DS64BR401EVK User Guide
SATA/SAS MiniSAS4X Cable Extender Demo Kit

General Description:
The DS64BR401EVK – miniSAS4X cable extender demonstration kit provides a complete cable extension solution using National's DS64BR401 – Quad Bi-directional Cable/Backplane Extender with Equalization and De-emphasis.

MiniSAS4X right angle I-PASS Molex receptacle connectors are used as the input and the output connections for SATA/SAS disk drive storage application. Adaptor board which provides connection from mini SAS4X (26-pin external) to mini SAS4Xi (36-pin internal) is provided to allow easy straight forward connection to existing hardware.

Features:
- Quad lane bi-directional transceiver up to 6.4 Gbps rate
- Signal conditioning on input and output for extended reach
- Adjustable receive equalization up to +33 dB gain
- Adjustable transmit de-emphasis up to −12 dB
- Adjustable transmit VOD (600 mVp-p to 1200 mVp-p)
- <0.25 UI of residual DJ at 6.4 Gbps with 40" FR4 trace
- Automatic de-emphasis scaling based on rate detect
- SATA/SAS: OOB signal pass-through,
  <3 ns (typ) envelope distortion
- Adjustable electrical IDLE detect threshold
- Low power (100 mW/channel), per-channel power down
- Programmable via pin selection or SMBus interface
- Single supply operation at 2.5V ±5%
- >6 kV HBM ESD Rating
- 3.3V LVCMOS input tolerant for SMBus interface
- High speed signal flow–thru pinout package: 54-pin LLP
  (10 mm x 5.5 mm)

Applications:
- SATA (1.5 Gbps / 3.0 Gbps / 6.0 Gbps)
- SAS (3.0 Gbps / 6.0 Gbps)

DS64BR401EVK Demo Kit Contents:
- End User License Agreement
- DS64BR401EVK User Guide Rev.1.7
- DS64BR401 Datasheet
- DS64BR401 MiniSAS4X Demo Board REV.2
- MiniSAS4X Connector Adaptor Board (EXT to INT) REV.2

Ordering Information:
Device: DS64BR401SQ
SATA/SAS miniSAS4X Cable Extender Demo Kit: DS64BR401EVK

