

### Features

- High-Speed Operation:  
1 Gb/s Data Rate  
500ps min Output Pulse Width  
750ps min Input Pulse Width
- Excellent Overall Timing Accuracy:  
Ultra-Stable Timing Delays  
Minimum Pattern Dependence  
Very Fine Timing Resolution (1 LSB = 8ps)
- High Level of Integration Reduces Board Area:  
16 Independently Adjustable Delay Lines in a Single Package
- Configurable as 2 1:8 or 1:16
- Wide Span: > 4ns Usable Range
- Pulse Width Adjustment to Compensate for Dispersion in Pin Electronics:  
 $\pm$  2ns Independent Adjustment of Rising and Falling Edges
- Fully Digital Single-Chip Solution:  
No Off-Chip DACs Required  
No DAC-Induced Timing Errors from Analog Crosstalk, Reference Noise, Temperature, or Voltage Drift
- Single Power Supply: -2V @ 5W
- 128-Pin PQFP, 14x20mm Thermally-Enhanced Package

### Applications

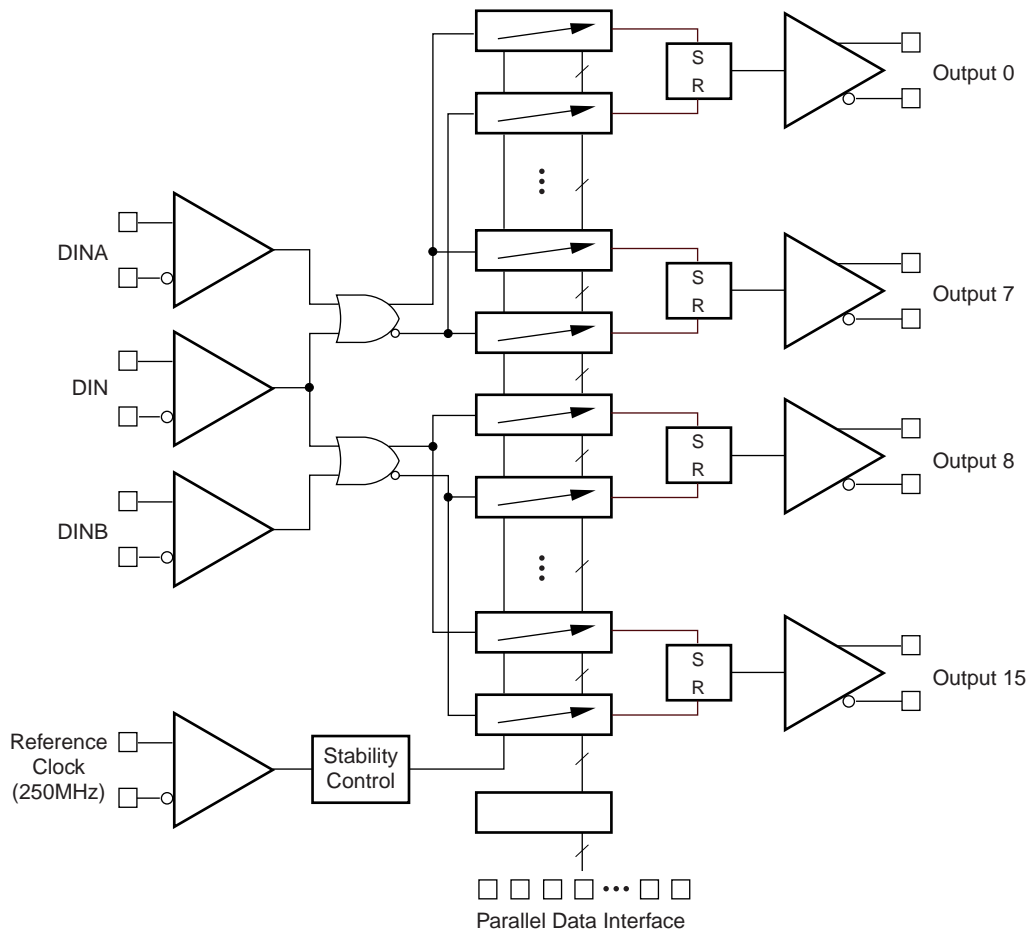
- Drive-Side Deskew in High-Speed Memory Testers
- Direct RAMBUS DRAM, SLDRAM, DDR SDRAM, Fast SSRAM
- High-Speed Instrumentation: Pulse Generators, Timing Margin Testers for Datalink, Interface, and Disk Drive Applications
- Telecom, Datacom, and Computer Deskew

### General Description

The VSC6250 is intended for use in the next generation of high-speed, high-accuracy memory testers for devices such as Direct RAMBUS DRAM, SLDRAM, DDR SDRAM, and fast SSRAM.

The VSC6250 provides ultra-precise timing to allow next generation memory testers to achieve excellent overall timing accuracy. Timing delays of the VSC6250 are extremely stable with respect to temperature and voltage. Proprietary circuit design and process technology reduce pattern, data, frequency, and duty-cycle dependencies to an absolute minimum. The VSC6250 requires no external DACs, which eliminates errors due to DAC reference noise and analog crosstalk, and DAC temperature and voltage drift. The VSC6250 is available in a 128-pin PQFP, 14x20mm thermally-enhanced package.

