DYTRAN INSTRUMENTS, INC.

Dynamic Transducers and Systems
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PLEASE KEEP THIS DOCUMENTATION WITH INSTRUMENTS.

CALIBRATION CERTIFICATES AND MANUALS ENCLOSED.

Dytran Instruments, Inc.
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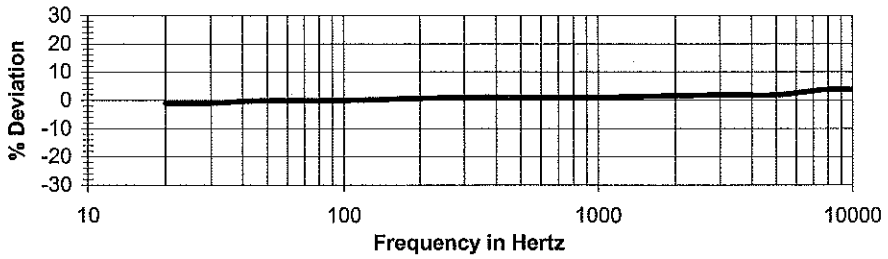
CALIBRATION CERTIFICATE
VOLTAGE MODE ACCELEROMETER

CUSTOMER:	*WESTERN EQUIPMENT INT., INC.*			**TEST REPORT #:**	*3459* *9/12/03*
PURCHASE ORDER #:	*9590*	**SALES ORDER #:**	*113270*	**PROCEDURE:**	*TP3002*
MODEL:	*3101B3*	**SERIAL #:**	*3459*	**RANGE, F.S. (g's):**	*+/- 500*
NEW UNIT	X	**RE-CALIBRATION [1]**		**AS RECEIVED CODE**	**AS RETURNED CODE**
REF. SENSITIVITY (mV/g) [2]:	***10.40***	**TEMP (°C):**	*24*	**HUMIDITY (%):**	*36*

FREQUENCY RESPONSE [3]

FREQUENCY (Hz)	SENSITIVITY (mV/g)	FREQUENCY (Hz)	SENSITIVITY (mV/g)
20	*10.30*	500	*10.50*
30	*10.30*	1000	*10.50*
50	*10.40*	3000	*10.60*
100	*10.40*	5000	*10.60*
300	*10.50*	8000	*10.80*
TRANSVERSE SENSITIVITY (%):	*<5*	10000	*10.80*
DISCHARGE TIME CONSTANT (sec):	*0.70*	**BIAS VOLTAGE (VDC):**	*9.6*

Amplitude Response



REMARKS:

TEST EQUIPMENT LIST - CALIBRATION STATION # 2

DII #	MANUFACTURER	MODEL	SERIAL #	DESCRIPTION	CAL DATE	DUE DATE
209	*MERCER*	*9805*	*ME01K1222*	*FUNCTION GENERATOR*	*01/28/03*	*01/28/04*
259	*TRIG-TEK*	*346B*	*175*	*SYNTHESIZED CALIBRATOR*	*02/24/03*	*02/24/04*
258	*INSTEK*	*OS-622B*	*9568873*	*OSCILLOSCOPE*	*11/18/02*	*11/18/03*
285	*FLUKE*	*45*	*7000003*	*MULTIMETER*	*05/05/03*	*05/05/04*
976	*DYTRAN INST.*	*3010M8*	*976*	*ACCELEROMETER*	*04/24/03*	*04/24/04*
014	*NICOLET*	*3091*	*84D00744*	*DIGITAL OSCILLOSCOPE*	*05/27/03*	*05/27/04*

[1] AS RECEIVED / AS RETURNED CODES:
1 = IN TOLERANCE, NO ADJUSTMENTS
2 = IN TOLERANCE, BUT ADJUSTED
3 = OUT OF TOLERANCE < 5%
4 = OUT OF TOLERANCE > 5%
5 = REPAIR REQUIRED
6 = REPAIRED AND CALIBRATED
7 = UNIT NON-REPAIRABLE, RECOMMEND REPLACEMENT
8 = UNIT SERVICEABLE WITH CURRENT CALIBRATION DATA

[2] THE REFERENCE SENSITIVITY IS MEASURED AT 100 Hz, 1G RMS.

[3] THIS CALIBRATION WAS PERFORMED IN ACCORDANCE WITH MIL-STD-45662A, ANSI/NCSL Z540-1-1994, ISO 10012-1 USING THE BACK-TO-BACK COMPARISON METHOD PER ISA RP37.2 AND IS TRACEABLE TO THE NIST THROUGH TEST REPORT # 8717-130LHS DUE 04-24-04.
ESTIMATED UNCERTAINTY OF CALIBRATION: 2% FROM 5-50 Hz, 1% FROM 100-2000 Hz, 2% FROM 2.5-10 kHz.

CALIBRATION TECHNICIAN: *TEODORO CUEVAS*

TEST DATE: *09/12/03*

RECALL DATE: *09/12/04*

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OG3101B.DOC
REV B 5-26-99

OPERATING GUIDE

MODELS 3101B, 3101B3, 3101B4 and 3101BG

MINIATURE LOW IMPEDANCE VOLTAGE MODE (LIVM)™*

HERMETICALLY SEALED ACCELEROMETERS

NOTE:
The "B" designation in the 3101B Model numbers denotes hermetic sealing. Model series 3101B is the replacement for the previous model series 3101A. Functionally, series 3101B is equivalent to series 3101A.
Model 3101B has a 5-40 integral mounting stud, Model 3101B3 has a 10-32 mounting stud and Model 3101BG, designed for adhesive mounting, has no mounting stud. 3101B4 is identical to 3101B except that the B4 is standardized to +/- 2%. All other specs same as 3101B.

