VSC7997
Data Sheet

SONET/SDH 10.7Gb/s High Gain Transimpedance Amplifier

FEATURES

- Adjustable Output Offset
- High-Gain 4.2kΩ Differential Transimpedance
- –5.2V Power Supply
- 2.2mA Peak-to-Peak Maximum Input Current
- AC- or DC-Coupled Outputs
- Known Good Die
- Input Sensitivity: –18.5dBm Typical

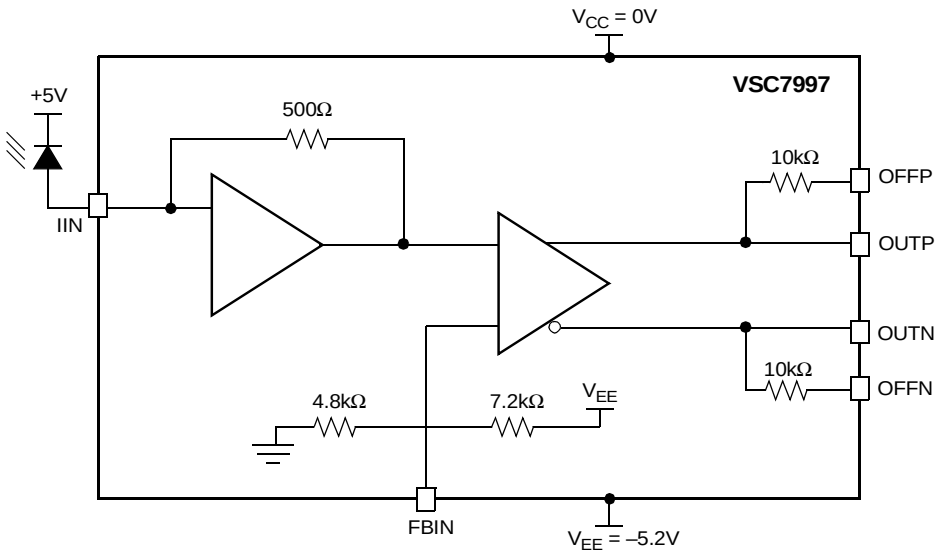
APPLICATIONS

- 10.7Gb/s SONET OC-192/SDH STM-64 Systems
- 10.3Gb/s Ethernet Applications
- Small Form Factor Transceivers
- OC-192/STM-64 Transponders

GENERAL DESCRIPTION

The VSC7997 is a 10.7Gb/s high performance Transimpedance Amplifier (TIA) designed for use in optical communication networks (SONET OC-192/SDH STM-64). The VSC7997 is intended for use with a PIN or APD photodetector and is capable of amplifying input currents of up to 2.2mA with low duty-cycle distortion. The outputs limit to a typical differential value of 1000mVp-p for input signals greater than 250µAp-p. To provide flexibility in setting the decision threshold of the limiting amplifier, the VSC7997 utilizes output offset adjustment.

