ADSANTEC
Ultra High-Speed Mixed Signal ASICs

Advanced Science And Novel Technology Company, Inc.
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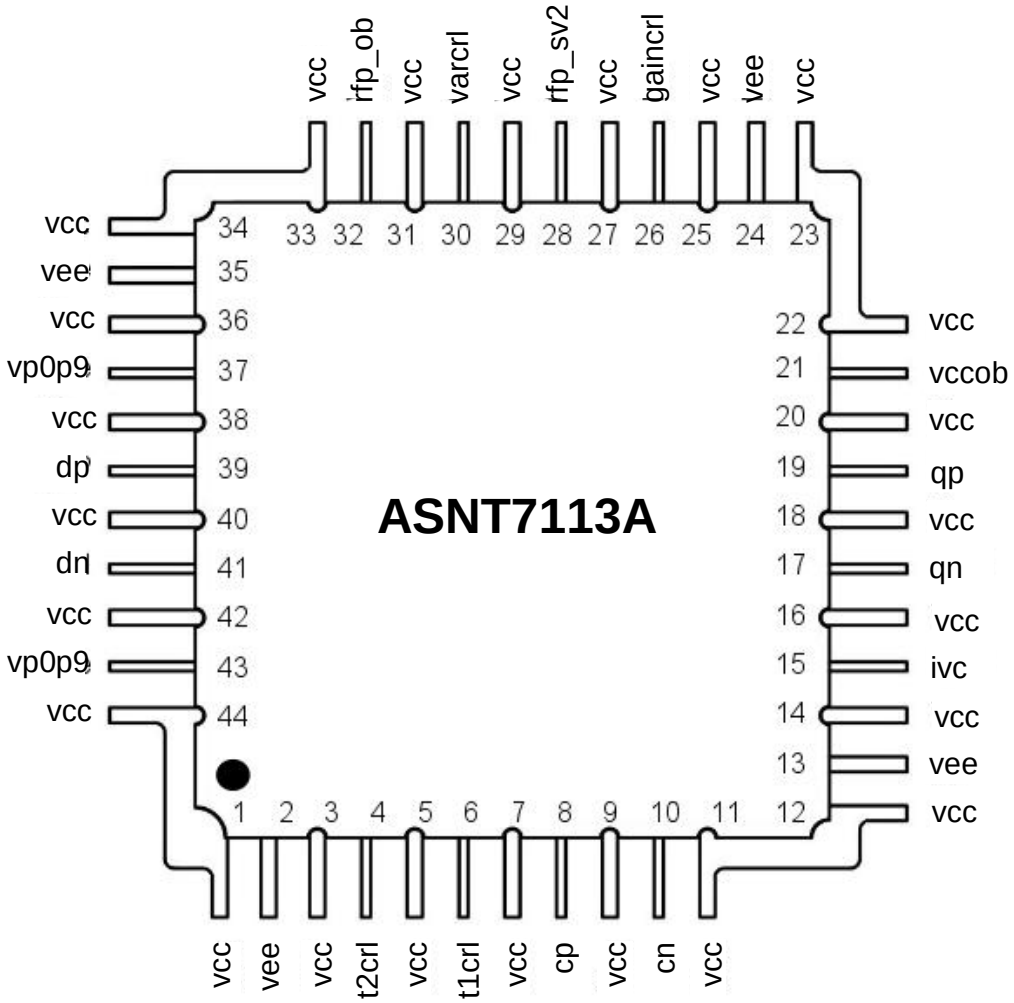
ASNT7113A-KMM
4*GSps* / 20*GHz* Differential Track-and-Hold Amplifier

- More than 8-bit accuracy within the full frequency range
- Sampling speed up to 4*GSps*
- Nominal 0*dB* differential gain with manual adjustment
- Adjustable duty cycle and delay of the internal sampling clocks
- Adjustable output common mode voltage level
- Adjustable input bandwidth
- Fully differential input and output data and clock buffers with on-chip 50*Ohm* termination
- Dual power supply
- Total power consumption of 1.75*W*
- Fabricated in SiGe for high performance, yield, and reliability
- Custom CQFP 44-pin package



