

S-UM5587P is a 16-channel, 3-level RTZ, high-voltage, high-speed ultrasound pulser.

The S-UM5587P comprises logic interfaces, level translators, MOSFET gate drive buffers with floating voltage regulators, high-voltage, high-current MOSFETs, and active T/R switches.

■ Functions

- 16channel 3-level pulser with active T/R switch with 2-input per channel

■ Features

- 0 to ± 100 V output voltage
- ± 2 A source and sink peak current for pulsing (V_{PP}/V_{NN})
- ± 1 A source and sink peak current for active ground clamp
- $250\ \Omega$ (± 0.1 A) active ground clamp without blocking diode for anti-leakage (Analog SW type)
- Embedded floating voltage regulators
- Symmetrical positive and negative pulse waveforms for low 2nd order harmonic distortion
- Up to 200 MHz LVDS/LVCMOS clock (transparent mode available)
- $10\ \Omega$ active T/R switch
- 20 MHz output frequency at ± 60 V output, 220 pF load
- 1.8 V to 3.3 V CMOS logic interface
- Noise-cut diodes at each high-voltage output
- Embedded high-voltage clamp diodes
- 4-mode output current control
- Automatic thermal protection with indicator
- Power-up/down reset function for free power sequencing and for fail-safe in abrupt power drop
- Latch-up free, low crosstalk between channels by SOI CMOS technology
- BGA-330(1313)A: 13 x 13 mm BGA package (RoHS compliant)

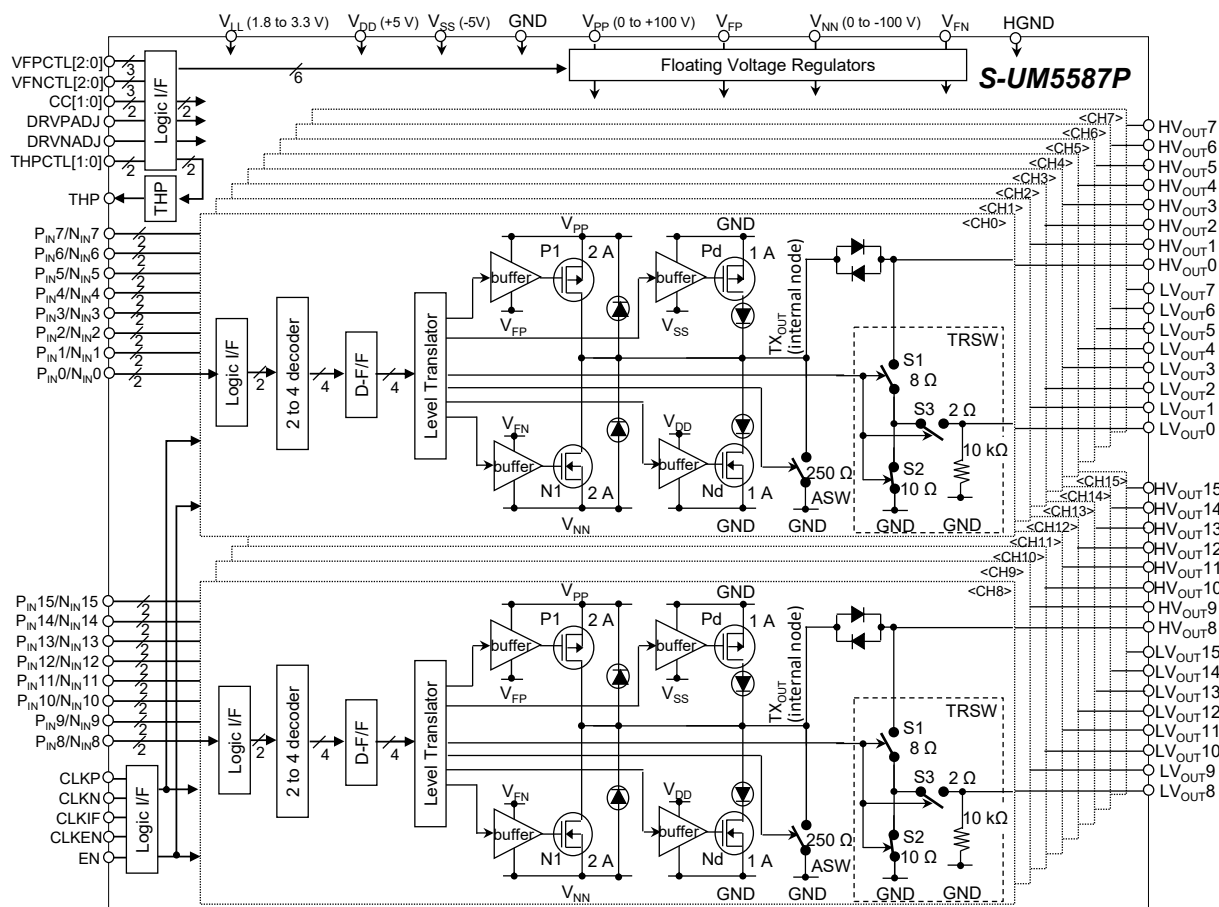


Figure 1 Block Diagram

■ Absolute Maximum Ratings

$T_a = 25^\circ\text{C}$ unless otherwise specified.

Table 1 Absolute Maximum Ratings

No.	Items	Symbol	Value	Unit	Condition
1	Logic supply voltage	V_{LL}	-0.4 to +7	V	
2	Positive supply voltage	V_{DD}	-0.4 to +7	V	
3	Negative supply voltage	V_{SS}	-7 to +0.4	V	
4	Positive high-voltage supplies	V_{PP}	-0.5 to +105	V	
5	Negative high-voltage supplies	V_{NN}	-105 to +0.5	V	
6	High-voltage outputs (x = 0 to 15)	HV_{OUTX}	-105 to +105	V	
7	Low-voltage outputs (x = 0 to 15)	LV_{OUTX}	-1 to +1	V	
8	Logic output voltage	SDOUT, FAULT	-0.4 to +7	V	
9	Logic input voltages	EN, CLKIF, CLKP, CLKN, CLKEN, CC[1:0], DRVPADJ, DRVNADJ, THPCTL<1:0>, VFPCTL<2:0>, VFNCTL<2:0>	-0.4 to +7	V	
10	Operating junction temperature	T_{Jop}	-20 to +125	$^\circ\text{C}$	
11	Storage temperature	T_{STG}	-55 to +150	$^\circ\text{C}$	
12	Maximum power dissipation	P_{Dmax}	4	W	

Remark Stresses beyond the absolute maximum ratings may cause permanent damage to the product.

■ Operating Supply Voltages, Logic Inputs

1. Operating supply voltage and temperature

Table 2 Operating Supply Voltage and Temperature

No.	Items	Symbol	Min.	Typ.	Max.	Unit	Condition
1	Logic supply voltage	V_{LL}	2.4	2.5 to 3.3	3.6	V	CMOS clock mode
			1.71	1.8 to 3.3	3.6	V	LVDS clock mode Transparent mode
2	Positive supply voltage	V_{DD}	4.75	5	5.25	V	
3	Negative supply voltage	V_{SS}	-5.25	-5	-4.75	V	
4	Positive high-voltage supplies	V_{PP}	0	—	100	V	
5	Negative high-voltage supplies	V_{NN}	-100	—	0	V	
6	IC substrate voltage*1	V_{SUB}	—	0	—	V	
7	V_{PP} , V_{NN} slew rate	SR_{MAX}	—	—	25	V/ms	
8	Operating free-air Temperature	T_A	0	—	75	$^\circ\text{C}$	

*1. The package exposed pad internally connected to the chip substrate must be soldered to the ground.

Clock Mode / Transparent Mode

Clock (CLK) mode synchronizes data inputs P_{INx} , N_{INx} ($x = 0$ to 15) with a differential LVDS/CMOS clock.
 Transparent (TP) mode without using clock is also available.

CLK mode:

Set $CLKEN = 0$. P_{INx} and N_{INx} are decoded, clocked, level-translated, then sent to high-voltage output stage.

Differential clock input has two modes as shown below.

- LVDS CLK mode: set $CLKIF = 0$. Connect $100\ \Omega$ between $CLKP$ and $CLKN$.
- CMOS CLK mode: set $CLKIF = 1$.

TP mode:

Set $CLKEN = CLKIF = 1$, $CLKP/CLKN = 0$. P_{INx} and N_{INx} are decoded, level-translated, then sent to high-voltage output stage.

