100BASE-FX/1000BASE-X Spring-Latch SFP Transceiver

(For 550m/2km transmission with MCU version)

Members of Flexon™ Family

- Compatible with IEEE 802.3ah-2004
- Compatible with FCC 47 CFR Part 15, Class B
- Compatible with FDA 21 CFR 1040.10 and 1040.11, Class I
- Compatible with Telcordia GR-468-CORE
- RoHS compliance

Features

- Build-in PHY supporting SGMII Interface
- Build-in high performance MCU supporting easier configuration
- Dual data-rate of 100BASE-FX/1000BASE-LX operation
- 1310nm FP laser and PIN photo-detector
- 0.5m~2km transmission with MMF at 125Mbps
- 0.5m~550m transmission with MMF at 1.25Gbps
- Standard serial ID information Compatible with SFP MSA
- SFP MSA package with duplex LC connector
- With Spring-Latch for high density application
- Very low EMI and excellent ESD protection
- +3.3V single power supply
- Operating case temperature: -40 to +85°C

Applications

- Switch to Switch interface
- Switched backplane applications
- Router/Server interface
- Other optical transmission systems

Standard

- Compatible with SFP MSA
- Compatible with IEEE 802.3-2002

Description

Fiberxon FTM-3413C-SL05iCG SFP transceiver is high performance, cost effective modules. It is designed for 100BASE-FX/1000BASE-LX applications from 0.5m to 2km with MMF at 125Mbps,.from 0.5m to 550m transmission with MMF at 1.25Gbps.

The transceiver consists of two sections: The standard SFP part and the PHY part. FTM-3413C-SL05iCG is built with SGMII interface. It can operate as 100BASE-FX or 1000BASE-X by software configuration.

The optical output can be disabled by a TTL logic high-level input of Tx Disable. Tx Fault is provided to indicate that degradation of the laser. Loss of signal (LOS) output is provided to indicate the loss of an input optical signal of receiver.

The standard serial ID information Compatible with SFP MSA describes the transceiver's capabilities, standard interfaces, manufacturer and other information. The host equipment can access this information via the 2-wire serial CMOS EEPROM protocol. For further information, please refer to SFP Multi-Source Agreement (MSA).

Regulatory Compliance

The transceivers have been tested according to American and European product safety and electromagnetic compatibility regulations (See Table 1). For further information regarding regulatory certification, please refer to Flexon^{TM} regulatory specification and safety guidelines, or contact with Fiberxon, Inc. America sales office listed at the end of the documentation.

Table 1 - Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 1(>500 V)
Electrostatic Discharge (ESD) to the Duplex LC Receptacle	IEC 61000-4-2 GR-1089-CORE	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022 Class B (CISPR 22B) VCCI Class B	Compatible with standards
Immunity	IEC 61000-4-3	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class I laser product. TUV Certificate No. 50030043
Component Recognition	UL and CSA	UL file E223705
RoHS	2002/95/EC 4.1&4.2 2005/747/EC	Compliant with standards [note]

Note:
In light of item 5 in Annex of 2002/95/EC, "Pb in the glass of cathode ray tubes, electronic components and fluorescent tubes." and item 13 in Annex of 2005/747/EC , " Lead and cadmium in optical and filter glass." ,the two exemptions are being concerned for Fiberxon's transceivers, because Fiberxon's transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

Absolute Maximum Ratings

Stress in excess of the maximum absolute ratings can cause permanent damage to the module.

Table 2 - Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T_S	-40	+85	°C
Supply Voltage	V_{CC}	-0.5	3.6	V
Operating Relative Humidity	-	5	95	%

Recommended Operating Conditions

Table 3- Recommended Operating Conditions

Parameter		Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature		T_C	-40		+85	°C	
Power Supply Voltage		V_{CC}	3.10	3.30	3.50	V	
Power Supply Current		I_{CC}			350	mA	1
Date Rate	1000BASE-LX			1250		Mbps	
	100BASE-LX			125			

Note 1: TBD.

