# Crystal Oscillator (SPXO)

· Package size (2.5 mm × 2.0 mm × 0.7 mm)

- Fundamental mode SPXO
- · Output: CMOS

· Reference weight Typ.13 mg

[1] Product Number / Product Name

(1-1) Product Number / Ordering Code

# X1G0056010281xx

Last 2 digits code(<u>xx</u>) defines Quantity.

The standard is "00", 3 000 pcs/Reel. (1-2) Product Name / Model Name

# SG-8018CG 36.532540 MHz TJHSA

# [2] Operating Range

Parameter	Symbol	0,	Specification	Unit	Conditions		
Falameter	Symbol	Min.	Тур.	Max.	Unit	Conditions	
Supply voltage	V <sub>CC</sub>	1.62	-	3.63	V	-	
Supply voltage	GND	0	0	0	V	-	
Operating temperature range	T_use	-40	+25	+105	°C	-	
CMOS load condition	L_CMOS	-	-	15	pF	-	

# [3] Frequency Characteristics

(Unless stated otherwise [2] Operating Range)

Parameter	Symbol		Specification	S	Unit	Conditions	
Falameter	Symbol	Min.	Тур.	Max.	Unit	Conditions	
Output frequency	fo	-	36.532540	-	MHz	-	
Frequency tolerance *1	f tol	-50	-	+50	×10 <sup>-6</sup>	T use	

\*1 Frequency tolerance includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient Frequency / load coefficient and frequency aging (+25 °C. 10 years)

# [4] Electrical Characteristics

(Unless stated otherwise [2] Operating Range)

Parameter	Symbol	5	Specificatio	าร	Unit	Conditions	
Parameter	Symbol	Min. Typ.		Max.	Unit	Conditions	
Start-up time	t_str	-	-	3	ms	t = 0 at 90 % Vcc	
Current consumption	I <sub>CC</sub>	-	3.8	4.4	mA	No load condition, Vcc = 3.3 V	
Stand-by current	I_std	-	1.1	2.5	μA	$\overline{ST} = GND$ , Vcc = 3.3 V	
Output voltage	V <sub>OH</sub>	90 % Vcc	-	-	V	Іон = -3 mA @Vcc = 3.3 V	
	V <sub>OL</sub>	-	-	10 % Vcc	V	IoL = 3 mA @Vcc = 3.3 V	
Rise time	tr	-	-	6	ns	20 % Vcc to 80 % Vcc Level, L_CMOS = 15 pF, Vcc = 3.3 V	
Fall time	tf	-	-	6	ns	80 % Vcc to 20 % Vcc Level, L_CMOS = 15 pF, Vcc = 3.3 V	
Symmetry	SYM	45	-	55	%	50 % Vcc Level, L_CMOS ≤ 15 pF	
Input voltage	Vih	70 % Vcc	-	-	V	ST terminal	
input voltage	Vil	-	-	30 % Vcc	V	ST terminal	
Output disable time (ST)	tstp_st	-	-	1	μs	$\overline{ST}$ terminal HIGH $\rightarrow$ LOW	
Output enable time (ST)	tsta_st	-	-	3	ms	$\overline{ST}$ terminal LOW $\rightarrow$ HIGH	
Phase jitter	t <sub>PJ</sub>	-	-	72.9	ps	Offset freq.:12 kHz to 20 MHz, Vcc = 3.3 V	
Peak to Peak jitter	t <sub>p-p</sub>	-	-	199.4	ps	Clock cycle > 50 000, Vcc = 3.3 V	
RMS jitter	t <sub>RMS</sub>	-	-	18.1	ps	Clock cycle > 50 000, Vcc = 3.3 V	
Cycle to Cycle jitter	t <sub>c-c</sub>	-	-	122.0	ps	Clock cycle > 50 000, Vcc = 3.3 V	

# [For other general specifications, please refer to the attached Full Data Sheet below]

# Programmable Crystal Oscillator: SG-8018CG/SG-8018CE/SG-8018CB/SG-8018CA

# Features

- Crystal oscillator (Programmable)
- Output frequency: 0.67 MHz to 170 MHz (1 × 10<sup>-6</sup> Step)
- Output:
- Supply voltage: 1.62 V to 3.63 V
- Frequency tolerance, Operating temperature:

±50 × 10<sup>-6</sup> / -40 °C to +105 °C

CMOS

\* Including frequency aging (+25 °C, 10 years)



# Description

Epson's SG-8018 series are Programmable Crystal Oscillator series with CMOS output. While this series offer the same easy programmability of frequencies and other parameters as comparable earlier SG-8002/SG-8003 series, they also have a wider operating temperature range, with a top-end limit of 105 °C. In addition to a  $2.5 \times 2.0$  mm package that will enable electronics manufacturers to save board space, the oscillators will also be available in the following popular package sizes:  $3.2 \times 2.5$  mm,  $5.0 \times 3.2$  mm and  $7.0 \times 5.0$  mm. The oscillator in the SG-8018 series have an approximately 66 % tighter frequency tolerance and 50 % lower current consumption than comparable products, and can be used under a wide range of environmental conditions. This will also significantly contribute to performance, lower power requirements, fast development cycles, and low-volume production.

# **Outline Drawing and Terminal Assignment**





SG-8018CB









### **Terminal Assignment**

Pin #	Connection	Function							
		OE terminal							
	OE	OE function	Osc. Circuit	Output					
	UE	"H" *	Oscillation	Specified frequency: Enable					
#1		"L"	Oscillation	Low (weak pull down): Disable					
#1		ST terminal							
	ST	$\overline{ST}$ function	Osc. Circuit	Output					
	51	"H" *	Oscillation	Specified frequency: Enable					
		"L"	Oscillation stop	Low (weak pull down): Disable					
#2	GND	GND terminal	· · ·						
#3	OUT	Output terminal							
#4	V <sub>cc</sub>	V <sub>cc</sub> terminal							

\* Please do not use the  $OE/\overline{ST}$  terminal in the open state.

