**Kuster Company**
**2900 E. 29th Street**
**Long Beach, CA  90806**
**Tel: (562) 595-0661**
**Fax: (562) 426-7897**
**Email: kuster@kusterco.com**

# K8 ELECTRONIC MEMORY PROBE (EMP)

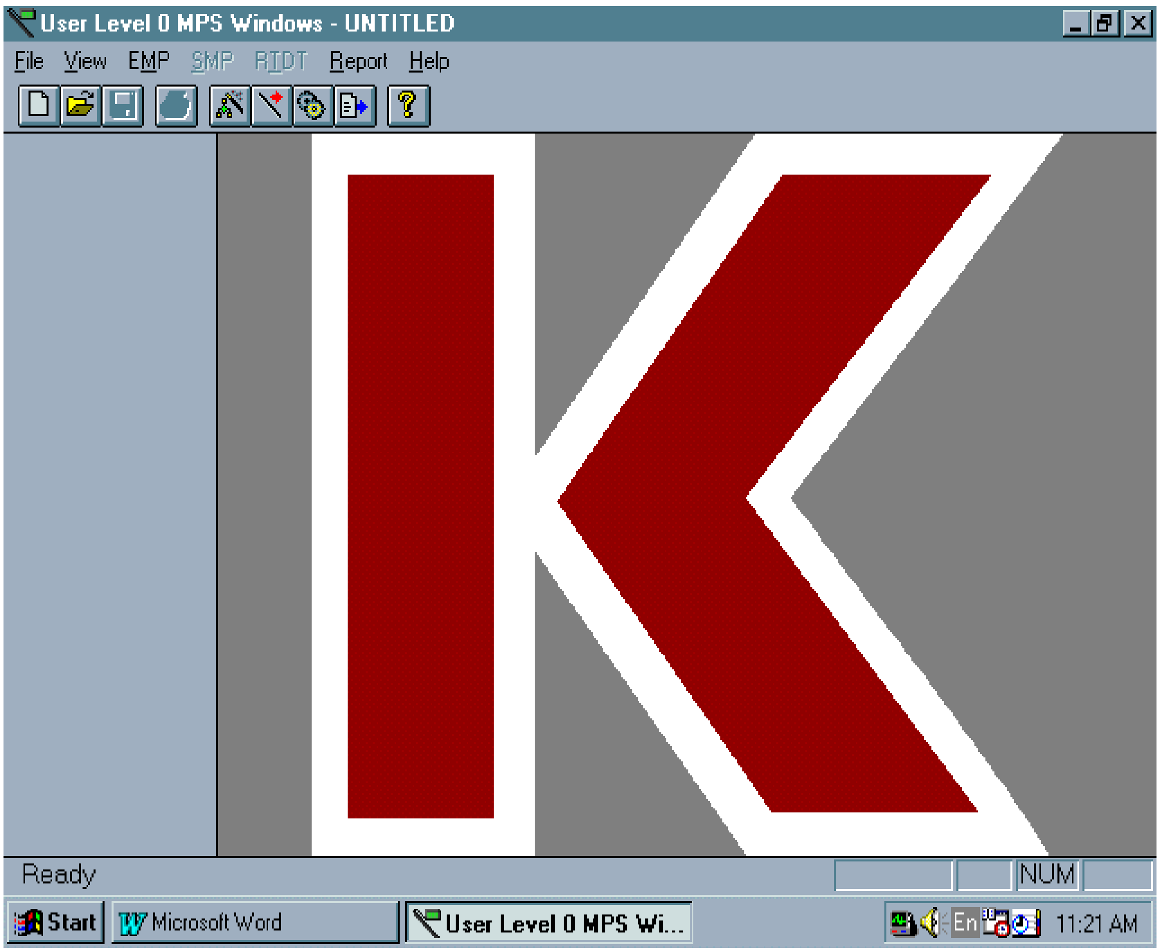
# OPERATOR'S MANUAL FOR WINDOWS 95/98



## Mechanical And Hardware Operation

# MPS WIN

**K8 SOFTWARE MANUAL FOR WINDOWS '95**



**K8**
**ELECTRONIC MEMORY PROBE (EMP)**
**FOR WINDOWS '95 (MPSWin)**

# OPERATOR'S MANUAL

## 1 - GENERAL INFORMATION

**Memory mode and SRO (Surface Read Out) mode**

The EMP can be programmed to run in either memory mode or SRO (Surface Read Out) mode.

**Memory mode** is selected when the probe will be used to collect temperature and pressure data for a specified period of time and store it in the probe's internal memory while still in the wellbore. After the probe is retrieved from the well, the data is downloaded to a computer and processed.

**SRO mode** is selected when the probe will be used to transmit pressure and temperature data to the surface is real time as it is being collected. SRO operation is described in Appendix 1 of this manual.

**Intervals and ratios**

The **reading interval** is the time the gauge will wait between readings. The pressure/temperature **ratio** is the number of pressure readings the gauge will take with each temperature reading. For example, where there is a 4-second interval and a pressure/temperature ratio of 6, the EMP will record a temperature and pressure reading, then 5 additional pressure readings 4 seconds apart (for the next 20 seconds), followed by another temperature and pressure reading.

EMP's are programmed with intervals and pressure/temperature ratios that will suit the needs of the user. The gauge can be programmed with up to 40 different intervals, and pressure/temperature ratios of 1 through 6. If the temperature is changing rapidly, a low P/T ratio is desirable. In tests where the temperature is stable, a larger P/T ratio can be used.

Static gradients should be run at a one-to-one ratio. It is recommended that the pressure/temperature ratio not exceed 3/1 during the first stage of a production test.

## 2 - INSTALLING MPSWin AND MPSReport

**System requirements and instruments**

The following system capabilities are required to run MPSWin and MPSReport:

- An IBM-compatible PC with an Intel Pentium 133 (minimum) processor, 32 MB RAM (minimum), and a 1 GB hard drive.
- Microsoft Windows 95.
- One serial port (usually 9 male pins) must be available exclusively for instrument communication.
- A Windows 95-supported printer or plotter.

The following system features are recommended:

- An Intel Pentium 200 processor with 32 MB RAM and a 2 GB hard drive.
- MMX processor technology for the associated larger on-chip cache memory.
- Fast, high-resolution graphics on machines to be used for detailed data review or reporting.
- Screen resolution (size) of 800 x 600 (12”) for notebooks, and 1024 x 768 (15”) for desktops.
- A color printer for plots, especially where multiple recorders are to be reported on a single plot.

*NOTE: Instrument set-up and check-out are possible using a 486/66 with 16 MB RAM, but this configuration is useful only for reporting small data sets such as bench checks. This configuration could be used for SRO operations where there is no user interaction and the data rate is greater than one second.*

MPSWin and MPSReport are designed for Windows 95 and its variants. They are not intended to run on Windows 3.X and earlier versions, or on Windows NT. If Windows NT-compatibility is a requirement, contact F.T.I. Kuster Co. for assistance.

MPSWin software is compatible with the following F.T.I. Kuster Co. instruments:

- EMP-Q 710 and 711, firmware Revision 3912, 3916, 3919.

- EMP-S-62X and later, firmware Revision 3917, 3918.

*NOTE: EMP-S, firmware Revision 3908, 3906, and all SMP models are NOT supported.*

## Installing MPSWin and MPSReport

The MPSWin program is supplied on one disk, and the MPSReport program is supplied on two disks. Install these two programs separately. For each:

1. Insert the either the MPSWin disk, or disk 1 of MPSReport, into your computer's floppy disk drive (usually Drive A:).
2. Click on the **Start** button at the bottom left-hand corner of the screen.
3. Select **Run.**
4. Type **a:\setup**. This will begin the installation process. Follow any instructions that are presented to you on the screen.

MPSWin automatically selects Serial Port 2 as the default port for communication with the Electronic Memory Probe. Some computers may require you to use Serial Port 1. If you run MPSWin and receive a message "Unable to open serial port," you can correct this with the following procedure:

1. In MPSWin, select **File/Setup.**
2. Click on the arrow beside the port selection field to open a list of computer ports.
3. Select **Port 1**.
4. Click **OK** to close the window.
5. Select **File/Exit** to close MPSWin.
6. Restart MPSWin to update the port selection.

If you are installing MPSWin on a notebook computer, you must disable all BIOS and Win95 power-saving functions. If you don't, the power-saving feature will disable the serial port after several minutes even if there is data coming in from an instrument. For assistance with this, please consult your computer supplier, or telephone. F.T.I. Kuster Co.

(The above power-saving feature may also apply to some newer desktop computers. Please confirm this with your computer supplier.)

The MPSWin installation includes a calibration file set. Updates for the calibration must be installed whenever gauges are received using the Calibration disk provided. This is done by running the EMPCALS application on disk supplied.

*NOTE: Please open and read the README file located on your software installation disk. You can locate it using Windows Explorer or File Manager with the disk inserted in drive a:. This file will provide up-to-date information to assist you with trouble-free installation.*

**The software license**

MPSReport is licensed to you until a specific calendar date. When you try to use the program after the license has expired, you will be notified by a message on the screen.

If at any time during the license period you install an upgrade to the software, a new license expiry date will be established.

The above does not apply to MPSWin, which is supplied without expiry date.

**MPSWin and MPSReport files**

The following files are created by MPSWin and MPSReport from data derived from the gauge tools:
**.mpd** files - These files contain the raw data downloaded from the probe, and are normally placed in a folder titled RAW.
**.prn** files - After MPSWin has processed the data, the program creates a **.prn** file and saves it to the PRO folder. (This includes gradient files, which are also **.prn** files.) MPSReport looks for and opens **.prn** files. The **.prn** files are ASCII files. You can view and read these files using the computer's Wordpad application. This format allows for importing the files into reservoir analysis programs and spreadsheet programs that have the capacity for large data files.
**.val** files - MPSReport saves the reports it creates as **.val** files. The **.val** file contains all of the processed data imported from the **.prn** file. When you open a **.val** file that you had saved and make any changes to the charts in that file, you can save the revised charts as a new **.val** file. This retains all of the original test data along with the test data, annotations, and other information in the file at the time of the save.
MPSReport is able to receive and display ACSII files created by the "MPT" DOS MakeDisk Customer applications.

*NOTE: To protect against loss or corruption of test data, the **.mpd** files in the RAW folder (or other folders where you may be* *storing **.mpd** files) should be copied regularly to a removable medium, such as diskette or tape, and stored in a protected location.*

**MPSWin Confuguration File Setup**

Last updated 990623. This section shows the options for setting up the configuration file for MPSWin. From the tool bar click view/configuration file. This action opens the MPS.INI file found in C:/windows.

The following entries in MPS.INI apply for MPSWin v.2.133 and later. Lines that start with (**;**) are comments and won't be processed. Lines that start with (**;;**) are for information only. Spelling IS important. Only the first instance of an entry is used.

[Process]

**Gauge Pressure = 1**

;; Sets the processed data (.PRN) to be reported in Gauge Pr.

**Gauge Pressure = 0**

;; Sets the processed data (.PRN) to be reported in Absolute Pr.

**Gauge Pressure = -1**

;; Use native tool pressure reference – in most instruments this means Absolute. (Default)

**Suppress Neg Gauge Pressure = 1**

;; negative gauge pressures are reported as 0.0 (Default)

**Suppress Neg Gauge Pressure = 0**

;; negative gauge pressures are reported as the calculated value,
;; if within the calculation limits of –400.0 PsiA or –2500 kPaA.

;; **NOTE:**
;; Indicated by the .PRN file header lines
;; "Negative Gauge Pressure Suppressed:
;; and
;; "Min Pressure: 0 psiG"
;; Neg. gauge pressures recovered by changing & re-processing

**Units=Imperial**

;; Sets processing units to Psi/F (Default)
;; Use this due to problem with MPSReport v2.239 double-converting Metric input
;; Sets processing units to kpa/C
;; NOT recommended due to MPSReport v 2.239 double-converting Metric input

**Atmospheric Pressure = 13.00 Psi**

; format xxx.xx Psi use only if Units=Imperial
; entry range limits 11.6 – 17.4 Psi; Default is 14.5 Psi

**Atmospheric Pressure = 93.00 kPa**

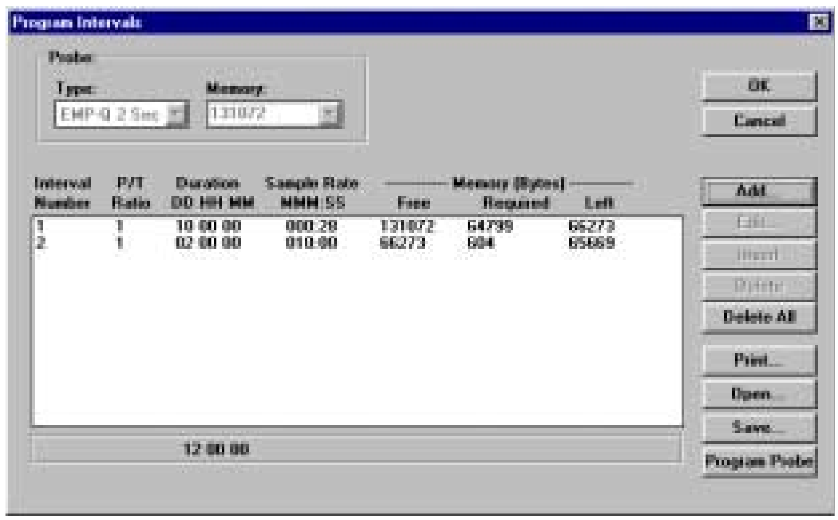
;    format xxx.xx kPa use only if Units = Metric
;  entry range limits 80 – 120 kPa;  Default is 100.0 kPa
; Set the value to be used as the initial value for the True Barometric Pressure,
;  This value can be changed by the user in each dump to match wellhead local conditions.

# 3 - PROGRAMMING THE EMP

**Programming the probe in memory mode**

With the probe connected to the computer and the MPSWin program running:

1. Select **EMP/Program/Memory** from the main menu bar.
2. If the program asks you if you want to retrieve the intervals from the probe, click **Yes.**
3. If the program asks you to specify the duration for the test, enter the total period of the test duration and click **OK**.
4. The **Program Intervals** window opens.




The **Program Intervals** window displays the following information:

- The type of probe, and the memory capacity of the probe that is connected to the computer are displayed.
- The pressure/temperature ratio, the duration, and the rate of sampling for each test interval of the probe's existing program are displayed. These can be changed using this window to create a new program for the probe. If there is no program in the probe, these data fields will be blank.
- The amount of the probe's memory required for each interval of the program, and the amount of memory remaining after each interval, are displayed. Memory size is displayed in bytes. Divide the bytes by 2 to get approximate memory in readings.

You can modify the probe's existing program or completely replace it. If you want to reprogram the probe, click **Delete All.** The details of the probe's existing program will disappear and you can create a new program by adding intervals as described below.

If you want to modify the probe's existing program, you can add or insert new intervals, edit existing intervals, and delete intervals as described below.

### Adding a program interval

Program intervals are added by the program in sequential order as they are created. If there are already intervals in the program, new intervals will be added to the end of the sequence.

1. In the **Program Intervals** window, click **Add.** The **Interval** window opens and specifies in its title the sequential number of the interval that is being created.
2. In the **Interval** window, specify a sample rate (minutes and seconds), duration (days and hours), and pressure/temperature ratio for this test interval. This can be done either by clicking on the arrows to the right of the data fields, or by selecting the fields and typing the data. The amount of probe memory available and required for the specified interval is displayed and changes as the data is entered. Use this as a guideline if necessary.
3. Click **OK** to return to the **Program Intervals** window.

Repeat this as often as required to create the desired program of test intervals.

**Inserting a program interval into an existing sequence**

You can modify an existing sequence of program intervals by inserting a new interval into the sequence.

In the **Program Intervals** window:

1. Click on the existing interval located below the position where the new interval is to be inserted. That interval will become highlighted.
2. Click **Insert**. The **Interval** window opens and specifies in its title the sequential number of the new interval. Ensure this number is correct.
3. Enter the new interval data as described above.
4. Click **OK** to return to the **Program Intervals** window. The new interval will appear in the sequence.

**Deleting an interval from an existing sequence**

You can remove an interval from the program.
In the **Program Intervals** window:

1. Click on the interval that is to be removed. It will become highlighted.
2. Click **Delete.** The selected interval will be removed from the sequence.

**Changing an existing program interval**

You can change the details of an existing program interval <u>without</u> having to remove it and create it again.
In the **Program Intervals** window:

1. Click on the interval you want to revise. It will become highlighted.
2. Click **Edit.** The **Intervals** window opens displaying the details of the selected interval.
3. Change the details as desired by clicking on the arrows to the right of the data fields, or by selecting the data fields and typing in the data.
4. Click **OK** to return to the **Program Intervals** window. The revised interval data will be displayed.

**Transferring the program to the probe**

When all the test intervals have been correctly created or revised in the **Program Intervals** window, transfer the program to the probe by clicking **Program Probe.**

There is a brief delay while the probe is being programmed. MPS will display a message on the screen when programming is complete. Click **OK** to close the message and return to the

**Program Probe** window. If you do not wish to save this program to a file for future use, click **OK** to return to the MPS main window.

