100Gbps QSFP28 IR4 Parallel Single Mode Optical Transceiver Module OPCW-S02-13-CBS datasheet

Features

- QSFP28 MSA compliant
- Compliant to IEEE 802.3bm 100GBASE PSM4
- Four independent full-duplex channels
- Supports 103.1Gb/s aggregate bit rate
- Up to 2km reach for G.652 SMF
- 4x25G electrical interface (OIF CEI-28G-VSR)
- Maximum power consumption 3.5W
- Single +3.3V power supply
- Operating case temperature: 0 to 70℃
- RoHS-6 compliant

Applications

- 100G Ethernet links
- Infiniband QDR and DDR interconnects
- Datacenter and Enterprise networking

Absolute Maximum Ratings

Parameter	*Symbol*	*Min.*	*Max.*	*Units*	*Note*
Storage Temperature	Ts	-40	85	℃	
Operating Case Temperature	T_{op}	0	70	℃	
Supply Voltage	V_{cc}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	
Damage Threshold, each Lane	TH_d	3.0		dBm	

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Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Case Temperature	T_{op}	0		70	℃
Power Supply Voltage	Vcc	3.135	3.3	3.465	V
Data Rate, each Lane			25.78125		Gb/s
Data Rate Accuracy		-100		100	ppm
Control Input Voltage High		2		Vcc	V
Control Input Voltage Low		0		0.8	V
Link Distance with G.652	D	0.002		2	km

Diagnostics Monitoring

Parameter	Symbol	Accuracy	Unit	Notes
Temperature monitor absolute error	DMI_Temp	± 3	°C	Over operating temperature range
Supply voltage monitor absolute error	DMI_VCC	± 0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	± 2	dB	1
Channel Bias current monitor	DMI_Ibias_Ch	± 10%	mA	
Channel TX power monitor absolute error	DMI_TX_Ch	± 2	dB	1

Notes:

1. Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

Transmitter Electro-optical Characteristics (each Lane)

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				3.5	W	
Supply Current	Icc			1.06	A	
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (Vcm)	TP1	-350		2850	mV	1
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz
Differential Return Loss (SDD11)	TP1			See CEI- 28G-VSR Equation 13-19	dB	
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)	TP1			See CEI- 28G-VSR Equation 13-20	dB	
Stressed Input Test	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
Center Wavelength	λ_C	1295	1310	1325	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Total Average Launch Power	P_T			8	dBm	
Average Launch Power, each Lane	P_{AVG}	-5.5		2	dBm	
Optical Modulation Amplitude (OMA), each Lane	P_{OMA}	-3.5		2.2	dBm	2
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane		-4.3			dBm	
TDP, each Lane	TDP			2.9	dB	
Extinction Ratio	ER	3.5			dB	
Optical Return Loss Tolerance	TOL			20	dB	
Transmitter Reflectance	R_T			-12	dB	
Average Launch Power OFF Transmitter, each Lane	Poff			-30	dBm	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}		{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}				

Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. 1. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.

Receiver Electro-optical Characteristics (each Lane)

