ARA2008

Reverse Amplifier with Step Attenuator

ADVANCED PRODUCT INFORMATION - Rev 0.0

FEATURES

- Low cost integrated amplifier with step attenuator
- Attenuation Range: 0-58 dB, adjustable in 1dB increments via a 3 wire serial control
- Meets DOCSIS distortion requirements at +60dBmV output signal level
- Low distortion and low noise
- Frequency range: 5-100MHz
- 5 Volt operation
- -40 to +85 ^{0}C temperature range

20 Pin SSOP Package

APPLICATIONS

- MCNS/DOCSIS Compliant Cable Modems
- CATV Interactive Set-Top Box
- Telephony over Cable Systems
- OpenCable Set-Top Box
- Residential Gateway

PRODUCT DESCRIPTION

The ARA2008 is designed to provide the reverse path amplification and output level control functions in a CATV Set-Top Box or Cable Modem. It incorporates a digitally controlled precision step attenuator that is preceded by an ultra low noise amplifier stage, and followed by an ultra-linear output driver amplifier. This device uses a balanced circuit design that exceeds the MCNS/DOCSIS requirement for harmonic performance at a +60dBmV output level while only requiring a single polarity +5V supply. Both the input and output are matched to 75 ohms with an appropriate transformer. The precision attenuator provides up to 58 dB of attenuation in 1 dB increments via a three-wire serial interface. With external passive components, this device meets IEC 1000-4-12 and ANSI/IEEE C62.41-1991 100KHz ringwave tests, as well as IEC1000-4-5 1.2/50μS surge tests. The ARA2008 is offered in a 20-pin SSOP package.

