

PT-II / V  
Addendum to Manuals  
900316 & 900323

Document: 900329  
Date: June 18<sup>th</sup>, 2002  
Revision: 1.0

# Contents

## **Introduction**

### **1.0 PT-II / V Mechanical Configuration**

- 1.1 Enclosure Dimensions
- 1.2 PT-II / V Internal Components
- 1.3 Battery Installation
- 1.4 Pressure Connection Port

### **2.0 IMU-II/s Input Wiring Configuration**

- 2.1 Overall Wiring Diagram
- 2.2 IMU-II/s Input Channel-1
- 2.3 IMU-II/s Input Channel-2

### **3.0 Linear Integrator Setup & Operation**

- 3.1 Linear Integrator Board Layout
- 3.2 Battery Power Options
- 3.3 Jumper Settings
- 3.4 Terminal Block Wire Connections
- 3.5 Calibration Settings

### **4.0 IMU-II/s EEPROM Memory Configuration**

- 4.1 Equipment Setup / Connections
- 4.2 Typical Programmer Screen Display
- 4.3 Field Options & Selections

### **5.0 Meter Multiplier Calculations**

- 5.1 Setting up an Account
- 5.2 DC-2000 Alarms
- 5.3 Meter Multiplier Calculations

### **6.0 Trouble-Shooting Hints**

- 6.1 Typical Field Problems

## **Appendix: Technical Specifications**

---

## Introduction

---

This document is intended to serve in a supporting role as a supplementary text to the Pressure Tracker-II owners manual 900316 (US) or 900323 (Australia / New Zealand). A Pressure Tracker-II is defined as an electronic measurement instrument that contains a pressure transducer, an ADM board to provide the analog to digital conversion process, and another electronics board (IMU-II/s) that provides a communications path with a Modem circuit and storage memory for recording ADM board measurements. The PT-II / V is a simple variation to the PT-II product where a larger enclosure is now utilized to provide space to accommodate a Linear Integrator circuit board. ADM board measurements are provided on the Input-1 channel of the IMU-II/s, while the Linear Integrator measurements are fed into Input-2. The product naming of PT-II / V implies that the device is a basic PT-II with the addition of voltage measurement capabilities.

It is recommended that the 900323 Pressure Tracker-II manual be reviewed first before attempting to read this supplementary document. Any questions that develop regarding pressure transducer measurements can be best answered by the 900323 document, while issues concerning the Linear Integrator are the primary focus of this text.

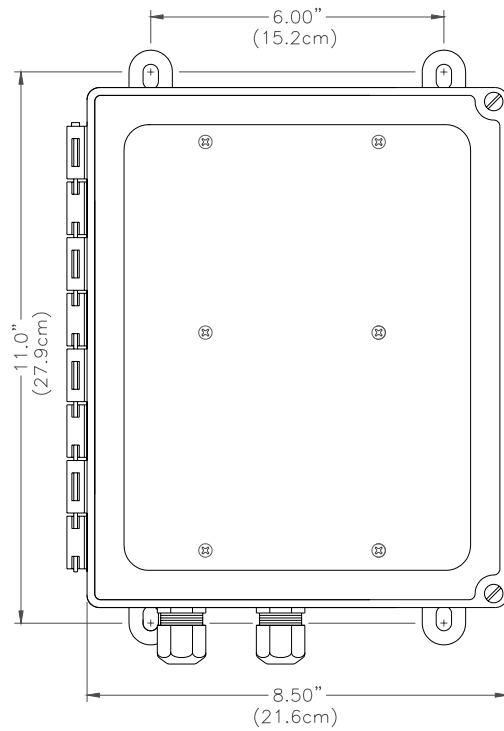
---

## 1. PT-II / V Mechanical Configuration

---

### 1.1 Enclosure Dimensions

Two views of the PT-II / V are shown in Figures 1.1 & 1.2 in order to provide dimensional mounting information, as well as reference views of the general unit appearance.



**Figure 1.1**  
View of PT-II / V with door closed.

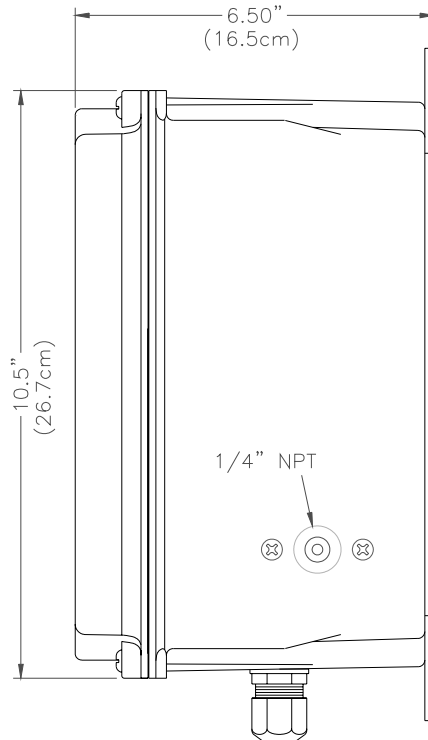


Figure 1.2  
Side view of PT-II / V.

## 1.2 PT-II / V Internal Components

Mechanical packaging of the PT-II / V was executed with the goal of creating a compact unit that would contain all the electrical and mechanical components within an integral package, while at the same time retaining easy user access to the circuit boards. Figure 1.3 illustrates the internal component placement, with two of the three circuit boards visible. The Analog Data Monitor (ADM) board resides underneath the IMU-II/s, and is therefore not visible in the illustration. Most of the necessary wiring connections have already been made at the factory, and there remains only a minimal number that the user must be concerned with.

Customer wiring connections include the following:

- a) Cathodic voltage wire connections to the Linear Integrator board.
- b) Attaching a telephone line connection to the IMU-II/s board.
- c) Alkaline battery installation, and the lithium battery connection.

It was the design intent that the left-most wiring gland would be used for routing of the cathodic voltage cable, while the right-hand gland would be used for the telephone cable. (reference Figure 1.3) Also visible in the illustration are the rectangular tamper detect sensor switch and magnetic actuator located on the top inside edges of the enclosure.