## Saving a program for future use

You can create and save a program for future use. This may be appropriate if you intend to reprogram the same probe, because this program can be modified.
In the **Program Intervals** window:

1. Click **Save**. The **Save a Custom Interval File** window opens.
2. Select the desired file location and create a file name. Do not specify a file extension - MPS will automatically add the **.mps** file extension.
3. Click **Save** to return to the **Program Intervals** window.

## **Programming when the probe is not connected to the computer**

You can create and save a program for a probe that is not connected to the computer. To do this, you will need to know the probe type and its memory capacity.

1. Select **EMP/Program/Memory** from the MPS main window menu bar.
2. The program will ask you whether you want to retrieve the intervals from the probe. Click **No**. The **Test Duration** window opens.
3. Specify a duration period for the test. Click **OK**. The **Program Intervals** window opens.
4. Create a set of program intervals as described above, and click **Save.**

# 4 - USING THE EMP

**Preparing the EMP for field use**

Double-check the mechanical condition of the EMP housing components, sealing surfaces and elastomers and assemble the required running components (Buffer Tube and Housing, Bullnose etc.). Remove any wrapping of tape that may be covering the hole in the Buffer Tube Housing.

**Attaching the battery pack**

1. Screw the Battery Pack onto the main body of the EMP. This should be done smoothly to ensure an efficient start-up.
2. Hand tighten at first. Tighten further using a girth wrench applied to the body of the Battery Pack Housing and an open-end wrench applied to the adjacent flats of the EMP body. The 1.25” instruments are then to be tightened with a ¼” - ½” turn. The 710 EMP-Q requires 80 ft. lb. of torque to fully tighten the tool. After tightening, there must be a small gap between the Battery Pack Housing and the main body of the EMP.
3. Note the time when the Battery Pack was attached to the EMP. This procedure starts the clock in the memory of the probe and is required for analysis of the data obtained.

**Installing the EMP in the Wireline toolstring**

*NOTE: If there is a possibility of a tubing obstruction or narrowing such that the EMP may be jarred or jammed, a gauge ring should be run first to verify that the path is clear. If there are problems with the well such that the start of the test will be significantly delayed, the EMP battery packs can be disconnected and reconnected later. When the battery housing is reconnected the EMP program will carry on where it left off, placing a marker in the memory to show where the disconnection occurred.*

Attach the EMP to the Wireline toolstring using only the wrench slots and an open-end wrench. **The EMP housings must not be gripped using pipe wrenches.**

If more than one EMP is being used, they should be attached one at a time to the Wireline toolstring, separated by knuckle joints or other running equipment as may be required by well conditions. A nose cone piece is provided for the end of the lower EMP if it may be required.

**Running the EMP into the well**

The running speed should be moderate: 150 ft./min. (50 m/min.).

In the event a gradient test is being run, it is desirable to make stops of at least 10 minutes at each required depth (longer if the depth increments are very large, such as near the surface). The time of the various Wireline operations (e.g. pressure up lubricator, start running-in, on bottom, flows, shut-ins, off bottom, vent lubricator, etc.) should be recorded. This information can be attached to the EMP data as comments and may be useful when validating the EMP data after the test is completed.

**Retrieving the EMP from the well**

At the end of the test, retrieve the EMP at a moderate running speed: 150 ft./min. (50 m/min.).

If the well test program requires a final surface measurement, the instruments should remain in the lubricator for at least 15 minutes to allow sufficient time for the EMP internal temperature to stabilize.

Disconnect the EMP form the Wireline toolstring using only the flats on the EMP Amerada adapters next to the joint to be broken apart.

The instrument housings should be cleaned of well fluids and the Buffer Tube Housing drained especially if hazardous or corrosive well fluids may have been present.

**Removing the battery pack**

1. Unscrew the Battery Pack using a girth wrench applied to the Battery Pack Housing and an open-end wrench on the adjacent flats of the EMP body. (If the proper girth wrench is not available, the battery pack can be left attached, although the instrument will be too long to fit the shipping case.)
2. Note the time when the Battery Pack was removed from the EMP.

Ship the EMP to the location where data download and processing will occur.

*NOTE: If the battery is to be re-used, the user is responsible for logging battery usage. Batteries supplied by Kuster Co. have a serial number that can be used to identify the battery for record-keeping.*

## Servicing the EMP for Re-Use

After each use, the EMP should be serviced in preparation for re-use.

Clean the outside of the EMP to remove any well fluids.

Refer to the diagram for your EMP model at the end of this manual. Separate the Buffer Tube Housing from the Electronics Housing as instructed on the diagram.

Inspect the external O-Rings after each use of the EMP. Replace them if there is any sign of wear or damage. Consult your Kuster Co. representative for guidance if you are not sure of specifications for replacement O-Rings.

Flush and clean the Buffer Tube Housing as directed below, depending on the EMP model you are using.

<u>Closed Bellows model</u>

1. Using a silicone-filled syringe with a tip that is approximately 3" in length, insert the tip into the Transducer Adapter Fitting and flush the inside the Bellows. Be careful not to touch the Bellows itself as the syringe tip could puncture the bellows. The procedure can also be done using an aerosol spray degreaser.
2. Flush all old oil from the Buffer Tube and Buffer Tube Housing and fill it with silicone oil of a type that will not congeal or inhibit the performance of the Bellows in any way.

<u>Open Bellows model:</u>

1. Using an aerosol spray degreaser, flush the Bellows flutes through the slots in the Bellows Cap. If there is an excessive build-up of oil, it may be necessary to remove the Bellows Isolator during this procedure. This must be done with great caution because even minor damage to the Bellows flutes will impair its operation.
2. Flush all old oil from the Buffer Tube Housing and fill it with silicone oil.

No Bellows model:

1. Flush all old oil from the Buffer Tube and Buffer Tube Housing and fill it with silicone oil.

Put a wrap of Teflon tape on the Buffer Tube threads (if buffer tube is required) and screw it onto the electronics housing. Use a wrench to tighten. Wrap a layer or two of electrical tape over the hole in the Buffer Tube Housing to retain the liquid.

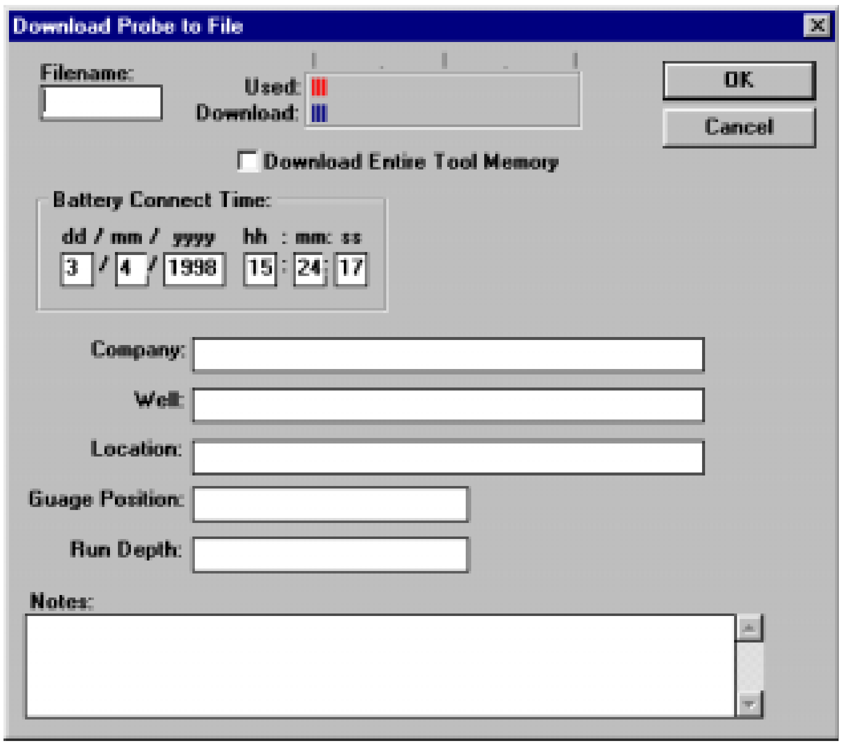
# 5 - DOWNLOADING TEST DATA FROM THE EMP

**The downloading procedure**

The downloading procedure is required after an EMP has been programmed in memory mode, run into the well to perform the programmed tests, and retrieved.

With the probe connected to the computer and the MPSWin program running:

1. Select **EMP/Download** from the main menu bar. The **Download Probe to File** window opens.




2. In the **Filename** box, enter a suitable file name for your test data if you do not want to use the file name automatically provided by the system. The file name provided by the MPSWin program is based on the serial number of the probe followed by a digit that is incremented each time a new file is created from that probe. For example, if file 2062-1 exists, the system will assign 2062-2 to the next file. The program automatically assigns an **.mpd** file extension.
3. Enter the exact time the battery was connected to the probe before it was run into the wellbore. The field staff who was

conducting the test will have recorded this. (The connect time first shown in the window when it opens is the time the probe was programmed.)

4. Enter any descriptive information about the well and the test that you wish to have as part of the file record.
5. Click in the **Download Entire Tool Memory** checkbox if you have any concerns about whether the program is recognizing all valid data from the test. This is an optional step that is not required in most cases. The graphic bar at the top of the window indicates the amount of the probe's total memory that is used for the current test's data.
6. Click **OK** to begin downloading the data from the probe. The **Downloading Probe** window opens to display the progress of the download. When downloading is complete, this window will close automatically.

This completes the downloading process.

# 6 - PROCESSING THE DATA AND VIEWING TEST RESULTS

**Processing the data**

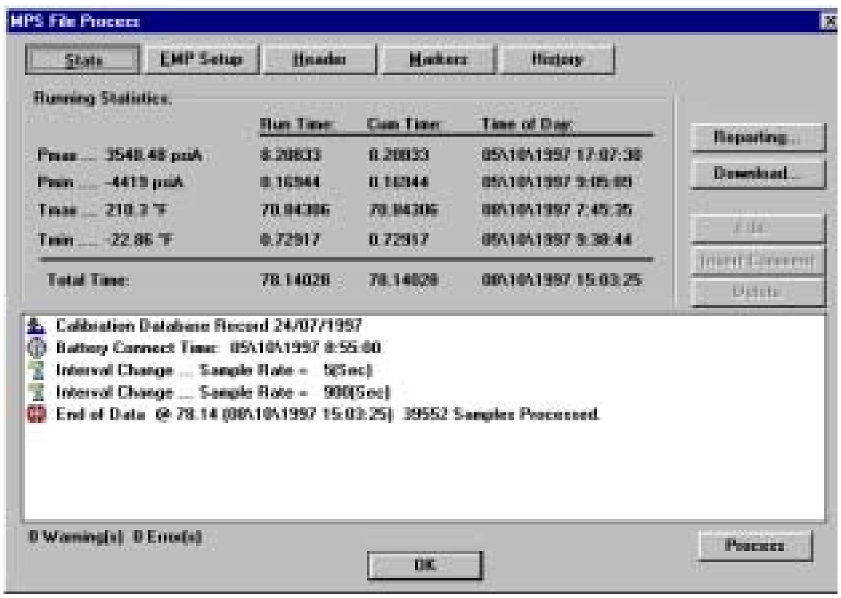
The downloading procedure saves the data from the memory probe in a raw data file with an **.mpd** file extension. MPSWin must process the data into a form that is usable for analysis and reporting. The processing procedure does this, and saves the processed data in a new file with a **.prn** file extension.

The MPS File Process window

The **MPS File Process** window will open automatically at the end of the downloading procedure, or can be opened from the MPSWin main window by selecting **EMP/Process** from the menu.

To open a file of raw data that has been previously downloaded from a memory probe:

1. Select **File/Open** from the MPSWin main window menu bar. The **File Open** window opens.
2. Select the folder and file to be opened.
3. Click **Open.** The **MPS File Process** window opens.




The **MPS File Process** window offers the user a selection of information about the test data:

- statistics relating to the various events of the test itself.
- information about the probe that was used in the test.

- additional details, called “markers,” about the events of the test.
- a “header” page that contains information about the company and the well.
- historical information about the processing of the file data.

### Processing the data

To process the data:

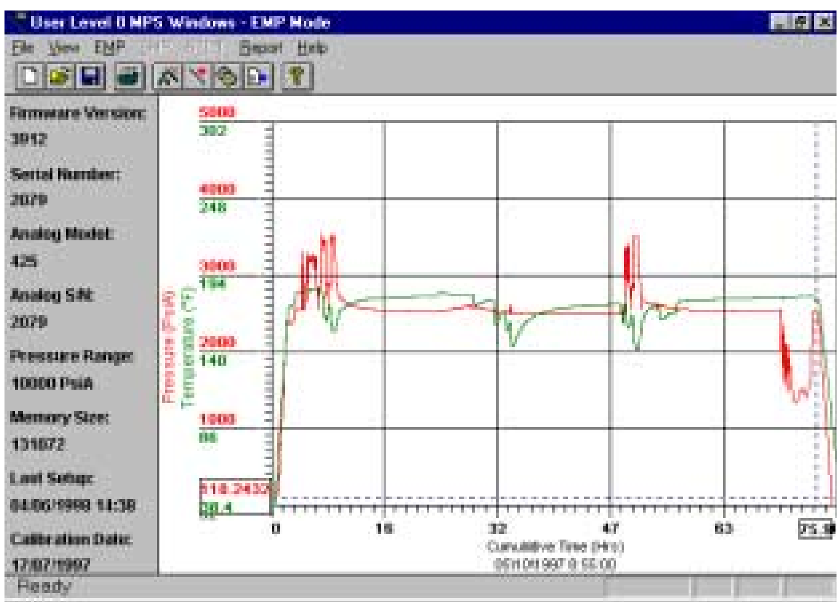
1. In the **MPS File Process** window, click **Process.** The **Save Processed File** window opens.
2. Enter a file name for the file of processed data. Click **OK.**

After a short delay while the processing occurs, the **MPS File Process** window returns to display statistics about the processed data.

### Viewing the test results using MPSWin

When the processing of data is finished, you can see a graph showing the results of the test immediately in MPSWin.

In the **MPS File Process** window, note that the **Process** button has been grayed. This indicates that the processing of data is complete. To view the test results, click **OK**. A chart that depicts that temperature and pressure data opens.




This chart is scaled to contain all of the test data. You can read the approximate time, temperature, and pressure details of any position on the chart by moving the mouse until the dotted lines intersect at the desired point on the chart.

### Printing the chart

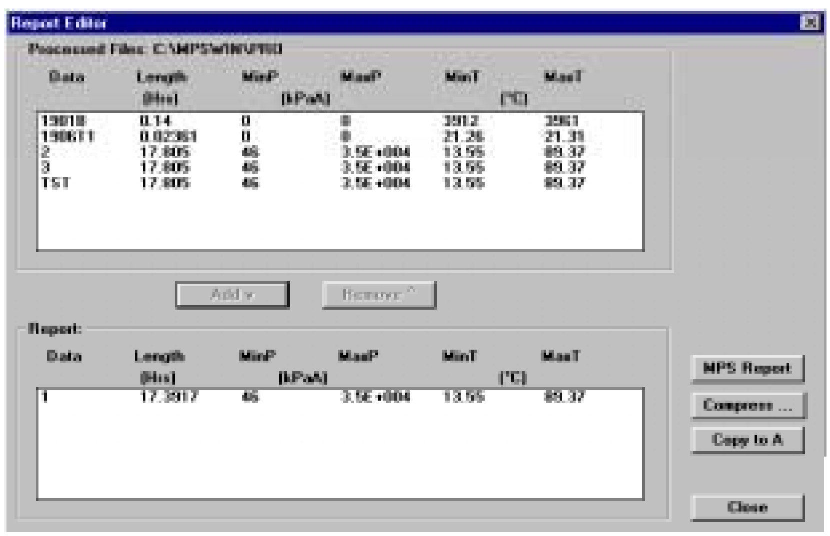
To print the chart, select **File/Print** from the menu bar. Note that only the curves and axes of the chart will print - the dotted lines and pressure/temperature data of the selected point on the chart will not show on the print-out.

### Viewing the test results in MPSReport

When you have completed the downloading process, you can view the results of the probe's test as a pressure/temperature graph on the computer screen.