Optical and Electrical Characteristics

Table 4 - Optical and Electrical Characteristics

Parameter		Symbol	Min.	Typical	Max.	Unit	Notes
Transmitter							
Centre Wavelength		λ_C	1270	1310	1355	nm	
Average Output Power	1000BASE-LX	P_{0ut}	-11.5		-3	dBm	2
	100BASE-FX	P_{0ut}	-20		-14		2
P_{0ut}@TX Disable Asserted		P_{0ut}			-45	dBm	1
Spectral Width (RMS)	1000BASE-LX	σ			4	nm	
	100BASE-FX				7.7		
Extinction Ratio		EX	9			dB	
Rise/Fall Time (20%～80%)	1000BASE-LX	t_r/t_f			0.26	ns	3
	100BASE-FX				3		
Total Jitterat TP2		J_T			0.43	UI	4
Deterministic Jitter at TP2		J_D			0.20		4
Output Optical Eye		Compatible with IEEE 802.3ah-2004					5
Data Input Swing Differential (SGMII Series interface)		V_{IN}	500		1200	mV	6
Input Differential Impedance		Z_{IN}	80	100	120	Ω	
TX Disable	Disable		2.0		Vcc	V	
	Enable		Vee		Vee+0.8		
TX Fault	Fault		2.0		Vcc	V	
	Normal		Vee		Vee+0.5		
Receiver							
Centre Wavelength		λ_C	1260	1310	1570	nm	
Receiver Sensitivity	1000BASE-LX				-22	dBm	7
	100BASE-FX				-28		8
Receiver Overload	1000BASE-LX		-3			dBm	7
	100BASE-FX		-8				8
Return Loss			12			dB	
LOS De-Assert	1000BASE-LX	LOS_D			-23	dBm	

	100BASE-FX				-29		
LOS Assert	1000BASE-LX	LOS_A	-35			dBm	
	100BASE-FX		-45				
LOS Hysteresis			0.5		4.5	dB	
Total Jitter at TP4		J_T			0.749	UI	4
Deterministic Jitter at TP4		J_D			0.462		4
Data Output Swing Differential (SGMII Series Interface)		V_{OUT}	370		2000	mV	6
LOS	High		2.0		Vcc+0.3	V	
	Low		Vee		Vee+0.5		

Notes:

2. The optical power is launched into 62.5/125um MMF.
3. Unfiltered, measured with 8B/10B code for 1.25Gbps and 4B/5B code for 125Mbps
4. Measured at 1.25Gbps, meet the specified maximum output jitter requirements if the specified maximum input jitter is present.
5. Measured with 8B/10B code for 1.25Gbps.
6. PECL logic, internally AC coupled.
7. Measured with 8B/10B code for 1.25Gbps, worst-case extinction ratio, BER $\leqslant 1\times 10^{-12}$.
8. Measured with 4B/5B code for 125Mbps, worst-case extinction ratio, BER $\leqslant 1\times 10^{-10}$.

EEPROM Information

The SFP MSA defines a 256-byte memory map in EEPROM describing the transceiver's capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2-wire serial interface at the 8-bit address 1010000X (A0h). For the memory contents, please refer to Table 5.

Table 5 - EEPROM Serial ID Memory Contents (A0h)

