

eMMC (4.41, 4.51 and 5.0) and SD (UHS-I) Electrical Validation and Protocol Decode Software



Detail View correlates Waveform, Protocol and electrical measurements

Key Features

- ✦ eMMC and SD (UHS-I) electrical measurements and Protocol testing software conforms to eMMC version 4.51 and 5.0 and SD version 3.01 specification.
- ✦ eMMC/SD/SDIO Protocol Aware Trigger features.
- ✦ Industry-first Protocol decoding CMD and Data (1 bit/4 bit and 8-bit mode) using MSO capabilities of Oscilloscope.
- ✦ Supports SDR and DDR and Boot mode for electrical measurement and Protocol Decode.
- ✦ Fast frame capability allows protocol analysis of CMD in 100s of the second time.
- ✦ The software automatically identifies the read and write operations using CMD and applies the electrical parameter limits accordingly.
- ✦ Detail View provides efficient debugging capability by correlating the analog waveform, protocol messages, and electrical measurements for each protocol packet in a single view.
- ✦ Protocol View lists the protocol activities in the sequential form to assist designers to know the host and card transactions.

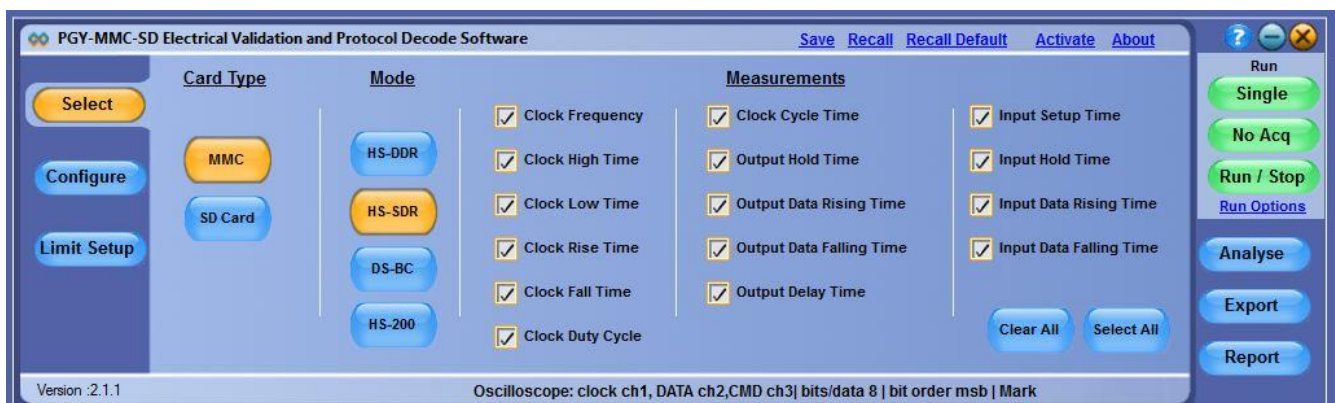
- ❖ Timestamp at the end of the command token and time stamp at beginning of the response token in Protocol View enables the designer to comply with specifications and locate any anomaly in timing between host and card.
- ❖ The software displays the details of command and response in Protocol View and lists the errors messages in card status for quick analysis.
- ❖ Ability to store the eMMC and SD protocol data in CSV and txt format.
- ❖ Utility features like zoom, undo, and fit to screen for easy maneuvering of the waveforms while debugging the cause of the problem in Detail View makes it easy to use tool.
- ❖ The software seamlessly integrates with Tektronix windows based oscilloscope and supports live signal analysis using live channels of the oscilloscope.
- ❖ Supports data analysis for long record length and more acquisition memory of oscilloscope enables analysis of protocol events for longer duration.
- ❖ Report generation in pdf format.
- ❖ Supports wfm and isf file formats of Tektronix oscilloscope for offline analysis.

