Charge Amplifier
User Manual

RJG, Inc.

Making Molding Simple™

11/21/01

Table of Contents

RJG Support

RJG, Inc. offers support services throughout North America.

Product Support

Contact your RJG, Inc. representative for:

- Sales and Order Support
- Product Technical Training
- Warranty Support
- Support Contracts

Technical Product Assistance

If you need to contact RJG, Inc. for technical assistance, please review the information in the Start Up, and Troubleshooting chapters first, then call your RJG representative.

Specifications

This chapter contains information on the following:

- Temperature
- Power Supply Loading/Requirements
- Outputs
- Inputs

Temperature:

Operating Temperature	0° C to +60° C (32° F to 140° F)
Storage Temperature	-40° C to +85° C (-40° F to +185° F)

Table 1

Power Supply Loading/Requirements:

Input Voltage	10 VDC - Regulated
Current Consumption	45 mA Max.

Table 2

Outputs:

Millivolt Output	0-20mV
Voltage Output	0-10 Volts
Maximum Drift	2% of Fullscale per Minute

Table 3

Inputs:

Range I	0 - 20,000pC
Range II	0 - 5,000pC

Table 4

Quick Start

1. Install the Charge Amplifier in an appropriate location so that the sensor and the interface cables are not strained.

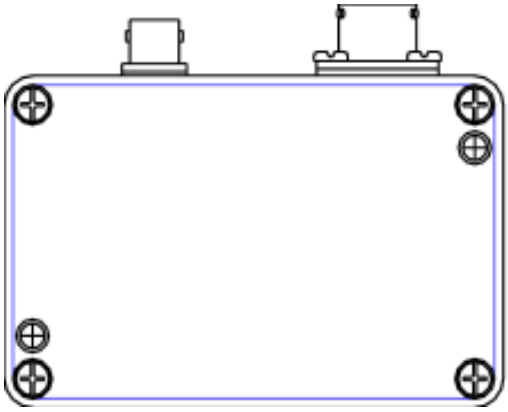

Figure 1: Charge Amplifier Diagram

2. Plug a T-CHRG6-F cable into the Charge Amplifier and into a DART*PAK*™ or DART*Scanner*™.

3. Set the gain on the channel being used to 1. (For high level voltage output)

4. In the DART*Vision*™ software, set up the Charge Amplifier as follows:

   Under the *Edit* menu select *Mold Edit*
   Select the desired mold to edit.
   Select the measurement that corresponds to the Charge Amplifier input.
   Hit the <Edit Meas> button.
   Select <Xdcer Scaling>.
   Under <Transducer>, select 0-10V.
   Under <F.S. Load>, enter 30860 for the Kistler type 6157 sensor. For other sensor types, see the details in this manual.
   Under <Units>, enter PSI.
   Turn software's autozero on.

5. After the Mold has been setup and a job is started with that mold, the software will ask you to *Recalibrate the Transducers*. To do this, turn the selector switch to the channel where the Charge Amplifier is plugged in. On the front panel of the DART*PAK*™, or DART*Scanner*™ unit, hold the toggle switch in the Zero position and push the *Enable* button. Then hold the toggle switch in the Calibrate position and push the *Enable* button. The system is now ready for pressure measurement.

Chapter 1: Charge Amplifier Overview

This chapter contains the following:

- Charge Amplifier Overview
- Operating Modes
- Hardware Features

Charge Amplifier Overview:

RJG, Inc. Charge Amplifier is used to interface piezoelectric sensors with RJG's DART*PAK*™ and DART*Scanner*™, or other data collection equipment. The Charge Amplifier circuitry is enclosed in a rugged aluminum housing that can be mounted directly to a mold containing a piezoelectric sensor.

The Charge Amplifier converts the electric charges generated by piezoelectric sensors to voltage level signals that can be input to RJG, Inc. equipment.

Operating Modes:

The Charge Amplifier has two input ranges for piezoelectric sensors: 5,000pC and 20,000pC. The input range is selected with a jumper located on the circuit board.

The output of the Charge Amplifier is either millivolt (0-20mV) or voltage (0-10 Volts) depending on the application. When interfacing with RJG, Inc. equipment, either a Low Level or High Level output can be used. The voltage output level is selected with a jumper on the Charge Amp circuit board. With either a High or Low Level, a T-CHRG6-F cable can be used.

The High Level output is the preferred operating mode for this device. When monitoring or controlling with contact closure, this mode can be used. **There is one situation where Low Level output must be used**. This is when the Charge Amp is interfaced to a DART*PAK*™ or DART*Scanner*™ and a 0-10V control output is needed from the DART*PAK*™ or DART*Scanner*™. Also, it is important that the DART*PAK*™ or DART*Scanner*™ have firmware that is Revision 143 or later.

