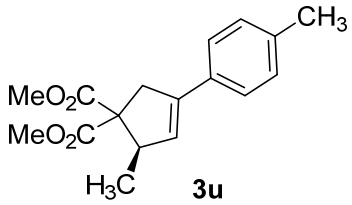


3t

Following the general procedure, treatment of (*Z*)-2-bromo-3-(naphthalen-2-yl)acrylaldehyde **1t** (98.0 mg, 0.38 mmol) and dimethyl 2-(2-oxo-2-phenylethyl)malonate **2a** (62.5 mg, 0.25 mmol) with triazolium salt **4** (9.2 mg, 0.025 mmol), Na_2CO_3 (106 mg, 1.0 mmol) in DME (3.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*S*)-2-(naphthalen-2-yl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate **3t** as a light yellow oil (55.0 mg, 57%).

R_f (Pet. ether /EtOAc = 80/20): 0.64; 99% ee, $[\alpha]_D^{25}$ = -200.97 (c 0.45, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 80:20 Hexane / IPA, 0.7 mL/min.) Major: 14.6 min, Minor: 20.0 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.78-7.73 (m, 3H, H_{ar}), 7.68 (s, 1H, H_{ar}), 7.56 (d, *J* = 7.3 Hz, 2H, H_{ar}), 7.45-7.30 (m, 6H, H_{ar}), 6.21 (s, 1H, $H_{olefinic}$), 5.24 (s, 1H), 4.00 (d, *J* = 16.9 Hz, 1H), 3.81 (s, 3H, CH_3), 3.25 (d, *J* = 16.9 Hz, 1H), 3.03 (s, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 172.62, 169.90, 140.57, 136.80, 135.11, 133.35, 132.89, 128.69, 128.09, 128.00, 127.93, 127.68, 127.42, 126.40, 126.10, 126.05, 125.92, 65.31, 57.44, 53.22, 52.14, 40.96. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{25}H_{22}O_4Na$: 409.1410, found: 409.1399. **FTIR (cm^{-1})** 3685, 3430, 3021, 2956, 2401, 2355, 1731, 1603, 1517, 1436, 1216, 1053, 928, 767.

Dimethyl (*R*) 2-methyl-4-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3u)

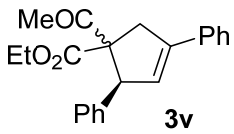


3u

Following the general procedure, treatment of (*Z*)-2-bromobut-2-enal **1u** (28.0 mg, 0.188 mmol) and dimethyl 2-(2-oxo-2-(*p*-tolyl)ethyl)malonate **2b** (33.0 mg, 0.125 mmol) with triazolium salt **4** (4.6 mg, 0.0125 mmol), Na_2CO_3 (53.0 mg, 0.5 mmol) in DME (2.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*R*) 2-methyl-4-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate **3u** as a light yellow oil (15.0 mg, 42%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.70; 90% ee, $[\alpha]_D^{25}$ = -60.5 (c 0.1, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 95:05 Petroleum ether / IPA, 0.5 mL/min.) Major: 12.8 min, Minor: 14.5 min. **^{1}H NMR (500 MHz, $CDCl_3$)** δ 7.30 (d, *J* = 8.2 Hz, 2H, H_{ar}), 7.12 (d, *J* = 8.0 Hz, 2H, H_{ar}), 5.93 (s, 1H), 3.79-3.76 (m, 1H), 3.75 (s, 3H, CH_3), 3.73 (s, 3H, CH_3), 3.70-3.66 (m, 1H), 3.09 (d, *J* = 16.5 Hz, 1H), 2.33 (s. 3H), 1.02 (d, *J* = 7.2 Hz, 3H). **^{13}C NMR (125 MHz, $CDCl_3$)** δ 172.78, 171.00, 137.90, 137.49, 132.61, 129.20, 127.84, 125.64, 63.47, 52.97, 52.51, 45.62, 40.12, 21.32, 16.09. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{17}H_{20}O_4Na$: 311.1254, found: 311.1251. FTIR (cm^{-1}) 3917, 3750, 3507, 3015, 2947, 2829, 2387, 2351, 1823, 1727, 1673, 1566, 1438, 1213, 1095, 1049, 949.

Ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate (3v)



3v

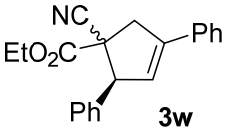
Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and ethyl 2-acetyl-4-oxo-4-phenylbutanoate **2v** (124 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford 3:1 diastereomeric mixture of ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate **3v** as a white solid (Major isomer 67 mg yield 38% and minor isomer 23 mg yield 16%, diastereomeric ratio was determined by ^{1}H-NMR analysis of crude reaction mixture).

Major Isomer ***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.61; >99% ee, $[\alpha]_D^{25}$ = -359.98 (c 0.35, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 10.5 min, Minor: 16.2 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.54-7.52 (m, 2H, H_{ar}), 7.39 (t, *J* = 7.8 Hz, 2H, H_{ar}), 7.33-

7.22 (m, 6H, H_{ar}), 6.15 (s, 1H, $H_{olefinic}$), 5.06 (s, 1H), 4.01-3.96 (m, 1H), 3.81-3.75 (m, 1H), 3.54-3.48 (m, 1H), 2.98 (d, J = 16.6 Hz, 1H), 2.29 (s, 3H, CH_3), 0.88 (t, J = 7.1 Hz, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 201.74, 170.24, 139.83, 139.01, 135.08, 129.35, 128.57, 128.11, 127.90, 127.43, 127.30, 125.84, 71.31, 61.40, 55.25, 39.53, 26.36, 13.53. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_3Na$: 357.1461, found: 357.1456. **FTIR (cm^{-1})** 3429, 3022, 2401, 2311, 1711, 1636, 1491, 1358, 1217, 1090, 768, 670.

Minor Isomer R_f (Pet. ether /EtOAc = 80/20): 0.64; >99% ee, $[\alpha]_D^{25}$ = -326.84 (c 0.25, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 10.4 min, Minor: 11.6 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.53-7.51 (m, 2H, H_{ar}), 7.38-7.35 (m, 2H, H_{ar}), 7.31-7.20 (m, 6H, H_{ar}), 6.09-6.08 (m,1H, $H_{olefinic}$), 5.08 (s, 1H), 4.32-4.22 (m, 2H), 4.01-3.96 (m, 1H), 3.05 (d, J = 17.0 Hz, 1H), 1.63 (s, 3H, CH_3), 1.30 (t, J = 7.1 Hz, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 202.00, 173.09, 140.11, 139.24, 135.21, 129.47, 128.67, 128.61, 127.96, 127.72, 126.73, 125.99, 71.38, 62.13, 57.10, 39.63, 27.93, 14.16. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{22}H_{22}O_3Na$: 357.1461, found: 357.1455. **FTIR (cm^{-1})** 3437, 3057, 3029, 2981, 1953, 1711, 1600, 1492, 1354, 1233, 1158, 1058, 840, 755.

Ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate (3w)



3w

Following the general procedure, treatment of (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (158.2 mg, 0.75 mmol) and ethyl 2-cyano-4-oxo-4-phenylbutanoate **2w** (115.6 mg, 0.50 mmol) with triazolium salt **4** (18.4 mg, 0.05 mmol), Na_2CO_3 (212 mg, 2.0 mmol) in DME (6.0 mL) and stirring the reaction mixture at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford 3:1 diastereomeric mixture of ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate **3w** as a colourless oil (Major isomer 48 mg yield 30% and minor isomer 18 mg yield 12%, diastereomeric ratio was determined by ^{1}H-NMR analysis of crude reaction mixture).

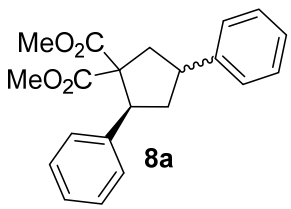
Major Isomer R_f (Pet. ether /EtOAc = 80/20): 0.55; 85% ee, $[\alpha]_D^{25}$ = -43.86 (c 0.15, $CHCl_3$). **HPLC** (Chiralcel OD-H, 95:05 Hexane / IPA, 0.7 mL/min.) Major: 22.9 min, Minor: 18.6 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.50 (d, J = 7.1 Hz, 2H, H_{ar}), 7.43-7.34 (m, 8H, H_{ar}), 6.20 (s, 1H, $H_{olefinic}$), 4.81 (s, 1H), 4.39-4.36 (m, 2H), 3.66 (d, J = 16.1 Hz, 1H), 3.54 (d, J = 16.1 Hz, 1H),

1.38 (t, J = 7.1 Hz, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 168.83, 140.81, 137.99, 134.16, 128.83, 128.80, 128.70, 128.57, 128.55, 125.95, 125.31, 118.53, 63.39, 59.32, 55.02, 44.07, 14.15. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_2NNa$: 340.1308, found: 340.1304. **FTIR (cm^{-1})** 3440, 3021, 1740, 1635, 1493, 1499, 1216, 1074, 757, 897, 669.

Minor Isomer R_f (Pet. ether /EtOAc = 80/20): 0.64; 95% ee, $[\alpha]_D^{25}$ = -95.71 (c 0.6, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 90:10 Hexane / IPA, 0.7 mL/min.) Major: 14.1 min, Minor: 10.9 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.52 (d, J = 7.3 Hz, 2H, H_{ar}), 7.41 (t, J = 7.7 Hz, 2H, H_{ar}), 7.36-7.29 (m, 4H, H_{ar}), 7.23-7.21 (m, 2H, H_{ar}), 6.15 (d, J = 2.0 Hz, 1H, $H_{olefinic}$), 4.82 (s, 1H), 3.88-3.84 (m, 1H), 3.82-3.79 (m, 1H), 3.64-3.61 (m, 1H), 3.35 (d, J = 16.4 Hz, 1H), 0.93 (t, J = 7.2 Hz, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 166.37, 141.68, 136.81, 134.25, 129.05, 128.83, 128.65, 128.57, 126.13, 124.26, 121.68, 62.78, 62.52, 52.12, 41.99, 13.60. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{19}O_2NNa$: 340.1308, found: 340.1303. **FTIR (cm^{-1})** 3682, 3464, 3021, 2984, 2931, 2401, 1743, 1602, 1394, 1246, 1072, 774, 669.

Diastereoselective Hydrogenation of 3a

Dimethyl (2*S*)-2,4-diphenylcyclopentane-1,1-dicarboxylate (8a)



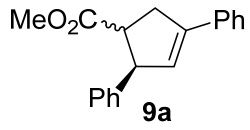
An oven dried round bottomed flask was charged with dimethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate **3a** (84.1 mg, 0.25 mmol, 1 equiv) and Pd 10% on activated carbon (10 mg, 0.03 equiv) in methanol (10 mL). The reaction mixture was kept stirring at 32 °C for 12 h under H_2 atmosphere (balloon pressure). Upon consumption of the starting material **3a** (TLC), the crude reaction mixture was passed through celite and concentrated under reduced pressure to get a sufficiently pure dimethyl (2*S*)-2,4-diphenylcyclopentane-1,1-dicarboxylate **8a** in 98% yield (82 mg, *dr* 20:1)

R_f (Pet. ether /EtOAc = 80/20): 0.65; $[\alpha]_D^{25}$ = -38.88 (c 0.2, $CHCl_3$). **HPLC** (Kromasil 5-AmyCoat, 99:1 Hexane / IPA, 0.5 mL/min.) Major diastereomer (Major: 19.2 min, Minor: 20.7 min). Minor diastereomer (Major: 22.6 min, Minor: 25.5 min). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.46-7.39 (m, 6H, H_{ar}), 7.34-7.25 (m, 4H, H_{ar}), 4.37-4.33 (m, 1H), 3.82 (s, 3H, CH_3), 3.24-3.16 (m, 4H), 3.01 (d, J = 13.2 Hz, 1H), 2.64-2.59 (m, 1H), 2.46-2.32 (m, 2H). **^{13}C NMR (100 MHz,**

$CDCl_3$) δ 173.23, 171.23, 143.02, 140.08, 128.73, 128.62, 128.07, 127.30, 127.10, 126.65, 65.33, 52.89, 52.00, 50.90, 43.66, 42.48, 40.54. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{21}H_{22}O_4Na$: 361.1410, found: 361.1404. **FTIR (cm^{-1})** 3463, 3061, 2952, 1728, 1603, 1455, 1365, 1096, 1046, 947, 752.

Decarboxylation of 3a

Methyl (2*R*)-2,4-diphenylcyclopent-3-ene-1-carboxylate (9a)

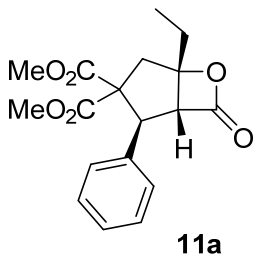


9a

To a microwave reaction tube was charged with **3a** (0.084 gm, 0.25 mmol) and LiCl (0.083 gm, 1.95 mmol, 7.8 equiv). Then the mixture was dissolved in DMSO (2.0 mL) : H_20 (1.5 mL). The reaction mixture was placed in a microwave reactor (Anton Paar, Monowave 300), and heated to 185 ^oC for 30 min. The resultant reaction mixture was quenched with saturated aq. solution of $NaHCO_3$ and extracted with Et_2O (3x10 mL). Then the organic layer was washed with brine, dried over Na_2SO_4, concentrated and the crude reaction mixture was purified by flash column chromatography to afford the diastereomeric mixture of methyl (2*R*)-2,4-diphenylcyclopent-3-ene-1-carboxylate **9a** in 51% yield (35 mg, *dr* 1:1).

R_f (Pet. ether /EtOAc = 80/20): 0.72; $[\alpha]_D^{25}$ = +104.5 (c 0.2, $CHCl_3$). **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.56 (d, *J* = 7.2 Hz, 2H, H_{ar}), 7.51 (d, *J* = 7.2 Hz, 2H, H_{ar}), 7.41-7.22 (m, 14H, H_{ar}), 7.20-7.17 (m, 2H, H_{ar}), 6.16 (s, 2H, $H_{olefinic}$), 4.45-4.42 (m, 2H), 3.80-3.73 (m, 4H), 3.49-3.41 (m, 1H), 3.26-3.14 (m, 6H), 2.96-2.89 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 175.61, 173.36, 144.49, 142.67, 141.43, 140.24, 135.56, 128.75, 128.62, 128.20, 127.81, 127.65, 127.18, 126.93, 126.77, 126.00, 125.90, 55.27, 54.66, 52.27, 52.08, 51.25, 48.75, 37.14, 34.62. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{19}H_{18}O_2Na$: 301.1199, found: 301.1196. **FTIR (cm^{-1})** 3021, 1745, 1379, 1214, 742, 669.

Dimethyl *(1R,2S,5S)* 5-ethyl-7-oxo-2-phenyl-6-oxabicyclo[3.2.0]heptane-3,3-dicarboxylate (11a)



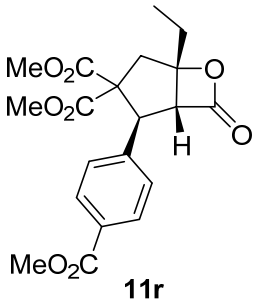
11a

To an oven-dried Schlenk reaction vessel with a teflon screw cap was taken the (*Z*)-2-bromo 3-phenylacrylaldehye **1a** (79.1 mg, 0.38 mmol), the dimethyl 2-(2-oxobutyl)malonate **10** (50.0 mg, 0.25 mmol) and Na_2CO_3

(106 mg, 1.0 mmol, 4.0 equiv). The mixture was kept under argon atmosphere, and dry DME (3.0 mL) was then introduced into the vessel by syringe under a positive pressure of argon, and the mixture was stirred at 32 °C. To this stirring solution was added the triazolium salt **4** (9.2 mg, 0.025 mmol), and the resulting mixture was stirred at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*1R,2S,5S*) 5-ethyl-7-oxo-2-phenyl-6-oxabicyclo[3.2.0] heptane-3,3-dicarboxylate **11a** as a white solid (38.0 mg, 46%).

***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.4, 99% ee, $[\alpha]_D^{25}$ = -188.7 (c 0.1, $CHCl_3$). **HPLC** (Chiralpak IA, 97:03 Petroleum ether / IPA, 0.5 mL/min, λ = 210 nm) Major: 18.7 min, Minor: 21.9 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.31-7.27 (m, 3H, H_{ar}), 6.99-6.97 (m, 2H, H_{ar}), 4.65 (s, 1H), 3.81 (s, 3H, CH_3), 3.70 (s, 1H), 3.31 (s, 3H, CH_3), 2.95-2.85 (m, 2H), 2.28-2.12 (m, 2H), 1.18 (t, *J* = 7.3 Hz, 3H, CH_3) **^{13}C NMR (100 MHz, $CDCl_3$)** δ 170.89, 168.36, 167.95, 138.52, 128.85, 128.10, 128.06, 90.77, 63.74, 53.65, 52.71, 50.68, 40.59, 28.57, 8.88. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{18}H_{20}O_6Na$: 355.1152, found: 355.1150. FTIR (cm^{-1}) 3118, 3022, 2430, 1827, 1734, 1780, 1556, 1445, 1035, 924.

Dimethyl (*1R,2S,5S*)-5-ethyl-2-(4-(methoxycarbonyl)phenyl)-7-oxo-6-oxabicyclo[3.2.0] heptane-3,3 dicarboxylate (11r)



11r

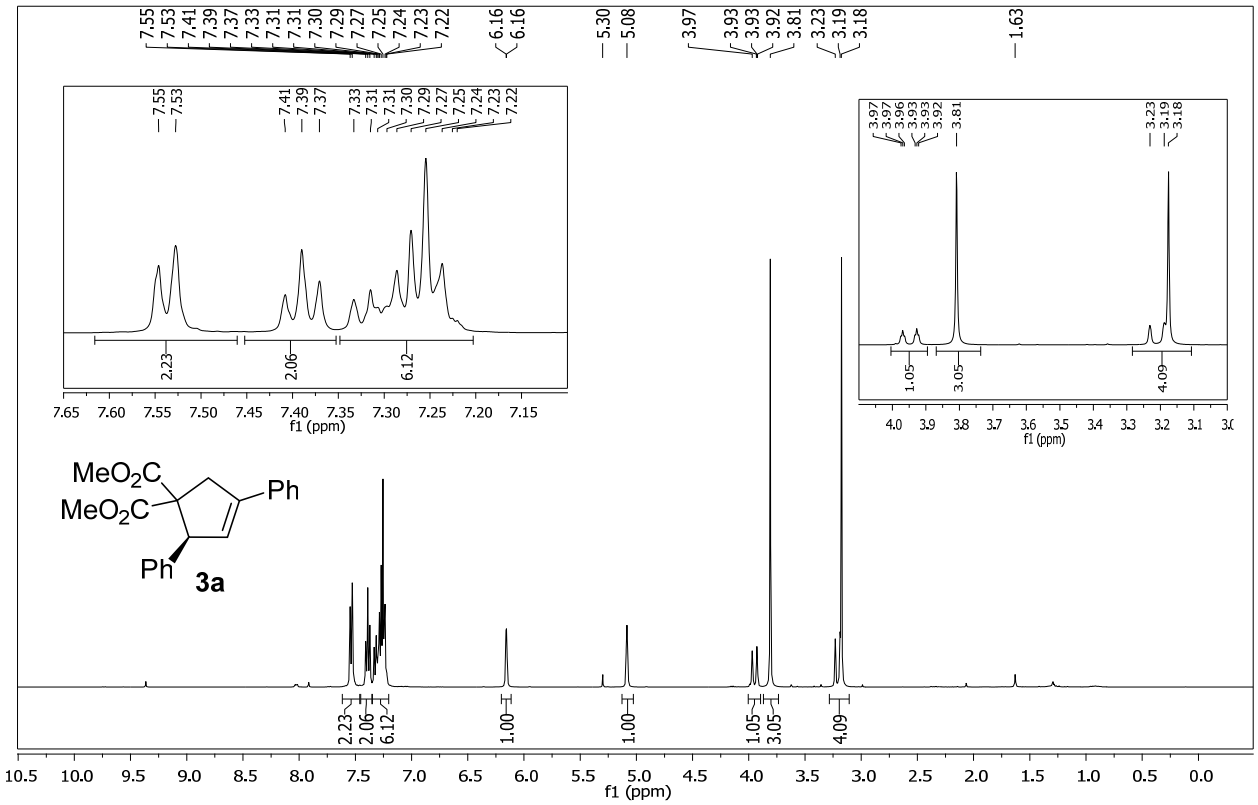
To an oven-dried Schlenk reaction vessel with a teflon screw cap was taken the (Z)-4-(2-bromo-3-oxoprop-1-en-1-yl)benzoate **1r** (101.0 mg, 0.38 mmol), the dimethyl 2-(2-oxobutyl)malonate **10** (50.0 mg, 0.25 mmol) and Na_2CO_3 (106 mg, 1.0 mmol, 4.0 equiv). The mixture was kept under argon atmosphere, and dry DME (3.0 mL) was then introduced into the vessel by syringe under a positive pressure of argon, and the mixture was stirred at 32 °C. To this stirring solution was added the triazolium salt **4** (9.2 mg, 0.025 mmol), and the resulting mixture was stirred at 32 °C for 72 h followed by flash column chromatography (EtOAc-Pet. ether 10:90) to afford dimethyl (*1R,2S,5S*) 5-ethyl-2-(4-(methoxycarbonyl) phenyl)-7-oxo-6-oxabicyclo[3.2.0]heptane-3,3 dicarboxylate **11r** as a white solid (70.0 mg, 72%).

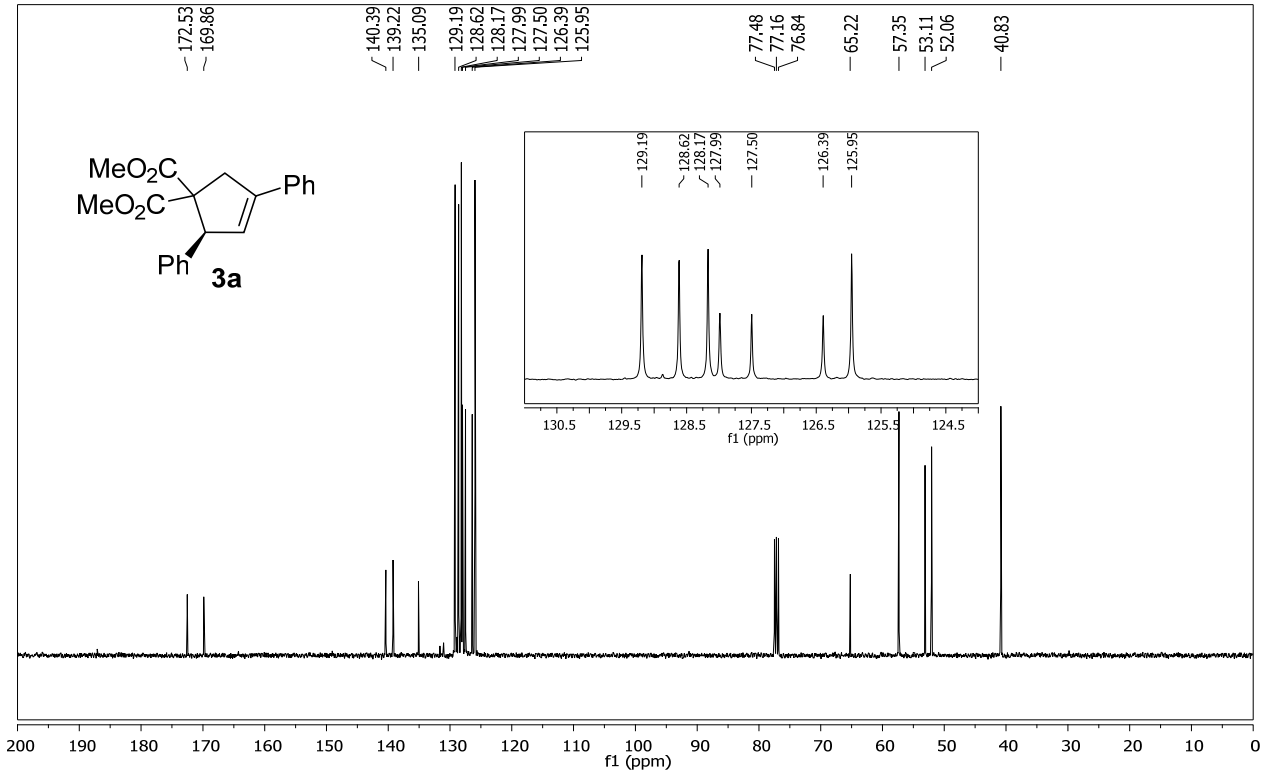
***R*$_f$** (Pet. ether /EtOAc = 80/20): 0.23, 99% ee, $[\alpha]_D^{25}$ = -74.1 (c 0.1, $CHCl_3$). **HPLC** (Chiralpak IA, 97:03 Petroleum ether / IPA, 1.0 mL/min. λ = 210nm). Major: 15.8 min, Minor: 16.8 min. **^{1}H NMR (400 MHz, $CDCl_3$)** δ 7.97 (d, *J* = 8.4 Hz, 2H, H_{ar}), 7.06 (d, *J* = 8.2 Hz, 2H, H_{ar}), 4.71 (s, 1H), 3.90 (d, 3H, CH_3), 3.81 (s, 3H, CH_3), 3.69 (s, 1H), 3.31 (s, 3H, CH_3), 2.97-2.85 (m, 2H),

2.26-2.14 (m,2H), 1.19 (t, J = 7.5 Hz, 3H, CH_3). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 170.57, 167.85, 167.68, 166.50, 130.11, 128.16, 90.68, 66.62, 63.53, 53.77, 52.86, 52.38, 50.52, 40.65, 28.60, 8.88. **HRMS (ESI)** calculated $[M+Na]^+$ for $C_{20}H_{22}O_8Na$: 413.1207, found: 413.1203. FTIR (cm^{-1}) 2973, 2954, 1828, 1723, 1612, 1531, 1435, 1418, 1375, 1280, 1227, 1153, 1112, 1018, 900, 864, 810, 763, 707, 665.

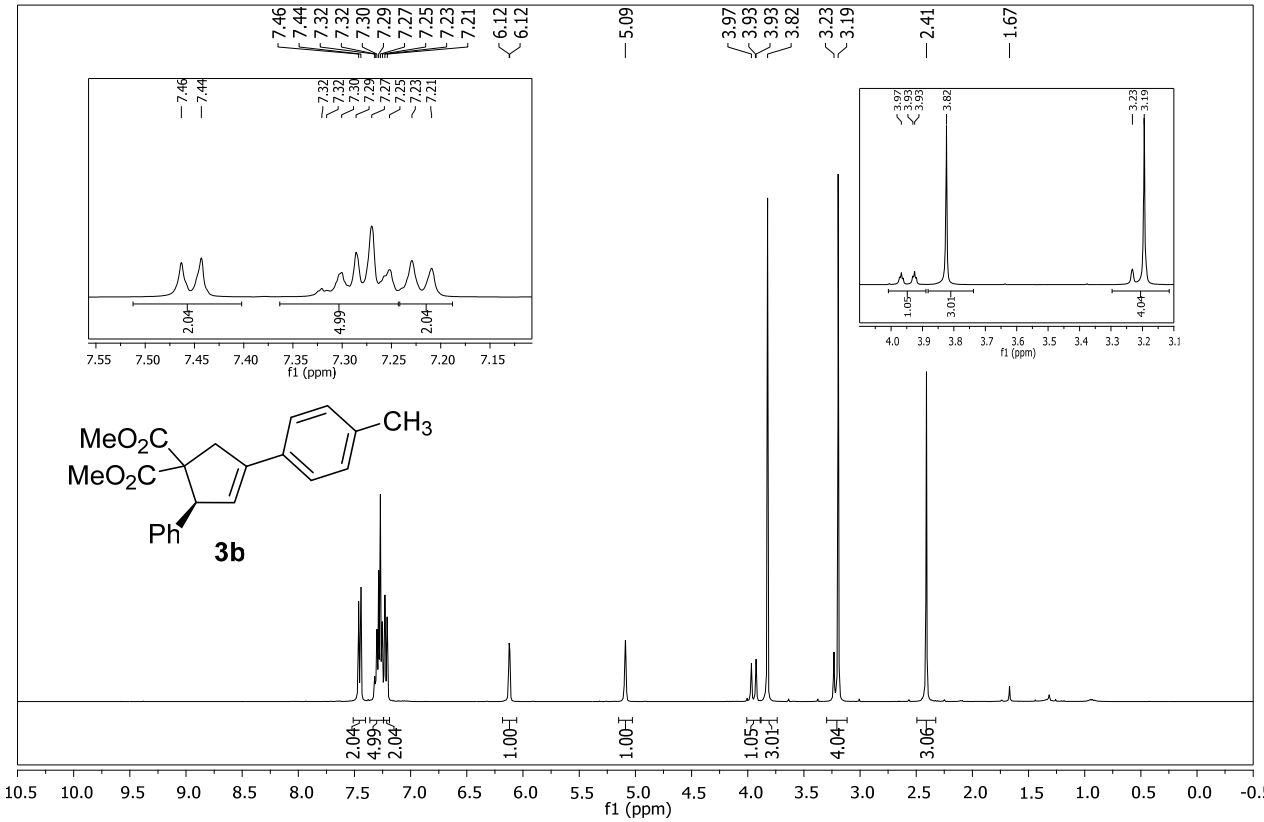
6. ^{1}H and ^{13}C NMR Spectra of Functionalized Cyclopentenes

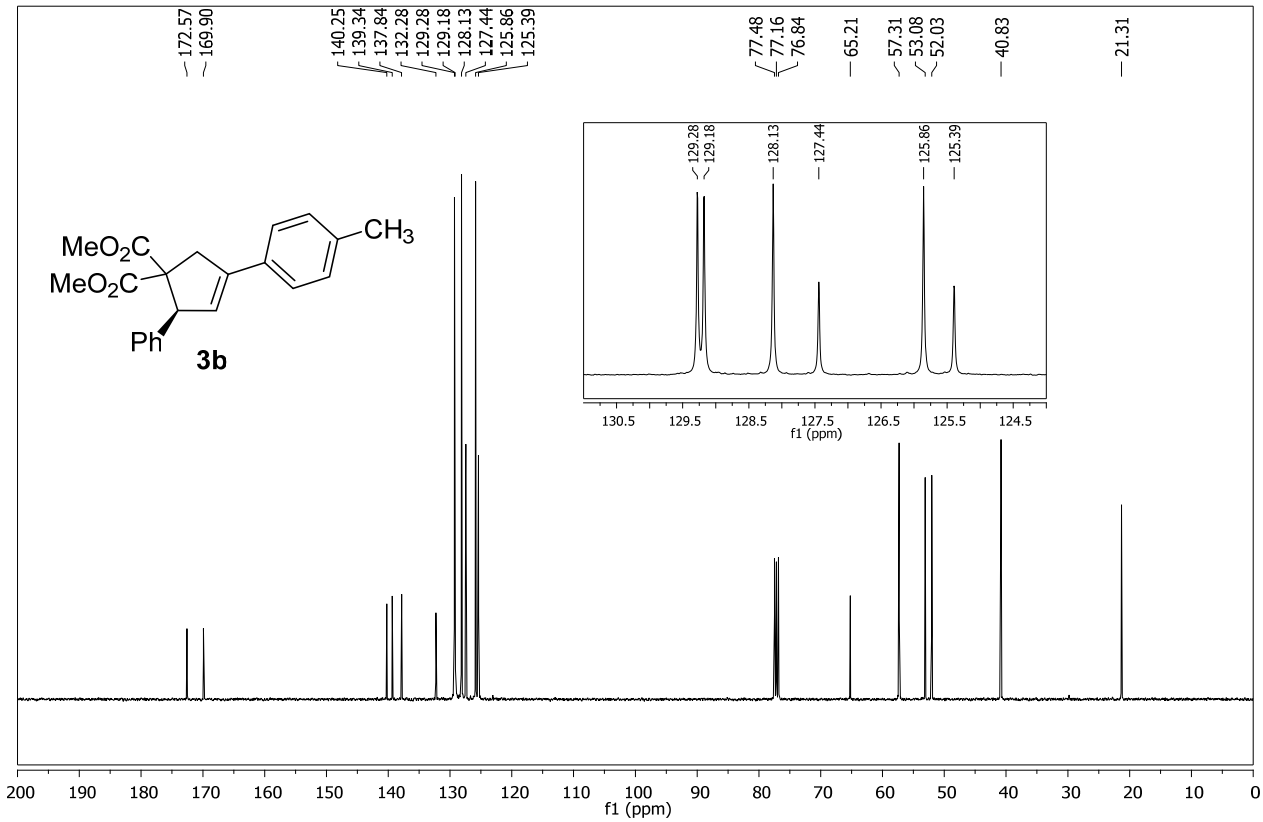
Dimethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate (3a)



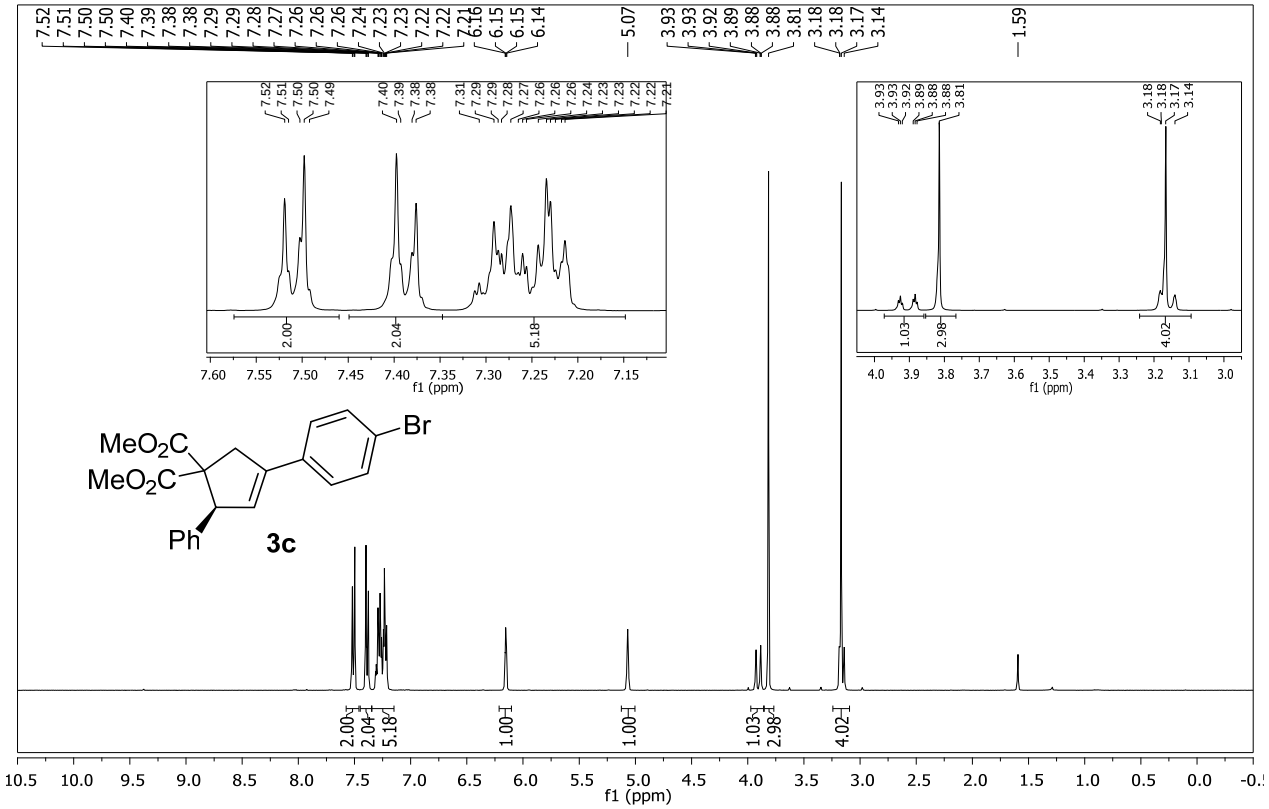


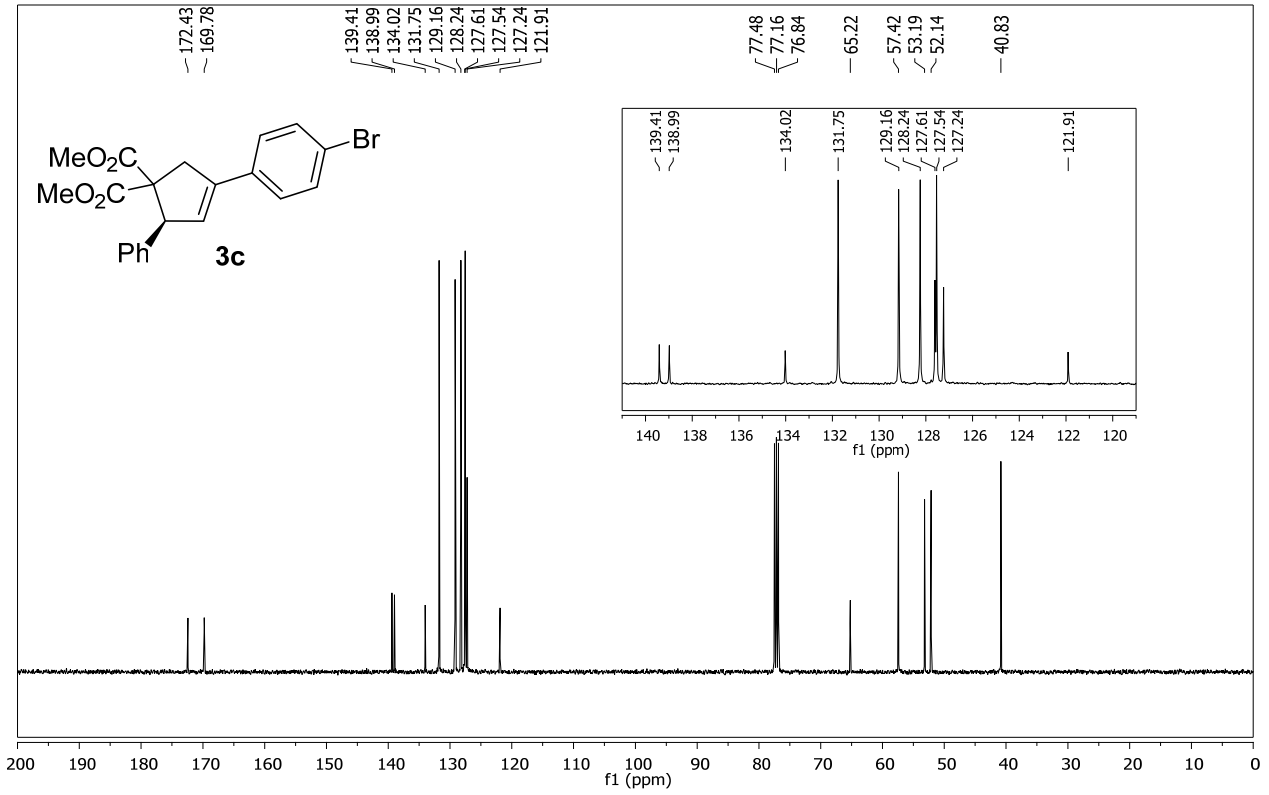
Dimethyl (*S*)-2-phenyl-4-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3b)



