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1 INTRODUCTION

In general all Grain Temperature Monitoring systems perform the process of data access, which reads data from a device and returns it to another device that requested it. More specifically, the data is requested, and then returned to the requesting device to be read. Typically there will be hundreds or even thousands of sensing points spread over a significant distance. It is a complicated and tedious process to cope with such distances and great number of points.

The KTX Remote simplifies this problem by integrating the measurement and switching of a small group of sensing points. It forms a system of independent switches, which measure and sequences through all the sources of the signals.

![KTX Remote, Pre-Installation](image)

Figure 1   KTX Remote, Pre-Installation
2 DESCRIPTION

The *KTX Remote* is a compact weatherproof enclosure divided into two compartments (refer to Figure 1). The bottom compartment is dedicated to wire splice connections. All wires from outside the box enter through this *Splice Compartment*. Electrical Conduit is attached here. The top compartment is sealed from moisture and dust. It is set apart to protect electronic components that are used for the purpose of switching signals. Access to the interior is provided by a hinged door with secure latches.

The sealed, top *Electronics Compartment* is occupied by a cage frame that holds the *Relay Switching Cards* in slots. All cards plug into a back plane board that inter-connects all cards. The *KTX Remote* has only one *K8X Control Card*, which is always in the first position closest to the hinge. The number of *K1 Cable Select Cards* ranges from 1 to 8 in order to scale the system to the number of *Temperature Cables*. Each K1 Card switches the signals of 1 to 3 cables.

The main function of the *KTX Switch* is to select one *Temperature Cable* and measure the thermocouple signals of the selected cable. The measurement is then sent through the RS 485 data link.

*KTX Remote specifications*

| Dimensions: | 17" (432mm) Height |
|            | 16" (406mm) Width |
|            | 8.25" (210mm) Depth |
| Enclosure: | NEMA 4 or 4X Water tight (intended for extremely wet or corrosive environments) |
| Input Power: | 12 VDC, 6W |
| TC Type: | Type T (Copper Constantan) |
| Size: | KTX-12(1-12 cables) |
|        | KTX-24(1-24 cables) |

1.1. The *KTX Remote* easily adapts to most existing temperature systems for add-on or renovation.
1.2. *Relay Switching Cards* plug-into slotted cage rack for ease of troubleshooting and repair.
1.3. Standard enclosure is made from heavy gauge steel with baked enamel finish.
1.4. An optional 304 Stainless Steel 4X enclosure is available by special order.
1.5. The KTX enclosure has an isolated splice compartment from the electronics compartment, sealed with an epoxy barrier to ensure that the switching remains in a clean, dust and moisture free environment.
1.6. Enclosure top has drip-shield / rain hood protecting door gasket.
1.7. All of the relay contacts and the card edge connectors are gold for reliable low level switching.
1.8. Edge connections of the *Relay Switching Cards* are bifurcated (split into two parts) and have a positive lock connection to ensure excellent contact even in high vibration conditions.
3 CONCEPTS

The following general discussion helps to better understand what is happening in the use of the KTX Remote.

3.1 Switches & Switching systems

Switches are electromechanical devices that control routing and operation of a signal path. Switching is a method that uses temporary connections, rather than permanent connections, to route information between Sensing Points and the Measuring Device. Even though a KTX Remote is internally made up of several Relay Switching Cards each having many electromechanical relays, it is just referred to as a single device.

Electromechanical relay-type switching systems operate on the premise that all paths are open until one path is directed to connect. A command to connect is called Selection. When internal control relays are open, all Sensing Points are isolated. Thus there is no way to turn on another Switch or Cable to give a false reading.

