

### Preliminary Data Sheet

155.52 Mb/s Clock and  
Data Recovery Units

#### Features

- Recovers Clock and Data at STS-3 (155.52 Mb/s) Data Rate.
- No External Components Required.
- Available in One-channel (VSC8101) or Eight-channel (VSC8102) Versions.
- Recovers Data from NRZ or NRZI Data Streams.
- No Output Clock Drift in Absence of Data Transitions Once Lock is Acquired.
- ECL or Psuedo ECL (PECL) Differential Inputs and Outputs.
- Maximum Power Dissipation:  
VSC8101: 400mW,  
VSC8102: 3W.
- Single 2V Power Supply
- Available in 28PLCC (VSC8101) and 100PQFP (VSC8102)

#### Functional Description

The VSC8101 and VSC8102 are clock and data recovery units for STS-3 (155.52 Mb/s) applications. They implement the complete clock and data recovery functions and require no external components. The one-channel device, VSC8101, accepts serial data in NRZ or NRZI format and re-times the data using a sampling clock extracted from the input data stream. The recovered clock (RCLK+/-) and re-timed data (RDAT+/-) are presented at the serial output ports, aligned such that the falling edge of the recovered clock (RCLK+) coincides with the center of the data eye (see figure 4). The VSC8102 is an octal version of the VSC8101. A single reference clock input (REFCK+/-) at the STS-3 data rate (155.52MHz) is required for either device. The data and reference clock inputs, and the recovered data and clock outputs are differential ECL levels referenced to the V<sub>CC</sub> supply. Only one supply, +2V or -2V, is required for operation.

Both the VSC8101 and VSC8102 employ a digital clock extraction technique, and do not contain a conventional PLL. As a result, the spectrum of the jitter in the recovered clock and data is non-Gaussian. Peak-to-peak jitter of RCLK+/- is  $\pm 400$  ps or less. The data input rate to the devices is required to be within  $\pm 30$  ppm from the reference clock frequency. The devices have data input jitter accommodation up to 3.2ns, half the data period. The VSC8101 and VSC8102 also provide an input which control the loop bandwidth of the clock extraction function.

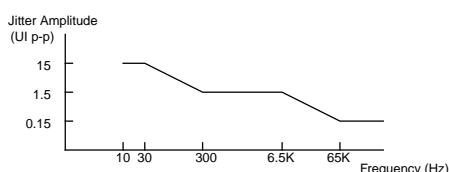
#### Tracking Frequency Bandwidth Control

The tracking of the recovered clock and data to the frequency variation of the input data stream can be adjusted in the VSC8101 and VSC8102. In particular, the FILTER0 input controls the degree to which the internal clock can track the input data frequency. The effect is equivalent to controlling the loop bandwidth of a conventional PLL-based clock recovery system. Equivalent bandwidths of 150 KHz and 10 KHz can be selected. The FILTER0 input truth data is shown in the AC Characteristic Table.

#### Jitter Tolerance

The VSC8101 and VSC8102 are designed to meet the BellcoreGR-253-CORE, section 5.6.2.2.2 Jitter Tolerance specification.

**Figure 1: Jitter Tolerance Mask for STS-3**



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Figure 2: VSC8101 Block Diagram

