

HOTDOG

User Manual

Substation patrol and inspection with the Deep Robotics Lynx M20

Version 1.0 · 2026-11-01

For substation operators and the robot crew. No robotics knowledge needed: every task is one `hotdog` command on the robot computer.

Revision history

Version	Date	Changes
1.0	2026-11-01	First version: patrols with the watchdog, reports, alerts, the hotdog command

The M20's own hardware (battery, charging dock, power switch, the M20 remote) is described in the Deep Robotics Lynx M20 manual, the pod in the Reebot UniPod MT11 manual and the acoustic camera in the Hertzinno HZ-FA-371 manual. This manual covers what HotDog adds: teaching routes, patrols, inspection, reports and alerts. Settings and maintenance are in the HotDog Technician Guide; the handover tests in the HotDog Site Acceptance Test.

Contents

1 Safety first 5
- 1.1 The substation's rules come first 5
- 1.2 Before every patrol 5
- 1.3 While the robot moves 6
- 1.4 Emergency stop 6

2 The system at a glance 7
- 2.1 What HotDog does 7
- 2.2 How you work with it 8
- 2.3 How a patrol works 8
- 2.4 Words you will see 9

3 Getting ready 10
- 3.1 Power on and log in 10
- 3.2 Start of a shift 10
- 3.3 The robot computer's commands 11

4 Teaching a route 12
- 4.1 Plan the route 12
- 4.2 Record the route 12
- 4.3 Teach the targets 13

5 Running patrols 15
- 5.1 Start a patrol 15
- 5.2 On a schedule 15
- 5.3 Pause, stop and bring it home 15
- 5.4 What the robot does on its own 16
- 5.5 When a patrol fails to start 16

6 Inspection results 17
- 6.1 The reports 17
- 6.2 Severities 17
- 6.3 The last round 18
- 6.4 Alerts on Telegram 18

7 After the shift 19
- 7.1 Park 19
- 7.2 Daily checklist 19

8 Troubleshooting 20

9 Quick card 21

1 Safety first

HotDog walks among energized high-voltage equipment. Read this chapter before you use the robot for the first time, and follow it on every shift.

1.1 The substation's rules come first

- HotDog works under the substation's safety rules and permits. Only people trained on this manual and authorized by the substation operate it; one of them is responsible for the robot during every patrol, including scheduled ones.
- **Safe distances.** The robot, the pod on top of it and anything it carries must stay outside the minimum approach distance of every energized part, for that voltage level, as the substation's rules set it. Teach routes only along walkways and roads that people may use when the equipment is energized. HotDog does not know where live parts are: the route is the only thing that keeps it away from them.
- **Switching and maintenance.** No patrol through a bay under switching or maintenance. Stop the schedule (`hotdog schedule off`) and keep the robot on its dock while work is going on.
- **Weather.** No patrols in a thunderstorm. Check the M20's protection rating in its manual before patrolling in rain. HotDog does not look at the weather: switch the schedule off when a storm is coming.

1.2 Before every patrol

- Walk the route or check it on the cameras. Cable trench covers closed, no open pits, no tools or materials left on the walkway, gates open as they were when the route was taught.
- **The robot does not see holes and drops.** It sees obstacles between about 15 cm and 1.6 m above the ground; a pit, an open trench or a low object (a flat cable, a step down) is not an obstacle to it.
- The battery is charged (a patrol does not start below 30 %).
- The M20 remote is with the responsible person and switched on.

1.3 While the robot moves

- Stay at least 2 m away from a moving robot. Keep visitors away from the route.
- Never touch the legs or wheels while the robot stands, never lift or push it then.
- In a patrol (AUTO) the robot slows down and stops for obstacles all around it. Driving with the M20 remote, **you are responsible for every movement**: the robot does not stop for obstacles then.

1.4 Emergency stop

> **IF ANYTHING GOES WRONG, STOP THE ROBOT**
>
> **The M20 remote's emergency stop** stops the robot at once (its own, hard stop). `hotdog estop` on the robot computer latches HotDog's stop: only standstill commands reach the robot until `hotdog release`.

- After `hotdog release` a patrol stays paused: `hotdog resume` when it is safe, or `hotdog return` to bring the robot home.
- After the M20's own emergency stop the robot needs `hotdog stand` before it moves again.
- The protective field stops the robot before an obstacle on any side, slowing down earlier the faster it goes. It is not a reason to walk into the robot's way.