Addr.	Field Size (Bytes)	Name of Field	Hex	Description
0	1	Identifier	03	SFP
1	1	Ext. Identifier	04	MOD4
2	1	Connector	07	LC
3—10	8	Transceiver	00 00 00 22 00 00 00 00	Transmitter Code
11	1	Encoding	01	8B10B
12	1	BR, nominal	0D	1.25Gbps
13	1	Reserved	00	
14	1	Length (9um)-km	00	
15	1	Length (9um)	00	
16	1	Length (50um)	37	550m
17	1	Length (62.5um)	37	550m
18	1	Length (copper)	00	
19	1	Reserved	00	
20—35	16	Vendor name	46 49 42 45 52 58 4F 4E 20 49 4E 43 2E 20 20 20	"FIBERXON INC. "(ASCⅡ)
36	1	Reserved	00	
37—39	3	Vendor OUI	00 00 00	
40—55	16	Vendor PN	33 34 31 33 43 2D 53 4C 30 35 69 43 47 20 20 20	"FTM-3413C-SL05iCG" (ASCⅡ)
56—59	4	Vendor rev	xx xx xx xx	ASCⅡ("31 30 20 20" means 1.0 revision)
60—61	2	Wavelength	05 1E	1310nm
62	1	Reserved	00	
63	1	CC BASE	xx	Check sum of bytes 0 - 62
64—65	2	Options	00 1A	LOS, TX_FAULT and TX_DISABLE
66	1	BR, max	00	
67	1	BR, min	00	
68—83	16	Vendor SN	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	ASCⅡ
84—91	8	Vendor date code	xx xx xx xx xx xx 20 20	Year(2 bytes), Month(2 bytes), Day (2 bytes)
92—94	3	Reserved	00 00 00	
95	1	CC_EXT	xx	Check sum of bytes 64 - 94
96—154	58	Vendor specific		
155	1	Reserved		Read only
156-247		Vendor specific		
248	1	Status		Read only

249	1	CFG0		Work mode configuration
250	1	CFG1		Work mode configuration
251	1	CFG2		Work mode configuration
252	1	Status		Module status indication
253	1	Reserved		Read only
254	1	PSWH		Password entry
255	1	PSWL		Password entry

Note: The “xx” byte should be filled in according to practical case. For more information, please refer to the related document of SFP Multi-Source Agreement (MSA) and application note.

Easier Configuration

Designing-in a high performance MCU in FTM-3413C-SL05iCG, host can configure Fiberxon’s SGMII series product easily.

For FTM-3413C-SL05iCG, host only need access few registers of A0H via I2C to configure SGMII series module, such as speed-selection, Auto-negotiation, LOS/Link detection, TX disable, FEFI/RFI and CRC counter function support. Host can get inner status via access specific register of FTM-3413C-SL05iCG.

The operation data rate can be configured via hardware pin and I2C bus independently.

For more detailed information, please refer to application note of FTM-3413C-SL05iCG.

Recommended Host Board Power Supply Circuit

Figure 1 shows the recommended host board power supply circuit.

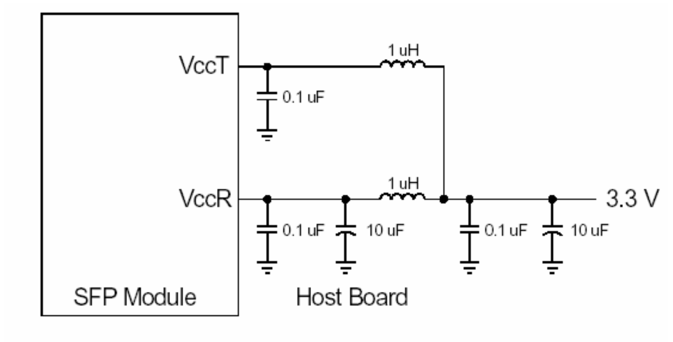

Figure 1, Recommended Host Board Power Supply Circuit

Recommended Interface Circuit

Figure 2 shows the recommended interface circuit.