The Charge Amplifier must be given an Operate signal to provide a voltage level output. The Operate signal is provided by connecting Pin F to Pin B during the molding cycle. When Pin F and B are connected, the Charge Amplifier is autozeroed and the output voltage tracks the pressure on the piezo sensor. The Operate signal should correspond with either the Injection Forward or Mold Closed signal from the machine.

The Autozero feature in the DART*Vision*™ software may be used; however, it is not absolutely necessary for pressure measurement. It is necessary that the Operate signal (the short between Pin F & B) be opened at the end of the molding cycle so that any drift in the Charge Amplifier is eliminated.

Hardware Features:

See Figure 2 for a description of the hardware features on this device.

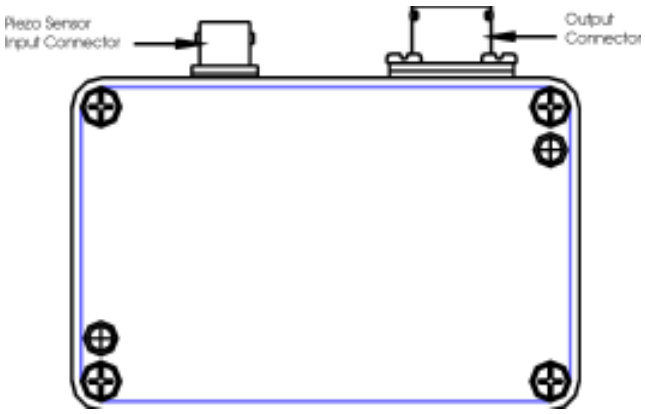

Figure 2: Hardware Features

Chapter 2: Amplifier Operation

This chapter contains the following:

- Amplifier Overview
- Input Range Selection
- Millivolt Output
- Voltage Output

Amplifier Overview:

As stated in Chapter 1, the Charge Amplifier converts signals from piezoelectric sensors to voltages that can be input into conventional measurement and data recording equipment.

The circuit is designed to convert two input charge ranges and can provide both millivolt output (0-20mV) and voltage (0-10V) output.

If the Charge Amplifier is not being used, the output connector and piezoelectric sensor input connector should be covered with the protective caps provided from the factory.

Millivolt Output:

One of the outputs from the Charge Amplifier is a low level voltage signal that has the same voltage output of a typical 350 ohm transducer. The output is 0-20mV for the input range 0-20000pC, or 0-20mV for the input range 0-5000pC. See Figure 3 for the jumper position on JP2 that will provide a low level output from the Charge Amplifier.

Voltage Output: (Default Setting)

The Charge Amplifier output is a high level signal of 0-10V for the selected charge input range of 0-20000pC or 0-5000pC. With the 0-10 Volt output, a 0-10 Volt measurement must be used in the DART*Vision*™ software. See Figure 4 for the jumper position on JP2 that will provide a high level output from the Charge Amplifier.

Input Range Selection:

Two input ranges are available on the amplifier: 5000pC and 20000pC. The 5000pC range is provided for lower pressure measurements where better resolution is required. The 20000pC range will accommodate most other applications where piezoelectric sensors are being used. The Charge Amplifiers are shipped from the factory with 20000pC range set as the default.

If the 5000pC range is required, open the enclosure by removing the four screws from the top cover. The JP1 jumper will be located on the circuit board near the two blue adjustment potentiometers. Lift the jumper from its position on one pin and place it on both pins as shown in Figure 5.

NOTE: When in the 20000pC range, the jumper can be stored on just one of the JP1 pins as shown in Figure 6.

	5000pC Input Range	20000pC Input Range
0-20mV Low Level Output	0-5000pC 0-20mV	0-20000pC 0-20mV
0-10V High Level Output	0-5000pC 0-10V	0-20000pC 0-10V

