TECHNICAL NOTE

DIRIS Digiware Busway Integration

When **energy** matters

socomec
Innovative Power Solutions

Summary

Introduction

The DIRIS Digiware Power and Energy Monitoring system is a modular plug and play RJ45 electrical power and energy monitoring system.

DIRIS Digiware fits into various electrical designs and architectures.

The integration of busways / tap off boxes is one such design element that requires specific consideration.

Agenda

1. **Standard DIRIS Digiware design rules**
2. **Why and how it has to be adapted for busway applications**

1. Standard Design rules:

A few things to consider in design rules:

a. Power supplied and temperature
b. Cable lengths
c. Repeater usage conditions
d. Amount of modules
e. End of line resistor

A. The total power consumed by the equipment connected to a Digiware bus must not exceed:

- The nominal power of the 24VDC power supply unit
- 20W at 70°C or 27W at 40°C

Equipment consumption

Product	Power delivered (W)	Power consumed (W)
Power supply		
P15 100-240 VAC / 24 VDC	15	
P30 100-240 VAC / 24 VDC	20	
Cables		
50 metre package		1.5
System interfaces		
DIRIS Digiware D-50/D-70		2.5
DIRIS Digiware C-31		0.8
Module voltage		
DIRIS Digiware U-xx		0.72
DIRIS Digiware U-3xdc		0.6
Current modules		
DIRIS Digiware I-3x		0.52
DIRIS Digiware I-4x		1.125
DIRIS Digiware I-6x		0.7
DIRIS Digiware I-3xdc (+ 3 DC current sensors)		2
DIRIS Digiware S-xx		0.35
Input/output modules		
DIRIS Digiware IO-10/ IO-20		0.5
Repeater		
DIRIS Digiware C-32		1.5

Calculation rules for the max. number of products on the Digiware Bus

The total power consumed by the equipment connected to the Digiware Bus must not exceed the power from the 24 VDC supply.

The power supply must not exceed 20 W/70°C or 27 W/40°C.

Size with P15 power supply (ref: 4829 0120) delivering 15 W

For example, it is possible to use

- 1 DIRIS Digiware D-50 display (2.5 W)
- 1 DIRIS Digiware voltage module U-xx (0.72 W)
- 50 metres of cable (1.5 W)

and

- 19 DIRIS Digiware current modules I-3x (19 x 0.52 = 9.9 W)
  ☐ **Total power = 14.845 W**

or

- 9 DIRIS Digiware current modules I-4x (9 x 1.125 = 10.125 W)
  ☐ **Total power = 14.345 W**.

Size with a 24 VDC power supply delivering a maximum of 20 W (Power supply P30 ref: 4729 0603)

For example, it is possible to use

- 1 DIRIS Digiware D-50 display (2.5 W)
- 1 DIRIS Digiware voltage module U-xx (0.72 W)
- 50 metres of cable (1.5 W)

and

- 29 DIRIS Digiware current modules I-3x (29 x 0.52 = 15.1 W)
  ☐ **Total power = 19.82 W**

or

- 13 DIRIS Digiware current modules I-4x (13 x 1.125 = 14.625)
  ☐ **Total power = 19.345 W**.

Fig. 1: Power supply and consumption table.

B. Lengths (contractor + equivalent connectors)

The length of a bus (sum of all cables used) must not be beyond 100m.

C. Repeater usage conditions

When the power limit or length limit is exceeded, a DIRIS Digiware C-32 repeater can be used.
We can use up to 2 repeaters for a total of either:

- 60W (20W x 3) max power (1 DXX or MXX and 2 repeaters C-32)
- 300m (100m x 3) max distance (1 DXX or MXX and 2 repeaters C-32)