### [1] Product Name / Product Number

(1-1) Product Name (Standard Form) SG-8018CG: X1G005601xxxx00 SG-8018CE: X1G005591xxxx00 SG-8018CB: X1G005581xxxx00 SG-8018CA: X1G005571xxxx00

(Please contact Epson for details)

### (1-2) Product Number / Ordering Code

<u>SG-8018CA</u> <u>25.000000MHz</u> <u>T J H P A</u> 1

2 45678 3

(1)Model (2)Size (3)Frequency (4)Supply voltage (T: 1.8 V to 3.3 V Typ.)

⑤Frequency tolerance / ⑥Operating temperature (JH: ±50 × 10<sup>-6</sup> / -40 °C to +105 °C)
⑦Function ⑧Rise time/Fall time

U	Inctic	on @Rise time/Fall t
	②Si	ze
	CG	2.5 mm × 2.0 mm
	CE	3.2 mm × 2.5 mm
	СВ	5.0 mm × 3.2 mm
	CA	7.0 mm × 5.0 mm

⑦ Function								
Ρ	Output enable (#1pin = OE)							
S	Standby (#1pin = $\overline{ST}$ )							
8 Rise time/Fall time								
Α	Default							
В	Fast							
C*	Slow							
	P S ⑧Ri A							

\* Available only when fo  $\leq$  20 MHz

#### [2] Absolute Maximum Ratings

Parameter	Symbol		Specificatior	۱	Unit	Conditions
Tarameter	Symbol	Min.	Тур.	Max.	Onit	Conditions
Maximum supply voltage	V <sub>CC</sub>	-0.3	-	4	V	
Input voltage	V <sub>IN</sub>	-0.3	-	V <sub>CC</sub> + 0.3	V	OE/ST terminal
Storage temperature range	T_stg	-40	-	+125	°C	

### [3] Operating Range

Parameter	Symbol		Specification	۱	Unit	Conditions
Falameter	Symbol	Min.	Тур.	Max.		Conditions
Supply voltage	V <sub>CC</sub>	1.62	-	3.63	V	
Supply voltage	GND	0.0	0.0	0.0	V	
Input voltage	V <sub>IN</sub>	GND	-	V <sub>cc</sub>	V	OE/ST terminal
Operating temperature range	T_use	-40	+25	+105	°C	
CMOS load condition	L_CMOS	-	-	15	pF	

\* Power supply startup time (0  $\%V_{CC} \rightarrow 90 \%V_{CC}$ ) should be between 5 µs and 500 ms

\* A 0.1  $\mu$ F or over bypass capacitor should be connected between V<sub>cc</sub> and GND pins located close to the device

#### [4] Frequency Characteristics

#### (Unless stated otherwise [3] Operating Range)

Parameter	Symbol		Specification	1	Unit	Conditions
Farameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Output frequency	fo	0.67		170	MHz	
Frequency tolerance *1	f_tol	-50	-	+50	×10 <sup>-6</sup>	T_use = -40 °C to +105 °C
Frequency aging	f_age	Included in frequency tolerance			×10 <sup>-6</sup>	+25 °C, 10 years

\*1 Frequency tolerance includes initial frequency tolerance, frequency / temperature characteristics, frequency / voltage coefficient, frequency / load coefficient and frequency aging (+25 °C, 10 years)

