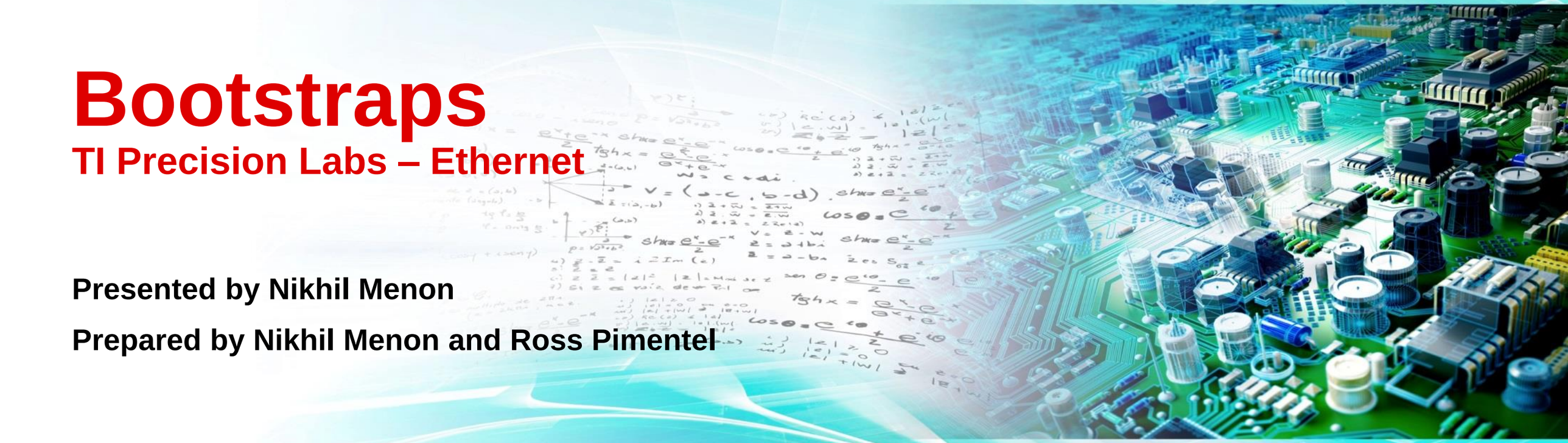
Bootstraps

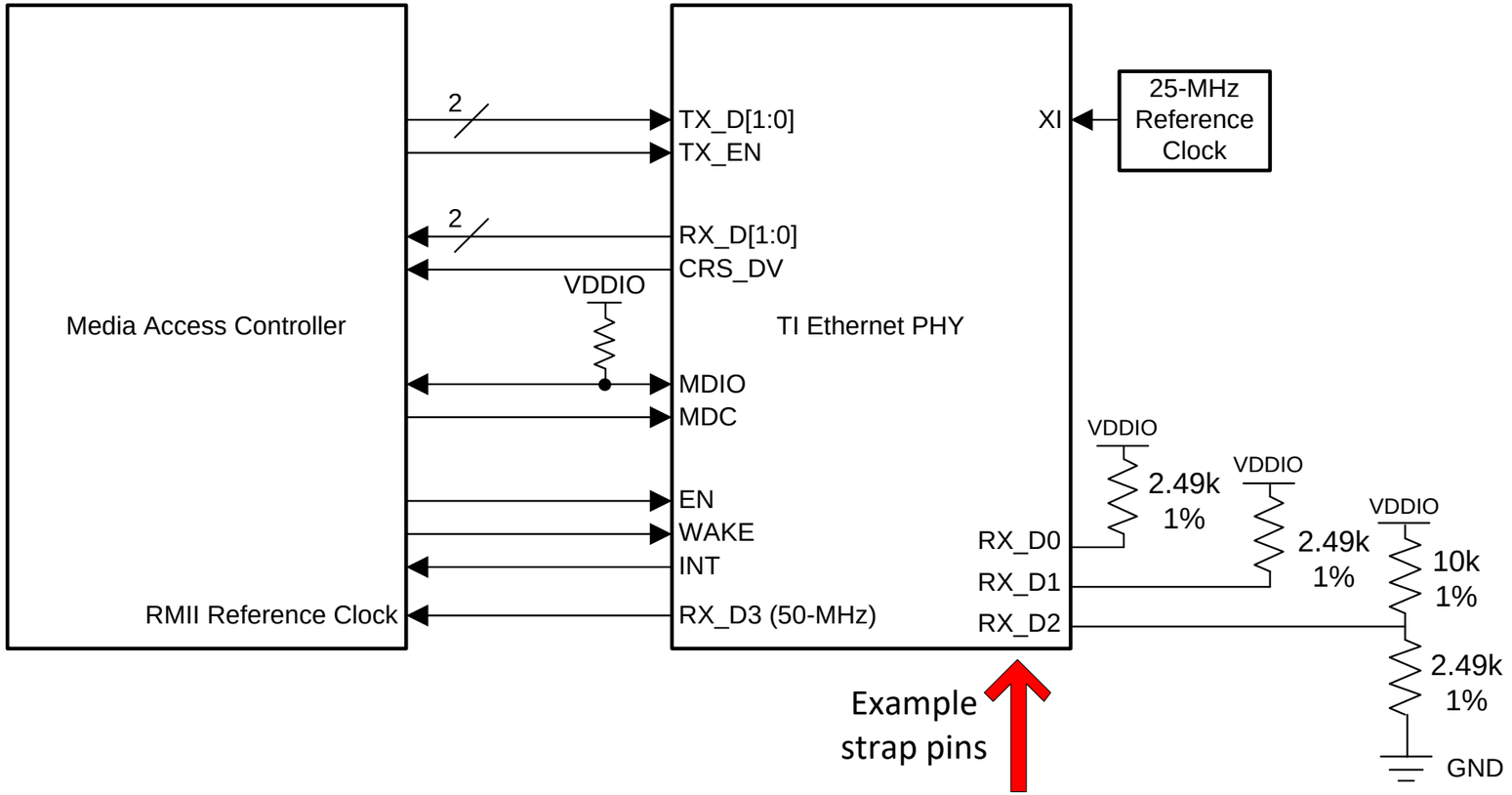
TI Precision Labs – Ethernet



