



## ASNT2031-MBL Digital DMUX 24-to-48 with SSTL Interface

- Digital demultiplexer (DMUX) 24-to-48 with SSTL1.5 input and output interfaces.
- Supports data rates from 1.0Mbps to 2.0Gbps.
- User-controllable independent internal delays for data and clock signals.
- 1.5V I<sup>2</sup>C control interface with a user-defined 3-bit chip address.
- Preset function for synchronization of multiple parallel devices.
- Full-rate output copy of external high-speed clock input signal.
- Two pairs of clock divided-by-2 and synchronous clock enable outputs for supporting the tree-type demultiplexation structure.
- Additional synchronous clock divided-by-4 output.
- Dual power supply of +3.0V and +1.5V.
- Industrial temperature range.
- Low power consumption of 2.1W at 2.0Gbps.
- Available in custom 256-pin BGA package (13mm x 13mm x 2.5mm).

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
A	d07	d06	d05	d04	d03	d02	d01	d00	c2bp	qb00	qb01	qb02	qa04	qa05	qb04	qb05
B	d08								c2bn	qa06	qa01	qb03	qa03	qb03	qa06	qb06
C	d09														qa07	qb07
D	d10					vref		cton	iton						qa08	qb08
E	d11														qa09	qb09
F	ce					vtt	vdd	vcc	vcc	vcc	vdd				qa10	qb10
G	cip					vdd	vdd	vtt	vcc	vdd	vdd				qa11	qb11
H	cin				vtt	vtt	vtt			vdd					c4n	c4p
J	cop				vtt	vtt	vtt			vdd					ceb	cea
K	con					vdd	vdd	vtt	vcc	vdd	vdd				qa12	qb12
L	nc					vtt	vdd	vtt	vcc	vcc	vdd				qa13	qb13
M	d12							sclk	sda						qa14	qb14
N	d13					vref		addr1							qa15	qb15
P	d14						addr3	addr2							qb17	qb16
R	d15								c2an	qa23	qa22	qa21	qa20	qb20	qb18	qa16
T	d16	d17	d18	d19	d20	d21	d22	d23	c2ap	qb23	qb22	qb21	qa19	qa18	qa19	qa17

Fig. 1. BGA Ball Placement, view from the Top of Package.

