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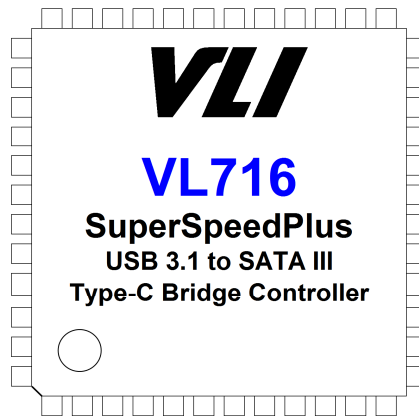
## Data Sheet

VL716  
USB3.1 to SATA 6Gb/s  
Bridge Controller for Type-C

Jan. 28, 2015  
Revision 0.50

CONFIDENTIAL

VL716



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## Revision History

Rev	Date	Initial	Note
0.5	01/28/2015	HC	Preliminary release

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## Product Features

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### VL716

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#### USB3.1 to SATA 6Gb/s Bridge Controller for Type-C Connector

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- **SuperSpeedPlus USB (10Gb/s) and High-Speed USB (480Mb/s)**
  - Compliant to Universal Serial Bus 3.1 Specification Revision 1.0
  - Compliant to Universal Serial Bus Specification Revision 2.0
  - Mass Storage Class Bulk-Only Transport (BOT)
  - USB Attached SCSI Protocol (UASP) for streaming
  - Integrated in-house SuperSpeedPlus PHY and USB2.0 PHY
- **Serial ATA 6Gb/s, 3Gb/s and 1.5Gb/s**
  - Compliant to Serial ATA Specification Revision 3.1
  - Integrated in-house SATA 6Gb/s PHY
  - RBC command conversion for ATA device
  - MMC-2 command pass-through to ATAPI
  - Support 48-bit LBA
  - Support multiple LUN
- **Fast 8051 Macro cell 80C32-Compatible Microcontroller**
  - Standard 1T 8051 instruction set
- **USB Type-C connector support**
  - CC1/CC2 cable orientation detection logic
  - Two sets of SuperSpeed USB signal pins to enable plug flipping feature
- **Built-in Voltage Regulators**
  - 5.0V to 3.3V LDO
  - 5.0V to 1.2V switching DC-DC
- **GPIOs for Special Function Usage**
  - 6 GPIOs for customer special usage
  - 2 dedicated BUSY/POWER LED indicators
- **Misc**
  - Support device power down function
  - Support external SPI flash for firmware upgrade
- **Software**
  - Support Microsoft Windows 8, Windows 7, Vista, XP
  - Support Mac OS 10.X
  - Support various Linux kernels
- **Physical**
  - QFN 48L green package (6x6x0.85 mm)
- **Certification**
  - USB-IF SuperSpeedPlus Certified: TBD

## VL716 System Overview

VIA Lab's VL716 is a high performance, low power single chip USB 3.1 to SATA 6Gb/s bridge controller with USB type-C connector support designed for new generation external storage devices that connecting Hard Disk Drive (HDD), Solid-State Drive (SSD), and Optical Disc Drive (ODD). Its integrated in-house USB 3.1 PHY enables VL716 to run in USB SuperSpeedPlus, Super-Speed, High-Speed, and Full-Speed modes. Supporting USB mass storage class Bulk-Only Transport (BOT), VL716 based devices can work on Windows 8, Windows 7, Vista, XP, Mac OS X and various Linux kernels without additional driver. Besides Bulk-Only Transport, VL716 also support USB Attached SCSI Protocol (UASP) that allowing mass storage command queuing and out of order data transfers to further enhance read/write performance. Its integrated in-house SATA 6Gb/s host controller can work with all SATA based storage devices and can connect at SATA 6Gb/s, SATA 3Gb/s, or SATA 1.5Gb/s automatically. Built-in CC1/CC2 cable orientation detection circuits and two sets of SuperSpeed USB signal pins can support USB type-C receptacle natively to enable plug flipping feature without any extra cost.

Built-in all required linear and switching voltage regulators, highly integrated VL716 work perfectly with single power input from USB 5V bus power to save customer BOM cost. 6 GPIO pins are available for push button, operation LEDs, device power down control, and other special usage. The SPI interface can support external flash for firmware upgrades or additional software enhancements. VL716 is available in QFN 48L (6x6x0.85 mm) green packages to fit small form-factor design supporting USB type-C receptacle.

