

SHF Communication Technologies AG

Data Sheet

SHF BPG 44
Bit Pattern
Generator

Data Sheet Version 1.4

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1 Introduction

The SHF BPG 44 pattern generator is a versatile test instrument for high bitrate PCM- and SDH-systems as well as for components used within high speed communication systems. The instrument generates true CCITT-type pseudo random bit sequences (PRBS) of various lengths and four additional user programmable patterns.

In combination with the error analyzer SHF EA 44, the generator can be used to build up a bit error rate test system performing CCITT type transmission tests.

An output signal voltage of more than 2.5 V at 44 GBit/s enables power splitting for driving multiple subsequent circuits. The required external clock frequency is half of the bitrate, i.e. 22 GHz produces 44 GBit/s output signals. The output signal bitrate can either be controlled by a low jitter internal crystal clock oscillator on 6 selected CCITT bitrates or by an external generator. The output drivers are tuned for optimum pulse performance at the end of two 0.5 m low loss, high precision cables, which are supplied with the instrument. All functions can be remote controlled by GPIB.

The SHF BPG 44 produces:

- two complementary AC coupled output signals at 44 GBit/s of ≥ 2.5 V amplitude,
- two 1/2 PRBS shifted complementary AC coupled output signals at 22 GBit/s of $4\text{ V} \pm 0.5\text{ V}$ amplitude, (i.e. four outputs at 22 GBit/s),
- four 1/4 PRBS shifted AC coupled output signals at 11 GBit/s of $5\text{ V} \pm 0.5\text{ V}$ amplitude,
- four single ended clock outputs Bitrate/2, Bitrate/4, Bitrate/16 and Bitrate/64 referenced to 44 Gbit/s,
- one word frame synchronized trigger signal

In conjunction with the pulse shaping 45 GHz amplifiers, the very low rise time of the internal multiplexer circuits allows the generation of excellent 44 GBit/s PRBS-signals. This enables easy testing of ultra high speed components and their assembly in complex communication systems. The wide range of the SHF BPG 44 pattern generator inputs and outputs offers a variety of further laboratory applications.

2 Summary of Features

CCITT conforming PRBS patterns $2^7 - 1$, $2^{15} - 1$, $2^{23} - 1$, $2^{31} - 1$

Four 256 bit programmable patterns in four different registers

Three different error injection modes (front panel, external trigger input and GPIB control)

Pattern inversion by push button

Four quarter PRBS shifted high amplitude single ended data outputs @11GBit/s

Two half PRBS shifted high amplitude complementary data outputs @ 22GBit/s

Complementary data outputs @ 44 GBit/s, $\geq 2.5 V_{amp}$ which can be individually disabled

Ruggedized 1.85 mm male output connectors for data and 2.9 mm for clock outputs

Two high precision, very low loss 50Ω output cables included, all signal parameter specifications refer to the output of these cables!

Very low risetime and low overshoot of output signals

External master clock input at half of the bitrate

Clock output at Bitrate/n; n=2,4,16,64

Low noise, low jitter advanced circuit for bit synchronized trigger output

Burst-Mode gating capability

External GPIB control

Option

Low noise, high stability internal crystal clock generator

Option LJ: Low Jitter. Output amplifiers are removed, reducing output level and jitter level

3 Specifications

Bit rate (clock input frequency half bit rate)	2 GBit/s...44 GBit/s
External Master Clock input ¹	1 GHz...22 GHz, $S_{11} < -10$ dB, 0.6...1 V _{pp}
Gating Input: AC coupled TTL compatible ²	R _{in} = 1 kΩ
Error Trigger: AC coupled TTL compatible ²	R _{in} = 1 kΩ
Electrical data outputs at 11 GBit/s, AC coupled: ¹ Four 1/4 PRBS shifted complementary outputs	5 V _{amp} ± 0.5 V
Electrical data outputs at 22 GBit/s, AC coupled: ¹ Two 1/2 PRBS shifted Data and $\overline{\text{Data}}$ outputs	4 V _{amp} ± 0.5 V
Electrical data outputs at 44 GBit/s, AC coupled: ³ Data and $\overline{\text{Data}}$ outputs (standard)	≥2.5 V _{amp}
Low Jitter (DC coupled, ground referenced CML)	≥0.5 V _{amp}
Rise/fall time (20 % to 80 %)	
11 GBit/s	≤ 30 ps
22 GBit/s	≤ 26 ps
44 GBit/s	≤ 12 ps
Bitsync/Word frame, AC coupled	0.8 V _{pp} ± 0.2 V
Jitter	<900 fs
Option LJ	<400 fs
Clock output	0.8 V _{pp} ± 0.2 V
Power supply	90 V...135 V 180 V...270 V 47...63 Hz
Power consumption	220 W
Weight	27 kg
Operating temperature	+ 10° to 35° C
Size (W × H × D)	470 × 430 × 497 mm

