High-Speed Drone Flock

Challenge Booklet 2026

Organised by:

DSO NATIONAL LABORATORIES

SCIENCE CENTRE singapore

Supported by:

MINDEF SINGAPORE

SAFMC 2026 CATEGORY HIGH-SPEED DRONE FLOCK

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	03 Nov 2025	Official challenge booklet release

CONTENTS

1. INTRODUCTION

Competition Schedule, General Rules and Regulations can be found in the “General Rules and Regulations” Booklet.

For Category High-Speed Drone Flock[1], teams of **TWO (2)** to **TEN (10)** members are expected to design and build **TWO (2) to THREE (3)** drones capable of executing autonomous flight in a circuit as a coordinated high-speed flock.

2. CATEGORY HIGH-SPEED DRONE FLOCK AWARDS

Award winners will be selected based on either presentation scores, performance on the competition’s challenge day, or a combination of both.

There is no limit to the number of awards that a team can win, and there may not be a winner for every award.

All scoring decisions made by the judges are **final**. For cases that require arbitration, the Singapore Amazing Flying Machine Competition (SAFMC) organising committee will have the **final** say.

The list of awards for Category High-Speed Drone Flock is listed in the subsequent sections.

2.1. CHAMPIONSHIP AWARD

This is the pinnacle award any team can win and is bestowed on the team that achieves the highest total score across all areas. For Category High-Speed Drone Flock, there will be **THREE (3)** Championship Awards: **ONE**

[1] Each team must include at least one Singapore citizen to be eligible to participate.

(1) winner and **TWO (2)** runners-up. The scoring and weightage can be found in Section 4.

2.2. JUDGES' COMMENDATION

This award is given out to Category High-Speed Drone Flock teams exhibiting a high quality in design and/or performance but did not win the Championship Award or the runners-up prizes. Teams that have won any of the top 3 prizes will not be considered for the Judges' Commendation Prizes. Overall scores may be taken into consideration for this award. Up to **TWO (2)** Judges' Commendation Prizes may be awarded for the whole Category High-Speed Drone Flock.

2.3. PRIZES

CATEGORY HIGH-SPEED DRONE FLOCK				
Awards	**Medal**	**Trophy**	**Cash Prize**	**Remarks**
Championship Award	✓	✓	$15,000	
1st Runner Up	✓		$7,500	
2nd Runner Up	✓		$5,000	
3rd and 4th runners up	✓			
Judge's Commendation	✓		$500	Up to two teams can win this award

3. CATEGORY HIGH-SPEED DRONE FLOCK MISSION

Teams are required to design a system that consists of a flock of **TWO (2) to THREE (3)** drones to autonomously navigate through a known indoor course, flying through a series of gates in sequence as quickly as possible whilst staying together as a group.

The detailed descriptions of the play field, mission tasks, as well as the scoring criteria are found in Section 3.4. Teams are advised to read through these sections in detail to develop a strategy and identify key design requirements, before designing the drone to execute the mission. The technical rules for the drone are found in Section 6.

3.1. MISSION TASKS

The mission requires the flock of drones to fly through a series of gates in sequence as fast as possible while staying together as a group.

The key phases of the mission are:

- Take off from within the START area
- Fly through a series of known gates as quickly as possible
- Stay together as a flock, completing the circuit together

3.2. PLAY FIELD

3.2.1 LAYOUT

The layout of the play field is shown in Figure 1. The play field is approximately 40m x 20m with safety nets surrounding the perimeter.

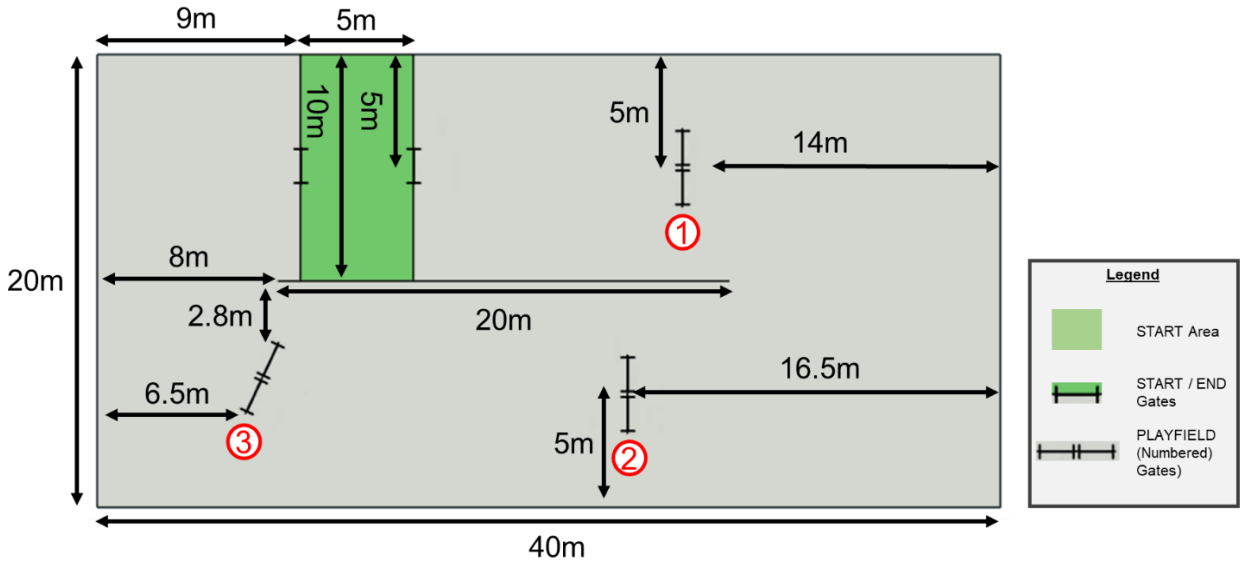

Figure 1 - Overall play field Layout

When referring to the above diagram, note that:

- The layout is **not drawn to scale**.
- The play field will be set up following the measurements shown in the above diagram.
- An enlarged version of the Figure 1 and an isometric view of the play field is included in ANNEX A.

The approximate dimensions of the play field elements are shown below.

Playfield Element	Approximate Dimensions
Start Area	5m x 10m
Centre Wall	20m Length x 2m Height
Perimeter Net	40m x 20m along the perimeter of the PLAY FIELD
Gates	See Section 3.2.2

3.2.2 GATES

There will be two types of gates positioned around the play field.

START / END Gates

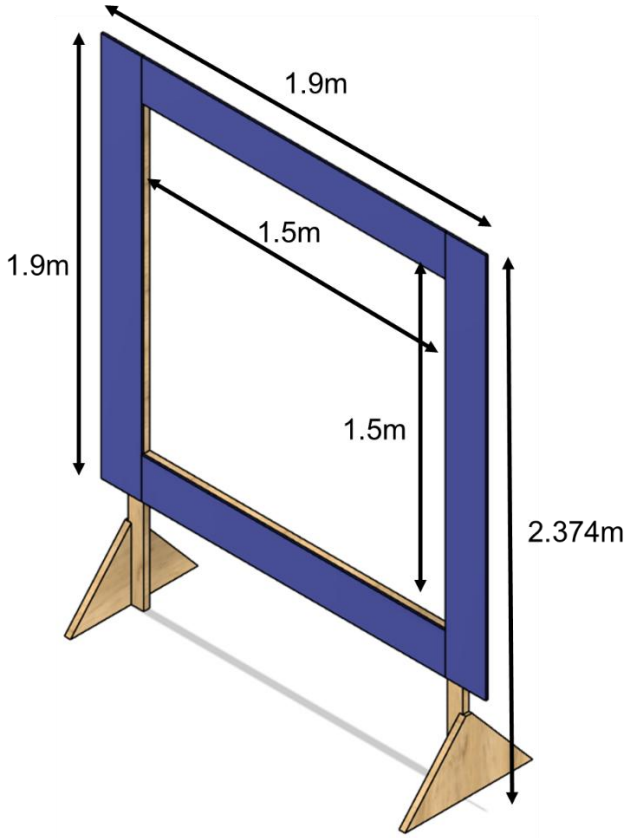

Figure 2 – START / END Gates

START and END gates, illustrated in Figure 2, will be positioned along the perimeter of the START area as shown in Figure 1.