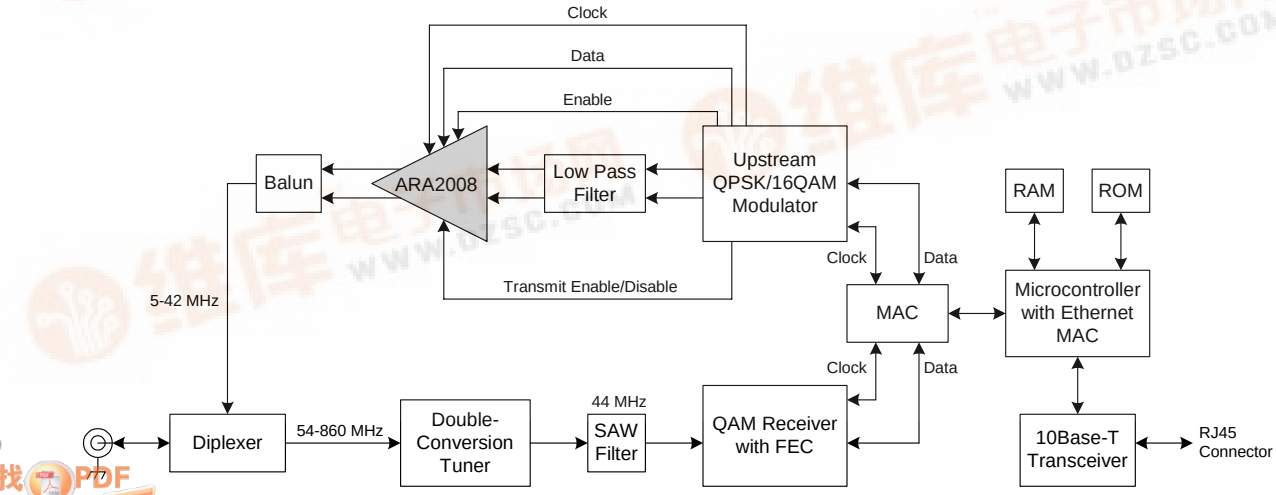

Figure 1. Cable Modem or Set Top Box Application Diagram

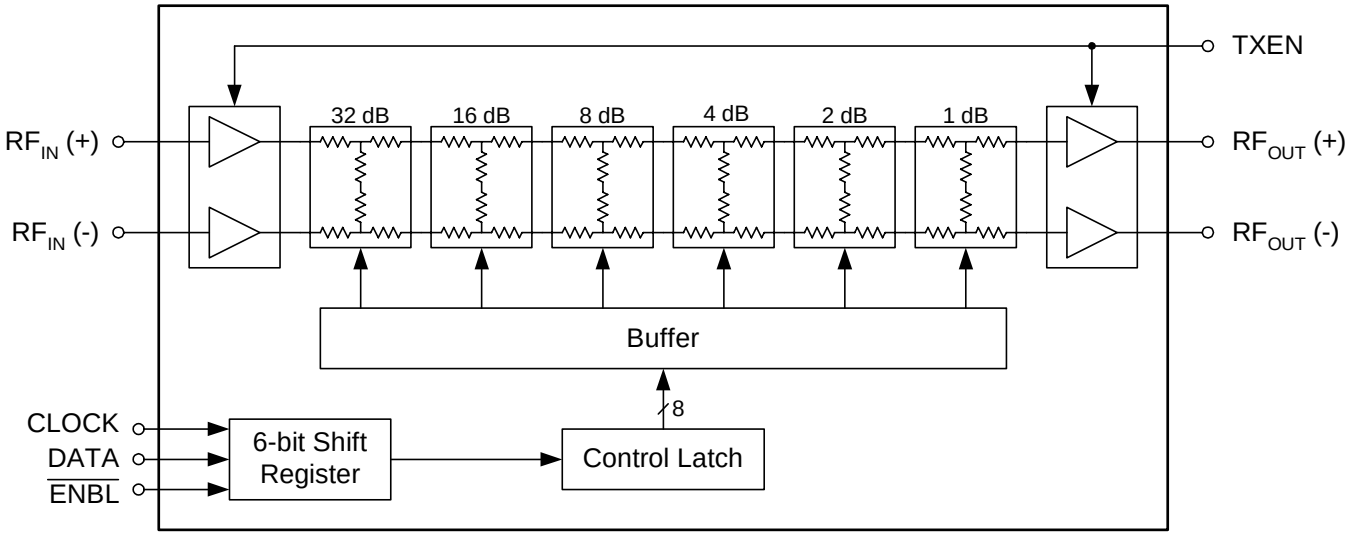

Figure 2: Functional Block Diagram

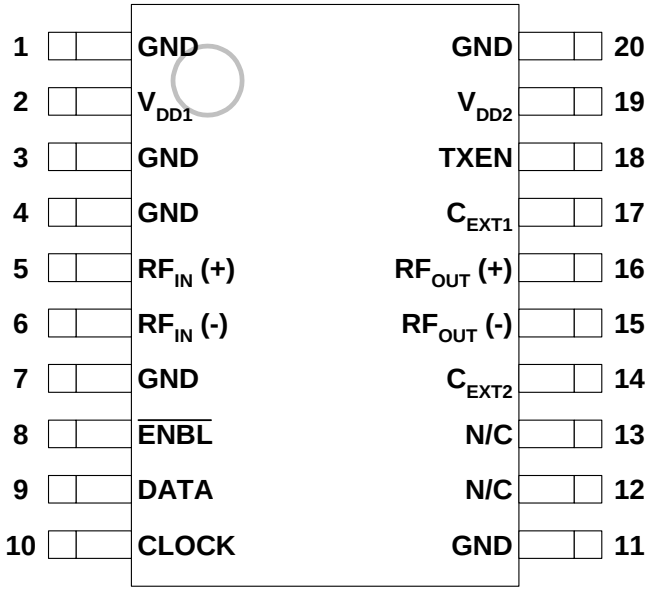

Figure 3: Pin Out - SSOP Package

Table 1: Pin Description - SSOP Package

PIN	NAME	DESCRIPTION	PIN	NAME	DESCRIPTION
1	GND	Ground	11	GND	Ground
2	V_{DD1}	Supply	12	N/C	No connection
3	GND	Ground	13	N/C	No connection
4	GND	Ground	14	C_{EXT2}	External Capacitor
5	RF_{IN} (+)	RF (+) Input	15	RF_{OUT} (-)	RF (-) Output
6	RF_{IN} (-)	RF (-) Input	16	RF_{OUT} (+)	RF (+) Output
7	GND	Ground	17	C_{EXT1}	External Capacitor
8	$\overline{ENBL}$	Enable	18	TXEN	Transmit Enable
9	DATA	Data	19	V_{DD2}	Supply
10	CLOCK	Clock	20	GND	Ground

ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT
Supply: V_{DD} (pins 2, 15, 16, 19)	0	9	VDC
RF Power at Inputs (pins 5, 6)	-	+60	dBmV
Digital Interface (pins 8, 9, 10)	-0.5	V_{DD}+0.5	V
Storage Temperature	-55	+200	^{0}C
Soldering Temperature	-	260	^{0}C
Soldering Time	-	5	Sec

Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability.

Table 3: Operating Ranges

PARAMETER	MIN	TYP	MAX	UNIT
Supply: V_{DD} (pins 2, 15, 16, 19)	4.5	5	7	VDC
Digital Interface (pins 8, 9, 10)	0	-	V_{DD}	V
Case Temperature	-40	25	85	^{0}C

The device may be operated safely over these conditions; however, parametric performance is guaranteed only over the conditions defined in the electrical specifications.

