Integrated Circuit Systems, Inc.

ICS8732-01

LOW VOLTAGE, LOW SKEW 3.3V LVPECL CLOCK GENERATOR

GENERAL DESCRIPTION

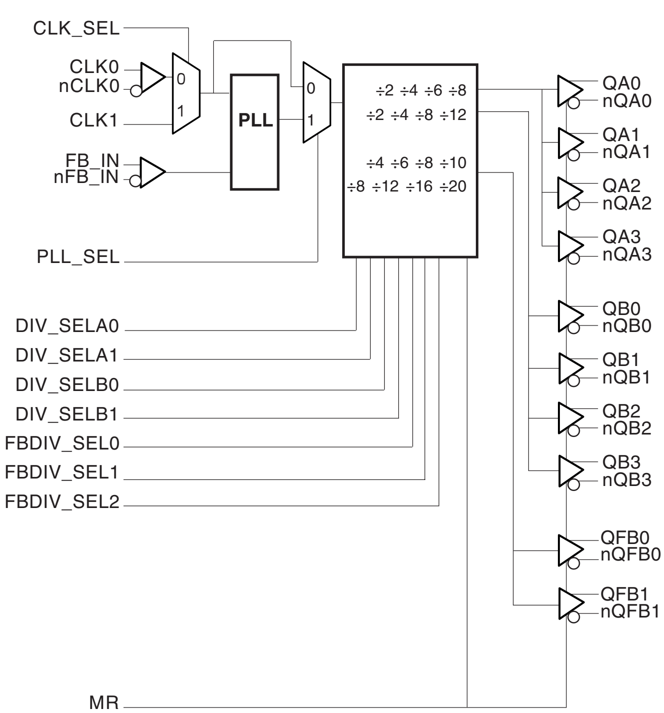
The ICS8732-01 is a low voltage, low skew, 3.3V LVPECL clock generator and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS8732-01 has two selectable clock inputs. The CLK0, nCLK0 pair can accept most standard differential input levels. The single ended clock input accepts LVCMOS or LVTTL input levels. The ICS8732-01 has a fully integrated PLL along with frequency configurable outputs. An external feedback input and outputs regenerate clocks with "zero delay".

The ICS8732-01 has multiple divide select pins for each bank of outputs along with 3 independent feedback divide select pins allowing the ICS8732-01 to function both as a frequency multiplier and divider. The PLL_SEL input can be used to bypass the PLL for test and system debug purposes. In bypass mode, the input clock is routed around the PLL and into the internal output dividers.

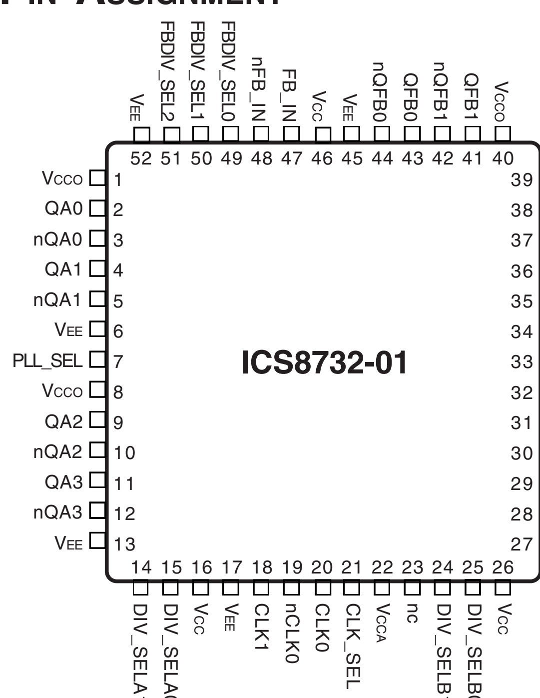
Features

- 10 differential 3.3V LVPECL outputs
- Selectable differential CLK0, nCLK0 or LVCMOS CLK1 inputs
- CLK0, nCLK0 supports the following input types: LVDS, LVPECL, LVHSTL, SSTL, HCSL
- CLK1 accepts the following input levels: LVCMOS or LVTTL
- Maximum output frequency up to 325MHz
- External feedback for "zero delay" clock regeneration with configurable frequencies
- Cycle-to-cycle jitter: 30ps (typical)
- Input-to-output jitter: 90ps (typical)
- Output skew: 75ps (typical)
- Bank skew: 50ps (typical)
- Multiple-frequency skew: TBD
- Static phase offset: TBD ±100ps (typical)
- 3.3V supply mode
- 0°C to 70°C ambient operating temperature
- Industrial temperature information available upon request

BLOCK DIAGRAM



PIN ASSIGNMENT



52-Lead LQFP
10mm x 10mm x 1.4mm package body
Y package
Top View

The Preliminary Information presented herein represents a product in prototyping or pre-production. The noted characteristics are based on initial product characterization. Integrated Circuit Systems, Incorporated (ICS) reserves the right to change any circuitry or specifications without notice.

