

Installation & Operation Manual

GreenSeeker[®] RT200 System

For Variable Rate Application and Mapping



740 South State Street Ukiah, CA 95482, USA

toll-free 888-728-2436



www.ntechindustries.com



OPERATOR SAFETY WARNINGS

- **Never use the GreenSeeker System without instructions. Review the Operations Manual.**
- **Always read chemical manufacturer instructions before handling or spraying chemicals.**
- **Always install boom stop before working under or around raised spray booms.**
- **The GreenSeeker RT200 interfaces with GPS receivers and spray controllers. Be sure to read and understand the other manufacturers' manuals and equipment before operating the RT200.**

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Introduction to the GreenSeeker System

This manual describes the installation and operation of the hardware and software for the NTech Industries RT200 System.

The *GreenSeeker RT200 Variable Rate Application and Mapping System* is a tool for variably applying agricultural chemicals based on real-time measurements of the crop. The sensors measure NDVI (Normalized Difference Vegetation Index) of the plants while traversing the field, and the software collects the data which can be used to generate maps of the NDVI and rates (where applicable) for crop analysis and historical data collection. This type of data can be used in conjunction with other agronomic references to index nutrient response, crop condition, yield potential, stress, pest, and disease impact in a quantitative manner. The RT200 can be used to monitor changing crop conditions during the growing season and the effects of different levels of an input compared to a defined standard.

The applicator provides the ability to variably apply agricultural chemicals in Real Time (as the applicator passes over the crop). The NDVI-based variable rate algorithm and parameters may be selected in the field, and all rate changes are then made “on the go,” so there are no lengthy delays between evaluating the crop and application. When applying fertilizer or other material, both the NDVI, the target rate on and the applied rate are mapped simultaneously with the RT200 GreenSeeker. Some spray controllers do not respond with an ‘As Applied’ value.

The GreenSeeker Optical Sensor utilizes NTech’s second-generation optical sensor technology. The RT200 emits light at two specific wavelengths, and measures the reflected light. The microprocessor in the sensor analyzes the reflected light and calculates the resulting Index value. The data from each sensor is collected by the Interface Module which is processed, and then transmitted to a ruggedized PDA in the cab running the *RT Commander Software*.

RT Commander displays the NDVI and location in real-time, logs the output data to a file, and sends the appropriate rates to the applicator’s rate controller. The logged data is readily transferred to a desktop computer for analysis.

Definitions of Terms

The following terms occur throughout this manual and in the RT Commander software. Becoming familiar with the terms will make using the RT Commander software much easier.

CAN. Controller Area Network. A high-integrity data communications bus for real-time applications that operates at data rates of up to 1 Megabit per second, and has excellent error detection and confinement capabilities.

GDD. Growing Degree Days. Some GreenSeeker algorithms use this value as an input to determine expected plant growth stage. Refer to the “Where to Find GDD Information” at <http://www.ntechindustries.com/software/> for more information.

GPS. Global Positioning System. A system using satellites, receivers and software to allow users to determine their exact geographic position.

N. Nitrogen fertilizer

NDVI. Normalized Difference Vegetation Index. Commonly used to measure plant health and vigor. $NDVI = (NIR_reflected - Red_reflected) / (NIR_reflected + Red_reflected)$.

NUE. Nitrogen Use Efficiency. A percentage of nitrogen taken up by the plant. For example, an NUE of 60% means that 6 lbs. of nitrogen fertilizer is expected to be used by the plant that year for every 10 lbs. applied. Go to www.nue.okstate.edu for more information.

NRS. Nitrogen Rich Strip. This reference strip/area allows for determining the amount of nitrogen being made available to the plant by the environment (mineralization, etc), and importantly *this year's* expected maximum yield potential and response to additional nitrogen.

RI. Response Index. Provides an indication of how the crop will respond this season to additional N.

User Interface. A portable computer, typically a PDA such as a TDS Recon or Nomad.

VI. Vegetation Index. A value that is calculated (or derived) from sets of remotely-sensed data that is used to quantify plant health, stress, and vigor.

VRA. Variable Rate Application. Based on information supplied to a rate controller, the rate of fertilizer or other chemical applied.

Primary Components

Interface Module

The Interface Module contains circuitry to interface boom mounted sensors with the User Interface. The interface module has CAN, serial, and power connections. The I/M is an environmentally sealed enclosure which can be installed inside or outside the cab.



User Interface/Ruggedized Computer with Color Display

The User Interface for the RT200 system is a rugged computer such as the TDS Nomad. The User Interface functions to display and store the data from the sensors as well as communicate with the applicator's rate controller. The *RT Commander* program is pre-loaded to the PDA. Some type of removable memory card is supplied for easy data transfer; or the PDA may be linked to a desktop computer for data transfer.



USB to Serial box

This box is used for all systems that have a TDS Nomad as the PDA. It converts the USB port at the bottom of the Nomad into four DB9 serial ports.



User Interface Mount

The RAM Mount allows for easy positioning and quick removal of your PDA from the applicator.

GreenSeeker® Sensors

Reflectance readings are taken by the sensor. These units generate their own illumination for use in any lighting condition, day or night. When the unit is on, a red band of light will be observed directly below the rectangular sensor window. The sensor is designed for an optimal height of 28-48" inches over the plant/crop canopy to be sensed. The field of view (width of the sensor measurement) is ~24 inches within the sensor's optimal height range.



Sensor Mounting Bracket

Sensors are typically mounted to a standard stainless steel bracket provided by NTEch. These brackets are designed to fit most boom structures. Typically, mounting is accomplished with U-bolts.



Product Rate Controller

Most applicators come with an installed product rate controller. The RT200 system interfaces with most available controllers. If you have a rate controller that is not currently supported by RT Commander, contact NTEch or your dealer to see about obtaining support for it.

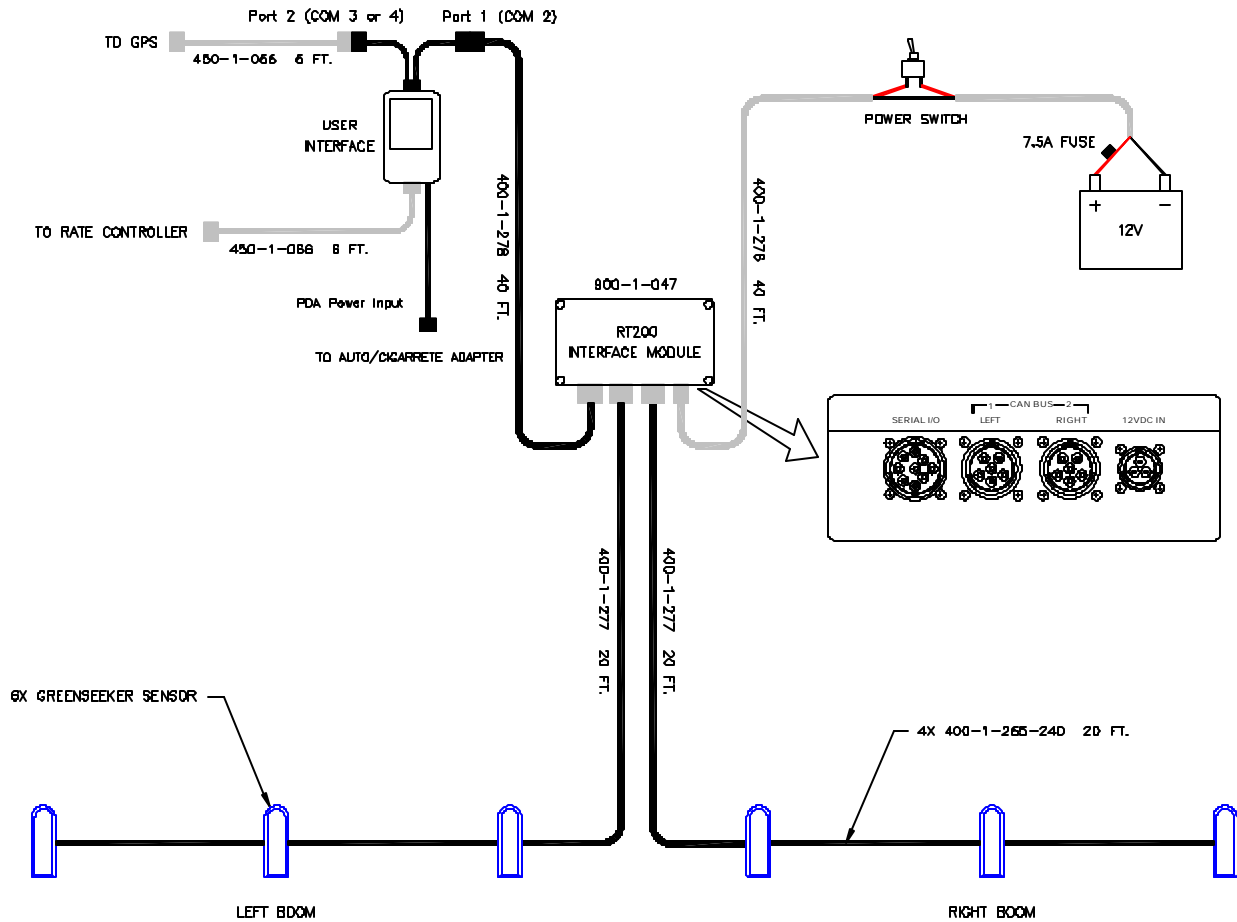
GPS Receiver

A GPS receiver is necessary for logging geo-referenced data and viewing on-the-go mapping. An applicator may already use a GPS receiver for other operations such as guidance. In many cases it can be shared. The RT200 accepts a serial connection (RS232) from a GPS receiver to the ruggedized PD, via a serial-to-USB converter.

