

### FEATURES

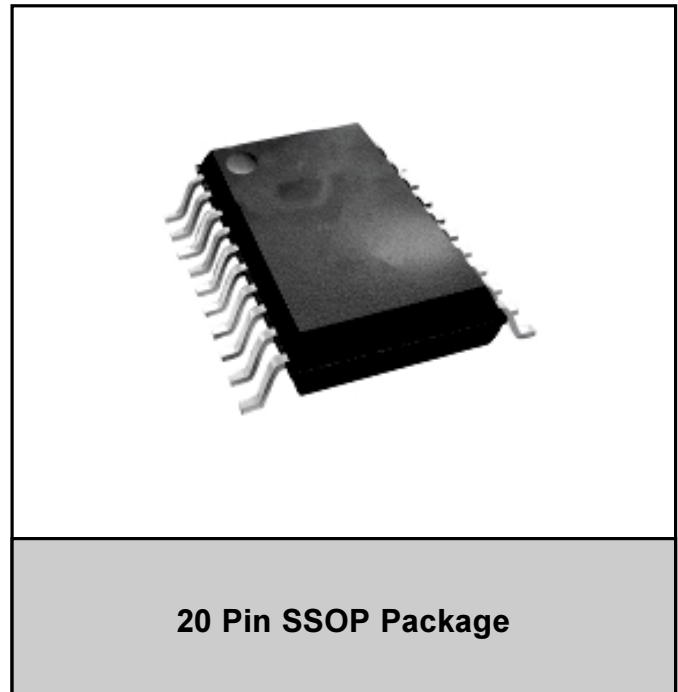
- Low cost integrated amplifier with step attenuator
- Attenuation Range: 0-58 dB, adjustable in 1dB increments via a 3 wire serial control
- Meets DOCSIS distortion requirements at +60dBmV output signal level
- Low distortion and low noise
- Frequency range: 5-100MHz
- 5 Volt operation
- -40 to +85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

