Synthesis of hydrosilylboronates via the monoborylation of a dihydrosilane Si–H bond and their application for the generation of dialkylhydrosilyl anions

Takumi Takeuchi, † Ryosuke Shishido, † Koji Kubota*, † ‡ and Hajime Ito*, † ‡

†Division of Applied Chemistry and Frontier Chemistry Center, Faculty of Engineering, Hokkaido University, Sapporo, Hokkaido, 060-8628, Japan.

‡Institute for Chemical Reaction Design and Discovery (WPI-I2R), Hokkaido University, Sapporo, Hokkaido 060-8628, Japan.

e-mail: hajito@eng.hokudai.ac.jp

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1. Instrumentation and Chemicals

All reactions were performed in oven-dried glassware using conventional Schlenk techniques under a static pressure of nitrogen or argon. Materials were obtained from commercial suppliers and used as received unless otherwise noted. Dry solvents for the reactions were purchased from commercial suppliers, degassed via three freeze-pump-thaw cycles, and further dried over molecular sieves (MS4A) before use. [Ir(cod)Cl]₂ (>93%), Ni(cod)₂ (>97%), K(O-t-Bu) (>97%), ICy·HCl (>98.0%) and di-tert-butylsilane (1a) were purchased from TCI and used as received. Bis(pinacolato)diboron [B₂(pin)₃] was recrystallized prior to use. Silica Gel 60 N (40–100 μm, spherical, neutral) purchased from Kanto Chemical Co. was used as received. GLC analyses were conducted with a Shimadzu GC-2014 or GC-2025 equipped with ULBON HR-1 glass capillary column (Shinwa Chemical Industries) and an FID detector. n-C₁₃H₂₈ was used as an internal standard for determining GC yield. Recycle preparative gel chromatography (GPC) was conducted with JAILC-9101 using CHCl₃ as an eluent. NMR spectra were recorded on JEOL JNM-ECX400P, ECS-400 (¹H: 400 MHz, ¹³C: 100 MHz, ²⁹Si: 79.5 MHz), JNM-ECA600, and ECZ600R/S3 (²⁹Si: 120 MHz). Tetramethylsilane (δ = 0.00 ppm for ¹H-NMR and ²⁹Si-NMR) and CDCl₃ (δ = 77.0 ppm for ¹³C-NMR) were employed as external standards, respectively. BF₃·Et₂O was used as an external standard for ¹¹B NMR analysis. Multiplicity was reported as follows: s = singlet, brs = broad singlet, d = doublet, t = triplet, q = quartet, quint = quintet, sept = septet, m = multiplet. High-resolution mass spectra were recorded at the Global Facility Center for Instrumental Analysis, Hokkaido University. Single crystal X-ray structural analyses were carried out on a Rigaku XtaLAB AFC11 (RCD3) and XtaLAB PRO MM007 diffractometer using graphite monochromated Mo-Kα or Cu-Kα radiation. The structure was solved by direct methods and expanded using Fourier techniques. Non-hydrogen atoms were refined anisotropically. Hydrogen atoms were refined using the riding model. All calculations were performed using the Olex2 crystallographic software package except for refinement, which was performed using SHELXL-2013.
2. Preparation Procedures of L3 and Substrates

Preparation of L3

This reaction was performed according to the literature procedure. 2-Bromopyridine (1.00 mL, 10.0 mmol) was added dropwise to 1-isopropylimidazole (1.10 g, 10.0 mmol, 1.00 equiv) under nitrogen atmosphere. The reaction mixture was allowed to warm to 160 °C and stirred for 25 h. After cooling to room temperature, the mixture was washed with hexane. The resulting solid was purified by recrystallization from Et₂O/CHCl₃ to afford the corresponding imidazolium salt L₃ (0.718 g, 2.68 mmol, 27% yield) as a brown needle crystal.

1H NMR (399 MHz, CDCl₃, δ): 1.74 (d, J = 6.8 Hz, 6H), 5.25 (sep, J = 6.7 Hz, 1H), 7.39 (q, J = 1.7 Hz, 1H), 7.47 (dd, J = 4.8, 7.6 Hz, 1H), 8.10 (td, J = 1.6, 8.1 Hz, 1H), 8.33 (t, J = 1.8 Hz, 1H), 8.48–8.55 (m, 1H), 8.80 (d, J = 8.0 Hz, 1H), 12.02 (t, J = 1.6 Hz, 1H). 13C NMR (99 MHz, CDCl₃, δ): 23.2 (CH₃), 54.1 (CH₂), 115.2 (CH), 119.0 (CH), 120.0 (CH), 125.0 (CH), 134.6 (CH), 140.5 (CH), 145.9 (C), 148.8 (CH). HRMS-ESI (m/z): [M–Br]⁺ calcd for C₁₁H₁₄N₃, 188.1182; found 188.1184.

Preparation of 1b

The reactions were performed according to the literature procedure. Cyclohexylmagnesium chloride (1.0 M in 2-MeTHF, 55.0 mL, 55.0 mmol, 2.20 equiv) was added dropwise to tetramethyl orthosilicate (3.83 g, 25.0 mmol) in toluene (55.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 17 h at 120 °C (reflux). After cooling to room temperature, the reaction was quenched with saturated NH₄Cl aqueous solution and extracted with Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (36 Pa, bath temp. 130 °C) to afford dicyclohexylidimethoxysilane (5.68 g, 22.2 mmol, 88% yield) as a colorless oil.

1H NMR (391 MHz, CDCl₃, δ): 0.81–0.91 (m, 2H), 1.12–1.35 (m, 10H), 1.62–1.82 (m, 10H),
3.57 (s, 6H). $^{13}$C NMR (100 MHz, CDCl$_3$, δ): 24.1 (CH), 26.9 (CH$_2$), 27.1 (CH$_2$), 27.9 (CH$_2$), 50.7 (CH$_3$). HRMS-EL (m/z): [M]$^+$ calecd for C$_{14}$H$_{26}$O$_3$Si, 256.1859; found 256.1854.

Dicyclohexyldimethoxysilane (5.18 g, 20.0 mmol) was added dropwise to a suspension of LiAlH$_4$ (0.761 g, 20.0 mmol, 1.00 equiv) in Et$_2$O (20.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 16 h at room temperature. Then, LiAlH$_4$ (0.286 g, 7.53 mmol, 0.375 equiv) was added to the reaction mixture in one portion. After stirring for 6 h, the reaction was quenched by water. The mixture was filtered through a celite pad. The resulting solution was dried over MgSO$_4$, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (50 Pa, bath temp. 110 °C) to afford the corresponding silane 1b (3.12 g, 15.9 mmol, 79% yield) as a colorless oil.

$^1$H NMR (401 MHz, CDCl$_3$, δ): 0.82–0.98 (m, 2H), 1.13–1.34 (m, 10H), 1.60–1.81 (m, 10H), 3.38 (t, $J$ = 3.0 Hz, 2H). $^{13}$C NMR (99 MHz, CDCl$_3$, δ): 20.5 (CH), 26.7 (CH$_2$), 27.8 (CH$_2$), 29.6 (CH$_3$). HRMS-EL (m/z): [M]$^+$ calecd for C$_{12}$H$_{24}$Si, 196.1647; found 196.1646.

**Preparation of 1c**

The reactions were performed using a modified literature procedure.$^3$ tert-Butylimagnesium chloride (2.0 M in THF, 15.0 mL, 30.0 mmol, 1.00 equiv) was added dropwise to the mixture of n-octyltrichlorosilane (7.27 g, 29.4 mmol), copper(I) chloride (0.302 g, 3.05 mmol, 0.104 equiv), and lithium chloride (1.27 g, 30.0 mmol, 1.02 equiv) in THF (30.0 mL) under nitrogen atmosphere. The reaction was stirred for 16 h at room temperature. Then, MeOH (5.00 mL, 120 mmol, 4.08 equiv) and Et$_3$N (8.50 mL, 60.0 mmol, 2.04 equiv) were added to the reaction mixture. The resulting mixture was stirred for 5 h at 85 °C (reflux). After cooling to room temperature, the reaction mixture was filtered and extracted with hexane three times. The combined organic layer was dried over MgSO$_4$, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (63 Pa, bath temp. 130 °C) to afford tert-butylidimethoxy(octyl)silane (6.46 g, 24.8 mmol, 84% yield) as a colorless oil.

$^1$H NMR (401 MHz, CDCl$_3$, δ): 0.63–0.69 (m, 2H), 0.88 (t, $J$ = 6.8 Hz, 3H), 0.94 (s, 9H), 1.22–1.37 (m, 10 H), 1.38–1.48 (m, 2H), 3.58 (s, 6H). $^{13}$C NMR (100 MHz, CDCl$_3$, δ): 10.1
tert-Butyldimethoxy(octyl)silane (6.24 g, 24.0 mmol) was added dropwise to a suspension of LiAlH₄ (0.913 mg, 24.0 mmol, 1.00 equiv) in Et₂O (24.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 16 h at room temperature. Then, LiAlH₄ (0.452 mg, 12.0 mmol, 0.500 equiv) was added to the reaction mixture in one portion. After stirring for 6 h at 30 °C, the reaction was quenched by water. The mixture was filtered through a celite pad. The resulting solution was dried over MgSO₄, followed by filtration and evaporation. The residue was passed through silica-gel column chromatography (hexane as eluent). The crude product was purified by Kugelrohr distillation under reduced pressure (7.0 hPa, bath temp. 150 °C) to afford the corresponding silane 1c (4.30 g, 21.2 mmol, 88% yield) as a colorless oil.

**Preparation of 1d**

\[ \text{OMe} \quad \text{Si} \quad \text{OMe} \]
\[ \xrightarrow{\text{n-BuLi (1.0 equiv)}} \]
\[ \text{OMe} \quad \text{Si} \quad \text{OMe} \]
\[ \text{LiAlH}_4 (1.0 \text{ equiv}) \quad \text{Et}_2\text{O, rt, 16 h} \]
\[ \text{OMe} \quad \text{Si} \quad \text{OMe} \]
\[ \xrightarrow{\text{LiAlH}_4 (0.38 \text{ equiv})} \]
\[ \text{H} \quad \text{Si} \quad \text{H} \]
\[ 1d \quad 42\% \text{ yield} \]

\( n \)-Butyllithium (1.57 M in hexane, 16.0 mL, 25.1 mmol, 1.00 equiv) was added dropwise to a hexane solution (250 mL) of cyclohexyltrimethoxysilane (5.13 g, 25.1 mmol) under nitrogen atmosphere. The reaction was stirred for 18 h at room temperature. After the reaction was quenched by saturated NH₄Cl aqueous solution, the resulting mixture was extracted by hexane three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (66 Pa, bath temp. 110 °C) to afford butyl(cyclohexyl)dimethoxysilane (5.44 g, 23.6 mmol, 94% yield) as a colorless oil.

\(^1\text{H NMR (401 MHz, CDCl}_3, \delta): 0.59–0.67 \text{ (m, 2H), 0.77–0.87} \text{ (m, 1H), 0.90 (t, } J = 6.8 \text{ Hz, 3H), 1.13–1.28} \text{ (m, 5H), 1.31–1.43} \text{ (m, 4H), 1.64–1.81} \text{ (m, 5H), 3.54 (s, 6H),} \)
\(^{13}\text{C NMR (100 MHz, CDCl}_3, \delta): 10.2 \text{ (CH}_3\text{), 13.6} \text{ (CH), 24.4 (CH}_3\text{), 25.0 (CH}_2\text{), 26.5 (CH}_2\text{), 26.7} \text{ (CH}_2\text{), 26.8
Butyl(cyclohexyl)dimethoxysilane (4.60 g, 20.0 mmol) was added dropwise to a suspension of LiAlH₄ (0.762 g, 20.1 mmol, 1.00 equiv) in Et₂O (40.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 16 h at room temperature. After diluting with Et₂O, the reaction was quenched by MeOH. The resulting mixture was filtered through a celite pad, followed by evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (60 Pa, bath temp. 100 °C) to afford the crude product. The crude product was passed through silica-gel column chromatography (hexane as eluent) to afford the corresponding silane 1d (1.43 g, 8.39 mmol, 42% yield) as a colorless oil.

1H NMR (401 MHz, CDCl₃, δ): 0.59–0.76 (m, 2H), 0.78–0.97 (m, 4H), 1.10–1.30 (m, 5H), 1.31–1.45 (m, 4H), 1.61–1.83 (m, 5H), 3.51 (quint, J = 3.1 Hz, 2H). 13C NMR (100 MHz, CDCl₃, δ): 7.5 (CH₂), 13.8 (CH), 21.3 (CH₃), 26.0 (CH₂), 26.8 (CH₂), 27.8 (CH₂), 27.9 (CH₂), 29.3 (CH₂). HRMS-El (m/z): [M]+ calcd for C₁₀H₂₂Si, 170.1491; found 170.1497.

Preparation of 1e

The reaction was performed according to the literature procedure. tert-Butyldichloro(phenyl)silane (1.02 g, 4.38 mmol) was added dropwise to a suspension of LiAlH₄ (0.334 g, 8.80 mmol, 2.0 equiv) in Et₂O (40.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 15 h at room temperature. After diluting with Et₂O, the reaction mixture was quenched by MeOH. After the resulting mixture was filtered through a celite pad, the filtrate was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford the corresponding silane 1e (0.607 g, 3.69 mmol, 84% yield) as a colorless oil. The NMR spectra of 1e were in agreement with the literature.
Preparation of 1f

The reaction was performed according to the literature procedure. Cyclohexylmagnesium chloride (1.0 M in 2-MeTHF, 10 mL, 1.0 equiv) was added dropwise to a solution of phenylsilane (1.09 g, 10.1 mmol) and lithium chloride (0.430 g, 10.2 mmol, 1.0 equiv) in THF (20.0 mL) at −78 °C under nitrogen atmosphere, and stirred for 1 h. Then, the reaction mixture was allowed to warm to room temperature slowly and stirred for 2 h. The reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford the corresponding silane 1f (1.58 g, 8.31 mmol, 82%) as a colorless oil. The NMR spectra of 1f were in agreement with the literature.

