



# INTEL<sup>®</sup> REALSENSE<sup>™</sup> D400 SERIES DYNAMIC CALIBRATION QUICK START GUIDE

January 2018

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# Introduction

This document provides details into setting up the environment and performing the Dynamic Calibration meant for the Intel® RealSense™ D400 Series camera module.

This document is a quick start guide to perform the Dynamic Calibration, for more details on the tool or API refer to the **“Intel® RealSense™ Depth Module D400 Series Dynamic Calibration User Guide”**

# Kit Requirements

Items Required	Description	How to Obtain
Intel® RealSense™ D400 Series Camera	Obtain the D400 Series module from Intel	<a href="https://www.intel.com/real-sense">Click.Intel.com</a>
Dynamic Calibration Software Package	The package consists software required to perform Dynamic Calibration	Linux - Amazon AWS Windows – Intel Download Center
Windows* System	This computer is preloaded with Win 10 RS2 (Refer to BKC section for more details on the typical set up)	End User to Source
Linux* System	This computer is preloaded with Ubuntu* 16.04 (Refer to BKC section for more details on the typical set up)	End User to Source
USB3 Type C to USB3 Type A	Used to connect camera module to the computer system	End User to Source
USB Hub	May be required to connect peripherals like Keyboard, Mouse etc	End User to Source
External Keyboard and Mouse	External Keyboard and Mouse	End User to Source

# Best Known Configuration (BKC)



Intel will specify the version of each component that should be used in the setup for each software release. To ensure Intel can provide the best support it is important that the version of each component matches the latest “best known configuration” table.



## Windows\* 10 Host Hardware Requirements:

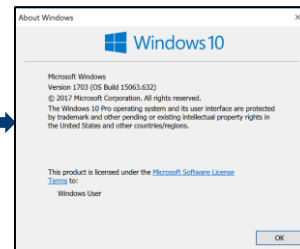
Component	Usage	Version
Intel based platform with USB 3 interface	Host System for D400 Camera	N/A
4GBs DDR RAM	Required for D400 Camera functionality	SODIMM
>128 GB HDD/SSD	At least 128GBs for OS + other software Packages	N/A
D400 Series	Capture 3D camera streams.	400/410/415/420/430/435



\*Make sure to use production firmware

## Windows\* 10 Host Software Requirements:

Component	Usage	Version	Location
Host System Operating System Windows* 10	Update Camera / Run dynamic calibration	Windows* 10, 64bit RS2 (Ver. 1703) Pro, 64bit	Press START Button -> Type “Winver” -> Press [ENTER]
Microsoft* Visual C++ 2015 Redistributable	Windows** dynamic calibration package requires the following installed on the host system	C++ 2015 Redistributable	MSDN Website / Also included in Windows installation package



The software installation process requires industry tools and software to be installed on a host system. The version of these tools is less strict than the software components, but recommended to align versions where possible.

# Best Known Configuration (BKC)



Intel will specify the version of each component that should be used in the setup for each software release. To ensure Intel can provide the best support it is important that the version of each component matches the latest “best known configuration” table.



## Ubuntu\* 16.04 Host Hardware Requirements:

Component	Usage	Version
Intel based platform with USB 3 interface	Host System for D400 Camera	N/A
4GBs DDR RAM	Required for D400 Camera functionality	SODIMM
>128 GB HDD/SSD	At least 128GBs for OS + Packages	N/A
D400 Series	Capture 3D camera streams.	400/410/415/420/430/435

**\*Make sure to use production firmware**



## Ubuntu\* 16.04 Host Software Requirements:

Component	Usage	Version	Location
Host System Operating System Ubuntu* 16.04	Update Camera / Run dynamic calibration	Windows* 10, 64bit RS2 (Ver. 1703) Pro, 64bit	System Settings -> Details



The software installation process requires industry tools and software to be installed on a host system. The version of these tools is less strict than the software components, but recommended to align versions where possible.

