

# Series 1405 TEOM Firmware Upgrade

## Version 1.74.00

### **OVERVIEW**

These instructions describe how to perform a firmware upgrade to version 1.74.00 for a series 1405 instrument. It describes the differences between firmware versions, how to unpack the firmware files, and how to install them on the instrument. There are two different ways to perform a firmware update, via an Ethernet connection (with or without a router) using **ePort** software or via a USB FLASH drive (for this method, see Instrument Firmware Upgrade Instructions in this document for Ethernet-Based or USB-Based upgrades).

IMPORTANT: For customers that haven't already updated to instrument firmware version 1.56.00: Prior to beginning the update of your equipment to version 1.74, you should verify the equipment has been updated to version 1.56 first. If the version currently loaded on the unit is not version 1.56, please visit the AQI On-Line Library to download 1.56 and refer to the readme file for version 1.56 for upgrade instructions. If you fail to update to 1.56 and try to go straight to version 1.74 you may encounter an unrecoverable error requiring you to replace the compact flash card.

**PLEASE NOTE:** It may be necessary to temporarily disable the Windows Firewall prior to upgrading firmware to resolve connection issues when upgrading.

### **INSTRUMENT FIRMWARE VERSION RELEASE NOTES**

Version 1.74.00 changes from version 1.73.00:

*Changes common to all product variants*

- Add fix to properly calculate the PMT10 values based on standard conditions.

Version 1.73.00 changes from version 1.72.00:

*Changes common to all product variants*

- Set time screen now has limits on the hour's value of 0-23 (was 1-24).
- Added warning screen to inform user that the unit must be in Stop mode to set the time. Unit now reboots automatically when the time is changed.
- Changes to the boot-up scripts to accommodate new Kontron processor board hardware.

Version 1.72.00 changes from version 1.71.00:

*Changes common to all product variants*

- Bug fix: address clock drift by synchronizing with onboard precision clock.

Version 1.71.00 changes from version 1.70.00:

*Changes common to all product variants*

- Fix the delay in COM port transmission for AK and German Network Protocols.
- Remapped the Operational Status codes from the standard 1405 definitions to ones compatible with the German Network Protocol.

Version 1.70.00 changes from version 1.57.00:

*Changes common to all product variants*

- New Feature added to Implement German Network Protocol
- New Feature added to Update Instrument GUI and add registers support to reflect updated EPA FEM Status
- Bug Fix: Enhance the stability of SSTO AK Protocol command.
- The AK Protocol PRC set was extended or modified to correspond with the changes described.
- Add Default Gateway item in network configuration

The following are new, added PRCs:

PRC	Description
421	German Network Protocol Instrument ID
422	German Network Protocol Location ID
423	German Network Protocol Registers to Read
424	German Network Protocol End Character
425	Coarse FEM MC Value
426	Coarse FEM MC Value 30 mins
427	Coarse FEM MC Value 1 hour
428	Coarse FEM MC Value xx hours
429	Coarse FEM MC Value 12 hours
430	Coarse FEM MC Value 24 hours
431	Total FEM MC Value
432	Total FEM MC Value 30 mins
433	Total FEM MC Value 1 hour
434	Total FEM MC Value xx hours
435	Total FEM MC Value 12 hours
436	Total FEM MC Value 24 hours
437	Default Gateway

Version 1.57.00 changes from version 1.56.00:

*Changes common to all product variants*

- The version numbers for various software components for the prior release and this release are as follows:

software component	instrument version 1.57	instrument version 1.56
bootloader	1.4*	1.3
ePort firmware update script	1.2	1.1
USB firmware update script	1.2	1.1

\* Only for factory units manufactured after version 1.57 of the instrument software was released.

- Enhancement that should improve the overall reliability and performance of the instrument by updating some of the underlying packages used (kernel, graphics, database, drivers). Similar enhancement that improves the reliability and performance of the data storage (Compact Flash) by reconfiguring the driver. Correct a minor memory usage bug.
- This instrument firmware update contains a new release of board firmware for the IO Interface board. The new version is 0.014 and in most cases will auto-update from version 0.013. **Please watch for the update the first time booting the instrument after the instrument firmware update. Refer to the section above about board firmware updates.** IO Board firmware version 0.014 provides a bug fix for an automatic input calibration problem.
- New feature added for ambient Relative Humidity (RH), dryer RH, and dryer temperature calibration (dryer fields are only on the FDMS variants). The calibration steps for these measurements now include a correction offset that is factored into the control, thereby improving instrument performance. A new set of corresponding Product Register Codes (PRCs) have been added, while maintaining backward compatibility with the existing PRCs. See the PRC table below for the new codes.
- Enhancement to the K0 audit wizard feature that displays the initial and final frequency values used in the calculation displayed on the results screen. These values are now displayed in new fields along with the fields that are currently being displayed, which are the pass/fail status and the K0 percent difference calculation.
- Enhancement to the USB-based data download feature that adds a header with additional information at the beginning of the .CSV file that gets created. This header information will now be the same as in .CSV files offloaded using the ePort client software. Also, the file names that are created will be named using unique identifiers that include the instrument serial number and follow the ePort downloaded file naming convention. Using the same naming convention will help eliminate confusion and errors especially when working with data files from multiple instruments. The

convention is SN\_YYYY-MM-DD\_HH-MM-SS.csv, where SN is expanded to be the instrument's serial number, YYYY is the year, MM is the month, DD is the day, HH is the hour (24 hour format), MM is the minutes and SS is the seconds.

- Enhancement that improves the instrument's network security by improving telnet protocol security.
- Enhancement to the flow audit wizard feature that adds a total flow field. This new total flow field value represents the combined values of the individual flows. The total flow is also available as a selectable audit similar to the existing flows. The results of the total flow audit will be displayed on the results screen, in addition to the individual flows as they are currently being displayed. At the end of the audit, the user has the option of applying an adjustment factor for the individual flows, but not the total flow. Note that it is recommended that users audit the individual flows first, before auditing the total flow.
- Enhancement to the flow audit wizard feature that displays the adjustment factor value in a new field on the completion screen.
- Bug fix to correct an issue where the flow audit adjustment factor was retained and used during a subsequent flow calibration. This issue only affected customers who utilized the flow audit adjustment factor function during the flow audits. When performing a flow audit, the operator has the ability to accept the use of a flow audit adjustment factor as a single point calibration adjustment for the instrument flow rates. In previous versions of the instrument software, the flow audit adjustment factor was retained and used during and after a new flow calibration. With this updated version, the audit adjustment factors are now reset to 1.0 and are not used during a flow calibration. During subsequent flow audits after a flow calibration, the audit adjustment factor is updated relative to the previous flow calibration and not the previous flow audit. This allows for a more consistent review of the flow calibration and audit results and allows for a better historical review of changes in the flow calibrations and audits of the instrument.
- Bug fix for problem where after performing an instrument firmware update using the USB-based update method, configuration changes in the Contact Closure feature (**Settings > Analog & Digital Outputs > Contact Closure**) would not be retained. Instead of being saved, those configuration items would revert back to their default values.
- Bug fix in the Leak Check Wizard feature for a problem where it incorrectly reported that the check was successful but one channel had failed.
- Bug fix to handle rare instances where a specific type of data on the Ethernet network could be misinterpreted by the instrument, causing it to attempt to modify its data logging interval with an invalid value. This would in-turn cause the instrument to stop logging data because the invalid value was not being handled correctly. There were two associated bug fixes for this. The first was to prevent the data logging

feature from being susceptible to the specific network data. The second was to limit the logging interval entry to 28,800 seconds (8 hours) at most.