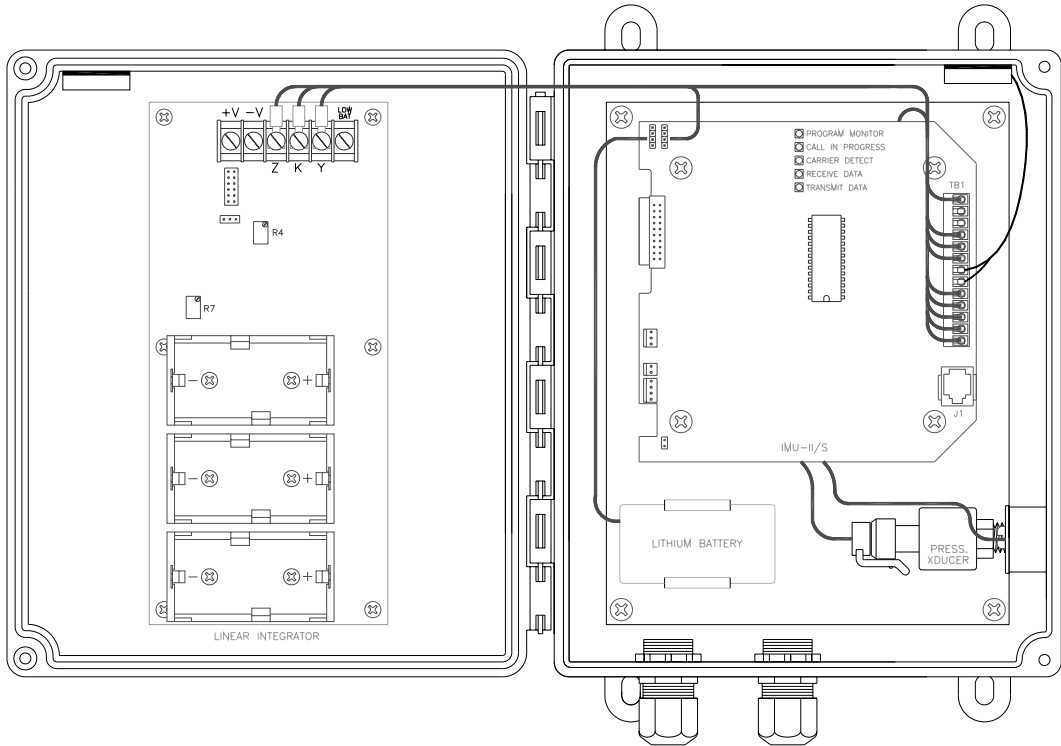


Figure 1.3  
PT-II / V Internal Components.

### 1.3 Battery Installation

Alkaline 'D' cell type batteries are required for the Linear Integrator (illustrated at the left-hand side of Figure 1.3). Installation simply requires that the three cells be inserted into the plastic battery holders while observing the correct polarity.

A single lithium 'D' cell battery back is necessary to provide the power to the IMU-II/s and ADM board set. This battery pack is retained by the plastic holder located just left of the pressure transducer. Replacement lithium battery cells are available from Metrotek under part number 1011-0022B-001. Because the length of the electrical cable from the battery is not long enough to reach the J3 connector on the IMU-II/s board, a short extension cable is provided to make this possible.

### 1.4 Pressure Connection Port

Figures 1.2 & 1.3 illustrate the location of the pressure transducer element. The aluminum coupler that is mounted on the side of the enclosure has an internal thread of 1/4 inch NPT. This ANSI Standard Taper Thread Type has a taper of 3/4 inches per foot and is cut with 18 threads per inch. Coupling adapters are available for conversion between the 1/4 inch NPT thread and other thread types, including Metric threads.

## NOTES

---

## 2. IMU-II/s Input Wiring Configuration

---

### 2.1 Overall Wiring Diagram

As already mentioned in Section 1.2, it is only necessary for the end-user to attach a telephone line cable and the cathodic input voltage connections to the PT-II / V in order to install the product at a field site location. It is sometimes helpful however to have a basic schematic diagram of the wiring connections within the device for use as a reference when trouble-shooting problems. Figure 2.1 illustrates all of the internal wiring connections within the PT-II / V product.

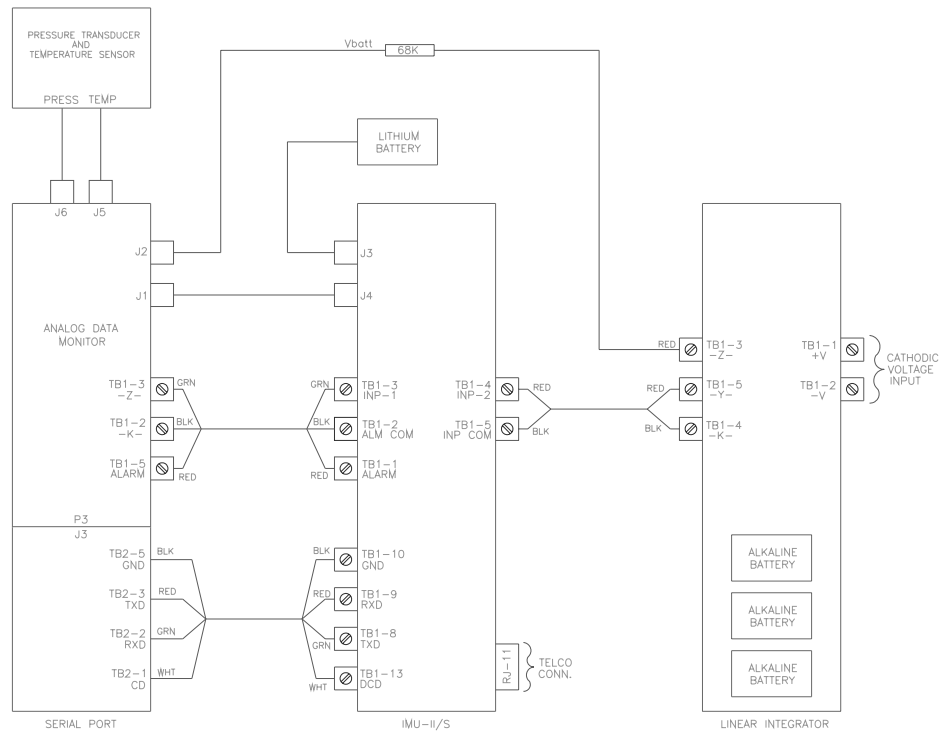


Figure 2.1  
PT-II / V Internal Wiring.

### 2.2 IMU-II/s Input Channel-1

Referring to Figure 2.1, it can be seen that the IMU-II/s in the center has the Input-1 terminal block connection (TB1-3) wired to the Analog Data Monitor board 'Z' pulse output at its terminal block connection TB1-3.

The Analog Data Monitor (ADM) board generates a pulse output rate that is proportional to the applied pressure on the pressure transducer element. Zero pressure will (of course) generate a zero pulse rate, while application of full scale pressure will generate 8 pulses per second. It then follows that if the applied pressure is 50% of full scale pressure, that the output pulse rate will be 4 pulses per second. Details for the calculation of the appropriate meter multiplier factor using DC-2000 are discussed in Chapter 5.

### **2.3 IMU-II/s Input Channel-2**

Referring again to Figure 2.1, it is found that the IMU-II/s in the center has the Input-2 terminal (TB1-4) wired to the 'Y' terminal (TB1-5) on the Linear Integrator.

The Linear Integrator board generates a pulse output rate that is proportional to the applied voltage on the terminal block. Zero applied voltage will generate a pulse rate of zero, while full scale voltage will generate 5 pulses per second. It then follows that if the applied voltage is at 50% of full scale, that the output pulse rate will be 2.5 pulses per second. As already mentioned, meter multiplier calculations for DC-2000 are discussed in Chapter 5.

---

## 3. Linear Integrator Setup & Operation

---

### 3.1 Linear Integrator Board Layout

Figure 3.1 below illustrates the physical layout of the Linear Integrator circuit board along with the components that are of interest to the user.