# Dynamic Calibration Windows\* Setup





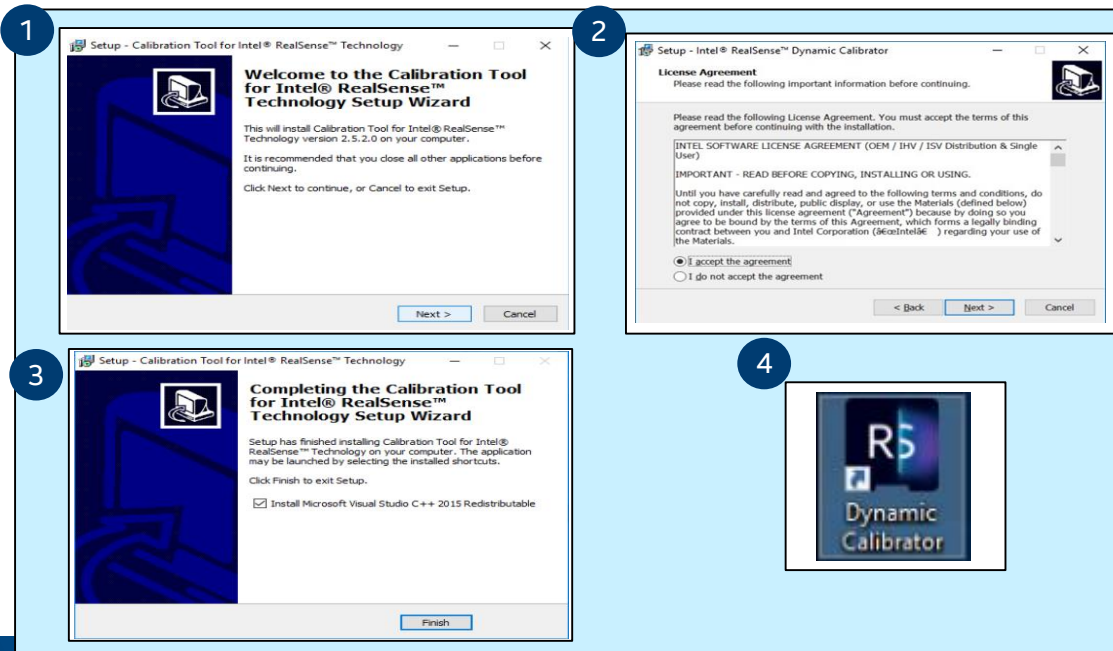
# Dynamic Calibration Set Up on Windows\* 10 Host System

The Dynamic Calibration software is distributed as a Windows\* Installer package and Users find the Windows\* installer method preferable because it is easier to use and installs an icon and application shortcut on the desktop.

**Download** - <https://downloadcenter.intel.com/download/27415/?v=t>

## Installation

1. Launch CalibrationTool-2.5.2.0-Setup.exe to install the dynamic calibration package on your system and click next.
2. Accept the license agreement and click next.
3. Check Visual Studio C++ 2015 Redistributable and click "Finish".
4. A Desktop shortcut created when installation is complete. Use this shortcut to launch the Dynamic Calibration Software



# Dynamic Calibration Ubuntu\* Set up



# Setup Ubuntu\* 16 Host System

The Linux\* package is distributed downloadable package via Amazon AWS

(NOTE: Make sure internet connection is not behind a firewall, corporate network connections NOT RECOMMEND)

## Installation Steps

1. Open terminal, press **Ctrl + Alt + T**.
2. Ensure Ubuntu\* 16 host is **connected to network**, type commands:
  - i. **sudo apt-get update** [Enter]
  - ii. **sudo apt-get upgrade** [Enter]
  - iii. **sudo apt-get dist-upgrade** [Enter]
  - iv. Reboot after all 3 commands have processed.
3. Follow these next steps to install libraries

Install Libusb-1.0

- i. **sudo apt-get install libusb-dev libusb-1.0-0-dev** [Enter]
- ii. **sudo apt-get install libglfw3 libglfw3-dev** [Enter]
- iii. **sudo apt-get install freeglut3 freeglut3-dev** [Enter]
- iv. **sudo apt-get install libpng12-dev** [Enter]

1. Open terminal, press **Ctrl + Alt + T**.

2. Ensure Ubuntu\* 16 host is **connected to network**, type commands:

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get dist-upgrade
```

3. Follow these next steps to install libraries

