Estimated Transmission Distance at Serial Data Rates

The distances listed below are estimates based upon the cable loss values (excluding connectors or connectivity) in the Society of Motion Picture and Television Engineers (SMPTE) standards listed. West Penn Wire cannot guarantee that these distances will be obtained due to variations in the equipment used. The manufacturer of the equipment used should be contacted to determine what distance can be expected with the cable intended to be used.

Data Rate:	270 Mb/s	360 Mb/s	1.5 Gb/s	3 Gb/s
Specs:	SMPTE ST 259	SMPTE ST 259	SMPTE ST 292	SMPTE ST 424
Application:	Component SD-SDI	Widescreen SD-SDI	HD 1.5G	HD 3G SDI
Cable Part Number	Distance (ft)	Distance (ft)	Distance (ft)	Distance (ft)
HD825	511	448	141	98
HD25825	500	430	133	90
819	1127	975	304	212
25819	1017	883	263	177
6350	1376	1203	367	255
256350	1319	1134	327	215
6450	1715	1512	494	343
256450	1570	1352	392	255

Data Rate:	3 Gb/s	6 Gb/s	12 Gb/s
Specs:	SMPTE ST 425-4 (3 Gb/s - stereo) ST 2081-1 (6 Gb/s - dual link) ST 2082-1 (12 Gb/s - quad) ST 2083-1 (24 Gb/s - octal link)1	ST 2081-1 (6 Gb/s - single link) ST 2082-1 (12 Gb/s - dual link) ST 2083-1 (24 Gb/s - quad link)1	ST 2082-1 (12 Gb/s - single link) ST 2083-1 (24 Gb/s - dual link)
Application:	UHDTV1, UHDTV2	UHDTV1, UHDTV2	UHDTV1, UHDTV2
Cable Part Number	Distance (ft)	Distance (ft)	Distance (ft)
819	425	287	–
25819	350	230	–
6350	509	340	–
256350	430	280	–
6450	538	374	257
256450	433	285	186

The serial digital interconnect standards are designed to operate where the signal loss at ½ the clock frequency does not exceed the approximate loss values listed below. The recommended length values shown are based on typical attenuation values for the cables listed and the following criteria:

Maximum length = 30 dB loss at 1/2 the clock frequency: SMPTE ST 259

Maximum length = 20 dB loss at 1/2 the clock frequency: SMPTE ST 292 & ST 424

Maximum length = 40 dB loss at 1/2 the clock frequency: SMPTE ST 425, ST 2081, ST 2082 & ST 20831

The bit error rate (BER) can vary dramatically as the calculated distances are approached. BER is dependent on receiver design and the losses of the actual coax used. Distribution and routing equipment manufacturers should be contacted to verify their maximum recommended transmission distance.

SMPTE ST 2083-1 is under development.

Bundled coax transmission distances slightly less than single coax due to helix of coax in bundled configuration.

Determining Cable Lengths for 12G-SDI Applications

While some designers use fiber optic cabling to achieve longer distances in 12G-SDI applications, there are quite a few applications where coax is still the best fit. Coax cables designed for SDI signals are offered in RG6 Non-Plenum and Plenum Designs from West Penn Wire.

To help, we created an Estimated Transmission Distance Chart at Serial Data Rates based on the cable loss values for given formats as specified by SMPTE. The chart establishes estimated distances that West Penn cables can support in broadcast and AV applications. However, actual cable distances can be shorter or longer based on the equipment being used. As new formats and new versions of cables become available, the chart is updated. (See p.1 distance charts)

Based on attenuation or signal loss at one-half the signal frequency as defined by SMPTE and signal type, the Estimated Transmission Distance Chart defines values for cables only; it doesn't include connectors, bulkheads or other items used to connect cables that add loss. While the table is helpful, it's important to remember that it always has a caveat: The bit error rate (BER) can vary dramatically as the calculated distances are approached. BER is dependent on receiver design and the losses of the actual coax used. Distribution and routing equipment manufacturers should be contacted to verify their maximum recommended transmission distance. In other words, although cable performance has a distance as listed in the distance chart provided, the active equipment may perform above or below the standards loss.

