Best Electronics and Components Company, Inc.

DVDS Test Design Review

Revision C – 07/02/2010

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Test Development Engineer	Erwin Bautista	

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Revision History

Rev	Changes Made	Date	Initials
A	Initial Draft	03/02/2010	JEB
B	Minimum Test System Requirement System Configuration Schematic Diagram	04/14/2010	JEB
C	Schematic Diagram	07/02/2010	JEB

Introduction

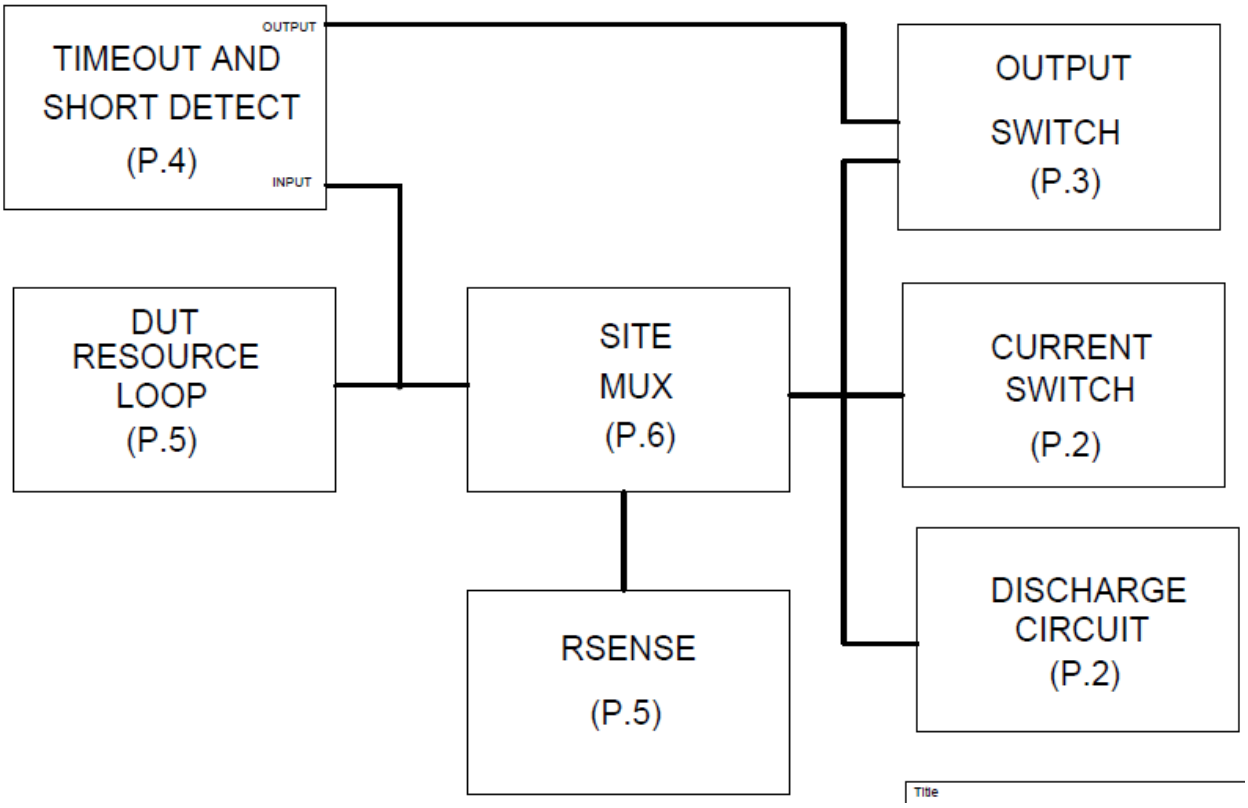
ISSUES AND CONCERNS

TEST REQUIREMENTS AND SPECIFICATIONS

Minimum Test System : TMT ASL 1000 Test System (4.82 ASL Version, Windows NT)
Configuration : DVI_9 (200mA), DVI_11 (200mA)
DDD_7 (128k), TMU_6
MUX_20

