

10 /100Base-Tx/Fx Media Converter

Features

- A 10/100BASE-TX/ 100BASE-FX converter
- Built in a 10/100BASE-TX transceiver
- Built in a PHY for 100BASE-FX
- Built in a 2-port switch
 - Pass all packets without address and CRC check (optional)
 - Supports modified cut-through frame forwarding for low latency
 - Supports pure converter mode data forwarding for extreme low latency
 - Supports flow control for full and half duplex operation
 - Bandwidth control
 - Forward 1600 bytes packet for management
 - Optional forward fragments
- Built in 128Kb RAM for data buffer
- Supports auto MDI-MDIX function
- Supports link fault pass through function
- Supports far end fault function
- LED display for link/activity, full/half, 10/100
- Built in a watchdog timer to monitor internal switch error
- Supports EEPROM Configuration
- 0.25u CMOS technology
- Single 2.5V power supply
- 48-pin LQFP package
- Support Lead Free package (Please refer to the Order Information)

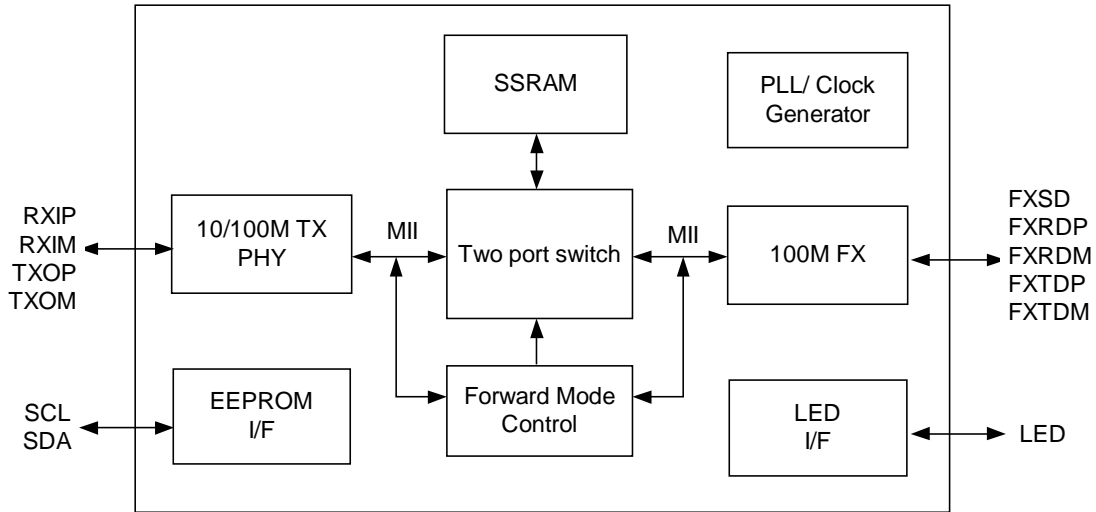
General Description

IP113C LF can be a 10/100BASE-TX to 100BASE-FX converter. It consists of a 2-port switch controller, a fast Ethernet transceiver and a PHY for 100BASE-FX. The transceivers in IP113C LF are designed in DSP approach with advance 0.25-um technology; this results in high noise immunity and robust performance.

IP113C LF not only supports store and forward mode, it also supports modified cut through mode and pure converter mode for low latency data forwarding. IP113C LF can transmit packet(s) up to 1600 bytes to meet requirement of extra long packets.

IP113C LF supports IEEE802.3x, collision base backpressure, and various LED functions, etc. These functions can be configured to fit the different requirements by feeding operation parameters via EEPROM interface or pull up/down resistors on specified pins.

