CEC Model 2700
Precision Signal Source

Operation and Maintenance Manual

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Contents

SECTION I – DESCRIPTION

1.1 INTRODUCTION

This document contains information on the operation, installation and maintenance of the CEC 2700-0104, 2700-0105 & 2700-0200 Precision Signal Source. This instrument is manufactured by CEC Vibration Products Inc.

The CEC 2700 Precision Signal Source provides accurate electrical outputs that simulate voltage and charge output type transducers. Designed to calibrate vibration instrumentation systems, its differential charge output is especially valuable for systems that use piezoelectric accelerometers. Because it provides a variety of output signals, the CEC 2700 is also valuable in troubleshooting and isolating signal problems in instrumentation systems

1.2 PHYSICAL DESCRIPTION

The instrument is housed in a rugged metal case 9" high x 11" wide x 7" deep, weighing 8 pounds. All electrical connections and controls are located on the front panel behind a hinged front cover. The system is portable, and operates from either 115/220 VAC, 50 to 400 Hz power source or from an internal NiCad battery pack. Table 1-1 gives the system specifications and Table 1-2 is the list of controls, indicators and connections, and their functions. Figure 1-1 shows the location of these controls, indicators and connections.

Table 1-1
Specifications

Output:	Single-ended and differential charge and single-ended low impedance (50 ohms) AC and DC. Low impedance output current is 10 mA maximum. Output units are Average, RMS or Peak.
Amplitude:	Adjustable in two ranges: 10.0 to 199.9 mV or Pico coulombs (pcmb) 200 to 1999 mV or pcmb
Amplitude Accuracy:	±0.05% FS ±1 count. (Full scale is 199.9 or 1999 mV)
Charge Capacitance:	Accuracy, 1000 pf ±3.5%.
Frequency:	Adjustable in 1 RPM increments from 600 RPM (10.0 Hz) to 99,999 RPM (1,667 Hz)
Frequency Accuracy:	±0.01%
Noise:	1% FS amplitude, maximum.
Distortion:	3% maximum at 99,999 RPM
Power:	Rechargeable NiCad battery or 115/220 VAC, 50 to 400 Hz (for battery charging and AC operation.) A fully charged battery operates up to 8 hours.
Operating Temperature:	AC power: 32°F to 122°F (0°C to 50°C) Battery power: 39°F to 122°F (4°C to 50°C)
Weight:	8 lbs. (not including cable accessories)
Dimensions:	11"W x 9"H x 7"D

Table 1-2
Controls, Indicators and Connectors

RPM Thumbwheel Control:	Five digit thumbwheel control for setting the RPM (frequency). The output frequency of the microprocessor based quartz crystal-controlled synthesized oscillator is adjustable in 1 RPM increments from 500 to 99999.
AVG/RMS/PEAK Rotary Switch:	Selects the output units. Select from AVG (Average), RMS (Root-Mean-Square), or Peak units.
OUTPUT ADJUST (*COARSE* and *FINE*):	Sets output levels with the *COARSE* and *FINE* controls. A 3½-digit LCD "pcmb/mV" indicator displays the current output level. Digital output levels are displayed in pcmb (Pico coulombs) or mV (millivolt).
POWER ON/OFF Switch:	Activates the instrument. When the instrument is ON, the LCD meter displays an output level.
LINE VOLTAGE SELECT Switch:	Recessed switch which selects 115 or 220 VAC operation
BAT CHG Light:	Indicates that battery is charging in fast charge mode.
LOW BAT Indicator:	"LOW BAT" illuminates when battery power is low. When this occurs, recharge the batteries before operation or operate from an AC power source. **NOTE:** The LOW BAT indicator will not function if the batteries are completely discharged.
GND Post:	Panel binding post provided for electrically grounding the instrument.
J1: DIFFERENTIAL Output Connector:	Supplies the differential charge output: Pin A = Differential Output Pin B = Differential Output Pin C = Case Ground
J2: AC & DC mV Output Connector:	Accesses both mV outputs: Pin A = AC mV output (+) Pin B = Common (circuit ground) Pin C = Shield (case ground) Pin D = DC mV output (+)
J3: SINGLE ENDED Output Connector:	Supplies the single-ended charge output: Center Pin = Output Body = Circuit Ground (shield)
J4: TACH OUTPUT:	Supplies the tachometer outputs: Pin A = Tach 3 Pin B = Tach 2 Pin C = Tach 1 Pin D = Chassis Ground Pin E = Signal Ground Pin F = Tach 4