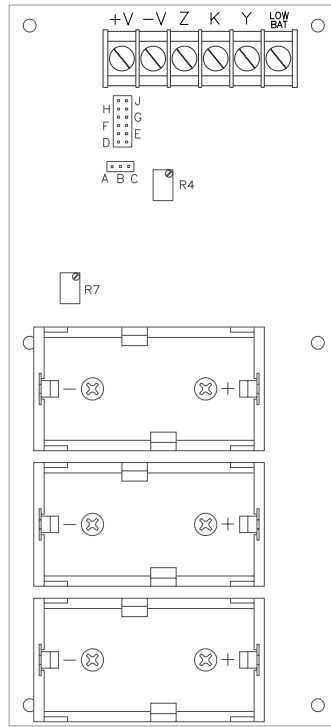


Figure 3.1  
Linear Integrator Circuit Board

The Metretek Linear Integrator is a highly accurate and reliable mechanism to convert a DC voltage input into an isolated KYZ type switch output whose frequency is directly proportional to the DC voltage applied. The maximum input voltage which can be applied is jumper selectable to a fixed level and is available at those measurement levels normally required for the monitoring of impressed current cathodic protection systems. The outputs derived from the voltage to frequency analog conversion circuitry represent a continuous time average of the applied input voltage rather than discrete time readings. This method is less subject to spurious noise readings since they are “averaged” out. Low power dissipation CMOS circuitry yields superior battery life performance. Because the pulse outputs are galvanically isolated via opto-isolators, the user need not be concerned about potential circuit conflicts created by ground loops or other extraneous paths.

### 3.2 Battery Power Options

Power is provided by three commonly available alkaline 'D' size battery cells that are inserted into the plastic battery holders residing on the circuit board. These cells are wired in series to provide a total of 4.5 volts to the electronics of the board. Typical battery life expectancy is just under two years of when operated within moderate temperature environments.

Lithium battery power is also available as an option, although this would need to be specified at the time of order. This option utilizes a single 'D' cell size type lithium battery that provides an output voltage of 3.6 volts. Typical battery life with a lithium pack is 1.5 years.

### 3.3 Jumper Settings

Two jumpers are available on the board for selection of the desired input voltage range as listed below in Table 3.1. A typical application, (as an example), may have a voltage in the region of 40 volts that needs to be monitored. The user would then select JP2 = 'G' and JP3 = 'B+C'. It is known that a full scale input of 50 volts will produce an output pulse rate of 5 hertz, therefore it can be calculated that the pulse rate with a 40 volt input will be  $40/50 \times 5.00$  Hertz = 4.00 Hertz.

Input Voltage	Jumper JP-2	Jumper JP-3
0 to 50mV	Position 'D'	Position 'A+B'
0 to 3 Volts	Position 'D'	Position 'B+C'
0 to 12 Volts	Position 'E'	Position 'B+C'
0 to 24 Volts	Position 'F'	Position 'B+C'
0 to 50 Volts	Position 'G'	Position 'B+C'
0 to 75 Volts	Position 'H'	Position 'B+C'
0 to 100 Volts	Position 'J'	Position 'B+C'

Table 3.1  
Jumper Options

### 3.4 Terminal Block Wire Connections

Connection of the user wiring to the Linear Integrator is a simple matter of making the attachment to the two screw connections on the terminal block. Referring to Figure 3.1, the positive voltage connection is made to the left-most terminal (+V), while the negative connection is made to the adjacent terminal labeled as (-V). Care should be exercised in that the jumper settings have already been selected prior to making the cathodic voltage wire connections.

Wiring of the KYZ pulse output circuit has already been made at the factory to the IMU-II/s. The wiring diagram of Figure 2.1 illustrates the electrical connections between the Linear Integrator and IMU-II/s. A connection to the low battery detection circuit is not made, and it is assumed that the user will replace the alkaline batteries as standard procedure at the same time that the lithium battery is replaced. It can be expected that the alkaline cells (of the Linear Integrator) will have a slightly greater life span than the lithium pack (of the IMU-II/s), therefore the policy of always replacing the alkaline cells at the same time as the lithium battery should prove to be valid. A low battery alarm warning from the IMU-II/s provides the indication that a battery replacement service call needs to be scheduled.

### **3.5 Calibration Settings**

Two potentiometers are used to provide the calibration settings for the Linear Integrator. Because this calibration has already been performed at the factory level, there should not be any reason for the user to be concerned with these adjustments. The following text is therefore provided as background reference information only.

Potentiometer R4 is used to provide adjustment for the maximum pulse rate (also known as span), which is to be 5.000 Hertz when the full scale voltage is applied. Potentiometer R7 provides compensation for the zero point, where it is adjusted to generate 0.000 Hertz when zero voltage is applied at the input. Because these two controls will interact with each other to some degree, it is always necessary to alternate back and forth during the calibration process until the error factor has been worked out. This may require as many as ten iterations to adjust out the error and verify final performance. A precision power supply is required, as well as a frequency counter with an adjustable gate delay time.

## NOTES

---

## 4. IMU-II/s EEPROM Memory Configuration

---

### 4.1 Equipment Setup / Connections

EEPROM memory configuration of the IMU-II/s is accomplished with a laptop computer, Metretek programmer software, and a special programmer cable attached to J8 of the IMU-II/s. Specific equipment requirements are as follows:

- a) IBM PC type personal computer with a 9-pin serial communications port available.
- b) MP programmer software version 2.04 or greater, Metretek P/N: SWD-001-V2.04.
- c) PC to Remote Interface cable, Metretek P/N: 2005-0019C-001.

Note: A single package containing the programmer software, cable, and manual are available under part number 2008-0013B-001.

Process Steps:

- a) Attach the 9 pin D-sub end of the PC to Remote Interface cable to an available serial communications (COM) port on the laptop computer.
- b) Attach the opposite end of the PC to Remote Interface cable to the 4-position connector (J8) at the bottom left-hand corner of the IMU-II/s board.
- c) Start the MP programmer software with the DOS level command "MP COMx IMU/S" where COMx is either COM1 or COM2.
- d) Select the desired action by pressing function key F2, F3 or F4 and updating the individual fields as necessary.

### 4.2 Typical Programmer Screen Display

Figure 4.1 provides an example of the IMU-II/s configuration screen with some typical default settings. Because the IMU-II/s within the PT-II / V supports only a single serial port, many of the fields related to the Port-2 dual-port options are blanked out with the 'xxxxx' type denotation.

```

6/18/02          METRETEK Programmer, Version 2.04          12:00
Dual Port IMU/S...<No> Default...<xxxxxxxx> Timeout...[xx] SECS
                Port 1                                     Port 2
Remote Unit ID.....[002244]                               [xxxxxx]
Telecom Mode.....<Orig&Answ>                             <xxxxxxxx>
Phone Number 1.....[3212599700                            ]
Phone Number 2..... [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
Dialer Type.....<Tone >                                  <xxxx>
Alarm String Download...<No >                             <xxx>
INPUT CONFIGURATION
  Input Type.....<Data >                                  <Data >
  Alarm Description..[xxxxxxxxxxxxxxxxxxxxxxxx]             [xxxxxxxxxxxxxxxxxxxxxxxx]
COMMUNICATION PARAMETERS
  Data Bits.....<8>                                       <x>
  Stop Bits.....<1 >                                       <xxx>
  Parity Type.....<None>                                    <xxxx>
  Max Line Speed.....<2400 > BPS                            <xxxxxx> BPS
Answer Ring Count (1-15).....[ 1]
Primary Call Retry Count (1-15).....[ 5]
Primary Call Retry Rate (1-15).....[10] 1 Minute Increments
Secondary Call Retry Rate (1-15).....[10] 1 Hour Increments
Time-Tagged Interval Size.....<10> Minute(s)
F1 = HELP  F2 = READ  F3 = MODIFY  F4 = PROGRAM          Esc = QUIT

```

Figure 4.1  
MP Programmer Screen.

### 4.3 Field Options & Selections

A brief description of each field is provided below:

#### Dual Port IMU/S:

Select 'No' to disable the dual serial port feature, as this function is not supported within the PT-II / V.

