



# MIRcat-QT™

## RAPID-SCAN, ULTRA-BROADLY TUNABLE MID-IR CW/PULSED LASER SYSTEM

Demanding Mid-IR spectroscopy applications such as nanoscale and microscale chemical imaging benefit greatly from rapid, high-SNR data acquisition. Until now, mid-IR laser sources required compromises in beam quality and wavelength fidelity to achieve high scan speeds. With the introduction of the new MIRcat-QT, you can now have superior beam quality, wavelength fidelity, and fast continuous scanning ( $>1,000 \text{ cm}^{-1}$  at 10 Hz) all in one ultra-broadly tunable, CW/pulsed mid-IR laser.

Incorporating the next generation of Daylight's field-proven Quantum Cascade Laser (QCL) technology, MIRcat-QT delivers uncompromised performance in application-critical areas. This includes peak tuning speeds to  $>30,000 \text{ cm}^{-1}/\text{s}$ , tuning ranges to  $>1,000 \text{ cm}^{-1}$ , CW RIN as low as  $-140 \text{ dBc}/\text{Hz}$ , peak power output up to  $1 \text{ W}^{[2]}$ , average power output up to  $0.5 \text{ W}$ , and wavelength repeatability as high as  $<0.1 \text{ cm}^{-1 [1,2]}$ . In addition, MIRcat-QT provides a single  $\text{TEM}_{00}$  output beam, which enables high-efficiency fiber coupling.

MIRcat-QT's flexible, modular design allows users to factory-configure their system for up to four pulsed or CW/pulsed modules, upgrade it later, or add a visible aiming beam<sup>6</sup>. With Daylight's proprietary HFQD™ (High-Fidelity QCL Drive) circuitry, your QCL chips are protected. With a GUI and SDK command set included as standard, MIRcat-QT users can control wavelength set-points, scans, power, triggering, pulse width, duty cycle, and repetition rate in pulsed operation. MIRcat-QT brings new capabilities and agility to a wide range of molecular sensing applications including: process and quality control, remote sensing, imaging, and spectroscopy. Please contact us today to learn how MIRcat-QT, and our highly experienced team, can help you.

# FOR SPECTROSCOPY AT SPEED, WITHOUT COMPROMISE.

## HIGHLIGHTS

- Tuning sweeps @ 10 Hz (>1,000  $\text{cm}^{-1}$  in < 100 ms)
- Pulsed AND CW operation modes
- Low relative intensity noise (RIN)
- Pulse repetition rates up to 3 MHz
- Pulse widths down to 40 ns

## MIRcat-QT SPECIFICATIONS

### PERFORMANCE SPECIFICATIONS<sup>1</sup>

Wavelength Availability	Module options covering from <4 $\mu\text{m}$ to >13 $\mu\text{m}$
Modes of Operation	Pulsed or CW <sup>2</sup>
Available Configurations	Select 1, 2, 3, or 4 laser modules
Example Configurations	MIRcat-2400-PX-A (Pulsed, 6.5—12.4 $\mu\text{m}$ ) <sup>3</sup> MIRcat-2400-PX-B (Pulsed, 5.5—11 $\mu\text{m}$ ) <sup>3</sup> MIRcat-2400-PCX-B (CW/Pulsed, 6—11 $\mu\text{m}$ ) <sup>3</sup>
Tuning Modes	Set $\lambda$ , Step & Measure, Continuous Scans
Max. Tuning Speed (Step)	250 ms step-and-settle time to arbitrary $\lambda$
Max. Tuning Speed (Scan)	Peak velocity to >30,000 $\text{cm}^{-1}/\text{s}$
Wavelength Accuracy	$\leq 1 \text{ cm}^{-1}$
Average Power Stability	< 3% (1 hr)
Spatial Mode	TEM <sub>00</sub> (nominal)
Beam Divergence	< 4 mrad at 4 $\mu\text{m}$ (full angle, $1/e^2$ intensity width) <sup>2,5</sup>
Beam Pointing Stability	< 2 mrad (beam centroid change) <sup>2</sup>
Spot Size	< 2.5 mm ( $1/e^2$ intensity radius) <sup>5</sup>
Polarization	Linear, vertical, >100:1

