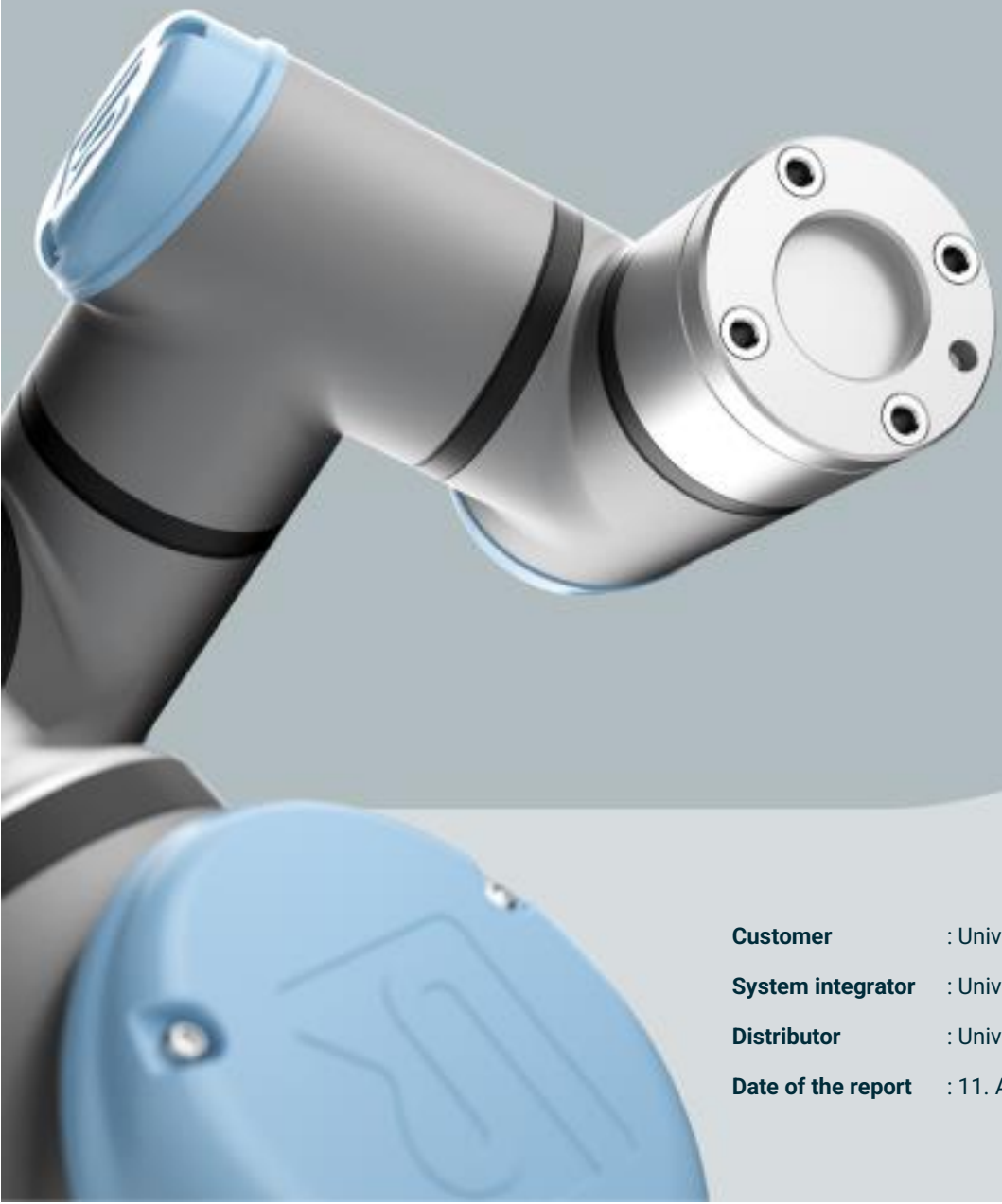
UNIVERSAL ROBOTS

Annual Cobot

Performance Check DEMO

Serial number: 20195099990
TS Case number: TS999990

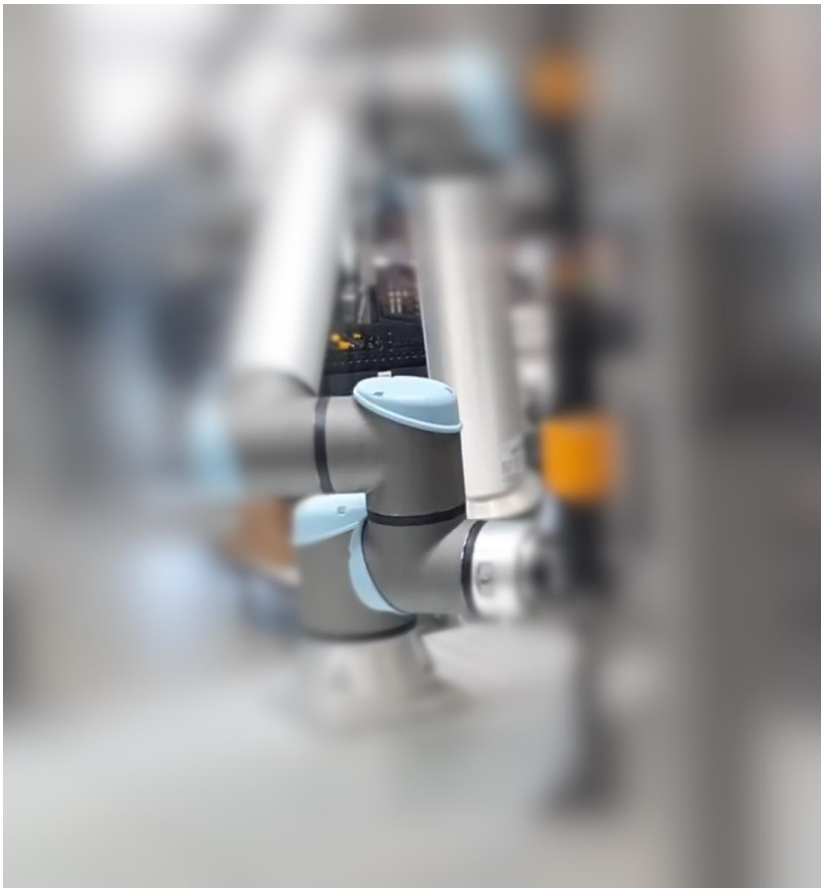


Customer	: Universal Robots
System integrator	: Universal Robots
Distributor	: Universal Robots
Date of the report	: 11. August 2022 10:57

Robot installation overview

Installation data	
Serial number	20195099990
TS Case number	TS999990
Date of extraction	25. July 2022 10:29
Robot model	UR10
Robot mount	Floor
Robot software version	5.11.4.108353 (Sep 16 2021)
Application type	Machine Tending
Running program	220114-cnc_tending.urp
Program last saved	14. February 2022 21:08
Safety checksum	3722558455
TCP	x: 0.006, y: -0.114, z: 0.342, rx: 0, ry: 0, rz: 0
Payload	7.25 kg
CoG	x: 0.012, y: -0.045, z: 0.135
Inertia	ixx: 0, iyy: 0, izz: 0, ixy: 0, ixz: 0, iyz: 0
Installed UR caps	Ethernet/IP, Profinet, Conveyor Tracking, polyscope-pallet-impl, polyscope-screwdriving-impl
Related cases	

Robot work environment



Performance review checklist

The following conditions have been checked and verified against the robot installation setup.

Application best practices		
Clean environment. No dirt or oil on robot.	✓	
Robot is intact. No broken/missing lids etc.	✓	
Robot mounting is sturdy.	✓	
Robust use of potential 7th axis.	✓	
Avoid fast movement to waiting position.	✓	
Blend at via points.		✗

Program analysis		
Up-to-date software versions.	✓	
Transition hardness.	✓	
Initial payload mass and CoG configuration.	✓	
Initial payload inertia configuration.	✓	
Dynamic payload configuration update.	✓	
Move types and motion parameters.	✓	
Blends and radii configuration.	✓	
Robust use of force mode.	✓	
Robust use of tool contact.	✓	
No use of deprecated functions.	✓	

Log info		
No position deviation warnings.	✓	
No custom messages spamming the log.	✓	

Log warnings		
No blend parameter warnings spamming the log (C171).	✓	
No Torque Overload warnings (C173).	✓	
No High Change in Torque warnings (C174).		✗
No Thread Time or CPU Load warnings (C218).	✓	
No Real-time Process Starvation warnings (C271).	✓	
No application robustness protective stops (C153 & C157).		✗