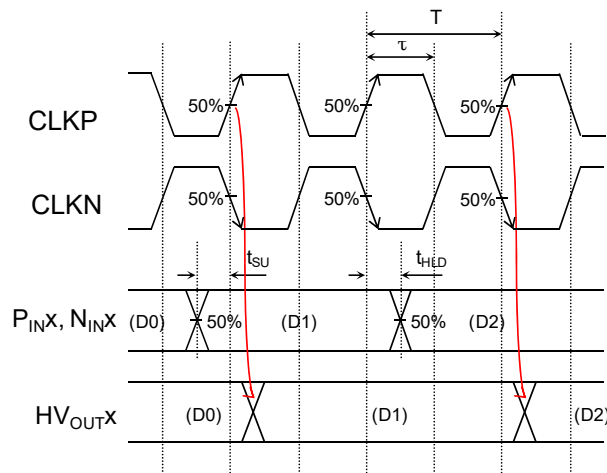


Figure 2 LVDS/CMOS CLK mode ($CLKEN = 0$)

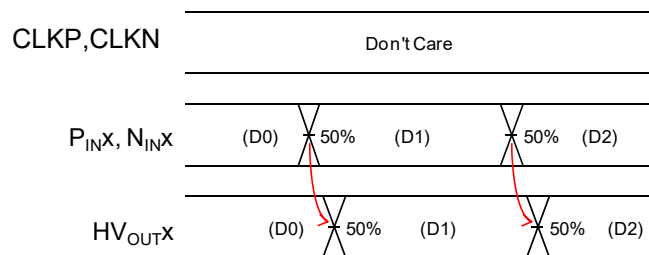


Figure 3 TP mode ($CLKEN = 1$)

2. Logic inputs and outputs

2.1 CMOS logic inputs

**Table 3 CLKP/CLKN^{*3}, PINx/NINx (x = 0 to 15), CLKEN, CLKIF, EN, CC[1:0],
 DRVPADJ, DRVNADJ, VFPCT[2:0], VFNCTL[2:0], THPCTL[1:0]**

No.	Items	Symbol	Min.	Typ.	Max.	Unit	Condition
1	High-level logic input voltage	V_{IH}	$0.8V_{LL}$	—	V_{LL}	V	
2	Low-level logic input voltage	V_{IL}	0	—	$0.2V_{LL}$	V	
3	Logic input capacitance	C_{IN}	—	3	—	pF	
4	Logic input high current ^{*1}	I_{IH}	-10	—	10	μA	
5	Logic input low current ^{*2}	I_{IL}	-10	—	10	μA	
6	Input rise/fall time	t_r, t_f	—	—	800	ps	CLK $\geq$ 100 MHz
			—	—	2.0	ns	CLK < 100 MHz
7	Input clock frequency	f_{CLK}	—	—	200	MHz	CMOS CLK mode, CLK, CLKB, $f_{CLK} = 1/T, D_{CLK} = \tau/T$, See Fig.2
8	Duty cycle	D_{CLK}	40	50	60	%	
9	Data setup time	t_{SU}	1.4	—	—	ns	CLK mode, PINx, NINx to CLK/CLKB
10	Data hold time	t_{HLD}	1.4	—	—	ns	See Fig.2

- ^{*1}. DRVPADJ, DRVNADJ, VFPCT[2:0], VFNCTL[2:0], THPCTL[1:0] have 50 μA leakage at $V_{LL} = 2.5$ V due to 50 k Ω internal pull-down resistor.
- ^{*2}. EN, CC[1:0], CLKEN, and CLKIF have 50 μA leakage at $V_{LL} = 2.5$ V due to 50 k Ω internal pull-up resistor.
- ^{*3}. Differential CMOS or Single-ended CMOS is also available for CLKP/N, CSP/N, SCLKP/N and SDATAP/N.
 In case of single-ended CMOS, N-terminals (CLKN, CSPN, SCLKN and SDATAN) need to be connected to half of V_{LL} ($V_{LL}/2$).

2.2 LVDS Differential Logic Inputs

Table 4 CLKP/CLKN

No.	Items	Symbol	Min.	Typ.	Max.	Unit	Condition
1	High-level input voltage	V_{IH}	1.265	—	—	V	$V_{IHCMR}(Typ) + V_{DIFF}(Min)/2$
2	Low-level input voltage	V_{IL}	—	—	1.135	V	$V_{IHCMR}(Typ) - V_{DIFF}(Min)/2$
3	Differential input voltage range	$V_{DIFF(range)}$	0.13	0.35	0.49	$\pm V$	same as CLK,CLKB voltage swing
4	Differential input voltage peak to peak swing	$V_{DIFF(p-p)}$	0.26	0.7	0.98	V_{pp}	$ CLK-CLKB $ differential peak-to-peak voltage swing
5	Input voltage common mode range	V_{IHCMR}	0.84	1.2	1.56	V	
6	Differential input impedance	R_{IN}	85	100	115	Ω	External Resistor
7	High-level input current	I_{IH}	—	—	5.8	mA	
8	Low-level input current	I_{IL}	—	—	5.8	mA	
9	Input rise/fall time	t_r, t_f	—	—	600	ps	20% to 80% of V_{DIFF}
10	Input clock frequency	f_{CLK}	—	—	200	MHz	LVDS CLK mode, CLK, CLKB,
11	Duty cycle	D_{CLK}	40	50	60	%	$f_{CLK} = 1/T, D_{CLK} = \tau/T$

NOTE: External termination Resistor (100 Ω) is necessary for LVDS I/F differential inputs.

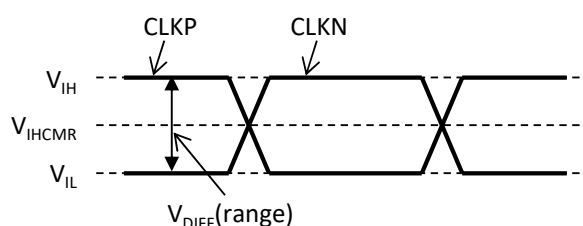


Figure 4 Differential input voltage range ($V_{DIFF(range)}$)

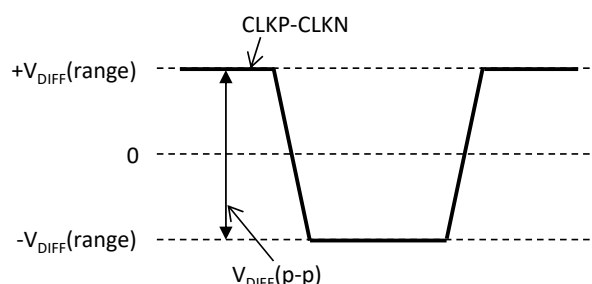


Figure 5 Differential input voltage peak to peak swing ($V_{DIFF(p-p)}$)

2.3 Open Drain Outputs

Table 5 THP

No.	Items	Symbol	Min.	Typ.	Max.	Unit	Condition
1	Pull-up voltage	$V_{PUTXFLAG}, V_{PUFAULT}$	—	—	V_{LL}	V	Connected to V_{LL} with R1
2	Output low voltage	$V_{OLTFLAG}, V_{OLFAULT}$	—	—	0.5	V	Active, $V_{LL} = 2.5$ V, R1 = 2.5 k Ω
3	Output current	I_{TXFLAG}, I_{FAULT}	—	1.0	—	mA	$V_{LL} = 2.5$ V, R1 = 2.5 k Ω
4	Off leak current	$I_{OFFLEAK}$	-10	—	10	μA	Disabled (Hi-Z)

■ Electrical Characteristics

1. Operating supply currents

Table 6 Operating Supply Currents (1/2)

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, CLKP/CLKN = 100 MHz, VFPCTL[2:0] = VFNCTL[2:0] = '000'

HV_{OUT} load = 220 pF // 200 Ω , LV_{OUT} load = 47 pF // 200 Ω , unless otherwise specified.

No.	Items		Symbol	Spec			Unit	Condition
				Min.	Typ.	Max.		
1	V _{LL} current	TP	I _{LLQD}	—	0.15	—	mA	Quiescent current-1 EN = 1 (Disable) P _{INX} = N _{INX} = 0 Current mode 3 (CC[1:0] = '11') V _{PP} /V _{NN} = ±100 V
		CMOS CLK		—	0.2	—	mA	
		LVDS CLK		—	0.25	—	mA	
2	V _{DD} current	TP	I _{DDQD}	—	4.4	—	mA	
		CMOS CLK		—	4.4	—	mA	
		LVDS CLK		—	4.4	—	mA	
3	V _{SS} current		I _{SSQD}	—	0.7	—	mA	
4	V _{PP} current		I _{PPQD}	—	0.1	—	mA	
5	V _{NN} current		I _{NNQD}	—	0.1	—	mA	
6	V _{LL} current		I _{LLQE}	—	0.2	—	mA	Quiescent current-2 EN = 0 (Enable) P _{INX} = N _{INX} = 0 Current mode 3 (CC[1:0] = '11') V _{PP} /V _{NN} = ±100 V
				—	0.25	—	mA	
				—	0.3	—	mA	
7	V _{DD} current		I _{DDQE}	—	5	—	mA	
				—	29	—	mA	
				—	31	—	mA	
8	V _{SS} current		I _{SSQE}	—	1	—	mA	
9	V _{PP} current		I _{PPQE}	—	0.3	—	mA	
10	V _{NN} current		I _{NNQE}	—	0.3	—	mA	
11	V _{LL} current	TP	I _{LLPW}	—	0.25	—	mA	PW operating current EN = 0 Current mode 3 (CC[1:0] = '11') 16-channel active Bipolar 3-level 2-cycle f = 5 MHz, PRT = 200 μs V _{PP} /V _{NN} = ±60 V
		CMOS CLK		—	0.3	—	mA	
		LVDS CLK		—	0.35	—	mA	
12	V _{DD} current	TP	I _{DDPW}	—	7	—	mA	
		CMOS CLK		—	29	—	mA	
		LVDS CLK		—	32	—	mA	
13	V _{SS} current		I _{SSPW}	—	2	—	mA	
14	V _{PP} current		I _{PPPW}	—	8	—	mA	
15	V _{NN} current		I _{NNPW}	—	9	—	mA	

Table 6 Operating Supply Currents (2/2)

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, CLKP/CLKN = 100 MHz, VFPCTL[2:0] = VFNCTL[2:0] = '000'
 HV_{OUT} load = 220 pF // 200 Ω , LV_{OUT} load = 47 pF // 200 Ω , unless otherwise specified.

