Anritsu envision : ensure

Ideal Remote-Control Sequences

BERTWave MP2100B

Table of Contents

1 Introduction

The BERTWave MP2100B (Fig. 1) was designed specifically for manufacturing applications and, in addition to helping to reduce initial infrastructure costs, it also reduces running costs. Furthermore, it has useful remote command functions for shortening measurement times on production lines.

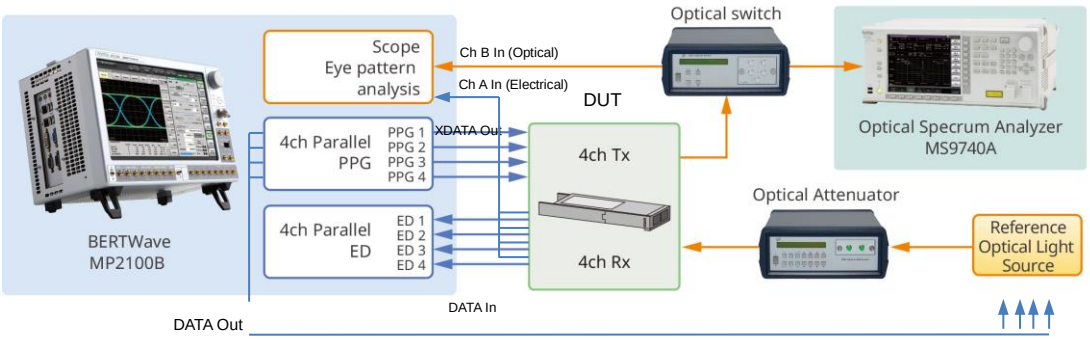
This document introduces some remote sequences using the MP2100B functions and speed for QSFP+ measurements.

Commands for production of QSFP+ modules can be selected from remote commands of the MP2100B using the remote sequences described in this document, helping with configuration of easy-to-use test systems for optical modules.

Fig. 1 BERTWave

2 Optical Module Test System

This document explains how to evaluate QSFP+ modules for 40GBase-LR4 as an example. Both the optical and electrical characteristics (Table 1) of optical modules can be evaluated using the system setup shown below (Fig. 2).



・Connect PPG XDATA Out of the BERTWave to the DUT
・Connect PPG DATA Out of the BERTWave to the Reference QSFP+
・Connect the DUT Rx Electrical output to the BERTWave ED Data In and Scope Ch A
・Connect the DUT Tx Optical output to the BERTWave Scope Ch B
・Connect the BERTWave sync out to Trigger Clk In

Fig. 2 MP2100B (with Opt-014 and Opt-023 installed) Measurement System

Table 1 Test Items

Interface	Test Items
Electrical IF	Jitter p-p, Jitter rms, Rise Time, Fall Time, etc.
Optical IF	Extinction Ratio, Average Power Adjustment
	Cross Point, Average Power, Extinction Ratio, OMA Value, etc.
	Mask Margin
Shared	Rx Optical Sensitivity

3 Measurement Flow

Fig. 3 shows the overall measurement flow when performing the tests in Table 1. This document explains the remote sequences when performing these tests.