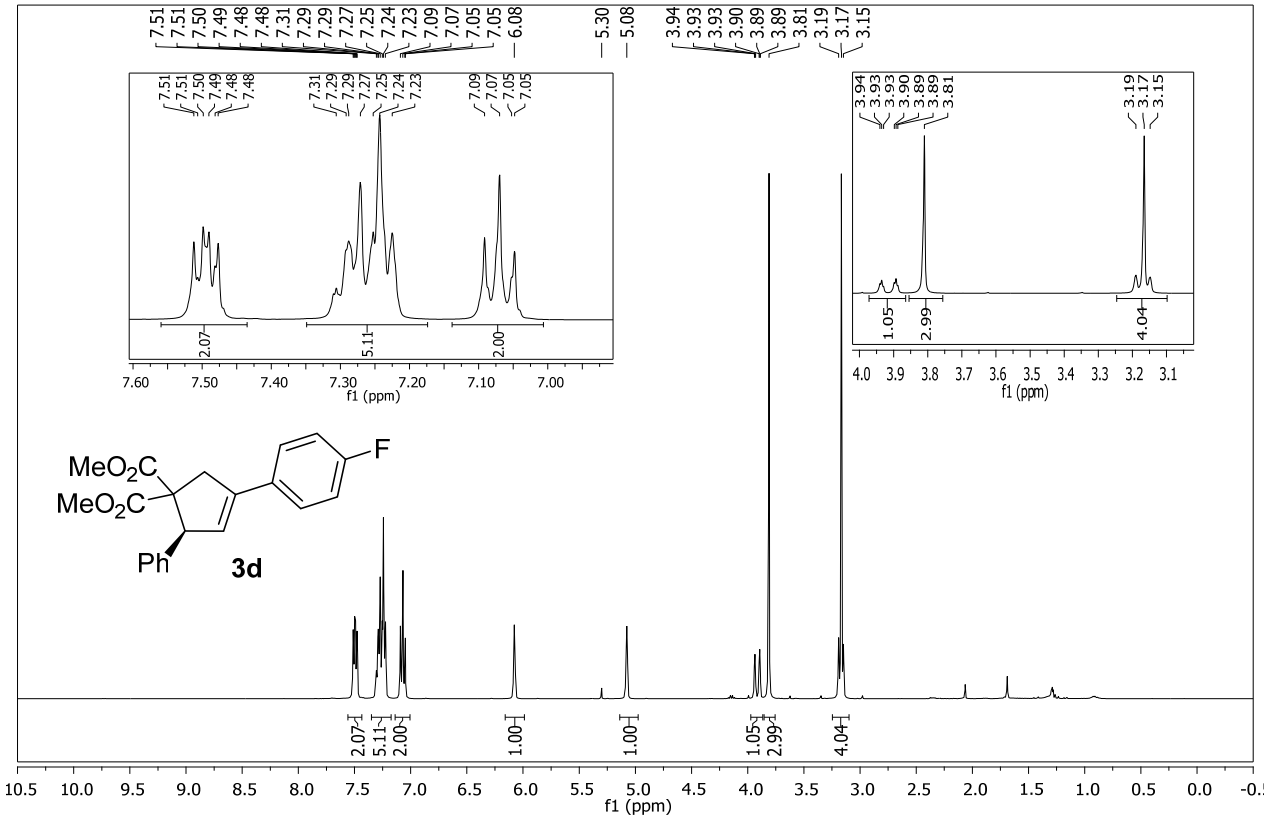


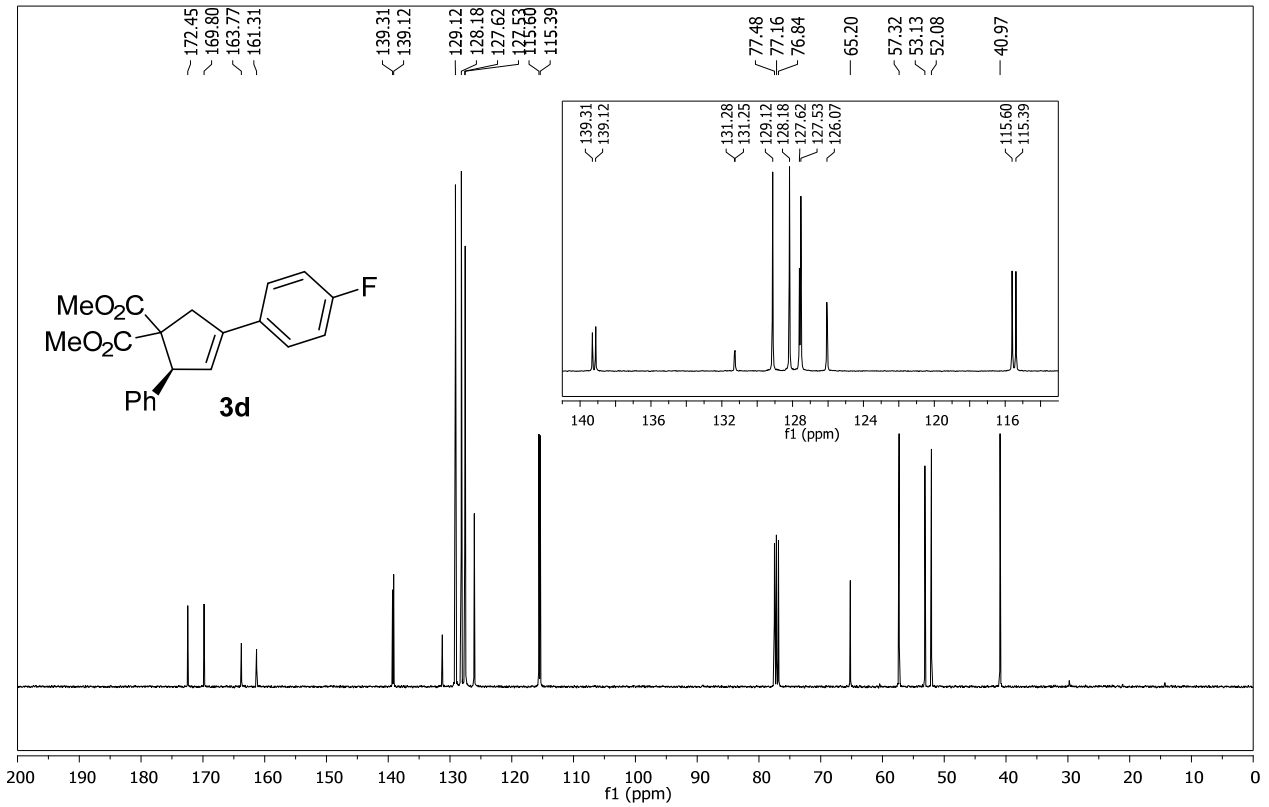
Dimethyl (*S*)-4-(4-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3c)



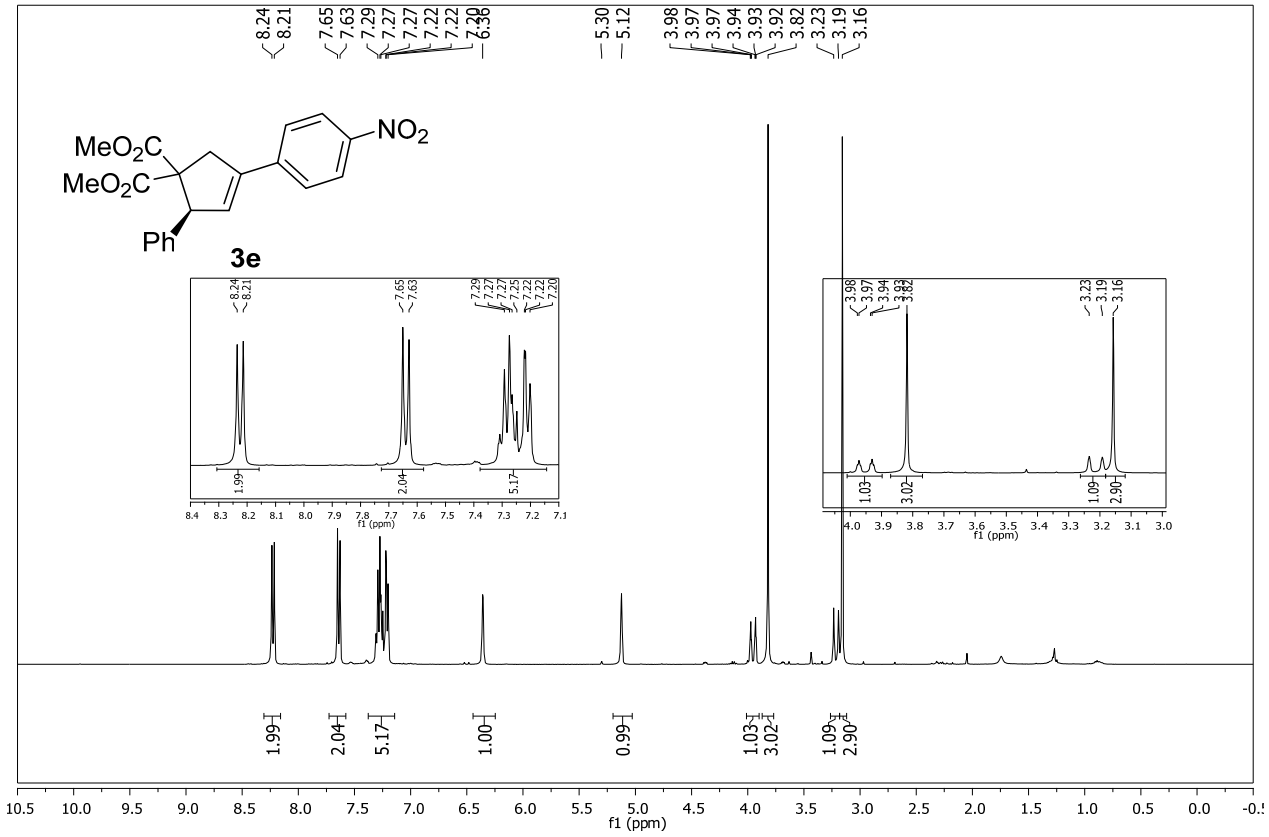


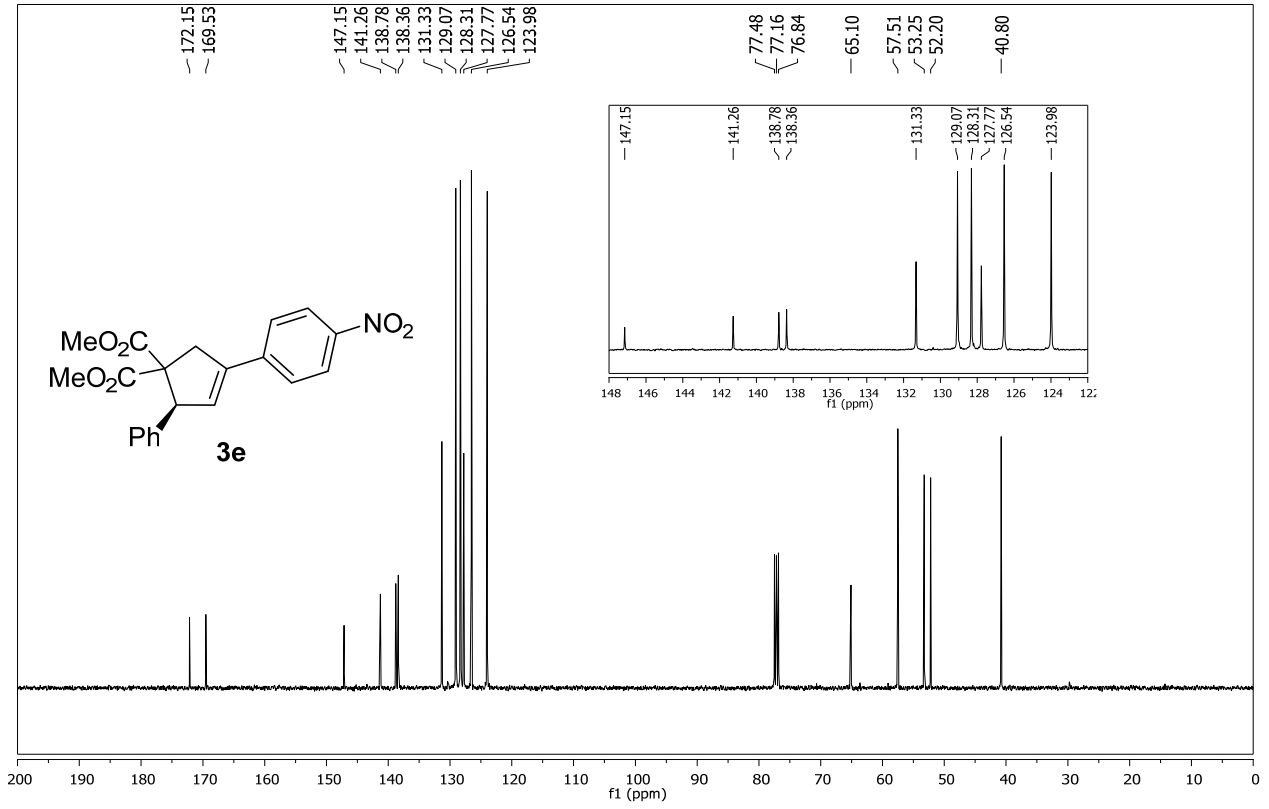
Dimethyl (*S*)-4-(4-fluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3d)



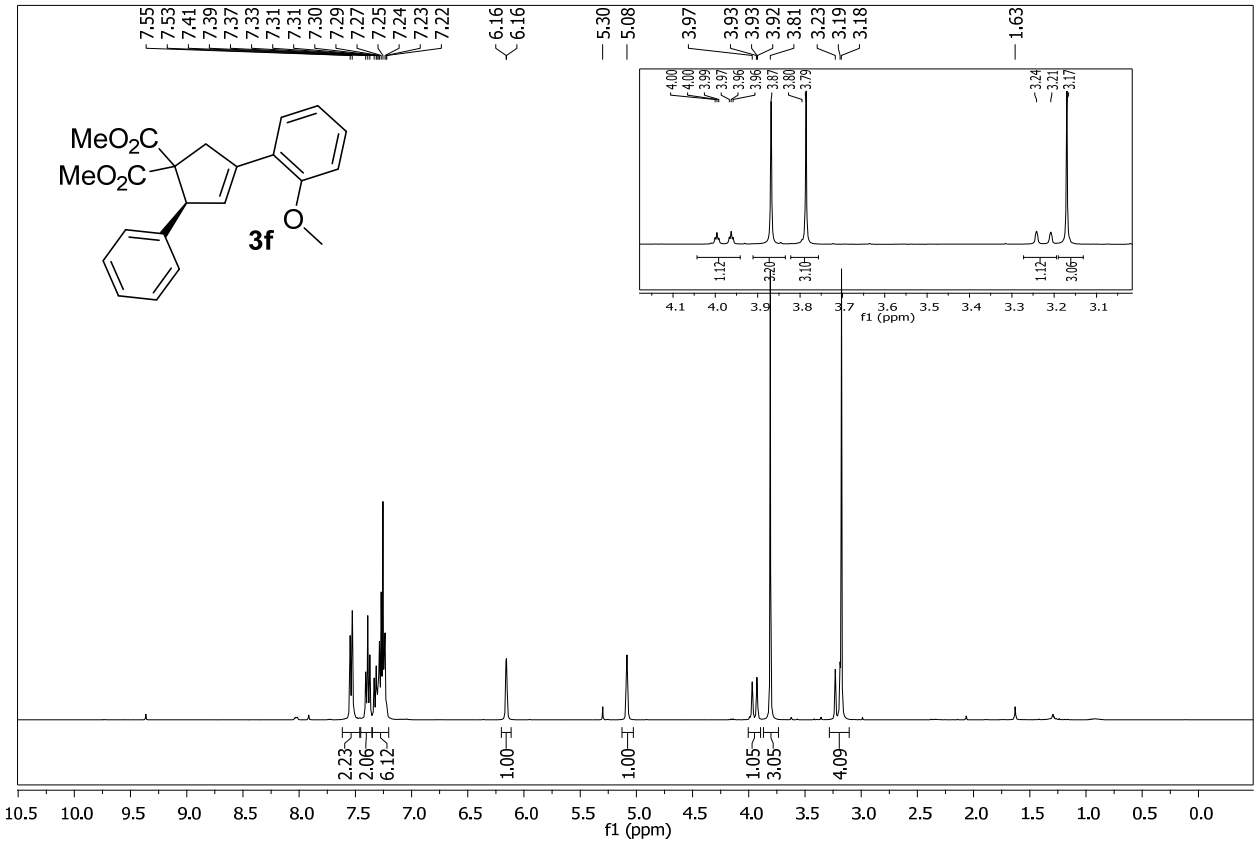


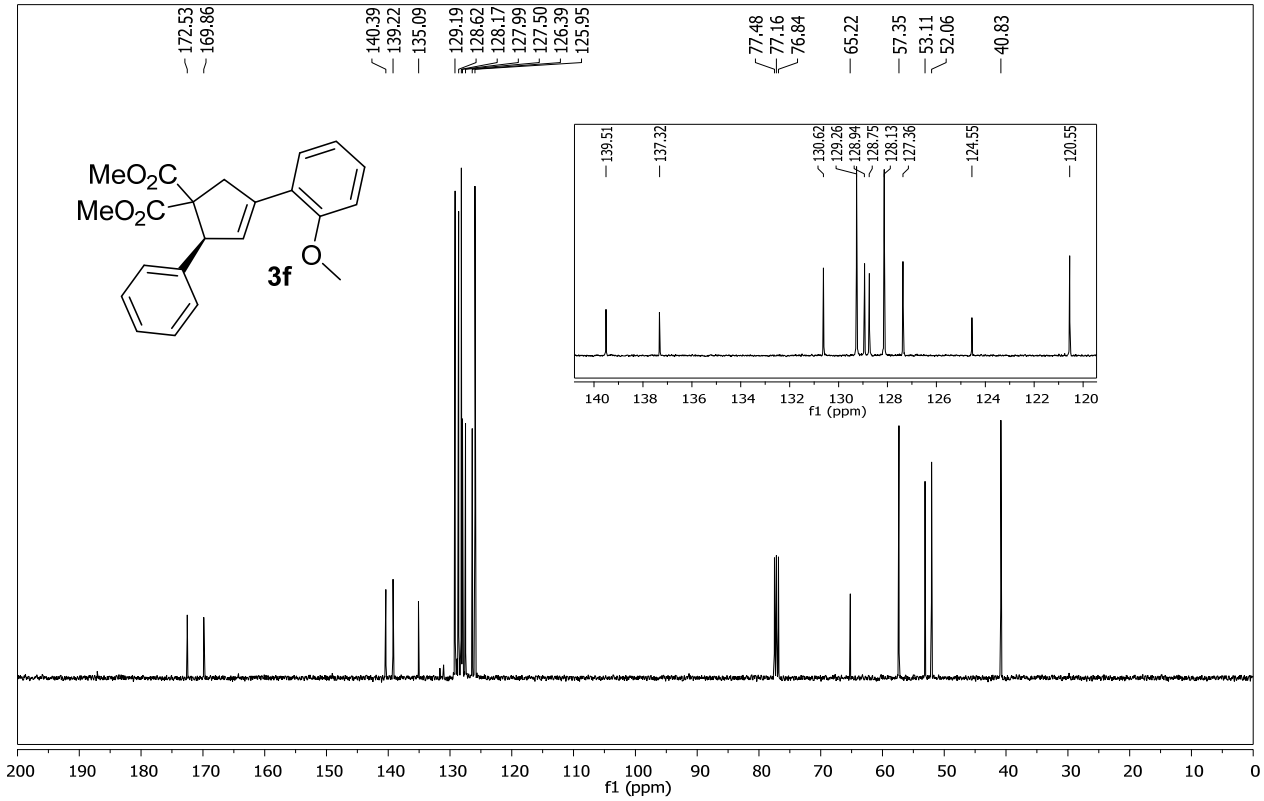
Dimethyl (*S*)-4-(4-nitrophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3e)



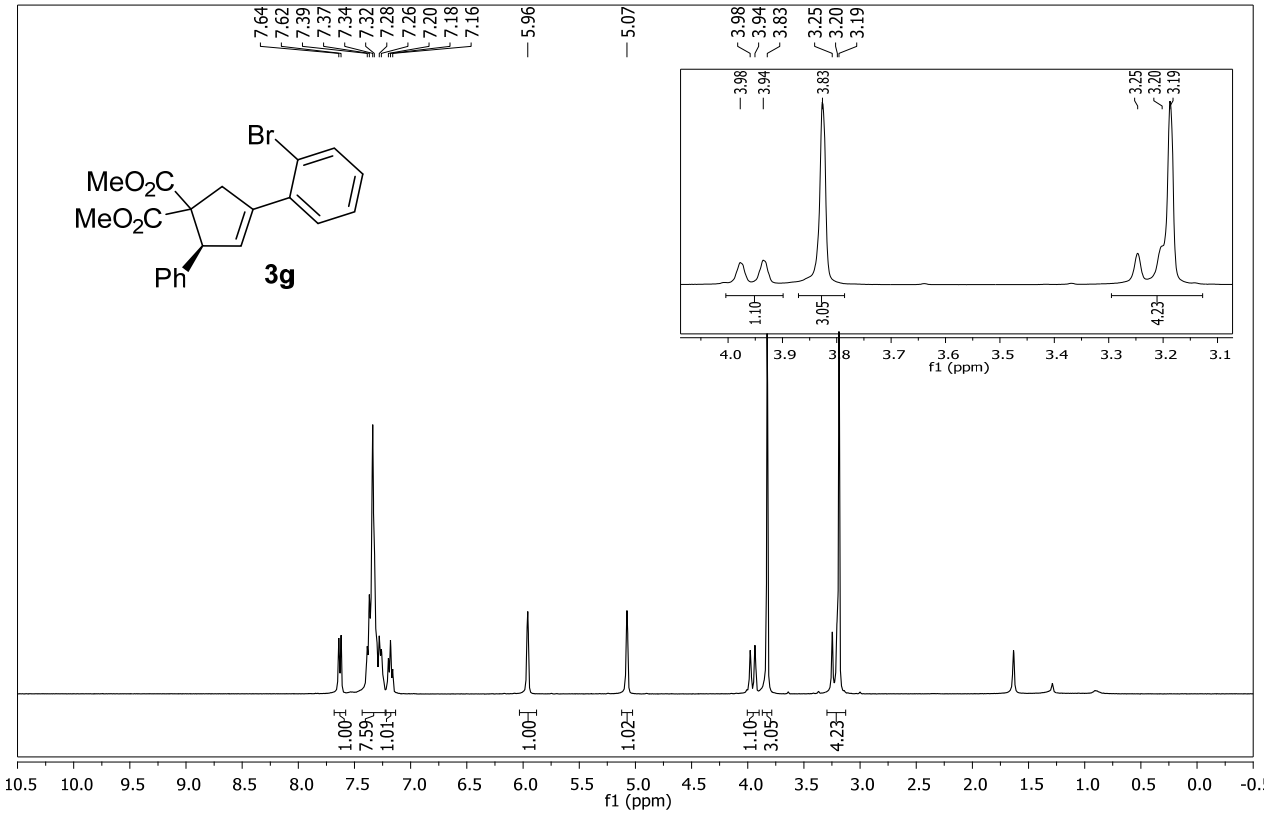


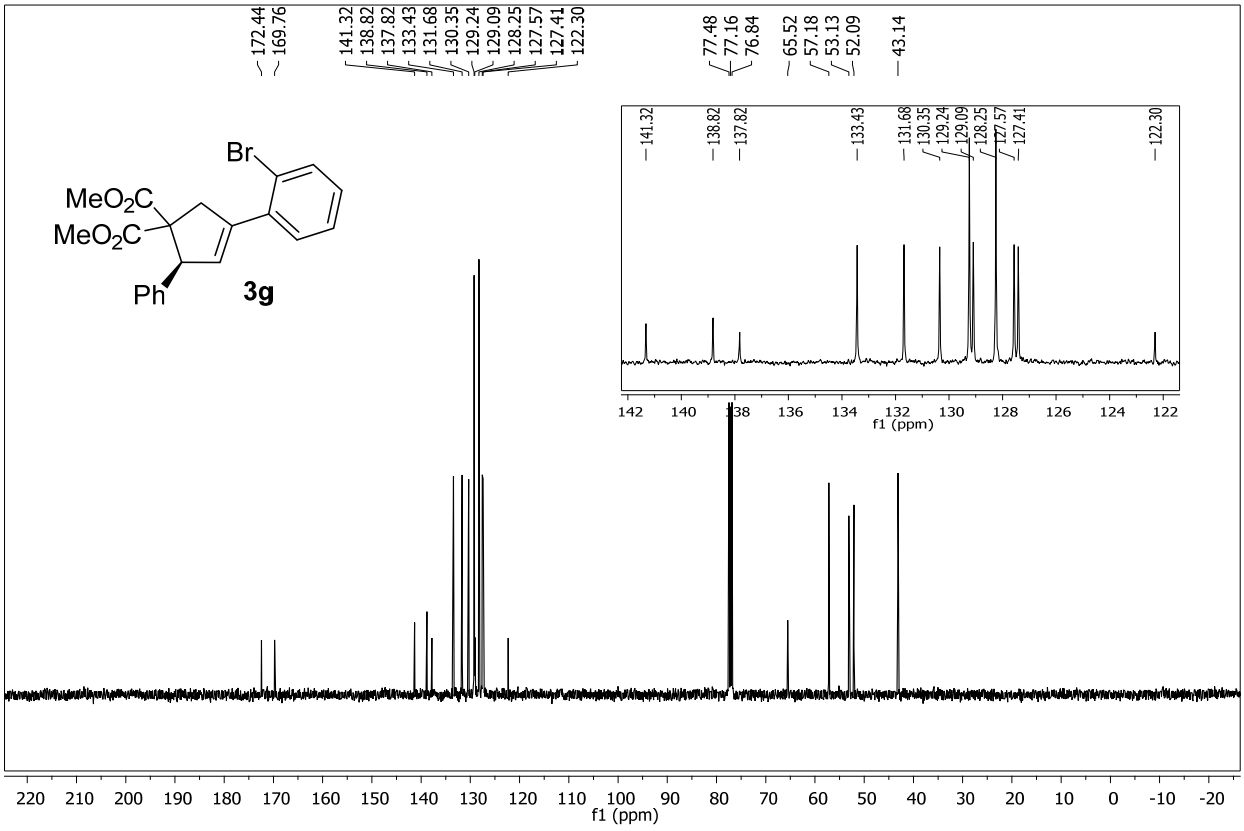
Dimethyl (*S*)-4-(2-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3f)



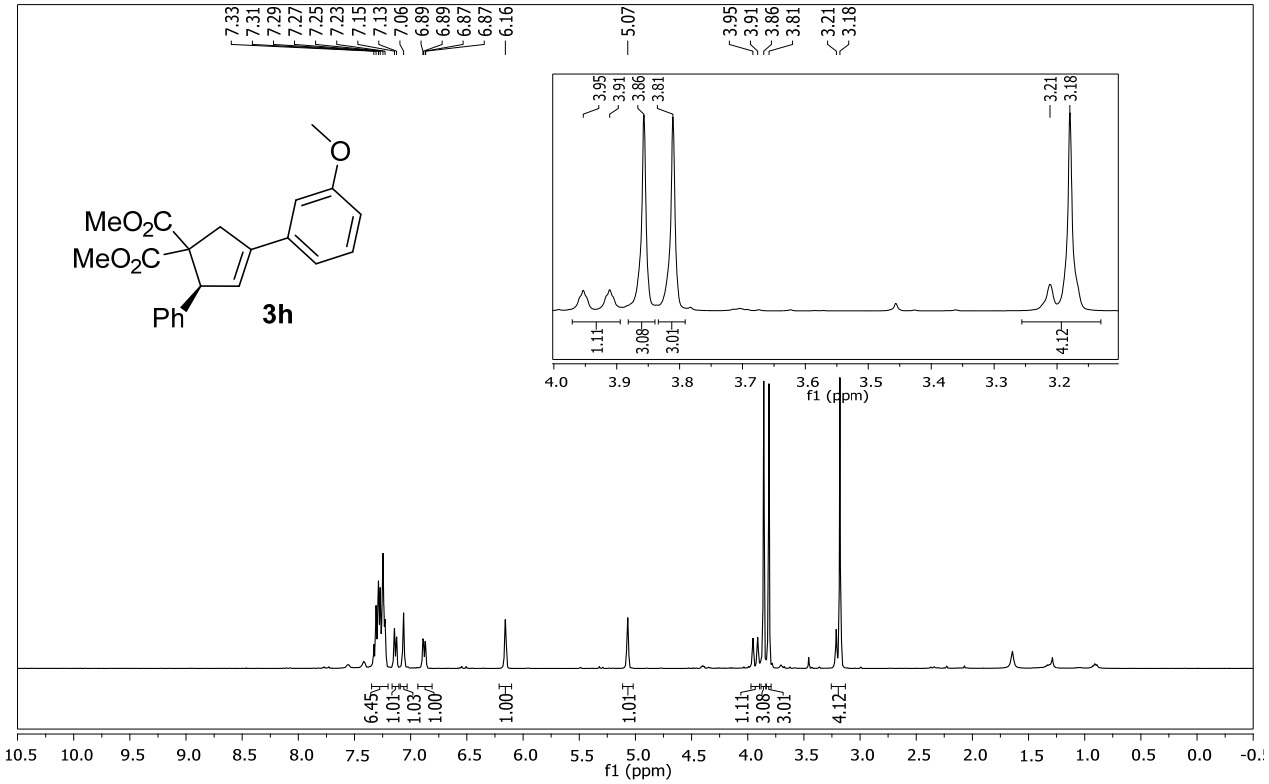


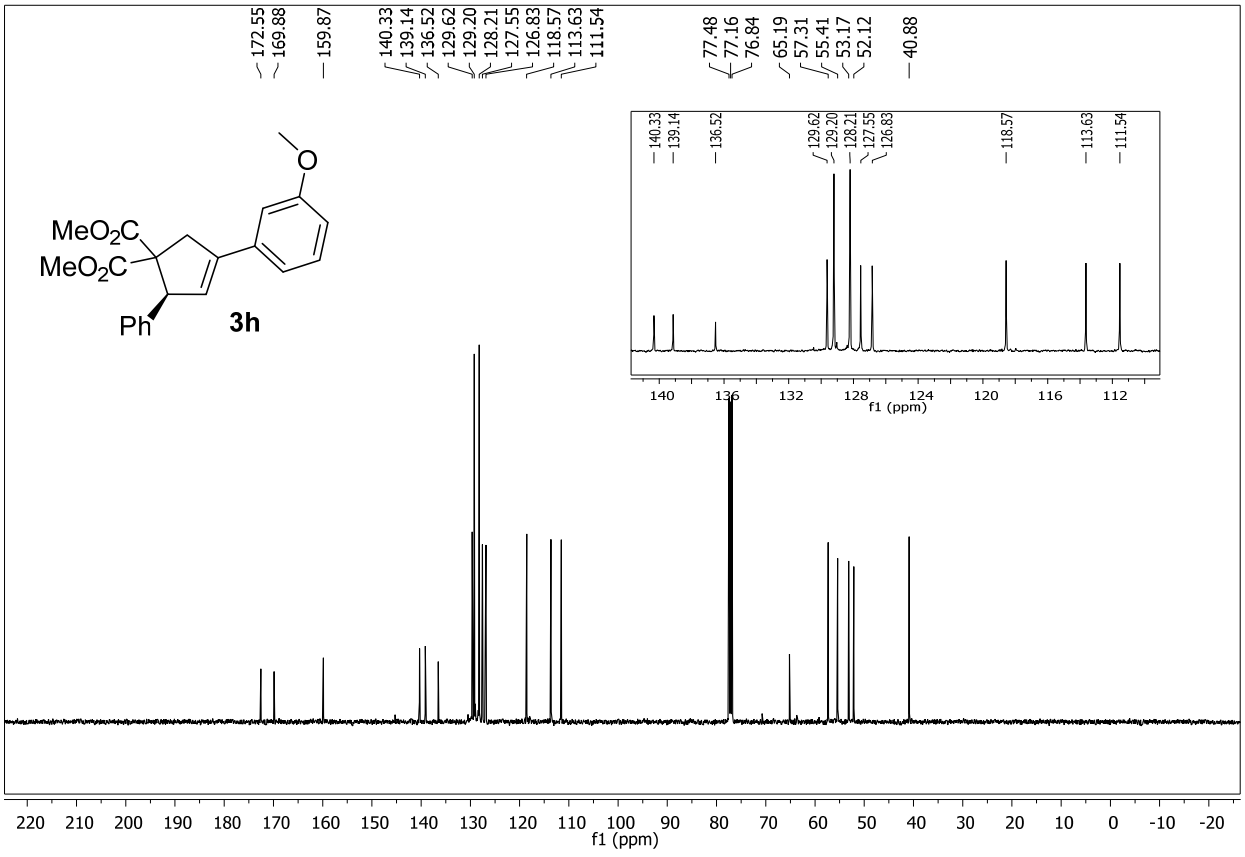
Dimethyl (*S*)-4-(2-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3g)



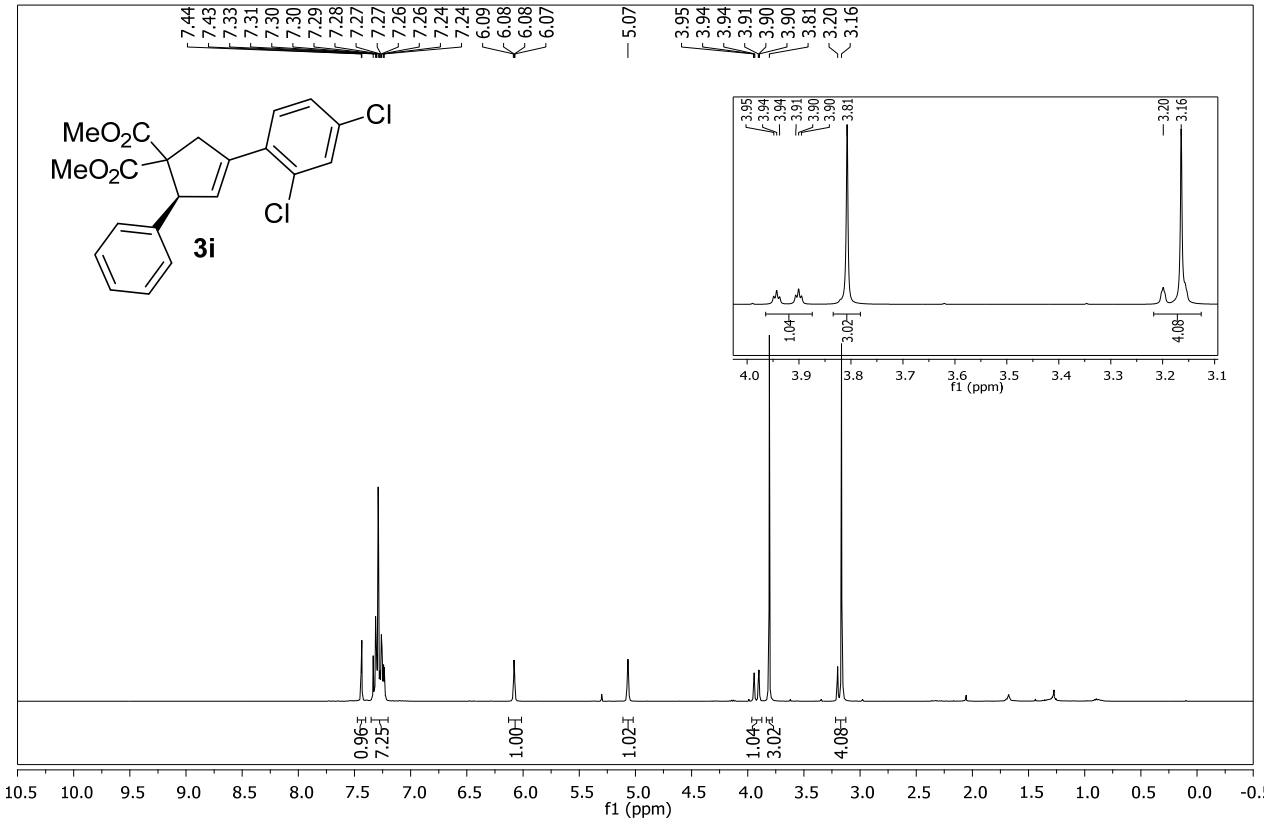


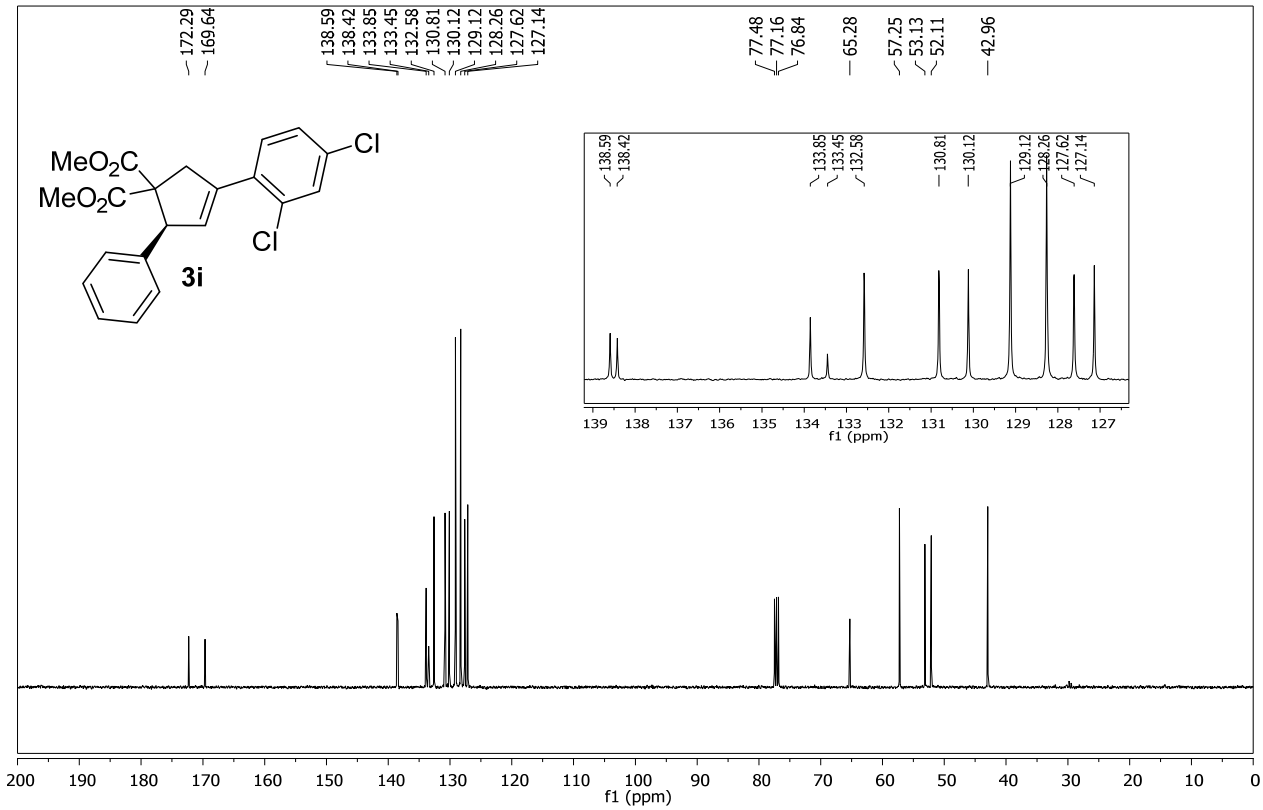
Dimethyl (*S*)-4-(3-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3h)