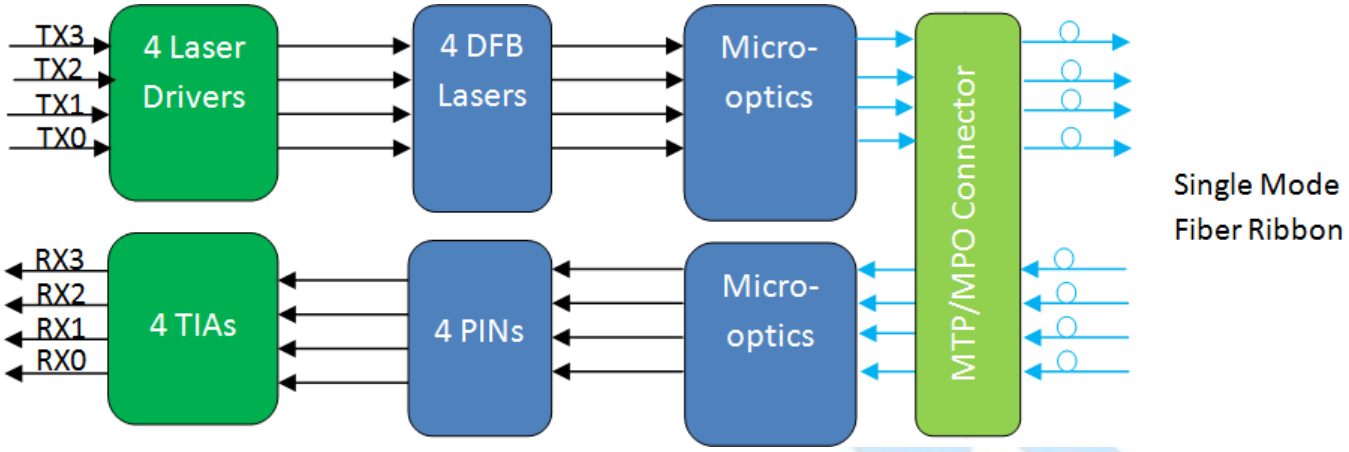
Parameter	Test Point	Min	Typical	Max	Units	Notes
Differential Voltage, pk-pk	TP4			900	mV	
Common Mode Voltage (Vcm)	TP4	-350		2850	mV	1
Common Mode Noise, RMS	TP4			17.5	mV	
Differential Termination Resistance Mismatch	TP4			10	%	At 1MHz
Differential Return Loss (SDD22)	TP4			See CEI- 28G-VSR Equation 13-19	dB	
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22)	TP4			See CEI- 28G-VSR Equation 13-21	dB	
Common Mode Return Loss (SCC22)	TP4			-2	dB	2
Transition Time, 20 to 80%	TP4	9.5			ps	
Vertical Eye Closure (VEC)	TP4			5.5	dB	
Eye Width at 10^{-15} probability (EW15)	TP4	0.57			UI	
Eye Height at 10^{-15} probability (EH15)	TP4	228			mV	
Center Wavelength	λ_C	1295	1310	1325	nm	
Damage Threshold, each Lane	TH_d	3			dBm	3
Average Receive Power, each Lane		-10.2		2	dBm	
Receive Power (OMA), each Lane				2.2	dBm	
Receiver Sensitivity (OMA), each Lane	SEN1			-9	dBm	for BER = $1x10^{-12}$
Stressed Receiver Sensitivity (OMA), each Lane				-6.44	dBm	for BER = $1x10^{-12}$
Receiver Sensitivity (OMA), each Lane	SEN2			-11.35	dBm	for BER = $5x10^{-5}$
Stressed Receiver Sensitivity (OMA), each Lane				-8.79	dBm	for BER = $5x10^{-5}$
Receiver Reflectance	R_R			-26	dB	
LOS Assert	LOSA	-30			dBm	
LOS Deassert	LOSD			-15	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Receiver Electrical 3 dB upper Cutoff Frequency, each Lane	Fc			31	GHz	

Conditions of Stress Receiver Sensitivity Test (Note 4)		
Vertical Eye Closure Penalty, each Lane	1.9	dB
Stressed Eye J2 Jitter, each Lane	0.27	UI
Stressed Eye J4 Jitter, each Lane	0.39	UI
Stressed Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}	{0.24, 0.5, 0.5, 0.24, 0.24, 0.4}	

Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.
3. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
4. Vertical eye closure penalty, stressed eye J2 jitter, stressed eye J4 jitter, and stressed receiver eye mask definition are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Block Diagram of Transceiver



This product is a parallel 100Gb/s Quad Small Form-factor Pluggable (QSFP28) optical module. It provides increased port density and total system cost savings. The QSFP28 full- duplex optical module offers 4 independent transmit and receive channels, each capable of 25Gb/s operation for an aggregate data rate of 100Gb/s on 2km of single mode fiber.

An optical fiber ribbon cable with an MTP/MPO connector can be plugged into the QSFP28 module receptacle. Proper alignment is ensured by the guide pins inside the receptacle. The cable usually cannot be twisted for proper channel to channel alignment. Electrical connection is achieved through an MSA-compliant 38-pin edge type connector.