SCHEMATIC DIAGRAM

Page 1



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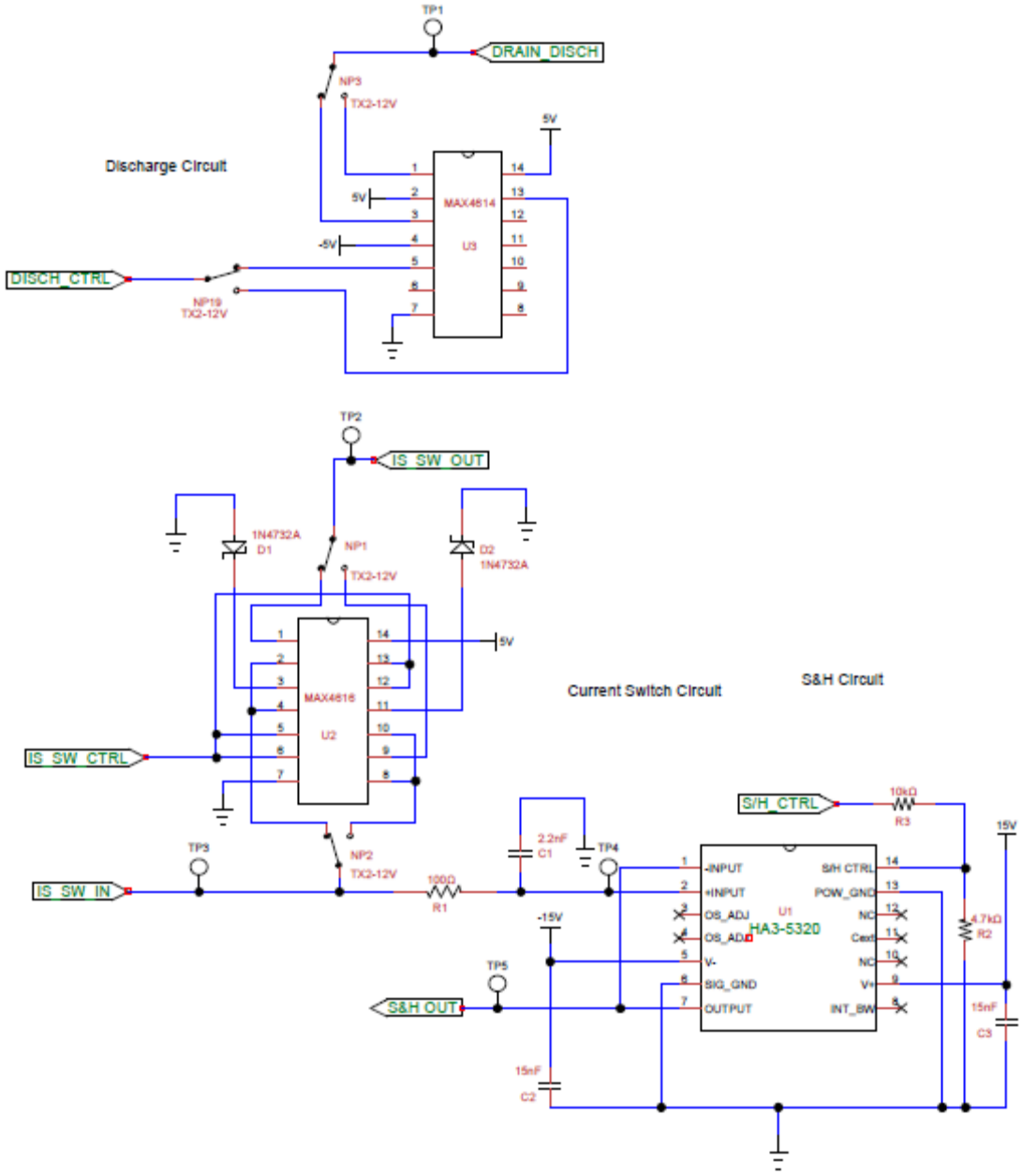
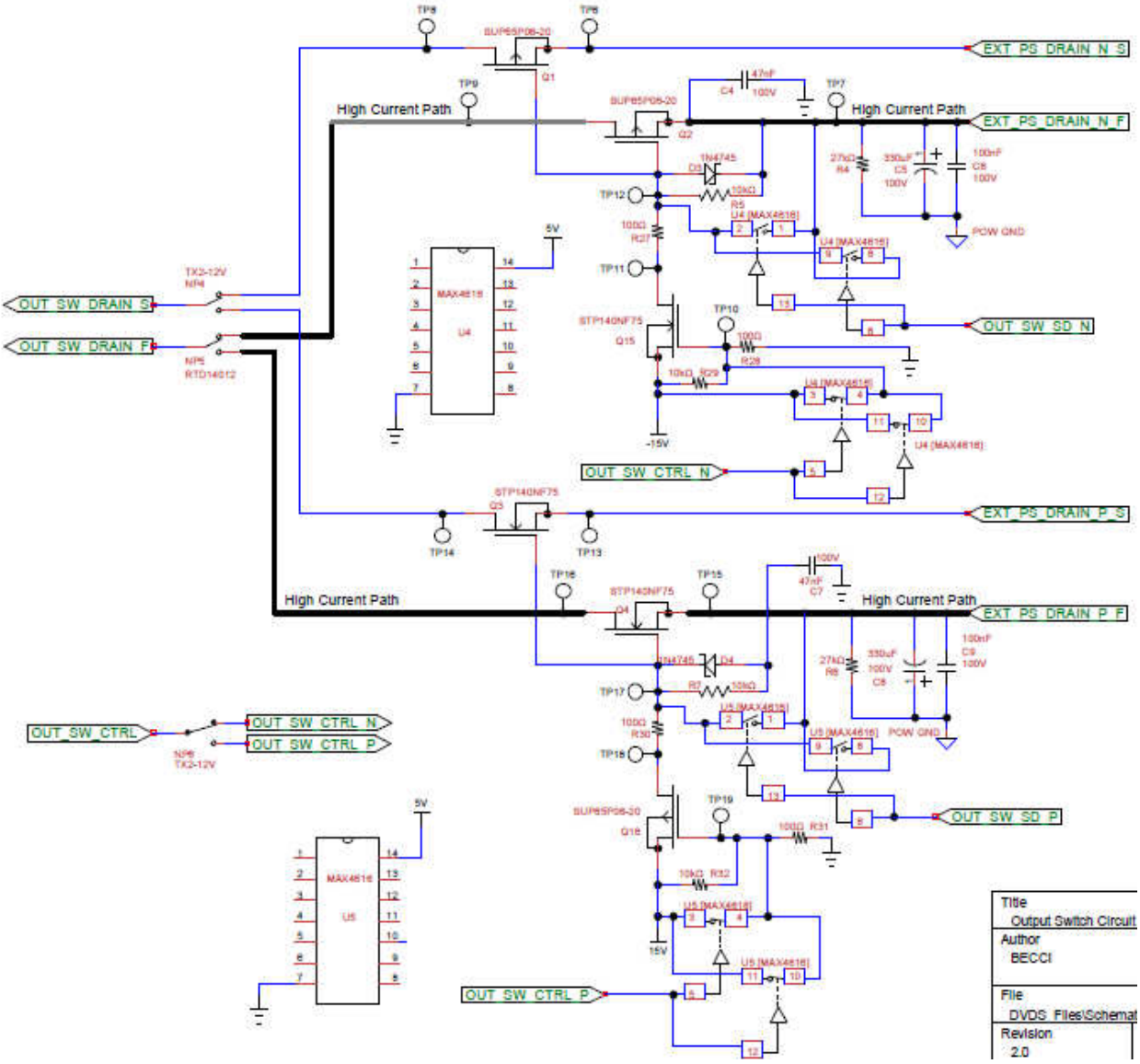