VSC7997 Block Diagram



SPECIFICATIONS

Table 1. AC Specifications

Symbol	Parameter	Min	Typ	Max	Units	Condition
Z_{T_SE}	AC Single-Ended Transimpedance Gain(1)	1600	2100	3000	Ω	50Ω load
Z_{T_DIFF}	AC Differential Transimpedance Gain(1)	3200	4200	6000	Ω	50Ω load
BW	Upper -3dB Bandwidth(2)	7.5	8		GHz	
f_L	Lower -3dB Cutoff Frequency		25	40	kHz	
R_O	Output Resistance	42	50	58	Ω	Single-ended, DC
I_{PKMAX}	Maximum Peak Input Current	2.2			mA	Peak-to-peak
I_{ND}	Input Noise Current Density		11		$pA\sqrt{Hz}$	0GHz to 11GHz
I_{NOISE}	Input Noise Current Power		1.0E-12		A^2	0GHz to 11GHz
Ripple	Output Ripple(2)	–0.9	0	0.5	dB	1GHz to 5GHz.
V_{OD}	Maximum Differential Output Swing			1400	mV	Peak-to-peak, differential, 100Ω line-to-line termination
V_{OS}	Maximum Single-Ended Output Swing		500	700	mV	Peak-to-peak, single-ended, 50Ω termination to ground
I_{IN_LIM}	Input Current for Output Limiting		250		µA	Peak-to-peak
S_{22}	Output Reflection Coefficient			–10	dB	1GHz to 7GHz
t_D	Group Delay Deviation(2)		35		ps	1GHz to f_{-3dB}, I_{IN} = 10µA to 1000µA.
Peak	Peaking(2)			1.2	dB	500MHz to 11GHz.
J_T	Total Jitter		0.12		UI	I_{IN} = 2.2mA, peak-to-peak, 10^{-12} BER
IPHS-AVG	Average Photocurrent Sensitivity(2)		10.0	19.9	µA	
IPHS-PEAK	Peak Input Photocurrent Sensitivity(2)		20.0	39.7	µA	
S	Optical Sensitivity(2)		–18.5		dBm	10^{-12} BER

1. *The transimpedance gain is defined as $Z_T = V_{OUTP(p-p)} / I_{PH(p-p)}$, where V_{OUT} is the peak-to-peak output voltage and I_{IN} is the peak-to-peak input current.*
2. *Guaranteed by optical board characterization. Assumes a photodetector with the following properties: C_{PD} = 0.2pF, L_{IN} = 0.7nH, BW_{PD} = 10GHz, referenced to 500MHz, R = 1.0A/W, and r_e = 20dB. See Figure 4 on page 6 for photodetector guidelines.*

Table 2. DC Specifications

Symbol	Parameter	Min	Typ	Max	Units	Condition
V_{EE}	Power Supply Voltage	–4.9	–5.2	–5.5	V	
I_{CC}	Power Supply Current		75	90	mA	
V_{INBIAS}	Input Bias Voltage		V_{EE} + 1.7		V	
V_{OUT-CM}	Common-Mode Output Voltage	GND – 0.7	GND – 0.45	GND – 0.2		50Ω termination to ground
V_{OUT-CM}	Common-Mode Output Voltage	GND– 1.4	GND – 0.90	GND – 0.4		100Ω line-to-line termination

Table 3. Output Offset Adjustment

Symbol	Parameter	Min	Typ	Max	Units	Condition
V_{OFFSET}	V_{OUTP} - V_{OUTN}, V_{OFFP} – V_{OFFN}	150			mV	DC voltage
V_{OFFSET_NEG}	V_{OUTP} - V_{OUTN}, V_{OFFN} – V_{OFFP}	150			mV	DC voltage
V_{FBIN_MIN}	V_{FBIN} for Maximum Positive Offset		-3		V	V_{OFFSET} = +200mV
V_{FBIN_NOM}	V_{FBIN} for Zero Offset		–2.0		V	V_{OFFSET} = 0mV
V_{FBIN_MAX}	V_{FBIN} for Maximum Negative Offset		–1		V	V_{OFFSET} = –200mV
R_{FBIN}	F_{BIN} Input Impedance		2.88		kΩ	

Table 4. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units	Condition
V_{EE}	Power Supply Voltage	–4.9	–5.2	–5.5	V	
T_J	Junction Temperature Range	–20		+100	°C	
T_B	Die Backside Temperature Range	–40		+85	°C	

Table 5. Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Units	Condition
V_{EE}	Power Supply Voltage	+0.5	–6	V	
I_{IN}	Input Current	0	3	mA	DC current
FBIN	Offset Adjustment	+0.5	–6	V	
OFFP/OFFN	Output DC Level	+0.5	–6	V	
OUTP/OUTN	Data Output	–1.5	+1.5	V	
T_J	Junction Temperature	–40	+125	°C	
T_S	Storage Temperature Range	–55	+140	°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 VSC7997 is a high performance Transimpedance Amplifier (TIA) designed for use in optical communication networks (SONET OC-192/SDH STM-64). The amplifier consists of a transimpedance stage and a single-to-differential output stage with a gain of 20dB (see VSC7997 Block Diagram on page 1). An external photodetector is connected to the IIN input. Pins OUTP and OUTN are the complementary data outputs. Pins FBIN, OFFP, and OFFN are used for output offset control. The data output OUTP goes HIGH (OUTN goes LOW) when light is applied to the external PIN photodetector. The output is linear for inputs up to 250µAp-p. For higher inputs, the output limits at typically 1000mVp-p differential, increasing the dynamic range of the system by reducing the possibility of exceeding the input voltage range of the limiting amplifier or clock and data recovery circuit. Figure 1 shows the relationship between input current and output voltage.

