



# **KSZ8081MNX / KSZ8091MNX**

## **10Base-T/100Base-TX Physical Layer Transceiver**

### **Evaluation Board User's Guide**

**Revision 1.0 / August 2012**

© Micrel, Inc. 2012  
All rights reserved

Micrel is a registered trademark of Micrel and its subsidiaries in the United States and certain other countries. All other trademarks are the property of their respective owners.

---

The information furnished by Micrel in this datasheet is believed to be accurate and reliable. However, no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer. Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is at Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

---

**Micrel, Inc. ♦ 2180 Fortune Drive ♦ San Jose, CA 95131 ♦ U.S.A.**  
**408-944-0800 (voice) ♦ 408-474-1000 (fax)**  
<http://www.Micrel.com>

## Revision History

Revision	Date	Summary of Changes
1.0	8/15/12	Initial Release

## Table of Contents

<b>1.0</b>	<b>Introduction .....</b>	<b>5</b>
<b>2.0</b>	<b>Board Features .....</b>	<b>5</b>
<b>3.0</b>	<b>Evaluation Kit Contents.....</b>	<b>5</b>
<b>4.0</b>	<b>Hardware Description .....</b>	<b>6</b>
4.1	MII (Media Independent Interface).....	7
4.2	Jumper Setting & Definition .....	9
4.3	Test Point Definition.....	12
4.4	RJ-45 Connector .....	12
4.5	LED Indicators .....	12
<b>5.0</b>	<b>Bill of Materials.....</b>	<b>13</b>

## **List of Figures**

Figure 1. KSZ8081MNX Evaluation Board.....	6
Figure 2. KSZ8081MNX-EVAL interfacing with KSZ8463MLI Evaluation Board.....	7

## **List of Tables**

Table 1. Connector J2 - MII Pin Definition.....	8
Table 2. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Strapping Jumper Definition.....	9
Table 3. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Loopback Jumper Definition.....	9
Table 4. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Miscellaneous Jumper Definition .....	10
Table 5. Strapping Pin Definitions for KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Jumpers.....	11
Table 6. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Test Point Definition .....	12
Table 7. KSZ8081MNX / KSZ8091MNX LED Definition .....	12

## **1.0 Introduction**

The KSZ8081MNX / KSZ8091MNX is a 10Base-T/100Base-TX Physical Layer Transceiver with an MII MAC interface. It utilizes a unique mixed-signal design to extend signaling distance while reducing power consumption, and offers HP Auto MDI/MDI-X for reliable detection of and correction for crossover and straight-through cables, eliminating the need to differentiate between crossover and straight-through cables.

The KSZ8091MNX has all the identical rich features of the KSZ8081MNX plus support for Energy Efficient Ethernet (EEE) and Wake-on-LAN (WOL). The KSZ8081MNX / KSZ8091MNX come in a 32-pin, lead-free QFN package and provides an ideal solution for 10Base-T/100Base-TX applications that have tight PCB board space.

The KSZ8081MNX and KSZ8091MNX Eval Boards (KSZ8081MNX-EVAL and KSZ8091MNX-EVAL) provide a convenient platform to evaluate the features of the device. All configuration pins are accessible either by jumpers, test points or interface connectors.

## **2.0 Board Features**

- Micrel KSZ8081MNX or KSZ8091MNX 10Base-T/100Base-TX Physical Layer Transceiver
- RJ-45 Jack for Fast Ethernet cable interface
- HP Auto MDI/MDI-X for automatic detection and correction for straight-through and crossover cables
- MII (Media Independent Interface) Connector to interface with a MAC controller
- 2 LED Indicators for status and activity
- Jumpers to configure strapping pins
- Manual Reset Button for quick reboot after re-configuration of strapping pins

## **3.0 Evaluation Kit Contents**

The KSZ8081MNX and KSZ8091MNX Evaluation Kits include the following hardware:

- KSZ8081MNX or KSZ8091MNX Evaluation Board

A design package with the following collaterals that can be downloaded from Micrel's website at <http://www.micrel.com>

- KSZ8081MNX / KSZ8091MNX Eval Board Schematic (PDF and OrCAD DSN file)
- KSZ80x1 (32-QFN) Eval Board Gerber Files (PDF version included)
- KSZ8081MNX / KSZ8091MNX Eval Board User's Guide (this document)
- KSZ8081MNX and KSZ8091MNX IBIS Models

and the KSZ8081MNX / KSZ8081RNB and KSZ8091MNX / KSZ8091RNB Datasheets which are also available from Micrel's website.

