ELECTRICAL SPECIFICATIONS

DC Characteristics

Over Recommended Operating Conditions.

Table 1. DC Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Condition
V_{CC}	Power supply	3.0	3.3	3.6	V	
I_{CC}	Power supply current	18	25	35	mA	VOUTP, VOUTN AC-coupled to 50Ω.
V_{OUT_CM}	Common-mode voltage at output pins		V_{CC} – 0.24		V	VOUTP, VOUTN AC-coupled to 50Ω.
V_{IN}	DC bias voltage on IN pin		0.9		V	
V_{FILTER}	DC bias voltage on FILTER pin		V_{CC} – 0.05		V	Reversed bias detector with no current requirement.
V_{BIAS}	DC bias voltage across photodetector		2.4		V	No input current.

AC Characteristics

Over Recommended Operating Conditions.

Table 2. AC Characteristics for Bare Dice in Probe Environment (VSC7970-W)

Symbol	Parameter	Min	Typ	Max	Units	Condition
ΔI_{PH}	Maximum peak-to-peak AC input current	2.2			mAp-p	
I_{NOISE}	Input-referred rms noise current		700		nArms	
V_{OUT_SE}	Single-ended output voltage amplitude		140		mV	
V_{OUT_DIFF}	Differential output voltage amplitude		280		mV	
Z_{T_DIFF}	Differential transimpedance gain(1)		5		kΩ	
BW	Upper –3dB bandwidth		2.0		GHz	
f_L	Lower –3dB cutoff frequency		7		kHz	S21 data in electrical environment.
R_O	Output resistance		50		Ω	Single-ended.
DC	Duty cycle	45		55	%	
T_J	Total jitter		40		ps	Peak-to-peak, I_{IN} >30µAp-p.

1. The differential transimpedance gain is defined as $Z_{T\_DIFF} = V_{OUT\_DIFFp\text{-}p} / I_{INp\text{-}p}$, where V_{OUT_DIFF} is the differential peak-to-peak output current voltage. IINp-p is the differential peak-to-peak input current.

Table 3. AC Characteristics for TO-46 with Ball Lens (VSC7970WE)

Symbol	Parameter	Min	Typ	Max	Units	Condition
ΔI_{PH}	Maximum peak-to-peak AC input current(1)	2.2			mAp-p	
OL	Maximum input optical power(1, 2)	2.3			dBm	
I_{NOISE}	Input-referred rms noise current		660	800	nArms	100Hz to 2.5GHz, 0.6pF photodetector capacitance.
OMA	Optical modulation amplitude(2)		8.8		µWp-p	
I_{PHS_PEAK}	Input photocurrent sensitivity(2)		7		µAp-p	
S	Average optical power at sensitivity(2)		–23		dBm	With recommended photodetector characteristics.
V_{OUT_SE}	Single-ended output voltage amplitude	100	140		mV	Single-ended peak-to-peak measurement, I_{IN}>120µA.
V_{OUT_DIFF}	Differential output voltage amplitude	200	280		mV	Differential peak-to-peak measurement, I_{IN}>120µA.
Z_{T_DIFF}	Differential transimpedance gain(3)		5		kΩ	
R_{DIFF}	Differential responsivity(1)		4		mV/µW	Peak-to-peak.
ΔZ_T	Ripple in passband transimpedance(3)		1		dB	Modulation frequency between f_L and BW.
BW	Upper –3dB bandwidth	1.7	1.7		GHz	Referenced to 100MHz, C_{PD} = 0.6pF.
f_L	Lower –3dB cutoff frequency			100	kHz	Referenced to 100MHz, C_{PD} = 0.6pF, 0.1µF AC-coupling capacitor, input power = 10µw.
R_O	Output resistance		50		Ω	Single-ended.
DC	Duty cycle	45		55	%	
T_J	Total jitter		40		ps	Peak-to-peak, I_{IN} >30µAp-p.
D_J	Deterministic jitter		20	30	ps	K28.5 pattern. –1dBm input optical power.