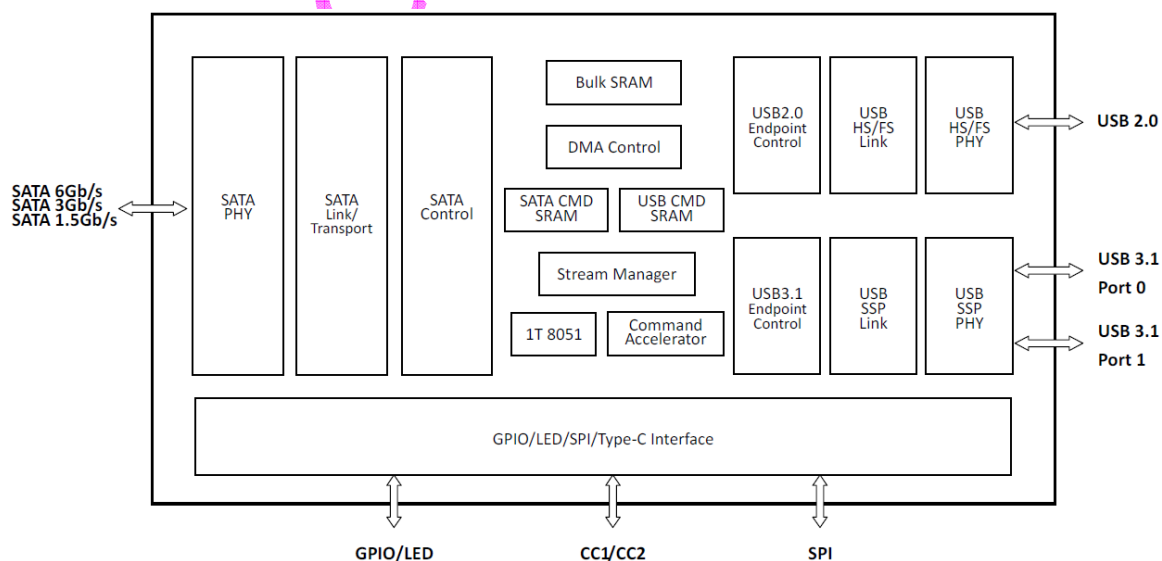


Figure 1 – VL716 Block Diagram

Pinout

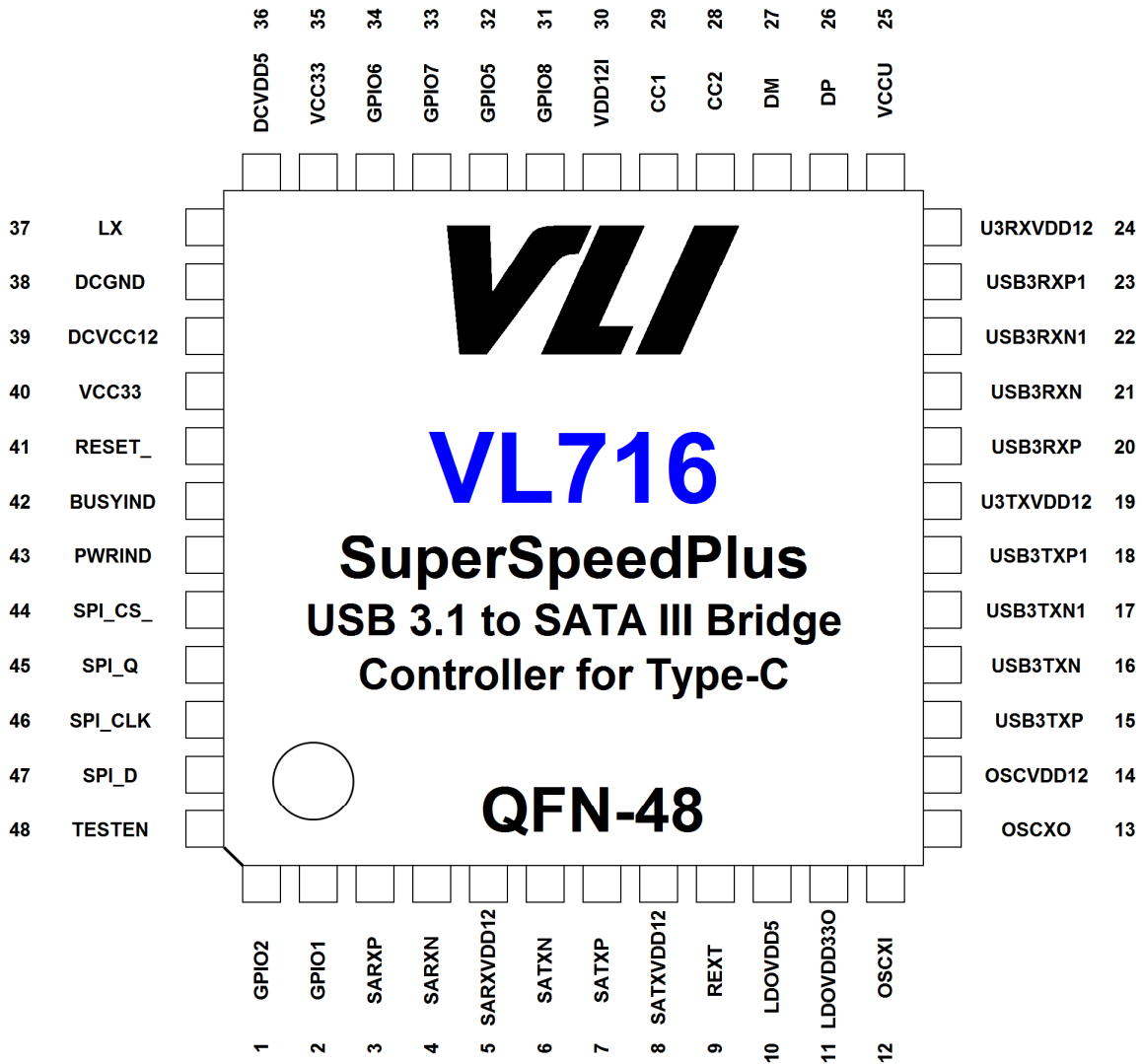


Figure 2 – VL716 QFN-48 Pin Diagram

## Pin List

**Table 1 – VL716 QFN-48 Pin List**

Pin	Pin Name	Pin	Pin Name
1	GPIO2	25	VCCU
2	GPIO1	26	DP
3	SARXP	27	DM
4	SARXN	28	CC2
5	SARXVDD12	29	CC1
6	SATXN	30	VDD12I
7	SATXP	31	GPIO8
8	SATXVDD12	32	GPIO5
9	REXT	33	GPIO7
10	LDOVDD5	34	GPIO6
11	LDOVDD330	35	VCC33
12	OSCXI	36	DCVDD5
13	OSCXO	37	LX
14	OSCVDD12	38	DCGND
15	USB3TXP	39	DCVCC12
16	USB3TXN	40	VCC33
17	USB3TXN1	41	RESET_
18	USB3TXP1	42	BUSYIND
19	U3TXVDD12	43	PWRIND
20	USB3RXP	44	SPI_CS_
21	USB3RXN	45	SPI_Q
22	USB3RXN1	46	SPI_CLK
23	USB3RXP1	47	SPI_D
24	U3RXVDD12	48	TESTEN

## Pin Descriptions

### Signal Type Definition

Name	Type	Signal Description
Input	I	A standard input-only signal
Output	O	A standard active driver
Input/Output	I/O	A bi-directional signal
Analog bias	A <sub>BIAS</sub>	Analog bias or reference signal. Must be tied to external resistor and/or capacitor bias network
Power	PWR	A power pin
Ground	GND	A ground pin

### Serial ATA Interface

Pin Name	QFN48	I/O	Signal Description
SARXP	3	I	SATA Port Differential Receive Data +
SARXN	4	I	SATA Port Differential Receive Data -
SATXP	7	O	SATA Port Differential Transmit Data +
SATXN	6	O	SATA Port Differential Transmit Data -
SATXVDD12	8	PWR	Analog 1.2V
SARXVDD12	5	PWR	Analog 1.2V

### USB 3.0 Interface

Pin Name	QFN48	I/O	Signal Description
USB3RXP	20	I	USB 3.0 Port0 Differential Receive Data +
