

# AMD8513/X

USB-to-10/100 Mbps Ethernet LAN Controller

Communications



N e v e r   s t o p   t h i n k i n g .

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## USB-to-10/100 Mbps Ethernet LAN Controller

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**Revision History: 2005-12-05, Rev. 1.21**

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### Previous Version:

Page/Date	Subjects (major changes since last revision)
2001-12	Rev. 0.1: Preliminary
2002-01	Rev. 1.0: Rearrange
2002-06	Rev. 1.1: 1.VAARef I/O is power pin, not input pin in P.7 2.GNDRef I/O is power pin, not input pin in P.7 3.Modify Pin Assignment Diagram P.5 4.Make small correction on P1, P2, P5, P10, P13, P17, P19, P35, P37, P38
2002-06	Rev 1.2: 1.Remove power consumption @ mode 1 in P.2 2.Change power consumption in P.33 3.Add layout guide in Appendix A
2005-09-13	Rev 1.21: when changed to the new Infineon format
2005-12-05	Minor change. Included Green package information

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## 1 Product Overview

### 1.1 Package Information

Product Name	Product Type	Package	Ordering Number
ADM8513	ADM8513-AD-T-1	P-LQFP-48-5	Q67801H 62A101 <sup>1)</sup>
ADM8513X	ADM8513X-AD-T-1	PG-LQFP-48-5	Q67801H 98A101

1) "x" stands as key to Infineon packing variants, such as "Tape&reel, drypacked" as well as for the environmentally "green" package version.

### 1.2 Features

Main features:

- **Industrial Standard**
  - IEEE 802.3/802.3u 10Base-T/100Base-Tx compliant.
  - Supports IEEE 802.3x flow control
  - Supports Auto-Negotiation for 10BASE-T and 100BASE-TX
  - USB specification 1.0 and 1.1 compliant
- **USB Interface**
  - USB specification 1.0 and 1.1 compliant
  - Full-Speed USB Device
  - Supports 1 USB configuration and 1 interface
  - Supports all USB standard commands
  - Supports two vendor specific commands
  - Supports USB Suspend/Resume detection logic
  - Supports 4 endpoints: 1 control endpoint with maximum 8-byte packet, 1 bulk IN endpoint with maximum 64-byte packet, 1 bulk OUT endpoint with maximum 64-byte packet and 1 interrupt IN endpoint with maximum 8-byte packet
- **MAC/PHY**
  - Integrates the PHY by using address 1
  - Supports configurable threshold for PAUSE frame.
  - Supports Auto-Negotiation
  - Provides transmit wave-shaper, receive filter, and adapter equalizer.
  - Provides MLT-3 transceiver with DC restoration for Base-Line wander.
  - Supports external transmit/receive transformer with turn ration 1:1.
- **EEPROM Interface**
  - Provides serial interface to access 93C46 EEPROM
  - Automatically load device ID, vendor ID from EEPROM after power-on reset
- **FIFO**
  - Synchronous SRAM.
  - Internal 2K-byte two port asynchronous SRAM.
- **LED Interface**
  - 2 LED operation modes
  - LED0: speed indication for 10Mbps or 100Mbps.
  - LED1: link indication.
  - LED2: full duplex indication.
- **Support Power Save Function @ USB suspend mode**

- Mode 0: Resume by remote wakeup or host when OS goes into standby
- Mode 1: Resume by host when OS goes into standby.
- **Miscellaneous**
  - Supports 6 GPIO pins
  - Provides 48-pin LQFP package
  - 3.3 V power supply with 5 V/3.3 V I/O tolerance
- **Support Driver**
  - Win98/ME/2000/XP
  - Linux driver, WinCE 3.0&4.0 driver
  - Manufacturing test utilities:
    - EEPROM Burn-in program
    - MFG testing program

## 2 Interface Description

### 2.1 Pin Assignment Diagram

Pin Diagram ADM8513/X.

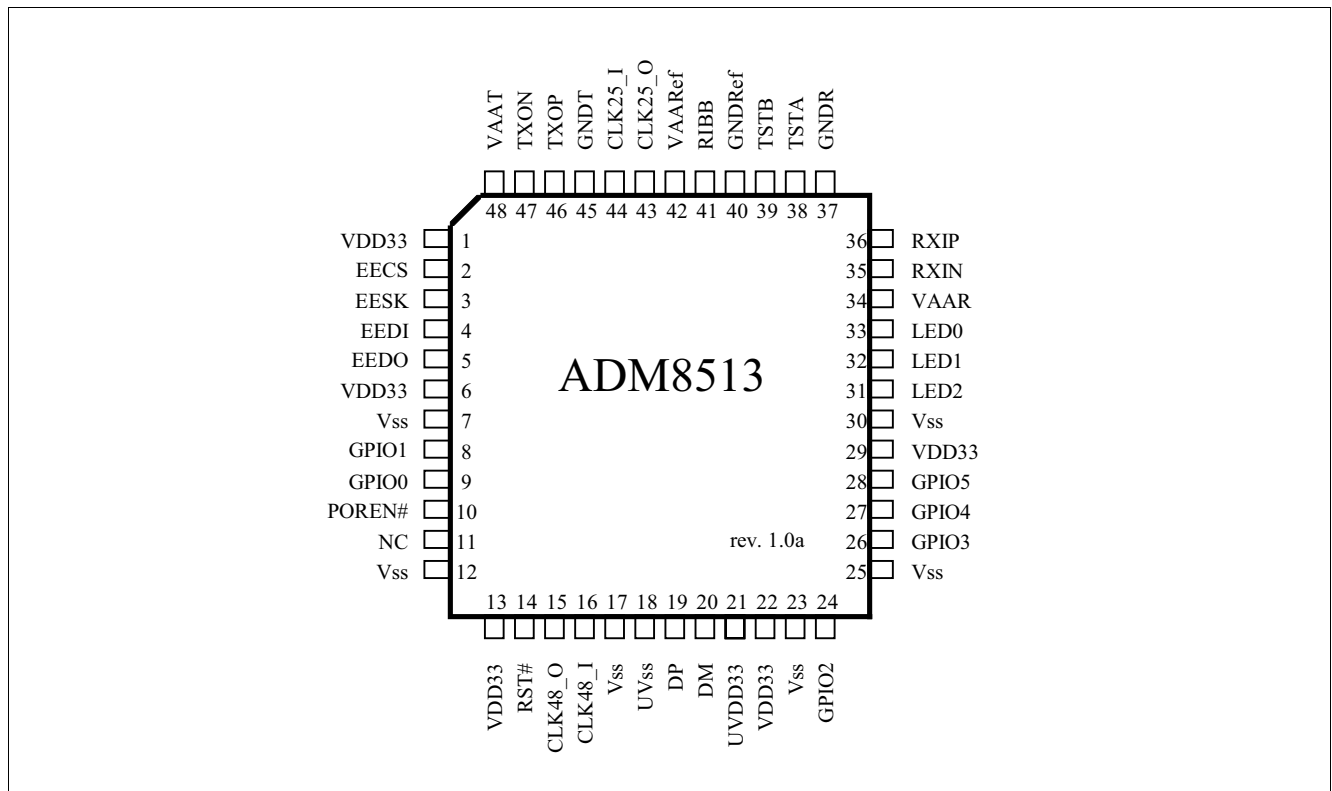


Figure 1 Pin Diagram

### 2.2 Pin Description by Function

Table 1 Abbreviations for Pin Type

Abbreviations	Description
I	Standard input-only pin. Digital levels.
O	Output. Digital levels.
I/O	I/O is a bidirectional input/output signal.
AI	Input. Analog levels.
AO	Output. Analog levels.
AI/O	Input or Output. Analog levels.
PWR	Power
GND	Ground
MCL	Must be connected to Low (JEDEC Standard)
MCH	Must be connected to High (JEDEC Standard)

**Table 1 Abbreviations for Pin Type (cont'd)**

Abbreviations	Description
NU	Not Usable (JEDEC Standard)
NC	Not Connected (JEDEC Standard)

**Table 2 Abbreviations for Buffer Type**

Abbreviations	Description
Z	High impedance
PU1	Pull up, 10 k $\Omega$
PD1	Pull down, 10 k $\Omega$
PD2	Pull down, 20 k $\Omega$
TS	Tristate capability: The corresponding pin has 3 operational states: Low, high and high-impedance.
OD	Open Drain. The corresponding pin has 2 operational states, active low and tristate, and allows multiple devices to share as a wire-OR. An external pull-up is required to sustain the inactive state until another agent drives it, and must be provided by the central resource.
OC	Open Collector
PP	Push-Pull. The corresponding pin has 2 operational states: Active-low and active-high (identical to output with no type attribute).
OD/PP	Open-Drain or Push-Pull. The corresponding pin can be configured either as an output with the OD attribute or as an output with the PP attribute.
ST	Schmitt-Trigger characteristics
TTL	TTL characteristics

## 2.2.1 Host Interface

**Table 3 Host Interface**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
16	CLK48_I	I		<b>Input Clock</b> 48 MHz clock input from crystal or oscillator.
15	CLK48_O	O		<b>Output for Crystal</b>
14	RST#	I		<b>External Hardware Reset Input</b> Schmitt-trigger, internal pull high.
20	DM	I/O		<b>USB Data Minus pin</b>
19	DP	I/O		<b>USB Data Plus Pin</b>

## 2.2.2 Physical Interface

**Table 4 Physical Interface**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
86, 35	RXIP, RXIN	I		<b>RX Input</b>
46, 47	TXOP, TXON	O		<b>TX Output</b>
44	CLK25_I	I		<b>Crystal Input</b> 25MHz
43	CLK25_O	O		<b>Crystal Output</b> 25MHz
41	RIBB	I		<b>Reference Bias Resistor, tied to external 10K(1%) resistor to ground</b>
38, 39	TSTA, TSTB	O		<b>Test Output Pin</b>

### 2.2.3 LED Interface

**Table 5 LED Interface**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
33	LED0	O		<b>LED display for 100M b/s or 10M b/s speed.</b> Active low indicates 100Base-TX, active high indicates 10 BaseT.
32	LED1	O		<b>LED display for link and activity status.</b> Active low when link is established.
31	LED2	O		<b>LED display for Full Duplex or Collision status.</b> Active low indicates full duplex, high indicates collision in half duplex.

Note: The LED interface is EEPROM-programmable, 2 bit EEPROM control bit, Address 0B[7:6] at EEPROM, is used to select LED mode, the default setting are:

1. LED0: 100Mbps(on, drive '0') or 10Mbps(off, drive '1')
2. LED1: link (keeps on when link ok) or activity (blinks with 10Hz when Pegasus II is receiving or transmitting but not colliding)
3. LED2: full duplex (keeps on when in full duplex mode) or collision (blinks with 20Hz when colliding)
4. All LED pins will be tri-state when using external PHY (offset 81h with bit[4:2] = 001<sub>B</sub>)

Mapping between LED action and EEPROM 0B[7:6] setting

**Table 6 Mapping between LED action and EEPROM 0B[7:6] setting**

EEPROM 0B[7:6]	LED	Action
0,0	LED0	10 / 100 (OFF/ON)
	LED1	LINK / ACTIVITY (ON/FLASH)
	LED2	FULL DUP / COL (ON/FLASH)
0,1	LED0	ACTIVITY when LINK (FLASH)
	LED1	LINK 10(ON)
	LED2	LINK 100(ON)

## 2.2.4 EEPROM Interface

**Table 7 EEPROM Interface**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
2	EECS	O		<b>EEPROM Chip Select</b> This pin enables the EEPROM during loading of the Ethernet configuration data. CMOS I/O with 5 V tolerant, 2mA
4	EEDI	O		<b>EEPROM Data In</b> The MAC will use this pin to serially write opcodes, addresses and data into the serial EEPROM. CMOS I/O with 5 V tolerant, 2mA
5	EEDO	I		<b>EEPROM Data Out, internal pull low</b> The MAC will read the contents of the EEPROM serially through this pin. Input, pull down, 5 V tolerant
3	EESK	O		<b>EEPROM Clock</b> After reset, the MAC if configured, will read the contents of the EEPROM using EESK, EEDO, and EEDI. This pin provides the clock for the EEPROM. CMOS I/O with 5 V tolerant, 2mA

## 2.2.5 Miscellaneous

**Table 8 Miscellaneous**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
9	GPIO5	I/O		<b>General Purpose Input/Output Pins</b> These pins are used as general purpose Input/Output pins and offset 0A[1] = 0 in EEPROM. Default is internal pull-low
8	GPIO4			
24	GPIO3			
26	GPIO2			
27	GPIO1			
28	GPIO0			
10	POREN#	I		<b>Test Pins</b>
11	NC	X		<b>Test Pins</b>

## 2.2.6 POWER USB

**Table 9 Power USB**

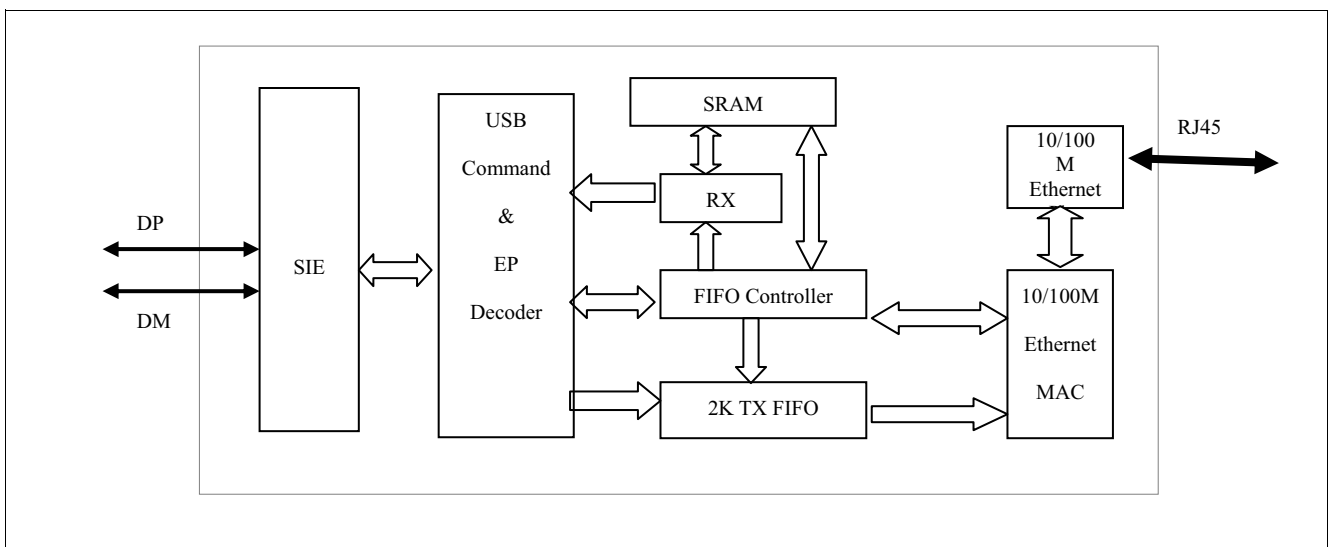
Pin or Ball No.	Name	Pin Type	Buffer Type	Function
21	UVDD 33	PWR		<b>3.3V power supply for USB transceiver</b>
18	UVSS	PWR		<b>Ground for USB transceiver</b>

## 2.2.7 POWER

**Table 10 Power**

Pin or Ball No.	Name	Pin Type	Buffer Type	Function
1, 6, 13, 22, 29	VDD 33	PWR		<b>3.3V Power Supply.</b>
7, 12, 23, 17, 25, 30	VSS	PWR		<b>Ground</b>
42	VAARef	PWR		<b>+3.3V Power Supply for PHY.</b>
40	GNDRed	PWR		<b>+3.3V Power Ground for PHY</b>
48	VAAT	PWR		<b>+3.3V for Transmitter</b>
45	GNDT	PWR		<b>GND for Transmitter</b>
34	VAAR	PWR		<b>+3.3V for Receiver</b>
37	GNDR	PWR		<b>GND for Receiver</b>

## 2.3 Block Diagram



**Figure 2 Block Diagram**

## 3 Function Description

### 3.1 USB Interface

USB is a likely solution any time you want to use a computer to communication with devices outside the computer. The interface is suitable for one-of-kind and small-scale designs as well as mass-produced, standard peripheral. The benefits to USB are easy to use, fast and reliable data transfers, flexibility, low cost and power conservation.

#### 3.1.1 SIE

SIE (Serial Interface Engine) is to control USB communications and check USB protocol, then transfer protocol to EP decoder. The SIE and USB transceivers, which provide the hardware interface to the USB cable, together comprise the USB engine.

#### 3.1.2 USB Command & EP Decoder

The detail description is in “USB Command”.

