1 MHz - 220 MHz High Performance Differential Oscillator



Features

- Any frequency between 1 MHz and 220 MHz accurate to 6 decimal places
- LVPECL and LVDS output signaling types
- 0.6ps RMS phase jitter (random) over 12 kHz to 20 MHz bandwidth
- Frequency stability as low as ±10 ppm
- Industrial and extended commercial temperature ranges
- Industry-standard packages: 3.2 x 2.5, 5.0 x 3.2 and 7.0 x 5.0 mm x mm
- For other frequencies, refer to SiT9120 and SiT9122 datasheets

Electrical Characteristics

Table 1. Electrical Characteristics

Applications

- 10 GB Ethernet, SONET, SATA, SAS, Fibre Channel, PCI-Express
- Telecom, networking, instrumentation, storage, server



Parameters	Symbol	Min.	Тур.	Max.	Unit	Condition			
	LVPECL and LVDS, Common Electrical Characteristics								
Supply Voltage	Vdd	2.97	3.3	3.63	V				
		2.25	2.5	2.75	V				
		2.25	-	3.63	V	Termination schemes in Figures 1 and 2 - XX ordering code			
Output Frequency Range	f	1	-	220	MHz				
Frequency Stability	F_stab	-10	I	+10	ppm	Inclusive of initial tolerance, operating temperature,			
		-20	-	+20	ppm	rated power supply voltage, and load variations			
		-25	-	+25	ppm				
		-50	-	+50	ppm				
First Year Aging	F_aging1	-2	-	+2	ppm	25°C			
10-year Aging	F_aging10	-5	-	+5	ppm	25°C			
Operating Temperature Range	T_use	-40	-	+85	°C	Industrial			
		-20	-	+70	°C	Extended Commercial			
Input Voltage High	VIH	70%	-	-	Vdd	Pin 1, OE or ST			
Input Voltage Low	VIL	-	١	30%	Vdd	Pin 1, OE or ST			
Input Pull-up Impedance	Z_in	-	100	250	kΩ	Pin 1, OE logic high or logic low, or \overline{ST} logic high			
		2	-	-	MΩ	Pin 1, ST logic low			
Start-up Time	T_start	-	6	10	ms	Measured from the time Vdd reaches its rated minimum value.			
Resume Time	T_resume	-	6	10	ms	In Standby mode, measured from the time \overline{ST} pin crosses 50% threshold.			
Duty Cycle	DC	45	-	55	%	Contact SiTime for tighter duty cycle			
			LVPECL,	DC and A	C Charact	restics			
Current Consumption	ldd	-	61	69	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V			
OE Disable Supply Current	I_OE	-	I	35	mA	OE = Low			
Output Disable Leakage Current	I_leak	-	-	1	μA	OE = Low			
Standby Current	I_std	-	-	100	μA	\overline{ST} = Low, for all Vdds			
Maximum Output Current	I_driver	-	-	30	mA	Maximum average current drawn from OUT+ or OUT-			
Output High Voltage	VOH	Vdd-1.1	-	Vdd-0.7	V	See Figure 1(a)			
Output Low Voltage	VOL	Vdd-1.9	-	Vdd-1.5	V	See Figure 1(a)			
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 1(b)			
Rise/Fall Time	Tr, Tf	-	300	700	ps	20% to 80%, see Figure 1(a)			
OE Enable/Disable Time	T_oe	-	-	115	ns	f = 212.5 MHz - For other frequencies, T_oe = 100ns + 3 period			
RMS Period Jitter	T_jitt	-	1.2	1.7	ps	f = 100 MHz, VDD = 3.3V or 2.5V			
		-	1.2	1.7	ps	f = 156.25 MHz, VDD = 3.3V or 2.5V			
		-	1.2	1.7	ps	f = 212.5 MHz, VDD = 3.3V or 2.5V			
RMS Phase Jitter (random)	T_phj	_	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds			

Table 1. Electrical Characteristics (continued)

