

Lunatone DALI-2 Sensor Instances

V1.1

Lunatone DALI-2 sensor instances enable the access of various sensors over the DALI bus. They are fully DALI-2 compatible by being implemented as DALI-2 "Generic purpose" instances (instance type 0, see IEC 62386-103).

1. Units

To distinguish the different sensor instances (all have DALI-2 instance type 0) the "unit" is used. It can be queried with the command "QUERY UNIT" (see Table 3). At the time of the creation of this document the following "units" are defined for Lunatone DALI-2 sensor instances:

Unit - Value	Description
0	Thermodynamic temperature [K]
1	CO ₂ -eq (CO ₂ equivalent) [ppm]
2 - 11	reserved
12	Relative humidity [%]
13 - 14	reserved
15	Barometric pressure [hPa]
16	IAQ (Indoor Air Quality) [1]
17 - 255	reserved

Table 1: Units

2. Commands

As DALI-2 instances of type 0 ("Generic purpose", IEC 62386-103) Lunatone sensor instances implement the following DALI-2 standard commands:

Command	Address byte	Instance byte	Opcode byte	Description
SET EVENT PRIORITY	Device	Instance	0x61	see IEC 62386-103
ENABLE INSTANCE	Device	Instance	0x62	see IEC 62386-103
DISABLE INSTANCE	Device	Instance	0x63	see IEC 62386-103
SET PRIMARY INSTANCE GROUP	Device	Instance	0x64	see IEC 62386-103

SET INSTANCE GROUP 1	Device	Instance	0x65	see IEC 62386-103
SET INSTANCE GROUP 2	Device	Instance	0x66	see IEC 62386-103
SET EVENT SCHEME	Device	Instance	0x67	see IEC 62386-103
SET EVENT FILTER	Device	Instance	0x68	see IEC 62386-103
QUERY INSTANCE TYPE	Device	Instance	0x80	see IEC 62386-103
QUERY RESOLUTION	Device	Instance	0x81	see IEC 62386-103
QUERY INSTANCE ERROR	Device	Instance	0x82	see IEC 62386-103
QUERY INSTANCE STATUS	Device	Instance	0x83	see IEC 62386-103
QUERY EVENT PRIORITY	Device	Instance	0x84	see IEC 62386-103
QUERY INSTANCE ENABLED	Device	Instance	0x86	see IEC 62386-103
QUERY PRIMARY INSTANCE GROUP	Device	Instance	0x88	see IEC 62386-103
QUERY INSTANCE GROUP 1	Device	Instance	0x89	see IEC 62386-103
QUERY INSTANCE GROUP 2	Device	Instance	0x8A	see IEC 62386-103
QUERY EVENT SCHEME	Device	Instance	0x8B	see IEC 62386-103
QUERY INPUT VALUE	Device	Instance	0x8C	see IEC 62386-103
QUERY INPUT VALUE LATCH	Device	Instance	0x8D	see IEC 62386-103
QUERY FEATURE TYPE	Device	Instance	0x8E	see IEC 62386-103
QUERY NEXT FEATURE TYPE	Device	Instance	0x8F	see IEC 62386-103
QUERY EVENT FILTER 0-7	Device	Instance	0x90	see IEC 62386-103
QUERY EVENT FILTER 8-15	Device	Instance	0x91	see IEC 62386-103
QUERY EVENT FILTER 16-23	Device	Instance	0x92	see IEC 62386-103

Table 2: Standard commands

In addition, the following sensor-specific commands are implemented:

Command	Address byte	Instance byte	Opcode byte	Description
SET REPORT TIMER	Device	Instance	0x30	Sets the report time to the value of "DTR0".
SET HYSTERESIS	Device	Instance	0x31	Sets the input-hysteresis to the value of "DTR0". (If "DTR0" > 25, the value of hysteresis will not change.)
SET DEADTIME TIMER	Device	Instance	0x32	Sets the dead time to the value of "DTR0".
SET HYSTERESIS MIN	Device	Instance	0x33	Sets the input-hysteresis-minimum to the value of "DTR0".
QUERY HYSTERESIS MIN	Device	Instance	0x3C	Returns the hysteresis minimum.

