Review: The Ameritron ALS-1306 1200-Watt HF-6 Meter Solid-State Power Amplifier
Phil Salas – AD5X

Figure 1: The new ALS-1306 1200 watt solid-state amplifier

Introduction

The new Ameritron ALS-1306 is the next iteration of the 1200-watt ALS-1300 solid-state amplifier previously reviewed (see QST September 2011). Whereas the ALS-1300 covered 160-15 meters (12/10 meters required an optional filter), the ALS-1306 covers all ham bands from 160-6 meters (less 60 meters). And while the ALS-1300 required the Ameritron ARI-500 for transceiver auto band tracking, the ALS-1306 has auto band tracking built-in.

The ALS-1306 Amplifier

The ALS-1306 consists of a main amplifier RF deck, and a separate 50VDC/50 amp switching power supply. A pendant power supply cable permits RF and power supply separation up to 6-feet. Both units are reasonably compact and light-weight making this amplifier/power supply combo convenient for home-, portable- and DX-operations. The amplifier specifications and performance measurements are given in Table 1. All switching times, spurious and harmonic suppression, and intermodulation distortion tests were performed in the ARRL lab.

Table 1: Ameritron ALS-1306 Serial Number 00038

Manufacturer's Specifications	Measured Performance
Frequency coverage: 160-6 meters (less 60 meters)	As specified
Output Power: Typically 1200 Watts PEP	See Table 2
Driving Power: 100 watts maximum	50 to 80 Watts (typical). See Table 2
Output Power, 100% Duty Cycle:	See Text

Not specified.	
Input SWR: Less than 1.5:1	See Table 2
TR switching time: not specified.	Amplifier key to RF output: 12 ms; Amplifier un-key to RF power off: 29 ms.
T/R Relay Drive:12VDC, < 20ma, gnd to enable	13ma
Spurious and harmonic suppression: Not specified.	60 dB (typical), except 45 dB at 10.125 MHz (3rd harmonic). Meets FCC requirements.
Third order intermodulation distortion (IMD): Not specified.	14 MHz, 3rd/5th/7th/9th: 37/40/52/56 dB below PEP; 50 MHz, 3rd/5th/7th/9th: 26/39/46/52 dB below PEP.
Amplification inhibited 26-28 MHz	See text

Indicators: ALC, SWR, PA, TX and frequency band

Metering:

Current:	Simultaneous monitors individual 600-watt module current
Multi-Meter:	FWD/REF Power, PA Unbalance, ALC, HV1, HV2

Power Requirements: 240VAC/12 amps

Inrush Current Protection: Step-start

Dimensions (ALS-1306): 7.7"H x 10.7"W x 18.9"D

Dimensions (ALS-1306SPS): 7"H x 10.7"W x 14”D*

Weight, Amplifier Section: 23.5 pounds

Weight, Power Supply: 12 pounds

*Power cord is permanently attached to unit. Depth shown is with power cord bent reasonably.

The ALS-1306 power supply (Figures 2 and 3) consists of two identical 25-amp 50 volt switching power supplies mounted back to back. A single 4” fan cools the power supply.

Figure 2: Power Supply Front Panel

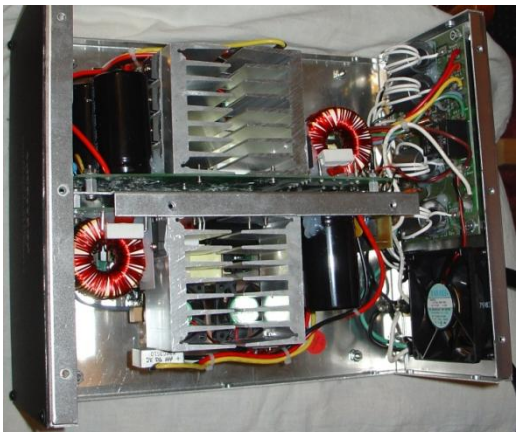

Figure 3: Power Supply Internal View

The ALS-1306 RF deck consists of two combined 600 watt amplifier modules, each with four MRF-150 FETs (eight MRF-150 FETs total). Four 3” temperature-controlled fans

cool the amplifier modules by drawing air through the heatsink fins. Figure 4 shows an edge view of the heatsink, and Figure 5 highlights the four cooling fans.