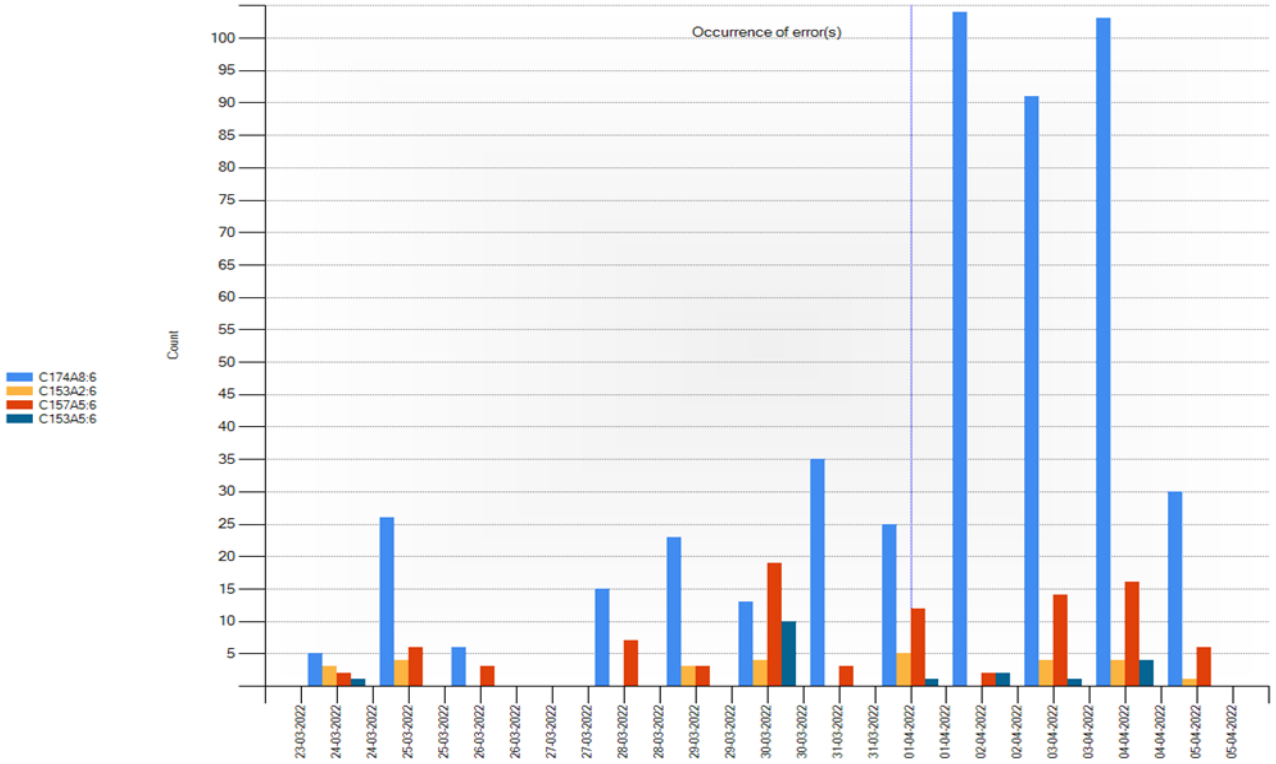
Log errors and safety stops		
No critical hardware or system faults.	✓	
No frequent or systematic hard safety stops.	✓	

Dynamics model		
Robot model and payload configuration.	✓	
No significant influence by unexpected external forces and collisions.	✓	
No unstable control.	✓	

Robot load		
Avoid constant operation at maximum load.	✓	
Avoid joint torque overload.	✓	

Trajectories		
Avoid high acceleration and high inertia combination.	✓	
Avoid high peak accelerations and hard stops.		✗
Avoid hard change in direction of acceleration.	✓	

Log statistics



Error code	Description	First	Last	Count
C153	Position deviates from path. Robot could not follow the path, either there was a collision, or a setting was incorrect. If protective stops occur frequently, resolve the cause. Make sure no objects are in the path, check payload, center of gravity and acceleration settings.	2022-03-24	2022-04-05	116
C157	Collision detected by joint. Robot could not follow the path, either there was a collision, or a setting was incorrect. If protective stops occur frequently, resolve the cause. Make sure no objects are in the path, check payload, center of gravity and acceleration settings.	2022-03-24	2022-04-05	102
C174	Robot motion causes too high jump in joint torques High jumps in joint torque ranges may damage robot hardware. This can be caused by sudden big changes in acceleration in the target trajectory. Use blends or reduce accelerations in the robot motions around where the error was discovered. You can use the script command "pause_on_error_code()" to make the robot stop when this warning occurs, to identify which motion causes the warning.	2022-03-24	2022-04-05	1494

Recommendation summary

Based on the data analysis the following recommendations for optimizations have been identified.

1. **Blend at via points**
2. **No High Change in Torque warnings (C174)**
3. **No application robustness protective stops (C153 & C157)**
4. **Avoid high peak accelerations and hard stops**

1. Blend at via points

Observation
The robot is stopping at via points, I.e., waypoints used to avoid obstacles or to ensure proper alignment of a tool where there is no need to stop.

Recommended action
Use blends to change direction faster when the robot does not need to stop. Prefer larger blend radii if the work cell allows for that.

2. No High Change in Torque warnings (C174)

Observation

Robot motion causes too high jump in joint torques.
1494 occurrences of the C174 warning have been registered between March 24th and April 5th, 2022.
It is triggered at script lines 278 and 482 which is just after exiting force mode.

Recommended action

Avoid rapid changes in the load on the joints, e.g., by reducing accelerations or avoiding oscillations in the system.
When exiting force mode, it is important that the robot is not moving during the transition of control mode. Wait until velocities have reduced or update force mode parameters before exiting to stop the movement generated by force mode.