## DESCRIPTION

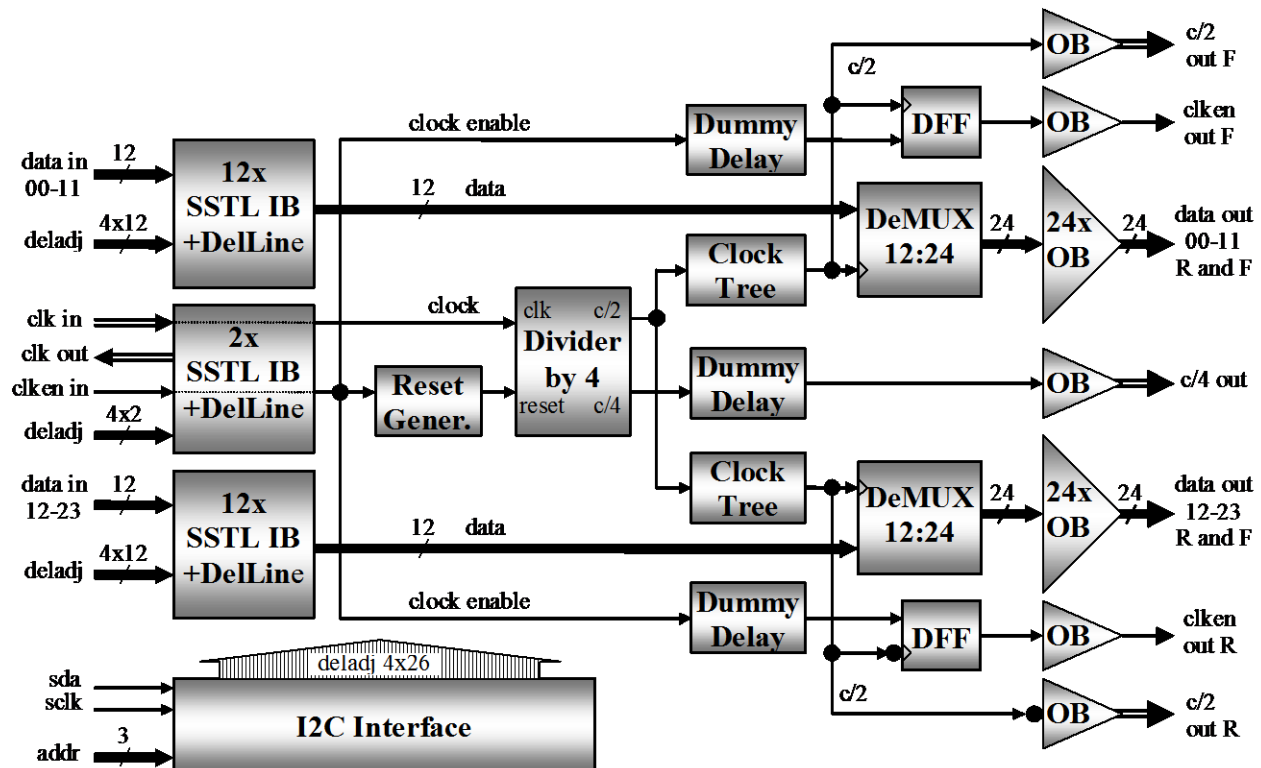


Fig. 2. Functional Block Diagram.

ASNT2031-MBL is a broad-band multi-channel digital deserializer-demultiplexer (DMUX) 24-to-48 with external initial preset functionality and 1.5V single-ended SSTL1.5 input and output interfaces for data and preset signals, as well as matching differential interfaces for clock signals.

The part includes active variable delay lines (DeLLine) in each input data and clock path for accurate signal alignment at the DMUX register inputs in order to define the optimal sampling point for the input data signals (**data in**). The value of each delay is externally controlled through an I<sup>2</sup>C interface with a user-selectable 3-bit chip address.

The operational speed of DMUX is defined by an external clock signal (**clk in**) that is converted into the required timing signals by an internal divider and is also supplied to the output of the chip (**clk out**). The divider can be preset to a certain initial state by the external clock enable signal (**clken in**), which allows synchronization of multiple DMUX devices operating in parallel.

The optimal alignment of input data (**data in**) and clock is illustrated in Fig. 3. The actual values of setup ( $t_{SU}$ ) and hold ( $t_H$ ) times are presented in Table 6.

This part also supports cascaded tree-type structures as shown in Fig. 4, by supplying two synchronous copies of clock divided-by-2 (**c/2 F**, **c/2 R**) and clock enable (**clken F**, **clken R**) signals.

Clock divided-by-4 (**c/4 out**) output signal is also provided for higher flexibility.

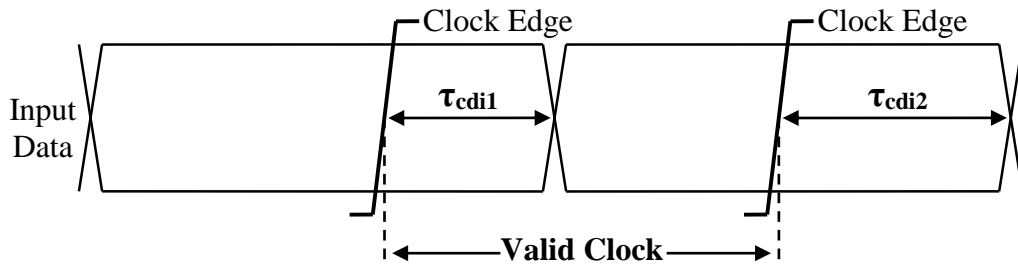


Fig. 3. Input Timing Diagram.