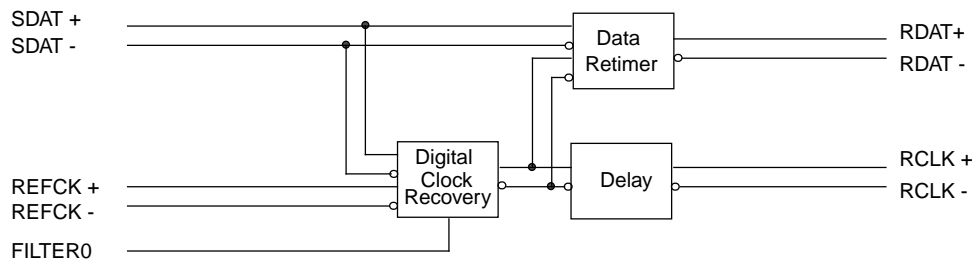
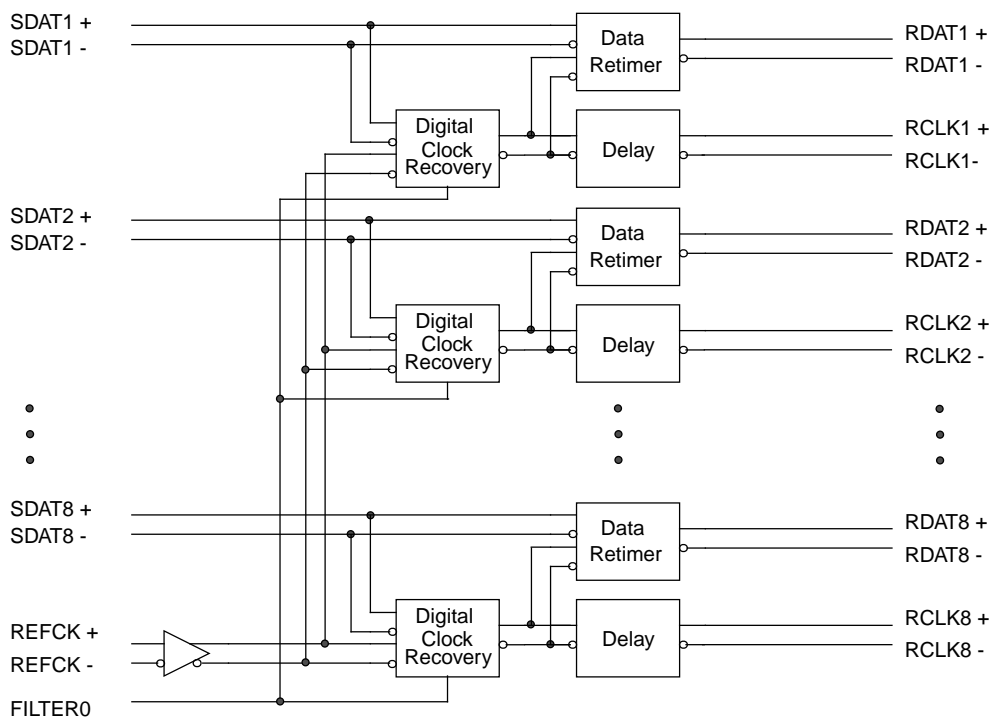


Figure 3: VSC8102 Block Diagram



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#### VSC8101/8102 AC Characteristics (Over recommended operating range)

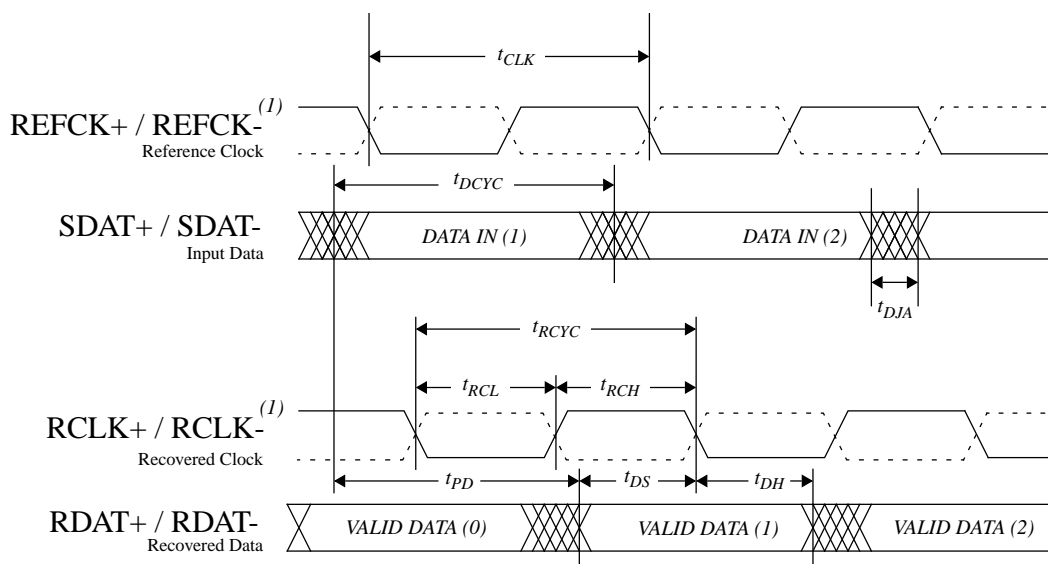
Parameter	Description	Min	Typ	Max	Units
$t_{CLK}$	REFCK+/- Input Clock period <sup>(1)</sup>	—	6.43	—	ns
$t_{DCYC}$	SDAT +/- Input data period	$t_{CLK} - 30 \text{ ppm}$	—	$t_{CLK} + 30 \text{ ppm}$	
$\Delta f_{DC}$	SDAT+/- Input Rate Difference with respect to REFCK+/-	-30	—	+30	ppm
$t_{CDC}$	REFCK+/- Duty Cycle	40	—	60	%
$t_{DH}$	Recovered Data hold time from falling edge of Recovered Clock <sup>(2)</sup>	2.5	—	3.9	ns
$t_{DS}$	Recovered Data setup time to falling edge of Recovered Clock <sup>(2)</sup>	2.5	—	3.9	ns
$t_{RCH}$	RCLK+/- Recovered Clock Output High Pulse Width	2.6	—	—	ns
$t_{RCL}$	RCLK+/- Recovered Clock Output Low Pulse Width	2.6	—	—	ns
$t_{RCYC}$	RCLK+/- Recovered Clock Period	6.0	—	6.8	ns
$t_{DJA}$	SDAT+/- Input Jitter Accommodation (DC to 20 MHz) Peak-to-peak	—	—	3.2	ns
$t_{LA}$	Lock Acquisition Time <sup>(3)</sup>	—	—	5.0	$\mu s$
$f_{BW}$	Loop Bandwidth: a) at FILTER0 = Lo b) at FILTER0 = Hi	—	—	150 10	KHz
$t_{RCJ}$	RCLK+/- Recovered Clock Jitter	-400	—	400	ps
$t_{PD}$	Propagation Delay from SDATA+/- Input to RDAT+/- Output	—	—	TBD	ps
$t_{Cr}, t_{Cf}$	REFCK+/- Input rise and fall time, 20% to 80%	—	—	1.2	ns
$t_{SDr}, t_{SDf}$	SDATA+/- Input rise and fall time, 20% to 80%	—	—	1.2	ns
$t_{RCr}, t_{RCf}$	RCLK+/- Recovered Clock Output rise and fall time, 20% to 80%	300	—	800	ps
$t_{RDr}, t_{RDf}$	RDAT+/- Recovered Data Output rise and fall time, 20% to 80%	300	—	800	ps

