DP83826A Diagnostics Guide

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TDR - Cable Diagnosis

Overview: TDR is used to diagnose cable faults and their corresponding location in a transmission line. To run a full cable simulation, TDR must be configured and run up to 6 times for each cable segment.

Segments are defined below

- Segment 1: 0-10m
- Segment 2: 10-20m
- Segment 3: 20-40m
- Segment 4: 40-80m
- Segment 5: 80-190m

Segments require different configurations to account for cable attenuation and propagation delay

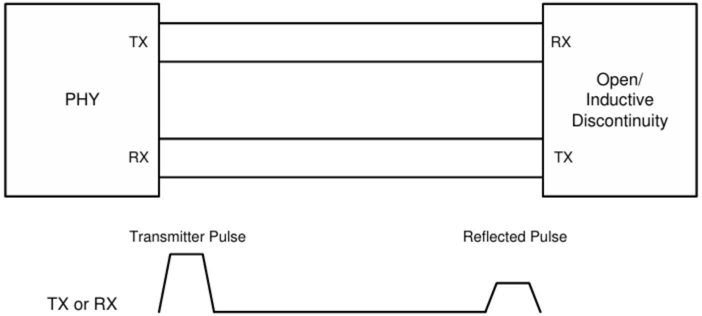


Figure 1-1. Open Circuit Cable

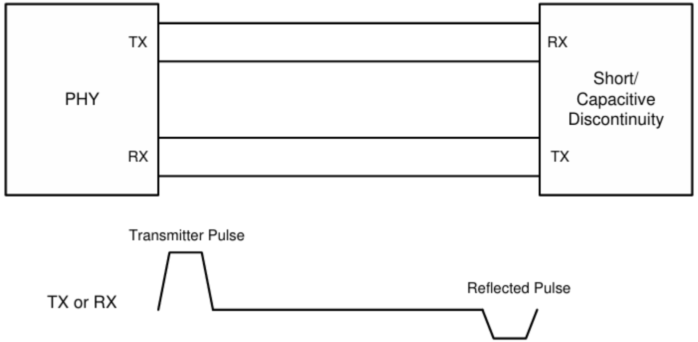
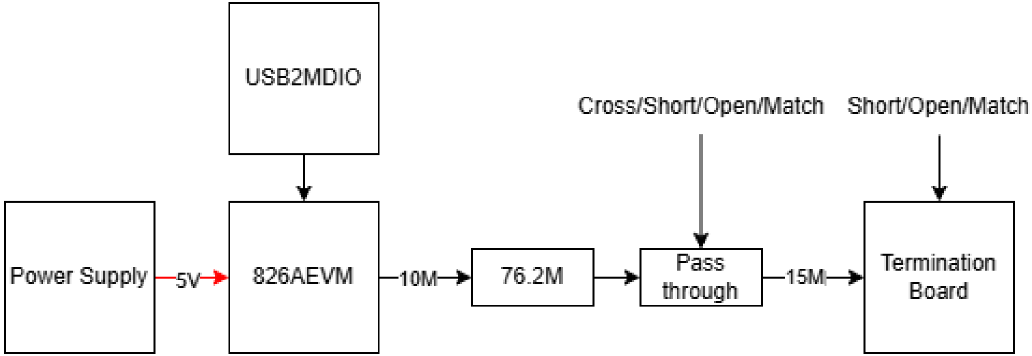


