

# DP83TG720S-Q1 1000BASE-T1 Automotive Ethernet PHY with SGMII and RGMII

## 1 Features

- IEEE802.3bp 1000BASE-T1 compliant
- Open Alliance TC12 Interoperability and EMC compliant
  - Interoperability tested with OA/IEEE compliant PHYs
  - EMC immunity Class-IV compliant for UTP (unshielded twisted pair)
- Integrated LPF on MDI pins
- MAC Interfaces: RGMII and SGMII
- Supported I/O voltages: 3.3V, 2.5V, and 1.8V
- Pin compatible with TI's 100BASE-T1 PHY
  - Single board design for 100BASE-T1 and 1000BASE-T1 with required BOM change
- Power savings features:
  - Standby and sleep
  - Local and remote wake-up
- Diagnostic tool kit
  - High accuracy temperature monitor
  - Voltage monitor
  - ESD event monitor
  - Data throughput calculator: inbuilt MAC packet generator, counter and error checker
  - Link quality monitoring
  - Cable open and short fault detection
  - Loopback modes
- 25MHz clock output source
- VQFN, wettable flank packaging
- AEC-Q100 Qualified
  - Inbuilt ESD protection: IEC61000-4-2 ESD: ±8kV contact discharge
  - Device temperature grade 1: –40°C to +125°C ambient operating temperature

## 2 Applications

- [Telematics control unit \(TCU, TBOX\)](#)
- [Gateway and Body Control Module \(BCM\)](#)
- [ADAS: LIDAR, RADAR, Front Camera](#)

## 3 Description

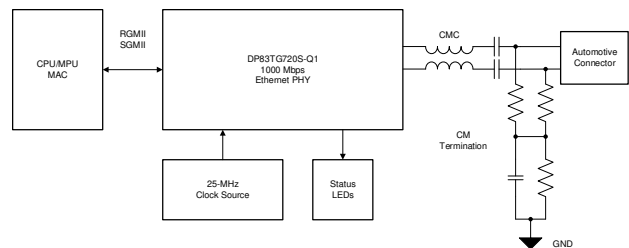
The DP83TG720S-Q1 device is an IEEE 802.3bp and Open Alliance compliant automotive Ethernet physical layer transceiver. The device provides all physical layer functions needed to transmit and receive data over unshielded/shielded single twisted-pair cables. The device provides xMII flexibility with support for RGMII and SGMII MAC interfaces.

DP83TG720 is compliant to Open Alliance EMC and interoperable specifications over unshielded twisted cable. DP83TG720 is front print compatible to TI's 100BASE-T1 PHY enabling design scalability with single board for both speeds. This device offers the Diagnostic Tool Kit, with an extensive list of real-time monitoring tools, debug tools and test modes. Within the tool kit is the first integrated electrostatic discharge (ESD) monitoring tool. The device is capable of counting ESD events on both the xMII and MDI as well as providing real-time monitoring through the use of a programmable interrupt. Additionally, the DP83TG720S-Q1 includes a data generator and checker tool to generate customizable MAC packets and check the errors on incoming packets. This enables system level datapath tests and optimizations without dependency on MAC.

### Package Information

PART NUMBER	PACKAGE (1)	PACKAGE SIZE (2)
DP83TG720S-Q1	VQFN (36)	6.00mm × 6.00mm

- (1) For all available packages, see the orderable addendum at the end of the datasheet.
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.



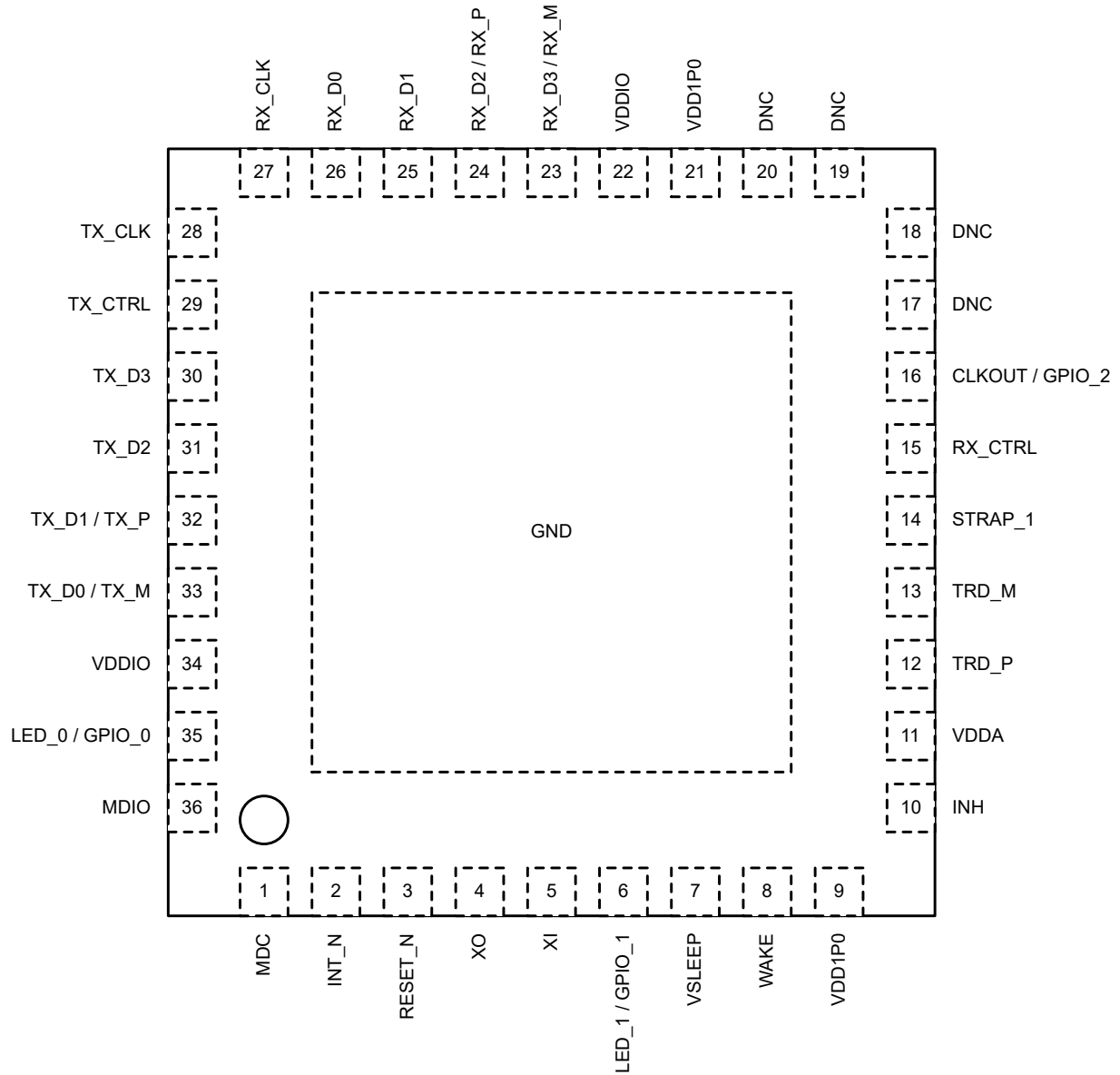
**Simplified Schematic**



## Table of Contents

<b>1 Features</b> .....	1	6.5 Programming.....	49
<b>2 Applications</b> .....	1	<b>7 Register Maps</b> .....	52
<b>3 Description</b> .....	1	7.1 Register Access Summary.....	52
<b>4 Pin Configuration and Functions</b> .....	3	7.2 DP83TG720 Registers.....	53
4.1 Pin States.....	6	<b>8 Application and Implementation</b> .....	162
4.2 Pin Power Domain.....	9	8.1 Application Information.....	162
<b>5 Specifications</b> .....	10	8.2 Typical Applications.....	162
5.1 Absolute Maximum Ratings.....	10	8.3 Power Supply Recommendations.....	162
5.2 ESD Ratings.....	10	8.4 Compatibility with TI's 100BT1 PHY .....	165
5.3 Recommended Operating Conditions.....	11	8.5 Layout.....	166
5.4 Thermal Information.....	11	<b>9 Device and Documentation Support</b> .....	169
5.5 Electrical Characteristics.....	11	9.1 Receiving Notification of Documentation Updates..	169
5.6 Timing Requirements.....	15	9.2 Support Resources.....	169
5.7 Timing Diagrams.....	19	9.3 Trademarks.....	169
5.8 LED Drive Characteristics.....	23	9.4 Electrostatic Discharge Caution.....	169
<b>6 Detailed Description</b> .....	24	9.5 Glossary.....	169
6.1 Overview.....	24	<b>10 Revision History</b> .....	169
6.2 Functional Block Diagram.....	25	<b>11 Mechanical, Packaging, and Orderable Information</b> .....	170
6.3 Feature Description.....	26		
6.4 Device Functional Modes.....	35		

## 4 Pin Configuration and Functions



**Figure 4-1. RHA Package  
 36-Pin VQFN  
 Top View**

Table 4-1. Pin Functions

PIN		STATE <sup>(1)</sup>	DESCRIPTION <sup>(2)</sup>
NAME	NO.		
<b>MAC INTERFACE</b>			
RX_D3 RX_M	23	S, PD, O	<b>Receive Data:</b> Symbols received on the cable are decoded and transmitted out of these pins synchronous to the rising edge of RX_CLK. Valid data is contained when RX_DV(decoded from RX_CTL) is asserted. A nibble, RX_D[3:0], is transmitted in RGMII mode. <b>RX_M / RX_P:</b> Differential SGMII Data Output. These pins transmit data from the PHY to the MAC.
RX_D2 RX_P	24		
RX_D1	25		
RX_D0	26		
RX_CLK	27	O	<b>Receive Clock:</b> In RGMII mode, PHY provides this 125MHz clock to MAC. <b>Unused in SGMII mode</b>
RX_CTRL	15	S, PD, O	<b>RGMII Receive Control:</b> Receive control combines receive data valid indication and receive error indication into a single signal. RX_DV is presented on the rising edge of RX_CLK and RX_ER is presented on the falling edge of RX_CLK. <b>Used only as strap in SGMII mode</b>
TX_CLK	28	I	<b>Transmit Clock:</b> In RGMII mode, MAC provides this 125MHz clock to PHY. <b>Unused in SGMII mode</b>
TX_CTRL	29	I	<b>RGMII Transmit Control:</b> Transmit control combines transmit enable and transmit error indication into a single signal. TX_EN is presented prior to the rising edge of TX_CLK; TX_ER is presented on the falling edge of TX_CLK. <b>Unused in SGMII mode</b>
TX_D3	30	I	<b>Transmit Data:</b> In RGMII mode, the transmit data nibble, TX_D[3:0], is received from the MAC . <b>TX_M / TX_P:</b> Differential SGMII Data Input. These pins receive data that is transmitted from the MAC to the PHY.
TX_D2	31		
TX_D1 TX_P	32		
TX_D0 TX_M	33		
<b>SERIAL MANAGEMENT INTERFACE</b>			
MDC	1	I	<b>Management Data Clock:</b> Synchronous clock to the MDIO serial management input and output data.
MDIO	36	OD, IO	<b>Management Data Input/Output:</b> Bidirectional management data signal that is sourced by either the management station or the PHY. This pin requires an external pull-up resistor to VDDIO (recommended value = 2.2kΩ) . MDIO/MDC Access is required to pass Open Alliance Compliance. See <a href="#">Section 6.3.2</a> .
<b>CONTROL INTERFACE</b>			
$\overline{\text{INT}}$	2	PU, OD, O	<b>Interrupt:</b> Active-LOW output, which is asserted LOW when an interrupt condition occurs. This pin has a weak internal pullup. Register access is necessary to enable various interrupt triggers. Once an interrupt event flag is set, register access is required to clear the interrupt event on this pin. This pin can be configured as an Active-HIGH output using register[0x0011]. To capture the interrupt source reliably, status from interrupt registers x12, x13, x18 is recommended to be read after interrupt is asserted on int_n pin.
$\overline{\text{RESET}}$	3	PU, I	<b>RESET:</b> Active-LOW input, which initializes or reinitializes the DP83TG720S-Q1. Asserting this pin LOW for at least 10μs forces a reset process to occur. All internal registers reinitialize to the default states as specified for each bit in the Register Map section. All bootstrap pins are resampled upon deassertion of reset.

**Table 4-1. Pin Functions (continued)**

PIN		STATE <sup>(1)</sup>	DESCRIPTION <sup>(2)</sup>
NAME	NO.		
INH	10	PMOS OD	<b>INH:</b> Active-HIGH PMOS open-drain output. When the PHY enters the sleep state, PHY releases the INH pin to allow an external pull-down resistor (recommended value = 10kΩ) to pull the line to ground. When in any other state, the INH pin drives a HIGH state to the VSLEEP rail.
WAKE	8	PD, I	<b>WAKE:</b> Active-HIGH (this pin works on VSLEEP domain) pulse on wake-up pin wakes up the PHY from the sleep state. For pulse width, refer to timing section. This pin can be directly tied to the VSLEEP rail when the sleep state is not used or left float.
STRP_1	14	I	<b>Strap 1:</b> This pin is for strapping PHY_AD bits.
<b>CLOCK INTERFACE</b>			
XI	5	I	<b>Reference Clock Input:</b> Reference clock 25MHz ±100ppm-tolerance crystal or oscillator input. The device supports either an external crystal resonator connected across pins XI and XO, or an external CMOS-level oscillator connected to pin XI only and XO left floating.
XO	4	O	<b>Reference Clock Output:</b> XO pin is used for crystal only. This pin is left floating when a CMOS-level oscillator is connected to XI.
<b>LED/GPIO INTERFACE</b>			
LED_0 / GPIO_0	35	S, PD, IO	<b>LED_0:</b> Link Status
LED_1 / GPIO_1	6	S, PD, IO	<b>LED_1:</b> Link Status and BLINK for TX/RX Activity
CLKOUT / GPIO_2	16	IO	<b>Clock Output:</b> 25MHz reference clock(buffered replication of XI) by default. If not used, clock output can be disabled by writing register 0x0453 = 0x0006.
<b>MEDIUM DEPENDENT INTERFACE</b>			
TRD_M	13	IO	<b>Differential Transmit and Receive:</b> Bidirectional differential signaling configured for 1000BASE-T1 operation, IEEE 802.3bp compliant.
TRD_P	12		
<b>POWER AND GROUND CONNECTIONS</b>			
VDDA3P3	11	SUPPLY	<b>Core Supply:</b> 3.3V. Refer to power supply recommendations for decoupling network.
VDDIO	22, 34	SUPPLY	<b>IO Supply:</b> 1.8V, 2.5V, or 3.3V. Refer to power supply recommendations for decoupling network.
VDD1P0	9, 21	SUPPLY	<b>Core Supply:</b> 1.0V. Refer to power supply recommendations for decoupling network.
VSLEEP	7	SUPPLY	<b>Sleep Supply:</b> 3.3V. Refer to power supply recommendations for decoupling network. This pin shall be tied to VDDA3P3 if sleep functionality is not used.
GROUND	DAP	GROUND	<b>Ground</b>
<b>DO NOT CONNECT</b>			
DNC	17, 18, 19, 20	DNC	<b>DNC:</b> Do Not Connect (test structures connected to these pins and must be kept floating to avoid damage or wrong mode entry of PHY)

- (1) Type: I = Input  
O = Output  
IO = Input/Output  
OD = Open Drain  
PD = Internal Pulldown  
PU = Internal Pullup  
S = Strap: Configuration pin (all configuration pins have weak internal pullups or pulldowns)

- (2) When pins are unused, follow the recommended connection requirements provided in the table above. The pins which do not have required termination can be left floating.

## 4.1 Pin States

Table 4-2. Pin States - RGMII

PIN NAME	POWER-UP / RESET			NORMAL OPERATION - RGMII		
	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)
MDC	I	none	-	I	none	-
INT_N	I	PU	9	OD	PU	9
RESET_N	I	PU	9	I	PU	9
XO	O	none	-	O	none	-
XI	I	none	-	I	none	-
LED_1	I	PD	9	O	none	-
WAKE	I	PD	50	I	PD	50
STRP_1	I	PD	6.3	I	none	-
INH	PMOS,OD,O	none	-	PMOS OD, O	none	-
RX_CTRL	I	PD	6.3	O	none	-
CLKOUT/GPIO_2	O	none	-	O	none	-
RX_D3	I	PD	9	O	none	-
RX_D2	I	PD	9	O	none	-
RX_D1	I	PD	9	O	none	-
RX_D0	I	PD	9	O	none	-
RX_CLK	I	PD	9	O	none	-
TX_CLK	I	none	-	I	none	-
TX_CTRL	I	none	-	I	none	-
TX_D3	I	none	-	I	none	-
TX_D2	I	none	-	I	none	-
TX_D1	I	none	-	I	none	-
TX_D0	I	none	-	I	none	-
LED_0	I	PD	9	O	none	-
MDIO	I	none	-	IO	none	-

- (1) Type: I = Input  
 O = Output  
 IO = Input/Output  
 OD = Open Drain  
 PD = Internal pulldown  
 PU = Internal pullup

**Table 4-3. Pin States - SGMII**

PIN NAME	POWER-UP / RESET			NORMAL OPERATION - SGMII		
	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)
MDC	I	none	-	I	none	-
INT_N	I	PU	9	OD	PU	9
RESET_N	I	PU	9	I	PU	9
XO	O	none	-	O	none	-
XI	I	none	-	I	none	-
LED_1	I	PD	9	O	none	-
WAKE	I	PD	50	I	PD	50
STRP_1	I	PD	6.3	I	none	-
INH	PMOS,OD,O	none	-	PMOS OD, O	none	-
RX_CTRL	I	PD	6.3	I	PD	6.3
CLKOUT/GPIO_2	O	none	-	O	none	-
RX_D3	I	PD	9	O	none	-
RX_D2	I	PD	9	O	none	-
RX_D1	I	PD	9	Hi-Z	PD	9
RX_D0	I	PD	9	Hi-Z	PD	9
RX_CLK	I	PD	9	Hi-Z	PD	9
TX_CLK	I	none	-	Hi-Z	none	-
TX_CTRL	I	none	-	Hi-Z	none	-
TX_D3	I	none	-	Hi-Z	none	-
TX_D2	I	none	-	Hi-Z	none	-
TX_D1	I	none	-	I	none	-
TX_D0	I	none	-	I	none	-
LED_0	I	PD	9	O	none	-
MDIO	I	none	-	IO	none	-

- (1) Type: I = Input  
O = Output  
IO = Input/Output  
OD = Open Drain  
PD = Internal pulldown  
PU = Internal pullup  
Hi-Z = High Impedence

**Table 4-4. Pin States - Sleep and Isolate**

PIN NAME	MAC ISOLATE			SLEEP		
	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)	PIN STATE <sup>(1)</sup>	PULL TYPE	PULL VALUE (kΩ)
MDC	I	none	-	Float	none	-
INT_N	O	PU	9	Float	none	-
RESET_N	I	PU	9	Float	none	-
XO	O	none	-	Float	none	-
XI	I	none	-	Float	none	-
LED_1	O	none	-	Float	none	-
WAKE	I	PD	50	I	none	50
STRP_1	I	none	-	Float	none	-
INH	PMOS,OD,O	none	-	PMOS OD, O	none	-
RX_CTRL	I	PD	6.3	Float	none	-
CLKOUT/GPIO_2	O	none	-	Float	none	-
RX_D3	I	PD/none <sup>(2)</sup>	9	Float	none	-
RX_D2	I	PD/none <sup>(2)</sup>	9	Float	none	-
RX_D1	I	PD	9	Float	none	-
RX_D0	I	PD	9	Float	none	-
RX_CLK	I	PD	9	Float	none	-
TX_CLK	I	none	-	Float	none	-
TX_CTRL	I	none	-	Float	none	-
TX_D3	I	none	-	Float	none	-
TX_D2	I	none	-	Float	none	-
TX_D1	I	none	-	Float	none	-
TX_D0	I	none	-	Float	none	-
LED_0	O	none	-	Float	none	-
MDIO	IO	none	-	Float	none	-

- (1) Type: I = Input  
 O = Output  
 IO = Input/Output  
 OD = Open Drain  
 PD = Internal pulldown  
 PU = Internal pullup  
 Hi-Z = High Impedence  
 Float = IO is not powered and hence pin is not biased by the PHY
- (2) PD only for Rgmii's isolate mode.

**Note**

For sleep mode entry vdda, vddio and vdd1p0 are supposed to be powered-down. See figure Required Implementation of Sleep Mode for further details.

## 4.2 Pin Power Domain

**Table 4-5. Pin Power Domain Table**

Input pins with external pull-up resistors should pull to the domain indicated in Table below

Pin	RGMII Mode	SGMII Mode
MDC	VDDIO	VDDIO
INT_N	VDDIO	VDDIO
RESET_N	VDDIO	VDDIO
XI	VDDIO	VDDIO
XO	VDDIO	VDDIO
LED_1	VDDIO	VDDIO
WAKE	VSLEEP	VSLEEP
STRP_1	VDDIO	VDDIO
INH	VSLEEP	VSLEEP
RX_CTRL	VDDIO	VDDIO
CLKOUT/GPIO_2	VDDIO	VDDIO
RX_D3	VDDIO	VDDA
RX_D2	VDDIO	VDDA
RX_D1	VDDIO	VDDIO
RX_D0	VDDIO	VDDIO
RX_CLK	VDDIO	VDDIO
TX_CLK	VDDIO	VDDIO
TX_CTRL	VDDIO	VDDIO
TX_D3	VDDIO	VDDIO
TX_D2	VDDIO	VDDIO
TX_D1	VDDIO	VDDA
TX_D0	VDDIO	VDDA
LED_0	VDDIO	VDDIO
MDIO	VDDIO	VDDIO
TRD_P	VDDA	VDDA
TRD_M	VDDA	VDDA

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	TYP	MAX	UNIT
Supply Voltage	VDDA3P3	-0.5		4	V
Supply Voltage	VDD1P0	-0.5		1.4	V
Supply Voltage	VDDIO (3.3V)	-0.5		4	V
Supply Voltage	VDDIO (2.5V)	-0.5		2.9	V
Supply Voltage	VDDIO (1.8V)	-0.5		2.2	V
Supply Voltage	V <sub>SLEEP</sub>	-0.5		4	V
MDI Pins	TRD_M, TRD_P	-0.5		4	V
LVC MOS/ LV TTL Input Voltage	MDC, RESET, XI, LED_1, STRP_1, RX_CTRL, CLKOUT, RX_D[3:0], TX_CLK, TX_CTRL, TX_D[3:0], LED_0, MDIO	-0.5		VDDIO + 0.3	V
LVC MOS/ LV TTL Input Voltage	WAKE	-0.5		V <sub>SLEEP</sub> + 0.3	V
LVC MOS/ LV TTL Output Voltage	INT, LED_1, RX_CTRL, CLKOUT, RX_D[3:0], RX_CLK, LED_0, MDIO	-0.5		VDDIO + 0.3	V
LVC MOS/ LV TTL Output Voltage	INH	-0.5		V <sub>SLEEP</sub> + 0.3	V
T <sub>J</sub>	Junction Temperature			150	°C
T <sub>stg</sub>	Storage temperature	-65		150	°C

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

### 5.2 ESD Ratings

				VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 <sup>(1)</sup>	All pins	±2000	V
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per AEC Q100-002 <sup>(1)</sup>	TRD_M, TRD_P	±8000	V
V <sub>(ESD)</sub>	Electrostatic discharge	Charged device model (CDM), per AEC Q100-011	All pins	±500	V
V <sub>(ESD)</sub>	Electrostatic discharge	IEC 61000-4-2 contact discharge	TRD_M, TRD_P	±8000	V

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
VDDIO	IO Supply Voltage, 1.8V operation	1.62	1.8	1.98	V
	IO Supply Voltage, 2.5V operation	2.25	2.5	2.75	
	IO Supply Voltage, 3.3V operation	2.97	3.3	3.63	
VDDA3P3	Core Supply Voltage, 3.3V	2.97	3.3	3.63	V
VDD1P0	Core Supply Voltage, 1.0V	0.95	1	1.1	V
V <sub>SLEEP</sub>	Sleep Supply Voltage, 3.3V	2.97	3.3	3.63	V
T <sub>A</sub>	Ambient temperature	-40		125	°C

### 5.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		DP83TG720	UNIT
		RHA (VQFN)	
		36 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	32.5	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	22.2	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	13.3	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	0.3	°C/W
Ψ <sub>JB</sub>	Junction-to-board characterization parameter	13.3	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case (bottom) thermal resistance	3.2	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics application note](#).

### 5.5 Electrical Characteristics

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DC CHARACTERISTICS						
XI						
V <sub>IH</sub>	High-level Input Voltage		1.3			V
V <sub>IL</sub>	Low-level Input Voltage				0.5	V
WAKE pin	WAKE pin	WAKE pin	WAKE pin	WAKE pin	WAKE pin	WAKE pin
V <sub>IH</sub>	High-level Input Voltage	V <sub>SLEEP</sub> = 3.3V ± 10%	2			V
V <sub>IL</sub>	Low-level Input Voltage	V <sub>SLEEP</sub> = 3.3V ± 10%			0.8	V
INH pin	INH pin	INH pin	INH pin	INH pin	INH pin	INH pin
V <sub>OH</sub>	High-level Output Voltage	I <sub>OH</sub> = -2mA, V <sub>SLEEP</sub> = 3.3V ± 10%	2.4			V
3.3V VDDIO <sup>(2)</sup>						
V <sub>OH</sub>	High-level Output Voltage	I <sub>OH</sub> = -2mA, VDDIO = 3.3V ± 10%	2.4			V
V <sub>OL</sub>	Low-level Output Voltage	I <sub>OL</sub> = 2mA, VDDIO = 3.3V ± 10%			0.4	V
V <sub>IH</sub>	High-level Input Voltage	VDDIO = 3.3V ± 10%	2			V
V <sub>IL</sub>	Low-level Input Voltage	VDDIO = 3.3V ± 10%			0.8	V
2.5V VDDIO <sup>(2)</sup>						
V <sub>OH</sub>	High-level Output Voltage	I <sub>OH</sub> = -2mA, VDDIO = 2.5V ± 10%	2			V
V <sub>OL</sub>	Low-level Output Voltage	I <sub>OL</sub> = 2mA, VDDIO = 2.5V ± 10%			0.4	V
V <sub>IH</sub>	High-level Input Voltage	VDDIO = 2.5V ± 10%	1.7			V

## 5.5 Electrical Characteristics (continued)

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V <sub>IL</sub>	Low-level Input Voltage	VDDIO = 2.5V ± 10%			0.7	V
1.8V VDDIO <sup>(2)</sup>						
V <sub>OH</sub>	High-level Output Voltage	I <sub>OH</sub> = -2mA, VDDIO = 1.8V ± 10%	VDDIO – 0.45			V
V <sub>OL</sub>	Low-level Output Voltage	I <sub>OL</sub> = 2mA, VDDIO = 1.8V ± 10%			0.45	V
V <sub>IH</sub>	High-level Input Voltage	VDDIO = 1.8V ± 10%	0.7 * VDDIO			V
V <sub>IL</sub>	Low-level Input Voltage	VDDIO = 1.8V ± 10%			0.3 * VDDIO	V
I <sub>IH</sub>	Input High Current (MDIO)	VIN = VCC, -40°C to 125°C	-5		5	µA
I <sub>IH</sub>	Input High Current (RGMII Input pin, MDC)	VIN = VCC, -40°C to 125°C	-20		20	µA
I <sub>OZ</sub>	Input High Current (MDIO)	VIN swept from 0V till VCC, -40°C to 125°C	-40		40	µA
I <sub>IL</sub>	Input Low Current (RGMII Input pin, MDC, MDIO)	VIN = GND, -40°C to 125°C	-40		5	µA
I <sub>OZL</sub>		INH			6	µA
I <sub>OZ</sub>	Tri-state Output Current <sup>(5)</sup>	VIN swept from 0V till VCC, -40°C to 125°C	-40		10	µA
I <sub>OZ</sub>	Tri-state Output Current <sup>(6)</sup>	VIN swept from 0V till VCC, -40°C to 125°C	-60		60	µA
C <sub>IN</sub>	Input Capacitance	LVCOS/LVTTL pins <sup>(3)</sup>			2	pF
C <sub>IN</sub>	Input Capacitance	LVCOS/LVTTL pins <sup>(4)</sup>			4	pF
		XI			1	pF
C <sub>OUT</sub>	Output Capacitance	LVCOS/LVTTL pins <sup>(3)</sup>			2	pF
C <sub>OUT</sub>	Output Capacitance	LVCOS/LVTTL pins <sup>(4)</sup>			4	pF
		XO			1	pF
R <sub>pull-up</sub>	Integrated Pull-Up Resistance	INT, RESET	6.5	9	12.5	kΩ
R <sub>pull-down</sub>	Integrated Pull-Down Resistance	STRP_1, RX_CTRL	4.725	6.3	7.875	kΩ
R <sub>pull-down</sub>	Integrated Pull-Down Resistance	LED_1, RX_D[3:0], RX_CLK, LED_0	7.3	9	13	kΩ
		WAKE	35	50	62.5	kΩ
R <sub>pull-down</sub>	Integrated Pull-Up Resistance when Active	INH		106		Ω
R <sub>series</sub>	Integrated MAC Series Termination Resistor ( Default)	RX_D[3:0], RX_CTRL, and RX_CLK	24	42	52	Ω
R <sub>series</sub>	Integrated MAC Series Termination Resistor (with register<0x0456> = 0x0148)	RX_D[3:0], RX_CTRL, and RX_CLK	30	52	65	Ω
R <sub>series</sub>	Integrated MAC Series Termination Resistor (with register<0x0456> = 0x0168)	RX_D[3:0], RX_CTRL, and RX_CLK	40	70	84	Ω
CURRENT CONSUMPTION, SLEEP MODE						
I <sub>SLEEP</sub>	Sleep Supply Current	V <sub>SLEEP</sub>		485	840	µA
CURRENT CONSUMPTION, RESET ASSERTED						
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 1.8V	VDDIO		4	9	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 2.5V	VDDIO		5	12	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 3.3V	VDDIO		6.5	15	mA
I <sub>DDA3P3</sub>	Core Supply Current, 3.3V	VDDA3P3		5	8	mA

## 5.5 Electrical Characteristics (continued)

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I <sub>DD1P0</sub>	Core Supply Current, 1.0V	VDD1P0		30	110	mA
CURRENT CONSUMPTION, STANDBY						
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 1.8V	VDDIO		4	11	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 2.5V	VDDIO		6	13	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 3.3V	VDDIO		8	15	mA
I <sub>DDA3P3</sub>	Core Supply Current, 3.3V	VDDA3P3		16	18	mA
I <sub>DD1P0</sub>	Core Supply Current, 1.0V	VDD1P0		33	112	mA
CURRENT CONSUMPTION, ACTIVE MODE, Voltage: +/- 10%, Traffic : 100%,Packet Size: 1518, Content : Random						
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 1.8V	RGMII		20	25	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 2.5V	RGMII		26	30	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 3.3V	RGMII		33	40	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 1.8V	SGMII		3.5	5	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 2.5V	SGMII		5	7	mA
I <sub>DDIO</sub>	IO Supply Current, VDDIO = 3.3V	SGMII		6.5	8	mA
I <sub>DDA3P3</sub>	Core Supply Current, 3.3V	RGMII		85	89	mA
I <sub>DD1P0</sub>	Core Supply Current, 1.0V	RGMII		177	250	mA
I <sub>DDA3P3</sub>	Core Supply Current, 3.3V	SGMII		95	100	mA
I <sub>DD1P0</sub>	Core Supply Current, 1.0V	SGMII		200	260	mA
I <sub>SLEEP</sub>	Sleep Supply Current	V <sub>SLEEP</sub> = 3.3V +/- 10%		1000	1500	µA
MDI CHARACTERISTICS						
V <sub>OD-MDI</sub>	Output Differential Voltage	R <sub>L(diff)</sub> = 100 Ω			1.3	V
R <sub>MDI-DIFF</sub>	Integrated Differential MDI Termination (Active State)	TRD_P, TRD_M		100		Ω
R <sub>MDI-DIFF</sub>	Integrated Differential MDI Termination (Sleep State)	TRD_P, TRD_M		100		Ω
SGMII DRIVER DC SPECIFICATIONS						
V <sub>OD-SGMII</sub>	Output Differential Voltage	R <sub>L(diff)</sub> = 100 Ω	150		400	mV
R <sub>OUT-DIFF</sub>	Integrated Differential Output Termination	RX_P, RX_M	78	100	130	Ω
SGMII RECEIVER DC SPECIFICATIONS						
V <sub>IDTH</sub>	Input Differential Threshold		100			mV
R <sub>IN-DIFF</sub>	Integrated Differential Input Termination	TX_P, TX_M	82	100	121	Ω
BOOTSTRAP DC CHARACTERISTICS						
2 level straps						
V <sub>bsl_1v8</sub>	Bootstrap Threshold	Mode 1, VDDIO = 1.8V ± 10%, 2-level	0	0.35*V <sub>DIO</sub>		V
V <sub>bsh_1v8</sub>	Bootstrap Threshold	Mode 2, VDDIO = 1.8V ± 10%, 2-level	1.175	VDDIO		V
V <sub>bsl_2v5</sub>	Bootstrap Threshold	Mode 1, VDDIO = 2.5V ± 10%, 2-level	0	0.7		V
V <sub>bsh_2v5</sub>	Bootstrap Threshold	Mode 2, VDDIO = 2.5V ± 10%, 2-level	1.175	VDDIO		V
V <sub>bsl_3v3</sub>	Bootstrap Threshold	Mode 1, VDDIO = 3.3V ± 10%, 2-level	0	0.7		V
V <sub>bsh_3v3</sub>	Bootstrap Threshold	Mode 2, VDDIO = 3.3V ± 10%, 2-level	1.175	VDDIO		V
3 level straps						

## 5.5 Electrical Characteristics (continued)

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V <sub>bs1_1V8</sub>	Bootstrap Threshold	Mode 1, VDDIO = 1.8V ± 10%, 3-level	0		0.35 * VDDIO	V
V <sub>bs2_1V8</sub>	Bootstrap Threshold	Mode 2, VDDIO = 1.8V ± 10%, 3-level	0.40 * VDDIO		0.75 * VDDIO	V
V <sub>bs3_1V8</sub>	Bootstrap Threshold	Mode 3, VDDIO = 1.8V ± 10%, 3-level	0.84 * VDDIO		VDDIO	V
V <sub>bs1_2V5</sub>	Bootstrap Threshold	Mode 1, VDDIO = 2.5V ± 10%, 3-level	0		0.19 * VDDIO	V
V <sub>bs2_2V5</sub>	Bootstrap Threshold	Mode 2, VDDIO = 2.5V ± 10%, 3-level	0.27 * VDDIO		0.41 * VDDIO	V
V <sub>bs3_2V5</sub>	Bootstrap Threshold	Mode 3, VDDIO = 2.5V ± 10%, 3-level	0.58 * VDDIO		VDDIO	V
V <sub>bs1_3V3</sub>	Bootstrap Threshold	Mode 1, VDDIO = 3.3V ± 10%, 3-level	0		0.18 * VDDIO	V
V <sub>bs2_3V3</sub>	Bootstrap Threshold	Mode 2, VDDIO = 3.3V ± 10%, 3-level	0.22 * VDDIO		0.42 * VDDIO	V
V <sub>bs3_3V3</sub>	Bootstrap Threshold	Mode 3, VDDIO = 3.3V ± 10%, 3-level	0.46 * VDDIO		VDDIO	V
Temperature Sensor						
	Temperature Sensor Resolution (LSB)	-40°C to 125°C		1.5		°C
	Temperature Sensor Accuracy ( Voltage and Temperature Variation on single part)	-40°C to 125°C	-7.5		7.5	°C
	Temperature Sensor Accuracy ( Voltage, Temperature and Part-to-Part variation)	-40°C to 125°C	-21.5		20	°C
	Temperature Sensor Range		-40		140	°C
Voltage Sensor						
	VDDA3P3 Sensor Range		2.66	3.3	3.96	V
	VDDA3P3 Sensor Resolution (LSB)	-40°C to 125°C		8.6		mV
	VDDA3P3 Sensor Accuracy ( Voltage and Temperature Variation)	-40°C to 125°C		8.6		mV
	VDDA3P3 Sensor Accuracy Part-to-Part	-40°C to 125°C	-68.8		68.8	mV
	VDD1P0 Sensor Range		0.8		1.2	V
	VDD1P0 Sensor Resolution (LSB)	-40°C to 125°C		2.8		mV
	VDD1P0 Sensor Accuracy ( Voltage and Temperature Variation)	-40°C to 125°C		2.8		mV
	VDD1P0 Sensor Accuracy Part-to-Part	-40°C to 125°C	-22.4		22.4	mV
	VDDIO Sensor Range		1.44		3.8	V
	VDDIO Sensor Resolution (LSB)	-40°C to 125°C		15.4		mV
	VDDIO Sensor Accuracy ( Voltage and Temperature Variation)	-40°C to 125°C		15.4		mV
	VDDIO Sensor Accuracy Part-to-Part	-40°C to 125°C	-78		78	mV

