

# Base 1394 Test Suite Definition Testing

Taipei, Taiwan



11/16/2007

# Agenda

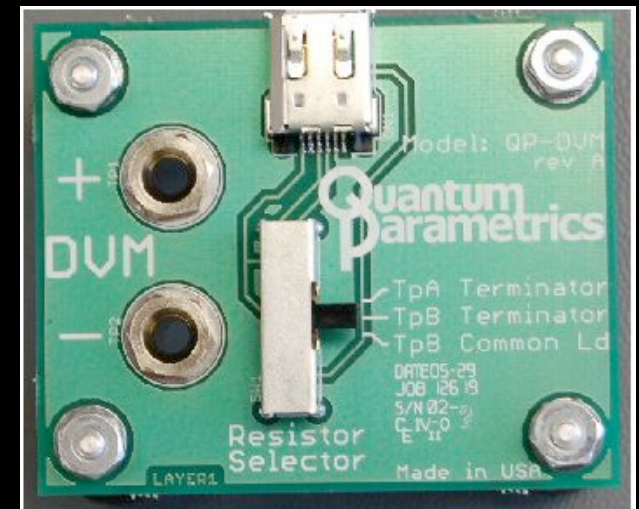
- Base 1394 Test Suite Overview
- Termination
- Data/Strobe Signaling
- Beta Signaling
- Cable Power
- IEEE-1394 Base Protocol Tests

# Base 1394 Test Suite Definition with Extension for 1394b

- The Base 1394 Test Suite targets fundamental IEEE-1394 technology layers needed to promote 1394 device and network interoperability
- 1394 Electrical Testing
  - Device electrical characteristics are tested as a system rather than component level (black box)
    - Assumes the Cable, Connectors and PHY silicon have passed other 1394TA tests
- 1394 Protocol Testing
  - Device capability is determined through Configuration ROM
  - Each capability is then tested
    - Cycle Master, Isochronous Resource Manager, Bus Manager