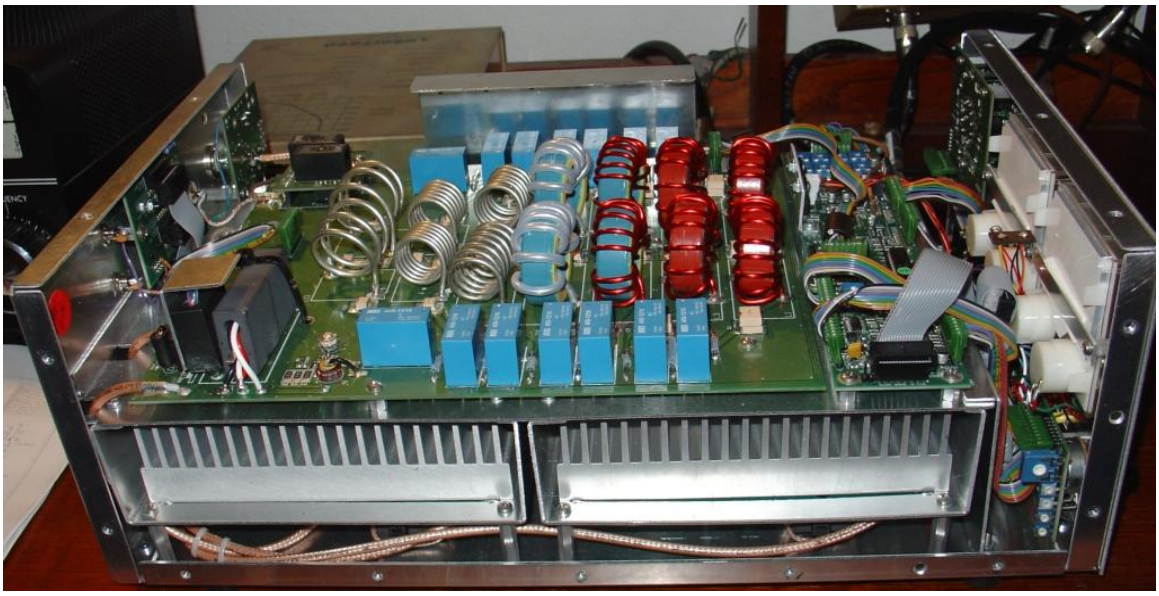

Figure 4: The two individual 600-watt amplifier heatsinks.

Figure 5: The ALS-1306 four 3" cooling fans.

The ALS-1306 includes effective protection circuitry. An on-board processor: monitors transmission between 26- and 28 MHz, high SWR, amplifier current mismatch, wrong filter selected, high PA heatsink temperature, and band set to remote but no remote band data is sensed. When the amplifier faults, it is automatically bypassed. Normal operation is restored by first clearing the fault and then switching from "Operate" to "Standby" and then back to "Operate".

Amplifier metering consists of two cross-needle LED back-lit meters. The left meter simultaneously monitors the FET drain currents of the two 600 watt amplifier modules. The right multi-meter monitors the following parameters:

REF: Amplifier forward and reflected power, and SWR
PAB: Power Amplifier Balance. A zero reading indicates perfect amplifier balance.
ALC: ALC activity between the amplifier and transceiver when ALC is used
HV1: Drain voltage applied to one of the two internal power amplifiers
HV2: Drain voltage applied to the second internal power amplifier

Back-lit frequency band indicators show the band selected, whether it is manually selected by the BAND switch or automatically selected by a connected transceiver. The ALC indicator flickers when ALC is active, and the TX indicator lights when the amplifier is keyed. Finally, the state of the SWR, PA and TX indicators (steady and blinking) provide detailed fault information as described in the ALS-1306 manual.

Amplifier Connections

Figure 6 shows the rear panel of the ALS-1306. The power supply comes wired for 240VAC operation, and includes a NEMA 6-15P plug which will mate with either a NEMA 6-15R or 6-20R receptacle. The 6-foot power supply pendant cable connects to the large Power Input connector. Standard UHF IN/OUT connectors, a ground wire post, and ALC and RELAY (amp-key) connectors provide transceiver interfacing. ALC should only be used to prevent accidentally overdriving an amplifier as you should always adjust your drive level to properly drive any amplifier prior to ALC onset.

Figure 6: Rear panel of the ALS-1306.

The RELAY input has an open circuit voltage of 12VDC and requires your transceiver's amplifier keying output circuitry to sink <20ma. Therefore the ALS-1306 can be keyed from any transceiver without requiring a special interface. Note that the ARRL lab measured 12ms for ALS-1306 T/R relay actuation. Most transceivers have an amp-key-to-RF-output delay menu setting. So set your transceiver menu setting to delay the RF output to more than 12ms to prevent hot-switching.