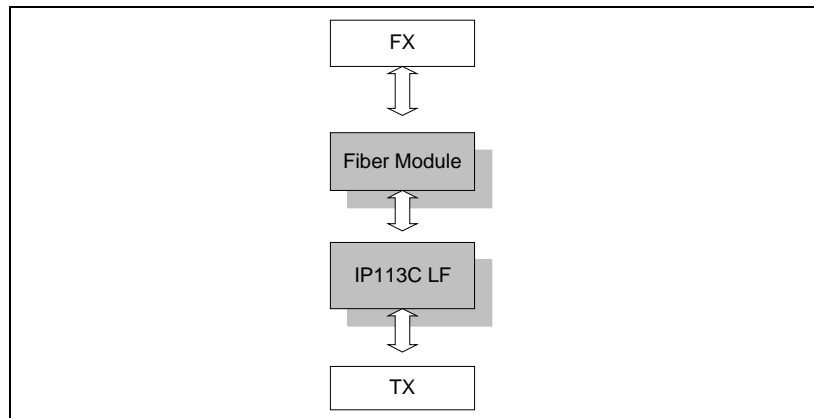
Block Diagram



Revision History

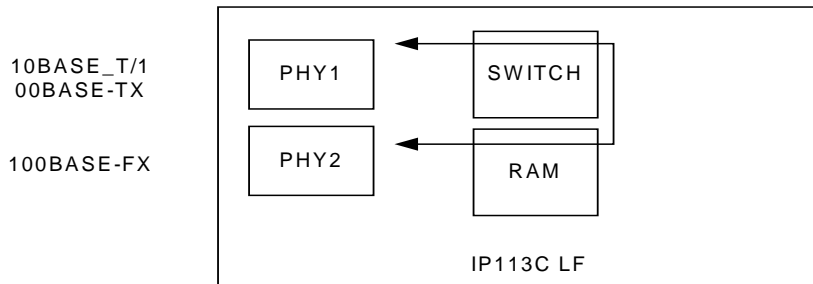
Revision #	Change Description
IP113C LF-DS-R01	Initial release.
IP113C LF-DS-R02	Remove Operation Junction Temperature.
IP113C LF-DS-R03	TP port should be linked at 100M full duplex when working at this mode.
IP113C LF-DS-R04	Add the order information for lead free package.
IP113CLF-DS-R05	Revise the diagram.
IP113CLF-DS-R06	TP_FORCE (Pin24) & X_EN(Pin29) It is an input pin during reset period. The default value is latched at the end of reset.
IP113C LF-DS-R07	Remove internal pull-high resistance & pull-low resistance on page 5. Modify the IPL : pull-low and IPH : pull-high
IP113C LF-DS-R08	Add Power Pin description on Page10

