
Theia®
TECHNOLOGIES

# TL410 family
# 4K Resolution Day/Night lenses up to 1/1.7” sensors

- ✓ **Ultra high resolution for 4K cameras**, up to 12.4 megapixel
- ✓ Available in DC **auto-iris**, **P-iris,** and **manual iris** versions
- ✓ **Fully motorized versions**, or combinations with zoom, focus, iris, IR cut, limit switch; non-motorized versions also available
- ✓ IR corrected for true **Day/Night** cameras
- ✓ **Compact design** to fit into domes as small as 4” mini-dome size
- ✓ **CS-mount** and smooth **D25 board mount** options, as well as **C-mount**
- ✓ Used for sensor sizes 1/2.5”, 1/2.3”,1/ 2” 1/1.8”, and **up to 1/1.7”** (Sony IMX178, Sony IMX226 for example)

**SL/TL410 lens family specifications**

| | |
|---|---|
| Focal length | 4-10mm |
| Image circle | Ø9.4mm |
| Resolution | 12.4 megapixel |
| F/# | F/1.4 @ 4mm – F/2.4 @ 10mm to close |
| Focus Range | 0.5m to infinity |
| IR Correction | Day/Night |
| Lens length | < 64mm TTL |
| Back focal length | BFL 8.4mm (in air) |
| CRA | < 7° |
| Distortion | < 61% at 4mm, < 8% at 10mm |
| Relative illumination | >45% |
| Lens transmission | >80% |
| Weight | 69-78g (depending on version) |
| Operating temperature | -20C to 60C (<70% humidity, non-condensing) |
| Storage temperature | -30C to 70C (<90% humidity, non-condensing) |

**Field of view for sensor sizes**

| Sensor size | 1/1.7” | 1/1.8” | 1/1.8” 4K* | 1/2” | 1/2.3” | 1/2.5” |
|---|---|---|---|---|---|---|
| Horizontal | 112° - 44° | 110° - 43° | 110° - 43° | 93° - 37° | 90° - 36° | 83° - 33° |
| Vertical | 81° - 33° | 71° - 29° | 52° - 21° | 68° - 28° | 67° - 27° | 60° - 25° |
| Diagonal | 149° - 55° | 139° - 52° | 126° - 48° | 120° - 46° | 117° - 45° | 106° - 42° |