Notes: (1) The part is designed to operate at 155.52 MHz. A reference clock with frequency variation of +/- 50 ppm or better is recommended. Consult the factory for applications other than this frequency.

(2) With minimum 50% Input Data Eye opening at 155.52 Mb/s.

(3) With a jitter-free data input and minimum transition density of 50%.

Figure 4: VSC8101/8102 AC Timing Waveform



Note: (1) Solid line indicates the true sense and dotted line indicates the complementary sense of the signal.

**Absolute Maximum Ratings (1)**

Power Supply Voltage ( $V_{CC} - V_{TT}$ ).....	-0.5V to +3.0V
Input Voltage ( $V_{IN}$ ) .....	$V_{CC} - 2.5V$ to $V_{CC} + 0.5V$
Output Current, $I_{OUT}$ (DC, Output HI) .....	-50mA
Case Temperature Under Bias, $T_C$ .....	-55° to +125°C
Storage Temperature ( $T_{STG}$ ) .....	-65°C to +135°C

**Recommended Operating Conditions**

The VSC8101 and VSC8102 can be powered by:

- a) connecting  $V_{CC}$  to +2V and  $V_{TT}$  to GND, or
- b) connecting  $V_{CC}$  to GND and  $V_{TT}$  to -2V.

Power Supply Voltage ( $V_{CC} - V_{TT}$ ).....	2.0V $\pm$ 5%
Operating Temperature Range(2) .....	0° to +70°C

Notes:

- (1) CAUTION: 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.
- (2) Lower limit is ambient temperature and upper limit is case temperature.

### VSC8101/8102 DC Characteristics (Over recommended operating conditions)

Table 1: Inputs and Outputs

Parameter	Description	Min	Typ	Max	Units	Conditions
$V_{IH}$	Input HIGH voltage	$V_{CC} - 1150$	—	$V_{CC} - 600$	mV	Guaranteed HIGH signal for all inputs
$V_{IL}$	Input LOW voltage	$V_{TT}$	—	$V_{CC} - 1500$	mV	Guaranteed LOW signal for all inputs
$V_{OH}$	Output HIGH voltage	$V_{CC} - 1020$	—	$V_{CC} - 700$	mV	$V_{IN} = V_{IH}$ (max) or $V_{IL}$ (min). Outputs terminated identically into $V_{TT}$ with 50 ohms.
$V_{OL}$	Output LOW voltage	$V_{TT}$	—	$V_{CC} - 1620$	mV	$V_{IN} = V_{IH}$ (max) or $V_{IL}$ (min). Outputs terminated identically into $V_{TT}$ with 50 ohms.
$\Delta V_I$	Input voltage swing for REFCK+/- and SDAT+/-	450	—	—	mV	(1) For AC-Coupling: input swing at the pin. (2) For DC-Coupling: input swing referenced to the common mode voltage;
$V_{OCM}$	Output common mode voltage for RDAT+/- and RCLK+/-	.5 + $V_{TT}$	—	.8 + $V_{TT}$		Differential Outputs terminated identically into $V_{TT}$ with 50 ohms.
$\Delta V_O$	Output voltage swing for RDAT+/- and RCLK+/-	600	—	—	mV	Differential Outputs terminated identically into $V_{TT}$ with 50 ohms.