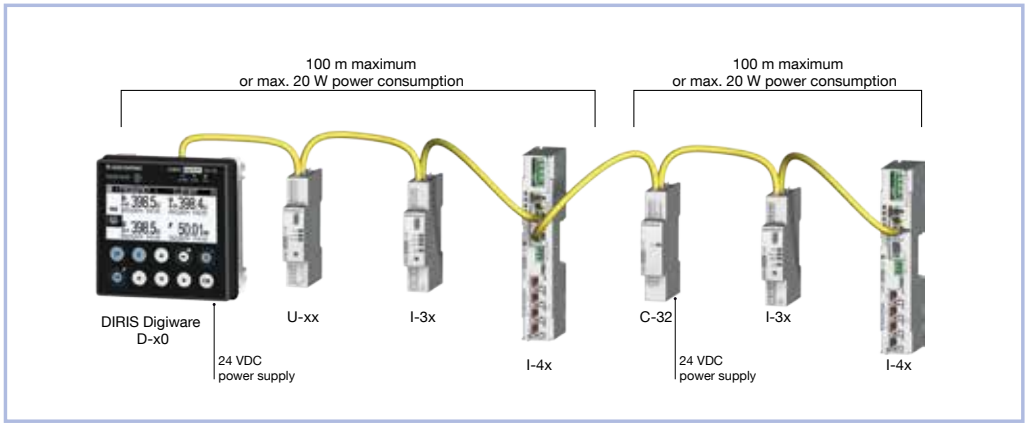

Fig. 2: DIRIS Digiware C-32 repeater usage example.

D. Amount of modules

The amount of modules is limited to 32 measurement modules for usage on the local display and for Bacnet/SNMP utilisation

The number of modules is limited to 255 (jbus/Modbus addresses) only in consideration with Modbus TCP usage as part of an EPMS/SCADA system.

The bandwidth consideration has to be taken into account to optimise the number of modules per display/gateway. Please refer to the specific technical white paper on the communication possibilities of DIRIS Digiware.

E. End of line resistor

It is vital to always position the end of line resistor on the last DIRIS Digiware module.
This will have a big impact not only upon the communication back to the head end / EPMS, but also upon the accuracy of the power/energy calculations.

2. Why does it have to be adapted for busway applications?

Specific considerations for busway/tap off box applications that can impact DIRIS Digiware design rules:

A. General description of DIRIS Digiware busway architecture
B. Intermediate connectors (3rd party or Socomec)
C. Cable lengths and cable specification impact
D. Evolution of sites and installation during life
E . High speed communication requirements

A. General description of DIRIS Digiware busway architecture

APPLI 860 A

1 DIRIS Digiware D-70
One dedicated display for the whole monitoring system. Communication and power control is centralised - shown via the display - and transmitted to all DIRIS Digiware modules through the RJ45 Digiware bus.

2 DIRIS Digiware U
One module inside the master tap-off unit measures voltage parameters of the incoming supply. The voltage information is then transmitted to all slave tap-off boxes for power and energy monitoring.
Data measured:
- U, V,
- voltage harmonics,
- voltage unbalance,
- power quality (swells, dips, interruptions).

3 DIRIS Digiware S
DIRIS Digiware S current modules measure single-phase or three-phase circuits up to 63 Amps.
With 3 integrated current sensors, they can be fitted directly on the MCBs inside each tap-off box.
Using the VirtualMonitor technology, the status of all breakers can be accessed remotely and in real time with no additional hardware.
Data measured:
- Amps, kW, kVar, kVA, PF,
- kWh, kVarh, kVAh,
- current harmonics,
- overcurrents,
- breaker status.

Fig. 3: Busway DIRIS Digiware architecture.

In a tap off box / busway type distribution, the DIRIS Digiware modules are implemented inside each TOB, with small cables connected to the output of the TOB:

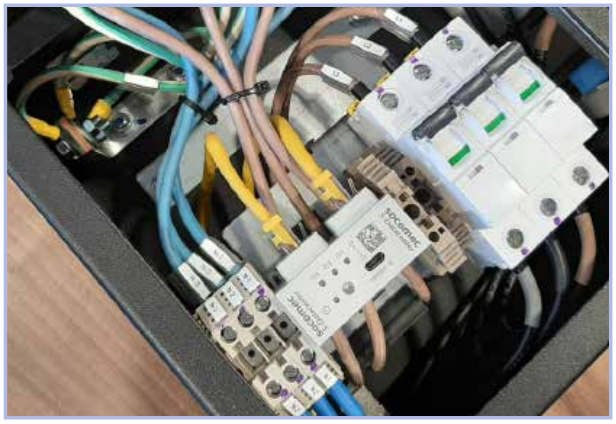

Fig. 4: Internal tap off box - DIRIS Digiware S integration.

