PRELIMINARY

Integrated Circuit Systems, Inc.

ICS87354I

÷4/÷5 DIFFERENTIAL-TO-2.5V/3.3V LVPECL CLOCK GENERATOR

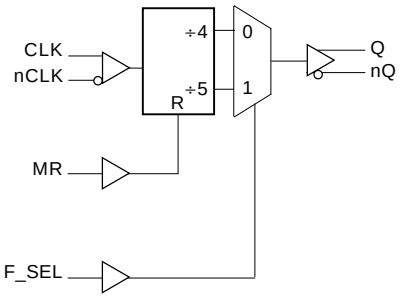
GENERAL DESCRIPTION

The ICS87354I is a high performance ÷4/÷5 Differential-to-2.5V/3.3V ECL/LVPECL Clock Generator and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The CLK, nCLK pair can accept most standard differential input levels. The ICS87354I is characterized to operate from either a 2.5V or a 3.3V power supply. Guaranteed output and part-to-part skew characteristics make the ICS87354I ideal for those clock distribution applications demanding well defined performance and repeatability.

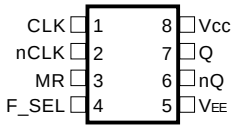
FEATURES

- 1 differential 2.5V/3.3V LVPECL / ECL output
- 1 CLK, nCLK input pair
- CLK, nCLK pair can accept the following differential input levels: LVPECL, LVDS, LVHSTL, SSTL, HCSL
- Maximum output frequency: 250MHz
- Input frequency: >1GHz
- Translates any single ended input signal to 3.3V LVPECL levels with resistor bias on nCLK input
- Output skew: 38ps (maximum)
- Part-to-part skew: 375ps (maximum)
- Propagation delay: 2.1ns (maximum)
- LVPECL mode operating voltage supply range: V_{CC} = 2.375V to 3.8V, V_{EE} = 0V
- ECL mode operating voltage supply range: V_{CC} = 0V, V_{EE} = -2.375V to -3.8V
- -40°C to 85°C ambient operating temperature

BLOCK DIAGRAM



PIN ASSIGNMENT



ICS87354I
8-Lead SOIC
3.90mm x 4.90mm x 1.37mm package body
M Package
Top View

TABLE 1. PIN DESCRIPTIONS

Number	Name	Type		Description
1	CLK	Input	Pulldown	Non-inverting differential clock input.
2	nCLK	Input	Pullup	Inverting differential clock input.
3	MR	Input	Pulldown	Master reset. When LOW, outputs are enabled. When HIGH, divider is reset forcing Q output LOW and nQ output HIGH. LVCMOS / LVTTL interface levels.
4	F_SEL	Input	Pulldown	Selects divider value for Q, nQ outputs as described in table 3. LVCMOS / LVTTL interface levels.
5	V_{EE}	Power		Negative supply pin.
6, 7	Q, nQ	Output		Differential output pair. LVPECL interface levels.
8	V_{CC}	Power		Positive supply pin.

NOTE: *Pullup* and *Pulldown* refer 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 3. FUNCTION TABLE

MR	F_SEL	Divide Value
1	X	Reset: Q output low, nQ output high
0	0	÷4
0	1	÷5

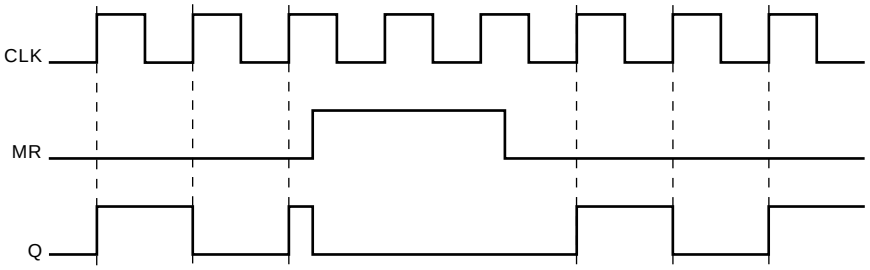


FIGURE 1. TIMING DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V_{CC}	4.6V
Inputs, V_I	-0.5V to V_{CC} + 0.5 V
Outputs, I_O	
Continuous Current	50mA
Surge Current	100mA
Package Thermal Impedance, θ_{JA}	112.7°C/W (0 lfpm)
Storage Temperature, T_{STG}	-65°C to 150°C