Play Field (Numbered) Gates

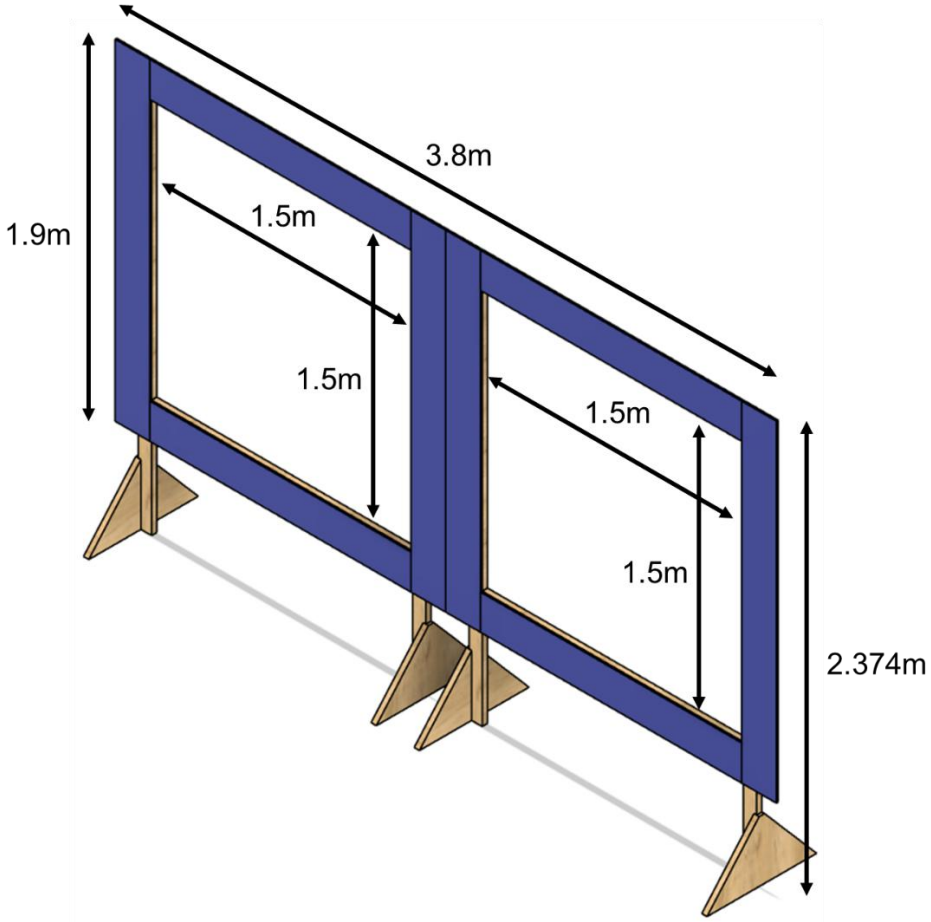

Figure 3 – Play Field (Numbered) Gates

Play field gates, illustrated in Figure 3, will be positioned around the play field as shown in Figure 1. There is a total of THREE (3) play field gates numbered from 1 to 3.

3.2.3 START ZONE

An area within the play field will be demarcated as the Start Zone. The floor will not be coloured and only the perimeter of the zone will be demarcated.

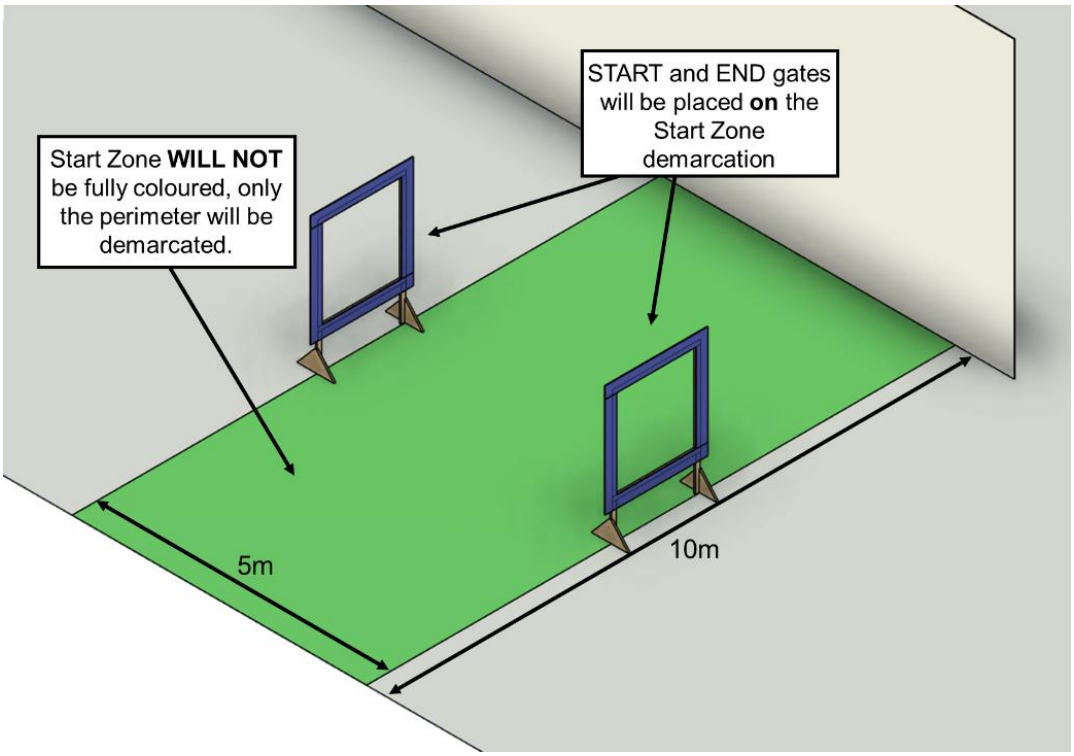

Figure 4: Start Zone Layout

3.3. MISSION RULES

3.3.1 GENERAL

1. Teams must consist of **TWO (2) to TEN (10**) members.
2. The duration of the entire challenge is 45 minutes, consisting of:
    a. **25 minutes setup and practice time**
    b. **20 minutes mission time**
3. Teams may conduct functional checks of their drone(s) through manual or autonomous flight during the setup and practice time, provided they obtain permission from the referee. These runs will not be scored.
4. Runs will only be scored during the mission time.
5. Mission time segment will start immediately after the setup time segment. No time extension will be given **even if setup is incomplete**.
6. **Unlimited runs** are permitted within the mission time, with each run receiving an independent score. The final score will be the highest score achieved in a single run, and not a cumulative total of all runs.
7. A **maximum of THREE (3)** drones is allowed per run.
8. At the start of each run, all drones must begin at the START Zone. A run's timing begins when the first drone takes off and crosses the START gate.
9. Teams need to obtain the referee's permission before starting any run.
10. Each drone is only allowed one lap per run.
11. A lap concludes under any of the following conditions, whichever occurs first:
    a. **Finished Lap**: The drone passes through every gate in sequence — START, 1, 2, 3, END.

b. **Unfinished Lap**: The drone passes through any gate out of sequence — START, 1, 3.
c. **Unfinished Lap**: The drone contacts the floor outside of the START Zone.