(1) Verified by production test, characterization or design

(2) For pins: LED\_1, STRP\_1, RX\_CTRL, CLKOUT, RX\_D[3:0], RX\_CLK, LED\_0

(3) For pins: MDC, INT, RESET, LED\_1, STRP\_1, RX\_CTRL, CLKOUT, RX\_D0, RX\_D1, RX\_CLK, TX\_CLK, TX\_CTRL, TX\_D2, TX\_D3, LED\_0, and MDIO

(4) For pins: TX\_D0, TX\_D1, RX\_D2, and RX\_D3

(5) For pins: LED\_1, RX\_D[3:0], RX\_CLK, LED\_0

(6) For pins: STRP\_1 and RX\_CTRL

## 5.6 Timing Requirements

(1)

PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
<b>POWER-UP TIMING</b>						
T5.1	VDDA3P3 Ramp Duration <sup>(2)</sup>	0% to 100% (+/- 10% VDDA3P3)	0.5		40	ms
T5.2	VDD1P0 Ramp Duration <sup>(2)</sup>	0% to 100% (+/- 10% VDD1P0)	0.1		40	ms
T5.2	VDDIO Ramp Duration <sup>(2)</sup>	VDDIO = 1.8V	0.1		40	ms
T5.2	VDDIO Ramp Duration <sup>(2)</sup>	VDDIO = 2.5V	0.1		40	ms
T5.2	VDDIO Ramp Duration <sup>(2)</sup>	VDDIO = 3.3V	0.1		40	ms
T5.2	V <sub>SLEEP</sub> Ramp Duration <sup>(2)</sup>	0% to 100% (+/- 10% V <sub>SLEEP</sub> )	0.1		40	ms
T5.3	Crystal stabilization-time post power-up (from last power rail ramp to 100%)			1500		µs
T5.4	Oscillator stabilization-time post power-up ( from last power rail ramp to 100%) <sup>(3)</sup>				20	ms
T5.5	Post power-up stabilization-time prior to MDC preamble for register access		65			ms
T5.6	Hardware configuration latch-in time from power-up				60	ms
T5.7	Hardware configuration pins transition to functional mode from latch-in completion				110	ns
T5.8	PAM3 IDLE Stream from power-up (Master Mode)				60	ms
<b>RESET TIMING (RESET_N)</b>						
T6.1	RESET pulse width		5			µs
T6.2	Post reset stabilization-time prior to MDC preamble for register access		1			ms
T6.3	Hardware configuration latch-in time from reset				2	µs
T6.4	Hardware configuration pins transition to functional mode from latch-in completion				1.5	µs
T6.5	PAM3 IDLE Stream from reset (Master Mode)				1500	µs
<b>SMI TIMING</b>						
T4.1	MDC to MDIO (Output) Delay Time (25pF load)		0	6	10	ns
T4.2	MDIO (Input) to MDC Setup Time		10			ns
T4.3	MDIO (Input) to MDC Hold Time		10			ns
	MDC Frequency ( 25pF load)			2.5	20	MHz
<b>RECEIVE LATENCY TIMING</b>						
	SSD symbol on MDI to Rising edge of RGMII RX_CLK with assertion of RX_CTRL				8	µs
	SSD symbol on MDI to Rising edge of RGMII RX_CLK with assertion of RX_CTRL (RS-FEC bypass mode)				400	ns
	SSD symbol on MDI to first symbol of SGMII				9	µs
	SSD symbol on MDI to first symbol of SGMII (RS-FEC bypass mode)				450	ns
<b>TRANSMIT LATENCY TIMING</b>						
	RGMII Rising edge TX_CLK with assertion TX_CTRL to SSD symbol on MDI				0.8	µs
	RGMII Rising edge TX_CLK with assertion TX_CTRL to SSD symbol on MDI (RS-FEC bypass mode)				600	ns
	First symbol of SGMII to SSD symbol on MDI				0.9	µs

## 5.6 Timing Requirements (continued)

(1)

PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
	First symbol of SGMII to SSD symbol on MDI (RS-FEC bypass mode)				700	ns
<b>25MHz OSCILLATOR REQUIREMENTS</b>						
	Frequency (XI)			25		MHz
	Frequency Tolerance and Stability Over temperature and aging		-100		100	ppm
	Rise / Fall Time (10% - 90%) <sup>(6)</sup>				8	ns
	Jitter (RMS)	Integrated upto 5MHz			1	ps
	Duty Cycle		40	50	60	%
<b>RGMII TIMING</b>						
T <sub>setupR</sub>	TX_D[3:0], TX_CTRL Setup to TX_CLK	on PHY pins	1	2		ns
T <sub>holdR</sub>	TX_D[3:0], TX_CTRL Hold from TX_CLK <sup>(5)</sup>	on PHY pins	1	2		ns
T <sub>skewT</sub>	RX_D[3:0], RX_CTRL Delay from RX_CLK (Align Mode Enabled)	On PHY Pins	-500	0	500	ps
T <sub>skewT (Shift)</sub>	RX_D[3:0], RX_CTRL Delay from RX_CLK (Shift Mode Enabled, default) <sup>(4)</sup>	On PHY Pins	2.190	2.650	2.970	ns
T <sub>cyc</sub>	Clock Cycle Duration	RX_CLK	7.2	8	8.8	ns
T <sub>cyc</sub>	Clock Cycle Duration	TX_CLK	7.2	8	8.8	ns
Duty_G	Duty Cycle	RX_CLK	45	50	55	%
Duty_G	Duty Cycle	TX_CLK	45	50	55	%
Tr	Rise Time (20% - 80%)	CL=Ctrace=5pF			0.75	ns
Tf	Fall Time (20% - 80%)	C <sub>L</sub> =Ctrace = 5pF			0.75	ns
RGMII RX Shift Mode Delays	DLL_DLL_RX_DELAY_CTRL_SL=0 <sup>(4)</sup>		0.330	0.650	0.970	ns
	DLL_DLL_RX_DELAY_CTRL_SL=1 <sup>(4)</sup>		0.580	0.900	1.220	ns
	DLL_DLL_RX_DELAY_CTRL_SL=2 <sup>(4)</sup>		0.830	1.150	1.470	ns
	DLL_DLL_RX_DELAY_CTRL_SL=3 <sup>(4)</sup>		1.000	1.400	1.720	ns
	DLL_DLL_RX_DELAY_CTRL_SL=4 <sup>(4)</sup>		1.230	1.650	1.970	ns
	DLL_DLL_RX_DELAY_CTRL_SL=5 <sup>(4)</sup>		1.490	1.990	2.220	ns
	DLL_DLL_RX_DELAY_CTRL_SL=6 <sup>(4)</sup>		1.690	2.150	2.470	ns
	DLL_DLL_RX_DELAY_CTRL_SL=7 <sup>(4)</sup>		1.960	2.400	2.730	ns
	DLL_DLL_RX_DELAY_CTRL_SL=8 <sup>(4)</sup>		2.180	2.650	2.970	ns
	DLL_DLL_RX_DELAY_CTRL_SL=9 <sup>(4)</sup>		2.490	2.900	3.220	ns
RGMII Shift TX Mode Delays						
	DLL_DLL_TX_DELAY_CTRL_SL=1 <sup>(4) (8)</sup>		0.08	0.25	0.38	ns
	DLL_DLL_TX_DELAY_CTRL_SL=2 <sup>(4) (8)</sup>		0.27	0.49	0.67	ns
	DLL_DLL_TX_DELAY_CTRL_SL=3 <sup>(4) (8)</sup>		0.51	0.73	0.91	ns
	DLL_DLL_TX_DELAY_CTRL_SL=4 <sup>(4) (8)</sup>		0.75	0.97	1.15	ns
	DLL_DLL_TX_DELAY_CTRL_SL=5 <sup>(4) (8)</sup>		0.94	1.21	1.44	ns
	DLL_DLL_TX_DELAY_CTRL_SL=6 <sup>(4) (8)</sup>		1.18	1.45	1.68	ns
	DLL_DLL_TX_DELAY_CTRL_SL=7 <sup>(4) (8)</sup>		1.37	1.69	1.98	ns

## 5.6 Timing Requirements (continued)

(1)

PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
	DLL_DLL_TX_DELAY_CTRL_SL=8 <sup>(4)</sup> <sup>(8)</sup>		1.61	1.93	2.22	ns
	DLL_DLL_TX_DELAY_CTRL_SL=9 <sup>(4)</sup> <sup>(8)</sup>		1.85	2.17	2.46	ns
	DLL_DLL_TX_DELAY_CTRL_SL=10 <sup>(4)</sup> <sup>(8)</sup>		2.04	2.42	2.75	ns
	DLL_DLL_TX_DELAY_CTRL_SL=11 <sup>(4)</sup> <sup>(8)</sup>		2.28	2.65	2.99	ns
	DLL_DLL_TX_DELAY_CTRL_SL=12 <sup>(4)</sup> <sup>(8)</sup>		2.52	2.9	3.23	ns
<b>SGMII TRANSMITTER AC TIMING</b>						
	Clock signal duty cycle at 625MHz		48		52	%
T <sub>rise</sub>	Vod Rise Time		100		200	ps
T <sub>fall</sub>	Vod Fall Time		100		200	ps
Jitter	Output jitter			200	320 <sup>(7)</sup>	ps
<b>25MHz CRYSTAL REQUIREMENTS</b>						
	Frequency			25		MHz
	Frequency Tolerance and Stability Over temperature and aging		-100		100	ppm
	Equivalent Series Resistance				100	Ω
<b>OUTPUT CLOCK TIMING (CLKOUT)</b>						
	Frequency			25		MHz
	Duty Cycle ( With crystal attached)		45		55	%
	Rise / Fall Time (10% - 90%)				2.5	ns
	Jitter (RMS) (Slave Mode, MAC linterface : SGMII)				5	ps
	Jitter (RMS) (Master Mode, MAC linterface : SGMII)				2.4	ps
	Jitter (RMS) (Slave Mode, MAC Interface : RGMII)				11	ps
	Jitter (RMS) (Master Mode, MAC Interface : RGMII)				15	ps
<b>Sleep Entry and Wake-Up</b>						
	WAKE LOW to Sleep Entry; INH Transition LOW	Normal Mode, MDI_Energy = FALSE sleep_en = TRUE		64	85	us
	sleep_en = True to Sleep Entry; INH Transition LOW (master mode)	Normal Mode, WAKE = LOW, MDI_Energy = FALSE		5	85	us
	sleep_en = True to Sleep Entry; INH Transition LOW (slave mode)	Normal Mode, WAKE = LOW, MDI_Energy = FALSE			5000	us
	MDI Energy Loss to Sleep Entry; INH Transition LOW	Normal Mode, WAKE = LOW, sleep_en = TRUE			5	ms
	Local Wake-Up Pulse Duration (on Wake pin)	Sleep Mode, WAKE pin	80			μs
	Send-S/Send-T pattern duration for wake up from MDI	Sleep Mode, Slave	1.25			ms
	Local Wake-Up; INH Transition HIGH	Sleep Mode, rising edge of WAKE pin to rising edge of INH			85	us
	Tolerable differential noise level on MDI for PHY to stay in sleep mode	Sleep Mode			200	mV pk-pk

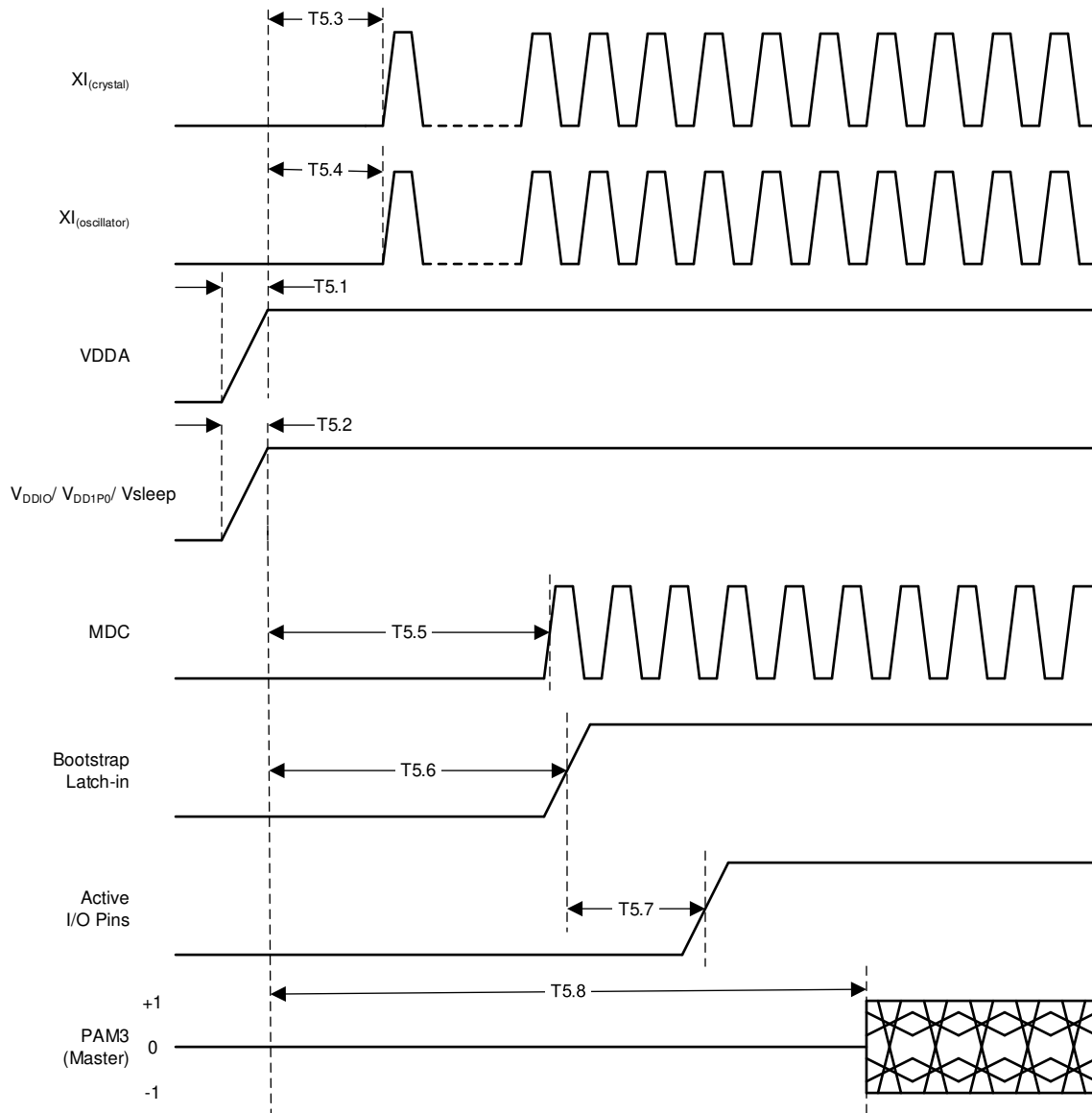
## 5.6 Timing Requirements (continued)

(1)

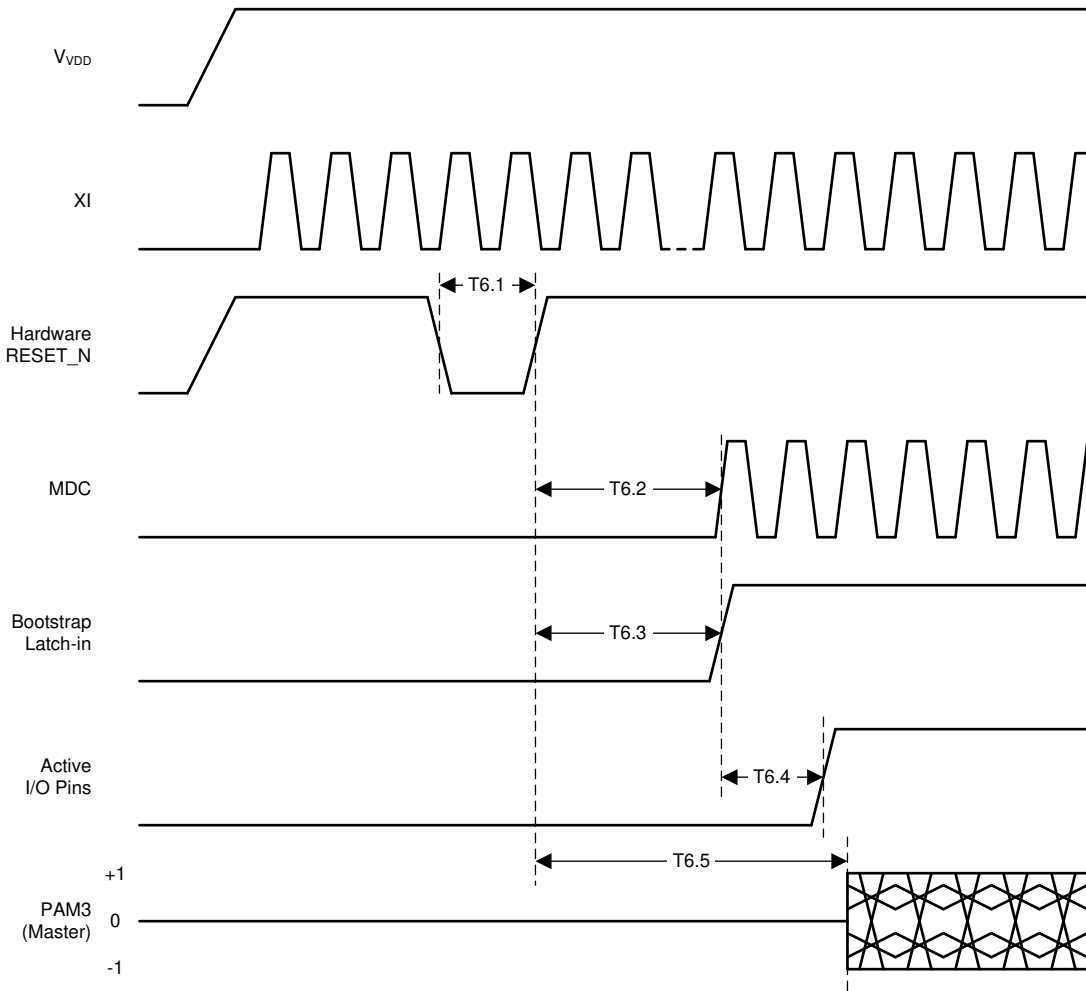
PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
	Link-partner's VOD for valid wake-up (for 5m cable)	Sleep Mode	840			mV pk-pk

- (1) Verified by production test or characterization or design.
- (2) No supply sequencing constraint across power rails
- (3) In case OSC clock is delayed, additional reset is needed post Osc clock stabilisation
- (4) Refer register[0x0430] for programmability of RX and TX delay codes
- (5) PHY provides internal delays on TX\_CLK to TX\_D[3:0] to add additional skew upto 2ns. Refer to register[0x0430] for programmability
- (6) Max rise/fall time of 8ns is supported for duty cycle of 40% to 55%. Max rise/fall time of 6ns is supported for duty cycle of 40% to 60%
- (7) Additional register configuration available to reduce this max number to 300ps (if required)
- (8) Data for 1.8V VDDIO.

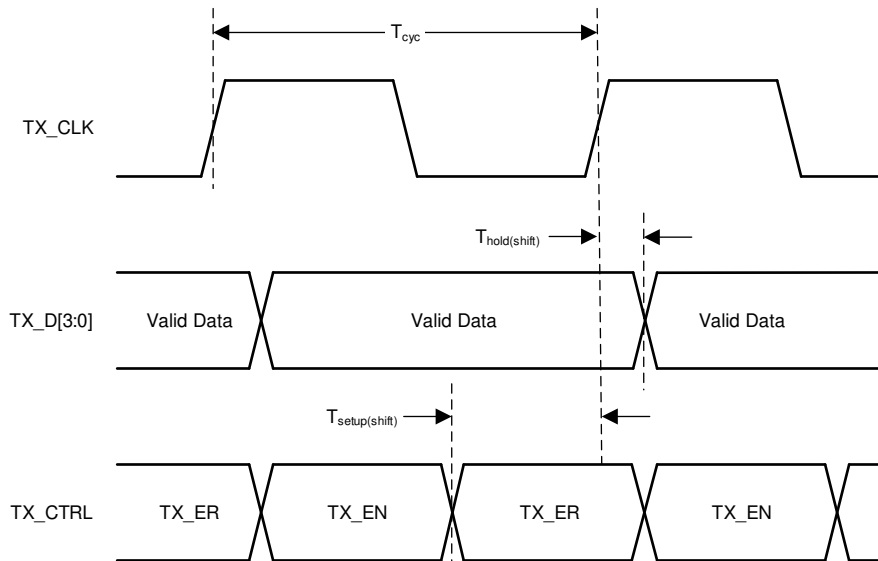
## 5.7 Timing Diagrams



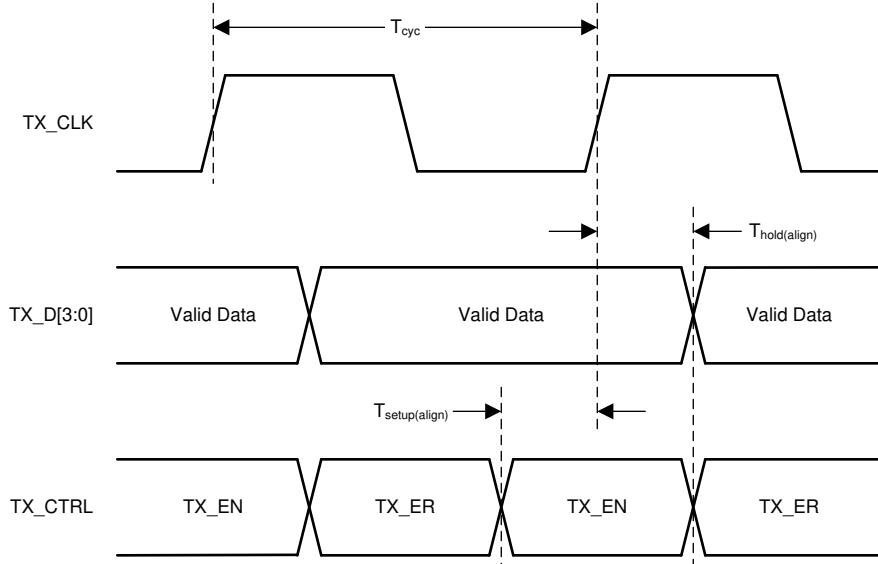
**Figure 5-1. Power Up Timing**



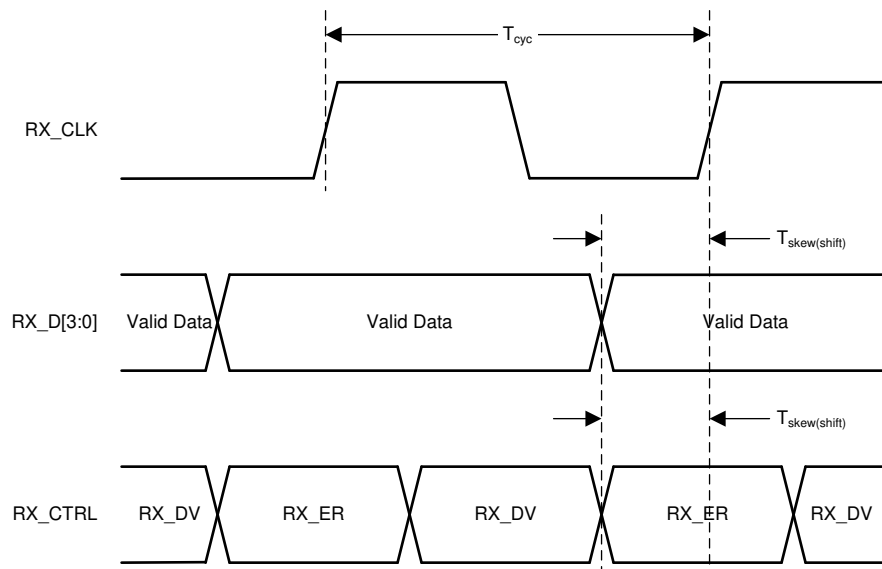
**Figure 5-2. Reset Timing**



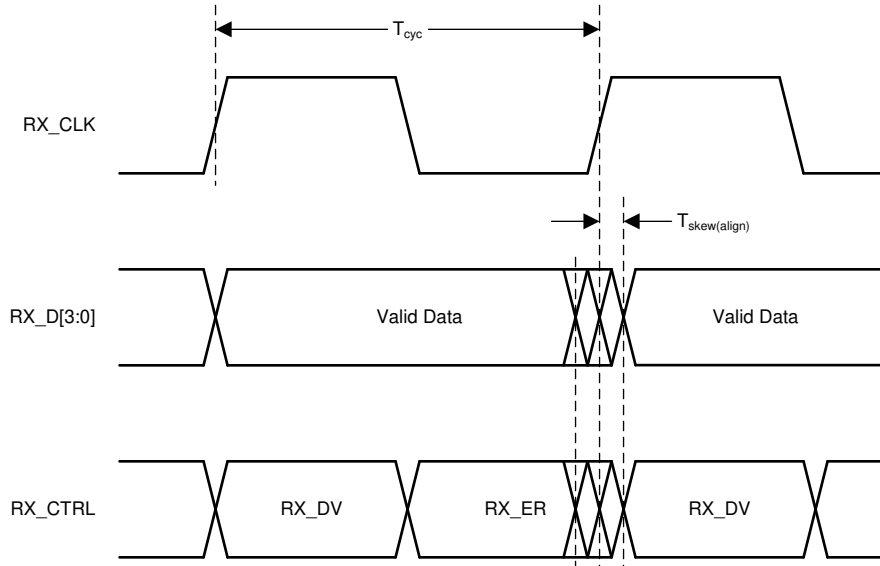
**Figure 5-3. RGMII Transmit Timing (Internal Delay Enabled)**



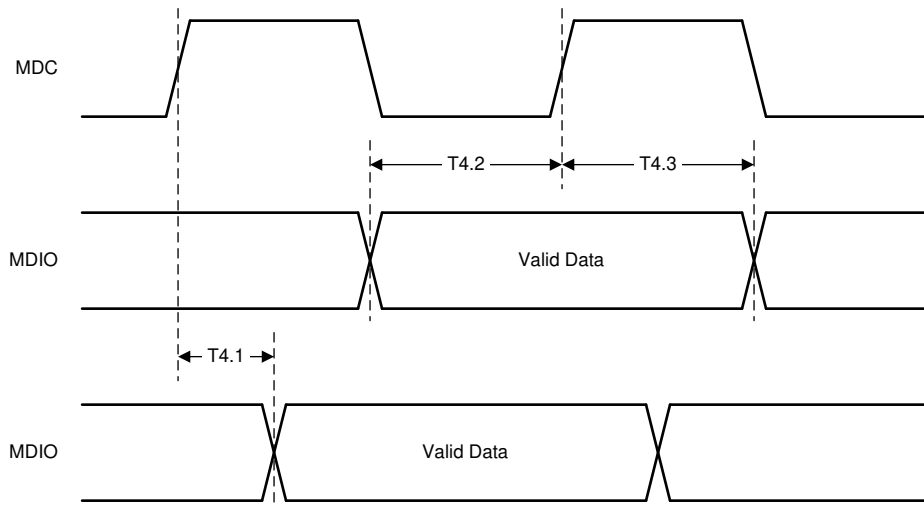
**Figure 5-4. RGMII Transmit Timing (Internal Delay Disabled)**



**Figure 5-5. RGMII Receive Timing (Internal Delay Enabled)**

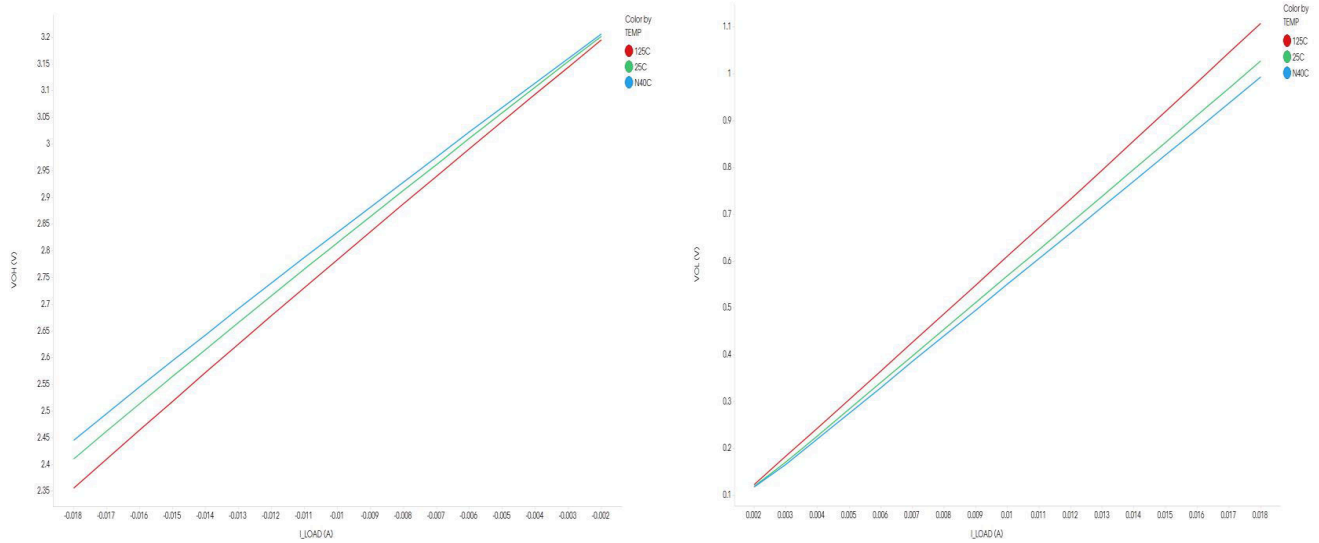


**Figure 5-6. RGMII Receive Timing (Internal Delay Disabled)**

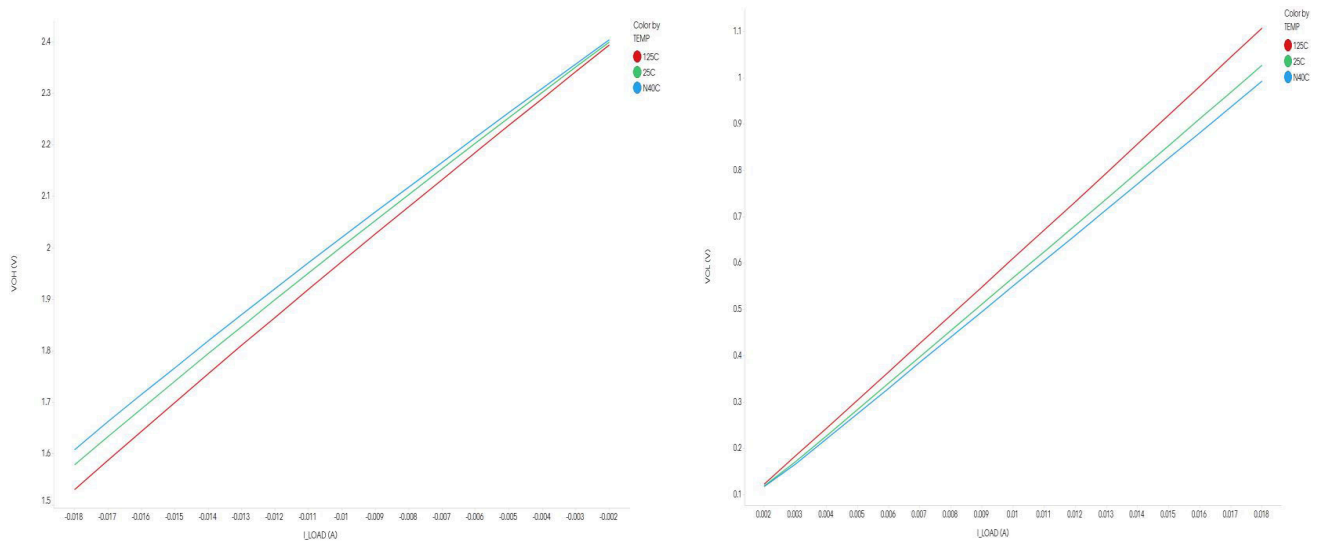


**Figure 5-7. Serial Management Timing**

## 5.8 LED Drive Characteristics



**Figure 5-8. LED V vs I for 3.3V VDDIO**



**Figure 5-9. LED V vs I for 2.5V VDDIO**

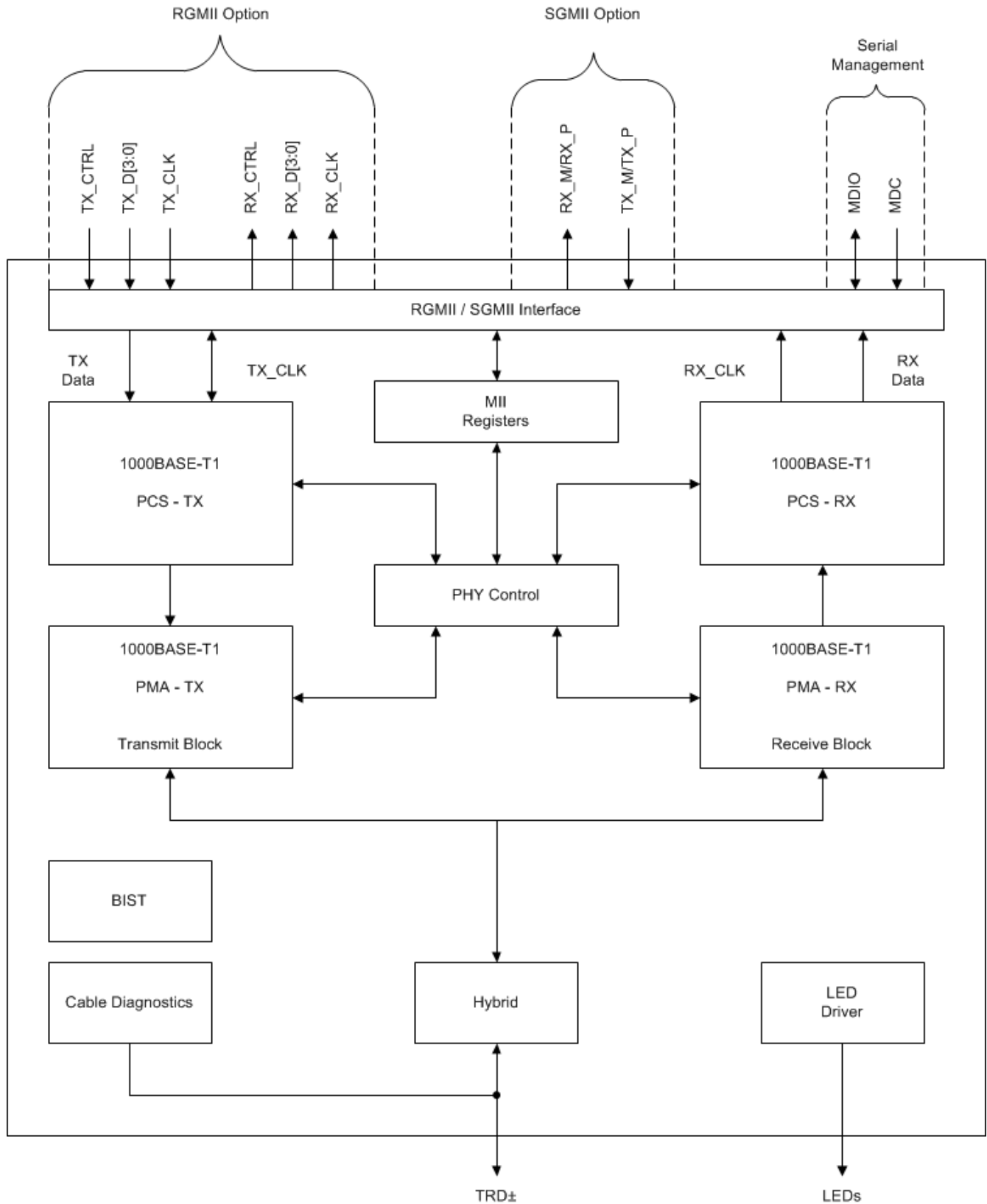
## 6 Detailed Description

### 6.1 Overview

The DP83TG720S-Q1 is a 1000BASE-T1 automotive Ethernet Physical Layer transceiver. It is IEEE 802.3bp compliant and AEC-Q100 qualified for automotive applications.