3.2 RS 485 data link

A RS 485 data link is used to transmit and receive data over a single twisted pair and can span relatively large distances (up to 4,000 feet (1,200 m)). It enables the communication between the KTX and a wireless data radio. The wireless data radio then communicates between the KTX and an Ethernet gateway.
4 Switch Locations

Leadbile, conduit and electronic hardware can be kept to a minimum by carefully distributing switching devices around the facility in strategic remote locations. These locations often include the roofs of tanks and interiors of head houses, see Figure 2. Often groups of cables in close proximity to each other have their leadwire conveniently routed to a single point. Where they come relatively close is a good place to locate a KTX Remote. Each KTX Remote measure the signals of the cables connected to it; not all of the cables in the facility. Note: Any power or communication lines needs to be run through conduit.

![Figure 2](image)

Figure 2  KTX Remote Switch Locations

5 Installation

The KTX Remote is mounted using its External Mounting Brackets (See Figure 1). The installer should check the system drawings and determine the proper location of each KTX Remote. Each remote should be easily accessible and free from obstruction. A fully loaded KTX Remote consists of one K8X Card and eight K1 Cards (full mux) and can handle up to 24 cables. A half loaded KTX Remote consists of one K8X Card and four K1 Cards (half mux) and can handle up to 12 cables. These cards and their capabilities will be discussed in detail later.
6 CONNEXIONS

6.1 DC Power
Nominally +12 Volt Direct Current Power comes from the RPX Power Supply. Run the Power from the Supply to the radio and from the radio to the KTX Remote Switch.
- 12 Volt SUPPLY, RED insulation, is the positive conductor.
- RETURN, BLACK insulation, is the negative conductor.

6.2 RS 485 Data Link
Use a single twisted pair to connect the KTX Remote to a communication device. Connect the twisted pair to control cable (CTLA, CTLB).
- A, BLACK insulation, Cable Select
- B, BLUE insulation, Cable Select

Figure 3 KTX Complete Setup
6.3 Dual Radio connections

For a Dual Radio setup, use a 4-pair twisted cable to run power and communication from the radio to both KTX Remote Switches. One twisted pair will run from the “485 A 1 B” connections on the radio to the first KTX Remote Switch and a second twisted pair from the “485 A 2 B” connections to the second KTX Remote Switch. See the picture below.

Figure 4   Dual Radio Setup
7 Wiring diagrams

The following sections will feature the more practical aspects and possibilities that may be encountered when installing the KTX Remote. In any Grain Temperature Monitoring System employing KTX Remotes, there will be variations in the number of temperature cables attached to each Remote. This part of the instructions will focus more on the most commonly used systems and using the color codes of wires to make the connections easier.

7.1 COLOR CODES

7.1.1 Cable Select & Switch Select

Cable Select A and B are used for RS485 communication. All other select lines (C, D, and E) are not used and should be left unconnected.

Table 1 describes how insulation colors of the Control Bus cable are organized.

<table>
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<tr>
<th>Logic</th>
<th>Insulation Color Code</th>
<th>GROUP (Constantan Insulation Color)</th>
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<tr>
<td>A</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>B</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>C</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>D</td>
<td>Red</td>
<td>White</td>
</tr>
<tr>
<td>E</td>
<td>Yellow</td>
<td>White</td>
</tr>
</tbody>
</table>

7.2 Thermocouple Cable

Table 2. Color Code Chart for 18TC Shielded Thermocouple Cable.