### 3.2 FIFO Controller

FIFO Controller in receive path is in charge of:

- Stores received Ethernet packets to SRAM and multiple packets can be stored to SRAM. If more than maximum packet counts are received or total packet size is more than the size of SRAM, the subsequent coming Ethernet packet will be discarded.
- FIFO controller will load data from SRAM to internal RX FIFO then inform EP Decoder that 64-byte data or a packet is ready in RX FIFO. Before FIFO controller informs about this, any USB access to bulk IN endpoint will return NAK. This is to maintain the data transfer on the USB bus via bulk IN transfer which is continuous, thus a 64-byte internal RX FIFO is needed.
- If an Ethernet packet is being received and loading into SRAM while FIFO Controller is moving data from SRAM to internal RX FIFO, writing the Ethernet packet to SRAM will get the higher priority.

### 3.3 TX FIFO and RX FIFO

RX FIFO is a one-port 64-byte FIFO and TX FIFO is a two-port 2K-byte FIFO.

### 3.4 10/100M Ethernet PHY

The Ethernet PHY is compliant to IEEE 802.3u 100BASE-TX and IEEE802.3 10BASE-T. It provides the whole physical layer functions for both 10M and 100M Ethernet speed.

## 4 USB Device Endpoint Operation

### 4.1 Endpoint 0

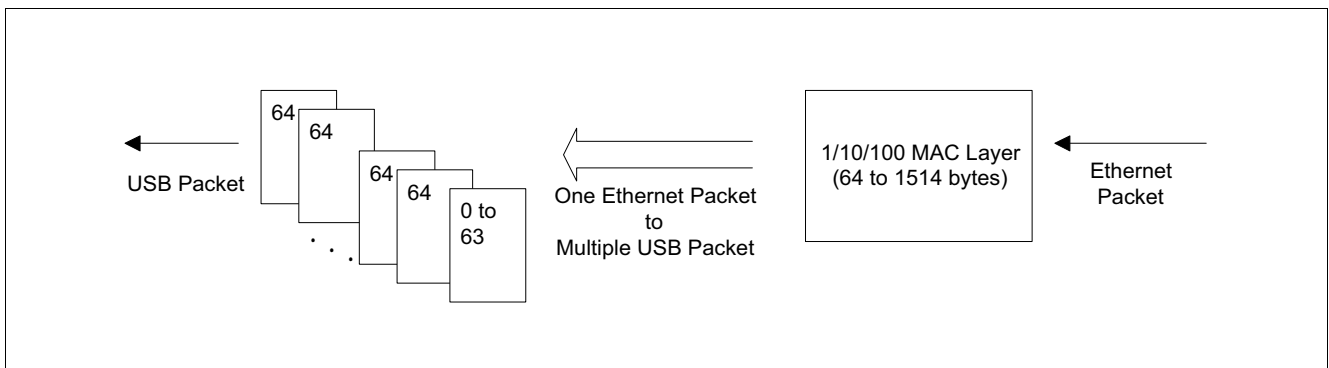
Endpoint 0 is in charge of response to standard USB commands and vendor specific commands. Internal register settings are also via this endpoint. The response to each command is described in section 6.



## 4.2 Endpoint 1 Bulk IN

Endpoint 1 is in charge of sending the received Ethernet packet to USB host. An Ethernet packet will be split to multiple 64 bytes USB packets on USB. The end of the Ethernet packet is indicated by less than 64-byte or 0 length data transfer in this pipe. The Ethernet received status is optionally reported at the end of the packet.

While accessing to this endpoint, if RXFIFO is either full or any packet is inside, the data in RXFIFO is returned in USB data stage. If ACK is received from USB host, data in RXFIFO is flushed. If no response or NAK is received from USB host, the content in RXFIFO will be re-transmitted. If RXFIFO isn't ready for transmission, NAK is returned to USB host.



**Figure 3 Packet Form when Receive**

The Received Status is Reported as Follows:

**Table 11 USB Received Status**

Offset	Bit	Field	Description
Offset0	7-0	rx_bytectl_lo	The received byte count[7:0].
Offset1	3-0	rx_bytectl_hi	The received byte count[11:8].
	7-4	reserved	
Offset2	0	multicast_frame	Indicates received a multicast frame.
	1	long_pkt	Indicates received packet length > 1518 bytes.
	2	runt_pkt	Indicates received packet length < 64 bytes.
	3	crc_err	Indicates CRC check error.
	4	dribble_bit	Indicates packet length is not integer multiple of 8-bit.
	7-5	reserved	
Offset3	7-0	reserved	

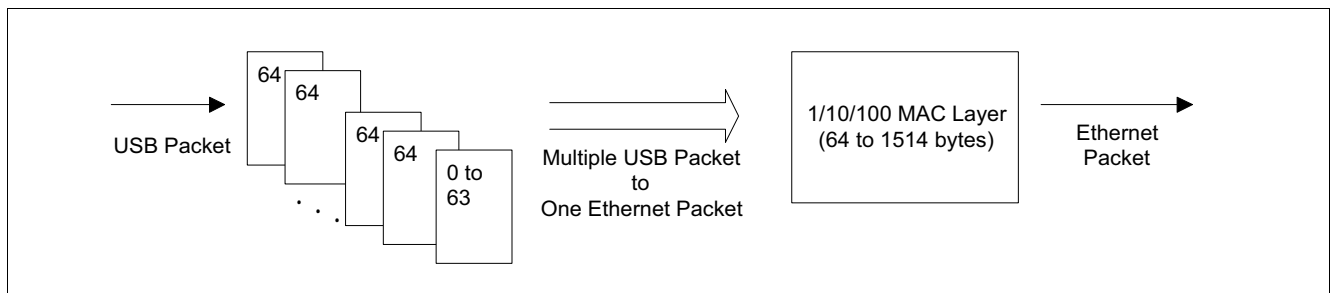
### 4.2.1 Endpoint 2 Bulk OUT

Endpoint 2 is in charge of sending the USB packet to Ethernet. An Ethernet packet is concatenated by multiple 64 bytes USB packets on USB. The first two bytes in every first concatenated USB packet indicate the length of the Ethernet packet. The end of the Ethernet packet is indicated by less than 64-byte or 0 length data transfer in this pipe. The Ethernet transmit status is reported in transmit status register.

When accessing to this endpoint, data in USB data stage is transferred to TXFIFO, if TXFIFO is free and ACK is returned. If TXFIFO isn't free, NAK is returned.

**Table 12 USB Packet Format**

Field	1st Byte in 1st USB Packet	2nd Byte in 1st USB Packet	The Following Packets
Content	len[7:0]: Low byte Ethernet packet length	{reserved[4:0], len[10:8]}	Ethernet packet



**Figure 4 Packet Form when Transmit**

### 4.2.2 Endpoint 3 Interrupt IN

Endpoint 3 is in charge of returning the current Ethernet transfer status every polling interval. When accessing to this endpoint, 8 bytes data is returned to USB host. The 8-byte packet contains

**Table 13 Interrupt Packet Form**

Offset0	Offset1	Offset2	Offset3	Offset4
tx_status(Reg2B <sub>H</sub> )	tx_status(Reg2C <sub>H</sub> )	rx_status(Reg2D <sub>H</sub> )	rx_lostpkt(Reg2E <sub>H</sub> )	rx_lostpkt(Reg2F <sub>H</sub> )

**Table 14 Interrupt Packet Form**

Offset5	Offset6(1B)	Offset7(1B)
wakeup_status(Reg7A <sub>H</sub> )	Packet number in RX FIFO (Reg82 <sub>H</sub> )	7'b00, length error

## 5 USB Commands

### 5.1 USB Command

#### 5.1.1 Get Register (Vendor Specific) Single/Burst Read

**Table 15 Setup Stage**

bmReq	bReq	wValue(2B)	wIndexLow(1B)	wIndexHigh(1B)	wLength L(1B)	wLength H(1B)
C0	F0	0	RegIndex[7:0]	00	Length Low	Length High

**Table 16 Data Stage**

Offset0(1B)	Offset1(1B)	Offset2(1B)
{RegIndex}	{RegIndex+1}	{RegIndex+2}

The returned total number of registers depends on the length field.

### 5.1.2 Set Register (Vendor Specific) Burst Write

**Table 17 Setup Stage**

bmReq	bReq	wValue(2B)	wIndexLow(1B)	wIndexHigh(1B)	wLength L(1B)	wLength H(1B)
40	F1	0	RegIndex[7:0]	00	Length Low	Length High

**Table 18 Data Stage**

Offset0(1B)	Offset1(1B)	Offset2(1B)	Offset3(1B)
{RegIndex}	{RegIndex+1}	{RegIndex+2}	{RegIndex+3}

Ex. Write 44 to RegIndex = 05<sub>H</sub>, the transfer will be

**Table 19 Setup Stage**

bmReq	bReq	wValue L(1B)	wValue H(1B)	wIndexLow (1B)	wIndexHigh (1B)	wLength L(1B)	wLength H(1B)
40	F1	44	00	05	00	01	00

If wLength > 1, more than 1 register is accessed (burst write) and mask is not supported => DataStage for 8-byte OUT transfer appears

Ex. Burst write 20 registers from RegIndex = 07<sub>H</sub> and data from 01<sub>D</sub> to 20<sub>D</sub>

- Setup Stage

**Table 20 Setup Stage**

bmReq	bReq	wValue(2B)	wIndexLow(1B)	wIndexHigh(1B)	wLength L(1B)	wLength H(1B)
40	F1	0000	07	00	14	00

- Data Stage

**Table 21 1st OUT Transfer**

Offset0(1B)	Offset1(1B)	Offset2(1B)	Offset3(1B)	Offset4(1B)	Offset5(1B)	Offset6(1B)	Offset7(1B)
01	02	03	04	05	06	07	08

**Table 22 2nd OUT Transfer**

Offset0(1B)	Offset1(1B)	Offset2(1B)	Offset3(1B)	Offset4(1B)	Offset5(1B)	Offset6(1B)	Offset7(1B)
09	0A	0B	0C	0D	0E	0F	10

**Table 23 3rd OUT Transfer**

Offset0(1B)	Offset1(1B)	Offset2(1B)
11	12	13

### 5.1.3 Get Status (Device)

**Table 24 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex(2B)	wLength L(1B)	wLength H(1B)
80	0	0	0	2	0

**Table 25 Data Stage**

D[15:2]	D[1]: Remote Wakeup	D[0]: Self Powered
0	Register of remote_wakeup	1

### 5.1.4 Get Status (Interface)

**Table 26 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex(2B)	wLength L(1B)	wLength H(1B)
81	0	0	0	2	0

**Table 27 Data Stage**

D[15:0]
0

### 5.1.5 Get Status (EP0)

**Table 28 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex L(1B)	wIndex H(1B)	wLength L(1B)	wLength H(1B)
82	0	0	80 or 00	00	2	0

**Table 29 Data Stage**

D[15:1]	D[0]: Halt
0	Register of ep0_halt

### 5.1.6 Get Status (EP1) Bulk In

**Table 30 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex L(1B)	wIndex H(1B)	wLength L(1B)	wLength H(1B)
82	0	0	81	00	2	0

**Table 31 Data Stage**

D[15:1]	D[0]: Halt
0	Register of ep1_halt

### 5.1.7 Get Status (EP2) Bulk OUT

**Table 32 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex L(1B)	wIndex H(1B)	wLength L(1B)	wLength H(1B)
82	0	0	02	00	2	0

**Table 33 Data Stage**

D[15:1]	D[0]: Halt
0	register of ep2_halt

### 5.1.8 Get Status (EP3) Interrupt IN

**Table 34 Setup Stage**

bmReq	bReq	wValue(2B)	wIndex L(1B)	wIndex H(1B)	wLength L(1B)	wLength H(1B)
82	0	0	83	00	2	0

**Table 35 Data Stage**

D[15:1]	D[0]: Halt
0	register of ep3_halt

### 5.1.9 Get Descriptor (Device) Total 18-byte

**Table 36 Setup Stage**

bmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex(2B)	wLength L(1B)	wLength H(1B)
80	6	01	00	0	Length low	Length high

**Table 37 Data Stage: wLength Field Specifies the Total byte Count to Return 1**

Offset 0	Offset 1 (type)	Offset 2 (USB release no. L)	Offset 3 (USB release no. H)	Offset 4 (Class code)	Offset 5 (Sub Class Code)	Offset 6 (Protocol)	Offset 7 (EP0 MaxPktSize)
12(1 <sub>B</sub> )	01(1 <sub>B</sub> )	10(1 <sub>B</sub> )	01(1 <sub>B</sub> )	FF(1 <sub>B</sub> )	00(1 <sub>B</sub> )	ff(1 <sub>B</sub> )	8(1 <sub>B</sub> )

**Table 38 Data Stage: wLength Field Specifies the Total byte Count to Return 2**

Offset 8 (vendor ID) Low	Offset 9(vendor ID) High	Offset 10 (productID) Low	Offset 11 (productID) High	Offset 12 (releaseID Low)
(1 <sub>B</sub> )	(1 <sub>B</sub> )	(1 <sub>B</sub> )	(1 <sub>B</sub> )	01(1 <sub>B</sub> )

**Table 39 Data Stage: wLength Field Specifies the Total byte Count to Return 3**

Offset 13 (releaseID High)	Offset 14 (manufacture)	Offset 15 (Product)	Offset 16 (serial no.)	Offset 17 (no. of config)
01(1 <sub>B</sub> )	01(1 <sub>B</sub> )	02(1 <sub>B</sub> )	03(1 <sub>B</sub> )	01(1 <sub>B</sub> )

### 5.1.10 Get Descriptor (Configuration) Total 39-byte

**Table 40 Setup Stage**

BmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex(2B)	wLength L(1B)	wLength H(1B)
80	6	02	00	0	Length low	Length high

- Data Stage

**Table 41 Configuration Descriptor 1**

Offset 0 (Length)	Offset 1 (DscrType)	Offset 2 (TotalLength) Low	Offset 3 (TotalLength) High	Offset 4 (NumInterface)
09(1 <sub>B</sub> )	02(1 <sub>B</sub> )	27(1 <sub>B</sub> )	00(1 <sub>B</sub> )	01(1 <sub>B</sub> )

**Table 42 Configuration Descriptor 2**

Offset 5 (CfgValue)	Offset 6 (StringIndex)	Offset 7 (Attribute)	Offset 8(MaxPower)
00(1 <sub>B</sub> )	00(1 <sub>B</sub> )	E0(1 <sub>B</sub> )	max_pwr(1 <sub>B</sub> )

**Table 43 Interface 0 Descriptor**

Offset 0 (Length)	Offset 1 (DscrType)	Offset 2 (Interface Num)	Offset 3 (AltInterface)	Offset 4 (NumEP)	Offset 5 (IntfClass)	Offset 6 (IntfSubClass)	Offset 7 (IntfProtocol)	Offset 8 (StringIndex)
09(1 <sub>B</sub> )	04(1 <sub>B</sub> )	00(1 <sub>B</sub> )	00(1 <sub>B</sub> )	03(1 <sub>B</sub> )	FF(1 <sub>B</sub> )	E0(1 <sub>B</sub> )	FF(1 <sub>B</sub> )	00(1 <sub>B</sub> )

**Table 44 EP1 Descriptor**

Offset 0 (Length)	Offset 1 (DscrType)	Offset 2 (EPAddr)	Offset 3 (Attribute)	Offset 4 (MaxPktSize) Low	Offset 5 (MaxPktSize) High	Offset 6 (Interval)
07(1 <sub>B</sub> )	05(1 <sub>B</sub> )	81(1 <sub>B</sub> )	02(1 <sub>B</sub> ) bulk	64(1 <sub>B</sub> )	00(1 <sub>B</sub> )	00(1 <sub>B</sub> )

**Table 45 EP2 Descriptor**

Offset 0 (Length)	Offset 1 (DscrType)	Offset 2 (EPAddr)	Offset 3 (Attribute)	Offset 4 (MaxPktSize) Low	Offset 4 (MaxPktSize) High	Offset 6 (Interval)
07(1 <sub>B</sub> )	05(1 <sub>B</sub> )	02(1 <sub>B</sub> )	02(1 <sub>B</sub> ) bulk	64(1 <sub>B</sub> )	00(1 <sub>B</sub> )	00(1 <sub>B</sub> )

**Table 46 EP3 Descriptor**

Offset 0 (Length)	Offset 1 (DscrType)	Offset 2 (EPAddr)	Offset 3 (Attribute)	Offset 4 (MaxPktSize) Low	Offset 5 (MaxPktSize) High	Offset 6 (Interval)
07(1 <sub>B</sub> )	05(1 <sub>B</sub> )	83(1 <sub>B</sub> )	03(1 <sub>B</sub> ) interrupt	08(1 <sub>B</sub> )	00(1 <sub>B</sub> )	ep3_interval(1 <sub>B</sub> )

### 5.1.11 Get Descriptor (String) Index 0, LanguageID Code

**Table 47 Setup Stage**

BmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex(2B)	wLength Low(1B)	wLength High(1B)
80	06	00	03	0000	Length Low	Length High

**Table 48 Data Stage**

Offset0 (Length)	Offset1 (DscrType)	Offset2 (LanguageID) L	Offset3 (LanguageID) H
04(1 <sub>B</sub> )	03(1 <sub>B</sub> )	09(1 <sub>B</sub> )	04(1 <sub>B</sub> )