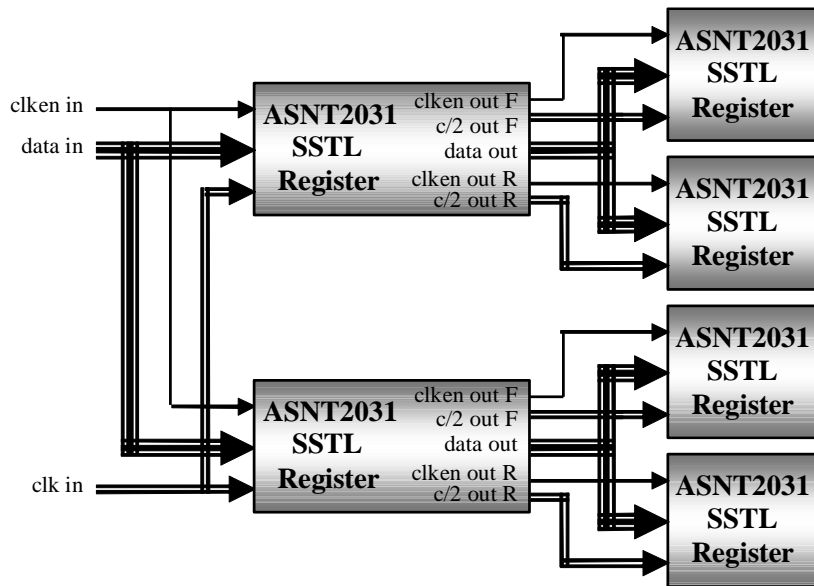


Fig. 4. Cascaded Tree-Type Structure.

All clock and clock enable outputs are phase-aligned as shown in Fig. 5. The defined phase relations are stabilized over PVT variations.

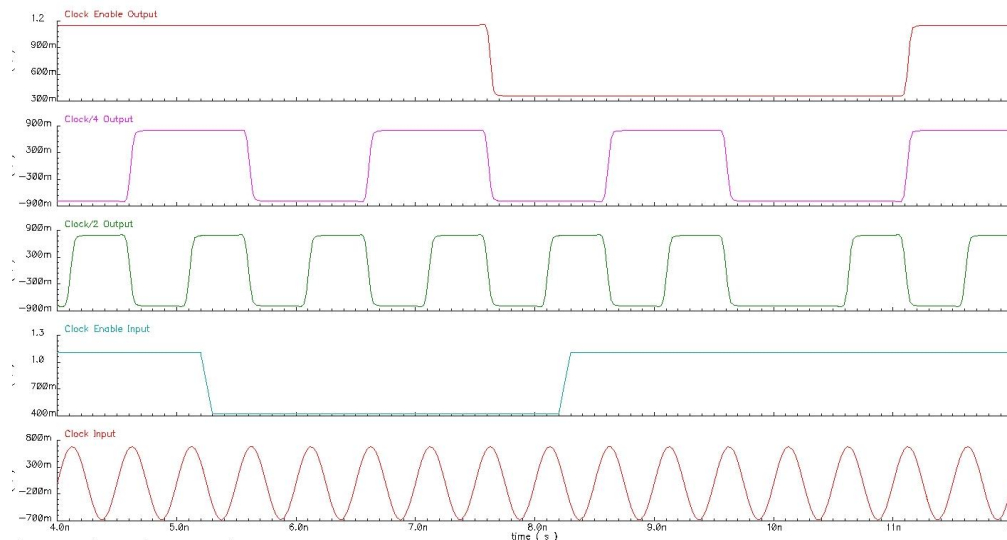


Fig. 5. Clock Signals.



The output data alignment to the output clock divided-by-2 is illustrated in Fig. 6. It is also stabilized over PVT variations. The actual values of setup ( $t_{SU}$ ) and hold ( $t_H$ ) times are presented in Table 6.

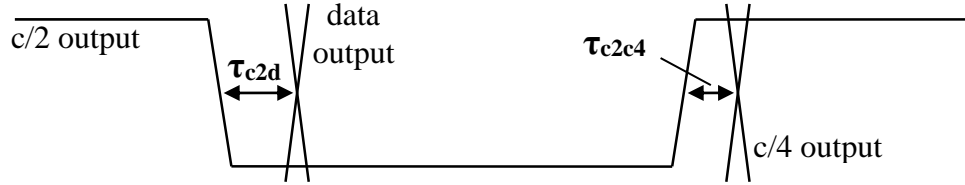


Fig. 6. Output Data Alignment.

The DMUX IC uses two power supplies:  $v_{DD} = +1.5V$  for CMOS I/Os and  $v_{CC} = +3.0V$  for the internal circuitry. It consumes about 2.1W of power and is characterized for operation from  $-25^{\circ}C$  to  $125^{\circ}C$  of junction temperature.