# Termination

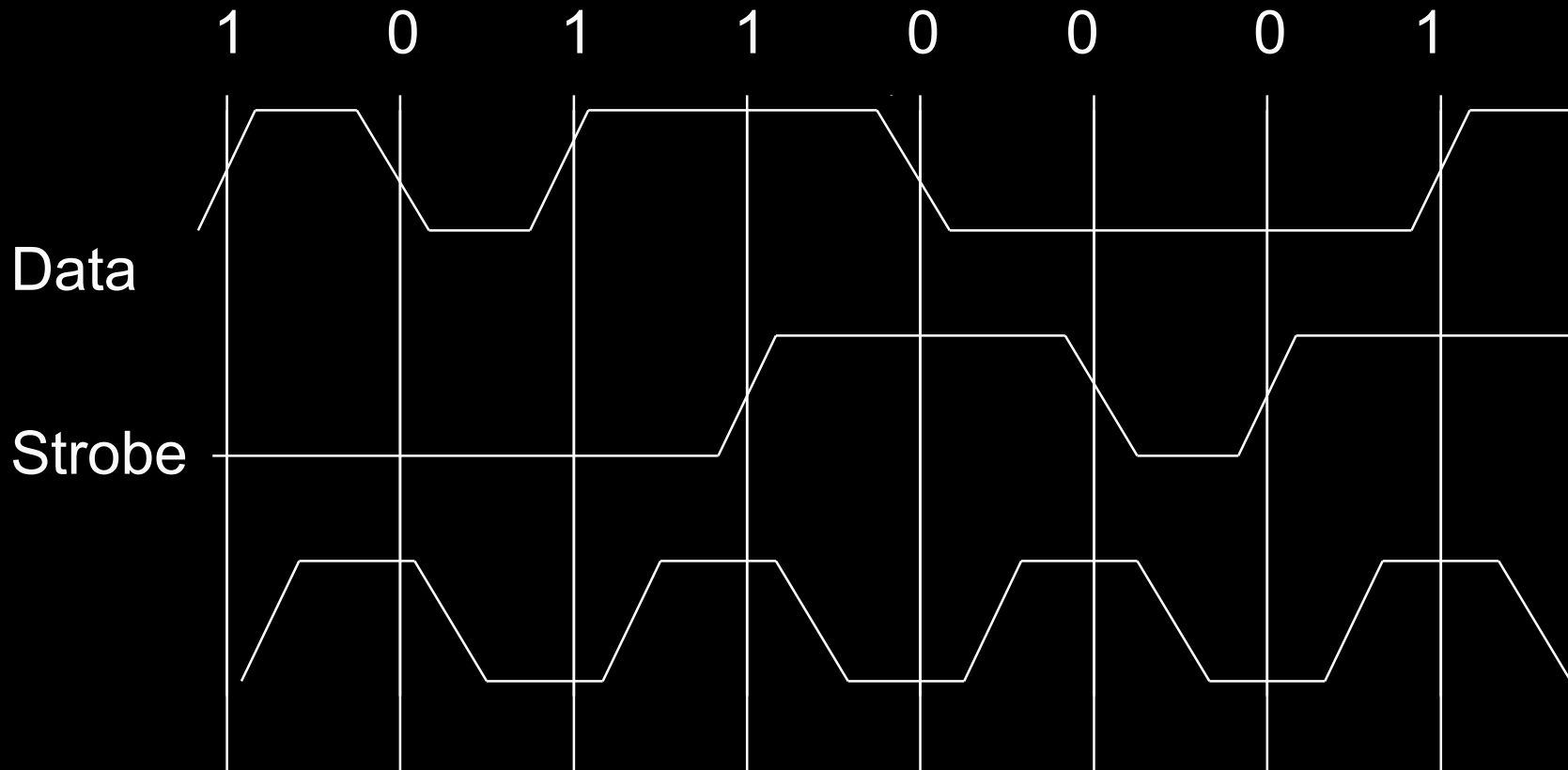
- Differential Termination
  - TPA and TPB termination shall be
    - $< 106\Omega$  and  $>116\Omega$
- TPB Common Mode shall be
  - $5,000\Omega \pm 5\%$
- Simply connect Device Under Test (DUT) to DVM test fixture and select which resistance to measure
  - Note: Cable used to measure resistance should be calibrated out



# Data/Strobe Signaling

- IEEE-1394-1995 defines Data/Strobe (**DS**) signaling
- Speeds of S100, S200, S400 supported
- Requires two twisted pairs
  - TPA and TPB
    - Data sent on TPB and Strobe sent on TPA
    - Data received on TPA and Strobe received on TPB
- Clock is recovered on every edge so short term (edge to edge not accumulated) jitter and skew are important
- Important parameters to measure
  - Jitter, Skew, Rise/Fall Time, and Amplitude

# DS Signaling



11/16/2007

# Automated Testing Available for DS Signal Testing

- Single and Multiple port testing supported
- Most oscopes are supported or can be
- 4, 6 and 9 (bilingual) connectors supported

The screenshot displays the Quantum Parametric's Total Test Executor (OPTTE) software interface. The main window shows a control panel with various test parameters and execution options. Below the control panel, a Microsoft Excel spreadsheet is open, displaying test results for S400. The spreadsheet includes a table with columns for test parameters and their corresponding values.

PORT	0	1
13 Tx Skew (nS)		
14 Ch1 to Ch2 rising edge instrument Skew	-0.0045	-0.00617
15 Ch1 to Ch2 falling edge instrument Skew	-0.0018	-0.00378
16 TpA rising position (7th cell)	17.8334	17.8182
17 TpA falling position (7th cell)	17.7702	17.7649
18 TpB rising position (7th cell)	17.8651	17.863
19 TpB falling position (7th cell)	17.8654	17.8543
20 Skew TpA rising to TpB rising	0.0362	0.05097
21 Skew TpA rising to TpB falling	0.0338	0.03988
22 Skew TpA falling to TpB rising	0.0004	0.00427
23 Skew TpA falling to TpB falling		
24 Tx Jitter (nS)		
25 TpA Cell Period (Mean)	2.5	
26 TpA Cell Period (StandDeviation)	0.0	
27 TpA Cell Period (Minimum)	2.1	
28 TpA Cell Period (Maximum)	2.1	