### 5.1.12 Get Descriptor (String) Index 1, Manufacture

**Table 49 Setup Stage**

BmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex (2B)	wLength Low(1B)	wLength High(1B)
80	06	01	03	0904	Length Low	Length High

**Table 50 Data Stage**

Offset0 (Length)	Offset1 (DscrType)	
length(1B)	03(1B)	String

**5.1.13 Get Descriptor (String) Index 2, Product**
**Table 51 Setup Stage**

BmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex (2B)	wLength Low(1B)	wLength High(1B)
80	06	02	03	0904	Length Low	Length High

**Table 52 Data Stage**

Offset 0 (Length)	Offset 1 (DscrType)	
length(1 <sub>B</sub> )	03(1 <sub>B</sub> )	String

**5.1.14 Get Descriptor (String) Index 3, Serial No.**
**Table 53 Setup Stage**

BmReq	bReq	wValue L(1B)	wValue H(1B)	wIndex (2B)	wLength Low(1B)	wLength High(1B)
80	06	03	03	0904	Length Low	Length High

**Table 54 Data Stage**

Offset 0 (Length)	Offset 1 (DscrType)	
Length(1 <sub>B</sub> )	03(1 <sub>B</sub> )	String

**5.1.15 Get Configuration**
**Table 55 Setup Stage**

BmReq	bReq	wValue(2B)	wIndex(2B)	wLength Low(1B)	wLength High(1B)
80	08	0	0	1	0

**Table 56 Data Stage**

Offset 0 (ConfigValue)(1B)	

**5.1.16 Get Interface**
**Table 57 Setup Stage**

BmReq	bReq	wValue(2B)	wIndex(2B)	wLength Low(1B)	wLength High(1B)
81	10	0	0	1	0



**Table 58 Data Stage**
**Offset0 (AltIntf) (1B)**

00

**5.1.17 Clear Feature (Device) Remote Wakeup**
**Table 59 Setup Stage**

BmReq	bReq	wValue L(1B)	WValue H(1B)	wIndex(2B)	wLength(2B)
00	01	01	00	0	0

**5.1.18 Set Feature (Device) Remote Wakeup**
**Table 60 Setup Stage**

BmReq	bReq	wValue L(1B)	WValue H(1B)	wIndex(2B)	wLength(2B)
00	03	01	00	0	0

**5.1.19 Clear Feature (EP 0, 1, 2, 3) Halt**
**Table 61 Setup Stage**

BmReq	bReq	wValue(2B)	WIndex L(1B)	wIndex L(2B)	WLength(2B)
02	03	0000	EP no	00	0

**5.1.20 Set Feature (EP 0, 1, 2, 3) Halt**
**Table 62 Setup Stage**

BmReq	bReq	wValue(2B)	WIndex H(1B)	wIndex H(2B)	WLength(2B)
02	03	0000	EP no	00	0

## 6 Registers Description

### 6.1 System Registers

**Table 63 Registers Address Space**

Module	Base Address	End Address	Note
System Registers	0000 0000 <sub>H</sub>	0000 0081 <sub>H</sub>	

**Table 64 Registers Overview**

Register Short Name	Register Long Name	Offset Address	Page Number
Res30_Res155	Reserved 30~Reserved 155	82~FF <sub>H</sub>	<a href="#">34</a>
<a href="#">EC0</a>	Ethernet Control 0	00 <sub>H</sub>	<a href="#">30</a>
<a href="#">EC1</a>	Ethernet Control 1	01 <sub>H</sub>	<a href="#">31</a>
<a href="#">EC2</a>	Ethernet Control 2	02 <sub>H</sub>	<a href="#">32</a>
<a href="#">Res0</a>	Reserved 0	03 <sub>H</sub>	<a href="#">33</a>
Res1	Reserved 1	04 <sub>H</sub>	<a href="#">33</a>
Res2	Reserved 2	05 <sub>H</sub>	<a href="#">33</a>
Res3	Reserved 3	06 <sub>H</sub>	<a href="#">33</a>
Res4	Reserved 4	07 <sub>H</sub>	<a href="#">33</a>
<a href="#">MA0</a>	Multicast Address 0	08 <sub>H</sub>	<a href="#">34</a>
<a href="#">MA1</a>	Multicast Address 1	09 <sub>H</sub>	<a href="#">34</a>
<a href="#">MA2</a>	Multicast Address 2	0A <sub>H</sub>	<a href="#">35</a>
<a href="#">MA3</a>	Multicast Address 3	0B <sub>H</sub>	<a href="#">35</a>
<a href="#">MA4</a>	Multicast Address 4	0C <sub>H</sub>	<a href="#">36</a>
<a href="#">MA5</a>	Multicast Address 5	0D <sub>H</sub>	<a href="#">36</a>
<a href="#">MA6</a>	Multicast Address 6	0E <sub>H</sub>	<a href="#">37</a>
<a href="#">MA7</a>	Multicast Address 7	0F <sub>H</sub>	<a href="#">37</a>
<a href="#">EID0</a>	Ethernet ID 0	10 <sub>H</sub>	<a href="#">38</a>
<a href="#">EID1</a>	Ethernet ID 1	11 <sub>H</sub>	<a href="#">38</a>
<a href="#">EID2</a>	Ethernet ID 2	12 <sub>H</sub>	<a href="#">39</a>
<a href="#">EID3</a>	Ethernet ID 3	13 <sub>H</sub>	<a href="#">39</a>
<a href="#">EID4</a>	Ethernet ID 4	14 <sub>H</sub>	<a href="#">40</a>
<a href="#">EID5</a>	Ethernet ID 5	15 <sub>H</sub>	<a href="#">40</a>
Res5	Reserved 5	16 <sub>H</sub>	<a href="#">33</a>
Res6	Reserved 6	17 <sub>H</sub>	<a href="#">33</a>
<a href="#">PT</a>	Pause Timer	18 <sub>H</sub>	<a href="#">41</a>
<a href="#">RPNBFC</a>	Receive Packet Number Based Flow Control	1A <sub>H</sub>	<a href="#">41</a>
<a href="#">ORFBFC</a>	Occupied Receive FIFO Based Flow Control	1B <sub>H</sub>	<a href="#">42</a>
<a href="#">EP1C</a>	EP1 Control	1C <sub>H</sub>	<a href="#">42</a>
Res7	Reserved 7	1C <sub>H</sub>	<a href="#">33</a>

**Table 64 Registers Overview (cont'd)**

Register Short Name	Register Long Name	Offset Address	Page Number
Res8	Reserved 8	1D <sub>H</sub>	<a href="#">33</a>
Res9	Reserved 9	1E <sub>H</sub>	<a href="#">33</a>
Res10	Reserved 10	1F <sub>H</sub>	<a href="#">33</a>
<a href="#">EEPROM0</a>	EEPROM Offset	20 <sub>H</sub>	<a href="#">43</a>
<a href="#">EEPROMDL</a>	EEPROM Data Low	21 <sub>H</sub>	<a href="#">43</a>
<a href="#">EEPROMDH</a>	EEPROM Data High	22 <sub>H</sub>	<a href="#">43</a>
<a href="#">EEPROMAC</a>	EEPROM Access Control	23 <sub>H</sub>	<a href="#">45</a>
Res11	Reserved 11	24 <sub>H</sub>	<a href="#">33</a>
<a href="#">PHYA</a>	PHY Address	25 <sub>H</sub>	<a href="#">45</a>
<a href="#">PHYDL</a>	PHY Data Low	26 <sub>H</sub>	<a href="#">46</a>
<a href="#">PHYDH</a>	PHY Data High	27 <sub>H</sub>	<a href="#">46</a>
<a href="#">PHYAC</a>	PHY Access Control	28 <sub>H</sub>	<a href="#">47</a>
Res12	Reserved 12	29 <sub>H</sub>	<a href="#">33</a>
<a href="#">USBBS</a>	USB Bus Status	2A <sub>H</sub>	<a href="#">47</a>
<a href="#">TS1</a>	Transmit Status 1	2B <sub>H</sub>	<a href="#">47</a>
<a href="#">TS2</a>	Transmit Status 2	2C <sub>H</sub>	<a href="#">49</a>
<a href="#">RS</a>	Receive Status	2D <sub>H</sub>	<a href="#">49</a>
<a href="#">RLPCH</a>	Receive Lost Packet Count High	2E <sub>H</sub>	<a href="#">50</a>
<a href="#">RLPCL</a>	Receive Lost Packet Count Low	2F <sub>H</sub>	<a href="#">50</a>
<a href="#">WUF0M_0</a>	Wakeup Frame 0 Mask	30 <sub>H</sub>	<a href="#">50</a>
<a href="#">WUF0M_1</a>	Wakeup Frame 0 Mask 1	31 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_2</a>	Wakeup Frame 0 Mask 2	32 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_3</a>	Wakeup Frame 0 Mask 3	33 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_4</a>	Wakeup Frame 0 Mask 4	34 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_5</a>	Wakeup Frame 0 Mask 5	35 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_6</a>	Wakeup Frame 0 Mask 6	36 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_7</a>	Wakeup Frame 0 Mask 7	37 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_8</a>	Wakeup Frame 0 Mask 8	38 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_9</a>	Wakeup Frame 0 Mask 9	39 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_10</a>	Wakeup Frame 0 Mask 10	3A <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_11</a>	Wakeup Frame 0 Mask 11	3B <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_12</a>	Wakeup Frame 0 Mask 12	3C <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_13</a>	Wakeup Frame 0 Mask 13	3D <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_14</a>	Wakeup Frame 0 Mask 14	3E <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0M_15</a>	Wakeup Frame 0 Mask 15	3F <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0O_0</a>	Wakeup Frame 0 Offset	40 <sub>H</sub>	<a href="#">51</a>
<a href="#">WUF0CRCL</a>	Wakeup Frame 0 CRC Low	41 <sub>H</sub>	<a href="#">52</a>
<a href="#">WUF0CRCH</a>	Wakeup Frame 0 CRC High	42 <sub>H</sub>	<a href="#">52</a>
Res13	Reserved 13	43 <sub>H</sub>	<a href="#">33</a>
Res14	Reserved 14	44 <sub>H</sub>	<a href="#">33</a>
Res15	Reserved 15	45 <sub>H</sub>	<a href="#">33</a>

**Table 64 Registers Overview (cont'd)**

<b>Register Short Name</b>	<b>Register Long Name</b>	<b>Offset Address</b>	<b>Page Number</b>
Res16	Reserved 16	46 <sub>H</sub>	<a href="#">33</a>
Res17	Reserved 17	47 <sub>H</sub>	<a href="#">33</a>
<a href="#">WUF1M_0</a>	Wakeup Frame 1 Mask	48 <sub>H</sub>	<a href="#">53</a>
WUF1M_1	Wakeup Frame 1 Mask 1	49 <sub>H</sub>	<a href="#">53</a>
WUF1M_2	Wakeup Frame 1 Mask 2	4A <sub>H</sub>	<a href="#">53</a>
WUF1M_3	Wakeup Frame 1 Mask 3	4B <sub>H</sub>	<a href="#">53</a>
WUF1M_4	Wakeup Frame 1 Mask 4	4C <sub>H</sub>	<a href="#">53</a>
WUF1M_5	Wakeup Frame 1 Mask 5	4D <sub>H</sub>	<a href="#">53</a>
WUF1M_6	Wakeup Frame 1 Mask 6	4E <sub>H</sub>	<a href="#">53</a>
WUF1M_7	Wakeup Frame 1 Mask 7	4F <sub>H</sub>	<a href="#">53</a>
WUF1M_8	Wakeup Frame 1 Mask 8	50 <sub>H</sub>	<a href="#">53</a>
WUF1M_9	Wakeup Frame 1 Mask 9	51 <sub>H</sub>	<a href="#">53</a>
WUF1M_10	Wakeup Frame 1 Mask 10	52 <sub>H</sub>	<a href="#">53</a>
WUF1M_12	Wakeup Frame 1 Mask 12	54 <sub>H</sub>	<a href="#">53</a>
WUF1M_13	Wakeup Frame 1 Mask 13	55 <sub>H</sub>	<a href="#">53</a>
WUF1M_11	Wakeup Frame 1 Mask 11	56 <sub>H</sub>	<a href="#">53</a>
WUF1M_14	Wakeup Frame 1 Mask 14	56 <sub>H</sub>	<a href="#">53</a>
WUF1M_15	Wakeup Frame 1 Mask 15	57 <sub>H</sub>	<a href="#">53</a>
<a href="#">WUF10</a>	Wakeup Frame 1 Offset	58 <sub>H</sub>	<a href="#">53</a>
<a href="#">WUF1CRCL</a>	Wakeup Frame 1 CRC Low	59 <sub>H</sub>	<a href="#">55</a>
<a href="#">WUF1CRCH</a>	Wakeup Frame 1 CRC High	5A <sub>H</sub>	<a href="#">55</a>
Res18	Reserved 18	5B <sub>H</sub>	<a href="#">33</a>
Res19	Reserved 19	5C <sub>H</sub>	<a href="#">33</a>
Res20	Reserved 20	5D <sub>H</sub>	<a href="#">33</a>
Res21	Reserved 21	5E <sub>H</sub>	<a href="#">33</a>
Res22	Reserved 22	5F <sub>H</sub>	<a href="#">33</a>
<a href="#">WUF2M</a>	Wakeup Frame 2 Mask	60 <sub>H</sub>	<a href="#">56</a>
WUF2M_1	Wakeup Frame 2 Mask 1	61 <sub>H</sub>	<a href="#">56</a>
WUF2M_2	Wakeup Frame 2 Mask 2	62 <sub>H</sub>	<a href="#">56</a>
WUF2M_3	Wakeup Frame 2 Mask 3	63 <sub>H</sub>	<a href="#">56</a>
WUF2M_4	Wakeup Frame 2 Mask 4	64 <sub>H</sub>	<a href="#">56</a>
WUF2M_5	Wakeup Frame 2 Mask 5	65 <sub>H</sub>	<a href="#">56</a>
WUF2M_6	Wakeup Frame 2 Mask 6	66 <sub>H</sub>	<a href="#">56</a>
WUF2M_7	Wakeup Frame 2 Mask 7	67 <sub>H</sub>	<a href="#">56</a>
WUF2M_8	Wakeup Frame 2 Mask 8	68 <sub>H</sub>	<a href="#">56</a>
WUF2M_9	Wakeup Frame 2 Mask 9	69 <sub>H</sub>	<a href="#">56</a>
WUF2M_10	Wakeup Frame 2 Mask 10	6A <sub>H</sub>	<a href="#">56</a>
WUF2M_11	Wakeup Frame 2 Mask 11	6B <sub>H</sub>	<a href="#">56</a>
WUF2M_12	Wakeup Frame 2 Mask 12	6C <sub>H</sub>	<a href="#">56</a>
WUF2M_13	Wakeup Frame 2 Mask 13	6D <sub>H</sub>	<a href="#">56</a>
WUF2M_14	Wakeup Frame 2 Mask 14	6E <sub>H</sub>	<a href="#">56</a>

**Table 64 Registers Overview (cont'd)**

Register Short Name	Register Long Name	Offset Address	Page Number
WUF2M_15	Wakeup Frame 2 Mask 15	6F <sub>H</sub>	<a href="#">56</a>
<a href="#">WUF20</a>	Wakeup Frame 2 Offset	70 <sub>H</sub>	<a href="#">56</a>
<a href="#">WUF2CRCL</a>	Wakeup Frame 2 CRC Low	71 <sub>H</sub>	<a href="#">58</a>
<a href="#">WUF2CRCH</a>	Wakeup Frame 2 CRC High	72 <sub>H</sub>	<a href="#">58</a>
Res23	Reserved 23	73 <sub>H</sub>	<a href="#">33</a>
Res24	Reserved 24	74 <sub>H</sub>	<a href="#">33</a>
Res25	Reserved 25	75 <sub>H</sub>	<a href="#">33</a>
Res26	Reserved 26	76 <sub>H</sub>	<a href="#">34</a>
Res27	Reserved 27	77 <sub>H</sub>	<a href="#">34</a>
<a href="#">WUC</a>	Wakeup Control	78 <sub>H</sub>	<a href="#">59</a>
Res28	Reserved 28	79 <sub>H</sub>	<a href="#">34</a>
<a href="#">WUS</a>	Wakeup Status	7A <sub>H</sub>	<a href="#">60</a>
<a href="#">IPHYC</a>	Internal PHY Control	7B <sub>H</sub>	<a href="#">60</a>
<a href="#">GPIO54C</a>	GPIO[5:4] Control	7C <sub>H</sub>	<a href="#">61</a>
Res29	Reserved 29	7D <sub>H</sub>	<a href="#">34</a>
<a href="#">GPIO10C</a>	GPIO[1:0] Control	7E <sub>H</sub>	<a href="#">62</a>
<a href="#">GPIO32C</a>	GPIO[3:2] Control	7F <sub>H</sub>	<a href="#">63</a>
<a href="#">Test</a>	TEST	80 <sub>H</sub>	<a href="#">64</a>
<a href="#">TM</a>	Test Mode	81 <sub>H</sub>	<a href="#">64</a>

The register is addressed wordwise.