USB3RXN	21	I	USB 3.0 Port0 Differential Receive Data -
USB3TXP	15	O	USB 3.0 Port0 Differential Transmit Data +
USB3TXN	16	O	USB 3.0 Port0 Differential Transmit Data -
USB3RXP1	23	I	USB 3.0 Port1 Differential Receive Data +
USB3RXN1	22	I	USB 3.0 Port1 Differential Receive Data -
USB3TXP1	18	O	USB 3.0 Port1 Differential Transmit Data +
USB3TXN1	17	O	USB 3.0 Port1 Differential Transmit Data -
U3RXVDD12	24	PWR	Analog 1.2V
U3TXVDD12	19	PWR	Analog 1.2V

### USB 2.0 Interface

Pin Name	QFN48	I/O	Signal Description
DP	26	I/O	USB 2.0 Bus Data Plus (D+)
DM	27	I/O	USB 2.0 Bus Data Minus (D-)
VCCU	25	PWR	Analog 3.3V



**Type-C Interface**

Pin Name	QFN48	I/O	Signal Description
CC1	29	I/O	Configuration Channel 1
CC2	28	I/O	Configuration Channel 2

**Serial EEPROM Interface**

Pin Name	QFN48	I/O	Signal Description
SPI_CS_	44	O	Serial Flash Chip Enable
SPI_D	47	O	Serial Flash Data Input
SPI_Q	45	I	Serial Flash Data Output
SPI_CLK	46	O	Serial Flash Clock

**Analog Command Block**

Pin Name	QFN48	I/O	Signal Description
OSCXI	12	I	25M crystal input
OSCXO	13	O	25M crystal output
REXT	9	A <sub>BIAS</sub>	Connect to external resistor
LDOVDD5	10	PWR	5.0V voltage input for 5V to 3.3V LDO
LDOVDD330	11	O	3.3V voltage output for 5V to 3.3V LDO
DCVDD5	36	PWR	5.0V voltage input for DC2DC regulator
LX	37	O	1.2V voltage output for DC2DC regulator
DCGND	38	GND	Ground for DC2DC regulator
DCVCC12	39	PWR	1.2V voltage input for core power
OSCVDD12	14	PWR	Oscillator analog 1.2V