Preparation of 1g

The reaction was performed according to the literature procedure. n-Butylmagnesium bromide (1.0 M in THF, 10.0 mL, 1.0 equiv) was added dropwise to a solution of phenylsilane (1.07 g, 9.92 mmol) and lithium chloride (0.443 g, 10.5 mmol, 1.1 equiv) in THF (20.0 mL) at −78 °C under nitrogen atmosphere, and stirred for 1 h. Then, the reaction mixture was allowed to warm to room temperature slowly and stirred for 1 h. The reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford the corresponding silane 1g (1.21 g, 7.37 mmol, 74%) as a colorless oil. The NMR spectra of 1g were in agreement with the literature.
Preparation of 1h

The reaction was performed according to the literature procedure.\(^8\) \(n\)-Butyllithium (1.57 M, 6.4 mL, 1.0 equiv) was added dropwise to a solution of 4-bromotoluene (1.73 g, 10.1 mmol) in \(\text{Et}_2\text{O}\) (14.0 mL) at room temperature and stirred for 1 h. After cooling to \(-78 \, ^\circ\text{C}\), the reaction mixture was added via cannula to the solution of tetraethyl orthosilicate (3.4 mL, 15.0 mmol, 1.5 equiv) in \(\text{Et}_2\text{O}\) (14.0 mL) at \(-78 \, ^\circ\text{C}\). The reaction mixture was stirred for 1 h. After warming to room temperature, the reaction mixture was quenched by a saturated aqueous \(\text{NH}_4\text{Cl}\). The resulting mixture was extracted by \(\text{Et}_2\text{O}\) three times. The combined organic layer was dried over \(\text{MgSO}_4\), followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (50 Pa, bath temp. 125 \(^\circ\text{C}\)) to afford triethoxy(p-tolyl)silane (1.93 g, 7.58 mmol, 76\% yield) as a colorless oil.

The hydride reduction of triethoxy(p-tolyl)silane, followed by reaction with \(\text{t-BuMgCl}\), were performed according to the literature procedure.\(^5\,^9\) Triethoxy(p-tolyl)silane (1.29 g, 5.07 mmol) was added dropwise to a suspension of \(\text{LiAlH}_4\) (0.377 g, 9.9 mmol, 2.0 equiv) in \(\text{Et}_2\text{O}\) (10.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 6 h at room temperature. After diluting with pentane (100 mL), the reaction mixture was filtered through a celite pad, followed by evaporation (150 hPa 0 \(^\circ\text{C}\)). \textit{Be careful with fires caused by the precipitated hydride species.} The residue was passed through a silica-gel column (\(\text{Et}_2\text{O}\) as an eluent), followed by evaporation (150 hPa, 0 \(^\circ\text{C}\)). The crude mixture was employed for the next reaction without further purification.

The crude mixture of \(p\)-tolylsilane was added to the solution of lithium chloride (0.319 g, 7.5 mmol, 1.5 equiv) in THF (10.0 mL). After \textit{tert}-butylmagnesium chloride (2.0 M, 3.8 mL, 7.6 mmol, 1.5 equiv) was added, the reaction mixture was warmed to 80 \(^\circ\text{C}\) (reflux) and stirred for 13 h. After cooling to room temperature, the reaction mixture was quenched by a saturated aqueous \(\text{NH}_4\text{Cl}\). The resulting mixture was extracted by \(\text{Et}_2\text{O}\) three times. The combined organic layer was dried over \(\text{MgSO}_4\), followed by filtration and evaporation. The residue was
purified by silica-gel column chromatography (hexane as eluent) to afford **1h** [0.495 g, 2.78 mmol, 55% (over two steps)] as a colorless oil.

$^1$H NMR (401 MHz, CDCl$_3$, δ): 1.00 (s, 9H), 2.36 (s, 3H), 4.12 (s, 2H), 7.18 (d, $J = 6.8$ Hz, 2H), 7.46 (d, $J = 6.4$ Hz, 2H). $^{13}$C NMR (99 MHz, CDCl$_3$, δ): 16.4 (C), 21.5 (CH$_3$), 27.4 (CH$_3$), 128.5 (C), 128.7 (CH), 135.9 (CH), 139.5 (C). HRMS (m/z): [M]$^+$ calcd for C$_{11}$H$_{18}$Si, 178.1178; found 178.1185.

**Preparation of 1i**

The reaction was performed according to the literature procedure.$^8$ *n*-Butyllithium (1.57 M, 6.4 mL, 1.0 equiv) was added dropwise to a solution of 3-bromotoluene (1.72 g, 10.1 mmol) in Et$_2$O (14.0 mL) at room temperature and stirred for 1 h. After cooling to –78 °C, the reaction mixture was added via cannula to the solution of tetraethyl orthosilicate (3.4 mL, 15.0 mmol, 1.5 equiv) in Et$_2$O (14.0 mL) at –78 °C. The reaction mixture was stirred for 1 h. After warming to room temperature, the reaction mixture was quenched by a saturated aqueous NH$_4$Cl. The resulting mixture was extracted by Et$_2$O three times. The combined organic layer was dried over MgSO$_4$, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (31 Pa, bath temp. 160 °C) to afford triethoxy(m-tolyl)silane (1.46 g, 5.73 mmol, 57% yield) as a colorless oil.

The hydride reduction of triethoxy(m-tolyl)silane, followed by reaction with $t$-BuMgCl, were performed according to the literature procedure.$^5,9$ Triethoxy(m-tolyl)silane (1.26 g, 4.97 mmol) was added dropwise to a suspension of LiAlH$_4$ (0.381 g, 10.0 mmol, 2.0 equiv) in Et$_2$O (10.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 3 h at room temperature. After diluting with pentane (100 mL), the reaction mixture was filtered through a celite pad, followed by evaporation (150 hPa, 0 °C). *Be careful with fires caused by the precipitated hydride species*. The residue was passed through a silica-gel column (Et$_2$O as an eluent), followed by evaporation (150 hPa, 0 °C). The crude mixture was employed for the next reaction.
without further purification.

The crude mixture of $m$-tolylsilane was added to the solution of lithium chloride (0.335 g, 7.9 mmol, 1.6 equiv) in THF (10.0 mL). After tert-butylmagnesium chloride (2.0 M, 3.8 mL, 7.6 mmol, 1.5 equiv) was added, the reaction mixture was warmed to 80 ℃ (reflux) and stirred for 15 h. After cooling to room temperature, the reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford $\text{Ii}$ [0.546 g, 3.06 mmol, 62% (over two steps)] as a colorless oil.

$^1$H NMR (399 MHz, CDCl₃, δ): 1.02 (s, 9H), 2.36 (s, 3H), 4.13 (s, 2H), 7.20–7.28 (m, 2H), 7.35–7.40 (m, 2H). $^{13}$C NMR (99 MHz, CDCl₃, δ): 16.4 (C), 21.5 (CH₃), 27.5 (CH₂), 127.7 (CH), 130.3 (CH), 132.0 (C), 132.9 (CH), 136.6 (CH), 137.1 (C). HRMS-El (m/z): [M]$^+$ calcd for C₁₁H₁₈Si, 178.1178; found 178.1178.

**Preparation of 1j**

The reaction was performed according to the literature procedure.⁸ $n$-Butyllithium (1.57 M, 6.4 mL, 1.0 equiv) was added dropwise to a solution of 2-bromotoluene (1.73 g, 10.1 mmol) in Et₂O (14.0 mL) at room temperature and stirred for 1 h. After cool to −78 ℃, the reaction mixture was added via cannula to the solution of tetraethyl orthosilicate (3.4 mL, 15.0 mmol, 1.5 equiv) in Et₂O (14.0 mL) at −78 ℃. The reaction mixture was stirred for 1 h. After warm to room temperature, the reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (35 Pa, bath temp. 110 ℃) to afford triethoxy($o$-tolyl)silane (1.46 g, 5.74 mmol, 57% yield) as a colorless oil.

The hydride reduction of triethoxy($o$-tolyl)silane, followed by reaction with $t$-BuMgCl, were
performed according to the literature procedure. Triethoxy(o-toly)silane (1.27 g, 5.00 mmol) was added dropwise to a suspension of LiAlH₄ (0.382 g, 10.1 mmol, 2.0 equiv) in Et₂O (10.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 4 h at room temperature. After diluting with pentane (100 mL), the reaction mixture was filtered through a celite pad, followed by evaporation (150 hPa, 0 °C). Be careful with fires caused by the precipitated hydride species. The residue was passed through a silica-gel column (Et₂O as an eluent), followed by evaporation (150 hPa, 0 °C). The crude mixture was employed for the next reaction without further purification.

The crude mixture of o-tolylsilane was added to the solution of lithium chloride (0.317 g, 7.5 mmol, 1.5 equiv) in THF (10.0 mL). After tert-butylmagnesium chloride (2.0 M, 3.8 mL, 7.6 mmol, 1.5 equiv) was added, the reaction mixture was warmed to 80 °C (reflux) and stirred for 24 h. After cool to room temperature, the reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford 1j [0.594 g, 3.33 mmol, 67% (over two steps)] as a colorless oil.

¹H NMR (401 MHz, CDCl₃, δ): 1.03 (s, 9H), 2.47 (s, 3H), 4.22 (s, 2H), 7.14–7.21 (m, 2H), 7.30 (td, J = 1.6, 7.5 Hz, 1H), 7.51 (dd = 1.4, 7.4 z, 1H). ¹³C NMR (99 MHz, CDCl₃, δ): 17.2 (C), 23.4 (CH₃), 27.9 (CH₃), 124.8 (CH), 129.6 (CH), 130.0 (CH), 131.5 (C), 137.5 (CH), 144.1 (C). HRMS-El (m/z): [M]+ calcd for C₁₁H₁₈Si, 178.1178; found 178.1174.

Preparation of 1k

![Diagram of the preparation of 1k]

The reaction was performed according to the literature procedure. 4-bromoanisole (3.65 g, 19.5 mmol) was added to a mixture of Mg (0.732 g, 30.1 mmol, 1.5 equiv), LiCl (0.850 g, 20.1 mmol, 1.0 equiv), and THF (20.0 mL) at room temperature. After stir for 1 h, the solution of the Grignard reagent was added dropwise via cannula to the solution of tetramethyl orthosilicate
(8.9 mL, 60 mmol, 3.0 equiv) in THF (20.0 mL) at –30 °C. Then, the reaction mixture was allowed to warm to room temperature and stirred for 16 h. The reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by Kugelrohr distillation under reduced pressure (34 Pa, bath temp. 120 °C) to afford trimethoxy(4-methoxyphenyl)silane (2.67 g, 11.7 mmol, 60% yield) as a colorless oil.

The hydride reduction of triethoxy(o-tolyl)silane, followed by reaction with t-BuMgCl, were performed according to the literature procedure.⁵ ⁶ Trimethoxy(4-methoxyphenyl)silane (1.14 g, 4.99 mmol) was added dropwise to a suspension of LiAlH₄ (0.381 g, 10.0 mmol, 2.0 equiv) in Et₂O (10.0 mL) under nitrogen atmosphere. The reaction mixture was stirred for 4 h at room temperature. After diluting with pentane (100 mL), the reaction mixture was filtered through a celite pad, followed by evaporation (150 hPa, 0 °C). Be careful with fires caused by the precipitated hydride species. The residue was passed through a silica-gel column (Et₂O as an eluent), followed by evaporation (150 hPa, 0 °C). The crude mixture was employed for the next reaction without further purification.

The crude mixture of (4-methoxyphenyl)silane was added to the solution of lithium chloride (0.323 g, 7.6 mmol, 1.5 equiv) in THF (10.0 mL). After tert-butylmagnesium chloride (2.0 M, 3.8 mL, 7.6 mmol, 1.5 equiv) was added, the reaction mixture was warmed to 80 °C (reflux) and stirred for 20 h. After cooling to room temperature, the reaction mixture was quenched by a saturated aqueous NH₄Cl. The resulting mixture was extracted by Et₂O three times. The combined organic layer was dried over MgSO₄, followed by filtration and evaporation. The residue was purified by silica-gel column chromatography (hexane as eluent) to afford 1k [0.804 g, 4.14 mmol, 83% (over two steps)] as a colorless oil.

¹H NMR (401 MHz, CDCl₃, δ): 1.00 (s, 9H), 3.83 (s, 3H), 4.12 (s, 2H), 6.92 (dt, J = 2.1, 8.6 Hz, 2H), 7.50 (dt, J = 2.2, 8.8 Hz, 2H). ¹³C NMR (99 MHz, CDCl₃, δ): 16.4 (C), 27.4 (CH₃), 54.9 (CH₃), 113.6 (CH), 122.9 (C), 137.3 (CH), 160.8 (C). HRMS-EL (m/z): [M]+ calcd for C₁₁H₁₈OSi, 194.1127; found 194.1127.
3. General Procedures for Si–H Borylation

General Procedure for Iridium-Catalyzed Si–H Borylation of Dialkylsilanes: Procedure A

\[
\begin{align*}
\text{Si-H} + \text{B(O-Pr)}_2(\text{pin})_2 & \rightarrow \text{Si-B(pin)} \\
1a (1.0 \text{ mmol}) + 2 (2.0 \text{ equiv}) & \rightarrow 3a \quad (63\% \text{ yield})
\end{align*}
\]

Bis(pinacolato)diboron 2 (507.1 mg, 2.00 mmol, 2.0 equiv) and L3 (2.8 mg, 0.010 mmol, 1.0 mol%) were placed in a vial with a screw cap containing a Teflon®-coated rubber septum under air. The vial was placed in a glove box under an argon atmosphere, and then [Ir(cod)Cl]2 (3.4 mg, 0.0051 mmol, 0.51 mol%) and K(O-t-Bu) (2.3 mg, 0.020 mmol, 2.0 mol%) were added to the vial. After the reaction vial was sealed with the screw cap, it was removed from the glove box. Then, cyclohexane (2.0 mL) was added to the vial via a syringe. The resulting mixture was allowed to warm at 80 °C and stirred for 1 h. Then, di-tert-butylsilane 1a (144.5 mg, 1.00 mmol, 1.0 equiv) was added dropwise via a syringe. After the reaction mixture was stirred at 80 °C for 24 h, the reaction mixture was analyzed by GC to determine the product's GC yield (71%). The mixture was directly filtered through a silica-gel pad with pentane/Et2O (9:1) as an eluent, and then the resulting solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/Et2O (100:0 to 98:2) as an eluent to afford the corresponding product 3a (171.1 mg, 0.633 mmol, 63% yield) as a colorless oil.