No.	Items		Symbol	Spec			Unit	Condition
				Min.	Typ.	Max.		
16	V_{LL} current	TP	I_{LLCW3}	—	1.1	—	mA	CW operating current-1 EN = 0 Current mode 3 (CC[1:0] = '11') 16-channel active Bipolar 3-level Continuous f = 5 MHz $V_{PP}/V_{NN} = \pm 5$ V
		CMOS CLK		—	1.15	—	mA	
		LVDS CLK		—	1.2	—	mA	
17	V_{DD} current	TP	I_{DDCW3}	—	77	—	mA	
		CMOS CLK		—	102	—	mA	
		LVDS CLK		—	106	—	mA	
18	V_{SS} current		I_{SSCW3}	—	51	—	mA	
19	V_{PP} current		I_{PPCW3}	—	400	—	mA	
20	V_{NN} current		I_{NNCW3}	—	420	—	mA	
21	V_{LL} current	TP	I_{LLCW2}	—	1.1	—	mA	CW operating current-2 EN = 0 Current mode 2 (CC[1:0] = '10') 16-channel active Bipolar 3-level Continuous f = 5 MHz $V_{PP}/V_{NN} = \pm 5$ V
		CMOS CLK		—	1.15	—	mA	
		LVDS CLK		—	1.2	—	mA	
22	V_{DD} current	TP	I_{DDCW2}	—	69	—	mA	
		CMOS CLK		—	95	—	mA	
		LVDS CLK		—	97	—	mA	
23	V_{SS} current		I_{SSCW2}	—	43	—	mA	
24	V_{PP} current		I_{PPCW2}	—	380	—	mA	
25	V_{NN} current		I_{NNCW2}	—	405	—	mA	
26	V_{LL} current	TP	I_{LLCW1}	—	1.1	—	mA	CW operating current-3 EN = 0 Current mode 3 (CC[1:0] = '01') 16-channel active Bipolar 3-level Continuous f = 5 MHz $V_{PP}/V_{NN} = \pm 5$ V
		CMOS CLK		—	1.15	—	mA	
		LVDS CLK		—	1.2	—	mA	
27	V_{DD} current	TP	I_{DDCW1}	—	60	—	mA	
		CMOS CLK		—	86	—	mA	
		LVDS CLK		—	88	—	mA	
28	V_{SS} current		I_{SSCW1}	—	35	—	mA	
29	V_{PP} current		I_{PPCW1}	—	360	—	mA	
30	V_{NN} current		I_{NNCW1}	—	380	—	mA	
31	V_{LL} current	TP	I_{LLCW0}	—	1.1	—	mA	CW operating current-4 EN = 0 Current mode 2 (CC[1:0] = '00') 16-channel active Bipolar 3-level Continuous f = 5 MHz $V_{PP}/V_{NN} = \pm 5$ V
		CMOS CLK		—	1.15	—	mA	
		LVDS CLK		—	1.2	—	mA	
32	V_{DD} current	TP	I_{DDCW0}	—	50	—	mA	
		CMOS CLK		—	77	—	mA	
		LVDS CLK		—	78	—	mA	
33	V_{SS} current		I_{SSCW0}	—	36	—	mA	
34	V_{PP} current		I_{PPCW0}	—	315	—	mA	
35	V_{NN} current		I_{NNCW0}	—	335	—	mA	

2. Static characteristics

Table 7 Static Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	HV _{OUTX} output voltage range	HV _{OUTX}	-100	—	+100	V	
2	HV _{OUTX} high-side peak current	I _{OH}	—	2.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 3 (CC[1:0] = '11')
			—	1.5	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 2 (CC[1:0] = '10')
			—	1.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 1 (CC[1:0] = '01')
			—	0.5	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 0 (CC[1:0] = '00')
3	HV _{OUTX} high-side GND clamp peak current	I _{OHCL}	—	1.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V
4	HV _{OUTX} low-side peak current	I _{OL}	—	2.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 3 (CC[1:0] = '11')
			—	1.5	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 2 (CC[1:0] = '10')
			—	1.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 1 (CC[1:0] = '01')
			—	0.5	—	A	$V_{PP}/V_{NN} = \pm 60$ V, Current mode 0 (CC[1:0] = '00')
5	HV _{OUTX} low-side GND clamp peak current	I _{OLCL}	—	1.0	—	A	$V_{PP}/V_{NN} = \pm 60$ V
6	HV _{OUTX} high-side on-resistance	R _{ONH}	—	10	—	Ω	I _{OH} = 100 mA, Current mode 3 (CC[1:0] = '11')
			—	13	—	Ω	I _{OH} = 100 mA, Current mode 2 (CC[1:0] = '10')
			—	18	—	Ω	I _{OH} = 100 mA, Current mode 1 (CC[1:0] = '01')
			—	31	—	Ω	I _{OH} = 100 mA, Current mode 0 (CC[1:0] = '00')
7	HV _{OUTX} high-side GND clamp on-resistance	R _{ONHCL}	—	21	—	Ω	I _{OHCL} = 100 mA
8	HV _{OUTX} low-side on-resistance	R _{ONL}	—	9	—	Ω	I _{OL} = 100 mA, Current mode 3 (CC[1:0] = '11')
			—	12	—	Ω	I _{OL} = 100 mA, Current mode 2 (CC[1:0] = '10')
			—	17	—	Ω	I _{OL} = 100 mA, Current mode 1 (CC[1:0] = '01')
			—	30	—	Ω	I _{OL} = 100 mA, Current mode 0 (CC[1:0] = '00')
9	HV _{OUTX} low-side GND clamp on-resistance	R _{ONLCL}	—	20	—	Ω	I _{OLCL} = 100 mA
10	HV _{OUTX} off-capacitance	CH _{VOFF}	—	34	—	pF	TX _{OUTX} = GND, TRSW = off

3. Dynamic characteristics

Table 8 Dynamic Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, $CLKP/CLKN = 100$ MHz, $VFPCTL[2:0] = VFNCTL[2:0] = '000'$

HV_{OUT} load = 220 pF // 200 Ω , LV_{OUT} load = 47 pF // 200 Ω , unless otherwise specified.

No.	Items		Symbol	Spec			Unit	Condition
				Min.	Typ.	Max.		
1	Output frequency		f _{OUT}	—	20	—	MHz	
2	Output rise propagation delay	TP mode	t _{dr}	—	31	—	ns	
		CLK mode		—	35	—	ns	
3	Output fall propagation delay	TP mode	t _{df}	—	31	—	ns	
		CLK mode		—	35	—	ns	
4	Output rise propagation delay clamp	TP mode	t _{drCL}	—	31	—	ns	
		CLK mode		—	35	—	ns	
5	Output fall propagation delay clamp	TP mode	t _{dfCL}	—	31	—	ns	
		CLK mode		—	35	—	ns	
6	Propagation delay matching		Δt _d	—	±1	±3	ns	
7	Output rise time		t _r	—	16	—	ns	CC[1:0] = '11'
				—	24	—	ns	CC[1:0] = '10'
				—	34	—	ns	CC[1:0] = '01'
				—	44	—	ns	CC[1:0] = '00'
			t _{rCL}	—	16	—	ns	
8	Output fall time		t _f	—	16	—	ns	CC[1:0] = '11'
				—	24	—	ns	CC[1:0] = '10'
				—	34	—	ns	CC[1:0] = '01'
				—	44	—	ns	CC[1:0] = '00'
			t _{fCL}	—	16	—	ns	
9	2nd harmonic distortion		HD2	—	-40	—	dBc	Bipolar, 2-cycle, f _{OUT} = 5 MHz
10	Pulse cancellation	HDPC	—	-40	—	dBc		
		HDPC2	—	-40	—	dBc		
11	RMS output jitter		t _j	—	10	—	ps	Bipolar CW, f _{OUT} = 5 MHz, V _{PP} /V _{NN} = ±5 V
12	Crosstalk between channels		X _{TLK}	—	-70	—	dB	f _{OUT} = 5 MHz, 10 V _{P-P} , HV _{OUT} load = 50 Ω
13	Output enable time	TP	t _{EN}	—	35	—	ns	
		LVDS CLK		—	1600	—	ns	
		CMOS CLK		—	1600	—	ns	
14	Output disable time		t _{DS}	—	37	—	ns	
15	Clock mode enable time		t _{CLKEN}	—	1600	—	ns	
16	Clock mode disable time		t _{CLKDS}	—	37	—	ns	

4. Integrated Peripheral Circuits Characteristics

4.1 T/R Switch characteristics

Table 9 T/R Switch Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $V_{PP1}/V_{NN1} = V_{PP2}/V_{NN2} = \pm 60$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	LV _{OUTX} output voltage range	LV _{OUTX}	-0.85	—	+0.85	V	
2	TRSW on-resistance	R _{ONTR}	—	10	—	Ω	HV _{OUTX} = 100 mV, LV _{OUTX} = 0 V
3	TRSW on-capacitance	C _{ONTR}	—	15	—	pF	LV _{OUTX} = 0 V
4	TRSW off-resistance on HV _{OUTX}	R _{OFFTRHV}	1	—	—	M Ω	
5	TRSW off-resistance on LV _{OUTX}	R _{OFFTRLV}	8	10	12	k Ω	
6	Spike voltage on HV _{OUTX} and LV _{OUTX}	V _{TRN}	—	—	50	mV _{PP}	50 pF // 200 Ω load on HV _{OUTX} 20 pF // 200 Ω load on LV _{OUTX}
7	TRSW turn-on time	t _{dTRON}	—	300	—	ns	Logic input-to-ready for Rx signal See Fig.9
8	TRSW turn-off time	t _{dTROFF}	—	50	100	ns	See Fig.9
9	Tx setup time	t _{TXSU}	100	—	—	ns	P _{INX} = N _{INX} = 0 (GND) for at least 100 ns before Tx burst. See Fig.9

4.2 Analog Switch

Table 10 Analog Switch Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	ASW on-resistance	R _{ONASW}	—	250	—	Ω	

4.3 HV Blocking Diode

Table 11 Output HV Blocking Diode Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	Forward voltage	V _{FHVD}	—	1.0	—	V	I _F = 100 mA
			—	1.2	—	V	I _F = 200 mA
2	Reverse voltage	V _{RHVD}	200	—	—	V	I _R = 1 μ A

4.4 LV Noise-cut Diode

Table 12 Output LV Noise-cut Diode Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	Forward voltage	V _{FLVD}	—	1.1	—	V	I _F = 100 mA
			—	1.25	—	V	I _F = 200 mA

4.5 Thermal Protection

Table 13 Thermal Protection Characteristics

$V_{LL} = 2.5$ V, $V_{DD}/V_{SS} = \pm 5$ V, $T_A = 25^\circ\text{C}$, unless otherwise specified.