5] Electrical Characteristic	CS			(Ur	less stated	otherwise [ 3 ] Operating Range)
Parameter	Symbol		Specificatior	1	Unit	Conditions
		Min.	Тур.	Max.		
Start-up time	t_str	-	-	3	ms	$t = 0 \text{ at } V_{CC} > 1.62 \text{ V}$
		-	2.7	3.2		0.67 MHz ≤ fo ≤ 20 MHz
Current consumption		-	3.1	3.7	-	$20 \text{ MHz} < \text{fo} \le 50 \text{ MHz}$
(No load)		-	3.5	4.0	mA	50 MHz < fo ≤ 75 MHz
$V_{CC}$ = 1.62 V to 1.98 V		-	3.8	4.4		75 MHz < fo ≤ 100 MHz
		-	4.1	4.8		100 MHz < fo ≤ 125 MHz
		-	4.7	5.5		$125 \text{ MHz} < \text{fo} \le 170 \text{ MHz}$
		-	2.7	3.3		0.67 MHz ≤ fo ≤ 20 MHz
Current consumption		-	3.1	3.8		$20 \text{ MHz} < \text{fo} \le 50 \text{ MHz}$
(No load)		-	3.5	4.2	mA	50 MHz < fo ≤ 75 MHz
$V_{CC}$ = 1.98 V to 2.20 V		-	3.8	4.6		75 MHz < fo ≤ 100 MHz
		-	4.1	5.0		100 MHz < fo ≤ 125 MHz
	I <sub>cc</sub>	-	4.7	5.8		125 MHz < fo ≤ 170 MHz
		-	2.9	3.4		0.67 MHz ≤ fo ≤ 20 MHz
Current consumption		-	3.4	4.0		20 MHz < fo ≤ 50 MHz 50 MHz < fo ≤ 75 MHz
(No load)		-	3.9	4.6	mA	$50 \text{ MHz} < 10 \le 75 \text{ MHz}$ 75 MHz < fo $\le 100 \text{ MHz}$
$V_{CC}$ = 2.20 V to 2.80 V		-	4.4	5.1		
		-	4.8	5.7 6.7		100 MHz < fo ≤ 125 MHz 125 MHz < fo ≤ 170 MHz
		-	5.7	3.5		$0.67 \text{ MHz} \le 10 \le 170 \text{ MHz}$
		-	3.0	4.4		$20 \text{ MHz} < \text{fo} \le 50 \text{ MHz}$
Current consumption		-	3.8 4.4	4.4 5.2	mA	$50 \text{ MHz} < \text{fo} \le 75 \text{ MHz}$
(No load)		-	4.4 5.0	5.9		$75 \text{ MHz} < \text{fo} \le 100 \text{ MHz}$
$V_{CC} = 2.70 \text{ V} \text{ to } 3.63 \text{ V}$		-	5.7	6.7		$100 \text{ MHz} < \text{fo} \le 125 \text{ MHz}$
		_	6.8	8.1		$125 \text{ MHz} < \text{fo} \le 170 \text{ MHz}$
		-	2.8	3.2		$V_{CC} = 1.62 \text{ V to } 1.98 \text{ V}$
	I_dis	-	2.8	3.3	mA	$V_{CC} = 1.98$ V to 2.20 V
Disable current		_	2.8	3.3		$V_{CC} = 2.20 \text{ V to } 2.80 \text{ V}$
		-	2.9	3.5		V <sub>CC</sub> = 2.70 V to 3.63 V
		-	0.3	0.9	μA	V <sub>CC</sub> = 1.62 V to 1.98 V
		-	0.4	1.0		V <sub>CC</sub> = 1.98 V to 2.20 V
Stand-by current	I_std	-	0.5	1.5		$V_{\rm CC} = 2.20$ V to 2.80 V
		-	1.1	2.5		$V_{\rm CC} = 2.70$ V to 3.63 V
	V <sub>OH</sub>	90 % V <sub>cc</sub>	-	-	V	I <sub>OH</sub> Condition     V <sub>CC</sub> [V]       tr/tf     1.62 to 1.98     1.98 to 2.20     1.20 to 2.80     2.70 to 3.63       A (to > 40 MHz), B     -2.5 mA     -3.5 mA     -4.0 mA     -5.0 mA
Output voltage (DC characteristics)						A (fo ≤ 40 MHz)     -1.5 mA     -2.0 mA     -2.5 mA     -3.0 mA       C     -1.0 mA     -1.5 mA     -2.0 mA     -2.5 mA       I <sub>OL</sub> Condition     -1.0 mA     -1.5 mA     -2.0 mA     -2.5 mA
(DC characteristics)	V <sub>OL</sub>	-	-	10 % V <sub>CC</sub>	V	trift     Vcc [V]       1.62 to 1.98 [1.98 to 2.00 [2.00 to 2.80 [2.70 to 3.63       A (to > 40 MHz), B     2.5 mA     3.5 mA     4.0 mA     5.0 mA       A (to > 40 MHz)     1.5 mA     2.0 mA     2.5 mA     3.0 mA       C     1.0 mA     1.5 mA     2.0 mA     2.5 mA     3.0 mA
Symmetry	SYM	45	50	55	%	50 % $V_{CC}$ level, L_CMOS $\leq$ 15 pF
		-	-	3		A (fo > 40 MHz)
Rise time/Fall time	tr/tf	-	-	6	ns	A (fo ≤ 40 MHz) 20 % - 80 % V <sub>CC</sub> level,
	u/u	-	-	3	115	B L_CMOS = 15 pF
		-	-	10		C (fo ≤ 20 MHz)
Input voltage	V <sub>IH</sub>	70 % V <sub>CC</sub>	-	-	V	OE/ST terminal
	V <sub>IL</sub>	-	-	30 % V <sub>CC</sub>	V	
Input capacitance	C <sub>IN</sub>	-	2.5	5	pF	OE/ST terminal OE/ST = 70 % V <sub>cc</sub>
Input pull up resistance	R <sub>UP1</sub>	20 <i>F</i>	-	150	kΩ	$OE/ST = 70 \% V_{CC}$ $OE/ST = 30 \% V_{CC}$
	R <sub>UP2</sub>	5	-	60 5	MΩ	$OE/ST = 30\% V_{CC}$ $OE/ST = GND, OUT = V_{CC}$
Output pull down resistance	R <sub>DN</sub>	0.5	-	5	MΩ	OE/ST = GND, OUT = $V_{CC}$ OE terminal HIGH $\rightarrow$ LOW
Output disable time (OE)	tstp_oe	-	-	1	μs	$\overline{ST}$ terminal HIGH $\rightarrow$ LOW
Output disable time (ST)	tstp_st	-	-	1	μs	ST terminal HIGH $\rightarrow$ LOW OE terminal LOW $\rightarrow$ HIGH
Output enable time (OE)	tsta_oe	-	-	1	μs	ST terminal LOW $\rightarrow$ HIGH
Output enable time (ST)	tsta_st	-	-	3	ms	