General Procedure for Nickel-Catalyzed Si–H Borylation: Procedure B

\[
\begin{align*}
\text{Si-H} + \text{B(O-Pr)}_2(\text{pin})_2 & \rightarrow \text{Si-B(pin)} \\
1a (0.5 \text{ mmol}) + 2 (2.0 \text{ equiv}) & \rightarrow 3a \quad (49\% \text{ yield})
\end{align*}
\]

Bis(pinacolato)diboron 2 (254.5 mg, 1.00 mmol, 2.0 equiv) was placed in a vial with a screw cap containing a Teflon®-coated rubber septum under air. The vial was placed in a glove box under an argon atmosphere, and then Ni(cod)2 (6.8 mg, 0.025 mmol, 5.0 mol%), L2 (13.5 mg, 0.0502 mmol, 10.0 mol%), and K(O-t-Bu) (5.7 mg, 0.51 mmol, 10 mol%) were added to the vial. After the vial was sealed with the screw cap, it was removed from the glove box. Then, n-octane (1.0 mL) was added to the vial via a syringe. The resulting mixture was allowed to warm at 120 °C and stirred for 1 h. Then, di-tert-butylsilane 1a (72.1 mg, 0.500 mmol, 1.0 equiv) was added dropwise via a syringe. After the reaction mixture was stirred at 120 °C for 24 h, the
reaction mixture was analyzed by GC to determine the product's GC yield (59%). The mixture was directly filtered through a silica-gel pad with pentane/Et₂O (9:1) as an eluent, and then the resulting solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 98:2) as an eluent to afford the corresponding product 3a (66.8 mg, 0.247 mmol, 49% yield) as a colorless oil.

**General Procedure for Iridium-Catalyzed Si–H Borylation of Alkylarylsilanes: Procedure C**

Bis(pinacolato)diboron 2 (255.7 mg, 1.01 mmol, 2.0 equiv) and L1 (1.4 mg, 0.0052 mmol, 1.0 mol%) were placed in a vial with a screw cap containing a Teflon®-coated rubber septum under air. The vial was placed in a glove box under an argon atmosphere, and then [Ir(cod)Cl]₂ (1.8 mg, 0.0027 mmol, 0.5 mol%) was added to the vial. After the reaction vial was sealed with the screw cap, it was removed from the glove box. Then, cyclohexane (1.0 mL) was added to the vial via a syringe. The resulting mixture was allowed to warm at 80 °C and stirred for 1 h. Then, tert-butylphenylsilane 1e (82.0 mg, 0.499 mmol, 1.00 equiv) was added dropwise via a syringe. After the reaction mixture was stirred at 80 °C for 24 h, the mixture was directly filtered through a silica-gel pad with pentane/Et₂O (9:1) as an eluent. The resulting solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding product 3e (81.9 mg, 0.282 mmol, 57% yield) as a colorless oil.
4. Details of Optimization Study

The nickel-catalyzed borylation reaction in cyclohexane at 80 °C afforded 3a in 50% yield (average of four runs, Table S1). However, the reproducibility of the reaction was unsatisfactory under these conditions. After an extensive screening of the reaction conditions, we found that when the reaction was carried out in n-octane at 120 °C, 3a was obtained in 54% yield (average of four runs, Table S1) with better reproducibility.

Table S1. Optimization on Reaction of 1a

| Conditions | GC Yield (%) |
|------------|--------------|
| Cyclohexane, 80 °C | 1st run 55% | 2nd run 48% | 3rd run 43% | 4th run 56% |
| n-Octane, 120 °C | 1st run 51% | 2nd run 54% | 3rd run 59% | 4th run 54% |
The borylations using more bulky diborons (B1 and B2) were carried out to improve the yield (Table S2). Although the iridium-based catalyst produced the borylated product, the nickel-based catalyst did not work well. Unfortunately, the yield was not satisfactory when other boron sources were used.

**Table S2. Investigation of other boron sources**

| entry | B₂(OR)₄ | conditions  | NMR yield (%) |
|-------|---------|-------------|---------------|
| 1     | B1      | [Ir]        | 8             |
| 2     | B1      | [Ni]        | trace         |
| 3     | B2      | [Ir]        | 11            |
| 4     | B2      | [Ni]        | no reaction   |

**Notes:**
- B1 and B2 represent different boron sources.
- [Ir] and [Ni] indicate the use of iridium and nickel catalysts, respectively.
- Conditions include specific ligands and reaction temperature/time.
The monoborylation of 1e was carried out under the developed conditions (Table S3). Although the Ir/L3 catalytic system produced the desired product in low yield (11%, entry 1), the Ir/dtbpy (L1) catalytic system resulted in a good yield (57%, entry 2). The nickel-based catalyst also produced the borylated product (31%, entry 3).

**Table S3. Investigation of the borylation of 1e**

| entry | conditions | isolated yield (%) |
|-------|------------|--------------------|
| 1     | [Ir(cod)Cl]_2 (0.5 mol%) L3 (1 mol%) K(O-t-Bu) (2 mol%) cyclohexane, 80 °C, 24 h | 11 |
| 2     | [Ir(cod)Cl]_2 (0.5 mol%) L3 (1 mol%) cyclohexane, 80 °C, 24 h | 57 |
| 3     | N(cod)_2 (5 mol%) L2 (1 mol%) K(O-t-Bu) (10 mol%) n-octane, 120 °C, 24 h | 31 |
The borylation of diarylsilanes did not produce the desired silylboronates (Table S4). In the case of the iridium-based catalyst, dehydrogenative homo-coupling afforded oligosilanes. On the other hand, the reactions using the nickel-based catalyst resulted in the production of complex mixtures.

Table S4. Investigation of the borylation of diarylsilanes

![Chemical structure](image)

| entry | dihydrosilane | conditions | result       |
|-------|--------------|------------|--------------|
| 1     | ![Image](image) | [Ir]       | oligosilanes |
|       |              | [Ni]       | complex mixture |
| 2     | ![Image](image) | [Ir]       | oligosilanes |
|       |              | [Ni]       | complex mixture |
| 3     | ![Image](image) | [Ir]       | oligosilanes |
|       |              | [Ni]       | complex mixture |
5. Characterization of Borylation Products 3a–3c, 3e, and 3h–3k

**Di-tert-butyl(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)silane (3a).**

Procedure A: The reaction was performed with 1a (144.5 mg, 1.00 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3a in 63% isolated yield (171.1 mg, 0.633 mmol) as a colorless oil.

Procedure B: The reaction was performed with 1a (72.1 mg, 0.500 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3a in 49% isolated yield (66.8 mg, 0.247 mmol) as a colorless oil.

**1H NMR (401 MHz, CDCl₃, δ):** 1.06 (s, 18H), 1.25 (s, 12H), 3.25 (s, 1H).

**13C NMR (100 MHz, CDCl₃, δ):** 18.4 (C), 24.9 (CH₃), 29.5 (CH₃), 83.1 (C). **11B {1H} NMR (126 MHz, CDCl₃, δ):** 34.5. **29Si {1H} NMR (119 MHz, CDCl₃, δ):** −8.45 (brs). The broad signal of 29Si was caused by the quadrupolar boron atom. HRMS-El (m/z): [M–Me]⁺ calcd for C₁₃H₂₈BO₂Si, 255.1951; found 255.1954.

**Dicyclohexyl(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)silane (3b).**

Procedure A: The reaction was performed with 1b (192.4 mg, 0.980 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3b in 24% GC yield.

Procedure B: The reaction was performed with 1b (99.7 mg, 0.508 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3b in 29% isolated yield (48.0 mg, 0.149 mmol) as a colorless oil.

**1H NMR (401 MHz, CDCl₃, δ):** 0.87–1.04 (m, 2H), 1.13–1.34 (m, 22H), 1.62–1.84 (m, 10H), 3.21 (brs, 1H). **13C NMR (100 MHz, CDCl₃, δ):** 20.9 (CH), 25.0 (CH₃), 26.8 (CH₂), 28.0 (CH₂), 29.8 (CH₂), 30.1 (CH₂), 83.2 (C). **11B {1H} NMR (127 MHz, CDCl₃, δ):** 34.6. The signal derived
from the silicon directly attached to the boron atom was not detected by $^{29}$Si-$^1$H NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]$^+$ calcld for C$_{17}$H$_{32}$BO$_2$Si, 307.2273; found 307.2268.

**tert-Butyl(octyl)(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)silane (3c).**

![Diagram of 3c]

Procedure A: The reaction was performed with 1c (200.7 mg, 1.00 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3c in 11% isolated yield (36.3 mg, 0.111 mmol) as a colorless oil.

Procedure B: The reaction was performed with 1c (100.2 mg, 0.500 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3c in 43% isolated yield (69.9 mg, 0.214 mmol) as a colorless oil.

$^1$H NMR (396 MHz, CDCl$_3$, δ): 0.65–0.75 (m, 2H), 0.86 (t, $J$ = 7.2 Hz, 3H), 0.99 (s, 9H), 1.20–1.45 (m, 24H), 3.35 (t, $J$ = 4.4 Hz, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$, δ): 8.04 (CH$_2$), 14.1 (CH$_3$), 16.4 (C), 22.7 (CH$_2$), 25.0 (CH$_3$), 26.1 (CH$_2$), 28.5 (CH$_3$), 29.2 (CH$_2$), 29.3 (CH$_2$), 31.9 (CH$_2$), 33.3 (CH$_2$), 83.2 (C). $^{11}$B-$^1$H NMR (126 MHz, CDCl$_3$, δ): 34.7. $^{29}$Si-$^1$H NMR (119 MHz, CDCl$_3$, δ): –22.0 (brs). The broad signal of $^{29}$Si was caused by the quadrupolar boron atom. HRMS-EI (m/z): [M–Me]$^+$ calcld for C$_{17}$H$_{36}$BO$_2$Si, 311.2582; found 311.2581.

**tert-Butyl(phenyl)(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)silane (3e).**

![Diagram of 3e]

Procedure C: The reaction was performed with 1e (82.0 mg, 0.499 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3e in 57% isolated yield (81.9 mg, 0.282 mmol) as a colorless oil.

Procedure B: The reaction was performed with 1e (82.0 mg, 0.499 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an
eluent to afford the corresponding silylboronate 3e in 31% isolated yield (45.1 mg, 0.155 mmol) as a colorless oil.

$^1$H NMR (401 MHz, CDCl$_3$, δ): 1.00 (s, 9H), 1.28 (s, 12H), 3.98 (s, 1H), 7.29–7.39 (m, 3H), 7.60–7.69 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$, δ): 17.1 (C), 25.0 (CH$_3$), 28.0 (CH$_3$), 83.6 (C), 127.5 (CH), 128.8 (CH), 133.8 (C), 136.4 (CH). $^{11}$B{$^1$H} NMR (126 MHz, CDCl$_3$, δ): 34.0. The signal derived from the silicon directly attached to the boron atom was not detected by $^{29}$Si{$^1$H} NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]$^+$ calcld for C$_{15}$H$_{24}$BO$_2$Si, 275.1639; found 275.1632.

tert-Butyl(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)(p-tolyl)silane (3h).

Procedure C: The reaction was performed with 1h (89.7 mg, 0.503 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3h in 61% isolated yield (92.9 mg, 0.305 mmol) as a white solid.

Procedure B: The reaction was performed with 1h (90.3 mg, 0.506 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3h in 29% isolated yield (45.1 mg, 0.148 mmol) as a white solid.

$^1$H NMR (401 MHz, CDCl$_3$, δ): 0.99 (s, 9H), 1.28 (s, 12H), 2.35 (s, 3H), 3.96 (s, 1H), 7.16 (d, $J = 7.2$ Hz, 2H), 7.53 (d, $J = 7.2$ Hz, 2H). $^{13}$C NMR (99 MHz, CDCl$_3$, δ): 17.1 (C), 21.5 (CH$_3$), 25.0 (CH$_3$), 28.0 (CH$_3$), 83.6 (C), 128.4 (CH), 130.1 (C), 136.4 (CH), 138.7 (C). $^{11}$B{$^1$H} NMR (126 MHz, CDCl$_3$, δ): 34.1. The signal derived from the silicon directly attached to the boron atom was not detected by $^{29}$Si{$^1$H} NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]$^+$ calcld for C$_{16}$H$_{26}$BO$_2$Si, 289.1795; found 289.1786. mp 50–58 °C.

tert-Butyl(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)(m-tolyl)silane (3i).

Procedure C: The reaction was performed with 1i (89.7 mg, 0.503 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et$_2$O (100:0 to 97:3) as an
eluent to afford the corresponding silylboronate 3i in 58% isolated yield (88.5 mg, 0.291 mmol) as a white solid.

Procedure B: The reaction was performed with 1i (89.2 mg, 0.500 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3i in 31% isolated yield (46.6 mg, 0.153 mmol) as a white solid.

1H NMR (401 MHz, CDCl₃, δ): 1.00 (s, 9H), 1.278 (s, 6H), 1.282 (s, 6H), 2.34 (s, 3H), 3.96 (s, 1H), 7.15–7.19 (m, 1H), 7.23 (t, J = 7.6 Hz, 1H), 7.41–7.46 (m, 2H). 13C NMR (99 MHz, CDCl₃, δ): 17.1 (C), 21.5 (CH₃), 25.0 (CH₃), 28.0 (CH₃), 83.6 (C), 127.5 (CH), 130.0 (CH), 133.4 (CH), 133.6 (C), 136.7 (C), 137.1 (CH). 11B {¹H} NMR (126 MHz, CDCl₃, δ): 34.0. The signal derived from the silicon directly attached to the boron atom was not detected by ²⁹Si {¹H} NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]⁺ calec for C₁₆H₂₆¹¹BO₂Si, 289.1795; found 289.1794. mp 40–45 °C.

tert-Butyl(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)(o-tolyl)silane (3j).

Procedure B: The reaction was performed with 1j (89.3 mg, 0.501 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3j in 59% isolated yield (89.7 mg, 0.295 mmol) as a colorless oil.

1H NMR (401 MHz, CDCl₃, δ): 1.03 (s, 9H), 1.27 (s, 6H), 1.28 (s, 6H), 2.47 (s, 3H), 4.16 (s, 1H), 7.11–7.19 (m, 2H), 7.25 (td, J = 1.6, 7.5 Hz, 1H), 7.63 (d, J = 7.2 Hz, 1H). 13C NMR (99 MHz, CDCl₃, δ): 18.0 (C), 23.8 (CH₃), 25.0 (CH₃), 28.4 (CH₃), 83.6 (C), 124.6 (CH), 129.2 (CH), 129.5 (CH), 132.9 (C), 137.9 (CH), 144.2 (C). 11B {¹H} NMR (126 MHz, CDCl₃, δ): 34.2. The signal derived from the silicon directly attached to the boron atom was not detected by ²⁹Si {¹H} NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]⁺ calec for C₁₆H₂₆¹¹BO₂Si, 289.1795; found 289.1794.
**tert-Butyl(4-methoxyphenyl)(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)silane (3k).**

![Chemical structure of 3k](image)

Procedure C: The reaction was performed with 1k (97.3 mg, 0.501 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3k in 71% isolated yield (113.1 mg, 0.353 mmol) as a white solid.

