

## Description

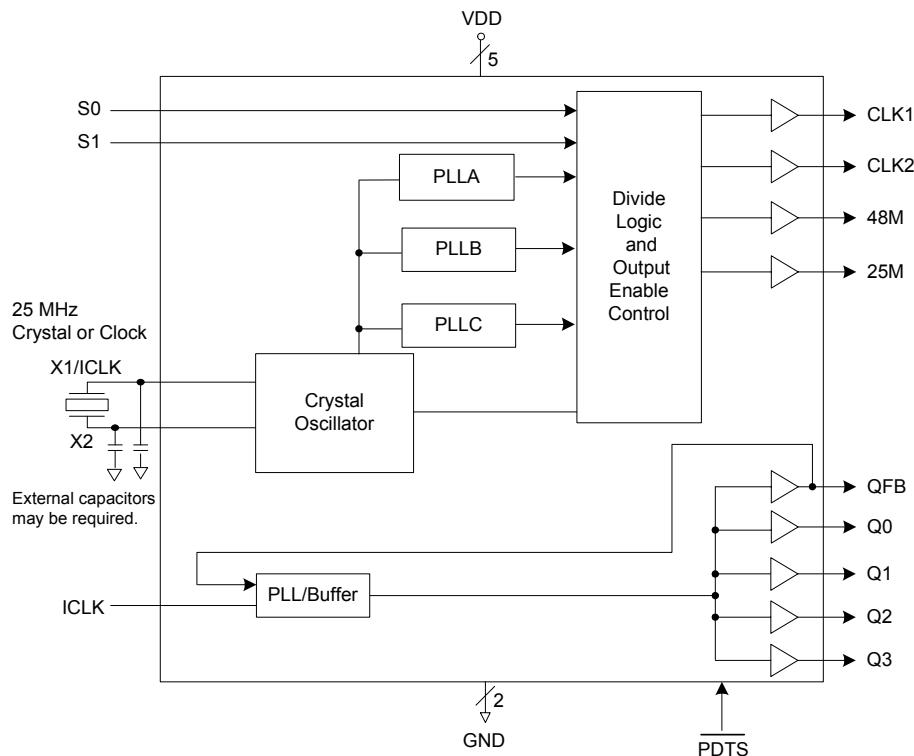
The ICS680-01 generates four high-frequency clock outputs and a reference from a 25 MHz crystal or clock input. The device includes a low-skew, single input to four output zero delay clock buffer. It can replace multiple crystals and oscillators, saving board space and cost.

The device has a power-down tri-state (PDTS) pin that places the clock outputs in a high-impedance state when pulled low. The PDTS pin includes an internal pull-up resistor.

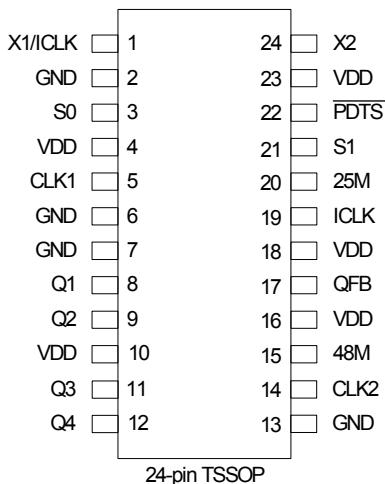
## Features

- Packaged in 24-pin TSSOP
- Pb (lead) free package, RoHS compliant
- Replaces multiple crystals and oscillators
- Input crystal or clock frequency of 25 MHz
- Five output driver driven by external clock
- Duty cycle of 45/55
- Operating voltage of 3.3 V
- Advanced, low-power CMOS process
- Fixed output frequencies of 25 MHz and 48 MHz
- Selectable output frequencies of 24 MHz, 48 MHz, 50 MHz and 66.6666 MHz
- Qx outputs replace costly discrete buffer
- Low-skew buffer outputs (250 ps)

## Block Diagram



## Pin Assignment



## Output Clock Select Table

S0	S1	CLK1 (MHz)	CLK2 (MHz)
M	M	OFF	48
0	0	50	48
0	1	66.6666	48
1	0	50	24
1	1	66.6666	24

## Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	X1/ICLK	XI	Crystal input. Connect this pin to a crystal or external clock source.
2	GND	Power	Connect to ground.
3	S0	Input	Select pin 0. See table above.
4	VDD	Power	Connect to voltage supply.
5	CLK1	Output	Selectable output clock. See table above. Weak internal pull-down when tri-state.
6	GND	Power	Connect to ground.
7	GND	Power	Connect to ground.
8	Q1	Output	Clock output 1. Weak internal pull-down when tri-state.
9	Q2	Output	Clock output 2. Weak internal pull-down when tri-state.
10	VDD	Power	Connect to voltage supply.
11	Q3	Output	Clock output 3. Weak internal pull-down when tri-state.
12	Q4	Output	Clock output 4. Weak internal pull-down when tri-state.
13	GND	Power	Connect to ground.
14	CLK2	Output	Selectable output clock. See table above. Weak internal pull-down when tri-state.
15	48M	Output	48 MHz output clock. Weak internal pull-down when tri-state.
16	VDD	Power	Connect to voltage supply.
17	QFB	Output	Feedback pin. Internally connected.

