TESIS – SF185401

SELEKSI KANAL BAGI TELEPORTASI KUANTUM DUA ARAH ASIMETRI DENGAN METODE TENSOR

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QUANTUM CHANNEL SELECTION OF BIDIRECTIONAL ASYMMETRY QUANTUM TELEPORTATION USING TENSOR METHOD

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Surabaya 2020

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LEMBAR PENGESAHAN TESIS

Tesis disusun untuk memenuhi salah satu syarat memperoleh gelar

Magister Sains (M. Si)

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Oleh:

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SELEKSI KANAL BAGI TELEPORTASI KUANTUM DUA ARAH ASIMETRI DENGAN METODE TENSOR

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Abstrak

Pada penelitian ini yang berjudul "Seleksi Kanal Bagi Teleportasi Kuantum Dua Arah Asimetri dengan Metode Tensor" dengan tujuan dari penelitian ini adalah merumuskan kanal yang diizinkan dalam teleportasi kuantum dua asimetri arah dengan menggunakan metode tensor. Didapatkan hasil bahwa skema teleportasi dua arah asimetri dengan menggunakan kanal quantum terbelit enam qubit, dengan informasi yang dikirimkan oleh Alice dua qubit dan yang dikirimkan oleh Bob satu qubit didapatkan matriks parameter kanal **R** sebagai kriteria kanal yang dapat digukan sebagai kanal pengiriman. Matriks parameter kanal ditentukan dari hasil pengukuran oleh Alice dan Bob $(\sigma^{\mu}, \sigma^{\nu}, \sigma^{\tau})$ yang merupakan matriks uniter 2×2 dan juga matriks T^{μ}, T^{ν} dan T^{τ}. Matreiks parameter kanal berupa matriks 8×8.

Kata kunci : Teleportasi Kuantum, Matriks Pareter Kanal Pengukuran.

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QUANTUM CHANNEL SELECTION OF BIDIRECTIONAL ASYMMETRY QUANTUM TELEPORTATION USING TENSOR METHOD

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Abstract

The aim of this study is to formalize the channel that can be used in bidirectional asymmetry quantum teleportation using tensor method. In this study, the delivery of single qubit information and two qubit informaton is carried out in two directions through 6 qubit channel via the tensor method. Furthermore, it was found that not all 6 qubit channel can transmit information in two directions and there are special criteria for channels that can transmit information in two-way quantum teleportation including those for measurement using Bell basis bidirectional quantum teleportation channels can be formed using matrix parameters channels **R**, this matrix is direct product of 2×2 unitary matrix derived from the transformation of Alice and Bob results then the matrix is ultiplied by the results of the tensor multiplication matrix transformation T^{μ}, T^{ν} dan T^{τ}.

Keywords : Channel Parameter Matrix, Matrix Measurement, Quantum Teleportation.

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SELEKSI KANAL BAGI TELEPORTASI KUANTUM DUA ARAH ASIMETRI DENGAN METODE TENSOR

Sebagai salah satu syarat kelulusan Program Magister Fisika FSAD ITS.

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Surabaya, Januari 2019

Penulis

Daftar Isi

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Daftar Gambar

Bab 1

Pendahuluan

1.1 Latar Belakang

Teleportasi kuantum adalah pengiriman informasi dengan menggunakan keadaan terbelit sebagai kanal dan saluran klasik antara pengirim dan penerima sebagai sarana untuk menginfokan pengukuran yang dilakukan oleh pengirim kepada penerima. Perumusan teleportasi kuantum pertama kali dilakukan oleh Bennet et al., pada tahun 1993 [1]. Pengiriman keadaan satu qubit informasi yang dilakukan Alice kepada Bob melalui keadaan terbelit dua qubit (keadaan Bell) sebagai kanal. Secara eksperimen teleportasi kuantum dilakukan pertama kali oleh Beuwmeester et al., pada tahun 1997 [2]. Merujuk pada penelitian Bennet eksperimen teleportasi pertama menggunaknan foton sebagai informasi dan kanal, dimana informasi yang dikirimkan merupan keadaan satu qubit dan kanal merupakan keadaan Bell. Kemudian, baik penelitian teoritis [3-8] maupun eksperimental [9,10] dikembangkan lebih lanjut.

Pengembangan lebih lanjut dilakukan oleh Karlsson, pada tahun 1998 [11]. Mengirimkan keadaan satu qubit informasi melalui keadaan terbelit tiga qubit (keadaan GHZ). Selain itu, karlsson mengusulkan adanya orang ketiga dalam skema teleportasinya. Dimana Alice mengirimkan informasi berupa keadaan satu qubit kebada Cliff melalui Bob sebagai perantara, Cliff sebagai penerima hanya menerapkan operasi pembalik berdasarkan pengukuran Bob. Selain Karlsson, pengiriman keadaan satu qubit melalului keadaan terbelit tiga qubit juga dilakukan oleh Joo [3]. Dimana dalam skema ini digunakan keadaan terbelit berupa keadaa W. Skema ini berhasil melakukan teleportasi keadaan yang tidak diketahui (unkown states) melalui keadaan W tergantung pada jenis pengukuran yang dilakukan oleh Alice.

Selanjutnya, Rigolin et al. [12] pada tahun 2005 mengusulkan teleportasi kuantum dua qubit melalui kanal empat qubit. Setelah itu keadaan dua qubit sembarang berhasil diteleportasi dengan menggunakan enam belas keadaan umum orthogonal yang dibangun dari keadaan Bell sebagai kanal. Pada penelitian yang lain , Zha dan Song [13] memperluas salurun empat qubit tidak hanya dengan menggunakan pasangan keadaan Bell tetapi juga menggunakan pasangan keadaan bukan Bell sebagai kanal.

Perkembangan selanjutnya dilakukan oleh Zha et al.[6], pada tahun 2013, dimana Zha melakukan penelitian tentang teleportasi kuantum dua arah dengan pengontrol, Alice tidak hanya sebagai pengerim dalam skema ini, tetapi juga sebagai penerima dari Bob, begitu pula dengan Bob juga berperan sebagai pengirim dan penerima. Zha menggunakan saluran lima qubit keadaan gugus. Pada tahun yang sama diajukan teleportasi kuantum dengan kanal enam qubit keadaan gugus[14], enam qubit keadaan terbelit umum [15]. Selain itu juga dilakukan penelitian tentang teleportasi kuantum dua arah tanpa pengontrol oleh Fu et al., [17] pada tahun 2014. Skema dua arah teleportasi kuantum yang diajukan menggukan salurun empat qubit keadaan gugus. Selain itu Fu juga melakukan perumusan untuk menentukan kanal yang dapat digunakan dalam teleportasi dua arah, tetapi dalam penelitian ini Fu hanya menggunakan matrik uniter bentuk khusus. Pada penelitian selanjutnya dilakukan dengan menggunakan matrik uniter dengan bentuk umum. Pada penelitian ini akan dirumuskan teleportasi dua arah asimetri dengan menggunakan metode tensor.

1.2 Rumusan Masalah

Rumusan masalah tesis ini adalah merumuskan kanal yang diizinkan dalam teleportasi kuantum dua arah asimetri dengan menggukan metode tensor..

1.3 Tujuan

Tujuan yang ingin dicapai pada penelitian ini adalah merumuskan kanal yang diizinkan dalam teleportasi kuantum dua asimetri arah dengan menggunakan metode tensor.

1.4 Batasan Masalah

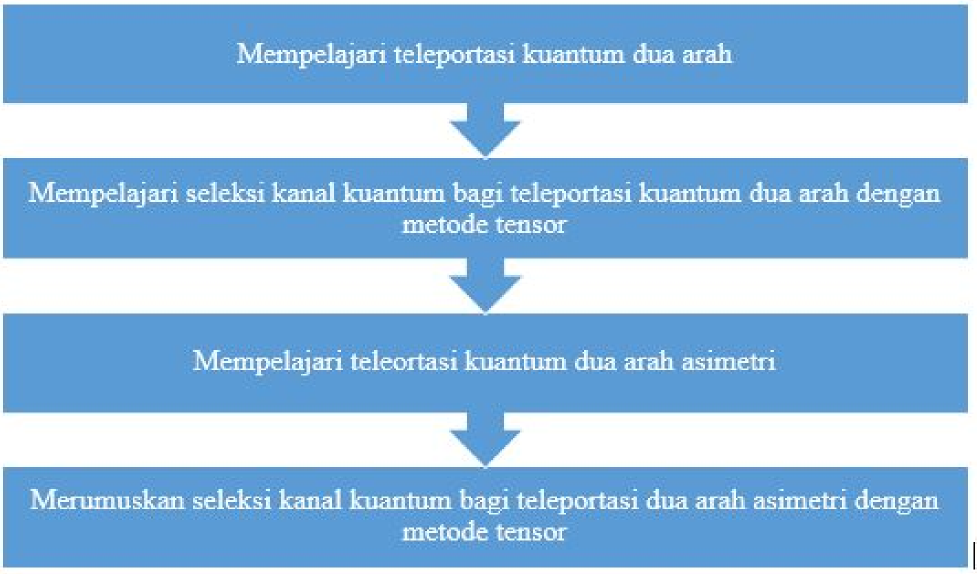
Pada penelitian ini permasalahan hanya dibatasi untuk teleportasi kuantum asimetri, dengan informasi yang dikirmkan adalah satu qubit dan dua qubit serta kanal yang digunakan kanal enam qubit.

1.5 Manfaat Penelitian

Penelitian ini diharapkan dapat bermanfaat untuk memberikan pemahaman pada sifat paling umum dari teleportasi satu qubit dengan saluran qubit rangkap dua sehingga dapat digunakan bagi penyelesaian kasus yang lebih kompleks.

1.6 Sistematika Penelitian

Penelitian ini adalah penelitian teoritis yang dilakukan degan mentelaah beberapa literatur berupa jurnal ilmiah buku-buku teks dan buku-buku lainnya. Skema kerja pada penelitian ditunjukan oleh Gambar (1.6) dibawah ini.



Gambar 1.1: Diagram Blok Alur Penelitian Tesis

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Bab 2

Teleportasi Kuantum

Teleportasi adalah memindahkan suatu informasi dari satu tempat ke tempat lain dengan sesaat (*melebihi kecepatan cahaya*), dimana teleportasi ini akan dianggap berhasil apabila informasi yang dikirimkan sama seperti informasi yang diterima, tanpa adanya perubahan. Contohnya apabila menteleportasi gelas, maka yang sampai harus gelas dengan bentuk yang sama tanpa cacat sedikitpun, meskipun terdapat interaksi dengan saluran yang digunakan. Pada teleportasi kuantum informasi yang dikirim akan menjadi satu dengan saluran yang digunakan, dimana informasi dan saluran akan menjadi satu, seoalah-olah informasi tersebut hancurkan terlebih dahulu, dan dibentuk kembali saat dilakukan pengukuran. Karena penghancuran informasi ini teleportasi kuantum memenuhi no cloning theorem dimana informasi tidak dapat disalin, sehingga informasi tadi tidak dapat diketahui oleh selain penerima[21]. Sekema dari teleportasi kuantum satu qubit informasi menggunakan saluran qubit ganda sebagai berikut.

2.1 Teleportasi Kuantum Menggunakan Saluran Pasangan *EPR*

Teleportasi kuantum adalah mengirimkan suatu informasi yang tidak diketahui dalam qubit tunggal,dimana informasi ini akan dikirimkan oleh Alice, keadaan yang akan dikirimkan oleh Alice sebagai berikut [1]

$$|\chi\rangle_1 = a\,|0\rangle + b\,|1\rangle \tag{2.1}$$

Informasi ini akan dikirimkan kepada Bob menggunakan keadaan terbelit, keadaan terbelit yang diguakan sebagai saluran adalah pasangan **EPR**, partikel yang terbelit ini dibawa oleh Alice dan Bob. Partikel yang dibawa oleh Alice kita sebut sebagai partikel 2 dan dibawa oleh Bob sebagai partikel 3

$$|\phi\rangle_{23} = \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle) \tag{2.2}$$

Proses pengiriman informasi ini dilakukan dengan cara menghacurkan informasi tersebut. Informasi tersebut akan menjadi satu dengan kanal. Maka hasil dari gabungan dari informasi dan anal secara matematis sebagai berikut :

$$|\psi\rangle_{123} = |\chi\rangle_1 \otimes |\phi\rangle_{23} = \frac{1}{\sqrt{2}}(a\,|001\rangle + b\,|101\rangle + a\,|010\rangle + b\,|110\rangle) \tag{2.3}$$

Informasi tersebut dapat terkirim setelah Alice melakukan pengukuran terhadap gabungan antara informasi dan saluran tersebut. Pengukuran dilakukan dengan menginteraksikan keadaan gabungan tersebut dengan keadaan lain,

$$\left|\pi^+\right\rangle = \frac{1}{\sqrt{2}} = (|00\rangle + |11\rangle) \tag{2.4}$$

Interaksi tersebut menyebabkan informasi dapat terkirim begitu saja, dan keadaan gabungan yang dibawa oleh Alice akan menjadi keadaan yang terbelit.

$$(\left\langle\pi^+\right| \otimes I)\,|\psi\rangle_{123} = \left\langle\pi^+\middle|\psi\right\rangle_{12} \otimes I\,|\psi\rangle_3 \tag{2.5}$$

Setelah dilakukan pengukuran informasi yang didapatkan oleh Bob sebagai berikut

$$|\psi\rangle_3 = \frac{1}{2}(a\,|1\rangle + b\,|0\rangle) \tag{2.6}$$

dimana informasi tersebut tidak seperti informasi yang dikirimkan oleh Alice. Bob akan mendapatkan informasi yang benar setelah menerima informasi mengenai pengukuran yang dilakukan oleh Alice yang dikirim melalui saluran klasik. oleh karena itu bob harus menginteraksikan informasi yang diterimanya agar informasi yang diterimanya sesuai, interaksi yang dilakukan oleh Bob berdasarkan pengukuran yang dilakukan oleh Alice.

$$|\psi\rangle_3 = 2\sigma_x\frac{1}{2}(a\,|1\rangle + b\,|0\rangle)_3 \tag{2.7}$$

Terdapat probabilitas keberhasilan pengiriman yang dilakukan, probabilas keberhasilan dirumuskan sebagai berikut:

$$p = \big(\,\langle\psi|\,(I \otimes \left|\pi^+\right\rangle)\big)\big((\left\langle\pi^+ \otimes\right| I)\,|\psi\rangle\,\big) \tag{2.8}$$

untuk teteleportasi ini memiliki probabilitas

$$\begin{aligned} p &= \big(\frac{1}{2}(\langle 0| + \langle 1|)\big)\big(\frac{1}{2}(|0\rangle + |1\rangle)\big) \\ &= \frac{1}{4} \end{aligned}$$

Setelah Bob melakukan interaksi terhadap informasi yang diterimanya, bob akan mendapatkan informasi yang sesuai

$$|\psi\rangle_3 = a\,|0\rangle + b\,|1\rangle$$

Alice dapat melakukan pengukuran demgan keadaan yang berbeda diantaranya

1. $|\pi^-\rangle = \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle)$
2. $|\kappa^+\rangle = \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle)$
3. $|\kappa^-\rangle = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)$

Informasi yang didapatkan oleh bob dari pengukuran tersebut sebagai berikut

1. $|\psi\rangle_3 = \frac{1}{2}(a|1\rangle - b|0\rangle)_3$
2. $|\psi\rangle_3 = \frac{1}{2}(a|0\rangle + b|1\rangle)_3$
3. $|\psi\rangle_3 = \frac{1}{2}(a|1\rangle - b|0\rangle)_3$

Bob harus menginteraksikan informasi yang diterimanya berdasarkan pengukura-pengukuran tersebut, yaitu:

1. $|\psi\rangle_3 = 2\sigma_x\sigma_z\frac{1}{2}(a|1\rangle - b|0\rangle)_3$
2. $|\psi\rangle_3 = 2I\frac{1}{2}(a|0\rangle + b|1\rangle)_3$
3. $|\psi\rangle_3 = 2\sigma\frac{1}{2}(a|1\rangle - b|0\rangle)_3$

dengan σ_x dan σ_z adalah matriks pauli, dan I adalah matriks identitas.

2.2 Teleportasi Kuantum Qubit Tunggal sembarang Melalui Saluran Qubit Ganda

Teleportasi kuantum bergantung pada tiga hal, yaitu keadaan yang dikirim, saluran yang digunakan dan pengukuran yang dilakukanoleh pengirim. Apabila Alice akan mengirimkan sutu Kubit informasi, dengan keadaan sebagai berikut.

$$|\chi\rangle = x_0|0\rangle + x_1|1\rangle$$

Menggunakan saluran umum dengan keadaan seperti dibawah ini.

$$|\phi\rangle = c_0|00\rangle + c_1|01\rangle + c_2|10\rangle + c_3|11\rangle \tag{2.9}$$

serta munggunakan pengukuran dengan keadaan keadaan umum.

$$|\pi\rangle = m_0|00\rangle + m_1|01\rangle + m_2|10\rangle + m_3|11\rangle \tag{2.10}$$

Keadaan sistem setelah informasi yang akan dikirim Alice tehadap Bob berinteraksi dengan salauran yang digunakan akan menjadi seperti dibawah ini

$$\begin{aligned} |\psi\rangle = |\chi\rangle \otimes |\phi\rangle \\ &= x_0c_0|000\rangle + x_0c_1|001\rangle + x_0c_2|010\rangle + x_0c_3|011\rangle \\ &+ x_1c_0|100\rangle + x_1c_1|101\rangle + x_1c_2|110\rangle + x_1c_3|111\rangle \end{aligned} \tag{2.11}$$

Alice akan melakukan pengukuran terhadap informasi tersebut, setelah Alice melakukan pengukuran, informasi akan dapat diterima oleh Bob dengan pelantara partikel terbelit yang dibawa oleh Bob. informasi yang diterima oleh Bob sebagai berikut.

$$\begin{aligned}
|\chi'\rangle &= (\langle\pi| \otimes I)\,|\psi\rangle \\
&= m_0x_0(c_0\,|0\rangle + c_1\,|1\rangle) + m_1x_0(c_2\,|0\rangle + c_3\,|1\rangle) \\
&+ m_2x_1(c_0\,|0\rangle + c_1\,|1\rangle) + m_3x_1(c_2\,|0\rangle + c_3\,|1\rangle) \\
&= (m_0x_0 + m_2x_1)(c_0\,|0\rangle + c_1\,|1\rangle) + (m_1x_0 + m_3x_1)(c_2\,|0\rangle + c_3\,|1\rangle)
\end{aligned} \tag{2.12}$$

Informasi akan sesuai setelah Bob mendapatkan informasi pengukuran dari Alice yang dikirim melalui saluran klasik, setelah Bob melakukan penguran terhadap partikel yang dibawanya untuk menyesuaikan informasi yang dikirim oleh Alice.

2.2.1 Teleportasi Menggunakan Keadaan Dua Suku Terbelit

Pada perumusan umum diatas, dapat dilakukan teleportasi menggunakan saluran yang ternelit apabila saluran yang digunakan oleh Alice dan Bob adalah saluran dengan keadaan dua suku terbelit yang kita keal sebagai keadaan *Bell*, maka teleportasi yang terjadi seperti dibawah ini.

$$|\phi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$$

$c_0 = c_3 = \frac{1}{\sqrt{2}}, c_1 = c_2 = 0$ Informasi yang akan didapatkan oleh Bob adalah sebagai berikut:

$$|\chi'\rangle = \frac{1}{\sqrt{2}}\big((m_0x_0 + m_2x_1)\,|0\rangle + (m_1x_0 + m_3x_1)\,|1\rangle\,\big)$$

saat Alice melakukan pengukuran dengan keadaan $m_0 = m_3 = \frac{1}{\sqrt{2}}, m_1 = m_2 = 0$ maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{2}(x_0\,|0\rangle + x_1\,|1\rangle) \\
&= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)
\end{aligned}$$

dengan nilai dari σ_B adalah $2I$.

saat Alice melakukan pengukuran dengan keadaan $m_0 = -m_3 = \frac{1}{\sqrt{2}}, m_1 = m_2 = 0$ maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{2}(x_0\,|0\rangle - x_1\,|1\rangle) \\
&= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)
\end{aligned}$$

dengan nilai dari σ_B adalah $2\sigma_z$.

saat Alice melakukan pengukuran dengan keadaan $m_0 = m_3 = 0, m_1 = m_2 = \frac{1}{\sqrt{2}}$ maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned} |\chi'\rangle &= \frac{1}{2}(x_1 |0\rangle + x_0 |1\rangle) \\ &= \sigma_B(x_0 |0\rangle + x_1 |1\rangle) \end{aligned}$$

dengan nilai dari σ_B adalah $2\sigma_x$.

saat Alice melakukan pengukuran dengan keadaan $m_0 = m_3 = 0, m_1 = -m_2 = \frac{1}{\sqrt{2}}$ maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned} |\chi'\rangle &= \frac{1}{2}(x_1 |0\rangle - x_0 |1\rangle) \\ &= \sigma_B(x_0 |0\rangle + x_1 |1\rangle) \end{aligned}$$

dengan nilai dari σ_B adalah $2\sigma_x\sigma_z$.

Pada teleportasi kuantum menggunakan keadaan terbelit umum dua suku memiliki probabilitas keberhasilan pengiriman sebesar $\frac{1}{4}$.

2.2.2 Teleportasi Menggunakan Keadaan Tiga Suku Terbelit

Selain menggunakan dua suku terbelit sebagai saluran, teleportasi kuantum juga dapat menggunakan saluran dengan tiga suku terbelit sebagai saluran. Contoh keaada dengan tiga suku terbelit sebagai saluran seperti dibawah:

$$|\psi\rangle = \frac{1}{\sqrt{3}}(|00\rangle + |01\rangle + |10\rangle)$$

$c_0 = c_1 = c_2 = \frac{1}{\sqrt{3}}, c_3 = 0$,informasi yang akan didapatkan oleh Bob:

$$|\chi'\rangle = \frac{1}{\sqrt{3}}\big((m_0x_0 + m_2x_1)(|0\rangle + |1\rangle) + (m_1x_0 + m_3x_1) |1\rangle\big)$$

saat menggunakan pengukuran $m_0 = -m_1 = m_3 = \frac{1}{\sqrt{3}}, m_2 = 0$

$$\begin{aligned} |\chi'\rangle &= \frac{1}{3}(x_0 |0\rangle + x_0 |1\rangle) - x_0 |0\rangle + x_1 0) \\ &= \frac{1}{3}(x_0 |1\rangle + x_1 |0\rangle) \\ &= \sigma_B(x_0 |0\rangle + x_1 |1\rangle) \\ \sigma_B &= 3\sigma_x \end{aligned}$$

saat menggunakan pengukuran $-m_0 = m_1 = m_3 = \frac{1}{\sqrt{3}}, m_2 = 0$

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{3}(-x_0|0\rangle - x_0|1\rangle) + x_0|0\rangle + x_1 0) \\
&= \frac{1}{3}(-x_0|1\rangle + x_1|0\rangle) \\
&= \sigma_B(x_0|0\rangle + x_1|1\rangle) \\
\sigma_B &= 3\sigma_x\sigma_z
\end{aligned}$$

saat menggunakan pengukuran $m_1 = -m_2 = m_3 = \frac{1}{\sqrt{3}}, m_0 = 0$

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{3}(-x_1|0\rangle - x_1|1\rangle) + x_0|0\rangle + x_1 0) \\
&= \frac{1}{3}(x_0|0\rangle - x_1|1\rangle) \\
&= \sigma_B(x_0|0\rangle + x_1|1\rangle) \\
\sigma_B &= 3\sigma_z
\end{aligned}$$

saat menggunakan pengukuran $m_1 = m_2 = -m_3 = \frac{1}{\sqrt{3}}, m_0 = 0$

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{3}(x_1|0\rangle + x_1|1\rangle) + x_0|0\rangle - x_1 0) \\
&= \frac{1}{3}(x_0|0\rangle + x_1|1\rangle) \\
&= \sigma_B(x_0|0\rangle + x_1|1\rangle) \\
\sigma_B &= 3I
\end{aligned}$$

Pada teleportasi kuantum menggunakan keadaan terbelit umum dua suku memiliki probabilitas keberhasilan pengiriman sebesar $\frac{1}{9}$

2.2.3 Teleportasi Menggunakan Keadaan Empat Suku Terbelit

Teleportasi kuantum juga dapat menggukan empat suku keadaan terbelit sebagai berikut.

$$|\psi\rangle = \frac{1}{2} = (|00\rangle + |01\rangle + |10\rangle - |11\rangle)$$

dengan nilai $c_0 = c_1 = c_2 = -c_3 = \frac{1}{2}$, informasi yang akan didaptkan oleh Bob adalah sebagai berikut:

$$|\chi'\rangle = \frac{1}{2}\big((m_0x_0 + m_2x_1)(|0\rangle + |1\rangle) + (m_1x_0 + m_3x_1)(|0\rangle + |1\rangle)\big)$$

saat Alice melakukan pengukuran dengan keadaan dibawah ini $m_0 = m_1 = m_2 = -m_3 = \frac{1}{2}$, maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}|\chi'\rangle &= \frac{1}{4}(x_0\,|0\rangle + x_1\,|1\rangle)\\ &= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)\\ \sigma_B &= 4I\end{aligned}$$

saat Alice melakukan pengukuran dengan keadaan dibawah ini $m_0 = m_1 = -m_2 = m_3 = \frac{1}{2}$, maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}|\chi'\rangle &= \frac{1}{4}(x_0\,|1\rangle + x_1\,|0\rangle)\\ &= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)\\ \sigma_B &= 4\sigma_x\end{aligned}$$

saat Alice melakukan pengukuran dengan keadaan dibawah ini $m_0 = -m_1 = m_2 = m_3 = \frac{1}{2}$, maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}|\chi'\rangle &= \frac{1}{4}(x_0\,|0\rangle - x_1\,|1\rangle)\\ &= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)\\ \sigma_B &= \sigma_z\end{aligned}$$

saat Alice melakukan pengukuran dengan keadaan dibawah ini $-m_0 = m_1 = m_2 = m_3 = \frac{1}{2}$, maka Bob harus melakukan pengukuran dengan σ_B agar informasi yang didapatkan sesuai

$$\begin{aligned}|\chi'\rangle &= \frac{1}{4}(x_0\,|1\rangle - x_1\,|0\rangle)\\ &= \sigma_B(x_0\,|0\rangle + x_1\,|1\rangle)\\ \sigma_B &= 4\sigma_x\sigma_z\end{aligned}$$

Pada teleportasi kuantum menggunakan keadaan terbelit umum empat suku memiliki probabilitas keberhasilan pengiriman sebesar $\frac{1}{16}$

2.2.4 Teleportasi Menggunakan Keadaan Terbelit Khusus

Saat menggunakan saluran khusus, yaitu saluran dengan nilai konstanta pada setiap suku bernilai berbeda seperti contohnya saluran dibawah ini.

Saat keadaan sembarang dua suku

$$|\psi\rangle = 0,8\,|00\rangle + 0,6\,|11\rangle$$

informasi yang akan didapatkan oleh Bob adalah sebagai berikut:

$$|\chi'\rangle = (m_0x_0 + m_2x_1)0,8\,|0\rangle + (m_1x_0 + m_3x_1)0,6\,|1\rangle$$

dengan menggunakan pungukuran $|\pi\rangle = 0,6\,|11\rangle + 0,8\,|00\rangle$, informasi yang akan diterima oleh Bob adalah sebagai berikut:

$$|\chi'\rangle = 0,48x_0\,|0\rangle + 0,48\,|1\rangle$$

Operator uniter yang harus dilakukan Bob agar mendapatkan informasi yang benar berupa $\sigma_B = \frac{1}{0,48}I$ dengan probabilitas terkirimnya informasi sebesar 0,2304

2.3 Teleportasi Dua Arah

Teleportasi kuantum dua arah merupakan teleportasi kuantum dimana Alice dan Bob akan sama-sama mengirimkan informasi. Alice akan mengirimkan informasi kepada Bob dan demikian pula Bob akan mengirimkan informasi kepada Alice secara bersamaan. Informasi yang dikirimkan oleh Alice:

$$|\chi\rangle_A = a_0\,|0\rangle + a_1\,|1\rangle \tag{2.13}$$

Informasi yang akan dikirimkan oleh Bob:

$$|\chi\rangle_B = b_0\,|0\rangle + b_1\,|1\rangle \tag{2.14}$$

Saluran yang akan digunakan merupakan keadaan terbelit 4 qubit, yang dapat dituliskan seperti berikut:

$$\begin{aligned}|\phi\rangle &= c_{0000}\,|0000\rangle + c_{0001}\,|0001\rangle + c_{0010}\,|0010\rangle + c_{0011}\,|0011\rangle \\ &+ c_{0100}\,|0100\rangle + c_{0101}\,|0101\rangle + c_{0110}\,|0110\rangle + c_{0111}\,|0111\rangle \\ &+ c_{1000}\,|1000\rangle + c_{1001}\,|1001\rangle + c_{1010}\,|1010\rangle + c_{1011}\,|1011\rangle \\ &+ c_{1100}\,|1100\rangle + c_{1101}\,|1101\rangle + c_{1110}\,|1110\rangle + c_{1111}\,|1111\rangle\end{aligned} \tag{2.15}$$

Peleburan informasi dengan saluran yang digunakan sebagai berikut:

$$\begin{aligned}|\psi\rangle &= |\chi\rangle_A \otimes |\chi\rangle_B \otimes |\phi\rangle \\ &= (a_0\,|0\rangle + a_1\,|1\rangle)(b_0\,|0\rangle + b_1\,|1\rangle) \\ &(c_{0000}\,|0000\rangle + c_{0001}\,|0001\rangle + c_{0010}\,|0010\rangle + c_{0011}\,|0011\rangle \\ &+ c_{0100}\,|0100\rangle + c_{0101}\,|0101\rangle + c_{0110}\,|0110\rangle + c_{0111}\,|0111\rangle \\ &+ c_{1000}\,|1000\rangle + c_{1001}\,|1001\rangle + c_{1010}\,|1010\rangle + c_{1011}\,|1011\rangle \\ &+ c_{1100}\,|1100\rangle + c_{1101}\,|1101\rangle + c_{1110}\,|1110\rangle + c_{1111}\,|1111\rangle)\end{aligned} \tag{2.16}$$

$$
\begin{aligned}
|\psi\rangle = a_0b_0(&c_{0000}|000000\rangle + c_{0001}|000001\rangle + c_{0010}|000010\rangle + c_{0011}|000011\rangle \\
&+ c_{0100}|000100\rangle + c_{0101}|000101\rangle + c_{0110}|000110\rangle + c_{0111}|000111\rangle \\
&+ c_{1000}|001000\rangle + c_{1001}|001001\rangle + c_{1010}|001010\rangle + c_{1011}|001011\rangle \\
&+ c_{1100}|001100\rangle + c_{1101}|001101\rangle + c_{1110}|001110\rangle + c_{1111}|001111\rangle) \\
&+ a_0b_1(c_{0000}|010000\rangle + c_{0001}|010001\rangle + c_{0010}|010010\rangle + c_{0011}|010011\rangle \\
&+ c_{0100}|010100\rangle + c_{0101}|010101\rangle + c_{0110}|010110\rangle + c_{0111}|010111\rangle \\
&+ c_{1000}|011000\rangle + c_{1001}|011001\rangle + c_{1010}|011010\rangle + c_{1011}|011011\rangle \\
&+ c_{1100}|011100\rangle + c_{1101}|011101\rangle + c_{1110}|011110\rangle + c_{1111}|011111\rangle) \\
&+ a_1b_0(c_{0000}|100000\rangle + c_{0001}|100001\rangle + c_{0010}|100010\rangle + c_{0011}|100011\rangle \\
&+ c_{0100}|100100\rangle + c_{0101}|100101\rangle + c_{0110}|100110\rangle + c_{0111}|100111\rangle \\
&+ c_{1000}|101000\rangle + c_{1001}|101001\rangle + c_{1010}|101010\rangle + c_{1011}|101011\rangle \\
&+ c_{1100}|101100\rangle + c_{1101}|101101\rangle + c_{1110}|101110\rangle + c_{1111}|101111\rangle) \\
&+ a_1b_1(c_{0000}|110000\rangle + c_{0001}|110001\rangle + c_{0010}|110010\rangle + c_{0011}|110011\rangle \\
&+ c_{0100}|110100\rangle + c_{0101}|110101\rangle + c_{0110}|110110\rangle + c_{0111}|110111\rangle \\
&+ c_{1000}|111000\rangle + c_{1001}|111001\rangle + c_{1010}|111010\rangle + c_{1011}|111011\rangle \\
&+ c_{1100}|111100\rangle + c_{1101}|111101\rangle + c_{1110}|111110\rangle + c_{1111}|111111\rangle)
\end{aligned}
\tag{2.17}
$$

Pengukuran bersama yang akan dilakukan menggunakan keadaan 4 qubit yang dapat dituliskan seperti berikut:

$$
\begin{aligned}
|\pi\rangle = &= m_{0000}|0000\rangle + m_{0001}|0001\rangle + m_{0010}|0010\rangle + m_{0011}|0011\rangle \\
&+ m_{0100}|0100\rangle + m_{0101}|0101\rangle + m_{0110}|0110\rangle + m_{0111}|0111\rangle \\
&+ m_{1000}|1000\rangle + m_{1001}|1001\rangle + m_{1010}|1010\rangle + m_{1011}|1011\rangle \\
&+ m_{1100}|1100\rangle + m_{1101}|1101\rangle + m_{1110}|1110\rangle + m_{1111}|1111\rangle
\end{aligned}
\tag{2.18}
$$

Informasi yang akan diterima oleh Alice dan juga Bob sebagai berikut:

$$\begin{aligned}
|\chi'\rangle &= (\langle\pi| \otimes I \otimes I)(|\psi\rangle) \\
&= m_{0000}a_0b_0(c_{0000}|00\rangle + c_{0001}|01\rangle + c_{0010}|01\rangle + c_{0011}|11\rangle) \\
&+ m_{0001}a_0b_0(c_{0100}|00\rangle + c_{0101}|01\rangle + c_{0110}|01\rangle + c_{0111}|11\rangle) \\
&+ m_{0010}a_0b_0(c_{1000}|00\rangle + c_{1001}|01\rangle + c_{1010}|01\rangle + c_{1011}|11\rangle) \\
&+ m_{0011}a_0b_0(c_{1100}|00\rangle + c_{1101}|01\rangle + c_{1110}|01\rangle + c_{1111}|11\rangle) \\
&+ m_{0100}a_0b_1(c_{0000}|00\rangle + c_{0001}|01\rangle + c_{0010}|01\rangle + c_{0011}|11\rangle) \\
&+ m_{0101}a_0b_1(c_{0100}|00\rangle + c_{0101}|01\rangle + c_{0110}|01\rangle + c_{0111}|11\rangle) \\
&+ m_{0110}a_0b_1(c_{1000}|00\rangle + c_{1001}|01\rangle + c_{1010}|01\rangle + c_{1011}|11\rangle) \\
&+ m_{0111}a_0b_1(c_{1100}|00\rangle + c_{1101}|01\rangle + c_{1110}|01\rangle + c_{1111}|11\rangle) \\
&+ m_{1000}a_1b_0(c_{0000}|00\rangle + c_{0001}|01\rangle + c_{0010}|01\rangle + c_{0011}|11\rangle) \\
&+ m_{1001}a_1b_0(c_{0100}|00\rangle + c_{0101}|01\rangle + c_{0110}|01\rangle + c_{0111}|11\rangle) \\
&+ m_{1010}a_1b_0(c_{1000}|00\rangle + c_{1001}|01\rangle + c_{1010}|01\rangle + c_{1011}|11\rangle) \\
&+ m_{1011}a_1b_0(c_{1100}|00\rangle + c_{1101}|01\rangle + c_{1110}|01\rangle + c_{1111}|11\rangle) \\
&+ m_{1100}a_1b_1(c_{0000}|00\rangle + c_{0001}|01\rangle + c_{0010}|01\rangle + c_{0011}|11\rangle) \\
&+ m_{1101}a_1b_1(c_{0100}|00\rangle + c_{0101}|01\rangle + c_{0110}|01\rangle + c_{0111}|11\rangle) \\
&+ m_{1110}a_1b_1(c_{1000}|00\rangle + c_{1001}|01\rangle + c_{1010}|01\rangle + c_{1011}|11\rangle) \\
&+ m_{1111}a_1b_1(c_{1100}|00\rangle + c_{1101}|01\rangle + c_{1110}|01\rangle + c_{1111}|11\rangle)
\end{aligned} \tag{2.19}$$

dimana hasil ini harus dapat dipecahmenjadi dua buah informasi

$$|\chi'\rangle = |\chi'\rangle_A \otimes |\chi'\rangle_B \tag{2.20}$$

dengan

$$\begin{aligned}
|\chi'\rangle_A &= \sigma_A(b_0|0\rangle + b_1|1\rangle) \\
&= \sigma_A|\chi\rangle_B
\end{aligned} \tag{2.21}$$

dan

$$\begin{aligned}
|\chi'\rangle_B &= \sigma_B(a_0|0\rangle + a_1|1\rangle) \\
&= \sigma_B|\chi\rangle_A
\end{aligned} \tag{2.22}$$

Contohnya sebagai berikut, apabila saluran kuantum yang digunakan seperti dibawah ini:

$$|\phi\rangle = \frac{1}{2}(0000 + |0101\rangle + |1010\rangle + |1111\rangle)$$

dan pengukur yang digunakan

$$|\pi\rangle = \frac{1}{2}(|0001\rangle + |0100\rangle + |1011\rangle + |1110\rangle)$$

maka informasi yang didapatkan seperti berikut

$$\begin{aligned}
|\chi'\rangle &= \frac{1}{4}(a_0b_1|00\rangle + a_0b_0|01\rangle + a_1b_1|10\rangle + a_1b_0|11\rangle) \\
&= \big(\sigma_A(b_0|0\rangle + b_1|1\rangle)\big)\big(\sigma_B(a_0|0\rangle + a_1|1\rangle)\big)
\end{aligned}$$

dengan nilai dari $\sigma_A = 2\sigma_x$ dan $\sigma_B = 2I$

2.4 Seleksi Kanal Kuantum Bagi Teleportasi Kuantum Dua Arah dengan Metode Tensor

Suatu informasi yang akan dikirimkan oleh Alice terhadap Bob didefinisikan sebagai berikut:

$$\begin{aligned} |\chi\rangle_A &= \sum_{i=0}^{1} x_i |i\rangle \\ &= x_0 |0\rangle + x_1 |1\rangle \end{aligned} \tag{2.23}$$

dengan nilai $\sum_{i=0}^{1} |x_i|^2 = 1$. Sedangkan informasi yang akan dikirimkan oleh Bob terhadap Alice sebagai berikut:

$$\begin{aligned} |\chi\rangle_B &= \sum_{j=0}^{1} y_j |j\rangle \\ &= y_0 |0\rangle + y_1 |1\rangle \end{aligned} \tag{2.24}$$

dengan ni;ai $\sum_{j=0}^{1} |y_j|^2 = 1$.

Selanjutnya saluran yang digunakan adalah sebagai berikut:

$$\begin{aligned} |\phi\rangle_{A_1B_1B_2A_1} &= \sum_{lmst=0}^{1} R_{lmst} |lmst\rangle \\ &= R_{0000} |0000\rangle + R_{0001} |0001\rangle + ... + R_1 111 |1111\rangle \end{aligned} \tag{2.25}$$

Keadaan gabungan dari peleburan informasi Alice dan infomasi Bob degan saluran kuantum yang digunakan sebagai berikut:

$$|\psi\rangle_{ABA_1B_1B_2A_2} = |\chi\rangle_A \otimes |\chi\rangle_B \otimes |\phi\rangle_{A_1B_1B_2B_1} \tag{2.26}$$

$|\psi\rangle_{ABA_1B_1B_2A_2} =$

$(x_0 |0\rangle + x_1 |1\rangle) \otimes (y_0 |0\rangle + y_1 |1\rangle) \otimes (R_{0000} |0000\rangle + R_{0001} |0001\rangle + ... + R_{1111} |1111\rangle)$

$$\begin{aligned} &= x_0 y_0 (R_{0000} |000000\rangle + R_{0001} |000001\rangle + R_{0010} |000010\rangle + R_{0011} |000011\rangle \\ &+ R_{0100} |000100\rangle + R_{0101} |000101\rangle + R_{0110} |000110\rangle + R_{0111} |000111\rangle \\ &+ R_{1000} |001000\rangle + R_{1001} |001001\rangle + R_{1010} |001010\rangle + R_{1011} |001011\rangle \\ &+ R_{1100} |001100\rangle + R_{1101} |001101\rangle + R_{1110} |001110\rangle + R_{1111} |001111\rangle) \end{aligned}$$

$$\begin{aligned} &+ x_0 y_1 (R_{0000} |010000\rangle + R_{0001} |010001\rangle + R_{0010} |010010\rangle + R_{0011} |010011\rangle \\ &+ R_{0100} |010100\rangle + R_{0101} |010101\rangle + R_{0110} |010110\rangle + R_{0111} |010111\rangle \\ &+ R_{1000} |011000\rangle + R_{1001} |011001\rangle + R_{1010} |011010\rangle + R_{1011} |011011\rangle \\ &+ R_{1100} |011100\rangle + R_{1101} |011101\rangle + R_{1110} |011110\rangle + R_{1111} |011111\rangle) \end{aligned}$$

$$+ x_1y_0(R_{0000}\,|100000\rangle + R_{0001}\,|100001\rangle + R_{0010}\,|100010\rangle + R_{0011}\,|100011\rangle$$
$$+ R_{0100}\,|100100\rangle + R_{0101}\,|100101\rangle + R_{0110}\,|100110\rangle + R_{0111}\,|100111\rangle$$
$$+ R_{1000}\,|101000\rangle + R_{1001}\,|101001\rangle + R_{1010}\,|101010\rangle + R_{1011}\,|101011\rangle$$
$$+ R_{1100}\,|101100\rangle + R_{1101}\,|101101\rangle + R_{1110}\,|101110\rangle + R_{1111}\,|101111\rangle)$$
$$+ x_1y_1(R_{0000}\,|110000\rangle + R_{0001}\,|110001\rangle + R_{0010}\,|110010\rangle + R_{0011}\,|110011\rangle$$
$$+ R_{0100}\,|110100\rangle + R_{0101}\,|110101\rangle + R_{0110}\,|110110\rangle + R_{0111}\,|110111\rangle$$
$$+ R_{1000}\,|111000\rangle + R_{1001}\,|111001\rangle + R_{1010}\,|111010\rangle + R_{1011}\,|111011\rangle$$
$$+ R_{1100}\,|111100\rangle + R_{1101}\,|111101\rangle + R_{1110}\,|111110\rangle + R_{1111}\,|111111\rangle)$$

Selanjutnya diperkenalkan Operator Swap (P_{23}) yang berfungsi untuk menukar qubit ke-2 dan ke-3

$$P_{23} = I \otimes P \otimes I \otimes I \otimes I \tag{2.27}$$

Lalu dilakukan perkalian langsung Operator Swap dengan hasil peleburan sebagai berikut

$$|\psi\rangle_{ABA_1B_1B_2A_2} = P_{23}\,|\psi\rangle_{ABA_1B_1B_2A_2} \tag{2.28}$$
$$= x_0y_0(R_{0000}\,|000000\rangle + R_{0001}\,|000001\rangle + R_{0010}\,|000010\rangle + R_{0011}\,|000011\rangle$$
$$+ R_{0100}\,|000100\rangle + R_{0101}\,|000101\rangle + R_{0110}\,|000110\rangle + R_{0111}\,|000111\rangle$$
$$+ R_{1000}\,|010000\rangle + R_{1001}\,|010001\rangle + R_{1010}\,|010010\rangle + R_{1011}\,|010011\rangle$$
$$+ R_{1100}\,|010100\rangle + R_{1101}\,|010101\rangle + R_{1110}\,|010110\rangle + R_{1111}\,|010111\rangle)$$
$$+ x_0y_1(R_{0000}\,|001000\rangle + R_{0001}\,|001001\rangle + R_{0010}\,|001010\rangle + R_{0011}\,|001011\rangle$$
$$+ R_{0100}\,|001100\rangle + R_{0101}\,|001101\rangle + R_{0110}\,|001110\rangle + R_{0111}\,|001111\rangle$$
$$+ R_{1000}\,|011000\rangle + R_{1001}\,|011001\rangle + R_{1010}\,|011010\rangle + R_{1011}\,|011011\rangle$$
$$+ R_{1100}\,|011100\rangle + R_{1101}\,|011101\rangle + R_{1110}\,|011110\rangle + R_{1111}\,|011111\rangle)$$
$$+ x_1y_0(R_{0000}\,|100000\rangle + R_{0001}\,|100001\rangle + R_{0010}\,|100010\rangle + R_{0011}\,|100011\rangle$$
$$+ R_{0100}\,|100100\rangle + R_{0101}\,|100101\rangle + R_{0110}\,|100110\rangle + R_{0111}\,|100111\rangle$$
$$+ R_{1000}\,|110000\rangle + R_{1001}\,|110001\rangle + R_{1010}\,|110010\rangle + R_{1011}\,|110011\rangle$$
$$+ R_{1100}\,|110100\rangle + R_{1101}\,|110101\rangle + R_{1110}\,|110110\rangle + R_{1111}\,|110111\rangle)$$
$$+ x_1y_1(R_{0000}\,|101000\rangle + R_{0001}\,|101001\rangle + R_{0010}\,|101010\rangle + R_{0011}\,|101011\rangle$$
$$+ R_{0100}\,|101100\rangle + R_{0101}\,|101101\rangle + R_{0110}\,|101110\rangle + R_{0111}\,|101111\rangle$$
$$+ R_{1000}\,|111000\rangle + R_{1001}\,|111001\rangle + R_{1010}\,|111010\rangle + R_{1011}\,|111011\rangle$$
$$+ R_{1100}\,|111100\rangle + R_{1101}\,|111101\rangle + R_{1110}\,|111110\rangle + R_{1111}\,|111111\rangle)$$

Selanjutnya jika keadaan pada persamaan (2.28) dituliskan sebagai berikut:

$$\begin{aligned}
&|0000\rangle := |1\rangle\,; \quad |0001\rangle := |2\rangle\,; |0010\rangle := |3\rangle\,; \quad |0011\rangle := |4\rangle\\
&|0100\rangle := |5\rangle\,; \quad |0101\rangle := |6\rangle\,; |0110\rangle := |7\rangle\,; \quad |0111\rangle := |8\rangle\\
&|1000\rangle := |9\rangle\,; \quad |1001\rangle := |10\rangle\,; |1010\rangle := |11\rangle\,; \quad |1011\rangle := |12\rangle\\
&|1100\rangle := |13\rangle\,; \quad |1101\rangle := |14\rangle\,; |1110\rangle := |15\rangle\,; \quad |1111\rangle := |16\rangle
\end{aligned} \tag{2.29}$$

