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The IDHX6 & IDHX8 ISOLATED DISTRIBUTION HUB (with built-in RS232⇔RS485 converter) for large RS485 networks and other industrial/robust applications.

GENERAL and BACKGROUND INFORMATION:

R. E. SMITH has been designing and producing **RS485** repeaters, converters, and distribution hubs (repeater hubs) for over 15 years. Most unit feature isolated **RS485** (2-wire, half duplex) and operate at speeds up to 115.2Kbps (and higher). During this time period we have incorporated various levels of galvanic isolation and transient protection schemes to allow our units to operate reliably in industrial and outdoor applications. Other feature of our product line include: Automatic data direction control with fast turn around time (27uS typical from the leading edge of the stop bit), wide operating input voltage range (9-35VDC), true pier-to-pier communications (on the fly repeater), built in bias and termination, removable terminal strips, Power/RXdata/TXdata LED indicators, independent TXdata and RXdata control jumpers, built-in auto-reset fuses on the communications lines, high voltage isolation (3.0KV, 1 sec.), built-in RS232⇔RS485 converter, -40C to +85C operating temperature range, 10-90% relative humidity (non-condensing) and other features to allow our units to be easily installed and serviced in the field.

Over the years we have made various recommendations to enhance the reliable operation of our products. While some of the recommendations appear to be easy to implement in a typical installation, many times these enhancements are not incorporated into the final application. Our product line has had a long and reliable track record in many applications from the bottom of the sea to the top of the atmosphere. With the advent of our new **IDHX6** and **IDHX8**, 3.0KV isolated distribution hubs, many of the field recommendations that we have made over the years. have now been incorporated into these new designs. While a direct hit from lightening usually wins all battles, the new features of the **IDHX Series** of multi-port distribution

hubs makes it much more difficult for induced lightening voltages/currents, or other extreme electrical conditions, to disrupt/damage these enhanced repeaters.

We have listened to suggestions from our customers and have endeavored to continually improve our product line over the years. We thank everyone who has participated in making our product line one of the, if not, the most robust line of RS485 products available. Any additional improvements or suggestions would be greatly appreciated.

Thank you,
Ronald Smith
513-874-4796

GENERAL DESCRIPTION of the IDHX6 and IDHX8 Units:

The **IDHX6 and IDHX8** are 6-port and 8-port **RS485** (two-wire, half-duplex) automatic repeater/ distribution hubs respectively, with galvanic isolation to 3.0KV for 1 second, a wide input voltage operating range (9-35VDC), with a built in **RS232⇔RS485** converter, and superior multi-stage transient protection. These units can be used to expand **RS485** serial communications networks by increasing the maximum distance and/or number of nodes on a network. **RS422** devices (4-wire, full or half-duplex), can also be supported by using two units. One unit can be used for outgoing data, and the other one for incoming data (or use split mode operation of on one unit).

Multiple units can be cascaded to form very large RS485 networks. While the RS485 specification calls for up to 32 standard unit loads (nodes), on a network that can be "daisy-chained" at distances up to 4000ft. (1200 meters), and at speeds up to 100Kbps, this is often not convenient to implement in many applications. Further the "daisy-chain" approach is often difficult to trouble shoot, or to find a defective unit on the network.

These units and other R. E. Smith products allow the user to make "homerun" connections to the repeater/distribution hub. One or two "homerun" connections can be made into each repeater port (A-F or A-H). As long as the total distance of the two "home runs" connected to one port is less then 4000 feet, and/or the number of devices connected to these lines do not impose more than 32 unit loads, the RS485 distance/loading specifications are not violated. This means that the **IDHX6** can support up to 12 "homerun" connections, and the **IDHX8** can support up to 16 "homerun" connections. The termination jumper should be removed from a port that has 2 "homerun" lines attached. Termination should be applied at the end of each "homerun" line. For a single "homerun" or a "daisy-chain" connection, leave the termination jumper installed. Further, two "daisy-chain" connections are supported by removing the termination jumper and applying termination at the end of both lines. A total of 32 standard load units can be connected for the two "daisy-chain" branches.

Each distribution port has its own termination jumper, a TXEN (transmit enable) jumper, and an RXEN (receive enable) jumper. Bias is fixed with 470 Ohms of pull-up and pull-down resistance to hold the data lines in a known state when the data lines are inactive. Each distribution port on the **IDHX6 or IDHX8** hub will support up to 32 full-load RS485 devices. Additional units/nodes can be added, using 1/2(64 units) and 1/4(128 units) load devices. The SN65LBC184 transceiver IC, employed on these units is a 1/4 load device, with built-in transient protection, and is slew rate limited to 250 Kbps.

Once an RS485 network exceeds about 32 nodes on a network, serious consideration should be given to using galvanic isolation. Even though some IC manufacturers offer light loading

devices, that can accommodate 256 or even 400 nodes on one RS485 network, you may not want to build such a network for a few reasons. One reason is that, large networks accumulate distributed electrical noise, which can make communications unreliable. In general it is very important not to run communications wires in the same trough or conduit that is in parallel with AC power cables. Maintain as much distance as possible and cross any power cable at a right angle. While shielding is not specified for RS485 systems, it can help in many instances. Further, by "isolating" sections of a large network, the accumulated noise on one isolated leg is not as likely to cause a data error that will propagate to another leg of the network. Galvanic isolation will break a large problem into several small, but manageable ones. Galvanic isolation can also help eliminate "ground loops."