The control panel includes buttons for 'Execute Test', 'Download Settings', 'Loop 6000', 'STOP Loop', 'JITTER TPA', 'JITTER TPB', 'Write Pattern', 'SKEW', 'Rise/Fall', 'Pattern: AAAAAAAAA', 'Automation: OFF', 'Map', 'Reset Bus', 'Force LOCAL Root', 'ForceFoot', 'Cycles Stopped', 'DUT Cycles', 'S100', 'S200', 'S400', 'TpA Jitter', 'TpB Jitter', 'Rise/Fall', and 'Single port Device'. The status bar at the bottom indicates 'BAT03CAREV 00'.

# Beta Signaling

- IEEE-1394b-2002 defines **Beta** signaling
- Speed of S100, S200, S400, S800, S1600 and S3200 supported
  - Typical computer applications are short haul copper (4.5m) running at S800, moving to S1600 and S3200
  - S100, S200, and S400 are mostly used in industrial, aerospace, space, and military applications
- Two twisted pairs required
  - Data transmitted on TPB and received on TPA
- Clock is recovered using PLL
  - Long term (hundreds of unit intervals) characteristics are important

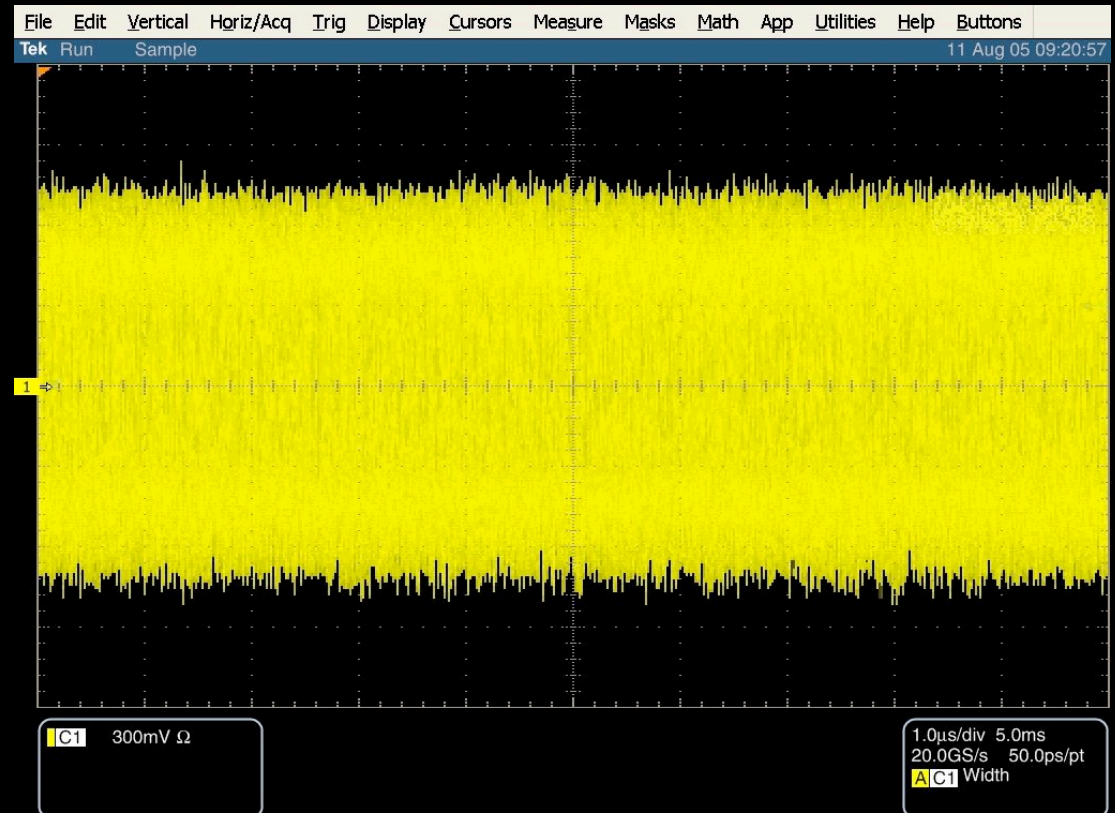
# Important Beta Parameters

## Differential

- ✓ Baud rate
- ✓ Differential amplitude
- ✓ Rise/Fall time
- ✓ Eye diagram with mask
- ✓ Jitter