NOTE: 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 4A. POWER SUPPLY DC CHARACTERISTICS, V_{CC} = 2.375V TO 3.8V, V_{EE} = 0, T_A = -40°C TO 85°C

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Units
V_{CC}	Positive Supply Voltage		2.375	3.3	3.8	V
I_{EE}	Power Supply Current			TBD		mA

TABLE 4B. LVCMOS/LVTTL DC CHARACTERISTICS, V_{CC} = 2.375V TO 3.8V, V_{EE} = 0, T_A = -40°C TO 85°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
V_{IH}	Input High Voltage			2		V_{CC} + 0.3	V
V_{IL}	Input Low Voltage			-0.3		0.8	V
I_{IH}	Input High Current	MR, F_SEL	V_{CC} = V_{IN} = 3.8V			150	µA
I_{IL}	Input Low Current	MR, F_SEL	V_{CC} = 3.8V, V_{IN} = 0V	-5			µA

TABLE 4C. DIFFERENTIAL DC CHARACTERISTICS, V_{CC} = 2.375V TO 3.8V, V_{EE} = 0, T_A = -40°C TO 85°C

Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
I_{IH}	Input High Current	CLK	V_{CC} = V_{IN} = 3.8V			150	µA
		nCLK	V_{CC} = V_{IN} = 3.8V			5	µA
I_{IL}	Input Low Current	CLK	V_{CC} = 3.8V, V_{IN} = 0V	-5			µA
		nCLK	V_{CC} = 3.8V, 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: Common mode voltage is defined as V_{IH}.
NOTE 2: For single ended applications, the maximum input voltage for CLK, nCLK is V_{CC} + 0.3V.

TABLE 4D. LVPECL DC CHARACTERISTICS, V_{CC} = 2.375V TO 3.8V, V_{EE} = 0, T_A = -40°C TO 85°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		0.65		0.9	V

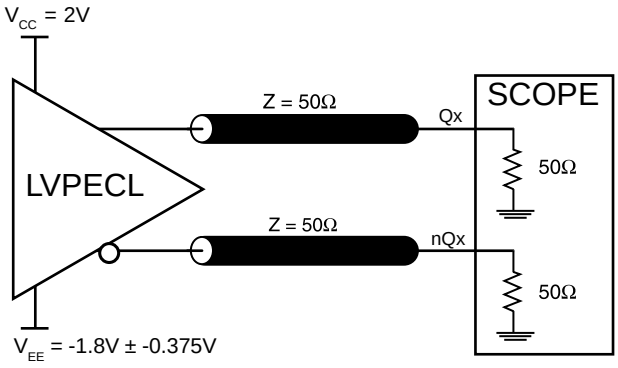
NOTE 1: Outputs terminated with 50Ω to V_{CC} - 2V.