Parameter	Symbol	Min.	Тур.	Max.	Unit	Condition
			LVDS, D	C and AC	Characte	ristics
Current Consumption	ldd	-	47	55	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	-	-	35	mA	OE = Low
Differential Output Voltage	VOD	250	350	450	mV	See Figure 2
Output Disable Leakage Current	I_leak	-	-	1	μΑ	OE = Low
Standby Current	I_std	-	-	100	μA	\overline{ST} = Low, for all Vdds
Delta VOD	ΔVOD	-	-	50	mV	See Figure 2
Offset Voltage	VOS	1.125	1.2	1.375	V	See Figure 2
Delta VOS	ΔVOS	-	-	50	mV	See Figure 2
Rise/Fall Time	Tr, Tf	-	495	700	ps	20% to 80%, see Figure 2
OE Enable/Disable Time	T_oe	-	-	115	ns	f = 212.5 MHz - For other frequencies, T_oe = 100ns + 3 period
RMS Period Jitter		-	1.2	1.7	ps	f = 100 MHz, VDD = 3.3V or 2.5V
	T_jitt	-	1.2	1.7	ps	f = 156.25 MHz, VDD = 3.3V or 2.5V
		-	1.2	1.7	ps	f = 212.5 MHz, VDD = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	-	0.6	0.85	ps	f = 156.25 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdds

Table 2. Pin Description

Pin	Мар	Functionality				
	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation			
1	OE	Input	H or Open: specified frequency output L: output is high impedance			
	ST	Input	H or Open: specified frequency output L: Device goes to sleep mode. Supply current reduces to I_std.			
2	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation			
3	GND	Power	VDD Power Supply Ground			
4	OUT+	Output	Oscillator output			
5	OUT-	Output	Complementary oscillator output			
6	VDD	Power	Power supply voltage			

Top View

SiTime

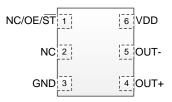


Figure 1. Pin Assignments



Table 3. Absolute Maximum Limits

Attempted operation outside the absolute maximum ratings of the part may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

Parameter	Min.	Max.	Unit
Storage Temperature	-65	150	°C
VDD	-0.5	4	V
Electrostatic Discharge (HBM)	-	2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	-	260	°C

Table 4. Thermal Consideration^[1]

Package	hetaJA, 4 Layer Board (°C/W)	hetaJC, Bottom (°C/W)
7050, 6-pin	142	27
5032, 6-pin	97	20
3225, 6-pin	109	20

Note:

1. Refer to JESD51-7 for θ JA and θ JC definitions, and reference layout used to determine the θ JA and θ JC values in the above table.

Table 5. Maximum Operating Junction Temperature^[2]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	90°C
85°C	105°C

Note:

2. Datasheet specifications are not guaranteed if junction temperature exceeds the maximum operating junction temperature.

Table 6. Environmental Compliance

Parameter	Condition/Test Method
Mechanical Shock	MIL-STD-883F, Method2002
Mechanical Vibration	MIL-STD-883F, Method2007
Temperature Cycle	JESD22, Method A104
Solderability	MIL-STD-883F, Method2003
Moisture Sensitivity Level	MSL1 @ 260°C



Waveform Diagrams

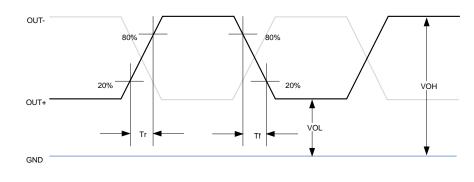


Figure 1(a). LVPECL Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)

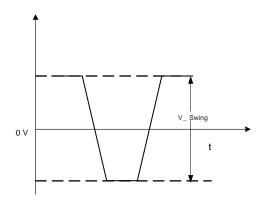


Figure 1(b). LVPECL Voltage Levels Across Differential Pair (i.e. OUT+ minus OUT-)

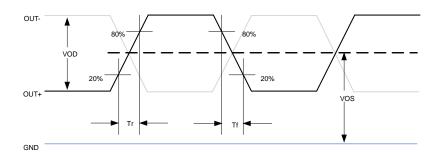


Figure 2. LVDS Voltage Levels per Differential Pin (i.e. OUT+, or OUT-)