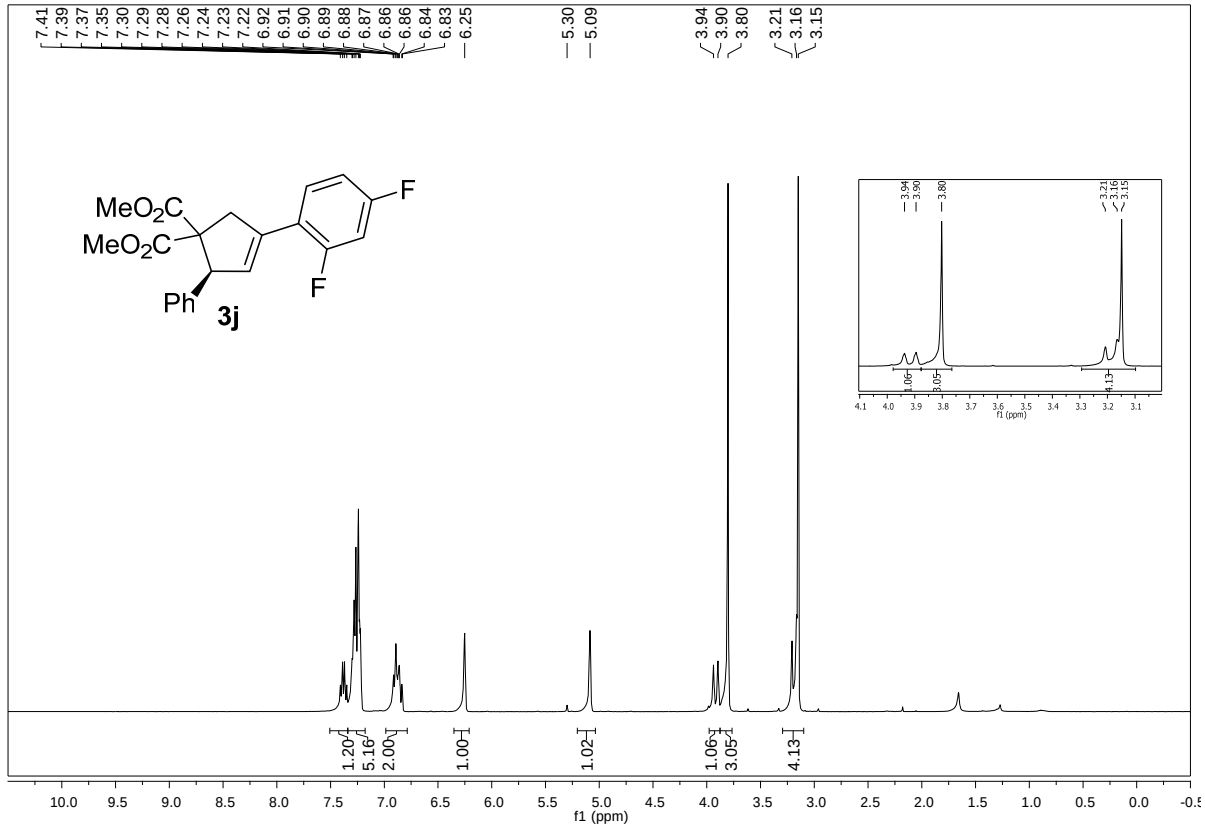


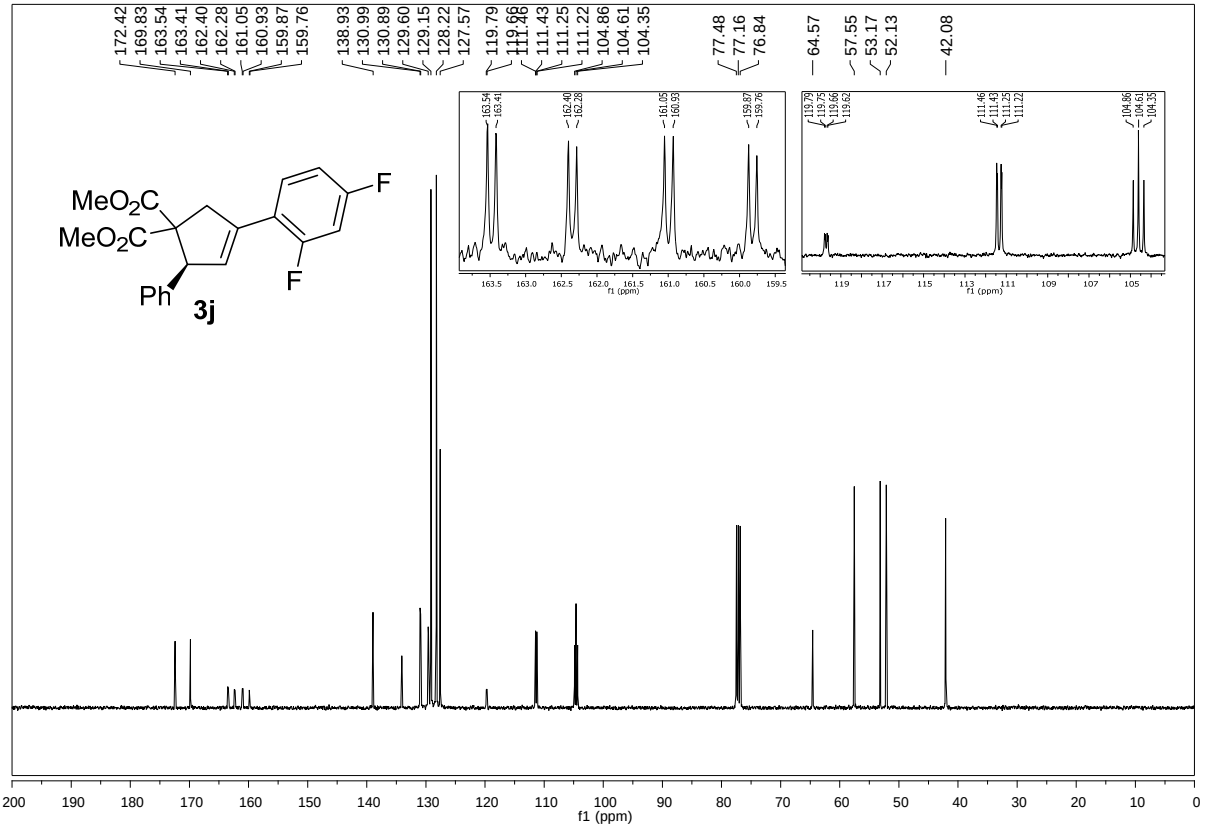
Dimethyl (*S*)-4-(2,4-dichlorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3i)



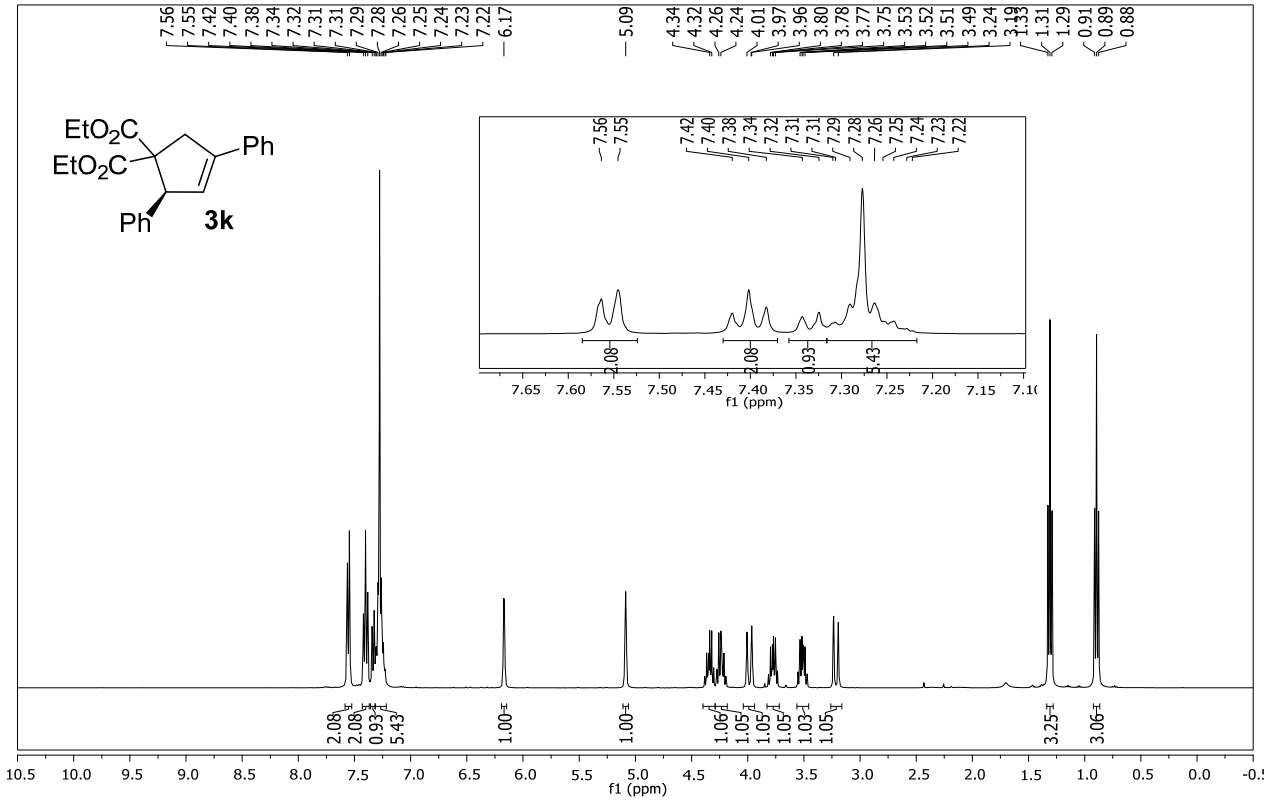


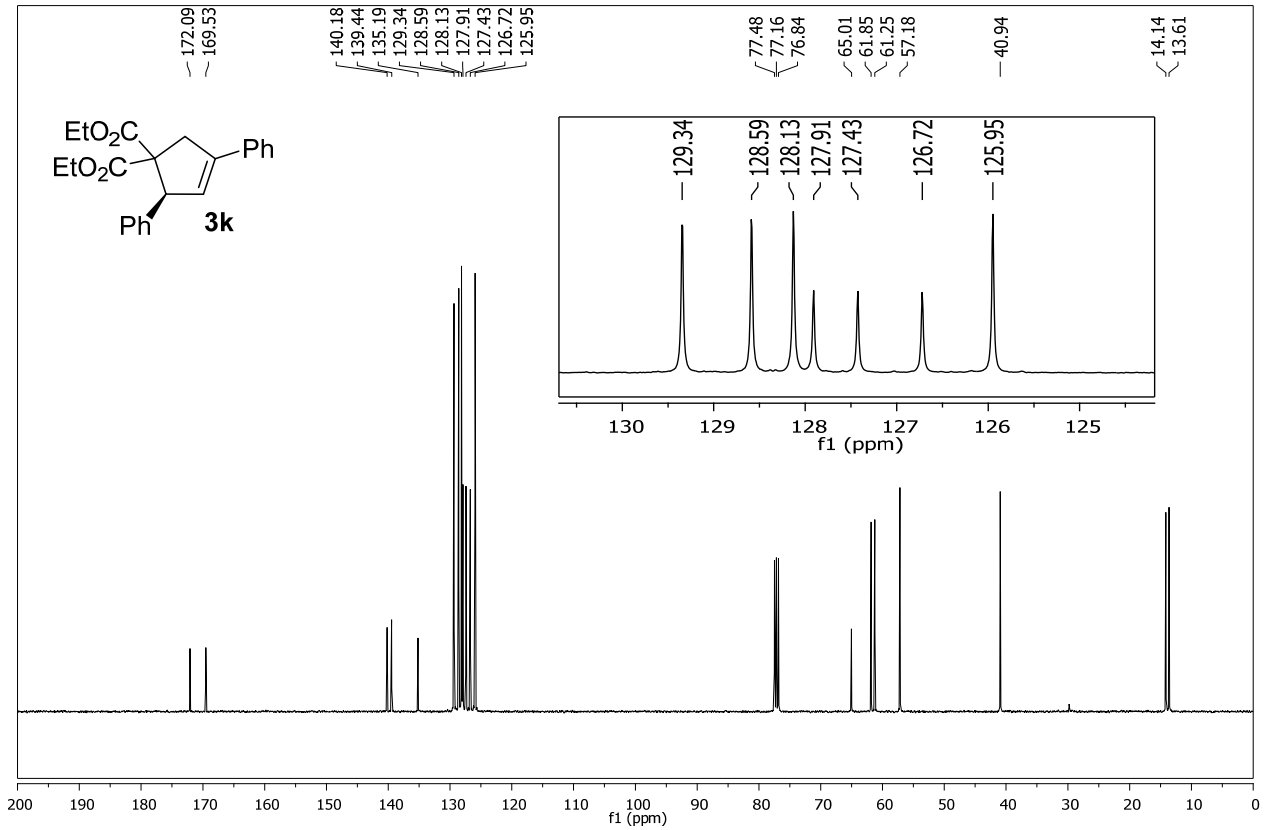
Dimethyl (*S*)-4-(2,4-difluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3j)



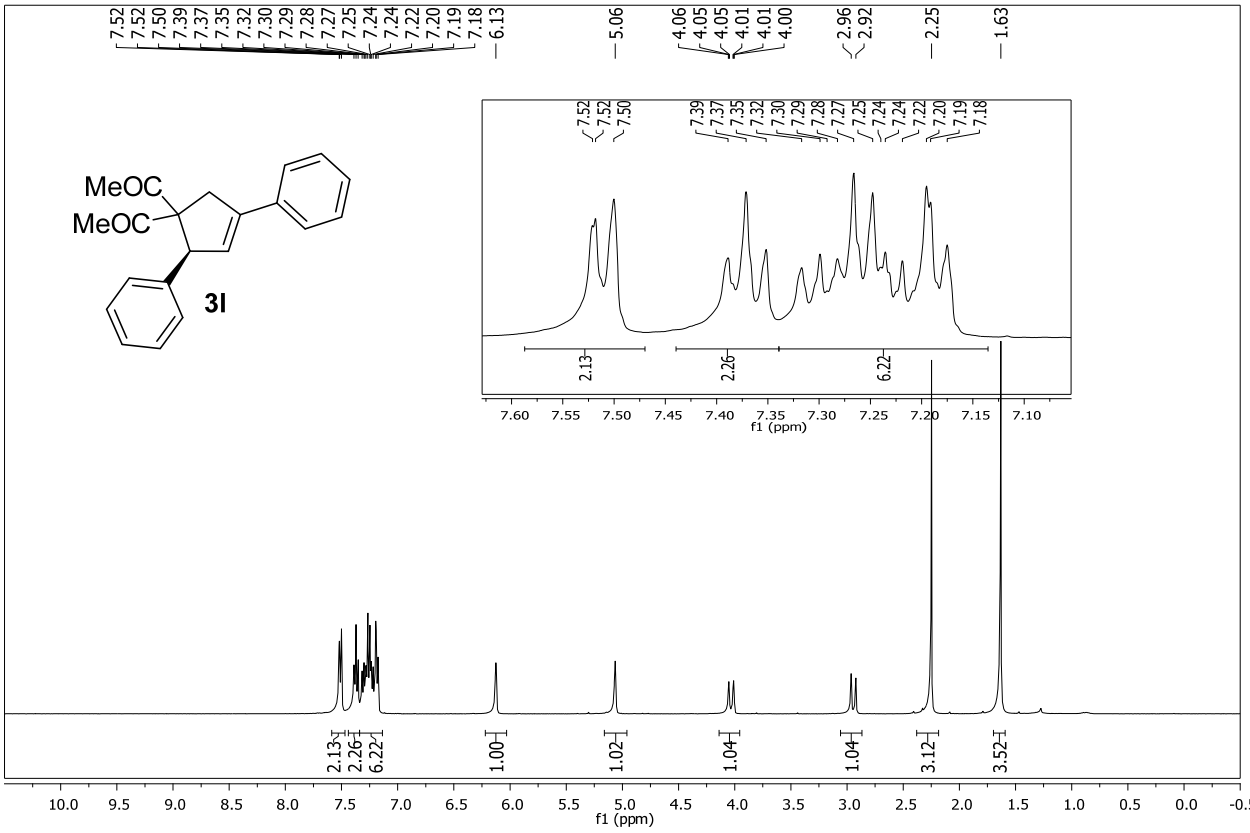


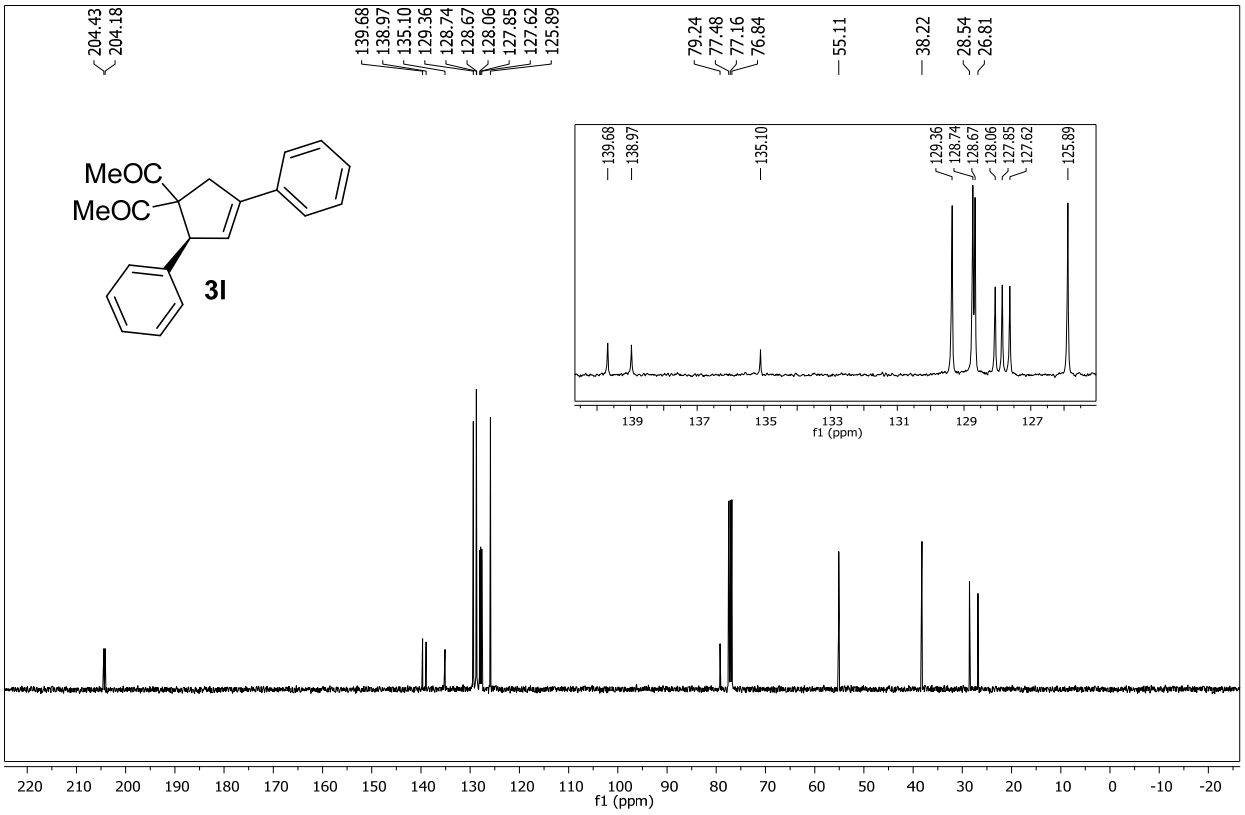
Diethyl 2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate (3k)



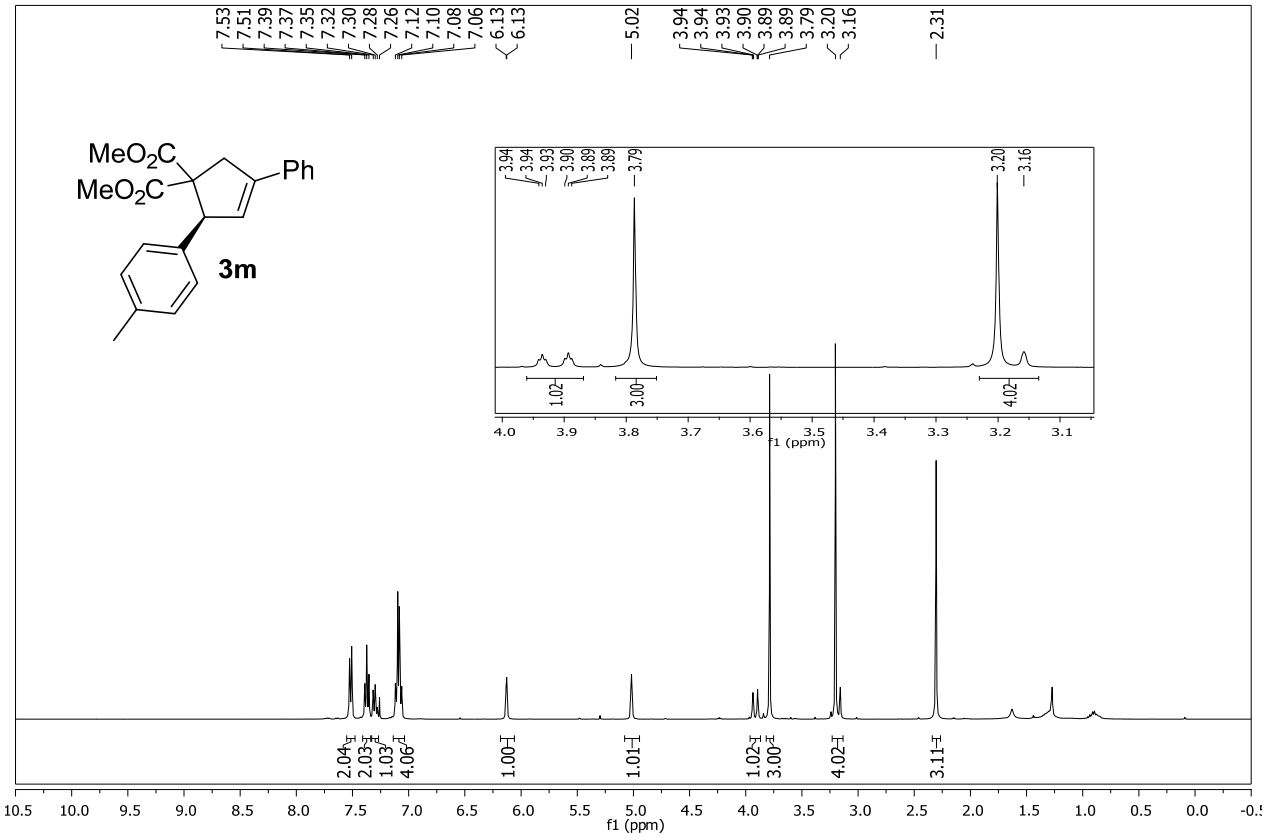


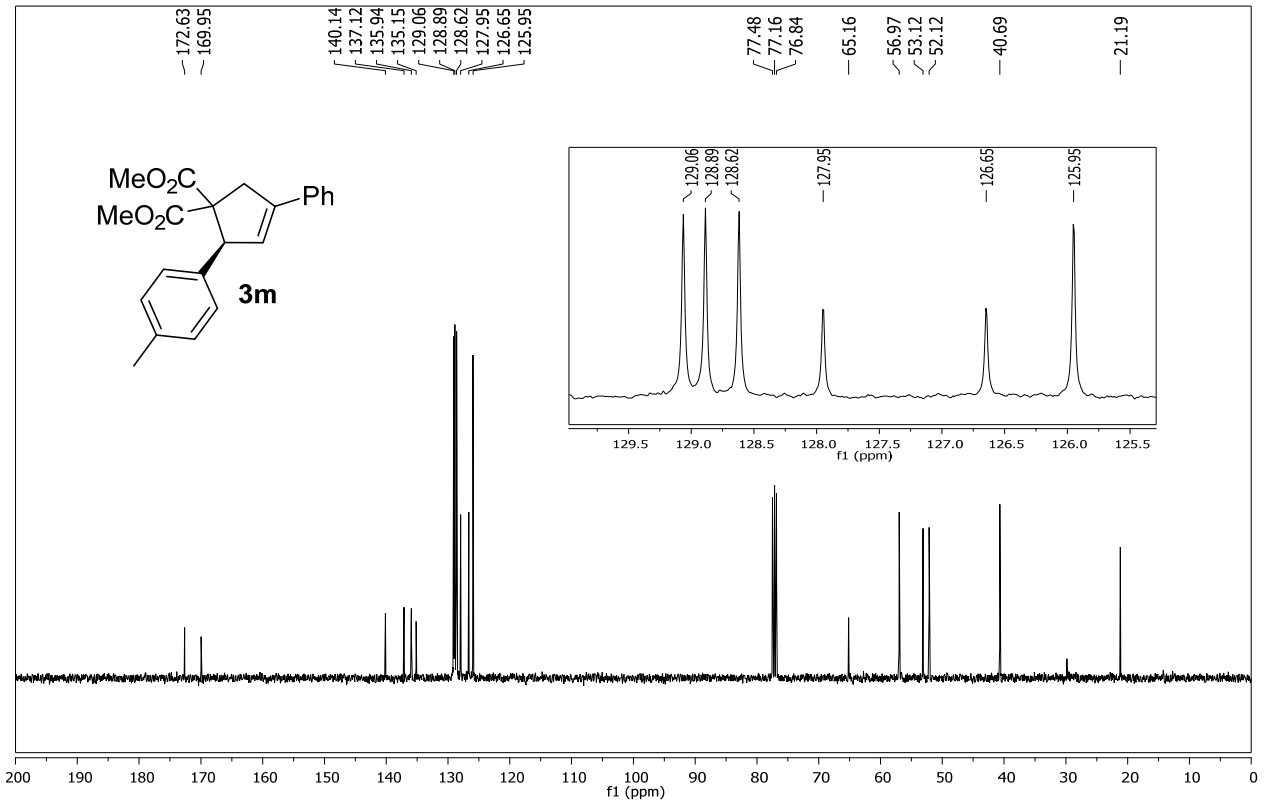
(*S*)-1,1'-(2,4-Diphenylcyclopent-3-ene-1,1-diyl)bis(ethan-1-one) (3l)



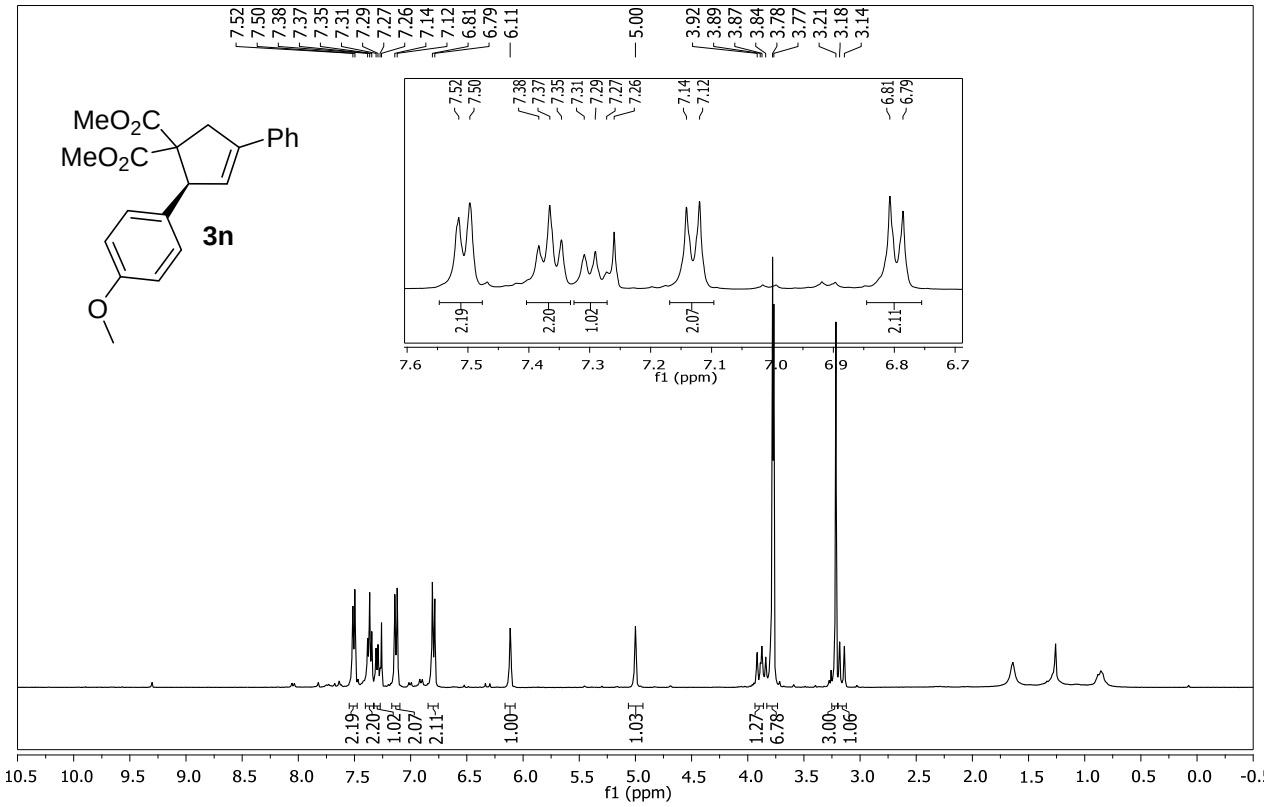


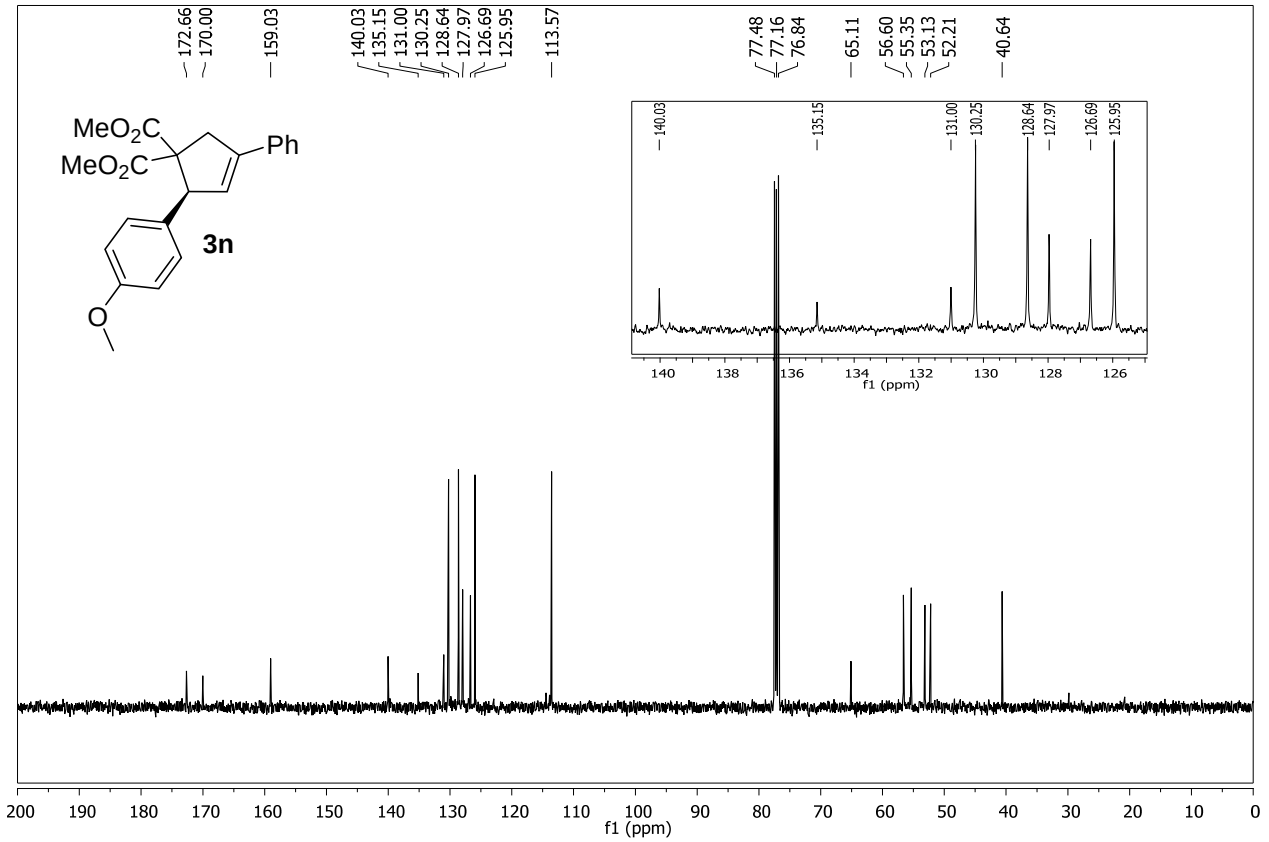
Dimethyl (*S*)-4-phenyl-2-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3m)



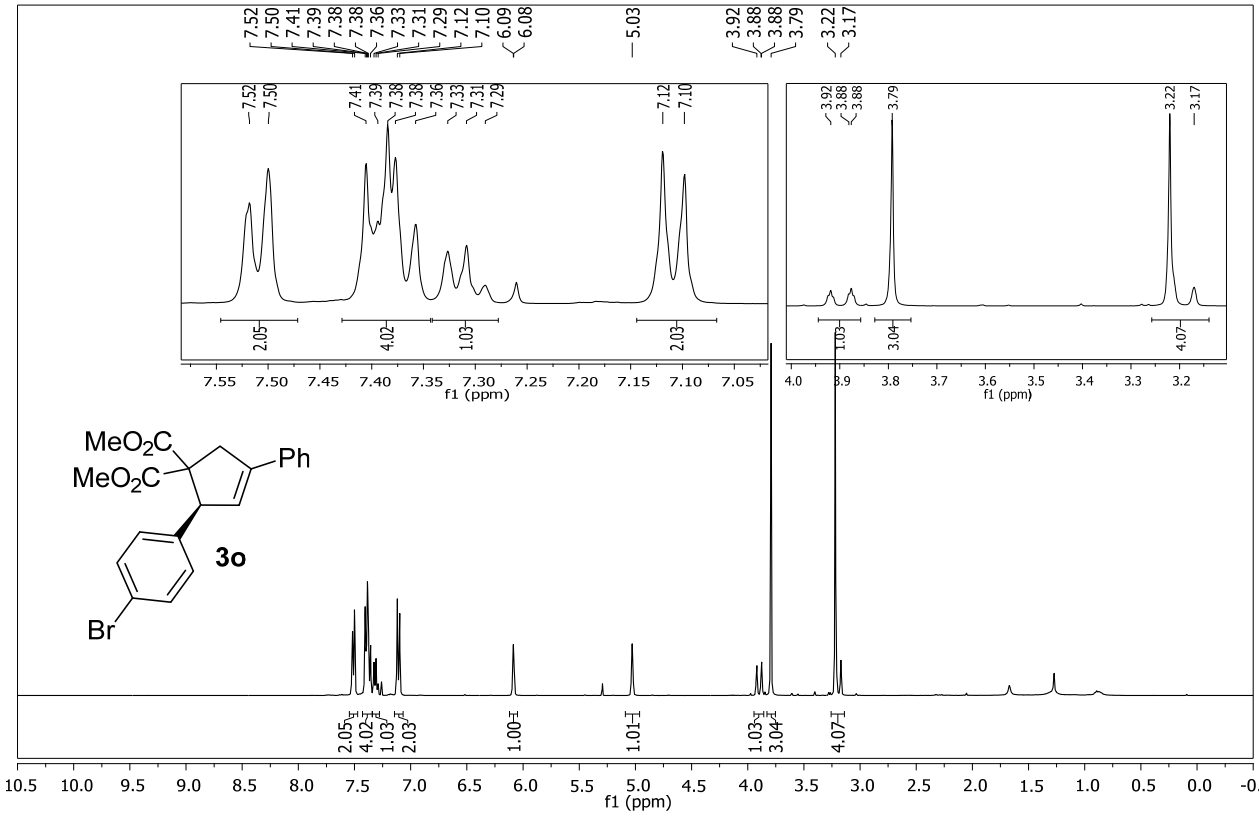


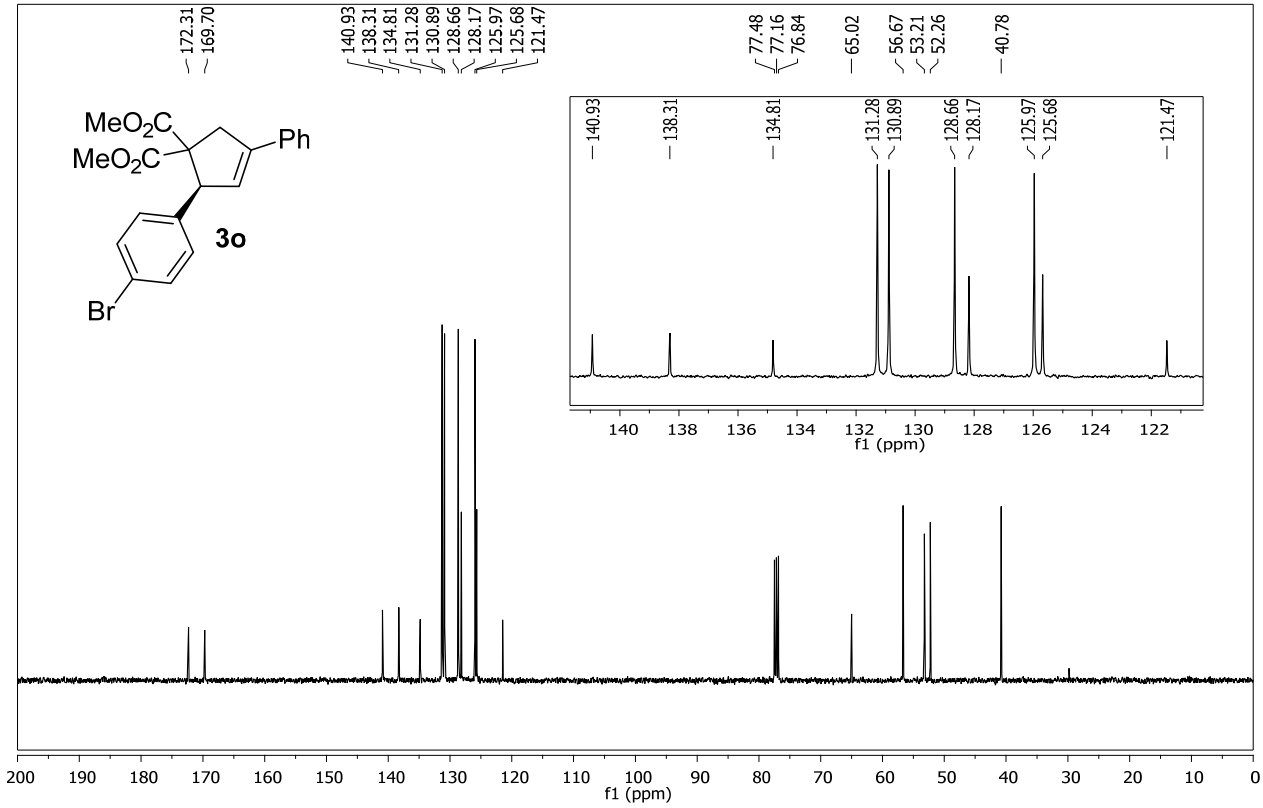
Dimethyl (S)-2-(4-methoxyphenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3n)



