Troubleshooting XPM 2+/XPM3 RS-485 Communications
September 1, 2011

Known Causes of RS-485 Communication Issues

1. The routing of RS-485 cables (W485-X) on ovens contributes to RS-485 communication issues.

   RS-485 cables being routed too close to high voltage cables or being tightly bundled with high voltage cables or wires.

   High voltage as far as RS-485 communications is concerned is any voltage greater then 24 VDC.

2. On some ovens with frequency inverters installed the behavior of the green COM3 RXD led on the DI board is normal

   (the green led flashes on an off as the response of each command is received from a device on the RS-485 network versus being constantly on from the effect of electrical noise on the RS-485 wiring saturating the RS-485 receiver on the DI board)

   when the cell fans are not running and is constantly on as soon as the cell fans are running.

   This problem was caused by the RS-485 cable in the wire duct above the electrical enclosure being too close to the cell fan cables.

   Ideally RS-485 cables should be left unbundled and separated as much as possible with other cables to minimize the amount of electrical noise coupled onto the RS-485 cables. This is not always easy to do especially in the wire duct above the electrical enclosure.
3. With the brush type rail width adjustment motors there will always be electrical noise generated by the arcing brushes in the motors.

   On some ovens the noise generated from the rail width adjustment motors prevents the measured value for the rail width adjust from updating while any of the width adjust motors are operating from the RS-485 receiver on the DI board being saturated with electrical noise.

   On some ovens this issue has been resolved from a combination of the following:

   Twist the positive and negative wires tightly together of each DC rail adjustment motor at each end of the W012 and W027 motor cables and make sure that the shield lead of cables W012 and W027 is connected with the ground wire on the motor end of the cables.

   On the electrical panel remove and discard all of the wire ties on RS-485 cables W485-2 and W485-3 on the right of the A1 board and keep the RS-485 cables as far away as possible from the width adjust motor cables at connectors P63 and P64 on the A1 board and also as far away as possible from 120 VAC wiring.
4. For ovens with the individual cell sensing option any of the following has caused RS-485 problems:

   The white and black wires being reversed or insulation captivated on one of the RS-485 connectors.

   One of the dip switches being set incorrectly on one of the individual cell sensing boards 3152210.