12. A run concludes under any of the following conditions, whichever occurs first:
    a. The team issues a command for all drones to land. Referees may instruct teams to land all drones at any time and end a run.
    b. All drones land outside the START Zone.
    c. All drones have each finished a lap.
13. Drones are not allowed to fly above any gates or walls.
14. Drones are not allowed to fly above 2.5m from the ground.
    a. Referees will instruct teams to land all drones and end the current run if drones are observed flying above 2.5m
15. Teams are not allowed to repair/troubleshoot the drones during the run.
16. Any drones that malfunction or land during the run will be out for that run. The run may continue if the remaining drones are deemed safe.
17. Ground robots are not allowed to be used.
18. Teams are only allowed to repair their drones or change batteries outside of runs.
19. Any rules requiring permission are not guaranteed and must be approved by the referees.
20. Cameras may be placed around the play field to record the runs.

3.3.2 NAVIGATIONAL AIDS

1. An **unlimited** number of navigational aids (e.g. UWB, fiducials) will be allowed per run.
2. Navigational aids can only be rearranged between runs. Teams are not allowed to change the positions of the navigation aids during the run. Any navigation aids that are displaced or malfunction during the run cannot be adjusted until the run ends and all drones are disarmed.
3. **Any** visual aid must not exceed **30cm X 30cm X 30cm (L X B X H).**
    a. Visual aids placed on the floor may be stacked, but the total height of each stack must not exceed 30cm from the floor surface.
4. **Any** UWB must not exceed a **base area of 1m X 1m (L X B)**.
5. Teams are allowed to place navigational aids on any of the gates and/or on the centre wall.
6. All navigational aids must be:
    a. Placed within the play field.
    b. Easily removable without leaving a mark.
    c. Properly secured, e.g. will not topple over.
    d. Cannot be secured to overhead structures.
7. Additionally, navigational aids placed on any of the gates and/or the centre wall should not protrude more than 5cm from the surface to which they are attached.

3.3.3 SAFETY

1. Drones must be disarmed with batteries disconnected before resetting the runs.

2. Each team must have at least one safety pilot to manually disarm or take over control of the drone(s). Teams are to conform to either one of two possible setups:
    a. Each drone must have an assigned safety pilot who is capable of manually taking over control of the drone in case of emergency or when instructed by SAFMC officials.
    b. If a team does not maintain a one-to-one ratio of safety pilots to drones (e.g., 3 drones with only 2 safety pilots), each safety pilot must be capable of disarming and **KILLING ALL** drones immediately under the following conditions:
        i. When instructed by the SAFMC official to do so.
        ii. When any one drone requires an emergency landing.

    Failure to comply to the safety rules will result in penalties at the referee's discretion or **disqualification.**
3. Safety pilots are only allowed to follow the drones (line-of-sight) outside the safety net. The safety pilots need to demonstrate to the referees that the drones are in computer-in-control (CIC) mode before any drones take off.
4. Safety pilots must be on standby for manual takeover, disarming via a switch during the runs.
5. Teams are to declare if they are following the one-to-one ratio of safety pilot or otherwise before the challenge starts.

3.4. MISSION SCORING

The possible points that can be awarded are listed in the table below. The referees will make all scoring decisions, and their decision is **final**. For arbitrary cases, the Chief Referee will have the **final** say.

Each run will be scored based on three components: gates passed, fastest lap time and coordination. Scoring for these components are detailed in the tables below.

Scoring Components:

During each run, the following items will be tracked and used for scoring:

1. Time first drone crosses the START gate.
2. Time EACH drone crosses the END gate after passing through each gate in sequence.
3. Last gate EACH drone passed in sequence

Scoring examples are included in ANNEX B.

Gates Passed (GP)	
Teams are awarded points for each drone in the flock for each gate it passes in sequence. The total points awarded each run is the sum of the individual scores of each drone for that run. Points are cumulative for each drone, e.g. a drone that passes the END gate in sequence will be awarded 15 points (1+2+3+4+5)	
Gate	Points
START	+1
1	+2
2	+3
3	+4
END	+5

Fastest Lap Time (FLT)					
Teams are awarded points for the fastest lap time of each drone. The lap time is the time between when a drone finishes a lap and when any drone first crosses the START gate. Only finished laps will be timed and scored.					
1st Drone to Complete		2nd Drone to Complete		3rd Drone to Complete	
Time	Points	Time	Points	Time	Points

<60s	+50	<65s	+200	<70s	+300
60-120s	+25	65-125s	+100	70s-130s	+150
>120s	+15	>125s	+50	>130s	+100

Coordination (C)		
Teams are awarded points based on the gap between the first drone and each other drone passing the END gate. Only teams with multiple drones with finished laps will be awarded points for this component.		
Time between 1st and 2nd Drone	Time between 1st and 3rd Drone	Points awarded
<10s	<15s	+100
10-20s	15-30s	+50
20-30s	30-45s	+25

NOTE: The **highest score** attained across the runs will be taken as the mission score.