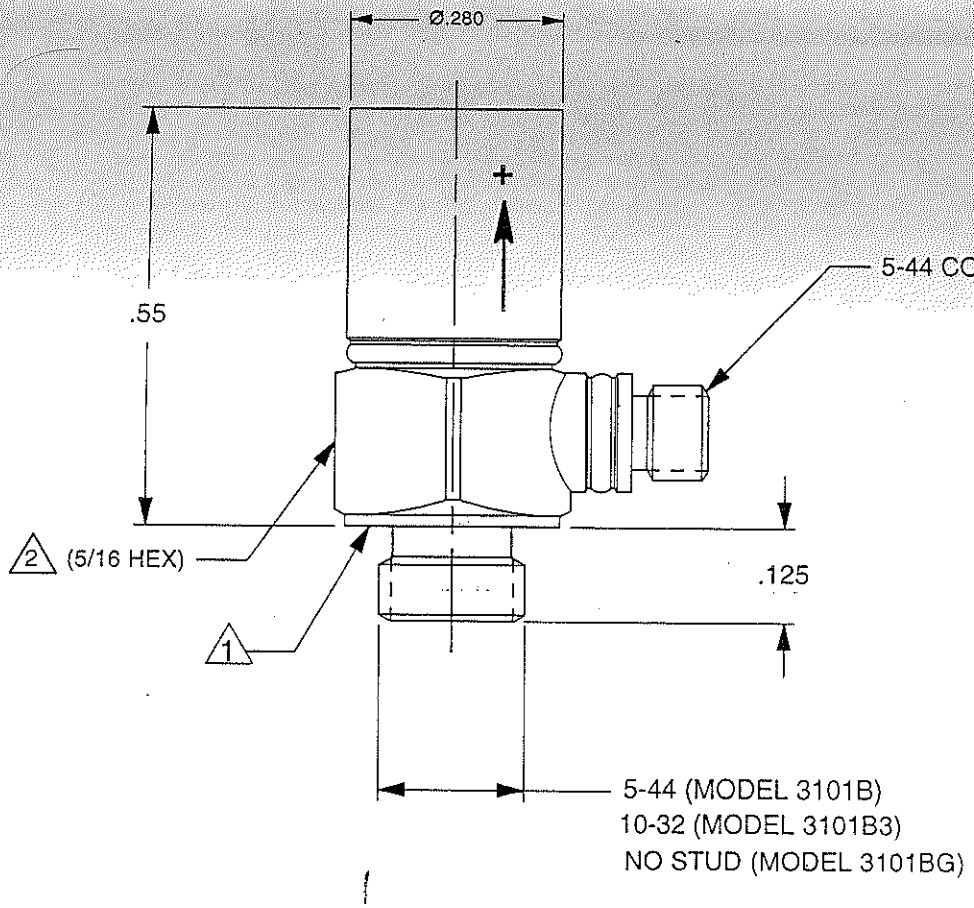
Includes:
1) Outline/Installation Drawing, 127-3101B.
2) Outline/Installation Drawing, 127-3101BG
3) Specifications, Model Series 3101B
4) Paper, "Low Impedance Voltage Mode (LIVM) Theory and Operation"

*NOTE: **LIVM** is Dytran's trademark for its line of **L**ow **I**mpedance **V**oltage **M**ode sensors with built-in amplifiers operating from constant current sources over two wires. **LIVM** instruments are compatible with most other manufacturers' comparable systems.

SPECIFICATIONS-SERIES 3101B MINIATURE ACCELEROMETER

SPECIFICATION	VALUE	UNITS
RANGE F.S., FOR +/- 5 VOLTS OUT	+/- 500	G's
SENSITIVITY, +/- 5% [1]	10.0	mV/G
Sensitivity, Model **3101B4 only**, +/-2%	10.0	mV/G
FREQUENCY RESPONSE, +/- 5%	1 to 10,000 [2]	Hz
+/- 3 db	.66 to 12,000 [2]	Hz
DISCHARGE TIME CONSTANT	0.5	SEC
EQUIVALENT ELECTRICAL NOISE	.007	G's, RMS
LINEARITY [3]	+/- 2	% FS
OUTPUT BIAS VOLTAGE, NOM.	+11	VDC
OUTPUT IMPEDANCE, NOM.	100	Ohms
TRANSVERSE SENSITIVITY, MAX.	5	%
OPERATING TEMPERATURE RANGE	-60 to +250	^{O}F
COEFFICIENT OF THERMAL SENSITIVITY	.03	$\%/^{O}F$
MAXIMUM VIBRATION	+/- 1000	G's
MAXIMUM SHOCK	2000	G's
SIZE (HEX x HEIGHT)	.31 x .60	IN.
WEIGHT	5	GRAMS
CONNECTOR, TRANSVERSE MOUNTED	5-44	COAXIAL
BASE/CASE/CONNECTOR MATERIAL	304L	STAINLESS STEEL
SEAL	HERMETIC	WELDED/GLASS TO METAL
SUPPLY CURRENT RANGE [4]	2 to 20	mA
COMPLIANCE (SUPPLY) VOLTAGE RANGE [4]	+18 to +30	VDC
MOUNTING STUD, MOD **3101B & B4/3101B3**	INTEGRAL, **5-40 x .125 long/10-32 x .125 long**	
MOUNTING STUD, MOD **3101BG**	NONE	ADHESIVE MOUNT

[1] Measured at 100 Hz, 1 G, RMS per ISA RP 37.2 (with back-to-back standard traceable to NIST).
[2] The high frequency response for adhesive mount Model 3101BG is -5% to 5kHz and -3db to 8kHz.
[3] Percent of advertised full scale or any lesser full scale range, zero-based best fit straight line method.
[4] Unit must be powered with Dytran LIVM power unit or other compatible current source power unit for proper operation. **Do not** connect unit to a source of DC power **without current limiting** (such as a battery or other DC voltage source. To do so **will immediately destroy** the integral IC amplifier.



MOUNTING PORT PREPARATION

MODEL 3101B
DRILL NO.38 (Ø.101) X .175 DEEP (MIN
TAP 5-40, UNC-2B X .140 MIN DEPTH.

MODEL 3101B3
DRILL NO.21 (Ø.159) X .175 DEEP (MIN
TAP 10-32, UNF-2B X .140 MIN DEPTH.