Table 5

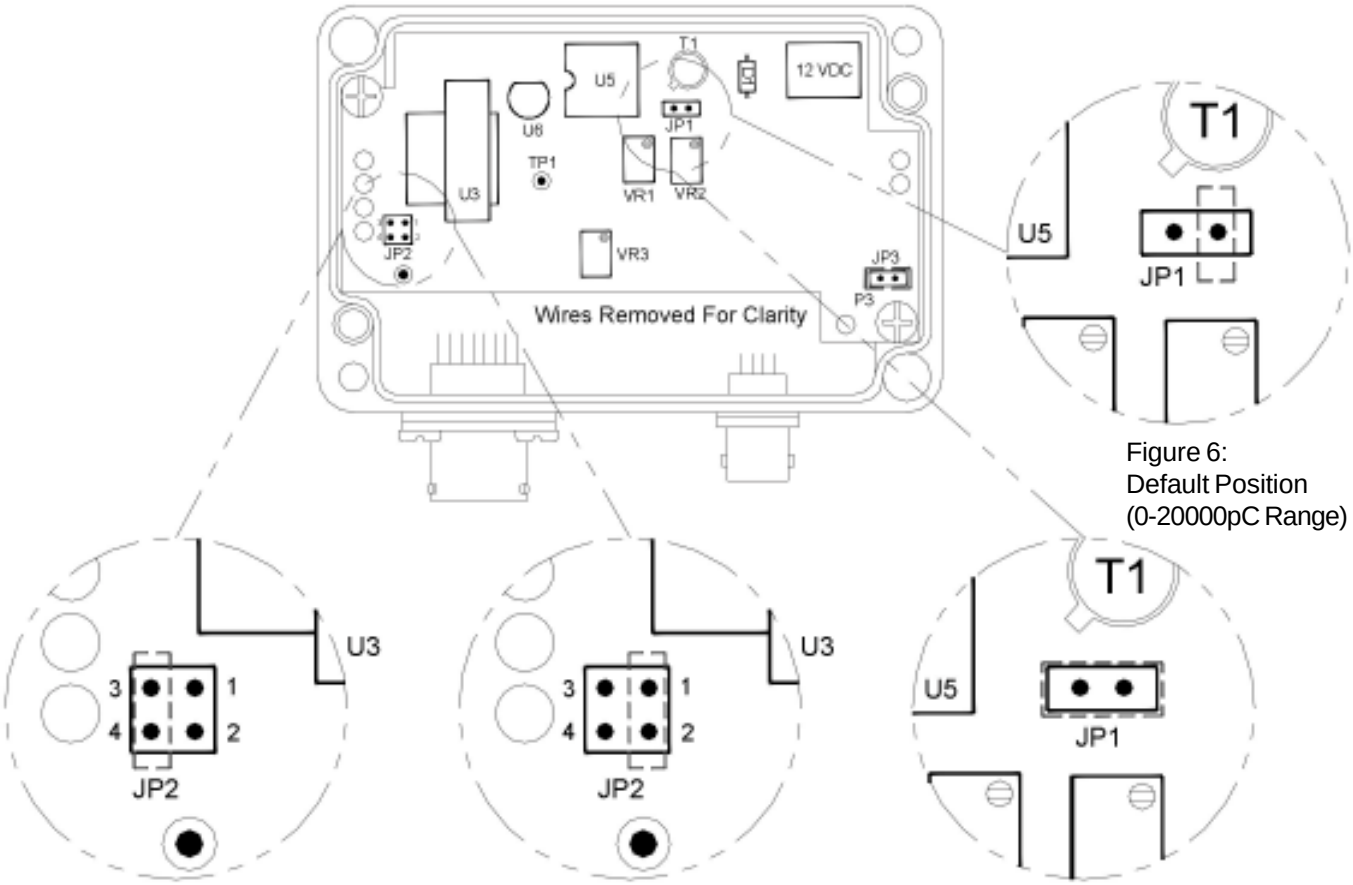

Figure 6:
Default Position
(0-20000pC Range)

Figure 3:
Position for MilliVolt Output
Low Level (0-20mV) Output

Figure 4:
Position for Voltage Output
High Level (0-10mV) Output

Figure 5:
0-5000pC Range Position

JP3: Shield Jumper

The JP3 jumper is installed as default from the factory. This jumper connects Pin E, the shield connection to the aluminum case. This connection is made to shield the circuit from sources of electrical noise. The jumper may be removed if erratic readings are observed from the Charge Amplifier output.

Chapter 3: Installation and Wiring

This chapter contains the following:

- Installing the Charge Amplifier
- Input and Output Connections

Installing the Charge Amplifier

The Charge Amplifier should ideally be mounted so that the connectors on the device are protected. The cables connected to the device should be strain relieved.

