



Collision Prevention

Active Area Monitoring with
LMS211/LMS221/LMS291 Laser Measurement Systems

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SICK
Sensor Intelligence.

Stop collisions!

SICK Laser Measurement Systems are employed wherever long-range collision prevention is required. The gap-free monitoring zones can be individually adapted to meet even especially difficult tasks. The system does not just report infringements of the optical fields by objects or obstructions, but also provides the precise position of the particular infringement.



Fig. 1: LMS laser scanner, LMI interface.

Special advantages of the system

- Freely adjustable monitored fields
- Monitored fields easily changed (e.g. when structural alterations are made)
- Active, dynamic measurement principle: thus fully independent of object illumination
- Unaffected by ambient light
- No mutual interference when several scanners are used simultaneously
- Operating temperatures from -30°C to $+50^{\circ}\text{C}$
- Very long range (up to 80 m, up to 180° scanning angle)
- Dynamic field changes possible during mobile operation (AGV)
- Navigational support by reporting of reflector marks
- Rain and snow suppression in outdoor applications
- Active fog correction prevents erroneous switching
- Simple system structure thanks to use of standard components

Typical areas of use

- Collision prevention for container cranes in lanes
- Collision prevention around swinging facilities e.g. crane arms
- Checking jut-out/overhang on conveyor belts and in high-bay warehouses
- Non-contact collision prevention on AGVs outdoors
- Monitoring closing actions of gates and barriers



Safety information: LMS laser scanners are not devices for protecting persons as defined by current machine safety standards.

Examples.

Collision-free crane operation at container terminals

Time spent in port is expensive. So several cranes generally operate simultaneously when loading and unloading container ships to reduce transshipment time to a minimum. It is vital to ensure that ship's superstructures and neighbouring cranes cannot be damaged while cranes are in motion. The crane operator in his cabin cannot handle this by himself, as he does not have a sufficient view of the crane's path nor of the jib in its operating position. Reliable collision prevention is thus essential for deck structures, funnels, auxiliary cranes or other parts of the ship.

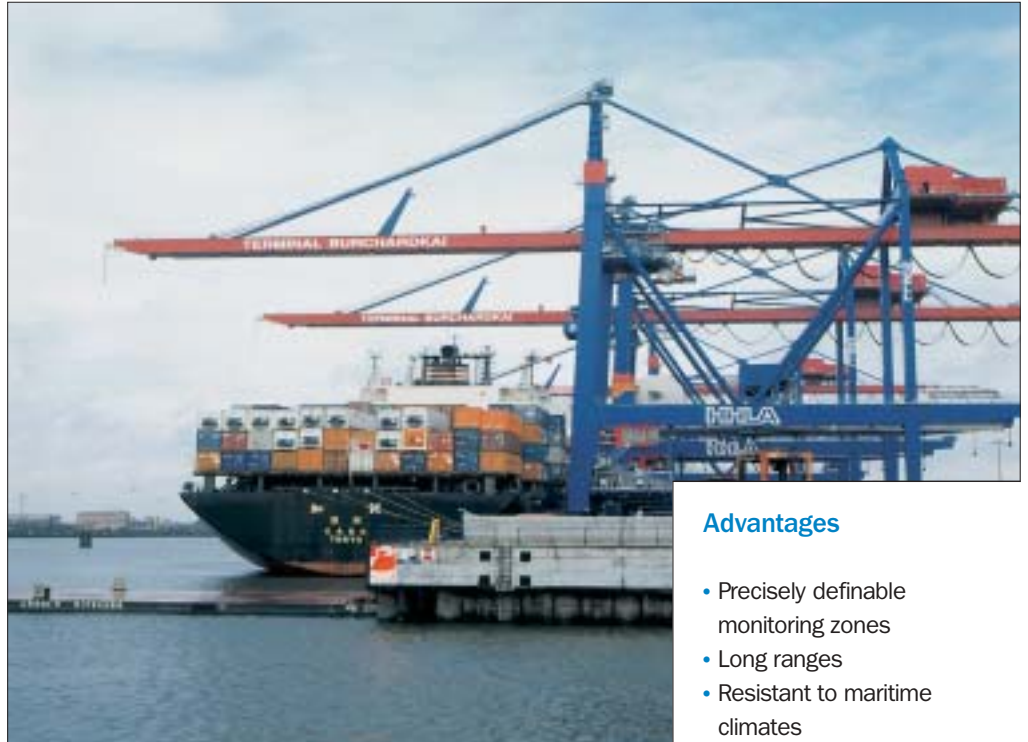


Fig. 2: Monitoring container crane lanes.

