



Keeping Workers and Workloads Safe With RF Range Control

ABSTRACT

Costly and dangerous equipment accidents and injuries to employees occur in industrial environments — but are avoidable with strong safety guidelines and the use of equipment that reinforces them. The Laird RF Range Control feature for the CattronControl™ family of products provides functionality that ensures operators have the flexibility to do their job while remaining within a safe zone of operations.

Problem

In industrial environments, such as material handling facilities, the use of large overhead cranes is essential for day-to-day operations. Engineers have the choice to use radio frequency (RF) or infrared (IR) technology to operate these cranes, and both have their uses. With their ability to move heavy equipment and goods swiftly and effortlessly, cranes just as easily have the potential to cause injuries to employees and damage to equipment, particularly if the operator moves outside the line-of-sight zone or if someone tampers with an operator control unit (OCU) that has been left unattended.

Solution

Unlike RF, IR limits an operator to one location and does not work when the line of sight between the OCU and machine is obstructed. This functionality does limit some of the safety concerns that occur with RF-operated cranes; however, in many environments, the operator simply cannot be limited to one location. Furthermore, RF is more reliable in environments where IR might be blocked by light sources, such as welding.

While companies put operating rules in place to help prevent issues such as those, limitations that are built directly into the equipment add a stronger layer of safety that is easier to enforce. This is the intent behind the RF Range Control functionality, which provides reliable close-start and range-limiting functionalities to reduce or eliminate the risk of unintentional and/or non-visible operation.

This functionality can be added to most cranes currently being operated with CattronControl MCUs by using a retrofit kit. Alternatively, companies can include a range control requirement in specifications for any new crane to ensure this capability.

The Benefits of IR vs. RF: Each Has Its Uses

Infrared: IR is ideal for situations where an operator needs to be limited to just one location, in close proximity to and within directional line of sight to the crane. IR is very directional and requires the OCU to be well aligned with a clear line of sight before close start is possible. Laird does supply IR start options for these types of applications.

Radio Frequency: RF is ideal for situations where an operator needs the freedom to move around while operating the crane, potentially moving the OCU out of the line of sight of the antennas mounted on the crane. RF is also not blocked by light sources, such as welding.

While both can be modified to provide range limiting, RF does not require the costly add-on components nor does it have the directional performance limitations associated with other IR products that offer similar safety measures. This means operators are free to move about the floor, as needed, without signal interruptions where the line of sight between the OCU and MCU may be partially broken.

Range-limiting Functionality

Range-limiting functionality imposes restrictions on the maximum distance between an operator and the crane. Prior to operation, engineers set a received signal strength (RSS) threshold that cannot be exceeded for longer than a specified amount of time. As the operator moves away from the crane, the RSS becomes weaker until the preset threshold is exceeded and operation halts. The operator must then move back into range before he can safely resume operation of the crane. A typical reliable range limit is approximately 15 m (50 ft); some intermittent operation would reach as far as 30 m (100 ft).

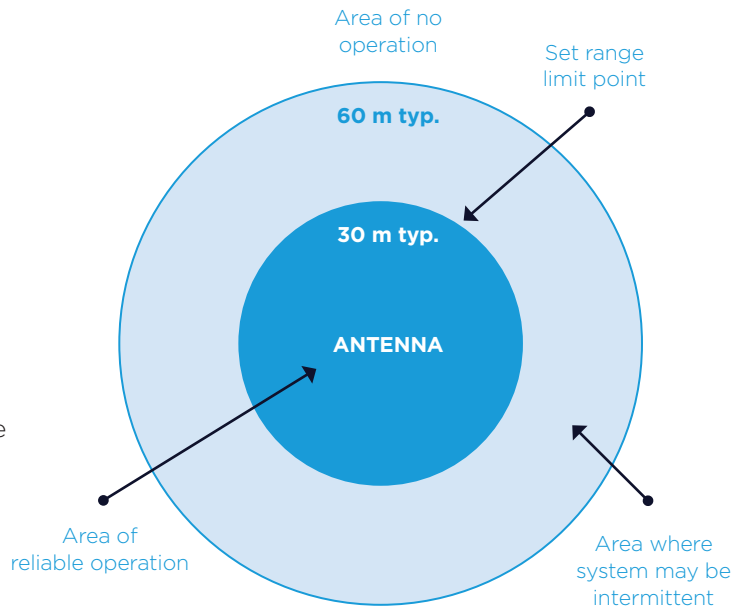


Figure 1:
Illustration of range-limit zone functionality

Close-start Functionality

Close-start functionality requires the operator to bring the OCU within a preset distance of the crane to gain control of it. This functionality prevents anyone from picking up an OCU and inadvertently operating a crane without being directly underneath it. A typical reliable close-start point is approximately 3 m (10 ft), but may stretch out to 6 m (20 ft). The operator (or anyone who might pick up the OCU) would need to be within this zone to initiate the motion of it but could then move outside this zone (optionally staying within the range-limiting zone) to continue operation. If the OCU is taken outside of the range-limiting zone or operations are stopped for a preset amount of time, the operator would need to move the OCU back into the close-start zone to resume operation of the crane.