No.	Items	Symbol	Spec			Unit	Condition
			Min.	Typ.	Max.		
1	THP temperature threshold	T _{THP}	90	110	120	$^\circ\text{C}$	THPCTL[1:0] = 00
			120	130	140	$^\circ\text{C}$	THPCTL[1:0] = 01
			140	150	160	$^\circ\text{C}$	THPCTL[1:0] = 10
			120	130	140	$^\circ\text{C}$	THPCTL[1:0] = 11 (THP is disabled)
2	THP reset hysteresis	T _{HYSTHP}	5	10	20	$^\circ\text{C}$	

■ Switching Time Diagram

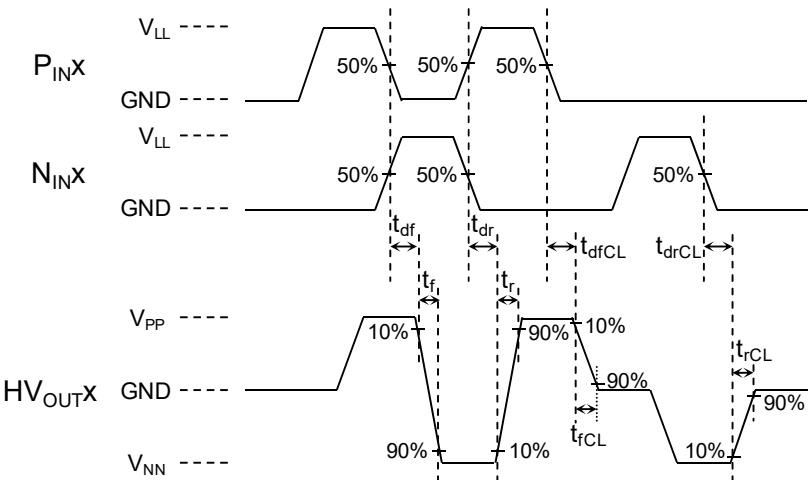


Figure 7 Propagation delay and Output rise/fall time

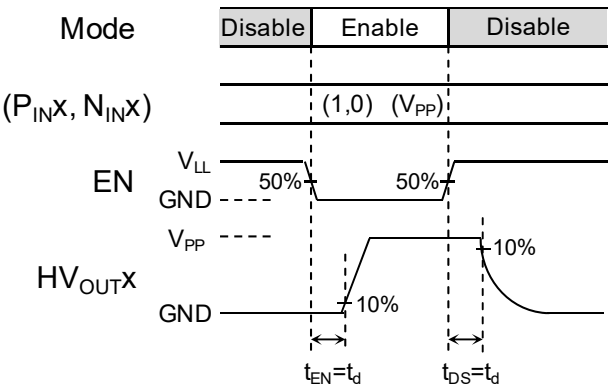


Figure 8 Output enable/disable time

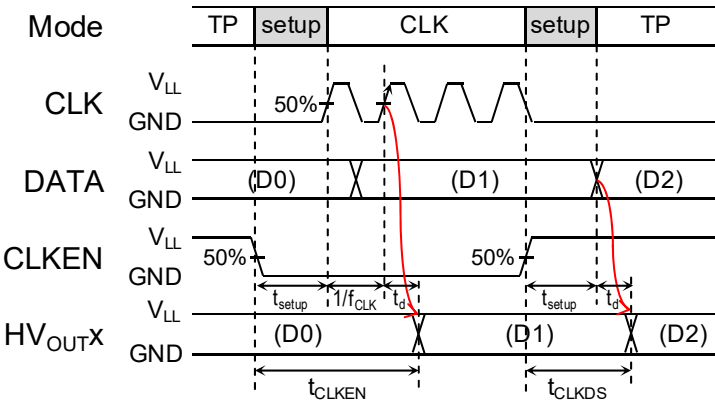


Figure 9 Clock enable/disable time

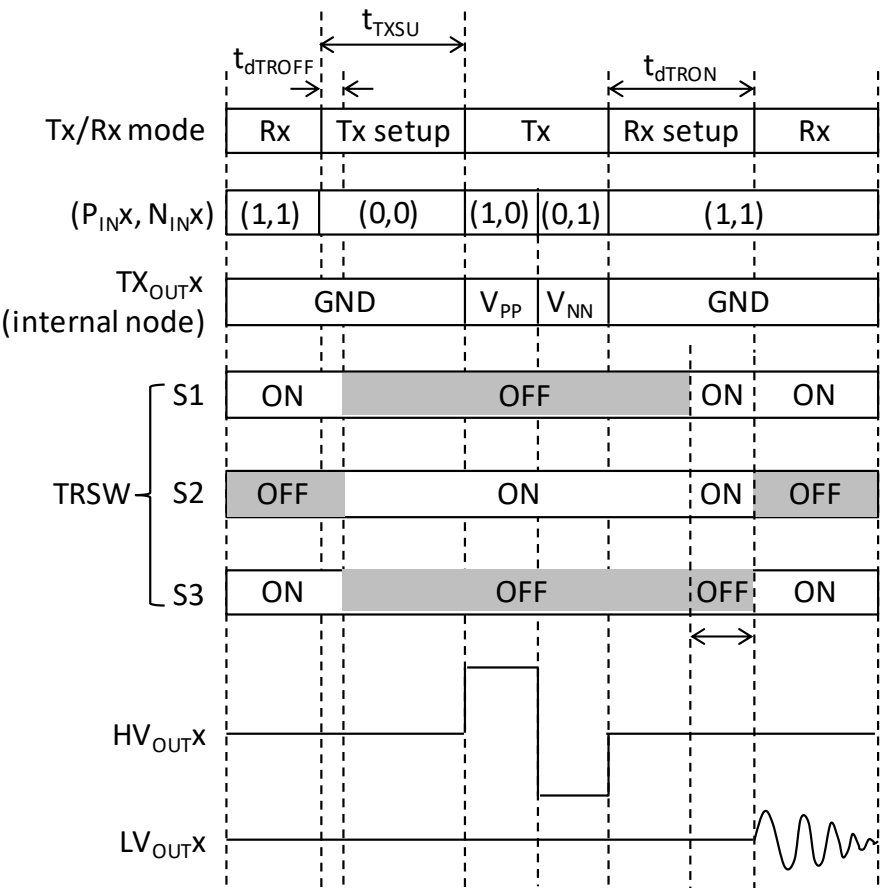


Figure 10 T/R Switch turn-on/off time

■ Truth Table

Table 14 Truth Table

Logic Inputs			Internal MOSFET state								Output state	
EN	P _{INX}	N _{INX}	P1	N1	P2	N2	ASW	TRSW			TX _{OUTX} (internal node)	LV _{OUTX}
			+HV	-HV	GND	GND	GND	S1	S2	S3		
0	0	0	OFF	OFF	ON	ON	ON	OFF	ON	OFF	GND	10 k Ω
0	0	1	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF	-HV	10 k Ω
0	1	0	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	+HV	10 k Ω
0	1	1	OFF	OFF	ON	ON	ON	ON	OFF	ON	GND	HV _{OUTX}
1	*	*	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	Hi-Z	10 k Ω

Table 15

Current mode	CC1	CC0	DRV _P ADJ	DRV _N ADJ	I _{OUT} [A]	
					P1	N1
0	0	0	×	×	0.5	0.5
1	0	1	×	×	1	1
2	1	0	×	×	1.5	1.5
3	1	1	0	0	2	2
			0	1	2	2.1
			1	0	2.1	2
			1	1	2.1	2.1

Remark ×: Don't care

Table 16

VFPCTL			VPP-VFP [V]
[2]	[1]	[0]	
0	0	0	5
0	0	1	5.15
0	1	0	5.3
0	1	1	5.45
1	0	0	5
1	0	1	4.85
1	1	0	4.7
1	1	1	4.55

Table 17

VFNCTL			VFN-VNN [V]
[2]	[1]	[0]	
0	0	0	5
0	0	1	5.15
0	1	0	5.3
0	1	1	5.45
1	0	0	5
1	0	1	4.85
1	1	0	4.7
1	1	1	4.55

Table 18

Current mode	CC1	CC0	DRV/P ADJ	DRV/N ADJ	I _{OUT} [A]	
					P1	N1
0	0	0	0	0	0.5	0.5
			0	1	0.5	0.6
			1	0	0.6	0.5
			1	1	0.6	0.6
1	0	1	0	0	1	1
			0	1	1	1.1
			1	0	1.1	1
			1	1	1.1	1.1
2	1	0	0	0	1.5	1.5
			0	1	1.5	1.6
			1	0	1.6	1.5
			1	1	1.6	1.6
3	1	1	0	0	2	2
			0	1	2	2.1
			1	0	2.1	2
			1	1	2.1	2.1