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DESCRIPTION

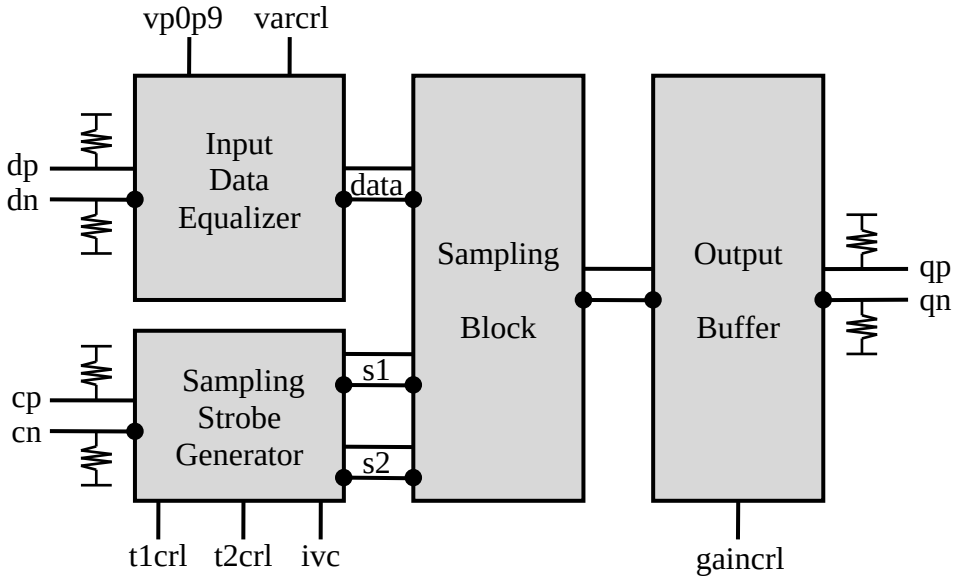

Fig. 1. Functional Block Diagram

The ASNT7113A-KMM SiGe IC is a high-speed, temperature stable, and broadband track-and-hold amplifier (THA) with improved reliability. The IC shown in Fig. 1 performs sampling of the input differential analog signal using two internally-generated strobe signals s1 and s2, and delivers a step-like differential signal to the output. It features an adjustable track period length controlled by two external voltages t1crl and t2crl that modify the states of internal delay lines. The additional ivc control voltage can be used to control the range of the delay adjustment (recommended setting is default). This allows for maximizing the length of the valid output step.

The differential gain of the chip is approximately 0*dB*, which corresponds to the single-ended-to-differential gain of -6*dB*. The gain can be adjusted using the external control voltage gaincrl. The chip supports both AC-coupled and DC-coupled inputs. In the DC-coupled mode, the input common-mode voltage must be equal to vcc for optimal performance of the chip. The input sampled data path includes an equalizer that increases the bandwidth of the chip. The level of equalization is controlled by the external voltage varcrl.

The frequency response and gain of the part is also controlled by the positive supply voltage vp0p9 that powers the input buffers of the Track-and-Hold. This voltage defines the common mode of the data signal at the input of the sampling switch and thus the frequency response of the device. Lower voltage results in less peaking in the input buffer and less overall gain of the device.

The output buffer features an independent supply voltage vccob which allows for the adjustment of the output signal's common mode voltage. The part's outputs support the CML-type logic interface with an on-chip 50*Ohm* termination to vccob and may be used differentially, AC/DC coupled, single-ended, or in any combination (see also POWER SUPPLY CONFIGURATION). The differential DC signaling is recommended for the optimal performance.

Input Data Equalizer

The bandwidth of the data input can be adjusted by the internal equalizer controlled with the external voltage varcrl. The equalizer is designed to compensate for the gain drop at high frequencies due to the characteristics of the front-end circuitry and the sampling block itself. The measured frequency response of the IC at maximum (magenta line) and minimum (orange line) values of the varcrl voltage is shown in Fig. 2. The measurements have been performed at the intermediate state of the gain control (see Fig. 4).

