White Paper
High Power Remote Powering Revisited

excel
without compromise.

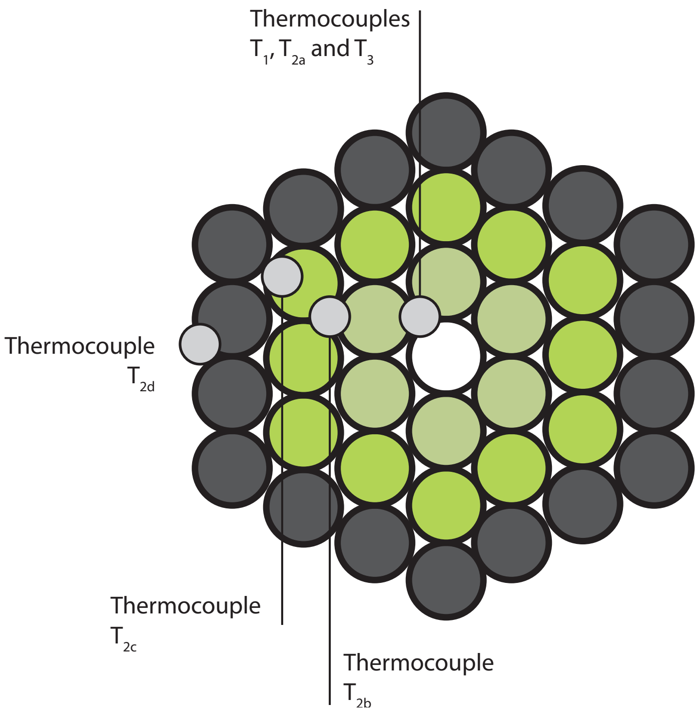
Background

Back in 2014, Excel published its first White Paper discussing the impact of high power 4PPoE on structured cabling.

The Paper was produced following extensive research at De Montfort University and the results were shared with Cenelec as one of the two sets of information that went on to develop TR EN50174-99-1 – Remote Powering.

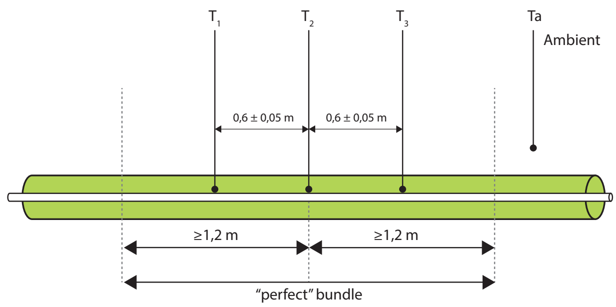
This Technical Report was developed to provide guidance or 'mitigation strategies' when deploying remote powering over structured cabling, mainly over existing cabling systems and what the impact would be.

In the beginning there was a lot of concern regarding the thermal impact of deploying high power remote powering such as what was proposed for IEEE 802.3bt, especially within confined and unventilated spaces and how that would impact the performance of the cabling system. The first stage of the testing was to create a test rig in accordance with the recommendations laid out in TR EN50174-99-1 as described in the diagrams below.



The 'perfect' bundle size for the test was 37, which allowed for 4 layers of cable in an almost perfect round (in reality it is a single 100m length of cable that is wrapped around a post at each end). A controlled power source was then used to ensure the correct levels of power were strictly controlled.

Not only were the Thermocouples distributed throughout the layers they were also installed along the length of the test sample, as well as having one remote from the test rig to measure the ambient temperature.



As opposed to a limited number of cable types, Excel took the time to test 7 different constructions and cable categories along with having them in 'Free Air' and Insulation to gain the two possible extremes of environment.

All this data was collated and shared with Cenelec along with the data from another vendor who was conducting the same testing in another location. Due to the stringency of the test model there was not a great deal of surprise when the data from the two completely independent tests showed almost identical results.

To give one example of the results.

Test Date	23/3/2014
Test ID	002A
Wires used	8
Conventional test set-up	Yes
Cable type	LS0H Cat6 UTP
Cable diameter	6.2mm
Installation conditions	Free Air
Humidity at test end	40%
Average Conductor Resistance	0.075Ω
DC Loop Resistance	15Ω /100m

Temperature Rise above Ambient					
Power	T1	T2a	T3	T2b	
Watts	ºC	ºC	ºC	ºC	ºC
34.2	14.02	15.89	14.45	15.3	14.17
60	22.9	26.2	23.77	25.35	23.39
100	35.16	40.67	36.82	39.38	36.36

The testing of the Category 6 U/UTP with 0.58mm (23AWG) conductors followed the same process as all the other samples.