Advantages

- Precisely definable monitoring zones
- Long ranges
- Resistant to maritime climates
- Enclosure rating: IP 67
- For ambient temperatures of $-30^{\circ}\dots+50^{\circ}\text{C}$
- Simple retrofitting
- No mutual interference

Collision cost money!

Crane – Crane Crane – Ship

Crane booms often need to work close in to ship structures as a result of the high container loading density on board. The low operating distance creates a high potential for possible collisions that would cause considerable damage.

The Laser Measurement System is responsible for non-contact distance measurements in these situations. The system continuously measures the space available within a freely selectable, 2-dimensional monitoring field and uses switching signals to the crane control system to indicate when distances are dangerously low.

Advantages

- Freely selectable field geometries
- Short reaction times
- Any mounting position
- Automatic pollution indication

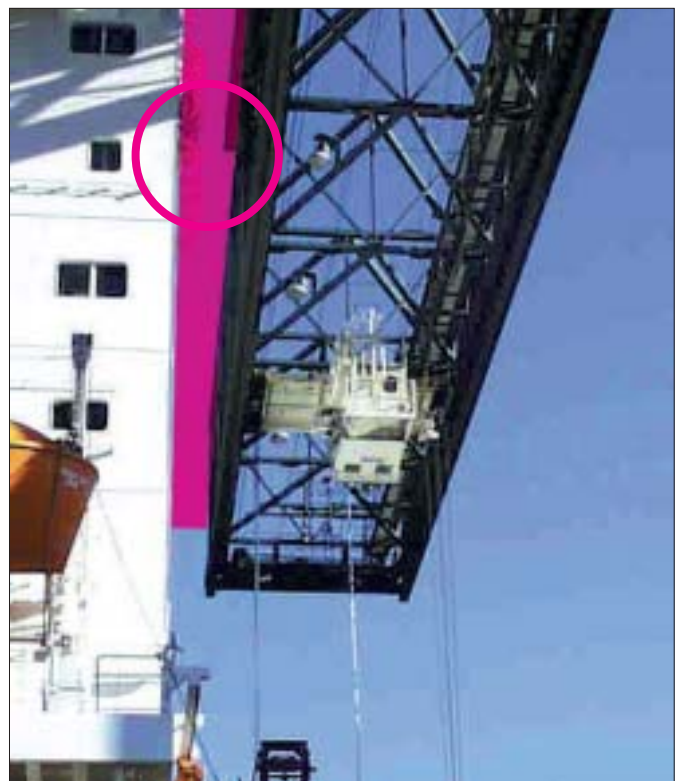


Fig. 3: Preventing collisions between crane and ship.

Keep a safe distance.

AGVs – Automatic Guided Vehicles

Collision prevention

Vehicle density and AGV speeds are constantly increasing in order to meet turnaround times that are getting shorter and shorter. Simple collision prevention, e.g. between bumper and electro-mechanical switching strips, is no longer sufficient. The LMS Laser Measurement System offers excellent performance features that keep pace with AGV developments.

Freely selectable monitoring fields scan lanes as optical radar, without any contact. Obstructive objects lead to a deceleration of the AGV or trigger a stop signal.



Fig. 4: Collision prevention on an AGV (container).

Advantages

- Long range
- Any shape for monitored fields
- Freely definable fields for negotiating curves
- Dynamic fields with automatic expansion in line with speed
- Rain and snow suppression
- Simple system structure thanks to use of standard components
- Easily integrated
- Automatic pollution indication



Fig. 5: Collision prevention on an AGV (air freight).

Advantages

- High measurement accuracy at long range – even in rain and snow
- Just one system for both collision prevention and navigation
- Easily integrated
- Data output in real time
- Automatic pollution indication

Navigation

AGVs are kept 'on course' by a variety of navigational equipment. Systems such as those guided by wire, however, do not allow any flexible changes to be made to the pre-defined lanes. Systems with 'free navigation' are increasingly coming to the fore. The LMS Laser Measurement System reliably supports the on-board computer. In addition to pure collision-prevention tasks the LMS provides signals when a reflector (reflector mark) is detected. The LMS provides the relative angle and distance to the reflector marc detected. The on-board computer can use this information update to compensate for deviations caused, for example, by slippage.