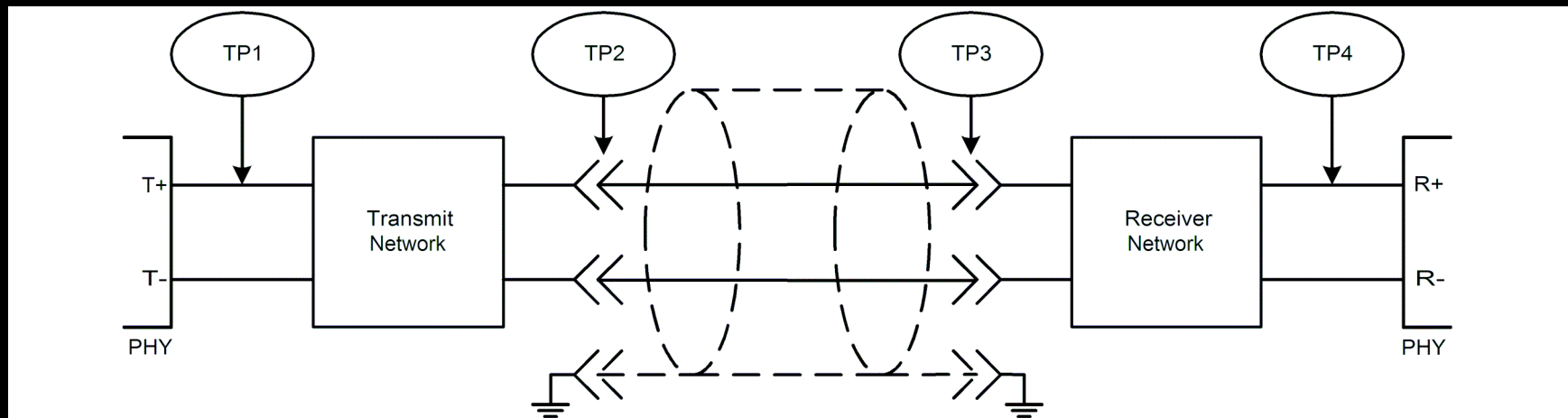
## Single-Ended

- ✓ Differential skew
- ✓ Common mode voltage

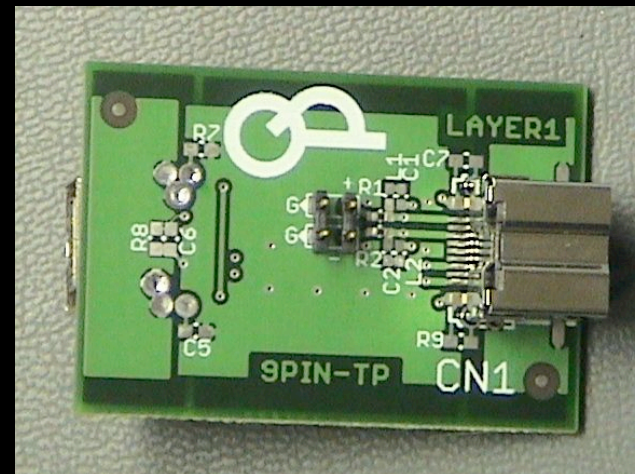
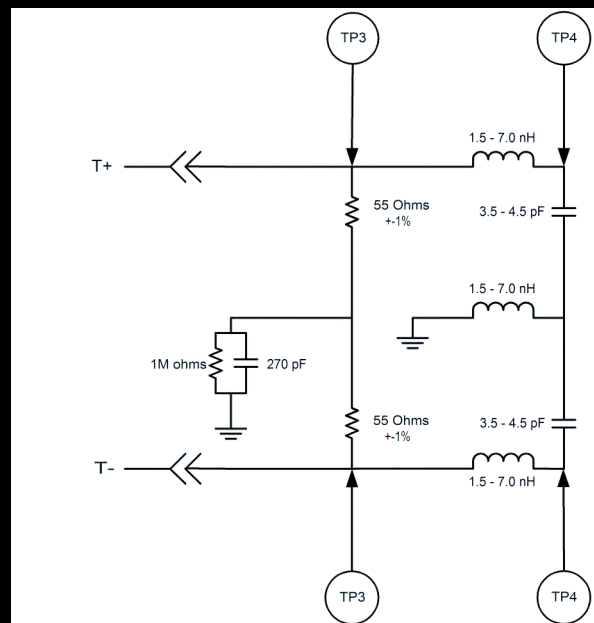
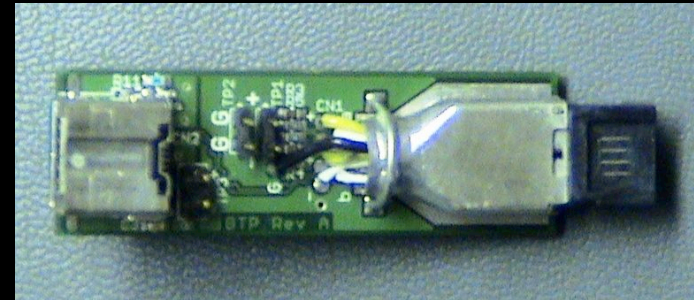
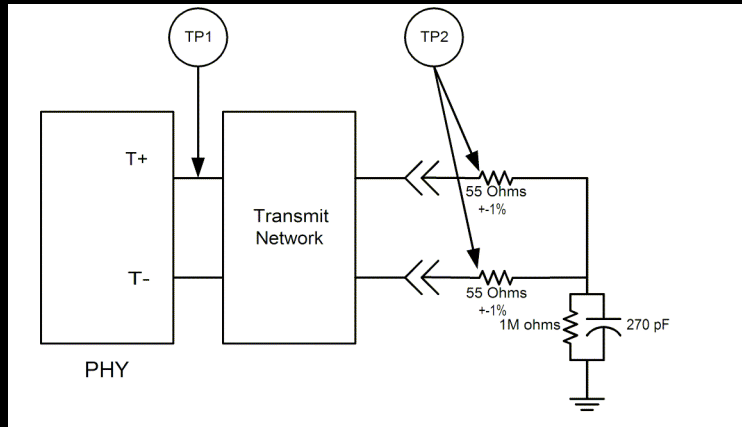


# Near End and Far End Measurements

- Near End test is conducted at the receptacle (TP2)
  - Products with 1394b receptacles shall test to Near End parameters
- Far End test is conducted at the cable plug (TP3)
  - Products with captive cable shall test to Far end parameters



# Near End and Far End Test Fixtures



11/16/2007

# Receiver Testing

- IEEE-1394b-2002 for short haul copper specifies a minimum differential sensitivity of 200mV.
  - The tester shall provide a valid 8B10B stream with minimum amplitude at TP3 (200mV to 220mV)
- The tester shall generate an adequate number of data bits in the packet payload to verify with 90% confidence an error rate of 10<sup>-12</sup> or less.
- If four (4) errors are detected before 90% confidence is reached the test maybe terminated.
- The tester shall verify
  - that all packets sent are received
  - the packet payload CRC for all packets