Another potential problem with large networks, without isolation, is that severe damage can occur to your entire system, if a high voltage source is connected (accidentally or otherwise) to your communications lines. Your entire network could be damaged. With galvanic isolation the damage is generally limited to only one leg of the network, except in extreme cases of very high voltage (induced by lightening for example). While it goes against conventional wisdom, and can potentially cause a problem with circulating currents by grounding a shielded cable at both ends, this method is very effective at keeping induced lightening noise away from the communications lines. In the alternative, ground one end of the shield and connect the other end to ground through a bi-directional transient protector (this protection is now provided by the **IDHX6 and IDHX8** units). R. E. Smith also provides an extensive line of optical/transformer isolated repeaters, converters, and multi-port repeaters as well as a series of fiber optic products which provide very high isolation. These products are extremely effective in applications involving industrial control, large RS485 networks, outdoor data links between buildings, etc.

Because the **IDHX6 and IDHX8** are both RS232/RS485 compatible, you can communicate with the devices connected to the distribution ports in either protocol. This allows a convenient way to connect the distribution hub(s) to a desktop computer or laptop without the need for a separate RS232⇔RS485 converter. You can also trouble shoot an active network by connecting a monitoring computer to the RS232 port if it is not being used for control. For example, if the network control is from an RS485 source on one of the ports, by connecting a laptop, or other computer, yoy can use the RS232 port to monitor the data that is received/transmitted on the RS485 ports. Be careful not to sent data from the monitoring computer in this mode, or a data collision could occur (a jumper is available to prevent this). In the alternative, the RS232 port can be used to control a network of RS485 devices. Transmit control on the RS485 ports are fully automatic, and will work at baud rates from 300-115.2Kbps (up to 250Kbps with RS485 only).

In general, RS485 is designed for multi-drop, "daisy-chain" operation over a single twisted pair cable with a nominal characteristic impedance of 120 Ohms. This cable is usually 24AWG. Category-5 cable will generally work well in most instances even though its characteristic impedance is 100 Ohms. "Tap points" or "T" connections should be short to eliminate reflections. It is possible to connect several RS485 circuits in parallel if the distances are below about 300 feet per leg @ 9600bps. By using limited slew rate devices this distance can probably be extended; however, at greater distances and higher data rates, the cable impedances add up and load the network. In addition there is no good way to add termination resistors at the ends of a "star" network, without using a multi-port repeater/distribution hub. The combination of the cable impedances and/or termination resistors will load the network and can make communications unreliable or non-existent. The limited slew rate drivers used on the **IDHX6 and IDHX8** units help eliminate some of these problems and allow a better chance for success.

If a remote node on a large network, turns on its transmitter, and then for some reason looses control and will not turn off, this one device could “lock-up” the entire network. By removing the RXEN (receive enable) jumper associated with the channel connected to the defective unit, that will not turn off, normal operation can be restored to the rest of the network while the problem is being fixed (the offending port will have the Green RXdata LED indicator on, and the remaining ports will have the Red TXdata LED indicators on.

It is possible to break the **IDHX6 and IDHX8** units into several smaller repeater configurations. The RS232⇔RS485 converter is always associated with ports A&B. Typical configurations for the **IDHX6** unit are: 6-port, 3-3-port, 4-2-port, and 2-2-2-port. Typical configurations for the **IDHX8** unit are: 8-port, 4-4-port, 6-2-port, 3-2-3-port, and 2-2-2-2-port.

DESCRIPTION of IMPROVED TRANSIENT PROTECTION AND OTHER FEATURES:

Multi-stage transient protection has been added to the **IDHX6 and IDHX8** isolated distribution hubs. Each port has 3.0KV galvanic isolation (transformer and optical), two 2-Watt 27-Ohm current limiting power resistors, a protection bridge consisting of four 1N4004 diodes and three Tranzorb transient suppressor (for differential and common mode protection), two auto-reset 100mA communications fuses, an SN65LBC184N RS485 tranceiver with built in transient protection, and a “shunt” Tranzorb transient suppressor (P6KE56CA) to “chassis common/earth ground” (connected to a local standoff for each port).

In addition a “protection bus” is provided via jumper selection (factory default) to connect the “backbone” non-isolated side of the interface and each of the individually isolated ports (A-F or A-H) onto one common bus with a terminal strip connection to earth/chassis ground. The connections to the “protection bus” are through a P6KE56CA transient suppressor from all sources (A-F or A-H and “backbone”). In the event that the unit is mounted to a non-metallic or non-grounded surface, a single connection to earth/chassis ground can be made to enhance the protection afforded to the unit. This configuration provides a very robust protection implementation and has NOT been available on previous multi-port repeater/distribution hub units. While the “clamping” effect of the transient suppressors limits the common mode range of the isolated ports to approximately +/-60V, this is a reasonable tradeoff and will dramatically improve the survival of the unit under extreme electrical conditions.

Shield connection: While a shield connection can be made directly to the common terminal on the isolated RS485 ports, doing so could cause intermittent communications during electrical activity induced into the shield. Connect the shield directly to earth/chassis ground if possible. In the alternative, connect the shield through a power resistor or a bi-directional transient suppressor to earth/chassis ground. While connecting the shield to the common terminal of the port is not necessarily bad, it is not the best choice (some series resistance could help, 100-Ohms @ 2W for example).

Improved timing has been implemented on the **IDHX6 and IDHX8** units, along with the elimination of a “glitch” problem at higher data rates that resulted in a partial bit data collision on other multi-port models. The overall improvements in the design of the **IDHX6 and IDHX8** units should allow for reliable/robust operation in industrial and/or outdoor applications with a minimum of down time. If you locate a better RS485 repeater/distribution hub let us know. It won’t be the best for long.

A schematic is provided with the repeater hub. If you have any questions or require any assistance with jumper settings, please give us a call at 513-874-4796.