```
sudo apt-get install libusb-dev libusb-1.0-0-dev
sudo apt-get install libglfw3 libglfw3-dev
sudo apt-get install freeglut3 freeglut3-dev
sudo apt-get install libpng12-dev
```



# Setup Ubuntu\* 16 Host System (Cont.)

## Installation Steps

4. Add Intel server to list of repositories:

- i. **echo 'deb http://realsense-hw-public.s3.amazonaws.com/Debian/apt-repo xenial main' | sudo tee /etc/apt/sources.list.d/realsense-public.list [Enter]**

5. Register the servers public key:

- i. **sudo apt-key adv --keyserver keys.gnupg.net --recv-key 6F3EFCDE [Enter]**

6. Refresh the list of repositories and packages available:

- i. **sudo apt-get update [Enter]**

7. Install the librscaleibrationtool package which includes Intel® RealSense™ Dynamic Calibrator:

- i. **sudo apt-get install librscaleibrationtool [Enter]**

8. Change current directory to librealsense:

- i. **cd /usr/share/doc/librscaleibrationtool/librealsense [Enter]**

9. Install udev rules:

- i. **sudo cp config/99-realsense-libusb.rules /etc/udev/rules.d/ [Enter]**
- ii. **sudo udevadm control --reload-rules && udevadm trigger [Enter]**

10. Patch UVC Video Driver:

- i. **sudo apt-get install libssl-dev [Enter]**
- ii. **sudo apt-get install socat [Enter]**
- iii. **sudo ./scripts/patch-realsense-ubuntu-xenial.sh [Enter]**

11. Reload the UVC Video Driver:

- i. **sudo modprobe uvcvideo [Enter]**

The Dynamic Calibration Tool is now installed and located under /usr/bin.

For example, to print tool version on screen:

**/usr/bin/Intel.Realsense.DynamicCalibrator -v [Enter]**

4

```
echo 'deb http://realsense-hw-public.s3.amazonaws.com/Debian/apt-repo xenial main' | sudo tee /etc/apt/sources.list.d/realsense-public.list
```

5

```
sudo apt-key adv --keyserver keys.gnupg.net --recv-key 6F3EFCDE
```

6

```
sudo apt-get update
```

7

```
sudo apt-get install librscaleibrationtool
```

8

```
cd /usr/share/doc/librscaleibrationtool/librealsense
```

9

```
sudo cp config/99-realsense-libusb.rules /etc/udev/rules.d/
sudo udevadm control --reload-rules && udevadm trigger
```

10

```
sudo apt-get install libssl-dev
sudo apt-get install socat
sudo ./scripts/patch-realsense-ubuntu-xenial.sh
```

11

