

V1.3

Using a 55-58 motor driver chip and
state-feedback control (FOC), the
RoboMaster C620 Brushless DC Motor Speed
Controller enables precise control over motor
torque.



Exclusively designed for the RoboMaster
M6200 P19 Brushless DC Gear Motor and
C620 Brushless DC Motor Speed Controller,
this 30-tooth gearset can be installed on any
motor and a terminal board.

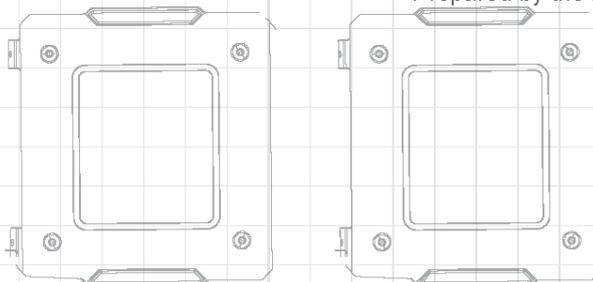
RoboMaster System Specification Manual,
RoboMaster System User Manual, Introduction
of RoboMaster System Manual

600-1000V Assembly Kit includes several
cables and a terminal board, covering a
complete assembly system for your
transportation.

ROBOMASTER 2022 UNIVERSITY CHAMPIONSHIP

RULES MANUAL

Prepared by the RoboMaster Organizing Committee
Updated on May 2022



Foreword

In order to further challenge participating teams' technical capabilities, the RMOC will modify the competition rules for the Wild Card Competition, International Regional Competition, Final Tournament of RMUC and Final Tournament of RMUT. Some of the revisions are hereby announced.

When interpreting the rules, participating teams should always refer to the latest version of rules manual.

Release Notes

Date	Version	Updates
2022.05.18	V1.1	<ol style="list-style-type: none">1. Modified drawings of Exchange Station2. Adjusted the coordinate system of Exchange Station3. Adjusted the exchanging process
2022.01.17	V1.0	First release

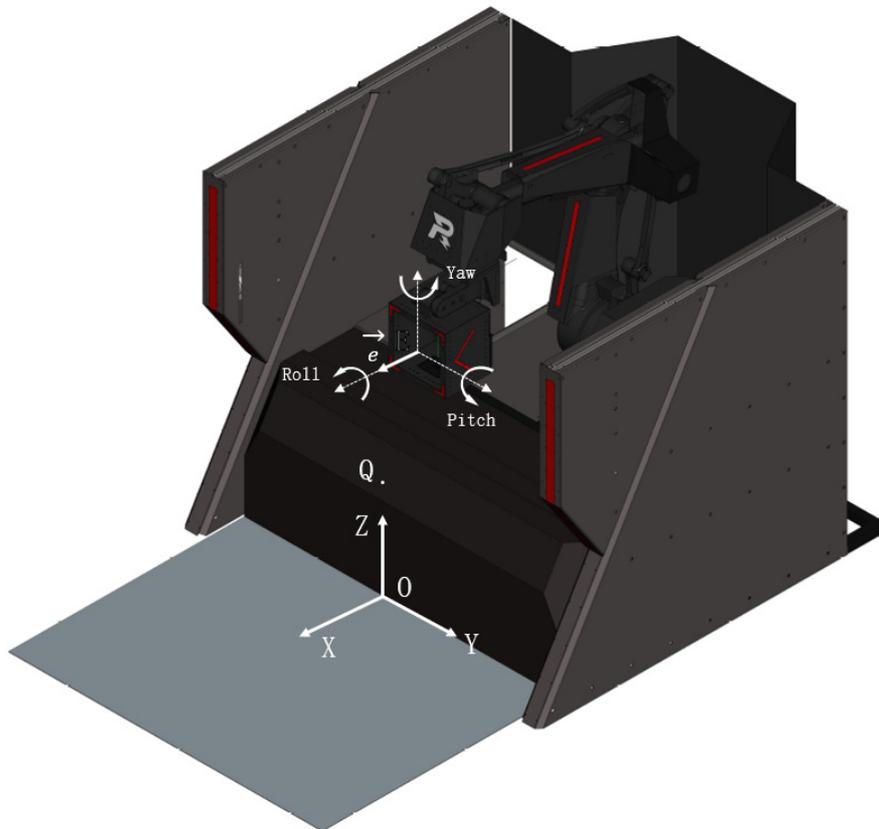
RMUC: Exchange Station and its Mechanism

