XC25BS8 Series

Ultra Small PLL Clock Generator ICs with Built-In Divider/Multiplier Circuits

■GENERAL DESCRIPTION

The XC25BS8 series is an ultra small PLL clock generator IC which can generate a high multiplier output up to 4095 from an input frequency as low as 8kHz. The series includes a divider circuit, phase/frequency comparator, charge pump, and VCO so it is possible to configure a fully operational circuit with a few external components like one low-pass filter capacitor. The Input divider ratio (M) can be selected from a range of 1 to 2047, the output divider ratio (N) can be selected from a range of 1 to 4095 and they are set internally by using laser timing technologies. Output frequency (fQ0) is equal to input clock frequency (f_{CLKin}) multiplied by N/M. Output frequency range is 1MHz to 100MHz. Reference clock from 8kHz to 36MHz can be input as the input clock. The IC stops operation and current drain is suppressed when a low level signal is input to the CE pin which greatly reduces current consumption and produces a high impedance output.

The setting of the input divider ratio (M), output divider ratio (N), and charge pump current (Ip) are factory fixed semi-custom. Please advise your Torex sales representative of your particular input/output frequency and supply voltage specifications so that we can see if we will be able to support your requirements. The series is available in small SOT-26W and USP-6C.

■ APPLICATIONS

- Clock for controlling a Imaging dot (LCD)
- DSC (Digital still camera)
- DVC (Digital video camera)
- PND (Car navigation system)
- UMPC (Ultra Mobile Personal Computer)
- SSD (Solid State Disk)
- Digital Photo Frame
- Microcomputer and HDD drives
- Cordless phones & Wireless communication equipment
- Various system clocks

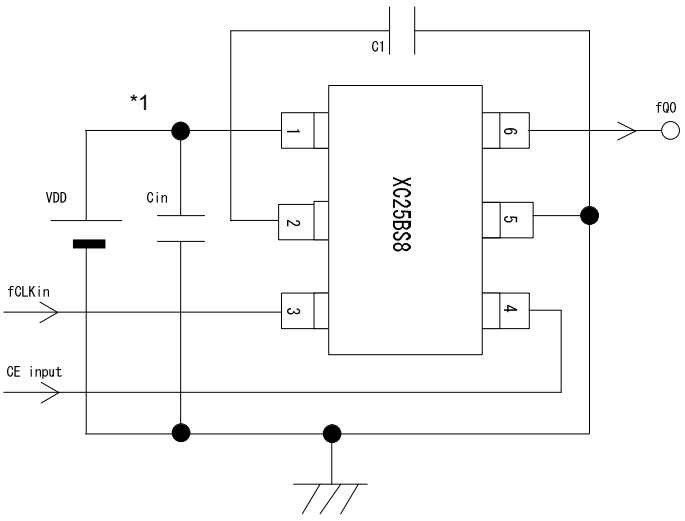
■FEATURES

Input Frequency Range	: 8kHz ~ 36MHz (*1)
Output Frequency Range	: 1MHz ~ 100MHz ($f_{Q0}=f_{CLKin} \times N/M$) (*1)
Output Divider (N) Range	: 1 ~ 4095 (*1)
Input Divider (M) Range	: 1 ~ 2047 (*1)
Operating Voltage Range	: 2.50V ~ 5.50V (*1)
Low Power Consumption	: 10 μA MAX. when stand-by (*2)
Small Packages	: SOT-26W, USP-6C

*1: The series are semi-custom products. Specifications for each product are limited within the above range. The input frequency range is set within ±5% of customer's designated typical frequency. Please note that setting of your some requirements may not be possible due to the specification limits of this series.

*2: When the IC is in stand-by mode, the output becomes high impedance and the IC stops operation.

■TYPICAL APPLICATION CIRCUIT

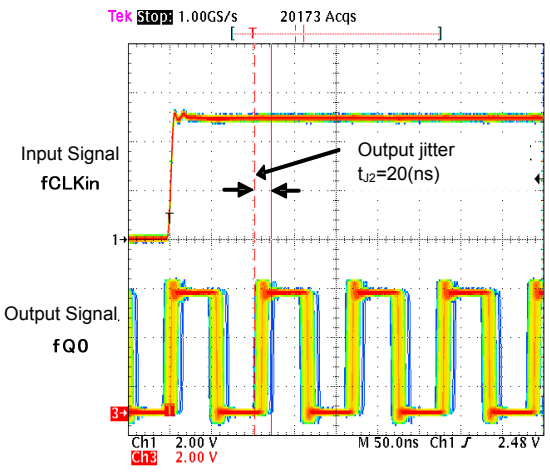


*1: C_{IN} (by-pass capacitor, 0.1 μF) and C1 (LPF capacitor, 0.1 μF) should be connected as close as possible to the IC. Please refer to the pattern reference layout schematics on page 8 for details.

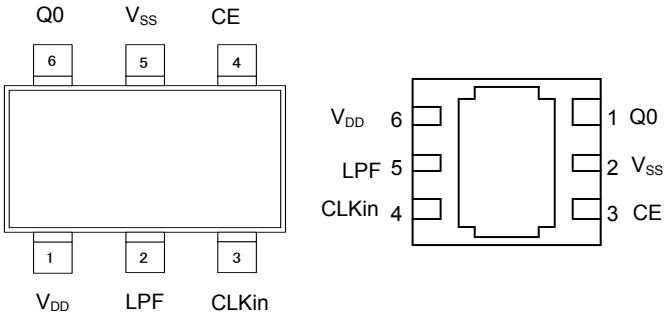
■ TYPICAL PERFORMANCE CHARACTERISTICS

PLL Output signal jitter 2 (t_{J2}) (synchronous to an input signal)

XC25BS8001xx (610 multiplier, input 15kHz (TYP.))



■PIN CONFIGURATION



SOT-26W
(TOP VIEW)

USP-6C
(BOTTOM VIEW)

* The dissipation pad (TAB) of the bottom view of the USP-6C package should be connected to the V_{SS} (No. 2) pin.