TABLE 5. AC CHARACTERISTICS, V_{CC} = 2.375V TO 3.8V, V_{EE} = 0, T_A = -40°C TO 85°C

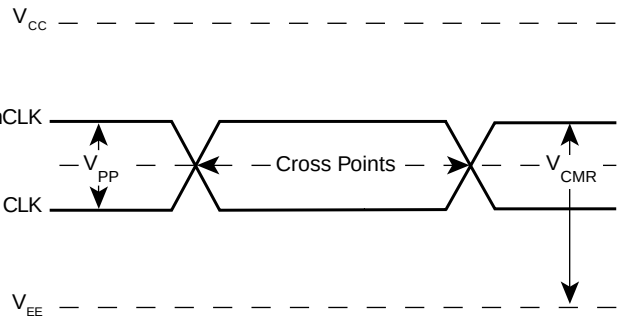
Symbol	Parameter		Test Conditions	Minimum	Typical	Maximum	Units
f_{MAX}	Input Frequency				>1		GHz
t_{PD}	Propagation Delay; NOTE 1	CLK to Q (Dif)		1.65		2.1	ns
*t*sk(o)	Output Skew; NOTE 2, 4					38	ps
*t*sk(pp)	Part-to-Part Skew; NOTE 3 , 4					375	ps
t_R / t_F	Output Rise/Fall Time		20% to 80%	200		600	ps

NOTE 1: Measured from the differential input crossing point to the differential output crossing point.
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions.
NOTE 3: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.

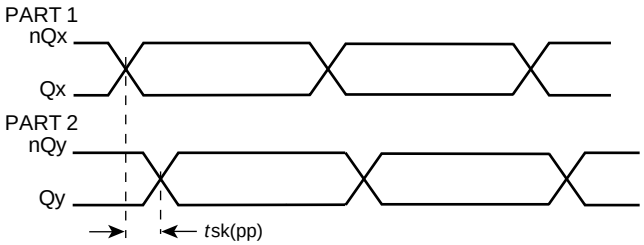
PARAMETER MEASUREMENT INFORMATION



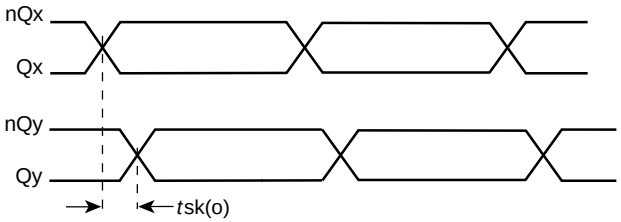
3.3V OUTPUT LOAD AC TEST CIRCUIT



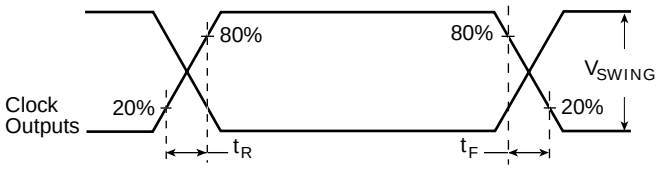
DIFFERENTIAL INPUT LEVEL



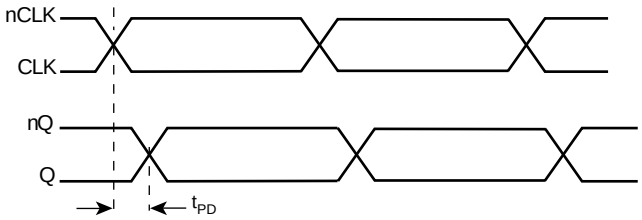
PART-TO-PART SKEW



OUTPUT SKEW



OUTPUT RISE/FALL TIME



PROPAGATION DELAY

APPLICATION INFORMATION

WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LEVELS

Figure 1 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.