Parameter	Symbol		Specification	<u></u> ו	Unit	Conditions
Faldilletei	Symbol	Min.	Тур.	Max.	Unit	Conditions
		-	-	68.2		10 MHz ≤ fo ≤ 20 MHz
Phase jitter	Ι Γ	-	-	67.0	1	20 MHz < fo ≤ 40 MHz
(Offset frequency: 12 kHz to 20 MHz)	Ι Γ	-	-	76.5	ps	40 MHz < fo ≤ 85 MHz
$V_{CC} = 1.62 \text{ V} \text{ to } 1.98 \text{ V}$	Ι Γ	-	-	74.1	1	85 MHz < fo ≤ 125 MHz
	Ι Γ	-	-	57.2	1	125 MHz < fo ≤ 170 MHz
	1 [	-	-	67.2		10 MHz ≤ fo ≤ 20 MHz
Phase jitter		-	-	65.3		20 MHz < fo ≤ 40 MHz
(Offset frequency: 12 kHz to 20 MHz)	t <sub>PJ</sub>	-	-	74.8	ps	40 MHz < fo ≤ 85 MHz
$V_{CC}$ = 2.25 V to 2.75 V		-	-	73.8		85 MHz < fo ≤ 125 MHz
		-	-	55.4		125 MHz < fo ≤ 170 MHz
	1 F	-	-	66.9		10 MHz ≤ fo ≤ 20 MHz
Phase jitter		-	-	72.9		20 MHz < fo ≤ 40 MHz
(Offset frequency: 12 kHz to 20 MHz)		-	-	71.3	ps	40 MHz < fo ≤ 85 MHz
$V_{CC} = 2.97 \text{ V} \text{ to } 3.63 \text{ V}$		-	-	68.7		85 MHz < fo ≤ 125 MHz
		-	-	55.4		125 MHz < fo ≤ 170 MHz
		-	-	366.0		10 MHz ≤ fo ≤ 20 MHz
Peak to Peak jitter	I F	_	_	263.4		$20 \text{ MHz} < \text{fo} \le 40 \text{ MHz}$
(Clock cycle > 50 000)		_	-	111.0	ps	$40 \text{ MHz} < \text{fo} \le 85 \text{ MHz}$
$V_{CC} = 1.62$ V to 1.98 V	-		<u>+</u>	81.9	P3	$85 \text{ MHz} < \text{fo} \le 125 \text{ MHz}$
		-	-	80.0	-	$125 \text{ MHz} < \text{fo} \le 170 \text{ MHz}$
	4 -		-	346.3		$10 \text{ MHz} \le 10 \le 170 \text{ MHz}$
Peak to Peak jitter	-	-	-	203.3	-	$20 \text{ MHz} < \text{fo} \le 40 \text{ MHz}$
Clock cycle > 50 000)	I + -	-	-		ne	$40 \text{ MHz} < \text{fo} \le 85 \text{ MHz}$
$V_{CC} = 2.25 \text{ V to } 2.75 \text{ V}$	t <sub>p-p</sub>	-	-	98.3	ps	$40 \text{ MHz} < 10 \le 65 \text{ MHz}$ 85 MHz < fo $\le 125 \text{ MHz}$
V <sub>CC</sub> = 2.25 V 10 2.75 V	-	-	-	55.4		
	4 -	-	-	42.8		125 MHz < fo ≤ 170 MHz
Deels to Deels iitter		-	-	344.1		$10 \text{ MHz} \le \text{fo} \le 20 \text{ MHz}$
Peak to Peak jitter		-	-	199.4		$20 \text{ MHz} < \text{fo} \le 40 \text{ MHz}$
(Clock cycle > 50 000)		-	-	97.2	ps	40 MHz < fo ≤ 85 MHz
$V_{CC}$ = 2.97 V to 3.63 V		-	-	53.0	-	85 MHz < fo ≤ 125 MHz
		-	-	33.8		125 MHz < fo ≤ 170 MHz
		-	-	33.2		$10 \text{ MHz} \le \text{fo} \le 20 \text{ MHz}$
RMS jitter		-	-	23.9	ps	20 MHz < fo ≤ 40 MHz
(Clock cycle > 50 000)		-	-	10.0		40 MHz < fo ≤ 85 MHz
$V_{CC} = 1.62 \text{ V to } 1.98 \text{ V}$		-	-	7.4		85 MHz < fo ≤ 125 MHz
	] [	-	-	7.2		125 MHz < fo ≦ 170 MHz
		-	-	31.4		10 MHz $\leq$ fo $\leq$ 20 MHz
RMS jitter		-	-	18.4		20 MHz < fo ≤ 40 MHz
(Clock cycle > 50 000)	t <sub>RMS</sub>	-	-	8.9	ps	40 MHz < fo ≤ 85 MHz
$V_{\rm CC}$ = 2.25 V to 2.75 V		-	-	5.0		85 MHz < fo ≤ 125 MHz
	Ι Γ	-	-	3.8		125 MHz < fo ≤ 170 MHz
	1 F	-	-	31.2		10 MHz $\leq$ fo $\leq$ 20 MHz
RMS jitter	Ι Γ	-	-	18.1		20 MHz < fo ≤ 40 MHz
(Clock cycle > 50 000)	Ι Γ	-	-	8.8	ps	40 MHz < fo ≤ 85 MHz
$V_{CC} = 2.97 \text{ V} \text{ to } 3.63 \text{ V}$	Ι Γ	-	-	4.8		85 MHz < fo ≤ 125 MHz
	Ι Γ	-	-	3.0		125 MHz < fo ≤ 170 MHz
		-	-	265.2		10 MHz ≤ fo ≤ 20 MHz
Cycle to Cycle jitter		-	-	208.7		20 MHz < fo ≤ 40 MHz
Clock cycle > 50 000)		-	-	75.7	ps	40 MHz < fo ≤ 85 MHz
$V_{CC} = 1.62 \text{ V} \text{ to } 1.98 \text{ V}$		-	-	63.3		85 MHz < fo ≤ 125 MHz
		-	-	66.1	1	125 MHz < fo ≤ 170 MHz
	1	-	-	253.2		$10 \text{ MHz} \le \text{fo} \le 20 \text{ MHz}$
Cycle to Cycle jitter		-	-	128.2	1	$20 \text{ MHz} < \text{fo} \le 40 \text{ MHz}$
Clock cycle > 50 000)	t <sub>c-c</sub>	-	-	45.3	ps	$40 \text{ MHz} < \text{fo} \le 85 \text{ MHz}$
$V_{CC} = 2.25 \text{ V to } 2.75 \text{ V}$	-C-C	_	-	35.8	- P0	$40 \text{ MHz} < 10 \pm 0.0 \text{ MHz}$ 85 MHz < fo $\le 125 \text{ MHz}$
	-	-	-	35.8	-	$125 \text{ MHz} < \text{fo} \le 170 \text{ MHz}$
	4 - 1-		-			$125 \text{ MHz} < 10 \le 170 \text{ MHz}$ 10 MHz $\le$ fo $\le 20 \text{ MHz}$
Quale to Quale "##= "		-	-	249.9	-	
Cycle to Cycle jitter		-	-	122.0	-	$20 \text{ MHz} < \text{fo} \le 40 \text{ MHz}$
(Clock cycle > 50 000)	1 F	-	-	42.8 28.0	ps	40 MHz < fo ≤ 85 MHz 85 MHz < fo ≤ 125 MHz
$V_{CC} = 2.97 \text{ V} \text{ to } 3.63 \text{ V}$					1	

[6] Thermal resistance (F	or referenc	e only)				
Parameter	Symbol		Specification	)	Unit	Conditions
i didilicici	Symbol	Min.	Тур.	Max.	Offic	Conditions
Junction temperature	Tj	-	-	+125	°C	
		-	15.2	-		SG-8018CG
Junction to case	θјс	-	23.1	-	°C/W	SG-8018CE
Sunction to case		-	16.1	-	0/11	SG-8018CB
		-	28.0	-		SG-8018CA
		-	91.9	-		SG-8018CG
Junction to ambient	Aio	-	103.8	-	°C/W	SG-8018CE
	θја	-	82.5	-	0/11	SG-8018CB
		-	78.8	-		SG-8018CA