Procedure B: The reaction was performed with 1k (97.2 mg, 0.500 mmol). The crude product was purified by silica-gel column chromatography with hexane/Et₂O (100:0 to 97:3) as an eluent to afford the corresponding silylboronate 3k in 29% isolated yield (45.8 mg, 0.143 mmol) as a white solid.

¹H NMR (392 MHz, CDCl₃, δ): 0.98 (s, 9H), 1.28 (s, 12H), 3.81 (s, 3H), 4.00 (s, 1H), 6.90 (dt, J = 2.1, 8.6 Hz, 2H), 7.57 (dt, J = 2.2, 8.6 Hz, 2H). ¹³C NMR (99 MHz, CDCl₃, δ): 17.2 (C), 25.0 (CH₃), 27.9 (CH₃), 54.9 (CH₃), 83.5 (C), 113.4 (CH), 124.5 (C), 137.8 (CH), 160.4 (C). ¹¹B {¹H} NMR (126 MHz, CDCl₃, δ): 34.1. The signal derived from the silicon directly attached to the boron atom was not detected by ²⁹Si {¹H} NMR, which is likely due to quadrupolar relaxation. HRMS-EI (m/z): [M–Me]⁺ calcd for C₁₆H₂₆¹¹BO₃Si, 305.1744; found 305.1747. mp 50–53 °C.
6. Procedure for Gram-Scale Synthesis of 3a

Bis(pinacolato)diboron 2 (3.56 g, 14.0 mmol, 2.00 equiv) and L3 (18.8 mg, 0.0701 mmol, 1.00 mol%) were placed in a vial with a screw cap containing a Teflon®-coated rubber septum under air. The vial was placed in a glove box under an argon atmosphere, and then [Ir(cod)Cl]2 (23.5 mg, 0.0350 mmol, 0.500 mol%) and K(O-t-Bu) (15.7 mg, 0.140 mmol, 2.00 mol%) were added to the vial. After the vial was sealed with the screw cap, it was removed from the glove box. Then, cyclohexane (7.0 mL) was added to the vial via a syringe. The resulting mixture was allowed to warm at 80 ℃ and stirred for 1 h. Then, di-tert-butylsilane 1a (1.01 g, 7.01 mmol, 1.00 equiv) was added dropwise via a syringe. After the reaction mixture was stirred at 80 ℃ for 24 h, the reaction mixture was analyzed by GC to determine the GC yield of the product (73%). The mixture was directly filtered through a silica-gel pad with pentane/Et2O (9:1) as an eluent, and then the resulting solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/Et2O (100:0 to 98:2) as an eluent to afford the corresponding product 3a (1.33 g, 4.93 mmol, 70% yield) as a colorless oil.
7. **Single Crystal X-ray Structural Analysis of 3a**

The molecular structure of 3a was confirmed by single-crystal X-ray diffraction analysis (Figure S1). Although several conformers of 3a were observed in the disordered structure, the presence of a silicon-boron bond was confirmed unambiguously.

**Figure S1.** Molecular structure of 3a with thermal ellipsoids at 50% probability. Hydrogen atoms are omitted for clarity.
**Table S5. Summary of X-ray crystallographic data for 3a.**

| Parameter                        | Value                      |
|----------------------------------|----------------------------|
| CCDC                             | 2065033                    |
| Empirical formula                | C_{14}H_{31}BO_{2}Si       |
| Formula weight                   | 270.29                     |
| Temperature/K                    | 173                        |
| Crystal system                   | orthorhombic               |
| Space group                      | Pnma                       |
| \(a\)/Å                         | 12.7304(6)                 |
| \(b\)/Å                         | 14.6636(6)                 |
| \(c\)/Å                         | 9.7331(4)                  |
| \(d^{\circ}\)                   | 90                         |
| \(\beta^{\circ}\)               | 90                         |
| \(\gamma^{\circ}\)              | 90                         |
| Volume/Å³                        | 1816.91(14)                |
| \(Z\)                            | 4                          |
| \(\rho_{\text{calc}}\) g/cm³    | 0.988                      |
| \(\mu\)/mm⁻¹                    | 0.124                      |
| F(000)                           | 600.0                      |
| Crystal size/mm³                 | 0.3×0.3×0.02               |
| Radiation                        | MoKα (\(\lambda = 0.71073\)) |
| 2θ range for data collection/°   | 5.268 to 58.418            |
| Index ranges                     | \(-15 \leq h \leq 16, -19 \leq k \leq 19, -12 \leq l \leq 12\) |
| Reflections collected            | 25184                      |
| Independent reflections          | 2333 [\(R_{\text{int}} = 0.0841, R_{\text{sigma}} = 0.0524\)] |
| Data/restraints/parameters       | 2333/449/236               |
| Goodness-of-fit on \(F^2\)       | 1.043                      |
| Final \(R\) indexes [I>=2σ (I)] | \(R_1 = 0.0772, wR_2 = 0.2346\) |
| Final \(R\) indexes [all data]  | \(R_1 = 0.0948, wR_2 = 0.2568\) |
| Largest diff. peak/hole / e Å⁻³  | 0.27/--0.59                |
8. Procedures for Organic Transformations of 3a

Copper-Catalyzed Conjugated Silylation

Copper(I) chloride (2.0 mg, 0.020 mmol, 10 mol %) and IMes·HCl (7.5 mg, 0.022 mmol, 11 mol %) were placed in a vial under air. The vial was placed in a glove box, and then Na(O-t-Bu) (4.5 mg, 0.048 mmol, 24 mol%) was added to the vial under an argon atmosphere. After the vial was sealed with a screw cap containing a Teflon®-coated rubber septum, it was removed from the glove box. Then, THF (1.0 mL) and 3a (54.8 mg, 0.203 mmol) were added to the vial via syringes. The resulting mixture was stirred for 10 min at room temperature, and then 2-cyclohexen-1-one (4) (38.0 μL, 0.400 mmol, 2.00 equiv) and MeOH (16.0 μL, 0.400 mmol, 2.00 equiv) were added dropwise to the vial. After the resulting mixture was stirred at 60 °C for 20 h, the mixture was directly filtered through a silica-gel pad with Et₂O as an eluent. Then, the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/ Et₂O (100:0 to 98:2) to give the corresponding product 5 (26.7 mg, 0.111 mmol, 56% yield) as a colorless oil.

¹H NMR (392 MHz, CDCl₃, δ): 1.07 (s, 9H), 1.08 (s, 9H), 1.39–1.50 (m, 1H), 1.70 (qt, J = 4.1, 12.6 Hz, 1H), 1.82 (qd, J = 3.2, 12.9 Hz, 1H), 1.97–2.04 (m, 1H), 2.16–2.23 (m, 1H), 2.33 (td, J = 6.0, 13.3 Hz, 1H), 2.39–2.57 (m, 3H), 3.29 (s, 1H). ¹³C NMR (99 MHz, CDCl₃, δ): 19.9 (C), 20.1 (C), 25.3 (CH), 28.9 (CH₂), 29.4 (CH₃), 29.5 (CH₃), 30.2 (CH₂), 42.0 (CH₂), 45.3 (CH₂), 211.9 (C). HRMS-El (m/z): [M–t-Bu]⁺ calcd for C₁₀H₁₉OSi, 183.1205; found 183.1203.

Nickel-Catalyzed Silylation of Ether

2-Methoxynaphthalene 6 (189.6 mg, 1.20 mmol, 2.00 equiv) was placed in a vial under air. The vial was placed in a glove box, and then Ni(cod)₂ (16.3 mg, 0.0593 mmol, 9.71 mol%) and K(O-t-Bu) (167.9 mg, 1.50 mmol, 2.45 equiv) were added to the vial under an argon atmosphere. After the vial was sealed with a screw cap containing a Teflon®-coated rubber septum, it was removed from the glove box. Then, toluene (3.0 mL) and 3a (165.6 mg, 0.613 mmol) were added to the vial via syringes. After the resulting mixture was stirred for 20 h at room temperature, the vial was placed in a glove box, and then Na(O-t-Bu) (40.9 mg, 0.345 mmol, 2.45 mol%) was added to the vial under argon. After the vial was sealed with a screw cap containing a Teflon®-coated rubber septum, it was removed from the glove box. Then, THF (1.0 mL) and 3a (54.8 mg, 0.203 mmol) were added to the vial via syringes. The resulting mixture was stirred for 10 min at room temperature, and then 2-cyclohexen-1-one (4) (38.0 μL, 0.400 mmol, 2.00 equiv) and MeOH (16.0 μL, 0.400 mmol, 2.00 equiv) were added dropwise to the vial. After the resulting mixture was stirred at 60 °C for 20 h, the mixture was directly filtered through a silica-gel pad with Et₂O as an eluent. Then, the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane/ Et₂O (100:0 to 98:2) to give the corresponding product 5 (26.7 mg, 0.111 mmol, 56% yield) as a colorless oil.

¹H NMR (392 MHz, CDCl₃, δ): 1.07 (s, 9H), 1.08 (s, 9H), 1.39–1.50 (m, 1H), 1.70 (qt, J = 4.1, 12.6 Hz, 1H), 1.82 (qd, J = 3.2, 12.9 Hz, 1H), 1.97–2.04 (m, 1H), 2.16–2.23 (m, 1H), 2.33 (td, J = 6.0, 13.3 Hz, 1H), 2.39–2.57 (m, 3H), 3.29 (s, 1H). ¹³C NMR (99 MHz, CDCl₃, δ): 19.9 (C), 20.1 (C), 25.3 (CH), 28.9 (CH₂), 29.4 (CH₃), 29.5 (CH₃), 30.2 (CH₂), 42.0 (CH₂), 45.3 (CH₂), 211.9 (C). HRMS-El (m/z): [M–t-Bu]⁺ calcd for C₁₀H₁₉OSi, 183.1205; found 183.1203.
temperature, the mixture was directly filtered through a silica-gel pad with Et₂O as an eluent. Then the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane as eluent and GPC to give the corresponding product 7 (60.1 mg, 0.222 mmol, 36% yield) as a white solid.

¹H NMR (401 MHz, CDCl₃, δ): 1.09 (s, 18H), 4.00 (s, 1H), 7.47–7.51 (m, 2H), 7.65 (dd, J = 1.2, 8.0 Hz, 1H), 7.78–7.87 (m, 3H), 8.09 (s, 1H). ¹³C NMR (99 MHz, CDCl₃, δ): 19.2 (C), 29.0 (CH₃), 125.8 (CH), 126.3 (CH), 126.5 (CH), 127.7 (CH), 128.1 (CH), 131.8 (CH), 132.8 (C), 133.2 (C), 133.6 (C), 136.8 (CH). HRMS-EI (m/z): [M]⁺ calcld for C₁₈H₂₆Si, 270.1804; found 270.1798. mp 50–53 °C.

**Chlorination of Si–H Bond**

\[
\begin{align*}
3a \text{ (0.6 mmol)} & \quad + \quad 8 \quad (1.1 \text{ equiv}) \\
\text{DCM, 0 °C, 1 h} & \quad \Rightarrow \quad 9 \\
\text{76% yield}
\end{align*}
\]

This reaction was performed according to the literature procedure.¹⁰ Trichloroisocyanuric acid 8 (763.6 mg, 3.29 mmol, 1.10 equiv) was placed in a vial under air. After the vial was sealed with a screw cap containing a Teflon®-coated rubber septum, it was connected to a vacuum/nitrogen manifold through a needle. It was evacuated and then backfilled with nitrogen. This cycle was repeated three times. CH₂Cl₂ (15.0 mL) was added to the vial via a syringe and allowed to cool at 0 °C. Then, 3a (809.1 mg, 2.99 mmol) was added dropwise to the mixture via a syringe. After the reaction mixture was stirred for 1 h at 0 °C, the solution was filtered under a nitrogen atmosphere and concentrated under reduced pressure. The crude product was purified by Kugelrohr distillation under reduced pressure (87 Pa, bath temp. 125 °C to 145 °C) to afford the corresponding product 9 (695.9 mg, 2.28 mmol, 76% yield) as a colorless oil.

¹H NMR (401 MHz, CDCl₃, δ): 1.09 (s, 18H), 1.27 (s, 12H). ¹³C NMR (100 MHz, CDCl₃, δ): 21.6 (C), 24.9 (CH₃), 27.6 (CH₃), 84.0 (C). ²⁹B {¹H} NMR (127 MHz, CDCl₃, δ): 33.0. ²⁹Si {¹H} NMR (79 MHz, CDCl₃, δ): 24.1 (brs). The broad signal of ²⁹Si was caused by the quadrupolar boron atom. HRMS-EI (m/z): [M–Me]⁺ calcld for C₁₃H₂₇Cl₂Si, 289.1572; found 289.1565.
9. Procedure for Silicon-Silicon Coupling with 3a

2,2-Di-tert-butyl-1,1,1-triethyldisilane (10a).

The vial was sealed with a screw cap containing a Teflon®-coated rubber septum and connected to a vacuum/nitrogen manifold through a needle. It was evacuated and then backfilled with nitrogen. This cycle was repeated three times. THF (2.0 mL) and 3a (135.7 mg, 0.502 mmol) were added to the vial via syringes and allowed to cool at −78 °C. Then MeLi (1.16 M in Et₂O, 500 μL, 0.580 mmol, 1.16 equiv) was added dropwise to the mixture via a syringe. After the reaction mixture was stirred for 30 min at −78 °C, triethylchlorosilane (125.0 μL, 0.750 mmol, 1.50 equiv) was added to the reaction mixture and allowed to warm to room temperature slowly. After stirring for 1.5 h, the mixture was directly filtered through a silica-gel pad with pentane as an eluent. Then, the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane as an eluent to afford the corresponding product 10a (119.7 mg, 0.463 mmol, 92% yield) as a colorless oil.

1H NMR (401 MHz, CDCl₃, δ): 0.76 (q, J = 7.6 Hz, 6H), 1.01 (t, J = 7.8 Hz, 9H), 1.09 (s, 18H), 3.43 (s, 1H). 13C NMR (100 MHz, CDCl₃, δ): 5.47 (CH₂), 8.32 (CH₃), 20.5 (C), 30.9 (CH₃). 29Si{¹H} NMR (79 MHz, CDCl₃, δ): −7.96, −5.89. HRMS-El (m/z): [M]+ calcld for C₁₄H₃₄Si₂, 258.2199; found 258.2194.

1,1,3,3-Tetra-tert-butyl-2,2-diethyltrisilane (10b).

