Features

- Any frequency between 1 MHz and 110 MHz accurate to 6 decimal places
- Operating temperature from -55°C to 125°C
- 100% pin-to-pin drop-in replacement to quartz-based XO
- Excellent total frequency stability as low as ±25 PPM
- Industry best G-sensitivity of 0.1 PPB/G
- Low power consumption of 3.6 mA typical
- Standby mode for longer battery life
- LVCMOS/HCMOS compatible output
- Industry-standard packages: 2.0 x 1.6, 2.5 x 2.0, 3.2 x 2.5, 5.0 x 3.2, 7.0 x 5.0 mm
- Pb-free, RoHS and REACH compliant
- Optional unique device ID for complete traceability (contact SiTime)

Applications

- Ruggedized equipment in harsh operating environment

EXPRESS SAMPLES GREEN SOLUTIONS QUARTZ FREE

Electrical Characteristics[1, 2]

Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency Range						
Output Frequency Range	f	1	–	110	MHz	
Frequency Stability and Aging						
Frequency Stability	F_stab	-25	–	+25	PPM	Inclusive of Initial tolerance at 25°C, and variations over operating temperature, rated power supply voltage and load.
		-50	–	+50	PPM	
Aging	Ag	–1.5	–	1.5	PPM	1st year at 25°C
Operating Temperature Range						
Operating Temperature Range	T_use	-55	–	+125	°C	
Supply Voltage and Current Consumption						
Supply Voltage	Vdd	1.62	1.8	1.98	V	Contact SiTime for 1.5V support
		2.25	2.5	2.75	V	
		2.52	2.8	3.08	V	
		2.7	3.0	3.3	V	
		2.97	3.3	3.63	V	
		2.25	–	3.63	V	
Current Consumption	Idd	–	3.9	5	mA	No load condition, f = 20 MHz, Vdd = 2.5V, 2.8V, 3.0V or 3.3V
		–	3.6	4.5	mA	No load condition, f = 20 MHz, Vdd = 1.8V
Standby Current	I_std	–	2.5	10	µA	$\overline{ST}$ = GND, Vdd = 3.0V or 3.3V, Output is Weakly Pulled Down
		–	2.5	10	µA	$\overline{ST}$ = GND, Vdd = 2.5V or 2.8V, Output is Weakly Pulled Down
		–	1	5	µA	$\overline{ST}$ = GND, Vdd = 1.8V, Output is Weakly Pulled Down
LVCMOS Output Characteristics						
Duty Cycle	DC	45	–	55	%	All Vdds
Rise/Fall Time	Tr, Tf	–	1.2	2.5	ns	Vdd = 2.5V, 2.8V, 3.0V or 3.3V, 20% - 80%
		–	1.5	3.5	ns	Vdd =1.8V, 20% - 80%
		–	1.5	3	ns	Vdd = 2.25V - 3.63V, 20% - 80%
Output High Voltage	VOH	90%	–	–	Vdd	IOH = -4 mA (Vdd = 3.0V or 3.3V) IOH = -3 mA (Vdd = 2.8V and Vdd = 2.5V) IOH = -2 mA (Vdd = 1.8V)
Output Low Voltage	VOL	–	–	10%	Vdd	IOL = 4 mA (Vdd = 3.0V or 3.3V) IOL = 3 mA (Vdd = 2.8V and Vdd = 2.5V) IOL = 2 mA (Vdd = 1.8V)
Input Characteristics						
Input High Voltage	VIH	70%	–	–	Vdd	Pin 1, OE or $\overline{ST}$
Input Low Voltage	VIL	–	–	30%	Vdd	Pin 1, OE or $\overline{ST}$
Input Pull-up Impedence	Z_in	–	100	250	kΩ	Pin 1, OE logic high or logic low, or $\overline{ST}$ logic high
		2	–	–	MΩ	Pin 1, $\overline{ST}$ logic low

Note:
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Electrical Characteristics[1, 2](continued)