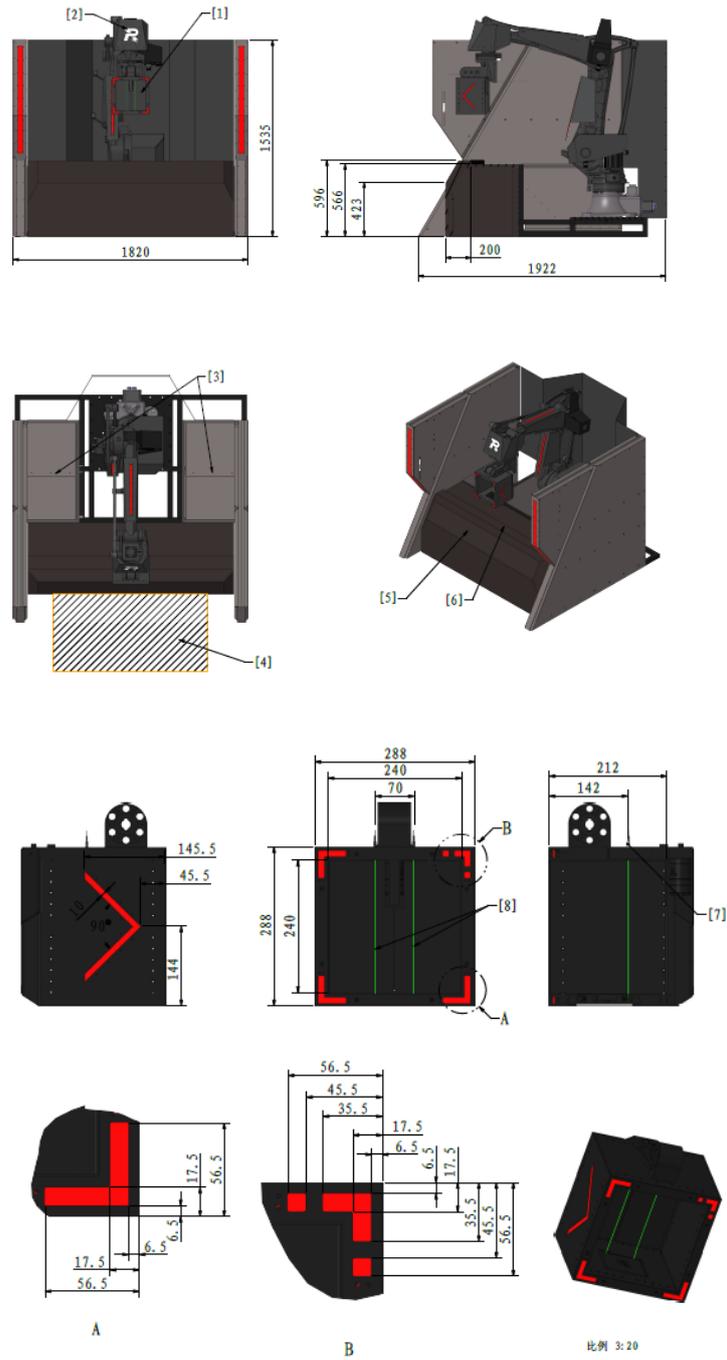
Exchange Station

The Exchange Station consists of the foundation, Mineral Receptacle and Mineral Collecting Slot.

Establish a right-handed rectangular coordinate system by taking the midpoint of the intersection between the front of the foundation and the battlefield ground as the origin O , the direction of the normal of the front of the foundation pointing to the Mineral Receptacle as the negative direction of the X-axis, and the vertical upward as the positive direction of the Z-axis. Suppose the counterclockwise directions along the X, Y, and Z axes are the negative directions of Pitch, Roll, and Yaw, respectively. The normal of the entrance of the Mineral Receptacle is \vec{e} . When \vec{e} is in the same direction of positive Y axis, or the plane of the Mineral Recognition Zone is below the normal and level, the attitude angle of the Mineral Receptacle is 0. The pose of the Point E at the entrance of the Mineral Receptacle is: $x=-120, y=0, z=1200, \text{pitch}=0, \text{roll}=0, \text{yaw}=0$.

