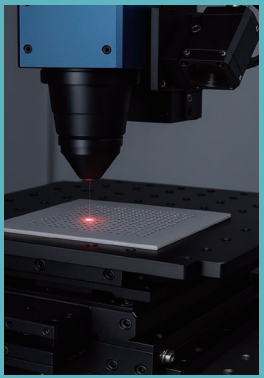
MOL

Optical & Laser Technologies

モル株式会社
MOL Solutions Inc.
www.mol-solutions.com

DROPTICAL







About MOL Solutions

Advancing precision manufacturing with optics and lasers

Headquartered in Tokyo, MOL Solutions specializes in optical metrology, laser inspection and precision laser processing. Combining R&D resources in Japan and Europe, we bring high-speed imaging, 3D metrology and laser micromachining to semiconductor, optoelectronic and advanced-material production, improving process precision, yield and productivity.

In Japan, we advance high-speed precision laser processing and metrology for through-glass vias (TGVs), wafer edge trimming, high-aspect-ratio microdrilling, wafer thickness and surface/subsurface defect inspection. With research institutes and industry partners, we translate R&D validation into production applications.

Our German R&D team focuses on high-speed close-range optical imaging, droplet analysis and laser surface microstructuring. Droptical combines optics, fluid dynamics and real-time data processing to convert droplet volume, velocity, direction, satellites and nozzle residue into measurable, traceable data for process control.

From R&D and process calibration to production monitoring, MOL Solutions combines precision metrology, multidisciplinary integration and intelligent control to deliver stable, transparent and efficient manufacturing.

MOL Metrology & Inspection Solutions

From droplet imaging and metrology to closed-loop control and rapid line-side calibration, select the solution for your deployment.

01 Core Droplet Inspection Technology 04-09
Droplet visualization and metrology
Single-drop imaging, 7 key metrics and real-time process feedback

02 NanoStrobeX 10-15
Real-time inline monitoring
Per-drop data, defect detection, trends, closed-loop control and cleaning

03 UltiStrobe 16-19
Laboratory / stationary 3D observation
Flexible optics, 3D analysis, virtual video and nozzle health monitoring

04 NeoScale 20-22
Rapid line-side calibration
Dual-view, non-contact measurement of 7 metrics in hundreds of milliseconds

05 Solution Selection 23
Solution deployment guide
Deployment comparison and integration assessment



MOL Solutions Droplet Inspection Technology

Droplet Metrology — **Real-Time Feedback** — **Non-Contact**

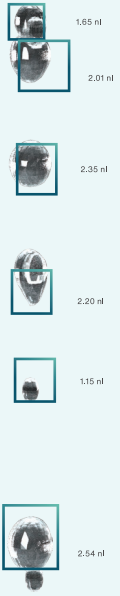


Make every droplet measurable, traceable and actionable.

From droplet formation and flight to satellites and nozzle residue, Droptical uses high-speed close-range imaging to turn subtle changes into real-time data, helping R&D, process and quality teams identify causes, tune parameters and verify results faster.

From Optical Imaging to Process Decisions

We combine optics, fluid dynamics and real-time processing to turn droplet volume, shape, velocity, direction and nozzle condition into actionable data for equipment setup and quality decisions, beyond periodic sampling.



01 Precise 3D Droplet Analysis

3D monitoring precisely measures dispensed volume, detects otherwise obscured satellite droplets, analyzes flight direction and predicts the landing position.

02 Nozzle Monitoring

Nozzle residue can alter droplet direction or volume and affect dispensing quality. Real-time nozzle monitoring enables cleaning when needed, reducing downtime and scrap.

03 Intuitive Web-GUI Control

The MOL AnalysisUnit's built-in web server supports process setup, acceptance criteria, statistics, GPIO and database connectivity. Control and monitor dispensing in a browser, with no software installation.

04 Real-Time Droplet Analysis

Replay droplet behavior over a selected interval to examine patterns, satellites, breakup, splashing and dynamic changes.