Application Diagram

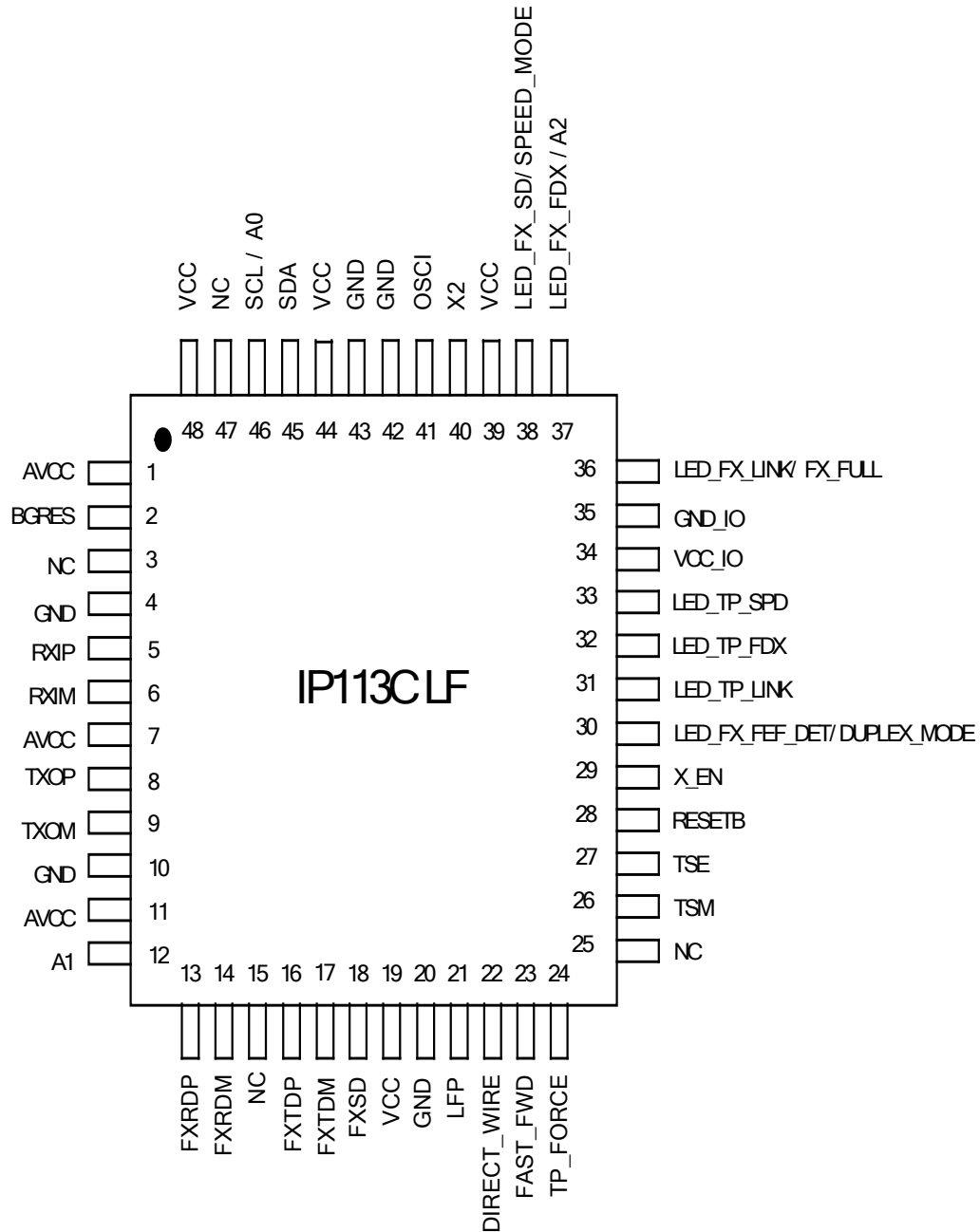


Applications

Un-managed converter



PIN Diagram





1. PIN Description

Type	Description
I	Input pin
O	Output pin
IPL	Input pin with internal pull-low resistor.
IPH	Input pin with internal pull-high resistor.

Pin no.	Label	Type	Description
Transceiver			
5, 6	RXIP, RXIM	I	TP receive
8, 9	TXOP, TXOM	O	TP transmit
2	BGRES	O	Band gap resistor It is connected to GND through a 6.19k (1%) resistor in application circuit.
18	FXSD	I	100Base-FX signal detect Fiber signal detect. It is an input signal from fiber MAU. Fiber signal detect is active if the voltage on FXSD is higher than the threshold voltage, which is $1.35\text{v} \pm 5\%$ when VCC is equal to 2.5v.
13, 14	FXRDP, FXRDM	I	Fiber receiver data pair Common-mode voltage of FXRDP and FXRDM are suggested to near $0.5 \times \text{AVCC}$. When voltage peak-to-peak $> 0.1\text{V}$, FXRX could be workable.
16, 17	FXTDP, FXTDM	O	Fiber transmitter data pair FXTX with the external 100Ω resistor. Common-mode voltage of FXTDP and FXTDM are suggested to near $0.5 \times \text{AVCC}$. Swing of Voltage $\geq 0.8\text{V}$.



1. PIN Description (continued)

Pin no.	Label	Type	Description
LED pins			
31	LED_TP_LINK	O	TP port link LED On: link ok, Off: link fail, Flash: link ok & activity (Flash: on for 20ms and off for 80ms)
33	LED_TP_SPD	O	TP port speed LED On: 100M, Off: 10M
32	LED_TP_FDX	O	TP port full duplex LED On: full, Off: half, Flash: half & collision happens (Flash: on for 20ms and off for 80ms)
36	LED_FX_LINK	O	Fiber port link LED On: link ok, Off: link fail, Flash: link ok & activity (Flash: on for 20ms and off for 80ms)
37	LED_FX_FDX	O	Fiber port full duplex LED On: full, Off: half, Flash: half & collision happens (Flash: on for 20ms and off for 80ms)
38	LED_FX_SD		Fiber port signal detect On: fiber signal detected, Off: fiber unplugged
30	LED_FX_FEF_DET	O	Far end fault pattern received For End Fault Patterns Receive LED On: 80ms, LED Off: 20ms For End Fault Pattern not Receive LED always Off

Note: The output of LED pin is logic low when the LED is on.

1. PIN Description (continued)

Pin no.	Label	Type	Description
MC operation mode			
29	X_EN	O/IPH	IEEE 802.3X enable on TP port and fiber port 1: enable (default), 0: disable It is an input pin during reset period. The default value is latched at the end of reset. After reset, it becomes an output pin for testing. It should be connected to GND through a 1k ohm resistor to set 0.
24	TP_FORCE	O/IPL	Local TP port auto negotiation enable 1: TP port supports auto-negotiation with limited capability defined in SPEED_MODE and DUPLEX_MODE. 0: TP port supports auto-negotiation with 10M/100M, full/half capability (default) The default value may be updated by either programming EEPROM register 3.5 or MII register 20.13. It is an input pin during reset period. The default value is latched at the end of reset. After reset, it becomes an output pin for testing. It should be connected to VCC through a 1k ohm resistor to set 1.
38	SPEED_MODE	IPH	Local TP port speed 1: TP port has the 100Mb speed ability 0: TP port has the 10Mb speed ability only It is valid only if TP_FORCE is enabled.
30	DUPLEX_MODE	IPH	Local TP port duplex 1: TP port has the Full duplex ability 0: TP port has the Half duplex ability only It is valid only if TP_FORCE is enabled.
36	FX_FULL	IPH	Set the duplex of fiber port 1: full duplex (default) 0: half duplex