■PIN ASSIGNEMNT

PIN NUMBER		PIN NAME	FUNCTION
SOT-26W	USP-6C		
6	1	Q0	Clock Output
5	2	V_{SS}	Ground
4	3	CE	Stand-by Control (*)
3	4	CLKin	Reference Clock Signal Input
2	5	LPF	Device connection for Low Pass Filter
1	6	V_{DD}	Power Input

■ FUNCTION LIST

CE	'H"	'L" or OPEN
Q0	Signal Output	High Impedance

*H: High level input
L: Low level input（stand-by mode）

■ PRODUCT CLASSIFICATION

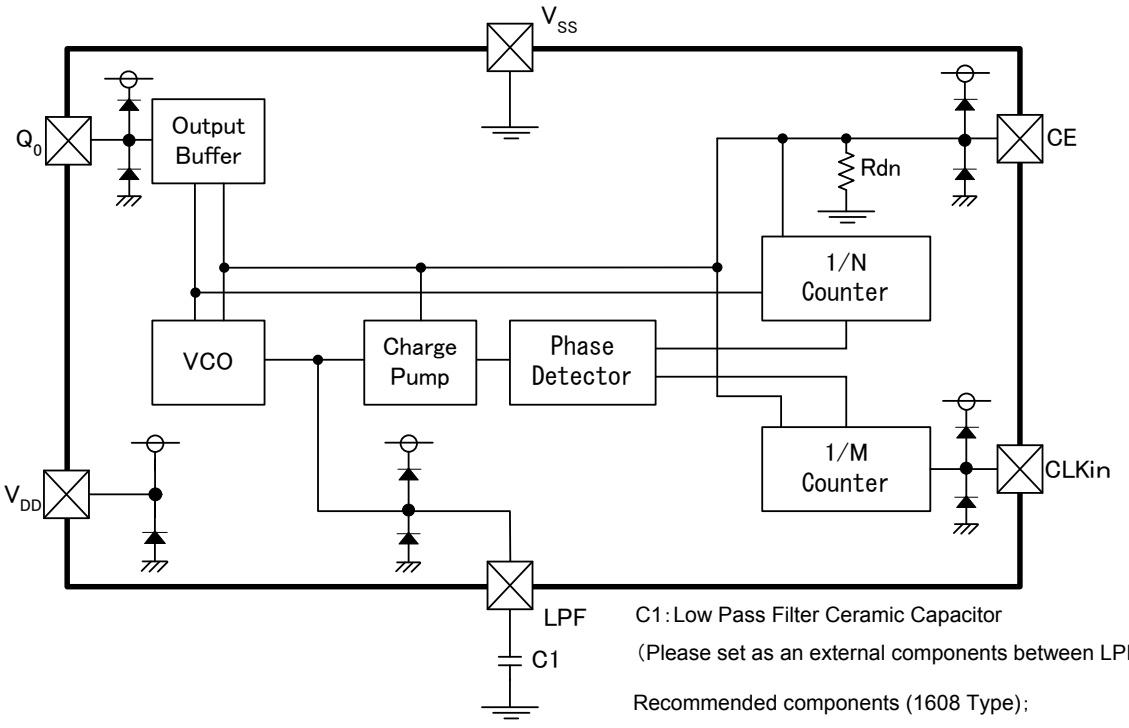
●Ordering Information

XC25BS8①②③④⑤-⑥ (*1)

DESIGNATOR	DESCRIPTION	SYMBOL	DESCRIPTION
①②③	Product Number	001~	Serial number based on internal standards e.g. product number 001→①②③=001
④⑤-⑥	Packages Taping Type (*2)	MR	SOT-26W
		MR-G	SOT-26W (Halogen & Antimony free)
		ER	USP-6C
		ER-G	USP-6C (Halogen & Antimony free)

(*1) The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.
(*2) The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ④R-⑥, Reverse orientation: ④L-⑥)

■BLOCK DIAGRAM



C1：Low Pass Filter Ceramic Capacitor
（Please set as an external components between LPF Pin and V_{SS}）

Recommended components (1608 Type)；
C1：0.1μF ---- Taiyo yuden EMK107BJ104KA

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNITS
Supply Voltage		V_{DD}	V_{SS} - 0.3 ～ V_{SS} + 7.0	V
CLKin Pin Input Voltage		V_{CK}	V_{SS} - 0.3 ～ V_{DD} + 0.3	V
CE Pin Input Voltage		V_{CE}	V_{SS} - 0.3 ～ V_{DD} + 0.3	V
Q0 Pin Output Voltage		V_{Q0}	V_{SS} - 0.3 ～ V_{DD} + 0.3	V
Q0 Pin Output Current		I_{Q0}	± 50	mA
Power Dissipation	SOT-26W	Pd	250	mW
	USP-6C		100	mW
Operating Temperature Range		Topr	-40 ～+85	℃
Storage Temperature Range		Tstg	-55 ～+125	℃

■ SELECTION GUIDE

*1: The table below introduces standard products. Please select with seeing the combination of input frequencies and multiplications.
The test condition: V_{DD}=3.3V±10%

*2: For other input frequency and multiplication, please ask your Torex sales contacts.

Multiplication	Input Frequency MIN	~	MAX	Synchronization jitter	Synchronization jitter / Output Period (%)	Product Series
64	32kHz	~	192kHz	36ns	10%	XC25BS8044
128	32kHz	~	192kHz	32ns	18%	XC25BS8027
	32kHz	~	96kHz	24ns	14%	XC25BS8028
	32kHz	~	48kHz	20ns	11%	XC25BS8057
192	32kHz	~	192kHz	30ns	25%	XC25BS8030
	32kHz	~	96kHz	20ns	17%	XC25BS8031
	32kHz	~	48kHz	16ns	14%	XC25BS8058
256	32kHz	~	192kHz	24ns	27%	XC25BS8033
	32kHz	~	96kHz	22ns	25%	XC25BS8026
	32kHz	~	48kHz	18ns	20%	XC25BS8025
384	32kHz	~	192kHz	21ns	36%	XC25BS8035
	32kHz	~	96kHz	20ns	34%	XC25BS8036
	32kHz	~	48kHz	18ns	30%	XC25BS8037
512	32kHz	~	96kHz	18ns	41%	XC25BS8039
	32kHz	~	48kHz	16ns	36%	XC25BS8040
768	32kHz	~	96kHz	16ns	54%	XC25BS8042
	32kHz	~	48kHz	14ns	47%	XC25BS8043

* Synchronization jitters are tested at f_{CLKIN}=44.1kHz.