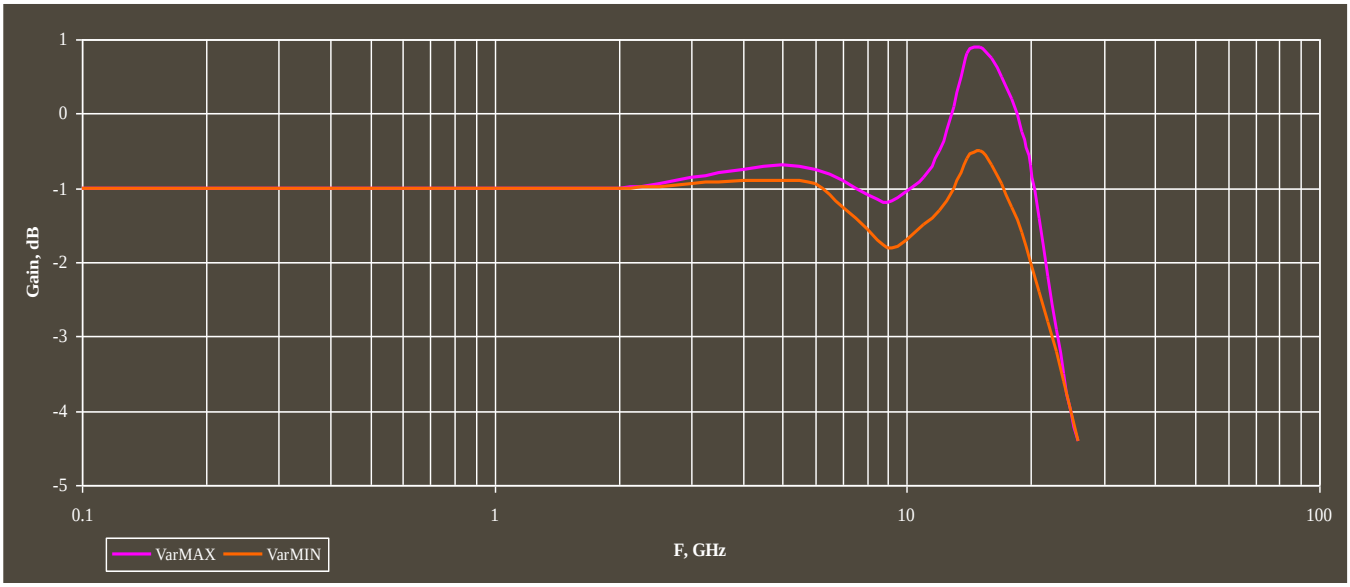

Fig. 2. Frequency Response of SHA with Max and Min Equalization

Input Clock Buffer

The input clock buffer converts the external clock cp/cn into two internal signals s1 and s2 with controlled pulse width (PW) and delay (τ) between them as shown in Fig. 3.

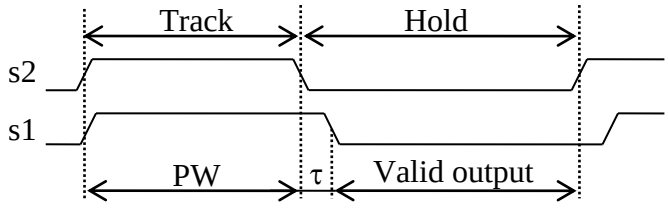

Fig. 3. Sampling Diagram

This allows for optimization of the hold time and the length of the valid output signal period. The value of PW is reverse-proportional to the t2crl voltage, while the value of τ is proportional to the t1crl voltage. The range of the delay controls is defined by the external voltage ivc. For the normal operational conditions, it is recommended to leave the pin ivc not connected.

WARNING: Too high values of the ivc voltage may upset the device operation.

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Sampling Block and Output Buffer

The sampling block performs conversion of the input signal into a step-like sampled signal under control of s1 and s2 pulses. The sampled signal is amplified by the output buffer to achieve a total gain of approximately 0*dB*. The output common-mode voltage level can be directly adjusted through changing of the vccob supply voltage. The gain can be adjusted using the gaincrl voltage signal. The measured frequency response of the SHA with the maximum and minimum gain at 2.5*GSps* rate is shown in Fig. 4.