Discharge Circuit
TP1
DRAIN_DISCH
NP3
TX2-12V
5V
MAX4814
U3
-5V
DISCH_CTRL
NP19
TX2-12V
TP2
IS_SW_OUT
1N4732A
D1
NP1
TX2-12V
D2
1N4732A
MAX4816
U2
Current Switch Circuit
S&H Circuit
IS_SW_CTRL
TP3
IS_SW_IN
NP2
TX2-12V
100Ω
R1
2.2nF
C1
TP4
S/H_CTRL
10kΩ
R3
15V
-INPUT
+INPUT
OS_ADJ
OS_ADJ
V-
SIG_GND
OUTPUT
S/H CTRL
POW_GND
NC
Cext
NC
V+
INT_BW
U1
HA3-5320
-15V
TP5
S&H OUT
15nF
C2
4.7kΩ
R2
15nF
C3

Page 3


EXT_PS_DRAIN_N_S
EXT_PS_DRAIN_N_F
EXT_PS_DRAIN_P_S
EXT_PS_DRAIN_P_F
High Current Path
High Current Path
High Current Path
OUT_SW_DRAIN_S
OUT_SW_DRAIN_F
OUT_SW_CTRL
OUT_SW_CTRL_N
OUT_SW_CTRL_P
OUT_SW_SD_N
OUT_SW_SD_P
OUT_SW_CTRL_N
OUT_SW_CTRL_P
POW GND
POW GND
Title
Output Switch Circuit
Author
BECCI
File
DVDS Files\Schemat
Revision
2.0

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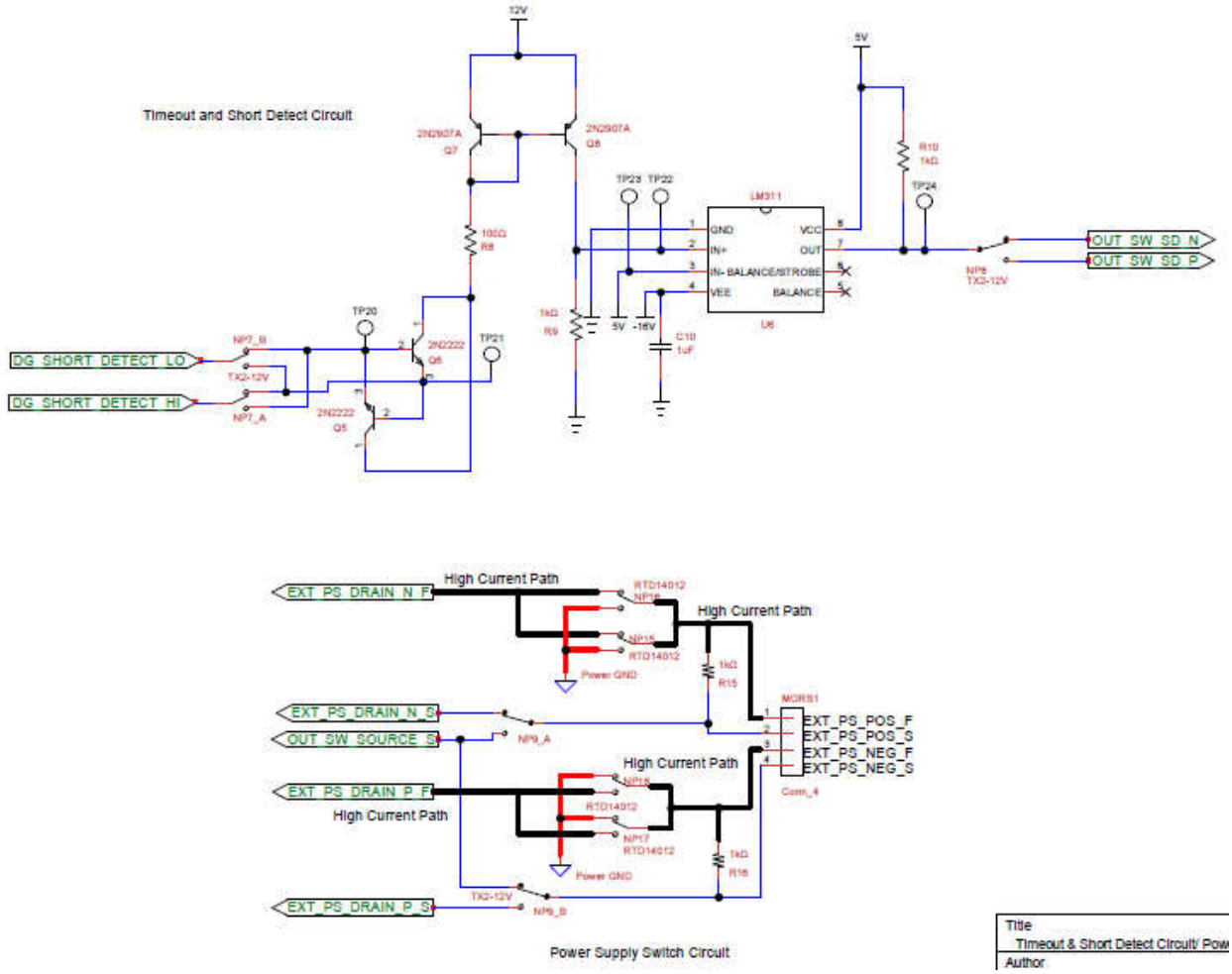
Timeout and Short Detect Circuit
12V
5V
2N2907A
Q7
2N2907A
Q8
TP23
TP22
LM311
GND
IN+
IN- BALANCE/STROBE
VEE
VCC
OUT
BALANCE
U6
R10
1kΩ
TP24
100Ω
R8
1kΩ
R9
5V
-16V
C10
1uF
TP20
TP21
2N2222
Q6
2N2222
Q5
NP7_B
NP7_A
TX2-12V
DG_SHORT_DETECT_LO
DG_SHORT_DETECT_HI
NP9
TX2-12V
OUT_SW_SD_N
OUT_SW_SD_P
High Current Path
EXT_PS_DRAIN_N_F
RTD14012
NP16
NP15
RTD14012
Power GND
High Current Path
1kΩ
R15
MOR81
EXT_PS_POS_F
EXT_PS_POS_S
EXT_PS_NEG_F
EXT_PS_NEG_S
Conn_4
EXT_PS_DRAIN_N_S
OUT_SW_SOURCE_S
NP9_A
High Current Path
EXT_PS_DRAIN_P_F
High Current Path
NP18
RTD14012
NP17
RTD14012
Power GND
1kΩ
R16
TX2-12V
NP9_B
EXT_PS_DRAIN_P_S
Power Supply Switch Circuit
Title
Timeout & Short Detect Circuit/ Pow
Author