## 4.0 Hardware Description

The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL (shown in Figure 1) comes in a compact form factor and plugs directly into boards with Ethernet MACs that expose the MII interface. Configuration of the KSZ8081MNX / KSZ8091MNX is accomplished through on-board jumper selections and/or by PHY register access via the MDC/MDIO management pins of the MII Interface.

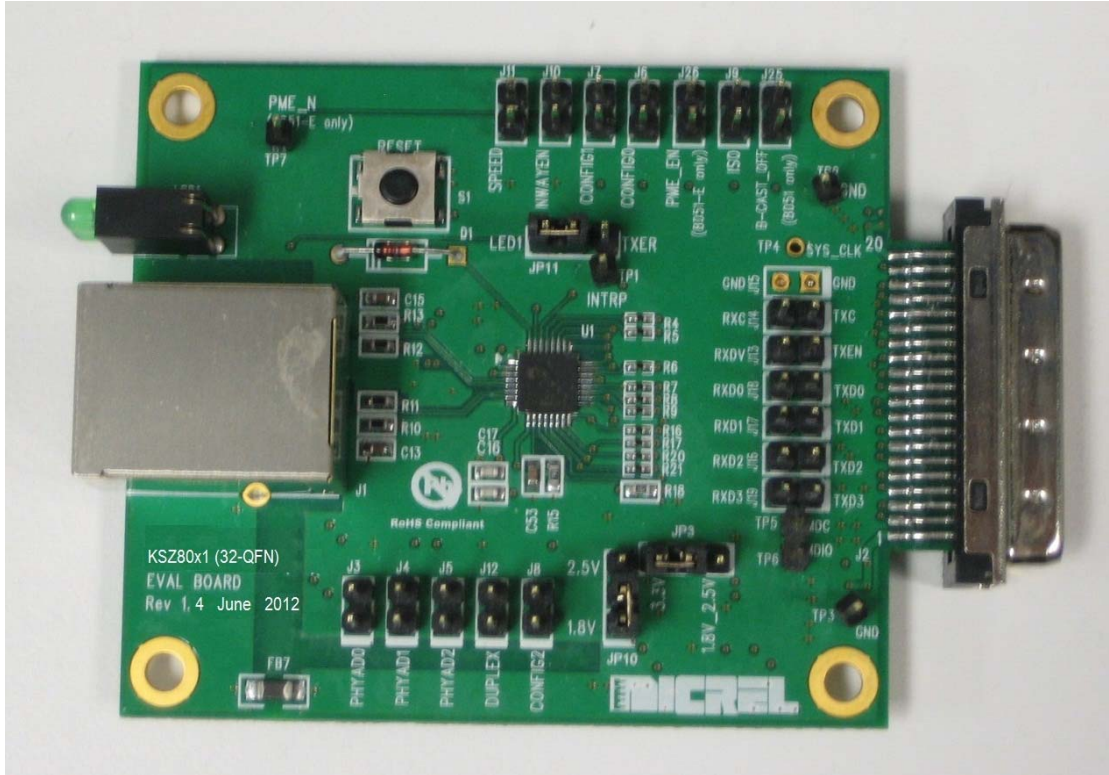


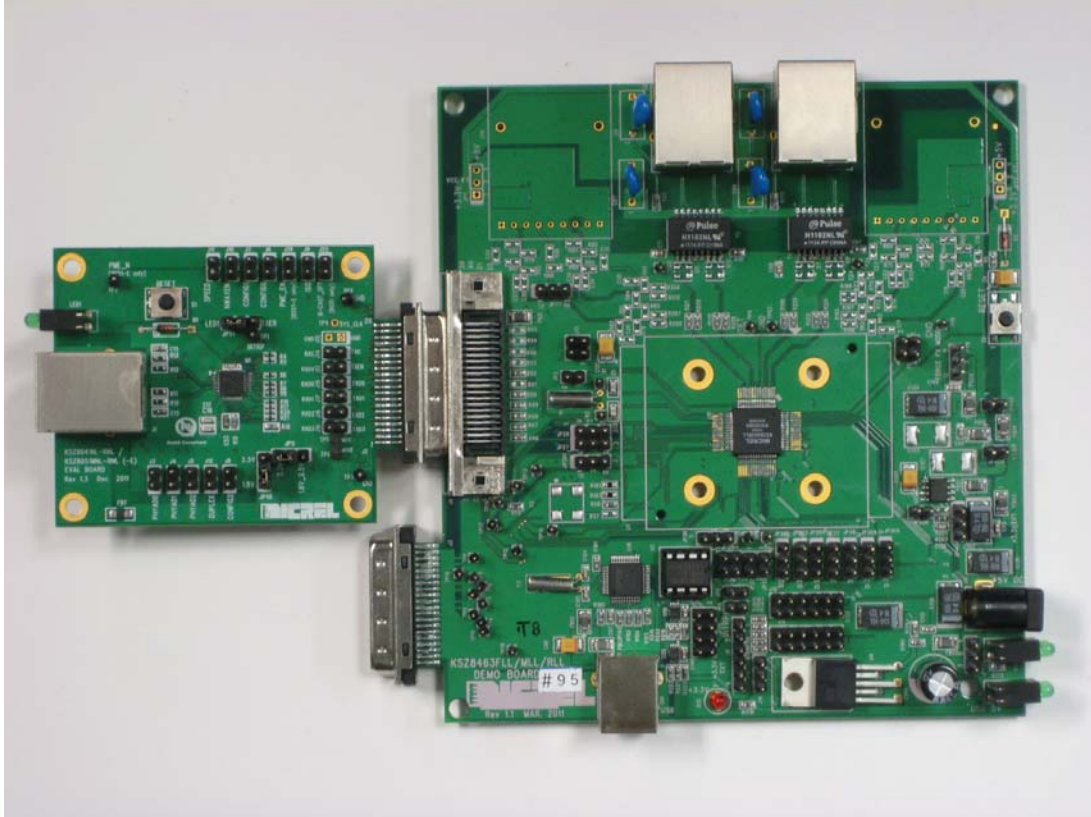
Figure 1. KSZ8081MNX Evaluation Board

Features include an RJ-45 Jack for Fast Ethernet cable connection, programmable LED indicators for reporting link status and activity, and a manual reset button for quick reboot after re-configuration of strapping pins.

The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL receives +5V DC input power through its MII connector.

## **4.1 MII (Media Independent Interface)**

The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL receives power and accesses MII data and management information from the MII connector J2. Figure 2 shows the KSZ8081MNX-EVAL / KSZ8091MNX-EVAL connected to the Micrel KSZ8463MLI Evaluation Board.



**Figure 2. KSZ8081MNX-EVAL interfacing with KSZ8463MLI Evaluation Board**

The MII interface is defined by Clause 22 of the IEEE 802.3 Specification. MII Management (MIIM) is conducted thru pins MDC (clock line) and MDIO (data line). MIIM allows upper-layer devices to monitor and control the states of the KSZ8081MNX / KSZ8091MNX. An external device with MDC/MDIO capability can be used to read the PHY status or configure the PHY registers. The MIIM frame format and timing information can be found in the KSZ8081MNX and KSZ8091MNX datasheets and in Clause 22 of the IEEE 802.3 Specification.

The Eval Board has a 40-pin male edge connector that interfaces with and plugs directly into Fast Ethernet MAC boards with the mating AMP 787170-4 (40-pin, right angle, female) connector. Table 1 lists the pin outs for the MII interface on connector J2.