Installation

System Layout with TDS Recon

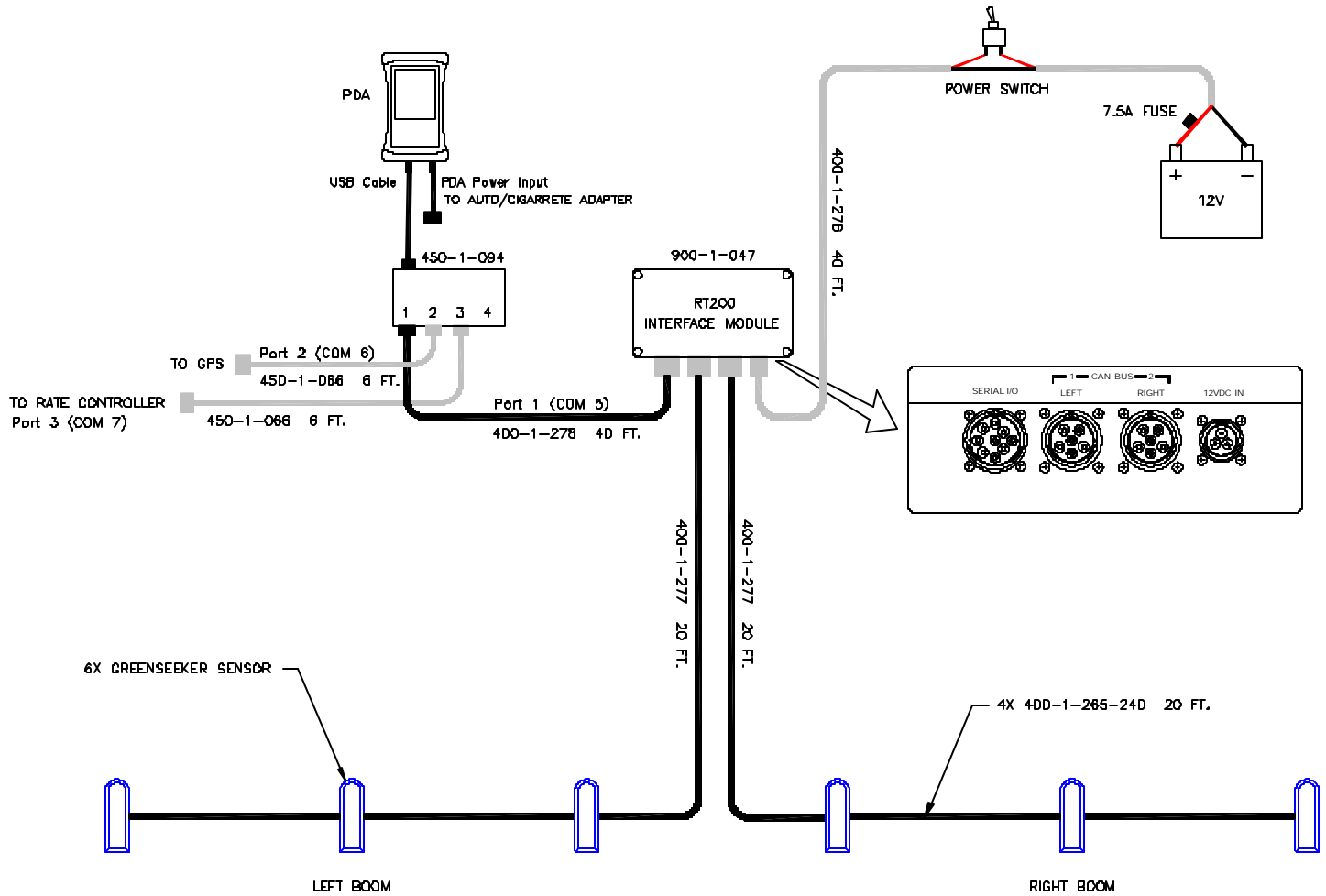
The GreenSeeker RT200 system's components are connected as shown below.



A complete list of all components is provided in Appendix B. Refer to this list to order spare or replacement components. NTech part numbers are required for ordering.

System Layout with TDS Nomad

The GreenSeeker RT200 system's components are connected as shown below.



A complete list of all components is provided in Appendix B. Refer to this list to order spare or replacement components. NTech part numbers are required for ordering.

Cables

Before mounting sensors, loosely route cables on the machine. Cable placement is described below. All cables should be routed in areas where protection from mechanical movement can be assured. Do not kink any of the cables. Always allow at least a 6 inch bend radius in all cables. Once cables are routed and all hardware is mounted, final placement of cables can be made. Finalize by securing cables with tie wraps, zip ties, etc., as required.

Cable 400-1-278 (Interface Module to Recon/User Interface) is to be routed to the Recon. As shown in the system layout, one end of the cable connects to the Recon and the other to the interface module. The cable end with the DB9 connector connects to the Y-cable connector marked "Port 1" on the Recon. Refer to the vehicle's manual for cab access holes. Most cabs have auxiliary access holes available. The other end of this cable is to be routed to the Interface Module. Refer to the Interface Module section below.

Cables labeled 400-1-265-240 (Daisy Cable) are to be placed between the outer three sensors on each side of the boom. These cables are commonly referred to as daisy cables, and connect the sensors in a daisy chain manner. Refer to the Sensor section for appropriate sensor placement.

Cables labeled 400-1-277 (Sensor to Interface Module) connect the two innermost sensors to the Interface Module. Note that the sensors daisy chained on the left side of the boom must connect to the port labeled Left CAN Bus, and the same for the right side. Refer to the Sensor section and Interface Module section for hardware placement.

Cable 400-1-276 (Power) provides 12VDC power to the system. One end of this cable connects to the Interface Module and the other to battery power. An inline toggle switch is provided to control system power. This switch is to be mounted in a desired location in the cab. Splice the toggle switch into the red wire (+12V) included with the cable. Note: some vehicles may provide battery power terminals in the cab. Also, a minimum of 11.4 Volts is required to operate the system.

Cables labeled 400-1-066 are serial cables with standard female DB9 connectors. These cables provide connections from the Recon to the GPS and rate control modules in the cab. Note that some GPS units and rate control modules may require a null modem or gender change adapter. Refer to the manuals for the GPS and rate controller for proper connections (if either module requires a null modem connection to a desktop computer then it will also require one to be connected to the Recon). Null modem cables and adapters can be found at most electronic stores.

Power Adapter Cable is provided with each PDA. It contains a voltage converter/regulator to provide the proper charging voltage for the RECON. **WARNING: DO NOT REMOVE/CUT OR BYPASS THE AUTO ADAPTER END OF THIS CHARGER. DO NOT CONNECT DIRECTLY TO 12VDC AS THIS WILL CAUSE IMMEDIATE FAILURE OF THE PDA.**

Cable diagrams are provided in Appendix A for emergency repair and troubleshooting purposes. These diagrams are provided for use by qualified technicians only.

Interface Module

The interface module is an environmentally sealed enclosure with four connections. Mount this module in close proximity to the center of the boom mounted sensors (check cable length of 400-1-277 and 400-1-278 for suitable placement). There are two small indicator lights on the lid. The interface module has mounting brackets with drilled holes for mounting. Mount the module in a structurally safe location on the machine. Also, it is suggested to mount the module with connectors facing down to avoid water in the connectors. An additional bracket may need to be fabricated.



After the enclosure has been mounted, connect the cable labeled 400-1-276 to the 12VDC port. Be sure to fully rotate (approx $\frac{1}{4}$ turn) the *gray* retaining nut on the connector into the locked position. Next, connect the cable labeled 400-1-277 (that goes to the innermost sensor on the right boom) to the port labeled Right CAN Bus. Then connect the other cable labeled 400-1-277 (that goes to the innermost sensor on the left boom) to the port labeled Left CAN Bus. Finally, connect the cable 400-1-278 to the connection port labeled Serial I/O. Note: Be careful not to loosen the *black* strain relief portion of the connector when connecting or disconnecting.



User Interface: Ruggedized PDA

The RT200 comes with a ruggedized PDA loaded with RT Commander (These products undergo constant development. Your system may have a TDS Recon or a TDS Nomad. These are similar. The Recon uses 3 serial ports via a CF-to-2-port serial splitter while the Nomad uses a USB-to-4 port serial converter). The PDA is a Windows device. An adjustable mount is provided with it for mounting in the cab, and should be placed where operator viewing and button selection is easy. It is useful to assemble the entire mounting structure before mounting the base. Verify that the mounting location allows for cable connections to the PDA (bottom and/or top as required by the specific PDA version).



TDS Recon



TDS Nomad

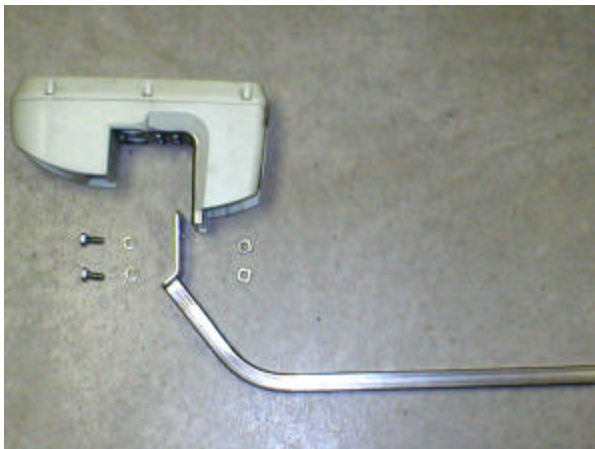
Once the mount has been secured in the cab, place the PDA in its corresponding clip mount. Snap the PDA into place until secure. Refer to the corresponding System Layout diagram for each PDA. The System Layout diagrams are in the **Installation** section of this manual. To keep the PDA's battery charged, plug the included auto adapter power cable into an available 12VDC outlet in the cab. Note: The auto adapter for the Recon and Nomad are not interchangeable. **WARNING: DO NOT REMOVE/CUT OR BYPASS THE AUTO ADAPTER END OF THIS CHARGER. DO NOT CONNECT DIRECTLY TO 12VDC AS THIS WILL CAUSE IMMEDIATE FAILURE OF THE PDA.** Once all the cables are connected, secure the cables in the cab so they will not be snagged accidentally.

GreenSeeker® Sensors

GreenSeeker sensors are designed to operate in harsh environments. The sensor enclosure and connections are environmentally sealed. Although the sensor is sealed, DO NOT wash the sensor directly with a high pressure washer. To clean the sensors, use low pressure and gentle washing procedures.

The sensor operates by emitting light from the rectangular window onto a crop's canopy. Reflected light from the canopy is focused on a detector behind the circular window. Both the rectangular and circular windows need to be free of any viewing obstructions when mounted. Mount the sensor so that there is at least 12 inches in front and 6 inches in back of the lenses' peripheral view. Keep at least 12 inches for the peripheral side view of the sensor free of objects. Optimal operating height of the sensor is in the range of 28 to 48 inches (0.7 to 1.2m) from the rectangular LED window to the crop canopy. Extended range (with greater deviation) is 26 to 62 inches (0.6 to 1.6m). Sensor readings are nearly constant with the optimal height range, but will vary somewhat over the extended range. Momentary movement out of the operating height range does not significantly affect performance of the RT200 system, but care should be taken to keep sensors within the recommended height range most of the time.