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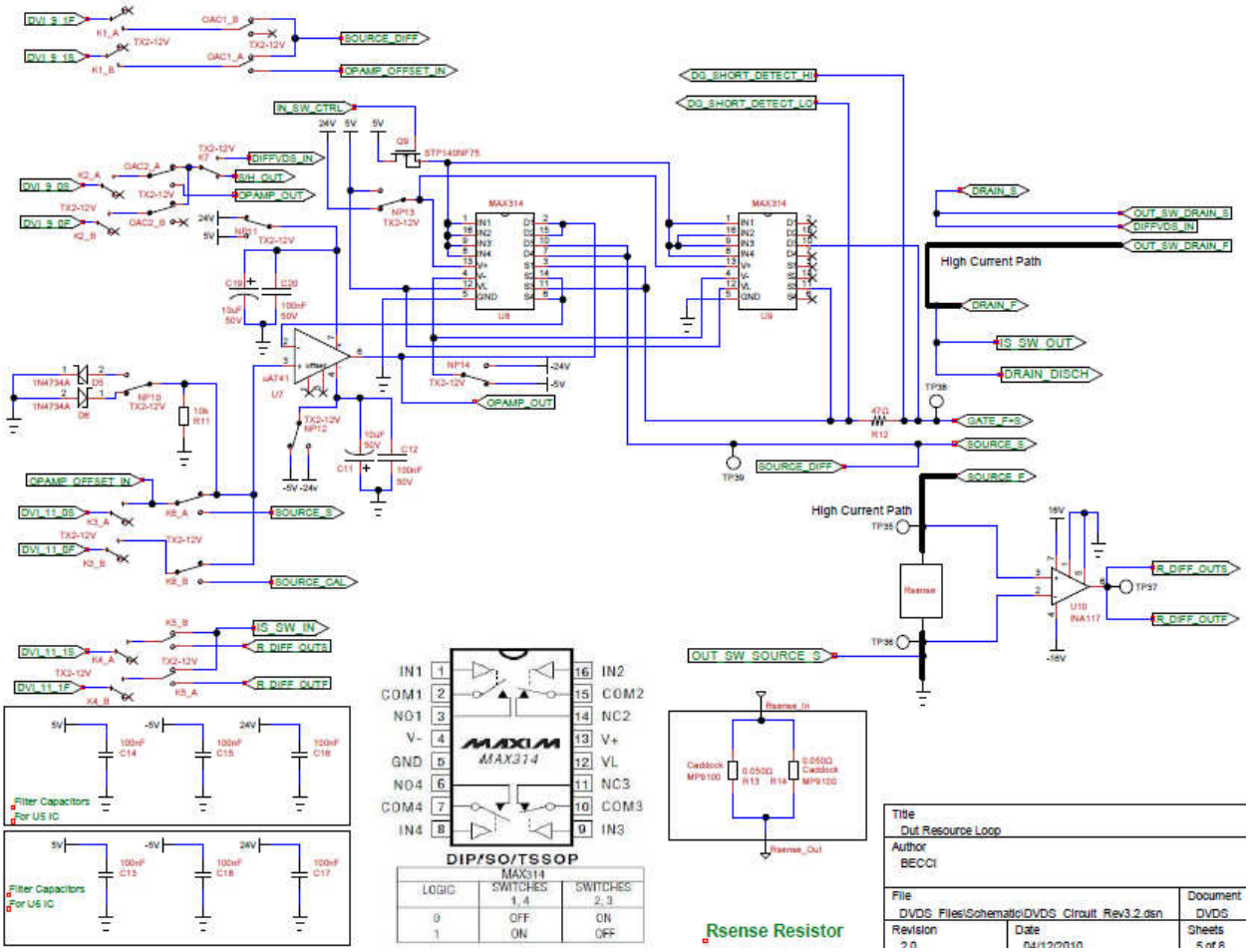
High Current Path
High Current Path
DRAIN_S
DRAIN_F
DRAIN_DISCH
GATE_F+S
SOURCE_S
SOURCE_F
SOURCE_DIFF
SOURCE_CAL
OPAMP_OFFSET_IN
OPAMP_OUT
IN_SW_CTRL
DIFFVDS_IN
S/H_OUT
IS_SW_OUT
R_DIFF_OUTS
R_DIFF_OUTF
OUT_SW_SOURCE_S
OUT_SW_DRAIN_S
OUT_SW_DRAIN_F
DG_SHORT_DETECT_HI
DG_SHORT_DETECT_LO
Filter Capacitors For U5 IC
Filter Capacitors For U6 IC
DIP/SO/TSSOP
MAX314
LOGIC
SWITCHES 1, 4
SWITCHES 2, 3
0 OFF ON
1 ON OFF
Rsense Resistor
Title
Dut Resource Loop
Author
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Document
DVDS
Revision
Date
Sheets

