```c
/**
 * @file pid.c
 * @brief A PID implementation
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 */

#include "../include/pid.h"
#include <math.h>

void PID(PIDSettings *settings) {
        float error;
        float power;

        error = settings->target - (settings->sensor ?
                                    settings->sensor->averageVal :
                                    settings->root->sensor->averageVal);

        if (sgn(error) != sgn(settings->_error))
                settings->_integral = 0;
        settings->_integral  += error / (millis() - settings->_time);
        settings->_time       = millis();
        settings->_derivative = error - settings->_error;
        settings->_error      = error;

        power = clipNum(
          (settings->kP * error) +
          (settings->kI * ((settings->integralLimit == -1) ? settings->_integral :
                           clipNum(settings->_integral, settings->integralLimit,
                                   -settings->integralLimit))) +
          (settings->kD * settings->_derivative),
          settings->max,
          settings->min);
```

```
        if (!mutexTake(settings->root->_mutex, 5)) {
                return;
        }

        settings->root->power = round(power);
        mutexGive(settings->root->_mutex);

        if (abs((int)(error + .5)) <= settings->tolerance) {
                if (settings->_reached) {
                        if (millis() - settings->_reached >= settings->precision) {
                                settings->isTargetReached = true;
                        } else {
                                settings->isTargetReached = false;
                        }
                } else {
                        settings->_reached        = millis();
                        settings->isTargetReached = false;
                }
        } else if (!settings->_reached || settings->isTargetReached) {
                settings->_reached        = 0;
                settings->isTargetReached = false;
        }
} /* PID */
```