#### Remote Unit ID:

A six-digit identifier that is used by the data collection software to distinguish the individual field devices. Legal entry values are 000000-FFFFFF (hexadecimal notation). Sequential numbering is not required, nor is it a requirement to use any of the hexadecimal digits 'A, B, C, D, E, or F'.

#### Telecom Mode:

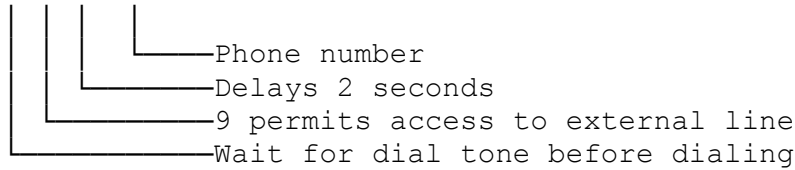
Enables or disables the IMU-II/s from calling the central computer. Most installations will have this parameter set to "Orig&Answ" except for systems with a manually polled arrangement.

#### Phone Number 1:

If 'Telcom Mode' = "Originate" or "Orig&Answ", then this field will accept a telephone number with a maximum digit count of 31. If it is desired to wait for dial tone before dialing, then a 'B' character should be added in the first position. A 'Dx' character set inserts a delay where the duration of the delay is determined by the value of 'x' in units of ½ seconds. Examples of typical delay values are D1 = 0.5sec, D4 = 2sec, D9 = 4.5sec.

The breakdown of an example phone number is as follows:

"B 9 D4 259 9700".



**Dialer Type:**

Selects whether touch-tone or rotary pulse dialing methods are used when calling out to the central. This parameter is almost always set for "TONE" to enable faster dialing with subsequent shorter call durations overall.

**Alarm String Download:**

When making a connection in transparent mode (does not apply if in Metretek mode), the IMU-II/s can be enabled to provide a brief ASCII format summary of the unit ID and alarm status. Information is not lost if this option is not enabled since the '+-+SA' command will produce the same summary text.

**Input Type:**

Permits selection of data or alarm functions for inputs 1 & 2. Since the PT-II / V has been wired with the intention that both input channels are to be used for data collection, this option should be set to 'Data'.

**Alarm Description:**

These fields cannot be edited since both inputs are configured as data inputs and not alarm.

**Data Bits:**

Serial port setting for data bits should always be set for '8' to ensure proper operation with the Analog Data Monitor.

**Stop Bits:**

Serial port setting for stop bits should always be set for '1' to ensure proper operation with the Analog Data Monitor.

**Parity Type:**

Serial port setting for the parity type should always be set for 'None' to ensure proper operation with the Analog Data Monitor.

**MAX Line Speed:**

This determines the Modem connection speed, with user selectable values of 300, 1200, or 2400 bits per second (bps). Land line telephone based units are normally set for 2400, while cellular systems should be set for 1200. It is always necessary to ensure that the bit rate of the IMU-II/s matches that of the Analog Data Monitor board. Jumper JP-4 of the Analog Data Monitor is selectable for A=300, B=1200 or C=2400bps.

Note: As shipped from the factory, the PT-II / V has jumper JP-4 of the ADM set to 2400bps.

**Answer Ring Count:**

Normally, this should be selected as a '1' to enable the fastest response for incoming calls.

**Primary Call Retry Count:**

Defines the number of times that the IMU-II/s will make call retry attempts at the primary call rate before switching to the secondary call retry rate. A value of '5' will serve most applications well.

**Primary Call Retry Rate:**

Determines the time interval between attempting call retries. A value of 10 or 15 minutes is recommended for most systems.

**Secondary Call Retry Rate:**

After the primary call retry count has expired, the secondary call retry rate determines the interval between successive attempts in 1-hour increments.

**Time Tagged Interval Size:**

Determines the resolution of the interval data collected on the pulse data inputs from the Analog Data Monitor (Input-1) and the Linear Integrator (Input-2). Possible selections available are 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, and 60 minutes, with 10, 15, 30, 60 being the most commonly used. A finer resolution permits short-term fluctuations to be more easily observed, but has the negative side effects of longer communications duration, increased battery drain, and more expensive telephone line charges.

When the EEPROM memory has been programmed (via the F4 function key), a final verification can be performed by reading back the contents with the F2 function key. The configuration settings that have been made are permanent to the memory of the IMU-II/s, and will be retained even if there is loss of battery power.

**NOTE:**

After programming the IMU-II/s with the MP software and cable, remember to disconnect the cable from J8 before attempting to make a call. Telephone communications will be blocked if the programming cable remains attached.

---

## 5. Meter Multiplier Calculations

---

### 5.1 Setting up an Account

Account information in the central computer must correlate with the hardware configuration of the IMU-II/s such that the number of data inputs and the interval sizes match. To start the process, it is necessary to go into the 'Remote Unit Configuration' application within DC-2000 as shown in Figure 5.1.

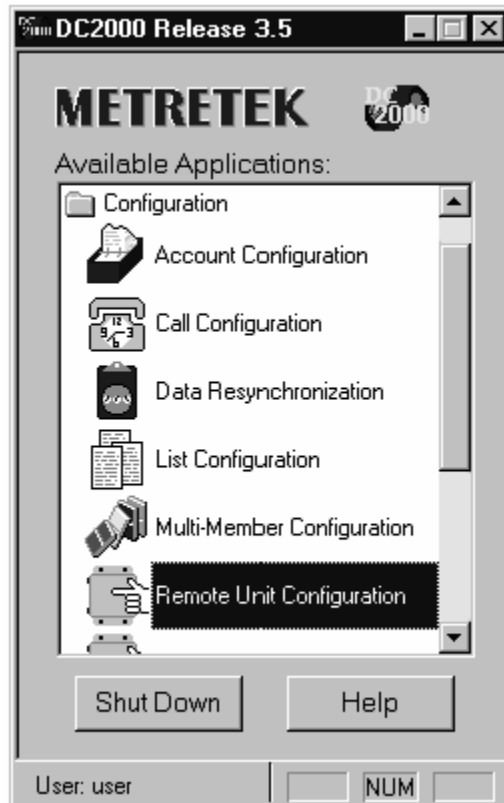


Figure 5.1  
Remote Unit Configuration Menu

The process of setting up an account is made easier by starting with a default account to be used as a template. In Figure 5.2, a template for an IMU product has been selected. Double-clicking on this selection will bring the user to another level where the account information is entered.