Applications

1. Protocol Analysis
2. eMMC and SD (UHS-I) Electrical Compliance Test (Supports eMMC 4.42, 4.51 and 5.0 & SD3.01)
3. Correlation of Analog waveform, Protocol activities, and Electrical Measurements

Seamless Integration with Oscilloscope

PGY-eMMC and SD Electrical Validation and Protocol Decode Software run inside the Tektronix high-performance windows oscilloscopes. Automatically imports the data from oscilloscopes live channels. Also supports Tektronix .wfm and .isf file formats. This enables live and offline testing of eMMC and SD Signals.

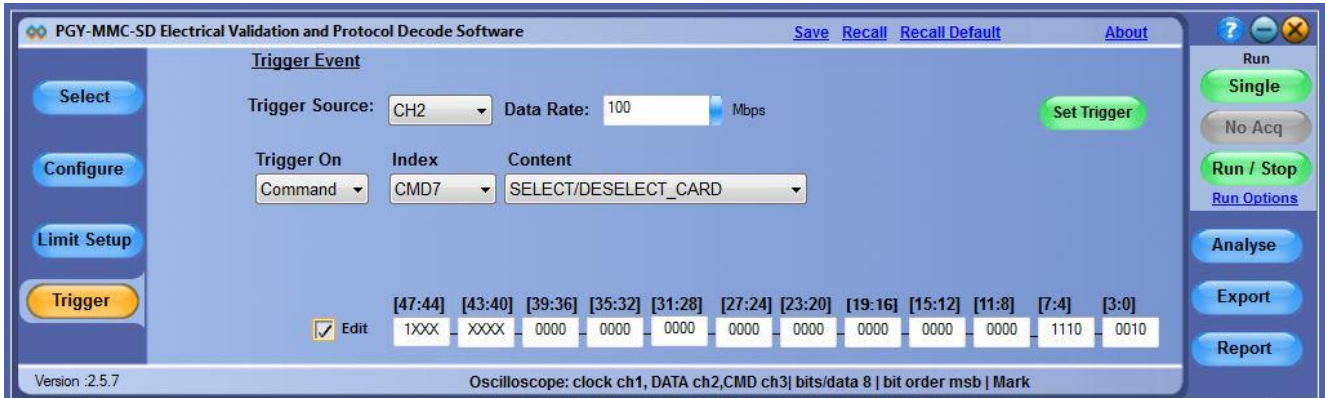


Measurement selections

1. Provides the flexibility to select the type of Card interface to be tested and related Bus speed modes
2. Flexibility select necessary or all electrical measurements
3. Save and recall application setup for repetitive testing at different times
4. Supports single and continuous test mode using oscilloscope live data
5. Ob-line help

eMMC/SD/SDIO Protocol Aware Triggering

For efficient testing and debugging of eMMC/SD/SDIO, it is important to capture signals in the right condition. PGY-eMMC-SD software provides protocol aware triggering along the serial pattern trigger option of the oscilloscope to capture signals at specific events in the CMD line.