This device is specifically designed to operate at 1Gbps speed while meeting stringent automotive EMC requirements. The DP83TG720S-Q1 transmits PAM3 ternary symbols at 750-MBd over unshielded/shielded single-twisted pair cable. It is designed for RGMII or SGMII support in a single 36-pin VQFN wettable flank package.

## 6.2 Functional Block Diagram



**Figure 6-1. DP83TG720S-Q1 Functional Block Diagram**

## 6.3 Feature Description

### 6.3.1 Diagnostic Tool Kit

The DP83TG720S-Q1 diagnostic tool kit provides mechanisms for monitoring normal operation, device-level debugging, system-level debugging, fault detection, and compliance testing. This tool kit includes a built-in self-test with PRBS data, various loopback modes, Signal Quality Indicator (SQI), Time Domain Reflectometry (TDR), voltage monitor, temperature monitor, electrostatic discharge monitor, and IEEE 802.3bp test modes.

#### 6.3.1.1 Signal Quality Indicator

When the DP83TG720S-Q1 is active, the Signal Quality Indicator can be used to determine the quality of link based on SNR readings made by the device.

SQI is derived based on the calculated SNR value and is presented as 8 level indication, where level of 5 provides a BER better than  $10^{-10}$ .

---

#### Note

Refer to [DP83TG720: Configuring for Open Alliance Specification Compliance](#) application note for details on using SQI register for Open Alliance TC12 SQI tests.

---

#### 6.3.1.2 Time Domain Reflectometry

Time domain reflectometry helps detecting and estimating the location of OPEN and SHORT faults along a cable.

TDR is activated by setting bit[15] = 'b1 in the register[0x001E]. When TDR diagnostic process gets completed successfully, Bit[1:0] of register[0x001E] becomes 'b10. After this status change, TDR results can be read in the register of following table.

**Table 6-1. TDR Result Registers : 0x030F**

Register Bits	Description
[1:0]	<ul style="list-style-type: none"> <li>01 = TDR Activation</li> <li>10 = TDR On</li> <li>00,11 = TDR Not Available</li> </ul>
[3:2]	Reserved
[7:4]	<ul style="list-style-type: none"> <li>0011 = Short</li> <li>0110 = Open</li> <li>0101 = Noise</li> <li>0111 = Cable OK</li> <li>1000 = Test in progress; initial value with TDR ON</li> <li>1101 = Test not possible (for example, noise, active link)</li> <li>Other values are not valid</li> </ul>
[13:8]	<ul style="list-style-type: none"> <li>Fault distance = Value in decimal of [13:8]</li> <li>'b1111111 = Resolution not possible/out of distance</li> </ul>
[15:14]	Reserved

---

#### Note

TDR must not be run if the link is already active. Running TDR on active line can make TDR fail and also can result in disruption of link.

Refer to [DP83TG720: Configuring for Open Alliance Specification Compliance](#) application note for detailed procedure of running TDR.

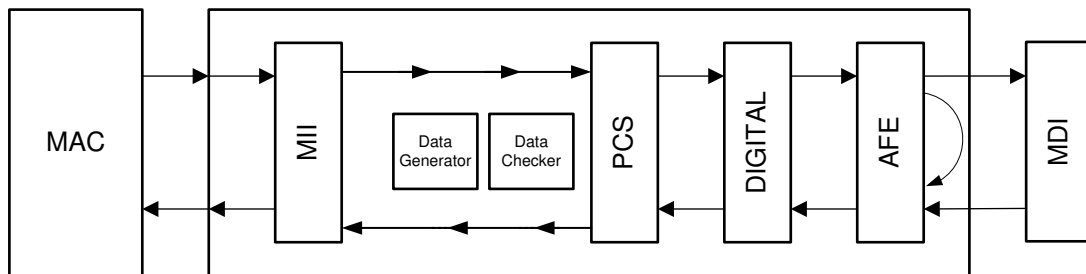
---

### 6.3.1.3 Built-In Self-Test For Datapath

The DP83TG720S-Q1 incorporates a data-path's Built-In-Self-Test (BIST) to check the PHY level and system level data-paths. BIST has following integrated features which make the system level data transfer tests (through-put and so forth) and diagnostics possible without relying on MAC or external data generator hardware/software.

1. Loopback modes
2. Data generator
  - a. Customizable MAC packets generator.
  - b. Transmitted packet counter.
  - c. PRBS stream generator.
3. Data checker
  - a. Received MAC packets error checker.
  - b. Received packet counter: Counts total packets received and packets received with errors.
  - c. PRBS lock and PRBS error checker.

#### 6.3.1.3.1 Loopback Modes

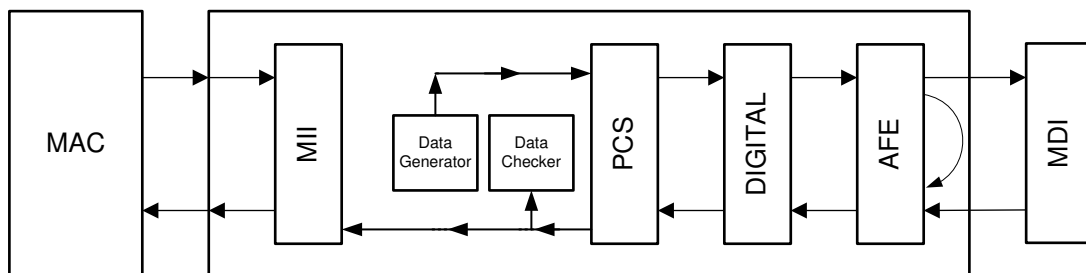


**Figure 6-2. All Loopbacks**

There are several loopback options within the DP83TG720S-Q1. Enabling different loopback modes enables/bypass different data-paths according to system verification requirements. Different loopbacks can be enabled along-side following data generation options :

- a. Inbuilt data-generator
- b. External data-generator (on Ethernet cable or MAC side)

Following diagrams illustrate data-flow during different loopback options :



**Figure 6-3. Analog Loopback With Inbuilt Data-Gen**

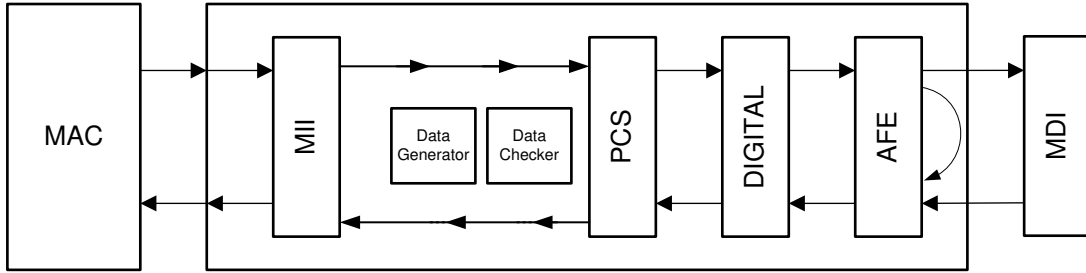


Figure 6-4. Analog Loopback With External Data-Gen

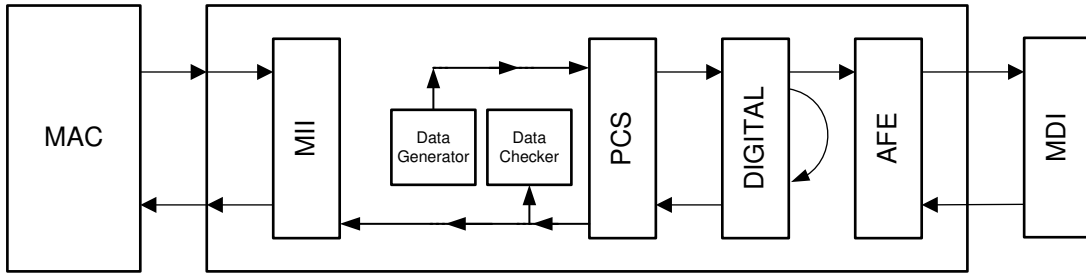


Figure 6-5. Digital Loopback With Inbuilt Data-Gen

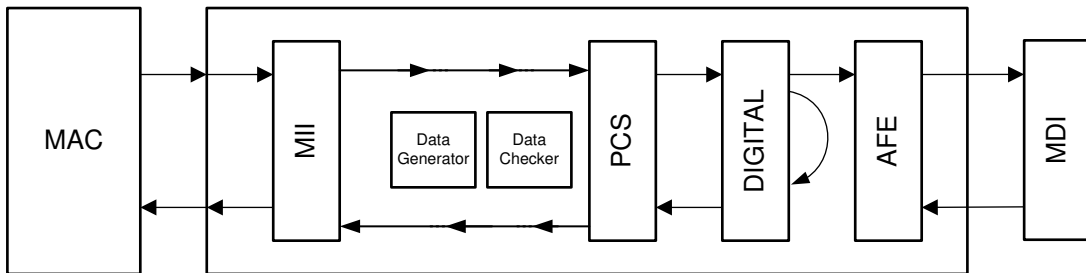


Figure 6-6. Digital Loopback With External Data-Gen

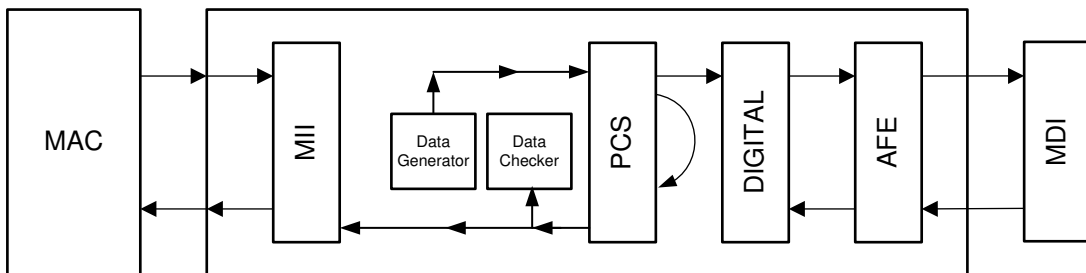


Figure 6-7. PCS Loopback With Inbuilt Data-Gen

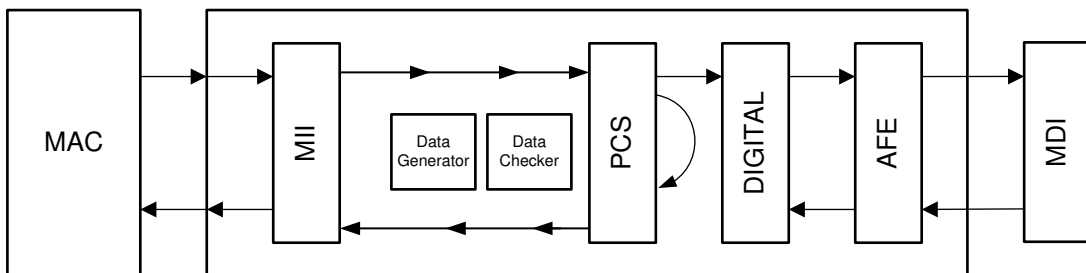


Figure 6-8. PCS Loopback With External Data-Gen

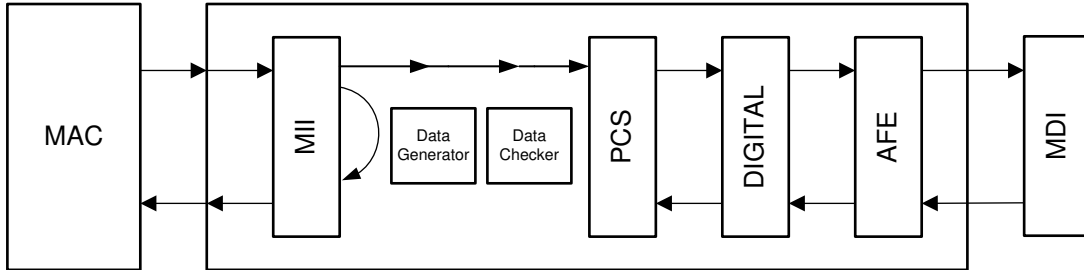


Figure 6-9. xMII Loopback With External Data-Gen

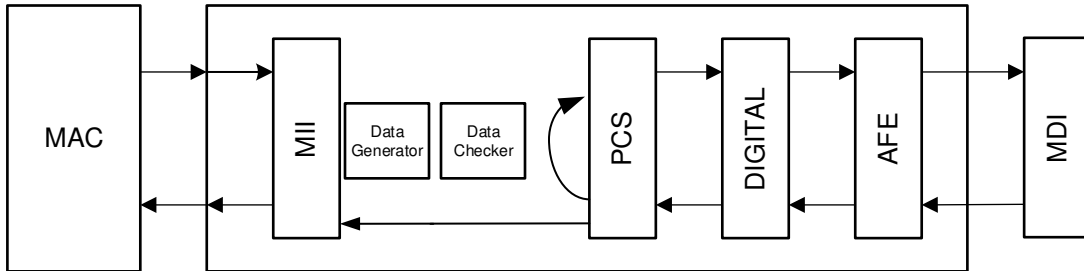


Figure 6-10. xMII Reverse Loopback With External Data-Gen

### 6.3.1.3.2 Data Generator

Data generator can be programmed to generate either user defined MAC packets or PRBS stream.

Following parameters of generated MAC packets can be configured (refer to registers<0x061B>, register<0x061A> and register<0x0624> for required configuration):

- Packet Length
- Inter-packet gap
- Defined number of packets to be sent or continuous transmission
- Packet data-type: Incremental/Fixed/PRBS
- Number of valid bytes per packet

### 6.3.1.3.3 Programming Datapath BIST

The following register settings enable different loopbacks, data generation and data checker procedures.

Table 6-2. Datapath BIST Programming

	Loopback Mode	To enable loopback mode	To enable data generator and checker: MAC packets	To check in-coming MAC packets status	To enable data generator and checker: PRBS stream	To check in-coming PRBS status: PRBS stream	Other care-about
1	Analog loopback	write : reg[0x0016]=0x0108 write : reg[0x0405]=0x2800	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x1555	read : reg[0x063C] for (15:0) of total received packets count. read : reg[0x063D] for (31:16) of total received packets count. read : reg[0x063E] for Packets received with CRC errors	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x0557	Step 1: write : reg[0x0620](1) = 1'b1 Step 2 : read : reg[0x0620] (7:0) = Number of error bytes received. read : reg[0x0620] (8) (1 indicates PRBS data is coming in and checker is locked)	Disconnect the cable/link-partner. Generated data goes to MAC side, to disable MAC side : write : reg[0x0000]=0x0540

**Table 6-2. Datapath BIST Programming (continued)**

	Loopback Mode	To enable loopback mode	To enable data generator and checker: MAC packets	To check in-coming MAC packets status	To enable data generator and checker: PRBS stream	To check in-coming PRBS status: PRBS stream	Other care-about
2	Digital loopback	write : reg[0x0016] = 0x0104 write : reg[0x0800][11]=1	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x1555	read : reg[0x063C] = [15:0] of total received packets count. read : reg[0x063D]= [31:16] of total received packets count. read : reg<0x063E> -> Packets received with CRC errors	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x0557	Step 1 : write : reg[0x0620][1] = 1'b1 Step 2 : read : reg[0x0620][7:0] = Number of error bytes received. read : reg[0x0620][8] (1 indicates PRBS data is coming in and checker is locked)	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000 Generated data goes to MAC side, to disable MAC side : write : reg[0x0000]=0x0540
3	PCS loopback	write : reg<0x0016> = 0x0101	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x1555	read : reg[0x063C]= [15:0] of total received packets count. read : reg[0x063D]= [31:16] of total received packets count. read : reg[0x063E]= Packets received with CRC errors	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x0557	Step 1 : write : reg[0x0620][1] = 1'b1 Step 2 : read : reg[0x0620][7:0] = Number of error bytes received. read : reg[0x0620][8] (1 indicates PRBS data is coming in and checker is locked)	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000 Generated data goes to MAC side, to disable MAC side : write : reg[0x0000]=0x0540
4	RGMII loopback	write : reg<0x0000> = 0x4140	Data is generated externally at Rgmii TX pins Write : reg[0x0619]=0x1004	Data can be verified at Rgmii RX pins. Packet errors can additionally be checked internally by : read : reg[0x063C]= [15:0] of total received packets count. read : reg[0x063D] = [31:16] of total received packets count. read : reg[0x063E]= Packets received with CRC errors	Data is generated externally at Rgmii Tx pins.	Not applicable as data is external. PRBS stream checker works only with internal data generator.	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000

**Table 6-2. Datapath BIST Programming (continued)**

	Loopback Mode	To enable loopback mode	To enable data generator and checker: MAC packets	To check in-coming MAC packets status	To enable data generator and checker: PRBS stream	To check in-coming PRBS status: PRBS stream	Other care-about
5	SGMII loopback	write : reg[0x0000] = 0x4140	Data is generated externally at Sgmii TX pins Write : reg[0x0619] = 0x1114	Data can be verified at Sgmii RX pins. Packet errors can additionally be checked internally by : read : reg[0x063C]= [15:0] of total received packets count. read : reg[0x063D] = [31:16] of total received packets count. read : reg[0x063E] = Packets received with CRC errors	Data is generated externally at Sgmii Tx pins.	Not applicable as data is external. PRBS stream checker works only with internal data generator.	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000
6	RGMII Reverse loopback	write : reg[0x0016] = 0x0010	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x1555	read : reg[0x063C] = [15:0] of total received packets count. read : reg[0x063D] = [31:16] of total received packets count. read : reg[0x063E] = Packets received with CRC errors	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x0557	Step 1 : write : reg[0x0620][1] = 1'b1 Step 2 : read : reg[0x0620][7:0] = Number of error bytes received. read : reg[0x0620][8] (1 indicates PRBS data is coming in and checker is locked)	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000
7	SGMII Reverse loopback	write : reg[0x042C] = 0x0010	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x1555	read : reg[0x063C] for [15:0] of total received packets count. read : reg[0x063D] for [31:16] of total received packets count. read : reg[0x063E] for Packets received with CRC errors	write : reg[0x0624]=0x55BF write : reg[0x0619]=0x0557	Step 1 : write : reg[0x0620][1] = 1'b1 Step 2 : read : reg[0x0620][7:0] for Number of error bytes received. read : reg[0x0620][8] (1 indicates PRBS data is coming in and checker is locked)	Generated data goes to Cu cable side, to disable this transmission : write : reg[0x041F] = 0x1000

**Note**

Different MAC packet parameters can be further configured with register[0x061B] and register[0x0624]

### 6.3.1.4 Temperature and Voltage Sensing

Temperature sensor of PHY can be used to give the indication of the temperature of the system and reading can be taken easily by reading the temperature sensor output register.

Voltage sensor senses the voltage of all the supply pins: vdda, vddio and vdd1p0. Each pins active voltage can be sensed by reading the corresponding voltage sensor output register.

All sensors are always active and monitor state machine polls the value of each sensor periodically. Monitor state machine can be further programmed to give higher priority/sampling time to one sensor over another by using MONITOR\_CTRL\_3 register.

Following software sequence can be used to read out any sensor's output:

- Step 1 : Program register[0x0467] = 0x6004 ; Initial configuration of monitors
- Step 2 : Program register [0x046A] = 0x00A6 and then register [0x046A]=0x00A3; Refresh the monitors
- Step 3 : Program register[0x0468] to select the corresponding sensor to be polled and read register [0x047B] [14:7] for selected sensor's output code.
- Step 4 : Feed the values of read sensor's output code (in decimal) in following equations to get the sensor's output value in decimals. Refer to [Sensor Select Table](#) for required value of constants to be used in equations :
  - $vdda\_value = 3.3 + (vdda\_output\_code - vdda\_output\_mean\_code) \times slope\_vdda\_sensor$
  - $vdd1p0\_value = 1.0 + (vdd1p0\_output\_code - vdd1p0\_output\_mean\_code) \times slope\_vdd1p0\_sensor$
  - $vddio\_calculated = 3.3 + (vddio\_output\_code - vddio\_output\_mean\_code) \times slope\_vddio\_sensor$
  - $temperature\_calculated = 25 + (temperature\_output\_code - temperature\_output\_mean\_code) \times slope\_temperature\_sensor$

**Table 6-3. Sensor Select Table**

Register[0x0468]	Sensor Selected To Read-out
0x1920	VDDA Voltage Sensor
0x2920	VDD1P0 Voltage Sensor
0x3920	VDDIO Voltage Sensor
0x4920	Temperature Sensor

**Table 6-4. Sensor's Constant Values**

Constant	Value (in decimal)
vdda_output_mean_code	128
slope_vdda3p3_sensor	8.63014e-3
vdd1p0_output_mean_code	93
slope_vdd1p0_sensor	2.85714e-3
vddio_output_mean_code	224
slope_vddio_sensor	15.686e-3
temperature_output_mean_code	161
slope_temperature_sensor	1

#### Note

Accuracy of temperature sensor can be maximized (7.5degreeC), if customer can sample "temperature\_output\_code" at 25°C and use it as "temperature\_output\_mean\_code".

### 6.3.1.5 Electrostatic Discharge Sensing

Electrostatic discharge is a serious issue for electronic circuits and if not properly mitigated can create short-term issues (signal integrity, link drops, packet loss) as well as long-term reliability faults. The DP83TG720S-Q1 has robust integrated ESD circuitry and offers an ESD sensing architecture. ESD events can be detected on MDI pins for further analysis and debug.

The ESD sensing tool is useful for both prototyping and end-applications. Additionally, the DP83TG720S-Q1 provides an interrupt status flag; when an ESD event is logged in the register<0x0442>. Hardware and software resets are ignored by the ESDS register to prevent unwarranted clearing.

**Table 6-5. ESD Sensing : Interrupt Setting and Count Reading**

Function	Required Read/Write
Interrupt Enable	<ul style="list-style-type: none"> <li>Write register&lt;0x0012&gt;[3] = 1</li> </ul>
ESD Event Counter	<ul style="list-style-type: none"> <li>Read register&lt;0x0442&gt;[14:9]</li> <li>Value in decimal indicates the ESD strikes since power-up.</li> </ul>

### 6.3.2 Compliance Test Modes

The six test modes for the DP83TG720S-Q1 are compliant to IEEE 802.3bp, Sub-clause 97.5.2. Supported test modes allow testing of the transmitter waveform Power Spectral Density (PSD) mask, distortion, MDI Master jitter, MDI Slave jitter, droop, transmitter frequency, frequency tolerance, BER monitoring, return loss, and mode conversion. Any of the three GPIOs can be used to output TX\_TCLK for MDI Slave jitter measurement.

#### 6.3.2.1 Test Mode 1

Test mode 1 tests the transmitter clock jitter when linked to a partner. In test mode 1, the DP83TG720S-Q1 PHYs are connected over link segment defined in section 97.6 within IEEE 802.3bp. TX\_TCLK125 is a divided clock derived from TX\_TCLK, which is one sixth the frequency.

#### 6.3.2.2 Test Mode 2

Test mode 2 tests the transmitter MDI Master mode jitter. In test mode 2, the DP83TG720S-Q1 transmits a continuous pattern of three {+1} symbols followed by three {-1} symbols. The transmitted symbols are timed from the 750MHz source, which results in a 125MHz signal.

#### 6.3.2.3 Test Mode 4

Test mode 4 tests the transmitter distortion. In test mode 4, the DP83TG720S-Q1 will transmit the sequence of symbols generated by [Equation 1](#):

$$g(x) = 1 + x^9 + x^{11} \tag{1}$$

The bit sequences, x0n and x1n, are generated from combinations of the scrambler in accordance to and :

$$x0_n = Scr_n[0] \tag{2}$$

$$x1_n = Scr_n[1] \wedge Scr_n[4] \tag{3}$$

$$x2_n = Scr_n[1] \wedge Scr_n[5] \tag{4}$$

Example streams of the 3-bit nibbles are shown in [Table 6-6](#).

**Table 6-6. Transmitter Test Mode 4 Symbol Mapping**

x2n	x1n	x0n	T1n	T0n
0	0	0	-1	-1
0	0	1	0	-1
0	1	0	-1	0

**Table 6-6. Transmitter Test Mode 4 Symbol Mapping (continued)**

x2n	x1n	x0n	T1n	T0n
0	1	1	-1	+1
1	0	0	+1	0
1	0	1	+1	-1
1	1	0	+1	+1
1	1	1	0	+1

**6.3.2.4 Test Mode 5**

Test mode 5 tests the transmitter PSD mask. In test mode 5, the DP83TG720S-Q1 will transmit normal Inter-Frame IDLE PAM3 symbols.

**6.3.2.5 Test Mode 6**

Test mode 6 tests the transmitter droop. In test mode 6, the DP83TG720S-Q1 transmits fifteen {+1} symbols followed by fifteen {-1} symbols with symbol transmission at 750MHz. This 25MHz pattern is repeated continuously until the test mode is disabled.

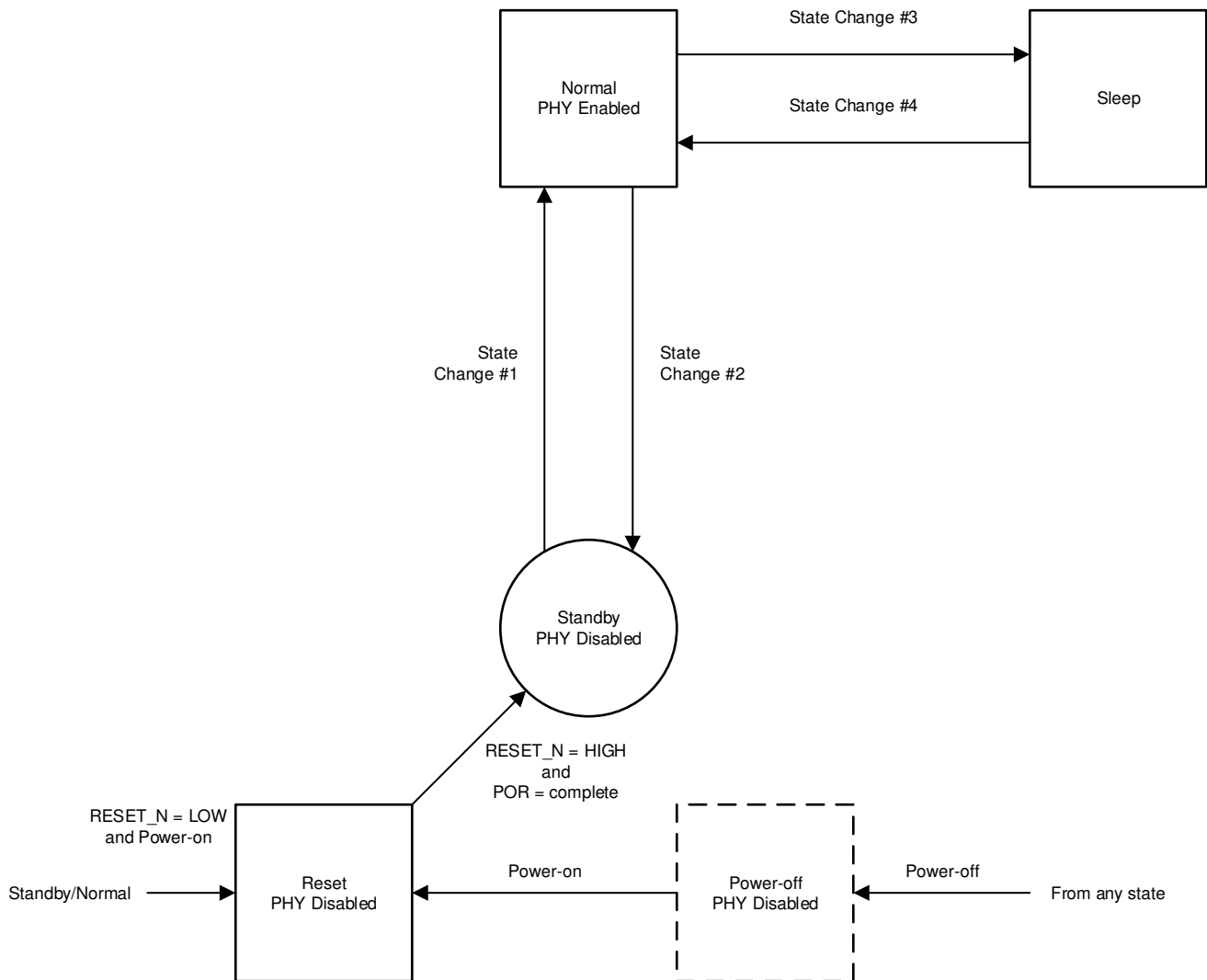
**6.3.2.6 Test Mode 7**

Test mode 7 enabled bit error rate measurement on a link segment. This mode uses zero data pattern on the MDI to check BER by comparing an expected zero data pattern to any non-zero bit received. Error checking is performed after FEC and 80B/81B decoding.

**Table 6-7. Test Mode Register Setting**

MMD	Register	Value	Test Mode
MMD1	0x0904	0x2000	Test Mode 1 : Tx_Tclk 125MHz is routed to clkout pin.
MMD1	0x0904	0x4000	Test Mode 2
MMD1	0x0904	0x8000	Test Mode 4 : Tx_Tclk 125MHz is routed to clkout pin.
MMD1F	0x0453	0x0019	
MMD1	0x0904	0xA000	Test Mode 5
MMD1	0x0904	0xC000	Test Mode 6
MMD1	0x0904	0xE000	Test Mode 7

## 6.4 Device Functional Modes



**Figure 6-11. PHY Operation State Diagram**

### 6.4.1 Power Down

When VDDA3P3 or VDDIO or VDD1P0 is below the POR threshold, the DP83TG720S-Q1 is in a power-down state. All digital IOs will remain in high impedance state and analog blocks are disabled. PMA termination is not present when in power-down.

### 6.4.2 Reset

Reset is activated upon power-up, when RESET\_N is pulled LOW (for the minimum reset pulse time) or if hardware reset is initiated by setting bit[15] in the register[0x001F].

- Digital state machine restarts after reset and all the register settings are cleared to the boot-up state.
- 25MHz clock on clkout pin will remain active during reset state also.
- MDI/PMA will not have termination during reset state.

#### Note

Straps are re-latched only with pin reset and not by hardware reset through register (register [0x001F] = x8000).

### 6.4.3 Standby

The device (MDI Master mode or MDI Slave mode) automatically enters into standby post power-up and reset so long that the device is bootstrapped for managed operation.

In standby, all PHY functions are operational except for PCS and PMA blocks. Link establishment is not possible in standby and data cannot be transmitted or received. SMI functions are operational and register configurations are maintained.

If the device is configured for autonomous operation through bootstrap setting, the PHY automatically switches to normal operation once powered on and reset complete.

### 6.4.4 Normal

Normal mode can be entered from either autonomous or managed operation. When in autonomous operation, the PHY will automatically try to establish link with a valid Link Partner once powered on.

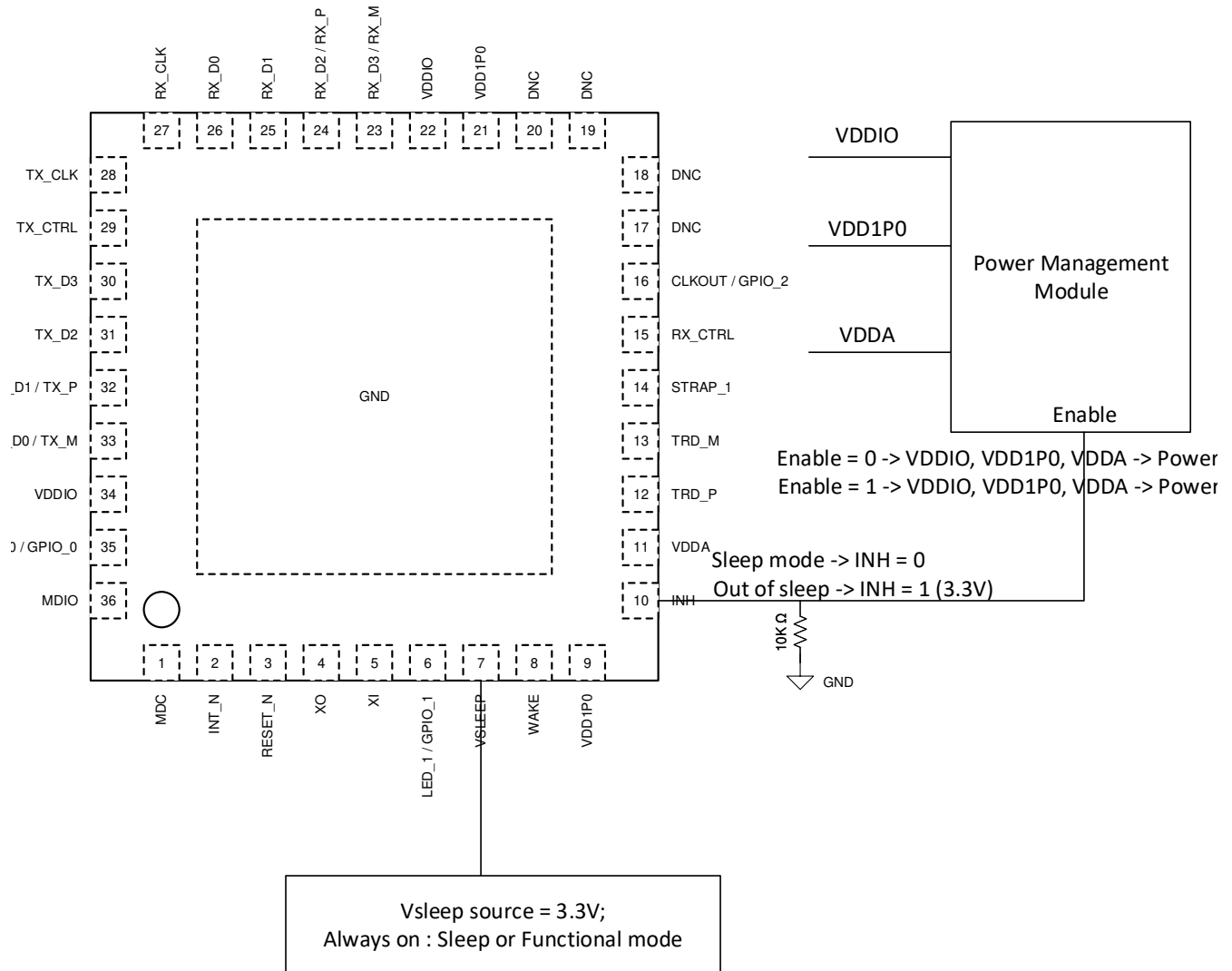
In managed operation, SMI access is required to allow the device to exit standby; commands issued through the SMI allow the device to exit standby and enables both the PCS and PMA blocks. All device features are operational in normal mode.

Autonomous operation can be enabled through SMI access by setting bit[6] in register 0x18B.

### 6.4.5 Sleep

Once in sleep mode, all PHY blocks are disabled except for energy detection. All register configurations are lost in sleep mode. No link can be established, data cannot be transmitted or received and SMI access is not available when in sleep mode.

To use sleep mode of PHY refer to implementation highlighted in following figure.



**Figure 6-12. Required Implementation for Sleep Mode**

**Note**

Phy does not go into sleep mode if supply sources are not disabled as per above figure.

**6.4.6 State Transitions**

**6.4.6.1 State Transition #1 - Standby to Normal**

*Autonomous Operation:* The PHY will automatically transition to Normal state upon POR completion.

*Managed Operation:* The PHY will transition to Normal state out of Standby only after writing register <0x018C> = 0x001.

**6.4.6.2 State Transition #2 - Normal to Standby**

The PHY can be forced back into Standby when in Normal state by writing register <0x018C> = 0x0010.

**6.4.6.3 State Transition #3 - Normal to Sleep**

Sleep state can be entered either locally or by remote link-partner.

Local sleep entry for Master mode phy :

- Step 1 : Write bit[7] = 'b1 of register[0x018B].

- Step 2 : Write reg0x042F = 0x0007, reg0x041E = 0x0100
- Step 3: Make "wake" pin low and hold it low for sleep mode.

Local sleep entry for Slave mode phy :

- Step 1 : Write bit[8] = 'b0 of register[0x018B] register.
- Step 2 : Write bit[7] = 'b1 of register[0x018B] register.
- Step 3 : Write reg0x042F = 0x0007, reg0x041E = 0x0100
- Step 4: Make "wake" pin low and hold it low for sleep mode.