- Removed a feature that provided a level of internationalization for number formatting (decimal point or comma representations) because it was not working properly. The feature may be included in a subsequent release.
- The PRC set was extended or modified to correspond with the changes described.

The following are new, added PRCs:

PRC	Description
401	Dichot mass conc standard
402	Dichot 30-min mass conc standard
403	Dichot 1-hr mass conc standard
404	Dichot XX-hr mass conc standard
405	Dichot 12-hr mass conc standard
406	Dichot 24-hr mass conc standard
407	TEOMA mass constant A
408	TEOMA mass constant B
409	TEOMB mass constant A
410	TEOMB mass constant B
411	TEOMA dryer temp offset
412	TEOMB dryer temp offset
413	TEOMA dryer temp raw
414	TEOMB dryer temp raw
415	ambient RH offset
416	TEOMA dryer RH offset
417	TEOMB dryer RH offset
418	ambient RH raw
419	TEOMA dryer RH raw
420	TEOMB dryer RH raw

The following are renamed PRCs.

PRC	New Description	Old Description
036	Dichot mass constant A	mass constant A
037	Dichot mass constant B	mass constant B

*Changes specific to the –Dichot (non-FDMS) product variant*

- Enhancement to the mass calculation constants feature that adds two new sets of configurable constants. The new sets of mass constants are for the PM 2.5 and PM-coarse measurements. Both new sets of constants are accessible on the Mass Calculation Variables screen (**Settings > Advanced > Mass Calculation Variables > Mass Constants**). Each set of constants are independently applied. Currently there is only a single set of mass constants for PM-10. Note that the PM-2.5 and PM-coarse constants are applied before the PM-10 constants are applied. Two new

pairs of corresponding PRCs have been added, while maintaining backward compatibility with the existing PRCs. See the PRC table above for the new codes.

*Changes specific to the –Dichot product variants (both FDMS and non-FDMS):*

- Enhance the PM-10 Mass Concentration measurement reporting by providing the ability to change the associated settings between the actual and standard condition settings. This is independent from the PM-2.5 and PM-coarse measurements. Currently there is only one reporting setting that is applied to all of the measurements. A new set of corresponding PRCs has been added, while maintaining backward compatibility with the existing PRCs. See the PRC table above for the new codes (the ones with “standard” in their names).

*Changes specific to the FDMS product variants (both SingleFDMS and DichotFDMS):*

- Bug fix to correct an error where the 1 hour average values were not properly synchronizing with the top of the hour recording. When recording hourly data, there were occasions where the hourly update occurred after the hour data update. This resulted in duplicate hourly data values. If data was recorded at a more frequent data rate, the hourly update is recorded at the next data period, prior to the start of the next hourly reporting period.
- Bug fix for a problem where non-default FEM configuration settings (**Settings > Advanced > Mass Calculation Variables > Equivalent Designation**) were not retained across a power cycle.

*Changes specific to the non-FDMS product variants (both Single and Dichot):*

- Enhancement to the mass calculation variables feature that adds two new configurable mass averaging constants. The two new constants are for the total mass averaging time and the MRMC averaging time. These items can be configured on the Mass Calculation Variables screen (**Settings > Advanced > Mass Calculation Variables**). Both settings have a default value of 300 seconds and a range of 10 to 20,000 seconds inclusive. In the prior version, the MRMC setting range was 0 to 1,000 seconds inclusive. A value of 1500 for these constants will allow the instrument to mimic the averaging behavior of the previous TEOM model 1400ab.

Version 1.56.00 changes from version 1.55.00:

*Changes common to all variants:*

- Add feature to align the data logging (**Settings > Data Storage**) updates with the top-of-the-hour when possible. For example when using even, align-able data storage intervals such as 1 Hour, 30 Minutes, 10 Minutes, etc., data logging updates will be aligned with top of the hour (align-able intervals are required so for example using odd values such as 7 Minutes will not align). To illustrate this, the following table from a data file offloaded from an instrument shows top of the hour alignment using a 1 hour data storage interval setting:



time_stamp	tmoTEOMAMC_0	tmoTEOMAMC1Hr_0
04/18/2011 20:00	0.0	0.0
04/18/2011 21:00	3.52034	0.8892
04/18/2011 22:00	0.382882	1.10901
04/18/2011 23:00	-2.2713	-0.423206
04/19/2011 00:00	1.80596	-0.020079
04/19/2011 01:00	1.52067	0.768729

In this example, the instrument data was cleared and the instrument was booted prior to 20:00 (between 19:00 and 20:00). The instrument won't log data until the top-of-the-hour and the logged values are populated just prior to the top-of-the-hour boundary. So not only is the data logging synchronized with the top of the hour, but the calculations are synchronized as well. In the prior version, the time stamps in the first column would be from whenever the instrument happened to have been started. As shown, in order to provide this feature, it is necessary to delay the startup sequence until it is in alignment, so users may notice this additional startup time.

- Detect humidity and temperature sensor failures even if unit is not configured for active control flow and set the corresponding Status Condition error code.
- Fix problem where data logging in some cases would start before the correct Real-Time Clock time value was read. This was limited to within the first minute after the instrument was powered on.
- Several increase-reliability types fixes.
- Removed an unused entry on the list of selectable Data Logging variables.
- Edit one of the PRC codes by renaming a reserved register to be the "MRMC average time" PRC (compatibility with version 1.55 is maintained).

*Changes specific to the SingleFDMS variant:*

- Enhancement to add U.S. EPA Federal Equivalent Method (FEM) support that includes an updated main screen with a new column and populated FEM variables.

*Changes specific to the Dichot (non-FDMS) variant:*

- Correctly account for a 10% loss of mass flowing through fine channel at the inlet in all the Coarse Mass Concentrations (both real-time and averages). Previously this loss adjustment was not being applied.

Version 1.55.00 changes from version 1.52.00:

*Changes specific to the Single and Dichot (non-FDMS) variants:*

- Modify the Mass Concentration output to have a less smoothed response that is very close to that of the 1400.

*Changes specific to the Single variant:*

- Correct the operation of the Mass Calculation constants (**Settings > Advanced > Mass Calculation Variables**), in the prior release these weren't functional. Also change the default values for these to match the 1400, so Mass Constant A will be 3.00 and Mass Constant B will be 1.03 by default.

*Changes common to all variants:*

- Correct the Touchscreen calibration reboot screen to place the buttons where they are accessible on the screen even when the instrument is in a mis-configured calibration state and the user is attempting to correct it.
- Update the bootloader to version 1.3 to correct a minor recoverable error that occurred during an ePort firmware update under some situations (only new production units or customers that update their Compact Flash card will get this specific/bootloader change).

Version 1.52.00 changes from version 1.51.00:

*Changes common to all variants:*

- Add Touchscreen configuration (**Service > Calibration > Touchscreen Calibration**) used to select between pre-calibrated configurations for the new model touchscreen (Berquest P/N 400456-01, which has a brown colored ribbon cable) and the old model touchscreen (Berquest P/N 400212-02, which has clear colored ribbon cable). Thermo Scientific recommends that all customers please read the associated Tech Note about touchscreens called "Series 1405 TEOM Touchscreens Technical Bulletin". This will be of particular interest to customers that have experienced touchscreen mis-alignments on instruments, but all customers will want to read it and possibly will need to follow a short procedure.
- Update touchscreen vendor driver software to version 3.04d.
- Correct operation of analog anemometer via I/O board firmware version 0.013.
- Bootloader update to version 1.2 (minor update, on new instruments only)

*Changes specific to the Dichot variant:*

- Correct a problem where if non-default values for the Mass Constants (**Settings > Advanced > Mass Calculation Variables**) were used, they were incorrectly being applied twice. The default value for Mass Constant A is 0.0 and the default value for Mass Constant B is 1.0.

