



Digivance™ Indoor Coverage Solution SMR⁺ Single- or Multi-Mode Fiber System Installation and Operation Manual





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Digivance™ Indoor Coverage Solution SMR+ Single or Multi-Mode Fiber System Installation and Operation Manual

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ABOUT THIS GUIDE

This installation and operation manual provides the following information:

- An overview of the Digivance Indoor Coverage Solution (ICS)
- A description of the basic system components including the Digital Host Unit (DHU), Digital Expansion Unit (DEU), and the Digital Remote Unit (DRU).
- System requirements for planning the Digivance ICS installation.
- Procedures for installing the DHU.
- Procedures for operating and maintaining the Digivance ICS.
- Product warranty, repair, return, and replacement information

The procedures for installing the DEU and DRU are provided in other publications which are referenced in the Related Publications section and at appropriate points within this manual.

RELATED PUBLICATIONS

Listed below are related manuals and their publication numbers. Copies of these publications can be ordered by contacting the ADC Technical Assistance Center at 1-800-366-3891 (in U.S.A. or Canada) or 952-946-3000, extension 63475 (outside U.S.A. and Canada).

Title/Description	ADCP Number
Digivance ICS Digital Expansion Unit Installation Instructions Provides a description of the DEU and procedures for installing the DEU.	75-111
Digivance ICS Digital Remote Unit Installation Instructions Provides a description of the DRU and procedures for installing the DRU.	75-112

ADMONISHMENTS

Important safety admonishments are used throughout this manual to warn of possible hazards to persons or equipment. An admonishment identifies a possible hazard and then explains what may happen if the hazard is not avoided. The admonishments — in the form of Dangers, Warnings, and Cautions — must be followed at all times. These warnings are flagged by use of the triangular alert icon (seen below), and are listed in descending order of severity of injury or damage and likelihood of occurrence.



Danger: *Danger is used to indicate the presence of a hazard that **will** cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*



Warning: *Warning is used to indicate the presence of a hazard that **can** cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*



Caution: *Caution is used to indicate the presence of a hazard that **will** or **can** cause minor personal injury or property damage if the hazard is not avoided.*

GENERAL SAFETY PRECAUTIONS

The following general admonishments apply throughout the procedures in this manual.



Warning: *Wet conditions increase the potential for receiving an electrical shock when installing or using electrically-powered equipment. To prevent electrical shock, never install or use electrical equipment in a wet location or during a lightning storm.*



Warning: *The DRU is powered by 48 VDC power which is supplied over customer-provided wiring. To prevent electrical shock when installing or modifying the DRU power wiring, disconnect the wiring at the power source before working with uninsulated wires or terminals.*



Danger: *This equipment uses a Class 1 Laser according to FDA/CDRH rules. Laser radiation can seriously damage the retina of the eye. Do not look into the ends of any optical fiber. Do not look directly into the optical adapters of any digital unit or exposure to laser radiation may result. An optical power meter should be used to verify active fibers. A protective cap or hood **MUST** be immediately placed over any radiating adapter or optical fiber connector to avoid the potential of dangerous amounts of radiation exposure. This practice also prevents dirt particles from entering the adapter or connector*



Danger: *Do not look into the ends of any optical fiber. Exposure to laser radiation may result. Do not assume laser power is turned-off or the fiber is disconnected at the other end.*



Danger: *Always allow sufficient fiber length to permit routing without severe bends. Fibers may be permanently damaged if bent/curved to a radius of less than 2 inches (50 mm).*

STANDARDS CERTIFICATION

FCC: This equipment complies with the applicable sections of Title 47 CFR Part 90.

UL/CUL: This equipment complies with UL and CUL 1950 Standard for Safety for Information Technology Equipment, Including Electrical Business Equipment.

The DRU is suitable for use in environmental air space in accordance with Section 300-22(c) of the National Electrical Code, and Sections 2-128, 12-010(3), and 12-100 of the Canadian Electrical Code, Part 1, C22.1.

FDA/CDRH: This equipment uses a Class 1 LASER according to FDA/CDRH Rules. This product conforms to all applicable standards of 21 CFR Part 1040.

IC: This equipment complies with the applicable sections of RSS-131. The term “IC:” before the radio certification number only signifies that Industry Canada Technical Specifications were met.