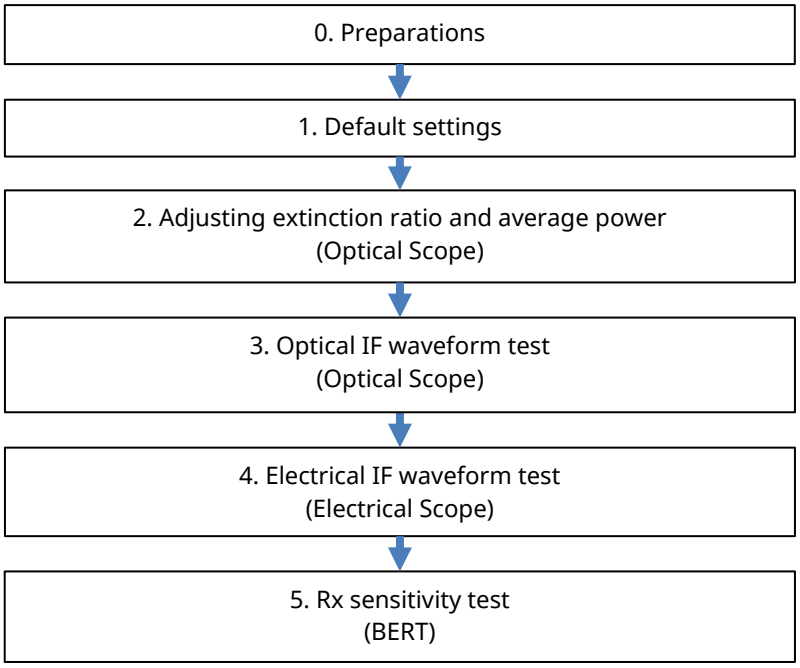


Fig. 3 Overall Flow of Optical Module Evaluation

4 Hardware Configuration

Table 2 below shows the options required for executing each block in Fig. 2.

Table 2 Options Required for Sequence Test

Module	MP2100B
BERT	014
Optical Scope	023*
Electrical Scope	023/021

*Requires filter option sold separately
014: 4CH BERT
023: Optical and Single-ended Electrical Scope
021: Dual Electrical Scope

5 Software Configuration

The command sequences explained in this document assume use of software version 4.0051 or later. Use of earlier software versions may result in abnormal operation and errors due to changes in command specifications. In addition, the MP2100B has commands to improve remote control speed. Table 3 explains the high-speed commands and compares the MP2100A and MP2100B. It also shows the improved remote commands.

Table 3 MP2100B New Commands

<table>
<tr><th>MP2100A Command</th><th>MP2100B Command</th><th></th></tr>
<tr><td>-</td><td>:BERT:ALL:PARam:TRACking</td><td>This command supports changing the Channel Tracking setting On/Off.
The MP2100B Channel Tracking function sets same PPG/ED basic settings for all channels when Ch1 is set.
The default is On.</td></tr>
<tr><td>-</td><td>:SCOPe:DISPlay:MODE:EYE:FAST</td><td>These command supports changing the Fast Sampling Mode setting On/Off.
The Fast Sampling Mode is 1.5 times faster than the MP2100A/02A.
The default is On.</td></tr>
<tr><td rowspan="2">:BERT[<ch>]:SENSe:MEASure:STARt
:BERT[<ch>]:SENSe:MEASure:EALarm:STATe?
:BERT[<ch>]:SENSe:MEASure:STOP
:BERT[<ch>]:CALCulate:DATA:MONitor?
:BERT[<ch>]:DISPlay:RESult:EALarm:HRESet
:BERT[<ch>]:CALCulate:DATA:EALarm? "<period>:<item>"

[<ch>]=1,2,3,4
The above commands must be repeated for each masurement channel.</td><td>:BERT:ALL:SENSe:MEASure:IMMediate? <time>[,<item>]</td><td>The :IMMediate? command performs BER measurement with one command at measurement times of 10 ms to 3 s.</td></tr>
<tr><td>:BERT:ALL:SENSe:MEASure:STARt
:BERT:ALL:SENSe:MEASure:EALarm:STATe?
:BERT:ALL:SENSe:MEASure:STOP
:BERT:ALL:CALCulate:DATA:MONitor?
:BERT:ALL:DISPlay:RESult:EALarm:HRESet
:BERT:ALL:CALCulate:DATA:EALarm? "<period>:<item>"</td><td>Using the MP2100B, appending the [:ALL] key word to a command performs a batch operation for all channels.
This command supports 50% faster measurement than the MP2100A.</td></tr>
</table>

Command Sequences

0. Preparations

Initialize the system and perform calibration before use. Execute the settings according to the following procedures (Tables 4).