Presented by Nikhil Menon

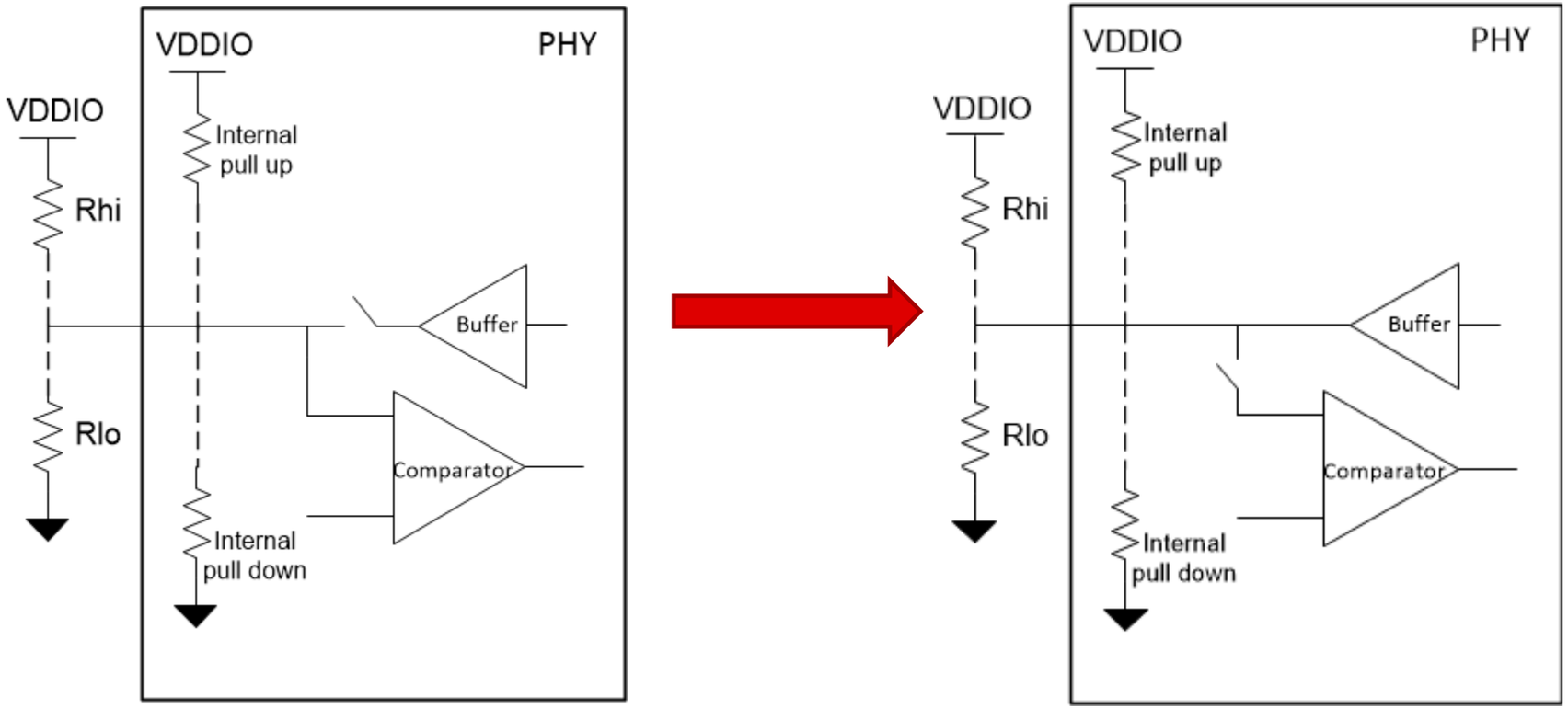
Prepared by Nikhil Menon and Ross Pimentel