```
sudo modprobe uvcvideo
```

# Dynamic Calibration on D400 Series Camera

# Dynamic Calibration

The Dynamic calibration can be classified into two categories

- **Targeted Dynamic Calibration (Depth Scale Calibration)** - Aligning the depth frame due to the changes in position of the optical elements.
- **Target-less Dynamic Calibration (Rectification Calibration) - BETA** – Aligning the epipolar line to enable the depth pipeline to work correctly and reduce the holes in the depth image.

Note: In the following section we will discuss both the target and target-less Dynamic Calibration for both Windows\* and Linux\* Systems

# Target Mode Dynamic Calibration



# Phone Target Set up – iOS\*

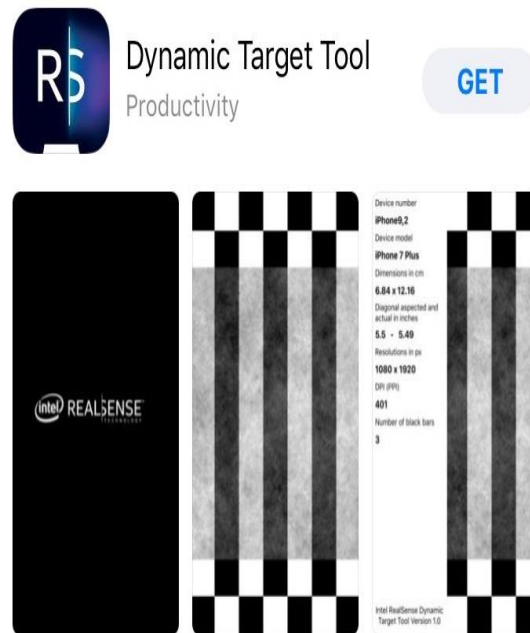
App full name: **Intel® RealSense™ Dynamic Target Tool**

App short name: **Dynamic Target Tool**

Apple Device Displays	Screen Physical Dimension Width x Height (cm)	Devices Validated
4"	4.99 x 8.85	iPhones 5, 5s
4.7"	5.88 x 10.46	iPhones 6, 6s, 7
5.5"	6.84 x 12.16	iPhone 6 plus, 6s plus, 7 plus

\*Make sure the dimensions of the target are correctly displayed on the phone screen. For Apple\* iOS\* devices, the Intel® RealSense™ Dynamic Target Tool application is available for iOS\* 10.0 and later.

- **Download and install Intel® RealSense™ Dynamic Target Tool from app store:**  
<https://itunes.apple.com/us/app/dynamic-target-tool/id1291448596>
- (Or) Search app store with keywords **"dynamic target tool"** or **"realsense"**.