### PULSED OPERATION

Peak Power	50 to 800 mW (depends on module) <sup>3</sup>
Energy Stability	< 3%, standard deviation
Linewidth	$\leq 1 \text{ cm}^{-1}$ (FWHM)
Pulse Width <sup>7</sup>	40 to 1 $\mu\text{s}$ , 20-ns increments
Repetition Rate <sup>7</sup>	0.1 kHz to 3 MHz, 0.1 kHz increments
Maximum Duty Cycle <sup>7</sup>	20% (custom up to 30%)

### CW OPERATION

CW Average Power	100 to 450mW (depends on module) <sup>3</sup>
Linewidth	$\leq 100 \text{ MHz}$ (FWHM, over 1s) <sup>8</sup>

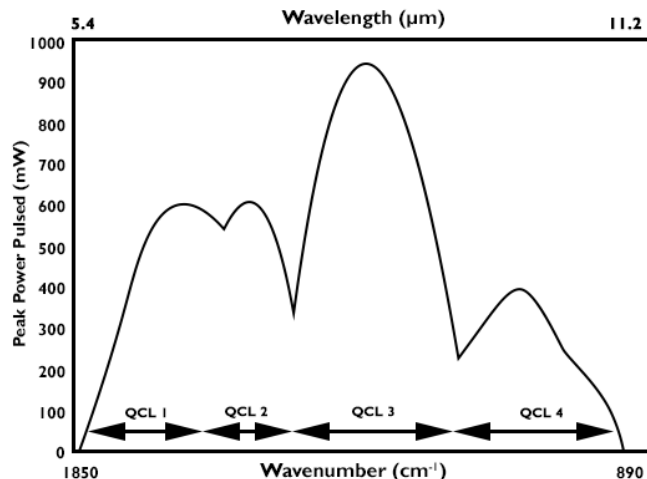
### OTHER PARAMETERS

Triggering (Pulsed)	Internal/external, external pulse input
Triggering (Scans)	External wavelength step, scan start
External Control Interface <sup>9</sup>	USB 2.0
Temperature Range (°C)	15 to 30 °C (operating)
Humidity	0—80% RH, non-condensing
Cooling	Passive Air (pulsed, up to 5% duty cycle) Water (CW, fast scans, or >5% duty cycle pulsed)
Power Requirements	$\leq 2 \text{ A}$ , 90 to 264VAC, 47 to 63Hz, single phase
Dimensions (L x W x H)	17.9 x 9.8 x 6.3 in. (45.5 x 24.9 x 16 cm)

COMPLIES WITH 21 CFR 1040.10 AND 1040.11 EXCEPT FOR DEVIATIONS PURSUANT TO LASER NOTICE NO. 50, DATED JUNE 24, 2007. COMPLIES WITH IEC 60825-01

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## HIGH-SPEED TUNING



Tune > 1,000  $\text{cm}^{-1}$  in 100 ms  
(example tuning curve for MIRcat-2400-PX-B configuration shown)

### UPGRADE OPTIONS

OPTIONS	DESCRIPTION
ZeroPoint™ Technology	Superb beam pointing (< 100 $\mu\text{rad}$ across the entire tuning range)
Red Aiming Beam	Provides visible ('red', Class 1) aiming beam co-boresighted with mid-IR beams

<sup>1</sup> All specifications are: subject to change without notice; defined at the tuning peak of each gain module; after a 10-min warm-up; at the factory-recommended operating current.

<sup>2</sup> Depends on chip(s) selected. CW requires CW-capable chip. Specifications to be agreed at time of order.

<sup>3</sup> Typical value. To request a specified value, please inquire.

<sup>4</sup> Fastest inter-module switching speeds may require water cooling—please inquire.

<sup>5</sup> Specification scales with wavelength—please inquire.

<sup>6</sup> Requires return to factory.