How and Why Equipment Plays a Role in Determining Cable Length

12G-SDI applications follow the SMPTE ST 2082-1:2015 (12 Gb/s Signal/Data Serial Interface – Electrical) standard. It establishes requirements for high-speed (12G) digital video using SDI standards and describes the suitable electrical and physical characteristics of a 12G-SDI coaxial cable.

Typical loss amounts for receivers (such as cameras, central control units, etc.) that operate within a 12G-SDI channel are also defined in the standard: up to -40 dB at one-half the clock frequency (6 GHz). In other words, to prevent performance problems, attenuation loss along the channel from the transmitter to the receiver should be no higher than -40 dB But the SMPTE ST 2082-1 standard also allows variance from this -40 dB threshold. It states: "… however, receivers designed to work with greater or lesser signal attenuation are acceptable." While -40 dB is typical for receivers, equipment that operates with higher or lower amounts of loss is also acceptable, according to the SMPTE standard.

This deviation from the -40 dB recommendation wasn't a major concern for previous technologies, like 3G-SDI, which had a level of -20 dB, because the equipment wasn't close to falling off the digital cliff—the equipment operated well above the threshold, which prevented sudden failures. In 12G-SDI applications, however, that isn't the case. When transmitting at 12G, you quickly approach the noise floor of the equipment (the amount of noise it generates without a signal) and reach that digital cliff.

Because there are no interoperability test standards to verify that broadcast equipment will—or should—operate within certain attenuation parameters, it's important to know what you're up against when working with 12G-SDI applications. SMPTE merely states that the overall system itself could support -40dB of attenuation loss. Not This issue can be confusing—and concerning—to integrators when a cable is deployed in accordance with the Estimated Transmission Distance Chart but receives no signal (or experiences lots of attenuation). Understandably, the assumption is often this: **Something is wrong with the cable! It doesn't support what the Estimated Transmission Distance Chart says it will!**

But this assumption is incorrect. As long as the cable is installed correctly and not damaged, then it's likely that the cable did not create the performance issue. Instead, the chosen equipment—whether it's a camera, converter or something else—doesn't support the -40 dB threshold. Remember: The SMPTE standard uses a recommended value of -40 dB but doesn't require active equipment to meet this value.If the equipment supports -40 dB, then you can confidently reach the distances stated in the Estimated Transmission Distance Chart. If the equipment only supports up to -35 dB, then the cable distance must drop to support it. As you can see in the charts below, as the dB threshold shrinks, so do the cable distances.

Does My Equipment Support Recommended Cable Distances?

Because manufacturers don't typically publish dB thresholds for their equipment, determining exactly what the equipment supports can be a challenge. (See dB threshold tables on next page) To verify that your equipment will work as intended in 12G-SDI applications—and in accordance with our Estimated Transmission Distance Chart—there are some steps you can take.

1. Check with the equipment manufacturer to confirm the dB threshold and the type of cable needed to achieve the distance you want to meet.
2. If this information is not available from the manufacturer, then consider conducting your own test to assess output signal using the chosen equipment and cable. Set up the equipment and run the cable at the required length to make sure it works. Ideally you would run this test prior to installation.
3. If the test results indicate a failure, then your options are to shorten the cable back in length until the equipment works, move up to a larger coaxial cable or install a fiber system.

The Road to 12G-SDI: How Far Can Your Cable Run?

Maximum WPW Cable Distance if your equipment supports -40 dB at 1/2 the clock frequency

Cable Part Number	Distance (ft)
6450	257
256450	186

Maximum WPW Cable Distance if your equipment supports -25 dB at 1/2 the clock frequency

Cable Part Number	Distance (ft)
6450	161
256450	116

Maximum WPW Cable Distance if your equipment supports -35 dB at 1/2 the clock frequency

Cable Part Number	Distance (ft)
6450	225
256450	163

Maximum WPW Cable Distance if your equipment supports -20 dB at 1/2 the clock frequency

Cable Part Number	Distance (ft)
6450	129
256450	93

Maximum WPW Cable Distance if your equipment supports -30 dB at 1/2 the clock frequency

Cable Part Number	Distance (ft)
6450	193
256450	140