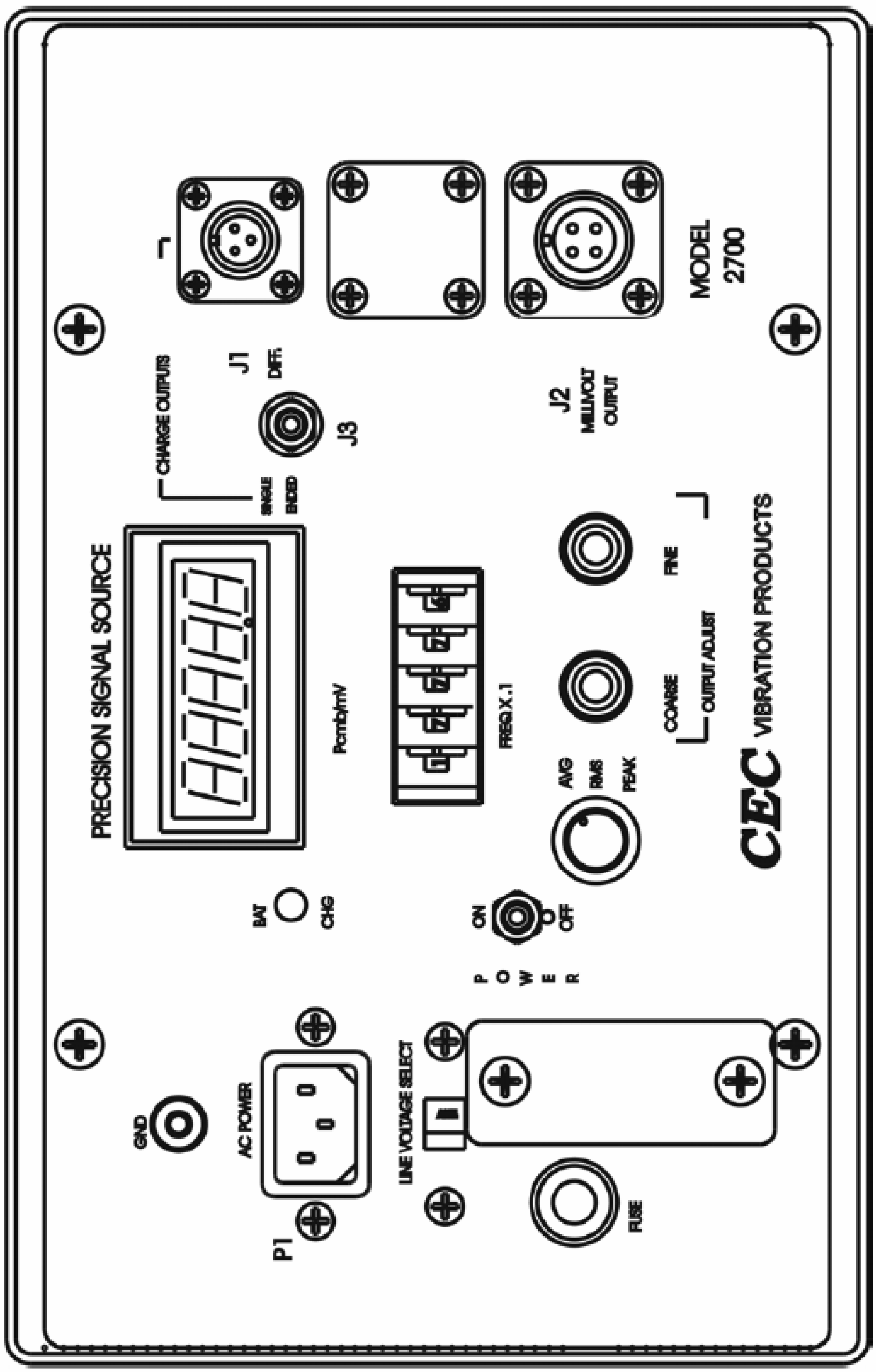

Figure 1-2. 2700-0105

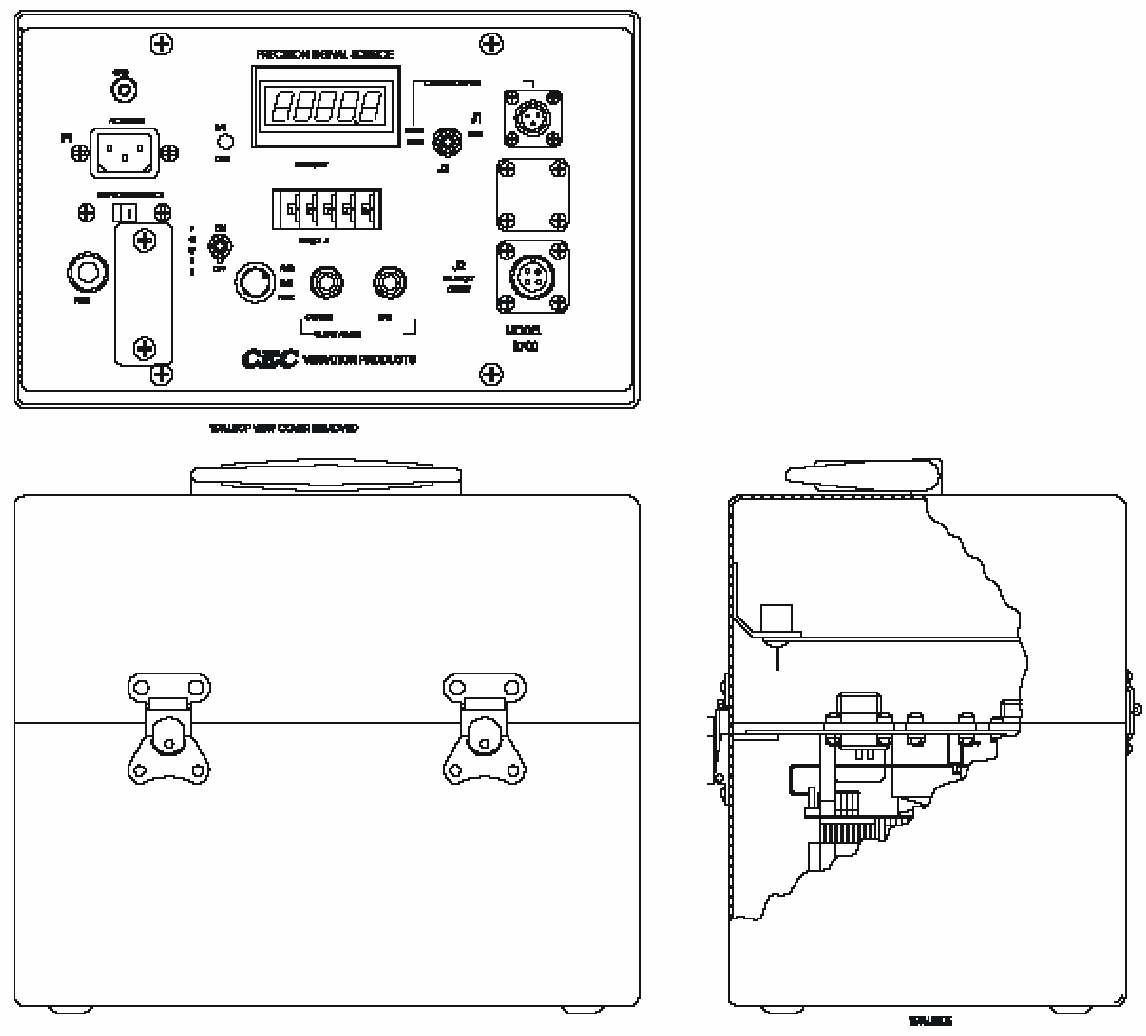

Figure 1-2
2700-0105

SECTION II – INSTALLATION

2.1 CABLE ASSEMBLIES

Cable assemblies are available from CEC Vibration Products Inc. that interfaces with the panel output connectors and many external connector configurations. For a complete list of available cables request Document No. 0700034-29-0000. CEC Vibration Products Inc. can also fabricate cable assemblies to accommodate your unique applications. The connectors that mate with the CEC 2700-0104, -0105 and -0200 are listed in Table 2-1.