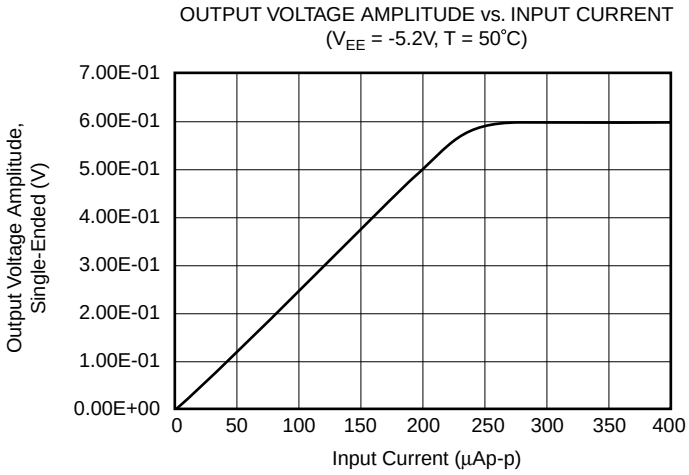


Figure 1. Output Voltage vs. Input Current

Power Supply

The VSC7997 requires –5.2V for operation. Connect all V_{EE} pins to –5.2V and all V_{CC} pins to ground.

Data Outputs

The VSC7997 can be AC-coupled or DC-coupled. For AC-coupled designs, the value of the capacitor will determine the low frequency cutoff for the system.

Output Offset Control

The VSC7997 provides flexibility in setting the decision threshold of the limiting amplifier or clock and data recovery circuit by providing DC output offset control of OUTP and OUTN. The OFFP and OFFN outputs, connected to ground through 100nF capacitors, provide the user with the DC component of the OUTP and OUTN

data outputs. An external circuit can be used to sense the OFFP and OFFN outputs and then generate the appropriate DC voltage at the FBIN input to set the DC offset between OUTP and OUTN. Figure 2 shows the relationship between the DC offset of OUTP, OUTN and F_{BIN}.