LIST OF ACRONYMS AND ABBREVIATIONS

The acronyms and abbreviations used in this manual are detailed in the following list:

A	Amperes
AC	Alternating Current
AGC	Automatic Gain Control
AMPS	Advanced Mobile Phone Service
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CDRH	Center for Devices and Radiological Health
CUL	Underwriters' Laboratories of Canada
DAS	Distributed Antenna System
DC	Direct Current
DEU	Digital Expansion Unit
DHU	Digital Host Unit
DRU	Digital Remote Unit
EIA	Electronic Industries Association
ERP	Effective Radiated Power
ESD	Electrostatic Discharge
FCC	Federal Communications Commission
FDA	Food and Drug Administration
ICS	Indoor Coverage Solution
iDEN	Integrated Digital Enhanced Network
MM	Multi-Mode
NOC	Network Operations Center
NPSPAC	National Public Safety Planning Advisory Committee
PWR	Power

RF	Radio Frequency
RSSI	Received Signal Strength Indication
RX	Receive or Receiver
SM	Single-Mode
SMR	Specialized Mobile Radio
TX	Transmit or Transmitter
UL	Underwriters' Laboratories
UPS	Uninterruptible Power Supply
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current
WECO	Western Electric Company

1 SYSTEM FUNCTIONAL OVERVIEW

The Digivance ICS is a digitally distributed antenna system that provides in-building coverage for wireless phone systems operating within the 800 MHz frequency bands used for SMR and NPSPAC (SMR⁺) communications. Large buildings typically interfere with the transmission or reception of cellular phone system signals by imposing high attenuation losses on RF signals. The Digivance ICS is designed to overcome the attenuation losses that make wireless communications within buildings or structures difficult or impossible. With the Digivance ICS, wireless phone RF signals can be distributed to the interior areas of any building or structure to eliminate dead spots and improve reception.

1.1 Basic System Components

The basic components of the Digivance ICS and their functions are shown in Figure 1. The basic system consists of the Digital Host Unit (DHU), Digital Remote Unit (DRU), and when additional capacity or longer fiber runs are required, the Digital Expansion Unit (DEU). In addition, a local interface device and a remote interface device must be used as needed to interface the DHU with the cellular system Base Transceiver Station (BTS).

1.2 Interface With BTS

The DHU interfaces, either locally or remotely, with the BTS. As referenced in this publication, the BTS could be either a microcell or a cell site base station. When the BTS is co-located (microcell interface) with the DHU, a local interface over coaxial cable is possible. An interface device (ancillary product) must be used to provide the proper input and output RF signal levels between the BTS and the DHU. When the BTS is not co-located (cell site base station interface) with the DHU, a remote interface using a donor antenna is required. An interface device (ancillary product) must be used to provide the proper input and output RF signal levels between the donor antenna and the DHU.

In the forward path, the DHU receives RF signals from the BTS. The DHU digitizes the RF signals and then converts them to digital optical signals for transport to the DEU's and DRU's. In the reverse path, the DHU receives digital optical signals from the DRU's and DEU's. The DHU converts the optical signals back to the original RF signal format for transmission to the BTS.

1.3 Interface With Cellular Phones

The DRU interfaces (through an external antenna) with the cellular phones. In the reverse path, the DRU receives RF signals from each cellular phone. The DRU digitizes the RF signals and then converts them to digital optical signals for transport to the DHU. In the forward path, the DRU receives digital optical signals from the DHU. The DRU converts the optical signals back to the original RF signal format for transmission to the cellular phones. A small external antenna is connected to the DRU to transmit and receive RF signals to and from the cellular phones.