Termination Diagrams

LVPECL

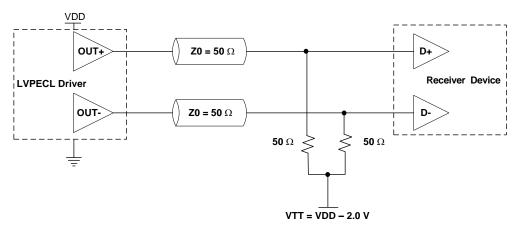
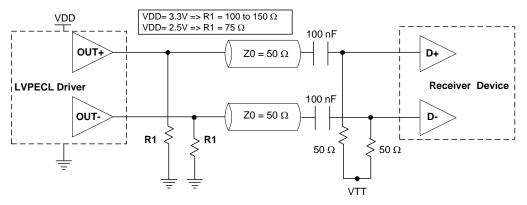
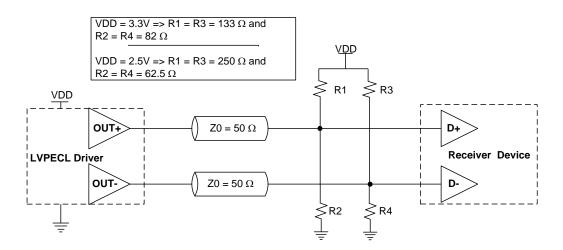
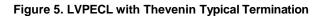


Figure 3. LVPECL Typical Termination











Termination Diagrams (continued)

LVDS

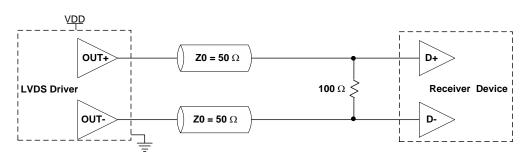
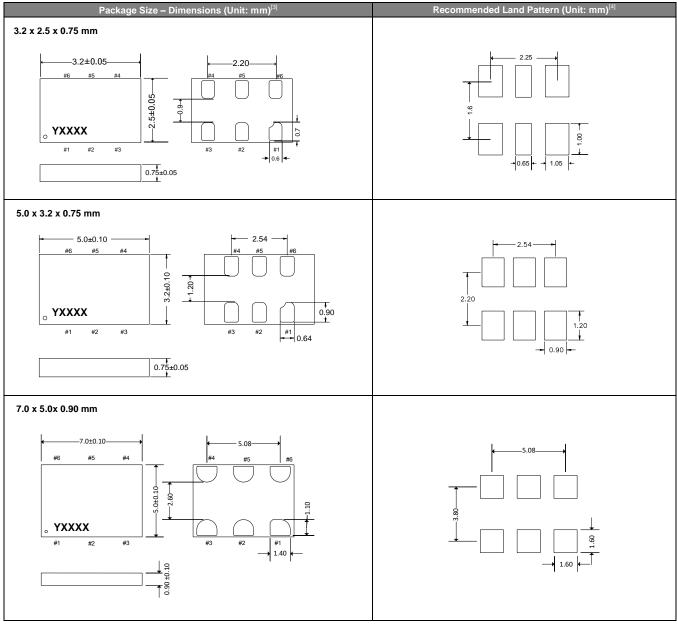


Figure 6. LVDS Single Termination (Load Terminated)



Dimensions and Patterns



Notes:

- 3. Top Marking: Y denotes manufacturing origin and XXXX denotes manufacturing lot number. The value of "Y" will depend on the assembly location of the device.
- 4. A capacitor of value 0.1 μF between VDD and GND is recommended.