The module operates with single +3.3V power supply. LVCMOS/LVTTL global control signals, such as Module Present, Reset, Interrupt and Low Power Mode, are available with the modules. A 2-wire serial interface is available to send and receive more complex control signals, and to receive digital diagnostic information. Individual channels can be addressed and unused channels can be shut down for maximum design flexibility.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module can be managed through the I2C two-wire serial interface.

This product is a QSFP28 parallel single mode optical transceiver with an MTP/MPO fiber ribbon connector. The transmitter module accepts electrical input signals compatible with Common Mode Logic (CML) levels. All input data signals are differential and internally terminated. The receiver module converts parallel optical input signals via a photo detector array into parallel electrical output signals. The receiver module outputs electrical signals are also voltage compatible with Common Mode Logic (CML) levels. All data signals are differential and support a data rates up to 25Gb/s per channel. Figure 1 shows the functional block diagram of this product.

A single +3.3V power supply is required to power up the module. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. Per MSA the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL. Module Select (ModSelL) is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP28 modules on a single 2-wire interface bus – individual ModSelL lines for each QSFP28 module must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP28 memory map.

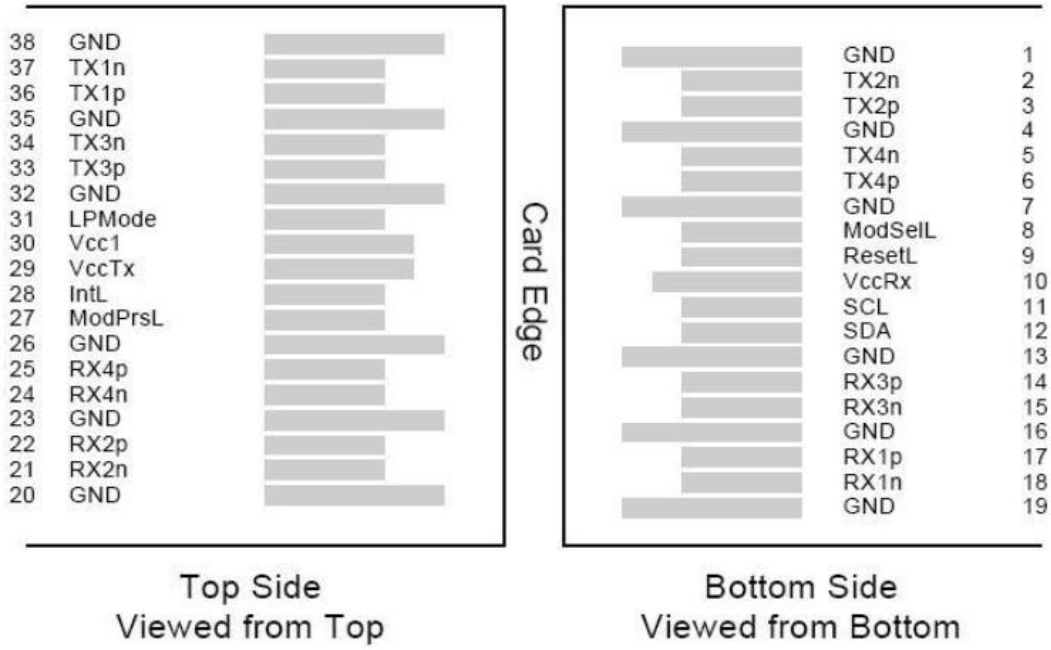
The ResetL pin enables a complete module reset, returning module settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the module in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a module, is normally pulled up to the host Vcc. When a module is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates a module is present by setting ModPrsL to a “Low” state.