Table 2: Power Dissipation

Parameter	Description	Min	Typ	Max	Units	Conditions
$P_D$	Power dissipation (VSC8101)	—	—	400	mW	Outputs open, $V_{CC} = 2.1V$
$P_D$	Power dissipation (VSC8102)	—	—	3.0	W	same as above
$I_{CC}$	Supply current (VSC8101)	—	—	190	mA	same as above
$I_{CC}$	Supply current (VSC8102)	—	—	1430	mA	same as above

**Generation of 2V Supply for the VSC8101/VSC8102**

In a ECL system, -2V will be one of the standard supplies and the VSC8101/VSC8102 can be powered with GND and -2V. However, for typical TTL systems, 2V is generally not available. In these applications, the 2V supply can be generated easily from a 5V or 3.3V supply. There are several manufacturers who supply complete single-chip linear regulators. Examples are:

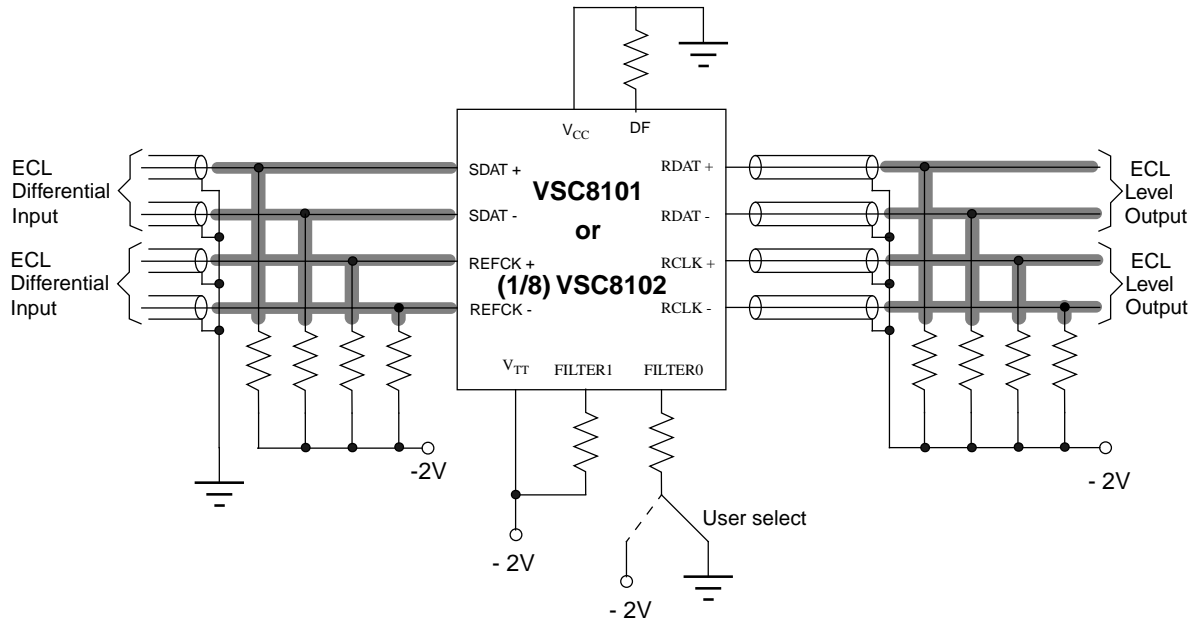
**Table 3: Linear Regulators and Suppliers**

<i>Device</i>	<i>Regulator Recommended</i>	<i>Maximum Supply Current</i>	<i>Manufacturer's Information</i>
VSC8101	REG1117	800mA	Burr Brown, 800-548-6132
VSC8102	LT1086	1.5A	Linear Tech, 408-432-1900

