BY RICHARD CADENA

Fractional load transceivers are a thing, but are they a good thing?

"THE MORE THINGS STAY THE SAME, the more they change." If DMX could talk, that would probably be its favorite saying. DMX, of course, doesn't talk but it's making a lot of people in the entertainment lighting industry talk. And what they're saying doesn't always gibe with the standard.

DMX is American National Standard *E1.11 – 2008 (R2013): Entertainment Technology USITT DMX512-A, Asynchronous Serial Data Transmission Standard for Controlling Lighting Equipment and Accessories*. Although it was last revised in 2013, those revisions, and the one before it in 1990 and 2008, were relatively minor. DMX has been around in pretty much the same form since 1986. It's one of the few things in the entertainment lighting industry that hasn't changed since the Reagan administration and isn't likely to change in the foreseeable future. DMX is almost like the immutable laws of nature, like the acceleration of gravity, or the speed of light. Yet the practices around setting up DMX have changed. Why is that?

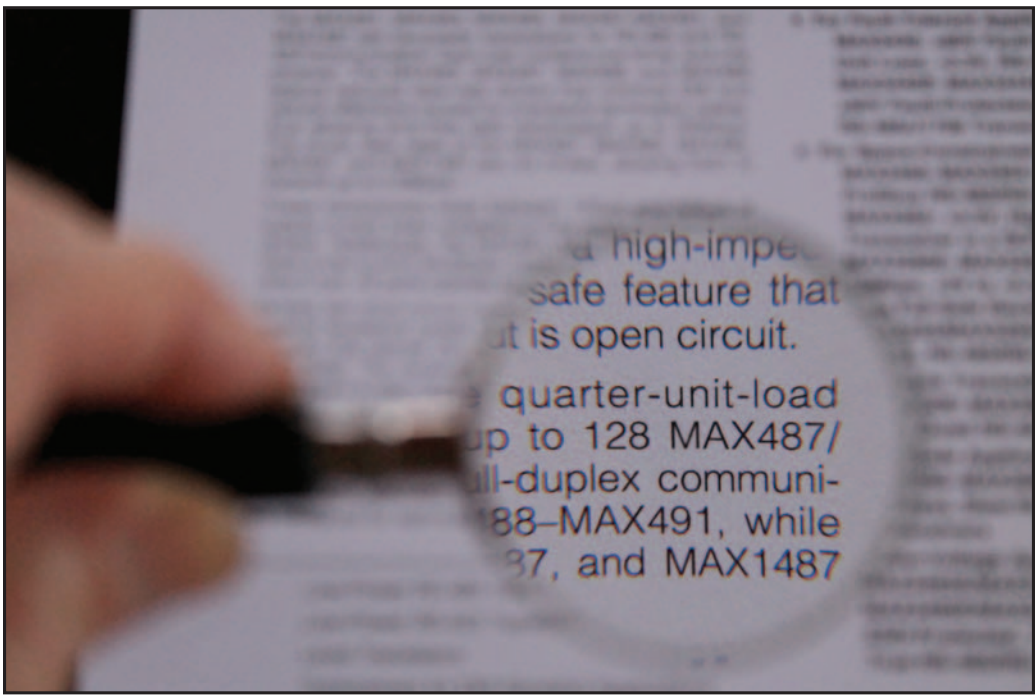
> **"The primary reason to limit the number of devices in a single data link is for reliability."**

A couple of weeks ago I was working on a job that had several ARRI L7 LED fixtures, and I was looking for some information in the user manual when I came across something that I've never seen before. It said, "You must not connect more than 256 products per data link." If you're at all familiar with the DMX standard, then you most likely know that it specifies a maximum of 32 unit loads per data link.

This is what the standard says: "As per *EIA-485-A*, the total load permitted on a DMX512 data link is 32 unit loads. Transmitters designed for this Standard shall be capable of driving 32 unit loads on a DMX512 data link. Each receiving port on a DMX512 device shall have a unit load of 1 or less as per *EIA-485*."