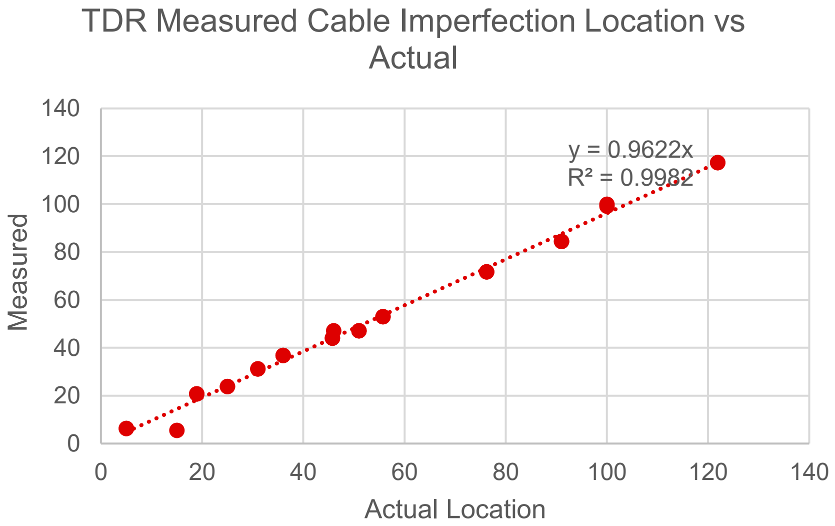
Figure 1-2. Short Circuit Cable

TDR - Demo

BOM
Ethernet Cables (CAT5e/6/7) of varied length
DP83826A EVM
Power Supply
2x Power Supply Leads
1x laptop on USB2MDIO
1x USB micro cable
1x Termination board (open/short/matched)

Procedure
1. Connect USB to DP83826AEVM
2. Connect 5V to DP83826AEVM (needed to read registers)
3. Open USB2MDIO and open port
4. Set PHY address to 0
5. Attach test cable and chosen termination
6. Run TDR script
7. Input data returned from script to TDR calculator





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TDR - Registers

Up to 6 tests are to be run depending on the length of cable. For unused segments, fill in registers with 0 or do not run the test.

Configuration registers and corresponding values for each segment →

//TDR segment 1A	//TDR segment 1B	//TDR segment 2	//TDR Segment 3	//TDR Segment 4	//TDR Segment 5
//TDR Config registers	//TDR Config registers	//TDR Config registers	//TDR Config registers	//TDR Config registers	//TDR Config registers
0170 5C12	0170 5C12	0170 5C22	0170 5E32	0170 5E42	0170 5E52
0173 0D00	0173 0D0C	0173 0D13	0173 1A20	0173 343A	0173 8F6E
0175 1007	0175 1007	0175 1007	0175 1007	0175 100A	0175 100D
0178 0002	0178 0002	0178 0002	0178 0002	0178 0002	0178 0006
0416 1FA0	0416 1FA0	0416 1FA0	0416 1FA0	0416 1FA0	0416 1F90
0411 0813	0411 0813	0411 0813	0411 0815	0411 0816	0411 0816
0456 0608	0456 0608	0456 0608	0456 0608	0456 0608	0456 0608
001E 8102	001E 8102	001E 8102	001E 8102	001E 8102	001E 8102
//START TDR	//START TDR	//START TDR	//START TDR	//START TDR	//START TDR
001E 8000	001E 8000	001E 8000	001E 8000	001E 8000	001E 8000

Registers to read after running a test for each segment →

001E	180	185	018A
if bit 1 is high, TDR is complete	returns peak location	returns amplitude of peak	Bit 11 gives polarity of peak (high = short)

TDR – Fault Determination

Once confirming that TDR is complete, compare peak amplitudes of segments and identify the first peak that is greater than 7. **(SNLA428 recommends 10. In testing, valid peak values had amplitudes as low as 7)**

001E	180	185	018A
if bit 1 is high, TDR is complete	returns peak location	returns amplitude of peak	Bit 11 gives polarity of peak (high = short)

To convert register 0x0180 data to peak location in meters, convert the value to decimal and input to the equation below

$$Peak\ Location\ (m) = [(PL - 5) * \frac{8}{2 * prop_{dly}}]$$

Prop_dly depends on your cable type:

- CAT5/5e = 5.35
- CAT6 = 5
- CAT7 = 4.6

Using 0x018A[11] determines whether the fault is a short or open

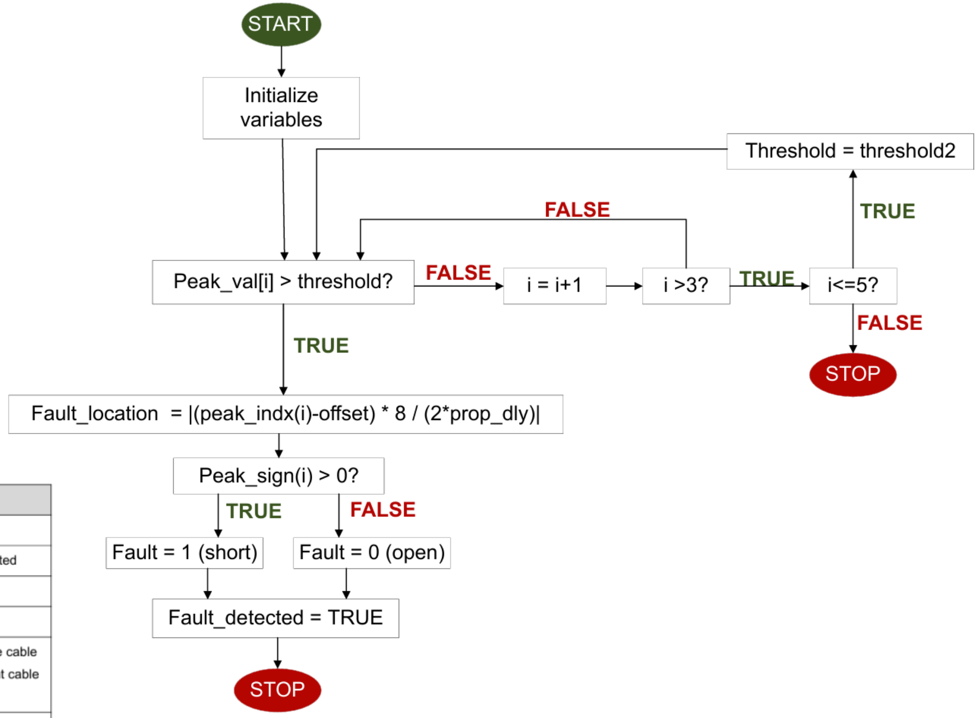
Fill in a data table as shown below

Table 2-2. TDR Data Table

Segment	peak_index (0x180)	peak_value (0x185)	peak_sign (0x18A)
2			
3			
4			
5			
1B			
1A			

TDR - Algorithm

With a complete data table, implement the algorithm shown to detect and identify cable faults



Variable	Type	Initial Value	Description
i	int	5	Current row of the matrix
threshold	int	10	The threshold that peak_indx must exceed for a fault to be detected
fault_detected	bool	FALSE	Defines whether a fault has been detected
fault_location	float	0	Fault location
prop_dly	float		Propogation delay variable. This value can be adjusted based on the cable type. See the Prop_dly Values table for suggested values for different cable types.
offset	int	5	Variable used in calculating the fault location.
fault	int	0	Defines whether a fault is a SHORT (1) or an OPEN (0) fault

SQI – Link Health

SQI can be used monitor link health and diagnose link issues.

The MSE register 0x0218 can be converted to effective SNR.

Convert the value to decimal and convert using the equation below:

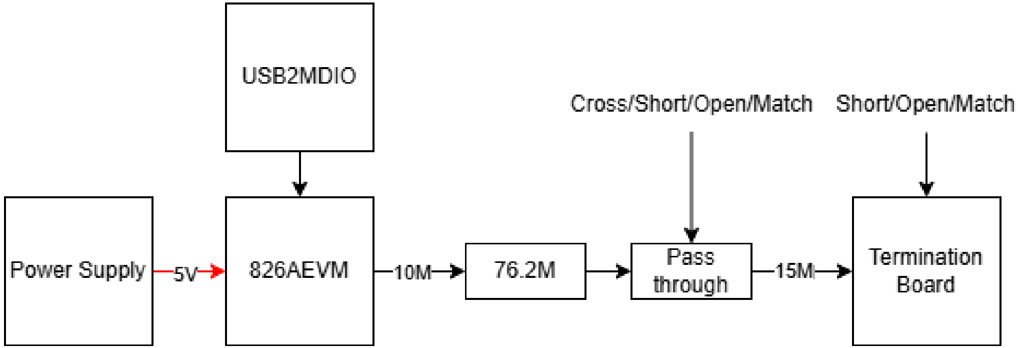
$$SNR(dB) = 10 * \log(0.5) - 10 * \log(\frac{MSE}{2^{17}})$$