Ordering Information

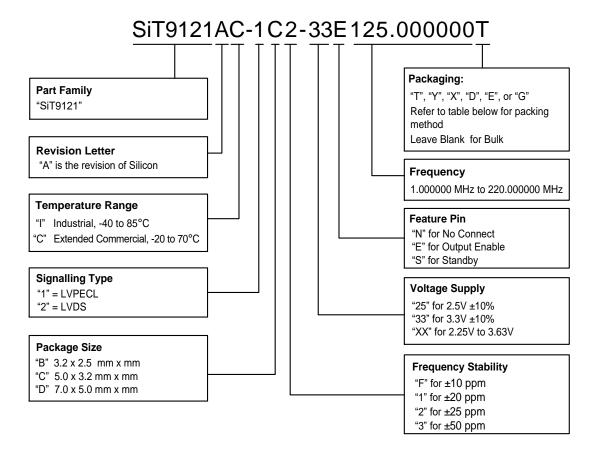


Table 7. Frequencies Not Supported

Frequency Range					
Min. Max.					
209.000001 MHz	210.999999 MHz				

Table 8. Ordering Codes for Supported Tape & Reel Packing Method

Device Size	8 mm T&R (3ku)	8 mm T&R (1ku)	8 mm T&R (250u)	12 mm T&R (3ku)	12 mm T&R (1ku)	12 mm T&R (250u)	16 mm T&R (3ku)	16 mm T&R (1ku)	16 mm T&R (250u)
7.0 x 5.0 mm	-	-	-	-	-	-	Т	Y	х
5.0 x 3.2 mm	-	-	-	Т	Y	Х	-	-	_
3.2 x 2.5 mm	D	E	G	Т	Y	Х	-	-	_



Table 9. Revision History

Revisions	Release Date	Change Summary
1.01	02/20/2013	Original
1.02	12/03/2013	Added input specifications, LVPECL/LVDS waveforms, packaging T&R options
1.03	02/06/2014	Added 8mm T&R option and ±10 ppm
1.04	04/08/2014	Included 1.8V option for LVDS output only
1.05	07/30/2014	Included Thermal Consideration table
1.06	10/20/2014	Modified Thermal Consideration values. Preliminary removed from the title
1.07	04/03/2017	Removed 1.8V option
1.08	08/17/2019	Added No Connect feature to Pin 1 Added Table 5: Maximum Operating Junction Temperature Updated logo and company address, other page layout changes

SiTime Corporation, 5451 Patrick Henry Drive, Santa Clara, CA 95054, USA | Phone: +1-408-328-4400 | Fax: +1-408-328-4439

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Supplemental Information

The Supplemental Information section is not part of the datasheet and is for informational purposes only.



Best Reliability

Silicon is inherently more reliable than quartz. Unlike quartz suppliers, SiTime has in-house MEMS and analog CMOS expertise, which allows SiTime to develop the most reliable products. Figure 1 shows a comparison with quartz technology.

Why is SiTime Best in Class:

- SiTime's MEMS resonators are vacuum sealed using an advanced EpiSeal[™] process, which eliminates foreign particles and improves long term aging and reliability
- World-class MEMS and CMOS design expertise

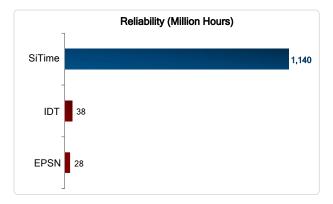


Figure 1. Reliability Comparison^[1]

Best Aging

Unlike quartz, MEMS oscillators have excellent long term aging performance which is why every new SiTime product specifies 10-year aging. A comparison is shown in Figure 2.

Why is SiTime Best in Class:

- SiTime's MEMS resonators are vacuum sealed using an advanced EpiSeal[™] process, which eliminates foreign particles and improves long term aging and reliability
- Inherently better immunity of electrostatically driven MEMS resonator

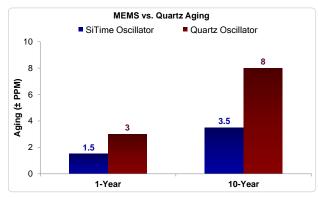


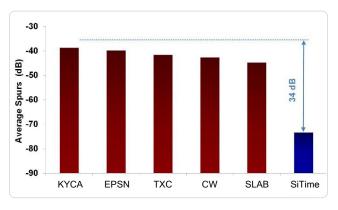
Figure 2. Aging Comparison^[2]

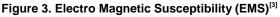
Best Electro Magnetic Susceptibility (EMS)

SiTime's oscillators in plastic packages are up to 54 times more immune to external electromagnetic fields than quartz oscillators as shown in Figure 3.

Why is SiTime Best in Class:

- Internal differential architecture for best common mode noise rejection
- Electrostatically driven MEMS resonator is more immune to EMS





Best Power Supply Noise Rejection

SiTime's MEMS oscillators are more resilient against noise on the power supply. A comparison is shown in Figure 4.

Why is SiTime Best in Class:

- On-chip regulators and internal differential architecture for common mode noise rejection
- MEMS resonator is paired with advanced analog CMOS IC

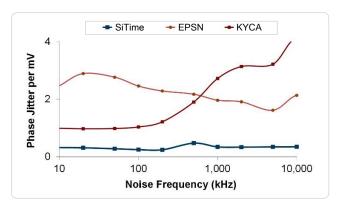


Figure 4. Power Supply Noise Rejection^[4]



Best Vibration Robustness

High-vibration environments are all around us. All electronics, from handheld devices to enterprise servers and storage systems are subject to vibration. Figure 5 shows a comparison of vibration robustness.