Table 4 Preparation Setting Sequence

Step	Module	Function	Remote Command	Explanation
0-1	Shared	Initializes settings	Write('*RST')	Initializes settings.
0-2	Scope	Calibrates scope	:SCOPe:CALibrate:AMPLitude?	Calibrates scope amplitude and returns calibration results. *When calibrating, confirm that there is no signal input to the scope input connectors (Ch A/B In, Trigger Clk In). *Since calibration processing requires about 50 s in the Eye mode, set the response wait timeout to at least 60 s. At other times, we recommend setting a timeout of at least 30 s because communications do not timeout during command execution.

1. Default Settings

Initial setting of the system and set items is the bit rate, electrical-signal parameters (amplitude, test pattern) and optical-signal wavelength, filters, etc., as follows for the optical module to be used. Execute the settings according to the following procedures (Tables 5).

Table 5 Initialization Setting Sequence using MP2100B

Step	Module	Function	Remote Command	Explanation
1-1	BERT	Displays PPG/ED ch1	:DISPlay:ACTive 1	Displays PPG/ED Ch1 screen.
1-2		Sets bit rate, offset, amplitude, test pattern	:BERT:OUTPut:BITRate:STANdard "10G_LAN" :BERT:SOURce:PATTern:TYPE PRBS31 :BERT1:OUTPut:DATA:AMPLitude DATA,0.5 :BERT2:OUTPut:DATA:AMPLitude DATA,0.5 :BERT3:OUTPut:DATA:AMPLitude DATA,0.5 :BERT4:OUTPut:DATA:AMPLitude DATA,0.5	Sets PPG/ED (10GbE bit rate (10.312G), PRBS31 test pattern and 0.5 Vp-p amplitude). Uses MP2100B Channel Tracking function to set same PPG/ED basic settings for all channels if Ch1 set.
1-3		Sets PPG output	:SOURce:OUTPut:ASET ON	Sets PPG output to ON. Use ":BERT:OUTPut:DATA:OUTPut" to set ON at each channel.
1-4	O/E	Sets optical input (filter, wavelength, correction factor)	:OE:INPut:FILTer 6 :OE:INPut:WAVLength 1310 :OE:CONFigure:EXRCorrection 1 :OE:CONFigure:EXRCorrection:FACTor 3.00	Sets optical input (10GbE filter, 1310 nm wavelength, 3% correction factor*) *Set the correction factor as required to give the reference Extinction Ratio.
1-5	Scope	Displays scope	:DISPlay:ACTive 5	Displays Scope screen.

2. Adjusting Extinction Ratio and Average Power (Optical Scope)
Adjust the Extinction Ratio and Average Power. The range for the Extinction Ratio and Average Power is determined by each standard so adjustment is made as necessary by adjusting within this range to change the Extinction Ratio and Average Power to the best position as follows:
Execute the settings according to the following procedures (Tables 6).

Table 6 Extinction Ratio and Average Power Adjustment Sequence

Step	Module	Function	Remote Command	Explanation
2-1	Optical Scope	Sets measured channel	:SCOPe:INPut:CHA OFF :SCOPe:INPut:CHB ON :SCOPe:CONFigure:MEASure:CHANnel B	Sets measured channel to B.
2-2		Sets sampling condition	:SCOPe:OPTion:MAX:SAMPles:NUMber 1350 :SCOPe:ACCUmulation:TYPe PERSistency	Sets sampling conditions (1350 sampling count and Persistency mode).
2-3		Sets amplitude	:SCOPe:DISPlay:WINDow:Y:DIVision:CHB 200	Sets y-axis scale.
2-4		Sets test mode	:SCOPe:CONFigure:MEASure:TYPe AMPTIME	Sets test mode to Amplitude/Time.
2-5		Selects measurement items	:SCOPe:CONF:MEAS:AMPTIME1 CHB, 6 :SCOPe:CONF:MEAS:AMPTIME2 CHB, 8	Selects items displayed on measurement screen (Average Power and Extinction Ratio).
2-6		Starts sampling	:SCOPe:SAMPling:STATus RUN	Starts sampling.
2-7		Executes measurement result	:SCOPe:FETCh:AMPLitude:AVEPower? :SCOPe:FETCh:AMPLitude:EXTRatio? :SCOPe:DISPlay:WINDow:GRAPhics:CLEar	Executes measurement results (Average Power and Extinction Ratio) and clears result. Adjusts DUT and repeats until measurement result becomes expected value.
2-8		Stops sampling	:SCOPe:SAMPling:STATus HOLD	Stops sampling.