EIA-485 is the Electronics Industry Association standard from which the lighting industry borrowed the specifications for the transceivers used for DMX transmission. The key to understanding is the DMX512 standard regarding the number of loads on a link is to understand a "unit load." A unit load is a hypothetical concept that defines how much current a standard load is allowed to draw. A standard unit load has an input resistance of about 12 k and draws 1 mA at 12 VDC.

It turns out that there are non-standard transceivers that only load the line to a fraction of a unit load. Fractional load transceivers are available as quarter-load



Although it's very rare in the entertainment industry, there are some fractional load transceivers that allow the connection of more than 32 devices on a single DMX data link.

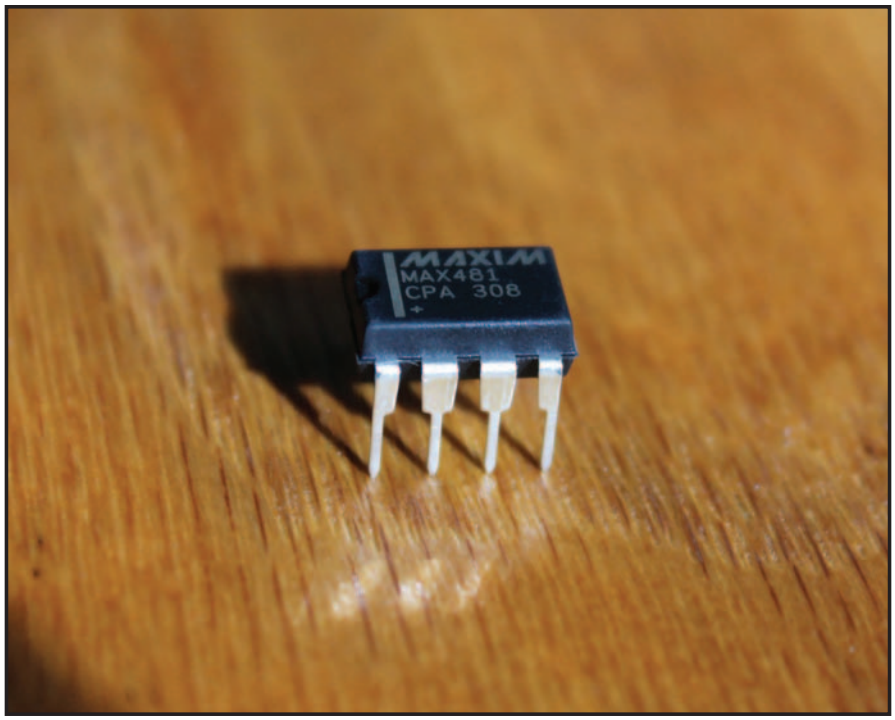
devices and 1/8-load devices. Quarter load devices draw currents of 250 µA or less, which allows for up to 128 transceivers on a single data link, and 1/8th-load devices draw 125 µA or less, which allows up to 256 devices on a link.

> **"The best practice is to follow best practices."**

But there are a couple of things to keep in mind when you're laying out or setting up your lighting system. First, fractional load transceivers are extremely rare in our industry. I've only come across one or two instances where the manufacturer said it is okay to connect more than 32 devices in a single data link or where such a system worked in the field. Even in the case where the user manual said that you can connect up to 256 devices in a single data link, I've never seen one that refers to fractional load transceivers, so I'm not 100% certain that it wasn't a typo.

Second, even if a fixture or device has fractional load transceivers and it can really handle a data link with 128 or 256 devices in a single data link, I would be very reluctant, in most circumstances, to link more than a handful of devices. The primary reason to limit the number of devices in a single data link is for reliability. If you have 128 or 256 fixtures in a link and one data cable is bad, how long will it take you to figure it out? The length of time it takes to troubleshoot it is exponentially proportional to the number of fixtures in the link, or at least, that's how it feels.