QUERY DEADTIME TIMER	Device	Instance	0x3D	Returns the dead time.
QUERY REPORT TIMER	Device	Instance	0x3E	Returns the report time.
QUERY HYSTERESIS	Device	Instance	0x3F	Returns the hysteresis.
QUERY VALUE MULTIPLICATOR	Device	Instance	0x40	Returns the value-multiplicator.
QUERY VALUE DIVISOR	Device	Instance	0x41	Returns the value-divisor.
QUERY OFFSET MSB	Device	Instance	0x42	Returns the MSB of the offset. (The offset is a signed 16 bit integer.)
QUERY OFFSET LSB	Device	Instance	0x43	Returns the LSB of the offset (The offset is a signed 16 bit integer.)
QUERY OFFSET MULTIPLICATOR	Device	Instance	0x44	Returns the offset-multiplicator.
QUERY OFFSET DIVISOR	Device	Instance	0x45	Returns the offset-divisor.
QUERY UNIT	Device	Instance	0x46	Returns the unit.

Table 3: Sensor specific commands

3. Querying the "input-value"

The DALI-"input-value" can be queried with the commands "QUERY INPUT VALUE" and "QUERY INPUT VALUE LATCH" (see Table 2). On receiving the command "QUERY INPUT VALUE" the instance latches its current "input-value" and answers with the most significant byte of the latched value. In case the "input-value" has more than one byte, the next lesser significant byte can be queried with the command "QUERY INPUT VALUE LATCH". This can be repeated until all bytes are read. Further "QUERY INPUT VALUE LATCH"-commands will be answered with a DALI-"NO".

If the DALI-"input-value" resolution (see "QUERY RESOLUTION" Table 2) is not an integer multiple of 8, the least significant byte will contain the remaining bits of "input-value" as most significant bits, unused bits contain a repeating pattern of the "input-value" bits (see IEC 62386-103 9.7.2).

4. Interpretation of the "input-value"

The DALI-"input-value" of the sensor instance, either queried by "QUERY INPUT VALUE" and "QUERY INPUT VALUE LATCH" or sent as an event (see **5. Events**), can be converted to the value of the underlying physical property by using the value-multiplicator, value-divisor, offset-multiplicator, offset-divisor, offset and "unit" according to:

$$PhysicalValue [unit] = InputValue \frac{ValueMultiplier}{ValueDivisor} + Offset \frac{OffsetMultiplier}{OffsetDivisor}$$

Example: **DALI-2 CS THP AQ** (Article Number: 86457786-INT-AQ)

The DALI-2 CS THP AQ has 4 Lunatone sensor instances (instance 2, ... ,5).

(In the following it is assumed, that the DALI-2 CS THP AQ has the DALI 24-bit address A0².)

Instance 2 (Temperature sensor):

DALI 24-bit Frame	Frame Description	8-bit Answer	Evaluation
0x010281	QUERY RESOLUTION	0x0A	Resolution = 10 (10 bits)
0x010246	QUERY UNIT	0x00	Unit = 0 (Thermodynamic temperature [K])
0x010240	QUERY VALUE MULTIPLICATOR	0x01	Value-multiplier = 1
0x010241	QUERY VALUE DIVISOR"	0x0A	Value-divisor = 10
0x010242	QUERY OFFSET MSB	0x62	see next
0x010243	QUERY OFFSET LSB	0xE3	Offset = 25315 (The offset is a signed 16 bit integer.)
0x010244	QUERY OFFSET MULTIPLICATOR	0x01	Offset-multiplier = 1
0x010245	QUERY OFFSET DIVISOR	0x64	Offset-divisor = 100

Table 4: Instance 2 (Temperature Sensor)

So an "input-value" of 0 yields a temperature of 253.15 K or -20.0 °C, an "input-value" of 420 yields a temperature of 295.15 K or 22.0 °C.