3. Optical IF Waveform Test (Optical Scope)
Execute the Waveform Test for the signal output from the optical IF of the optical module. This is the most important test item for confirming the optical module characteristics; it is an index of the compatibility of transceivers in the network and the performance. To confirm that the optical signal quality satisfies the standards, in addition to evaluating the Cross Point, Average Power, Extinction Ratio, and OMA, also use the Mask Margin test to confirm that the margin satisfies the mask determined by the standard.
Execute the settings according to the following procedures (Tables 7).

Table 7 Optical IF Waveform Test Sequence

Step	Module	Function	Remote Command	Explanation
3-1	Optical Scope	Sets measurement channel	:SCOPe:INPut:CHA OFF :SCOPe:INPut:CHB ON :SCOPe:CONFigure:MEASure:CHANnel B	Sets measurement channel to B.
3-2		Sets sampling conditions	:SCOPe:OPTion:MAX:SAMPles:NUMber 1350 :SCOPe:ACCUmulation:TYPe LIMited :SCOPe:ACCUmulation:LIMit WAVeform,100	Sets sampling conditions (1350 sampling number, Limited mode and 100 waveform capture count).
3-3		Sets test mode	:SCOPe:CONFigure:MEASure:TYPe AMPMask :SCOPe:CONFigure:MASK:TYPe 11	Sets test mode to Amplitude/Time & Mask. Specifies mask file (10 GbE LAN/PHY).
3-4		Selects measurement items	:SCOPe:CONFigure:MEASure:AMPTIME 1 CHA, 4 :SCOPe:CONFigure:MEASure:AMPTIME 2 CHA, 6 :SCOPe:CONFigure:MEASure:AMPTIME 3 CHA, 8 :SCOPe:CONFigure:MEASure:AMPTIME 4 CHA, 15	Selects items displayed on measurement items (Cross Point, Average Power (dBm), Extinction Ratio, OMA (mW)).
3-5		Executes Auto scale	:SCOPe:DISPlay:WINDow:SCALe:AUTOscale BOTH	Executes Auto scale. Specifying the parameters with the Auto scale command can shorten the execution time (about 1 s at BOTH).
3-6		Executes sampling	:SCOPe:SAMPling:STATus RUN :SCOPe:SAMPling:STATus?', 'HOLD	Executes sampling and waits until completed. (Repeats until HOLD returned by STATe? command.)
3-7		Queries measurement results	:SCOPe:MEASure:MASK:MARGin? :SCOPe:FETCh:AMPLitude:CROSsing? :SCOPe:FETCh:AMPLitude:AVEPower? :SCOPe:FETCh:AMPLitude:EXTRatio? :SCOPe:FETCh:AMPLitude:OMA:MW?	Queries measurement results (Mask Margin, Cross Point, Average Power, Extinction Ratio, OMA).
3-8		Executes screen copy	:MODule:ID 5 :SCOPe:EYEPulse:PRINt:COPY "screen_data","C:/screen_copy"	Executes screen copy and captures screen data.

			:SYSTem:DISPlay:DATA?	*Use the same file name for the COPY command file name (to prevent compressing BERTWave disk region). *Special read processing is required because the response to the :SYSTem:DISPlay:DATA? command (screen data) is binary data. For details, refer to the explanation of the DATA? command in the operation manual.

4. Electrical IF Waveform Test (Electrical Scope)
Execute the Waveform Test for the signal output from the electrical IF of the optical module. To confirm that the output signal quality meets the standards, evaluate the Jitter and the Rise Time and Fall Time using the following procedure:
Execute the settings according to the following procedures (Tables 8).