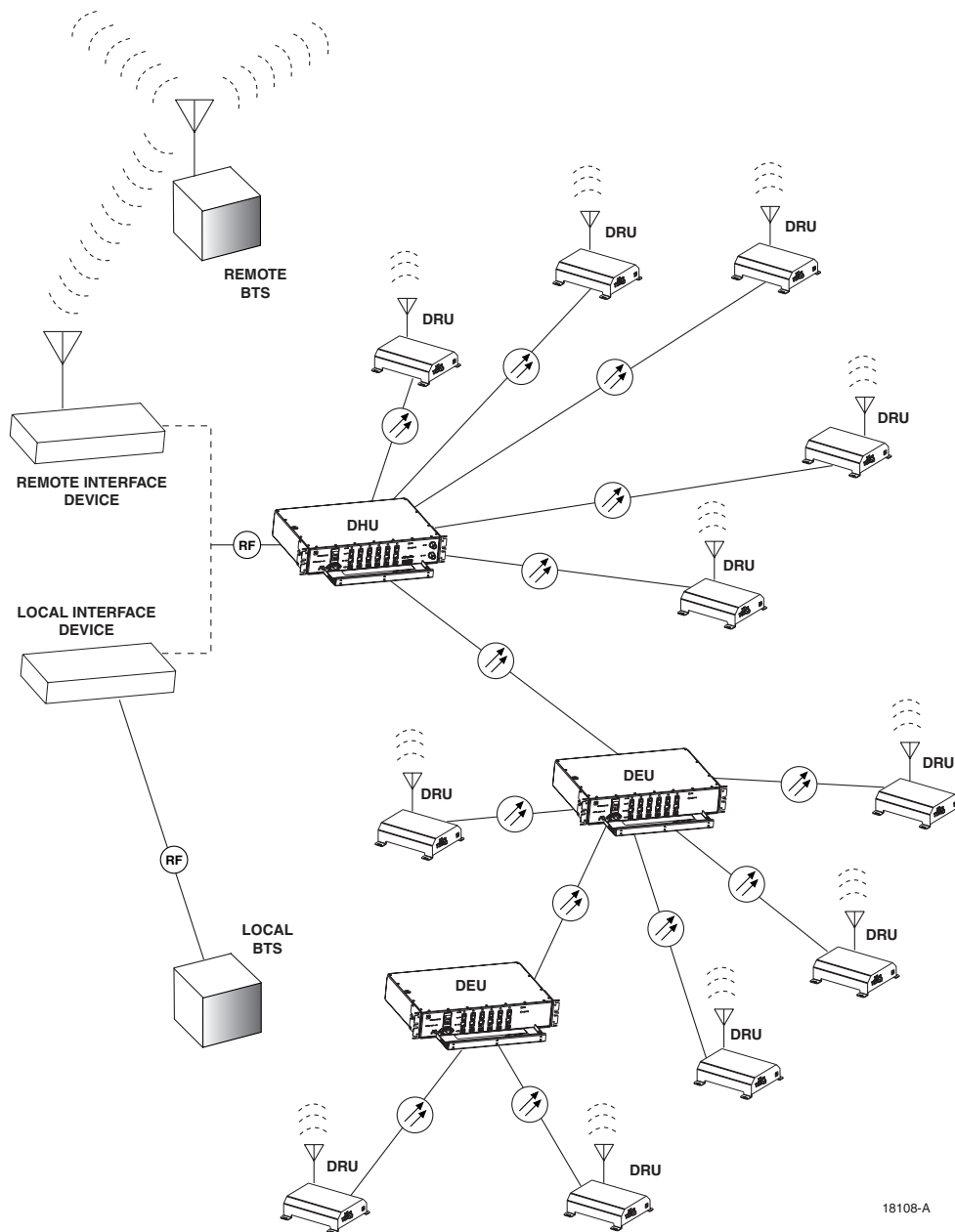


Figure 1. System Overview Functional Block Diagram

1.4 Digital Fiber Optic Transport

The DHU is connected to each DRU unit over a pair of either multi-mode or single-mode (depending on the type of optical transceiver specified) optical fibers. One fiber is used to transport the forward path optical signal. The other fiber is used to transport the reverse path optical signal. Because the optical signal is digital, no adjustments to the optical signal level are required at the DRU or the DHU as long as the BER is adequate. Either 62.5 or 50 micron core multi-mode optical fiber; or 9 micron core single-mode optical fiber may be used for the

optical transport connection. With 62.5 micron core multi-mode fiber , the optical path may be up to 500 meters in length. With 50 micron core multi-mode fiber, the optical path may be up to 750 meters in length. With 9 micron core single-mode fiber, the optical path may be up to 10 kilometers in length. Single- and multi-mode fibers may be used in the same system. The optical fibers must be terminated with duplex LC connectors for connection with the DHU, DEU's and DRU's.

1.5 Capacity for Expansion and Extended Runs

The DEU enables 6-way expansion of any optical port. This makes it possible to add more DRU's without having to install additional DHU's. Each DHU is equipped with six optical ports. If more than six DRU's are required by the application, a DEU may be connected to one of the DHU optical ports which expands that port to six ports. If still more optical ports are required, then a second DEU may be connected to the DHU; or a second DEU may be connected to the first DEU. The ability to cascade DEU's in parallel or in series provides unlimited flexibility. It is physically possible to connect an unlimited number DRU's to the DHU through the installation of DEU's. The maximum number of DRU's that can connected to the DHU is limited only by the cumulative noise effect caused by antenna combining.