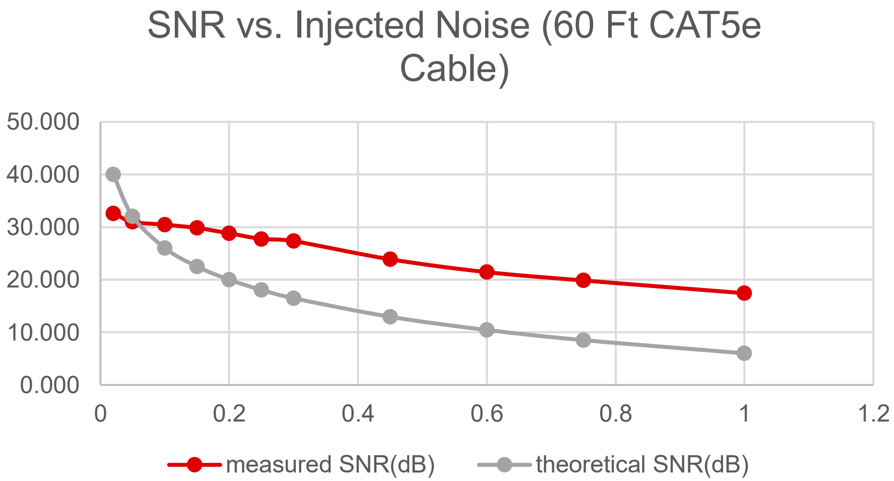
LINK QUALITY	SNR RANGE
Excellent	SNR > 22dB
Good	19.5dB < SNR < 22dB
Poor	SNR < 19.5dB

SQI - Demo

BOM
1x Function generator
2x male to male jumper wires
1x BNC to grabber cable
1x laptop on USB2MDIO
1x USB Micro cable
1-2x DP83826AEVMs
1x Pkt Gen if not using 2x EVMs
1x Ethernet passthrough board

Procedure
1. Connect USB to DP83826AEVM(s)
2. Connect 5V to DP83826AEVM (needed to read registers)
3. Open USB2MDIO and open port
4. Set PHY address to 0
5. If using 2 EVMs, set one to be Pkt Gen
6. Swap usb over to receiver EVM
7. Set function generator to generate noise
8. Vary amplitude and read register 0x0218





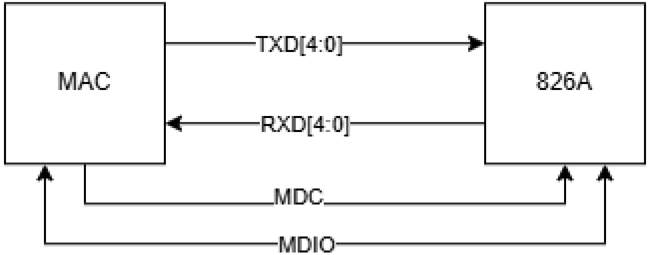
MII Loopback – MAC Interface Diagnosis

MII loopback is vital to diagnosing MAC interface issues. This can identify if an error is on the MAC side, PHY side or in the layout itself.

Set BMCR 0x0[14] = ‘1’

Set traffic to transmit from MAC 0x16[2] = ‘1’

Configure MAC to send known packets on TX line and read RX data. Implement an error counter



Reverse Loopback – Link Diagnosis

Link quality can be tested using reverse loopback between 2 link partners.

This is activated by setting bit [4] in the BISCR (0x0016)

Combining this with another 826A that is generating PRBS packets with the MAC reading RX err count (0x0015) or SNR (0x0218) allows for diagnosis of the link quality.

References

TDR

Time Domain Reflectometry with DP83826

SQI

DP83826E Troubleshooting Guide (Rev. A)

Datasheet

DP83826Ax Deterministic, Low-Latency, Low-Power, 10/100 Mbps, Industrial Ethernet PHY datasheet (Rev. A)