*Changes specific to the DichotFDMS variant:*

- The instrument reboot (**Service > Run Control > Reboot**) via the graphical user interface should function correctly. Note: There's a small delay when it power cycles the circuit boards in the system when rebooting.

Version 1.51.00 changes from version 1.28.00:

*Changes common to all variants:*

- Enhancement adding an instrument variable ordering feature that allows a customer-defined ordering to appear within data files offloaded from the instrument. The left-to-right column ordering in the spreadsheet data files will correspond to the top-to-



bottom ordering specified on the Data Storage screen (**Settings > Data Storage**). See the on-screen instructions and the 1405 Operating Guide for more information. Also see the release notes section below for the **ePort** and **RPComm** Thermo Scientific applications.

- Correct problem where occasionally, especially after quickly entering Stop or Setup mode and then back to Run mode, the instrument would enter Stabilization mode as expected but not exit it. On the SingleFDMS and DichotFDMS variants, the instrument may have continued to correctly calculate the Mass Concentration values when in this state, but in some cases it may not for example the Base Mass Concentration for Side A may have an opposite/negative signed value vs. expected. Also, the noise values may incorrectly appear as zero when the instrument is in this state.
- Correct problem that was preventing **ePort** from obtaining diagnostic information from the instrument. This feature is accessed on **ePort's** Help menu (**Help > Download Diagnostics**) and is used to obtain items such as information status logs and board firmware revision levels for the various circuit boards in the instrument.
- Add startup message to display the Bootloader version level when the instrument powers up. Remove unnecessary startup messages.

*Changes specific to the DichotFDMS and SingleFDMS variants:*

- Correct a problem where the Leak Check Verification feature could potentially damage a value under some circumstances (when the Leak Check Verification is running and the stabilization timer has expired and a 6-minute valve switch event occurs).
- Enhancement to the Leak Check Verification feature (**Service > Verification > Leak Check**) that allows each TEOM side to be independently checked for leaks. The new results screen shows additional information (the zero level measured and the pass/fail threshold limits) and displays results for both sides (if both sides were tested).
- Correct a problem where the main data screen and the “FDMS Module” screen Dichot “total” columns unexpectedly contained non-zero values, unlike the other columns that get zeroed correctly, when the instrument mode is changed from Run to Setup or Stop mode.
- Correct problem where if the Leak Check Back button (**Service > Verification > Leak Check**) was used when the stabilization timer was running, it would sometimes produce a timer-related exception error message.
- Added U.S. EPA Federal Equivalent Method (FEM) related PRC codes to the set of supported codes for use with **RPComm**. The updates are entries appended to the end of the PRC codes list so the list should remain backward compatible.

*Changes specific to the DichotFDMS variant:*

- Enhancement to add U.S. EPA Federal Equivalent Method (FEM) support that includes an updated main screen with a new column and new instrument variables.

Note: Initially this feature is only for the DichotFDMS variant but a future release may provide support for the SingleFDMS variant.

The new instrument variables parallel the existing PM sets so there are instrument variables for the FEM Mass Concentration and the various FEM Mass Concentration averages. The new variables follow the same naming convention but instead have the “TEOMA FEM” prefix. A new configuration button is used to select between the default calculations mode (as in earlier versions, using the “none” selection) and with the new additional FEM calculations mode (using the “EPA” selection). This configuration item is on a new Equivalent Designation screen (**Settings > Advanced > Mass Calculations Variables > Equivalent Designation**). Note: there are Equivalent Designation buttons for “TUV”, “Japan” and “Other” but these are not supported at this time.

*Changes specific to the Dichot variant:*

- Corrects the K0 Verification Wizard (**Service > Verification > Mass Transducer K0 Verification**) title and description text.

Version 1.28.00 changes from version 1.27.00:

- Back-off and separate the vacuum warning thresholds because the vacuum warning enhancement added in the prior release was causing warning messages too soon at some installations on some variants. The new vacuum warning thresholds are 0.4 atm for the FDMS variants and 0.75 atm for the non-FDMS variants.

Version 1.27.00 changes:

*Note: Version 1.25.00 was the last official release for the FDMS variants, and it had limited scope. Prior to that, V1.23.00 was the last official release for the FDMS variants. Version 1.22.00 was the last official release for the non-FDMS variants.*

*Changes common to all variants:*

- Correct the way the Filter Loading is calculated to factor in elevated altitude conditions.
- Change the vacuum warning determination method to better detect warning conditions and change the corresponding warning message. The warning appears when the Vacuum Pressure > 0.3 atm instead of when the Ambient Pressure – Vacuum Pressure < 0.1 atm.
- Add detection that the external Relative Humidity/Temperature sensor is not connected and add a corresponding warning message. The hexadecimal system warning code for this warning is 0x00000008. The sensing is dynamic so it will detect sensor installation/removal changes while the instrument is running. Note that this check only takes place when the flow control is set to Active (**Instrument Conditions > Flows > Flow Control > Volumetric Flow Control = Active**).

*Changes specific to the DichotFDMS and SingleFDMS variants:*

- Constrain the Frequency Wait time values (**Settings > Advanced > Mass Calculation variables**) that the user can enter to be one of the following, in seconds: 60, 70, 80, 90.

*Changes specific to the SingleFDMS variant:*

- On the Single-FDMS variant only, on the Cooler Cleaning Wizard (**Service > Maintenance > Clean Coolers**), correct a problem where, after stabilizing at 50 °C, the wizard should have started a 1-minute countdown timer to allow the system to stabilize, this step was being skipped.

Version 1.25.00 changes from version 1.23.00 are:

*SingleFDMS and DichotFDMS variants only (note: version 1.23.00 was the last official release for these variants):*

- Reduce the likelihood of a TEOM dryer dew point warning that was being activated too soon under some ambient conditions. Changed the method of determining if a warning condition exists to: dryer dew point is greater than the cooler temperature set point minus 2 °C, from: dryer dew point is greater than 2 °C.
- Correct problem where occasionally, especially after quickly changing modes from Run to Stop or Setup mode back to Run mode, the instrument would enter Stabilization mode as expected but not exit it. The instrument may or may not continue to correctly calculate the Mass Concentration values when in this state. In at least one instance the Base Mass Concentration value for the PM-2.5 flow path was observed to have an opposite/negative-signed value vs. expected.

Version 1.23.00 changes from version 1.22.00 are:

- SingleFDMS and DichotFDMS variants only: Mass Concentration calculation algorithm timing value change related to the TEOM(s) to further improve the temperature stability of the instrument when combined with other associated mechanical changes.

Version 1.22.00 changes from version 1.21.00 are:

- Single and Dichot variants only: Make the mass concentration algorithms equivalent to the ones in the 1400ab instrument, including: a) software changes combined with other changes to eliminate the rare occurrence of a mass-measurement temperature sensitivity, b) mass concentration hourly average updates aligned with the top of the hour, c) 300 second mass averaging interval vs. 120 seconds.
- SingleFDMS and DichotFDMS variants only: Make the mass concentration algorithms equivalent to the ones in the 8500c instrument, including: a) software

changes combined with other changes to eliminate the rare occurrence of a mass-measurement temperature sensitivity, b) lower noise levels due to better calculation methods, c) mass concentration hourly average updates aligned with the top of the hour.

Version 1.21.00 changes from version 1.20.00 are:

- On Dichot variant only, correct a problem where the mass constants were incorrectly being applied at the Fine and Coarse mass concentration calculation stages. The change is to only apply the A and B Mass constants after the Dichot calculation that sums the Fine and Coarse values for PM-10.