2 TORQUE TO 12 LB-IN ON 5/16 HEX WHEN INSTALLING.

1 APPLY THIN COATING IF SILICONE GREASE TO MATING SURFACES BEFOREMOUNTING.

REDRAWN ON CAD 10/13/97

EXCEPT AS OTHERWISE NOTED
ALL DIMENSIONS IN INCHES
TOLERANCE: .XXX = ± .XX= ±
SURFACE FINISH EXCEPT AS NOTED √
BREAK EDGES TO DEBURR RADIUS OR CHAMFER
△ THESE DIAS Ⓜ TO T.I.R.
FILLETS - MAX RAD.

DYTRAN INSTRUMENTS, INC. MASTER ONLY IF IN RED CHATSWORTH, CA.

SCALE 4X	REV -	DATE -	ECN -				
DATE 4/10/92	PART NO. -						
DRAWN N.C.	CHECKED N.C.	MAT'L -					
APPROVED 10-14-97	NEXT ASSEMBLY -	USED ON 3101B, 3101B3					

TITLE
OUTLINE/INSTALLATION DRAWING
MODEL 3101B, 3101B3

DWG NO. **127-3101B**

SHEET 1 OF 1

OPERATING INSTRUCTIONS
SERIES 3101B MINIATURE LIVM ACCELEROMETERS

INTRODUCTION

Dytran's series 3101B consists of miniature Low Impedance Voltage Mode (LIVM) piezoelectric accelerometers designed to analyze the response of small structures where small size and flat frequency response are important.

This series consists of 3 accelerometers, the Model **3101B** with integral 5-40 mounting stud, the Model **3101B3** with 10-32 integral stud and the Model **3101BG** with no stud, for adhesive mounting.

All models feature transverse mounted 5-44 coaxial electrical connector and hermetic sealed construction for use in damp of dirty environments.

DESCRIPTION

Series 3101B contain self-generating quartz seismic elements consisting of two compression mode quartz discs preloaded to a seismic mass and coupled to the accelerometer base through a strain-isolation device. (see Fig. 1)

Motion into the base is transferred to the seismic mass through the crystals creating a reaction force exactly analogous to input acceleration.

This force acting on the crystals, generates a voltage, analogous to input acceleration, and this voltage is coupled to a miniature Integrated Circuit (IC) amplifier located within the 3101B. This MOSFET converter couples the signal from the crystals to the power unit where it can be read out by many different types of readout instruments.

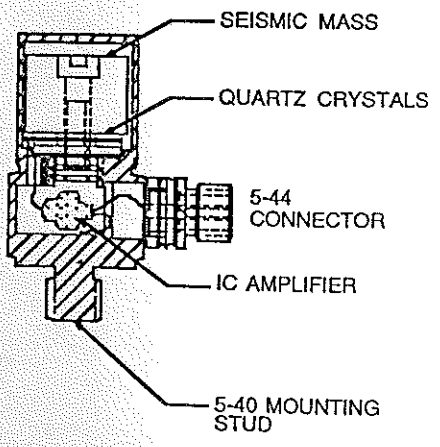


FIGURE 1 CROSS SECTION MODEL 3101B

INSTALLATION, STEP-BY-STEP PROCEDURE

To obtain best high frequency performance from series 3101B, it will be necessary to observe certain procedures to arrive at a mounting installation which adequately couples the motion of the test surface into the base of the accelerometer. To install series 3101B, proceed as follows:

1) Select a rigid section of structure on the test article for mounting the accelerometer avoiding thin sheet metal or other relatively compliant areas which may resonate easily when excited.

2) Unless the selected surface is smooth enough, prepare by spotfacing, grinding, milling, turning, etc., a flat surface area of at least .312 inches diameter. This is most important for good frequency response.

3) **For Models 3101B and 3101B3,** at the center of the prepared (or selected) mounting area, drill and tap a 5-40 x .130 min. deep mounting hole for Model 3101B and a 10-32 tapped hole for Model 3101B3. **Model 3101BG,** intended for adhesive mounting, **requires no mounting hole. For this model, go directly to step #8.**

> **NOTE:** It is very important that the mounting hole be drilled perpendicular to the mounting surface within +/- 1 degree of angle since it is important that the two surfaces (the base of the accelerometer and the mounting surface of the test article) meet in total intimate contact when the accel. is torqued in place.

4) After drilling and tapping, clean the mounting area thoroughly removing all traces of oils and chips.

5) Thread the accelerometer stud into the mounting hole by hand as far as it will go and observe the contact line between the two surfaces. They must meet flush with no light able to pass between them when snugged down by hand. Remove the accelerometer from the mounting hole.

6) Apply a light coating of silicone grease to either mating surface just prior to mounting and thread the accelerometer stud into the threaded hole again and snug down by hand.

7) For best results, use a torque wrench to measure the mounting torque while torquing the

accelerometer down. (The correct torque value is specified on the Outline/Installation drawing supplied). Too much torque can break the mounting stud while not enough could cause erratic operation.

If you do not have access to a torque wrench, torque the accelerometer in place with a very small wrench on the 5/26 in. hex flats to a value slightly greater than hand tight.

NOTE: Dytran can supply a special deep socket wrench modified to allow it to fit over the hex surface of the instrument. This accessory, the Dytran model **6225**, allows coupling to a small **torque wrench.** This is highly recommended for best results with Model series 3101B.

8) For **Model 3101BG**, after selecting or preparing a flat mounting surface, clean the surface to remove any traces of oil or other foreign matter, then put a very tiny drop of a cynoacrylate type adhesive on either surface. Orient the connector in the desired direction, then firmly press the accelerometer to the mounting surface and hold for 10 seconds. For best results, do not use adhesive which is old, i.e., adhesive whose "use by" date has expired.

9) For all installations, tie the coaxial cable down within one inch of the connector ferrule if possible to avoid "cable whip". If the cable must be attached to a surface which does not move with the accelerometer, provide a strain relief loop to avoid stressing the cable.

POWERING THE ACCELEROMETER

Model series 3101B are Voltage Mode instruments, i.e., they contain integral IC amplifiers which operate from constant current supplies. They operate over the "drive current" range of 2 to 20 milliamperes DC current with a compliance voltage range of from +18 to +30 Volts.