### 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.

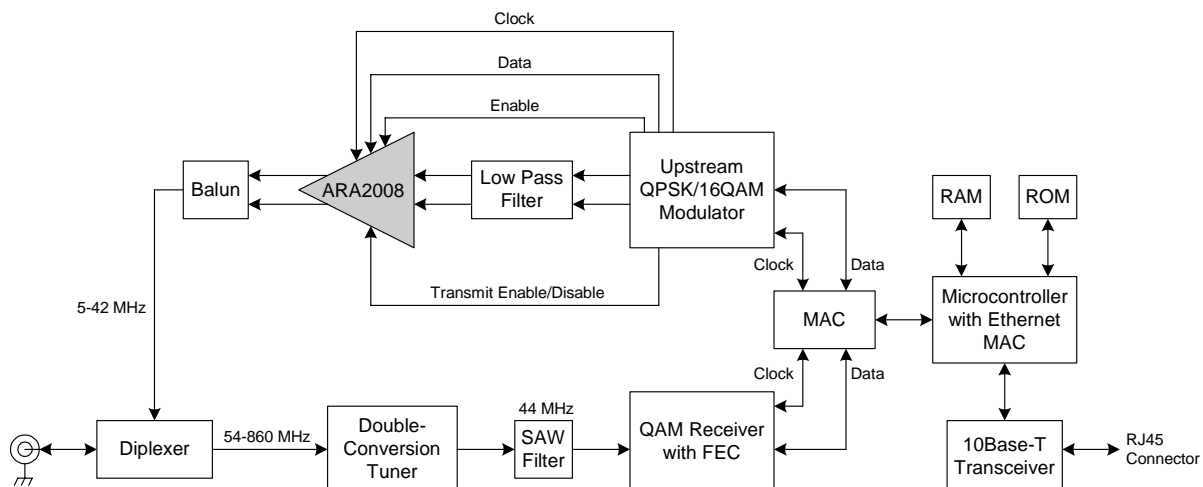


Figure 1. Cable Modem or Set Top Box Application Diagram

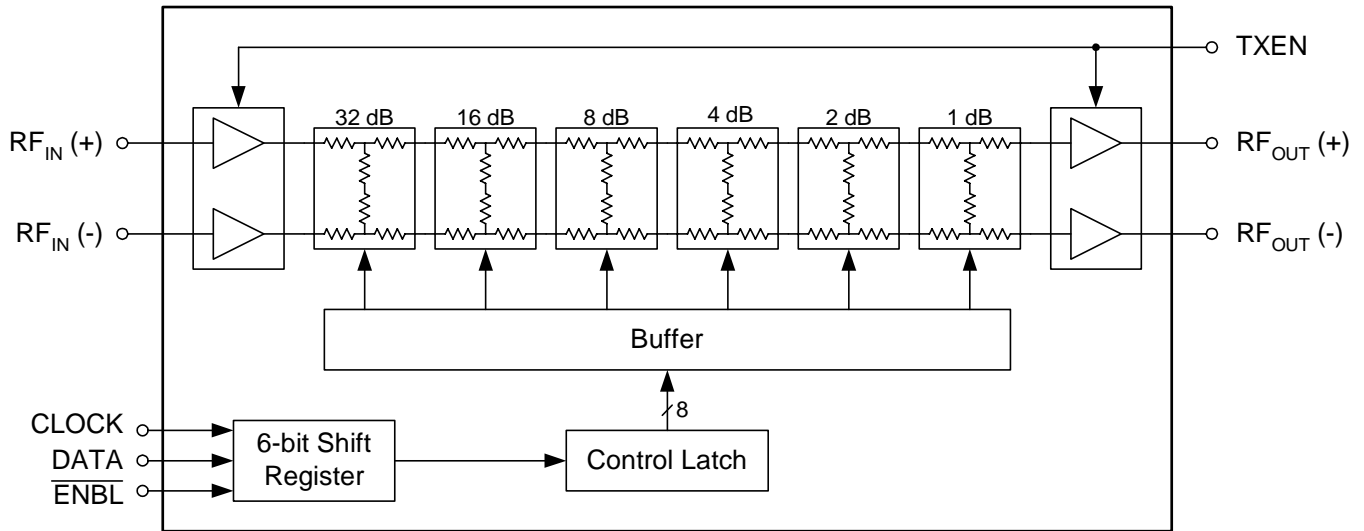


Figure 2: Functional Block Diagram

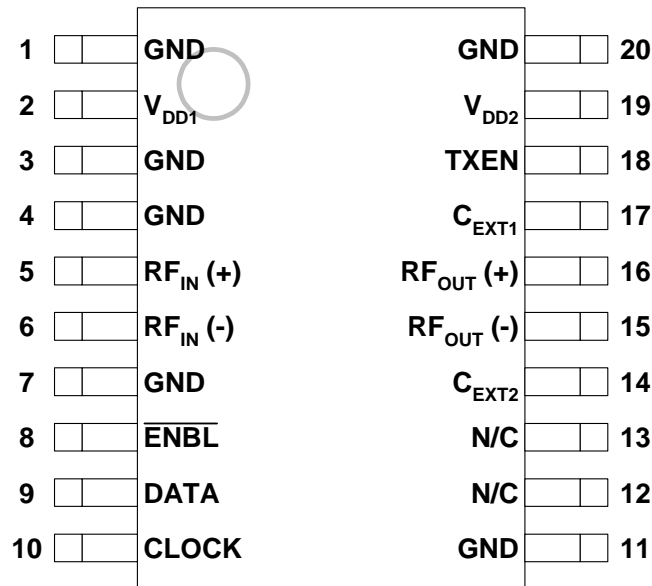


Figure 3: Pin Out - SSOP Package

Table 1: Pin Description - SSOP Package

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

## ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT
Supply: V <sub>DD</sub> (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 <sub>DD</sub> +0.5	V
Storage Temperature	-55	+200	°C
Soldering Temperature	-	260	°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 <sub>DD</sub> (pins 2, 15, 16, 19)	4.5	5	7	VDC
Digital Interface (pins 8, 9, 10)	0	-	V <sub>DD</sub>	V
Case Temperature	-40	25	85	°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<sub>A</sub>=25°C; V<sub>DD</sub> = +5.0 VDC

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

Table 5: Digital Interface Specifications

T<sub>A</sub>=25°C; V<sub>DD</sub> = +5.0 VDC

PARAMETER	MIN	TYP	MAX	UNIT
Logic High Input Voltage: V <sub>IN,HIGH</sub>	2.0	-	V <sub>DD</sub>	V
Logic Low Input Voltage: V <sub>IN,LOW</sub>	0	-	0.8	V

**Table 6: AC Electrical Specifications**  
**T<sub>A</sub>=25°C; V<sub>DD</sub> = +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	
2 <sup>nd</sup> Harmonic Distortion Level (10 MHz)	-	-	-53	dBc	+60 dBmV into 75 Ohms
3 <sup>rd</sup> Harmonic Distortion Level (10 MHz)	-	-	-53	dBc	+60 dBmV into 75 Ohms
3 <sup>rd</sup> 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.

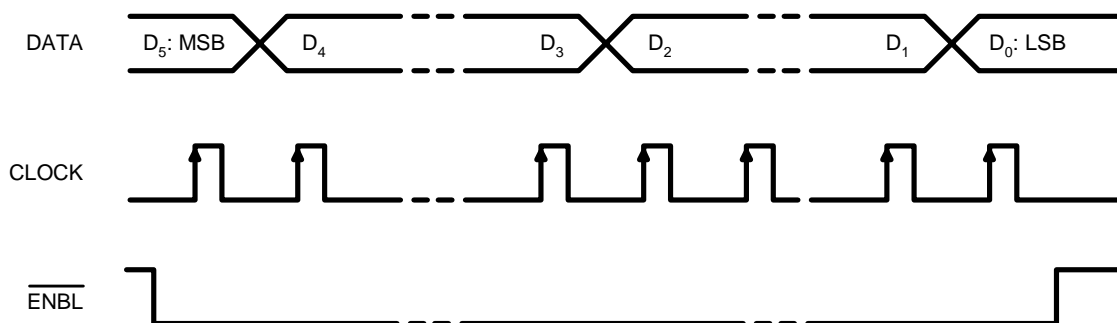
The enable line must be low for the duration of the data entry, then set high to latch the shift register. The rising edge of the clock pulse shifts each data value into the register.

**Table 7: Programming Word**

DATA BIT	D <sub>5</sub>	D <sub>4</sub>	D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>
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](mailto:Mktg@anadigics.com)

**IMPORTANT NOTICE**

ANADIGICS, Inc. reserves the right to make changes to its products or to discontinue any product at any time without notice. The product specifications contained in Advanced Product Information sheets and Preliminary Data Sheets are subject to change prior to a product's formal introduction. Information in Data Sheets have been carefully checked and are assumed to be reliable; however, ANADIGICS assumes no responsibilities for inaccuracies. ANADIGICS strongly urges customers to verify that the information they are using is current before placing orders.

**WARNING**

ANADIGICS products are not intended for use in life support appliances, devices or systems. Use of an ANADIGICS product in any such application without written consent is prohibited.