Sensors are typically mounted using the standard stainless steel bracket provided. The two outer sensors will have only one cable connected. The other port in the outer sensors will have to be *electrically terminated*. This is done with a small plug device called a CAN Terminator. (The CAN terminator is usually pre-installed in two sensors.) Mount these sensors in the outside (end) positions. The bracket can be secured to most boom structures with standard size U-bolts. One set of U-bolts is included with the system. Some booms may require different U-bolts and/or custom fabricated brackets. The sensor is bolted to the bracket with two 5/16" bolts provided.



Sensors can be mounted in front of or behind a boom. The “direction” of the sensor is not important, but the rectangular LED window must be parallel to the applicator boom.



For crops like wheat and canola, the RT200 system works the best when sensors are evenly spaced across the swath of the boom. For example, if a boom is 60 feet wide then the sensors would be spaced approximately 10 feet apart and the outer two sensors would be spaced approximately 5 feet from the tips. Boom folding procedures may prevent even spacing of sensors. This is okay, as long as the sensors are spread across the boom as evenly as possible. For row crop applications, sensors must be positioned directly over a row. When used in fields with a “guess row” or “wide and narrow row” you may have to mount sensor within your planter width.



Once the sensors have been mounted, connect the daisy cables (400-1-265-240) as shown in system layout figure. These cables have a 12 pin connector on each end. Slide the connector into one of the ports on the sensor with the keyed side towards the front of the sensor. After firmly seating the connector, use a Phillips screwdriver to secure the connectors retaining ring. It does not matter which port the 400-1-265-240 cables are connected to. The two outer sensors will have only one cable connected. The other port in the outer sensors will have to be *terminated*. Insert terminator (if not already installed) in the unused port of the outer sensors and secure the retaining ring.

As indicated in previous sections, the two inner sensors are to be connected to the interface module with cables labeled 400-1-277. Connect these cables to the sensors in the same manner as the 400-1-265-240 cables. Once all cables are connected, secure the cables to the boom. Verify that cables are free of harm from any moving parts.

Care and Maintenance

Proper care of your *GreenSeeker* RT200 Variable Rate Application and Mapping System is important to maintain high performance. At the end of each day of spraying, the following steps should be taken:

- Check the Detector and Light Source Windows for dust and dirt, and wipe clean with a soft rag.
- The *GreenSeeker*® System should not be left outdoors during extreme weather conditions. Wide temperature variations are hard on electronics and fluid seals, and may reduce the operating life of the system.
- **DO NOT store a GreenSeeker system with the sensors facing upward.** Doing so may allow water to collect around the windows and gaskets, causing seal failures in those areas. *Also direct sunlight can in some cases focus enough energy into the sensor to damage the detector.*

There are no field serviceable components of the electronic system; do not attempt any field repair of a malfunctioning Controller or Sensors. If you experience operating problems, contact your local dealer or representative or GreenSeeker distributor for assistance.

Field Preparations for Nitrogen Application

Field Information

Before the GreenSeeker applicator can be utilized to apply nitrogen (N) across a field, a nitrogen rich reference strip (NRS) must be established prior to or shortly after planting. This reference strip is used to determine the amount of nitrogen being made available to the plant by the environment (mineralization, etc) and importantly, *this year's* expected maximum yield potential and response to additional nitrogen. The ideal NRS would run the length of the field, but it should at least be 400 ft long. Establish the NRS in a representative portion of the field (i.e. not in high spot or low spot). The rate of N necessary to establish a NRS is crop and region dependent, and should be equivalent to the highest rate necessary to satisfy crop needs throughout the growing season. For example, winter wheat grown in the Southern Great Plains should have a minimum of 100 lbs N/acre applied to establish the NRS. Lower pre-plant N rates should be applied across the rest of the field. Application of 20 to 30 lbs of pre-plant N/acre would be ideal for this situation.

The rest of the field is referred to as the Non-Reference (Non-Ref) portion. It may also be referred to as the *N-limited area* or farmer practice region.

For best results, the RT200 should be used to “read” the NRS and apply N at growth stages dependent upon the crop algorithm used. For NTech supplied algorithms this is typically: Wheat: *Feekes* growth stage 4-6, Corn: V8-V12.

In order for the sensors to accurately determine NDVI for topdressing (or sidedressing), plant coverage should be at least 50%. The RT200 system with RT Commander can use the sensor mounted booms to read the NRS, or the GreenSeeker Hand Held sensor can be used to determine field conditions.

To collect sensor readings for the NRS, the boom mounted sensor (or handheld sensor) should be passed over the crop at 32-48” above the canopy. A large area of the NRS and Non-Reference portion of the field should be sensed to accurately determine their respective NDVI values. Once the NDVI values have been measured, they can be entered into the RT Commander software (This can be done automatically with the boom mounted sensors, or manually entered if the GreenSeeker Hand Held is used). RT Commander software and the RT200 system allows for “straddling” the edge of the NRS and using either the right side or left side of the boom for reading the respective areas. (Example: 3 sensors over the NRS, 3 over the rest of the field.) The complete boom (with all sensors) can also be used to “read” NDVI in each area separately.

If response is obviously variable across the field, select an area where the difference between the Reference and the Non-Reference areas are most apparent. This assures that the algorithm will determine a rate that utilizes the highest yield potential prediction and maximum response to N for that year.

In order to estimate yield potential, an environmental factor (Growing Degree Days) is used, which takes into account weather and time since planting. (Note that different GDD variations are used for different crops; To obtain the GDD value, the planting date and sensing date must be known. Regional values for GDD may be found on the internet. Refer to the “Where to Find GDD Information” at <http://www.ntechindustries.com/software/> for more information.

Field Setup Steps

1. Decrease pre-plant N application rate of the field to a level at least half of previous total N applied during non GreenSeeker management practice. For spring or winter wheat, if application rate has historically been 100 lbs N/acre decrease rate to 50 lbs N/acre. For corn, if application rates have historically been 200 lbs N/acre decrease to 75 to 125 lbs N/acre.
2. Prior to or shortly after planting, establish the NRS (Nitrogen Rich Strip) in a representative portion of the field (i.e. not in a historically high spot or low spot) Apply an applicators width swath of N. The rate of N applied should be high enough to satisfy crop N needs in a good year. For spring or winter wheat, the N rate should be at least 100 lbs N/acre. For corn, the N rate should be at least 200lbs N/acre.
3. Make certain to use a permanent land marker or temporary marker to ensure that the NRS can easily be found later in the season.
4. The ideal NRS would run the length of the field, but it should at least be 300 ft long.
5. At appropriate crop growth stage, take readings of the NRS and an adjacent part of the field to be fertilized. For the supplied algorithms the following is typical: Wheat: Feekes growth stage 4-6. Corn: V8-V12.
6. Find the area where the nitrogen rich strip is most apparent in comparison to the rest of the field (this indicates greatest potential for the crop).
7. Take sensor readings with RT200 or Hand Held sensor for input to your selected Crop Algorithm.
8. Be sure to match nozzles and/or rate control system to maximize response time and performance for each field's requirements. See *Application Information - Delivery System/Liquid* below for more details. Be sure to consult your application equipment and rate control systems manuals.

Field Preparations for User Defined Rates (Custom Table)

Example: Cotton Defoliant

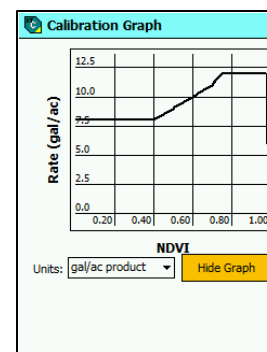
The RT200 system can be used to apply other materials than Nitrogen. The RT200 software permits a custom algorithm to be entered which is a table of product values vs. NDVI. A table has 16 points corresponding to an NDVI range of 0.25 – 0.88. These values are entered directly on the RTC screen (Crop Algorithm > Custom Formula...) *Note: in RTC ver. 1.3.x and above, there is also a high-resolution 100pt table option for NDVI values from 0.00 – 0.99. All points must have a value entered.*

Growers or crop consultants having crop historical knowledge allows them to determine different crop input requirements based upon biomass/size of the crop/plant. An example of this type of use would be variable rate application of defoliant in cotton. In this case, the field is scouted or “field calibrated” to determine areas of the field that require different rates of defoliant. The RT200 system or a GreenSeeker Hand Held is used to obtain the NDVI values in representative areas of the field. Then a table is created with NDVI values corresponding to application rates. These values are entered into the Custom Formula application table as shown in Appendix E.

Here is an example of a table that might be used for defoliant variable rate application in cotton. **These values are only an example; the grower/consultant must develop these rates.** You must also keep in mind the rate range ability of your specific rate controller and nozzles used to achieve these rates.

NDVI	Rate	NDVI	Rate
0.20	8.00	0.60	10.00
0.25	8.00	0.65	10.50
0.30	8.00	0.70	11.00
0.35	8.00	0.75	12.00
0.40	8.00	0.80	12.00
0.45	8.50	0.85	12.00
0.50	9.00	0.90	12.00
0.55	9.50	0.95	12.00

16 Step Table Entry



Graph View



To use the Custom Formula feature you must input some “required” values. Below are examples of these. The default is zero; you will need to put a value (1 for example) in Non-Ref, Ref and Ref-Peak fields along with GDD.

Example of a “field calibration.” The NDVI of the crop was measured under particular conditions for which the grower knew the approximate desired rate. The GreenSeeker Hand Held is used in the photo; can also be accomplished with the RT200.

Operating Instructions

The software interface for RT200 systems is *RT Commander*. RT Commander was developed to be used with a ruggedized PDA running Pocket PC 2003 or Windows Mobile OS. Typically RT200 systems are supplied with a ruggedized Recon PDA from Tripod Data Systems (TDS). This software provides an interface where setup features are selected and operating parameters are entered. This software can also display the current system status and data logging capabilities. Please also familiarize yourself with the PDA's operating instructions.