Version 1.20.00 changes from version 1.19.00 are:

- Align the PRC codes, which are used by **RPComm** software and data loggers, to make the codes on the non-Dichot-FDMS variants match the codes on the Dichot-FDMS variant. Add a new PRC code at the end ("instrument time", PRC code 390) to provide the instrument's current time (The time is expressed in seconds since the Epoch, which is 00:00:00 UTC, January 1 1970.).
- Created a 1405 register configuration file for use with **RPComm**. A single configuration file is common to all model variants. See section below about how to install this new configuration file for use with **RPComm**.
- Correct problem where the Maintenance Schedule screen date field was not visible (without a reboot) after changing the Display background color setting.
- Change the Ambient Pressure field on the display (Instrument Conditions > Ambient Conditions screen) to have 3 decimal points instead of 2.
- Change the file extension on data files downloaded via the USB port on the instrument to be ".csv" instead of ".txt".

Version 1.19.00 changes from version 1.18.00 are:

- Correct problem on the 1405-Dichot model variant where the Mass Rate and Mass Concentration values were being calculated incorrectly.

Version 1.18.00 changes from version 1.17.00 are:

- Correct problem on the 1405-Single model variant where the Mass Rate and Mass Concentration values were being calculated incorrectly.

Version 1.17.00 changes from version 1.16.00 are:

- Correct problem on the 1405-Single and 1405-SingleFDMS variants where the K0 Verification Wizard hangs waiting for the frequency to stabilize.
- Minor update to the K0 Verification Wizard screen messages to match the Operating Guide manual, for all model variants.

## **INSTRUMENT FIRMWARE - FILE UNPACKING INSTRUCTIONS (DOWNLOADS)**

The updated instrument firmware is available either by a download from the Thermo Scientific Air Quality Instruments Online Library or a Thermo Scientific 1405 CD (when requested from Thermo Scientific Technical Service). If the CD media is used, this section should be skipped since the instrument firmware files are already uncompressed, instead proceed to the “INSTRUMENT FIRMWARE – UPGRADE INSTRUCTIONS” section below to install the firmware update.

Requirements:

- A PKZIP-compatible uncompression program is required, such as WinZIP or 7-Zip.
- Approximately 25MB of free disk space (per variant, in the unusual case that more than one is variant instrument is being updated) available.

Firmware package file unpacking instructions:

1. Using the table below, identify the instrument firmware package upgrade file. Each of the instrument model variants (1405-Single, 1405-Dichot, 1405-SingleFDMS, 1405-DichotFDMS) are upgraded using a different file as shown.

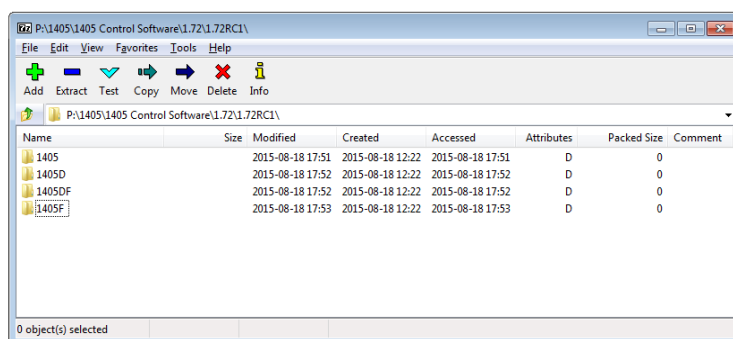
Note: In this example, a Dichot-FDMS variant firmware package is being extracted.

**IMPORTANT: Make sure you have the correct firmware for the model variant of the instrument you are upgrading (see table below). If you perform an upgrade using firmware intended for a different model, the instrument will not operate correctly.**

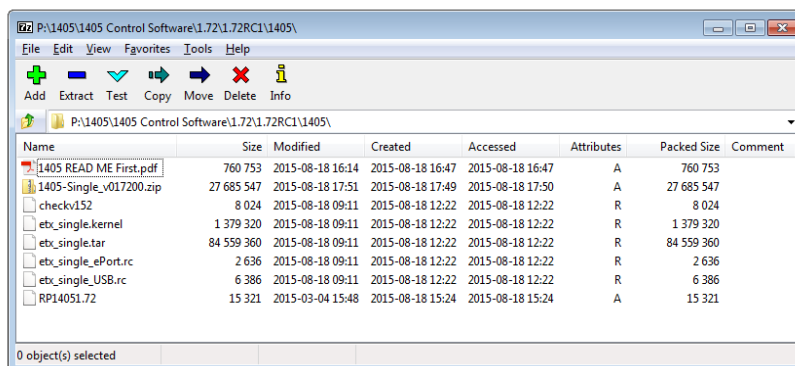
<b>1405 model variant</b>	<b>Instrument firmware package filename</b>
Dichot FDMS – 1405DF	1405-DichotFDMS_v017200.zip
Single FDMS – 1405F	1405-SingleFDMS_v017200.zip
Dichot – 1405D	1405-Dichot_v017200.zip
Single – 1405	1405-Single_v017200.zip

2. On Windows, start the 7-Zip File Manager.

3. Navigate to the directory in which the instrument firmware package resides, just like in the Windows File Manager.



4. Select the directory in which the instrument firmware package resides, then either double-click on it or click **File > Open**. The Open Archive dialog box should appear.



Note: the time stamps and file sizes may be slightly different from as shown.

5. Select all of the files, then click **Extract**. The Extract dialog box should appear.
6. Navigate to the desired extraction directory (or enter in a directory name directly in the “Extract to” data entry field) then click the **OK** button. An Extracting message box should be displayed while the files are being extracted. The files shown should have been extracted into the selected extraction directory, for a –Single variant in this example.
7. Click **File > Exit** to exit the 7-Zip File Manager.

## **INSTRUMENT FIRMWARE - UPGRADE INSTRUCTIONS (ETHERNET-BASED)**

Follow these instructions to update an instrument's firmware using an Ethernet connection and the **ePort** application software.

Ethernet-based firmware upgrade procedure:

1. Unpack the correct firmware files as described in the unpacking section above.
2. The firmware update process should automatically backup and restore the configuration, but just in case anything goes wrong, record a couple of important



factor settings. Record the K0 value(s) on the screen “**Settings**” > “**Advanced**” > “**Mass Transducer K0 Constants**”, and the Serial Number on the “**Settings**” > “**Advanced**” > “**Serial number**” screen.

3. IMPORTANT: Also, please offload any required data files that the instrument is currently holding because they will be deleted when the new firmware is installed.
4. The next set of steps actually update the instrument firmware and are described in more detail in the **1405 TEOM Operating Guide** for the instrument model, in the **Installing New Firmware** section. It is recommended you refer to that in addition to the steps are outlined here. The instrument’s configuration will be backed-up and restored during the process.
  - a. On the “**System Status**” screen of the instrument being updated, locate and record the values for the “**Serial number**” and “**IP address**” fields. If there is no IP address or if networking needs to be setup on the instrument, refer to the network configuration section at the end of this procedure. The next steps refer to **ePort**.
  - b. Open **ePort** and select the “**Open Saved Configuration**” option if one exists or the “**Find Samplers**” option, and then click the “**OK**” button.
  - c. On the list of recognized instruments on the left side, find the entry that matches the Serial Number noted for the instrument to upgrade, and click it once to select it (it should become high-lighted). Once selected, on the center status field, it should display the IP address associated with the instrument and that should match the IP address noted.
  - d. Find the “Upgrade Instrument Firmware” menu item and click it (On **ePort** version 1.4.1, the “Upgrade Instrument Firmware” menu item is on the File menu, **File > Upgrade Instrument Firmware**, and on earlier versions it is a button on the main screen). The 1405 Installer Wizard screen should appear. Click the “**Next**” button to continue.
  - e. Use the following table to identify the script file name that will correspond to the instrument model variant being upgraded. The script file is the one with the .rc extension and is shown in bold font. The other files shown in the same row are the other necessary firmware files.

f.