Interrupt (IntL) is an output pin. Low indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

Pin Assignment



MSA compliant Connector

Pin Description

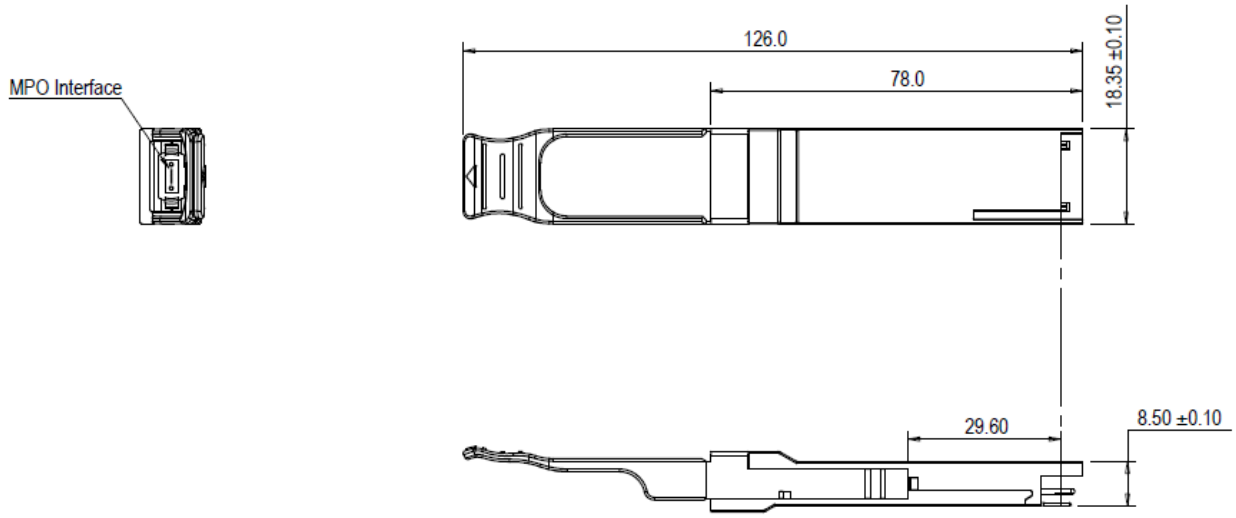
PIN	Logic	Symbol	Name/Description	Note
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTLL-I	ModSelL	Module Select	
9	LVTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVCMOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVCMOS-I/O	SDA	2-Wire Serial Interface Data	
13		GNC	Ground	
14	CML-O	Rx3p	Receiver Non-Inverted Data output	
15	CML-O	Rx3n	Receiver Inverted Data output	
16		GND	Ground	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	

PIN	Logic	Symbol	Name/Description	Note
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data output	
22	CML-O	Rx2p	Receiver Non-Inverted Data output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3V Power Supply transmitter	2
30		Vcc1	+3.3V Power Supply	2
31	LVTTL-I	LPMode	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	Tx1n	Transmitter Inverted Data Output	
38		GND	Ground	1

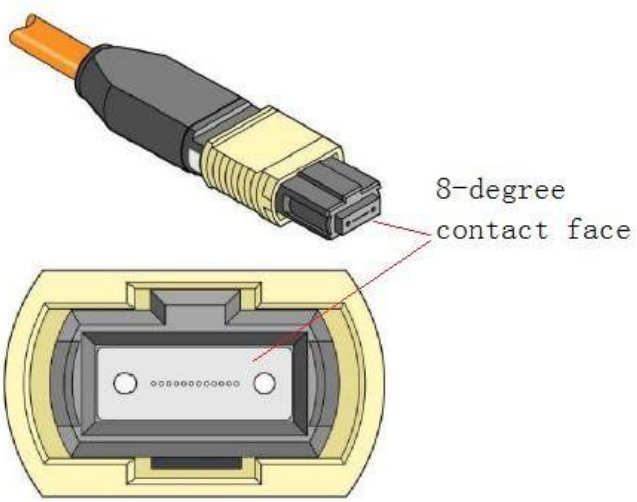
Notes:

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and VccTx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

Dimensions

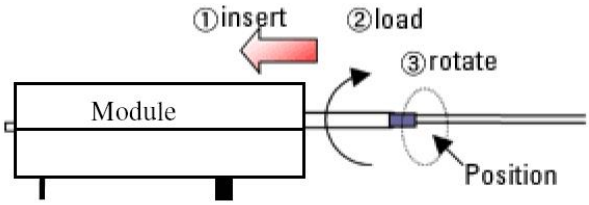


Attention: To minimize MPO connection induced reflections, an MPO receptacle with 8- degree angled end-face is utilized for this product. A female MPO connector with 8-degree end-face should be used with this product as illustrated in below figure.