1. PIN Description (continued)

Pin no.	Label	Type	Description
MC operation mode			



1. PIN Description (continued)

Pin no.	Label	Type	Description															
MC operation mode																		
21	LFP	IPL	Link fault pass through (LFP) 1: enable Link status of one port is forwarded to the other port. 0: disable (default)															
22, 23	DIRECT_WIRE, FAST_FWD	IPL	<table><tr><th>DIRECT_WIRE</th><th>FAST_FWD</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>Store and forward switch mode (default)</td></tr><tr><td>0</td><td>1</td><td>Modified cut-through switch mode</td></tr><tr><td>1</td><td>0</td><td>Converter mode</td></tr><tr><td>1</td><td>1</td><td>Converter mode with auto-change-forward function</td></tr></table>	DIRECT_WIRE	FAST_FWD	Function	0	0	Store and forward switch mode (default)	0	1	Modified cut-through switch mode	1	0	Converter mode	1	1	Converter mode with auto-change-forward function
			DIRECT_WIRE	FAST_FWD	Function													
			0	0	Store and forward switch mode (default)													
			0	1	Modified cut-through switch mode													
			1	0	Converter mode													
1	1	Converter mode with auto-change-forward function																
Store and forward switch mode: IP113C LF will begin to transmit a frame right after the completion of receiving a frame.																		
Modified cut-through switch mode: IP113C LF will begin to forward a frame after the first 64 bytes data received. TP port should be forced at 100M at this mode.																		
Converter mode: Incoming frames are not buffered in IP113C LF to achieve the min latency. Both TP port and fiber port of IP113C LF should work at 100M full duplex in this mode. If TP port is linked at half duplex, the total length of UTP cable and fiber should be less than 60 meters to meet the requirement of CSMACD in IEEE802.3.																		
Converter mode with auto-change-forward function: IP113C LF will change to forward mode if it detects the speed is different in TP port and FX port.																		
In converter mode, IP113C LF forwards IEEE802.3x pause frame directly. In the other modes, IP113C LF doesn't forward IEEE802.3x pause frame directly, it sends out pause frame when its internal buffer is full.																		



1. PIN Description (continued)

Pin no.	Label	Type	Description
EEPROM interface			
45, 46	SDA, SCL	IPH, O	EEPROM interface
37, 12, 46	A[2:0]	IPL	PHY address IP113C LF uses A[2:0] as EEPROM address to read EPROM.

Pin no.	Label	Type	Description
Misc.			
28	RESETB	I	Reset It is low active.
41, 40	OSCI, X2	I, O	Crystal pins OSCI and X2 are connected to a 25Mhz crystal. If a 25MHz oscillator is used, OSCI is connected to the oscillator's output and X2 should be left open.
26, 27	TSM, TSE	IPL	Scan pins These two pins should be left open or connected to ground for normal operation.

Pin no.	Label	Type	Description
Power			
1,7,11	AVCC		2.5V Analog Power
19,39,44	VCC		2.5V Digital Power
34	VCC_IO		3.3V or 2.5V Digital Power
35	GND_IO		I/O Ground
4,10,20,42,43	GND		Ground

2. Functional Description

Data forwarding

IP113C LF supports three types of data forwarding mode, store & forward mode, modified cut-through mode and pure converter mode. It can forward a frame despite of its address and CRC error. IP113C LF begins to forward the received data only after it receives the frame completely. The latency depends on the packet length.

Modified cut-through mode

IP113C LF begins to forward the received data when it receives the first 64 bytes of the frame. The latency is about 512 bits time width. The maximum packet length can be up to 1600 bytes in this mode. Please refer to the pin description of FAST_FWD for configuration information.

Pure converter mode

IP113C LF operates with the minimum latency in this mode. The transmission flow does not wait until entire frame is ready, but instead it forwards the received data immediately after the data being received. Both transceivers are interconnected via internal MII signals, therefore the internal switch engine and data buffer are not used. Both TP port and fiber port of IP113C LF should work at 100M full duplex in this mode. If TP port is linked at half duplex, the total length of UTP cable and fiber should be less than 60 meters to meet the requirement of CSMA/CD in IEEE802.3. The packet length is not limited at this mode. Please see pin description of DIRECT_WIRE for configuration information.

Fragment forwarding

IP113C LF forwards CRC error packets but it will filter fragments when it works in modified cut-through mode. IP113C LF forwards fragments if user turns on bit 3 of EEPROM register 2.



TP port force mode

The TP port of IP113C LF can work at auto mode or force mode. The following table shows all of the combination of its TP port.

		Link partner's capability							
		AN on				AN off			
{TP_FORCE, SPEED_MODE, DUPLEX_MODE}	IP113C LF's link result	100F	100H	10F	10H	100F	100H	10F	10H
	IP113C LF's capability								
011	100/10M, Full/Half, AN on	100F	100H	10F	10H	100H	100H	10H	10H
010	100/10M, Half, AN on	X	100H	X	10H	100H	100H	10H	10H
001	10M, Full/Half, AN on	X	X	10F	10H	100H	100H	10H	10H
000	10M, Half, AN on	X	X	X	10H	100H	100H	10H	10H
111	100M, Full, AN on	100F	X	X	X	100F	100F	X	X
110	100M, Half, AN on	X	100H	X	X	100H	100H	X	X
101	10M, Full, AN on	X	X	10F	X	X	X	10F	10F
100	10M, Half, AN on	X	X	X	10H	X	X	10H	10H