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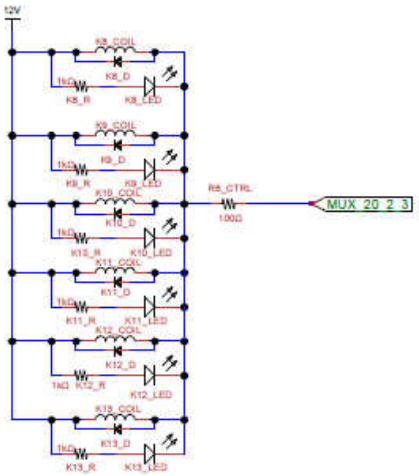

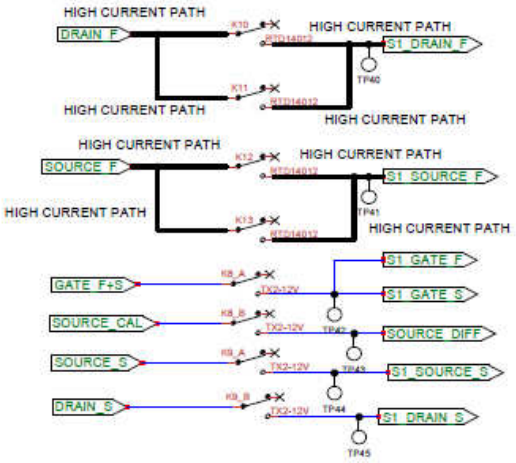

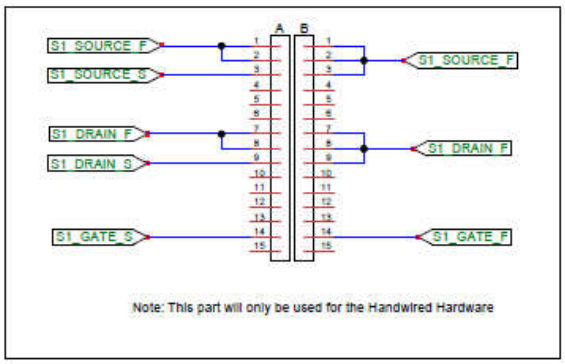

HSMS-C150	1N4148
K8_LED	K8_D
K9_LED	K9_D
K10_LED	K10_D
K11_LED	K11_D
K12_LED	K12_D
K13_LED	K13_D

Title
Site Mux
Author
BECCI
File
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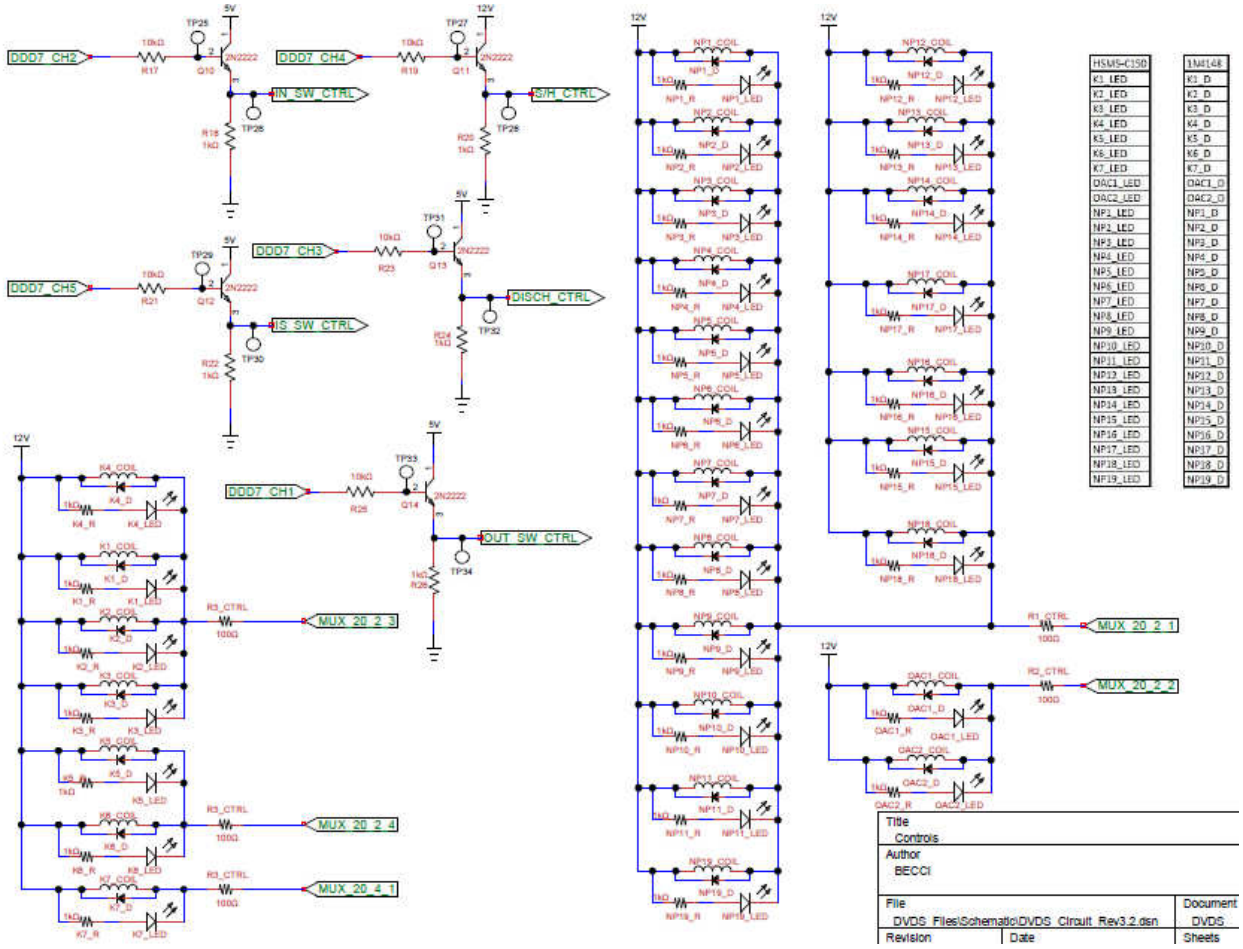
DDD7_CH2
DDD7_CH4
DDD7_CH3
DDD7_CH5
DDD7_CH1
IN_SW_CTRL
S/H_CTRL
IS_SW_CTRL
DISCH_CTRL
OUT_SW_CTRL
MUX_20_2_3
MUX_20_2_4
MUX_20_4_1
MUX_20_2_1
MUX_20_2_2
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Controls
Author
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Document
DVDS
Revision
Date
Sheets