1405 model variant	firmware files (ePort-based)
Dichot FDMS – 1405DF	<b>etx_dichotFDMS_ePort.rc</b> etx_dichotFDMS.kernel etx_dichotFDMS.tar
Single FDMS – 1405F	<b>etx_singleFDMS_ePort.rc</b>

	etx_singleFDMS.kernel etx_singleFDMS.tar
Dichot – 1405D	<b>etx_dichot_ePort.rc</b> etx_dichot.kernel etx_dichot.tar
Single – 1405	<b>etx_single_ePort.rc</b> etx_single.kernel etx_single.tar

Note: The **ePort** update script file names have changed since the prior release, so they can be more easily distinguished from the USB-based update scripts.

Important: Be sure to use the correct update script or the instrument may not operate correctly afterwards.

Next to the “**Choose File to Upload**” text box, click the “**Browse**” button. Navigate to where the firmware files were extracted and select the .rc script file from the table by clicking it, then click the “**Open**” button.

- g. Back on the installer dialog box, click the “**Next**” button to continue and the firmware update should begin. Once the software update process starts, do not interrupt it or the instrument may not operate correctly.
- h. When the Installer screen displays the message “**Restarting instrument – This may take a few minutes**”, watch the instrument if possible and if it does not automatically reboot after 1-2 minutes (the screen will also continue to display this “Restarting Instrument” message), manually power cycle the instrument at that point. After the instrument reboots, the “Restarting Instrument” message on **ePort** should change when detected.
- i. The Upload Progress screen should be displayed next as the update process continues, it will take approximately 5-15 minutes. After it reaches 100%, a “Software Update Completed” message should be displayed. Click the “**Finish**” button to exit the Firmware Installer. The instrument should reboot automatically and should have the new firmware installed. To check, see on the “**Instrument Status**” screen that the “**Instrument firmware version**” field shows “**1. 72**”.

Note: Once the instrument restart after the instrument firmware update, most installations will see an automatic firmware update for one of the circuit boards. This is because version 01.72.00 contains an embedded instrument firmware update for one of the circuit boards, an update to firmware 0.014 for the I/O board. See the end of the Overview section

above about board firmware updates and be sure not to interrupt the firmware update.

- j. Later, after all installation steps have completed successfully including the **RPComm** register configuration file installation steps (below, if needed), the firmware upgrade files that were extracted into a temporary work area may be deleted.

## **INSTRUMENT FIRMWARE - UPGRADE INSTRUCTIONS (USB-BASED)**

IMPORTANT: Instrument firmware update using a USB stick requires instrument firmware version 1.51.00 or greater (the full version, see the highlighted section on the 1<sup>st</sup> page). This is because instrument firmware version 1.51.00 contains Bootloader V1.1 which is necessary for the instrument to recognize the USB stick. Without instrument firmware version 1.51.00, the instrument will ignore the USB firmware update steps and boot normally.

It is recommended that the user read through all these steps prior to starting the actual firmware upgrade.

Requirements:

1. A Phillips screwdriver.
2. A USB stick formatted using the FAT file system, non-write-protected, with approximately 100MB free space (per variant-type to be updated, in the unusual case where more than one variant instrument is being updated) is required.

Note: While there are many different types of USB devices that could be used for the USB-based firmware update, the recommended device is a standard USB FLASH drive device. USB hard drives and other USB devices might work but in some cases the 1405 may not supply enough current to power them, or may not correctly recognize them, so a small standard FLASH drive device is recommended.

Notes about the upgrade process:

1. The 1405 instrument firmware files are named in such a way as to allow the firmware for all variants to be copied to a single USB stick without naming collisions. For customers with different variants of instrument to update, the firmware for all variants to be upgraded may safely be copied to a single USB stick.
2. During the upgrade process, backup configuration files from the instrument are saved to the USB stick in order to restore them later during the upgrade. Since this configuration is good to have in case it somehow gets lost, the configuration backups are not deleted after the upgrade is complete (if you wish to, you may

manually delete them after). Configuration backups are saved for both the current configuration and the last configuration backup. The configuration files are backed-up on a per-variant basis so they won't over-write each other (in the unusual case where more than one instrument is being updated using a single USB stick). The file names used are in the form *{variant}\_NV\_Settings.tar* where *{variant}* is the name corresponding to one of the variants ("dichotFDMS", "singleFDMS", "dichot" or "single") for the most recent backup and *{variant}\_NV\_Settings\_OLD.tar* for the older backup. The file format used is the Linux tar file format.

#### USB-based firmware upgrade procedure:

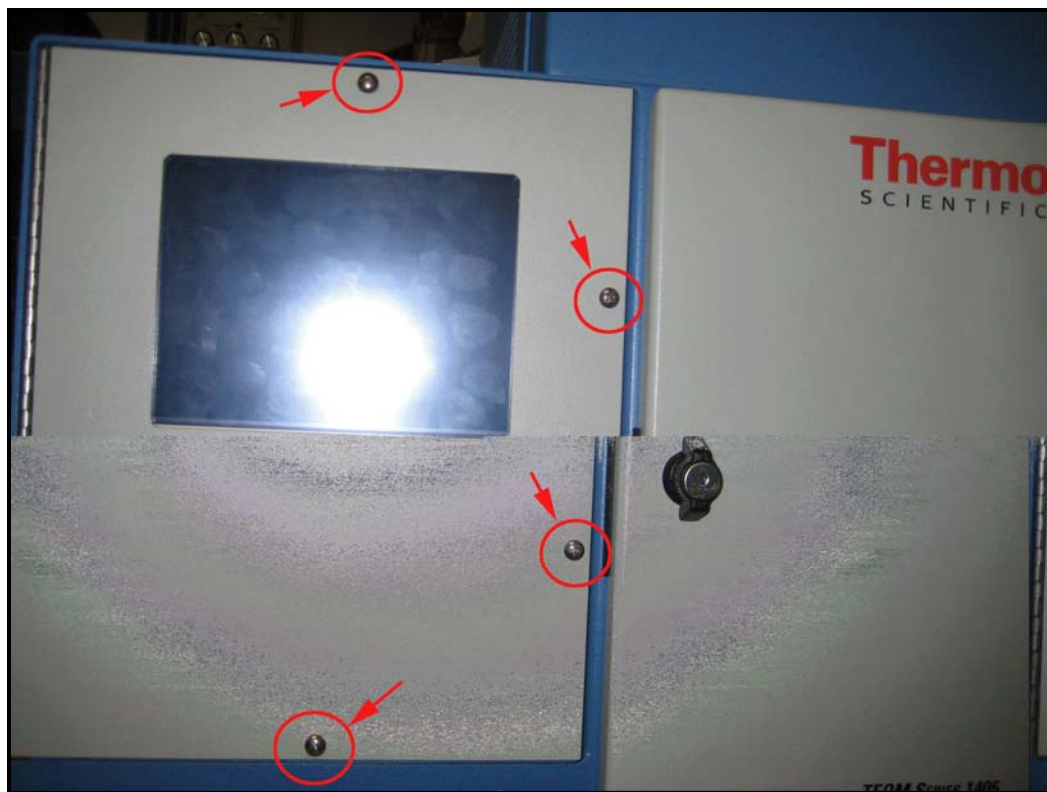
1. Unpack the correct firmware files as described in the unpacking section above.
2. The firmware update process should automatically backup and restore the configuration, but just in case anything goes wrong, record a couple of important factor settings. Record the K0 value(s) on the screen "**Settings**" > "**Advanced**" > "**Mass Transducer K0 Constants**", and the Serial Number on the "**Settings**" > "**Advanced**" > "**Serial number**" screen.
3. IMPORTANT: Also, please offload any required data files that the instrument is currently holding because they will be deleted when the new firmware is installed.
4. Copy the 1405 instrument firmware files for the instrument to be updated onto the USB stick using Windows Explorer or another means. The necessary files for a given variant of the 1405 instrument are listed below. They must be copied into the root directory of the USB stick's file system otherwise they won't be recognized.