Warehouse and conveyor technology

Warehouse technology

Modern goods handling is largely automated. Service modules such as, for example, storage and retrieval units for high-bay warehouses approach the appropriate storage area in automatic mode.

The LMS Laser Measurement System helps prevent costly damage caused by collisions with overhanging parts. Mounted on the storage and retrieval unit, the LMS monitors the lanes between the bays for any overhang while in motion. The monitoring fields are selected in such a way as to form an optical curtain parallel to and in front of the bays. Should any overhang be present the storage and retrieval unit is stopped reliably and in good time.



Fig. 6: Checking overhang in a high-bay warehouse.

Advantages

- Long range
- Short response time
- Easy integration
- Complete cover on the sides of the storage and retrieval unit
- Monitored fields can be changed rapidly in the event of structural alterations
- High detection reliability
- Automatic pollution indication

Conveyor systems

Overhang and excess heights occur relatively frequently in conveyed goods, e.g. pallet loads. Parts jutting out over the pallet can cause considerable damage or can themselves be damaged during transport. Checking overhang using simple photoelectric switches, etc. is generally unsatisfactory in practice. The LMS Laser Scanner Measurement System, on the other hand, forms a complete, gap-free, optical gate and overhang or excess heights are immediately registered. The areas monitored can be flexibly adapted to local circumstances and have extremely rapid response times.

A supplementary height classification of the transported goods can be carried out if several fields of varying sizes are set up directly above the conveyor section. A separate switching signal is available for each height class.

Advantages

- Complete area monitoring
- Easy integration and retrofitting
- Rapid reaction times
- Height classification possible
- Optional volume determination of the transported goods is available
- High detection reliability

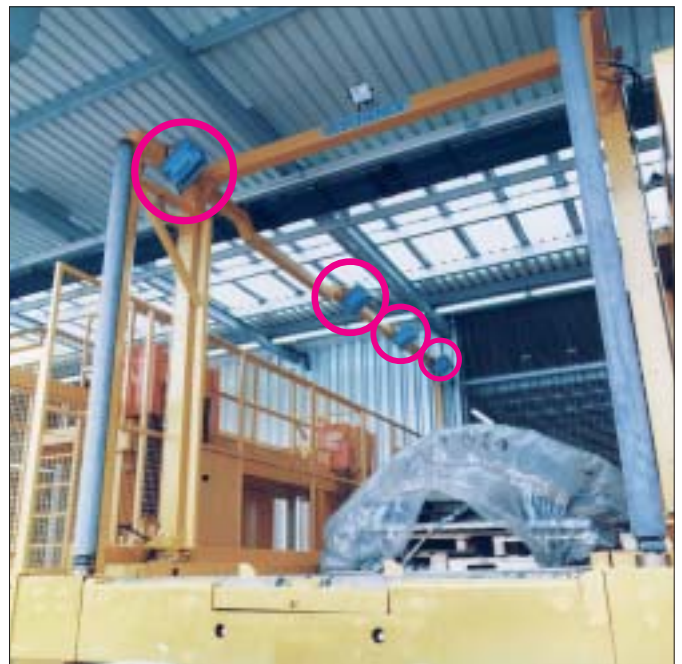


Fig. 7: Checking overhang on conveyor equipment.

Forward-looking.

Industrial sensors

Automated processes make increasing demands on the sensor systems employed. Basic functions more and more often require the addition of supplementary features. The LMS Laser Measurement System meets the need for both in exemplary fashion.



Fig. 8: Providing an 'area free' report at barriers.

Gate and barrier control

The LMS system's flexible monitoring fields can cover large areas. Entrances and exits with mixed pedestrian and vehicular traffic, e.g. works entrances, require supplementary differentiation between persons and vehicles – in addition to purely basic functions (namely, automatic gate opening). This then has the advantage that the gate is only opened when a vehicle triggers the request. Personnel do not cause the gate to open so that no attempt is made to walk on the traffic lane.