Remote sleep entry for Master mode phy :

- Master can be put to sleep remotely by slave PHY provided the below instructions when the device is already linked-up with the link partner.
- Step 1: Write bit[8] = 'b1 of register [0x018B] register and bit[7] = 'b1 of register[0x018B] register.
- Step 2: Make "wake" pin low
- Step 3: Phy will go into sleep mode with loss of energy on Line

Remote sleep entry for Slave mode phy :

- Step 1 : Write bit[7] = 'b1 of register[0x018B] register.
- Step 2 : Make "wake" pin low.
- Step 3: Phy will go into sleep mode with loss of energy on line (when master will go quite : no data, no send-s). This can be achieved by putting link-partner in managed mode (where device is not allowed to start link-up sequence).

---

#### **Note**

Phy will go into sleep mode only if power supplies are disconnected using INH signal as shown in figure **Required Implementation for Sleep Mode**.

---

#### **6.4.6.4 State Transition #4 - Sleep to Normal**

Sleep state can be exited either locally or by remote link-partner.

#### **Local Sleep Exit**

Local sleep exit for Master mode PHY by :

- Making "wake" pin high (3.3V).

Local sleep exit for Slave mode PHY by :

- Making "wake" pin high (3.3V).

#### **Remote Sleep Exit**

Device can be made to exit the sleep mode by link-partner by either of the following :

1. Remote sleep exit using Send-S symbols from link-partner.
2. Remote sleep exit using Send-T symbols from link-partner

Details of these procedures are in the following table :

**Table 6-8. Remote Sleep Exit Procedures**

Method	Device Mode	Procedure	Required Link-partner Cabability
Using Send-S	Master	<p>Step 1 : Start IEEE defined Send-S pattern from link-partner for atleast 1.25ms.</p> <p>Step 2 : Put link-partner in the normal mode to start the link-up.</p> <p>Note : Link-partner with low VOD can limit the remote wake-up upto a maximum of 5m cable.</p>	<p>Link-partner needs to have a mode to send Send-S pattern on demand in Slave mode also.</p> <p>One possible way is :</p> <p>Step 1 : Put link-partner in master mode for atleast 1.25ms.</p> <p>Step 2 : Put link-partner in normal mode to start the link-up</p>
	Slave	<p>Step 1 : Start IEEE defined Send-S pattern from link-partner for atleast 1.25ms.</p> <p>Step 2 : Put link-partner in the normal mode to start the link-up.</p> <p>Note : Link-partner with low VOD can limit the remote wake-up upto a maximum of 5m cable.</p> <p>Note : To keep the slave mode DP83TG720 in sleep mode, link-partner can be put in managed mode (where device is not allowed to start link-up sequence).</p>	<p>Any IEEE compliant link-partner works, as master mode link-partner is supposed to send Send-S signals to start the link-up</p>

**Table 6-8. Remote Sleep Exit Procedures (continued)**

Method	Device Mode	Procedure	Required Link-partner Cabability
Using Send-T	Master	<p>Step 1 : Enable Send-T pattern on link-partner for atleast 1.25ms.</p> <p>Step 2 : Put link-partner in the normal mode to start the link-up.</p>	<p>Link-partner needs to have a mode to send Send-T pattern on demand.</p> <p>Swing during Send-T mode at pins of link-partner must be greater than 0.92V for remote wake-up over 15m cable. Link-partner with lower VOD can limit the remote wake-up to 5m cable.</p> <p>DP83T720 as link-partner can do the required with following steps :</p> <p>Step 1 : Enable Send-T pattern on DP83TG720 link-partner : write reg[0x0405]=0x7400; reg[0x0509]=0x4007 and reg[0x0576]=0x0500</p> <p>Step 2 : After 100ms disable send-T pattern on DP83TG720 link-partner : write reg[0x0405]=x5800; reg[0x0509]=0x4005 and reg[0x0576]=0x0000</p>
	Slave	<p>Step 1 : Enable Send-T pattern on link-partner for atleast 1.25ms.</p> <p>Step 2 : Put link-partner in the normal mode to start the link-up.</p>	<p>Link-partner needs to have a mode to send Send-T pattern on demand.</p> <p>Swing during Send-T mode at pins of link-partner must be greater than 0.92V for remote wake-up over 15m cable. Link-partner with lower VOD can limit the remote wake-up to 5m cable.</p> <p>DP83T720 as link-partner can do the required with following steps :</p> <p>Step 1 : Enable Send-T pattern on DP83TG720 link-partner : write reg[0x0405]=0x7400; reg[0x0509]=0x4007 and reg[0x0576]=0x0500</p> <p>Step 2 : After 100ms disable send-T pattern on DP83TG720 link-partner : write reg[0x0405]=x5800; reg[0x0509]=0x4005 and reg[0x0576]=0x0000</p>

## 6.4.7 Media Dependent Interface

### 6.4.7.1 MDI Master and MDI Slave Configuration

MDI Master and MDI Slave are configured using either hardware bootstraps or through register access.

LED\_0 controls the MDI Master and MDI Slave bootstrap configuration. By default, MDI Slave mode is configured because there is an internal pulldown resistor on LED\_0 pin. If MDI Master mode configuration through hardware bootstrap is preferred, an external pullup resistor is required.

Additionally, bit[14] in the PMA\_CTRL2 register controls the MDI Master and MDI Slave configuration. When this bit is set, MDI Master mode is enabled.

### 6.4.7.2 Auto-Polarity Detection and Correction

During the link training process, the DP83TG720S-Q1 as MDI receiver is able to detect polarity reversal and automatically correct for the error. Both master and slave detects can do the required correction in the receiver polarity.

Auto-Polarity Correction cannot be disabled on DP83TG720S-Q1

## 6.4.8 MAC Interfaces

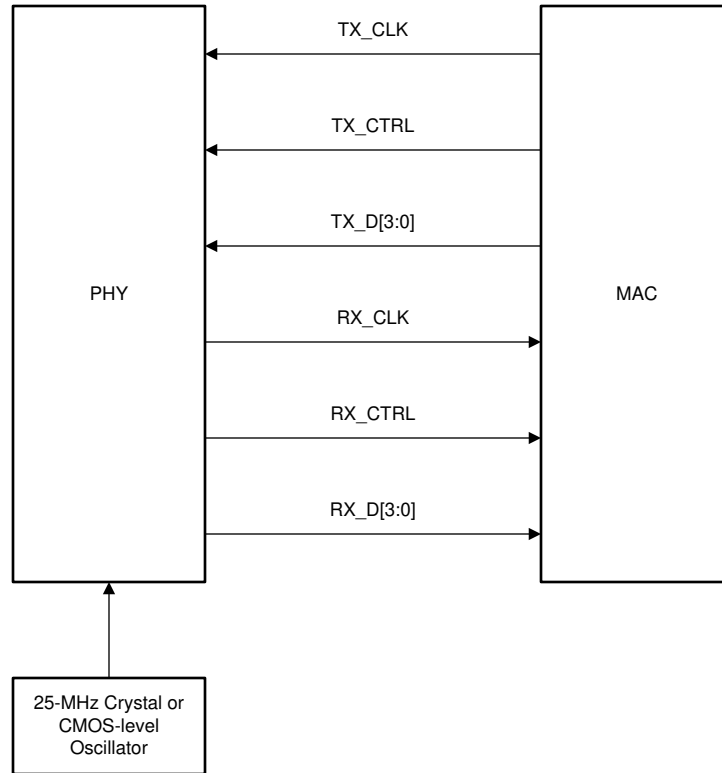
### 6.4.8.1 Reduced Gigabit Media Independent Interface

The DP83TG720S-Q1 also supports Reduced Gigabit Media Independent Interface (RGMII) as specified by RGMII version 2.0. RGMII is designed to reduce the number of pins required to connect MAC and PHY. To accomplish this goal, the control signals are multiplexed. Both rising and falling edges of the clock are used to sample the control signal pin on transmit and receive paths. For 1Gbps operation, RX\_CLK and TX\_CLK operate at 125MHz.

The RGMII signals are summarized in [Table 6-9](#):

**Table 6-9. RGMII Signals**

FUNCTION	PINS
Data Signals	TX_D[3:0]
	RX_D[3:0]
Control Signals	TX_CTRL
	RX_CTRL
Clock Signals	TX_CLK
	RX_CLK



**Figure 6-13. RGMII Connections**

**Table 6-10. RGMII Transmit Encoding**

TX_CTRL (POSITIVE EDGE)	TX_CTRL (NEGATIVE EDGE)	TX_D[3:0]	DESCRIPTION
0	0	0000 through 1111	Normal Inter-Frame
0	1	0000 through 1111	Reserved
1	0	0000 through 1111	Transmit Error Propagation
1	1	0000 through 1111	Normal Data Transmission

**Table 6-11. RGMII Receive Encoding**

RX_CTRL (POSITIVE EDGE)	RX_CTRL (NEGATIVE EDGE)	RX_D[3:0]	DESCRIPTION
0	0	0000 through 1111	Normal Inter-Frame
0	1	0000 through 1101	Reserved
0	1	1110	False Carrier Indication
0	1	1111	Reserved
1	0	0000 through 1111	Data Reception with Errors
1	1	0000 through 1111	Normal Data Reception

The DP83TG720S-Q1 supports in-band status indication to help simplify link status detection. Inter-frame signals on RX\_D[3:0] pins as specified in [Table 6-12](#).

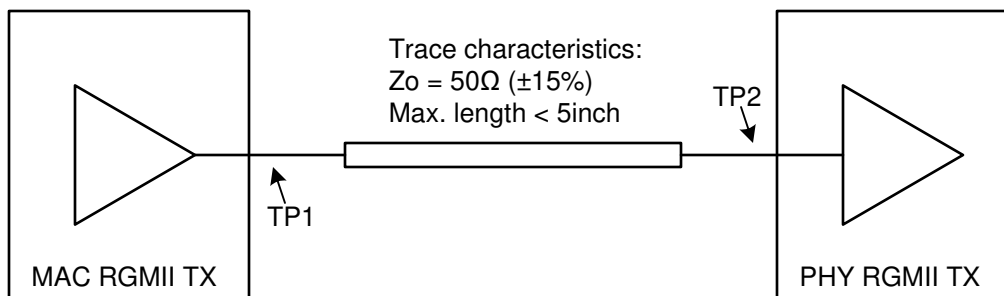
**Table 6-12. RGMII In-Band Status**

RX_CTRL	RX_D3	RX_D[2:1]	RX_D0
0 <b>Note:</b> In-band status is only valid when RX_CTRL is low	<b>Duplex Status:</b> 0 = Half-Duplex 1 = Full-Duplex	<b>RX_CLK Clock Speed:</b> 00 = 2.5MHz 01 = 25MHz 10 = 125MHz 11 = Reserved	<b>Link Status:</b> 0 = Link not established 1 = Valid link established

RGMII MAC Interface for Gigabit Ethernet has stringent timing requirements to meet system level performance. To meet these timing requirements and to operate with different MACs over RGMII, the following requirements must be taken into consideration when designing PCB. TI recommends to check board level signal integrity by using the DP83TG720 IBIS model.

### RGMII-TX Requirements

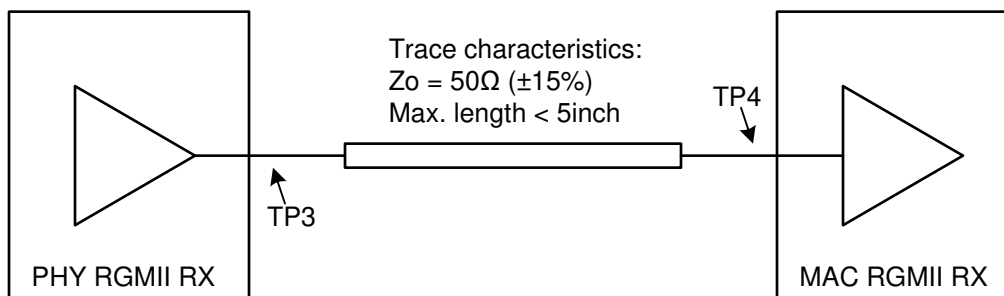
- RGMII TX signals routed with controlled impedance of  $50\Omega \pm 15\%$ .
- Max routing length limited to 5inches for better signal integrity performance.
- [Figure 6-14](#) shows a RGMII interface requirements for TX\* signals. MAC RGMII driver output impedance of  $50\Omega \pm 20\%$ .
- Skew for all RGMII TX signals at TP2, in [Figure 6-14](#), less than  $\pm 500\text{ps}$ .
- Signal Integrity at TP1 and TP2, in [Figure 6-14](#), can be verified with IBIS model simulation, that the following requirements are met:
  - At TP2, signal meeting rise/fall time of 1ns (20-80%) of signal amplitude.
  - Rise/fall time is monotonic between VIH/VIL level at TP2.



**Figure 6-14. RGMII TX Requirements**

### RGMII-RX Requirements

- RGMII RX signals routed with controlled impedance of  $50\Omega \pm 15\%$ .
- Max routing length limited to 5inch for better signal integrity performance.
- No damping resistors added at TP3/TP4, in [Figure 6-15](#), as that can impact signal integrity of RX signals.
- [Figure 6-15](#) shows a RGMII interface requirements for RX\* signals. MAC RGMII driver output impedance is  $50\Omega \pm 20\%$ .
- Signal Integrity at TP3 and TP4, in [Figure 6-15](#), can be verified with IBIS model simulation, that the following requirements are met:
  - At TP4, signal meeting rise/fall time of 1ns (20-80%) of signal amplitude.
  - Rise/fall time is monotonic between VIH/VIL level at TP4.



**Figure 6-15. RGMII RX Requirements**

### Note

1. TI recommends routing RGMII on buried traces to minimize EMC emissions.
2. Buried traces connected with via placement as close as possible to the PHY and MAC.

#### 6.4.8.2 Serial Gigabit Media Independent Interface

The Serial Gigabit Media Independent Interface (SGMII) provides a means for data transfer between MAC and PHY with significantly less signal pins (4 pins) compared to RGMII (12 pins). SGMII uses low-voltage differential signaling (LVDS) to reduce emissions and improve signal quality.

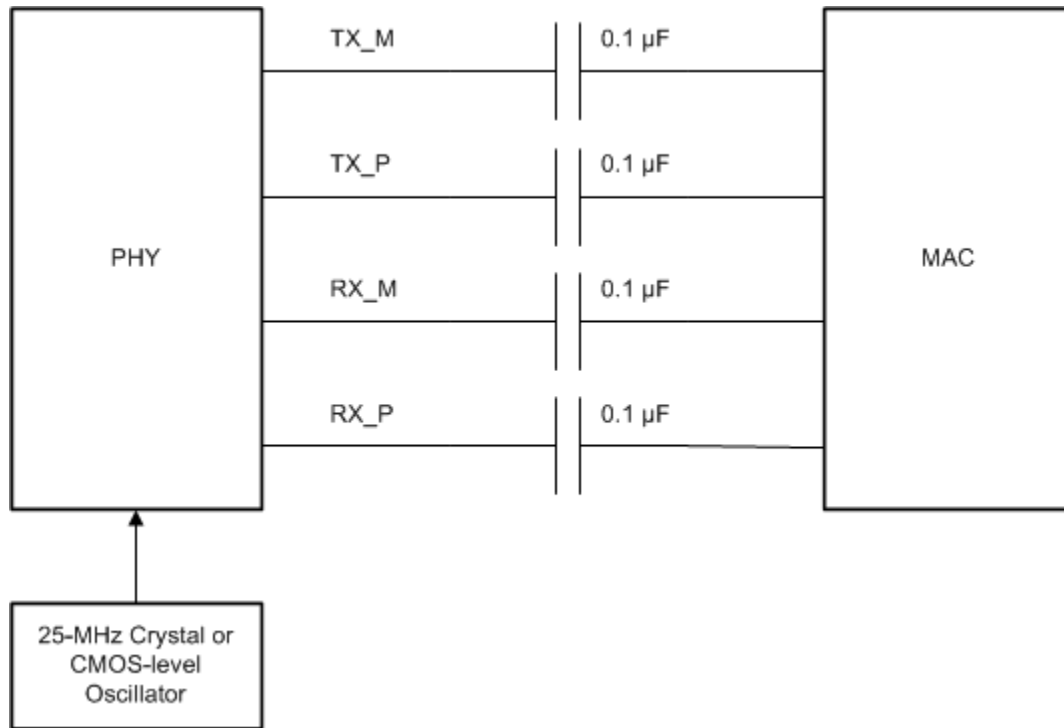
The DP83TG720S-Q1 SGMII is capable of operating in 4-wire mode. In 4-wire operation, two differential pairs are used to transmit and receive data. Clock and data recovery are performed in the MAC and in the PHY in the case of the RX and TX directions, respectively.

SGMII Auto-Negotiation can be disabled by setting bit[0] = 0b0 in the SGMII Configuration Register (SGMIICL, address 0x608).

The SGMII signals are summarized in [Table 6-13](#).

**Table 6-13. SGMII Signals**

FUNCTION	PINS
Data Signals	TX_M, TX_P
	RX_M, RX_P

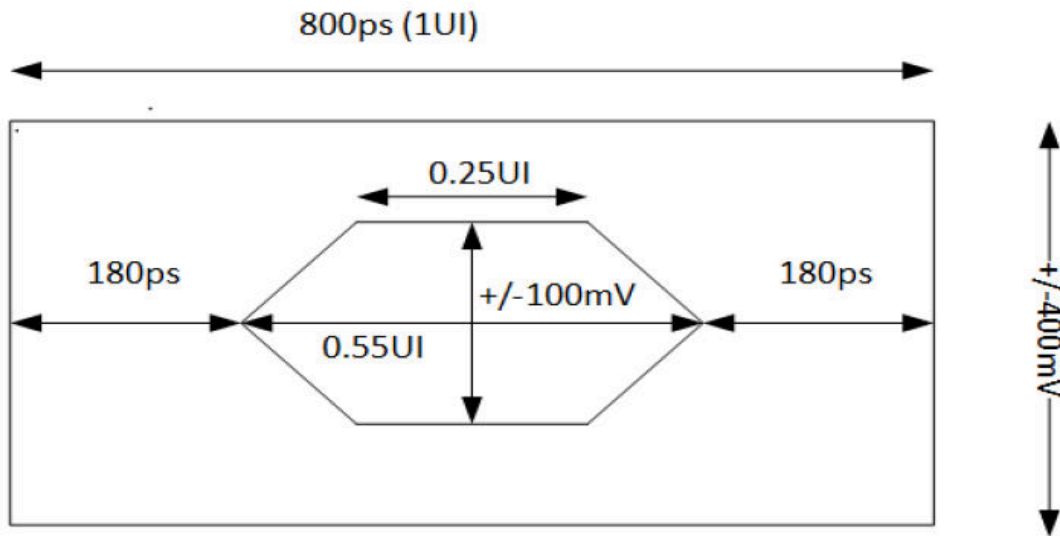


**Figure 6-16. SGMII Connections**

SGMII MAC Interface for Gigabit Ethernet has stringent signal integrity requirements to meet system level performance. The following requirements must be into consideration when designing PCB. TI recommends to check board level signal integrity by using the DP83TG720 IBIS model.

**SGMII Signals Guidelines**

- Sgmii Tx and Rx signals routed on board with controlled differential impedance of 100Ωs ± 5%.
- Maximum routing length limited to 5inch for better signal integrity.
- Mismatch in routing length of p and n limited to 5mils.
- AC-coupling caps on rx lines placed close to rx\_p and rx\_m pins of PHY.
- AC-coupling caps on tx lines placed close to tx\_p and tx\_m pins of MAC.
- Signal integrity checked only at the pins of the receiver (PHY or MAC) using the high speed differential probe.
- At PHY's TX\_M and TX\_P following eye mask is met :



**Figure 6-17. Sgmii PHY Receiver Mask Requirement**

#### 6.4.9 Serial Management Interface

The Serial Management Interface provides access to the DP83TG720S-Q1 internal register space for status information and configuration. The SMI is compatible with IEEE 802.3 clause 22. The implemented register set consists of the registers required by the IEEE 802.3 plus several others to provide additional visibility and controllability of the DP83TG720S-Q1.

The SMI includes the management clock (MDC) and the management input and output data pin (MDIO). MDC is sourced by the external management entity, also called Station (STA). MDC is not expected to be continuous, and can be turned off by the external management entity when the bus is idle.

MDIO is sourced by the external management entity and by the PHY. The data on the MDIO pin is latched on the rising edge of the MDC. MDIO pin requires a pullup resistor (2.2k $\Omega$ ) to VDDIO, which pulls MDIO high during IDLE and turnaround.

Up to 9 DP83TG720S-Q1 PHYs can share a common SMI bus. To distinguish between the PHYs, a 3-bit address is used. During power-up-reset, the DP83TG720S-Q1 latches the PHY\_AD configuration pins to determine its address.

The management entity must not start an SMI transaction in the first cycle after power-up-reset. To maintain valid operation, the SMI bus must remain inactive at least one MDC cycle after hard reset is deasserted. In normal MDIO transactions, the register address is taken directly from the management-frame reg\_addr field, thus allowing direct access to 32 16-bit registers (including those defined in IEEE 802.3 and vendor specific). The data field is used for both reading and writing. The Start code is indicated by a <01> pattern. This pattern makes sure that the MDIO line transitions from the default idle line state. Turnaround is defined as an idle bit time inserted between the Register Address field and the Data field. To avoid contention during a read transaction, no device can actively drive the MDIO signal during the first bit of turnaround. The addressed DP83TG720S-Q1 drives the MDIO with a zero for the second bit of turnaround and follows this with the required data.

For write transactions, the station-management entity writes data to the addressed DP83TG720S-Q1, thus eliminating the requirement for MDIO Turnaround. The turnaround time is filled by the management entity by inserting <10>.

**Table 6-14. SMI Protocol Structure**

SMI PROTOCOL	<idle> <start> <op code> <device address> <reg address> <turnaround> <data> <idle>
Read Operation	<idle><01><10><AAAA><RRRR><Z0><XXXX XXXX XXXX XXXX><idle>
Write Operation	<idle><01><01><AAAA><RRRR><10><XXXX XXXX XXXX XXXX><idle>

#### 6.4.9.1 Direct Register Access

Direct register access can be used for the first 31 registers (0x0h through 0x1Fh).

#### 6.4.9.2 Extended Register Space Access

The DP83TG720S-Q1 SMI function supports read and write access to the extended register set using registers REGCR (0x000Dh) and ADDAR (0x000Eh) and the MDIO Manageable Device (MMD) indirect method defined in IEEE 802.3ah Draft for Clause 22 for accessing the Clause 45 extended register set.

#### Note

Registers with addresses above 0x001F require indirect access. For indirect access, a sequence of register writes must be followed. The MMD value defines the Device Address (DEVAD) of the register set. The DEVAD must be configured in the register 0x000D (REGCR) bits [4:0] for indirect access

The DP83TG720S-Q1 supports 4 MMD device addresses. The 4 MMD register spaces are:

1. MMD1F (Vendor specific registers): DEVAD [4:0] = '11111'
2. MMD1 (IEEE 802.3az defined registers): DEVAD [4:0] = '00001'
3. MMD3 (IEEE 802.3az defined registers): DEVAD [4:0] = '00011'
4. MMD3 (IEEE 802.3az defined registers): DEVAD [4:0] = '00111'

**Table 6-15. MMD Register Space Division**

MMD Register Space	Register Address Range
MMD1F	0x0000 - 0x0FFF
MMD1	0x1000 - 0x1FFF
MMD3	0x3000 - 0x3FFF
MMD7	0x7000 - 0x7FFF

#### Note

For MMD1/3/7, most significant nibble of the register address is used to denote the respective MMD space. This must be ignored during actual register access operation. For example to access register 0x1904 use 0x0904 as the register address and x01 as the MMD.

The following sections describe how to perform operations on the extended register set using register REGCR and ADDAR.

#### 6.4.9.2.1 Write Operation (No Post Increment)

To write a register in the extended register set:

Instruction	Example: Set reg 0x0170 = 0C50
1. Write the value 0x001F (address function field = 00, DEVAD = 31) to register REGCR (0x0D).	Write register 0x0D to value 0x001F
2. Write the desired register address to register ADDAR (0x0E).	Write register 0x0E to value 0x0170
3. Write the value 0x401F (data, no post increment function field = 01, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x401F

Instruction	Example: Set reg 0x0170 = 0C50
4. Write the content of the desired extended register set register to register ADDAR.	Write register 0x0E to value 0x0C50

Subsequent writes to register ADDAR (step 4) continue to rewrite the register selected by the value in the address register.

---

**Note**

Steps (1) and (2) can be skipped if the address register was previously configured.

---

#### 6.4.9.2.2 Read Operation (No Post Increment)

To read a register in the extended register set:

Instruction	Example: Read 0x0170
1. Write the value 0x001F (address function field = 00, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x001F
2. Write the desired register address to register ADDAR.	Write register 0x0E to value 0x0170
3. Write the value 0x401F (data, no post increment function field = 01, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x401F
4. Read the content of the desired extended register set register to register ADDAR.	Read register 0x0E

Subsequent reads from register ADDAR (step 4) continue reading the register selected by the value in the address register.

---

**Note**

Steps (1) and (2) can be skipped if the address register was previously configured.

---

#### 6.4.9.2.3 Write Operation (Post Increment)

To write a register in the extended register set and automatically increment the address register to the next higher value following the write operation:

Instruction	Example: Set reg 0x0170 = 0C50 & reg 0x0171 = 0x0011
1. Write the value 0x001F (address function field = 00, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x001F
2. Write the register address from register ADDAR.	Write register 0x0E to value 0x0170
3. Write the value 0x801F (data, post increment on reads and writes function field = 10, DEVAD = 31) or the value 0xC01F (data, post increment on writes function field = 11, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x801F
4. Write the content of the desired extended register set register to register ADDAR.	Write register 0x0E to value 0x0C50
5. Subsequent writes to register ADDAR (step 4) writes the next higher addressed data register selected by the value of the address register; the address register is incremented after each access.	Write register 0x0E to value 0x0011

Step 4 Writes register 0x0170 to 0x0C50 and because post increment is enabled, Step 5 writes register 0x0171 to 0x0011.

#### 6.4.9.2.4 Read Operation (Post Increment)

To read a register in the extended register set and automatically increment the address register to the next higher value following the read operation:

Instruction	Example: Read register 0x0170 & 0x0171
1. Write the value 0x001F (address function field = 00, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x001F
2. Write the desired register address to register ADDAR.	Write register 0x0E to value 0x0170
3. Write the value 0x801F (data, post increment on reads and writes function field = 10, DEVAD = 31) to register REGCR.	Write register 0x0D to value 0x801F
4. Read the content of the desired extended register set register to register ADDAR.	Read register 0x0E
5. Subsequent reads to register ADDAR (step 4) reads the next higher addressed data register selected by the value of the address register; the address register is incremented after each access.	Read register 0x0E

Step 4 Reads register 0x0170 and because post increment is enabled, Step 5 reads register 0x0171.

## 6.5 Programming

### 6.5.1 Strap Configuration

The DP83TG720S-Q1 uses functional pins as strap options to place the device into specific modes of operation. The values of these pins are sampled at power up and hardware reset (through either the RESET\_N pin or register access). The strap pins support 2-levels and 3-levels, which are described in greater detail below. Configuration of the device is done through strapping or through serial management interface.

#### Note

- Strap pins are functional pins after reset is deasserted and must not be connected directly to VCC or GND.
- Pull up strap resistors are sufficient to enter different strap modes.
- Pull down strap resistor can have application for LED pin straps. Refer to LED Configuration section.

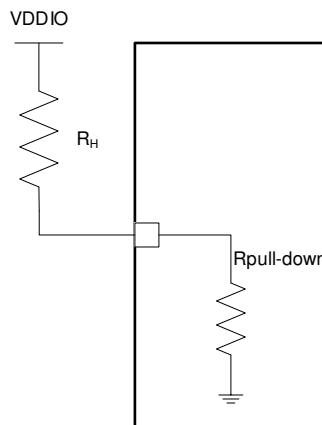


Figure 6-18. Strap Circuit

Table 6-16. Recommended 3-level Strap Resistor Ratios

MODE	Recommended RH (k $\Omega$ ) <sup>1</sup> for VDDIO = 3.3V	Recommended RH (k $\Omega$ ) <sup>2</sup> for VDDIO = 2.5V	Recommended RH (k $\Omega$ ) <sup>1</sup> for VDDIO = 1.8V
1	OPEN	OPEN	OPEN
2	13	12	4
3	4.5	2	0.8

1. 10% resistor accuracy

## 2. 1% resistor accuracy

**Table 6-17. Recommended 2-level Strap Resistor**

MODE	Recommended RH (k $\Omega$ ) <sup>1 2</sup>
1	OPEN
2	2.49

- 10% resistor accuracy
- To gain more margin in customer application for 1.8V VDDIO, either 2.1K $\pm$ 10% pull-up can be used or resistor accuracy of 2.49K resistor can be limited to 1%.

The following table describes the DP83TG720S-Q1 configuration bootstraps:

**Table 6-18. 2-level Bootstraps**

PIN NAME	PIN NO.	STRAP MODE	STRAP FUNCTION	DESCRIPTION
RX_D0	26	1 (default)	MAC[0] = 0	MAC Interface Selection [0]. Refer to <a href="#">Table 6-19</a> for full description.
		2	MAC[0] = 1	
RX_D1	25	1 (default)	MAC[1] = 0	MAC Interface Selection [1]. Refer to <a href="#">Table 6-19</a> for full description.
		2	MAC[1] = 1	
RX_D2	24	1 (default)	MAC[2] = 0	MAC Interface Selection [2]. Refer to <a href="#">Table 6-19</a> for full description.
		2	MAC[2] = 1	
LED_0	35	1 (default)	MS = 0	MDI Master Slave Select. MS = 0 Slave MS = 1 Master
		2	MS = 1	
LED_1	6	1 (default)	$\overline{\text{AUTO}} = 0$	Autonomous Disable $\overline{\text{AUTO}} = 0$ Autonomous $\overline{\text{AUTO}} = 1$ Managed
		2	$\overline{\text{AUTO}} = 1$	

**Table 6-19. MAC Interface Selection Bootstraps**

MAC[2]	MAC[1]	MAC[0]	DESCRIPTION
0	0	0	SGMII (4-wire)
0	0	1	RESERVED
0	1	0	RESERVED
0	1	1	RESERVED
1	0	0	RGMII (Align Mode)
1	0	1	RGMII (TX Shift Mode)
1	1	0	RGMII (TX and RX Shift Mode)
1	1	1	RGMII (RX Shift Mode)

**Table 6-20. 3-Level Bootstrap: PHY Address**

PHY_AD[3:0]	RX_CTRL STRAP MODE	STRP_1 STRAP MODE	DESCRIPTION
0000	1	1	PHY Address: 0x0000 (0)
0001	-	-	RESERVED
0010	-	-	RESERVED
0011	-	-	RESERVED
0100	2	1	PHY Address: 0x0004 (4)
0101	3	1	PHY Address: 0x0005 (5)
0110	-	-	RESERVED
0111	-	-	RESERVED
1000	1	2	PHY Address: 0x0008 (8)

**Table 6-20. 3-Level Bootstrap: PHY Address (continued)**

PHY_AD[3:0]	RX_CTRL STRAP MODE	STRP_1 STRAP MODE	DESCRIPTION
1001	-	-	RESERVED
1010	1	3	PHY Address: 0x000A (10)
1011	-	-	RESERVED
1100	2	2	PHY Address: 0x000C (12)
1101	3	2	PHY Address: 0x000D (13)
1110	2	3	PHY Address: 0x000E (14)
1111	3	3	PHY Address: 0x000F (15)

### 6.5.2 LED Configuration

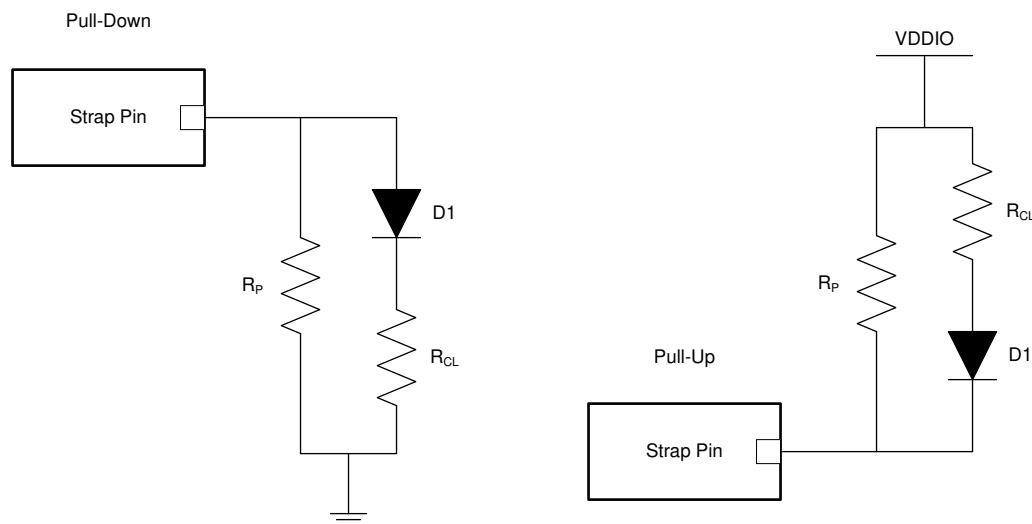
The DP83TG720S-Q1 supports up to three configurable Light Emitting Diode (LED) pins: LED\_0, LED\_1, and LED\_2 (CLKOUT). Several functions can be multiplexed onto the LEDs for different modes of operation. LED operations are selected using registers 0x0450 and 0x0451.

#### Note

CLKOUT has 25MHz clock output as default. If required, it can be configured to LED2 using register 0x0453.

Because the LED output pins are also used as strap pins, external components required for strapping and the user must consider the LED usage to avoid contention. Specifically, when the LED outputs are used to drive LEDs directly, the active state of each output driver is dependent on the logic level sampled by the corresponding input upon power up or hardware reset.

Figure 6-19 shows the two proper ways of connecting LEDs directly to the DP83TG720S-Q1.



**Figure 6-19. Example Strap Connections**

### 6.5.3 PHY Address Configuration

The DP83TG720S-Q1 can be set to respond to any of 9 possible PHY addresses through bootstrap pins. The PHY address is latched into the device upon power-up or hardware reset. Each DP83TG720S-Q1 or port sharing PHY on the serial management bus in the system must have a unique PHY address. The DP83TG720S-Q1 supports PHY address as described in Table 6-20.

By default, the DP83TG720S-Q1 will latch to a PHY address of 0 ([0000]). This address can be changed by adding pullup resistors to bootstrap pins found in Table 6-18.

## 7 Register Maps

### 7.1 Register Access Summary

There are two different methods for accessing registers within the field. Direct register access method is only allowed for the first 31 registers (0x0h through 0x1Fh) of MMD1F register space. Registers beyond 0x1Fh must be accessed by use of the Indirect Method (Extended Register Space) described in [Section 6.4.9.2](#).

**Table 7-1. MMD Register Space Division**

MMD REGISTER SPACE	REGISTER ADDRESS RANGE
MMD1F	0x0000 - 0x0FFF
MMD1	0x1000 - 0x1FFF
MMD3	0x3000 - 0x3FFF
MMD7	0x7000 - 0x7FFF

**Table 7-2. Register Access Summary**

REGISTER FIELD	REGISTER ACCESS METHODS
0x0h through 0x1Fh	Direct Access Indirect Access, MMD1F = '11111' <b>Example:</b> to read register 0x17h in MMD1F field with no post increment Step 1) write 0x1Fh to register 0xDh Step 2) write 0x17h to register 0xEh Step 3) write 0x401Fh to register 0xDh Step 4) read register 0xEh
MMD1F Field 0x20h - 0xFFFFh	Indirect Access, MMD1F = '11111' <b>Example:</b> to read register 0x462h in MMD1F field with no post increment Step 1) write 0x1Fh to register 0xDh Step 2) write 0x462h to register 0xEh Step 3) write 0x401Fh to register 0xDh Step 4) read register 0xEh
MMD1 Field 0x0000h - 0xFFFFh	Indirect Access, MMD1 = '00001' <b>Example:</b> to read register 0x7h in MMD1 field with no post increment Step 1) write 0x1h to register 0xDh Step 2) write 0x7h to register 0xEh Step 3) write 0x4001h to register 0xDh Step 4) read register 0xEh

## 7.2 DP83TG720 Registers

Table 7-3 lists the memory-mapped registers for the DP83TG720 registers. All register offset addresses not listed in Table 7-3 should be considered as reserved locations and the register contents should not be modified.