Each TOB is then connected to the next from outside of the TOB.

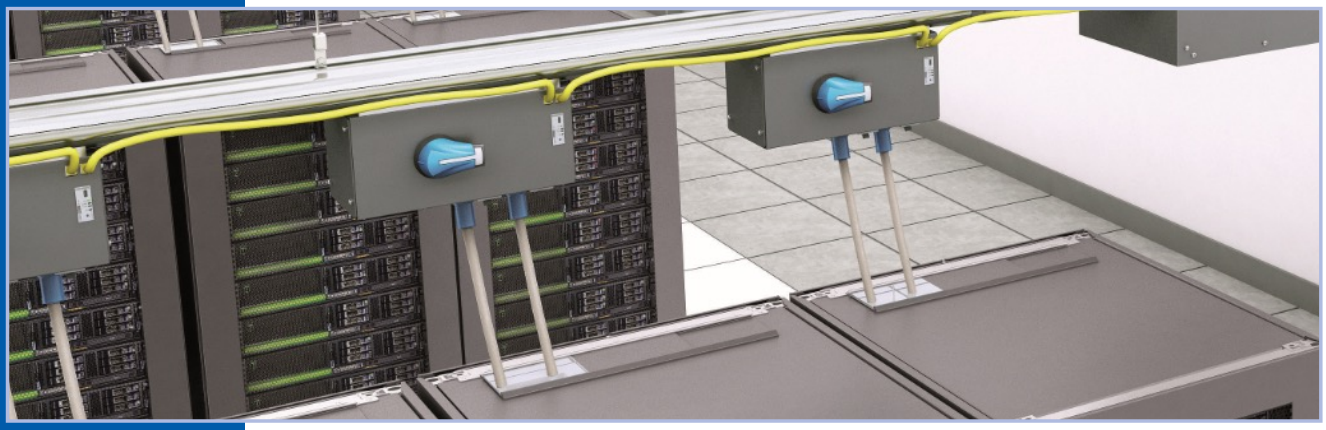

Fig. 5: Tap off box DIRIS Digiware interconnection.

B. Intermediate connectors (3rd party or Socomec)

This connection from each tap off box to the next is made through of RJ45 female/female connectors:

Fig. 6: Tap off box - external DIRIS Digiware connectors.

These connectors can have an impact on the DIRIS Digiware bus.

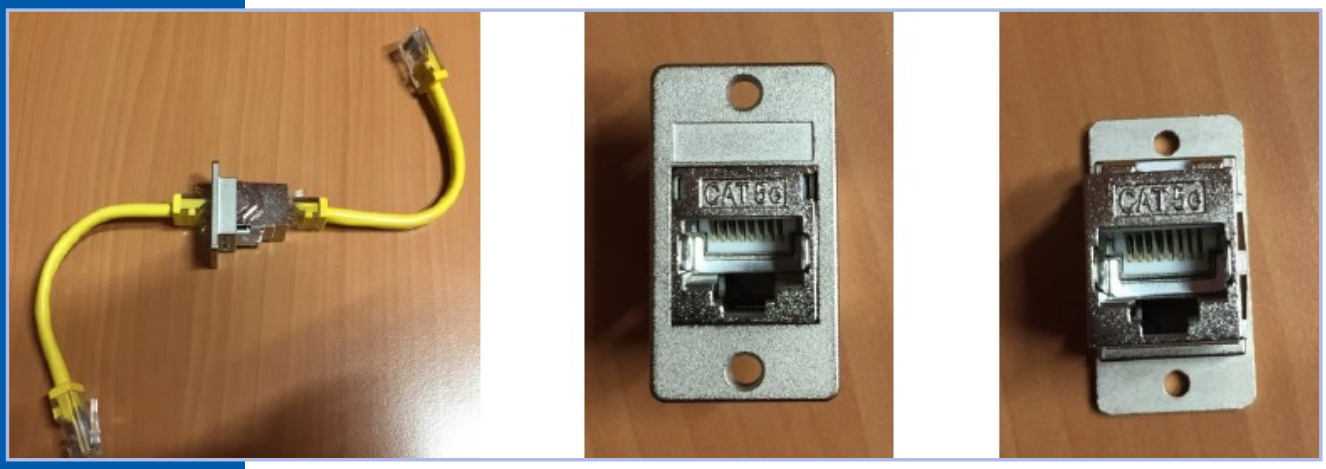

Fig. 7, 8, 9: RJ45 female/female connector.