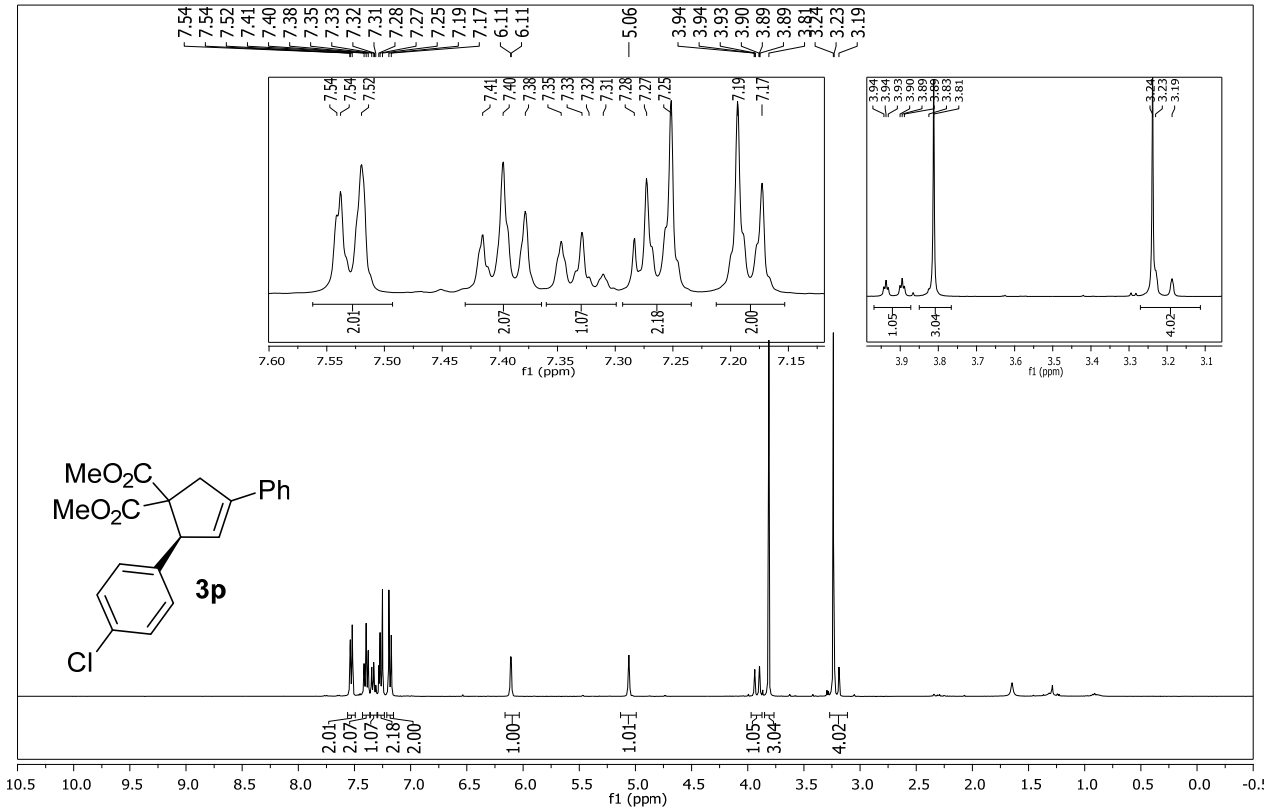


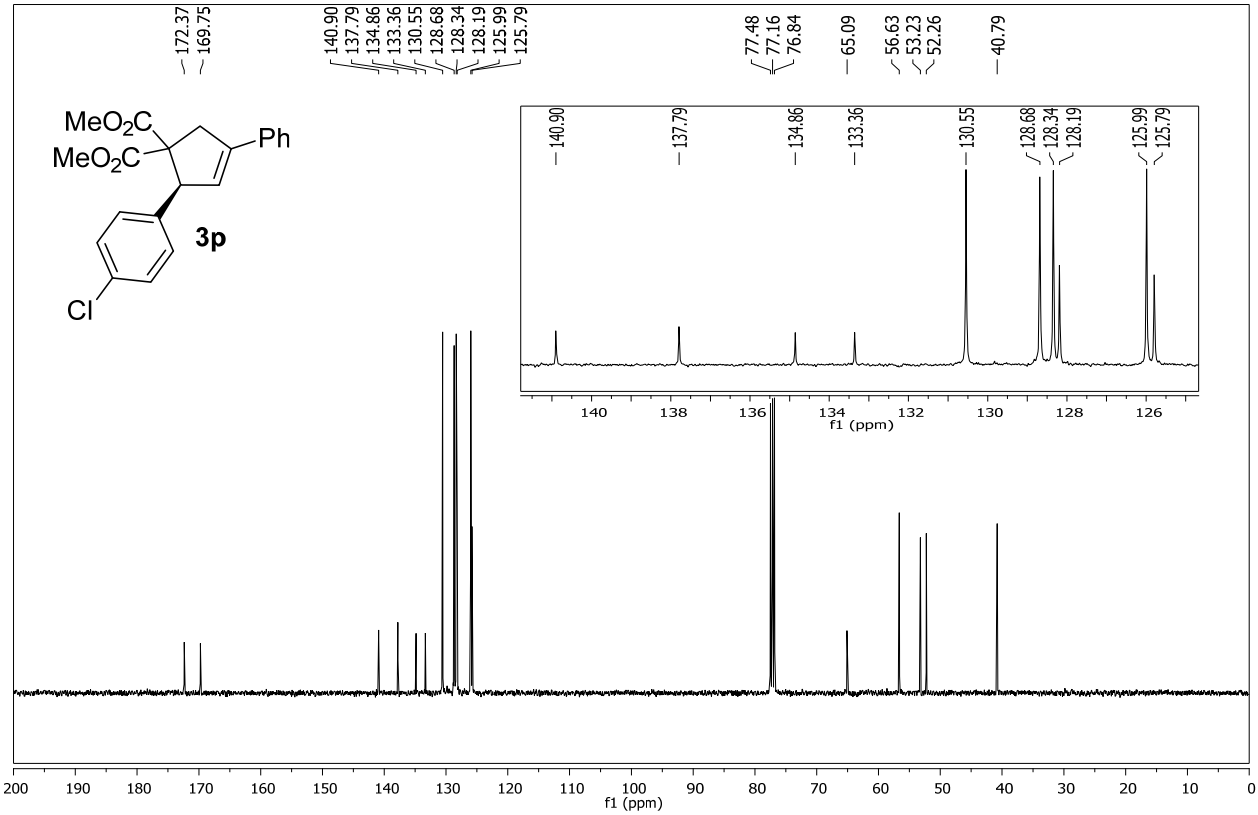
Dimethyl (*S*)-2-(4-bromophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3o)



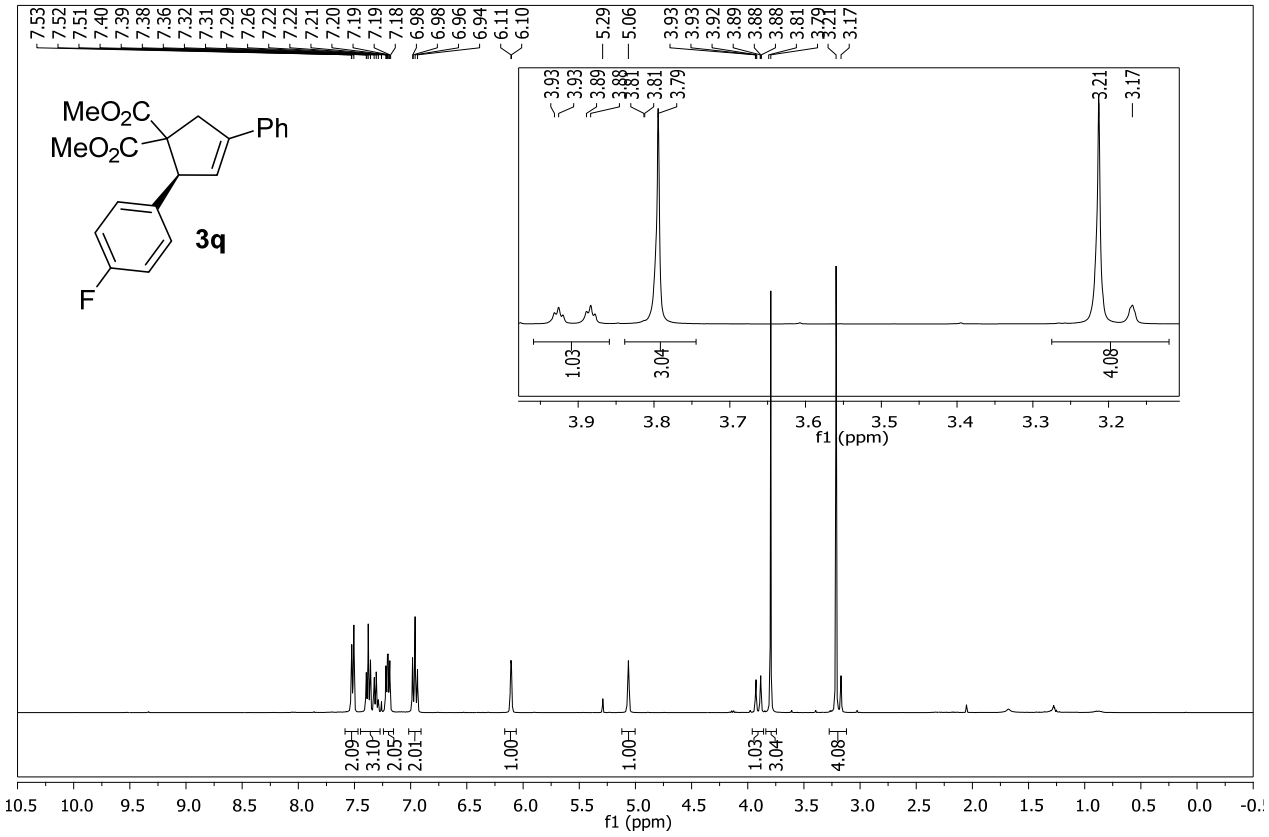


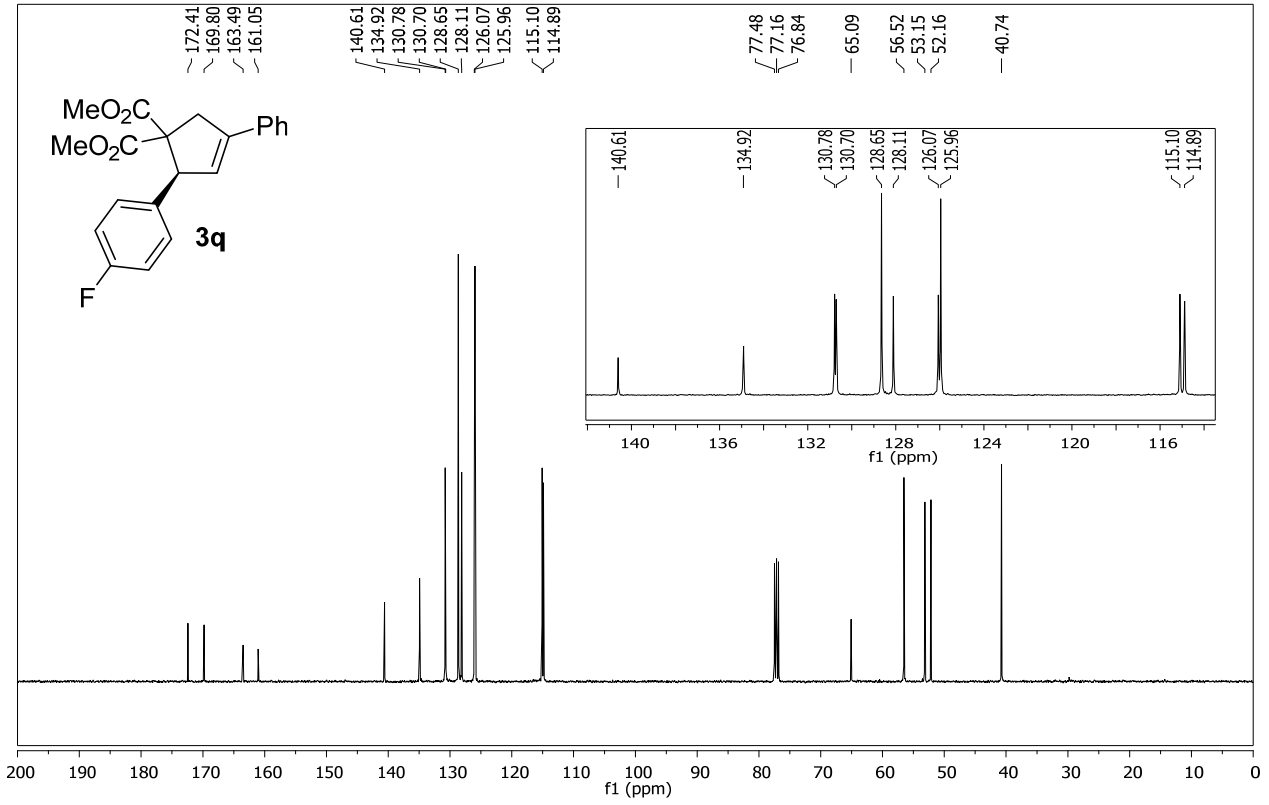
Dimethyl (*S*)-2-(4-chlorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3p)



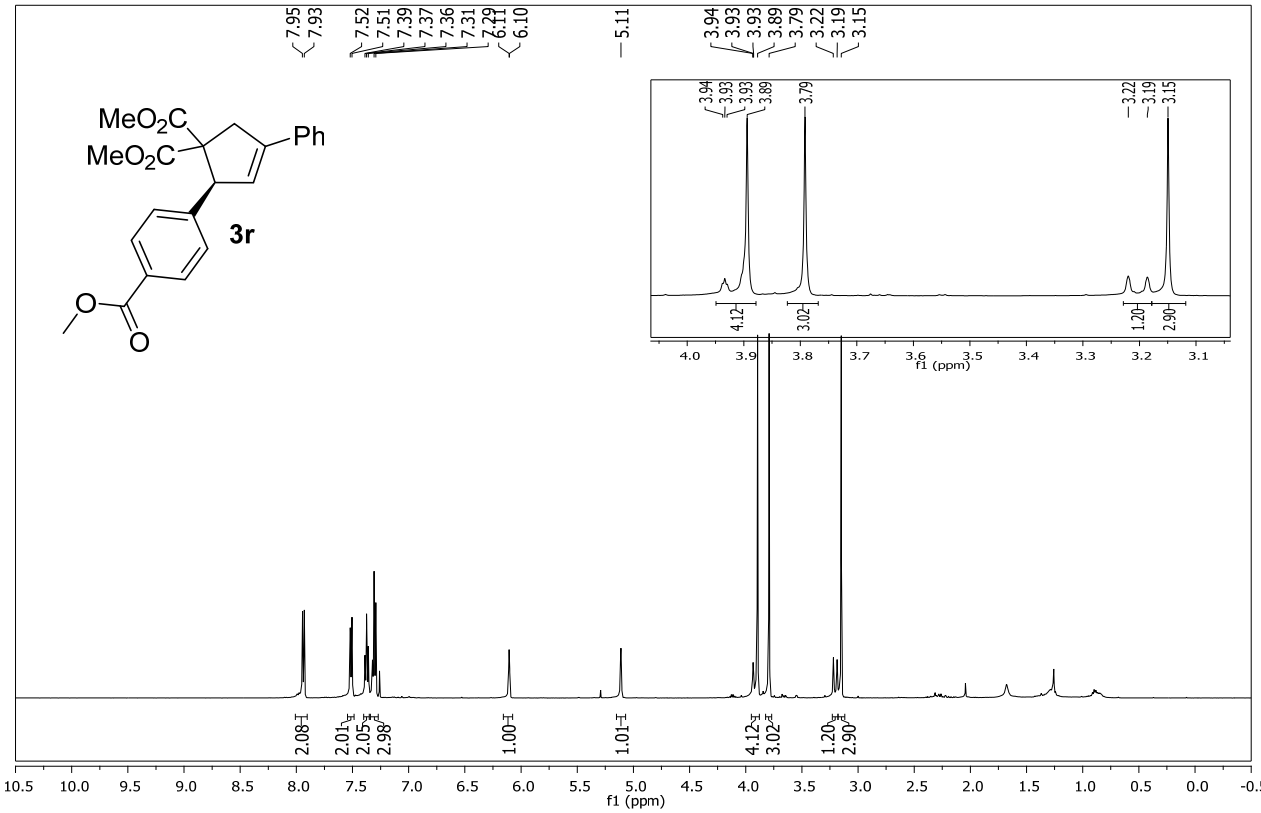


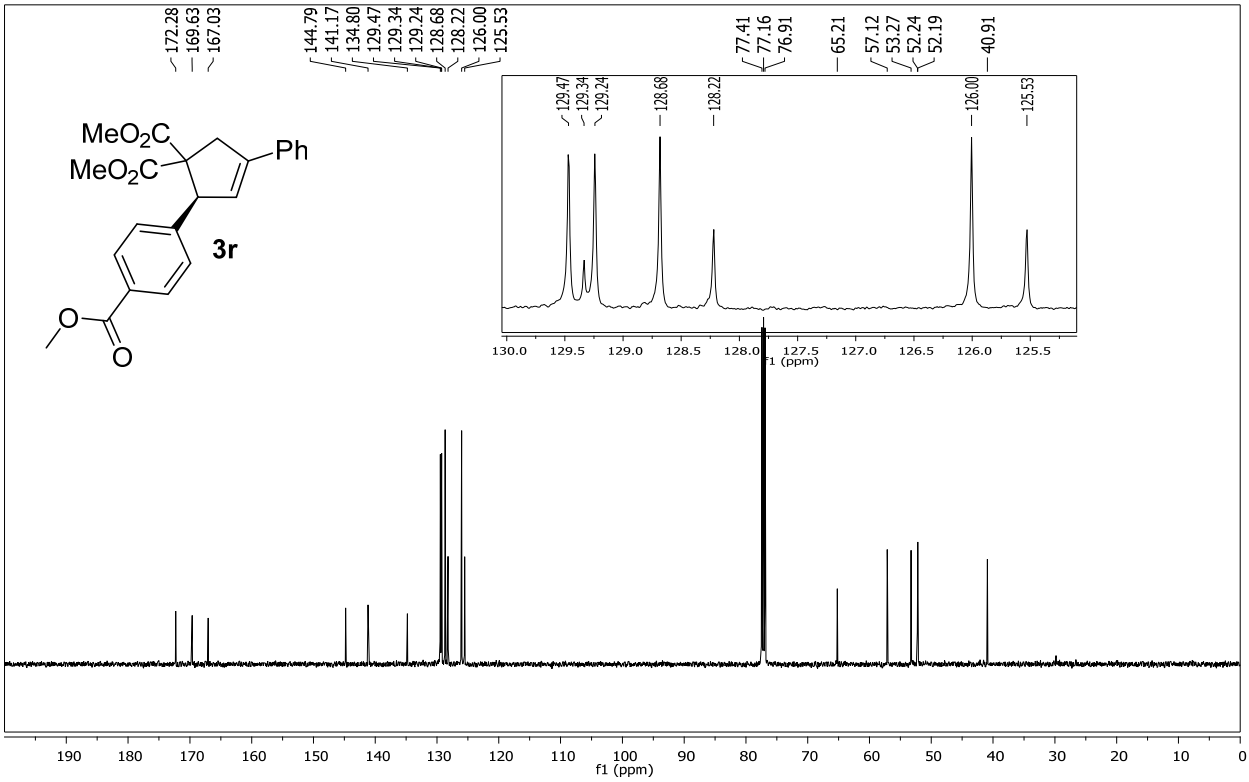
Dimethyl (*S*)-2-(4-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3q)



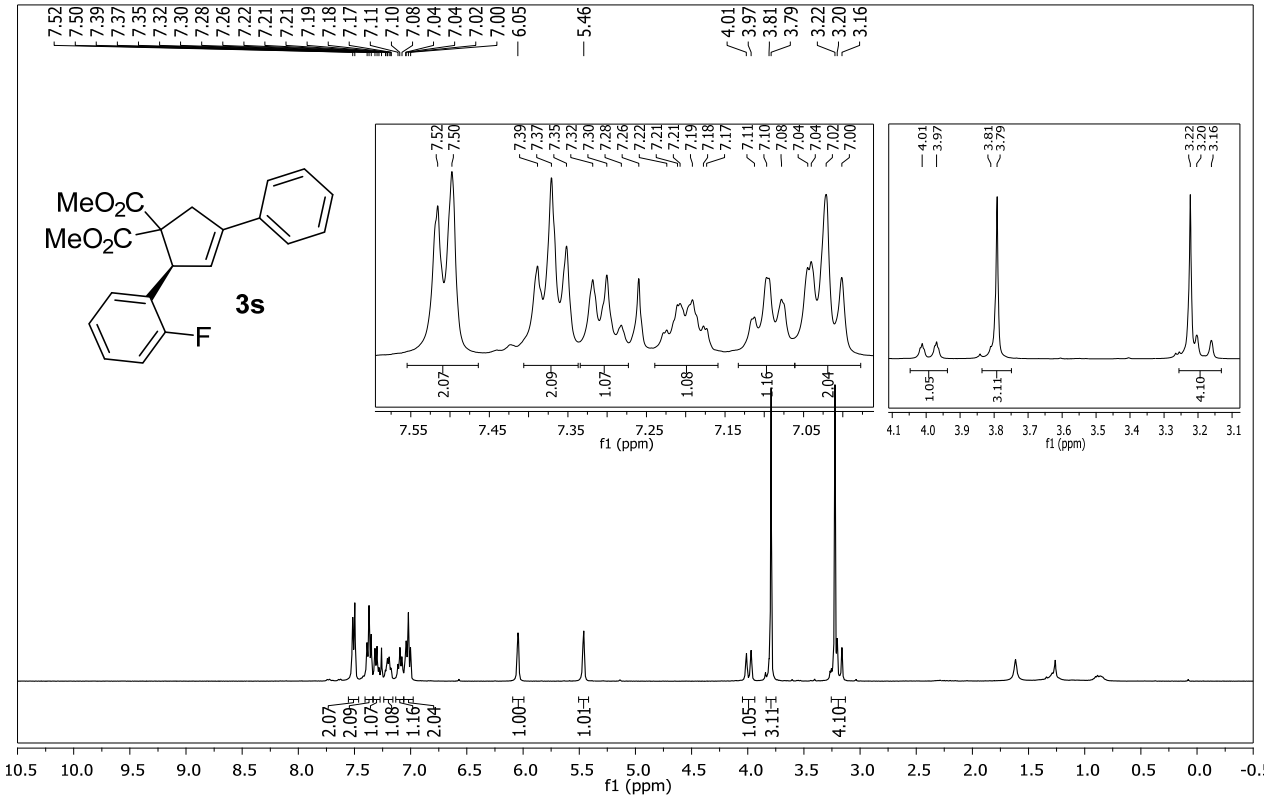


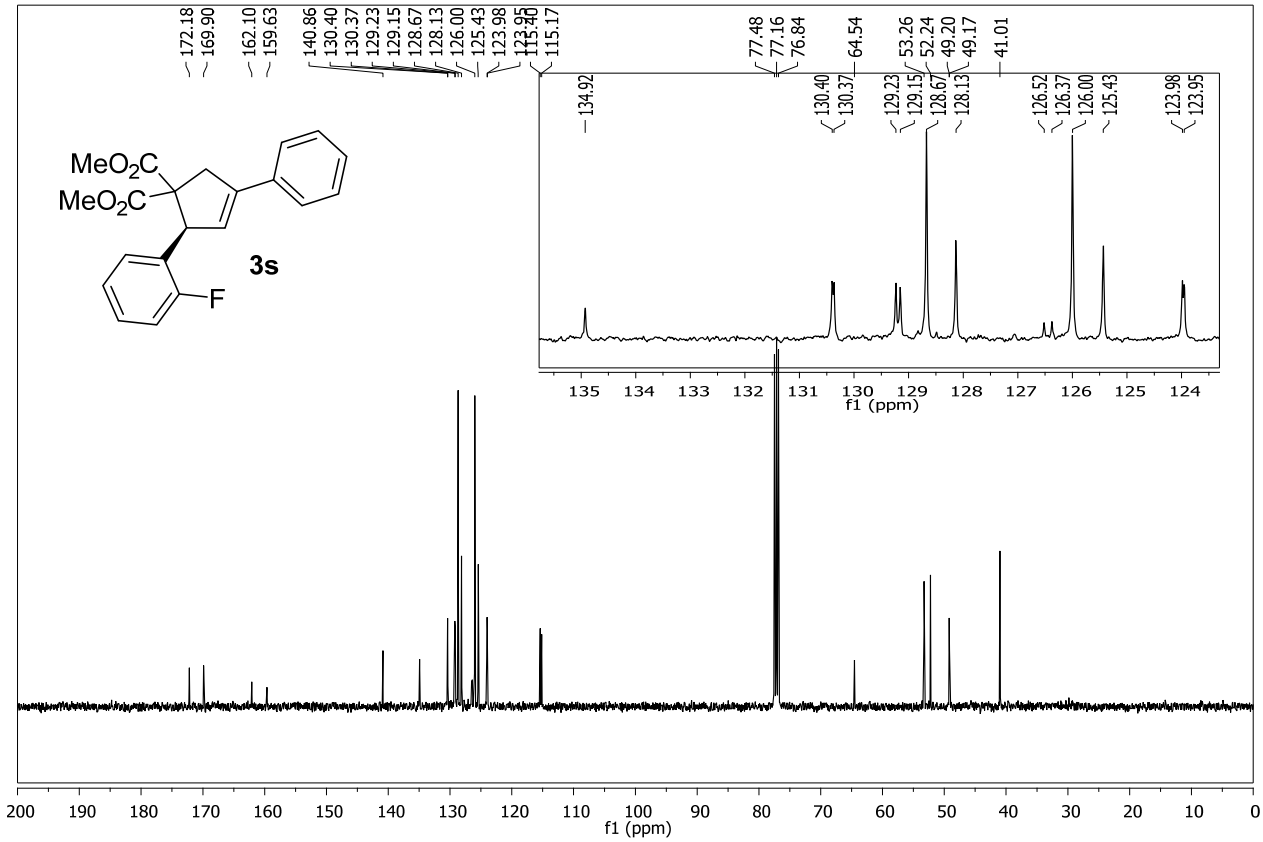
Dimethyl (*S*)-2-(4-(methoxycarbonyl)phenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3r)



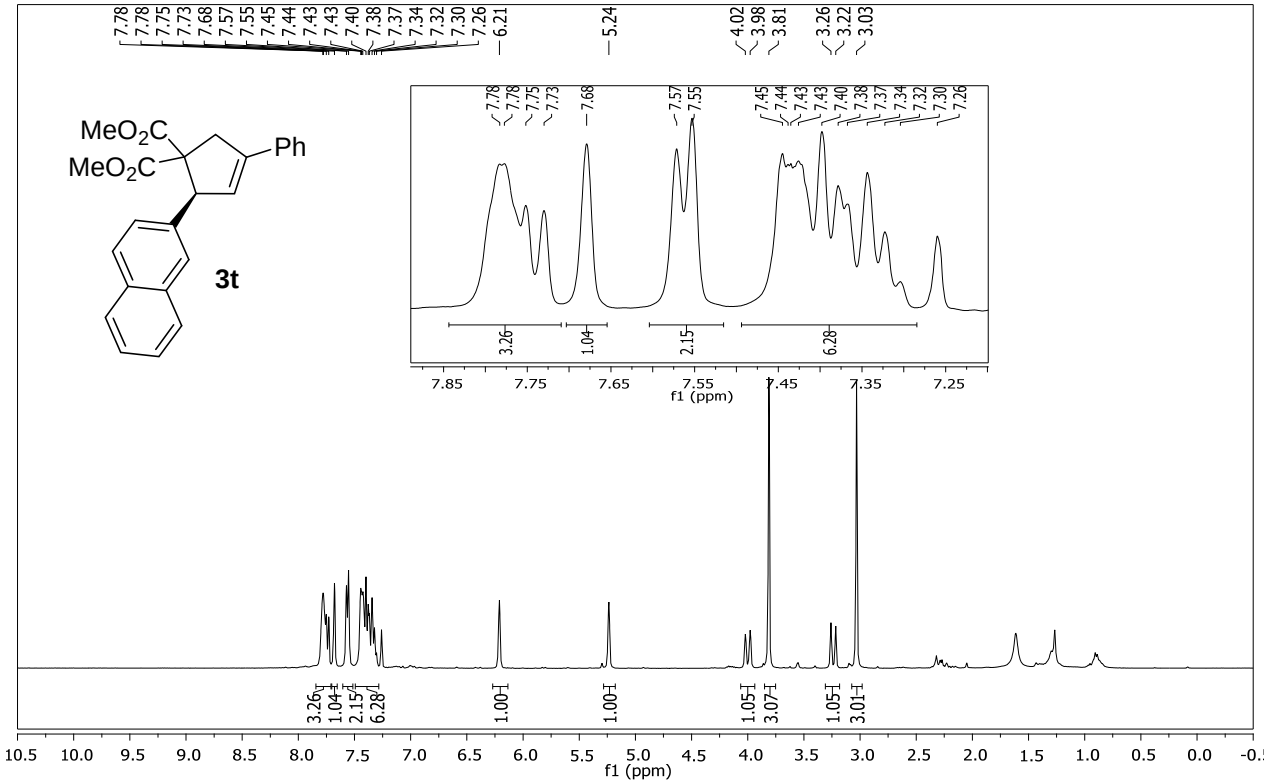


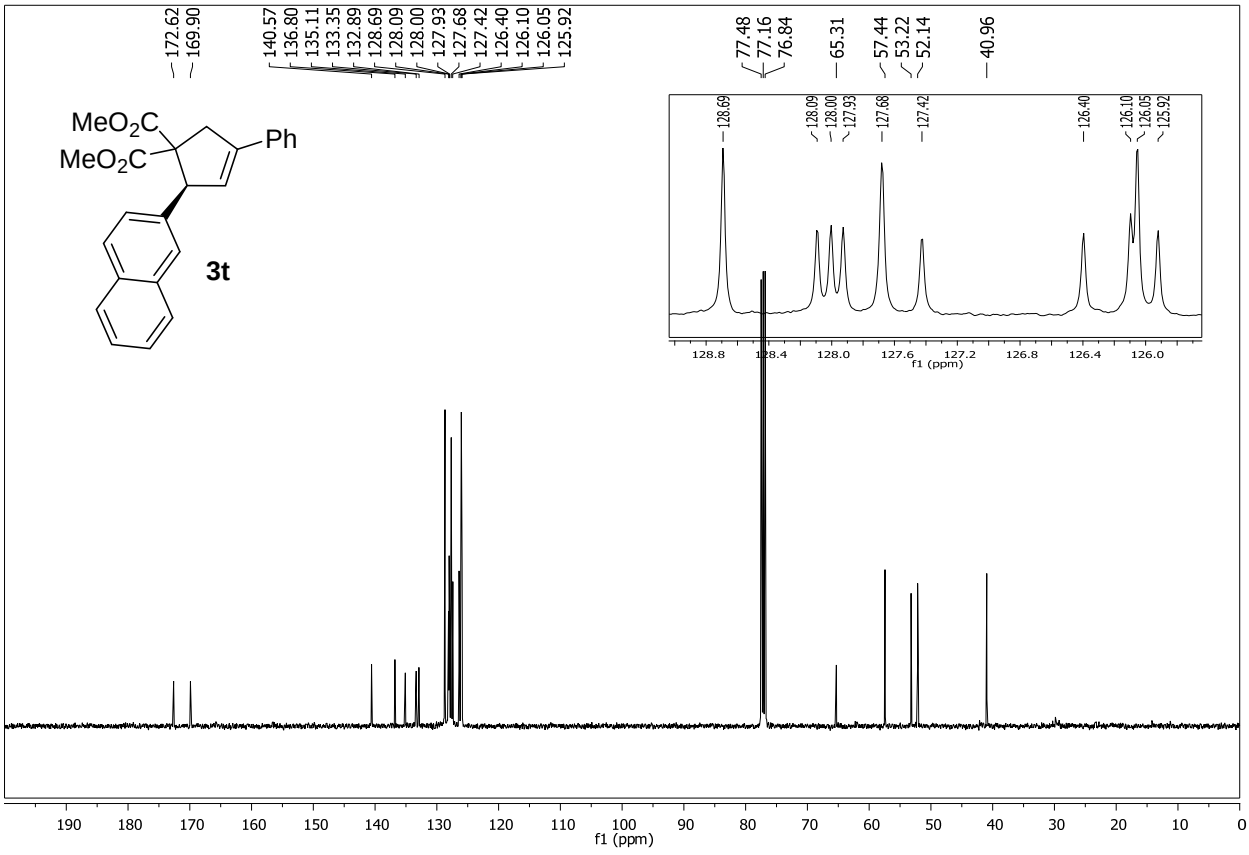
Dimethyl (*R*)-2-(2-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3s)