There may be times when fractional load transceivers would come in handy. If you have a limited number of data cables and you want to make them go as far as possible (no pun intended—just kidding, pun definitely intended), or you have a situation where you have a large number of lights that are not mission critical, then it might make sense to link as many fixtures as possible.



A quarter-load transceiver chip is designed to allow up to 128 devices on a single data link, while an 1/8th-load transceiver allows up to 256. If a device has fractional load transceivers, there are still compelling reasons to limit the number of devices that you connect on a single data link.

Suppose, for example, that you have a truss structure ringing an arena or stadium, and it has a lot of truss warmers in it. If you lose the data link to the truss warmers during the show, it's (likely) not the end of your career. So, in that case it might be okay to link 128 or 256 fixtures in a data link. But good luck getting them all to fit in one DMX universe without overlapping addresses.

I recently received an email from someone who was in a situation where the LD instructed him to connect 45 Chroma-Q ColorForce II fixtures in a single link. He did it and he was surprised that it worked. Then he emailed me to ask whether the DMX standard had changed. It has not, but I checked the user manual to see if this was approved by the manufacturer. As far as I can tell, the manual makes no mention of the number of luminaires that can be linked on a single data run, nor does it mention fractional load transceivers. But, the fact that the system worked with that many fixtures linked through the DMX line doesn't necessarily mean they have fractional load transceivers.

Sometimes you can get away with bending or breaking the rules without dire consequences, although it's not recommended. The concept of a unit load is based on the DC resistance of the transceiver chip, but the AC characteristics can also influence the current draw. The DMX standard goes on to say, "A receiver biased to any voltage from -7 to +12 volts shall not present a capacitive load to the line of more than 125 pF per unit load…If a manufacturer chooses to declare or mark their products with a unit load value, the declared or marked value shall be the greater of either the DC unit load determined by *EIA-485-A* clause 4.1 or the unit load as determined by the capacitive loading."

So, things like the length of cable, the spacing of devices, and the capacitance of the system can also affect the current draw. In certain circumstances you might be able to get away with connecting more devices

than is recommended by the standards. That doesn't mean it's a good idea. If you are going to bend or break the rules, make sure it's for a good reason and not just because you're being lazy.

A great resource to read is Adam Bennette's book, *Recommended Practice for DMX512, Second Edition: Incorporating USITT DMX512-A and Remote Device Management*. (It's available on the http://tsp.esta.org/freestandards page near the end of the list.) Familiarize yourself with the Fault Finding Checklist on page 67 and pay close attention to the line that says, "Most DMX512 faults are due to incorrect termination, faulty wiring, or groundloop effects." He recommends checking, among other things, to make sure there are no more than 32 standard receivers on the line, and that the line is terminated (yes, termination is still required!). He also recommends that the maximum length of a data run is 300 m (about 1,000') and no longer. Technically, *EIA-485* is capable of running 1,000 m but in practice, because of all the interconnections, it's much more reliable when it's limited to no more than 300 m.

On the subject of terminating your data runs, this is another area where the practice has changed and many systems are not being terminated. The fact is, unterminated data links cause signal reflections and data errors. And as Bennette says, "Incorrect or missing termination is probably the single most common reason for faulty DMX512-A systems." Your system may work without data termination, but when it fails, there's no point in troubleshooting it until it has been properly terminated because that is likely what is causing the failure. So why not just start with data termination to begin with? Yes, there are now some self-terminating fixtures on the market, but they are far more rare than some people would like to believe. And there's no harm in terminating a self-terminating fixture.

The whole idea behind the standards is to create stability and reliability in a system. Just because it happens to work on a particular day doesn't mean it's reliable. The best practice is to follow best practices. If DMX could talk, it would probably complain to you about how you take it for granted because it works most of the time. Be kind to your DMX and don't make it work any harder than it has to. ■

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