Socomec has estimated - although this can vary from one RJ45 female/female connector to another - that a connector is equivalent to:

- **0.1W loss (generally 2 per tap off box makes 0.2W per tap off box)**
- **3.33 m equivalent cable length**

When considering complete DIRIS Digiware system design rules, the amount of RJ45 female/female connectors have to be taken into account in terms of lengths and power limits.

If these connectors impact upon power supply and lenghts are not taken into account, the complete monitoring system would be working beyond its specifications and could be subject to communication errors.

Socomec can also propose a withdrawable connector, that would limit the power and length loss, but that also enables all TOB downstream of the disconnected TOB stay “on”:

Fig. 10: Socomec withdrawable connector tap off box integration.

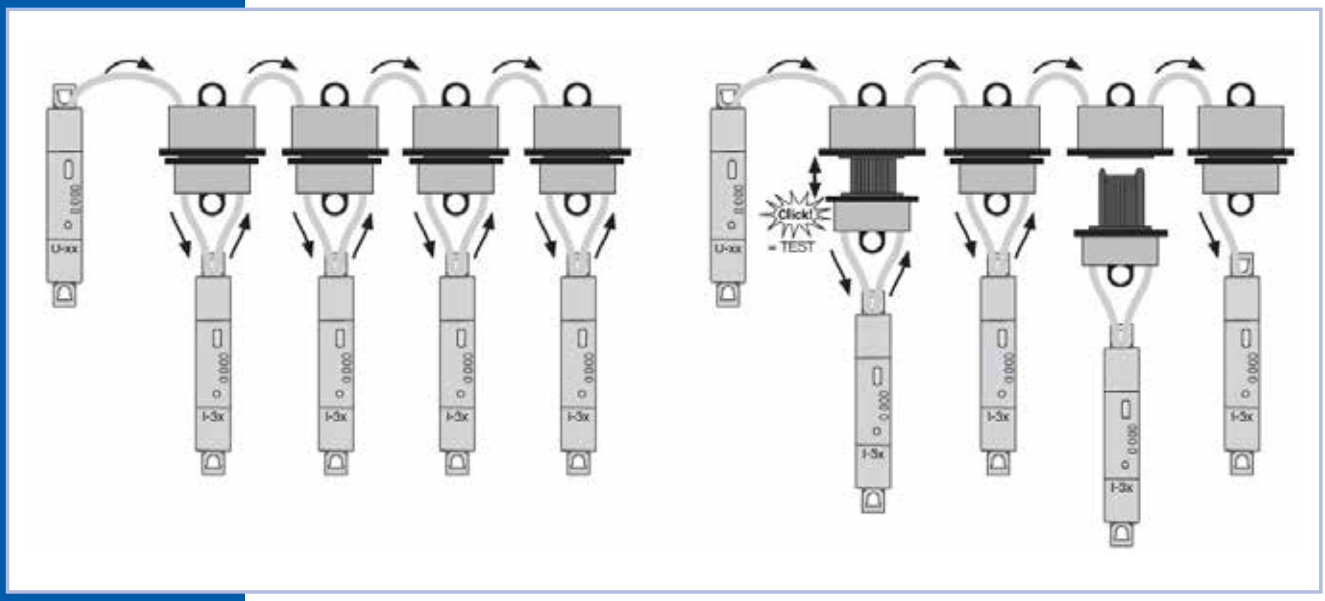

Fig. 11: Socomec withdrawable connector functioning principle.

The Socomec withdrawable connector impact on lengths and power is smaller than a standard RJ45 female/female connector.