<b>Pin #</b>	<b>Signal</b>	<b>Pin #</b>	<b>Signal</b>
1	+5V	21	+5V
2	MDIO	22	Ground
3	MDC	23	Ground
4	RXD3	24	Ground
5	RXD2	25	Ground
6	RXD1	26	Ground
7	RXD0	27	Ground
8	RXDV	28	Ground
9	RXCLK	29	Ground
10	RXER	30	Ground
11	TXER	31	Ground
12	TXCLK	32	Ground
13	TXEN	33	Ground
14	TXD0	34	Ground
15	TXD1	35	Ground
16	TXD2	36	Ground
17	TXD3	37	Ground
18	COL	38	Ground
19	CRS	39	Ground
20	+5V	40	+5V

**Table 1. Connector J2 - MII Pin Definition**



## 4.2 Jumper Setting & Definition

At power-up, the KSZ8081MNX / KSZ8091MNX is configured using the chip's internal pull-up and pull-down resistors with its default strapping pin values. Jumpers are provided to override the default settings, allowing for quick configuration and re-configuration of the board. To override the default settings, simply select and close the desired jumper setting(s) and toggle the on-board manual reset button (S1) for the new setting(s) to take effect. The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL strapping jumper settings are defined in Table 2 below.

Jumper	Definition	Open (default)	Close						
J3	PHYAD0	1	0						
J4	PHYAD1	0	1						
J5	PHYAD2	0	1						
J6	CONFIG0	<table border="1"> <thead> <tr> <th>CONFIG[2:0]</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>[open, open, open]</td> <td>MII (default)</td> </tr> <tr> <td>[close, close, open]</td> <td>MII Back-to-Back</td> </tr> </tbody> </table> <p>All other CONFIG[2:0] settings not listed are reserved (not used).</p>		CONFIG[2:0]	Mode	[open, open, open]	MII (default)	[close, close, open]	MII Back-to-Back
CONFIG[2:0]	Mode								
[open, open, open]	MII (default)								
[close, close, open]	MII Back-to-Back								
J7	CONFIG1								
J8	CONFIG2								
J9	Isolate Mode	Disable	Enable						
J10	Nway Auto-Negotiation	Enable	Disable						
J11	Forced Speed (KSZ8081 only)	100Base-TX	10Base-T						
J12	Forced Duplex	Half	Full						
J25	Broadcast Off – for PHY Address 0	Broadcast PHY address	Unique PHY address						
J26	PME_N Pin Enable (KSZ8091 only)	Disable	Enable						

**Table 2. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Strapping Jumper Definition**

The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL has another set of jumpers that may be used to loopback the MII interface. To loopback, all six jumpers must be installed. The individual jumpers are defined in Table 3.

Jumper	MII Signals	Normal Operation	MII Loopback Mode
J13	RXDV / TXEN	Open	Close
J14	RXC / TXC	Open	Close
J16	RXD2 / TXD2	Open	Close
J17	RXD1 / TXD1	Open	Close
J18	RXD0 / TXD0	Open	Close
J19	RXD3 / TXD3	Open	Close

**Table 3. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Loopback Jumper Definition**

The last group of jumpers is defined in Table 4 below. These jumpers are not related to reset strapping, nor to loopback. Two jumpers are used to set the VDDIO voltage, and one jumper is used to route pin 31 as dependent on the device part number.

Note that for the eval board to function, a jumper must be installed on JP3. If pins 1 & 2 of JP3 are closed, then a jumper must also be installed on JP10.

For the KSZ8091MNX, a jumper must be installed on pins 2 & 3 of JP11.

Jumper	Definition	Close pins 1, 2	Close pins 2, 3
JP3	VDDIO voltage selection: 3.3V / low	VDDIO set by JP10	VDDIO = 3.3V
JP10	VDDIO low voltage selection	1.8V_2.5V = 1.8V	1.8V_2.5V = 2.5V
JP11	Pin 31 connection (LED1 or TXER)	For KSZ8081 only (pin 31 = LED1)	For KSZ8091 only (pin 31 = TXER)

**Table 4. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Miscellaneous Jumper Definition**

Table 5 lists the strapping pin definitions for the KSZ8081MNX-EVAL / KSZ8091MNX-EVAL jumpers.