Advantages

- Flexible monitored areas for individual adaptation to local circumstances
- Distinguishes between persons and vehicles using its 'object size' standard function
- Rain and snow suppression

Sliding gates

Automatic sliding gates are often used in large halls. In, for example, aircraft hangars the gates are only opened for bringing in an aircraft or taking one out and then close automatically afterwards. Here the LMS system is responsible for automatically providing a free signal for the closing area to prevent extremely costly collisions between the gate and aircraft parts. The long range of the LMS, and in particular its complete, gap-free cover of the gate area, enable it to handle the task without any problem.

Advantages

- Long range and reliable detection
- No limitations caused by reflective surfaces
- Monitored area can be segmented allowing the use of differentiated switching signals



Fig. 9: Providing an 'area free' report at sliding gates.

**Many more
LMS applications
on the way.**

Collision prevention with laser scanners – Safety at the speed of light.

The LMS laser scanner is a non-contact measurement system. It scans a freely adjustable monitoring field by means of a fan-shaped laser beam and reports any objects detected.

Application-related data are entered into the laser scanner, or the optional LMI interface, using a PC (laptop) with the Windows user software provided.

How the laser scanner makes measurements

The laser scanner operates on the principle of the time-of-flight measurement of a light impulse: an invisible, fan-shaped, pulsed laser beam is emitted with a high angular velocity as a kind of 'measurement feeler'. If it hits an obstruction (machine part, object) it is reflected and registered in the laser scanner's receiver unit.

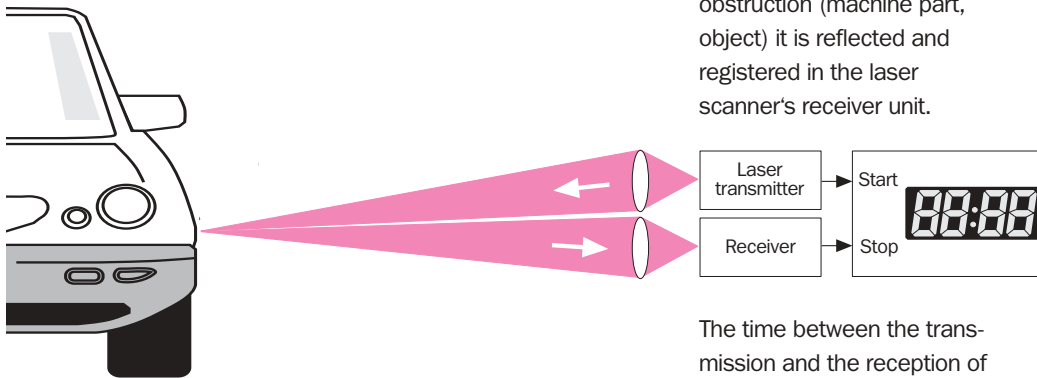


Fig. 10: Principle of function of the laser scanner.

The time between the transmission and the reception of this impulse (the time-of-flight) is directly proportional to the distance between the scanner and the object.

The precise position of the object can be determined from the sequence of impulses received.

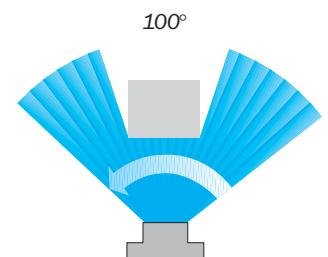


Fig. 12: The LMS 211 scanner's 'laser fan'.

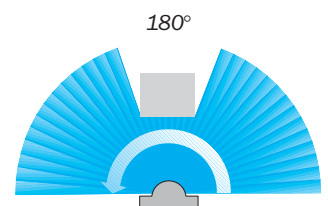


Fig. 13: The LMS 221/LMS 291 scanner's 'laser fan'.

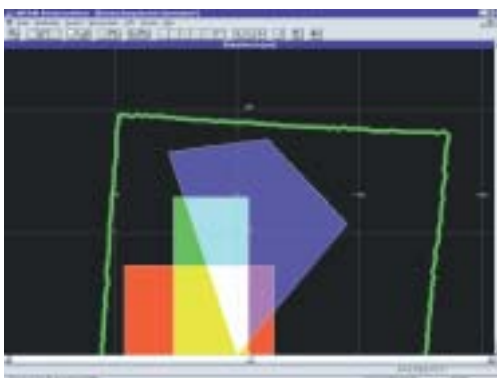


Fig. 11: User interface with display of the scanning line (green) and monitored areas.