## VSC6250 Block Diagram



## Functional Description

The VSC6250 is a 1Gb/s 16-channel drive-path deskew IC designed for deskewing differences in path delay between multiple DUTs in a high-speed memory test system. The VSC6250 can be used as two independent 1:8 fanout and deskew sections or as a single 1:16 fanout and deskew. When used as two 1:8 deskews, input signals are applied to inputs DIN A and DIN B. When used as a single 1:16 deskew, the input is applied to input DIN.

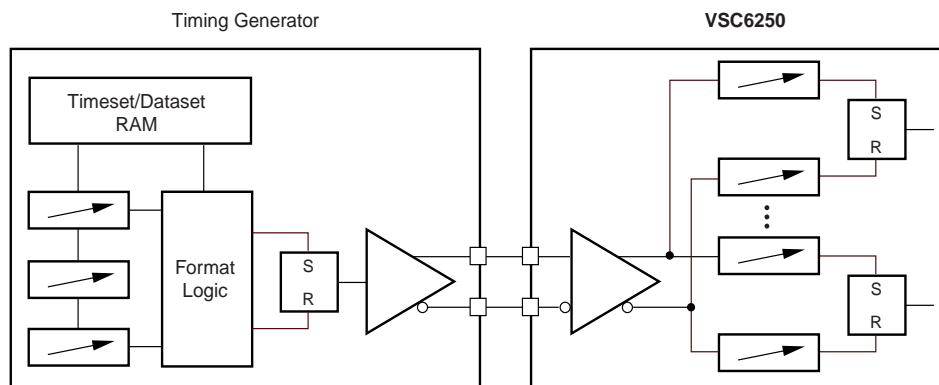
The VSC6250 is designed to operate with a conventional 500MHz timing generator which outputs formatted pulses to the VSC6250 deskew IC. See Figure 1. The waveform at the input of the VSC6250 is the same as that presented to the DUT pin. In a memory tester, such a 500MHz timing generator IC may be designed:

- Using one edge to output a single 500Mb/s data stream
- Using two edges to output a single 500Mb/s data stream preceded its complement
- Using three edges to output a single data stream at 500Mb/s surrounded by its complement
- Using two edges to output two interleaved 500Mb/s data streams for an aggregate bandwidth of 1Gb/s.

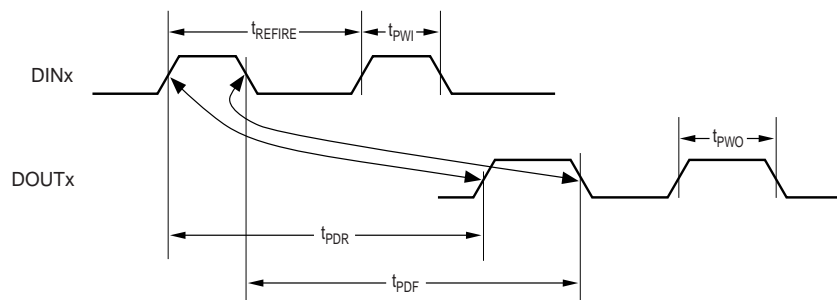
Formatting is performed inside the timing generator IC. An example interface between the timing generator IC and the deskew is shown in Figure 1. This configuration is capable of supporting the four different data output choices, with appropriate design of the formatting logic.

The VSC6250 can handle pulses with a data rate up to 1Gb/s or a pulse repetition rate up to 2ns. A timing diagram for the VSC6250 is shown in Figure 2.