Table 19

VFPCTL			VPP-VFP [V]
[2]	[1]	[0]	
0	0	0	5
0	0	1	5.15
0	1	0	5.3
0	1	1	5.45
1	0	0	5
1	0	1	4.85
1	1	0	4.7
1	1	1	4.55

Table 20

VFNCTL			VFN-VNN [V]
[2]	[1]	[0]	
0	0	0	5
0	0	1	5.15
0	1	0	5.3
0	1	1	5.45
1	0	0	5
1	0	1	4.85
1	1	0	4.7
1	1	1	4.55

Table 21

THPCTL		THP Threshold [°C]	Tx reset function	FAULT Indication
[1]	[0]			
0	0	110	ON	ON
0	1	130	ON	ON
1	0	150	ON	ON
1	1	130	OFF	ON

■ Pin Configuration

Table 22 Pin Configuration

No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name	No.	Pin name
A1	GND	C1	LVOUT1	E1	PIN0	G1	PIN2	J1	VDD	L1	VSS	N1	PIN13	Q1	PIN15	S1	LVOUT14	U1	GND
A2	VNN	C2	GND	E2	NIN0	G2	NIN2	J2	VDD	L2	VSS	N2	NIN13	Q2	NIN15	S2	GND	U2	VNN
A3	VFN	C3	GND	E3	GND	G3	GND	J3	VLL	L3	GND	N3	GND	Q3	GND	S3	GND	U3	VFN
A4	HVOUT0	C4	GND	E4	GND(T)	G4	GND(T)	J4	GND(T)	L4	GND(T)	N4	GND(T)	Q4	GND(T)	S4	GND	U4	HVOUT15
A5	HGND	C5	GND	E5	GND(T)	G5	GND(T)	J5	GND(T)	L5	GND(T)	N5	GND(T)	Q5	GND(T)	S5	GND	U5	HGND
A6	HVOUT2	C6	GND	E6	GND(T)	-	-	-	-	-	-	-	-	Q6	GND(T)	S6	GND	U6	HVOUT13
A7	VFP	C7	GND	E7	GND(T)	G7	GND(T)	J7	GND(T)	L7	GND(T)	N7	GND(T)	Q7	GND(T)	S7	GND	U7	VFP
A8	VPP	C8	GND	E8	GND(T)	G8	GND(T)	J8	GND(T)	L8	GND(T)	N8	GND(T)	Q8	GND(T)	S8	GND	U8	VPP
A9	LVOUT2	C9	GND	E9	GND(T)	G9	GND(T)	J9	GND(T)	L9	GND(T)	N9	GND(T)	Q9	GND(T)	S9	GND	U9	LVOUT13
A10	HGND	C10	GND	E10	GND(T)	G10	GND(T)	J10	GND(T)	L10	GND(T)	N10	GND(T)	Q10	GND(T)	S10	GND	U10	HGND
A11	LVOUT4	C11	GND	E11	GND(T)	G11	GND(T)	J11	GND(T)	L11	GND(T)	N11	GND(T)	Q11	GND(T)	S11	GND	U11	LVOUT11
A12	VPP	C12	GND	E12	GND(T)	G12	GND(T)	J12	GND(T)	L12	GND(T)	N12	GND(T)	Q12	GND(T)	S12	GND	U12	VPP
A13	VFP	C13	GND	E13	GND(T)	G13	GND(T)	J13	GND(T)	L13	GND(T)	N13	GND(T)	Q13	GND(T)	S13	GND	U13	VFP
A14	HVOUT4	C14	GND	E14	GND(T)	-	-	-	-	-	-	-	-	Q14	GND(T)	S14	GND	U14	HVOUT11
A15	HGND	C15	GND	E15	GND(T)	G15	GND(T)	J15	GND(T)	L15	GND(T)	N15	GND(T)	Q15	GND(T)	S15	GND	U15	HGND
A16	HVOUT6	C16	GND	E16	GND(T)	G16	GND(T)	J16	GND(T)	L16	GND(T)	N16	GND(T)	Q16	GND(T)	S16	GND	U16	HVOUT9
A17	VFN	C17	GND	E17	GND	G17	GND	J17	GND	L17	VLL	N17	GND	Q17	GND	S17	GND	U17	VFN
A18	VNN	C18	GND	E18	NIN7	G18	NIN5	J18	VSS	L18	VDD	N18	NIN10	Q18	NIN8	S18	GND	U18	VNN
A19	GND	C19	LVOUT7	E19	PIN7	G19	PIN5	J19	VSS	L19	VDD	N19	PIN10	Q19	PIN8	S19	LVOUT8	U19	GND
B1	LVOUT0	D1	VFNCCTL0	F1	PIN1	H1	PIN3	K1	CLKP	M1	PIN12	P1	PIN14	R1	VFPCTL0	T1	LVOUT15		
B2	VNN	D2	VFNCCTL1	F2	NIN1	H2	NIN3	K2	CLKN	M2	NIN12	P2	NIN14	R2	VFPCTL1	T2	VNN		
B3	VNN	D3	VFNCCTL2	F3	GND	H3	EN	K3	GND	M3	CLKEN	P3	GND	R3	VFPCTL2	T3	VNN		
B4	HVOUT1	D4	GND(T)	F4	GND(T)	H4	GND(T)	K4	GND(T)	M4	GND(T)	P4	GND(T)	R4	GND(T)	T4	HVOUT14		
B5	HGND	D5	GND(T)	F5	GND(T)	H5	GND(T)	K5	GND(T)	M5	GND(T)	P5	GND(T)	R5	GND(T)	T5	HGND		
B6	HVOUT3	D6	GND(T)	F6	GND(T)	-	-	-	-	-	-	-	-	R6	GND(T)	T6	HVOUT12		
B7	VPP	D7	GND(T)	-	-	H7	GND(T)	K7	GND(T)	M7	GND(T)	-	-	R7	GND(T)	T7	VPP		
B8	VPP	D8	GND(T)	-	-	H8	GND(T)	K8	GND(T)	M8	GND(T)	-	-	R8	GND(T)	T8	VPP		
B9	LVOUT3	D9	GND(T)	-	-	H9	GND(T)	K9	GND(T)	M9	GND(T)	-	-	R9	GND(T)	T9	LVOUT12		
B10	HGND	D10	GND(T)	-	-	H10	GND(T)	K10	GND(T)	M10	GND(T)	-	-	R10	GND(T)	T10	HGND		
B11	LVOUT5	D11	GND(T)	-	-	H11	GND(T)	K11	GND(T)	M11	GND(T)	-	-	R11	GND(T)	T11	LVOUT10		
B12	VPP	D12	GND(T)	-	-	H12	GND(T)	K12	GND(T)	M12	GND(T)	-	-	R12	GND(T)	T12	VPP		
B13	VPP	D13	GND(T)	-	-	H13	GND(T)	K13	GND(T)	M13	GND(T)	-	-	R13	GND(T)	T13	VPP		
B14	HVOUT5	D14	GND(T)	-	-	-	-	-	-	-	-	-	-	R14	GND(T)	T14	HVOUT10		
B15	HGND	D15	GND(T)	F15	GND(T)	H15	GND(T)	K15	GND(T)	M15	GND(T)	P15	GND(T)	R15	GND(T)	T15	HGND		
B16	HVOUT7	D16	GND(T)	F16	GND(T)	H16	GND(T)	K16	GND(T)	M16	GND(T)	P16	GND(T)	R16	GND(T)	T16	HVOUT8		
B17	VNN	D17	GND	F17	GND	H17	DRVNADJ	K17	GND	M17	DRVPADJ	P17	GND	R17	GND	T17	VNN		
B18	VNN	D18	THPCTL0	F18	NIN6	H18	NIN4	K18	CLKIF	M18	NIN11	P18	NIN9	R18	CC0	T18	VNN		
B19	LVOUT6	D19	THPCTL1	F19	PIN6	H19	PIN4	K19	THP	M19	PIN11	P19	PIN9	R19	CC1	T19	LVOUT9		

■ Pin Configuration (MAP)

TOP VIEW

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	GND	VNN	VFN	HVOUT 0	HGND	HVOUT 2	VFP	VPP	LVOUT 2	HGND	LVOUT 4	VPP	VFP	HVOUT 4	HGND	HVOUT 6	VFN	VNN	GND
B	LVOUT 0	VNN	VNN	HVOUT 1	HGND	HVOUT 3	VPP	VPP	LVOUT 3	HGND	LVOUT 5	VPP	VPP	HVOUT 5	HGND	HVOUT 7	VNN	VNN	LVOUT 6
C	LVOUT 1	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	LVOUT 7
D	VFN CTL0	VFN CTL1	VFN CTL2	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND	THP CTL0	THP CTL1
E	PIN0	NIN0	GND	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND	NIN7	PIN7
F	PIN1	NIN1	GND	GND(T)	GND(T)	GND(T)	-	-	-	-	-	-	-	-	GND(T)	GND(T)	GND	NIN6	PIN6
G	PIN2	NIN2	GND	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	GND	NIN5	PIN5
H	PIN3	NIN3	EN	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	DRVN ADJ	NIN4	PIN4
J	VDD	VDD	VLL	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	GND	VSS	VSS
K	CLKP	CLKN	GND	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	GND	CLKIF	THP
L	VSS	VSS	GND	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	VLL	VDD	VDD
M	PIN12	NIN12	CLKEN	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	DRV P ADJ	NIN11	PIN11
N	PIN13	NIN13	GND	GND(T)	GND(T)	-	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	-	GND(T)	GND(T)	GND	NIN10	PIN10
P	PIN14	NIN14	GND	GND(T)	GND(T)	-	-	-	-	-	-	-	-	-	GND(T)	GND(T)	GND	NIN9	PIN9
Q	PIN15	NIN15	GND	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND	NIN8	PIN8
R	VFP CTL0	VFP CTL1	VFP CTL2	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND(T)	GND	CC0	CC1
S	LVOUT 14	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	LVOUT 8
T	LVOUT 15	VNN	VNN	HVOUT 14	HGND	HVOUT 12	VPP	VPP	LVOUT 12	HGND	LVOUT 10	VPP	VPP	HVOUT 10	HGND	HVOUT 8	VNN	VNN	LVOUT 9
U	GND	VNN	VFN	HVOUT 15	HGND	HVOUT 13	VFP	VPP	LVOUT 13	HGND	LVOUT 11	VPP	VFP	HVOUT 11	HGND	HVOUT 9	VFN	VNN	GND