The 24 V DC LMS switching outputs immediately signal any infringement of the monitored areas. The contour data can also be transferred to the LMI interface or other external evaluation device via the data interface (RS 232/422).

The following signals are available:

- Report of infringement of an area
- Position of the infringing object

Take your pick.

- Large monitoring area with radius up to 80 m and field of view of up to 180°
- Active system – no external illumination necessary
- Gap-free monitoring
- Individually adaptable monitored areas
- Rain/snow suppression through integrated evaluation
- Fog correction prevents erroneous switching
- Self-testing
- Simple mounting with a variety of mounting sets
- Ambient temperatures of +30 °C.....+50 °C
- Extremely robust housing with IP 65/IP 67



LMS 211 laser scanner
with dust prevention shield,
100° scanning angle;
IP 67; with internal and front
window heating,
3 x PNP switching outputs,
RS 232/422 data interface

Fig. 12: The LMS 211 laser scanner.



LMS 221 laser scanner
180° scanning angle;
IP 67; with internal heating,
3 x PNP switching outputs,
RS 232/422 data interface

Fig. 13: The LMS 221 laser scanner.



LMS 291 laser scanner
180° scanning angle;
IP 65;
3 x PNP switching outputs,
RS 232/422 data interface

Fig. 14: The LMS 291 laser scanner.

Far-reaching.

The laser scanner's range is basically dependent on the object's surface. The greater the reflectivity of the object, the longer the measurement system's range. The over-dimensional range reserve, however, ensures that the LMS reliably detects even weakly reflective objects. See the table below for the reflectivity of some typical materials („Kodak-Standards“):

Weatherproof.

Rain and snow have no effect on the range of the measurement system. Please note the special range details and minimum reflectivity values in foggy conditions.

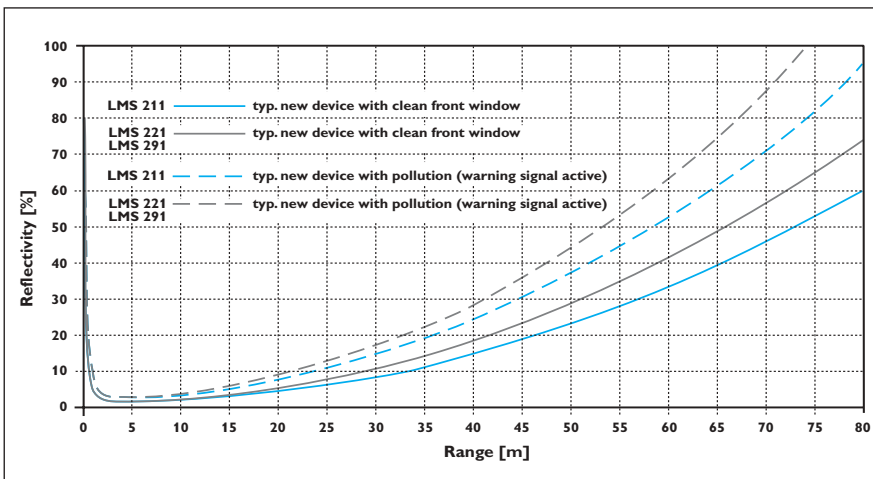


Fig. 15: Range in relation to the object's reflectivity.

Material	Reflectivity
Cardboard, matt black	10 %
Wood (raw pine, dirty)	40 %
PVC, grey	50 %
Aluminium, black anodised	110...150 %
Plaster, white	100 %
Reflectors	>2000 %

LMS 211/221/291 technical data		
Range, max.		80 m
Range for 10 % reflectivity		30 m
Resolution		1 cm
Systematical error		typ. 4 cm, max. 6 cm
Scanning angle	LMS 211	100°
	LMS 221/291	180°
Angular resolution		1°/0,5°/0,25°
Response time		13 ms /26 ms /53 ms
Power supply		24 V DC
Outputs	switching outputs	3 x PNP; 24 V
	interface	RS 232/422; selectable
Enclosure rating	LMS 211/221	IP 67
	LMS 291	IP 65
Ambient temperatur	LMS 211/221	-30...+50 °C
	LMS 291	0...+50 °C
Dimensions (W x H x D)	LMS 211/221	ca. 352 x 265 x 202 mm ³
	LMS 291	155 x 185 x 156 mm ³

Expandable.