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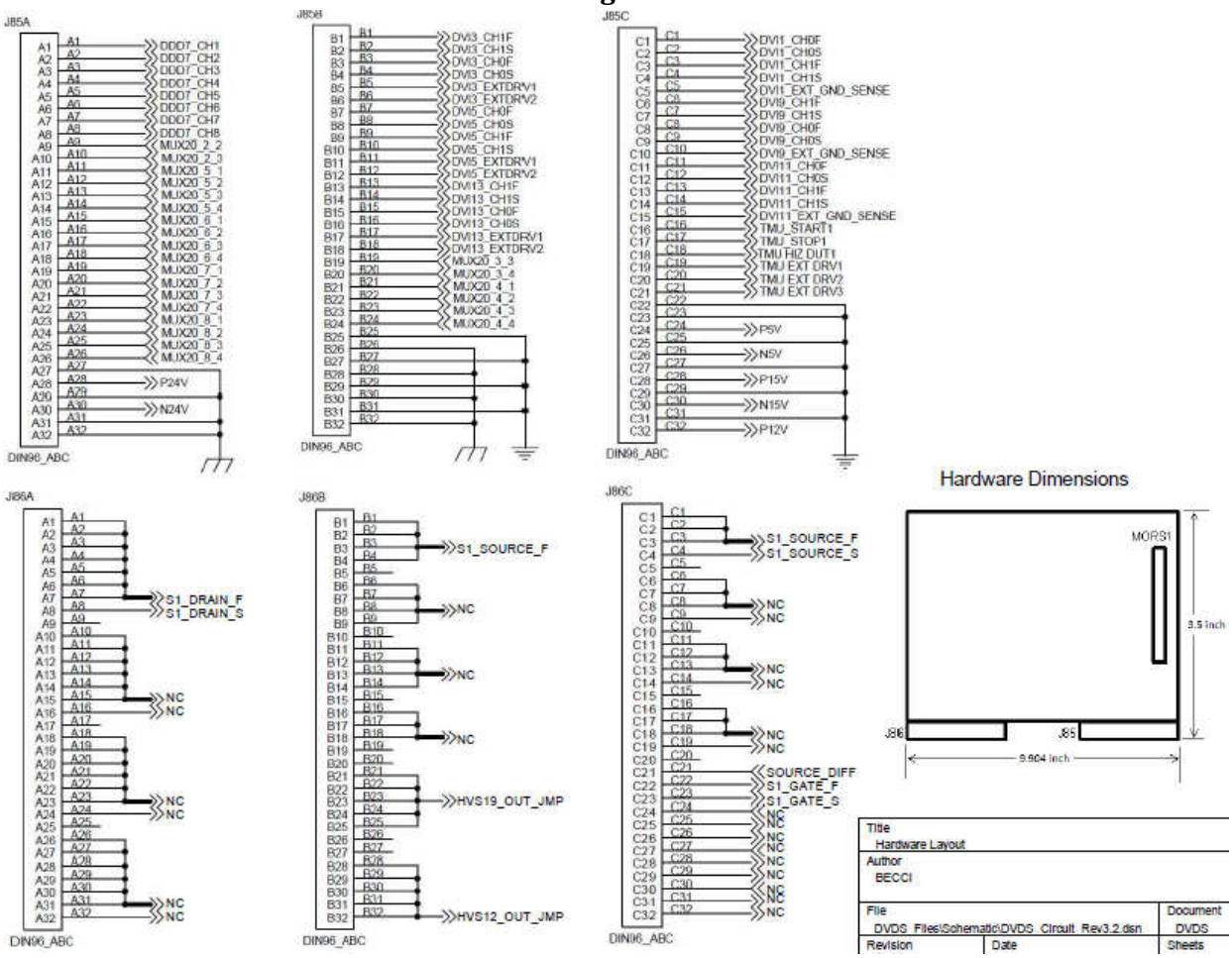
J85A
DDD7_CH1
DDD7_CH2
DDD7_CH3
DDD7_CH4
DDD7_CH5
DDD7_CH6
DDD7_CH7
DDD7_CH8
MUX20_2_2
MUX20_2_3
MUX20_5_1
MUX20_5_2
MUX20_5_3
MUX20_5_4
MUX20_6_1
MUX20_6_2
MUX20_6_3
MUX20_6_4
MUX20_7_1
MUX20_7_2
MUX20_7_3
MUX20_7_4
MUX20_8_1
MUX20_8_2
MUX20_8_3
MUX20_8_4
P24V
N24V
DIN96_ABC
J85B
DVI3_CH1F
DVI3_CH1S
DVI3_CH0F
DVI3_CH0S
DVI3_EXTDRV1
DVI3_EXTDRV2
DVI5_CH0F
DVI5_CH0S
DVI5_CH1F
DVI5_CH1S
DVI5_EXTDRV1
DVI5_EXTDRV2
DVI13_CH1F
DVI13_CH1S
DVI13_CH0F
DVI13_CH0S
DVI13_EXTDRV1
DVI13_EXTDRV2
MUX20_3_3
MUX20_3_4
MUX20_4_1
MUX20_4_2
MUX20_4_3
MUX20_4_4
DIN96_ABC
J85C
DVI1_CH0F
DVI1_CH0S
DVI1_CH1F
DVI1_CH1S
DVI1_EXT_GND_SENSE
DVI9_CH1F
DVI9_CH1S
DVI9_CH0F
DVI9_CH0S
DVI9_EXT_GND_SENSE
DVI11_CH0F
DVI11_CH0S
DVI11_CH1F
DVI11_CH1S
DVI11_EXT_GND_SENSE
TMU_START1
TMU_STOP1
TMU FIZ OUT1
TMU EXT DRV1
TMU EXT DRV2
TMU EXT DRV3
P5V
N5V
P15V
N15V
P12V
DIN96_ABC
J86A
S1_DRAIN_F
S1_DRAIN_S
NC
NC
NC
NC
NC
NC
DIN96_ABC
J86B
S1_SOURCE_F
NC
NC
NC
HVS19_OUT_JMP
HVS12_OUT_JMP
DIN96_ABC
J86C
S1_SOURCE_F
S1_SOURCE_S
NC
NC
NC
NC
NC
NC
SOURCE_DIFF
S1_GATE_F
S1_GATE_S
NC
NC
NC
NC
NC
NC
NC
NC
DIN96_ABC
Hardware Dimensions
MORS1
3.5 Inch
J86
J85
9.904 Inch
Title
Hardware Layout
Author
BECCI
File
DVDS_Files\Schematic\DVDS_Circuit_Rev3.2.dsn
Document
DVDS
Revision
Date
Sheets