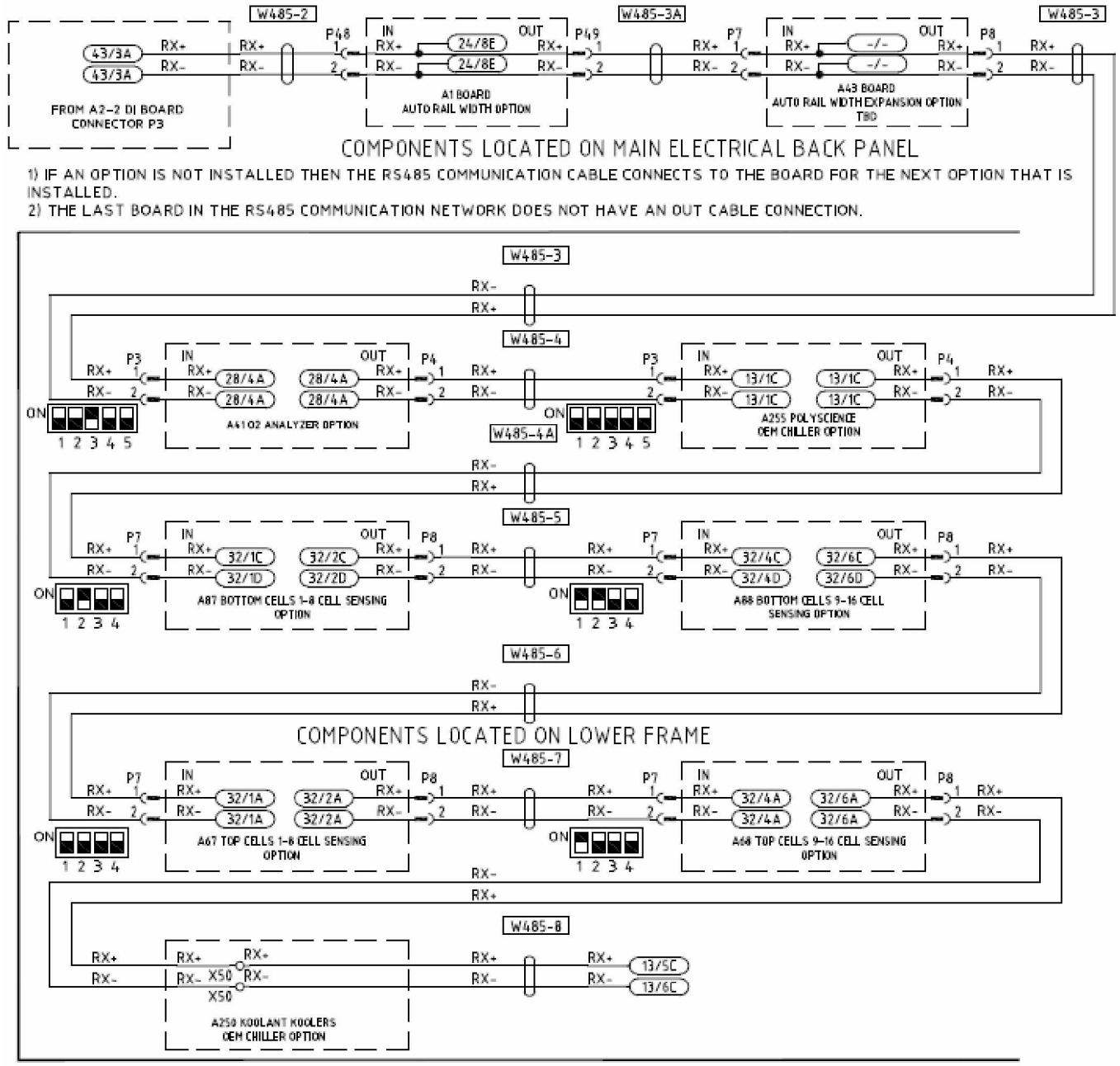
   One of the individual cell sensing boards 3152210 having a bad RS-485 transceiver component that is pulling down the entire RS-485 network. This can be traced by removing and bypassing each individual cell sensing board one at time starting with the last board in the network until the problem is isolated to one board.
5. Some RS-485 transceiver components are more sensitive to electrical noise then others and sometimes exchanging or removing and reinserting the RS-485 transceiver components in the DI board resolves RS-485 communication issues. Refer to the end of this document for more information.

RS-485 oven wiring and dip switch settings

A41 DIP SWITCH SETTINGS
ANALYZER TYPE POSITIONS 2 & 3
2 ON, 3 OFF = RIDZEWSKI
2 OFF, 3 OFF= NTRON MODEL 3100
2 OFF, 3 ON = PBI MAP CHECK 9000

ANALOG OUTPUT FULL SCALE POSITION 5
5 OFF = 0-10 VDC
5 ON = 0-5 VDC

Note: The dip switch setting for the analyzer option on the A41 board is shown for a PBI analyzer below.



RS-485 Oven Wiring practices:

The outer jacket is stripped back several inches on most of the cables in the ovens including the RS-485 communications to make bundles of cables easier to harness and to restrict the amount of stress that cables exert on the plug in connectors on the A1 board. Unfortunately the practice of stripping the outer jacket back on cables several inches contributes to noise being introduced onto signal wires.

A recent change has been implemented in manufacturing to improve this situation by tightly twisting the black and white wires of the RS-485 communication cables that have the outer jacket stripped back over an inch prior to terminating the individual wires in the Wago connectors. This appears to help with the noise issues that effect RS-485 communications.