3.5. PENALTIES

The referees will make all penalty decisions, and their decision is **final**. For arbitrary cases, the Chief Referee will have the **final** say. Further correspondence will not be entertained.

S/N	DESCRIPTION	PENALTY
1	Exceeding the 25 minutes setup time.	Mission time will start regardless.
2	Use of external markers outside of the play field.	Referee's discretion or **disqualification**
3	Internal markers within the play field unable to be removed or leave a mark after being removed.	Referee's discretion or **disqualification**
4	Interrupting the competition by potentially interfering with other competitors, e.g. switching on your platform's VTX, transmitters, etc.	Referee's discretion or **disqualification**
5	Attempting to subvert competition rules or gain an unfair advantage over other teams, e.g. receiving assistance from spectators, etc.	Referee's discretion or **disqualification**
6	Violation of any Safety Rules during the competition.	Referee's discretion or **disqualification**
7	Violation of any Mission Rules in Section 3.3.	Referee's discretion or **disqualification**

4. OVERALL SCORING

The scoring components for Category High-Speed Drone Flock are:

1. Team Challenge **V**ideo (V)

2. Team Live **P**resentation (P)

3. **M**ission (M)

The first two components (V and P) will be assessed by our Category High-Speed Drone Flock Judges, while the Mission (M) will be computed from the highest attained score from the challenge attempts.

Scores will be awarded relative to the performance of other teams. Further details on the scoring components can be found below.

The weightage of the scoring components is listed as follows:

Component	Weightage
Team Challenge Video	15%
Team Live Presentation • Strategy – 30% • Presentation Quality – 10%	40%
Mission	45%
Total	**100%**

For **CATEGORY HIGH-SPEED DRONE FLOCK,** the total score **T** is computed as T = V + P + M.

4.1. TEAM CHALLENGE VIDEO (V)

The Team Challenge Video provides a proof-of-flight insight into how the flock performs before the challenge day. The video should include:

1. Flightworthiness
    a. Demonstrate stable and sustained flight of up to **THREE (3)** drones.
    b. Demonstrate on-demand failsafe functionality of drone(s).
        i. If controlled landing is chosen as a failsafe function on the challenge day, it must be demonstrated in the challenge video.
2. Mission-readiness
    a. Demonstrate autonomous flight as a flock of **TWO (2)** to **THREE (3)** drones.
    b. Demonstrate autonomous flight of up to **THREE (3)** drone(s) through gates.
    c. Teams are highly encouraged but not required to show both 2a. and 2b. together.
3. Creativity
    a. Resourcefulness in re-creating competition layout to showcase similar mission requirements.

4.2. TEAM LIVE PRESENTATION (P)

Teams should present their **proposed strategy and learning outcomes and insights**. Additionally, teams would be assessed on the overall quality of presentation.

4.2.1 PROPOSED STRATEGY

Teams are to explain how their drones, sub-systems, and algorithms help in their mission strategy. These include, but are not limited to:

1. Choice of sensor suite used to tackle the mission.
2. Obstacle and collision avoidance method.
3. Localisation method.
4. Method of coordinating drones in the flock.
5. Method of communication between drones in the flock.
6. Any other algorithms used in completion of the mission.

Teams are also encouraged to utilise and present unique concepts, which may include:

1. Robust and intelligent methods of autonomous control.
2. Unconventional ideas and methods to complete the mission.
3. Methods to achieve greater flight speeds.

4.2.2 LEARNING OUTCOMES AND INSIGHTS

Teams are to share about their experience preparing for the competition. These include:

1. Challenges faced and lessons learnt.
2. Key decisions made during the design process and their rationale.

4.3. MISSION (M)

The challenge segment scores on the challenge day will form the **Mission (M)** score. Please refer to Section 3.4 and Section 3.5 for the mission scoring and penalties.

5. FLOW OF EVENTS

Similar to real-world scenarios, teams may face unexpected issues during the competition. They should not expect the conditions or layout of the challenges to be fully defined beforehand or to remain identical for each attempt between competitors. Factors such as venue conditions, and other uncontrollable elements can also influence competition results.

5.1. PRESENTATION SEGMENT

Teams will deliver their presentation to a panel of judges in person during the challenge day.

Teams will be given a maximum of **TWENTY (20)** minutes for this segment. **FIFTEEN (15)** minutes are allocated for the team presentation, and **FIVE (5)** minutes for Questions & Answers.

Please refer to Section 4.2 for scoring factors for the presentation component.

During the presentation segment, teams are required to:

1. Bring each unique drone to be used for the challenge.
2. Teams are to prepare **ONE (1)** presentation in the form of **TWO (2)** A0 posters OR up to **TWENTY (20)** slides. The time limit for the presentation is 15 minutes.

5.2. TEAM CHALLENGE VIDEO

Teams are to submit **ONE (1)** Team Challenge Video to the SAFMC organising committee. The video length should be no longer than **TEN (10)** minutes and should include the key components as stated in Section 4.1.