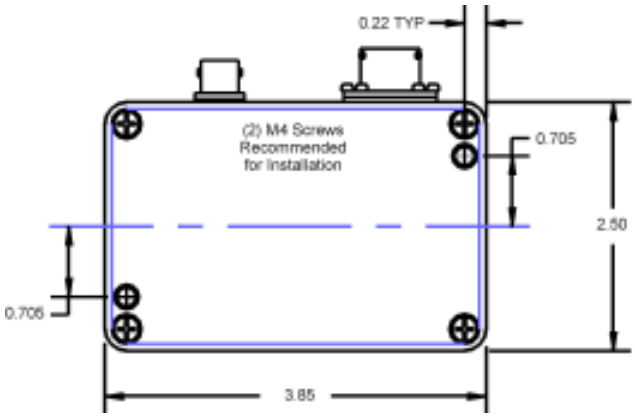

Figure 7: Charge Amplifier Mounting Recommendation

The maximum operating temperature of the Charge Amp is 60°C (140°F.) If the temperature is expected to exceed 60°C, then the Charge Amp should be mounted in a cooler location. Operation of this device at a temperature greater than 60°C will degrade its performance, and possibly cause permanent damage.

Input and Output Connections

Piezoelectric Sensor Input Connector:

The piezoelectric sensor input connector is a standard BNC type connector commonly found on most piezoelectric sensors. RJG, Inc. can provide other connectors if required.

Output Connector:

The output connector is a standard Bendix PT02E-10-6P. A T-CHRG6-F cable should be used to connect the device to an RJG DART*PAK*™ or DART*Scanner*™ unit. The pinout of the Charge Amplifier is shown in Figure 8.

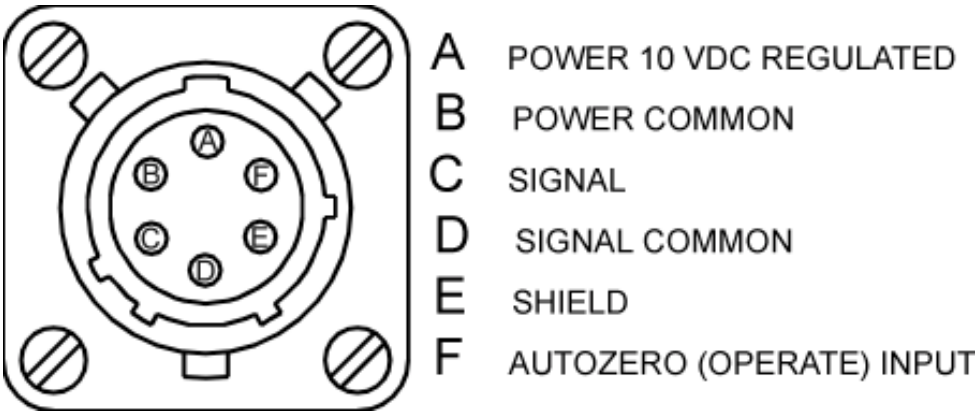

Figure 8: Output Connector Pinout

To operate the Charge Amplifier, Pin F should be connected to Pin B. Some DART*PAK*™ and DART*Scanner*™ modules have the Operate signal pre-wired to Pins F & B. Contact RJG, Inc. for more details

Chapter 4: Configuration

This chapter contains the following:

- Hardware Autozero
- Software Autozero
- Software Setup
- Determining Full Scale Psi Values

Hardware Autozero

An Operate signal is required before the Charge Amplifier can provide a voltage output. The Operate signal resets the amplifier and eliminates any drift, or pre-load output from the piezoelectric sensor. The Operate signal should be turned on at injection forward or at the beginning of the molding cycle, and turned off after the cycle. Once the Operate signal is invoked, the amplifier is momentarily autozeroed and then the voltage signal begins tracking the input pressure on the piezo electric sensor.

Some DART*PAK*™ and DART*Scanner*™ modules have the Operate signal pre-wired. The connection from Pin F to Pin B is automatically invoked when Trigger 1 is turned on. Contact RJG, Inc. to find out if this feature has been added to your DART*PAK*™ or DART*Scanner*™.

Software Autozero

Software Autozero is set in the DART*Vision*™ software before any pressure measurements are made. With this setting turned on, the software will subtract the first pressure value in the cycle from all subsequent measurements in the cycle. It is not necessary to turn on this software setting; however, having it turned on will not adversely affect the pressure measurement.

Software Setup

You are required to setup the measuring Charge Amplifier in the DART*Win*™ software - Mold Setup window. To configure the measurement, follow these steps:

1. Under the Edit menu, select *Mold Edit.*
2. Select the desired mold to edit.
3. Select the measurement that corresponds to the Charge Amplifier input.
4. Click on the <Edit Meas> button.
5. Select the <Xdcer Scaling> button.
6. Under the *Transducer* field, select 0 – 10 V.
7. Under the F.S. Load field enter the full scale pressure for the Piezo sensor being used. For the Kistler type 6157 sensor this value is 30860. For sensors with other sensitivities, reference the following section: *Determining Full Scale Psi Values*.
8. Under Units, enter PSI.
9. Make sure the *Autozero* radio button in the *Mold Edit* window is ON.