**General Purpose I/O and Miscellaneous**

Pin Name	QFN48	I/O	Signal Description
BUSYIND	42	O	Busy LED Indicator, including PWM Typical driving current 15.8mA @ 0.4V & 26.5mA @ 2.4V
PWRIND	43	O	Power LED Indicator, including PWM Typical driving current 15.8mA @ 0.4V & 26.5mA @ 2.4V
RESET_	41	I	External Chip Reset
GPIO_1	2	I/O	General Purpose I/O (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: Device power down control
GPIO_2	1	I/O	General Purpose I/O, including PWM (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: USB3.1/USB2.0 mode indicator
GPIO_5	32	I/O	General Purpose I/O (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: Push button trigger pin
GPIO_6	34	I/O	General Purpose I/O (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: USB cable power detect
GPIO_7	33	I/O	General Purpose I/O (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: Device write protect control
GPIO_8	31	I/O	General Purpose I/O (15.8mA @ 0.4V & 26.5mA @ 2.4V in output mode) Default: Push button status indicator

**Test Pin**

Pin Name	QFN48	I/O	Signal Description
TESTEN	48	I	Test Mode Enable Do not connect for normal operation. Internal pull down

**Power and Ground**

Pin Name	QFN48	I/O	Signal Description
VCC33	35, 40	PWR	Digital IO power 3.3V
VDD12I	30	PWR	Digital Core power 1.2V

## Electrical Specification

### Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit	Note
T <sub>STG</sub>	Storage Temperature	-55	125	°C	—
T <sub>A</sub>	Ambient Temperature	0	70	°C	—
V <sub>DD33</sub>	Power Supply Voltage	-0.5	3.69	V	—
V <sub>DD50</sub>	Input Voltage	-0.5	5.5	V	—
V <sub>O</sub>	Output Voltage at any output	-0.5	VCC+ 0.5	V	—
V <sub>ESD</sub>	Electrostatic Discharge	—	2	kV	Human Body Model

Note: Stress above conditions may cause permanent damage to the device. Functional operation of this device should be restricted to the conditions described.

### Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>CC33</sub>	Digital IO power 3.3V	3.0	3.3	3.6	V
LDOVDD5	5V to 3.3V LDO 5V Power Input	4.5	5	5.5	V
DCVDD5	5V to 1.2V DC2DC 5V Power Input	4.5	5	5.5	V
V <sub>DD12I</sub>	Digital Core power 1.2V	1.08	1.2	1.36	V
DGND	Ground	—	0	—	V

### General IO DC Characteristics

Symbol	Parameter	Min	Max	Unit	Note
V <sub>IL</sub>	Input Low Voltage	-0.30	0.8	V	—
V <sub>IH</sub>	Input High Voltage	2.0	3.6	V	—
V <sub>OL</sub>	Output Low Voltage	—	0.4	V	I <sub>OL</sub> =15.8mA
V <sub>OH</sub>	Output High Voltage	2.4	—	V	I <sub>OH</sub> =26.5mA
I <sub>IL</sub>	Input Leakage Current	—	+/-10	μA	0<V <sub>IN</sub> <VCC
I <sub>OZ</sub>	Tristate Leakage Current	—	+/-10	μA	0<V <sub>OUT</sub> <VCC

### Internal 5V to 1.2V DC/DC Converter

Parameter	Min	Typ.	Max	Unit	Note
Input Voltage	4.5	5.0	5.5	V	
Output Voltage	1.14	1.2	1.26	V	
Max. Output Current		TBD	TBD	mA	
Output Voltage Tolerance		+/- 5%			

### Internal 5V to 3.3V LDO Regulator

Parameter	Min	Typ.	Max	Unit	Note
Input Voltage	4.5	5.0	5.5	V	

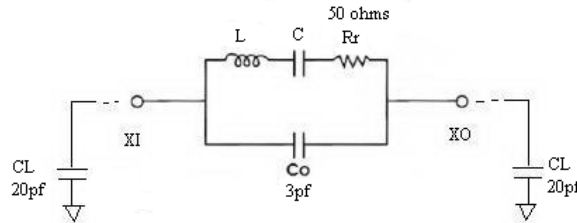


Output Voltage	3.135	3.3	3.465	V
Max. Output Current		TBD	TBD	mA
Output Voltage Tolerance		+/- 5%		

**External Crystal Electrical Characteristics**

Please refer to the Figure 4.

