

## Operating quadrant

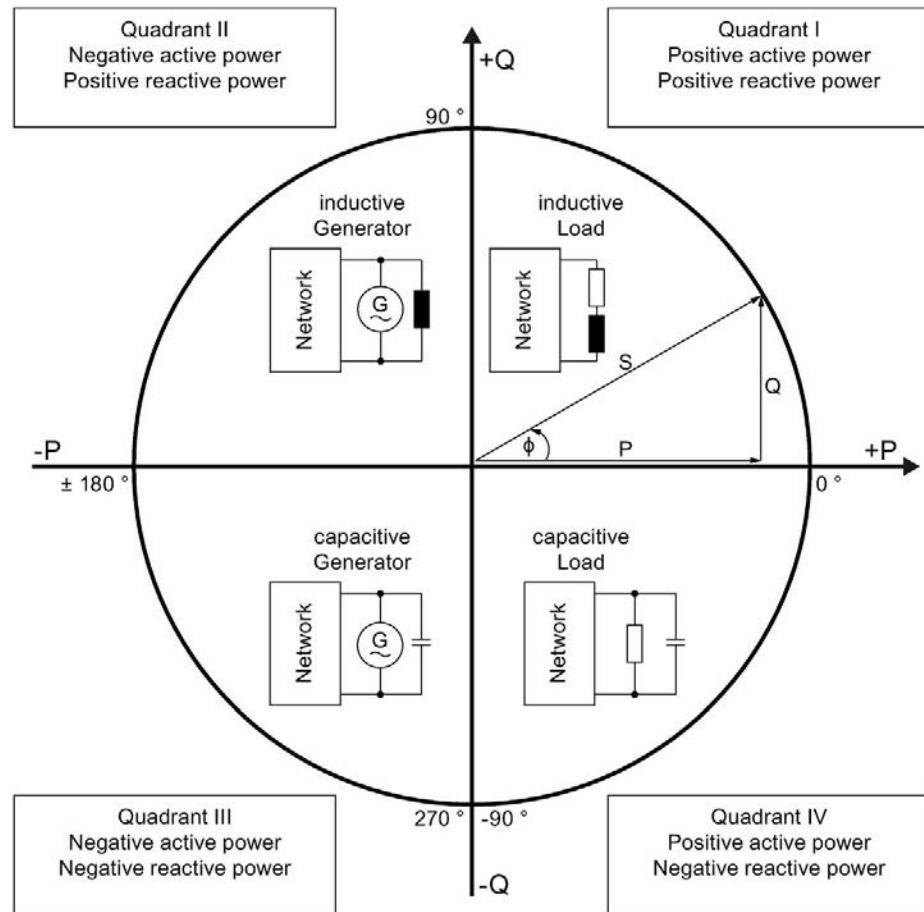


Figure 6-2 Voltage to electrical current phase angle quadrant in the quality bits

## 6.3 Reading measured values from the user data cyclically

周期性地从用户数据中读取测量值

### Requirement

- STEP 7 (TIA Portal) is open.
- SM 1238 Energy Meter 480VAC module is configured.

由于16位值的值范围通常小于物理值的值范围，因此在用户数据中为各自测量或计算的过程值提供一个比例因子和基本值。用下式确定被测变量的实际值：

### Scaling of measured values in the user data

Since the value range of 16-bit values is often smaller than the value range of the physical value, a scaling factor is supplied together with the basic value in the user data for the respective measured or calculated process values. You determine the actual value of the measured variable with the following formula:

Actual value of measured quantity = measured value in the user data  $\times 10^{\text{scaling factor}}$   
被测数量的实测值=用户数据中的实测值 $\times 10$ 比例因子

### Procedure

要循环地从用户数据读取测量值，请执行以下步骤

To read measured values from the user data cyclically, proceed as follows:

1. Read the relevant measured value from the PLC's input data. 从PLC的输入数据中读取相应的测量值。
2. Read the scaling factor for the scaled measured values and convert the measured value using the scaling factor. 读取缩放后的测量值的缩放因子，并使用缩放因子转换测量值。

### Example

The Process data variant 254 ( $FE_H$ ) "Total power L1, L2, L3" is configured on the SM 1238 Energy Meter 480VAC. Read the measured value for "Current L1".