## SSTL Input Buffers

The SSTL input buffer is designed as a differential current switch with high tolerance to input common-mode voltage level variation. In a differential mode used for clock inputs, it accepts two complementary signals and provides a selectable internal termination for both of them depending on the state of an internal switch. The switch is controlled by external 3.0V CMOS signal  $term\_on$  as shown in Table 1. A special external voltage  $v_{TT} = v_{DD}/2$  should be provided for the correct operation of the termination circuit.

Table 1. Input Termination States.

$term\_on$ signal state	Switch state	Termination type
High	Closed	50Ω to $v_{TT}$
Low	Open	High impedance

The buffer can also operate in a single-ended mode used for data and clock enable inputs. In this mode, it accepts one input signal and external reference voltage  $v_{REF} = v_{DD}/2$ . Deviations of the reference voltage may result in the duty cycle distortion of input signals.

## Delay Lines

Digitally-controlled on-chip active delay lines are used for the alignment of input clock and data signals in order to achieve the optimal sampling conditions at the inputs of the demultiplexer's internal register. Each delay line has 15 states with an absolute delay from 400ps to 1400ps. The accuracy of the minimum delay value is within  $\pm 20\%$  for the full PVT range. This relatively high variation is insignificant for the chip operation due to the matching delays in all input paths. The additional controllable delay of 1ns is highly stabilized and falls within  $\pm 5\%$  accuracy range.

The states of the delay lines are controlled within the 1-2-4-8 algorithm by signals provided from the internal I<sup>2</sup>C interface.

## DeMUX 24:48

The block consists of 24 independent demultiplexers 1-to-2 with the standard M-S/M-S-S architecture. It latches in the data signals on both edges of half-rate clock  $c/2$  that is supplied by the internal divider-by-4



and delivers the deserialized outputs aligned to the corresponding clock edges. The output data signals are marked A and B and are aligned to the rising edge of  $c/2$ .

## Divider-by-4

The Divider-by-4 converts the input clock signal (clk in) into clock divided-by-2 ( $c/2$ ) and clock divided-by-4 ( $c/4$ ) signals aligned to a positive edge of the input clock. The divider can be preset to the 0 initial state by the external `clken_in` signal that is preliminarily retimed by the input clock.

## SSTL Output Buffers

The SSTL output buffers are designed in full compliance with the SSTL1.5 standard and operate from a nominal 1.5V supply. Their CMOS driver can source or sink the required current through a 25 $\Omega$  series resistor. The output of the buffer may be 50 $\Omega$  terminated to an external voltage equal to a half of the buffer's supply voltage, or left non-terminated.

## Clock Enable and Divider Reset

The clock enable signal must be at least 2 high-speed input clock periods long. The clock enable signal must be aligned with the falling edge of the high-speed input clock.

## I<sup>2</sup>C Interface

This 2-wire 3.0V serial-to-parallel interface with initial preset (**with the all "0" address word for reset**) is used for setting the values of internal delays in the data and clock paths. The chip incorporates a Slave I<sup>2</sup>C device that supports write operations as described below.

The I<sup>2</sup>C system uses a serial data line (SDA) and a serial clock line (SCL) for data transfers. Data is transferred between Master and Slave synchronously on a byte-by-byte basis. There is one SCL clock pulse for each data bit with the MSB being transmitted first. An acknowledgement bit set by Slave follows each transferred byte. Each bit is sampled during the high period of SCL.

The first byte of data transferred by Master immediately after START signal is the requested slave address. It consists of Vendor/Device code (currently 0xD) followed by Chip Address `Addr[2:0]` and an RW bit. The address of DMUX chip is defined by hard-wiring of 3 corresponding pins to either `vee` or `vcc`. The RW bit defines the type of operation: writing information from Master to Slave, or reading information by Master from Slave.

When `RW=0` (write operation) and the requested address matches the preset slave address, the chip's I<sup>2</sup>C block responds by pulling the following bit (9-th acknowledgement bit) low. It then saves 4 LSBs of the next byte in the Input Address Register and returns another acknowledgement bit at the end of the second byte. After that, the block saves the next byte in the Input Data Register and returns acknowledgement bit one more time. During the same time, the interface transfers the previously stored byte of data from the Input Data Register to the internal register in accordance with the 4-bit address previously saved in the Input Address Register. The address assignment is detailed in Table 2.