Another change that was implemented long ago was to twist the red and black wires together of the rail adjust motors prior to terminating them in the Wago connectors to help cancel out the noise generated by the arcing brushes in the rail adjust motor. On occasion some ovens do not have the red and black rail adjust motor wires twisted together at the A1 board for unknown reasons.

If possible the rail adjust motor wiring and the RS-485 communication cables should be verified on the oven at connectors P63, P64, P48 and P49 on the A1 board and also on the lower front connector on the DI board.

If the red and black wires of the motor cables are not twisted together then they should be removed from the Wago connectors, twisted together and reinstalled into the Wago connectors.

The same should be applied with the white and black wires from the RS-485 communication cables including the RS-485 connections on the O2 analyzer board on the off-load end of the oven if the oven has an integrated O2 analyzer.

The black and white wires of the RS-485 communication cables to individual cell sensing boards should also be twisted together on the on-load if the option is installed.

Operation of RS-485 Communication in the controller software:

1. The controller sends a command to each of the configured RS-485 devices once a second. This is indicated by the red COM3 led on the DI board flashing on and off.
2. If an RS-485 device fails to respond within a second the controller software repeatedly sends the command that failed to respond up to 3 times to the device before giving up and sending a command to another RS-485 device.
3. The rail width interface and O2 analyzer interface boards have internal software to shut off all of the outputs on the boards if there has not been successful RS-485 communication between the board and the controller for over 10 seconds. This is to prevent the boards from remaining in an unknown state.

Devices in the oven that use RS-485 communications:

1. Manual or automatic rail adjust through rail interface A40 (V/S PN 3152010-C).
   This board is not present on a belt only conveyor configuration.
2. Integrated oxygen analyzer through oxygen analyzer A41 (V/S PN 3152510-D).
   This board is not present on air only ovens.
   It is present when an integrated oxygen analyzer is installed and when multi-port sampling is ordered separately without and integrated oxygen analyzer.
3. Individual cell sensing through 16 channel digital input boards A67, A68, A87, A88 (V/S PN 3152210-B).
   Two or more of these boards are present when the individual cell sensing is installed. The controller software determines how many boards to communicate with based on the number of configured heat and cool cells.
4. External chiller using either a Koolant Koolers chiller or a Poly Science chiller versus and integrated cooling system or factory supplied cooling.

   The Koolant Koolers chiller has a direct RS-485 connection from a cable from the rear of the chiller to the coolant connection panel on the rear of the oven.

   The Poly Science chiller has an RS-232 connection to a modified oxygen interface board with special software loaded into the board. All of the dip switches are set to off on this modified board.

Common symptoms of RS-485 related communication problems:

1. The sampling port solenoids switch on and off while the oven is running in a nitrogen mode.
   This is from the o2 analyzer interface board not receiving RS-485 communications often enough from the controller because another device on the RS-485 is not communicating or an option with RS-485 communication is configured, but not installed on the oven.
2. A rail width adjust motor stops and starts while positioning.
   This is from the rail width adjust board not receiving RS-485 communications often enough from the controller because another device on the RS-485 is not communicating or an option with RS-485 communication is configured, but not installed on the oven.
3. Several individual cell sensing nuisance alarms.
   One or more of the dip switch settings is incorrect on the individual cell sensing boards or there is excessive noise on the RS-485 network.

RS-485 communication error counters:

RS-485 communication error counters are available for viewing **starting with controller software version 2.08.01.00 04/22/2008**.

The counters can be viewed to determine which device on the RS-485 network is experiencing the most RS-485 communication errors to isolate the problem to a specific device or to a wire connection that supplies several devices.

