# J. MeterValues

# 1. Introduction

This Functional Block describes the functionality that enables a Charging Station to send periodic, possibly clock-aligned MeterValues.

The transfer of the MeterValues from the Charging Station to the CSMS will be taken over by the new Device Management Monitoring feature, however this mechanism has not been proven in the field yet. So the old MeterValuesRequest message remains available for use for now.

Extensive metering data relating to transactions can be recorded and transmitted in different ways depending on its intended purpose. There are two obvious use cases (but the use of meter values is not limited to these two):

- Transaction Meter Values
- Clock-Aligned Meter Values

Both types of meter readings MAY be reported in the *meterValue* element of the TransactionEventRequest message. Clock-Aligned Meter Values MAY be reported in standalone MeterValuesRequest messages.

# 2. Configuration

*This section is normative.*

## 2.1. Transaction Meter Values

Frequent (e.g. 1-5 minute interval) meter readings taken and transmitted (usually in "real time") to the CSMS, to allow it to provide information updates to the EV user (who is usually not at the Charging Station), via web, app, SMS, etc., as to the progress of the transaction. In OCPP, this is called "sampled meter data", as the exact frequency and time of readings is not very significant, as long as it is "frequent enough". "Sampled meter data" can be configured with the following Configuration Variables:

- `SampledDataTxStartedMeasurands`

- `SampledDataTxUpdatedMeasurands`

- `SampledDataTxUpdatedInterval`

- `SampledDataTxEndedMeasurands`

- `SampledDataTxEndedInterval`

`SampledDataTxUpdatedInterval` is the time (in seconds) between sampling of metering (or other) data, intended to be transmitted by TransactionEventRequest (eventType = Updated) messages during a transaction. A value of "0" (numeric zero), by convention, is to be interpreted to mean that no sampled data should be transmitted.

`SampledDataTxEndedInterval` is the time (in seconds) between sampling of metering (or other) data, intended to be transmitted in the TransactionEventRequest (eventType = Ended) message. A value of "0" (numeric zero), by convention, is to be interpreted to mean that only the values taken at the start and end of a transaction should be transmitted (no intermediate values).

`SampledDataTxStartedMeasurands` is a comma separated list that prescribes the set of measurands to be included in the *meterValues* field of a TransactionEventRequest (eventType = Started).

`SampledDataTxUpdatedMeasurands` is a comma separated list that prescribes the set of measurands to be included in the *meterValues* field of a TransactionEventRequest (eventType = Updated), every `SampledDataTxUpdatedInterval` seconds.

`SampledDataTxEndedMeasurands` is a comma separated list that prescribes the sampled measurands to be included in the *meterValues* field of a TransactionEventRequest (eventType = Ended), these measurands have to be taken every `SampledDataTxEndedInterval` seconds from the start of the transaction, and will only be sent in the TransactionEventRequest (eventType = Ended).

| NOTE | Please note: *Transaction related* MeterValues are never transmitted in MeterValuesRequest. |

## 2.2. Clock-Aligned Meter Values

Grid Operator might require meter readings to be taken from fiscally certified energy meters, at specific Clock aligned times (usually every quarter hour, or half hour).

"Clock-Aligned Meter Values" can be configured with the following Configuration Variables:

- `AlignedDataMeasurands`

- `AlignedDataInterval`

- `AlignedDataTxEndedMeasurands`

- `AlignedDataTxEndedInterval`

- `AlignedDataSendDuringIdle`

`AlignedDataInterval` is the size of the clock-aligned data interval (in seconds). This defines the set of evenly spaced meter data aggregation intervals per day, starting at 00:00:00 (midnight), at which time the Charging Station should take measurements and send them to the CSMS in a MeterValuesRequest message. A value of "0" (numeric zero), by convention, is to be interpreted to mean that no clock-aligned data should be transmitted.

`AlignedDataTxEndedInterval` is the size of the clock-aligned data interval (in seconds). This defines the set of evenly spaced meter data aggregation intervals per day, starting at 00:00:00 (midnight) intended to be transmitted in the TransactionEventRequest (eventType = Ended) message. A value of "0" (numeric zero), by convention, is to be interpreted to mean that only the values taken at the start and end of a transaction should be transmitted (no intermediate values). TransactionEventRequest (eventType = Ended) message. For example, a value of 900 (15 minutes) indicates that every day should be broken into 96 15-minute intervals, starting

at 0:00 and then measured every 15 minutes: 0:15, 0:30, 0:45, 1:00, 1:15 etc.

`AlignedDataMeasurands` is a comma separated list that prescribes the set of measurands to be included in a MeterValuesRequest PDU, every `AlignedDataInterval` seconds.