The sensitivity of the instrument is not affected by operating within these voltage and current limits.

Any Dytran LIVM power unit may be used to power these instruments but, depending upon the application, some will perform better than others. Dytran can supply a wide array of power units including line and battery power, single and multiple channel and including other features such as gain and filtering.

Series 3101B may also be compatible with other manufacturers' current source type power units. If you are unsure of the compatibility, contact the factory for help before using a power unit which may damage the accelerometer.

IMPORTANT
Do not, under any circumstances, connect the accelerometer to a DC voltage source which does not have current limiting, i.e., a battery, a DC power supply, etc. If this is done the IC amplifier will try to draw infinite current and will be immediately destroyed!

If you wish to design your own LIVM power unit, contact the factory and you will be given the necessary technical support to allow you to do so.

ACCELEROMETER DRIVE CURRENT

Dytran manufactures several LIVM power units which feature adjustable sensor drive current. The supply (drive) current range for series 3101B is given as "from 2 to 20 mA". The user may wonder which is the best current level to use. A few simple rules will help in this determination.

There are three system performance factors affected by drive current. These are:

1) Cable length from sensor to power unit,
2) High frequency response and,
3) Output voltage swing

These are the same three factors one would take into account when selecting an operational amplifier to do a given job. The governing performance parameter of the op-amp is its "slew rate" and this is the same feature which can limit the performance of the series 3101B. Higher sensor drive currents provide higher system slew rates, thus the higher currents will drive longer cables (higher capacitive loads), will drive to higher frequencies and will drive greater output voltage swings.

On the other hand, using lower drive currents results in lower noise, more stable operation, lower sensor IC heat dissipation, and longer battery life.

Most Dytran battery powered power units supply 2 mA of drive current and most line powered power units are factory set to 5 mA. These settings will serve adequately for the majority of all applications.

For special circumstances, when it becomes necessary to select a new drive current, remember the following guidelines:

Use the lowest drive current which gives good results. For example, if you are driving short cables (<25 feet), 2 mA should be sufficient. As the cable

length, frequency response and voltage swing increase, so should the drive current.

For example, 2 mA will drive 100 ft. of cable at +/- 5 Volts to 16 kHz while 20 mA will drive 1000 ft. of cable to +/- 5 Volts to 20 kHz. Experimentation is still the best way to determine the best drive current for your particular application.

If you have further questions on this topic, consult the factory for assistance.

To power the 3101B from Dytran power units, simply connect the accelerometer cable to the accelerometer connector, (hand tight will suffice) then to the "Sensor" jack of the power unit.

Connect the "Output" jack of the power unit to the readout instrument and power the system up. Allow several minutes for coupling capacitors to fully charge before taking readings.

OPERATION

After powering the system, observe the monitor voltmeter located at the front panel of most Dytran power units. This meter reads the DC bias level of the IC amplifier within the accelerometer, (+11 Volts for series 3101B) thus, it may be used for trouble shooting the accelerometer/power unit/cable system.

Normal operation is indicated by an approximate mid-scale reading (in the "Normal" area) on this meter. This tells the user that the power unit is working, the cable to the accel. is O.K. and the accel IC amplifier has normal bias.

If the meter indicates "Short", check the accel. cable for shorts. Check specifically the connector ends of the cable for metallic shards or burrs which can short across contacts. Also check the accelerometer connector and clean out with a stiff brush.

If the meter reads in the "Open" area, this means that the cable is open or not making contact. Again, check for this problem. This indication will also be seen if the IC amplifier in the accel. is "blown".

POLARITY OF OUTPUT SIGNAL

Model series 3101B produces a positive-going output signal for acceleration into the base toward the top of the unit. Conversely, the polarity will be negative-going for the opposite sense of acceleration.

OPERATIONAL HINT, NOISY SIGNAL

If ragged "hash" type noise is observed on the output signal, inspect the installation for loose cable connection to the accelerometer connector or for loose fastening of the accelerometer to its mounting hole. Also, check to see if the cable is rattling against one of the surfaces. Tape cable down if this is noticed.

RMS VS. PEAK VS. PEAK TO PEAK

The accelerometer produces a voltage output exactly analogous to input acceleration be it a steady state vibration or unidirectional shock pulses, i.e., what you see is what you get. There is no transformation such as RMS to peak, etc.

For example, if you observe a steady AC waveform with amplitude 10 mV, RMS, the accelerometer is seeing an input vibration level of 1 G RMS , obtained as follows:

$$\frac{\text{Observed voltage (mV, RMS)}}{\text{Accelerometer sensitivity (mV/G)}} = \text{vib.level (G, RMS)}$$

On the other hand, if you observe a unidirectional voltage pulse of say 100 mV amplitude, the peak input acceleration is 100/10 or 10 G's, peak.

Contact the factory for help in interpreting results if help is needed.

MAINTENANCE AND REPAIR

The sealed construction of series 3101B precludes field maintenance other than for the cleaning of the electrical connector if necessary. Simply wipe the end of the connector with a cloth or paper wipe dipped in alcohol or other non-ozone destroying chemical solvent.

Also, inspect the mounting (bottom) surface for foreign matter, nicks, gouges, burrs, etc. If any of these are noticed, it may be time to send the unit back to the factory for refurbishing of this surface. Do not attempt this yourself as any machining or alteration of the instrument will void the warranty.

If you feel the instrument is not performing well or is inoperative, contact the factory for trouble shooting assistance and/or for instructions in returning the unit for repair.

Always contact the factory to obtain an RMA (Returned Materials Authorization) number before returning the instrument for repair of recalibration.

There is no charge for evaluation and we will not proceed with the repair until we submit a repair cost estimate and get your approval to proceed.

Consult customer service at the factory for costs for routine recalibration. Dytran maintains an NIST traceable calibration facility for this purpose and in most cases can give very quick turnaround on both routine recalibration and repair.

out, use the Monitor meter on the front panel of most Dytran LIVM power units. This topic is covered in the following section, "The fault monitor meter as a trouble shooting tool."

