GENERAL INFORMATION AND INSTALLATION

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1 GENERAL INFORMATION

One of the keys to a successful installation is meticulous planning and adequate allowances for task times. Allow sufficient time to consider and plan all aspects of the installation, including the building, whether new or existing. Once determined allow for realistic time spans for the building construction or renovation, equipment transportation and installation, and final commissioning. A low powered transmitter will require a very short time span for these activities, while high powered equipment could require many months. For more information, contact our Applications Engineering Manager who is available and able to guide you. Your consulting engineer is also a good source of information. Both these persons would be familiar with technical aspects of the proposed installation.

Applications Engineering support offered by LARCAN includes technical information, recommendations on vendor products when requested, and advice on project task considerations and time span estimation. This assistance is available upon request.

Although general application information is included in this manual, it is important that specific system layouts be prepared and that locations of cabinets and RF equipment, such as RF patching or switching equipment, are determined together with the routing of the transmission line, AC power (Mains) feeds and other wiring, grounding (earthing), and ventilation air ducting. Lightning protection should be considered early in the planning process, because a good building layout can offer significant benefit.

The DTR10SC series transmitter is a single chassis transmitter intended for rack mounting in a standard 19" cabinet. Since this type of product is often supplied for standby use or in unattended isolated site locations and therefore it is anticipated that any rack mounting arrangement pre-exists and is supplied by the customer. The installation of the DTR10SC must take into account ventilation considerations as outlined further in this document. That said, please note the ventilation openings of the cabinet should be fitted with air filters, to help the transmitter components remain clean. Also because of the small size of this product a tabletop style of cabinet can be used and may be preferred.

Due consideration must be given to ventilation, as proper cooling ensures the longest equipment lifetime. Basic cooling information is provided, but if a higher powered transmitter is also on site, an experienced air conditioning contractor should be consulted.

Ensure that sufficient space is available both in front and rear of all cabinets and other equipment to permit easy access while equipment is being moved around, and to enhance accessibility for future maintenance. A minimum 90 to 100cm (about 3 to 3½ feet) of clearance is recommended to allow access for a technician and test equipment, but you may need more clearance for other reasons or for the lifting devices sometimes used during installations. You may wish to consult local equipment rental agencies for dimensions of their available lifting apparatus; the required clearance is one of the "planning" items to be considered.

All cabinets should be level. An uneven floor surface can distort the sheet metal frames of many cabinets so that door latches will not operate properly.

2 GROUNDING/EARTHING

For safety, it is important that grounding conductors of adequate size be used to connect the transmitter (and other) cabinet(s) to the station "technical ground" point. The following notes are supplied as a guide to grounding at full-service transmitter installations but are useful for all cases.

The metal bulkhead plate through which all circuits and coax lines to and from the tower will pass, makes an excellent technical ground because it will be connected with one or two, 150mm wide x 1.5mm thick copper straps to the tower ground system.

One method is that in which copper bar 75 or 100mm wide and the same thickness as the floor tile is laid under transmitter and other cabinets for grounding. Each cabinet rack or tabletop cabinet is then connected with 1.5mm copper strap or automotive starter cable to the copper ground bar. The copper bar in turn connects to the metal bulkhead plate. Alternatively, copper strap can be laid in a grounded overhead cable tray. Indoor grounding conductors must ultimately connect to the bulkhead plate.

Consult your electrical code book, or ask your electrical contractor about the minimum permissible ground conductor size, but for broadcast installations a low ground impedance is desirable, so generally the cross section of each cabinet ground should be the same or larger than the total of its AC wiring cross section.

All outdoor ground connections should be well bonded using an exothermic brazing process such as *Cadweld* or equivalent. Special precautions should be taken to minimize corrosion where connections are made of dissimilar metals. Indoor connections can be brazed, silver soldered, or simply bolted together and then tin-lead soldered in the conventional manner. When indoors, don't forget that the steelwork, the ventilation system, and all other metallic objects in the building should also be grounded.