<sup>[7]</sup> Typical Performance Characteristics (For reference only)



#### (7-2) Current Consumption No load, T\_use = +25 °C, Freq. Dependency 10.0 16.0 9.0 9.0 8.0 14.0 ۲ () 7.0 10.0 6.0 consumption consumption 5.0 8.0 4.0 6.0 3.0 4.0 Current ( Current of 2.0 Vcc = 1.8 V -Vcc = 2.5 V Vcc = 3.3 V 2.0 1.0 Spec at 1.8 V Spec at 2.5 V Spec at 3.3 V 0.0 0.0 0 20 40 60 80 100 120 140 160 0 Output frequency (fo) [MHz]

#### fo = 19.2 MHz

L\_CMOS = 5 pF, Temperature Characteristic









#### fo = 60 MHz











area) is not guaranteed, and the data is for reference.



Output load condition under  $L_CMOS > 15 \text{ pF}$  (dotted line area) is not guaranteed, and the data is for reference.





# (7-2) Current Consumption [cont'd]

#### fo = 80 MHz



fo = 122.88 MHz











\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.





Output load condition under  $L_CMOS > 15 \text{ pF}$  (dotted line area) is not guaranteed, and the data is for reference.



The actual current consumption is the total of the current under the condition of no load and the current to drive the output load (fo  $\times L_CMOS \times V_{CC}$ ). To reduce the current consumption, it is effective to use lower frequency, lower supply voltage and lower output load.

# (7-3) Rise Time/Fall Time

fo = 19.2 MHz, Rise time/Fall time: A (Default) **Rise Time** 



20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.





20 % - 80 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char.







Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference

fo = 19.2 MHz, Rise time/Fall time: B (Fast) **Rise Time** 



Fall Time





20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.









(7-3) Rise Time/Fall Time [cont'd]

fo = 40 MHz, Rise time/Fall time: A (Default) **Rise Time** 



20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.





20 % - 80 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char.







Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference

fo = 40 MHz, Rise time/Fall time: B (Fast) **Rise Time** 



Fall Time





20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.







# (7-3) Rise Time/Fall Time [cont'd]

fo = 60 MHz, Rise time/Fall time: A (Default) & B (Fast) **Rise Time** 





20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.



Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference





Fall Time





20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.







Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

Output load (L\_CMOS) [pF] Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

#### (7-3) Rise Time / Fall Time [cont'd] fo = 122.88 MHz, Rise time/Fall time: A (Default) & B (Fast) **Rise Time** 20 % - 80 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char. 20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char. 10.0 10.0 ▲ Vcc = 1.8 V → Vcc = 1.8 V 9.0 9.0 ▲ Vcc = 2.5 V Vcc = 2.5 V 8.0 8.0 \_\_\_\_\_Vcc = 3.3 V 7.0 : (tr) [ns] 7.0 Rise time (tr) [ns] 6.0 6.0 5.0 5.0 time 4.0 4.0 Rise 3.0 3.0 ..... 2.0 2.0 **A**..... 1.0 1.0 0.0 0.0 10 20 30 40 50 0 -40 -30 -20 -10 0 60 70 80 90 100 10 20 30 40 50 Temperature [ºC] Output load (L\_CMOS) [pF] Fall Time 20 % - 80 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char. 20 % - 80 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char. 10.0 10.0 ▲ Vcc = 1.8 V 9.0 9.0 -Vcc = 2.5 V 8.0 8.0 ▲ Vcc = 3.3 V 7.0 7.0 (tf)[ns] Fall time (tf) [ns] 6.0 6.0 5.0 5.0 Fall time 4.0 4.0 3.0 3.0 Autoria and a state of the stat 2.0 2.0 1.0 1.0 0.0 0.0 10 20 30 40 50 -40 -30 -20 -10 0 60 70 80 90 100 0 10 20 30 40 50

Temperature [°C]

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## (7-4) Symmetry

fo = 19.2 MHz, Rise time/Fall time: A (Default) 50  $%V_{CC}$ , L\_CMOS = 15 pF, Temp. Char.



fo = 19.2 MHz, Rise time/Fall time: B (Fast) 50  $%V_{CC}$ , L\_CMOS = 15 pF, Temp. Char.



fo = 19.2 MHz, Rise time/Fall time: C (Slow) 50 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char.





\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.





\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.





# (7-4) Symmetry [cont'd] fo = 40 MHz, Rise time/Fall time: A (Default) $50 \% V_{CC}$ , L\_CMOS = 15 pF, Temp. Char.

















\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.





\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.





\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

50 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.



# (7-4) Symmetry [cont'd]

fo = 122.88 MHz, Rise time/Fall time: A (Default) & B (Fast)



fo = 170 MHz, Rise time/Fall time: A (Default) & B (Fast) 50 %V<sub>CC</sub>, L\_CMOS = 15 pF, Temp. Char.



50 %V<sub>CC</sub>, T\_use = +25 °C, Output load Char.



 $^{\ast}$  Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.



#### (7-5) Output Voltage fo = 19.2 MHz, Rise time/Fall time: A (Default) V<sub>OH</sub>, L\_CMOS = 15 pF, Temp. Char. V<sub>OH</sub>, T\_use = +25 °C, Output load Char. 3.5 3.5 . 3 3 voltage (V<sub>OH</sub>) [V] Output voltage (V<sub>OH</sub>) [V] 2.5 2.5 2 2 1.5 1.5 1 1 Output 0.5 0.5 - Vcc = 1.8 \ Vcc = 1.8 \ Vcc = 2.5 V Vcc = 2.5 V 0 0 - Vcc = 3.3 V --0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 10 20 40 50 30 Temperature [ºC] Output load (L\_CMOS) [pF] V<sub>OL</sub>, L\_CMOS = 15 pF, Temp. Char. V<sub>OL</sub>, T\_use = +25 °C, Output load Char. 3.5 3.5 3 3 - Vcc = 2.5 V → Vcc = 2.5 V - Vcc = 3.3 V (V<sub>oL</sub>) [V] (V<sub>oL</sub>) [V] - Vcc = 3.3 V 2.5 2.5 2 2 voltage ( voltage / 1.5 1.5 1 1 Output Output 0.5 0.5 0 0 -0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 40 50 10 20 30 Temperature [°C] Output load (L\_CMOS) [pF]

\* Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.









