REMOTE DEVICE

USER REFERENCE SHEET

FOR

REMOTE I/O [INPUT/OUTPUT] CONTROLLER LAN NODE PCB (RIO) Part No. 46S02790-0010

For use on MicroTrac DSD Local Area Network

INTRODUCTION

The Remote Input/Output Controller LAN Node PCB (RIO) provides the MicroTrac DSD system with the ability to have remote inputs and outputs with a minimal amount of wiring. The RIO has some I/O of its own and can support up to 6 Remote I/O boards through use of an I/O expansion bus. The RIO communicates through use of a Local Area Network (LAN) using a proprietary message protocol defined by MagneTek. This protocol allows messages to be sent to and from the RIO in order to pass input and output information (e.g., turn on an output, give the value of an A/D input, etc.).

This document explains the hardware and software operations of the Remote Input/Output Controller LAN Node PCB (RIO).

HARDWARE DESCRIPTION

<u>POWER REQUIREMENTS</u>

The power connector on the RIO is used to supply the RIO and the Remote I/O boards with power. The RIO supplies power to each of the Remote I/O board through the I/O expansion bus. The power requirements for each of the voltages connected to the RIO, therefore, include the power drawn by the RIO and the power drawn by each of the Remote I/O boards.

In order to select a properly sized power supply, the current (I) requirements of the PCBs for each of the voltages must be known. The I requirements are as follows:

I for +5 VDC = (I of RIO) + (I of I/O boards) + (I of external loads)

= (1250 mA)+(I of I/O boards) + (I of external loads)

I for +15 VDC = (I of RIO)+(I of I/O boards) + (I of external loads)

= (2.8 mA) + (I of I/O boards) + (I of external loads)

I for -15 VDC = (I of RIO)+(I of I/O boards) + (I of external loads)

= (273 mA)+(I of I/O boards) + (I of external loads)

I for +24 VDC = (I of RIO)+(I of I/O boards) + (I of external loads)

= (0 mA) + (I of I/O boards) + (I of external loads)

Effective 6/18/90

LAN INTERCONNECT

There are 2 connections to be made in order to connect the RIO to the LAN.

The first connector, J6 (faston tab), is to be connected to chassis ground. This is necessary in order to provide a return path for the snubber network of the LAN.

The other connector, J2, is a BNC connector to be connected to the LAN coaxial cable. In order to meet LAN requirements, type RG-62/U coaxial cable should be used.

The RIO uses a High Impedence Transceiver (HIT) for signal transceiving in order to utilize a bus topology on the LAN.

NOTE

For a full discussion of the LAN, refer to the MicroTrac DSD technical manual, TM 6100.

LAN NODE ADDRESS SWITCHES

The LAN Node address switches allow for the selection of the network ID. The RIO may have a Node address from 100 to 199. Since the Node address is in the hundreds range, the 1 in the hundred's place is assumed, and silk-screened on the circuit board as a reminder. There is a switch for each of the other 2 numeric positions, ten's place (S1) and one's place (S2). These switches must be set before power-up, and remain set while powered up, for proper operation. If the switches are changed while powered up, then the LAN Node will get a new network ID; however, the software will not (and cannot) be made aware of the ID change, thus invalid operation will occur.

ANALOG INPUTS

The RIO has 3 analog inputs. These are 0 to +5 VDC non-isolated analog inputs. The inputs have 10-bit resolution, are single ended, and are as accurate as the +5 VDC supply (+/- 5% but stable). They are recommended to be used as ratio type inputs only. In other words, each analog input should be a fraction of the +5 VDC supply (e.g., one end of a potentiometer connected to COMMON, and the wiper terminal connected to the analog input).

The analog inputs are called AI0, AI1, and AI2, and can be connected through TB1 pins 1, 2, and 5, respectively. Power connection terminals are provided that will supply +5 VDC (TB1 pins 6 and 7) and COMMON (TB1 pin 4) to the external loads.

I/O EXPANSION BUS

There is an I/O expansion bus connector on the RIO that allows Remote I/O boards to be added in order to configure a given system to meet specific requirements.

The I/O expansion bus uses a 40 pin connector (J3) that is to be connected to Remote I/O boards through use of a 40 pin ribbon cable. The bus is intended to be connected in a daisy chain style from Remote I/O board to Remote I/O board, originating from the RIO. A maximum of 6 Remote I/O boards may be connected to the I/O expansion bus at one time.

The I/O expansion bus carries logic level signals and power to the Remote I/O boards. Care should be taken in the routing of the cable in order to keep it away from noise inducing circuitry. Furthermore, the maximum I/O expansion bus length should not exceed 10 feet.