The vial was sealed with a screw cap containing a Teflon®-coated rubber septum and connected to a vacuum/nitrogen manifold through a needle. It was evacuated and then backfilled with nitrogen. This cycle was repeated three times. THF (2.0 mL) and 3a (135.7 mg, 0.502 mmol) were added to the vial via syringes and allowed to cool at −78 °C. Then MeLi (1.16 M in Et₂O, 500 μL, 0.580 mmol, 1.16 equiv) was added dropwise to the mixture via a syringe. After the reaction mixture was stirred for 30 min at −78 °C, diethylchlorosilane (37.0
μL, 0.250 mmol, 0.500 equiv) was added to the reaction mixture and allowed to warm to room temperature slowly. After stirring for 1 h, the mixture was directly filtered through a silica-gel pad with pentane as an eluent. Then the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane as an eluent to afford the corresponding product 10b (79.8 mg, 0.214 mmol, 85% yield) as a white solid.

\[ \text{H NMR (401 MHz, CDCl}_3, \delta): 1.02-1.17 (m, 46H), 3.64 (s, 2H). \]
\[ \text{C NMR (100 MHz, CDCl}_3, \delta): 4.35 (CH\_2), 10.5 (CH\_3), 21.9 (CH\_3), 31.1 (CH\_3). \]
\[ \text{Si}^{1}\text{H} \text{ NMR (79 MHz, CDCl}_3, \delta) \text{: } -33.0, 3.74. \]
\[ \text{HRMS-EI (m/z): } [M-tBu]^+ \text{ calcd for C}_{16}H_{39}Si_3, 315.2360; \text{ found } 315.2350. \]

mp 102–103 °C.

1,1,4,4-Tetra-tert-butyl-2,2,3,3-tetramethyldisilane (10c).

The vial was sealed with a screw cap containing a Teflon®-coated rubber septum and connected to a vacuum/nitrogen manifold through a needle. It was evacuated and then backfilled with nitrogen. This cycle was repeated three times. THF (2.0 mL) and 3a (134.9 mg, 0.499 mmol) were added to the vial via syringes and allowed to cool at −78 °C. Then MeLi (1.16 M in Et\_2O, 500 μL, 0.580 mmol, 1.16 equiv) was added dropwise to the mixture via a syringe. After the reaction mixture was stirred for 30 min at −78 °C, 1,2-dichloro-1,1,2,2-tetramethyldisilane (46.0 μL, 0.250 mmol, 0.500 equiv) was added to the reaction mixture and allowed to warm to room temperature slowly. After stirring for 30 min, the mixture was directly filtered through a silica-gel pad with pentane as an eluent. Then the resultant solution was concentrated under reduced pressure. The crude product was purified by silica-gel column chromatography with hexane as an eluent to afford the corresponding product 10c (76.5 mg, 0.190 mmol, 76% yield) as a white solid.

\[ \text{H NMR (401 MHz, CDCl}_3, \delta): 0.33 (s, 12 H), 1.09 (s, 36 H), 3.55 (s, 2 H). \]
\[ \text{C NMR (100 MHz, CDCl}_3, \delta): -1.38 (CH\_3), 21.0 (CH\_3), 30.7 (CH\_3). \]
\[ \text{Si}^{1}\text{H} \text{ NMR (79 MHz, CDCl}_3, \delta): -42.9, -1.58. \]

HRMS-EI (m/z): [M-tBu]^+ calcd for C\_{16}H_{41}Si_4, 345.2285; found 345.2279. mp 108–110 °C.
10. Details of $^{29}\text{Si}$ NMR Experiments

The vial was sealed with a screw cap containing a Teflon®-coated rubber septum and connected to a vacuum/nitrogen manifold through a needle. It was evacuated and then backfilled with nitrogen. This cycle was repeated three times. THF (500 μL) and 3a (27.0 mg, 0.10 mmol) were added to the vial via syringes and allowed to cool at –78 °C. Then MeLi (1.16 M in Et$_2$O, 130 μL, 0.151 mmol, 1.51 equiv) was added dropwise to the mixture via a syringe. After the reaction mixture was stirred for 1 h at –78 °C and a further 1 h at room temperature, the resulting mixture was transferred to an NMR tube and analyzed by $^{29}\text{Si}\{-^1\text{H}\}$ NMR spectroscopy (JEOL JNM-ECZ600R/S3) at room temperature.

![Figure S2. $^{29}\text{Si}\{-^1\text{H}\}$ NMR spectra of (t-Bu)$_2$HSiLi (11) at room temperature.](image)
syringe. After the reaction mixture was stirred for 1 h at –78 ℃, the resulting mixture was transferred to an NMR tube and analyzed by $^{29}\text{Si}^\text{1H}$ NMR spectroscopy (JEOL JNM-ECA600) at –95℃.

Figure S3. $^{29}\text{Si}^\text{1H}$ NMR spectra of ($t$-Bu)$_2$HSiLi (11) at –95℃.

$^{29}\text{Si}^\text{1H}$ NMR analysis revealed that 11 was generated in the reaction mixture (Figure S2 and S3). Signals derived from the corresponding borate and hydrolyzed dihydrosilane 1a were also observed at –95℃ (Figure S3).
11. References

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- Processing Parameters -

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X_Pulse = 4.9[us]
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X: parts per Million: 13C
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Revision_Time = 31-JUL-2021 10:59:38
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X : parts per Million : Proton

3.393 3.375 1.806 1.595 1.338 1.130 0.984 0.852 0.000

1b
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X: parts per Million: 13C
13C NMR

X : parts per Million : 13C

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Spectrometer = DHLTA2_NM
Field_Strength = 9.4073814[T] (400[MHz])
X_Acq_Duration = 2.18103808[s]
X_Domain = [Hz]
X_Freq = 400.3219825[MHz]
X_Offset = 5[ppm]
X_Points = 16384
X_Resolution = 0.45849727[Hz]
X_Sweep = 7.51201923[KHz]
X_Sweep_Climped = 6.00961538[KHz]
Irq_Domain = Proton
Irq_Freq = 400.3219825[MHz]
Irq_Offset = 5[ppm]
Tri_Domain = Proton
Tri_Freq = 400.3219825[MHz]
Tri_Offset = 5[ppm]
Clipped = FALSE
Scans = 8
Total_Scans = 8
Relaxation_Delay = 5[s]
Recov_Gain = 42
Temp_Gain = 18.6[DC]
X_90_Width = 6[us]
X_Acq_Time = 2.18103808[s]
X_Angle = 45[deg]
X_Amp = 0.[dB]
X_Pulse = 3[us]
Irq_Mode = Off
Tri_Mode = Off
Dante_Preset = FALSE
Initial_Wait = 1[s]
Repetation_Time = 7.18103808[s]

X: parts per Million: Proton
--- PROCESSING PARAMETERS ---
do_balance (0, FALSE)
samp(2.0[MHz], 0.0[s])
trapezoid(0[deg], 0.0[s], 100[deg])
zero_fill(1)
fft(1, TRUE, TRUE)
machine_phase
ppm

Derived from: TKT-869-13C-1.pdf

Filename = TKT-869-13C-2.pdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 6
Solvent = CHLOROFORM-D
Actual_Start_Time = 26-JAN-2023 11:27:36
Revision_Time = 26-JAN-2023 11:02:31
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Size = 25214
X_Domain = 13C
Dia_Title = 13C
Dim_Units = [ppm]
Dimensions = X
Site = RXC 400P
Spectrometer = DELTAX
Field_Strength = 9.29821531[T][400[MHz]]
X_Acq_Duration = 1.048576[s]
X_Domain = 13C
X_Freq = 99.54517666[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Prescans = 4
X_Resolution = 0.95367432[Hz]
X_Sweep = 31.25[kHz]
Irr_Domain = 1H
Irr_Freq = 395.88430144[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 1024
Total_Scans = 1024
Relaxation_Delay = 2[s]
Recvr_Gain = 50
Temp_Get = 22.3[deg]
X_90_Width = 9.8[us]
X_Acq_Time = 1.048576[s]
X_Angle = 30[deg]
X_Atn = 3.4[db]
X_Pulse = 3.26666667[us]
Irr_Atn_Dec = 22.71[deg]
Irr_Atn_No = 22.71[deg]
Irr_Noise = WAIST
Decoupling = TRUE
Initial_Wait = 1[s]
Nce = TRUE
Nce_Time = 2[s]
Repetition_Time = 3.048576[s]
--- PROCESSING PARAMETERS ---
dc_balance = 0, FALSE
seamp = 2.0[Hz], 0.0[us]
trapezoid3(0[%, 0[%, 100[%])
szeffil(1)
fit(1, TRUE, TRUE)
machinephase
ppm
Derived from: TKT-1146-13C-1.jdf

--- DATA ---
Filename = TKT-1146-13C-2.jdf
Author = element
Experiment = single_pulse_dec
Sample_ID = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 13-JUL-2021 19:51:28
Revision_Time = 14-JUL-2021 20:18:50
Comment = single pulse decoupled gas
Data_Format = 1D COMPLEX
Dim_Size = 26214
Dim_Title = 13C
Dim_Units = ppm
Dimensions = X
Site = ECS 400
Spectrometer = JNM-ECS400
Field_Strength = 9.201970687 [T] (390[MHz])
X_Acq_Duration = 1.064304644[s]
X_Domain = 13C
X_Freq = 29.5179726[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Fracans = 4
X_Resolution = 0.93958061[Hz]
X_Sweep = 30.78817734[kHz]
Irr_Domain = 18
Irr_Freq = 391.78655441[MHz]
Irr_Offset = 5[ppm]
Clipped = TRUE
Scans = 128
Total_Scans = 128
Relaxation_Delay = 2[s]
Recovr_Gain = 60
Temp_Set = 21.5[°C]
X_90_Width = 8.7[us]
X_Acq_Time = 1.064304644[s]
X_Angle = 30[deg]
X_Atn = 4.9[db]
X_Pulse = 2.9[us]
Irr_Atn_Dec = 22.45[db]
Irr_Atn_Noise = NULL
Decoupling = TRUE
Initial_Wait = 1[s]
Noe = TRUE
Noe_Time = 2[s]
Repetition_Time = 3.064304644[s]
1H NMR

--- PROCESSING PARAMETERS ---
dc_balance( 0, FALSE )
sweep( 0.2[Hz], 0.0[s] )
trapezoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase

Derived from: TKT-1152-1H_Proton-1-1.jdf

Filename = TKT-1152-1H_Proton-1-2.jdf
Author = element
Experiment = proton.jsp
Sample_Id = TKT-1152-1H
Solvent = CHLOROFORM-D
Actual_Start_Time = 5-JUL-2021 15:49:35
Revision_Time = 30-JUL-2021 16:10:37
Comment = single_pulse
Data_Format = 1D COMPLEX
Dim_Size = 13107
Dim_Title = Proton
Dim_Units = [ppm]
Dimensions = X
Spectrometer = DELTA2_NMR
Field_Strength = 9.4073814[T] (400[MHz])
X_Acq_Duration = 2.18103808[s]
X_Domain = 18
X_Freq = 400.53219825[MHz]
X_Offset = 5[ppm]
X_Points = 16384
X_Prescans = 1
X_Resolution = 0.45849727[Hz]
X_Sweep = 7.51201923[kHz]
X_Sweep_Clipped = 6.00961538[kHz]
Irr_Domain = Proton
Irr_Freq = 94.53219825[MHz]
Irr_Offset = 5[ppm]
Tri_Domain = Proton
Tri_Freq = 400.53219825[MHz]
Tri_Offset = 5[ppm]
Clipped = FALSE
Scans = 8
Total_Scans = 8
Relaxation_Delay = 5[s]
Recvr_Gain = 44
Temp_Set = 20.8[deg]
X_90_Width = 6[us]
X_Acq_Time = 2.18103808[s]
X_Angle = 45[deg]
X_Atn = 0.8[db]
X_Pulse = 3[us]
Irr_Mode = Off
Tri_Mode = Off
Dante_Preset = FALSE
Initial_Wait = 1[s]
Repetition_Time = 7.18103808[s]
----- PROCESSING PARAMETERS -----
dc_balance(0, FALSE)
amp(2.0[Hz], 0.0[s])
trapezoid(0[%, 80[%, 100[%])
zerofill(1)
fft(1, TRUE, TRUE)
machinephase
ppm

Derived from: TKT-1152-13C-1.jdf

Filename = TKT-1152-13C-2.jdf
Author = element
Experiment = single_pulse_dec
Sample_ID = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 13-JUL-2021 17:21:03
Revision_Date = 14-JUL-2021 20:29:26
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 13C
Dim_Title = 13C
Dim_Units = [ppm]
Dimensions = X
Site = ECS 400
Spectrometer = JNM-ECS400
Field_Strength = 9.20197068[T] (390[MHz])
X_Acq_Duration = 1.06430464[s]
X_Domain = 13C
X_Freq = 98.51479726[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Frames = 4
X_Resolution = 0.939985061[Hz]
X_Sweep = 30.78617734[KHz]
Irr_Domain = 18
Irr_Freq = 391.78655441[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 128
Total_Scans = 128
Relaxation_Delay = 2[s]
Recvr_Gain = 60
Temp_Set = 21[dC]
X_90_Width = 8.7[us]
X_Acq_Time = 1.06430464[s]
X_Angle = 30[deg]
X_Atn = 4.9[deg]
X_Pulse = 2.9[us]
Irr_Atn_Dec = 22.45[deg]
Irr_Atn_Noise = N/A
Decoupling = TRUE
Initial_Wait = 1[s]
Now = TRUE
Now_Time = 2[s]
Repetition_Time = 3.06430464[s]
--- PROCESSING PARAMETERS ---
dc_balance( 0, FALSE )
axx( 0.2[Hz], 0.0[sec] )
trapezoid( 0[%, 0[%, 80[%, 100[%] )
zerofill( 1 )
free( 1, TRUE, TRUE )
machine_phase
ppm

