

## Drip-free fluid connectors enable power module hot-swaps on liquid-cooled TV broadcast transmitters



*CPC's specially designed leak-free quick disconnects help GatesAir reduce both transmitter downtime and operating costs for TV broadcasters.*

For nearly 100 years, GatesAir has supplied broadcasters with some of the industry's most operationally efficient analog and digital transmitters. In television, its wireless UHF and VHF solutions span a range of power requirements from single-station over-the-air broadcasters to large national networks in the U.S. and around the world. When the company recently redesigned its liquid-cooled Maxiva™ ULXT UHF TV transmitter, it turned to fluid connector expert CPC for a reliable and drip-free quick disconnect solution.

Television broadcast transmitters generate large amounts of waste heat that must be removed in order to prevent damage to electronic components. Many smaller transmitter power modules are air-cooled. For larger transmitters, air cooling is expensive to operate, noisy and a major contributor to facility air conditioning loads. Liquid cooling, on the other hand, has more efficient heat-transfer characteristics, runs quietly, is more economical to operate and reduces total heat in the facility. There is one drawback, however. Liquid cooling brings water or other coolant into proximity with electrical components — where any leak, no matter how small, is likely to have dire consequences.

"GatesAir came to us in the early stages of their product development. They needed a bullet-proof fluid coupling, one that would allow transmitter operators to hot-swap individual transmitter power modules with no risk of coolant leaks," said David Vranish, liquid cooling applications engineer with CPC.

### PROBLEM:

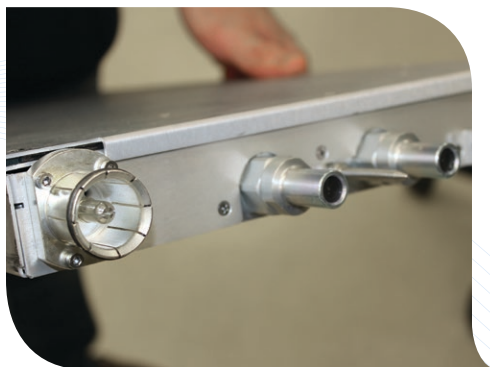
Liquid cooling systems inside television broadcast transmitters needed leak-proof, problem-free fluid connectors

### DESIGN NEEDS:

- Provide long-term connection with non-spill performance upon disconnect to protect sensitive electronics
- Function as part of an integrated power module that can be connected and disconnected as a single unit

### SOLUTION:

Rack-and-panel style of CPC's proven LQ Series connectors designed specifically for liquid cooling



The application required the coupling to remain connected for long periods of time and then to disconnect without leaking a drop of fluid. CPC initially designed a quick disconnect that connected manually with a thumb latch. Each half of the connector incorporated an internal valve that would open upon connection and close upon disconnection without leaking. Made of brass and featuring injection-molded, dripless plastic valves, the design satisfied the application's original performance requirements. This development later led to CPC's release of the LQ6 connector series. (See Figure 1.)

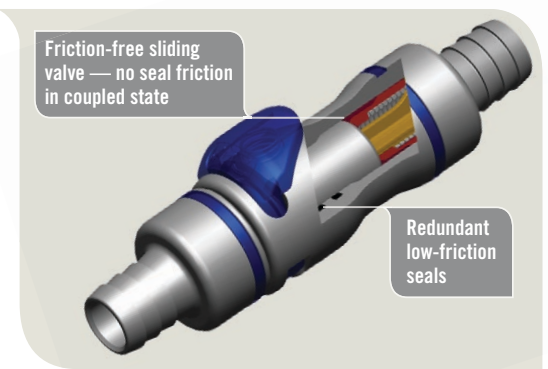
### Connector requirements change

As its new transmitter design developed, GatesAir required a coupling that could connect without direct operator intervention. Transmitters consist of a series of stacked-up and rack-mounted power modules. The number of modules determines the total power output. GatesAir now aimed for a design where individual modules would slide into the rack while simultaneously plugging into built-in electrical and coolant connections on the back of each transmitter rack (called a power block).

"We saw the industry's interest in an all-in-one power module connection for electrical and liquid cooling," explained Al Davis, manager of mechanical engineering for GatesAir, "and we wanted to deliver this ease of use to our customers." Power modules are removed for replacement or maintenance only a couple of times a year, so connectors need to be able to remain connected for months on end and then disconnect easily without leaking. "The connector we selected would also have to withstand long-term use," added Davis, "because GatesAir transmitters can be upgraded in the field to newer digital standards for extended product life."

