Application note

Grid connections
3-phase meters

Behavior of P1 values

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1 Introduction

A consumer with a polyphase meters can be connected to in several different configurations. Depending on the connection type (wiring), the content (values) on the P1-port will behave in a different way. This document gives insight in the P1 differences between the possible configurations.

Note that this document focusses on the behaviour of the polyphase meter. The behaviour of the monophase meter is more straightforward in that sense that it only can be connected to the consumer in one single configuration. For the monophase meter(s) the P1 specification (eMUCS-P1 Vx.x) is clear enough that there is no need for further explanation.

2 Different configurations for a polyphase meter

A polyphase meter can be connected in four different configurations towards the consumer:

- In a monophase configuration, connected to a distribution grid with distribution of the neutral(3N400V). Further in this document called “400V 1P”
- In a monophase configuration, connected to a distribution grid without distribution of the neutral (3x230V). Further in this document called “230V 1P”
- In a polyphase configuration, connected to a distribution grid with distribution of the neutral(3N400V). Further in this document called “400V 3P”
- In a polyphase configuration, connected to a distribution grid without distribution of the neutral (3x230V). Further in this document called “230V 3P”

The beneath illustrations show the difference between the configuration types. The connection to the consumer, the outlet of the meter, is highlighted.

Note that the polyphase meter on grid side, the inlet of the meter, is always connected to the three phases

The meter is certified for all possible configurations and the accuracy is guaranteed.

Note that for measuring on a 3x230V grid, the L2 inlet of the polyphase meter is bridged on grid side to the N inlet of the meter. The reason behind is the use of a 2W-meter measurement method. See chapter 3 for further information.

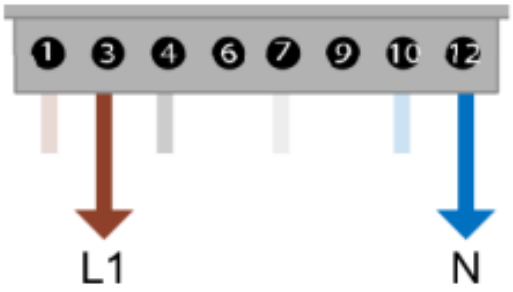
2.1 Monophase configurations towards the consumer

Note that the illustrations for monophase configurations show a connection between L1-N for 400V 1P and L1-L3 for 230V 1P. This is not fixed and can vary.

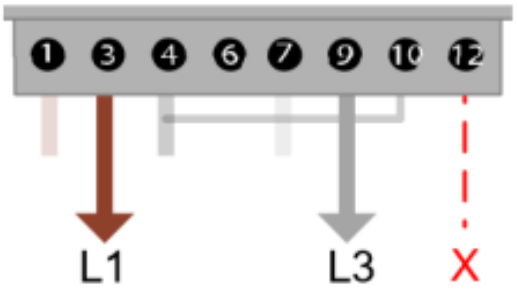
The possible connections:

- For 400V 1P: L1-N or L2-N or L3-N
- For 230V 1P: L1-L3 or L1-L2 or L2-L3

Over time this can even vary for a single installation. A physical reconfiguration can be done due to grid optimalisations / better phase distribution