After installing the sensor in accordance with instructions in the Operating Guide (manual) supplied with each instrument, connect the sensor to the power unit "Sensor" jack. This jack is, in most power units, a BNC coaxial connector. You should have been supplied with the proper cable to connect the sensor to the power unit.

It is important to carefully support the cable, especially in situations where there is movement between the sensor and the surroundings. This practice will prolong cable life and will diminish the effects of triboelectric (cable generated) noise on the signal.

THE FAULT MONITOR METER AS A TROUBLE SHOOTING TOOL

Most Dytran LIVM power units incorporate a DC voltmeter on the front panel which measures the DC bias voltage at the sensor terminal. Measuring this voltage supplies information about the health of the sensor, cable and power unit which can be very useful in searching for problems in the measurement system. The three conditions it can identify are: 1) normal operation, 2) shorted cable or power unit or non operating power unit and 3) open sensor, or cable. We will examine each condition here.

NOTE: The fault monitor meter may be the led style (shown on left in Fig 2) or the D'Arsonval panel meter style, shown on the right, Fig 2, depending on the power unit model.

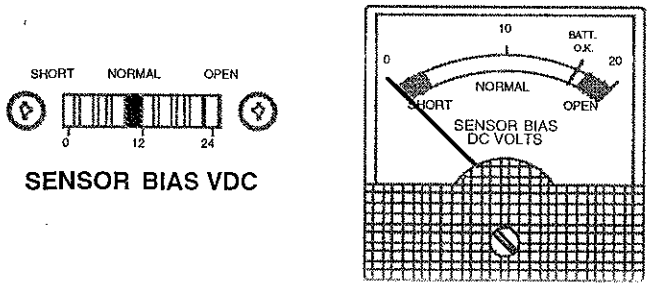


FIGURE 2 TYPICAL FAULT MONITOR METERS

NORMAL OPERATION

Under normal operating conditions, the Monitor meter will indicate mid scale or approximately +10 volts DC when the sensor is connected. Many of the meter faces have a "Normal" area delineated to indicate that the sensor IC is functioning and the cable from sensor to power unit is not open or shorted. It is still possible that certain failure modes of the sensors can provide "Normal" indications but these modes are very rare. In most cases, if the meter reads in the normal area, the system is ready to receive data

As a further quick check on normal operation, with some sensors such as pressure and force sensors, pressing on the diaphragm or force sensitive surface with the hand can cause the monitor meter pointer to deflect showing that the sensor is "alive". With some higher sensitivity accelerometers, shaking them back and forth in the sensitive axis can deflect the monitor meter enough to show that the sensor is functioning.

OPEN SENSOR OR CABLE (FULL SCALE METER READING)

If the sensor amplifier is blown or the cable connecting sensor to power unit is open, the monitor meter will read full scale (in the "Open" area) since the current source in the power unit has no load. To see if the problem is in the sensor, disconnect the sensor from its cable, (leaving the other end of the cable attached to the power unit), and short across the cable end with a metallic object while observing the meter. If the meter does not go to zero ("Short" indication) while the cable end is shorted, the cable is bad (open) replace the cable and try again for the "normal" indication.

If the meter reads zero when the short is applied, the cable is OK but the sensor is open. If another sensor is available, try it to verify the finding.

SHORTED SENSOR OR CABLE ("SHORT" METER READING)

If the fault monitor meter reads in the "short" (zero volts) region after connecting the sensor, this means that a short has brought the voltage output of the constant current circuit to zero volts.

This condition cannot destroy the power unit since the current will be limited to from 2 to 20 mA, depending upon the specific power unit. Sometimes, shards of metal will scrape off the cable connector threads (with the 10-32 connectors) and will short across the cable contacts. To remove these shards, tap the ends of the cable connectors gently against a rigid surface to dislodge them. Cleaning the connector end with a stiff bristled brush may also dislodge any metal shavings.

If the short is still indicated, then the problem is with the cable or the power unit itself. Disconnecting the cable from the power unit and getting a full scale reading means that the power unit is OK and the problem is a shorted cable. Replace the cable.

MAINTENANCE AND REPAIR

Because of their small size and sealed construction, field maintenance of LIVM sensors is limited to cleaning of connectors and maintenance of mounting surfaces.

Clean connectors with a cloth or paper wipe dipped in solvents such as alcohol, Freon, etc. For hermetically sealed units, acetone may be used also. Acetone is not recommended for non-sealed units.

Clean epoxy from the mounting surfaces of accelerometers with acetone or such other solvent which will dissolve epoxies.

If the problem you are having is poor low frequency response and the sensor is not hermetically sealed, baking in a 250 degree F oven for an hour will often get rid of moisture which may have shortened the discharge time constant.

If you cannot solve the problem, call the factory for assistance in trouble shooting the system or for instructions in returning the unit for evaluation and/or possible repair.

If the instruments to be returned, you will be issued a Returned Material Authorization (RMA) number by the Service Department which helps speed the instrument through the evaluation process. Do not return an instrument without first contacting the factory.

DYTRAN INSTRUMENTS, INC.

LOW IMPEDANCE VOLTAGE MODE (LIVM)
THEORY AND OPERATION

LIVM: WHAT IS IT?

LIVM is Dytran's trademark for our version of Low Impedance Voltage Mode piezoelectric instruments, i.e., piezoelectric instruments with integral impedance-converting amplifiers operating from constant current over two wires.

LIVM instruments produced at Dytran include force, pressure and acceleration sensors. Each class of sensor is produced in many variations for a wide variety of applications.

Also falling under the class of LIVM instruments are in-line charge amplifiers utilizing the same two-wire mode of operation as the LIVM sensors.

Operating principles for all LIVM sensors and in-line amplifiers are similar in that all utilize the two wire constant current operating principle. The amplifier built into the sensors is either a MOSFET input unity gain voltage amplifier or an MOS or JFET input charge amplifier.

Both types of amplifier serve to convert the very high impedance of the piezoelectric crystals to a much lower impedance voltage signal which has the capability of driving long cables with little signal degradation.