**Table 65 Register Access Types**

Mode	Symbol	Description HW	Description SW
read/write	rw	Register is used as input for the HW	Register is readable and writable by SW
read	r	Register is written by HW (register between input and output -> one cycle delay)	Value written by software is ignored by hardware; that is, software may write any value to this field without affecting hardware behavior (= Target for development.)
Read only	ro	Register is set by HW (register between input and output -> one cycle delay)	SW can only read this register
Read virtual	rv	Physically, there is no new register, the input of the signal is connected directly to the address multiplexer.	SW can only read this register
Latch high, self clearing	lhsc	Latch high signal at high level, clear on read	SW can read the register
Latch low, self clearing	llsc	Latch high signal at low-level, clear on read	SW can read the register
Latch high, mask clearing	lhmk	Latch high signal at high level, register cleared with written mask	SW can read the register, with write mask the register can be cleared (1 clears)
Latch low, mask clearing	llmk	Latch high signal at low-level, register cleared on read	SW can read the register, with write mask the register can be cleared (1 clears)

**Registers Description**
**Table 65 Register Access Types (cont'd)**

Mode	Symbol	Description HW	Description SW
Interrupt high, self clearing	ihsc	Differentiates the input signal (low->high) register cleared on read	SW can read the register
Interrupt low, self clearing	ilsc	Differentiates the input signal (high->low) register cleared on read	SW can read the register
Interrupt high, mask clearing	ihmk	Differentiates the input signal (high->low) register cleared with written mask	SW can read the register, with write mask the register can be cleared
Interrupt low, mask clearing	ilmk	Differentiates the input signal (low->high) register cleared with written mask	SW can read the register, with write mask the register can be cleared
Interrupt enable register	ien	Enables the interrupt source for interrupt generation	SW can read and write this register
latch_on_reset	lor	rw register, value is latched after first clock cycle after reset	Register is readable and writable by SW
Read/write self clearing	rwsc	Register is used as input for the hw, the register will be cleared due to a HW mechanism.	Writing to the register generates a strobe signal for the HW (1 pdi clock cycle) Register is readable and writable by SW.

**Table 66 Registers Clock DomainsRegisters Clock Domains**

Clock Short Name	Description

### 6.1.1 System Registers

#### Ethernet Control 0

**EC0** **Offset** **Reset Value**  
**Ethernet Control 0** **00<sub>H</sub>** **09<sub>H</sub>**

7	6	5	4	3	2	1	0
<b>TXE</b>	<b>RXE</b>	<b>RXFCE</b>	<b>WOE</b>	<b>RXSA</b>	<b>SBO</b>	<b>RXMA</b>	<b>RXCS</b>
rw	rw	rw	rw	rw	rw	rw	rw

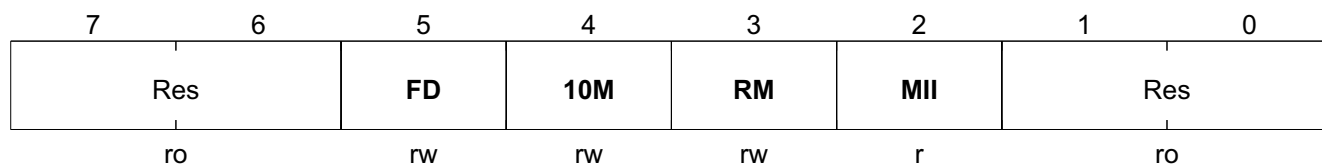
Field	Bits	Type	Description
TXE	7	rw	<b>Ethernet Transmission Enable</b>
RXE	6	rw	<b>Ethernet Receive Enable</b>
RXFCE	5	rw	<b>Receive Pause Frame Enable</b>
WOE	4	rw	<b>Wake-on-LAN Mode Enable</b>
RXSA	3	rw	<b>Status Append at the End of Received Packet Enable</b>

**Registers Description**

Field	Bits	Type	Description
SBO	2	rw	<b>Stop Back Off</b> 0 <sub>B</sub> <b>CNOT</b> , Back-off counter isn't affected by carrier 1 <sub>B</sub> <b>CST</b> , Back-off counter stops when carrier is active and resumes when carrier drops
RXMA	1	rw	<b>Receive All Multicast Packet</b>
RXCS	0	rw	<b>Include CRC in Receive Packet</b>

**Ethernet Control 1**

**EC1** **Offset** **Reset Value**  
**Ethernet Control 1** **01<sub>H</sub>** **00<sub>H</sub>**



Field	Bits	Type	Description
Res	7:6	ro	<b>Reserved</b>
FD	5	rw	<b>Full Duplex</b> 0 <sub>B</sub> <b>HDM</b> , Half-duplex mode 1 <sub>B</sub> <b>FDM</b> , Full-duplex mode
10M	4	rw	<b>10mode</b> 0 <sub>B</sub> <b>10Base</b> , 10Base-T mode 1 <sub>B</sub> <b>100Base</b> , 100Base-T mode
RM	3	rw	<b>Reset MAC</b> After write 1, HW will clear this bit after MAC reset.
MII	2	r	<b>MII Mode</b> 0 <sub>B</sub> <b>MIIM</b> , MII mode
Res	1:0	ro	<b>Reserved</b>

**Ethernet Control 2**

<b>EC2</b>	<b>Offset</b>	<b>Reset Value</b>
<b>Ethernet Control 2</b>	<b>02<sub>H</sub></b>	<b>00<sub>H</sub></b>

7	6	5	4	3	2	1	0
<b>MEPL</b>	Res	<b>LEEPRS</b>	<b>EEPRW</b>	<b>LB</b>	<b>PROM</b>	<b>RXBP</b>	<b>EP3RC</b>
rw	ro	rw	rw	rw	rw	rw	rw

Field	Bits	Type	Description
MEPL	7	rw	<b>Max Ethernet Packet Length</b> 0 <sub>B</sub> <b>1528B</b> , 1528 bytes 1 <sub>B</sub> <b>1638B</b> , 1638 bytes, Default is 0
Res	6	ro	<b>Reserved</b>
LEEPRS	5	rw	<b>Load EEPROM Start</b> When this bit is written with 1, HW will start to load EEPROM.
EEPRW	4	rw	<b>EEPROM Write Enable/disable</b> 0 <sub>B</sub> <b>WEDC</b> , EEPROM writes enable/disable command 1 <sub>B</sub> <b>WC</b> , EEPROM writes command
LB	3	rw	<b>MAC Loop Back Mode Enable</b>
PROM	2	rw	<b>Promiscuous</b> 0 <sub>B</sub> <b>RPP</b> , Receives packets which pass the address filter 1 <sub>B</sub> <b>RAP</b> , Receives any packet
RXBP	1	rw	<b>Receive Bad Packets</b> 0 <sub>B</sub> <b>FABP</b> , Filters all bad packet 1 <sub>B</sub> <b>RBPP</b> , Receives bad packets which pass the address filter
EP3RC	0	rw	<b>EP3 Read Cleared</b> 0 <sub>B</sub> <b>AEP3</b> , Access EP3, no effect to those registers. 1 <sub>B</sub> <b>OEP3</b> , Once EP3 is accessed, those registers (2B-2F, 7A) will be cleared.





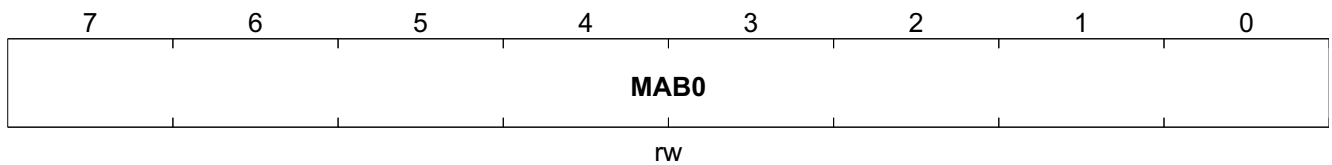
Registers Description

Table 67 Reserved Registers (cont'd)

Register Short Name	Register Long Name	Offset Address	Page Number
Res26	Reserved 26	76 <sub>H</sub>	
Res27	Reserved 27	77 <sub>H</sub>	
Res28	Reserved 28	79 <sub>H</sub>	
Res29	Reserved 29	7D <sub>H</sub>	
Res30_Res155	Reserved 30~Reserved 155	82~FF <sub>H</sub>	

**Multicast Address 0**

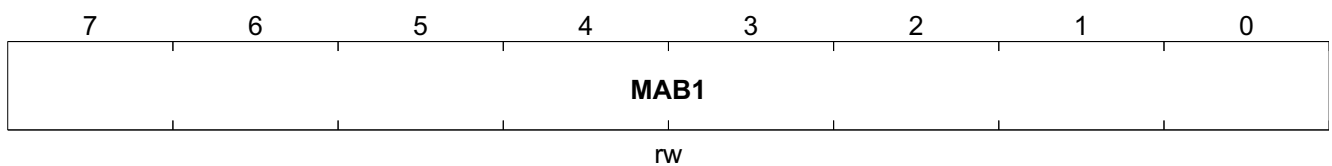
**MA0** **Offset**  
**Multicast Address 0** **08<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
MAB0	7:0	rw	<b>Multicast 0</b> Multicast address byte [7:0]

**Multicast Address 1**

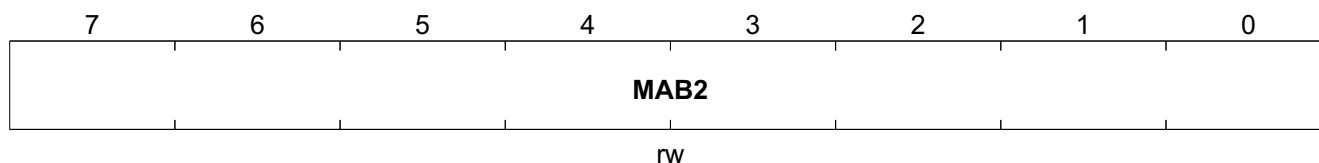
**MA1** **Offset**  
**Multicast Address 1** **09<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
MAB1	7:0	rw	<b>Multicast 1</b> Multicast address byte [15:8]

**Multicast Address 2**

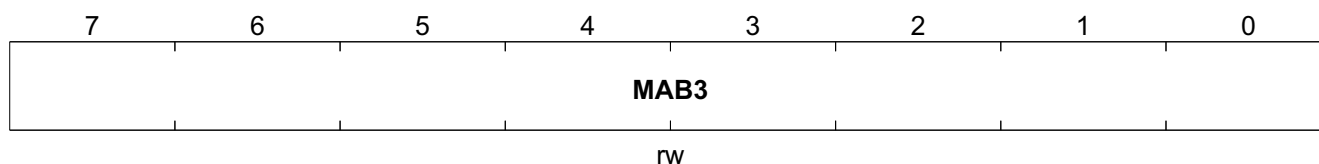
**MA2** **Offset**  
**Multicast Address 2** **0A<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
MAB2	7:0	rw	<b>Multicast 2</b> Multicast address byte [23:16]

**Multicast Address 3**

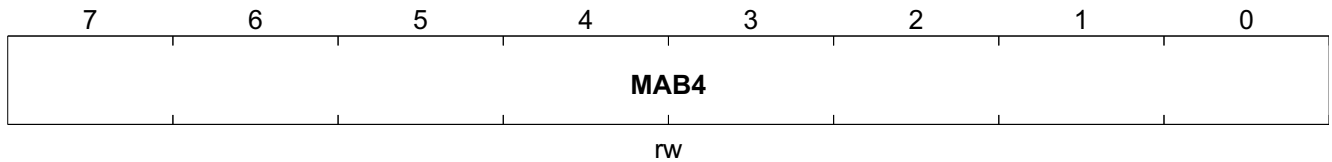
**MA3** **Offset**  
**Multicast Address 3** **0B<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
MAB3	7:0	rw	<b>Multicast 3</b> Multicast address byte [31:24]

**Multicast Address 4**

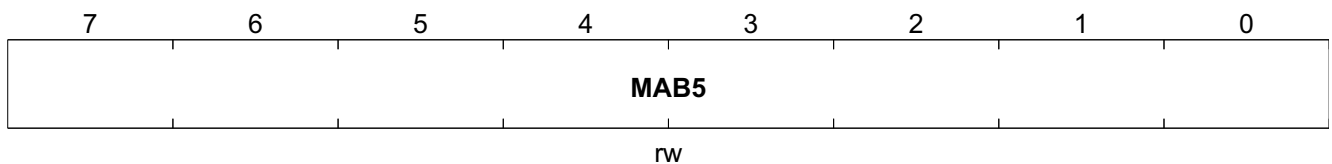
**MA4** **Offset** **Reset Value**  
**Multicast Address 4** **0C<sub>H</sub>** **00<sub>H</sub>**



Field	Bits	Type	Description
MAB4	7:0	rw	<b>Multicast 4</b> Multicast address byte [39:32]

**Multicast Address 5**

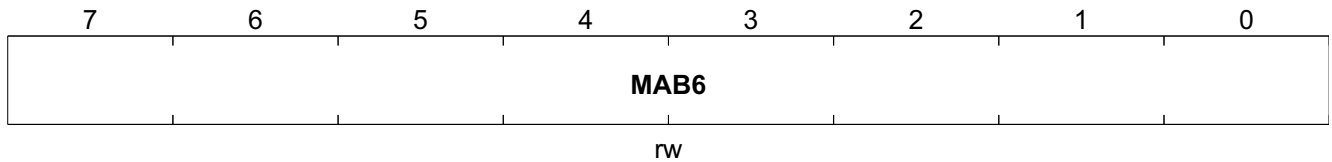
**MA5** **Offset** **Reset Value**  
**Multicast Address 5** **0D<sub>H</sub>** **00<sub>H</sub>**



Field	Bits	Type	Description
MAB5	7:0	rw	<b>Multicast 5</b> Multicast address byte [47:40]

**Multicast Address 6**

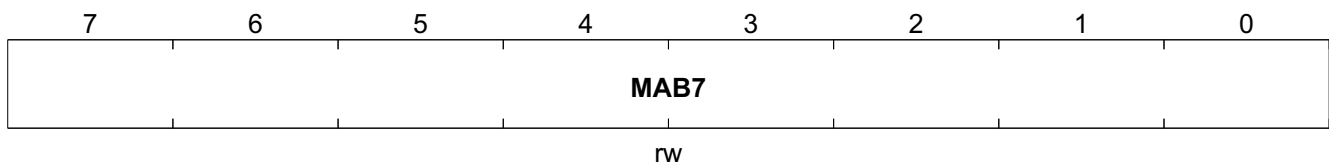
**MA6** **Offset** **Reset Value**  
**Multicast Address 6** **0E<sub>H</sub>** **00<sub>H</sub>**



Field	Bits	Type	Description
MAB6	7:0	rw	<b>Multicast 6</b> Multicast address byte [55:48]

**Multicast Address 7**

**MA7** **Offset** **Reset Value**  
**Multicast Address 7** **0F<sub>H</sub>** **00<sub>H</sub>**



Field	Bits	Type	Description
MAB7	7:0	rw	<b>Multicast 7</b> Multicast address byte [63:56]



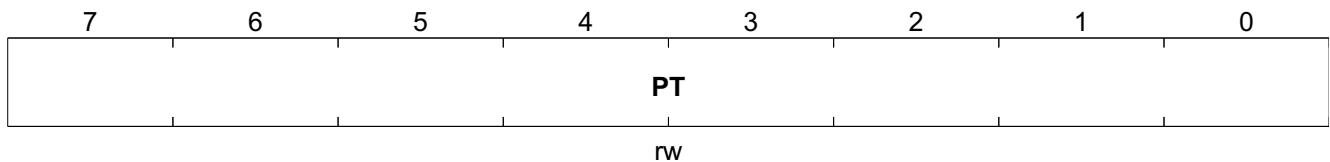






**Pause Timer**

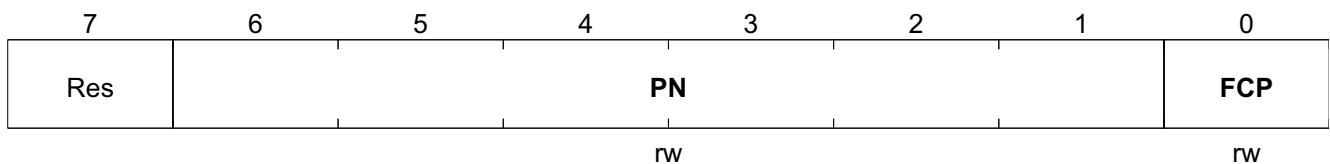
**PT** **Offset**  
**Pause Timer** **18<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
PT	7:0	rw	<b>Pause Timer</b> The [11:4] of pause time in the PAUSE frame.