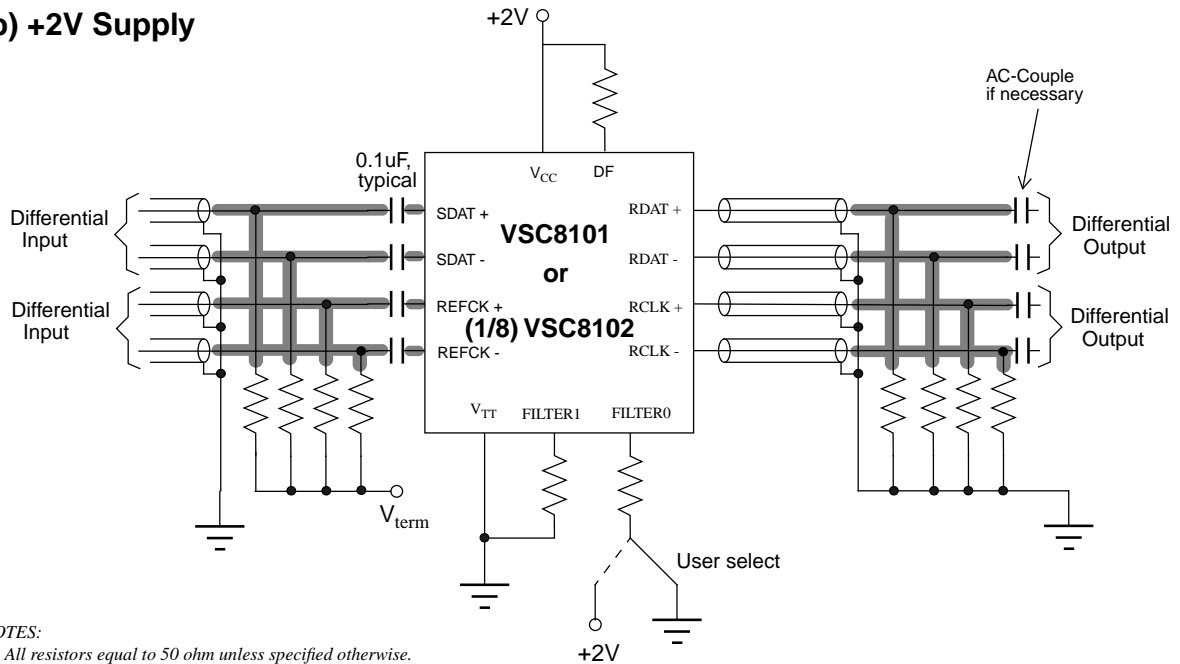
*Note: (1) Complete data sheets for these regulators can be obtained from the manufacturers.*

Figure 5: Typical Applications

(a) -2V Supply



(b) +2V Supply



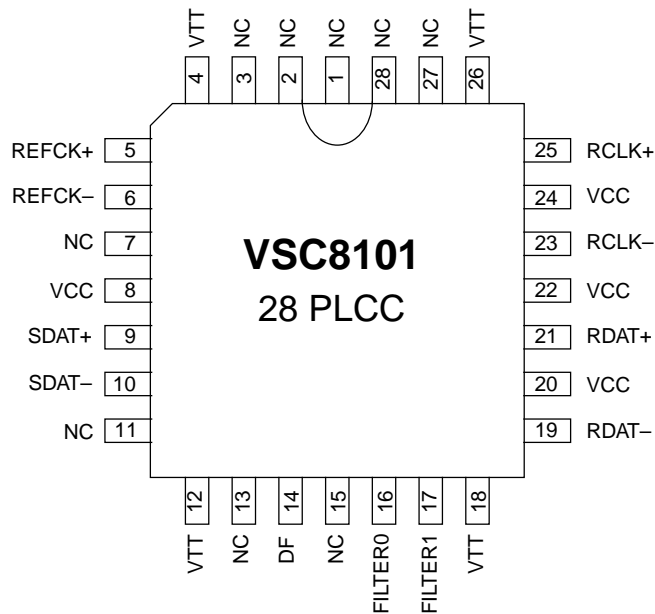
NOTES:

- (1) All resistors equal to 50 ohm unless specified otherwise.
- (2) Shaded lines represent stubs of transmission lines. They should have the corresponding traces on board be as short as possible to minimize reflection.

**Table 4: VSC8101 Pin Description**

Signal Name	Pin	Level	Description
REFCK+	5	ECL	Reference Clock input true
REFCK-	6	ECL	Reference Clock input complement
SDAT+	9	ECL	Data input true
SDAT-	10	ECL	Data input complement
RCLK+	25	ECL	Recovered Clock true
RCLK-	23	ECL	Recovered Clock complement
RDAT+	21	ECL	Recovered Data true
RDAT-	19	ECL	Recovered Data complement
FILTER0	16	V <sub>CC</sub> /V <sub>TT</sub>	Selects the Loop Bandwidth: (1) FILTER0 = LO, Bandwidth = 150 KHz (2) FILTER0 = HI, Bandwidth = 10 KHz
FILTER1	17	V <sub>TT</sub>	For normal operation, connect to V <sub>TT</sub> thru 50 ohm resistor
DF	14	V <sub>CC</sub>	For normal operation, connect to V <sub>CC</sub> thru 50 ohm resistor
NC	1-3,7,11,13, 15,27,28		Do not connect, leave open
VCC	8,20,22,24		Positive supply, V <sub>CC</sub>
VTT	4,12,18,26		Negative supply, V <sub>TT</sub>