Table 6- 1 Total power L1L2L3

Byte	Allocation	Data type	Unit	Value range	Measured value ID
0	Process data variant	BYTE	-	254 ( $FE_H$ )	-
1	Quality information = QQ <sub>1</sub> I <sub>3</sub> U <sub>3</sub> I <sub>2</sub> U <sub>2</sub> I <sub>1</sub> U <sub>1</sub>	BYTE	Bit string	qq xx xx xx	-
2 ... 3	Current L1	UINT	1 mA	0 ... 65535	66007
4 ... 5	Current L2	UINT	1 mA	0 ... 65535	66008
6 ... 7	Current L3	UINT	1 mA	0 ... 65535	66009
:	:	:	:	:	:
24	Scaling current L1	USINT	-	0 ... 255	-
25	Scaling current L2	USINT	-	0 ... 255	-
26	Scaling current L3	USINT	-	0 ... 255	-
:	:	:	:	:	:
31	Scaling total reactive energy L1L2L3	USINT	-	0 ... 255	-

In the Process data variant FE<sub>H</sub> (254) the measured value for the current L1 is stored in Bytes 2 and 3. The current is supplied by the module as a 16-bit fixed-point number in the value range from 0 ... 65535 in 1 mA units. In addition, the scaling factor for the current L1 must be read. The module supplies the related scaling factor in Byte 24.

在过程数据变型FEH(254)中，存储当前L1的测量值

电流L1的实际值计算如下：

The actual value for current L1 is calculated as follows:

Actual value for current L1 = Current L1 × 10<sup>Scaling current L1</sup>

电流L1的实际值=电流L1 × 10scale电流L1

字节2和字节3。该模块提供的电流为16位定点数，取值范围从0...65535在1毫安单位。此外，必须读取当前L1的比例因子。该模块以字节24提供相关的比例因子。

## 6.4 Read measured value from a measured data record

从测量数据记录中读取测量值

### Introduction

Use the RDREC instruction to read measured values from a measured value data record.

The values read are stored in a PLC variable with user-defined data type (UDT).

读取的值存储在具有用户定义数据类型(UDT)的PLC变量中。

You can find more information on the "RDREC" instruction in the STEP 7 (TIA Portal) documentation.

### Requirement

- STEP 7 is open.
- SM 1238 Energy Meter 480VAC module is configured.

### Procedure

1. In STEP 7, create a user-defined data type with the structure of the data record to be read. 创建一个用户定义的数据类型，该数据类型具有要读取的数据记录的结构。
2. Insert the number of structural elements, which corresponds to the number of entries contained in the measured value data record. 插入结构元素的数量，与实测值数据记录中包含的条目数量相对应。
3. Insert the RDREC instruction in the user program.
4. Configure the RDREC instruction as follows:
  - ID: Hardware identifier or start address of the Energy Meter (depending on the CPU used). 电能表的硬件标识符或启动地址(取决于使用的CPU)。
  - INDEX: Number of measured value data record whose entries are read. 被读取条目的测量值数据记录的数量。
  - MLEN: Length of the measured value data record in bytes. "0" if all the entries are to be read. 测量值数据记录的长度(以字节为单位)。如果要读取所有条目，则为“0”。三
  - RECORD: Target range for the read data record Length depends on MLEN. 读取数据记录长度的目标范围取决于MLEN。
5. Call the RDREC instruction with REQ = 1.

### Result

The values from the measured value data record are transferred into the target data area.