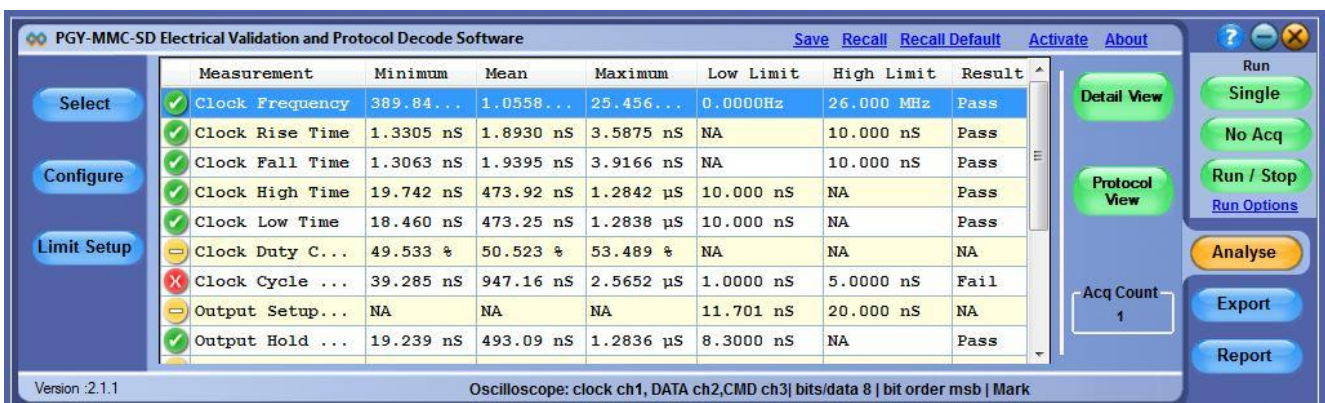


Trigger Setup menu

- Flexibility to trigger on command or response.
- Offers all the standard triggers patterns with command and response.
- Flexibility to edit trigger pattern.

Automated Electrical Validation and Protocol Decode Software

As per the specification of eMMC and SD, the measurement limits are different for reading and writing operations. The PGY-eMMC-SD measurement algorithms automatically find the read and write operations and validate with the respective limits. This enables you to save time in identifying the read and write operation and isolating any compliance issues.



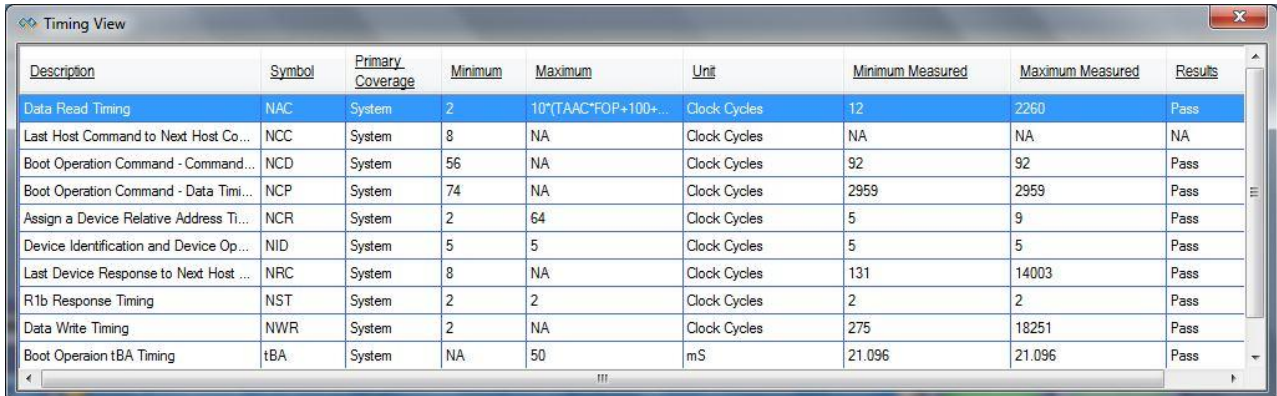
Analyze lists all electrical measurements with pass/fail report

- Lists electrical measurements with mean, minimum, and maximum values measured for the entire acquired waveform.
- Indicates if the measurement exceeds the min or max limits by the orange color.
- The lower and Upper limits of the electrical measurements are compared against measured values.

