

# ***AN-1301 Dual Footprint Layout Notes for DP83865 Gig PHYTER® V and DP83847 DS PHYTER II***

---

## **ABSTRACT**

This application report contains information needed to combine the 10/100 DS PHYTER® II and the 10/100/1000 Gig PHYTER V on the printed circuit board (PCB).

---

## **Contents**

1	Introduction .....	2
2	Layout Notes .....	2
	2.1 MDI Side .....	2
	2.2 MAC Side .....	3
	2.3 Clock Circuitry .....	3
3	BOM and Component Selection .....	4
	3.1 DS PHYTER II BOM .....	4
	3.2 Gig PHYTER V BOM .....	4
	3.3 Component Selection .....	5
4	References .....	5

## **List of Figures**

1	Use RF6 for Reduce Stubb .....	3
2	A “multidrop” Connection.....	3
3	Avoid Stubb .....	3

PHYTER is a registered trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

## 1 Introduction

The objectives are:

- To accommodate 10/100 or Gigabit PHY on the same board as a stuff option
- A separate reference bill of material for each of the PHY option
- Retain optimal performance for each option
- Minimize board space
- Use integrated magnetics/RJ45
- Minimize component cost for each PHY option

Since the DS PHYTER has a smaller LLP package, it fits within the Gig PHYTER footprint. On the MDI side, the 10/100 and the Gigabit signals remains almost the same. This is achieved by having an integrated magnetics that maintain the same footprint, but having different windings for the 10/100 and the Gigabit options. On the MAC side, the GMII and MII data lines are combined to save board space and termination resistors.

This document is divided into two sections:

- Layout notes
- Bill of material (BOM) and component selection

A schematic diagram of the reference design can be downloaded from the following URL:  
<http://www.ti.com/product/dp83865>

To ease the PCB design job, the design notes for DS PHYTER II and Gig PHYTER V are included in this documentation. The integrated magnetics/RJ45 that have the same footprint for both the 10/100 version and Gigabit version is included in the BOM.

If a discrete magnetics is desired, there are transformers available from pulse engineering that share the same footprint between 10/100 and Gigabit.

## 2 Layout Notes

The most critical parts of the dual footprint layout are the MDI section, the RGMII/MII section, and the crystal oscillator section.

The MDIO clock rate is 2.5 MHz maximum; however, the clock edge may be fast. Care should be taken to minimize reflections that may cause glitches on the edge that could cause double clocking.

Check out the data sheet design notes and follow the recommendations.

### 2.1 MDI Side

The MDI connection between the DS PHYTER II and the Gig PHYTER V should be kept at minimum. In the Gigabit operation, the PC trace stubs could cause reflection that may degrade the cable length performance of the Gigabit mode.

The MDI termination resistors should be placed as close to the Gig PHYTER as possible. The power supply decoupling caps (C2 and C5) should be placed close to the termination resistors.

The transformer center tap decoupling caps (C3 and C4) should be placed as close to the magnetics as possible.

The MDI traces are differential signal pairs. The spacing between the pairs should be kept at least 0.25 inch apart. The differential pairs should be running close in parallel to minimize common mode noise pick up. In addition, avoid placing via on the differential trace since via presents extra capacitive load.

Place solid ground plane under the differential signals to minimize EMI radiation. For more information, see the device-specific data sheet design notes.

## 2.2 MAC Side

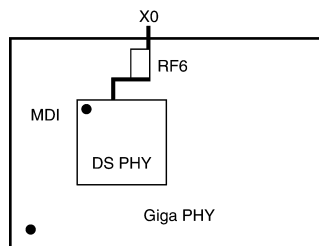
The RGMII signaling is 125 MHz using both rising and falling edges of the clock. The Tx and the RX side trace length should be matched within the signal group to minimize timing skew. It is advised to match the trace length within 0.1 inch within the Tx and Rx signal groups.

Minimize the number of via on the RGMII lines to minimize timing skew. Since the signal rise and fall time are sub-nano second, transmission line design guide lines should be followed. For more information, see the device-specific data sheet design notes and DP83865 application report on the RGMII.

## 2.3 Clock Circuitry

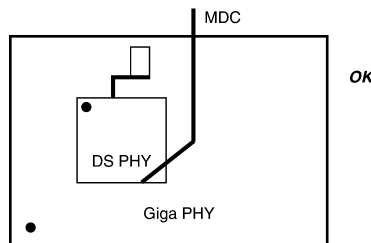
The crystal is shared between the DS PHYTER II and the Gig PHYTER V. Keep all the crystal circuitry traces as short as possible and as close to the PHY as possible.

Place the RF6 stuff option resistor as close to the Gig PHYTER clock pad as possible. In the Gigabit mode, the RF6 resistor is not stuffed so that the X0 signal terminates at the Gig PHYTER V clock input. This minimizes the trace stub (see [Figure 1](#)).