**Figure 6: VSC8101 Pin Diagram**





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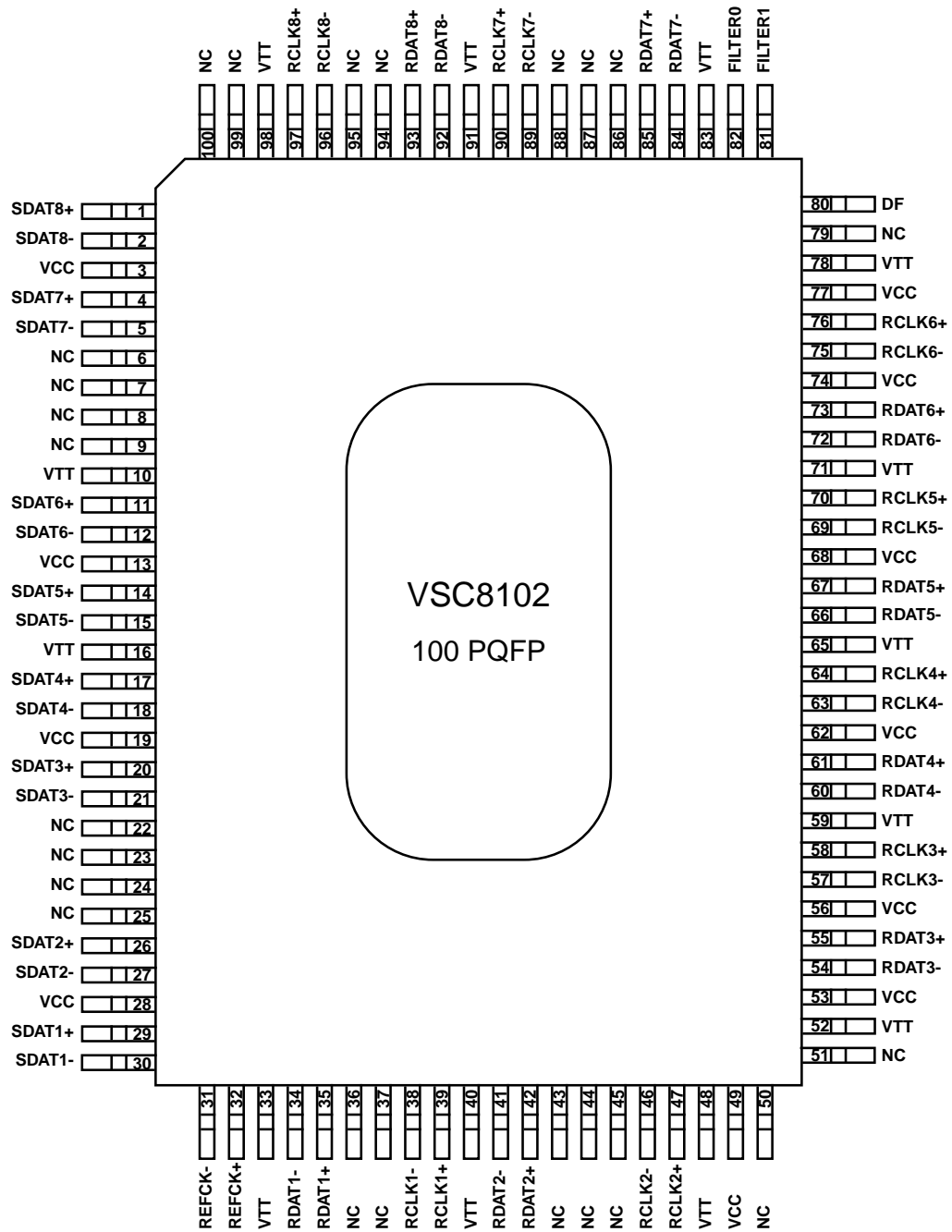
**Table 5: VSC8102 Pin Description**

<i>Signal Name</i>	<i>Pin</i>	<i>Level</i>	<i>Description</i>
REFCK+	32	ECL	Reference Clock Input True
REFCK-	31	ECL	Reference Clock input complement
SDAT+	29,26,20,17, 14,11,4,1	ECL	Data input true
SDAT-	30,27,21,18, 15,12,5,2	ECL	Data input complement
RCLK+	39,47,58,64, 70,76,90,97	ECL	Recovered Clock true
RCLK-	38,46,57,63, 69,75,89,96	ECL	Recovered Clock complement
RDAT+	35,42,55,61, 67,73,85,93	ECL	Recovered Data true
RDAT-	34,41,54,60, 66,72,84,92	ECL	Recovered Data complement
FILTER0	82	$V_{CC}/V_{TT}$	Selects the Loop Bandwidth: (1) FILTER0 = LO, Bandwidth = 150 KHz (2) FILTER0 = HI, Bandwidth = 10 KHz
FILTER1	81	$V_{TT}$	For normal operation, connect to $V_{TT}$ thru 50 ohm resistor
DF	80	$V_{CC}$	For normal operation, connect to $V_{CC}$ thru 50 ohm resistor
NC	6-9,22-25,36,37,43- 45,50,51,79, 86-88,94,95, 99,100		Do not connect, leave open
VCC	3,13,19,28,49,53,56, 62,68, 74,77		Positive supply, $V_{CC}$
VTT	10,16,33,40, 48,52,59,65, 71,78,83,91, 98		Negative supply, $V_{TT}$