**Receive Packet Number Based Flow Control**

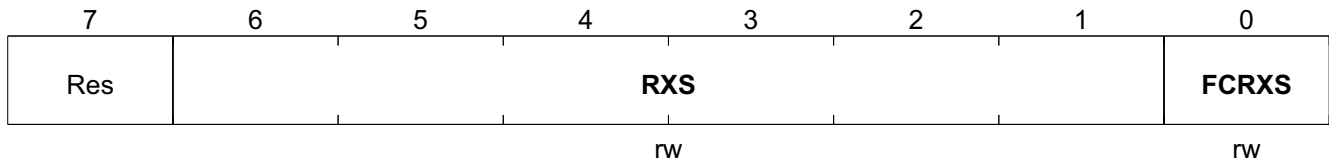
**RPNBFC** **Offset**  
**Receive Packet Number Based Flow Control** **1A<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
PN	6:1	rw	<b>Packet Number</b> This field specifies the threshold for transmitting the PAUSE frame. As the received packet number is more than or equal to this field, the PAUSE frame is sent automatically by HW.
FCP	0	rw	<b>Flow Control Packet</b> 1 <sub>B</sub> <b>RPN</b> , Enables pause frame transmission based on received packet number

**Occupied Receive FIFO Based Flow Control**

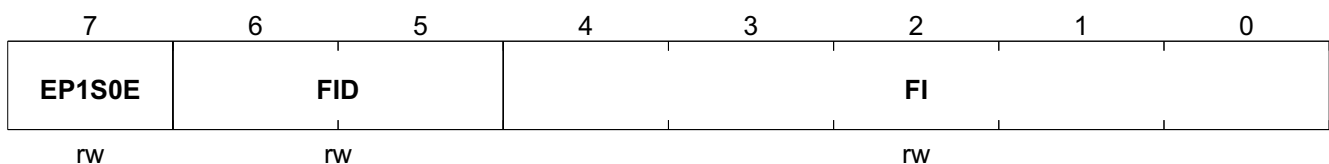
**ORFBFC** **Offset**  
**Occupied Receive FIFO Based Flow Control** **1B<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
RXS	6:1	rw	<b>RX Size</b> This field specifies the Kbyte threshold for transmitting the PAUSE frame. As the received FIFO is occupied than or equal to this field, the PAUSE frame is sent automatically by HW. If this field = 2, as receive FIFO is occupied more than or equal to 2 Kbyte, the PAUSE frame is transmitted.
FCRXS	0	rw	<b>Flow Control RX Size</b> 1 <sub>B</sub> <b>RFS</b> , Enables pause frame transmission based on occupied received FIFO size

**EP1 Control**

**EP1C** **Offset**  
**EP1 Control** **1C<sub>H</sub>** **Reset Value**  
**04<sub>H</sub>**



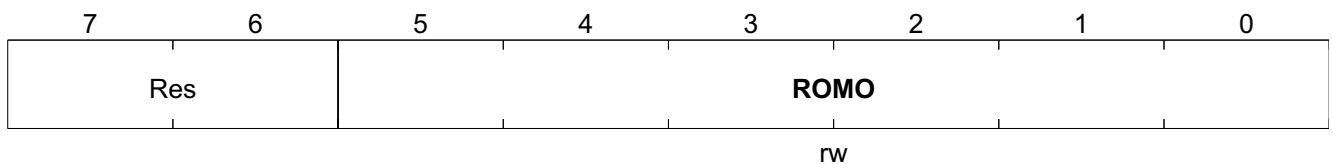
Field	Bits	Type	Description
EP1S0E	7	rw	<b>EP1 Send</b> 0 <sub>B</sub> <b>DEP1</b> , Disables EP1 send 1-byte 00 function 1 <sub>B</sub> <b>EEP1</b> , Enables EP1 send 1-byte 00 when more than frame_ interval's NAK is received
FID	6:5	rw	<b>Frame Interval Detail</b> This value is the detailed scale of frame interval, it is from 0ms to 3ms. 00 <sub>B</sub> , for more than 0 plus frame_interval ms NAK, EP1 sends 1-byte 00 01 <sub>B</sub> , for more than 1 plus frame_interval ms NAK, EP1 sends 1-byte 00 11 <sub>B</sub> , for more than 3 plus frame_interval ms NAK, EP1 sends 1-byte 00

**Registers Description**

Field	Bits	Type	Description
FI	4:0	rw	<b>Frame Interval</b> This value multiply with 4 is the frame interval, it is from 4ms to 124ms 0000 <sub>B</sub> , for more than 4 ms NAK, EP1 sends 1-byte 00 0001 <sub>B</sub> , for more than 8 ms NAK, EP1 sends 1-byte 00 1111 <sub>B</sub> , for more than 124 ms NAK, EP1 sends 1-byte 00

**EEPROM Offset**

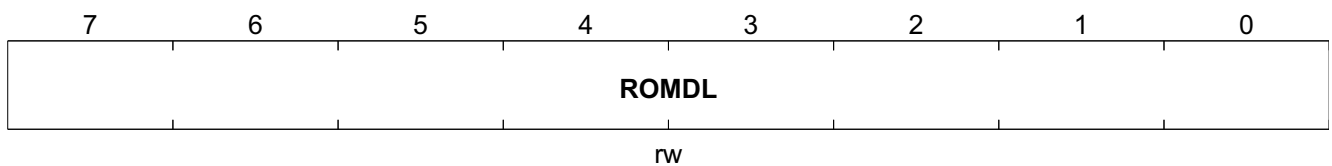
<b>EEPROMO</b>	<b>Offset</b>	<b>Reset Value</b>
<b>EEPROM Offset</b>	<b>20<sub>H</sub></b>	<b>00<sub>H</sub></b>



Field	Bits	Type	Description
ROMO	5:0	rw	<b>ROM Offset</b> SW sets this register when access to EEPROM.

**EEPROM Data Low**

<b>EEPROMDL</b>	<b>Offset</b>	<b>Reset Value</b>
<b>EEPROM Data Low</b>	<b>21<sub>H</sub></b>	<b>00<sub>H</sub></b>

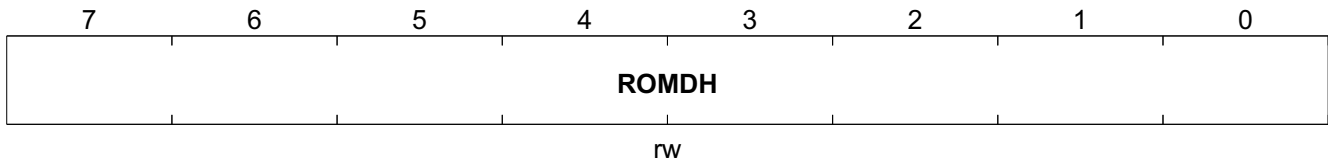


Field	Bits	Type	Description
ROMDL	7:0	rw	<b>ROM Data Low</b> EEPROM Write: The data set in this register will be written to EEPROM EEPROM Read: The data red from EEPROM will be stored in this register

**EEPROM Data High**

<b>EEPROMDH</b>	<b>Offset</b>	<b>Reset Value</b>
<b>EEPROM Data High</b>	<b>22<sub>H</sub></b>	<b>00<sub>H</sub></b>

Registers Description

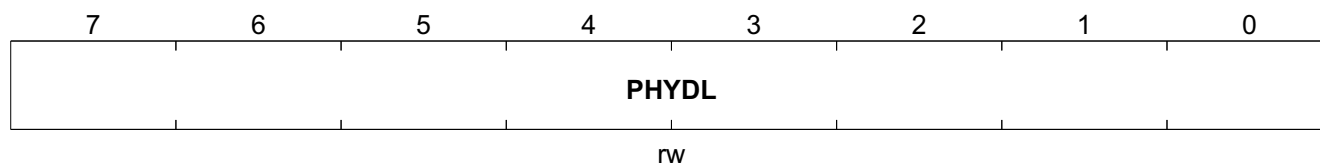


Field	Bits	Type	Description
ROMDH	7:0	rw	<b>ROM Data High</b> EEPROM Write: The data set in this register will be written to EEPROM EEPROM Read: The data read from EEPROM will be stored in this register



**PHY Data Low**

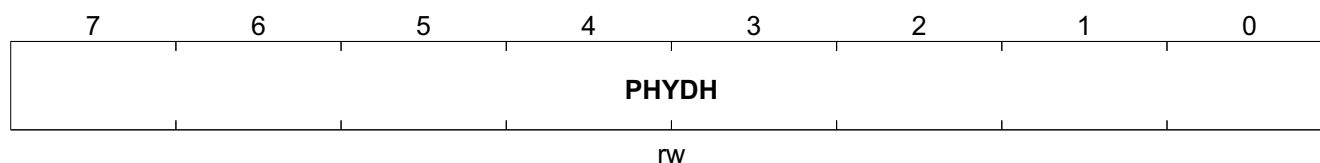
<b>PHYDL</b>	<b>Offset</b>	<b>Reset Value</b>
PHY Data Low	26 <sub>H</sub>	00 <sub>H</sub>



Field	Bits	Type	Description
PHYDL	7:0	rw	<b>PHY Data Low</b> SW set this register when write to PHY register. HW set this register when read data from PHY register.

**PHY Data High**

<b>PHYDH</b>	<b>Offset</b>	<b>Reset Value</b>
PHY Data High	27 <sub>H</sub>	00 <sub>H</sub>



Field	Bits	Type	Description
PHYDH	7:0	rw	<b>PHY Data High</b> SW set this register when write to PHY register. HW set this register when read data from PHY register.

**Registers Description**
**PHY Access Control**

**PHYAC** **Offset**  
**PHY Access Control** **28<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**

7	6	5	4	3	2	1	0
<b>DO</b>	<b>RDPHY</b>	<b>WRPHY</b>	<b>PHYRA</b>				
rw	rw	rw	rw				

Field	Bits	Type	Description
DO	7	rw	<b>Done</b> Set by HW to indicate successful completion of PHY access. Clear by SW when initiate a new access to PHY.
RDPHY	6	rw	<b>Read Access to PHY Register</b> Set by SW to initiate a read access to PHY register. SW set this bit after it well setting the phy_addr and phyreg_addr.
WRPHY	5	rw	<b>Write Access to PHY Register</b> Set by SW to initiate a write access to PHY register. SW set this bit after it well setting the phy_addr, phyreg_addr and phyreg_data.
PHYRA	4:0	rw	<b>PHY Register Address</b>

**USB Bus Status**

**USBBS** **Offset**  
**USB Bus Status** **2A<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**

7	6	5	4	3	2	1	0
Res						<b>USBR</b>	<b>USBS</b>
						rw	rw

Field	Bits	Type	Description
USBR	1	rw	<b>USB Bus in Resume State</b> Set by HW to indicate usb bus in resumed state. Clear by SW read this register.
USBS	0	rw	<b>USB Bus in Suspend State</b> Set by HW to indicate usb bus in suspended state. Clear by SW read this register.

**Transmit Status 1**

**Registers Description**

**TS1** **Offset** **Reset Value**  
**Transmit Status 1** **2B<sub>H</sub>** **00<sub>H</sub>**

	7	6	5	4	3	2	1	0
	<b>TXUE</b>	<b>EC</b>	<b>LC</b>	<b>NC</b>	<b>CL</b>	<b>JTO</b>	<b>Res</b>	
	r	r	r	r	r	r		

Field	Bits	Type	Description
TXUE	7	r	<b>TX Underrun Error</b> Set by HW to indicate tx underrun error. Clear by SW read this register or after EP3 is accessed.
EC	6	r	<b>Excessive Collision</b> Set by HW to indicate excessive collision. Clear by SW read this register or after EP3 is accessed.
LC	5	r	<b>Late Collision Error</b> Set by HW to indicate late collision error. Clear this register by SW Read or after EP3 is accessed.
NC	4	r	<b>No Carrier</b> Set by HW to indicate no carrier. Clear this register by SW Read or after EP3 is accessed.
CL	3	r	<b>Carrier Loss</b> Set by HW to indicate carrier loss. Clear this register by SW Read or after EP3 is accessed.
JTO	2	r	<b>Jabber Time Out</b> Set by HW to indicate jabber time out. Clear this register by SW Read or after EP3 is accessed.



**Transmit Status 2**

**TS2** **Offset** **Reset Value**  
**Transmit Status 2** **2C<sub>H</sub>** **00<sub>H</sub>**

7	6	5	4	3	2	1	0
<b>TXFF</b>	<b>TXFE</b>	Res		<b>TXPC</b>			
r	r			r			

Field	Bits	Type	Description
TXFF	7	r	<b>TX Fifo Full</b> Set by HW to indicate tx fifo full. Clear this register by SW Read or after EP3 is accessed.
TXFE	6	r	<b>TX Fifo Empty</b> Set by HW to indicate tx fifo empty. Clear this register by SW Read or after EP3 is accessed.
TXPC	3:0	r	<b>TX Packet Count</b> Set by HW to indicate Ethernet transmit packet counts every interrupt EP polling. If more than 15 packets have been transmitted, this value will stay as 15. Clear by SW read or after EP3 is accessed.

**Receive Status**

**RS** **Offset** **Reset Value**  
**Receive Status** **2D<sub>H</sub>** **00<sub>H</sub>**

7	6	5	4	3	2	1	0
Res						<b>RXP</b>	<b>R XO</b>
						r	r

Field	Bits	Type	Description
RXP	1	r	<b>RX Pause</b> Set by HW to indicate a PAUSE frame is received. Clear this register by SW Read or after EP3 is accessed.
R XO	0	r	<b>RX Overflow</b> Set by HW to indicate external SRAM overflow. Clear this register by SW Read or after EP3 is accessed.

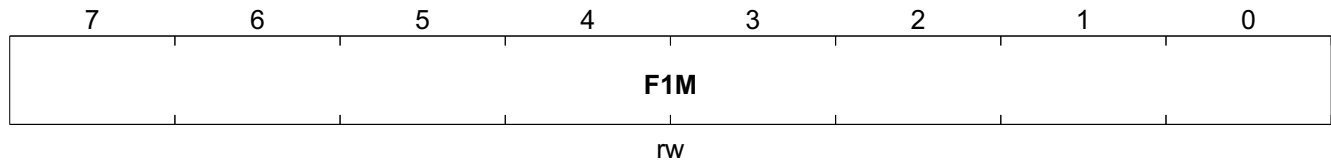






**Wakeup Frame 1 Mask**

**WUF1M\_0** **Offset**  
**Wakeup Frame 1 Mask** **48<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**



Field	Bits	Type	Description
F1M	7:0	rw	The 128 Mask Bits for Frame 1

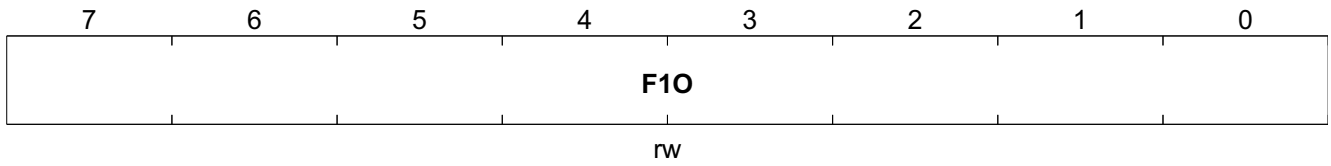
**Similar Registers**
**Table 69 Wakeup Frame 1 Mask Registers**

Register Short Name	Register Long Name	Offset Address	Page Number
WUF1M_1	Wakeup Frame 1 Mask 1	49 <sub>H</sub>	
WUF1M_2	Wakeup Frame 1 Mask 2	4A <sub>H</sub>	
WUF1M_3	Wakeup Frame 1 Mask 3	4B <sub>H</sub>	
WUF1M_4	Wakeup Frame 1 Mask 4	4C <sub>H</sub>	
WUF1M_5	Wakeup Frame 1 Mask 5	4D <sub>H</sub>	
WUF1M_6	Wakeup Frame 1 Mask 6	4E <sub>H</sub>	
WUF1M_7	Wakeup Frame 1 Mask 7	4F <sub>H</sub>	
WUF1M_8	Wakeup Frame 1 Mask 8	50 <sub>H</sub>	
WUF1M_9	Wakeup Frame 1 Mask 9	51 <sub>H</sub>	
WUF1M_10	Wakeup Frame 1 Mask 10	52 <sub>H</sub>	
WUF1M_11	Wakeup Frame 1 Mask 11	56 <sub>H</sub>	
WUF1M_12	Wakeup Frame 1 Mask 12	54 <sub>H</sub>	
WUF1M_13	Wakeup Frame 1 Mask 13	55 <sub>H</sub>	
WUF1M_14	Wakeup Frame 1 Mask 14	56 <sub>H</sub>	
WUF1M_15	Wakeup Frame 1 Mask 15	57 <sub>H</sub>	

**Wakeup Frame 1 Offset**

**WUF1O** **Offset**  
**Wakeup Frame 1 Offset** **58<sub>H</sub>** **Reset Value**  
**00<sub>H</sub>**

**Registers Description**



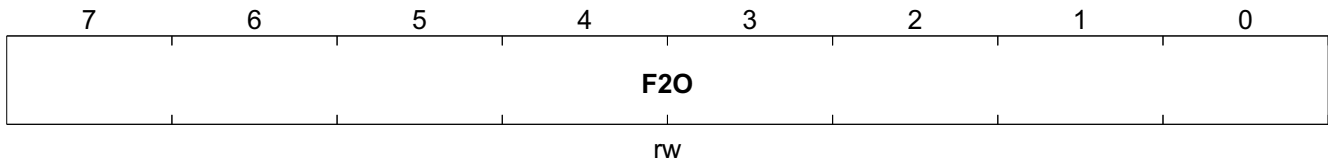
Field	Bits	Type	Description
F10	7:0	rw	Offset for Wakeup Frame 1







**Registers Description**



Field	Bits	Type	Description
F20	7:0	rw	Offset for Wakeup Frame 2









**GPIO[1:0] Control**

<b>GPIO10C</b>	<b>Offset</b>	<b>Reset Value</b>
<b>GPIO[1:0] Control</b>	<b>7E<sub>H</sub></b>	<b>00<sub>H</sub></b>

7	6	5	4	3	2	1	0
Res		<b>G1OE</b>	<b>G1OV</b>	<b>G1IV</b>	<b>G1OE</b>	<b>G0OV</b>	<b>G0IV</b>
		rw	rw	r	rw	rw	r

Field	Bits	Type	Description
G1OE	5	rw	<b>GPIO1 Output Enable</b> 0 <sub>B</sub> <b>IN</b> , GPIO1 is used for input 1 <sub>B</sub> <b>OUT</b> , GPIO1 is used for output
G1OV	4	rw	<b>GPIO1 Output Value</b> When GPIO1 is used for output, this value is driven to GPIO1 pin. Set by SW.
G1IV	3	r	<b>GPIO1 Input Value</b> When GPIO1 is used for input, this field reflects the status of GPIO1. Set by HW.
G1OE	2	rw	<b>GPIO0 Output Enable</b> 0 <sub>B</sub> <b>IN</b> , GPIO0 is used for input 1 <sub>B</sub> <b>OUT</b> , GPIO0 is used for output
G0OV	1	rw	<b>GPIO0 Output Value</b> When GPIO0 is used for output, this value is driven to GPIO0 pin. Set by SW.
G0IV	0	r	<b>GPIO0 Input Value</b> When GPIO0 is used for input, this field reflects the status of GPIO0. Set by HW.