The REMOTE A/B connectors are for future remote control devices. The Band Data connector provides for automatic band tracking with most transceivers, as well as an amp-key input that is in parallel with the RELAY jack. The Band Data interface currently supports ICOM band voltage (not CI-V), Elecraft and Yaesu BCD, and Kenwood RS-232. And no special set-up is needed. Just connect the appropriate interface cable between your transceiver and the ALS-1306, and the amplifier will sense the band data information and track your transceiver. Incidentally, ICOM band voltage does not discriminate between 15- and 17-meters, and 12- and 10-meters. Therefore the ALS-1306 band indication may not correspond to the ICOM band selected for these bands, depending on the previous band selected (i.e. if the previous band is below or above 15/17 or 12/10 meters). However, the ALS-1306 uses the same filters for 15- and 17-meters, and for 12- and 10-meters, so the amplifier will operate fine even if the indication is wrong on these bands.

As I have an Elecraft K3, I acquired the Ameritron DB-DB15HE cable. However, after receiving the cable I found that it was not optimum for my application. While the DB-DB15HE provides the Elecraft BCD Band Data information to the ALS-1306, it also provides direct keying of the ALS-1306 via the K3 accessory connector. The first problem is that the ALS-1306 keying input was measured at 13ma. This is above the 10ma maximum keying capability specified by Elecraft for their ACCESSORY connector. Further, my lower-band antenna is a 43-foot vertical so I use a MFJ-998 autotuner to tune this antenna system. The MFJ-998 interrupts the amp-key line when the SWR is high or when the MFJ-998 is tuning. The Palstar AT-AUTO does this as well. And high SWR can also interrupt the amp-key line with high-end SWR/power meters from a number of companies. But for this to work, the amp-key line cannot connect directly to the ALS-1306 Band Data amp-key input. Therefore, I built my own version of a K3 interface cable that does not include amp-keying, and also brings out the K3 ALC input. Amp-keying is provided by a standard RCA cable that connects the K3 RCA amp-key output through the MFJ-998, and then on to the ALS-1306 RELAY input RCA jack. See the Sidebar article for details on this cable.

Performance Measurement

FCC compliance and IMD testing was performed in the ARRL lab. Testing revealed that inhibiting amplification from 26-28MHz occurred when the CW input drive level exceeded 9.6 watts. While 9.6 watts is below the PEP output of a modulated CB AM or SSB transceiver, Ameritron has changed the trip sensitivity to less than 4-watts CW.

My first tests included measuring amplifier power output and checking the amplifier's internal power meter against an Array Solutions PowerMaster NIST-traceable digital

peak-hold wattmeter (spec'd accuracy ±3%). I adjusted the drive until the output power of the amplifier was 1200 watts PEP using a properly spaced Morse "E" string (this should correspond to about a 25% duty cycle, which is similar to the SSB duty cycle). Then I measured the power after key-down for 5-seconds. The test results are displayed in Table 2. The ALS-1306 met its 1200 watt PEP specification on all bands, though there is some power sag under longer key-down conditions. Note the drive necessary to get the US limit of 200 watts on 30 meters. I also found the ALS-1306 peak-reading wattmeter to be quite accurate for an analog meter. Each "tick " on the meter is 100 watts, and all ALS-1306 meter readings were within 1-tick of the PowerMaster readings.

TABLE 2: Amplifier Input SWR/Output Power Output Measurements (external digital wattmeter). Bypassed SWR was 1:1 on all bands.

Band	Input SWR	Drive for 1200W PEP	5-sec Key Down Output Power
160M	1.02:1	50W	1100W
80M	1.08:1	70W	1050W
40M	1.19:1	65W	1050W
30M	1.21:1	12W/80W	200W/900W
20M	1.27:1	50W	1100W
17M	1.29:1	60W	1080W
15M	1.57:1	55W	1100W
12M	1.51:1	40W	1150W
10M	1.27:1	42W	1050W
6M	1.16:1	75W	950W

At the time of this review, Ameritron had not specified the 100% duty cycle output power that is necessary for RTTY or other continuous carrier modes. Ameritron states that the ALS-1306 can run 1200W or more at some duty cycles, and 500W key-down 24/7 operation. This all depends on the load impedance, SWR, ambient air temperature, duty cycle, and band. Based on the 350-watt output/10-minute on-off/50% duty cycle RTTY spec of the ALS-600, a 700-watt spec would probably be appropriate as the ALS-1306 is essentially two combined ALS-600 amplifiers. I transmitted 700 watts for the 60 seconds that my dummy load could take this power level without overheating. During that time the ALS-1306 fans did not speed up, and no thermal alarm was given. While not a perfect test due to limitations in my equipment, I believe that a 700-watt RTTY or other continuous carrier mode specification is probably appropriate.