Beyond Total Volume: See Every Droplet

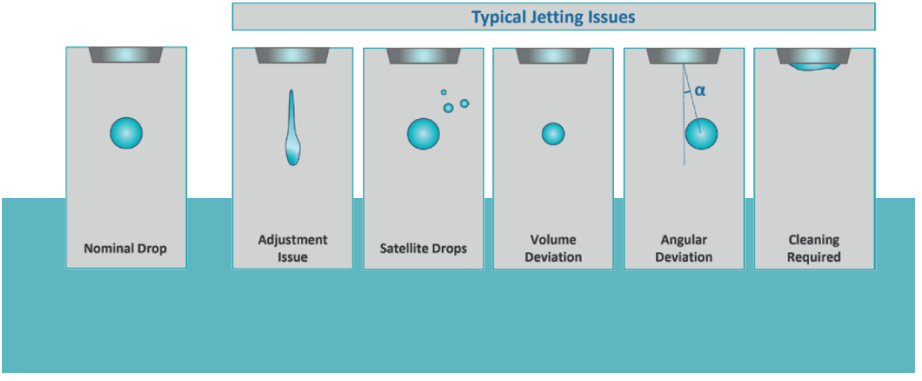
Conventional gravimetric measurement evaluates accumulated dispense volume. Even when the total is within specification, it can miss individual drop-volume variation, trajectory deviation, satellite droplets and nozzle residue. MOL Solutions' optical technology monitors each droplet in process, analyzing volume, shape, velocity and direction to reveal anomalies before they cause defects.

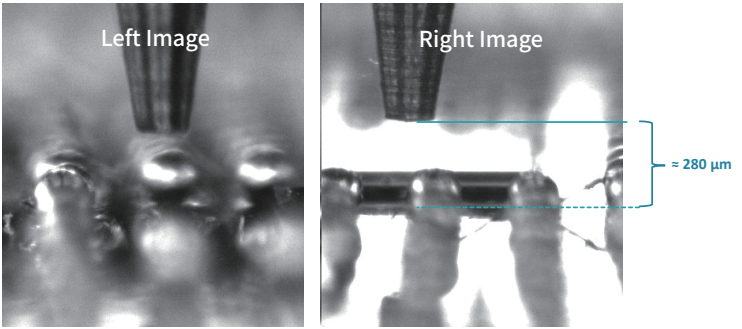
Optical Droplet Metrology

- Real-time in-process monitoring
- Millisecond-scale feedback
- Non-contact; no weighing platform
- Multiple flight metrics in one acquisition

Conventional Gravimetry

- Post-process or offline sampling
- Requires settling time
- Sensitive to evaporation and vibration
- Limited insight into individual jetting events





3D Optical Metrology: 7 Key Droplet Metrics

Synchronized X-Z and Y-Z images convert two-dimensional views into 3D flight data. Measure volume, size, velocity and flight angle while identifying satellite droplets and nozzle residue to rapidly assess landing-position error and process anomalies.

Key Metrics

- Droplet volume
- Satellite droplets
- Droplet length
- Diameter / width
- 3D flight angle
- Droplet velocity
- Nozzle residue factor

Real-Time Monitoring to Closed-Loop Correction

Optical droplet metrology links images and measurements to process control. Web-GUI, PLC and database connectivity form a complete loop of monitoring, measurement, assessment, correction and verification.

Real-Time Monitoring

High-speed imaging reveals subtle changes in droplet formation, flight and nozzle residue as they occur.

Optical Measurement

Calculate volume, size, velocity, flight angle and trajectory together, converting images into process data.

Anomaly Detection

Compare specification limits and historical trends to detect volume drift, trajectory deviation, satellites and nozzle contamination.

Feedback & Correction

Send results to the PLC to adjust dispensing parameters or trigger nozzle cleaning, then verify the correction immediately.

System Integration

01 Web-GUI | Monitoring & Control

View droplet images, set acceptance criteria and verify process and correction results in a browser, without installing software.

02 PLC / DATABASE | Integration

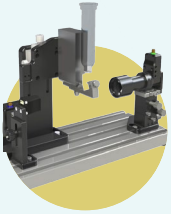
Send results to the equipment for parameter adjustment or cleaning. Store process data for quality analysis and traceability.

Three Optical Solutions. Three Core Tasks.

In-depth 3D analysis | Inline closed-loop control | Sub-second calibration

UltiStrobe provides in-depth analysis, NanoStrobeX brings per-drop monitoring and closed-loop control to production, and NeoScale accelerates calibration with dual-view imaging. Select the right tool for R&D, production or changeover checks.

UltiStrobe



Laboratory 3D analysis

Droplet tuning and quality control

3D volume, trajectory and landing analysis
Plug-and-play Web-GUI; flexible lens options

NanoStrobeX



Per-drop inline monitoring

Real-time droplet monitoring

Fast sampling; instant anomaly detection
PLC closed-loop control; automatic cleaning

NeoScale



High-speed line-side calibration

Microvolume calibration

7 metrics from dual views
Results in hundreds of milliseconds; no settling delay

NanoStrobeX

Real-Time Optical Droplet Monitoring

From reactive response to predictive control: real-time fluid intelligence.

