



Dynamic Transducers and Systems

21592 Marilla St. • Chatsworth, CA 91311 • Phone 818-700-7818
www.dytran.com • e-mail: info@dytran.com

OG1210C
REV A ECN 5370 7/29/08

OPERATING GUIDE

MODEL SERIES 1210C RING TYPE CHARGE MODE FORCE SENSORS, HERMETICALLY SEALED

This manual includes:

- 1) Specifications, series 1210C
- 2) Outline/Installation drawing, series 127-1210C

SPECIFICATIONS, MODEL SERIES 1210C DYNAMIC FORCE SENSORS

SPECIFICATIONS	VALUE							UNITS
MODEL	1210C1	1210C2	1210C3	1210C4	1210C5	1210C6	1210C7	
RANGE, F.S.	5,000	10,000	20,000	40,000	60,000	80,000	100,000	lbs. Force
MAX. FORCE	10,000	15,000	25,000	50,000	70,000	90,000	110,000	lbs. Force
O.D.	0.65	0.87	1.10	1.34	1.58	2.05	2.95	Inches
I.D.	0.26	0.41	0.52	0.66	0.83	1.03	1.61	Inches
THRU BOLT	Ø0.25	Ø0.375	Ø0.50	Ø0.625	Ø0.75	Ø1.0	Ø1.50	Inches
THICKNESS	0.31	0.39	0.43	0.47	0.51	0.59	0.67	Inches
CAPACITANCE								
WEIGHT					81	Grams		
STIFFNESS					160	lb/μ in		
RES. FREQ., NO LOAD					75	kHz		
COMMON SPECIFICATIONS								
SENSITIVITY, NOM.					-18.0	pC/Lb		
OUTPUT SIGNAL POLARITY FOR COMPRESSIVE INPUT						Negative		
SENSING MATERIAL						ALPHA QUARTZ		
LINEARITY [1]					±1	%F.S.		
MAX. VIBRATION, UNLOADED					2,000	g's, Peak		
COEFFICIENT OF THERMAL SENSITIVITY					.01	%°F		
TEMPERATURE RANGE					-400 to +500	°F		
ENVIRONMENTAL SEAL					HERMETIC, WELDED, GLASS-TO-METAL SEAL			
MATERIAL					316L	STAINLESS STEEL		
ELECTRICAL CONNECTOR					RADIALLY MOUNTED, WITH 10-32 MICRO COAX CONNECTOR			

[1] Percent of full scale or of any lesser range, zero based best-fit straight line method.

OPERATING GUIDE MODEL SERIES 1210C CHARGE MODE RING TYPE FORCE SENSORS

INTRODUCTION

Model 1210C are ring type charge output force sensors (also called a force washers) that produces an analogous electrostatic charge mode signal when compressed. The nominal sensitivity is -18 pC/Lb force .

This sensors are in the form of a thin rings with thru holes, resembling washers. They are designed to measure rapid or slowly changing dynamic forces in machines and in other applications where a through stud or bolt holds the sensor in place in a preloaded condition. They can measure vibratory compressive forces over a wide frequency range and pulsing forces from punch and forming presses and other repetitive force applications as well as impact forces.

Model series 1210c consists of seven models with full scale ranges from 5,000 to 100,000 Lbs. Force and in diameter from 0.65 to 2.95 inches.

They contain two thin synthetic alpha quartz crystals which, when compressed, produce a charge-mode output signal exactly analogous to the compressive force being applied.

The high stiffness of series 1210C (they are only slightly less stiff than a solid steel washer of similar dimensions) provides very high resonant frequencies. Loading the sensors, since this adds mass to the dynamic spring-mass system, (the crystals are the spring and the load is the mass) will lower the resonant frequency accordingly.

DESCRIPTION

Refer to Figure 1, following, (a cross-section representation), and Outline/Installation drawing 127-1210C, included with this Operating Guide.

Refer to the specification sheet as part of this operating guide for specific specifications for each of the seven variations of series 1210C. In all models, two thin washer-shaped quartz crystals are sandwiched between the platen and the base and are preloaded by a central preload sleeve, ensuring that the crystals are tightly compressed at all times for maximum linearity and stiffness.

The charge mode output signal is brought out via a glass-to-metal sealed 10-32 coaxial connector, extending radially from the sensor housing.