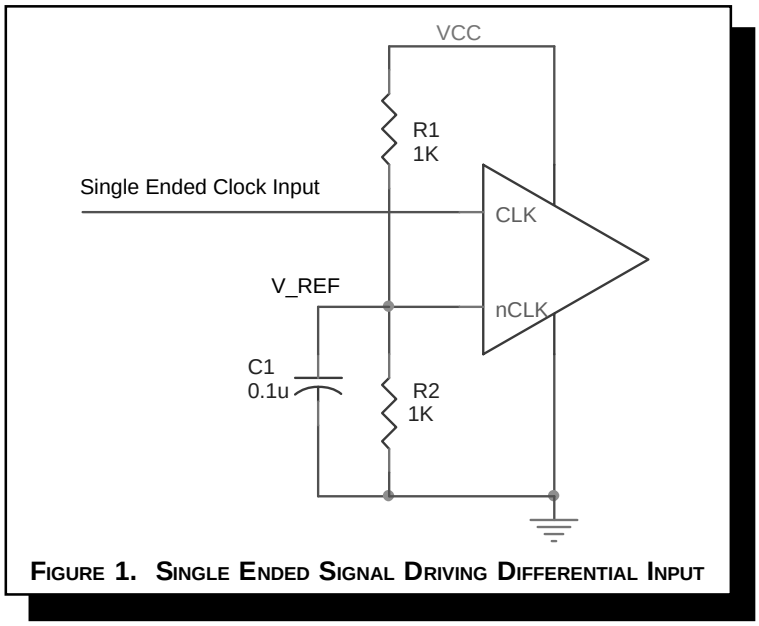


FIGURE 1. SINGLE ENDED SIGNAL DRIVING DIFFERENTIAL INPUT

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.

FOUT and nFOUT 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. *Figures 2A and 2B* 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.

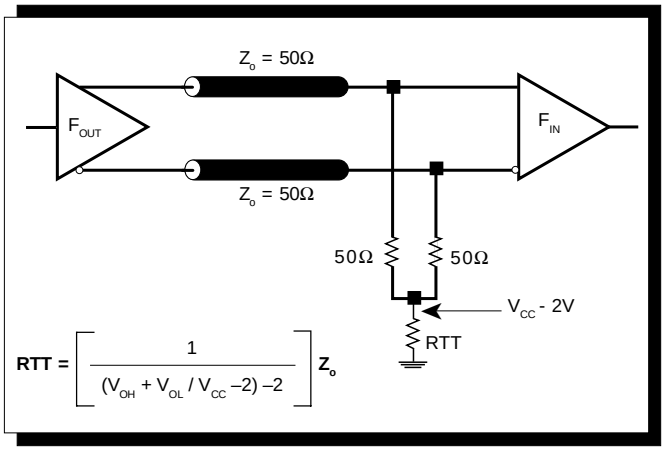


FIGURE 2A. LVPECL OUTPUT TERMINATION

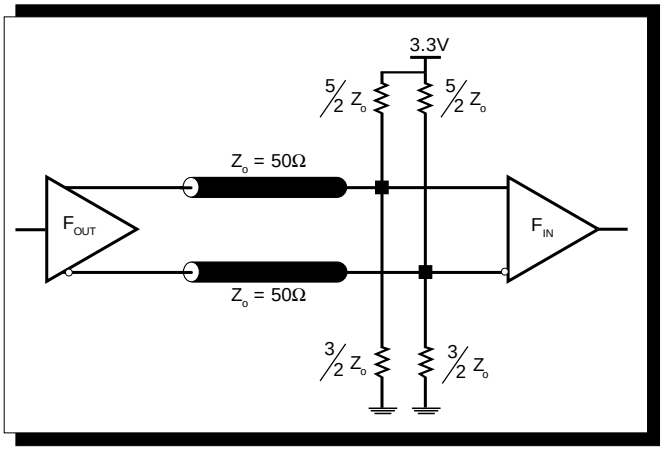


FIGURE 2B. LVPECL OUTPUT TERMINATION

DIFFERENTIAL CLOCK INPUT INTERFACE

The CLK /nCLK accepts LVDS, LVPECL, LVHSTL, SSTL, HCSL and other differential signals. Both V_{SWING} and V_{OH} must meet the V_{PP} and V_{CMR} input requirements. Figures 3A to 3E show interface examples for the HiPerClockS CLK/nCLK input driven by the most common driver types. The input interfaces suggested here are examples only. Please consult with the vendor of the driver component to confirm the driver termination requirements. For example in *Figure 3A,* the input termination applies for ICS HiPerClockS LVHSTL drivers. If you are using an LVHSTL driver from another vendor, use their termination recommendation.

