

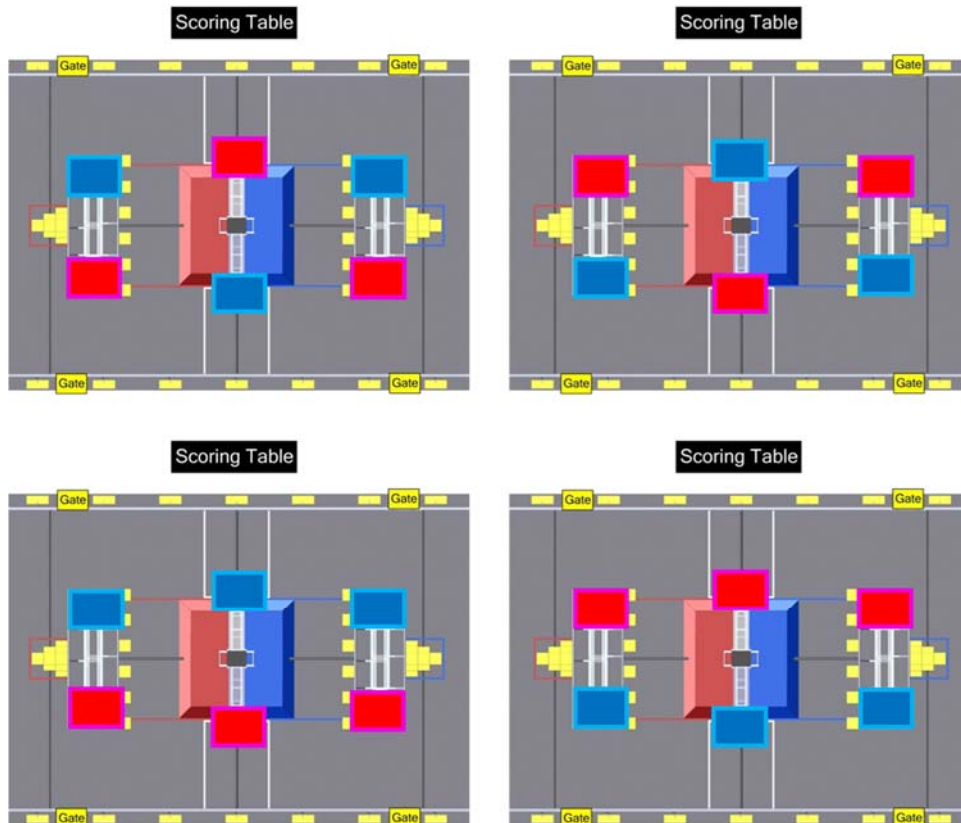
4 MATCH Play

During each *FIRST*[®] POWER UPSM MATCH, two ALLIANCES (cooperatives of up to four (4) *FIRST*[®] Robotics Competition Teams) play out a multiplayer video game to defeat the boss by gaining OWNERSHIP of a SCALE and SWITCHES by tipping them in their favor or by using POWER UPS.

4.1.1 Stages

Each MATCH is divided into two stages. The first stage, called Autonomous (AUTO), is the first fifteen (0:15) seconds of a MATCH in which ROBOTS operate without any DRIVE TEAM control or input. Prior to the start of AUTO, the assignments of ALLIANCE colors for SWITCH and SCALE PLATES are randomized among the four states in Figure 4-1 and transmitted to the OPERATOR CONSOLE by the Field Management System (FMS). During AUTO, ROBOTS attempt to deliver preloaded POWER CUBES to PLATES, retrieve additional POWER CUBES from around the FIELD, and cross their AUTO LINE any time before the end of the stage.

Figure 4-1 Possible PLATE assignments



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Teleoperated (TELEOP) is the second stage in a MATCH and is two minutes and fifteen seconds (2:15) long. During this stage, DRIVERS remotely operate ROBOTS to retrieve and place POWER CUBES on the PLATES and feed POWER CUBES through the EXCHANGE for placement in the VAULT to earn

POWER UPS. The final thirty (30) seconds of the TELEOP stage is considered the ENDGAME, during which ROBOTS prepare to FACE THE BOSS.