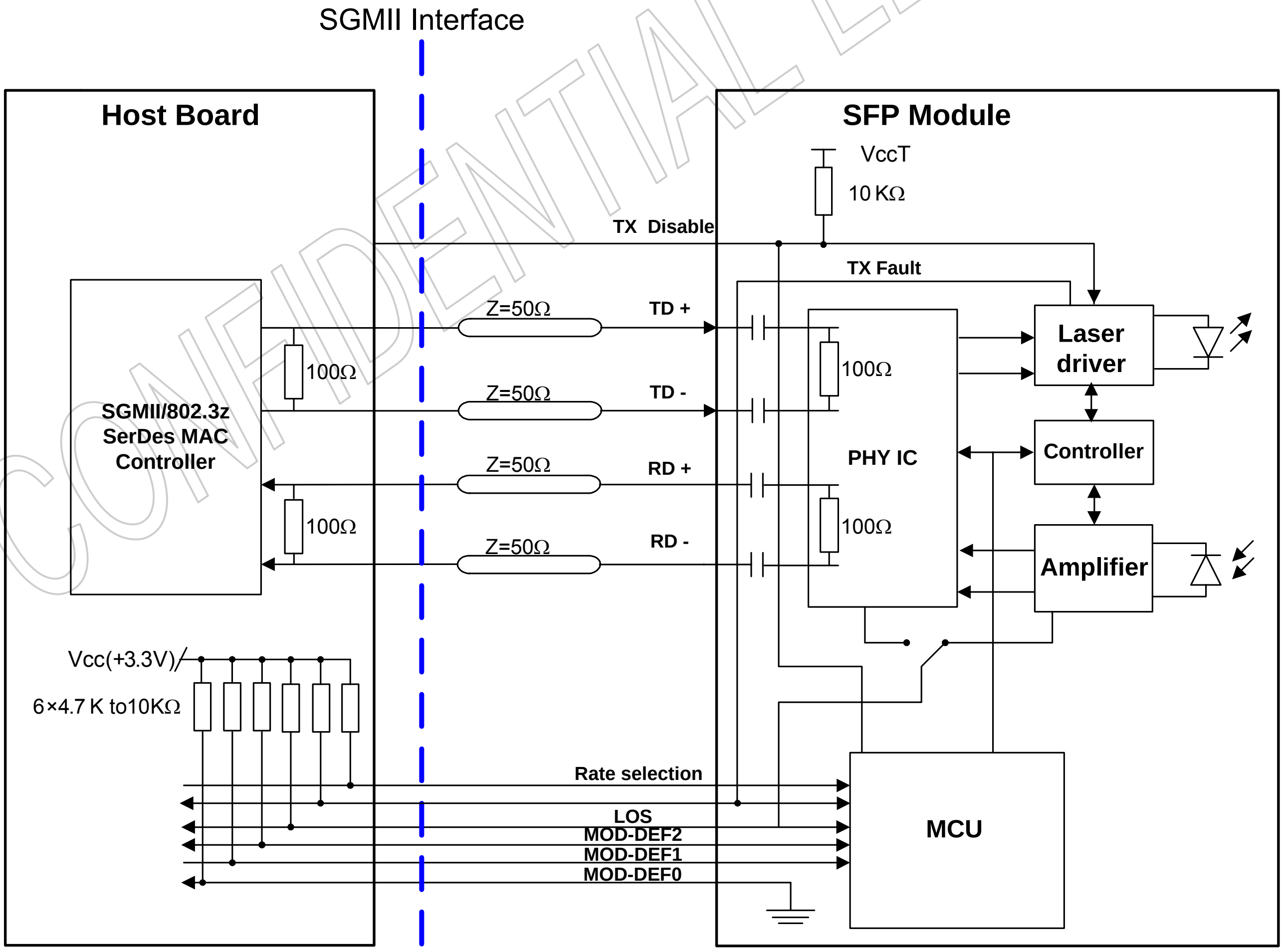

Figure 2, Recommended Interface Circuit

Pin Definitions

Figure 3 below shows the pin numbering of SFP electrical interface. The pin functions are described in Table 6 with some accompanying notes.