Before the quarterfinals of RMUC 2022 Final Tournament, a horizontal plate with a width of 100 mm and a thickness of 30 mm will be added to the foundation to facilitate the placement of minerals by Engineer robots.





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|-----|--------------------|-----|---------------------------------|-----|-------------------------|-----|---|
| [1] | Mineral receptacle | [2] | R-figure status light indicator | [3] | Mineral collecting slot | [4] | Exchange zone |
| [5] | Foundation | [6] | Horizontal plate | [7] | Photoelectric sensor | [8] | Photoelectric sensor beam (non-visible) |

Figure 1 Exchange Station

Exchange Station Mechanism

To exchange minerals, Engineers should put minerals into the Mineral Receptacle.

Before the quarterfinals of the RMUC 2022 Final Tournament, the coordinates and attitude angle of Point E are fixed: $x=-300, y=0, z=720, \text{pitch}=0, \text{roll}=0, \text{yaw}=0$.

During the quarterfinals and subsequent stages of the RMUC 2022 Final Tournament, the coordinates and attitude angle of Point E satisfies the following conditions:

- The movement range of Point E constitutes a part of a sphere with Point Q (0, 0, 600) as the center and a radius of 300 mm;
- The movement range formula is: $x^2+y^2+(z-600)^2 \leq 300^2$ ($-270 \leq x \leq 0, -255 \leq y \leq 255, 720 \leq z \leq 900$, the unit is mm);
- The attitude angle of the Mineral Receptacle is: $\text{pitch} \in [-60, 0], \text{roll} \in [-45, 45], \text{yaw} \in [-90, 90]$, the unit is degree;
- When the Mineral Receptacle is at any position and angle, $|\langle \vec{e}, \overrightarrow{EQ} \rangle| \in [0^\circ, 90^\circ]$, and any structure of the Mineral Receptacle will not exceed the plane of the front of the foundation.

The pose of Point E varies by the accumulated exchanged gold coins. Every time a mineral-exchanging operation is performed, the coordinates and attitude angle of Point E will be updated once within a certain value range.

Table 1 Relationship between the accumulated exchanged gold coins and the coordinates and attitude angle of Point E

Accumulated exchanged gold coins	x	y	z	pitch	roll	yaw
[0, 300)	-200	[-185,185]	720	0	0	0
[300, 400)	[-270, 0]	[-255, 255]	[720, 900]	0	0	0
[400, 900)	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	0
[900, 2100]	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	[-90,90]



For each round, when red and blue teams' accumulated exchanged gold coins are the same, the pose of Point E will be the same.

To initiate or terminate an exchanging operation:

To initiate an exchanging operation, the operator should press the “U” key on the keyboard.

- If the Engineer robot has detected the RFID card under the exchange zone, its chassis will be powered off, and the exchange station will become available;

- If the Engineer robot fails to detect the RFID card under the exchange zone, the operator can force the exchange station into an available state through a “Force Startup” command and the chassis of the Engineering robot will be powered off.

To terminate an exchanging operation, the operator should press the “U” key on the keyboard. The chassis of the Engineer robot will be powered up and the Exchange Station will be initialized. If the Exchange Station is performing an mineral-exchanging operation, it will be initialized at the completion of the mineral-exchanging operation.



Take the plane on the front of the foundation as the dividing line. When the Mineral Receptacle is moving, any object shall not exceed the dividing line, otherwise the Mineral Receptacle will immediately suspend movement until the object moves out of the plane.

To exchange a mineral:

The following four steps must be completed:

1. The operator presses the “U” key to activate the Exchange Station
2. The Engineer robot puts the mineral into the Mineral Receptacle
3. When the photoelectric sensor is triggered, the operator presses the “Y” key to exchange the mineral
4. Once the mineral is recovered by the Exchange Station, corresponding gold coins will be given to the exchanging party

Detailed mineral-exchanging process is as follows:

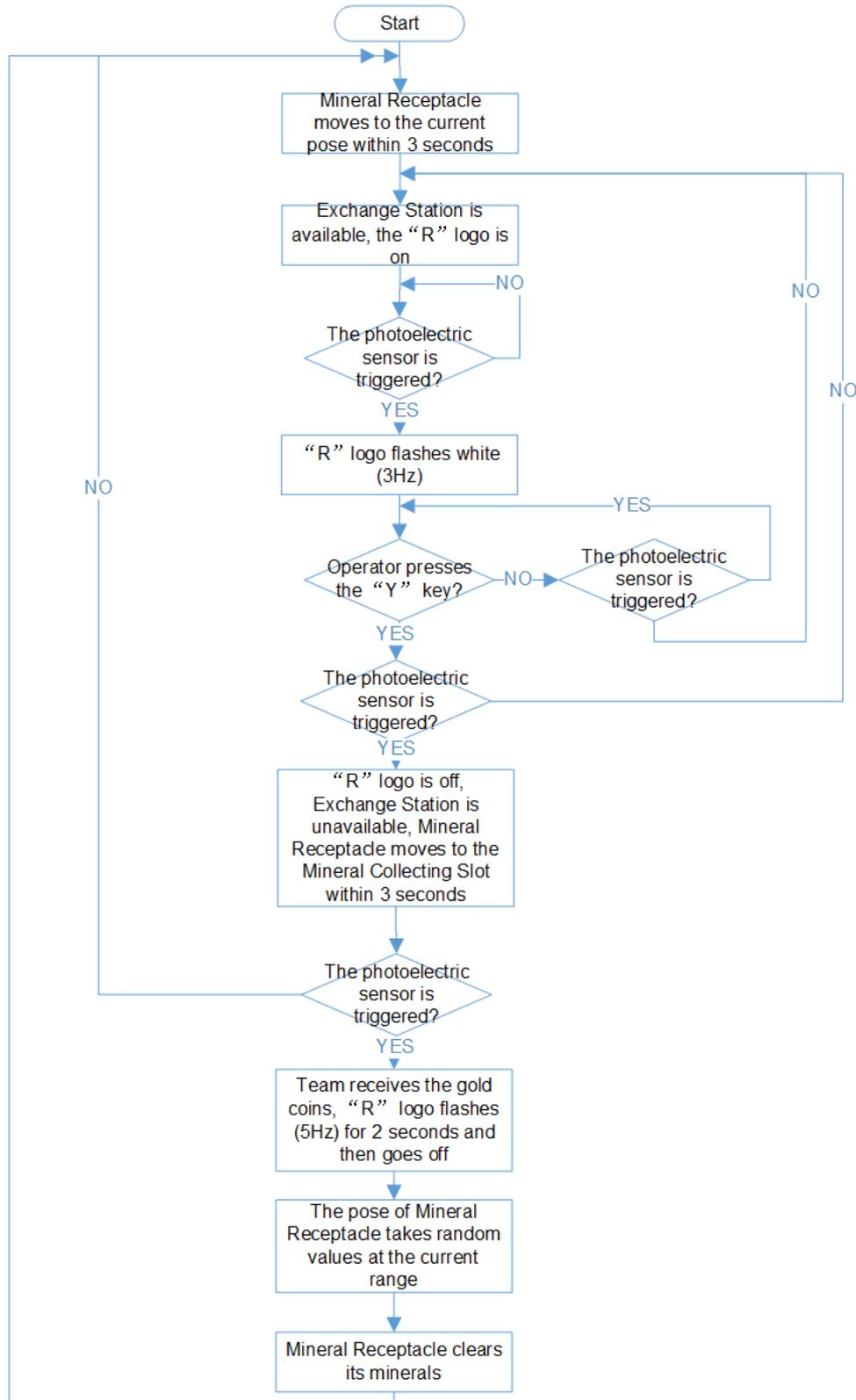


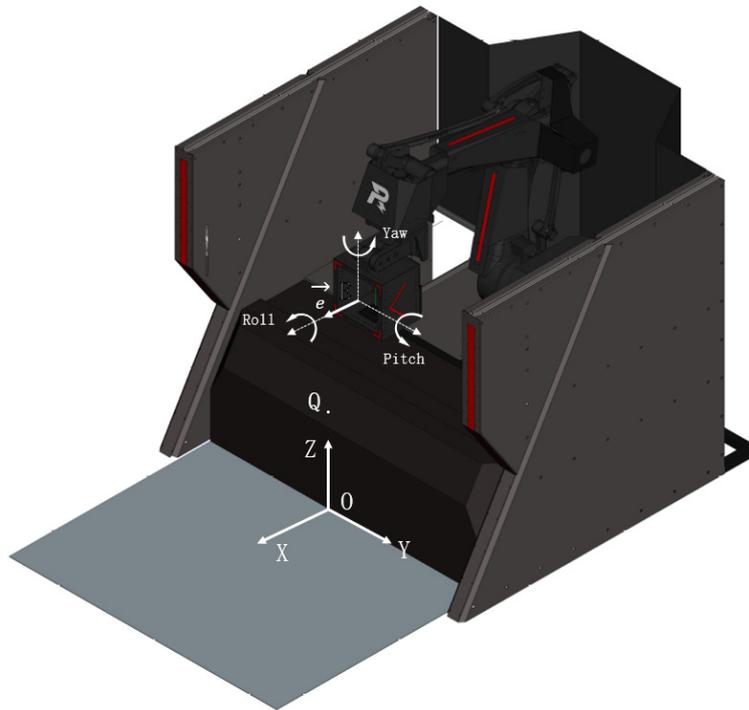
Figure 2 Mineral-exchanging logic

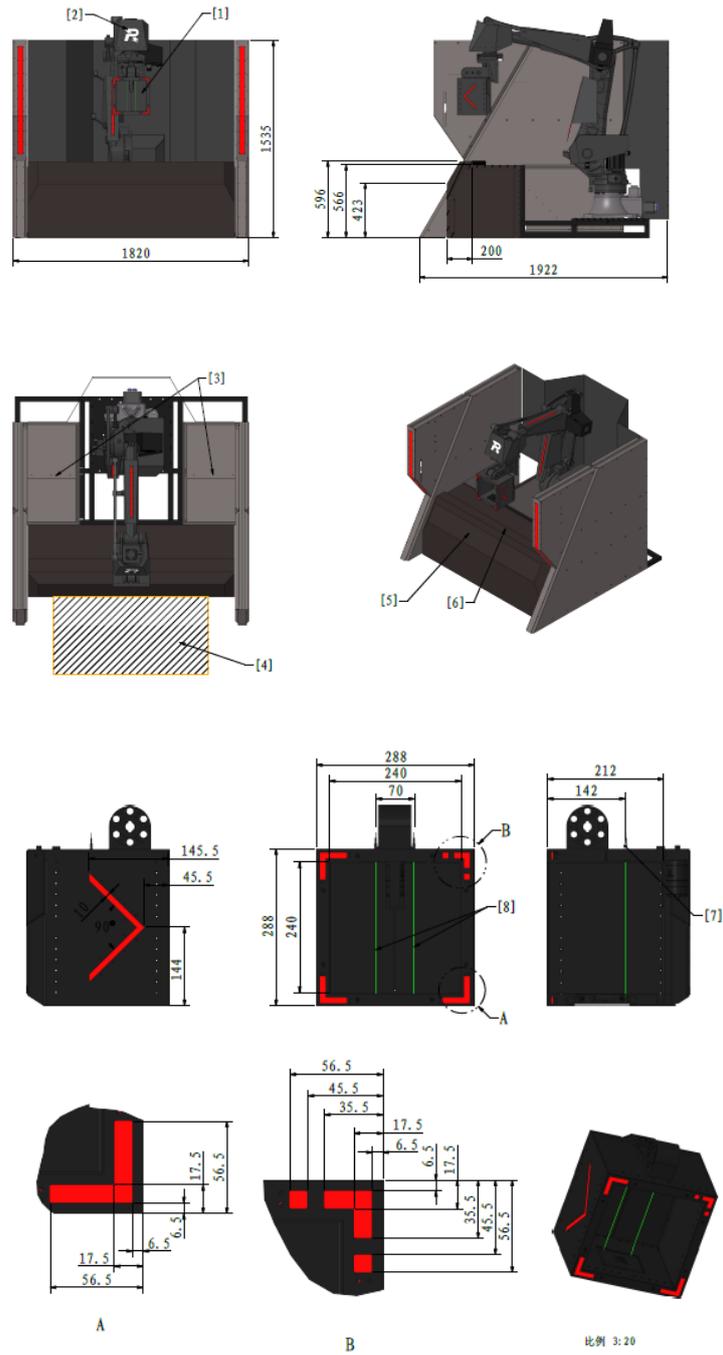
RMUT Engineer Mining: Exchange Station and its Mechanism

Exchange Station

The Exchange Station consists of the foundation, Mineral Receptacle and Mineral Collecting Slot.