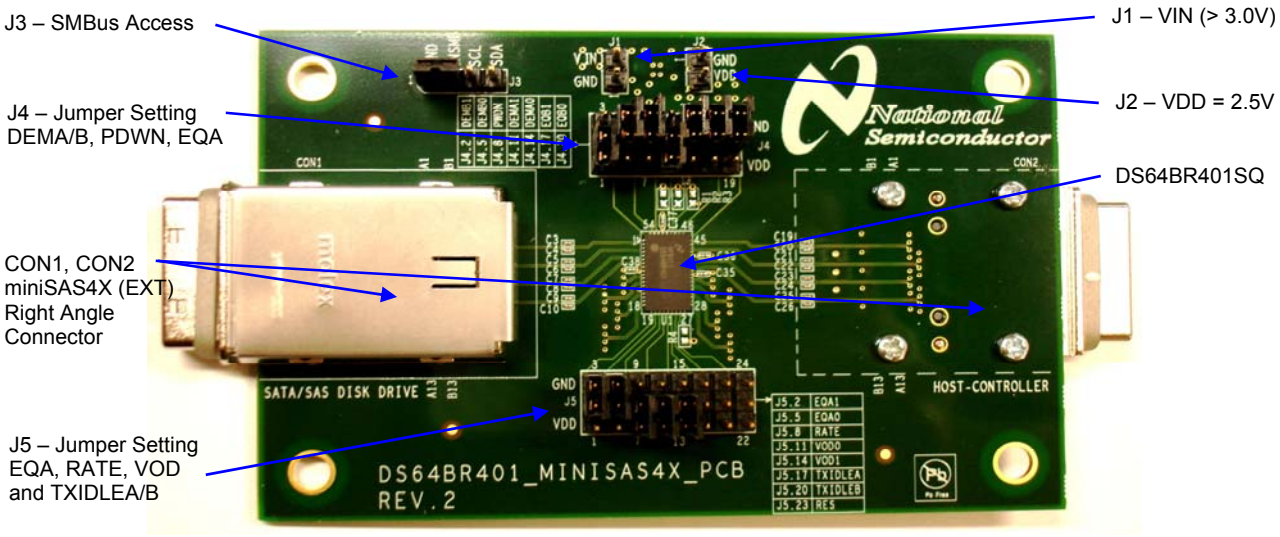


Figure 1. DS64BR401EVK Evaluation Board

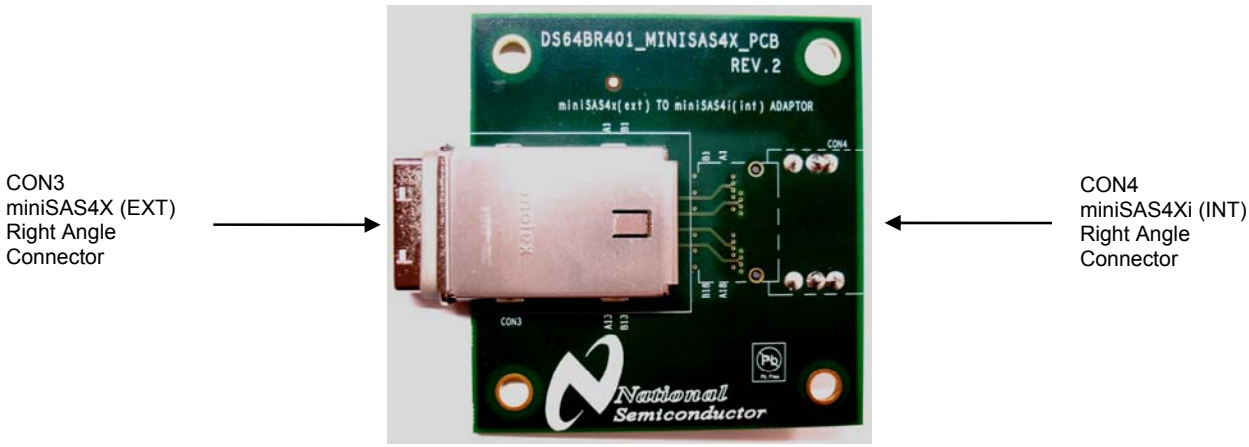
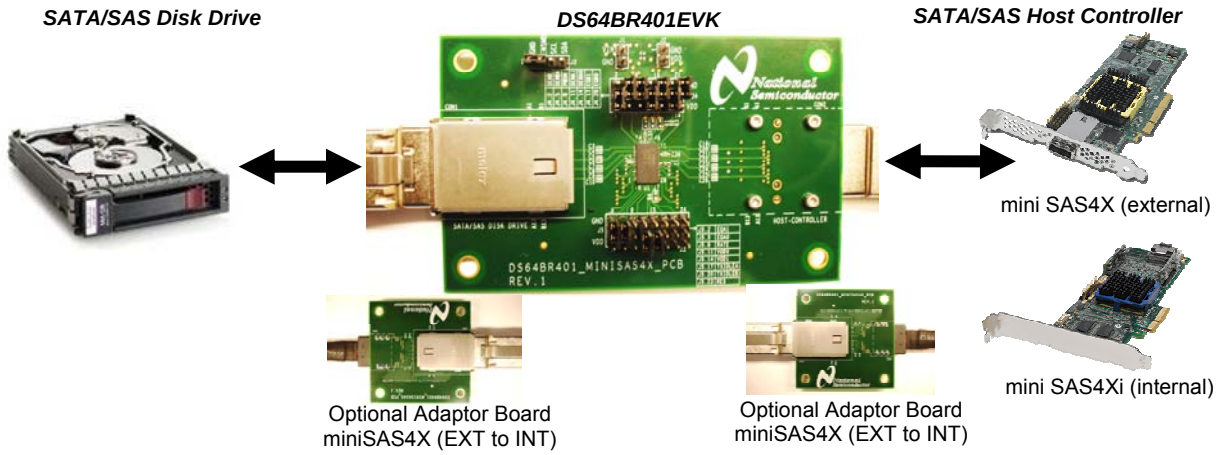


Figure 2. MiniSAS4X Connector Adaptor Board (EXT to INT)

Typical Repeater Application:



Quick Start Guide:

1. Connect > 3.0V DC power to J1. Measure 2.5 V on J2.
2. Attach two mini SAS4X external cables to the board. If cable is not the 4X external (26-pin) then use the adaptor board to convert to mini SAS4Xi (36-pin internal) connector.
3. Set EQ and DE level according to the length of the inter-connect media.