Table 2-1
Mating Connectors

MATES WITH	CEC PART NO.	DESCRIPTION
J1	619571-0001	MS3106F10SL-3P
J2	619571-0002	MS3106F14S-2P
J3	618332	10-32 RF Receptacle
*J4	0700069-90-0106	MS3106F14S-6P

* Model 2700-0104 & -0200 only

2.2 POWER CONNECTIONS

NOTE: *Internal batteries are shipped in an uncharged condition, charge batteries fully before attempting operation from battery power. See Paragraph 4-2 for procedure.*

You may operate the system at anytime from an AC power source by connecting the power cable into P1 and the other end into a 115/220 VAC, 50/60 Hz power source. Make sure the Line Voltage Select switch (located on the front panel next to P1) is set for the correct input voltage.

2.3 ELECTRICAL CONNECTIONS

Disconnect the transducer and connect the system input cable to the Signal Source.

- For differential charge outputs, use connector J1.
- For single-ended charge output, use connector J3.
- If the transducer has an AC or DC mV output, use connector J2.
- Note: The AC output is located on Pin A and the DC output is located on Pin D, both shares Pin B as the common.

If the system uses tracking filters driven by the machines tachometer, connect the proper system tachometer input cables to J4. (Models 2700-0104 & -0200 only)

☜ Prior to disconnecting any tachometer wiring of the system being checked, make sure the system is on manual operation and all personnel are aware of potential over speed alarms.

SECTION III - OPERATION

3.1 BASIC OPERATION

Basic operation of the Signal Source is as follows:

1. Place the POWER switch in the ON position. If the LOW BAT indicator lights, charge the batteries, *(see Section 4-2)* or operate from an AC source.
2. Determine the RPM, units and output level needed to calibrate or check the instrumentation system. See paragraph 3-4 for procedure.
3. Set the desired RPM with the RPM thumbwheel control on the front panel.
4. Select the desired units (AVG, RMS, PEAK) with the AVG/RMS/PEAK rotary switch on front panel.
5. Set the desired output level with the COARSE and FINE OUTPUT ADJUST controls.
6. If using tachometer outputs select the proper ratio set from Table 3-1 and set the Dip Switch as shown. (Models 2700-0104 & -0200 only)

3.2 OPERATION EXAMPLE

Assume we are calibrating a vibration monitoring system, and have determined that the CEC 2700 simulation output must be 67.8 pcmb peak at 5,000 RPM.

1. Turn the Signal Source "ON" with the power switch.
2. Set the COARSE and FINE OUTPUT ADJUST controls to their full counter-clockwise positions (minimum output level.)

***NOTE**: The case of the Precision Signal Source is not grounded when operating from the internal batteries. In some installations, to avoid ground loop problems, the shield of the transducer connector will not be connected to the cable shield. When connecting the Precision Signal Source to this wiring arrangement, connect the GND post of the Precision Signal Source case to the signal conditioner ground. This assures that both instruments are at a common electrical ground.*

3. Set the RPM to "0 5 0 0 0” with the thumbwheel switches.
4. Select PEAK units using the panel switch.
5. Set the approximate output level with the COARSE OUTPUT ADJUST control, and then make precise adjustments with the FINE control so that the LCD meter reads "67.8."

You can now calibrate or check the instrumentation system.

3.3 SIMULATING ENGINE TACHOMETERS

(Models 2700-0104 & -0200 only)

To simulate engine tachometers, after performing the basic operation in Paragraph 3-1, set the RATIO dip switches according to the engine tachometer being simulated. Tachometer outputs 1, 2 & 3 are programmable as a set. Tachometer 4 output is always one pulse per revolution. See Table 3-1 for proper pulse per revolution settings.