**Figure 1: VSC6250 Interface to Timing Generator IC**



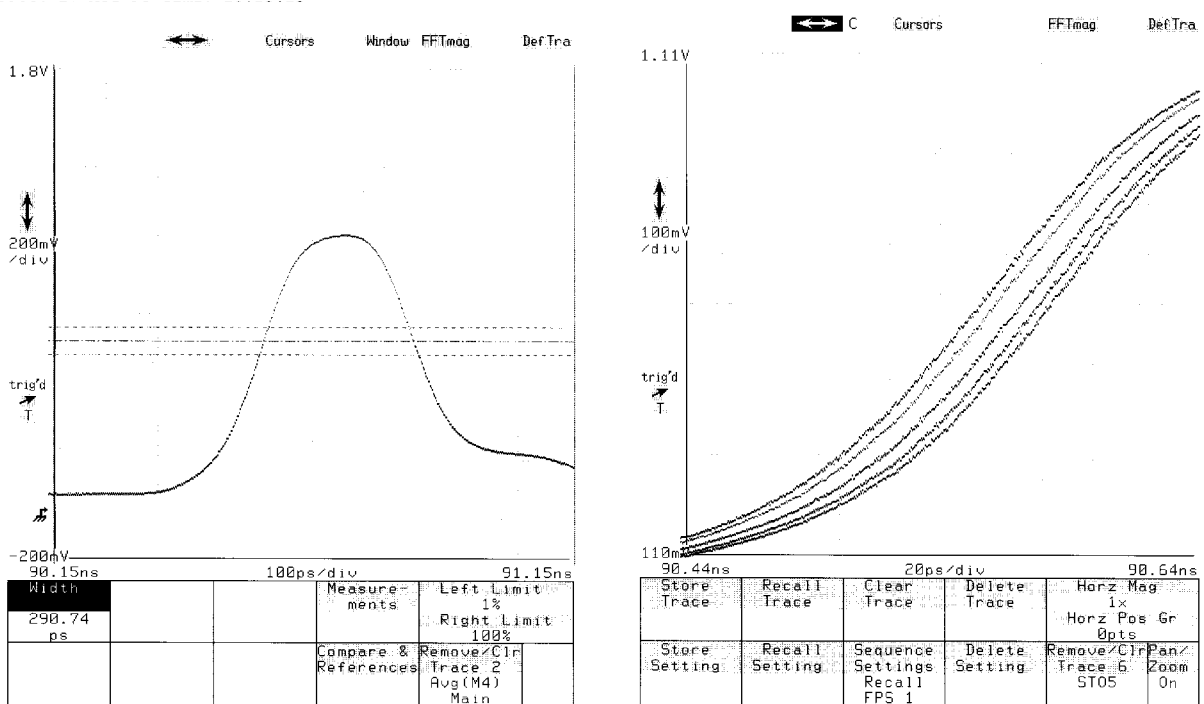
**Figure 2: VSC6250 AC Timing Diagram**



The delay of each of the deskewed outputs can be adjusted separately to compensate for differences in path length between DUTs on a single test head. The maximum delay is 7ns. Delay span is 5ns. Usable range is a minimum of 4ns<sup>(1)</sup>. Resolution is 8ps. To compensate for pulse dispersion in pin electronics, delay of the rising and falling edges can be adjusted independently.

To ensure timing performance, delay of the VSC6250 is measured in production at every time step of every vernier. Figure 3 shows measured output waveforms of the VSC6250. Figure 3 (a) shows a measured minimum output pulse width. The specified minimum output pulse width is 500ps, but this measurement shows operation down to 300ps. Figure 3 (b) shows typical timing resolution of 8ps.

**Figure 3: VSC6250 Measured Output Waveforms**



a) Minimum output pulse width of 300ps

(b) Typical timing resolution of 8ps

With next generation testers required to test more DUTs per testhead in the same footprint, board area is a critical design parameter. Providing 16 deskew channels in a 14mmx20mm thermally-enhanced 128-pin PQFP package, the VSC6250 consumes less than 1/2 the total board area of the bipolar alternative.

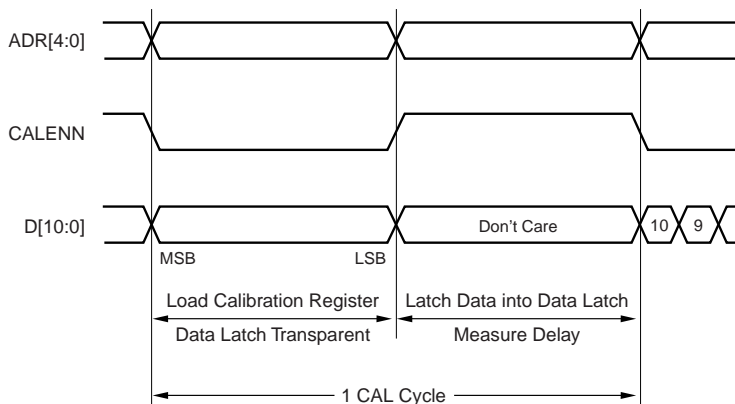
The 32 delays (rising and falling edges for 16 channels) in the VSC6250 are programmed using a parallel interface. Verniers are selected by a 5-bit address word and controlled by two function enable bits. Each vernier requires 11 bits to set the delay value.

Power dissipation of the VSC6250 is less than 5W from a single -2V supply.

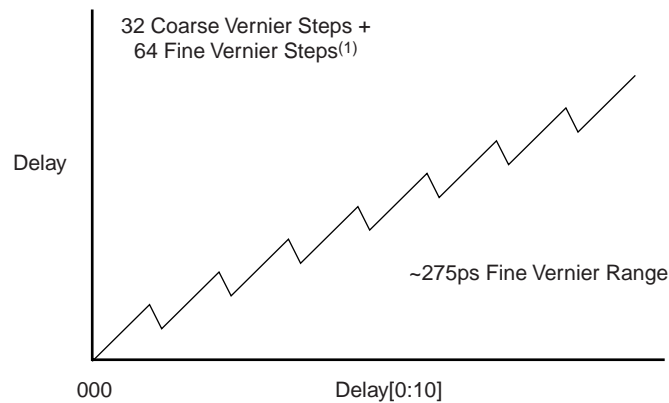
**Table 1: Operational Mode Truth Table**

Mode #	Mode Name	CALENN	Mode Description
1	Cal Mode	0	Sets timing delays with each vernier selected with ADR [3:0] Serial Data Input.
2	User Mode	1	Generates timing delays as set by data in Cal Mode.