Derived from: TET-1149-1H_Protion-1-1.jdf

Filename = TET-1149-1H_Protion-1-2.jd
Author = element
Experiment = proton_3px
Sample_Id = TETP-1149-1H
Solvent = CHLOROFORM-D
Actual_Start_Time = 1-JUL-2021 22:43:27
Revision_Time = 30-JUL-2021 16:14:39
Comment = single_pulse
Data_Format = 1D COMPLEX
Dim_Size = 13207
X_Domain = Proton
Dim_Title = Proton
Dim_Units = [ppm]
Dimensions = X
Spectrometer = DELTA2_NMR
Field_Strength = 9.4073814[T] (400[MHz])
X_Acq_Duration = 2.18103808[sec]
X_Domin = 18
X_Freq = 400.53219825[MHz]
X_Offset = 5[ppm]
X_Points = 16384
X_Preamplifiers = 1
X_Resolution = 0.45849727[Hz]
X_Sweep = 7.51201923[KHz]
X_Sweep_Clip = 6.00961338[KHz]
X_Domain = Proton
X_Freq = 400.53219825[MHz]
X_Offset = 5[ppm]
X_Domain = Proton
X_Freq = 400.53219825[MHz]
X_Offset = 5[ppm]
Clipped = FALSE
Scans = 8
Total_Scans = 8
Relaxation_Delay = 5[sec]
Recover_gain = 44
Temp_Gain = 20.6[dc]
X90_Width = 6[usec]
X_Acq_Time = 2.18103808[sec]
X_Angle = 45[deg]
X_Amp = 0.8[V]
X_Pulse = 3[usec]
X_Domain = Off
X_Domain = Off
Dante_Preset = FALSE
Initial_Wait = 1[sec]
Repetition_Time = 7.18103808[sec]

X : parts per Million : Proton
\[ ^{13}\text{C NMR} \]

**Processing Parameters**

- dc balance: 0, FALSE
- shape: 2.0[Hz], 0.0[s]
- trapezoid: 0[%, 80[%, 100[%]
- zero fill: 1
- FFT: 1, TRUE, TRUE
- machine phase
- ppm

Derived from: TKT-1149-13C-1.jdf

**Filename**: TKT-1149-13C-2.jdf

**Author**: element

**Experiment**: single_pulse_dec

**Sample 1D**: 1

**Solvent**: CHLORFORM-D

**Actual Start Time**: 14-JUL-2021 00:26:24

**Revision Time**: 14-JUL-2021 00:43:34

**Comment**: single pulse decoupled gas

**Data Format**: 1D COMPLEX

**Dim Size**: 26214

**X Domain**: 13C

**Dim Title**: 13C

**Dim Units**: [ppm]

**Site**: KCS 400

**Spectrometer**: JNM-KCS400

**Field Strength**: 9.20197068[T] (390[MHz])

**X Acq Duration**: 1.06430464[sec]

**X Freq**: 51.5179726[MHz]

**X Offset**: 100[ppm]

**X Points**: 32768

**X Prescans**: 4

**X Resolution**: 0.93958061[Hz]

**X Sweep**: 30.78817734[kHz]

**Irr Domain**: 18

**Irr Freq**: 391.78655441[Hz]

**Irr Offset**: 5[ppm]

**Clipped**: FALSE

**Total Scans**: 128

**Relaxation Delay**: 2[sec]

**Recover Gain**: 60

**Temp Set**: 21.5[°C]

**X 90 Width**: 8.7[us]

**X Acq Time**: 1.06430464[sec]

**X Angle**: 30[deg]

**X Attn**: 4.9[db]

**X Pulse**: 2.9[us]

**Irr Attn Dec**: 22.45[db]

**Irr Attn Noe**: 22.45[db]

**Irr Noise**: 80.72

**Decoupling**: TRUE

**Initial Wait**: 1[sec]

**Noe**: TRUE

**Noe Time**: 2[sec]

**Repetition Time**: 3.06430464[sec]
**1H NMR**

--- PROCESSING PARAMETERS ---

- **dc_balance**: (0, FALSE)
- **saxp**: (0.2[Hz], 0.0[s])
- **trapezoid**: (0[%], 0[%], 80[%], 100[%])
- **zerofill**: (1)
- **fft**: (1, TRUE, TRUE)
- **machinephase**

*ppm*

Derived from: 3a-1H.jdf

--- FILE INFORMATION ---

- **Filename**: 3a-1H-1.jdf
- **Author**: element
- **Experiment**: proton.jxp
- **Sample_Id**: TPT-929-1H
- **Solvent**: CHLOROFORM-D
- **Actual Start Time**: 1-DEC-2020 17:38:51
- **Revision Time**: 30-JUL-2021 16:49:59
- **Comment**: single_pulse
- **Data Format**: 1D COMPLEX
- **Dim_Size**: 13107
- **X_Domain**: Proton
- **Dim_Title**: Proton
- **Dim_Units**: [ppm]
- **Dimensions**: X
- **Spectrometer**: DELTA2 NMR
- **Field_Strength**: 9.4073814[T] (400[MHz])
- **X_Acq_Duration**: 2.18103808[s]
- **X_Domain**: 1H
- **X_Freq**: 400.53219825[MHz]
- **X_Offset**: 5[ppm]
- **X_Points**: 16384
- **X_Freescans**: 1
- **X_Resolution**: 0.45849727[Hz]
- **X_Sweep**: 7.51201923[kHz]
- **X_Sweep_Cliped**: 6.00961538[kHz]
- **Irr_Domain**: Proton
- **Irr_Offset**: 5[ppm]
- **Tri_Domain**: Proton
- **Tri_Offset**: 5[ppm]
- **Clipped**: FALSE
- **Scans**: 8
- **Total_Scans**: 8
- **Relaxation_Delay**: 5[s]
- **Recvr_Gain**: 40
- **Temp_Get**: 18.7[°C]
- **X_90_Width**: 6[us]
- **X_Acq_Time**: 2.18103808[s]
- **X_Angle**: 45[deg]
- **X_Atn**: 0.8[dB]
- **X_Pulse**: 3[us]
- **Irr_Mode**: Off
- **Tri_Mode**: Off
- **Dante_Preset**: FALSE
- **Initial_Wait**: 1[s]
- **Repetition_Time**: 7.18103808[s]

--- DIMENSIONS ---

- **X**: parts per Million: Proton

--- GRAPHICS ---

- **Abundance**: 7.263, 3.234, 1.24, 0.90, 0.56
13C NMR
--- PROCESSING PARAMETERS ---
dc_balance(0, FALSE)
samp(0.2[Hz], 0.01[s])
trapezoid(0[%, 0[%, 80[%, 100[%])
zerofill(1)
fft(1, TRUE, TRUE)
machine_phase

Derived from: 3b-1H_Proton-1-1.jdf

| Property          | Value                                      |
|-------------------|--------------------------------------------|
| Filename           | 3b-1H_Proton-1-2.jdf                       |
| Author             | element                                    |
| Experiment         | proton.jxp                                 |
| Sample_Id          | TXT-893-1H                                 |
| Solvent            | CHLOROFORM-D                               |
| Actual_Start_Time  | 22-OCT-2020 16:55:25                      |
| Revision_Time      | 30-JUL-2021 16:54:27                      |
| Comment            | single_pulse                               |
| Data_Format        | 1D COMPLEX                                 |
| Dim_Size           | 13107                                      |
| Dim_Title          | Proton                                     |
| Dim_Units          | [ppm]                                      |
| Dimensions         | X                                          |
| Spectrometer       | DELTA2-NMR                                 |
| Field_Strength     | 9.4073814[T] (400[MHz])                    |
| X_Acq_Duration     | 2.18103808[s]                             |
| X_Domain           | 1H                                         |
| X_Freq             | 400.53219825[MHz]                          |
| X_Offset           | 5[ppm]                                     |
| X_Points           | 16364                                      |
| X_Prescans         | 1                                          |
| X_Resolution       | 0.45849727[Hz]                            |
| X_Sweep            | 7.51201923[kHz]                            |
| X_Sweep_Clippted   | 6.00961538[kHz]                            |
| Irr_Domain         | Proton                                     |
| Irr_Freq           | 400.53219825[MHz]                          |
| Irr_Offset         | 5[ppm]                                     |
| Tri_Domain         | Proton                                     |
| Tri_Freq           | 400.53219825[MHz]                          |
| Tri_Offset         | 5[ppm]                                     |
| Clipped            | FALSE                                      |
| Scans              | 8                                          |
| Total_Scans        | 8                                          |
| Relaxation_Delay   | 5[s]                                       |
| Recvr_Gain         | 40                                         |
| Temp_Gut           | 19.6[dC]                                   |
| X_90_Width         | 6[us]                                      |
| X_Acq_Time         | 2.18103808[s]                             |
| X_Angle            | 45[deg]                                    |
| X_Atn              | 0.8[dB]                                    |
| X_Pulse            | 3[us]                                      |
| Irr_Mode           | Off                                        |
| Tri_Mode           | Off                                        |
| Dante_Preset       | FALSE                                      |
| Initial_Wait       | 1[s]                                       |
| Repetition_Time    | 7.18103808[s]                             |

X: parts per Million: Proton
--- PROCESSING PARAMETERS ---
dc_balance( 0, FALSE )
exp( 2.0[Hz], 0.0[sec] )
trapezoid( 0%, 80%, 100% )
zerosfill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

以下の由来: 3b-13C-1.jdf

Filename = 3b-13C-1.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 1
Solvent = CHLOROFORM-D
Actual Start Time = 23-0CT-2020 01:05:47
Revision Time = 1-MAR-2021 17:48:51

Comment = single pulse decoupled gas
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 13C
Dim_title = 13C
Dim_Units = (ppm)
Dimensions = X
Site = ECX 400P
Spectrometer = DELTA2 NMR

Field_Strength = 9.2651231[T] (400[MHz])
X_Acq_Duration = 1.048576[sec]
X_Domain = 13C
X_Freq = 99.54517664[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Prescans = 4
X_Sweep = 0.95367432[Hertz]
X_Acq_Time = 31.25[kHz]
X_Angle = 1K
X_Pulse = 22.71[deg]
X_Atn = 3.4[dB]
X_Pulse = 3.26666667[us]
X_Atn_Dec = 22.71[deg]
X_Atn_No = 22.71[deg]
X_Noise = 872
Decoupling = TRUE
Initial_Wait = 1[sec]
Noe = TRUE
Noe_time = 1[sec]
Rep_time = 1[sec]

--- PROCESSING PARAMETERS ---
dc_balance( 0, FALSE )
exp( 2.0[Hz], 0.0[sec] )
trapezoid( 0%, 80%, 100% )
zerosfill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

以下の由来: 3b-13C-1.jdf

Filename = 3b-13C-1.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 1
Solvent = CHLOROFORM-D
Actual Start Time = 23-0CT-2020 01:05:47
Revision Time = 1-MAR-2021 17:48:51

Comment = single pulse decoupled gas
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 13C
Dim_title = 13C
Dim_Units = (ppm)
Dimensions = X
Site = ECX 400P
Spectrometer = DELTA2 NMR

Field_Strength = 9.2651231[T] (400[MHz])
X_Acq_Duration = 1.048576[sec]
X_Domain = 13C
X_Freq = 99.54517664[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Prescans = 4
X_Sweep = 0.95367432[Hertz]
X_Acq_Time = 31.25[kHz]
X_Angle = 1K
X_Pulse = 22.71[deg]
X_Atn = 3.4[dB]
X_Pulse = 3.26666667[us]
X_Atn_Dec = 22.71[deg]
X_Atn_No = 22.71[deg]
X_Noise = 872
Decoupling = TRUE
Initial_Wait = 1[sec]
Noe = TRUE
Noe_time = 1[sec]
Rep_time = 1[sec]
B NMR

--- PROCESSING PARAMETERS ---
don_balance( 0, FALSE )
#exp( 2.0[Hz], 0.0[s] )
trapezoid( 0[%], 00[s], 100[%] )
solvent( 1)
fft( 1, TRUE, TRUE )
ppm

Filename = 3b-11B-1.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = EM24469
Solvent = CHLOROFORM-D
Actual_Start_Time = 25-07-2021 01:30:25
Revision_Time = 1-MAR-2021 17:50:06
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Size = 5248
X_Domain = 1B
Dim_Title = 1B
Dim_Units = [ppm]
Dimensions = X
Site = NEX 400P
Spectrometer = DBTA2_NMR
Field_Strength = 9.2952153[T] (400[MHz])
X_Acq_Duration = 1.64626432[s]
X_Domain = 1B
X_Freq = 127.01553457[MHz]
X_Offset = 0[ppm]
X_Points = 65536
X_PreScans = 4
X_Resolution = 0.60743587[Hz]
X_Sweep = 39.0899172[kHz]
Irr_Domain = 1H
Irr_Freq = 395.88430144[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 1883
Total_Scans = 1883
Relaxation_Delay = 2[s]
Recvr_Gain = 50
Temp_Set = 19.5[DC]
X_90_Width = 10[us]
X_Acq_Time = 1.64626432[s]
X_Angle = 30[deg]
X_Atn = 4.8[db]
X_Pulse = 3.33333333[us]
Irr_Atn_Dec = 22.71[db]
Irr_Atn_NoE = WALTZ
Decoupling = TRUE
Initial_Wait = 1[s]
NoE = TRUE
NoE_Time = 2[s]
Repetition_Time = 3.64626432[s]

X : parts per Million : 11B
### PROCESSING PARAMETERS

- **Filename:** 3c-1H-1.jdf
- **Author:** element
- **Experiment:** single_pulse.ex2
- **Sample_Id:** 561266
- **Solvent:** CHLOROFORM-D
- **Actual_Start_Time:** 12-NOV-2020 01:19:32
- **Revision_Time:** 30-JUL-2021 17:01:59

#### Derived from:

- **Filename:** 3c-1H-2.jdf
- **Field_Strength:** 9.2982153[T] (400[MHz])
- **X_Acq_Duration:** 2.20725248[s]
- **X_Domain:** 1H
- **X_Freq:** 395.88430144[MHz]
- **X_Offset:** 5[ppm]
- **X_Points:** 1024
- **X_Prescans:** 1
- **X_Sweep:** 7.42280285[kHz]
- **Irr_Domain:** 1H
- **Irr_Freq:** 395.88430144[MHz]
- **Irr_Offset:** 5[ppm]
- **Tri_Domain:** 1H
- **Tri_Freq:** 395.88430144[MHz]
- **Tri_Offset:** 5[ppm]
- **Clipped:** FALSE
- **Scans:** 8
- **Total_Scans:** 8
- **Relaxation_Delay:** 5[s]
- **Recvr_Gain:** 38
- **Temp_Gel:** 19.7[°C]
- **X_90_Width:** 12.6[μs]
- **X_Acq_Time:** 2.20725248[s]
- **X_Angle:** 45(deg)
- **X_Atn:** 3.2[dB]
- **X_Pulse:** 6.3[μs]
- **Tri_Mode:** Off
- **Tri_Mode:** Off
- **Dante_Presat:** FALSE
- **Initial_Wait:** 1[s]
- **Repetition_Time:** 7.20725248[s]