Using the PC Controller grid within the Vitronics Soltec Menu through the Master Password view the following locations at row 140:

Column 1 Total RS-485 communication errors
Column 2 Chiller communication errors
Column 4 A40 Rail board communication errors
Column 5 A41 O2 analyzer interface board communication errors
(dip switch 1,2,4,5 off, dip switch 3 is on for a PBI analyzer,
all off for an Ntron Model 3100 analyzer,
dip switch 1,3,4,5 off, dip switch 2 on for a Ridzewski analyzer)
Column 6 A67 Individual cell sensing board communication errors for zones 1-8 Top
(all dip switch positions are off)
Column 7 A68 Individual cell sensing board communication errors for zones 9-16 Top
(only dip switch position 1 is on)
Column 8 A87 Individual cell sensing board communication errors for zones 1-8 Bottom
(only dip switch position 2 is on)
Column 9 A88 Individual cell sensing board communication errors for zones 9-16 Bottom
(dip switch positions 1&2 are on)

These columns are incremented by the controller software each time an RS-485 device fails to respond to a command that is sent by the DI board to the device's address.

These columns can be cleared manually by copying, pasting and writing zero to them since the controller software does not monitor them and increments the existing value at each location by one when an error is detected.

PC Controller Grid Locations for Checking RS-485 Communications with devices

Oxygen analyzer measured value in tenths of PPM (000.0) read from the analyzer.
Row 142, Columns 42 and Columns 43
This value is read at all times from the analyzer regardless if the analyzer is ready to measure or if the oven is operating in nitrogen mode.

Row 142, Column 42 value	Row 142, Column 43 value	PPM representation
65535	31	Not ready to measure
58384	31	209,000.0 ppm or 20.9%
10000	0	1000 ppm or 0.1%
500	0	50 ppm

Poly Science chiller fluid temperature reading in tenths of degrees C
Row 142, Column 119

Individual Cell Sensing Option Boards digital input readings (zero = no inputs active and no alarms)
Row 144, Column 1 Board 1 A67 top cells 1-8
Row 144, Column 18 Board 2 A68 top cells 9-16
Row 144, Column 35 Board 3 A87 bottom cells 1-8
Row 144, Column 86 Board 4 A88 bottom cells 9-16

RS-485 Components on 31866XX DI Board:

Some RS485 transceiver chips are more sensitive to noise then others.

On the XPM3 DI board there are two RS-485 ports and the bottom port is not currently being used.

The RS485 transceiver chips on the XPM3 DI board are socketed 8 pin DIPS that are visible through an opening on the front of the board.
The XPM3 DI board must be removed from the rack in order to remove these chips from their sockets.

It is possible to swap the bottom RS485 transceiver chip with the top one when all other measures do not resolve RS485 communication problems.

During normal operation the green (receive) LEDS of the communication ports that are in use should switch off between communications.

With some problem RS485 transceiver chips or with an excessive amount of noise on the RS-485 wiring the green COM3 RXD LED stays on constantly and RS-485 communication error alarms are reported.

There are 7 LEDS on the front of the XPM3 DI board.