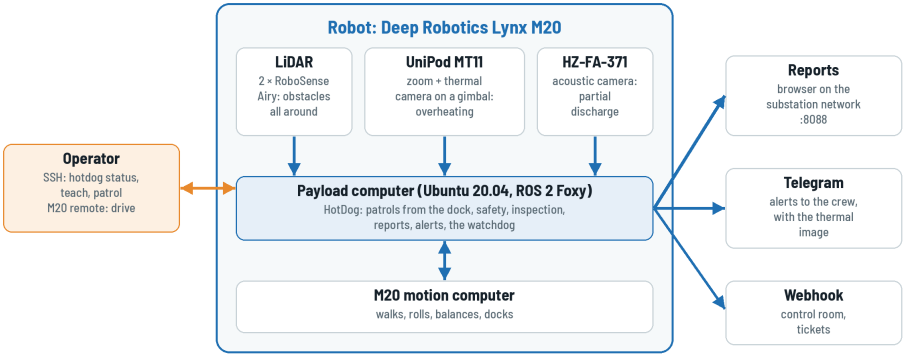
2 The system at a glance

2.1 What HotDog does

Substation equipment is inspected on fixed rounds: the same disconnectors, busbar joints, bushings and cable terminations, every shift. HotDog walks such a round on its own. It stops in front of each piece of equipment, points its camera pod there and checks it:

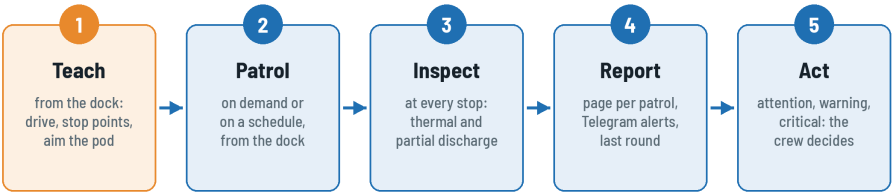
- **Overheating**, with the thermal camera of the UniPod MT11: the hottest spot, compared with fixed limits, with the air temperature and with the other phases of the same equipment.
- **Partial discharge**, with the Hertzinno HZ-FA-371 acoustic camera: corona, surface discharge (tracking) and floating discharge (a loose part).

Every patrol becomes a report you open in a browser, and every serious finding reaches the crew's Telegram group within seconds, with its thermal image.



HotDog's parts and how they connect

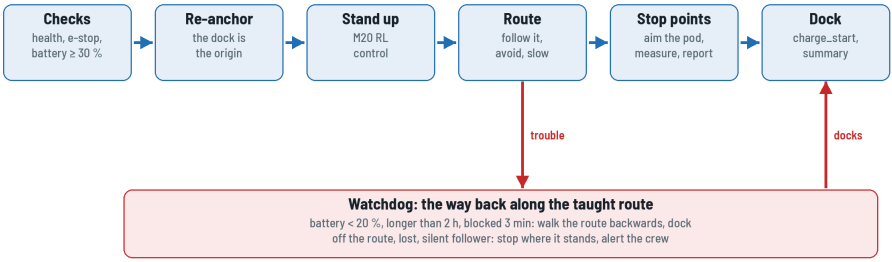
2.2 How you work with it



Teach once, then patrol

1. **Teach** a route once: drive it with the M20 remote from the dock, mark a stop point at each piece of equipment and aim the pod at it.
2. **Patrol**: on demand or at fixed times, HotDog walks the route from the dock, inspects at every stop point and docks again.
3. **Read** the report and act on the findings: attention, warning, critical.

2.3 How a patrol works



A patrol and the watchdog

HotDog has no map of the substation. It knows where it is from the M20's own sense of motion (odometry), counted from the dock. That is why **every route starts at the dock** and every patrol starts there too: the dock is the origin of everything HotDog knows.

A watchdog guards every patrol. When the battery runs low, the patrol runs too long or the robot is blocked, it walks the taught route backwards to the dock. When it is lost or off the route, it stops where it stands and the crew gets an alert.