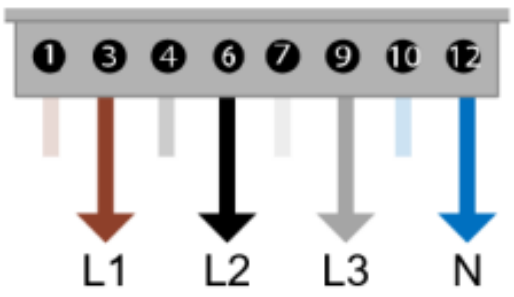


Connection type **“400V 1P”**

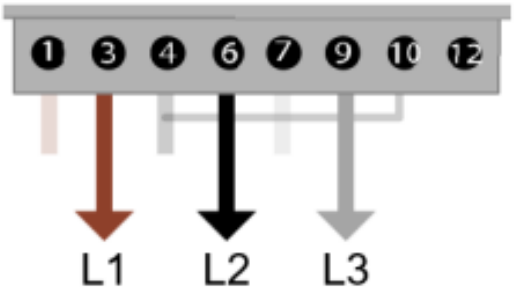


Connection type **“230V 1P”**

2.2 Polyphase connections towards the consumer



Connection type **“400V 3P”**



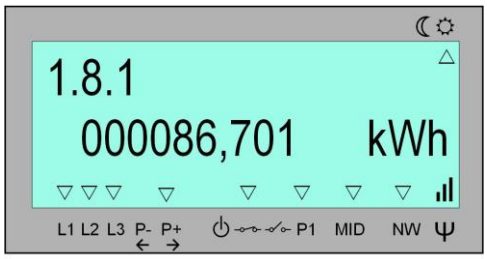
Connection type **“230V 3P”**

2.3 How to distinguish between the possibilities on-site

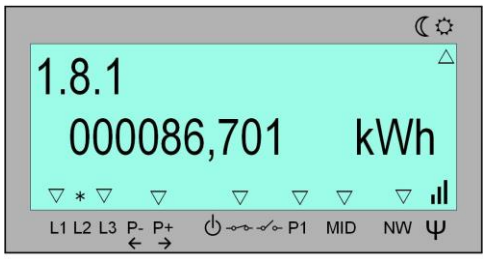
There are two indicators that can be used to determine the configuration on-site, at a consumers installation.

2.3.1 Determination of the grid connection

Determination of the distribution grid type (3x230V or 3N400V) can be done on the display of the polyphase meter or based on information available in the P1 telegram.



Connection to 3N400 grid
Phase indicator above L2 shows an arrow



Connection to 3x230V grid
Phase indicator above L2 shows an astrix

For a meter connected to a 3N400V grid, the value in OBIS-code 1-0:94.32.1 shows “400”. In case of a 3x230V grid, the value is “230”. This makes an automatic detection by the P1-application possible.

Note that OBIS-code 1-0:94.32.1 is only available since P1 version 2.1. For older versions, the alternative for the grid detection is the use of OBIS-code 1-0:52.7.0. If the value is showing “0V” the meter is connected to a 3x230V grid. In case other than 0, the grid is 3N400V

2.3.2 Determination of the consumer connection

Determination of the consumer connection (monophase or polyphase) can be done by checking the consumers home installation (distribution board). If the differential current device is a single-phase device, the consumer connection monophase. In case the differential current device is a multiphase device, the consumer connection polyphase.

Example of a single-phase differential current device

Example of a multiphase differential current device

The consumer connection (1P or 3P) cannot be directly deducted out of the P1-telegram. An indirect deduction is possible based on the behavior of P1-values. Later in this document this will be further explained, see chapter 0

3 Behaviour of the P1 values per configuration

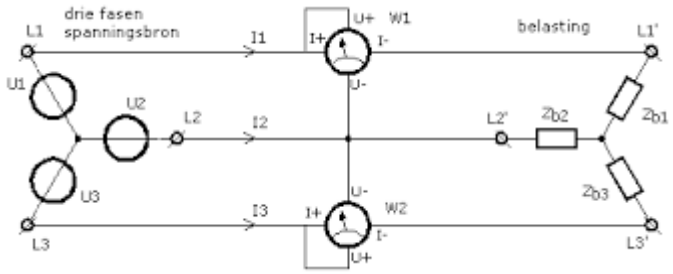
This chapter explains the behaviour of the P1 values that are impacted by the different ways of configuration related to the polyphase meters

3.1 Configuration of the digital meter as 3W-meter or 2W-meter (Aron)

To understand the way the values on the P1 behave, we need to give some insights in the digital meter design. The meter is designed with 3 watt-meters to measure the energy. In a distribution grid with distributed neutral connection (3N400V), all three watt-meters are connected.

In a distribution grid without distributed neutral connection (3x230V), this is not possible due to the absence of the neutral. In this grid type, one phase will be taken as “reference” for the meter and only two watt meters are used to perform the energy measurement. The wiring of the meter will be done in a way that one of the three watt-meters is short circuited and the other two are placed in an Aron circuit.

The convention is that L2 is used as “the reference” in the 3x230V measurement setup



Configuration of the watt-meters in an Aron circuit for measuring energy

Only the impacted OBIS-codes are listed in this chapter

3.2 Behaviour in a 400V 3P configuration

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “400” and means 3N400V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power between L1 and N
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power between L2 and N

1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power between L3 and N
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power between L1 and N
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power between L2 and N
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power between L3 and N
1-0:32.7.0 (Voltage L1)	The value shows the voltage between L1 and N
1-0:52.7.0 (Voltage L2)	The value shows the voltage between L2 and N
1-0:72.7.0 (Voltage L3)	The value shows the voltage between L3 and N
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1 (towards N)
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 (towards N)
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3 (towards N)

3.3 Behaviour in a 230V 3P configuration

Note that the behaviour is slightly different depending on the meter type. The meter type or identification can be found on the meter plate or in the P1 telegram at the start of each telegram