Multiplication	Input Frequency MIN	~	MAX	Amount of Jitter Synchronization	Amount of Jitter Synchronization / Output Period (%)	Product Series
64	8kHz	~	16kHz	160ns	8%	XC25BS8045
128	8kHz	~	16kHz	140ns	14%	XC25BS8029
192	8kHz	~	16kHz	110ns	17%	XC25BS8032
256	8kHz	~	16kHz	100ns	20%	XC25BS8034
384	8kHz	~	16kHz	96ns	29%	XC25BS8038
512	8kHz	~	16kHz	52ns	21%	XC25BS8041
768	8kHz	~	16kHz	48ns	29%	XC25BS8046

* Synchronization jitters are tested at f_{CLKIN}=8kH.

Multiplication	Input Frequency MIN	~	MAX	Amount of Jitter Synchronization	Amount of Jitter Synchronization / Output Period (%)	Product Series
1	8MHz	~	74MHz	7ns	8%	XC25BS8047
2	6MHz	~	37MHz	6ns	11%	XC25BS8048
3	2MHz	~	24MHz	12ns	11%	XC25BS8049
4	2MHz	~	18MHz	7ns	8%	XC25BS8050
5	2MHz	~	14MHz	8ns	12%	XC25BS8051
6	2MHz	~	12MHz	7ns	13%	XC25BS8052
7	2MHz	~	10MHz	7ns	15%	XC25BS8053
8	2MHz	~	9MHz	6ns	14%	XC25BS8054
9	2MHz	~	8MHz	6ns	16%	XC25BS8055
10	2MHz	~	7MHz	7ns	21%	XC25BS8056

* Synchronization jitters are tested in the condition below.

For the XC258047 (1 Multiplication), f_{CLKIN} =12MHz. For the XC258048(2 Multiplication), f_{CLKIN}= 8MHz

Except above, f_{CLKIN}=3MHz is used.

■ELECTRICAL CHARACTERISTICS

●Recommended Operating Conditions: XC25BS8050xx (4 multiplication, Input 3MHz (TYP.)) 3.3V (TYP.)

Tested below Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNITS
Supply Voltage 3.3V	V_{DD}	3.3V (TYP.) operation	2.97	3.63	V
Input Frequency	f_{CLKin}	(*1)	2.000	18.500	MHz
Multiplier Ratio	N/M	Typical value is shown (*1)	4		-
Output Frequency	f_{Q0}	(*1)	8.000	74.000	MHz
Load Capacity (*3)	CL		-	15	pF
Output Start Time (*2)(*3)	t_{START}	f_{CLKin}=2.000MHz	0.05	20	ms

NOTE:

*1: The values are measured when a capacitor C_{IN}=0.1μF is connected between V_{DD} and V_{SS} pins, a capacitor C1=0.1μF is connected between LFP and V_{SS} pins

*2: It is a time to get stable output signal from Q0 pin after the CE pin is turned on while applying supply voltage to the V_{DD} pin and applying the input signal to the CLKin pin.

*3: Values indicated are design values which are not guaranteed 100%.

●DC Characteristics: XC25BS8050xx (4 multiplication, Input 3MHz (TYP.)) 3.3V (TYP.)

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
H Level Input Voltage	V_{IH}		2.70	-	-	V	①
L Level Input Voltage	V_{IL}		-	-	0.60	V	①
H Level Input Current	Ii_H	V_{CLKin}=V_{DD}-0.3V	-	-	3.0	μA	②
L Level Input Current	Ii_L	V_{CLKin}=0.3V	-3.0	-	-	μA	②
H Level Output Voltage	V_{OH}	V_{DD}=2.97V, IOH=-4mA	2.38	-	-	V	③
L Level Output Voltage	V_{OL}	V_{DD}=2.97V, IOL= 4mA	-	-	0.45	V	③
Supply Current 1	I_{DD1}	V_{DD}=3.63V, CE= 3.63V	-	5.0	10.0	mA	④
Supply Current 2	I_{DD2}	V_{DD}=3.63V, CE= 0.0V	-	-	10	μA	④
CE H Level Voltage	V_{CEH}		2.70	-	-	V	①
CE L Level Voltage	V_{CEL}		-	-	0.45	V	①
CE Pull-Down Resistance 1	Rdn1	CE= V_{DD}	0.1	0.6	1.2	MΩ	⑤
CE Pull-Down Resistance 2	Rdn2	CE= 0.1*V_{DD}	5	30	60	kΩ	⑤
Output Off Leak Current	I_{OZ}	V_{DD}=3.63V, CE= 0.0V	-	-	10	μA	⑥

NOTE:

TEST CONDITION: V_{DD}=3.0V, f_{CLKin}=3MHz, C1=0.1μF, Multiplier ratio=4, No load

●AC Characteristics: XC25BS8050xx (4 multiplication, 3MHz(TYP.)) 3.3V (TYP.)

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Rise Time (*1)	t_R	(20% ~ 80%)	-	4.0	8.0	ns	①
Output Fall Time (*1)	t_F	(20% ~ 80%)	-	4.0	8.0	ns	①
Output Signal Duty Cycle (*1)	Duty		45	50	55	%	①
PLL Output Signal Jitter 1 (*1)	t_{J1}	1σ (Output Period)	-	45	-	ps	①
PLL Output Signal Jitter 2 (*1)	t_{J2}	Peak to Peak (Output Tracking)	-	8.0	-	ns	①

NOTE:

TEST CONDITION: V_{DD}=3.3V, f_{CLKin}=3MHz, C1=0.1μF, Multiplier ratio=4, C_L=15pF

*1: Values indicated are design values, which are not guaranteed 100%.

