



# ARA1400S12

## CATV Reverse Amplifier with Step Attenuator Advanced Product Information

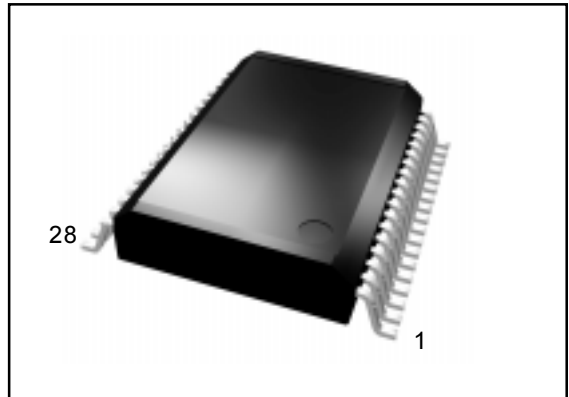
Rev. 2

### FEATURES

- Low cost integrated monolithic GaAs amplifier and step attenuator with output disconnect switch.
- Meets DOCSIS distortion requirements at +60 dBmV
- Frequency range: 5 – 100 MHz
- Attenuation Range: 0 – 56 dB, variable in 4 dB steps
- 5 Volt operation
- Low distortion & Low noise figure

### APPLICATIONS

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



**S12**  
**28 PIN SSOP PACKAGE**

### DESCRIPTION

The ARA1400S12 is a GaAs IC designed to perform 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. It is capable of meeting the MCNS/DOCSIS harmonic distortion specifications while only requiring

a single polarity +5V supply. This part is a single ended design that does not require an output balun to achieve  $-52$  dBc 2<sup>nd</sup> harmonic performance at +60 dBmV output levels. Both the input and output are matched to 75 ohms. The precision attenuator provides up to 56 dB of attenuation in 4 dB increments. The ARA1400S12 is supplied in a 28-pin SSOP package featuring a thermal heat slug on the bottom of package. Soldering this heat slug to the ground plane of the PC board ensures the lowest possible thermal resistance for the device resulting in a long MTF.