<table>
<thead>
<tr>
<th>TC №</th>
<th>Leadwire Insulation Color Code</th>
<th>GROUP (Constantan Insulation Color)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>4</td>
<td>Red</td>
<td>White</td>
</tr>
<tr>
<td>5</td>
<td>Yellow</td>
<td>White</td>
</tr>
<tr>
<td>6</td>
<td>Clear</td>
<td>White</td>
</tr>
<tr>
<td>7</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>8</td>
<td>Blue</td>
<td>Brown</td>
</tr>
<tr>
<td>9</td>
<td>Green</td>
<td>Brown</td>
</tr>
<tr>
<td>10</td>
<td>Red</td>
<td>Brown</td>
</tr>
<tr>
<td>11</td>
<td>Yellow</td>
<td>Brown</td>
</tr>
<tr>
<td>12</td>
<td>Clear</td>
<td>Brown</td>
</tr>
<tr>
<td>13</td>
<td>Black</td>
<td>Orange</td>
</tr>
<tr>
<td>14</td>
<td>Blue</td>
<td>Orange</td>
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<tr>
<td>15</td>
<td>Green</td>
<td>Orange</td>
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<tr>
<td>16</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>17</td>
<td>Yellow</td>
<td>Orange</td>
</tr>
<tr>
<td>18</td>
<td>Clear</td>
<td>Orange</td>
</tr>
</tbody>
</table>
Figure 5  WIRING OF 18-TC KTX Remote SWITCH  TO 6-TC CABLE
Figure 6  Wiring of 18-TC KTX Remote Switch To Three 6-TC Cables  (6-TC Special)
Figure 7  WIRING OF 18-TC KTX Remote SWITCH TO 12-TC CABLE
Figure 8  Wiring of 18-TC KT Remote Cable Switch to 18-TC Cable
Figure 9  Wiring of 21-TC KTX Remote Switch to 21-TC Cable
8  KT Remote Switch Theory & Troubleshooting

By putting the cable relays onto plug in cards you allow flexibility in sizing the system to the individual location requirements.

Figure 10  KTX REMOTE SWITCH
8.1 K1 Cable Select Card

8.1.1 Circuit Theory
Each K1 card contains switching that can select one of three cables. Selection of an individual cable is identical for all three. The operation of cable A will be explained as being typical of all three.
The K8X has energized cable A. Nominally 12 volts is applied to the coils of the bottom row of relays K1 to K11. When the relays are actuated, cable A is routed into the K8X card, through the eleven relays. The K8X card then must select one of the 21 TC’s and measure the temperature for each TC.
The actual voltage across the relays can be read at test points A, B and C (right side of LED’s). This voltage should be between 11 and 14 volts for the relays to operate accurately.

8.1.2 Trouble Shooting the K1 Card
One problem that may occur on the cards is an open TC. Swap the K1 Board with another one to determine if the K1 Board is at fault.
Red Light Emitting Diodes give easy visual indication of which cable has been activated. In some cases the LED may be burnt out but the cable still activated properly. This problem can be checked by measuring test points A, B and C located on top of card.
Send the faulty board in for repair or replacement.
Contact Rolfes@Boone at 1-800-265-2010

8.1.3 K8X Control Card

8.1.4 Circuit Theory
This card is designed to communicate using the RS485 data link. The K8X has a microcontroller, a digital to analog converter, thermocouple select logic, and relay drivers. The relay driver selects one of the 24 cables on the appropriate K1 card. The thermocouple logic selects one thermocouple and the analog to digital converter measures the thermocouple voltage. The microcontroller coordinates all devices and communicates the results back to host computer.

8.2 Trouble Shooting the K8X Card
One (or two) Red Light Emitting Diode gives easy visual indication if the KTX Remote has power applied. The other red LED blinks when a read is in progress. If the K8X is operating improperly, switch it with another one to determine if the K8X Board is faulty.
Send the faulty board in for repair or replacement.
Contact Rolfes@Boone at 1-800-265-2010
SETUP AND SOFTWARE INSTALLATION INSTRUCTIONS FOR THE KTX WIRELESS SYSTEM

SPECIAL NOTE
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READ THIS ENTIRE BOOKLET BEFORE PROCEEDING WITH THE INSTALLATION
The following instructions will explain how to setup the Gateway (Connectport X2D) with the wireless radio(s) (BRX-KTX#(s)) on a computer and using it with the BCS Grain software.