Table 2. Internal Address Assignments.

Address	Destination	Data
1'b0000	Not Used	
1'b0001	Delay for Data Channel 13 and 1	Data[7:4] and Data[3:0]
1'b0010	Delay for Data Channel 14 and 2	Data[7:4] and Data[3:0]
1'b0011	Delay for Data Channel 15 and 3	Data[7:4] and Data[3:0]
1'b0100	Delay for Data Channel 16 and 4	Data[7:4] and Data[3:0]
1'b0101	Delay for Data Channel 17 and 5	Data[7:4] and Data[3:0]
1'b0110	Delay for Data Channel 18 and 6	Data[7:4] and Data[3:0]
1'b0111	Delay for Data Channel 19 and 7	Data[7:4] and Data[3:0]
1'b1000	Delay for Data Channel 20 and 8	Data[7:4] and Data[3:0]
1'b1001	Delay for Data Channel 21 and 9	Data[7:4] and Data[3:0]
1'b1010	Delay for Data Channel 22 and 10	Data[7:4] and Data[3:0]
1'b1011	Delay for Data Channel 23 and 11	Data[7:4] and Data[3:0]
1'b1100	Delay for Data Channel 24 and 12	Data[7:4] and Data[3:0]
1'b1101	Delay for Clock Enable and Clock	Data[7:4] and Data[3:0]
1'b1110	Not Used	
1'b1111	Delay for Data Channels 13-to-24 and 1-to-12	Data[7:4] and Data[3:0]

## ABSOLUTE MAXIMUM RATINGS

Caution: Exceeding the absolute maximum ratings shown in Table 3 may cause damage to this product and/or lead to reduced reliability. Functional performance is specified over the recommended operating conditions for power supply and temperature only. AC and DC device characteristics at or beyond the absolute maximum ratings are not assumed or implied. All min and max voltage limits are referenced to ground.

Table 3. Absolute Maximum Ratings.

Parameter	Min	Max	Units
First Supply Voltage (VCC)		+3.6	V
Second Supply Voltage (VDD)		+1.8	V
Power Consumption		2.3	W
RF Input Voltage Swing (SE)		1.8	V
Case Temperature		+90	°C
Storage Temperature	-40	+100	°C
Operational Humidity	10	98	%
Storage Humidity	10	98	%





## TERMINAL FUNCTIONS

The ball assignment for the BGA package is shown in Table 4 and Table 5.

Table 4. Package Signal Balls.

Name	Code	Type	Description	
<b>High-Speed Inputs</b>				
data in 00	A8	1.5V CMOS input	Single-ended data inputs	
data in 01	A7			
data in 02	A6			
data in 03	A5			
data in 04	A4			
data in 05	A3			
data in 06	A2			
data in 07	A1			
data in 08	B1			
data in 09	C1			
data in 10	D1			
data in 11	E1			
data in 12	M1			
data in 13	N1			
data in 14	P1			
data in 15	R1			
data in 16	T1			
data in 17	T2			
data in 18	T3			
data in 19	T4			
data in 20	T5			
data in 21	T6			
data in 22	T7			
data in 23	T8			
clk in p	G1		Differential clock inputs	
clk in n	H1			
clken in	F1		Single-ended clock enable input	
<b>High-Speed Outputs</b>				
clk out p	J1	SSTL 1.5V output	Differential clock outputs	
clk out n	K1			
c/2 out A p	T9			Differential clock outputs
c/2 out A n	R9			
c/2 out B p	A9			Differential clock outputs
c/2 out B n	B9			
c/4 out p	H16			Differential clock outputs
c/4 out n	H15			
clken out A	J16			Single-ended clock enable output
clken out B	J15			Single-ended clock enable output