TABLE 1. PIN DESCRIPTIONS

Number	Name	Type		Description
1, 8, 32, 39, 40	V_{CCO}	Power		Output supply pins. Connect to 3.3V.
2, 3, 4, 5	QA0, nQA0, QA1, nQA1	Output		Differential output pair. LVPECL interface levels.
6, 13, 17, 27, 34, 45, 52	V_{EE}	Power		Negative supply pins. Connect to ground.
7	PLL_SEL	Input	Pullup	Selects between the PLL and reference clock as the input to the dividers. When LOW, selects reference clock. When HIGH, selects PLL. LVCMOS interface levels.
9, 10, 11, 12	QA2, nQA2, QA3, nQA3	Output		Differential output pair. LVPECL interface levels.
14	DIV_SELA1	Input	Pulldown	Determines output divider valued in Table 3. LVCMOS interface levels.
15	DIV_SELA0	Input	Pulldown	Determines output divider valued in Table 3. LVCMOS interface level
16, 26, 46	V_{CC}	Power		Positive supply pins. Connect to 3.3V.
18	CLK1	Input	Pulldown	LVCMOS reference clock input.
19	nCLK0	Input	Pullup	Inverting differential clock input.
20	CLK0	Input	Pulldown	Non-inverting differential clock input.
21	CLK_SEL	Input	Pulldown	Clock select input. When LOW, selects CLK0, nCLK0. When HIGH, selects CLK1.
22	V_{CCA}	Power		Analog supply pin. Connect to 3.3V.
23	nc	Unused		No connect.
24	DIV_SELB1	Input	Pulldown	Determines output divider valued in Table 3. LVCMOS interface level
25	DIV_SELB0	Input	Pulldown	Determines output divider valued in Table 3. LVCMOS interface level
28, 29, 30, 31	QB0, nQB0, QB1, nQB1	Output		Differential output pair. LVPECL interface levels.
33	MR	Input	Pulldown	Resets dividers and determines state of the outputs. LVPECL interface levels.
35, 36, 37, 38	QB2, nQB2, QB3, nQB3	Output		Differential output pair. LVPECL interface levels.
41, 42, 43, 44	QFB1, nQFB1, QFB0, nQFB0	Output		Differential feedback output pairs. LVPECL interface levels.
47	FB_IN	Input	Pulldown	Feedback input to phase detector for regenerating clocks with "zero delay".
48	nFB_IN	Input	Pullup	Feedback input to phase detector for regenerating clocks with "zero delay".
49	FBDIV_SEL0	Input	Pulldown	Selects divide value for differential feedback output pairs. LVCMOS interface levels.
50	FBDIV_SEL1	Input	Pulldown	Selects divide value for differential feedback output pairs. LVCMOS interface levels.
51	FBDIV_SEL2	Input	Pulldown	Selects divide value for differential feedback output pairs. LVCMOS interface levels.

NOTE: *Pullup* and *Pulldown* refers to internal input resistors. See Table 2, Pin Characteristics, for typical values.

TABLE 2. PIN CHARACTERISTICS

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
C_{IN}	Input Capacitance				4	pF
R_{PULLUP}	Input Pullup Resistor			51		KΩ
$R_{PULLDOWN}$	Input Pulldown Resistor			51		KΩ

TABLE 3A. CONTROL INPUT FUNCTION TABLE FOR QA0 - QA3 OUTPUTS

Inputs				Outputs
MR	PLL_SEL	DIV_SELA1	DIV_SELA0	QA0 - QA3, nQA0 - nQA3
1	X	X	X	Low
0	1	0	0	fVCO/2
0	1	0	1	fVCO/4
0	1	1	0	fVCO/6
0	1	1	1	fVCO/8
0	0	0	0	fREF_CLK/2
0	0	0	1	fREF_CLK/4
0	0	1	0	fREF_CLK/6
0	0	1	1	fREF_CLK/8

TABLE 3B. CONTROL INPUT FUNCTION TABLE FOR QB0 - QB3 OUTPUTS

Inputs				Outputs
MR	PLL_SEL	DIV_SELB1	DIV_SELB0	QB0 - QB3, nQB0 - nQB3
1	X	X	X	Low
0	1	0	0	fVCO/2
0	1	0	1	fVCO/4
0	1	1	0	fVCO/8
0	1	1	1	fVCO/12
0	0	0	0	fREF_CLK/2
0	0	0	1	fREF_CLK/4
0	0	1	0	fREF_CLK/8
0	0	1	1	fREF_CLK/12

