

Single Motor Extension Cable Solution for HIPERFACE DSL® Encoder

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Information on Kinetix® 2090-series single motor extension cable shield design for End Users and OEMs using Rockwell Automation® Servo Drive and Motor Applications.

Introduction

HIPERFACE DSL® (Digital Servo Link) is a type of encoder/sensor feedback communication technology used in drive and motor systems. Single motor cables, which incorporate the motor power, brake and DSL data wires into the same cable, are designed for drive motor connection. Single motor cables can help save time and reduce cost. The simplified cable connections and routing lead to a reduction in potential points of failure, helping decrease possible downtime. For some user applications, single motor extension cables are necessary. An extension motor cable features a motor-type connector on its drive end and a “regular” cable plug on its opposing end. Extension cables help reduce maintenance time due to ease of replacement. They have a smaller containment area of cable to replace as compared to other cables, where you would need to replace the entire route of cable to the machine. They also provide the option to connect a cable to a bulkhead when a drive is installed in a cabinet. It is essential to maintain the integrity of signal transmission in today’s noisy industrial environment when extension cables are connected to the system.

Rockwell Automation products are designed with system integration in mind to achieve high architectural performance. This white paper demonstrates the 2090-series single motor extension cable shield design. A representative DSL feedback eye-diagram test result is provided to illustrate the signal quality when a 2090-series single motor extension cable is used with Kinetix 5000-series drive and VP Servo motor system. Additionally, a recommendation of motor cable installation guidelines and best practices is included to enhance DSL feedback system performance.

* Note that the extension cable only comes with the flex version.

Single Motor Extension Cable Shield Design

The 2090-series single motor cable design is tailored to fit the Kinetix 5000-series drive motor system for transmission of DSL communication. The construction of the overall cable and DSL pair is optimized for the industrial environment. The 2090-series single motor extension cable inherits the same bulk cable design. The cable shield design is one of the critical elements to ensure DSL signal integrity and system EMC (Electromagnetic Compatibility) performance.

The single cable contains three motor power conductors, a PE (Protective Earth) conductor, a motor brake pair and a DSL pair. Each pair, as well as the overall cable, contains two layers of shields – with the foil shield placed underneath the braided shield. The overall cable braided shield is made with carriers of tinned copper strands that provide a low-impedance path to ground. The braided shield is effective for both low and radio frequency electromagnetic interference. The braid strand size, number of strands, number of carriers and braid angle are optimized for 2090 single motor cables to achieve a high braided shield coverage. The overall cable foil shield is a thin layer of aluminum on top of polyester tape that provides sufficient EMC protection from radio frequency noise. The foil side is facing outward and is in direct contact with the braided shield. The foil shield offers 100% shield coverage to fill the gaps of the braided shield. The combination of foil and braided shield gives the best system EMC performance.

The DSL-pair shield construction is similar to the overall shield construction that features superior shield coverage. The shields of the DSL pair also help to minimize crosstalk from the power conductors and brake pair.

Both brake-pair and DSL-pair braided shields are folded back over the outer jacket edge along with the overall cable braided shield. Connectors are then assembled to the connected braided shields with proper guidelines. This ensures 360° shield connection to avoid pigtail style connections. Connectivity between the overall/brake/DSL braided shields and connector housing is 100% tested. Thus, the integrity of cable shield connection is guaranteed for data integrity and EMC performance, even when extension motor cables are used.

Single Motor Extension Cable Tests

To qualify the cable, system tests with different user configurations were completed, and the system met the established requirements of Rockwell Automation. The representative test results shown below (Figure 1) were tested with a maximum total single cable length of 90 m.

Product Catalog Number	Product Description
2198-D057-ERS3	Kinetix 5700 Servo Drive
VPC-B1652D-QJ14FS	Kinetix VP Servo Motor
2090-CSBM1DE-14AF80	80 m Single Motor Cable, w/Brake, Flex
2090-CSBM1E1-14AF10	10 m Single Motor Extension Cable, w/Brake, Flex

Table 1: Representative Test Configuration for Single Extension Motor Cable System

DSL Eye Diagram Tests

The DSL feedback communication interface utilizes the power over bi-directional RS-485 technology. The DSL physical layer drive circuitry is designed with impedance control and signal termination to ensure DSL signal integrity within the drive. It is essential to evaluate the DSL differential signal integrity by observing the eye diagram. The eye diagram is a method to test the high-speed data signal quality. This test repetitively samples the same bit position in many transmission frames of differential DSL signals received at the drive and overlays the records on an oscilloscope. Eye height is then measured to determine the margin of the signal.

Requirement: Verify that the eye height is greater than 200 mV per SICK HIPERFACE DSL specification [1].