NanoStrobeX is an in-process optical sampling system for jet and inkjet dispensing. Ultrafast, real-time droplet monitoring with AI-driven feedback and control extends process insight beyond conventional weighing-based inspection.



Ultrafast Sampling

Real-time acquisition up to 300 Hz (0.0033 seconds per droplet)

Real-Time Defect Detection

Instant visualization of abnormal droplets and satellites

Satellite Detection Limit

Minimum satellite volume: 0.01 nL
Main droplet range: 0.1-50 nL

AI-Driven Feedback Control

Intelligent algorithms and closed-loop feedback

Non-Contact, Vibration-Immune

No stabilized platform required

Intuitive Interface

Easy to learn, intuitive to operate

Compatible Adhesives & Fluids

> UV-curable adhesives
> Silver-filled adhesives / pastes
> Underfill epoxy
> Silicones
> Solvents
> Solder paste
> Acrylic adhesives
> Hot-melt adhesives
> Oils

Real-Time Droplet Visibility in Production

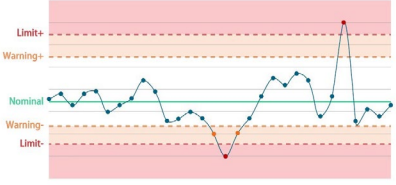
NanoStrobeX advances fluid control to improve efficiency across high-volume manufacturing.

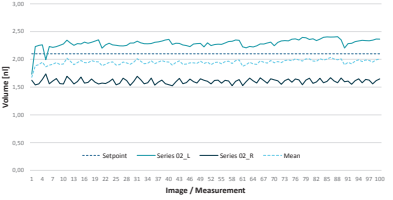
As manufacturing advances, dispensing precision becomes increasingly critical. In high-speed automated production, accurate dispensing and fewer process defects help engineers and production managers improve overall process performance.

From Droplet Monitoring to Process Decisions

Real-time images, quantitative analysis and historical trends reveal dispensing performance.

NanoStrobeX provides precise droplet data, including volume, jetting frequency, flight velocity, satellite count and displacement. These measurements reveal jet valve performance and guide parameter adjustments to improve productivity and reduce equipment downtime. Continuous monitoring and data analysis help anticipate anomalies and enable preventive action for stable production.





Four Common Defects: Detect and Respond in Real Time

01

Satellite Droplets

Dispense gap, valve damage, static charge or bubbles can cause satellites.

02

Nozzle Residue

Adhesive buildup causes deflection, contamination and size variation.

03

Bent / Worn Needles

Impact damage to 28-32 gauge needles can shift the landing position.

04

Volume Drift

Changes in viscosity, pressure or temperature, or piezo aging, affect volume.

Closed-Loop Control & Automatic Cleaning

NanoStrobeX feeds real-time results to the equipment control system. Volume, velocity and angle data drive dynamic parameter adjustments, while anomaly or contamination detection triggers cleaning, reducing manual intervention and improving dispensing stability and production efficiency.

Dynamic Closed-Loop Feedback

Feed volume, velocity and angle to the PLC to adjust pressure or process parameters.

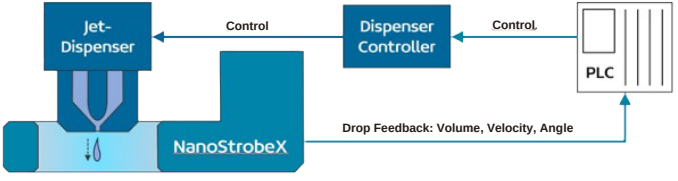
Smart Cleaning & Maintenance

Switch to cleaning or maintenance when contamination or clogging is detected.

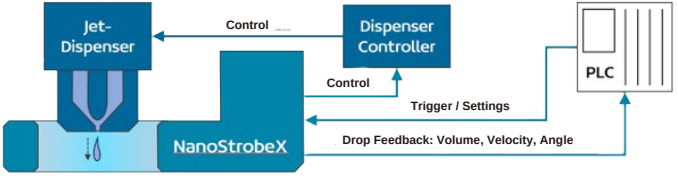
Flexible System Integration

Supports major jet valve types and a range of installation requirements.