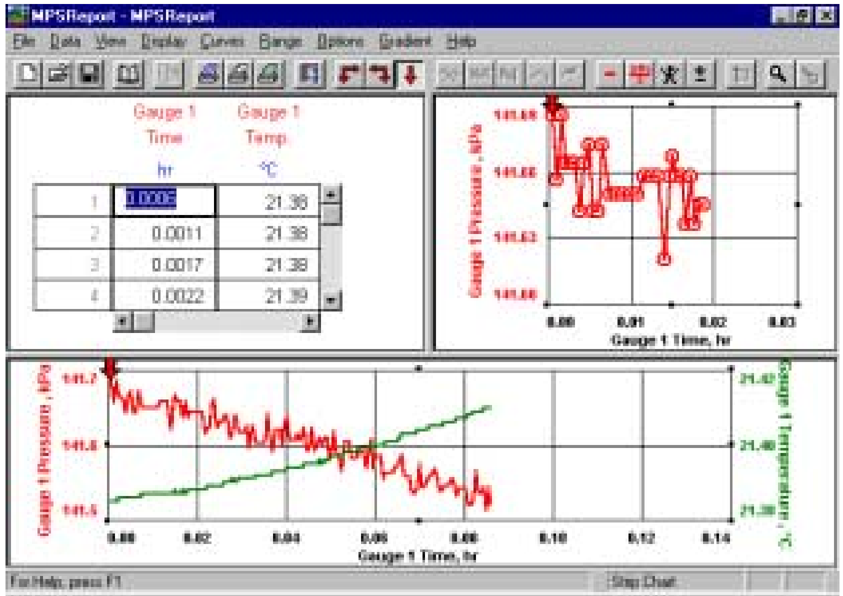
*NOTE: For this procedure, you must have MPSWin running, and you must have MPSReport installed on your computer but NOT running.*

1. Select **Report/Edit** from the MPSWin main window menu bar. The **Report Editor** window opens.




2. In the Processed Files data box in the upper portion of the window, click on the file of data that was just created during the downloading process. The file will become highlighted.
3. Click **Add.** The file will be transferred to the Report data box in the lower portion of the window.
4. Click on the file name in the Report section. It will become highlighted.
5. Click on the **MPSReport** button. The **MPSReport** window opens.
   Clicking **Compress** will compress the **.prn** file (with a zip

extension) and copy it to a drive of your choice.
**Copy to A:** will copy the **.prn** file to drive **A:**




The pressure and temperature data is plotted in the strip chart in the lower portion of the screen. The individual data points for each reading are listed in the data table in the upper left-hand portion of the screen. The chart in the upper right-hand portion is a magnified image of the individual data points that pertain to the part of the curve indicated by the red arrow on the strip chart.

## Using MPSReport

You can perform many functions with the data and charts created by MPSReport. **For detailed procedures, please refer to MPSReport User's Guide manual available from Kuster Co.**

## Printing the chart and data

You can print a copy of the strip chart and the data table. Select **Print/Chart** or **Print/Table** from the menu bar.

*NOTE: Depending on the length of the test, there may be a very large amount of data. You can determine the number of data points by scrolling through the data in the data table portion of the window, or by selecting* ***Data/ Recorder Statistics*** *from the menu bar . Printing the complete table could result in a very large report that ties up your computer and printer for an extended period. As with most Windows applications, you can choose to print only a specific number of pages by choosing this option in the* ***Print*** *window.*

**Closing the program**

To exit from the MPSReport program, click in the **X** box in the top right-hand corner of the window. MPSReport will ask you whether you want to save any changes to your file. In most cases, you will only have altered the configuration of the window, and you will click **No** to exit the program.

# APPENDIX 1 - OPERATING THE EMP IN SRO MODE

## About SRO functions

*NOTE: This section applies to three-wire interface models of the EMP. The two-wire models ("600" series) will not operate in SRO mode without hardware changes.*

The Electronic Memory Probe can be run into the wellbore and, using an electric line, transmit test data to the surface for observation in real time. This enables the operator to observe temperature and pressure data as the readings are being taken, watch the graph and data details develop on the computer screen, and save the data and the graphs to files for future reference.

The probe must first be programmed to operate in SRO mode.

## Programming the probe for SRO operation

With the probe attached to the computer in accordance with the memory-mode hook-up diagram, and with MPSWin running:

1. In the MPSWin main window, select **EMP/Program/SRO** from the menu bar.
2. You will be asked to confirm that you want to program the probe for SRO operation. Click **Yes**. The **Program SRO For…** window opens.
3. Select either Maximum Resolution or 1 Second Readings. (Maximum resolution is the recommended option.) Click **OK.**
4. You will be advised that the probe has been programmed for SRO operation. Click **OK** to close the confirmation.

## Connecting the probe

When the gauge has been programmed for SRO operation, fitted with a cable head adapter and run into the wellbore with an electric line to the surface, it must be connected to the computer in accordance with the SRO hook-up diagram provided in Appendix 2.

*NOTE: Older probes using the Revision F digital boards (16, 32, 48, 96K memory) should have a jumper installed to ensure 100% start-up downhole. The probe can be operated without this as a dedicated SRO tool, but depending on the line length some problems may be experienced on start-up downhole due to the power supply voltage loss on the line. A SRO voltage drop connector must be used with this probe type when the jumper is not installed.*

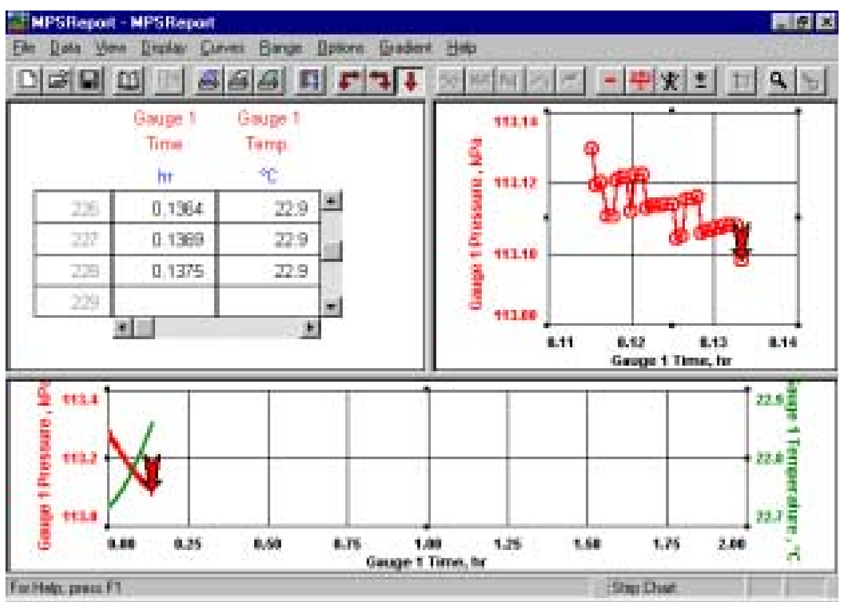
## Viewing the data

When the probe is installed in the electric line, connected to the computer and powered up, it will begin to take readings. When you start MPSWin, the program will take a few seconds to recognize the gauge.  If you do not see appearing in the left-hand side of the window after 20 seconds, then the program has not recognized the gauge and you should check your connections.

When the computer recognizes the gauge, MPSWin will launch MPSReport automatically.  The **Save Processed File** window opens.

You can name your file of SRO data and click **OK** to create the file.  You must do this within 30 seconds from the time this window opens.  If you do not do so, the program will create a default file name (SRO00000) and begin storing data automatically to that file.

When the data file has been created, the **MPSReport** window opens to display the data from the probe as it is being received and processed.




The strip chart across the bottom of the window displays the curves as they are being plotted.  The graph to the upper-right displays a detailed view of the graph showing individual data points associated with the part of the curve indicated by the red arrow.  (You can move the arrow using the mouse or arrow keys to change the area being displayed in detail. Before doing this, you should pause the processing of data by selecting **File/MPS/SRO Pause** from the main menu. You can resume processing by selecting the same menu item again to reverse the toggle.) The table in the upper-left section of the screen shows the pressure and temperature data as it is being received.

### Managing your data files

When you close MPSReport, MPSWin will continue to run and record the test data in the file that was created. The data file has a **.mpd** extension and is located in the RAW directory unless you have specified a different location.

When you terminate the MPSWin session, the program will not continue recording data although the probe is still powered up and transmitting readings. When you start MPSWin again, the program will have to create a new file for the data it is receiving. If you do not specify a file name, MPSWin will by default create an SRO000X file name using the next number in sequence after the last file was created.

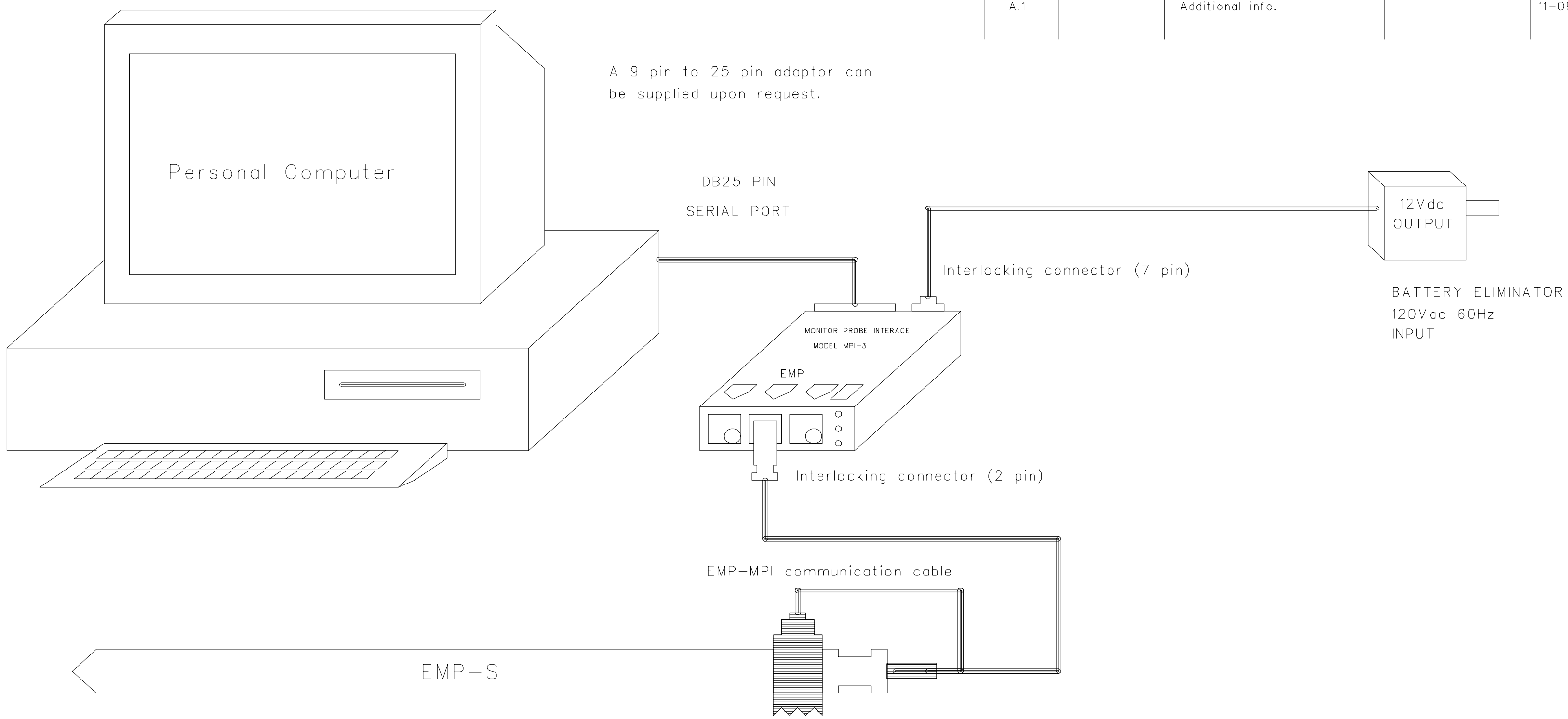
As you are closing the MPSReport session, you will be asked whether you want to save the graphs and table as a report file. Normally you would not save this unless you had been making notations on the chart that you want to keep. (See the MPSReport User's Guide for instructions.)

### Terminating the SRO session

Close the MPSReport window by clicking on the **X** in the upper right-hand corner. You will be asked whether you want to save the report file. Click **Yes** or **No**.

If you want MPSWin to continue recording the test data in the data file it created, do not terminate the MPSWin session. If you do not want to continue recording data in this session, close MPSWin by selecting **File/Exit** or by clicking the **X** in the upper right-hand corner of the screen.

| REVISION RECORD | | | | |
|---|---|---|---|---|
| LTR. | E.C.O. # | DESCRIPTION: | APPROVED BY: | DATE: |
| | | ORIGINAL | | 09-26-95 |
| A.1 | | Additional info. | | 11-09-95 |




THIS DRAWING CONTAINS PROPRIETARY INFORMATION.
DO NOT COPY, DISPLAY, OR USE WITHOUT AUTHORIZATION

Note:
- Used for SETUP / DUMPING of probes with 2-wire communication capabilities
- Not suitable for SURFACE READOUT operation (SRO)

| TITLE: | INTERFACE HOOKUP | | | | |
|---|---|---|---|---|---|
| DRAWN BY: | DATE: | PROJECT: | FILE NAME: | SHEET | REV: |
| KK | 11-09-95 | | QR_CNECT | 3 / 3 | A.1 |
| CHECKED: | DATE: | NOMENCLATURE: Setup / Dumping E008 | | | |

K8dwg002.wmf

## K8S ELECTRONIC MEMORY PROBE SYSTEM

The K8S is a non-volatile memory probe with a strain gauge measurement sensor for recording down-hole pressure/temperature data.

- Bellows isolated for extended transducer life
- Memory: 16000, 24000, 48000, 64000, 96000 or 128000 Total Readings (Pressure or Temperature)
- Custom programmable up to 40 various reading intervals
- Low Power consumption:
    - over 30 days on an extended 6 cell pack
    - up to 120 days on an extended 10 cell pack
    - probe can be operated on alkaline batteries
- K8S can be software programmed to run E Line, Surface Read Out (SRO) mode
- Operating Software allows for use with most 'IBM compatible' PCs. A Field Operation version as well as a more versatile Shop version is included with the instrument.
- Operating and maintenance manuals

**Operating Pressure Ranges:**

| | | |
|---|---|---|
| K8S | 15000, 20000 psi | 0 to 175°C(348°F) |
| | 5000, 10000, 15000, 20000 psi | 0 to 150°C(305°F), 348°F on request |
| | 2500 psi | -25 to 125°C(257°F) |
| K8S | 1250 psi (Buffer Tube Isolation Only) | -25 to 125°C(257°F) |

**Specifications:**

| | | |
|---|---|---|
| Resolution: | Pressure: | 0.002% of Full Scale |
| | Temperature: | 0.04°C (0.02°F) |
| Accuracy: | Pressure: | +/- 0.05% of Full Scale |
| | Temperature: | +/- 1°C (1.8°F) |
| Diameter: | 1.25" OD | Up to 15000 psi |
| | 1.31" OD | 15000, 20000 psi |
| Length: | 56 or 64 inches with Battery Pack depending on configuration ordered. | |

## Basic K8 Operation Information

The Kuster K8S, version 3.9 has non-volatile memory. Once data is stored in memory, no power is required to sustain it.

**Interval:** The K8S can be programmed with up to 40 different intervals with a pressure/temperature ratio of 1 to 15. The reading intervals can be 4 seconds (K8S) or 2 seconds (K8Q) to four hours in increments of 4 seconds. The standard K8S (3.908/6 version UVEPROM or older) requires 4 seconds to take a reading and the standard K8Q takes 2 seconds to take a reading. The K8S (3.917 version UVEPROM or newer) can be operated at 1 second intervals. Three seconds and under is operated at reduced resolution while four seconds and above operates at standard resolution. (0.002% of full scale) The K8Q (3.918 version UVEPROM or newer) operates at 1 second intervals. These models will become the standards in 1997. The reading interval is the time the gauge will wait between readings. The pressure/temperature ratio is the number of pressure readings the gauge will take with each temperature. If the temperature is changing rapidly, a low P/T ratio is desirable. On tests where the temperature is stable a larger P/T ratio can be used. In the case of a 4 second interval at a P/T ratio of 15, the K8 will record a temperature and pressure followed by a pressure reading every 4 seconds for the next 56 seconds. The pressure readings following the initial temperature/pressure reading are referenced to the temperature during data processing. If the temperature is changing fast enough during the 56 seconds, the final few pressure readings may lose some of their accuracy as they are referenced to the temperature reading taken one minute earlier. Static gradients should be run at a 1 to 1 ratio. It is recommended that the pressure/temperature ration no exceed 3.1 during the first stage of a production test.

**Voltages:** Battery trip levels referred to the amount of voltage required to put the K8 in operating mode. The communication trip level refers to the amount of voltage required to put the K8 in communication mode. All K8's have a battery trip level of approximately 9.5 volts on and 6.5 volts off. The K8S also has a communication trip level of approximately 17.5 volts on and 16.5 volts off. The K8Q does not have communication trip levels because it uses a 3-wire interface, which disables the operating trip level when connected to a computer. The analog subassembly on the K8S requires a minimum of 8.5 volts to record accurate data. In order for the K8 to start up during a test, the battery pack or power source must be at least 10.2 volts. Once running the K8's analog to digital circuitry will function accurately to a power source of 8.5 volts. When the level gets below 6.5 volts the K8 will shut down. This level will vary slightly between probes. In order for the K8S to communicate properly to a computer, the power output of the monitor probe interface box (MPI) must be at least 18 volts at room temperature. The probes trip levels will vary due to the temperature. At 150$^{o}$C the on and off trip levels can be as much as 2 volts higher. This should not cause any problem since the MPI box has approximately 21 volts on its output during communication. For the K8Q to communicate the 3-wire interface must have a regulated 12 volt DC power supply. For tests, the K8s are put under power prior to being

run down hole and once powered, they will continue to record data until the voltage drops below 6.5 volts. However, below 8.5 volts the data will not be accurate.