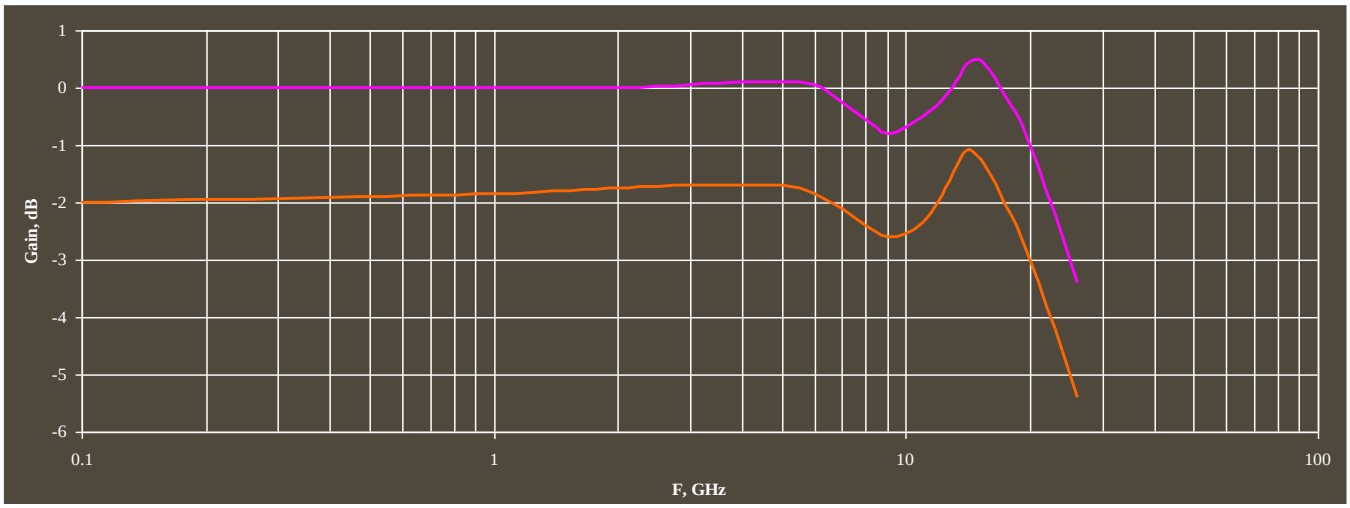

Fig. 4. THA Gain at Max and Min gaincrl Values vs. Data Frequency

The harmonic distortion of the THA has been demonstrated by 3rd harmonic as shown in Fig. 5 for differential clock and data input signals at the sampling rate of 4*GSps*. The data amplitude is 125*mV* differential or 125*mV* pk-pk at both direct and inverted pins.

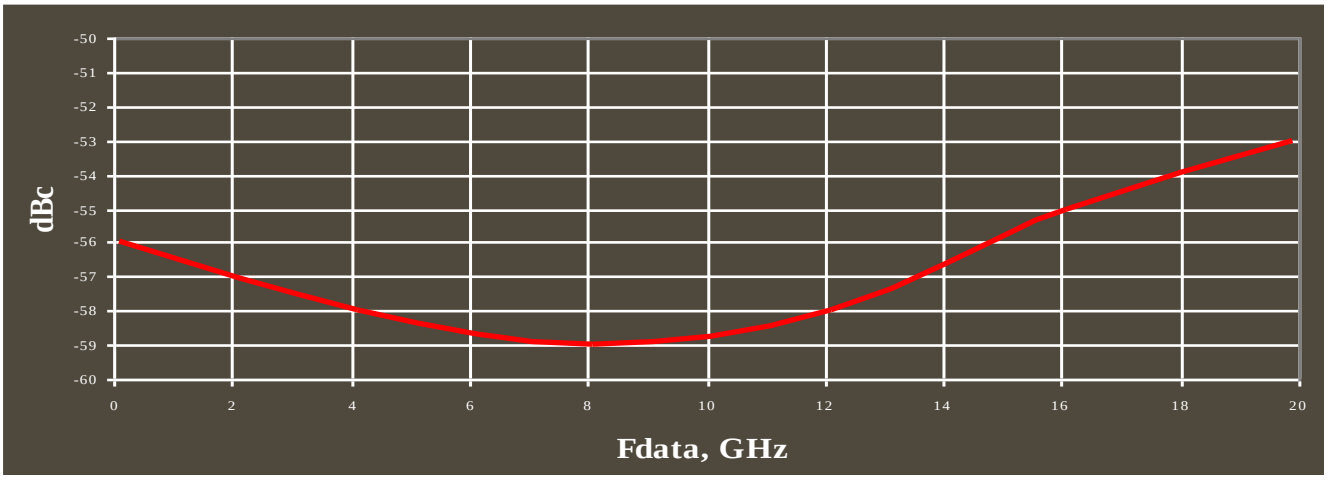

Fig. 5. 3-rd Harmonic at 4GHz Input Clock (C) and 125mV Differential Data (D) Amplitude

The linearity of the signal conversion is illustrated by Fig. 6 that demonstrates the part's gain at 2.5*GSps*.