TABLE 3C. CONTROL INPUT FUNCTION TABLE FOR QFB0 - QFB1

Inputs					Outputs
MR	PLL_SEL	FBDIV_SEL2	FBDIV_SEL1	FBDIV_SEL0	QFB0, QFB1 nQFB0, nQFB1
1	X	X	X	X	Low
0	1	0	0	0	fVCO/4
0	1	0	0	1	fVCO/6
0	1	0	1	0	fVCO/8
0	1	0	1	1	fVCO/10
0	1	1	0	0	fVCO/8
0	1	1	0	1	fVCO/12
0	1	1	1	0	fVCO/16
0	1	1	1	1	fVCO/20
0	0	0	0	0	fREF_CLK/4
0	0	0	0	1	fREF_CLK/6
0	0	0	1	0	fREF_CLK/8
0	0	0	1	1	fREF_CLK/10
0	0	1	0	0	fREF_CLK/8
0	0	1	0	1	fREF_CLK/12
0	0	1	1	0	fREF_CLK/16
0	0	1	1	1	fREF_CLK/20

TABLE 4A. QX OUTPUT FREQUENCY W/FB_IN = QFB0

Inputs							fVCO
FB_IN	FBDIV_SEL2	FBDIV_SEL1	FBDIV_SEL0	Output Divider Mode	CLK1 (MHz)		(NOTE 1)
					Minimum	Maximum	
QFB	0	0	0	÷4	50	162.5 (NOTE 2)	fREF_CLK x 4
QFB	0	0	1	÷6	33.3	108.33	fREF_CLK x 6
QFB	0	1	0	÷8	25	81.25	fREF_CLK x 8
QFB	0	1	1	÷10	20	65	fREF_CLK x 10
QFB	1	0	0	÷8	33.3	81.25	fREF_CLK x 8
QFB	1	0	1	÷12	16.66	54.16	fREF_CLK x 12
QFB	1	1	0	÷16	12.5	40.625	fREF_CLK x 16
QFB	1	1	1	÷20	10	32.5	fREF_CLK x 20

NOTE 1: VCO frequency range is 200MHz to 650MHz.
NOTE 2: The maximum input frequency that the phase detector can accept is 200MHz.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CCx}	4.6V
Inputs, V_I	-0.5V to V_{CC}+0.5 V
Outputs, V_O	-0.5V to V_{CCO}+0.5V
Package Thermal Impedance, θ_{JA}	42.3°C/W (0 lfpm)
Storage Temperature, T_{STG}	-65°C to 150°C

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

TABLE 5A. POWER SUPPLY DC CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO}$ = 3.3V±5%, TA = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{CC}	Positive Supply Voltage		3.135	3.3	3.465	V
V_{CCA}	Analog Supply Voltage		3.135	3.3	3.465	V
V_{CCO}	Output Supply Voltage		3.135	3.3	3.465	V
I_{EE}	Power Supply Current			178		mA
I_{CC}	Positive Supply Current			120		mA
I_{CCA}	Analog Supply Current			20		mA
I_{CCO}	Output Supply Current			204		mA

TABLE 5B. LVCMOS/LVTTL DC CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO}$ = 3.3V±5%, TA = 0°C TO 70°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage	CLK1		2		V_{CC}+ 0.3	V
		CLK_SEL, PLL_SEL, DIV_SELAx, DIV_SELBx, FBDIV_SELx, MR		2		V_{CC}+ 0.3	V
V_{IL}	Input Low Voltage	CLK1		-0.3		1.3	V
		CLK_SEL, PLL_SEL, DIV_SELAx, DIV_SELBx, FBDIV_SELx, MR		-0.3		0.8	V
I_{IH}	Input High Current	CLK_SEL, MR, CLK1 DIV_SELAx, DIV_SELBx, FBDIV_SELx	*$V_{CCx} = V_{IN}$ = 3.465V			150	µA
		PLL_SEL	*$V_{CCx} = V_{IN}$ = 3.465V			5	µA
I_{IL}	Input Low Current	CLK_SEL, MR, CLK1 DIV_SELAx, DIV_SELBx, FBDIV_SELx	*V_{CCx} = 3.465V, V_{IN} = 0V	-5			µA
		PLL_SEL	*V_{CCx} = 3.465V, V_{IN} = 0V	-150			µA

NOTE: *V_{CCx} denotes V_{CC}, V_{CCA}, and V_{CCO}.

TABLE 5C. DIFFERENTIAL DC CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO} = 3.3V\pm5\%$, TA = 0°C TO 70°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	CLK0, FB_IN	$*V_{CCx} = V_{IN} = 3.465V$			150	µA
		nCLK0, nFB_IN	$*V_{CCx} = V_{IN} = 3.465V$			5	µA
I_{IL}	Input Low Current	CLK0, FB_IN	$*V_{CCx} = 3.465V, V_{IN} = 0V$	-5			µA
		nCLK0, nFB_IN	$*V_{CCx} = 3.465V, V_{IN} = 0V$	-150			µA
V_{PP}	Peak-to-Peak Input Voltage			0.15		1.3	V
V_{CMR}	Common Mode Input Voltage; NOTE 1, 2			V_{EE} + 0.5		V_{CC} - 0.85	V

NOTE 1: For single ended applications, the maximum input voltage for FB_IN, nFB_IN isV_{CC} + 0.3V.
NOTE 2: Common mode voltage is defined as V_{IH}.
NOTE: $*V_{CCx}$ denotes V_{CC}, V_{CCA}, and V_{CCO}.