**GPIO[3:2] Control**

<b>GPIO32C</b>	<b>Offset</b>	<b>Reset Value</b>
<b>GPIO[3:2] Control</b>	<b>7F<sub>H</sub></b>	<b>00<sub>H</sub></b>

	7	6	5	4	3	2	1	0
	Res		<b>G3OE</b>	<b>G3OV</b>	<b>G3IV</b>	<b>G2OE</b>	<b>G2OV</b>	<b>G2IV</b>
			rw	rw	r	rw	rw	r

Field	Bits	Type	Description
G3OE	5	rw	<b>GPIO3 Output Enable</b> 0 <sub>B</sub> <b>IN</b> , GPIO3 is used for input 1 <sub>B</sub> <b>OUT</b> , GPIO3 is used for output
G3OV	4	rw	<b>GPIO3 Output Value</b> When GPIO3 is used for output, this value is driven to GPIO3 pin. Set by SW.
G3IV	3	r	<b>GPIO3 Input Value</b> When GPIO3 is used for input, this field reflects the status of GPIO3. Set by HW.
G2OE	2	rw	<b>GPIO2 Output Enable</b> 0 <sub>B</sub> <b>IN</b> , GPIO2 is used for input 1 <sub>B</sub> <b>OUT</b> , GPIO2 is used for output
G2OV	1	rw	<b>GPIO2 Output Value</b> When GPIO2 is used for output, this value is driven to GPIO2 pin. Set by SW.
G2IV	0	r	<b>GPIO2 Input Value</b> When GPIO2 is used for input, this field reflects the status of GPIO2. Set by HW.





**Registers Description**
**Table 72 Registers Overview (cont'd)**

Register Short Name	Register Long Name	Offset Address	Page Number
<b>ANLPA</b>	Auto-Negotiation Link Partner Ability	5 <sub>H</sub>	<b>72</b>
<b>ANE</b>	Auto-Negotiation Expansion	6 <sub>H</sub>	<b>72</b>

The register is addressed wordwise.

**Table 73 Register Access Types**

Mode	Symbol	Description HW	Description SW
read/write	rw	Register is used as input for the HW	Register is readable and writable by SW
read	r	Register is written by HW (register between input and output -> one cycle delay)	Value written by software is ignored by hardware; that is, software may write any value to this field without affecting hardware behavior (= Target for development.)
Read only	ro	Register is set by HW (register between input and output -> one cycle delay)	SW can only read this register
Read virtual	rv	Physically, there is no new register, the input of the signal is connected directly to the address multiplexer.	SW can only read this register
Latch high, self clearing	lhsc	Latch high signal at high level, clear on read	SW can read the register
Latch low, self clearing	llsc	Latch high signal at low-level, clear on read	SW can read the register
Latch high, mask clearing	lhmk	Latch high signal at high level, register cleared with written mask	SW can read the register, with write mask the register can be cleared (1 clears)
Latch low, mask clearing	llmk	Latch high signal at low-level, register cleared on read	SW can read the register, with write mask the register can be cleared (1 clears)
Interrupt high, self clearing	ihsc	Differentiate the input signal (low->high) register cleared on read	SW can read the register
Interrupt low, self clearing	ilsc	Differentiate the input signal (high->low) register cleared on read	SW can read the register
Interrupt high, mask clearing	ihmk	Differentiate the input signal (high->low) register cleared with written mask	SW can read the register, with write mask the register can be cleared
Interrupt low, mask clearing	ilmk	Differentiate the input signal (low->high) register cleared with written mask	SW can read the register, with write mask the register can be cleared
Interrupt enable register	ien	Enables the interrupt source for interrupt generation	SW can read and write this register
latch_on_reset	lor	rw register, value is latched after first clock cycle after reset	Register is readable and writable by SW
Read/write self clearing	rwsc	Register is used as input for the hw, the register will be cleared due to a HW mechanism.	Writing to the register generates a strobe signal for the HW (1 pdi clock cycle) Register is readable and writable by SW.

Table 74 Registers Clock DomainsRegisters Clock Domains

Clock Short Name	Description

### 6.2.1 PHY Registers

**Control**

<b>CTL</b>	<b>Offset</b>	<b>Reset Value</b>
<b>Control</b>	<b>0<sub>H</sub></b>	<b>1000<sub>H</sub></b>

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>RST</b>	<b>LP</b>	<b>SS</b>	<b>ANE</b>	<b>PD</b>	<b>ISO</b>	<b>RA</b>	<b>DM</b>	<b>CT</b>	Res						
rwsc	rw	rw	rw	rw	rw	rwsc	rw	ro							

Field	Bits	Type	Description
RST	15	rwsc	<b>Reset</b> 0 <sub>B</sub> <b>NO</b> , Normal operation 1 <sub>B</sub> <b>PR</b> , PHY Reset
LP	14	rw	<b>Loopback</b> 0 <sub>B</sub> <b>DL</b> , Disable loopback 1 <sub>B</sub> <b>EL</b> , Enable loopback
SS	13	rw	<b>Speed Selection</b> 0 <sub>B</sub> <b>10M</b> , 10 Mbit/s 1 <sub>B</sub> <b>100M</b> , 100 Mbit/s
ANE	12	rw	<b>Autonegotiation Enable</b> 0 <sub>B</sub> <b>DAN</b> , Disable auto-neg 1 <sub>B</sub> <b>EAN</b> , Enable auto-neg
PD	11	rw	<b>Power Down</b> 0 <sub>B</sub> <b>NO</b> , Normal operation 1 <sub>B</sub> <b>PD</b> , Power Down
ISO	10	rw	<b>Isolate</b> 0 <sub>B</sub> <b>NO</b> , normal operation 1 <sub>B</sub> <b>IPHY</b> , isolate PHY from MII
RA	9	rwsc	<b>Restart Autonegotiation</b> 1 <sub>B</sub> <b>RAN</b> , Restart Auto-neg
DM	8	rw	<b>Duplex Mode</b> 0 <sub>B</sub> <b>HA</b> , Half 1 <sub>B</sub> <b>FU</b> , Full
CT	7	ro	<b>Collision Test</b> Not implemented

**SC**

Self Clearing

**Reset**

Reset this port only. This will cause the following:

1. Restart the auto-negotiation process.

**Registers Description**

2. Reset the registers to their default values. Note that this does not affect registers 20, 22, 30 or 31. These registers are not reset by this bit to allow test configurations to be written and then not affected by resetting the port.

Note: No reset is performed to analogue sections of the port. There is also no physical reset to any internal clock synthesisers or the local clock recovery oscillator which will continue to run throughout the reset period. However since the port is restarted and autoneg re-run the process of locking the frequency of the local oscillator (slave) to the reference oscillator (master) will be repeated as it is at the start of any link initialization process.

**Loopback** Loop back of transmit data to receive via a path as closed to the wire as possible. When set inhibits actual transmission on the wire.

**Speed Selection** Forces speed of Phy only when auto-negotiation is disabled. The default state of this bit will be determined by a power-up configuration pin in this case. Otherwise it defaults to 1.

**Auto-neg Enable** Defaults to pin programmed value. When cleared allows forcing of speed and duplex settings. When set (after being cleared) causes re-start of auto-neg process. Pin programming at power-up allows it to come up disabled and for software to write the desired capability before allowing the first negotiation to commence.

**Restart Negotiation** Only has effect when auto-negotiating. Restarts state machine.

**Power Down** Has no effect in this device. Test mode power down modes may be implemented in other specific modules.

**Isolate** Puts RMII receive signals into high impedance state and ignores transmit signals.

**Duplex Mode** When bit12 is cleared (i.e. autoneg disabled), this bit forces full duplex (bit = 1) or half duplex (bit = 0).

**Collision Test** Always 0 because collision signal is not implemented.

**Status**

STA	Offset														Reset Value	
Status	1 <sub>H</sub>														7849 <sub>H</sub>	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	100T 4	100F D	100H D	10FD	10HD	100T FD	100T HD	Res		MFPS	ANC	RF	ANA	LS	JD	EC
	ro	ro	ro	ro	ro	ro	ro			ro	ro	ro, lh	ro	ro, ll	ro, lh	ro

Field	Bits	Type	Description
100T4	15	ro	<b>100 BASE T4</b> Not supported
100FD	14	ro	<b>100BASE-X Full Duplex</b> 0 <sub>B</sub> <b>100FDN</b> , PHY is not 100BASE-X full duplex capable 1 <sub>B</sub> <b>100FD</b> , PHY is 100BASE-X full duplex capable
100HD	13	ro	<b>100BASE-X Half Duplex</b> 0 <sub>B</sub> <b>100HDN</b> , PHY is not 100BASE-X half duplex capable 1 <sub>B</sub> <b>100HD</b> , PHY is 100BASE-X half duplex capable
10FD	12	ro	<b>10 Mbit/s Full Duplex</b> 0 <sub>B</sub> <b>10FDN</b> , PHY is not 10 Mbit/s Full duplex capable 1 <sub>B</sub> <b>10FD</b> , PHY is 10 Mbit/s Full duplex capable

**Registers Description**

Field	Bits	Type	Description
10HD	11	ro	<b>10 Mbit/s Half Duplex</b> 0 <sub>B</sub> <b>10HDN</b> , PHY is not 10 Mbit/s Half duplex capable 1 <sub>B</sub> <b>10HD</b> , PHY is 10 Mbit/s Half duplex capable
100TFD	10	ro	<b>100BASE-T2 Full Duplex</b> Not Supported
100THD	9	ro	<b>100BASE-T2 Half Duplex</b> Not Supported
MFPS	6	ro	<b>MF Preamble Suppression</b> 0 <sub>B</sub> <b>MFPSN</b> , PHY cannot accept management frames with preamble suppression 1 <sub>B</sub> <b>MFPS</b> , PHY can accept management frames with preamble suppression
ANC	5	ro	<b>Auto-neg Complete</b> 0 <sub>B</sub> <b>ANI</b> , Auto-neg incomplete 1 <sub>B</sub> <b>ANC</b> , Auto-neg completed
RF	4	ro, lh	<b>Remote Fault</b> 0 <sub>B</sub> <b>RFN</b> , No remote fault detected 1 <sub>B</sub> <b>RF</b> , Remote fault detected
ANA	3	ro	<b>Auto-neg Ability</b> 0 <sub>B</sub> <b>ANN</b> , PHY cannot auto-negotiate 1 <sub>B</sub> <b>AN</b> , PHY can auto-negotiate
LS	2	ro, ll	<b>Link Status</b> 0 <sub>B</sub> <b>LD</b> , Link is down 1 <sub>B</sub> <b>LU</b> , Link is up
JD	1	ro, lh	<b>Jabber Detect</b> 1 <sub>B</sub> <b>JCD</b> , Jabber condition detected
EC	0	ro	<b>Extended Capability</b> 0 <sub>B</sub> <b>BSC</b> , Basic register set capabilities only 1 <sub>B</sub> <b>EC</b> , Extended register capabilities

*Note: **Jabber Detect** Only used in 10Base-T mode. Read as 0 in 100Base-TX mode.*

**PHY Identifier 2 and 3**

Each PHY has an identifier, which is assigned to the device.

The identifier contains a total of 32 bits, which consists of the following: 22 bits of a 24 bit organizationally unique identifier (OUI) for the manufacturer; a 6-bit manufacturer's model number; a 4-bit manufacturer's revision number. For an explanation of how the OUI maps to the register, please refer to IEEE 802-1990 clause 5.1



**Auto-Negotiation Advertisement**

<b>ANA</b>	<b>Offset</b>	<b>Reset Value</b>
<b>Auto-Negotiation Advertisement</b>	<b>4<sub>H</sub></b>	<b>0001<sub>H</sub></b>

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>NP</b>	Res	<b>RF</b>	<b>NI</b>	<b>PAU</b>	<b>NI</b>	<b>100F D</b>	<b>100H D</b>	<b>10FD</b>	<b>10HD</b>				<b>SF</b>		
rw		rw	ro	rw	ro	rw	rw	rw	rw				ro		

Field	Bits	Type	Description
NP	15	rw	<b>Next Page</b> 0 <sub>B</sub> <b>NNP</b> , Device not set to use Next Page 1 <sub>B</sub> <b>NP</b> , Device set to use Next Page
RF	13	rw	<b>Remote Fault</b> 0 <sub>B</sub> <b>NFD</b> , No fault detected 1 <sub>B</sub> <b>RF</b> , Local remote fault sent to link partner
NI	12:11	ro	<b>Not Implemented</b> Technology ability bits A7-A6
PAU	10	rw	<b>Pause</b> Technology ability bit A5
NI	9	ro	<b>Not Implemented</b> Technology ability bit A4
100FD	8	rw	<b>100BASE-TX Full Duplex</b> Technology ability bit A3 0 <sub>B</sub> <b>100NFD</b> , Unit is not capable of Full Duplex 1 <sub>B</sub> <b>100FD</b> , Unit is capable of Full Duplex
100HD	7	rw	<b>100BASE-TX Half Duplex</b> Technology ability bit A2 0 <sub>B</sub> <b>100NHD</b> , Unit is not capable of Half Duplex 100BASE-TX 1 <sub>B</sub> <b>100HD</b> , Unit is capable of Half Duplex
10FD	6	rw	<b>10BASE-T Full Duplex</b> Technology ability bit A1 0 <sub>B</sub> <b>10NFD</b> , Unit is not capable of Full Duplex 10BASE-T 1 <sub>B</sub> <b>10FD</b> , Unit is capable of Full Duplex 10BASE-T
10HD	5	rw	<b>10BASE-T Half Duplex</b> Technology ability bit A0 0 <sub>B</sub> <b>10NHD</b> , Unit is not capable of Half Duplex 10BASE-T 1 <sub>B</sub> <b>10HD</b> , Unit is capable of Half Duplex 10BASE-T
SF	4:0	ro	<b>Selector Field</b> Identifies type of message being sent. Currently only one value is defined.

