1 Introduction

Power Station interface standards exist in order to aid in interoperability between Power Station products from different manufacturers.

1.1 Served Use Cases

Document the two predominate types of Power Station Interface.

The intent is that any Command Station, Power Station, or Power Station Interface Repeater which conforms to the standard, from any manufacturer, will be inter-operable within a given Power Station Interface type.

1.2 Unserved Use Cases

It is not the purpose of the standard to ensure that Command Stations, Power Stations, or Power Station Interface Repeaters are inter-operable between different Power Station Interface types.

2 Annotations to the Standard

2.1 General

2.1.1 Introduction and Intended Use

2.1.2 References

Additional relevant references are found in S-9.1.2

- S-9.1.2 Power Station Interface

2.1.3 Terms

2.1.4 Requirements

It is important to note that this standard has been created after the fact of multiple established products already available in the market. It is for this reason that the NMRA Conformance and Inspection department may grant exemptions for established products. This standard seeks to encompass as many of the existing product conventions as possible while providing a basis for interoperability of future products.

2.2 Electrical Characteristics

While there exists two types of interface, Full Scale and Driver/Receiver, it may be possible in some cases to interchange the two types. A manufacturer may promote this interchange by providing supplemental instructions in their product documentation.

2.2.1 Common Characteristics

2.2.1.1 Command Station (signal generator) Output Signal

NMRA DCC Standard S-9.1 provides for a 3 microsecond margin between transmitter and receiver bit timing. The ABS(T_{off} – T_{on}) specification is designed to fit within this limit. A Power Station is allocated 2 microseconds of this margin while a Power Station Repeater is allocated 0.5 microseconds of the margin. The remaining 0.5 microseconds provides an additional safety factor.

In practice, the propagation delay (T_{on} and T_{off}) are only important where a receiver may bridge the gap between Power Station outputs. If the difference in propagation is too large, this may appear as a short circuit to the Power Station.

2.2.1.2 Power Station Input to Output Distortion

2.2.1.3 Power Station Interface Repeater Input to Output Distortion

2.2.1.4 Power Station Common

It is recommended that all Power Stations provide a Power Station Common even though it is only strictly required if the Power Station Interface input is not isolated.

Without Power Station input isolation, a Power Station Common becomes critically important in order to be a lowest impedance path for return currents between Power Stations. With isolation, there is no alternative return path which could be damaged by high currents.

Providing a Power Station Common can still be beneficial to Power Stations with input isolation as it can aid the transition of locomotives between Power Stations, especially if split frame/wheel pickup is present.

2.2.1.5 Power Station Fail-Safe

If a Power Station is not monitoring the incoming signal, it is possible that an invalid signal can result in an amplified output signal which could be misinterpreted as a signal for a receiver to convert to an alternate power source. If a power station is designed for multiple protocol use, this requirement may be disabled, or have a different duration set, through a configuration option. If this requirement can be disabled through configuration, it must be documented in the product documentation.

2.2.2 Full Scale Interfaces

This is a common method for generating the Power Station Interface in part because it can use common components with a Power Station output that may be bundled in the same product as a Command Station.

2.2.2.1 Command Station Output Signal

2.2.2.2 Power Station Input Signal

The requirements listed here are derived from the historically popular 6N137 optocoupler. The typical 6N137 input circuit would place the LED of the optocoupler in series with a 1KΩ resistor.

Though the 6N137 is the original model for the requirements, the 6N137 is not required to be used. Other models of optocoupler and other types of isolation, which present less of a load, such as inductive, capacitive, and RF, may also be used. Furthermore, input isolation is not strictly required, though it is highly encouraged.

2.2.3 Driver/Receiver Interfaces

The requirements of the Driver/Receiver mode are developed as a compromise between TIA/EIA-422 and TIA/EIA-485 driver/receiver standards. These two driver/receiver standards have overlapping operating ranges and are commonly used together and/or interchangeably.

Table 1 Summary Comparison of TIA/EIA-422 and TIA/EIA-485[1]

Parameter	TIA/EIA-422	TIA/EIA-485	Unit
Number of drivers and receivers	1 driver / 10 receivers	32	
Maximum theoretical cable length	1200	1200	m
Maximum data rate	10	>10	Mbps
Maximum common-mode voltage	+/- 7	-7 to +12	V
Driver differential output level	$2 \leq \lvert V_{OD} \rvert \leq 10$	$1.5 \leq \lvert V_{OD} \rvert \leq 5$	V
Driver load	≥ 100	≥ 60	Ω
Driver output short-circuit limit	150 to GND	250 to -7V or +12V	mA
High-impedance state, power off	60	12	KΩ
Receiver input resistance	4	12	KΩ
Receiver sensitivity	+/- 200	+/- 200	mV

2.2.3.1 Command Station Output Signal

2.2.3.2 Power Station Input Signal

2.3 Physical Medium

Manufacturers are encouraged to provide installation guidance within the product documentation.

1 Referenced from Texas Instruments Application Report SLLAA070D: RS-422 and RS-485 Standards Overview and System Configurations

2.4 Topology

2.5 Labeling

The labeling examples below are provided as guidance only and aree designed to meet the requirements. Exact labeling is up to the manufacturer. The Conformance and Inspection department, working with the product manufacturer, may use its discretion to evaluate compliance with the labeling requirements.

Command Station Example

> This device provides a Full Scale Power Station (Booster) Interface output capable of supplying up to 500 mA. Terminal A is the positive polarity signal and Terminal B is the negative polarity signal. The Power Station (Booster) common is labeled COM.

Power Station Example

> This device provides a Full Scale Power Station (Booster) Interface input with a maximum loading of 15 mA. Terminal A is the positive polarity signal and Terminal B is the negative polarity signal. The Power Station (Booster) common is labeled COM.

Power Station Interface Repeater Example

> This device provides a Full Scale Power Station (Booster) Interface output capable of supplying up to 500 mA. Terminal A is the positive polarity signal and Terminal B is the negative polarity signal. The Power Station (Booster) common is labeled COM.
>
> This device provides a Full Scale Power Station (Booster) Interface input with a maximum loading of 15 mA. Terminal A is the positive polarity signal and Terminal B is the negative polarity signal. The Power Station (Booster) common is labeled COM.