**Current:** Once the K8 is downloaded, its operation can be checked using a current meter in series with the power source. For example, a 1 minute, 3-pressure/temperature ratio will be used for the download. On power up, the standard K8 will take its first reading at 4 or 2 seconds and then it will take a reading every minute after that. There are 3 different current levels when the gauge is running. the first level is the idle state in which the K8 is shut down to conserve power. This level is about 4.5 milliamps. The K8S will be at this level for 52 seconds before the Analog board turns on to warm up, and the K8Q will be at this level for 58 seconds before the Quartz Transducer is activated. The K8s are now at a current level of approximately 8.5 milliamps for the K8S and 13 milliamps for the K8Q. The K8 will then go into its idle state and wait until its time to take the next reading. In this case it will be in the idle state for the next 52 or 58 seconds. The current levels will vary from K8 to K8 by small amounts and will increase with temperatures over 125$^{o}$C. Current readings play a very important part in determining probe failures.

In the case of a K8S with a temperature sensitive transducer, a warm-up time may be placed in the probes working registers. This is required in order to allow sufficient time for the transducer to stabilize to the calibration standard. In K8s such as these, the currents monitored during operation will be directly related to the length of the warm-up. For example, a K8 with a 5 minute warm-up, running a 1 minute 3 P/T ratio like above will display currents as follows: The K8 will draw 8.5 milliamps for 56 seconds and 13.5 milliamps for the final 4 seconds. Unless the reading interval is greater than 5 minutes, the 4.5 milliamp idle state will not be seen. It is important to note that battery life will vary according to the amount of warm up required. In the case of a 5 minute warm-up, you can expect approximately 50% less running time from standard operating hours per pack. The warm-up time for each K8S is determined and entered into the probes working resistors during the manufacturing stage.

# K8S Self Test Operation

There is a self-test mode built into the K8S. This self test mode will run after a probe has been setup and is connected to a battery or a 12 volt power supply. When the probe is set up a 1 minute delay will be placed into the memory automatically. This delay is used by the probe for the self-test. After the self test is complete the probe will start to run its downloaded program. The self-test consists of three repeated sequences. If the probe fails twice it's considered an operating failure. This will eliminate any problems due to erroneous readings. Once the self-test has run for 1 minute and the probe starts to take readings the self test will not run again until the probe has been programmed with a new setup.

K8S probes with software revision #3917 will not run the self test when the probe is setup in SRO mode.

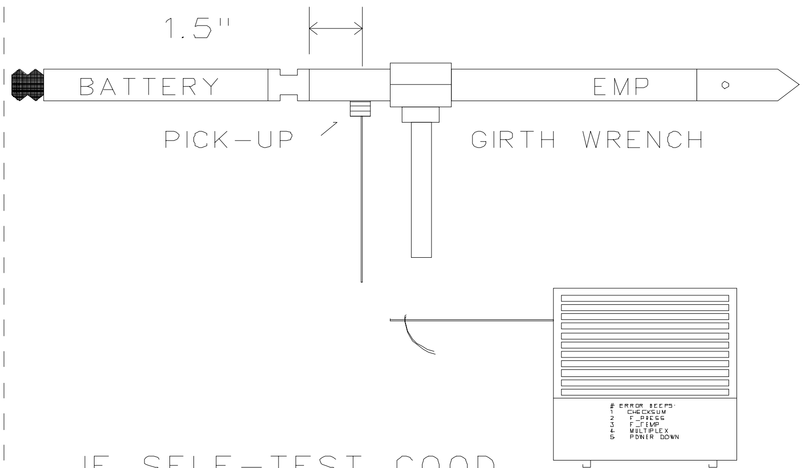
This self-test requires a pickup coil placed close to the I/O contact to indicate if the probe is operating properly or if it has failed. (See Drawing #E077_STK) The self-test mode tests for 6 different failures.

| | **FAILURE** | **INDICATION** |
|---|---|---|
| 1) | No Power | No Sound |
| 2) | Checksum | 1 Beep |
| 3) | No Pressure | 2 Beeps |
| 4) | No Temperature | 3 Beeps |
| 5) | Multiplex Failure | 4 Beeps |
| 6) | Power Down Failure | 5 Beeps |

If the probe is operating properly then the pickup coil will pickup a continuous 'TUNE' which will last for 1 minute.

**NOTE: If the probe fails the self test then it will beep for 1 minute to alert operator and then continue to take readings. The purpose for the probe is to notify the operator of a problem and then to go into operations mode. The data stored can be used by the operator to analyze the type of problem.**

# PICK-UP COIL PLACEMENT




IF SELF-TEST GOOD
'TUNE' duration = ONE minute
playing ONLY from the FIRST
battery connect time.

IF THE SELF-TEST FAILS;
Count the # of ERROR BEEPS

1 CHECKSUM
2 F_PRESS
3 F_TEMP
4 MULTIPLEX
5 POWER DOWN

## EMP Operation Summary

### Introduction

Operation of the Kuster K8 is fairly straightforward. If the instruments are properly prepared and run, useful test results can usually be obtained. The use of two instruments on each job gives a success rate of better than 99% under normal conditions. In extreme conditions (for example, tests over 30 days at high temperatures, corrosive well conditions, offshore testing) three or four instruments may be used.

The main difference between the quartz and strain gauge operations is in the running and the maintenance. The housing threads and seals on the K8Q are different and not interchangeable with the strain-gauge parts. The small diameter K8Q uses basically the same mechanical parts as the K8S. The fluid inside the pressure port must be kept clean so that the buffer tube doesn't become blocked. Even a little tap water can be a problem. The buffer tube must not become blocked. This requires cleaning (flushing) and filling of the internal volume and buffer tube before each test. The internal volume of the bellows isolator must be also kept clean and filled with oil. Usually silicone oil like OC 200 series 100cs is used. The maintenance of these components on the strain gauge version is also important (especially as a means of keeping H2S away from the transducer diaphragm).

The general procedure is described below. Some variation may be made in the steps after 17, depending on the user's requirements. The standard operating procedure is to have instruments, housing components and battery packs on the shelf, ready for field use. This minimizes the time required to prepare for a test. Some customers (or government regulations) may require periodic calibration of the gauges against a certified deadweight gauge.

### Preparing the K8 for a test

1. Follow the recommended Kuster procedures to determine the instrument running configuration: battery pack size, pressure port buffer tube, etc. plus any specialized wireline equipment (eg., bombwells and/or inhibitor for sour gas, soft-set tools etc.) As a general rule, the same wireline tools used with the mechanical recorders are usable with the K8, although more care should be exercised in the operations due to the fact that electronic instruments are more easily damaged.

2. Double-check the mechanical condition of the K8 housing components, sealing surfaces and elastomers and assemble the required running components (buffer tube and housing, bullnose etc.).

3. Test the battery pack before and after installing it in the required housing. (Refer to the “Battery Testing” section of this manual for more details - p.48)

4. Verify that the instrument is operating. This is referred to as a 'bench check' and involves operating the K8 at room temperature and atmospheric pressure for a few minutes. This can also serve as an additional battery pack test. The procedure for this is the same as for setting up the K8 for the field operation, except the program is very simple: usually the reading interval is set to 4 seconds or so. The most meaningful results are obtained when the ambient temperature is reasonably constant. The data is dumped and processed to confirm that the pressure and temperature recorded were correct. This also serves to establish a zero-check for the pressure transducer, however, the presence of an isolation bellows will degrade repeatability below 345 KPA (50PSIA).

5. The K8 is prepared using the Program selection on the computer to create and download the test sequence required for the well testing program. The K8 can be programmed to fill the memory with readings taken at one fixed interval or the interval can be varied in up to 40 segments, each of different duration. The ratio of pressure to temperature readings can be changed in each interval so that more memory is available for pressure data when the temperature is constant. The 64000 readings refers to pressures plus temperatures, so that if each pressure has a new temperature there is room for 32000 data points.

Complex or repetitive test sequences can be prepared in advance and stored as a disk file to simplify the download operation. Stored test sequences can be changed before downloading to the K8. The computer clock is used to determine a setup time, which is recorded in the K8. It is therefore important that the computer clock is correct.

6. Place the K8 components in the field shipping case for transport to the field. The method of transport may be restricted by 'Transportation of Dangerous Goods' regulations due to the lithium battery packs.

**Running the K8**

At this stage the K8 is ready to be run as soon as it reaches the well site. The wireline operator need only screw on the battery pack housing to start the K8 clock (noting the time for later reference), tighten it with a girth wrench, and attach the K8 to the wireline tool string. If desired, steps 1 - 6 can be accomplished on-site, however, the computer equipment must be protected from temperature extremes. The K8 threaded components must be protected from dust and dirt when servicing operations are done in the field. It is recommended that the K8 electronics housing NOT be opened under field conditions.

7. If there is a possibility of a tubing obstruction or narrow section such that the K8 may be jarred or jammed, a gauge ring should be run first to verify that the path is clear.

8. The K8s may now be attached one at a time to the wireline tool string, separating them by knuckle joints or such other running equipment as may be required by well conditions. **The K8 housings must not be gripped by pipe wrenches.** Attachment of the K8 to the wireline tools should be done using only the wrench slots and a 1.062 open-end wrench.

If there are problems with the well such that the start of the test will be significantly delayed, the K8 battery packs can be disconnected and reconnected later. When the battery housing is reconnected the K8 program will carry on where it left off, placing a marker in the memory to show where the disconnection occurred.

9. The well test program may require an initial surface measurement. In this case the instruments should remain in the lubricator for 15 minutes or more to allow sufficient time for the readings to stabilize this settling time is required for thermal equilibrium to be reached inside the instrument.

The running speed should be moderate: 150 ft./min. (50 m/min.).

In the event a gradient test is being run, it is desirable to make stops of at least 10 minutes at each required depth (longer if the depth increments are very large, such as near the surface). The time of the various wireline operations (eg. pressure up lubricator, start running-in, on bottom, flows, shut-ins, off bottom, vent lubricator, etc.) should be recorded. This information can be attached to the K8 data as comments and may be useful when validating the K8 data after the test is completed.

10. At the end of the test the K8 tools should be retrieved with the same speed restriction used during run-in. If the well test program requires a final surface measurement, the instruments should remain in the lubricator for at least 15 minutes to allow sufficient time for the K8 internal temperature to stabilize.

11. The K8s are disconnected from the tool string, reversing the attachment procedure. **Pipe wrenches must not be used on the K8.**

12. The instrument housings should be cleaned of well fluids and the buffer tube housing drained, especially if hazardous (eg. $H_2S$) or corrosive well fluids may be present.

13. The battery housing must be removed from the K8 where it joins the I/O contact sub. This requires the girth wrench for the housing and 1.062 open-end wrench for the sub from the K8 tool kit. **Pipe wrenches must not be used.** The time of the battery pack disconnect should be recorded. The instruments can then be packed for shipment to town for data retrieval and processing, or the data can be dumped and processed on-site. If the proper girth wrench is not available, the battery pack can be left attached, although the instrument will be too long to fit the shipping case.

Spares of critical components (eg., MPI and cables) should be on hand in case of equipment problems. It is a good idea to have a spare computer, since the K8 cannot be set up or dumped without a working computer.

**Post-Test Servicing**

The servicing operations which do not require opening of the K8 electronics housing may be carried out in the field. These include pressure port cleaning and battery pack replacement. Other procedures (described in Kuster documentation) require a lab or clean shop environment. For example, deadweight calibration checks require a high-quality deadweight (.01%) or secondary standard and controlled ambient conditions (temperature, humidity, barometric pressure) to be meaningful. Replacement of internal O-rings requires access to the inside of the electronics housing. It should be opened in a controlled environment. The humidity must not be too (low to prevent static electricity problems, nor too high to prevent condensation of moisture on the circuitry). Contamination of the electronics by oil, dirt and the like must be minimized.

## K8 MECHANICAL SERVICE PROCEDURE – K8-S - STRAIN GAUGE

### A. Description

This procedure describes the proper method of removing the electronics of the Kuster K8 from its housing for regular servicing. It is important to understand that the electronic subassemblies, once removed from the housing, are static sensitive.

The mechanical design of the Kuster K8 uses a tapered seal. The reason is to have a metal to metal seal with O-ring backups, because of this design, it is important to keep in mind that new fittings will have a small gap even when fully tightened. If there is no standoff a metal to metal seal cannot be obtained.

The normal procedure is to hand tighten the fittings and then usually no more than 1/8 to a 1/4 turn with the wrench is necessary to fully tighten. The gap will decrease with wear, thus requiring more rotation force to fully tighten the fittings. It is recommended that the fittings be replaced before they wear to the point that no gap is left when the K8 is fully assembled.

**B. Tools Required**

1. 1.062” open end or combination wrench.
2. 1 - 1/4” girth wrench - Parmalee #1 handle assembly & 1 - 1/4” OD girth for #1 handle.
3. 1/2” open end or combination wrench.
4. 0.6875” (11/16”) thin (1/4” width) open-end wrench GEDORE No. 12.
5. O-ring tool - Parker Seal O-ring Installation/Extraction Kit with pointed-end and flat blade brass tools.
6. Syringes (plastic) with a 1.5” long blunt “needle” end (one for solvent and one for silicone oil). A standard oil can is recommended over the syringes.
7. #40 hex socket drive tool.
8. 1/4” hex deep socket.
9. 7/16” socket or nut driver with a 3” extension.
10. 3/8” socket or nut driver.
11. Anti-static work station. Anti-static wrist strap, mat etc.

**C. Materials Required**

1. High-temperature tape (e.g. Dominion Kapton High-Temp. #23 in 1” or 3” widths).
2. 5 of 119 o-rings, 80 durometer. Recommended o-ring material for down-hole services.
3. 10 of 119 Viton, 90 durometer Parbak backup rings.
4. Thread anti-seize and O-ring lubricant (must be non-sulphur and have low volatile content for compatibility with electronic circuitry).
5. Silicone oil - Dow Corning 200 Fluid (50 to 200 Cs viscosity or similar).
6. $H_2S$ Inhibitor oil - TRETOLITE KONTOL K-142 or KP-12 manufactured by PETROLITE.
7. Varsol or similar solvent.
8. High strength thread sealant (e.g. LOCTITE 271 Cat. no. 271-31).
9. Teflon sleeve - 6 x 3.5” square, .005” thick, 180°C.
10. PVC insulation tape (electrician’s tape).

**D. Procedure for taking the K8 apart (refer to mechanical layout drawing supplied). Completely read through entire procedure prior to attempting to dismantle or service the instrument.**

1. Remove bull nose (wireline adapter or DST cap) by using the 1.062” wrench to hold the K8 (insert the wrench in the wrench flats on the transducer adapter) and the 1.062” open end wrench to turn the bull nose. Considerable force may be needed. If the Electronics Housing has to be held down during the operation, do not stand on the tubular housing - it will bend unless supported along its full length.
2. Remove buffer tube using a 1/2” wrench. If the K8 is a closed bellow model than, ensure that the HIP fitting does not loosen or come off of the bellows. The high-pressure cone seal will be damaged. In the case of an open bellows (slotted protector

cap allows operator to inspect and flush out the bellows flutes) there is no buffer tube to remove.

3. Use the girth wrench to hold the Electronics Housing and the 1.062” wrench to remove the I/O contact adapter. It may be helpful to place the Electronics Housing and girth wrench on a bench, with the I/O contact adapter over the edge, so there is clearance for 1.062” wrench/ I/O contact adapter to rotate.
4. Use the 1.062” open-end wrench and girth wrench to break the joint at the Transducer Adapter and the Electronics Housing.
5. Pull the electronics out of the housing.

**Note:** The electronic sections are static sensitive and can be damaged if proper care is not taken. The K8 should be grounded via ground wire as soon as it is removed from the housing.

**E. Service Operations**

1. Replace all exposed O-rings (2 of 119 O-rings / 4 of 119 Parbak backup rings on the I/O contact adapter, 2 of 119 O-ring / 4 of 119 Parbak backup ring on the transducer adapter.

**Note:** O-rings may not require changing after each test. O-rings can be used for a number of short tests (1-5 days) if $H_2S$ or $CO_2$ was not present in the wells. Recommended o-rings are listed on K8 layout part listing attached.

2. **None or Closed Bellows Models:** If the transducer pressure port is dirty, flush it several times with solvent until clean, then flush several times with clean silicone oil to remove solvent (use the syringes). Fill the pressure port with silicone oil. If the probe was in heavy well fluid, such as drilling mud, and the transducer adapter pressure port has become plugged so that normal flushing will not work. The adapter will have to be removed (this is not likely to occur if the supplied buffer tube is used on field jobs).
3. **Open Bellows Model:** Flush the bellows flutes through the slots on the protector cap. An aerosol can of a good degreaser works very well. If an excessive build-up is present and you are unable to flush it out, remove the protector cap. Extreme caution must be used to ensure no damage is done to the bellows during removal or reinstalling the protector cap. The bellows flutes are very fragile and a slight crimp or bend will effect the probe’s accuracy.

**Transducer Adapter Removal**

**If the K8 has a bellows attached to protect the transducer, you should not have to remove the transducer unless the bellows has been damaged**. If the transducer adapter is removed, to replace the bellows, the transducer/bellows system will have to be totally evacuated of air (vacuum pump) and possibly re-calibrated prior to reuse.