- L+G E360 3P telegram: /LGF5E360
- Sagemcom (X)T211 telegram: /FLU5**********

3.3.1 L+G E360 3P

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “230” and means 3x230V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power measured by the first watt-meter (Aron) **Is disabled, the value is always 0**
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power measured by the second watt-meter (Aron) **Is disabled, the value is always 0**
1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power measured by the third watt-meter (Aron) **Is disabled, the value is always 0**
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power measured by the first watt-meter (Aron) **Is disabled, the value is always 0**
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power measured by the second watt-meter (Aron) **Is disabled, the value is always 0**
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power measured by the third watt-meter (Aron) **Is disabled, the value is always 0**
1-0:32.7.0 (Voltage L1)	The value shows line voltage L12
1-0:52.7.0 (Voltage L2)	The value shows the voltage of the short circuited voltage coil of second watt meter **The value is always 0**
1-0:72.7.0 (Voltage L3)	The value shows line voltage L23
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 **Is disabled, the value is always showing 0**
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3

Note that Line voltage L31 is not shown in the P1 telegram

3.3.2 Sagemcom (X)T211

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “230” and means 3x230V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power measured by the first watt-meter (Aron)
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power measured by the second watt-meter (Aron) **This wattmeter is short circuited so always showing 0**
1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power measured by the third watt-meter (Aron)
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power measured by the first watt-meter (Aron)
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power measured by the second watt-meter (Aron) **This wattmeter is short circuited so always showing 0**
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power measured by the third watt-meter (Aron)
1-0:32.7.0 (Voltage L1)	The value shows line voltage L12
1-0:52.7.0 (Voltage L2)	The value shows the voltage of the short circuited voltage coil of second watt meter **The value is always 0**
1-0:72.7.0 (Voltage L3)	The value shows line voltage L23
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 **Side effect of still having the current coil of the second watt-meter in L2, does not impact the energy measurement (0V * xA = 0W)**
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3

Note that Line voltage L31 is not shown in the P1 telegram

3.4 Behaviour in a 400V 1P configuration

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “400” and means 3N400V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power between L1 and N **In case consumer connection is between L2-N or L3-N, the value is always 0**
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power between L2 and N **In case consumer connection is between L1-N or L3-N, the value always is 0**
1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power between L3 and N **In case consumer connection is between L1-N or L2-N, the value always is 0**
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power between L1 and N **In case consumer connection is between L2-N or L3-N, the value is always 0**
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power between L2 and N **In case consumer connection is between L1-N or L3-N, the value always is 0**
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power between L3 and N **In case consumer connection is between L1-N or L2-N, the value always is 0**
1-0:32.7.0 (Voltage L1)	The value shows the voltage between L1 and N
1-0:52.7.0 (Voltage L2)	The value shows the voltage between L2 and N
1-0:72.7.0 (Voltage L3)	The value shows the voltage between L3 and N
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1 (towards N) **In case consumer connection is between L2-N or L3-N, the value is always 0**
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 (towards N) **In case consumer connection is between L1-N or L3-N, the value always is 0**
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3 (towards N) **In case consumer connection is between L1-N or L2-N, the value always is 0**

3.5 Behaviour in a 230V 1P configuration

Note that the behaviour is slightly different depending on the meter type. The meter type or identification can be found on the meter plate or in the P1 telegram at the start of each telegram

- L+G E360 3P telegram: /LGF5E360
- Sagemcom (X)T211 telegram: /FLU5\253769484_A

3.5.1 L+G E360 3P

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “230” and means 3x230V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power measured by the first watt-meter (Aron) **Is disabled, the value is always 0**
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power measured by the second watt-meter (Aron) **Is disabled, the value is always 0**
1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power measured by the third watt-meter (Aron) **Is disabled, the value is always 0**
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power measured by the first watt-meter (Aron) **Is disabled, the value is always 0**
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power measured by the second watt-meter (Aron) **Is disabled, the value is always 0**
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power measured by the third watt-meter (Aron) **Is disabled, the value is always 0**
1-0:32.7.0 (Voltage L1)	The value shows line voltage L12
1-0:52.7.0 (Voltage L2)	The value shows the voltage of the short circuited voltage coil of second watt meter **The value is always 0**
1-0:72.7.0 (Voltage L3)	The value shows line voltage L23
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1 **The value is 0 when the consumer is connected between L3 and L2**
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 **Is disabled, the value is always showing 0**
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3 **The value is 0 when the consumer is connected between L1 and L2**