Symbol	Parameter	Min	Typ	Max	Unit
FL	Normal Frequency		25		MHz
	Oscillation Mode		Fundamental		
	Frequency Tolerance	-30		30	ppm
	Aging	-5		5	ppm
CL	Loading Capacitance		20		pf
C0	Shunt Capacitance	1	3	7	pf
Rr	Effective Resistance			50	ohms



**Figure 3 – 25MHz Crystal equivalent circuit and spec requirement**

**USB Full Speed DC/AC Characteristics**

Symbol	Parameter	Min	Max	Unit	Note
VFSIH	Full-speed Input High	2.0		V	—
VFSIL	Full-speed Input Low		0.8	V	—
VFSCM	Differential Common Mode Voltage	0.8	2.5	V	—
VFSOL	Full-speed Output Low	0.0	0.3	V	—
VFSOH	Full-speed Output High	2.8	3.6	V	—
TFSR	Full-speed Rise Time	4	20	ns	—
TFSF	Full-speed Fall Time	4	20	ns	—
VFSCRS	Full-speed Output Signal Crossover Voltage	1.3	2.0	V	—

**USB High Speed DC/AC Characteristics**

Symbol	Parameter	Min	Max	Unit	Note
VHSSQ	High-speed squelch detection threshold	100	150	mV	—
VHSCM	High-speed data signaling common mode voltage	-50	500	mV	—
VHSOI	High-speed idle level	-10	10	mV	—
VHSOH	High-speed data high	360	440	mV	—



V <sub>HSOL</sub>	High-speed data low	-10	10	mV	—
V <sub>CHIRPJ</sub>	Chirp J level	700	1100	mV	—
V <sub>CHIRPK</sub>	Chirp K level	-900	-500	mV	—
Z <sub>HSDRV</sub>	Drive output resistance	40.5	49.5	Ω	—
T <sub>HSR</sub>	High-speed Rise Time	500		ps	—
T <sub>HSF</sub>	High-speed Fall Time	500		ps	—

**USB SuperSpeedPlus TX RX Characteristics**

TBD

**USB Super Speed TX Characteristics**

Symbol	Parameter	Min	Max	Unit	Note
V <sub>TX-DIFF-PP</sub>	Differential p-p Tx swing	0.8	1.2	V	—
V <sub>TX-DE-RATIO</sub>	Tx de-emphasis	3.0	4.0	dB	—
R <sub>TX-DIFF-DC</sub>	DC differential impedance	72	120	Ω	—
V <sub>TX-RCV-DETECT</sub>	The Voltage Change allowed during Receiver Detection		0.6	V	—
T <sub>TX-EYE</sub>	Transmitter Eye	0.625		UI	—
T <sub>TX-DJ-DD</sub>	Tx Deterministic Jitter		0.205	UI	—
R <sub>TX-DC</sub>	Transmitter DC Common Mode Impedance	18	30	Ω	—
V <sub>TX-DC-CM</sub>	Transmitter DC Common Mode Voltage	0	2.2	V	—
V <sub>TX-CM-AC-PP-AC-TIVE</sub>	Tx AC Common Mode Voltage Active		100	mV	—
V <sub>TX-IDLE-DIFF-AC-PP</sub>	Electrical Idle Differential P-P Output Voltage	0	10	mV	—
V <sub>TX-IDLE-DIFF-DC</sub>	DC Electrical Idle Differential Output Voltage	0	10	mV	—

**USB Super Speed RX Characteristics (5.0 GT/s)**

Symbol	Parameter	Min	Max	Unit	Note
UI	Unit Interval	199.94	200.06	ps	UI does not account for SSC caused variations
R <sub>RX-DC</sub>	Receiver DC common mode impedance	18	30	Ω	DC impedance limits are needed to guarantee Receiver detect Measured with respect to ground over a voltage of 500mV maximum
R <sub>RX-DIFF-DC</sub>	DC differential impedance	72	120	Ω	
Z <sub>RX-HIGH-IMP-DC-POS</sub>	DC Input CM Input Impedance for V>0 during Reset or power down	25k		Ω	Rx DC CM impedance with the Rx terminations not powered, measured over the range 0 – 500mv with respect to ground



$V_{RX-LFPS-DET-DIFF-P-P}$	LFPS Detect Threshold	100	300	mV	Below the minimum is noise Must wake up above the maximum
$V_{RX-DIFF-PP-POST-EQ}$	Differential Rx peak-to-peak voltage	30		mV	Measured after the Rx EQ function (Section 6.8.2)
$t_{RX-TJ}$	Max Rx inherent timing error		0.45	UI	Measured after the Rx EQ function (Section 6.8.2)
$t_{RX-DJ-DD}$	Max Rx inherent deterministic timing error		0.3	UI	Maximum Rx inherent deterministic timing error
$C_{RX-PARASITIC}$	Rx input capacitance for return loss		1.1	pf	
$V_{RX-CM-AC-P}$	Rx AC common mode voltage		150	mV Peak	Measured at Rx pins into a pair of 50Ω terminations into ground Includes Tx and channel conversion, AC range up to 5 GHz
$V_{RX-CM-DC-ACTIVE-IDLE-DELTA-P}$	Rx AC common mode voltage during the U1 to U0 transition		200	mV Peak	Measured at Rx pins into a pair of 50Ω terminations into ground Includes Tx and channel conversion, AC range up to 5 GHz