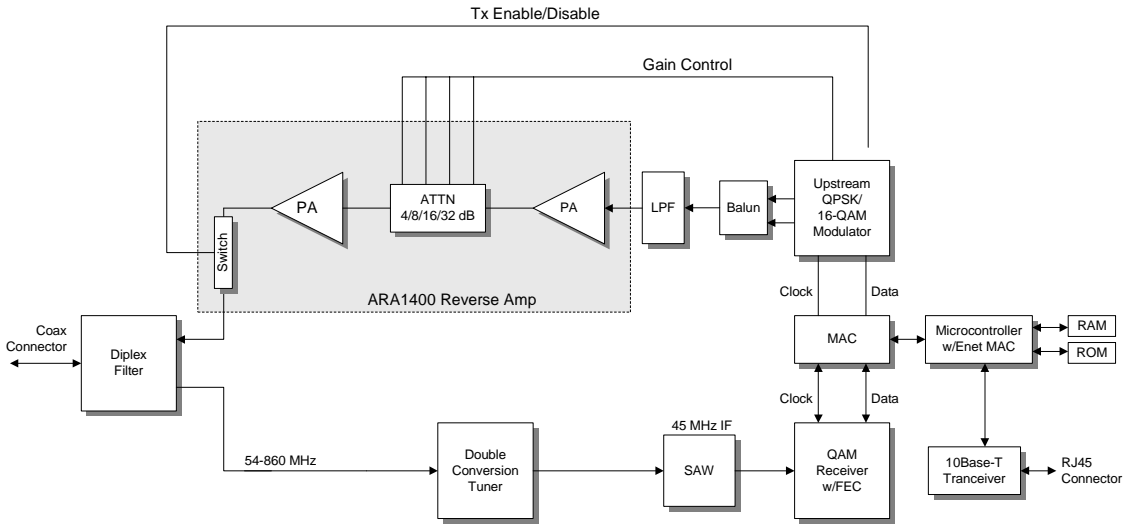
### ABSOLUTE MAXIMUM RATINGS

PARAMETER	PARAMETER	
V <sub>DD</sub> (PINS 4,12,17)	9	VDC
V <sub>RFIN</sub> (PINS 10, 26)	0 to -3	VDC
ATT <sub>IN</sub> (3) ATT <sub>OUT</sub> (28)V	5	VDC
V <sub>ISSET</sub> (PINS 11, 27)	2	VDC
RF Input Voltage (PINS 10, 26)*	+ 60	dBmV
Storage Temperature	- 55 to +200	°C
Soldering Temperature	260	°C
Soldering Time	5	Sec
Operating Case Temperature	0 to + 85	°C

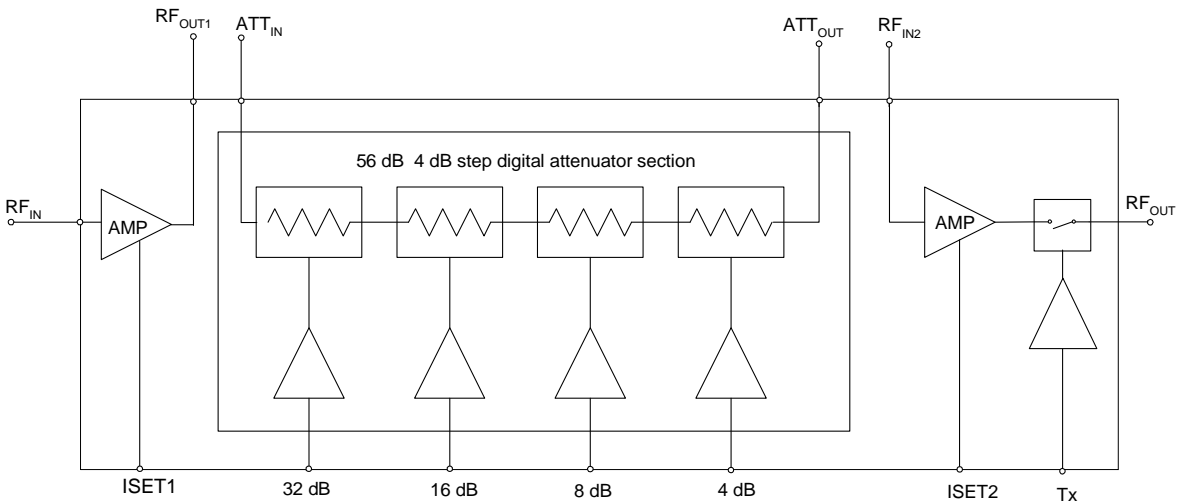
<b>ELECTRICAL CHARACTERISTICS (TYPICAL) (<math>V_{DD}=5V_{DC}</math>, <math>T_C=25^\circ C</math>)</b>						
PARAMETER		MIN	TYP	MAX	UNIT	COMMENTS
Gain <sup>1</sup>		30	32	33	dB	At 0dB attenuation setting
Gain Flatness <sup>1</sup>		-	0.75	-	dB	5 to 100 MHz
Gain Variation Over Temp		-	-0.006	-	dB/°c	
Attenuation Steps <sup>1</sup>	4 dB 8 dB 16 dB 32 dB	3.6 7.7 15.3 31.0	3.9 8.0 15.7 31.5	4.2 8.3 16.1 32.0	dB	
2 <sup>nd</sup> Harmonic Distortion Level <sup>2</sup>	10 MHz	-	-57	-52	dBc	at +60 dBmV
3 <sup>rd</sup> Harmonic Distortion Level <sup>2</sup>	10 MHz	-	-64	-56	dBc	at +60 dBmV
3 <sup>rd</sup> Order Output Intercept Point		78	-	-	dBmV	