- Supports Electrical Measurements as per eMMC 4.41 and 4.51 and UHS3.1 Specification.
- Automated identification read and write operation and apply electrical limits as per eMMC and

Timing Parameters between CMD, Response, and Data

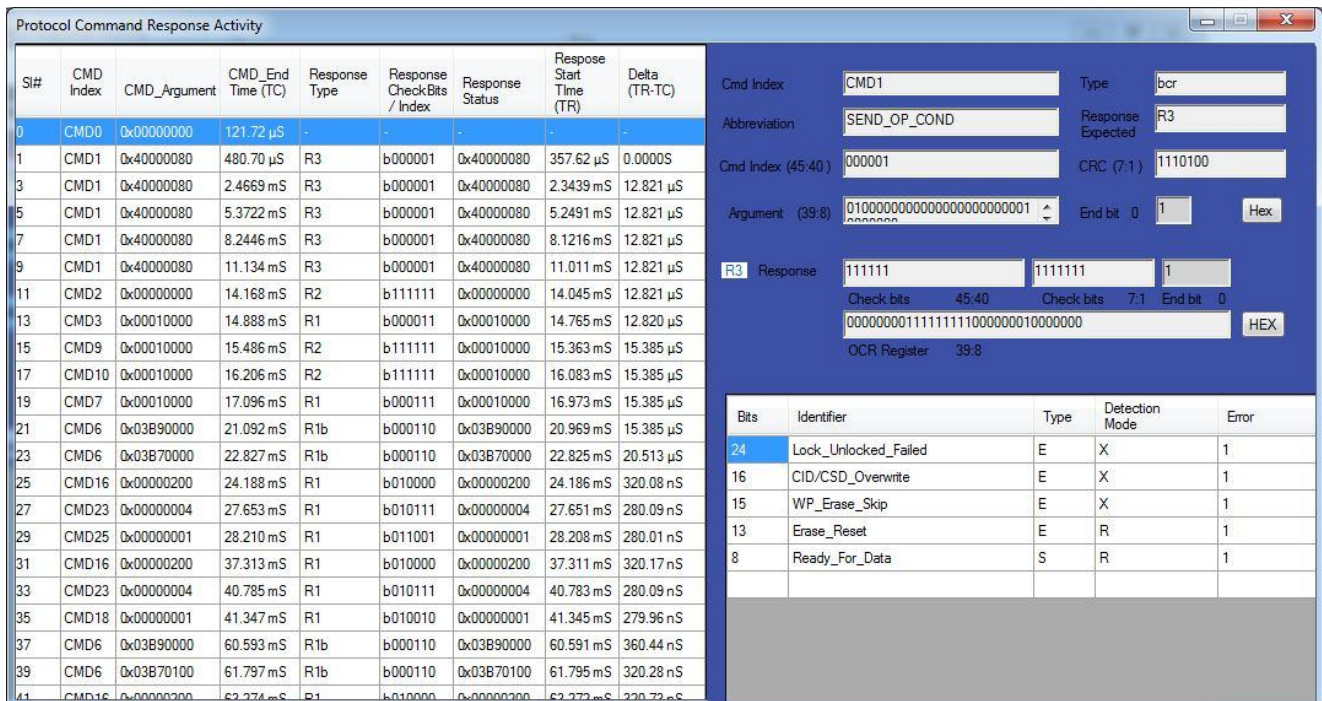
EMMC specifies the minimum and maximum cycles to present between the host and device to ensure interoperability. PGY-eMMC-SD analyzes the data for these specifications and offers results.



Description	Symbol	Primary Coverage	Minimum	Maximum	Unit	Minimum Measured	Maximum Measured	Results
Data Read Timing	NAC	System	2	10*(TAAC*FOP+100+...	Clock Cycles	12	2260	Pass
Last Host Command to Next Host Co...	NCC	System	8	NA	Clock Cycles	NA	NA	NA
Boot Operation Command - Command...	NCD	System	56	NA	Clock Cycles	92	92	Pass
Boot Operation Command - Data Timi...	NCP	System	74	NA	Clock Cycles	2959	2959	Pass
Assign a Device Relative Address Ti...	NCR	System	2	64	Clock Cycles	5	9	Pass
Device Identification and Device Op...	NID	System	5	5	Clock Cycles	5	5	Pass
Last Device Response to Next Host ...	NRC	System	8	NA	Clock Cycles	131	14003	Pass
R1b Response Timing	NST	System	2	2	Clock Cycles	2	2	Pass
Data Write Timing	NWR	System	2	NA	Clock Cycles	275	18251	Pass
Boot Operation tBA Timing	tBA	System	NA	50	mS	21.096	21.096	Pass