Remove the transducer sleeve from the adapter. This is a left-hand thread and should be hand tight with Loctite being used to hold it in place. Remove the tape holding the transducer wires on the analog board and gently slide the transducer forward as to ensure no **strain** is placed on the wires. If excessive force is applied to the wires, intermittent operation or complete failure may occur. Internal transducer connections are not repairable. Remove the transducer adapter by using the .6875" wrench on the transducer and the 1.062" wrench on the adapter.

Flush the transducer adapter out with solvent and oil. Do the same for the transducer but do not insert anything more than .5" long into the transducer. Ensure there are no scratches on the inside cone surface of the adapter. The main transducer seal is metal to metal and surface damage can cause pressure leaks.
Apply high strength thread locking compound to the threads (keep the compound off the transducer cone and be sure to follow the instructions for the quantity and set time of the type of thread locker used).

Remount the transducer adapter by hand tightening it and then tighten up with the wrenches. Be sure to make this connection tight. (25 ft./lbs.) Gently pull the transducer wires back through the transducer sleeve as you slide the transducer inside the sleeve. Screw the transducer sleeve onto the adapter, and secure with non-permanent Loctite. Note this is a left-hand thread. Using the high temperature tape, tape the wires to the analog board. Be careful not to allow the wires to hang over the side of the circuit board or to set too high on the board as pinching may occur when the K8 is put into its housing.

**Note:** The elastomers on the buffer tube side of the transducer adapter (Item #2) do not provide a necessary pressure seal when the standard buffer tube cap is used. They do serve to fill the gap and exclude well fluids. This seal position is provided for use with a "porting adapter" for a DST recorder carrier.

**Note: If the transducer is removed from the adapter, then the connection must be pressure tested for leaks prior to final assembly and before field use. A leak could destroy the K8. The adapter should only be removed if absolutely necessary. For purposes of pressure testing, the transducer adapter has 1/16" NPT thread or in the case of a bellows system a 1/2" HIP fitting.**

3. Look in the main battery pack end of the I/O contact adapter and check the I/O contact to see if it is bent and that its O-ring (008 Viton, 90 durometer) is intact. If the O-ring is good, it will not be visible. Replace if necessary by using the 1/4" hex deep socket supplied.
4. Visually check electronics for signs of rubbing against the inside of the housing. Check the transducer wires for twisting. If any is indicated, refer to the "Servicing Electronic Subassembly" section. Check the circuit board I/O adapter (F.F. Teflon material and aluminum rail mount). Ensure its rail mount connection is good. Give the red power wire a light pull to ensure a good connection is present. If the red wire is broken, remove the eccentric I/O contact retainer by unscrewing it from the circuit

board I/O adapter (use a flat bladed screw driver if not hand tight but take care not to damage the socket contact). The contact sleeve and the eccentric I/O contact end (brass material) can slide out. Remove the #40 hex socket screw from the brass eccentric and slide out the socket contact. Using an 800°F soldering iron and 200°C (400°F) rated solder, solder the red wire into the end of the sleeve. Install contact sleeve back into the I/O contact end and re-tighten the hex screw. Be careful not to over tighten as the screw may strip. Screw the I/O contact retainer in place. Hand tight is all that is required. The socket contact sleeve should not extend beyond the insulation retainer or a short may occur once the K8 is completely reinstalled in its housing. Put the wave spring over the end of the circuit board I/O adapter.

5. Clean the threads and the sealing surfaces of the adapters and the housing so that they will not jam or be damaged when put back together. Check the threads, O-ring groove shoulders and seal bore taper for galling. If any of these parts are damaged, they should be resurfaced or replaced. A light coating of thread lubricant or anti-seize compound should be applied to the replacement parts to prevent galling.

**Note:** The transducer adapter and I/O contact adapter should be cleaned of any film that may have built up during the field test. This is to ensure a proper connection is made with the MPI to K8 cable ground clamp. A faulty connection can cause communication errors and improper operation when running bench tests.

**Warning! Do not mate parts that have not been lubricated, they may be permanently damaged.**

## F. Procedure for Assembling the K8

1. Ensure that all threads are cleaned and lightly lubricated. A light film of lubricant on any new O-ring will help ease them into the seat.
2. Ensure the wave spring is on the circuit board I/O adapter with the convex side away from the transducer. The spring is used to make sure that there is no internal movement once housing fittings are tightened.
3. Slide the I/O end of the electronics into the Electronics Housing. If threads are undamaged and clean, the K8 should be able to be hand tightened.
4. With the 1.062” open-end wrench and the girth wrench, tighten the transducer adapter/electronics housing joint.

**Note:** The K8 mechanical fittings are of a tapered seal design. Caution should be used as not to over tighten the parts. If properly done, new parts should have a very small gap between the fittings. Usually hand tight and then wrench-tighten a 1/8 turn is sufficient. Over tightening the fittings will cause excessive wear and a lessening of the tapered seal effect. Basically, it is a metal to metal seal with the O-rings acting as a backup seal only.

5. Check to be sure that the curved spring washer is over the circuit board I/O contact adapter, with the convex side away from the transducer.

6. Slide the I/O contact adapter over the circuit board I/O contact adapter, making sure that the I/O contact slides into the contact sleeve. Hand-tighten the I/O contact adapter and wrench tighten a 1/8 to 1/4 turn maximum.
7. Use the syringe to oil fill the buffer tube. Force oil into the tube until clean oil comes out of the opposite end. Put a wrap of Teflon tape on the buffer tube threads and then screw it into the transducer adapter. Use the 1/2" wrench to tighten.

8. Install the bull nose. It is good practice to fill the bull nose with silicone oil. In the $H_2S$ applications suitable inhibitor should be used to fill the bull nose (e.g. TRETOLITE KONTOL K-142 or KP-12 manufactured by PETROLITE).
9. Wrap a layer or two of electrical tape over the hole in the bull nose to retain the liquid.

**Warning! The electrical tape must be removed or punctured before use, to allow the well bore pressure to reach the K8 pressure sensor.**

## G. Servicing the Main Battery Pack

1. With the girth wrench and the 1.062" open-end wrench remove the battery cap.
2. Remove the compressing spring, the battery and the Teflon battery sleeve.
3. Clean threads and lubricate lightly.
4. Replace 2 of 119 Viton, 90 durometer Parbaks and 1 of 119 o-rings, 80 durometer on the battery cap.
5. If there was a pressure leak at either the battery cap or the I/O contact adapter/battery pack union, take the brass drive tool and remove the battery contact insulator. Replace the 118 Viton O-ring on the battery contact insulator and reinstall the insulator in the battery pack housing. Care must be taken not to strip the insulator threads. Once properly tightened, the tip of the insulator should just clear the end of the battery housing.
6. Check the battery pack housing electrical contact by inserting the .062" diameter test pin. The tester has approximately 1.5 oz of weight attached to its pin by a 6" wire. If the connector is good, the battery housing should be able to be turned upside down with the test pin hanging. If the test pin cannot be suspended without falling, then the connector must be replaced. Remove the battery contact using the 7/16" socket from inside the modified battery contact insulator. Install a new bolt and contact. Use the brass drive tool on the modified battery contact insulator to keep it from turning.
7. The bolt contact should be checked periodically for corrosion buildup that may hinder electrical connections. In most cases, a wire brush will clean off any buildup. This is especially important when using battery packs that do not have a positive terminal spring, as some of these types use glue to hold the end caps in place. The glue can leak out at high temperatures causing a failure on the next low temperature test.
8. If the battery housing is designed for a four-cell pack, but is being used with a three-cell pack, unscrew the metal spacer (approximately 2" long) from the wireline adapter battery housing plug. Clean the spring well, ensure a good electrical contact. When

replacing the spacer clean the threads as well as the top and bottom surfaces, to ensure a good electrical contact between the adapter plug and the battery spring.

**Note:** Four cell housings are required if used some battery manufacturers that have a low cell voltage (e.g. 2.4 volts per cell).

9. Insert the Teflon sleeve in the battery housing. If the sleeve is badly wrinkled or creased replace it. This sleeve is to prevent the battery pack from shortening against the battery housing, if the insulation on the battery pack splits at high temperatures.
10. Insert a battery pack in the housing (positive end first), while ensuring that the Teflon sleeve is not being bent. Battery packs will differ depending upon manufacturer. Kuster made packs will have a small compression spring on the positive terminal. The pack should fit into the housing easily. Packs made by other manufacturers may require spacers to be used. These spacers are generally a large rubber O-ring with a center hole that allows the larger compression spring to make contact with the pack. The spacer is to ensure that a good, tight fit is made to compensate for possible battery movement if bumped. Care should be taken to ensure that the pack will not move and break contact with vibration, but at the same time too tight of a fitting could collapse the pack.
11. Place the large compression spring in the housing, screw the battery cap onto the housing and tighten.
12. Test battery pack (refer to “Battery Pack Testing Procedure” section).

**H. Servicing Electronic Subassembly**

Ensure that a proper anti-static station is present and that a good anti-static wrist strap is used at all times. Damage caused by static electricity can seriously impair the K8’s operation and lead to costly repairs.

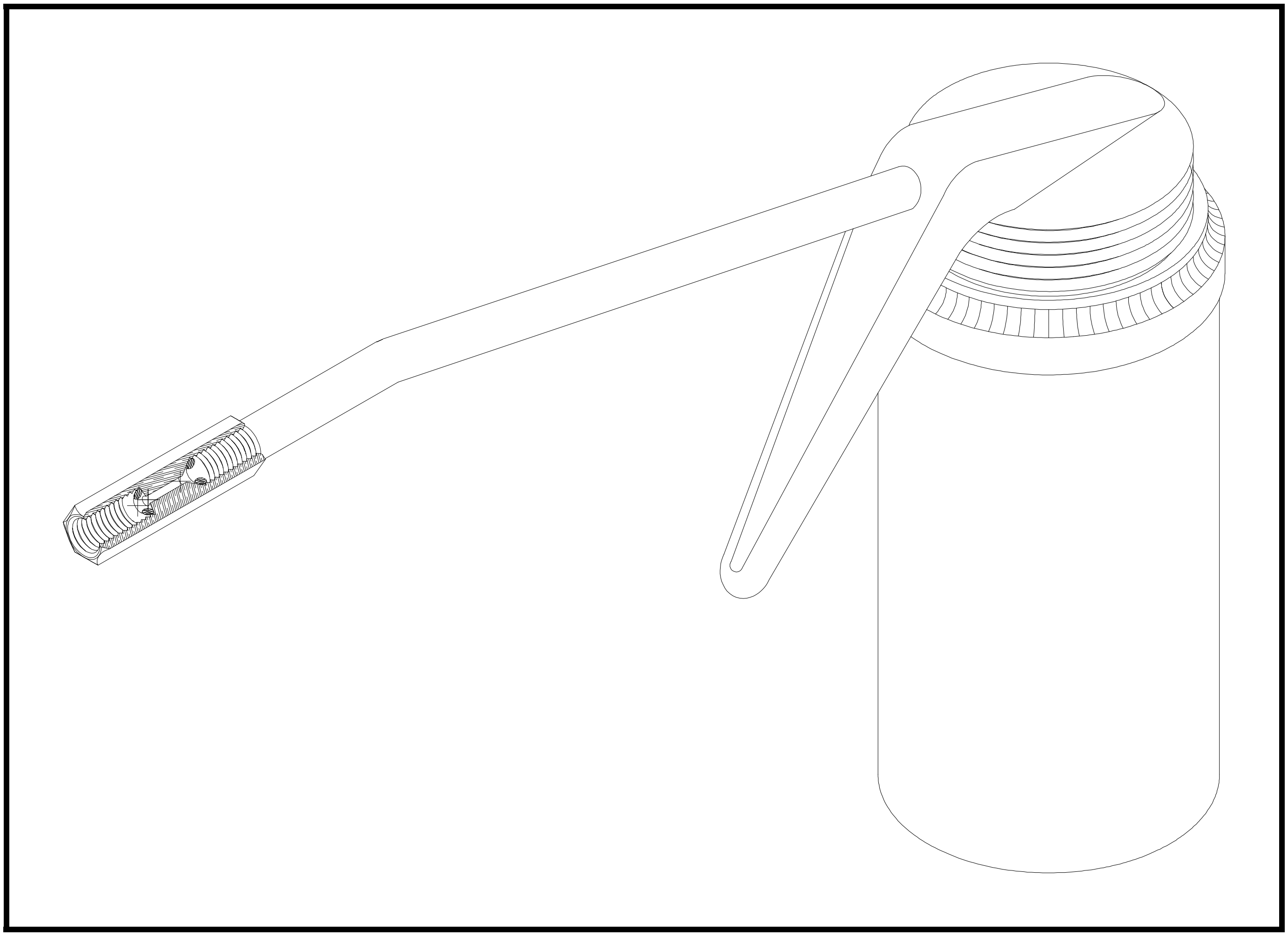
If the transducer wires are twisted, remove the tape on the analog subassembly. If there is only a slight twist, remove the transducer sleeve and adapter from the rail and turn the assembly to untwist the wires. If the wires are tightly twisted, de-solder them from the circuit board. Once the transducer wires are removed, it and the analog section are open to static damage. The bare transducer wire ends should be immediately tied together.

The four transducer wire contacts on the end of the analog board should be shorted together with a bare wire. Once the transducer wires are untwisted, they can be re-soldered to the circuit board using high temperature solder (200°C) and a soldering iron using an 800°F tip. When re-taping the electronics, be careful to unroll the tape prior to applying it to the circuit boards. This is to help prevent static damage caused by static generated when unrolling the tape.

Digital subassembly - 23” long contains the K8 memory section.

Analog subassembly – It is 8” long and connected to the digital board via pin connectors. The pressure and temperature sensing transducer is connected to the analog circuit board by five soldered wires.

Although not recommended, the digital and analog subassemblies can be removed by simply removing the four nuts under the rail for servicing.



**Buffer Tube Filler**

The oil can has been modified so that it can be used to not only fill a Kuster bellows and unbellows on Kuster mechanical gauges but also the buffer tube on the K8S and K8Q electronic gauges.

Step 1. Remove the buffer tube from the gauge. Clean if necessary by forcing a solvent through the unit (use the syringe provided). Then follow the solvent with compressed air.

Step 2. Fill the oil can with silicone oil and screw the brass buffer tube adapter onto the end of the can. Thread the buffer tube onto the adapter and force the oil into it until oil exits the open end. Continue pumping the oil until all the air bubbles are gone. The buffer tube is now full.

Step 3. Fill the pressure port with silicone oil and assemble the buffer tube back onto the gauge.

Repeat the above steps either before or after every survey run with the gauge. This will extend the life of the diaphragm in the transducer, and make calibrations less frequent.

## K8 Battery Pack Voltages & Test Duration

Outlined below is a general format to follow when using the various Lithium battery types with the Kuster K8S and K8Q equipment. It is recommended that these regulations be followed and records of battery usage be kept. This will decrease the chances of test problems related to batteries and test duration.

The battery trip point level will vary between K8's due to component tolerances. Ideally, at normal temperature the K8S will trip on at 7.8 volts, off at 5 volts and the K8Q probes will trip on at approximately 8.4 volts and off at 7.2 volts. The reason for lower voltages than the operating minimum is that since there are no back-up batteries to use as a reference voltage source, the trip point levels will drift upward with temperature. The levels can be higher by as much as 2 volts at 175$^{o}$C.

The K8S analog subassembly requires a minimum of 8.2 volts coming into its power supply for proper operation. Since there will be approximately a 1 volt drop across the input circuitry of the K8 (limiting resistor), the actual battery voltage under load cannot be below 9.2 volts for proper operation. The K8Q will operate properly down to its trip off level of approximately 7.2 volts.

Since lithium batteries have a fast voltage drop-off at end-of-life, we do not recommend the use of any battery packs that measure less than 10 volts under the 600 ohm load test. Once the batteries fall below this level, the drop-off rate increases rapidly. Lithium batteries have a rated shelf life of several years at 25$^{o}$C. However, if they sit on the shelf for long periods, the chemical process which gives the long shelf life can cause a decreased voltage output when tested. If a new or slightly used pack do not show a reasonable voltage with the 600 ohm load test after 3 - 5 minutes, then you could use a lower resistance (100 ohm) for a short time. Usually a minute is satisfactory. After removing the load, let the pack set for 10 minutes as it will continue to "wake up" after the load is removed. If after this time the pack still does not recover above 10 volts under 600 ohm, then it is recommended that the pack not be used. When the load is first applied the battery pack voltage will drop off rapidly but in a few seconds it should start to recover.  These test results will vary slightly depending upon the type of cell and manufacturer.  Sometimes just shaking the pack in you hand is enough to waken them.

**ll Kuster supplied battery packs are fuse protected.  Extreme caution must be used when installing the packs into their housing.  If the pack is shorted to ground, the fuse will blow making the pack unusable.**

A battery pack used on multiple short term tests will not last as long as a pack used on a single long term test.  This is because on a long term test, the pack voltage can drop to 8.2 volts and still give valid data since the gauge is already started.  Unless a battery disconnection takes place, the higher trip level needed to properly restart the K8 is not a problem.