¹ ruggedized 2.9 mm precision male connector

² female SMA connector

³ ruggedized 1.85 mm male connector

Clock output connectors:

Bitrate /2:	50 Ω ruggedized 2.9 mm precision male connector
Bitrate /4:	50 Ω ruggedized 2.9 mm precision male connector
Bitrate /16:	50 Ω SMA female connector
Bitrate /64:	50 Ω SMA female connector

Internal clock generator (Option 01)

60° C ovenized precision crystal oscillator

Available outputs:

1.244 GHz

2.488 GHz

4.976 GHz

9.952 GHz

19.904 GHz

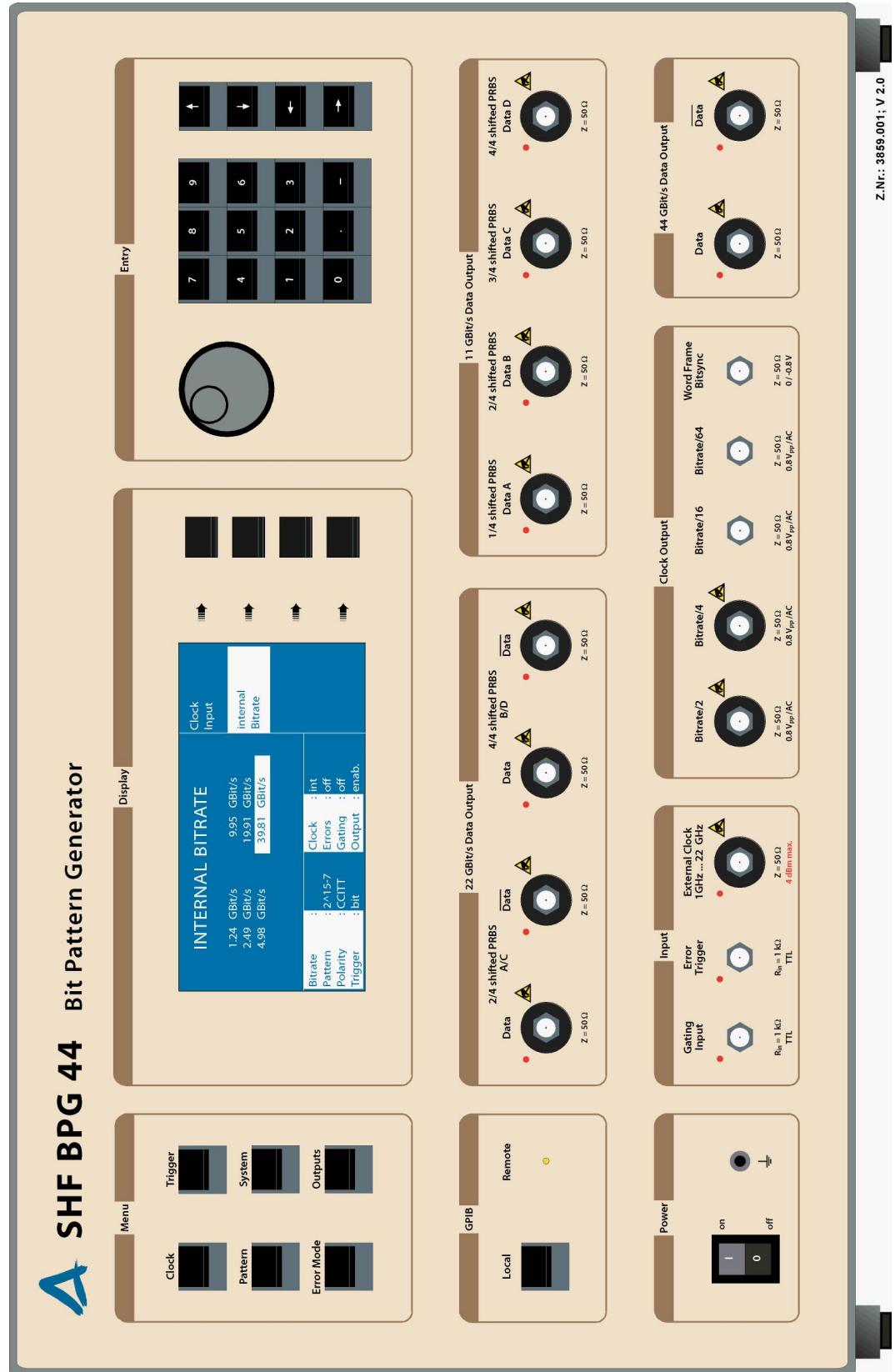
(other frequencies, e.g. 21.5 GHz, available on request)