TABLE 5D. LVPECL DC CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO} = 3.3V\pm5\%$, TA = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{OH}	Output High Voltage; NOTE 1		V_{CC} - 1.4		V_{CC} - 1.0	V
V_{OL}	Output Low Voltage; NOTE 1		V_{CC} - 2.0		V_{CC} - 1.7	V
V_{SWING}	Peak-to-Peak Output Voltage Swing		0.6		0.85	V

NOTE 1: Outputs terminated with 50Ω to V_{CC} - 2V.

TABLE 6. PLL INPUT REFERENCE CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO} = 3.3V\pm5\%$, TA = 0°C TO 70°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
f_{REF}	Input Reference Frequency				350	MHz

TABLE 7. AC CHARACTERISTICS, $V_{CC} = V_{CCA} = V_{CCO} = 3.3V\pm5\%$, TA = 0°C TO 70°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Output Frequency					350	MHz
t(Ø)	Static Phase Offset; NOTE 1	CLK0	PLL_SEL = 3.3V, fREF = 50MHz, fVCO = 200MHz		TBD±100		ps
		nCLK0			TBD±100		ps
*t*sk(o)	Output Skew; NOTE 2, 4		Measured on rising edge at $V_{CCO}/2$		75		ps
*t*sk(w)	Multiple Frequency Skew; NOTE 3, 4		Measured on rising edge at $V_{CCO}/2$		50		ps
*t*jit(cc)	Cycle-to-Cycle Jitter; NOTE 3		Measured on rising edge at $V_{CCO}/2$		30		ps
t_L	PLL Lock Time					10	ms
t_R	Output Rise Time		20% to 80% @ 50MHz		460		ps
t_F	Output Fall Time		20% to 80% @ 50MHz		560		ps
odc	Output Duty Cycle				50		%

All parameters measured at f_{MAX} unless noted otherwise.
NOTE 1: Defined as the time difference between the input reference clock and the averaged feedback input signal when the PLL is locked and the input reference frequency is stable.
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at the output differential cross points.
NOTE 3: Defined as skew across banks of outputs operating at different frequency with the same supply voltages and equal load conditions.
NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