TOP

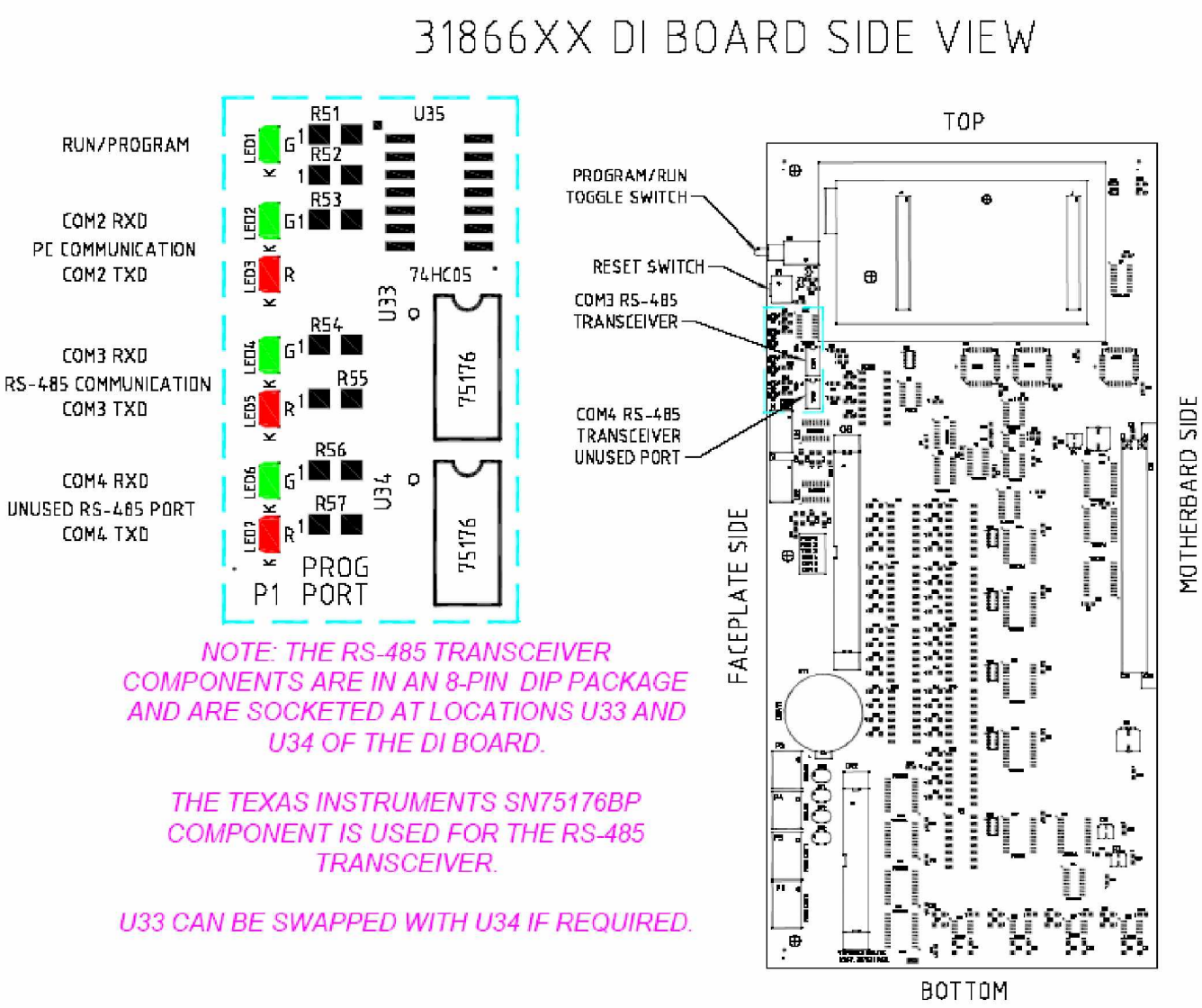
RUN - Green LED that is always on, except when programming the DI board or when power is absent.

COM2 RXD - green LED indicates data being received from the PC
(i.e. the data that the PC is sending to the controller)
COM2 TXD - red LED indicates data that the controller is sending to the PC

COM3 RXD - green LED indicates that data is being received from a device connected to the first RS-485 communication port
COM3 TXD - red LED indicates that the controller is sending data to a device connected to the first RS-485 communication port

COM4 RXD - green LED is normally on since this port is not currently being used
COM4 TXD - red LED indicates that the controller is sending data to a device connected to the second RS-485 communication port

BOTTOM



NOTE: THE RS-485 TRANSCEIVER COMPONENTS ARE IN AN 8-PIN DIP PACKAGE AND ARE SOCKETED AT LOCATIONS U33 AND U34 OF THE DI BOARD.

THE TEXAS INSTRUMENTS SN75176BP COMPONENT IS USED FOR THE RS-485 TRANSCEIVER.

U33 CAN BE SWAPPED WITH U34 IF REQUIRED.