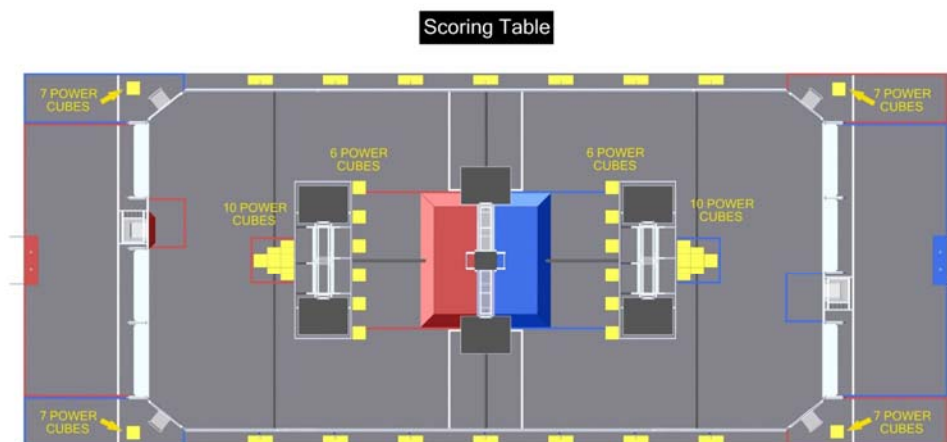
In addition to the two (2) minutes and thirty (30) seconds of game play, each MATCH also has pre- and post-MATCH time for setup and reset of the ARCADE. During ARCADE reset, the ARCADE is cleared of ROBOTS and OPERATOR CONSOLES from the MATCH that just ended. The ROBOTS and OPERATOR CONSOLES for the subsequent MATCH are loaded into the ARCADE by DRIVE TEAMS at this time. FIELD STAFF also use this time to reset ARCADE elements and POWER CUBES.

4.1.2 MATCH Setup

Prior to the start of each MATCH, POWER CUBES, elements used to affect the position of the SCALE and SWITCHES and earn POWER UPS, are staged as shown in Figure 4-2. Staging details are as follows:

- A. Seven (7) in each PORTAL (on the carpet between the PORTAL wall and the STARTING LINE), minus any preloaded POWER CUBES,
- B. Six (6) next to each SWITCH. They are arranged approximately equidistant from each other along the face of the FENCE closest to the SCALE, *FIRST* logo facing up
- C. Ten (10) located in each ALLIANCE POWER CUBE PILE (in a pyramid formation, with six on the bottom, three in the middle, and one on top, justified toward the SWITCH, *FIRST* logo facing up)

Figure 4-2: POWER CUBE staging



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When a DRIVE TEAM loads their ROBOT onto the FIELD for a MATCH they may elect to preload up to one (1) POWER CUBE in or on their ROBOT such that it is fully and only supported by the ROBOT. A minimum of five (5) POWER CUBES must remain in each of their two (2) PORTALS after any preloads.

If order placement of ROBOTS matters to either or both ALLIANCES, the ALLIANCE must notify the Head REFEREE during setup for that MATCH. Upon notification, the Head REFEREE will require ALLIANCES alternate placement of all ROBOTS. In a Qualification MATCH, ROBOTS will be placed in the following order: Red Station 1 ROBOT, Blue Station 1 ROBOT, Red Station 2 ROBOT, Blue Station 2 ROBOT, Red Station 3 ROBOT, Blue Station 3 ROBOT. In a PLAYOFF MATCH, the same pattern is applied, but instead of Red ALLIANCE placing, the higher seeded ALLIANCE (regardless of color) will place last.

4.2 Scoring

ALLIANCES are rewarded for accomplishing various actions throughout the course of a MATCH, including autonomous movement, having OWNERSHIP of their SWITCH or the SCALE, CLIMBING to FACE THE BOSS, and winning or tying MATCHES. Rewards are granted either via MATCH points (which contribute to the ALLIANCE'S MATCH score) or Ranking Points (which increase the measure used to rank teams in the Qualification tournament). Such actions, their criteria for completion, and their point values are listed in Table 4-1. Scores are assessed and updated throughout the MATCH.

The primary method of earning points in *FIRST*[®] POWER UPSM is by placing POWER CUBES on the PLATES of the SWITCH or SCALE to establish OWNERSHIP. OWNERSHIP is a state of the ALLIANCE'S SWITCH or SCALE where it is tilted in favor of an ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE colored PLATE is at or less than a specified height above the carpet. ALLIANCES earn points when OWNERSHIP is established and additional points for each additional second of OWNERSHIP.

The SWITCH located closest to its ALLIANCE STATION is considered that ALLIANCE'S SWITCH. While any ROBOT can place POWER CUBES on the PLATES of either SWITCH, an ALLIANCE can only have OWNERSHIP of, and accumulate points for, their SWITCH.