In 'Free Air' the larger cable reached very similar temperatures as the Category 5e of the previous test, however one major change was the time it took to reach 'Steady State' where the temperature stabilized. It took 4 times longer at 34.2Watts = 720 minutes – nearly twice as long for 60Watts at 986 minutes and 1446 minutes at 100Watts. The insulated values followed a similar trend although we included one additional level for validation purposes of 80Watts.

All this research carried out more than 4 years prior to IEEE 802.3bt being published helped in the development of the mitigation strategies contained with BS EN 50174-99-1. These include several recommendations, including but not limited to:

- Loose Lay cables
- Create random bundles rather than neat uniform ones in the horizontal
- Bundles should be limited to 24 cables
- Leave a 15mm air gap between bundles
- Use cables with thicker conductors
- Use screened cables

Industry Drivers - Why this work was important

There are many drivers that are pushing the increase in demand for remote powering, the main one being the cost savings being achieved both in Capex and Opex terms. It has removed the requirement of a local fused spur and power convertor at the device, saving on both materials and labour. As well as ongoing energy savings, providing DC powering to a remote device is far more energy efficient than converting at the device.

A pleasant side effect of both of the above is that the network becomes more energy efficient overall and reduces the amount of NRM (Non-Renewable Material) involved, making the installation more environmentally friendly.

Back in 2013 there was a study that stated there were approx. 100 million devices deployed across the globe, which was leading to major energy saving. The adoption of Remote Powering has only accelerated since that time.

In a report published in March 2019 it stated that in the 5-year period between 2017 and 2022 would see CAGR of 13% resulting in the market for PoE enabled devices to reach $1bn a year by 2022. This means there is going to be no slowing down, hence the recent changes in the ISO and Cenelec standards to pay particular attention to how the cables installation is designed support remote powering as highlighted in the following excerpt from BS EN 50174-2:2018:

"Separation of cable bundles within pathways (and pathway systems) shall be adequate to support any remote powering objectives defined in the installation specification of EN 50174-1:2018, 4.11 provides details of appropriate assessments".

Moving back to BS EN 50174-99-1, there is an algorithm contained within it which can be used to create a model that would allow the designer to forecast the heating impact on the cable bundles depending on the power levels involved and number of cables energised. We have used this internally a few times and it is far less than some doomsayers have claimed recently.

Other Important Developments that may play a part

There are other technology developments that could have an impact in this area, Firstly IEEE 802.3cg -10 Mb/s Single Pair Ethernet, the intention is to deliver 10Mbs up to a distance of 1Km over a single pair of conductors, however these conductors will have a much thicker gauge.

This has come about due to the increase in low bandwidth IP devices being deployed as controllers and sensors. Therefore, this cabling will also have to provide remote powering however it will not be PoE but a new development called 'Power over Data Line' or PODL (pronounced 'poodle'). The forecast power levels will be similar to those that have been ratified in 4PPoE so we are already comfortable with what the impact will be.

The second development is the improvement in the efficiency of Remote Power devices and it should be carefully considered when designing the installation. First generation devices used to have a relatively high standby load, i.e. they would still draw 8-10 watts when not in use, now 2nd generation devices are less than half this.

The third relates to a different technology that is on the rise; Passive Optical LAN. This may seem a very strange statement to make, however I am being totally serious. One key factor to understand is that by default, it adopts one of the recommendations contained within BS EN 50174-99-1, which is to reduce the length of the copper cable and implement the power closer to the required devices either by way of an injector or mid-span device.

In Passive Optical LANs, PoE is introduced at the ONT, which is the final element in the network before the end device. Typically, these have only a few ports and the end devices are connected by way of short copper links. This will ensure minimal heating of a small number of cables.

Conclusions

Remote Powering in whatever form is not going away, quite the opposite. Some commentators are forecasting growth rates higher than those quoted earlier, which will not surprise, as many of the previous forecasts have been outdated shortly after they were published. We have only relatively recently seen IEEE 802.3bt published so I am not sure that all potential applications that can use it have been discovered. It may prove to be the stimulus for the manufacturers of devices that are just 'out of reach' to re-energise their efforts to make them more energy efficient.

The key to the future is going to be smarter designs, this paper has highlighted some of the techniques that can be used that will lessen the load and designers of the structured cabling, IT networks, IP security networks and building services networks need to start talking to each other to fully understand the impact of each other's design requirements.

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