Protocol View

PGY-eMMC-SD software lists all the protocol activity between the host and card. Engineers can now quickly view the command and its corresponding response from the card. Selected protocol activity details are listed on the right side of the list table. Now Engineers can know the errors reported by card or any other message to host without struggling to know the content of each message.



Sl#	CMD Index	CMD_Argument	CMD_End Time (TC)	Response Type	Response CheckBits / Index	Response Status	Response Start Time (TR)	Delta (TR-TC)
0	CMD0	0x00000000	121.72 µS	-	-	-	-	-
1	CMD1	0x40000080	480.70 µS	R3	b000001	0x40000080	357.62 µS	0.0000S
3	CMD1	0x40000080	2.4669 mS	R3	b000001	0x40000080	2.3439 mS	12.821 µS
5	CMD1	0x40000080	5.3722 mS	R3	b000001	0x40000080	5.2491 mS	12.821 µS
7	CMD1	0x40000080	8.2446 mS	R3	b000001	0x40000080	8.1216 mS	12.821 µS
9	CMD1	0x40000080	11.134 mS	R3	b000001	0x40000080	11.011 mS	12.821 µS
11	CMD2	0x00000000	14.168 mS	R2	b111111	0x00000000	14.045 mS	12.821 µS
13	CMD3	0x00010000	14.888 mS	R1	b000011	0x00010000	14.765 mS	12.820 µS
15	CMD9	0x00010000	15.486 mS	R2	b111111	0x00010000	15.363 mS	15.385 µS
17	CMD10	0x00010000	16.206 mS	R2	b111111	0x00010000	16.083 mS	15.385 µS
19	CMD7	0x00010000	17.096 mS	R1	b000111	0x00010000	16.973 mS	15.385 µS
21	CMD6	0x03B90000	21.092 mS	R1b	b000110	0x03B90000	20.969 mS	15.385 µS
23	CMD6	0x03B70000	22.827 mS	R1b	b000110	0x03B70000	22.825 mS	20.513 µS
25	CMD16	0x00000200	24.188 mS	R1	b010000	0x00000200	24.186 mS	320.08 nS
27	CMD23	0x00000004	27.653 mS	R1	b010111	0x00000004	27.651 mS	280.09 nS
29	CMD25	0x00000001	28.210 mS	R1	b011001	0x00000001	28.208 mS	280.01 nS
31	CMD16	0x00000200	37.313 mS	R1	b010000	0x00000200	37.311 mS	320.17 nS
33	CMD23	0x00000004	40.785 mS	R1	b010111	0x00000004	40.783 mS	280.09 nS
35	CMD18	0x00000001	41.347 mS	R1	b010010	0x00000001	41.345 mS	279.96 nS
37	CMD6	0x03B90000	60.593 mS	R1b	b000110	0x03B90000	60.591 mS	360.44 nS
39	CMD6	0x03B70100	61.797 mS	R1b	b000110	0x03B70100	61.795 mS	320.28 nS
41	CMD16	0x00000200	62.272 mS	R1	b010000	0x00000200	62.272 mS	220.72 nS

Protocol Command Response Activity

Cmd Index: Type:

Abbreviation: Response Expected:

Cmd Index (45:40): CRC (7:1):

Argument (39:8): End bit: Hex

R3 Response:

Check bits: 45:40 Check bits: 7:1 End bit: 0

HEX

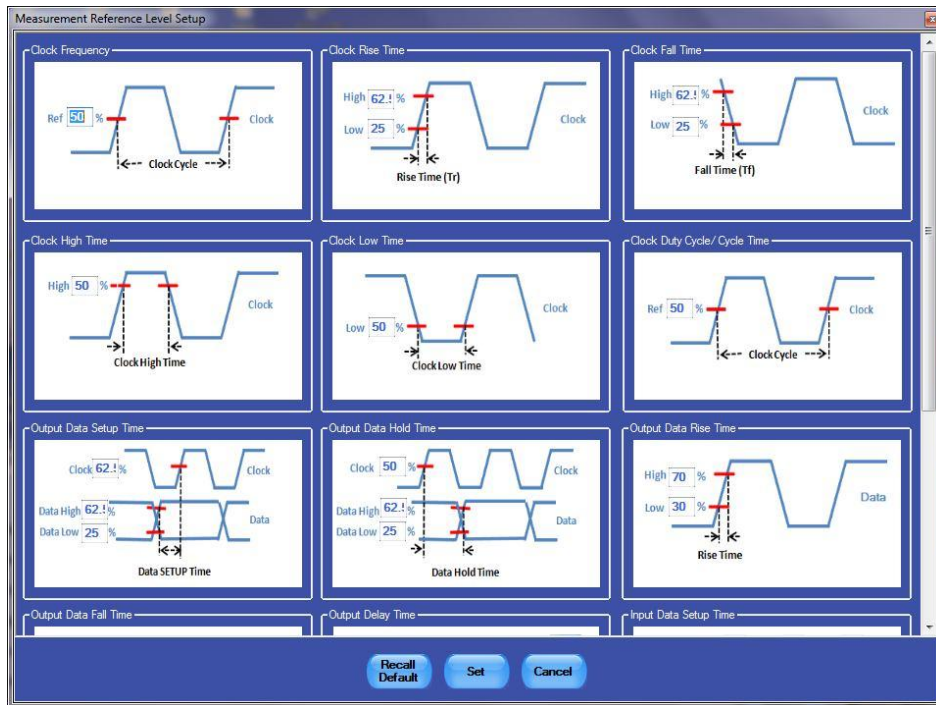
OCR Register: 39:8

Bits	Identifier	Type	Detection Mode	Error
24	Lock_Unlocked_Failed	E	X	1
16	CID/CSD_Overwrite	E	X	1
15	WP_Erase_Skip	E	X	1
13	Erase_Reset	E	R	1
8	Ready_For_Data	S	R	1

Protocol view

Characterization of PHY layer by custom limit setup

PGY-eMMC-SD is not just for standard electrical compliance testing, you can also vary the limits and test your device with custom limits. The intuitive limits and reference level setup allows you to configure the limits and reference levels for your custom testing needs. This enables you to test your device beyond the specification and characterize it.



Config panel to custom set the reference setting for electrical measurement

Powerful Debug environment: Detail view

In Detail View, engineers can view the analog waveform, details of the protocol, and electrical measurements in a single view. If there is any failure in electrical measurement or error in protocol messages, designers can quickly correlate the protocol data with analog waveforms. These protocol errors can be caused due to the failure in electrical measurements. Users can select any row in the detail view; the corresponding analog waveform will be zoomed in and displayed. In the same row, engineers can view all the electrical measurements corresponding to the selected row. Utility features such as zoom, cursors, and markers make custom measurements while debugging.