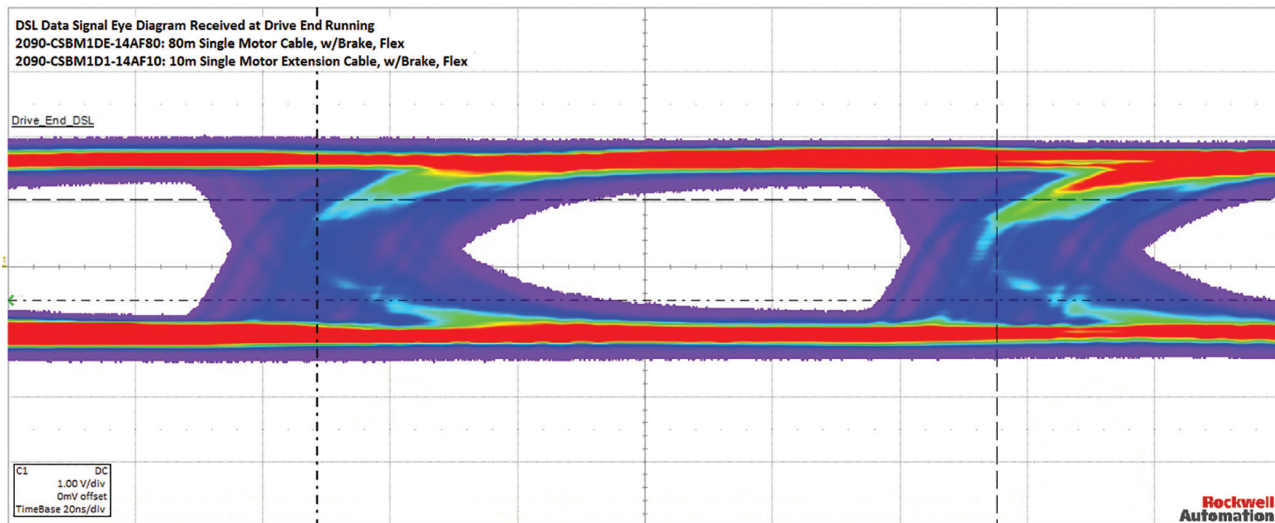


Figure 1: Eye Diagram Test Result on 14 AWG 90 (80+10) meter Single Motor Flex Cable

Figure 1 above illustrates the DSL eye diagram data captured for a set, continuous run on an extension motor cable system. Channel 1 is the DSL differential signal at drive end (input data to drive) and it is triggered by DSL sample signal.

The eye height and eye width show the test result surpassed the minimum 200 mV requirement with a high margin. Thus, the 2090-series single motor extension cable offers well above acceptable performance on differential DSL signal integrity.

Single Motor Extension Cable Installation Guidelines

The single motor extension cable was released into the market in the Summer of 2015 and with no known issues found with this cable extension in the field. To ensure the best performance of this cable, it is highly recommended for the users to follow the installation guidelines and best practices below.

- Select the single extension cable that matches the drive motor system – reference cable compatibility tables in Kinetix Motion Accessories Specifications, PUB KNX-TD004.
- Install only one single extension cable per axis for best practice. Rockwell Automation has not performed qualification testing with additional extension cables in series or parallel on the same axis of motion.
- Connect a total single motor cable length (Single Motor Cable + Extension) per drive system specification. See Kinetix Motion Accessories Specifications, PUB KNX-TD004 for supported drive product maximum cable length.
- Confirm the DSL connector kit (2198-KITCON-DSL) is properly installed if it does not come with the cable assembly. Confirm a reliable overall single motor cable shield connection on both the drive end and motor end.
 - See Chapter 5 of Kinetix 5700 Servo Drives User Manual, PUB 2198-UM002 for connecting Kinetix 5700 drive systems.
 - See Chapter 5 of Kinetix 5500 Servo Drives User Manual, PUB 2198-UM001 for connecting Kinetix 5500 drive systems.
- Follow “Install Continuous-flex Extension Cables” section of 2090-Series Single Motor Cables, PUB 2090-IN051 for flex cable installation guidelines.

Conclusion

The 2090-series single motor extension cables are designed with quality in mind for power and feedback communication while providing excellent protection against electrical noise. Based on the extensive test results and positive field experience, we are confident that this extension cable is appropriate for use as recommended for your servo drive and motor applications with Kinetix motion control systems.

References

- [1] HIPERFACE DSL Implementation Manual; SICK-Stegmann GmbH, Donaueschingen version 1.06, released May 31, 2014
- [2] Kinetix 5700 Servo Drives User Manual, PUB 2198-UM002
- [3] Kinetix 5500 Servo Drives User Manual, PUB 2198-UM001
- [4] 2090-Series Single Motor Cables, PUB 2090-IN0511
- [5] Kinetix Rotary Motion Specifications, PUB KNX-TD001
- [6] Kinetix Motion Accessories Specifications, PUB KNX-TD004

To learn more about Allen-Bradley Kinetix cable solutions, visit:
<https://ab.rockwellautomation.com/Motion-Control/Kinetix-Cables>

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