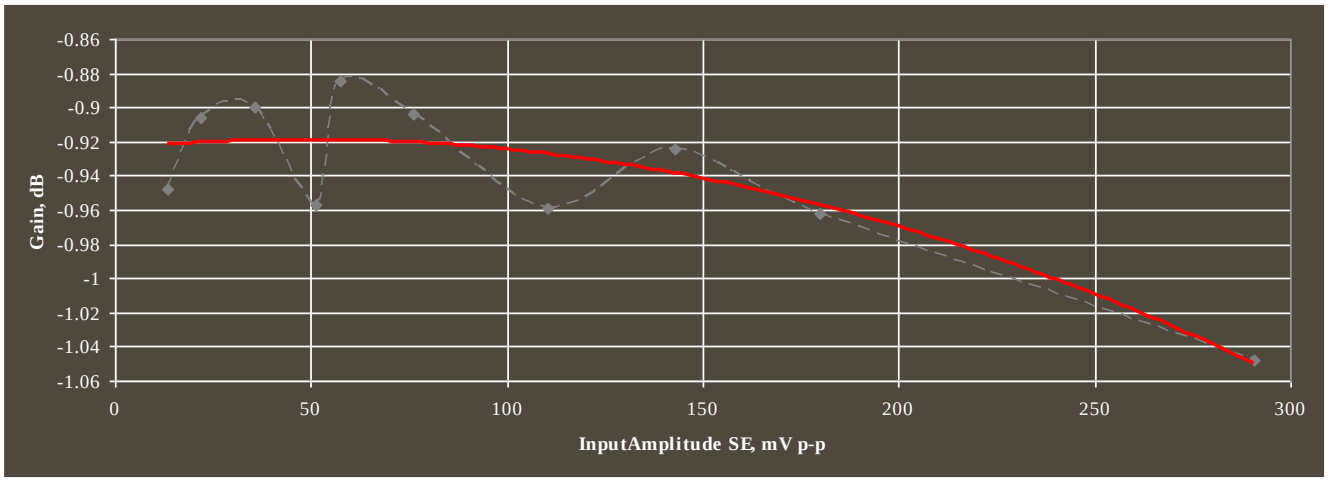

Fig. 6. THA Gain vs. Input Data Amplitude at Medium State of gaincrl

POWER SUPPLY CONFIGURATION

The part operates with either a negative supply scheme (vcc = 0.0*V* = ground) or a positive supply scheme (vee = 0*V* = ground). In case of the positive supply, all I/Os need AC termination when connected to any devices with 50*Ohm* termination to ground. Different PCB layouts will be needed for each different power supply combination.

All the characteristics detailed below assume the negative supply scheme.

ABSOLUTE MAXIMUM RATINGS

Caution: Exceeding the absolute maximum ratings shown in Table 1 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 (assumed vcc).

Table 1. Absolute Maximum Ratings

Parameter	Min	Max	Units
First Supply Voltage (vee)	-3.5 (negative scheme)	0 (positive scheme)	*V*
Second Supply Voltage (vcc)	0 (negative scheme)	3.5 (positive scheme)	*V*
Third Supply Voltage (vp0p9)		vcc+1.1	*V*
Power Consumption		2	*W*
RF Input Voltage Swing (Diff)		2.0	*V* pk-pk
Clock Input Voltage Swing (Diff)		1.0	*V* pk-pk
Case Temperature		+90	*ºC*
Storage Temperature	-40	+100	*ºC*
Operational and storage Humidity	10	98	*%*

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TERMINAL FUNCTIONS

TERMINAL			DESCRIPTION
Name	**No.**	**Type**	
High-Speed I/Os			
cp	8	CML input	Sampling clock inputs with internal SE 50*Ohm* termination to vcc
cn	10		
dp	39	Analog input	Analog sampled data inputs with internal SE 50*Ohm* termination to vcc
dn	41		
qn	17	CML output	Differential data outputs with internal SE 50*Ohm* termination to vcc. Require external SE 50*Ohm* termination to vcc
qp	19		
Controls			
t1crl	6	Analog voltage	Sampling clock duty cycle control
t2crl	4	Analog voltage	Sampling clock delay control
gaincrl	26	Analog voltage	Gain adjustment
varcrl	30	Analog voltage	Equalizer peaking control
ivc	15	Analog voltage	Delay range control
rfp_sv2	28	Analog voltage	Special test pins. **Leave not connected!**
rfp_ob	32	Analog voltage	