TEST PLAN

TEST LIST

Group	Test #	Test Name	Unit	Limits	
				Min	Max
Test Group 1: DVDS Test					
1	1.01	Vds@Cold	mV	None	None
	1.02	Vds@Hot	mV	None	None
	1.03	DVDS	mV	None	None

Calibration Functions

This section of the TDR (**T**est **D**esign **R**eview) explains the methodology of different calibration functions performed to make sure that the measurements/ readings during the actual DVDS Test are accurate. Calibration Functions are done only once.

Calibrate Function 1: Calibration of Meters

This test will calibrate the V-I to be use in measuring the Vds value.

1. Open the force and sense line of dvi_9_0 and dvi_9_1.
2. Short channel 0 and channel 1 of dvi_9 then set-up dvi_9 for differential measurement.
3. Measure the differential voltage between the 2 channels. Store the measured voltage to be used in the succeeding operations.
4. Un-short channel 0 and channel 1 of dvi_9.
5. Close the force and sense line of dvi_9_0 and dvi_9_1.

*note: the calibration of dvi_11 is removed because dvi_11 which is used to measure differential voltage across the Rsense is replace by a differential Op-Amp.

Calibrate Function 2: Rsense Calibration

This test will measure the value of the Rsense resistor. The Rsense resistor is connected to the DUT Source. The input voltage to the Op-Amp and the programmed voltage of the External Power Supply can be calculated using the measured Rsense resistor. The Op-Amp's input voltage and the programmed voltage of the External Power Supply is important since it will determine the current that the External Power Supply will sink/ source going through the device.

Function	Test #	Test Name	Unit	Limits		
				Min	Typical	Max
Calibrate Function 2: Rsense Calibration						
2	2.01	R_Diff_V	mV	4	5	6
	2.02	Rsense_I	mA	195	199	204
	2.03	Rsense	mΩ	20	25	30

1. Connect dvi_11_0 to DUT Source and dvi_11_1 to the output of the Differential Amp (U10) by closing K5.
2. Force 199mA through Rsense.
3. Measure and record the current (**Rsense_I**) through Rsense using dvi_11_0.
4. Measure and record the output voltage (**R_Diff_V**) of the Differential Amp using dvi_11_1.
5. Calculate Rsense using formula 1:

   Formula 1: Rsense = R_Diff_V / Rsense_I (mΩ)

6. Record and store Rsense value.
7. Disconnect dvi_11_0 from DUT Source and dvi_11_1 from the output of the Differential Amp (U10) by opening K5.

Calibrate Function 3: Calibrate Op-Amp Output Voltage

This test will determine if there is an offset in the Op-Amps's output voltage. This test is done by forcing a voltage on the Op-Amps input then measuring the differential voltage between the input and the output of the Op-Amp.