1 dB Gain Compression Point			70	-	dBmV	
Noise Figure		-	1.7	2.5	dB	
Output Noise Power	Active/No Signal/Min Attn. Setting Active/No Signal/Max Attn. Setting	- -	- -	-24.6 -41.6	dBmV	Any 3200 KHz bandwidth from 5-42 MHz
Switch Isolation at 45 MHz		-	35	30	dB	Difference in output signal level between active and standby
Input Impedance <sup>1</sup>		-	75	-	ohm	
Input Return Loss <sup>1</sup>		-	-20	-15	dB	
Output Impedance <sup>1</sup>		-	75	-	ohm	
Output Return Loss <sup>1</sup>		-	-20	-15	dB	Tx enabled
Output Return Loss <sup>1</sup>		-	-12	-10	dB	Tx disabled
Output Switch Control Logic	V <sub>L</sub> V <sub>H</sub>	0 2.8	- -	1 V <sub>DD</sub>	V V	(OPEN) (CLOSED)
Output Switch Control Impedance		-	10K	-	ohm	
V <sub>DD1</sub> , V <sub>DD2</sub>		-	5	7	V	
V <sub>DD</sub> Digital		-	5	-	V	
V Shutdown		-1.5	-	-2	V	
I <sub>DD1</sub>		-	74	95	mA	
I <sub>DD2</sub>		-	108	130	mA	
I <sub>DD</sub> Digital		-	12	20	mA	
Power Consumption		-	0.97	1.23	W	
Attenuator Control Logic <sup>4</sup>	V <sub>L</sub> V <sub>H</sub>	0 2.7	- -	0.5 6.5	Volts	Attn. Disabled Attn. Enabled
Attenuator Control Impedance		-	5 K	-	ohm	