Videos should be uploaded to YouTube and set as “Unlisted”. The link to the video should be sent to SAFMC@science.edu.sg with title subject: “[CAT HIGH-SPEED DRONE FLOCK] - [Team Name] – Challenge Video” before the deadline. The deadline for submission is **28 February 2026, 2359hrs**. Video should be uploaded before the deadline, and any re-upload of the video detected past the deadline may result in **penalisation** or **disqualification**. You may write in to the SAFMC 2026 organising committee to request for a re-upload of the Team Video if necessary.

The submitted video should adhere to the following guidelines:

1. Animations are **NOT** allowed.
2. Computer-aided simulations may **NOT** be used to prove flight worthiness and mission-readiness.
3. Video must **NOT** be produced by a professional, or with professional assistance.
4. No offensive images or audio.
5. Narration and/or subtitles are allowed.
6. All videos must be original work conceived and created by the participants. No copyright materials (images, music, etc.) may be used in the video unless the participants own the copyright or have a license to use the material in the video.
7. If the participants have gained formal permission to use any copyright materials (images, music, etc.) under terms and conditions stipulated by the copyright owners, acknowledgements/credits must be included at the end of the video.
8. The use of logos including known commercial brands, institutional crests or trademarks, unless integral to the project, is not allowed.

9. Ownership of the underlying intellectual property of the video remains with the participant(s) of the individual/team project, with the following exception:
    a. Participant(s) grant the SAFMC organising committee the right to use, distribute and display their videos without further compensation or notification to the participant(s).
    b. Participant(s) grant the SAFMC organising committee the right to use their images and videos for publicity and advertising without further compensation or notification to the participant(s).

5.3. CHALLENGE SEGMENT

Teams are expected to comply with the following during the challenge segment:

1. Teams are to arrive at their designated reporting time.
2. At the allocated competition schedule, the team shall report to the safety inspection point. An SAFMC official will check the drones for any violation of the category rules and regulations. Teams who do not pass the inspection will **not** be allowed to fly their drones in the challenge mission and may face **immediate disqualification** from the competition. The inspection will include, but is not limited to, the following checks:
    a. The maximum take-off weight (MTOW) and size of the drones.
    b. RC / datalink / video link transmitter and receiver are operating on allowed frequencies.
    c. Electrical harnessing should be appropriately insulated and should not be chafed or broken. No exposed wires and connectors are permitted.

d. All major assemblies and critical components must be securely fastened to the drones; loose items should be tied down and kept away from the propellers.

e. For drones operating on semi-autonomous / autonomous modes, it should allow complete manual pilot override on-demand via RC or GCS.

f. The drones must demonstrate failsafe capability in the event of a loss of link between the RC/GCS and the drones. The failsafe check procedure is as follows:

   (1) All propellers and releasable payloads are to be removed from the drones.

   (2) Flight motors will be armed.

   (3) Throttle will be applied to spin the motors. While the motors are still spinning in the same flight mode, the Wi-Fi router(s) will be switched off to simulate a link loss.

   (4) All motors should come to a **complete stop immediately**. The drones should not attempt a hover / controlled descent / to return home.

g. An SAFMC official will be with the operator during the mission attempt. The official may give instructions to the operator depending on the behaviour of the drones (e.g. to land immediately if the drones appear to be uncontrollable). The operator is to comply immediately with all such instructions, which may include the activation of the failsafe to ground the drones.

h. The drones must demonstrate failsafe capability upon operator command. The failsafe check procedure is as follows:
    (1) All propellers and releasable payloads are to be removed from the platform.
    (2) Flight motors will be armed and throttled up.
    (3) While the motors are still spinning in the same flight mode, the operator must be able to activate a kill-switch.
    (4) All motors should come to a **complete stop immediately**. The drones should not attempt a hover / controlled descent / to return home.

i. At the end of each mission attempt, the radio control transmitter, datalink transceiver, video receiver and any other wireless device for the flying machine must be switched off.

5.4. KEY RULES TO NOTE

Rules for personnel movement and communication during the setup time and the mission attempt are dictated in the following points:

1. Only members of the participating team are allowed to be inside the play field during their allocated time.
2. No outside communication or assistance from the audience / spectators is allowed at any point. No headphones or earpieces are allowed to be worn by the operator/pilot. Teams who flout this rule may be **disqualified**. Communication amongst teammates is allowed.
3. The netted play field **must** be clear of persons whenever any drone(s) are armed or in flight.

4. If any drone(s) are **connected to batteries**, persons entering the netted play field must don the appropriate Personal Protective Equipment (PPE), which will be provided.
5. Team members may enter the field to collect their drones, or to bring it out of the play field to modify or repair (including changing batteries) **after** it has landed, and all drones have been disarmed. Entry into the play field is only allowed upon confirmation with SAFMC officials.
6. Multiple video **receivers** are allowed. Only **ONE (1)** video transmitter is allowed for each drone.
7. No radio control transmitters, datalink transmitters and video transmitters and receivers are to be switched on within the competition venue, unless permitted to do so in the holding area or play field. All repairs / maintenance / troubleshooting should be done in Raceband channel 8 with VTX set to either 25mW or pit-stop mode. Non-compliance may lead to **disqualification**.
8. There will be a charging space allocated for teams to charge their batteries. Teams will have to bring their own charger/charging equipment should they plan to charge their batteries. At any point, there **MUST** be at least **ONE (1)** team member overseeing the charging. Failure to do so will result in **disqualification**.
9. Teams shall make sure that their designated representatives are contactable and should arrive at least **TEN (10)** minutes before any allocated timing. Latecomers may have their mission times shortened or may be **disqualified**.