测量值数据记录中的值被传输到目标数据区域

# Energy counters

## 7.1 How the energy meter works 电能表是如何工作的

### Introduction

The SM 1238 Energy Meter 480VAC provides 42 energy counters that detect both line-based and phase-based energy values. SM 1238能量表480VAC提供42个能量计数器，可以检测基于线路和基于相位的能量值。

- Active energy (total, outflow, inflow)
- Reactive energy (total, outflow, inflow)
- Apparent energy (total)

### How energy recording works

The Energy Meter calculates the active, reactive and apparent energy based on the measured currents and voltages and the calculation cycle. The active, reactive and apparent energies are updated in each calculation cycle. 电能表根据测量的电流、电压和计算周期计算有功、无功和视在能。在每个计算周期中，有功、无功和表观能量都要更新。

### Values retained through power interruption 通过断电保留的值

All the counter states of the module are stored retentively in the Energy Meter. After an interruption (e.g. System power Off → System power On), the energy counting resumes using the retentively stored values. 模块的所有计数器状态都存储在能量计中。在中断之后(例如系统电源关闭→系统电源打开)，使用保留的存储值恢复能量计数。

### Configuring

You configure the following settings for the energy counter:

- Activation of the gate for the energy counter 激活能量计数器的门  
The gate allows you to start and stop the counters via output data (DQ bit). If you deactivate the gate, the count starts immediately when the Energy Meter is switched on.
  - Modes of the energy counters  
The energy counters count either infinitely or periodically. For periodic counting, the adjustable full-scale values are 10<sup>3</sup>, 10<sup>6</sup>, 10<sup>12</sup> and 10<sup>15</sup> Wh (Watt hour). When the full-scale value is exceeded, the energy counter begins again at 0. At the same time the overflow counter is incremented by 1 (see Resetting energy counter and overflow counters (Page 47)).
- The settings apply to the energy counters for all phases.

您可以在运行时更改以下能量计数器的属性:

### Changing properties in RUN

You can change the following properties of energy counters in runtime:

- Enable / disable energy counter 启用/禁用能量计数器
- Reset energy counter 重置能源计数器
- Set initial values for the energy counter 设置能量计数器的初始值
- Change the mode of the energy counter 改变能量计数器的模式

### Automatic reset of the energy counter

The energy counters are automatically reset to "0" when parameter settings relevant to the energy counter are changed. In the case of phase-specific changing of parameter settings relevant to the energy counter only the energy counters of the respective phases are reset.

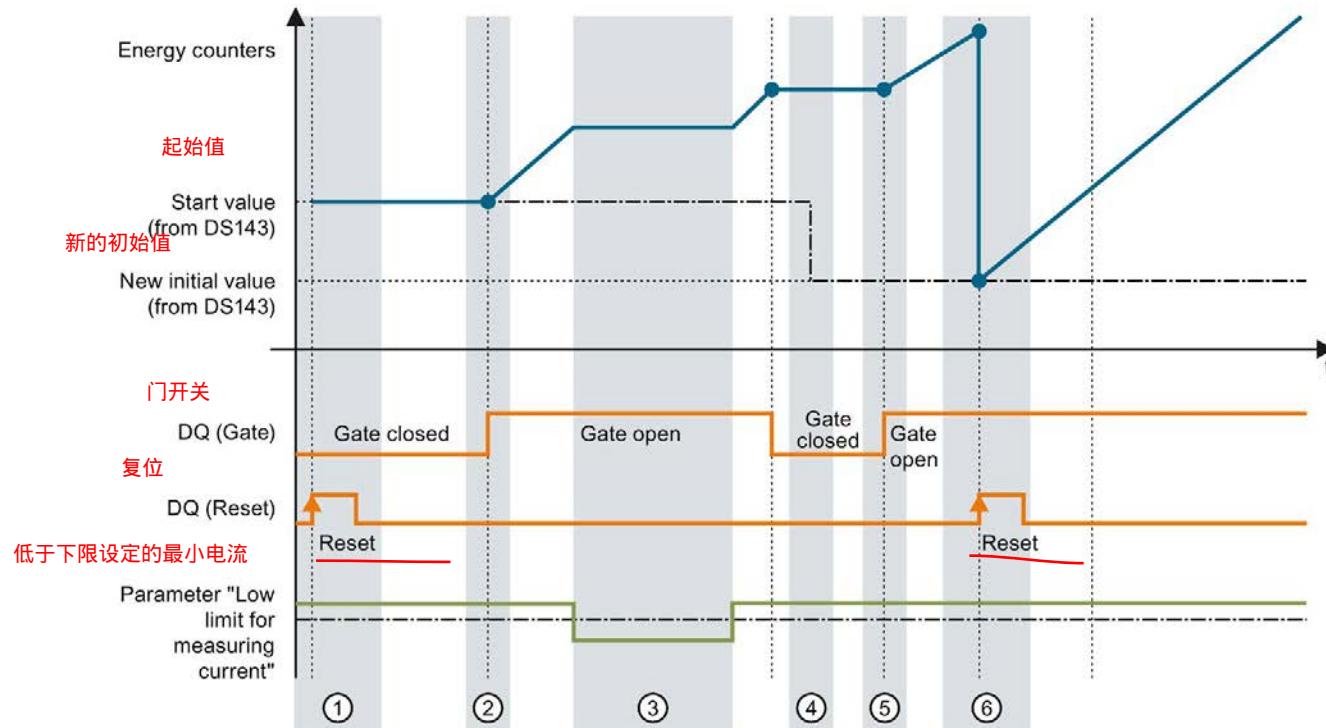
Changing of the following parameters results in resetting of the energy counters: 更改下列参数可重置能量计数器:

- Measurement type or range
- Electrical current transformer (primary current/secondary current)
- Voltage transformer (primary voltage/secondary voltage)
- Direction of current
- Full-scale value for energy counter
- Mode of the energy counter (infinite / periodic)

如下图所示，以能量计数器为例，激活门控后，初始值、复位、启动/停止参数的效果如下图所示：

## Example

The following figure shows the effect of initial value, reset and start/stop parameters with activated gating using the energy counter as an example:



- ① The counter is reset to the value assigned in the configuration. The gate is closed. The counter does not count.
- ② The gate is opened via the control byte 1 in the output data of the Process data variant. The counter counts.
- ③ The current is less than the configured electrical current low limit. The counter does not count.
- ④ The gate is closed. The counter does not count. A new start value is written to the measured value data record 143 with the WRREC instruction.
- ⑤ The gate is opened again via the control byte 1 in the output data of the Process data variant. The counter counts with the new start value.
- ⑥ The counter is reset via the control byte 1 in the output data of the Process data variant. The counter counts from the new start value that was transferred from the measured value data record 143.

## 7.2 Configuring the energy counters 配置能量计数器

### Overview

You can configure the various counters of the SM 1238 Energy Meter 480VAC as follows:

- Activate / Deactivate
- Start / stop counters using gate 使用gate启动/停止计数器
- Set and reset start value 设置和重置开始值

### Energy counter gate control

You have the option of starting and stopping the energy counter using a gate. To use the gate function, you must:

- Enable the "Activate gate for energy meter" parameter in the configuration of the SM 1238 Energy Meter 480VAC.
- Set the DQ bit for the counter gate in the user data Control byte 1 of the output data (Bit 6 in Control byte 1). 在输出数据的用户数据控制字节1(控制字节1中的第6位)中设置计数器门的DQ位。

The "Activate gate for energy meter" parameter and the DQ bit for the counter gate behave like the parallel connection of contacts.

Gate enabled: Gate "open" if DQ = "1"

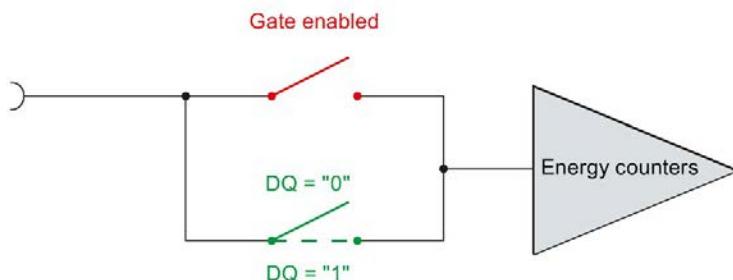


Figure 7-1 Gate switch activated

如果取消选择“激活电能表闸门”参数，则在配置中

## 7.2 Configuring the energy counters

SM 1238能量计480VAC，只要电流值高于配置的“低限电流测量”，能量计数器独立于DQ位运行。

If you deselect the "Activate gate for energy meter" parameter in the configuration of the SM 1238 Energy Meter 480VAC, the energy counters operate independently of the DQ bit as long as the electrical current value lies above the configured "Low limit electrical current measurement".

