



Transmitter Power Amplifiers: Benefits of Size and Power Reduction

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In Brief

Using smaller, lower-power PA modules versus large higher-power modules in a transmitter results in several user benefits, including:

- Lighter weight and size.
- Single-person removal/replacement versus a two-person task, reducing labor costs.
- Significantly less power is lost when a PA module is removed from service (refer to figure 1).
- Each PA module has fewer RF devices, resulting in a lower PA cost.
- Spare parts kit cost is reduced.
- Lighter PA modules are easier and less expensive to transport/ship between warehouse and transmission site, or between the site and the service depot.

Background

Liquid-cooled TV transmitters have become the preferred choice over their air-cooled counterparts at relatively low power levels, often as low as 1.2kW

average power. The system level efficiency is generally better, since the vast majority of transmitter waste heat can be inexpensively removed via an efficient liquid cooling system. Cool liquid is passed through the Power Amplifier modules and then to an outdoor liquid-to-air heat exchanger, where the heat is dissipated to the atmosphere. The cooled liquid is then re-circulated using a small pump system. Such systems have been proven reliable and are simple to maintain.

Power Amplifier Size & Weight

The usual philosophy is to make the final RF Power Amplifiers in a transmitter relatively high in power. This can simplify combining systems and potentially save some cost. Larger sized power amplifiers are typically rated between 1.2kW and 1.5kW in average power and utilize either 6 or 8 RF amplifier pallets to achieve this power. In addition, it is common practice to also integrate the PA power supplies into each PA module versus using separate small light COTS power supplies. One obvious disadvantage will be that these large Power Amplifiers are typically very heavy, approximately 28kg each.

Customer Required Power kW	Brand X		GatesAir ULXTE		Max Power with 1 PA removed (kW)		% of Customer Required Power with 1 PA removed	
	No. of PA's	Tx Pwr kW	No. of PA's	Tx Pwr kW	Brand X	GatesAir	Brand X	GatesAir
1.0	1	1.5	2	1.2	0.00	0.30	0%	30%
1.2	1	1.5	2	1.2	0.00	0.30	0%	25%
1.5	1	1.5	4	2.4	0.00	1.35	0%	90%
1.8	2	3.0	4	2.4	0.75	1.35	42%	75%
2.0	2	3.0	4	2.4	0.75	1.35	38%	68%
2.4	2	3.0	4	2.4	0.75	1.35	31%	56%
3.0	2	3.0	6	3.6	0.75	2.50	25%	83%
3.6	3	4.5	6	3.6	2.00	2.50	56%	69%
5.0	4	6.0	8	5.5	3.38	4.21	68%	84%
5.5	4	6.0	8	5.5	3.38	4.21	61%	77%

Fig 1 – Effect on transmitter output power with a single PA module removed from service



A 28kg PA module can be very difficult to remove and replace. National or local safety regulations in many regions mandate that two people perform such service. GatesAir has a strong philosophy of designing for ease of maintenance and serviceability. Such is the case with our Maxiva ULXTE series of liquid-cooled UHF transmitters. In this design, each PA Module is relatively compact as only 3 RF pallets are used. This not only reduces the physical size, it also helps keep the module weight well within the capability of a single-person removal/replacement task. The PA modules used in the ULXTE transmitter weigh in at about 11.3kg each.



Fig 2 – Maxiva ULXTE PA Module and Power Supply

Power During PA Fault or Removal

The use of small light-weight power amplifier modules brings with it an even greater benefit: because each three-pallet PA transmits only half the power of a six-pallet PA, the resulting drop in transmitter output power due to the removal of a single (or multiple) PA(s) is greatly reduced.

Figure 1 clearly shows how these two different design approaches affect the transmitter power available whenever a power amplifier module is either removed or switched off. For this chart, calculations regarding power loss assume standard hybrid combining loss formulae.

Conclusions

As discussed, the use of small light-weight Power Amplifiers, along with separate, independently removable power supplies, results in a far more service-friendly architecture, as well as providing higher transmitter output power if a PA module needs to be replaced or serviced. For additional information, please contact GatesAir.