Note:

AN on: with auto-negotiation capability

AN off: without auto-negotiation capability

100F: 100M full duplex

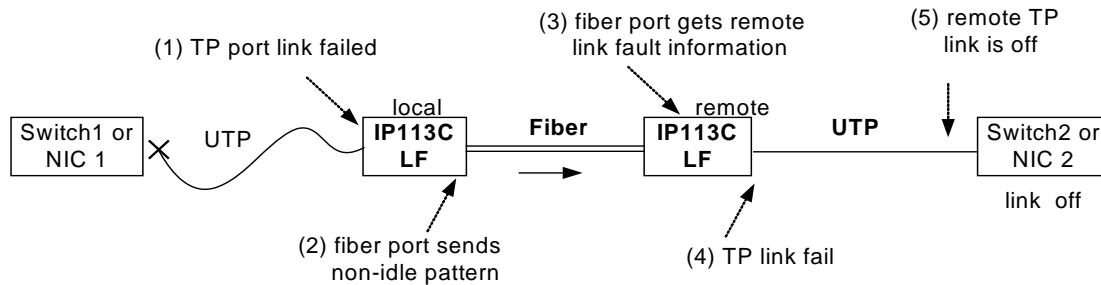
100H: 100M half duplex

10F: 10M full duplex

10H: 10M half duplex

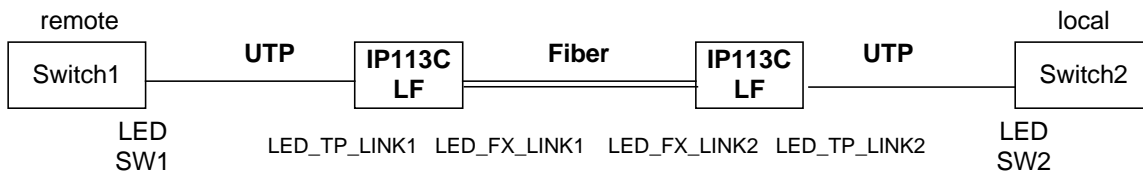
Link fault pass through

When link fault pass through function is enabled, link status on TX port will inform the FX port of the same device and vice versa. From the link fault pass through procedure illustrates in the figure below, if link fail happens on IP113C LF's TX port (1), the local FX port sends non-idle pattern to notice the remote FX port (2). The remote FX port then forces its TX port to link failed after receiving the non-idle pattern (4). In other words, this mechanism will alert the link fault status of local TX port to the remote converter's TX port, and the link status of the remote TX port will become off. Link status LED will also be off for both IP113C LF and its link partner.



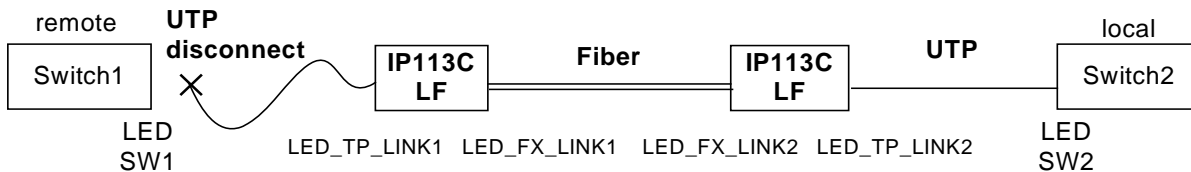
The procedure of link fault pass through

Normal case



Link LED on SW1	LED_TP_LINK1	LED_FX_LINK1	LED_FX_LINK2	LED_TP_LINK2	Link LED on SW2
ON	ON	ON	ON	ON	ON

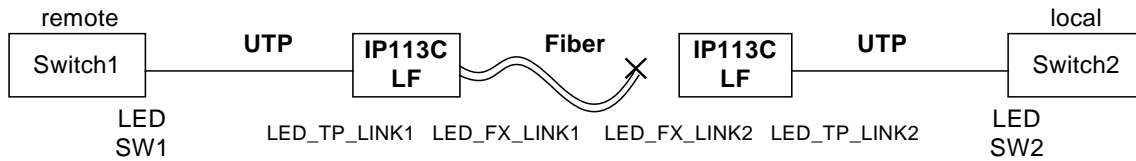
Remote TP port disconnected



Link LED on SW1	LED_TP_LINK1	LED_FX_LINK1	LED_FX_LINK2	LED_TP_LINK2	Link LED on SW2
Off	Off	Off	Off	Off	Off



FX port disconnected



Link LED on SW1	LED_TP_LINK1	LED_FX_LINK1	LED_FX_LINK2	LED_TP_LINK2	Link LED on SW2
Off	Off	Off	Off	Off	Off