1405 model variant	firmware files (USB-based)
Dichot FDMS – 1405DF	etx_dichotFDMS_USB.rc etx_dichotFDMS.kernel etx_dichotFDMS.tar checkv152
Single FDMS – 1405F	etx_singleFDMS_USB.rc etx_singleFDMS.kernel etx_singleFDMS.tar checkv152
Dichot – 1405D	etx_dichot_USB.rc etx_dichot.kernel etx_dichot.tar checkv152
Single – 1405	etx_single_USB.rc etx_single.kernel

	etx_single.tar checkv152
--	-----------------------------

Note: A new file (“checkv152”) was added in the instrument firmware version 1.52.00 package from the prior release, so please include that when copying the files to the USB device. This program is identical in all the variant sets.

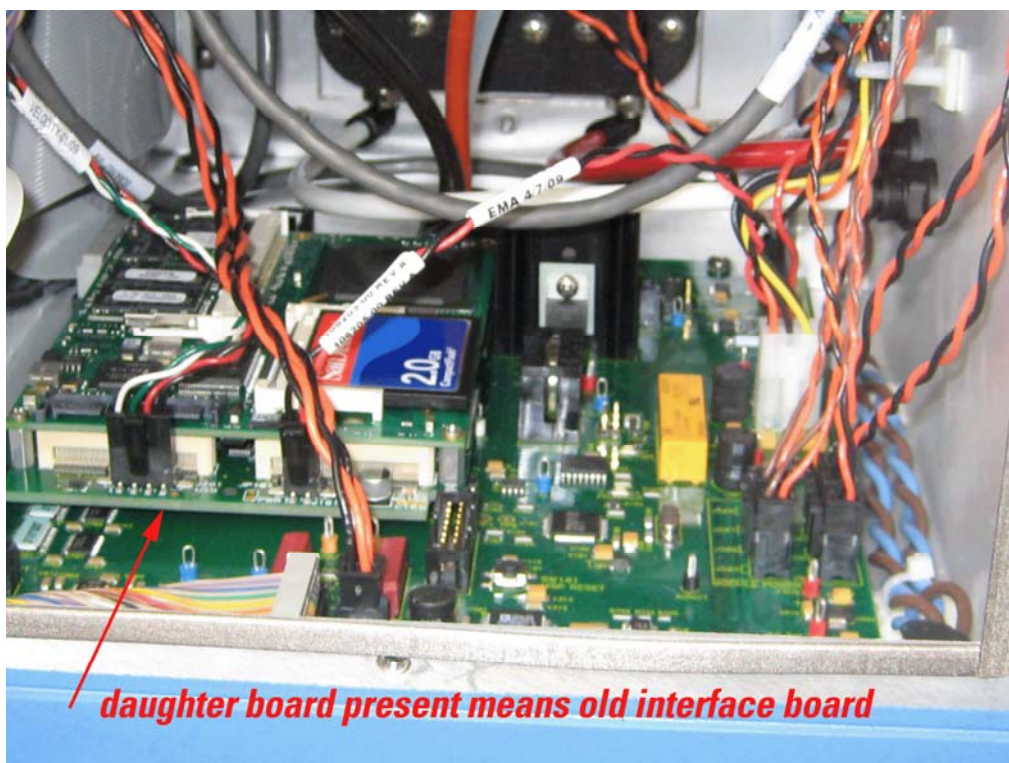
5. IMPORTANT: For safety reasons, disconnect the AC power to the instrument.
6. The next steps are only for 1405 instruments that contain an old style of a circuit board called an Interface board (most 1405 systems built in the year 2009 and prior have an old style Interface board), so this step determines which style board is present. If the firmware upgrade is being performed on an instrument with an old style interface board, additional steps need to be performed first.
  - a. As shown in the figure below, unscrew the (4) screws on the front left side of the 1405's enclosure. The door should swing open allowing internal access.



**Figure 1 – Front Cover Screws**



- b. Using the figure below as a guide, determine if there is a daughter board present in the system. The daughterboard is located in-between the Interface board below it and the CPU board (the CPU board is the board with the Compact Flash card in it) above it. If the daughterboard is NOT present as is shown, that means that the Interface board is a new style board, skip ahead to step 7 otherwise the Interface board is an old style board so continue the steps in the sequence.



**Figure 2 – Daughter Board and Old Interface Board**

7. *[Old style interface board present]* Here a jumper needs to be installed because without the jumper the old style interface board won't supply USB power until after the system fully boots, so USB-based firmware updates won't work.

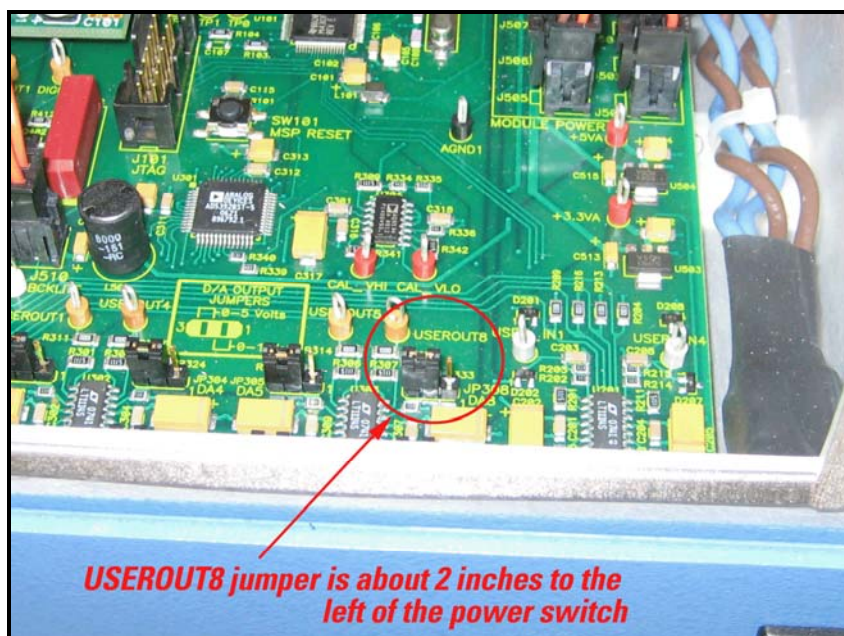
The jumper plug is a small plastic-encased shunt used to jumper two pins together on a circuit board. If no spare jumper plugs are otherwise available, one of the other jumper plugs that are normally present on the Interface board may be borrowed for this purpose, and these instructions include that step (if one is otherwise available, skip ahead to the next numbered step).