Supply and Termination Voltages		
Name	**Description**	**Pin Number**
vcc	1st positive supply voltage	1, 3, 5, 7, 9, 11, 12, 14, 16, 18, 20, 22, 23, 25, 27, 29, 31, 33, 34, 36, 38, 40, 42, 44
vee	Negative power supply	2, 13, 24, 35
vp0p9	2nd positive power supply	37, 43
vccob	Output buffer power supply	21

Please note that pins 28 and 32 should be always left not-connected! Termination of those pins may result in mal-function or damage of the part.

ELECTRICAL CHARACTERISTICS

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
General Parameters					
vee	-3.3 / 0	-3.2 / 0	-3.1 / 0	*V*	Negative scheme / Positive scheme
vcc	0 / 3.1	0 / 3.2	0 / 3.3	*V*	Negative scheme / Positive scheme
vp0p9	0.75	0.85	0.95		Above vcc, any scheme
vccob	vcc-0.3	vcc	vcc+0.3	*V*	Output buffer's power supply
*I*vcc		430		*mA*	*I*vee = *I*vcc + *I*vp0p9
*I*vp0p9		100		*mA*	
Power consumption		1750		*mW*	
Junction temperature	-25	50	125	*°C*	

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PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Input Data (dp/dn)					
Input data frequency	0.0		20	*GHz*	
Swing, differential, p-p	0		300	*mV*	3rd HD<-52*dBc* in full data bandwidth
	0		400	*mV*	3rd HD <-48*dBc* in full data bandwidth
	0		500	*mV*	3rd HD <-45*dBc* in full data bandwidth
CM Voltage Level		vcc		*V*	For DC coupling
S11		-10		*dB*	DC to 20*GHz*
Input Clock (cp/cn)					
Frequency	0.05		4.0	*GHz*	
Swing	80		240	*mV*	SE or differential, p-p
CM Voltage Level		vcc		*V*	
Jitter			50	*fs*	p-p
Duty cycle	48	50	52	*%*	
Duty Cycle Control Voltage (t1crl)					
Voltage range	vcc – 1.4		vcc	*V*	
Adjustment range		50		*ps*	For the delay of s1 vs. s2
Delay Control Voltage (t2crl)					
Voltage range	vcc – 1.4		vcc	*V*	
Adjustment range		20		*ps*	For the pulse width of s1 and s2
Delay Range Control Voltage (ivc)					
Voltage range	vcc – 2.1		vcc – 1.6	*V*	
Gain Control Voltage (gaincrl)					
Voltage range	vcc – 1.8		vcc	*V*	
Equalizer Control Voltage (varcrl)					
Voltage range	vcc – 1.8		vcc	*V*	
Additional peaking		1.5		*dB*	At 20*GHz* and nominal conditions
Output Signal Common Mode Control (vccob)					
CM Level		vccob-0.4		*V*	
Input Data Common Mode Control (vp0p9)					
Voltage Range	vcc + 0.7		vcc + 0.9	*V*	
HS Output Data (qp/qn)					
Voltage Range	vcc – 0.5		vcc + 0.8	*V*	
3rd HD					See Fig. 5.
Noise		15		$nV/Hz^{1/2}$	At 2.5*GSps* within full data bandwidth
Track period length			250	*ps*	At 2.5*GSps*. Adjustable by t1crl signal.
Total DC gain	-2.1		0.1	*dB*	Adjustable by gaincrl signal.
S22		-20		*dB*	DC to 4*GHz*

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PACKAGE INFORMATION

The chip die is housed in a custom 44-pin CQFP package shown in Fig. 7. The package provides a center heat slug located on its back side to be used for heat dissipation. ADSANTEC recommends for this section to be soldered to the vcc plain, which is ground for a negative supply, or power for a positive supply.