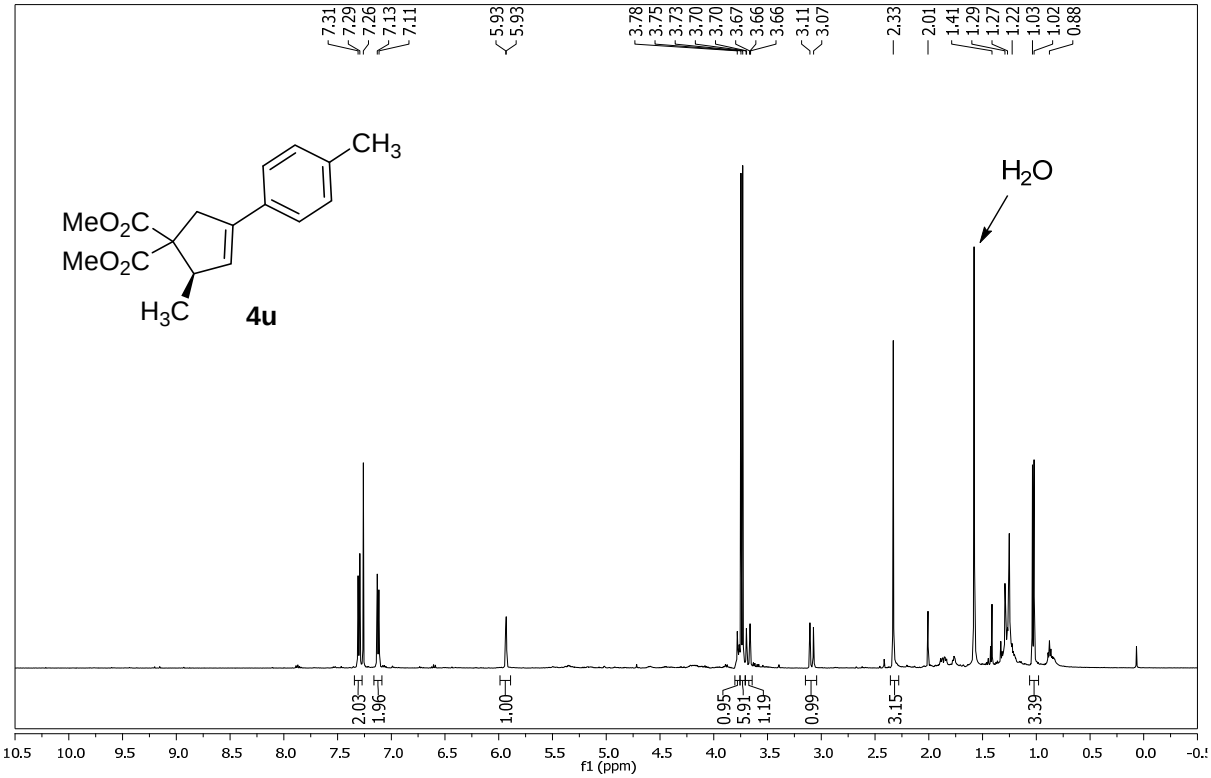


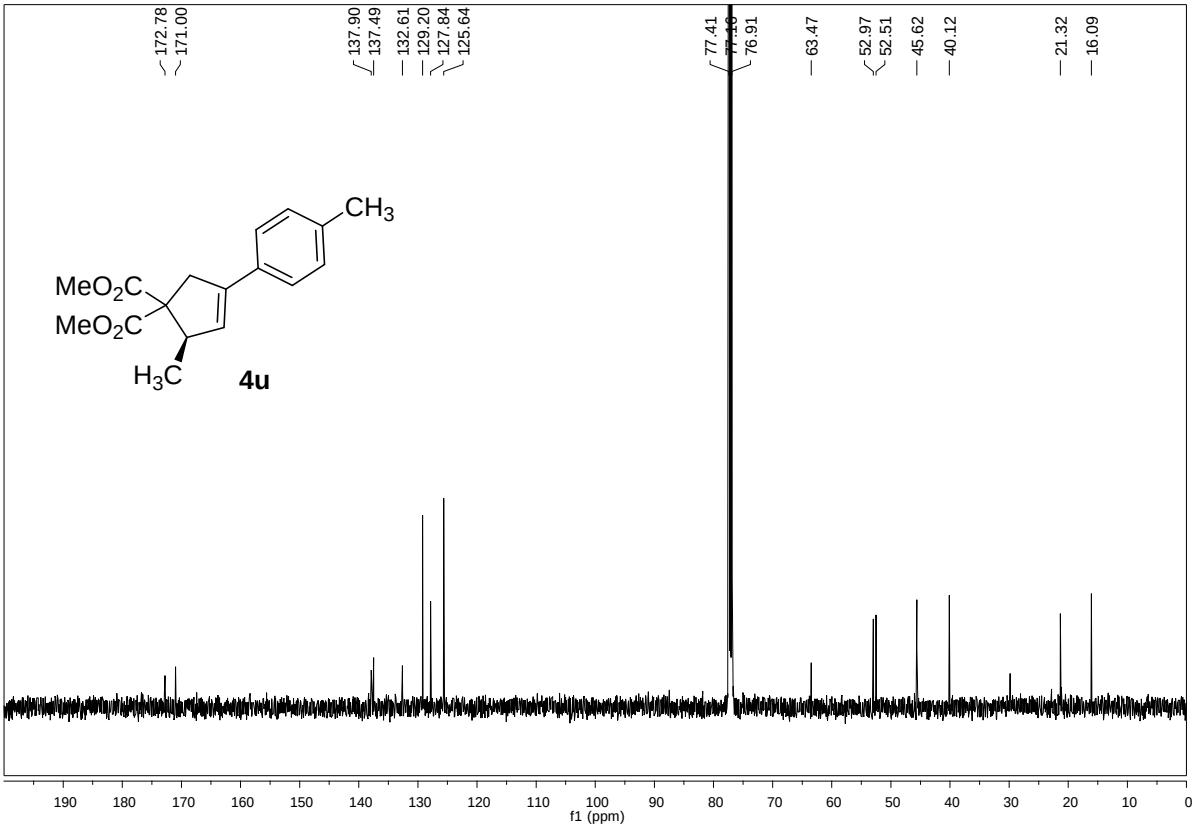
Dimethyl (*S*)-2-(naphthalen-2-yl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3t)



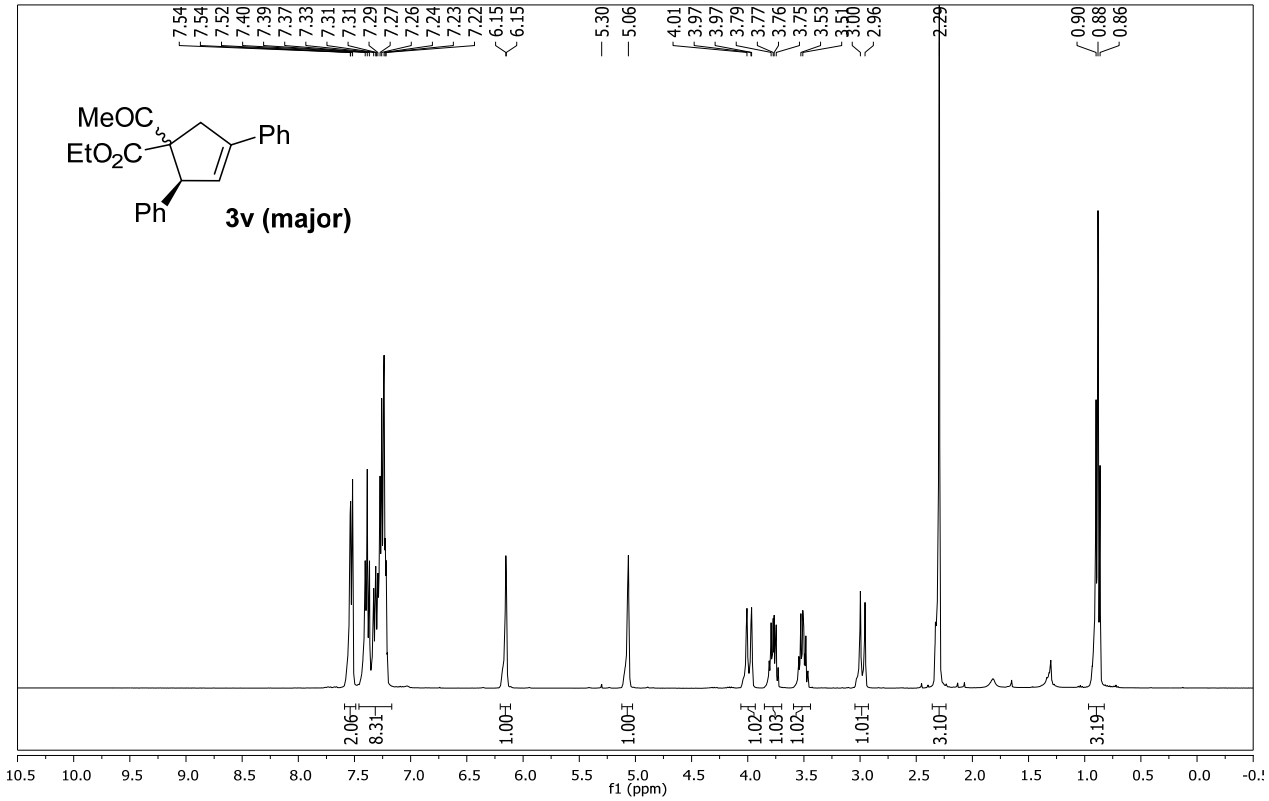


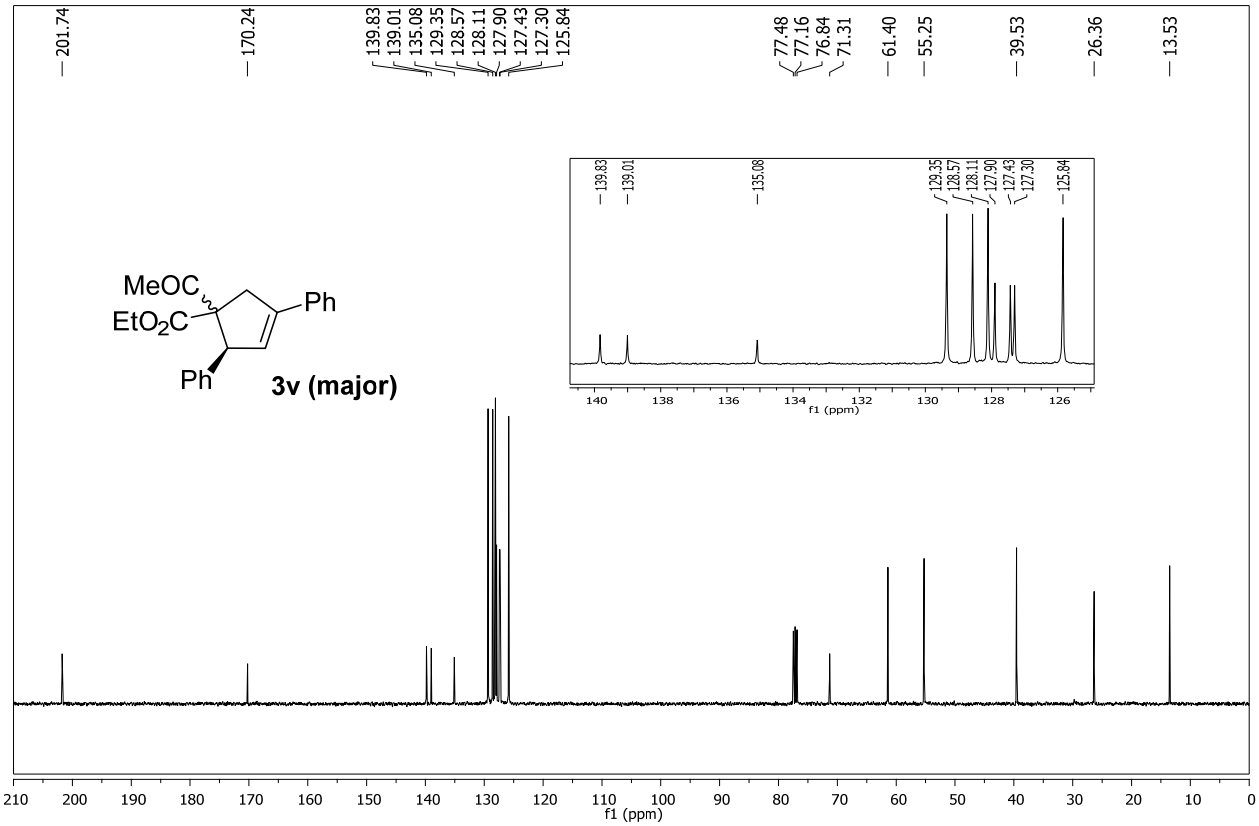
Dimethyl (*R*) 2-methyl-4-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (4u)



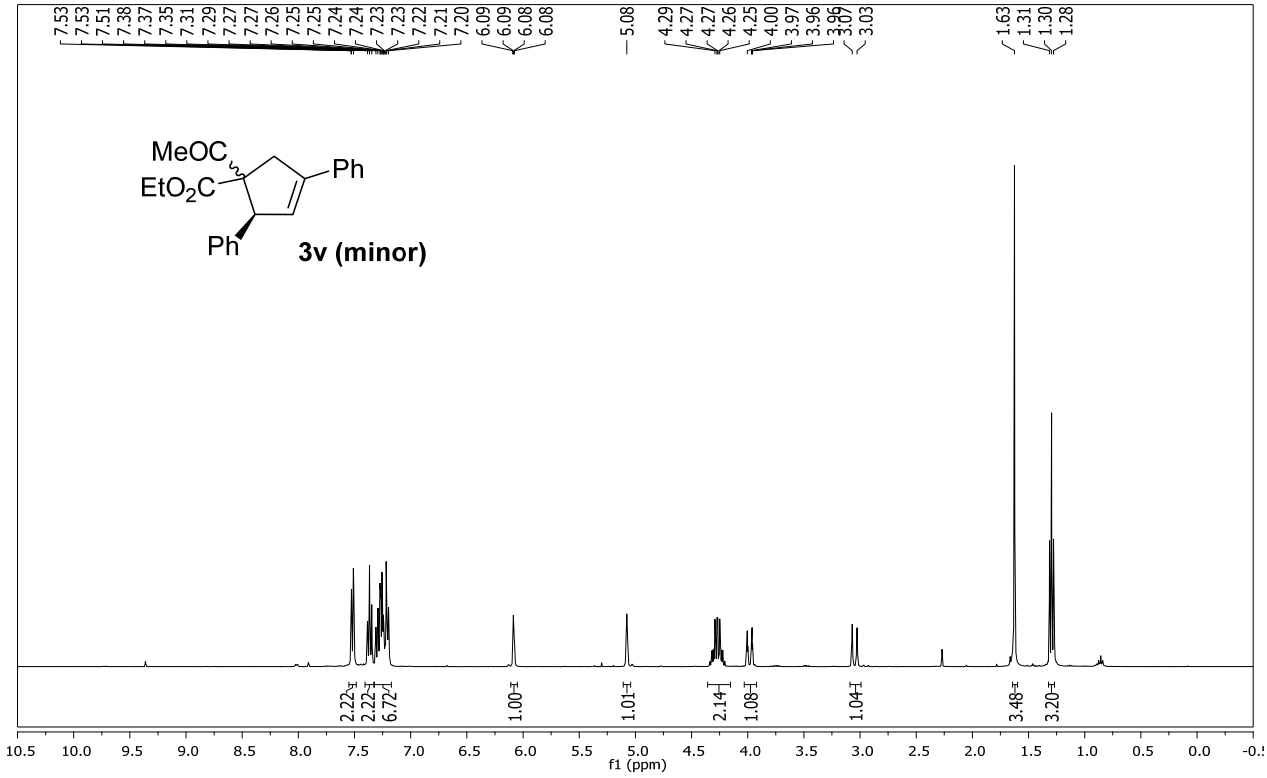


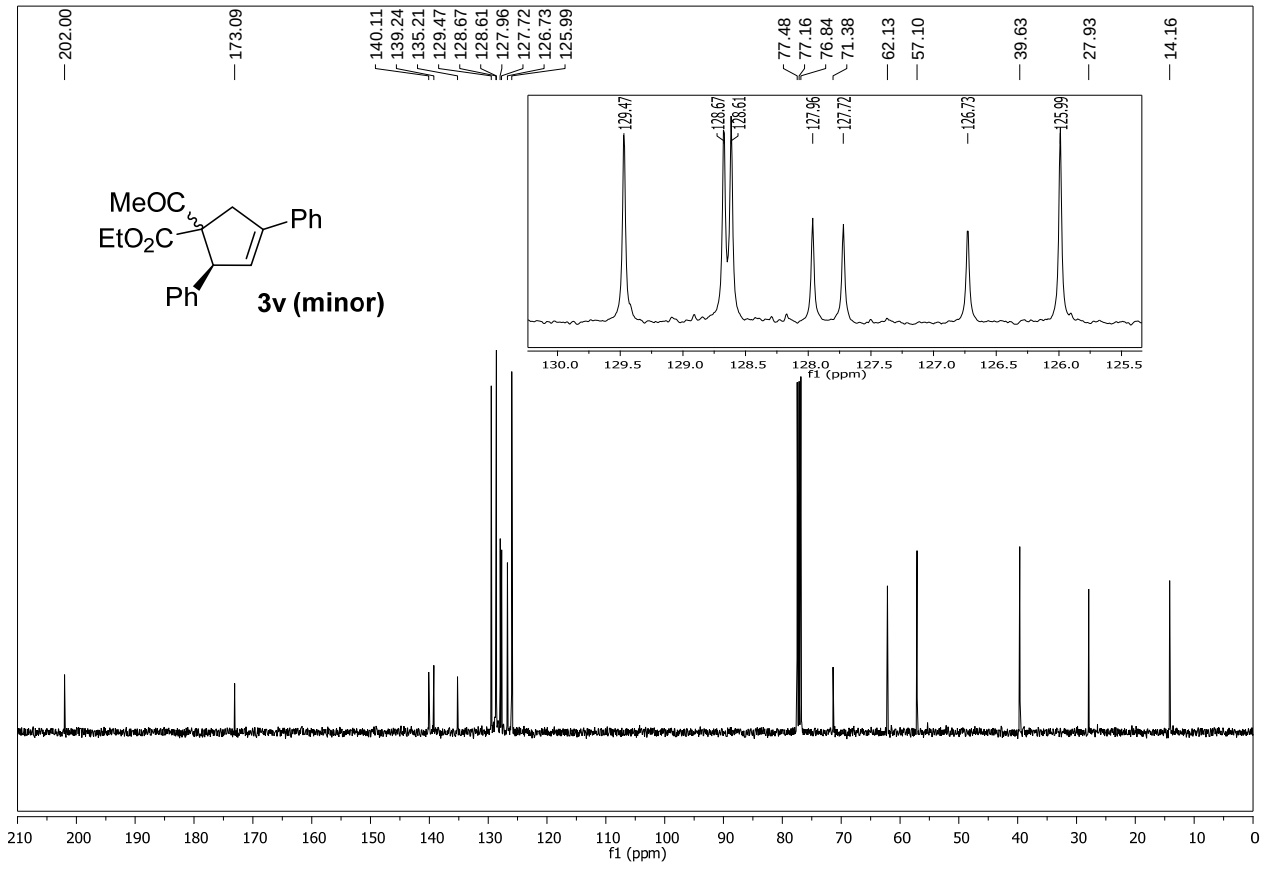
Ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate (3v *major*)



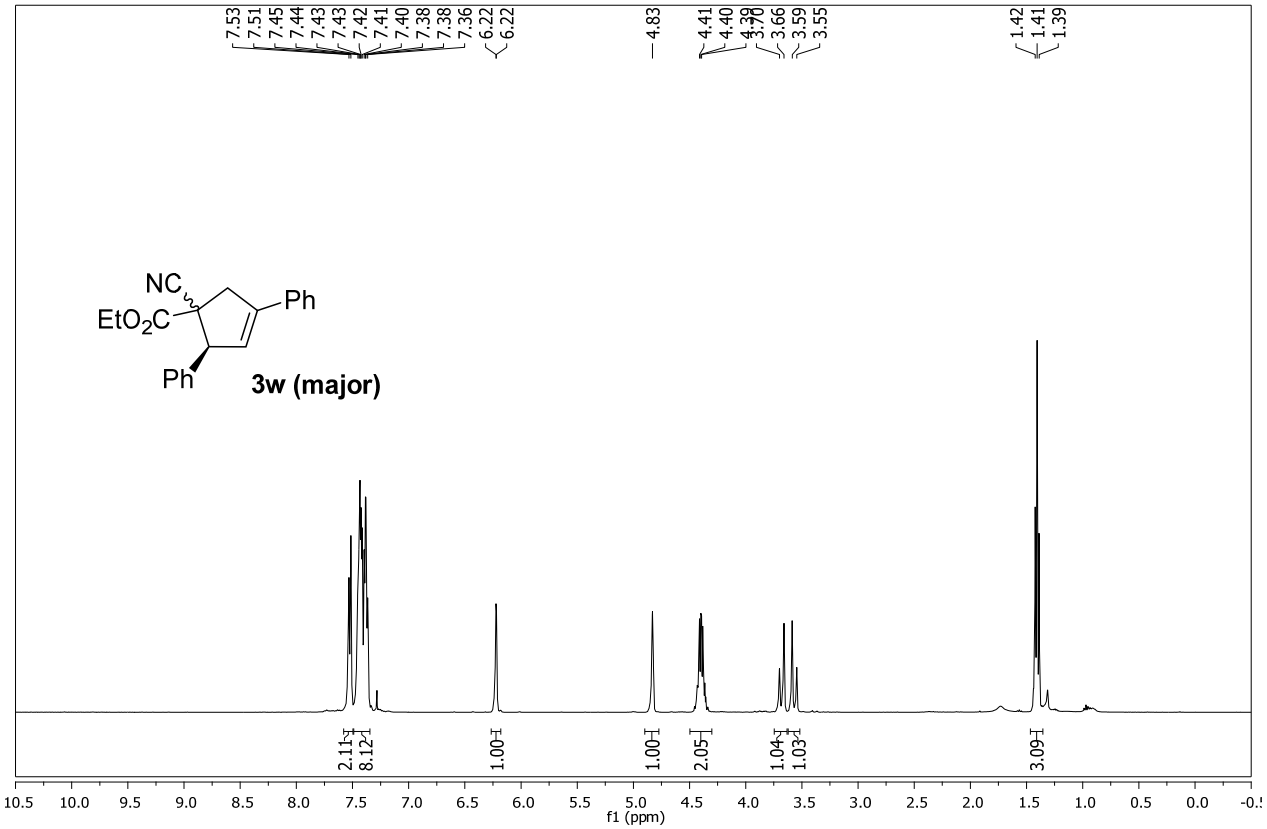


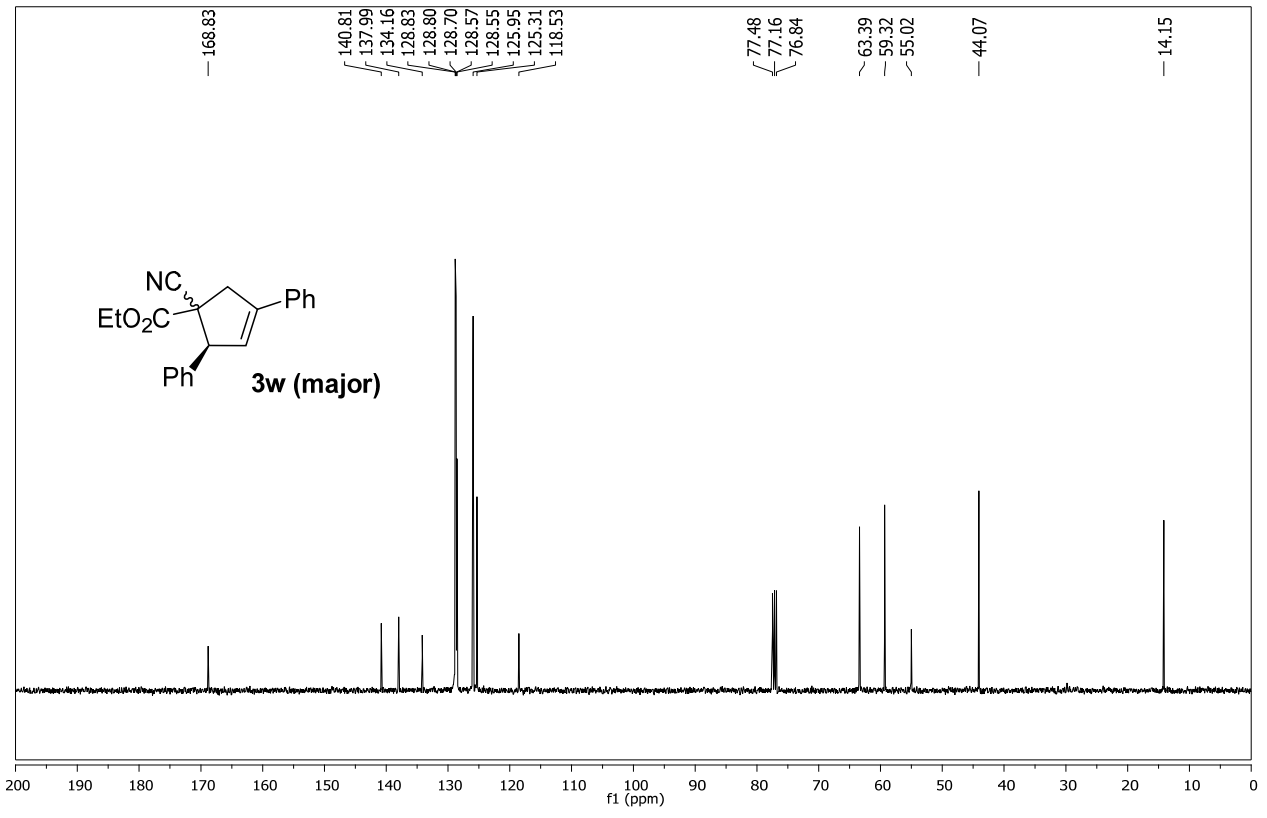
Ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate (3v *minor*)



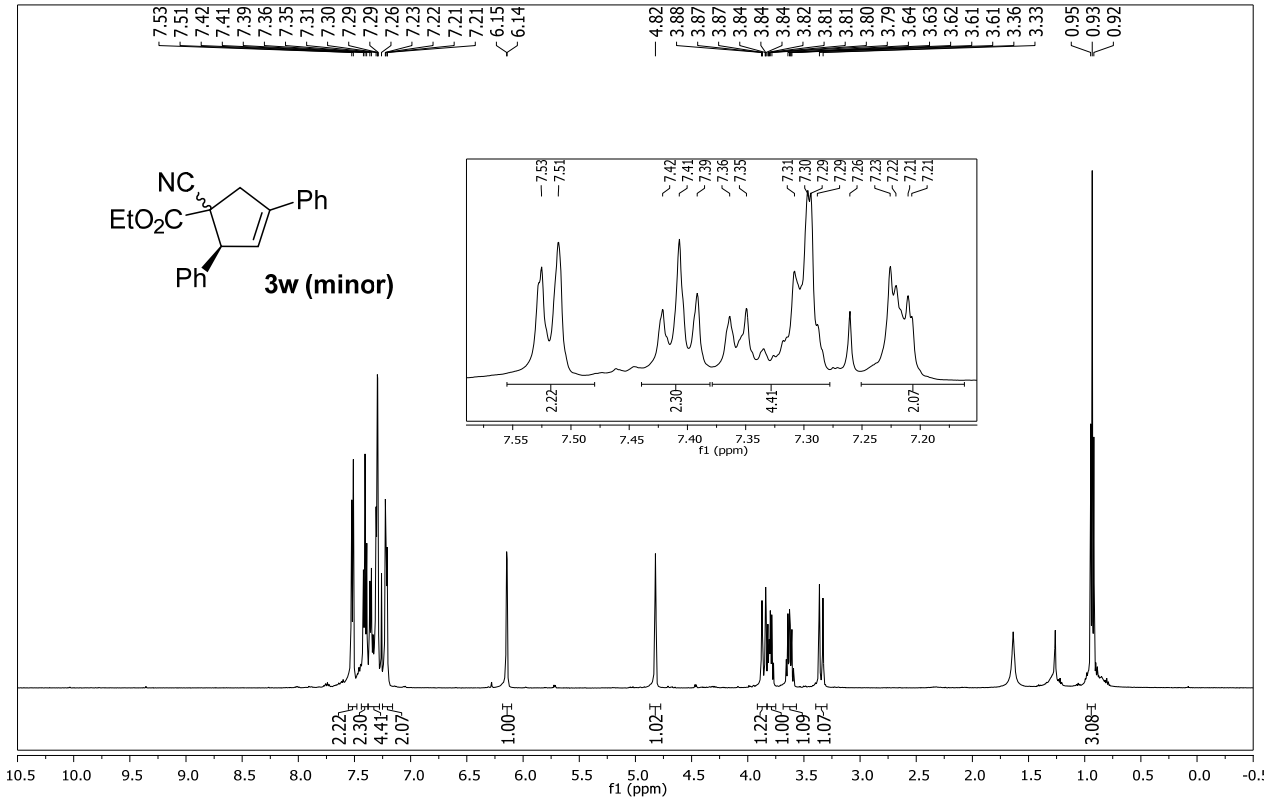


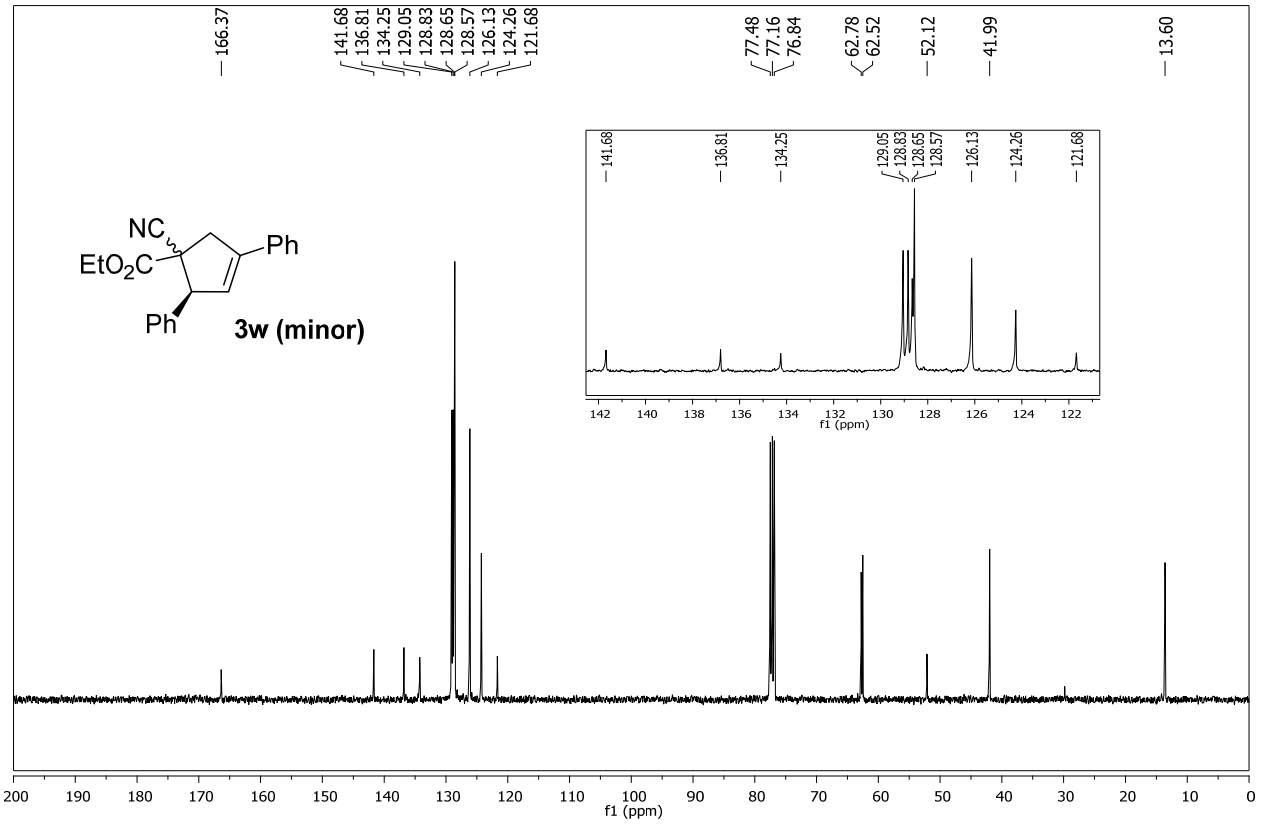
Ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate (3w *major*)



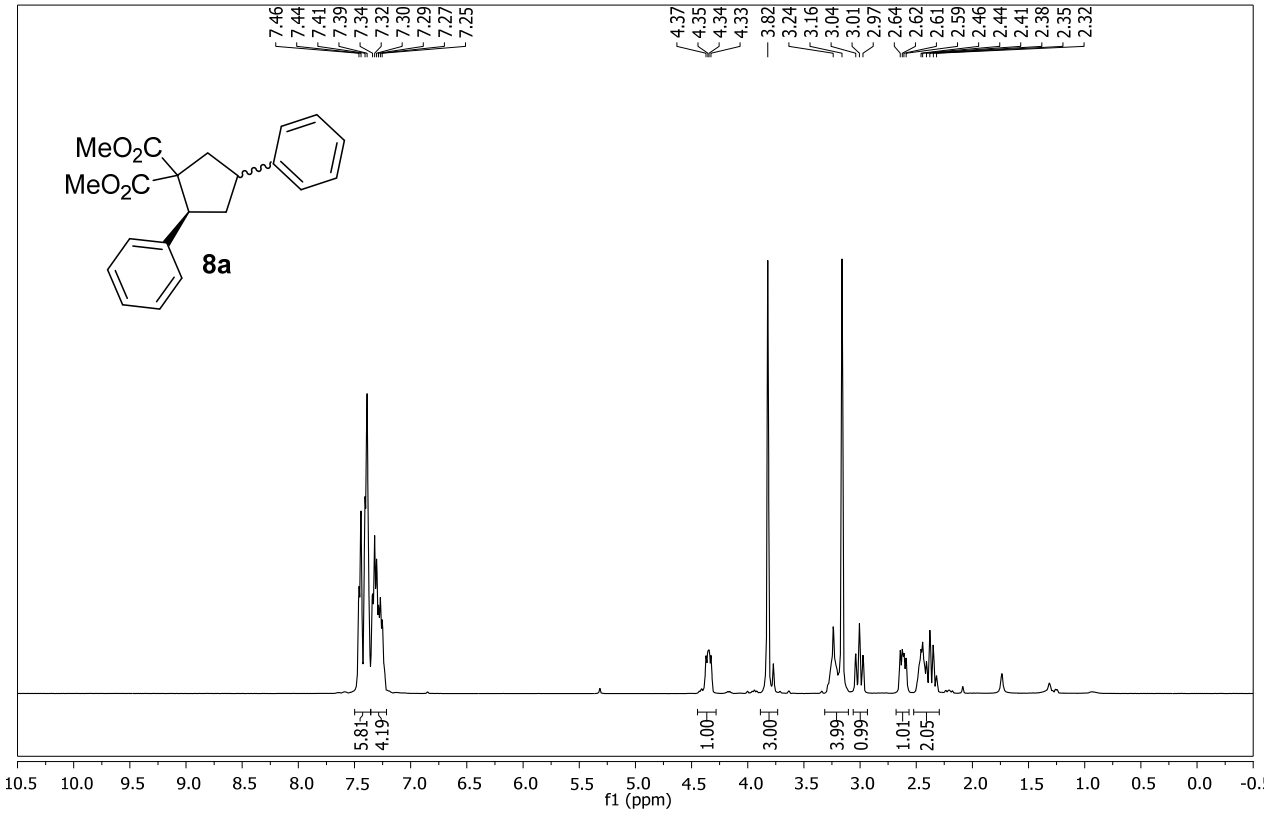


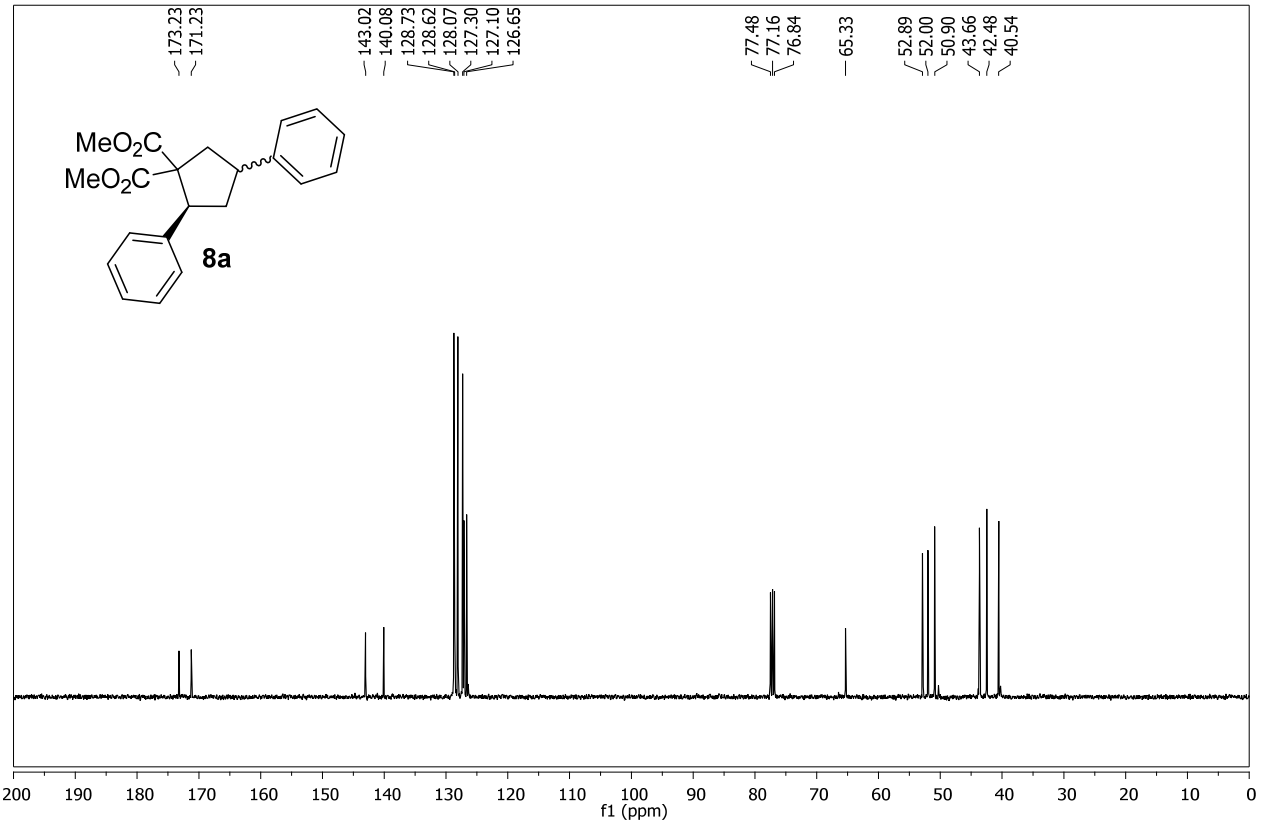
Ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate (3w *minor*)