**SATA TX Characteristics**

Symbol	Parameter	Min	Max	Unit	Note
$Z_{diffTX}$	TX Pair Differential Impedance	85	115	Ohm	
$Z_{s-eTX}$	TX Single-Ended Impedance	40			
$RL_{DD11,TX}$	TX Differential Mode Return Loss (150MHz-300MHz)	14		dB	
	TX Differential Mode Return Loss (300MHz-600MHz)	8		dB	
	TX Differential Mode Return Loss (600MHz-1.2GHz)	6		dB	
	TX Differential Mode Return Loss (1.2GHz-2.4GHz)	6		dB	
	TX Differential Mode Return Loss (2.4GHz-3.0GHz)	3		dB	
$RL_{DD11,TX}$	TX Differential Mode Return Loss (3.0GHz-5.0GHz)	1		dB	Only for Gen2i
	TX Differential Mode Return Loss Start for slope for Gen3	Min at 300MHz z is 14		dB	

	Slope of TX Differential Mode Return Loss for Gen3	-13			dB/dec	
	TX Differential Mode Return Loss Max Frequency for Gen3		Max is 3		GHz	
RL <sub>CC11,TX</sub>	TX Common Mode Return Loss (150MHz-300MHz)	8			dB	
	TX Common Mode Return Loss (300MHz-600MHz)	5			dB	
	TX Common Mode Return Loss (600MHz-1.2GHz)	2			dB	
	TX Common Mode Return Loss (1.2GHz-2.4GHz)	1			dB	
	TX Common Mode Return Loss (2.4GHz-3.0GHz)	1			dB	
	TX Common Mode Return Loss (3.0GHz-5.0GHz)	1			dB	Only for Gen2i
RL <sub>DC11,TX</sub>	TX Impedance Balance (150MHz-300MHz)	30			dB	
	TX Impedance Balance (300MHz-600MHz)	20			dB	
	TX Impedance Balance (600MHz-1.2GHz)	10			dB	
	TX Impedance Balance (1.2GHz-2.4GHz)	10			dB	
	TX Impedance Balance (2.4GHz-3.0GHz)	4/10			dB	For Gen3i is 10dB
	TX Impedance Balance (3.0GHz-5.0GHz)	4			dB	
	TX Impedance Balance (5.0GHz-6.5GHz)	4				Only for Gen3i
V <sub>diffTX</sub>	TX Differential Output Voltage	400	600		mVppd	For Gen1
	TX Differential Output Voltage	400	700		mVppd	For Gen2
	TX Differential Output Voltage	200	900		mVppd	For Gen3
UI <sub>VminTX</sub>	TX Minimum Voltage Measurement Interval	0.45	0.55		UI	
t <sub>20-80TX</sub>	TX Rise/Fall Time	100	273		ps	For Gen1
	TX Rise/Fall Time	67	136		ps	For Gen2
	TX Rise/Fall Time	33	80		ps	For Gen3
t <sub>skewTX</sub>	TX Differential Skew		20		ps	
V <sub>cm,acTX</sub>	TX AC Common Mode Voltage		50		mVp-p	
	TX AC Common Mode Voltage 3 GHz Max		26		dBmV(rms)	For Gen3
	TX AC Common Mode Voltage 6 GHz Max		30		dBmV(rms)	For Gen3
D <sub>vdiffOOB</sub>	OOB Differential Delta		25		mV	
D <sub>vcmOOB</sub>	OOB Common Mode Delta		50		mV	
R/F <sub>bal</sub>	TX Rise/Fall Imbalance		20		%	Only for Gen2
Amp <sub>bal</sub>	TX Amplitude Imbalance		30		%	Only for Gen2

TJ at Connector Clk-Data f <sub>BAUD</sub> /500 JTF Defined		0.37	UI	For Gen1/Gen2
DJ at Connector Clk-Data f <sub>BAUD</sub> /500 JTF Defined		0.19	UI	For Gen1/Gen2
Jitter Transfer Function Bandwidth (D24.3,high pass -3dB)	1.1	3.1	MHz	For Gen1/Gen2
Jitter Transfer Function Peaking		3.5	dB	For Gen1/Gen2
Jitter Transfer Function Low Frequency Attenuation	69	75	db	For Gen1/Gen2
Jitter Transfer Function Bandwidth (D24.3,high pass -3dB)	2.2	6.2	MHz	For Gen3
Jitter Transfer Function Peaking		3.5	dB	For Gen3
Jitter Transfer Function Low Frequency Attenuation	35.2	41.2	db	For Gen3
TJ(10-12)before and after CIC,Clk-Data JTF Defined		0.52	UI	For Gen3
TJ(10-6)before and after CIC,Clk-Data JTF Defined		0.46	UI	For Gen3