oscillator stability: $< \pm 1$ ppm/° C;

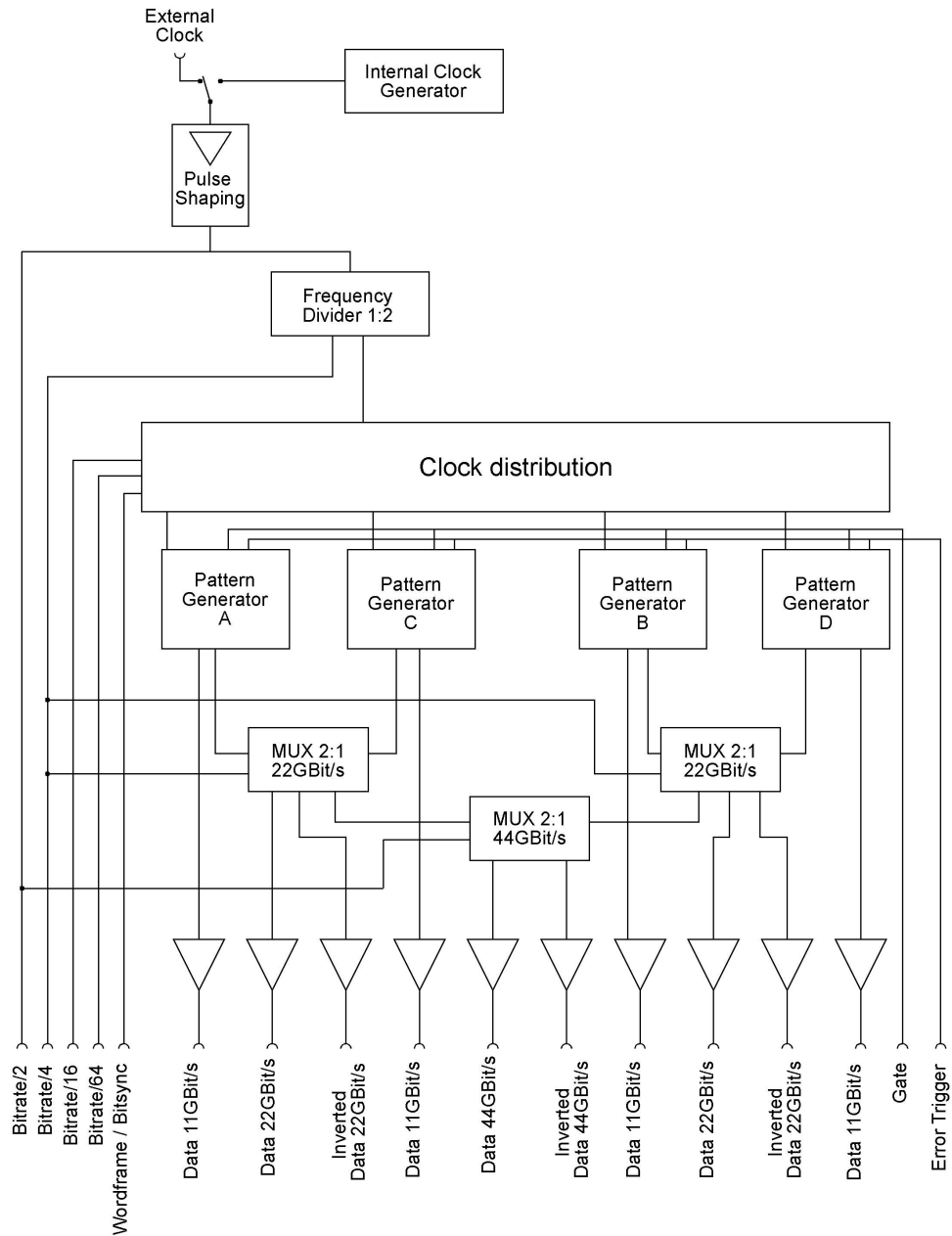
warm up time: approx. 15 minutes;