An ALLIANCE has OWNERSHIP of their SWITCH when:

- A. the SWITCH is tilted in favor of their ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE colored PLATE is at or less than 6 in. (~15 cm) from the floor for at least one (1) second, or
- B. they have played the FORCE POWER UP at level 1 or 3 (see Section 4.3 POWER UPS)

The Blue ALLIANCE'S SWITCH accumulates points for the Blue ALLIANCE when the PLATE illuminated and pulsing with blue lights is down.

The SWITCH does not accumulate points for either ALLIANCE when the blue PLATE is above 6 in (~15 cm).

An ALLIANCE has OWNERSHIP of the SCALE when:

- A. the SCALE is tilted in favor of their ALLIANCE colored PLATE, such that the outside edge of the ALLIANCE'S colored PLATE is at or lower than 4 ft. 8 in. (~142 cm) from the floor for at least one (1) second and there isn't an active opponent's Level 2 or 3 FORCE, or
- B. they have played the FORCE POWER UP at level 2 or 3 (see [Section 4.3 POWER UPS](#))

Note that points for the SWITCH and SCALE are accrued over time and not a direct function of the number of POWER CUBES placed on the SWITCH or SCALE.

Points are not taken away when OWNERSHIP changes, but rather stop accumulating (if balanced) or start accumulating for the opposite ALLIANCE if they take OWNERSHIP of the SCALE.

ROBOTS deliver POWER CUBES to HUMAN PLAYERS through the EXCHANGE. Once a POWER CUBE is delivered through the EXCHANGE, HUMAN PLAYERS may:

1. place the POWER CUBE into the VAULT for points and application toward a POWER UP, or

2. return the POWER CUBE to the FIELD using the RETURN in the EXCHANGE wall, or
3. keep the POWER CUBE inside the ALLIANCE STATION (effectively delaying the selection until a later time or not using it all.)

An ALLIANCE can earn up to four (4) Ranking Points (RP) per Qualification MATCH, as described in Table 4-1. There are no RP, or comparable point bonuses, in Playoff MATCHES.

Table 4-1: FIRST® POWER UPSM rewards

Action	Criteria	MATCH Points		Ranking Points
		AUTO	TELEOP	
AUTO-RUN	For each ROBOT that breaks the vertical plane of the AUTO LINE with its BUMPER at any point in the AUTO stage	5	-	-
OWNERSHIP	SCALE	2 + 2/sec	1 + 1/sec	-
	ALLIANCE'S SWITCH	2 + 2/sec	1 + 1/sec	-
VAULT	For each POWER CUBE placed in the VAULT	-	5	-
PARKING	For each ROBOT fully supported by the SCALE (either directly or transitively), not at all in the opponent's PLATFORM ZONE, and has not CLIMBED	-	5	-
CLIMBING	For each ROBOT fully supported by the SCALE (either directly or transitively) with BUMPERS fully above the BRICKS at T=0, not in direct contact with their PLATFORM, and not at all in the opponent's PLATFORM ZONE	-	30	-
FACE THE BOSS	All three (3) ALLIANCE ROBOTS have CLIMBED or two (2) ROBOTS have CLIMBED and the ALLIANCE has played the LEVITATE POWER UP	-	-	1
AUTO QUEST	ALLIANCE completes three (3) AUTO-RUNS and has OWNERSHIP of their SWITCH at T=0 of the AUTO stage	-	-	1
Win	ALLIANCE's final MATCH score exceeds their opponents'	-	-	2
Tie	ALLIANCE's final MATCH score equals their opponents'	-	-	1

Points are earned for establishing OWNERSHIP, with additional points earned for each additional second of OWNERSHIP. For example, a team that establishes OWNERSHIP of their SWITCH three (3) seconds after the start of AUTO and maintains OWNERSHIP for five (5) seconds earns two (2) points + ten (10) points, for a total of twelve (12) points.

The MATCH points listed in Table 4-1 for OWNERSHIP during the TELEOP stage are increased if the BOOST POWER UP is played. See [Section 4.3](#) for details on BOOST.

AUTO-RUN and CLIMBING are both evaluated and scored by human REFEREES. Teams are encouraged to make these actions obvious and unambiguous.

4.3 POWER UPS

POWER UPS are advantages an ALLIANCE can earn and play throughout the TELEOP stage of the MATCH. ALLIANCES earn POWER UPS by delivering POWER CUBES through their EXCHANGE to their HUMAN PLAYERS who place them into their VAULT. Table 4-2 lists the POWER UPS, their cost, and the effect when it is played by an ALLIANCE.