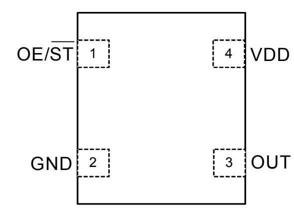
Parameter and Conditions	Symbol	Min.	Typ.	Max.	Unit	Condition
			Startup and Resume Timing			
Startup Time	T_start	–	–	5	ms	Measured from the time Vdd reaches its rated minimum value
Enable/Disable Time	T_oe	–	–	150	ns	
Resume Time	T_resume	–	–	5	ms	Measured from the time ST pin crosses 50% threshold
			Jitter			
RMS Period Jitter	T_jitt	–	2	4	ps	f = 20 MHz, Vdd = 2.5V, 2.8V, 3.0V or 3.3V
		–	2	4.5	ps	f = 20 MHz, Vdd = 1.8V
RMS Phase Jitter (random)	T_phj	–	0.7	1	ps	Integration bandwidth = 900 kHz to 7.5 MHz
		–	1.5	3	ps	Integration bandwidth = 12 kHz to 20 MHz

Notes:
1. All electrical specifications in the above table are specified with 15 pF output load and for all Vdd(s) unless otherwise stated.
2. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Pin Description

Pin	Symbol		Functionality
1	OE/ $\overline{ST}$	Output Enable	H or Open[3]: specified frequency output L: output is high impedance. Only output driver is disabled.
		Standby	H or Open[3]: specified frequency output L: output is low (weak pull down). Device goes to sleep mode. Supply current reduces to I_std.
2	GND	Power	Electrical ground[4]
3	OUT	Output	Oscillator output
4	VDD	Power	Power supply voltage[4]

Top View



Notes:
3. A pull-up resistor of <10 kΩ between OE/ $\overline{ST}$ pin and Vdd is recommended in high noise environment.
4. A capacitor value of 0.1 µF between Vdd and GND is recommended.

Absolute Maximum

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	–	2000	V
Soldering Temperature (follow standard Pb free soldering guidelines)	–	260	°C
Junction Temperature	–	150	°C

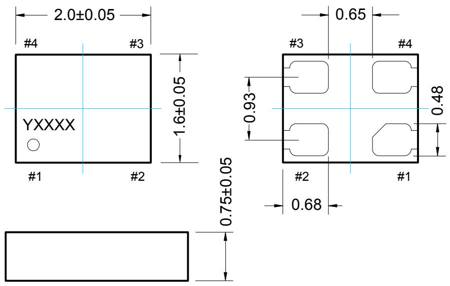
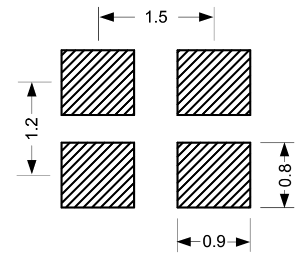
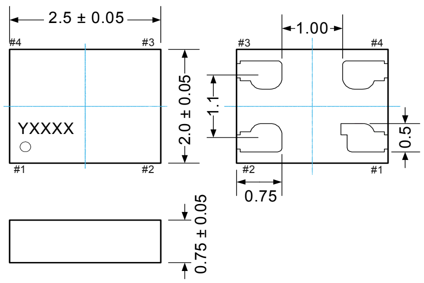
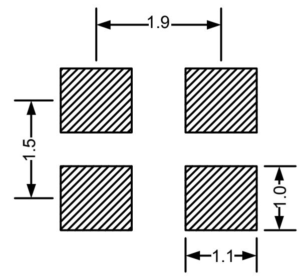
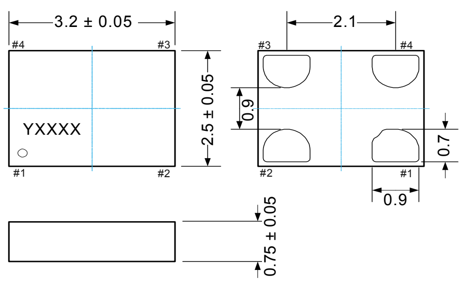
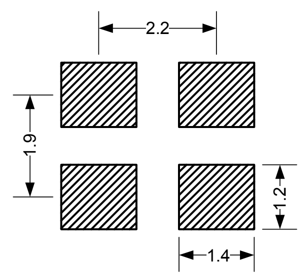
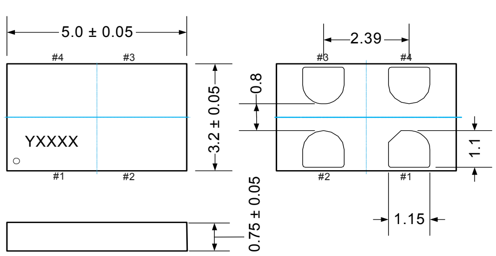
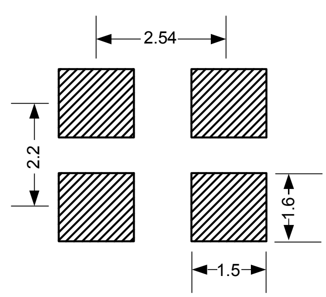
Thermal Consideration