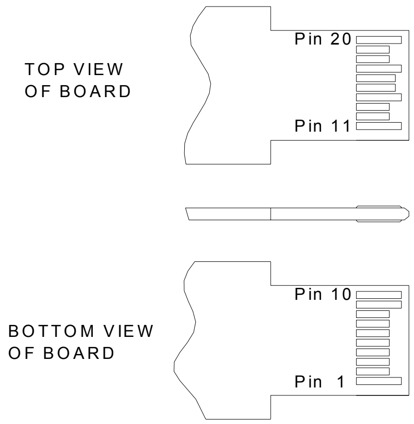

Figure 3, Pin View

Table 6– Pin Function Definitions

Pin No.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	
2	TX Fault	Transmitter Fault Indication	3	Note 1
3	TX Disable	Transmitter Disable	3	Note 2
4	MOD-DEF2	Module Definition 2	3	Note 3
5	MOD-DEF1	Module Definition 1	3	Note 3
6	MOD-DEF0	Module Definition 0	3	Note 3
7	Rate Select	Not Connected	3	
8	LOS	Loss of Signal	3	Note 4
9	VeeR	Receiver Ground	1	
10	VeeR	Receiver Ground	1	
11	VeeR	Receiver Ground	1	
12	RD-	Inv. Received Data Out	3	Note 5
13	RD+	Received Data Out	3	Note 5
14	VeeR	Receiver Ground	1	
15	VccR	Receiver Power	2	
16	VccT	Transmitter Power	2	
17	VeeT	Transmitter Ground	1	
18	TD+	Transmit Data In	3	Note 6
19	TD-	Inv. Transmit Data In	3	Note 6
20	VeeT	Transmitter Ground	1	

Notes:

1. TX Fault is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; logic 1 indicates a

laser fault of some kind. In the low state, the output will be pulled to less than 0.8V.

2. TX Disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7k~10kΩ resistor. Its states are:

Low (0~0.8V):	Transmitter on
(>0.8V, <2.0V):	Undefined
High (2.0~3.465V):	Transmitter Disabled
Open:	Transmitter Disabled

3. MOD-DEF 0,1,2 are the module definition pins. They should be pulled up with a 4.7k~10kΩ resistor on the host board. The pull-up voltage shall be VccT or VccR.
   MOD-DEF 0 is grounded by the module to indicate that the module is present
   MOD-DEF 1 is the clock line of two wire serial interface for serial ID
   MOD-DEF 2 is the data line of two wire serial interface for serial ID
4. LOS is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; logic 1 indicates loss of signal. In the low state, the output will be pulled to less than 0.8V.
5. These are the differential receiver output. They are internally AC-coupled 100Ω differential lines which should be terminated with 100Ω (differential) at host with SGMII interface.
6. These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module.

SGMII Interface

SGMII uses two data signals and two clock signals to convey frame data and link rate information between a 100/1000 PHY and an Ethernet MAC. The data signals operate at 1.25 Gbaud and the clocks operate at 625 MHz (a DDR interface). Due to the speed of operation, each of these signals is realized as a differential pair thus providing signal integrity while minimizing system noise.
However, specific implementations may desire to recover clock from the data rather than use the supplied clock, such as in our transceiver design. This operation is allowed.
Clearly, SGMII's 1.25 Gbaud transfer rate is excessive for interfaces operating at 100 Mbps. When these situations occur, the interface "elongates" the frame by replicating each frame byte 10 times for 100 Mbps. This frame elongation takes place "above" the 802.3z PCS layer, thus the start frame delimiter only appears once per frame.The 802.3z PCS layer may remove the first byte of the "elongated" frame.
For further information about how to use transceivers with SGMII interface, please refer to the application note

Mechanical Design Diagram

The mechanical design diagram is shown in Figure 4.