**Table 7-3. DP83TG720 Registers**

Offset	Acronym	Register Name	Section
0h	BMCR		<a href="#">Section 7.2.1</a>
1h	BMSR		<a href="#">Section 7.2.2</a>
2h	PHYID1		<a href="#">Section 7.2.3</a>
3h	PHYID2		<a href="#">Section 7.2.4</a>
Dh	REGCR		<a href="#">Section 7.2.5</a>
Eh	ADDAR		<a href="#">Section 7.2.6</a>
10h	MII_REG_10		<a href="#">Section 7.2.7</a>
11h	MII_REG_11		<a href="#">Section 7.2.8</a>
12h	MII_REG_12		<a href="#">Section 7.2.9</a>
13h	MII_REG_13		<a href="#">Section 7.2.10</a>
16h	MII_REG_16		<a href="#">Section 7.2.11</a>
18h	MII_REG_18		<a href="#">Section 7.2.12</a>
19h	MII_REG_19		<a href="#">Section 7.2.13</a>
1Eh	MII_REG_1E		<a href="#">Section 7.2.14</a>
1Fh	MII_REG_1F		<a href="#">Section 7.2.15</a>
180h	LSR		<a href="#">Section 7.2.16</a>
18Bh	LPS_CFG2		<a href="#">Section 7.2.17</a>
18Ch	LPS_CFG3		<a href="#">Section 7.2.18</a>
18Eh	LPS_STATUS		<a href="#">Section 7.2.19</a>
30Fh	TDR_TC12		<a href="#">Section 7.2.20</a>
405h	A2D_REG_05		<a href="#">Section 7.2.21</a>
41Eh	A2D_REG_30		<a href="#">Section 7.2.22</a>
428h	A2D_REG_40		<a href="#">Section 7.2.23</a>
429h	A2D_REG_41		<a href="#">Section 7.2.24</a>
42Ch	A2D_REG_44		<a href="#">Section 7.2.25</a>
42Fh	A2D_REG_47		<a href="#">Section 7.2.26</a>
430h	A2D_REG_48		<a href="#">Section 7.2.27</a>
442h	A2D_REG_66		<a href="#">Section 7.2.28</a>
450h	LEDS_CFG_1		<a href="#">Section 7.2.29</a>
451h	LEDS_CFG_2		<a href="#">Section 7.2.30</a>
452h	IO_MUX_CFG_1		<a href="#">Section 7.2.31</a>
453h	IO_MUX_CFG_2		<a href="#">Section 7.2.32</a>
456h	IO_CONTROL_3		<a href="#">Section 7.2.33</a>
45Dh	SOR_VECTOR_1		<a href="#">Section 7.2.34</a>
45Eh	SOR_VECTOR_2		<a href="#">Section 7.2.35</a>
468h	MONITOR_CTRL2		<a href="#">Section 7.2.36</a>
46Ah	MONITOR_CTRL4		<a href="#">Section 7.2.37</a>
47Bh	MONITOR_STAT1		<a href="#">Section 7.2.38</a>
510h	RS_DECODER		<a href="#">Section 7.2.39</a>
52Bh	TRAINING_RX_STATUS_7		<a href="#">Section 7.2.40</a>
543h	LINK_QUAL_1		<a href="#">Section 7.2.41</a>

**Table 7-3. DP83TG720 Registers (continued)**

Offset	Acronym	Register Name	Section
544h	LINK_QUAL_2		<a href="#">Section 7.2.42</a>
545h	LINK_DOWN_LATCH_STAT		<a href="#">Section 7.2.43</a>
547h	LINK_QUAL_3		<a href="#">Section 7.2.44</a>
548h	LINK_QUAL_4		<a href="#">Section 7.2.45</a>
552h	RS_DECODER_FRAME_STAT_2		<a href="#">Section 7.2.46</a>
553h	RS_DECODER_FRAME_STAT_3		<a href="#">Section 7.2.47</a>
600h	RGMI_CTRL		<a href="#">Section 7.2.48</a>
601h	RGMI_FIFO_STATUS		<a href="#">Section 7.2.49</a>
602h	RGMI_DELAY_CTRL		<a href="#">Section 7.2.50</a>
608h	SGMI_CTRL_1		<a href="#">Section 7.2.51</a>
60Ah	SGMI_STATUS		<a href="#">Section 7.2.52</a>
60Ch	SGMI_CTRL_2		<a href="#">Section 7.2.53</a>
60Dh	SGMI_FIFO_STATUS		<a href="#">Section 7.2.54</a>
618h	PRBS_STATUS_1		<a href="#">Section 7.2.55</a>
619h	PRBS_CTRL_1		<a href="#">Section 7.2.56</a>
61Ah	PRBS_CTRL_2		<a href="#">Section 7.2.57</a>
61Bh	PRBS_CTRL_3		<a href="#">Section 7.2.58</a>
61Ch	PRBS_STATUS_2		<a href="#">Section 7.2.59</a>
61Dh	PRBS_STATUS_3		<a href="#">Section 7.2.60</a>
61Eh	PRBS_STATUS_4		<a href="#">Section 7.2.61</a>
620h	PRBS_STATUS_6		<a href="#">Section 7.2.62</a>
622h	PRBS_STATUS_8		<a href="#">Section 7.2.63</a>
623h	PRBS_STATUS_9		<a href="#">Section 7.2.64</a>
624h	PRBS_CTRL_4		<a href="#">Section 7.2.65</a>
625h	PRBS_CTRL_5		<a href="#">Section 7.2.66</a>
626h	PRBS_CTRL_6		<a href="#">Section 7.2.67</a>
627h	PRBS_CTRL_7		<a href="#">Section 7.2.68</a>
628h	PRBS_CTRL_8		<a href="#">Section 7.2.69</a>
629h	PRBS_CTRL_9		<a href="#">Section 7.2.70</a>
62Ah	PRBS_CTRL_10		<a href="#">Section 7.2.71</a>
638h	CRC_STATUS		<a href="#">Section 7.2.72</a>
639h	PKT_STAT_1		<a href="#">Section 7.2.73</a>
63Ah	PKT_STAT_2		<a href="#">Section 7.2.74</a>
63Bh	PKT_STAT_3		<a href="#">Section 7.2.75</a>
63Ch	PKT_STAT_4		<a href="#">Section 7.2.76</a>
63Dh	PKT_STAT_5		<a href="#">Section 7.2.77</a>
63Eh	PKT_STAT_6		<a href="#">Section 7.2.78</a>
871h	SQI_REG_1		<a href="#">Section 7.2.79</a>
874h	DSP_REG_74		<a href="#">Section 7.2.80</a>
875h	DSP_REG_75		<a href="#">Section 7.2.81</a>
1000h	PMA_PMD_CONTROL_1		<a href="#">Section 7.2.82</a>
1007h	PMA_PMD_CONTROL_2		<a href="#">Section 7.2.83</a>
1009h	PMA_PMD_TRANSMIT_DISABLE		<a href="#">Section 7.2.84</a>
100Bh	PMA_PMD_EXTENDED_ABILITY2		<a href="#">Section 7.2.85</a>

**Table 7-3. DP83TG720 Registers (continued)**

Offset	Acronym	Register Name	Section
1012h	PMA_PMD_EXTENDED_ABILITY		<a href="#">Section 7.2.86</a>
1834h	PMA_PMD_CONTROL		<a href="#">Section 7.2.87</a>
1900h	PMA_CONTROL		<a href="#">Section 7.2.88</a>
1901h	PMA_STATUS		<a href="#">Section 7.2.89</a>
1902h	TRAINING		<a href="#">Section 7.2.90</a>
1903h	LP_TRAINING		<a href="#">Section 7.2.91</a>
1904h	TEST_MODE_CONTROL		<a href="#">Section 7.2.92</a>
3900h	PCS_CONTROL		<a href="#">Section 7.2.93</a>
3901h	PCS_STATUS		<a href="#">Section 7.2.94</a>
3902h	PCS_STATUS_2		<a href="#">Section 7.2.95</a>
3904h	OAM_TRANSMIT		<a href="#">Section 7.2.96</a>
3905h	OAM_TX_MESSAGE_1		<a href="#">Section 7.2.97</a>
3906h	OAM_TX_MESSAGE_2		<a href="#">Section 7.2.98</a>
3907h	OAM_TX_MESSAGE_3		<a href="#">Section 7.2.99</a>
3908h	OAM_TX_MESSAGE_4		<a href="#">Section 7.2.100</a>
3909h	OAM_RECEIVE		<a href="#">Section 7.2.101</a>
390Ah	OAM_RX_MESSAGE_1		<a href="#">Section 7.2.102</a>
390Bh	OAM_RX_MESSAGE_2		<a href="#">Section 7.2.103</a>
390Ch	OAM_RX_MESSAGE_3		<a href="#">Section 7.2.104</a>
390Dh	OAM_RX_MESSAGE_4		<a href="#">Section 7.2.105</a>
7200h	AN_CFG		<a href="#">Section 7.2.106</a>

Complex bit access types are encoded to fit into small table cells. [Table 7-4](#) shows the codes that are used for access types in this section.

**Table 7-4. DP83TG720 Access Type Codes**

Access Type	Code	Description
Read Type		
R	R	Read
Write Type		
W	W	Write
W0C	W 0C	Write 0 to clear
W0S	W 0S	Write 0 to set
WMC	W	Write
WMC,0	W	Write
WMC,1	W	Write
WSC	W	Write
WSC,0	W	Write
Reset or Default Value		
-n		Value after reset or the default value

### 7.2.1 BMCR Register (Offset = 0h) [Reset = 0140h]

BMCR is shown in [Figure 7-1](#) and described in [Table 7-5](#).

Return to the [Summary Table](#).

**Figure 7-1. BMCR Register**

15		14		13		12		11		10		9		8	
mii_reset		loopback		RESERVED		RESERVED		power_down		isolate		RESERVED		RESERVED	
R/WMC-0h		R/W-0h		R-0h		R-0h		R/W-0h		R/W-0h		R-0h		R-0h	
7		6		5		4		3		2		1		0	
RESERVED		speed_sel_msb		RESERVED		RESERVED									
R-0h		R-1h		R-0h		R-0h									

**Table 7-5. BMCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	mii_reset	R/WMC	0h	1b = Digital in reset and all MII regs (0x0 - 0xF) reset to default 0b = No reset
14	loopback	R/W	0h	1b = MII loopback 0b = No MII loopback
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	power_down	R/W	0h	1b = Power down via register or pin 0b = Normal mode
10	isolate	R/W	0h	1b = MAC isolate mode (No output to MAC from the PHY) 0b = Normal Mode
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	speed_sel_msb	R	1h	0b= Reserved 1b= 1000Mb/s
5	RESERVED	R	0h	Reserved
4-0	RESERVED	R	0h	Reserved

### 7.2.2 BMSR Register (Offset = 1h) [Reset = 0141h]

BMSR is shown in [Figure 7-2](#) and described in [Table 7-6](#).

Return to the [Summary Table](#).

**Figure 7-2. BMSR Register**

15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	extended_status		
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h			R-1h
7		6		5		4		3		2		1		0	
unidirectional_ability	preamble_supression	aneg_complete	remote_fault	aneg_ability	link_status	jabber_detect	extended_capability								
R-0h	R-1h	R-0h	R/W0C-0h	R-0h	R/W0S-0h	R/W0C-0h									R-1h

**Table 7-6. BMSR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	extended_status	R	1h	1b = Extended status information in Register 15 0b = No extended status information in Register 15
7	unidirectional_ability	R	0h	Reserved
6	preamble_supression	R	1h	1b = PHY accepts management frames with preamble suppressed. 0b = PHY does not accept management frames with preamble suppressed
5	aneg_complete	R	0h	Reserved
4	remote_fault	R/W0C	0h	Reserved
3	aneg_ability	R	0h	Reserved
2	link_status	R/W0S	0h	1b = link is up 0b = link down
1	jabber_detect	R/W0C	0h	Reserved
0	extended_capability	R	1h	1b = extended register capabilities 0b = basic register set capabilities only

### 7.2.3 PHYID1 Register (Offset = 2h) [Reset = 2000h]

PHYID1 is shown in [Figure 7-3](#) and described in [Table 7-7](#).

Return to the [Summary Table](#).

**Figure 7-3. PHYID1 Register**

15	14	13	12	11	10	9	8
oui_21_16							
R-2000h							
7	6	5	4	3	2	1	0
oui_21_16							
R-2000h							

**Table 7-7. PHYID1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	oui_21_16	R	2000h	Unique identifier for the part

### 7.2.4 PHYID2 Register (Offset = 3h) [Reset = A284h]

PHYID2 is shown in [Figure 7-4](#) and described in [Table 7-8](#).

Return to the [Summary Table](#).

**Figure 7-4. PHYID2 Register**

15	14	13	12	11	10	9	8
oui_5_0						model_number	
R-28h						R-28h	
7	6	5	4	3	2	1	0
model_number				rev_number			
R-28h				R-4h			

**Table 7-8. PHYID2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	oui_5_0	R	28h	Unique identifier for the part
9-4	model_number	R	28h	Unique identifier for the part
3-0	rev_number	R	4h	Unique identifier for the part

### 7.2.5 REGCR Register (Offset = Dh) [Reset = 0000h]

REGCR is shown in [Figure 7-5](#) and described in [Table 7-9](#).

Return to the [Summary Table](#).

**Figure 7-5. REGCR Register**

15	14	13	12	11	10	9	8
Extended Register Command			RESERVED				
R/W-0h				R-0h			
7	6	5	4	3	2	1	0
RESERVED			DEVAD				
R-0h				R/W-0h			

**Table 7-9. REGCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	Extended Register Command	R/W	0h	00b = Address 01b = Data, no post increment 10b = Data, post increment on read and write 11b = Data, post increment on write only
13-5	RESERVED	R	0h	Reserved
4-0	DEVAD	R/W	0h	MMD field for indirect register access

### 7.2.6 ADDAR Register (Offset = Eh) [Reset = 0000h]

ADDAR is shown in [Figure 7-6](#) and described in [Table 7-10](#).

Return to the [Summary Table](#).

**Figure 7-6. ADDAR Register**

15	14	13	12	11	10	9	8
Address/Data							
R/W-0h							
7	6	5	4	3	2	1	0
Address/Data							
R/W-0h							

**Table 7-10. ADDAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	Address/Data	R/W	0h	Address Data field for indirect register access

### 7.2.7 MII\_REG\_10 Register (Offset = 10h) [Reset = 0004h]

MI\_REG\_10 is shown in [Figure 7-7](#) and described in [Table 7-11](#).

Return to the [Summary Table](#).

**Figure 7-7. MII\_REG\_10 Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED		descr_lock_bit	RESERVED
R-0h				R-0h		R/W0S-0h	R-0h
7	6	5	4	3	2	1	0
mii_int_bit	RESERVED			mii_loopback	duplex_mode_env	RESERVED	link_status_bit
R-0h	R-0h			R-0h	R-1h	R-0h	R-0h

**Table 7-11. MII\_REG\_10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	descr_lock_bit	R/W0S	0h	1b = Descrambler is locked 0b = Descrambler is unlocked atleast once
8	RESERVED	R	0h	Reserved
7	mii_int_bit	R	0h	1b = Interrupt pin had been set 0b = Interrupts pin not set Cleared on Read
6-4	RESERVED	R	0h	Reserved
3	mii_loopback	R	0h	1b = MII loopback 0b = No MII loopback
2	duplex_mode_env	R	1h	1b = Full duplex 0b = Half duplex
1	RESERVED	R	0h	Reserved
0	link_status_bit	R	0h	1b = link is up 0b = link had been down

### 7.2.8 MII\_REG\_11 Register (Offset = 11h) [Reset = 000Bh]

MI\_REG\_11 is shown in [Figure 7-8](#) and described in [Table 7-12](#).

Return to the [Summary Table](#).

**Figure 7-8. MII\_REG\_11 Register**

15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED		RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
7		6		5		4		3		2		1		0	
RESERVED	RESERVED	RESERVED		RESERVED		RESERVED		int_polarity	force_interrupt	int_en		RESERVED		RESERVED	
R-0h		R-0h		R-0h		R-0h		R/W-1h		R/W-0h		R/W-1h		R-0h	

**Table 7-12. MII\_REG\_11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13-12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5-4	RESERVED	R	0h	Reserved
3	int_polarity	R/W	1h	1b = Active low 0b = Active high
2	force_interrupt	R/W	0h	1b = Force interrupt pin 0b = Do not force interrupt pin
1	int_en	R/W	1h	1b = Enable interrupts 0b = Disable interrupts
0	RESERVED	R	0h	Reserved

### 7.2.9 MII\_REG\_12 Register (Offset = 12h) [Reset = 0000h]

MII\_REG\_12 is shown in [Figure 7-9](#) and described in [Table 7-13](#).

Return to the [Summary Table](#).

**Figure 7-9. MII\_REG\_12 Register**

15		14		13		12		11		10		9		8	
RESERVED	energy_det_int	link_int	RESERVED	esd_int	ms_train_done_int	RESERVED	RESERVED								
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h								
7		6		5		4		3		2		1		0	
RESERVED	energy_det_int_en	link_int_en	RESERVED	esd_int_en	ms_train_done_int_en	RESERVED	RESERVED								
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R-0h	R-0h								

**Table 7-13. MII\_REG\_12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	energy_det_int	R	0h	Energy det change interrupt status
13	link_int	R	0h	Link status change interrupt status
12	RESERVED	R	0h	Reserved
11	esd_int	R	0h	ESD fault detected interrupt status
10	ms_train_done_int	R	0h	Training done interrupt status
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	energy_det_int_en	R/W	0h	Energy det change interrupt enable
5	link_int_en	R/W	0h	Link status change interrupt enable
4	RESERVED	R	0h	Reserved
3	esd_int_en	R/W	0h	ESD fault detected interrupt enable
2	ms_train_done_int_en	R/W	0h	Training done interrupt enable
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 7.2.10 MII\_REG\_13 Register (Offset = 13h) [Reset = 0000h]

MI\_REG\_13 is shown in [Figure 7-10](#) and described in [Table 7-14](#).

Return to the [Summary Table](#).

**Figure 7-10. MII\_REG\_13 Register**

15		14		13		12		11		10		9		8	
under_volt_int	over_volt_int	RESERVED	RESERVED	RESERVED	RESERVED	over_temp_int	RESERVED	RESERVED	pol_change_int	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7		6		5		4		3		2		1		0	
under_volt_int_en	over_volt_int_en	RESERVED	RESERVED	RESERVED	RESERVED	over_temp_int_en	RESERVED	RESERVED	pol_change_int_en	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R/W-0h	R/W-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h	R-0h	R-0h	R/W-0h	R-0h	R-0h	R/W-0h	R-0h	R-0h	R-0h

**Table 7-14. MII\_REG\_13 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	under_volt_int	R	0h	Under volt interrupt status
14	over_volt_int	R	0h	Over volt interrupt status
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	over_temp_int	R	0h	Over temp interrupt status
10	RESERVED	R	0h	Reserved
9	pol_change_int	R	0h	Data polarity change interrupt status
8	RESERVED	R	0h	Reserved
7	under_volt_int_en	R/W	0h	Under volt interrupt enable
6	over_volt_int_en	R/W	0h	Over volt interrupt enable
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	over_temp_int_en	R/W	0h	Over temp interrupt enable
2	RESERVED	R	0h	Reserved
1	pol_change_int_en	R/W	0h	Data Polarity change interrupt enable
0	RESERVED	R	0h	Reserved

**7.2.11 MII\_REG\_16 Register (Offset = 16h) [Reset = 0000h]**

MI\_REG\_16 is shown in [Figure 7-11](#) and described in [Table 7-15](#).

Return to the [Summary Table](#).

**Figure 7-11. MII\_REG\_16 Register**

15	14	13	12	11	10	9	8
RESERVED					RESERVED	RESERVED	core_pwr_mode
R-0h					R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	loopback_mode						
R-0h				R/W-0h			

**Table 7-15. MII\_REG\_16 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	core_pwr_mode	R	0h	1b = Core is in normal power mode 0b = Core is in power down or sleep mode
7	RESERVED	R	0h	Reserved
6-0	loopback_mode	R/W	0h	000001b = PCS loop 000010b = RS loop 000100b = Digital loop 001000b = Analog loop 010000b = Reverse loop

### 7.2.12 MII\_REG\_18 Register (Offset = 18h) [Reset = 0008h]

MI\_REG\_18 is shown in [Figure 7-12](#) and described in [Table 7-16](#).

Return to the [Summary Table](#).

**Figure 7-12. MII\_REG\_18 Register**

15		14		13		12		11		10		9		8	
ack_received_int	tx_valid_clr_int	RESERVED	RESERVED	RESERVED	RESERVED	por_done_int	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7		6		5		4		3		2		1		0	
ack_received_int_en	tx_valid_clr_int_en	RESERVED	RESERVED	RESERVED	RESERVED	por_done_int_en	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R/W-0h	R/W-0h	R-0h	R-0h	R-0h	R-0h	R/W-1h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 7-16. MII\_REG\_18 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	ack_received_int	R	0h	Ack received interrupt status (OAM)
14	tx_valid_clr_int	R	0h	mr_tx_valid clear interrupt status (OAM)
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	por_done_int	R	0h	POR done interrupt status
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	ack_received_int_en	R/W	0h	Ack received interrupt enable (OAM)
6	tx_valid_clr_int_en	R/W	0h	mr_tx_valid clear interrupt enable (OAM)
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	por_done_int_en	R/W	1h	POR done interrupt enable
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

**7.2.13 MII\_REG\_19 Register (Offset = 19h) [Reset = 00XXh]**

MI\_REG\_19 is shown in [Figure 7-13](#) and described in [Table 7-17](#).

Return to the [Summary Table](#).

**Figure 7-13. MII\_REG\_19 Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED		RESERVED	
R-0h				R-0h		R-0h	
7	6	5	4	3	2	1	0
RESERVED			SOR_PHYADDR				
R-0h			R-Xh				

**Table 7-17. MII\_REG\_19 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9-5	RESERVED	R	0h	Reserved
4-0	SOR_PHYADDR	R	X	PHY ADDRESS latched from strap

### 7.2.14 MII\_REG\_1E Register (Offset = 1Eh) [Reset = 0000h]

MI\_REG\_1E is shown in [Figure 7-14](#) and described in [Table 7-18](#).

Return to the [Summary Table](#).

**Figure 7-14. MII\_REG\_1E Register**

15	14	13	12	11	10	9	8
tdr_start	cfg_tdr_auto_run	RESERVED					
R/WMC-0h	R/W-0h	R-0h					
7	6	5	4	3	2	1	0
RESERVED						tdr_done	tdr_fail
R-0h						R-0h	R-0h

**Table 7-18. MII\_REG\_1E Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	tdr_start	R/WMC	0h	1b = TDR start Bit is cleared after TDR run is complete
14	cfg_tdr_auto_run	R/W	0h	1b = TDR start automatically on link down 0b = TDR start manually using 0x1E[15]
13-2	RESERVED	R	0h	Reserved
1	tdr_done	R	0h	TDR done status 1b = TDR done 0b = TDR on-going or not initiated
0	tdr_fail	R	0h	When tdr_done status is 1, this bit indicates if TDR ran successfully 1b = TDR run failed 0b = TDR ran successfully

### 7.2.15 MII\_REG\_1F Register (Offset = 1Fh) [Reset = 0000h]

MI\_REG\_1F is shown in [Figure 7-15](#) and described in [Table 7-19](#).

Return to the [Summary Table](#).

**Figure 7-15. MII\_REG\_1F Register**

15		14		13		12		11		10		9		8	
sw_global_reset		digital_reset		RESERVED		RESERVED									
R/WMC-0h		R/WMC-0h		R-0h		R-0h									
7		6		5		4		3		2		1		0	
RESERVED		RESERVED		RESERVED		RESERVED									
R-0h		R-0h		R-0h		R-0h									

**Table 7-19. MII\_REG\_1F Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	sw_global_reset	R/WMC	0h	Hardware reset - Reset digital + register file This bit is self clearing
14	digital_reset	R/WMC	0h	Soft reset - Reset only digital core This bit is self clearing
13	RESERVED	R	0h	Reserved
12-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4-0	RESERVED	R	0h	Reserved

### 7.2.16 LSR Register (Offset = 180h) [Reset = 0000h]

LSR is shown in [Figure 7-16](#) and described in [Table 7-20](#).

Return to the [Summary Table](#).

**Figure 7-16. LSR Register**

15		14		13		12		11		10		9		8	
link_up		link_down		phy_ctrl_send_data		link_status		RESERVED							
R-0h		R-0h		R-0h		R-0h		R-0h							
7		6		5		4		3		2		1		0	
RESERVED		RESERVED		RESERVED		RESERVED		channel_ok		descr_sync		loc_rcvr_status		rem_rcvr_status	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	

**Table 7-20. LSR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	link_up	R	0h	Link up as defined by CnS
14	link_down	R	0h	Link down as defined by CnS
13	phy_ctrl_send_data	R	0h	Phy control in send data status
12	link_status	R	0h	IEEE defined Live Link status
11-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	channel_ok	R	0h	channel okay status
2	descr_sync	R	0h	Descrambler lock status
1	loc_rcvr_status	R	0h	Local receiver status
0	rem_rcvr_status	R	0h	Remote receiver status

**7.2.17 LPS\_CFG2 Register (Offset = 18Bh) [Reset = 0000h]**

 LPS\_CFG2 is shown in [Figure 7-17](#) and described in [Table 7-21](#).

 Return to the [Summary Table](#).

**Figure 7-17. LPS\_CFG2 Register**

15	14	13	12	11	10	9	8
RESERVED							ed_en
R-0h							R/W-0h
7	6	5	4	3	2	1	0
sleep_en	cfg_auto_mode_en_strap	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R/W-0h	R/WMC,1-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 7-21. LPS\_CFG2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	RESERVED	R	0h	Reserved
8	ed_en	R/W	0h	1b = Enable energy detection on MDI 0b = Disable energy detection on MDI
7	sleep_en	R/W	0h	1b = Allow PHY to enter sleep 0b = Do not allow PHY to enter sleep
6	cfg_auto_mode_en_strap	R/WMC,1	0h	LPS autonomous mode enable 1b = PHY enters normal mode on power up 0b = PHY enters standby mode on power up
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 7.2.18 LPS\_CFG3 Register (Offset = 18Ch) [Reset = 0000h]

LPS\_CFG3 is shown in [Figure 7-18](#) and described in [Table 7-22](#).

Return to the [Summary Table](#).

**Figure 7-18. LPS\_CFG3 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	cfg_lps_pwr_mode_4	RESERVED	RESERVED	RESERVED	cfg_lps_pwr_mode_0
R-0h	R-0h	R-0h	R/WMC,0-0h	R-0h	R-0h	R-0h	R/WMC,0-0h

**Table 7-22. LPS\_CFG3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	cfg_lps_pwr_mode_4	R/WMC,0	0h	Set to enter standby mode
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	cfg_lps_pwr_mode_0	R/WMC,0	0h	Set to enter normal mode

**7.2.19 LPS\_STATUS Register (Offset = 18Eh) [Reset = 0000h]**

LPS\_STATUS is shown in [Figure 7-19](#) and described in [Table 7-23](#).

Return to the [Summary Table](#).

**Figure 7-19. LPS\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		status_lps_st					
R-0h		R-0h					

**Table 7-23. LPS\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R	0h	Reserved
6-0	status_lps_st	R	0h	Observe LPS state : 0x2 = Standby mode 0x4 = Normal mode

### 7.2.20 TDR\_TC12 Register (Offset = 30Fh) [Reset = 0000h]

TDR\_TC12 is shown in [Figure 7-20](#) and described in [Table 7-24](#).

Return to the [Summary Table](#).

**Figure 7-20. TDR\_TC12 Register**

15	14	13	12	11	10	9	8
RESERVED			fault_loc				
R-0h			R-0h				
7	6	5	4	3	2	1	0
tdr_state				RESERVED		tdr_activation	
R-0h				R-0h		R-0h	

**Table 7-24. TDR\_TC12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13-8	fault_loc	R	0h	See TC12
7-4	tdr_state	R	0h	See TC12
3-2	RESERVED	R	0h	Reserved
1-0	tdr_activation	R	0h	See TC12

**7.2.21 A2D\_REG\_05 Register (Offset = 405h) [Reset = 6400h]**

A2D\_REG\_05 is shown in [Figure 7-21](#) and described in [Table 7-25](#).

Return to the [Summary Table](#).

**Figure 7-21. A2D\_REG\_05 Register**

15	14	13	12	11	10	9	8
ld_bias_1p0v_sl						RESERVED	
R/W-19h						R-0h	
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-25. A2D\_REG\_05 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	ld_bias_1p0v_sl	R/W	19h	Bits to control the DAC current of LD and hence the swing. 001010b = 400mV 001011b = 440mV 001100b = 480mV 001101b = 520mV 001110b = 560mV 001111b = 600mV 010000b = 640mV 010001b = 680mV 010010b = 720mV 010011b = 760mV 010100b = 800mV 010101b = 840mV 010110b = 880mV 010111b = 920mV 011000b = 960mV 011001b = 1000mV 011010b = 1040mV 011011b = 1080mV 011100b = 1120mV 011101b = 1160mV 011110b = 1200mV
9-0	RESERVED	R	0h	Reserved

### 7.2.22 A2D\_REG\_30 Register (Offset = 41Eh) [Reset = 0000h]

A2D\_REG\_30 is shown in [Figure 7-22](#) and described in [Table 7-26](#).

Return to the [Summary Table](#).

**Figure 7-22. A2D\_REG\_30 Register**

15	14	13	12	11	10	9	8
RESERVED							spare_in_2_fromdig_sl_force_en
R-0h							R/W-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED			
R-0h	R-0h	R-0h	R-0h	R-0h			

**Table 7-26. A2D\_REG\_30 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	RESERVED	R	0h	Reserved
8	spare_in_2_fromdig_sl_force_en	R/W	0h	Force control enable for Reg0x042F
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3-0	RESERVED	R	0h	Reserved

**7.2.23 A2D\_REG\_40 Register (Offset = 428h) [Reset = 6002h]**

A2D\_REG\_40 is shown in [Figure 7-23](#) and described in [Table 7-27](#).

Return to the [Summary Table](#).

**Figure 7-23. A2D\_REG\_40 Register**

15	14	13	12	11	10	9	8
RESERVED	SGMII_TESTMODE		RESERVED	SGMII_SOP_SON_SLEW_CTRL	RESERVED	RESERVED	
R-0h	R/W-3h		R-0h	R/W-0h	R-0h	R-0h	
7	6	5	4	3	2	1	0
RESERVED	RESERVED					RESERVED	
R-0h	R-0h					R-0h	

**Table 7-27. A2D\_REG\_40 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-13	SGMII_TESTMODE	R/W	3h	00b = 1000mV Sgmii output swing 01b = 1260mV Sgmii output swing 10b = 900mV Sgmii output swing 11b = 720mV Sgmii output swing
12	RESERVED	R	0h	Reserved
11	SGMII_SOP_SON_SLEW_CTRL	R/W	0h	0b =Default output rise/fall time 1b = Slow output rise/fall time
10	RESERVED	R	0h	Reserved
9-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6-1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 7.2.24 A2D\_REG\_41 Register (Offset = 429h) [Reset = 0030h]

A2D\_REG\_41 is shown in [Figure 7-24](#) and described in [Table 7-28](#).

Return to the [Summary Table](#).

**Figure 7-24. A2D\_REG\_41 Register**

15	14	13	12	11	10	9	8
RESERVED					RESERVED	RESERVED	RESERVED
R-0h				R-0h		R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED						SGMII_IO_LOOPBACK_EN	RESERVED
R-0h						R/W-0h	R-0h

**Table 7-28. A2D\_REG\_41 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7-2	RESERVED	R	0h	Reserved
1	SGMII_IO_LOOPBACK_EN	R/W	0h	1b = Connects RX and TX signals internally to provide internal loopback option without external components.
0	RESERVED	R	0h	Reserved

### 7.2.25 A2D\_REG\_44 Register (Offset = 42Ch) [Reset = 0000h]

A2D\_REG\_44 is shown in [Figure 7-25](#) and described in [Table 7-29](#).

Return to the [Summary Table](#).

**Figure 7-25. A2D\_REG\_44 Register**

15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
7		6		5		4		3		2		1		0	
RESERVED	RESERVED	RESERVED	RESERVED	SGMII_DIG_LO OPBACK_EN	RESERVED						RESERVED				
R-0h		R-0h		R-0h		R/W-0h		R-0h		R-0h		R-0h		R-0h	

**Table 7-29. A2D\_REG\_44 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	SGMII_DIG_LOOPBACK_EN	R/W	0h	1b = Loops back TX data to RX before the IO
3-1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 7.2.26 A2D\_REG\_47 Register (Offset = 42Fh) [Reset = 0000h]

A2D\_REG\_47 is shown in [Figure 7-26](#) and described in [Table 7-30](#).

Return to the [Summary Table](#).

**Figure 7-26. A2D\_REG\_47 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	spare_in_2_fro mdig_sl_2	spare_in_2_fro mdig_sl_1	spare_in_2_fro mdig_sl_0
R-0h				R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-30. A2D\_REG\_47 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	spare_in_2_fromdig_sl_2	R/W	0h	energy lost indication force control value
1	spare_in_2_fromdig_sl_1	R/W	0h	energy lost detector enable force control value
0	spare_in_2_fromdig_sl_0	R/W	0h	[0] - sleep enable force control value Force control enable is controlled by reg0x041E[8]

**7.2.27 A2D\_REG\_48 Register (Offset = 430h) [Reset = 0960h]**

A2D\_REG\_48 is shown in [Figure 7-27](#) and described in [Table 7-31](#).

Return to the [Summary Table](#).

**Figure 7-27. A2D\_REG\_48 Register**

15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	DLL_TX_DELAY_CTRL_SL			
R-0h	R-0h	R-0h	R-0h	R/W-9h			
7	6	5	4	3	2	1	0
DLL_RX_DELAY_CTRL_SL				RESERVED			
R/W-6h				R-0h			

**Table 7-31. A2D\_REG\_48 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11-8	DLL_TX_DELAY_CTRL_SL	R/W	9h	Refer to electrical specification for delay vs code information.
7-4	DLL_RX_DELAY_CTRL_SL	R/W	6h	Refer to electrical specification for delay vs code information.
3-0	RESERVED	R	0h	Reserved

**7.2.28 A2D\_REG\_66 Register (Offset = 442h) [Reset = 0000h]**

A2D\_REG\_66 is shown in [Figure 7-28](#) and described in [Table 7-32](#).

Return to the [Summary Table](#).

**Figure 7-28. A2D\_REG\_66 Register**

15	14	13	12	11	10	9	8
RESERVED		esd_event_count				RESERVED	
R-0h		R-0h				R-0h	
7	6	5	4	3	2	1	0
RESERVED			RESERVED		RESERVED		
R-0h			R-0h		R-0h		

**Table 7-32. A2D\_REG\_66 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-9	esd_event_count	R	0h	Number gives the number of esd events on the copper channel
8	RESERVED	R	0h	Reserved
7-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3-0	RESERVED	R	0h	Reserved

### 7.2.29 LEDS\_CFG\_1 Register (Offset = 450h) [Reset = 2610h]

LEDS\_CFG\_1 is shown in [Figure 7-29](#) and described in [Table 7-33](#).

Return to the [Summary Table](#).

**Figure 7-29. LEDS\_CFG\_1 Register**

15	14	13	12	11	10	9	8
RESERVED	leds_bypass_str etching	leds_blink_rate		led_2_option			
R-0h	R/W-0h	R/W-2h		R/W-6h			
7	6	5	4	3	2	1	0
led_1_option				led_0_option			
R/W-1h				R/W-0h			

**Table 7-33. LEDS\_CFG\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	leds_bypass_stretching	R/W	0h	Bypass LED Signal Stretch
13-12	leds_blink_rate	R/W	2h	Blink Rate for the LED - 00b = 20Hz (50mSec) 01b = 10Hz (100mSec) 10b = 5Hz (200mSec) 11b = 2Hz (500mSec)
11-8	led_2_option	R/W	6h	0000b = link OK 0001b = link OK + blink on TX/RX activity 0010b = link OK + blink on TX activity 0011b = link OK + blink on RX activity 0100b = link OK + 100Base-T1 Master 0101b = link OK + 100Base-T1 Slave 0110b = TX/RX activity with stretch option 0111b = Reserved 1000b = Reserved 1001b = Link lost (remains on until register 0x1 is read) 1010b = PRBS error latch until cleared by 0x620(1) 1011b = XMII TX/RX Error with stretch option
7-4	led_1_option	R/W	1h	0000b = link OK 0001b = link OK + blink on TX/RX activity 0010b = link OK + blink on TX activity 0011b = link OK + blink on RX activity 0100b = link OK + 100Base-T1 Master 0101b = link OK + 100Base-T1 Slave 0110b = TX/RX activity with stretch option 0111b = Reserved 1000b = Reserved 1001b = Link lost (remains on until register 0x1 is read) 1010b = PRBS error (latch until cleared by 0x620(1)) 1011b = XMII TX/RX Error with stretch option
3-0	led_0_option	R/W	0h	0000b = link OK 0001b = link OK + blink on TX/RX activity 0010b = link OK + blink on TX activity 0011b = link OK + blink on RX activity 0100b = link OK + 100Base-T1 Master 0101b = link OK + 100Base-T1 Slave 0110b = TX/RX activity with stretch option 0111b = Reserved 1000b = Reserved 1001b = Link lost (remains on until register 0x1 is read) 1010b = PRBS error (latch until cleared by 0x620(1)) 1011b = XMII TX/RX Error with stretch option

### 7.2.30 LEDS\_CFG\_2 Register (Offset = 451h) [Reset = 0000h]

LEDS\_CFG\_2 is shown in [Figure 7-30](#) and described in [Table 7-34](#).