---

**H NMR**

![Chemical Structure](image)
**11B NMR**

--- PROCESSING PARAMETERS ---
dc_balance ( 0, PULSR )
swep( 2.0[Hz], 0.0[Hz] )
trapezoid( 0[%], 80[%], 100[%] )
serrfill1( 1 )
fit ( 1, TRUE, TRUE )
machinephase
ppm

--- FILE ---
Filename = 3c-11B-re-1.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = #525422
Solvent = CHLOROFORM-D
Actual_Start_Time = 10-FEB-2021 21:30:35
Revision_Time = 1-MAR-2021 17:44:09
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Size = 26224
X_Domain = 11B
X_Title = 11B
X_Units = [ppm]
Dimensions = X, 1
Site = EBC 400
Spectrometer = JNM-RCS400
Field_Strength = 9.20197068[TT] (390[MHz])
X_Acq_Duration = 0.83361792[ms]
X_Domain = 11B
X_Offset = 125.70081325[MHz]
X_Points = 32768
X_Rescans = 4
X_Sweep = 1.9959034[Hz]
X_Offset = 39.3081761[kHz]
X_Offset = 391.78655441[Hz]
Irr_Offset = 9[ppm]
Clipped = FALSE
Scans = 512
Total_Scans = 512
Relaxation_Delay = 2[s]
Recvr_Gain = 144
Temp_Get = 17.1[°C]
X_90_Width = 10[μs]
X_Acq_Time = 0.83361792[ms]
X_Angle = 30[°]
X_Atm = 5.5[°B]
X_Noise = 3.33333333[μW]
Irr_Atm_Dec = 22.45[°B]
Irr_Atm_No = 22.45[°B]
Irr_Noise = WALTZ
Decoupling = TRUE
Initial_Wait = 1[s]
Noe = TRUE
Noe_Time = 2[s]
Repetition_Time = 2.83361792[s]

X : parts per Million : 11B
13C NMR

ـــ PROCESSING PARAMETERS ـــ

sweep (2.0 [Hz], 0.0 [s])
trapzoid (0%, 0%, 80%, 100%)
zerofill (A)
fft (1, TRUE, TRUE)
machinephase
ppm

Derived from: TRK-1095_Carbon-1-1.jpg

---

Filename = TRK-1095_Carbon-1-
Author = element
Experiment = carbon_auto.jsp
Sample_Id = TRK-1095
Solvent = CHLOROFORM-D
Actual_Start_Time = 11-MAY-2021 16:36:
Revision_Time = 14-JUL-2021 20:59:
Comment = single pulse decou
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = Carbon13
Dim_Title = Carbon13
Dim_Units = [ppm]
Dimensions = X
Spectrometer = JNM-ECS4008/L1
Field_Strength = 9.29825157[8] (400[
X_Acq_Duration = 1.04857618[s]
X_Domain = Carbon13
X_Freq = 99.54517664[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Dacscans = 4
X_Resolution = 0.95367432[Hz]
X_Sweep = 31.25[kHz]
X_Sweep_Clipped = 30[kHz]
Irr_Domain = Proton
Irr_Freq = 395.88430144[MHz]
Irr_Offset = 5[ppm]
Blanking = 5[ms]
Clipped = TRUE
Scans = 512
Total_Scans = 512

Relaxation_Delay = 2[s]
Recvr_Gain = 50
Temp_Set = 17.5[°C]
X_90_Width = 9.65[us]
X_Acq_Time = 1.04857618[s]
X_Angle = 30[deg]
X_Atn = 8[°dB]
X_Pulse = 3.21566667[us]
Irr_Atn_Dec = 25.244[°dB]
Irr_Atn_Dec_Calo = 25.244[°dB]
Irr_Atn_Dec_default_Calo = 25.244[°dB]
Irr_Atn_Noe = 25.244[°dB]
Irr_DecBandwidth_Hz = 4.7826087[kHz]
Irr_DecBandwidth_Ppm = 12.08082432[ppm]
Irr_Dec_FREQ = 395.88430144[MHz]
Irr_Dec_Merit_Factor = 2.2
Irr_Decoupling = TRUE
Irr_Noe = TRUE
Irr_Noise = BALDI
Irr_Offset_default = 5[ppm]

X : parts per Million : Carbon13
13C NMR

Derived from: TRK-1150-13C-1.jdf

Field Strength = 9.20197068[T] (390[MHz])
X_Acq_Duration = 1.06430464[s]
X_Domain = 13C
X_Freq = 98.51479276[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Frescans = 4
X_Resolution = 0.93958061[Hz]
X_Sweep = 30.78817734[kHz]
Irr_Domain = 18
Irr_Freq = 391.78655441[MHz]
Irr_Offset = 5[ppm]
Clipped = TRUE
Scans = 128
Total Scans = 128

Relaxation_Delay = 2[s]
Recr_Gain = 60
Temp_Set = 21.6[°C]
X_90_Width = 8.7[us]
X_Acq_Time = 1.06430464[s]
X_Angle = 30[deg]
X_Atn = 4.9[db]
X_Pulse = 2.9[us]
Irr_Atn_Dec = 22.45[db]
Irr_Atn_Noe = 22.45[db]
Irr_Noise = "WATIS"
Decoupling = TRUE
Initial_Wait = 1[s]
Noe = TRUE
Noe_Time = 2[s]
Repetition_Time = 3.06430464[s]
11B NMR

Field Strength = 9.201970687 [T] (390 [MHz])
X_Acq_Duration = 0.83361792 [s]
X_Domain = 11B
X_Freq = 125,70081325 [MHz]
X_Offset = 0 [ppm]
X_Points = 32768
X_Freespecs = 4
X_Resolution = 1.19959034 [Hz]
X_Sweep = 39.3081761 [kHz]
Irr_Domain = 1B
Irr_Freq = 391.78665441 [MHz]
Irr_Offset = 5 [ppm]
Clipped = FALSE
Scans = 256
Total Scans = 256
Relaxation_Delay = 2 [s]
Recover_Gain = 48
Temp_Set = 23.6 [°C]
X_90_Width = 10 [us]
X_Acq_Time = 0.63361792 [s]
X_Angle = 30 [deg]
X_Atn = 5.5 [dB]
X_Pulse = 3.33333333 [us]
Irr_Atn_Dec = 22.45 [dB]
Irr_Atn_Noe = 22.45 [dB]
Irr_Noise = WALTZ
Demodulating = TRUE
Initial_Wait = 1 [s]
Noe = TRUE
Noe_Time = 2 [s]
Repetition_Time = 2.83361792 [s]
--- PROCESSING PARAMETERS ---

dc_balance( 0, FALSE )
seep( 0.2[Hz], 0.0[s] )
trapexoid( 0[%], 0[%], 80[%], 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Derived from: TKT-1151-1N_Proton-1-1.jdf

Filename = TKT-1151-1H_Proton-1-1.jdf
Author = element
Experiment = proton-jmp
Sample_Id = TKT-1151-1N
Solvent = CHLOROFORM-D
Actual_Start_Time = 3-JUL-2021 19:30:41
Revision_Time = 30-JUL-2021 17:24:12
Comment = single_pulse
Data_Format = 1D COMPLEX
Dim_Size = 13107
X_Domain = Proton
X_Dim_Title = Proton
Dim_Units = [ppm]
Dimensions = X
Spectrometer = DELTA2_NMR

Field_Strength = 9.4073814[T] (400[MHz])
X_Acc_Duration = 2.18103808[s]
X_Domain = 1H
X_Freq = 400.53219825[MHz]
X_Offset = 5[ppm]
X_Points = 16384
X_Prescans =
X_Resolution = 0.45849727[Hz]
X_Sweep = 7.51201923[kHz]
X_Sweep_Clip = 6.00961538[kHz]
Sweep = Proton
Sweep_Clipped = FALSE
Clipped = FALSE
Scans = 8
Total_Scans =

Relaxation_Delay = 5[s]
Recvr_Gain = 44
Temp_Get = 20.7[°C]
X_90_Width = 6[us]
X_Acc_Time = 2.18103808[s]
X_Angle = 45[deg]
X_Atn = 0.8[°/dB]
X_Pulse = 3[us]
IF Mode = Off
Tri Mode = Off
Dante_Presat = FALSE
Initial_Wait = 1[s]
Repetition_Time = 7.18103808[s]
13C NMR

---- PROCESSING PARAMETERS ----

dc_balance (0, FALSE)
scp(2.0[s], 0.0[s])
trapezoid3(0[%, 80[%, 100%])
szellfill(1)
fft(1, TRUE, TRUE)
machinephase
ppm

Derived from: TKT-1151-13C-1.pdf

Filename = TKT-1151-13C-2.pdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 14-JUL-2021 22:39:59
Revision_Time = 14-JUL-2021 22:48:46
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Xise = 26214
X_Domain = 13C
Dim_Title = 13C
Dim_Units = [ppm]
Dimensions = X
Site = ECS 400
Spectrometer = JNM-ECS400
Field_Strength = 9.201970587 [T] (390 [MHz])
X_Acq_Duration = 1.06430464[s]
X_Domain = 13C
X_Freq = 29.51479726[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Precalcs = 4
X_Resolution = 0.93958061[KHz]
X_Sweep = 30.78817734[KHz]
Irr_Domain = 18
Irr_Freq = 391.78655441[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 128
Total_Scans = 128
Relaxation_Delay = 2[s]
Recvr_Gain = 60
Temp_Set = 21.5[°C]
X_90_Width = 8.7[us]
X_Acq_Time = 1.06430464[s]
X_Angle = 30[deg]
X_Atn = 4.9[dB]
X_Pulse = 2.9[us]
Irr_Atn_Dec = 22.45[db]
Irr_Atn_Noe = 22.45[db]
Irr_Noise = ALT
Decoupling = TRUE
Initial_Wait = 1[s]
Noe = TRUE
Noe_Time = 2[s]
Repetition_Time = 3.06430464[s]

X : parts per Million : 13C
\[ ^1H \text{ NMR} \]

- Processing Parameters:
  - File Name: TKT-1154-1H_Proton-1-1.jdf
  - Author: element
  - Experiment: proton_1xp
  - Sample ID: TKT-1154-1H
  - Solvent: CHLOROFORM-D
  - Actual Start Time: 7-JUL-2021 19:18:42
  - Revision Time: 30-JUL-2021 17:29:19
  - Comment: single_pulse
  - Data Format: 1D COMPLEX
  - Dim Size: 13107
  - Dim Title: Proton
  - Dim Units: [ppm]
  - Dimensions: X
  - Spectrometer: DELTA2_NMR
  - Field Strength: 9.4073814[T] (400 [MHz])
  - Xqac_Duration: 2.18103808[s]
  - XDomain: 1K
  - XFreq: 400.53219425[MHz]
  - X_Offset: 5[ppm]
  - X_Points: 16384
  - X_Freqs: 1
  - X_Resolution: 0.45849727[Bs]
  - X_Sweep: 7.51201923[kHz]
  - X_Sweep_Clipped: 6.00961538[kHz]
  - Irr_Domain: Proton
  - Irr_Freq: 400.53219425[MHz]
  - Irr_Offset: 5[ppm]
  - Tri_Domain: Proton
  - Tri_Freq: 400.53219425[MHz]
  - Tri_Offset: 5[ppm]
  - Clipped: FALSE
  - Scans: 8
  - Total Scans: 8
  - Relaxation Delay: 6[s]
  - Recov_Gain: 44
  - Temp Set: 21.9[°C]
  - X 90 Width: 6[us]
  - Xqac_Time: 2.18103808[s]
  - X_Angle: 45[deg]
  - X_Atn: 0.8[db]
  - X_Pulse: 3[us]
  - Irr_Mode: Off
  - Tri_Mode: Off
  - D2o_Press: FALSE
  - Initial Wait: 1[s]
  - Repetition Time: 7.18103808[s]

X: parts per Million: Proton
**B NMR**

**Derived from:** TKT-1154-11B-1.jdf

**Processing Parameters:**
- dc_balance: 0, FALSE
- samp(2.0[Hz], 0.0[s])
- trapazoid3(0[%, 60[%, 100[%])
- zerofill(1)
- fft(1, TRUE, TRUE)
- machinephase
- ppm

**Filename:** TKT-1154-11B-2.jdf
**Author:** element
**Experiment:** single_pulse_decoupled
**Sample Id:** 1
**Solvent:** CHLOROFORM-D
**Actual_Start_Time:** 15-JUL-2021 01:50:46
**Revision_Time:** 14-JUL-2021 22:32:50
**Comment:** single pulse decoupled ga
**Data_Format:** 1D COMPLEX
**Dim_Size:** 26214
**X_Domain:** 11B
**Dim_Title:** 11B
**Dim_Units:** [ppm]
**Dimensions:** X
**Site:** ECS 400
**Spectrometer:** JNM-ECS400
**Field_Strength:** 9.001970681[T] (390[MHz])
**X_Acq_Duration:** 0.83361792[s]
**X_Domain:** 11B
**X_Freq:** 125.70081325[MHz]
**X_Offset:** 0[ppm]
**X_Points:** 32768
**X_Frescans:** 4
**X_Resolution:** 1.19959034[MHz]
**X_Sweep:** 39.3081761[kHz]
**Irr_Domain:** 18
**Irr_Freq:** 391.78655441[MHz]
**Irr_Offset:** 0[ppm]
**Clipped:** TRUE
**Scans:** 256
**Total_Scans:** 256
**Relaxation_Delay:** 2[s]
**Recvr_Gain:** 44
**Temp_Sig:** 21.2[dc]
**X_90_Width:** 10[us]
**X_Acq_Time:** 0.83361792[s]
**X_Angle:** 30[deg]
**X_Atn:** 5.5[db]
**X_Pulse:** 3.33333333[us]
**Irr_Atn_Dec:** 22.45[db]
**Irr_Atn_Noie:** 22.45[db]
**Irr_Noise:** N/A
**Decoupling:** TRUE
**Initial_Wait:** 1[s]
**Noe:** TRUE
**Noe_Time:** 2[s]
**Repetition_Time:** 2.83361792[s]
--- PROCESSING PARAMETERS ---
dc_balance(0, FALSE)
semp(2,0[Hz], 0.01[s])
trapezoid(0[%, 80[%, 100[%])
zerofill(1)
fft(1, TRUE, TRUE)
machine_phase
ppm