6. TECHNICAL RULES & REGULATIONS

Each team is to design and build or acquire a flock based on the following guidelines:

1. Off-the-shelf products and components are allowed in the competition.
2. For safety considerations, the MTOW of an aerial drone **must not exceed 2.5kg.** The platform **cannot not exceed 75cm** in any direction (this measurement includes the maximum diameter of the propeller circles and propeller guards).
3. Participants are only allowed to use between to **TWO (2) TO THREE (3)** aerial drones for mission attempt. Teams can bring similar backup drones to replace any drones that has become incapable of flight. No additional time will be given to replace the drones.
4. Only electric-based flight propulsion is allowed. Both brushed and brushless motors are allowed. No modification to the motors is allowed.
5. No internal combustion or gasoline engines are allowed.
6. No tethering or umbilical wires to the drones are allowed during flight.
7. External aids such as markers, indicators etc. will be allowed only in the play field and can only be placed when there are no drones armed or in flight.
8. For safety considerations, the drones must be able to perform full RC manual pilot override and RC failsafe on demand.

6.1. AVIONICS SYSTEM

There is no limit on the number of inertial measurement units (IMUs), flight controllers (FCs), and other electronics used in the drones.

6.2. BATTERY

There is no limit on the number of batteries used, in series or parallel. Participants should size their batteries and drones appropriately for the respective mission. Lithium-Polymer (LiPo) batteries are preferred.

Batteries must be properly strapped or locked onto the drones before launch.