Connection and Control Description

Component	Name	Function
J1	PWR	DC Power - VIN to Low Drop-out Regulator - VIN > 3.0V.
J2	PWR	DC Power - VOUT of Low Drop-out Regulator – fixed 2.5V.
J3	ENSMB, SCL, SDA	Optional SMBus access pins. See datasheet for additional information.
J4	DEM, EQ and /PWDN	Control pins for De-emphasis, Equalizer and Power-down.
J5	EQ, RATE, VOD and TXIDLE pins	Control pins for Equalizer, Rate Select, Output VOD levels and TX output.
CON1	miniSAS4X Connector	Molex mini SAS4X (ext) right angle receptacle connector.
CON2	miniSAS4X Connector	Molex mini SAS4X (ext) right angle receptacle connector.
CON3	miniSAS4X Connector	Adaptor board with Molex mini SAS4X (EXT) right angle receptacle connector.
CON4	miniSAS4Xi Connector	Adaptor board with Molex mini SAS4Xi (INT) right angle receptacle connector.

J1, J2 – Power Connection

VIN (>3.0V) on J1 is needed for power. The LP38690 – 1A Low Dropout Linear Regulator is used to provide fixed 2.5V. J2 is available to allow access to the 2.5V supply. When by-passing the LP38690, the RS1 (0.01 ohm) should be removed and a 2.5V external supply can be connected to J2.

J3 – SMBus Access

J3 is used to access the SMBus to configure the DS64BR401. ENSMB should be tied low for external pin control. When ENSMB is tied high, SCL (clock input) and SDA (data input/output) are enabled.

J4, J5 – Control Pins

Jumpers should be used to tie the control pins to 1-high (VDD), 0-low (GND) or F-float (NC). The EQA, EQB, DEMA, DEMB, TXIDLEA, TXIDLEB and RATE are 3-level inputs. The PWDN is used to enable and disable the

device. PWDN should be tied low (GND) for normal operation. The VOD[1:0] are used to set the output amplitude voltage level. Please refer to the tables below for detail information.

Equalization Control Pins (EQA/EQB)

EQA/B0	EQA/B1	Equalization Level	Recommend Media Length
F	F	Off	Bypass
1	1	5.8 dB at 3 GHz	8 inch FR4 or 0.7 meter (30AWG) cable
0	0	9 dB at 3 GHz	12 inch FR4 or 1 meter (30AWG) cable
0	F	11.7 dB at 3 GHz	20 inch FR4 or 5 meter (30AWG) cable
0	1	14.6 dB at 3 GHz	25 inch FR4 or 6 meter (30AWG) cable
1	F	18.4 dB at 3 GHz	35 inch FR4 or 9 meter (30AWG) cable
1	0	20 dB at 3 GHz	40 inch FR4 or 10 meter (30AWG) cable
F	0	21.2 dB at 3 GHz	10 meter (30AWG) cable
F	1	28.4 dB at 3 GHz	12 meter (30AWG) cable

De-emphasis Control Pins (DEMA/DEMB)

DEMA1/B1	DEMA0/B0	De-emphasis Level	VOD Level
0	0	0 dB	VOD: 600 mV to 1200 mV
0	1	-3.5dB	VOD = 1000 mV
0	1	-2 dB	VOD = 1200 mV
1	0	-6 dB	VOD = 1000 mV
1	0	-3 dB	VOD = 1200 mV
1	1	-9 dB enhanced	VOD = 1000 mV
1	1	-11 dB enhanced	VOD = 1200 mV
0	F	-6 dB enhanced	VOD = 1000 mV
0	F	-8 dB enhanced	VOD = 1200 mV
1	F	-12 dB enhanced	VOD = 1000 mV
1	F	-13 dB enhanced	VOD = 1200 mV
F	0	-9 dB enhanced	VOD = 1000 + 200 mV
F	0	-10 dB enhanced	VOD = 1200 + 200 mV
F	1	-12 dB enhanced	VOD = (1000 to 1200) + 200 mV
F	F	Reserved, don't use	

Rate Control Pins (RATE)

RATE	Functional Description
0	Set the De-emphasis pulse width duration for 3 Gbps (low rate)
1	Set the De-emphasis pulse width duration for 6 Gbps (high rate).
F	Enables the auto rate select function.

TX Output Control Pins (TXIDLEA/TXIDLEB)

TXIDLEA/B	Functional Description
0	Disables the signal detect/squelch function for all outputs A or B.
1	Forces all outputs to be muted (electrical idle).
F	Enables the signal detect/squelch function for all channels. Signal detect voltage level threshold can be adjusted with an external resistor on the SD_TH pin to GND. Default level is 130 mVp-p when SD_TH is floating. Please refer to the Table 4 in the datasheet for typical resistor value.