Hardware bootstraps



TI Ethernet PHY strapped for RMII master mode

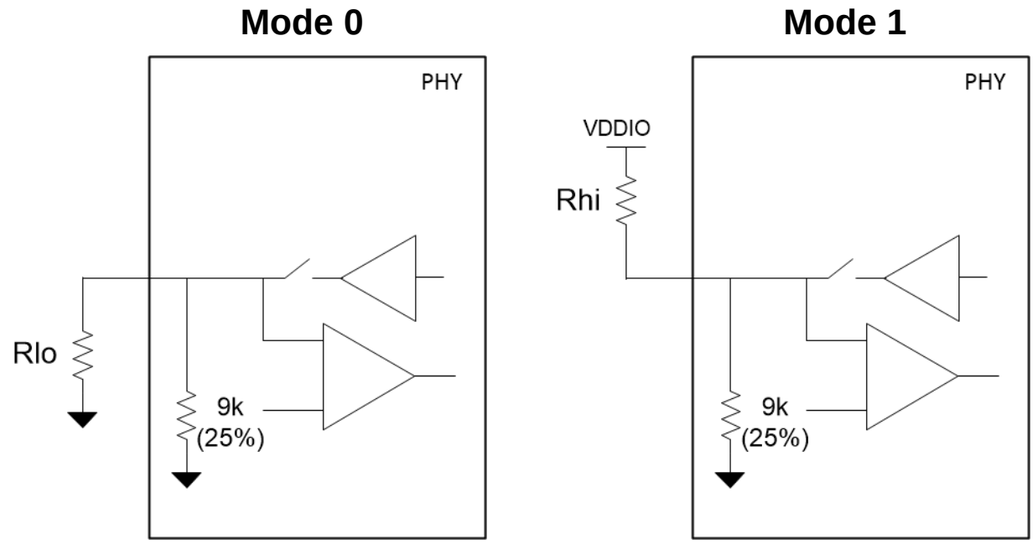
Hardware bootstraps



Power up and reset

Normal operation

Hardware bootstraps: two level



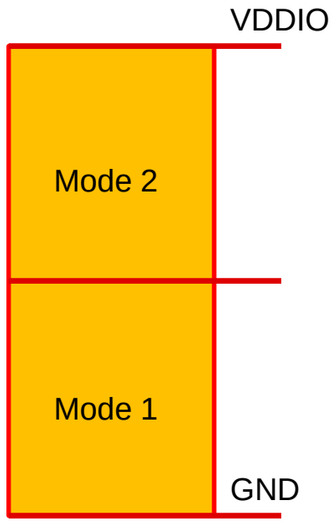
2-Level strap resistor ratio

MODE	TARGET VOLTAGE			IDEAL RESISTORS	
	Vmin (V)	Vtyp (V)	Vmax (V)	Rhi (kΩ)	Rlo (kΩ)
0	0		0.35 x VDDIO	OPEN	2.49
1	0.7 x VDDIO		VDDIO	2.49	OPEN

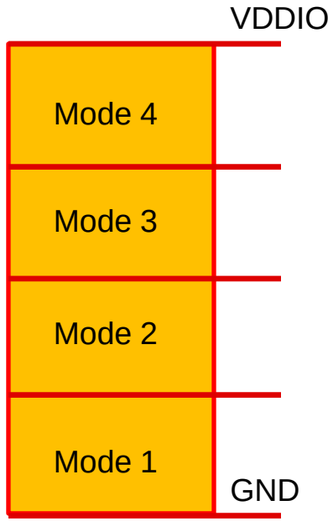
Auto-neg strap table

PIN NAME	STRAP NAME	PIN #	DEFAULT		
RX_ER	A-MDIX	22	0	0	Auto-MDIX Enable
				1	Auto-MDIX Disable