Table 8 Electrical IF Waveform Test Sequence

Step	Module	Function	Remote Command	Explanation
4-1	Electrical Scope	Sets measurement channel	:SCOPe:INPut:CHA ON :SCOPe:INPut:CHB OFF :SCOPe:CONFigure:MEASure:CHANnel A	Sets measurement channel to A.
4-2		Sets sampling conditions	:SCOPe:OPTion:MAX:SAMPles:NUMber 1350 :SCOPe:ACCUmulation:TYPe LIMited :SCOPe:ACCUmulation:LIMit WAVeform,100	Sets sampling conditions (1350 sampling number, Limited mode and 100 waveform capture count).
4-3		Sets test mode	:SCOPe:CONFigure:MEASure:TYPe AMPTIME	Sets test mode to Amplitude/Time & Mask.
4-4		Selects measurement items	:SCOPe:CONFigure:MEASure:AMPTIME 1 CHA, 9 :SCOPe:CONFigure:MEASure:AMPTIME 2 CHA, 10 :SCOPe:CONFigure:MEASure:AMPTIME 3 CHA, 11 :SCOPe:CONFigure:MEASure:AMPTIME 4 CHA, 12	Selects items displayed on measurement items (Jitter p-p, Jitter (rms), Rise Time, Fall Time).
4-5		Executes Auto Scale	:SCOPe:DISPlay:WINDow:SCALe:AUTOscale BOTH	Executes Auto scale. Specifying the parameters with the Auto scale command can shorten the execution time (about 1 s at BOTH).
4-6		Executes sampling	:SCOPe:SAMPling:STATus RUN :SCOPe:SAMPling:STATus?', 'HOLD'	Executes sampling and waits until completed. (Repeats until HOLD returned by STATe? command.)
4-7		Queries measurement result	:SCOPe:FETCh:TIME:JITTer:PPeak? :SCOPe:FETCh:TIME:JITTer:RMS? :SCOPe:FETCh:TIME:TRISe? :SCOPe:FETCh:TIME:FTIMe?	Queries measurement results (Jitter p-p, Jitter (rms), Rise Time, Fall Time).
4-8		Executes screen copy	:SCOPe:EYEPulse:PRINt:COPY "screen_data","C:/screen_copy" :SYSTem:DISPlay:DATA?	Executes screen copy and captures screen data. *Use the same file name for the COPY command file name (to prevent compressing BERTWave disk region).

				*Special read processing is required because the response to the :SYSTem:DISPlay:DATA? command (screen data) is binary data. For details, refer to the explanation of the DATA? command in the instruction manual.

5. Rx Sensitivity Test (BERT)

The Rx Sensitivity Test is one of the most important test items for quantifying the optical receiver tolerance; it confirms the minimum optical signal power that can be recognized. In concrete terms, the optical power is reduced using a variable optical attenuator while using a BERT to confirm the number of bit errors. Generally, it is the optical power when there are no errors of 1 x 10^{-12} bit. The Rx Sensitivity Test is performed as follows:
Execute the settings according to the following procedures (Tables 9).

Table 9 RX Sensitivity Test Sequence

Step	Module	Function	Remote Command	Explanation
5-1	BERT	Excutes BER	:BERT:ALL:SENSe:MEASure:IMMediate? 10,"ER:TOTal"	[At BER curve estimation] The MP2100B can capture measurement results after the measurement start using the IMMediate? command. If the measurement time is 10 ms to 3 s, it is a fast speed.
5-2		Excutes BER	:BERT:SENSe:MEASure:EALarm:MODE SINGle :BERT:SENSe:MEASure:EALarm:PERiod 0,0,1,40 :BERT:ALL:SENSe:MEASure:STARt :BERT:ALL:SENSe:MEASure:EALarm:STATe?', '0' :BERT:ALL:CALCulate:DATA:EALarm? "CURRent:ER:TOTal"	[Requires BER measurement for more than 3 s] In this example, the time for a single measurement is set to 100 s (1 minute 40 seconds), the BER measurement is started, and the error rate is confirmed. Using the MP2100B, appending the [:ALL] key word to a command executes batch operation for all channels. Continuous BER measurement using Optical Attenuator and changing optical level when no error

6 Summary

This document introduces some sequences using the MP2100B for fast and stable measurements of optical modules on production lines.