LED diagnostic functions for fault indication

LED_TP_LINK	LED_FX_LINK	LED_FX_SD	LED_FX_FEF_DET	Status
On	On	On	Off	Link ok
Flash	Flash	On	Off	Link ok & activity
Off	Off	On	Off	Remote TP link off
Off	Off	Off	Off	Fiber RX off, Fiber TX/ RX off
Off	Off	On	Flash	Fiber TX off

Note

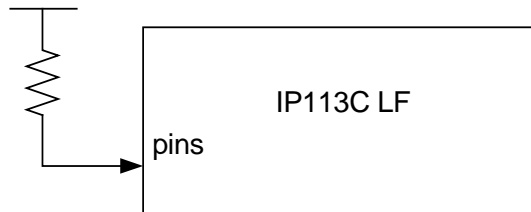
Flash: flash, period 100 ms

Link fault pass through is enabled.

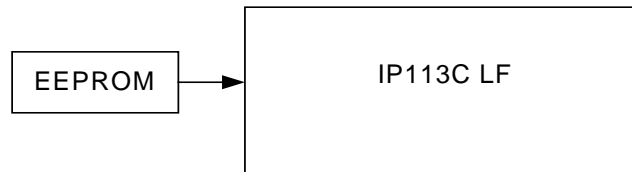
EEPROM – store the initial value

IP113C LF supports two ways to load initial value of MII registers. The procedure is illustrated as below.

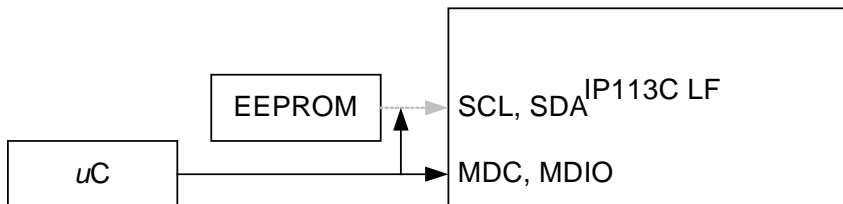
1. IP113C LF reads the default setting of MII register from pins



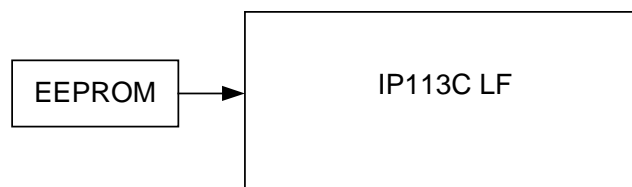
2. IP113C LF updates the default setting of MII by reading EEPROM. If there exists an EEPROM



3. After reading EEPROM, IP113C LF is virtually isolated from the EEPROM. Micro-controller can program both MII register and EEPROM.

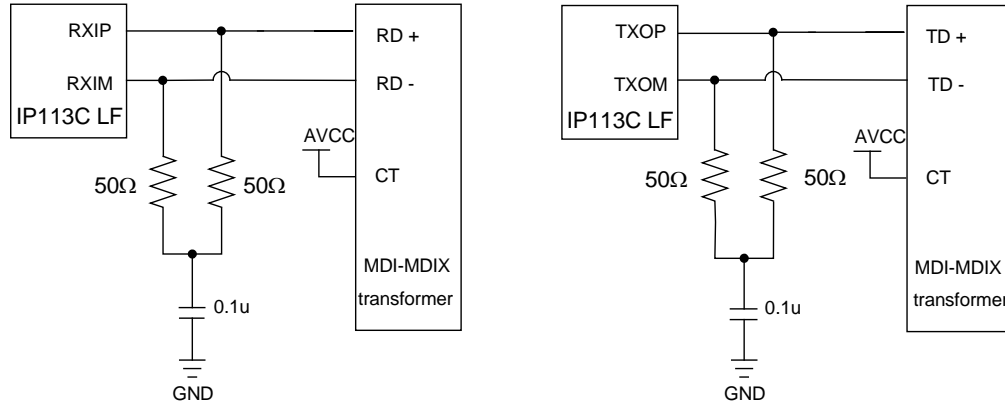


4. IP113C LF reloads the content of EEPROM to recover the value in MII registers programmed by Micro-controller after power on reset.



Auto MDI_MDIX

IP113C LF supports auto MDI-MDIX. It is always enabled. The following is its application circuit for auto MDI-MDIX.



IP113C LF's application circuit (auto MDI-MDIX on)



EEPROM registers

Type	Description
R/W	Read/Write
SC	Self-Clearing
RO	Read Only
Pin(1)	The default value is "1" and it depends on the setting of its corresponding pin.

Type	Description
RC	Read and Clear
LL	Latching Low
LH	Latching High
Pin(0)	The default value is "0" and it depends on the setting of its corresponding pin.