Hardware bootstraps: four level



2 level voltage thresholds

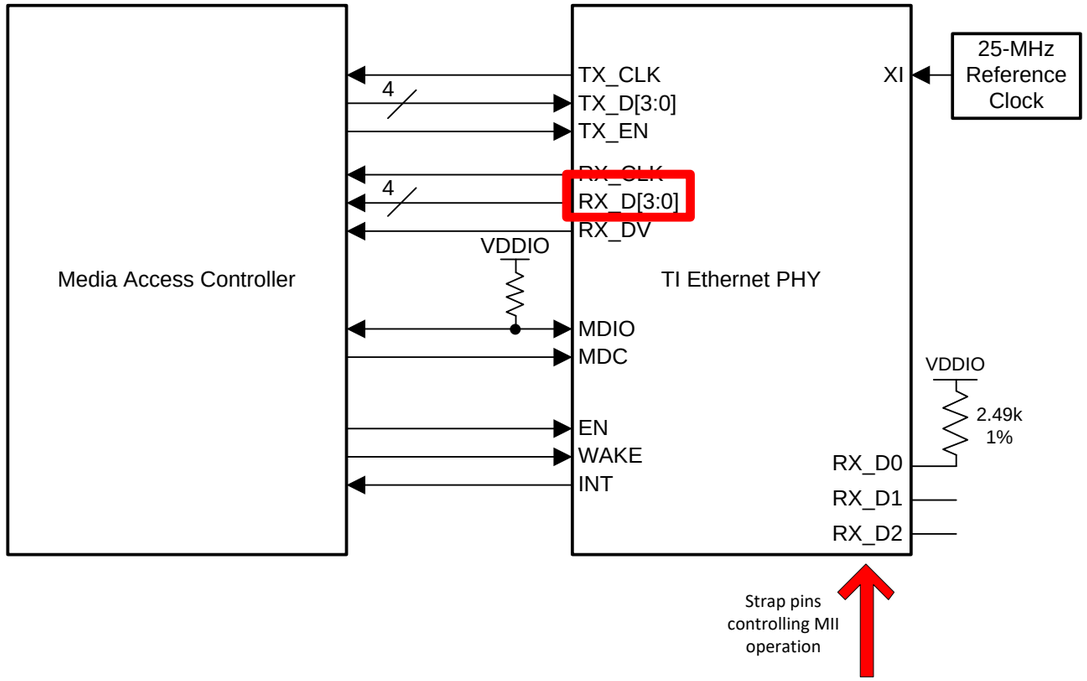


4 level voltage thresholds

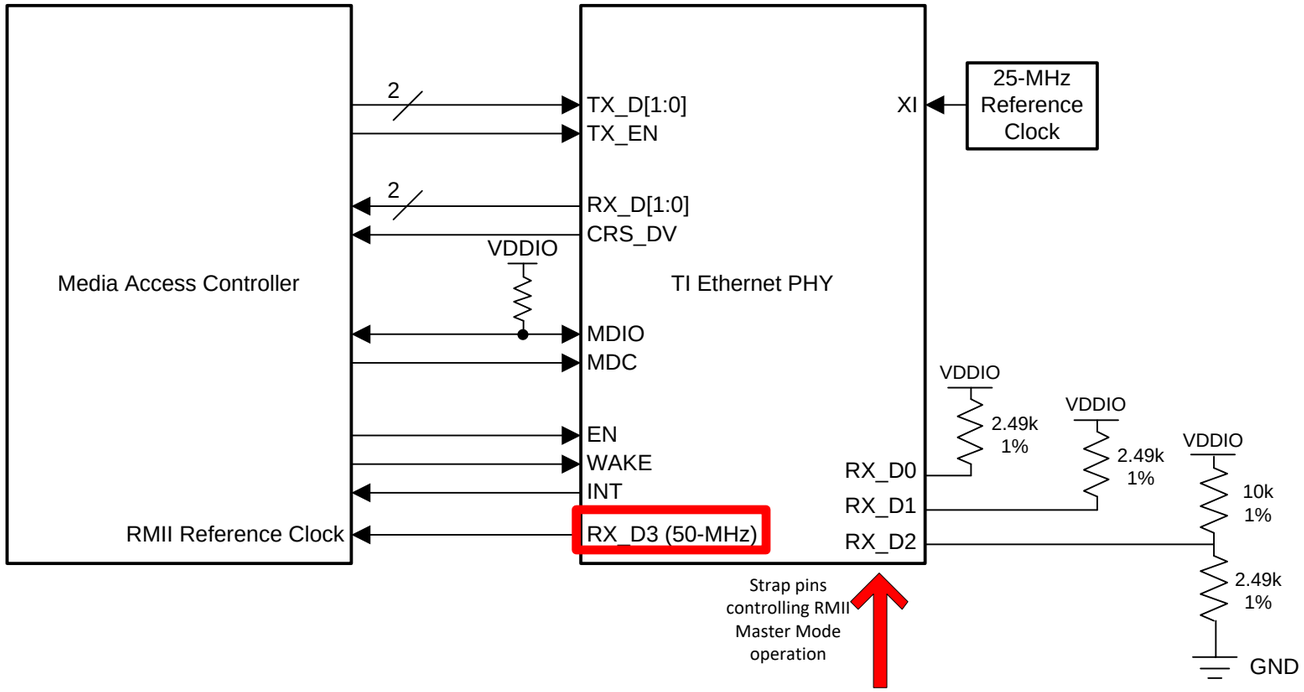
BOOTSTRAP DC CHARACTERISTICS					
			Vmin (V)	Vtyp (V)	Vmax (V)
V_{bs_1}	Bootstrap Threshold	Mode 1	0	0	0.08 x VDDIO
V_{bs_2}		Mode 2	0.148 x VDDIO	0.165 x VDDIO	0.181 x VDDIO
V_{bs_3}		Mode 3	0.235 x VDDIO	0.252 x VDDIO	0.277 x VDDIO
V_{bs_4}		Mode 4	0.694 x VDDIO	VDDIO	VDDIO

4-Level strap voltage threshold levels

Bootstrap implementation: design changes



TI Ethernet PHY in MII mode



TI Ethernet PHY in RMII Master mode

Bootstrap implementation: four level

4-Level bootstraps

PIN NAME	PIN NO.	DEFAULT	STRAP FUNCTION		
			MODE	MAC[0]	TEST[0]
RX_D0	26	1	1	0	0
			2	0	1
			3	1	1
			4	1	0
			MODE	MAC[1]	TEST[1]
RX_D1	25	1	1	0	0
			2	0	1
			3	1	1
			4	1	0
			MODE	MAC[2]	TEST[2]
RX_D2	24	1	1	0	0
			2	0	1
			3	1	1
			4	1	0

MAC interface selection bootstraps

MAC[2]	MAC[1]	MAC[0]	Description
0	0	0	RESERVED
0	0	1	MII
0	1	0	RMII Slave
0	1	1	RMII Master
1	0	0	RGMII (Align Mode)
1	0	1	RGMII (TX Internal Delay Mode)
1	1	0	RGMII (TX and RX Interal Delay Mode)
1	1	1	TGMII (RX Internet Delay Mode)

Test mode bootstraps

TEST[2]	TEST[1]	TEST[0]	Description
0	0	0	Normal Operation
0	0	1	Test Mode 1
0	1	0	Test Mode 2
0	1	1	RESERVED
1	0	0	Test Mode 4
1	0	1	Test Mode 5
1	1	0	RESERVED
1	1	1	RESERVED