Please use these better test methods to help improve the quality and competitiveness of customers' manufactured products.

Appendix

Sample code

```
private void ExecuteInitializeSequence()
        {
            Query("*CLS;*IDN?");
            Query("*OPT?");

            Log("-------------------------");
            Log("----- 0. Berfore Use -----");
            Log("-------------------------");

            Log("-- Reset BERTWave");
            Write("*RST");

            Log("-- Check error and operation complete");
            Query(":SYSTem:ERRor?");

            if (checkBoxOpticalScope.Checked || checkBoxElectricalScope.Checked)
            {
                Log("-- Caribrate Scope");
                Write(":DISPlay:ACTive 5");
                MessageBox.Show("Scope Calibration:¥nPlease turn off or disconnect all data and clock
input signals.¥nThis will take about 50 seconds.¥n");

                Log("(This will take about 50 seconds)");
                int currentTimeout = m_mbs.Timeout;
                m_mbs.Timeout = 60000;
                Query(":SCOPe:CALibrate:AMPLitude?");
                m_mbs.Timeout = currentTimeout;
            }

            Log("-----------------------------");
            Log("----- 1. Initial Setting -----");
            Log("-----------------------------");

            if (checkBoxBERT.Checked)
            {
                Log("-- Setup PPG/ED");
                Write(":DISPlay:ACTive 1");
                Write(":BERT:OUTPut:BITRate:STANdard ¥"10G_LAN¥"");
                Write(":BERT:SOURce:PATTern:TYPE PRBS31");
                //Write(":BERT1:OUTPut:DATA:AMPLitude DATA,0.5");
                //Write(":BERT2:OUTPut:DATA:AMPLitude DATA,0.5");
                //Write(":BERT3:OUTPut:DATA:AMPLitude DATA,0.5");
                //Write(":BERT4:OUTPut:DATA:AMPLitude DATA,0.5");
                Write(":SOURce:OUTPut:ASET ON");
```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```
            Log("-- Check error and setup operation complete");
            Query(":SYSTem:ERRor?");
        }

        if (checkBoxOpticalScope.Checked)
        {
            Log("-- Setup O/E");
            Write(":OE:INPut:FILTer 6"); // 10GbE LAN/PHY (10.3125G)
            Write(":OE:INPut:WAVLength 1310");
            //Write(":OE:CONFigure:EXRCorrection 1");
            //Write(":OE:CONFigure:EXRCorrection:FACTor 3.00");

            Log("-- Check error and setup operation complete");
            Query(":SYSTem:ERRor?");
        }

        if (checkBoxOpticalScope.Checked || checkBoxElectricalScope.Checked)
        {
            Log("-- Setup Scope trigger input");
            Write(":DISPlay:ACTive 5");
            if (checkBoxBERT.Checked)
            {
                Write(":SCOPe:CONFigure:TRACking:DRATe 1");
                Write(":SCOPe:CONFigure:TRACking:DRATe:MASTer 0");
            }
            else
            {
                Write(":SCOPe:TIME:DATRate 10.3125 Gbps");
                Write(":SCOPe:TIME:DIVRatio 4,CLKR");
                Query(":SCOPe:TIME:ACQClock?");
            }

            Log("-- Check error and setup operation complete");
            Query(":SYSTem:ERRor?");
        }
    }

    private void ExecuteTestSequence()
    {
        byte[] image;

        Query("*CLS;*IDN?");
        Query("*OPT?");

        if (checkBoxOpticalScope.Checked)
        {
            Log("-----------------------------------------------");
            Log("----- 2. ExR Adjustment (Optical Scope) -----");
```

```
        Log("-------------------------------------------");

        Log("-- Select CHB");
        Write(":SCOPe:INPut:CHA OFF");
        Write(":SCOPe:INPut:CHB ON");
        Write(":SCOPe:CONFigure:MEASure:CHANnel B");