Output Voltage Amplitude Level (VOD)

VOD1	VOD0	Functional Description
0	0	Output VOD = 600 mVp-p
0	1	Output VOD = 800 mVp-p
1	0	Output VOD = 1000 mVp-p
1	1	Output VOD = 1200 mVp-p

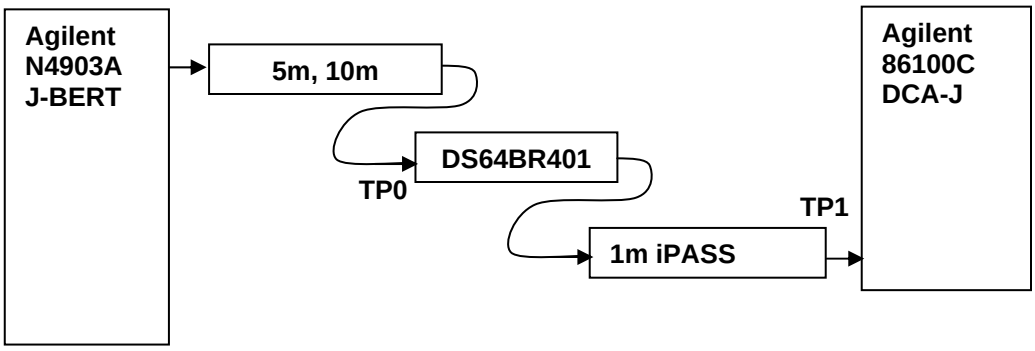
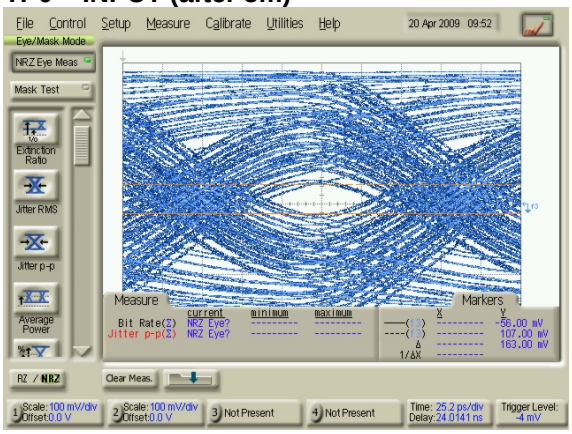


Figure 3. DS64BR401EVK Equalization Test Setup

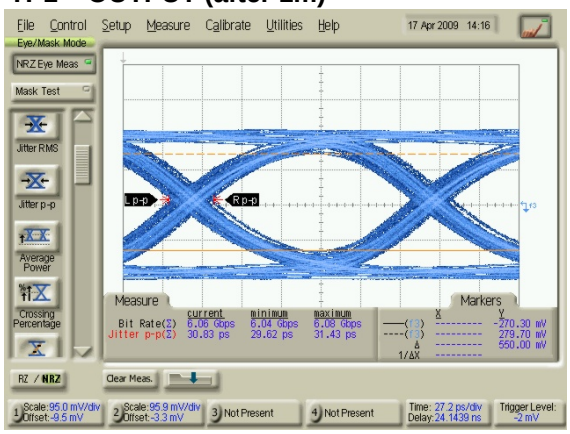
DS64BR401 Equalization Performance with 5m 26AWG cable at 6 Gbps:

TP0 – INPUT (after 5m)



VOD = 1.0 Vp-p, PRBS7

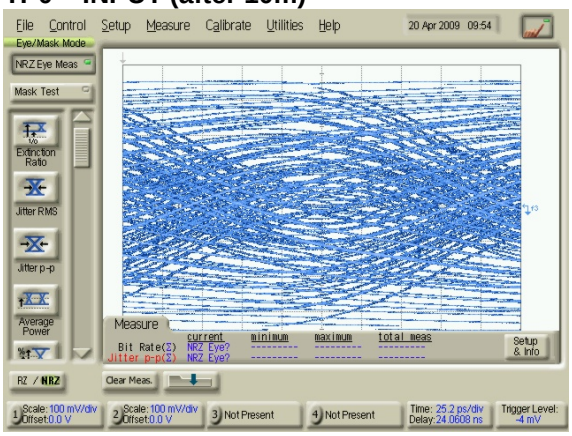
TP1 – OUTPUT (after 1m)



DS64BR401 setup condition:
EQ[1:0] = F0 (~11.7 dB at 3 GHz)
DEM[1:0] = 01 (-2 dB with VOD = 1.2 Vp-p)