Next I looked at SWR protection. The ALS-1306 is designed to protect itself when it senses approximately 150 watts reflected power. To test this, I built a "SWR degradation" box consisting of a high-current 220pf capacitor placed in series with my high power dummy load. This permitted me to vary SWR by simply changing bands. See Figures 7 and 8.

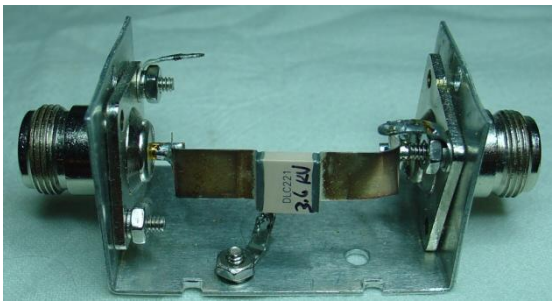

Figure 7: SWR degradation box - Internal

Figure 8: SWR degradation box - External

For my first SWR test, I applied the full drive required for 1200 watts PEP as listed in Table 2 to the SWR degradation box/dummy load. For any SWR of 2:1 or greater, the amplifier immediately faulted with no damage. Then, starting with very low drive, I increased the drive level until the amplifier faulted. Table 3 lists the actual forward power versus SWR that caused the amplifier to fault.

Table 3: SWR vs Ham Band for the SWR Degradation Box

Band	SWR	Fault Forward Power
80M	17:1	150W
40M	5.6:1	250W
20M	2.5:1	650W
17M	2:1	950W
10M	1.5:1	No Fault

Just A Few Options

The only ALS-1306 options currently available are the various transceiver interface cables and the external QSK-5 pin-diode switch. As mentioned earlier, at least some of the interface cables include the amp-keying line, so this should be considered if you use an external means of interrupting amplifier keying. Contesters or other heavy QSK users will probably prefer the silent-operating PIN-diode QSK-5.

Finally – Some Thoughts on an Antenna Tuner

Unless you have a near-perfect antenna system, the ALS-1306 will require an antenna tuner. And since the ALS-1306 is a no-tune amplifier, an autotuner may be your first choice. The MFJ-998 handles 160-10 meters nicely, and provides amplifier disabling during tuning and/or high SWR conditions. Since most 6-meter antennas are resonant and well-matched, 6-meter antenna tuner capability isn't often necessary. However, the 6-meter bypassed SWR of the MFJ-998 is a little high at about 1.5:1. Further, it would be nice if the MFJ-998 followed transceiver band changes as does the ALS-1306. So hopefully an updated version of the MFJ-998 is in the works.

Conclusion

If you've been considering a near-legal-limit solid-state amplifier, the Ameritron ALS-1306 may fit your needs. Its well-protected 1200 watt PEP output, no-tune operation, and auto band-switching provides simple installation and operation.

Manufacturer: Ameritron, 116 Willow Road, Starkville, MS 39759.
www.ameritron.com.

Sidebar: ALS-1306 K3 Band Data Cable Phil Salas AD5X

As discussed in the review, the Ameritron DB-DB15HE K3 cable has a direct amp-key line and no ALC interface, so an alternative cable was built. Table 1 lists the ALS-1306 and K3 interface pin-outs. The ALS-1306 XCVR Interface connector is a DB9/male, and the K3 Accessory connector is a DB15HD/female. Therefore the cable mating connectors are a DB9/F for the ALS-1306, and a DB15HD/M for the K3.

