help desk

Digital light tracks | By Wayne Howell

"The reality is that transmitting DMX512 over a track is already breaking the rules . . ."

I've recently seen a number of questions about digital track lighting appear via the Artistic Licence *Help Desk* and have also fielded a few calls from customers on the same subject. So, whilst I freely admit that this is not my expert subject, this column is based on the research I've done in order to help customers resolve problems.

For those unfamiliar with the concept, a track lighting system consists of an aluminium extrusion that allows electrical conductors to run in parallel and be accessed by light fixtures that clamp into the track. There are also assorted adapters that allow the tracks to intersect, connect to power and fixtures. There seems to be little intentional standardisation between manufacturers, although many of the systems on offer appear to interoperate.

Early track systems were designed with four conductors for three live circuits plus neutral, as shown in the diagram below, which is a cross section through the track. This design allowed three circuits to be externally dimmed. The extrusion provides the earth conductor, shown in green in *Figure 1*.

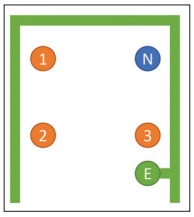

Figure 1

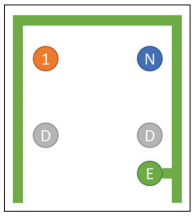

Figure 2

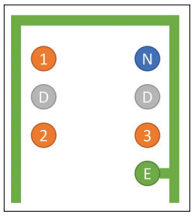

Figure 3

DALI

As the requirement for digitally-controlled track evolved, DALI was the obvious solution as it enabled the use of 64 individually-dimmed circuits rather than three externally-dimmed circuits. The first implementations of this effectively re-tasked the second and third live conductors, as shown in *Figure 2*.

The circles marked 'D' provide the two conductors needed for DALI. Other systems also exist which have six conductors (plus earth), as shown in *Figure 3*.

In this scenario, there are three live circuits plus the DALI conductors. I think this is a vast improvement as there is no way that one could end up with a potential compatibility issue between digital and non-digital products.

Track systems are designed to click together to make useful geometric shapes, such as the plan diagram in *Figure 4*. The orange rectangle represents the point at which power and data enter the track.

That's no problem for the power, but let's look at the data topology: the blue and orange represent the route of the two DALI conductors in *Figure 5*.

The engineer in me feels rather ill looking at a network with loops. But the DALI protocol is slow and uses a very robust data transmission mechanism and it works. So, by and large, DALI track lighting works.

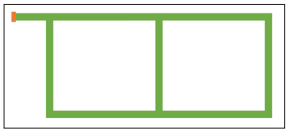

Figure 4

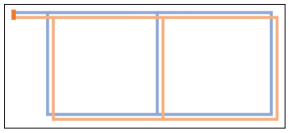

Figure 5

DMX TRACKS

Earlier, I mentioned that I'd seen numerous customers having difficulty with digital track systems, but they were not DALI; they were DMX512. There are a number of companies offering DMX512 lighting tracks, and many of these businesses purport to offer track systems designed for DMX512, but I have my doubts.

DMX512 uses three conductors: common, data minus and data plus. For the avoidance of any confusion, all three matter. However, in my research, I phoned numerous suppliers of digital lighting tracks that supported DMX512 and asked how many DMX512 conductors existed in their track? Without exception, the answer was two (and if anyone knows of a three-conductor track, please send me the link). I then asked what to do with the common connector. Answers ranged from: "it's a balanced signal so the common doesn't matter," to: "oh, you just connect that to earth". I think the phrase I'm looking for is 'dangerously naïve'!

THE REAL WORLD

The reality is that DMX512 lighting track and "designed for DMX512" lighting track is out in the market. As far as I can see, these products are, at best, designed for DALI and someone has assumed that DALI and DMX512 are similar so it will be fine either way. Let's take a look at the major pitfalls and how to make these products work reliably . . .

DMX512 requires twisted pair cable which is part of the mechanism by which the communication rejects noise. The data conductors in a lighting track are parallel and so theoretically fail this first test. Interestingly, this isn't really a problem - the data conductors are completely enclosed inside the earthed track and run very close to each other. I'm not suggesting that you could run DMX down 300m of lighting track (300m is the maximum allowed by the standard over good cable), but if you limit track to tens of metres, it is unlikely to be a problem. Topology or track layout is a major consideration and all of the things that will 'be ok' for DALI will break DMX512.

In *Figure 6* the blue and orange represent the DMX512 data plus and data minus conductors. The red circles show 'Y' splits which are disallowed by the DMX512 standard. The purple circles show closed loops in the DMX512 network, these are so illegal that the standard doesn't even mention them - it's just understood that you can't do that. So, how would you correctly drive that topology with DMX?

Figure 7 shows one solution. Each linear section of track is driven by an output from a DMX512 splitter. This avoids Y splits and loopback faults.

Connecting the DMX512 common to earth has the potential

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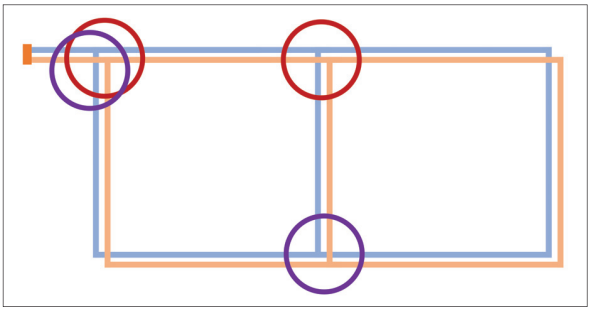

Figure 6

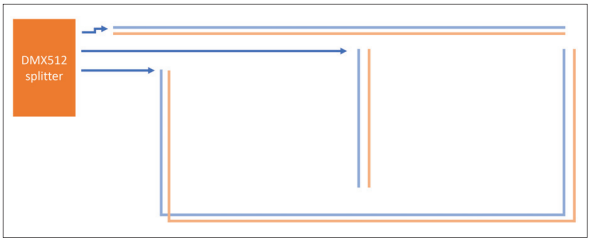

Figure 7

to cause significant problems. The DMX512 common should be referenced to mains earth at the controller, not the track. That said, if an isolated splitter is used to drive the track and the track is relatively short (say 20m) it should be fine. Rule of thumb: always put an isolated splitter between track and controller.

Meanwhile, if you are attempting to drive multiple tracks in different rooms, ensure that there is an isolated splitter in front of each track. That will avoid the problems caused by the mains earth in each room being connected together via the control system. Rule of thumb: isolate data in each room.

The track manufacturers who say you do not need to connect DMX512 common are misinformed (come and join a PlugFest event and we'll show you why). The common connection keeps a variable called common mode voltage under control. Rule of thumb: isolate data in each room and connect the common output of the splitter to the track earth.

In addition, DMX512 requires a terminator at the end of the cable - everyone knows that, I've written it so many times in my columns. So where does it go in a track system? The reality is that transmitting DMX512 over a track is already breaking the rules. Terminators are all about matching impedance, but the track system already broke that! So, there are no hard and fast rules, a lot of the time termination will not add any benefit. Rule of thumb: don't fret about termination in this environment.

I've also been asked whether RDM works over track lighting. I've not tried, but I suspect it only will if you are using relatively short lengths with no Y or T connections. Incidentally, my comment about termination above is only for DMX512. With RDM, you absolutely must have a termination. Rule of thumb: RDM on a track system is unlikely to be reliable unless the manufacturer has specifically designed it in.

SUMMARY

If you are using digital track then DALI is the safe bet as it's remarkably tolerant of weird track topology. If you need to use DMX512 track, keep to short linear sections and put an isolated splitter in front of each section.