Figure 11 Pin Configuration (MAP)

■ Pin Description

Table 23 Pin Description

Pin name	Function	Pin name	Function
VPP	Positive high voltage power supply (0 to +100 V)	CLKP	Positive clock input (up to 200 MHz)
VFP	Built-in power supply for P-MOS (P1) gate drive	CLKN	Negative clock Input (up to 200 MHz)
VNN	negative high voltage power supply (0 to -100 V)	CLKIF	Clock I/F selection: H = CMOS, L = LVDS (50 k Ω internal pull-up)
VFN	Built-in power supply for N-MOS (N1) gate drive	CLKEN	Control of clock enable, H = disable, L = enable (50 k Ω internal pull-up)
VLL	Positive low voltage power supply (+2.5 to 3.3 V)	THPCTL[1:0]	THP detection control (00: 110°C, 01: 130°C, 10: 150°C, 11: disabled)
VDD	Positive low voltage power supply (+5 V)	DRVPADJ	Size adjustment for P1 Driver (0: none, 1: +0.1 A to P1 drive current)
VSS	Negative low voltage power supply (-5 V)	DRVNADJ	Size adjustment for N1 Driver (0: none, 1: +0.1 A to N1 drive current)
HGND	Drive power ground (0 V)	CC[1:0]	Control of P1/N1 drive current (50 k Ω internal pull-up)
GND	Logic power ground (0 V)	VFPCTL[2:0]	Built-in power supply control for P-MOS gatedrive
GND(T)	Ground for Thermal heat sink	VFNCTL[2:0]	Built-in power supply control for N-MOS gatedrive
EN	Control of chip enable, H = disable, L = enable (50 k Ω internal pull-up)	THP	THP output flag, Open N-MOS drain
P _{IN} 0	Logic inputs for channel 0	HVOUT0	High voltage output of channel 0
N _{IN} 0		HVOUT1	High voltage output of channel 1
P _{IN} 1	Logic inputs for channel 1	HVOUT2	High voltage output of channel 2
N _{IN} 1		HVOUT3	High voltage output of channel 3
P _{IN} 2	Logic inputs for channel 2	HVOUT4	High voltage output of channel 4
N _{IN} 2		HVOUT5	High voltage output of channel 5
P _{IN} 3	Logic inputs for channel 3	HVOUT6	High voltage output of channel 6
N _{IN} 3		HVOUT7	High voltage output of channel 7
P _{IN} 4	Logic inputs for channel 4	HVOUT8	High voltage output of channel 8
N _{IN} 4		HVOUT9	High voltage output of channel 9
P _{IN} 5	Logic inputs for channel 5	HVOUT10	High voltage output of channel 10
N _{IN} 5		HVOUT11	High voltage output of channel 11
P _{IN} 6	Logic inputs for channel 6	HVOUT12	High voltage output of channel 12
N _{IN} 6		HVOUT13	High voltage output of channel 13
P _{IN} 7	Logic inputs for channel 7	HVOUT14	High voltage output of channel 14
N _{IN} 7		HVOUT15	High voltage output of channel 15
P _{IN} 8	Logic inputs for channel 8	LVOUT0	Low voltage output of channel 0
N _{IN} 8		LVOUT1	Low voltage output of channel 1
P _{IN} 9	Logic inputs for channel 9	LVOUT2	Low voltage output of channel 2
N _{IN} 9		LVOUT3	Low voltage output of channel 3
P _{IN} 10	Logic inputs for channel 10	LVOUT4	Low voltage output of channel 4
N _{IN} 10		LVOUT5	Low voltage output of channel 5
P _{IN} 11	Logic inputs for channel 11	LVOUT6	Low voltage output of channel 6
N _{IN} 11		LVOUT7	Low voltage output of channel 7
P _{IN} 12	Logic inputs for channel 12	LVOUT8	Low voltage output of channel 8
N _{IN} 12		LVOUT9	Low voltage output of channel 9
P _{IN} 13	Logic inputs for channel 13	LVOUT10	Low voltage output of channel 10
N _{IN} 13		LVOUT11	Low voltage output of channel 11
P _{IN} 14	Logic inputs for channel 14	LVOUT12	Low voltage output of channel 12
N _{IN} 14		LVOUT13	Low voltage output of channel 13
P _{IN} 15	Logic inputs for channel 15	LVOUT14	Low voltage output of channel 14
N _{IN} 15		LVOUT15	Low voltage output of channel 15

■ Package

Table 24 Package Drawing Codes

Package Name	Dimension	Tray	Marking	Land	Packing
BGA-330(1313)A	RA330-A-P-S2	RA330-A-T-SD	RA330-A-M-SD	RA330-A-L-SD	RA330-A-K-SD

■ Storage, Mounting

1. Storage Conditions

1. 1 The storage location should be kept at 5 to 35°C and 40 to 70% relative humidity. Keeping in a dry box is recommended. Moisture-proof property is assured for 12 months from delivery date for sealed moisture-proof packing, while it is guaranteed for 7 days from unpacked date under the condition above.
1. 2 When the storage conditions do not conform to those above or other conditions occur indicating moisture exposure, the ICs should be dried to avoid package cracks. A baking process at 125°C lasting for 24 hours results in sufficient dehumidification. The baking is not allowed more than twice, and the ICs should be mounted within 7 days after initial baking or within 10 days of total exposure after the second dehumidification.

2. Reflow soldering

The temperature rise may be different in the resin and a terminal part due to the reflow soldering. It is necessary to check the package surface temperature (resin) before setting the temperature profile.

Figure 12 shows the resistance to soldering heat condition for package (Reflow method).

Confirm the heat resistance of the package shown below. (Based on JEDEC J-STD-020).