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Figure 7: VSC8102 Pin Diagram



DRAWING IS HEAT SINK UP

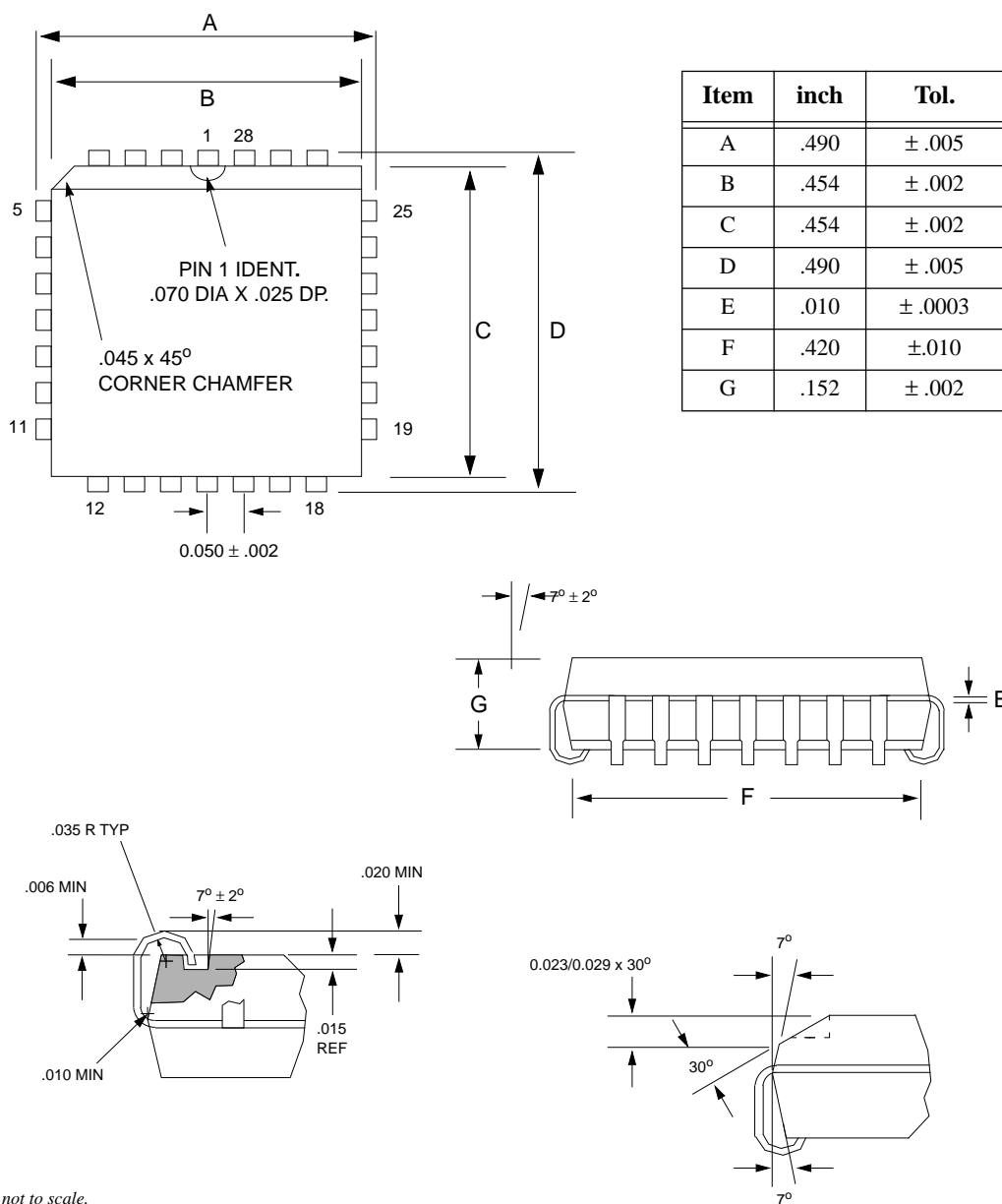
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### Package Information

The VSC8101 is packaged in a 28-pin Plastic Leaded Chip Carrier (PLCC), 0.454 x 0.454 in.<sup>2</sup> body size. The VSC8102 is packaged in a 100-pin Plastic Quad Flat Pack (PQFP), 20 x 14 mm<sup>2</sup> body size).