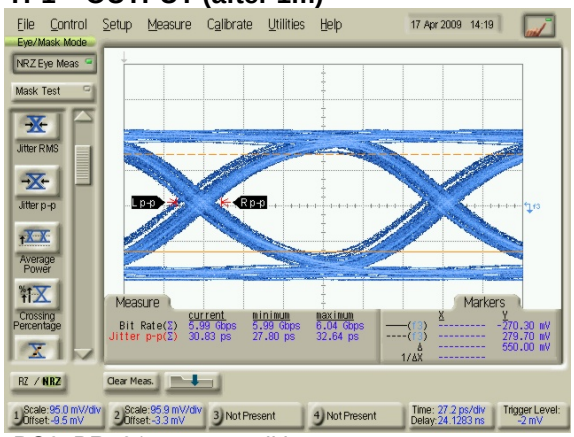
DS64BR401 Equalization Performance with 10m 24AWG cable at 6 Gbps:

TP0 – INPUT (after 10m)



VOD = 1.0 Vp-p, PRBS7

TP1 – OUTPUT (after 1m)



DS64BR401 setup condition:
EQ[1:0] = 01 (~20 dB at 3 GHz)
DEM[1:0] = 01 (-2 dB with VOD = 1.2 Vp-p)

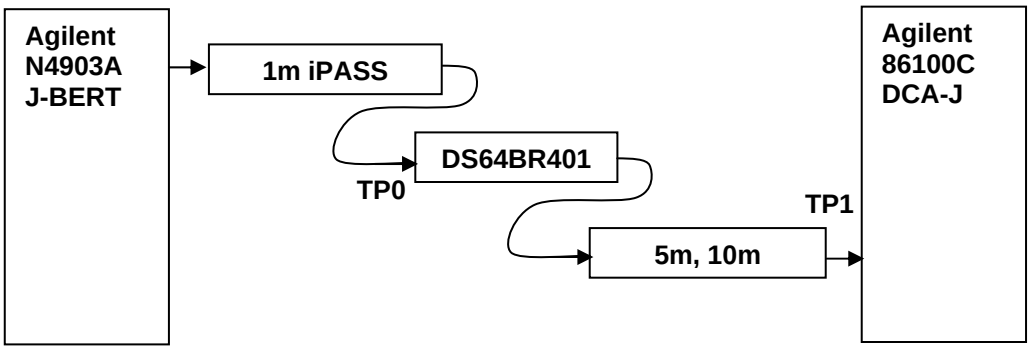
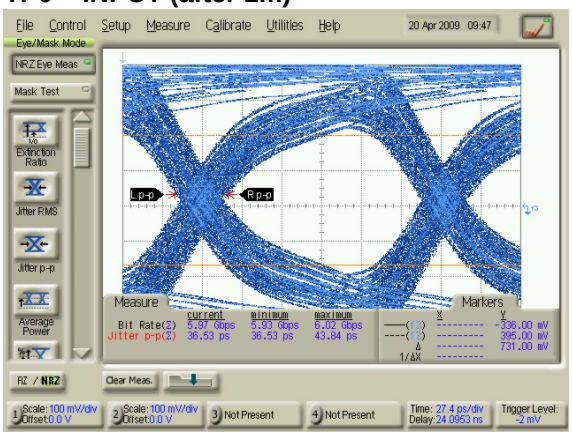


Figure 4. DS64BR401EVK De-emphasis Test Setup

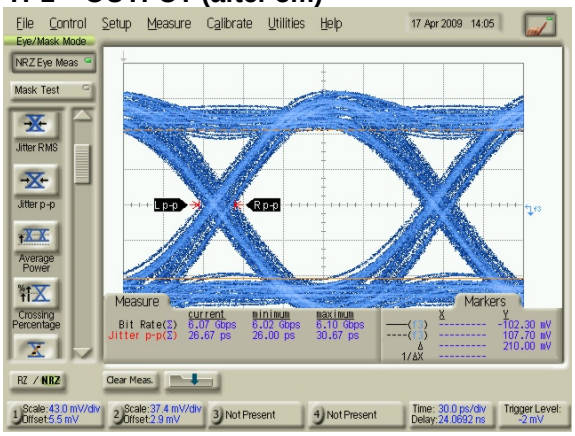
DS64BR401 De-emphasis with 5m 26AWG cable at 6 Gbps:

TP0 – INPUT (after 1m)