Optical Receptacle Cleaning Recommendations :

All fiber stubs inside the receptacle portions were cleaned before shipment. In the event of contamination of the optical ports, the recommended cleaning process is the use of forced nitrogen. If contamination is thought to have remained, the optical ports can be cleaned using a NTT international Cletop® stick type and HFE7100 cleaning fluid. Before the mating of patch-cord, the fiber end should be cleaned up by using Cletop® cleaning cassette.

Cleaning of patch-cord	Cleaning of fiber stub
	 1. Insert Ensure that stick is held straight when inserting into sleeve. 2. Load Apply sufficient pressure (approx 600-700g) to ensure ferrule a little depressed in sleeve. 3. Rotate Rotate stick clockwise 4-5 times, while ensuring direct contact with ferrule end-face is maintained. *Notice: Number of possible wipes: Maintenance (repair) ~1 use / piece Equipment construction: 4 uses / piece (max.)*

Note: The pictures were extracted from NTT-ME website. And the Cletop® is a trademark registered by NTT-ME

Ordering Information

OP C W - S 02 - 13 - C B S

Product Code:
5=GBIC;
6=SFP-LC;
7=XFP;
8=XENPAK;
9=X2;
A=SFP+ (SFP28);
C=QSFP+ (QSFP28);
F=CFP;
G=CFP2;
H=CFP4;
P=SFP-SC;
Q=SFP-MTRJ

Data Rate:
A=155Mb/s;
B=622Mb/s;
C=1.25Gb/s;
D=2.125Gb/s;
E=2.5Gb/s;
F=4.25Gb/s;
G=3.1Gb/s;
J=2.97G
P=6.144G:
Q=7.37G;
H=8.5Gb/s;
K=10Gb/s;
T=1/10Gb/s
L=16Gb/s;
R=20Gb/s;
X=25Gb/s;
S=40Gb/s;
W=100Gb/s (4x25G or 10x10G);
M=100Base-X SGMII;
N=100/1000Base-X SGMII;

Type:
S=Single-mode;
M=Multi-mode;
W=BWDM;
B=DUAL-BWDM;
C=CWDM;
D=DWDM;
T=Copper-T (RJ-45)
E=GEPON ONU;
F=GEPON OLT;
G=GPON ONU;
H=GPON OLT
X=MMF/SMF

Reach:
Normal:
X1=Under 150m;
X2=220m;
X3=300m;
X5=550m;
02=2km,
10=10km;
70=70km;
A0=100km;
C0=120km

CWDM:
20=20dB;
24=24dB;
28=28dB

Wavelength:
Normal:
85=850nm;
13=1310nm;
15=1550nm;
00=Copper T (RJ-45)

CWDM:
27=1270nm;
47=1470nm;
61=1610nm

BWDM:
B3=Tx1310/Rx1550; B5=Tx1550/Rx1310;
B4=Tx1310/Rx1490; B9=Tx1490/Rx1310;
51=Tx1510/Rx1570; 57=Tx1570/Rx1510;
27=Tx1270/Rx1330; 33=Tx1330/Rx1270;
B2=Tx1270/Rx1577; B7=Tx1577/Rx1270
T2=2TX1310nm; T3=TX1310nm;
T5=TX1550nm

DWDM:
17=Channel 17
34= Channel 34
00=Channel 17~61 Tunable

Operating Temperature:
C=Commercial Purpose
(0~70℃);
I= Industrial Purpose
(Extended Range)

For Optech Internal Ref.

Model Number	*Part Number*	*Voltage*	*Temperature*
QSFP28-IR4-PSM	OPCW-S02-13-CBS	3.3V	0°C to 70 °C

Note: All information contained in this document is subject to change without notice.