`AlignedDataTxEndedMeasurands` is a comma separated list that prescribes the set of clock-aligned periodic measurands to be included in the *meterValue* elements of TransactionEventRequest (eventType = Ended) PDU for every `AlignedDataTxEndedInterval` of the transaction.

`AlignedDataSendDuringIdle` can be used to only send clock aligned meter values when there are no ongoing transactions.

## 2.3. Multiple Locations/Phases

When a Charging Station can measure the same measurand on multiple locations or phases, all possible locations and/or phases SHALL be reported when configured in one of the relevant Configuration Variables.

For example: A Charging Station capable of measuring *Current.Import* on *Inlet* (all 3 phases) (grid connection) and *Outlet* (3 phases per EVSE on both its EVSEs). *Current.Import* is set in `AlignedDataMeasurands`. `AlignedDataInterval` is set to 900 (seconds). Then the Charging Station should send: (every 15 minutes)

- a MeterValuesRequest with: evseId = 0; with 3 SampledValue elements, one per phase with location = Inlet.
- a MeterValuesRequest with: evseId = 1; with 3 SampledValue elements, one per phase with location = Outlet.
- a MeterValuesRequest with: evseId = 2; with 3 SampledValue elements, one per phase with location = Outlet.

## 2.4. Signed Meter Values

OCPP 2.0.1 supports signed meter values. When a Charging Station support signed meter values it can use the Configuration Variables `AlignedDataSignReadings` and `SampledDataSignReadings` to report this. The CSMS can then use this same variables to turn the use of signed meter values *on* or *off*.

When enabled the Charging Station shall put the signed meter value in the *SignedMeterValue* field of the SampledValue.

# 3. Use cases & Requirements

## 3.1. MeterValues

## J01 - Sending Meter Values not related to a transaction

*Table 152. J01 - Sending Meter Values not related to a transaction*

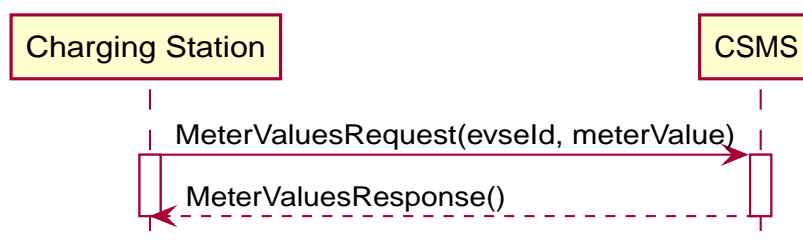| No. | Type | Description |
|---|---|---|
| 1 | **Name** | Sending Meter Values not related to a transaction |
| 2 | **ID** | J01 |
| | *Functional block* | J. Meter Values |
| 3 | **Objective(s)** | To sample the electrical meter or other sensor/transducer hardware to provide information about the Charging Stations' Meter Values. |
| 4 | **Description** | The Charging Station samples the electrical meter or other sensor/transducer hardware to provide information about its Meter Values. Depending on configuration settings, the Charging Station will send Meter Values. |
| | *Actors* | Charging Station, CSMS |
| | *Scenario description* | **1.** The Charging Station sends a MeterValuesRequest message, for offloading Meter Values to the CSMS.<br>**2.** Upon receipt of a MeterValuesRequest message, the CSMS responds with a MeterValuesResponse message. |
| 5 | **Prerequisite(s)** | The Charging Station is configured to send Meter values every XX seconds.<br>No transaction is running. |
| 6 | **Postcondition(s)** | **Successful postcondition:**<br>n/a<br><br>**Failure postcondition:**<br>n/a |



*Figure 90. Sequence Diagram: Sending Meter Values*

| 7 | **Error handling** | n/a |
|---|---|---|
| 8 | **Remark(s)** | The phase field is not applicable to all Measurands.<br><br>The phase rotation of a Connector relative to the grid connection can be derived by querying the `PhaseRotation` Configuration Variables of all components in the chain from grid connection up to Connector.<br><br>The nature of each sampledValue is determined by the optional Measurand, context, location, unit and phase fields.<br><br>The optional SignedMeterValue field can contain digitally signed binary meter value data. |