■ELECTRICAL CHARACTERISTICS (Continued)

●Recommended Operating Conditions: XC25BS8025xx (256multiplication, Input 44.1kHz (TYP.)) 5.0V (TYP.)

Tested below Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	MAX.	UNITS
Supply Voltage 5.0V	V_{DD}	5.0V (TYP.) operation	4.50	5.50	V
Input Frequency	f_{CLKin}	(*1)	32.000	48.000	kHz
Multiplier Ratio	N/M	Typical value is shown (*1)	256		
Output Frequency	f_{Q0}	(*1)	8.693	96.075	MHz
Load Capacity (*3)	CL		-	15	pF
Output Start Time (*2)(*3)	t_{START}	f_{CLKin}=32.000kHz	0.05	20	ms

NOTE:

*1: The values are measured when a capacitor C_{IN}=0.1μF is connected between V_{DD} and V_{SS} pins, a capacitor C1=0.1μF is connected between LFP and V_{SS} pins.

*2: It is a time to get stable output signal from Q0 pin after the CE pin is turned on while applying supply voltage to the V_{DD} pin and applying the input signal to the CLKin pin.

*3: Values indicated are design values which are not guaranteed 100%.

●DC Characteristics: XC25BS8025xx (256 multiplication, Input 44.1kHz (TYP.)) 5.0V (TYP.)

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
H Level Input Voltage	V_{IH}		4.00	-	-	V	①
L Level Input Voltage	V_{IL}		-	-	1.00	V	①
H Level Input Current	I_{IH}	V_{CLKin}=V_{DD}-0.5V	-	-	5.0	μA	②
L Level Input Current	I_{IL}	V_{CLKin}=0.5V	-5.0	-	-	μA	②
H Level Output Voltage	V_{OH}	V_{DD}=4.50V, IOH=-8mA	3.60	-	-	V	③
L Level Output Voltage	V_{OL}	V_{DD}=4.50V, IOL= 8mA	-	-	0.65	V	③
Supply Current 1	I_{DD1}	V_{DD}=5.50V, CE= 5.50V	-	6.5	13.0	mA	④
Supply Current 2	I_{DD2}	V_{DD}=5.50V, CE= 0.0V	-	-	20	μA	④
CE H Level Voltage	V_{CEH}		4.00	-	-	V	①
CE L Level Voltage	V_{CEL}		-	-	1.00	V	①
CE Pull-Down Resistance 1	Rdn1	CE= V_{DD}	0.1	0.4	0.8	MΩ	⑤
CE Pull-Down Resistance 2	Rdn2	CE= 0.1*V_{DD}	2	20	40	kΩ	⑤
Output Off Leak Current	I_{OZ}	V_{DD}=5.50V, CE= 0.0V	-	-	10	μA	⑥

NOTE:

TEST CONDITION: V_{DD}=5.0V, f_{CLKin}=44.1kHz, C1=0.1μF, Multiplier ratio=256, No load

●AC Characteristics: XC25BS8025xx (256 multiplication, Input 44.1kHz (TYP.)) 5.0V (TYP.)

Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Output Rise Time (*1)	t_R	(20% ~ 80%)	-	2.5	5.0	ns	①
Output Fall Time (*1)	t_F	(20% ~ 80%)	-	2.5	5.0	ns	①
Output Signal Duty Cycle (*1)	Duty		45	50	55	%	①
PLL Output Signal Jitter 1 (*1)	t_{J1}	1σ (Output Period)	-	20	-	ps	①
PLL Output Signal Jitter 2 (*1)	t_{J2}	Peak to Peak (Output Tracking)	-	18.0	-	ns	①

NOTE:

TEST CONDITION: V_{DD}=5.0V, fCLKin=44.1kHz, C1=0.1μF, Multiplier ratio=256, C_L=15pF

*1: Values indicated are design values, which are not guaranteed 100%.

■NOTE ON USE

(1) Please use this IC within the stated absolute maximum ratings. The IC is liable to malfunction should the ratings be exceeded.

(2) The series is an analog IC. Please use a 0.01 μF to 0.1 μF of a by-pass capacitor.

(3) The constant of the LPF element of this IC is preset. Always use the capacitance value (=0.1 μF) specified by us for the external ceramic capacitor (C1) for LPF. Operating this IC with a capacitor of the wrong capacitance will cause erroneous operation.

(4) Rq0 shown in the Typical Application Circuit is a matching resistor. The use is recommended in order to counter unwanted radiations.

(5) Please place the by-pass capacitor and the matching resistor as close to the IC as possible. The IC may not operate normally if the by-pass capacitor is not close enough to the IC. Further, the unwanted radiation may occur between the resistor and the IC pin if the matching resistor is not close enough to the IC.

(6)When the CE pin is not controlled by external signals, it is recommended that a time constant circuit of R1=1kΩ ×C2 = 0.1 μF be added for stability.

(7) With this IC, output is achieved by dividing and multiplying the reference oscillation by means of the PLL circuit. In cases where this output is further used as a reference oscillation of another PLL circuit, it may be that the final output signal's jitter increases; therefore, all necessary precautions should be taken to avoid this.

(8) It is recommended that a low noise power supply, such as a series regulator, be used as the series' supply voltage. Using a power supply such as a switching regulator may enlarge the jitter, which in turn may lead to abnormal operation. Please confirm its operation with the actual device.