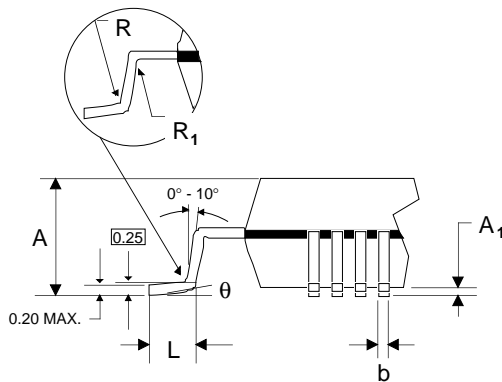
Figure 8: VSC8101 Package Drawings (28PLCC-JEDEC)



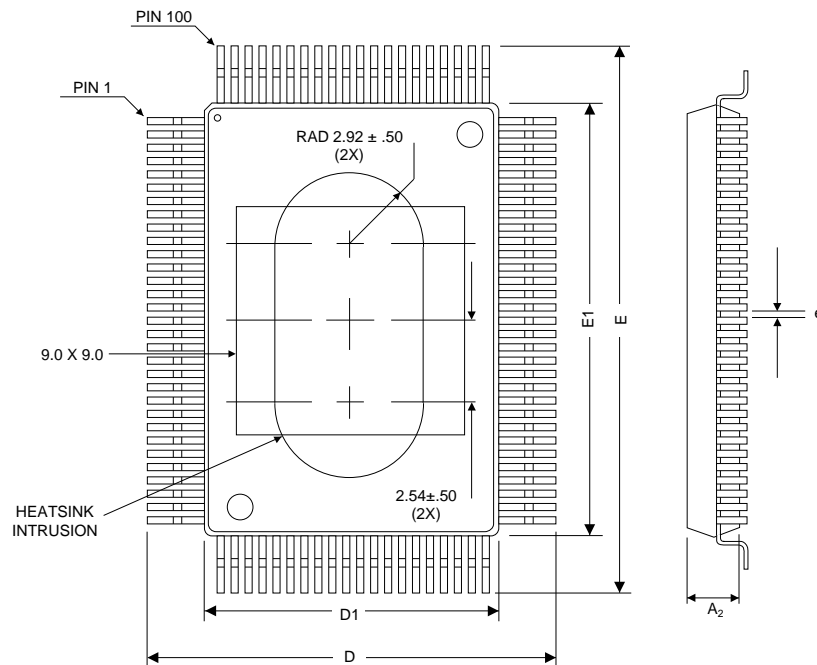
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Figure 9: VSC8102 Package Drawings (100PQFP)



Dims.	mm	Tolerance
A	3.40	MAX
A1	0.60	MAX
A2	2.7	±.10
D	17.20	±.40
D1	14.00	±.10
E	23.20	±.40
E1	20.00	±.10
L	0.80	±.2
e	0.65	NOM
b	0.30	±.10
θ	0-10°	
R	.25	NOM
R1	.2	NOM



NOTES:  
 (1) Drawings not to scale.  
 (2) Two styles of exposed heat spreaders may be used; square or oval.  
 (3) All units in millimeters

### **Thermal Characteristics of the VSC8101 and VSC8102 Packages**

#### **VSC8101**

The VSC8101 is packaged in a 28PLCC, with an internal heat spreader for improved heat dissipation. With natural convection, the Case to Air Thermal Resistance ( $\theta_{CA}$ ) is estimated to be 65°C/W.

#### **VSC8102**

The VSC8102 is packaged in a thermally enhanced 100PQFP with an embedded heat spreader. The heat spreader surface area is shown in figure 9. With natural convection, the Case to Air Thermal Resistance ( $\theta_{CA}$ ) is estimated to be 27.5°C/W. The Air Flow versus Thermal Resistance relationship is shown in the following table:

**Table 6:  $\theta_{CA}$  Versus Air Velocity for the VSC8102 Package**

<i>Air Velocity (LFPM)</i>	<i>Case to Air Thermal Resistance (°C/W)</i>
0	27.5
100	23.1
200	19.8
400	17.6
600	16

***Ordering Information***

The order numbers for this product family are:

<b>Part Number</b>	<b>Device Type</b>
VSC8101JA:	1-Channel Clock and Data Recovery Unit in 28 Pin PLCC
VSC8102QB:	8-Channel Clock and Data Recovery Unit in 100 Pin PQFP

***Notice***

This document contains information about a product during its preproduction phase of development. The information in this document is based on test results and initial product characterization. Characteristic data and other specifications are subject to change without notice. Therefore the reader is cautioned to confirm that this datasheet is current prior to design or order placement.

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