3.4 DETERMINING OUTPUT SIGNAL PARAMETERS

To find the parameters of the output signal needed to simulate a transducer and calibrate the instrumentation system, proceed as follows:

1. Find the level and frequency required to adjust or calibrate the system.

2. From the output sensitivity of the transducer, determine the CEC 2700 settings needed to simulate that transducer at the system's operating or calibration levels.

In some dynamic systems, determining the CEC 2700 settings may be more complex. You may have to calculate the RPM and level of the simulated transducer output when the output units of the transducer are different from the system output. This is common with vibration instrumentation. Often, the system will read out in units of displacement or velocity and the transducer's output may be in acceleration. The system may also read in units of displacement or acceleration, while the transducer's output is in velocity. Since displacement, velocity and acceleration units are mathematically related in sinusoidal waveforms, it is not difficult to make the conversions. (To use these conversions, you must convert RPM to frequency in Hz; RPM = frequency x 60.)

The following special frequencies are helpful when converting between various vibration units:

- 61.4 Hz, acceleration (g peak) equals velocity (ips, peak)

- At 139.9 Hz, acceleration (g peak) equals displacement (mils, peak-peak)

- At 318.3 Hz, velocity (ips peak) equals displacement (mils, peak-peak)

Unlike other fixed-setting calibrators the CEC 2700 lets you calibrate systems at actual test or operating condition. This is because you can adjust the RPM (frequency) and output level to any value within their range.

To calculate the inputs required for any other frequency, proceed as follows:
Reference Tables 3-2, 3-3 & 3-4

1. Find the mode on the system's output indicator
   (Displacement, velocity or acceleration)

2. Determine the output units
   (Average, RMS, Peak, Peak-Peak)

3. Determine the desired amplitude of the reading on the indicator
   (e.g. 5 ips, 5 g's, or 5 mils)

4. Determine the desired calibration frequency, and then convert to RPM by multiplying the frequency (Hz) by 60.

Use Tables 3-2, 3-3 and 3-4 to find the conversion constant (K) required for satisfying the conditions. Then use the formula associated with the appropriate chart to calculate the relationship between the transducer output and system reading. Finally, calculate the transducer sensitivity, and calculate the signal level *(in mV or Pico coulombs)* needed to simulate the transducer at the system calibration point.

Table 3-1
Tachometer Ratio Dip Switch Settings

ENGINE	DIP SWITCH SETTING O = Open C = Closed								TACH 1	TACH 2	TACH 3
	1	2	3	4	5	6	7	8			
Special	O	O	O	O	O	O	O	O	83	47	40
ADC	C	O	O	O	O	O	O	O	60	60	60
AGT-1500	O	C	O	O	O	O	O	O	4	3	--
APS2000											
APS3200											
CF 34-8C											
CF6-50	C	C	O	O	O	O	O	O	38	12.68	--
CF6-80A	O	O	C	O	O	O	O	O	38	9.3	--
CF6-80C P											
CF6-80C F											
CFM-56	C	O	C	O	O	O	O	O	31.46	7.76	--
CFM-56-2	O	C	C	O	O	O	O	O	30	8	--
CFM 56-3											
CFM 56-5A											
CFM 56-5B											
CFM 56-5C											
CFM 56-7B											
F100-PW-100	C	C	C	O	O	O	O	O	38	9.66	--
F100-PW-200	C	C	C	O	O	O	O	O	38	9.66	--
F100-PW-220	C	C	C	O	O	O	O	O	38	9.66	--
F110-GE-100	O	O	O	C	O	O	O	O	12	9.14	--
F110-GE-129	C	O	O	C	O	O	O	O	12	9.12	--
F110-GE-400	C	O	O	C	O	O	O	O	12	9.12	--
F404-GE-400	O	C	O	C	O	O	O	O	42	14.32	--
GE-1012	C	C	O	C	O	O	O	O	160	--	--
J-52-P6	O	O	C	C	O	O	O	O	0.77	0.36	--
J-52-P8	C	O	C	C	O	O	O	O	0.77	0.35	--
J-52-P408	O	C	C	C	O	O	O	O	0.38	0.34	--
J-79-GE-15/17	C	C	C	C	O	O	O	O	0.55	--	--
J-85-GE-13	O	O	O	O	C	O	O	O	0.25	--	--
J-85-GE-21	C	O	O	O	C	O	O	O	0.25	--	--
JT3D	O	C	O	O	C	O	O	O	0.68	0.44	--
JT8D	C	C	O	O	C	O	O	O	0.49	0.34	--
JT9D-3A	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7A	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7F	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7J	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7Q	O	O	C	O	C	O	O	O	1.15	0.54	--
JT9D-7R4/ALL	O	O	C	O	C	O	O	O	1.15	0.54	--
JT15D1	C	O	C	O	C	O	O	O	47.55	23	--
JT15D4	C	O	C	O	C	O	O	O	47.55	23	--
JT15D48	C	O	C	O	C	O	O	O	47.55	23	--
JT15D4C	O	C	C	O	C	O	O	O	23.25	23	--
JT15D5	C	C	C	O	C	O	O	O	24	11.28	--
LM2500	O	O	O	C	C	O	O	O	83	47	--
LM5000	O	C	O	C	C	C	O	O	55	48	--
M53-P2	C	C	O	C	C	C	O	O	62.74	0.159388	60