3.5.2 Sagemcom (X)T211

OBIS-code	Behaviour
1-0:94.32.1 (Grid configuration)	The value shows “230” and means 3x230V grid connection. (only available from P1 version 2.1)
1-0:21.7.0 (Active power L1 – import)	The value shows the active imported power measured by the first watt-meter (Aron) **The value is 0 when the consumer is connected between L2 and L3**
1-0:41.7.0 (Active power L2 – import)	The value shows the active imported power measured by the second watt-meter (Aron) **This wattmeter is short circuited so always showing 0**
1-0:61.7.0 (Active power L3 – import)	The value shows the active imported power measured by the third watt-meter (Aron) **The value is 0 when the consumer is connected between L1 and L2**
1-0:22.7.0 (Active power L1 – export)	The value shows the active exported power measured by the first watt-meter (Aron) **The value is 0 when the consumer is connected between L2 and L3**
1-0:42.7.0 (Active power L2 – export)	The value shows the active exported power measured by the second watt-meter (Aron) **This wattmeter is short circuited so always showing 0**
1-0:62.7.0 (Active power L3 – export)	The value shows the active exported power measured by the third watt-meter (Aron) **The value is 0 when the consumer is connected between L1 and L2**
1-0:32.7.0 (Voltage L1)	The value shows line voltage L12
1-0:52.7.0 (Voltage L2)	The value shows the voltage of the short circuited voltage coil of second watt meter **The value is always 0**
1-0:72.7.0 (Voltage L3)	The value shows line voltage L23
1-0:31.7.0 (Current L1)	The value shows the current flowing in L1 **The value is 0 when the consumer is connected between L3 and L2**
1-0:51.7.0 (Current L2)	The value shows the current flowing in L2 **Side effect of still having the current coil of the second watt-meter in L2, does not impact the energy measurement (0V * xA = 0W)**
1-0:71.7.0 (Current L3)	The value shows the current flowing in L3 **The value is 0 when the consumer is connected between L1 and L2**

Note that Line voltage L31 is not shown in the P1 telegram

4 Attachment

4.1 P1 example 230V 1P with consumer connection between L1-L3

This example illustrates the behaviour of a polyphase meter connected to a distribution grid without distribution of the neutral (3x230V). A load of 642W is connected between L1 and L2

/FLU5\253769484_A

0-0:96.1.4(50217)
0-0:96.1.1(3153414733313030303337383431)
0-0:1.0.0(251209131241W)
1-0:1.8.1(000000.684*kWh)
1-0:1.8.2(000000.978*kWh)
1-0:2.8.1(000000.043*kWh)
1-0:2.8.2(000000.002*kWh)
0-0:96.14.0(0001)
1-0:1.4.0(00.144*kW)
1-0:1.6.0(251209114500W)(00.020*kW)
0-0:98.1.0(13)(1-0:1.6.0)(1-0:1.6.0)(250101000000W)(632525252525W)(00.000*kW)(250201000000W)(632525252525W)(00.000*kW)(250301000000W)(632525252525W)(00.000*kW)(250401000000S)(632525252525W)(00.000*kW)(250501000000S)(632525252525W)(00.000*kW)(250601000000S)(632525252525W)(00.000*kW)(250701000000S)(632525252525W)(00.000*kW)(250801000000S)(632525252525W)(00.000*kW)(250901000000S)(632525252525W)(00.000*kW)(250904000000S)(632525252525W)(00.000*kW)(251001000000S)(632525252525W)(00.000*kW)(251101000000W)(632525252525W)(00.000*kW)(251201000000W)(632525252525W)(00.000*kW)
1-0:1.7.0(00.648*kW)
1-0:2.7.0(00.000*kW)
1-0:21.7.0(00.648*kW)
1-0:41.7.0(00.000*kW)
1-0:61.7.0(00.000*kW)
1-0:22.7.0(00.000*kW)
1-0:42.7.0(00.000*kW)
1-0:62.7.0(00.000*kW)
1-0:32.7.0(221.6*V)
1-0:52.7.0(000.0*V)
1-0:72.7.0(223.2*V)
1-0:31.7.0(003.02*A)
1-0:51.7.0(003.02*A)
1-0:71.7.0(000.00*A)
0-0:96.3.10(1)
0-0:17.0.0(999.9*kW)
1-0:31.4.0(999*A)
0-0:96.13.0()

!BB68

4.2 P1 example 230V 1P with consumer connection between L2-L3

This example illustrates the behaviour of a polyphase meter connected to a distribution grid without distribution of the neutral (3x230V). A load of 642W is connected between L2 and L3