        Log("-- Setup sampling parameter");
        Write(":SCOPe:OPTion:MAX:SAMPles:NUMber 1350");
        Write(":SCOPe:ACCUmulation:TYPe PERSistency");

        Log("-- Setup scale");
        Write(":SCOPe:DISPlay:WINDow:Y:DIVision:CHB 200");

        Log("-- Setup test mode");
        Write(":SCOPe:CONFigure:MEASure:TYPe AMPTIME");

        Log("-- Setup display item");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME1 CHB, 6");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME2 CHB, 8");

        Log("-- Check error and setup operation complete");
        Query(":SYSTem:ERRor?");

        Log("-- Start sampling and query mesurement results");
        Write(":SCOPe:SAMPling:STATus RUN");
        while (true)
        {
            string avePower = Query(":SCOPe:FETCh:AMPLitude:AVEPower?").Split(',')[1];
            string extRatio = Query(":SCOPe:FETCh:AMPLitude:EXTRatio?").Split(',')[0];
            DialogResult retry = MessageBox.Show(
                "Average Power: " + avePower + " dBm¥n" +
                "Extinction Ratio: " + extRatio + " dB¥n" +
                "¥nRetry?",
                "",
                MessageBoxButtons.YesNo);
            if (retry == DialogResult.No)
            {
                break;
            }
            Write(":SCOPe:DISPlay:WINDow:GRAPhics:CLEar");
        }
        Write(":SCOPe:SAMPling:STATus HOLD");
    }


    if (checkBoxOpticalScope.Checked)
    {
```

```
        Log("-------------------------------------------");
        Log("----- 3. Waveform Test (Optical Scope) -----");
        Log("-------------------------------------------");

        Log("-- Select CHB");
        Write(":SCOPe:INPut:CHA OFF");
        Write(":SCOPe:INPut:CHB ON");
        Write(":SCOPe:CONFigure:MEASure:CHANnel B");

        Log("-- Setup sampling parameter");
        Write(":SCOPe:OPTion:MAX:SAMPles:NUMber 1350");
        Write(":SCOPe:ACCUmulation:TYPe LIMited");
        Write(":SCOPe:ACCUmulation:LIMit WAVeform,100");

        Log("-- Setup test mode and mask");
        Write(":SCOPe:CONFigure:MEASure:TYPe AMPMask");
        Write(":SCOPe:CONFigure:MASK:TYPe 11");

        Log("-- Setup display item");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME1 CHB, 4");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME2 CHB, 6");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME3 CHB, 8");
        Write(":SCOPe:CONFigure:MEASure:AMPTIME4 CHB, 15");

        Log("-- Setup scale");
        Write(":SCOPe:DISPlay:WINDow:SCALe:AUTOscale BOTH");

        Log("-- Check error and setup operation complete");
        Query(":SYSTem:ERRor?");

        Log("-- Start sampling and query mesurement results");
        Write(":SCOPe:SAMPling:STATus RUN");
        WaitStatus(":SCOPe:SAMPling:STATus?", "HOLD");
        Query(":SCOPe:MEASure:MASK:MARGin?");
        Query(":SCOPe:FETCh:AMPLitude:CROSsing?");
        Query(":SCOPe:FETCh:AMPLitude:AVEPower?");
        Query(":SCOPe:FETCh:AMPLitude:EXTRatio?");
        Query(":SCOPe:FETCh:AMPLitude:OMA:MW?");

        Log("-- Screen copy");
        Write(":MODule:ID 5");
        Write(":SCOPe:EYEPulse:PRINt:COPY ¥"screen_data¥", ¥"C:/screen_copy¥"");
        image = BinaryQuery(":SYSTem:DISPlay:DATA?");
        WriteImageToFile(image, @"C:¥bertwave_screen_copy¥screen_copy_optical.png");
}


if (checkBoxElectricalScope.Checked)
```

```
{
    Log("-----------------------------------------------");
    Log("----- 4. Waveform Test (Electrical Scope) -----");
    Log("-----------------------------------------------");