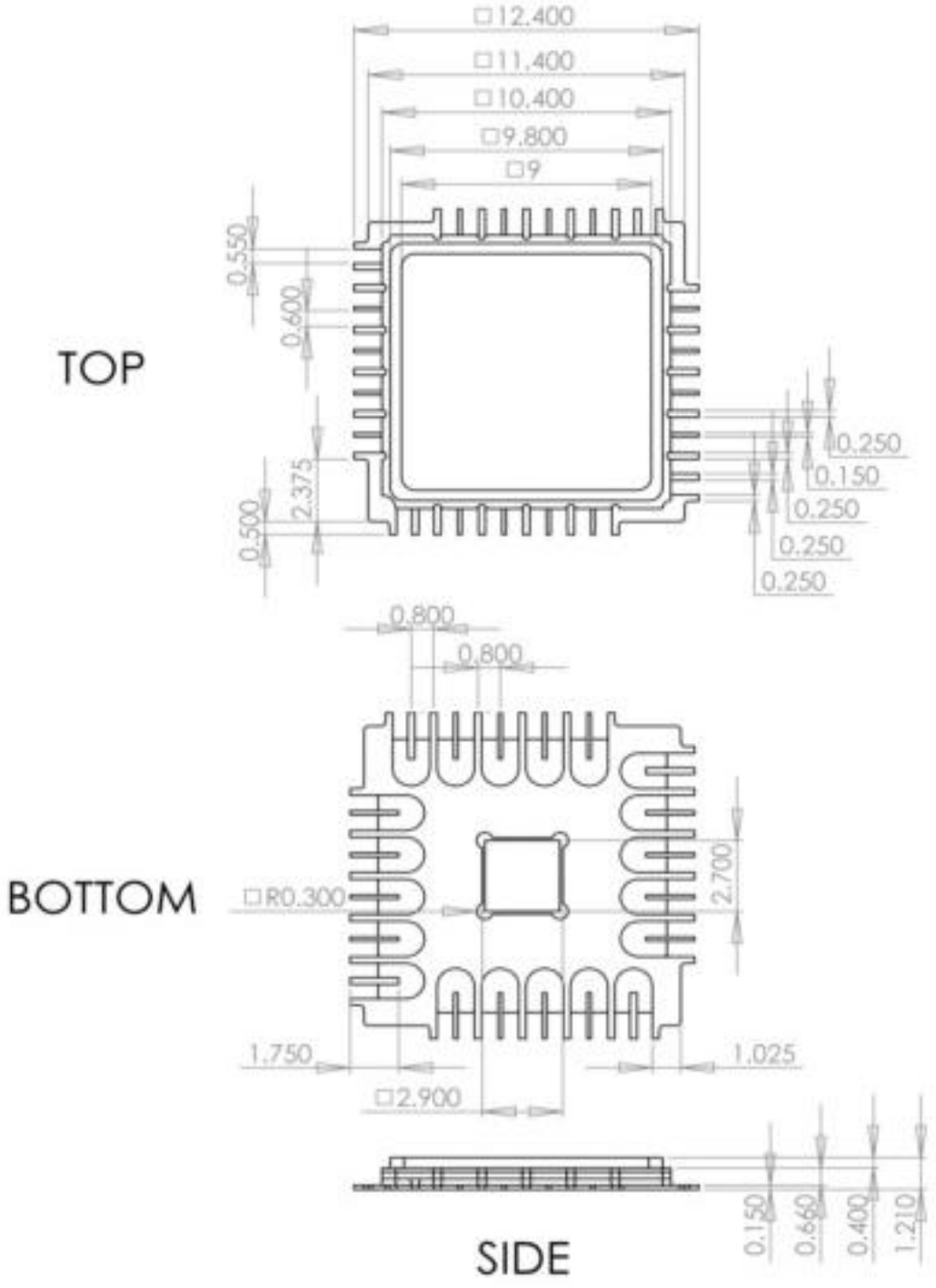

Fig. 7. CQFP 44-Pin Package Drawing (All Dimensions in mm)

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The part's identification label is ASNT7113A-KMM. The first 9 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 Commission Delegated Directive (EU) 2015/863 of 4 June 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances (Text with EEA relevance) on the restriction of the use of certain hazardous substances in electrical and electronics equipment (RoHS Directive) in accordance with the definitions set forth in the directives for all ten substances.

REVISION HISTORY

Revision	Date	Changes
1.2.2	11-2022	Changed definition of vccob Updated Package Information
1.1.2	02-2020	Updated Package Information
1.0.2	11-2019	Updated Letterhead Corrected absolute Maximum supply values Corrected vcc supply values
0.0.1	04-2013	Preliminary release.