*4K format = 4000 x 2000 pixels

www.TheiaTech.com

**Lens designation**

**xx410x xx -xx**

CS: CS mount
25: smooth Ø25mm mount

TL: motorized
SL: non-motorized
ML: C mount

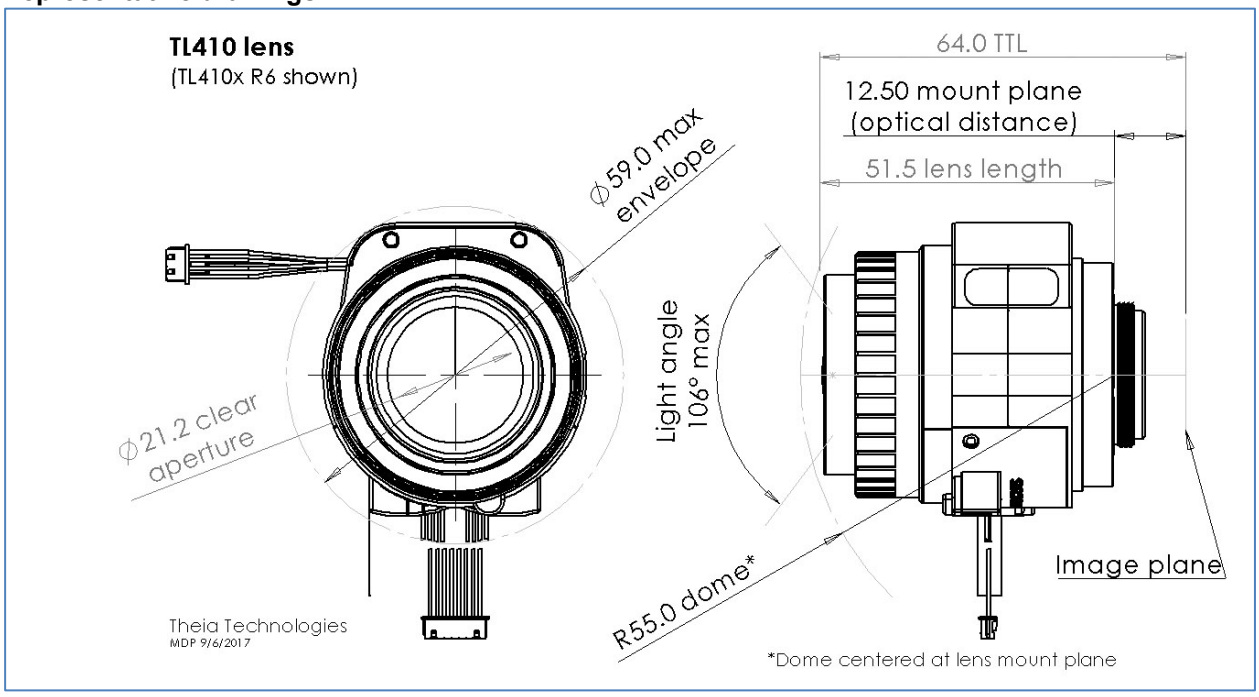
A: autoiris
P: P-iris
M: manual iris

R3: motorized zoom, focus, iris
R4: motorized zoom, focus, iris, IRC
R5: motorized zoom, focus, iris, with limit switch for zoom, focus limits
R6: motorized zoom, focus, iris, IRC, with limit switch for zoom, focus limits

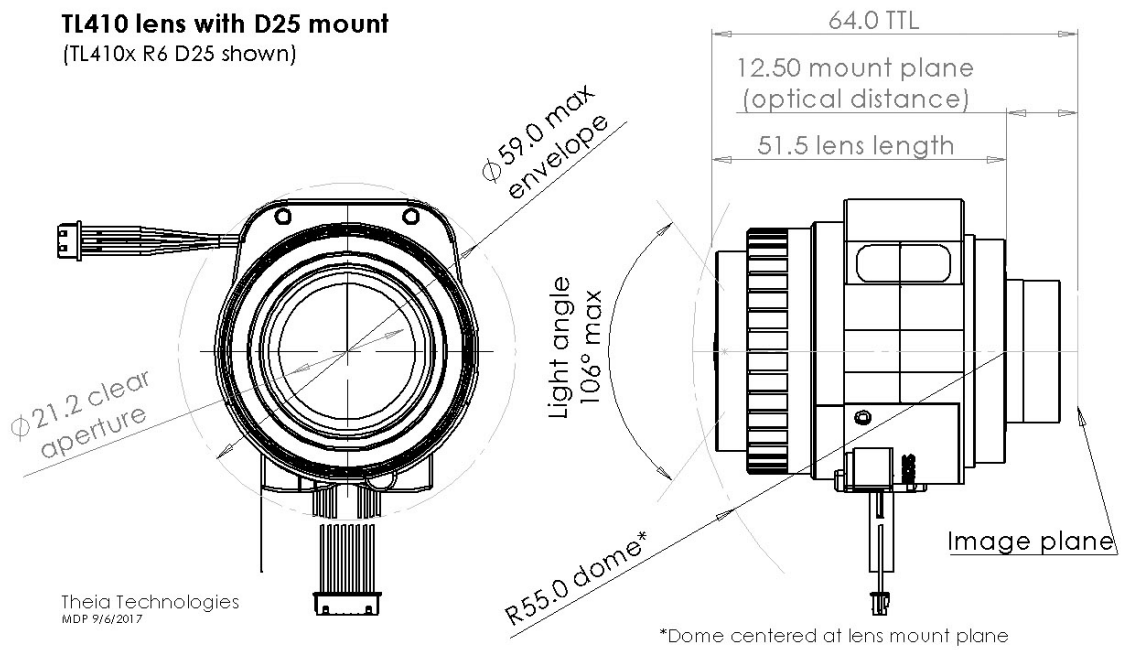
**Production versions:** (call for other versions)
SL410M (manual lens, manual iris, CS mount)
SL410A (manual lens, DC autoiris, CS mount)
SL410P (manual lens, P-iris, CS mount)
ML410M (manual lens, manual iris, C mount)
TL410A R6-CS (fully motorized, DC autoiris lens)
TL410P R6-CS (fully motorized, P-iris lens)
TL410P R6-25 (fully motorized, P-iris, D25 mount)

Other versions are available by special request and may be added to regular production

