



Pluggable Module Temperature Rating

Considerations for different operating environments

This application note explains the different temperature ratings for pluggable transceivers, such as SFPs and XFPs, and how it relates to the operational temperature range of a given system platform.

Module temperature rating

Pluggable transceivers are typically rated as Commercial Temperature (CT), Extended Temperature (ET) or Industrial Temperature (IT). Some vendors also use the terms Standard Temperature (ST) and Reduced Industrial Temperature (RT) instead of CT and ET, respectively. These temperature ratings refer to the operational temperature range for the pluggable transceiver, as measured by its internal sensor, which typically reflects the case temperature of the pluggable module. The temperature ratings usually correspond to an operational temperature range of 0 to 70 °C for CT, -5 to 85 °C for ET, and -40 to 85 °C for IT. However, it is not uncommon for pluggable vendors to deviate slightly from these definitions. For example, some may specify a lower limit of -5 °C rather than 0 °C for a CT grade module, or a lower limit of -5 °C or -20 °C instead of -10 °C for an ET grade device. Similarly, an upper limit of 80 °C rather than 85 °C may be specified for an ET device.

It is over a module's rated temperature range that all specifications for the module are guaranteed to be met, such as transmit power, wavelength stability, receiver sensitivity, etc. A module may continue to function outside its rated temperature range, but with some specifications potentially compromised. The temperature alarm threshold programmed into a transceiver by module vendors is typically at, or slightly beyond, the rated operational temperature limits for the device, depending on the module's ability to continue to function slightly beyond its normal operational temperature limits.

System platform temperature

A given system platform has a specified operational temperature range, which is -5 to 55 °C for NEBS Level 3 equipment. This temperature refers to the ambient temperature of the environment over which the equipment is designed to operate normally and reliably. For a forced-air (fan cooled) system, it represents the temperature of the air that enters the shelf, usually at the front row of an equipment aisle. For a natural convection-cooled system, which has no integrated forced-air cooling, it represents the ambient temperature around or near the shelf, but it should be noted that in this case it is possible for there to be significant temperature gradients due to natural convection air dynamics caused by obstructions and perturbations within the environment, such as fans in other equipment, air-conditioning and venting systems, etc.

Relating pluggable temperature to system platform temperature

The temperature of a module will generally always be higher than the ambient temperature of the equipment environment, where the temperature delta depends on the type of equipment, power consumption, thermal load of adjacent cards and equipment, heatsink design, type and configuration of fans used, air flow resistance and fan control algorithm, etc. The temperature delta for forced-air cooling is typically in the range of 10 to 20 °C, whereas for natural convection cooling it is typically in the range 20 to 35 °C. Hence, for a system platform having an operational temperature range up to 55 °C, the pluggable module can usually be rated CT without exceeding the upper operational temperature limit of the pluggable transceiver. For system platforms with an operational temperature range up to 65 °C, which is common for outdoor cabinets that are not environmentally controlled, the pluggable modules generally need to be ET or IT rated.

For natural convection-cooled systems, the pluggable temperature rating needed may be any one of CT, ET or IT, depending on the operational temperature range desired for the system platform, and the assumptions made about adjacent equipment and air movement within the environment.

Regarding the low temperature operation of a system platform, the transceiver-to-ambient temperature delta can be an advantage, as it can allow the use of pluggable transceivers with a higher lower temperature limit than the ambient conditions. Even for systems with forced air cooling, fan speeds can be reduced, or the fans turned off completely at very low temperatures in order to keep transceiver modules within their operating range. One requirement, though, is that the system must be able to achieve a cold start, whereby it is possible to start the system at, say, -40 °C after dwelling at such a temperature unpowered for hours or days. In this case, the equipment may take several minutes to eventually operate from a cold start, but as long as it eventually achieves normal operation, a delay for cold starting is often acceptable and reasonable.

Practical considerations

It may be tempting to “play it safe” and simply always specify ET or IT rated transceiver modules for all equipment types, regardless of whether or not an ET or IT rating is actually needed. However, there are important caveats to this. The cost of ET or IT rated modules is generally higher than CT modules, and the lead time can be longer for such devices. This is due to a combination of market demand and stocking levels for such devices, additional testing and calibration required, lower yields, etc., resulting from the wider temperature range they must support. Moreover, ET or IT devices may require their specifications to be relaxed slightly in order to meet the specifications over a wider temperature range. Specifying ET or IT devices when they are not needed amounts to overdesigning a system for the intended application, which can translate into higher costs and potential delays for activating new services.

Optelian always thoroughly tests and determines the required temperature rating for pluggable transceiver modules used with a given system platform, and it is highly recommended that these guidelines be followed to provide a cost-optimized solution with the fastest time-to-revenue.

CANADA

1 Brewer Hunt Way
Ottawa, Ontario K2K 2B5
T: +1 613 287 2000
sales@optelian.com

UNITED STATES

1700 Enterprise Way, SE, Ste. 101
Marietta, GA 30067-9219
T: +1 877 225 9428
T: +1 770 690 9575



optelian.com