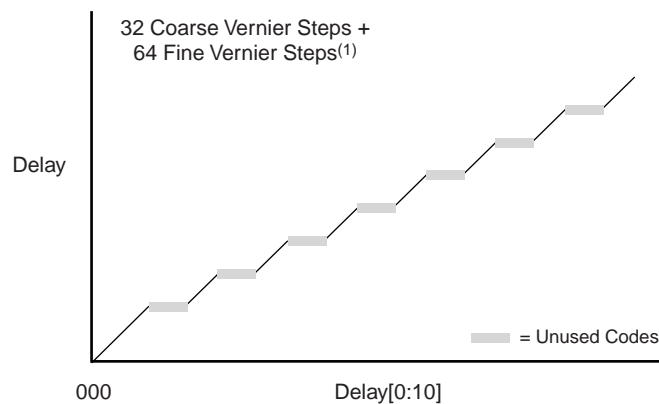
**Figure 4: CAL Mode Timing Diagram**



**Figure 5: CAL Mode: Pre-Calibration Delay Range**



**Figure 6: CAL Mode: Post-Calibration Delay Range**



NOTE: (1) There are 32 coarse vernier codes and 64 fine vernier codes. Not all of the codes are used to reach maximum delay. The current design utilizes 22 coarse codes and 47 fine vernier codes. Future designs will utilize 22 course designs and 59 fine vernier codes. These numbers must be used when calculating INL and DNL. System calibration should be performed with the maximum usable codes. When a code is programmed beyond the maximum utilized code, the delay will toggle between maximum delay and maximum delay minus 1LSB. Please contact your local Vitesse sales representative to determine when the future design will be available.

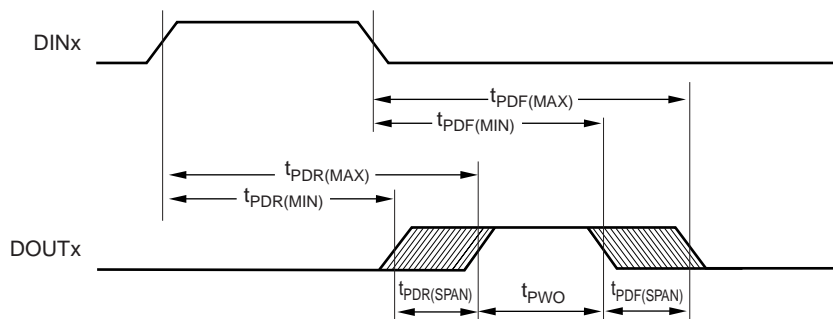
## AC Timing Characteristics

**Table 2: AC Timing Characteristics**

Parameter	Description	Min	Typ	Max	Units
$t_{PDR(MIN)}$ , $t_{PDF(MIN)}$	Propagation Delay, Minimum Delay	4.1	5	6.5	ns
$t_{PDR(MAX)}$ , $t_{PDF(MAX)}$	Propagation Delay, Maximum Delay	9.9	11.6	13.5	ns
$t_{PD(SPAN)}$	Propagation Delay, Span	5.8	—	7	ns
$t_{RES}$	Delay Element Resolution	—	8	20	ps
DNL	Delay Differential Nonlinearity	-2	—	+2	LSB
$t_{PWI}$	Input Pulse Width	0.75	—	—	ns
$t_{PWO}$	Output Pulse Width	0.5	—	—	ns
FRCK	Reference Clock Frequency	—	250	—	MHz
DTDD	Variation in Delay vs. Duty Cycle	-50	—	+50	ps
DTDT	Variation in Delay vs Temperature	—	2	—	ps/C°
PSRR	Power Supply Rejection Ratio <sup>(1)</sup>	—	—	230	ps/100mV
$t_R/t_F$	Output Rise Fall Times (20% to 80%)	—	300	—	ps
$t_{REFIRE}$	Adjacent Edge Spacing	2	—	—	ns
$J_O$	Output Jitter	—	3	—	ps rms

NOTE: (1) Change in range of maximum delay.

**Figure 7: AC Timing Diagram**



## DC Characteristics

**Table 3: Single Ended ECL Inputs and Outputs**

Parameter	Description	Min	Typ	Max	Units	Conditions
V <sub>OH</sub>	Output HIGH Voltage	-1020	—	-700	mV	
V <sub>OL</sub>	Output LOW Voltage	-2000	—	-1620	mV	
V <sub>IH</sub>	Input HIGH Voltage	-1165	—	-700	mV	
V <sub>IL</sub>	Input LOW Voltage	-2000	—	-1475	mV	
I <sub>IH</sub>	Input HIGH Current	-	—	200	μA	V <sub>IN</sub> = V <sub>IH</sub> (max)
I <sub>IL</sub>	Input LOW Current	-50	—	—	μA	V <sub>IN</sub> = V <sub>IL</sub> (min)

NOTE: V<sub>TT</sub> = -2.0V ± 5%, V<sub>CC</sub> = V<sub>CCA</sub> = GND, R<sub>LOAD</sub> = 50Ω to -2.0V, external reference (V<sub>REF</sub>) = -1.32V ± 25mV.