# Phone Target Set up – Android\*

App full name: **Intel® RealSense™ Dynamic Target Tool**

App short name: **Dynamic Target Tool**

Phone	Display size (Inches)
Samsung* Galaxy Note 5	5.3
Samsung* Galaxy S7 Edge	5.5
Google* Nexus 5	5
LG* G4	5.5
Google* Nexus 6	5.7
Samsung* Galaxy S7	5.1
Samsung* Galaxy S8 plus	6.2

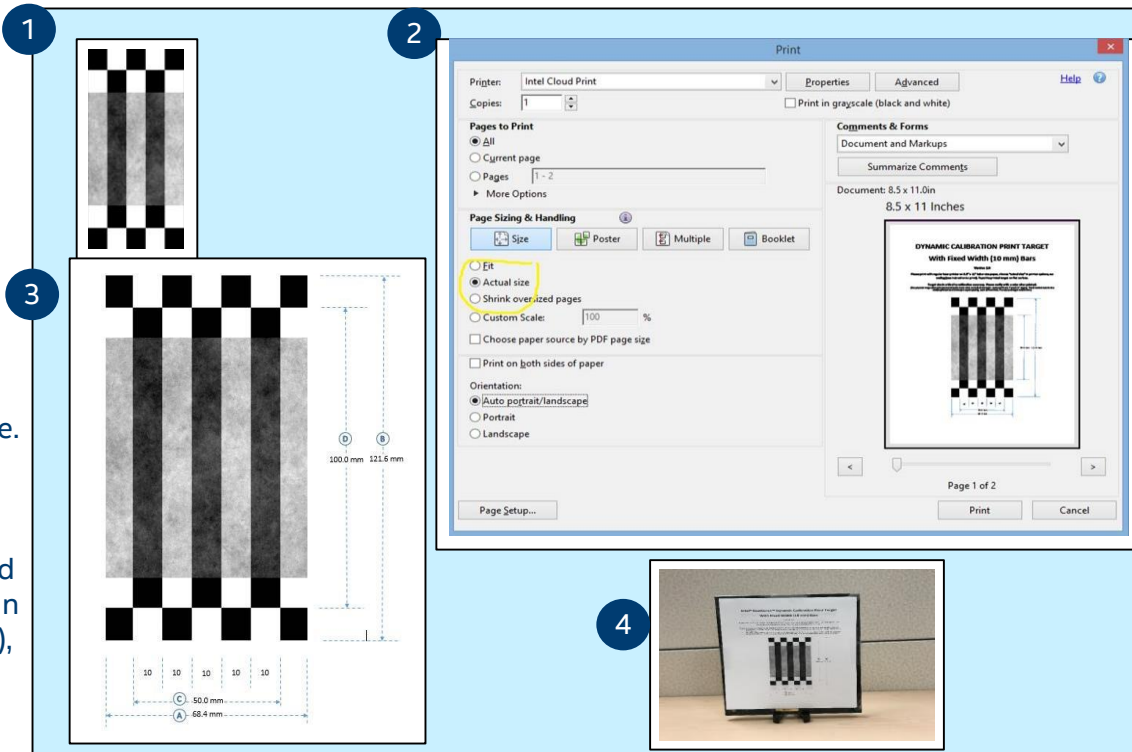
\*Make sure the dimensions of the target are correctly displayed on the phone screen.

- **Download and install Intel® RealSense™ Dynamic Target Tool from app store:**  
<https://play.google.com/store/apps/details?id=com.intel.realsenseviewer17613>
- (Or) Search app store with keywords "**dynamic target tool**" or "**realsense**".

# Printed Target Setup

## Steps

1. After Dynamic Calibration installation, printed target file is located in following locations:  
Windows:  
**(C:\CalibrationToolAPI\{Version Number}\target)**  
Ubuntu:  
**(/usr/share/doc/librscalibrationtool/target/)**
2. Print the image with a regular laser printer on 8.5" x 11" letter size paper, choose "Actual size" in printer options, no scaling.
3. After the target is printed, check the physical target image on the paper.  
The specific dimensions are marked around the image.  
**Target size** - overall image should be 68.4 mm wide (A) and 121.6 mm tall (B) (same size as iPhone 7 plus 5.5" display).  
**Bar size** - the 5 vertical bars in the middle (3 black and 2 white, in the order, black-white-black-white-black) in equal spacing each 10 mm wide, total 50 mm wide (C), and the vertical bar length is 100.0 mm (D).
4. Setup the printed target on a flat surface so the bars are vertical.