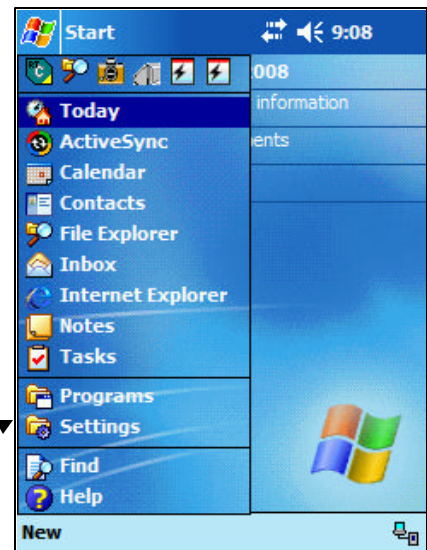
This manual describes RT Commander version 1.3.x. The operation is the same as 1.2; however additional functions for diagnostics have been added, plus more options for custom algorithms.

Startup

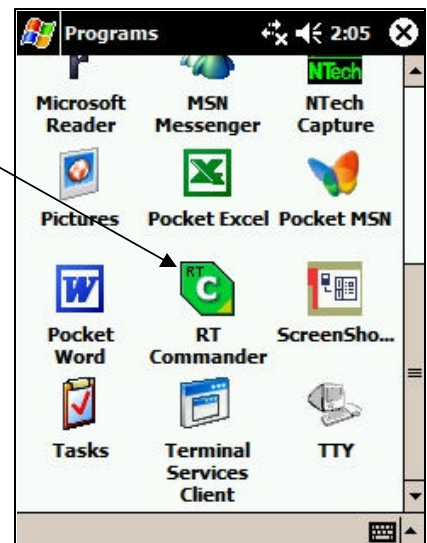
Power up the RT200 Interface Module, GPS, and Rate Controller if applicable. Note that the RT200 green Power LED will blink three times accompanied by three beeps when it's first turned on. Then the Status LED will blink corresponding to each transmission of sensor data over the CAN bus. You'll observe a brief green flash, followed by a red flash at the I/M message rate (typically at .5sec), indicating data from the Left and Right CAN ports, respectively. (The RT200 can be re-configured by connecting to a laptop; while the configuration menus are active, the Power LED will blink and the Status LED will not.)

Turn on the PDA. During startup you might hear two separate "new hardware" chimes. The first chime is indicating that the CF-to-Serial device has been detected. The second chime marks the initialization of the two additional COM ports. If no chimes are heard after the first five seconds, your PDA does not include the chimes feature and you must wait at least 10 seconds before opening any applications. **Do not launch RT Commander until both chimes** have been heard or until at least 10 seconds have passed.

Select "Start", then "Programs"



Select "RT Commander" to launch the program. The "RT Commander" startup screen should appear.



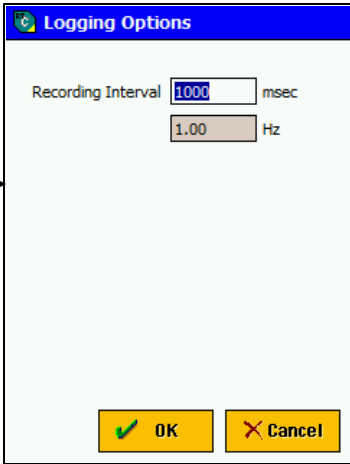
General Setup

Setup of the GPS, Rate Controller and RT200 configurations is normally done once and remembered by the software. If new equipment is used with the system, the setup parameters will need to be updated. If you will only collect GreenSeeker sensor data for mapping, you may skip the Controller section of the setup.

The RT Commander software communicates with up to three devices: GPS Receiver, Rate Controller, and the NTech RT200 Interface Module (gray box).



Recording Interval is the rate at which data points are written to the file. It defaults to 1000ms (1 sec) and should always be less than or equal to the GPS rate.



	Nomad	Recon
RT200 Data	COM 5	COM 2 (Port 1)
GPS	COM 6	COM 3 (Port 2)
Rate Controller	COM 7	COM 1 (Built in)

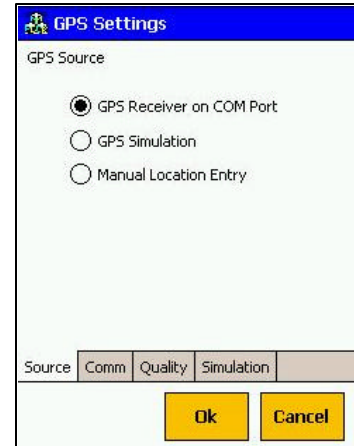
Table 1. Communication Port Assignments

GPS Receiver Communication Setup

The RT Commander software is configured to accept GPS data in NMEA 0183 format (industry standard). The minimum NMEA messages necessary to acquire a valid GPS coordinate are GGA and VTG or GGA and RMC. Most GPS receivers are configured to output these messages by default and no additional programming or configuration is necessary. Refer to your GPS receiver manual for additional information.

- Select “Setup: GSP Setup” tab located at the bottom of the main screen.

Select GPS on COM port. GPS simulation is for troubleshooting only.

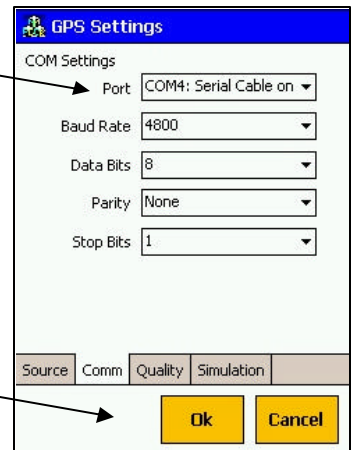


- Select “Comm” tab located at the bottom of the “GPS Settings” screen.

Verify “Com Port” is sel. Refer to Table 1 for Com settings.

Configure COM settings to match output specifications of your GPS receiver (values shown are typical). See your GPS unit’s manufacturer default for exact settings.

Click “OK” when finished configuring the GPS COM settings



Check Status Bar to confirm that a valid GPS coordinate is displayed after entering settings. Note: opening a job before acquiring a valid GPS location may result on trouble seeing data on mapping screen.



Rate Controller Communication Setup

- Select “Setup” tab located at the bottom of the main screen.

RT Commander is capable of communicating with several brands and models of rate controllers. Select “Rate Controller Setup” and create new setup by pressing “New...” button.

Tap the “Setup Description” field and enter a description of the equipment and/or controller used. For example, “rav1” might be for your RoGator 854 w/Raven 440. Typically you will only need to create this configuration once, unless the RT200 is moved to other equipment.

Select controller brand/type from the “Type” pull-down menu.

Select appropriate Com Port. Refer to Table 1 for Com settings.

Select the “Controller” tab at the bottom of the screen and verify your controller’s specifications match the options as shown. These specifications and screen options change depending on controller brand chosen.

RT200 Interface Module Communication Setup

- Select “Setup” tab located at the bottom of the main screen. Click on “NTech RT200 Setup”.

Select appropriate Com Port. Refer to Table 1 for Com settings.

In the “Selected V.I.” field, NDVI is the default, but other indices can be used. NDVI is the most commonly used index and is likely the one you will use. When you select an algorithm (on the Measure Parameters screen), it will change this value automatically as appropriate for the algorithm. (Custom tables will not change the value you select here)

The “Update” field is the frequency at which sensor data is sent to the RT Commander software. The interval should be about half of the GPS update interval at lower rates and equal to the GPS interval at higher rates.

GPS: 1Hz	Update: 495ms (~2Hz)
GPS: 2Hz	Update: 245ms (~4Hz)
GPS: 5Hz	Update: 200ms (~5Hz)

In the “Data Format” field, RT200 must be used to log Sensor data and perform variable rate application using Sensor readings. The other options are to create simulated data **for troubleshooting only**.

NTech Setup

Comm Port: COM2

Selected V.I.: NDVI

Update: 495 ms

Lf Qty: 3 Rt Qty: 3

Data Format: RT200

Create raw data log file

OK Cancel

Variable Rate Application

The RT200 provides the ability to apply variable amounts of nitrogen in real-time based on the condition of the crop.

Select "New Application Job..." or "Open Existing Job..."

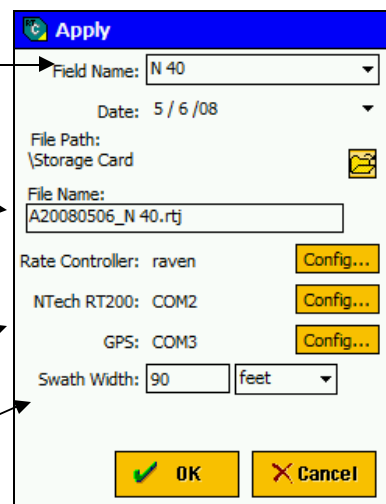


Click the drop down box to choose field, or Add/Edit fields

File name is created automatically. Starts with "A" for application file, today's date, and field at end of file name. Tapping small yellow box allows for changing location of file "save to" location. See the *Data Management* Section for more information.

You can confirm configuration from setup steps.

Input swath width of applicator for mapping screen display.



Next you will collect and/or input the Reference Strip Data. This can be done with the boom mounted sensors on the RT200, or with the GreenSeeker Hand Held sensor prior to application.

You can use the GreenSeeker Hand Held for "reading" the reference strip.

Input the data previously collected with the stylus, a numeric key pad will appear when you tap the appropriate box. Tap "OK" when done.
The Ref-Peak value must be entered, and must be equal to or greater than the Ref value.

Select Measurement Method

Get Cal Info:

- From GreenSeeker Handheld
- Simultaneous Ref Strip & Non-Ref Strip
 - Ref Strip on LEFT
 - Ref Strip on RIGHT
- Drive Calibration Reference Strip
- Drive Non-Reference Area of Field

NonRef-Min	Non-Ref	Ref	Ref-Max
0.00	0.00	0.00	0.00

Go Stop

OK Cancel

You can use the GreenSeeker RT200 sensors for "reading" the reference strip.

You can "straddle" the edge of the reference strip with the left or right side of the boom over the reference strip.

Or, you can use the full boom with all sensors to read the reference strip and the non-reference strip (area to apply to) separately.

Once over the appropriate area, tap Go and collect data which will populate the appropriate fields in real time. Tap Stop when done taking readings. This step can be repeated if necessary.
"OK" will progress to next screen.

Select Measurement Method

Get Cal Info:

- From GreenSeeker Handheld
- Simultaneous Ref Strip & Non-Ref Strip
 - Ref Strip on LEFT
 - Ref Strip on RIGHT
- Drive Calibration Reference Strip
- Drive Non-Reference Area of Field

NonRef-Min	Non-Ref	Ref	Ref-Max
0.00	0.00	0.00	0.00
NDVI Left	NDVI Right		
0.00	0.00		

Go Stop

OK Cancel

The reference data from the earlier step will be transferred to this next screen. After tapping the yellow edit button, the values can be changed.