(9) For operating the IC normally, please take procedures below when applying voltage to the series' input pin:

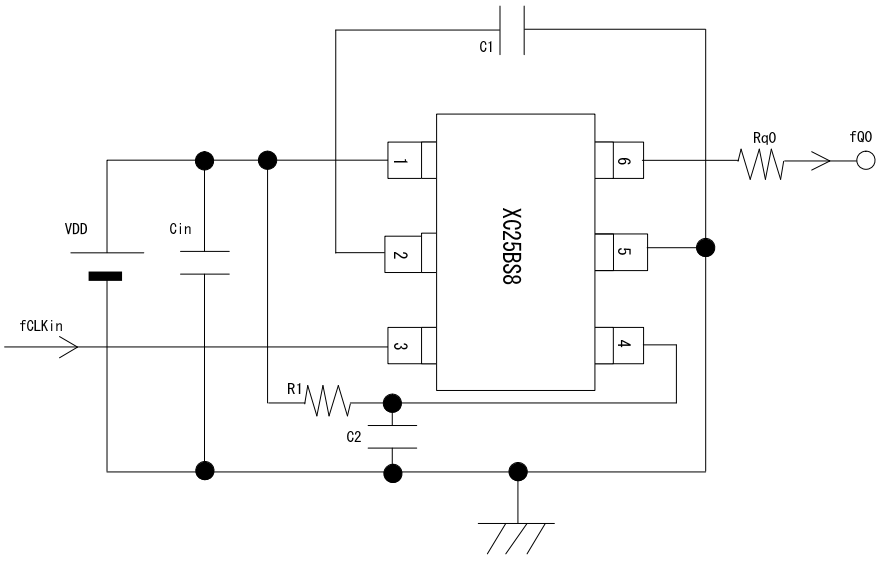
1) Apply power source while the CE pin is "L" level with no clock input (high-Impedance or "L"),

2) Input the clock,

3) At least 100 μs after applying clock input, change the CE pin into "H" level and then to enable.

The IC has to be started by inputting the clock once the power rises completely. The CE pin, then, should be enabling. If the CE pin becomes enable and the clock is inputted before the power rises completely, an internal reset circuit does not operate normally which may cause to generate extraneous frequency.

●eg.)Matching Resistance（Rq0）and Device for Time constant circuit (R1,C2）are connected,
（Package: SOT-26W）



■NOTE ON USE (Continued)

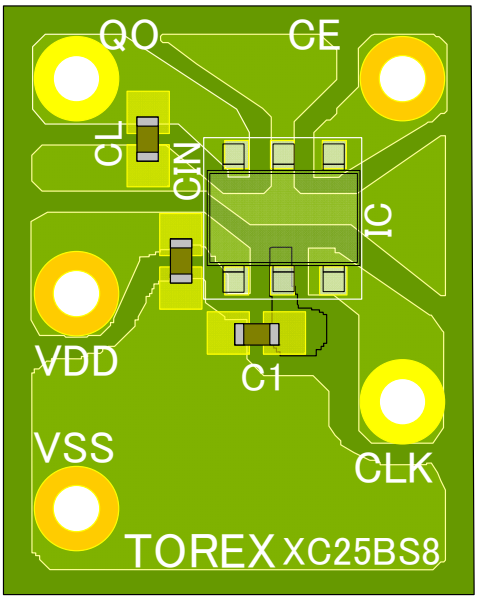
●Instructions on Pattern Layout

1. In order to stabilize V_{DD} voltage level, we recommend that a by-pass capacitor (C_{IN}) be connected as close as possible to the V_{DD} and V_{SS} pins.
2. Please mount the low pass filter capacitor C1(=0.1μF) as close to the IC as possible.
3. Make the pattern as close to the IC as possible and use thick, short connecting traces to reduce the circuit impedance.
4. Make sure that the V_{SS} (GND) traces are as thick as possible, as variations in ground potential caused by noise may result in instability of this product.

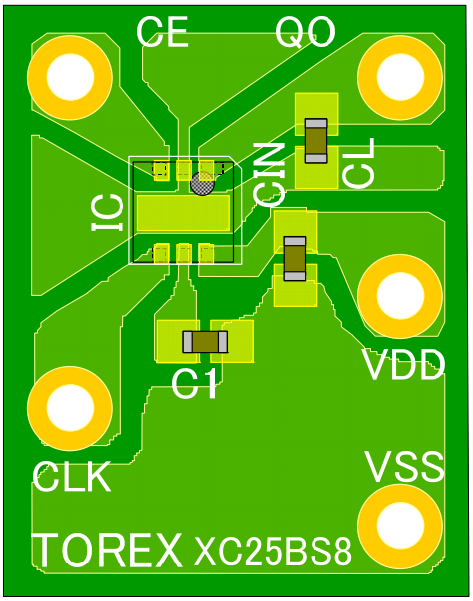
< Reference pattern layout >

* We prepare the evaluation board PCB, which is designed by the below layout pattern.

1. SOT-26W Reference Pattern Layout

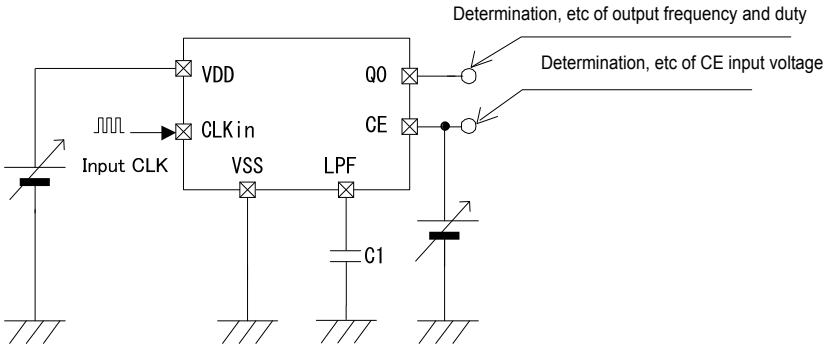


2. USP-6C Reference Pattern Layout



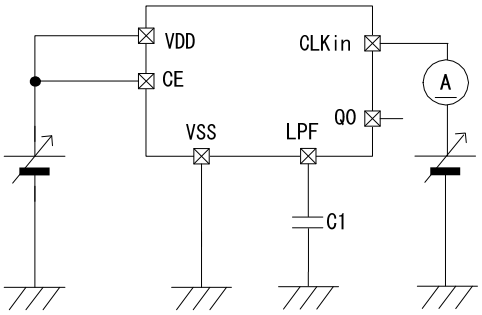
■TEST CIRCUIT

①Operating Supply Voltage
H Level Input Voltage
L Level Input Voltage
CE “H” Level Voltage
CE “L” Level Voltage
Output Rise Time
Output Fall Time
Output Signal Duty
PLL Output Signal Jitter 1
PLL Output Signal Jitter 2