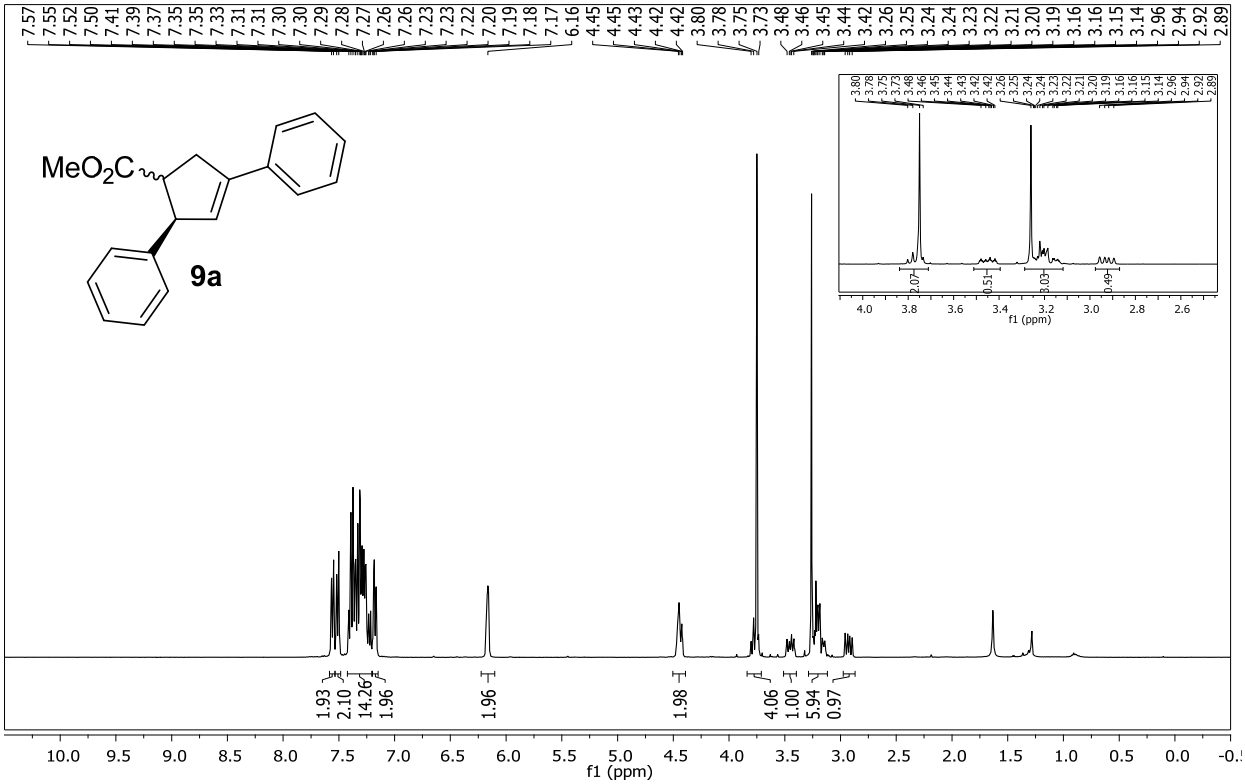


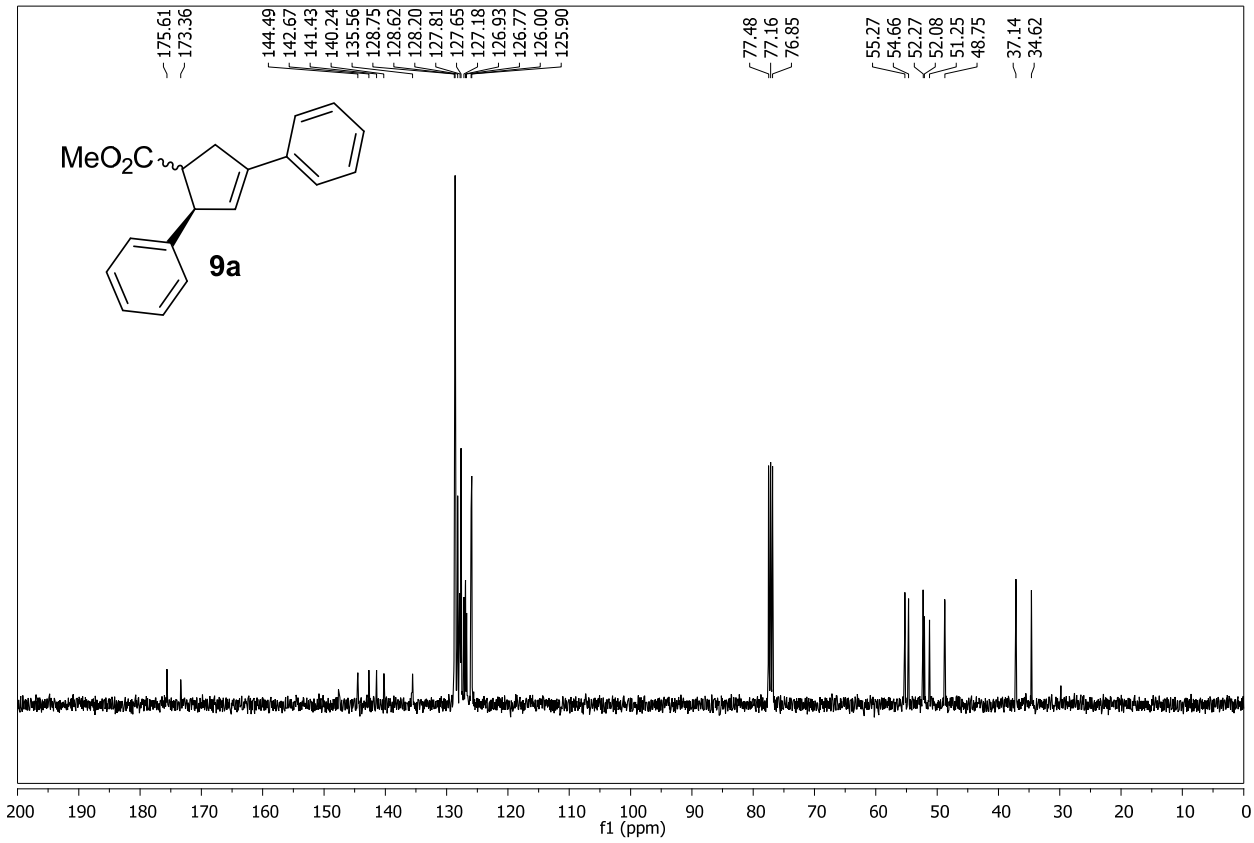
Dimethyl (2*S*)-2,4-diphenylcyclopentane-1,1-dicarboxylate (8a)



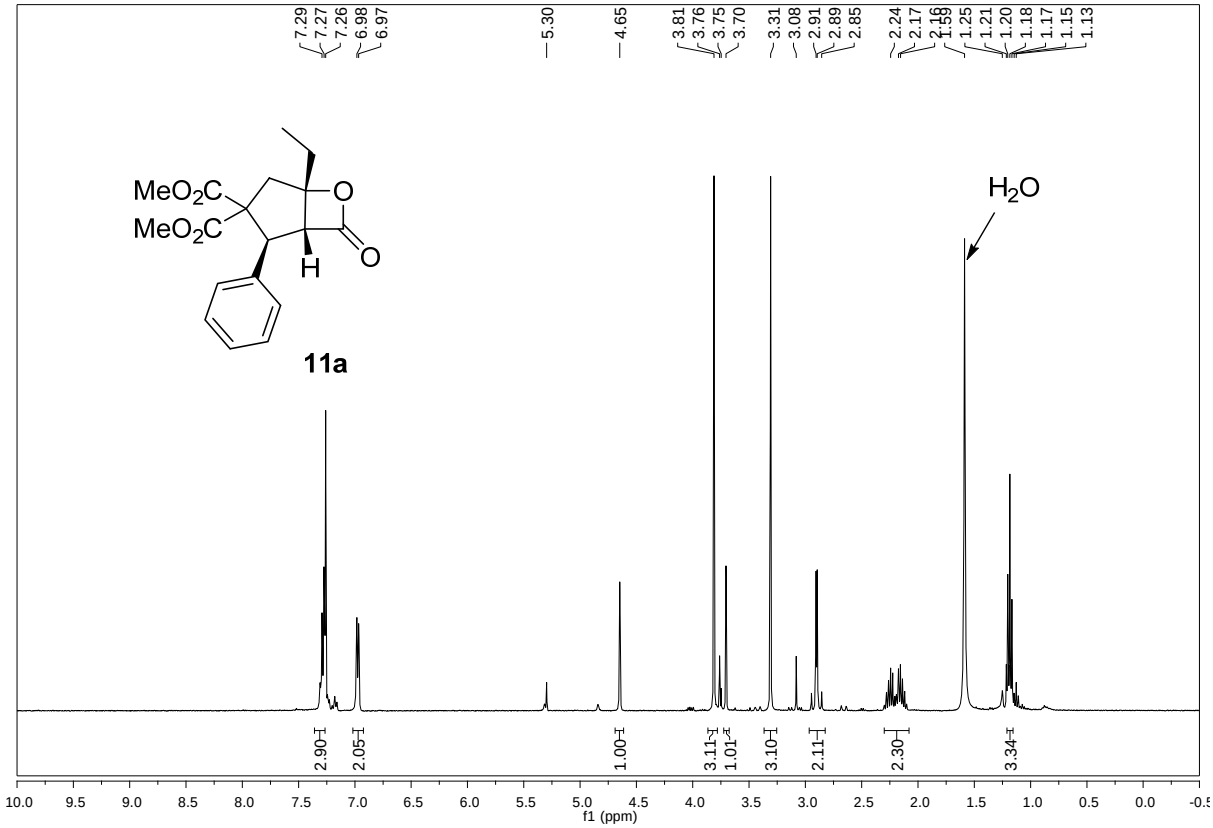


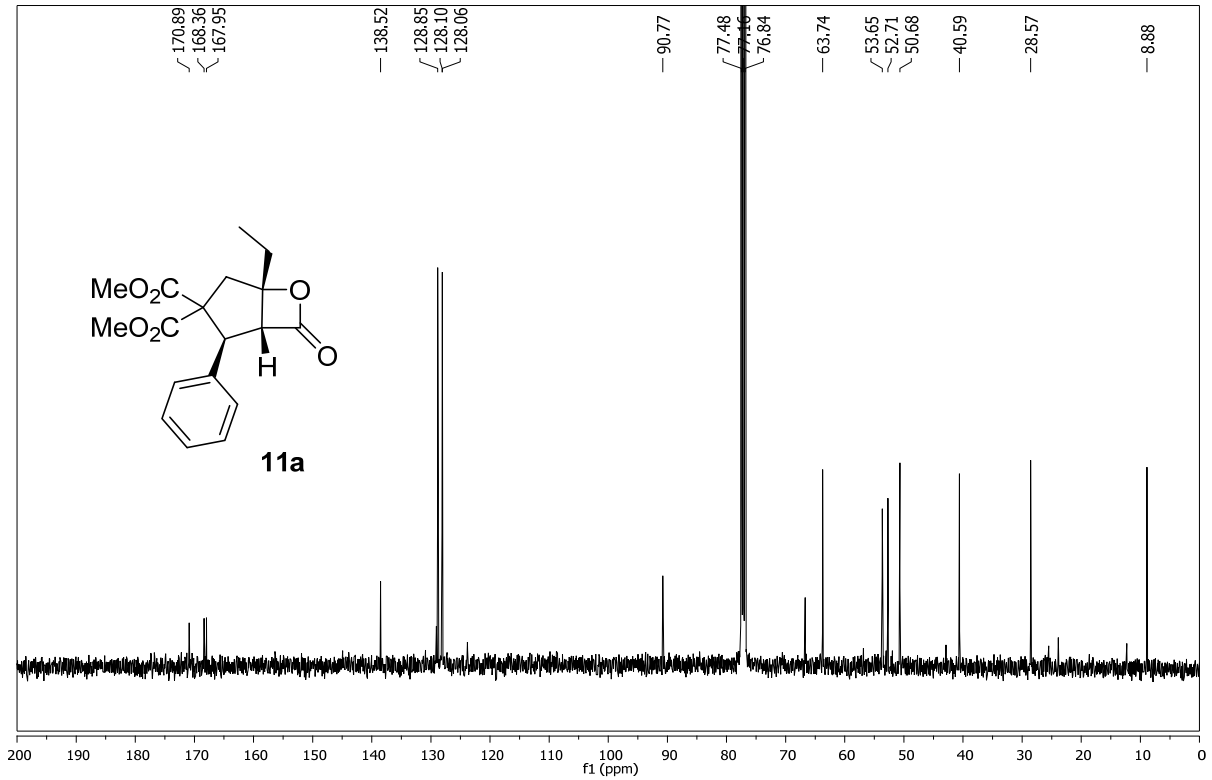
Methyl (2*R*)-2,4-diphenylcyclopent-3-ene-1-carboxylate (9a)



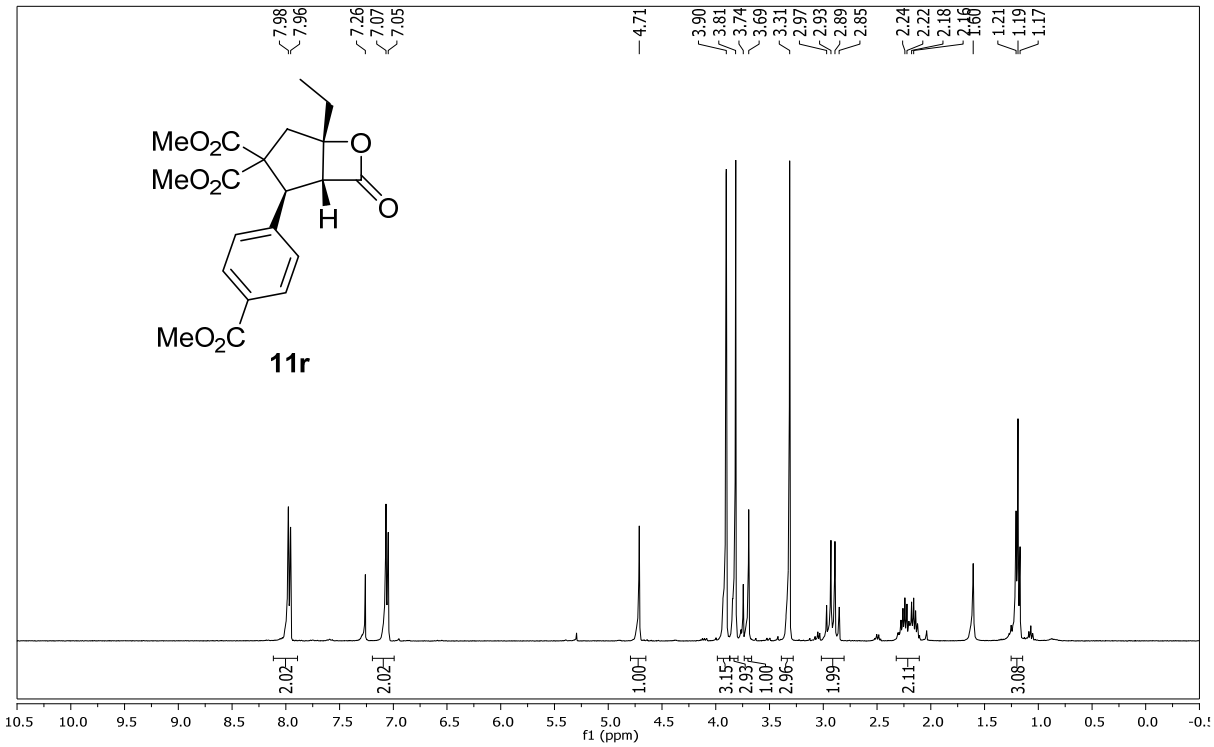


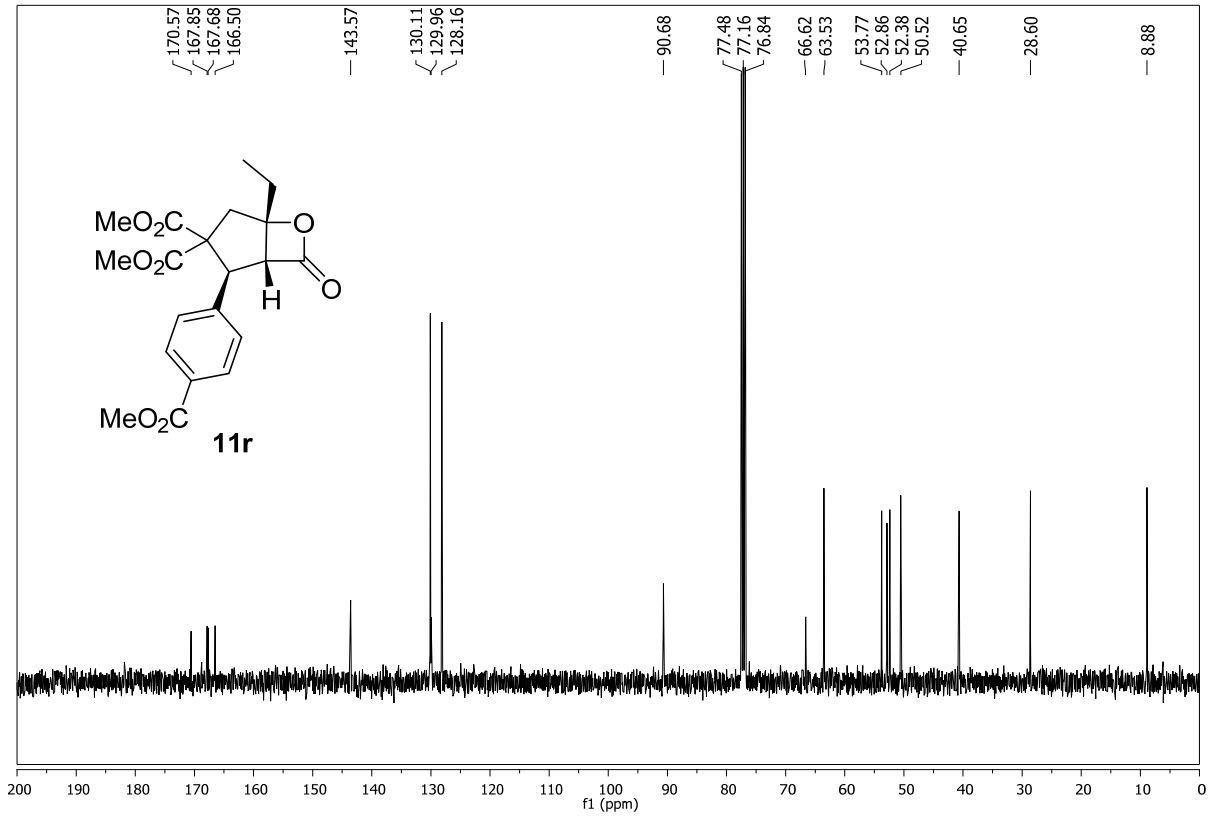
Dimethyl (*1R2S5S*) 5-ethyl-7-oxo-2-phenyl-6-oxabicyclo[3.2.0]heptane-3,3-dicarboxylate (11a)





Dimethyl (*1R2S5S*) 5-ethyl-2-(4-(methoxycarbonyl)phenyl)-7-oxo-6-oxabicyclo[3.2.0] heptane-3,3-dicarboxylate (11r)

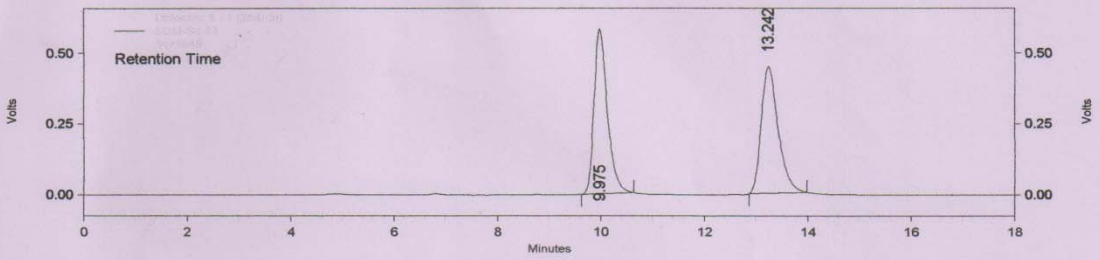




7. HPLC Scans of Functionalized Cyclopentenes

Dimethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate (3a)

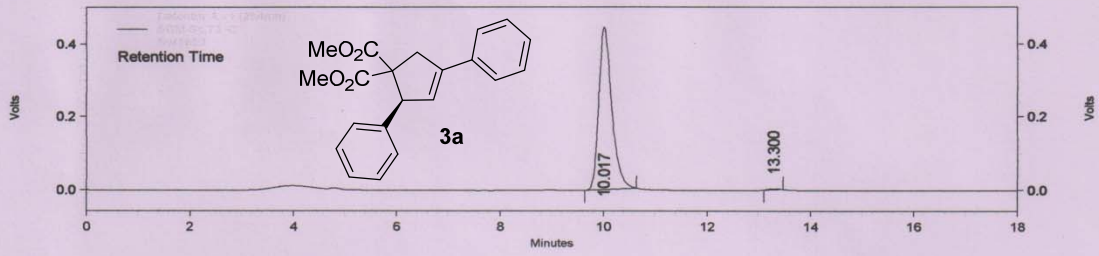
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1649
User: System
Acquired: 5/5/14 2:52:21 PM
Printed: 7/14/14 3:55:10 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	9.975	10354304	50.660
2	13.242	10084592	49.340
Totals		20438896	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1650
User: System
Acquired: 5/5/14 3:15:56 PM
Printed: 7/14/14 3:57:49 PM



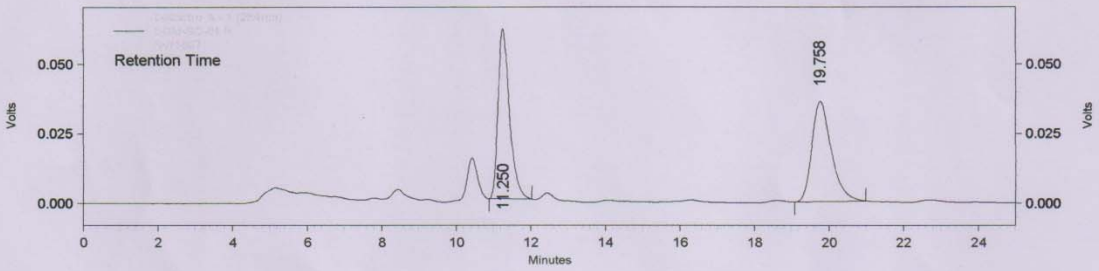
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	10.017	7755530	99.507
2	13.300	38449	0.493
Totals		7793979	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5- AmyCoat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-2-phenyl-4-(p-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3b)

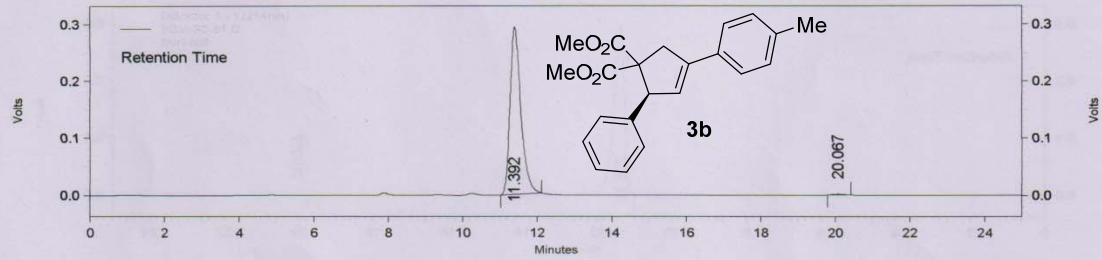
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1667
User: System
Acquired: 5/9/14 3:55:32 PM
Printed: 5/9/14 4:57:03 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	11.250	1319716	50.243
2	19.758	1306967	49.757
Totals		2626683	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1668
User: System
Acquired: 5/9/14 4:22:06 PM
Printed: 5/9/14 5:12:52 PM



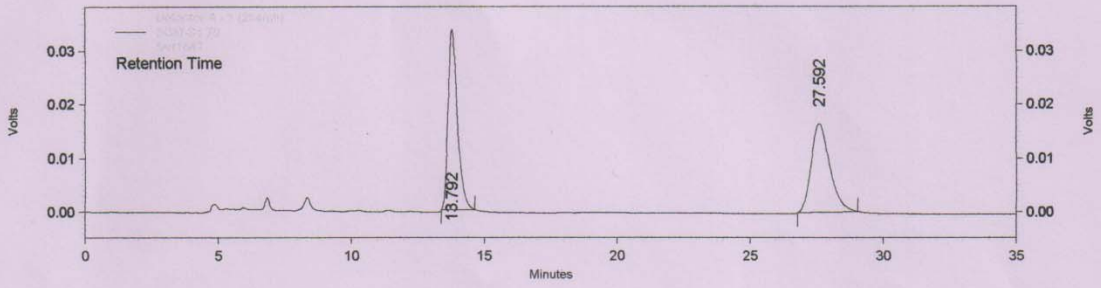
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	11.392	5898228	99.483
2	20.067	30625	0.517
Totals		5928853	100.000

Project Leader : Dr A. T. BIJU
Column : Kromasil 5-AmyCoat (250mmX4.6mm)
Mobile Phase :IPA:n-Hexane(10:90)
Wavelength : 254nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 15ul
Date : 09-05-2014

Dimethyl (*S*)-4-(4-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3c)

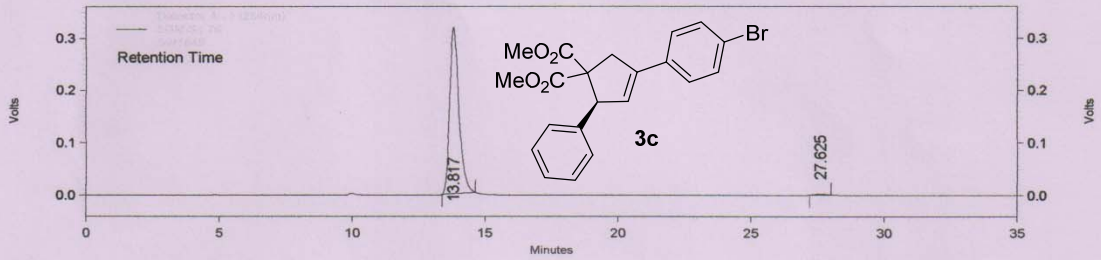
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1647
User: System
Acquired: 5/2/14 4:17:15 PM
Printed: 7/14/14 3:59:42 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	13.792	822570	50.508
2	27.592	806029	49.492
Totals		1628599	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1648
User: System
Acquired: 5/2/14 4:54:54 PM
Printed: 7/14/14 4:01:25 PM



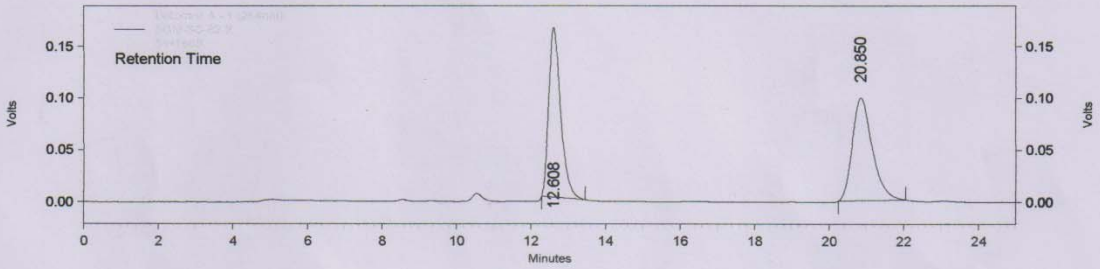
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	13.817	7710643	99.391
2	27.625	47233	0.609
Totals		7757876	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5- AmyCoat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-4-(4-fluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3d)

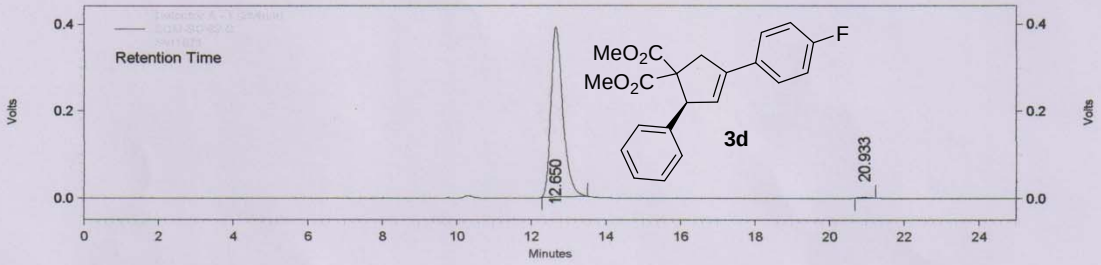
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1669
User: System
Acquired: 5/9/14 4:49:06 PM
Printed: 5/9/14 6:38:35 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	12.608	3632997	49.806
2	20.850	3661248	50.194
Totals		7294245	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1671
User: System
Acquired: 5/9/14 6:26:29 PM
Printed: 5/9/14 6:55:40 PM



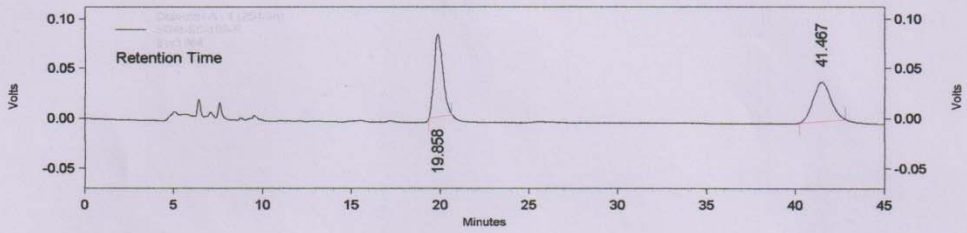
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	12.650	8614095	99.643
2	20.933	30858	0.357
Totals		8644953	100.000

Project Leader : Dr A. T. BIJU
Column : Kromasil 5-AmyCoat (250mmX4.6mm)
Mobile Phase :IPA:n-Hexane(10:90)
Wavelength : 254nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 5ul
Date : 09-05-2014

Dimethyl (*S*)-4-(4-nitrophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3e)

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1754
User: System
Acquired: 6/27/14 2:25:16 PM
Printed: 6/27/14 3:13:14 PM
Sample Name SGM-SC-109-R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
19.858	694995	50.655
41.467	677016	49.345
Totals	1372011	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1755
User: System
Acquired: 6/27/14 3:14:25 PM
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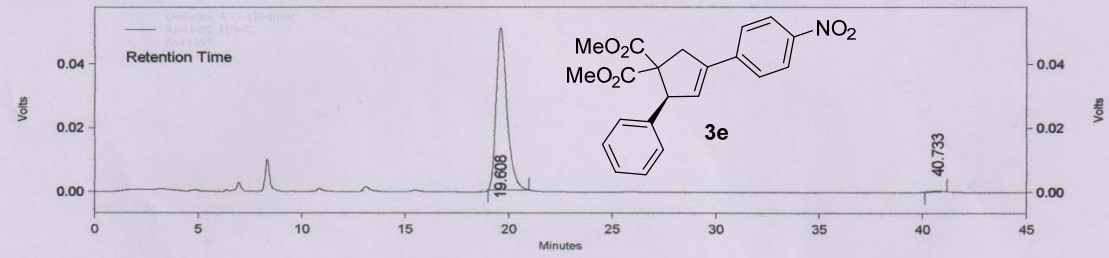


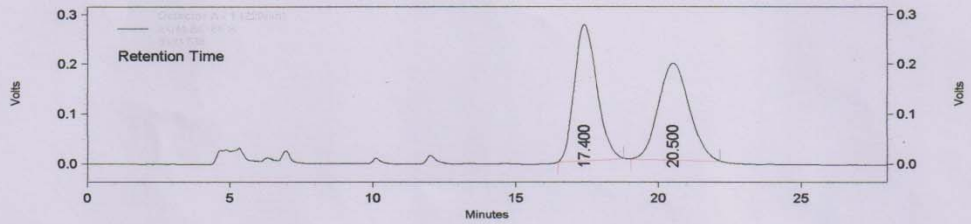
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	19.608	1844646	99.453
2	40.733	10147	0.547
Totals		1854793	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amy Coat
Mobile Phase :IPA:PE (20:80)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-4-(2-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3f)

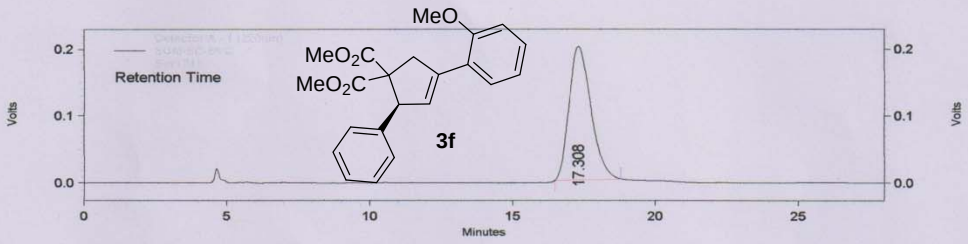
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1738
User: System
Acquired: 6/13/14 3:02:11 PM
Printed: 6/13/14 4:53:27 PM
Sample Name SGM-SC-86 R



Detector A - 1 (220nm)

Retention Time	C Area	Area %
17.400	7441947	50.597
20.500	7266299	49.403
Totals	14708246	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1741
User: System
Acquired: 6/13/14 4:14:19 PM
Printed: 6/13/14 4:55:11 PM
Sample Name SGM-SC-86 C

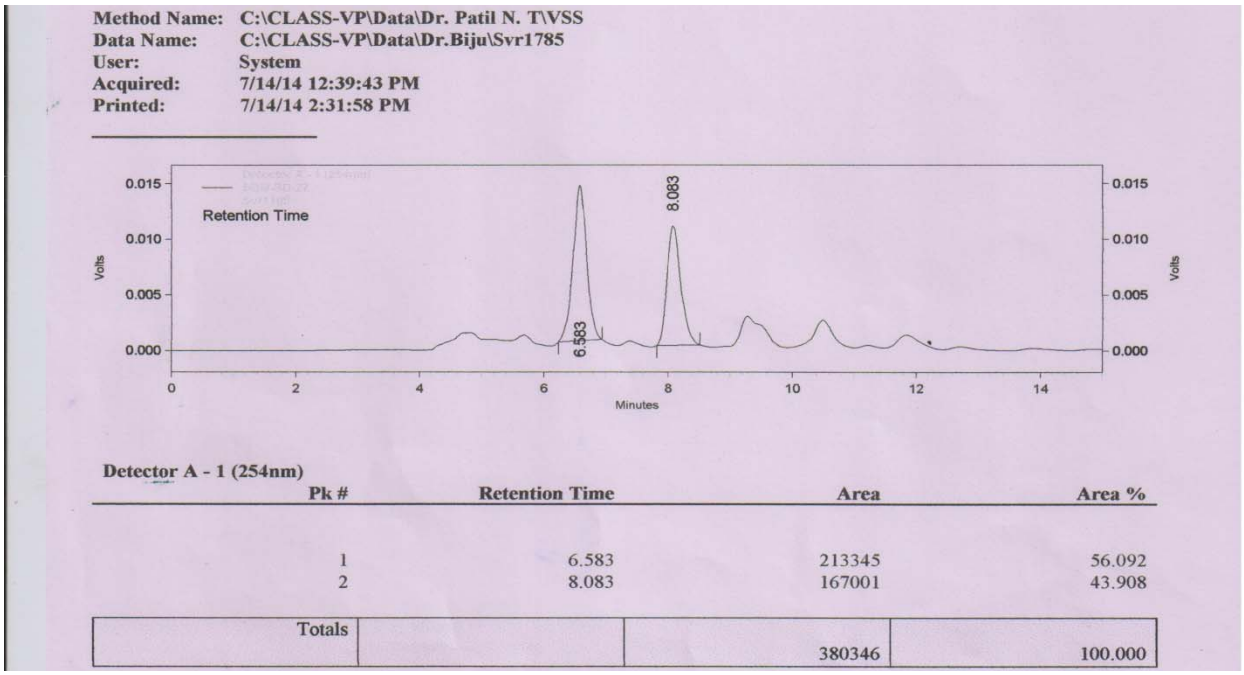


Detector A - 1 (220nm)

Retention Time	C Area	Area %
17.308	5292239	100.000
Totals	5292239	100.000

Project Leader : Dr.A. T. Biju
Column :Chiralcel OJ-H
Mobile Phase :IPA:Hexane (10:90)
Wavelength :220nm
Flow Rate : 0.7 ml/min (780psi)
Conc. :1mg/mL
Inj vol- :5 ul

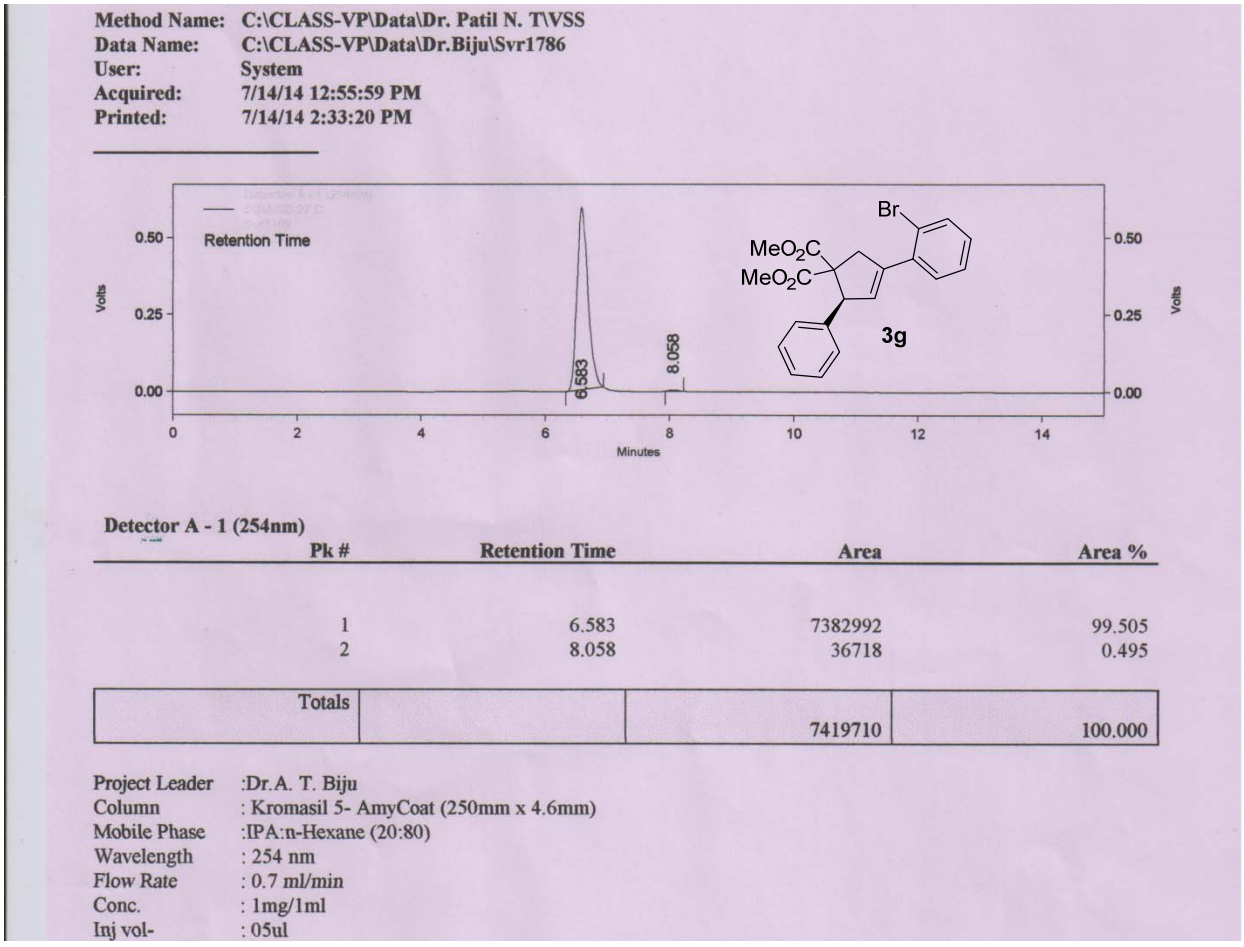
Dimethyl (*S*)-4-(2-bromophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3g)