PARAMETER MEASUREMENT INFORMATION

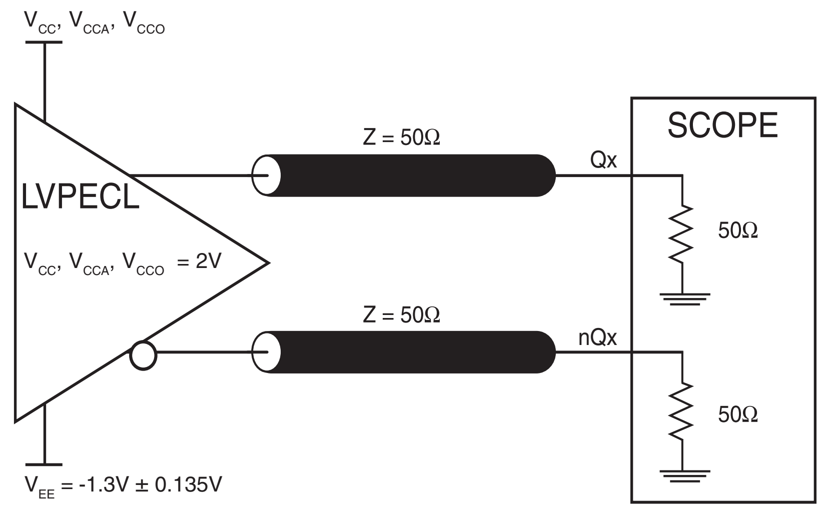


FIGURE 1 - 3.3V OUTPUT LOAD TEST CIRCUIT

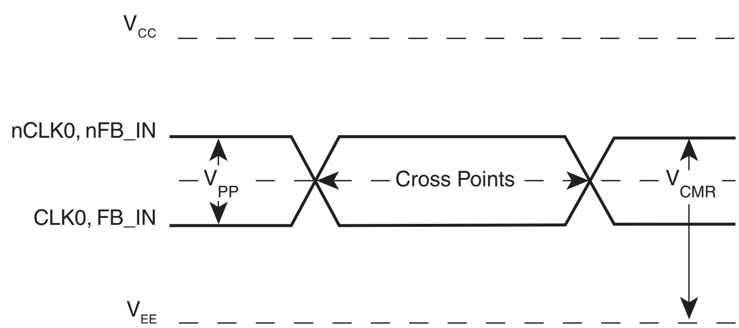


FIGURE 2 - DIFFERENTIAL INPUT LEVEL

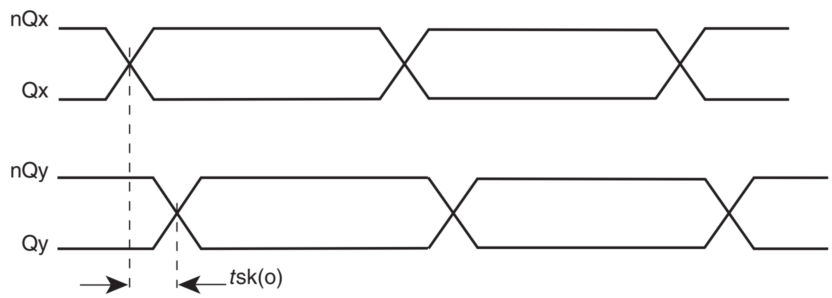
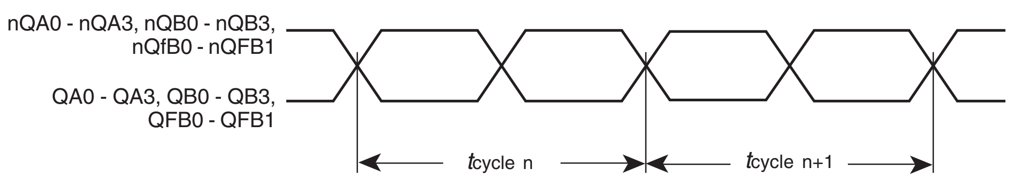
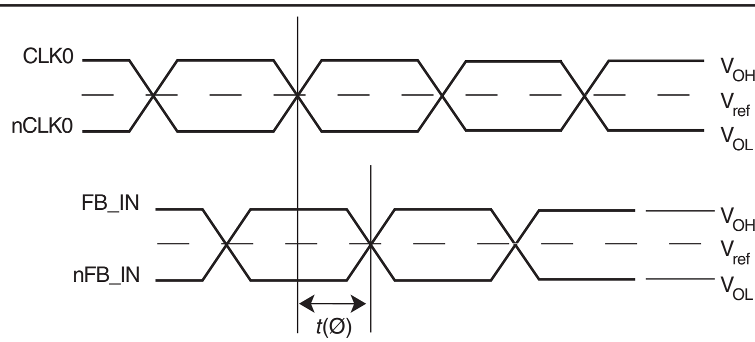


FIGURE 3 - OUTPUT SKEW



$t$jit(cc) = $t$cycle n – $t$cycle n+1
1000 Cycles

FIGURE 4 - Cycle-to-Cycle Jitter



$t$jit(Ø) = | t(Ø) — t(Ø) mean | = Phase Jitter t(Ø) mean = Static Phase Offset

(where t(Ø) is any random sample, and t(Ø) mean is the average of the sampled cycles measured on controlled edges)

FIGURE 5 - PHASE JITTER AND STATIC PHASE OFFSET

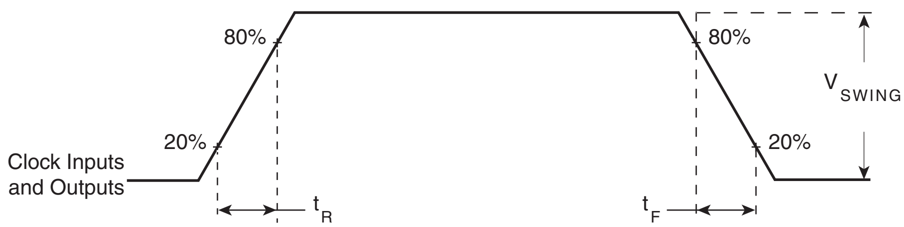


FIGURE 6 - INPUT AND OUTPUT RISE AND FALL TIME

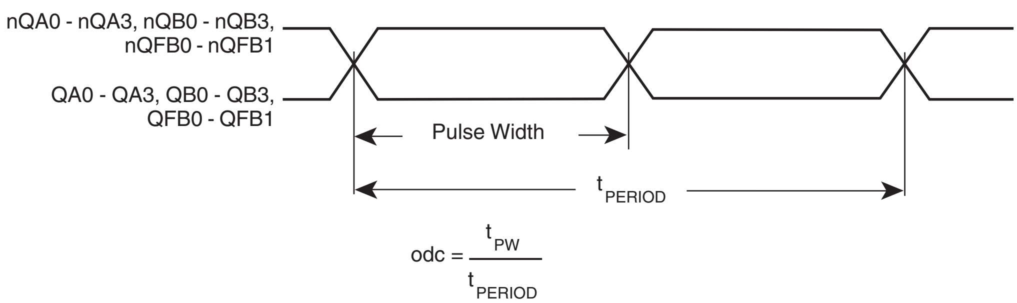


FIGURE 7 - odc & t_{PERIOD}

APPLICATION INFORMATION

WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LEVELS

Figure 8 shows how the differential input can be wired to accept single ended levels. The reference voltage V_REF = $V_{CC}/2$ is generated by the bias resistors R1, R2 and C1. This bias circuit should be located as close as possible to the input pin. The ratio of R1 and R2 might need to be adjusted to position the V_REF in the center of the input voltage swing. For example, if the input clock swing is only 2.5V and V_{CC} = 3.3V, V_REF should be 1.25V and R2/R1 = 0.609.