**Auto-Negotiation Link Partner Ability**

The register is used to view the advertised capabilities of the link partner once auto negotiation is complete. The contents of this register should not be relied upon unless register 1 bit 5 is set (auto negotiation complete). After negotiation this register should contain a copy of the link partner's register 4. All bits are therefore defined in the same way as for register 4. All bits are readable only. This register is used for Base Page code word only. Base Page Register Format

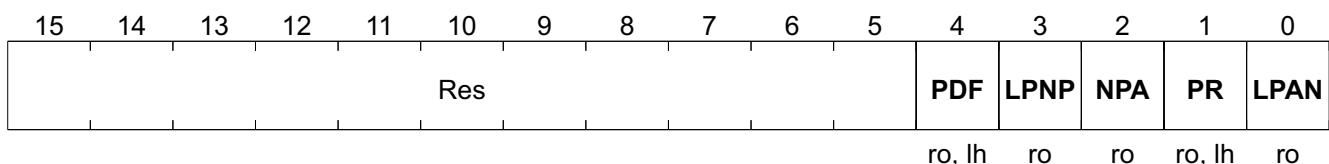
**ANLPA** **Offset**  
**Auto-Negotiation Link Partner Ability** **5<sub>H</sub>** **Reset Value**  
**0000<sub>H</sub>**



Field	Bits	Type	Description
NP	15	ro	<b>Next Page</b> 0 <sub>B</sub> , Base Page is requested 1 <sub>B</sub> , Link Partner is requesting Next Page function
ACK	14	ro	<b>Acknowledge</b> Link Partner acknowledgement bit
RF	13	ro	<b>Remote Fault</b> Link Partner is indicating a fault
TA	12:5	ro	<b>Technology Ability</b> Link Partner technology ability field.
SF	4:0	ro	<b>Selector Field</b> Link Partner selector field

**Auto-Negotiation Expansion**

**ANE** **Offset**  
**Auto-Negotiation Expansion** **6<sub>H</sub>** **Reset Value**  
**0004<sub>H</sub>**



Field	Bits	Type	Description
PDF	4	ro, lh	<b>Parallel Detection Fault</b> 0 <sub>B</sub> <b>NFD</b> , No fault detected 1 <sub>B</sub> <b>FD</b> , Local Device Parallel Detection Fault



**Registers Description**

<b>Field</b>	<b>Bits</b>	<b>Type</b>	<b>Description</b>
LPNP	3	ro	<b>Link Partner Next Page Able</b> 0 <sub>B</sub> <b>NNP</b> , Link Partner is not Next Page Able 1 <sub>B</sub> <b>NP</b> , Link Partner is Next Page Able
NPA	2	ro	<b>Next Page Able</b> 0 <sub>B</sub> , Local device is not Next Page Able 1 <sub>B</sub> , Local device is Next Page Able
PR	1	ro, lh	<b>Page Received</b> 0 <sub>B</sub> <b>NPR</b> , A New Page has not been received 1 <sub>B</sub> <b>PR</b> , A New Page has been received
LPAN	0	ro	<b>Link Partner Auto Negotiation Able</b> 0 <sub>B</sub> <b>NAN</b> , Link Partner is not Auto negotiation able 1 <sub>B</sub> <b>AN</b> , Link Partner is Auto negotiation able

## 7 Electrical Characteristics

### 7.1 Absolute Maximum Ratings

**Table 75 Absolute Maximum Rating**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{DD}$	–	–	4.6	V	–
DC Input Voltage	$V_{IN}$	–	–	6	V	–
DC Output Voltage	$V_{OUT}$	–	–	4.6	V	–
Power Consumption	$P_C$	–	–	126	mA	@ Idle State
		–	–	7	mA	@ Suspend Mode
		–	–	142	mA	@ 10M Full Duplex Mode
		–	–	152	mA	@ 100M Full Duplex Mode
Storage Temperature	$T_{STG}$	-65	–	150	°C	–
Operation Temperature	$T_{AMB}$	-40	–	125	W	–
ESD Rating	$V_{ESD}$	–	–	2000	V	–

### 7.2 Operating Condition

**Table 76 Operating Condition**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{DD}$	3.0	–	3.6	V	–
Supply Current	$I_{DD}$	–	–	150	mA	–

### 7.3 DC Specifications

#### 7.3.1 USB Interface DC Specification

**Table 77 USB Interface DC Specification**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input High Voltage	$V_{IH}$	2.0	–	–	V	–
Input Low Voltage	$V_{IL}$	–	–	0.8	V	–
Differential Input Sensitivity	$V_{DI}$	0.2	–	–	V	–

**EEPROM Interface DC Specification**
**Table 77 USB Interface DC Specification (cont'd)**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Differential Common Mode Range	$V_{CM}$	0.8	–	2.5	V	–
Output High Voltage	$V_{CH}$	2.8	–	3.6	V	–
Output Low Voltage	$V_{OL}$	0.0	–	0.3	V	–
Output Signal Crossover Voltage	$V_{CRS}$	1.3	–	2.0	V	–

## 8 EEPROM Interface DC Specification

### 8.1 Recommended Operating Conditions

**Table 78 EEPROM Interface DC Specification**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input High Voltage	$V_{IH}$	1.8	–	5.5	V	–
Input Low Voltage	$V_{IL}$	-0.5	–	1.0	V	–
Input Leakage Current	$I_I$	± 1	–	± 1000	nA	$V_{IN}$ 3.3V or 0 V
Output High Voltage	$V_{OH}$	2.4	–	–	V	–
Output Low Voltage	$V_{OL}$	–	–	0.4	V	–
Input Pin Capacitance	$C_{IN}$	–	–	5.66	pF	–

### 8.2 GPIO Interface DC Specification

**Table 79 GPIO Interface DC Specification**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input High Voltage	$V_{IH}$	1.8	–	5.5	V	–
Input Low Voltage	$V_{IL}$	-0.5	–	1.0	V	–
Input Leakage Current	$I_I$	± 1	–	± 1000	nA	$V_{IN}$ 3.3 V or 0 V
Output High Voltage	$V_{OH}$	2.4	–	–	V	–
Output Low Voltage	$V_{OL}$	–	–	0.4	V	–
Input Pin Capacitance	$C_{IN}$	–	–	5.64	pF	–

## 9 Timing

## 9.1 Reset Timing

ADM8513/X can be reset either by hardware, software or USB reset.

- A hardware reset is accomplished by asserting the RST# pin after powering up the device. It should have a duration of at least 100 ms to ensure the external 12 MHz and crystal is in stable and correct frequency. All registers will be reset to default values.
- A software reset is accomplished by setting the reset bit (bit 4) of the Ethernet Control Register (address 01<sub>H</sub>). This software reset will reset all registers to default values.
- When ADM8513/X sees an SE0 on USB bus for more than 2.5 s. This USB reset will reset all registers to default values

## 9.2 USB Interface Timing

**Table 80** GPIO Interface DC Specification

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Rise Time	$T_{FR}$	4	–	20	ns	$C_L=50$ pF
Fall Time	$T_{FF}$	4	–	20	ns	$C_L=50$ pF
Rise and fall time matching	$T_{FRFF}$	90	–	111.11	%	$T_{FRFF} = T_{FR} / T_{FF}$

## 9.3 EEPROM Interface Timing

**Table 81** EEPROM Interface Timing

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
EESK Clock Frequency	$t_{EESK}$	0	–	1	MHz	–
EECS Setup Time to EESK	$t_{EECSS}$	0.2	–	–	μs	–
EECS Hold Time from EESK	$t_{EECSH}$	0	–	–	ns	–
EEDO Hold Time from EESK	$t_{EEDOH}$	70	–	–	ns	–
EEDO Output Delay to “1” or “0”	$t_{EEDOP}$	–	–	2	μs	–
EEDI Setup Time to EESK	$t_{EEDIS}$	0.4	–	–	μs	–
EEDI Hold Time from EESK	$t_{EEDIH}$	0.4	–	–	μs	–

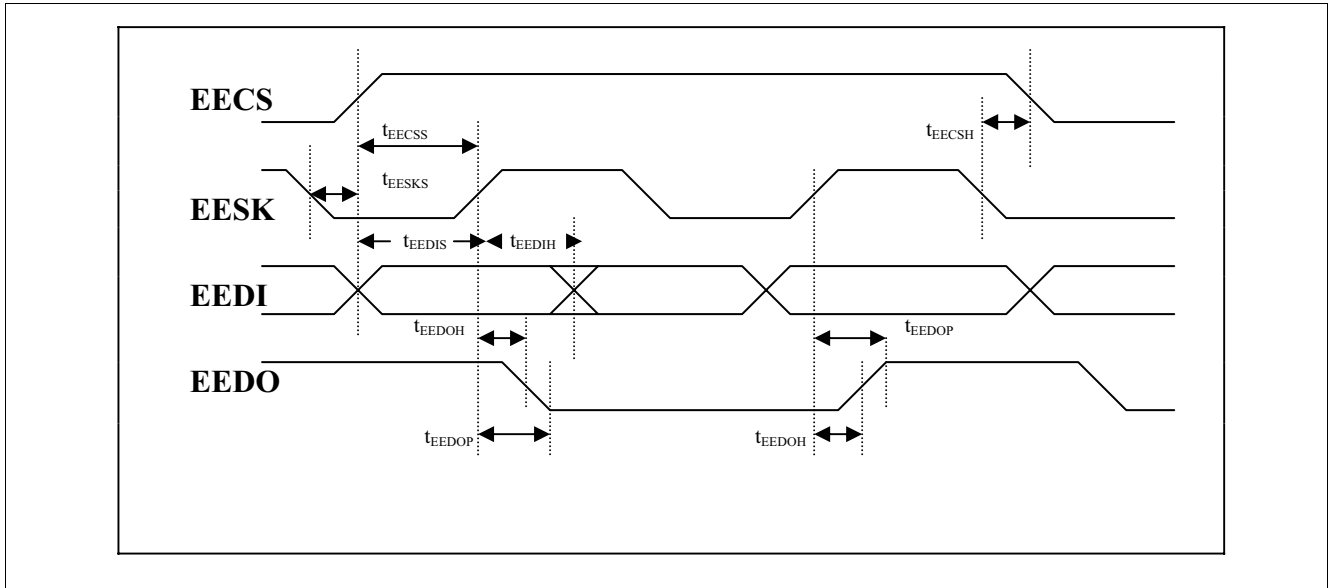


Figure 5 EEPROM Interface Timing

## 10 EEPROM Interface & Example

If the EEPROM contents from offset 0 to offset 5 is “FF\_FF\_FF\_FF\_FF\_FF”, the EEPROM isn't programmed correctly. The default values for every field are used instead of loading from EEPROM.

Table 82 EEPROM Interface

Offset(Byte)	Field	Description
00	node_id0	The 1st byte of Ethernet node ID.
01	node_id1	The 2st byte of Ethernet node ID.
02	node_id2	The 3st byte of Ethernet node ID.
03	node_id3	The 4st byte of Ethernet node ID.
04	node_id4	The 5st byte of Ethernet node ID.
05	node_id5	The 6st byte of Ethernet node ID.
06-07	Reserved	
08	Max_Pwr	The maximum USB power consumption.
09	Ep3_Interval	The polling interval for endpoint 3. If this value is 0, EP3 is disabled.
0A[0]	Reserved	
0A[1]	USB_Sel	0A[1] = 1: select internal USB transceiver.
0A[4:2]	PHY Mode	0A[4:2]= 000
0B[0]	Reserved	
0B[5:1]	Reserved	
0B[7:6]	LED Mode	Refer to Pin assignment
0C	Languageid_lo	The low byte of language ID.
0D	Languageid_hi	The high byte of language ID.
0E-0F	Reserved	
10	Manuid_lo	The low byte of manufacture ID.
11	Manuid_hi	The high byte of manufacture ID.

**Table 82 EEPROM Interface (cont'd)**

Offset(Byte)	Field	Description
12	ProID_lo	The low byte of product ID.
13	ProID_hi	The high byte of product ID.
14	Manu_str_len	The length for manufacture string.
15	Manu_str_offset	The word offset address of manufacture string.
16	Pro_str_len	The length for product string.
17	Pro_str_offset	The word offset address of product string.
18	Seri_str_len	The length for serial number string.
19	Seri_str_offset	The word offset address of serial number string.

### 10.1 Example

offset(byte)	Value
0000 <sub>H</sub> :	00, 00 E8 00 02 2C 00 00,
0008 <sub>H</sub> :	50 01 02 00 09 04 00 00
0010 <sub>H</sub> :	A6 07 13 85 0E 10 2A 20
0018 <sub>H</sub> :	0A 38 00 00 00 00 00 00
0020 <sub>H</sub> :	0E 03 41 00 44 00 4D 00
0028 <sub>H</sub> :	74 00 65 00 6B 00 00 00
0030 <sub>H</sub> :	1E 00 55 00 53 00 42 00
0038 <sub>H</sub> :	20 00 31 00 30 00 2F 00
0040 <sub>H</sub> :	2A 03 55 00 53 00 42 00
0048 <sub>H</sub> :	-20 00 54 00 6F 00 20 00
0050 <sub>H</sub> :	4C 00 41 00 4E 00 20 00
0058 <sub>H</sub> :	43 00 6F 00 6E 00 76 00
0060 <sub>H</sub> :	65 00 72 00 74 00 65 00
0068 <sub>H</sub> :	72 00 00 00 00 00 00 00
0070 <sub>H</sub> :	0A 03 30 00 30 00 30 00
0078 <sub>H</sub> :	31 00 00 00 00 00 00 00

**Table 83 EEPROM Example**

Offset(Byte)	Value	Description
00-05	00_00_E8_10 _46_02	NIC node ID
08	50	maximum power 160mA
09	01	interrupt endpoint 3 polling interval 1ms
0A	02	isochronous endpoint disables, selects internal USB transceiver Uses internal Ethernet PHY, Wakes on Lan en
0C-0D	0904	Language ID 0409
10-11	A607	manufacture ID 07A6
12-13	8513	product ID 8513
14	0E	manufacture string length 0E bytes
15	10	manufacture string starts from word offset 10h, thus byte offset 20 <sub>H</sub> .

**Table 83** EEPROM Example (cont'd)

Offset(Byte)	Value	Description
16	1E	product string length 1E bytes
17	18	product string starts from word offset 18h, thus byte offset 30 <sub>H</sub> .
18	0A	serial number string length 0A bytes
19	38	serial number string starts from word offset 38h, thus byte offset 70 <sub>H</sub> .
20-2E	0E 03 41 00 44 00 4D 00 74 00 65 00 6B 00	0E:descriptor size 14 bytes 03: string descriptor 41.....: UNICODE encoded string
30-4E	1E 03 55 00 53 00 42 00 20 00.....	1E:descriptor size 30 bytes 03: string descriptor 55.....: UNICODE encoded string
50-5A	0A 03 30 00 30 00 30 00 31 00	0A: descriptor size 10 bytes 03: string descriptor 30.....: UNICODE encoded string





*Note: This diagram has a 32pin. But, the relative parameters presents 48pin package data. So, please ignore the pin number and regard the diagram as 48pin. Make an example: Parameter "E" (9mm) means the distance between the two opposite sides. Parameter "e" (0.8mm) means the distance between two adjacent pins. D&E1 means body size.*

**Table 84 Dimensions for 48 Pin LQFP Package**

Symbol	Millimeter (mm)			Inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	–	–	1.60	–	–	0.063
A <sub>1</sub>	0.05	–	0.15	0.002	–	0.006
A <sub>2</sub>	1.35	1.40	1.45	0.053	0.005	0.057
D	9.00 BSC.			0.354 BSC.		
D <sub>1</sub>	7.00 BSC			0.276 BSC.		
E	9.00 BSC			0.354 BSC.		
E <sub>1</sub>	7.00 BSC			0.276 BSC.		
R <sub>2</sub>	0.08	–	0.20	0.003	–	0.008
R <sub>1</sub>	0.08	–	–	0.003	–	–
Θ	0°	3.5°	7°	0°	3.5°	7°
Θ <sub>1</sub>	0°	–	–	0°	–	–
Θ <sub>2</sub>	11°	12°	13°	11°	12°	13°
Θ <sub>3</sub>	11°	12°	13°	11°	12°	13°
c	0.09	–	0.20	0.004	–	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L <sub>1</sub>	1.00 Ref.			0.039 Ref.		
S	0.20	–	–	0.008	–	–
<b>32L</b>						
b	0.30	0.35	0.45	0.0012	0.0014	0.018
e	0.80 BSC.			0.031 BSC.		
D <sub>2</sub>	5.60			0.220		
E <sub>2</sub>	5.60			0.220		
Tolerance of Form and Position						
aaa	0.20			0.008		
bbb	0.20			0.008		
ccc	0.10			0.003		
ddd	0.20			0.008		
<b>34L</b>						
b	0.17	0.20	0.27	0.007	0.008	0.011
e	0.50 BSC.			0.020 BSC.		
D <sub>2</sub>	5.00			0.197		
E <sub>2</sub>	5.00			0.197		
Tolerance of Form and Position						
aaa	0.20			0.008		
bbb	0.20			0.008		
ccc	0.08			0.003		
ddd	0.08			0.003		
<b>48L</b>						
b	0.17	0.20	0.27	0.007	0.008	0.011

**Table 84 Dimensions for 48 Pin LQFP Package (cont'd)**

<b>Symbol</b>	<b>Millimeter (mm)</b>	<b>Inch</b>
e	0.50 BSC.	0.020 BSC.
D <sub>2</sub>	5.50	0.217
E <sub>2</sub>	5.50	0.217
Tolerance of Form and Position		
aaa	0.20	0.008
bbb	0.20	0.008
ccc	0.08	0.003
ddd	0.08	0.003

## 12 Appendix Layout Guide

### Placement:

- At USB side, place ADM8513/X and USB connector as close as possible.
- At Ethernet side, place ADM8513/X, transformer and RJ45 as close as possible.
- The crystal or OSC device should be closed to ADM8513/X and away from the following items
  - Any analog signal
  - PCB edge
  - Any other high frequency components and their associated traces.