Establish a right-handed rectangular coordinate system by taking the midpoint of the intersection between the front of the foundation and the battlefield ground as the origin O , the direction of the normal of the front of the foundation pointing to the Mineral Receptacle as the negative direction of the X-axis, and the vertical upward as the positive direction of the Z-axis. Suppose the counterclockwise directions along the X, Y, and Z axes are the negative directions of Pitch, Roll, and Yaw, respectively. The normal of the entrance of the Mineral Receptacle is \vec{e} . When \vec{e} is in the same direction of positive Y axis, or the plane of the Mineral Recognition Zone is below the normal and level, the attitude angle of the Mineral Receptacle is 0. The pose of the Point E at the entrance of the Mineral Receptacle is: $x=-120, y=0, z=1200, \text{pitch}=0, \text{roll}=0, \text{yaw}=0$.





- | | | | | | | | |
|-----|--------------------|-----|---------------------------------|-----|-------------------------|-----|---|
| [1] | Mineral receptacle | [2] | R-figure status light indicator | [3] | Mineral collecting slot | [4] | Exchange zone |
| [5] | Foundation | [6] | Horizontal plate | [7] | Photoelectric sensor | [8] | Photoelectric sensor beam (non-visible) |

Figure 3 Exchange Station

Exchange Station Mechanism

To exchange minerals, Engineers should put minerals into the Mineral Receptacle.

The coordinates and attitude angle of Point E satisfies the following conditions:

- The movement range of Point E constitutes a part of a sphere with Point Q (0, 0, 600) as the center and a radius of 300 mm;
- The movement range formula is: $x^2+y^2+(z-600)^2\leq 300^2$ ($-270\leq x\leq 0$, $-255\leq y\leq 255$, $720\leq z\leq 900$, the unit is mm);
- The attitude angle of the Mineral Receptacle is: pitch $\in [-60, 0]$, roll $\in [-45, 45]$, yaw $\in [-90, 90]$, the unit is degree;
- When the Mineral Receptacle is at any position and angle, $|\langle \vec{e}, \overrightarrow{EQ} \rangle| \in [0^\circ, 90^\circ]$, and any structure of the Mineral Receptacle will not exceed the plane of the front of the foundation.

The pose of Point E varies by the accumulated scores. Every time a mineral-exchanging operation is performed, the coordinates and attitude angle of Point E will be updated once within a certain value range.

Table 2 Relationship between the accumulated scores and the coordinates and attitude angle of Point E

Accumulated scores	x	y	z	pitch	roll	yaw
0	-200	0	720	0	0	0
5	-200	[-185, 185]	720	0	0	0
10	[-270, 0]	[-255, 255]	[720, 900]	0	0	0
15	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	0
20	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	[-90, 90]

To initiate or terminate an exchanging operation:

To initiate an exchanging operation, the operator should press the “U” key on the keyboard.

- If the Engineer robot has detected the RFID card under the exchange zone, its chassis will be powered off, and the exchange station will become available;
- If the Engineer robot fails to detect the RFID card under the exchange zone, the operator can force the exchange station into an available state through a “Force Startup” command and the chassis of the Engineering robot will be powered off.

To terminate an exchanging operation, the operator should press the “U” key on the keyboard. The chassis of the Engineer robot will be powered up and the Exchange Station will be initialized. If the Exchange Station is performing an mineral-exchanging operation, it will be initialized at the completion of the mineral-exchanging

operation.



Take the plane on the front of the foundation as the dividing line. When the Mineral Receptacle is moving, any object shall not exceed the dividing line, otherwise the Mineral Receptacle will immediately suspend movement until the object moves out of the plane.