2.4 Words you will see

Word	Meaning
dock	the M20's charging dock; the start of every route and the origin of the robot's map
site	one substation: its routes and its inspection points
route	a path taught by driving it, with stop points; a file named by the time it was taught
stop point	where the robot stops on a route to inspect
target	one view of the pod at a stop point (direction and zoom), with what to check there
finding	one result of a check: a temperature or a discharge, with its severity
severity	normal, attention, warning, critical
round	one patrol; "the last round" is the previous measurement of the same finding
AUTO / REMOTE	HotDog drives / a person drives
watchdog	what brings a patrol home or stops it when something is wrong
the way back	the taught route walked backwards to the dock

3 Getting ready

3.1 Power on and log in

1. The M20 stands or sits on its dock and is switched on (see its manual). The payload computer starts with it, and HotDog starts on it by itself.
2. Log in to the payload computer from a laptop on the robot's network: `ssh robot@<robot address>` (the address and the password are on the robot's label).
3. Wait about a minute after power on, then: `hotdog status`.

3.2 Start of a shift

```
$ hotdog status
patrol      IDLE  points 0 (C0 W0 A0) next 14:00
health      OK  speed 100%
localize    LOCALIZED  (odometry) drift ±0.00 m
control     AUTO  e-stop off field CLEAR
battery     96%
inspection  IDLE  pod ok acoustic ok ambient 30.0 °C 12 points 30 targets
navigation  INACTIVE
alerts      nothing waiting
reports     http://10.21.31.50:8088/
```

Line	Good	Otherwise
patrol	IDLE, the next time expected	FAILED: read the message; RUNNING: a patrol is on
health	OK (WARN with a known reason)	ERROR: no patrol starts; call the technician
localize	LOCALIZED	NONE: put the robot on its dock, `hotdog anchor`
control	AUTO, e-stop off	e-stop on: find out why, then `hotdog release`
battery	above 30 %	let it charge on the dock
inspection	pod ok, acoustic ok	MISSING: the patrol runs but cannot measure: technician
alerts	nothing waiting	waiting: the robot has no Internet; they go out later

Then set the **air temperature of the day**, the reference of the "rise over ambient" check:

```
hotdog ambient 33        # °C, from the substation's thermometer
```

3.3 The robot computer's commands

Every task is one `hotdog` command; `hotdog help` lists them all.

Command	Does
`hotdog status`	the robot at a glance
`hotdog patrol [route]`	start a patrol from the dock (no route: the one patrolled last)
`hotdog return`	walk the route back to the dock and dock
`hotdog stop`, `pause`, `resume`	stop the patrol where the robot stands, hold it, go on
`hotdog estop`, `release`	HotDog's latched emergency stop, and its release
`hotdog teach start / point / stop`	teach a route
`hotdog aim`, `hotdog teach target`	point the pod, teach what it looks at
`hotdog routes`, `hotdog site`	the routes of the site, the active site
`hotdog stand`, `sit`, `dock`	the M20 stands up, sits down, goes to its dock
`hotdog ambient <°C>`	today's air temperature
`hotdog schedule on / off / show`	scheduled patrols
`hotdog reports`, `hotdog alert-test`	where the reports are; a test alert to Telegram
`hotdog logs`, `hotdog restart`	the service log; restart HotDog

4 Teaching a route

4.1 Plan the route

- Walk it first. Follow walkways and roads that are allowed with the equipment energized, at a safe distance from every live part (section 1.1).
- Choose a **stop point** in front of each piece of equipment to inspect: where the pod sees the parts that matter (clamps, joints, bushings, terminations, insulators) without other equipment in the way, and where the robot stands on level, firm ground.
- A route may go out and come back along the same walkway; the way back home then takes the short way.
- Keep routes short enough. The robot's position drifts a little with every metre walked; if it stops noticeably short or long of a stop point at the far end of a long route, split the route into two.
- End the route close to the dock, facing it: the M20 docks by itself from there.

4.2 Record the route

1. On the dock. The robot stands on its dock, in AUTO, nothing in the way. Stand it up and start recording; the dock becomes the origin:

```
hotdog stand
hotdog teach start
```

2. Drive. Drive the route with the **M20 remote**, slowly and smoothly: the robot repeats it as you drive it. HotDog sends no motion while you teach, so the remote has the robot.