Package	θJA, 4 Layer Board °C/W)	θJA, 2 Layer Board (°C/W)	θJC, Bottom (°C/W)
7050	191	263	30
5032	97	199	24
3225	109	212	27
2520	117	222	26
2016	124	227	26

Environmental Compliance

Parameter	Condition/Test Method
Mechanical Shock	MIL-STD-883F, Method 2002
Mechanical Vibration	MIL-STD-883F, Method 2007
Temperature Cycle	JESD22, Method A104
Solderability	MIL-STD-883F, Method 2003
Moisture Sensitivity Level	MSL1 @ 260°C

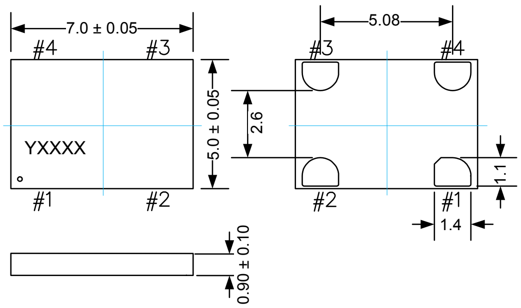
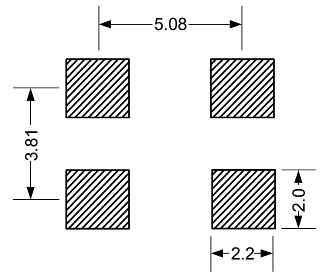
Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[5]	Recommended Land Pattern (Unit: mm)[6]
2.0 x 1.6 x 0.75 mm 	
2.5 x 2.0 x 0.75 mm 	
3.2 x 2.5 x 0.75 mm 	
5.0 x 3.2 x 0.75 mm 	

Notes:

5. 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.
6. A capacitor of value 0.1 µF between Vdd and GND is recommended.

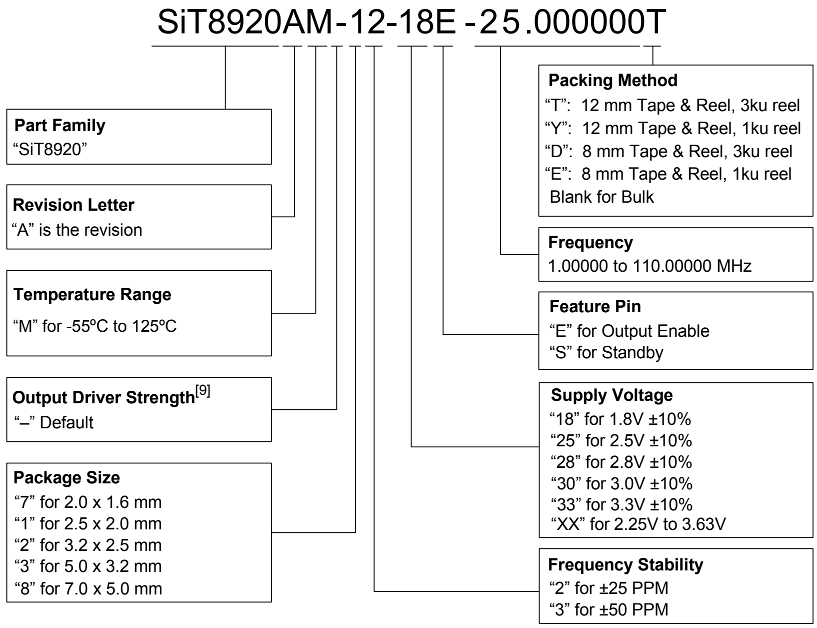
Dimensions and Patterns

Package Size – Dimensions (Unit: mm)[7]	Recommended Land Pattern (Unit: mm)[8]
7.0 x 5.0 x 0.90 mm 	

Notes:

7. 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.
8. A capacitor of value 0.1 μF between Vdd and GND is recommended.