1.6 Power Requirements

The DHU and DEU are each powered by 120–240 Vac (50–60 Hz) power which is supplied through a standard three-conductor AC power cord. The DRU is powered by 34–48 Vdc which is supplied by either the DHU, DEU, or an ac/dc wall-mount style converter. When the DRU is powered by the DHU or DEU, the power is fed through a category 3 or 5 cable terminated with male RJ-45 connectors.

1.7 Fault Detection and Alarm Reporting

LED indicators are provided on the front panel of the various units to indicate if the system is normal or if a fault is detected. In addition, normally open and normally closed alarm contacts (for both major and minor alarms) are provided at the DHU for connection to a customer provided external alarm system. This could be a local system or automatic call-out system.

2 DIGITAL UNIT DESCRIPTION

This section provides a description of the functions and features provided by the units that comprise the ICS system, a listing of terms used and their definition, and a table of specifications.

2.1 Digital Host Unit Description

The DHU, shown in Figure 2, serves as the BTS servicing unit for the Digivance ICS. The DHU provides the following basic functions:

- RF inputs and outputs
- Optical interface to the DRU's or DEU's
- Digitizing of the cellular forward path RF signal
- Distribution of the digitized forward path RF signals into six digitized optical signals
- Conversion of up to six reverse path digitized optical signals to six digitized RF signals
- Combining of the six digitized RF signals into a single composite digitized RF signal
- Conversion of the combined digitized RF signal to a composite RF signal
- DC power for powering the DRU's
- Relay contact closures to provide alarm information to an external alarm system

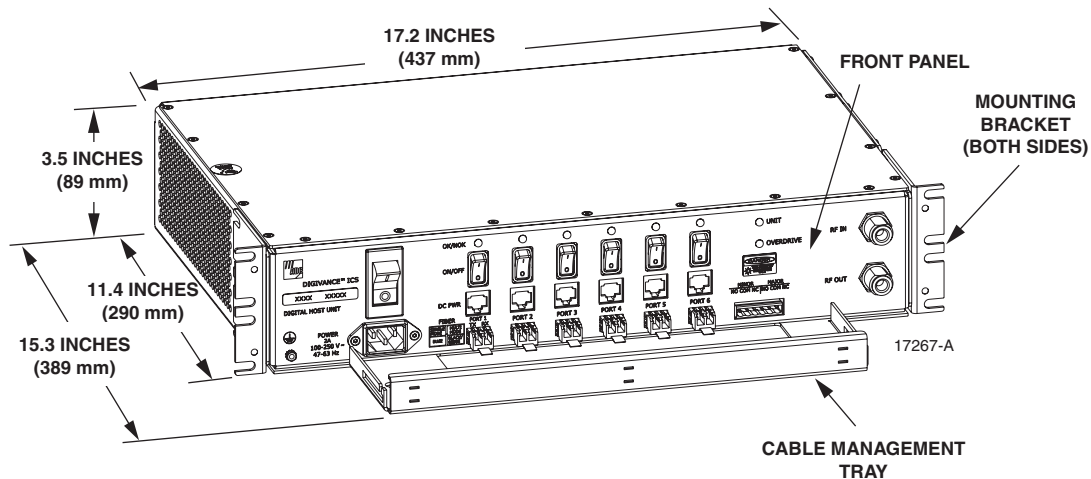


Figure 2. Digital Host Unit

2.1.1 Primary Components

The DHU consists of two electronic circuit board assemblies, a power supply assembly, and a fan assembly that are mounted within a powder-coated sheet metal enclosure. The metal enclosure provides a mounting point for the electronic assemblies, serves as a heat sink, and controls RF emissions. Except for the fan units and optical transceivers, the DHU components are not field replaceable. The DHU is designed for use within a non-condensing indoor environment such as inside a wiring closet or cabinet. All controls, connectors, and indicators are mounted on the DHU front panel for convenient access. Cable management functions for the power and fiber optic cables are provided by a cable management tray that extends outward from the DHU front panel.

2.1.2 Mounting

The DHU may be used in both rack-mount and wall-mount applications. For rack mount applications, a pair of reversible mounting brackets is provided that allow the DHU to be mounted in either a 19-inch or 23-inch EIA or WECO equipment rack. When rack-mounted, the front panel of the DHU is flush with the front of the rack and the cable management tray extends 3.9 inches (99 mm) beyond the front panel. For wall-mount applications, a pair of holes is provided in the cable management tray which allow the DHU to be mounted on any flat vertical surface. The DHU should be oriented with the front panel facing upward when wall-mounted. Fasteners are provided for rack-mount applications.