#### SATA RX Characteristics

Symbol	Parameter	Min	Max	Unit	Note
V <sub>diffRX</sub>	Gen1 RX Differential Input Voltage	240	600	mVppd	
	Gen2 RX Differential Input Voltage	240	750		
	Gen3 RX Differential Input Voltage	240	1000		
t <sub>20-80RX</sub>	Gen1 RX Rise/Fall time	100	273	ps	
	Gen2 RX Rise/Fall time	67	136		
	Gen2 RX Rise/Fall time	62	75		
t <sub>skewRX</sub>	Gen2 RX Differential Skew		50	Ps	
	Gen3 RX Differential Skew		30		
V <sub>cm,acRX</sub>	RX AC Common Mode Voltage		100	mVppd	
f <sub>cm,acRX</sub>	RX AC Common Mode Frequency	2	200	MHz	
	Gen1 TJ at Connector, Data-Data, 5UI		0.43	UI	
	Gen1 DJ at Connector, Data-Data, 5UI		0.25	UI	
	Gen1 TJ at Connector, Data-Data, 250UI		0.6	UI	
	Gen1 TJ at Connector, Data-Data, 250UI		0.35	UI	
	Gen2 TJ at Connector, Clk-Data, f <sub>BAUD</sub> /10		0.46	UI	
	Gen2 DJ at Connector, Clk-Data, f <sub>BAUD</sub> /10		0.35	UI	
	Gen2 TJ at Connector, Clk-Data, f <sub>BAUD</sub> /500		0.60	UI	





	Gen2 DJ at Connector, Clk-Data, $f_{BAUD}/500$		0.42		UI
Gen3 TJ after CIC	Clk-Data JTF Defined		0.60		UI
Gen3 RJ before CIC	MFTP Clk-Data JTF Defined		0.60		
$Z_{diffRX}$	RX Pair Differential Impedance	85	115		Ohm
$Z_{s-eRX}$	RX single-ended Impedance	40			Ohm
$RL_{DD11,RX}$	Gen2i/m RX Differential Mode Return Loss (150MHz-300MHz)	18			dB
	Gen2i/m RX Differential Mode Return Loss (300MHz-600MHz)	14			dB
	Gen2i/m RX Differential Mode Return Loss (600MHz-1.2GHz)	10			dB
	Gen2i/m RX Differential Mode Return Loss (1.2GHz-2.4GHz)	8			dB
	Gen2i/m RX Differential Mode Return Loss (2.4GHz-3.0GHz)	3			dB
	Gen2i/m RX Differential Mode Return Loss (3.0GHz-5.0GHz)	1			dB
	Gen3i RX Differential Mode Return Loss (min @ 300MHz)			18	
Gen3i Slop of RX Differential Mode Return Loss		-13			dB/dec
Gen3i RX Differential Mode Return Loss max frequency			6.0		GHz
$RL_{CC11}$	Gen2i/m RX Common Mode Return Loss (150MHz-300MHz)	5			dB
	Gen2i/m RX Common Mode Return Loss (300MHz-600MHz)	5			dB
	Gen2i/m RX Common Mode Return Loss (600MHz-1.2GHz)	2			dB
	Gen2i/m RX Common Mode Return Loss (1.2GHz-2.4GHz)	1			dB
	Gen2i/m RX Common Mode Return Loss (2.4GHz-3.0GHz)	1			dB
	Gen2i/m RX Common Mode Return Loss (3.0GHz-5.0GHz)	1			dB
$V_{thresh}$	Gen1 OOB Signal Detection Threshold	50	200		mVppd
	Gen2/3 OOB Signal Detection Threshold	75	200		mVppd
$UI_{OOB}$	UI During OOB Signaling	646.67	686.67		ps
	COMINIT/COMRESET/COMWA KE Transmit Burst Length	160	160		$UI_{OOB}$
	COMINIT/COMRESET Transmit Gap Length	480	480		$UI_{OOB}$
	COMWAKE Transmit Gap Length	160	160		$UI_{OOB}$
	COMWAKE Gap Detection Window	55	175		ns

---

COMINIT/COMRESET Gap	175	525	ns
Detection Window			

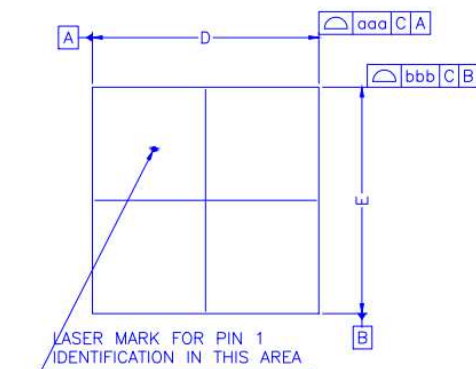
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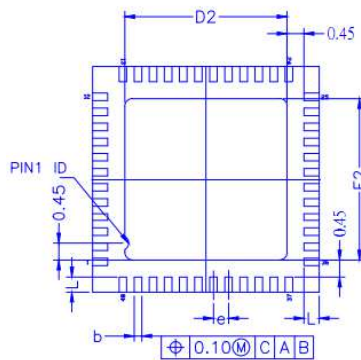
## Package Mechanical Specifications