THEORY OF OPERATION

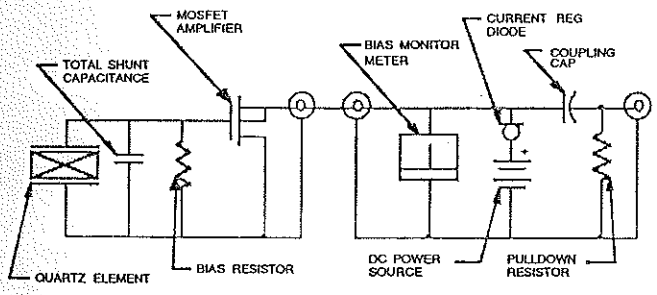


FIGURE I THE VOLTAGE MODE LIVM SYSTEM

Figure I is a simplified schematic of a basic LIVM system including the sensor with integral electronics, the cable and the power unit. The sensor amplifier in this case is the unity gain voltage follower. This is the type of amplifier used in most LIVM sensors and almost exclusively used with quartz sensors.

The sensing element (force, pressure or acceleration) usually made from quartz, is connected directly to the gate of a MOSFET input integrated circuit (IC) amplifier. The amplifier is operated as a source follower and as such has unity voltage gain.

The source terminal of the IC is supplied with constant current over the range of 2 to 20 mA at a compliance (supply) voltage of 18 to 30 volts DC. The power unit can take many configurations from simple battery powered 2 mA supplies with constant current diode to line powered adjustable current power units able to supply 2 to 20 mA of constant current from a variable magnitude constant current circuit.

In either case, the constant current device (current diode or constant current circuit) acts as the source impedance for the IC built into the sensor or the in-line charge amplifier.

Under quiescent conditions, the IC will bias itself at approximately +10 volts DC at the input (source) terminal of the sensor. This bias voltage is monitored with most Dytran power units and this feature serves as a handy trouble shooting tool serving as an indicator for normal or abnormal operation of sensor, cable and power unit. (More on this topic in a following section, "The fault monitor as a trouble shooting tool)".

The sensor signal, produced by the measurand acting upon the piezo element, is superimposed upon the +10 Volt DC bias and appears at the "Sensor" jack of the power unit. At this point, the DC bias portion of the signal is blocked by a coupling capacitor and the AC portion containing the sensor information, is coupled to the "Output" jack. This jack is connected directly to the readout instrument(s), (oscilloscope, spectrum analyzer, frequency counter, etc. The very low output impedance of the sensor (about 100 Ohms) makes the effect of most readout instruments negligible.

Be aware that the coupling capacitor in the power unit (usually 10 mF) and the impedance of the readout load constitute a high pass filter which may set the low frequency response of the system. In most accelerometer applications, the 10 mF coupling capacitor provides ample time constant to allow vibration measurements down to fractions of a Hz.

Dytran also manufactures a DC coupled power unit for LIVM sensors which utilizes an active variable voltage amplifier circuit to buck out the bias voltage of the sensor IC. This unit, the Model 4115, supplies constant current to the sensor and direct couples the sensor to the output jack eliminating the coupling capacitor. This allows the user to take full advantage of the long time constant built into the sensor and precludes the effect or readout load on the low frequency response of the system. This unit is especially useful for very long term (quasi-static) measurements with force and pressure sensors.

OPERATION, GENERAL

Special note: LIVM sensors depend on the power unit to supply a fixed amount of current to the sensor IC. These circuits will absorb any amount of current supplied until the exceed their power rating and burn up. For this reason, never apply power to an LIVM sensor without this current limiting protection. This precludes the connection to batteries, Ac and DC power units and many types of resistance measuring instruments. Never measure the continuity of an LIVM sensor with any type of Ohmmeter. This type of measurement is redundant and may lead to destruction of the sensor IC. To determine if the IC is burned

ENS PE 92/03

P96.42

MECAPTELEC.

DYTRAN INSTRUMENTS, INC.
Dynamic Transducers and Systems
21592 Marilla St. • Chatsworth, CA 91311 • Phone 818-700-7818 • FAX 818-700-7880

CALIBRATION CERTIFICATE
VOLTAGE MODE ACCELEROMETER

MODEL 3101A3 SERIAL NO. 2456

RANGE, F.S. 500 G's REFERENCE SENSITIVITY 10.2 mV/G [1]

FREQUENCY RESPONSE [2]

FREQUENCY (Hz)	SENSITIVITY (mV/G)
20	10.1
30	10.2
50	10.2
100	10.2
300	10.3
500	10.3
1000	10.3
3000	10.4
5000	10.3
8000	10.2
10000	10.3

TEMP. 23 °C

HUMIDITY 40 %

TRANSVERSE SENSITIVITY < 5 %

BIAS VOLTAGE 11.0 VDC

DISCHARGE TIME CONSTANT > 0.1 SEC

[1] The reference sensitivity is measured at 100 Hz, 1 G RMS.
[2] This calibration was performed in accordance with MIL-STD-45662A using the Back-to-Back Comparison Method per ISA S37.2 and is traceable to the NIST through test number 737/229495.

CUSTOMER WESTERN EQUIPMENT CO. P.O.# 790-22

ORDER NO. 87358 DATE 1-17-92

CALIBRATION PERFORMED BY: [signature]

DYTRAN INSTRUMENTS INC.
Dynamic Transducers and Systems

21592 MARILLA AVENUE
CHATSWORTH, CA. 91311
818·700·7818

INSTRUCTION MANUAL
MODEL 3101A3
HIGH FREQUENCY, VOLTAGE MODE
ACCELEROMETER

Note: Model 3101A3 is identical to Model 3101A except that Model 3101A3 has a 10-32 mounting stud .