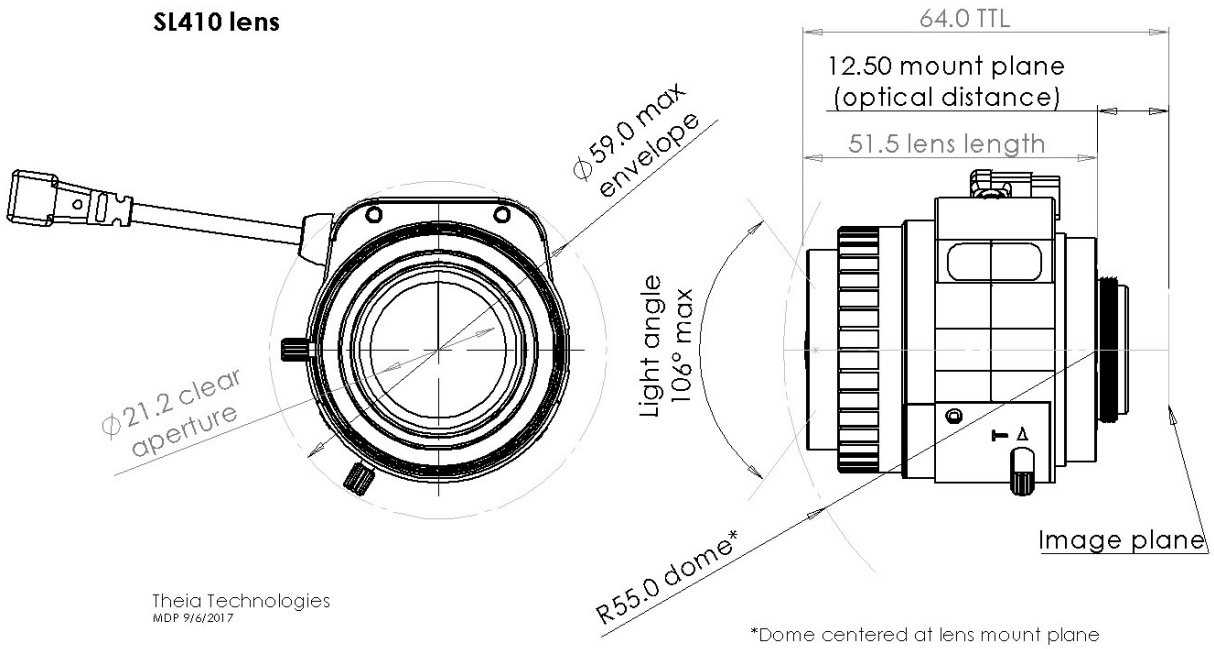
**Representative drawings**



**TL410 lens with D25 mount**
(TL410x R6 D25 shown)

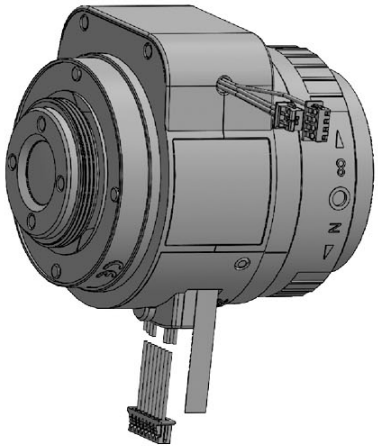



**SL410 lens**

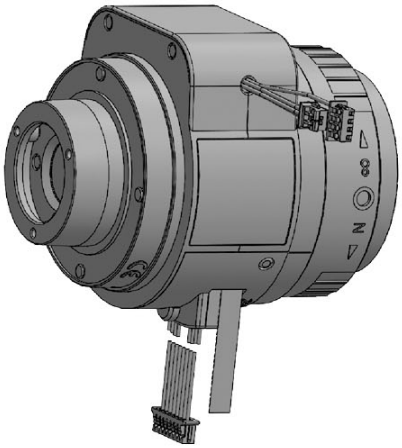


**Pictures of some of the versions**

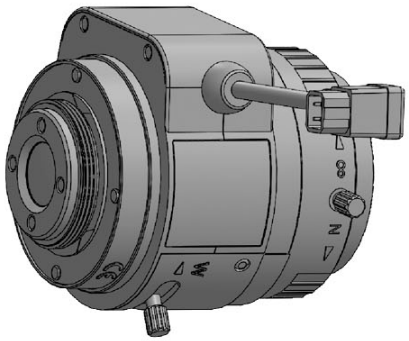
TL410x R6



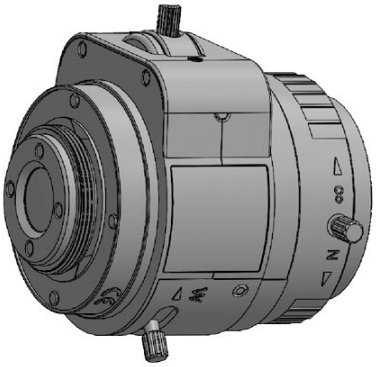
TL410x R6 D25



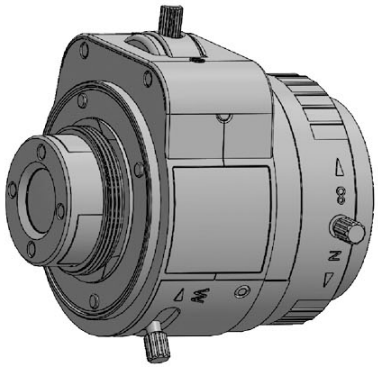
SL410x



SL410M



ML410M



## Zoom/Focus motor specifications

Applicable models: TL410Axx, TL410Pxx

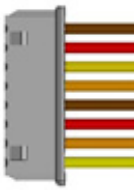
| | |
|---|---|
| Drive | Stepper motor<br>2 phase bipolar drive |
| Operation voltage | 3.3V (operating range 2.6~4.8V) |
| Maximum continuous operation time (seconds) for operation voltage and ambient temperature* | |
| Coil resistance | 28.5Ω (±7%) |
| Gear ratio | 1:2025 |
| Zoom number of steps | 4073 steps between hard stops |