1. *Value is calculated using photodetector responsivity = 0.95A/W, extinction ratio = 10dB.*
2. *Value is calculated from I_{NOISE}, BER = 10^{-12}, photodetector responsivity = 0.95A/W, extinction ratio = 10dB.*
3. *The differential transimpedance gain is defined as $Z_{T\_DIFF} = V_{OUT\_DIFFp\text{-}p} / I_{INp\text{-}p}$, where V_{OUT_DIFF} is the differential peak-to-peak output current voltage. $I_{INp\text{-}p}$ is the differential peak-to-peak input current.*

Table 4. Photodetector Current Monitor

Symbol	Parameters	Min	Typ	Max	Units	Condition
I_{MON_SLOPE}	Slope of IMON current vs. input current		1			
I_{MON_OFFSET}	I_{MON} current at zero input current	0	3	9	µA	Average current, 1kΩ pull-up resistor.
I_{MON_RANGE}	Photocurrent monitor linearity range	5		1100	µA	Average current, 1kΩ pull-up resistor.

Table 5. Recommended Photodetector Characteristics (VSC7970-W)

Symbol	Parameter	Min	Typ	Max	Units	
CPD	Photodetector capacitance	0.4	0.6	0.8	pF	Bias voltage on detector at 2.0V.
LPD	Photodetector bond wire inductance		0.8		nH	
BW_{PD}	Photodetector –3dB bandwidth		3.5		GHz	

Recommended Operating Conditions

Table 6. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units	
V_{CC}	Power supply voltage	3.0	3.3	3.6		
T	Operating temperature range(1)	0		+85	°C	

1. Lower limit of specification is ambient temperature and upper limit is case temperature.

Absolute Maximum Ratings

Table 7. Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Units
V_{CC}	Power supply voltage	0	5	V
I_{IN}	Input DC current	0	4	mA
T_J	Junction temperature	–55	+125	°C
T_S	Storage temperature	–55	+125	°C

Stresses listed under Absolute Maximum Ratings may be applied to devices one at a time without causing permanent damage. Functionality at or above the values listed is not implied. Exposure to these values for extended periods may affect device reliability.

ELECTROSTATIC DISCHARGE

This device can be damaged by ESD. Vitesse recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures may adversely affect reliability of the device.

FUNCTIONAL DESCRIPTION

The VSC7970 data path consists of several stages: transimpedance input stage, limiting amplifier, and output driver. The transimpedance amplifier accepts current from a photodetector connected to the input pad, IN, and converts the input current to a differential output voltage. The signal then travels to the second-stage limiting amplifier, which provides DC restoration, eliminating the DC component of the input signal. The linear photocurrent monitor is also provided by this stage. The final stage consists of an output driver with a differential pair connected to V_{CC} via 50Ω internal pull-up resistors. The overall effective differential transimpedance of the VSC7970 is typically 5kΩ. The limited output single-ended voltage swing is typically 150mVp-p.

Data Outputs

The outputs of the VSC7970 can be DC-coupled or AC-coupled. This capacitor will determine the low-frequency cutoff for the system, which is directly related to the receiver's deterministic jitter. For ATM/SONET or other applications using PRBS NRZ data, select a capacitor of at least 0.1µF or greater that provides less than 32kHz low-frequency cutoff. For Fibre Channel, Gigabit Ethernet or other applications requiring 8B/10B data coding, select a capacitor of at least 0.01µF or greater that provides less than 320kHz low-frequency cutoff.

The outputs can be used single-ended or differential, however, for best performance, differential operation is recommended. If single-ended operation is necessary, the unused output should be AC-coupled and terminated with an impedance equal to the load on the pin in use. See Figure 1.