It is mandatory that a good low impedance earth ground be provided for the tower and it is good practice to employ this tower ground for all station ground connections. A system of buried radial conductors, extending outwards from the tower base and from each guy anchor, with their far ends terminated in several ground rods spaced about twice their length apart and driven into the water table, is considered to be a good ground. The steel rebars and J-bolts in footings should also be bonded to this ground system. *Be careful of dissimilar metals and don't braze anything to the tower legs!* Use stainless steel worm gear style hose clamps to clamp copper strap or copper wires to the tower members. A special conductive grease is available to avoid dissimilar metals corrosion, but frequent inspection is necessary.

Other measures become necessary if the tower footing is located on solid bare rock. These include setting the grounding radials in poured concrete (which has good conductivity), doping with conductivity-enhancing chemical salts such as magnesium sulphate (Epsom salts are supposed to be less environmentally harmful than others), and using special hollow ground rods that are intended to be driven into holes drilled in the rock and which are said to bond chemically to the rock and provide excellent grounding, as long as they are kept filled with water or chemical solution.

The building layout should place the tower, its wiring, transmission line, the AC panels and surge suppressor, and the telephone terminations all near one another so that all ground connections are as short as possible; all indoor equipment should be grounded to the same "technical ground" which we suggest should be the bulkhead plate, which will become a good low impedance ground when connected with several 150mm copper straps to the tower. This single technical ground will provide the basis for lightning protection of all equipment in the building. Both the power company and the telephone company should also use this same technical ground, otherwise a lightning hit to the tower could easily induce damaging transients that back up *through the equipment* and out the power or phone line to its own ground connections. Surge suppressors for coax lines and other tower circuits can mount (and ground) on the bulkhead plate.

Many installations in large cities make use of existing tall buildings or specifically dedicated structures (such as the CN Tower in Toronto, Ontario, Canada), and grounding for these installations could present a slight challenge.

Most tall structures are provided with wide copper straps running from top to base and grounded at or under the building foundations. The structural steel is also grounded to the same point. The challenge occurs when the structure sustains a lightning hit, because an enormous voltage gradient will be present from top to bottom. Equipment grounding must be done *to one point only.*

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Although most audio and video signals around the transmitter plant are of relatively high levels, it is well to be aware of another planning aspect; this is the possibility of inadvertent creation of one or more "ground loops" of the kind that can induce hum into low level audio circuits.

The most common cause of the hum-inducing kind of "ground loop" is a result of code-approved electrical work in which all wiring is placed inside metallic conduit or raceway, and the conduit is attached to, and in contact with, the grounded structural steelwork of the building.

Here is what can happen: 1. The transmitter cabinets are grounded; 2. The electrical service panels are grounded; 3. The conduit or raceway additionally may be grounded through its fasteners to the structural steel; 4. The service panel is connected by the metallic path through a conduit or raceway to the transmitter cabinet. The result is one or more large area single turn loops that have AC induced in them due to the wiring in the conduit, but which can induce significant hum currents into low level audio wiring.

Suggested treatment for these AC ground loops, is simply to break each metallic loop by using a short length of non-metallic duct on the end of the metallic raceway, or use a short non-metallic section or a non-metallic coupling in the run of conduit. This non-metallic part should be located as near as possible to the cabinet. **IMPORTANT:** ***Non-metallic parts used for electrical work must not be able to burn, nor emit hazardous gases when subjected to flames.*** You will need to work out the exact ground loop treatment method with your electrical contractor, and probably with your local electrical inspector as well.

This grounding treatment is acceptable to most regulatory authorities in North America and perhaps elsewhere as well, *provided that the equipment in fact is grounded through the copper ground conductors, the bulkhead plate, and solid tower ground.* Note that this method does require installation of a separate dedicated grounding wire inside each conduit for the connection of the isolated ground contact of each receptacle, wherever receptacles are used. It is assumed that isolated ground receptacles are available, usually for use in computer rooms and in hospitals.

It may be necessary that you and your electrical contractor also become technical instructors, in order to reassure your electrical inspector that reduction of ground loops does not in fact contravene the applicable codes. At the very least you will probably need to prove that all your equipment is indeed grounded, despite the non-metallic connection of conduit or raceway.