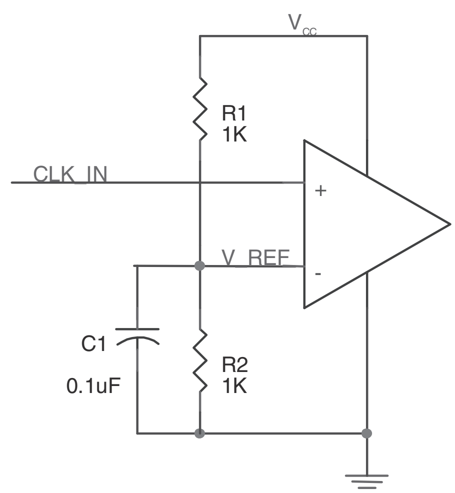


FIGURE 8 - SINGLE ENDED SIGNAL DRIVING DIFFERENTIAL INPUT

POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. The ICS8732-01 provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL. V_{CC}, V_{CCA}, and V_{CCO} should be individually connected to the power supply plane through vias, and bypass capacitors should be used for each pin. To achieve optimum jitter performance, power supply isolation is required. *Figure 9* illustrates how a 10Ω resistor along with a 10µF and a .01µF bypass capacitor should be connected to each V_{CCA} pin.

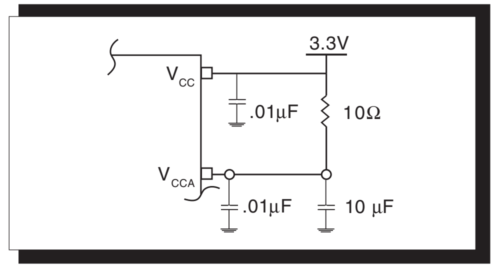
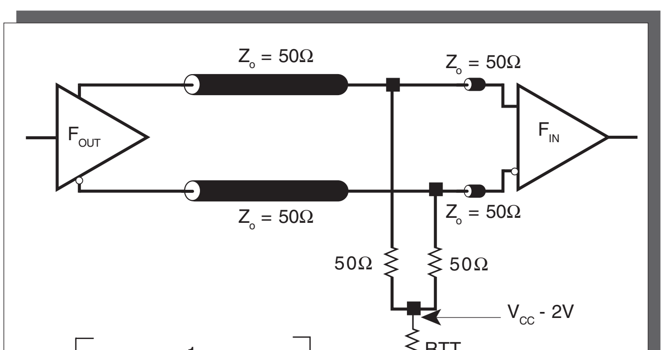


FIGURE 9. POWER SUPPLY FILTERING

TERMINATION FOR LVPECL OUTPUTS

The clock layout topology shown below is a typical termination for LVPECL outputs. The two different layouts mentioned are recommended only as guidelines.

Q and nQ are low impedance follower outputs that generate ECL/LVPECL compatible outputs. Therefore, terminating resistors (DC current path to ground) or current sources must be used for functionality. These outputs are designed to drive 50Ω transmission lines. Matched impedance techniques should be used to maximize operating frequency and minimize signal distortion. There are a few simple termination schemes. *Figures 10A and 10B* show two different layouts which are recommended only as guidelines. Other suitable clock layouts may exist and it would be recommended that the board designers simulate to guarantee compatibility across all printed circuit and clock component process variations.



$$RTT = \left[\frac{1}{(V_{OH} + V_{OL} / V_{CC} - 2) - 2} \right] Z_o$$

FIGURE 10A. LVPECL OUTPUT TERMINATION

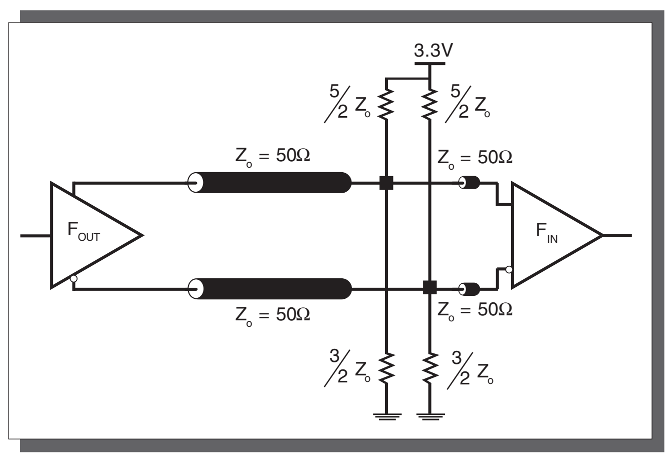


FIGURE 10B. LVPECL OUTPUT TERMINATION

POWER CONSIDERATIONS

This section provides information on power dissipation and junction temperature for the ICS8732-01. Equations and example calculations are also provided.