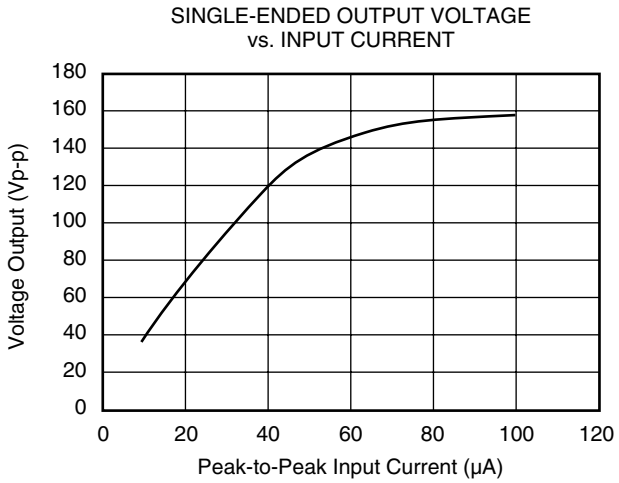


Figure 1. Typical Input vs. Output

Photodetector Current Monitor

The IMON pin provides a linear measurement of the average input current from the photodetector to the transimpedance amplifier (Figure 2). For example, if 20µA is the average input current to the transimpedance amplifier, the current through the IMON pin will be 20µA. To use this feature, connect the IMON pin to V_{CC} using a resistor less than 2kΩ. If this feature is not used, the IMON pin can be left unconnected.

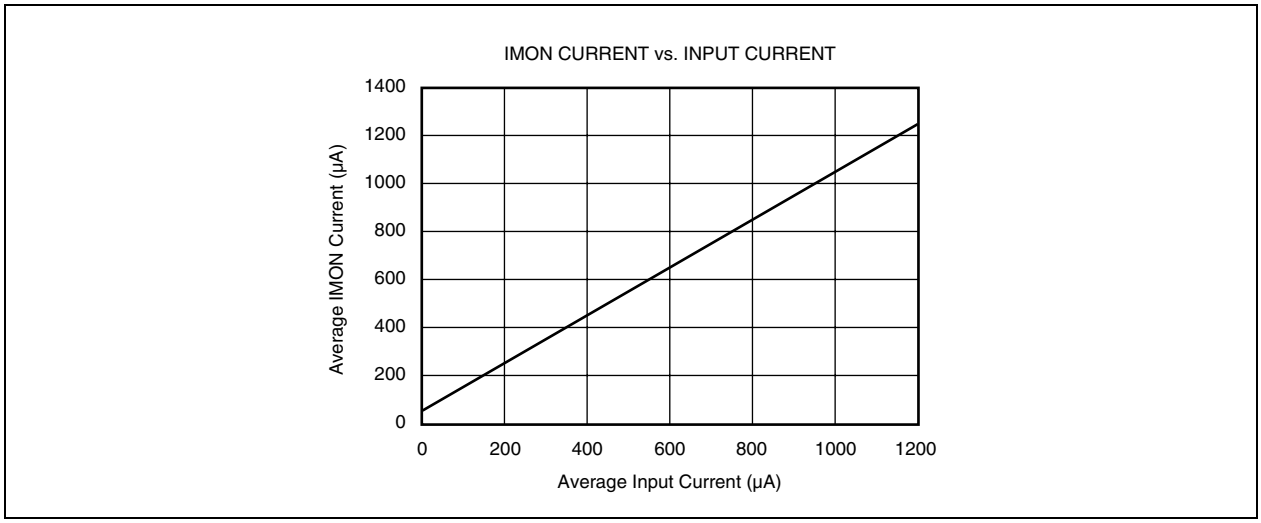
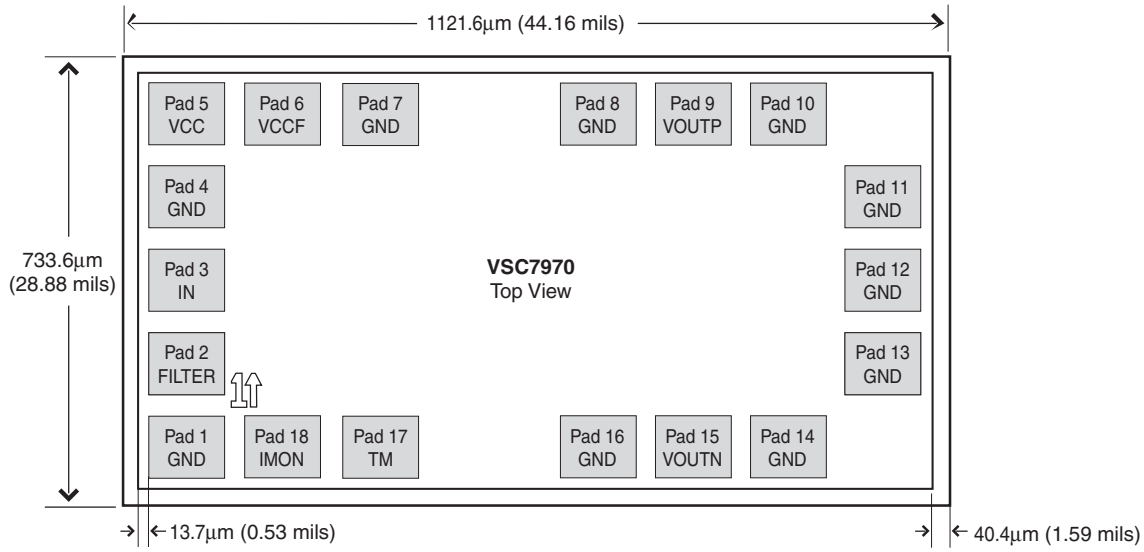


