

# N-Trig touchscreen Driver

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This driver provides support for N-Trig pen and multi-touch sensors. Single and multi-touch events are translated to the appropriate protocols for the hid and input systems. Pen events are sufficiently hid compliant and are left to the hid core. The driver also provides additional filtering and utility functions accessible with sysfs and module parameters.

This driver has been reported to work properly with multiple N-Trig devices attached.

## Parameters

Note: values set at load time are global and will apply to all applicable devices. Adjusting parameters with sysfs will override the load time values, but only for that one device.

The following parameters are used to configure filters to reduce noise:

activate_slack	number of fingers to ignore before processing events
activation_height, activation_width	size threshold to activate immediately
min_height, min_width	size threshold below which fingers are ignored both to decide activation and during activity
deactivate_slack	the number of "no contact" frames to ignore before propagating the end of activity events

When the last finger is removed from the device, it sends a number of empty frames. By holding off on deactivation for a few frames we can tolerate false erroneous disconnects, where the sensor may mistakenly not detect a finger that is still present. Thus deactivate\_slack addresses problems where a users might see breaks in lines during drawing, or drop an object during a long drag.

## Additional sysfs items

These nodes just provide easy access to the ranges reported by the device.

sensor_logical_height, sensor_logical_width	the range for positions reported during activity
sensor_physical_height, sensor_physical_width	internal ranges not used for normal events but useful for tuning

All N-Trig devices with product id of 1 report events in the ranges of

- X: 0-9600
- Y: 0-7200

However not all of these devices have the same physical dimensions. Most seem to be 12" sensors (Dell Latitude XT and XT2 and the HP TX2), and at least one model (Dell Studio 17) has a 17" sensor. The ratio of physical to logical sizes is used to adjust the size based filter parameters.

## Filtering

With the release of the early multi-touch firmwares it became increasingly obvious that these sensors were prone to erroneous events. Users reported seeing both inappropriately dropped contact and ghosts, contacts reported where no finger was actually touching the screen.

Deactivation slack helps prevent dropped contact for single touch use, but does not address the problem of dropping one of more contacts while other contacts are still active. Drops in the multi-touch context require additional processing and should be handled in tandem with tacking.

As observed ghost contacts are similar to actual use of the sensor, but they seem to have different profiles. Ghost activity typically shows up as small short lived touches. As such, I assume that the longer the continuous stream of events the more likely those events are from a real contact, and that the larger the size of each contact the more likely it is real. Balancing the goals of preventing ghosts and accepting real events quickly (to minimize user observable latency), the filter accumulates confidence for incoming events until it hits thresholds and begins propagating. In the interest in minimizing stored state as well as the cost of operations to make a decision, I've kept that decision simple.

Time is measured in terms of the number of fingers reported, not frames since the probability of multiple simultaneous ghosts is expected to drop off dramatically with increasing numbers. Rather than accumulate weight as a function of size, I just use it as a binary threshold. A sufficiently large contact immediately overrides the waiting period and leads to activation.

Setting the activation size thresholds to large values will result in deciding primarily on activation slack. If you see longer lived ghosts, turning up the activation slack while reducing the size thresholds may suffice to eliminate the ghosts while keeping the screen quite responsive to firm taps.

Contacts continue to be filtered with min\_height and min\_width even after the initial activation filter is satisfied. The intent is to provide

a mechanism for filtering out ghosts in the form of an extra finger while you actually are using the screen. In practice this sort of ghost has been far less problematic or relatively rare and I've left the defaults set to 0 for both parameters, effectively turning off that filter.

I don't know what the optimal values are for these filters. If the defaults don't work for you, please play with the parameters. If you do find other values more comfortable, I would appreciate feedback.

The calibration of these devices does drift over time. If ghosts or contact dropping worsen and interfere with the normal usage of your device, try recalibrating it.

## Calibration

The N-Trig windows tools provide calibration and testing routines. Also an unofficial unsupported set of user space tools including a calibrator is available at: [http://code.launchpad.net/~rafi-seas/+junk/ntrig\\_calib](http://code.launchpad.net/~rafi-seas/+junk/ntrig_calib)

## Tracking

As of yet, all tested N-Trig firmwares do not track fingers. When multiple contacts are active they seem to be sorted primarily by Y position.