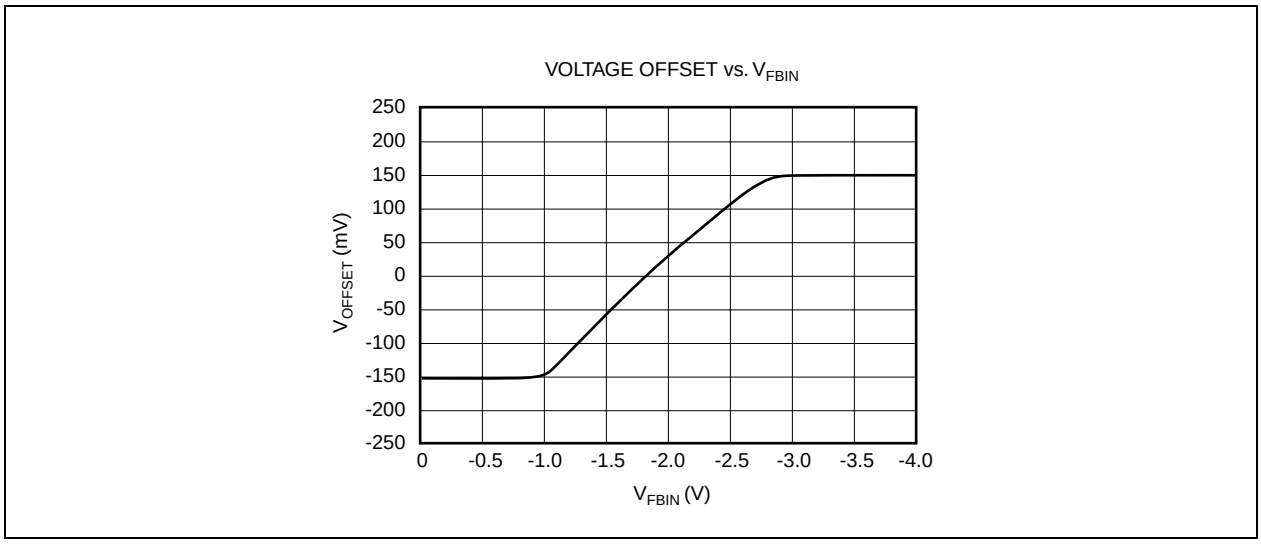


Figure 2. V_{OFFSET} vs. V_{FBIN}

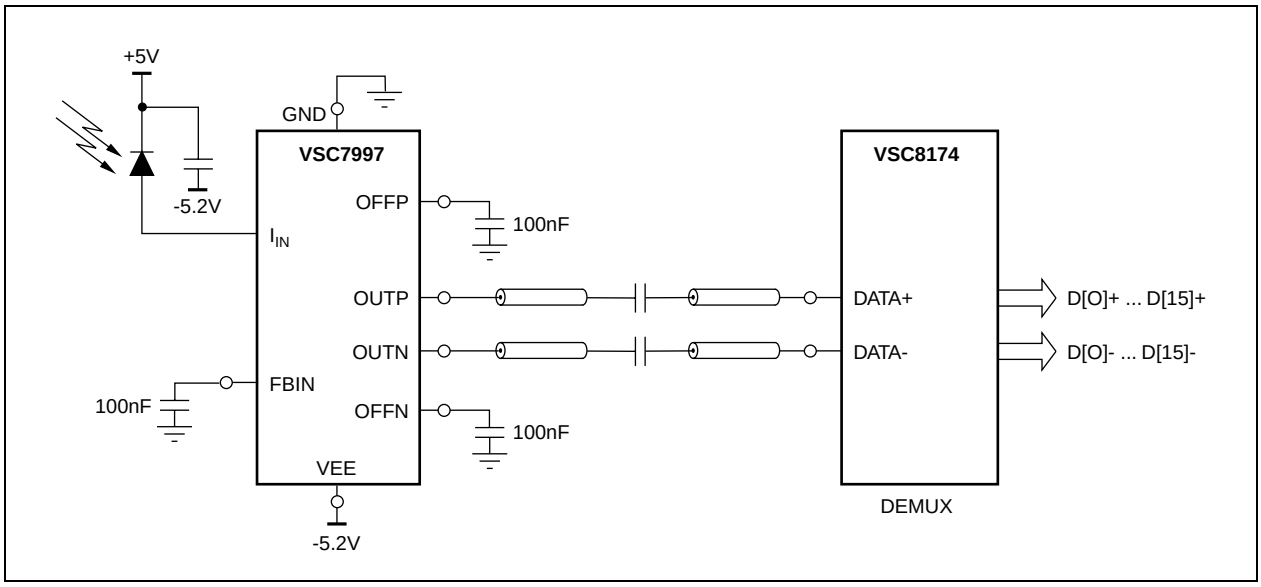