Table 4: DC Electrical Specifications
T_A=25°C; V_{DD} = +5.0 VDC

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Total Supply Current (pins 2, 15, 16, 19)	- -	135 15	- -	mA	Tx enabled (TXEN high) Tx disabled (TXEN low)
Total Power Consumption	- -	675 75	- -	mW	Tx enabled (TXEN high) Tx disabled (TXEN low)

Table 5: Digital Interface Specifications
T_A=25°C; V_{DD} = +5.0 VDC

PARAMETER	MIN	TYP	MAX	UNIT
Logic High Input Voltage: $V_{IN,HIGH}$	2.0	-	V_{DD}	V
Logic Low Input Voltage: $V_{IN,LOW}$	0	-	0.8	V

Table 6: AC Electrical Specifications
T_A=25°C; V_{DD} = +5.0 VDC

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Gain (10 MHz)	-	29	-	dB	0 dB attenuation setting
Gain Flatness	-	1.5	-	dB	5 to 65 MHz
Gain Variation over Temperature	-	-0.006	-	dB/°C	
Attenuation Step Size	-	1	-	dB	Monotonic
Maximum Attenuation	58	-	-	dB	
2nd Harmonic Distortion Level (10 MHz)	-	-	-53	dBc	+60 dBmV into 75 Ohms
3rd Harmonic Distortion Level (10 MHz)	-	-	-53	dBc	+60 dBmV into 75 Ohms
3rd Order Output Intercept	78	-	-	dBmV	
1 dB Gain Compression Point	-	68.5	-	dBmV	
Noise Figure	-	3.0	-	dB	Includes input balun loss
Output Noise Power Active / No Signal / Min. Atten. Set. Active / No Signal / Max. Atten. Set.	 - -	 - -	 -38.5 -53.8	dBmV	Any 160 kHz bandwidth from 5 to 42 MHz
Isolation (45 MHz) in Tx disable mode	-	60	-	dB	
Differential Input Impedance (Tx enabled)	-	300	-	Ohms	
Input Impedance (Tx enabled)	-	75	-	Ohms	with transformer
Input Return Loss (75 Ohms)	-	-15	-	dB	
Differential Output Impedance	-	300	-	Ohms	
Output Impedance	-	75	-	Ohms	with transformer
Output Return Loss (75 Ohms)	-	-15	-	dB	
Output Voltage Transient Tx enable / Tx disable	- -	- 4	100 7	mVp-p	0 dB attenuator setting 24 dB attenuator setting

LOGIC PROGRAMMING

Programming Instructions

The programming word is set through a 6 bit shift register via the data, clock and enable lines. The data is entered in order with the most significant bit (MSB) first and the least significant bit (LSB) last. The enable line must be low for the duration of the data entry, then set high to latch the shift register. The rising edge of the clock pulse shifts each data value into the register.

Table 7: Programming Word

DATA BIT	D_5	D_4	D_3	D_2	D_1	D_0
Value	P5	P4	P3	P2	P1	P0

Table 8: Data Description

VALUE	FUNCTION (0 = on, 1 = bypass)
P5	32 dB Attenuator Bit
P4	16 dB Attenuator Bit
P3	8 dB Attenuator Bit
P2	4 dB Attenuator Bit
P1	2 dB Attenuator Bit
P0	1 dB Attenuator Bit

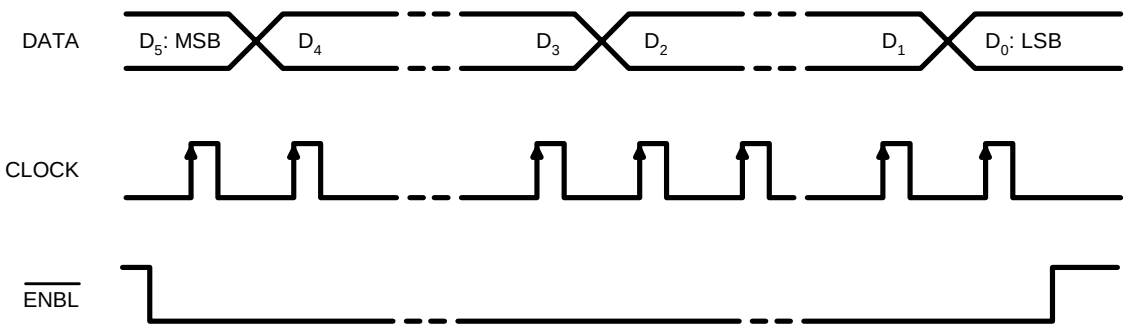

Figure 4: Serial Data Input Timing

APPLICATION INFORMATION

Output Transformer

Matching the output of the ARA2008 to a 75 Ohm load is accomplished using a 2:1 turns ratio transformer. In addition to providing an impedance transformation, this transformer provides the bias to the output amplifier stage via the center tap.

The transformer also cancels even mode distortion products and common mode signals, such as the voltage transients that occur while enabling and disabling the amplifiers. As a result, care must be taken when selecting the transformer to be used at the output. It must be capable of handling the RF and DC power requirements without saturating the core, and it must have adequate isolation and good phase and amplitude balance. It also must operate over the desired frequency and temperature range for the intended application.

ESD Sensitivity

Electrostatic discharges can cause permanent damage to this device. Electrostatic charges accumulate on test equipment and the human body, and can discharge without detection. Although the ARA2008 has some built-in ESD protection, proper precautions and handling are strongly recommended. Refer to the ANADIGICS application note on ESD precautions.

ANADIGICS, Inc.
141 Mount Bethel Road
Warren, New Jersey 07059, U.S.A.
Tel: +1 (908) 668-5000
Fax: +1 (908) 668-5132

URL: http://www.anadigics.com
E-mail: Mktg@anadigics.com