| Zoom speed range | 600pps to 1000pps |
| Zoom cam rotation | 85° |
| Focus number of steps | 9354 steps between hard stops |
| Focus speed range | 600pps to 1000pps |
| Focus cam rotation | 196° |
| Focus/zoom connectors | Housing: Molex 51021-0800<br>Terminal: Molex 50058-8000 |
| Cable length | 150mm |

| | 3.3V | 4.0V | 4.8V |
|---|---|---|---|
| 20C | 200s | 90s | 50s |
| 40C | 100s | 60s | 30s |
| 60C | 40s | 30s | 15s |

Zoom: Wide -> Tele
Focus: Near -> ∞

| Step | A+ | A- | B+ | B- |
|---|---|---|---|---|
| 0 | H | L | H | L |
| 1 | L | H | H | L |
| 2 | L | H | L | H |
| 3 | H | L | L | H |

| Pin | Color | Function | Motor |
|---|---|---|---|
| 1 | Brown | A+ | Focus |
| 2 | Red | A- | Focus |
| 3 | Yellow | B+ | Focus |
| 4 | Gray/Orange | B- | Focus |
| 5 | Brown | A+ | Zoom |
| 6 | Red | A- | Zoom |
| 7 | Gray/Orange | B+ | Zoom |
| 8 | Yellow | B- | Zoom |