Figure 2. IMON Current vs. Input Current

BARE DICE AND PACKAGE INFORMATION



Die Size:	1121.6µm x 733.6µm (44.16 mils x 28.88 mils)
Die Thickness:	279µm (10.98 mils)
Pad Size:	90µm x 90µm (3.54 mils x 3.54 mils)
Pad Pitch:	125µm (4.92 mils)
Pad Passivation Opening:	75µm x 75µm (2.95 mils x 2.95 mils)
Scribe Size:	80.4µm (3.17 mils)

Die backside must be floating or connected to the most negative supply.

Figure 3. Pad Diagram for Bare Dice (-W)

Table 8. Pad Coordinates for Bare Dice (-W)

Signal	Pad Number	Coordinates (µm)		Description
		X	Y	
GND	1	58.70	57.45	Ground.
FILTER	2	58.70	182.45	Photodetector cathode connection (filtered V_{CC}).
IN	3	58.70	307.45	Photodetector anode connection.
GND	4	58.70	432.45	Ground.
VCC	5	58.70	594.10	Power supply, +3.3V.
VCCF	6	183.70	594.10	Connection to external capacitor.
GND	7	308.70	594.10	Ground.
GND	8	608.70	594.10	Ground.
VOUTP	9	733.70	594.10	Data output, true.
GND	10	858.70	594.10	Ground.
GND	11	982.10	451.40	Ground.
GND	12	982.10	326.40	Ground.
GND	13	982.10	201.40	Ground.
GND	14	858.70	58.70	Ground.
VOUTN	15	733.70	58.70	Data output, complement.
GND	16	638.70	58.70	Ground.
TM	17	302.70	58.70	Temperature monitor.
IMON	18	183.70	58.70	Photocurrent monitor.

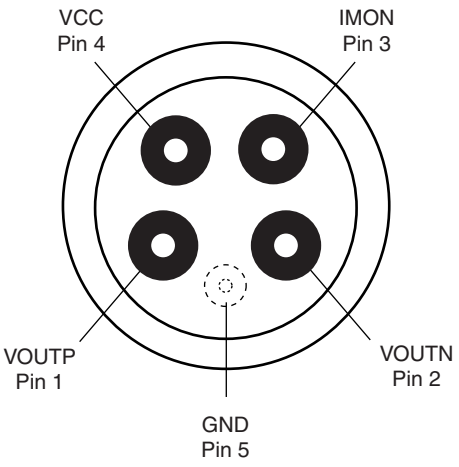


Figure 4. Pin Diagram for 5-Pin TO-46 with Ball Lens (WE-01)

Table 9. Pin Identification for 5-Pin TO-46 with Ball Lens (WE)

Pin	Signal	Type	Level	Description
1	VOUTP	O		Data output, true.
2	VOUTN	O		Data output, complement.
3	IMON	O		Photocurrent monitor.
4	VCC		Pwr	Power supply, +3.3V.
5	GND		Pwr	Ground.