5. Events

A Lunatone DALI-2 sensor instance is capable of sending a DALI-2 event. The encoded event information is dependent on the resolution:

- Resolution > 10: The event carries the 10 most significant bits of the "input-value".
- Resolution ≤ 10: The event carries the "input-value" as most significant bits, unused bits contain a repeating pattern of the "input-value" bits. (see IEC 62386-103 9.7.2)

A Lunatone DALI-2 sensor event can either be triggered by the report timer (see 6. Report time and Dead time) or by a change of the "input-value" with respect to the hysteresis (see 7. Hysteresis).

6. Report time and Dead time

Lunatone DALI-2 sensor instances have a report timer, that allows the periodic transmission of sensor events. Every time the report timer expires the current "input-value" is sent as a DALI-2 event (encoded according to 5. Events). The report timer can be set with the command "SET REPORT TIMER" and queried with the command "QUERY REPORT TIMER".

Additionally, a deadtime timer is implemented, that can block the event transmission. It can be used to reduce the number of events in case events are triggered by a change of the sensor "input-value". The deadtime timer can be set with the command "SET DEADTIME TIMER" and queried with the command "QUERY DEADTIME TIMER".

The 8-bit timer value has to be multiplied with the timer increment (see Table 5) to get the actual time. For example, a report timer value of 20 yields a report time of 1 second ($20 * 50 \text{ ms} = 1 \text{ s}$). Further the timers have a minimum and a maximum value (see Table 5).

Time	Increment	Minimum	Maximum	Remark
Report time	50 ms	0 s	12.75 s	The report timer is disabled, if the report time is set to 0. (If the report time is shorter than the dead time, the report time will be equal to the dead time.)
Dead time	1 s	1 s	4 min 15 s	The deadtime timer is disabled, if the dead time is set to 0.

Table 5: Timer parameters

7. Hysteresis

To avoid the flooding of the DALI-bus with events on small changes of the sensor "input-value" a hysteresis is used.

The hysteresis is defined by two parameters, the input-hysteresis (a relative value in %, max. 25, see Table 3) and the input-hysteresis-minimum (an absolute value). Both parameters can be set and queried with the commands "SET HYSTERESIS", "SET HYSTERESIS MIN", "QUERY HYSTERESIS" and "QUERY HYSTERESIS MIN".

The width of the hysteresis (hysteresis-band) is given as the input-hysteresis percentage of the current "input-value". To prevent very narrow hysteresis-bands, there is also an input-hysteresis-minimum. So, the actual hysteresis-band is the maximum of:

- input-hysteresis percentage of "input-value" and
- input-hysteresis-minimum

The hysteresis-band is not symmetrical towards the "input-value". When an event is generated the hysteresis-band is recalculated and the thresholds hysteresis-band-high and hysteresis-band-low are set according to:

- if the "input-value" is greater than the old hysteresis-band-high, then:
 - new hysteresis-band-high is set to "input-value" and
 - new hysteresis-band-low is set to $\max(\text{"input-value"} - \text{hysteresis-band}, 0)$
- if the "input-value" is less than the old hysteresis-band-low, then:
 - new hysteresis-band-low is set to "input-value" and
 - new hysteresis-band-high is set to $\text{"input-value"} + \text{hysteresis-band}$

Whenever the "input-value" is greater than the hysteresis-band-high or less than the hysteresis-band-low a Lunatone DALI-2 sensor event is created.

(The initial values of hysteresis-band-high and hysteresis-band-low are 0, so that the first non-zero "input-value" will force an event.)

Document History

Revision	Chapter	Description	Date
1.0		first	November 2022
1.1	1., 3., 4.	correct units, add chapter "Querying the "input-value"", fix typos	November 2022

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The compatibility with other devices must be tested in advance to the installation.