1. Power Dissipation.

The total power dissipation for the ICS8732-01 is the sum of the core power plus the power dissipated in the load(s). The following is the power dissipation for V_{CC} = 3.3V + 5% = 3.465V, which gives worst case results.

NOTE: Please refer to Section 3 for details on calculating power dissipated in the load.

- Power $(core)_{MAX} = V_{CC\_MAX} * I_{EE\_MAX}$ = 3.465V * 178mA = **616.8mW**
- Power $(outputs)_{MAX}$ = **30.2mW/Loaded Output pair**
  If all outputs are loaded, the total power is 10 * 30.2mW = **302mW**

Total Power $_{\_MAX}$ (3.465V, with all outputs switching) = 616.8mW + 302mW = **918.8mW**

2. Junction Temperature.

Junction temperature, Tj, is the temperature at the junction of the bond wire and bond pad and directly affects the reliability of the device. The maximum recommended junction temperature for HiPerClockS™ devices is 125°C.

The equation for Tj is as follows: $Tj = \theta_{JA} * Pd\_total + T_A$

Tj = Junction Temperature

θ_{JA} = junction-to-ambient thermal resistance

Pd_total = Total device power dissipation (example calculation is in section 1 above)

T_A = Ambient Temperature

In order to calculate junction temperature, the appropriate junction-to-ambient thermal resistance θ_{JA} must be used. Assuming a moderate air flow of 200 linear feet per minute and a multi-layer board, the appropriate value is 36.4°C/W per Table 8 below.

Therefore, Tj for an ambient temperature of 70°C with all outputs switching is:

70°C + 0.918W * 36.4°C/W = 103.4°C. This is well below the limit of 125°C

This calculation is only an example. Tj will obviously vary depending on the number of loaded outputs, supply voltage, air flow, and the type of board (single layer or multi-layer).

Table 8. Thermal Resistance θ_{JA} for 52-pin LQFP, Forced Convection

θ_{JA} by Velocity (Linear Feet per Minute)			
	0	**200**	**500**
Single-Layer PCB, JEDEC Standard Test Boards	58.0°C/W	47.1°C/W	42.0°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	42.3°C/W	36.4°C/W	34.0°C/W

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

3. Calculations and Equations.

The purpose of this section is to derive the power dissipated into the load.

LVPECL output driver circuit and termination are shown in *Figure 11.*

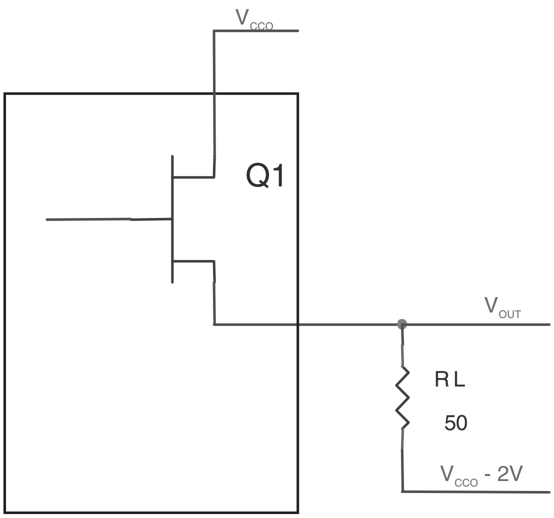


FIGURE 11 - LVPECL DRIVER CIRCUIT AND TERMINATION

To calculate worst case power dissipation into the load, use the following equations which assume a 50Ω load, and a termination voltage of V_{CCO} - 2V.

- For logic high, $V_{OUT} = V_{OH\_MAX} = V_{CCO\_MAX} - 1.0V$

  $(V_{CCO\_MAX} - V_{OH\_MAX}) = 1.0V$

- For logic low, $V_{OUT} = V_{OL\_MAX} = V_{CCO\_MAX} - 1.7V$

  $(V_{CCO\_MAX} - V_{OL\_MAX}) = 1.7V$

Pd_H is power dissipation when the output drives high.
Pd_L is the power dissipation when the output drives low.