Notes:

1. As measured in ANADIGICS test fixture
2. At +60 dBmV output level into 75 ohm load

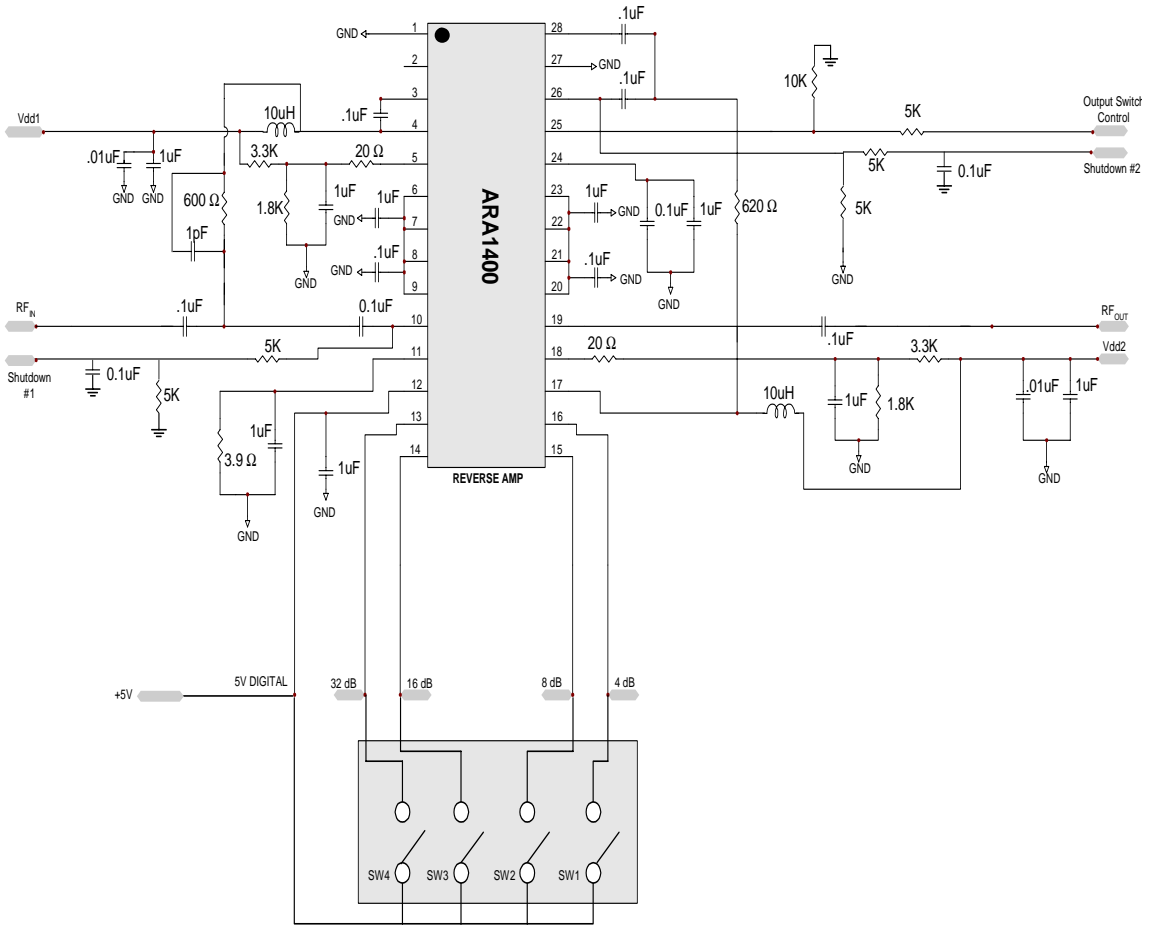


**Figure 1: Cable Modem or Interactive Set-Top Box Block Diagram**



**Figure 2**

**TEST CIRCUIT**

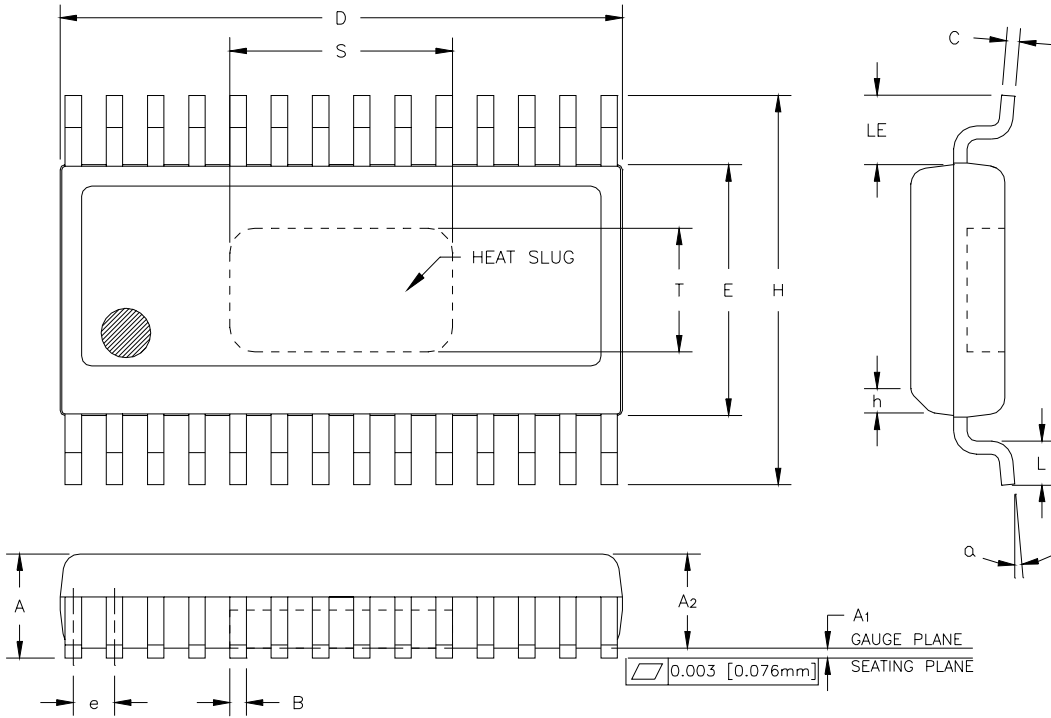


**DIP SWITCH LOGIC TABLE**

Attn (dB)	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
SW 1	X	O	X	O	X	O	X	O	X	O	X	O	X	O	X
SW 2	O	X	X	O	O	X	X	O	O	X	X	O	O	X	X
SW 3	O	O	O	X	X	X	X	O	O	O	O	X	X	X	X
SW 4	O	O	O	O	O	O	O	X	X	X	X	X	X	X	X

O = Open (0 Vdc)  
 X = Closed (+5 Vdc)

**PACKAGE DIAGRAM**



SYMBOL	INCHES		MILLIMETERS		NOTE
	MIN.	MAX.	MIN.	MAX.	
A	0.058	0.068	1.47	1.73	
A1	0.000	0.004	0.00	0.10	
A2	0.054	0.060	1.37	1.52	
B	0.008	0.012	0.20	0.31	
C	0.007	0.009	0.18	0.23	5
D	0.385	0.393	9.78	9.98	2
E	0.151	0.157	3.84	3.99	3
e	0.025	BSC	0.64	BSC	4
H	0.228	0.244	5.79	6.20	
h	0.015x45°		0.38x45°		
L	0.016	0.032	0.41	0.81	
LE	0.042	—	1.07	—	
α	0°	8°	0°	8°	
S	0.105	0.135	2.67	3.43	6
T	0.045	0.075	1.41	1.91	6

**NOTES:**

1. CONTROLLING DIMENSION: INCHES
2. DIMENSION "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 0.006 [0.15mm] PER SIDE.
3. DIMENSION "E" DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED 0.010 [0.25mm] PER SIDE.
4. MAXIMUM LEAD TWIST/SKEW TO BE 0.002 [0.05mm]
5. LEAD THICKNESS AFTER PLATING TO BE 0.012 [0.30mm] MAXIMUM.