LED

There is an LED on the RIO (DS1) that is used to indicate the operating status of the RIO. This is the only visual means that the RIO has in order to give its operating status.

OPERATIONAL DESCRIPTION

NODE/CHANNEL/SUBCHANNEL DEFINITION

The PAC language defines a particular Input or Output by use of a Node, a Channel, and a Subchannel. When concerning an RIO, the Node, Channel, and Subchannel are defined as follows:

NODE: RIO LAN Node Address Switch Setting

CHANNEL:
- 0 — The Remote I/O LAN Node PCB (RIO)
- 1 — Remote I/O board with jumper at CH 1.
- 2 — Remote I/O board with jumper at CH 2.
- 3 — Remote I/O board with jumper at CH 3.
- 4 — Remote I/O board with jumper at CH 4.
- 5 — Remote I/O board with jumper at CH 5.
- 6 — Remote I/O board with jumper at CH 6.

SUBCHANNEL: The Subchannels of Channel 0 (the RIO) are defined as follows:
- 0 — AI0, Analog Input 0
- 1 — AI1, Analog Input 1
- 2 — AI2, Analog Input 2

The Subchannels of the Remote I/O boards are dependent on their configur-ation. The definitions of the Remote I/O board Subchannels are beyond the scope of this document, however, they can be found in the User Referecne Sheet for desired Remote I/O board.

LOGIC INPUTS

Logic inputs are any bit oriented input, such as the state of a push button. Any drive connected to the LAN may request to be updated with the state of a logic input. Any time a logic input changes state, a LAN message is sent to each of the drives that had previously asked to be updated. The drives that had previously asked to be updated will also be updated at 4 second intervals, for redundancy in case of a previous communication failure.

Some DC logic inputs may be specified as source or sink. An input that is specified as source means that an input is a logical 1 (High) when the input is at the +24 VDC level. An input that is specified as sink is a logical 1 (Hi) when the input is grounded. The way that logic inputs may be specified as source or sink is dependant on the type of Remote I/O board that is being utilized and is beyond the scope of this document. The User Reference Sheet on the desired Remote I/O board will explain how to specify source or sink.

LOGIC OUTPUTS

Logic outputs are any bit oriented output, such as that to turn on a lamp. When first powered up, the RIO will drive all of the outputs to 0. The RIO will also announce its power-up state onto the LAN so that any concerned drives may allocate outputs and request inputs. Drives will also allocate outputs and request inputs when they are first powered up in case they are powered up after the RIO is powered up (thus not seeing the RIO power-up announcement on the LAN). The first drive to allocate an output will have exclusive rights of controlling the output. Any drives trying to allocate an already allocated output will receive an error message and not be allowed to control the output.

When specifying a logic output, an output time needs to be defined. The output time is entered in number of whole seconds, not to exceed 36. An entered time of 0 means to never time out. This output time is used by the RIO to determine if the drive is communicating with the RIO. Each drive that has allocated an output has an output timer in the RIO. A drive's output timer is reset to the original output time each time that an output update message is received by the RIO from the drive through the LAN. When a drive's output timer times out, the RIO assumes that communication with the drive is no longer occuring; thus all of the outputs that the drive has allocated will be driven to 0.

Furthermore, when specifying an output, a fault reaction must be defined. A fault reaction may be defined as either Allocate or Deallocate. If a drive's output timer times out, the fault reaction determines what the RIO should do. If defined as Allocate, then the output will remain allocated to the drive. If defined as Deallocate, then the output will no longer be allocated to the drive. Consider the following case:

> A drive sees that an RIO is powered up (by the RIO announcing that it is powered up). The drive then sends a message to allocate an output with a given output time and a fault reaction. The drive then proceeds to send output update messages to update the allocated output, at time intervals which are less than the given output time. For some unforseen reason, the drive does not send the RIO an update message within the given output time. Some time later, the drive resumes sending the RIO output update messages.

In this case, when the output timer timed out, the output would have been driven to 0. When the drive resumes sending the RIO output update messages, the RIO will react differently depending on how the fault reaction was defined. Had Allocate been defined as the fault reaction, then the output value would have been set to the value in the message. Had Deallocate been defined as the fault reaction, then the output update messages received from the drive, after the fault, would be ignored (since the output is no longer allocated to the drive). Deallocate would require the drive to allocate the output again, which would mean resetting the drive or power cycling the RIO.

NUMERIC INPUTS

Numeric inputs are any numeric type inputs such as analog inputs and Thumbwheel switch inputs. Any Drive connected to the LAN may request to be updated with the value of the input. The way that the RIO keeps the drive updated depends on the type of numeric input and is described in the following text.