ageing: $< 3 \times 10^{-9}$ /d

4 Front Panel



5 Block Diagram

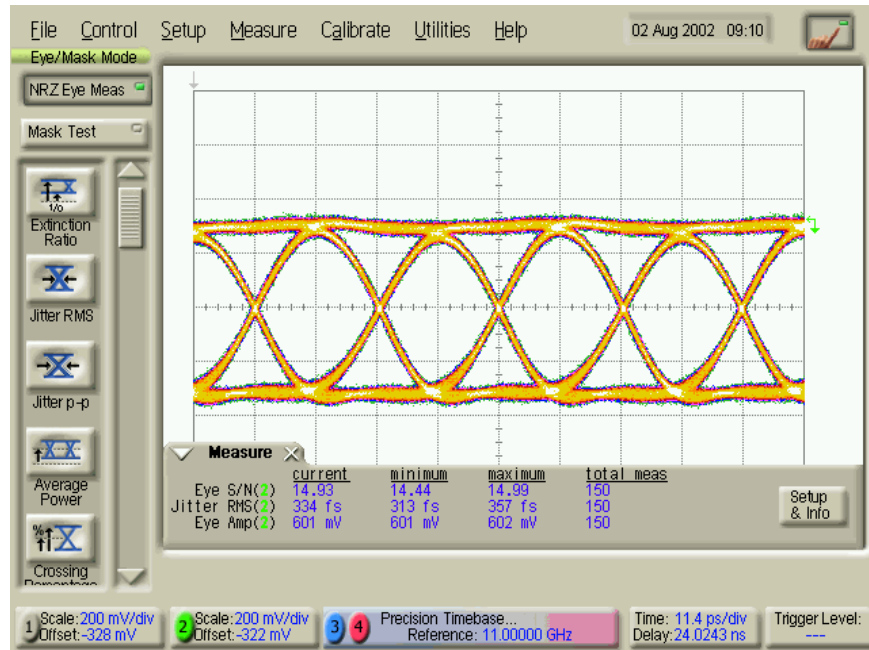


6 Performance: Test and Measured Results

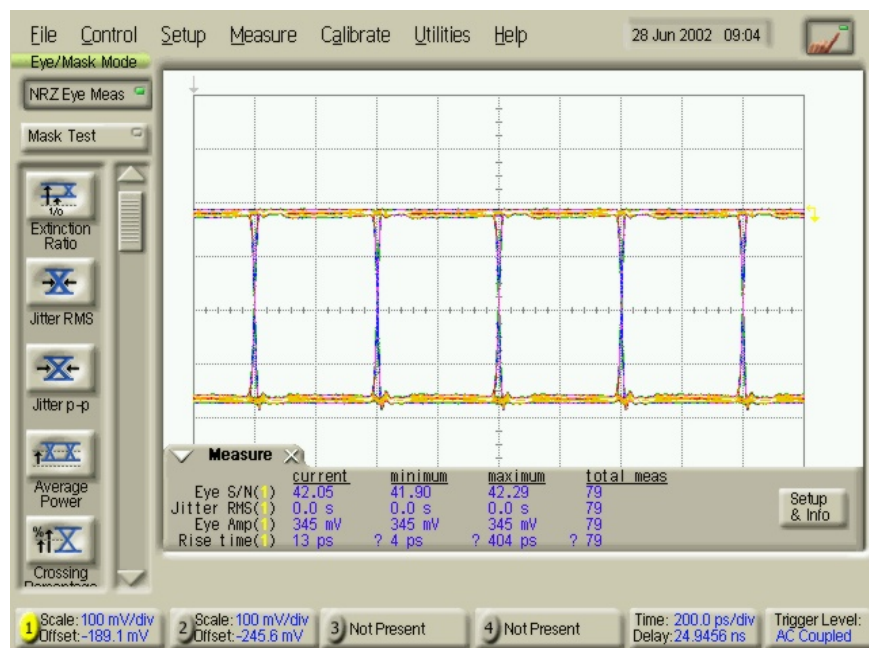
All following tests were performed using an external clock source. The eye diagrams were measured using a Agilent 86116 A digitizing oscilloscope (including enhanced trigger option) and a 50 GHz plug-in sampling head.