Jumper	Pin	Pin Name	Pin Function						
J5 J4 J3	15 14 13	PHYAD2 PHYAD1 PHYAD0	The PHY Address is latched at power-up / reset and is configurable to any value from 0 to 7. The default PHY Address is 00001. PHY Address 00000 is enabled only if the B-CAST_OFF strapping pin is pulled high. PHY Address bits [4:3] are always set to '00'.						
J8 J7 J6	18 29 28	CONFIG2 CONFIG1 CONFIG0	The CONFIG[2:0] strap-in pins are latched at power-up / reset and are defined as follows: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>CONFIG[2:0]</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>000</td> <td>MII (default)</td> </tr> <tr> <td>110</td> <td>MII Back-to-Back</td> </tr> </tbody> </table> <p>All other CONFIG[2:0] settings not listed are reserved (not used).</p>	CONFIG[2:0]	Mode	000	MII (default)	110	MII Back-to-Back
CONFIG[2:0]	Mode								
000	MII (default)								
110	MII Back-to-Back								
J9	20	ISO	ISOLATE mode Pull-up = Enable Pull-down (default) = Disable At the de-assertion of reset, this pin value is latched into register 0h bit 10.						

Jumper	Pin	Pin Name	Pin Function
J11	31	SPEED (KSZ8081 only)	SPEED mode Pull-up (default) = 100Mbps Pull-down = 10Mbps At the de-assertion of reset, this pin value is latched into register 0h bit 13 as the Speed Select, and also is latched into register 4h (Auto-Negotiation Advertisement) as the Speed capability support.
J12	16	DUPLEX	DUPLEX mode Pull-up (default) = Half Duplex Pull-down = Full Duplex At the de-assertion of reset, this pin value is latched into register 0h bit 8 as the Duplex Mode.
J10	30	NWAYEN	Nway Auto-Negotiation Enable Pull-up (default) = Enable Auto-Negotiation Pull-down = Disable Auto-Negotiation At the de-assertion of reset, this pin value is latched into register 0h bit 12.
J25	19	B-CAST_OFF	Broadcast Off – for PHY Address 0 Pull-up = PHY Address 0 is set as a unique PHY address Pull-down (default) = PHY Address 0 is set as a broadcast PHY address At the de-assertion of reset, this pin value is latched by the chip.
J26	22	PME_EN (KSZ8091 only)	PME_N Output Pin for Wake-On-LAN Function Pull-up = Enable Pull-down = Disable At the de-assertion of reset, this pin value is latched into the chip.
N/A	21	NAND_Tree#	NAND Tree Mode Pull-up (default) = Disable Pull-down = Enable At the de-assertion of reset, this pin value is latched by the chip.

**Table 5. Strapping Pin Definitions for KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Jumpers**

### 4.3 Test Point Definition

The KSZ8081MNX-EVAL / KSZ8091MNX-EVAL has four test points. They are defined in the following table.

Test Point	Definition
TP1	Pin 21 (with external pull-up) KSZ8081: Interrupt KSZ8091: Interrupt or PME_N2
TP2	Ground
TP3	Ground
TP7	Pin 30 KSZ8081: LED0 KSZ8091: LED0 or PME_N1

**Table 6. KSZ8081MNX-EVAL / KSZ8091MNX-EVAL Test Point Definition**

### 4.4 RJ-45 Connector

The RJ-45 Connector (J1) is a TDK TLA-6T718A or similar integrated magnetic jack. It connects to standard CAT-5 Ethernet cable to interface with 10Base-T / 100Base-TX Ethernet devices.

### 4.5 LED Indicators

A dual LED indicator (LED1) is located adjacent to the RJ-45 Connector. The top LED and bottom LED are connected to LED1 (pin 31) and LED0 (pin 30) respectively.

The two LEDs are programmable to LED mode '00' or '01' via register 1Fh bits [5:4], and are defined in the following table.