Name	Code	Type	Description
data out A 00	B10	SSTL 1.5V output	Single-ended data outputs
data out B 00	A10		
data out A 01	B11		
data out B 01	A11		
data out A 02	B12		
data out B 02	A12		
data out A 03	B13		
data out B 03	B14		
data out A 04	A13		
data out B 04	A15		
data out A 05	A14		
data out B 05	A16		
data out A 06	B15		
data out B 06	B16		
data out A 07	C15		
data out B 07	C16		
data out A 08	D15		
data out B 08	D16		
data out A 09	E15		
data out B 09	E16		
data out A 10	F15		
data out B 10	F16		
data out A 11	G15		
data out B 11	G16		
data out A 12	K15		
data out B 12	K16		
data out A 13	L15		
data out B 13	L16		
data out A 14	M15		
data out B 14	M16		
data out A 15	N15		
data out B 15	N16		
data out A 16	R16		
data out B 16	P16		
data out A 17	T16		
data out B 17	P15		
data out A 18	T14		
data out B 18	R15		
data out A 19	T13		
data out B 19	T15		
data out A 20	R13		
data out B 20	R14		





Name	Code	Type	Description
data out A 21	R12	SSTL 1.5V output	Single-ended data outputs
data out B 21	T12		
data out A 22	R11		
data out B 22	T11		
data out A 23	R10		
data out B 23	T10		
sda	M9	1.5V CMOS input	I2C bi-directional data signal
selk	M8		I2C clock signal
add1	N8	1.5V DC CMOS inputs	Chip address setup pins
add2	P8		
add3	P7		
dton	D9	3V DC CMOS inputs	Activation of internal termination for data and clock inputs: “high”-termination “ON”, “low”-termination “OFF”
cton	D8		

Table 5. Package Power Supply Balls.

Name	Code	Type	Value, V
vee	B2-B8, C2-C14, D2-D4, D10-D14, E2-E14, F2-F4, F12-F14, G2-G4, G12-G14, H2-H4, H12-H14, J2-J4, J12-J14, K2-K4, K12-K14, L2-L4, L12-L14, M2-M7, M10-M14, N2-N5, N9-N14, P2-P6, P9-P14, R2-R8	Ground	0
vcc	F8, F9, F10, G9, K9, L9, L10	Analog positive supply voltage	2.9 – 3.3
vdd	F7, F11, G6, G7, G10, G11, H10, J10, K6, K7, K10, K11, L7, L11	Digital positive supply voltage	1.4 – 1.6
vtt	F6, G8, H5, H6, H7, J5, J6, J7, K8, L6, L8	SSTL input termination voltage	vdd/2
vref	D6, N6	Reference voltage for SSTL input buffers	vdd/2
n/c	L1	Not connected	
X	D5, D7, F5, G5, H8, H9, H11, J8, J9, J11, K5, L5, N7	Removed balls	