Maka persamaan (2.28) dapat dituliskan kembali menjadi:

$$|\psi\rangle_{ABA_1B_1B_2A_2} =$$

$$\begin{aligned}
&\sum_{st=0}^{1} x_0y_0(R_{00st}|1\rangle + R_{01st}|2\rangle + R_{10st}|5\rangle + R_{11st}|6\rangle)|st\rangle \\
&+\sum_{st=0}^{1} x_0y_1(R_{00st}|3\rangle + R_{01st}|4\rangle + R_{10st}|7\rangle + R_{11st}|8\rangle)|st\rangle \\
&+\sum_{st=0}^{1} x_1y_0(R_{00st}|9\rangle + R_{01st}|10\rangle + R_{10st}|13\rangle + R_{11st}|14\rangle)|st\rangle \\
&+\sum_{st=0}^{1} x_1y_1(R_{00st}|11\rangle + R_{01st}|12\rangle + R_{10st}|15\rangle + R_{11st}|16\rangle)|st\rangle
\end{aligned} \tag{2.30}$$

$$|\psi\rangle_{ABA_1B_1B_2A_2} =$$

$$\begin{aligned}
&= x_0y_0\sum_{st=0}^{1}\begin{pmatrix}R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix}|1\rangle\\|2\rangle\\|5\rangle\\|6\rangle\end{pmatrix}|st\rangle \\
&+ x_0y_1\sum_{st=0}^{1}\begin{pmatrix}R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix}|3\rangle\\|4\rangle\\|7\rangle\\|8\rangle\end{pmatrix}|st\rangle \\
&+ x_1y_0\sum_{st=0}^{1}\begin{pmatrix}R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix}|9\rangle\\|10\rangle\\|13\rangle\\|14\rangle\end{pmatrix}|st\rangle \\
&+ x_1y_1\sum_{st=0}^{1}\begin{pmatrix}R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix}|11\rangle\\|12\rangle\\|15\rangle\\|16\rangle\end{pmatrix}|st\rangle
\end{aligned} \tag{2.31}$$

Selanjutnya ditinjau keadaan Bell, sebagai berikut:

$$\begin{aligned}
|\phi\rangle^1_{mn} &= \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle) \\
|\phi\rangle^2_{mn} &= \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle) \\
|\phi\rangle^3_{mn} &= \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle) \\
|\phi\rangle^3_{mn} &= \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)
\end{aligned} \tag{2.32}$$

dari keadaan Bell diatas dapat dituliskan basis baru sebagai berikut:

$$\begin{aligned} |00\rangle &= \frac{1}{\sqrt{2}}(|\phi\rangle^1_{mn} + |\phi\rangle^2_{mn}) \\ |01\rangle &= \frac{1}{\sqrt{2}}(|\phi\rangle^3_{mn} + |\phi\rangle^4_{mn}) \\ |10\rangle &= \frac{1}{\sqrt{2}}(|\phi\rangle^3_{mn} - |\phi\rangle^4_{mn}) \\ |11\rangle &= \frac{1}{\sqrt{2}}(|\phi\rangle^1_{mn} - |\phi\rangle^2_{mn}) \end{aligned} \tag{2.33}$$

dengan indeks mn merupakan indeks dari qubit yang dibentuk. Selanjutnya dengan mensubtitusikan persamaan (2.33) kedalam persamaan (2.31) diperoleh:

$$\begin{aligned} &|\psi\rangle_{ABA_1B_1B_2A_2} = \\ &\frac{1}{2}x_0y_0\sum_{st=0}^{1}\begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \\ (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \end{pmatrix}|st\rangle \\ &+\frac{1}{2}x_0y_1\sum_{st=0}^{1}\begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(|\phi\rangle^3_{10} - |\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(|\phi\rangle^1_{11} - |\phi\rangle^2_{11}) \\ (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(|\phi\rangle^3_{10} - |\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(|\phi\rangle^1_{11} - |\phi\rangle^2_{11}) \end{pmatrix}|st\rangle \\ &+\frac{1}{2}x_1y_0\sum_{st=0}^{1}\begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix} (|\phi\rangle^3_{10} - |\phi\rangle^4_{10})(|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{10} - |\phi\rangle^4_{10})(|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \\ (|\phi\rangle^1_{11} - |\phi\rangle^2_{11})(|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{11} - |\phi\rangle^2_{11})(|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \end{pmatrix}|st\rangle \\ &+\frac{1}{2}x_1y_0\sum_{st=0}^{1}\begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st}\end{pmatrix}\begin{pmatrix} (|\phi\rangle^3_{10} - |\phi\rangle^4_{10})(|\phi\rangle^3_{10} - |\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{10} - |\phi\rangle^4_{10})(|\phi\rangle^1_{11} - |\phi\rangle^2_{11}) \\ (|\phi\rangle^1_{11} - |\phi\rangle^2_{11})(|\phi\rangle^3_{10} - |\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{11} - |\phi\rangle^2_{11})(|\phi\rangle^1_{11} - |\phi\rangle^2_{11}) \end{pmatrix}|st\rangle \end{aligned} \tag{2.34}$$

$$\begin{aligned} &|\psi\rangle_{ABA_1B_1B_2A_2} = \\ &\frac{1}{2}x_0\sum_{st=0}^{1}R_{00st}(|\phi\rangle^1_{00} + |\phi\rangle^2_{00})\Big(\big(y_0(|\phi\rangle^1_{00} + |\phi\rangle^2_{00})\big) + \big(y_1(|\phi\rangle^3_{10} - |\phi\rangle^4_{10})\big)\Big) \\ &\quad +R_{01st}(|\phi\rangle^1_{00} + |\phi\rangle^2_{00})\Big(\big(y_0(|\phi\rangle^3_{01} + |\phi\rangle^4_{01})\big) + \big(y_1(|\phi\rangle^1_{11} - |\phi\rangle^2_{11})\big)\Big) \\ &\quad +R_{10st}(|\phi\rangle^3_{01} + |\phi\rangle^4_{01})\Big(\big(y_0(|\phi\rangle^3_{00} + |\phi\rangle^2_{00})\big) + \big(y_1(|\phi\rangle^3_{10} - |\phi\rangle^4_{10})\big)\Big) \\ &\quad +R_{11st}(|\phi\rangle^3_{01} + |\phi\rangle^4_{01})\Big(\big(y_0(|\phi\rangle^1_{01} + |\phi\rangle^4_{01})\big) + \big(y_1(|\phi\rangle^1_{11} - |\phi\rangle^2_{11})\big)\Big)|st\rangle \end{aligned}$$

$$+\frac{1}{2}x_1\sum_{st=0}^{1}R_{00st}(|\phi\rangle_{01}^{3}-|\phi\rangle_{01}^{4})\Big(\big(y_0(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\big)+\big(y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{01st}(|\phi\rangle_{01}^{3}-|\phi\rangle_{01}^{4})\Big(\big(y_0(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\big)+\big(y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\big)\Big)$$
$$+R_{10st}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{1})\Big(\big(y_0(|\phi\rangle_{00}^{3}+|\phi\rangle_{00}^{2})\big)+\big(y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{11st}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\Big(\big(y_0(|\phi\rangle_{01}^{1}+|\phi\rangle_{01}^{4})\big)+\big(y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\big)\Big)|st\rangle \tag{2.35}$$

selanjutnya apabila persamaan (2.35) dituliskan menjadi $|\psi\rangle_{ABA_1B_1B_2A_2}=$

$$\frac{1}{\sqrt{2}}x_0\sum_{st=0}^{1}R_{00st}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\Big(\big(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\big)$$
$$+\big(y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{01st}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\Big(\big(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}\,T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\big)$$
$$+\big(y_1(\left|T_{11}^{1}\phi\right\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+\left|T_{11}^{3}\phi\right\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4})\big)\Big)$$
$$+R_{10st}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\Big(\big(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\big)$$
$$+\big(y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{11st}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\Big(\big(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}\,T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\big)$$
$$+\big(y_1(\left|T_{11}^{1}\phi\right\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+\left|T_{11}^{3}\phi\right\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4})\big)\Big)|st\rangle$$

$$\frac{1}{\sqrt{2}}x_1\sum_{st=0}^{1}R_{00st}(|\phi\rangle_{01}^{3}-|\phi\rangle_{01}^{4})\Big(\big(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\big)$$
$$+\big(y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{01st}(|\phi\rangle_{01}^{3}-|\phi\rangle_{01}^{4})\Big(\big(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}\,T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\big)$$
$$+R_{10st}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{1})\Big(\big(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\big)$$
$$+\big(y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4})\big)\Big)$$
$$+R_{11st}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\Big(\big(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}\,T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\big)|st\rangle \tag{2.36}$$

dengan T^{τ}_{jm} adalah kosntanta yang bekerja pada keadaan Bell $|\phi\rangle^{\tau}_{jm}$ untuk $\tau = 1, 2, 3, 4$, maka dengan mereduksi persamaan (2.35) dan persamaan (2.36) didapatkan nilai keseluruhan dari kosntanta T^{τ}_{jm} adalah

$$\begin{pmatrix} T^1_{00} & T^2_{00} & T^3_{00} & T^4_{00} \\ T^1_{01} & T^2_{01} & T^3_{01} & T^4_{01} \\ T^1_{10} & T^2_{10} & T^3_{10} & T^4_{10} \\ T^1_{11} & T^2_{11} & T^3_{11} & T^4_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \\ 1 & -1 & 0 & 0 \end{pmatrix} \tag{2.37}$$

Persamaan (2.36) dapat dituliskan kembali dengan

$$\begin{aligned}
&|\psi\rangle_{ABA_1B_1B_2A_2} = \\
&\frac{1}{\sqrt{2}} x_0 \sum_{j=0}^{1} y_j \sum_{st=0}^{1} \Big(R_{00st}\big((|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{01st}\big((|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big) \\
&\quad + R_{10st}\big((|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{11st}\big((|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big)\Big)|st\rangle \\
&\frac{1}{\sqrt{2}} x_1 \sum_{j=0}^{1} y_j \sum_{st=0}^{1} \Big(R_{00st}\big((|\phi\rangle^3_{0} - |\phi\rangle^4_{10})(T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{01st}\big((|\phi\rangle^3_{10} - |\phi\rangle^4_{10})(T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big) \\
&\quad + R_{10st}\big((|\phi\rangle^1_{11} - |\phi\rangle^2_{11})y_j(T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{11st}\big((|\phi\rangle^1_{11} - |\phi\rangle^2_{11})(T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big)\Big)|st\rangle
\end{aligned} \tag{2.38}$$

Selanjutnya jika persamaan (2.38) dituliskan sebagai berikut

$$\begin{aligned}
&|\psi\rangle_{ABA_1B_1B_2A_2} = \\
&\frac{1}{\sqrt{2}} \sum_{i=0}^{1} x_i \sum_{j=0}^{1} y_j \sum_{st=0}^{1} \Big(R_{00st}\big((T^1_{i0}|\phi\rangle^1_{i0} + T^2_{i0}|\phi\rangle^2_{i0} + T^3_{i0}|\phi\rangle^3_{i0} + T^4_{i0}|\phi\rangle^4_{i0}) \\
&\quad (T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{01st}\big((T^1_{i0}|\phi\rangle^1_{i0} + T^2_{i0}|\phi\rangle^2_{i0} + T^3_{i0}|\phi\rangle^3_{i0} + T^4_{i0}|\phi\rangle^4_{i0}) \\
&\quad (T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big) \\
&\quad + R_{10st}\big((T^1_{i1}|\phi\rangle^1_{i0} + T^2_{i1}|\phi\rangle^2_{i1} + T^3_{i1}|\phi\rangle^3_{i1} + T^4_{i1}|\phi\rangle^4_{i1}) \\
&\quad (T^1_{j0}|\phi\rangle^1_{j0} + T^2_{j0}|\phi\rangle^2_{j0} + T^3_{j0}|\phi\rangle^3_{j0} + T^4_{j0}|\phi\rangle^4_{j0})\big) \\
&\quad + R_{11st}\big((T^1_{i1}|\phi\rangle^1_{i0} + T^2_{i1}|\phi\rangle^2_{i1} + T^3_{i1}|\phi\rangle^3_{i1} + T^4_{i1}|\phi\rangle^4_{i1}) \\
&\quad (T^1_{j1}|\phi\rangle^1_{j1} + T^2_{j1}|\phi\rangle^2_{j1} + T^3_{j1}|\phi\rangle^3_{j1} + T^4_{j1}|\phi\rangle^4_{j1})\big)\Big)|st\rangle
\end{aligned} \tag{2.39}$$

maka dengan mereduksi persamaan (2.38) dan persamaan (2.39) diperoleh nilai keseluruhan dari konstanta T_{il}^{θ} untuk $\theta = 1,2,3,4$ yang sama dengan konstanta T_{jm}^{τ} pada persamaan (2.37). Selanjutnya persamaan (2.39) dapat dituliskan dengan

$$|\psi\rangle_{ABA_1B_1B_2A_2} =$$

$$\sum_{i=0}^{1} x_i \sum_{j=0}^{1} y_j \sum_{st=0}^{1} \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix}$$

$$\begin{pmatrix} (T_{i0}^1 |\phi\rangle_{i0}^1 + T_{i0}^2 |\phi\rangle_{i0}^2 + T_{i0}^3 |\phi\rangle_{i0}^3 + T_{i0}^4 |\phi\rangle_{i0}^4)(T_{j0}^1 |\phi\rangle_{j0}^1 + T_{j0}^2 |\phi\rangle_{j0}^2 + T_{j0}^3 |\phi\rangle_{j0}^3 + T_{j0}^4 |\phi\rangle_{j0}^4) \\ (T_{i0}^1 |\phi\rangle_{i0}^1 + T_{i0}^2 |\phi\rangle_{i0}^2 + T_{i0}^3 |\phi\rangle_{i0}^3 + T_{i0}^4 |\phi\rangle_{i0}^4)(T_{j1}^1 |\phi\rangle_{j1}^1 + T_{j1}^2 |\phi\rangle_{j1}^2 + T_{j1}^3 |\phi\rangle_{j1}^3 + T_{j1}^4 |\phi\rangle_{j1}^4) \\ (T_{i1}^1 |\phi\rangle_{i0}^1 + T_{i1}^2 |\phi\rangle_{i1}^2 + T_{i1}^3 |\phi\rangle_{i1}^3 + T_{i1}^4 |\phi\rangle_{i1}^4)(T_{j0}^1 |\phi\rangle_{j0}^1 + T_{j0}^2 |\phi\rangle_{j0}^2 + T_{j0}^3 |\phi\rangle_{j0}^3 + T_{j0}^4 |\phi\rangle_{j0}^4) \\ (T_{i1}^1 |\phi\rangle_{i0}^1 + T_{i1}^2 |\phi\rangle_{i1}^2 + T_{i1}^3 |\phi\rangle_{i1}^3 + T_{i1}^4 |\phi\rangle_{i1}^4)(T_{j1}^1 |\phi\rangle_{j1}^1 + T_{j1}^2 |\phi\rangle_{j1}^2 + T_{j1}^3 |\phi\rangle_{j1}^3 + T_{j1}^4 |\phi\rangle_{j1}^4) \end{pmatrix} |st\rangle$$

$$= \sum_{i=0}^{1} x_i \sum_{j=0}^{1} y_j \sum_{st=0}^{1} \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} \sum_{\theta=1}^4 T_{i0}^{\theta} |\phi\rangle_{i0}^{\theta} \sum_{\tau=1}^4 T_{j0}^{\tau} |\phi\rangle_{j0}^{\tau} \\ \sum_{\theta=1}^4 T_{i0}^{\theta} |\phi\rangle_{i0}^{\theta} \sum_{\tau=1}^4 T_{j1}^{\tau} |\phi\rangle_{j1}^{\tau} \\ \sum_{\theta=1}^4 T_{i1}^{\theta} |\phi\rangle_{i1}^{\theta} \sum_{\tau=1}^4 T_{j0}^{\tau} |\phi\rangle_{j0}^{\tau} \\ \sum_{\theta=1}^4 T_{i1}^{\theta} |\phi\rangle_{i1}^{\theta} \sum_{\tau=1}^4 T_{j1}^{\tau} |\phi\rangle_{j1}^{\tau} \end{pmatrix} |st\rangle$$

$$= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{st=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T_{i0}^{\theta} |\phi\rangle_{i0}^{\theta} T_{j0}^{\tau} |\phi\rangle_{j0}^{\tau} \\ T_{i0}^{\theta} |\phi\rangle_{i0}^{\theta} T_{j1}^{\tau} |\phi\rangle_{j1}^{\tau} \\ T_{i1}^{\theta} |\phi\rangle_{i1}^{\theta} T_{j0}^{\tau} |\phi\rangle_{j0}^{\tau} \\ T_{i1}^{\theta} |\phi\rangle_{i1}^{\theta} T_{j1}^{\tau} |\phi\rangle_{j1}^{\tau} \end{pmatrix} |st\rangle$$

$$= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{mst=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j \begin{pmatrix} R_{0mst} & R_{1mst} \end{pmatrix} \begin{pmatrix} T_{i0}^{\theta} |\phi\rangle_{i0}^{\theta} T_{jm}^{\tau} |\phi\rangle_{jm}^{\tau} \\ T_{i1}^{\theta} |\phi\rangle_{i}^{\theta} T_{jm}^{\tau} |\phi\rangle_{jm}^{\tau} \end{pmatrix} |st\rangle$$

$$= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{lmst=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j R_{lmst} T_{il}^{\theta} |\phi\rangle_{il}^{\theta} T_{jm}^{\tau} |\phi\rangle_{jm}^{\tau} |st\rangle$$

$$= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{lmst=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j R_{lmst} T_{il}^{\theta} T_{jm}^{\tau} (|\phi\rangle_{il}^{\theta} |\phi\rangle_{jm}^{\tau}) |st\rangle \tag{2.40}$$

Selanjutnya apabila dituliskan $|\phi\rangle_{il}^{\theta} = |\theta\rangle_{il}; |\phi\rangle_{il}^{\theta} = |\theta\rangle_{il} |\phi\rangle_{jm}^{\tau} = |\tau\rangle_{jm}$ dengan $\theta, \tau = 1,2,3,4$ maka persamaan (2.40) dapat dituliskan dengan

$$\begin{aligned} |\psi\rangle_{ABA_1B_1B_2A_2} &= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{lmst=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j R_{lmst} T_{il}^{\theta} T_{jm}^{\tau} (|\theta\rangle |\tau\rangle) |st\rangle \\ &= \sum_{i=0}^{1} \sum_{j=0}^{1} \sum_{lmst=0}^{1} \sum_{\theta=1}^{4} \sum_{\tau=1}^{4} x_i y_j R_{lmst} T_{il}^{\theta} T_{jm}^{\tau} |\theta\tau\rangle |st\rangle \end{aligned} \tag{2.41}$$

Selanjutanya dengan mengeluarkan nilai $|st\rangle$ pada persamaan di atas maka diperoleh

$$|\phi\rangle_{A_1B_1B_2A_1} =$$

$$\sum_{st=0}^{1}\sum_{i=0}^{1}\sum_{j=0}^{1} x_i y_j \sum_{\theta\tau=1}^{4} \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{i0}T^{\tau}_{j0} \\ T^{\theta}_{i0}T^{\tau}_{j1} \\ T^{\theta}_{i1}T^{\tau}_{j0} \\ T^{\theta}_{i1}T^{\tau}_{j1} \end{pmatrix} |\theta\tau\rangle\, |st\rangle$$

$$= \sum_{st=0}^{1}\sum_{\theta\tau=1}^{4} \Bigg(x_0y_0 \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} \\ T^{\theta}_{00}T^{\tau}_{01} \\ T^{\theta}_{01}T^{\tau}_{00} \\ T^{\theta}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_0y_1 \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_1y_0 \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{10}T^{\tau}_{00} \\ T^{\theta}_{10}T^{\tau}_{01} \\ T^{\theta}_{11}T^{\tau}_{00} \\ T^{\theta}_{11}T^{\tau}_{01} \end{pmatrix}$$

$$+x_1y_1 \begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix} \Bigg) |\theta\tau\rangle\, |st\rangle$$

$$= \sum_{st=0}^{1}\sum_{\theta\tau=1}^{4} \Bigg(\Bigg(\begin{pmatrix} R_{00st} & R_{01st} & R_{10st} & R_{11st} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix} \Bigg) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) |\theta\tau\rangle\, |st\rangle$$

$$= \sum_{\theta\tau=1}^{4} \Bigg(\Bigg((\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix}) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) |\theta\tau\rangle\, |00\rangle \Bigg)$$

$$+ \sum_{\theta\tau=1}^{4} \Bigg(\Bigg((\begin{pmatrix} R_{0001} & R_{0101} & R_{1001} & R_{1101} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix}) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) |\theta\tau\rangle\, |01\rangle \Bigg)$$

$$+ \sum_{\theta\tau=1}^{4} \Bigg(\Bigg((\begin{pmatrix} R_{0010} & R_{0110} & R_{1010} & R_{1110} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix}) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) |\theta\tau\rangle\, |10\rangle \Bigg)$$

$$+ \sum_{\theta\tau=1}^{4} \Bigg(\Bigg((\begin{pmatrix} R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix}) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) |\theta\tau\rangle\, |11\rangle \Bigg)$$

$$= \sum_{\theta\tau=1}^{4} \Bigg(\Bigg(\Bigg(\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \\ R_{0001} & R_{0101} & R_{1001} & R_{1101} \\ R_{0010} & R_{0110} & R_{1010} & R_{1110} \\ R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} \begin{pmatrix} T^{\theta}_{00}T^{\tau}_{00} & T^{\theta}_{00}T^{\tau}_{10} & T^{\theta}_{10}T^{\tau}_{00} & T^{\theta}_{10}T^{\tau}_{10} \\ T^{\theta}_{00}T^{\tau}_{01} & T^{\theta}_{00}T^{\tau}_{11} & T^{\theta}_{10}T^{\tau}_{01} & T^{\theta}_{10}T^{\tau}_{11} \\ T^{\theta}_{01}T^{\tau}_{00} & T^{\theta}_{01}T^{\tau}_{10} & T^{\theta}_{11}T^{\tau}_{00} & T^{\theta}_{11}T^{\tau}_{10} \\ T^{\theta}_{01}T^{\tau}_{01} & T^{\theta}_{01}T^{\tau}_{11} & T^{\theta}_{11}T^{\tau}_{01} & T^{\theta}_{11}T^{\tau}_{11} \end{pmatrix} \Bigg) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) \big(|00\rangle \quad |01\rangle\, |10\rangle\, |11\rangle\big)\, |\theta\tau\rangle \Bigg)$$

$$= \sum_{\theta\tau=1}^{4} \Bigg(\Bigg(\Bigg(\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \\ R_{0001} & R_{0101} & R_{1001} & R_{1101} \\ R_{0010} & R_{0110} & R_{1010} & R_{1110} \\ R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} \left(\left(\begin{pmatrix} T^{\theta}_{00} & T^{\theta}_{10} \\ T^{\theta}_{01} & T^{\theta}_{11} \end{pmatrix} \otimes \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix}\right)\right) \Bigg) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) \big(|00\rangle \quad |01\rangle\, |10\rangle\, |11\rangle\big)\, |\theta\tau\rangle \Bigg) \tag{2.42}$$

Selanjutnya dengan menuliskan bentuk matriks T^{θ} dan T^{τ} sebagai berikut

$$T^{\theta} = \begin{pmatrix} T^{\theta}_{00} & T^{\theta}_{10} \\ T^{\theta}_{01} & T^{\theta}_{11} \end{pmatrix}; T^{\tau} = \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix} \tag{2.43}$$

yang nerupakan bentuk matriks dari nilai koefisien T^{θ}_{il} dan T^{τ}_{jm} dengan

$$T^{1} = \begin{pmatrix} T^{1}_{00} & T^{1}_{10} \\ T^{1}_{01} & T^{1}_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$T^{2} = \begin{pmatrix} T^{2}_{00} & T^{2}_{10} \\ T^{2}_{01} & T^{2}_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

$$T^{3} = \begin{pmatrix} T^{3}_{00} & T^{3}_{10} \\ T^{3}_{01} & T^{3}_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$T^{4} = \begin{pmatrix} T^{4}_{00} & T^{4}_{10} \\ T^{4}_{01} & T^{4}_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \tag{2.44}$$

Selanjutnya dengan mensubtitusikan persamaan (2.43) dan persamaan (2.42) diperoleh

$$|\psi\rangle_{ABA_1B_1B_2A_2} = \sum_{\theta\tau=1}^{4} \Bigg(\Bigg(\Bigg(\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \\ R_{0001} & R_{0101} & R_{1001} & R_{1101} \\ R_{0010} & R_{0110} & R_{1010} & R_{1110} \\ R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} (T^{\theta} \otimes T^{\tau}) \Bigg) \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \Bigg) \big(|00\rangle \quad |01\rangle\, |10\rangle\, |11\rangle\big)\, |\theta\tau\rangle \Bigg) \tag{2.45}$$

Memperlihatkan ulang persmaan (2.41) dengan menuliskan $R_{lmst}T^{\theta}_{il}T^{\tau}_{jm} = \sigma^{\theta\tau}_{iljmst}$ maka dapat dituliskan

$$|\psi\rangle_{ABA_1B_1B_2A_2} = \sum_{i=0}^{1}\sum_{j=0}^{1}\sum_{lmst=0}^{1}\sum_{\theta=1}^{4}\sum_{\tau=1}^{4} x_i y_j \sigma^{\theta\tau}_{iljmst} |\theta\tau\rangle |st\rangle \tag{2.46}$$

selanjutnya jika $|\theta\tau\rangle$ dan indeks lm nya dijalankan, maka persamaan (2.46) dapat dituliskan sebagai berikut

$$|\psi\rangle_{ABA_1B_1B_2A_2} =$$

$$\begin{aligned}
&\sum_{st=0}^{1}\sum_{ij=0}^{1} x_i y_j \big((\sigma^{11}_{i0j0st} + \sigma^{11}_{i0j1st} + \sigma^{11}_{i1j0st} + \sigma^{11}_{i1j1st} |11\rangle) + (\sigma^{12}_{i0j0st} + \sigma^{12}_{i0j1st} + \sigma^{12}_{i1j0st} + \sigma^{12}_{i1j1st} |12\rangle) \\
&\quad + (\sigma^{13}_{i0j0st} + \sigma^{13}_{i0j1st} + \sigma^{13}_{i1j0st} + \sigma^{13}_{i1j1st} |13\rangle) + (\sigma^{14}_{i0j0st} + \sigma^{14}_{i0j1st} + \sigma^{14}_{i1j0st} + \sigma^{14}_{i1j1st} |14\rangle) \\
&\quad (\sigma^{21}_{i0j0st} + \sigma^{21}_{i0j1st} + \sigma^{21}_{i1j0st} + \sigma^{21}_{i1j1st} |21\rangle) + (\sigma^{22}_{i0j0st} + \sigma^{22}_{i0j1st} + \sigma^{22}_{i1j0st} + \sigma^{22}_{i1j1st} |22\rangle) \\
&\quad + (\sigma^{23}_{i0j0st} + \sigma^{23}_{i0j1st} + \sigma^{23}_{i1j0st} + \sigma^{23}_{i1j1st} |23\rangle) + (\sigma^{24}_{i0j0st} + \sigma^{24}_{i0j1st} + \sigma^{24}_{i1j0st} + \sigma^{24}_{i1j1st} |24\rangle) \\
&\quad (\sigma^{31}_{i0j0st} + \sigma^{31}_{i0j1st} + \sigma^{31}_{i1j0st} + \sigma^{31}_{i1j1st} |31\rangle) + (\sigma^{32}_{i0j0st} + \sigma^{32}_{i0j1st} + \sigma^{32}_{i1j0st} + \sigma^{32}_{i1j1st} |32\rangle) \\
&\quad + (\sigma^{33}_{i0j0st} + \sigma^{33}_{i0j1st} + \sigma^{33}_{i1j0st} + \sigma^{33}_{i1j1st} |33\rangle) + (\sigma^{34}_{i0j0st} + \sigma^{34}_{i0j1st} + \sigma^{34}_{i1j0st} + \sigma^{34}_{i1j1st} |34\rangle) \\
&\quad (\sigma^{41}_{i0j0st} + \sigma^{41}_{i0j1st} + \sigma^{41}_{i1j0st} + \sigma^{41}_{i1j1st} |41\rangle) + (\sigma^{42}_{i0j0st} + \sigma^{42}_{i0j1st} + \sigma^{42}_{i1j0st} + \sigma^{42}_{i1j1st} |42\rangle) \\
&\quad + (\sigma^{43}_{i0j0st} + \sigma^{43}_{i0j1st} + \sigma^{43}_{i1j0st} + \sigma^{43}_{i1j1st} |43\rangle) + (\sigma^{44}_{i0j0st} + \sigma^{44}_{i0j1st} + \sigma^{44}_{i1j0st} + \sigma^{44}_{i1j1st} |44\rangle) \big) |st\rangle
\end{aligned}$$

$$= \sum_{st=0}^{1}\sum_{i=0}^{1}\sum_{j=0}^{1} x_i y_j \sum_{\theta\tau=1}^{4} \big((\sigma^{\theta\tau}_{i0j0st} + \sigma^{\theta\tau}_{i0j1st} + \sigma^{\theta\tau}_{i1j0st} + \sigma^{\theta\tau}_{i1j1st}) |\theta\tau\rangle \big) |st\rangle \tag{2.47}$$

selanjutnya drngan menuliskan

$$(\sigma^{\theta\tau}_{i0j0st} + \sigma^{\theta\tau}_{i0j1st} + \sigma^{\theta\tau}_{i1j0st} + \sigma^{\theta\tau}_{i1j1st}) = \sigma^{\theta\tau}_{ijst} \tag{2.48}$$

dan menjalankan indeks ij pada persamaan (2,47) maka dapat dituliskan

$$\begin{aligned}
|\psi\rangle_{ABA_1B_1B_2A_2} = \sum_{st=0}^{1}\sum_{\theta\tau=1}^{4} \big(& x_0 y_0 (\sigma^{\theta\tau}_{0000st} + \sigma^{\theta\tau}_{0001st} + \sigma^{\theta\tau}_{0100st} + \sigma^{\theta\tau}_{0101st}) \\
& + x_0 y_1 (\sigma^{\theta\tau}_{0010st} + \sigma^{\theta\tau}_{0011st} + \sigma^{\theta\tau}_{0110st} + \sigma^{\theta\tau}_{0111st}) \\
& + x_1 y_0 (\sigma^{\theta\tau}_{1000st} + \sigma^{\theta\tau}_{1001st} + \sigma^{\theta\tau}_{1100st} + \sigma^{\theta\tau}_{1101st}) \\
& + x_0 y_1 (\sigma^{\theta\tau}_{1010st} + \sigma^{\theta\tau}_{1011st} + \sigma^{\theta\tau}_{1110st} + \sigma^{\theta\tau}_{1111st}) \big) |\theta\tau\rangle |st\rangle
\end{aligned}$$

$$|\psi\rangle_{ABA_1B_1B_2A_2} = \sum_{st=0}^{1}\sum_{\theta\tau=1}^{4} (x_0 y_0 \sigma^{\theta\tau}_{00st} + x_0 y_1 \sigma^{\theta\tau}_{01st} + x_1 y_0 \sigma^{\theta\tau}_{01st} + x_1 y_1 \sigma^{\theta\tau}_{11st}) |\theta\tau\rangle |st\rangle$$

$$|\psi\rangle_{ABA_1B_1B_2A_2} = \sum_{st=0}^{1}\sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma^{\theta\tau}_{00st} & \sigma^{\theta\tau}_{01st} & \sigma^{\theta\tau}_{01st} & \sigma^{\theta\tau}_{11st} \end{pmatrix} \begin{pmatrix} x_0 y_0 \\ x_0 y_1 \\ x_1 y_0 \\ x_1 y_1 \end{pmatrix} \right) |\theta\tau\rangle |st\rangle$$

$$= \sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma_{0000}^{\theta\tau} & \sigma_{0100}^{\theta\tau} & \sigma_{1000}^{\theta\tau} & \sigma_{1100}^{\theta\tau} \end{pmatrix} \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \right) |\theta\tau\rangle |00\rangle$$

$$+ \sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma_{0001}^{\theta\tau} & \sigma_{0101}^{\theta\tau} & \sigma_{1001}^{\theta\tau} & \sigma_{1101}^{\theta\tau} \end{pmatrix} \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \right) |\theta\tau\rangle |01\rangle$$

$$+ \sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma_{0010}^{\theta\tau} & \sigma_{0110}^{\theta\tau} & \sigma_{1010}^{\theta\tau} & \sigma_{1110}^{\theta\tau} \end{pmatrix} \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \right) |\theta\tau\rangle |10\rangle$$

$$+ \sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma_{0011}^{\theta\tau} & \sigma_{0111}^{\theta\tau} & \sigma_{1011}^{\theta\tau} & \sigma_{1111}^{\theta\tau} \end{pmatrix} \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \right) |\theta\tau\rangle |11\rangle$$

$$= \sum_{\theta\tau=1}^{4} \left(\begin{pmatrix} \sigma_{0000}^{\theta\tau} & \sigma_{0100}^{\theta\tau} & \sigma_{1000}^{\theta\tau} & \sigma_{1100}^{\theta\tau} \\ \sigma_{0001}^{\theta\tau} & \sigma_{0101}^{\theta\tau} & \sigma_{1001}^{\theta\tau} & \sigma_{1101}^{\theta\tau} \\ \sigma_{0010}^{\theta\tau} & \sigma_{0110}^{\theta\tau} & \sigma_{1010}^{\theta\tau} & \sigma_{1110}^{\theta\tau} \\ \sigma_{0011}^{\theta\tau} & \sigma_{0111}^{\theta\tau} & \sigma_{1011}^{\theta\tau} & \sigma_{1111}^{\theta\tau} \end{pmatrix} \begin{pmatrix} x_0y_0 \\ x_0y_1 \\ x_1y_0 \\ x_1y_1 \end{pmatrix} \right) \begin{pmatrix} |00\rangle & |01\rangle & |10\rangle & |11\rangle \end{pmatrix} |\theta\tau\rangle \tag{2.49}$$

selanjutnya dengan mereduksi persamaan (2.41) ke dalam persamaan (2.45) diperoleh

$$\left(\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \\ R_{0001} & R_{0101} & R_{1001} & R_{1101} \\ R_{0010} & R_{0110} & R_{1010} & R_{1110} \\ R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} (T^{\theta} \otimes T^{\tau}) \right) = \begin{pmatrix} \sigma_{0000}^{\theta\tau} & \sigma_{0100}^{\theta\tau} & \sigma_{1000}^{\theta\tau} & \sigma_{1100}^{\theta\tau} \\ \sigma_{0001}^{\theta\tau} & \sigma_{0101}^{\theta\tau} & \sigma_{1001}^{\theta\tau} & \sigma_{1101}^{\theta\tau} \\ \sigma_{0010}^{\theta\tau} & \sigma_{0110}^{\theta\tau} & \sigma_{1010}^{\theta\tau} & \sigma_{1110}^{\theta\tau} \\ \sigma_{0011}^{\theta\tau} & \sigma_{0111}^{\theta\tau} & \sigma_{1011}^{\theta\tau} & \sigma_{1111}^{\theta\tau} \end{pmatrix} \tag{2.50}$$

selanjutnya, jika dituliskan matriks berikut

$$\begin{pmatrix} R_{0000} & R_{0100} & R_{1000} & R_{1100} \\ R_{0001} & R_{0101} & R_{1001} & R_{1101} \\ R_{0010} & R_{0110} & R_{1010} & R_{1110} \\ R_{0011} & R_{0111} & R_{1011} & R_{1111} \end{pmatrix} = \mathbf{R} \tag{2.51}$$

dengan **R** disebut sebagai matriks parameter kanal, dan untuk

$$\begin{pmatrix} \sigma_{0000}^{\theta\tau} & \sigma_{0100}^{\theta\tau} & \sigma_{1000}^{\theta\tau} & \sigma_{1100}^{\theta\tau} \\ \sigma_{0001}^{\theta\tau} & \sigma_{0101}^{\theta\tau} & \sigma_{1001}^{\theta\tau} & \sigma_{1101}^{\theta\tau} \\ \sigma_{0010}^{\theta\tau} & \sigma_{0110}^{\theta\tau} & \sigma_{1010}^{\theta\tau} & \sigma_{1110}^{\theta\tau} \\ \sigma_{0011}^{\theta\tau} & \sigma_{0111}^{\theta\tau} & \sigma_{1011}^{\theta\tau} & \sigma_{1111}^{\theta\tau} \end{pmatrix} = \sigma^{\theta\tau} \tag{2.52}$$

maka persamaan (2.50) dapat dituliskan menjadi

$$\mathbf{R}(T^{\theta} \otimes T^{\tau}) = \sigma^{\theta\tau} \tag{2.53}$$

Selanjutnya untuk mencari nilai dari matriks parameter kanal maka dilakukan perkalian invers dari matriks $(T^{\theta} \otimes T^{\tau})$ dari kanan, sebagai berikut

$$\begin{aligned} \mathbf{R}(T^{\theta} \otimes T^{\tau})(T^{\theta} \otimes T^{\tau})^{-1} &= \sigma^{\theta\tau}(T^{\theta} \otimes T^{\tau})^{-1} \\ \mathbf{R} &= \sigma^{\theta\tau}(T^{\theta} \otimes T^{\tau})^{-1} \end{aligned} \tag{2.54}$$

selanjutnya saat Alice dan Bob melakukan pengukuran menggunakan basis Bell sebagai berikut

$$\begin{aligned} \left|\psi^{\theta\tau}\right\rangle_T &= (\langle\pi\kappa| \otimes I \otimes I) \left|\psi\right\rangle_{ABA_1B_1B_2A_2} \\ &= (\langle\pi\kappa| \otimes I \otimes I) \sum_{ijst=0}^{1} \sum_{\theta\tau=1}^{4} \left|\theta\tau\right\rangle x_i y_j (\sigma)^{\theta\tau} \left|s\right\rangle_{B2} \left|t\right\rangle_{A2} \\ &= \sum_{ijst=0}^{1} \sum_{\theta\tau=1}^{4} \langle\pi\kappa|\theta\tau\rangle x_i y_j (\sigma)^{\theta\tau} \left|s\right\rangle_{B2} \left|t\right\rangle_{A2} \\ &= \sum_{ijst=0}^{1} \sum_{\theta\tau=1}^{4} \langle\pi|\theta\rangle \langle\kappa|\tau\rangle x_i y_j (\sigma)^{\theta\tau} \left|s\right\rangle_{B2} \left|t\right\rangle_{A2} \end{aligned}$$

dengan π dan κ merupakan basis Bell dan untuk $\langle\pi|\theta\rangle = \delta_{\pi\theta}$ dan $\langle\kappa|\tau\rangle = \delta_{\kappa\tau}$ merupakan delta kronecker

$$\delta_{\pi\theta} \begin{cases} 1, & \pi = \theta, \\ 0, & \pi \neq \theta. \end{cases}$$

$$\delta_{\kappa\tau} \begin{cases} 1, & \kappa = \tau, \\ 0, & \kappa \neq \tau. \end{cases}$$

sehingga

$$\begin{aligned} \left|\psi^{\theta\tau}\right\rangle_T &= \sum_{ijst=0}^{1} \sum_{\theta\tau=1}^{4} \delta_{\pi\theta}\delta_{\kappa\tau} x_i y_j (\sigma)^{\theta\tau} \left|s\right\rangle_{B2} \left|t\right\rangle_{A2} \\ &= \sum_{\theta\tau=1}^{4} x_i y_j (\sigma)^{\theta\tau} \left|s\right\rangle_{B2} \left|t\right\rangle_{A2} \\ &= \sum_{\theta\tau=1}^{4} x_i y_j (\sigma^{\theta} \otimes \sigma^{\tau})(\left|s\right\rangle_{B2} \otimes \left|t\right\rangle_{A2}) \\ &= \sum_{\theta\tau=1}^{4} x_i y_j (\sigma^{\theta} \left|s\right\rangle_{B2}) \otimes (\sigma^{\tau} \left|t\right\rangle_{A2}) \end{aligned} \tag{2.55}$$

dengan σ^{θ} merupakan matriks yang diturunkan melalui transformasi hasil pengukuran oleh Alice, dan juga untuk σ^{τ} merupakan matriks yang diturunkan melaui hasil pengukuran oleh Bob, maka parameter kanal dapat dituliskan sebagai berikut

$$\begin{aligned} \mathbf{R} &= \sigma^{\theta\tau}(T^{\sigma} \otimes T^{\tau})^{-1} \\ &= (\sigma^{\theta} \otimes \sigma^{\tau})(T^{\sigma} \otimes T^{\tau})^{-1} \\ &= (\sigma^{\theta} \otimes \sigma^{\tau})\big((T^{\sigma})^{-1} \otimes (T^{\tau})^{-1}\big) \end{aligned} \tag{2.56}$$

dengan perkalian tensor dari matrik T^θ dan T^τ menghasilkan bentuk matriks 4x4 yang uniter, begitu pula dengan matriks σ^θ dan σ^τ harus merupakan matriks uniter. Oleh karena itu matriks parameter kanalnya juga matriks uniter.

2.5 Matriks Uniter

Suatu matriks (U) dikatakan sebagai matriks uniter jika

$$UU^\dagger = U^\dagger U = 1 \tag{2.57}$$

dengan dimisalkan

$$U = \begin{pmatrix} ae^{i\alpha} & be^{i\beta} \\ ce^{i\gamma} & de^{i\delta} \end{pmatrix} \tag{2.58}$$

maka dengan mengoprasikan U pada persamaan (2.58) sebagai berikut

$$\begin{aligned} UU^\dagger &= \begin{pmatrix} ae^{i\alpha} & be^{i\beta} \\ ce^{i\gamma} & de^{i\delta} \end{pmatrix} \begin{pmatrix} ae^{-i\alpha} & ce^{-i\gamma} \\ be^{-i\beta} & de^{-i\delta} \end{pmatrix} \\ &= \begin{pmatrix} a^2 + b^2 & ace^{i(\alpha-\gamma)} + bde^{i(\beta-\delta)} \\ ace^{-i(\alpha-\gamma)} + bde^{-i(\beta-\delta)} & c^2 + d^2 \end{pmatrix} \\ &= \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \end{aligned} \tag{2.59}$$

maka didapatkan

$$a^2 + b^2 = 1$$

dan juga

$$\begin{aligned} ace^{i(\alpha-\gamma)} + bde^{i(\beta-\delta)} &= 0 \\ ace^{i(\alpha-\gamma)} &= -bde^{i(\beta-\delta)} \\ ac &= -bde^{-i(\alpha-\gamma)}e^{i(\beta-\delta)} \\ ac &= -bde^{i(\beta+\gamma-\alpha-\delta)} \end{aligned}$$

sehingga untuk $ac + bd = 0$, maka $\beta + \gamma - \alpha - \delta = 0$ atau dapat dituliskan sebagai

$$\delta = \beta + \gamma - \alpha$$

Selanjutnya jika $a = \cos(\theta), b = \sin(\theta), c = \sin(\omega), d = \cos(\omega)$ maka diperoleh

$$\begin{aligned} ac + bd &= 0 \\ \cos(\theta)\sin(\omega) + \sin(\theta)\cos(\omega) &= 0 \\ \sin(\theta + \omega) &= \sin(0) \\ \theta + \omega &= 0 \\ \theta &= -\omega \end{aligned}$$

dan jika $a = \cos(\theta), b = \sin(\theta), c = -\sin(\omega), d = \cos(\omega)$ maka diperoleh

$$\begin{aligned} ac + bd &= 0 \\ -\cos(\theta)\sin(\omega) + \sin(\theta)\cos(\omega) &= 0 \\ \sin(\theta - \omega) &= \sin(0) \\ \theta - \omega &= 0 \\ \theta &= \omega \end{aligned}$$

maka untuk $sin(\theta \pm \omega) = \sin 0$ didapatkan

$$\begin{aligned} \theta \pm \omega &= 0 \\ \theta &= \mp\omega \end{aligned}$$

dan dengan melihat hubungan $aac = -bd$ diperoleh

$$\begin{aligned} a &= \pm d = \cos(\theta) \\ b &= \mp c = \sin(\theta) \end{aligned}$$

sehingga bentuk matriks uniter berukuran 2×2 juga dapat dituliskan secara umum dengan

$$\begin{aligned} U &= \begin{pmatrix} \cos(\theta)e^{i\alpha} & \sin(\theta)e^{i\beta} \\ -\sin(\theta)e^{i\gamma} & \cos(\theta)e^{i\delta} \end{pmatrix} \\ &= \begin{pmatrix} \cos(\theta)e^{i\alpha} & \sin(\theta)e^{i\beta} \\ -\sin(\theta)e^{i\gamma} & \cos(\theta)e^{i\beta+\gamma-\alpha} \end{pmatrix} \end{aligned} \tag{2.60}$$

dan dapat ditentukan hanya dengan 4 parameter yaitu $\theta, \alpha, \beta, \gamma$

2.6 Bentuk Umum Matriks Parameter Kanal Teleportasi Dua Arah

Matrik parametek kanal merupakan matriks yang dibentuk dari representasi dari matriks transformasi ($T^{\theta} dan T^{\tau}$) dan matrik transformasi dari pengukuran oleh Alice dan Bob. Matriks parameter kanal dibentuk dari persamaan (2.56) dan dapat kita tuliskan sebagai berikut.

$$\begin{aligned} R &= \sigma^{\theta}(T^{\theta})^{-1} \otimes \sigma^{\tau}(T^{\tau})^{-1} \\ &= U(\pi)(T^{\theta})^{-1} \otimes U(\kappa)(T^{\tau})^{-1} \end{aligned} \tag{2.61}$$

dengan $U(\pi)$ dan $U(\kappa)$ adalah matriks uniter secara umum untuk $\sigma^t heta$ dan $\sigma^t au$. Jika didefinisikan $U_1 = U(\pi)(T^{\theta})^{-1}$ dan $U_2 = U(\kappa)(T^{\tau})^{-1}$ maka persamaan (2.61) dapat dituliskan sebagai berikut

$$R = U_1 \otimes U_2 \tag{2.62}$$

Bentuk matriks U_1 sebagai berikut

$$\begin{aligned}
U_1 &= \begin{pmatrix} \cos(\theta_1)e^{i\alpha_1} & \sin(\theta_1)e^{i\beta_1} \\ -\sin(\theta_1)e^{i\gamma_1} & \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1} \end{pmatrix} \begin{pmatrix} T^\theta_{00} & T^\theta_{10} \\ T^\theta_{01} & T^\theta_{11} \end{pmatrix}^{-1} \\
&= \begin{pmatrix} \cos(\theta_1)e^{i\alpha_1} & -\sin(\theta_1)e^{i\beta_1} \\ -\sin(\theta_1)e^{i\gamma_1} & \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1} \end{pmatrix} \frac{1}{\det(T^\theta)} \begin{pmatrix} T^\theta_{11} & -T^\theta_{10} \\ -T^\theta_{01} & T^\theta_{00} \end{pmatrix} \\
&= \frac{1}{\det(T^\theta)} \left(\begin{matrix} \cos(\theta_1)e^{i\alpha_1}T^\theta_{11} + \sin(\theta_1)e^{i\beta_1}T^\theta_{01} & \ldots \\ -\sin(\theta_1)e^{i\gamma_1}T^\theta_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^\theta_{01} & \ldots \end{matrix} \right. \\
&\left. \begin{matrix} \ldots & -\cos(\theta_1)e^{i\alpha_1}T^\theta_{10} - \sin(\theta_1)e^{i\beta_1}T^\theta_{00} \\ \ldots & \sin(\theta_1)e^{i\gamma_1}T^\theta_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^\theta_{00} \end{matrix} \right)
\end{aligned} \tag{2.63}$$

dan matriks U_2 sebagai berikut

$$\begin{aligned}
U_2 &= \begin{pmatrix} \cos(\theta_2)e^{i\alpha_2} & \sin(\theta_2)e^{i\beta_2} \\ -\sin(\theta_2)e^{i\gamma_2} & \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2} \end{pmatrix} \begin{pmatrix} T^\tau_{00} & T^\tau_{10} \\ T^\tau_{01} & T^\tau_{11} \end{pmatrix}^{-1} \\
&= \begin{pmatrix} \cos(\theta_2)e^{i\alpha_2} & -\sin(\theta_2)e^{i\beta_2} \\ -\sin(\theta_2)e^{i\gamma_2} & \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2} \end{pmatrix} \frac{1}{\det(T^\tau)} \begin{pmatrix} T^\tau_{11} & -T^\tau_{10} \\ -T^\tau_{01} & T^\tau_{00} \end{pmatrix} \\
&= \frac{1}{\det(T^\tau)} \left(\begin{matrix} \cos(\theta_2)e^{i\alpha_2}T^\tau_{11} + \sin(\theta_2)e^{i\beta_2}T^\tau_{01} & \ldots \\ -\sin(\theta_2)e^{i\gamma_2}T^\tau_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^\tau_{01} & \ldots \end{matrix} \right. \\
&\left. \begin{matrix} \ldots & -\cos(\theta_2)e^{i\alpha_2}T^\tau_{10} - \sin(\theta_2)e^{i\beta_2}T^\tau_{00} \\ \ldots & \sin(\theta_2)e^{i\gamma_2}T^\tau_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^\tau_{00} \end{matrix} \right)
\end{aligned} \tag{2.64}$$

Contohnya sebagai berikut, saat kita ambil $\theta = 2$ dan $\tau = 3$

$$\begin{aligned}
R &= U_1 \otimes U_2 \\
&= \frac{1}{\sqrt{2}} \begin{pmatrix} \cos(\theta_1)e^{i\alpha_1} & -\sin(\theta_1)e^{i\beta_1} \\ -\sin(\theta_1)e^{i\gamma_1} & -\cos(\theta_1)e^{i(\beta_1+\gamma_1-\alpha_1)} \end{pmatrix} \\
&\otimes \frac{1}{\sqrt{2}} \begin{pmatrix} \sin(\theta_2)e^{i\beta_2} & \cos(\theta_2)e^{i\alpha_2} \\ \cos(\theta_2)e^{i(\beta_2+\gamma_2-\alpha_2)} & -\sin(\theta_2)e^{i\gamma_2} \end{pmatrix} \\
&= \frac{1}{2} \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix}
\end{aligned}$$

dimana

$$\begin{aligned}
a_{11} &= \cos(\theta_1)\sin(\theta_2)e^{i(\alpha_1+\beta_2)} \\
a_{12} &= \cos(\theta_1)\cos(\theta_2)e^{i(\alpha_1+\alpha_2)} \\
a_{13} &= -\sin(\theta_1)\sin(\theta_2)e^{i(\beta_1+\beta_2)} \\
a_{14} &= -\sin(\theta_1)\cos(\theta_2)e^{i(\beta_1+\alpha_2)} \\
a_{21} &= \cos(\theta_1)\cos(\theta_2)e^{i(\alpha_1+\beta_2+\gamma_2-\alpha_2)} \\
a_{22} &= -\cos(\theta_1)\sin(\theta_2)e^{i(\alpha_1+\gamma_2)} \\
a_{23} &= -\sin(\theta_1)\cos(\theta_2)e^{i(\beta_1+\beta_2+\gamma_2-\alpha_2)} \\
a_{24} &= \sin(\theta_1)\sin(\theta_2)e^{i(\beta_1+\gamma_2)}
\end{aligned}$$

$$\begin{aligned}
a_{31} &= -\sin(\theta_1)\sin(\theta_2)e^{i(\gamma_1+\beta_2)}\\
a_{32} &= -\sin(\theta_1)\cos(\theta_2)e^{i(\gamma_1+\alpha_2)}\\
a_{33} &= -\cos(\theta_1)\sin(\theta_2)e^{i(\beta_1+\gamma_1-\alpha_1+\beta_2)}\\
a_{34} &= -\cos(\theta_1)\cos(\theta_2)e^{i(\beta_1+\gamma_1-\alpha_1+\alpha_2)}\\
a_{41} &= -\sin(\theta_1)\cos(\theta_2)e^{i(\gamma_1+\beta_2+\gamma_2-\alpha_2)}\\
a_{42} &= \sin(\theta_1)\sin(\theta_2)e^{i(\gamma_1+\gamma_2)}\\
a_{43} &= -\cos(\theta_1)\cos(\theta_2)e^{i(\beta_1+\gamma_1-\alpha_1+\beta_2+\gamma_2-\alpha_2)}\\
a_{44} &= \cos(\theta_1)\sin(\theta_2)e^{i(\beta_1+\gamma_1-\alpha_1+\gamma_2)}
\end{aligned}$$

contoh bentuk khusus, saat pengukur Alice dan Bob berupa σ_x dan $\theta = 2$, $\tau = 3$

$$\begin{aligned}
R &= (\sigma^\theta \otimes \sigma^\tau)\big((T^\theta)^{(-1)} \otimes (T^\tau)^{(-1)}\big)\\
&= (\sigma_x \otimes \sigma_x)\big((T^2)^{(-1)} \otimes (T^3)^{(-1)}\big)\\
&= \left(\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix} \otimes \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\right)\left(\frac{1}{\sqrt{2}}\begin{pmatrix}1 & 0\\ 0 & -1\end{pmatrix} \otimes \frac{1}{\sqrt{2}}\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\right)\\
&= \frac{1}{2}\begin{pmatrix}0&0&0&1\\0&0&1&0\\0&1&0&0\\1&0&0&0\end{pmatrix}\begin{pmatrix}0&1&0&0\\1&0&0&0\\0&0&0&-1\\0&0&-1&0\end{pmatrix}\\
&= \frac{1}{2}\begin{pmatrix}0&0&-1&0\\0&0&0&-1\\1&0&0&0\\0&1&0&0\end{pmatrix}
\end{aligned}$$

dari matriks parameter kanal ini dapat diketahui bahwa saluran yang sesuai berupa

$$|\phi\rangle_{A_1B_1B_2A_2} = \frac{1}{2}(|0011\rangle - |0110\rangle - |1001\rangle + |1100\rangle)$$

2.7 Teleportasi Kuantum Dua Arah Asimetri

Teleportasi dua arah asimetri merupakan teleortasi dua arah dimana informasi yang dikirimkan oleh Alice dan Bob memiliki jumlah informasi yang berbeda. Alice mengirimkan informasi dengan dua qubit kepada bob, sementara Bob mengirimkan informasi satu qubit kepada Alice.