All results measured at the end of a 0.5m cable (supplied with instrument)

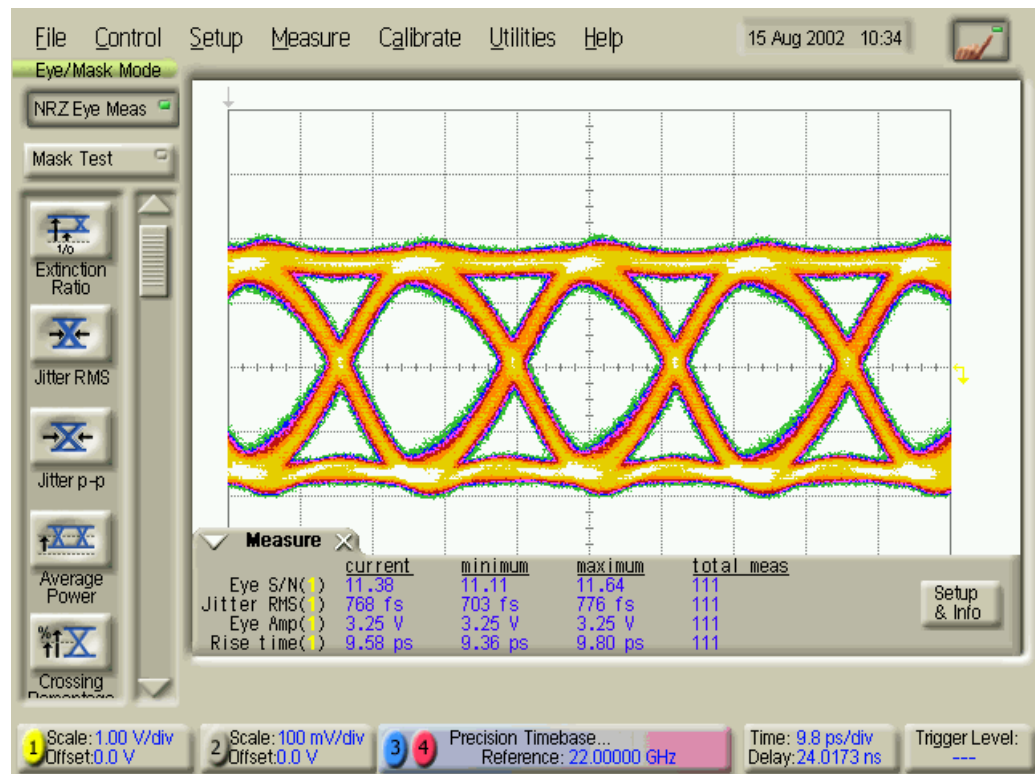
44 GBit/s: Low Jitter option:



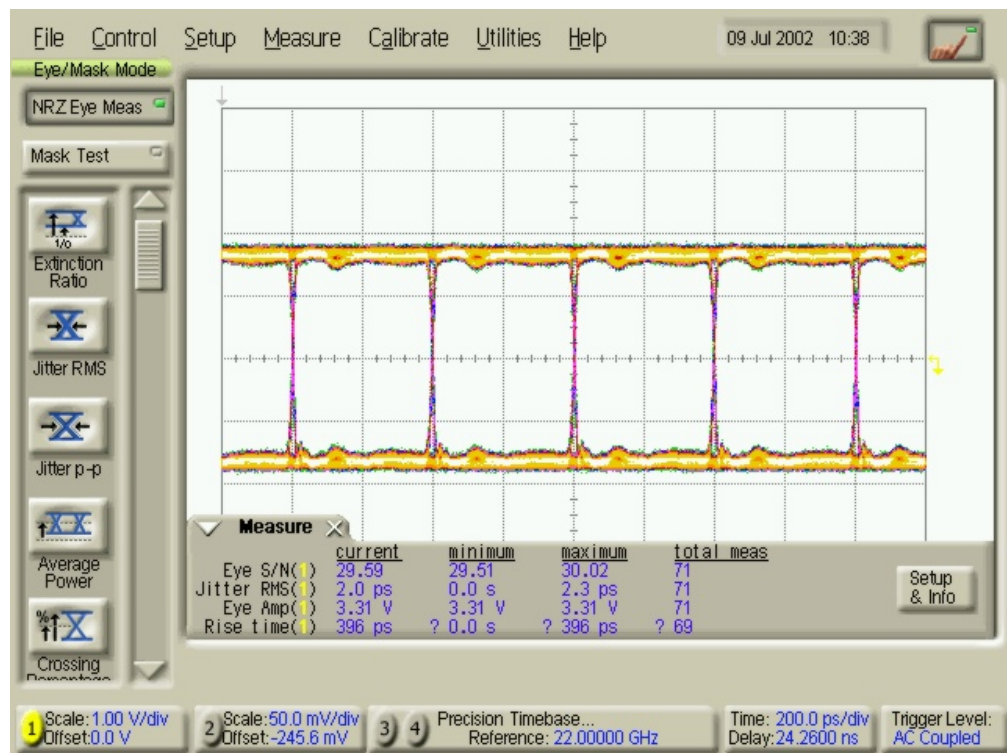
2.5 GBit/s: Low Jitter option:



44 GBit/s Standard



2.5 GBit/s Standard

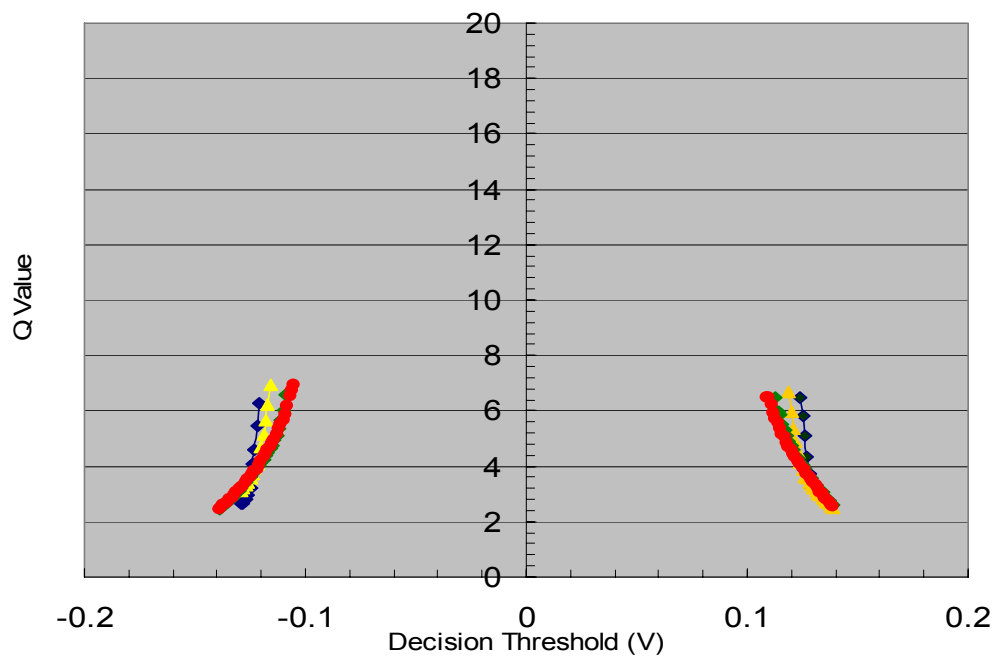


Extrapolated Q-Factor

Taken from back to back measurements made using a BPG 44 Low Jitter in conjunction with the SHF EA44 error analyzer.

Q: 31 for $2^{31}-1$; 95 for 2^7-1 prbs

Eye closure: < 13 % between 2^7-1 and $2^{31}-1$ PRBS



Blue: 2^7-1
 Yellow: $2^{15}-1$
 Green: $2^{23}-1$
 Red: $2^{31}-1$