**Table 4: Differential ECL Inputs and Outputs**

Parameter	Description	Min	Typ	Max	Units	Conditions
V <sub>INDIFF</sub>	Input Voltage Differential	200	—	—	mV	Required for full output swing
V <sub>INCM</sub>	Input Common-Mode Voltage	-1.5	—	-0.5	V	Common-mode range required for full output swing with V <sub>DIFF</sub> applied
V <sub>OUTDIFF</sub>	Output Voltage Differential	400	—	—	mV	Output voltage swing
V <sub>OUTCM</sub>	Output Common-Mode Voltage	-1.5	—	-0.7	V	Common-mode output voltage

**Table 5: VSC6250 Power Dissipation**

Parameter	Description	Min	Typ	Max	Units	Conditions
I <sub>TT</sub>	V <sub>TT</sub> Supply Current	—	2000	2870	mA	
P <sub>D</sub>	Power Dissipation <sup>(1)</sup>	—	4	6	W	

NOTE: (1) Output power dissipation does not include load power.



### **Absolute Maximum Ratings<sup>(1)</sup>**

Power Supply Voltage ( $V_{TT}$ ) .....	-2.5V to +0.5V
ECL Input Voltage Applied, ( $V_{IN\ ECL}$ ).....	+0.5V to $V_{TT} + -0.5V$
Output Current ( $I_{OUT}$ ) .....	50mA
Case Temperature Under Bias ( $T_C$ ) .....	-55°C to + 125°C
Storage Temperature ( $T_{STG}$ ).....	-65°C to + 150°C

### **Recommended Operating Conditions**

Power Supply Voltage ( $V_{TT}$ ).....	-2.0V $\pm$ 5%
Commercial Operating Temperature Range <sup>(2)</sup> (T) .....	30°C 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 of specification is ambient temperature and upper limit is case temperature.*

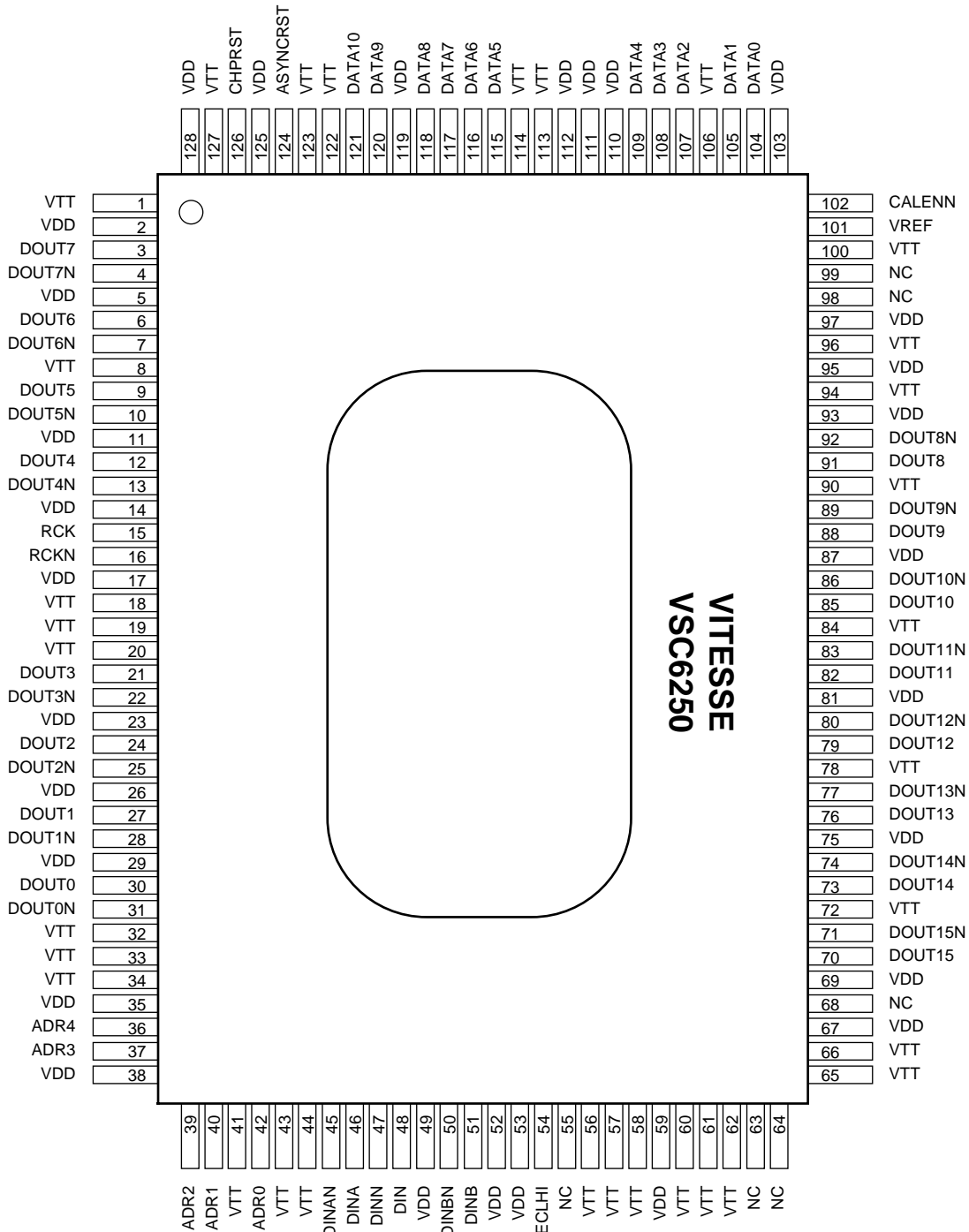
### **ESD Ratings**

Proper ESD procedures should be used when handling this product. The VSC6250 is rated to the following ESD voltages based on the human body model:

1. All pins are rated at or above 1500V.

## Package Information

Figure 8: Pin Diagram



**Table 6: Pin Identifications**

<i>Pin #</i>	<i>Signal Name</i>	<i>Signal Type</i>	<i>Levels</i>	<i>Description</i>
1	VTT	—	-2.0V	Power Supply
2	VDD	—	0V	Ground
3	DOUT7	O	ECL	Output Channel 7, True
4	DOUT7N	O	ECL	Output Channel 7, Complementary
5	VDD	—	0V	Ground
6	DOUT6	O	ECL	Output Channel 6, True
7	DOUT6N	O	ECL	Output Channel 6, Complementary
8	VTT	—	-2.0V	Power Supply
9	DOUT5	O	ECL	Output Channel 5, True
10	DOUT5N	O	ECL	Output Channel 5, Complementary
11	VDD	—	0V	Power Supply
12	DOUT4	O	ECL	Output Channel 4, True
13	DOUT4N	O	ECL	Output Channel 4, Complementary
14	VDD	—	0V	Ground
15	RCK	I	ECL	250 MHz Reference Clock, True
16	RCKN	I	ECL	250 MHz Reference Clock, Complementary
17	VDD	—	0V	Ground
18	VTT	—	-2.0V	Power Supply
19	VTT	—	-2.0V	Power Supply
20	VTT	—	-2.0V	Power Supply
21	DOUT3	O	ECL	Output Channel 3, True
22	DOUT3N	O	ECL	Output Channel 3, Complementary
23	VDD	—	0V	Ground
24	DOUT2	O	ECL	Output Channel 2, True
25	DOUT2N	O	ECL	Output Channel 2, Complementary
26	VDD	—	0V	Ground
27	DOUT1	O	ECL	Output Channel 1, True
28	DOUT1N	O	ECL	Output Channel 1, Complementary
29	VDD	—	0V	Ground
30	DOUT0	O	ECL	Output Channel 0, True
31	DOUT0N	O	ECL	Output Channel 0, Complementary
32	VTT	—	-2.0V	Power Supply
33	VTT	—	-2.0V	Power Supply
34	VTT	—	-2.0V	Power Supply
35	VDD	—	0V	Ground
36	ADR4	I	ECL	Address Bit 4 for Vernier Selection
37	ADR3	I	ECL	Address Bit 3 for Vernier Selection