3. Stop points. At each piece of equipment, stop and mark the stop point, then teach its targets (section 4.3) before driving on:

```
hotdog teach point          # waits 5 s here; teach point 8: 8 s
```

4. Back at the dock, facing it, save the route and dock:

```
hotdog teach stop           # saved, named by date and time
hotdog dock
```

> **TEACH FROM THE DOCK, PATROL FROM THE DOCK**
>
> A route taught from anywhere else, or a patrol started away from the dock, puts every stop point in the wrong place. If the robot was moved by hand or the M20 restarted, bring it back to the dock and run `hotdog anchor` before the next patrol.

4.3 Teach the targets

Standing on the stop point, point the pod at the equipment and teach that view:

```
hotdog aim 35 -10 4         # yaw 35° right, pitch 10° down, zoom 4×
hotdog teach target bay1_ds_clamps strips=3 acoustic
```

Watch the pod's picture while you aim it: in VLC, `rtsp://<pod address>:8554/video1` (zoom camera) and `/video2` (thermal camera), from a laptop on the robot's network.

Equipment	Target	What is checked
three phases side by side (clamps, bushings, CTs)	`hotdog teach target <name> strips=3`	hottest spot; the phases compared
one joint, one termination	`hotdog teach target <name>`	hottest spot, over the air temperature
a part with its own limit	`hotdog teach target <name> max=95`	… and 95 °C as critical
insulators, cable terminations, spacers	`hotdog teach target <name> acoustic`	partial discharge
both	`hotdog teach target <name> strips=3 acoustic`	both

- Name targets after the equipment and the part, with letters, digits, `_` and `-`: `bay1_ds_clamps`, `tx2_hv_bushings`.
- One stop point may have several targets (each a direction and zoom).
- Fill the thermal picture with the equipment: zoom in until the parts to compare take most of the frame. For three phases, keep them side by side across the picture.

The technician can fine-tune targets later (regions, limits, detection time) in the site's inspection file (Technician Guide).

5 Running patrols

5.1 Start a patrol

The robot is on its dock:

```
hotdog patrol                       # the route patrolled last
hotdog patrol 2026-11-01_09-30-00   # or one by name: hotdog routes
hotdog status
```

The robot checks its health, the e-stop and the battery, takes the dock as its origin, stands up and walks the route. At each stop point it stops, points the pod at each target, measures and moves on. At the end it docks. `patrol` in `hotdog status` shows RUNNING, then DONE.

5.2 On a schedule

Patrols at fixed times of the day, every day. The times and the route are set by the technician in the robot's site file; you switch them on and off:

```
hotdog schedule show
hotdog schedule off        # e.g. during switching or a storm
hotdog schedule on
```

A time missed by more than 10 minutes (robot busy or off) is skipped, not caught up. While a patrol runs, a due time is skipped.

5.3 Pause, stop and bring it home

You want to	Command	The robot
hold it for a moment	`hotdog pause`	stands still; `hotdog resume` goes on
end the patrol here	`hotdog stop`	stands where it is; bring it home with the remote
end the patrol and bring it home	`hotdog return`	walks the route backwards, no inspections, then docks

You want to	Command	The robot
stop it at once	`hotdog estop`	stands still until `hotdog release`, then `resume`

5.4 What the robot does on its own

When	It
an obstacle is in the way	slows down, steps around it within the walkway, or stops
the battery drops below 20 %	walks the route back to the dock and docks
the patrol runs longer than 2 hours	walks back to the dock
it is blocked for 3 minutes	walks back to the dock
it is off the route or lost for 3 minutes	stops where it stands; the crew gets an alert
an operator paused it, the e-stop or the remote holds it	waits: it never overrules a person

A patrol that came back on its own ends FAILED with `returned`; its reports up to there are kept, and the alert says why.

5.5 When a patrol fails to start

`hotdog status` shows FAILED and why. The usual reasons: health ERROR, the e-stop latched, the battery below 30 %, the M20 charging or on its own emergency stop (`hotdog stand` fails), no site loaded. Fix it and start again.

6 Inspection results

6.1 The reports

Open the address of `hotdog status` (`reports`) in a browser on the substation network, e.g. `http://10.21.31.50:8088/`:

- **All days**: the newest first, with the patrols, points and findings of each day and the worst one.
- **A day**: its patrols and every inspected point.
- **A patrol**: the summary, the points, and for each point every finding with its value, the reference it was compared with, the difference, **the last round** and the evidence images: the thermal and zoom pictures, the sound map and the PRPD for partial discharge.