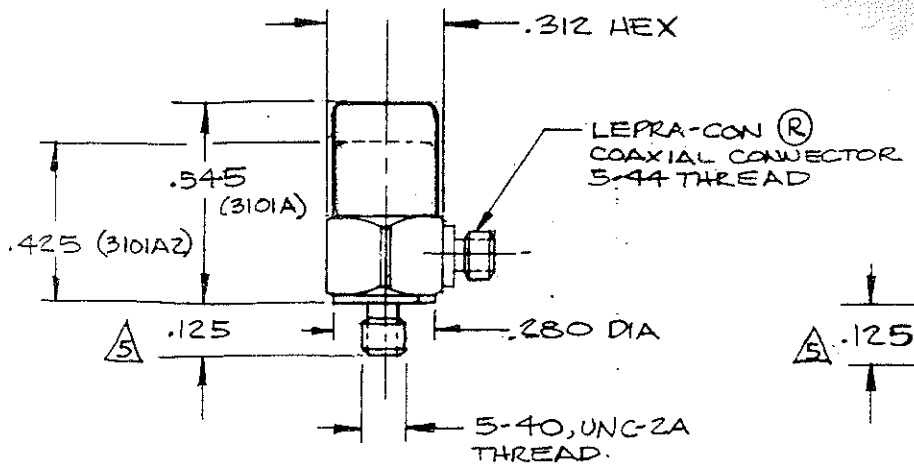
SPECIFICATIONS

MODEL SERIES 3101A3 HIGH FREQUENCY LIVM ACCELEROMETERS

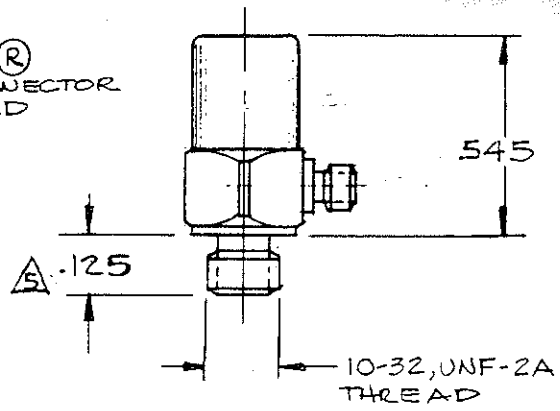
SPECIFICATION	MODEL 3101A3	MODEL 3101A2	UNITS
Range, F.S. for ±5V out	500	1000	g
Sensitivity, Nom.	10	5	mV/g
Frequency Range, ±0.5db	2-10,000	2-10,000	Hz
Discharge Time Constant, Min.	0.1	0.1	Sec
Resolution	0.02	0.04	g
Linearity	±1	±1	%FS
Output Bias Voltage, Nom.	+11	+11	VDC
Output Impedance, Max.	100	100	Ohms
Transverse Sensitivity, Max.	5	5	%
Temperature Range	-60 to +250	-60 to +250	°F
Thermal Coeff. of Sensitivity	0.03	0.03	%/°F
Max. Vibration	±1000	±1500	g
Max. Shock	3000	4000	g
Size, Hex. X Height	.31 X .545	.31 X .425	In.
Weight	5	4	Grams
Connector, Coaxial	5-44 Lepra-Con, Microdot (MALCO) ®		
Base/Case Material	Stainless Steel		
Seal	Epoxy		
Supply Current, from Constant Current Source	2 to 20	2 to 20	mA
Supply Voltage	+18 to +30	+18 to +30	VDC
Mounting Stud, Integral	10-32 x .150 long	5-44 x .125 long	

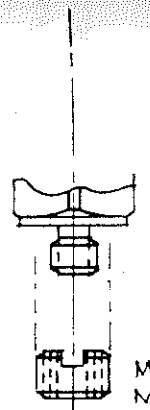
® Lepra-Con is a registered trade mark of MALCO

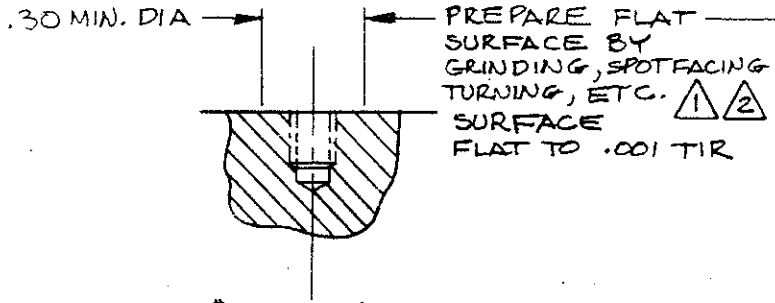
MODEL 3101A, 3101A2

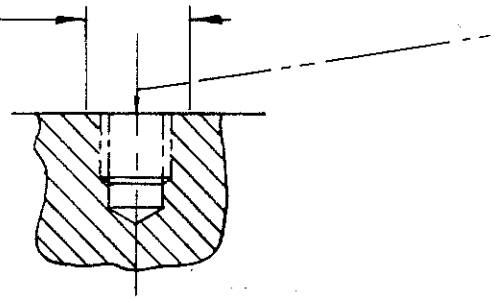


MODEL 3101A3, 3121A









1. APPLY COATING OF SILICONE GREASE (DC-4 OR EQUIV.) TO MATING SURFACES BEFORE MOUNTING.
2. INSPECT MATING SURFACES FOR CHIPS, BURRS AND OTHER FOREIGN MATTER THAT WOULD PREVENT INTIMATE CONTACT BETWEEN SURFACES.
3. TORQUE IN PLACE USING 12 IN-LBS OF TORQUE. DO NOT OVERTORQUE. 5-40 STUD IS FRAGILE
4. USE ONLY FLEXIBLE MODEL 6014A CABLE
5. MODELS 3101AG AND 3121AG HAVE NO STUD.

(R) LEPRA-CON IS A REG. TRADE MARK OF MALCO CO.