If you can't avoid those designs, please add a Resistor between Crystal (or OSC) and ADM8513/X chip clk48\_I pin as figure show:

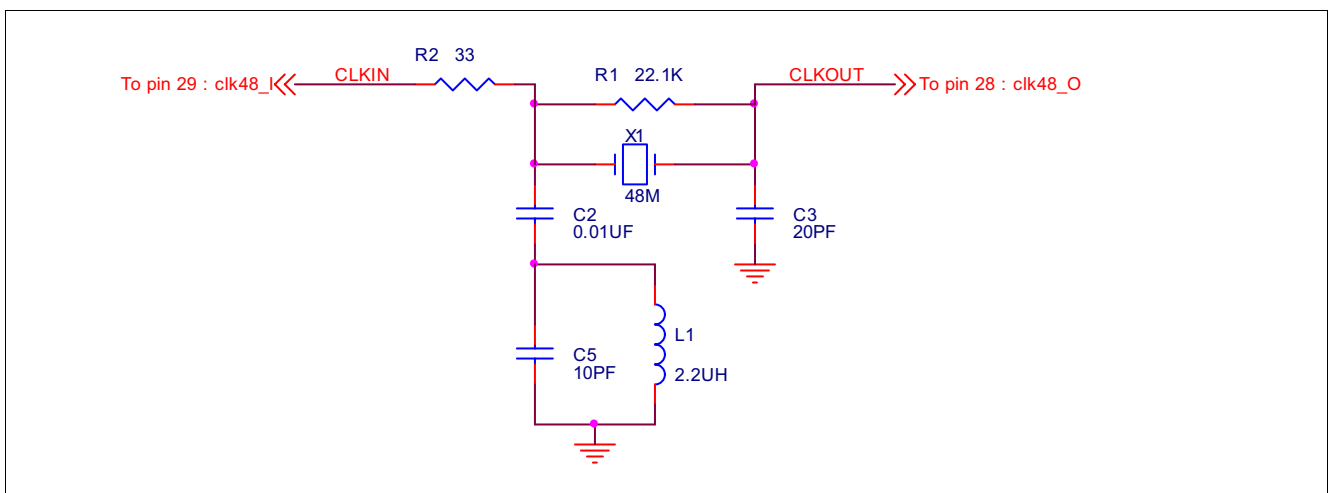


Figure 7 Placement 1

- Place the filtering capacitor as closed as possible at the Vcc pin of ADM8513/X and its trace must be short and wide.

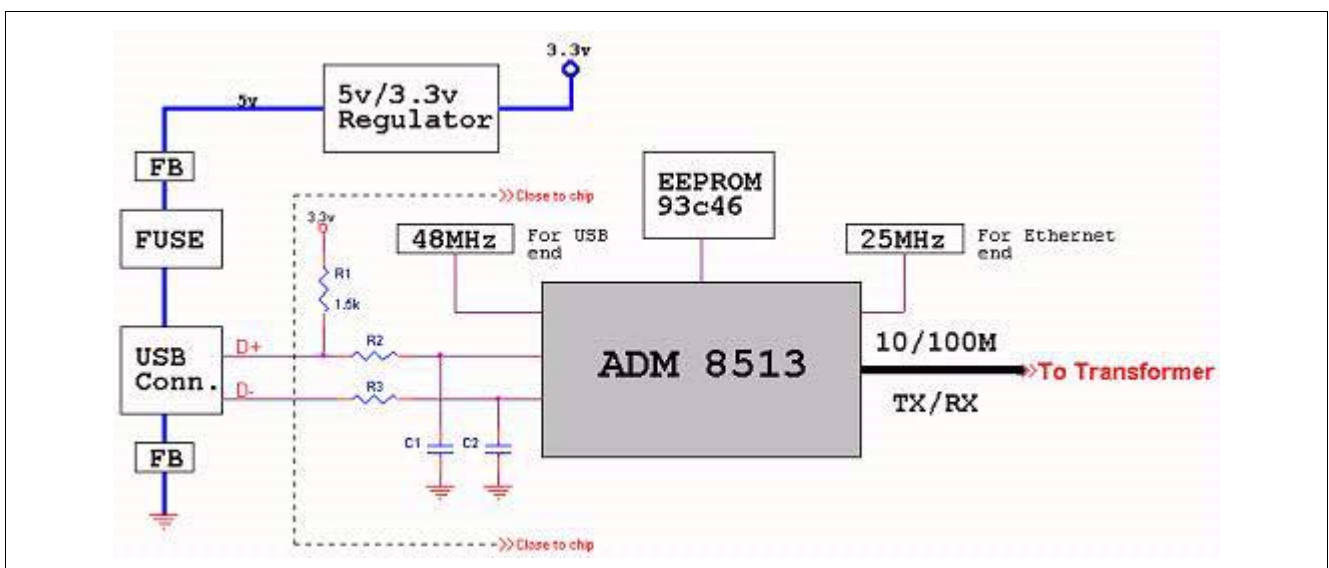


Figure 8 Placement 2

### Trace routing

- Keep USB differential pair data signal D+ and D-:
  - Trace width should be as wide as possible.
  - Make D+ and D- traces route at the same signal plane and not pass through the other plane.
  - Inhibit crossover on D+ and D-
  - The termination resistance (R2,R3) and decoupling capacitors (C1,C2) should be closed to ADM8513/X.
  - D+ and D- Signal trace length should be equal and as short as possible.
- Arrangement Tx and Rx trace
  - Tx+/- and Rx+/- trace avoid right angle and round angle >90 degree, suggested.
  - Trace width must be wide and should be wider than 8 mils.
  - Signal trace length between Tx+/- differential pairs should be crossed and have equal length. The total length should be no longer than 2 cm. The same requirement applies to Rx+/- also.
  - Make Tx and Rx trace route at the same signal plane and not pass through the other plane.
  - Every differential pairs as cross as possible, but no less than 8 mils and space should be almost equal.
  - Keep space large between Tx and Rx differential pairs, even separated ground planes underneath Tx and Rx signal pairs.
  - Away from clock and power traces.
  - If Tx routed trace must cross, the trace can be swapped between chip and transformer, and transformer to RJ45, too.

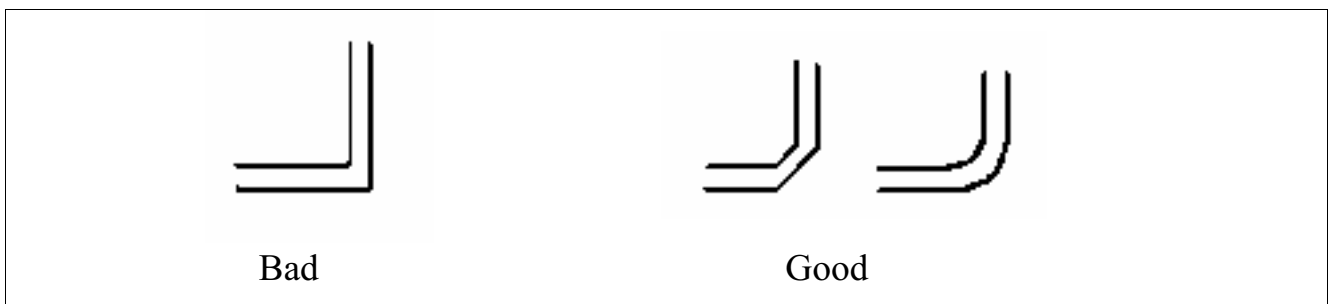


Figure 9 Trace Routing 1

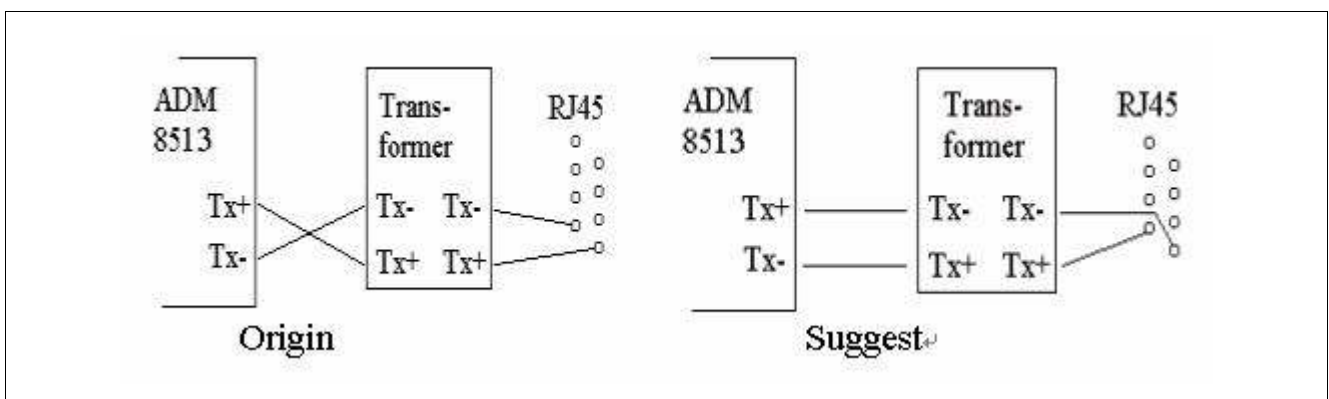
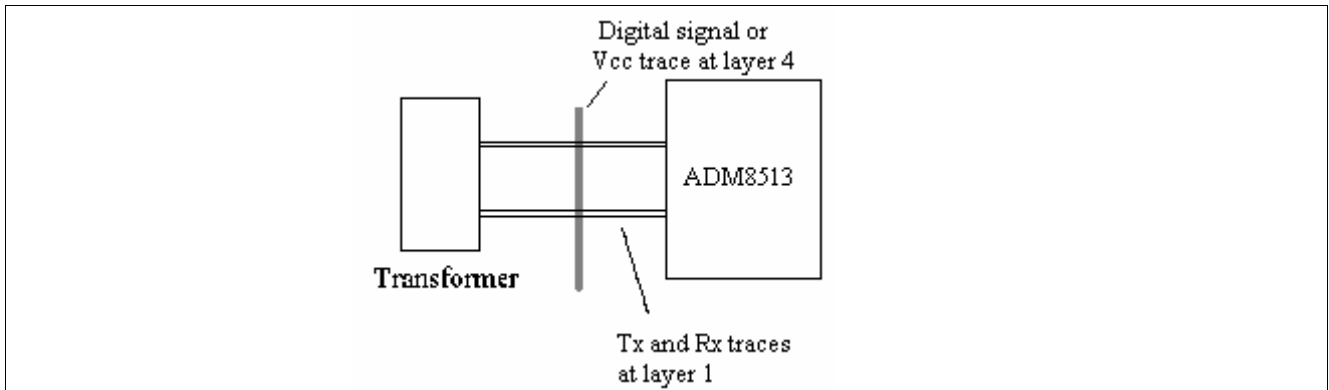


Figure 10 Trace Routing 2

- Digital signal should be away from analog signal and Vcc traces. If you can't avoid this situation, analog signal or Vcc trace should cross over 90 degree at other plane.

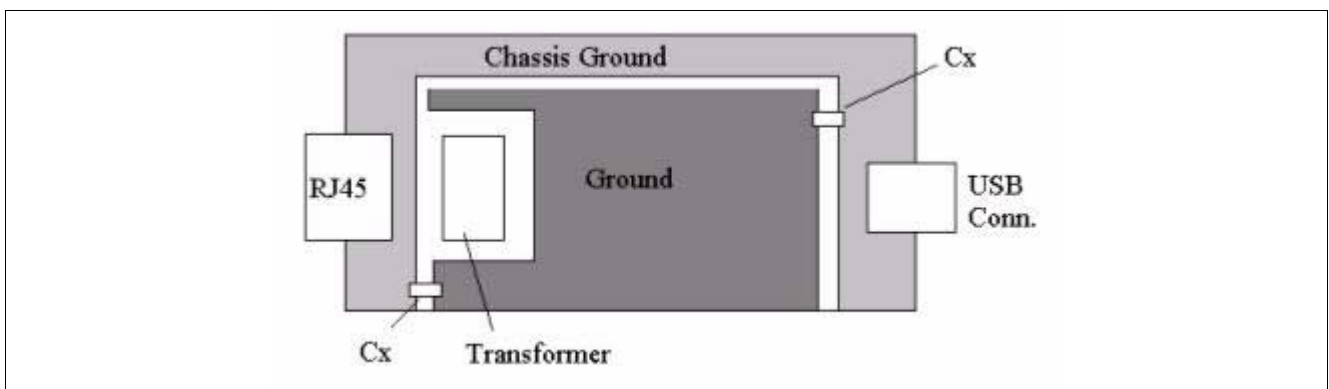


**Figure 11 Trace Routing 3**

- Vcc trace should be short and prefer route in the format of the plane a special for GND.

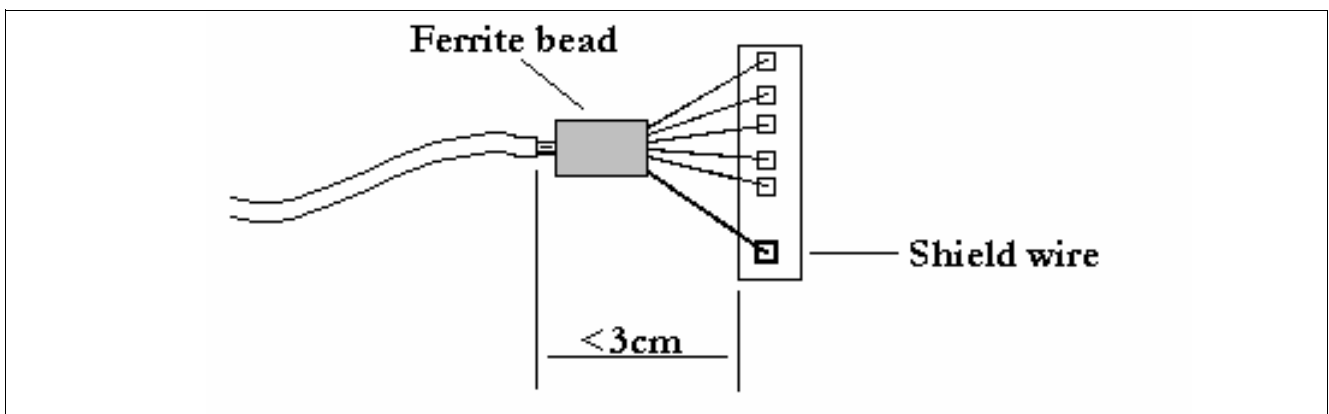
**Power and Ground**

- All of the Vcc pin should have a 0.1uF SMD capacitors which placed with it. To be effective, the capacitors should be placed as close as possible at the pin.
- The chassis ground plane connected to the USB B type and network connector chassis should be isolated from the signal plane with 0.1uF capacitors or bead to prevent any radiation from leaking and resulting in EMI failure.
- Right angle is recommend when partition Vcc as well as GND planes.
- Avoid Vcc and ground planes placing directly under the transformer. See the Figure as below.



**Figure 12 Power and Ground 1**

- If you use a captive cable (plus the shield wire) it may require additional filtering for EMI test pass and the length of unshielded cable should be limited to 3cm or less.



**Figure 13 Power and Ground 2**

- Please connect 10K Ohm Ribb resistance gnd, pin40(GndRef) and pin37(GndR) first then use signal via to Gnd (Specially for 2 layers board design).

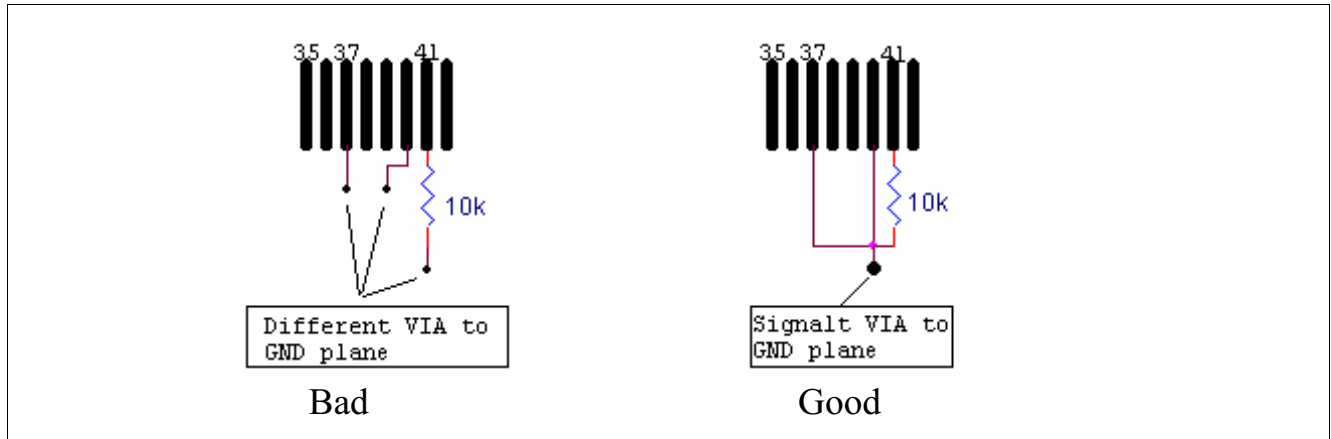


Figure 14 Power and Ground 3

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