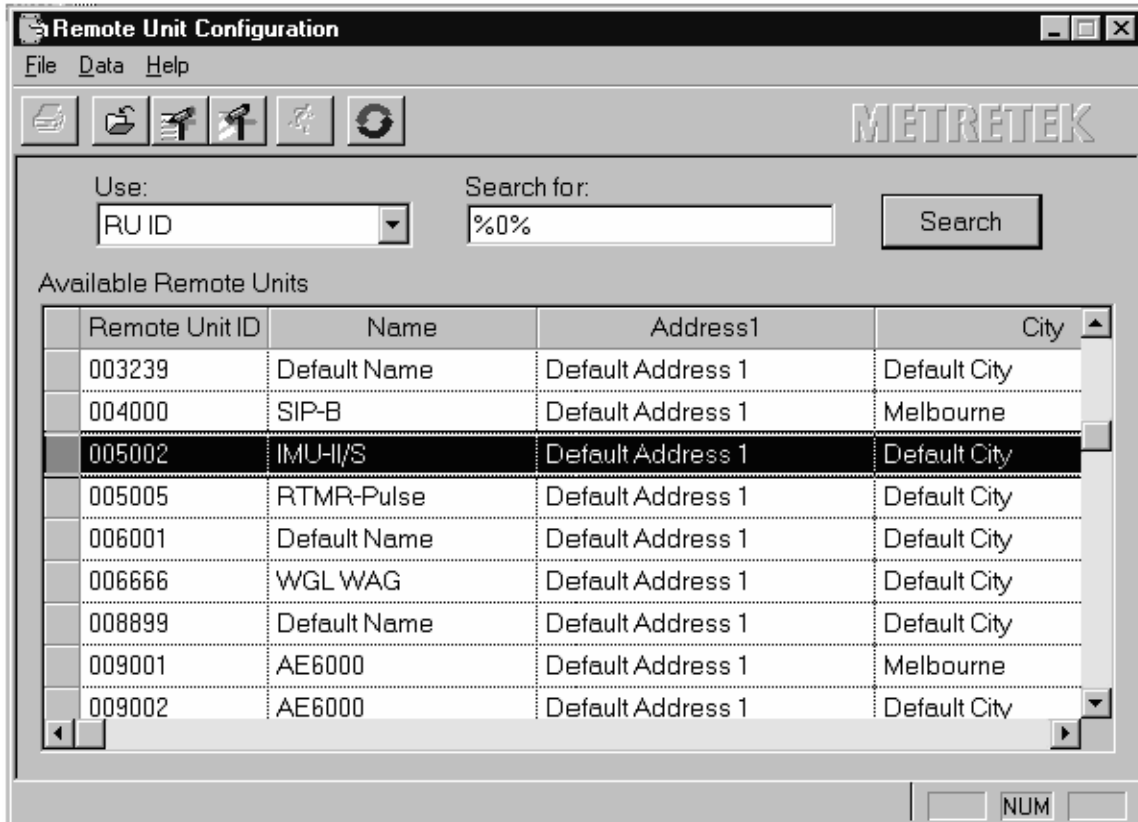


Figure 5.2  
Selection of a Default Account.

Figure 5.3 illustrates one of the seven ‘tabs’ or ‘folders’ that can be accessed at this level. It is important to select the correct number of data inputs and to instruct the remote device to ‘Send Latest’ data only. Some of the fields (i.e.-- Battery Information) are not critical since they exist primarily as a convenience for the system operator.

The screenshot shows a window titled "Edit Remote Unit Data: 005002 Name: IMU-II/S". The window contains several tabs: "Site Information", "Call Information", "Relay Information", "Hardware Alarms", "Input Description", "General Information" (which is selected), "Install Information", and "Party Line Definition".

The "General Information" tab is divided into two main sections:

- Configuration:**
  - Product: IMU  Active
  - Available HW inputs: 2
  - Instrument firmware version: [dropdown]
  - Instrument type: [dropdown]
  - Control
  - Audit Trail Date/Time Format:
    - MM/DD/YY
    - DD/MM/YY
    - YY/MM/DD
  - Access Code Information:
    - Access Code: [text box]
    - Edit Password: [text box]
- Battery Information:**
  - Date: 04/06/2000 [calendar icon]
  - Battery description:
    - Description: Niced
    - Add [button]
    - Remove [button]

At the bottom of the configuration area, there are fields for:

- Atmospheric pressure: 14.73
- Contract pressure: 14.4
- Standard command control: Send Latest [dropdown]
- Special command control: [dropdown]
- Special command count: 0 [spin box]

At the bottom right of the window are buttons for "OK", "Cancel", and "Help".

Figure 5.3  
Configuration Setup Screen.

Figure 5.4 below illustrates the configuration for the data inputs. It is critical that the interval size setup in DC-2000 matches the interval size that was programmed into the memory of the IMU-II/s. It is possible to assign various names to the data input. In the example below, it has been called “Corrected Volume”, although other names such as “Regulator Pressure” or “Cathodic Voltage” may be more applicable depending on the application.

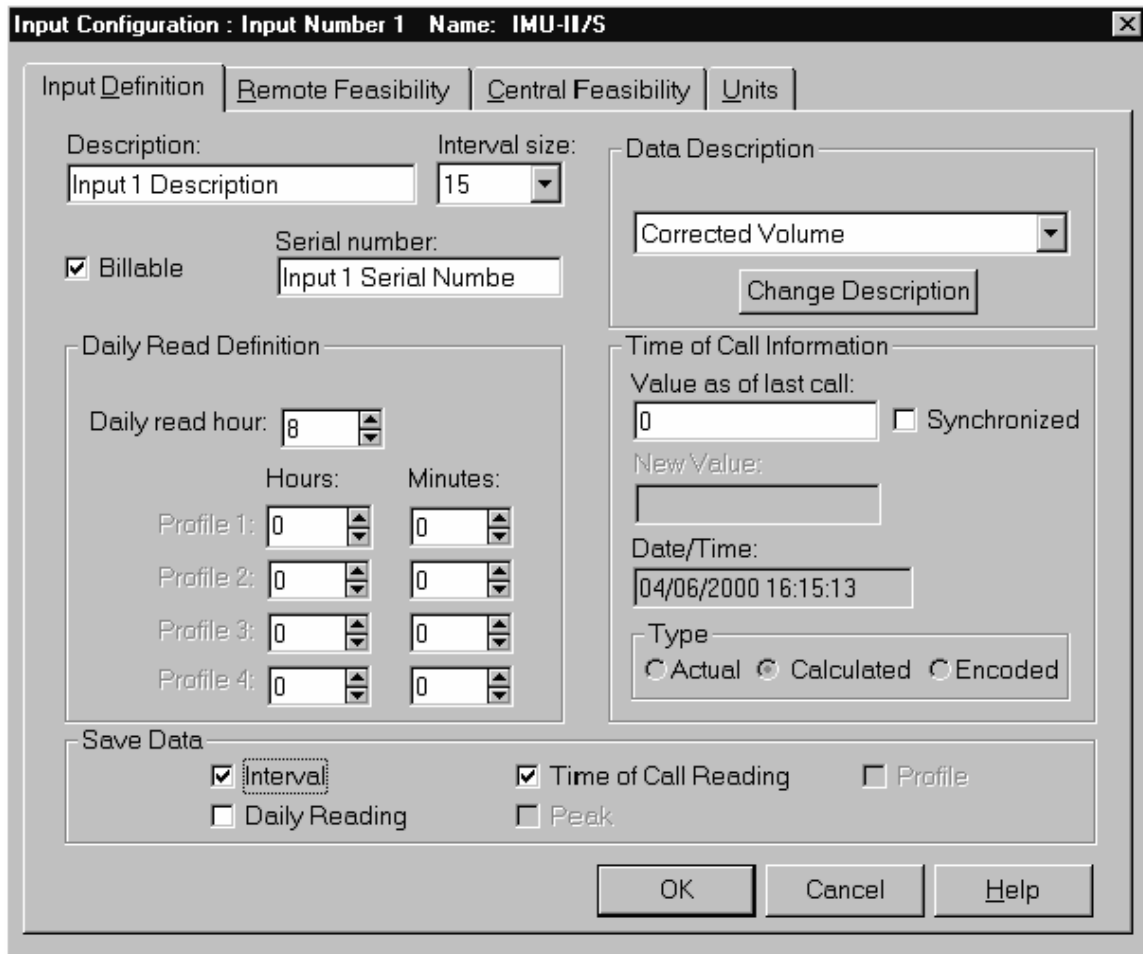


Figure 5.4  
Data Input Configuration Screen.