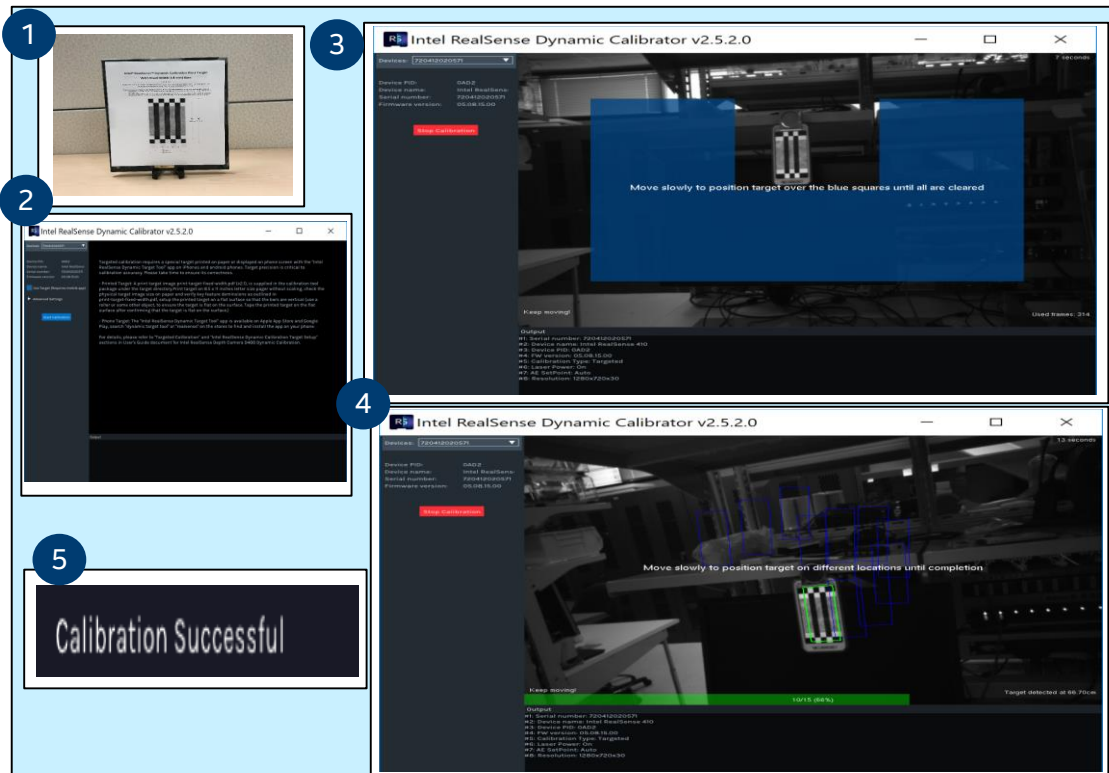




# Target Mode Dynamic Calibration on Windows\*

## Steps

1. Set up calibration target (i.e printed or phone target) on a flat surface, so the face of the camera is parallel to the target. Hold the camera at about 50-70 cm away from the target pointing to the target.
2. Connect the Intel® RealSense™ 400 Series Camera to the Windows\* system. Launch Dynamic Calibrator App From Windows\* to start calibration process. Make sure target is checked.
3. In the rectification phase, point the camera to the calibration target and move camera slowly to position target over the blue squares until all are cleared.
4. Scale calibration phase immediately begins after the rectification phase. After the green bar extends to full, scale calibration completes.
5. Final Calibration Result is displayed on the screen.



# Target Mode Dynamic Calibration on Ubuntu\*

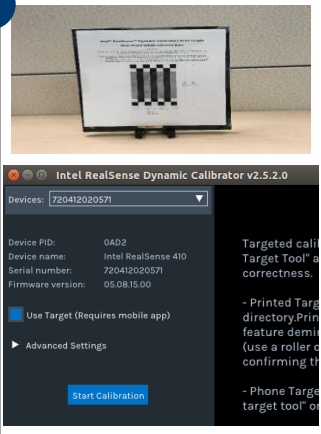
## Steps

1. Connect the Intel® RealSense™ 400 Series Camera to the Ubuntu\* system, and run the Intel Dynamic Calibration Tool:
  - i. Launch terminal pressing **CTRL+ALT+T**
  - ii. Type **Intel.RealSense.DynamicCalibrator** [Enter]
2. Set up the target and make sure the camera is enumerated on the tool displaying device information and target button is checked.
3. In the rectification phase, point the camera to the calibration target and move camera slowly to position target over the blue squares until all are cleared.