ANNEX A

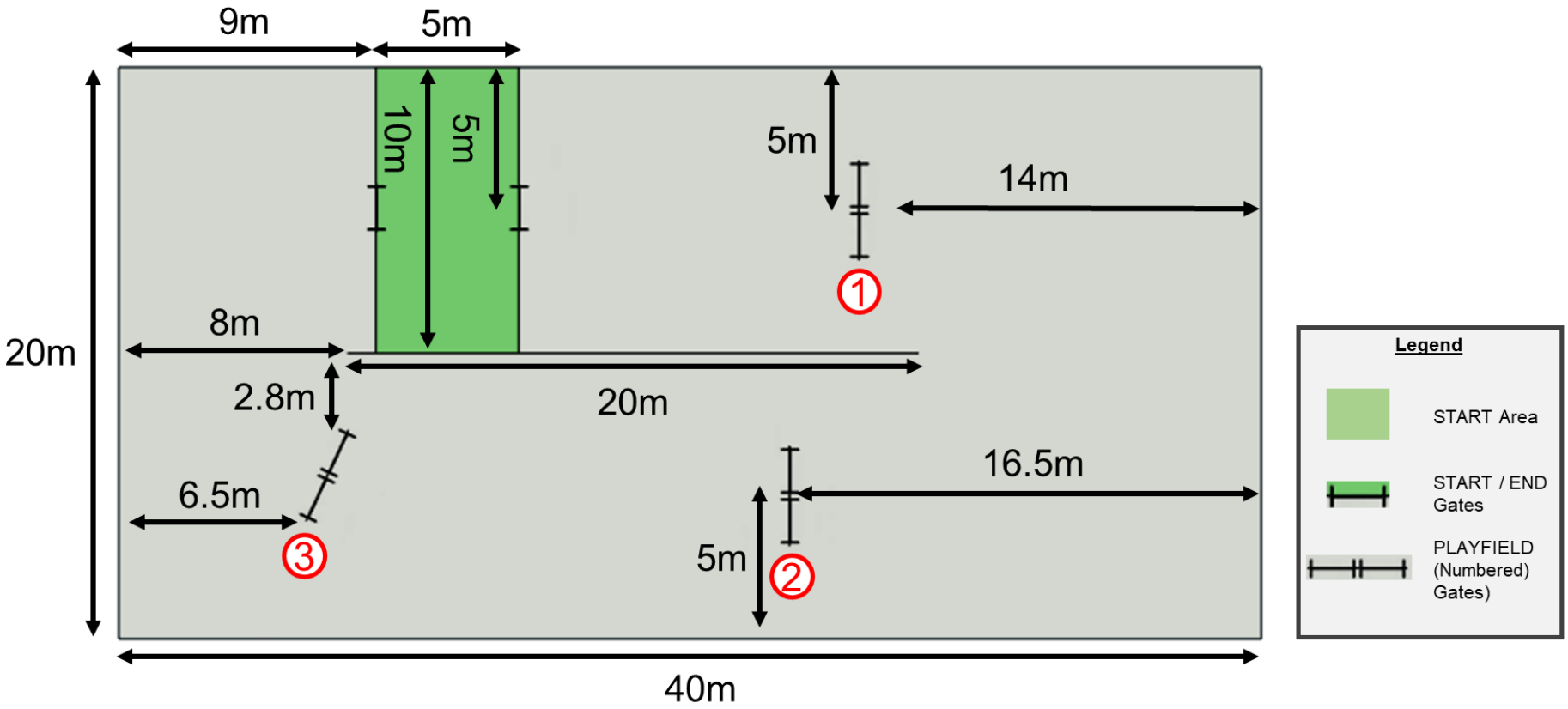

Figure 5: Enlarged Overview of Play Field Layout

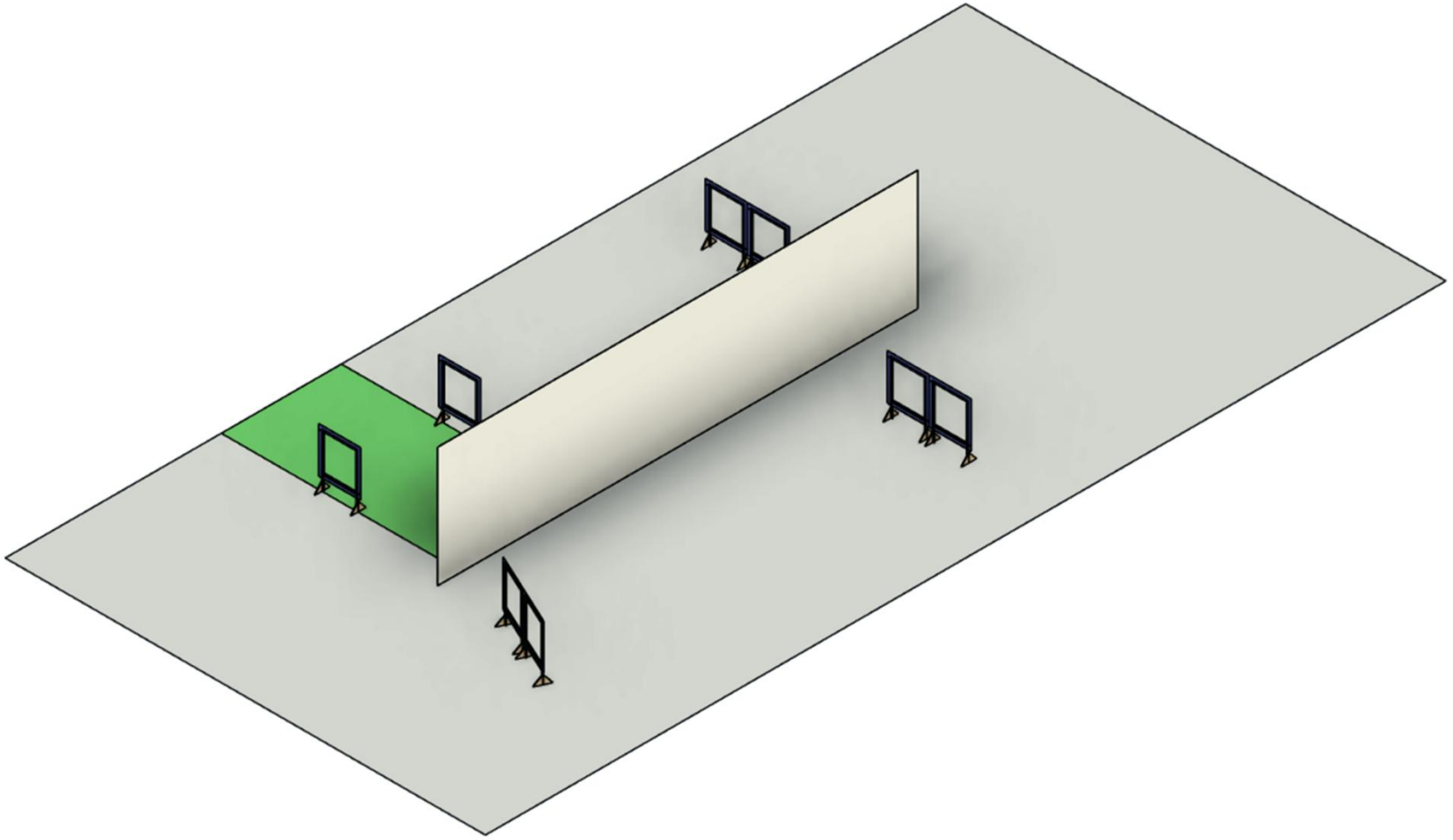

Figure 6: Isometric View of the Play Field for Illustration Purposes

ANNEX B

The following table details some scoring examples.

Scoring Examples											
No.	START Time	Last Gate Passed in Sequence			END Time (s)			Point Awarded			
		1st Drone	2nd Drone	3rd Drone	1st Drone	2nd Drone	3rd Drone	Gates Passed	Fastest Lap Time	Coordination	Total
1	0.0	END	3	2	59.0	DNF	DNF	15 + 10 + 6 = 31	50	0	81
2	0.0	END	END	-	100.0	115.0	DNF	15 + 15 = 30	12 + 100 = 125	50	205
3	0.0	3	-	-	DNF	DNF	DNF	10	0	0	10
4	0.0	END	END	END	125.0	140.0	150.0	15 + 15 + 15 = 45	15 + 50 + 100 = 165	50 + 50 = 100	310