PT6T-3	C	O	O	C	C	O	O	O	0.11	0.12	--
PW205B/MBB	O	C	O	C	C	O	O	O	2.41	20.84	--
PW205B/BELL	C	C	O	C	C	O	O	O	2.41	20.84	--
PW300	O	O	C	C	C	O	O	O	31.79	17.14	--
PW300B/BD	C	O	C	C	C	O	O	O	33	17.14	--
PW300P/TYP	O	C	C	C	C	O	O	O	27	17.14	--
PW1120	C	C	C	C	C	O	O	O	38	9.66	--
PW2037	O	O	O	O	O	C	O	O	60	17.47	--
PW4000											
RB211	C	O	O	O	O	C	O	O	60	60	2.37
RB211-524	O	C	O	O	O	C	O	O	64	64	2.56
RB211-535C	C	O	O	O	O	C	O	O	60	60	2.37
T-56-A-14-LFE	O	O	C	O	O	C	O	O	0.3	--	--
T-58-10	C	O	C	O	O	C	O	O	0.2	0.16	--
T-58-GE-5D	O	C	C	O	O	C	O	O	0.22	0.16	--
T-62T-2A1	C	C	C	O	O	C	O	O	3.75	--	--
T-62T-2B	O	O	O	C	O	C	O	O	4.81	--	--
T-62T-2C/2D	C	C	C	O	O	C	O	O	3.75	--	--
T-62T-11	O	O	O	C	O	C	O	O	4.81	--	--
T-62T-25	O	O	O	C	O	C	O	O	4.81	--	--
T-62T-29/ALL	O	O	O	C	O	C	O	O	4.81	--	--
T-62T-39	O	O	O	C	O	C	O	O	4.81	--	--
T-62T-12/ALL	C	C	O	C	O	C	O	O	4.57	--	--
T-62T-27/ALL	C	C	O	C	O	C	O	O	4.57	--	--
T-62T-40C	C	C	O	C	O	C	O	O	4.57	--	--
T-62T-39	C	C	O	C	O	C	O	O	4.57	--	--
T-62T-16/ALL	O	O	C	C	O	C	O	O	4.79	--	--
T-62T-40-1	O	O	O	O	C	C	O	O	4.67	--	--
T-62T-40-5	O	C	C	C	O	C	O	O	4.7	--	--
T-62T-40C3	O	C	C	C	O	C	O	O	4.7	--	--
T-62T-40C3A	O	O	O	O	C	C	O	O	4.67	--	--
T-62T-40C4	O	O	O	O	C	C	O	O	4.67	--	--
T-62T-40C7	O	O	O	O	C	C	O	O	4.67	--	--
T-62T-40C7A	O	O	O	O	C	C	O	O	4.67	--	--
T-62T-40C7D	O	O	O	O	C	C	O	O	4.67	--	--
T-64GE7A/T4C2	C	O	O	O	C	C	O	O	0.23	0.31	--
T-700	O	C	O	O	C	C	O	O	4	3.62	--
TF-30-P6	C	C	O	O	C	C	O	O	0.42	0.28	--
TF-30-P408	C	C	O	O	C	C	O	O	0.42	0.28	--
TF-30-T414	O	O	C	O	C	C	O	O	0.42	0.23	--
TF-34	C	O	C	O	C	C	O	O	28	0.24	--
TF-39-GE-1C	O	C	C	O	C	C	O	O	1	0.43	--
TF-41	C	C	C	O	C	C	O	O	0.46	0.33	--
V2500											
250C-20B	O	O	O	C	C	C	O	O	0.08	0.13	--
250C-30F	C	O	O	C	C	C	O	O	0.08	0.08	--