Table 4-2: POWER UPS

Name	# of POWER CUBES	Effect	Duration (seconds)
LEVITATE	3	An additional CLIMBING ROBOT, up to a maximum of three (3) ROBOTS, is credited to the ALLIANCE at the end of the MATCH	N/A
FORCE	1	ALLIANCE earns OWNERSHIP points from their SWITCH regardless of PLATE position	10
	2	ALLIANCE earns OWNERSHIP points from the SCALE regardless of PLATE position	10
	3	ALLIANCE earns OWNERSHIP points from the SWITCH and the SCALE regardless of PLATE position	10
BOOST	1	Doubles the points being earned by the ALLIANCE for OWNERSHIP of their SWITCH.	10
	2	Doubles the points being earned by the ALLIANCE for OWNERSHIP of the SCALE.	10
	3	Doubles the points earned by the ALLIANCE for OWNERSHIP of a) their SWITCH and b) the SCALE.	10

If LEVITATE is played the CLIMB is credited randomly to any ROBOT on the ALLIANCE who is not PARKING or CLIMBING at the end of the MATCH. If all ROBOTS on the ALLIANCE are either PARKING or CLIMBING, one randomly chosen PARKING ROBOT will be upgraded from PARKING to CLIMBING.

An ALLIANCE plays a POWER UP by pressing the corresponding button on the VAULT. Only one (1) instance of the FORCE or BOOST POWER UP can be active at a time. If an ALLIANCE pushes the button for FORCE/BOOST while their other FORCE/BOOST is active, the button press is ignored. The LEVITATE POWER UP can be played at any time during the TELEOP stage.

A POWER UP is active for the duration listed in Table 4-2. If an ALLIANCE plays BOOST or FORCE during the time when an opposing ALLIANCE's POWER UP is active, the POWER UP is queued and becomes active immediately upon the conclusion of the currently active POWER UP. Once a POWER UP is played, it cannot be cancelled.

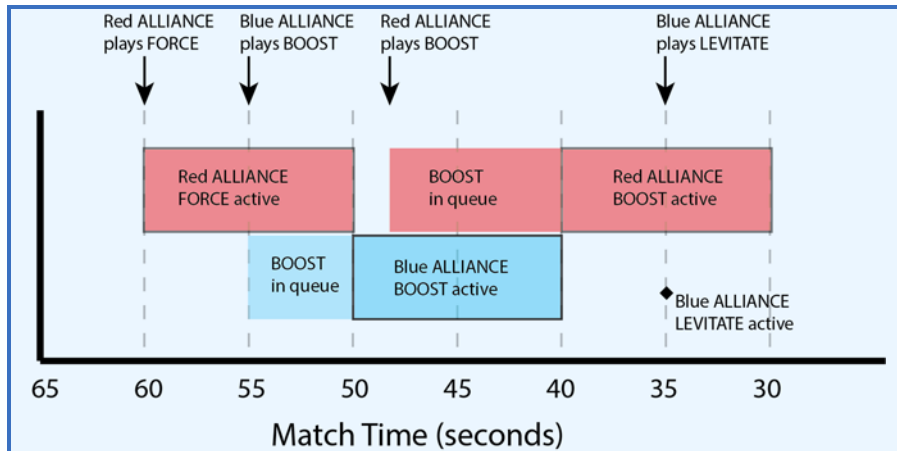


Figure 4-3: POWER UP timeline example

Example: the Red ALLIANCE plays FORCE with sixty (60) seconds remaining in the MATCH. FORCE is in-progress from sixty (60) seconds to fifty (50) seconds, during which time no additional instances of FORCE or BOOST can be active.

The Blue ALLIANCE plays BOOST with fifty-five (55) seconds remaining in the MATCH, but it does not become active until the Red ALLIANCE FORCE ends at fifty (50) seconds.

The Red ALLIANCE plays BOOST with forty-eight (48) seconds remaining in the MATCH, but it does not become active until the Blue ALLIANCE BOOST ends at forty (40) seconds.

The Blue ALLIANCE plays LEVITATE with thirty-five (35) seconds remaining in the MATCH. It is immediately active for the Blue ALLIANCE and added to their score.

FORCE and BOOST can be played with as few as one (1) or as many as three (3) POWER CUBES in their corresponding column of the VAULT. However, an ALLIANCE may only play each POWER UP one time in the MATCH. Additional POWER CUBES placed into the FORCE or BOOST columns after the activation of the corresponding POWER UP do earn points for the ALLIANCE.