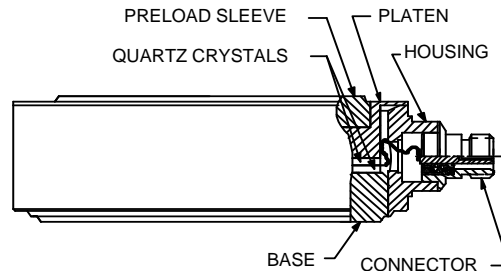


Figure 1 Cross section, series 1210C

The housing and preload sleeve are welded to the base and the platen forming a hermetic seal. The connector housing, integral to the main housing, supports the hermetic 10-32 connector completing the hermetic seal. The welded construction and the glass-to-metal sealed hermetic connector result in a truly hermetic package, impervious to moisture and contaminants.

INSTALLATION

Series 1210C sensors are designed to be used in a preloaded state, i.e., with a preloading member, such as a bolt or rod, passing through the center hole in the sensor. When used in this manner, the sensitivity of the sensor will be reduced by the ratio of the stiffness of the preloading member to the stiffness of the sensor. Refer to Figure 2 below.

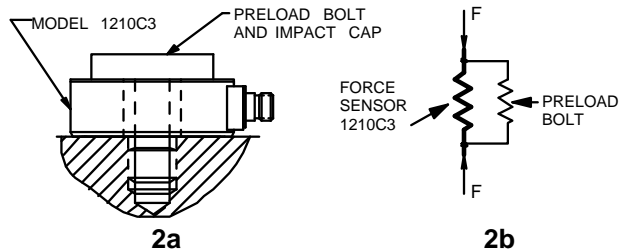


Figure 2. Preloaded 1210C & mechanical schematic of the sensor/preload system

Figure 2a, above, is a representation of the preloaded sensor mounted with thru bolt. Fig. 2b is a schematic of the sensor/preload bolt system, a heavy spring, (representing the force sensor), in parallel with a lighter one (representing the less stiff preload bolt).

Since force is a through variable, the preloading member (bolt or rod) passing through the sensor will carry a portion of the total load F , essentially shunting some force around the sensor. As an example, if the member passing through the sensor has 5% of the stiffness of the sensor, then it stands to reason that 5% of the force will be carried by the preloading member and 95% will be carried by the sensor. Therefore, the effective sensitivity of the sensor is reduced by 5%. This is a very typical situation in actuality.

Because of this, the user is advised to calibrate the sensor in place after the installation is complete, for optimum accuracy of measurement. Dytran may be able to assist in certain of these calibrations. Contact a factory sales engineer for possible help in such calibrations.

Preloading the sensor will not effect the sensitivity beyond the effect just mentioned, i.e., the **amount** of preload does not effect sensitivity, only the **ratio of stiffnesses** as mentioned, can do this. Do not preload the sensor however, beyond the maximum force limit of the sensor, taking into account the maximum load to be measured. This could damage the sensor permanently.

For calculation purposes, the following example is provided.

The approximate stiffness of model 1210C5 is 160 Lb/ μ inch (Lbs. force per micro inch of deformation.) To calculate the expected reduction in sensitivity of the preloaded sensor, divide the stiffness of the preloading bolt or rod by the stiffness of the force sensor, subtract this value from one, then multiply this result by the un-preloaded sensitivity of the sensor, (the value presented in the calibration certificate supplied by Dytran). This will give the approximate preloaded sensitivity of the sensor/preload combination. As previously mentioned, for best (most accurate) results, calibrate the preloaded sensor in place.

NOTE:

When preparing the mounting surfaces for the installation of any 1210C, the mating surfaces must be very flat, i.e., flat to .0005 TIR, preferably. If the surface are not flat, the crystals are stressed differently than when initially calibrated and the sensitivity may shift as a result. Also, it is possible, if the surfaces are not flat enough, to strain the mating surfaces of the force sensor sufficiently to crack the quartz crystals.

Also, clean the surfaces thoroughly before mounting the 1210C and apply a light coat of silicone

grease between mating surfaces. This will give better coupling into the sensor and will improve high frequency transmissibility, thus high frequency response.