Other, less severe, ground loops can result from the outer conductors of coax cables being grounded to the chassis of the equipment at both ends of the cable, and of course these components are also grounded through the cabinets in which they mount. The transmission line is grounded at the tower, at the bulkhead, and at the transmitter.

Treatment of coax cable ground loops usually consists of coaxial cable dress in such a manner as to minimize the area presented by the loop. Lowering the line bridge between the building and tower will indeed reduce the loop area presented by the transmission line, but more importantly a lowered line bridge significantly reduces the energy induced on the center conductor due to a direct lightning hit to the tower. 100 to 130cm (3-4 feet) above grade is the suggested maximum bridge height.

3 LIGHTNING AND OTHER TRANSIENT PROTECTION

The real-world environment of transmitting equipment is one where periodic lightning storms may occur and cause antenna, tower, and power line strikes. The actual incidence varies widely with geographic location and is also affected by local topography, the height of the tower, and routing of the incoming power and telephone lines. Unless precautionary steps are taken, such strikes could cause transmitter damage, particularly to the final amplifiers and to the AC line rectifiers associated with them.

4 ABOUT POWER WIRING

The DTR10SC transmitter requires a single phase power source. Typical measured power consumption of the amplifier unit at full power is 150W.

The standard design allows the transmitter to operate line-to-neutral from single phase 100 to 130V.

For standard line-to-neutral operation, a single fuse is employed for circuit protection of the DTR10SC. Because the transmitter uses a switching power supply, the fuse specified is **fast blow** 5 Amps. For the AC power source, a slow trip breaker of 10 amps is suggested.

The DTR10SC series and the associated transcoder (LARCAN HCS-5000R+) have good internal regulation for wide extremes (nominal ±10%) of incoming AC line voltage. However other on-site equipment may not be as forgiving of poor line regulation, and a voltage regulator is a desirable accessory. If the site mains voltage extremes are greater than 10% variation, a voltage regulator that has wide range input voltage specifications, should be considered mandatory.

5 VENTILATION/AIR CONDITIONING INFORMATION

At full power, the maximum amount of heat is generated by the RF amplifier. This heat is removed by natural convection mostly through the heatsink on the front of the unit and partially through the amplifier's enclosure. Care must be taken when locating the DTR10SC amplifier that there is nothing impeding air flow around the heatsink. This applies to both top and bottom as air must flow freely to maintain correct operating temperature of the active devices. Also note that the specified maximum transmitter ambient temperature of 45°C is not exceeded at any time.

The RF average power output delivered to the transmission line is 10 watts average, when the DTR10SC transmitter is operating at its rated output. Subtracting this 10W amount from the (150W) = 140W of AC power input, gives us the heat generated by all stages in the transmitter; about 140W total. Add about 40W transcoder power input to this, and the total is about 180W for the transmitter on the air. Note also that this heat calculation does not include the heat dissipated by input and monitoring equipment, or other sources of heat in the room.

Due to the complexity of "heating, ventilation and air conditioning" (HVAC), it is recommended that an experienced air conditioning contractor/engineer be consulted. This is perhaps more important at shared sites using a single tower, such as for two-way radio, cell phone, telco, and/or other uses, such as in small communities where a studio installation may be in the same building.

6 FIRE PROTECTION

Planning fire protection is important in installations where electrical and electronic equipment exist. Systems may be needed to shut down other air systems in the building, to close air dampers and fire doors, and to enable activation of automatic firefighting apparatus, if provided. Automatic methods should be made available for reporting of the fire through the remote control.

Building designers once thought that a fire alarm system needed only to trip the main AC breaker to the building, which would automatically stop all fans and blowers. As long as the fire is prevented from spreading by ensuring all blowers are stopped and air dampers closed, and fire doors are closed, there is no reason that AC cannot remain on, to keep lighting available for evacuation of personnel. Check with local by-law enforcement to make certain the proper codes are followed.

For installations where the transmitter is located on top of a tall building, the main AC should never be able to be tripped by a fire alarm, because doing this can also stop elevators full of people, sometimes between floors. Fire alarm systems for these situations should be engineered by specialists.