2.1.3 Fault Detection and Alarm Reporting

The DHU detects internal circuitry faults and optical port faults. Various front panel Light Emitting Diode (LED) indicators turn from green to red or yellow if a fault is detected or an optical input is lost. A set of alarm contacts (normally open and normally closed) are also provided for reporting an alarm to an external alarm system when a fault is detected. Both major alarm (all fault conditions except high temperature) and minor alarm (high temperature fault condition) contacts are provided.

2.1.4 RF Signal Connections

The RF signal connections with the BTS are supported through two type N female connectors. One connector is used for coaxial cable connection of the forward path RF signal. The other connector is used for coaxial cable connection of the reverse path RF signal. In most installations, the DHU will not connect directly to the BTS but will be connected to an interface device (ancillary product).

The DHU requires a composite forward path RF signal level of **-20 dBm** or lower. An overdrive limiter protects the system against excessive inputs but does not function during normal operation. The DHU does not have Automatic Gain Control (AGC).

2.1.5 Optical and Electrical Connections

The optical and electrical connections with the DRU's and DEU's are supported by six optical and six electrical ports. Each optical and electrical port includes a status LED, a small form factor LC-type optical transceiver, an RJ-45 DC power jack, and a port enable/disable switch. Each transceiver is color-coded to identify whether it supports single-mode (blue) or multi-mode (black/beige) fiber. An optical port may be connected to a DRU, a DEU, or not used. An electrical port may be connected to a DRU or not used. Unused ports are disabled via the corresponding port enable/disable switch. When disabled, the port LED is off, the alarm reporting function is disabled, the laser is off, and the DC power is off. Enabling the enable/disable switch activates all functions. The modular optical transceivers are available separately as accessory items and are field replaceable.

2.1.6 Powering

The DHU is powered by 120–240 Vac (50–60 Hz) power which is supplied through a standard three-conductor AC power cord. The power cord is provided with the DHU and is 98 inches (2.5 meters) long. A resettable circuit breaker/On-Off switch is provided at the unit front panel. The switch applies power to the DHU internal power supply.

2.1.7 Cooling

Continuous air flow for cooling is provided by dual fans mounted on the right side of the housing. A minimum of 3 inches (76 mm) of clearance space must be provided on both the left and right sides of the DHU for air intake and exhaust. An alarm is provided that indicates if a high temperature condition ($>50^{\circ}\text{C}/122^{\circ}\text{F}$) occurs. The fans may be field-replaced if either fan fails.

2.1.8 User Interface

The DHU user interface consists of the various connectors, switches, terminals, and LEDs that are provided on the DHU front panel. The DHU user interface points are described in Table 1 and indicated in Figure 3.

Table 1. Digital Host Unit User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1		Ground stud	Used for connecting a grounding cable to the DHU chassis.
2	POWER	3-wire AC power cord connector	Used for connecting the AC power cord.
3	I/O	I/O rocker switch/circuit breaker	Provides AC power On/Off control and AC power over current protection.
4	OK/NOK (Ports 1–6)	Multi-colored LED (Red/Green/Yellow)	Indicates if the DRU or remote DEU connected to the optical port is normal or faulty or if the reverse path optical input from the DRU or remote DEU is normal or lost. (see Note)
5	ON/OFF (Ports 1–6)	I/O rocker switch	Enables or disables corresponding electrical and optical ports.
6	DC PWR (Ports 1–6)	RJ-45 jack (female)	Used for connecting a DRU cat 3 or 5 power cable to the designated DC power jack.
7	FIBER (Ports 1–6)	LC-type optical transceiver	Used for connecting each DEU or DRU forward path and reverse path optical fibers to the designated optical port.
8	UNIT	Multi-colored LED (Red/Green/Yellow)	Indicates if the DHU is normal or faulty. (see Note)
9	OVERDRIVE	Multi-colored LED (Red/Green/Yellow)	Indicates when the forward path RF input power is overdriving the DHU digitizing circuitry. (see Note)
10	MAJOR MINOR	Screw-type terminal connector (14–26 AWG)	Used for connecting an external alarm system to the DHU. Includes normally open (NO), normally closed (NC), and common (COM) wiring connections.
11	RF IN	N-type female RF coaxial connector	Used for connecting the forward path RF coaxial cable to the DHU.
12	RF OUT	N-type female RF coaxial connector	Used for connecting the reverse path RF coaxial cable to the DHU.

Note: A more detailed description of LED operation is provided in Section 5.