Return to the [Summary Table](#).

**Figure 7-30. LEDS\_CFG\_2 Register**

15	14	13	12	11	10	9	8
RESERVED		RESERVED				XXXX	RESERVED
R-0h		R-0h				R-0h	
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	RESERVED	led_1_polarity	RESERVED	RESERVED	led_0_polarity
R-0h	R-0h	R-0h	R-0h	R/W-0h	R-0h	R-0h	R/W-0h

**Table 7-34. LEDS\_CFG\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13-10	RESERVED	R	0h	Reserved
11-9	cfg_ieee_compl_sel	R/W	0h	Observe IEEE Compliance signals in LED_0_GPIO_0, when LED_0_GPIO_CTRL= 'h5 as follows - 000b = loc_rcvr_status 001b = rem_rcvr_status 010b = loc_snr_margin 011b = rem_phy_ready 100b = pma_watchdog_status 101b = link_sync_link_control
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	led_1_polarity	R/W	0h	LED_1 polarity
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	led_0_polarity	R/W	0h	LED_0 polarity

**7.2.31 IO\_MUX\_CFG\_1 Register (Offset = 452h) [Reset = 0000h]**

IO\_MUX\_CFG\_1 is shown in [Figure 7-31](#) and described in [Table 7-35](#).

Return to the [Summary Table](#).

**Figure 7-31. IO\_MUX\_CFG\_1 Register**

15	14	13	12	11	10	9	8
RESERVED		RESERVED			led_1_gpio_ctrl		
R-0h		R-0h			R/W-0h		
7	6	5	4	3	2	1	0
RESERVED		RESERVED			led_0_gpio_ctrl		
R-0h		R-0h			R/W-0h		

**Table 7-35. IO\_MUX\_CFG\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13-11	RESERVED	R	0h	Reserved
10-8	led_1_gpio_ctrl	R/W	0h	Controls the output of LED_1 IO - 000b = LED_1 (default: link OK + blink on TX/RX activity) 001b = Reserved 010b = RGMII data match indication 011b = Under-Voltage indication 100b = Interrupt 101b = IEEE compliance signals 110b = constant 0 111b = constant 1
7-6	RESERVED	R	0h	Reserved
5-3	RESERVED	R	0h	Reserved
2-0	led_0_gpio_ctrl	R/W	0h	Controls the output of LED_0 IO: 000b = LED_0 (default: LINK) 001b = Reserved 010b = RGMII data match indication 011b = Under-Voltage indication 100b = Interrupt 101b = IEEE compliance signals (see 0x451[11:9]) 110b = constant 0 111b = constant 1

**7.2.32 IO\_MUX\_CFG\_2 Register (Offset = 453h) [Reset = 0001h]**

IO\_MUX\_CFG\_2 is shown in [Figure 7-32](#) and described in [Table 7-36](#).

Return to the [Summary Table](#).

**Figure 7-32. IO\_MUX\_CFG\_2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		clk_o_clk_source			clk_o_gpio_ctrl		
R-0h		R/W-0h			R/W-1h		

**Table 7-36. IO\_MUX\_CFG\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5-3	clk_o_clk_source	R/W	0h	Clock Observable in CLK_O pin - 000b = xi_osc_25m_1p0v_dl (25MHz crystal output - from analog) 001b = Reserved 010b = Reserved 011b = 125MHz clock 100b = 125MHz clock 101b = Reserved 110b = Reserved 111b = Reserved
2-0	clk_o_gpio_ctrl	R/W	1h	Controls the output of CLK_O IO - 000b = LED_2 (default: TX/RX activity with stretch option(LED_2_OPTION=0x6)) 001b = Clock out (see 0x453[5:3]) 010b = RGMII data match indication 011b = Under-Voltage indication 100b = constant 0 101b = constant 0 110b = constant 0 111b = constant 1

**7.2.33 IO\_CONTROL\_3 Register (Offset = 456h) [Reset = 0108h]**

IO\_CONTROL\_3 is shown in [Figure 7-33](#) and described in [Table 7-37](#).

Return to the [Summary Table](#).

**Figure 7-33. IO\_CONTROL\_3 Register**

15	14	13	12	11	10	9	8
RESERVED						cfg_mac_rx_impedance	
R-0h						R/W-8h	
7	6	5	4	3	2	1	0
cfg_mac_rx_impedance			RESERVED				
R/W-8h			R-0h				

**Table 7-37. IO\_CONTROL\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-5	cfg_mac_rx_impedance	R/W	8h	Slew Rate Control for RGMII pads - 01010b = Medium Slew (OA tr/ta compliant, max tr/ta = 1ns) 01011b = Slowest Slew (For low emissions, max tr/ta = 1.2ns) 01000b = Default mode (rgmii tr/ta compliant, max tr/ta=750ps)
4-0	RESERVED	R	0h	Reserved

### 7.2.34 SOR\_VECTOR\_1 Register (Offset = 45Dh) [Reset = 0000h]

SOR\_VECTOR\_1 is shown in [Figure 7-34](#) and described in [Table 7-38](#).

Return to the [Summary Table](#).

Strap Status Register:

This register has information on modes selected based on straps. Any override of mode using other registers will not be reflected in this register

**Figure 7-34. SOR\_VECTOR\_1 Register**

15	14	13	12	11	10	9	8
RGMII_TX_SHIFT	RGMII_RX_SHIFT	SGMII_EN	RGMII_EN	RESERVED			MAC_MODE
R-0h	R-0h	R-0h	R-0h	R-0h			R-0h
7	6	5	4	3	2	1	0
MAC_MODE		MAS/SLV	PHY_AD				
R-0h		R-0h	R-0h				

**Table 7-38. SOR\_VECTOR\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RGMII_TX_SHIFT	R	0h	0x0 = TX shift disabled 0x1 = TX shift enabled
14	RGMII_RX_SHIFT	R	0h	0x0 = RX shift disabled 0x1 = RX shift enabled
13	SGMII_EN	R	0h	0x0 = SGMII disabled 0x1 = SGMII enabled
12	RGMII_EN	R	0h	0x0 = RGMII disabled 0x1 = RGMII enabled
11-9	RESERVED	R	0h	Reserved
8-6	MAC_MODE	R	0h	0x0 = SGMII 0x1 = Reserved 0x2 = Reserved 0x3 = Reserved 0x4 = RGMII align 0x5 = RGMII TX shift 0x6 = RGMII TX and RX shift 0x7 = RGMII RX shift
5	MAS/SLV	R	0h	0x0 = Slave 0x1 = Master
4-0	PHY_AD	R	0h	0x0 = PHY address 0 0x4 = PHY address 4 0x5 = PHY address 5 0x8 = PHY address 8 0xA = PHY address A 0xC = PHY address C 0xD = PHY address D 0xE = PHY address E 0xF = PHY address F

**7.2.35 SOR\_VECTOR\_2 Register (Offset = 45Eh) [Reset = 0000h]**

 SOR\_VECTOR\_2 is shown in [Figure 7-35](#) and described in [Table 7-39](#).

 Return to the [Summary Table](#).

Strap Status Register:

This register has information on modes selected based on straps. Any override of mode using other registers will not be reflected in this register

**Figure 7-35. SOR\_VECTOR\_2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							AUTO/ MANAGED
R-0h							R-0h

**Table 7-39. SOR\_VECTOR\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	AUTO/MANAGED	R	0h	0x0 = Autonomous mode enabled 0x1 = Managed mode enabled

### 7.2.36 MONITOR\_CTRL2 Register (Offset = 468h) [Reset = 0920h]

MONITOR\_CTRL2 is shown in [Figure 7-36](#) and described in [Table 7-40](#).

Return to the [Summary Table](#).

**Figure 7-36. MONITOR\_CTRL2 Register**

15	14	13	12	11	10	9	8
RESERVED	cfg_rd_data			RESERVED			RESERVED
R-0h	R/W-0h			R-0h			R-0h
7	6	5	4	3	2	1	0
RESERVED		RESERVED			RESERVED		
R-0h		R-0h			R-0h		

**Table 7-40. MONITOR\_CTRL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-12	cfg_rd_data	R/W	0h	Sensor select for read-out: 001b = VDDA 010b = VDD1P0 011b = VDDIO 100b = Temperature
11-9	RESERVED	R	0h	Reserved
8-6	RESERVED	R	0h	Reserved
5-3	RESERVED	R	0h	Reserved
2-0	RESERVED	R	0h	Reserved

**7.2.37 MONITOR\_CTRL4 Register (Offset = 46Ah) [Reset = 0094h]**

 MONITOR\_CTRL4 is shown in [Figure 7-37](#) and described in [Table 7-41](#).

 Return to the [Summary Table](#).

**Figure 7-37. MONITOR\_CTRL4 Register**

15	14	13	12	11	10	9	8
RESERVED							RESERVED
R-0h							R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED		RESERVED	cfg_reset	periodic	start
R-0h	R-0h	R-0h		R-0h	R/W-1h	R/W-0h	R/WSC-0h

**Table 7-41. MONITOR\_CTRL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	cfg_reset	R/W	1h	0b = Enable the monitor 1b = Monitor is held in reset state At any point of time, if the signal is changed to 1, the module abruptly goes to reset state
1	periodic	R/W	0h	0b = Monitor is enabled only when start is set for one iteration 1b = Monitor is enabled for periodic iteration
0	start	R/WSC	0h	Start indication for sensor monitor FSM, self clearing

**7.2.38 MONITOR\_STAT1 Register (Offset = 47Bh) [Reset = 0000h]**

 MONITOR\_STAT1 is shown in [Figure 7-38](#) and described in [Table 7-42](#).

 Return to the [Summary Table](#).

**Figure 7-38. MONITOR\_STAT1 Register**

15	14	13	12	11	10	9	8
stat_rd_data							
R-0h							
7	6	5	4	3	2	1	0
stat_rd_data							
R-0h							

**Table 7-42. MONITOR\_STAT1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	stat_rd_data	R	0h	Read sensor data

**7.2.39 RS\_DECODER Register (Offset = 510h) [Reset = 2D50h]**

RS\_DECODER is shown in [Figure 7-39](#) and described in [Table 7-43](#).

Return to the [Summary Table](#).

**Figure 7-39. RS\_DECODER Register**

15	14	13	12	11	10	9	8
cfg_rs_decoder_bypass	RESERVED	RESERVED					
R/W-0h	R-0h	R-0h					
7	6	5	4	3	2	1	0
RESERVED							RESERVED
R-0h							R-0h

**Table 7-43. RS\_DECODER Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	cfg_rs_decoder_bypass	R/W	0h	Bypass RS decoder 0h = RS decoder in use 1h = Bypass RS decoder
14	RESERVED	R	0h	Reserved
13-8	RESERVED	R	0h	Reserved
7-1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 7.2.40 TRAINING\_RX\_STATUS\_7 Register (Offset = 52Bh) [Reset = 0000h]

TRAINING\_RX\_STATUS\_7 is shown in [Figure 7-40](#) and described in [Table 7-44](#).

Return to the [Summary Table](#).

**Figure 7-40. TRAINING\_RX\_STATUS\_7 Register**

15	14	13	12	11	10	9	8
RESERVED			rx_rvrs_pol	RESERVED			
R-0h			R-0h	R-0h			
7	6	5	4	3	2	1	0
RESERVED				RESERVED			
R-0h				R-0h			

**Table 7-44. TRAINING\_RX\_STATUS\_7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	rx_rvrs_pol	R	0h	Received polarity 0h = Polarity decoded from received is not inverted 1h = Polarity decoded from receiver is inverted
11-8	RESERVED	R	0h	Reserved
7-4	RESERVED	R	0h	Reserved
3-0	RESERVED	R	0h	Reserved

**7.2.41 LINK\_QUAL\_1 Register (Offset = 543h) [Reset = 0000h]**

LINK\_QUAL\_1 is shown in [Figure 7-41](#) and described in [Table 7-45](#).

Return to the [Summary Table](#).

**Figure 7-41. LINK\_QUAL\_1 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
link_training_time							
R-0h							

**Table 7-45. LINK\_QUAL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	link_training_time	R	0h	Link training time in ms (TC12)

### 7.2.42 LINK\_QUAL\_2 Register (Offset = 544h) [Reset = 0000h]

LINK\_QUAL\_2 is shown in [Figure 7-42](#) and described in [Table 7-46](#).

Return to the [Summary Table](#).

**Figure 7-42. LINK\_QUAL\_2 Register**

15	14	13	12	11	10	9	8
remote_receiver_time							
R-0h							
7	6	5	4	3	2	1	0
local_receiver_time							
R-0h							

**Table 7-46. LINK\_QUAL\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	remote_receiver_time	R	0h	Remote receiver time in ms (TC12)
7-0	local_receiver_time	R	0h	Local receiver time in ms (TC12)

**7.2.43 LINK\_DOWN\_LATCH\_STAT Register (Offset = 545h) [Reset = 0000h]**

 LINK\_DOWN\_LATCH\_STAT is shown in [Figure 7-43](#) and described in [Table 7-47](#).

 Return to the [Summary Table](#).

**Figure 7-43. LINK\_DOWN\_LATCH\_STAT Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		channel_ok_ll	link_fail_inhibit_lh	send_s_sigdet_lh	hi_rfer_lh	block_lock_ll	pma_watchdog_ll
R-0h		R/W0C-0h	R/W0C-0h	R/W0C-0h	R/W0C-0h	R/W0S-0h	R/W0S-0h

**Table 7-47. LINK\_DOWN\_LATCH\_STAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5	channel_ok_ll	R/W0C	0h	1b = Channel ok was never de-asserted 0b = Channel ok was de-asserted
4	link_fail_inhibit_lh	R/W0C	0h	1b = Link fail inhibit assertion was reported 0b = Link fail inhibit assertion was never reported
3	send_s_sigdet_lh	R/W0C	0h	1b = Send s sigdet assertion was reported 0b = Send s sigdet assertion was never reported
2	hi_rfer_lh	R/W0C	0h	1b = High ri rfer assertion was reported 0b = High ri rfer assertion was never reported
1	block_lock_ll	R/W0S	0h	1b = Block lock de-assertion was never reported 0b = Block lock de-assertion was never reported
0	pma_watchdog_ll	R/W0S	0h	1b = Low pma watchdog was never reported 0b = Low pma watchdof was reported

**7.2.44 LINK\_QUAL\_3 Register (Offset = 547h) [Reset = 0000h]**

LINK\_QUAL\_3 is shown in [Figure 7-44](#) and described in [Table 7-48](#).

Return to the [Summary Table](#).

**Figure 7-44. LINK\_QUAL\_3 Register**

15	14	13	12	11	10	9	8
link_loss_cnt						link_fail_cnt	
R-0h						R-0h	
7	6	5	4	3	2	1	0
link_fail_cnt							
R-0h							

**Table 7-48. LINK\_QUAL\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	link_loss_cnt	R	0h	Link loss count since last power cycle (TC12)
9-0	link_fail_cnt	R	0h	Link fail without link loss count since last power cycle (TC12)

**7.2.45 LINK\_QUAL\_4 Register (Offset = 548h) [Reset = 0000h]**

LINK\_QUAL\_4 is shown in [Figure 7-45](#) and described in [Table 7-49](#).

Return to the [Summary Table](#).

**Figure 7-45. LINK\_QUAL\_4 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							comm_ready
R-0h							R-0h

**Table 7-49. LINK\_QUAL\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	comm_ready	R	0h	Communication ready status (TC12)

**7.2.46 RS\_DECODER\_FRAME\_STAT\_2 Register (Offset = 552h) [Reset = 0000h]**

RS\_DECODER\_FRAME\_STAT\_2 is shown in [Figure 7-46](#) and described in [Table 7-50](#).

Return to the [Summary Table](#).

**Figure 7-46. RS\_DECODER\_FRAME\_STAT\_2 Register**

15	14	13	12	11	10	9	8
rs_dec_uncorr_frame_cnt							
R-0h							
7	6	5	4	3	2	1	0
rs_dec_uncorr_frame_cnt							
R-0h							

**Table 7-50. RS\_DECODER\_FRAME\_STAT\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	rs_dec_uncorr_frame_cnt	R	0h	No of uncorrectable RS frames received at RS decoder, clear on read, saturates

**7.2.47 RS\_DECODER\_FRAME\_STAT\_3 Register (Offset = 553h) [Reset = 0000h]**

RS\_DECODER\_FRAME\_STAT\_3 is shown in [Figure 7-47](#) and described in [Table 7-51](#).

Return to the [Summary Table](#).

**Figure 7-47. RS\_DECODER\_FRAME\_STAT\_3 Register**

15	14	13	12	11	10	9	8
rs_dec_err_frame_cnt							
R-0h							
7	6	5	4	3	2	1	0
rs_dec_err_frame_cnt							
R-0h							

**Table 7-51. RS\_DECODER\_FRAME\_STAT\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	rs_dec_err_frame_cnt	R	0h	No of erroneous RS frames received at RS decoder, clear on read, saturates

### 7.2.48 RGMII\_CTRL Register (Offset = 600h) [Reset = 0120h]

RGMII\_CTRL is shown in [Figure 7-48](#) and described in [Table 7-52](#).

Return to the [Summary Table](#).

**Figure 7-48. RGMII\_CTRL Register**

15	14	13	12	11	10	9	8
RESERVED						rgmii_rx_half_full_th	
R-0h						R/W-2h	
7	6	5	4	3	2	1	0
rgmii_rx_half_full_th	rgmii_tx_half_full_th			rgmii_tx_if_en	invert_rgmii_txd	invert_rgmii_rxd	RESERVED
R/W-2h	R/W-2h			R/W-0h	R/W-0h	R/W-0h	R-0h

**Table 7-52. RGMII\_CTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-7	rgmii_rx_half_full_th	R/W	2h	RGMII RX sync FIFO half full threshold
6-4	rgmii_tx_half_full_th	R/W	2h	RGMII TX sync FIFO half full threshold
3	rgmii_tx_if_en	R/W	0h	RGMII enable bit Default from strap 0h = RGMII disable 1h = RGMII enable
2	invert_rgmii_txd	R/W	0h	Invert RGMII Tx wire order - full swap [3:0] to [0:3] 0h = Keep RGMII Tx wire order same 1h = Invert RGMII Tx wire order
1	invert_rgmii_rxd	R/W	0h	Invert RGMII Rx wire order - full swap [3:0] to [0:3] 0h = Keep RGMII Rx wire order same 1h = Invert RGMII Rx wire order
0	RESERVED	R	0h	Reserved

**7.2.49 RGMII\_FIFO\_STATUS Register (Offset = 601h) [Reset = 0000h]**

 RGMII\_FIFO\_STATUS is shown in [Figure 7-49](#) and described in [Table 7-53](#).

 Return to the [Summary Table](#).

**Figure 7-49. RGMII\_FIFO\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				rgmii_rx_af_full_err	rgmii_rx_af_empty_err	rgmii_tx_af_full_err	rgmii_tx_af_empty_err
R-0h				R/W0C-0h	R/W0C-0h	R/W0C-0h	R/W0C-0h

**Table 7-53. RGMII\_FIFO\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	rgmii_rx_af_full_err	R/W0C	0h	RGMII RX fifo full error 0h = No empty fifo error 1h = RGMII TX full error has been indicated
2	rgmii_rx_af_empty_err	R/W0C	0h	RGMII RX fifo empty error 0h = No empty fifo error 1h = RGMII RX empty error has been indicated
1	rgmii_tx_af_full_err	R/W0C	0h	RGMII TX fifo full error 0h = No empty fifo error 1h = RGMII TX full error has been indicated
0	rgmii_tx_af_empty_err	R/W0C	0h	RGMII TX fifo empty error 0h = No empty fifo error 1h = RGMII TX empty error has been indicated

### 7.2.50 RGMII\_DELAY\_CTRL Register (Offset = 602h) [Reset = 0000h]

RGMII\_DELAY\_CTRL is shown in [Figure 7-50](#) and described in [Table 7-54](#).

Return to the [Summary Table](#).

**Figure 7-50. RGMII\_DELAY\_CTRL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						rx_clk_sel	tx_clk_sel
R-0h						R/W-0h	R/W-0h

**Table 7-54. RGMII\_DELAY\_CTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-2	RESERVED	R	0h	Reserved
1	rx_clk_sel	R/W	0h	In RGMII mode, Enable or disable the internal delay for RXD wrt RX_CLK (use this mode when RGMII_RX_CLK and RGMII_RXD are aligned). The delay magnitude can be configured by programming register 0x430[7:4] 0h = clock and data are aligned 1h = clock is delayed relative to RGMII_RX data
0	tx_clk_sel	R/W	0h	In RGMII mode, Enable or disable the internal delay for TXD wrt TX_CLK (use this mode when RGMII_TX_CLK and RGMII_TXD are aligned). The delay magnitude can be configured by programming register 0x430[11:8] 0h = clock and data are aligned 1h = clock is internally delayed

**7.2.51 SGMII\_CTRL\_1 Register (Offset = 608h) [Reset = 007Bh]**

 SGMII\_CTRL\_1 is shown in [Figure 7-51](#) and described in [Table 7-55](#).

 Return to the [Summary Table](#).

SGMII Register: Available only on DP83TG720S-Q1

**Figure 7-51. SGMII\_CTRL\_1 Register**

15	14	13	12	11	10	9	8
sgmii_tx_err_dis	cfg_align_idx_force	cfg_align_idx_value			cfg_sgmii_en	cfg_sgmii_rx_pol_invert	
R/W-0h	R/W-0h	R/W-0h			R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
cfg_sgmii_tx_pol_invert	RESERVED		RESERVED	RESERVED	sgmii_autoneg_timer		mr_an_enable
R/W-0h	R-0h		R-0h	R-0h	R/W-1h		R/W-1h

**Table 7-55. SGMII\_CTRL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	sgmii_tx_err_dis	R/W	0h	1 = Disable SGMII TX Error indication 0 = Enable SGMII TX Error indication
14	cfg_align_idx_force	R/W	0h	Force word boundray index selection
13-10	cfg_align_idx_value	R/W	0h	when cfg_align_idx_force = 1 This value set the iword boundray index
9	cfg_sgmii_en	R/W	0h	SGMII enable bit Default from strap 0h = SGMII disable 1h = SGMII enable
8	cfg_sgmii_rx_pol_invert	R/W	0h	SGMII RX bus invert polarity 0h = Polarity not inverted 1h = SGMII RX bus invert polarity
7	cfg_sgmii_tx_pol_invert	R/W	0h	SGMII TX bus invert polarity 0h = Polarity not inverted 1h = SGMII TX bus invert polarity
6-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2-1	sgmii_autoneg_timer	R/W	1h	Selects duration of SGMII Auto-Negotiation timer: 00: 1.6ms 01: 2us 10: 800us 11: 11ms
0	mr_an_enable	R/W	1h	1 = Enable SGMII Auto-Negotaition 0 = Disable SGMII Auto-Negotiation

### 7.2.52 SGMII\_STATUS Register (Offset = 60Ah) [Reset = 0000h]

SGMII\_STATUS is shown in [Figure 7-52](#) and described in [Table 7-56](#).

Return to the [Summary Table](#).

SGMII Register: Available only on DP83TG720S-Q1

**Figure 7-52. SGMII\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED			sgmii_page_recei ved	link_status_100 0bx	mr_an_comple te	cfg_align_en	cfg_sync_status
R-0h			R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
cfg_align_idx				cfg_state			
R-0h				R-0h			

**Table 7-56. SGMII\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	sgmii_page_received	R	0h	Indicates that a new auto neg page was received 0h = No new auto neg page received 1h = A new auto neg page received
11	link_status_1000bx	R	0h	sgmii link status 0h = SGMII link down 1h = SGMII link up
10	mr_an_complete	R	0h	sgmii autoneg complete indication 0h = SGMII autoneg not completed 1h = SGMII autoneg completed
9	cfg_align_en	R	0h	word boundary FSM - align indication
8	cfg_sync_status	R	0h	word boundary FSM - sync status indication 0h = sync not achieved 1h = sync achieved
7-4	cfg_align_idx	R	0h	word boundary index selection
3-0	cfg_state	R	0h	word boundary FSM state

**7.2.53 SGMII\_CTRL\_2 Register (Offset = 60Ch) [Reset = 001Bh]**

 SGMII\_CTRL\_2 is shown in [Figure 7-53](#) and described in [Table 7-57](#).

 Return to the [Summary Table](#).

SGMII Register: Available only on DP83TG720S-Q1

**Figure 7-53. SGMII\_CTRL\_2 Register**

15	14	13	12	11	10	9	8
RESERVED							RESERVED
R-0h							R-0h
7	6	5	4	3	2	1	0
RESERVED	mr_restart_an	tx_half_full_th			rx_half_full_th		
R-0h	R/WSC,0-0h	R/W-3h			R/W-3h		

**Table 7-57. SGMII\_CTRL\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	mr_restart_an	R/WSC,0	0h	Restart sgmii autonegotiation
5-3	tx_half_full_th	R/W	3h	SGMII TX sync FIFO half full threshold
2-0	rx_half_full_th	R/W	3h	SGMII RX sync FIFO half full threshold

### 7.2.54 SGMII\_FIFO\_STATUS Register (Offset = 60Dh) [Reset = 0000h]

SGMII\_FIFO\_STATUS is shown in [Figure 7-54](#) and described in [Table 7-58](#).

Return to the [Summary Table](#).

SGMII Register: Available only on DP83TG720S-Q1

**Figure 7-54. SGMII\_FIFO\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				sgmii_rx_af_full_err	sgmii_rx_af_empty_err	sgmii_tx_af_full_err	sgmii_tx_af_empty_err
R-0h				R/W0C-0h	R/W0C-0h	R/W0C-0h	R/W0C-0h

**Table 7-58. SGMII\_FIFO\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	sgmii_rx_af_full_err	R/W0C	0h	SGMII RX fifo full error 0h = No error indication 1h = SGMII RX fifo full error has been indicated
2	sgmii_rx_af_empty_err	R/W0C	0h	SGMII RX fifo empty error 0h = No error indication 1h = SGMII RX fifo empty error has been indicated
1	sgmii_tx_af_full_err	R/W0C	0h	SGMII TX fifo full error 0h = No error indication 1h = SGMII TX fifo full error has been indicated
0	sgmii_tx_af_empty_err	R/W0C	0h	SGMII TX fifo empty error 0h = No error indication 1h = SGMII TX fifo empty error has been indicated

**7.2.55 PRBS\_STATUS\_1 Register (Offset = 618h) [Reset = 0000h]**

 PRBS\_STATUS\_1 is shown in [Figure 7-55](#) and described in [Table 7-59](#).

 Return to the [Summary Table](#).

**Figure 7-55. PRBS\_STATUS\_1 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
prbs_err_ov_cnt							
R-0h							

**Table 7-59. PRBS\_STATUS\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	prbs_err_ov_cnt	R	0h	Holds number of error counter overflow that received by the PRBS checker. Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. Counter stops on 0xFF. Note: when PRBS counters work in single mode, overflow counter is not active

### 7.2.56 PRBS\_CTRL\_1 Register (Offset = 619h) [Reset = 0574h]

PRBS\_CTRL\_1 is shown in [Figure 7-56](#) and described in [Table 7-60](#).

Return to the [Summary Table](#).

**Figure 7-56. PRBS\_CTRL\_1 Register**

15	14	13	12	11	10	9	8
RESERVED		RESERVED	send_pkt	RESERVED	cfg_prbs_chk_sel		
R-0h		R-0h	R/WMC,0-0h	R-0h	R/W-5h		
7	6	5	4	3	2	1	0
RESERVED	cfg_prbs_gen_sel			cfg_prbs_cnt_mode	cfg_prbs_chk_enable	cfg_pkt_gen_prbs	pkt_gen_en
R-0h	R/W-7h			R/W-0h	R/W-1h	R/W-0h	R/W-0h

**Table 7-60. PRBS\_CTRL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	send_pkt	R/WMC,0	0h	Enables generating MAC packet with fix/incremental data w CRC (pkt_gen_en has to be set and cfg_pkt_gen_prbs has to be clear) Cleared automatically when pkt_done is set 0h = Stop MAC packet 1h = Transmit MAC packet w CRC
11	RESERVED	R	0h	Reserved
10-8	cfg_prbs_chk_sel	R/W	5h	000 : Checker receives from RGMII TX 001 : Checker receives SGMII TX 101 : Checker receives from Cu RX
7	RESERVED	R	0h	Reserved
6-4	cfg_prbs_gen_sel	R/W	7h	000 : PRBS transmits to RGMII RX 001 : PRBS transmits to SGMII RX 101 : PRBS transmits to Cu TX
3	cfg_prbs_cnt_mode	R/W	0h	1 = Continuous mode, when one of the PRBS counters reaches max value, pulse is generated and counter starts counting from zero again 0 = Single mode, When one of the PRBS counters reaches max value, PRBS checker stops counting.
2	cfg_prbs_chk_enable	R/W	1h	Enable PRBS checker xbar (to receive data) To be enabled for counters in 0x63C, 0x63D, 0x63E to work 0h = Disable PRBS checker 1h = Enable PRBS checker
1	cfg_pkt_gen_prbs	R/W	0h	If set: (1) When pkt_gen_en is set, PRBS packets are generated continuously (3) When pkt_gen_en is cleared, PRBS RX checker is still enabled If cleared: (1) When pkt_gen_en is set, non - PRBS packet is generated (3) When pkt_gen_en is cleared, PRBS RX checker is disabled as well 0h = Stop PRBS packet 1h = Transmit PRBS packet
0	pkt_gen_en	R/W	0h	1 = Enable packet/PRBS generator 0 = Disable packet/PRBS generator

**7.2.57 PRBS\_CTRL\_2 Register (Offset = 61Ah) [Reset = 05DCh]**

 PRBS\_CTRL\_2 is shown in [Figure 7-57](#) and described in [Table 7-61](#).

 Return to the [Summary Table](#).

**Figure 7-57. PRBS\_CTRL\_2 Register**

15	14	13	12	11	10	9	8
cfg_pkt_len_prbs							
R/W-5DCh							
7	6	5	4	3	2	1	0
cfg_pkt_len_prbs							
R/W-5DCh							

**Table 7-61. PRBS\_CTRL\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	cfg_pkt_len_prbs	R/W	5DCh	Length (in bytes) of PRBS packets and MAC packets w CRC

**7.2.58 PRBS\_CTRL\_3 Register (Offset = 61Bh) [Reset = 007Dh]**

 PRBS\_CTRL\_3 is shown in [Figure 7-58](#) and described in [Table 7-62](#).

 Return to the [Summary Table](#).

**Figure 7-58. PRBS\_CTRL\_3 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
cfg_ipg_len							
R/W-7Dh							

**Table 7-62. PRBS\_CTRL\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	cfg_ipg_len	R/W	7Dh	Inter-packet gap (in bytes) between packets

**7.2.59 PRBS\_STATUS\_2 Register (Offset = 61Ch) [Reset = 0000h]**

 PRBS\_STATUS\_2 is shown in [Figure 7-59](#) and described in [Table 7-63](#).

 Return to the [Summary Table](#).

**Figure 7-59. PRBS\_STATUS\_2 Register**

15	14	13	12	11	10	9	8
prbs_byte_cnt							
R-0h							
7	6	5	4	3	2	1	0
prbs_byte_cnt							
R-0h							

**Table 7-63. PRBS\_STATUS\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	prbs_byte_cnt	R	0h	Holds number of total bytes that received by the PRBS checker. Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. When PRBS Count Mode set to zero, count stops on 0xFFFF

### 7.2.60 PRBS\_STATUS\_3 Register (Offset = 61Dh) [Reset = 0000h]

PRBS\_STATUS\_3 is shown in [Figure 7-60](#) and described in [Table 7-64](#).

Return to the [Summary Table](#).

**Figure 7-60. PRBS\_STATUS\_3 Register**

15	14	13	12	11	10	9	8
prbs_pkt_cnt_15_0							
R-0h							
7	6	5	4	3	2	1	0
prbs_pkt_cnt_15_0							
R-0h							

**Table 7-64. PRBS\_STATUS\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	prbs_pkt_cnt_15_0	R	0h	Bits [15:0] of number of total packets received by the PRBS checker Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. When PRBS Count Mode set to zero, count stops on 0xFFFFFFFF

**7.2.61 PRBS\_STATUS\_4 Register (Offset = 61Eh) [Reset = 0000h]**

 PRBS\_STATUS\_4 is shown in [Figure 7-61](#) and described in [Table 7-65](#).

 Return to the [Summary Table](#).

**Figure 7-61. PRBS\_STATUS\_4 Register**

15	14	13	12	11	10	9	8
prbs_pkt_cnt_31_16							
R-0h							
7	6	5	4	3	2	1	0
prbs_pkt_cnt_31_16							
R-0h							

**Table 7-65. PRBS\_STATUS\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	prbs_pkt_cnt_31_16	R	0h	Bits [31:16] of number of total packets received by the PRBS checker Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. When PRBS Count Mode set to zero, count stops on 0xFFFFFFFF

### 7.2.62 PRBS\_STATUS\_6 Register (Offset = 620h) [Reset = 0000h]

PRBS\_STATUS\_6 is shown in [Figure 7-62](#) and described in [Table 7-66](#).

Return to the [Summary Table](#).

**Figure 7-62. PRBS\_STATUS\_6 Register**

15	14	13	12	11	10	9	8
RESERVED			pkt_done	pkt_gen_busy	prbs_pkt_ov	prbs_byte_ov	prbs_lock
R-0h			R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
prbs_err_cnt							
R-0h							

**Table 7-66. PRBS\_STATUS\_6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	pkt_done	R	0h	Set when all MAC packets w CRC are transmitted 0h = MAC packet transmission in progress 1h = MAC packets transmission completed
11	pkt_gen_busy	R	0h	1 = Packet generator is in process 0 = Packet generator is not in process
10	prbs_pkt_ov	R	0h	If set, packet counter reached overflow Overflow is cleared when PRBS counters are cleared - done by setting bit #1 of prbs_status_6 0h = No overflow 1h = Packet counter overflow
9	prbs_byte_ov	R	0h	If set, bytes counter reached overflow Overflow is cleared when PRBS counters are cleared - done by setting bit #1 of prbs_status_6 0h = No overflow 1h = byte counter overflow
8	prbs_lock	R	0h	1 = PRBS checker is locked sync) on received byte stream 0 = PRBS checker is not locked 0h = PRBS checker is not locked 1h = PRBS checker is locked sync) on received byte stream
7-0	prbs_err_cnt	R	0h	Holds number of errored bits received by the PRBS checker Value in this register is locked when write is done to bit[0] or bit[1] When PRBS Count Mode set to zero, count stops on 0xFF Notes: Writing bit 0 generates a lock signal for the PRBS counters. Writing bit 1 generates a lock and clear signal for the PRBS counters

**7.2.63 PRBS\_STATUS\_8 Register (Offset = 622h) [Reset = 0000h]**

PRBS\_STATUS\_8 is shown in [Figure 7-63](#) and described in [Table 7-67](#).

Return to the [Summary Table](#).

**Figure 7-63. PRBS\_STATUS\_8 Register**

15	14	13	12	11	10	9	8
pkt_err_cnt_15_0							
R-0h							
7	6	5	4	3	2	1	0
pkt_err_cnt_15_0							
R-0h							

**Table 7-67. PRBS\_STATUS\_8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pkt_err_cnt_15_0	R	0h	Bits [15:0] of number of total packets with error received by the PRBS checker Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. When PRBS Count Mode set to zero, count stops on 0xFFFFFFFF

### 7.2.64 PRBS\_STATUS\_9 Register (Offset = 623h) [Reset = 0000h]

PRBS\_STATUS\_9 is shown in [Figure 7-64](#) and described in [Table 7-68](#).

Return to the [Summary Table](#).