It is assumed that if an emergency alternator is installed at the station, it is located in either a separate building, a fire proof vault with its own separate ventilation, or in its own enclosure, and is fitted with its own fire protection systems, so the above air system considerations would not apply to it. Specific building codes may apply to it though, particularly regarding its fuel supply. Check with your fire chief, fire marshal's office, and/or building inspector for applicable code requirements.

Even if the site is normally unattended, it must be mandatory that any automatically activated fire fighting system can be disabled whenever personnel are working in the space protected by the system. Most systems for use with electrical apparatus, depend on the high pressure discharge of carbon dioxide, halogenated hydrocarbons such as Halon, carbon tetrachloride, or other equally deadly extinguisher gases into a closed equipment room; this puts a fire out by displacing all oxygen. *The design must be fail-safe, because when personnel are working in the room, they must never under any circumstances be exposed to a risk of system malfunction which could be fatal.*

7 UNPACKING

Carefully inspect each package as it is received, for possible shipping damage. Claims for damaged equipment must be filed with the carrier within seven days of delivery or the claims will not be accepted.

Unless specific contractual arrangements for title, FOB location, etc. have been made, generally the delivery of the equipment to the carrier by LARCAN INC. constitutes transfer of title to the customer and it is therefore customer responsibility to ensure that any such claims are promptly filed directly with the carrier.

Check the equipment received against the shipping list. If there is a shipping error or if replacement equipment must be ordered due to transportation damage, notify your LARCAN representative as soon as possible.

If construction or renovation work at the transmitter site is not complete by the time the equipment is received, repack all equipment items after their inspection and store them in a clean, safe, dry area to avoid harm to any of the equipment. Repacking for storage should be performed in such manner to prevent access by mice and other small animals which can damage wire coverings. Construction debris such as plaster dust, metal filings, and other abrasive contaminants entering the equipment can also cause damage.

When the construction work is complete, the area should be cleared of all dirt and debris, and vacuumed thoroughly before the equipment is installed. Plain concrete floors should be sealed or tiled to prevent surface dust from being drawn into the equipment.

When the installation work is complete, the area should again be cleared of all debris and vacuumed once more, before any of the equipment is initially turned on. Check for loose screws and connections and tighten where necessary.

Finally, before powering up, be certain that all tools, surplus and scrap installation materials, stray hardware, stray "blobs" of solder, ends cut from wires, stripped wire insulation, and other trash, are completely removed from inside the cabinets.

8 FIRST-TIME, ON-SITE TRANSMITTER START-UP PROCEDURE

The DTR10SC transmitter's power meter is calibrated in the factory for 100% at full power at the channel specified when the unit is tested. The DTR10SC, as delivered, is also tested with the accompanying HCS-5000R+ transcoder so that the transcoder RF output level is already set to the correct level to achieve 100% power when the system is correctly installed and powered. The power meter calibration is slightly channel-dependent and requires a minor re-calibration when changing the channel of operation.

1. Connect the DTR10SC transmitter RF OUT to a 50 ohm test load or the antenna. To confirm output power use a calibrated coupler and spectrum analyser with band power function , if available, for measuring power when the DTR10SC is turned on.
2. Connect the HCS-5000R+ transcoder's RF OUT to the DTR10SC amplifier's RF IN.
3. Connect the 115VAC mains input to the DTR10SC transmitter and any other related equipment including the transcoder. Supply the 115VAC AC mains to the DTR10SC through a slow-tripping breaker or time delay fuse with at least 5A rating.
4. Set the front panel power switch (rocker-type) to on position "I"; off position is "O". The LED marked ON will illuminate green. INTRLK and TEMP should be unlit. At this time the DTR10SC has DC power.
5. If the VSWR LED is lit, then there is an incorrect load impedance attached to the DTR10SC's RF OUT. Turn the unit off using the front panel rocker switch and correct the RF load by checking the connections from RF OUT to the load or antenna, making reparations and re-starting the transmitter as per step 4.
6. The amplifier is equipped with AGC and VSWR protections which have been factory set. The output rf level as displayed on the amplifier LCD display will be 100% under normal operating conditions.

NOTES