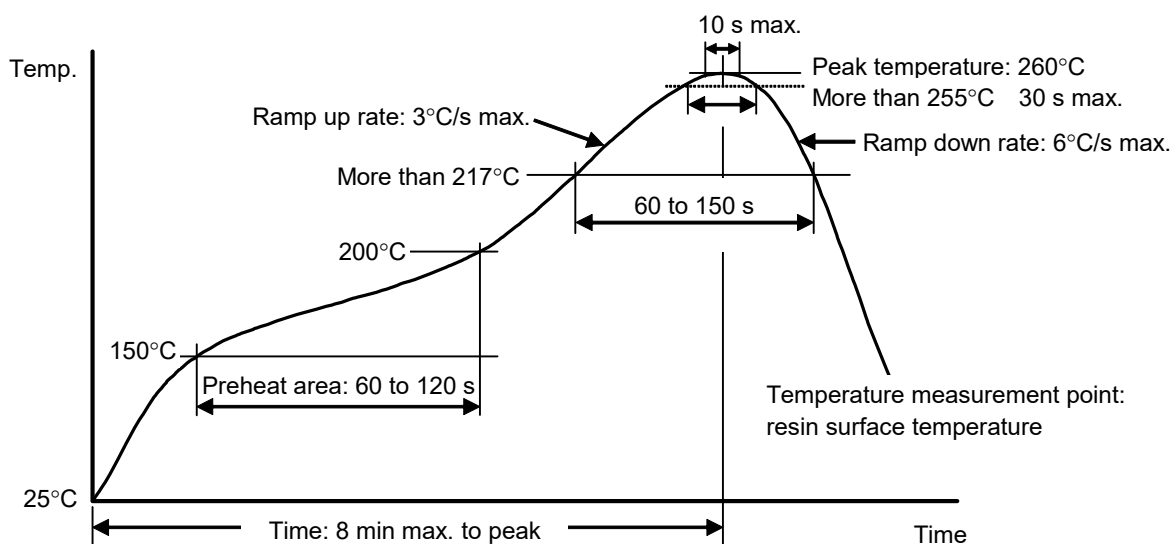


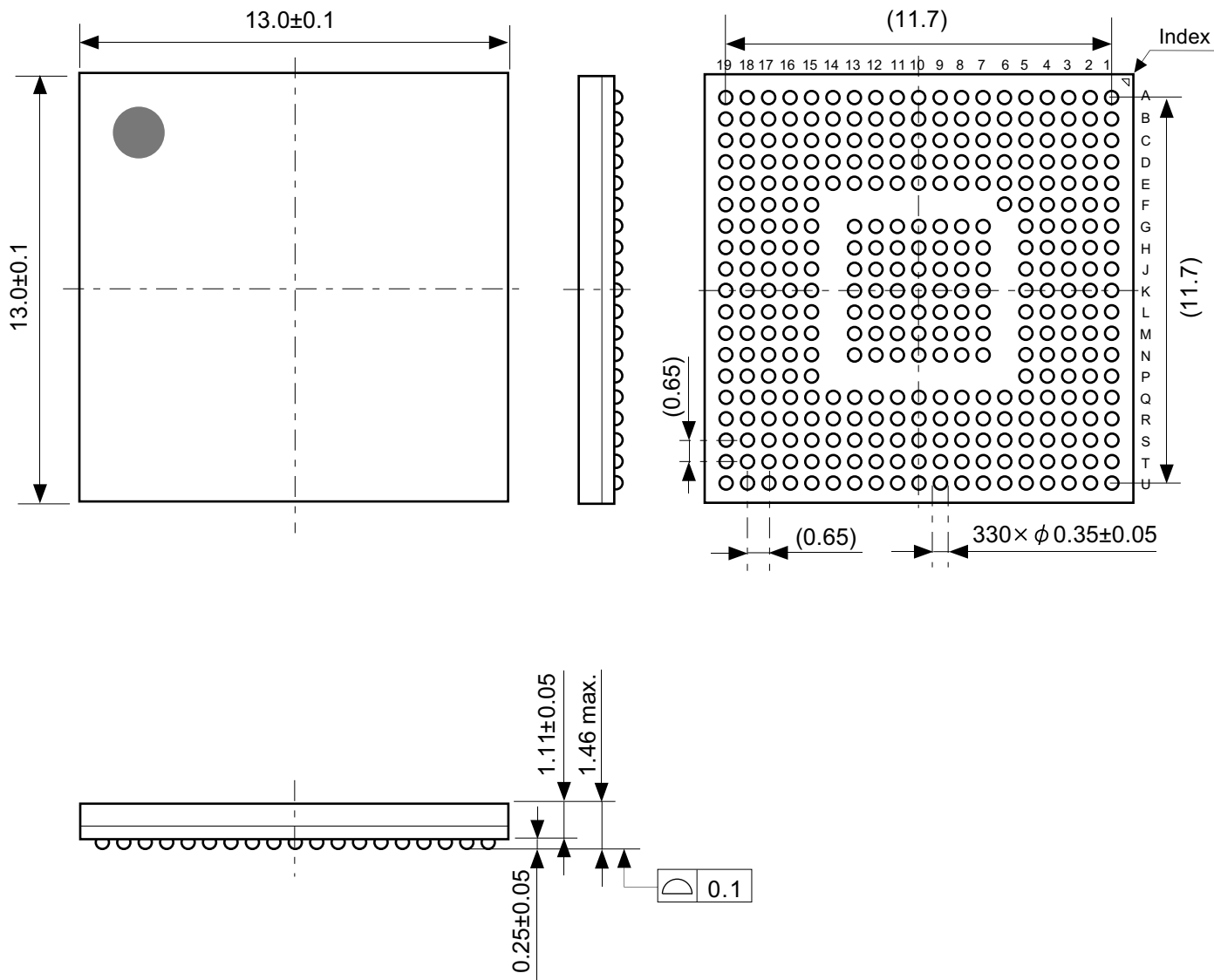
Figure 12 Resistance to soldering heat condition for package (Reflow method)

■ Important Notice

1. ABLIC Inc. warrants performance of its hardware products (hereinafter called "products") to the specifications applicable at the time of sale in accordance with the Product Specification. Testing and other quality control techniques are utilized to the extent ABLIC Inc. needs to meet specifications described in the Product Specification. Specific testing of all parameters of each device is not necessarily performed, except those mandated by related laws and/or regulations.
2. Should any claim be made within one month of product delivery about products' failure to meet performance described in the Product Specification, all the products in relevant lot(s) shall be re-tested and re-delivered. Products delivered more than one month before of such claim shall not be counted for such response.
3. ABLIC Inc. assumes no obligation or any way of compensation should any fault about customer products and applications using ABLIC Inc. products be found in marketplace. Only in such a case fault of ABLIC Inc. is evident and products concerned do not meet the Product Specification, compensation shall be conducted if claimed within one year of product delivery up to in the way of product replacement or payment of equivalent amount.
4. ABLIC Inc. reserves the right to make changes to the Product Specification at any time and to discontinue mass production of the relevant products without notice. Customers are advised before placing orders to confirm that the Product Specification of inquiry is the latest version and that the relevant product is currently on mass production status.
5. In no event shall ABLIC Inc. be liable for any damage that may result from an accident or any other cause during operation of the user's units according to the Product Specification. ABLIC Inc. assumes no responsibility for any intellectual property claims or any other problems that may result from applications of information, products or circuits described in the Product Specification.
6. No license is granted by the Product Specification under any patents or other rights of any third party or ABLIC Inc.
7. The Product Specification may not be reproduced or duplicated, in any form, in whole or in part, without the expressed written permission of ABLIC Inc.
8. Resale of ABLIC Inc. products with statements different from or beyond the parameters described in the Product Specification voids all express and any implied warranties for the products, and is an unfair and deceptive business practice. ABLIC Inc. is not responsible or liable for any such statements.
9. Products (technologies) described in the Product Specification are not to be provided to any party whose purpose in their application will hinder maintenance of international peace and safety nor are they to be applied to that purpose by their direct purchasers or any third party. When exporting those products (technologies), the necessary procedures are to be taken in accordance with related laws and regulations.

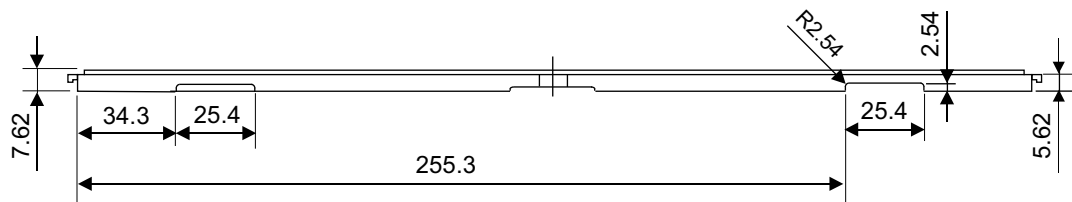
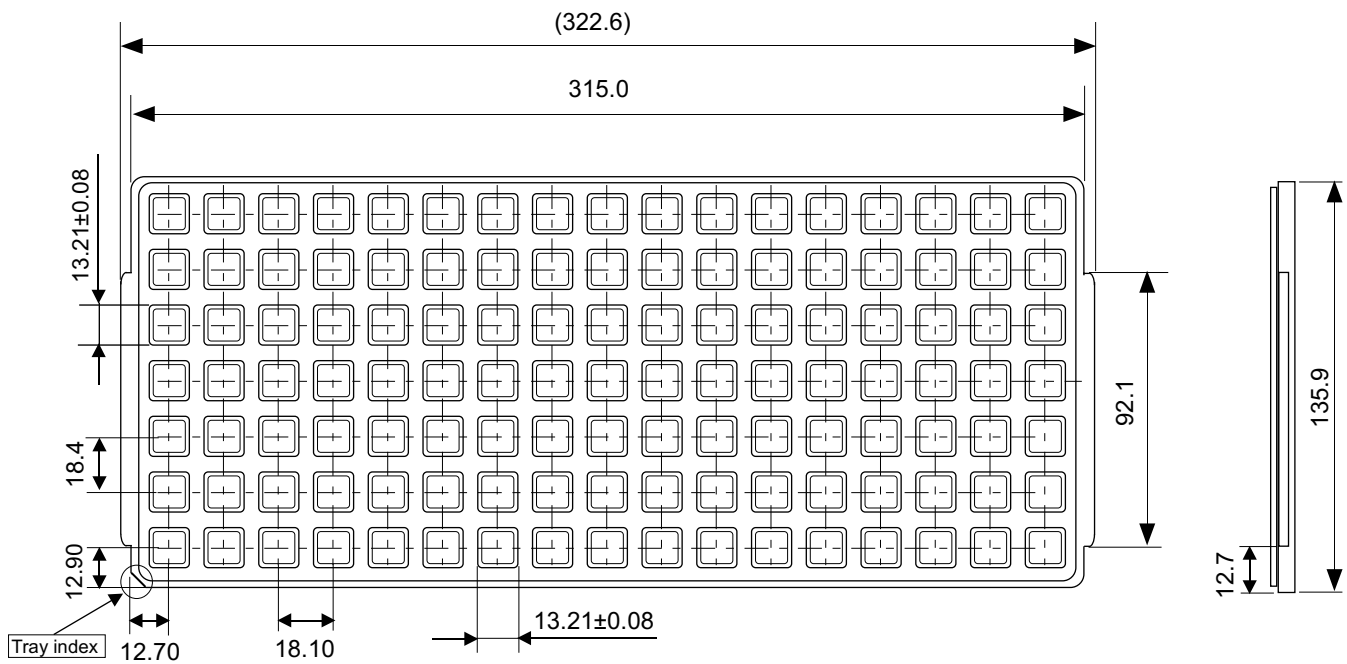
■ Cautions

1. Customers are advised to follow the cautions below to protect products from damage caused by electrical static discharge (ESD).
 1. 1 Material of container or any device to carry products should be free from ESD, which may be caused by vibration while transportation. It is recommended that electric-conductive container or aluminum sheet be used as an effective countermeasure.
 1. 2 Those who touch products such as work platform, machine, measurement/test equipment should be grounded.
 1. 3 Those who deal with products should be grounded through a large series impedance around 100 k Ω to 1 M Ω .
 1. 4 Prevent friction with other materials made with high polymer.
 1. 5 Prevent vibration or friction when carrying the printed circuit board (PCB) where products are mounted. To short circuit terminals is a recommended countermeasure to keep the same electric potential on the PCB.
 1. 6 Avoid dealing with or storing products in an extremely arid environment.
2. "Absolute maximum ratings" should never be exceeded during use regardless of any change in external conditions. Otherwise, products may be damaged or destroyed. In no event shall ABLIC Inc. be liable for any failure in products or any secondary damage resulting from use at a value exceeding the absolute maximum ratings.
3. Products may experience failures due to accident or unexpected surge voltages. Accordingly, adopt safe design features, such as redundancy or prevention of erroneous action, to avoid extensive damage in the event of a failure. (If a semiconductor device fails, there may be cases in which the semiconductor device, wiring or wiring pattern will emit smoke or cause a fire or in which the semiconductor device will burst.)
4. Products may experience failures or malfunction in poor surroundings, such as electrical leakage in products due to long-term use in high humidity, malfunctioning or permanent damage due to chemical reaction of products in corrosive environment or due to discharge by strongly charged object near products or due to excessive mechanical shock. To use products in radiation environment is not assumed. To use products near material easy to ignite may cause a fire due to its flammable package. Avoid using products in such environment or take appropriate countermeasures depending on the environment.
5. Products are not designed, manufactured, or warranted to be suitable for use where extremely high reliability is required (such as use in nuclear power control, aerospace and aviation, traffic equipment, life-support-related medical equipment, fuel control equipment and various kinds of safety equipment). Inclusion of products in such application shall be fully at the risk of customers. ABLIC Inc. assumes no liability for applications assistance, customer product design, or performance.