DYTRAN Instruments Inc. Buffalo, New York

SCALE	2X	REVISIONS	BY	DATE
DATE	12/6/83	A - 2/14/86		
DRN.	CKD.			
APP'D.	12-6			

TITLE: OUTLINE/INSTALLATION DWG MODS. 3101A, 3101A2, 3101A3, 3121A, 3121AG

NO. 127-3101

BRUNING 40-K65

Operating Instructions
Series 3101A
Voltage Mode Accelerometer

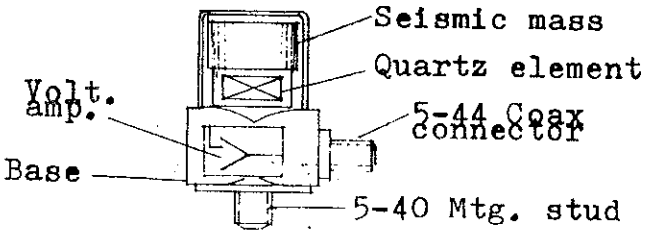
Introduction

The Dytran Model Series 3101A consists of miniature piezoelectric accelerometers designed for frequency analysis of structures and mechanisms where small size, low mass and extended frequency response are important.

The Model 3101A has a nominal sensitivity of 10 mV/g while the Model 3101A02 has a sensitivity of 5 mV/g with slightly better frequency response. Both mount with integral 5-40 mounting stud and feature side mounted coaxial connector.

Description

Both Models contain Quartz elements acted upon by a seismic mass tightly preloaded together and rigidly coupled to the accelerometer base. Motion into the base is transmitted to the seismic mass through the Quartz element resulting in a reaction force exactly proportional to the instantaneous acceleration.



Series 3101A Accelerometer

FIG. 1

A Microelectronic Impedance Converter contained within the base converts the high impedance voltage generated by the Quartz element to a low impedance voltage mode signal able to drive most readouts directly.

Installation

Since the Mod 3101A is a high frequency accelerometer certain precautions must be observed when mounting.

1) Select a rigid section of structure to mount the accelerometer, avoiding thin sheet metal or other flexible areas that might resonate at specific frequencies.

2) Drill and tap a #5-40 mounting hole with useable thread depth of at least .130 inch.

> NOTE: It is important that the mounting hole be perpendicular to the mounting surface within ± 1 degree of angle.

3) Prepare (by spotfacing, grinding, milling, etc.) a flat surface area of at least 5/16 (.312) in. dia. coaxial to the mounting hole. This step is most important for good high frequency coupling into the base.

4) Clean mating surfaces removing all chips, grease etc.

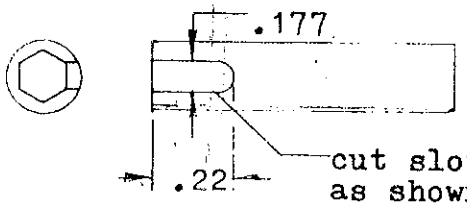
5) Apply a light coating of silicone grease (Dow Corning DC-3 or equiv.) to the mounting surface just prior to mounting.

6) Carefully, by hand, thraad the accelerometer stud into the mounting hole. The accel. should rotate freely into the mounting hole untill the mounting surface seats.

IMPORTANT

Use a torque wrench to tighten the 3101A in place. use 12 in.-lbs of torque. Do not exceed this value. The 5-40 integral stud can be twisted off by excessive mounting torque.

Note: Modify a ¼ in. drive deep hex socket as shown here or order modified socket from Dytran to facilitate installation.



5/16,deep hex socket. ¼ in. drive.

cut slot in one side as shown.

FIG 2

7) Tie cable to mounting surface within one inch of accel. if possible, to avoid excessive cable motion.

If cable must be fastened to non-moving surface, allow a strain relief loop to avoid stressing the cable.

Powering

The 3101A is a Voltage Mode unit i.e., it contains an internal amplifier that must be supplied with 2 to 20 mA of constant current at a +18 to+24V DC level.

Use any Dytran Voltage Mode Current Source for this purpose. The 3101A may be compatible with various other manufacturers power units. Consult the factory if in doubt before using as permanent damage can be inflicted by improper powering. This damage is not covered by the warranty.

IMPORTANT

Do not, under any circumstances apply power to the 3101A without current limiting within the range specified herein as to do so will immediately destroy the internal amplifier.

Some power units, such as the Dytran Mod. 4110, have adjustable transducer current settings. Use the lower current settings (less than 10 mA) for typical operation. Currents above this value are needed only when driving longer cables at high frequencies.

To power the 3101A, simply connect the transducer cable to the 5-40 connector, hand tightening the threaded lock ring securely, then connect the Microdot 10-32 end to the Current Source at the "Sensor" jack.

The readout instrument, oscilloscope, meter, recorder, etc., is connected to the "Output" jack using the RG58/U cable. (Dytran Mod. 6020).

Operation

Turn on Current Source and observe the front panel system checkout meter on the front panel. If the meter indicates in the "Normal" or mid-scale area, the transducer amplifier is functioning, the cables are not open or shorted and the system is ready for use.

If the meter reads to the left, check cables and connections for shorts.

If the meter reads to the right, check for open circuits.

Remember, the system is AC coupled, therefore allow several seconds for coupling capacitors to fully charge. During this time, drifting of the output signal will be observed.

The Model 3101A produces a positive going signal for positive acceleration into the mounting base.(Motion towards the top of the unit)

The output is proportional

to instantaneous acceleration i.e., it will provide 10 mVpeak signal for 1g peak acceleration input.

For sinusoidal motion, multiply peak acceleration by 2 to obtain "peak to peak" and by.707 to obtain "RMS" vibration level in "G's, RMS".

If electrical noise is observed on the accelerometer output signal at certain frequencies, check the torque on the accel.

Also check the tightness of cable connector at the accel.

Excessive cable "whip", especially at lower frequencies when motion is greater can generate noise. Tie cables dowm to avoid this problem.

Maintenance and Repair

The 3101A is a miniature epoxy sealed unit with self contained amplifier and as such, maintenance is minimal. If low frequency response shows degradation, bake the unit out in an oven set at +250 degrees F. This will remove any moisture that may have entered the unit and should restore the insulation resistance of the quartz crystals.

Warranty

All Dytran products are warranted for 6 months against any failure due to faulty materials, workmanship or inherant design, beginning at the time delivery is acceptedby the user.

Should a failure occur,return the unit along with a brief note describing the problem. Warranty repairs will be promptly handled. If there is some question as to liability, the customer will be contacted before any repair work is started.