

Design for State Grid Corporation of China RS-485 Standard - THVD1500

ABSTRACT

The new THVD1500 half-duplex RS-485 transceiver was designed to meet the Electro-Static Discharge (ESD) requirements listed in the Q/GDW 11179.11-2015 standard, published by the State Grid Corporation of China (SGCC). This document describes these standards, and details the THVD1500 performance versus the standards.

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1 State Grid Corporation of China (SGCC)

The State Grid Corporation of China (SGCC) is a state-owned electric utility company in China which provides electricity to five geographic regions and 80% of the Chinese population. In the State Grid Enterprise Standard (Q/GDW), published by SGCC, the standard Q/GDW 11179.11-2015 covers the technical specification of components for electricity meters. The document is published with the intention to promote smart e-meters and electricity information acquisition systems. Part 11 of the standard discusses serial communication protocol for RS-485 transceivers. The standard gives technical specifications in many details such as pin-out, functionality, data rate, and the electrical characteristics of drivers and receivers. To help make the e-meter energy efficient, the standard also requires RS-485 devices to consume lower power, such as 1-uA receiver input leakage and 700-uA operation current for driver and receiver. Additionally, to accommodate the latest industrial needs, the standard gives specific requirements on ESD performance, which is ± 4 -kV HBM, ± 2 -kV EFT (similar to IEC 61000-4-4), and ± 8 -kV IEC (similar to IEC61000-4-2).

2 IEC 61000-4-2 and IEC 61000-4-4 Tests

IEC 61000-4-2 is a system-level ESD test that imitates a charged person discharging to a grounded end system through a metal object, such as a screw driver. This test is considered more stringent than HBM, and is summarized in [Table 1](#). The ± 8 -kV test voltage of level 4 is equivalent to 30-A peak current during the transient. THVD1500 can create a low impedance at the transient event that takes a large amount of current. Thus, it survives the 8-kV IEC test under the SGCC inspection.

Table 1. IEC 61000-4-2 ESD Test Voltage Levels

Contact Discharge			Air Discharge	
Level	Test Voltage (kV)	Peak Current (A)	Level	Test Voltage (kV)
1	2	7.5	1	2
2	4	15	2	4
3	6	22.5	3	8
4	8	30	4	15
*	Special	Special	*	Special

Inductive loads such as relays, switch contactors, or heavy-duty motors can create high-frequency bursts during transition. The IEC 61000-4-4 test is intended to simulate the transients created by such switching of inductive loads on AC power lines. The test can be performed on power lines or I/O data lines, with a burst of pulses that have predetermined amplitude and limited duration. [Figure 1](#) shows the shape of a typical EFT pulse and the timing sequence of the test pulses. SGCC requires RS-485 transceivers to have BER < 10^{-7} during communication with the disturbance of ± 2 -kV spikes at a repetition rate of 5 kHz, 10 kHz, and 100 kHz.

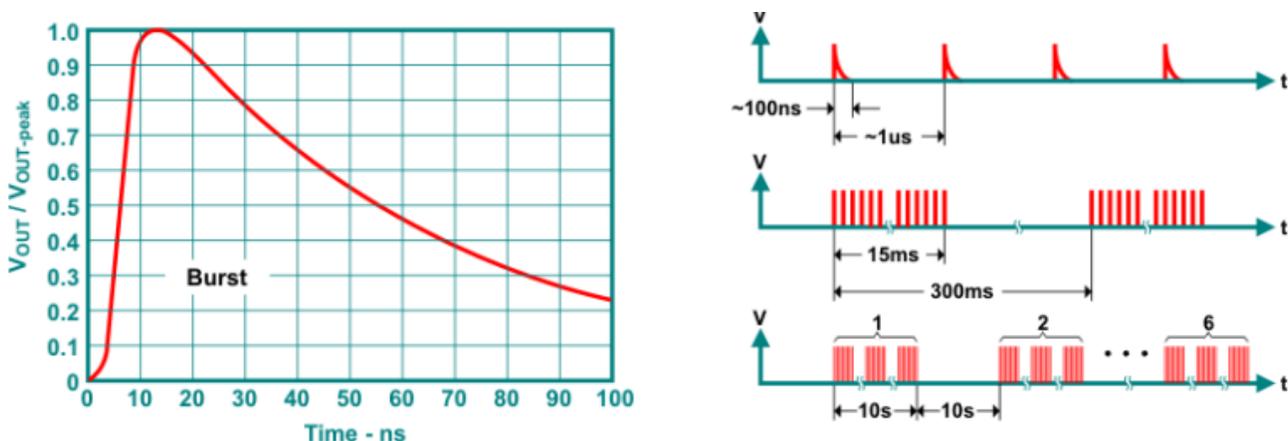


Figure 1. Voltage Waveform of an EFT Pulse and Timing Sequence of an Entire Test Cycle

Figure 2 shows the voltage waveform captured on the bus (differential voltage) during the EFT test. The waveform shows that THVD1500 recovers the communication quickly enough that the message to or from the controller does not get misinterpreted.