ROM	NAME	R/W	DESCRIPTION	DEFAULT
EEPROM enable register 0				
0[7:0]		--	EEPROM enable register 0 This register should be filled with 55. IP113C LF will examine the specified pattern to confirm if there is a valid EEPROM.	55h

ROM	NAME	R/W	DESCRIPTION	DEFAULT
EEPROM enable register 1				
1[7:0]		--	EEPROM enable register 1 This register should be filled with AA. IP113C LF will examine the specified pattern to confirm if there is a valid EEPROM. The initial setting is updated with the content of EEPROM only if the specified pattern 55AA is found.	AAh



EEPROM registers (continued)

ROM	NAME	R/W	DESCRIPTION	DEFAULT
Switch configuration register 1				
2.0	reserved	--	The default value must be adopted for normal operation.	0
2.1	direct_wire	--	Please see pin description of DIRECT_WIRE for more detail information.	Pin (0)
2.2	fast_fwd	--	Please see pin description of FAST_FWD for more detail information.	Pin (0)
2.3	mg_pass_fragment_en	--	Pass fragment packet (>7B and <64B) 1: pass fragment 0: not pass fragment	0
2.4	mg_col16_drop_en	--	Collision 16 times drop enable 1: drop 0: not drop	0
2.5	mg_col_backoff_en	--	Collision back-off enable 1: back after collision 0: not back off after collision	1
2.6	reserved	--	The default value must be adopted for normal operation.	0
2.7	p01_mg_backpress_en	--	TP port backpressure control enable for half duplex 1: backpressure enable 0: backpressure disable	1
3.0	reserved	--	The default value must be adopted for normal operation.	0
3.1	reserved	--	The default value must be adopted for normal operation.	0
3.2	reserved	--	The default value must be adopted for normal operation.	1
3.3	reserved	--	The default value must be adopted for normal operation.	1
3.4	mg_em_bist_en	--	SSRAM BIST enable (R/W by EEPROM only) 1: BIST enable 0: bypass BIST	1
3.5	tp_force	--	This pin overwrites the setting on pin 26 TP_FORCE.	Pin (0)
3.6	mg_receive_en	--	TP receive enable 1: TP port can receive packet 0: TP port drop all received packet	1
3.7	reserved	--	The default value must be adopted for normal operation.	0



ROM	NAME	R/W	DESCRIPTION	DEFAULT
Switch configuration register 2				
4[7:0]	p01_mg_port_page_no	--	TP port allocated memory pages The default is 120 pages with 64 bytes per page.	120d
5[7:0]	p02_mg_port_page_no	--	FX port allocated memory pages The default is 120 pages with 64 bytes per page.	120d

Note: p01_mg_port_page_no adds p02_mg_port_page_no must be equal to 240.



EEPROM registers (continued)

ROM	NAME	R/W	DESCRIPTION	DEFAULT
Local MC extended register				
6.0	reserved	--	The default value must be adopted for normal operation.	0
6.1	reserved	--	The default value must be adopted for normal operation.	0
6.2	p01_mg_auto_neg_en	--	TP port auto-negotiation enable 1: TP auto-negotiation enable 0: TP auto-negotiation disable	1
6.3	p01_mg_speed_mode	--	TP port speed selection 1: 100M, 0:10M	1
6.4	p01_mg_duplex_mode	--	TP port duplex mode selection 1: full duplex, 0:half duplex	1
6.5	p01_mg_flow_ctrl_en	--	TP port flow control selection 1: on, 0:off	1
6.6	reserved	--	The default value must be adopted for normal operation.	0
6.7	p02_mg_flow_ctrl_en	--	Fiber port flow control/backpressure enable 1: enable, 0: disable	Pin (1)
7.0	p02_mg_duplex_mode	--	Fiber port duplex mode (FX_FULLL) 1: full duplex, 0:half duplex	1
7.1	reserved	--	The default value must be adopted for normal operation.	1
7.2	reserved	--	The default value must be adopted for normal operation.	0
7[4:3]	p01_mg_throttle_conf	--	TP port input Rate Control 2'b00: full speed 2'b01: 1/4 speed 2'b10: 2/4 speed 2'b11: 3/4 speed	00
7[6:5]	p01_mg_throttle_conf	--	TP port output Rate Control 2'b00: full speed 2'b01: 1/4 speed 2'b10: 2/4 speed 2'b11: 3/4 speed	00
7.7	mg_link_pass_en	--	Link Fault Pass through enable (LFP) 1: enable, 0: disable	1

3. Signal Requirements

Absolute Maximum Rating

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. Functional performance and device reliability are not guaranteed under these conditions. All voltages are specified with respect to GND.