To exchange a mineral:

The following four steps must be completed:

5. The operator presses the “U” key to activate the Exchange Station
6. The Engineer robot puts the mineral into the Mineral Receptacle
7. When the photoelectric sensor is triggered, the operator presses the “Y” key to exchange the mineral
8. Once the mineral is recovered by the Exchange Station, corresponding scores will be given to the exchanging party

Detailed mineral-exchanging process is as follows:

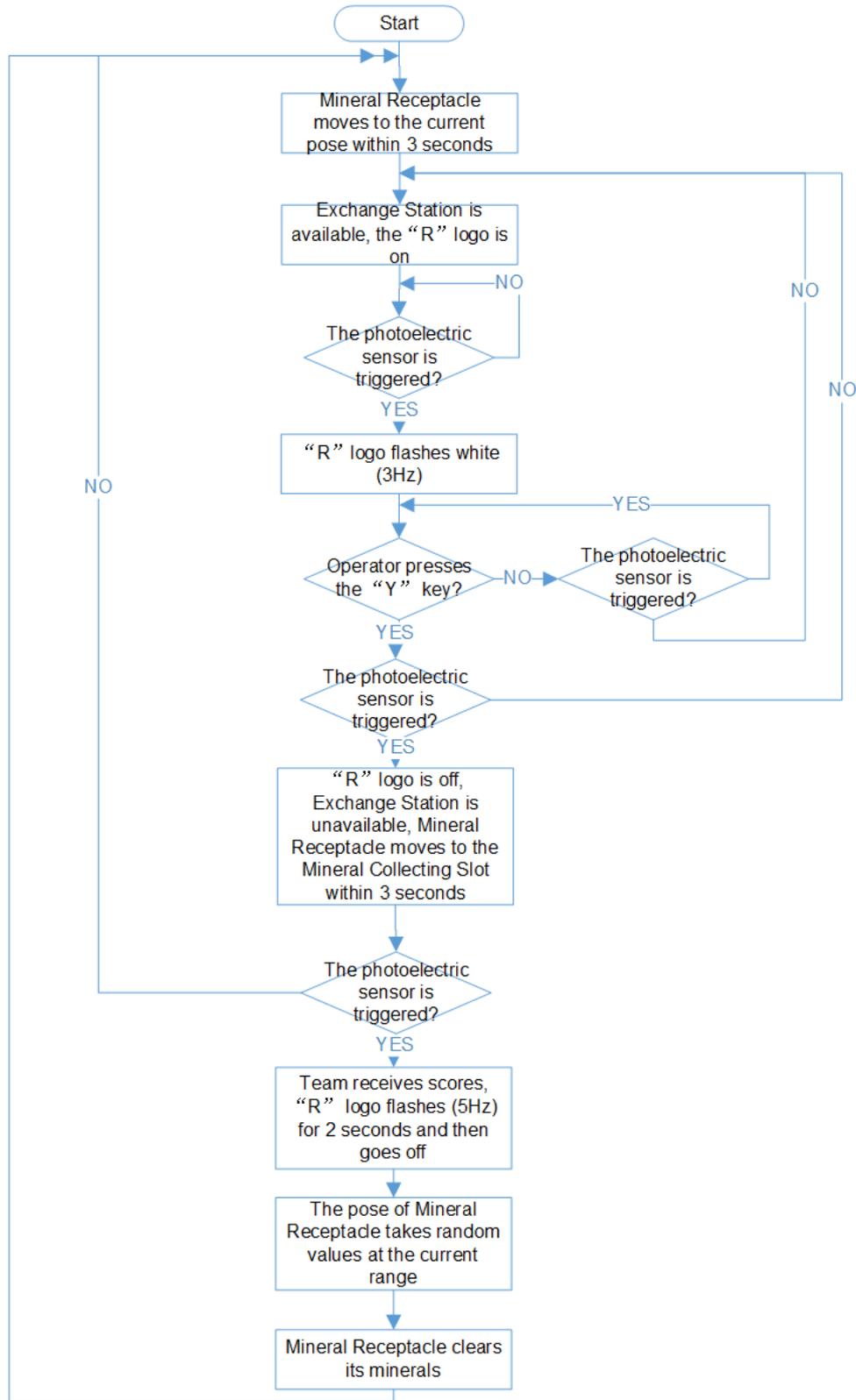
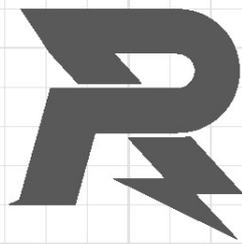


Figure 4 Mineral-exchanging logic



In Engineer Mining, Engineer can carry no more than one mineral each time.



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