Volume on Demand (VoD): PLC-Based Closed-Loop Volume Control



Volume on Demand (VoD): Closed-Loop Control via NanoStrobeX



NanoStrobeX Benefits in Production

Consistent Droplet Volume

Detect volume differences across nozzles and integrate closed-loop feedback to maintain dispense consistency and improve production precision.

Satellite Droplet Detection

Capture satellite formation in real time to prevent dispensing defects and reduce reject rates.

Nozzle Residue Detection

Detect nozzle residue to prevent contamination and measurement error, improving process stability.

Higher Production Efficiency

Real-time monitoring and equipment adjustment reduce downtime and keep dispensing stable.

Lower Production Costs

Reduce material waste from inaccurate dispensing, optimize production and lower operating costs.

Visual Monitoring & Analysis

Detailed visual data for every droplet supports rapid engineering decisions and better product quality.

Higher Throughput (UPH)

Eliminate conventional load-cell measurements, which take several seconds per cycle and require equipment travel to the weighing position.

Specifications

Droplet velocity
0-4 m/s
Higher-speed options available

Droplet dimensions
1 nL diameter: approx. 125 µm
Z direction: approx. 1500 µm

Detectable volume range
0.1-50 nL
Smaller-drop options available; optics and calculation methods depend on measurement needs

Satellite detection limit
>= 0.01 nL
Approx. 27 µm diameter

Flight-angle deviation
Maximum X/Y deviation: 5°
Configurable angle limits for pass/fail assessment

Field of view
X / Z: 2 × 2 mm

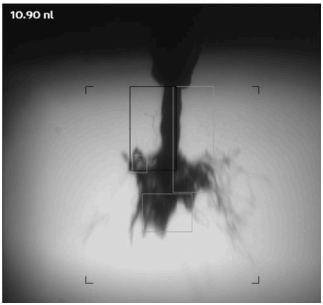
Measurement frequency
300 Hz
Depends on image dimensions

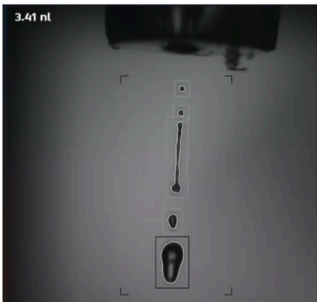
Measurement gap
Minimum: 0.8 mm

Camera thickness
4 mm

Droplet count
Counts dispensed droplets

Satellite count
Counts satellite droplets





Smarter Dispensing Higher Yield

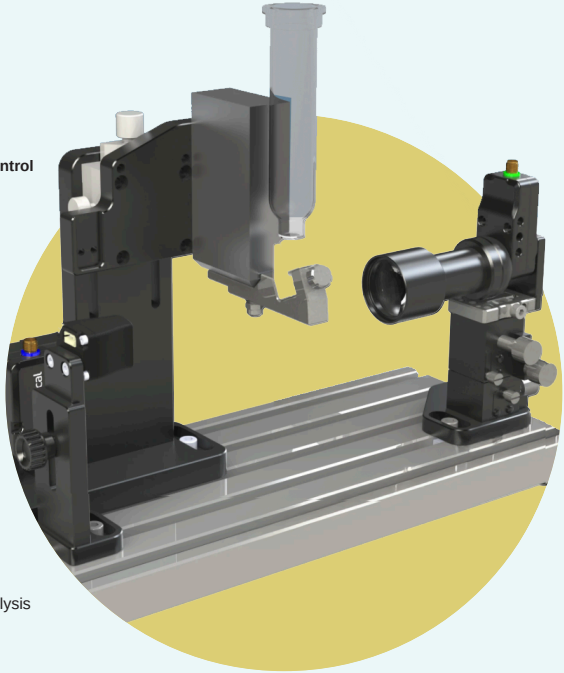
NanoStrobeX advances dispensing from post-process inspection to real-time process control. High-speed vision sampling at up to 300 Hz and precise quantitative analysis help reduce defects, stabilize dispensing and accelerate parameter tuning. From drop-volume consistency and satellite detection to nozzle residue monitoring, comprehensive real-time data improves productivity, process precision and quality.

UltiStrobe

Advanced Droplet Tuning & Quality Control

Real-time optical insight beyond conventional balances

UltiStrobe is a versatile, high-precision dropwatcher for non-contact jet and inkjet dispensing. High-speed, real-time optical monitoring reduces the effects of evaporation, vibration and resolution limits associated with electronic balances. It supports stationary systems in laboratory and industrial environments.