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1785
User: System
Acquired: 7/14/14 12:39:43 PM
Printed: 7/14/14 2:31:58 PM

Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	6.583	213345	56.092
2	8.083	167001	43.908
Totals		380346	100.000



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1786
User: System
Acquired: 7/14/14 12:55:59 PM
Printed: 7/14/14 2:33:20 PM

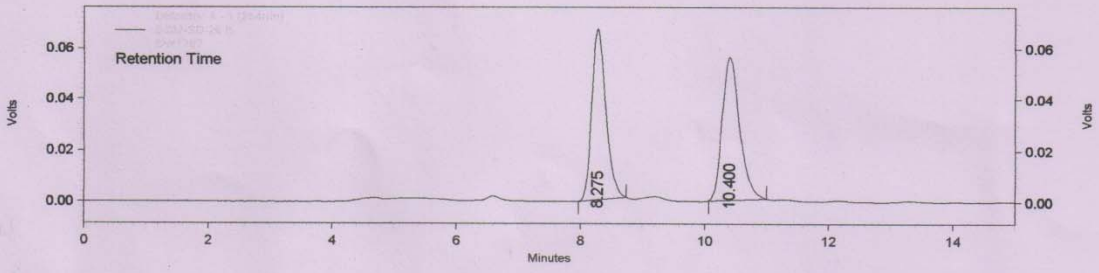
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	6.583	7382992	99.505
2	8.058	36718	0.495
Totals		7419710	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5- AmyCoat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane (20:80)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-4-(3-methoxyphenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3h)

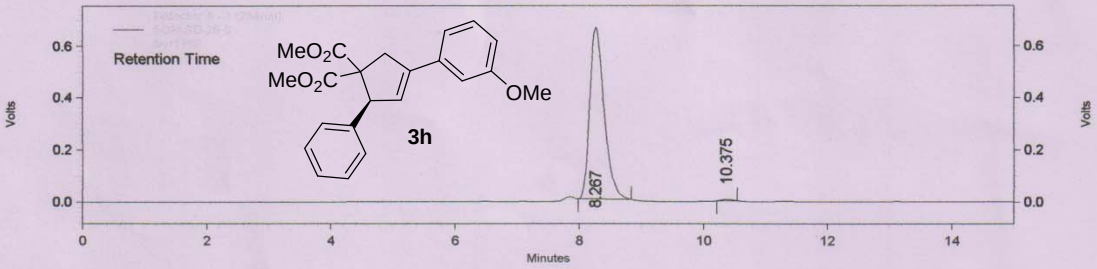
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1787
User: System
Acquired: 7/14/14 1:12:36 PM
Printed: 7/14/14 2:34:32 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	8.275	1051067	49.078
2	10.400	1090564	50.922
Totals		2141631	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1788
User: System
Acquired: 7/14/14 1:29:44 PM
Printed: 7/14/14 2:36:09 PM



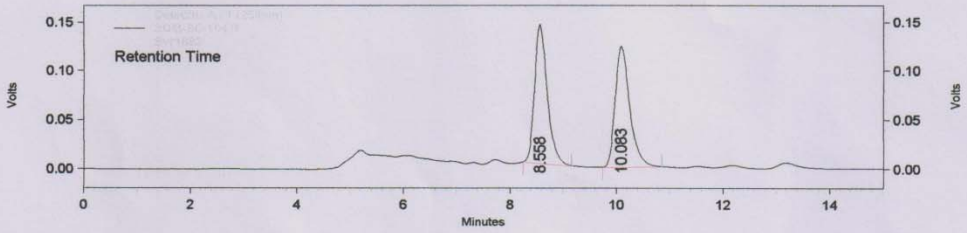
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	8.267	10651950	99.441
2	10.375	59854	0.559
Totals		10711804	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5- AmyCoat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane (20:80)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-4-(2,4-dichlorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3i)

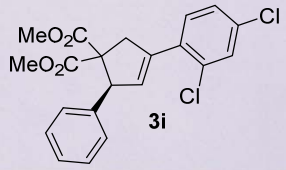
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1692
User: System
Acquired: 5/27/14 6:27:21 PM
Printed: 5/27/14 7:04:36 PM
Sample Name SGM-SC-104 R



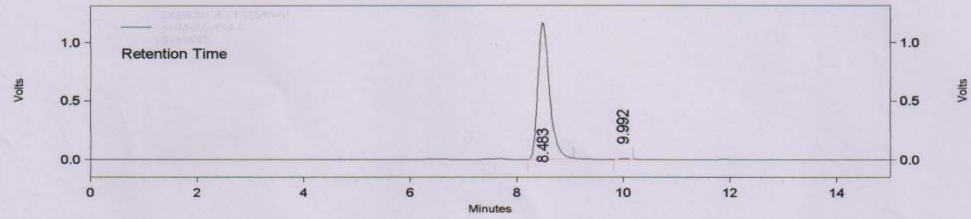
Detector A - 1 (254nm)

Retention Time	C Area	Area %
8.558	1166745	49.979
10.083	1167714	50.021
Totals	2334459	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1693
User: System
Acquired: 5/27/14 6:44:33 PM
Printed: 5/27/14 7:11:45 PM
Sample Name SGM-SC-104 C



3i

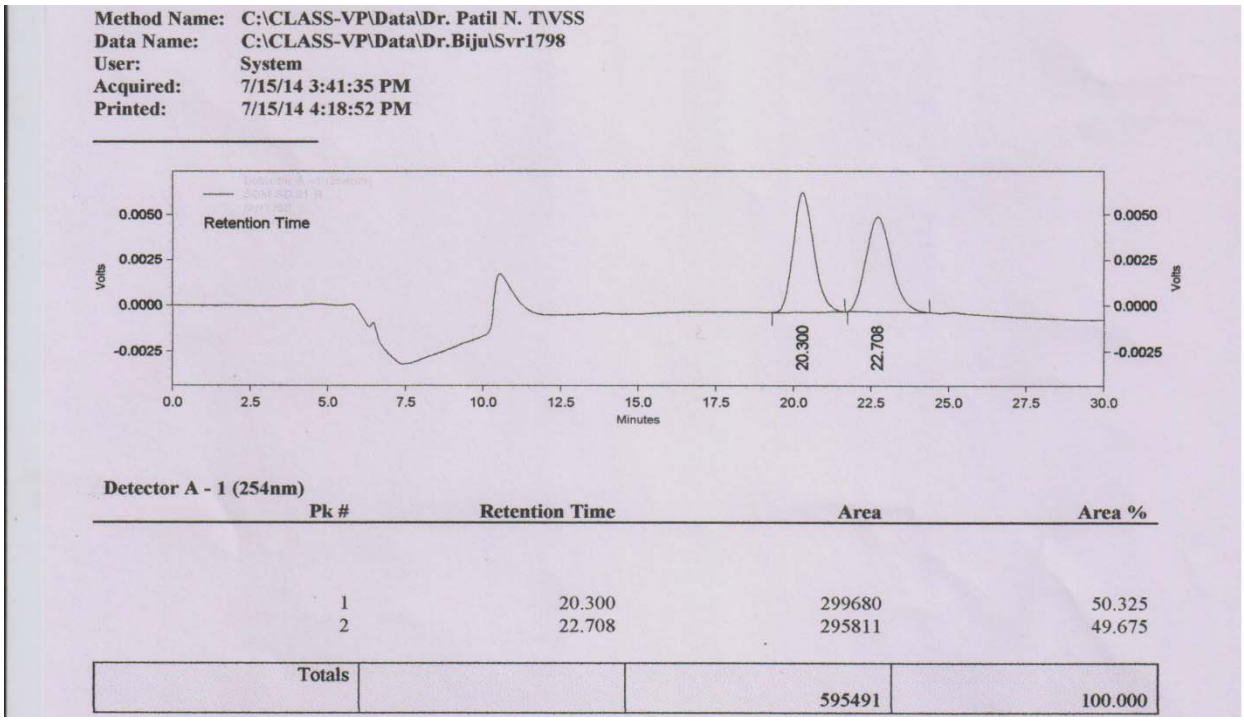


Detector A - 1 (254nm)

Retention Time	C Area	Area %
8.483	8702082	99.573
9.992	37310	0.427
Totals	8739392	100.000

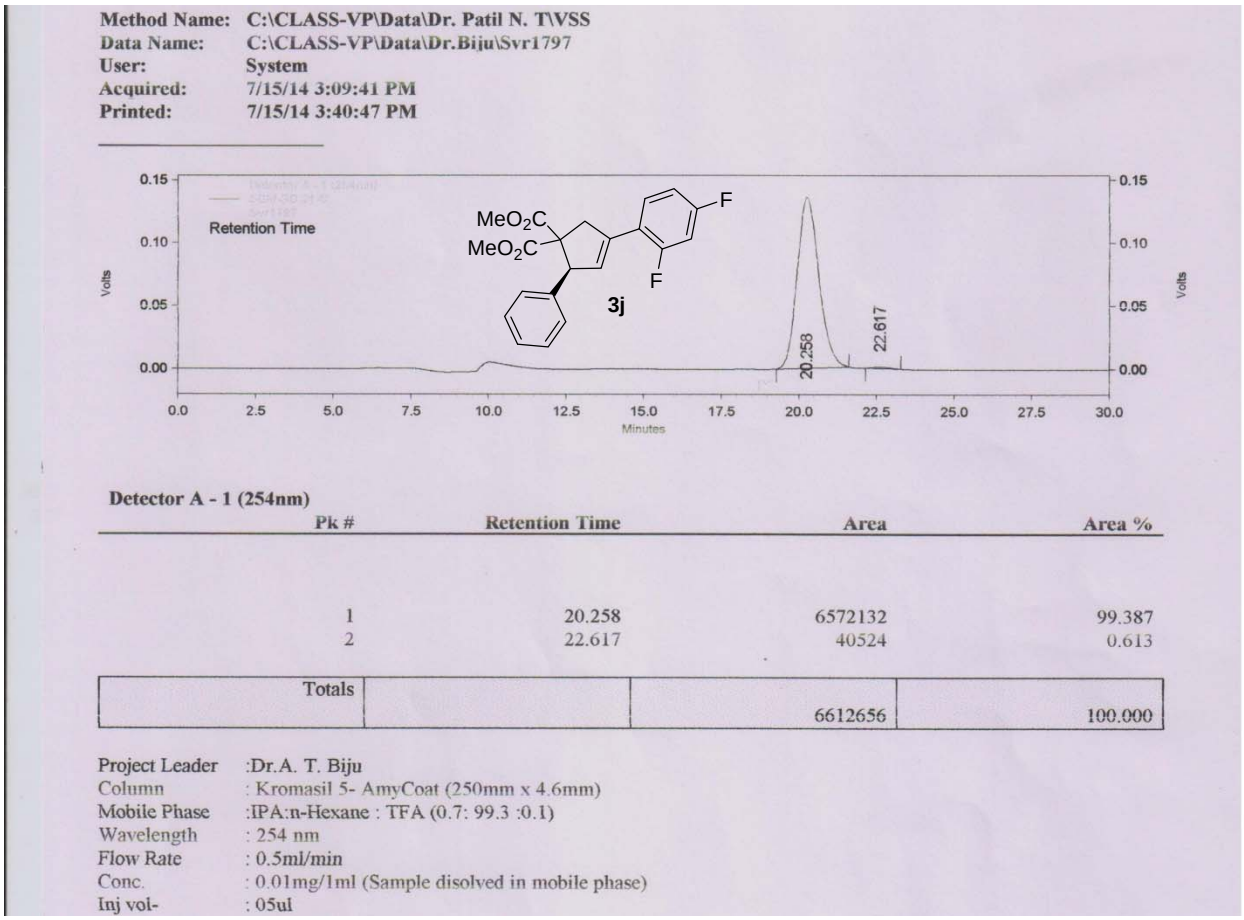
Project Leader : Dr.A. T. Biju
Column :Kromasil 5 AmyCoat (4.6X250mm)
Mobile Phase :IPA:*n-Hexane* (10:90)
Wavelength :254nm
Flow Rate : 0.7 ml/min (43)kgf
Conc. :1mg/mL
Inj vol- :3 ul

Dimethyl (*S*)-4-(2,4-difluorophenyl)-2-phenylcyclopent-3-ene-1,1-dicarboxylate (3j)



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	20.300	299680	50.325
2	22.708	295811	49.675
Totals		595491	100.000



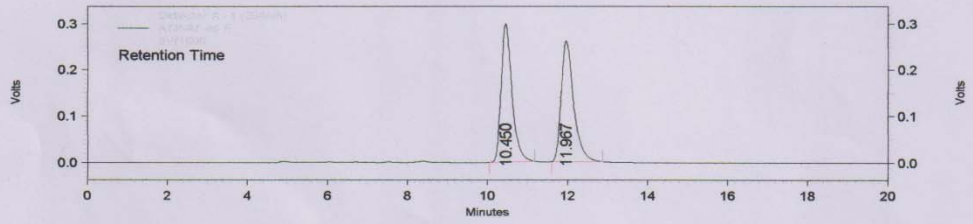
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	20.258	6572132	99.387
2	22.617	40524	0.613
Totals		6612656	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5- AmyCoat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane : TFA (0.7: 99.3 :0.1)
Wavelength : 254 nm
Flow Rate : 0.5ml/min
Conc. : 0.01mg/1ml (Sample disolved in mobile phase)
Inj vol- : 05ul

Diethyl (*S*)-2,4-diphenylcyclopent-3-ene-1,1-dicarboxylate (3k)

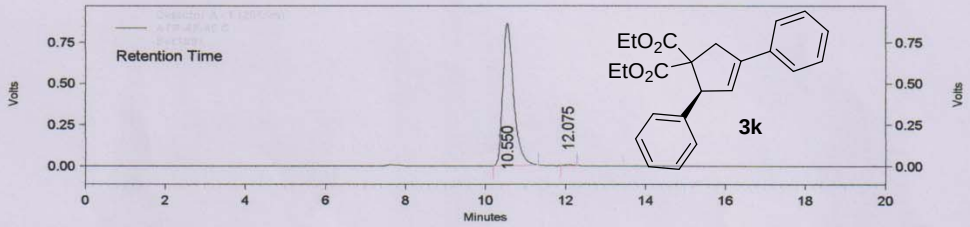
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1690
User: System
Acquired: 5/20/14 3:42:16 PM
Printed: 5/20/14 4:28:11 PM
Sample Name ATP-AF-46 R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.450	2811165	49.787
11.967	2835176	50.213
Totals	5646341	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1691
User: System
Acquired: 5/20/14 4:03:18 PM
Printed: 5/20/14 4:24:54 PM
Sample Name ATP-AF-46 C



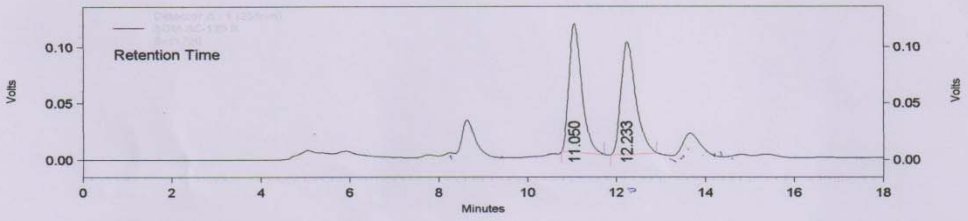
Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.550	8086308	99.569
12.075	34996	0.431
Totals	8121304	100.000

Project Leader : Dr.A. T. Biju
Column :Kromasil 5-AmyCoat (4.6X250mm)
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength :254nm
Flow Rate : 0.7 ml/min (43)kgf
Conc. :1mg/mL
Inj vol- :5 ul

(*S*)-1,1'-(2,4-Diphenylcyclopent-3-ene-1,1-diyl)bis(ethan-1-one) (3l)

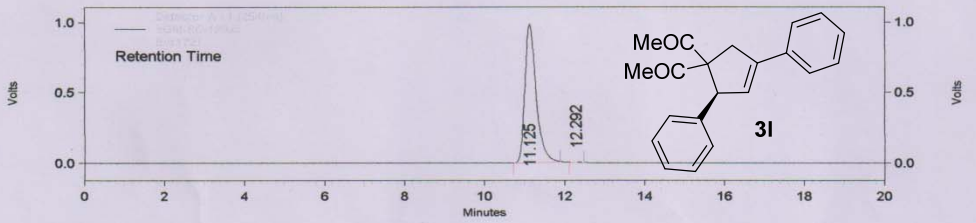
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1720
User: System
Acquired: 6/11/14 3:11:17 PM
Printed: 6/11/14 3:32:28 PM
Sample Name SGM-SC-129 R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
11.050	1146037	50.038
12.233	1144288	49.962
Totals	2290325	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1721
User: System
Acquired: 6/11/14 3:36:25 PM
Printed: 6/11/14 4:23:14 PM
Sample Name SGM-SC-129 C



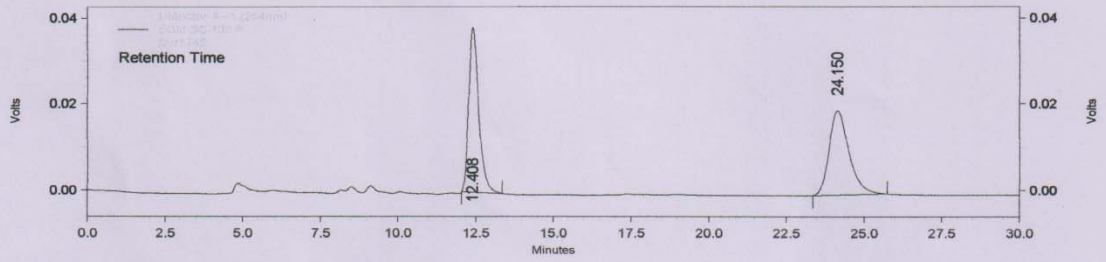
Detector A - 1 (254nm)

Retention Time	C Area	Area %
11.125	9577500	99.850
12.292	14353	0.150
Totals	9591853	100.000

Project Leader : Dr.A. T. Biju
Column :Kromasil 5-AmyCoat (4.6X250mm)
Mobile Phase :IPA:PE (10:90)
Wavelength :254nm
Flow Rate : 0.7 ml/min (40kgf)
Conc. :1mg/mL
Inj vol- :5 ul

Dimethyl (*S*)-4-phenyl-2-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (3m)

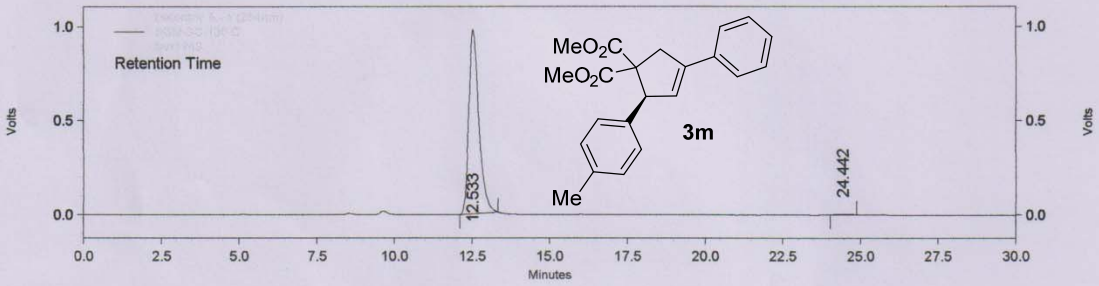
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1745
User: System
Acquired: 6/23/14 11:54:24 AM
Printed: 6/23/14 2:48:19 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	12.408	867717	50.008
2	24.150	867441	49.992
Totals		1735158	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1749
User: System
Acquired: 6/23/14 12:54:09 PM
Printed: 6/23/14 2:54:57 PM

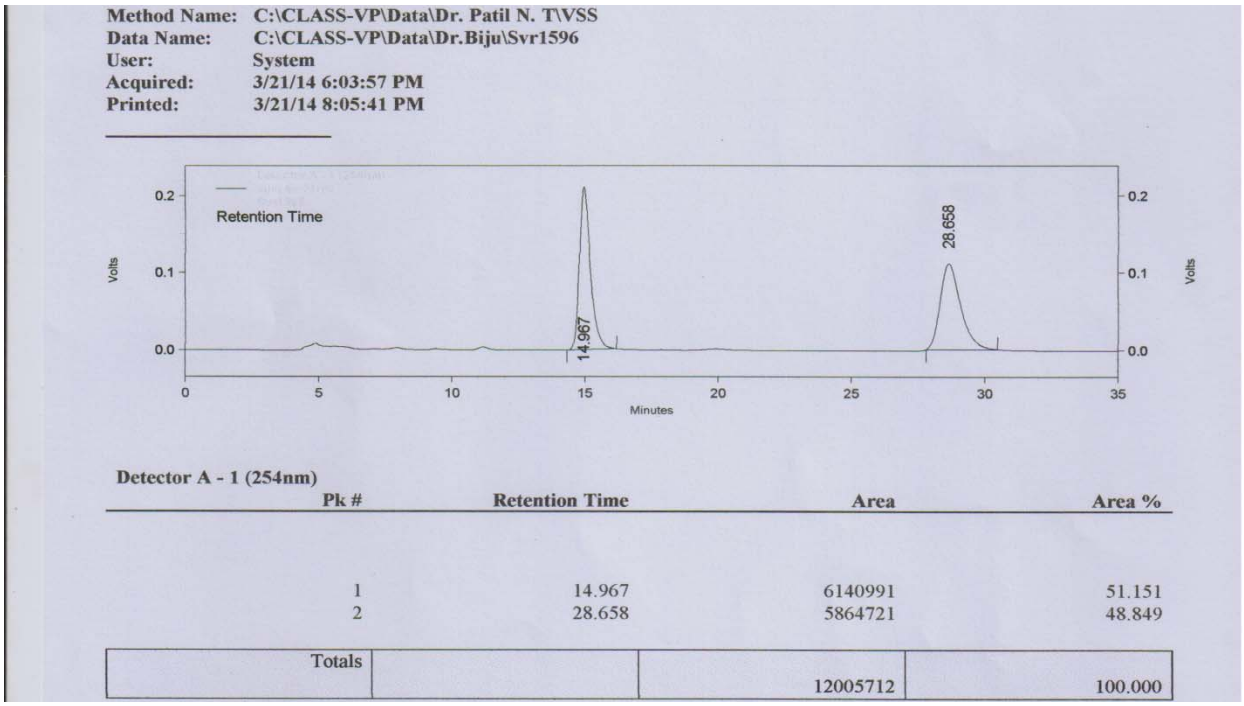


Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	12.533	22007965	99.580
2	24.442	92830	0.420
Totals		22100795	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amy Coat
Mobile Phase :IPA:Hexane (10:90)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

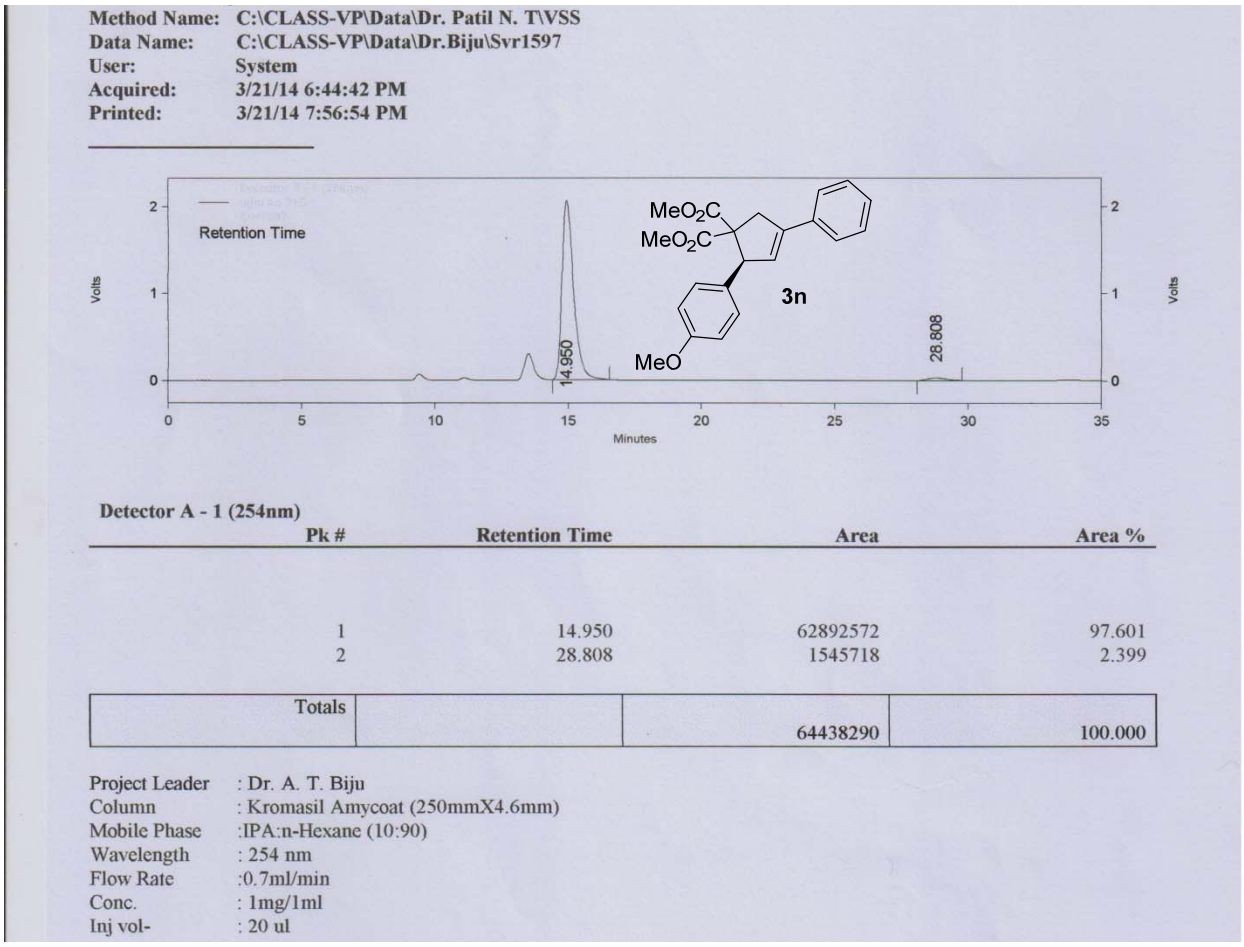
Dimethyl (*S*)-2-(4-methoxyphenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3n)



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1596
User: System
Acquired: 3/21/14 6:03:57 PM
Printed: 3/21/14 8:05:41 PM

Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	14.967	6140991	51.151
2	28.658	5864721	48.849
Totals		12005712	100.000



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1597
User: System
Acquired: 3/21/14 6:44:42 PM
Printed: 3/21/14 7:56:54 PM

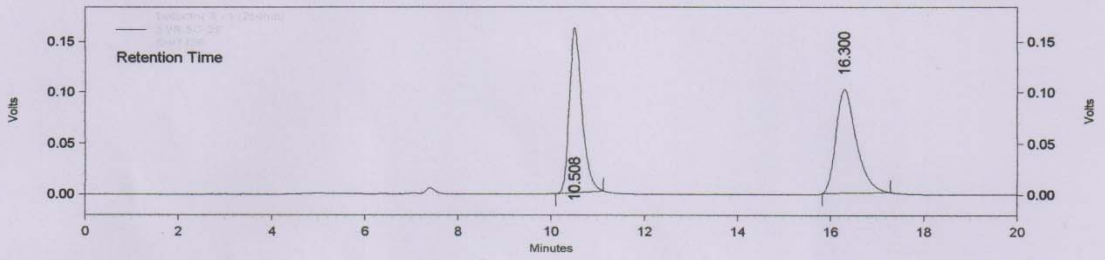
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	14.950	62892572	97.601
2	28.808	1545718	2.399
Totals		64438290	100.000

Project Leader : Dr. A. T. Biju
Column : Kromasil Amycoat (250mmX4.6mm)
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength : 254 nm
Flow Rate :0.7ml/min
Conc. : 1mg/1ml
Inj vol- : 20 ul

Dimethyl (*S*)-2-(4-bromophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3o)

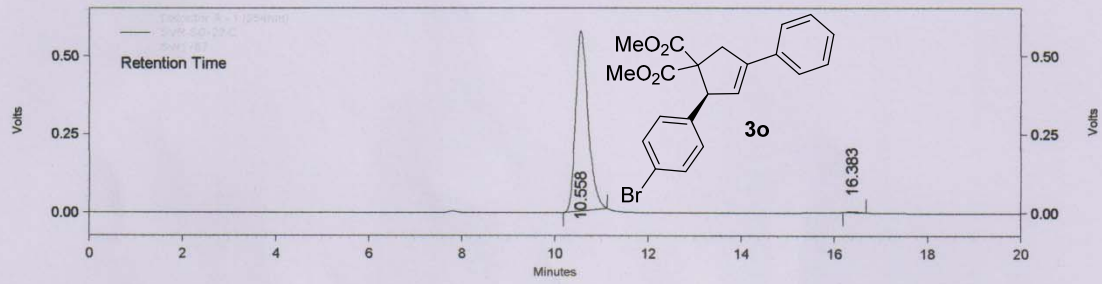
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1756
User: System
Acquired: 6/27/14 4:02:12 PM
Printed: 6/27/14 4:30:23 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	10.508	3075215	49.893
2	16.300	3088376	50.107
Totals		6163591	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1757
User: System
Acquired: 6/27/14 4:23:59 PM
Printed: 6/27/14 4:45:55 PM



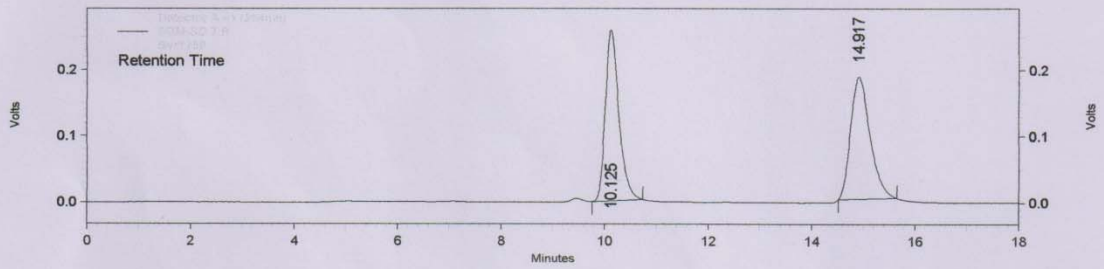
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	10.558	10637787	99.596
2	16.383	43185	0.404
Totals		10680972	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amy Coat
Mobile Phase :IPA:PE (20:80)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*S*)-2-(4-chlorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3p)

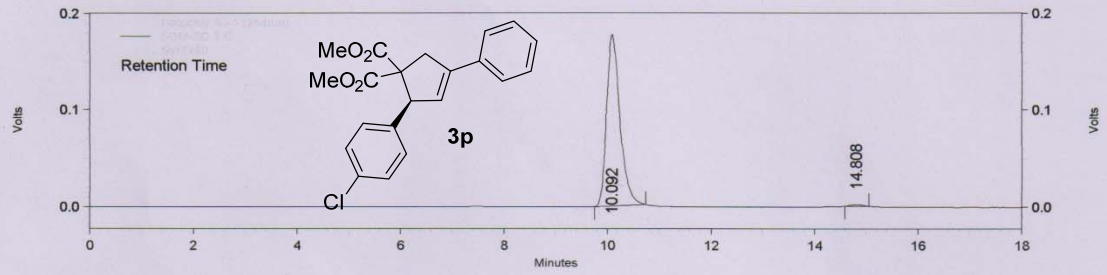
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1758
User: System
Acquired: 6/27/14 4:44:51 PM
Printed: 6/27/14 5:07:30 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	10.125	4679079	49.349
2	14.917	4802595	50.651
Totals		9481674	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1759
User: System
Acquired: 6/27/14 5:03:34 PM
Printed: 6/27/14 5:23:38 PM

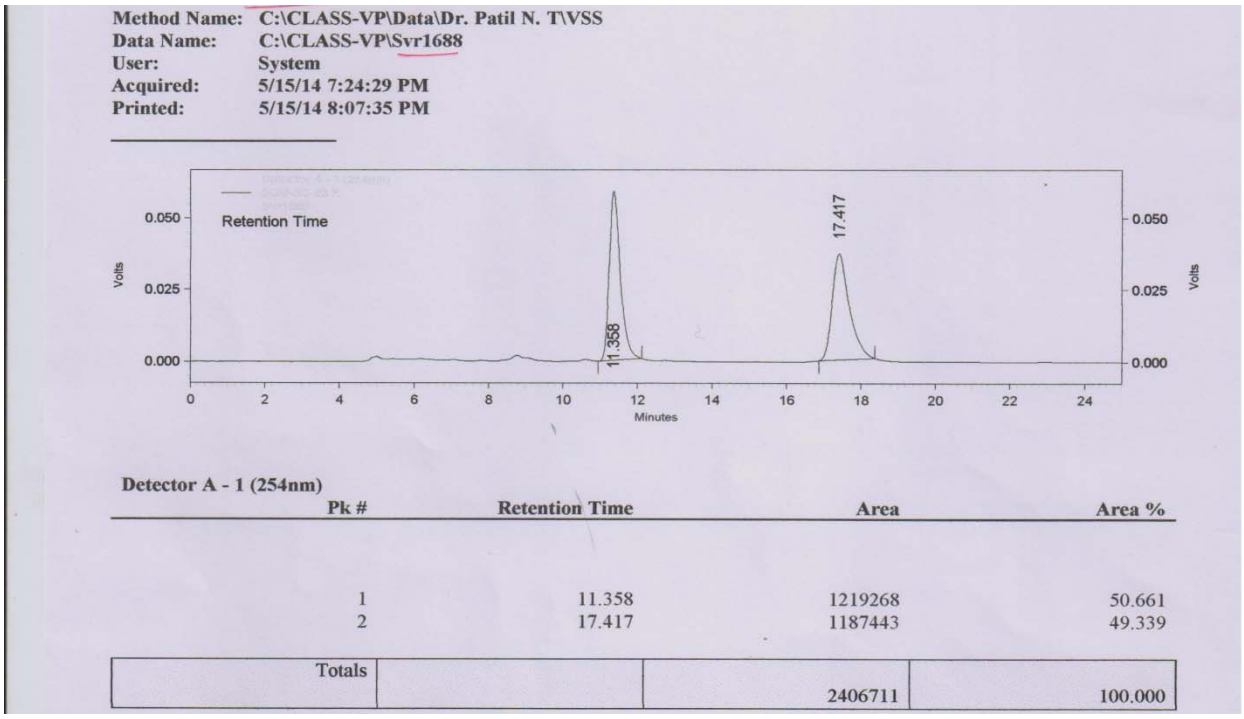


Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	10.092	3169392	99.256
2	14.808	23772	0.744
Totals		3193164	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amy Coat
Mobile Phase :IPA:PE (20:80)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

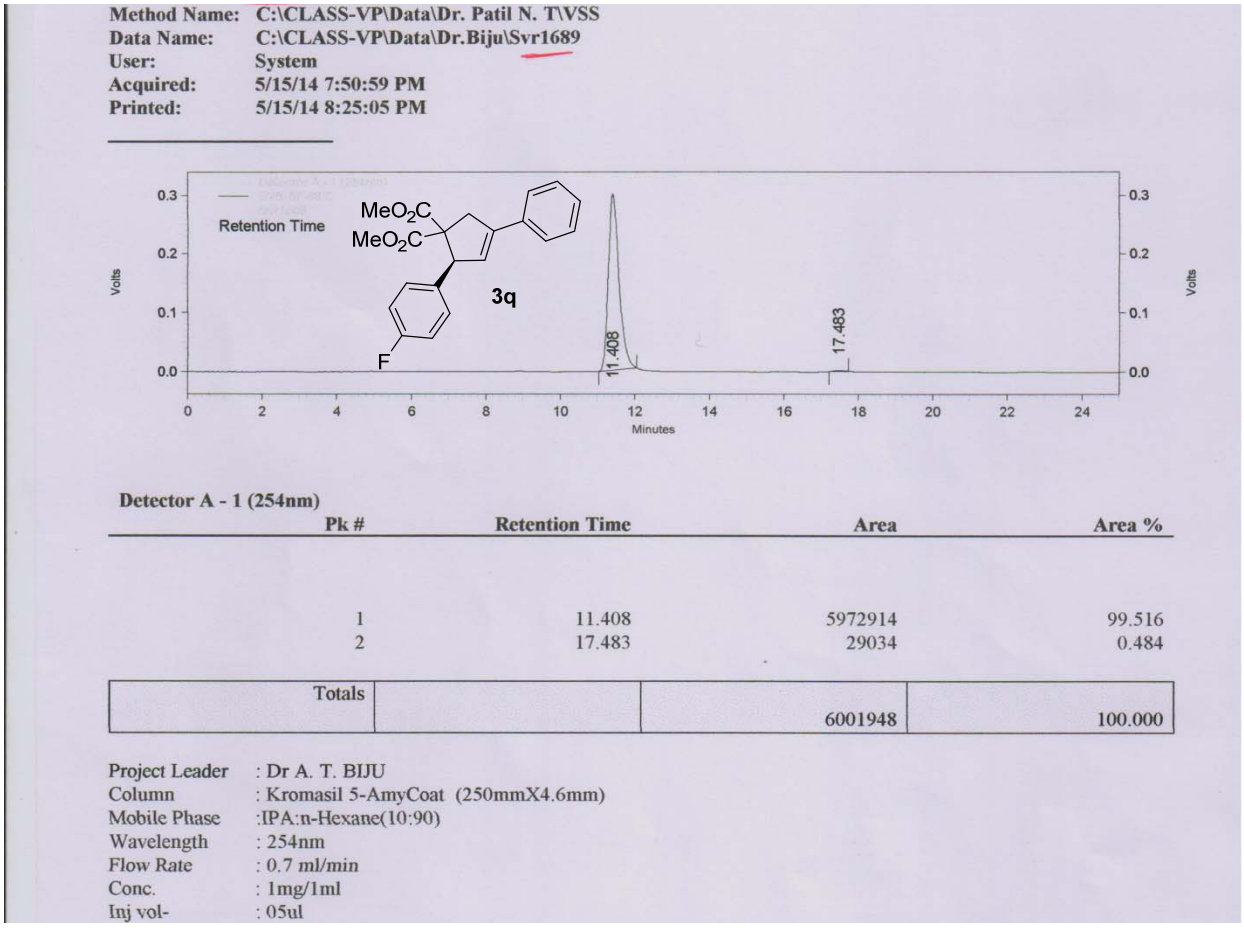
Dimethyl (*S*)-2-(4-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3q)