Numeric Inputs From A/D Sources

Many A/D conversions are made on each analog input in each second. Due to the nature of analog signals (they may have many minor fluctuations), the drive will not be updated every time that the A/D conversion yields a different result than the previous conversion. This would tend to tie up the LAN with unnecessary messages. Instead, numeric update messages are sent to all concerned drives at regular intervals (approximately 140 ms per interval).

The value sent is the average of all of the A/D conversions made since the last numeric update message. The value sent is in a floating point format and will range from -1 to +1, corresponding to -maximum analog input value to +maximum analog input value, respectively.

When specifying a Numeric input, a decimal point location value must be defined. This value is ignored when the Numeric input is from an A/D source.

Numeric Inputs From Thumbwheel Switch Sources

Any time a Thumbwheel Switch Bank's Push-To-Load input is asserted, the value set on the Thumbwheel Switch Bank is read. If at this time the value is different from the previous value, then a numeric update LAN message is sent to each of the drives that had previously asked to be updated. The drives that had previously asked to be updated will also be updated at 4 second intervals, for redundancy in case of a previous communication failure.

When specifying a Numeric input, a decimal point location value must be defined. This value is used to determine where the decimal point is in order to scale the value read from the Thumbwheel Switch Bank (since there is no way to read the decimal point location). The value read from the Thumbwheel Switch Bank sent to the drive will be in a floating point format. The decimal point location value is the number of digits to the right of the decimal point. The acceptable decimal point values are in the range of 0 through 6. Decimal point values received higher than 6 will be set internally to 6.

Numeric Inputs From D/A Output Sources

A drive may request Numeric input updates from D/A output sources. This means that a drive can place the burden of keeping it updated (with the value of a numeric output) onto the RIO, and not put the burden on another drive. Numeric update messages are sent to all concerned drives at regular intervals (approximately 140 ms per interval). The value sent is in a floating point format and will range from -1 to +1, corresponding to -maximum analog input value to +maximum analog input value, respectively.

When specifying a Numeric input, a decimal point location value must be defined. This value is ignored when the Numeric input is from a D/A source.

NUMERIC OUTPUTS

Numeric outputs are any numeric type outputs, such as an analog output. Numeric update messages are expected by the RIO from the drives. The value received is expected to be in a floating point format in the range from -1 to +1, corresponding to -maximum analog output value to +maximum analog output value, respectively.

When first powered up, the RIO will drive all of the outputs to 0. The RIO will also announce its power up state onto the LAN so that any concerned drives may allocate outputs and request inputs. Drives will also allocate outputs and request inputs when they are first powered up in case they are powered up after the RIO is powered up (thus not seeing the RIO power-up announcement on the LAN). The first drive to allocate an output will have exclusive rights of controlling the output. Any drives trying to allocate an already allocated output will receive an error message and not be allowed to control the output.

When specifying an analog output, an output time needs to be defined. The output time is entered in number of whole seconds, not to exceed 36. An entered time of 0 means to never time out. This output time is used by the RIO to determine if the drive is communicating with the RIO. Each drive that has allocated an output has an output timer in the RIO. A drive's output timer is reset to the original output time each time that an output update message is received by the RIO from the drive through the LAN. When a drive's output timer times out, the RIO assumes that communication with the drive is no longer occuring; thus all of the outputs that the drive has allocated will be driven to 0.

Furthermore, when specifying an output, a fault reaction must be defined. A fault reaction may be defined as either Allocate or Deallocate. If a drive's output timer times out, the fault reaction determines what the RIO should do. If defined as Allocate, then the output will remain allocated to the drive. If defined as Deallocate, then the output will no longer be allocated to the drive. Consider the following case:

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In this case, when the output timer timed out, the output would have been driven to 0. When the drive resumes sending the RIO output update messages, the RIO will react differently depending on how the fault reaction was defined. Had Allocate been defined as the fault reaction, then the output value would have been set to the value in the message. Had Deallocate been defined as the fault reaction, then the output update messages received from the drive, after the fault, would be ignored (since the output is no longer allocated to the drive). Deallocate would require the drive to allocate the output again, which would mean reseting the drive or power cycling the RIO.

LED STATES

The LED on the RIO is used to indicate the operating status of the RIO.

LED STATE	RIO OPERATING STATUS
On, steady	Power is applied, and the RIO software is executing.
On, blinking	Power is applied, the RIO software is executing, and the RIO is receiving LAN messages.
Off	Power is not applied, or power is applied and the RIO has experienced a fault and has halted execution.