Technical Highlights

- Precise 3D droplet analysis
- Real-time droplet behavior analysis
- Intuitive Web-GUI control
- Nozzle monitoring

Key Applications

- Semiconductor dispensing / photoresist
- OLED and display inkjet printing
- Biomedical dispensing and diagnostics
- Chemical analysis / microfluidic control
- Precision coating and packaging

Lens Configuration



Lens	Mag.	FOV [mm]	Resolution [µm/px]	Work Dist.	Thread
S-1.0	1.0	3.9 x 4.45	2.79	15	S-Mount
S-2.0	2.0	1.95 x 2.2	1.39	15	S-Mount
C-0.5	0.5	7.8 x 8.9	5.58	75	C-Mount
C-1.0	1.0	3.9 x 4.45	2.79	69	C-Mount
C-2.0	2.0	1.95 x 2.2	1.39	65	C-Mount

3D Droplet Analysis: Trajectories and Anomalies

UltiStrobe synchronizes two high-speed views to quantify droplet volume, flight angle, trajectory deviation and satellites. Dual-view analysis reveals deviations that a single image may obscure, giving engineers a clearer view of dispensing quality and potential process risks.



VOLUME

Droplet Volume

Measure individual volume and trends in real time to identify drift and inconsistency and assess dispense stability.

DIRECTION

Flight Direction

Analyze angle and trajectory from two views to detect lateral displacement and direction errors hidden in a single image.

IMPACT

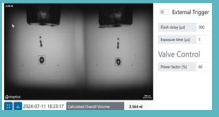
Landing Position

Predict landing position from trajectory and angle to flag anomalies that may cause dispensing placement errors.

SATELLITE

Satellite Analysis

Track satellite count, position and flight direction, reducing missed detections caused by overlapping views.



Virtual Video + Web-GUI

From single-drop images to dynamic reconstruction of jetting behavior

UltiStrobe reconstructs droplet formation, flight and separation by combining high-speed single-drop images in time sequence. Virtual video reveals satellites, ligament breakup, splashing and transient anomalies more clearly than isolated snapshots, helping engineers assess jetting and process changes.
The Web-GUI enables browser-based image review, condition setup and measurement data management across workstations.

01 Virtual Video Reconstruction

Reassemble sequential high-speed images to reconstruct the complete droplet formation and flight cycle.

02 Transient Behavior Analysis

Observe transient events including ligament breakup, satellite formation, splashing and unstable jetting.

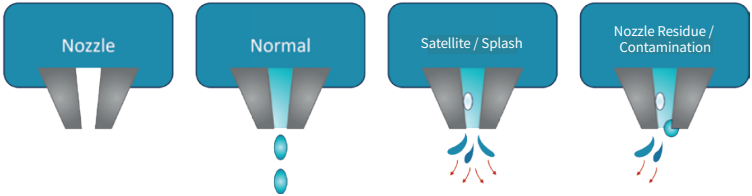
03 Real-Time Web-GUI Control

Set conditions and view images and results in a standard browser, without dedicated software.

04 Cross-Device Data Access

Access via computers, tablets and mobile devices; integrate systems through GPIO or databases.





Monitor Nozzles and Satellites to Anticipate Defects

Nozzle residue, contamination, wear or clogging can change droplet volume, direction and landing position, destabilizing the process. UltiStrobe monitors nozzle condition and droplet behavior together, linking contamination to satellites and trajectory deviation. Engineers can identify root causes faster and schedule cleaning, maintenance or parameter adjustments based on actual conditions.

Nozzle Residue Monitoring

Identify adhesive residue, contamination and liquid buildup at the needle and nozzle tip in real time.

Satellite Detection

Track the formation, count and flight direction of tiny satellites to reduce missed detections.

Jetting Anomaly Assessment

Correlate volume, trajectory and angle changes to determine whether contamination is affecting dispensing quality.

Condition-Based Cleaning

Schedule cleaning from actual contamination and jetting conditions, reducing unnecessary downtime from fixed maintenance intervals.