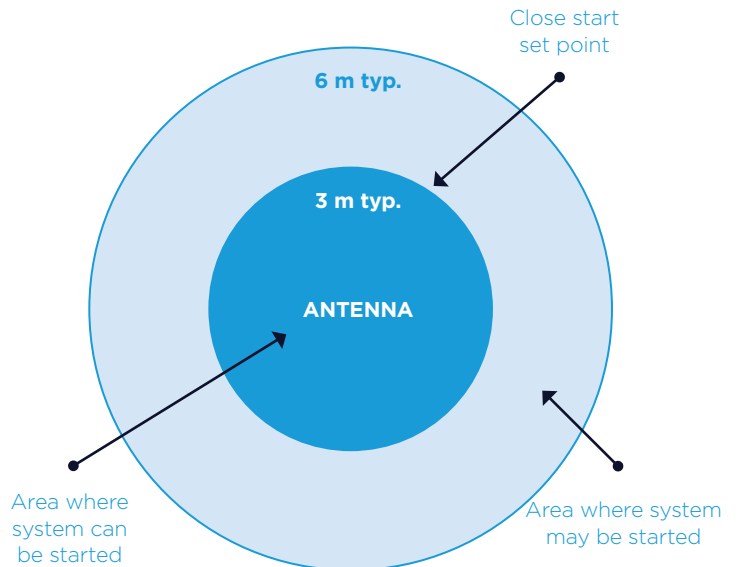


Figure 2:
Illustration of close-start zone functionality

How It Works

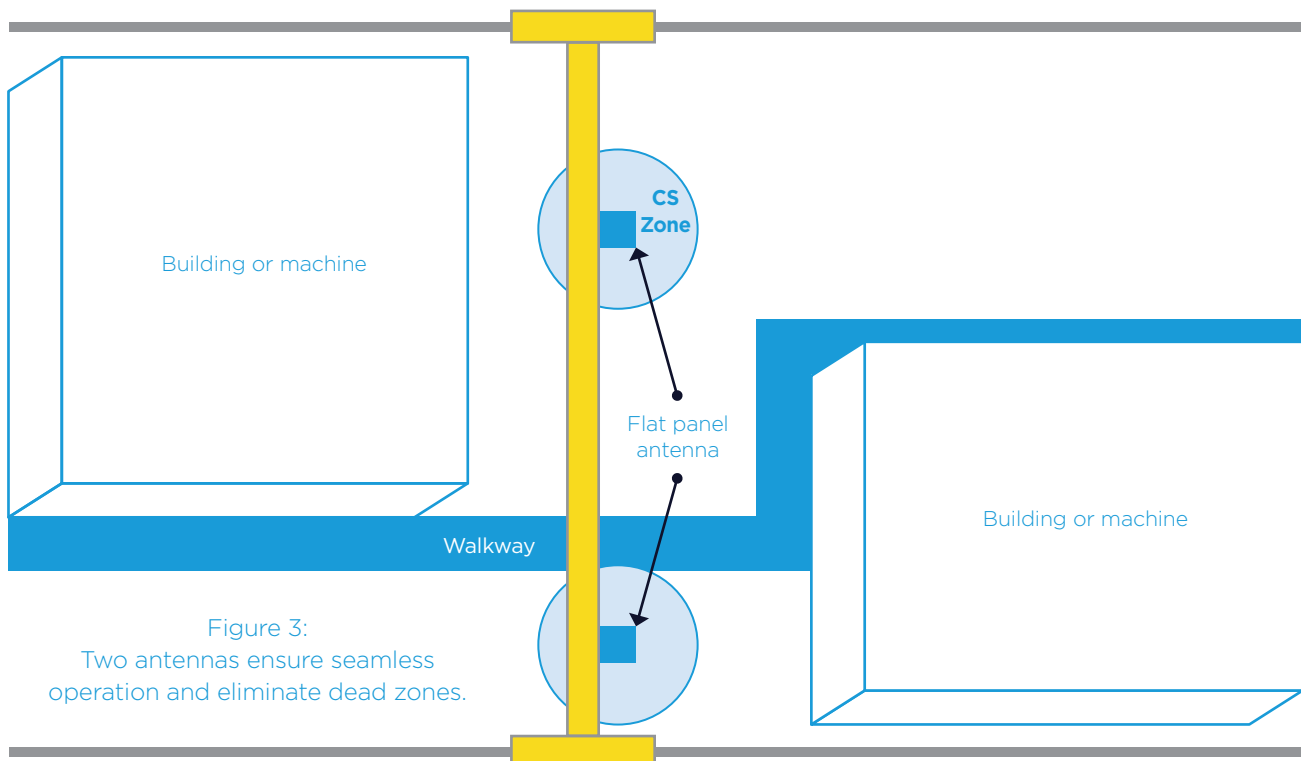
The CattronControl MCU is fitted with equipment that enables it to measure the RSS with a reasonable degree of accuracy through the use of:

- Multiple flat-panel gain antennas to increase the signal level attenuation vs. distance
- Smart software averaging routines to account for fluctuations in measured signal or distance

By measuring the RSS, the MCU can translate it to the relative distance between it and the associated OCU. This solution operates in the UHF band, and under ideal conditions the signal decays at a rate equal to the inverse square law (i.e., if we double the distance between the antennas and the OCU, we get one-quarter the signal). It's important to note that UHF can reflect off many surfaces and is attenuated by others, so the signal strength is an indication of distance, but not a precise measurement. By mounting two gain antennas aimed at the ground under the crane, we can get a more accurate, though not perfectly precise, average distance reading.