For each we can consider:
- **0.01 W**
- **0.33 m loss**

Using a Socomec withdrawable connector limits the impact of these connectors on total length and power consumed, enabling more metering modules to be used before introducing repeaters.

C. Cable lengths and cable specification impact

It is not always possible for either Socomec or the company producing/assembling the busway and tap off boxes to determine the cable lengths.

For example, in this layout, we may think that each tap off box is connected to the next one by using 1 m cables:

Fig. 12: Tap off box DIRIS Digiware interconnection.

For reasons of standardisation, however, the on site contracting company might choose to use their 5m stock cables.

The extra length of cable can be can either be pending deployment or rolled into/around the busway trunking.

The impact on the total length of the bus (and the need for a repeater if beyond 100m) will be important.

Socomec's recommendation is to anticipate this by either:

- Warning the site contractor team to optimise the cable lengths during installation, to be compliant with the design calculations;
- Use a derating/safety factor when designing the system so that the system is resilient to using longer than anticipated cabling. For instance, the use of a repeater after a maximum of 15W or 75m during the design stage.

It is also important to use only 100% RJ45 Socomec cables.

Why this is important:

- The sections of the wires are generally larger than a standard Ethernet cable.
  This is because the power supply is transmitted through the RJ45 Digiware bus. Using other type of cables could, for example, limit the maximum distance to 60m instead of 100m.

- The Socomec cable insulation is 600V rated and can be in contact with live voltage parts without any risk.

The usage of Socomec cables guarantees both the electrical safety and performance up to the power and length limits.

Verifying the voltage output of the PSU is important too, as the voltage level can drop below 24VDC if the total length of cable is longer than expected.

The cable should be installed in such a way as to avoid stressing or damaging the cable as far as possible.

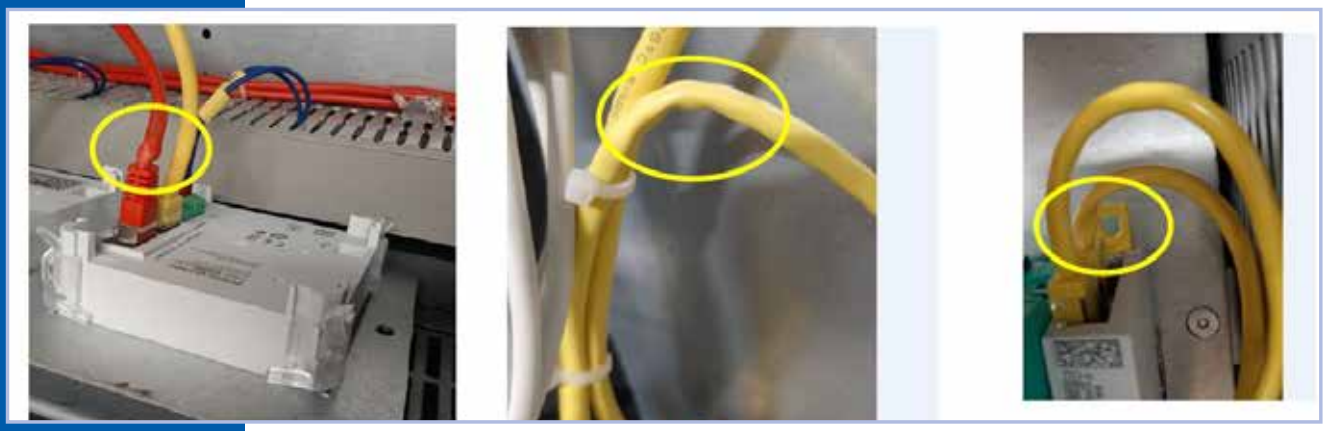

Fig. 13: Examples of poor RJ45 cabling.

D. Evolution of sites and installation during life

The end of line resistor must always be put on the last DIRIS Digiware module = on the last TOB. A site which would displace and change the layout of the distribution and the positioning of the TOBs must be aware that it might be required to displace and reposition this end of line resistor.