V<sub>OH</sub>, T\_use = +25 °C, Output load Char.









area) is not guaranteed, and the data is for reference.





V<sub>OL</sub>, L\_CMOS = 15 pF, Temp. Char.



V<sub>OH</sub>, T\_use = +25 °C, Output load Char.



 $V_{OL}$ , T\_use = +25 °C, Output load Char.



<sup>\*</sup> Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.









V<sub>OL</sub>, L\_CMOS = 15 pF, Temp. Char.



V<sub>OH</sub>, T\_use = +25 °C, Output load Char.







#### (7-5) Output Voltage [cont'd] fo = 80 MHz, Rise time/Fall time: A (Default) & B (Fast) V<sub>OH</sub>, L\_CMOS = 15 pF, Temp. Char. V<sub>OH</sub>, T\_use = +25 °C, Output load Char. 3.5 3.5 3 3 Output voltage (V<sub>OH</sub>) [V] 2.5 2.5 voltage (V<sub>OH</sub>) [V] 2 2 1.5 1.5 1 1 Output 0.5 0.5 Vcc = 1.8 \ Vcc = 1.8 \ Vcc = 2.5 V ▲ Vcc = 2.5 V 0 0 - Vcc = 3.3 V - Vcc = 3.3 V ---0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 10 20 40 50 30 Temperature [ºC] Output load (L\_CMOS) [pF] V<sub>OL</sub>, T\_use = +25 °C, Output load Char. V<sub>OL</sub>, L\_CMOS = 15 pF, Temp. Char. 3.5 3.5 3 3 - Vcc = 2.5 V → Vcc = 2.5 V - Vcc = 3.3 V (V<sub>oL</sub>) [V] (V<sub>oL</sub>) [V] - Vcc = 3.3 V 2.5 2.5 2 2 voltage ( voltage / 1.5 1.5 1 1 Output Output 0.5 0.5 ..... 0 0 -0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 50 10 20 30 40 Temperature [°C] Output load (L\_CMOS) [pF]









V<sub>OH</sub>, T\_use = +25 °C, Output load Char.







#### (7-5) Output Voltage [cont'd] fo = 170 MHz, Rise time/Fall time: A (Default) & B (Fast) V<sub>OH</sub>, L\_CMOS = 15 pF, Temp. Char. V<sub>OH</sub>, T\_use = +25 °C, Output load Char. 3.5 3.5 3 3 Output voltage (V<sub>OH</sub>) [V] voltage (V<sub>OH</sub>) [V] 2.5 2.5 2 2 1.5 1.5 1 1 Output 0.5 0.5 Vcc = 1.8 V - Vcc = 1.8 \ Vcc = 2.5 V - Vcc = 2.5 V 0 0 -0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 10 20 40 50 30 Output load (L\_CMOS) [pF] Temperature [ºC] V<sub>OL</sub>, L\_CMOS = 15 pF, Temp. Char. $V_{OL}$ , T\_use = +25 °C, Output load Char. 3.5 3.5 3 3 ▲-- Vcc = 2.5 V → Vcc = 2.5 V ← Vcc = 3.3 V (V<sub>oL</sub>) [V] - Vcc = 3.3 V voltage (V<sub>oL</sub>) [V] 2.5 2.5 2 2 voltage / 1.5 1.5 1 1 Output Output 0.5 0.5 ..... 0 0 -0.5 -0.5 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 0 40 50 10 20 30 Temperature [°C] Output load (L\_CMOS) [pF]

<sup>t</sup> Output load condition under L\_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.



fo  $\geq$  39 MHz:

12 kHz to 20 MHz















 $V_{CC}$  = 2.5 V, L\_CMOS = 15 pF, T\_use = +25 °C









V<sub>CC</sub> = 2.5 V, L\_CMOS = 15 pF, T\_use = +25 °C





fo = 60 MHz, Rise time/Fall time: A (Default) & B (Fast) V<sub>CC</sub> = 3.3 V, L\_CMOS = 15 pF, T\_use = +25 °C V<sub>CC</sub> = 2.5 V, L\_CMOS = 15 pF, T\_use = +25 °C





Time [5 ns / div]



fo = 122.88 MHz, Rise time/Fall time: A (Default) & B (Fast)







The bandwidth should be minimum 5 times wider than measurement frequency The probe ground should be placed closely to the test point and the lead length should be as short as possible

\* It is recommended to use miniature socket. (Don't use earth lead.)

- (2) L\_CMOS includes probe capacitance.
- (3) A 0.1  $\mu F$  bypass capacitor should be connected between  $V_{CC}$  and GND pins located close to the device
- (4) Use a current meter with a low internal impedance
- (5) Power Supply

Power supply startup time (0  $%V_{CC} \rightarrow 90 \% V_{CC}$ ) should be between 5 µs and 500 ms Power supply impedance should be as low as possible and GND line should be as short as possible

# (8-6) Timing Chart

(1) Output Waveform and Level



# (2) $OE/\overline{ST}$ Function and Timing

OE/ST terminal	Osc. circuit	Output status
"H"	Oscillation	Specified frequency: Enable
"["	OE: Oscillation	
L	ST: Oscillation stop	Low (Weak pull down <sup>*3</sup> ): Disable



- \*1 The period from  $OE/\overline{ST} = V_{IL}$  to OUT = Low (weak pull down) (Disable)
- \*2 The period from  $OE/\overline{ST} = V_{IH}$  to OUT = Enable
- \*3 Pulled down with Output pull down resistance ( $R_{DN}$ )
- \* Judging the start of output when output waveform is observed.
- \* OE/ST terminal voltage level should not exceed supply voltage when using OE/ST function. Please note that OE/ST rise time should not exceed supply voltage rise time at the start-up.
- \* Please do not use the  $OE/\overline{ST}$  terminal in the open state.
  - Typically the output will be enable when OE/ST is open state, but the input pull resistance is large and OE/ST terminal may drop to "L" level and be disable due to noise or leakage current.