Proper configuration of the call information fields is necessary to ensure that the data will have been collected and available for processing when expected. Figure 5.5 illustrates a configuration screen that does not have a target telephone number field completed yet. It should be remembered that less frequent call-in cycles are desirable for battery-powered units in order to conserve battery life.

The screenshot shows a software window titled "Edit Remote Unit Data: 005002 Name: IMU-II/S". The window has several tabs: "Input Description", "General Information", "Install Information", "Party Line Definition", "Site Information", "Call Information" (selected), "Relay Information", and "Hardware Alarms".

Under the "Call Information" tab, there are several sections:

- Dial Out:** Contains three input fields for "Prefix", "Phone number", and "Suffix". To the right is a larger input field for "Target phone number:". Below these is a checkbox labeled "Long Distance".
- Last Call:** Contains input fields for "Date" (04/06/2000) and "Time" (16:19:01). Below is a checkbox labeled "Called In".
- Next Call:** Contains input fields for "Date" (04/07/2000) and "Time" (15:40:36). There are small icons next to the date and time fields.
- Available Call Profiles:** A list box showing "Current Call Profile" at the top, followed by "Default Call Profile" (highlighted), "AEPROFILE", "Sip 4hr Test", and "DickD. Red?".
- Field Modem Type:** A group box containing six radio buttons: "Standard" (selected), "Mercury A", "Mercury B", "Metretek", "Mercury C", and "Mercury D".

At the bottom of the window are three buttons: "OK", "Cancel", and "Help".

Figure 5.5  
Call Profile Screen.

## 5.2 DC-2000 Alarms

Alarms are of benefit to the user since they can be used to report unusual event occurrences that might require immediate attention. Figure 5.6 illustrates a typical DC-2000 screen menu for an alarm configuration. A brief listing of available alarms has also been provided below:

**Magnetic Switch Alarm:** This input on the IMU-II/s has been wired to the Analog Data Monitor high / low pressure alarm output. If a pressure alarm setpoint (set within the ADM) has been violated, then this alarm will be triggered.

Tamper Detect Alarm: Reports when the enclosure door has been opened via the tamper detect alarm switch.

Customer Alarm 1: Not available. Input-1 is configured as a data input.

Customer Alarm 2: Not available. Input-2 is configured as a data input.

Unit Reset Alarm: Reports if the IMU microprocessor has had a reset event. These will be reported each time that the battery pack has been replaced.

Call Retry Alarm: Reports if the previous call attempt was not successfully completed.

KYZ-1 Input Failure: Not available.

KYZ-2 Input Failure: Not available.

Queue 75% Full Alarm: Triggered if the IMU data memory becomes 75% or more filled since the last successful data call.

Clock Resync Alarm: Reported if the IMU's time-of-day clock has been corrected.

Remote Daily Volume Low Input-1,2: Reports if daily volume use is below limits.

Remote Daily Volume High Input-1,2: Reports if daily volume use is above limits.

Remote TTI Consumption Low Input-1,2: Reports if interval volume use is below limits.

Remote TTI Consumption High Input-1,2: Reports if interval volume use is above limits.

AC-On Alarm: Not available.

AC-Off Alarm: Not available.

Low Battery Alarm: Provides a warning to the operator that the lithium battery within the PT-II / V has reached a point where the remaining capacity is almost depleted. A service call to replace the batteries should be scheduled in order to maintain unit operation.

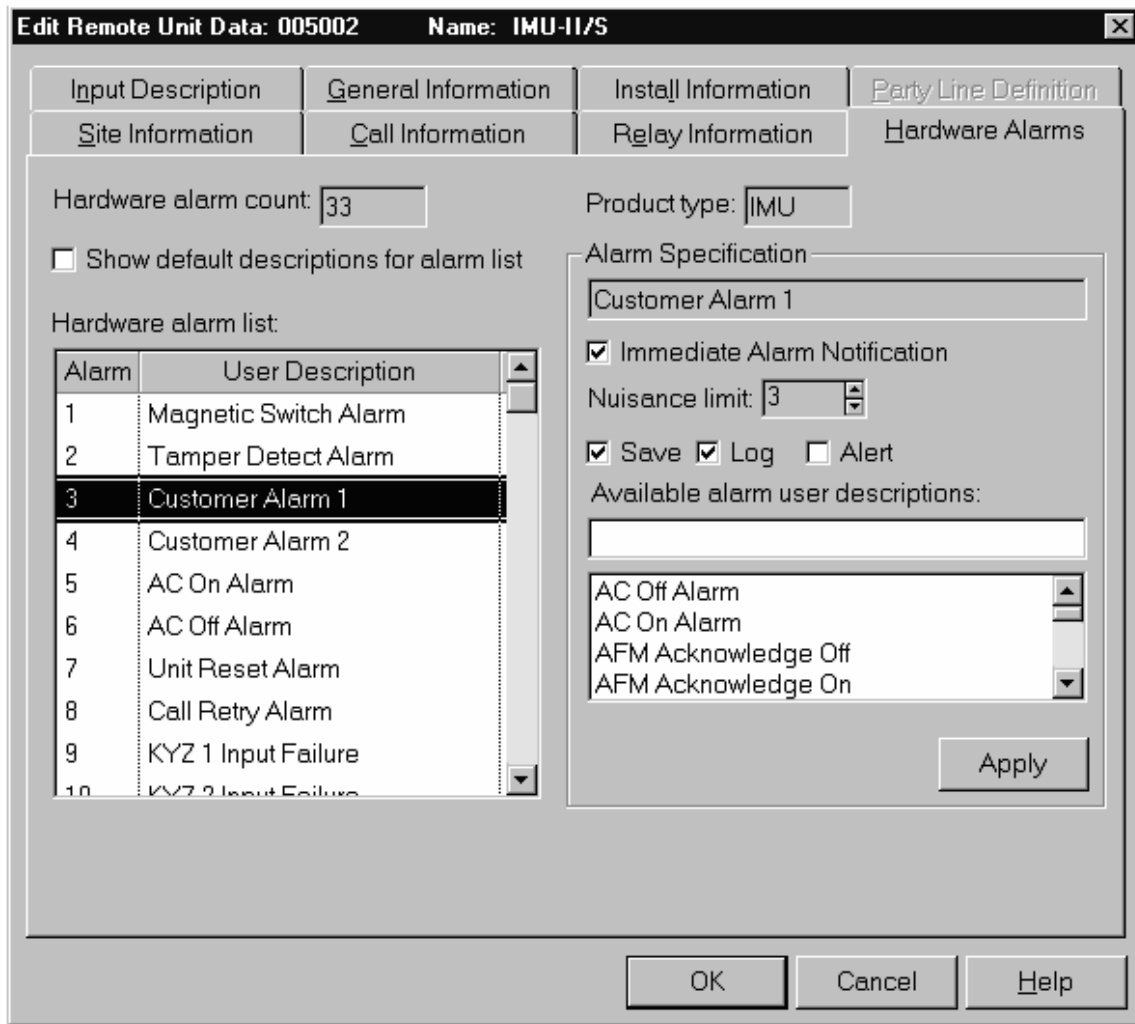


Figure 5.6  
Hardware Alarm Configuration.