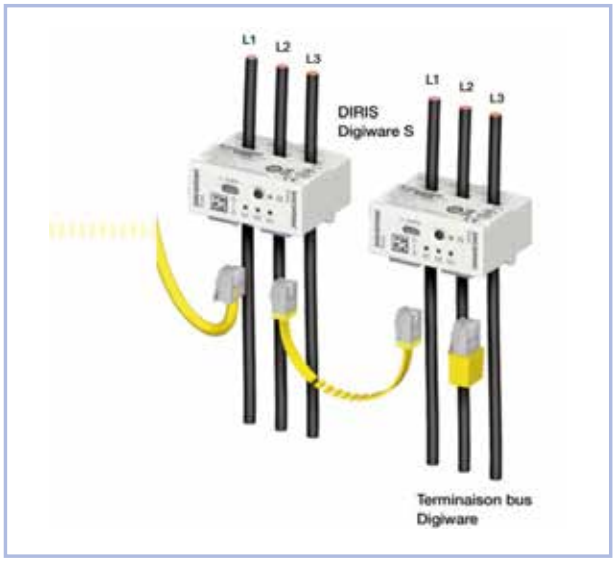

Fig. 14: DIRIS Digiware end of line RJ45 resistor.

It is also important, prior to the installation, to define which company (busway manufacturer, contractor, EPMS team, Socomec) is in charge of guaranteeing the implementation of the end of line resistor.

E. High speed communication requirements

In Data Centres, the quick and accurate management of power distribution is key.
The quantity of information measured and the establishment of permanent real-time readings can support trends in the usage of measurement data and associated communication bandwidth to its limit.

A dedicated technical white paper on DIRIS Digiware communication possibilities details this topic.

The amount of DIRIS Digiware modules per system or the amount of displays/gateways to multiply the bandwidth can contribute to an interesting design.

Use of the head end 2 or 3 DIRIS Digiware gateways can multiply the data communication bandwidth by 2 or 3 times.
This is also a way to multiply the power and/or lengths limit instead of using DIRIS Digiware C-32 repeaters.