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[9] Outline Drawing and Recommended Footprint (9-1) SG-8018CG



For stable operation, it is recommended that 0.1  $\mu F$  bypass capacitor should be connected between V<sub>CC</sub> and GND and placed as close to the V<sub>CC</sub> pin as possible.

Reference Weight Typ.: 13 mg

1.7

## **Terminal Assignment**

<u>ک</u>

Pin #	Connection	Function		
		OE terminal		
	OE	OE function	Osc. Circuit	Output
	UE	"H" *	Oscillation	Specified frequency: Enable
#1		"L"	Oscillation	Low (weak pull down): Disable
#1		ST terminal		
	ST	$\overline{ST}$ function	Osc. Circuit	Output
	51	"H" *	Oscillation	Specified frequency: Enable
		"L"	Oscillation stop	Low (weak pull down): Disable
#2	GND	GND terminal		
#3	OUT	Output terminal		
#4	V <sub>cc</sub>	V <sub>cc</sub> terminal		

\* Please do not use the  $OE/\overline{ST}$  terminal in the open state.

# Marking



Units: mm

Units: mm



Reference Weight Typ.: 25 mg

# **Terminal Assignment**

Pin #	Connection	Function		
		OE terminal		
	OE	OE function	Osc. Circuit	Output
	0E	"H" *	Oscillation	Specified frequency: Enable
#1		"L"	Oscillation	Low (weak pull down): Disable
#1		ST terminal		
	ST	$\overline{ST}$ function	Osc. Circuit	Output
	51	"H" *	Oscillation	Specified frequency: Enable
		"L"	Oscillation stop	Low (weak pull down): Disable
#2	GND	GND terminal		
#3	OUT	Output terminal		
#4	V <sub>cc</sub>	V <sub>cc</sub> terminal		

\* Please do not use the  $OE/\overline{ST}$  terminal in the open state.

# Marking





Reference Weight Typ.: 51 mg

# **Terminal Assignment**

Pin #	Connection	Function		
		OE terminal		
	OE	OE function	Osc. Circuit	Output
	0E	"H" *	Oscillation	Specified frequency: Enable
#1		"L"	Oscillation	Low (weak pull down): Disable
#1		ST terminal		
	ST	$\overline{ST}$ function	Osc. Circuit	Output
	51	"H" *	Oscillation	Specified frequency: Enable
		"L"	Oscillation stop	Low (weak pull down): Disable
#2	GND	GND terminal		
#3	OUT	Output terminal		
#4	V <sub>cc</sub>	V <sub>cc</sub> terminal		

\* Please do not use the  $OE/\overline{ST}$  terminal in the open state.

# Marking



# SEIKO EPSON CORPORATION



Reference Weight Typ.: 143 mg

# **Terminal Assignment**

Pin #	Connection	Function			
	OE	OE terminal			
		OE function	Osc. Circuit	Output	
		"H" *	Oscillation	Specified frequency: Enable	
#1		"L"	Oscillation	Low (weak pull down): Disable	
#1	ST	ST terminal			
		ST function	Osc. Circuit	Output	
		"H" *	Oscillation	Specified frequency: Enable	
		"L"	Oscillation stop	Low (weak pull down): Disable	
#2	GND	GND terminal			
#3	OUT	Output terminal			
#4	V <sub>cc</sub>	V <sub>cc</sub> terminal			

\* Please do not use the  $OE/\overline{ST}$  terminal in the open state.

# Marking



[10] Moisture Sensitivity Level

Parameter	Specification	Conditions
MSL	LEVEL 1	IPC/JEDEC J-STD-020D.1

# [11] Reflow Profiles

IPC/JEDEC J-STD-020D.1



[12] Packing Information

#### (12-1) SG-8018CG

(1) Packing Quantity

The last two digits of the Product Number (X1G005601xxxx $\underline{xx}$ ) are a code that defines the packing quantity. The standard is "00" for a 3 000 pcs/Reel.

(2) Taping Specification

Subject to EIA-481, IEC-60286 and JIS C0806

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

Top Tape Material: PET (Polyethylene Terephthalate) + PE (Polyethylene)

Units: mm

Units: mm



2) Reel Dimensions

Reel Material: PS (Polystyrene)



3) Storage Environment

We recommend to keep less than +30 °C and 85 %RH of humidity in a packed condition, and to use it less than 6 months after delivery.

# (12-2) SG-8018CE

# (1) Packing Quantity

The last two digits of the Product Number (X1G005591xxxx<u>xx</u>) are a code that defines the packing quantity. The standard is "00" for a 2 000 pcs/Reel.

### (2) Taping Specification

Subject to EIA-481, IEC-60286 and JIS C0806

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

Top Tape Material: PET (Polyethylene Terephthalate) + PE (Polyethylene)

Units: mm



# 2) Reel Dimensions



3) Storage Environment

We recommend to keep less than +30  $^{\circ}$ C and 85  $^{\circ}$ RH of humidity in a packed condition, and to use it less than 6 months after delivery.

Units: mm

# (12-3) SG-8018CB

# (1) Packing Quantity

The last two digits of the Product Number (X1G005581xxxx<u>xx</u>) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

### (2) Taping Specification

Subject to EIA-481 & IEC-60286

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene) Top Tape Material: PET (Polyethylene Terephthalate)



# 2) Reel Dimensions

Reel Material: PS (Polystyrene)

Units: mm



3) Storage Environment

We recommend to keep less than +30 °C and 85 %RH of humidity in a packed condition, and to use it less than 6 months after delivery.

# (12-4) SG-8018CA

# (1) Packing Quantity

The last two digits of the Product Number (X1G005571xxxx<u>xx</u>) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

### (2) Taping Specification

Subject to EIA-481 & IEC-60286

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene) Top Tape Material: PET (Polyethylene Terephthalate)

Units: mm

Units: mm



# 2) Reel Dimensions



3) Storage Environment

We recommend to keep less than +30 °C and 85 %RH of humidity in a packed condition, and to use it less than 6 months after delivery.