Detail view

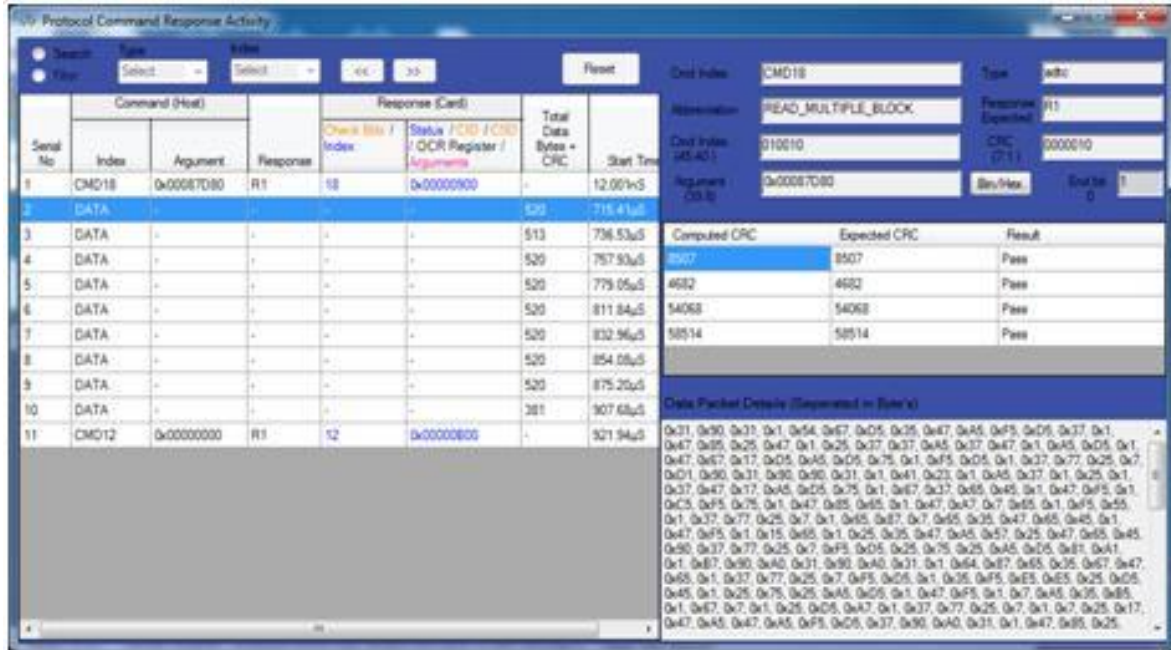
Detail view provides the following capabilities:

- Plots the acquired waveform in the waveform view window.
- Lists all decoded command and response tokens in each row in the decode table.
- Identifies of type of command and response for easy protocol interpretation.
- Lists respective electrical measurements for command and response for each row.
- Selected Protocol command or response's related analog waveform is plotted in a window.
- Bus Diagram view overlays protocol data for the selected row along with waveform.
- Snap button enables storing selected waveform window for report generation purpose.
- Zoom, fit to screen, pan, undo, vertical and horizontal cursors enables quick analysis and measurement of electrical signals.



Industry First Decoding of CMD and data Signals:

PGY-eMMC-SD leverages powerful capabilities of Digital Channels of MS070000/5000 series oscilloscope to provide industry decoding of data signals in eMMC and UHS-I.



Serial No	Command (Host)	Response (Card)	Total Data Bytes + CRC	Start Time
1	CMD18 0x00087080	R1 18 0x00000900	-	12.001ns
2	DATA	-	520	715.41µs
3	DATA	-	513	736.53µs
4	DATA	-	520	757.50µs
5	DATA	-	520	779.05µs
6	DATA	-	520	811.84µs
7	DATA	-	520	832.96µs
8	DATA	-	520	854.08µs
9	DATA	-	520	875.20µs
10	DATA	-	381	907.68µs
11	CMD12 0x00000000	R1 12 0x00000000	-	921.94µs

Computed CRC	Expected CRC	Result
8507	8507	Pass
4682	4682	Pass
54068	54068	Pass
58514	58514	Pass

Data Packet Display (Segmented in Bytes)