Informasi yang dikirimakn oleh Alice

$$|\chi\rangle_a = x_{00}|00\rangle + x_{01}|01\rangle + x_{10}|10\rangle + x_{11}|11\rangle \tag{2.65}$$

Informasi yabg dikirimkan oleh Bob

$$|\chi\rangle_a = x_{00}|00\rangle + x_{01}|01\rangle + x_{10}|10\rangle + x_{11}|11\rangle \tag{2.66}$$

Kanal yang digunakan merupakan kanal 6 qubit

$$|\phi\rangle = R_{000000}|000000\rangle + R_{000001}|000001\rangle + R_{000010}|000010\rangle + ... + R_{111111}|111111\rangle \tag{2.67}$$

Peleburan informasi dan kanal yang digunakan sebagai berikut

$$|\psi\rangle = |\chi\rangle_A \otimes |\chi\rangle_B \otimes |\phi\rangle \tag{2.68}$$

$$\begin{aligned}
&= (x_{00}|00\rangle + x_{01}|01\rangle + x_{10}|10\rangle + x_{11}|11\rangle) \otimes (y_0|0\rangle + y_1|1\rangle)\\
&\otimes (R_{000000}|000000\rangle + R_{000001}|000001\rangle + R_{000010}|000010\rangle + R_{000011}|000011\rangle\\
&+ R_{000100}|000100\rangle + R_{000101}|000101\rangle + R_{000110}|000110\rangle + R_{000111}|000111\rangle\\
&+ R_{001000}|001000\rangle + R_{001001}|001001\rangle + R_{001010}|001010\rangle + R_{001011}|001011\rangle\\
&+ R_{001100}|001100\rangle + R_{001101}|001101\rangle + R_{001110}|001110\rangle + R_{001111}|001111\rangle\\
&+ R_{010000}|010000\rangle + R_{010001}|010001\rangle + R_{010010}|010010\rangle + R_{010011}|010011\rangle\\
&+ R_{010100}|010100\rangle + R_{010101}|010101\rangle + R_{010110}|010110\rangle + R_{010111}|010111\rangle\\
&+ R_{011000}|011000\rangle + R_{011001}|011001\rangle + R_{011010}|011010\rangle + R_{011011}|011011\rangle\\
&+ R_{011100}|011100\rangle + R_{011101}|011101\rangle + R_{011110}|011110\rangle + R_{011111}|011111\rangle\\
&+ R_{100000}|100000\rangle + R_{100001}|100001\rangle + R_{100010}|100010\rangle + R_{100011}|100011\rangle\\
&+ R_{100100}|100100\rangle + R_{100101}|100101\rangle + R_{100110}|100110\rangle + R_{100111}|100111\rangle\\
&+ R_{101000}|101000\rangle + R_{101001}|101001\rangle + R_{101010}|101010\rangle + R_{101011}|101011\rangle\\
&+ R_{101100}|101100\rangle + R_{101101}|101101\rangle + R_{101110}|101110\rangle + R_{101111}|101111\rangle\\
&+ R_{110000}|110000\rangle + R_{110001}|110001\rangle + R_{110010}|110010\rangle + R_{110011}|110011\rangle\\
&+ R_{110100}|110100\rangle + R_{110101}|110101\rangle + R_{110110}|110110\rangle + R_{110111}|110111\rangle\\
&+ R_{111000}|111000\rangle + R_{111001}|111001\rangle + R_{111010}|111010\rangle + R_{111011}|111011\rangle\\
&+ R_{111100}|111100\rangle + R_{111101}|111101\rangle + R_{111110}|111110\rangle + R_{111111}|111111\rangle)
\end{aligned}$$

$$
\begin{aligned}
&= x_{00}y_0(R_{000000}\,|000000000\rangle + R_{000001}\,|000000001\rangle + R_{000010}\,|000000010\rangle \\
&\qquad + R_{000011}\,|000000011\rangle + R_{000100}\,|000000100\rangle + R_{000101}\,|000000101\rangle \\
&\qquad + R_{000110}\,|000000110\rangle + R_{000111}\,|000000111\rangle + R_{001000}\,|000001000\rangle \\
&\qquad + R_{001001}\,|000001001\rangle + R_{001010}\,|000001010\rangle + R_{001011}\,|000001011\rangle \\
&\qquad + R_{001100}\,|000001100\rangle + R_{001101}\,|000001101\rangle + R_{001110}\,|000001110\rangle \\
&\qquad + R_{001111}\,|000001111\rangle + R_{010000}\,|000010000\rangle + R_{010001}\,|000010001\rangle \\
&\qquad + R_{010010}\,|000010010\rangle + R_{010011}\,|000010011\rangle + R_{010100}\,|000010100\rangle \\
&\qquad + R_{010101}\,|000010101\rangle + R_{010110}\,|000010110\rangle + R_{010111}\,|000010111\rangle \\
&\qquad + R_{011000}\,|000011000\rangle + R_{011001}\,|000011001\rangle + R_{011010}\,|000011010\rangle \\
&\qquad + R_{011011}\,|000011011\rangle + R_{011100}\,|000011100\rangle + R_{011101}\,|000011101\rangle \\
&\qquad + R_{011110}\,|000011110\rangle + R_{011111}\,|000011111\rangle + R_{100000}\,|000100000\rangle \\
&\qquad + R_{100001}\,|000100001\rangle + R_{100010}\,|000100010\rangle + R_{100011}\,|000100011\rangle \\
&\qquad + R_{100100}\,|000100100\rangle + R_{100101}\,|000100101\rangle + R_{100110}\,|000100110\rangle \\
&\qquad + R_{100111}\,|000100111\rangle + R_{101000}\,|000101000\rangle + R_{101001}\,|000101001\rangle \\
&\qquad + R_{101010}\,|000101010\rangle + R_{101011}\,|000101011\rangle + R_{101100}\,|000101100\rangle \\
&\qquad + R_{101101}\,|000101101\rangle + R_{101110}\,|000101110\rangle + R_{101111}\,|000101111\rangle \\
&\qquad + R_{110000}\,|000110000\rangle + R_{110001}\,|000110001\rangle + R_{110010}\,|000110010\rangle \\
&\qquad + R_{110011}\,|000110011\rangle + R_{110100}\,|000110100\rangle + R_{110101}\,|000110101\rangle \\
&\qquad + R_{110110}\,|000110110\rangle + R_{110111}\,|000110111\rangle + R_{111000}\,|000111000\rangle \\
&\qquad + R_{111001}\,|000111001\rangle + R_{111010}\,|000111010\rangle + R_{111011}\,|000111011\rangle \\
&\qquad + R_{111100}\,|000111100\rangle + R_{111101}\,|000111101\rangle + R_{111110}\,|000111110\rangle \\
&\qquad + R_{111111}\,|000111111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{00}y_1(&R_{000000}\left|001000000\right\rangle + R_{000001}\left|001000001\right\rangle + R_{000010}\left|001000010\right\rangle \\
&+ R_{000011}\left|001000011\right\rangle + R_{000100}\left|001000100\right\rangle + R_{000101}\left|001000101\right\rangle \\
&+ R_{000110}\left|001000110\right\rangle + R_{000111}\left|001000111\right\rangle + R_{001000}\left|001001000\right\rangle \\
&+ R_{001001}\left|001001001\right\rangle + R_{001010}\left|001001010\right\rangle + R_{001011}\left|001001011\right\rangle \\
&+ R_{001100}\left|001001100\right\rangle + R_{001101}\left|001001101\right\rangle + R_{001110}\left|001001110\right\rangle \\
&+ R_{001111}\left|001001111\right\rangle + R_{010000}\left|001010000\right\rangle + R_{010001}\left|001010001\right\rangle \\
&+ R_{010010}\left|001010010\right\rangle + R_{010011}\left|001010011\right\rangle + R_{010100}\left|001010100\right\rangle \\
&+ R_{010101}\left|001010101\right\rangle + R_{010110}\left|001010110\right\rangle + R_{010111}\left|001010111\right\rangle \\
&+ R_{011000}\left|001011000\right\rangle + R_{011001}\left|001011001\right\rangle + R_{011010}\left|001011010\right\rangle \\
&+ R_{011011}\left|001011011\right\rangle + R_{011100}\left|001011100\right\rangle + R_{011101}\left|001011101\right\rangle \\
&+ R_{011110}\left|001011110\right\rangle + R_{011111}\left|001011111\right\rangle + R_{100000}\left|001100000\right\rangle \\
&+ R_{100001}\left|001100001\right\rangle + R_{100010}\left|001100010\right\rangle + R_{100011}\left|001100011\right\rangle \\
&+ R_{100100}\left|001100100\right\rangle + R_{100101}\left|001100101\right\rangle + R_{100110}\left|001100110\right\rangle \\
&+ R_{100111}\left|001100111\right\rangle + R_{101000}\left|001101000\right\rangle + R_{101001}\left|001101001\right\rangle \\
&+ R_{101010}\left|001101010\right\rangle + R_{101011}\left|001101011\right\rangle + R_{101100}\left|001101100\right\rangle \\
&+ R_{101101}\left|001101101\right\rangle + R_{101110}\left|001101110\right\rangle + R_{101111}\left|001101111\right\rangle \\
&+ R_{110000}\left|001110000\right\rangle + R_{110001}\left|001110001\right\rangle + R_{110010}\left|001110010\right\rangle \\
&+ R_{110011}\left|001110011\right\rangle + R_{110100}\left|001110100\right\rangle + R_{110101}\left|001110101\right\rangle \\
&+ R_{110110}\left|001110110\right\rangle + R_{110111}\left|001110111\right\rangle + R_{111000}\left|001111000\right\rangle \\
&+ R_{111001}\left|001111001\right\rangle + R_{111010}\left|001111010\right\rangle + R_{111011}\left|001111011\right\rangle \\
&+ R_{111100}\left|001111100\right\rangle + R_{111101}\left|001111101\right\rangle + R_{111110}\left|001111110\right\rangle \\
&+ R_{111111}\left|001111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{01}y_0(R_{000000}\left|010000000\right\rangle + R_{000001}\left|010000001\right\rangle + R_{000010}\left|010000010\right\rangle \\
&\quad + R_{000011}\left|010000011\right\rangle + R_{000100}\left|010000100\right\rangle + R_{000101}\left|010000101\right\rangle \\
&\quad + R_{000110}\left|010000110\right\rangle + R_{000111}\left|010000111\right\rangle + R_{001000}\left|010001000\right\rangle \\
&\quad + R_{001001}\left|010001001\right\rangle + R_{001010}\left|010001010\right\rangle + R_{001011}\left|010001011\right\rangle \\
&\quad + R_{001100}\left|010001100\right\rangle + R_{001101}\left|010001101\right\rangle + R_{001110}\left|010001110\right\rangle \\
&\quad + R_{001111}\left|010001111\right\rangle + R_{010000}\left|010010000\right\rangle + R_{010001}\left|010010001\right\rangle \\
&\quad + R_{010010}\left|010010010\right\rangle + R_{010011}\left|010010011\right\rangle + R_{010100}\left|010010100\right\rangle \\
&\quad + R_{010101}\left|010010101\right\rangle + R_{010110}\left|010010110\right\rangle + R_{010111}\left|010010111\right\rangle \\
&\quad + R_{011000}\left|010011000\right\rangle + R_{011001}\left|010011001\right\rangle + R_{011010}\left|010011010\right\rangle \\
&\quad + R_{011011}\left|010011011\right\rangle + R_{011100}\left|010011100\right\rangle + R_{011101}\left|010011101\right\rangle \\
&\quad + R_{011110}\left|010011110\right\rangle + R_{011111}\left|010011111\right\rangle + R_{100000}\left|010100000\right\rangle \\
&\quad + R_{100001}\left|010100001\right\rangle + R_{100010}\left|010100010\right\rangle + R_{100011}\left|010100011\right\rangle \\
&\quad + R_{100100}\left|010100100\right\rangle + R_{100101}\left|010100101\right\rangle + R_{100110}\left|010100110\right\rangle \\
&\quad + R_{100111}\left|010100111\right\rangle + R_{101000}\left|010101000\right\rangle + R_{101001}\left|010101001\right\rangle \\
&\quad + R_{101010}\left|010101010\right\rangle + R_{101011}\left|010101011\right\rangle + R_{101100}\left|010101100\right\rangle \\
&\quad + R_{101101}\left|010101101\right\rangle + R_{101110}\left|010101110\right\rangle + R_{101111}\left|010101111\right\rangle \\
&\quad + R_{110000}\left|010110000\right\rangle + R_{110001}\left|010110001\right\rangle + R_{110010}\left|010110010\right\rangle \\
&\quad + R_{110011}\left|010110011\right\rangle + R_{110100}\left|010110100\right\rangle + R_{110101}\left|010110101\right\rangle \\
&\quad + R_{110110}\left|010110110\right\rangle + R_{110111}\left|010110111\right\rangle + R_{111000}\left|010111000\right\rangle \\
&\quad + R_{111001}\left|010111001\right\rangle + R_{111010}\left|010111010\right\rangle + R_{111011}\left|010111011\right\rangle \\
&\quad + R_{111100}\left|010111100\right\rangle + R_{111101}\left|010111101\right\rangle + R_{111110}\left|010111110\right\rangle \\
&\quad + R_{111111}\left|010111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{01}y_1(R_{000000}\left|011000000\right\rangle + R_{000001}\left|011000001\right\rangle + R_{000010}\left|011000010\right\rangle \\
&\quad + R_{000011}\left|011000011\right\rangle + R_{000100}\left|011000100\right\rangle + R_{000101}\left|011000101\right\rangle \\
&\quad + R_{000110}\left|011000110\right\rangle + R_{000111}\left|011000111\right\rangle + R_{001000}\left|011001000\right\rangle \\
&\quad + R_{001001}\left|011001001\right\rangle + R_{001010}\left|011001010\right\rangle + R_{001011}\left|011001011\right\rangle \\
&\quad + R_{001100}\left|011001100\right\rangle + R_{001101}\left|011001101\right\rangle + R_{001110}\left|011001110\right\rangle \\
&\quad + R_{001111}\left|011001111\right\rangle + R_{010000}\left|011010000\right\rangle + R_{010001}\left|011010001\right\rangle \\
&\quad + R_{010010}\left|011010010\right\rangle + R_{010011}\left|011010011\right\rangle + R_{010100}\left|011010100\right\rangle \\
&\quad + R_{010101}\left|011010101\right\rangle + R_{010110}\left|011010110\right\rangle + R_{010111}\left|011010111\right\rangle \\
&\quad + R_{011000}\left|011011000\right\rangle + R_{011001}\left|011011001\right\rangle + R_{011010}\left|011011010\right\rangle \\
&\quad + R_{011011}\left|011011011\right\rangle + R_{011100}\left|011011100\right\rangle + R_{011101}\left|011011101\right\rangle \\
&\quad + R_{011110}\left|011011110\right\rangle + R_{011111}\left|011011111\right\rangle + R_{100000}\left|011100000\right\rangle \\
&\quad + R_{100001}\left|011100001\right\rangle + R_{100010}\left|011100010\right\rangle + R_{100011}\left|011100011\right\rangle \\
&\quad + R_{100100}\left|011100100\right\rangle + R_{100101}\left|011100101\right\rangle + R_{100110}\left|011100110\right\rangle \\
&\quad + R_{100111}\left|011100111\right\rangle + R_{101000}\left|011101000\right\rangle + R_{101001}\left|011101001\right\rangle \\
&\quad + R_{101010}\left|011101010\right\rangle + R_{101011}\left|011101011\right\rangle + R_{101100}\left|011101100\right\rangle \\
&\quad + R_{101101}\left|011101101\right\rangle + R_{101110}\left|011101110\right\rangle + R_{101111}\left|011101111\right\rangle \\
&\quad + R_{110000}\left|011110000\right\rangle + R_{110001}\left|011110001\right\rangle + R_{110010}\left|011110010\right\rangle \\
&\quad + R_{110011}\left|011110011\right\rangle + R_{110100}\left|011110100\right\rangle + R_{110101}\left|011110101\right\rangle \\
&\quad + R_{110110}\left|011110110\right\rangle + R_{110111}\left|011110111\right\rangle + R_{111000}\left|011111000\right\rangle \\
&\quad + R_{111001}\left|011111001\right\rangle + R_{111010}\left|011111010\right\rangle + R_{111011}\left|011111011\right\rangle \\
&\quad + R_{111100}\left|011111100\right\rangle + R_{111101}\left|011111101\right\rangle + R_{111110}\left|011111110\right\rangle \\
&\quad + R_{111111}\left|011111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{10}y_0(&R_{000000}\left|100000000\right\rangle + R_{000001}\left|100000001\right\rangle + R_{000010}\left|100000010\right\rangle \\
&+ R_{000011}\left|100000011\right\rangle + R_{000100}\left|100000100\right\rangle + R_{000101}\left|100000101\right\rangle \\
&+ R_{000110}\left|100000110\right\rangle + R_{000111}\left|100000111\right\rangle + R_{001000}\left|100001000\right\rangle \\
&+ R_{001001}\left|100001001\right\rangle + R_{001010}\left|100001010\right\rangle + R_{001011}\left|100001011\right\rangle \\
&+ R_{001100}\left|100001100\right\rangle + R_{001101}\left|100001101\right\rangle + R_{001110}\left|100001110\right\rangle \\
&+ R_{001111}\left|100001111\right\rangle + R_{010000}\left|100010000\right\rangle + R_{010001}\left|100010001\right\rangle \\
&+ R_{010010}\left|100010010\right\rangle + R_{010011}\left|100010011\right\rangle + R_{010100}\left|100010100\right\rangle \\
&+ R_{010101}\left|100010101\right\rangle + R_{010110}\left|100010110\right\rangle + R_{010111}\left|100010111\right\rangle \\
&+ R_{011000}\left|100011000\right\rangle + R_{011001}\left|100011001\right\rangle + R_{011010}\left|100011010\right\rangle \\
&+ R_{011011}\left|100011011\right\rangle + R_{011100}\left|100011100\right\rangle + R_{011101}\left|100011101\right\rangle \\
&+ R_{011110}\left|100011110\right\rangle + R_{011111}\left|100011111\right\rangle + R_{100000}\left|100100000\right\rangle \\
&+ R_{100001}\left|100100001\right\rangle + R_{100010}\left|100100010\right\rangle + R_{100011}\left|100100011\right\rangle \\
&+ R_{100100}\left|100100100\right\rangle + R_{100101}\left|100100101\right\rangle + R_{100110}\left|100100110\right\rangle \\
&+ R_{100111}\left|100100111\right\rangle + R_{101000}\left|100101000\right\rangle + R_{101001}\left|100101001\right\rangle \\
&+ R_{101010}\left|100101010\right\rangle + R_{101011}\left|100101011\right\rangle + R_{101100}\left|100101100\right\rangle \\
&+ R_{101101}\left|100101101\right\rangle + R_{101110}\left|100101110\right\rangle + R_{101111}\left|100101111\right\rangle \\
&+ R_{110000}\left|100110000\right\rangle + R_{110001}\left|100110001\right\rangle + R_{110010}\left|100110010\right\rangle \\
&+ R_{110011}\left|100110011\right\rangle + R_{110100}\left|100110100\right\rangle + R_{110101}\left|100110101\right\rangle \\
&+ R_{110110}\left|100110110\right\rangle + R_{110111}\left|100110111\right\rangle + R_{111000}\left|100111000\right\rangle \\
&+ R_{111001}\left|100111001\right\rangle + R_{111010}\left|100111010\right\rangle + R_{111011}\left|100111011\right\rangle \\
&+ R_{111100}\left|100111100\right\rangle + R_{111101}\left|100111101\right\rangle + R_{111110}\left|100111110\right\rangle \\
&+ R_{111111}\left|100111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{10}y_1(R_{000000}\left|101000000\right\rangle + R_{000001}\left|101000001\right\rangle + R_{000010}\left|101000010\right\rangle \\
&\quad + R_{000011}\left|101000011\right\rangle + R_{000100}\left|101000100\right\rangle + R_{000101}\left|101000101\right\rangle \\
&\quad + R_{000110}\left|101000110\right\rangle + R_{000111}\left|101000111\right\rangle + R_{001000}\left|101001000\right\rangle \\
&\quad + R_{001001}\left|101001001\right\rangle + R_{001010}\left|101001010\right\rangle + R_{001011}\left|101001011\right\rangle \\
&\quad + R_{001100}\left|101001100\right\rangle + R_{001101}\left|101001101\right\rangle + R_{001110}\left|101001110\right\rangle \\
&\quad + R_{001111}\left|101001111\right\rangle + R_{010000}\left|101010000\right\rangle + R_{010001}\left|101010001\right\rangle \\
&\quad + R_{010010}\left|101010010\right\rangle + R_{010011}\left|101010011\right\rangle + R_{010100}\left|101010100\right\rangle \\
&\quad + R_{010101}\left|101010101\right\rangle + R_{010110}\left|101010110\right\rangle + R_{010111}\left|101010111\right\rangle \\
&\quad + R_{011000}\left|101011000\right\rangle + R_{011001}\left|101011001\right\rangle + R_{011010}\left|101011010\right\rangle \\
&\quad + R_{011011}\left|101011011\right\rangle + R_{011100}\left|101011100\right\rangle + R_{011101}\left|101011101\right\rangle \\
&\quad + R_{011110}\left|101011110\right\rangle + R_{011111}\left|101011111\right\rangle + R_{100000}\left|101100000\right\rangle \\
&\quad + R_{100001}\left|101100001\right\rangle + R_{100010}\left|101100010\right\rangle + R_{100011}\left|101100011\right\rangle \\
&\quad + R_{100100}\left|101100100\right\rangle + R_{100101}\left|101100101\right\rangle + R_{100110}\left|101100110\right\rangle \\
&\quad + R_{100111}\left|101100111\right\rangle + R_{101000}\left|101101000\right\rangle + R_{101001}\left|101101001\right\rangle \\
&\quad + R_{101010}\left|101101010\right\rangle + R_{101011}\left|101101011\right\rangle + R_{101100}\left|101101100\right\rangle \\
&\quad + R_{101101}\left|101101101\right\rangle + R_{101110}\left|101101110\right\rangle + R_{101111}\left|101101111\right\rangle \\
&\quad + R_{110000}\left|101110000\right\rangle + R_{110001}\left|101110001\right\rangle + R_{110010}\left|101110010\right\rangle \\
&\quad + R_{110011}\left|101110011\right\rangle + R_{110100}\left|101110100\right\rangle + R_{110101}\left|101110101\right\rangle \\
&\quad + R_{110110}\left|101110110\right\rangle + R_{110111}\left|101110111\right\rangle + R_{111000}\left|101111000\right\rangle \\
&\quad + R_{111001}\left|101111001\right\rangle + R_{111010}\left|101111010\right\rangle + R_{111011}\left|101111011\right\rangle \\
&\quad + R_{111100}\left|101111100\right\rangle + R_{111101}\left|101111101\right\rangle + R_{111110}\left|101111110\right\rangle \\
&\quad + R_{111111}\left|101111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{11}y_0(&R_{000000}\left|110000000\right\rangle + R_{000001}\left|110000001\right\rangle + R_{000010}\left|110000010\right\rangle \\
&+ R_{000011}\left|110000011\right\rangle + R_{000100}\left|110000100\right\rangle + R_{000101}\left|110000101\right\rangle \\
&+ R_{000110}\left|110000110\right\rangle + R_{000111}\left|110000111\right\rangle + R_{001000}\left|110001000\right\rangle \\
&+ R_{001001}\left|110001001\right\rangle + R_{001010}\left|110001010\right\rangle + R_{001011}\left|110001011\right\rangle \\
&+ R_{001100}\left|110001100\right\rangle + R_{001101}\left|110001101\right\rangle + R_{001110}\left|110001110\right\rangle \\
&+ R_{001111}\left|110001111\right\rangle + R_{010000}\left|110010000\right\rangle + R_{010001}\left|110010001\right\rangle \\
&+ R_{010010}\left|110010010\right\rangle + R_{010011}\left|110010011\right\rangle + R_{010100}\left|110010100\right\rangle \\
&+ R_{010101}\left|110010101\right\rangle + R_{010110}\left|110010110\right\rangle + R_{010111}\left|110010111\right\rangle \\
&+ R_{011000}\left|110011000\right\rangle + R_{011001}\left|110011001\right\rangle + R_{011010}\left|110011010\right\rangle \\
&+ R_{011011}\left|110011011\right\rangle + R_{011100}\left|110011100\right\rangle + R_{011101}\left|110011101\right\rangle \\
&+ R_{011110}\left|110011110\right\rangle + R_{011111}\left|110011111\right\rangle + R_{100000}\left|110100000\right\rangle \\
&+ R_{100001}\left|110100001\right\rangle + R_{100010}\left|110100010\right\rangle + R_{100011}\left|110100011\right\rangle \\
&+ R_{100100}\left|110100100\right\rangle + R_{100101}\left|110100101\right\rangle + R_{100110}\left|110100110\right\rangle \\
&+ R_{100111}\left|110100111\right\rangle + R_{101000}\left|110101000\right\rangle + R_{101001}\left|110101001\right\rangle \\
&+ R_{101010}\left|110101010\right\rangle + R_{101011}\left|110101011\right\rangle + R_{101100}\left|110101100\right\rangle \\
&+ R_{101101}\left|110101101\right\rangle + R_{101110}\left|110101110\right\rangle + R_{101111}\left|110101111\right\rangle \\
&+ R_{110000}\left|110110000\right\rangle + R_{110001}\left|110110001\right\rangle + R_{110010}\left|110110010\right\rangle \\
&+ R_{110011}\left|110110011\right\rangle + R_{110100}\left|110110100\right\rangle + R_{110101}\left|110110101\right\rangle \\
&+ R_{110110}\left|110110110\right\rangle + R_{110111}\left|110110111\right\rangle + R_{111000}\left|110111000\right\rangle \\
&+ R_{111001}\left|110111001\right\rangle + R_{111010}\left|110111010\right\rangle + R_{111011}\left|110111011\right\rangle \\
&+ R_{111100}\left|110111100\right\rangle + R_{111101}\left|110111101\right\rangle + R_{111110}\left|110111110\right\rangle \\
&+ R_{111111}\left|110111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{11}y_1(R_{000000}\left|111000000\right\rangle + R_{000001}\left|111000001\right\rangle + R_{000010}\left|111000010\right\rangle \\
&\quad + R_{000011}\left|111000011\right\rangle + R_{000100}\left|111000100\right\rangle + R_{000101}\left|111000101\right\rangle \\
&\quad + R_{000110}\left|111000110\right\rangle + R_{000111}\left|111000111\right\rangle + R_{001000}\left|111001000\right\rangle \\
&\quad + R_{001001}\left|111001001\right\rangle + R_{001010}\left|111001010\right\rangle + R_{001011}\left|111001011\right\rangle \\
&\quad + R_{001100}\left|111001100\right\rangle + R_{001101}\left|111001101\right\rangle + R_{001110}\left|111001110\right\rangle \\
&\quad + R_{001111}\left|111001111\right\rangle + R_{010000}\left|111010000\right\rangle + R_{010001}\left|111010001\right\rangle \\
&\quad + R_{010010}\left|111010010\right\rangle + R_{010011}\left|111010011\right\rangle + R_{010100}\left|111010100\right\rangle \\
&\quad + R_{010101}\left|111010101\right\rangle + R_{010110}\left|111010110\right\rangle + R_{010111}\left|111010111\right\rangle \\
&\quad + R_{011000}\left|111011000\right\rangle + R_{011001}\left|111011001\right\rangle + R_{011010}\left|111011010\right\rangle \\
&\quad + R_{011011}\left|111011011\right\rangle + R_{011100}\left|111011100\right\rangle + R_{011101}\left|111011101\right\rangle \\
&\quad + R_{011110}\left|111011110\right\rangle + R_{011111}\left|111011111\right\rangle + R_{100000}\left|111100000\right\rangle \\
&\quad + R_{100001}\left|111100001\right\rangle + R_{100010}\left|111100010\right\rangle + R_{100011}\left|111100011\right\rangle \\
&\quad + R_{100100}\left|111100100\right\rangle + R_{100101}\left|111100101\right\rangle + R_{100110}\left|111100110\right\rangle \\
&\quad + R_{100111}\left|111100111\right\rangle + R_{101000}\left|111101000\right\rangle + R_{101001}\left|111101001\right\rangle \\
&\quad + R_{101010}\left|111101010\right\rangle + R_{101011}\left|111101011\right\rangle + R_{101100}\left|111101100\right\rangle \\
&\quad + R_{101101}\left|111101101\right\rangle + R_{101110}\left|111101110\right\rangle + R_{101111}\left|111101111\right\rangle \\
&\quad + R_{110000}\left|111110000\right\rangle + R_{110001}\left|111110001\right\rangle + R_{110010}\left|111110010\right\rangle \\
&\quad + R_{110011}\left|111110011\right\rangle + R_{110100}\left|111110100\right\rangle + R_{110101}\left|111110101\right\rangle \\
&\quad + R_{110110}\left|111110110\right\rangle + R_{110111}\left|111110111\right\rangle + R_{111000}\left|111111000\right\rangle \\
&\quad + R_{111001}\left|111111001\right\rangle + R_{111010}\left|111111010\right\rangle + R_{111011}\left|111111011\right\rangle \\
&\quad + R_{111100}\left|111111100\right\rangle + R_{111101}\left|111111101\right\rangle + R_{111110}\left|111111110\right\rangle \\
&\quad + R_{111111}\left|111111111\right\rangle)
\end{aligned}
$$

Pengukur yang digunakan merupakan pengukur 6 qubit Kanal yang digunakan merupakan kanal 6 kubit

$$\left|\pi\right\rangle = m_{000000}\left|000000\right\rangle + m_{000001}\left|000001\right\rangle + m_{000010}\left|000010\right\rangle + ... + m_{111111}\left|111111\right\rangle \tag{2.69}$$

Setelah dilakukan pengukuran sebagai berikut

$$\left|\chi'\right\rangle = (\left\langle\pi\right| \otimes I \otimes I \otimes I)(\left|\phi\right\rangle) \tag{2.70}$$

$$
\begin{aligned}
= x_{00}y_0\big(&m_{000000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{000001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{000010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{000011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{000100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{000101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{000110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{000111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

$$
\begin{aligned}
+x_{00}y_1\big(&m_{001000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{001001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{001010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{001011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{001100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{001101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{001110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{001111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

$$
\begin{aligned}
= x_{01}y_0\big(& m_{010000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{010001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{010010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{010011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{010100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{010101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{010110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{010111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big) \\
+x_{01}y_1\big(& m_{011000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{011001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{011010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{011011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{011100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{011101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{011110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{011111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

$$
\begin{aligned}
= x_{10}y_0\big(&m_{100000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{100001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{100010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{100011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{100100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{100101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{100110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{100111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

$$
\begin{aligned}
+x_{10}y_1\big(&m_{101000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&+m_{101001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&+m_{101010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&+m_{101011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&+m_{101100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&+m_{101101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&+m_{101110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&+m_{101111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

$$
\begin{aligned}
&= x_{11}y_0\big(m_{110000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&\quad +m_{110001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&\quad +m_{110010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&\quad +m_{110011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&\quad +m_{110100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&\quad +m_{110101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&\quad +m_{110110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&\quad +m_{110111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big) \\
&+ x_{11}y_1\big(m_{111000}(R_{000000}\left|000\right\rangle + R_{000001}\left|001\right\rangle + R_{000010}\left|010\right\rangle + R_{000011}\left|011\right\rangle \\
&\qquad + R_{000100}\left|100\right\rangle + R_{000101}\left|101\right\rangle + R_{000110}\left|110\right\rangle + R_{000111}\left|111\right\rangle) \\
&\quad +m_{111001}(R_{001000}\left|000\right\rangle + R_{001001}\left|001\right\rangle + R_{001010}\left|010\right\rangle + R_{001011}\left|011\right\rangle \\
&\qquad + R_{001100}\left|100\right\rangle + R_{001101}\left|101\right\rangle + R_{001110}\left|110\right\rangle + R_{001111}\left|111\right\rangle) \\
&\quad +m_{111010}(R_{010000}\left|000\right\rangle + R_{010001}\left|001\right\rangle + R_{010010}\left|010\right\rangle + R_{010011}\left|011\right\rangle \\
&\qquad + R_{010100}\left|100\right\rangle + R_{010101}\left|101\right\rangle + R_{010110}\left|110\right\rangle + R_{010111}\left|111\right\rangle) \\
&\quad +m_{111011}(R_{011000}\left|000\right\rangle + R_{011001}\left|001\right\rangle + R_{011010}\left|010\right\rangle + R_{011011}\left|011\right\rangle \\
&\qquad + R_{011100}\left|100\right\rangle + R_{011101}\left|101\right\rangle + R_{011110}\left|110\right\rangle + R_{011111}\left|111\right\rangle) \\
&\quad +m_{111100}(R_{100000}\left|000\right\rangle + R_{100001}\left|001\right\rangle + R_{100010}\left|010\right\rangle + R_{100011}\left|011\right\rangle \\
&\qquad + R_{100100}\left|100\right\rangle + R_{100101}\left|101\right\rangle + R_{100110}\left|110\right\rangle + R_{100111}\left|111\right\rangle) \\
&\quad +m_{111101}(R_{101000}\left|000\right\rangle + R_{101001}\left|001\right\rangle + R_{101010}\left|010\right\rangle + R_{101011}\left|011\right\rangle \\
&\qquad + R_{101100}\left|100\right\rangle + R_{101101}\left|101\right\rangle + R_{101110}\left|110\right\rangle + R_{101111}\left|111\right\rangle) \\
&\quad +m_{111110}(R_{110000}\left|000\right\rangle + R_{110001}\left|001\right\rangle + R_{110010}\left|010\right\rangle + R_{110011}\left|011\right\rangle \\
&\qquad + R_{110100}\left|100\right\rangle + R_{110101}\left|101\right\rangle + R_{110110}\left|110\right\rangle + R_{110111}\left|111\right\rangle) \\
&\quad +m_{111111}(R_{111000}\left|000\right\rangle + R_{111001}\left|001\right\rangle + R_{111010}\left|010\right\rangle + R_{111011}\left|011\right\rangle \\
&\qquad + R_{111100}\left|100\right\rangle + R_{111101}\left|101\right\rangle + R_{111110}\left|110\right\rangle + R_{111111}\left|111\right\rangle)\big)
\end{aligned}
$$

dimana

$$
\begin{aligned}
\left|\chi'\right\rangle &= \left|\chi'\right\rangle_a \otimes \left|\chi'\right\rangle_b \\
\left|\chi\right\rangle_a &= \sigma_a \left|\chi'\right\rangle_b \\
\left|\chi\right\rangle_b &= \sigma_b \left|\chi'\right\rangle_a
\end{aligned}
\tag{2.71}
$$

dengan σ_a merupakan matriks uniter 2x2 dan σ_b merupakan matriks uniter 2x2. Contoh sebagai berikut, saat kanal yang digunakan oleh Alice dan Bob R_{000000}=R_{001001}=R_{010010}=R_{011011}=R_{100100}=R_{101101}=R_{110110}=R_{111111}=$\frac{1}{2\sqrt{2}}$ dan konstanta yang lain bernilai nol. Sementara pengukur yang digunakan adalah m_{011011}=m_{111111}=m_{001001}=m_{101101}=m_{011011}=m_{010010}=m_{110110}=m_{000000}=m_{100100}=$\frac{1}{2\sqrt{2}}$ dan konstanta yang lain bernilai nol.

$$\begin{aligned}|\chi'\rangle = \frac{1}{8}(&x_{00}y_0\,|011\rangle + x_{00}y_1\,|111\rangle + x_{01}y_0\,|001\rangle + x_{01}y_1\,|101\rangle \\ &+x_{10}y_0\,|010\rangle + x_{10}y_1\,|110\rangle + x_{11}y_0\,|000\rangle + x_{11}y_1\,|100\rangle)\end{aligned}$$

$$\begin{aligned}|\chi'\rangle &= |\chi'\rangle_a \otimes |\chi'\rangle_b \\ |\chi\rangle_a &= \sigma_a(y_0\,|0\rangle + y_1\,|1\rangle) \\ |\chi\rangle_b &= \sigma_b(x_{00}\,|11\rangle + x_{01}\,|10\rangle + x_{10}\,|01\rangle\, x_{11}\,|00\rangle)\end{aligned}$$

denga $\sigma_a = 2\sqrt{2}I$ dan $\sigma_b = 2\sqrt{2}(\sigma_x \otimes \sigma_x)$