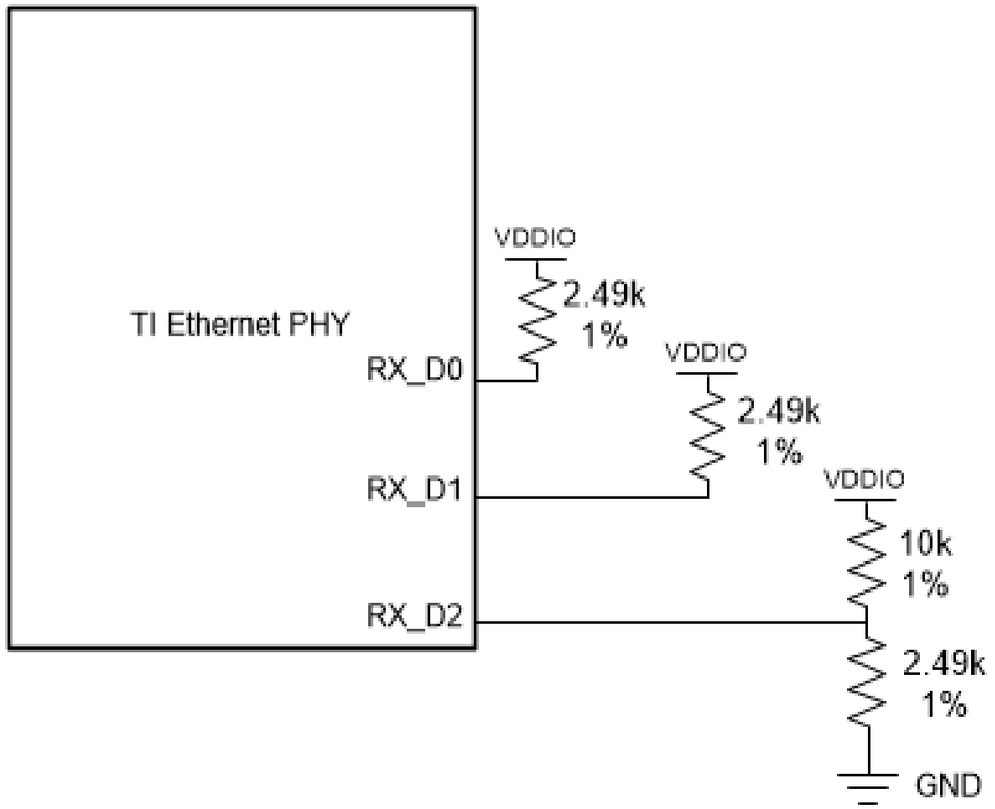
Bootstrap implementation: four level

MODE	IDEAL Rhi (kΩ)	IDEAL Rlo (kΩ)
1	OPEN	OPEN
2	10	2.49
3	5.76	2.49
4	2.49	OPEN

Recommended 4-level strap resistor ratios

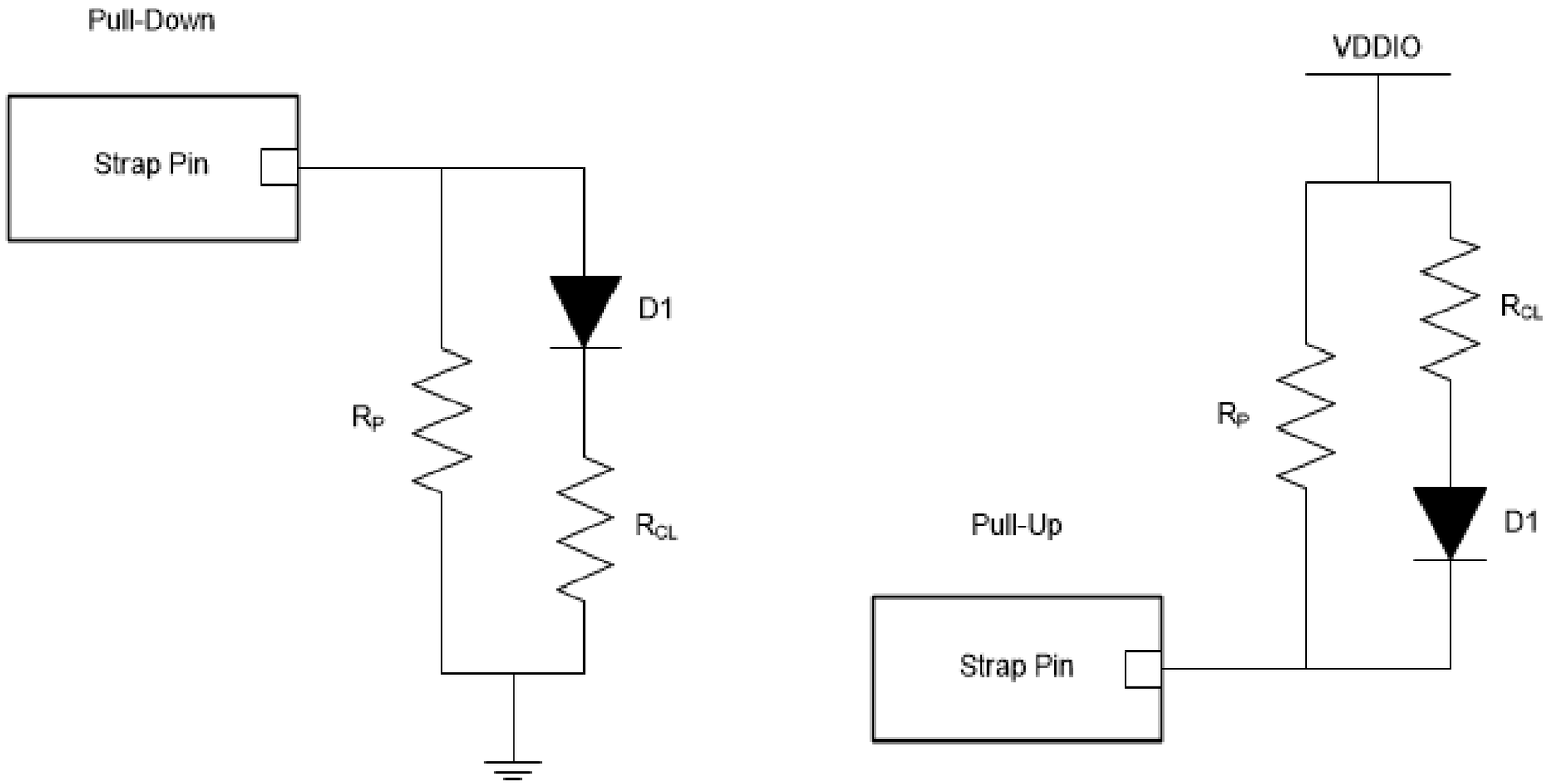
BOOTSTRAP DC CHARACTERISTICS					
			Vmin (V)	Vtyp (V)	Vmax (V)
V_{bs_1}	Bootstrap Threshold	Mode 1	0	0	0.08 x VDDIO
V_{bs_2}		Mode 2	0.148 x VDDIO	0.165 x VDDIO	0.181 x VDDIO
V_{bs_3}		Mode 3	0.235 x VDDIO	0.252 x VDDIO	0.277 x VDDIO
V_{bs_4}		Mode 4	0.694 x VDDIO	VDDIO	VDDIO