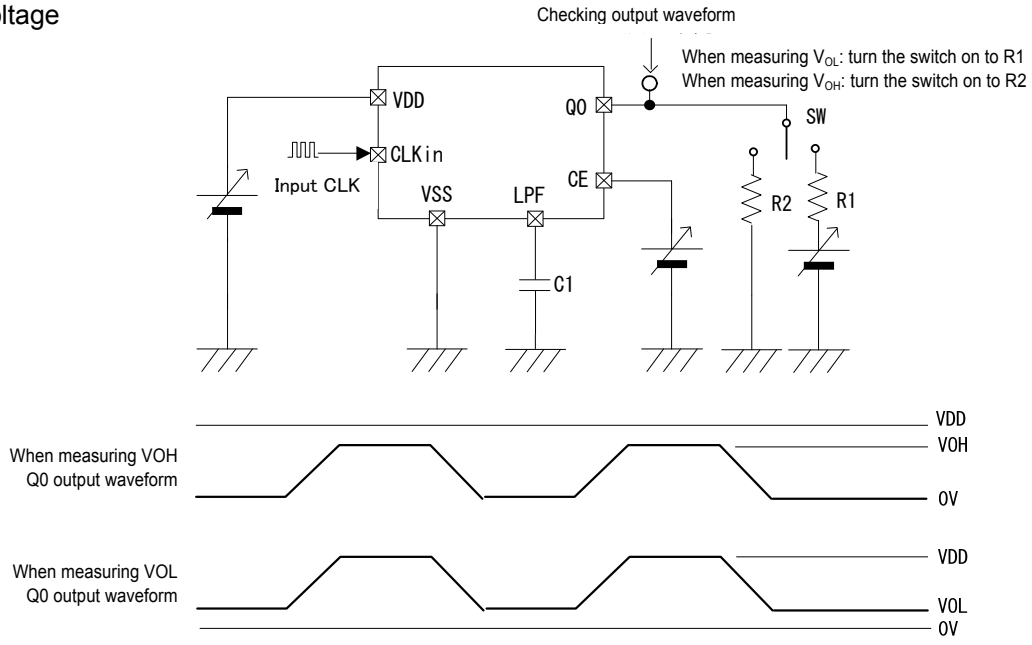
②H Level Input Current

L Level Input Current



③H Level Output Voltage

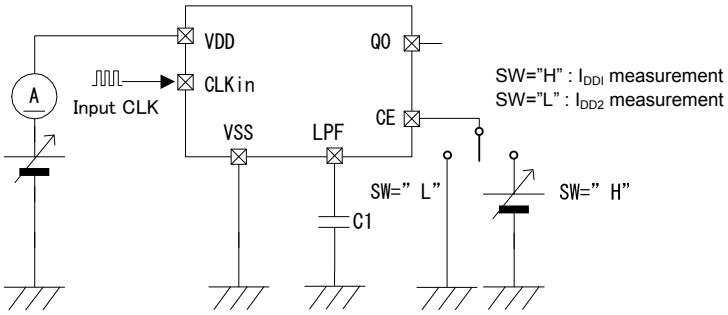
L Level Output Voltage



■TEST CIRCUIT (Continued)