Ordering Information



Note:

9. Contact SiTime for custom drive strength to drive higher or multiple load, or SoftEdge™ option for EMI reduction.

Ordering Codes for Supported Tape & Reel Packing Method[10]

Device Size	8 mm T&R (3ku)	8 mm T&R (1ku)	12 mm T&R (3ku)	12 mm T&R (1ku)	16 mm T&R (3ku)	16 mm T&R (1ku)
2.0 x 1.6 mm	D	E	–	–	–	–
2.5 x 2.0 mm	D	E	–	–	–	–
3.2 x 2.5 mm	D	E	–	–	–	–
5.0 x 3.2 mm	–	–	T	Y	–	–
7.0 x 5.0 mm	–	–	–	–	T	Y

Note:

10. For "–", contact SiTime for availability.

Supplemental Information

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

Silicon MEMS Outperforms Quartz

Silicon MEMS Outperforms Quartz

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 Epi-Seal™ process, which eliminates foreign particles and improves long term aging and reliability
- World-class MEMS and CMOS design expertise

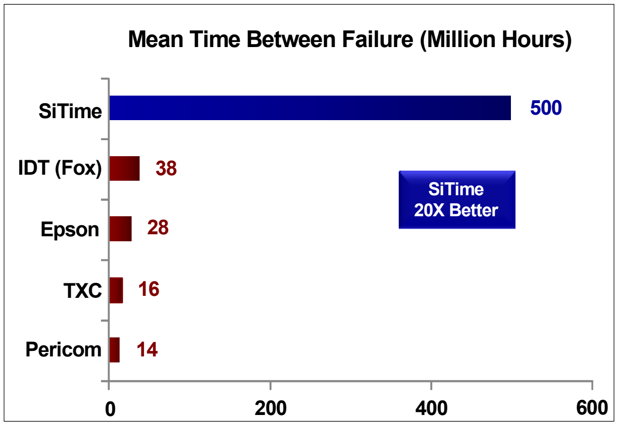


Figure 1. Reliability Comparison[1]

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 Epi-Seal™ process, which eliminates foreign particles and improves long term aging and reliability
- Inherently better immunity of electrostatically driven MEMS resonator

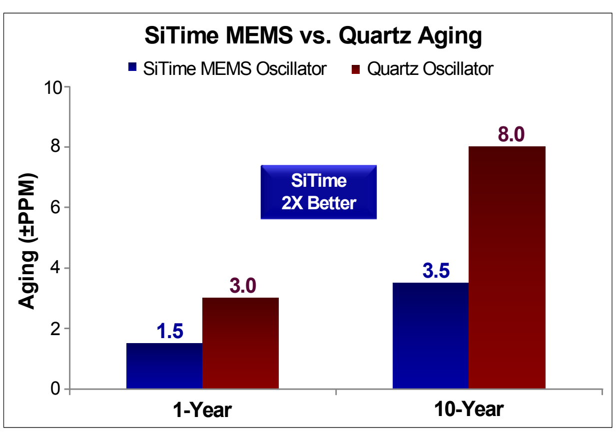


Figure 2. Aging Comparison[2]

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

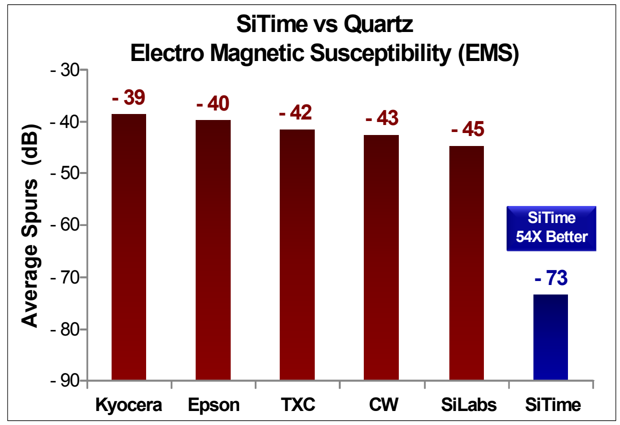


Figure 3. Electro Magnetic Susceptibility (EMS)[3]

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
- Best analog CMOS design expertise