NEOSCALE

Microvolume Droplet Calibration

From manual adjustment to real-time precision: intelligent calibration



NeoScale advances microbalance-based calibration with faster, more precise optical measurements and droplet behavior analysis, including:

Nozzle monitoring
Residue factor
Droplet measurement
Volume
Satellites (small drops beside the main drop)
Droplet length
Diameter / width
3D flight angle
Droplet velocity

Technical Highlights

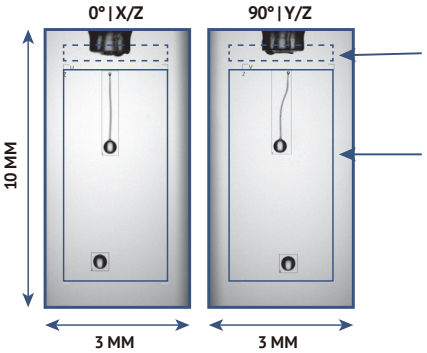
· No settling time
· No evaporation effects
· No vibration effects
· No environmental interference

Key Applications

High-speed optical calibration
Uses brief periods of process dead time
Compact design for direct next-to-line integration

7 Key Droplet Metrics in One Measurement

NeoScale captures droplets simultaneously from orthogonal X-Z and Y-Z views for comprehensive flight and shape analysis. Alongside volume, it measures satellites, dimensions, velocity and 3D flight angle while monitoring nozzle residue, providing key dispensing-quality metrics in a single measurement.

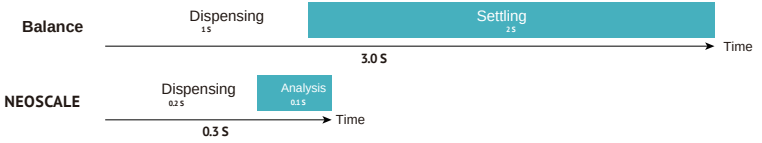


Nozzle Monitoring
Residue Factor

Droplet Analysis
Volume
Satellite Droplets
Droplet Length
Diameter / Width
3D Flight Angle
Droplet Velocity

Optical Calibration Beyond Gravimetric Limits

NeoScale replaces conventional microbalance measurements with high-speed optical analysis of individual droplets. It requires no settling time and greatly reduces the effects of evaporation, vibration and environmental changes. In addition to volume, it captures velocity, angle, dimensions, satellites and nozzle residue, extending calibration beyond total weight to the actual state and jetting quality of each droplet.



Parameter	Balance	NeoScale
Accuracy	1μg	0.001 μg
Test count	> 100	> 2
Evaporation effect	Significant	Negligible
Vibration sensitivity	Sensitive	Negligible
Outputs	Total weight	Total weight Single-shot weight Satellite weight Flight angle Droplet velocity Droplet size Nozzle residue
Settling time	5 s	0 s
Startup time	60 min	1 min

Based on MOL test results; for technical reference only.

Three Solutions for Different Process Stages

From R&D analysis and real-time inline monitoring to rapid line-side calibration, Droptical offers application-specific droplet metrology, giving engineers the data they need throughout development, process engineering and production.

Product	UltiStrobe	NanoStrobeX	NeoScale
Environment	Laboratory / R&D / stationary monitoring	Inline production equipment	Next-to-line
Primary use	In-depth analysis, setup and process research	Real-time monitoring and process feedback	Rapid calibration and process checks
Data outputs	3D volume, flight direction and predicted landing position	Up to 300 Hz sampling, anomaly detection and trend tracking	7 droplet and nozzle metrics
Integration	Flexible optics / Web-GUI	PLC feedback, on-demand cleaning and valve integration	High-speed optical calibration / next-to-line integration
	For R&D requiring flexible observation and in-depth analysis	For production requiring continuous monitoring and real-time feedback	For rapid calibration, sampling and line-side process checks

R&D analysis | Inline production monitoring | Rapid line-side calibration

MOL Solutions Inc
Optical & laser measurement
モル株式会社

CONTACT INFO

MOL Solutions Inc. Japan
Worldwide Headquarters
Mr. Suzuki Nobuaki
☎+81 90 1586 9307
✉ suzuki@mol-solutions.com

MOL Solutions Germany
European Headquarters
Mr. Thomas Wanka
☎+49 157 3244 6761
✉ thomas@mol-solutions.com

MOL Solutions Inc. Taiwan
Far East Headquarters
Mr. Michael Lai
☎+886 952 060 567
✉ yx@mol-solutions.com

MOL Solutions Malaysia
Mr. Lee Chong Sin
☎+603 5103 9277
✉ c.s.lee@mol-solutions.com

MOL Solutions Shanghai Inc
Mr. Michael Lai
☎ +86 136 0186 9233
✉ yx@mol-solutions.com

VISTA Industry Korea
Alex Park
☎ +82 010 3136 8910
✉ alex.park@vista-ind.com

MOL Solutions Inc. France
Mr. Loic Nadot
☎ +33 6 7857 9064
✉ loic.nadot@mol-solutions.com

www.mol-solutions.com