## J01 - Sending Meter Values not related to a transaction - Requirements

*Table 153. J01 - Requirements*

| ID | Precondition | Requirement definition | Note |
|---|---|---|---|
| J01.FR.01 | | The Charging Station MAY sample the energy meter (or other sensor/transducer hardware) to provide extra information about its Meter Values. | It is up to the Charging Station when it will send Meter Values. This can be configured using the SetVariablesRequest message to data acquisition intervals and specify data to be acquired & reported. |
| J01.FR.02 | | The MeterValuesRequest message SHALL contain the id of the EVSE from which samples were taken. | |
| J01.FR.03 | J01.FR.02 AND The evseId is 0. | The MeterValuesRequest message SHALL be associated with the entire Charging Station. | |
| J01.FR.04 | J01.FR.03 AND Measurand is energy related. | The sample SHALL be taken from the main energy meter. | |
| J01.FR.05 | If all captured at the same point in time. | Each MeterValue element SHALL contain a timestamp. | |
| J01.FR.06 | If all captured at the same point in time. | Each MeterValue(s) element SHALL contain a set of one or more individual SampledValue elements. | |
| J01.FR.07 | | The optional measurand field SHALL specify the type of value being measured/reported. | |
| J01.FR.08 | | The optional context field SHALL specify the reason/event triggering the reading. | |
| J01.FR.09 | | The optional location field SHALL specify where the measurement is taken. | (e.g. Inlet, Outlet). |
| J01.FR.10 | | The optional phase field SHALL specify to which phase or phases of the electric installation the value applies. | |
| J01.FR.11 | | The Charging Station SHALL report all phase number dependent values from the electrical meter (or grid connection when absent) point of view. | |
| J01.FR.13 | When reporting phase rotation of a component | The Charging Station SHALL report the phase rotation relative to the grid connection | |
| J01.FR.14 | When configured to send MeterValuesRequest, See: Meter Values - Configuration | The Charging Station SHALL send MeterValuesRequest messages to the CSMS as configured. | |
| J01.FR.15 | J01.FR.14 AND Amount of measurands is too much for 1 MeterValuesRequest | The Charging Station MAY use multiple MeterValuesRequest messages to send all measurands. | |
| J01.FR.16 | `SampledDataSignReadings` is *true* | The Charging Station SHALL retrieve signed meter values from components that support data signing and put them in the *signedMeterValue* field. | This will usually only apply to energy meters. |
| J01.FR.17 | | The timestamp of a MeterValue SHALL apply to all its SampledValues. | |
| J01.FR.18 | When CSMS receives a MeterValuesRequest | CSMS SHALL respond with MeterValuesResponse. | Failing to respond with MeterValuesResponse might cause the Charging Station to try the same message again. |

# J02 - Sending transaction related Meter Values

*Table 154. J02 - Sending transaction related Meter Values*

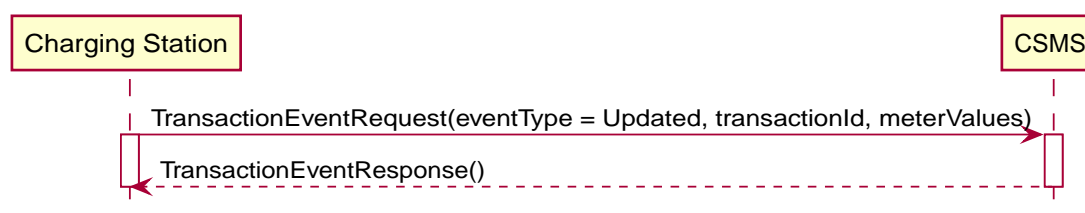| No. | Type | Description |
|-----|------|-------------|
| 1 | **Name** | Sending transaction related Meter Values |
| 2 | **ID** | J02 |
|   | *Functional block* | J. Meter Values |
| 3 | **Objective(s)** | To sample the energy meter or other sensor/transducer hardware to provide information about the Charging Stations' transaction related Meter Values. |
| 4 | **Description** | The Charging Station samples the energy meter or other sensor/transducer hardware to provide information about its transaction related Meter Values. Depending on configuration settings, the Charging Station will send Meter Values during a transaction. |
|   | *Actors* | Charging Station, CSMS |
|   | *Scenario description* | **1.** The Charging Station sends a TransactionEventRequest (eventType = Updated) message, for offloading Meter Values to the CSMS.<br>**2.** Upon receipt of a TransactionEventRequest message, the CSMS responds with a TransactionEventResponse message. |
| 5 | **Prerequisite(s)** | The Charging Station is configured to send Meter Values every XX seconds.<br>A transaction is running. |
| 6 | **Postcondition(s)** | **Successful postcondition:**<br>n/a<br><br>**Failure postcondition:**<br>n/a |



```
Charging Station                                                              CSMS

        TransactionEventRequest(eventType = Updated, transactionId, meterValues)

        TransactionEventResponse()
```