4. Scale calibration phase immediately begins after the rectification phase. After the green bar extends to full, scale calibration completes.
5. Final Calibration Result is displayed on the screen.

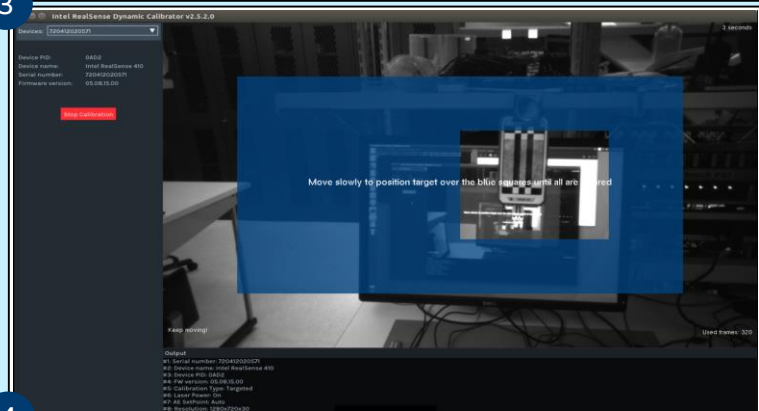
1

Intel.RealSense.Dynamic Calibrator

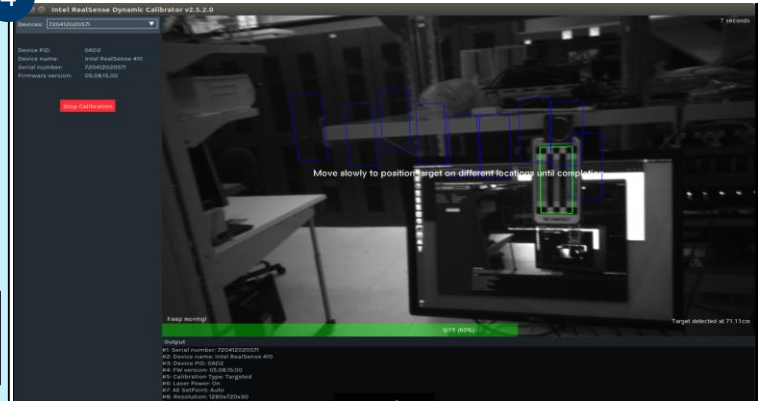
2



3



4



5

Calibration Successful

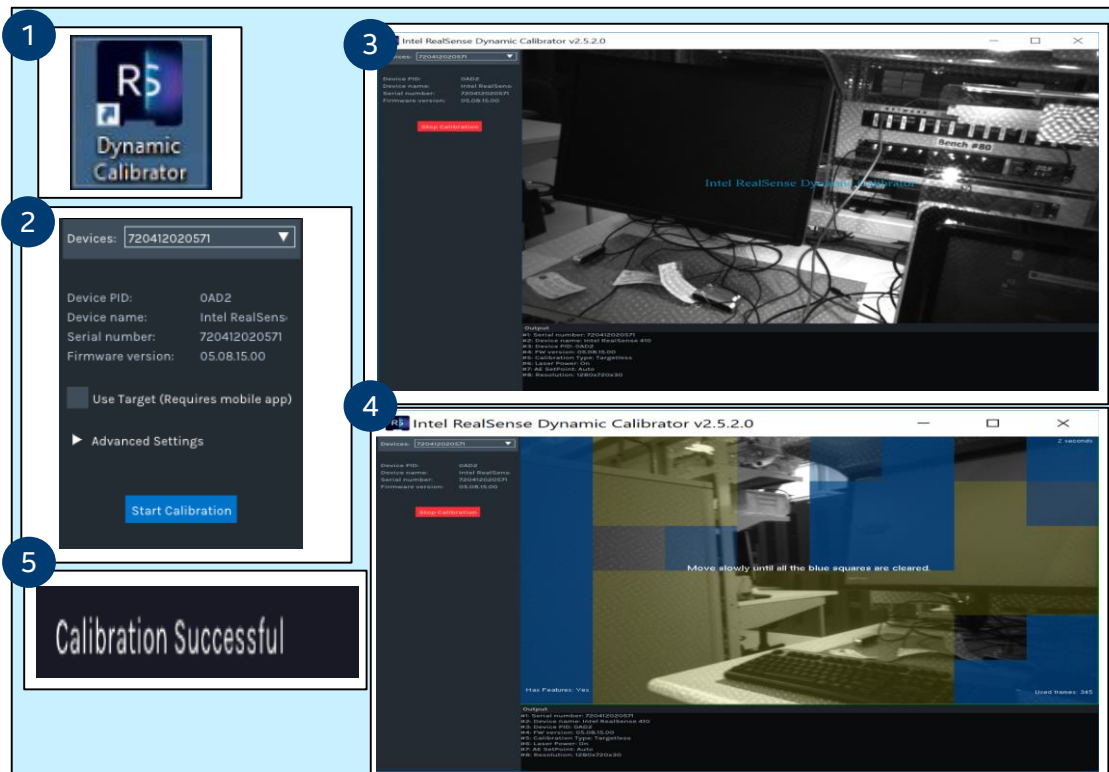
# Target-Less Mode Dynamic Calibration



# Target Less Mode Dynamic Calibration - Windows\*

## Steps

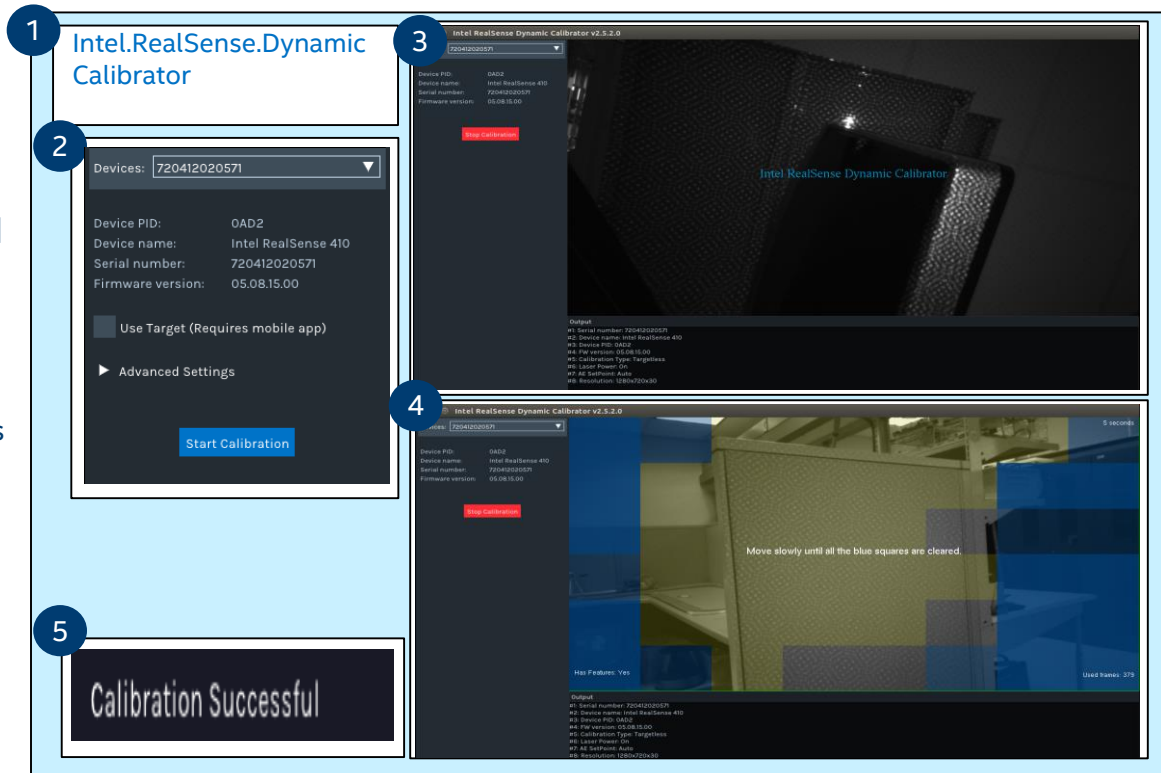
1. Connect the Intel® RealSense™ 400 Series Camera to the Windows\* System. Launch Dynamic Calibrator app from the Desktop.
2. Make sure the camera is enumerated on the tool window displaying device information and “Use Target” button is unchecked.
3. Click on Start Calibration and follow the instructions on the screen. Keep the camera steady until instruction on the screen ask to move the camera.
4. Move the camera very slowly around the room to eliminate the blue squares.
5. Final Calibration Result is displayed on the screen



# Target Less Mode Dynamic Calibration - Ubuntu\*

## Steps

1. Connect the Intel® RealSense™ 400 Series Camera to the Ubuntu\* system, and run the Intel Dynamic Calibration Tool:
  - i. Launch terminal pressing **CTRL+ALT+T**
  - ii. Type **Intel.RealSense.DynamicCalibrator** [Enter]
2. Make sure the camera is enumerated on the tool displaying device information and “Use Target” button is unchecked.