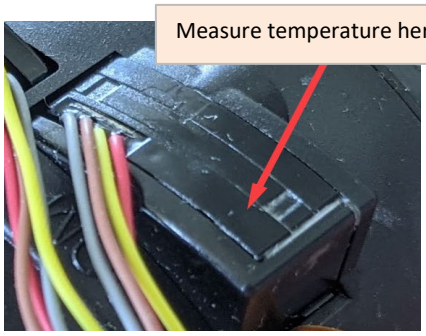


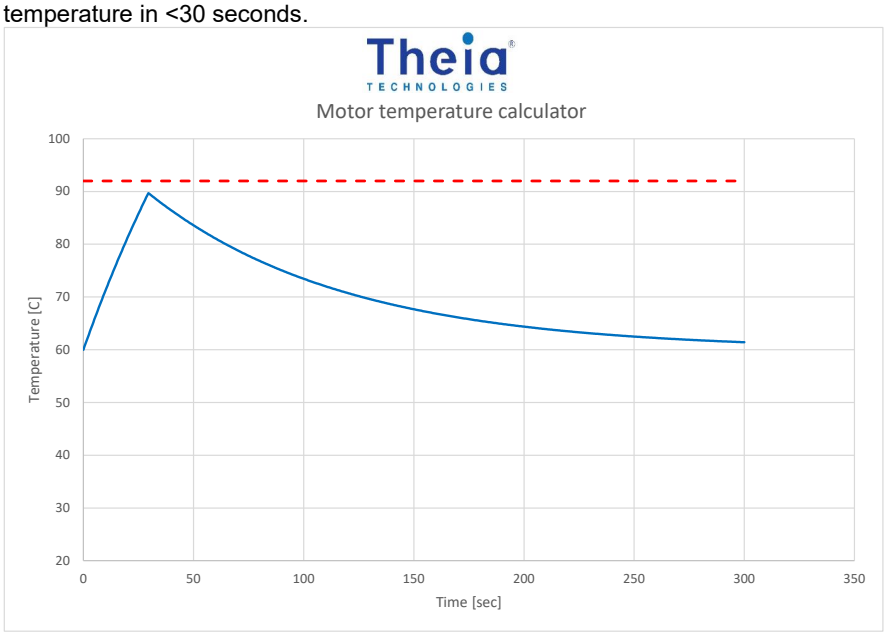
*Do not let motor temperature exceed 92°C.

Theia's motor temperature calculator can be used to estimate the focus and zoom motor temperatures after a set number of run/ cool down cycles. This can be downloaded from Theia's website (see the QR code below).

Motors require 5 minutes to cool down completely to ambient temperature.

The example below shows 60C ambient and 4V motor driven at 1000pps. Motors reach maximum temperature in <30 seconds and should be allowed to cool down. If the motor is run again before complete cool down it will reach maximum temperature in <30 seconds.



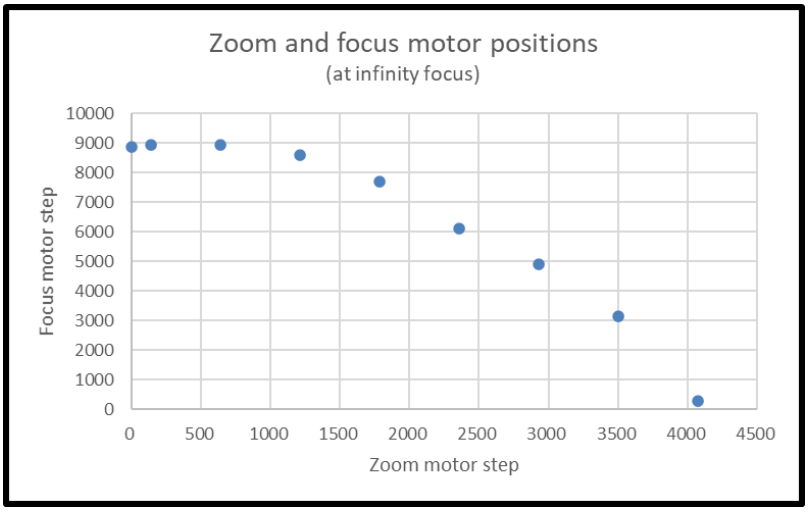

Motor temperature calculator
bit.ly/motorTemp

Zoom/Focus motor step map (at infinite focus position). PI positions only available with -R5 and -R6 lenses.

| ***Zoom motor*** | | ***Focus motor*** | |
|---|---|---|---|
| *Note* | *Step* | *Note* | *Step* |
| Hard stop (wide) | 4073 | Hard stop (far) | 9353 |
| Wide design position | 4073 | Far focus design | 8771 |
| PI position | 154 | PI position | 8652 |
| Tele design position | 0 | Near focus design | 188 |
| Hard stop (tele) | 0 | Hard stop (near) | 0 |

Zoom/Focus synchronizing map (observe min/max motor speeds)

| ***Focal length*** | ***Zoom motor note*** | ***Zoom motor step number*** | ***Focus ring note*** | ***Focus motor step number*** |
|---|---|---|---|---|
| *[mm]* | | *[#]* | | *[#]* |
| 4.15 | Wide end | 4073 | | 288 |
| 4.96 | | 3501 | | 3149 |
| 5.77 | | 2929 | | 4892 |
| 6.58 | | 2356 | | 6125 |
| 7.39 | | 1784 | | 7687 |
| 8.19 | | 1212 | | 8599 |
| 9.00 | | 640 | | 8960 |
| 9.70 | | 139 | | 8931 |
| 9.90 | Tele end | 0 | | 8871 |




**Notes:**
1. Zoom and focus **motor positions may be affected** by backlash and lost steps during movement. Zoom motor lost steps are tested to <45 over the full 3934 step range. Focus motor lost steps are tested to <30 over the full 8464 step range.