Gate disabled: Gate is always "open" (signal path closed)

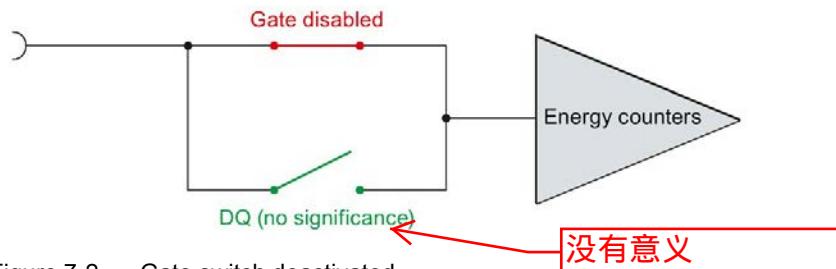


Figure 7-2 Gate switch deactivated

### Set and reset start value

可以通过每个进程数据变体的输出数据将计数器设置为它们的起始值。

对于能量计数器，必须在数据记录143的控制字节2中重置能量计数器的位。

The counters can be set to their start value via the output data of each Process data variant. For energy counters, you must reset the bit of the energy counter in control byte 2 of the data record 143.

You can reset each energy counter to the start value or assign a new start value via the data record 143. You define the moment for updating of the start values in the data record 143 and the user data control byte 1. Start values are either applied immediately, or after a reset bit transition from 0 to 1.

You can find a detailed description of this behavior in section Resetting energy counter and overflow counters (Page 47).

## 7.3

## Evaluating energy counters and overflow counters

### Introduction

The energy counters are evaluated by:

- Using the input data of the Process data variants for energy
  - Process data variant "Total energy L1 L2 L3" (ID 249 or F9<sub>H</sub>)
  - Process data variant "Energy L1" (ID 248 or F8<sub>H</sub>)
  - Process data variant "Energy L2" (ID 247 or F7<sub>H</sub>)
  - Process data variant "Energy L3" (ID 246 or F6<sub>H</sub>)
- Using the input data of the Process data variant and the measured value IDs for energy counters
- By reading measurement data records
  - "Data record for basic measured values (DS 142)" for evaluation of the total energies L1 L2 L3
  - "Data record for energy counter (DS 143)" for evaluation of the phase-specific energy
  - "Data record for phase-specific measured values L1 - L3 (DS 147 - 149) for evaluation of the phase-specific energies

The overflow counters are evaluated by: 溢出计数器的计算方法为:

- Using the input data of the Process data variant and the measured value IDs for overflow counters
- Reading the "Data record for energy counters (DS 143)"

### Evaluate measured values

The evaluation of measured values via the input data of Process data variants and reading of data records with the RDREC instruction is described in the section Reading and processing measured values (Page 34).

## 7.4 Resetting energy counter and overflow counters

### 7.4.1 Introduction

#### Introduction

At the beginning of a factory production run, it may be useful to reset the energy and overflow counters of the Energy meter. The energy counters are reset to their start values and the overflow counters are reset to 0.

The following section describes how to:

- Reset energy counters via the user data output data.
- Reset energy counters and overflow counters via data record 143.

### 7.4.2 Resetting energy counters by user data

#### Introduction

Due to the differing lengths of the output data, resetting the energy counters depends on the configured module version.

If you use module versions with 12 bytes output data, you can

- Reset energy counters for all phases separately by active, reactive and apparent energy.
- Reset energy counters for each individual phase separately by active, reactive and apparent energy.

If you use the module version with 2 bytes output data, you always reset all the energy counters simultaneously. Separate resetting of the active, reactive or apparent energy counters is only possible via data set DS 143, for details see section Resetting energy counters and overflow counters by data set DS 143 (Page 49).

#### Requirements

Resetting of the energy counters is enabled via user data in the default setting and may not be blocked in Control byte 1 of the data record 143.