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1. THINGS YOU MUST DO FIRST

1.1 You must be logged on to Windows as the Computer Administrator (see glossary below)
   1.1.1. To check this, open Control Panel.
   1.1.2. Open User Accounts, you will see a list of accounts that have Administrator privileges.
1.2 Make sure the computer is fully updated through Windows Update; Hardware, and Software. Also check for updates through the computer's manufacturer's website.
1.3 Close all other programs prior to installation.
1.4 When using a stand-alone computer, set the Local Area Connection to IP address: 169.254.1.50, with Subnet mask: 255.255.0.0.
1.5 If the stand-alone computer has a wireless connection, disable it first, then change the Local Area Connection.
   For Windows XP; go to Start -> Control Panel -> Network Connections -> right click the Wireless Adapter -> Disable.
   For Windows 7; go to Start -> Control Panel -> Network and Internet -> Network and Sharing Center -> Change Adapter Settings (top left corner) -> right click the Wireless Adapter -> Disable.
1.6 The Gateway (Connectport X2D) uses UDP port 7650. The BRX radios use UPD ports 7661 and up, depending on how many BRX units are used. Verify with your IT administrator that these ports are available on the network.
2. DIGI DEVICE DISCOVERY

2.1 Insert the BCSGrain CD into the Computers CDROM Drive.
2.2 Make sure the AutoPlay window appears, like the picture below:

![AutoPlay window](image)

2.3 Select “Open folder to view files”.
2.4 If the window above does not appear, double click on “computer”, right click on the DVD/CD Drive and select open.
2.4 Double click the “Digi Device Utility” folder.
2.5 Right click the Digi Device Discovery application and select “Copy”.
2.6 Close the window and right click the desktop and select “Paste”. The Digi Device Discovery icon should now be on the desktop.
3. CONFIGURING THE GATEWAY

The Gateway uses DHCP to identify itself on the Network. It will create a random address available on the Network. If you wish to use your own IP address, you can change it afterwards.

3.1 Make sure the Gateway, the radio(s) (BRX-KTX#), and the KTX Mux(s) are hooked up and powered on.
3.2 When using a stand-alone computer, set the Local Area Connection to IP address: 169.254.1.50, with Subnet mask: 255.255.0.0.
3.3 Run the Digi Device Discovery and make sure the Gateway (ConnectPort X2D) shows up in the list with an IP and MAC address.

3.3 Highlight the IP address and select ‘Open web interface’ at the top left or double click the IP address.
3.4 The Configuration and Management window should open up in your web browser.
3.5 To change the DHCP settings of the Gateway, select ‘Network’ at the top left.
3.6 Select ‘Use the following IP address’ to either change the IP address or use the current IP address. Apply when done.
3.7 To setup the radio(s) or KTX(s), select ‘XBee Network’ at the top left.
3.8 Select ‘Discover Xbee Device’ to refresh the list. Make sure you check-mark the “Clear list before discovery”. The Gateway will show up as the coordinator. The radio(s) will show up as router(s).

ConnectPort X2D Configuration and Management

![XBe Configuration](image)

3.9 If the KTX(s) don’t show up or some of them do not show up in the list, verify connections to the radio(s) (BRX-KTX#(s)). Once everything has been verified, select “Reboot” from the Administration section on the left and click the reboot button. This should take about a minute.
4 SWITCH TEST

4.1 Go back to the CDROM and run the setup.exe from the Switch test folder.
4.2 The 2 Switch test windows will appear. The BCS Interfaces window will have the Gateway with an IP address and Port#..

4.3 Highlight the Gateway and click on the “Select” button. The Interfaces window will disappear.
4.4 On the BCS Switch Test window, underneath the last line put the cursor in the window and type “gd”.

![](image-url)
4.5 A list will appear of all the switches (Mux) out in the field.

4.6 To verify each switch or Mux is working, set the Device output to the individual Mux’s. For each Mux it should give a 3-line output (see picture below).

![Switch Test](image)

4.7 When an “Xbee not found” message appears on one of the Mux’s, check the power to the BRX board associated with the Mux.

4.8 When only an “>ack” appears, check the connections from the radio to the KTX Mux and power to the Mux (lights on the K8X board).
5 BCSDGRAIN SOFTWARE INSTALLATION AND SETUP

5.1 Re-insert the CD in the computer. Select, “Run setup.exe”.

5.2 Select “Install” when prompted.
5.3 After the program installs it will ask for the Site file. Select “OK”.

5.4 A new window will open up. Make sure it’s at the CD location. If not, direct to that location. The CD Drive could be D: or E:.