# Receiver Test Errors

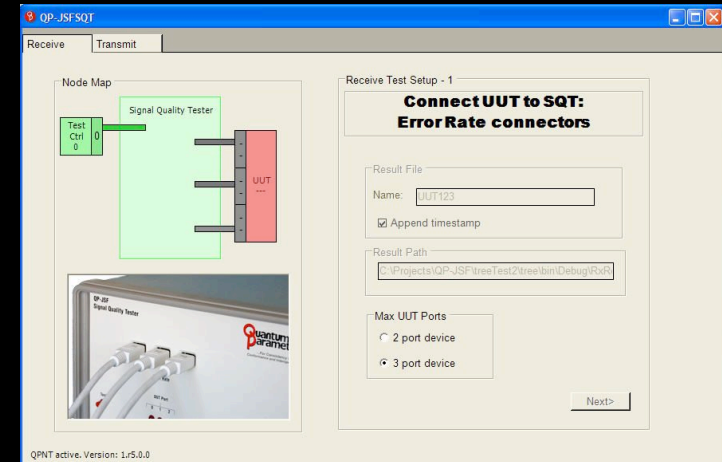
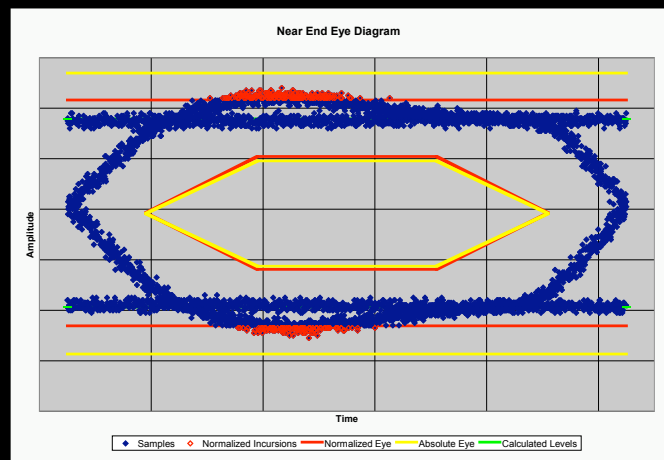
- Errors – the follow items constitute an error:
  - The number of packets sent is more then the packets received (one error for each packet)
  - The packet payload CRC fails (one error for each packet)
  - Unsolicited bus reset
  - Unsolicited 1394b disconnect (bit errors can cause the disconnect)

# Automated Testing Available for Beta Tx and Rx Testing

Normative Measurements		
Baud Rate		491.5690 Mhz
Max Diff Amplitude		548.2 mV
Min Diff Amplitude		524.0 mV
Min Rise/Fall Time		458.6 ps
Max Rise/Fall Time		581.6 ps
Differential Skew		30.2 ps
Normalized Eye		284 Violations
Absolute Eye		0 Violations
Calculated DJ	PP	117.9 ps
Calculated TJ	PP	333.9 ps
Common Mode		1.582 V

Specification Limits S400		
Baud Rate	Hz	491.4708 Mhz
	Hz	491.5692 Mhz
Differential Amplitude	mV	300 mV
	mV	800 mV
Rise/ Fall 10%-90%	ps	80 ps
	ps	800 ps
Differential Skew	ps	50 ps
Tx Deterministic Jitter	ps	244 ps
Tx Total Jitter	ps	529 ps
Common Mode	V	2.415 V



11/16/2007

# Cable Power

- Primary Power providers have power class bits of 1, 2 or 3
  - They can be single port or multiple port, and must only have 6 and/or 9 pin connectors (3 are recommend)
  - A primary power provider must be tested to insure that it is capable of sourcing the POWER specified by the power class bits.
  - The quality of the power provider must also be verified.
    - The VOLTAGE and RIPPLE are tested to insure this quality.
  - Primary Power providers must not repeat power if their system power is present and provide power domain isolation.
  - Primary Power providers must never exceed 1.5 amps sourcing on any port.