<sup>7</sup> Some chips can support pulses up to 1  $\mu\text{s}$ , PRF up to 3 MHz, and duty cycles up to 30%—please inquire.

<sup>8</sup> If laser is tuned for single longitudinal mode operation.

<sup>9</sup> GUI compatible with Windows<sup>®</sup> 10. Please inquire for other OS.

<sup>10</sup> Does not include acceleration and deceleration time.

INVISIBLE LASER RADIATION  
AVOID EXPOSURE TO THE BEAM  
CLASS 3B LASER PRODUCT



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# ZERO POINTING FOR PRECISION TARGETING

## APPLICATIONS

- Nanoscale Imaging
- Photothermal Imaging
- Stand-Off Detection
- Point Scanning Microscopy
- Fiber Optic Coupling
- Wide-field Imaging

## MIRCAT-QT-Z SPECIFICATIONS

### RELATIVE POINTING

Maximum relative beam pointing across specified wavelength range:  $< \pm 100 \mu\text{rad}$  using the specified calibration procedure:

Relative pointing for each wavelength is calculated by measuring the average centroid beam position at the specified wavelength at the focal plane of a one meter spherical mirror using a 'step-and-measure' tuning mode and at fixed ambient temperature (23°C).

Relative pointing measurements are reported with respect to the median pointing angle computed for all beams across all wavelengths.

ZeroPoint factory calibration and specifications apply only to: 23°C; laboratory conditions; 'step-and-measure' tuning; wavelength sweep scans up to 1-Hz.<sup>1,2</sup>

### CONFIGURATION OPTIONS

MIRCAT-QT-Z Configurations	Number of channels
MIRCAT-QT-Z-2100	1
MIRCAT-QT-Z-2200	2
MIRCAT-QT-Z-2300	3
MIRCAT-QT-Z-2400	4

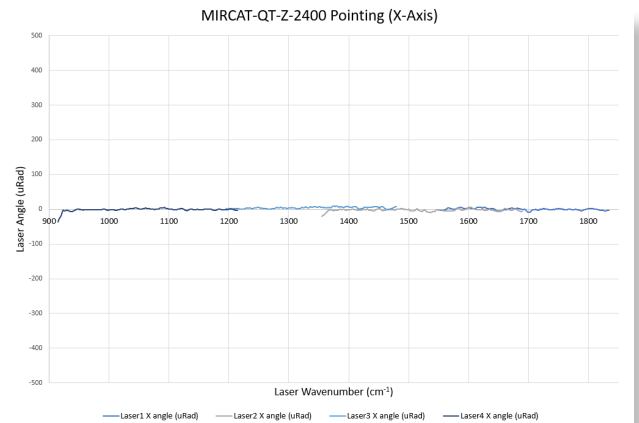
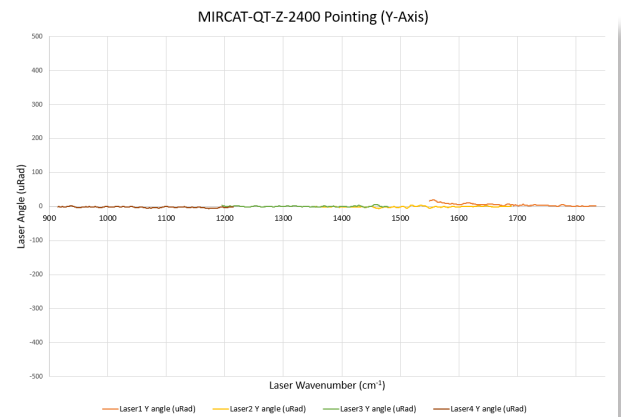
### POINTING REPEATABILITY

Pointing repeatability better than 50  $\mu\text{rad}$

Notes:

<sup>1</sup>Operation under different conditions (e.g. temperature, faster sweep scan rates, environment) may require user re-calibration

<sup>2</sup>GUI (included) allows the user to upload unique pointing correction tables for user specified laser operating conditions. The creation of unique correction tables will require an IR beam pointing measurement system.



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