Pin Number	Pin Name	Pin Type	Pin Description
18	VDD	Power	Connect to voltage supply.
19	ICLK	Input	Zero Delay Buffer Input. Weak Internal pull-up.
20	25M	Output	25 MHz reference output clock. Weak internal pull-down when tri-state.
21	S1	Input	Select pin 1. See table above.
22	PDTS	Power	Power-down tri-state. Powers down entire chip and tri-states outputs when low. Internal pull-up resistor.
23	VDD	Power	Connect to voltage supply.
24	X2	XO	Crystal output. Connect this pin to a crystal. Float for clock input.

## External Components

The ICS680-01 requires a minimum number of external components for proper operation.

### Decoupling Capacitor

A decoupling capacitor of  $0.01\mu\text{F}$  must be connected between VDD (pins 5 and 16) and GND (pins 6 and 15), as close to these pins as possible. For optimum device performance, the decoupling capacitor should be mounted on the component side of the PCB. Avoid the use of vias in the decoupling circuit.

### Series Termination Resistor

When the PCB trace between the clock outputs and the loads are over 1 inch, series termination should be used. To series terminate a  $50\Omega$  trace (a commonly used trace impedance) place a  $33\Omega$  resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is  $20\Omega$ .

### Crystal Information

The crystal used should be a fundamental mode (do not use third overtone), parallel resonant. Crystal capacitors should be connected from pins X1 to ground and X2 to ground to optimize the initial accuracy. The value of these capacitors is given by the following equation crystal caps (pF) =  $(C_L - 6) \times 2$

In the equation,  $C_L$  is the crystal load capacitance. So for a crystal with a 16 pF load capacitance, two 20 pF[(16-6)x2] capacitors should be used

### PCB Layout Recommendations

For optimum device performance and lowest output phase noise, the following guidelines should be observed.

- 1) The  $0.01\mu\text{F}$  decoupling capacitor should be mounted on the component side of the board as close to the VDD pin as possible. No vias should be used between decoupling capacitor and VDD pin. The PCB trace to VDD pin should be kept as short as possible, as should the PCB trace to the ground via.
- 2) The external crystal should be mounted just next to the device with short traces. The X1 and X2 traces should not be routed next to each other with minimum spaces, instead they should be separated and away from other traces.
- 3) To minimize EMI, the  $33\Omega$  series termination resistor (if needed) should be placed close to the clock output.
- 4) An optimum layout is one with all components on the same side of the board, minimizing vias through other signal layers. Other signal traces should be routed away from the ICS680-01. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS680-01. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7 V
All Inputs and Outputs	-0.5 V to VDD+0.5 V
Ambient Operating Temperature	0 to +70°C
Storage Temperature	-65 to +150°C
Junction Temperature	125°C
Soldering Temperature	260°C

## Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	0		+70	°C
Power Supply Voltage (measured in respect to GND)	+3.13	+3.3	+3.46	V

## DC Electrical Characteristics

Unless stated otherwise,  $VDD = 3.3 \text{ V} \pm 5\%$ , Ambient Temperature 0 to  $+70^\circ\text{C}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	$VDD$		3.13	3.3	3.46	V
Supply Current	$IDD$	No load, $\overline{PDTs}=1$		32		mA
		No load, $\overline{PDTs}=0$		300		$\mu\text{A}$
Input High Voltage, binary inputs	$V_{IH}$	$\overline{PDTs}$ , ICLK	2			V
Input High Voltage, trinary inputs	$V_{IH}$	$S0, S1$	$VDD-0.5$			V
Input Low Voltage, binary inputs	$V_{IL}$	$\overline{PDTs}$ , ICLK			0.8	V
Input Low Voltage, trinary inputs	$V_{IL}$	$S0, S1$			0.5	V
Output High Voltage	$V_{OH}$	$I_{OH} = -4 \text{ mA}$	$VDD-0.4$			V
Output High Voltage	$V_{OH}$	$I_{OH} = -12 \text{ mA}$	2.4			V
Output Low Voltage	$V_{OL}$	$I_{OL} = 12 \text{ mA}$			0.8	V
		$I_{OL} = 4 \text{ mA}$			0.4	V
Short Circuit Current	$I_{OS}$	CLK output		$\pm 50$		mA
Input Capacitance, Inputs	$C_{IN}$			5		pF
Nominal Output Impedance	$Z_{OUT}$			20		$\Omega$
On-Chip Pull-up Resistor, Inputs	$R_{PU}$	$\overline{PDTs}$ , SEL		250		$\text{k}\Omega$
On-Chip Pull-down Resistor, Outputs	$R_{PD}$	CLK outputs		250		$\text{k}\Omega$