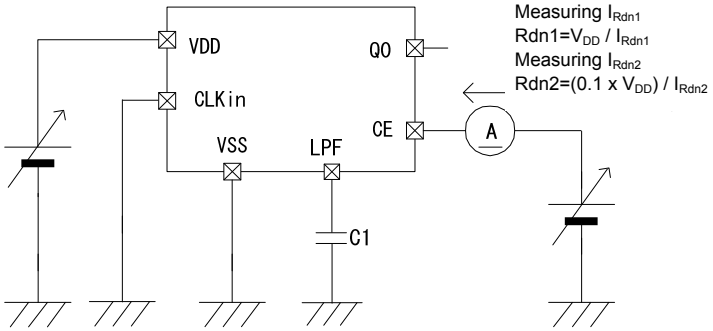
④Supply Current 1

Supply Current 2

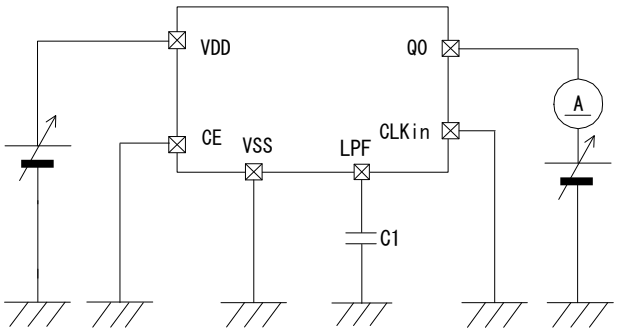


⑤CE Pull-Down Resistance 1

CE Pull-Down Resistance 2

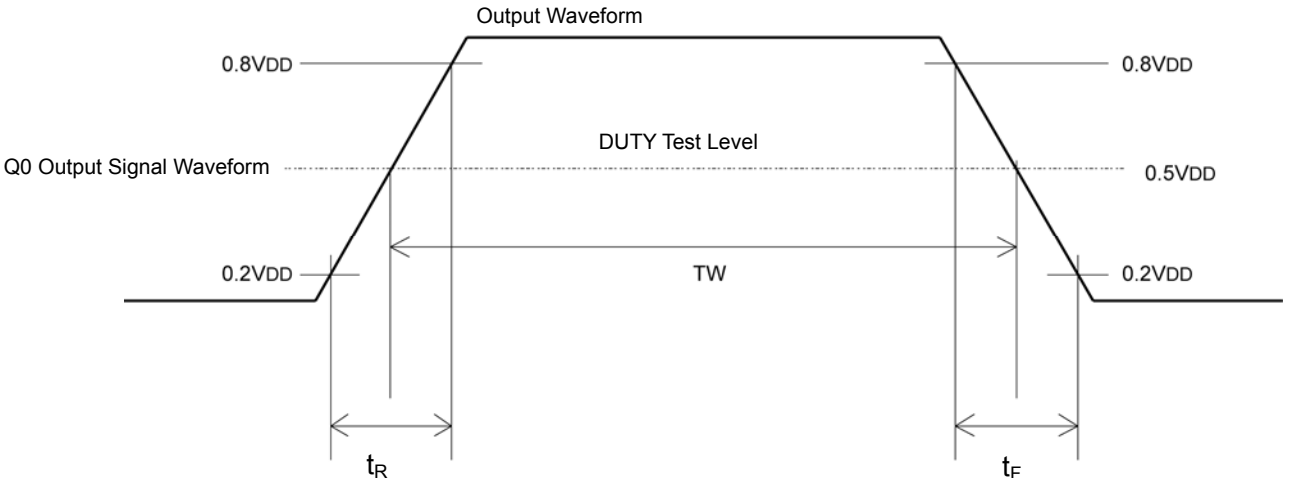


⑥Output Off Leak Current

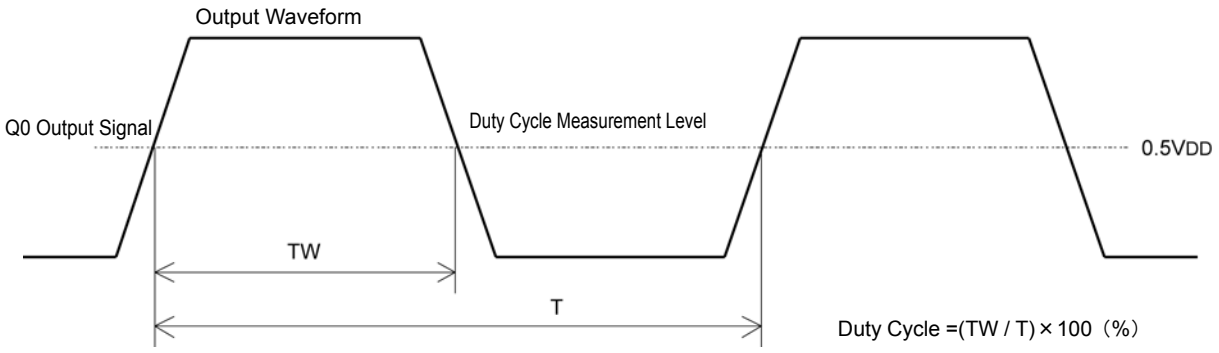


■AC CHARACTERISTICS TEST WAVEFORM

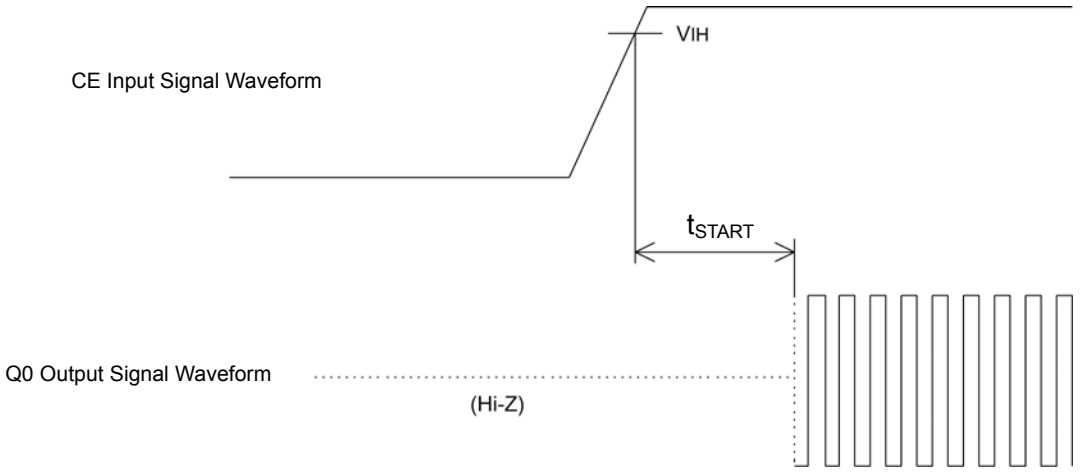
1) Output Rise Time, Output Fall Time



2) Duty Cycle



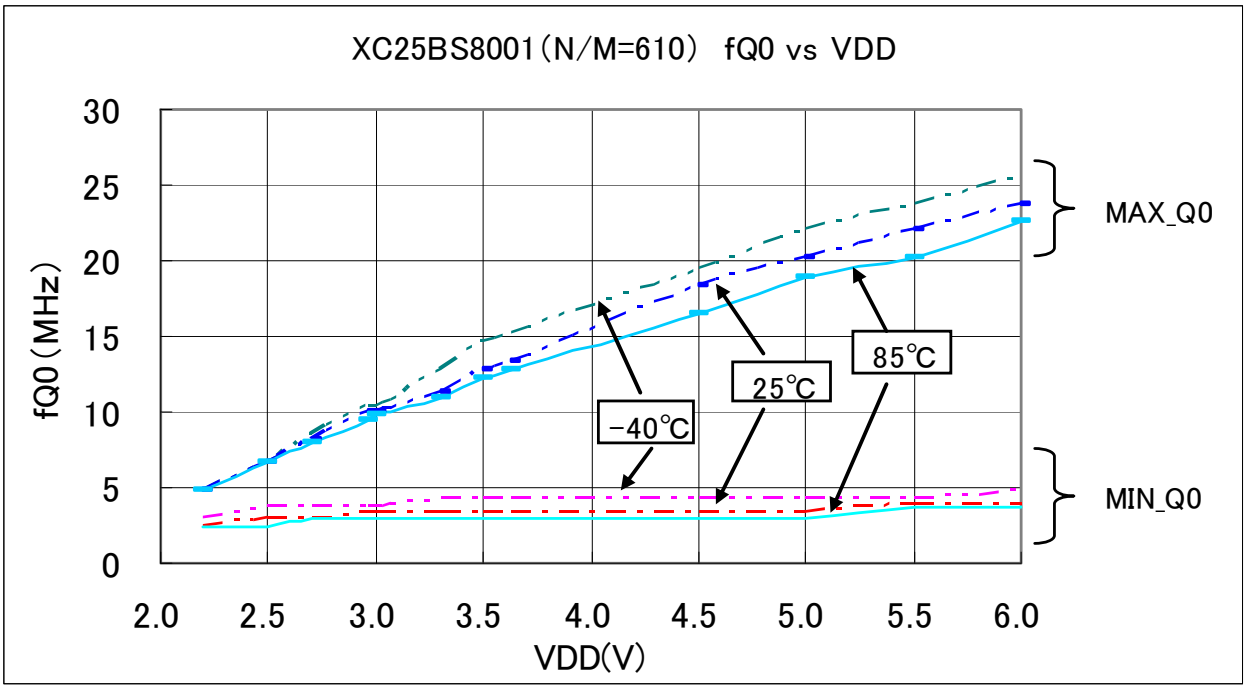
3) Output Start Time



■TYPICAL PERFORMANCE CHARACTERISTICS

●Synchronous Output Frequency vs. Supply Voltage