2. These motorized lenses are intended for integration into cameras and require motor drivers and controllers. Typically, Theia works with the camera manufacturer to ensure that the camera motor controller matches the lens. It is possible to supply your own motor controller, but Theia cannot guarantee that your motor controller will not damage the lens. Theia does not offer any warranty on the suitability of these motorized lenses for any particular camera. These motorized lenses are **not intended for continuous use** of the motors as in PTZ applications. Theia offers motor control boards that are suitable to control motorized lenses with P-iris.

## DC auto-iris motor specifications

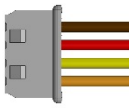
Applicable models: SL410A, TL410Axx

| | |
|---|---|
| Drive | DC |
| Operation voltage | 3V (2.5~5.0V) |
| Max current consumption | 22mA |
| Drive coil resistance | 190Ω |
| Damper coil resistance | 855Ω |

Connector type 1 (Molex)
Applicable models **TL410A R4, TL410A R6**

| | |
|---|---|
| Connector type | Housing: Molex 51021-0400<br>Terminal: Molex 50058-8000 |
| Cable length | 150mm |

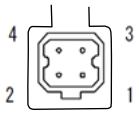
| Pin | Color | Function |
|---|---|---|
| 1 | Brown | Control - |
| 2 | Red | Control + |
| 3 | Yellow | Drive + |
| 4 | Orange | Drive - |



Connector type 2 (CCTV)
Applicable models **SL410A, TL410A R3, TL410A R5**

| | |
|---|---|
| Connector type | Housing: EYC 221 |
| Cable length | 300mm |

| Pin | Function |
|---|---|
| 1 | Control - |
| 2 | Control + |
| 3 | Drive + |
| 4 | Drive - |



## P-iris motor specifications

Applicable models: SL410P, TL410Pxx

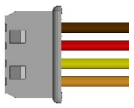
| | |
|---|---|
| Drive | Stepper motor<br>2 phase bipolar drive |
| Operating voltage | 4V (+/-1) |
| Number of steps | 75 |
| Basic step angle | 18° |
| Maximum response freq. | 200 pps |
| Coil resistance | 30Ω (each phase) |

| P-iris: open->close | | | | |
|---|---|---|---|---|
| Step | A+ | A- | B+ | B- |
| 0 | H | L | H | L |
| 1 | L | H | H | L |
| 2 | L | H | L | H |
| 3 | H | L | L | H |

Connector type 1 (Molex)
Applicable models **TL410P R4, TL410P R6**

| | |
|---|---|
| Connector type | Housing: Molex 51021-0400<br>Terminal: Molex 50058-8000 |
| Cable length | 150mm |

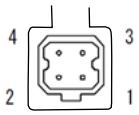
| Pin | Color | Function |
|---|---|---|
| 1 | Brown | B+ |
| 2 | Red | B- |
| 3 | Yellow | A+ |
| 4 | Orange | A- |



Connector type 2 (CCTV)
Applicable models **SL410P, TL410P R3, TL410P R5**

| | |
|---|---|
| Connector type | Housing: EYC 221 |
| Cable length | 300mm |

| Pin | Function |
|---|---|
| 1 | B+ |
| 2 | A+ |
| 3 | A- |
| 4 | B- |




## P-iris motor map

| Step | Aperture Size [mm2] | F/# |
|---|---|---|
| 1 | 65.0 | 1.43 (open) |
| 5 | 65.0 | 1.43 (open) |
| 10 | 65.0 | 1.43 (open) |
| 15 | 65.0 | 1.43 (open) |
| 19 | 65.0 | 1.43 (open) |
| 20 | 63.4 | 1.50 |
| 25 | 54.0 | 1.63 |
| 30 | 44.9 | 1.78 |
| 35 | 36.0 | 1.98 |

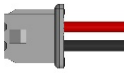
| Step | Aperture Size [mm2] | F/# |
|---|---|---|
| 40 | 27.7 | 2.26 |
| 45 | 20.0 | 2.65 |
| 50 | 13.2 | 3.26 |
| 55 | 7.5 | 4.34 |
| 60 | 3.1 | 6.71 |
| 65 | 0.8 | 12.86 |
| 70 | 0.1 | 46.06 |
| 72 | 0.0 | Closed |
| 75 | 0.0 | Closed |