1. Calculate the Op-Amp's input voltage (**V_In**) using formula 2:

   Formula 2: V_In = Id * Rsense (V)

   Where: Id = current required for the DVDS Test

2. Setup dvi_9 to measure differential voltage.
3. Set the current and voltage of dvi9_0 and dvi9_1.
4. Open the force line of dvi_9_1.
5. Connect the sense line of dvi_9_1 to the input of the Op-Amp by closing OAC1.
6. Connect dvi_9_0 to the output of the Op-Amp by closing OAC2.
7. Force V_In, 199mA to the input of the Op-Amp using dvi_11_0.

8. Measure the differential voltage between the Op-Amp's input and output using dvi_9. The measured voltage will be stored to be used in the succeeding operations.

9. Disconnect dvi_9_0 from the output of the Op-Amp and disconnect dvi_9_1 from the input of the Op-Amp by opening OAC2 and OAC1 respectively.

Calibration Function 4: Calibration of S&H

This part of the methodology is included in the **Issues And Concerns** section of this document. There are methods which has connections that cannot be trace.

1. Turn on Current Switch by turning on Q12 and turn off Output Switch Circuit, DUT Resource Loop, Discharge Circuit and S&H Circuit.

2. Connect dvi_9_0 to DUT Drain Sense by closing K7 then open the force line of dvi_9_0. Dvi_9_1 is already connected to the DUT Source.

3. Measure differential voltage from DUT Source to Drain using dvi_9. Subtract the stored voltage in the Meter Calibration to the measured differential voltage.

4. Open K7 to connect dvi_9_0 to the S&H Output.

5. Turn on Current Switch Circuit. After 1ms turn on S&H Circuit and turn off Output Switch Circuit, DUT Resource Loop and Discharge Circuit.

6. Measure differential voltage from DUT Source to S&H Output using dvi_9. Subtract the stored voltage in the Meter Calibration to the measured differential voltage.

7. Get the difference between the result in step #3 and step #5 and store this value. This value will be the S&H Offset to be used in the succeeding operations.

Test Group 1: DVDS Test

This test is done by calculating the change of Vsd from the Mosfet's cold state Vsd to the Mosfet's hot state Vds.

1. Close K1, K2, K3 and K4.

2. The default setting of the hardware is applicable only to N-ch MOSFET. If the hardware is applied to a P-ch MOSFET, close the NP relays at the start.

3. Setup DDD Board.

4. Before starting the actual DVDS Test, calibration on the external circuits to be used in the test is performed first. The calibration is only performed once.

5. First, the calibration of meters/ resources to be used in measuring is performed. See **Calibration Function 1**.

6. After the calibration of meters, perform calibration of the Rsense resistor. See **Calibration Function 2**.
7. After calibrating the Rsense resistor, perform Op-Amp calibration. See **Calibration Function 3**.
8. Program the voltage of the External Power Supply. The programmed voltage is equal to **Vds+(Id*Rsense).** Vds value is the Mosfet's Vds.
9. Prepare to turn on the discharge circuit, current switch circuit and the S&H circuit.
10. Connect dvi_11_0 to the Op-Amp's input. Connect dvi_11_1 to the current switch circuit.
11. Calculate the Op-Amp's input voltage using the formula **V_In = (Id*Rsense)-offset voltage**. The offset voltage was the voltage measured during the calibration of the Op-Amp.
12. Set-up dvi_9 for differential measurement between the DUT's Drain-to-S&H Output.
13. Input the calculated V_In to the Op-Amp using dvi_11_0.
14. Set-up dvi_11_1 to measure voltage. Set the voltage and current (V_Test, Itest) of dvi_11_1 where **V_Test** is the test voltage limit and **Itest** is the test current to measure VDS at cold and hot
15. Set dvi_9 to measure Vds voltage. Set 0V, 10mA on both channels of dvi_9 then open the force line of both channels.
16. If this is the first run, calibrate first the S&H circuit. See **Calibration Function 4**.
17. Turn on Current Switch Circuit. After 1ms turn on S&H Circuit and turn off Output Switch Circuit, DUT Resource Loop and Discharge Circuit.
18. After 500us measure Vds at cold through the S&H output. The measured Vds value will be subtracted by the stored measurement in Calibration Function 1 and Calibration Function 4.
19. Discharge drain to 0 by setting 0V, 200mA on dvi_11_1 .
20. After 500us turn off Output Switch Circuit, DUT Resource Loop, Discharge Circuit and Current Switch Circuit and turn on the S&H Circuit. After 5us connect the External Power Supply through the Output Switch Circuit. After 5us turn on the DUT by connecting the Op-Amp circuit to the DUT.
21. 2ms after turning on the DUT, set-up dvi_11_1 for the V_Test voltage and Itest current.
22. Let the required current pass through the Mosfet to heat up the device at the specified duration (**Theat**). Typically 50ms

23. After 50ms disconnect External Power Supply by disconnecting the output switch circuit, turn off DUT Resource Loop and S&H Circuit. Turn on the discharge circuit for 10us. The disconnecting of external power supply and the turning on of the discharge circuit is done together.

24. After 10us turn off the discharge circuit, then turn on the current switch circuit. After 10us turn on the S&H circuit together with the current switch circuit.

25. Measure the Vds at hot through the S&H circuit output. The measured Vds value will be subtracted by the stored measurement in Calibration Function 1 and Calibration Function 4.

26. Calculate DVDS Value using this formula:

    DVDS = Vds@Hot – Vds@Cold (mV)

27. Record Vds@Cold, Vds@Hot and DVDS value.

28. Switch off Itest by setting 0V, 1uA on dvi_11_1.

29. Switch off Op-Amp's input voltage by setting 0V, 1uA on dvi_11_0.

30. Reset all relays that were used. Switch off current switch circuit and the opamp's input voltage.