6. DIMENSIONS "S" AND "T" INDICATE EXPOSED SLUG AREA.

PIN DESCRIPTION		
PIN	FUNCTION	DESCRIPTION
1	Dig GND	Digital Ground
2	NC	
3	$ATT_{IN}$	Attenuator Input
4	$RF_{OUT1} + V_{DD1}$	RF Output and +5v Supply for 1st Amplifier Stage
5	$V_{REF1}$	Reference voltage for 1st Amplifier
6,7,8,9	AC_GND1	AC Ground for 32 dB attenuator bit. These pins must be externally ac decoupled
10	$RF_{IN}$	RF Input to 1st Amplifier Stage & Shutdown pin for 1st Amplifier
11	$I_{SET1}$	Resistor Set Current for 1st Amplifier
12	5V digital	5 volts digital supply voltage
13	32 dB	32 dB Attenuator Control Parallel data input
14	16 dB	16 dB Attenuator Control Parallel data input
15	8 dB	8 dB Attenuator Control Parallel data input
16	4 dB	4 dB Attenuator Control Parallel data input
17	$V_{DD2}$	+5V Supply for 2nd Amplifier Stage
18	$R_{REF2}$	Reference voltage for 2nd Amplifier
19	$RF_{OUT}$	RF Output From Switch
20,21,22,23	AC_GND2	AC Ground for 4,8, 16 dB attenuator bits. These pins must be externally ac decoupled.
24	AC_GND3	AC Ground for output switch. These pins must be externally ac decoupled.
25	Tx	Output Switch Control
26	$RF_{IN2}$	RF Input to 2nd Amplifier Stage and Shutdown pin for 2nd Amplifier
27	$I_{SET2}$	Resistor set current for 2nd Amplifier (ground for max performance)
28	$ATT_{OUT}$	Attenuator Output

## NOTES



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