*Figure 91. Sequence Diagram: Sending transaction related Meter Values*

| No. | Type | Description |
|-----|------|-------------|
| 7 | **Error handling** | When *Offline*, the Charging Station MUST queue any transaction-related messages (Meter Values belonging to a transaction) that it would have sent to the CSMS if the Charging Station had been online. |
| 8 | **Remark(s)** | The phase field is not applicable to all Measurands.<br><br>The phase rotation of a Connector relative to the grid connection can be derived by querying the PhaseRotation Configuration Variables of all components in the chain from grid connection up to Connector.<br><br>The nature of each sampledValue is determined by the optional Measurand, context, location, unit and phase fields.<br><br>The optional SignedMeterValue field can contain digitally signed binary meter value data. |

## J02 - Sending transaction related Meter Values - Requirements

*Table 155. J02 - Requirements*

| ID | Precondition | Requirement definition | Note |
|---|---|---|---|
| J02.FR.01 | | The Charging Station MAY sample the energy meter (or other sensor/transducer hardware) to provide extra information about its Meter Values. | It is up to the Charging Station when it will send Meter Values. This can be configured using the SetVariablesRequest message to data acquisition intervals and specify data to be acquired & reported. |
| J02.FR.02 | If all captured at the same point in time. | Each MeterValue element SHALL contain a set of one or more individual SampledValue elements. | |
| J02.FR.03 | | The optional measurand field SHALL specify the type of value being measured/reported. | |
| J02.FR.04 | | The optional context field SHALL specify the reason/event triggering the reading. | |
| J02.FR.05 | | The optional location field SHALL specify where the measurement is taken. | (e.g. Inlet, Outlet). |
| J02.FR.06 | | The optional phase field SHALL specify to which phase or phases of the electric installation the value applies. | |
| J02.FR.07 | | The Charging Station SHALL report all phase number dependent values from the power meter (or grid connection when absent) point of view. | |
| J02.FR.09 | When reporting phase rotation of a component | The Charging Station SHALL report the phase rotation relative to the grid connection. | |
| J02.FR.10 | | The meterValue measurements in the same TransactionEventRequest message SHALL all belong to the timestamp in the message | meterValues for other timestamps should be sent in separate TransactionEventRequest messages. |
| J02.FR.11 | When configured to send meter data in the TransactionEventRequest (eventType = Updated), See: Meter Values - Configuration | The Charging Station SHALL add the configured measurands to the optional meterValue field in the TransactionEventRequest(eventType = Updated) sent to the CSMS to provide more details during the transaction. | |
| J02.FR.12 | J02.FR.11<br><br>AND<br><br>*Offline*<br><br>AND<br>The Charging Station is running low on memory | The Charging Station MAY drop TransactionEventRequest(eventType = Updated) messages. | |
| J02.FR.13 | J02.FR.12 | When dropping TransactionEventRequest (eventType = Updated) messages, the Charging Station SHALL drop intermediate messages first (1st message, 3th message, 5th message etc.), not start dropping messages from the start or stop adding messages to the queue. | |
| J02.FR.14 | J02.FR.11<br><br>AND<br><br>Amount of meter data is too much for 1 TransactionEventRequest (eventType = Updated) | The Charging Station MAY use multiple TransactionEventRequest(eventType = Updated) messages with the same *timestamp* to send all measurands. | |
| J02.FR.15 | `AlignedDataSignReadings` is *true* | The Charging Station SHALL retrieve signed meter values from components that support data signing and put them in the *signedMeterValue* field. | This will usually only apply to energy meters. |

| ID | Precondition | Requirement definition | Note |
|---|---|---|---|
| J02.FR.16 | | All "Register" values relating to a single charging transaction, or a non-transactional consumer (e.g. Charging Station internal power supply, overall supply) MUST be monotonically increasing in time. | Except in the case of a meter replacement. See MeasurandEnumType. |
| J02.FR.17 | | For improved auditability, ".Register" values SHOULD be reported exactly as they are directly read from a non-volatile register in the electrical metering hardware, and SHOULD NOT be re-based to zero at the start of transactions | This allows any "missing energy" between sequential transactions, due to hardware fault, meter replacement, mis-wiring, fraud, etc. to be identified, by allowing the CSMS to confirm that the starting register value of any transaction is identical to the finishing register value of the preceding transaction on the same connector. |
| J02.FR.18 | | The timestamp of a MeterValue SHALL apply to all its SampledValues. | |
| J02.FR.19 | When CSMS receives a TransactionEventRequest | CSMS SHALL respond with TransactionEventResponse. | Failing to respond with TransactionEventResponse might cause the Charging Station to try the same message again. |