Figure 3. Typical Application for VSC7997

DESIGN GUIDELINE

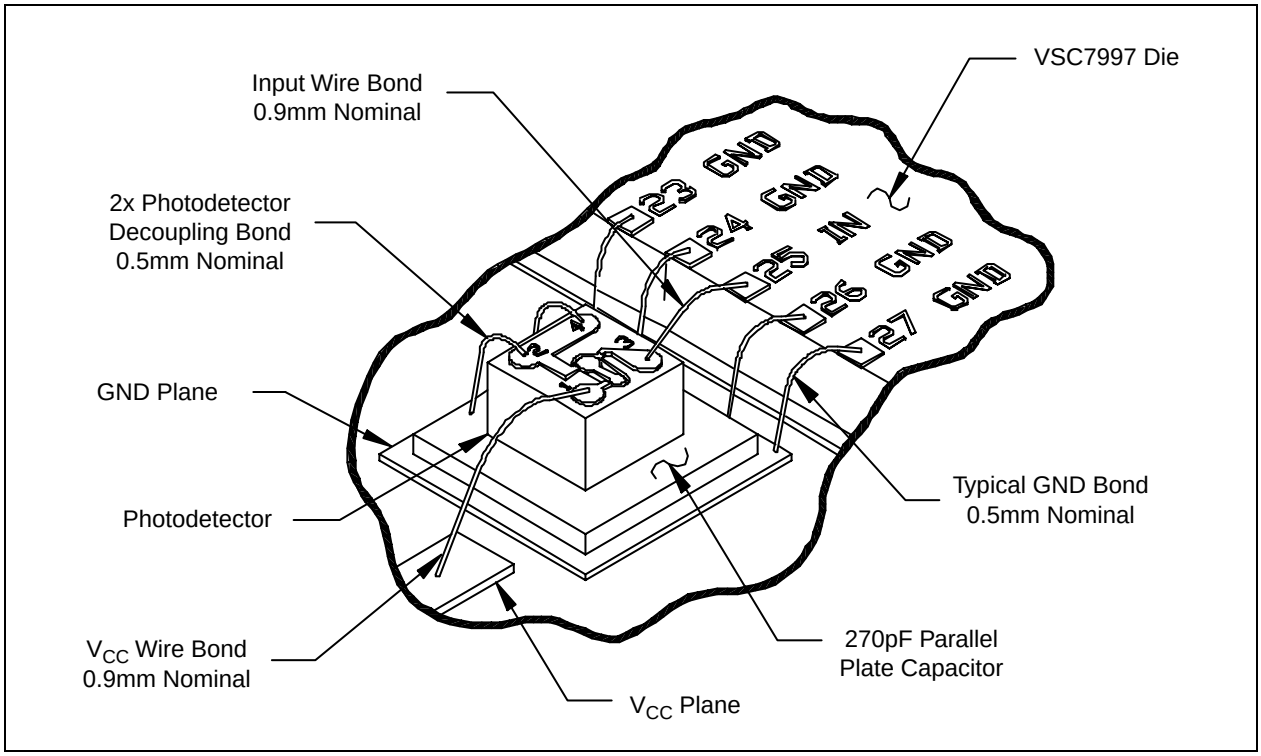
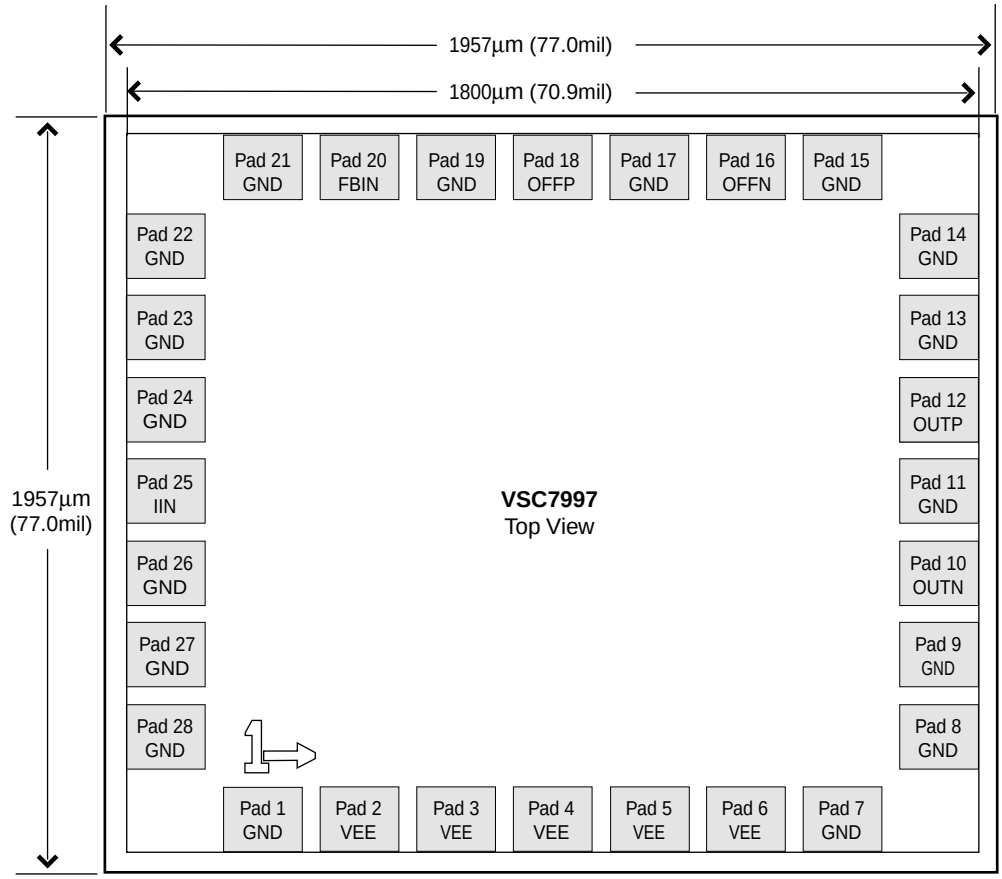