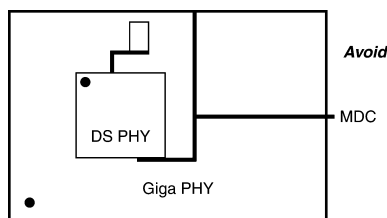


**Figure 1. Use RF6 for Reduce Stubb**

Care should be taken on the MDC signal to minimize glitch on the clock edge as mentioned in [Section 2](#). The glitch on the clock edge may cause double clocking. Connect the MDC as multidrop instead of branched between the DS PHYTER II and Gig PHYTER V pads (see [Figure 2](#) and [Figure 3](#)).



**Figure 2. A “multidrop” Connection**



**Figure 3. Avoid Stubb**

For notes on reset requirement, power supply decoupling, sensitive pins, PCB layer stacking, and other information, see the device-specific data sheet design notes or application reports.

### 3 BOM and Component Selection

Reference designators R and C are shared in both DS PHYTER and Gig PHYTER circuitries. References CG and RG are used in Gig PHYTER circuitry only. Reference CF and RF are used in the DS PHYTER only. (“G” stands for Gigabit; “F” stands for Fast Ethernet.) RX and TX values are different between the DS PHYTER II and the Gig PHYTER V.

#### 3.1 DS PHYTER II BOM

The 10/100 BOM is listed in [Table 1](#).

**Table 1. DS PHYTER II BOM**

Item	Qty	Reference	Description	MFG Part Number
1	2	C7,C9	Cap, 0.01uF, ceramic, SMD 0603	
2	7	C2, C3, C4, C5, C6, C8, CF2	Cap, 0.1uF, Ceramic, SMD 0603	
3	2	C1, CF1	Cap, 10uF, 16V, Tant, SMD 3528	
4	2	C10,C11	Cap, 33pF, Ceramic, SMD 0603	
5	1	RF1	Res, 10K, 1%, SMD 0603	
6	7	RF2,RF3,RF4, R5, R6, R7, R8	Res, 33R, 5%, SMD 0603	
7	2	RF5,RF6	Res, 0R, SMD 0603	
8	6	R3,R4,R9,R10,R11,R12	Res, 49R9, 1%, SMD 0603	
9	2	RX1,RX2	Res, 54R9, 1%, SMD 0603	
10	3	R1,R2,R13	Res, 2K0, 5%, SMD 0603	
11	1 TX1		10/100 Magnetics-RJ45	PulseEng JK0-0003
12	1	UF1	IC, 10/100 PHY, LLP	NSC DP83847 LQA56A
13	1	Y1	Crystal, 25MHz, 50PPM	

#### 3.2 Gig PHYTER V BOM

The 10/100/1000 Gig PHYTER V BOM is listed in [Table 2](#).

**Table 2. Gig PHYTER V BOM**

Item	Qty	Reference	Description	MFG Part Number
1	6	CG1,CG4,CG6,C7,CG8,C9	Cap, 0.01uF, ceramic, SMD 0603	
2	1	CG2	Cap, 22uF, 16V, Tant, SMD 3528	
3	9	C2,CG3,C3,C4,CG5,C5,C6,CG 7,C8	Cap, 0.1uF, Ceramic, SMD 0603	
4	2	C1,CG9	Cap, 10uF, 16V, Tant, SMD 3528	
5	2	C10, C11	Cap, 33pF, Ceramic, SMD 0603	
6	6	RG5, R5, RG6, R6, R7, R8	Res, 33R, 5%, SMD 0603	
7	3	RG1, RG2, RG4	Res, 0R, SMD 0603	
8	1	RG3	Res, 18R, 5%, SMD 0603	
9	1	RG7	Res, 9K76, 1%, SMD 0603	
10	8	RX1,RX2,R3,R4,R9,R10,R11,R 12	Res, 49R9, 1%, SMD 0603	
11	3	R1,R2,R13	Res, 2K0, 5%, SMD 0603	
12	1 TX1		10/100/1000 Magnetics-RJ45	PulseEng JK065421

**Table 2. Gig PHYTER V BOM (continued)**

Item	Qty	Reference	Description	MFG Part Number
13	1	UG1	IC, 10/100/1000 PHY, PQFP	NSC DP83865BVH
14	1	Y1	Crystal, 25MHz, 50PPM	

### 3.3 Component Selection

The listed Pulse Engineering Magnetics/RJ45 shares the same footprint between the 10/100 and the 10/100/1000 modules.

Pulse engineering also has a 10/100 discrete transformer (H1267) that shares the same footprint with the commonly used H5007 Gigabit transformer.

The crystal requirement is listed in the *DP83865 Gig PHYTER V 10/100/1000 Ethernet Physical Layer (SNLS165)*. Follow the recommendations in the *AN-1263 DP83865 Gig PHYTER V 10/100/1000 Ethernet Physical Layer Design Guide (SNLA056)*.

## 4 References

- *DP83865 Gig PHYTER V 10/100/1000 Ethernet Physical Layer (SNLS165)*
- *AN-1263 DP83865 Gig PHYTER V 10/100/1000 Ethernet Physical Layer Design Guide (SNLA056)*

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)