Choose the appropriate crop algorithm, or choose to create a custom application rate table of your own. (See Appendix E for details on using a custom table as your algorithm)

Most crop algorithms require a value for GDD (Growing Degree Days). For some crops this will be *Days From Planting*.

Non-Ref	Ref	Ref-Max	RIadj
0.50	.6	.65	1.50

Location Name: N 40

Crop: Winter Wheat Dryland OKstate v1.4

NUE: 0.50 GD_40F: 65

Liquid Granular

Max [] GPA 28.0 %N by Wt

Min [] GPA

Dual Booms

Fixed [] GPA

Show Graph

OK Cancel

For fertilizer, choose NUE (Nitrogen Use Efficiency), default depends on selected Algorithm

Select Liquid or Granular, and %N by weight.

Min and Max settings will limit the rate commands given to the rate controller. Use these for nozzle and or application system limitations.

If you have a second boom that will be operated at a flat rate (example: herbicide injection system using UAN for carrier fluid), input fixed rate value.

The actual application graph for the specific sensor to rate commands can be displayed on the screen by tapping the "Show Graph" button

Non-Ref	Ref	Ref-Max	RIadj
0.50	.6	.65	1.50

Location Name: N 40

Crop: Winter Wheat Dryland OKstate v1.4

NUE: 0.50 GD_40F: 65

Liquid Granular

Max [] GPA 28.0 %N by Wt

Min [] GPA

Dual Booms

Fixed [] GPA

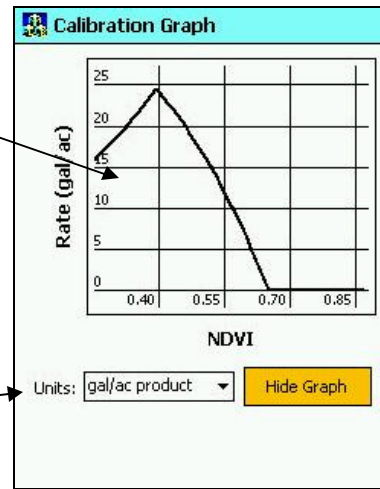
Show Graph

OK Cancel

Be sure to review the application graph for each field to determine the appropriate nozzle selections and/or application equipment settings.

An important step in using the RT200 for variable rate control is setting up the application equipment and rate controller to match to expected delivery rate commands. (see *Application Information* section for more information)

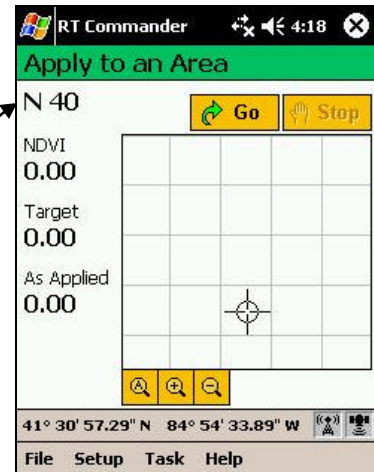
Other units may be selected as applicable to the material/delivery system of your sprayer.



- You are now ready to begin applying. Tap the "OK" button, and it will take you to the *Apply to an Area* screen.

With your application system and rate controller ready to perform VRA, tap the "Go" button and begin applying. Tap "Stop" button when finished.

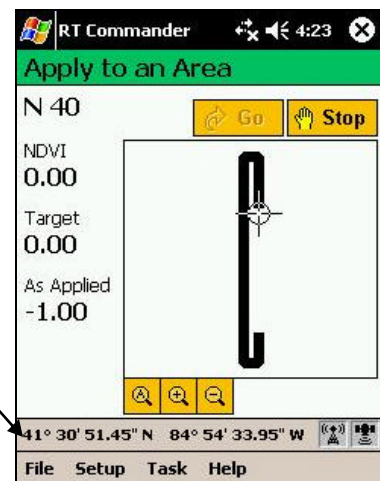
Field name will be shown on upper left of screen



Your progress in the field will be shown on the screen, along with sensor values, target application rates, and as applied rates received back from the rate controller.

GPS will be shown on the "Status Bar", tapping this area with a stylus will take you to a Status Screen.

The "Stop" button only stops data logging and rate commands. Use your existing boom controls to stop application of material.

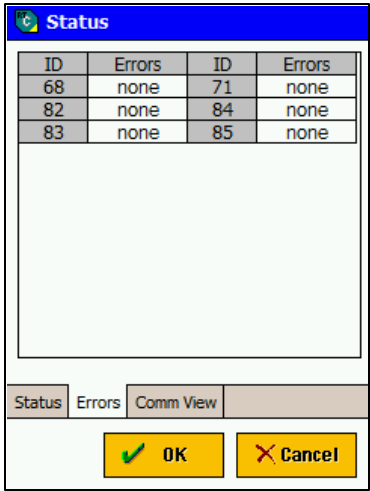
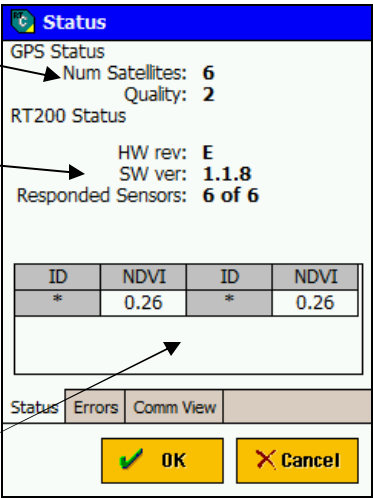


GPS detail status.

RT200 Sensor status. Quantity of sensors detected on system and error reporting. The RT200 system monitors the sensors for proper operation, and if a sensor reports erroneous data, the data is not included in the rate control calculation. Erroneous data can come from mud on the sensor lenses, sensors viewing concrete, snow, wet asphalt, or other non soil or plant surface. The Sensor Errors field reports the number of sensors reporting NDVI out of expected values. See Data Output and Error Codes section of this manual for more details.

RT200 Interface Module hardware and software version report. Also confirms that the RT200 Interface Module and the User Interface are communicating. The NDVI shown is the combined real-time value from all sensors on the left and right booms respectively.

Version 1.3.x adds the more detailed Errors screen, which confirms operation of each sensor by position. The sensor ID is the last two digits of the serial number, indicated on the sensor. While the system doesn't care, it is convenient to mount the sensors in numerical order (lowest on driver's left by convention) to aid in diagnosis, or if doing high-resolution mapping with the RT220 system. If there is a problem with a sensor or a connection, use this screen to isolate the location.

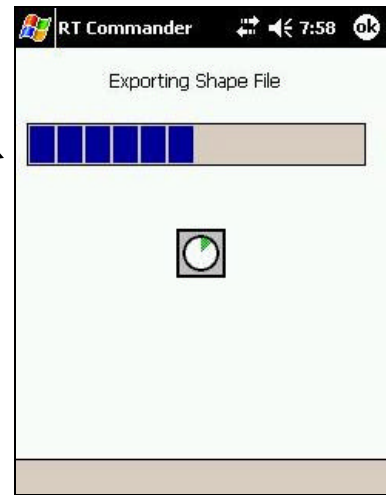


- Select “Ok” to return to the *Apply to an Area* screen
- At the end of the job, you can “Close Job” to begin another, or exit the program.

Choose to end the job, or exit the program. You will be asked to confirm this action, and then your data will be saved.



This Progress Bar will show the progress of creating a shape file for allowing mapping of your data. Depending upon how long you ran, this could take several minutes. **Note:** *As of V1.3.6, data is written to the file incrementally, so closing happens within 3 seconds.*



Mapping with the RT200

The RT200 provides the ability to map vegetation characteristics for crop analysis and historical data collection.

Select "New Mapping Job..." or "Open Existing Job..."

Click the drop down box to choose field, or Add/Edit fields

File name is created automatically. Starts with "M" for mapping file, today's date, and field at end of file name. Tapping small yellow box allows for changing location of file "save to" location. See the *Data Management* Section for more information.

You can confirm configuration from setup steps.

Input swath width of applicator for mapping screen display

Field name will be shown on upper left of screen

Tap the "Go" button and begin mapping. Tap "Stop" button when finished.

GPS will be shown on the "Status Bar" tapping this area with a stylus will take you to a Status Screen. (Same as Task>Status.)

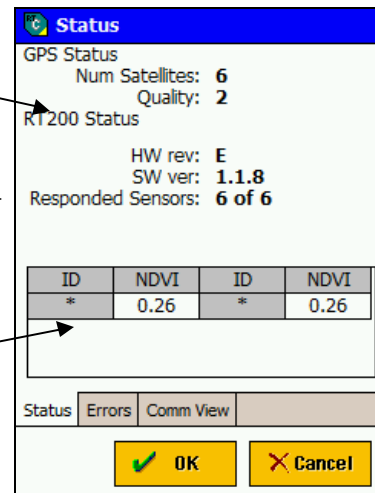
The screenshots show the RT Commander interface. The first screenshot displays the main menu with options for "New Mapping Job...", "New Application Job...", and "Open Existing Job...". The second screenshot shows the "Map the Area" configuration screen with fields for "Field Name" (N 40), "Date" (5 / 6 / 08), "File Path" (\Storage Card), "File Name" (M20080506_N 40.rtj), "NTech RT200" (COM2), "GPS" (COM3), and "Swath Width" (90 feet). The third screenshot shows the "Map an Area" screen with the field name "N 40" and NDVI value "0.00", along with "Go" and "Stop" buttons and a GPS status bar at the bottom.

GPS detail status.

RT200 Sensor status. Reports total number of sensors detected on system bus. If any persistent errors are reported, contact your dealer.

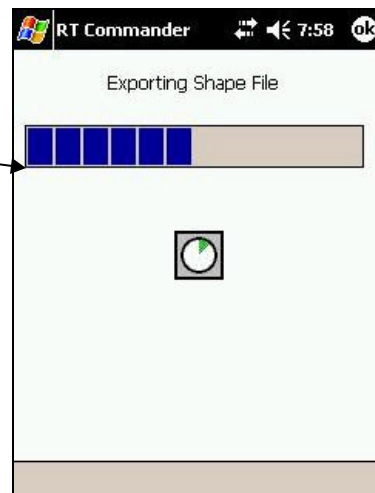
Indicates real-time values from the RT200 sensors.