The optional LMI interface is available for expanding the system. It is employed wherever more than 3 monitored fields or switching signals are required, or where special field types with logical linkages are necessary.

Typical applications include:

AGV Automatic Guided Vehicles

The use of a shaft encoder allows the various monitored fields to be operated dynamically. I.e. the fields automatically expand with increasing speed. Special field sets can be activated for negotiating curves, and the activation of the appropriate LMS scanner when the direction of movement changes is also carried out by the LMI.

Classification of the heights of transported materials

The LMI can administer 6 different fields or switching signals. Therefore, up to 9 different messages can be distinguished by also utilising the 3 fields or signals provided separately by the LMS. The LMS scanner is mounted vertically above the conveyor section.



Fig. 16: The LMI 400 interface.

Advantages

- Up to 4 laser scanners can be connected
- Up to 6 independent monitored fields can be set up
- 6 individual switching outputs
- Freely selectable evaluation cases and logical linkages for outputs and inputs
- Suppression of rain and snow
- Self-testing
- Easy system diagnosis
- LED indicators for operating states
- Maintenance-free
- Compact design

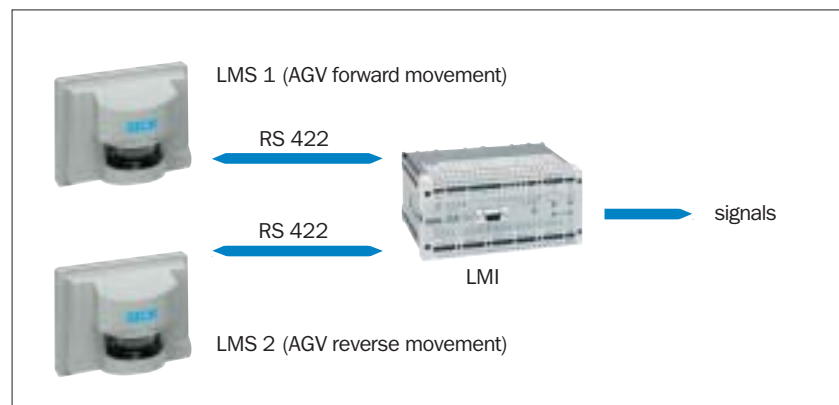


Fig. 17: Variant with LMI providing control and switching signals.

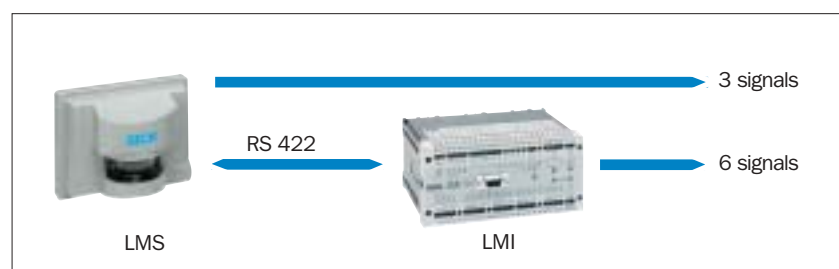







Fig. 18: Variant with both LMS and LMI providing switching signals.

LMI 400 technical data	
Laser scanner inputs	4
User interface	RS 232 or RS 422
Switching outputs	6 (typ. 24 V)
Power supply	24 V DC
Enclosure rating	IP 20
Ambient temperature	0...+50 °C
Dimensions (W x H x D)	152 x 73 x 118 mm ³
Terminal housing	snap-in mounting

Diversity.

	LMS type	Scanning angle max.	Resolution/typ. accuracy	Range on 10% remission	Heating built-in	Fog correction
	LMS 211-30206	100°	10 mm/± 60 mm	30 m	✓	✓
	LMS 221-30206	180°	10 mm/± 60 mm	30 m	✓	✓
	LMS 291-S05	180°	10 mm/± 60 mm	30 m	–	✓
	LMS 200-30106	180°	10 mm/± 30 mm	10 m	–	–
	LMS 220-30106	180°	10 mm/± 30 mm	10 m	✓	–

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