**Figure 7-64. PRBS\_STATUS\_9 Register**

15	14	13	12	11	10	9	8
pkt_err_cnt_31_16							
R-0h							
7	6	5	4	3	2	1	0
pkt_err_cnt_31_16							
R-0h							

**Table 7-68. PRBS\_STATUS\_9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pkt_err_cnt_31_16	R	0h	Bits [31:16] of number of total packets with error received by the PRBS checker Value in this register is locked when write is done to register prbs_status_6 bit[0] or bit[1]. When PRBS Count Mode set to zero, count stops on 0xFFFFFFFF

**7.2.65 PRBS\_CTRL\_4 Register (Offset = 624h) [Reset = 5511h]**

 PRBS\_CTRL\_4 is shown in [Figure 7-65](#) and described in [Table 7-69](#).

 Return to the [Summary Table](#).

**Figure 7-65. PRBS\_CTRL\_4 Register**

15	14	13	12	11	10	9	8
cfg_pkt_data							
R/W-55h							
7	6	5	4	3	2	1	0
cfg_pkt_mode		cfg_pattern_vld_bytes				cfg_pkt_cnt	
R/W-0h		R/W-2h				R/W-1h	

**Table 7-69. PRBS\_CTRL\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	cfg_pkt_data	R/W	55h	Fixed data to be sent in Fix data mode
7-6	cfg_pkt_mode	R/W	0h	0h = Incremental 1h = Fixed 2h = PRBS 3h = PRBS
5-3	cfg_pattern_vld_bytes	R/W	2h	Number of bytes of valid pattern in packet (Max - 6) 0h = 0 bytes 1h = 1 bytes 2h = 2 bytes 3h = 3 bytes 4h = 4 bytes 5h = 5 bytes 6h = 6 bytes 7h = 6 bytes
2-0	cfg_pkt_cnt	R/W	1h	000b = 1 packet 001b = 10 packets 010b = 100 packets 011b = 1000 packets 100b = 10000 packets 101b = 100000 packets 110b = 1000000 packets 111b = Continuous packets

**7.2.66 PRBS\_CTRL\_5 Register (Offset = 625h) [Reset = 0000h]**

PRBS\_CTRL\_5 is shown in [Figure 7-66](#) and described in [Table 7-70](#).

Return to the [Summary Table](#).

**Figure 7-66. PRBS\_CTRL\_5 Register**

15	14	13	12	11	10	9	8
pattern_15_0							
R/W-0h							
7	6	5	4	3	2	1	0
pattern_15_0							
R/W-0h							

**Table 7-70. PRBS\_CTRL\_5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pattern_15_0	R/W	0h	Bits 15:0 of pattern

**7.2.67 PRBS\_CTRL\_6 Register (Offset = 626h) [Reset = 0000h]**

 PRBS\_CTRL\_6 is shown in [Figure 7-67](#) and described in [Table 7-71](#).

 Return to the [Summary Table](#).

**Figure 7-67. PRBS\_CTRL\_6 Register**

15	14	13	12	11	10	9	8
pattern_31_16							
R/W-0h							
7	6	5	4	3	2	1	0
pattern_31_16							
R/W-0h							

**Table 7-71. PRBS\_CTRL\_6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pattern_31_16	R/W	0h	Bits 31:16 of pattern

### 7.2.68 PRBS\_CTRL\_7 Register (Offset = 627h) [Reset = 0000h]

PRBS\_CTRL\_7 is shown in [Figure 7-68](#) and described in [Table 7-72](#).

Return to the [Summary Table](#).

**Figure 7-68. PRBS\_CTRL\_7 Register**

15	14	13	12	11	10	9	8
pattern_47_32							
R/W-0h							
7	6	5	4	3	2	1	0
pattern_47_32							
R/W-0h							

**Table 7-72. PRBS\_CTRL\_7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pattern_47_32	R/W	0h	Bits 47:32 of pattern

**7.2.69 PRBS\_CTRL\_8 Register (Offset = 628h) [Reset = 0000h]**

 PRBS\_CTRL\_8 is shown in [Figure 7-69](#) and described in [Table 7-73](#).

 Return to the [Summary Table](#).

**Figure 7-69. PRBS\_CTRL\_8 Register**

15	14	13	12	11	10	9	8
pmatch_data_15_0							
R/W-0h							
7	6	5	4	3	2	1	0
pmatch_data_15_0							
R/W-0h							

**Table 7-73. PRBS\_CTRL\_8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pmatch_data_15_0	R/W	0h	Bits 15:0 of Perfect Match Data - used for DA (destination address) match

### 7.2.70 PRBS\_CTRL\_9 Register (Offset = 629h) [Reset = 0000h]

PRBS\_CTRL\_9 is shown in [Figure 7-70](#) and described in [Table 7-74](#).

Return to the [Summary Table](#).

**Figure 7-70. PRBS\_CTRL\_9 Register**

15	14	13	12	11	10	9	8
pmatch_data_31_16							
R/W-0h							
7	6	5	4	3	2	1	0
pmatch_data_31_16							
R/W-0h							

**Table 7-74. PRBS\_CTRL\_9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pmatch_data_31_16	R/W	0h	Bits 31:16 of Perfect Match Data - used for DA (destination address) match

**7.2.71 PRBS\_CTRL\_10 Register (Offset = 62Ah) [Reset = 0000h]**

PRBS\_CTRL\_10 is shown in [Figure 7-71](#) and described in [Table 7-75](#).

Return to the [Summary Table](#).

**Figure 7-71. PRBS\_CTRL\_10 Register**

15	14	13	12	11	10	9	8
pmatch_data_47_32							
R/W-0h							
7	6	5	4	3	2	1	0
pmatch_data_47_32							
R/W-0h							

**Table 7-75. PRBS\_CTRL\_10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	pmatch_data_47_32	R/W	0h	Bits 47:32 of Perfect Match Data - used for DA (destination address) match

**7.2.72 CRC\_STATUS Register (Offset = 638h) [Reset = 0000h]**

CRC\_STATUS is shown in [Figure 7-72](#) and described in [Table 7-76](#).

Return to the [Summary Table](#).

**Figure 7-72. CRC\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						rx_bad_crc	tx_bad_crc
R-0h						R-0h	R-0h

**Table 7-76. CRC\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-2	RESERVED	R	0h	Reserved
1	rx_bad_crc	R	0h	CRC error indication in packet received on Cu RX 0h = No CRC error 1h = CRC error
0	tx_bad_crc	R	0h	CRC error indication in packet transmitted on Cu TX 0h = No CRC error 1h = CRC error

**7.2.73 PKT\_STAT\_1 Register (Offset = 639h) [Reset = 0000h]**

 PKT\_STAT\_1 is shown in [Figure 7-73](#) and described in [Table 7-77](#).

 Return to the [Summary Table](#).

**Figure 7-73. PKT\_STAT\_1 Register**

15	14	13	12	11	10	9	8
tx_pkt_cnt_15_0							
R-0h							
7	6	5	4	3	2	1	0
tx_pkt_cnt_15_0							
R-0h							

**Table 7-77. PKT\_STAT\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	tx_pkt_cnt_15_0	R	0h	Lower 16 bits of Tx packet counter Note : Register is cleared when 0x639, 0x63A, 0x63B are read in sequence

**7.2.74 PKT\_STAT\_2 Register (Offset = 63Ah) [Reset = 0000h]**

PKT\_STAT\_2 is shown in [Figure 7-74](#) and described in [Table 7-78](#).

Return to the [Summary Table](#).

**Figure 7-74. PKT\_STAT\_2 Register**

15	14	13	12	11	10	9	8
tx_pkt_cnt_31_16							
R-0h							
7	6	5	4	3	2	1	0
tx_pkt_cnt_31_16							
R-0h							

**Table 7-78. PKT\_STAT\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	tx_pkt_cnt_31_16	R	0h	Upper 16 bits of Tx packet counter Note : Register is cleared when 0x639, 0x63A, 0x63B are read in sequence

**7.2.75 PKT\_STAT\_3 Register (Offset = 63Bh) [Reset = 0000h]**

 PKT\_STAT\_3 is shown in [Figure 7-75](#) and described in [Table 7-79](#).

 Return to the [Summary Table](#).

**Figure 7-75. PKT\_STAT\_3 Register**

15	14	13	12	11	10	9	8
tx_err_pkt_cnt							
R-0h							
7	6	5	4	3	2	1	0
tx_err_pkt_cnt							
R-0h							

**Table 7-79. PKT\_STAT\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	tx_err_pkt_cnt	R	0h	Tx packet w error (CRC error) counter Note : Register is cleared when 0x639, 0x63A, 0x63B are read in sequence

**7.2.76 PKT\_STAT\_4 Register (Offset = 63Ch) [Reset = 0000h]**

PKT\_STAT\_4 is shown in [Figure 7-76](#) and described in [Table 7-80](#).

Return to the [Summary Table](#).

**Figure 7-76. PKT\_STAT\_4 Register**

15	14	13	12	11	10	9	8
rx_pkt_cnt_15_0							
R-0h							
7	6	5	4	3	2	1	0
rx_pkt_cnt_15_0							
R-0h							

**Table 7-80. PKT\_STAT\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	rx_pkt_cnt_15_0	R	0h	Lower 16 bits of Rx packet counter Note : Register is cleared when 0x63C, 0x63D, 0x63E are read in sequence

**7.2.77 PKT\_STAT\_5 Register (Offset = 63Dh) [Reset = 0000h]**

 PKT\_STAT\_5 is shown in [Figure 7-77](#) and described in [Table 7-81](#).

 Return to the [Summary Table](#).

**Figure 7-77. PKT\_STAT\_5 Register**

15	14	13	12	11	10	9	8
rx_pkt_cnt_31_16							
R-0h							
7	6	5	4	3	2	1	0
rx_pkt_cnt_31_16							
R-0h							

**Table 7-81. PKT\_STAT\_5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	rx_pkt_cnt_31_16	R	0h	Upper 16 bits of Rx packet counter Note : Register is cleared when 0x63C, 0x63D, 0x63E are read in sequence

**7.2.78 PKT\_STAT\_6 Register (Offset = 63Eh) [Reset = 0000h]**

PKT\_STAT\_6 is shown in [Figure 7-78](#) and described in [Table 7-82](#).

Return to the [Summary Table](#).

**Figure 7-78. PKT\_STAT\_6 Register**

15	14	13	12	11	10	9	8
rx_err_pkt_cnt							
R-0h							
7	6	5	4	3	2	1	0
rx_err_pkt_cnt							
R-0h							

**Table 7-82. PKT\_STAT\_6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	rx_err_pkt_cnt	R	0h	Rx packet w error (CRC error) counter Note : Register is cleared when 0x63C, 0x63D, 0x63E are read in sequence

**7.2.79 SQI\_REG\_1 Register (Offset = 871h) [Reset = 0000h]**

 SQI\_REG\_1 is shown in [Figure 7-79](#) and described in [Table 7-83](#).

 Return to the [Summary Table](#).

**Figure 7-79. SQI\_REG\_1 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
worst_sqi_out			RESERVED	sqi_out			RESERVED
R-0h			R-0h	R-0h			R-0h

**Table 7-83. SQI\_REG\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-5	worst_sqi_out	R	0h	3 bit Worst SQI since last read (see SQI mapping above) Cleared on Read
4	RESERVED	R	0h	Reserved
3-1	sqi_out	R	0h	3 bit SQI - (mse here refers to Mean Square Error 0x875[9:0]) 0b000 = MSE > 102 0b001 = 81 < MSE ≤ 102 0b010 = 65 < MSE ≤ 81 0b011 = 51 < MSE ≤ 65 0b100 = 41 < MSE ≤ 51 0b101 = 32 < MSE ≤ 41 0b110 = 25 < MSE ≤ 32 0b111 = MSE ≤ 25
0	RESERVED	R	0h	Reserved

**7.2.80 DSP\_REG\_74 Register (Offset = 874h) [Reset = 0000h]**

DSP\_REG\_74 is shown in [Figure 7-80](#) and described in [Table 7-84](#).

Return to the [Summary Table](#).

**Figure 7-80. DSP\_REG\_74 Register**

15	14	13	12	11	10	9	8
worst_peak_mse_out							
R-0h							
7	6	5	4	3	2	1	0
peak_mse_out							
R-0h							

**Table 7-84. DSP\_REG\_74 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	worst_peak_mse_out	R	0h	Worst peak mse out since last read as per TC12 (see peak mse mapping above) Cleared on Read
7-0	peak_mse_out	R	0h	Peak mse as per TC12 - This value is 0.0625*averaged squared slicer error(max val = 0.015625). To get actual squared slicer error divide this value by 248.

**7.2.81 DSP\_REG\_75 Register (Offset = 875h) [Reset = 0000h]**

DSP\_REG\_75 is shown in [Figure 7-81](#) and described in [Table 7-85](#).

Return to the [Summary Table](#).

**Figure 7-81. DSP\_REG\_75 Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED		mse_lock	
R-0h				R-0h		R-0h	
7	6	5	4	3	2	1	0
mse_lock							
R-0h							

**Table 7-85. DSP\_REG\_75 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-10	RESERVED	R	0h	Reserved
9-0	mse_lock	R	0h	10 bit mse used for SQI mapping. (mse = mean square error at the receiver)

### 7.2.82 PMA\_PMD\_CONTROL\_1 Register (Offset = 1000h) [Reset = 0000h]

PMA\_PMD\_CONTROL\_1 is shown in [Figure 7-82](#) and described in [Table 7-86](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-82. PMA\_PMD\_CONTROL\_1 Register**

15	14	13	12	11	10	9	8
pma_reset_2	RESERVED			RESERVED		RESERVED	
R-0h	R-0h			R-0h		R-0h	
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-86. PMA\_PMD\_CONTROL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	pma_reset_2	R	0h	1 = PMA/PMD reset 0 = Normal operation Note - RW bit, self clearing
14-12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10-0	RESERVED	R	0h	Reserved

**7.2.83 PMA\_PMD\_CONTROL\_2 Register (Offset = 1007h) [Reset = 003Dh]**

 PMA\_PMD\_CONTROL\_2 is shown in [Figure 7-83](#) and described in [Table 7-87](#).

 Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-83. PMA\_PMD\_CONTROL\_2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		cfg_pma_type_selection					
R-0h		R/W-3Dh					

**Table 7-87. PMA\_PMD\_CONTROL\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5-0	cfg_pma_type_selection	R/W	3Dh	BASE-T1 type selection for device 3Dh = BASE-T1 type selection for device

### 7.2.84 PMA\_PMD\_TRANSMIT\_DISABLE Register (Offset = 1009h) [Reset = 0000h]

PMA\_PMD\_TRANSMIT\_DISABLE is shown in [Figure 7-84](#) and described in [Table 7-88](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-84. PMA\_PMD\_TRANSMIT\_DISABLE Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							cfg_transmit_di sable_2
R-0h							R-0h

**Table 7-88. PMA\_PMD\_TRANSMIT\_DISABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	cfg_transmit_disable_2	R	0h	1 = Transmit disable 0 = Normal operation Note - RW bit

**7.2.85 PMA\_PMD\_EXTENDED\_ABILITY2 Register (Offset = 100Bh) [Reset = 0800h]**

 PMA\_PMD\_EXTENDED\_ABILITY2 is shown in [Figure 7-85](#) and described in [Table 7-89](#).

 Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-85. PMA\_PMD\_EXTENDED\_ABILITY2 Register**

15	14	13	12	11	10	9	8
RESERVED				base_t1_extended_abilities	RESERVED		
R-0h				R-1h	R-0h		
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-89. PMA\_PMD\_EXTENDED\_ABILITY2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	base_t1_extended_abilities	R	1h	1 = PMA/PMD has BASE-T1 extended abilities listed in register 1.18 0 = PMA/PMD does not have BASE-T1 extended abilities
10-0	RESERVED	R	0h	Reserved

**7.2.86 PMA\_PMD\_EXTENDED\_ABILITY Register (Offset = 1012h) [Reset = 0002h]**

PMA\_PMD\_EXTENDED\_ABILITY is shown in [Figure 7-86](#) and described in [Table 7-90](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-86. PMA\_PMD\_EXTENDED\_ABILITY Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						mr_1000_base_t1_ability	mr_100_base_t1_ability
R-0h						R-1h	R-0h

**Table 7-90. PMA\_PMD\_EXTENDED\_ABILITY Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-2	RESERVED	R	0h	Reserved
1	mr_1000_base_t1_ability	R	1h	1 = PMA/PMD is able to perform 1000BASE-T1 0 = PMA/PMD is not able to perform 1000BASE-T1
0	mr_100_base_t1_ability	R	0h	1 = PMA/PMD is able to perform 100BASE-T1 0 = PMA/PMD is not able to perform 100BASE-T1

**7.2.87 PMA\_PMD\_CONTROL Register (Offset = 1834h) [Reset = 8001h]**

PMA\_PMD\_CONTROL is shown in [Figure 7-87](#) and described in [Table 7-91](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-87. PMA\_PMD\_CONTROL Register**

15	14	13	12	11	10	9	8
RESERVED	cfg_master_slave_val	RESERVED					
R-0h	R/W-0h	R-0h					
7	6	5	4	3	2	1	0
RESERVED				RESERVED			
R-0h				R-0h			

**Table 7-91. PMA\_PMD\_CONTROL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	cfg_master_slave_val	R/W	0h	1 = Configure PHY as MASTER 0 = Configure PHY as SLAVE
13-4	RESERVED	R	0h	Reserved
3-0	RESERVED	R	0h	Reserved

### 7.2.88 PMA\_CONTROL Register (Offset = 1900h) [Reset = 0000h]

PMA\_CONTROL is shown in [Figure 7-88](#) and described in [Table 7-92](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-88. PMA\_CONTROL Register**

15	14	13	12	11	10	9	8
pma_reset	cfg_transmit_disable	RESERVED		RESERVED	RESERVED		
R-0h	R-0h	R-0h		R-0h	R-0h		
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-92. PMA\_CONTROL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	pma_reset	R	0h	1 = PMA/PMD reset 0 = Normal operation Note - RW bit, self clearing
14	cfg_transmit_disable	R	0h	1 = Transmit disable 0 = Normal operation Note - RW bit
13-12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10-0	RESERVED	R	0h	Reserved

**7.2.89 PMA\_STATUS Register (Offset = 1901h) [Reset = 0900h]**

PMA\_STATUS is shown in [Figure 7-89](#) and described in [Table 7-93](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-89. PMA\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED				oam_ability	eee_ability	receive_fault_ability	low_power_ability
R-0h				R-1h	R-0h	R-0h	R-1h
7	6	5	4	3	2	1	0
RESERVED					receive_polarity	receive_fault	pma_receive_link_status_ll
R-0h					R-0h	R-0h	R/W0S-0h

**Table 7-93. PMA\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	oam_ability	R	1h	1 = PHY has 1000BASE-T1 OAM ability 0 = PHY does not have 1000BASE-T1 OAM ability
10	eee_ability	R	0h	1 = PHY has EEE ability 0 = PHY does not have EEE ability
9	receive_fault_ability	R	0h	1 = PMA/PMD has the ability to detect a fault condition on the receive path 0 = PMA/PMD does not have the ability to detect a fault condition on the receive path
8	low_power_ability	R	1h	1 = PMA/PMD has low-power ability 0 = PMA/PMD does not have low-power ability
7-3	RESERVED	R	0h	Reserved
2	receive_polarity	R	0h	1 = Receive polarity is reversed 0 = Receive polarity is not reversed
1	receive_fault	R	0h	1 = Fault condition detected 0 = Fault condition not detected
0	pma_receive_link_status_ll	R/W0S	0h	1 = PMA/PMD receive link up 0 = PMA/PMD receive link down

### 7.2.90 TRAINING Register (Offset = 1902h) [Reset = 0002h]

TRAINING is shown in [Figure 7-90](#) and described in [Table 7-94](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-90. TRAINING Register**

15	14	13	12	11	10	9	8
RESERVED					cfg_training_user_fld		
R-0h					R/W-0h		
7	6	5	4	3	2	1	0
cfg_training_user_fld				RESERVED		cfg_oam_en	cfg_eee_en
R/W-0h				R-0h		R/W-1h	R/W-0h

**Table 7-94. TRAINING Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10-4	cfg_training_user_fld	R/W	0h	7-bit user defined field to send to the link partner
3-2	RESERVED	R	0h	Reserved
1	cfg_oam_en	R/W	1h	1 = 1000BASE-T1 OAM ability advertised to link partner 0 = 1000BASE-T1 OAM ability not advertised to link partner
0	cfg_eee_en	R/W	0h	1 = EEE ability advertised to link partner 0 = EEE ability not advertised to link partner

**7.2.91 LP\_TRAINING Register (Offset = 1903h) [Reset = 0000h]**

LP\_TRAINING is shown in [Figure 7-91](#) and described in [Table 7-95](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-91. LP\_TRAINING Register**

15	14	13	12	11	10	9	8
RESERVED					lp_training_user_fld		
R-0h					R-0h		
7	6	5	4	3	2	1	0
lp_training_user_fld				RESERVED		lp_oam_adv	lp_eee_adv
R-0h				R-0h		R-0h	R-0h

**Table 7-95. LP\_TRAINING Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10-4	lp_training_user_fld	R	0h	7-bit user defined field received from the link partner
3-2	RESERVED	R	0h	Reserved
1	lp_oam_adv	R	0h	1 = Link partner has 1000BASE-T1 OAM ability 0 = Link partner does not have 1000BASE-T1 OAM ability
0	lp_eee_adv	R	0h	1 = Link partner has EEE ability 0 = Link partner does not have EEE ability

### 7.2.92 TEST\_MODE\_CONTROL Register (Offset = 1904h) [Reset = 0000h]

TEST\_MODE\_CONTROL is shown in [Figure 7-92](#) and described in [Table 7-96](#).

Return to the [Summary Table](#).

First nibble (0x1) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-92. TEST\_MODE\_CONTROL Register**

15	14	13	12	11	10	9	8
cfg_test_mode				RESERVED			
R/W-0h				R-0h			
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-96. TEST\_MODE\_CONTROL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	cfg_test_mode	R/W	0h	111 = Test mode 7 110 = Test mode 6 101 = Test mode 5 100 = Test mode 4 011 = Reserved 010 = Test mode 2 001 = Test mode 1 000 = Normal (non-test) operation
12-0	RESERVED	R	0h	Reserved

**7.2.93 PCS\_CONTROL Register (Offset = 3900h) [Reset = 0000h]**

PCS\_CONTROL is shown in [Figure 7-93](#) and described in [Table 7-97](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-93. PCS\_CONTROL Register**

15	14	13	12	11	10	9	8
pcs_reset	RESERVED	RESERVED					
R-0h	R-0h	R-0h					
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 7-97. PCS\_CONTROL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	pcs_reset	R	0h	Note - RW bit, self clear bit 0h = Normal operation 1h = PCS reset
14	RESERVED	R	0h	Reserved
13-0	RESERVED	R	0h	Reserved

### 7.2.94 PCS\_STATUS Register (Offset = 3901h) [Reset = 0000h]

PCS\_STATUS is shown in [Figure 7-94](#) and described in [Table 7-98](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-94. PCS\_STATUS Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED	RESERVED	RESERVED	RESERVED
R-0h				R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
pcs_fault	RESERVED				pcs_receive_link_status_ll	RESERVED	
R-0h	R-0h				R/W0S-0h	R-0h	

**Table 7-98. PCS\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	pcs_fault	R	0h	0h = No fault condition detected 1h = Fault condition detected
6-3	RESERVED	R	0h	Reserved
2	pcs_receive_link_status_ll	R/W0S	0h	0h = PCS receive link down 1h = PCS receive link up
1-0	RESERVED	R	0h	Reserved

**7.2.95 PCS\_STATUS\_2 Register (Offset = 3902h) [Reset = 0000h]**

PCS\_STATUS\_2 is shown in [Figure 7-95](#) and described in [Table 7-99](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-95. PCS\_STATUS\_2 Register**

15	14	13	12	11	10	9	8
RESERVED					pcs_receive_lin k_status	hi_rfer	block_lock
R-0h					R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
hi_rfer_lh	block_lock_ll	RESERVED					
R/W0C-0h	R/W0S-0h	R-0h					

**Table 7-99. PCS\_STATUS\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	pcs_receive_link_status	R	0h	0h = PCS receive link down 1h = PCS receive link up
9	hi_rfer	R	0h	0h = PCS not reporting a high BER 1h = PCS reporting a high BER
8	block_lock	R	0h	0h = PCS not locked to received blocks 1h = PCS locked to received blocks
7	hi_rfer_lh	R/W0C	0h	0h = PCS has not reported a high BER 1h = PCS has reported a high BER
6	block_lock_ll	R/W0S	0h	0h = PCS does not have block lock 1h = PCS has block lock
5-0	RESERVED	R	0h	Reserved

### 7.2.96 OAM\_TRANSMIT Register (Offset = 3904h) [Reset = 0000h]

OAM\_TRANSMIT is shown in [Figure 7-96](#) and described in [Table 7-100](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-96. OAM\_TRANSMIT Register**

15		14		13		12		11		10		9		8	
mr_tx_valid		mr_tx_toggle		mr_tx_received		mr_tx_received_toggle		mr_tx_message_num							
R/WMC,0-0h		R-0h		R-0h		R-0h		R/W-0h							
7		6		5		4		3		2		1		0	
RESERVED								mr_rx_ping		mr_tx_ping		mr_tx_snr			
R-0h				R-0h				R/W-0h		R-0h					

**Table 7-100. OAM\_TRANSMIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	mr_tx_valid	R/WMC,0	0h	This bit is used to indicate message data in registers 3.2308.11:8, 3.2309, 3.2310, 3.2311, and 3.2312 are valid and ready to be loaded. This bit shall self-clear when registers are loaded by the state machine. 1 = Message data in registers are valid 0 = Message data in registers are not valid
14	mr_tx_toggle	R	0h	Toggle value to be transmitted with message. This bit is set by the state machine and cannot be overridden by the user.
13	mr_tx_received	R	0h	This bit shall self clear on read. 1 = 1000BASE-T1 OAM message received by link partner 0 = 1000BASE-T1 OAM message not received by link partner
12	mr_tx_received_toggle	R	0h	Toggle value of message that was received by link partner
11-8	mr_tx_message_num	R/W	0h	User-defined message number to send
7-4	RESERVED	R	0h	Reserved
3	mr_rx_ping	R	0h	Received PingTx value from latest good 1000BASE-T1 OAM frame received
2	mr_tx_ping	R/W	0h	Ping value to send to link partner
1-0	mr_tx_snr	R	0h	00 = PHY link is failing and shall drop link and relink within 2ms to 4ms after the end of the current 1000BASE-T1 OAM frame. 01 = LPI refresh is insufficient to maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled). 10 = PHY SNR is marginal. 11 = PHY SNR is good.

**7.2.97 OAM\_TX\_MESSAGE\_1 Register (Offset = 3905h) [Reset = 0000h]**

OAM\_TX\_MESSAGE\_1 is shown in [Figure 7-97](#) and described in [Table 7-101](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-97. OAM\_TX\_MESSAGE\_1 Register**

15	14	13	12	11	10	9	8
mr_tx_message_15_0							
R/W-0h							
7	6	5	4	3	2	1	0
mr_tx_message_15_0							
R/W-0h							

**Table 7-101. OAM\_TX\_MESSAGE\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_tx_message_15_0	R/W	0h	Message octet 1/0. LSB transmitted first.

### 7.2.98 OAM\_TX\_MESSAGE\_2 Register (Offset = 3906h) [Reset = 0000h]

OAM\_TX\_MESSAGE\_2 is shown in [Figure 7-98](#) and described in [Table 7-102](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-98. OAM\_TX\_MESSAGE\_2 Register**

15	14	13	12	11	10	9	8
mr_tx_message_31_16							
R/W-0h							
7	6	5	4	3	2	1	0
mr_tx_message_31_16							
R/W-0h							

**Table 7-102. OAM\_TX\_MESSAGE\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_tx_message_31_16	R/W	0h	Message octet 3/2. LSB transmitted first.

**7.2.99 OAM\_TX\_MESSAGE\_3 Register (Offset = 3907h) [Reset = 0000h]**

OAM\_TX\_MESSAGE\_3 is shown in [Figure 7-99](#) and described in [Table 7-103](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-99. OAM\_TX\_MESSAGE\_3 Register**

15	14	13	12	11	10	9	8
mr_tx_message_47_32							
R/W-0h							
7	6	5	4	3	2	1	0
mr_tx_message_47_32							
R/W-0h							

**Table 7-103. OAM\_TX\_MESSAGE\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_tx_message_47_32	R/W	0h	Message octet 5/4. LSB transmitted first.

**7.2.100 OAM\_TX\_MESSAGE\_4 Register (Offset = 3908h) [Reset = 0000h]**

OAM\_TX\_MESSAGE\_4 is shown in [Figure 7-100](#) and described in [Table 7-104](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-100. OAM\_TX\_MESSAGE\_4 Register**

15	14	13	12	11	10	9	8
mr_tx_message_63_48							
R/W-0h							
7	6	5	4	3	2	1	0
mr_tx_message_63_48							
R/W-0h							

**Table 7-104. OAM\_TX\_MESSAGE\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_tx_message_63_48	R/W	0h	Message octet 7/6. LSB transmitted first.

**7.2.101 OAM\_RECEIVE Register (Offset = 3909h) [Reset = 0000h]**

OAM\_RECEIVE is shown in [Figure 7-101](#) and described in [Table 7-105](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-101. OAM\_RECEIVE Register**

15	14	13	12	11	10	9	8
mr_rx_lp_valid	mr_rx_lp_toggle	RESERVED		mr_rx_lp_message_num			
R-0h	R-0h	R-0h		R-0h			
7	6	5	4	3	2	1	0
RESERVED						mr_rx_lp_SNR	
R-0h						R-0h	

**Table 7-105. OAM\_RECEIVE Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	mr_rx_lp_valid	R	0h	This bit is used to indicate message data in registers 3.2313.11:8, 3.2314, 3.2315, 3.2316, and 3.2317 are stored and ready to be read. This bit shall self clear when register 3.2317 is read. 0h = Message data in registers are not valid 1h = Message data in registers are valid
14	mr_rx_lp_toggle	R	0h	Toggle value received with message Note - 0x3 added in [15:12] to differentiate
13-12	RESERVED	R	0h	Reserved
11-8	mr_rx_lp_message_num	R	0h	Message number from link partner Note - 0x3 added in [15:12] to differentiate
7-2	RESERVED	R	0h	Reserved
1-0	mr_rx_lp_SNR	R	0h	00 = Link partner link is failing and shall drop link and relink within 2ms to 4ms after the end of the current 1000BASE-T1 OAM frame. 01 = LPI refresh is insufficient to maintain link partner SNR. Link partner requests local device to exit LPI and send idles (used only when EEE is enabled). 10 = Link partner SNR is marginal. 11 = Link partner SNR is good

**7.2.102 OAM\_RX\_MESSAGE\_1 Register (Offset = 390Ah) [Reset = 0000h]**

OAM\_RX\_MESSAGE\_1 is shown in [Figure 7-102](#) and described in [Table 7-106](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-102. OAM\_RX\_MESSAGE\_1 Register**

15	14	13	12	11	10	9	8
mr_rx_lp_message_15_0							
R-0h							
7	6	5	4	3	2	1	0
mr_rx_lp_message_15_0							
R-0h							

**Table 7-106. OAM\_RX\_MESSAGE\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_rx_lp_message_15_0	R	0h	Message octet 1/0. LSB transmitted first.

**7.2.103 OAM\_RX\_MESSAGE\_2 Register (Offset = 390Bh) [Reset = 0000h]**

OAM\_RX\_MESSAGE\_2 is shown in [Figure 7-103](#) and described in [Table 7-107](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-103. OAM\_RX\_MESSAGE\_2 Register**

15	14	13	12	11	10	9	8
mr_rx_lp_message_31_16							
R-0h							
7	6	5	4	3	2	1	0
mr_rx_lp_message_31_16							
R-0h							

**Table 7-107. OAM\_RX\_MESSAGE\_2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_rx_lp_message_31_16	R	0h	Message octet 3/2. LSB transmitted first.

### 7.2.104 OAM\_RX\_MESSAGE\_3 Register (Offset = 390Ch) [Reset = 0000h]

OAM\_RX\_MESSAGE\_3 is shown in [Figure 7-104](#) and described in [Table 7-108](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-104. OAM\_RX\_MESSAGE\_3 Register**

15	14	13	12	11	10	9	8
mr_rx_lp_message_47_32							
R-0h							
7	6	5	4	3	2	1	0
mr_rx_lp_message_47_32							
R-0h							

**Table 7-108. OAM\_RX\_MESSAGE\_3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_rx_lp_message_47_32	R	0h	Message octet 5/4. LSB transmitted first.

**7.2.105 OAM\_RX\_MESSAGE\_4 Register (Offset = 390Dh) [Reset = 0000h]**

OAM\_RX\_MESSAGE\_4 is shown in [Figure 7-105](#) and described in [Table 7-109](#).

Return to the [Summary Table](#).

First nibble (0x3) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-105. OAM\_RX\_MESSAGE\_4 Register**

15	14	13	12	11	10	9	8
mr_rx_lp_message_63_48							
R-0h							
7	6	5	4	3	2	1	0
mr_rx_lp_message_63_48							
R-0h							

**Table 7-109. OAM\_RX\_MESSAGE\_4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	mr_rx_lp_message_63_48	R	0h	Message octet 7/6. LSB transmitted first.

**7.2.106 AN\_CFG Register (Offset = 7200h) [Reset = 0000h]**

AN\_CFG is shown in [Figure 7-106](#) and described in [Table 7-110](#).

Return to the [Summary Table](#).

First nibble (0x7) in the register address is to indicate MMD register space. For register access, ignore the first nibble.

**Figure 7-106. AN\_CFG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							mr_main_reset
R-0h							R/WSC-0h

**Table 7-110. AN\_CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	mr_main_reset	R/WSC	0h	1 = Reset link sync/autoneg Note - RW bit

## 8 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

The DP83TG720S-Q1 is a single-port 1Gbps Automotive Ethernet PHY. It supports IEEE 802.3bp and allows for connections to an Ethernet MAC through RGMII or SGMII. When using the device for Ethernet applications, it is necessary to meet certain requirements for normal operation. The following subsections are intended to assist in appropriate component selection and required connections.

### 8.2 Typical Applications

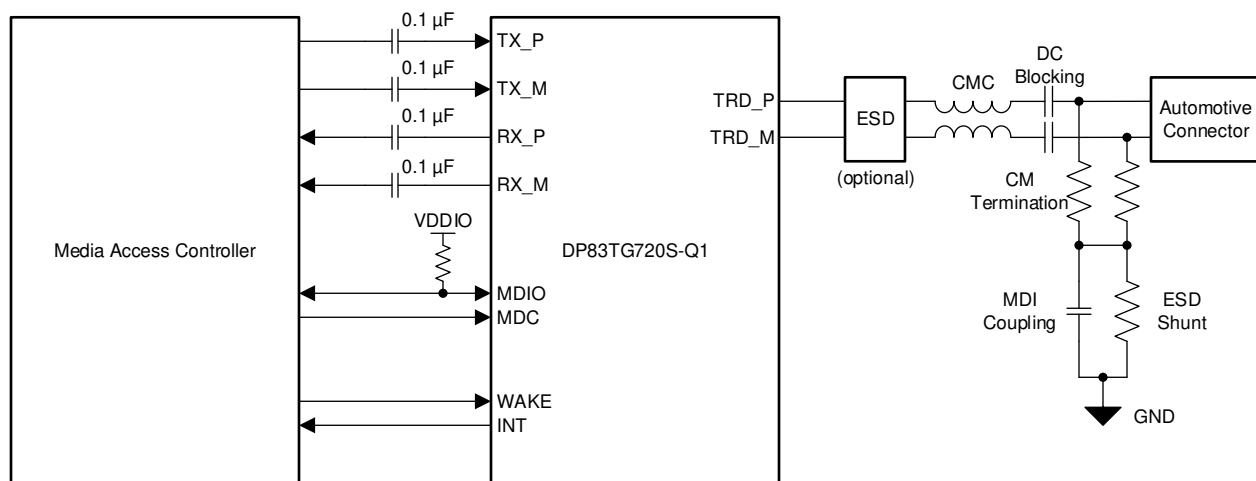


Figure 8-1. Typical Application (SGMII)

Table 8-1. Recommended Components for MDI Network

Design Parameter	Value
DC Blocking Capacitors <sup>(1)</sup>	0.1µF
Common-Mode Choke	Murata™: DLW32MH101XT2
Common Mode Termination Resistors <sup>(1) (2)</sup>	1kΩ
MDI Coupling Capacitor	4.7nF
ESD Shunt	100kΩ

(1) 1% tolerance components are recommended for margins over spec of return loss and mode conversion.

(2) CM termination resistor size higher than 0805 helps in increasing ESD margin.