The actual operating days for a given pack will vary depending upon the cell type manufacturer.  Because of the difference between the amp hour rating of the various cells the Battery Engineering (BEI) 3-cell pack, 150$^{o}$C is one of a number of cell manufacturers that Kuster uses.  Outlined below is a general guideline that Kuster follows when using the 25-48 HT (150$^{o}$C rated) BEI packs.  Their useable rated amp hour capacity is 4.2 AH.  The cell orientation of some types of various lithium cells plays a large part in the life expectancy.  For example, if the BEI packs are run positive terminal down during a test, up to 20% of the amp hours life could be lost.  The capacity loss is less at higher temperature (above 70$^{o}$C).  When running the BEI packs in the “battery pack up” configuration (reversing the K8 so that the battery pack is at the bottom when run into the well), a single test could be as long as 32 days.

On multiple tests Kuster follows this guideline;1 - 26 day tests, 2 - 10 to 12 day tests, 4 - 5 day tests, 20 - 1 day tests.  When a pack has been used to this extent, we stop using the pack regardless of what it tests under load.  However, for 1 day tests, if the pack measures over 10 volts under load, it will likely run the test.  Bare in mind that after 2 - 8 day tests, the pack could still be used on a number of 1 to 3 day tests.  When mixing various length tests, a close watch should be kept on the total pack usage.  Kuster discards any packs with combined test usage over 20 days.  Although some of our customers run theirs longer, we use this as a cut-off time to reduce failures due to incorrectly marked packs, weak cells, etc.  Another factor to keep in mind that effects battery life is the probes internal warm up time.  This is the time it takes the transducer to reach a stable level due to internal self-heating.  Warm up times of 16 seconds or lower are not considered a problem.  Warm up times greater than this must be factored in as it will increase the overall average operating current thus reducing the battery life on long term tests.

**The 600 ohm load test is critical because an exhausted pack will read 10.5 to 11 volts open circuit although it can read 7 volts or less under load and is in fact unusable.**

Some types of lithium batteries are not effected by cell orientation (Electrochem Siprowound cells, due to different construction).  Others have as much as a 40% loss when run positive terminal down.  Due to allowance for liquid expansion with temperatures, the cells are not completely filled. As a result there is a dead space in the cell at low temperatures. 70$^{o}$C is the boiling point of the liquid, so at temperatures in excess of 70$^{o}$C the loss will be minimal. At 30$^{o}$C and lower, the loss will be greatest.

## RE-USING BATTERY PACKS GUIDELINES

1. If in doubt do not re-use battery pack.

2. A battery pack used on multiple short term tests will not last as long as a pack used on a single long term test. This is a result of the pack's loaded voltage dropping below the required voltage (10 volts) to start the K8 where as a battery used in one long continuous test can drop to approximately 8.5 volts before effecting the probe's readings.

3. It is best to use a used battery pack on short terms tests such as static gradients or drill stem Tests.

4. If the battery pack is the type that has a spring mounted on the positive terminal, check the spring for corrosion and if necessary clean the top of it to ensure a proper electrical contact with the battery contact.

5. Check the battery pack's insulation for splitting. If the insulation has split be sure that the Teflon insulating sleeve covers the split areas upon installation in the housing. It is better to use high temperature tape (Kapton Dominion Tape #23) to insulate the split areas.

6. After every few tests, the battery contact should be removed for inspection. Check the bolt head for corrosion build up and ensure a proper electrical connection can be made to the battery. Refer to K8 Mechanical Service Procedure for removing battery contact.

# CAUTION

**The Battery Housing lengths have changed due to changes in battery pack lengths. The older single battery housings are 22 cm / 8.66” in length and the new housings are 23.25 cm / 9.15” long.**

**When installing the batteries into the housings check the space left between the housing threads and the end of the battery pack. Once the battery pack is inserted into the housing and the positive spring is compressed the battery should be located approximately 1.25 cm / .5” below the threads. If the space between the battery and the threads are less a shorter spring will be required. See Figure 1**

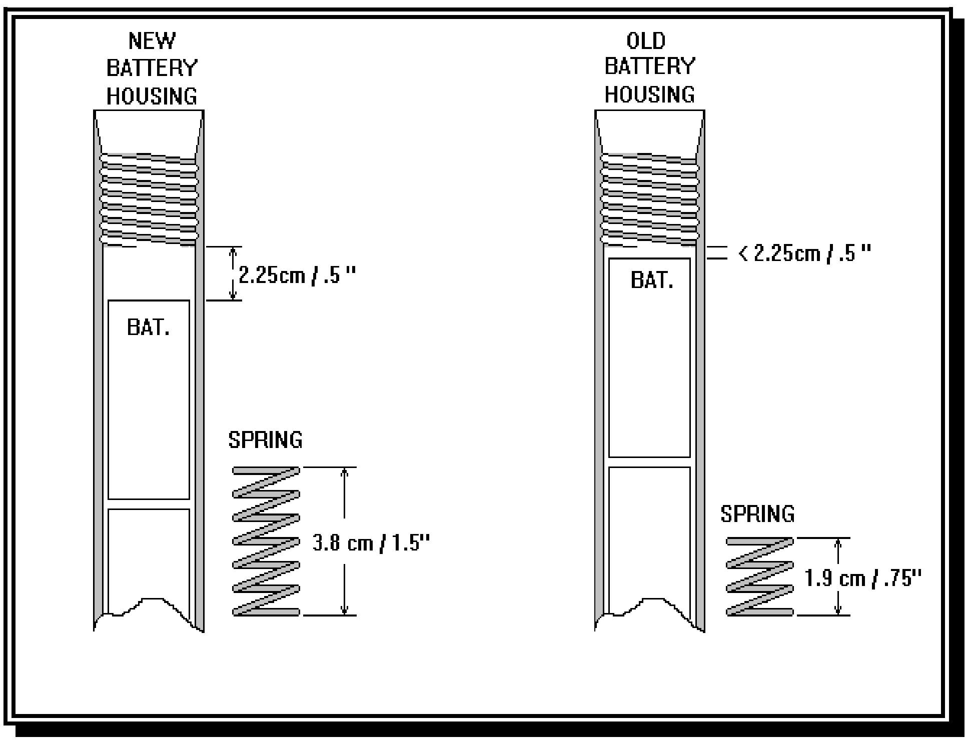



**Figure 1**

**If the proper space is there then a standard spring 3.8 cm / 1.5” long can be used, but if the space is smaller a spring half the length 1.9 cm / .75” long is to be used.**

**This procedure applies to all battery housings. 3 & 4 Cell single housings, double housings, and triple housings for the EMP-Q and the EMP-S type probes.**

## Monitor Probe Interface MPI-3 410 Models

### Operating Summary

The MPI-3 requires a good regulated 12 volt supply for proper operation. To communicate properly with a K8, the power supply must be capable of supplying 12 volts at 250 mA. If a poorly regulated supply is used, the MPI may not communicate with the K8 all of the time. This is especially true if the AC line voltage is low or unstable. Typical MPI input range is 10.8 volts to 13.8 volts. Below 10.8 volts, the MPI may not operate and above 13.8 volts, its internal DC/DC converter could be permanently damaged. Currently manufactured MPIs use a new DC/DC converter that requires no heat sinking and has a much larger input operating range (9 to 15 volts). However, its output is not short circuit protected and can be seriously damaged under this condition. To check for the type of DC/DC converter your MPI operates with, you can either contact Kuster or open the MPI lid for a visual inspection. The newer MPI's use a small DC/DC converter (approximately 1" X 1/2" X 1/4"), while the older versions use a 429 converter (approximately 1 1/4" X 3/4" X 3/4"). Any MPI-3-410 manufactured after 94/01 will have a voltage regulator installed on the DC/DC converter input for added protection against excessively high input voltages.

The "TEST" connector on the MPI-3 is used to supply 12 volts to run a K8f or its atmospheric bench test. The "EMP" connector is used to program or dump a K8. The "SSMP" connector is used to run a sub surface monitor probe.

There are three LEDs on the front of the box. The Red LED indicates power-in and should be lit as long as power (12 volts) is connected to the MPI. If power is connected and the LED is off, check the MPI's internal fuse (3/4 AMP Fast Blow). The Green LED indicates power out. This will light up if a K8 and computer are connected. The output voltage should be 19.5 to 21 volts without a K8 connected and between 18 to 20 volts with a K8. The Yellow LED indicates the K8 is drawing current (normal current drain is 5.5 to 6.5 mA). This will light up during communication. If a K8 is drawing large amounts of current, the LED may not light up during communication attempts. The Red LED will remain on, while the green and yellow LEDs will turn on and off as the computer cycles the power to the K8 during programming and dumping of data.

INSTALLATION GUIDE

EXTERNAL POWER SUPPLY FOR MONITOR PROBE INTERFACE (MPI)

This note refers to the "PC" version of the Monitor Probe Interface (MPI-2A or MPI-3) which has 7-pin circular and 25-pin D-type connectors on the computer end of the interface.

The DB25 connector on the MPI box is used to connect the MPI to the serial port of the Compaq or similar personal computer. Power for the MPI is provided via the 7-pin connector using an external power module or small DC power supply.

There are several ways to provide a DC power source for the MPI:

1) AC to DC adapter (battery eliminator) module (e.g. Radio)
2) Automotive cigarette lighter adapter cable
3) Battery Pack--rechargeable or other.

All of these methods require fabrication of a cable from the power source to the MPI's 7-pin connector. The various methods are described in more detail below.
Electrical Connections:

The external electrical connections are as follows (for the computer/power end of the MPI box):

| Pin Function | Connector & Pinout DB25S | RM | Notes |
|---|---|---|---|
| Ground | 7 | 3 | |
| +12 volts | --- | 7 | Nominal (see below) |
| Serial In | 2 | 2 | From PC |
| Serial Out | 3 | 6 | To PC |
| Power Down | 20 | 4 | EMP is Reset by P.D. |
| Channel A/B | --- | 5 | Open = Ch. B & K8 ***** |
| Pulse Signal | --- | 1 | Open (not used) |

***** MPI-2A Model Only

The DB25S is the 25 contact rectangular connector. The RM is the 7-pin circular connector. Pin numbers are marked on the connectors (molded into the plastic insulators).

The +12 volt supply must be within 10.8 to 13.2 volts for proper operation of older MPI-2A units (circuit board installed component side down). On some MPI's (with the circuit board installed component side up), a different DC/DC converter module is used and the allowed input range is 10.2 to 13.8 volts. The peak MPI input current while communicating with an attached K8 is typically 150 to 200 mA. The idle MPI current is 80 to 90 mA.

The 12 volt input is protected by a 0.75 A fast-blow fuse mounted on the MPI printed circuit board. The fuse is mainly intended to protect the power source from failure of the DC/DC converter (it shorts out, blowing the fuse). The fuse may not protect the DC/DC converter from reversal of the input polarity. Newer MPI-3 units have a voltage regulator built in to protect the DC/DC converters input against over-ranging.

Power Sources

1) AC to DC adapter (battery eliminator) module

(eg. Radio Shack/Archer #273-1652A). The module must be able to supply 12vDC at 250mA. These devices usually plug directly into the AC line outlet with a 2-prong plug and have a two-wire cord with a coaxial DC power plug. This plug is cut off and replaced with a 7-pin circular plug (Hirose RM12BPG-7S) supplied by Kuster.

Select the power module carefully. They are not usually rated for outdoor use. Be sure that the output is filtered DC, not rectified but unfiltered AC as found on some battery charger modules.

2) Automotive cigarette lighter adapter cable

These can be found at automotive supply stores or at video equipment stores (e.g. Quasar Car Battery Cord Model VE265). Choose an adapter with large, well-sprung negative contacts. This will insure that a secure connection is made to the vehicle cigarette lighter socket and reduce the chances that it pulls out during use. The adapters usually have a two-wire cord with a coaxial DC power plug. This plug is cut off and replaced with a 7-pin circular plug (Hirose RM12BPG-7S) supplied by Kuster.

WARNING: Electrical transients created when the engine is started could damage the MPI. Do not start or stop the engine while the MPI is connected.

3) Battery Pack

The MPI can be operated from any battery pack which can deliver the required voltage and current. A rechargeable video camera pack could be used. The Sidekick Rechargeable battery pack made by Gates Energy Products of Denver, CO, is a sealed lead-acid pack with a cigarette-lighter output socket and a re-charger module. The unit is rated 12 volts at 5 AHr, and should operate the MPI for several hours on a charge.

WIRING DIAGRAM FOR MONITOR PROBE INTERFACE EMP - 410 MODELS

INTERNAL WIRING COLOR CODE
FOR 2 - PIN CONNECTORS

| | PIN 1 | PIN 2 |
|---|---|---|
| TEST - | BROWN | GREEN |
| EMP - | RED | GREEN |
| SSMP- | ORANGE | GREEN |

**INTERNAL PIN DESIGNATION**

| | COMPUTER | MPI CONNECTORS | | |
|---|---|---|---|---|
| FUNCTION | DB25s | RS232 | 7 PIN HIROSE | COLOR CODE MPI |
| SERIAL-IN | 2 | 2 | 2 | Blue |
| SERIAL OUT (TO PC) | 3 | 3 | 6 | Orange |
| GND | 7 | 7 | 3 | Black |
| POWER DOWN | 20 | 20 | 4 | Yellow |
| 12 VOLTS | - | - | 7 | Red |
| | | | 5 | Green |
| | | | 1 | Brown |

**WARNING:** MPI IS NOT PROTECTED AGAINST REVERSE POLARITY

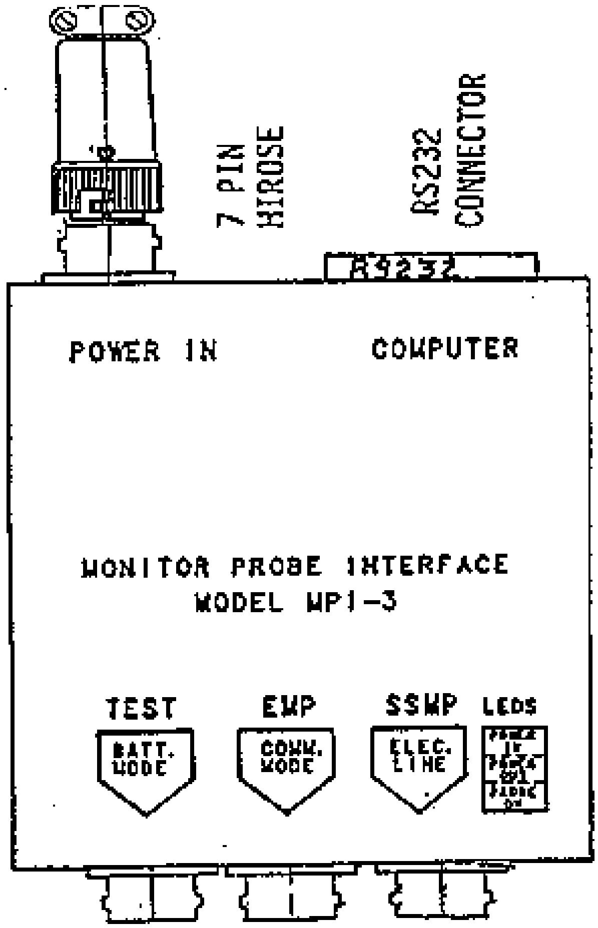
NOTE: WHEN USING THE LARGER POWER GENERAL 429 SERIES CONVERTORS THE MPI BOARD MUST BE INSTALLED WITH THE DC/DC CONVERTOR AGAINST BOTTOM OF BOX. (COMPONENT SIDE UP) THIS IS TO ALLOW THE CASE TO ACT AS A HEAT SINK.

THREE OPERATING CHANNELS

CH: EMP - EMP Communication Channel.

CH: SSMP Receive only channel used for Surface readout (SRO).

CH: Test Supplies 12 volts for running EMP bench tests.




## SURFACE READOUT OPERATION FOR K8 WINDOWS SOFTWARE

<u>For Quartz Gauge (bench test):</u>

Equipment list: Quartz gauge
Electronic interface cable (for quartz gauge – 3 conductor)
MPI box
12vdc. Power Supply
RS232 25pin to 9 pin serial cable.
Electronic interface cable (for strain gauge– or a 2 conductor substitute)

1). Connect the RS232 male 25 pin to 9 pin female serial cable to the serial port on the computer. Connect the electronic interface cable to the RS232 cable. Clamp the ground clip onto the gauge housing and press the black conductor onto the gold plated pin in the end of the gauge.

2). Connect the 12V. power supply female output to the male connector on the electronic interface cable. The green LED should light up.

3). In the K8 windows software click on **EMP.** A drop down window will open. Move the pointer to **Program**. Move the pointer to **SRO. C**lick on **SRO**. The side bar will display gauge information. A window will open asking if you want to program the probe for SRO operation. Click on yes. A window will open requesting sampling rate. 1 second readings give a lower resolution because the transducer doesn't have enough time to warm up and stabilize Max resolution samples every 3 seconds. Click the rate you want. A final window will open telling you the probe is in SRO mode. Click OK

4). Disconnect the electronic interface cable from the computer and the probe.