LED Mode	LED1 (pin 31)	LED0 (pin 30)																					
00	<table border="1"> <thead> <tr> <th>Speed</th> <th>Pin State</th> <th>LED Definition</th> </tr> </thead> <tbody> <tr> <td>10Base-T</td> <td>H</td> <td>OFF</td> </tr> <tr> <td>100Base-Tx</td> <td>L</td> <td>ON</td> </tr> </tbody> </table>	Speed	Pin State	LED Definition	10Base-T	H	OFF	100Base-Tx	L	ON	<table border="1"> <thead> <tr> <th>Link/Activity</th> <th>Pin State</th> <th>LED Definition</th> </tr> </thead> <tbody> <tr> <td>No Link</td> <td>H</td> <td>OFF</td> </tr> <tr> <td>Link</td> <td>L</td> <td>ON</td> </tr> <tr> <td>Activity</td> <td>Toggle</td> <td>Blinking</td> </tr> </tbody> </table>	Link/Activity	Pin State	LED Definition	No Link	H	OFF	Link	L	ON	Activity	Toggle	Blinking
	Speed	Pin State	LED Definition																				
	10Base-T	H	OFF																				
	100Base-Tx	L	ON																				
Link/Activity	Pin State	LED Definition																					
No Link	H	OFF																					
Link	L	ON																					
Activity	Toggle	Blinking																					
01	<table border="1"> <thead> <tr> <th>Activity</th> <th>Pin State</th> <th>LED Definition</th> </tr> </thead> <tbody> <tr> <td>No Activity</td> <td>H</td> <td>OFF</td> </tr> <tr> <td>Activity</td> <td>Toggle</td> <td>Blinking</td> </tr> </tbody> </table>	Activity	Pin State	LED Definition	No Activity	H	OFF	Activity	Toggle	Blinking	<table border="1"> <thead> <tr> <th>Link</th> <th>Pin State</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>No Link</td> <td>H</td> <td>OFF</td> </tr> <tr> <td>Link</td> <td>L</td> <td>ON</td> </tr> </tbody> </table>	Link	Pin State	Definition	No Link	H	OFF	Link	L	ON			
	Activity	Pin State	LED Definition																				
	No Activity	H	OFF																				
Activity	Toggle	Blinking																					
Link	Pin State	Definition																					
No Link	H	OFF																					
Link	L	ON																					
10	Reserved – not used	Reserved – not used																					
11	Reserved – not used	Reserved – not used																					

**Table 7. KSZ8081MNX / KSZ8091MNX LED Definition**

## 5.0 Bill of Materials

KSZ8081MNX / KSZ8091MNX Eval Board, Schematic Revision 1.0

Item	Quantity	Reference	Description	Package
1	2	C1,C2	47uF / Tantalum	B-size
2	1	C3	22uF / Tantalum	B-size
3	10	C4,C5,C7,C10,C11,C12, C49,C51,C57,C58	0.1uF	0603
4	4	C6,C8,C48,C50	10uF / Tantalum	A-size
5	1	C9	2.2uF	A-size
6	2	C16,C17	22pF	0603
7	1	C52	470pF	0603
8	1	D1	1N4148	DO-35 / axial lead
9	2	FB1,FB7	Ferrite Bead	1206
10	1	J1	RJ-45 Mag Jack	thru hole / PC mount
11	1	J2	Male MII Connector	PCB edge mount
12	18	J3,J4,J5,J6,J7,J8,J9,J10, J11,J12,J13,J14,J16 J17,J18,J19,J25,J26	Header 2X1	thru hole / 0.1" pitch
13	3	JP3,JP10,JP11	Header 3X1	thru hole / 0.1" pitch
14	1	LED1	LEDx2 / Green	thru hole / 0.1" pitch
15	1	R1	100K	0603
16	1	R2	10K	0603
17	9	R3,R25,R26,R27,R28, R29,R30,R102,R103	4.7K	0603
18	10	R4,R5,R6,R7,R8,R9,R16, R17,R20,R21	33	0603
19	1	R112	680	0603
20	1	R15	6.49K	0603
21	2	R22,R24	220	0603
22	5	R18,R23,R31,R32,R33	1K	0603
23	2	R111,R113	1.5K	0603
24	1	S1	SW PUSHBUTTON	SMT
25	4	TP1,TP2,TP3,TP7	TestPoint	thru hole / 0.1" pitch
26	1	U1	KSZ8081MNX or KSZ8091MNX	32-pin QFN
27	1	U2	MIC5216-3.3YM5	SOT-23-5
28	1	U7	MIC5207YM5	SOT-23-5
29	1	Y1	Xtal 25MHz +/-50ppm	cylinder