Bab 3

Perumusan Teleportasi Dua Arah Asimetri Menggunakan Metode Tensor

3.1 Perumusan Meode Tensor

Informasi yang akan dikirimkan oleh Alice :

$$|\chi\rangle_a = \sum_{ij=0}^{1} x_{ij} |ij\rangle$$

$$|\chi\rangle_a = x_{00} |00\rangle + x_{01} |01\rangle + x_{10} |10\rangle + x_{11} |11\rangle$$

dengan nilai

$$\sum_{ij=0}^{1} |x_{ij}|^2 = 1$$

Informasi yang akan dikirimkan oleh Bob:

$$|\chi\rangle_b = \sum_{k=0}^{1} y_k |k\rangle$$

$$|\chi\rangle_b = y_0 |0\rangle + y_1 |1\rangle$$

dengan nilai

$$\sum_{k=0}^{1} |y_k|^2 = 1$$

Kanal yang digunakan merupakan kanal 6 kubit

$$|\varphi\rangle_{A_1,A_1,B_1,B_2,B_2,B_1} = \sum_{lmstuv=0}^{1} R_{lmstuv} |lmstuv\rangle$$

$$\sum_{lmstuv=0}^{1} |R_{lmstuv}|^2 = 1$$

Peleburan informasi:

$$\begin{aligned}
&|\Psi\rangle_{A,B,A_1,A_1,B_1,B_2,B_2,A_2} = |\chi\rangle_A \otimes |\chi\rangle_B \otimes |\varphi\rangle_{A_1,A_1,B_1,B_2,B_2,A_2} \\
&= (x_{00}\,|00\rangle + x_{01}\,|01\rangle + x_{10}\,|10\rangle + x_{11}\,|11\rangle) \otimes (y_0\,|0\rangle + y_1\,|1\rangle) \\
&\otimes (R_{000000}\,|000000\rangle + R_{000001}\,|000001\rangle + R_{000010}\,|000010\rangle + R_{000011}\,|000011\rangle \\
&+ R_{000100}\,|000100\rangle + R_{000101}\,|000101\rangle + R_{000110}\,|000110\rangle + R_{000111}\,|000111\rangle \\
&+ R_{001000}\,|001000\rangle + R_{001001}\,|001001\rangle + R_{001010}\,|001010\rangle + R_{001011}\,|001011\rangle \\
&+ R_{001100}\,|001100\rangle + R_{001101}\,|001101\rangle + R_{001110}\,|001110\rangle + R_{001111}\,|001111\rangle \\
&+ R_{010000}\,|010000\rangle + R_{010001}\,|010001\rangle + R_{010010}\,|010010\rangle + R_{010011}\,|010011\rangle \\
&+ R_{010100}\,|010100\rangle + R_{010101}\,|010101\rangle + R_{010110}\,|010110\rangle + R_{010111}\,|010111\rangle \\
&+ R_{011000}\,|011000\rangle + R_{011001}\,|011001\rangle + R_{011010}\,|011010\rangle + R_{011011}\,|011011\rangle \\
&+ R_{011100}\,|011100\rangle + R_{011101}\,|011101\rangle + R_{011110}\,|011110\rangle + R_{011111}\,|011111\rangle \\
&+ R_{100000}\,|100000\rangle + R_{100001}\,|100001\rangle + R_{100010}\,|100010\rangle + R_{100011}\,|100011\rangle \\
&+ R_{100100}\,|100100\rangle + R_{100101}\,|100101\rangle + R_{100110}\,|100110\rangle + R_{100111}\,|100111\rangle \\
&+ R_{101000}\,|101000\rangle + R_{101001}\,|101001\rangle + R_{101010}\,|101010\rangle + R_{101011}\,|101011\rangle \\
&+ R_{101100}\,|101100\rangle + R_{101101}\,|101101\rangle + R_{101110}\,|101110\rangle + R_{101111}\,|101111\rangle \\
&+ R_{110000}\,|110000\rangle + R_{110001}\,|110001\rangle + R_{110010}\,|110010\rangle + R_{110011}\,|110011\rangle \\
&+ R_{110100}\,|110100\rangle + R_{110101}\,|110101\rangle + R_{110110}\,|110110\rangle + R_{110111}\,|110111\rangle \\
&+ R_{111000}\,|111000\rangle + R_{111001}\,|111001\rangle + R_{111010}\,|111010\rangle + R_{111011}\,|111011\rangle \\
&+ R_{111100}\,|111100\rangle + R_{111101}\,|111101\rangle + R_{111110}\,|111110\rangle + R_{111111}\,|111111\rangle)
\end{aligned}$$

$$
\begin{aligned}
= x_{00}y_0(&R_{000000}\,|000000000\rangle + R_{000001}\,|000000001\rangle + R_{000010}\,|000000010\rangle \\
&+ R_{000011}\,|000000011\rangle + R_{000100}\,|000000100\rangle + R_{000101}\,|000000101\rangle \\
&+ R_{000110}\,|000000110\rangle + R_{000111}\,|000000111\rangle + R_{001000}\,|000001000\rangle \\
&+ R_{001001}\,|000001001\rangle + R_{001010}\,|000001010\rangle + R_{001011}\,|000001011\rangle \\
&+ R_{001100}\,|000001100\rangle + R_{001101}\,|000001101\rangle + R_{001110}\,|000001110\rangle \\
&+ R_{001111}\,|000001111\rangle + R_{010000}\,|000010000\rangle + R_{010001}\,|000010001\rangle \\
&+ R_{010010}\,|000010010\rangle + R_{010011}\,|000010011\rangle + R_{010100}\,|000010100\rangle \\
&+ R_{010101}\,|000010101\rangle + R_{010110}\,|000010110\rangle + R_{010111}\,|000010111\rangle \\
&+ R_{011000}\,|000011000\rangle + R_{011001}\,|000011001\rangle + R_{011010}\,|000011010\rangle \\
&+ R_{011011}\,|000011011\rangle + R_{011100}\,|000011100\rangle + R_{011101}\,|000011101\rangle \\
&+ R_{011110}\,|000011110\rangle + R_{011111}\,|000011111\rangle + R_{100000}\,|000100000\rangle \\
&+ R_{100001}\,|000100001\rangle + R_{100010}\,|000100010\rangle + R_{100011}\,|000100011\rangle \\
&+ R_{100100}\,|000100100\rangle + R_{100101}\,|000100101\rangle + R_{100110}\,|000100110\rangle \\
&+ R_{100111}\,|000100111\rangle + R_{101000}\,|000101000\rangle + R_{101001}\,|000101001\rangle \\
&+ R_{101010}\,|000101010\rangle + R_{101011}\,|000101011\rangle + R_{101100}\,|000101100\rangle \\
&+ R_{101101}\,|000101101\rangle + R_{101110}\,|000101110\rangle + R_{101111}\,|000101111\rangle \\
&+ R_{110000}\,|000110000\rangle + R_{110001}\,|000110001\rangle + R_{110010}\,|000110010\rangle \\
&+ R_{110011}\,|000110011\rangle + R_{110100}\,|000110100\rangle + R_{110101}\,|000110101\rangle \\
&+ R_{110110}\,|000110110\rangle + R_{110111}\,|000110111\rangle + R_{111000}\,|000111000\rangle \\
&+ R_{111001}\,|000111001\rangle + R_{111010}\,|000111010\rangle + R_{111011}\,|000111011\rangle \\
&+ R_{111100}\,|000111100\rangle + R_{111101}\,|000111101\rangle + R_{111110}\,|000111110\rangle \\
&+ R_{111111}\,|000111111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{00}y_1(&R_{000000}\left|001000000\right\rangle + R_{000001}\left|001000001\right\rangle + R_{000010}\left|001000010\right\rangle \\
&+ R_{000011}\left|001000011\right\rangle + R_{000100}\left|001000100\right\rangle + R_{000101}\left|001000101\right\rangle \\
&+ R_{000110}\left|001000110\right\rangle + R_{000111}\left|001000111\right\rangle + R_{001000}\left|001001000\right\rangle \\
&+ R_{001001}\left|001001001\right\rangle + R_{001010}\left|001001010\right\rangle + R_{001011}\left|001001011\right\rangle \\
&+ R_{001100}\left|001001100\right\rangle + R_{001101}\left|001001101\right\rangle + R_{001110}\left|001001110\right\rangle \\
&+ R_{001111}\left|001001111\right\rangle + R_{010000}\left|001010000\right\rangle + R_{010001}\left|001010001\right\rangle \\
&+ R_{010010}\left|001010010\right\rangle + R_{010011}\left|001010011\right\rangle + R_{010100}\left|001010100\right\rangle \\
&+ R_{010101}\left|001010101\right\rangle + R_{010110}\left|001010110\right\rangle + R_{010111}\left|001010111\right\rangle \\
&+ R_{011000}\left|001011000\right\rangle + R_{011001}\left|001011001\right\rangle + R_{011010}\left|001011010\right\rangle \\
&+ R_{011011}\left|001011011\right\rangle + R_{011100}\left|001011100\right\rangle + R_{011101}\left|001011101\right\rangle \\
&+ R_{011110}\left|001011110\right\rangle + R_{011111}\left|001011111\right\rangle + R_{100000}\left|001100000\right\rangle \\
&+ R_{100001}\left|001100001\right\rangle + R_{100010}\left|001100010\right\rangle + R_{100011}\left|001100011\right\rangle \\
&+ R_{100100}\left|001100100\right\rangle + R_{100101}\left|001100101\right\rangle + R_{100110}\left|001100110\right\rangle \\
&+ R_{100111}\left|001100111\right\rangle + R_{101000}\left|001101000\right\rangle + R_{101001}\left|001101001\right\rangle \\
&+ R_{101010}\left|001101010\right\rangle + R_{101011}\left|001101011\right\rangle + R_{101100}\left|001101100\right\rangle \\
&+ R_{101101}\left|001101101\right\rangle + R_{101110}\left|001101110\right\rangle + R_{101111}\left|001101111\right\rangle \\
&+ R_{110000}\left|001110000\right\rangle + R_{110001}\left|001110001\right\rangle + R_{110010}\left|001110010\right\rangle \\
&+ R_{110011}\left|001110011\right\rangle + R_{110100}\left|001110100\right\rangle + R_{110101}\left|001110101\right\rangle \\
&+ R_{110110}\left|001110110\right\rangle + R_{110111}\left|001110111\right\rangle + R_{111000}\left|001111000\right\rangle \\
&+ R_{111001}\left|001111001\right\rangle + R_{111010}\left|001111010\right\rangle + R_{111011}\left|001111011\right\rangle \\
&+ R_{111100}\left|001111100\right\rangle + R_{111101}\left|001111101\right\rangle + R_{111110}\left|001111110\right\rangle \\
&+ R_{111111}\left|001111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{01}y_0(&R_{000000}\left|010000000\right\rangle + R_{000001}\left|010000001\right\rangle + R_{000010}\left|010000010\right\rangle \\
&+ R_{000011}\left|010000011\right\rangle + R_{000100}\left|010000100\right\rangle + R_{000101}\left|010000101\right\rangle \\
&+ R_{000110}\left|010000110\right\rangle + R_{000111}\left|010000111\right\rangle + R_{001000}\left|010001000\right\rangle \\
&+ R_{001001}\left|010001001\right\rangle + R_{001010}\left|010001010\right\rangle + R_{001011}\left|010001011\right\rangle \\
&+ R_{001100}\left|010001100\right\rangle + R_{001101}\left|010001101\right\rangle + R_{001110}\left|010001110\right\rangle \\
&+ R_{001111}\left|010001111\right\rangle + R_{010000}\left|010010000\right\rangle + R_{010001}\left|010010001\right\rangle \\
&+ R_{010010}\left|010010010\right\rangle + R_{010011}\left|010010011\right\rangle + R_{010100}\left|010010100\right\rangle \\
&+ R_{010101}\left|010010101\right\rangle + R_{010110}\left|010010110\right\rangle + R_{010111}\left|010010111\right\rangle \\
&+ R_{011000}\left|010011000\right\rangle + R_{011001}\left|010011001\right\rangle + R_{011010}\left|010011010\right\rangle \\
&+ R_{011011}\left|010011011\right\rangle + R_{011100}\left|010011100\right\rangle + R_{011101}\left|010011101\right\rangle \\
&+ R_{011110}\left|010011110\right\rangle + R_{011111}\left|010011111\right\rangle + R_{100000}\left|010100000\right\rangle \\
&+ R_{100001}\left|010100001\right\rangle + R_{100010}\left|010100010\right\rangle + R_{100011}\left|010100011\right\rangle \\
&+ R_{100100}\left|010100100\right\rangle + R_{100101}\left|010100101\right\rangle + R_{100110}\left|010100110\right\rangle \\
&+ R_{100111}\left|010100111\right\rangle + R_{101000}\left|010101000\right\rangle + R_{101001}\left|010101001\right\rangle \\
&+ R_{101010}\left|010101010\right\rangle + R_{101011}\left|010101011\right\rangle + R_{101100}\left|010101100\right\rangle \\
&+ R_{101101}\left|010101101\right\rangle + R_{101110}\left|010101110\right\rangle + R_{101111}\left|010101111\right\rangle \\
&+ R_{110000}\left|010110000\right\rangle + R_{110001}\left|010110001\right\rangle + R_{110010}\left|010110010\right\rangle \\
&+ R_{110011}\left|010110011\right\rangle + R_{110100}\left|010110100\right\rangle + R_{110101}\left|010110101\right\rangle \\
&+ R_{110110}\left|010110110\right\rangle + R_{110111}\left|010110111\right\rangle + R_{111000}\left|010111000\right\rangle \\
&+ R_{111001}\left|010111001\right\rangle + R_{111010}\left|010111010\right\rangle + R_{111011}\left|010111011\right\rangle \\
&+ R_{111100}\left|010111100\right\rangle + R_{111101}\left|010111101\right\rangle + R_{111110}\left|010111110\right\rangle \\
&+ R_{111111}\left|010111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{01}y_1(R_{000000}\,|011000000\rangle + R_{000001}\,|011000001\rangle + R_{000010}\,|011000010\rangle \\
&\quad + R_{000011}\,|011000011\rangle + R_{000100}\,|011000100\rangle + R_{000101}\,|011000101\rangle \\
&\quad + R_{000110}\,|011000110\rangle + R_{000111}\,|011000111\rangle + R_{001000}\,|011001000\rangle \\
&\quad + R_{001001}\,|011001001\rangle + R_{001010}\,|011001010\rangle + R_{001011}\,|011001011\rangle \\
&\quad + R_{001100}\,|011001100\rangle + R_{001101}\,|011001101\rangle + R_{001110}\,|011001110\rangle \\
&\quad + R_{001111}\,|011001111\rangle + R_{010000}\,|011010000\rangle + R_{010001}\,|011010001\rangle \\
&\quad + R_{010010}\,|011010010\rangle + R_{010011}\,|011010011\rangle + R_{010100}\,|011010100\rangle \\
&\quad + R_{010101}\,|011010101\rangle + R_{010110}\,|011010110\rangle + R_{010111}\,|011010111\rangle \\
&\quad + R_{011000}\,|011011000\rangle + R_{011001}\,|011011001\rangle + R_{011010}\,|011011010\rangle \\
&\quad + R_{011011}\,|011011011\rangle + R_{011100}\,|011011100\rangle + R_{011101}\,|011011101\rangle \\
&\quad + R_{011110}\,|011011110\rangle + R_{011111}\,|011011111\rangle + R_{100000}\,|011100000\rangle \\
&\quad + R_{100001}\,|011100001\rangle + R_{100010}\,|011100010\rangle + R_{100011}\,|011100011\rangle \\
&\quad + R_{100100}\,|011100100\rangle + R_{100101}\,|011100101\rangle + R_{100110}\,|011100110\rangle \\
&\quad + R_{100111}\,|011100111\rangle + R_{101000}\,|011101000\rangle + R_{101001}\,|011101001\rangle \\
&\quad + R_{101010}\,|011101010\rangle + R_{101011}\,|011101011\rangle + R_{101100}\,|011101100\rangle \\
&\quad + R_{101101}\,|011101101\rangle + R_{101110}\,|011101110\rangle + R_{101111}\,|011101111\rangle \\
&\quad + R_{110000}\,|011110000\rangle + R_{110001}\,|011110001\rangle + R_{110010}\,|011110010\rangle \\
&\quad + R_{110011}\,|011110011\rangle + R_{110100}\,|011110100\rangle + R_{110101}\,|011110101\rangle \\
&\quad + R_{110110}\,|011110110\rangle + R_{110111}\,|011110111\rangle + R_{111000}\,|011111000\rangle \\
&\quad + R_{111001}\,|011111001\rangle + R_{111010}\,|011111010\rangle + R_{111011}\,|011111011\rangle \\
&\quad + R_{111100}\,|011111100\rangle + R_{111101}\,|011111101\rangle + R_{111110}\,|011111110\rangle \\
&\quad + R_{111111}\,|011111111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{10}y_0(&R_{000000}\left|100000000\right\rangle + R_{000001}\left|100000001\right\rangle + R_{000010}\left|100000010\right\rangle \\
&+ R_{000011}\left|100000011\right\rangle + R_{000100}\left|100000100\right\rangle + R_{000101}\left|100000101\right\rangle \\
&+ R_{000110}\left|100000110\right\rangle + R_{000111}\left|100000111\right\rangle + R_{001000}\left|100001000\right\rangle \\
&+ R_{001001}\left|100001001\right\rangle + R_{001010}\left|100001010\right\rangle + R_{001011}\left|100001011\right\rangle \\
&+ R_{001100}\left|100001100\right\rangle + R_{001101}\left|100001101\right\rangle + R_{001110}\left|100001110\right\rangle \\
&+ R_{001111}\left|100001111\right\rangle + R_{010000}\left|100010000\right\rangle + R_{010001}\left|100010001\right\rangle \\
&+ R_{010010}\left|100010010\right\rangle + R_{010011}\left|100010011\right\rangle + R_{010100}\left|100010100\right\rangle \\
&+ R_{010101}\left|100010101\right\rangle + R_{010110}\left|100010110\right\rangle + R_{010111}\left|100010111\right\rangle \\
&+ R_{011000}\left|100011000\right\rangle + R_{011001}\left|100011001\right\rangle + R_{011010}\left|100011010\right\rangle \\
&+ R_{011011}\left|100011011\right\rangle + R_{011100}\left|100011100\right\rangle + R_{011101}\left|100011101\right\rangle \\
&+ R_{011110}\left|100011110\right\rangle + R_{011111}\left|100011111\right\rangle + R_{100000}\left|100100000\right\rangle \\
&+ R_{100001}\left|100100001\right\rangle + R_{100010}\left|100100010\right\rangle + R_{100011}\left|100100011\right\rangle \\
&+ R_{100100}\left|100100100\right\rangle + R_{100101}\left|100100101\right\rangle + R_{100110}\left|100100110\right\rangle \\
&+ R_{100111}\left|100100111\right\rangle + R_{101000}\left|100101000\right\rangle + R_{101001}\left|100101001\right\rangle \\
&+ R_{101010}\left|100101010\right\rangle + R_{101011}\left|100101011\right\rangle + R_{101100}\left|100101100\right\rangle \\
&+ R_{101101}\left|100101101\right\rangle + R_{101110}\left|100101110\right\rangle + R_{101111}\left|100101111\right\rangle \\
&+ R_{110000}\left|100110000\right\rangle + R_{110001}\left|100110001\right\rangle + R_{110010}\left|100110010\right\rangle \\
&+ R_{110011}\left|100110011\right\rangle + R_{110100}\left|100110100\right\rangle + R_{110101}\left|100110101\right\rangle \\
&+ R_{110110}\left|100110110\right\rangle + R_{110111}\left|100110111\right\rangle + R_{111000}\left|100111000\right\rangle \\
&+ R_{111001}\left|100111001\right\rangle + R_{111010}\left|100111010\right\rangle + R_{111011}\left|100111011\right\rangle \\
&+ R_{111100}\left|100111100\right\rangle + R_{111101}\left|100111101\right\rangle + R_{111110}\left|100111110\right\rangle \\
&+ R_{111111}\left|100111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{10}y_1(R_{000000}\left|101000000\right\rangle + R_{000001}\left|101000001\right\rangle + R_{000010}\left|101000010\right\rangle \\
&\quad + R_{000011}\left|101000011\right\rangle + R_{000100}\left|101000100\right\rangle + R_{000101}\left|101000101\right\rangle \\
&\quad + R_{000110}\left|101000110\right\rangle + R_{000111}\left|101000111\right\rangle + R_{001000}\left|101001000\right\rangle \\
&\quad + R_{001001}\left|101001001\right\rangle + R_{001010}\left|101001010\right\rangle + R_{001011}\left|101001011\right\rangle \\
&\quad + R_{001100}\left|101001100\right\rangle + R_{001101}\left|101001101\right\rangle + R_{001110}\left|101001110\right\rangle \\
&\quad + R_{001111}\left|101001111\right\rangle + R_{010000}\left|101010000\right\rangle + R_{010001}\left|101010001\right\rangle \\
&\quad + R_{010010}\left|101010010\right\rangle + R_{010011}\left|101010011\right\rangle + R_{010100}\left|101010100\right\rangle \\
&\quad + R_{010101}\left|101010101\right\rangle + R_{010110}\left|101010110\right\rangle + R_{010111}\left|101010111\right\rangle \\
&\quad + R_{011000}\left|101011000\right\rangle + R_{011001}\left|101011001\right\rangle + R_{011010}\left|101011010\right\rangle \\
&\quad + R_{011011}\left|101011011\right\rangle + R_{011100}\left|101011100\right\rangle + R_{011101}\left|101011101\right\rangle \\
&\quad + R_{011110}\left|101011110\right\rangle + R_{011111}\left|101011111\right\rangle + R_{100000}\left|101100000\right\rangle \\
&\quad + R_{100001}\left|101100001\right\rangle + R_{100010}\left|101100010\right\rangle + R_{100011}\left|101100011\right\rangle \\
&\quad + R_{100100}\left|101100100\right\rangle + R_{100101}\left|101100101\right\rangle + R_{100110}\left|101100110\right\rangle \\
&\quad + R_{100111}\left|101100111\right\rangle + R_{101000}\left|101101000\right\rangle + R_{101001}\left|101101001\right\rangle \\
&\quad + R_{101010}\left|101101010\right\rangle + R_{101011}\left|101101011\right\rangle + R_{101100}\left|101101100\right\rangle \\
&\quad + R_{101101}\left|101101101\right\rangle + R_{101110}\left|101101110\right\rangle + R_{101111}\left|101101111\right\rangle \\
&\quad + R_{110000}\left|101110000\right\rangle + R_{110001}\left|101110001\right\rangle + R_{110010}\left|101110010\right\rangle \\
&\quad + R_{110011}\left|101110011\right\rangle + R_{110100}\left|101110100\right\rangle + R_{110101}\left|101110101\right\rangle \\
&\quad + R_{110110}\left|101110110\right\rangle + R_{110111}\left|101110111\right\rangle + R_{111000}\left|101111000\right\rangle \\
&\quad + R_{111001}\left|101111001\right\rangle + R_{111010}\left|101111010\right\rangle + R_{111011}\left|101111011\right\rangle \\
&\quad + R_{111100}\left|101111100\right\rangle + R_{111101}\left|101111101\right\rangle + R_{111110}\left|101111110\right\rangle \\
&\quad + R_{111111}\left|101111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{11}y_0(R_{000000}\,|110000000\rangle + R_{000001}\,|110000001\rangle + R_{000010}\,|110000010\rangle \\
&\quad + R_{000011}\,|110000011\rangle + R_{000100}\,|110000100\rangle + R_{000101}\,|110000101\rangle \\
&\quad + R_{000110}\,|110000110\rangle + R_{000111}\,|110000111\rangle + R_{001000}\,|110001000\rangle \\
&\quad + R_{001001}\,|110001001\rangle + R_{001010}\,|110001010\rangle + R_{001011}\,|110001011\rangle \\
&\quad + R_{001100}\,|110001100\rangle + R_{001101}\,|110001101\rangle + R_{001110}\,|110001110\rangle \\
&\quad + R_{001111}\,|110001111\rangle + R_{010000}\,|110010000\rangle + R_{010001}\,|110010001\rangle \\
&\quad + R_{010010}\,|110010010\rangle + R_{010011}\,|110010011\rangle + R_{010100}\,|110010100\rangle \\
&\quad + R_{010101}\,|110010101\rangle + R_{010110}\,|110010110\rangle + R_{010111}\,|110010111\rangle \\
&\quad + R_{011000}\,|110011000\rangle + R_{011001}\,|110011001\rangle + R_{011010}\,|110011010\rangle \\
&\quad + R_{011011}\,|110011011\rangle + R_{011100}\,|110011100\rangle + R_{011101}\,|110011101\rangle \\
&\quad + R_{011110}\,|110011110\rangle + R_{011111}\,|110011111\rangle + R_{100000}\,|110100000\rangle \\
&\quad + R_{100001}\,|110100001\rangle + R_{100010}\,|110100010\rangle + R_{100011}\,|110100011\rangle \\
&\quad + R_{100100}\,|110100100\rangle + R_{100101}\,|110100101\rangle + R_{100110}\,|110100110\rangle \\
&\quad + R_{100111}\,|110100111\rangle + R_{101000}\,|110101000\rangle + R_{101001}\,|110101001\rangle \\
&\quad + R_{101010}\,|110101010\rangle + R_{101011}\,|110101011\rangle + R_{101100}\,|110101100\rangle \\
&\quad + R_{101101}\,|110101101\rangle + R_{101110}\,|110101110\rangle + R_{101111}\,|110101111\rangle \\
&\quad + R_{110000}\,|110110000\rangle + R_{110001}\,|110110001\rangle + R_{110010}\,|110110010\rangle \\
&\quad + R_{110011}\,|110110011\rangle + R_{110100}\,|110110100\rangle + R_{110101}\,|110110101\rangle \\
&\quad + R_{110110}\,|110110110\rangle + R_{110111}\,|110110111\rangle + R_{111000}\,|110111000\rangle \\
&\quad + R_{111001}\,|110111001\rangle + R_{111010}\,|110111010\rangle + R_{111011}\,|110111011\rangle \\
&\quad + R_{111100}\,|110111100\rangle + R_{111101}\,|110111101\rangle + R_{111110}\,|110111110\rangle \\
&\quad + R_{111111}\,|110111111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{11}y_1(R_{000000}\,|111000000\rangle + R_{000001}\,|111000001\rangle + R_{000010}\,|111000010\rangle\\
&\quad + R_{000011}\,|111000011\rangle + R_{000100}\,|111000100\rangle + R_{000101}\,|111000101\rangle\\
&\quad + R_{000110}\,|111000110\rangle + R_{000111}\,|111000111\rangle + R_{001000}\,|111001000\rangle\\
&\quad + R_{001001}\,|111001001\rangle + R_{001010}\,|111001010\rangle + R_{001011}\,|111001011\rangle\\
&\quad + R_{001100}\,|111001100\rangle + R_{001101}\,|111001101\rangle + R_{001110}\,|111001110\rangle\\
&\quad + R_{001111}\,|111001111\rangle + R_{010000}\,|111010000\rangle + R_{010001}\,|111010001\rangle\\
&\quad + R_{010010}\,|111010010\rangle + R_{010011}\,|111010011\rangle + R_{010100}\,|111010100\rangle\\
&\quad + R_{010101}\,|111010101\rangle + R_{010110}\,|111010110\rangle + R_{010111}\,|111010111\rangle\\
&\quad + R_{011000}\,|111011000\rangle + R_{011001}\,|111011001\rangle + R_{011010}\,|111011010\rangle\\
&\quad + R_{011011}\,|111011011\rangle + R_{011100}\,|111011100\rangle + R_{011101}\,|111011101\rangle\\
&\quad + R_{011110}\,|111011110\rangle + R_{011111}\,|111011111\rangle + R_{100000}\,|111100000\rangle\\
&\quad + R_{100001}\,|111100001\rangle + R_{100010}\,|111100010\rangle + R_{100011}\,|111100011\rangle\\
&\quad + R_{100100}\,|111100100\rangle + R_{100101}\,|111100101\rangle + R_{100110}\,|111100110\rangle\\
&\quad + R_{100111}\,|111100111\rangle + R_{101000}\,|111101000\rangle + R_{101001}\,|111101001\rangle\\
&\quad + R_{101010}\,|111101010\rangle + R_{101011}\,|111101011\rangle + R_{101100}\,|111101100\rangle\\
&\quad + R_{101101}\,|111101101\rangle + R_{101110}\,|111101110\rangle + R_{101111}\,|111101111\rangle\\
&\quad + R_{110000}\,|111110000\rangle + R_{110001}\,|111110001\rangle + R_{110010}\,|111110010\rangle\\
&\quad + R_{110011}\,|111110011\rangle + R_{110100}\,|111110100\rangle + R_{110101}\,|111110101\rangle\\
&\quad + R_{110110}\,|111110110\rangle + R_{110111}\,|111110111\rangle + R_{111000}\,|111111000\rangle\\
&\quad + R_{111001}\,|111111001\rangle + R_{111010}\,|111111010\rangle + R_{111011}\,|111111011\rangle\\
&\quad + R_{111100}\,|111111100\rangle + R_{111101}\,|111111101\rangle + R_{111110}\,|111111110\rangle\\
&\quad + R_{111111}\,|111111111\rangle)
\end{aligned}
$$

Selanjutnya diperkenalkan operator Swap (P_{24}) yang berfungsi menukar qubit ke-2 dan ke-4

$$P_{24} = I \otimes P \otimes I \otimes I \otimes I \otimes I \otimes I \otimes I$$

$$\begin{aligned}
&|\Psi\rangle_{A,B,A_1,A_1,B_1,B_2,B_2,A_2} = \\
&x_{00}y_0(R_{000000}|000000000\rangle + R_{000001}|000000001\rangle + R_{000010}|000000010\rangle \\
&+ R_{000011}|000000011\rangle + R_{000100}|000000100\rangle + R_{000101}|000000101\rangle \\
&+ R_{000110}|000000110\rangle + R_{000111}|000000111\rangle + R_{001000}|000001000\rangle \\
&+ R_{001001}|000001001\rangle + R_{001010}|000001010\rangle + R_{001011}|000001011\rangle \\
&+ R_{001100}|000001100\rangle + R_{001101}|000001101\rangle + R_{001110}|000001110\rangle \\
&+ R_{001111}|000001111\rangle + R_{010000}|000010000\rangle + R_{010001}|000010001\rangle \\
&+ R_{010010}|000010010\rangle + R_{010011}|000010011\rangle + R_{010100}|000010100\rangle \\
&+ R_{010101}|000010101\rangle + R_{010110}|000010110\rangle + R_{010111}|000010111\rangle \\
&+ R_{011000}|000011000\rangle + R_{011001}|000011001\rangle + R_{011010}|000011010\rangle \\
&+ R_{011011}|000011011\rangle + R_{011100}|000011100\rangle + R_{011101}|000011101\rangle \\
&+ R_{011110}|000011110\rangle + R_{011111}|000011111\rangle + R_{100000}|010000000\rangle \\
&+ R_{100001}|010000001\rangle + R_{100010}|010000010\rangle + R_{100011}|010000011\rangle \\
&+ R_{100100}|010000100\rangle + R_{100101}|010000101\rangle + R_{100110}|010000110\rangle \\
&+ R_{100111}|010000111\rangle + R_{101000}|010001000\rangle + R_{101001}|010001001\rangle \\
&+ R_{101010}|010001010\rangle + R_{101011}|010001011\rangle + R_{101100}|010001100\rangle \\
&+ R_{101101}|010001101\rangle + R_{101110}|010001110\rangle + R_{101111}|010001111\rangle \\
&+ R_{110000}|010010000\rangle + R_{110001}|010010001\rangle + R_{110010}|010010010\rangle \\
&+ R_{110011}|010010011\rangle + R_{110100}|010010100\rangle + R_{110101}|010010101\rangle \\
&+ R_{110110}|010010110\rangle + R_{110111}|010010111\rangle + R_{111000}|010011000\rangle \\
&+ R_{111001}|010011001\rangle + R_{111010}|010011010\rangle + R_{111011}|010011011\rangle \\
&+ R_{111100}|010011100\rangle + R_{111101}|010011101\rangle + R_{111110}|010011110\rangle \\
&+ R_{111111}|010011111\rangle)
\end{aligned}$$

$$
\begin{aligned}
&+x_{00}y_1(R_{000000}\left|001000000\right\rangle + R_{000001}\left|001000001\right\rangle + R_{000010}\left|001000010\right\rangle \\
&\quad + R_{000011}\left|001000011\right\rangle + R_{000100}\left|001000100\right\rangle + R_{000101}\left|001000101\right\rangle \\
&\quad + R_{000110}\left|001000110\right\rangle + R_{000111}\left|001000111\right\rangle + R_{001000}\left|001001000\right\rangle \\
&\quad + R_{001001}\left|001001001\right\rangle + R_{001010}\left|001001010\right\rangle + R_{001011}\left|001001011\right\rangle \\
&\quad + R_{001100}\left|001001100\right\rangle + R_{001101}\left|001001101\right\rangle + R_{001110}\left|001001110\right\rangle \\
&\quad + R_{001111}\left|001001111\right\rangle + R_{010000}\left|001010000\right\rangle + R_{010001}\left|001010001\right\rangle \\
&\quad + R_{010010}\left|001010010\right\rangle + R_{010011}\left|001010011\right\rangle + R_{010100}\left|001010100\right\rangle \\
&\quad + R_{010101}\left|001010101\right\rangle + R_{010110}\left|001010110\right\rangle + R_{010111}\left|001010111\right\rangle \\
&\quad + R_{011000}\left|001011000\right\rangle + R_{011001}\left|001011001\right\rangle + R_{011010}\left|001011010\right\rangle \\
&\quad + R_{011011}\left|001011011\right\rangle + R_{011100}\left|001011100\right\rangle + R_{011101}\left|001011101\right\rangle \\
&\quad + R_{011110}\left|001011110\right\rangle + R_{011111}\left|001011111\right\rangle + R_{100000}\left|011000000\right\rangle \\
&\quad + R_{100001}\left|011000001\right\rangle + R_{100010}\left|011000010\right\rangle + R_{100011}\left|011000011\right\rangle \\
&\quad + R_{100100}\left|011000100\right\rangle + R_{100101}\left|011000101\right\rangle + R_{100110}\left|011000110\right\rangle \\
&\quad + R_{100111}\left|011000111\right\rangle + R_{101000}\left|011001000\right\rangle + R_{101001}\left|011001001\right\rangle \\
&\quad + R_{101010}\left|011001010\right\rangle + R_{101011}\left|011001011\right\rangle + R_{101100}\left|011001100\right\rangle \\
&\quad + R_{101101}\left|011001101\right\rangle + R_{101110}\left|011001110\right\rangle + R_{101111}\left|011001111\right\rangle \\
&\quad + R_{110000}\left|011010000\right\rangle + R_{110001}\left|011010001\right\rangle + R_{110010}\left|011010010\right\rangle \\
&\quad + R_{110011}\left|011010011\right\rangle + R_{110100}\left|011010100\right\rangle + R_{110101}\left|011010101\right\rangle \\
&\quad + R_{110110}\left|011010110\right\rangle + R_{110111}\left|011010111\right\rangle + R_{111000}\left|011011000\right\rangle \\
&\quad + R_{111001}\left|011011001\right\rangle + R_{111010}\left|011011010\right\rangle + R_{111011}\left|011011011\right\rangle \\
&\quad + R_{111100}\left|011011100\right\rangle + R_{111101}\left|011011101\right\rangle + R_{111110}\left|011011110\right\rangle \\
&\quad + R_{111111}\left|011011111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{01}y_0(&R_{000000}\left|000100000\right\rangle + R_{000001}\left|000100001\right\rangle + R_{000010}\left|000100010\right\rangle \\
&+ R_{000011}\left|000100011\right\rangle + R_{000100}\left|000100100\right\rangle + R_{000101}\left|000100101\right\rangle \\
&+ R_{000110}\left|000100110\right\rangle + R_{000111}\left|000100111\right\rangle + R_{001000}\left|000101000\right\rangle \\
&+ R_{001001}\left|000101001\right\rangle + R_{001010}\left|000101010\right\rangle + R_{001011}\left|000101011\right\rangle \\
&+ R_{001100}\left|000101100\right\rangle + R_{001101}\left|000101101\right\rangle + R_{001110}\left|000101110\right\rangle \\
&+ R_{001111}\left|000101111\right\rangle + R_{010000}\left|000110000\right\rangle + R_{010001}\left|000110001\right\rangle \\
&+ R_{010010}\left|000110010\right\rangle + R_{010011}\left|000110011\right\rangle + R_{010100}\left|000110100\right\rangle \\
&+ R_{010101}\left|000110101\right\rangle + R_{010110}\left|000110110\right\rangle + R_{010111}\left|000110111\right\rangle \\
&+ R_{011000}\left|000111000\right\rangle + R_{011001}\left|000111001\right\rangle + R_{011010}\left|000111010\right\rangle \\
&+ R_{011011}\left|000111011\right\rangle + R_{011100}\left|000111100\right\rangle + R_{011101}\left|000111101\right\rangle \\
&+ R_{011110}\left|000111110\right\rangle + R_{011111}\left|000111111\right\rangle + R_{100000}\left|010100000\right\rangle \\
&+ R_{100001}\left|010100001\right\rangle + R_{100010}\left|010100010\right\rangle + R_{100011}\left|010100011\right\rangle \\
&+ R_{100100}\left|010100100\right\rangle + R_{100101}\left|010100101\right\rangle + R_{100110}\left|010100110\right\rangle \\
&+ R_{100111}\left|010100111\right\rangle + R_{101000}\left|010101000\right\rangle + R_{101001}\left|010101001\right\rangle \\
&+ R_{101010}\left|010101010\right\rangle + R_{101011}\left|010101011\right\rangle + R_{101100}\left|010101100\right\rangle \\
&+ R_{101101}\left|010101101\right\rangle + R_{101110}\left|010101110\right\rangle + R_{101111}\left|010101111\right\rangle \\
&+ R_{110000}\left|010110000\right\rangle + R_{110001}\left|010110001\right\rangle + R_{110010}\left|010110010\right\rangle \\
&+ R_{110011}\left|010110011\right\rangle + R_{110100}\left|010110100\right\rangle + R_{110101}\left|010110101\right\rangle \\
&+ R_{110110}\left|010110110\right\rangle + R_{110111}\left|010110111\right\rangle + R_{111000}\left|010111000\right\rangle \\
&+ R_{111001}\left|010111001\right\rangle + R_{111010}\left|010111010\right\rangle + R_{111011}\left|010111011\right\rangle \\
&+ R_{111100}\left|010111100\right\rangle + R_{111101}\left|010111101\right\rangle + R_{111110}\left|010111110\right\rangle \\
&+ R_{111111}\left|010111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{01}y_1(R_{000000}\left|001100000\right\rangle + R_{000001}\left|001100001\right\rangle + R_{000010}\left|001100010\right\rangle \\
&\quad + R_{000011}\left|001100011\right\rangle + R_{000100}\left|001100100\right\rangle + R_{000101}\left|001100101\right\rangle \\
&\quad + R_{000110}\left|001100110\right\rangle + R_{000111}\left|001100111\right\rangle + R_{001000}\left|001101000\right\rangle \\
&\quad + R_{001001}\left|001101001\right\rangle + R_{001010}\left|001101010\right\rangle + R_{001011}\left|001101011\right\rangle \\
&\quad + R_{001100}\left|001101100\right\rangle + R_{001101}\left|001101101\right\rangle + R_{001110}\left|001101110\right\rangle \\
&\quad + R_{001111}\left|001101111\right\rangle + R_{010000}\left|001110000\right\rangle + R_{010001}\left|001110001\right\rangle \\
&\quad + R_{010010}\left|001110010\right\rangle + R_{010011}\left|001110011\right\rangle + R_{010100}\left|001110100\right\rangle \\
&\quad + R_{010101}\left|001110101\right\rangle + R_{010110}\left|001110110\right\rangle + R_{010111}\left|001110111\right\rangle \\
&\quad + R_{011000}\left|001111000\right\rangle + R_{011001}\left|001111001\right\rangle + R_{011010}\left|001111010\right\rangle \\
&\quad + R_{011011}\left|001111011\right\rangle + R_{011100}\left|001111100\right\rangle + R_{011101}\left|001111101\right\rangle \\
&\quad + R_{011110}\left|001111110\right\rangle + R_{011111}\left|001111111\right\rangle + R_{100000}\left|011100000\right\rangle \\
&\quad + R_{100001}\left|011100001\right\rangle + R_{100010}\left|011100010\right\rangle + R_{100011}\left|011100011\right\rangle \\
&\quad + R_{100100}\left|011100100\right\rangle + R_{100101}\left|011100101\right\rangle + R_{100110}\left|011100110\right\rangle \\
&\quad + R_{100111}\left|011100111\right\rangle + R_{101000}\left|011101000\right\rangle + R_{101001}\left|011101001\right\rangle \\
&\quad + R_{101010}\left|011101010\right\rangle + R_{101011}\left|011101011\right\rangle + R_{101100}\left|011101100\right\rangle \\
&\quad + R_{101101}\left|011101101\right\rangle + R_{101110}\left|011101110\right\rangle + R_{101111}\left|011101111\right\rangle \\
&\quad + R_{110000}\left|011110000\right\rangle + R_{110001}\left|011110001\right\rangle + R_{110010}\left|011110010\right\rangle \\
&\quad + R_{110011}\left|011110011\right\rangle + R_{110100}\left|011110100\right\rangle + R_{110101}\left|011110101\right\rangle \\
&\quad + R_{110110}\left|011110110\right\rangle + R_{110111}\left|011110111\right\rangle + R_{111000}\left|011111000\right\rangle \\
&\quad + R_{111001}\left|011111001\right\rangle + R_{111010}\left|011111010\right\rangle + R_{111011}\left|011111011\right\rangle \\
&\quad + R_{111100}\left|011111100\right\rangle + R_{111101}\left|011111101\right\rangle + R_{111110}\left|011111110\right\rangle \\
&\quad + R_{111111}\left|011111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{10}y_0(R_{000000}\left|100000000\right\rangle + R_{000001}\left|100000001\right\rangle + R_{000010}\left|100000010\right\rangle \\
&\qquad + R_{000011}\left|100000011\right\rangle + R_{000100}\left|100000100\right\rangle + R_{000101}\left|100000101\right\rangle \\
&\qquad + R_{000110}\left|100000110\right\rangle + R_{000111}\left|100000111\right\rangle + R_{001000}\left|100001000\right\rangle \\
&\qquad + R_{001001}\left|100001001\right\rangle + R_{001010}\left|100001010\right\rangle + R_{001011}\left|100001011\right\rangle \\
&\qquad + R_{001100}\left|100001100\right\rangle + R_{001101}\left|100001101\right\rangle + R_{001110}\left|100001110\right\rangle \\
&\qquad + R_{001111}\left|100001111\right\rangle + R_{010000}\left|100010000\right\rangle + R_{010001}\left|100010001\right\rangle \\
&\qquad + R_{010010}\left|100010010\right\rangle + R_{010011}\left|100010011\right\rangle + R_{010100}\left|100010100\right\rangle \\
&\qquad + R_{010101}\left|100010101\right\rangle + R_{010110}\left|100010110\right\rangle + R_{010111}\left|100010111\right\rangle \\
&\qquad + R_{011000}\left|100011000\right\rangle + R_{011001}\left|100011001\right\rangle + R_{011010}\left|100011010\right\rangle \\
&\qquad + R_{011011}\left|100011011\right\rangle + R_{011100}\left|100011100\right\rangle + R_{011101}\left|100011101\right\rangle \\
&\qquad + R_{011110}\left|100011110\right\rangle + R_{011111}\left|100011111\right\rangle + R_{100000}\left|110000000\right\rangle \\
&\qquad + R_{100001}\left|110000001\right\rangle + R_{100010}\left|110000010\right\rangle + R_{100011}\left|110000011\right\rangle \\
&\qquad + R_{100100}\left|110000100\right\rangle + R_{100101}\left|110000101\right\rangle + R_{100110}\left|110000110\right\rangle \\
&\qquad + R_{100111}\left|110000111\right\rangle + R_{101000}\left|110001000\right\rangle + R_{101001}\left|110001001\right\rangle \\
&\qquad + R_{101010}\left|110001010\right\rangle + R_{101011}\left|110001011\right\rangle + R_{101100}\left|110001100\right\rangle \\
&\qquad + R_{101101}\left|110001101\right\rangle + R_{101110}\left|110001110\right\rangle + R_{101111}\left|110001111\right\rangle \\
&\qquad + R_{110000}\left|110010000\right\rangle + R_{110001}\left|110010001\right\rangle + R_{110010}\left|110010010\right\rangle \\
&\qquad + R_{110011}\left|110010011\right\rangle + R_{110100}\left|110010100\right\rangle + R_{110101}\left|110010101\right\rangle \\
&\qquad + R_{110110}\left|110010110\right\rangle + R_{110111}\left|110010111\right\rangle + R_{111000}\left|110011000\right\rangle \\
&\qquad + R_{111001}\left|110011001\right\rangle + R_{111010}\left|110011010\right\rangle + R_{111011}\left|110011011\right\rangle \\
&\qquad + R_{111100}\left|110011100\right\rangle + R_{111101}\left|110011101\right\rangle + R_{111110}\left|110011110\right\rangle \\
&\qquad + R_{111111}\left|110011111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{10}y_1(&R_{000000}\left|101000000\right\rangle + R_{000001}\left|101000001\right\rangle + R_{000010}\left|101000010\right\rangle \\
&+ R_{000011}\left|101000011\right\rangle + R_{000100}\left|101000100\right\rangle + R_{000101}\left|101000101\right\rangle \\
&+ R_{000110}\left|101000110\right\rangle + R_{000111}\left|101000111\right\rangle + R_{001000}\left|101001000\right\rangle \\
&+ R_{001001}\left|101001001\right\rangle + R_{001010}\left|101001010\right\rangle + R_{001011}\left|101001011\right\rangle \\
&+ R_{001100}\left|101001100\right\rangle + R_{001101}\left|101001101\right\rangle + R_{001110}\left|101001110\right\rangle \\
&+ R_{001111}\left|101001111\right\rangle + R_{010000}\left|101010000\right\rangle + R_{010001}\left|101010001\right\rangle \\
&+ R_{010010}\left|101010010\right\rangle + R_{010011}\left|101010011\right\rangle + R_{010100}\left|101010100\right\rangle \\
&+ R_{010101}\left|101010101\right\rangle + R_{010110}\left|101010110\right\rangle + R_{010111}\left|101010111\right\rangle \\
&+ R_{011000}\left|101011000\right\rangle + R_{011001}\left|101011001\right\rangle + R_{011010}\left|101011010\right\rangle \\
&+ R_{011011}\left|101011011\right\rangle + R_{011100}\left|101011100\right\rangle + R_{011101}\left|101011101\right\rangle \\
&+ R_{011110}\left|101011110\right\rangle + R_{011111}\left|101011111\right\rangle + R_{100000}\left|111000000\right\rangle \\
&+ R_{100001}\left|111000001\right\rangle + R_{100010}\left|111000010\right\rangle + R_{100011}\left|111000011\right\rangle \\
&+ R_{100100}\left|111000100\right\rangle + R_{100101}\left|111000101\right\rangle + R_{100110}\left|111000110\right\rangle \\
&+ R_{100111}\left|111000111\right\rangle + R_{101000}\left|111001000\right\rangle + R_{101001}\left|111001001\right\rangle \\
&+ R_{101010}\left|111001010\right\rangle + R_{101011}\left|111001011\right\rangle + R_{101100}\left|111001100\right\rangle \\
&+ R_{101101}\left|111001101\right\rangle + R_{101110}\left|111001110\right\rangle + R_{101111}\left|111001111\right\rangle \\
&+ R_{110000}\left|111010000\right\rangle + R_{110001}\left|111010001\right\rangle + R_{110010}\left|111010010\right\rangle \\
&+ R_{110011}\left|111010011\right\rangle + R_{110100}\left|111010100\right\rangle + R_{110101}\left|111010101\right\rangle \\
&+ R_{110110}\left|111010110\right\rangle + R_{110111}\left|111010111\right\rangle + R_{111000}\left|111011000\right\rangle \\
&+ R_{111001}\left|111011001\right\rangle + R_{111010}\left|111011010\right\rangle + R_{111011}\left|111011011\right\rangle \\
&+ R_{111100}\left|111011100\right\rangle + R_{111101}\left|111011101\right\rangle + R_{111110}\left|111011110\right\rangle \\
&+ R_{111111}\left|111011111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{11}y_0(&R_{000000}\left|100100000\right\rangle + R_{000001}\left|100100001\right\rangle + R_{000010}\left|100100010\right\rangle \\
&+ R_{000011}\left|100100011\right\rangle + R_{000100}\left|100100100\right\rangle + R_{000101}\left|100100101\right\rangle \\
&+ R_{000110}\left|100100110\right\rangle + R_{000111}\left|100100111\right\rangle + R_{001000}\left|100101000\right\rangle \\
&+ R_{001001}\left|100101001\right\rangle + R_{001010}\left|100101010\right\rangle + R_{001011}\left|100101011\right\rangle \\
&+ R_{001100}\left|100101100\right\rangle + R_{001101}\left|100101101\right\rangle + R_{001110}\left|100101110\right\rangle \\
&+ R_{001111}\left|100101111\right\rangle + R_{010000}\left|100110000\right\rangle + R_{010001}\left|100110001\right\rangle \\
&+ R_{010010}\left|100110010\right\rangle + R_{010011}\left|100110011\right\rangle + R_{010100}\left|100110100\right\rangle \\
&+ R_{010101}\left|100110101\right\rangle + R_{010110}\left|100110110\right\rangle + R_{010111}\left|100110111\right\rangle \\
&+ R_{011000}\left|100111000\right\rangle + R_{011001}\left|100111001\right\rangle + R_{011010}\left|100111010\right\rangle \\
&+ R_{011011}\left|100111011\right\rangle + R_{011100}\left|100111100\right\rangle + R_{011101}\left|100111101\right\rangle \\
&+ R_{011110}\left|100111110\right\rangle + R_{011111}\left|100111111\right\rangle + R_{100000}\left|110100000\right\rangle \\
&+ R_{100001}\left|110100001\right\rangle + R_{100010}\left|110100010\right\rangle + R_{100011}\left|110100011\right\rangle \\
&+ R_{100100}\left|110100100\right\rangle + R_{100101}\left|110100101\right\rangle + R_{100110}\left|110100110\right\rangle \\
&+ R_{100111}\left|110100111\right\rangle + R_{101000}\left|110101000\right\rangle + R_{101001}\left|110101001\right\rangle \\
&+ R_{101010}\left|110101010\right\rangle + R_{101011}\left|110101011\right\rangle + R_{101100}\left|110101100\right\rangle \\
&+ R_{101101}\left|110101101\right\rangle + R_{101110}\left|110101110\right\rangle + R_{101111}\left|110101111\right\rangle \\
&+ R_{110000}\left|110110000\right\rangle + R_{110001}\left|110110001\right\rangle + R_{110010}\left|110110010\right\rangle \\
&+ R_{110011}\left|110110011\right\rangle + R_{110100}\left|110110100\right\rangle + R_{110101}\left|110110101\right\rangle \\
&+ R_{110110}\left|110110110\right\rangle + R_{110111}\left|110110111\right\rangle + R_{111000}\left|110111000\right\rangle \\
&+ R_{111001}\left|110111001\right\rangle + R_{111010}\left|110111010\right\rangle + R_{111011}\left|110111011\right\rangle \\
&+ R_{111100}\left|110111100\right\rangle + R_{111101}\left|110111101\right\rangle + R_{111110}\left|110111110\right\rangle \\
&+ R_{111111}\left|110111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{11}y_1(&R_{000000}\left|101100000\right\rangle + R_{000001}\left|101100001\right\rangle + R_{000010}\left|101100010\right\rangle\\
&+ R_{000011}\left|101100011\right\rangle + R_{000100}\left|101100100\right\rangle + R_{000101}\left|101100101\right\rangle\\
&+ R_{000110}\left|101100110\right\rangle + R_{000111}\left|101100111\right\rangle + R_{001000}\left|101101000\right\rangle\\
&+ R_{001001}\left|101101001\right\rangle + R_{001010}\left|101101010\right\rangle + R_{001011}\left|101101011\right\rangle\\
&+ R_{001100}\left|101101100\right\rangle + R_{001101}\left|101101101\right\rangle + R_{001110}\left|101101110\right\rangle\\
&+ R_{001111}\left|101101111\right\rangle + R_{010000}\left|101110000\right\rangle + R_{010001}\left|101110001\right\rangle\\
&+ R_{010010}\left|101110010\right\rangle + R_{010011}\left|101110011\right\rangle + R_{010100}\left|101110100\right\rangle\\
&+ R_{010101}\left|101110101\right\rangle + R_{010110}\left|101110110\right\rangle + R_{010111}\left|101110111\right\rangle\\
&+ R_{011000}\left|101111000\right\rangle + R_{011001}\left|101111001\right\rangle + R_{011010}\left|101111010\right\rangle\\
&+ R_{011011}\left|101111011\right\rangle + R_{011100}\left|101111100\right\rangle + R_{011101}\left|101111101\right\rangle\\
&+ R_{011110}\left|101111110\right\rangle + R_{011111}\left|101111111\right\rangle + R_{100000}\left|111100000\right\rangle\\
&+ R_{100001}\left|111100001\right\rangle + R_{100010}\left|111100010\right\rangle + R_{100011}\left|111100011\right\rangle\\
&+ R_{100100}\left|111100100\right\rangle + R_{100101}\left|111100101\right\rangle + R_{100110}\left|111100110\right\rangle\\
&+ R_{100111}\left|111100111\right\rangle + R_{101000}\left|111101000\right\rangle + R_{101001}\left|111101001\right\rangle\\
&+ R_{101010}\left|111101010\right\rangle + R_{101011}\left|111101011\right\rangle + R_{101100}\left|111101100\right\rangle\\
&+ R_{101101}\left|111101101\right\rangle + R_{101110}\left|111101110\right\rangle + R_{101111}\left|111101111\right\rangle\\
&+ R_{110000}\left|111110000\right\rangle + R_{110001}\left|111110001\right\rangle + R_{110010}\left|111110010\right\rangle\\
&+ R_{110011}\left|111110011\right\rangle + R_{110100}\left|111110100\right\rangle + R_{110101}\left|111110101\right\rangle\\
&+ R_{110110}\left|111110110\right\rangle + R_{110111}\left|111110111\right\rangle + R_{111000}\left|111111000\right\rangle\\
&+ R_{111001}\left|111111001\right\rangle + R_{111010}\left|111111010\right\rangle + R_{111011}\left|111111011\right\rangle\\
&+ R_{111100}\left|111111100\right\rangle + R_{111101}\left|111111101\right\rangle + R_{111110}\left|111111110\right\rangle\\
&+ R_{111111}\left|111111111\right\rangle)
\end{aligned}
$$