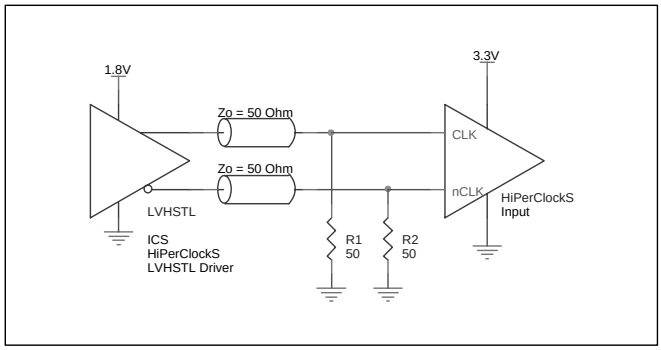


FIGURE 3A. HIPERCLOCKS CLK/NCLK INPUT DRIVEN BY ICS HIPERCLOCKS LVHSTL DRIVER

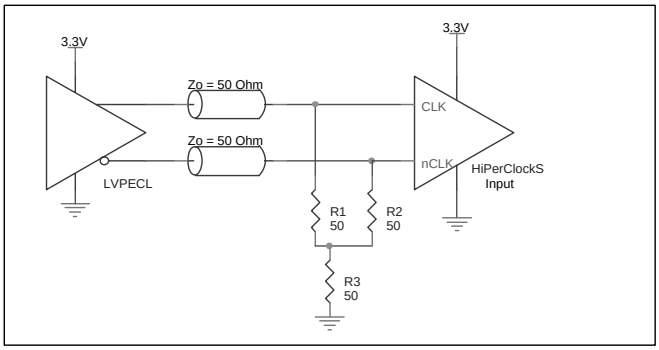


FIGURE 3B. HIPERCLOCKS CLK/NCLK INPUT DRIVEN BY 3.3V LVPECL DRIVER

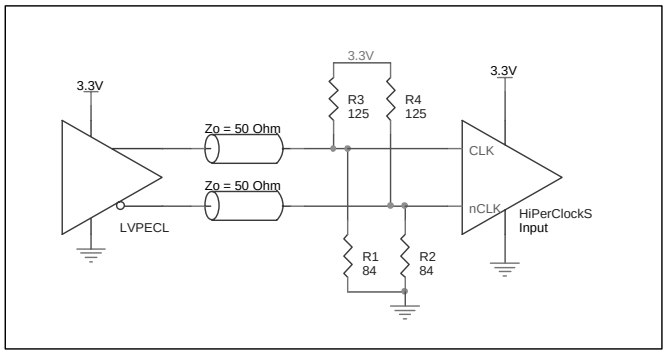


FIGURE 3C. HIPERCLOCKS CLK/NCLK INPUT DRIVEN BY 3.3V LVPECL DRIVER

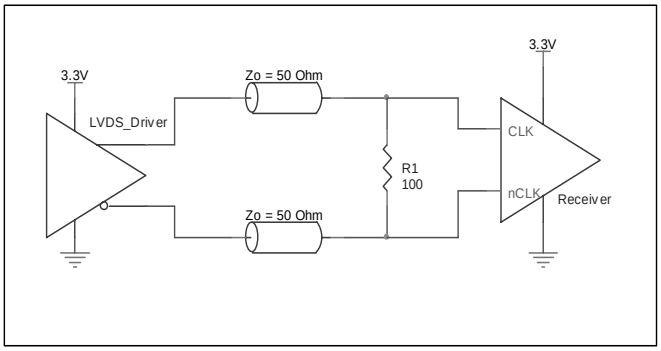


FIGURE 3D. HIPERCLOCKS CLK/NCLK INPUT DRIVEN BY 3.3V LVDS DRIVER

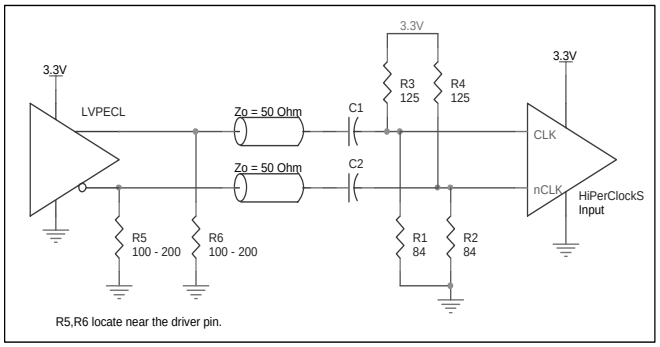


FIGURE 3E. HIPERCLOCKS CLK/NCLK INPUT DRIVEN BY 3.3V LVPECL DRIVER WITH AC COUPLE

RELIABILITY INFORMATION

TABLE 6. θ_{JA} VS. AIR FLOW TABLE

θ_{JA} by Velocity (Linear Feet per Minute)			
	0	**200**	**500**