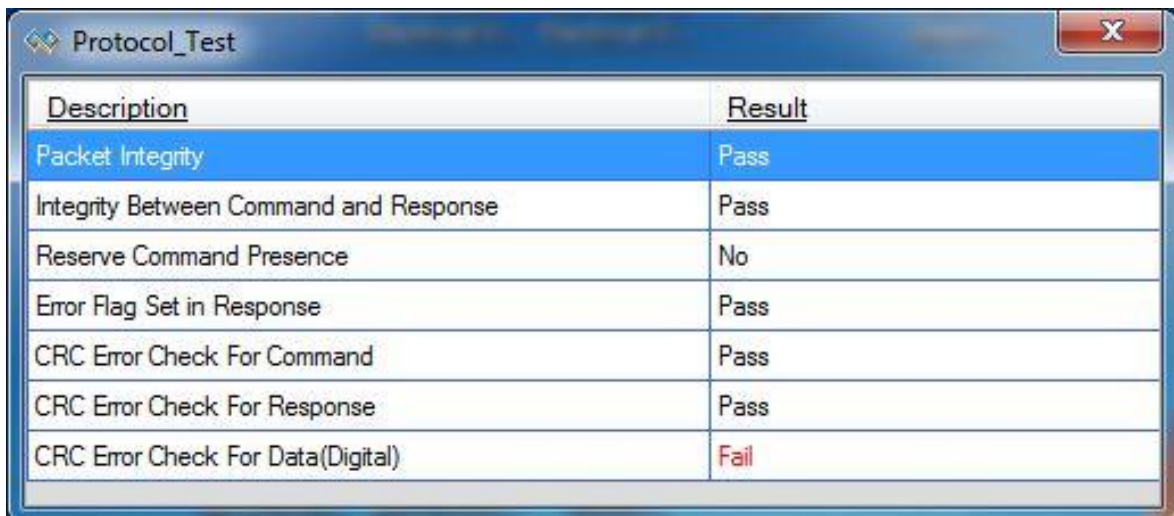
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0x31, 0x90, 0x31, 0x1, 0x54, 0x67, 0x05, 0x25, 0x47, 0x45, 0x45, 0x25, 0x37, 0x1,
0x47, 0x95, 0x25, 0x47, 0x1, 0x25, 0x37, 0x37, 0x45, 0x37, 0x47, 0x1, 0x45, 0x25, 0x1,
0x47, 0x67, 0x17, 0x05, 0x45, 0x05, 0x75, 0x1, 0x45, 0x05, 0x1, 0x37, 0x77, 0x25, 0x7,
0x01, 0x90, 0x31, 0x90, 0x90, 0x31, 0x1, 0x41, 0x23, 0x1, 0x45, 0x37, 0x1, 0x25, 0x1,
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0x47, 0x45, 0x47, 0x45, 0x45, 0x45, 0x37, 0x90, 0x40, 0x31, 0x1, 0x47, 0x65, 0x25.
    
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Digital Decode view

Protocol test:

PGY-MMC-SD software automatically checks for Protocol Integrity. This allows a very easy method of ensuring protocol packets are as per protocol specifications of eMMC, and UHS-I Specifications.



Description	Result
Packet Integrity	Pass
Integrity Between Command and Response	Pass
Reserve Command Presence	No
Error Flag Set in Response	Pass
CRC Error Check For Command	Pass
CRC Error Check For Response	Pass
CRC Error Check For Data(Digital)	Fail



Tektronix Oscilloscopes Supported:

- DPO/MSO5000 series
- DPO7000 series
- DPO/MSO/DSA 70000 series
- MSO5 series, MSO6 series

All need to be windows 7 or higher OS based

Ordering Information:

PGY-MMC-SD (shipment includes CD with PGY-MMC-SD Electrical Validation and Protocol Decode Software)

Contact Information



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About Prodigy Technovations Pvt Ltd

Prodigy Technovations Pvt Ltd (www.prodigytechno.com) is a leading global technology provider of Protocol Decode, and Physical layer testing solutions on test and measurement equipment. The company's ongoing efforts include successful implementation of innovative and comprehensive protocol decode and physical layer testing solutions that span the serial data, telecommunications, automotive, and defense electronics sectors worldwide.