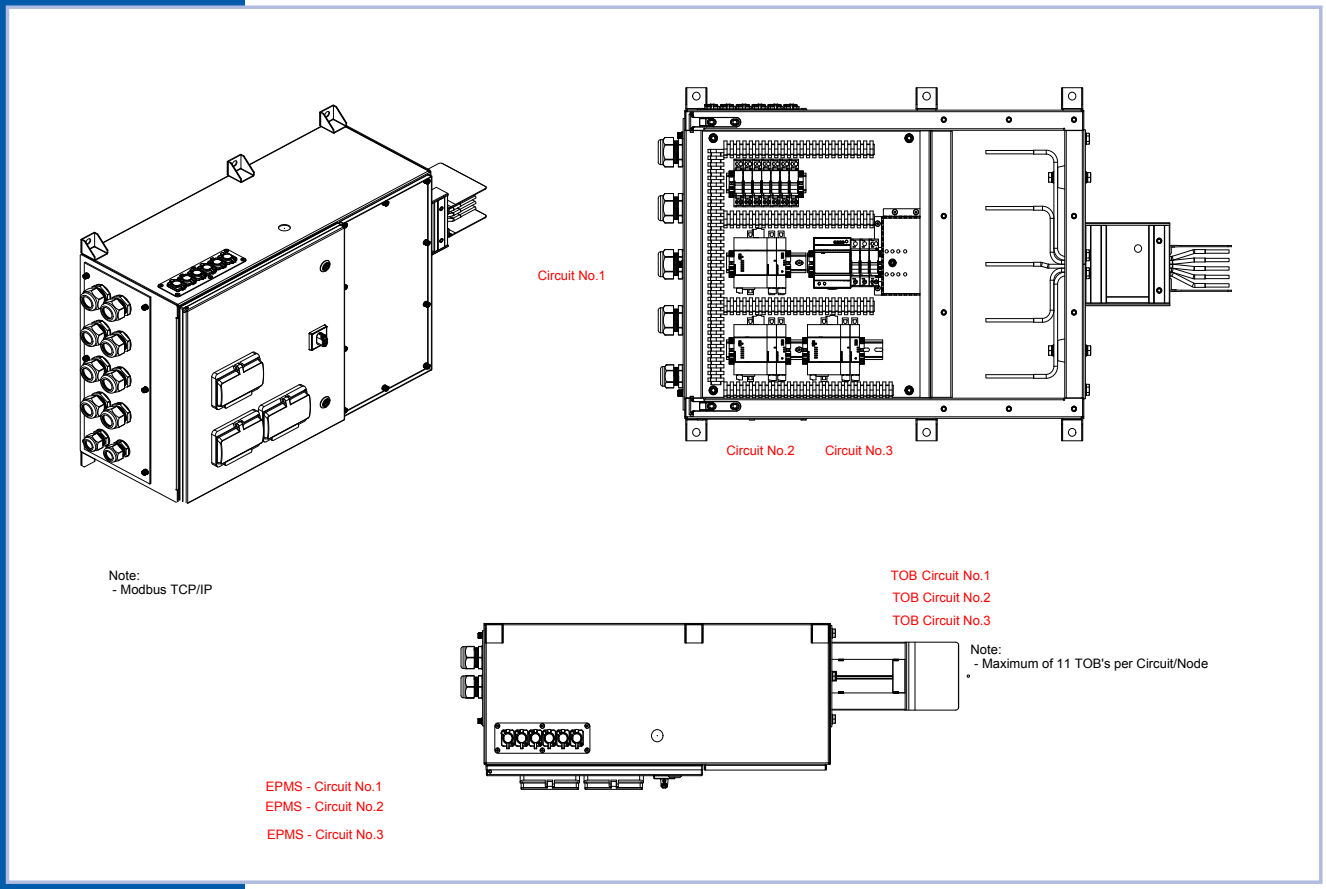

Fig. 15: End feed DIRIS DIGIWARE multiple system paralleling example.

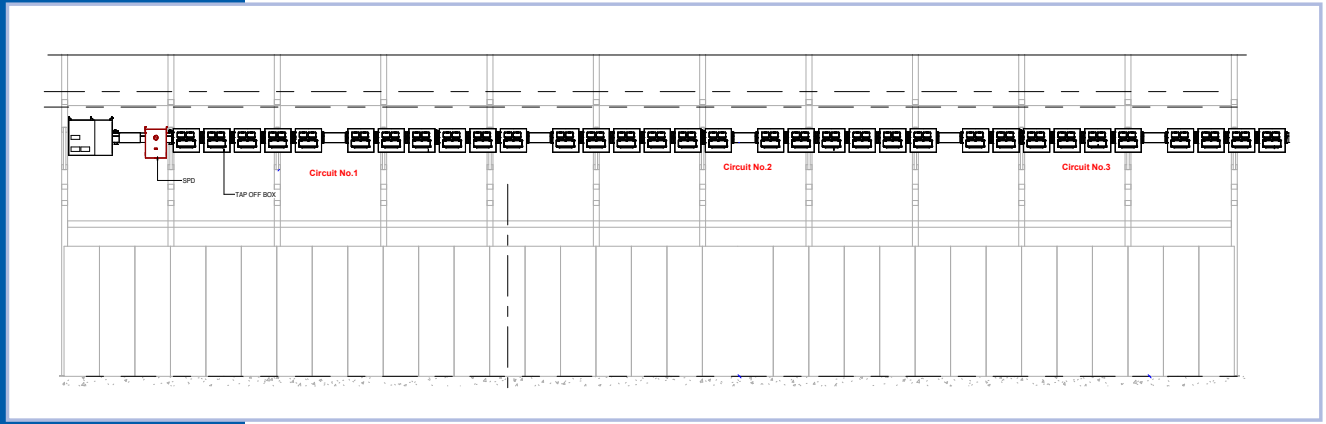

Fig. 16: Split of the busway in multiple DIRIS Digiware examples.

Summary:

DIRIS Digiware is a great solution for busway/tap off box power monitoring.

Ensuring that general installation guidelines are followed and that the recommended design rules are adopted in line with this technical white paper will help to ensure a good and robust monitoring system that is always safe.

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