Single-Layer PCB, JEDEC Standard Test Boards	153.3°C/W	128.5°C/W	115.5°C/W
Multi-Layer PCB, JEDEC Standard Test Boards	112.7°C/W	103.3°C/W	97.1°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 ICS87354I is: TBD

PACKAGE OUTLINE - M SUFFIX

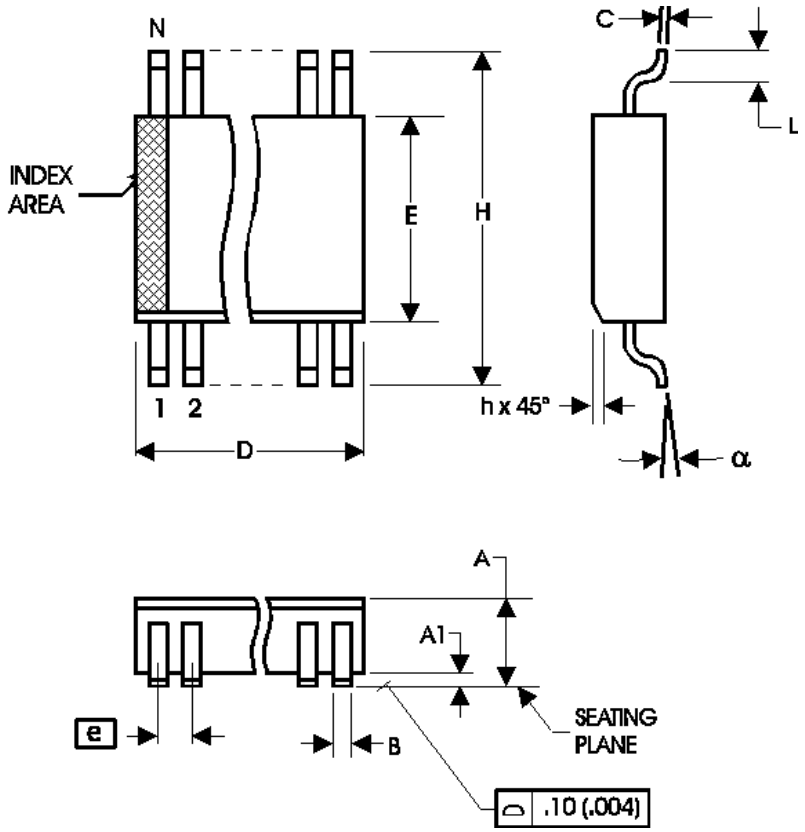


TABLE 7. PACKAGE DIMENSIONS

SYMBOL	Millimeters	
	MINIMUN	MAXIMUM
N	8	
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BASIC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
α	0°	8°

Reference Document: JEDEC Publication 95, MS-012

TABLE 8. ORDERING INFORMATION

Part/Order Number	Marking	Package	Count	Temperature
ICS87354AMI	87354AI	8 lead SOIC	96 per tube	-40°C to 85°C
ICS87354AMIT	87354AI	8 lead SOIC on Tape and Reel	2500	-40°C to 85°C