A good jumper-plug candidate for this purpose is the Analog Output jumper 8 (called USEROUT8) which may not be used in many installations unless all the analog



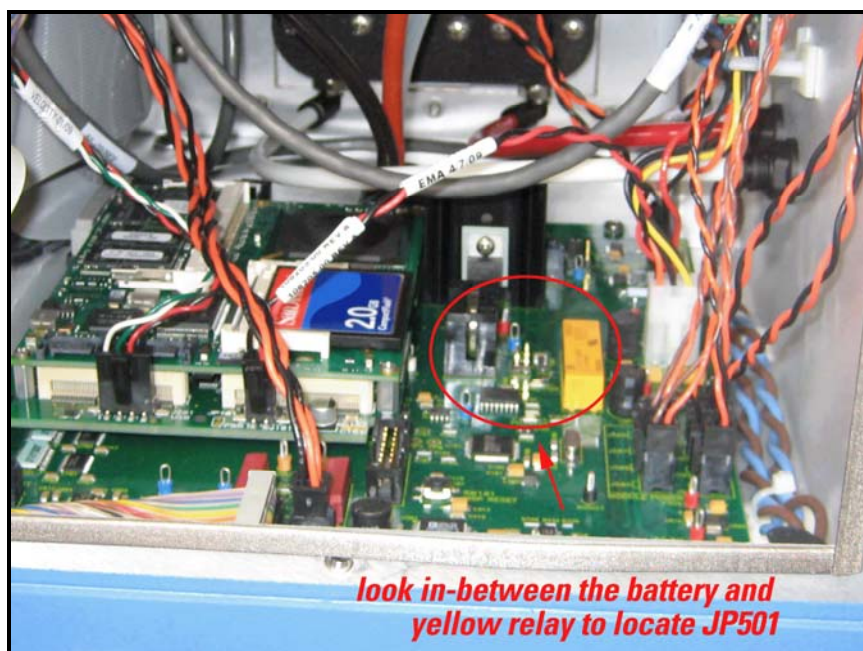
outputs are in use (or one or more are in use but some are skipped and the last one is used). Even if it's in use, it can be temporarily borrowed for the USB-based firmware update procedure and then returned afterwards – remember to re-install it after though, the procedure will remind you). The following steps assume that the USEROUT8 jumper is being borrowed.

Locate the USEROUT8 jumper as shown in the picture below and remove it by grasping it with two fingers and pulling it up.



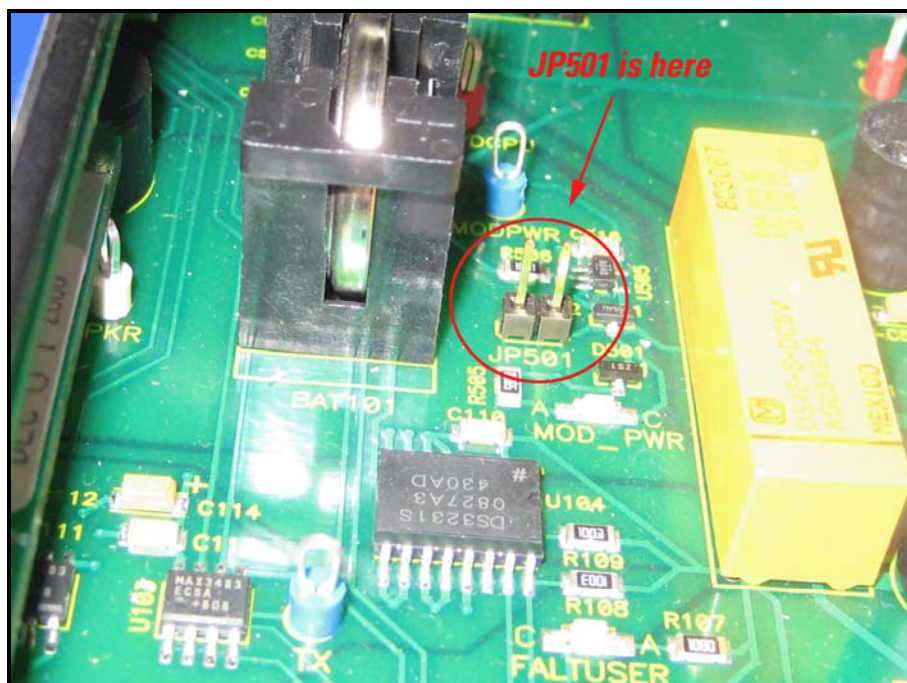
**Figure 3 – Jumper USEROUT8**

8. *[Old style interface board present]* Install the jumper plug into the JP501 location as described below.
  - a. First, become familiar with the instrument's layout by using the picture below. Identify the general area that the JP501 jumper plug can be found. Look towards the center of the Interface board, in-between the small silver colored battery and the yellow relay.



**Figure 4 - Jumper JP501 (wide view)**

- b. Next, locate the exact position of JP501 using the following picture.



**Figure 5 - Jumper JP501 (detailed view)**

- c. Finally, grasp the jumper plug using two fingers, find the open end of the jumper plug, and reach in and install it on JP501 by placing the open end over the pins and then pushing down on it.

9. Insert the USB stick into the USB connector on the front of the instrument. The USB connector is on the left side of the instrument when facing the front of the instrument, next to the RS-232 connector.

If the front of the unit is inaccessible, there is another USB connector on the rear of the instrument which may be used. This connector is on the lower right side of the instrument when facing the rear of the instrument, directly above the Ethernet connector.

10. Re-connect AC Power to the instrument and power the instrument on. The USB-based firmware update procedure is automatic and will take approximately 10 minutes to complete, however it is strongly recommended that upgrade is watched because at the end the USB stick needs to be removed (If it is not removed, it will attempt to upgrade again. If this happens, allow it to complete the upgrade if it has already begun and watch closely the second time for the USB stick removal message, or if it has not yet started the upgrade, power the instrument off when it says to cancel the 2<sup>nd</sup> upgrade). The on-screen instructions will display what it is doing at each step and some steps may take several minutes to complete. If the update script displays a message saying a necessary file is missing, it will inform the user with a **"file not found"** message at which time the instrument should be powered off and the files checked.

IMPORTANT: do not power off the instrument while the firmware update is in progress or the instrument may not operate boot or operate correctly afterwards.

There is a small window of time before the actual upgrade process starts and it will allow powering off the instrument to cancel the update before it actually begins.

11. As described above, remove the USB stick when the firmware update complete and you are prompted to do so.
12. The instrument should reboot automatically and the new firmware should be running when it starts up. To confirm the version of firmware that the instrument is running, see on the **"Instrument Status"** screen that the **"Instrument firmware version"** field shows **"1.72"**.

Note: Once the instrument restart after the instrument firmware update, most installations will see an automatic firmware update for one of the circuit boards. This is because version 01.72.00 contains an embedded instrument firmware update for one of the circuit boards, an update to firmware 0.014 for the I/O board. See the end of the Overview section above about board firmware updates and be sure not to interrupt the firmware update.

13. *[Old style interface board present. If a customer-supplied jumper plug was used and there was no need to borrow one off the 1405's Interface board, skip ahead to the next numbered step].* Once the new firmware has been verified, the jumper that has

been temporarily installed on JP501 needs to be removed and put back onto the pins it was borrowed from.

To restore the jumper plug, follow these steps:

- a. IMPORTANT, for safety, power off the instrument and disconnect the AC power to the instrument.
- b. Reach into the instrument and remove the jumper plug installed on JP501 earlier in this procedure by grasping it with two fingers and pulling up on it.
- c. Locate the jumper pins that the jumper plug was removed from earlier. These would be USEROUT8 if the pins suggested in this procedure were utilized. Place the open end of the jumper plug on top of the USEROUT8 pins and push down until it reaches the base of the pins.
- d. Skip to step 15 below.