4-Level strap voltage threshold levels



RMII Master/Test Mode 4 Strap Configuration

LED straps



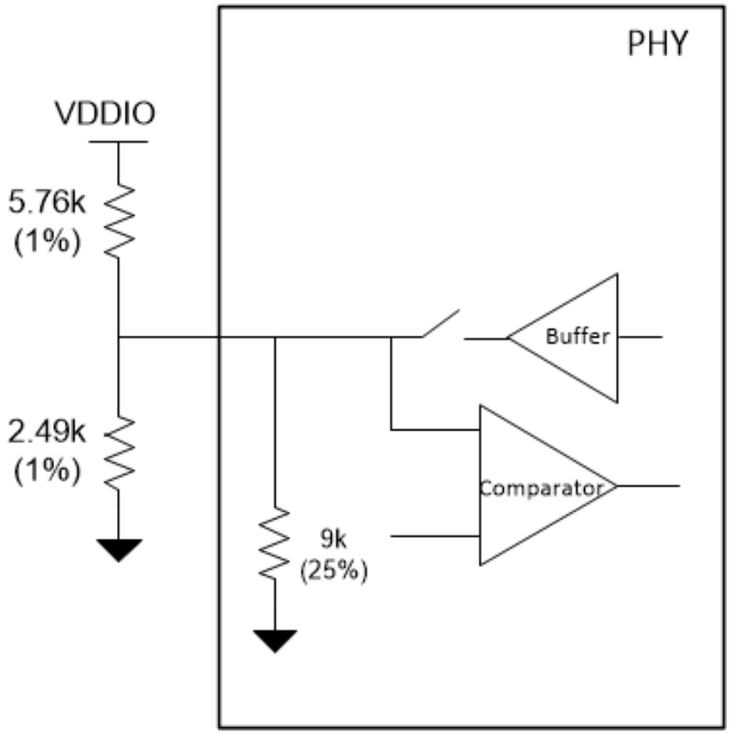
Bootstrap voltage threshold calculation

Recommended 4-level strap resistor ratios

MODE	IDEAL Rhi (kΩ)	IDEAL Rlo (kΩ)
1	OPEN	OPEN
2	10	2.49
3	5.76	2.49
4	2.49	OPEN

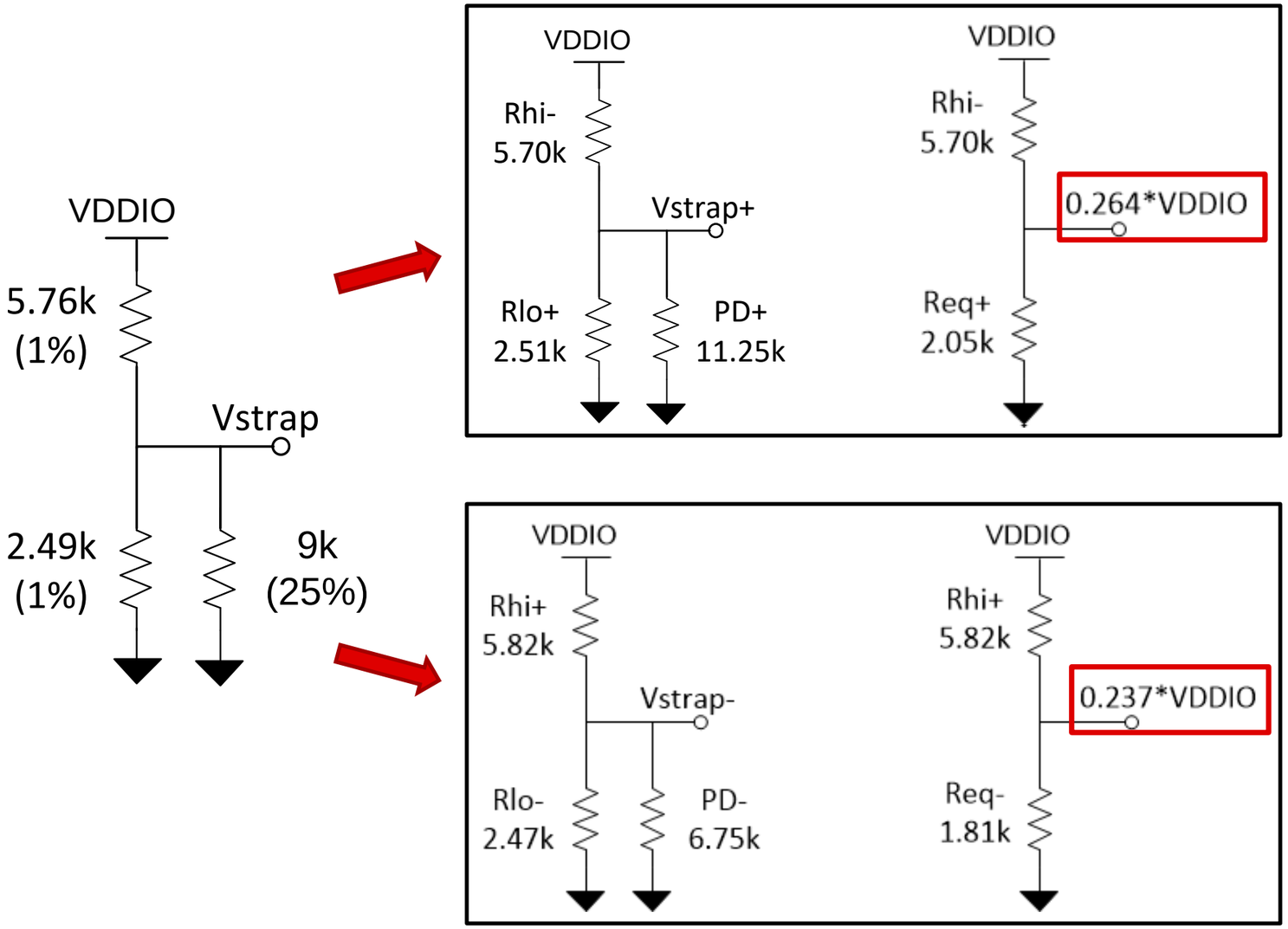
BOOTSTRAP DC CHARACTERISTICS					
			Vmin (V)	Vtyp (V)	Vmax (V)
V_{bs_1}	Bootstrap Threshold	Mode 1	0	0	0.08 x VDDIO
V_{bs_2}		Mode 2	0.148 x VDDIO	0.165 x VDDIO	0.181 x VDDIO
V_{bs_3}		Mode 3	0.235 x VDDIO	0.252 x VDDIO	0.277 x VDDIO
V_{bs_4}		Mode 4	0.694 x VDDIO	VDDIO	VDDIO