5.5 Double click the “Site” file or “GrainSite” file from the CD. This will start the BCSGrain software.

5.6 Go to Tools -> Options and select the Network tab. The Lan Address is the Computer’s IP address.

5.7 Click on “Add”, to add the Gateway. ID #1 will be added to the list with the default SysType (BCS), the default IP address (192.168.0.198), and default Remote port# (7654).
5.8 Change the SysType to GW by double clicking “BCS”. A drop down arrow will appear to change it.

5.9 Change the Address from 192.168.0.198 to IP address of the Gateway listed in Switch Test and/or Digi Discovery. Double click the address to change it.

5.10 Change the Remote port from 7654 to 7650 as was listed in Switch Test. Double click to change it.

5.11 When it's done, select “OK” and restart the BCSGrain program. Select Read and begin a read.

5.12 In the case where there is already a BCSE1000 instrument in place, set the BCS to ID 1 with its IP address, RemotePort to 7654, and LocalPort to 7661. The Gateway will be ID 2 with RemotePort 7650 and LocalPort 7662.
6 TROUBLE SHOOTING

6.1 When all the radios are powered up and a “Fail Interface Check” error message appears, check the list under Tools -> Options -> Network and make sure the settings match the ones found in Switch Test. If they are, close the program, reopen Digi Device Discovery and reboot the Gateway.

6.2 To check the Signal Strength of each radio, do the following:

7.2.1 Open Digi Device Discovery and double click the Gateway.
7.2.2 Select XBee Network from the Configuration section and do a Discover Xbee Devices (check-mark “clear list”).
7.2.3 Select the first KTX (or closest radio to the Gateway) and go to the “Device Status” at the bottom.

---

XBees Configuration

Extended Address: 00:13:a2:00:40:9f:3f:ef1f
Product Type: Unspecified
Firmware Version: 0x22a7

- Basic Settings
- Advanced Settings
- Device Status

XBees Node

Node Type: router
Profile ID: 0xc105
Manufacturer ID: 0x101e

RF Module

PAN identifier (OI): 0x5b67
Extended PAN identifier (OP): 0x3f4a21c2067556e0
Operating channel (CH): 0xb
Network address (MY): 0x9296
Parent address (MP): 0xffff
Association indication (AI): 0x0
Firmware version (VR): 0x22a7
Hardware version (HV): 0x1e46
Device type identifier (DD): 0x30000
ACK failures (EA): 1
Number of remaining children (NC): 12
Maximum RF payload (NP): 84 bytes

Received signal strength (DB): 51 - dBm
Supply voltage (%V): 3275 mvolts
Temperature (TP): 26 degrees C
Transmit power at PLA (PP): 18 dBm

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7.2.4 Make sure the “Received signal strength (DB)” is as low as possible. Anything over 90 –dbm for the radio closest to the Gateway is not acceptable. Adjust the position of the radio to get a better signal strength.

6.3 If only one of the KTX Mux’s is not responding, instead of going to “Device Status’, select “Advanced Settings” and make sure the “DIO7 Configuration (D&7)” is set to “7”. If not, change it and select “Apply” at the bottom of the screen. Reboot the Gateway.

6.4 To restart the Gateway, right click the Gateway in the Digi Device Discovery program and select “Restart Device”. Be aware, If DHCP is still selected in the Gateway, the IP address might change.

6.5 If the date and time doesn’t want to match up with the actual date and time, go back to the “Date and Time Settings” described in item 4. Under the “Time Source Settings”, select “1” and change the “FQDN” to ‘time.devicecloud.com. Select “Apply” and make sure the date and time is correct.

6.6 If there are problems installing this software or any other issues, please contact Boone Cable Works & Electronics at (515) 432-2010 or 1-800-265-2010 or visit our website: http://www.rolfesatboone.com.