## IR Cut specifications

Applicable models: TL410A R4, TL410P R4, TL410A R6, TL410P R6

| Electrical specifications | |
|---|---|
| Drive | DC |
| Operating voltage | 4V |
| Drive coil resistance | 130Ω |
| Connector type | Housing: Molex 51021-0200<br>Terminal: Molex 50058-8000 |
| Cable length | 150mm |
| **Optical specifications for IR filter (Day)** | |
| Cut-on wavelength | 405nm ±10nm |
| Visible transmission | 430-610nm |
| Cut-off wavelength | 650nm ±10nm |
| IR transmission | <5% max 700-1000nm<br><10% ave 1000-1100nm |
| **Optical specifications for clear filter (Night)** | |
| Visible transmission | 400-1050nm |

| Mode | Pin 1 | Pin 2 |
|---|---|---|
| Day (IR filter) | L | H |
| Night (clear filter) | H | L |
| Wire color | Red | Black |



## Zoom/Focus limit switch

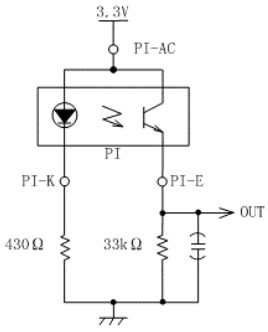
Applicable models: TL410A R5, TL410P R5, TL410A R6, TL410P R6

| | |
|---|---|
| Type | Photo interrupter phototransistor |
| Part model | Sharp GP1S396HCPSF |
| Operating voltage | 3.3V |
| Output level | >2.2V HIGH<br><0.6V LOW |
| Connector type | FPC cable |
| Board-side mating connector type (not supplied) | Molex 52746-0671<br>Molex 52745-0697<br>Molex 52559-0652 |
| Cable length | 150mm |

| Pin* | Function | Motor |
|---|---|---|
| 1 | Emitter | Focus |
| 2 | Anode/Collector | Focus |
| 3 | Cathode | Focus |
| 4 | Emitter | Zoom |
| 5 | Anode/Collector | Zoom |
| 6 | Cathode | Zoom |


*cable side pin designation matches Molex 52746-0671 bottom side contacts connector

Recommended circuit for each photo interrupter




**For more information contact**
**Theia Technologies**

info@TheiaTech.com
www.TheiaTech.com
+1-503-570-3296

## Revisions

| Version | Change | Reason |
|---|---|---|
| 160104 | Changed IR cut pin-out | Changed to match industry standard |
| | Updated focus/zoom map | Due to changed focus cam design |
| 160108 | Added focus photo interrupter trigger point | Missing from spec |
| 160112 | Swapped 2 focus motor pins | Motor phases did not match stepper sequence direction |
| 160113 | Added motor energizing time maximums | Clarification to prevent focus/zoom motor overheating |
| | Updated temperature spec | Consistent with motor supplier specification |
| | Updated weight | Missing from spec |
| | Updated IR filter transmission specs | |
| 160128 | Swapped focus motor pin 3-4 functions | Not updated correctly when motor direction was reversed |
| 161107 | Added applicable model numbers to iris section | Available iris connectors was confusing |
| 170109 | Changed PI FPC pin-outs | To match bottom side contacts connector; top side contacts connector may be discontinued |
| 170905 | Corrected focus ring rotation amount | Older version, pre-focus improvement number |
| | Updated drawings | Added additional version drawings, corrected 2x 4-pin connectors for zoom/focus. |
| 180117 | Corrected FPC pinout | Pinout numbering was reversed |
| 181206 | Updated motor speed specs | Focus/zoom recommended speed unspecified, P-iris speed too high |
| | Added QR code | Directed to TL410 webpage |
| 190730 | Typo correction | Lens designation ended midsentence |
| 190924 | Zoom/Focus motor map | Changed map and tables to be more clear |
| 200304 | Added page number and rev | Revision control |
| | Added Z/F motor step note | Motor position accuracy not previously specified |
| | Updated motor speed spec | Focus/zoom recommended speed too high, adjusted to tested range |
| 200327 | Added motor cool down graph | New information |
| | Highlighted model numbers | Clarify which specification sections apply to which lens family members |
| 201013 | Changed focus/zoom tracking curve tables and chart | Inconsistent sign/motor direction values between tables and charts |
| 210407 | Changed motor run time limits | Motor temperature testing and modeling |
| 210429 | Updated lens picture | Prototype lens was shown |
| | Changed file name | Website SEO optimization |