### [13] Handling Precautions

Prior to using this product, please carefully read the section entitled "Precautions" on our Web site (https://www5.epsondevice.com/en/information/#precaution) for instructions on how to handle and use the product properly to ensure optimal performance of the product in your equipment. Before using the product under any conditions other than those specified therein,

please consult with us to verify and confirm that the performance of the product will not be negatively affected by use under such conditions.

In addition to the foregoing precautions, in order to avoid the deteriorating performance of the product, we strongly recommend that you DO NOT use the product under ANY of the following conditions:

- (1) Do not expose this product to excessive mechanical shock or vibration.
- (2) This product can be damaged by mechanical shock during the soldering process depending on the equipment used, process conditions, and any impact forces experienced. Always follow appropriate procedures, particularly when changing the assembly process in any way and be sure to follow applicable process qualification standards before starting production.
- (3) These devices are sensitive to ESD, use appropriate precautions during handling, assembly, test, shipment, and installation.
- (4) The use of ultrasonic technology for cleaning, bonding, etc. can damage the Xtal unit inside this product.
- Please carefully check for this consideration before using ultrasonic equipment for volume production with this product.Noise and ripple on the power supply may have undesirable affects on operation and cause degradation of phase noise
  - characteristics. Evaluate the operation of this device with appropriate power supplies carefully before use.
- (6) When applying power, ensure that the supply voltage increases monotonically for proper operation. On power down, do not reapply power until the supplies, bypass capacitors, and any bulk capacitors are completely discharged since that may cause the unit to malfunction.
- (7) Aging specifications are estimated from environmental reliability tests and expected frequency variation over time. They do not provide a guarantee of aging over the product lifecycle.
- (8) The metal cap on top of the device is directly connected to the GND terminal (pin #2). Take necessary precautions to prevent any conductor not at ground potential from contacting the cap as that could cause a short circuit to GND.
- (9) Do not route any signal lines, supply voltage lines, or GND lines underneath the area where the oscillators are mounted including any internal layers and on the opposite side of the PCB. To avoid any issues due to interference of other signal lines, please take care not to place signal lines near the product as this may have an adverse affect on the performance of the product.
- (10) A bypass capacitor of the recommended value(s) must be connected between the V<sub>CC</sub> and GND terminals of the product. Whenever possible, mount the capacitor(s) on the same side of the PCB and as close to the product as possible to keep the routing traces short.
- (11) Power supply connections to V<sub>CC</sub> and GND pins should be routed as thick as possible while keeping the high frequency impedance low in order to get the best performance.
- (12) The use of a filter or similar element in series with the power supply connections to protect from electromagnetic radiation noise may increase the high frequency impedance of the power supply line and may cause the oscillator to not operate properly. Please verify the design to ensure sufficient operational margin prior to use.
- (13) Keep PCB routing from the output terminal(s) to the load as short as possible for best performance.
- (14) The Enable (OE or ST) input terminal is high impedance and so susceptible to noise. Connect it to a low impedance source when used and when not used it is recommended to connect it to Vcc for active high inputs and GND for active low inputs.
- (15) Do not short the output to GND as that will damage the product. Always use with an appropriate load resistor connected.

(16) This product should be reflowed no more than 3 times. If rework is needed after reflow, please correct it with a soldering iron with the tip set for a temperature of +350 °C or less and only contact each terminal once and for no more than 5 seconds. If this product is mounted on the bottom of the board during a reflow please check that it soldered down properly afterwards.

[A	[Availability of mounting conditions]					
	Reflow on the board	Avallable				
	Reflow under the board	The parts may fall. Please judge whether it is possible to implement.				
V	Soldering pot/bath (Dip soldering system, Flow soldering system)	Not Avallable				
	Soldering iron	Avallable				

- (17) Product failures during the warranty period only apply when the product is used according to the recommended operating conditions described in the specifications. Products that have been opened for analysis or damaged will not be covered. It is recommended to store and use in normal temperature and humidity environments described in the specifications to ensure frequency accuracy and prevent moisture condensation. If the product is stored for more than one year, please confirm the pin solderability prior to use.
- (18) If the oscillation circuit is exposed to condensation, the frequency may change or oscillation may stop. Do not use in any conditions where condensation occurs.
- (19) Do not store or use the product in an environment where it can be exposed to chemical substances that are corrosive to metal or plastics such as salt water, organic solvents, chemical gasses, etc. Do not use the product when it is exposed to sunlight, dust, corrosive gasses, or other materials for long periods of time.
- (20) When using water-soluble solder flux make sure to completely remove the flux residue after soldering.
- Pay particular attention when the residues contain active halogens which will negatively affect the product and its performance. (21) Terminals on the side of the product are internally connected to the IC, be careful not to cause short-circuits or reduce the insulation resistance of them in any way.
- (22) Should any customer use the product in any manner contrary to the precautions and/or advice herein, such use shall be done at the customer's own risk.

# PROMOTION OF ENVIRONMENTAL MANAGEMENT SYSTEM CONFORMING TO INTERNATIONAL STANDARDS

At Seiko Epson, all environmental initiatives operate under the Plan-Do-Check-Action (PDCA) cycle designed to achieve continuous improvements. The environmental management system (EMS) operates under the ISO 14001 environmental management standard. All of our major manufacturing and non-manufacturing sites, in Japan and overseas, completed the acquisition of ISO 14001 certification.

#### WORKING FOR HIGH QUALITY

In order provide high quality and reliable products and services than meet customer needs, Seiko Epson made early efforts towards obtaining ISO9000 series certification and has acquired ISO9001 for all business establishments in Japan and abroad. We have also acquired IATF 16949 certification that is requested strongly by major manufacturers as standard.

Explanation of marks used in this datasheet

ISO 14000 is an international standard for environmental management that was established by the International Standards Organization in 1996 against the background of growing concern regarding global warming, destruction of the ozone layer, and global deforestation.

IATF 16949 is the international standard that added the sector-specific supplemental requirements for automotive industry based on ISO9001.

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