### 8.3 Power Supply Recommendations

The DP83TG720S-Q1 is capable of operating with a wide range of IO supply voltages (3.3V, 2.5V, or 1.8V). No power supply sequencing is required. The recommended power supply de-coupling network is shown in following figure :

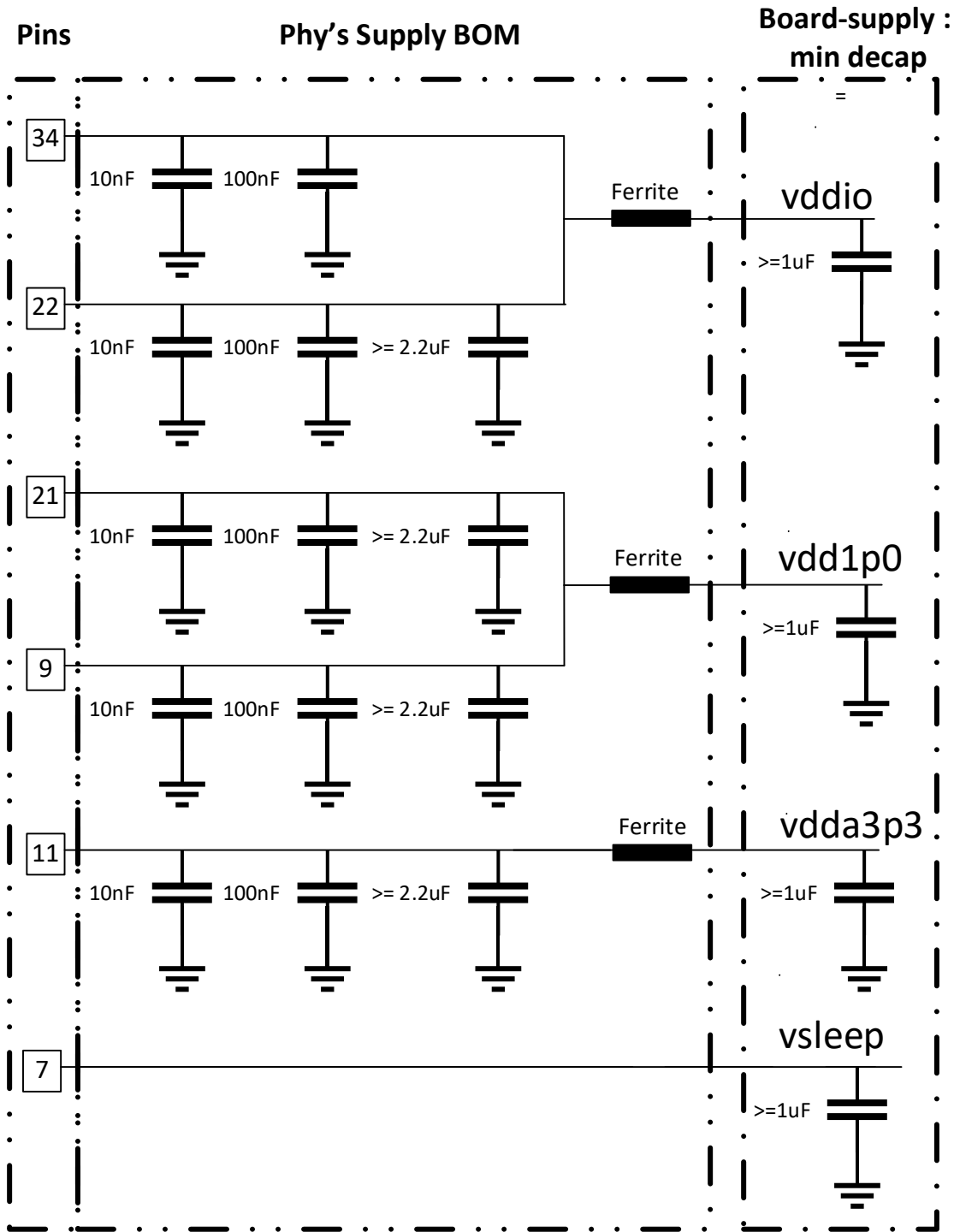


Figure 8-2. Recommended Supply De-Coupling Network (if sleep mode is used in the application)

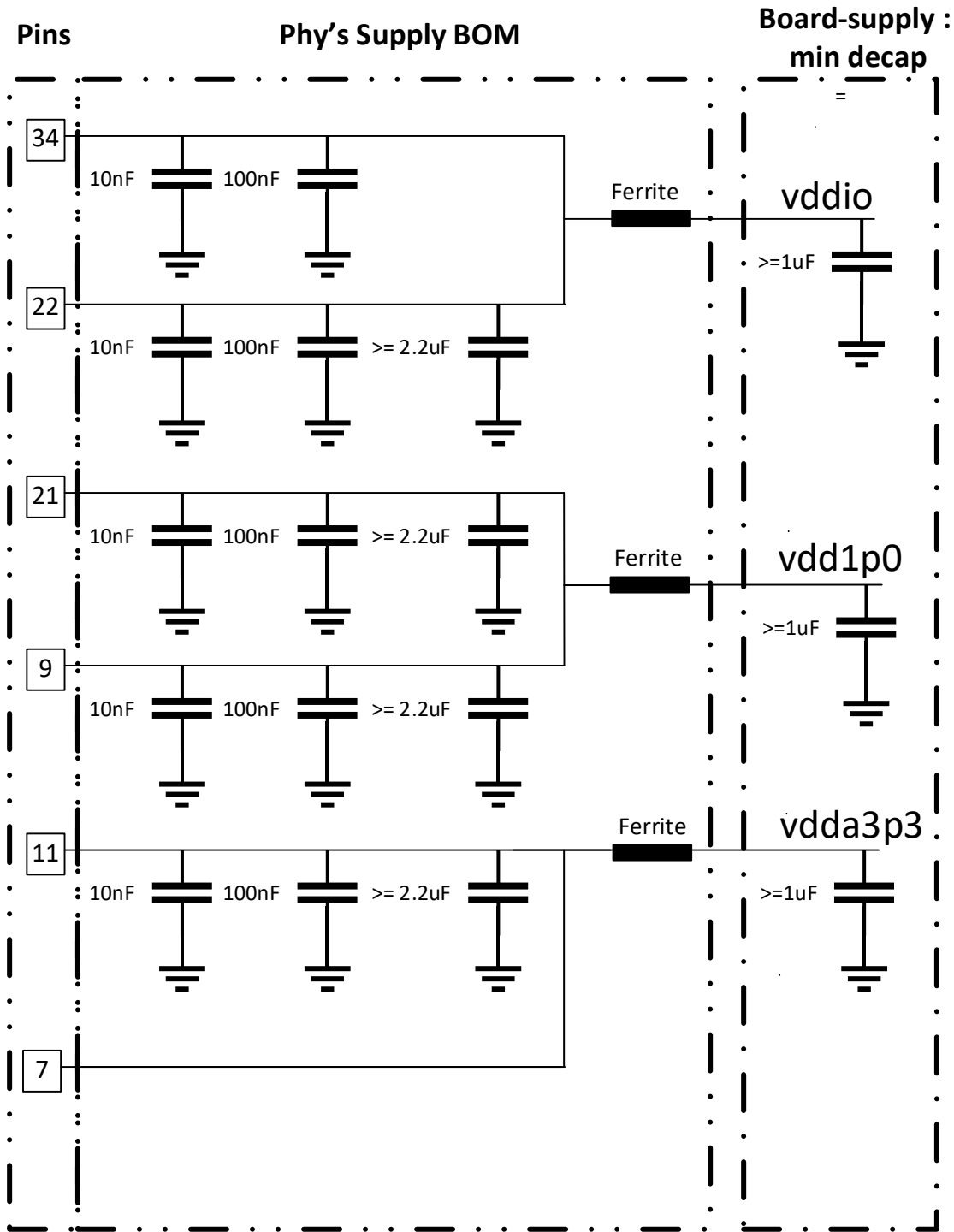


Figure 8-3. Recommended Supply De-Coupling Network (if sleep mode is not used in application)

Table 8-2. Recommended Components for Power Network

Design Parameter	Value
V <sub>DDIO</sub>	1.8V, 2.5V, or 3.3V
De-Coupling Capacitors V <sub>DDIO</sub> (pin 34)	10nF, 100nF
De-Coupling Capacitors V <sub>DDIO</sub> (pin 22)	10nF, 100nF, 2.2uF
Combined Ferrite Bead for VDDIO	BLM18HE102SN1

**Table 8-2. Recommended Components for Power Network (continued)**

Design Parameter	Value
V <sub>D</sub> DA	3.3V
De-Coupling Capacitors V <sub>D</sub> DA (pin 11)	10nF, 100nF, 2.2uF
Ferrite Bead for V <sub>D</sub> DA	BLM18KG601SH1
V <sub>D</sub> D1p0	1V
De-Coupling Capacitors V <sub>D</sub> D1P0 (pin 9)	10nF, 100nF, 2.2uF
De-Coupling Capacitors V <sub>D</sub> DA (pin 21)	10nF, 100nF, 2.2uF
Combined Ferrite Bead for V <sub>D</sub> D1P0	BLM18KG601SH1
V <sub>sleep</sub>	3.3V

**Note**

For recommendation on LDOs for V<sub>D</sub>D1p0 and V<sub>sleep</sub>, please refer to the [DP83TC811](#), [DP83TG730 Rollover Document](#) application note.

### 8.4 Compatibility with TI's 100BT1 PHY

Following table shows pin comparison between DP83TC811 and DP83TG720. Pins highlighted in bold need attention while designing a common board for both 100BT1 and 1000BT1 PHY. 100BT1 and 1000BT1 PHY's different BOM requirements can also be taken care by a common board.

Details and recommendation for common board design can be found in [DP83TC811](#), [DP83TG720 Rollover Document](#) application report.

**Table 8-3. Pin Comparison Table**

Pin No.	DP83TC811	DP83TG720
1	MDC	MDC
2	INT_N	INT_N
3	RESET_N	RESET_N
4	XO	XO
5	XI	XI
6	LED_1	LED_1
7	<b>EN</b>	<b>VSLEEP</b>
8	<b>WAKE</b>	<b>WAKE</b>
9	<b>DNC</b>	<b>VDD1P0</b>
10	<b>INH</b>	<b>INH</b>
11	VDDA	VDDA
12	TRD_P	TRD_P
13	TRD_M	TRD_M
14	RX_ER	STRP1
15	RX_DV	RX_CTRL
16	CLKOUT	CLKOUT
17	<b>TCK</b>	<b>DNC</b>
18	<b>TDO</b>	<b>DNC</b>
19	<b>TMS</b>	<b>DNC</b>
20	<b>TCK</b>	<b>DNC</b>
21	<b>DNC</b>	<b>VDD1P0</b>
22	VDDIO	VDDIO
23	RX_D3	RX_D3
24	RX_D2	RX_D2

**Table 8-3. Pin Comparison Table (continued)**

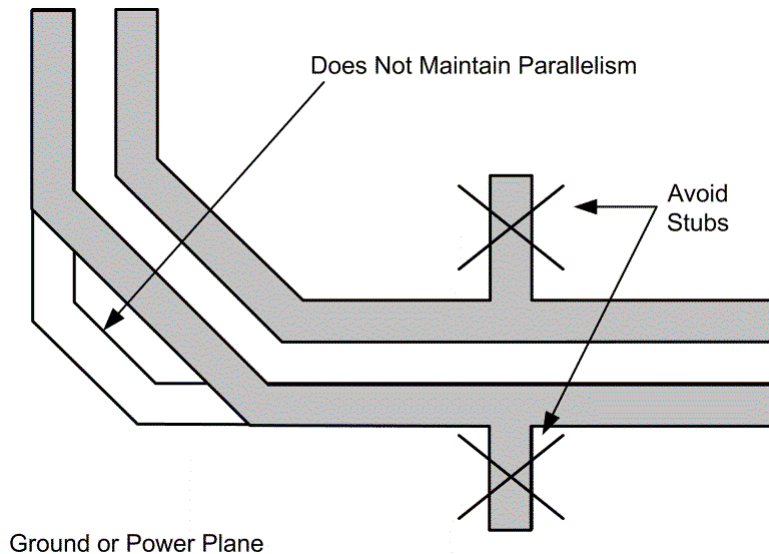
Pin No.	DP83TC811	DP83TG720
25	RX_D1	RX_D1
26	RX_D0	RX_D0
27	RX_CLK	RX_CLK
28	TXCLK	TXCLK
29	TX_EN	TX_CTRL
30	TX_D3	TX_D3
31	TX_D2	TX_D2
32	TX_D1	TX_D1
33	TX_D0	TX_D0
<b>34</b>	<b>TX_ER</b>	<b>VDDIO</b>
35	LED_0	LED_0
36	MDIO	MDIO

## 8.5 Layout

### 8.5.1 Layout Guidelines

#### 8.5.1.1 Signal Traces

PCB traces are lossy and long traces can degrade signal quality. Traces must be kept short as possible. Unless mentioned otherwise, all signal traces must be 50Ω, single-ended impedance. Differential traces must be 50Ω single-ended and 100Ω differential. Impedance discontinuities cause reflections leading to emissions and signal integrity issues. Stubs must be avoided on all signal traces, especially differential signal pairs.



**Figure 8-4. Differential Signal Trace Routing**

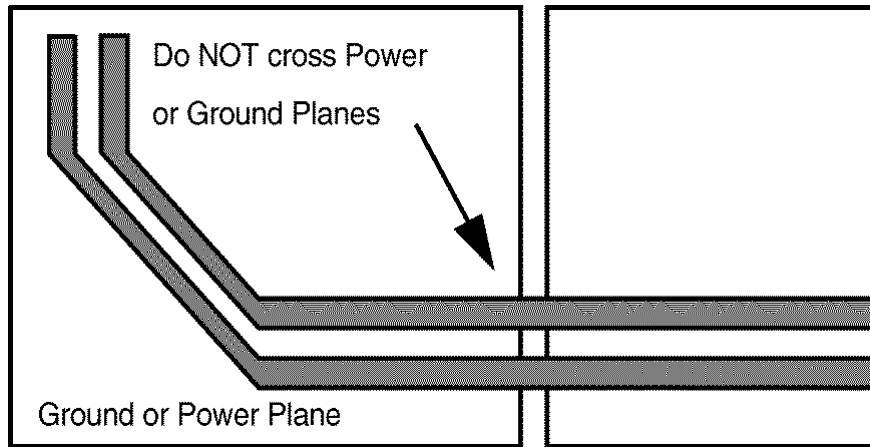
Within the differential pairs, trace lengths must be run parallel to each other and matched in length. Matched lengths minimize delay differences, avoiding an increase in common mode noise and emissions. Length matching is also important for MAC interface connections. All transmit signal traces must be length matched to each other and all receive signal traces must be length matched to each other.

Avoid crossover or vias on signal path traces. Vias present impedance discontinuities and be minimized when possible. Route trace pairs on the same layer. Avoid signals on different layers crossing each other without at least one return path plane between them. Differential pairs must always have a constant coupling

distance between them. For convenience and efficiency, TI recommends routing critical signals first (that is, MDI differential pairs, reference clock, and MAC IF traces).

#### 8.5.1.2 Return Path

A general best practice is to have a solid return path beneath all signal traces. This return path can be a continuous ground or DC power plane. Reducing the width of the return path can potentially affect the impedance of the signal trace. This effect is more prominent when the width of the return path is comparable to the width of the signal trace. Breaks in return path between the signal traces must be avoided. A signal crossing a split plane causes unpredictable return path currents and impacts signal quality and result in emissions issues.



**Figure 8-5. Power and Ground Plane Breaks**

#### 8.5.1.3 Physical Medium Attachment

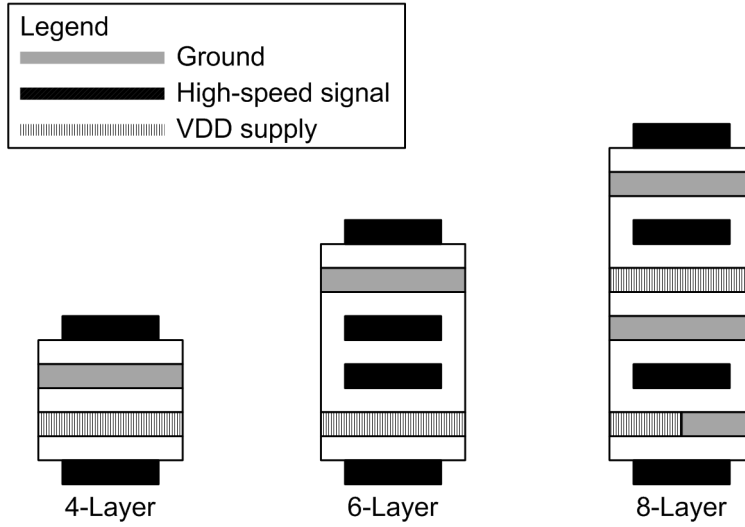
There must be no metal running beneath the common-mode choke. CMCs can inject noise into metal beneath them, which can affect the emissions and immunity performance of the system. Because the DP83TG720S-Q1 is a voltage mode line driver, no external termination resistors are required. The ESD shunt and MDI coupling capacitor must be connected to ground. Select common mode termination resistors that are 1% tolerance or better to improve differential coupling.

#### 8.5.1.4 Metal Pour

All metal pours that are not signals or power must be tied to ground. There must be no floating metal in the system, and there must be no metal between differential traces.

#### 8.5.1.5 PCB Layer Stacking

To meet signal integrity and performance requirements, minimum four-layer PCB is recommended. However, a six-layer PCB and above should be used when possible.



**Figure 8-6. Recommended PCB Layer Stack-Up**

## 9 Device and Documentation Support

### Note

TI is transitioning to use more inclusive terminology. Some language may be different than what you would expect to see for certain technology areas.

### 9.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 9.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 9.3 Trademarks

Murata™ is a trademark of Murata Manufacturing Co., Ltd.

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 9.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 9.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision F (April 2025) to Revision G (June 2026)	Page
• Updated pin configuration and functions to clarify population of rail pull-up resistors.....	3
• Updated RGMII Transmit Encoding and RGMII In-Band Status tables.....	41
• Updated address ranges in Register Space Division.....	47
• Updated register descriptions.....	52

Changes from Revision E (February 2022) to Revision F (April 2025)	Page
• Changed the order of register 0x619 and 0x624 writes .....	29
• Changed the parameter 'slope_temperature_sensor'.....	32
• Added a statement that Auto-Polarity Correction can't be disabled on DP83TG720-Q1.....	41
• Simplified the description of Serial Management Interface for ease of readability.....	46
• Changed LED_0 pin number from 1 to 35 in Table 7-18.....	49
• Removed unused register fields from the register map.....	52

## 11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left navigation.

## PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">DP83TG720SWRHARQ1</a>	Active	Production	VQFN (RHA)   36	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	720S
DP83TG720SWRHARQ1.A	Active	Production	VQFN (RHA)   36	2500   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	720S
<a href="#">DP83TG720SWRHATQ1</a>	Active	Production	VQFN (RHA)   36	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	720S
DP83TG720SWRHATQ1.A	Active	Production	VQFN (RHA)   36	250   SMALL T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	720S

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

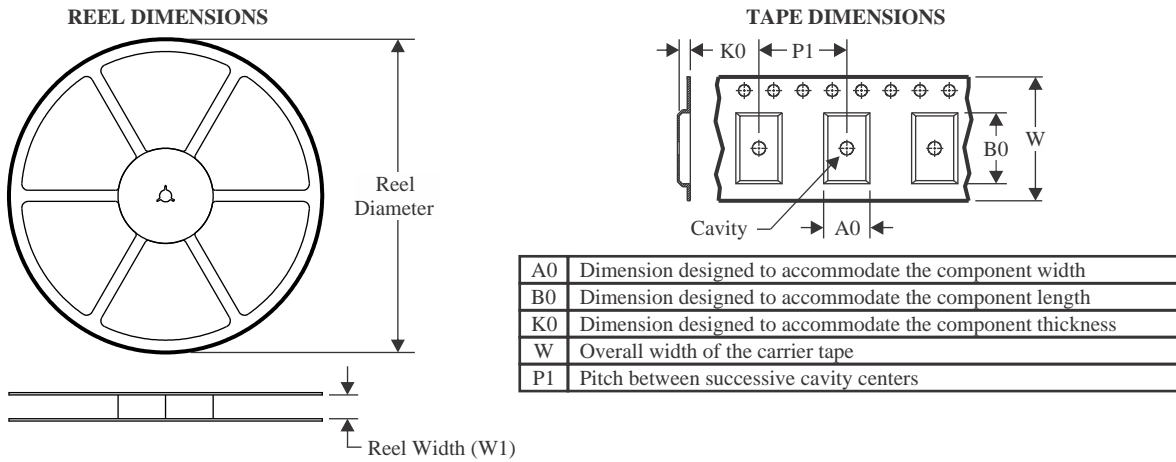
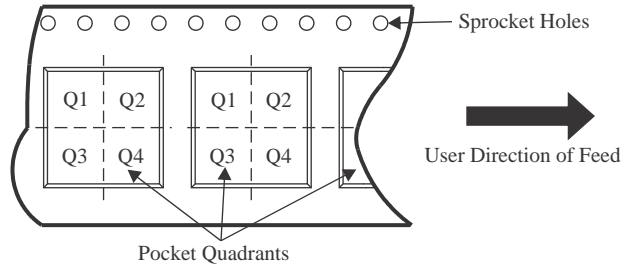
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

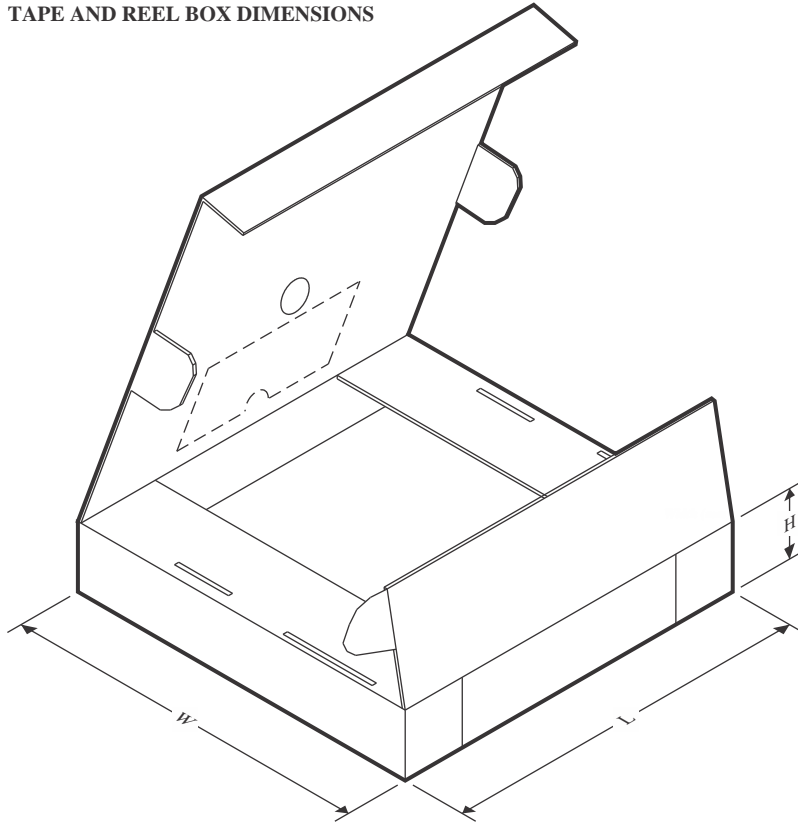
**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DP83TG720SWRHARQ1	VQFN	RHA	36	2500	330.0	16.4	6.3	6.3	1.1	12.0	16.0	Q2
DP83TG720SWRHATQ1	VQFN	RHA	36	250	180.0	16.4	6.3	6.3	1.1	12.0	16.0	Q2

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DP83TG720SWRHARQ1	VQFN	RHA	36	2500	367.0	367.0	35.0
DP83TG720SWRHATQ1	VQFN	RHA	36	250	210.0	185.0	35.0

## GENERIC PACKAGE VIEW

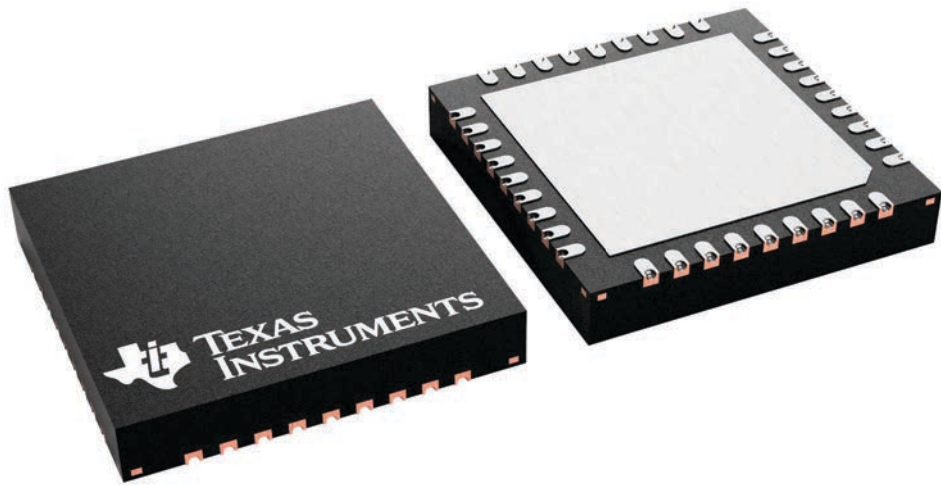
**RHA 36**

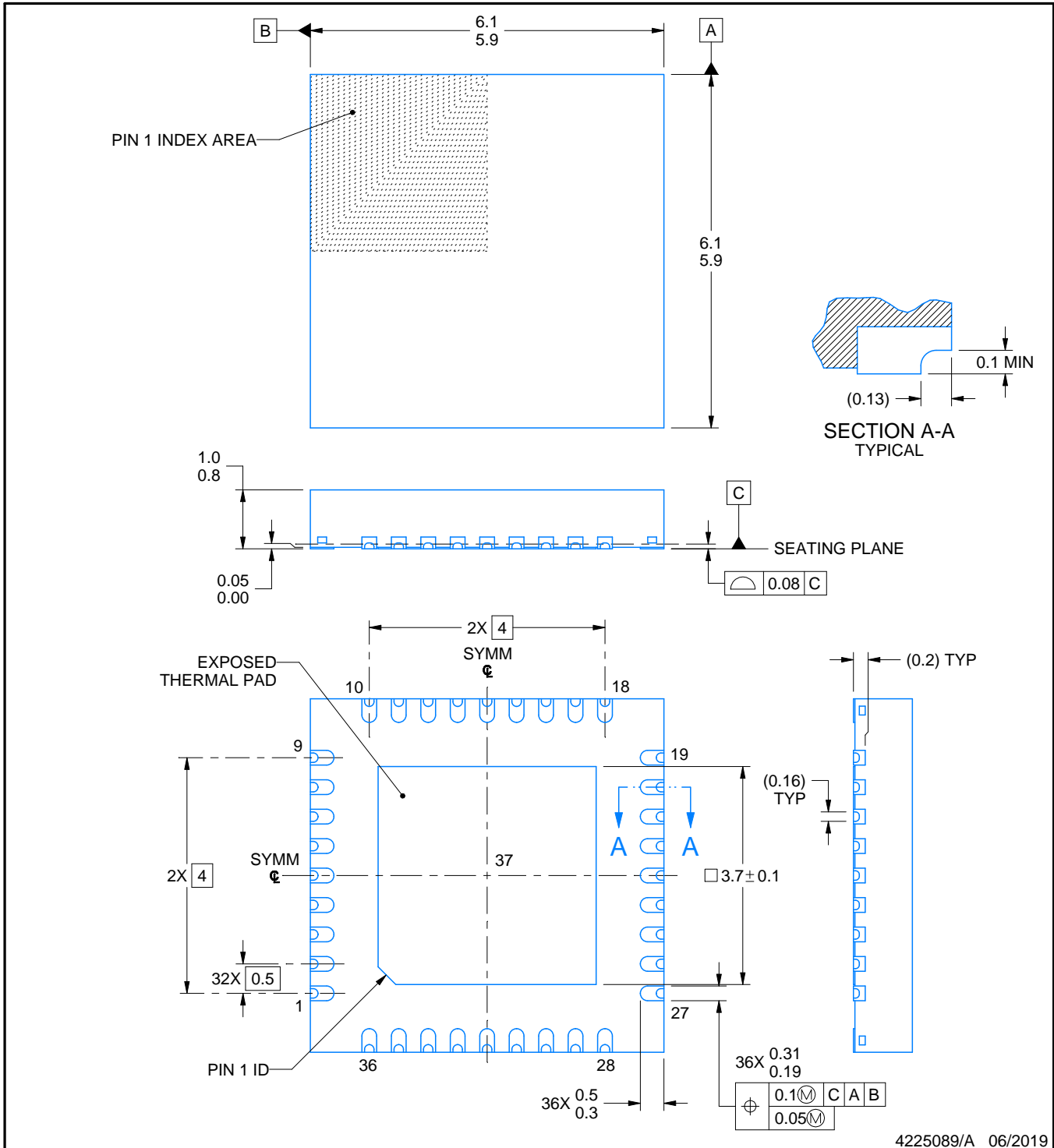
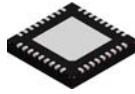
**VQFN - 1 mm max height**

6 x 6, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.





4225089/A 06/2019

NOTES:

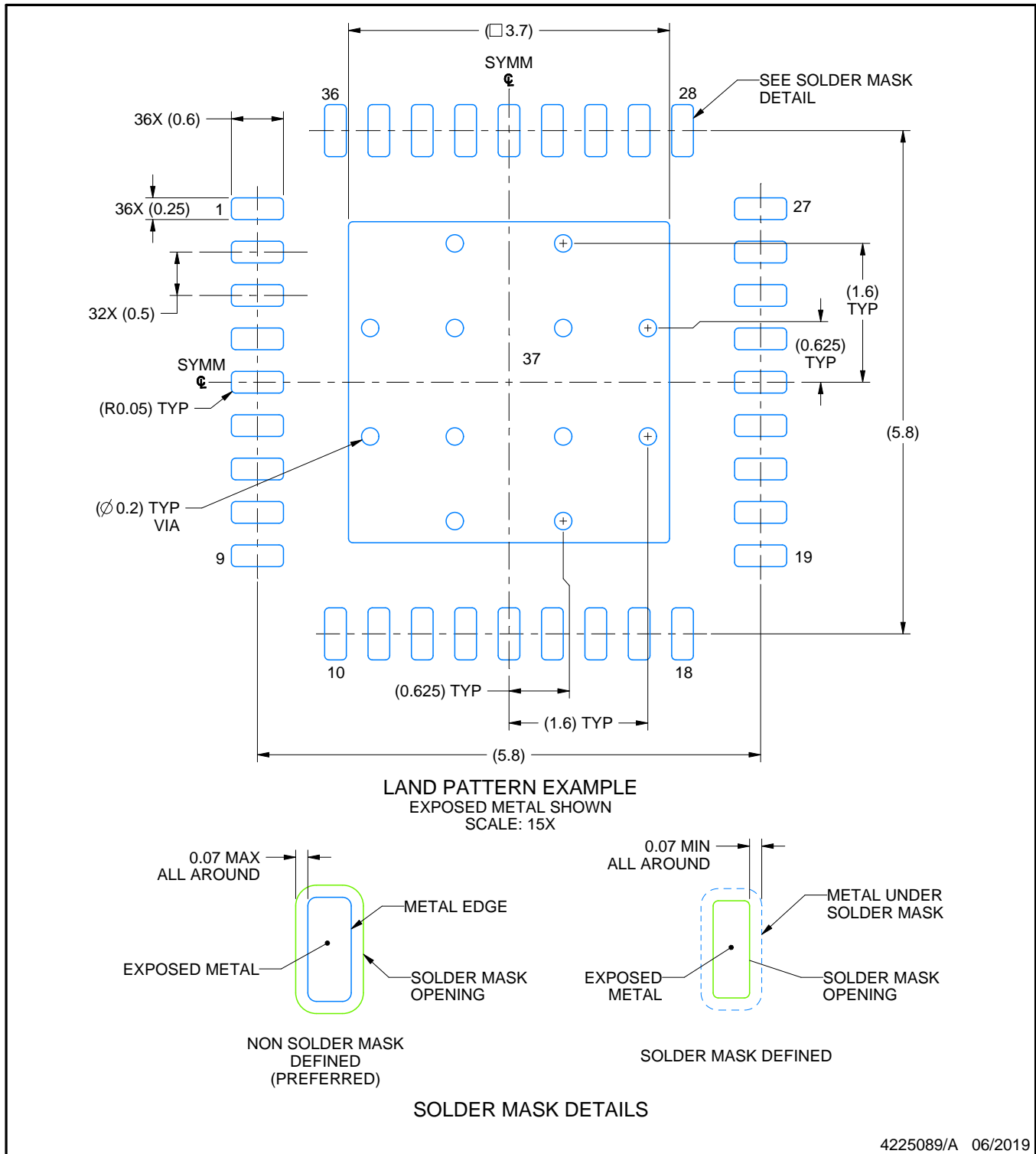
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# EXAMPLE BOARD LAYOUT

RHA0036A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4225089/A 06/2019

NOTES: (continued)

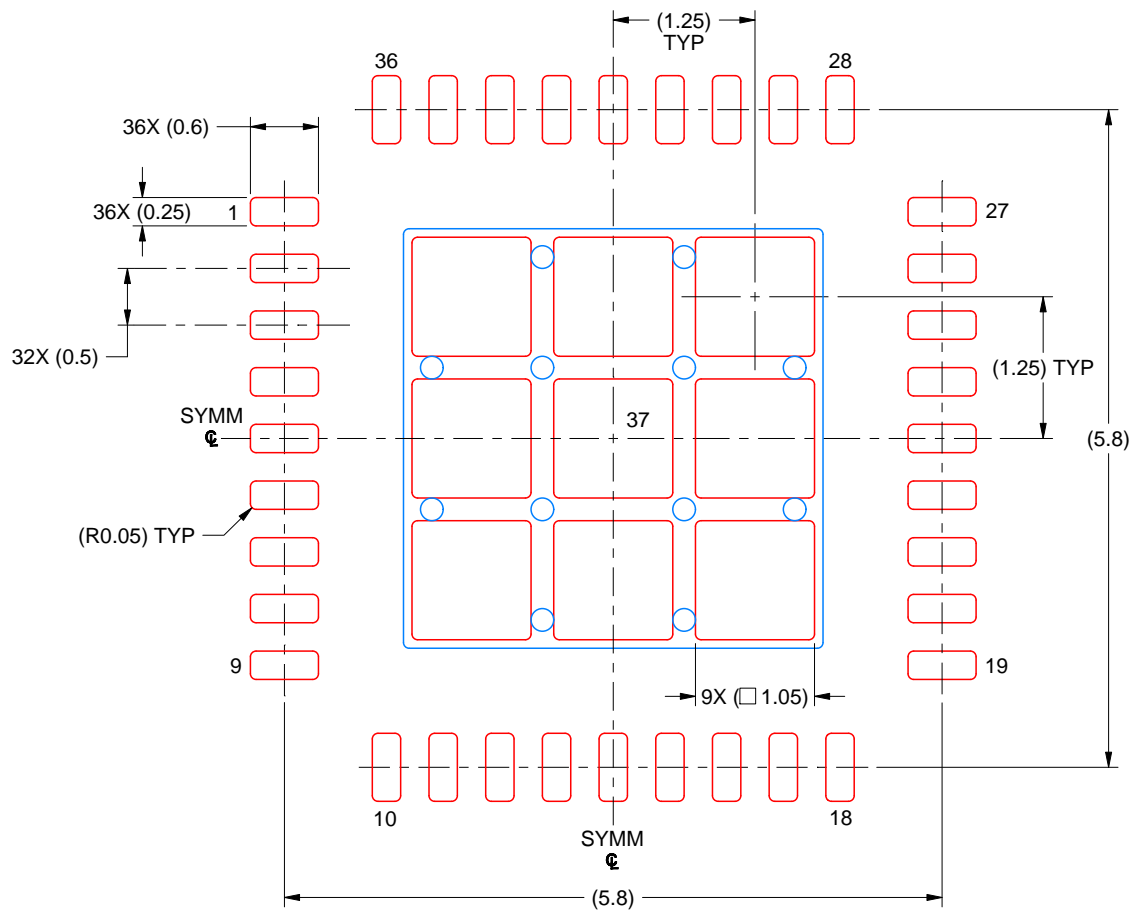
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

# EXAMPLE STENCIL DESIGN

RHA0036A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 MM THICK STENCIL  
 SCALE: 15X

EXPOSED PAD 37  
 72% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4225089/A 06/2019

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025