### 5.3 Meter Multiplier Calculations

It has already been discussed in an earlier section of this text that the IMU-II/s Input-1 will receive a maximum pulse input rate of 8 hertz (when full scale pressure is applied), and Input-2 will receive a maximum pulse input rate of 5 hertz (when full scale voltage is applied to the Linear Integrator). It is logical that the operator at the data collection system will want the data that has been downloaded to be displayed in a format that is easy to interpret, as opposed to raw pulse counts.

Normally the system will be configured so that the data from Input-1 will be displayed in units of 'psig' or perhaps 'kPa', and Input-2 will be reported as voltage. The following example demonstrates how to perform the calculations for Input-1 with a 175 psig type transducer attached. Although this example has been performed for 'psig' units, it could easily be modified for 'kPa' by using a multiplier of 6.89473.

Factors that have been assumed for this example problem:

- Maximum pulse rate for ADM board is 8 pulses per second at full scale pressure.
- Full scale pressure is 175 psig.
- Interval size for the IMU-II/s input channels has been set to 10 minutes.

The maximum possible pulses per 10 minute interval period are calculated as follows:

8 pulses/second x 60 seconds/minute x 10 minute intervals = 4800 pulses / interval.

To calculate the required divisor, we must divide 4800 pulses by 175 psig = 27.42857.

A simple formula can thus be created as follows:

$$\text{Divisor} = \frac{8 \times 60 \times \text{Interval Size}}{\text{Full Scale Pressure Value}}$$

Using the new equation, we can plug in the numbers as shown below:

$$\text{Divisor} = \frac{8 \times 60 \times 10}{175}$$

Answer: Divisor = 27.42857

Alternatively, if the user would prefer to use a multiplier factor, the following equation would apply:

$$\text{Multiplier} = \frac{\text{Full Scale Pressure Value}}{8 \times 60 \times \text{Interval Size}}$$

These same equations would apply to Input-2 with the Linear Integrator, although it must be remembered that the '8' will be replaced by a '5' since the maximum pulse rate here is 5 Hertz.

Figure 5.7 illustrates the DC-2000 screen that will be presented when the user attempts to edit the multiplier / divisor factor that is applied against the data input. This screen has already been edited so that the operator is a division function, and the Factor1 uses the previously calculated example value of 27.42857.

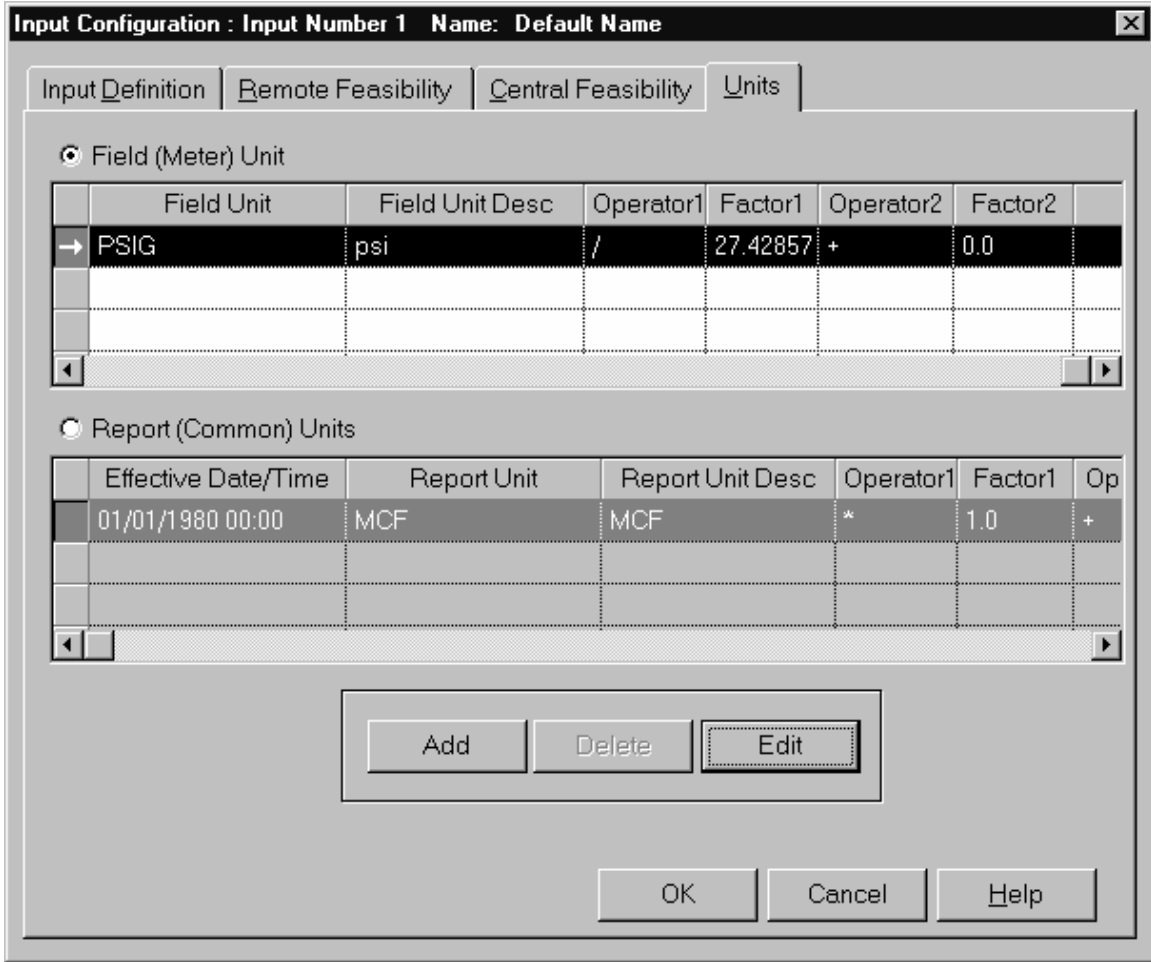


Figure 5.7  
Changing the Input Multiplier / Divisor Factor

The screen image presented in Figure 5.8 simply illustrates the menu level where the actual data entry of the division factor must be placed. If it is necessary to use a multiplier instead, then the 'Operator 1' field will need to be changed to the appropriate symbol.

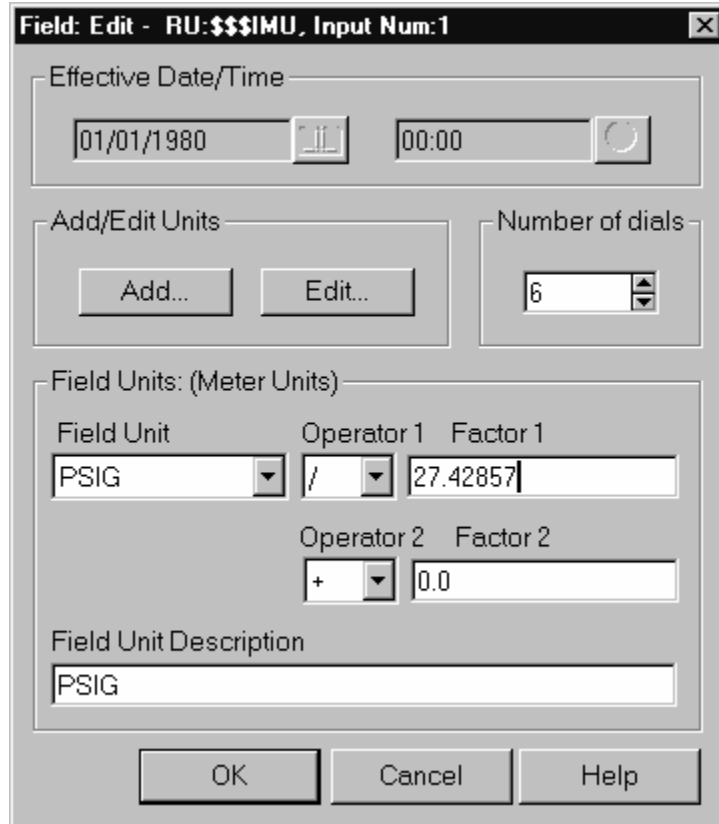


Figure 5.8  
Editing the Divisor Factor.