Version 1.2 Status Screen doesn't show NDVI table.



- Select “Ok” to return to the “Map an Area” screen
- Select “File...Close Job” and select “Yes” to save application data or “No” to resume.

When you close a job, this progress bar will show the progress of creating a shape file for allowing mapping of your data. Depending upon how long you ran, this could take several minutes. **Note:** *As of V1.3.6, data is written to the file incrementally, so closing happens within 3 seconds.*

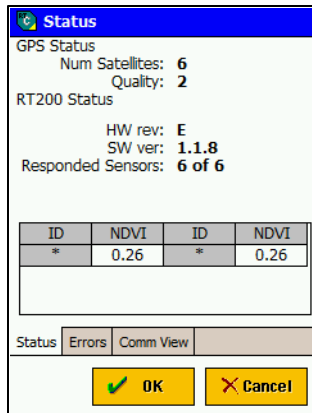


Data Output

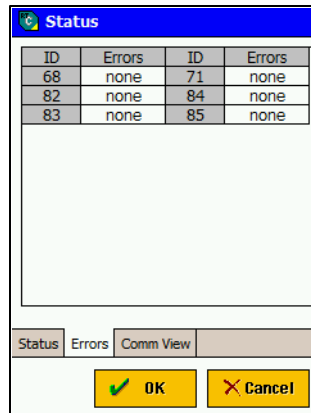
The data from the GreenSeeker sensors is collected by the RT200 Interface Module over the CAN bus, and then output as ASCII text in RS232 format (38,400 8,N,1) to RT Commander on the PDA. At each sample interval, the data is transmitted based on the selected options for the RT200. In particular, each line of data includes the value of NDVI and the value for a 2nd VI chosen by the user.

Dagnostic Tools

Select Task>Show Status... to view the Status screen. Three tabs are available to see GPS/NDVI condition, individual sensor conditions, and to view data streams to/from the connected peripherals.

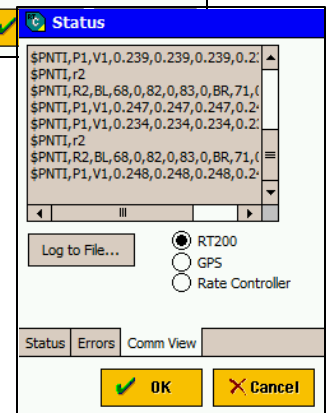
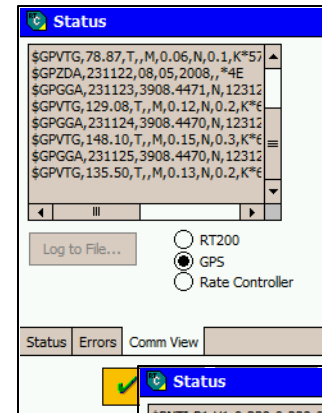


Status. Shows GPS condition and RT200 sensor quantity and software version. *Data here indicates positive communication to these devices*



Error Codes. NDVI values for crop analysis should range from 0.000 to 0.999. Therefore the RT200 uses negative NDVI numbers to communicate error conditions to RT Commander.

To make setup and troubleshooting easier, RT Commander v1.3.x, has an additional screen added as a tab on the Status Screen that indicates the ID and error codes from each sensor. The error codes are short messages to help diagnose any problems related to a sensor. Note that the ID is the last two characters of the Serial Number.



Comm View. Especially during setup, it is useful to see if data is streaming to or from various sources, allowing the operator to confirm cabling and serial port settings.

Select RT200 to see data from RT200

Error	Code	Description
-1	RED > NIR	Red reflectance higher than NIR
-2	BOTH < .01	Both reflectances below 0.01
-3	RED < .01	Red reflectance below 0.01
-4	NIR < .01	NIR reflectance below 0.01
-5	BOTH > .98	Either reflectance above 0.98
-.9	NIR < .015	NIR net reflectance below .015
-9.x	-9.x	All sensors responded with invalid data
-10.x	-10.x	No sensors responded at all

Error conditions include sensors disconnected from the CAN bus, or a sensor transmitting invalid data. Invalid data could occur if the sensor malfunctions, or more commonly, if it is seeing a target other than plants and soil. For example, when setting up, the sensors may be pointed in the air, or against wet asphalt; either of these will likely generate an error code from a sensor.

Data Management

The default location for RT Commander files is My Documents. If you wish to save these files in another location on the PDA, you may do so by selecting the alternate location at Job setup.

The files created by RT Commander are:

[A/M][date][filename].dbf*
[A/M][date][filename].fgp
[A/M][date][filename].fsn
[A/M][date][filename].gpe
[A/M][date][filename].rtj
[A/M][date][filename].shp*
[A/M][date][filename].shx*

**These files are typically used for creating maps of the data using a shape file format.*

Example of an application job file: A20050120_North40.rtj

CAUTION: If the Recon has not been charged for several days, data will be lost. To avoid:

- Run the Backup Now utility installed on the Recon,* or
- Pull the data off the Recon and save it to your PC, or
- Copy the files to the Compact Flash card.

**This built-in backup is now done at the factory to preserve the software installation. (See the TDS Recon Getting Started Guide for instructions on using the backup utility.)*

Application Information

Delivery System and Liquid Control

As with any variable rate system, the minimum and maximum rates obtainable are dependent upon the delivery system. The RT200 is capable of “requesting” any rate, but the actual rates delivered are dependent upon the rate controller and its components. Most liquid rate control systems control or “throttle” the pressure of the system to affect flow and application rate. There are also more advanced delivery systems that use two booms, multiple nozzles, or special pulsing solenoids on each nozzle, to obtain larger rate changes.

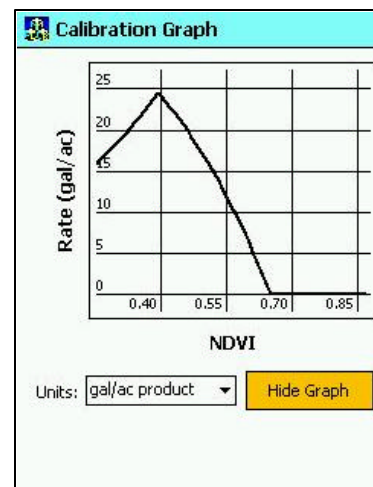
When using the RT200 with a typical liquid delivery system, it is important to match nozzle sizes to expected delivery rates. After the appropriate reference strip readings, GDD, and selection of crop type are input into RT Commander, the application graph can be accessed to show the prescription rates at various sensor NDVI readings. Review the Crop and Measurement screen features of the RT Commander software to determine the expected delivery ranges in each specific field. This is done by tapping the “Show Table” feature of the software. Depending upon what delivery system is used, there will be actual minimum and maximum rates obtainable. These will be dependent upon components like the pump, control valve, nozzles, and boom plumbing sizes.

The RT Commander has feature that allow for minimum and maximum rates to be set, regardless of the crop algorithm prescription. Once a nozzle set is chosen, the minimum should be set at the lowest rate the nozzles will still give adequate pattern/performance. Maximum rates may be limited by rates that lessen atomization or drift.

Selecting a nozzle

It is usually best to match nozzles to the lower midrange of the typical rates shown on the application graph. It is ultimately up to the grower or crop consultant to determine the min/max rates and nozzles which are most appropriate.

Example: If most of your NDVI readings (in the area of the field *not* in the NRS) are around 0.53, and your review the application graph shows at 0.53 NDVI you should be applying 15GPA, then you should choose a nozzle that will have the ability to change rates above and below this NDVI reading. You might choose a nozzle that puts out 12.5GPA at its lowest pressure (e.g. 20psi) and 21GPA at its highest pressure (e.g. 60psi). Since the penalty to under-fertilize (harm yield) is usually greater than to over-fertilize (waste fertilizer), it may be best to choose a strategy similar to the one shown here. Of course, you will need to modify to fit your circumstances, and to meet local field and delivery system conditions.



Maintenance

- When rinsing off the machine, take care not to use high pressure to directly spray the sensors. Even though all connectors and modules are fully sealed, there still exists potential leakage from a pressurized stream.
- Every time the spray tank is filled, take a soft cloth and wipe the lenses of the sensors if needed. Try to check sensors at least once a day during full time operation.
- Be more aware of cleaning the sensors directly behind the machine.
- If you do not have ground protection devices on the boom, such as gauge wheels or skids, take extra care to not run the boom into the ground. Also, be aware of sensor vulnerability to stationary structures in the field. Sensors are usually mounted on the front of the boom and do not have rigid protection.
- Rinse boom after the end of every day. This will keep the system clean and wash any corrosive materials off. This will greatly extend the life of your machine.
- Sensors should be re-calibrated after approximately 1000 hours of use due to possible changes in light output. This is generally done at the factory (NTech Industries inc.).
- Sensors have an optimum operating range of 32-48 inches above crop canopy. 38 inches is the optimum height, to be measured to the rectangular LED window of the sensor.
- At the beginning of each season, and periodically as required, check the hose clamps, plumbing connections, and other fluid handling system components for tightness and leak free operation.
- Make sure all wiring harness components remain fastened to the boom as to not obstruct the view of the sensors and are free of any pinch points from boom folding and movement.

Troubleshooting

- If you do not hear the chimes after turning on the PDA as described in the “Setup” section (or do not get serial communication to GPS and/or RT200), perform a soft reset by holding the power button down for approximately eight seconds. Then power Off and On. If no chimes are heard again, your PDA does not include the chimes feature and you must wait at least 10 seconds before opening any applications. **Do not launch RT Commander until both chimes have been heard or until at least 10 seconds have passed.**
- It is recommended that you run a backup often to ensure you never lose any data due to an unforeseen hard reset. Refer to the Recon’s *Pocket PC Getting Started Guide* for more information.
- If you are not seeing a black path being drawn on the map screen, verify that the signal quality of GPS is set no higher than 1 on the GPS Setup screen>Quality tab.

Note that rate commands are not sent unless a valid GPS is present; if GPS is not present, you can switch to GPS Setup>Simulation in order to proceed with Rate Controller setup.

- Refer to the online troubleshooting document for further assistance:
http://www.ntechindustries.com/lit/gps/RT200_Troubleshooting_Tree_v3.pdf

Design Revisions

Continuing a policy of research and development, NTech Industries, Inc. and its subsidiaries reserve the right of price, product or design changes without notice of obligation.