The new manifold design approach sent Vranish and CPC's engineering team back to the drawing board. "What we did was take the LQ6 design we originally created for GatesAir, removed the latching mechanism and remade the connector in a rack-and-panel form," said Vranish. (See Figure 2.) CPC kept the

Figure 1.  
CPC's LQ Series couplings are designed with unique double-sealed internal valves that open upon connection and close upon disconnection, resulting in leak-free disconnects.



redundant seal in the connected state, as well as the frictionless valve, because these features were integral to the connector's non-spill performance. To aid in aligning the two connector halves when the power module is pushed against the back of the transmitter rack, CPC designed a special internal connector geometry with "axial tolerance engagement." Explained Vranish, "This tolerance means the connectors do not have to be fully connected to maintain full flow; there can be a slight gap because the valve design is very forgiving."

Other connector design changes included switching the housing material from brass to aluminum to reduce the unit's weight and eliminate any potential for galvanic corrosion in the system. To keep the connection forces low, CPC designed the two halves of the connector to seal against each other using Quad-Ring® seals for their low friction properties. CPC also designed the connectors to terminate to the manifold using a standard SAE joint, typical of hydraulic joints, to ensure the connection was leak-free and easy to install. The final product's double-sealed internal valves are injection-molded from polysulfone, a strong, high-temperature and chemical-resistant thermal plastic that results in a lightweight and rugged connector.

### Reliability is the key

Leak-free reliability was a primary objective for GatesAir and one of the key reasons its supplier search led to CPC. "Right now there is equipment with CPC connectors that has been operating in our lab for well over a year. Plus there are more than 100 CPC-equipped transmitter systems in the field, and these have each been operating for six months or longer," reported Davis. "We have yet to see a failure in the lab or in the field." Other attributes of the CPC connector that GatesAir liked were the low insertion force required in comparison to other connectors the company reviewed and the good flow vs. pressure characteristics of the internal valves, important for optimum coolant flow.

To live up to its promise of quality and reliability, CPC inspects and leak-tests every GatesAir connector before it leaves CPC's

Figure 2.  
GatesAir required a rack-and-panel style connector for its manifold design. CPC's LQ Series products are also available in a manual thumb-latch style.



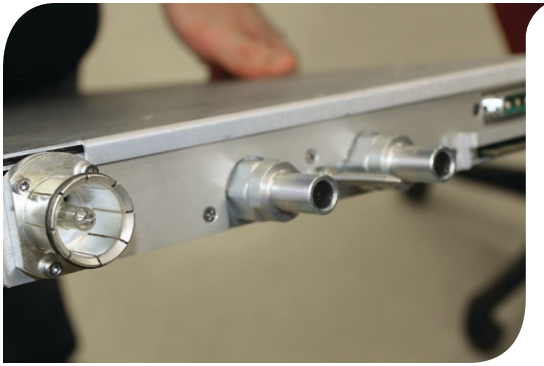


Figure 3.  
A GatesAir power module showing the UHF connection and the cooling connector inlet, cooling connector outlet and guide pin.



Figure 4.  
Power modules simply slide into the power block and join both electrical and leak-free cooling connectors. Two panel screws secure the power module.



#### About CPC

CPC is the leading provider of quick disconnect couplings, fittings and connectors for life sciences, specialty industrial and chemical handling markets.

Used in a broad range of applications, innovative coupling and connection technologies from CPC allow flexible tubing to be quickly and safely connected and disconnected.



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facility. “We are committed to shipping connectors that are 100 percent functioning and leak-proof,” said Vranish.

#### Keeping it simple

“We do a lot with our transmitter designs to reduce the cost of ownership for our customers,” said Davis. “With liquid cooling, we can transfer the heat load outside the building, which helps our customers save on air conditioning expenses.” The GatesAir liquid cooling system operates with an inlet coolant temperature of 55 degrees C (131 degrees F) and an outlet temperature of 65 degrees C (149 degrees F) at 40 psi. Two redundant coolant pumps located within the power block on smaller transmitters or externally on larger systems maintain pressure. A liquid-air heat exchanger located outside of the building, usually on the roof, dissipates the heat. “The ability to confidently employ liquid cooling in an electronics environment is hugely dependent upon fluid connectors that don’t leak,” said Vranish, “regardless of how long they remain in a connected state prior to disconnection.”

In addition to reducing air conditioning loads, the new Maxiva transmitter design minimizes downtime due to maintenance. “The removal and insertion of an individual power module can be done while the transmitter is operating, making it plug-and-play, thanks in part to the CPC connectors,” reported Davis. The transmitter module slides into the rack on rails and engages guide-pins that lift the module to line up with both the fluid connectors and the electrical connectors. “Then the module simply pushes in.” (See Figures 3 and 4.)

#### Positive results

The relationship between GatesAir and CPC has been positive for both companies. GatesAir has a new UHF transmitter with the market-driven features it set out to achieve: a reduced footprint, high liquid-cooled efficiency and a low cost of ownership. In turn, GatesAir’s application led CPC to develop a new line of connectors specially designed for liquid cooling.

“This experience has been outstanding,” Davis summed up. “CPC was easy to work with and very collaborative in sharing ideas and coming up with ways to meet our requirements. In the end, we’ve simplified the operation of our transmitters while eliminating downtime for our customers.”