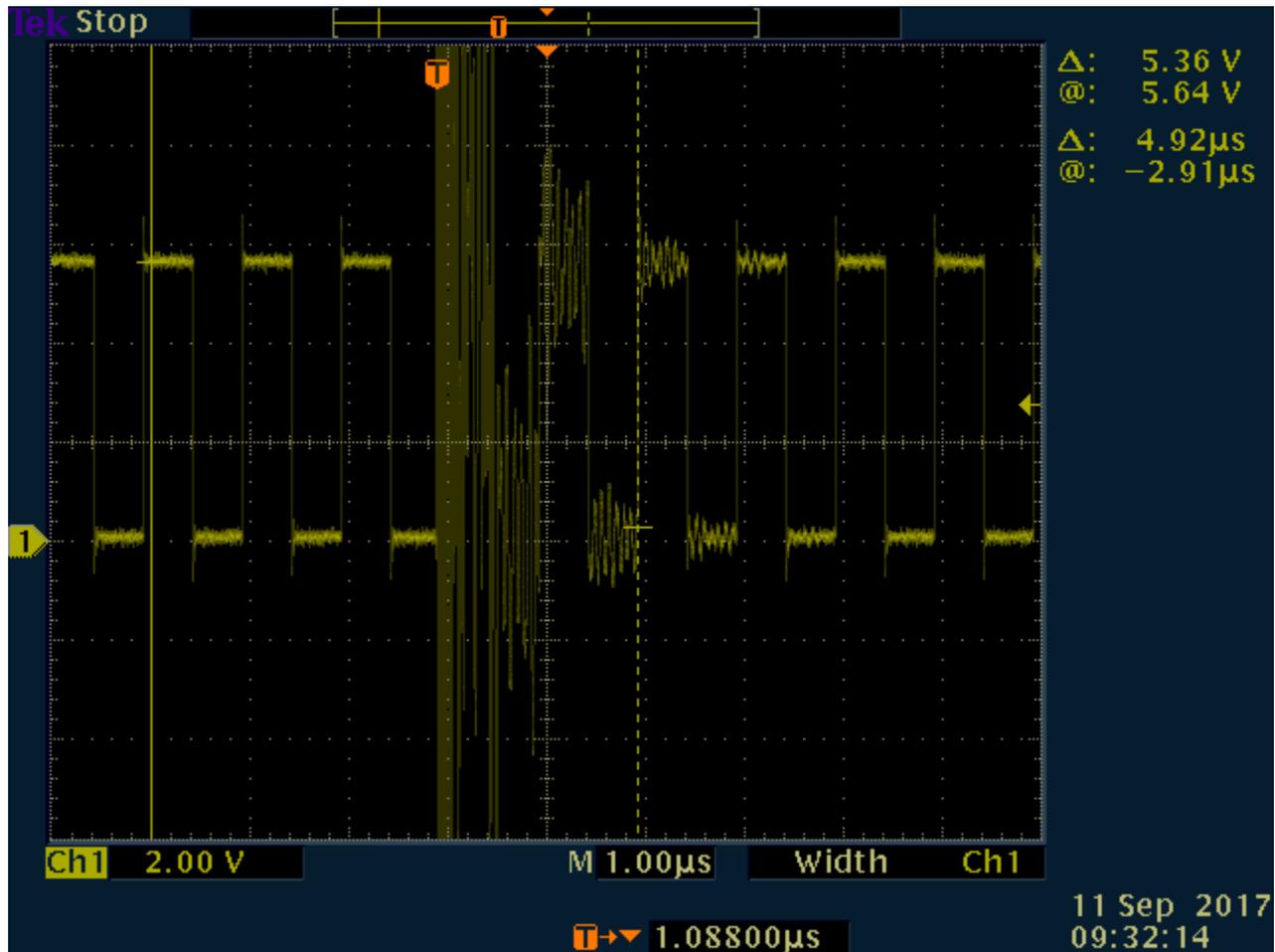


Figure 2. THVD1500 Bus Voltage Waveform During EFT Strike

3 Application Case

To demonstrate a real application case, TI published [reference design TIDM-1005](#). This reference design implements a smart meter data collector with protocol conversion between Meter Bus (M-Bus) and RS-485 networks. The system design is discussed in detail, and many related system tests are also shown. This report shows that the system passed the IEC ESD tests beyond the ± 8 -kV level, and showed less than 10^{-7} BER with all EFT tests.

These test results demonstrate that the THVD1500 meets the requirements specified in Q/GDW 11179.11-2015. The THVD1500 has been certified by SGCC (shown in [Figure 3](#)) and is qualified for use in all smart e-meters deployed by SGCC.

编号: SGCM014620170098

国网计量中心 检验报告

样品名称	RS-485 芯片	样品型号	THVD1500DR
委托单位	新晔电子(深圳)有限公司	检验类别	委托试验
生产单位	德州仪器半导体技术(上海)有限公司	单位地址	深圳市福田区市花路3号福年广场B3栋513-525
取样方式	自取	样品数量	19只
环境温度	20°C±5°C	相对湿度	25%~75%
检验日期	2017-05-25~2017-09-11	检验项目	24项
样品编号	SGCM014620170098-01~19		
检验依据	Q/GDW 11179.11-2015 电能表用元器件技术规范 第11部分: 串口通信协议 RS-485 芯片 THVD1500DR 器件手册		
检验结论	<p style="text-align: center;">受检样品所有检验项目的技术指标符合检验依据的要求。</p> <p>签发人: </p> <p style="text-align: right;">  签发日期: 2017年09月12日 有效期至: 2018年09月11日 </p>		
备注			

Figure 3. Inspection Report From SGCC Showing the THVD1500 Passed All Tests

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