Selanjutnya diperkenalkan operator Swap (P_{45}) yang berfungsi menukar qubit ke-4 dan ke-5

$$
\begin{aligned}
P_{45} &= I \otimes I \otimes I \otimes P \otimes I \otimes I \otimes I \otimes I \\
&|\Psi\rangle_{A,B,A_1,A_1,B_1,B_2,B_2,A_2} = \\
&= x_{00}y_0(R_{000000}\,|000000000\rangle + R_{000001}\,|000000001\rangle + R_{000010}\,|000000010\rangle \\
&+ R_{000011}\,|000000011\rangle + R_{000100}\,|000000100\rangle + R_{000101}\,|000000101\rangle \\
&+ R_{000110}\,|000000110\rangle + R_{000111}\,|000000111\rangle + R_{001000}\,|000001000\rangle \\
&+ R_{001001}\,|000001001\rangle + R_{001010}\,|000001010\rangle + R_{001011}\,|000001011\rangle \\
&+ R_{001100}\,|000001100\rangle + R_{001101}\,|000001101\rangle + R_{001110}\,|000001110\rangle \\
&+ R_{001111}\,|000001111\rangle + R_{010000}\,|000100000\rangle + R_{010001}\,|000100001\rangle \\
&+ R_{010010}\,|000100010\rangle + R_{010011}\,|000100011\rangle + R_{010100}\,|000100100\rangle \\
&+ R_{010101}\,|000100101\rangle + R_{010110}\,|000100110\rangle + R_{010111}\,|000100111\rangle \\
&+ R_{011000}\,|000101000\rangle + R_{011001}\,|000101001\rangle + R_{011010}\,|000101010\rangle \\
&+ R_{011011}\,|000101011\rangle + R_{011100}\,|000101100\rangle + R_{011101}\,|000101101\rangle \\
&+ R_{011110}\,|000101110\rangle + R_{011111}\,|000101111\rangle + R_{100000}\,|010000000\rangle \\
&+ R_{100001}\,|010000001\rangle + R_{100010}\,|010000010\rangle + R_{100011}\,|010000011\rangle \\
&+ R_{100100}\,|010000100\rangle + R_{100101}\,|010000101\rangle + R_{100110}\,|010000110\rangle \\
&+ R_{100111}\,|010000111\rangle + R_{101000}\,|010001000\rangle + R_{101001}\,|010001001\rangle \\
&+ R_{101010}\,|010001010\rangle + R_{101011}\,|010001011\rangle + R_{101100}\,|010001100\rangle \\
&+ R_{101101}\,|010001101\rangle + R_{101110}\,|010001110\rangle + R_{101111}\,|010001111\rangle \\
&+ R_{110000}\,|010100000\rangle + R_{110001}\,|010100001\rangle + R_{110010}\,|010100010\rangle \\
&+ R_{110011}\,|010100011\rangle + R_{110100}\,|010100100\rangle + R_{110101}\,|010100101\rangle \\
&+ R_{110110}\,|010100110\rangle + R_{110111}\,|010100111\rangle + R_{111000}\,|010101000\rangle \\
&+ R_{111001}\,|010101001\rangle + R_{111010}\,|010101010\rangle + R_{111011}\,|010101011\rangle \\
&+ R_{111100}\,|010101100\rangle + R_{111101}\,|010101101\rangle + R_{111110}\,|010101110\rangle \\
&+ R_{111111}\,|010101111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{00}y_1(&R_{000000}\,|001000000\rangle + R_{000001}\,|001000001\rangle + R_{000010}\,|001000010\rangle \\
&+ R_{000011}\,|001000011\rangle + R_{000100}\,|001000100\rangle + R_{000101}\,|001000101\rangle \\
&+ R_{000110}\,|001000110\rangle + R_{000111}\,|001000111\rangle + R_{001000}\,|001001000\rangle \\
&+ R_{001001}\,|001001001\rangle + R_{001010}\,|001001010\rangle + R_{001011}\,|001001011\rangle \\
&+ R_{001100}\,|001001100\rangle + R_{001101}\,|001001101\rangle + R_{001110}\,|001001110\rangle \\
&+ R_{001111}\,|001001111\rangle + R_{010000}\,|001100000\rangle + R_{010001}\,|001100001\rangle \\
&+ R_{010010}\,|001100010\rangle + R_{010011}\,|001100011\rangle + R_{010100}\,|001100100\rangle \\
&+ R_{010101}\,|001100101\rangle + R_{010110}\,|001100110\rangle + R_{010111}\,|001100111\rangle \\
&+ R_{011000}\,|001101000\rangle + R_{011001}\,|001101001\rangle + R_{011010}\,|001101010\rangle \\
&+ R_{011011}\,|001101011\rangle + R_{011100}\,|001101100\rangle + R_{011101}\,|001101101\rangle \\
&+ R_{011110}\,|001101110\rangle + R_{011111}\,|001101111\rangle + R_{100000}\,|011000000\rangle \\
&+ R_{100001}\,|011000001\rangle + R_{100010}\,|011000010\rangle + R_{100011}\,|011000011\rangle \\
&+ R_{100100}\,|011000100\rangle + R_{100101}\,|011000101\rangle + R_{100110}\,|011000110\rangle \\
&+ R_{100111}\,|011000111\rangle + R_{101000}\,|011001000\rangle + R_{101001}\,|011001001\rangle \\
&+ R_{101010}\,|011001010\rangle + R_{101011}\,|011001011\rangle + R_{101100}\,|011001100\rangle \\
&+ R_{101101}\,|011001101\rangle + R_{101110}\,|011001110\rangle + R_{101111}\,|011001111\rangle \\
&+ R_{110000}\,|011100000\rangle + R_{110001}\,|011100001\rangle + R_{110010}\,|011100010\rangle \\
&+ R_{110011}\,|011100011\rangle + R_{110100}\,|011100100\rangle + R_{110101}\,|011100101\rangle \\
&+ R_{110110}\,|011100110\rangle + R_{110111}\,|011100111\rangle + R_{111000}\,|011101000\rangle \\
&+ R_{111001}\,|011101001\rangle + R_{111010}\,|011101010\rangle + R_{111011}\,|011101011\rangle \\
&+ R_{111100}\,|011101100\rangle + R_{111101}\,|011101101\rangle + R_{111110}\,|011101110\rangle \\
&+ R_{111111}\,|011101111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{01}y_0(R_{000000}\left|000010000\right\rangle + R_{000001}\left|000010001\right\rangle + R_{000010}\left|000010010\right\rangle \\
&\quad + R_{000011}\left|000010011\right\rangle + R_{000100}\left|000010100\right\rangle + R_{000101}\left|000010101\right\rangle \\
&\quad + R_{000110}\left|000010110\right\rangle + R_{000111}\left|000010111\right\rangle + R_{001000}\left|000011000\right\rangle \\
&\quad + R_{001001}\left|000011001\right\rangle + R_{001010}\left|000011010\right\rangle + R_{001011}\left|000011011\right\rangle \\
&\quad + R_{001100}\left|000011100\right\rangle + R_{001101}\left|000011101\right\rangle + R_{001110}\left|000011110\right\rangle \\
&\quad + R_{001111}\left|000011111\right\rangle + R_{010000}\left|000110000\right\rangle + R_{010001}\left|000110001\right\rangle \\
&\quad + R_{010010}\left|000110010\right\rangle + R_{010011}\left|000110011\right\rangle + R_{010100}\left|000110100\right\rangle \\
&\quad + R_{010101}\left|000110101\right\rangle + R_{010110}\left|000110110\right\rangle + R_{010111}\left|000110111\right\rangle \\
&\quad + R_{011000}\left|000111000\right\rangle + R_{011001}\left|000111001\right\rangle + R_{011010}\left|000111010\right\rangle \\
&\quad + R_{011011}\left|000111011\right\rangle + R_{011100}\left|000111100\right\rangle + R_{011101}\left|000111101\right\rangle \\
&\quad + R_{011110}\left|000111110\right\rangle + R_{011111}\left|000111111\right\rangle + R_{100000}\left|010010000\right\rangle \\
&\quad + R_{100001}\left|010010001\right\rangle + R_{100010}\left|010010010\right\rangle + R_{100011}\left|010010011\right\rangle \\
&\quad + R_{100100}\left|010010100\right\rangle + R_{100101}\left|010010101\right\rangle + R_{100110}\left|010010110\right\rangle \\
&\quad + R_{100111}\left|010010111\right\rangle + R_{101000}\left|010011000\right\rangle + R_{101001}\left|010011001\right\rangle \\
&\quad + R_{101010}\left|010011010\right\rangle + R_{101011}\left|010011011\right\rangle + R_{101100}\left|010011100\right\rangle \\
&\quad + R_{101101}\left|010011101\right\rangle + R_{101110}\left|010011110\right\rangle + R_{101111}\left|010011111\right\rangle \\
&\quad + R_{110000}\left|010110000\right\rangle + R_{110001}\left|010110001\right\rangle + R_{110010}\left|010110010\right\rangle \\
&\quad + R_{110011}\left|010110011\right\rangle + R_{110100}\left|010110100\right\rangle + R_{110101}\left|010110101\right\rangle \\
&\quad + R_{110110}\left|010110110\right\rangle + R_{110111}\left|010110111\right\rangle + R_{111000}\left|010111000\right\rangle \\
&\quad + R_{111001}\left|010111001\right\rangle + R_{111010}\left|010111010\right\rangle + R_{111011}\left|010111011\right\rangle \\
&\quad + R_{111100}\left|010111100\right\rangle + R_{111101}\left|010111101\right\rangle + R_{111110}\left|010111110\right\rangle \\
&\quad + R_{111111}\left|010111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{01}y_1(&R_{000000}\left|001010000\right\rangle + R_{000001}\left|001010001\right\rangle + R_{000010}\left|001010010\right\rangle \\
&+ R_{000011}\left|001010011\right\rangle + R_{000100}\left|001010100\right\rangle + R_{000101}\left|001010101\right\rangle \\
&+ R_{000110}\left|001010110\right\rangle + R_{000111}\left|001010111\right\rangle + R_{001000}\left|001011000\right\rangle \\
&+ R_{001001}\left|001011001\right\rangle + R_{001010}\left|001011010\right\rangle + R_{001011}\left|001011011\right\rangle \\
&+ R_{001100}\left|001011100\right\rangle + R_{001101}\left|001011101\right\rangle + R_{001110}\left|001011110\right\rangle \\
&+ R_{001111}\left|001011111\right\rangle + R_{010000}\left|001110000\right\rangle + R_{010001}\left|001110001\right\rangle \\
&+ R_{010010}\left|001110010\right\rangle + R_{010011}\left|001110011\right\rangle + R_{010100}\left|001110100\right\rangle \\
&+ R_{010101}\left|001110101\right\rangle + R_{010110}\left|001110110\right\rangle + R_{010111}\left|001110111\right\rangle \\
&+ R_{011000}\left|001111000\right\rangle + R_{011001}\left|001111001\right\rangle + R_{011010}\left|001111010\right\rangle \\
&+ R_{011011}\left|001111011\right\rangle + R_{011100}\left|001111100\right\rangle + R_{011101}\left|001111101\right\rangle \\
&+ R_{011110}\left|001111110\right\rangle + R_{011111}\left|001111111\right\rangle + R_{100000}\left|011010000\right\rangle \\
&+ R_{100001}\left|011010001\right\rangle + R_{100010}\left|011010010\right\rangle + R_{100011}\left|011010011\right\rangle \\
&+ R_{100100}\left|011010100\right\rangle + R_{100101}\left|011010101\right\rangle + R_{100110}\left|011010110\right\rangle \\
&+ R_{100111}\left|011010111\right\rangle + R_{101000}\left|011011000\right\rangle + R_{101001}\left|011011001\right\rangle \\
&+ R_{101010}\left|011011010\right\rangle + R_{101011}\left|011011011\right\rangle + R_{101100}\left|011011100\right\rangle \\
&+ R_{101101}\left|011011101\right\rangle + R_{101110}\left|011011110\right\rangle + R_{101111}\left|011011111\right\rangle \\
&+ R_{110000}\left|011110000\right\rangle + R_{110001}\left|011110001\right\rangle + R_{110010}\left|011110010\right\rangle \\
&+ R_{110011}\left|011110011\right\rangle + R_{110100}\left|011110100\right\rangle + R_{110101}\left|011110101\right\rangle \\
&+ R_{110110}\left|011110110\right\rangle + R_{110111}\left|011110111\right\rangle + R_{111000}\left|011111000\right\rangle \\
&+ R_{111001}\left|011111001\right\rangle + R_{111010}\left|011111010\right\rangle + R_{111011}\left|011111011\right\rangle \\
&+ R_{111100}\left|011111100\right\rangle + R_{111101}\left|011111101\right\rangle + R_{111110}\left|011111110\right\rangle \\
&+ R_{111111}\left|011111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{10}y_0(&R_{000000}\left|100000000\right\rangle + R_{000001}\left|100000001\right\rangle + R_{000010}\left|100000010\right\rangle \\
&+ R_{000011}\left|100000011\right\rangle + R_{000100}\left|100000100\right\rangle + R_{000101}\left|100000101\right\rangle \\
&+ R_{000110}\left|100000110\right\rangle + R_{000111}\left|100000111\right\rangle + R_{001000}\left|100001000\right\rangle \\
&+ R_{001001}\left|100001001\right\rangle + R_{001010}\left|100001010\right\rangle + R_{001011}\left|100001011\right\rangle \\
&+ R_{001100}\left|100001100\right\rangle + R_{001101}\left|100001101\right\rangle + R_{001110}\left|100001110\right\rangle \\
&+ R_{001111}\left|100001111\right\rangle + R_{010000}\left|100100000\right\rangle + R_{010001}\left|100100001\right\rangle \\
&+ R_{010010}\left|100100010\right\rangle + R_{010011}\left|100100011\right\rangle + R_{010100}\left|100100100\right\rangle \\
&+ R_{010101}\left|100100101\right\rangle + R_{010110}\left|100100110\right\rangle + R_{010111}\left|100100111\right\rangle \\
&+ R_{011000}\left|100101000\right\rangle + R_{011001}\left|100101001\right\rangle + R_{011010}\left|100101010\right\rangle \\
&+ R_{011011}\left|100101011\right\rangle + R_{011100}\left|100101100\right\rangle + R_{011101}\left|100101101\right\rangle \\
&+ R_{011110}\left|100101110\right\rangle + R_{011111}\left|100101111\right\rangle + R_{100000}\left|110000000\right\rangle \\
&+ R_{100001}\left|110000001\right\rangle + R_{100010}\left|110000010\right\rangle + R_{100011}\left|110000011\right\rangle \\
&+ R_{100100}\left|110000100\right\rangle + R_{100101}\left|110000101\right\rangle + R_{100110}\left|110000110\right\rangle \\
&+ R_{100111}\left|110000111\right\rangle + R_{101000}\left|110001000\right\rangle + R_{101001}\left|110001001\right\rangle \\
&+ R_{101010}\left|110001010\right\rangle + R_{101011}\left|110001011\right\rangle + R_{101100}\left|110001100\right\rangle \\
&+ R_{101101}\left|110001101\right\rangle + R_{101110}\left|110001110\right\rangle + R_{101111}\left|110001111\right\rangle \\
&+ R_{110000}\left|110100000\right\rangle + R_{110001}\left|110100001\right\rangle + R_{110010}\left|110100010\right\rangle \\
&+ R_{110011}\left|110100011\right\rangle + R_{110100}\left|110100100\right\rangle + R_{110101}\left|110100101\right\rangle \\
&+ R_{110110}\left|110100110\right\rangle + R_{110111}\left|110100111\right\rangle + R_{111000}\left|110101000\right\rangle \\
&+ R_{111001}\left|110101001\right\rangle + R_{111010}\left|110101010\right\rangle + R_{111011}\left|110101011\right\rangle \\
&+ R_{111100}\left|110101100\right\rangle + R_{111101}\left|110101101\right\rangle + R_{111110}\left|110101110\right\rangle \\
&+ R_{111111}\left|110101111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{10}y_1(R_{000000}\,|101000000\rangle + R_{000001}\,|101000001\rangle + R_{000010}\,|101000010\rangle \\
&\quad + R_{000011}\,|101000011\rangle + R_{000100}\,|101000100\rangle + R_{000101}\,|101000101\rangle \\
&\quad + R_{000110}\,|101000110\rangle + R_{000111}\,|101000111\rangle + R_{001000}\,|101001000\rangle \\
&\quad + R_{001001}\,|101001001\rangle + R_{001010}\,|101001010\rangle + R_{001011}\,|101001011\rangle \\
&\quad + R_{001100}\,|101001100\rangle + R_{001101}\,|101001101\rangle + R_{001110}\,|101001110\rangle \\
&\quad + R_{001111}\,|101001111\rangle + R_{010000}\,|101100000\rangle + R_{010001}\,|101100001\rangle \\
&\quad + R_{010010}\,|101100010\rangle + R_{010011}\,|101100011\rangle + R_{010100}\,|101100100\rangle \\
&\quad + R_{010101}\,|101100101\rangle + R_{010110}\,|101100110\rangle + R_{010111}\,|101100111\rangle \\
&\quad + R_{011000}\,|101101000\rangle + R_{011001}\,|101101001\rangle + R_{011010}\,|101101010\rangle \\
&\quad + R_{011011}\,|101101011\rangle + R_{011100}\,|101101100\rangle + R_{011101}\,|101101101\rangle \\
&\quad + R_{011110}\,|101101110\rangle + R_{011111}\,|101101111\rangle + R_{100000}\,|111000000\rangle \\
&\quad + R_{100001}\,|111000001\rangle + R_{100010}\,|111000010\rangle + R_{100011}\,|111000011\rangle \\
&\quad + R_{100100}\,|111000100\rangle + R_{100101}\,|111000101\rangle + R_{100110}\,|111000110\rangle \\
&\quad + R_{100111}\,|111000111\rangle + R_{101000}\,|111001000\rangle + R_{101001}\,|111001001\rangle \\
&\quad + R_{101010}\,|111001010\rangle + R_{101011}\,|111001011\rangle + R_{101100}\,|111001100\rangle \\
&\quad + R_{101101}\,|111001101\rangle + R_{101110}\,|111001110\rangle + R_{101111}\,|111001111\rangle \\
&\quad + R_{110000}\,|111100000\rangle + R_{110001}\,|111100001\rangle + R_{110010}\,|111100010\rangle \\
&\quad + R_{110011}\,|111100011\rangle + R_{110100}\,|111100100\rangle + R_{110101}\,|111100101\rangle \\
&\quad + R_{110110}\,|111100110\rangle + R_{110111}\,|111100111\rangle + R_{111000}\,|111101000\rangle \\
&\quad + R_{111001}\,|111101001\rangle + R_{111010}\,|111101010\rangle + R_{111011}\,|111101011\rangle \\
&\quad + R_{111100}\,|111101100\rangle + R_{111101}\,|111101101\rangle + R_{111110}\,|111101110\rangle \\
&\quad + R_{111111}\,|111101111\rangle)
\end{aligned}
$$

$$
\begin{aligned}
+x_{11}y_0(&R_{000000}\left|100010000\right\rangle + R_{000001}\left|100010001\right\rangle + R_{000010}\left|100010010\right\rangle \\
&+ R_{000011}\left|100010011\right\rangle + R_{000100}\left|100010100\right\rangle + R_{000101}\left|100010101\right\rangle \\
&+ R_{000110}\left|100010110\right\rangle + R_{000111}\left|100010111\right\rangle + R_{001000}\left|100011000\right\rangle \\
&+ R_{001001}\left|100011001\right\rangle + R_{001010}\left|100011010\right\rangle + R_{001011}\left|100011011\right\rangle \\
&+ R_{001100}\left|100011100\right\rangle + R_{001101}\left|100011101\right\rangle + R_{001110}\left|100011110\right\rangle \\
&+ R_{001111}\left|100011111\right\rangle + R_{010000}\left|100110000\right\rangle + R_{010001}\left|100110001\right\rangle \\
&+ R_{010010}\left|100110010\right\rangle + R_{010011}\left|100110011\right\rangle + R_{010100}\left|100110100\right\rangle \\
&+ R_{010101}\left|100110101\right\rangle + R_{010110}\left|100110110\right\rangle + R_{010111}\left|100110111\right\rangle \\
&+ R_{011000}\left|100111000\right\rangle + R_{011001}\left|100111001\right\rangle + R_{011010}\left|100111010\right\rangle \\
&+ R_{011011}\left|100111011\right\rangle + R_{011100}\left|100111100\right\rangle + R_{011101}\left|100111101\right\rangle \\
&+ R_{011110}\left|100111110\right\rangle + R_{011111}\left|100111111\right\rangle + R_{100000}\left|110010000\right\rangle \\
&+ R_{100001}\left|110010001\right\rangle + R_{100010}\left|110010010\right\rangle + R_{100011}\left|110010011\right\rangle \\
&+ R_{100100}\left|110010100\right\rangle + R_{100101}\left|110010101\right\rangle + R_{100110}\left|110010110\right\rangle \\
&+ R_{100111}\left|110010111\right\rangle + R_{101000}\left|110011000\right\rangle + R_{101001}\left|110011001\right\rangle \\
&+ R_{101010}\left|110011010\right\rangle + R_{101011}\left|110011011\right\rangle + R_{101100}\left|110011100\right\rangle \\
&+ R_{101101}\left|110011101\right\rangle + R_{101110}\left|110011110\right\rangle + R_{101111}\left|110011111\right\rangle \\
&+ R_{110000}\left|110110000\right\rangle + R_{110001}\left|110110001\right\rangle + R_{110010}\left|110110010\right\rangle \\
&+ R_{110011}\left|110110011\right\rangle + R_{110100}\left|110110100\right\rangle + R_{110101}\left|110110101\right\rangle \\
&+ R_{110110}\left|110110110\right\rangle + R_{110111}\left|110110111\right\rangle + R_{111000}\left|110111000\right\rangle \\
&+ R_{111001}\left|110111001\right\rangle + R_{111010}\left|110111010\right\rangle + R_{111011}\left|110111011\right\rangle \\
&+ R_{111100}\left|110111100\right\rangle + R_{111101}\left|110111101\right\rangle + R_{111110}\left|110111110\right\rangle \\
&+ R_{111111}\left|110111111\right\rangle)
\end{aligned}
$$

$$
\begin{aligned}
&+x_{11}y_1(R_{000000}\left|101010000\right\rangle + R_{000001}\left|101010001\right\rangle + R_{000010}\left|101010010\right\rangle \\
&\quad + R_{000011}\left|101010011\right\rangle + R_{000100}\left|101010100\right\rangle + R_{000101}\left|101010101\right\rangle \\
&\quad + R_{000110}\left|101010110\right\rangle + R_{000111}\left|101010111\right\rangle + R_{001000}\left|101011000\right\rangle \\
&\quad + R_{001001}\left|101011001\right\rangle + R_{001010}\left|101011010\right\rangle + R_{001011}\left|101011011\right\rangle \\
&\quad + R_{001100}\left|101011100\right\rangle + R_{001101}\left|101011101\right\rangle + R_{001110}\left|101011110\right\rangle \\
&\quad + R_{001111}\left|101011111\right\rangle + R_{010000}\left|101110000\right\rangle + R_{010001}\left|101110001\right\rangle \\
&\quad + R_{010010}\left|101110010\right\rangle + R_{010011}\left|101110011\right\rangle + R_{010100}\left|101110100\right\rangle \\
&\quad + R_{010101}\left|101110101\right\rangle + R_{010110}\left|101110110\right\rangle + R_{010111}\left|101110111\right\rangle \\
&\quad + R_{011000}\left|101111000\right\rangle + R_{011001}\left|101111001\right\rangle + R_{011010}\left|101111010\right\rangle \\
&\quad + R_{011011}\left|101111011\right\rangle + R_{011100}\left|101111100\right\rangle + R_{011101}\left|101111101\right\rangle \\
&\quad + R_{011110}\left|101111110\right\rangle + R_{011111}\left|101111111\right\rangle + R_{100000}\left|111010000\right\rangle \\
&\quad + R_{100001}\left|111010001\right\rangle + R_{100010}\left|111010010\right\rangle + R_{100011}\left|111010011\right\rangle \\
&\quad + R_{100100}\left|111010100\right\rangle + R_{100101}\left|111010101\right\rangle + R_{100110}\left|111010110\right\rangle \\
&\quad + R_{100111}\left|111010111\right\rangle + R_{101000}\left|111011000\right\rangle + R_{101001}\left|111011001\right\rangle \\
&\quad + R_{101010}\left|111011010\right\rangle + R_{101011}\left|111011011\right\rangle + R_{101100}\left|111011100\right\rangle \\
&\quad + R_{101101}\left|111011101\right\rangle + R_{101110}\left|111011110\right\rangle + R_{101111}\left|111011111\right\rangle \\
&\quad + R_{110000}\left|111110000\right\rangle + R_{110001}\left|111110001\right\rangle + R_{110010}\left|111110010\right\rangle \\
&\quad + R_{110011}\left|111110011\right\rangle + R_{110100}\left|111110100\right\rangle + R_{110101}\left|111110101\right\rangle \\
&\quad + R_{110110}\left|111110110\right\rangle + R_{110111}\left|111110111\right\rangle + R_{111000}\left|111111000\right\rangle \\
&\quad + R_{111001}\left|111111001\right\rangle + R_{111010}\left|111111010\right\rangle + R_{111011}\left|111111011\right\rangle \\
&\quad + R_{111100}\left|111111100\right\rangle + R_{111101}\left|111111101\right\rangle + R_{111110}\left|111111110\right\rangle \\
&\quad + R_{111111}\left|111111111\right\rangle)
\end{aligned}
$$

Jika keadaan diatas dituliakan sebagai berikut:

$$\begin{array}{llll}
|000000\rangle := |1\rangle\,, & |000001\rangle := |2\rangle\,, & |000010\rangle := |3\rangle\,, & |000011\rangle := |4\rangle\,, \\
|000100\rangle := |5\rangle\,, & |000101\rangle := |6\rangle\,, & |000110\rangle := |7\rangle\,, & |000111\rangle := |8\rangle\,, \\
|001000\rangle := |9\rangle\,, & |001001\rangle := |10\rangle\,, & |001010\rangle := |11\rangle\,, & |001011\rangle := |12\rangle\,, \\
|001100\rangle := |13\rangle\,, & |001101\rangle := |14\rangle\,, & |001110\rangle := |15\rangle\,, & |001111\rangle := |16\rangle\,, \\
|010000\rangle := |17\rangle\,, & |010001\rangle := |18\rangle\,, & |010010\rangle := |19\rangle\,, & |010011\rangle := |20\rangle\,, \\
|010100\rangle := |21\rangle\,, & |010101\rangle := |22\rangle\,, & |010110\rangle := |23\rangle\,, & |010111\rangle := |24\rangle\,, \\
|011000\rangle := |25\rangle\,, & |011001\rangle := |26\rangle\,, & |011010\rangle := |27\rangle\,, & |011011\rangle := |28\rangle\,, \\
|011100\rangle := |29\rangle\,, & |011101\rangle := |30\rangle\,, & |011110\rangle := |31\rangle\,, & |011111\rangle := |32\rangle\,, \\
|100000\rangle := |33\rangle\,, & |100001\rangle := |34\rangle\,, & |100010\rangle := |35\rangle\,, & |100011\rangle := |36\rangle\,, \\
|100100\rangle := |37\rangle\,, & |100101\rangle := |38\rangle\,, & |100110\rangle := |39\rangle\,, & |100111\rangle := |40\rangle\,, \\
|101000\rangle := |41\rangle\,, & |101001\rangle := |42\rangle\,, & |101010\rangle := |43\rangle\,, & |101011\rangle := |44\rangle\,, \\
|101100\rangle := |45\rangle\,, & |101101\rangle := |46\rangle\,, & |101110\rangle := |47\rangle\,, & |101111\rangle := |48\rangle\,, \\
|110000\rangle := |49\rangle\,, & |110001\rangle := |50\rangle\,, & |110010\rangle := |51\rangle\,, & |110011\rangle := |52\rangle\,, \\
|110100\rangle := |53\rangle\,, & |110101\rangle := |54\rangle\,, & |110110\rangle := |55\rangle\,, & |110111\rangle := |56\rangle\,, \\
|111000\rangle := |57\rangle\,, & |111001\rangle := |58\rangle\,, & |111010\rangle := |59\rangle\,, & |111011\rangle := |60\rangle\,, \\
|111100\rangle := |61\rangle\,, & |111101\rangle := |62\rangle\,, & |111110\rangle := |63\rangle\,, & |111111\rangle := |64\rangle\,,
\end{array}$$

Maka persamaan diatas dapat berbentuk sebagai berikut:

$$\begin{aligned}
= \sum_{tuv=0}^{1} x_{00}y_0(&R_{000tuv}|000000\rangle + R_{001tuv}|000001\rangle + R_{010tuv}|000100\rangle \\
&+ R_{011tuv}|000101\rangle + R_{100tuv}|010000\rangle + R_{101tuv}|010001\rangle \\
&+ R_{110tuv}|010100\rangle + R_{111tuv}|010101\rangle)|tuv\rangle \\
+ \sum_{tuv=0}^{1} x_{00}y_1(&R_{000tuv}|001000\rangle + R_{001tuv}|001001\rangle + R_{010tuv}|001100\rangle \\
&+ R_{011tuv}|001101\rangle + R_{100tuv}|011000\rangle + R_{101tuv}|011001\rangle \\
&+ R_{110tuv}|011100\rangle + R_{111tuv}|011101\rangle)|tuv\rangle
\end{aligned}$$

$$\begin{aligned}
+ \sum_{tuv=0}^{1} x_{01}y_0(&R_{000tuv}|000010\rangle + R_{001tuv}|000011\rangle + R_{010tuv}|000110\rangle \\
&+ R_{011tuv}|000111\rangle + R_{100tuv}|010010\rangle + R_{101tuv}|010011\rangle \\
&+ R_{110tuv}|010110\rangle + R_{111tuv}|010111\rangle)|tuv\rangle \\
+ \sum_{tuv=0}^{1} x_{01}y_1(&R_{000tuv}|001010\rangle + R_{001tuv}|001011\rangle + R_{010tuv}|001110\rangle \\
&+ R_{011tuv}|001111\rangle + R_{100tuv}|011010\rangle + R_{101tuv}|011011\rangle \\
&+ R_{110tuv}|011110\rangle + R_{111tuv}|011111\rangle)|tuv\rangle
\end{aligned}$$

$$
\begin{aligned}
&+\sum_{tuv=0}^{1} x_{10}y_0(R_{000tuv}\left|100000\right\rangle + R_{001tuv}\left|100001\right\rangle + R_{010tuv}\left|100100\right\rangle \\
&\qquad + R_{011tuv}\left|100101\right\rangle + R_{100tuv}\left|110000\right\rangle + R_{101tuv}\left|110001\right\rangle \\
&\qquad + R_{110tuv}\left|110100\right\rangle + R_{111tuv}\left|110101\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{10}y_1(R_{000tuv}\left|101000\right\rangle + R_{001tuv}\left|101001\right\rangle + R_{010tuv}\left|101100\right\rangle \\
&\qquad + R_{011tuv}\left|101101\right\rangle + R_{100tuv}\left|111000\right\rangle + R_{101tuv}\left|111001\right\rangle \\
&\qquad + R_{110tuv}\left|111100\right\rangle + R_{111tuv}\left|111101\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{11}y_0(R_{000tuv}\left|100010\right\rangle + R_{001tuv}\left|100011\right\rangle + R_{010tuv}\left|100110\right\rangle \\
&\qquad + R_{011tuv}\left|100111\right\rangle + R_{100tuv}\left|110010\right\rangle + R_{101tuv}\left|110011\right\rangle \\
&\qquad + R_{110tuv}\left|110110\right\rangle + R_{111tuv}\left|110111\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{11}y_1(R_{000tuv}\left|101010\right\rangle + R_{001tuv}\left|101011\right\rangle + R_{010tuv}\left|101110\right\rangle \\
&\qquad + R_{011tuv}\left|101111\right\rangle + R_{100tuv}\left|111010\right\rangle + R_{101tuv}\left|111011\right\rangle \\
&\qquad + R_{110tuv}\left|111110\right\rangle + R_{111tuv}\left|111111\right\rangle)\left|tuv\right\rangle \\
=&\sum_{tuv=0}^{1} x_{00}y_0(R_{000tuv}\left|1\right\rangle + R_{001tuv}\left|2\right\rangle + R_{010tuv}\left|5\right\rangle + R_{011tuv}\left|6\right\rangle \\
&\qquad + R_{100tuv}\left|17\right\rangle + R_{101tuv}\left|18\right\rangle + R_{110tuv}\left|21\right\rangle + R_{111tuv}\left|22\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{00}y_1(R_{000tuv}\left|9\right\rangle + R_{001tuv}\left|10\right\rangle + R_{010tuv}\left|13\right\rangle + R_{011tuv}\left|14\right\rangle \\
&\qquad + R_{100tuv}\left|25\right\rangle + R_{101tuv}\left|26\right\rangle + R_{110tuv}\left|29\right\rangle + R_{111tuv}\left|30\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{01}y_0(R_{000tuv}\left|3\right\rangle + R_{001tuv}\left|4\right\rangle + R_{010tuv}\left|7\right\rangle + R_{011tuv}\left|8\right\rangle \\
&\qquad + R_{100tuv}\left|19\right\rangle + R_{101tuv}\left|20\right\rangle + R_{110tuv}\left|23\right\rangle + R_{111tuv}\left|24\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{01}y_1(R_{000tuv}\left|11\right\rangle + R_{001tuv}\left|12\right\rangle + R_{010tuv}\left|15\right\rangle + R_{011tuv}\left|16\right\rangle \\
&\qquad + R_{100tuv}\left|27\right\rangle + R_{101tuv}\left|28\right\rangle + R_{110tuv}\left|31\right\rangle + R_{111tuv}\left|32\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{10}y_0(R_{000tuv}\left|33\right\rangle + R_{001tuv}\left|34\right\rangle + R_{010tuv}\left|37\right\rangle + R_{011tuv}\left|38\right\rangle \\
&\qquad + R_{100tuv}\left|49\right\rangle + R_{101tuv}\left|50\right\rangle + R_{110tuv}\left|53\right\rangle + R_{111tuv}\left|54\right\rangle)\left|tuv\right\rangle \\
&+\sum_{tuv=0}^{1} x_{10}y_1(R_{000tuv}\left|41\right\rangle + R_{001tuv}\left|42\right\rangle + R_{010tuv}\left|45\right\rangle + R_{011tuv}\left|46\right\rangle \\
&\qquad + R_{100tuv}\left|57\right\rangle + R_{101tuv}\left|58\right\rangle + R_{110tuv}\left|61\right\rangle + R_{111tuv}\left|62\right\rangle)\left|tuv\right\rangle
\end{aligned}
$$

$$+\sum_{tuv=0}^{1} x_{11}y_0(R_{000tuv}|35\rangle + R_{001tuv}|36\rangle + R_{010tuv}|39\rangle + R_{011tuv}|40\rangle + R_{100tuv}|51\rangle + R_{101tuv}|52\rangle + R_{110tuv}|55\rangle + R_{111tuv}|56\rangle)|tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{11}y_1(R_{000tuv}|43\rangle + R_{001tuv}|44\rangle + R_{010tuv}|47\rangle + R_{011tuv}|48\rangle + R_{100tuv}|59\rangle + R_{101tuv}|60\rangle + R_{110tuv}|63\rangle + R_{111tuv}|64\rangle)|tuv\rangle$$

$$=\sum_{tuv=0}^{1} x_{00}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |1\rangle \\ |2\rangle \\ |5\rangle \\ |6\rangle \\ |17\rangle \\ |18\rangle \\ |21\rangle \\ |22\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{00}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |9\rangle \\ |10\rangle \\ |13\rangle \\ |14\rangle \\ |25\rangle \\ |26\rangle \\ |29\rangle \\ |30\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{01}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |3\rangle \\ |4\rangle \\ |7\rangle \\ |8\rangle \\ |19\rangle \\ |20\rangle \\ |23\rangle \\ |24\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{01}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |11\rangle \\ |12\rangle \\ |15\rangle \\ |16\rangle \\ |27\rangle \\ |28\rangle \\ |31\rangle \\ |32\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{10}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |33\rangle \\ |34\rangle \\ |37\rangle \\ |38\rangle \\ |49\rangle \\ |50\rangle \\ |53\rangle \\ |54\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{10}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |41\rangle \\ |42\rangle \\ |45\rangle \\ |46\rangle \\ |57\rangle \\ |58\rangle \\ |61\rangle \\ |62\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{11}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |35\rangle \\ |36\rangle \\ |39\rangle \\ |40\rangle \\ |51\rangle \\ |52\rangle \\ |55\rangle \\ |56\rangle \end{pmatrix} |tuv\rangle$$

$$+\sum_{tuv=0}^{1} x_{11}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} |43\rangle \\ |44\rangle \\ |47\rangle \\ |48\rangle \\ |59\rangle \\ |60\rangle \\ |63\rangle \\ |64\rangle \end{pmatrix} |tuv\rangle$$

Selanjutnya ditinjau keadaan Bell sebagai berikut:

$$\begin{aligned}
|\phi\rangle^1_{mn} &= \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)_{mn} \\
|\phi\rangle^2_{mn} &= \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle)_{mn} \\
|\phi\rangle^3_{mn} &= \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle)_{mn} \\
|\phi\rangle^4_{mn} &= \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)_{mn}
\end{aligned}$$

dari keadaan Bell di atas dapat dituliskan basis baru sebagai berikut:

$$\begin{aligned}
|00\rangle_{mn} &= \frac{1}{\sqrt{2}}(|\phi\rangle^1_{mn} + |\phi\rangle^2_{mn}) \\
|01\rangle_{mn} &= \frac{1}{\sqrt{2}}(|\phi\rangle^3_{mn} + |\phi\rangle^4_{mn}) \\
|10\rangle_{mn} &= \frac{1}{\sqrt{2}}(|\phi\rangle^3_{mn} - |\phi\rangle^4_{mn}) \\
|11\rangle_{mn} &= \frac{1}{\sqrt{2}}(|\phi\rangle^1_{mn} - |\phi\rangle^2_{mn})
\end{aligned}$$

dengan indeks mn merupakan indeks dari kubit yang dibentuk. Selanjutnya dengan mensubtitusikan basis baru tersebut kedalam persamaan yg didapatkan di atas, diperoleh:

$$|\Psi_{A,B,A_1,A_1,B_1,B_2,B_2,A_2}\rangle =$$

$$\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{00}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{00}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{01}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{01}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^1_{00}+|\phi\rangle^2_{00})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^3_{10}-|\phi\rangle^4_{10}) \\ (|\phi\rangle^3_{01}+|\phi\rangle^4_{01})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11})(|\phi\rangle^1_{11}-|\phi\rangle^2_{11}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{10}y_0 \left(R_{000tuv} \quad R_{001tuv} \quad R_{010tuv} \quad R_{011tuv} \quad R_{100tuv} \quad R_{101tuv} \quad R_{110tuv} \quad R_{111tuv}\right)$$

$$\begin{pmatrix} (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{10}y_1 \left(R_{000tuv} \quad R_{001tuv} \quad R_{010tuv} \quad R_{011tuv} \quad R_{100tuv} \quad R_{101tuv} \quad R_{110tuv} \quad R_{111tuv}\right)$$

$$\begin{pmatrix} (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{11}y_0 \left(R_{000tuv} \quad R_{001tuv} \quad R_{010tuv} \quad R_{011tuv} \quad R_{100tuv} \quad R_{101tuv} \quad R_{110tuv} \quad R_{111tuv}\right)$$

$$\begin{pmatrix} (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{00} + |\phi\rangle^{2}_{00})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{01} + |\phi\rangle^{4}_{01})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \end{pmatrix} |tuv\rangle$$

$$+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{11}y_1 \left(R_{000tuv} \quad R_{001tuv} \quad R_{010tuv} \quad R_{011tuv} \quad R_{100tuv} \quad R_{101tuv} \quad R_{110tuv} \quad R_{111tuv}\right)$$

$$\begin{pmatrix} (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{3}_{10} - |\phi\rangle^{4}_{10}) \\ (|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11})(|\phi\rangle^{1}_{11} - |\phi\rangle^{2}_{11}) \end{pmatrix} |tuv\rangle$$

$$
\begin{aligned}
= \frac{1}{2\sqrt{2}} \sum_{tuv=0}^{1} x_{00}(&R_{000tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{001tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{010tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{011tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{100tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{101tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{110tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{111tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})) \\
&|tuv\rangle
\end{aligned}
$$

$$
\begin{aligned}
+ \frac{1}{2\sqrt{2}} \sum_{tuv=0}^{1} x_{01}(&R_{000tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&+ R_{001tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&+ R_{010tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&+ R_{011tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&+ R_{100tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&+ R_{101tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&+ R_{110tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&+ R_{111tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})) \\
&|tuv\rangle
\end{aligned}
$$

$$
\begin{aligned}
+ \frac{1}{2\sqrt{2}} \sum_{tuv=0}^{1} x_{10}(&R_{001tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{001tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{010tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{011tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{100tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{101tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) + y_1(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&+ R_{110tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&+ R_{111tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) + y_1(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})) \\
&|tuv\rangle
\end{aligned}
$$

$$
\begin{aligned}
&+\frac{1}{2\sqrt{2}}\sum_{tuv=0}^{1} x_{11}(R_{000tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})+y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\\
&\qquad+R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})+y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\\
&\qquad+R_{010tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})+y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\\
&\qquad+R_{011tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(y_0(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})+y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\\
&\qquad+R_{100tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})+y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\\
&\qquad+R_{101tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})+y_1(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\\
&\qquad+R_{110tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})+y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\\
&\qquad+R_{111tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(y_0(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})+y_1(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))\\
&\qquad|tuv\rangle
\end{aligned}
$$

$$
\begin{aligned}
&=\frac{1}{2}\sum_{tuv=0}^{1} x_{00}(R_{000tuv}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\\
&\qquad+y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\\
&\qquad+R_{001tuv}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\\
&\qquad+y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\\
&\qquad+R_{010tuv}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}+T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\\
&\qquad+y_1(T_{11}^{1}|\phi\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+T_{11}^{3}|\phi\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4}))(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\\
&\qquad+R_{011tuv}(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}+T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\\
&\qquad+y_1(T_{11}^{1}|\phi\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+T_{11}^{3}|\phi\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4}))(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\\
&\qquad+R_{100tuv}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\\
&\qquad+y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\\
&\qquad+R_{101tuv}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})(y_0(T_{00}^{1}|\phi\rangle_{00}^{1}+T_{00}^{2}|\phi\rangle_{00}^{2}+T_{00}^{3}|\phi\rangle_{00}^{3}+T_{00}^{4}|\phi\rangle_{00}^{4})\\
&\qquad+y_1(T_{10}^{1}|\phi\rangle_{10}^{1}+T_{10}^{2}|\phi\rangle_{10}^{2}+T_{10}^{3}|\phi\rangle_{10}^{3}+T_{10}^{4}|\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})\\
&\qquad+R_{110tuv}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}+T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\\
&\qquad+y_1(T_{11}^{1}|\phi\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+T_{11}^{3}|\phi\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4}))(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})\\
&\qquad+R_{111tuv}(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})(y_0(T_{01}^{1}|\phi\rangle_{01}^{1}+T_{01}^{2}|\phi\rangle_{01}^{2}+T_{01}^{3}|\phi\rangle_{01}^{3}+T_{01}^{4}|\phi\rangle_{01}^{4})\\
&\qquad+y_1(T_{11}^{1}|\phi\rangle_{11}^{1}+T_{11}^{2}|\phi\rangle_{11}^{2}+T_{11}^{3}|\phi\rangle_{11}^{3}+T_{11}^{4}|\phi\rangle_{11}^{4}))(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4}))\,|tuv\rangle
\end{aligned}
$$

$$
\begin{aligned}
+\frac{1}{2}\sum_{tuv=0}^{1} x_{01}(R_{000tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{001tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{010tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{2} + T_{11}^{3}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{011tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{2} + T_{11}^{3}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{100tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{101tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{110tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{2} + T_{11}^{3}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{111tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{2} + T_{11}^{3}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))\,|tuv\rangle
\end{aligned}
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\begin{aligned}
+\frac{1}{2}\sum_{tuv=0}^{1} x_{10}(R_{001tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})\\
&+ R_{001tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})\\
&+ R_{010tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})\\
&+ R_{011tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})\\
&+ R_{100tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})\\
&+ R_{101tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
&+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})\\
&+ R_{110tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})\\
&+ R_{111tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
&+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}))\,|tuv\rangle
\end{aligned}
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\begin{aligned}
+\frac{1}{2}\sum_{tuv=0}^{1} x_{11}(R_{000tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
+ R_{001tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
+ R_{010tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
+ R_{011tuv}(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
+ R_{100tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
+ R_{101tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{00}^{1}\,|\phi\rangle_{00}^{1} + T_{00}^{2}\,|\phi\rangle_{00}^{2} + T_{00}^{3}\,|\phi\rangle_{00}^{3} + T_{00}^{4}\,|\phi\rangle_{00}^{4})\\
+ y_1(T_{10}^{1}\,|\phi\rangle_{10}^{1} + T_{10}^{2}\,|\phi\rangle_{10}^{2} + T_{10}^{3}\,|\phi\rangle_{10}^{3} + T_{10}^{4}\,|\phi\rangle_{10}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
+ R_{110tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
+ R_{111tuv}(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})(y_0(T_{01}^{1}\,|\phi\rangle_{01}^{1} + T_{01}^{2}\,|\phi\rangle_{01}^{2} + T_{01}^{3}\,|\phi\rangle_{01}^{3} + T_{01}^{4}\,|\phi\rangle_{01}^{4})\\
+ y_1(T_{11}^{1}\,|\phi\rangle_{11}^{1} + T_{11}^{2}\,|\phi\rangle_{11}^{3} + T_{11}^{1}\,|\phi\rangle_{11}^{3} + T_{11}^{4}\,|\phi\rangle_{11}^{4}))(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))\,|tuv\rangle
\end{aligned}
$$

dengan T^{τ}_{pq} adalah konstanta pada keadaan Bell $|\phi\rangle^{\tau}_{pq}$ untuk $\tau = 1, 2, 3, 4$ maka nilai dari T^{τ}_{pq} adalah:

$$\begin{pmatrix} T^1_{00} & T^2_{00} & T^3_{00} & T^4_{00} \\ T^1_{01} & T^2_{01} & T^3_{01} & T^4_{01} \\ T^1_{10} & T^2_{10} & T^3_{10} & T^4_{10} \\ T^1_{11} & T^2_{11} & T^3_{11} & T^4_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & -1 \\ 1 & -1 & 0 & 0 \end{pmatrix}$$

maka hasil persamaan diatas dapat dituliskan sebagai:

$$\begin{aligned} = \frac{1}{2} \sum_{tuv=0}^{1} \sum_{k=0}^{1} x_{00} y_k (& R_{000tuv} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{k0} |\phi\rangle^1_{k0} + T^2_{k0} |\phi\rangle^2_{k0} + T^3_{k0} |\phi\rangle^3_{k0} + T^4_{k0} |\phi\rangle^4_{k0}) \\ & (|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ & + R_{001tuv} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{k0} |\phi\rangle^1_{k0} + T^2_{k0} |\phi\rangle^2_{k0} + T^3_{k0} |\phi\rangle^3_{k0} + T^4_{k0} |\phi\rangle^4_{k0}) \\ & (|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \\ & + R_{010tuv} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{k1} |\phi\rangle^1_{k1} + T^2_{k1} |\phi\rangle^2_{k1} + T^3_{k1} |\phi\rangle^3_{k1} + T^4_{k1} |\phi\rangle^4_{k1}) \\ & (|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ & + R_{011tuv} (|\phi\rangle^1_{00} + |\phi\rangle^2_{00})(T^1_{k1} |\phi\rangle^1_{k1} + T^2_{k1} |\phi\rangle^2_{k1} + T^3_{k1} |\phi\rangle^3_{k1} + T^4_{k1} |\phi\rangle^4_{k1}) \\ & (|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \\ & + R_{100tuv} (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{k0} |\phi\rangle^1_{k0} + T^2_{k0} |\phi\rangle^2_{k0} + T^3_{k0} |\phi\rangle^3_{k0} + T^4_{k0} |\phi\rangle^4_{k0}) \\ & (|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ & + R_{101tuv} (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{k0} |\phi\rangle^1_{k0} + T^2_{k0} |\phi\rangle^2_{k0} + T^3_{k0} |\phi\rangle^3_{k0} + T^4_{k0} |\phi\rangle^4_{k0}) \\ & (|\phi\rangle^3_{01} + |\phi\rangle^4_{01}) \\ & + R_{110tuv} (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{k1} |\phi\rangle^1_{k1} + T^2_{k1} |\phi\rangle^2_{k1} + T^3_{k1} |\phi\rangle^3_{k1} + T^4_{k1} |\phi\rangle^4_{k1}) \\ & (|\phi\rangle^1_{00} + |\phi\rangle^2_{00}) \\ & + R_{111tuv} (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})(T^1_{k1} |\phi\rangle^1_{k1} + T^2_{k1} |\phi\rangle^2_{k1} + T^3_{k1} |\phi\rangle^3_{k1} + T^4_{k1} |\phi\rangle^4_{k1}) \\ & (|\phi\rangle^3_{01} + |\phi\rangle^4_{01})) \, |tuv\rangle \end{aligned}$$

$$
\begin{aligned}
+\frac{1}{2}\sum_{tuv=0}^{1}\sum_{k=0}^{1} x_{01}y_k(&R_{000tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(T_{k0}^{1}|\phi\rangle_{k0}^{1} + T_{k0}^{2}|\phi\rangle_{k0}^{2} + T_{k0}^{3}|\phi\rangle_{k0}^{3} + T_{k0}^{4}|\phi\rangle_{k0}^{4})\\
&(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{001tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(T_{k0}^{1}|\phi\rangle_{k0}^{1} + T_{k0}^{2}|\phi\rangle_{k0}^{2} + T_{k0}^{3}|\phi\rangle_{k0}^{3} + T_{k0}^{4}|\phi\rangle_{k0}^{4})\\
&(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{010tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(T_{k1}^{1}|\phi\rangle_{k1}^{1} + T_{k1}^{2}|\phi\rangle_{k1}^{2} + T_{k1}^{3}|\phi\rangle_{k1}^{3} + T_{k1}^{4}|\phi\rangle_{k1}^{4})\\
&(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{011tuv}(|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2})(T_{k1}^{1}|\phi\rangle_{k1}^{1} + T_{k1}^{2}|\phi\rangle_{k1}^{2} + T_{k1}^{3}|\phi\rangle_{k1}^{3} + T_{k1}^{4}|\phi\rangle_{k1}^{4})\\
&(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{100tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(T_{k0}^{1}|\phi\rangle_{k0}^{1} + T_{k0}^{2}|\phi\rangle_{k0}^{2} + T_{k0}^{3}|\phi\rangle_{k0}^{3} + T_{k0}^{4}|\phi\rangle_{k0}^{4})\\
&(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{101tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(T_{k0}^{1}|\phi\rangle_{k0}^{1} + T_{k0}^{2}|\phi\rangle_{k0}^{2} + T_{k0}^{3}|\phi\rangle_{k0}^{3} + T_{k0}^{4}|\phi\rangle_{k0}^{4})\\
&(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})\\
&+ R_{110tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(T_{k1}^{1}|\phi\rangle_{k1}^{1} + T_{k1}^{2}|\phi\rangle_{k1}^{2} + T_{k1}^{3}|\phi\rangle_{k1}^{3} + T_{k1}^{4}|\phi\rangle_{k1}^{4})\\
&(|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4})\\
&+ R_{111tuv}(|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})(T_{k1}^{1}|\phi\rangle_{k1}^{1} + T_{k1}^{2}|\phi\rangle_{k1}^{2} + T_{k1}^{3}|\phi\rangle_{k1}^{3} + T_{k1}^{4}|\phi\rangle_{k1}^{4})\\
&(|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}))\,|tuv\rangle
\end{aligned}
$$

$$+\frac{1}{2}\sum_{tuv=0}^{1}\sum_{k=0}^{1}x_{10}y_k(R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(T_{k0}^{1}|\phi\rangle_{k0}^{1}+T_{k0}^{2}|\phi\rangle_{k0}^{2}+T_{k0}^{3}|\phi\rangle_{k0}^{3}+T_{k0}^{4}|\phi\rangle_{k0}^{4})$$
$$(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$
$$+R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(T_{k0}^{1}|\phi\rangle_{k0}^{1}+T_{k0}^{2}|\phi\rangle_{k0}^{2}+T_{k0}^{3}|\phi\rangle_{k0}^{3}+T_{k0}^{4}|\phi\rangle_{k0}^{4})$$
$$(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$
$$+R_{010tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(T_{k1}^{1}|\phi\rangle_{k1}^{1}+T_{k1}^{2}|\phi\rangle_{k1}^{2}+T_{k1}^{3}|\phi\rangle_{k1}^{3}+T_{k1}^{4}|\phi\rangle_{k1}^{4})$$
$$(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$
$$+R_{011tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})(T_{k1}^{1}|\phi\rangle_{k1}^{1}+T_{k1}^{2}|\phi\rangle_{k1}^{2}+T_{k1}^{3}|\phi\rangle_{k1}^{3}+T_{k1}^{4}|\phi\rangle_{k1}^{4})$$
$$(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$
$$+R_{100tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(T_{k0}^{1}|\phi\rangle_{k0}^{1}+T_{k0}^{2}|\phi\rangle_{k0}^{2}+T_{k0}^{3}|\phi\rangle_{k0}^{3}+T_{k0}^{4}|\phi\rangle_{k0}^{4})$$
$$(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$
$$+R_{101tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(T_{k0}^{1}|\phi\rangle_{k0}^{1}+T_{k0}^{2}|\phi\rangle_{k0}^{2}+T_{k0}^{3}|\phi\rangle_{k0}^{3}+T_{k0}^{4}|\phi\rangle_{k0}^{4})$$
$$(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$
$$+R_{110tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(T_{k1}^{1}|\phi\rangle_{k1}^{1}+T_{k1}^{2}|\phi\rangle_{k1}^{2}+T_{k1}^{3}|\phi\rangle_{k1}^{3}+T_{k1}^{4}|\phi\rangle_{k1}^{4})$$
$$(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$
$$+R_{111tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})(T_{k1}^{1}|\phi\rangle_{k1}^{1}+T_{k1}^{2}|\phi\rangle_{k1}^{2}+T_{k1}^{3}|\phi\rangle_{k1}^{3}+T_{k1}^{4}|\phi\rangle_{k1}^{4})$$
$$(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4}))\,|tuv\rangle$$

$$+\frac{1}{2}\sum_{tuv=0}^{1}\sum_{k=0}^{1}x_{11}y_k(R_{000tuv}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})(T_{k0}^{1}\left|\phi\right\rangle_{k0}^{1}+T_{k0}^{2}\left|\phi\right\rangle_{k0}^{2}+T_{k0}^{3}\left|\phi\right\rangle_{k0}^{3}+T_{k0}^{4}\left|\phi\right\rangle_{k0}^{4})$$

$$(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{001tuv}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})(T_{k0}^{1}\left|\phi\right\rangle_{k0}^{1}+T_{k0}^{2}\left|\phi\right\rangle_{k0}^{2}+T_{k0}^{3}\left|\phi\right\rangle_{k0}^{3}+T_{k0}^{4}\left|\phi\right\rangle_{k0}^{4})$$

$$(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{010tuv}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})(T_{k1}^{1}\left|\phi\right\rangle_{k1}^{1}+T_{k1}^{2}\left|\phi\right\rangle_{k1}^{2}+T_{k1}^{3}\left|\phi\right\rangle_{k1}^{3}+T_{k1}^{4}\left|\phi\right\rangle_{k1}^{4})$$

$$(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{011tuv}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})(T_{k1}^{1}\left|\phi\right\rangle_{k1}^{1}+T_{k1}^{2}\left|\phi\right\rangle_{k1}^{2}+T_{k1}^{3}\left|\phi\right\rangle_{k1}^{3}+T_{k1}^{4}\left|\phi\right\rangle_{k1}^{4})$$

$$(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{100tuv}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})(T_{k0}^{1}\left|\phi\right\rangle_{k0}^{1}+T_{k0}^{2}\left|\phi\right\rangle_{k0}^{2}+T_{k0}^{3}\left|\phi\right\rangle_{k0}^{3}+T_{k0}^{4}\left|\phi\right\rangle_{k0}^{4})$$

$$(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{101tuv}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})(T_{k0}^{1}\left|\phi\right\rangle_{k0}^{1}+T_{k0}^{2}\left|\phi\right\rangle_{k0}^{2}+T_{k0}^{3}\left|\phi\right\rangle_{k0}^{3}+T_{k0}^{4}\left|\phi\right\rangle_{k0}^{4})$$

$$(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{110tuv}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})(T_{k1}^{1}\left|\phi\right\rangle_{k1}^{1}+T_{k1}^{2}\left|\phi\right\rangle_{k1}^{2}+T_{k1}^{3}\left|\phi\right\rangle_{k1}^{3}+T_{k1}^{4}\left|\phi\right\rangle_{k1}^{4})$$

$$(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{111tuv}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})(T_{k1}^{1}\left|\phi\right\rangle_{k1}^{1}+T_{k1}^{2}\left|\phi\right\rangle_{k1}^{2}+T_{k1}^{3}\left|\phi\right\rangle_{k1}^{3}+T_{k1}^{4}\left|\phi\right\rangle_{k1}^{4})$$

$$(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2}))\left|tuv\right\rangle$$

$$
\begin{aligned}
&= \frac{1}{2} \sum_{tuv=0}^{1} \sum_{k=0}^{1} x_{00} y_k (R_{000tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&\qquad + R_{001tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&\qquad + R_{010tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&\qquad + R_{011tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&\qquad + R_{100tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&\qquad + R_{101tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \\
&\qquad + R_{110tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \\
&\qquad + R_{111tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4})) \, |tuv\rangle \\
&+ \frac{1}{2} \sum_{tuv=0}^{1} \sum_{k=0}^{1} x_{01} y_k (R_{000tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&\qquad + R_{001tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&\qquad + R_{010tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&\qquad + R_{011tuv} (|\phi\rangle_{00}^{1} + |\phi\rangle_{00}^{2}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&\qquad + R_{100tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&\qquad + R_{101tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k0}^{\nu} \, |\phi\rangle_{k0}^{\nu} \, (|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2}) \\
&\qquad + R_{110tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{10}^{3} - |\phi\rangle_{10}^{4}) \\
&\qquad + R_{111tuv} (|\phi\rangle_{01}^{3} + |\phi\rangle_{01}^{4}) \sum_{\nu=1}^{4} T_{k1}^{\nu} \, |\phi\rangle_{k1}^{\nu} \, (|\phi\rangle_{11}^{1} - |\phi\rangle_{11}^{2})) \, |tuv\rangle
\end{aligned}
$$

$$+\frac{1}{2}\sum_{tuv=0}^{1}\sum_{k=0}^{1}x_{10}y_k(R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$

$$+R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$

$$+R_{010tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$

$$+R_{011tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$

$$+R_{100tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$

$$+R_{101tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4})$$

$$+R_{110tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{00}^{1}+|\phi\rangle_{00}^{2})$$

$$+R_{111tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{01}^{3}+|\phi\rangle_{01}^{4}))\,|tuv\rangle$$

$$+\frac{1}{2}\sum_{tuv=0}^{1}\sum_{k=0}^{1}x_{11}y_k(R_{000tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})$$

$$+R_{001tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})$$

$$+R_{010tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})$$

$$+R_{011tuv}(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})$$

$$+R_{100tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})$$

$$+R_{101tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})$$

$$+R_{110tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{10}^{3}-|\phi\rangle_{10}^{4})$$

$$+R_{111tuv}(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2})\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{11}^{1}-|\phi\rangle_{11}^{2}))\,|tuv\rangle$$

Selanjutnya persamaan di atas akan menjadi seperti berikiut:

$$= \frac{1}{\sqrt{2}} \sum_{tuv=0}^{1} \sum_{k=0}^{1} x_{00} y_k (R_{000tuv}(T_{00}^1 |\phi\rangle_{00}^1 + T_{00}^2 |\phi\rangle_{00}^2 + T_{00}^3 |\phi\rangle_{00}^3 + T_{00}^4 |\phi\rangle_{00}^4)$$

$$\sum_{\nu=1}^{4} T_{k0}^{\nu} |\phi\rangle_{k0}^{\nu} (|\phi\rangle_{00}^1 + |\phi\rangle_{00}^2)$$

$$+ R_{001tuv}(T_{00}^1 |\phi\rangle_{00}^1 + T_{00}^2 |\phi\rangle_{00}^2 + T_{00}^3 |\phi\rangle_{00}^3 + T_{00}^4 |\phi\rangle_{00}^4)$$

$$\sum_{\nu=1}^{4} T_{k0}^{\nu} |\phi\rangle_{k0}^{\nu} (|\phi\rangle_{01}^3 + |\phi\rangle_{01}^4)$$

$$+ R_{010tuv}(T_{00}^1 |\phi\rangle_{00}^1 + T_{00}^2 |\phi\rangle_{00}^2 + T_{00}^3 |\phi\rangle_{00}^3 + T_{00}^4 |\phi\rangle_{00}^4)$$

$$\sum_{\nu=1}^{4} T_{k1}^{\nu} |\phi\rangle_{k1}^{\nu} (|\phi\rangle_{00}^1 + |\phi\rangle_{00}^2)$$

$$+ R_{011tuv}(T_{00}^1 |\phi\rangle_{00}^1 + T_{00}^2 |\phi\rangle_{00}^2 + T_{00}^3 |\phi\rangle_{00}^3 + T_{00}^4 |\phi\rangle_{00}^4)$$

$$\sum_{\nu=1}^{4} T_{k1}^{\nu} |\phi\rangle_{k1}^{\nu} (|\phi\rangle_{01}^3 + |\phi\rangle_{01}^4)$$

$$+ R_{100tuv}(T_{01}^1 |\phi\rangle_{01}^1 + T_{01}^2 |\phi\rangle_{01}^2 + T_{01}^3 |\phi\rangle_{01}^3 + T_{01}^4 |\phi\rangle_{01}^4)$$

$$\sum_{\nu=1}^{4} T_{k0}^{\nu} |\phi\rangle_{k0}^{\nu} (|\phi\rangle_{00}^1 + |\phi\rangle_{00}^2)$$

$$+ R_{101tuv}(T_{01}^1 |\phi\rangle_{01}^1 + T_{01}^2 |\phi\rangle_{01}^2 + T_{01}^3 |\phi\rangle_{01}^3 + T_{01}^4 |\phi\rangle_{01}^4)$$

$$\sum_{\nu=1}^{4} T_{k0}^{\nu} |\phi\rangle_{k0}^{\nu} (|\phi\rangle_{01}^3 + |\phi\rangle_{01}^4)$$

$$+ R_{110tuv}(T_{01}^1 |\phi\rangle_{01}^1 + T_{01}^2 |\phi\rangle_{01}^2 + T_{01}^3 |\phi\rangle_{01}^3 + T_{01}^4 |\phi\rangle_{01}^4)$$

$$\sum_{\nu=1}^{4} T_{k1}^{\nu} |\phi\rangle_{k1}^{\nu} (|\phi\rangle_{00}^1 + |\phi\rangle_{00}^2)$$

$$+ R_{111tuv}(T_{01}^1 |\phi\rangle_{01}^1 + T_{01}^2 |\phi\rangle_{01}^2 + T_{01}^3 |\phi\rangle_{01}^3 + T_{01}^4 |\phi\rangle_{01}^4)$$

$$\sum_{\nu=1}^{4} T_{k1}^{\nu} |\phi\rangle_{k1}^{\nu} (|\phi\rangle_{01}^3 + |\phi\rangle_{01}^4)) |tuv\rangle$$

$$
\begin{aligned}
+\frac{1}{\sqrt{2}}\sum_{tuv=0}^{1}\sum_{k=0}^{1} x_{01}y_k(R_{000tuv}&(T^1_{00}\left|\phi\right\rangle^1_{00}+T^2_{00}\left|\phi\right\rangle^2_{00}+T^3_{00}\left|\phi\right\rangle^3_{00}+T^4_{00}\left|\phi\right\rangle^4_{00})\\
&\sum_{\nu=1}^{4}T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^3_{10}-\left|\phi\right\rangle^4_{10})\\
&+R_{001tuv}(T^1_{00}\left|\phi\right\rangle^1_{00}+T^2_{00}\left|\phi\right\rangle^2_{00}+T^3_{00}\left|\phi\right\rangle^3_{00}+T^4_{00}\left|\phi\right\rangle^4_{00})\\
&\sum_{\nu=1}^{4}T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^1_{11}-\left|\phi\right\rangle^2_{11})\\
&+R_{010tuv}(T^1_{00}\left|\phi\right\rangle^1_{00}+T^2_{00}\left|\phi\right\rangle^2_{00}+T^3_{00}\left|\phi\right\rangle^3_{00}+T^4_{00}\left|\phi\right\rangle^4_{00})\\
&\sum_{\nu=1}^{4}T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^3_{10}-\left|\phi\right\rangle^4_{10})\\
&+R_{011tuv}(T^1_{00}\left|\phi\right\rangle^1_{00}+T^2_{00}\left|\phi\right\rangle^2_{00}+T^3_{00}\left|\phi\right\rangle^3_{00}+T^4_{00}\left|\phi\right\rangle^4_{00})\\
&\sum_{\nu=1}^{4}T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^1_{11}-\left|\phi\right\rangle^2_{11})\\
&+R_{100tuv}(T^1_{01}\left|\phi\right\rangle^1_{01}+T^2_{01}\left|\phi\right\rangle^2_{01}+T^3_{01}\left|\phi\right\rangle^3_{01}+T^4_{01}\left|\phi\right\rangle^4_{01})\\
&\sum_{\nu=1}^{4}T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^3_{10}-\left|\phi\right\rangle^4_{10})\\
&+R_{101tuv}(T^1_{01}\left|\phi\right\rangle^1_{01}+T^2_{01}\left|\phi\right\rangle^2_{01}+T^3_{01}\left|\phi\right\rangle^3_{01}+T^4_{01}\left|\phi\right\rangle^4_{01})\\
&\sum_{\nu=1}^{4}T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^1_{11}-\left|\phi\right\rangle^2_{11})\\
&+R_{110tuv}(T^1_{01}\left|\phi\right\rangle^1_{01}+T^2_{01}\left|\phi\right\rangle^2_{01}+T^3_{01}\left|\phi\right\rangle^3_{01}+T^4_{01}\left|\phi\right\rangle^4_{01})\\
&\sum_{\nu=1}^{4}T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^3_{10}-\left|\phi\right\rangle^4_{10})\\
&+R_{111tuv}(T^1_{01}\left|\phi\right\rangle^1_{01}+T^2_{01}\left|\phi\right\rangle^2_{01}+T^3_{01}\left|\phi\right\rangle^3_{01}+T^4_{01}\left|\phi\right\rangle^4_{01})\\
&\sum_{\nu=1}^{4}T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^1_{11}-\left|\phi\right\rangle^2_{11}))\left|tuv\right\rangle
\end{aligned}
$$

$$+\frac{1}{\sqrt{2}}\sum_{tuv=0}^{1}\sum_{k=0}^{1}x_{10}y_k(R_{001tuv}(T_{10}^{1}\left|\phi\right\rangle_{10}^{1}+T_{10}^{2}\left|\phi\right\rangle_{10}^{2}+T_{10}^{3}\left|\phi\right\rangle_{10}^{3}+T_{10}^{4}\left|\phi\right\rangle_{10}^{4})$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{00}^{1}+\left|\phi\right\rangle_{00}^{2})$$

$$+R_{001tuv}(T_{10}^{1}\left|\phi\right\rangle_{10}^{1}+T_{10}^{2}\left|\phi\right\rangle_{10}^{2}+T_{10}^{3}\left|\phi\right\rangle_{10}^{3}+T_{10}^{4}\left|\phi\right\rangle_{10}^{4})$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{01}^{3}+\left|\phi\right\rangle_{01}^{4})$$

$$+R_{010tuv}(T_{10}^{1}\left|\phi\right\rangle_{10}^{1}+T_{10}^{2}\left|\phi\right\rangle_{10}^{2}+T_{10}^{3}\left|\phi\right\rangle_{10}^{3}+T_{10}^{4}\left|\phi\right\rangle_{10}^{4})$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{00}^{1}+\left|\phi\right\rangle_{00}^{2})$$

$$+R_{011tuv}(T_{10}^{1}\left|\phi\right\rangle_{10}^{1}+T_{10}^{2}\left|\phi\right\rangle_{10}^{2}+T_{10}^{3}\left|\phi\right\rangle_{10}^{3}+T_{10}^{4}\left|\phi\right\rangle_{10}^{4})$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{01}^{3}+\left|\phi\right\rangle_{01}^{4})$$

$$+R_{100tuv}(T_{11}^{1}\left|\phi\right\rangle_{11}^{1}+T_{11}^{2}\left|\phi\right\rangle_{11}^{2}+T_{11}^{3}\left|\phi\right\rangle_{11}^{3}+T_{11}^{4}\left|\phi\right\rangle_{11}^{4})$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{00}^{1}+\left|\phi\right\rangle_{00}^{2})$$

$$+R_{101tuv}(T_{11}^{1}\left|\phi\right\rangle_{11}^{1}+T_{11}^{2}\left|\phi\right\rangle_{11}^{2}+T_{11}^{3}\left|\phi\right\rangle_{11}^{3}+T_{11}^{4}\left|\phi\right\rangle_{11}^{4})$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{01}^{3}+\left|\phi\right\rangle_{01}^{4})$$

$$+R_{110tuv}(T_{11}^{1}\left|\phi\right\rangle_{11}^{1}+T_{11}^{2}\left|\phi\right\rangle_{11}^{2}+T_{11}^{3}\left|\phi\right\rangle_{11}^{3}+T_{11}^{4}\left|\phi\right\rangle_{11}^{4})$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{00}^{1}+\left|\phi\right\rangle_{00}^{2})$$

$$+R_{111tuv}(T_{11}^{1}\left|\phi\right\rangle_{11}^{1}+T_{11}^{2}\left|\phi\right\rangle_{11}^{2}+T_{11}^{3}\left|\phi\right\rangle_{11}^{3}+T_{11}^{4}\left|\phi\right\rangle_{11}^{4})$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{01}^{3}+\left|\phi\right\rangle_{01}^{4}))\left|tuv\right\rangle$$

$$
\begin{aligned}
+\frac{1}{\sqrt{2}}\sum_{tuv=0}^{1}\sum_{k=0}^{1} x_{11}y_k(R_{000tuv}(&T^1_{10}\left|\phi\right\rangle^1_{10} + T^2_{10}\left|\phi\right\rangle^2_{10} + T^3_{10}\left|\phi\right\rangle^3_{10} + T^4_{10}\left|\phi\right\rangle^4_{10}) \\
&\sum_{\nu=1}^{4} T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^3_{10} - \left|\phi\right\rangle^4_{10}) \\
&+ R_{001tuv}(T^1_{10}\left|\phi\right\rangle^1_{10} + T^2_{10}\left|\phi\right\rangle^2_{10} + T^3_{10}\left|\phi\right\rangle^3_{10} + T^4_{10}\left|\phi\right\rangle^4_{10}) \\
&\sum_{\nu=1}^{4} T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^1_{11} - \left|\phi\right\rangle^2_{11}) \\
&+ R_{010tuv}(T^1_{10}\left|\phi\right\rangle^1_{10} + T^2_{10}\left|\phi\right\rangle^2_{10} + T^3_{10}\left|\phi\right\rangle^3_{10} + T^4_{10}\left|\phi\right\rangle^4_{10}) \\
&\sum_{\nu=1}^{4} T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^3_{10} - \left|\phi\right\rangle^4_{10}) \\
&+ R_{011tuv}(T^1_{10}\left|\phi\right\rangle^1_{10} + T^2_{10}\left|\phi\right\rangle^2_{10} + T^3_{10}\left|\phi\right\rangle^3_{10} + T^4_{10}\left|\phi\right\rangle^4_{10}) \\
&\sum_{\nu=1}^{4} T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^1_{11} - \left|\phi\right\rangle^2_{11}) \\
&+ R_{100tuv}(T^1_{11}\left|\phi\right\rangle^1_{11} + T^2_{11}\left|\phi\right\rangle^2_{11} + T^3_{11}\left|\phi\right\rangle^3_{11} + T^4_{11}\left|\phi\right\rangle^4_{11}) \\
&\sum_{\nu=1}^{4} T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^3_{10} - \left|\phi\right\rangle^4_{10}) \\
&+ R_{101tuv}(T^1_{11}\left|\phi\right\rangle^1_{11} + T^2_{11}\left|\phi\right\rangle^2_{11} + T^3_{11}\left|\phi\right\rangle^3_{11} + T^4_{11}\left|\phi\right\rangle^4_{11}) \\
&\sum_{\nu=1}^{4} T^\nu_{k0}\left|\phi\right\rangle^\nu_{k0}(\left|\phi\right\rangle^1_{11} - \left|\phi\right\rangle^2_{11}) \\
&+ R_{110tuv}(T^1_{11}\left|\phi\right\rangle^1_{11} + T^2_{11}\left|\phi\right\rangle^2_{11} + T^3_{11}\left|\phi\right\rangle^3_{11} + T^4_{11}\left|\phi\right\rangle^4_{11}) \\
&\sum_{\nu=1}^{4} T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^3_{10} - \left|\phi\right\rangle^4_{10}) \\
&+ R_{111tuv}(T^1_{11}\left|\phi\right\rangle^1_{11} + T^2_{11}\left|\phi\right\rangle^2_{11} + T^3_{11}\left|\phi\right\rangle^3_{11} + T^4_{11}\left|\phi\right\rangle^4_{11}) \\
&\sum_{\nu=1}^{4} T^\nu_{k1}\left|\phi\right\rangle^\nu_{k1}(\left|\phi\right\rangle^1_{11} - \left|\phi\right\rangle^2_{11}))\left|tuv\right\rangle
\end{aligned}
$$

$$
\begin{aligned}
= \frac{1}{\sqrt{2}} \sum_{tuv=0}^{1} \sum_{ik=0}^{1} x_{i0} y_k (R_{000tuv} & (T_{i0}^1 \left|\phi\right\rangle_{i0}^1 + T_{i0}^2 \left|\phi\right\rangle_{i0}^2 + T_{i0}^3 \left|\phi\right\rangle_{i0}^3 + T_{i0}^4 \left|\phi\right\rangle_{i0}^4) \\
& \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{00}^1 + \left|\phi\right\rangle_{00}^2) \\
& + R_{001tuv} (T_{i0}^1 \left|\phi\right\rangle_{i0}^1 + T_{i0}^2 \left|\phi\right\rangle_{i0}^2 + T_{i0}^3 \left|\phi\right\rangle_{i0}^3 + T_{i0}^4 \left|\phi\right\rangle_{i0}^4) \\
& \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{01}^3 + \left|\phi\right\rangle_{01}^4) \\
& + R_{010tuv} (T_{i0}^1 \left|\phi\right\rangle_{i0}^1 + T_{i0}^2 \left|\phi\right\rangle_{i0}^2 + T_{i0}^3 \left|\phi\right\rangle_{i0}^3 + T_{i0}^4 \left|\phi\right\rangle_{i0}^4) \\
& \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{00}^1 + \left|\phi\right\rangle_{00}^2) \\
& + R_{011tuv} (T_{i0}^1 \left|\phi\right\rangle_{i0}^1 + T_{i0}^2 \left|\phi\right\rangle_{i0}^2 + T_{i0}^3 \left|\phi\right\rangle_{i0}^3 + T_{i0}^4 \left|\phi\right\rangle_{i0}^4) \\
& \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{01}^3 + \left|\phi\right\rangle_{01}^4) \\
& + R_{100tuv} (T_{i1}^1 \left|\phi\right\rangle_{i1}^1 + T_{i1}^2 \left|\phi\right\rangle_{i1}^2 + T_{i1}^3 \left|\phi\right\rangle_{i1}^3 + T_{i1}^4 \left|\phi\right\rangle_{i1}^4) \\
& \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{00}^1 + \left|\phi\right\rangle_{00}^2) \\
& + R_{101tuv} (T_{i1}^1 \left|\phi\right\rangle_{i1}^1 + T_{i1}^2 \left|\phi\right\rangle_{i1}^2 + T_{i1}^3 \left|\phi\right\rangle_{i1}^3 + T_{i1}^4 \left|\phi\right\rangle_{i1}^4) \\
& \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{01}^3 + \left|\phi\right\rangle_{01}^4) \\
& + R_{110tuv} (T_{i1}^1 \left|\phi\right\rangle_{i1}^1 + T_{i1}^2 \left|\phi\right\rangle_{i1}^2 + T_{i1}^3 \left|\phi\right\rangle_{i1}^3 + T_{i1}^4 \left|\phi\right\rangle_{i1}^4) \\
& \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{00}^1 + \left|\phi\right\rangle_{00}^2) \\
& + R_{111tuv} (T_{i1}^1 \left|\phi\right\rangle_{i1}^1 + T_{i1}^2 \left|\phi\right\rangle_{i1}^2 + T_{i1}^3 \left|\phi\right\rangle_{i1}^3 + T_{i1}^4 \left|\phi\right\rangle_{i1}^4) \\
& \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{01}^3 + \left|\phi\right\rangle_{01}^4)) \left|tuv\right\rangle
\end{aligned}
$$

$$+\frac{1}{\sqrt{2}}\sum_{tuv=0}^{1}\sum_{ik=0}^{1}x_{i1}y_k(R_{000tuv}(T_{i0}^1\,|\phi\rangle_{i0}^1+T_{i0}^2\,|\phi\rangle_{i0}^2+T_{i0}^3\,|\phi\rangle_{i0}^3+T_{i0}^4\,|\phi\rangle_{i0}^4)$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{10}^3-|\phi\rangle_{10}^4)$$

$$+R_{001tuv}(T_{i0}^1\,|\phi\rangle_{i0}^1+T_{i0}^2\,|\phi\rangle_{i0}^2+T_{i0}^3\,|\phi\rangle_{i0}^3+T_{i0}^4\,|\phi\rangle_{i0}^4)$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{11}^1-|\phi\rangle_{11}^2)$$

$$+R_{010tuv}(T_{i0}^1\,|\phi\rangle_{i0}^1+T_{i0}^2\,|\phi\rangle_{i0}^2+T_{i0}^3\,|\phi\rangle_{i0}^3+T_{i0}^4\,|\phi\rangle_{i0}^4)$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{10}^3-|\phi\rangle_{10}^4)$$

$$+R_{011tuv}(T_{i0}^1\,|\phi\rangle_{i0}^1+T_{i0}^2\,|\phi\rangle_{i0}^2+T_{i0}^3\,|\phi\rangle_{i0}^3+T_{i0}^4\,|\phi\rangle_{i0}^4)$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{11}^1-|\phi\rangle_{11}^2)$$

$$+R_{100tuv}(T_{i1}^1\,|\phi\rangle_{i1}^1+T_{i1}^2\,|\phi\rangle_{i1}^2+T_{i1}^3\,|\phi\rangle_{i1}^3+T_{i1}^4\,|\phi\rangle_{i1}^4)$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{10}^3-|\phi\rangle_{10}^4)$$

$$+R_{101tuv}(T_{i1}^1\,|\phi\rangle_{i1}^1+T_{i1}^2\,|\phi\rangle_{i1}^2+T_{i1}^3\,|\phi\rangle_{i1}^3+T_{i1}^4\,|\phi\rangle_{i1}^4)$$

$$\sum_{\nu=1}^{4}T_{k0}^{\nu}\,|\phi\rangle_{k0}^{\nu}\,(|\phi\rangle_{11}^1-|\phi\rangle_{11}^2)$$

$$+R_{110tuv}(T_{i1}^1\,|\phi\rangle_{i1}^1+T_{i1}^2\,|\phi\rangle_{i1}^2+T_{i1}^3\,|\phi\rangle_{i1}^3+T_{i1}^4\,|\phi\rangle_{i1}^4)$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{10}^3-|\phi\rangle_{10}^4)$$

$$+R_{111tuv}(T_{i1}^1\,|\phi\rangle_{i1}^1+T_{i1}^2\,|\phi\rangle_{i1}^2+T_{i1}^3\,|\phi\rangle_{i1}^3+T_{i1}^4\,|\phi\rangle_{i1}^4)$$

$$\sum_{\nu=1}^{4}T_{k1}^{\nu}\,|\phi\rangle_{k1}^{\nu}\,(|\phi\rangle_{11}^1-|\phi\rangle_{11}^2))\,|tuv\rangle$$

$$
\begin{aligned}
= \frac{1}{\sqrt{2}} \sum_{tuv=0}^{1} \sum_{ik=0}^{1} x_{i0} y_k (& R_{000tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{00}^{1} + \left|\phi\right\rangle_{00}^{2}) \\
& + R_{001tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{01}^{3} + \left|\phi\right\rangle_{01}^{4}) \\
& + R_{010tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{00}^{1} + \left|\phi\right\rangle_{00}^{2}) \\
& + R_{011tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{01}^{3} + \left|\phi\right\rangle_{01}^{4}) \\
& + R_{100tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{00}^{1} + \left|\phi\right\rangle_{00}^{2}) \\
& + R_{101tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (\left|\phi\right\rangle_{01}^{3} + \left|\phi\right\rangle_{01}^{4}) \\
& + R_{110tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{00}^{1} + \left|\phi\right\rangle_{00}^{2}) \\
& + R_{111tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (\left|\phi\right\rangle_{01}^{3} + \left|\phi\right\rangle_{01}^{4})) \left|tuv\right\rangle
\end{aligned}
$$

$$+\frac{1}{\sqrt{2}}\sum_{tuv=0}^{1}\sum_{ik=0}^{1}x_{i1}y_k(R_{000tuv}\sum_{\mu=1}^{4}T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{001tuv}\sum_{\mu=1}^{4}T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{010tuv}\sum_{\mu=1}^{4}T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{011tuv}\sum_{\mu=1}^{4}T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{100tuv}\sum_{\mu=1}^{4}T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{101tuv}\sum_{\mu=1}^{4}T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4}T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2})$$

$$+R_{110tuv}\sum_{\mu=1}^{4}T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{10}^{3}-\left|\phi\right\rangle_{10}^{4})$$

$$+R_{111tuv}\sum_{\mu=1}^{4}T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4}T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(\left|\phi\right\rangle_{11}^{1}-\left|\phi\right\rangle_{11}^{2}))\left|tuv\right\rangle$$

$$
\begin{aligned}
= \sum_{tuv=0}^{1} \sum_{ik=0}^{1} x_{i0} y_k (R_{000tuv} & \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{00}^{1} \left|\phi\right\rangle_{00}^{1} + T_{00}^{2} \left|\phi\right\rangle_{00}^{2} \\
& + T_{00}^{3} \left|\phi\right\rangle_{00}^{3} + T_{00}^{4} \left|\phi\right\rangle_{00}^{4}) \\
& + R_{001tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{01}^{1} \left|\phi\right\rangle_{01}^{1} + T_{01}^{2} \left|\phi\right\rangle_{01}^{2} \\
& + T_{01}^{3} \left|\phi\right\rangle_{01}^{3} + T_{01}^{4} \left|\phi\right\rangle_{01}^{4}) \\
& + R_{010tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{00}^{1} \left|\phi\right\rangle_{00}^{1} + T_{00}^{2} \left|\phi\right\rangle_{00}^{2} \\
& + T_{00}^{3} \left|\phi\right\rangle_{00}^{3} + T_{00}^{4} \left|\phi\right\rangle_{00}^{4}) \\
& + R_{011tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{01}^{1} \left|\phi\right\rangle_{01}^{1} + T_{01}^{2} \left|\phi\right\rangle_{01}^{2} \\
& + T_{01}^{3} \left|\phi\right\rangle_{01}^{3} + T_{01}^{4} \left|\phi\right\rangle_{01}^{4}) \\
& + R_{100tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{00}^{1} \left|\phi\right\rangle_{00}^{1} + T_{00}^{2} \left|\phi\right\rangle_{00}^{2} \\
& + T_{00}^{3} \left|\phi\right\rangle_{00}^{3} + T_{00}^{4} \left|\phi\right\rangle_{00}^{4}) \\
& + R_{101tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{01}^{1} \left|\phi\right\rangle_{01}^{1} + T_{01}^{2} \left|\phi\right\rangle_{01}^{2} \\
& + T_{01}^{3} \left|\phi\right\rangle_{01}^{3} + T_{01}^{4} \left|\phi\right\rangle_{01}^{4}) \\
& + R_{110tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{00}^{1} \left|\phi\right\rangle_{00}^{1} + T_{00}^{2} \left|\phi\right\rangle_{00}^{2} \\
& + T_{00}^{3} \left|\phi\right\rangle_{00}^{3} + T_{00}^{4} \left|\phi\right\rangle_{00}^{4}) \\
& + R_{111tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{01}^{1} \left|\phi\right\rangle_{01}^{1} + T_{01}^{2} \left|\phi\right\rangle_{01}^{2} \\
& + T_{01}^{3} \left|\phi\right\rangle_{01}^{3} + T_{01}^{4} \left|\phi\right\rangle_{01}^{4})) \left|tuv\right\rangle
\end{aligned}
$$

$$
\begin{aligned}
+ \sum_{tuv=0}^{1} \sum_{ik=0}^{1} x_{i1} y_k (& R_{000tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{10}^{1} \left|\phi\right\rangle_{10}^{1} + T_{10}^{2} \left|\phi\right\rangle_{10}^{2} \\
& + T_{10}^{3} \left|\phi\right\rangle_{10}^{3} + T_{10}^{4} \left|\phi\right\rangle_{10}^{4}) \\
& + R_{001tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{11}^{1} \left|\phi\right\rangle_{11}^{1} + T_{11}^{2} \left|\phi\right\rangle_{11}^{2} \\
& + T_{11}^{3} \left|\phi\right\rangle_{11}^{3} + T_{11}^{4} \left|\phi\right\rangle_{11}^{4}) \\
& + R_{010tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{10}^{1} \left|\phi\right\rangle_{10}^{1} + T_{10}^{2} \left|\phi\right\rangle_{10}^{2} \\
& + T_{10}^{3} \left|\phi\right\rangle_{10}^{3} + T_{10}^{4} \left|\phi\right\rangle_{10}^{4}) \\
& + R_{011tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{11}^{1} \left|\phi\right\rangle_{11}^{1} + T_{11}^{2} \left|\phi\right\rangle_{11}^{2} \\
& + T_{11}^{3} \left|\phi\right\rangle_{11}^{3} + T_{11}^{4} \left|\phi\right\rangle_{11}^{4}) \\
& + R_{100tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{10}^{1} \left|\phi\right\rangle_{10}^{1} + T_{10}^{2} \left|\phi\right\rangle_{10}^{2} \\
& + T_{10}^{3} \left|\phi\right\rangle_{10}^{3} + T_{10}^{4} \left|\phi\right\rangle_{10}^{4}) \\
& + R_{101tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} (T_{11}^{1} \left|\phi\right\rangle_{11}^{1} + T_{11}^{2} \left|\phi\right\rangle_{11}^{2} \\
& + T_{11}^{3} \left|\phi\right\rangle_{11}^{3} + T_{11}^{4} \left|\phi\right\rangle_{11}^{4}) \\
& + R_{110tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{10}^{1} \left|\phi\right\rangle_{10}^{1} + T_{10}^{2} \left|\phi\right\rangle_{10}^{2} \\
& + T_{10}^{3} \left|\phi\right\rangle_{10}^{3} + T_{10}^{4} \left|\phi\right\rangle_{10}^{4}) \\
& + R_{111tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} (T_{11}^{1} \left|\phi\right\rangle_{11}^{1} + T_{11}^{2} \left|\phi\right\rangle_{11}^{2} \\
& + T_{11}^{3} \left|\phi\right\rangle_{11}^{3} + T_{11}^{4} \left|\phi\right\rangle_{11}^{4})) \left|tuv\right\rangle
\end{aligned}
$$

$$
\begin{aligned}
= \sum_{tuv=0}^{1}\sum_{ijk=0}^{1} x_{ij}y_k(R_{000tuv}&\sum_{\mu=1}^{4} T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4} T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(T_{j0}^{1}\left|\phi\right\rangle_{j0}^{1}+T_{j0}^{2}\left|\phi\right\rangle_{j0}^{2}\\
&+T_{j0}^{3}\left|\phi\right\rangle_{j0}^{3}+T_{j0}^{4}\left|\phi\right\rangle_{j0}^{4})\\
&+R_{001tuv}\sum_{\mu=1}^{4} T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4} T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(T_{j1}^{1}\left|\phi\right\rangle_{j1}^{1}+T_{j1}^{2}\left|\phi\right\rangle_{j1}^{2}\\
&+T_{j1}^{3}\left|\phi\right\rangle_{j1}^{3}+T_{j1}^{4}\left|\phi\right\rangle_{j1}^{4})\\
&+R_{010tuv}\sum_{\mu=1}^{4} T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4} T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(T_{j0}^{1}\left|\phi\right\rangle_{j0}^{1}+T_{j0}^{2}\left|\phi\right\rangle_{j0}^{2}\\
&+T_{j0}^{3}\left|\phi\right\rangle_{j0}^{3}+T_{j0}^{4}\left|\phi\right\rangle_{j0}^{4})\\
&+R_{011tuv}\sum_{\mu=1}^{4} T_{i0}^{\mu}\left|\phi\right\rangle_{i0}^{\mu}\sum_{\nu=1}^{4} T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(T_{j1}^{1}\left|\phi\right\rangle_{j1}^{1}+T_{j1}^{2}\left|\phi\right\rangle_{j1}^{2}\\
&+T_{j1}^{3}\left|\phi\right\rangle_{j1}^{3}+T_{j1}^{4}\left|\phi\right\rangle_{j1}^{4})\\
&+R_{100tuv}\sum_{\mu=1}^{4} T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4} T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(T_{j0}^{1}\left|\phi\right\rangle_{j0}^{1}+T_{j0}^{2}\left|\phi\right\rangle_{j0}^{2}\\
&+T_{j0}^{3}\left|\phi\right\rangle_{j0}^{3}+T_{j0}^{4}\left|\phi\right\rangle_{j0}^{4})\\
&+R_{101tuv}\sum_{\mu=1}^{4} T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4} T_{k0}^{\nu}\left|\phi\right\rangle_{k0}^{\nu}(T_{j1}^{1}\left|\phi\right\rangle_{j1}^{1}+T_{j1}^{2}\left|\phi\right\rangle_{j1}^{2}\\
&+T_{j1}^{3}\left|\phi\right\rangle_{j1}^{3}+T_{j1}^{4}\left|\phi\right\rangle_{j1}^{4})\\
&+R_{110tuv}\sum_{\mu=1}^{4} T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4} T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(T_{j0}^{1}\left|\phi\right\rangle_{j0}^{1}+T_{j0}^{2}\left|\phi\right\rangle_{j0}^{2}\\
&+T_{j0}^{3}\left|\phi\right\rangle_{j0}^{3}+T_{j0}^{4}\left|\phi\right\rangle_{j0}^{4})\\
&+R_{111tuv}\sum_{\mu=1}^{4} T_{i1}^{\mu}\left|\phi\right\rangle_{i1}^{\mu}\sum_{\nu=1}^{4} T_{k1}^{\nu}\left|\phi\right\rangle_{k1}^{\nu}(T_{j1}^{1}\left|\phi\right\rangle_{j1}^{1}+T_{j1}^{2}\left|\phi\right\rangle_{j1}^{2}\\
&+T_{j1}^{3}\left|\phi\right\rangle_{j1}^{3}+T_{j1}^{4}\left|\phi\right\rangle_{j1}^{4}))\left|tuv\right\rangle
\end{aligned}
$$

$$= \sum_{tuv=0}^{1} \sum_{ijk=0}^{1} x_{ij} y_k (R_{000tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau}$$
$$+ R_{001tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau}$$
$$+ R_{010tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau}$$
$$+ R_{011tuv} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau}$$
$$+ R_{100tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau}$$
$$+ R_{101tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau}$$
$$+ R_{110tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau}$$
$$+ R_{111tuv} \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau}) \left|tuv\right\rangle$$

$$= \sum_{tuv=0}^{1} \sum_{ijk=0}^{1} x_{ij} y_k \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix}$$
$$\begin{pmatrix} \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau} \\ \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau} \\ \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau} \\ \sum_{\mu=1}^{4} T_{i0}^{\mu} \left|\phi\right\rangle_{i0}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau} \\ \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau} \\ \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k0}^{\nu} \left|\phi\right\rangle_{k0}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau} \\ \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j0}^{\tau} \left|\phi\right\rangle_{j0}^{\tau} \\ \sum_{\mu=1}^{4} T_{i1}^{\mu} \left|\phi\right\rangle_{i1}^{\mu} \sum_{\nu=1}^{4} T_{k1}^{\nu} \left|\phi\right\rangle_{k1}^{\nu} \sum_{\tau=1}^{4} T_{j1}^{\tau} \left|\phi\right\rangle_{j1}^{\tau} \end{pmatrix} \left|tuv\right\rangle$$

$$= \sum_{tuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix}$$

$$\begin{pmatrix} T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{j0}\left|\phi\right\rangle^{\tau}_{j0} \\ T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{j1}\left|\phi\right\rangle^{\tau}_{j1} \\ T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{j0}\left|\phi\right\rangle^{\tau}_{j0} \\ T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{j1}\left|\phi\right\rangle^{\tau}_{j1} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{j0}\left|\phi\right\rangle^{\tau}_{j0} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{j1}\left|\phi\right\rangle^{\tau}_{j1} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{j0}\left|\phi\right\rangle^{\tau}_{j0} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{j1}\left|\phi\right\rangle^{\tau}_{j1} \end{pmatrix} \left|tuv\right\rangle$$

$$= \sum_{stuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k \begin{pmatrix} R_{00stuv} & R_{01stuv} & R_{10stuv} & R_{11stuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \\ T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k0}\left|\phi\right\rangle^{\nu}_{k0} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{k1}\left|\phi\right\rangle^{\nu}_{k1} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \end{pmatrix} \left|tuv\right\rangle$$

$$= \sum_{mstuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k \begin{pmatrix} R_{0mstuv} & R_{1mstuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{i0}\left|\phi\right\rangle^{\mu}_{i0} T^{\nu}_{km}\left|\phi\right\rangle^{\nu}_{km} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \\ T^{\mu}_{i1}\left|\phi\right\rangle^{\mu}_{i1} T^{\nu}_{km}\left|\phi\right\rangle^{\nu}_{km} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js} \end{pmatrix} \left|tuv\right\rangle$$

$$= \sum_{lmstuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k R_{lmstuv} T^{\mu}_{il}\left|\phi\right\rangle^{\mu}_{il} T^{\nu}_{km}\left|\phi\right\rangle^{\nu}_{km} T^{\tau}_{js}\left|\phi\right\rangle^{\tau}_{js}\left|tuv\right\rangle$$

$$= \sum_{lmstuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k R_{lmstuv} T^{\mu}_{il}T^{\nu}_{km}T^{\tau}_{js}\left|\phi\right\rangle^{\mu}_{il}\left|\phi\right\rangle^{\nu}_{km}\left|\phi\right\rangle^{\tau}_{js}\left|tuv\right\rangle$$