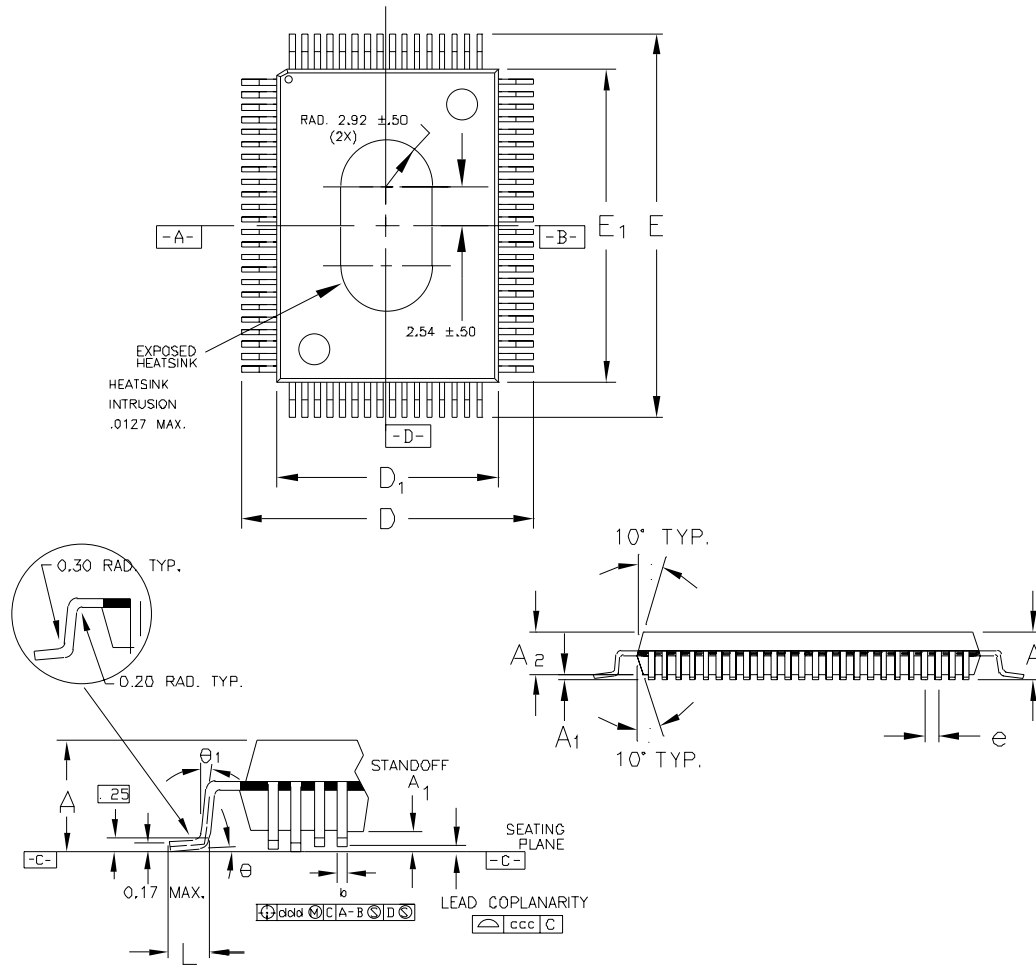
<i>Pin #</i>	<i>Signal Name</i>	<i>Signal Type</i>	<i>Levels</i>	<i>Description</i>
38	VDD	—	0V	Ground
39	ADR2	I	ECL	Address Bit 2 for Vernier Selection
40	ADR1	I	ECL	Address Bit 1 for Vernier Selection
41	VTT	—	-2.0V	Power Supply
42	ADR0	I	ECL	Address Bit 3 for Vernier Selection
43	VTT	—	-2.0V	Power Supply
44	VTT	—	-2.0V	Power Supply
45	DINAN	I	ECL	Input A, Complementary
46	DINA	I	ECL	Input A, True
47	DINN	I	ECL	Common Input, Complementary
48	DIN	I	ECL	Common Input, True
49	VDD	—	0V	Ground
50	DINBN	I	ECL	Input B, Complementary
51	DINB	I	ECL	Input B, True
52	VDD	—	0V	Ground
53	VDD	—	0V	Ground
54	ECLHI	O	ECL	ECL High Voltage
55	NC	—	—	Not Connected
56	VTT	—	-2.0V	Power Supply
57	VTT	—	-2.0V	Power Supply
58	VTT	—	-2.0V	Power Supply
59	VDD	—	0V	Ground
60	VTT	—	-2.0V	Power Supply
61	VTT	—	-2.0V	Power Supply
62	VTT	—	-2.0V	Power Supply
63	NC	—	0V	Not Connected
64	NC	—	0V	Not Connected
65	VTT	—	-2.0V	Power Supply
66	VTT	—	-2.0V	Power Supply
67	VDD	—	0V	Ground
68	NC	—	0V	Not Connected
69	VDD	—	0V	Ground
70	DOUT15	O	ECL	Output Channel 15, True
71	DOUT15N	O	ECL	Output Channel 15, Complementary
72	VTT	—	-2.0V	Power Supply
73	DOUT14	O	ECL	Output Channel 14, True
74	DOUT14N	O	ECL	Output Channel 14, Complementary
75	VDD	—	0V	Ground

<i>Pin #</i>	<i>Signal Name</i>	<i>Signal Type</i>	<i>Levels</i>	<i>Description</i>
76	DOUT13	O	ECL	Output Channel 13, True
77	DOUT13N	O	ECL	Output Channel 13, Complementary
78	VTT	—	-2.0V	Power Supply
79	DOUT12	O	ECL	Output Channel 12, True
80	DOUT12N	O	ECL	Output Channel 12, Complementary
81	VDD	—	0V	Ground
82	DOUT11	O	ECL	Output Channel 11, True
83	DOUT11N	O	ECL	Output Channel 11, Complementary
84	VTT	—	-2.0V	Power Supply
85	DOUT10	O	ECL	Output Channel 10, True
86	DOUT10N	O	ECL	Output Channel 10, Complementary
87	VDD	—	0V	Ground
88	DOUT9	O	ECL	Output Channel 9, True
89	DOUT9N	O	ECL	Output Channel 9, Complementary
90	VTT	—	-2.0V	Power Supply
91	DOUT8	O	ECL	Output Channel 8, True
92	DOUT8N	O	ECL	Output Channel 8, Complementary
93	VDD	—	0V	Ground
94	VTT	—	-2.0V	Power Supply
95	VDD	—	0V	Ground
96	VTT	—	-2.0V	Power Supply
97	VDD	—	0V	Ground
98	NC	—	—	Not Connected
99	NC	—	—	Not Connected
100	VTT	—	-2.0V	Power Supply
101	VREF	DC	-1.32V	ECL Reference Voltage
102	CALENN	I	ECL	Write Delay Register
103	VDD	—	0V	Ground
104	DATA0	I	ECL	Delay Bit 0
105	DATA1	I	ECL	Delay Bit 1
106	VTT	—	0V	Power Supply
107	DATA2	I	ECL	Delay Bit 2
108	DATA3	I	ECL	Delay Bit 3
109	DATA4	I	ECL	Delay Bit 4
110	VDD	—	0V	Ground
111	VDD	—	0V	Ground
112	VDD	—	0V	Ground
113	VTT	—	-2.0V	Power Supply
114	VTT	—	-2.0V	Power Supply