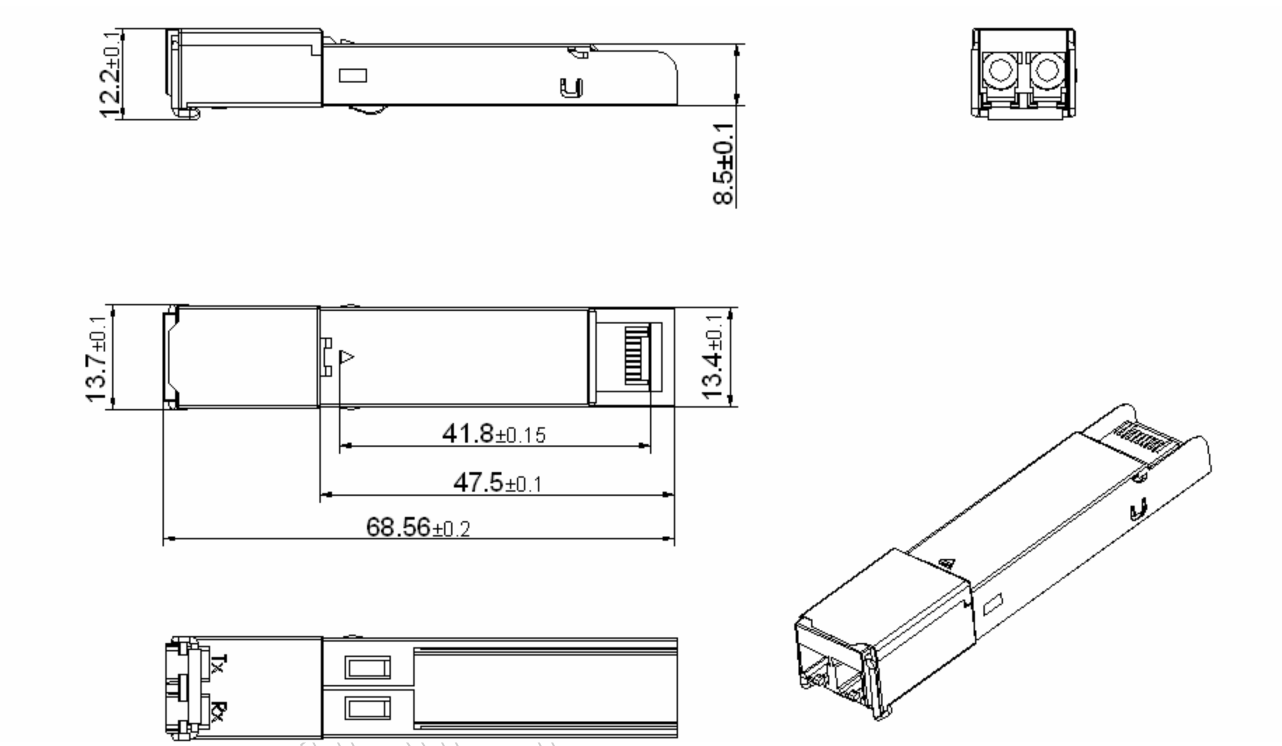

Figure 4, Mechanical Design Diagram of the SFP with Spring- Latch

Ordering information

FTM – 3 4 1 3 C – SL 05 i C G

Medium
3 : 1310nm

Function
4 : PHY

Data rate
13 : 125/1250 Mbps

Receptacle
C : LC

Package
SL: SFP with Spring-Latch

Distance
05 : 550m

Temperature
i: industrial

MCU
C: MCU version

Others
G : RoHS compliance

Product part Number	Media	Data Rate(Mbps)	Transmission Distance(km)	Temperature
FTM-3413C-SL05iCG	Multi-Mode Fiber	125/1250	0.5	-40~+85°C

Related SGMII SFP Products

Product part Number	Media	Data Rate(Mbps)	Transmission Distance	Note	Temperature
FTM-C012R-LCG	Cat. 5 Copper	10/100/1000	100m		0~+70°C
FTM-3401C-SL2CG	MMF	125	2km	MCU version	0~+70°C
FTM-3401C-SL10CG	SMF	125	10km	MCU version	0~+70°C
FTM-3413C-SLCG	SMF	125/1250	10km	MCU version	0~+70°C
FTM-3413C-SL05CG	MMF	125/1250	550m	MCU version	0~+70°C
FTM-3401C-SL2iCG	MMF	125	2km	MCU version	-40~+85°C
FTM-3401C-SL10iCG	SMF	125	10KM	MCU version	-40~+85°C
FTM-3413C-SLiCG	SMF	125/1250	10Km	MCU version	-40~+85°C

Related Documents

For further information, please refer to the following documents:

- *Fiberxon Spring-Latch SFP Installation Guide*
- *Fiberxon SFP Application Notes*
- *SFP Multi-Source Agreement (MSA)*

Obtaining Document

You can visit our website:

http://www.fiberxon.com
Or contact with Fiberxon, Inc. America Sales Office listed at the end of documentation to get the latest documents.

Revision History

Revision	Initiate	Review	Approve	Subject	Release Date
Rev. 1a	Henry.Xiao	Tripper.Huang	Walker.Wei	Initial datasheet	Feb. 05, 2007

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