Derived from: TKT-1153-11B-1.jdf

 Filename = TKT-1153-11B-2.jdf
 Author = element
 Experiment = single_pulse_dec
 Sample_ID = 1
 Solvent = CHLOROFORM-D
 Actual_Start_Time = 15-JUL-2021 02:26:24
 Revision_Time = 14-JUL-2021 23:06:39
 Comment = single pulse decoupled ga
 Data_Format = 1D COMPLEX
 Dim_Size = 26214
 X_Domain = 11B
 Dim_Title = 11B
 Dim_Units = [ppm]
 Dimensions = X
 Site = ECS 400
 Spectrometer = JNM-ECS400
 Field_Strength = 9.201970687[7] (900[MHz])
 X_Acq_Duration = 0.83361792[s]
 X_Domain = 11B
 X_Freq = 125.70081325[MHz]
 X_Offset = 0[ppm]
 X_Points = 32768
 X_Fracsans = 4
 X_Resolution = 1.19959034[E6]
 X_Sweep = 39.3081761[kHz]
 Irr_Domain = 1B
 Irr_Freq = 391.7665441[MHz]
 Irr_Offset = 5[ppm]
 Clipped = FALSE
 Scans = 256
 Total_Scans = 256
 Relaxation_Delay = 2[s]
 Recvr_Gain = 44
 Temp_Set = 21[øC]
 X_90_Width = 10[µs]
 X_Acq_Time = 0.83361792[s]
 X_Angle = 30[deg]
 X_Atn = 5.5[db]
 X_Pulse = 3.3333333333[us]
 Irr_Atn_Dec = 22.45[db]
 Irr_Atn_Noe = 22.45[db]
 Irr_Noise = NULL
 Decoupling = TRUE
 Initial_Wait = 1[s]
 Now = TRUE
 Now_Time = 2[s]
 Repetition_Time = 2.83361792[s]

--- B NMR ---

MeO

\[ \text{B (ppm)} \]

Si

\(3\text{k}\)

X : parts per Million : 11B

---- FORNIX NMR ----

Filename = TKT-1153-11B-2.jdf
Author = element
Experiment = single_pulse_dec
Sample_ID = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 15-JUL-2021 02:26:24
Revision_Time = 14-JUL-2021 23:06:39
Comment = single pulse decoupled ga
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 11B
Dim_Title = 11B
Dim_Units = [ppm]
Dimensions = X
Site = ECS 400
Spectrometer = JNM-ECS400
Field_Strength = 9.201970687[7] (900[MHz])
X_Acq_Duration = 0.83361792[s]
X_Domain = 11B
X_Freq = 125.70081325[MHz]
X_Offset = 0[ppm]
X_Points = 32768
X_Fracsans = 4
X_Resolution = 1.19959034[E6]
X_Sweep = 39.3081761[kHz]
Irr_Domain = 1B
Irr_Freq = 391.7665441[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 256
Total_Scans = 256
Relaxation_Delay = 2[s]
Recvr_Gain = 44
Temp_Set = 21[øC]
X_90_Width = 10[µs]
X_Acq_Time = 0.83361792[s]
X_Angle = 30[deg]
X_Atn = 5.5[db]
X_Pulse = 3.3333333333[us]
Irr_Atn_Dec = 22.45[db]
Irr_Atn_Noe = 22.45[db]
Irr_Noise = NULL
Decoupling = TRUE
Initial_Wait = 1[s]
Now = TRUE
Now_Time = 2[s]
Repetition_Time = 2.83361792[s]
H NMR

Filename = TKT-918-16-1.jpg
Author = element
Experiment = single_pulse.ex2
Sample_Id = S8434168
Solvent = CHLOROFORM-D
Actual_Start_Time = 13-NOV-2020 01:59:42
Revision_Time = 2-MAR-2021 16:42:03
Comment = single_pulse
Data_Format = 1D COMPLEX
Dim_Size = 13107
Dim_Title = 1H
Dim_Units = [ppm]
Dimensions = 1
Site = KCK 400P
Spectrometer = DELTA_400
Field_Strength = 9.2092153[T] (400[MHz])
X_Acq_Duration = 2.20725248[s]
X_Domain = 1H
X_Freq = 395.88430144[MHz]
X_Offset = 5[ppm]
X_Points = 16384
X_Prescan = 1
X_Resolution = 0.45305193[Hz]
X_Sweep = 7.42280285[kHz]
Irr_Domain = 1H
Irr_Freq = 395.88430144[MHz]
Irr_Offset = 5[ppm]
Tri_Domain = 1H
Tri_Freq = 395.88430144[MHz]
Tri_Offset = 5[ppm]
Clipped = FALSE
Scans = 8
Total_Scans = 8
Relaxation_Delay = 5[s]
Recvr_Gain = 38
Temp_Get = 18.3[oc]
X_90_Width = 12.6[us]
X_Acq_Time = 2.20725248[s]
X_Angle = 45[deg]
X_Atn = 3.5[DB]
X_Pulse = 6.3[us]
Irr_Mode = Off
Tri_Mode = Off
Dante_Freq = FALSE
Initial_Delay = 1[s]
Repetition_Time = 7.20725248[s]
13C NMR

X: parts per Million: 13C
--- PROCESSING PARAMETERS ---

dc_balance(0, FALSE)
sexp (2.0[Hz], 0.0[s])
trapezoid3 (0%, 80%, 100%)
zerofill (2)
fft (1, TRUE, TRUE)
machinephase

ppm

Derived from: TKT-927-11B-1.jdf

Filename = TKT-927-11B-2.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 29-JAN-2021 04:14:29
Revision_Time = 1-FEB-2021 15:38:16

Comment = single pulse decoupled gas
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 11B
Dim_Title = 11B
Dim_Units = [ppm]
Dimensions = X
Site = ECX 400P
Spectrometer = DELTA2 NMR

Field_Strength = 9.2962133[T] (400[MHz])
X_Acq_Duration = 0.92313216[s]
X_Domain = 11B
X_Offset = 0[ppm]
X_Points = 32768
X_Prescans = 4
X_Resolution = 1.21487174[Hz]
X_Sweep = 35.809372[kHz]
Irr_Domain = 1H
Irr_Freq = 395.88430144[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 1024
Total_Scans = 1024

Relaxation_Delay = 2[s]
Recvr_Gain = 50
Temp_Set = 21.5[°C]
X_90_Width = 10[us]
X_Acq_Time = 0.82313216[s]
X_Angle = 30[deg]
X_Atn = 4.8[db]
X_Pulse = 3.33333333[us]
Irr_Atn_Dec = 7.71[db]
Irr_Atn_Noel = 22.71[db]
Irr_Noise = WALTZ
Decoupling = TRUE
Initial_Wait = 1[s]
Noe = TRUE
Noe_Time = 2[s]
Repetition_Time = 2.82313216[s]
--- PROCESSING PARAMETERS ---
sexp( 2.0[Hz], 0.0[s] )
trapezoid( 0%, 0%, 80%, 100% )
srofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Derived from: TKT-29Si_single_pulse_dec-1

Filename = TKT-29Si_single_pulse_dec-1
Author = name
Experiment = single_pulse_dec-1
Sample_Id = TKT-29Si
Solvent = CHLOROFORM-D
Actual_Start_Time = 28-JAN-2021 21:09
Revision_Time = 1-FEB-2021 15:39
Comment = single pulse decoupled
Data_Format = 1D COMPLEX
Dim_Size = 32499
X_Domain = Silicon29
Dim_Title = Silicon29
Dim_Units = ppm
Dimensions = X
Spectrometer = JNM-ECS600R/83
Field_Strength = 14.09536928[7][60]
X_Acq_Duration = 0.888803004[s]
X_Domain = Silicon29
X_Freq = 119.23728868[MHz]
X_Offset = 0(ppm)
X_Points = 65536
X_Precscans = 4
X_Resolution = 1.13532657[Hz]
X_Sweep = 74.4047619[kHz]
X_Sweep_Clipped = 59.52380952[kHz]
Irr_Domain = Proton
Irr_Freq = 600.1723046[MHz]
Irr_Offset = 5(ppm)
Blanking = 5(01)
Clipped = FALSE
Scans = 4096
Total_Scans = 4096
Relaxation_Delay = 10[s]
Recvr_Gain = 56
Temp_Get = 20.2[0C]
X_90_Width = 18[us]
X_Acq_Time = 0.888803004[s]
X_Angle = 30[deg]
X_Atn = 9[db]
X_Pulse = 3.333333333[us]
Irr_Atn_Dec = 26.628[db]
Irr_Atn_Dec_Calc = 26.628[db]
Irr_Atn_Dec_Default_Calc = 26.628[db]
Irr_Dec_Bandwidth_Hz = 7.23684211[kHz]
Irr_Dec_Bandwidth_Ppm = 12.0794078[ppm]
Irr_Dec_Freq = 690.1723046[kHz]
Irr_Dec_Merit_Factor = 2.2
Irr_Decoupling = TRUE
Irr_Noise = FALSE
Irr_Offset_Default = 5(ppm)
Irr_Offset = 38.8[ppm]

X : parts per Million : Silicon29
13C NMR

X: parts per Million: 13C

--- PROCESSING PARAMETERS ---

dc_balance( 0, FALSE )
seexp( 2.0[Hz], 0.0[Hz] )
trapezoid3( 0[%, 80[%, 100[%] )
zerofill( 1 )
fft( 1, TRUE, TRUE )
machinephase
ppm

Derived from: TET-930-13C-1.jdf

Filename = TET-930-13C-1.jdf
Author = element
Experiment = single_pulse_dec
Sample_Id = 1
Solvent = CHLOROFORM-D
Actual_Start_Time = 27-JAN-2021 09:29:01
Revision_Time = 27-JAN-2021 15:54:13

Comment = single pulse decoupled ga
Data_Format = 1D_COMPLEX
Dim_Size = 6254
X_Domain = 13C
Dim_Title = 13C
Dim_Units = [ppm]
Dimensions = X
Site = HCH 400P
Spectrometer = DELTA2_NMR

Field_Strength = 9.2982153[T] (400[MHz])
X_Acq_Duration = 1.048576[s]
X_Domain = 13C
X_Freq = 99.54517646[MHz]
X_Offset = 100[ppm]
X_Points = 32768
X_Prescans = 4
X_Resolution = 0.95367432[Hz]
X_Sweep = 31.25[MHz]
Irr_Domain = 1H
Irr_Freq = 395.80630144[MHz]
Irr_Offset = 5[ppm]
Clipped = FALSE
Scans = 128
Total_Scans = 128

Relaxation_Delay = 2[s]
Receive_Gain = 54
Temp_Gate = 23.5[°C]
X_0D_Width = 9.8[us]
X_Acq_Time = 1.048576[s]
X_Angle = 30[°]
X_Atm = 3.4[GB]
X_Pulse = 3.26666667[us]
Irr_Atm_Dec = 22.71[GB]
Irr_Atm_Noe = 22.71[GB]
Irr_Noise = WALTZ
Decoupling = TRUE
Initial_Wait = 1[s]
Nce = TRUE
Nce_Time = 2[s]
Repetition_Time = 3.048576[s]

X: parts per Million: 13C
**29Si NMR**

![NMR Spectrum](image)

**Processing Parameters**
- **dc_balance**: (0, FALSE)
- **sweep**: (2.0[Hertz], 0.0[s])
- **trapswoi**: (0[%, 80[%], 100[%])
- **zerofill**: (1)
- **fft**: (1, TRUE, TRUE)
- **machinephase**
- **ppm**
- **phase**: (68.91786, 0, 50[%])

Derived from: TET-932-29Si-2.jdf

**Filename**: TET-932-29Si-3.jdf
**Author**: element
**Experiment**: single_pulse_dec
**Sample Id**: 2
**Solvent**: CHLOROFORM-D
**Actual Start Time**: 27-JAN-2021 09:52:13
**Revision Time**: 27-JAN-2021 13:05:36
**Comment**: single pulse decoupled ga
**Data Format**: 1D COMPLEX
**Dim Size**: 52428
**X Domain**: 29Si
**Dim Title**: 29Si
**Dim Units**: [ppm]
**Dimensions**: X
**Site**: BCC 400P
**Spectrometer**: DELTA_400
**Field Strength**: 9.2682153[T] (400[MHz])
**X_Acq_Duration**: 1.33169152[s]
**X_Domain**: 29Si
**X_Offset**: 78.6510331[MHz]
**X_Points**: 40556
**X_Prescans**: 4
**X_Resolution**: 0.759024468[Hz]
**X_Sweep**: 49.312398408[KHz]
**Irr_Domain**: 1H
**Irr_Freq**: 395.8430144[MHz]
**Irr_Offset**: 5[ppm]
**Clipped**: FALSE
**Scans**: 1024
**Total Scans**: 1024
**Relaxation_Delay**: 10[s]
**Recvr_Gain**: 56
**Temp_Get**: 23.2[°C]
**X_90_Width**: 16.3[us]
**X_Acq_Time**: 1.33169152[s]
**X_Angle**: 30[°deg]
**X_Atn**: 7.2[°dB]
**X_Pulse**: 5.43333333[us]
**Irr_Atn_Dec**: 22.71[°dB]
**Irr_Noise**: NUL
**Decoupling**: TRUE
**Initial Wait**: 1[s]
**Noise**: FALSE
**Repetition Time**: 11.33169152[s]

X: parts per Million: 29Si
13C NMR

Filename = TKT-933-13C-2.5df
Author = element
Experiment = single_pulse_dec
Sample_Id = 3
Solvent = CHLOROFORM-D
Actual_Start_Time = 27-JAN-2021 16:31:26
Revision_Time = 27-JAN-2021 13:10:33

Comment = single pulse decoupled gas
Data_Format = 1D COMPLEX
Dim_Size = 26214
X_Domain = 13C
Dim_Title = 13C
Dim_Units = [ppm]
Dimensions = [1]
Site = ECR 400P
Spectrometer = DBLT2A_400

Field_Strength = 9.2982153[T] (400[MHz])
X_Acq_Duration = 1.048576[s]
X_Domain = 13C
X_Offset = 99.54517664[MHz]
X_Freq = 100[ppm]
X_Points = 32768
X_Precs = 4
X_Resolution = 0.95367432[MHz]
X_Sweep = 31.25[MHz]
Irr_Domain = 1H
Irr_Offset = 395.88430144[MHz]
Clipped = FALSE
Scans = 128
Total_Scans = 128

Relaxation_Delay = 2[s]
Recvr_Gain = 94
Temp_Gct = 23.6[°C]
X_3D_Width = 9.8[us]
X_Acq_Time = 1.048576[s]
X_Angle = 30[°]
X_Atm = 3.4[GB]
X_Fulse = 3.266666667[us]
Irr_Atm_Dec = 22.71[dB]
Irr_Atm_Hoe = 22.71[dB]
Noise = FALSE
Decoupling = TRUE
Initial_Wait = 1[s]
Non = TRUE
Noe_Time = 2[s]
Repetition_Time = 3.048576[s]