# Cable Power

- Alternate Power providers should have a power class bit setting of 4.
  - They can be single port or multiple port, and must only have 6 and/or 9 pin connectors (2 are recommend).
  - The voltage output of an alternate power provider is less than that of a primary power provider, but must still meet a minimum requirement of 8 volts, though 9.25 volts is recommended.
  - A maximum of 30 volts output is expected.
  - Isolation rules apply if the output voltage is greater than 20 volts, but at 20 volts and less, diode isolation may or may not be implemented.
  - Current limiters (if not using diode isolation) should limit current output 1.5 amps.

# Cable Power

- Cable power consumers must report power class of 4, 6 or 7 and must have only one 6 or 9 pin connector.
  - The device's PHY must be tested to operate with an input cable voltage of 7.5.
  - Power consumption should be limited to 3 watts prior to link activation.
  - After link activation, power consumption should not exceed the amount specified by the power class bits.

# Cable Power

- Self powered devices can be single port with a power class of 0 or multi-port with a power class of 0 or 4.
- If it is a multi-port device, then it must be tested to cable power the PHY when the devices power is not up.
  - In this mode, the cable power consumptions should not exceed 3 W.
- Self powered devices must be tested to insure that they never source power.
- If the device has only 2 ports, then it should repeat power without limiters, but if more than 2 ports, then each port should employ a 1.5 amp current limiter.

# 1394 Base Protocol Tests

- A **transaction capable** node shall implement the following:
  - Base Rate (S100 for the cable environment)
  - Quadlet read and write transaction support
  - The following Core CSR registers
    - STATE\_CLEAR
    - STATE\_SET
    - NODE\_IDS
    - RESET\_START
    - SPLIT\_TIMEOUT
  - General format Configuration ROM
  - Speed routes

# 1394 Base Protocol Tests

- The general format configuration ROM can be used to determine what optional IEEE-1394 facilities are supported.
  - Isochronous capable (isc)
  - Cycle master capable (cmc)
  - Isochronous resource manager capable (irmc)
  - Bus manager capable (bmc)
  - Power manager capable (pmc)

# 1394 Base Protocol Tests

- **Isochronous capable**
  - Implement configuration ROM in general ROM format
  - Implement the CYCLE\_TIME serial bus dependant CSR
- **Cycle master capable**
  - Implement configuration ROM in general ROM format
  - Implement the CYCLE\_TIME serial bus dependant CSR
  - Generate cycle start packets
  - Implement the BUS\_TIME serial bus dependant CSR

# 1394 Base Protocol Tests

- **Isochronous resource manager capable**
  - The following Serial Bus Dependant Register:
    - BUS\_MANAGER\_ID
    - BANDWIDTH\_AVAILABLE
    - CHANNELS\_AVAILABLE
    - BROADCAST\_CHANNEL
  - Have the ability to analyze received self-ID packet to determine the physical ID of the isochronous resource manager from all the contender nodes.
  - Implement the general configuration ROM format
  - Execute the responsibilities of the isochronous resource manager (IRM)
  - In the absence of a bus manager, the IRM must be able to perform the following functions:
    - gap count optimization
    - limited power management
    - set a node's force root flag true

# 1394 Base Protocol Tests

- **Bus manager capable**
  - The following Serial Bus Dependant Register:
    - BUS\_MANAGER\_ID
    - BANDWIDTH\_AVAILABLE
    - CHANNELS\_AVAILABLE
    - BROADCAST\_CHANNEL
    - TOPOLOGY\_MAP
  - Have the ability to analyze received self-ID packet to determine the physical ID of the isochronous resource manager from all the contender nodes.
  - Implement the general configuration ROM format
  - Execute the responsibilities of the isochronous resource manager (IRM)
  - Perform the following functions:
    - gap count optimization
    - power management
  - set a node's force root flag true

# Thank You!

Richard Mourn  
Quantum Parametrics LLC  
rmourn@goqp.com

11/16/2007



11/16/2007