/FLU5\253769484_A

0-0:96.1.4(50217)
0-0:96.1.1(3153414733313030303337383431)
0-0:1.0.0(251209131505W)
1-0:1.8.1(000000.704*kWh)
1-0:1.8.2(000000.978*kWh)
1-0:2.8.1(000000.043*kWh)
1-0:2.8.2(000000.002*kWh)
0-0:96.14.0(0001)
1-0:1.4.0(00.004*kW)
1-0:1.6.0(251209131500W)(00.220*kW)
0-0:98.1.0(13)(1-0:1.6.0)(1-0:1.6.0)(250101000000W)(632525252525W)(00.000*kW)(250201000000W)(632525252525W)(00.000*kW)(250301000000W)(632525252525W)(00.000*kW)(250401000000S)(632525252525W)(00.000*kW)(250501000000S)(632525252525W)(00.000*kW)(250601000000S)(632525252525W)(00.000*kW)(250701000000S)(632525252525W)(00.000*kW)(250801000000S)(632525252525W)(00.000*kW)(250901000000S)(632525252525W)(00.000*kW)(250904000000S)(632525252525W)(00.000*kW)(251001000000S)(632525252525W)(00.000*kW)(251101000000W)(632525252525W)(00.000*kW)(251201000000W)(632525252525W)(00.000*kW)
1-0:1.7.0(00.642*kW)
1-0:2.7.0(00.000*kW)
1-0:21.7.0(00.000*kW)
1-0:41.7.0(00.000*kW)
1-0:61.7.0(00.642*kW)
1-0:22.7.0(00.000*kW)
1-0:42.7.0(00.000*kW)
1-0:62.7.0(00.000*kW)
1-0:32.7.0(224.9*V)
1-0:52.7.0(000.0*V)
1-0:72.7.0(220.5*V)
1-0:31.7.0(000.00*A)
1-0:51.7.0(003.00*A)
1-0:71.7.0(003.00*A)
0-0:96.3.10(1)
0-0:17.0.0(999.9*kW)
1-0:31.4.0(999*A)
0-0:96.13.0()
!DE70

4.3 P1 example 230V 1P with consumer connection between L1-L3

This example illustrates the behaviour of a polyphase meter connected to a distribution grid without distribution of the neutral (3x230V). A load of 659W is connected between L1 and L3

/FLU5\253769484_A

0-0:96.1.4(50217)
0-0:96.1.1(3153414733313030303337383431)
0-0:1.0.0(251209130934W)
1-0:1.8.1(000000.656*kWh)
1-0:1.8.2(000000.978*kWh)
1-0:2.8.1(000000.043*kWh)
1-0:2.8.2(000000.002*kWh)
0-0:96.14.0(0001)
1-0:1.4.0(00.028*kW)
1-0:1.6.0(251209114500W)(00.020*kW)
0-0:98.1.0(13)(1-0:1.6.0)(1-
0:1.6.0)(250101000000W)(632525252525W)(00.000*kW)(250201000000W)(632525252525W)(00
.000*kW)(250301000000W)(632525252525W)(00.000*kW)(250401000000S)(632525252525W)(0
0.000*kW)(250501000000S)(632525252525W)(00.000*kW)(250601000000S)(632525252525W)(0
0.000*kW)(250701000000S)(632525252525W)(00.000*kW)(250801000000S)(632525252525W)(0
0.000*kW)(250901000000S)(632525252525W)(00.000*kW)(250904000000S)(632525252525W)(0
0.000*kW)(251001000000S)(632525252525W)(00.000*kW)(251101000000W)(632525252525W)(
00.000*kW)(251201000000W)(632525252525W)(00.000*kW)
1-0:1.7.0(00.659*kW)
1-0:2.7.0(00.000*kW)
1-0:21.7.0(00.455*kW)
1-0:41.7.0(00.000*kW)
1-0:61.7.0(00.204*kW)
1-0:22.7.0(00.000*kW)
1-0:42.7.0(00.000*kW)
1-0:62.7.0(00.000*kW)
1-0:32.7.0(225.1*V)
1-0:52.7.0(000.0*V)
1-0:72.7.0(224.6*V)
1-0:31.7.0(003.07*A)
1-0:51.7.0(000.00*A)
1-0:71.7.0(003.06*A)
0-0:96.3.10(1)
0-0:17.0.0(999.9*kW)
1-0:31.4.0(999*A)
0-0:96.13.0()
!325C