3. No application robustness protective stops (C153 & C157)

Observation
Robot could not follow the path, either there was a collision, or a setting was incorrect.
A total of 116 C153 and 102 C157 protective stops have been registered between March 24th and April 5th, 2022, which is an average of 16 protective stops a day.

Recommended action
Protective stops should not occur during normal operation.
C153 and C157 protective stops indicate a problem with the robot deployment or payload configuration and should be thoroughly investigated.
They are triggered due to a discrepancy between the software model and the actual control of the robot which is critical for stable operation of a collaborative robot.

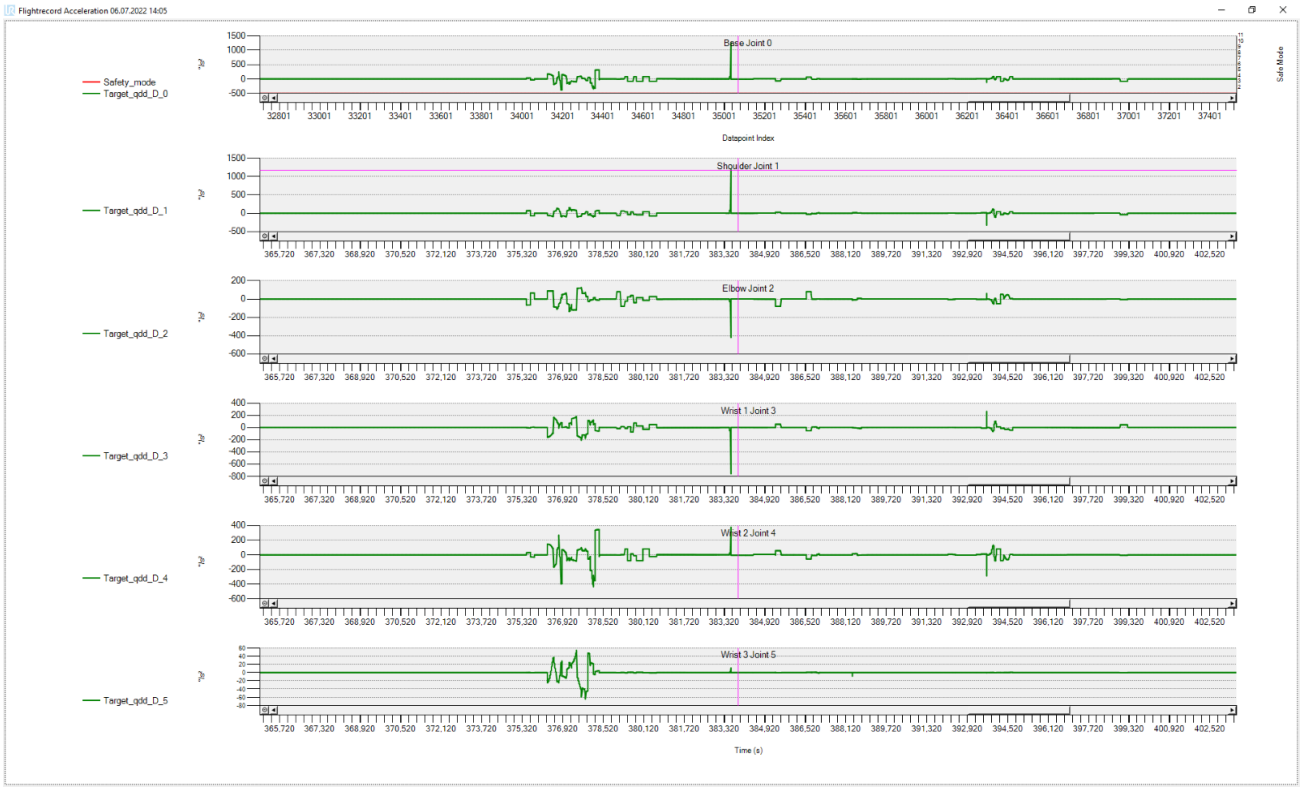
Several things can cause this, and two guides for resolving typical issues are available here:

https://www.universal-robots.com/articles/ur/robot-care-maintenance/preventive-actions-for-error-code-c153-protective-stop-joint-positions-deviates-from-path/

https://www.universal-robots.com/articles/ur/robot-care-maintenance/protective-stop-service-note/

4. Avoid high peak accelerations and hard stops

Observation
There are unexpected and high acceleration spikes on especially the larger joints - base, shoulder and elbow, as seen in the acceleration plot below.



Recommended action
Make sure that all paths through the robot program generate continuous robot movement, I.e., a blended waypoint should never be followed by a wait command and all aborted movements (e.g., in continuously evaluated if-statements) should be ramped down using the stopj or stopl commands.