Figure 4. VSC7997 Photodetector Wire Bonding Diagram

BARE DIE INFORMATION



Die Size Including Scribe:	1957µmx 1957µm (77.0mil x 77.0mil)
Die Size Not Including Scribe:	1800µm x 1800µm (70.9mil x 70.9mil)
Pad Size:	94µm x 94µm (3.7mil x 3.7mil)
Pad Passivation Opening:	80µm x 80µm (3.1mil x 3.1mil)
Die Thickness:	279µm (11mils)

Connect die backside to V_{EE} or leave unconnected

Figure 5. Pad Diagram for Bare Die (-W)

Table 6. Coordinates for Bare Die (-W)

Signal	Pad Number	Coordinates (µm)		Description
		X	Y	
GND	1	292.2	88.9	Ground
VEE	2	491.1	88.9	Negative Power Supply
VEE	3	689.9	88.9	Negative Power Supply
VEE	4	888.8	88.9	Negative Power Supply
VEE	5	1087.7	88.9	Negative Power Supply
VEE	6	1286.5	88.9	Negative Power Supply
GND	7	1485.4	88.9	Ground
GND	8	1689.1	253.0	Ground
GND	9	1689.1	519.1	Ground
OUTN	10	1689.1	690.2	Negative Output
GND	11	1689.1	889.1	Ground
OUTP	12	1689.1	1087.9	Positive Output (HIGH for optical input)
GND	13	1689.1	1259.0	Ground
GND	14	1689.1	1525.0	Ground
GND	15	1485.4	1689.1	Ground
OFFN	16	1286.5	1689.1	OUTN DC Level. Connect 100nF capacitor to ground.
GND	17	1087.7	1689.1	Ground
OFFP	18	888.8	1689.1	OUTP DC Level. Connect 100nF capacitor to ground.
GND	19	689.9	1689.1	Ground
FBIN	20	491.1	1689.1	Offset Control Between OUTP and OUTN. Set to –2V for no offset. See Figure 3 on page 5.
GND	21	292.2	1689.1	Ground
GND	22	99.1	1525.0	Ground
GND	23	99.1	1326.1	Ground
GND	24	99.1	1127.2	Ground
IIN	25	99.1	889.1	Input from PIN diode.
GND	26	99.1	650.7	Ground
GND	27	99.1	451.9	Ground
GND	28	99.1	253.0	Ground

ORDERING INFORMATION

VSC7997: SONET/SDH 10.7Gbs High Gain Transimpedance Amplifier

Part Number	Description
VSC7997-W	Dice Waffle Pack

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