## AC Electrical Characteristics

Unless stated otherwise,  $VDD = 3.3 \text{ V} \pm 5\%$ , Ambient Temperature 0 to  $+70^\circ \text{ C}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency	$f_{IN}$	X1		25		MHz
		ICLK		33		MHz
Output Frequency	$f_{OUT}$	Q0 to Q3, QFB, Note 1		33		MHz
Output Rise Time	$t_{OR}$	20% to 80%, Note 1		1.5		ns
Output Fall Time	$t_{OF}$	80% to 20%, Note 1		1.5		ns
Output Clock Duty Cycle	$t_D$	at $VDD/2$ , Note 2	40		60	%
Power-up Time		PLL lock-time from power-up to 1% of final frequency			10	ms
		PDTs goes high until stable CLK outputs at 1% of final frequency			2	ms
One Sigma Clock Period Jitter		Configuration dependent		50		ps
Maximum Absolute Jitter	$t_{ja}$	Deviation from mean. Configuration dependent.		$\pm 200$		ps
QFB to ICLK Skew	$t_{PD}$	Measured at $VDD/2$ , Note 3	-350		350	
Pin-to-pin Skew		QFB, Q0 to Q3, Note 3	-250		250	ps

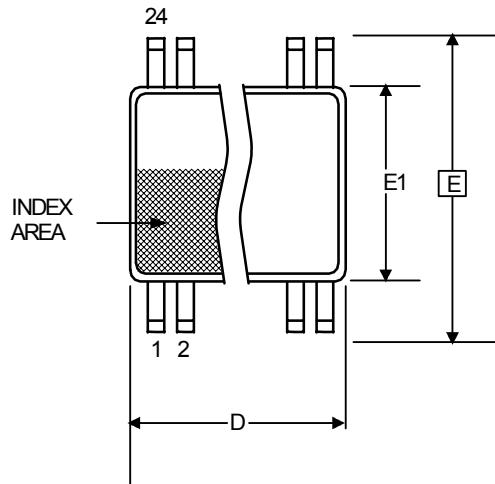
Note 1: Measured with a 15 pF load.

Note 2: Duty cycle is configuration dependent. Most configurations are min 45% / max 55%.

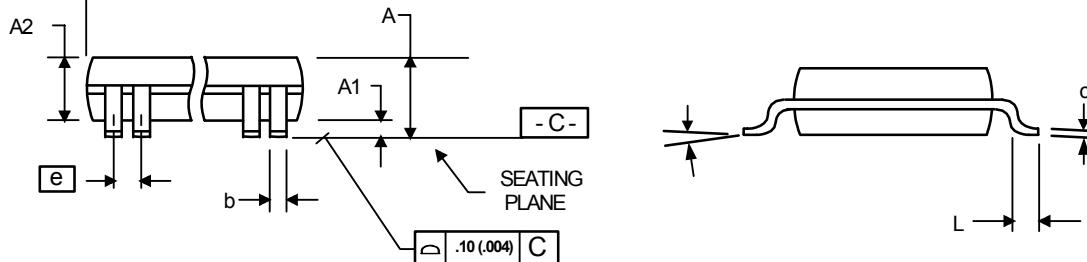
Note 3: Skew is measured at 1.4 V on rising edges with a 33 MHz ICLK.

## Package Outline and Package Dimensions (24-pin TSSOP, 173 Mil. Body)

Package dimensions are kept current with JEDEC Publication No. 95



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
—	—	1.20	—	.047
A1	0.05	0.15	0.002	0.006
A2	0.80	1.05	0.032	0.041
b	0.19	0.30	0.007	0.012
C	0.09	0.20	0.0035	0.008
D	7.70	7.90	0.303	0.311
E	6.40 BASIC		0.252 BASIC	
E1	4.30	4.50	0.169	0.177
e	0.65 Basic		0.0256 Basic	
L	0.45	0.75	.018	.030
$\alpha$	0°	8°	0°	8°



## Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
680G-01LF	680G-01LF	Tubes	24-pin TSSOP	0 to +70° C
680G-01LFT	680G-01LF	Tape and Reel	24-pin TSSOP	0 to +70° C

“LF” denotes Pb (lead) free package.

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## Revision History

Rev.	Originator	Date	Description of Change
D	P.Griffith	10/01/04	Removed power supply ramp-up time spec; added trinary input specs to DC chars; added a second Output Low Voltage spec; updated Supply Current specs from 50 to 32 mA, and 50 to 300 $\mu$ A; changed pull-down resistor value from 525 to 250 kohms; changed Output Rise/Fall times from 1 to 1.5 ns
E	P.Griffith	12/21/04	Released as standard product from custom device.
F	J. Sarma	02/03/05	Add LF ordering info.
G		11/04/09	Added EOL note for non-green parts.
H		05/13/10	Removed EOL note and non-green parts.

ICS680-01

NETWORKING CLOCK SYNTHESIZER AND ZERO DELAY BUFFER

ZDB AND SYNTHESIZER

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