Selanjutnya apa bila dituliskan $\left|\phi\right\rangle^{\mu}_{il} := \left|\mu\right\rangle; \left|\phi\right\rangle^{\nu}_{km} := \left|\nu\right\rangle; \left|\phi\right\rangle^{\tau}_{js} := \left|\tau\right\rangle$ dengan $\mu, \nu, \tau = 1, 2, 3, 4$ maka persamaan di atas dapat dituliskan menjadi:

$$= \sum_{lmstuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k R_{lmstuv} T^{\mu}_{il}T^{\nu}_{km}T^{\tau}_{js}\left|\mu\right\rangle\left|\nu\right\rangle\left|\tau\right\rangle\left|tuv\right\rangle$$

Kemudian dengan mengeluarkan nilai $\left|tuv\right\rangle$ pada persamaan di atas maka diperoleh:

$$= \sum_{tuv=0}^{1}\sum_{ijk=0}^{1}\sum_{\mu\nu\tau=1}^{4} x_{ij}y_k \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix}$$

$$\begin{pmatrix} T^{\mu}_{i0}T^{\nu}_{k0}T^{\tau}_{j0} \\ T^{\mu}_{i0}T^{\nu}_{k0}T^{\tau}_{j1} \\ T^{\mu}_{i0}T^{\nu}_{k1}T^{\tau}_{j0} \\ T^{\mu}_{i0}T^{\nu}_{k1}T^{\tau}_{j1} \\ T^{\mu}_{i1}T^{\nu}_{k0}T^{\tau}_{j0} \\ T^{\mu}_{i1}T^{\nu}_{k0}T^{\tau}_{j1} \\ T^{\mu}_{i1}T^{\nu}_{k1}T^{\tau}_{j0} \\ T^{\mu}_{i1}T^{\nu}_{k1}T^{\tau}_{j1} \end{pmatrix} T^{\mu}_{il}T^{\nu}_{km}T^{\tau}_{js}\left|\mu\nu\tau\right\rangle\left|tuv\right\rangle$$

$$= \sum_{lmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} \Big(x_{00}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{00}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{01}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_{01}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_{10}y_0\begin{pmatrix}R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv}\end{pmatrix}\begin{pmatrix}T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00}\\T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01}\\T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00}\\T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01}\\T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00}\\T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01}\\T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00}\\T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01}\end{pmatrix}$$

$$+x_{10}y_1\begin{pmatrix}R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv}\end{pmatrix}\begin{pmatrix}T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00}\\T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01}\\T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00}\\T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01}\\T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00}\\T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01}\\T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00}\\T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01}\end{pmatrix}$$

$$+x_{11}y_0\begin{pmatrix}R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv}\end{pmatrix}\begin{pmatrix}T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10}\\T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11}\\T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10}\\T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11}\\T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10}\\T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11}\\T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10}\\T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11}\end{pmatrix}$$

$$+x_{11}y_1\begin{pmatrix}R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv}\end{pmatrix}\begin{pmatrix}T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10}\\T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11}\\T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10}\\T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11}\\T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10}\\T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11}\\T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10}\\T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}\end{pmatrix})\left|\mu\nu\tau\right\rangle\left|tuv\right\rangle$$

Menukar suku ke-2 dan ke-3 serta suku ke-6 dan ke-7 karena posisi indeks j ada di bagian belakang dari indeks k

$$= \sum_{tuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} (x_{00}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{01}y_0 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_{00}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} \\ T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{01}y_1 \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} \\ T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} \\ T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} \\ T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_{10}y_0\left(R_{000tuv}\quad R_{001tuv}\quad R_{010tuv}\quad R_{011tuv}\quad R_{100tuv}\quad R_{101tuv}\quad R_{110tuv}\quad R_{111tuv}\right)\begin{pmatrix} T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00}\\ T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01}\\ T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00}\\ T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01}\\ T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00}\\ T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01}\\ T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00}\\ T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{11}y_0\left(R_{000tuv}\quad R_{001tuv}\quad R_{010tuv}\quad R_{011tuv}\quad R_{100tuv}\quad R_{101tuv}\quad R_{110tuv}\quad R_{111tuv}\right)\begin{pmatrix} T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10}\\ T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11}\\ T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10}\\ T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11}\\ T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10}\\ T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11}\\ T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10}\\ T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} \end{pmatrix}$$

$$+x_{10}y_1\left(R_{000tuv}\quad R_{001tuv}\quad R_{010tuv}\quad R_{011tuv}\quad R_{100tuv}\quad R_{101tuv}\quad R_{110tuv}\quad R_{111tuv}\right)\begin{pmatrix} T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00}\\ T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01}\\ T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00}\\ T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01}\\ T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00}\\ T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01}\\ T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00}\\ T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} \end{pmatrix}$$

$$+x_{11}y_1\left(R_{000tuv}\quad R_{001tuv}\quad R_{010tuv}\quad R_{011tuv}\quad R_{100tuv}\quad R_{101tuv}\quad R_{110tuv}\quad R_{111tuv}\right)\begin{pmatrix} T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10}\\ T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11}\\ T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10}\\ T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11}\\ T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10}\\ T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11}\\ T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10}\\ T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11} \end{pmatrix})\left|\mu\nu\tau\right\rangle\left|tuv\right\rangle$$

$$
= \sum_{tuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} R_{000tuv} & R_{001tuv} & R_{010tuv} & R_{011tuv} & R_{100tuv} & R_{101tuv} & R_{110tuv} & R_{111tuv} \end{pmatrix}
$$

$$
\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}
$$

$$
\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\, |tuv\rangle
$$

$$
= \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \end{pmatrix}
$$

$$
\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}
$$

$$
\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\, |000\rangle
$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\,|001\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\,|010\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix}x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|011\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix}x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|100\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\,|101\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110010} & R_{111110}\end{pmatrix}$$

$$\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}$$

$$\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\,|110\rangle$$

$$
+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix} R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111}\end{pmatrix}
$$

$$
\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}
$$

$$
\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\,|111\rangle
$$

$$
=\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}
R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \\
R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001} \\
R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010} \\
R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011} \\
R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100} \\
R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101} \\
R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110110} & R_{111110} \\
R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111}
\end{pmatrix}
$$

$$
\begin{pmatrix}
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{00}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{10}T^{\nu}_{11}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{10}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{00}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{10}T^{\tau}_{11} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{10} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{00} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{10} \\
T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{01}T^{\nu}_{11}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{01}T^{\tau}_{11} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{01} & T^{\mu}_{11}T^{\nu}_{11}T^{\tau}_{11}
\end{pmatrix}
$$

$$
\begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} \begin{pmatrix} |000\rangle & |001\rangle & |010\rangle & |011\rangle & |100\rangle & |101\rangle & |110\rangle & |111\rangle \end{pmatrix} |\mu\nu\tau\rangle
$$

$$= \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \\ R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001} \\ R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010} \\ R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011} \\ R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100} \\ R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101} \\ R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110110} & R_{111110} \\ R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111} \end{pmatrix}$$

$$\left(\begin{pmatrix} T^{\mu}_{00} & T^{\mu}_{10} \\ T^{\mu}_{01} & T^{\mu}_{11} \end{pmatrix} \otimes \begin{pmatrix} T^{\nu}_{00} & T^{\nu}_{10} \\ T^{\nu}_{01} & T^{\nu}_{11} \end{pmatrix} \otimes \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix}\right) \begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix}$$

$$\begin{pmatrix} |000\rangle & |001\rangle & |010\rangle & |011\rangle & |100\rangle & |101\rangle & |110\rangle & |111\rangle \end{pmatrix} |\mu\nu\tau\rangle$$

Selanjutnya dengan menuliskan bentuk matriks T^{μ}, T^{ν} dan T^{τ} sebagai berikut:

$$T^{\mu} = \begin{pmatrix} T^{\mu}_{00} & T^{\mu}_{10} \\ T^{\mu}_{01} & T^{\mu}_{11} \end{pmatrix}$$

dan

$$T^{\nu} = \begin{pmatrix} T^{\nu}_{00} & T^{\nu}_{10} \\ T^{\nu}_{01} & T^{\nu}_{11} \end{pmatrix}$$

dan

$$T^{\tau} = \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix}$$

yang merupakan bentuk matriks dari nilai koefisien T^{μ}_{il}, T^{ν}_{km} dan T^{τ}_{js} dengan:

$$T^1 = \begin{pmatrix} T^1_{00} & T^1_{10} \\ T^1_{01} & T^1_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$T^2 = \begin{pmatrix} T^2_{00} & T^2_{10} \\ T^2_{01} & T^2_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

$$T^3 = \begin{pmatrix} T^3_{00} & T^3_{10} \\ T^3_{01} & T^3_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$T^4 = \begin{pmatrix} T^4_{00} & T^4_{10} \\ T^4_{01} & T^4_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

Memperlihatkan ulang persamaan hasil peluburan dengan menuliskan $R_{lmstuv}T^{\mu}_{il}T^{\nu}_{km}T^{\tau}_{js} = \sigma^{\mu\nu\tau}_{ilkmjs}$, maka dapat dituliskan sebagai berikut:

$$|\Psi\rangle_{A,B,A_1,A_1,B_1,B_2,B_2,A_2} = \sum_{ijk=0}^{1} \sum_{lmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} x_{ij}y_k\sigma^{\mu\nu\tau}_{ilkmjs} |\mu\nu\tau\rangle |tuv\rangle$$

Apabila jika indeks lms dan $\mu\nu\tau$ dijalankan, maka persamaan di atas dapat dituliskan sebagai berikut:

$$
\begin{aligned}
= \sum_{tuv=0}^{1} \sum_{ijk=0}^{1} x_{ij} y_k ((\sigma^{111}_{i0k0j0tuv} + \sigma^{111}_{i0k0j1tuv} + \sigma^{111}_{i0k1j0tuv} + \sigma^{111}_{i0k1j1tuv} \\
+ \sigma^{111}_{i1k0j0tuv} + \sigma^{111}_{i1k0j1tuv} + \sigma^{111}_{i1k1j0tuv} + \sigma^{111}_{i1k1j1tuv}) \left|111\right\rangle \\
+ (\sigma^{112}_{i0k0j0tuv} + \sigma^{112}_{i0k0j1tuv} + \sigma^{112}_{i0k1j0tuv} + \sigma^{112}_{i0k1j1tuv} \\
+ \sigma^{112}_{i1k0j0tuv} + \sigma^{112}_{i1k0j1tuv} + \sigma^{112}_{i1k1j0tuv} + \sigma^{112}_{i1k1j1tuv}) \left|112\right\rangle \\
+ (\sigma^{113}_{i0k0j0tuv} + \sigma^{113}_{i0k0j1tuv} + \sigma^{113}_{i0k1j0tuv} + \sigma^{113}_{i0k1j1tuv} \\
+ \sigma^{113}_{i1k0j0tuv} + \sigma^{113}_{i1k0j1tuv} + \sigma^{113}_{i1k1j0tuv} + \sigma^{113}_{i1k1j1tuv}) \left|113\right\rangle \\
+ (\sigma^{114}_{10k0j0tuv} + \sigma^{114}_{i0k0j1tuv} + \sigma^{114}_{i0k1j0tuv} + \sigma^{114}_{i0k1j1tuv} \\
+ \sigma^{114}_{i1k0j0tuv} + \sigma^{114}_{i1k0j1tuv} + \sigma^{114}_{i1k1j0tuv} + \sigma^{114}_{i1k1j1tuv}) \left|114\right\rangle \\
+ (\sigma^{121}_{i0k0j0tuv} + \sigma^{121}_{i0k0j1tuv} + \sigma^{121}_{i0k1j0tuv} + \sigma^{121}_{i0k1j1tuv} \\
+ \sigma^{121}_{i1k0j0tuv} + \sigma^{121}_{i1k0j1tuv} + \sigma^{121}_{i1k1j0tuv} + \sigma^{121}_{i1k1j1tuv}) \left|121\right\rangle \\
+ (\sigma^{122}_{i0k0j0tuv} + \sigma^{122}_{i0k0j1tuv} + \sigma^{122}_{i0k1j0tuv} + \sigma^{122}_{i0k1j1tuv} \\
+ \sigma^{122}_{i1k0j0tuv} + \sigma^{122}_{i1k0j1tuv} + \sigma^{122}_{i1k1j0tuv} + \sigma^{122}_{i1k1j1tuv}) \left|122\right\rangle \\
+ (\sigma^{123}_{i0k0j0tuv} + \sigma^{123}_{i0k0j1tuv} + \sigma^{123}_{i0k1j0tuv} + \sigma^{123}_{i0k1j1tuv} \\
+ \sigma^{123}_{i1k0j0tuv} + \sigma^{123}_{i1k0j1tuv} + \sigma^{123}_{i1k1j0tuv} + \sigma^{123}_{i1k1j1tuv}) \left|123\right\rangle \\
+ (\sigma^{124}_{i0k0j0tuv} + \sigma^{124}_{i0k0j1tuv} + \sigma^{124}_{i0k1j0tuv} + \sigma^{124}_{i0k1j1tuv} \\
+ \sigma^{124}_{i1k0j0tuv} + \sigma^{124}_{i1k0j1tuv} + \sigma^{124}_{i1k1j0tuv} + \sigma^{124}_{i1k1j1tuv}) \left|124\right\rangle \\
+ (\sigma^{131}_{i0k0j0tuv} + \sigma^{131}_{i0k0j1tuv} + \sigma^{131}_{i0k1j0tuv} + \sigma^{131}_{i0k1j1tuv} \\
+ \sigma^{131}_{i1k0j0tuv} + \sigma^{131}_{i1k0j1tuv} + \sigma^{131}_{i1k1j0tuv} + \sigma^{131}_{i1k1j1tuv}) \left|131\right\rangle \\
+ (\sigma^{132}_{i0k0j0tuv} + \sigma^{132}_{i0k0j1tuv} + \sigma^{132}_{i0k1j0tuv} + \sigma^{132}_{i0k1j1tuv} \\
+ \sigma^{132}_{i1k0j0tuv} + \sigma^{132}_{i1k0j1tuv} + \sigma^{132}_{i1k1j0tuv} + \sigma^{132}_{i1k1j1tuv}) \left|132\right\rangle \\
+ (\sigma^{133}_{i0k0j0tuv} + \sigma^{133}_{i0k0j1tuv} + \sigma^{133}_{i0k1j0tuv} + \sigma^{133}_{i0k1j1tuv} \\
+ \sigma^{133}_{i1k0j0tuv} + \sigma^{133}_{i1k0j1tuv} + \sigma^{133}_{i1k1j0tuv} + \sigma^{133}_{i1k1j1tuv}) \left|133\right\rangle \\
+ (\sigma^{134}_{i0k0j0tuv} + \sigma^{134}_{i0k0j1tuv} + \sigma^{134}_{i0k1j0tuv} + \sigma^{134}_{i0k1j1tuv} \\
+ \sigma^{134}_{i1k0j0tuv} + \sigma^{134}_{i1k0j1tuv} + \sigma^{134}_{i1k1j0tuv} + \sigma^{134}_{i1k1j1tuv}) \left|134\right\rangle \\
+ (\sigma^{141}_{i0j0k0tuv} + \sigma^{141}_{i0j0k1tuv} + \sigma^{141}_{i0j1k0tuv} + \sigma^{141}_{i0j1k1tuv} \\
+ \sigma^{141}_{i1j0k0tuv} + \sigma^{141}_{i1j0k1tuv} + \sigma^{141}_{i1j1k0tuv} + \sigma^{141}_{i1j1k1tuv}) \left|141\right\rangle \\
+ (\sigma^{142}_{i0j0k0tuv} + \sigma^{142}_{i0j0k1tuv} + \sigma^{142}_{i0j1k0tuv} + \sigma^{142}_{i0j1k1tuv} \\
+ \sigma^{142}_{i1j0k0tuv} + \sigma^{142}_{i1j0k1tuv} + \sigma^{142}_{i1j1k0tuv} + \sigma^{142}_{i1j1k1tuv}) \left|142\right\rangle \\
+ (\sigma^{143}_{i0j0k0tuv} + \sigma^{143}_{i0j0k1tuv} + \sigma^{143}_{i0j1k0tuv} + \sigma^{143}_{i0j1k1tuv} \\
+ \sigma^{143}_{i1j0k0tuv} + \sigma^{143}_{i1j0k1tuv} + \sigma^{143}_{i1j1k0tuv} + \sigma^{143}_{i1j1k1tuv}) \left|143\right\rangle \\
+ (\sigma^{144}_{i0j0k0tuv} + \sigma^{144}_{i0j0k1tuv} + \sigma^{144}_{i0j1k0tuv} + \sigma^{144}_{i0j1k1tuv} \\
+ \sigma^{144}_{i1j0k0tuv} + \sigma^{144}_{i1j0k1tuv} + \sigma^{144}_{i1j1k0tuv} + \sigma^{144}_{i1j1k1tuv}) \left|144\right\rangle
\end{aligned}
$$

$$+ (\sigma^{211}_{i0k0j0tuv} + \sigma^{211}_{i0k0j1tuv} + \sigma^{211}_{i0k1j0tuv} + \sigma^{211}_{i0k1j1tuv}$$
$$+ \sigma^{211}_{i1k0j0tuv} + \sigma^{211}_{i1k0j1tuv} + \sigma^{211}_{i1k1j0tuv} + \sigma^{211}_{i1k1j1tuv}) \left|211\right\rangle$$
$$+ (\sigma^{212}_{i0k0j0tuv} + \sigma^{212}_{i0k0j1tuv} + \sigma^{212}_{i0k1j0tuv} + \sigma^{212}_{i0k1j1tuv}$$
$$+ \sigma^{212}_{i1k0j0tuv} + \sigma^{212}_{i1k0j1tuv} + \sigma^{212}_{i1k1j0tuv} + \sigma^{212}_{i1k1j1tuv}) \left|212\right\rangle$$
$$+ (\sigma^{213}_{i0k0j0tuv} + \sigma^{213}_{i0k0j1tuv} + \sigma^{213}_{i0k1j0tuv} + \sigma^{213}_{i0k1j1tuv}$$
$$+ \sigma^{213}_{i1k0j0tuv} + \sigma^{213}_{i1k0j1tuv} + \sigma^{213}_{i1k1j0tuv} + \sigma^{213}_{i1k1j1tuv}) \left|213\right\rangle$$
$$+ (\sigma^{214}_{i0k0j0tuv} + \sigma^{214}_{i0k0j1tuv} + \sigma^{214}_{i0k1j0tuv} + \sigma^{214}_{i0k1j1tuv}$$
$$+ \sigma^{214}_{i1k0j0tuv} + \sigma^{214}_{i1k0j1tuv} + \sigma^{214}_{i1k1j0tuv} + \sigma^{214}_{i1k1j1tuv}) \left|214\right\rangle$$

$$+ (\sigma^{221}_{i0k0j0tuv} + \sigma^{221}_{i0k0j1tuv} + \sigma^{221}_{i0k1j0tuv} + \sigma^{221}_{i0k1j1tuv}$$
$$+ \sigma^{221}_{i1k0j0tuv} + \sigma^{221}_{i1k0j1tuv} + \sigma^{221}_{i1k1j0tuv} + \sigma^{221}_{i1k1j1tuv}) \left|221\right\rangle$$
$$+ (\sigma^{222}_{i0k0j0tuv} + \sigma^{222}_{i0k0j1tuv} + \sigma^{222}_{i0k1j0tuv} + \sigma^{222}_{i0k1j1tuv}$$
$$+ \sigma^{222}_{i1k0j0tuv} + \sigma^{222}_{i1k0j1tuv} + \sigma^{222}_{i1k1j0tuv} + \sigma^{222}_{i1k1j1tuv}) \left|222\right\rangle$$
$$+ (\sigma^{223}_{i0k0j0tuv} + \sigma^{223}_{i0k0j1tuv} + \sigma^{223}_{i0k1j0tuv} + \sigma^{223}_{i0k1j1tuv}$$
$$+ \sigma^{223}_{i1k0j0tuv} + \sigma^{223}_{i1k0j1tuv} + \sigma^{223}_{i1k1j0tuv} + \sigma^{223}_{i1k1j1tuv}) \left|223\right\rangle$$
$$+ (\sigma^{224}_{i0k0j0tuv} + \sigma^{224}_{i0k0j1tuv} + \sigma^{224}_{i0k1j0tuv} + \sigma^{224}_{i0k1j1tuv}$$
$$+ \sigma^{224}_{i1k0j0tuv} + \sigma^{224}_{i1k0j1tuv} + \sigma^{224}_{i1k1j0tuv} + \sigma^{224}_{i1k1j1tuv}) \left|224\right\rangle$$

$$+ (\sigma^{231}_{i0k0j0tuv} + \sigma^{231}_{i0k0j1tuv} + \sigma^{231}_{i0k1j0tuv} + \sigma^{231}_{i0k1j1tuv}$$
$$+ \sigma^{231}_{i1k0j0tuv} + \sigma^{231}_{i1k0j1tuv} + \sigma^{231}_{i1k1j0tuv} + \sigma^{231}_{i1k1j1tuv}) \left|231\right\rangle$$
$$+ (\sigma^{232}_{i0k0j0tuv} + \sigma^{232}_{i0k0j1tuv} + \sigma^{232}_{i0k1j0tuv} + \sigma^{232}_{i0k1j1tuv}$$
$$+ \sigma^{232}_{i1k0j0tuv} + \sigma^{232}_{i1k0j1tuv} + \sigma^{232}_{i1k1j0tuv} + \sigma^{232}_{i1k1j1tuv}) \left|232\right\rangle$$
$$+ (\sigma^{233}_{i0k0j0tuv} + \sigma^{233}_{i0k0j1tuv} + \sigma^{233}_{i0k1j0tuv} + \sigma^{233}_{i0k1j1tuv}$$
$$+ \sigma^{233}_{i1k0j0tuv} + \sigma^{233}_{i1k0j1tuv} + \sigma^{233}_{i1k1j0tuv} + \sigma^{233}_{i1k1j1tuv}) \left|233\right\rangle$$
$$+ (\sigma^{234}_{i0k0j0tuv} + \sigma^{234}_{i0k0j1tuv} + \sigma^{234}_{i0k1j0tuv} + \sigma^{234}_{i0k1j1tuv}$$
$$+ \sigma^{234}_{i1k0j0tuv} + \sigma^{234}_{i1k0j1tuv} + \sigma^{234}_{i1k1j0tuv} + \sigma^{234}_{i1k1j1tuv}) \left|234\right\rangle$$

$$+ (\sigma^{241}_{i0k0j0tuv} + \sigma^{241}_{i0k0j1tuv} + \sigma^{241}_{i0k1j0tuv} + \sigma^{241}_{i0k1j1tuv}$$
$$+ \sigma^{241}_{i1k0j0tuv} + \sigma^{241}_{i1k0j1tuv} + \sigma^{241}_{i1k1j0tuv} + \sigma^{241}_{i1k1j1tuv}) \left|241\right\rangle$$
$$+ (\sigma^{242}_{i0k0j0tuv} + \sigma^{242}_{i0k0j1tuv} + \sigma^{242}_{i0k1j0tuv} + \sigma^{242}_{i0k1j1tuv}$$
$$+ \sigma^{242}_{i1k0j0tuv} + \sigma^{242}_{i1k0j1tuv} + \sigma^{242}_{i1k1j0tuv} + \sigma^{242}_{i1k1j1tuv}) \left|242\right\rangle$$
$$+ (\sigma^{243}_{i0k0j0tuv} + \sigma^{243}_{i0k0j1tuv} + \sigma^{243}_{i0k1j0tuv} + \sigma^{243}_{i0k1j1tuv}$$
$$+ \sigma^{243}_{i1k0k0tuv} + \sigma^{243}_{i1k0j1tuv} + \sigma^{243}_{i1k1j0tuv} + \sigma^{243}_{i1k1j1tuv}) \left|243\right\rangle$$
$$+ (\sigma^{244}_{i0k0j0tuv} + \sigma^{244}_{i0k0j1tuv} + \sigma^{244}_{i0k1j0tuv} + \sigma^{244}_{i0k1j1tuv}$$
$$+ \sigma^{244}_{i1k0j0tuv} + \sigma^{244}_{i1k0j1tuv} + \sigma^{244}_{i1k1j0tuv} + \sigma^{244}_{i1k1j1tuv}) \left|244\right\rangle$$

$$+ (\sigma^{311}_{i0k0j0tuv} + \sigma^{311}_{i0k0j1tuv} + \sigma^{311}_{i0k1j0tuv} + \sigma^{311}_{i0k1j1tuv}$$
$$+ \sigma^{311}_{i1k0j0tuv} + \sigma^{311}_{i1k0j1tuv} + \sigma^{311}_{i1k1j0tuv} + \sigma^{311}_{i1k1j1tuv}) \left|311\right\rangle$$
$$+ (\sigma^{312}_{i0k0j0tuv} + \sigma^{312}_{i0k0j1tuv} + \sigma^{312}_{i0k1j0tuv} + \sigma^{312}_{i0k1j1tuv}$$
$$+ \sigma^{312}_{i1k0j0tuv} + \sigma^{312}_{i1k0j1tuv} + \sigma^{312}_{i1k1j0tuv} + \sigma^{312}_{i1k1j1tuv}) \left|312\right\rangle$$
$$+ (\sigma^{313}_{i0k0j0tuv} + \sigma^{313}_{i0k0j1tuv} + \sigma^{313}_{i0k1j0tuv} + \sigma^{313}_{i0k1j1tuv}$$
$$+ \sigma^{313}_{i1k0j0tuv} + \sigma^{313}_{i1k0j1tuv} + \sigma^{313}_{i1k1j0tuv} + \sigma^{313}_{i1k1j1tuv}) \left|313\right\rangle$$
$$+ (\sigma^{314}_{i0k0j0tuv} + \sigma^{314}_{i0k0j1tuv} + \sigma^{314}_{i0k1j0tuv} + \sigma^{314}_{i0k1k1tuv}$$
$$+ \sigma^{314}_{i1k0j0tuv} + \sigma^{314}_{i1k0j1tuv} + \sigma^{314}_{i1k1j0tuv} + \sigma^{314}_{i1k1j1tuv}) \left|314\right\rangle$$

$$+ (\sigma^{321}_{i0k0j0tuv} + \sigma^{321}_{i0k0j1tuv} + \sigma^{321}_{i0k1j0tuv} + \sigma^{321}_{i0k1j1tuv}$$
$$+ \sigma^{321}_{i1k0j0tuv} + \sigma^{321}_{i1k0j1tuv} + \sigma^{321}_{i1k1j0tuv} + \sigma^{321}_{i1k1j1tuv}) \left|321\right\rangle$$
$$+ (\sigma^{322}_{i0k0j0tuv} + \sigma^{322}_{i0k0j1tuv} + \sigma^{322}_{i0k1j0tuv} + \sigma^{322}_{i0k1j1tuv}$$
$$+ \sigma^{322}_{i1k0j0tuv} + \sigma^{322}_{i1k0j1tuv} + \sigma^{322}_{i1k1j0tuv} + \sigma^{322}_{i1k1j1tuv}) \left|322\right\rangle$$
$$+ (\sigma^{323}_{i0k0j0tuv} + \sigma^{323}_{i0k0j1tuv} + \sigma^{323}_{i0k1j0tuv} + \sigma^{323}_{i0k1j1tuv}$$
$$+ \sigma^{323}_{i1k0j0tuv} + \sigma^{323}_{i1k0j1tuv} + \sigma^{323}_{i1k1j0tuv} + \sigma^{323}_{i1k1j1tuv}) \left|323\right\rangle$$
$$+ (\sigma^{324}_{i0k0j0tuv} + \sigma^{324}_{i0k0j1tuv} + \sigma^{324}_{i0k1j0tuv} + \sigma^{324}_{i0k1j1tuv}$$
$$+ \sigma^{324}_{i1k0j0tuv} + \sigma^{324}_{i1k0j1tuv} + \sigma^{324}_{i1k1j0tuv} + \sigma^{324}_{i1k1j1tuv}) \left|324\right\rangle$$

$$+ (\sigma^{331}_{i0k0j0tuv} + \sigma^{331}_{i0k0j1tuv} + \sigma^{331}_{i0k1j0tuv} + \sigma^{331}_{i0k1j1tuv}$$
$$+ \sigma^{331}_{i1k0j0tuv} + \sigma^{331}_{i1k0j1tuv} + \sigma^{331}_{i1k1j0tuv} + \sigma^{331}_{i1k1j1tuv}) \left|331\right\rangle$$
$$+ (\sigma^{332}_{i0k0j0tuv} + \sigma^{332}_{i0k0j1tuv} + \sigma^{332}_{i0k1j0tuv} + \sigma^{332}_{i0k1j1tuv}$$
$$+ \sigma^{332}_{i1k0j0tuv} + \sigma^{332}_{i1k0j1tuv} + \sigma^{332}_{i1k1j0tuv} + \sigma^{332}_{i1k1j1tuv}) \left|332\right\rangle$$
$$+ (\sigma^{333}_{i0k0j0tuv} + \sigma^{333}_{i0k0j1tuv} + \sigma^{333}_{i0k1j0tuv} + \sigma^{333}_{i0k1jtuv}$$
$$+ \sigma^{333}_{i1k0j0tuv} + \sigma^{333}_{i1k0j1tuv} + \sigma^{333}_{i1k1j0tuv} + \sigma^{333}_{i1k1j1tuv}) \left|333\right\rangle$$
$$+ (\sigma^{334}_{i0k0j0tuv} + \sigma^{334}_{i0k0j1tuv} + \sigma^{334}_{i0k1j0tuv} + \sigma^{334}_{i0k1j1tuv}$$
$$+ \sigma^{334}_{i1k0j0tuv} + \sigma^{334}_{i1k0j1tuv} + \sigma^{334}_{i1k1j0tuv} + \sigma^{334}_{i1k1j1tuv}) \left|334\right\rangle$$

$$+ (\sigma^{341}_{i0k0j0tuv} + \sigma^{341}_{i0k0j1tuv} + \sigma^{341}_{i0k1j0tuv} + \sigma^{341}_{i0k1j1tuv}$$
$$+ \sigma^{341}_{i1k0j0tuv} + \sigma^{341}_{i1k0j1tuv} + \sigma^{341}_{i1k1j0tuv} + \sigma^{341}_{i1k1j1tuv}) \left|341\right\rangle$$
$$+ (\sigma^{342}_{i0k0j0tuv} + \sigma^{342}_{i0k0j1tuv} + \sigma^{342}_{i0k1j0tuv} + \sigma^{342}_{i0k1j1tuv}$$
$$+ \sigma^{342}_{i1k0j0tuv} + \sigma^{342}_{i1k0j1tuv} + \sigma^{342}_{i1k1j0tuv} + \sigma^{342}_{i1k1j1tuv}) \left|342\right\rangle$$
$$+ (\sigma^{343}_{i0k0j0tuv} + \sigma^{343}_{i0k0j1tuv} + \sigma^{343}_{i0k1j0tuv} + \sigma^{343}_{i0k1j1tuv}$$
$$+ \sigma^{343}_{i1k0j0tuv} + \sigma^{343}_{i1k0j1tuv} + \sigma^{343}_{i1k1j0tuv} + \sigma^{343}_{i1k1j1tuv}) \left|343\right\rangle$$
$$+ (\sigma^{344}_{i0k0j0tuv} + \sigma^{344}_{i0k0j1tuv} + \sigma^{344}_{i0k1j0tuv} + \sigma^{344}_{i0k1j1tuv}$$
$$+ \sigma^{344}_{i1k0j0tuv} + \sigma^{344}_{i1k0j1tuv} + \sigma^{344}_{i1k1j0tuv} + \sigma^{344}_{i1k1j1tuv}) \left|344\right\rangle$$

$$
\begin{aligned}
&+ (\sigma^{411}_{i0k0j0tuv} + \sigma^{411}_{i0k0j1tuv} + \sigma^{411}_{i0k1j0tuv} + \sigma^{411}_{i0k1j1tuv} \\
&+ \sigma^{411}_{i1k0j0tuv} + \sigma^{411}_{i1k0j1tuv} + \sigma^{411}_{i1k1j0tuv} + \sigma^{411}_{i1k1j1tuv}) \left|411\right\rangle \\
&+ (\sigma^{412}_{i0k0j0tuv} + \sigma^{412}_{i0k0j1tuv} + \sigma^{412}_{i0k1j0tuv} + \sigma^{412}_{i0k1j1tuv} \\
&+ \sigma^{412}_{i1k0j0tuv} + \sigma^{412}_{i1k0j1tuv} + \sigma^{412}_{i1k1j0tuv} + \sigma^{412}_{i1k1j1tuv}) \left|412\right\rangle \\
&+ (\sigma^{413}_{i0k0j0tuv} + \sigma^{413}_{i0k0j1tuv} + \sigma^{413}_{i0k1j0tuv} + \sigma^{413}_{i0k1j1tuv} \\
&+ \sigma^{413}_{i1k0j0tuv} + \sigma^{413}_{i1k0j1tuv} + \sigma^{413}_{i1k1j0tuv} + \sigma^{413}_{i1k1j1tuv}) \left|413\right\rangle \\
&+ (\sigma^{414}_{i0k0j0tuv} + \sigma^{414}_{i0k0j1tuv} + \sigma^{414}_{i0k1j0tuv} + \sigma^{414}_{i0k1j1tuv} \\
&+ \sigma^{414}_{i1k0j0tuv} + \sigma^{414}_{i1k0j1tuv} + \sigma^{414}_{i1k1kjtuv} + \sigma^{414}_{i1k1j1tuv}) \left|414\right\rangle \\
&+ (\sigma^{421}_{i0k0j0tuv} + \sigma^{421}_{i0k0j1tuv} + \sigma^{421}_{i0k1j0tuv} + \sigma^{421}_{i0k1j1tuv} \\
&+ \sigma^{421}_{i1k0j0tuv} + \sigma^{421}_{i1k0j1tuv} + \sigma^{421}_{i1k1j0tuv} + \sigma^{421}_{i1k1j1tuv}) \left|421\right\rangle \\
&+ (\sigma^{422}_{i0k0j0tuv} + \sigma^{422}_{i0k0j1tuv} + \sigma^{422}_{i0k1j0tuv} + \sigma^{422}_{i0k1j1tuv} \\
&+ \sigma^{422}_{i1k0j0tuv} + \sigma^{422}_{i1k0j1tuv} + \sigma^{422}_{i1k1j0tuv} + \sigma^{422}_{i1k1j1tuv}) \left|422\right\rangle \\
&+ (\sigma^{423}_{i0k0j0tuv} + \sigma^{423}_{i0k0j1tuv} + \sigma^{423}_{i0k1j0tuv} + \sigma^{423}_{i0k1j1tuv} \\
&+ \sigma^{423}_{i1k0j0tuv} + \sigma^{423}_{i1k0j1tuv} + \sigma^{423}_{i1k1j0tuv} + \sigma^{423}_{i1k1j1tuv}) \left|423\right\rangle \\
&+ (\sigma^{424}_{i0k0j0tuv} + \sigma^{424}_{i0k0j1tuv} + \sigma^{424}_{i0k1j0tuv} + \sigma^{424}_{i0k1j1tuv} \\
&+ \sigma^{424}_{i1k0j0tuv} + \sigma^{424}_{i1k0j1tuv} + \sigma^{424}_{i1k1j0tuv} + \sigma^{424}_{i1k1j1tuv}) \left|424\right\rangle \\
&+ (\sigma^{431}_{i0k0j0tuv} + \sigma^{431}_{i0k0j1tuv} + \sigma^{431}_{i0k1j0tuv} + \sigma^{431}_{i0k1j1tuv} \\
&+ \sigma^{431}_{i1k0j0tuv} + \sigma^{431}_{i1k0j1tuv} + \sigma^{431}_{i1k1j0tuv} + \sigma^{431}_{i1k1j1tuv}) \left|431\right\rangle \\
&+ (\sigma^{432}_{i0k0j0tuv} + \sigma^{432}_{i0k0j1tuv} + \sigma^{432}_{i0k1j0tuv} + \sigma^{432}_{i0k1j1tuv} \\
&+ \sigma^{432}_{i1k0j0tuv} + \sigma^{432}_{i1k0j1tuv} + \sigma^{432}_{i1k1j0tuv} + \sigma^{432}_{i1k1j1tuv}) \left|432\right\rangle \\
&+ (\sigma^{433}_{i0k0j0tuv} + \sigma^{433}_{i0k0j1tuv} + \sigma^{433}_{i0k1j0tuv} + \sigma^{433}_{i0k1j1tuv} \\
&+ \sigma^{433}_{i1k0j0tuv} + \sigma^{433}_{i1k0j1tuv} + \sigma^{433}_{i1k1j0tuv} + \sigma^{433}_{i1k1j1tuv}) \left|433\right\rangle \\
&+ (\sigma^{434}_{i0k0j0tuv} + \sigma^{434}_{i0k0j1tuv} + \sigma^{434}_{i0k1j0tuv} + \sigma^{434}_{i0k1j1tuv} \\
&+ \sigma^{434}_{i1k0j0tuv} + \sigma^{434}_{i1k0j1tuv} + \sigma^{434}_{i1k1j0tuv} + \sigma^{434}_{i1k1j1tuv}) \left|434\right\rangle \\
&+ (\sigma^{441}_{i0k0j0tuv} + \sigma^{441}_{i0k0j1tuv} + \sigma^{441}_{i0k1j0tuv} + \sigma^{441}_{i0k1j1tuv} \\
&+ \sigma^{441}_{i1k0j0tuv} + \sigma^{441}_{i1k0j1tuv} + \sigma^{441}_{i1k1j0tuv} + \sigma^{441}_{i1k1j1tuv}) \left|441\right\rangle \\
&+ (\sigma^{442}_{i0k0j0tuv} + \sigma^{442}_{i0k0j1tuv} + \sigma^{442}_{i0k1j0tuv} + \sigma^{442}_{i0k1j1tuv} \\
&+ \sigma^{442}_{i1k0j0tuv} + \sigma^{442}_{i1k0j1tuv} + \sigma^{442}_{i1k1j0tuv} + \sigma^{442}_{i1k1j1tuv}) \left|442\right\rangle \\
&+ (\sigma^{443}_{i0k0j0tuv} + \sigma^{443}_{i0k0j1tuv} + \sigma^{443}_{i0k1j0tuv} + \sigma^{443}_{i0k1j1tuv} \\
&+ \sigma^{443}_{i1k0j0tuv} + \sigma^{443}_{i1k0j1tuv} + \sigma^{443}_{i1k1j0tuv} + \sigma^{443}_{i1k1j1tuv}) \left|443\right\rangle \\
&+ (\sigma^{444}_{i0k0j0tuv} + \sigma^{444}_{i0k0j1tuv} + \sigma^{444}_{i0k1j0tuv} + \sigma^{444}_{i0k1j1tuv} \\
&+ \sigma^{444}_{i1k0j0tuv} + \sigma^{444}_{i1k0j1tuv} + \sigma^{444}_{i1k1j0tuv} + \sigma^{444}_{i1k1j1tuv}) \left|444\right\rangle) \left|tuv\right\rangle
\end{aligned}
$$

$$
\begin{aligned}
= \sum_{tuv=0}^{1} \sum_{ijk=0}^{1} x_{ij} y_k ((&\sigma^{\mu\nu\tau}_{i0k0j0tuv} + \sigma^{\mu\nu\tau}_{i0k0j1tuv} + \sigma^{\mu\nu\tau}_{i0k1j0tuv} + \sigma^{\mu\nu\tau}_{i0k1j1tuv} \\
&+ \sigma^{\mu\nu\tau}_{i1k0j0tuv} + \sigma^{\mu\nu\tau}_{i1k0j1tuv} + \sigma^{\mu\nu\tau}_{i1k1j0tuv} + \sigma^{\mu\nu\tau}_{i1k1j1tuv}) \left|\mu\nu\tau\right\rangle) \left|tuv\right\rangle
\end{aligned}
$$

Selanjutnya dengan menuliskan

$$\sigma^{\mu\nu\tau}_{i0k0j0tuv}+\sigma^{\mu\nu\tau}_{i0k0j1tuv}+\sigma^{\mu\nu\tau}_{i0k1j0tuv}+\sigma^{\mu\nu\tau}_{i0k1j1tuv}+\sigma^{\mu\nu\tau}_{i1k0j0tuv}+\sigma^{\mu\nu\tau}_{i1k0j1tuv}+\sigma^{\mu\nu\tau}_{i1k1j0tuv}+\sigma^{\mu\nu\tau}_{i1k1j1tuv} = \sigma^{\mu\nu\tau}_{ijktuv}$$

Kemudian indeks ijk dijalankan maka:

$$\begin{aligned}
= \sum_{tuv=0}^{1}\sum_{\mu\nu\tau=1}^{4} (x_{00}y_0(&\sigma^{\mu\nu\tau}_{000000tuv} + \sigma^{\mu\nu\tau}_{000001tuv} + \sigma^{\mu\nu\tau}_{000100tuv} + \sigma^{\mu\nu\tau}_{000101tuv} \\
&+ \sigma^{\mu\nu\tau}_{010000tuv} + \sigma^{\mu\nu\tau}_{010001tuv} + \sigma^{\mu\nu\tau}_{010100tuv} + \sigma^{\mu\nu\tau}_{010101tuv}) \\
&+ x_{01}y_0(\sigma^{\mu\nu\tau}_{000010tuv} + \sigma^{\mu\nu\tau}_{000011tuv} + \sigma^{\mu\nu\tau}_{000110tuv} + \sigma^{\mu\nu\tau}_{000111tuv} \\
&+ \sigma^{\mu\nu\tau}_{010010tuv} + \sigma^{\mu\nu\tau}_{010011tuv} + \sigma^{\mu\nu\tau}_{010110tuv} + \sigma^{\mu\nu\tau}_{010111tuv}) \\
&+ x_{00}y_1(\sigma^{\mu\nu\tau}_{001000tuv} + \sigma^{\mu\nu\tau}_{001001tuv} + \sigma^{\mu\nu\tau}_{001100tuv} + \sigma^{\mu\nu\tau}_{001101tuv} \\
&+ \sigma^{\mu\nu\tau}_{011000tuv} + \sigma^{\mu\nu\tau}_{011001tuv} + \sigma^{\mu\nu\tau}_{011100tuv} + \sigma^{\mu\nu\tau}_{011101tuv}) \\
&+ x_{01}y_1(\sigma^{\mu\nu\tau}_{001010tuv} + \sigma^{\mu\nu\tau}_{001011tuv} + \sigma^{\mu\nu\tau}_{001110tuv} + \sigma^{\mu\nu\tau}_{001111tuv} \\
&+ \sigma^{\mu\nu\tau}_{011010tuv} + \sigma^{\mu\nu\tau}_{011011tuv} + \sigma^{\mu\nu\tau}_{011110tuv} + \sigma^{\mu\nu\tau}_{011111tuv}) \\
&+ x_{10}y_0(\sigma^{\mu\nu\tau}_{100000tuv} + \sigma^{\mu\nu\tau}_{100001tuv} + \sigma^{\mu\nu\tau}_{100100tuv} + \sigma^{\mu\nu\tau}_{100101tuv} \\
&+ \sigma^{\mu\nu\tau}_{110000tuv} + \sigma^{\mu\nu\tau}_{110001tuv} + \sigma^{\mu\nu\tau}_{110100tuv} + \sigma^{\mu\nu\tau}_{110101tuv}) \\
&+ x_{11}y_0(\sigma^{\mu\nu\tau}_{100010tuv} + \sigma^{\mu\nu\tau}_{100011tuv} + \sigma^{\mu\nu\tau}_{100110tuv} + \sigma^{\mu\nu\tau}_{100111tuv} \\
&+ \sigma^{\mu\nu\tau}_{110010tuv} + \sigma^{\mu\nu\tau}_{110011tuv} + \sigma^{\mu\nu\tau}_{110110tuv} + \sigma^{\mu\nu\tau}_{110111tuv}) \\
&+ x_{10}y_1(\sigma^{\mu\nu\tau}_{101000tuv} + \sigma^{\mu\nu\tau}_{101001tuv} + \sigma^{\mu\nu\tau}_{101100tuv} + \sigma^{\mu\nu\tau}_{101101tuv} \\
&+ \sigma^{\mu\nu\tau}_{111000tuv} + \sigma^{\mu\nu\tau}_{111001tuv} + \sigma^{\mu\nu\tau}_{111100tuv} + \sigma^{\mu\nu\tau}_{111101tuv}) \\
&+ x_{11}y_1(\sigma^{\mu\nu\tau}_{101010tuv} + \sigma^{\mu\nu\tau}_{101011tuv} + \sigma^{\mu\nu\tau}_{101110tuv} + \sigma^{\mu\nu\tau}_{101111tuv} \\
&+ \sigma^{\mu\nu\tau}_{111010tuv} + \sigma^{\mu\nu\tau}_{111011tuv} + \sigma^{\mu\nu\tau}_{111110tuv} + \sigma^{\mu\nu\tau}_{111111tuv}) \left|\mu\nu\tau\right\rangle \left|tuv\right\rangle)
\end{aligned}$$

$$\begin{aligned}
= \sum_{tuv=0}^{1}\sum_{\mu\nu\tau=1}^{4} (&x_{00}y_0\sigma^{\mu\nu\tau}_{000tuv} + x_{01}y_0\sigma^{\mu\nu\tau}_{001tuv} + x_{00}y_1\sigma^{\mu\nu\tau}_{010tuv} + x_{01}y_1\sigma^{\mu\nu\tau}_{011tuv} \\
&+ x_{10}y_0\sigma^{\mu\nu\tau}_{100tuv} + x_{11}y_0\sigma^{\mu\nu\tau}_{101tuv} + x_{10}y_1\sigma^{\mu\nu\tau}_{110tuv} + x_{11}y_1\sigma^{\mu\nu\tau}_{111tuv}) \left|\mu\nu\tau\right\rangle \left|tuv\right\rangle
\end{aligned}$$

$$= \sum_{tuv=0}^{1}\sum_{\mu\nu\tau=1}^{4} \begin{pmatrix}\sigma^{\mu\nu\tau}_{000tuv} & \sigma^{\mu\nu\tau}_{001tuv} & \sigma^{\mu\nu\tau}_{010tuv} & \sigma^{\mu\nu\tau}_{011tuv} & \sigma^{\mu\nu\tau}_{100tuv} & \sigma^{\mu\nu\tau}_{101tuv} & \sigma^{\mu\nu\tau}_{110tuv} & \sigma^{\mu\nu\tau}_{111tuv}\end{pmatrix} \begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} \left|\mu\nu\tau\right\rangle \left|tuv\right\rangle$$