$Pd\_H = [(V_{OH\_MAX} - (V_{CC\_MAX} - 2V))/R_L] * (V_{CC\_MAX} - V_{OH\_MAX}) = [(2V - (V_{CCO} - V_{OH\_MAX}))/R_L] * (V_{CCO} - V_{OH\_MAX}) = (2V - 1V) * 1V = 20.0mW$

$Pd\_L = [(V_{OL\_MAX} - (V_{CC\_MAX} - 2V))/R_L] * (V_{CC\_MAX} - V_{OL\_MAX}) = [(2V - (V_{CCO} - V_{OL\_MAX}))/R_L] * (V_{CCO} - V_{OL\_MAX}) = (2V - 1.7V) * 1.7V =$
$10.2mW$

Total Power Dissipation per output pair = Pd_H + Pd_L = 30.2mW

RELIABILITY INFORMATION

TABLE 9. θ_{JA} VS. AIR FLOW TABLE

θ_{JA} by Velocity (Linear Feet per Minute)

	0	**200**	**500**
Single-Layer PCB, JEDEC Standard Test Boards	58.0°C/W	47.1°C/W	42.0°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	42.3°C/W	36.4°C/W	34.0°C/W

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

TRANSISTOR COUNT

The transistor count for ICS8732-01 is: 1800

PACKAGE OUTLINE - Y SUFFIX

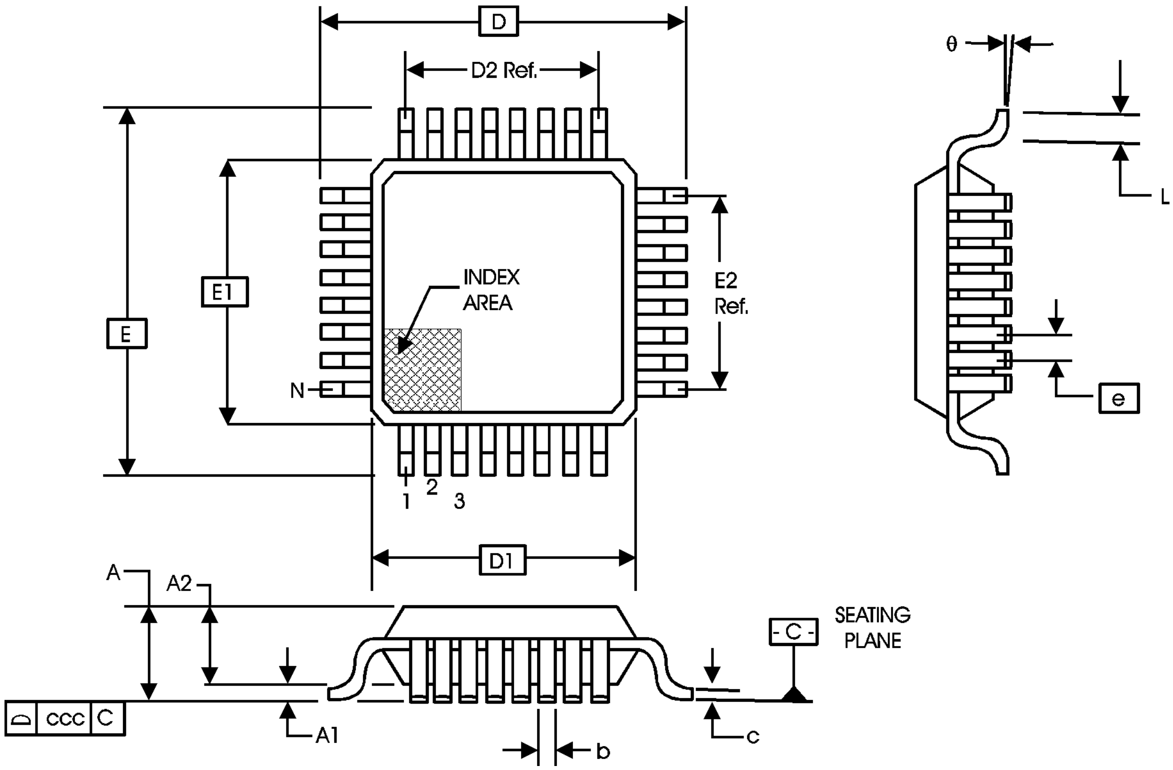


TABLE 10. PACKAGE DIMENSIONS

JEDEC VARIATION ALL DIMENSIONS IN MILLIMETERS			
SYMBOL	BCC		
	MINIMUM	NOMINAL	MAXIMUM
N		52	
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.22	0.32	0.38
c	0.09	--	0.20
D		12.00 BASIC	
D1		10.00 BASIC	
D2		7.80 Ref.	
E		12.00 BASIC	
E1		10.00 BASIC	
E2		7.80 Ref.	
e		0.65 BASIC	
L	0.45	--	0.75
θ	0°	--	7°
ccc	--	--	0.10

Reference Document: JEDEC Publication 95, MS-026

TABLE 11. ORDERING INFORMATION

Part/Order Number	Marking	Package	Count	Temperature
ICS8732AY-01	ICS8732AY-01	52 Lead LQFP	250 per tray	0°C to 70°C
ICS8732AY-01T	ICS8732AY-01T	52 Lead LQFP on Tape and Reel	1000	0°C to 70°C