5). Connect the male 25 pin serial cable to the MPI box. (The MPI box is now connected to the computer's serial port). Connect the 12vdc. power supply to the MPI box. The LED,s will light.

6). Connect the gauge to the **SSMP** location on the MPI box. A two conductor cable is necessary for this. The strain gauge electronic interface cable works best for this purpose. If you don't have the strain gauge cable you can make a cable. Facing the front of the MPI box the +24V is the pin out on the left of the SSMP connector. The ground is on the right. Make sure positive voltage is applied to the gold plated pin in the end of the gauge and ground is on the housing, as damage could occur if + and – are switched.

7). Once the gauge is connected to the MPI box the **MPSReport** (Validata in earlier versions) window comes up. A **Save Processed File** window also opens. You are asked for a file name to store data. A default file name will occur within 30 seconds. This window will close, once the file has been named, leaving the MPSReport window in place. Sampled data will be displayed on the three report screens. Minimize the MPSWin screen. <u>Do not close it!</u>

**<u>For Quartz Gauge (actual survey):</u>**

Equipment list: Quartz gauge
Cablehead adapter

Electronic interface cable (for quartz gauge – 3 conductor)
MPI box
12vdc. Power Supply
RS232 25 pin male to 9 pin female serial cable.
MPI/Wireline Interface cable- 2 conductor cable for MPI to conductor wireline outputs in the truck. Usually male banana plugs terminating in the two conductor Hi-Rose connector.)

1). Connect the RS232 male 25 pin to 9 pin female serial cable to the serial port on the computer. Connect the electronic interface cable to the RS232 cable. Clamp the ground clip onto the gauge housing and press the black conductor onto the gold plated pin in the end of the gauge.

2). Connect the 12V. power supply female output to the male connector on the electronic interface cable. The green LED should light up.

3). In the K8 windows software click on **EMP.** A drop down window will open. Move the pointer to **Program**. Move the pointer to **SRO. C**lick on **SRO**. The side bar will display gauge information. A window will open asking if you want to program the probe for SRO operation. Click on yes. A window will open requesting sampling rate. 1 second readings give a lower resolution because the transducer doesn't have enough time to warm up and stabilize  Max resolution samples every 3 seconds.  Click the rate you want. A final window will open telling you the probe is in SRO mode. Click OK

4). Disconnect the electronic interface cable from the computer and the probe.

5). Connect the male 25 pin serial cable to the MPI box. (The MPI box is now connected to the computer's serial port). Connect the 12vdc. power supply to the MPI box. The LED,s will light.

2). Attach the cablehead adapter to the wireline cablehead.

3). Attach the gauge to the cablehead adapter.

4). Connect the wireline outputs in the truck to the **SSMP** location on the MPI box using the MPI/Wireline Interface cable.

7). Once the gauge is connected to the MPI box the **MPSReport** (Validata in earlier versions) window comes up. A **Save Processed File** window also opens. You are asked for a file name to store data. A default file name will occur within 30 seconds. This window will close, once the file has been named, leaving the MPSReport window in place. Sampled data will be displayed on the three report screens. Minimize the MPSWin screen. <u>Do not close it!</u>

.

Note: It is a good idea to disable any screen saver and power saving applications. These could shut down SRO operation when they go into effect.

**<u>For Strain Gauge (bench test):</u>**

Equipment list: Strain Gauge
MPI box
12vdc. Power Supply

RS232 25 pin male to 9 pin female serial cable.
Electronic interface cable (2 conductor for strain gauge)

1). Connect. The RS232 male 25 pin to 9 pin female serial cable to the computer and to the MPI box.

2). Connect the Electronic interface cable to the EMP (comm mode) on the MPI box. Clamp the ground clip onto the gauge housing and press the black conductor onto the gold plated pin in the end of the gauge.

3). Connect the 12V. power supply female output to the male connector on the electronic interface cable. The LED,s should light up.

4). In the K8 windows software click on **EMP.** A drop down window will open. Move the pointer to **Program**. Move the pointer to **SRO. C**lick on **SRO**. The side bar will display gauge information. A window will open asking if you want to program the probe for SRO operation. Click on yes. A window will open requesting sampling rate. 1 second readings give a lower resolution because the transducer doesn't have enough time to warm up and stabilize  Max resolution samples every 3 seconds.  Click the rate you want. A final window will open telling you the probe is in SRO mode. Click OK

5). Move the interface cable connection to the **SSMP** location on the MPI box.

6). Once the gauge is connected to the MPI box the **MPSReport** (Validata in earlier versions) window comes up. A **Save Processed File** window also opens. You are asked for a file name to store data. A default file name will occur within 30 seconds. This window will close, once the file has been named, leaving the MPSReport window in place. Sampled data will be displayed on the three report screens. Minimize the **MPSWin** screen. <u>Do not close it!</u>

**<u>For Strain Gauge (actual survey):</u>**

Equipment list: Strain gauge
Cablehead adapter
MPI box
12vdc. Power Supply
RS232 25 pin male to 9 pin female serial cable.
MPI/Wireline Interface cable- 2 conductor cable for MPI to conductor wireline outputs in the truck. Usually male banana plugs terminating in the two conductor Hi-Rose connector.

1). Connect. The RS232 male 25 pin to 9 pin female serial cable to the computer and to the MPI box.

2). Connect the Electronic interface cable to the EMP (comm mode) on the MPI box. Clamp the ground clip onto the gauge housing and press the black conductor onto the gold plated pin in the end of the gauge.

3). Connect the 12V. power supply female output to the male connector on the electronic interface cable. The LED,s should light up.

4). In the K8 windows software click on **EMP.** A drop down window will open. Move the pointer to **Program**. Move the pointer to **SRO. C**lick on **SRO**. The side bar will display gauge information. A window will open asking if you want to program the probe for SRO operation. Click on yes. A window will open requesting sampling rate. 1 second readings give a lower resolution because the transducer doesn't have enough time to warm up and stabilize  Max resolution samples every 3 seconds.  Click the rate you want. A final window will open telling you the probe is in SRO mode. Click OK

5). Attach the cablehead adapter to the wireline cablehead.

6). Attach the gauge to the cablehead adapter.

7). Connect the wireline outputs in the truck to the **SSMP** location on the MPI box using the MPI/Wireline Interface cable.

8). Once the gauge is connected to the MPI box the **MPSReport** (Validata in earlier versions) window comes up. A **Save Processed File** window also opens. You are asked for a file name to store data. A default file name will occur within 30 seconds. This window will close, once the file has been named, leaving the MPSReport window in place. Sampled data will be displayed on the three report screens. Minimize the **MPSWin** screen. <u>Do not close it!</u>

Note: It is a good idea to disable any screen saver and power saving applications. These could shut down SRO operation when they go into effect.

## TROUBLESHOOTING

Suggested equipment:

1) Variable DC Power Supply, 0 to 30V, 100mA output;
2) Digital Volt Meter;
3) Oscilloscope;

4) 800°F Soldering Iron.

This guide covers the basic steps to follow to help determine the cause of failure and is not designed for major in depth repairs. It applies only to the strain-gauge version of the K8.

If you have any questions about the use of different cleaners, solder, or other pieces of equipment with our gauges please call the Kuster repair department to find out whether or not they are usable.

**A) EMP does not communicate**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) Ensure that the connections to the MPI and the computer are correct. If you are connected to the wrong port or are using a damaged or improper cable communication cannot be established. Use a ‘Modem’ cables not a 'Null Modem' or 'Plotter Cable'.

2) Using a terminal or terminal program such as Procomm, the program should be set up with the following parameters (I) 9600 baud, n, 8, 1. When the gauge is connected an 'A>' should appear on the screen. The power to the gauge might have to be cycled to get the `A>` to appear on the screen of the terminal.

***(I) Older gauges (Ver. 3.906) run at 2400 baud.**

3) If there is no 'A>' check the output of the MPI. The voltage at that point should be at least 20vdc. If the voltage is low or not at the proper level check the input 12 V power supply module. Refer to Section I for more information on MPI problems.

4) Check the current the gauge is drawing through the MPI. It should be 5 to 8mA. If it is higher, go to Section B. In either case remove the gauge from the housing. Refer to 'K8 Service procedure' for instructions on removing the housing. If you are not familiar with the procedure the K8 can be seriously damaged.

5) Once the gauge has been removed from the housing check to see if the main power lines are still connected between digital board and the I/O connector. Check for any possible shorts from loose or broken screw heads or other materials.

6) Check the prom to ensure that it is still inserted in the socket properly. Also check that the socket and prom leads are clean.

7) On Rev. C and D digital boards (II) there is a wire that runs between pin 7 of the CPU and pin 11 of the operating prom. If it is broken the gauge will not communicate. The wire should be on the component side of the board but some units may have it located on the solder side.

***(II) Revision Number is marked on the board by the crystal.**

8) Sometimes a digital board will latch up for no particular reason. To reset the gauge you have to manually short out the reset capacitor (C4) while the gauge is under power. Hold for a second and then release. Use a set of leads or a pair of needle nose pliers.

9) If the current is less than 3mA, the crystal oscillator may not be running. Refer to Section C.

10) Remove the operating prom (I) from the K8 and install a Toggle 'Q' prom onto the board. This prom will produce a square wave on the output of pin 4 of the CPU. This signal should also be seen on top of the plus 12 volts being supplied to the gauge (II). If not the communication FET (Q3) is probably faulty.

***(I) Make sure the power is removed. Use an IC pulling tool and anti-static ground strap when removing or installing the prom. Be careful not to bend the IC pins during installation.**

***(II) Gauges that have Q2 installed will not show the square wave on top of the 12vdc supply.**

11) If the square wave signal seems to be getting through reinstall the operating prom and try to re-establish communication. If the gauge sends out an 'A>' the IRFD 120 FET (Q3) on the digital board should be replaced.

12) If the 'A>' appears then type in a ':21'. The gauge should come back with a '>'. At the '>' type in 'D2000,200F'. The gauge should then dump out a string of data that looks something like this:

2000 60 03 01 AE 02 F4 27 DF 00 00 00 A9 0F 44 23 8D

*** NOTE: These values are not the same for all gauges. The correct values should have been sent with the EMP. Refer to the Set ID write up.**

13) If these values do not look similar try to run the Set ID program to reset the ID of the recorder. You should type in the values instead of having the Set ID program read it from the gauge.

**B) High current drain**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) There are three typical current levels in a properly operating K8:Low-3 to 4mA,Med-9 to 10mA, High - 12 to 14mA. * These levels are measured in the battery mode (12 V applied to the K8).
2) If your gauge is drawing high currents while in the housing it is possible that the boards might be shorting against the housing. Remove the gauge from the housing. Refer to the K8 Service Procedure for housing removal. Take your current measurements again. Examine the board for loose or broken screw heads or other materials. If the current levels are good check that there are no pinched or twisted wires on the gauge, or IC's that have rubbed through the tape that covers the boards.

*** NOTE: Ensure proper anti-static handling procedures are followed once the gauge is removed from the housing.**

3) It is recommended that at this time the power supply levels be checked. There are two different supply levels. The first is the 5V supply on the digital board, which also provides power to part of the analog board, and the second is the 8V supply on the analog board. The 5V supply is on as long as the gauge is powered by a supply. The 8V supply only turns on when the gauge is in battery mode and is trying to take a reading. Typical power supply levels should be 4.9 to 5.1 volts and 7.9 to 8.2 volts. If these levels are low there is a chance that there is a short or power supply problem on one of the boards.

4) The next step is to determine which board is the cause of the high current drain. You must remove the 4 screws that hold the boards onto the rail. At this point you can disconnect the analog board from the digital board.

5) If you run the digital board without the analog attached there will be only 2 current levels. Typical values are Low 3.5mA and High 5.0mA (these are battery mode values).

If the values are good proceed to step 10.

6) If the levels are higher than the above values the first test is to replace the operating prom (I) with a prom (same revision) that you know is in working condition and re-measure the currents.

> ***(I) Make sure the power is removed. Use an IC pulling tool and anti-static ground strap when removing or installing the prom. Be careful not to bend the IC pins during installation.**

7) There are 3 wires that run the length of the digital board. The main power to the analog (red), the 5V line to the analog board (black), and the ground line (green) are the three wires. If one of these wires shorts out then current levels could be extreme. Examine these wires carefully the length of the board. These wires run between IC pins it is possible for them to get cut. To eliminate these unsolder the (II) red, black, and the green wires at the power supply end of the digital board. It might be necessary for the wires to be removed from the entire length of the board and replaced with new wire.

> ***(II) Due to manufacturing requirements, color codes for wiring may not conform to this description on some instruments**

8) If the current levels now match those listed in step 5 reconnect the digital to the analog board. If the levels are still to high we recommend that you contact the Kuster repair department outlining what steps you have taken.

| If the gauge is taking normal readings ignore steps 9 to 11. |
|---|

9) If the analog board is drawing too much current you can disconnect the red wire of the transducer from the analog board. After this you can measure the current again. If the transducer was damaged an internal short could cause the high currents. There are some transducers that have a low resistance and will draw more current. The typical analog currents are 4.5 to 5.5mA, these levels would be added to the digital levels in step 5.

10) On some of the older analog boards there are small retrofit (SGA) boards installed. It is possible for a short to occur between the retrofit and main analog boards. There is a small piece of Teflon sheet between the two boards. If the two boards are pushed together the Teflon sheet could easily be punctured by a lead or a solder joint on the SGA board and short out against the analog board.

11) Before removing the retrofit board try to find the short by using a DMM. It is recommended that you contact the Kuster repair department before removing the SGA Retrofit Board.

12) If the gauge runs normally but does not power down to minimum current levels the power down on the analog board is not working properly (I). If the working registers were not set up correctly (II) or the analog board has a faulty power down FET the current levels would be high during the low current mode.

***(I) The gauge has to have a setup of at least 20 seconds for CEC transducers, and over 5 minutes for Paine transducers.**

***(II) Refer to Set ID documentation.**

*** NOTE: For ease in trouble shooting we recommend changing the warm-up parameter in the working registers for the gauges with Paine transducers. Remember to reset the parameters to the factory settings as these are required to compensate for the different transducer warm-up times.**

If the current levels are still high we recommend that you contact the Kuster repair department outlining the steps that you have taken. This will help determine the next course of action.

**C) Low current drain**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) If your gauge draws low currents (under 3mA) there are some points to check. The 5Vdc power supply on the digital board is the most obvious. If there is no voltage on the supply the problem is likely to be in the 5 Volt supply section. Check the transistor (Q1), the constant current diode (D4), the small signal diode (D5), and the zener diode (D6) for physical damage. These are the most obvious problem components. If there is no visual physical damage we recommend you contact the Kuster repair department for more detailed instructions on component testing.

2) If you have the 5 Volts check the oscillator circuit. To test the circuit an oscilloscope is needed. Test for a 5Vdc peak to peak sine wave on pin 1 of the CPU. If the crystal oscillator is not running it is possible that the trip points are

not operating properly. Check the battery trip point to ensure that it trips on at approximately 7.5 volts. The trip point should turn off at approximately 4.5 volts.

3) If the trip points are working then it is possible that the crystal is faulty. Check the crystal can for any dents. The crystal could be damaged or shorted internally. Unsolder the binding wire and lift the wire away from the crystal. If the sine wave appears after the wire has been removed the crystal needs to be replaced.

4) The reset line on the digital board might be resetting the gauge permanently. If the reset capacitor (C4) is shorted the gauge will not come out of the reset mode. The gauge might also have to be manually reset.

| If the gauge is taking normal readings ignore steps 5 to 9. |
|---|

5) If the gauge is drawing normal low current but the Med. and the High current are still low it is possible that the analog assembly is not turning on (I). Check the power supply voltage on the analog board to ensure that it is 8V across the transducer red and green wires.

***(I) The gauge should have a 4 second download in it or be set into 'DEBUG' mode to ensure that the analog board is on all the time.**

6) If the analog FET (Q1) is faulty the 8V supply on the analog may not turn on.

7) The power to the analog is supplied from the digital board by the 3 wires that run the length of the digital assembly. If one or more of these were broken the peak currents would be low.

8) If the transistor (Q2), small signal diode (D1), constant current diode (D2), or the zener diode (D3) of the analog power supply are faulty, low currents would be the result.

9) If the transducer opened between the red and the green wires the result would be low currents during the Med. and the High current mode.

If the problem still exists contact the Kuster repair department for more instructions.

**D) No Real Pressure or Temperature Readings**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When**

**you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) The pressure and temperature signals originate on the analog board. If the board or the transducer was damaged in any way the gauge will not store correct pressure and temperature readings.

2) When the analog board quits sending data to the digital board the digital will store one or more of the following four values. FDE8, and 2710 (full scale markers) or FEF9, and FEFA (over range markers) will be stored depending on the failure mode of the analog board.

3) If the gauge was taken apart in the wrong order the transducer wires will be twisted, and transducer or analog board damage could result. The wires must be unsoldered from the analog board and carefully untwisted (I). Check all of the wires for broken insulation before reattaching to the analog board. It is very important that any soldering done to the transducer section of the analog board is properly cleaned as contamination in this area will effect the gauge calibration.