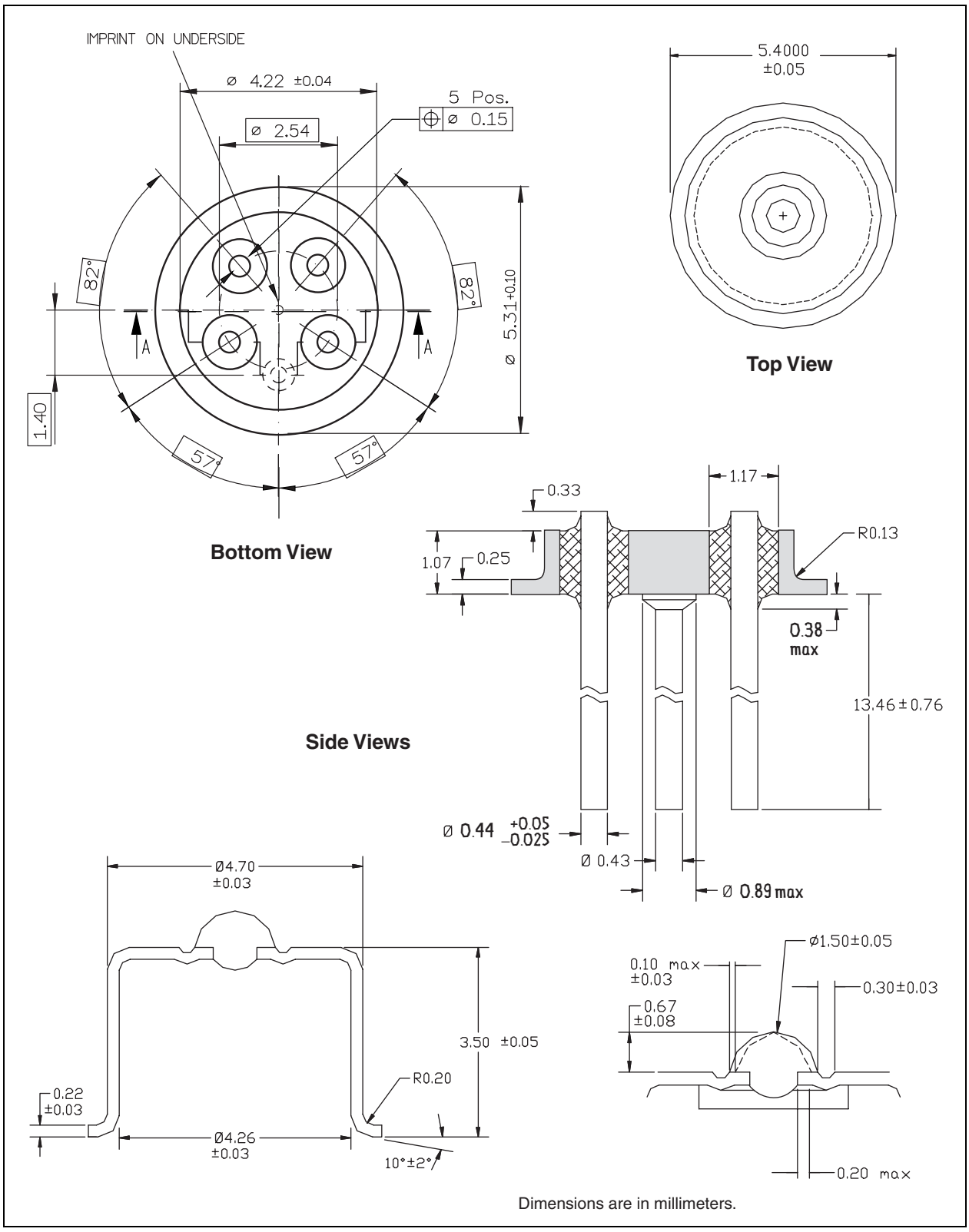


Figure 5. Package Drawing for 5-Pin TO-46 with Ball Lens (WE-01)

ORDERING INFORMATION

VSC7970 2.5Gb/s Transimpedance Amplifier with Photocurrent Monitor

Part Number	Description
VSC7970-W	Bare dice in waffle pack
VSC7970WE-01	5-pin TO-46 with ball lens (13mm lead length) 1310nm PIN

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