VOD = 1.0 Vp-p, PRBS7

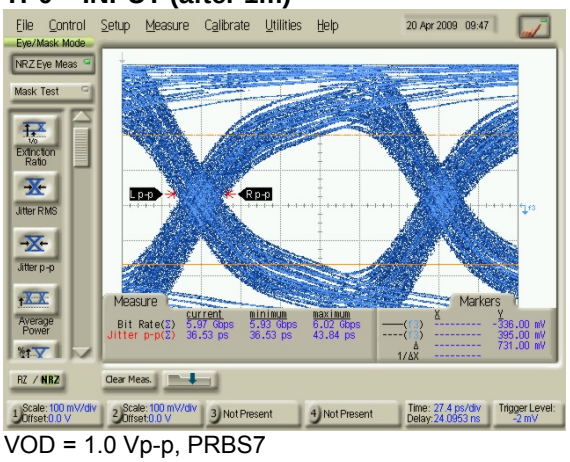
TP1 – OUTPUT (after 5m)



DS64BR401 setup condition:
EQ[1:0] = 11 (~5.8 dB at 3 GHz)
DEM[1:0] = F0 (-10 dB with VOD = 1.4 Vp-p)

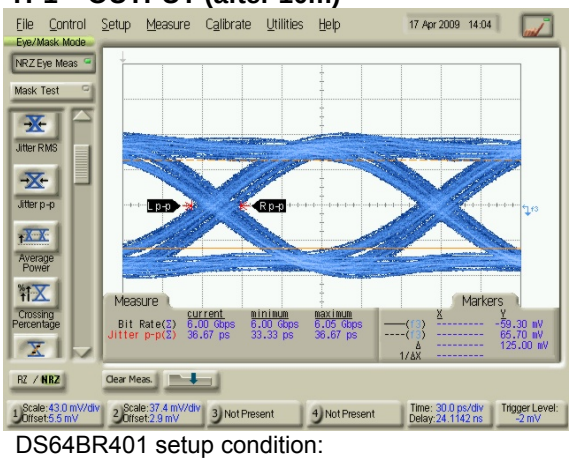
DS64BR401 De-emphasis with 10m 24AWG cable at 6 Gbps:

TP0 – INPUT (after 1m)



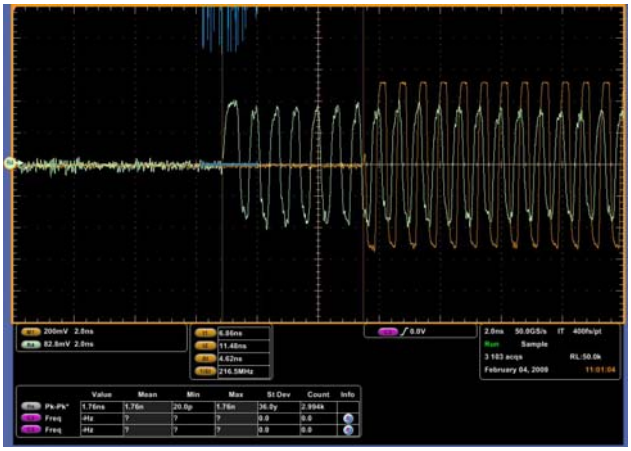
VOD = 1.0 Vp-p, PRBS7

TP1 – OUTPUT (after 10m)

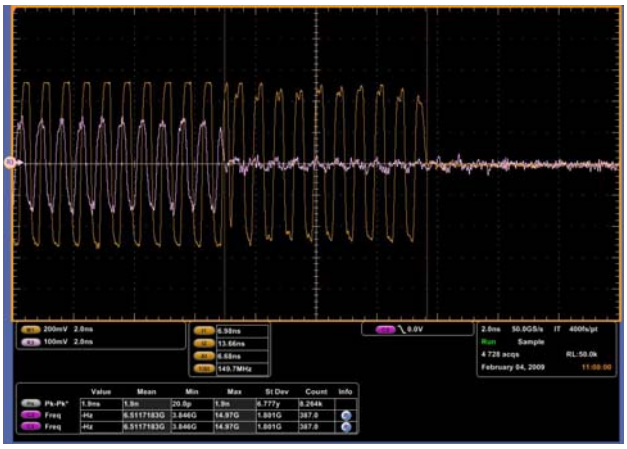


DS64BR401 setup condition:
EQ[1:0] = 11 (~5.8 dB at 3 GHz)
DEM[1:0] = F1 (-12 dB with VOD = 1.4 Vp-p)

Scope plots of OOB (out of band) signal through the DS64BR401:



Idle to Active Response Time: ~ 4.6 ns

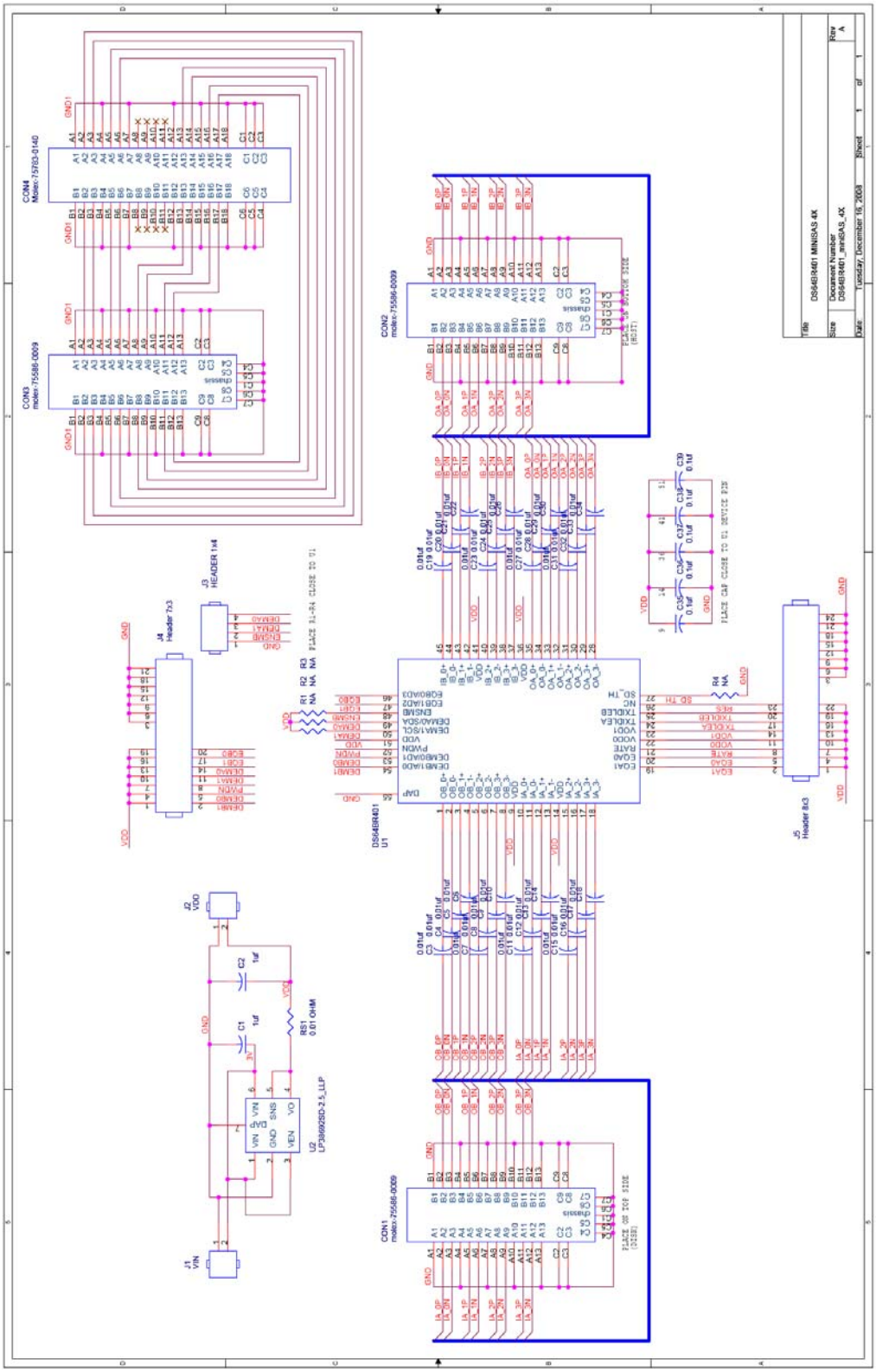


Active to Idle Response Time: ~ 6.7 ns

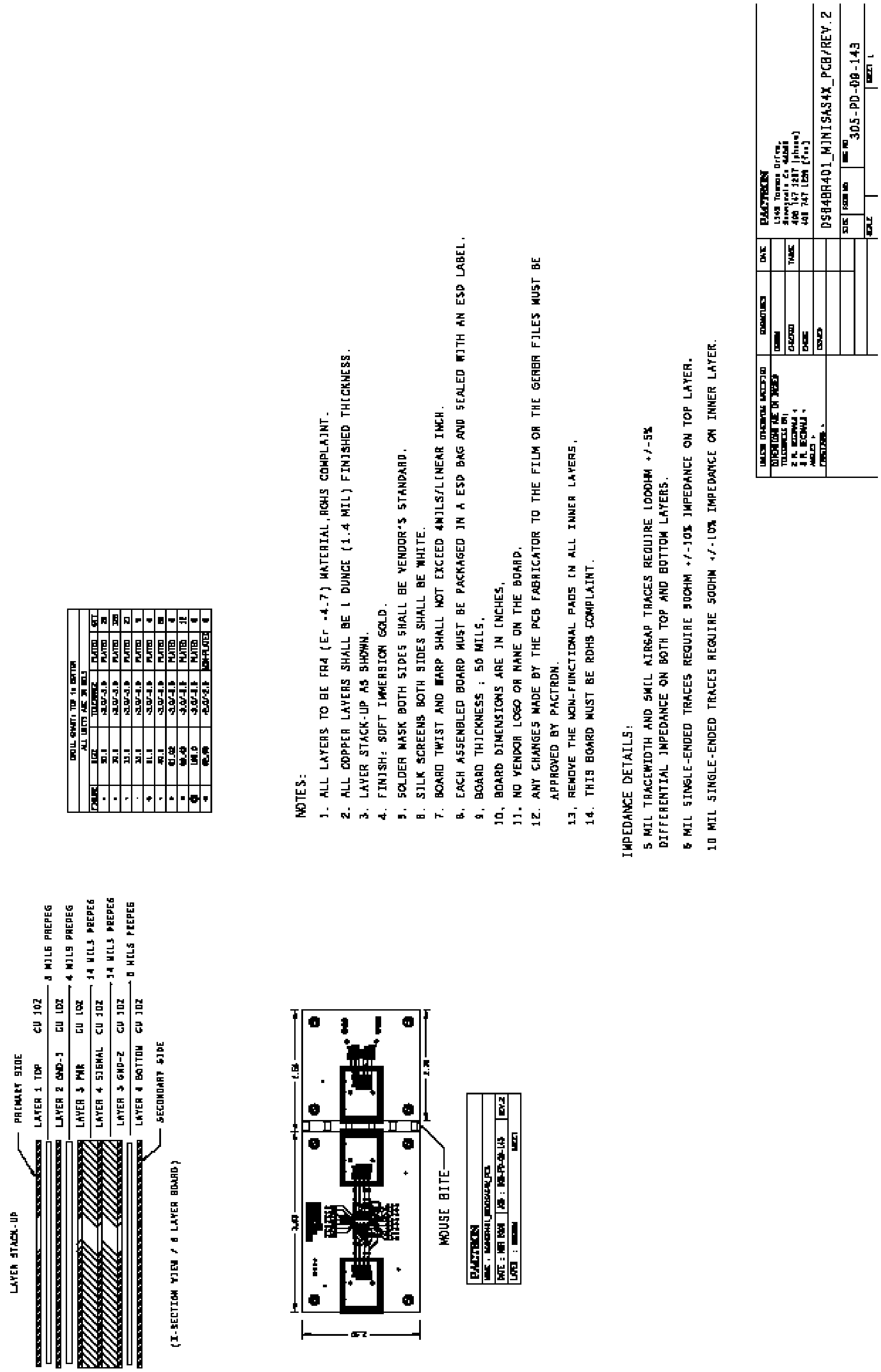
Bill of Materials:

DESIGNATION	QTY	DESCRIPTION
CON1,CON2,CON3	3	Molex - 75586-0009: CONN RCPT 26POS IPASS RT ANG SMD, Molex - 74548-0211: CONN IPASS SAS 1X1 GUIDE FRAME
CON4	1	Molex - 75783-0140: CONN RCPT 36POS IPASS RT ANG SMD
C1,C2	2	CAP CERAMIC 1UF 10V X5R 0402
C3,C4,C5,C6,C7,C8,C9,C10, C11,C12,C13,C14,C15,C16, C17,C18,C19,C20,C21,C22, C23,C24,C25,C26,C27,C28, C29,C30,C31,C32,C33,C34	32	CAP .01UF 6.3V CERAMIC X5R 0201
C35,C36,C37,C38,C39	5	CAP CERAMIC .1UF 6.3V X5R 0201
J1, J2	2	HEADER 1x2
J3	1	HEADER 1x4
J4	1	HEADER 3x7
J5	1	HEADER 3x8
RS1	1	RESISTOR 0.01 OHM 1/4W 1% 0805
R1,R2,R3,R4	4	NA – Only needed for special circumstance
U1	1	DS64BR401
U2	1	LP38692SD-2.5_LLP IC REG LDO 1A 2.5V 6-LLP

Schematic:



FAB/Manufacture Information:



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