<i>Pin #</i>	<i>Signal Name</i>	<i>Signal Type</i>	<i>Levels</i>	<i>Description</i>
115	DATA5	I	ECL	Delay Bit 5
116	DATA6	I	ECL	Delay Bit 6
117	DATA7	I	ECL	Delay Bit 7
118	DATA8	I	ECL	Delay Bit 8
119	VDD	—	0V	Ground
120	DATA9	I	ECL	Delay Bit 9
121	DATA10	I	ECL	Delay Bit 10
122	VTT	—	-2.0V	Power Supply
123	VTT	—	-2.0V	Power Supply
124	ASYNCRST	I	ECL	Asynchronously resets all vernier outputs to logic LOW.
125	VDD	—	0V	Ground
126	CHPRST	I	ECL	Chip Reset. Resets all vernier outputs to LOW and initializes all delay registers to zero.
127	VTT	—	-2.0V	Power Supply
128	VDD	—	0V	Ground

## Package Information

### 128-Pin Thermally-Enhanced PQFP



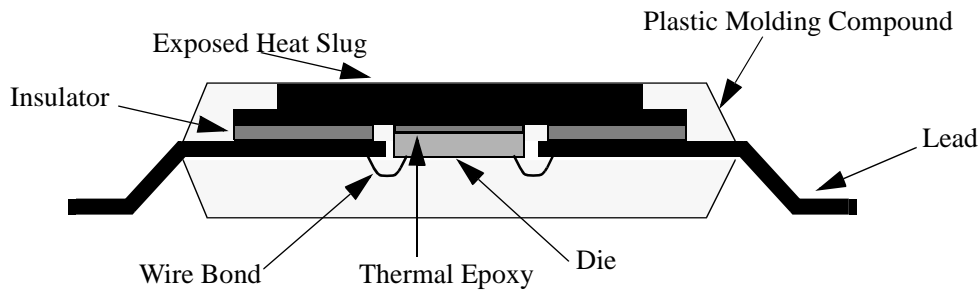
Body + 3.2mm Footprint, 2.70mm Thick

DIMENSIONS	LEADS	TOLERANCES	NOTES:
A	3.40	MAX.	1) All dimensions in mm.
A <sub>1</sub>	0.25 / 0.50	MIN./MAX.	2) Dimensions shown are nominal with tolerances as indicated.
A <sub>2</sub>	2.70	±0.10	3) Foot length "L" is measure at gage plane, 0.25 above the seating plane.
D	17.20	±0.20	
D <sub>1</sub>	14.00	±0.10	
E	23.20	±0.20	
E <sub>1</sub>	20.00	±0.10	
L	0.88	+0.15 / -0.10	
e	0.50	BASIC	
b	0.22	±0.05	
θ	0° - 7°		
θ <sub>1</sub>	6°	±4°	
ddd	0.8 MAX.		
ccc	0.08	MAX.	

## Package Thermal Characteristics

The VSC6250 is packaged in an 128-pin, 14x20mm thermally-enhanced PQFP with an internal heat spreader. These packages use industry-standard EIAJ footprints, which have been enhanced to improve thermal dissipation. The construction of the packages are as shown in Figure 9. The VSC6250 is designed to operate with a case temperature up to 90°C. The user must guarantee that the temperature specification is not violated.

**Figure 9: Package Cross Section**



**Table 7: Thermal Resistance**

<i>Symbol</i>	<i>Description</i>	<i>Value</i>	<i>Units</i>
$\theta_{JC}$	Thermal resistance from junction-to-case	6.6	°C/W
$\theta_{CA-0}$	Thermal resistance from case-to-ambient, still air	23	°C/W
$\theta_{CA-100}$	Thermal resistance from case-to-ambient, 100 LFPM air	21	°C/W
$\theta_{CA-200}$	Thermal resistance from case-to-ambient, 200 LFPM air	19.9	°C/W
$\theta_{CA-400}$	Thermal resistance from case-to-ambient, 400 LFPM air	18	°C/W
$\theta_{CA-600}$	Thermal resistance from case-to-ambient, 600 LFPM air	17.3	°C/W
$\theta_{CA-800}$	Thermal resistance from case-to-ambient, 800 LFPM air	16.6	°C/W



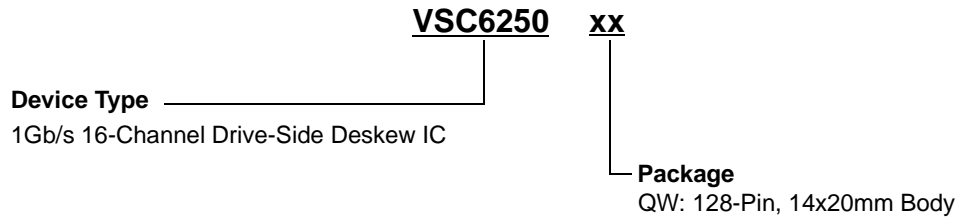
## Data Sheet

# VSC6250

1Gb/s 16-Channel  
Drive-Side Deskew IC

### Ordering Information

The part number for this product is formed by a combination of the device type and the package style:



### Notice

Vitesse Semiconductor Corporation reserves the right to make changes in its products, specifications, or other information at any time without prior notice. Therefore the reader is cautioned to confirm that this data sheet is current prior to placing any orders. The Company assumes no responsibility for any circuitry described other than circuitry entirely embodied in a Vitesse product.

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