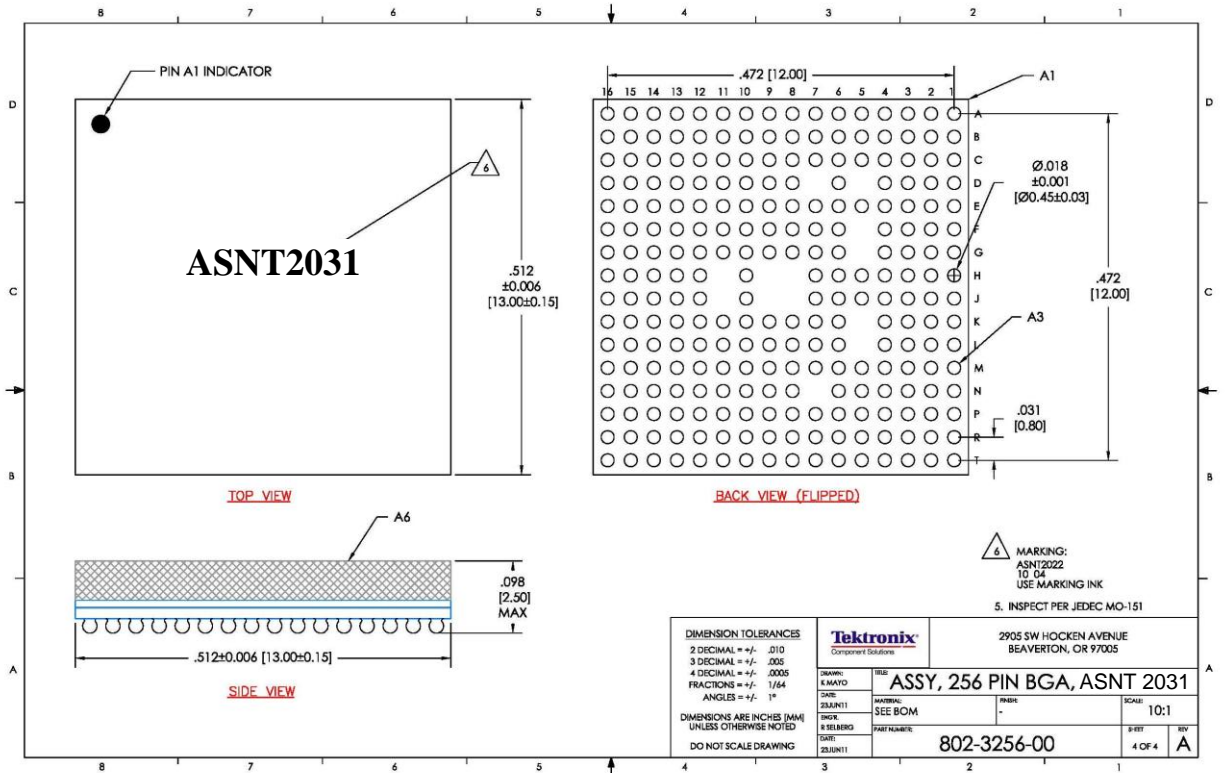
## ELECTRICAL CHARACTERISTICS

Table 6. Electrical Characteristics.

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
<b>General Parameters</b>					
V <sub>CC</sub>	+3.14	+3.3	+3.47	V	±5%
V <sub>DD</sub>	+1.43	+1.5	+1.57		
V <sub>EE</sub>		0.0		V	
Power consumption		2.1		W	
Junction temperature	-25	50	125	°C	
<b>Input Data (data in)</b>					
Data Rate	1		2000	Mbps	
Swing (SE)		1.5		V	Peak-to-peak
CM Voltage Level		750		mV	
Allowed V <sub>IH</sub> range	1.1		1.8	V	
Allowed V <sub>IL</sub> range	0		450	mV	
<b>Input Clock (clk in)</b>					
Frequency	1		2000	MHz	
Swing (SE)		1.5		V	Peak-to-peak
CM Voltage Level		750		mV	
<b>Output Data (data out)</b>					
Data Rate	0.5		1000	Mbps	
Swing (SE)		1.5		V	Peak-to-peak
CM Voltage Level		750		mV	
Interface		SSTL1.5			
<b>HS Output Clock (clk out)</b>					
Frequency	1		2000	MHz	
Swing (SE)		1.5		V	Peak-to-peak
CM Voltage Level		750		mV	
Interface		SSTL1.5			
<b>Timing Parameters</b>					
clk_in to clk_out	420	510	560	ps	Propagation delay
clk_in to c2_out	640	780	880	ps	
clk_in to c4_out	640	760	890	ps	
Data skew		0		ps	By simulation
Clock skew		0		ps	
τ <sub>cdi1</sub>	200	245	300	ps	
τ <sub>cdi2</sub>	230	275	330	ps	
τ <sub>c2d</sub>	9	20	24	ps	
τ <sub>c2c4</sub>	0	1	-1	ps	

## PACKAGE INFORMATION

The chip is packaged in a custom 256-pin BGA package. The drawing of the package is shown in **Fig. 7**.



**Fig. 7. BGA Package.**

The part's identification label is ASNT2031-MBL. The first 8 characters of the name before the dash identify the bare die including general circuit family, fabrication technology, specific circuit type, and part version while the 3 characters after the dash represent the package's manufacturer, type, and pin out count.

This device complies with the Restriction of Hazardous Substances (RoHS) per 2011/65/EU for all ten substances.



## REVISION HISTORY

Revision	Date	Changes
1.6.2	05-2020	Updated Package Information
1.5.2	07-2019	Updated Letterhead
1.5.1	01-2013	Corrected format. Added pin out drawing. Corrected block diagram. Added Absolute Maximums Rating table. Corrected Package Information section. Added Revision History table.
1.4	08-2011	Revised Electrical Characteristics.
1.3	08-2011	Revised Electrical Characteristics.
1.2	07-2011	Revised Electrical Characteristics.
1.1	07-2011	Revised Electrical Characteristics.
1.0	06-2011	First release.