   ***(I) REMOVE TRANSDUCER AT A STATIC FREE STATION!**
   **Solder the green and orange wire together as soon as they are unsoldered from the board. This protects the transducer from static damage.**

4) On the older version analog boards the retrofit board can short against the analog board. This can cause the pressure and or the temperature signals to be lost. Refer to section B 11.

5) The wires that run on the digital board can be broken and cause one or more of the signals to be lost. The pressure (orange wire) and the temperature (yellow wire) run from the analog to digital connector to the CPU pins 24 and 23 respectively.

6) A quick way to tell if the transducer is damaged is to measure the voltage across the outputs of the transducer to ground (I). It is recommended that the gauge be connected to a terminal and be in the DEBUG mode so that the analog power stays on and there are no measurement disturbances. Measure from the blue wire to ground and then the yellow wire to ground. The voltage levels should be approximately 4.6 volts and within 0.2 volts of each other.

   ***(I) A high impedance digital voltmeter is required to make accurate measurements.**

7) If a gauge has a very large shift it may not take pressure readings. Refer to section G.

8) If a bench check has a very high pressure and temperature or if a test looks like it is inverted there is a chance that the wrong operating prom is in the digital board. **Rev. M analog boards are 'Not Q' analogs (S/N 640 and up).** These analog boards require a **Ver 3.908 Rev 6 'QQ'** operating prom. Older analogs require **Ver 3.908 Rev 6 'Q'** proms. If the incorrect prom was used the test will look like it is upside down. To correct this problem the prom should be changed to match the analog board. The data can be reprocessed using Ver. 4.40 or newer 'Process' programs with the InvCnt option activated.

**E) Spikes in Data**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

A spike is defined as an abnormally large or small pressure or temperature reading that is not part of the actual test.

1) There are two possible areas that a spiked reading can originate from. The digital board can cause a spiked reading if the memory is starting to fail. The analog board can be a cause if the transducer or one of the other components is unstable.

2) The way you can tell is to find out which reading number the spike is by using the 'Comment' program. Move the cursor to the spiked reading, then use the [shift] F5 function to find the reading number. Use the 'Dataview' program to go to the reading number of the spike. If the spike is caused by one of the following; FDE8, 2710, FEFA, FEF9, then the problem is probably analog related. If the spiked data has an (FF) in it when the readings before or after don't then it is possibly digital related. Memory errors will usually be seen in more than one location or in a block, but not always.

For Example: Data from a gauge running at a ratio of 1 to 1.

| 56D3 | 1100 | FFD4 | 1100 | 56D5 | 1100 | 985F | 1100 | 56D7 |
|---|---|---|---|---|---|---|---|---|
| P | T | P | T | P | T | P | T | P |

In this example there are two possible spikes. The first is FFD4, this would be a possible memory spike. The second is 985F, this could be a possible analog problem.

3) The spiked data could be the result of a faulty memory IC especially if the test that was run was at high temperature (>140 C). The best way to test this is to remove

the digital board from the gauge and run the digital board at the maximum rated operating temperature in a clean oven. A room memory test may show the problem if an oven is not available, but a test at temperature is recommended. Once the board has reached oven temperature run a memory test on it (I). To run this test a terminal or terminal program setup with 9600, n, 8, 1 is needed. When the gauge is plugged into the MPI it will send an 'A>' to the terminal. Type a ':21' and a '>' should be returned by the gauge. At this time a memory test can be started. There are different codes for different memory sizes. 16K = M160 / 32K = M320 / 48K = M480. The memory test will then run itself.

***(I)**

KEEP A COPY OF THE GAUGE ID.
A MEMORY TEST WILL ERASE THE ENTIRE MEMORY INCLUDING THE ID. IF ANY DATA IS NEEDED ENSURE THAT IT IS TAKEN FROM THE EMP.
A FORCE DUMP MIGHT BE REQUIRED.

A memory test should look like this:

M 320
TESTING IC 12B
TEST (A) BANK 1  BANK 2  :2034 :2035  BANK 3  BANK 4
TEST SHIFT BANK 1  BANK 2 :2034 :2035  BANK 3  BANK 4
TEST (B) BANK 1 ...

If there is an error in the memory it will be displayed as a number. Above there is an error in BANK 2 in location 2034 and 2035. There are boards that will send erroneous characters during the memory test. These characters that appear on the screen are due to current spikes created by the digital board as it writes into the memory. These are not memory errors!

4) If the spike seems to be analog related the first step is to find out if it is temperature or pressure related. A temperature spike will cause the pressure to have a spike in it as well. To tell if it is temperature related compare the temperature readings before, during, and after the spike. If they are all the same temperature or are similar then it is not a temperature spike.

5) The first test to run would be a thermal shock test. To run this test you have to put the gauge into an oven that has already settled in at the well temperature or at a temperature near to the maximum operating temperature of the gauge, e.g. 145 C for a 150 C rated gauge. Run the gauge at room temperature for a few minutes before setting the gauge into the hot oven. Leave the gauge in the oven for two to three hours so that it can stabilize. At this point you can remove the gauge. Let

the gauge take readings for a couple of hours so that it will stabilize at room temp. Dump the gauge and examine the data for any bad readings.

*** NOTE: Do not drop or tap the gauge on a concrete floor because of permanent damage to the fittings and transducer.**

6) If the spike is pressure or temperature related check the respective circuits very closely for any solder contamination or cold solder joints.

7) If step #5 fails to produce any spikes try to run a vibration test on the gauge. If a vibration table is not available run the gauge with the battery connected to it. Gently roll the gauge on the floor or hold gauge upright and gently tap the battery end of the gauge on a wooden block to cause some vibration to the gauge. Excessive force could damage the transducer so do not allow the gauge to drop more than 1 inch onto the wooden block.

8) Dump the gauge to check for any spikes in the data. If a spike occurs beside a battery break it is possible that the reading was only half recorded into the memory before the battery break occurred. If the spike occurs due to a bad pressure reading check the pressure circuit for any intermittent components including the transducer.

At this stage it is recommended you contact the Kuster repair department for more instructions.

**F) Scrambled Data**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) There is the odd time that the gauge data will be scrambled. A test that is scrambled could be identified by a pressure profile that matches the temperature profile or by numerous vertical lines when viewing the data in the comment or plot programs. If a gauge is taking readings in a certain format and a battery break occurs that is not registered the pressure and temperature readings will be processed incorrectly. The gauge will always store a pressure followed by a temperature at the start of a test, after a battery break marker (0000), or after an interval marker (FEFE).

Standard running of a gauge at 3 to 1.

*P* **T** *P P P* **T** *P P P* **T** *P P P* **T** *P*
*P P* **T** *P P P* **T** *P P P* **T** *P P P* **T**
*P P P* **T** *P P P* **T** *P P P* **T** *P P P*

**T** *P P* 0 *P* **T** *P P P* **T** *P P P* **T** *P*
*P P* **T** *P P P* **T** *P P P* **T** *P P P* **T**

*P* = Pressure Reading
T = Temperature Reading
0 = Battery Break Marker

In the above format the pressure and the temperature readings are processed in the correct order.

Data with missed battery break.

*P* **T** *P P P* **T** *P P P* **T** *P P P* **T** *P*
*P P* **T** *P P P* **T** *P* T *P* ***P*** *P* T *P* ***P***
*P* T *P* ***P*** *P* T *P* ***P*** *P* T *P* ***P*** *P* T P

In the above example the battery break marker was missed. This causes the pressure reading to be processed as a temperature reading, and the temperature as a pressure. To fix this problem one of the readings has to be changed to a battery break marker. In this case the second temperature in the second line would be changed to a battery break (0000). This would cause the remainder of the readings to fall into place for processing although it will disturb the timing of subsequent readings. The amount of time lost will depend on the interval rate at that point in the test.

2) Data that is scrambled because of a missed battery break would fall into correct order at the next interval change in custom mode, or at the next battery break that is recorded.

3) There is a possibility of a gauge recording a pressure reading of 0000. If this happens the processing program assumes that this is a battery break marker. If there are only a few of these readings replace the 0000 readings with 0001, and then reprocess. This will show data spikes in these locations but the K8 running time will be correct. Another method is to ensure the format is re-established following the 0000 readings by inserting battery break markers at strategic points in the data. The first readings following the 0000's should be pressure followed by a temperature followed by the correct amount of pressure readings relating to the ratio being run. If this situation happens there is something wrong with the analog board. It should be repaired before reusing the K8.

4) Other forms of scrambled data occur if the digital board does not record the data sequentially. This is usually caused by a memory IC failure. With this type of an error the data should be sent back to Kuster Company for possible unscrambling.

5) Dataview is the program that allows you to view and edit the data files. It will highlight the readings that will be processed as temperatures, mark the battery breaks, and show you the interval markers.

**G) Pressure Shifts**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) If the difference between the two gauges is very large check the Cal ID in each of the gauges. If the ID's are correct then make sure that the correct calibrations for the gauges are on your computer.

2) If the temperature circuit has shifted it will make the gauge look like it had a pressure shift.

3) Measure the temperature sensors resistance with a digital meter and compare it to the room temperature. It should be within 1°C of room temperature. The transducer should be allowed to sit at room temperature for an hour or so before the measurement is taken. This allows the temperature sensor to come up to room temperature.

4) The 104K capacitors that are across the pressure transducer output will cause the gauge to shift if they start to go resistive. To check these lift the capacitors and run the gauge to see if the pressure has changed.

5) After repeated or long term tests (60 days) in sour gas or high temperature applications the K8 can be expected to show a pressure shift. This shift will vary from gauge to gauge and with the duration and exposure to sour gas.

6) A comparison between a set of gauges on a test where one of them shifted will usually show a greater difference between the two gauges towards the end of the test. Usually only one of the gauges may shift but in some cases both K8's might. To help verify a shift a bench check must be run on the gauges. Sometimes it is possible for the shift to occur only at the well conditions so a dead weight test will be necessary. We recommend four temperatures starting and ending with a room temperature test to ensure the gauges don't shift during the dead weight test. The test should include the well temperature and pressure. There should also be at least 3 other pressures for each temperature of the dead weight test.

7) The shift will more than likely occur in the transducer unless it was a very high temperature in which case the calibration resistors may shift. To verify this the transducer must be measured. To measure the transducer four of the transducer

wires must be unsoldered from the analog boards. The RED, BLUE, YELLOW, and BLACK wires should be the only wires removed. Leaving the rest connected will reduce the possibility of the transducer being damaged from static electricity.

8) Measure the transducer parameter(s) (I):

| | |
|---|---|
| Bridge Resistance: | 1) Red - Green (Input resistance) |
| | 2) Blue - Yellow (Output Resistance) |
| | 3) Red - Blue |
| | 4) Red - Yellow |
| | 5) Green - Blue |
| | 6) Green - Yellow |
| RTD Resistance: | Black - White |
| Input Voltage: | Red(+) - Green(-) = 10 V |

*** NOTE: A stable 10 V supply is required to power the transducer while taking Output Voltage measurements.**

Output Voltage: Yellow(+) - Blue(-)

*** NOTE: A good DVM with a 200mV range is required to measure the output of the transducer.**

9) Send these measurements to Kuster Company for comparison with the transducers history records.

***(I)**

**ANTISTATIC STRAP MUST BE USED WHEN MEASURING TRANSDUCER PARAMETERS**

10) Gauges with a transducer isolation system (e.g. Bellows) will show a shift if the transducer isolation system has leaked. A bench check cannot be run with accuracy in an isolated system. A minimum of 50 PSI must be applied to ensure a gauge has not shifted.

**WARNING! Do not remove or loosen the seal between the transducer and the isolation system. If the seal is broken the transducer and isolation system will have to be evacuated and re--calibrated.**

11) An indication of a leaked isolation system would be a leveling off of a field test at high pressure before the maximum rating of the gauge is reached. This would indicate the transducer isolation has bottomed out and isn't allowing the well pressure through to the transducer.

**H) High Temperature Failures**

**ATTENTION! When working with the gauges out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) If a gauge quits during a high temperature test it could be for a number of reasons.

2) The battery that was used must be load checked. The voltage should be above 10 volts if it is still good. Also check the battery housing and the contact to ensure that they are in good shape. Check all parts for corrosion.

3) If the batteries are in good shape then you can run a temperature shock test on the gauges. At least one gauge that you know is in working condition should be run into the oven so that the results can be compared.

4) The gauges should be monitored through current meters to ensure that they are running while they are at temperature.

5) If a gauge quits taking readings at temperature note the current that is being drawn by the gauge. If the current is low the crystal, or the power supply might not be operating properly at temperature. Refer to section C.

6) If the gauge is drawing high currents it is possible that there is a short in one or more of the memory IC's (I). Refer to section B.

***(I) The battery will usually be dead if a gauge has a short at high temperatures.**

7) If the memory is suspected run a memory test. See section E.

8) The tests that are run should point to the problem in the gauge. If not call Kuster for more help.

**I) Monitor Probe Interface (MPI) Failures**

**ATTENTION! When working with the gauges or MPI out of their housings use anti-static handling procedures. Use a grounded anti-static mat with wrist**

**straps. When you pick up a gauge out of the housing always touch the bench first and then pick up the gauge by one of the metal ends.**

1) There are two different types of MPI. The first is the MPI2-A which is a box 4.5" x 7.5" x 2". The second is the MPI-3 which is a box 3.5" x 4.5" x 1". Both boxes work on the same principle.

2) If the gauges do not communicate with your gauges check the 12 volt power supply for your MPI. The power being supplied should be between 10.2 and 13.8 volts. If the power supply voltage is out of this range your MPI will be damaged and may not function properly.

3) The 12 volt input is protected by a 3/4 A fast-blow fuse. This fuse is mounted to protect the input power source from being damaged if there is a failure to the DC/DC converter.

4) When the MPI is connected to a computer that is trying to communicate through the MPI, the output voltage from the MPI, without a gauge connected, should be about 20 volts through the EMP connector and 23 volts through the SSMP connector. If these levels are low the gauges will not communicate properly.

5) The new model 'MPI-3' has three lights on the box. These lights indicate 'Power In', 'Power Out' and 'Probe On'. The colors are red, green and yellow respectively. If one or more of these lights are off, while the gauge is connected and the computer is trying to communicate to the gauge, there is a possible problem with the MPI.

| LIGHT | PROBLEM INDICATED IF LIGHT IS OUT. |
|---|---|
| RED | If the red light is not on, none of the other lights should come on if the red LED is burned out. Check the power supply for the correct voltage level. Also check the internal fuse of the MPI. |
| GREEN & YELLOW | If the green and yellow lights are out when trying to communicate to a |

| | |
|---|---|
| | connected gauge, make sure that the RS232 cable is connected to the proper port on the computer and to the MPI. Make sure that it is a proper 'Modem' cable and not a 'Null Modem' cable. |
| GREEN | If the green light is the only one that is out when trying to communicate with a connected gauge, check the MPI cable for a short. If the light comes on when the cable is disconnected, there is a short in either the gauge or the cable. |
| YELLOW | If the yellow light is not on when there is a gauge connected, then there is the possibility of there being an open in the cable of in the gauge. Check the output voltage of the MPI to ensure that there is a 20 volt output. |

5) The last step is to measure the current being drawn by the MPI. The current being drawn by the MPI-3 should be about 11 mA with the computer off. With the computer on and trying to communicate with no gauge connected, the MPI should draw 105 mA. When the gauge is connected the current draw should come up to 135 mA. These levels will change slightly with the different types of DC/DC converters and with the different models of MPI.

## Probe Serial Number Identification

The serial numbers and other markings on the probes indicate information relating to the type/model and available features. There are two sets of identification numbers stenciled or engraved on the probes:

1.) Stenciled or engraved on the transducer adapter

| |
|---|
| XXX-XXXX<br>XXK PSIA |

- XXX - indicates probe mechanical design type. eg. 710, 711, 621... etc.
- XXXX - Actual probes serial number used to trace manufacturing and repair records. Range depends on design type.
- XXK PSIA - Transducer pressure range.

2.) Stenciled on the I/O contact adapter.

| |
|---|
| Version XXXX<br>Memory XXK<br>AD |

- Version XXXX - Refers to operating UVEPROM version. It indicates what firmware features are available in the probe. eg. 3917. Values depend on design type.
- Memory XXK - Refers to memory capacity of the digital subassembly. $K=10^3$ $M=10^6$
  $K=10^3$ $M=10^6$
- AD - Each letter refers to a specific option available in the probe. (Refer to the chart listed below)

3.) The I/O Contact Adapter will also have the actual probes serial number and pressure range either stamped into the wrench flats or stenciled on the curved surface.

**Options:**

| | |
|---|---|
| No letter | K8S standard options. 125°C to 150°C with 4 second minimum reading interval, high resolution.<br>K8Q standard option 150°C with 2 second minimum reading interval. |
| A | 175°C digital subassembly. |
| B | 170°C digital subassembly SA0711 |
| C | K8S Digital Subassembly 73X type. Based on SA0711 assembly. |
| D | 1 second minimum reading interval at low resolution from 1 to 3 seconds and standard resolution from 4 seconds on. |

| | |
|---|---|
| E | K8S 1 second minimum reading interval at low resolution. |
| | K8Q 1 second minimum reading interval across the board at high resolution. |

**Note: Starting January, 1997 options "D" for the K8S and E for the K8Q will become standard on all new probes.**