## 3.2. ISO 15118 MeterValue signing

## J03 - Charging Loop with metering information exchange

*Table 156. J03 - Charging Loop with metering information exchange*

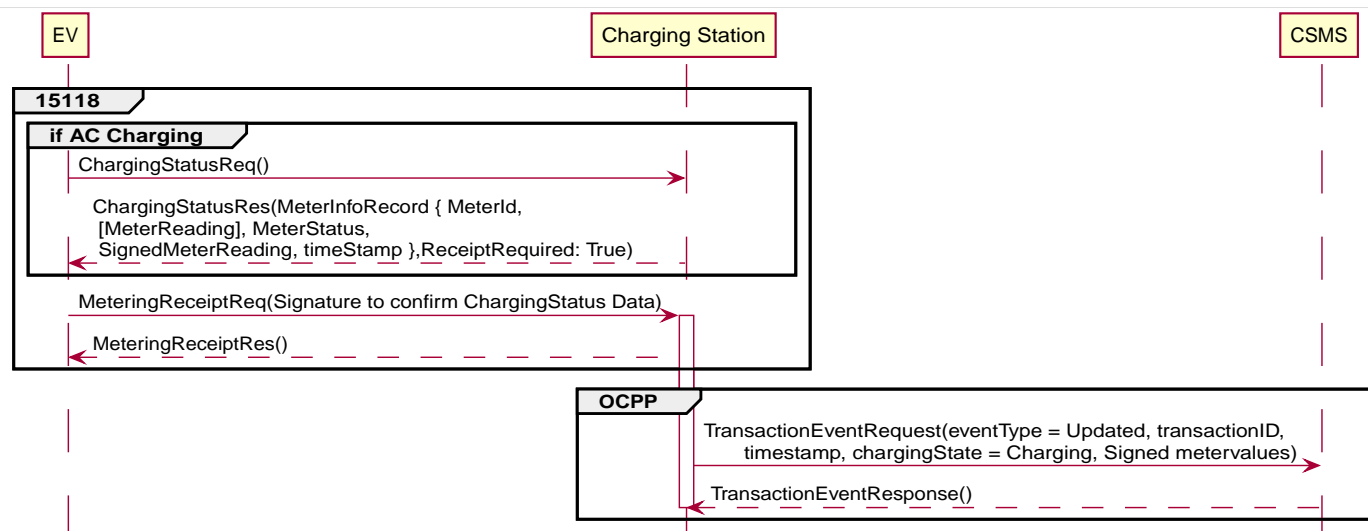| No. | Type | Description |
|---|---|---|
| 1 | **Name** | Charging Loop with metering information exchange |
| 2 | **ID** | J03 |
| | *Functional block* | J. Meter Values |
| | *Reference* | ISO15118-1 F1 |
| 3 | **Objectives** | See ISO15118-1, use case Objective F1, page 37. |
| 4 | **Description** | See ISO15118-1, use case Description F1, page 37. |
| 5 | **Prerequisites** | - If authorization according use cases in Functional Block C is applied, it SHALL be finished successfully.<br><br>See ISO15118-1, use case Prerequisites F1, page 37. |
| 6 | Actors | EV, EVSE, Charging Station |
| 7 | **Combined scenario description** | **15118**<br>**1.** The EV sends a ChargingStatusReq (in case of AC charging) message to the Charging Station.<br>**2.** The EV sends a MeteringReceiptReq to the Charging Station.<br><br><br>**OCPP**<br>**3.** Between the Charging Station and the CSMS, the TransactionEventRequest(eventType = Updated) message is being exchanged.<br>When sending a MeteringReceiptReq message the EV acknowledges that the data elements MeterInfo record, SessionID and the SAScheduleTupleID included in the ChargingStatusRes message prior to this request have been received from the Charging Station. This confirmation is implemented by applying a signature to the message body of the MeteringReceiptReq message. |
| 8 | **Postcondition(s)** | See ISO15118-1, use case End conditions F1, page 37. |

*Figure 92. Charging Loop with metering information exchange*

| 9 | Error handling | n/a |
|---|---|---|
| 10 | Remark(s) | The MeteringReceiptReq message in ISO 15118 only applies to ChargingStatusReq (for AC), because CurrentDemandReq (for DC) does not contain meter values. |

## J03 - Charging Loop with metering information exchange - Requirements

*Table 157. J03 - Requirements*

| ID | Precondition | Requirement definition |
|---|---|---|
| J03.FR.04 | When the Charging Station receives ISO 15118 signed meter values | The Charging Station SHALL pass them to CSMS in a TransactionEventRequest(eventType = Updated) message. |