Print a patrol page to PDF from the browser (one point per page) to file it or send it.

6.2 Severities

Severity	Thermal: hottest spot	Partial discharge	Do
normal	below every limit	noise	nothing
attention	≥ 80 °C, or 11 °C over the air, or 2 °C over the other phases	corona	look again on the next round
warning	≥ 90 °C, or 21 °C over the air, or 4 °C over the other phases	surface	plan a repair
critical	≥ 105 °C, or 41 °C over the air, or 16 °C over the other phases	floating	report to the substation now

These are the default limits, after the usual infrared inspection practice (NETA MTS); the technician may set others for the site.

> **FINDINGS ARE SCREENING RESULTS**
>
> A finding says where to look, not what to switch. Confirm it on site with the substation's own instruments and procedures before any switching or maintenance decision.

6.3 The last round

Each finding is compared with the same finding on the previous round (same point, target, check and phase). A part that is still "normal" but several degrees hotter than yesterday shows up in red in the **Last round** column: it is worth a look before it crosses a limit. Corona that comes back every round is worth watching too.

6.4 Alerts on Telegram

The crew's group gets, within seconds:

- every **warning** and **critical** finding, with its thermal image or sound map and what to do;
- every patrol that **failed** or **came back on its own**, with the reason;
- every finished patrol, with its findings and a link to its report;
- a robot whose health is **ERROR**.

```
🔴 CRITICAL at bay1_disconnector
HotDog 01 · site gi_cawang
bay1_ds_clamps (s): 112.4 °C, +38.0 °C over the other phases
Report to the substation now.
```

The same finding is not sent again within 12 hours unless it gets worse. Without Internet the alerts wait on the robot and arrive when the link is back. `hotdog alert-test` sends a test message.

7 After the shift

7.1 Park

- The robot is on its dock after the last patrol (`hotdog status`: patrol DONE, battery charging). If not: drive it there with the remote, or `hotdog dock` near the dock.
- Leave the schedule on for the night rounds, or `hotdog schedule off`.
- Switching the robot off: see the M20 manual. HotDog starts again with it.

7.2 Daily checklist

Check	How
every patrol of the day ran	the day's page in the reports
every warning and critical finding was passed on	the Telegram group
the robot is on its dock and charging	`hotdog status`
the pod and the acoustic camera are clean and dry	look; the technician cleans them
no alerts waiting	`hotdog status`: alerts

8 Troubleshooting

You see	Do
`hotdog status` : every line `?`	HotDog is not running: wait a minute after power on; `hotdog restart` ; then the technician
patrol FAILED at `checks`	the message says which: health ERROR, e-stop, battery
patrol FAILED at `stand up`	the M20 is charging or on its own emergency stop: undock it, `hotdog stand`
the robot stops and does not go on	`hotdog status` : control (e-stop, field STOP: something is in the way), navigation (PAUSED, BLOCKED)
localize NONE in the middle of a patrol	the M20 restarted: drive it to the dock with the remote, `hotdog anchor` , start again
it stops short of the stop points at the end of the route	the route is too long for its drift: split it
reports say `partial` , inspection: POD MISSING	the pod has no power or network: technician
no partial discharge results, ACOUSTIC MISSING	the acoustic camera: technician
no alerts arrive	`hotdog alert-test` ; alerts waiting in `hotdog status` : no Internet on the robot
the report page does not open	the laptop must be on the substation network; the address is in `hotdog status`

9 Quick card

Task	Command
how is the robot	`hotdog status`
air temperature	`hotdog ambient 33`
teach a route	`hotdog stand` · `hotdog teach start` · drive · `hotdog teach point` · `hotdog aim 35 -10 4` · `hotdog teach target <name> strips=3 acoustic` · … · `hotdog teach stop` · `hotdog dock`
patrol now	`hotdog patrol` (or `hotdog patrol <route>`)
bring it home	`hotdog return`
stop now	M20 remote e-stop, or `hotdog estop` (`hotdog release`, `hotdog resume`)
schedule	`hotdog schedule on / off / show`
reports	`http://<robot>:8088/`
test the alerts	`hotdog alert-test`
something is wrong	`hotdog status`, `hotdog logs`, call the technician