Table 1: ALS-1306 Transceiver Interface and K3 Accessory Connector Interface

ALS-1306 XCVR Intfc		K3 Accessory Connector			
Pin	Function	Pin	Function	Pin	Function
1	BCD B IN	1	FSK IN	9	BCD C OUT
2	BCD A IN	2	AUXBUS I/O	10	Amp-Key OUT (10ma max)
3	Kenwood RX (data in)	3	BCD B OUT	11	DIGOUT1
4	Kenwood TX (data out)	4	PTT IN	12	GND
5	Icom Band Data	5	GND	13	BCD A OUT
6	GND	6	DIGOUT0	14	BCD D OUT
7	Amp-Key IN	7	TX INH (IN)	15	ALC IN
8	BCD D IN	8	POWER ON		
9	BCD C IN				

Figure 9 shows my K3 interface cable schematic. Start with a 6-foot VGA extension cable with all 15 pins independent and connected through (such as 10H1-01106 from www.cablewholesale.com). Replace the female DB15HD connector on one end with a DB9F connector to interface with the ALS-1306. Amp-keying is provided by the normal RCA jacks on the K3 and the ALS-1306. ALC is provided by a short RCA cable connected to the DB15HD pin 15 wire inside the DB9F connector. The completed cable assembly is shown in Figure 10.

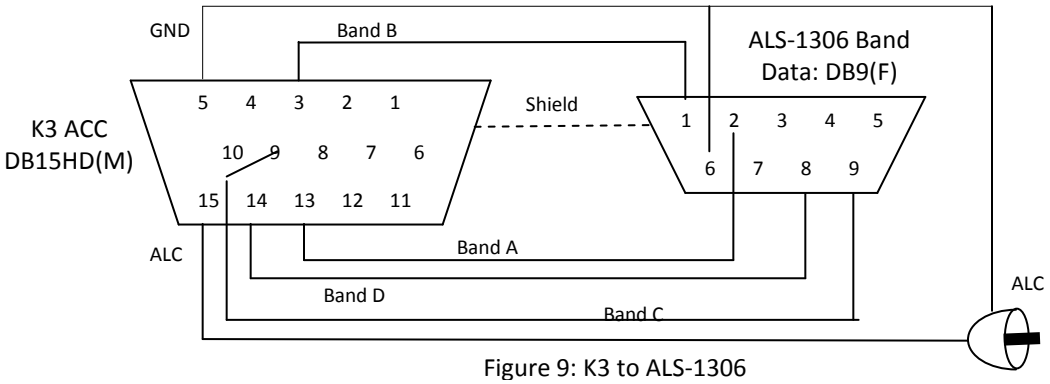

Figure 9: K3 to ALS-1306

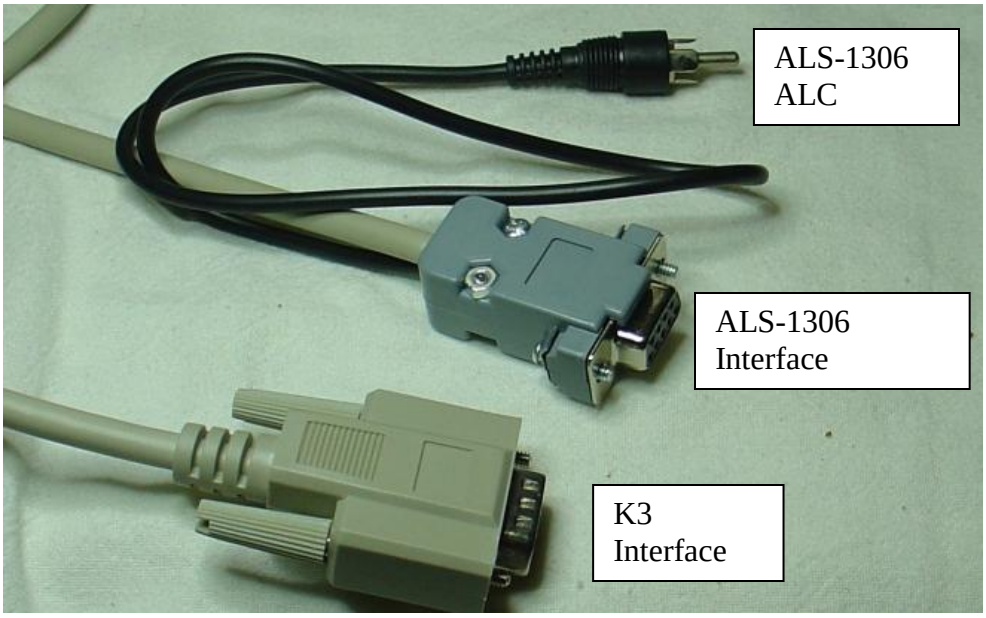

Figure 10: Authors K3/ALS1306 interface cable