To complete the installation, connect the 10-32 electrical connector on the 1210C to the "Input" jack of the charge amplifier and switch the power 'on'. Wait a few minutes for the feedback capacitor to fully charge and for the output to stabilize. Most laboratory type charge amplifiers have time constant (TC) control. Select the very long time constant setting for low frequency and quasi-static measurements. In this setting, it may take several minutes for the output voltage from the charge amplifier to settle. This is normal. Meanwhile, connect the "Output" jack of the power unit to the readout device (oscilloscope, meter, spectrum analyzer, etc.). When the bias has stabilized, the system is ready to take data.

OPERATION

The quartz crystals, when stressed by a compressive force, will produce an electrostatic charge output signal exactly analogous to the stress. This electrostatic charge is measured in picocoulombs (pC). The sensitivity of series 1210C is nominally -18 pC/Lb force. The polarity of the output charge signal in response to compressive force input is negative. This is because charge amplifiers are, in general, inverting amplifiers so the resultant output signal polarity from the charge amplifier will then be positive-going for compressive force inputs.

As previously stated, series 1210C force sensors are designed to be used with charge amplifiers. These special amplifiers consists basically of very high gain, high input impedance, inverting amplifiers with capacitive feedback. The charge amplifier converts the electrostatic charge signal from the 1210C to a low impedance voltage signal which may be read out by oscilloscopes, recorders and other types of data collecting instrumentation.

Dytran produces many different types of charge amplifiers including the fixed range "in-line" types which are designed to be used with constant current (LIVM or IEPE) power units. This type of charge amplifier converts the high impedance charge mode signal from the sensor to a low impedance voltage signal which can drive many feet of cable and connect directly to readout devices such as oscilloscopes, recorders, computers and other types of metering and recording devices.

Many such devices have built-in current source power units capable of providing the constant

current power to the in-line charge amplifiers. These may be labeled ICP, LIVM or IEPE.

Dytran also can provide laboratory type charge amplifiers which offer ranging, filtering and standardization along with the ability to vary the discharge time constant.

Consult the factory if you need help in choosing a charge amplifier for your particular application.

ADDITIONAL CONSIDERATIONS

The model series 1210C are designed to measure very quickly changing forces down to several microseconds in rise time and duration to several seconds long. Be sure to consider the dynamics of the impact when analyzing the data.. For example, if you attach a large mass, (such as a heavy steel impact cap) to any 1210C, expect the natural frequency of your measurement system to drop. What this means to the user is that it will become easier to “ring” or resonate the measurement system with sharp metal to metal impacts. This ringing, if not mitigated, can mask good data and make the measurement seem meaningless.

Often, softer materials such as plastic pads or even tape, interposed between the impacting object and the force sensor, can clear up the problem and yet not adversely affect the test goals.

Never impact objects directly onto the surface of the 1210C without the protection of an impact cap. These surfaces are not designed to withstand metal-to-metal impacts. This will damage the sensor. Instead, contact a Dytran customer service representative or one of our sales engineers with your measurement problem and let us supply a standard impact cap or design a special impact cap tailored to your application.

Model 1210C sensors may be used to measure tensile forces if properly preloaded and fixtured. Dytran can provide “force link” systems consisting of two threaded steel end caps with a preload screw passing through the sensor. The sensor is “sandwiched” between the end caps. The end caps are threaded so the system may be stressed in tension as well compression. Contact the factory for details.

MAINTENANCE & REPAIR

Model series sensors 1210C are totally sealed instruments, as a result, the only routine maintenance that is required is keeping the connector clean to maintain the very high impedance. This is critical to the proper operation of the sensor/charge amplifier combination, especially if the charge amplifier is a direct-connected electrostatic type. If an insulation resistance problem is noticed, wipe the connector with alcohol or Freon, then bake in a 250° F oven for an hour.

Should a problem occur with the 1203C, or should you desire routine recalibration, contact the factory immediately for assistance. You will be put in touch with a sales engineer who may be able to solve the problem over the phone. If the instrument needs to be sent back to the factory for evaluation and possible repair or recalibration, our customer service representative will issue a **Returned Material Authorization (RMA)** number to help guide the instrument through the evaluation and repair procedure.

Do not send an instrument back to the factory for evaluation, repair or recalibration without first obtaining a RMA number and receiving instruction on returning the suspected faulty instrument.