3. Click on Start Calibration and follow the instructions on the screen. Keep the camera steady until instruction on the screen ask to move the camera.
4. Move the camera very slowly around the room to eliminate the blue squares.
5. Final Calibration Result is displayed on the screen.



**1 Intel.RealSense.Dynamic Calibrator**

**2**

Devices: 720412020571

Device PID: 0AD2  
Device name: Intel RealSense 410  
Serial number: 720412020571  
Firmware version: 05.08.15.00

☐ Use Target (Requires mobile app)

▶ Advanced Settings

**Start Calibration**

**3**

Intel RealSense Dynamic Calibrator v2.5.2.0

Device PID: 0AD2  
Device name: Intel RealSense 410  
Serial number: 720412020571  
Firmware version: 05.08.15.00

**Use Calibration**

Output

#1 Serial number: 720412020571  
#2 Device name: Intel RealSense 410  
#3 Device PID: 0AD2  
#4 FW version: 05.08.15.00  
#5 Calibration Type: Targetless  
#6 Laser Power: On  
#7 AI SelfPower: Auto  
#8 Resolution: 1280x720x30

**4**

Intel RealSense Dynamic Calibrator v2.5.2.0

Device PID: 0AD2  
Device name: Intel RealSense 410  
Serial number: 720412020571  
Firmware version: 05.08.15.00

**Use Calibration**

Move slowly until all the blue squares are cleared.

Has Feature: Yes

Output

#1 Serial number: 720412020571  
#2 Device name: Intel RealSense 410  
#3 Device PID: 0AD2  
#4 FW version: 05.08.15.00  
#5 Calibration Type: Targetless  
#6 Laser Power: On  
#7 AI SelfPower: Auto  
#8 Resolution: 1280x720x30

**5**

**Calibration Successful**