Why is SiTime Best in Class:

- The moving mass of SiTime's MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

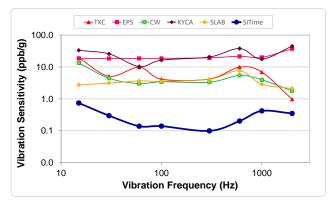


Figure 5. Vibration Robustness^[5]

Figure labels:

- TXC = TXC
- Epson = EPSN
- Connor Winfield = CW
- Kyocera = KYCA
- SiLabs = SLAB
- SiTime = EpiSeal MEMS

Best Shock Robustness

SiTime's oscillators can withstand at least 50,000 g shock. They all maintain their electrical performance in operation during shock events. A comparison with quartz devices is shown in Figure 6.

Why is SiTime Best in Class:

- The moving mass of SiTime's MEMS resonators is up to 3000 times smaller than quartz
- Center-anchored MEMS resonator is the most robust design

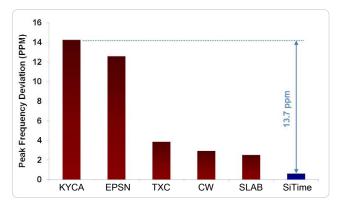


Figure 6. Shock Robustness^[6]



Notes:

- 1. Data source: Reliability documents of named companies.
- 2. Data source: SiTime and quartz oscillator devices datasheets.
- 3. Test conditions for Electro Magnetic Susceptibility (EMS):
 - According to IEC EN61000-4.3 (Electromagnetic compatibility standard)
 - Field strength: 3V/m
 - Radiated signal modulation: AM 1 kHz at 80% depth
 - Carrier frequency scan: 80 MHz 1 GHz in 1% steps
 - Antenna polarization: Vertical
 - DUT position: Center aligned to antenna

Devices used in this test:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	SiTime	SiT9120AC-1D2-33E156.250000	MEMS + PLL
EPSN	Epson	EG-2102CA156.2500M-PHPAL3	Quartz, SAW
TXC	TXC	BB-156.250MBE-T	Quartz, 3 rd Overtone
CW	Conner Winfield	P123-156.25M	Quartz, 3 rd Overtone
KYCA	AVX Kyocera	KC7050T156.250P30E00	Quartz, SAW
SLAB	SiLab	590AB-BDG	Quartz, 3 rd Overtone + PLL

4. 50 mV pk-pk Sinusoidal voltage.

Devices used in this test:

Label	Manufacturer	Part Number	Technology
EpiSeal MEMS	SiTime	SiT8208AI-33-33E-25.000000	MEMS + PLL
NDK	NDK	NZ2523SB-25.6M	Quartz
KYCA	AVX Kyocera	KC2016B25M0C1GE00	Quartz
EPSN	Epson	SG-310SCF-25M0-MB3	Quartz

5. Devices used in this test:

same as EMS test stated in Note 3.

- 6. Test conditions for shock test:
 - MIL-STD-883F Method 2002
 - Condition A: half sine wave shock pulse, 500-g, 1ms
 - Continuous frequency measurement in 100 µs gate time for 10 seconds
 - Devices used in this test:
 - same as EMS test stated in Note 3.

7. Additional data, including setup and detailed results, is available upon request to qualified customer. Please contact productsupport@sitime.com.