    Log("-- Select CHA");
    Write(":SCOPe:INPut:CHA ON");
    Write(":SCOPe:INPut:CHB OFF");
    Write(":SCOPe:CONFigure:MEASure:CHANnel A");

    Log("-- Setup sampling parameter");
    Write(":SCOPe:OPTion:MAX:SAMPles:NUMber 1350");
    Write(":SCOPe:ACCUmulation:TYPe LIMited");
    Write(":SCOPe:ACCUmulation:LIMit WAVeform,100");

    Log("-- Setup test mode");
    Write(":SCOPe:CONFigure:MEASure:TYPe AMPTIME");

    Log("-- Setup display item");
    Write(":SCOPe:CONFigure:MEASure:AMPTIME1 CHA, 9");
    Write(":SCOPe:CONFigure:MEASure:AMPTIME2 CHA, 10");
    Write(":SCOPe:CONFigure:MEASure:AMPTIME3 CHA, 11");
    Write(":SCOPe:CONFigure:MEASure:AMPTIME4 CHA, 12");

    Log("-- Setup scale");
    Write(":SCOPe:DISPlay:WINDow:SCALe:AUTOscale BOTH");

    Log("-- Check error and setup operation complete");
    Query(":SYSTem:ERRor?");

    Log("-- Start sampling and query mesurement results");
    Write(":SCOPe:SAMPling:STATus RUN");
    WaitStatus(":SCOPe:SAMPling:STATus?", "HOLD");
    Query(":SCOPe:FETCh:TIME:JITTer:PPeak?");
    Query(":SCOPe:FETCh:TIME:JITTer:RMS?");
    Query(":SCOPe:FETCh:TIME:TRISe?");
    Query(":SCOPe:FETCh:TIME:FTIMe?");

    Log("-- Screen copy");
    Write(":MODule:ID 5");
    Write(":SCOPe:EYEPulse:PRINt:COPY ¥"screen_data¥", ¥"C:/screen_copy¥"");
    image = BinaryQuery(":SYSTem:DISPlay:DATA?");
    WriteImageToFile(image, @"C:¥bertwave_screen_copy¥screen_copy_electrical.png");
}


if (checkBoxBERT.Checked)
{
```

```
                Log("---------------------------------------");
                Log("----- 5. Input Sensitivity (BERT) -----");
                Log("---------------------------------------");

                DialogResult retry;

                Log("----------------------");
                Log("-- Short period BER --");
                Log("----------------------");

                do
                {
                    Log("-- (Setup ATT)");

                    Log("-- Start measurement and query results");
                    string er = Query(":BERT:ALL:SENSe:MEASure:IMMediate? 10,¥"ER:TOTal¥"");
                    retry = MessageBox.Show("Error Rate: " + er + "¥n¥nRetry?", "",
MessageBoxButtons.YesNo);

                } while (retry == DialogResult.Yes);

                Log("----------------------");
                Log("-- Long period BER --");
                Log("----------------------");

                Log("-- Setup mesurement period");
                Write(":BERT:SENSe:MEASure:EALarm:MODE SINGle");
                Write(":BERT:SENSe:MEASure:EALarm:PERiod 0,0,0,10"); // 10 sec

                Log("-- Check error and setup operation complete");
                Query(":SYSTem:ERRor?");

                do
                {
                    Log("-- (Setup ATT)");

                    Log("-- Start measurement");
                    Write(":BERT:ALL:SENSe:MEASure:STARt");
                    WaitStatus(":BERT:ALL:SENSe:MEASure:EALarm:STATe?", "0");

                    Log("-- Query results");
                    string er = Query(":BERT:ALL:CALCulate:DATA:EALarm? ¥"CURRent:ER:TOTal¥"");
                    retry = MessageBox.Show("Error Rate: " + er + "¥n¥nRetry?", "",
MessageBoxButtons.YesNo);

                } while (retry == DialogResult.Yes);
            }
        }
```

Anritsu envision : ensure

Specifications are subject to change without notice.

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