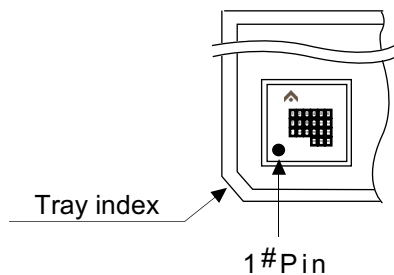


No. RA330-A-P-S2-1.0

TITLE	BGA330-A-PKG Dimensions (S-UM5587/S-UM5587P)
No.	RA330-A-P-S2-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

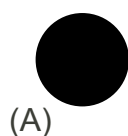
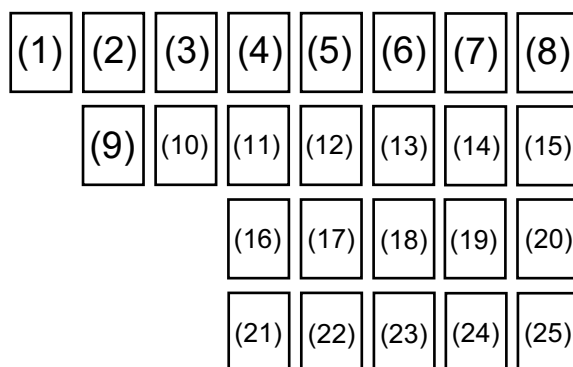


(Direction of IC in tray)



No. RA330-A-T-SD-3.0

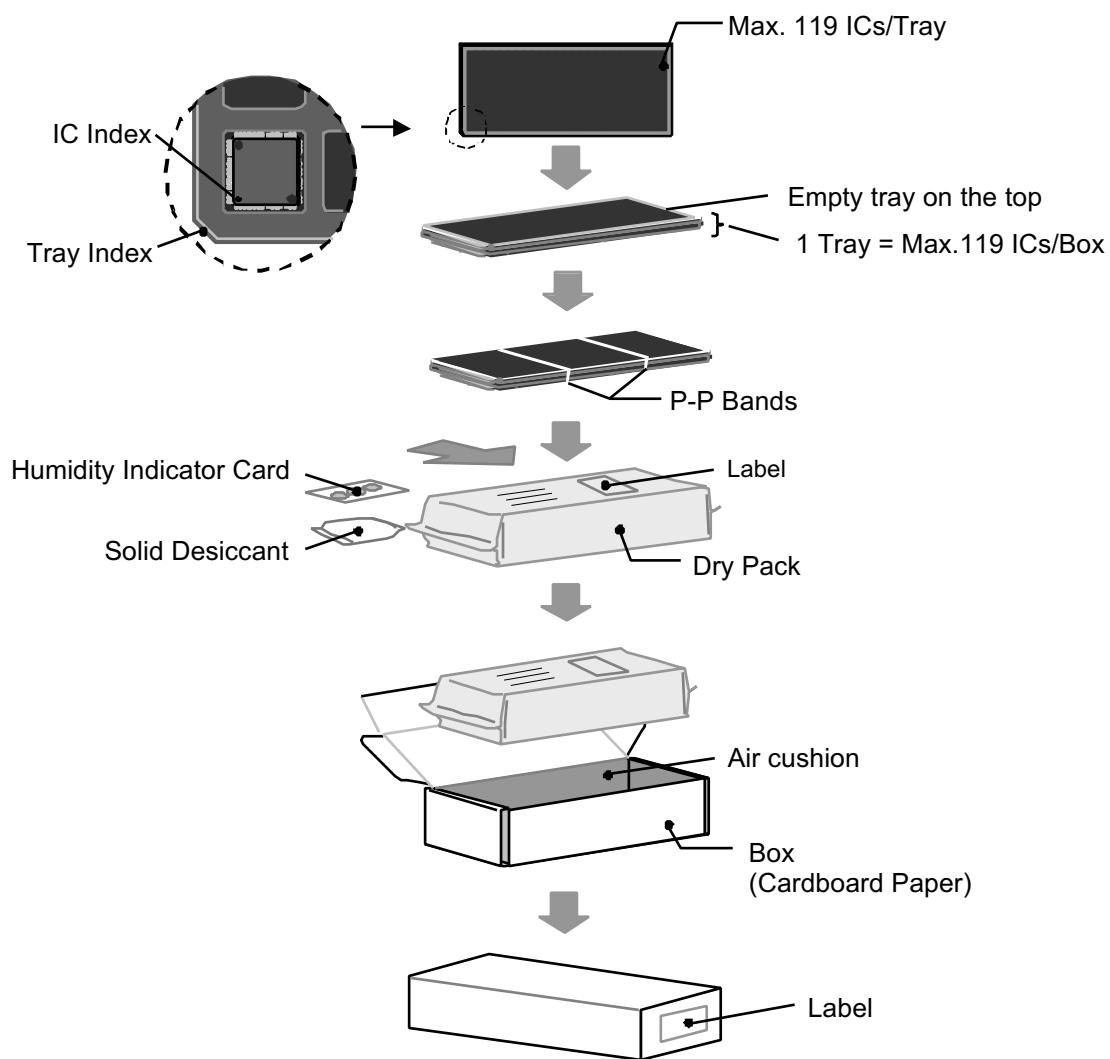
TITLE	BGA330-A-Tray		
No.	RA330-A-T-SD-3.0		
ANGLE		QTY.	119
UNIT	mm		
ABLIC Inc.			



- (1) to (10) : Product code
(11) , (12) : Quality control code
(13) : Year of assembly
(14) : Month of assembly
(15) : Week of assembly
(16) to (25) : Quality control code
(A) : 1-pin mark

No. RA330-A-M-SD-1.0

TITLE	BGA330-A-Markings		
No.	RA330-A-M-SD-1.0		
ANGLE			
UNIT		TYPE	LASER
ABLIC Inc.			



TITLE	BGA330-A -Packing Procedure
No.	RA330-A-K-SD-1.0
ANGLE	
UNIT	
ABLIC Inc.	

Disclaimers (Handling Precautions)

1. All the information described herein (product data, specifications, figures, tables, programs, algorithms and application circuit examples, etc.) is current as of publishing date of this document and is subject to change without notice.
2. The circuit examples and the usages described herein are for reference only, and do not guarantee the success of any specific mass-production design.
ABLIC Inc. is not liable for any losses, damages, claims or demands caused by the reasons other than the products described herein (hereinafter "the products") or infringement of third-party intellectual property right and any other right due to the use of the information described herein.
3. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by the incorrect information described herein.
4. Be careful to use the products within their ranges described herein. Pay special attention for use to the absolute maximum ratings, operation voltage range and electrical characteristics, etc.
ABLIC Inc. is not liable for any losses, damages, claims or demands caused by failures and / or accidents, etc. due to the use of the products outside their specified ranges.
5. Before using the products, confirm their applications, and the laws and regulations of the region or country where they are used and verify suitability, safety and other factors for the intended use.
6. When exporting the products, comply with the Foreign Exchange and Foreign Trade Act and all other export-related laws, and follow the required procedures.
7. The products are strictly prohibited from using, providing or exporting for the purposes of the development of weapons of mass destruction or military use. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by any provision or export to the person or entity who intends to develop, manufacture, use or store nuclear, biological or chemical weapons or missiles, or use any other military purposes.
8. The products are not designed to be used as part of any device or equipment that may affect the human body, human life, or assets (such as medical equipment, disaster prevention systems, security systems, combustion control systems, infrastructure control systems, vehicle equipment, traffic systems, in-vehicle equipment, aviation equipment, aerospace equipment, and nuclear-related equipment), excluding when specified for in-vehicle use or other uses by ABLIC, Inc. Do not apply the products to the above listed devices and equipments.
ABLIC Inc. is not liable for any losses, damages, claims or demands caused by unauthorized or unspecified use of the products.
9. In general, semiconductor products may fail or malfunction with some probability. The user of the products should therefore take responsibility to give thorough consideration to safety design including redundancy, fire spread prevention measures, and malfunction prevention to prevent accidents causing injury or death, fires and social damage, etc. that may ensue from the products' failure or malfunction.
The entire system in which the products are used must be sufficiently evaluated and judged whether the products are allowed to apply for the system on customer's own responsibility.
10. The products are not designed to be radiation-proof. The necessary radiation measures should be taken in the product design by the customer depending on the intended use.
11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.
12. When disposing of the products, comply with the laws and ordinances of the country or region where they are used.
13. The information described herein contains copyright information and know-how of ABLIC Inc. The information described herein does not convey any license under any intellectual property rights or any other rights belonging to ABLIC Inc. or a third party. Reproduction or copying of the information from this document or any part of this document described herein for the purpose of disclosing it to a third-party is strictly prohibited without the express permission of ABLIC Inc.
14. For more details on the information described herein or any other questions, please contact ABLIC Inc.'s sales representative.
15. This Disclaimers have been delivered in a text using the Japanese language, which text, despite any translations into the English language and the Chinese language, shall be controlling.

2.4-2019.07

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[ABLIC:](#)

[S-UM5587P](#)