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THIS PRODUCT INCLUDES SOFTWARE THAT IS ONLY PROVIDED UNDER THE TERMS OF THE ENCLOSED SOFTWARE LICENSE AGREEMENT. YOU MUST ACCEPT THE ENCLOSED SOFTWARE LICENSE AGREEMENT BEFORE YOU CAN USE THIS PRODUCT. IF YOU DO NOT ACCEPT THE TERMS OF THE SOFTWARE LICENSE AGREEMENT, YOU SHOULD PROMPTLY RETURN THE PRODUCT FOR A FULL REFUND.

Disclaimer

The NTech Industries, Inc. products can be used to determine rates and apply several materials to various crops and plants. Results vary depending on factors outside NTech's control, such as weather and soil conditions. NTech and its distributors make no guarantees regarding the results you may obtain from the use of this equipment. NTech and its distributors will not be liable for any consequential damages incurred by the use of NTech products, including, but not limited to, loss or reduction of crop yields or changes in the amounts and expenses of crop fertilizers or other input materials.

U.S. Patent No: 5,585,626 5,296,702 5,389,781

www.ntechindustries.com

APPENDIX A: Cable Diagrams

XX IN +/- 1/2 IN
SEE TABLE B

CONNECTOR BODY MOVED FROM INSERTION END

NOTE 7

NOTE 1

NOTE 2

NOTE 4

2.0" MAX CABLE STRIPPING

CONNECTOR ASSEMBLY IS DUPLICATED ON OTHER SIDE

NOTES:

- SLIDE 1" HEAT SHRINK (3" LENGTH) ONTO CABLE. SNAP TWO CAPTIVE SCREWS INTO RETAINER AND SLIDE ONTO CABLE.
- STRIP CABLE JACKET AS SHOWN. PEEL BACK SHIELD. ADD 0.125" HEAT SHRINK (1.6" LENGTH) TO DRAW WIRE FOR INSULATION.
- HEATSHRINK SHIELD AROUND WIRES.
- CRIMP PINS TO WIRES PER TABLE A.
- DRILL HOLES IN MOLEX CONNECTOR AS SHOWN ON PAGE 2. SNAP THE TWO CONNECTOR HOUSINGS TOGETHER MAKING SURE TO LINE UP THE TWO ALIGNMENT PROTRUSIONS IN EACH CONNECTOR WITH THE CORRESPONDING FEATURES IN THE MOLEX CONNECTOR.
- REFER TO ACCOMPANYING IDENTIFICATION DOCUMENT 402-1-025 FOR POTTING INSTRUCTIONS.
- ADHESIVE BACKED CABLE LABEL WILL CONTAIN NUMBERS "400-1-265-XX" AND WILL BE MIN 0.125" HIGH.

PIN #	COLOR	GA	SIGNAL
1	BLACK	18	GND
2			
3			
4			
5			
6			
7			
8			
9	DRAIN	-	GND
10	WHITE	18	HIGH BUS
11	BLUE	18	LOW BUS
12	RED	15	+12V

XX	DESCRIPTION
8D	80" DAISY CABLE
12C	120" DAISY CABLE
18C	180" DAISY CABLE
24C	240" DAISY CABLE
30C	300" DAISY CABLE

REV	DESCRIPTION	DATE	APPROVED
A	CABLE PIN CONNECTION	02/15/04	SR
B	PART NUMBER CHANGES/ADDITIONS	03/20/04	SR
C	CHANGED CONNECTOR SEAL/POTTING INSTRUCTIONS	04/15/04	SR
D	CHANGED POTTING METHOD TO HUMANEL STRAIN RELIEF	04/16/04	SR
E	CORRECTED WIRE GAUGE/REMOVED 0.0" HT BRKF	08/23/04	SR

ITEM	PART NUMBER	VENDOR	QTY	UNIT	DESCRIPTION	NOTE
12		OPTIONAL	1	EA	LABEL, CABLE P/N	8
11		OPTIONAL	8	IN	1" ID HEAT SHRINK, 3:1	8
10		OPTIONAL	3	IN	0.125" ID HEAT SHRINK, 3:1	2
8	300-1-042	NTECH	2	EA	HUMANEL STRN RELF, PN CD018A-BK	7
8		OPTIONAL	4	EA	1#-32 X .5 CAPTIVE SCREW, PHIL	1
7	D10-1-218	NTECH	2	EA	RETAINER, CONNECTOR HOUSING	3
6	D10-1-222	NTECH	2	EA	SEAL, CONNECTOR HOUSING	
5	D10-1-215	NTECH	2	EA	HOUSING2, 12-PIN CONNECTOR	2
4	D10-1-214	NTECH	2	EA	HOUSING, 12-PIN CONNECTOR	2
3		OPTIONAL	24	EA	PIN, FEMALE CRIMP 02-06-0103	4
2		OPTIONAL	2	EA	MOLEX IDENTIFIED, SEE PAGE 2	
1		OPTIONAL	XX	IN	CABLE - Identical, PN 575 or 578	

APPROVALS	DATE
DESIGN: S. REED	03-11-04
DRAWN:	
APPROVED:	

NO SCALE

RT200 DAISY CABLE ASSEMBLY

SIZE B DRAWING NO. 400-1-265-XX REV E

FILE NAME 400-1-265-XX RT200 Daisy Cable.dwg SHEET 1 OF 2

CONNECTOR BODY MOVED FROM INSERTION END

30 FT ± 2 IN

NOTE 4

NOTE D

END "A"

END "B"

PIN #	COLOR	GA	SIGNAL	PIN #
A	RED	14	+12V	-
B	BLACK	14	GND	-
C	-	-	NOT USED	-

NOTES:

- STRIP CABLE JACKET BACK 2" ON END "A".
- CRIMP PINS TO WIRES PER TABLE A.
- INSTALL PLUGS IN UNUSED POSITIONS IN DEUTSCH CONNECTOR.
- LEAVE CABLE END "B" UNFINISHED.
- ADHESIVE BACKED CABLE LABEL WILL CONTAIN NUMBERS "400-1-276" AND WILL BE MIN .125" HIGH.
- PACKAGE FUSE HOLDER, FUSE, AND RING TERMINALS IN A ZIPLOC BAG AND TETHER TO ASSEMBLED CABLE.

REV	DESCRIPTION	DATE	APPROVED
A	RELEASE	10/1/04	J

ITEM	PART NUMBER	QTY	UNIT	DESCRIPTION	NOTE
10	VENDOR SUPPLIED	1	EA	LABEL, CABLE P/N	3
8	300-3-095	1	EA	PLUG, SEALING, CONTACT SIZE 12-16	3
8	300-3-108	1	EA	CONNECTOR, 3-PIN PLUG, HD10-3-083	
7	300-3-171	1	EA	BACKSHELL, HD10 3-PIN	
6	300-3-172	1	EA	COMPRESSION NUT, SIZE 1	
5	300-4-028	1	EA	FUSE HOLDER	6
4	300-4-027	1	EA	FUSE, ATQ, 7.5 AMP	6
3	300-4-032	2	EA	TERMINAL RING, 5/16" STD	6
2	300-4-080	2	EA	CONTACT, SOCKET, SIZE 16, GOLD	2
1	375-1-022	30	FT	CABLE - 2-CORE, 14AWG, RED/BLK	