Example: the RED ALLIANCE places two (2) POWER CUBES in the FORCE column of their VAULT. With ninety (90) seconds remaining in the MATCH, a HUMAN PLAYER plays FORCE on the SCALE. The Red ALLIANCE has now played their FORCE, and cannot play another FORCE during the MATCH. Additional POWER CUBES placed into the FORCE column will earn points for the Red ALLIANCE, per Table 4-1.

4.4 Rule Violations

Upon a rule violation, one or more of the penalties listed in Table 4-3 will be assessed.

Table 4-3: Penalty Table

Action	Penalty
FOUL	5 points credited towards the opponent's total score.
TECH FOUL	25 points credited towards the opponent's total score.
YELLOW CARD	a warning issued by the Head REFEREE for egregious ROBOT or Team member behavior or rule violations. A subsequent YELLOW CARD within the same tournament phase will lead to a RED CARD.
RED CARD	a penalty assessed for egregious ROBOT or Team member behavior, or rule violations, which results in a Team being DISQUALIFIED for the MATCH.
DISABLED	ROBOT will be commanded to deactivate all outputs, rendering the ROBOT inoperable for the remainder of the MATCH.
DISQUALIFIED	the state of a Team in which they receive zero (0) MATCH points in a qualification MATCH or causes their ALLIANCE to receive zero (0) MATCH points in a Playoff MATCH

4.5 DRIVE TEAM

A DRIVE TEAM is a set of up to five (5) people from the same FIRST Robotics Competition Team responsible for Team performance for a specific a MATCH. There are four (4) specific roles on a DRIVE TEAM which ALLIANCES can use to assist ROBOTS with FIRST® POWER UPSM.

Table 4-4: DRIVE TEAM roles

Role	Description	Max./ DRIVE TEAM	Criteria
COACH	a guide or advisor	1	<ul style="list-style-type: none"> Pre-college student or adult mentor Must wear "Coach" button
DRIVER	an operator and controller of the ROBOT	3	<ul style="list-style-type: none"> Pre-college student
HUMAN PLAYER	a POWER CUBE manager		<ul style="list-style-type: none"> Must wear one (1) of the three (3) "Drive Team" buttons
TECHNICIAN	a resource for ROBOT troubleshooting, setup, and removal from the FIELD	1	<ul style="list-style-type: none"> Pre-college student Must wear "Technician" button

The TECHNICIAN is a new role for the 2018 season and provides teams with a technical resource for pre-MATCH setup, ROBOT connectivity, OPERATOR CONSOLE troubleshooting, and post-MATCH removal of the ROBOT. Some pre-MATCH responsibilities for the TECHNICIAN may include, but are not limited to:

- location of the ROBOT radio, its power connection, and understanding of its indicator lights
- location of the roboRIO and understanding of its indicator lights
- username and password for the OPERATOR CONSOLE



- restarting the Driver Station and Dashboard software on the OPERATOR CONSOLE
- changing the bandwidth utilization (e.g. camera resolution, frame rate, etc.)
- changing a battery
- charging pneumatics

While the TECHNICIAN may be the primary technical member of the DRIVE TEAM, all members of the DRIVE TEAM are encouraged to have knowledge of the basic functionality of the ROBOT, such as the location and operation of the main circuit breaker, connecting and resetting joysticks or gamepads from the OPERATOR CONSOLE, and releasing the ROBOT from the SCALE.

4.6 Logistics

Any POWER CUBE that leaves the FIELD will not be returned to MATCH play. POWER CUBES that inadvertently deflect back in to the FIELD will be considered fair game.

Note that ROBOTS may not deliberately cause POWER CUBES to leave the FIELD (see G21), except through the lower opening of the EXCHANGE.

There will not be an ARCADE FAULT called for MATCHES that accidentally begin with an incorrect number of, incorrectly positioned, or damaged POWER CUBES. Damaged POWER CUBES will not be replaced until the next FIELD reset period. DRIVE TEAMS should alert the FIELD STAFF to any missing or damaged POWER CUBES prior to the start of the MATCH.

Once the MATCH is over, if the Head REFEREE determines that the FIELD is safe for FIELD STAFF but not safe for everyone (e.g. the SCALE is full of POWER CUBES that create a falling hazard for a DRIVE TEAM carrying a ROBOT), they will turn the LED lights on the PLATES purple. Once the FIELD is ready for DRIVE TEAM traffic, the Head REFEREE or their designee will change the LED lights to green and DRIVE TEAMS may retrieve their ROBOT in accordance with S02.