Supply Voltage	-0.3V to Vcc+0.3V
Input Voltage	-0.3V to Vcc+0.3V
Output Voltage	-0.3V to Vcc+0.3V
Storage Temperature	-55°C to 125°C
Ambient Operating Temperature (Ta)	0°C to 70°C

DC Characteristic

Operating Conditions

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Supply Voltage	VCC	2.375	2.5	2.625	V	
Power Consumption			0.475		W	VCC=2.5v

Input Clock

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Frequency			25		MHz	
Frequency Tolerance		-100		+100	PPM	

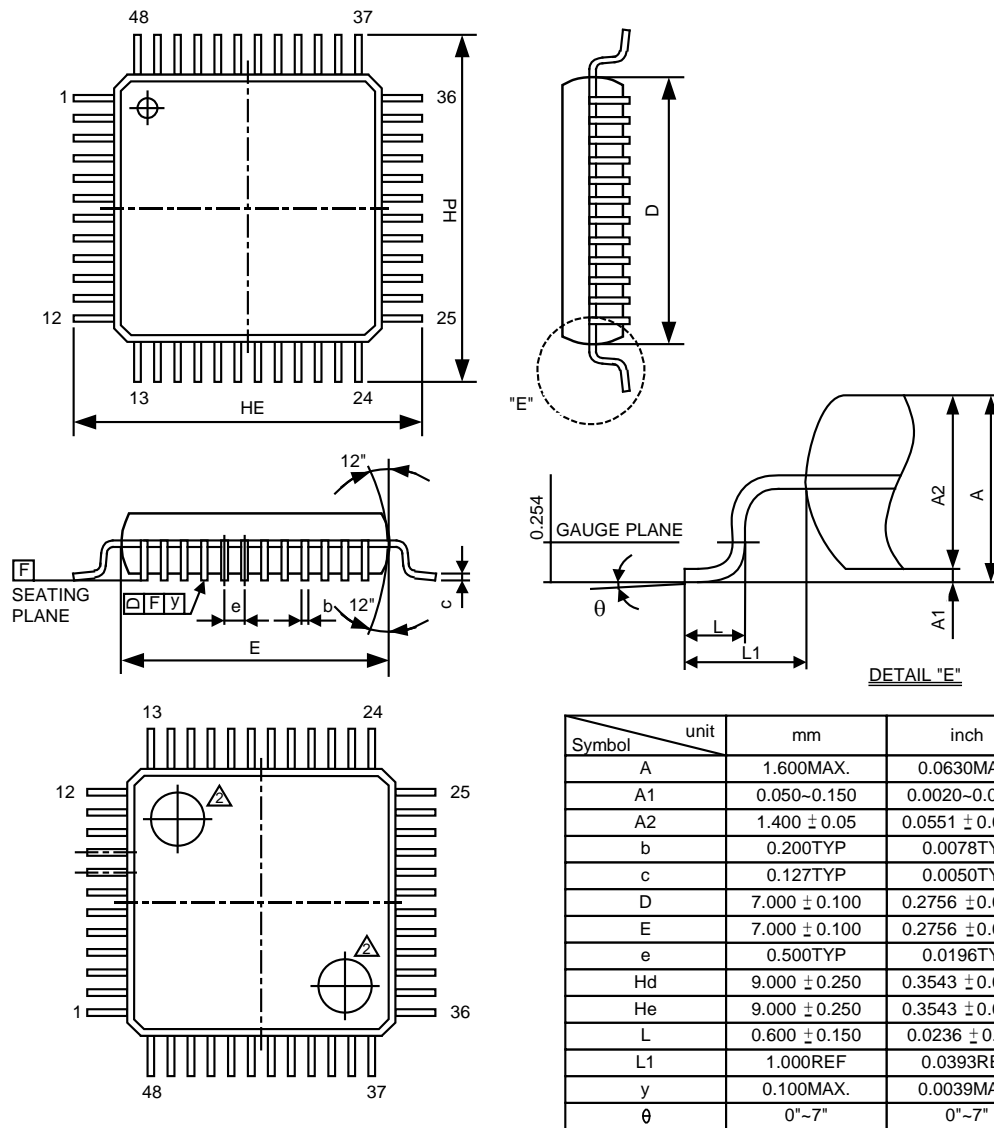
I/O Electrical Characteristics

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Input Low Voltage	VIL			0.8	V	
Input High Voltage	VIH	2.0			V	
Output Low Voltage	VOL			0.4	V	IOH=4mA
Output High Voltage	VOH	VCC_I O-0.4			V	IOL=4mA

4. Order Information

Part No.	Package	Notice
IP113C	48-PIN LQFP	-
IP113C LF	48-PIN LQFP	Lead free

5. Package Detail



Notes:

1. DIMENSION D & E DO NOT INCLUDE MOLD FLASH OR PROTRUSION.
 2. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION / INTRUSION.
 3. MAX. END FLASH IS 0.15MM.
 4. MAX. DAMBAR PROTRUSION IS 0.13MM.
- GENERAL APPEARANCE SPEC SHOULD BE BASED ON FINAL VISUAL INSPECTION SPEC.

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