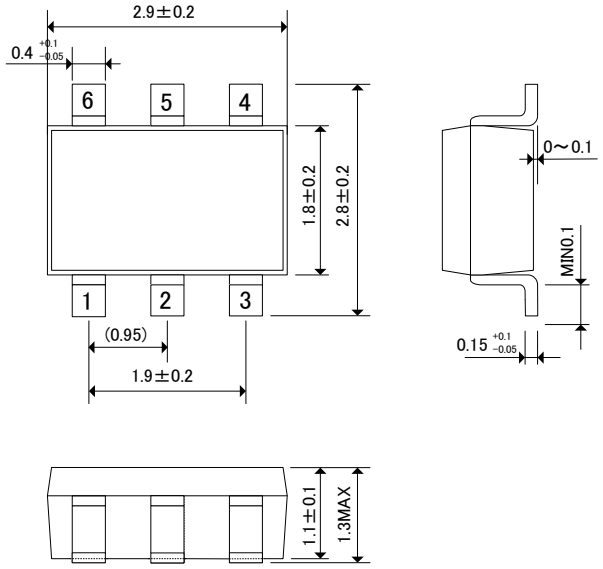
XC25BS8001xx (610 multiplication, Input 15kHz(TYP.))



■PACKAGE INFORMATION

●SOT-26W

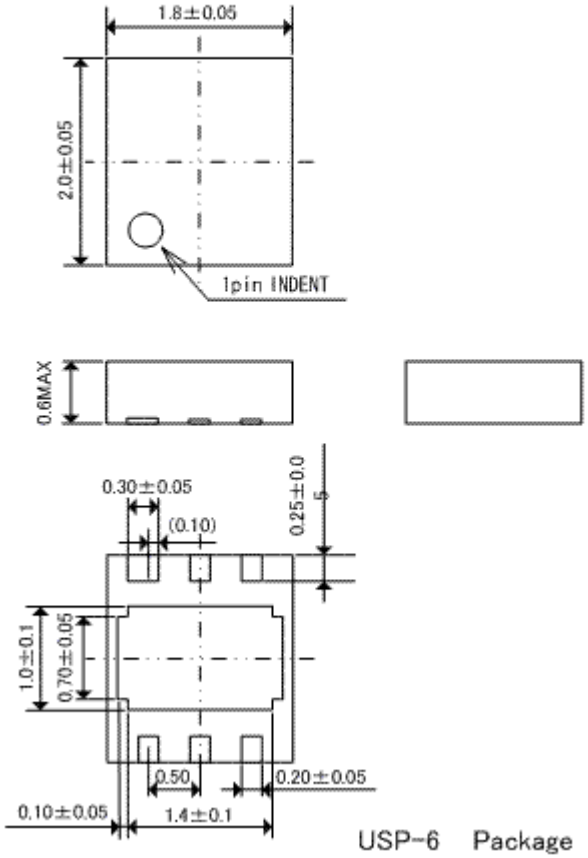
(unit : mm)



SOT-26W Package

●USP-6C

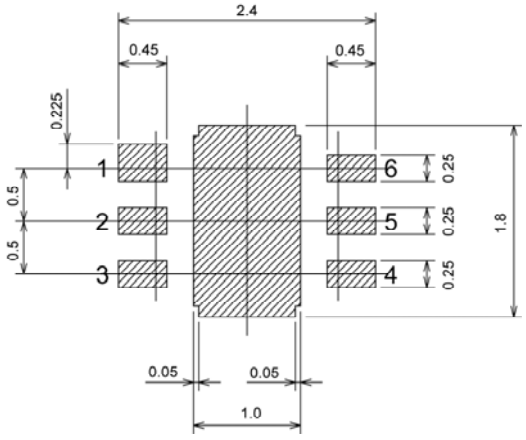
(unit : mm)



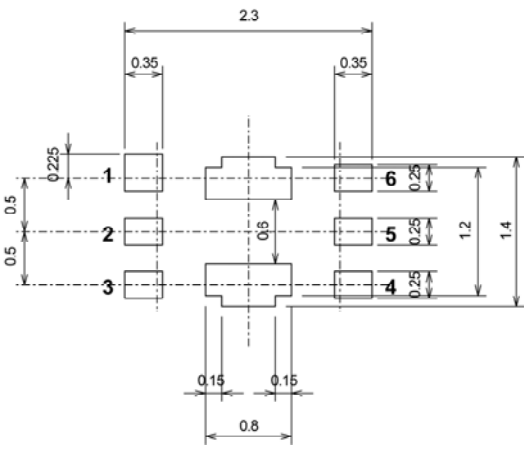
USP-6 Package

* No. 1 pin is wider than the other pins.
Soldering fillet surface is not formed because the sides of the pins are not plated.

●USP-6C Reference Pattern Layout



●USP-6C Reference Metal Mask Design



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