### QFN-48 Pb-free Maximum Temperature for IR Reflow

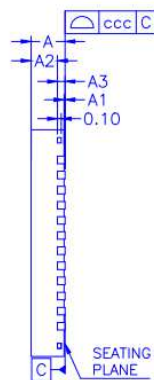
Parameter	Value	Unit
Maximum Temperature $T_p$	250	°C
Max Time within 5°C of $T_p$	30	seconds



TOP VIEW



BOTTOM VIEW



SIDE VIEW

\* CONTROLLING DIMENSION : MM

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.85	0.90	0.031	0.033	0.035
A1	0.00	0.035	0.05	0.000	0.001	0.002
A2	---	0.65	0.70	---	0.026	0.028
A3	0.203	REF.		0.008	REF.	
b	0.15	0.20	0.25	0.006	0.008	0.010
D	6.00 bsc			0.236 bsc		
D2	4.20	4.30	4.40	0.165	0.165	0.173
E	6.00 bsc			0.236 bsc		
E2	4.20	4.30	4.40	0.165	0.165	0.173
L	0.35	0.40	0.45	0.014	0.016	0.018
e	0.40 bsc			0.016 bsc		
TOLERANCES OF FORM AND POSITION						
aaa	0.10			0.004		
bbb	0.10			0.004		
ccc	0.08			0.003		

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIE THICKNESS ALLOWABLE IS 0.305 mm MAXIMUM (0.012 INCHES MAXIMUM)
3. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M, -1994.
4. THE PIN #1 IDENTIFIER MUST BE PLACED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR OTHER FEATURE OF PACKAGE BODY.
5. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
6. PACKAGE WARPAGE MAX 0.08 mm.
7. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
8. APPLIED ONLY TO TERMINALS.

Figure 4 – QFN 48L 6x6x0.85 mm Mechanical Specification

### Package Top Side Marking

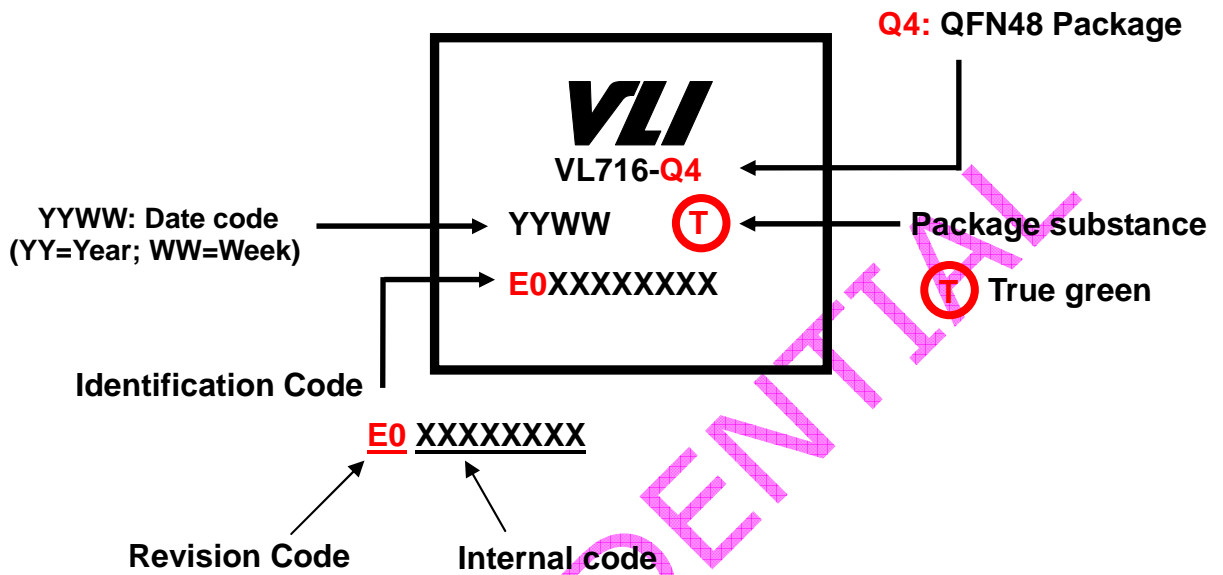


Figure 5 - VL716 Package Top Side Marking

### Ordering Information

Part Number	Description	Package
VL716-Q4	USB3.1 to SATA 6Gb/s bridge for Type-C	48-pin QFN (6x6mm)



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