This method ensures that a full signal is always available and the operator's ability to control the system is based on preset RSS values, not on the lack of a signal. The use of multiple antennas also ensures that at least one antenna is within range of the OCU and there are no "dead zones," an area where the crane could not be operated once inside that zone.

With the two antennas, active diversity switching and smart software, a close-start setting of 6 m, for example, may require the operator to move within 3 m to gain control in certain instances, and a range-limiting setting of 15 m may still operate intermittently at 30 m (see Figure 4).

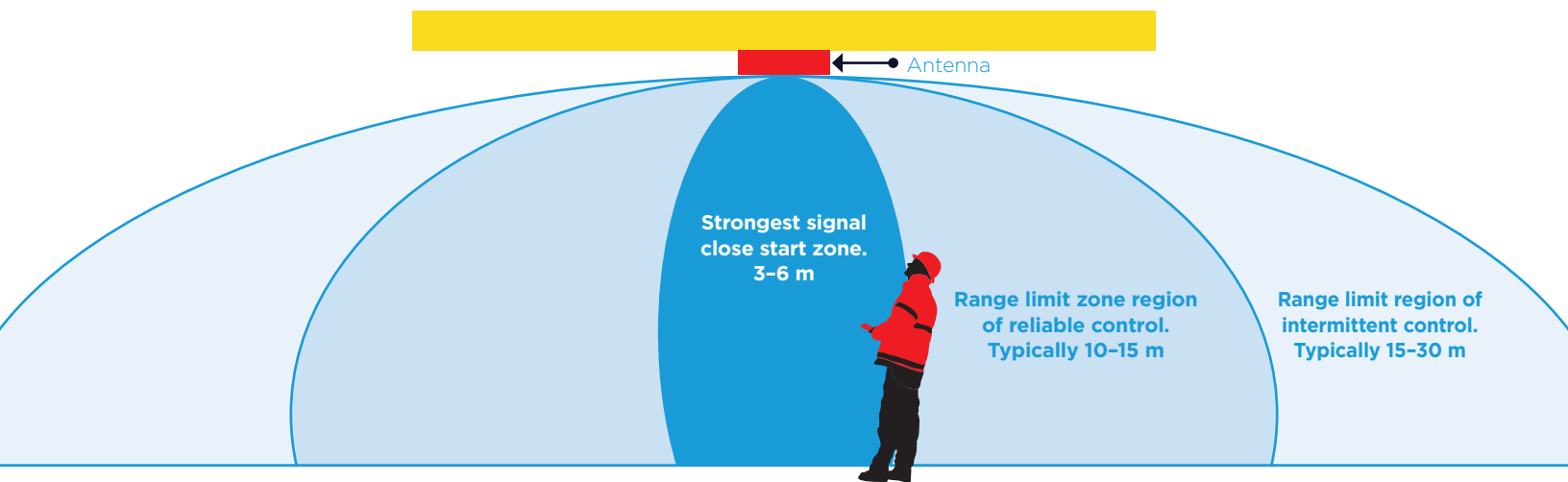


Benefits of RF Range Control Functionality

RF operation gives the operator the freedom to move around the shop floor as needed while minimizing interruptions to the signal between the MCU and OCU from line-of-sight disruptions or light sources. In addition, the smart software and dual antennas further minimize temporary disruptions to the signal from obstructions, providing seamless, reliable operations. This combination also improves the ability to approximate the distance between the MCU and the OCU using the RSS.

Furthermore, the range-control functionality provides two ways to ensure the safety of employees and equipment. With the close-start functionality, the chance of inadvertent crane operation from a bystander is virtually eliminated by forcing the OCU to be directly under the crane within a 3-6 m zone to enable the system to be started. This limitation greatly reduces the chance of an expensive and dangerous accident. With the range-limiting functionality, the operator can utilize the benefit of RF's longer range, while still being limited to a basic zone of safe operations.

Figure 4:
Illustration of signal strength and operating distances



Summary

The Laird RF Range Control feature for CattronControl systems provides the flexibility for operators to move around within a well-defined zone, which is necessary in most industrial environments, while still providing a level of safety to both employees and equipment. It also provides a further level of safety through the close-start functionality by creating a limited zone in which an operator (or anyone who might pick up the OCU) has to be positioned to activate the crane.

With the addition of this functionality to all overhead cranes on-site, costly and dangerous accidents from inadvertent or blind crane operations are virtually eliminated.

Why Can't I Simply Cut My Signal Strength?

Some engineers will attempt to create a similar range limit by lowering the signal strength of their OCU, which would then require the operator to remain closer to the crane to maintain a signal. In theory, this does limit the operating range of the OCU; however, it also leads to poor performance and nuisance trips that will affect operational efficiency.

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