4-Level strap voltage threshold levels



Sample strap connections

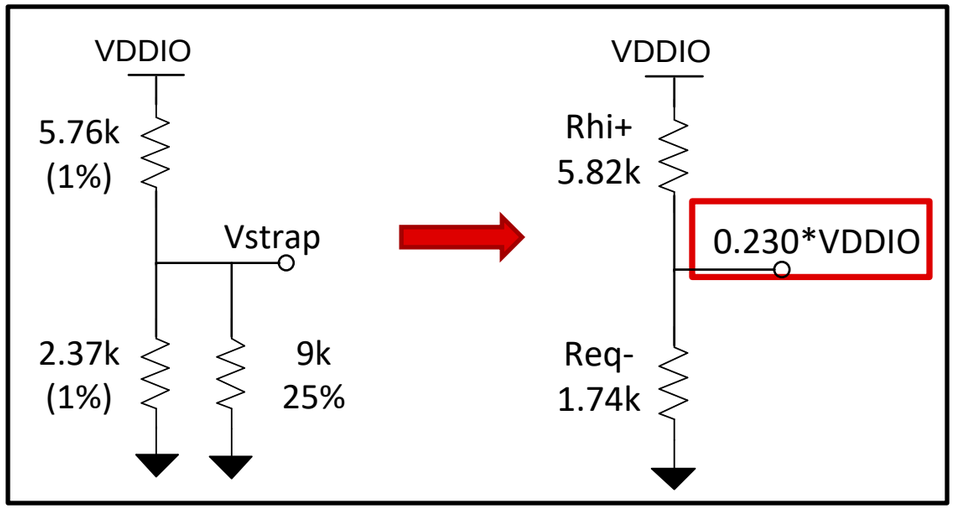
Bootstrap voltage threshold calculation

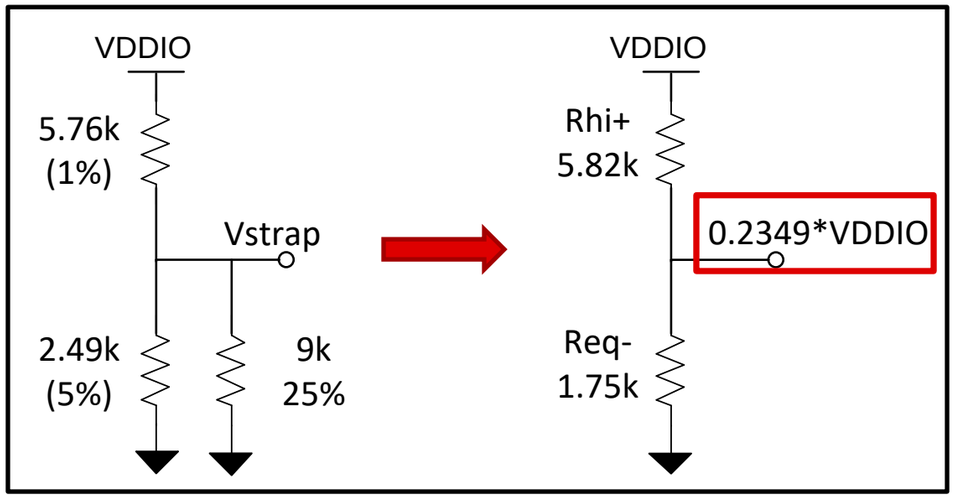


Mode 1	0	0	0.08 x VDDIO	V
Mode 2	0.148 x VDDIO	0.165 x VDDIO	0.181 x VDDIO	V
Mode 3	0.235 x VDDIO	0.252 x VDDIO	0.277 x VDDIO	V
Mode 4	0.694 x VDDIO	VDDIO	VDDIO	V

4-level strap voltage threshold levels

Bootstrap voltage threshold calculation



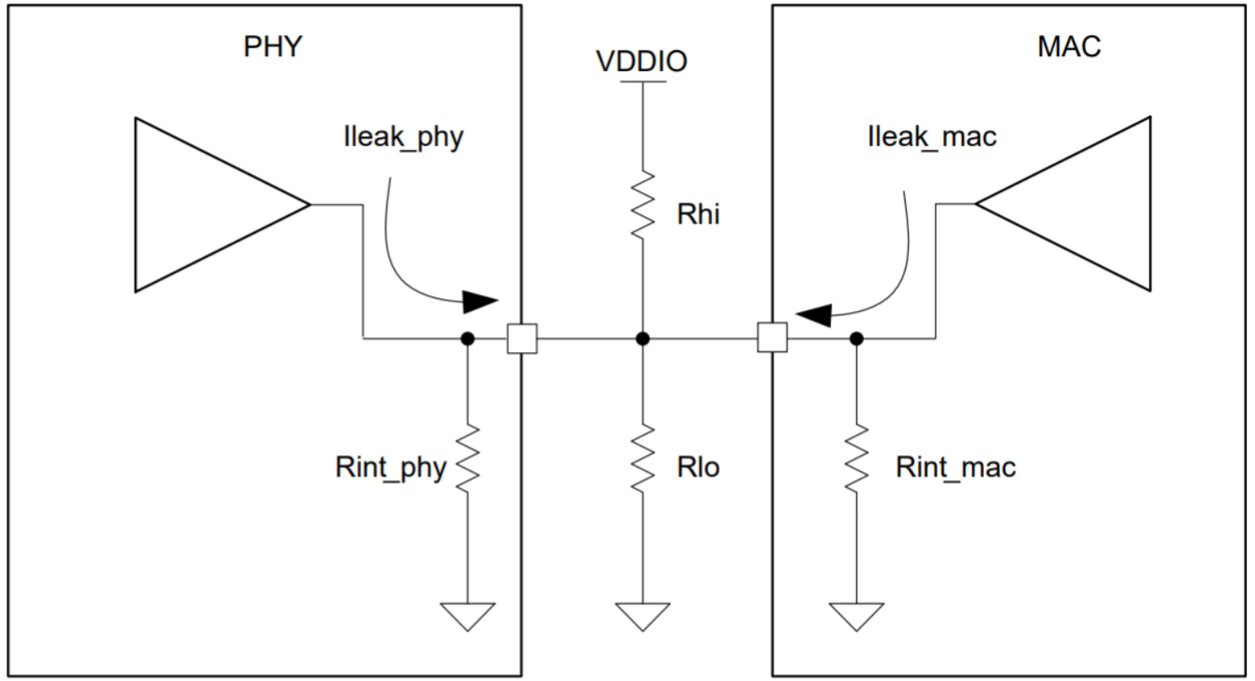


Mode 1	0	0	0.08 x VDDIO	V
Mode 2	0.148 x VDDIO	0.165 x VDDIO	0.181 x VDDIO	V
Mode 3	0.235 x VDDIO	0.252 x VDDIO	0.277 x VDDIO	V
Mode 4	0.694 x VDDIO	VDDIO	VDDIO	V

4-level strap voltage threshold levels

4-Level strap device configuration

- Refer to TI App Note for additional information “4-Level strap device configuration”
  - http://www.ti.com/lit/an/snla258a/snla258a.pdf



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