You will also be required to perform a zero, and calibrate routine on the DART*PAK*™ or DART*Scanner*™ being used. Once the software is configured, select the channel on the DART*PAK*™ or DART*Scanner*™ where the Charge Amplifier is plugged in. On the front panel, hold the toggle switch in the Zero position and push the *Enable* button. Then, hold the toggle switch in the CAL position and push the *Enable* button. The system will now be ready for pressure measurement.

Determining Full Scale Psi Values

For Flush Mount Piezoelectric sensors with different pressure sensitivities, you will be required to calculate the proper full scale psi value for accurate pressure measurement. The example below illustrates the method for determining the full scale psi value for a given pC/bar sensitivity.

The calibrated output for the Charge Amplifier in High Level Voltage mode is:

10V Output = 20,000pC Input

For a sensor with a sensitivity of 9pC/bar, the sensor will reach 20,000pC at:

$$\frac{20{,}000\text{pC}}{9\text{pC/bar}} = 2222.22 \text{ bar}$$

Since 1 bar = 14.504 psi, the full scale psi value is:

$$\frac{14.504 \text{ psi}}{\text{bar}} \times 2222.22 \text{ bar} = 32{,}231 \text{ psi}$$

To calculate the full scale value when using an indirect piezo sensor, use the following example. The installation uses a sensor with a sensitivity of 3.3pC/N under a 1/4" pin:

The pin area is: $B(r)^2 = B(1/8")^2 = 0.04909$ sq.in.

To convert the sensitivity to pC/lbf:

$$\frac{3.3\text{pC}}{\text{N}} \times \frac{1\text{N}}{0.2248 \text{ lbf.}} = \frac{14.679\text{pC}}{\text{lbf.}}$$

Calculating the required lbf. to reach 20,000pC:

$$\frac{20{,}000\text{pC}}{14.679\text{pC/lbf.}} = 1{,}362.48 \text{ lbf.}$$

Divide the force calculated above by the pin area:

$$\frac{1{,}362.48 \text{ lbf.}}{0.04909 \text{ sq.in.}} = 27{,}756 \text{ psi}$$

This is the full scale value for a 10V input.

Full Scale Values for Low Level (0-20mV) Inputs:

In some instances it is desirable to use the 0-20mV output of the Charge Amplifier as an input to a DART*PAK*™ or DART*Scanner*™. This option **must** be used if the 0-10V control voltage output on the DART*PAK*™ or DART*Scanner*™ is needed. When using the 0-20mV output, the gain on the DART*PAK*™ or DART*Scanner*™ should be set to 500 or 250 (500 is preferred.) **The firmware revision on the DART*PAK*™ or DART*Scanner*™ must be Version 143 or later.** Also, a later revision of DART*Vision*™ is required. Contact RJG, Inc. Inside Sales or Customer Support if there are questions about this option.

For the full scale pressure setting, the psi values are calculated the same as the High Level (0-10V) inputs as shown on the previous page.

Chapter 5: Start Up and Troubleshooting

This chapter contains the following:

- Start Up
- Normal Operation and Maintenance
- Troubleshooting

Start Up

Where possible, the Charge Amplifier should be securely mounted in a recess in the mold with two M4 (or similar) socket head cap screws as shown in Figure 7. Cables to the charge amp should be secured to eliminate any problems due to flexing or vibration.

Every effort has been made to seal the device from dust, moisture, and hydraulic oil. However, when not in use, the protective caps that were shipped with the charge amp should be installed on the 6 Pin Output connector and the BNC Piezoelectric sensor connector.

The pin connections for the output connector are given in Figure 8. Special care must be taken to ensure that power is not applied to the signal and signal common pins of the amplifier. Doing so may cause permanent damage to the device.

Normal Operation and Maintenance

Under normal operating conditions, the Charge Amplifier will provide reliable pressure measurement readings with an accuracy of +/- 1% or better. Once installed, the Charge Amplifier's connections should be checked occasionally for wire or connector damage. No other maintenance is required.

Troubleshooting

Listed below are some possible problems that could be encountered and their corrective actions:

Symptom	Possible Problems	Corrective Action
Pressure readings drift excessively with no pressure applied.	Damaged, or pinched sensor cable.	Check sensor installation. Check charge amp with a sensor that is not installed in the mold.
There are no pressure readings from the device.	Damaged sensor.	Check charge amp operation with a known working sensor.
	Damaged output cable.	Check continuity of output cable.
	Operate signal wired incorrectly.	Check to insure that Pin F is shorted to Pin B during the molding cycle.

Table 6