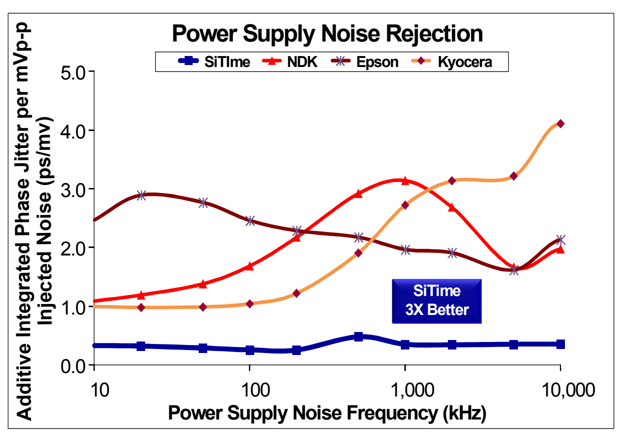


Figure 4. Power Supply Noise Rejection[4]

Silicon MEMS Outperforms Quartz

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

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

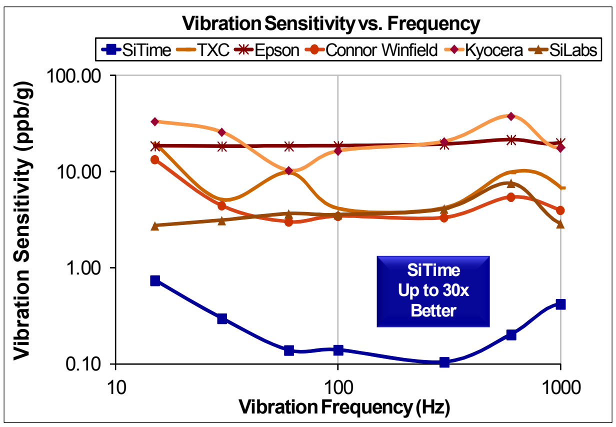


Figure 5. Vibration Robustness[5]

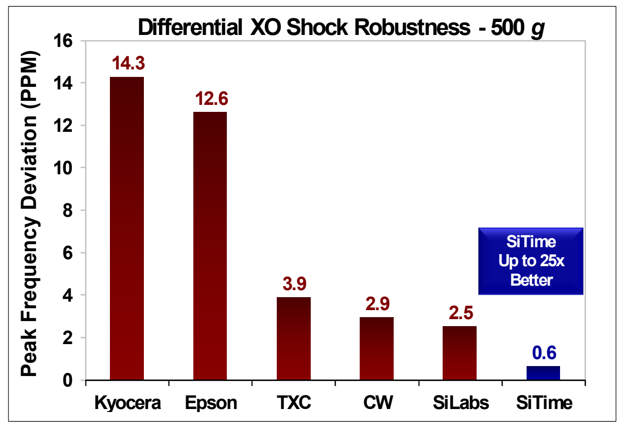


Figure 6. Shock Robustness[6]

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:
   SiTime, SiT9120AC-1D2-33E156.250000 - MEMS based - 156.25 MHz
   Epson, EG-2102CA 156.2500M-PHPAL3 - SAW based - 156.25 MHz
   TXC, BB-156.250MBE-T - 3rd Overtone quartz based - 156.25 MHz
   Kyocera, KC7050T156.250P30E00 - SAW based - 156.25 MHz
   Connor Winfield (CW), P123-156.25M - 3rd overtone quartz based - 156.25 MHz
   SiLabs, Si590AB-BDG - 3rd overtone quartz based - 156.25 MHz
4. 50 mV pk-pk Sinusoidal voltage.

   Devices used in this test:
   SiTime, SiT8208AI-33-33E-25.000000, MEMS based - 25 MHz
   NDK, NZ2523SB-25.6M - quartz based - 25.6 MHz
   Kyocera, KC2016B25M0C1GE00 - quartz based - 25 MHz
   Epson, SG-310SCF-25M0-MB3 - quartz based - 25 MHz
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 customers. Please contact productsupport@sitime.com.

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If No, what parameters are missing?

---

2. Is the organization of this document easy to follow? ◯ Yes ◯ No

If "No," please suggest improvements that we can make:

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3. Is there any application specific information that you would like to see in this document? (Check all that apply)

☐ EMI ☐ Termination recommendations ☐ Shock and vibration performance ☐ Other

If "Other," please specify:

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4. Are there any errors in this document? ◯ Yes ◯ No

If "Yes", please specify (what and where):

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