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Svr1688
User: System
Acquired: 5/15/14 7:24:29 PM
Printed: 5/15/14 8:07:35 PM

Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	11.358	1219268	50.661
2	17.417	1187443	49.339
Totals		2406711	100.000



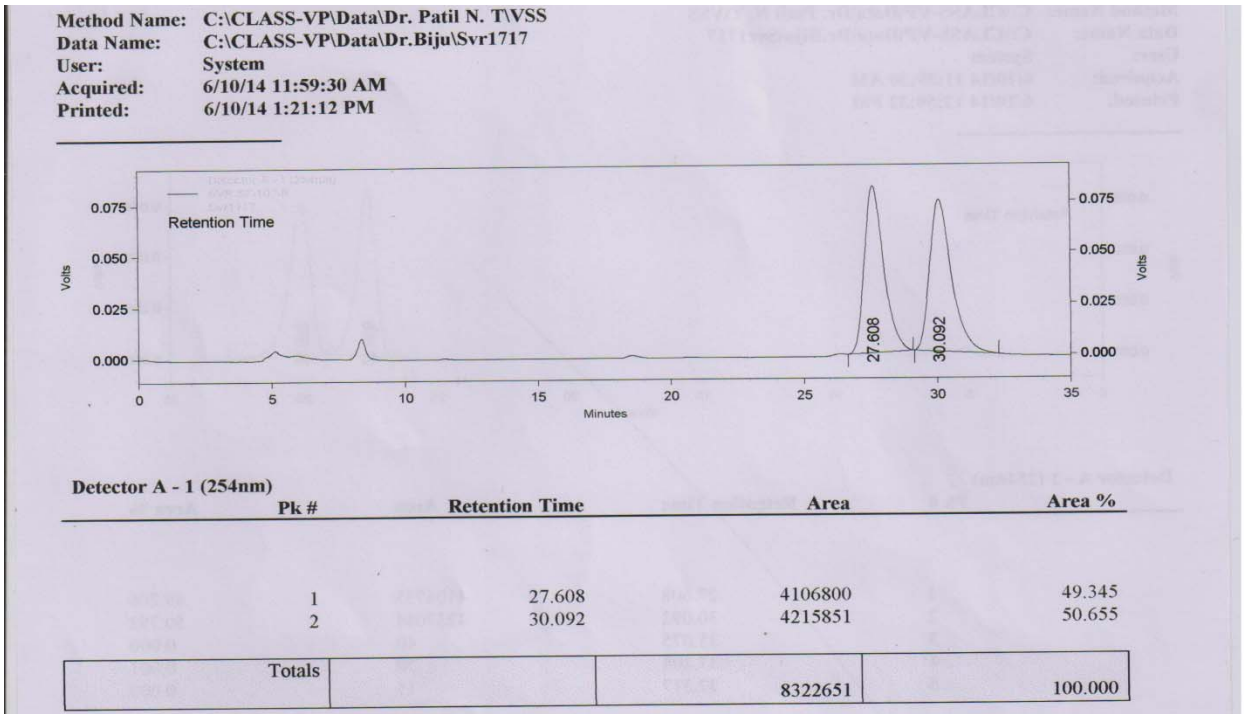
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1689
User: System
Acquired: 5/15/14 7:50:59 PM
Printed: 5/15/14 8:25:05 PM

Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	11.408	5972914	99.516
2	17.483	29034	0.484
Totals		6001948	100.000

Project Leader : Dr A. T. BIJU
Column : Kromasil 5-AmyCoat (250mmX4.6mm)
Mobile Phase :IPA:n-Hexane(10:90)
Wavelength : 254nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

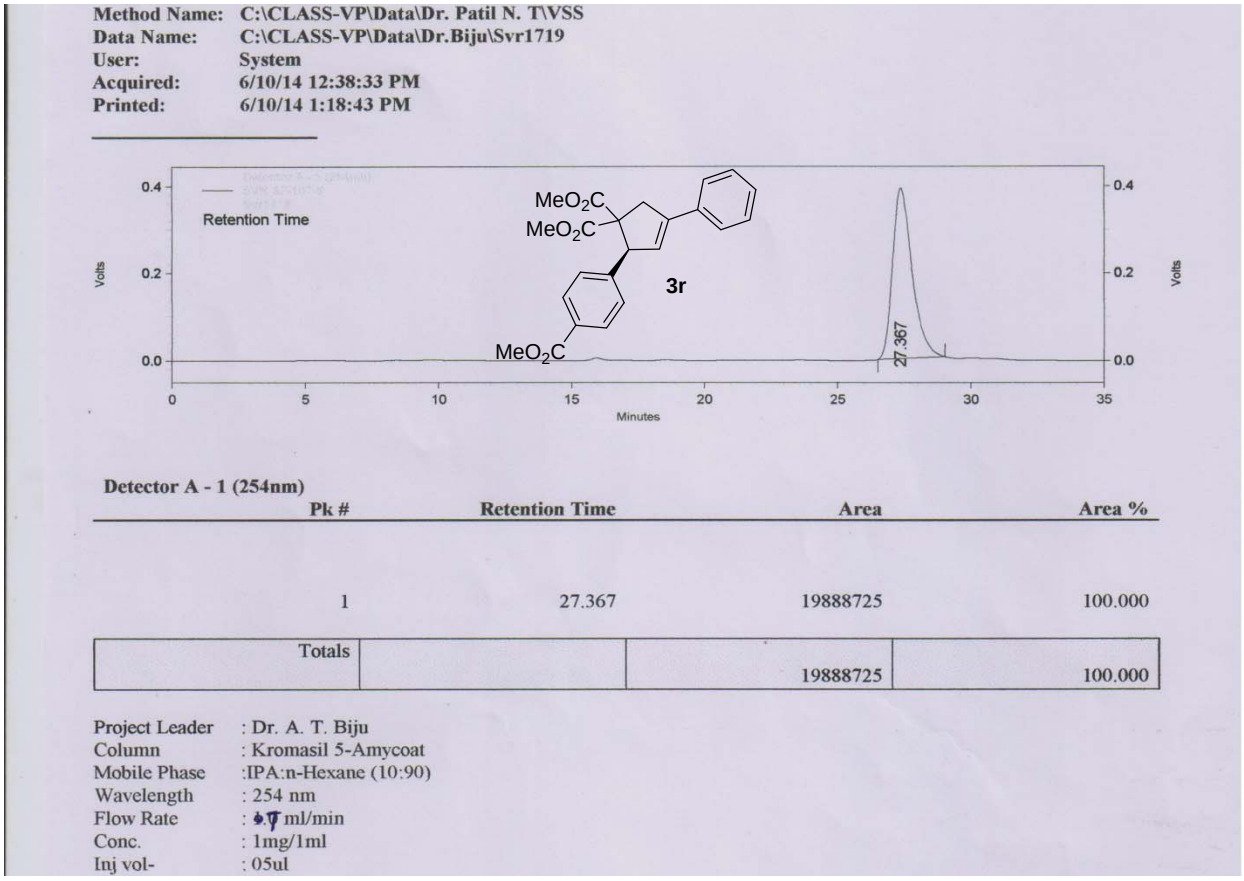
Dimethyl (*S*)-2-(4-(methoxycarbonyl)phenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3r)



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1717
User: System
Acquired: 6/10/14 11:59:30 AM
Printed: 6/10/14 1:21:12 PM

Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	27.608	4106800	49.345
2	30.092	4215851	50.655
Totals		8322651	100.000



Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1719
User: System
Acquired: 6/10/14 12:38:33 PM
Printed: 6/10/14 1:18:43 PM

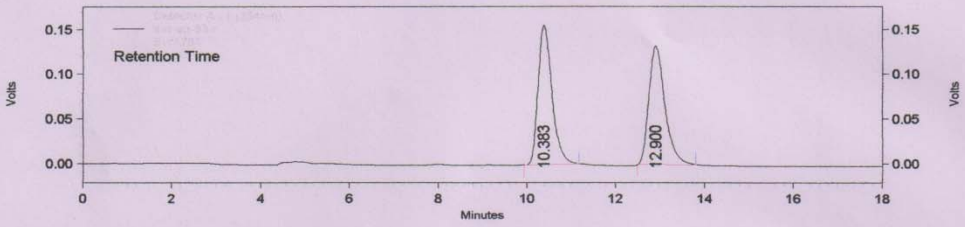
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	27.367	19888725	100.000
Totals		19888725	100.000

Project Leader : Dr. A. T. Biju
Column : Kromasil 5-Amycoat
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*R*)-2-(2-fluorophenyl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3s)

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1783
User: System
Acquired: 7/11/14 3:47:15 PM
Printed: 7/11/14 4:16:08 PM
Sample Name svr-sg-33-r

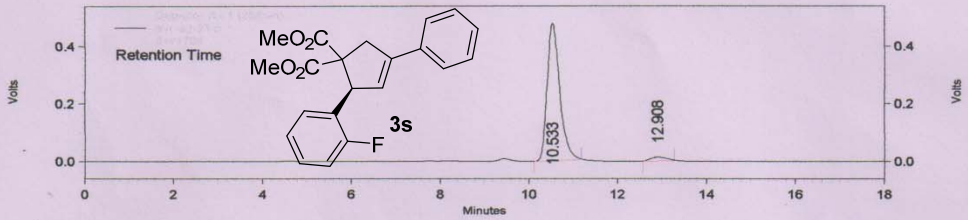


94% ee

Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.383	1688938	50.409
12.900	1661521	49.591
Totals	3350459	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1784
User: System
Acquired: 7/11/14 4:06:44 PM
Printed: 7/11/14 4:29:59 PM
Sample Name svr-sg-33-c



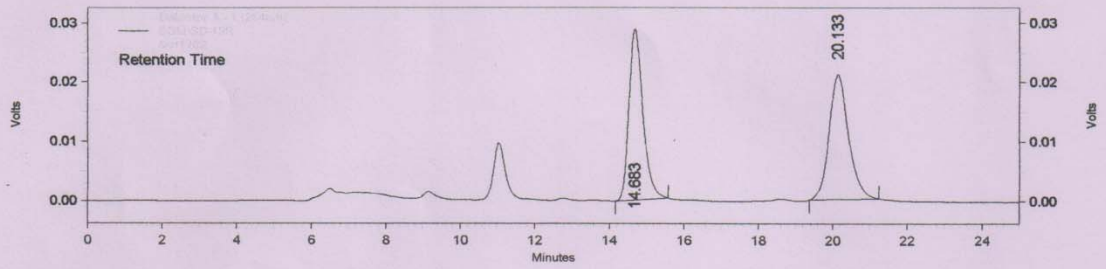
Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.533	4687081	96.987
12.908	145624	3.013
Totals	4832705	100.000

Project Leader : Dr. A. T. Biju
Column : Kromasil 5-AmyCoat(250x4.6mm)
Mobile Phase : IPA:PE (10:90)
Wavelength : 254nm
Flow Rate :0.7 ml/min
Conc. : 1mg/1mL
Inj vol- : 5 ul

Dimethyl (*S*)-2-(naphthalen-2-yl)-4-phenylcyclopent-3-ene-1,1-dicarboxylate (3t)

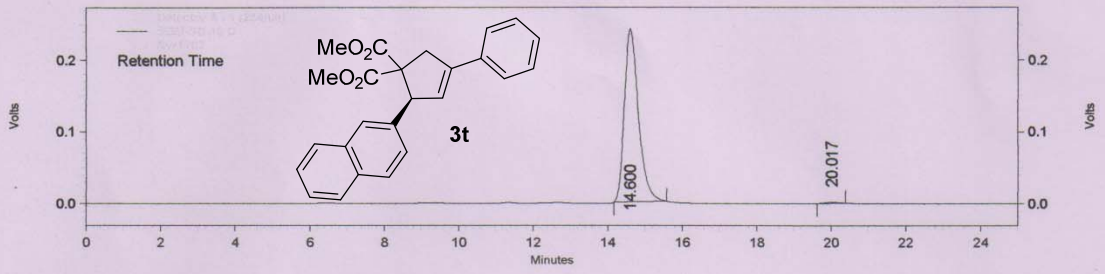
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1762
User: System
Acquired: 7/8/14 1:28:40 PM
Printed: 7/8/14 1:54:16 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	14.683	748560	49.609
2	20.133	760356	50.391
Totals		1508916	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1763
User: System
Acquired: 7/8/14 1:54:36 PM
Printed: 7/8/14 2:22:14 PM



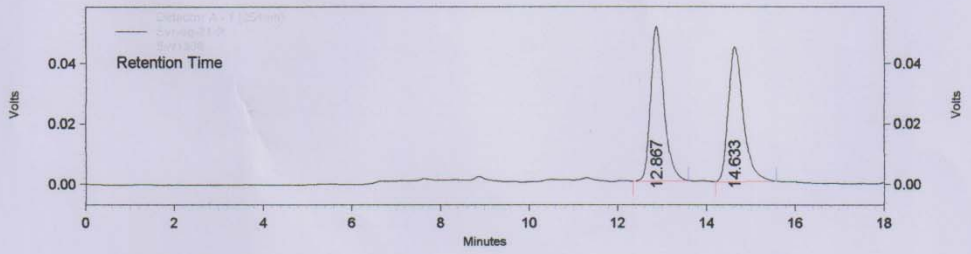
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	14.600	6312885	99.413
2	20.017	37284	0.587
Totals		6350169	100.000

Project Leader :Dr.Biju A.T.
Column : Kromasil 5-Amy Coat (250mm x 4.6mm)
Mobile Phase :IPA:n-Hexane (20:80)
Wavelength : 254 nm
Flow Rate : 0.5 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Dimethyl (*R*) 2-methyl-4-(*p*-tolyl)cyclopent-3-ene-1,1-dicarboxylate (4u)

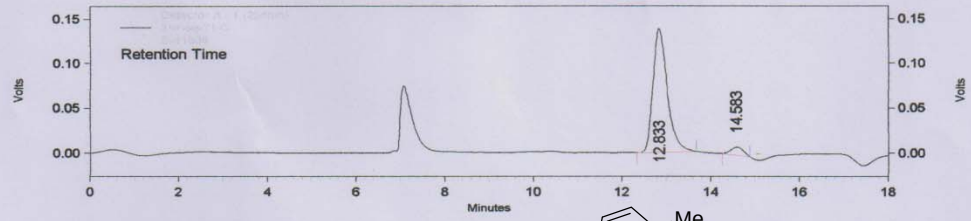
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1936
User: System
Acquired: 8/27/14 5:28:34 PM
Printed: 8/27/14 6:27:11 PM
Sample Name Svr-sg-71-R

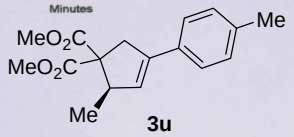


Detector A - 1 (254nm)

Retention Time	C Area	Area %
12.867	530970	50.347
14.633	523652	49.653

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1939
User: System
Acquired: 8/27/14 6:06:22 PM
Printed: 8/27/14 6:25:46 PM
Sample Name Svr-sg-71-C





3u

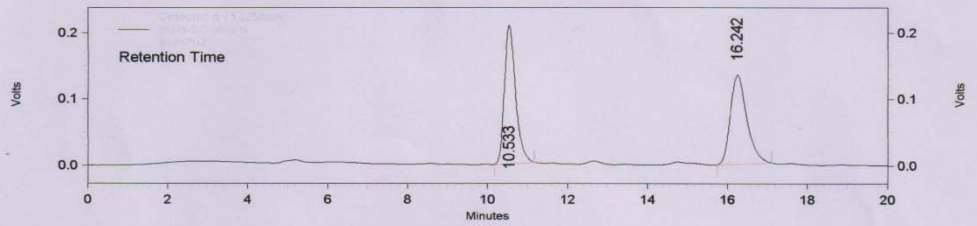
Detector A - 1 (254nm)

Retention Time	C Area	Area %
12.833	1550285	94.714
14.583	86520	5.286
Totals	1636805	100.000

Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amycoat (250mm x 4.6mm)
Mobile Phase :IPA:Pet ether (05:95)
Wavelength : 254 nm
Flow Rate : 0.5ml/min
Conc. : 1mg/2ml
Inj vol- : 05ul

Ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate (3v *major*)

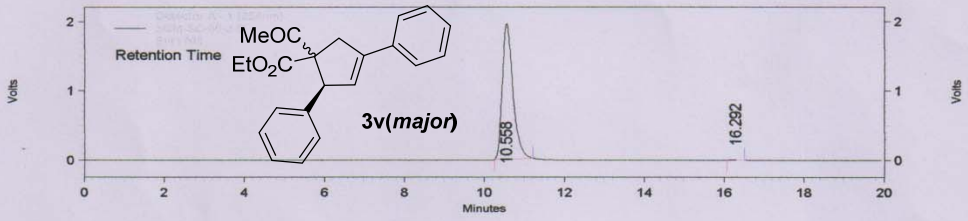
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1702
User: System
Acquired: 6/3/14 8:16:49 PM
Printed: 6/3/14 9:20:56 PM
Sample Name SGM-SC-96-2-R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.533	2020256	51.064
16.242	1936057	48.936
Totals	3956313	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1703
User: System
Acquired: 6/3/14 8:38:06 PM
Printed: 6/3/14 9:23:33 PM
Sample Name SGM-SC-96-2-C



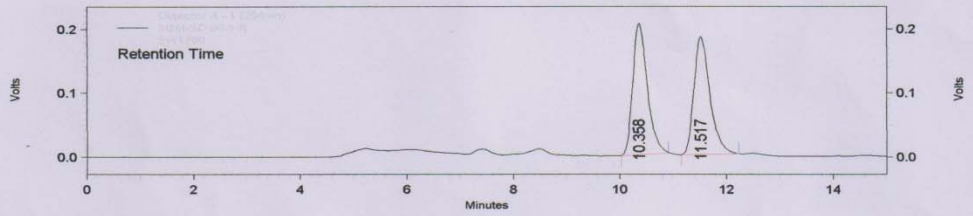
Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.558	17840785	99.768
16.292	41517	0.232
Totals	17882302	100.000

Project Leader : Dr.A. T. Biju
Column :Kromasil 5-AmyCoat (4.6X250mm)
Mobile Phase :IPA:n-Hexane (10:90)
Wavelength :254nm
Flow Rate : 0.7 ml/min (43kgf)
Conc. :1mg/mL
Inj vol- :5 ul

Ethyl (2*S*)-1-acetyl-2,4-diphenylcyclopent-3-ene-1-carboxylate (3v *minor*)

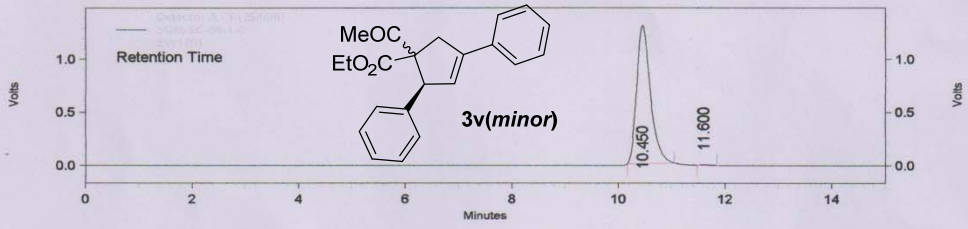
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1700
User: System
Acquired: 6/3/14 7:42:29 PM
Printed: 6/3/14 9:10:05 PM
Sample Name SGM-SC-96-1-R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.358	1926318	50.317
11.517	1902023	49.683
Totals	3828341	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1701
User: System
Acquired: 6/3/14 7:59:03 PM
Printed: 6/3/14 9:17:04 PM
Sample Name SGM-SC-96-1-C



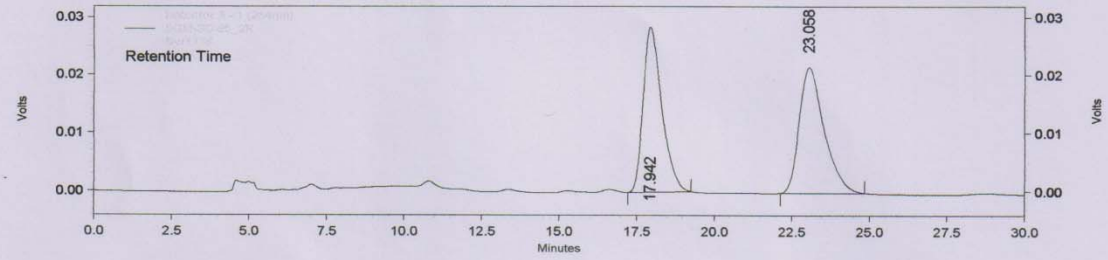
Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.450	11758370	99.849
11.600	17767	0.151
Totals	11776137	100.000

Project Leader : Dr.A. T. Biju
Column :Kromasil 5-AmyCoat (4.6X250mm)
Mobile Phase :IPA:*n-Hexane* (10:90)
Wavelength :254nm
Flow Rate : 0.7 ml/min (43kgf)
Conc. :1mg/mL
Inj vol- :5 ul

Ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate (3w *major*)

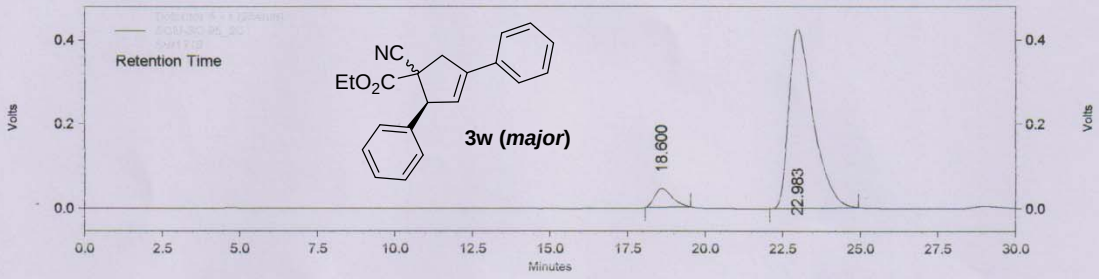
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1716
User: System
Acquired: 6/10/14 11:35:59 AM
Printed: 6/10/14 12:52:26 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	17.942	1198323	49.728
2	23.058	1211420	50.272
Totals		2409743	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1718
User: System
Acquired: 6/10/14 12:08:34 PM
Printed: 6/10/14 12:41:24 PM



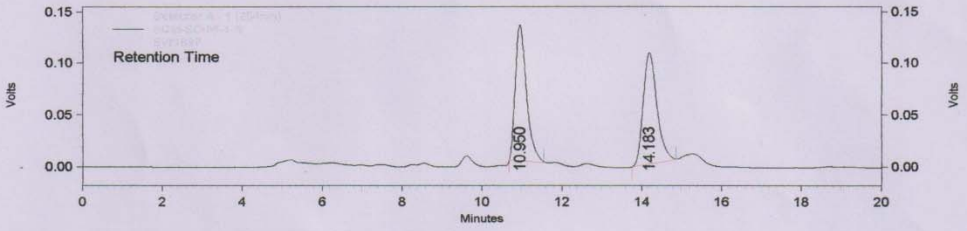
Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	18.600	1750783	7.036
2	22.983	23133469	92.964
Totals		24884252	100.000

Project Leader : Dr. A. T. Biju
Column : Chiralcel OD-H
Mobile Phase :IPA:n-Hexane (05:95)
Wavelength : 254 nm
Flow Rate : 0.7 ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul

Ethyl (2*S*)-1-cyano-2,4-diphenylcyclopent-3-ene-1-carboxylate (3w *minor*)

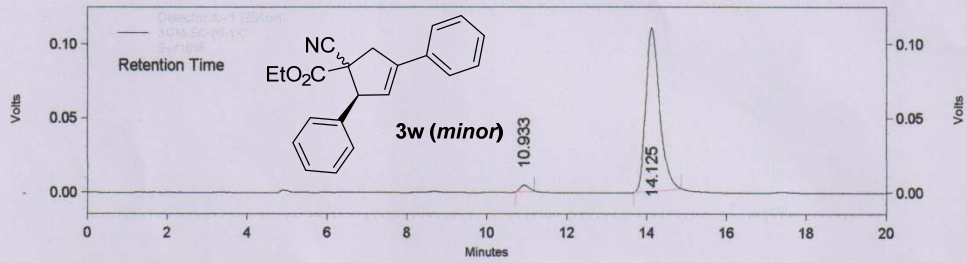
Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1697
User: System
Acquired: 6/3/14 6:18:51 PM
Printed: 6/3/14 9:03:33 PM
Sample Name SGM-SC-95-1-R



Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.950	1261925	49.625
14.183	1281017	50.375
Totals	2542942	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1698
User: System
Acquired: 6/3/14 6:41:29 PM
Printed: 6/3/14 9:06:35 PM
Sample Name SGM-SC-95-1-C

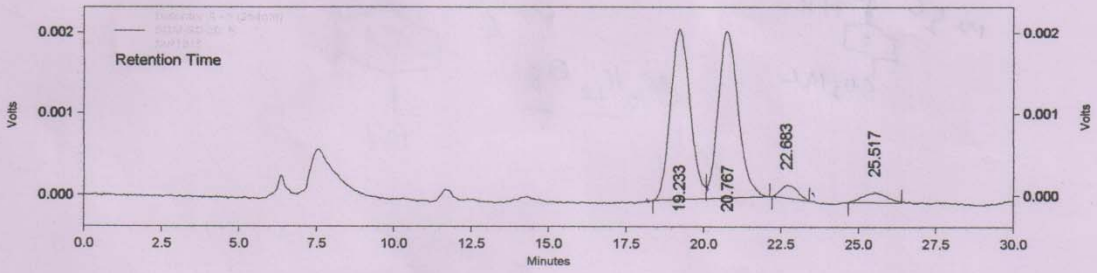


Detector A - 1 (254nm)

Retention Time	C Area	Area %
10.933	30449	2.242
14.125	1327747	97.758
Totals	1358196	100.000

Dimethyl (2*S*)-2,4-diphenylcyclopentane-1,1-dicarboxylate (8a)

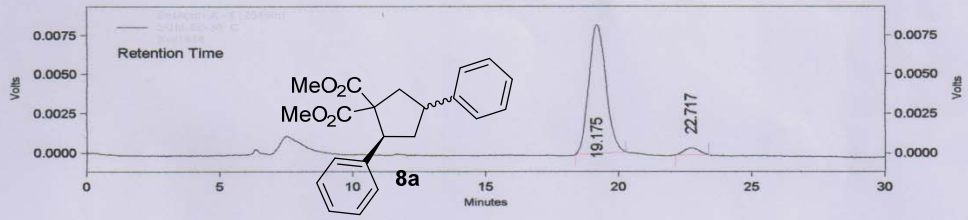
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1815
User: System
Acquired: 7/24/14 11:56:36 AM
Printed: 7/24/14 1:05:20 PM



Detector A - 1 (254nm)

Pk #	Retention Time	Area	Area %
1	19.233	91881	46.676
2	20.767	92352	46.915
3	22.683	6063	3.080
4	25.517	6552	3.328
Totals		196848	100.000

Method Name: C:\CLASS-VP\Method ch 2.met
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1816
User: System
Acquired: 7/24/14 12:28:40 PM
Printed: 8/28/14 1:08:02 PM
Sample Name SGM-SD-30 C



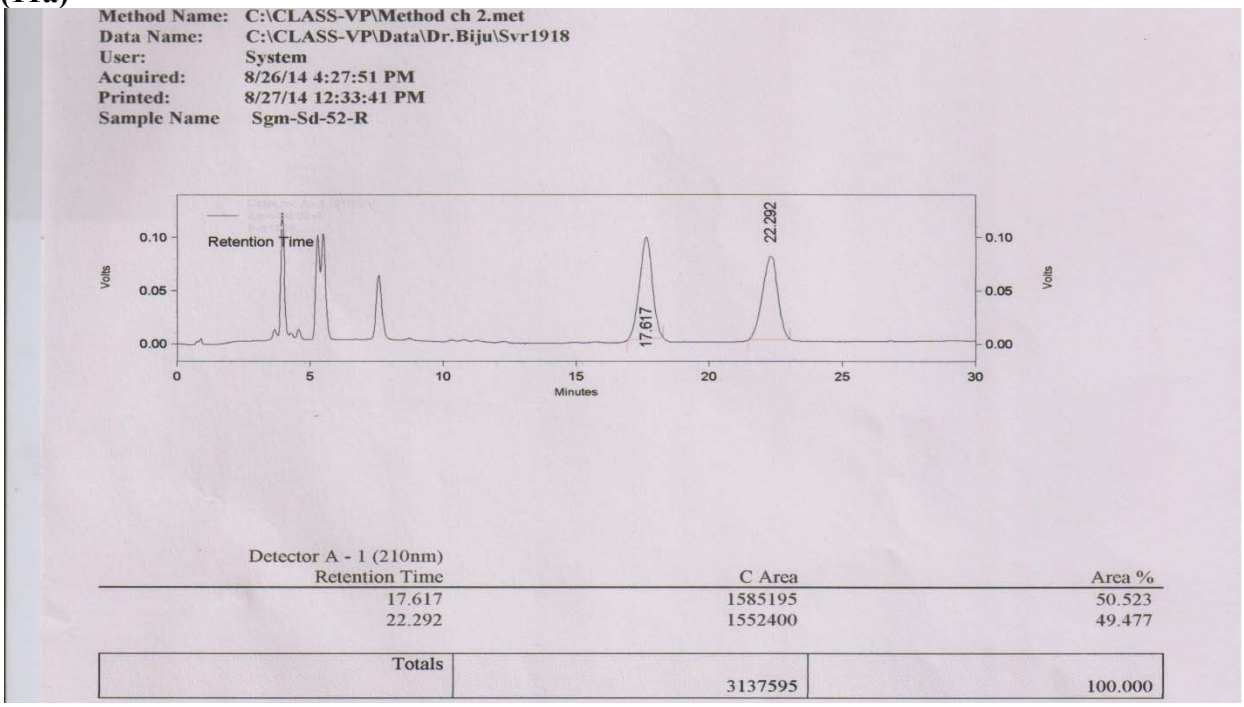
ee of major diastereomer = 99%
ee of minor diastereomer = 99%

Detector A - 1 (254nm)

Retention Time	C Area	Area %
19.175	181438	95.548
22.717	8454	4.452
Totals	189892	100.000

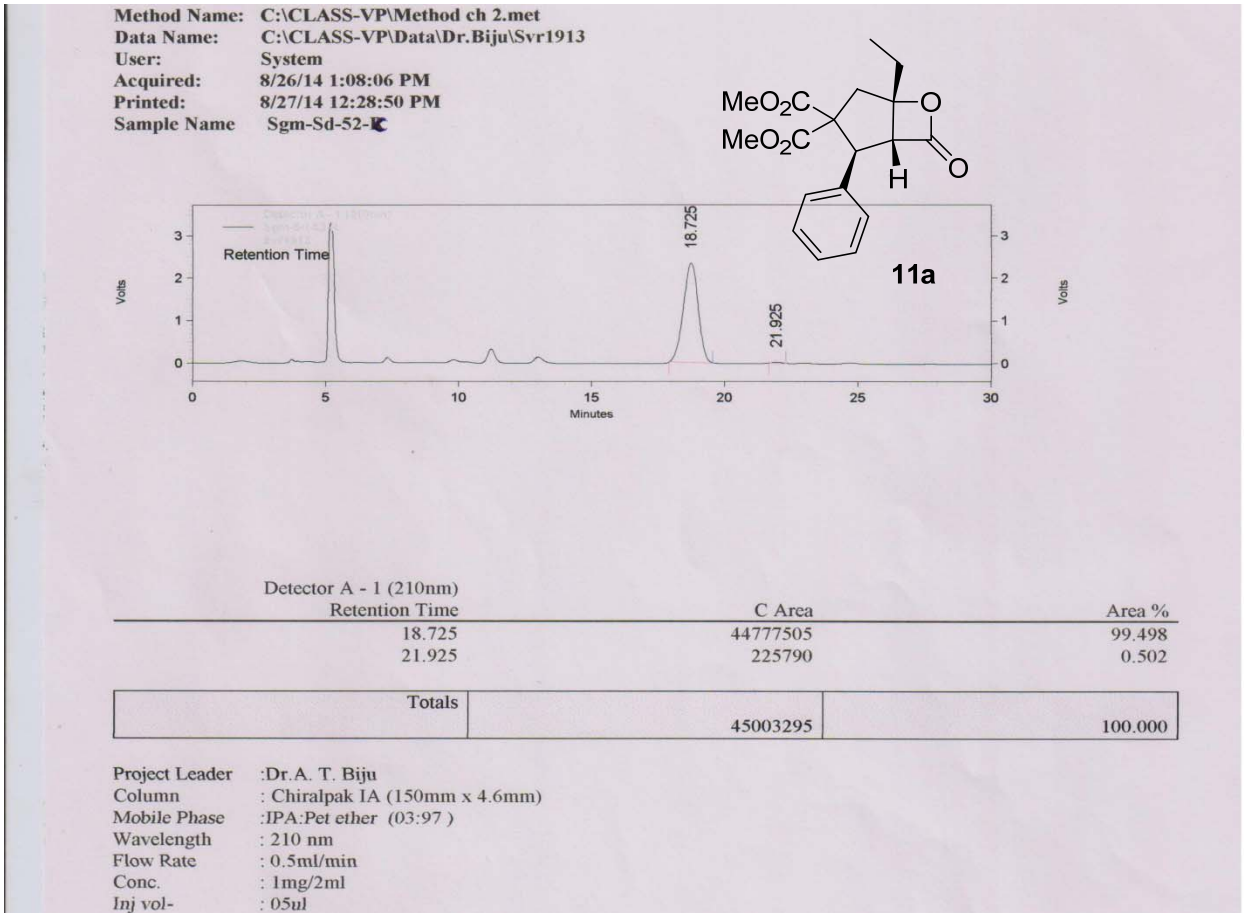
Project Leader :Dr.A. T. Biju
Column : Kromasil 5-Amycoat (250mm x 4.6mm)
Mobile Phase :IPA:Pet ether (01:99)
Wavelength : 254 nm
Flow Rate : 0.5ml/min
Conc. : 1mg/2ml
Inj vol- : 05ul

Dimethyl (*1R2S5S*) 5-ethyl-7-oxo-2-phenyl-6-oxabicyclo[3.2.0]heptane-3,3-dicarboxylate (11a)



Detector A - 1 (210nm)

Retention Time	C Area	Area %
17.617	1585195	50.523
22.292	1552400	49.477
Totals	3137595	100.000



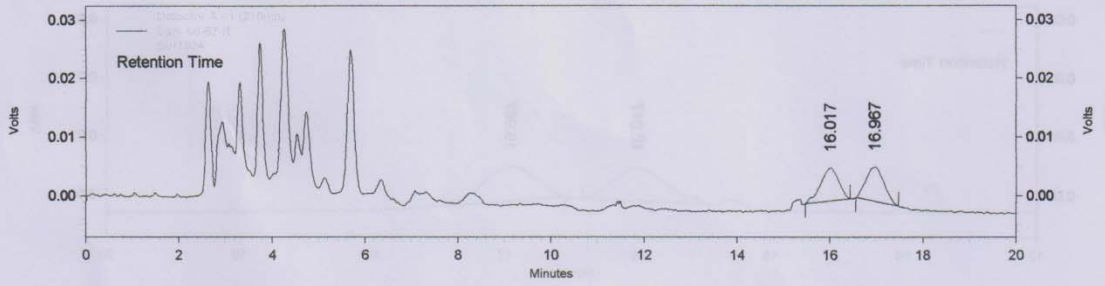
Detector A - 1 (210nm)

Retention Time	C Area	Area %
18.725	44777505	99.498
21.925	225790	0.502
Totals	45003295	100.000

Project Leader :Dr.A. T. Biju
Column : Chiralpak IA (150mm x 4.6mm)
Mobile Phase :IPA:Pet ether (03:97)
Wavelength : 210 nm
Flow Rate : 0.5ml/min
Conc. : 1mg/2ml
Inj vol- : 05µl

Dimethyl (*1R2S5S*) 5-ethyl-2-(4-(methoxycarbonyl)phenyl)-7-oxo-6-oxabicyclo[3.2.0] heptane-3,3-dicarboxylate (11r)

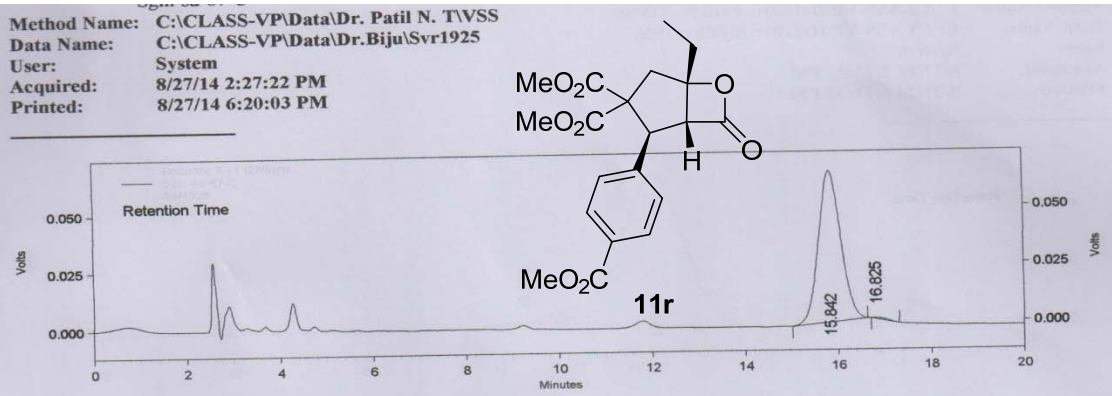
Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1924
User: System
Acquired: 8/27/14 1:56:57 PM
Printed: 8/27/14 6:16:58 PM



Detector A - 1 (210nm)

Pk #	Retention Time	Area	Area %
1	16.017	151714	49.046
2	16.967	157619	50.954
Totals		309333	100.000

Method Name: C:\CLASS-VP\Data\Dr. Patil N. T\VSS
Data Name: C:\CLASS-VP\Data\Dr.Biju\Svr1925
User: System
Acquired: 8/27/14 2:27:22 PM
Printed: 8/27/14 6:20:03 PM



11r

Detector A - 1 (230nm)

Pk #	Retention Time	Area	Area %
1	15.842	2172821	99.410
2	16.825	12887	0.590
Totals		2185708	100.000

Project Leader : Dr.A. T. Biju
Column : CHIRALPAK IA (150mm x 4.6mm)
Mobile Phase : IPA:n-Hexane (03:97)
Wavelength : 210 nm
Flow Rate : 1ml/min
Conc. : 1mg/1ml
Inj vol- : 05ul