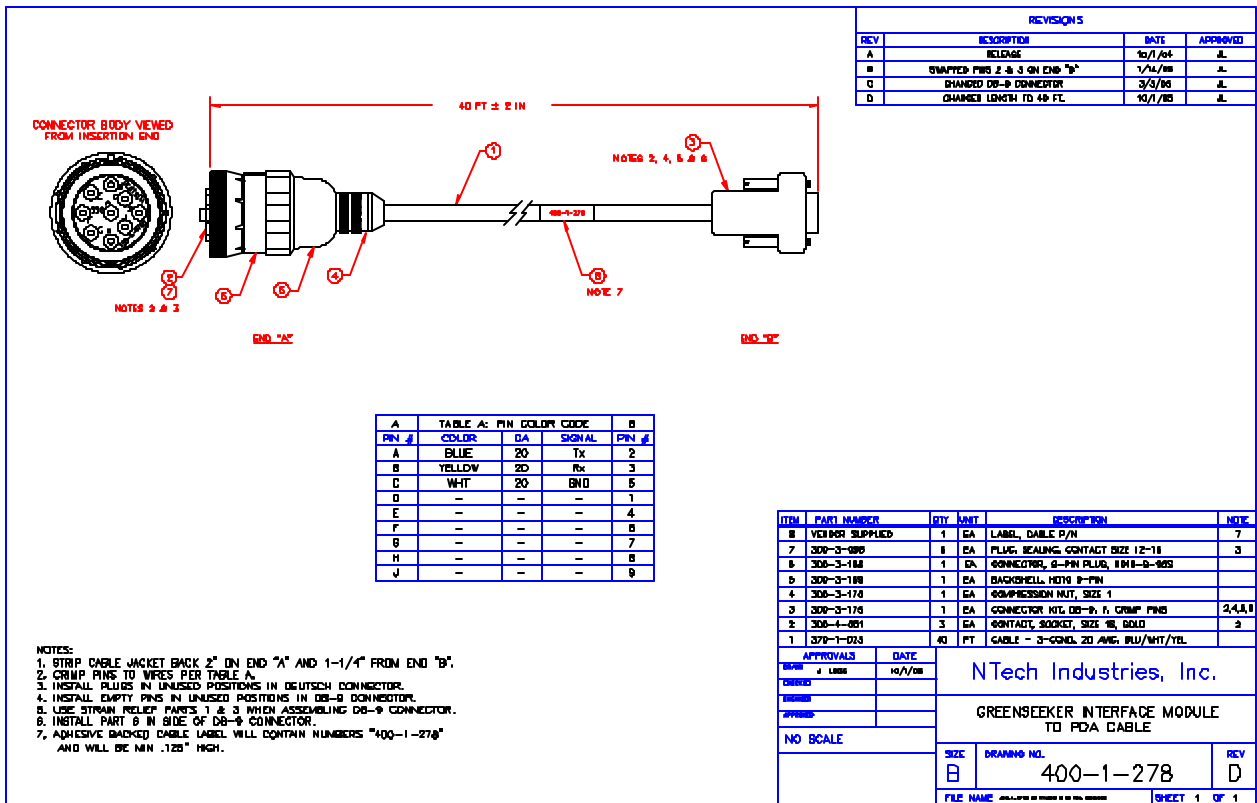
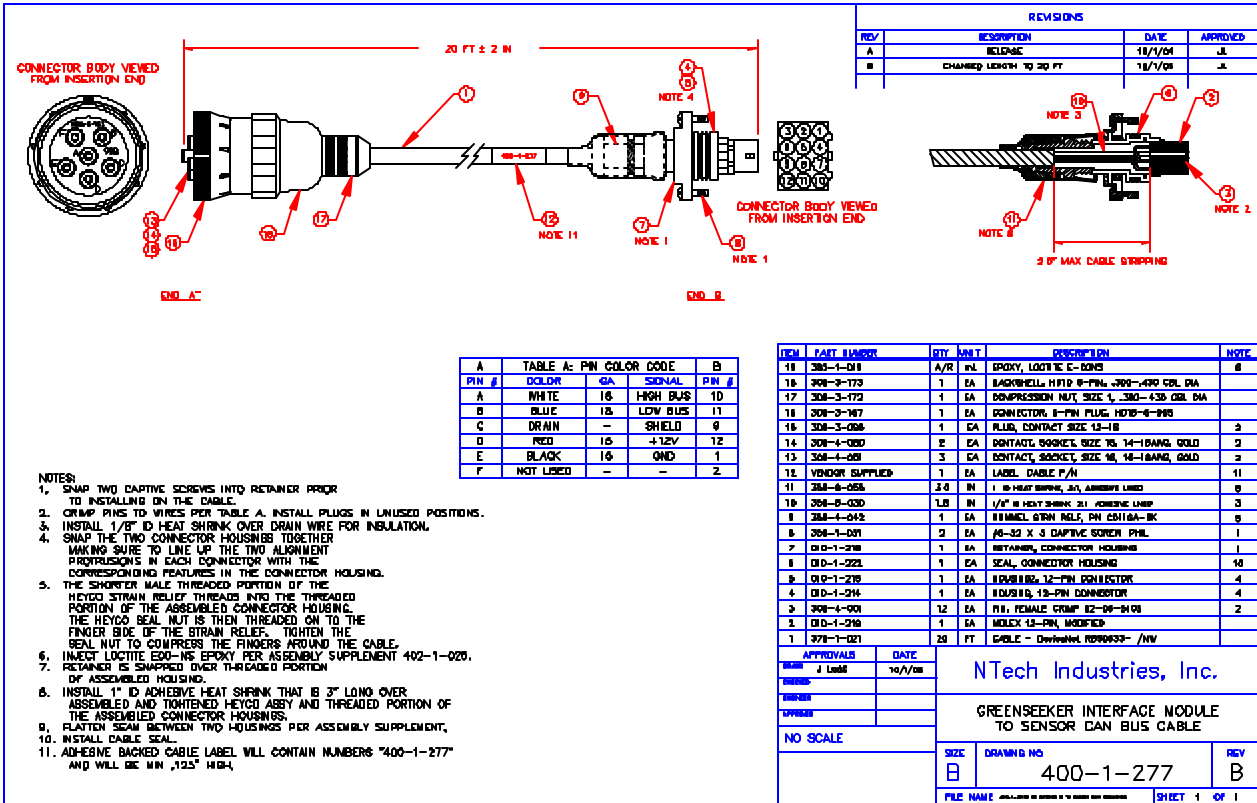
APPROVALS	DATE
DESIGN: J. LIND	10/1/04
DRAWN:	
DRAWN:	
APPROVED:	

NO SCALE

GREENSEEKER RT200B INTERFACE MODULE POWER CABLE

SIZE B DRAWING NO. 400-1-276 REV A

FILE NAME 400-1-276-01 POWER.dwg SHEET 1 OF 1



APPENDIX B: List of Components

Part #: 900-1-314 Description: BASIC SYSTEM,GS RT200 "C",W/TDS NOMAD

Item ID	Item Description	Qty Needed
350-6-088	RT200 RAM Cradle Mounting Kit	1.00
. . 450-1-043-1	RAM V Base Ball & Straps	1.00
. . 450-1-043-2	RAM Double Socket Arm 1" Ball	1.00
. . 450-1-043-3	RAM Diamond Base w/Ball	1.00
. . 450-1-064	RAM 6 1/4" x 2" Base Unpackaged	1.00
. . 450-1-069	RAM TDS Nomad Holder Unpackaged	1.00
350-6-089	RT200 Cable/Connector Kit	1.00
. . 300-4-029	Disconnect Female Fully Insul 16-14AWG bl	2.00
. . 310-1-002	Switch Toggle SPST Quick Connect S1F	1.00
. . 310-2-008	Toggle Switch Panel 1 POS	1.00
. . 310-2-009	Face Plate Toggle SW on/off	1.00
. . 350-6-077	Null Modem Adapter Mini	1.00
. . 350-6-078	Gender Changer Mini DB9M/DB9M	1.00
. . 450-1-066	Serial Cable DB9F/DB9F 6'	2.00
350-6-090	RT200 GS Sensor Mounting Kit	1.00
. . 350-1-049	BLT Hex 5/16"-18 x 3/4"	14.00
. . 350-1-107	BLT U Round 2 1/2" x 5 5/8" x 5/16-18	14.00
. . 350-1-108	Plate Backing for 350-1-107	14.00
. . 350-2-009	WSR 5/16" Lock SS	14.00
. . 350-3-005	Nut 5/16" -18 SQ SS	14.00
. . 350-3-027	Nut 5/16" -18 Hex NYL SS	28.00
370-2-011	Cable Ties, 6", 10-Pack	1.00
370-2-012	Cable Ties, 15.5", 50-Pack	1.00
385-1-026	Dielectric Grease .33 OZ Tube	1.00
400-1-228	ASSY Term GS Sensor CAN 12-pin	2.00
400-1-265-240	ASSY Cable 240" Daisy RT200	4.00
400-1-266	ASSY Bracket RT200 GSK MS	6.00
400-1-276	ASSY Cable 30' RT200B PWR	1.00
400-1-277	ASSY Cable 20' RT200B IM-Sensor	2.00
400-1-278	ASSY Cable 40' RT200B IM - PDA	1.00
400-1-310	Kit EasySync box w label & cable	1.00
. . 010-3-126	Label 4-port Serial splitter	1.00
. . 450-1-074	USB Cable TypeA M to TypeB M 10'	1.00
. . 450-1-094	EasySync 4port USB/Serial box	1.00
. . 800-1-900	Labor Inside	0.10
450-1-046	Compact Flash Card 2GB	1.00
450-1-068	PDA Pocket PC TDS Nomad	1.00
450-1-073	Auto Charger TDS Nomad	1.00
550-1-022	Software License RT Commander	1.00
900-1-009	Model 500 GreenSeeker Sensor	6.00
900-1-047	RT200 GS Interface Module	1.00
500-1-035	DOC GSK RT 200C Op Manual	1.00

APPENDIX C: Resources

NTech Industries, Inc.

www.ntechindustries.com

PDA Support: Tripod Data Systems

www.tdsway.com/support/

Tel: 541-757-7254

Other resources

Nitrogen Use Efficiency

www.nue.okstate.edu

Sensor-Based Nitrogen Rate Calculator

www.soiltesting.okstate.edu/SBNRC/SBNRC.php

APPENDIX D: How To Re-install RT Commander

An update procedure is available online for installing or updating RT Commander:

http://www.ntechindustries.com/lit/gs/RTCommander_Update_Procedure.pdf

You may also follow these instructions if the Recon has lost its charge, has had to be Hard reset, or if you need to install the factory installed software and drivers on a new Recon.

- Connect your Recon to your computer using Microsoft ActiveSync™.
- Once Microsoft ActiveSync™ indicates that the Recon is connected, insert the NTech RT Commander CD into your computer.
- From the Windows Taskbar, select Start | Run. Once the Run window opens, type:
D:\RT Commander\Install.exe (where D: is the CD drive)
- Follow the on-screen instructions to complete the installation.
- Soft reset the Recon by holding down the power button for about 8 seconds.
- If prompted to enter a registration number after running the program for the first time, please register your software at <http://www.ntechindustries.com/register/> and a registration number will be e-mailed to you.

If additional help is needed, contact your dealer or distributor for assistance.

APPENDIX E: Custom Algorithm

The Custom Formula feature provides the ability for the user to choose the application rates that will be applied at different sensor readings. In version 1.3.x of *RT Commander*, Interpolation is added to the 16point table, and a 100pt table option is added. Note that all positions of the 100pt table must have a valid rate entered.

Select the New Custom Formula.

Crop & Measurement Parameters

Location Name: N 40

Non-Ref	Ref	Ref-Peak	RIadj
0.00	0.00	0.00	0.00

Crop
 <New Custom Formula>

Linear, Index*100
 Winter Wheat, Dryland 2005
 Spring Wheat, Irrigated 2004
 Corn, Dryland 2003
 Corn, Irrigated 2003

 My Turnip Algorithm 2005
 <New Custom Formula>

Max GPA
 Min GPA

Ok Cancel Show Graph Edit

Important: Tap on the text box to name the formula.

Select the rate that the RT200 will send the applicator's rate controller as sensor values change. Standard table is 16 rates spanning NDVIs of 0.20 – 0.95, with an interpolation option. A high-resolution choice has been added with 100 points for NDVIs of 0.00 to 0.99. Note the horizontal scroll bar at the bottom of the gray area to access additional fields. Be sure to put a value in each rate box.

Custom Application Table

Custom Formula: New Formula

NDVI	Rate	NDVI	Rate
0.20	0.00	0.60	0.00
0.25	0.00	0.65	0.00
0.30	0.00	0.70	0.00
0.35	0.00	0.75	0.00
0.40	0.00	0.80	0.00
0.45	0.00	0.85	0.00
0.50	0.00	0.90	0.00
0.55	0.00	0.95	0.00

Units: gal/ac Product

Stepped
 Interpolated

Ok Cancel

Custom Application Table

Custom Formula: cot1

NDVI	Rate	NDVI	Rate
0.15	0.00	0.20	6.00
0.16	3.00	0.21	9.00
0.17	3.00	0.22	10.00
0.18	4.00	0.23	12
0.19	5.00	0.24	0.00

Units: gal/ac Product

Stepped
 Interpolated

Ok Cancel

When finished, select the OK button to return to the Crop and Measurement Parameter screen.

NTech Industries, Inc.

740 South State Street Ukiah, CA 95482

tel 707-467-3747 fax 707-467-3750

toll-free 888-728-2436

www.ntechindustries.com