Kemudian indeks *tuv* dijalankan

$$= \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} \sigma_{000000}^{\mu\nu\tau} & \sigma_{001000}^{\mu\nu\tau} & \sigma_{010000}^{\mu\nu\tau} & \sigma_{011000}^{\mu\nu\tau} & \sigma_{100000}^{\mu\nu\tau} & \sigma_{101000}^{\mu\nu\tau} & \sigma_{110000}^{\mu\nu\tau} & \sigma_{111000}^{\mu\nu\tau} \end{pmatrix} \begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\, |000\rangle$$

$$+ \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} \sigma_{000001}^{\mu\nu\tau} & \sigma_{001001}^{\mu\nu\tau} & \sigma_{010001}^{\mu\nu\tau} & \sigma_{011001}^{\mu\nu\tau} & \sigma_{100001}^{\mu\nu\tau} & \sigma_{101001}^{\mu\nu\tau} & \sigma_{110001}^{\mu\nu\tau} & \sigma_{111001}^{\mu\nu\tau} \end{pmatrix} \begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\, |001\rangle$$

$$+ \sum_{\mu\nu\tau=1}^{4} \begin{pmatrix} \sigma_{000010}^{\mu\nu\tau} & \sigma_{001010}^{\mu\nu\tau} & \sigma_{010010}^{\mu\nu\tau} & \sigma_{011010}^{\mu\nu\tau} & \sigma_{100010}^{\mu\nu\tau} & \sigma_{101010}^{\mu\nu\tau} & \sigma_{110010}^{\mu\nu\tau} & \sigma_{111010}^{\mu\nu\tau} \end{pmatrix} \begin{pmatrix} x_{00}y_0 \\ x_{01}y_0 \\ x_{00}y_1 \\ x_{01}y_1 \\ x_{10}y_0 \\ x_{11}y_0 \\ x_{10}y_1 \\ x_{11}y_1 \end{pmatrix} |\mu\nu\tau\rangle\, |010\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}\sigma_{000011}^{\mu\nu\tau} & \sigma_{001011}^{\mu\nu\tau} & \sigma_{010011}^{\mu\nu\tau} & \sigma_{011011}^{\mu\nu\tau} & \sigma_{100011}^{\mu\nu\tau} & \sigma_{101011}^{\mu\nu\tau} & \sigma_{110011}^{\mu\nu\tau} & \sigma_{111011}^{\mu\nu\tau}\end{pmatrix}\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|011\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}\sigma_{000100}^{\mu\nu\tau} & \sigma_{001100}^{\mu\nu\tau} & \sigma_{010100}^{\mu\nu\tau} & \sigma_{011100}^{\mu\nu\tau} & \sigma_{100100}^{\mu\nu\tau} & \sigma_{101100}^{\mu\nu\tau} & \sigma_{110100}^{\mu\nu\tau} & \sigma_{111100}^{\mu\nu\tau}\end{pmatrix}\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|100\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}\sigma_{000101}^{\mu\nu\tau} & \sigma_{001101}^{\mu\nu\tau} & \sigma_{010101}^{\mu\nu\tau} & \sigma_{011101}^{\mu\nu\tau} & \sigma_{100101}^{\mu\nu\tau} & \sigma_{101101}^{\mu\nu\tau} & \sigma_{110101}^{\mu\nu\tau} & \sigma_{111101}^{\mu\nu\tau}\end{pmatrix}\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|101\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}\sigma_{000110}^{\mu\nu\tau} & \sigma_{001110}^{\mu\nu\tau} & \sigma_{010110}^{\mu\nu\tau} & \sigma_{011110}^{\mu\nu\tau} & \sigma_{100110}^{\mu\nu\tau} & \sigma_{101110}^{\mu\nu\tau} & \sigma_{110110}^{\mu\nu\tau} & \sigma_{111110}^{\mu\nu\tau}\end{pmatrix}\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|110\rangle$$

$$+\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}\sigma^{\mu\nu\tau}_{000111} & \sigma^{\mu\nu\tau}_{001111} & \sigma^{\mu\nu\tau}_{010111} & \sigma^{\mu\nu\tau}_{011111} & \sigma^{\mu\nu\tau}_{100111} & \sigma^{\mu\nu\tau}_{101111} & \sigma^{\mu\nu\tau}_{110111} & \sigma^{\mu\nu\tau}_{111111}\end{pmatrix}$$

$$\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}|\mu\nu\tau\rangle\,|111\rangle$$

$$=\sum_{\mu\nu\tau=1}^{4}\begin{pmatrix}
\sigma^{\mu\nu\tau}_{000000} & \sigma^{\mu\nu\tau}_{001000} & \sigma^{\mu\nu\tau}_{010000} & \sigma^{\mu\nu\tau}_{011000} & \sigma^{\mu\nu\tau}_{100000} & \sigma^{\mu\nu\tau}_{101000} & \sigma^{\mu\nu\tau}_{110000} & \sigma^{\mu\nu\tau}_{111000}\\
\sigma^{\mu\nu\tau}_{000001} & \sigma^{\mu\nu\tau}_{001001} & \sigma^{\mu\nu\tau}_{010001} & \sigma^{\mu\nu\tau}_{011001} & \sigma^{\mu\nu\tau}_{100001} & \sigma^{\mu\nu\tau}_{101001} & \sigma^{\mu\nu\tau}_{110001} & \sigma^{\mu\nu\tau}_{111001}\\
\sigma^{\mu\nu\tau}_{000010} & \sigma^{\mu\nu\tau}_{001010} & \sigma^{\mu\nu\tau}_{010010} & \sigma^{\mu\nu\tau}_{011010} & \sigma^{\mu\nu\tau}_{100010} & \sigma^{\mu\nu\tau}_{101010} & \sigma^{\mu\nu\tau}_{110010} & \sigma^{\mu\nu\tau}_{111010}\\
\sigma^{\mu\nu\tau}_{000011} & \sigma^{\mu\nu\tau}_{001011} & \sigma^{\mu\nu\tau}_{010011} & \sigma^{\mu\nu\tau}_{011011} & \sigma^{\mu\nu\tau}_{100011} & \sigma^{\mu\nu\tau}_{101011} & \sigma^{\mu\nu\tau}_{110011} & \sigma^{\mu\nu\tau}_{111011}\\
\sigma^{\mu\nu\tau}_{000100} & \sigma^{\mu\nu\tau}_{001100} & \sigma^{\mu\nu\tau}_{010100} & \sigma^{\mu\nu\tau}_{011100} & \sigma^{\mu\nu\tau}_{100100} & \sigma^{\mu\nu\tau}_{101100} & \sigma^{\mu\nu\tau}_{110100} & \sigma^{\mu\nu\tau}_{111100}\\
\sigma^{\mu\nu\tau}_{000101} & \sigma^{\mu\nu\tau}_{001101} & \sigma^{\mu\nu\tau}_{010101} & \sigma^{\mu\nu\tau}_{011101} & \sigma^{\mu\nu\tau}_{100101} & \sigma^{\mu\nu\tau}_{101101} & \sigma^{\mu\nu\tau}_{110101} & \sigma^{\mu\nu\tau}_{111101}\\
\sigma^{\mu\nu\tau}_{000110} & \sigma^{\mu\nu\tau}_{001110} & \sigma^{\mu\nu\tau}_{010110} & \sigma^{\mu\nu\tau}_{011110} & \sigma^{\mu\nu\tau}_{100110} & \sigma^{\mu\nu\tau}_{101110} & \sigma^{\mu\nu\tau}_{110110} & \sigma^{\mu\nu\tau}_{111110}\\
\sigma^{\mu\nu\tau}_{000111} & \sigma^{\mu\nu\tau}_{001111} & \sigma^{\mu\nu\tau}_{010111} & \sigma^{\mu\nu\tau}_{011111} & \sigma^{\mu\nu\tau}_{100111} & \sigma^{\mu\nu\tau}_{101111} & \sigma^{\mu\nu\tau}_{110111} & \sigma^{\mu\nu\tau}_{111111}
\end{pmatrix}$$

$$\begin{pmatrix}x_{00}y_0\\x_{01}y_0\\x_{00}y_1\\x_{01}y_1\\x_{10}y_0\\x_{11}y_0\\x_{10}y_1\\x_{11}y_1\end{pmatrix}\begin{pmatrix}|000\rangle & |001\rangle & |010\rangle & |011\rangle & |100\rangle & |101\rangle & |110\rangle & |111\rangle\end{pmatrix}|000\rangle\,|\mu\nu\tau\rangle$$

Setelah itu kita dapatkan bahwa:

$$\begin{pmatrix}
R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \\
R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001} \\
R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010} \\
R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011} \\
R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100} \\
R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101} \\
R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110110} & R_{111110} \\
R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111}
\end{pmatrix}$$
$$\left(\begin{pmatrix} T^{\mu}_{00} & T^{\mu}_{10} \\ T^{\mu}_{01} & T^{\mu}_{11} \end{pmatrix} \otimes \begin{pmatrix} T^{\nu}_{00} & T^{\nu}_{10} \\ T^{\nu}_{01} & T^{\nu}_{11} \end{pmatrix} \otimes \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix}\right) =$$
$$\begin{pmatrix}
\sigma^{\mu\nu\tau}_{000000} & \sigma^{\mu\nu\tau}_{001000} & \sigma^{\mu\nu\tau}_{010000} & \sigma^{\mu\nu\tau}_{011000} & \sigma^{\mu\nu\tau}_{100000} & \sigma^{\mu\nu\tau}_{101000} & \sigma^{\mu\nu\tau}_{110000} & \sigma^{\mu\nu\tau}_{111000} \\
\sigma^{\mu\nu\tau}_{000001} & \sigma^{\mu\nu\tau}_{001001} & \sigma^{\mu\nu\tau}_{010001} & \sigma^{\mu\nu\tau}_{011001} & \sigma^{\mu\nu\tau}_{100001} & \sigma^{\mu\nu\tau}_{101001} & \sigma^{\mu\nu\tau}_{110001} & \sigma^{\mu\nu\tau}_{111001} \\
\sigma^{\mu\nu\tau}_{000010} & \sigma^{\mu\nu\tau}_{001010} & \sigma^{\mu\nu\tau}_{010010} & \sigma^{\mu\nu\tau}_{011010} & \sigma^{\mu\nu\tau}_{100010} & \sigma^{\mu\nu\tau}_{101010} & \sigma^{\mu\nu\tau}_{110010} & \sigma^{\mu\nu\tau}_{111010} \\
\sigma^{\mu\nu\tau}_{000011} & \sigma^{\mu\nu\tau}_{001011} & \sigma^{\mu\nu\tau}_{010011} & \sigma^{\mu\nu\tau}_{011011} & \sigma^{\mu\nu\tau}_{100011} & \sigma^{\mu\nu\tau}_{101011} & \sigma^{\mu\nu\tau}_{110011} & \sigma^{\mu\nu\tau}_{111011} \\
\sigma^{\mu\nu\tau}_{000100} & \sigma^{\mu\nu\tau}_{001100} & \sigma^{\mu\nu\tau}_{010100} & \sigma^{\mu\nu\tau}_{011100} & \sigma^{\mu\nu\tau}_{100100} & \sigma^{\mu\nu\tau}_{101100} & \sigma^{\mu\nu\tau}_{110100} & \sigma^{\mu\nu\tau}_{111100} \\
\sigma^{\mu\nu\tau}_{000101} & \sigma^{\mu\nu\tau}_{001101} & \sigma^{\mu\nu\tau}_{010101} & \sigma^{\mu\nu\tau}_{011101} & \sigma^{\mu\nu\tau}_{100101} & \sigma^{\mu\nu\tau}_{101101} & \sigma^{\mu\nu\tau}_{110101} & \sigma^{\mu\nu\tau}_{111101} \\
\sigma^{\mu\nu\tau}_{000110} & \sigma^{\mu\nu\tau}_{001110} & \sigma^{\mu\nu\tau}_{010110} & \sigma^{\mu\nu\tau}_{011110} & \sigma^{\mu\nu\tau}_{100110} & \sigma^{\mu\nu\tau}_{101110} & \sigma^{\mu\nu\tau}_{110110} & \sigma^{\mu\nu\tau}_{111110} \\
\sigma^{\mu\nu\tau}_{000111} & \sigma^{\mu\nu\tau}_{001111} & \sigma^{\mu\nu\tau}_{010111} & \sigma^{\mu\nu\tau}_{011111} & \sigma^{\mu\nu\tau}_{100111} & \sigma^{\mu\nu\tau}_{101111} & \sigma^{\mu\nu\tau}_{110111} & \sigma^{\mu\nu\tau}_{111111}
\end{pmatrix}$$

Selanjutnya, jika dituliskan matriks berikut

$$\begin{pmatrix}
R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \\
R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001} \\
R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010} \\
R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011} \\
R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100} \\
R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101} \\
R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110110} & R_{111110} \\
R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111}
\end{pmatrix} = \mathbf{R}$$

dengan $\mathbf{R}$ disebut sebagai matriks parameter kanal, dan untuk

$$\begin{pmatrix}
\sigma^{\mu\nu\tau}_{000000} & \sigma^{\mu\nu\tau}_{001000} & \sigma^{\mu\nu\tau}_{010000} & \sigma^{\mu\nu\tau}_{011000} & \sigma^{\mu\nu\tau}_{100000} & \sigma^{\mu\nu\tau}_{101000} & \sigma^{\mu\nu\tau}_{110000} & \sigma^{\mu\nu\tau}_{111000} \\
\sigma^{\mu\nu\tau}_{000001} & \sigma^{\mu\nu\tau}_{001001} & \sigma^{\mu\nu\tau}_{010001} & \sigma^{\mu\nu\tau}_{011001} & \sigma^{\mu\nu\tau}_{100001} & \sigma^{\mu\nu\tau}_{101001} & \sigma^{\mu\nu\tau}_{110001} & \sigma^{\mu\nu\tau}_{111001} \\
\sigma^{\mu\nu\tau}_{000010} & \sigma^{\mu\nu\tau}_{001010} & \sigma^{\mu\nu\tau}_{010010} & \sigma^{\mu\nu\tau}_{011010} & \sigma^{\mu\nu\tau}_{100010} & \sigma^{\mu\nu\tau}_{101010} & \sigma^{\mu\nu\tau}_{110010} & \sigma^{\mu\nu\tau}_{111010} \\
\sigma^{\mu\nu\tau}_{000011} & \sigma^{\mu\nu\tau}_{001011} & \sigma^{\mu\nu\tau}_{010011} & \sigma^{\mu\nu\tau}_{011011} & \sigma^{\mu\nu\tau}_{100011} & \sigma^{\mu\nu\tau}_{101011} & \sigma^{\mu\nu\tau}_{110011} & \sigma^{\mu\nu\tau}_{111011} \\
\sigma^{\mu\nu\tau}_{000100} & \sigma^{\mu\nu\tau}_{001100} & \sigma^{\mu\nu\tau}_{010100} & \sigma^{\mu\nu\tau}_{011100} & \sigma^{\mu\nu\tau}_{100100} & \sigma^{\mu\nu\tau}_{101100} & \sigma^{\mu\nu\tau}_{110100} & \sigma^{\mu\nu\tau}_{111100} \\
\sigma^{\mu\nu\tau}_{000101} & \sigma^{\mu\nu\tau}_{001101} & \sigma^{\mu\nu\tau}_{010101} & \sigma^{\mu\nu\tau}_{011101} & \sigma^{\mu\nu\tau}_{100101} & \sigma^{\mu\nu\tau}_{101101} & \sigma^{\mu\nu\tau}_{110101} & \sigma^{\mu\nu\tau}_{111101} \\
\sigma^{\mu\nu\tau}_{000110} & \sigma^{\mu\nu\tau}_{001110} & \sigma^{\mu\nu\tau}_{010110} & \sigma^{\mu\nu\tau}_{011110} & \sigma^{\mu\nu\tau}_{100110} & \sigma^{\mu\nu\tau}_{101110} & \sigma^{\mu\nu\tau}_{110110} & \sigma^{\mu\nu\tau}_{111110} \\
\sigma^{\mu\nu\tau}_{000111} & \sigma^{\mu\nu\tau}_{001111} & \sigma^{\mu\nu\tau}_{010111} & \sigma^{\mu\nu\tau}_{011111} & \sigma^{\mu\nu\tau}_{100111} & \sigma^{\mu\nu\tau}_{101111} & \sigma^{\mu\nu\tau}_{110111} & \sigma^{\mu\nu\tau}_{111111}
\end{pmatrix} = \sigma^{\mu\nu\tau}$$

maka persamaan di atas dapat dituliskan menjadi

$$\mathbf{R}(T^{\mu} \otimes T^{\nu} \otimes T^{\tau}) = \sigma^{\mu\nu\tau}$$

Selanjutnya untuk mencari nilai dari matriks parameter kanal maka dilakukan perkalian invers dari matriks $(T^\mu \otimes T^\nu \otimes T^\tau)$ dari kanan, sebagai berikut

$$\begin{aligned}\mathbf{R}(T^\mu \otimes T^\nu \otimes T^\tau)(T^\mu \otimes T^\nu \otimes T^\tau)^{-1} &= \sigma^{\mu\nu\tau}(T^\mu \otimes T^\nu \otimes T^\tau)^{-1} \\ \mathbf{R} &= \sigma^{\mu\nu\tau}(T^\mu \otimes T^\nu \otimes T^\tau)^{-1}\end{aligned}$$

Saat Alice dan Bob melakukan pengukuran dengan menggunakan basis Bell sebagai berikut

$$\begin{aligned}|\chi'\rangle &= (\langle\pi\kappa\zeta| \otimes I \otimes I \otimes I)\, |\Psi\rangle_{A,B,A_1,A_1,B_1,B_2,B_2,A_2} \\ &= (\langle\pi\kappa\zeta| \otimes I \otimes I \otimes I) \sum_{ijklmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} |\mu\nu\tau\rangle\, x_{ik} y_j (\sigma)^{\mu\nu\tau} |t\rangle_{B2} |u\rangle_{A2} |v\rangle_{A2} \\ &= \sum_{ijklmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} \langle\pi\kappa\zeta|\mu\nu\tau\rangle\, x_{ik} y_j (\sigma)^{\mu\nu\tau} |t\rangle_{B2} |u\rangle_{A2} |v\rangle_{A2} \\ &= \sum_{ijklmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} \langle\pi|\mu\rangle \langle\kappa|\nu\rangle \langle\zeta|\tau\rangle\, x_{ik} y_j (\sigma)^{\mu\nu\tau} |t\rangle_{B2} |u\rangle_{A2} |v\rangle_{A2} \\ &= \sum_{ijklmstuv=0}^{1} \sum_{\mu\nu\tau=1}^{4} \delta_{\pi\mu}\delta\kappa\nu\delta\zeta\tau x_{ik} y_j (\sigma)^{\mu\nu\tau} |t\rangle_{B2} |u\rangle_{A2} |v\rangle_{A2} \\ &= \sum_{ijklmstuv=0}^{1} x_{ik} y_j (\sigma)^{\mu\nu\tau} |t\rangle_{B2} |u\rangle_{A2} |v\rangle_{A2} \\ &= \sum_{ijklmstuv=0}^{1} x_{ik} y_j (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\tau)(|t\rangle_{B2} \otimes |u\rangle_{A2} \otimes |v\rangle_{A2}) \\ &= \sum_{ijklmstuv=0}^{1} x_{ik} y_j (\sigma^\mu |t\rangle_{B2}) \otimes (\sigma^\nu |u\rangle_{A2}) \otimes (\sigma^\tau |v\rangle_{A2})\end{aligned} \tag{3.1}$$

dengan σ^μ merupakan matriks yang diturunkan dari hasil pengukuran oleh Alice σ^ν dan σ^τ merupakan matriks yang diturunkan dari hasil pengukuran oleh Bob, maka untuk mendapatkan matriks parameter kanal dapat dituliskan sebagai berikut

$$\begin{aligned}\mathbf{R} &= (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\tau)(T^\mu \otimes T^\nu \otimes T^\tau)^{-1} \\ \mathbf{R} &= (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\tau)((T^\mu)^{-1} \otimes (T^\nu)^{-1} \otimes (T^\tau)^{-1})\end{aligned} \tag{3.2}$$

dengan perkalian tensor matriks T^μ,T^ν dan T^τ mengkasilkan matriks 8×8

Bab 4

Bentuk Umum Matrik Parameter Kanal Teleportasi Dua Arah Asimetri

Matriks parameter kanal merupakan matriks yang dibentuk dari matriks transformasi T^μ, T^ν dan T^τ dan juga matriks transformasi dari pengukuran Alice dan juga Bob $(\sigma^\mu, \sigma^\nu, \sigma^\tau)$. Matriks parameter kanal untuk teleportasi dua arah asimetri ini berbentuk matriks 8×8 sebagai berikut

$$\begin{pmatrix} R_{000000} & R_{001000} & R_{010000} & R_{011000} & R_{100000} & R_{101000} & R_{110000} & R_{111000} \\ R_{000001} & R_{001001} & R_{010001} & R_{011001} & R_{100001} & R_{101001} & R_{110001} & R_{111001} \\ R_{000010} & R_{001010} & R_{010010} & R_{011010} & R_{100010} & R_{101010} & R_{110010} & R_{111010} \\ R_{000011} & R_{001011} & R_{010011} & R_{011011} & R_{100011} & R_{101011} & R_{110011} & R_{111011} \\ R_{000100} & R_{001100} & R_{010100} & R_{011100} & R_{100100} & R_{101100} & R_{110100} & R_{111100} \\ R_{000101} & R_{001101} & R_{010101} & R_{011101} & R_{100101} & R_{101101} & R_{110101} & R_{111101} \\ R_{000110} & R_{001110} & R_{010110} & R_{011110} & R_{100110} & R_{101110} & R_{110110} & R_{111110} \\ R_{000111} & R_{001111} & R_{010111} & R_{011111} & R_{100111} & R_{101111} & R_{110111} & R_{111111} \end{pmatrix} = \mathbf{R} \tag{4.1}$$

dengan $R_{000000}, R_{000001}, ..., R_{111111}$ merupakan konstanta dari kanal yang digunakan. Untuk membentuk matriks parameter kanal untuk teleportasi dua arah asimetri digunakan perumusan seperti dibawah ini

$$\begin{aligned} \mathbf{R} &= (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\mu)(T^\mu \otimes T^\nu \otimes T^\tau)^{-1} \\ &= (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\tau)((T^\mu)^{-1} \otimes (T^\nu)^{-1} \otimes (T^\tau)^{-1}) \\ &= (\sigma^\mu \otimes \sigma^\nu \otimes \sigma^\tau)((T^\mu)^{-1} \otimes (T^\nu)^{-1} \otimes (T^\tau)^{-1}) \\ &= (\sigma^\mu (T^\mu)^{-1}) \otimes (\sigma^\nu (T^\nu)^{-1}) \otimes (\sigma^\tau (T^\tau)^{-1}) \end{aligned} \tag{4.2}$$

Matriks parameter kanal $\mathbf{R}$ dapat dibentuk dengan memenuhi syarat uniter dituliskan sebagai berikut:

$$\begin{aligned} \mathbf{R} &= (\sigma^\mu (T^\mu)^{-1}) \otimes (\sigma^\nu (T^\nu)^{-1}) \otimes (\sigma^\tau (T^\tau)^{-1}) \\ &= (U(\pi)(T^\mu)^{-1}) \otimes (U(\kappa)(T^\nu)^{-1}) \otimes (U(\zeta)(T^\tau)^{-1}) \end{aligned} \tag{4.3}$$

dengan $(U(\pi)$,$(U(\kappa)$ dan $(U(\zeta)$ merupakan matriks uniter secara umum untuk σ^{μ},σ^{ν} dan σ^{τ}. Selanjutnya jika didefinisakan sebagai beriku

$$\begin{aligned} U_1 &= (U(\pi)(T^{\mu})^{-1}) \\ U_2 &= (U(\kappa)(T^{\nu})^{-1}) \\ U_3 &= (U(\zeta)(T^{\tau})^{-1}) \end{aligned}$$

maka persamaan di atas dapat dituliskan sebagai dengan

$$\mathbf{R} = U_1 \otimes U_2 \otimes U_3 \tag{4.4}$$

Bentuk matriks U_1 sebagai berikut

$$\begin{aligned} U_1 &= \begin{pmatrix} \cos(\theta_1)e^{i\alpha_1} & \sin(\theta_1)e^{i\beta_1} \\ -\sin(\theta_1)e^{i\gamma_1} & \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1} \end{pmatrix} \begin{pmatrix} T^{\mu}_{00} & T^{\mu}_{10} \\ T^{\mu}_{01} & T^{\mu}_{11} \end{pmatrix}^{-1} \\ &= \begin{pmatrix} \cos(\theta_1)e^{i\alpha_1} & -\sin(\theta_1)e^{i\beta_1} \\ -\sin(\theta_1)e^{i\gamma_1} & \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1} \end{pmatrix} \frac{1}{\det(T^{\mu})} \begin{pmatrix} T^{\mu}_{11} & -T^{\mu}_{10} \\ -T^{\mu}_{01} & T^{\mu}_{00} \end{pmatrix} \\ &= \frac{1}{\det(T^{\mu})} \left(\begin{matrix} \cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01} & ... \\ -\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01} & ... \end{matrix} \right. \\ &\quad \left. \begin{matrix} ... & -\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00} \\ ... & \sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00} \end{matrix} \right) \end{aligned} \tag{4.5}$$

matriks U_2 sebagai berikut

$$\begin{aligned} U_2 &= \begin{pmatrix} \cos(\theta_2)e^{i\alpha_2} & \sin(\theta_2)e^{i\beta_2} \\ -\sin(\theta_2)e^{i\gamma_2} & \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2} \end{pmatrix} \begin{pmatrix} T^{\nu}_{00} & T^{\nu}_{10} \\ T^{\nu}_{01} & T^{\nu}_{11} \end{pmatrix}^{-1} \\ &= \begin{pmatrix} \cos(\theta_2)e^{i\alpha_2} & -\sin(\theta_2)e^{i\beta_2} \\ -\sin(\theta_2)e^{i\gamma_2} & \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2} \end{pmatrix} \frac{1}{\det(T^{\nu})} \begin{pmatrix} T^{\nu}_{11} & -T^{\nu}_{10} \\ -T^{\nu}_{01} & T^{\nu}_{00} \end{pmatrix} \\ &= \frac{1}{\det(T^{\nu})} \left(\begin{matrix} \cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01} & ... \\ -\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01} & ... \end{matrix} \right. \\ &\quad \left. \begin{matrix} ... & -\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00} \\ ... & \sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00} \end{matrix} \right) \end{aligned} \tag{4.6}$$

dan matriks U_3 sebagai berikut

$$\begin{aligned} U_3 &= \begin{pmatrix} \cos(\theta_3)e^{i\alpha_3} & \sin(\theta_2)e^{i\beta_3} \\ -\sin(\theta_3)e^{i\gamma_3} & \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3} \end{pmatrix} \begin{pmatrix} T^{\tau}_{00} & T^{\tau}_{10} \\ T^{\tau}_{01} & T^{\tau}_{11} \end{pmatrix}^{-1} \\ &= \begin{pmatrix} \cos(\theta_3)e^{i\alpha_3} & -\sin(\theta_3)e^{i\beta_3} \\ -\sin(\theta_3)e^{i\gamma_3} & \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3} \end{pmatrix} \frac{1}{\det(T^{\tau})} \begin{pmatrix} T^{\tau}_{11} & -T^{\tau}_{10} \\ -T^{\tau}_{01} & T^{\tau}_{00} \end{pmatrix} \\ &= \frac{1}{\det(T^{\tau})} \left(\begin{matrix} \cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01} & ... \\ -\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01} & ... \end{matrix} \right. \\ &\quad \left. \begin{matrix} ... & -\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00} \\ ... & \sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00} \end{matrix} \right) \end{aligned} \tag{4.7}$$

Setelah persamaan (4.5), (4.6) dan (4.7) disubtitusikan ke dalam persamaan (4.4) maka bentuk matriks parameter kanal menjadi

$$\mathbf{R} = \frac{1}{\det(T^{\mu})\det(T^{\mu})\det(T^{\tau})}\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} & a_{17} & a_{18} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} & a_{27} & a_{28} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} & a_{37} & a_{38} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} & a_{47} & a_{48} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} & a_{57} & a_{58} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & a_{67} & a_{68} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & a_{77} & a_{78} \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & a_{88} \end{pmatrix} \quad (4.8)$$

dimana tiap elemen matriks parameter kanal sebagai berikut:

$$\begin{aligned}
a_{11} =& (\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01}) \\
& (\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01}) \\
a_{21} =& (\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01}) \\
& (-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01}) \\
a_{31} =& (\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01}) \\
& (\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01}) \\
a_{41} =& (\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01}) \\
& (-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01}) \\
a_{51} =& (-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01}) \\
& (\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01}) \\
a_{61} =& (-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01}) \\
& (-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01}) \\
a_{71} =& (-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01}) \\
& (\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01}) \\
a_{81} =& (-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01}) \\
& (-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})
\end{aligned}$$

$$a_{12} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})$$
$$(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})$$
$$a_{22} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})$$
$$(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})$$
$$a_{32} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})$$
$$(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})$$
$$a_{42} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})$$
$$(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})$$
$$a_{52} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})$$
$$(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})$$
$$a_{62} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})$$
$$(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})$$
$$a_{72} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})$$
$$(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})$$
$$a_{82} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})$$
$$(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})$$

$$a_{13} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})$$
$$(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})$$
$$a_{23} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})$$
$$(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})$$
$$a_{33} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})$$
$$(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})$$
$$a_{43} =(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})$$
$$(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})$$
$$a_{53} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})$$
$$(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})$$
$$a_{63} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})$$
$$(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})$$
$$a_{73} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})$$
$$(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})$$
$$a_{83} =(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})$$
$$(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})$$

$$
\begin{aligned}
a_{14} =&(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{24} =&(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{34} =&(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{44} =&(\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{11} + \sin(\theta_1)e^{i\beta_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{54} =&(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{64} =&(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{74} =&(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{84} =&(-\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{11} - \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{01})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})
\end{aligned}
$$

$$
\begin{aligned}
a_{15} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{25} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{35} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{45} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{55} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{65} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{75} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{85} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})
\end{aligned}
$$

$$
\begin{aligned}
a_{16} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{26} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{36} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{46} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{56} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{66} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{11} + \sin(\theta_2)e^{i\beta_2}T^{\nu}_{01})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{76} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{86} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{11} - \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{01})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})
\end{aligned}
$$

$$
\begin{aligned}
a_{17} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{27} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{37} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{47} =&(-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{57} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{67} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})\\
a_{77} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{11} + \sin(\theta_3)e^{i\beta_2}T^{\tau}_{01})\\
a_{87} =&\sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{11} - \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{01})
\end{aligned}
$$

$$
\begin{aligned}
a_{18} =& (-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{28} =& (-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{38} =& (-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{48} =& (-\cos(\theta_1)e^{i\alpha_1}T^{\mu}_{10} - \sin(\theta_1)e^{i\beta_1}T^{\mu}_{00})(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{58} =& \sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{68} =& \sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(-\cos(\theta_2)e^{i\alpha_2}T^{\nu}_{10} - \sin(\theta_2)e^{i\beta_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})\\
a_{78} =& \sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(-\cos(\theta_3)e^{i\alpha_3}T^{\tau}_{10} - \sin(\theta_3)e^{i\beta_3}T^{\tau}_{00})\\
a_{88} =& \sin(\theta_1)e^{i\gamma_1}T^{\mu}_{10} + \cos(\theta_1)e^{i\beta_1+\gamma_1-\alpha_1}T^{\mu}_{00}(\sin(\theta_2)e^{i\gamma_2}T^{\nu}_{10} + \cos(\theta_2)e^{i\beta_2+\gamma_2-\alpha_2}T^{\nu}_{00})\\
&(\sin(\theta_3)e^{i\gamma_3}T^{\tau}_{10} + \cos(\theta_3)e^{i\beta_3+\gamma_3-\alpha_3}T^{\tau}_{00})
\end{aligned}
$$

contohnya saat pengukur Alice σ_x dan Bob berupa $\sigma_x \otimes \sigma_x$ dan $\mu = 2$, $\nu = 3$ $\tau = 3$

$$
\begin{aligned}
R &= (\sigma^{\mu} \otimes \sigma^{\nu} \otimes \sigma^{\tau})\big((T^{\mu})^{(-1)} \otimes (T^{\nu})^{(-1)} \otimes (T^{\tau})^{(-1)}\big)\\
&= (\sigma_x \otimes \sigma_x \otimes \sigma_x)\big((T^{2})^{(-1)} \otimes (T^{3})^{(-1)} \otimes (T^{3})^{(-1)}\big)\\
&= \left(\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix} \otimes \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix} \otimes \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\right)\left(\tfrac{1}{\sqrt{2}}\begin{pmatrix}1 & 0\\ 0 & -1\end{pmatrix} \otimes \tfrac{1}{\sqrt{2}}\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix} \otimes \tfrac{1}{\sqrt{2}}\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\right)\\
&= \frac{1}{2\sqrt{2}}\begin{pmatrix}
0&0&0&0&0&0&0&1\\
0&0&0&0&0&0&1&0\\
0&0&0&0&0&1&0&0\\
0&0&0&0&1&0&0&0\\
0&0&0&1&0&0&0&0\\
0&0&1&0&0&0&0&0\\
0&1&0&0&0&0&0&0\\
1&0&0&0&0&0&0&0
\end{pmatrix}\begin{pmatrix}
0&0&0&1&0&0&0&0\\
0&0&1&0&0&0&0&0\\
0&1&0&0&0&0&0&0\\
1&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&-1\\
0&0&0&0&0&0&-1&0\\
0&0&0&0&0&-1&0&0\\
0&0&0&0&-1&0&0&0
\end{pmatrix}\\
&= \frac{1}{2\sqrt{2}}\begin{pmatrix}
0&0&0&0&-1&0&0&0\\
0&0&0&0&0&-1&0&0\\
0&0&0&0&0&0&-1&0\\
0&0&0&0&0&0&0&-1\\
1&0&0&0&0&0&0&0\\
0&1&0&0&0&0&0&0\\
0&0&1&0&0&0&0&0\\
0&0&0&1&0&0&0&0
\end{pmatrix}
\end{aligned}
$$

dari matriks parameter kanal ini dapat diketahui bahwa saluran yang sesuai berupa

$$
\begin{aligned}
|\phi\rangle_{A_1A_1B_1B_2B_2A_2} = \frac{1}{2\sqrt{2}}(&|000100\rangle + |001101\rangle + |010110\rangle + |011111\rangle \\
&- |100000\rangle - |101001\rangle - |110010\rangle - |111011\rangle)
\end{aligned}
$$

Bab 5

Penutup

5.1 Kesimpulan

Dalam skema teleportasi dua arah asimetri dimana Alice akan mengirimkan informasi dua qubit terhadap Bob, dan Bob akan mengirimkan informasi satu qubit terhadap Alice yang secara berturut-turut dapat dituliskan sebagai berikut

$$|\chi\rangle_a = \sum_{ij=0}^{1} x_{ij} |ij\rangle$$

$$|\chi\rangle_b = \sum_{k=0}^{1} y_k |k\rangle$$

dengan menggunakan kanal quantum terbelit enam qubit yang dapat diungkapkan sebagai

$$|\varphi\rangle_{A_1,A_1,B_1,B_2,B_2,B_1} = \sum_{lmstuv=0}^{1} R_{lmstuv} |lmstuv\rangle$$

Digunakan dua operator swap yaitu P_{24} dan P_{45} setelah dilakukan peleburan antara informasi dan kanal yang digunakan. Basis yang digunakan merupakan basis Bell, seperti dibawah ini

$$|\phi\rangle^1_{mn} = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)_{mn}$$

$$|\phi\rangle^2_{mn} = \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle)_{mn}$$

$$|\phi\rangle^3_{mn} = \frac{1}{\sqrt{2}}(|01\rangle + |10\rangle)_{mn}$$

$$|\phi\rangle^4_{mn} = \frac{1}{\sqrt{2}}(|01\rangle - |10\rangle)_{mn}$$

didapatkan matriks parameter kanal **R** sebagai kriteria kanal yang dapat digukan sebagai kanal pengiriman yang dapat diungkapkan sebagai

$$\mathbf{R} = (\sigma^\mu (T^\mu)^{-1}) \otimes (\sigma^\nu (T^\nu)^{-1}) \otimes (\sigma^\tau (T^\tau)^{-1})$$

Dimana tiga indeks awal pada matriks kanal menunjukkan baris dan tiga indeks berikutnya menunjukkan kolom.Matriks parameter kanal berupa matriks 8×8 seperti pada persamaan (4.8). Matriks parameter kanal ditentukan dari hasil pengukuran oleh Alice dan Bob $(\sigma^{\mu}, \sigma^{\nu}, \sigma^{\tau})$ yang merupakan matriks pauli dan matriks identitas 2×2 seperti di bawah ini

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$
$$\sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$
$$\sigma_x \sigma_y = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$
$$I = \sigma_x \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

selanjutnya matriks pengukur akan dirumuskan menggunakan matriks uniter 2×2 dalam bentuk umum sebagai berikut

$$U = \begin{pmatrix} \cos(\theta)e^{i\alpha} & \sin(\theta)e^{i\beta} \\ -\sin(\theta)e^{i\gamma} & \cos(\theta)e^{i\beta+\gamma-\alpha} \end{pmatrix}$$

dan bentuk matriks parameter kanal menjadi

$$\mathbf{R} = (U(\pi)(T^{\mu})^{-1}) \otimes (U(\kappa)(T^{\nu})^{-1}) \otimes (U(\zeta)(T^{\tau})^{-1})$$

Selain itu matriks parameter kanal juga bergantung pada matriks T^{μ}, T^{ν} dan T^{τ} yang merupakan bentuk transformasi dari kanal yang digunakan yang dapat dituliskan sebagai

$$T^1 = \begin{pmatrix} T^1_{00} & T^1_{10} \\ T^1_{01} & T^1_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$
$$T^2 = \begin{pmatrix} T^2_{00} & T^2_{10} \\ T^2_{01} & T^2_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$
$$T^3 = \begin{pmatrix} T^3_{00} & T^3_{10} \\ T^3_{01} & T^3_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$
$$T^4 = \begin{pmatrix} T^4_{00} & T^4_{10} \\ T^4_{01} & T^4_{11} \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}.$$

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Lampiran A

Qubit

Sistem informasi kuantum memiliki beberapa cabang diantaranya adalah komputer kuantum, kriptografi kuantum dan teleportasi kuantum. Komputer kuantum dan kriptografi kuantum adalah perkembangan dari komputer klasik dan kriptografi klasik, yang menggunakan data digital berupa bit, yaitu 0 dan 1. Pada komputer kuantum dan kriptografi kuantum data yang digunakan adalah data kuantum yang disebut kuantum bit atau qubit. Qubit merepresentasi sistem kuantum dengan dua keadaan yaitu $|0\rangle$ dan $|1\rangle$. Pada teleportasi kuantum informasi atau data yang dikirimkan sama yakni qubit [19]. Keadaan ternormalisasi dari qubit sapat berbentuk kombinasi linier dari keduanya $|\psi\rangle$, yang dibatasi syarat normalisasi

$$|\psi\rangle = a\,|0\rangle + b\,|1\rangle \tag{A.1}$$

Koefisien a dan b merupakan bilangan kompleks yang memenuhi orthonormalitas

$$\langle\psi|\psi\rangle = |a|^2 + |b|^2 = 1 \tag{A.2}$$

$|0\rangle$ dan $|1\rangle$ adalah basis orthonormal dari keadaan $|\psi\rangle$, dimana meskipun secara umum a dan b memiliki empat parameter bebas tetapi hanya terdepat dua parameter yang merupakan parameter bebas. Koefisien a dan b dapat dinyatakan sebagai berikut

$$a = r_a e^{i\phi_a}$$
$$b = r_b e^{i\phi_b}$$

dengan meninjau syarat orthonormalitas didapatkan

$$\begin{aligned} 1 &= |a|^2 + |b|^2 \\ &= (r_a e^{i\phi_a})(r_a e^{-i\phi_a}) + (r_b e^{i\phi_b})(r_b e^{-i\phi_b}) \\ &= {r_a}^2 + {r_b}^2 \end{aligned} \tag{A.3}$$

yang merupakan persamaan lingkaran dengan jari-jari satu. Apabila dipilih

$$r_a = \cos(\theta)$$
$$r_b = \sin(\theta)$$

Maka koefisien a dan b dapat dinyatakan sebagai berikut

$$a = \cos(\theta)e^{i\phi_a}$$
$$b = \sin(\theta)e^{i\phi_b}$$

Sehingga vektor keadaan dapat dinyatakan menjadi

$$|\psi\rangle = \cos(\theta)e^{i\phi_a}|0\rangle + \sin(\theta)e^{i\phi_b}|1\rangle \quad \text{(A.4)}$$

Prinsip pengukuran pada mekanika kuantum menyatakan bahwa pengukuran dua keadaan kuantum yang berbeda hanya pada faktor fase global ($e^{i\delta}$) selalu memberikan hasil yang sama

$$|\psi\rangle \cong (e^{i\delta})|\psi\rangle$$

Sehingga persamaan keadaan tersebut dapat tereduksi menjadi

$$\begin{aligned} e^{-i\phi_a}|\psi\rangle &= e^{-i\phi_a}(\cos(\theta)e^{i\phi_a}|0\rangle + \sin(\theta)e^{i\phi_b}|1\rangle) \\ &= \cos(\theta)|0\rangle + \sin(\theta)e^{i\phi_b - i\phi_a}|1\rangle \\ &= \cos(\theta)|0\rangle + \sin(\theta)e^{i\phi}|1\rangle \end{aligned}$$

dengan $\phi = \phi_b - \phi_a$.

Lampiran B

Keadaan Terbelit

Secara umum keadaan 2 qubit dapat dipisahkan menjadi perkalian langsung (*tensor product*) dari dua buah qubit tunggal.

$$|\psi\rangle = |\psi_0\rangle \otimes |\psi_1\rangle \tag{B.1}$$

dengan

$$|\psi_0\rangle = c_0\,|0\rangle + c_1\,|1\rangle$$

dan

$$|\psi_1\rangle = d_0\,|0\rangle + d_1\,|1\rangle$$

konstanta pada keadaan tersebut adalah bilangan kompleks.

Keadaan 2 qubit yang tidak dapat dipisahkan sebagai perkalian langsung dari dua buah qbit tunggal disebut keadaan terbelit dan apabila dapat dipisahkan sebagai perkalian langsung dari dua buah qbit tunggal disebut sebagai keadaan tak terbelit (*disentangle state*) atau keadaan yang dapat dipisah (*sparable state*). Apabila terdapat pernyataan matematis yang tidak konsisten keadaan tersebut dapat dikatakan sebagai keadaan terbelit. Apabila terdapat keadaan

$$|\psi\rangle = \frac{1}{2}(|00\rangle + |01\rangle + |10\rangle + |11\rangle) \tag{B.2}$$

Berdasarkan pernyataan diatas dapat diketahui

$$c_0 d_0 = c_0 d_1 = c_1 d_0 = c_1 d_1$$

$$\begin{array}{ll} c_0 d_0 = c_0 d_1 & c_1 d_0 = c_1 d_1 = \frac{1}{1} \\ \frac{d_0}{d_1} = 1 & \frac{d_0}{d_1} = 1 \end{array}$$

karena dua persamaan matematis tersebut menunjukan konsistensi terhadap nilai dari konstanta pada keadaan tersebut maka dapat dikatakan keadaan tersebut adalah keadaan yang terpisah. Apabila terdapat keadaan

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle) \tag{B.3}$$

$$c_0 d_0 = c_1 d_1 = \frac{1}{\sqrt{2}}, c_0 d_1 = c_1 d_0 = 0$$

$$\begin{array}{ll} c_0d_0 = c_1d_1 = \frac{1}{\sqrt{2}} & c_0d_1 = c_1d_0 = 0 \\ \frac{d_0}{d_1} = \frac{c_0}{c_1} = \frac{1}{\sqrt{2}} & \frac{c_0}{c_1} = \frac{d_0}{d_1} = 0 \end{array}$$

karena dua persamaan matematis tersebut menunjukan ke tidak konsistensi terhadap nilai dari konstanta pada keadaan tersebut maka dapat dikatakan keadaan tersebut adalah keadaan yang terbelit.

Lampiran C

Theorema Tanpa *Cloning*

Menyalin (*cloning*) suatu data merukan proses penggandaan data tersebut, dimana pada keadaan kuatum menyalin data harus dilakukan dengan mengoprasikan suatu operator pada data yang akan disalin, secara matematis seperti berikut.

$$u|x0\rangle = |xx\rangle \tag{C.1}$$

Data yang disalin dapat berupa suatu keadaan sistem kuatum, misalkan $|\phi\rangle$ maka.

$$u|\phi 0\rangle = |\phi\phi\rangle \tag{C.2}$$

Bila keadaan kuantum tersebut adalah gabungan (*superposisi*) dari beberapa keadaan, missal

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|\chi\rangle + |\phi\rangle)$$

maka proses penyalinan data tersebut seperti berikut.

$$u|\psi 0\rangle = u\big(\frac{1}{\sqrt{2}}(|\chi 0\rangle + |\phi 0\rangle)\big) \tag{C.3}$$

uraian suku kanan seperti berikut.

$$\begin{aligned} u\big(\frac{1}{\sqrt{2}}(|\chi 0\rangle + |\phi 0\rangle)\big) &= \frac{1}{\sqrt{2}}(u|\chi 0\rangle + u|\phi 0\rangle) \\ &= \frac{1}{\sqrt{2}}(|\chi\chi\rangle + |\phi\phi\rangle) \end{aligned} \tag{C.4}$$

Sedangkan uraian pada kanan menghasilkan

$$\begin{aligned} u|\psi 0\rangle &= |\psi\psi\rangle \\ &= \frac{1}{\sqrt{2}}(|\chi\chi\rangle + |\chi\phi\rangle + |\phi\chi\rangle + |\phi\phi\rangle) \end{aligned} \tag{C.5}$$

Terdapat perbedaan pada kedua sisi, dimana ada ketidak konsistenan pada penyaliana data dalam keadaan kuantum, sehingga dalam keadaan kuantum suatu informasi tidak dapat disalin yang dikenal dengan istilah *non cloning theorem*.

BIODATA PENULIS

Penulis bernama Dwi Januriyanto, biasa dipanggil Dwi lahir di Lumajang tahun 1995. Penulis merupakan anak ke 2 dari 2 bersaudara. Penulis menempuh pendidikan formal di SDN Sumberwuluh 2, SMPN 2 Candipuro, SMAN Candipuro, dan kuliah di Departemen Fisika ITS. Penulis mengambil bidang minat di fisika teori. Penulis menempuh tahap sarjana ITS pada tahun 2013, dan tahap magister pada tahun 2018.Penulis bergabung dengan laboratorium fisika teori dan filsafat alam (LaFTiFA). Selama perkuliahan penulis aktif dalam organisasi Forum Studi Islam Fisika (FOSIF) sebagai staf Ukhuwah Usaha dan Jamaah Masjid Manarul Ilmi (JMMI) sebagai staf keilmuan. Penulis pernah mengikuti Pekan Ilmiah Mahasiswa Nasional (PIMNAS) ke-28. Selain itu penulis juga pernah menjadi Assisten Laboratorium Fisika Dasar I. Penulis berharap agar hasil penelitian ini bermanfaat dan dapat dikembangkan lebih lanjut. Apabila terdapat kritik atau saran dapat dihubungi melalui email ke dwijanuriyanto91@gmail.com.