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Authorized Distributor

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SIT9121AC-2CF-33E25.00000 SIT9121AC-2CF-33E125.0000 SIT9121AI-2C2-33E125.000000 SIT9121AI-2B3-33E108.00000 SIT9121AC-2C3-33E125.000000 SIT9121AI-2B2-33E156.25000 SIT9121AI-2B233E100.000000 SIT9121AI-2B3-33E135.00000 SIT9121AI-2D2-33E150.000000 SIT9121AC-2C3-33E66.670000 SIT9121AI-2B233E150.000000 SIT9121AI-2D2-33E200.000000 SIT9121AI-2D2-33E100.00000 SIT9121AC-2CF-33E25.00000X SIT9121AC-2CF-33E125.0000X SIT9121AC-2C3-33E66.670000X SIT9121AC-2C3-33E125.000000X SIT9121AI-2D2-33E200.000000X SIT9121AI-2D2-33E100.00000X SIT9121AI-2C2-33E125.000000X SIT9121AI-2B3-33E108.00000G SIT9121AI-2D2-33E150.000000X SIT9121AI-2B233E150.000000G SIT9121AI-2B1-33E148.500000G SIT9121AI-2B3-33E200.00000G SIT9121AC-1DF-33E75.497472X SIT9121AI-2B2-33E156.25000G SIT9121AC-1DF-33E77.760000X SIT9121AI-2B3-33E135.00000G SiT9121AI-2B1-33E100.000000G SIT9121AI-2B3-33E200.00000 SIT9121AC-1DF-33E77.760000 SIT9121AI-2B1-33E148.500000 SIT9121AI-2B2-33E100.000000G SIT9121AC-1DF-33E75.497472 SiT9121AI-2B1-XXE125.000000E SIT9121AI-2C2-33E012.000000X SIT9121AI-2C2-33E016.000000X SIT9121AI-2D2-33E100.000000X SIT9121AI-2B3-33E200.000000X SIT9121AI-2B2-33E150.000000X SIT9121AI-2B2-33E100.000000X SIT9121AI-2BF-XXS200.000000X SiT9121AC-1D2-33E28.900000X SiT9121AI-2C3-33E100.000000X SiT9121AI-2D3-33E62.500000X SiT9121AC-1CF-33E100.300000X SIT9121AC-1D3-33E150.000000x SIT9121AC-1DF-33E80.000000x SIT9121AI-1C1-XXE100.000000x SIT9121AI-1C1-XXE156.250000x SIT9121AI-1C2-33E156.257000x SIT9121AI-1C2-33S187.500000x SIT9121AI-2D3-XXE125.000000x SIT9121AI-2D3-XXE156.250000x SIT9121AI-2D3-XXE200.000000x SIT9121AI-1D2-33E10.000000x SIT9121AI-2B2-33E50.000000x SIT9121AI-2B3-25E20.000000x SIT9121AI-2BF-25E100.000000x SIT9121AI-2BF-33E128.000000x SIT9121AI-2BF-XXS156.250000x SIT9121AI-2CF-33E125.000000X SIT9121AI-2DF-25E200.000000 SiT9121AC-2CF-25E133.000000T SiT9121AC-2CF-25E75.000000T SiT9121AC-2DF-25E100.000000Y SiT9121AC-2DF-25E100.000000T SiT9121AC-2DF-25E133.333333Y SiT9121AC-2DF-25E156.250000T SiT9121AC-1DF-33E75.497472T SiT9121AC-1DF-33E77.760000T SiT9121AC-2DF-33E80.000000T SIT9121AI-2CF-25E148.351600X SIT9121AI-2CF-25E150.000000T SIT9121AI-1CF-25E161.132800T SiT9121AI-2CF-25E200.000000Y SiT9121AI-2CF-25E200.000000T SiT9121AI-2CF-33E100.000000T SiT9121AI-2CF-33E125.000000Y SiT9121AI-2CF-33E125.000000T SiT9121AI-2CF-33E25.000000T SiT9121AI-1CF-33E25.000000X SiT9121AI-1CF-33E33.333330Y SiT9121AI-1CF-33E33.333330T SiT9121AI-2DF-33E200.000000Y

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 SiT9121AI-1CF-33E25.000000T
 SiT9121AI-2BF

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 SiT9121AI-2BF-25E100.00000G
 SiT9121AI-2CF-33E25.00000X
 SIT9121AI-2C1

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 SIT9121AI-1C1-XXX000.FP0000X
 SIT9121AI-1D1-XXX000.FP0000X
 SIT9121AI-2B1

 XXX000.FP0000X
 SIT9121AI-2C1-XXX000.FP0000X
 SIT9121AI-2D1-XXX000.FP0000X
 SIT9121AI-2B1

 SIT9121AI-1C1-25E156.25
 SIT9121AI-2D1-XXX000.FP0000X
 SIT9121AI-1C1-25E200.00