14. IMPORTANT, for safety, power off the instrument and disconnect the AC power to the instrument.

15. Re-install the front panel screws that were removed in the step above.

16. Reconnect AC power to the instrument and power the instrument back on if desired.

#### **ePort VERSION 1.4.1 - RELEASE NOTES AND INSTALLATION INSTRUCTIONS**

- **ePort** version 1.4.1 provides support for backing up and restoring the touchscreen type and calibration configuration across future instrument firmware updates. It also provides preliminary Windows 64-bit support.
- The only change that **ePort** version 1.4.0 has relative to version 1.3.0 is that it provides support for customer-defined instrument variable orderings when used with a 1405 instrument that supports it that feature (instrument firmware version 1.51.00 or greater, see the instrument firmware release notes above). So after an ordering has been setup on the instrument using the Data Storage screen on the instrument's graphical user interface, the **ePort** "Download Data" feature will retrieve a data file that contains the desired column ordering.

**ePort** install/update instructions:

1. If a previous version of **ePort** is already installed, uninstall it before installing this version. Uninstall it by going into the Windows Control Panel, selecting the **ePort** program and then clicking the **Remove** button. When the program remove completes, close the "Add or Remove Programs" window and close the Control Panel utility.
2. Locate the **ePort** version 1.4.1 installer program called "**ePort\_Setup\_1\_4\_1.exe**". Either a Thermo Scientific 1405 CD (requested from Thermo Scientific Technical Service) or a file downloaded from the Thermo Scientific Air Quality Instruments Online Library may be used.
3. On Windows, click **start** > **Run**. On the Run dialog box, click the **Browse** button then navigate to where the **ePort** installer program is, click it to select it, then click



**Open** button. Back on the Run dialog box, click the **OK** button to run it and the Install Shield Wizard should run.

4. Click **Next**, then read and **accept** the license agreement if it is acceptable and click the **Next** button.
5. Be sure to follow the notes on the next screen about requirements. If the requirements are not satisfied, click Cancel to exit the **ePort** installer, update the system to meet the requirements, then restart this procedure at step 2. If the requirements are met, click the **Next** button.
6. Fill in the User Name and Organization data fields, select the appropriate user install option and click the **Next** button.
7. The install process will be ready to begin, click the **Install** button to start it.
8. When the Install Shield Wizard completes, click the **Finish** button.

#### **RPCOMM VERSION 2.1.0 - RELEASE NOTES AND INSTALLATION INSTRUCTIONS**

- The only change that **RPComm** version 2.1.0 has relative to version 2.0.0 is that it provides support for customer-defined instrument variable orderings when used with a 1405 instrument that supports it that feature (instrument firmware version 1.51.00 or greater, see the instrument firmware release notes above). So after an ordering has been setup on the instrument using the Data Storage screen on the instrument's graphical user interface, the **RPComm** "Download Data" feature will retrieve a data file that contains the desired column ordering.

#### **RPComm** install/update instructions:

1. If a previous version of **RPComm** is already installed, uninstall it before installing this version. Uninstall it by going into the control panel and selecting the **RPComm** program and click the **Change/Remove** button. When the program remove completes, close the Add or Remove Programs window and close the Control Panel.

Note: The uninstall process will leave any files that weren't part of the original package such as newer register configuration files, but you may wish to backup those files manually (these get installed into the "**C:\Program Files\RPCO\RPComm**" directory by default). After the install, the newer **RPComm** directory should contain all the latest register configuration files for all supported Thermo Scientific instruments as of the software creation date.

2. Locate the **RPComm** version 2.1.0 installer program called "**RPComm\_2\_1\_setup.exe**". Either a Thermo Scientific 1405 CD (requested from Thermo Scientific Technical Service) or a file downloaded from the Thermo Scientific Air Quality Instruments Online Library may be used.

3. On Windows, click **start** > **Run**. On the Run dialog box, click the **Browse** button then navigate to where the **RPComm** installer program is, click it to select it, then click **Open** button. Back on the Run dialog box, click the **OK** button to run it and the Install Shield Wizard should run.
4. Click **Next**, read and **accept** the license agreement, then click the **Next** button.
5. Fill in the User Name and Organization data fields, select the appropriate user install option and click the **Next** button.
6. Use the default installation destination folder or change it and click the **Next** button.
7. The install process will be ready to begin, click the **Install** button to start it.
8. When the Install Shield Wizard completes, click the **Finish** button.
9. Go to the “RPCOMM - CONFIGURATION FILE INSTALLATION” section below in order ensure the latest 1405 instrument register file matching the instrument firmware gets installed, if desired.

#### **RPCOMM - CONFIGURATION FILE INSTALLATION**

A new **RPComm** 1405 register configuration file corresponding to this particular instrument firmware release is provided. Installation of this new configuration file only requires a manual copy of the file into the proper installation directory so **RPComm** will recognize and utilize it when connecting to an instrument.

1. Open **Windows Explorer** and navigate to the directory where the firmware package was extracted, for example, “**C:\TEMP**”.
2. Locate the file called “**RP14051.72**”, right click it, and select “**Copy**”. The filename convention used with the configuration files is “RP” then the model then the version, truncated to version **1.72** (refers to version 1.72.00) in this case.
3. Using Windows Explorer, navigate to the installation directory for **RPComm** (This corresponds to the directory where program file RPComm.exe was installed). If the default installation directory was used, it would be something like “**C:\Program Files\RPCO\RPComm**”. Right click on a blank area within the file pane on the right side, and select “**Paste**”. You should see Windows copy the file into the current directory.

To see if the new register file is recognized, connect a cable from the PC the instrument, open **RPComm**, and create a new connection for a 1405 instrument (“**File**” > “**New Connection**” > “**1405**”, then click “**OK**”). This should create a new connection line, click it to highlight it then click the “**Connect to selected instrument**” icon. A window should appear with a title that includes the string “version **1.72**” in it and the 1405-specific registers should appear in the right-side pane.



## **INSTRUMENT NETWORK CONFIGURATION**

To connect the 1405 instrument to the network, begin by plugging in a 10/100 Ethernet cable into the instrument's Ethernet connector, on the back of the instrument. The orange LED's built-into the Ethernet connector should begin blinking if the connection is active, so if the LED's are not blinking check that the network connection is activated.

To configure the instrument to work over the network, use the Network Configuration screen on the instrument, which is accessed by selecting "**Settings**" > "**System**" > "**Network Configuration**". There are two ways to configure it, automatic IP addresses (which uses a DHCP server) or specify the IP address (which uses a static or reserved IP address), options for these settings are on this screen, select the desired option.

If you are using automatic IP addresses, and you are connecting the instrument to a router on a local network segment, make sure the router provides a DHCP service and that it is enabled. If you are connecting the instrument to a Local Area Network, make sure that there is a server on the network that provides a DHCP service.

If you are using a specified IP address, you will need to enter in the network parameters for "**IP address**" and "**subnet mask**" fields. Check with your system administrator if you are unsure of the network parameters to use.

If you make a change to any setting on the "**Network Configuration**" screen, reboot the instrument to make sure the settings take effect.

When the instrument is recognized on the network, the "**System Status**" screen on the instrument should show a valid IP address in the "**IP address**" field, and **ePort** should recognize it.

If a router-less configuration between a PC or laptop and the instrument is being used, an Ethernet "cross-over" cable is required, and a static IP address needs to be assigned on the instrument. The firmware update process using **ePort** software will be the same in this configuration. See a Thermo Scientific Tech Note on this topic for the instructions.

– END –