---

## 6. Trouble-Shooting Hints

---

### 6.1 Typical Field Problems

Problem: Linear Integrator measurements are not accurate.

Solution: a) Jumpers JP2 or JP3 may not be set correctly for the voltage range. Refer to Section 3.3 for guidance with jumper settings.

b) Alkaline batteries may have become depleted. A handheld voltmeter can be used to test the batteries while they are in the circuit and consequently under a loading effect. A rough guide to the battery levels are: 1.2 volts = Very Weak, 1.3 volts = Weak, 1.4 volts = Somewhat Depleted, 1.5 volts = Strong, 1.55 volts = Very Strong.

c) The meter multiplier in DC-2000 should be rechecked. Section 5.3 of this document details a suitable method for calculating the meter multiplier.

d) A wiring problem may exist that is causing a voltage loss. Checking the voltage directly at the terminal block of the Linear Integrator may reveal that the cable is defective due to corrosion or a cut in the line.

e) Smaller errors in accuracy that do not appear to have an obvious source may indicate that the Linear Integrator requires a factory calibration. Swapping out the suspect board with a spare should help to resolve whether the problem is related to calibration or not.

Problem: Measurements that are reported by the Linear Integrator display a tendency to fluctuate, despite the fact that the cathodic protection voltages at the source are known to be relatively stable.

Solution: Shielded cable may be necessary for the wire run between the cathodic rectifier site and the PT-II / V. This type of cable is commonly available from industrial suppliers. Belden shielded cable type 9501 (24 awg, 2 conductor) or equivalent is recommended. A heavier gage wire is also acceptable, and may prove to be easier to strip and secure connectors to. The drain wire for the shield should be connected to a ground point at one end of the cable only, preferably at the rectifier site.

Problem: Alkaline batteries within the Linear Integrator deplete sooner than the lithium pack that powers the IMU-II/s.

Solution: Operation at temperature extremes (either hot or cold) for extended periods of time will have a negative impact on the battery life. Possible solutions include moving the PT-II / V indoors (if this is possible), or else replacing the alkaline batteries at a schedule that is twice as frequent as the lithium pack.

## NOTES

---

## Appendix: Technical Specifications

---

### Enclosure:

Length: 10.50 inches or 26.7cm.

Width: 8.50 inches or 21.6cm (excluding hinge).

Depth: 6.25 inches or 15.9cm (without the mounting feet).

Environment Ratings: Nema 4X, IP66.

Flammability: UL508.

Model Number: A-1086CHSCFG.

Consult the Hoffman printed catalog or their web site at [www.hoffmanonline.com](http://www.hoffmanonline.com) to obtain additional ratings information for this enclosure model.

### Unit Weight:

Including Batteries: 6.4 pounds or 2.9 kilograms.

Omitting Batteries: 5.3 pounds or 2.4 kilograms.

### Pressure Feed Connection:

Thread Type: ¼ inch NPT, (American National Standard Taper Pipe Thread).

Gender: Female.

Taper: ¾ inches per foot.

Threads: 18 per inch.

### Linear Integrator:

Jumper Selectable Input Ranges:

0 to 50mV	JP2 = D	JP3 = A+B
0 to 3 Volt	JP2 = D	JP3 = B+C
0 to 12 Volt	JP2 = E	JP3 = B+C
0 to 24 Volt	JP2 = F	JP3 = B+C
0 to 50 Volt	JP2 = G	JP3 = B+C
0 to 75 Volt	JP2 = H	JP3 = B+C
0 to 100 Volt	JP2 = J	JP3 = B+C

Linearity: +/- 0.1% of span.

Temperature Range: -20° to +70° Celsius.

Temperature Impact: +/- 0.03% per °C.

Power Source: Alkaline 'D' cell size batteries, 1.5 volts. Three cells are required.

Current Consumption: 850uA typical from the 4.5 volt alkaline source.

Pulse Outputs: Isolated KYZ type providing a frequency range from 0 to 5 Hertz (proportional to input voltage) and a current sink rating of 3mA maximum per channel. This design requires only a momentary activation of the appropriate opto-coupler (8111) to make the circuit toggle, thereby minimizing power consumption. Due to the unique design of the isolation circuit, a wetting voltage is required on both the 'Y' and 'Z' channels to provide proper operation. A schematic drawing of the KYZ output circuit is illustrated in Figure A-1.

Figure A-1 below provides a basic schematic illustration of the pulse output circuit for the Linear Integrator. Isolation of the KYZ output circuit is achieved with MOC8111 type opto-isolators that are surge rated at 7500Vac for 1 second at 60Hz. It is necessary to provide a wetting voltage on both the 'Y' and 'Z' channels due to the circuit design where the wetting voltage from the 'open' channel will drive the Mosfet of the opposite channel to hold it 'closed'. A brief pulse on the appropriate opto-isolator will then cause the circuit to toggle, and the process is repeated for the opposite side where the wetting voltage holds the other channel in a low state.

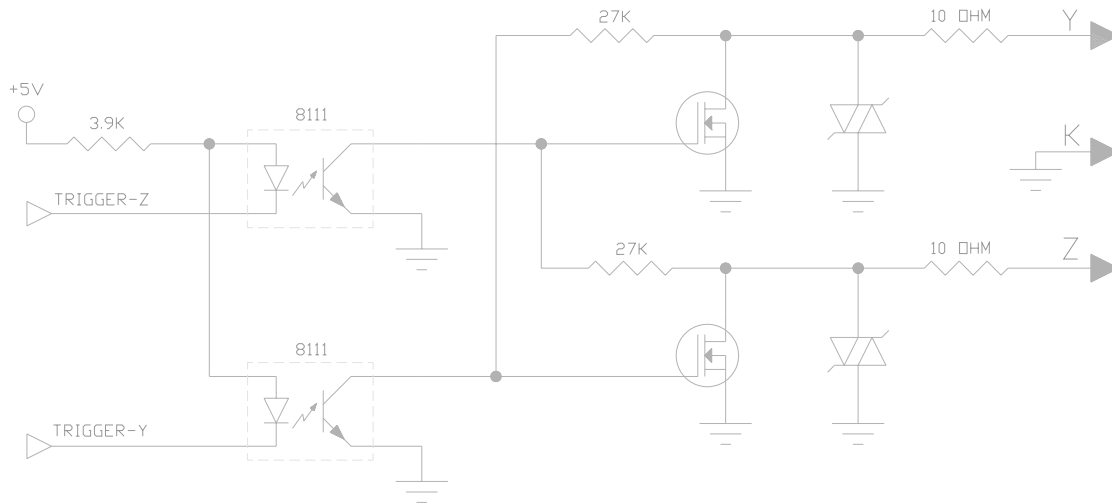


Figure A-1  
Linear Integrator Pulse Output Circuit.