Table 3-2
Values of K for various Units of V and D

Velocity in/sec (ips)	**Displacement, inches**			
	Average	**RMS**	**Peak**	**Peak-Peak**
Average	6.28319	5.65685	4	2
RMS	6.97886	6.28319	4.44288	2.22144
Peak	9.8696	8.88577	6.28319	3.14159
Peak-Peak	19.7392	17.7715	12.5664	6.28319

To find velocity when frequency and displacement are known use the following factors:

V = K f D where:	D = Displacement	inches
	f = Frequency	Hz
	V = Velocity	In / sec (ips)

Table 3-3
Values of K for various Units of g and D

Acceleration g's	**Displacement, inches**			
	Average	**RMS**	**Peak**	**Peak-Peak**
Average	0.102252	0.0920593	0.0650958	0.0325479
RMS	0.113574	0.102252	0.0723032	0.0361516
Peak	0.160617	0.144606	0.102252	0.0511261
Peak-Peak	0.321235	0.289213	0.204504	0.102252

To find acceleration (g’s) when displacement and frequency are known, use the following factors:

$g = K f^2 D$ where:	g = Acceleration	g’s
	F = Frequency	Hz
	D = Displacement	inches

Table 3-4
Values of K for various Units of g and D

Acceleration g's	**Velocity, inches/seconds (ips)**			
	Average	**RMS**	**Peak**	**Peak-Peak**
Average	0.0162739	0.0146517	0.0103603	0.00518016
RMS	0.0180758	0.0162739	0.0115074	0.00575371
Peak	0.0255631	0.0230148	0.0162739	0.00813697
Peak-Peak	0.0511261	0.0460297	0.0325479	0.0162739

To find acceleration (g's) when velocity and frequency are known use the following factors:

g = K f V where:	g = Acceleration	g's
	F = Frequency	Hz
	V = Velocity	In / sec (ips)

Example:

Suppose you must set the alarm level of a machine vibration monitoring system to 5 ips at the machine's normal operating speed of 5,000 RPM (83.3 Hz.) The monitoring system uses a differential accelerometer with a charge sensitivity of 10 pcmb/g peak.

To convert acceleration (g's, peak) to velocity (ips, peak), use the constant K=0.0162739 from Table 3-4. Then, Solve g = K f V; g = (0.0162739)(83.3)(5) = 6.78g. The sensitivity of the accelerometer is 10 pcmb/g, so we must supply the vibration monitor with a calibration signal of 67.8 Pico coulombs peak (6.78g X 10 pcmb/g):

1. Set the frequency to 83.3 Hz (5000 RPM) with the thumbwheel switches.
2. Select PEAK on the AVG / RMS / PEAK control.
3. Set the output display to read 67.8 with the COARSE and FINE OUTPUT ADJUST controls.

You can now calibrate the monitor precisely at the proper operating conditions.

3.4 ISOLATING A PROBLEM

The CEC 2700 Precision Signal Source is also useful when you must isolate problems in instrumentation systems.

Assume your system is malfunctioning; since the CEC 2700 provides charge, AC mV, and DC mV signal outputs, you can isolate the problem in this system by injecting the appropriate signal at each system component. (See Figure 3-1)

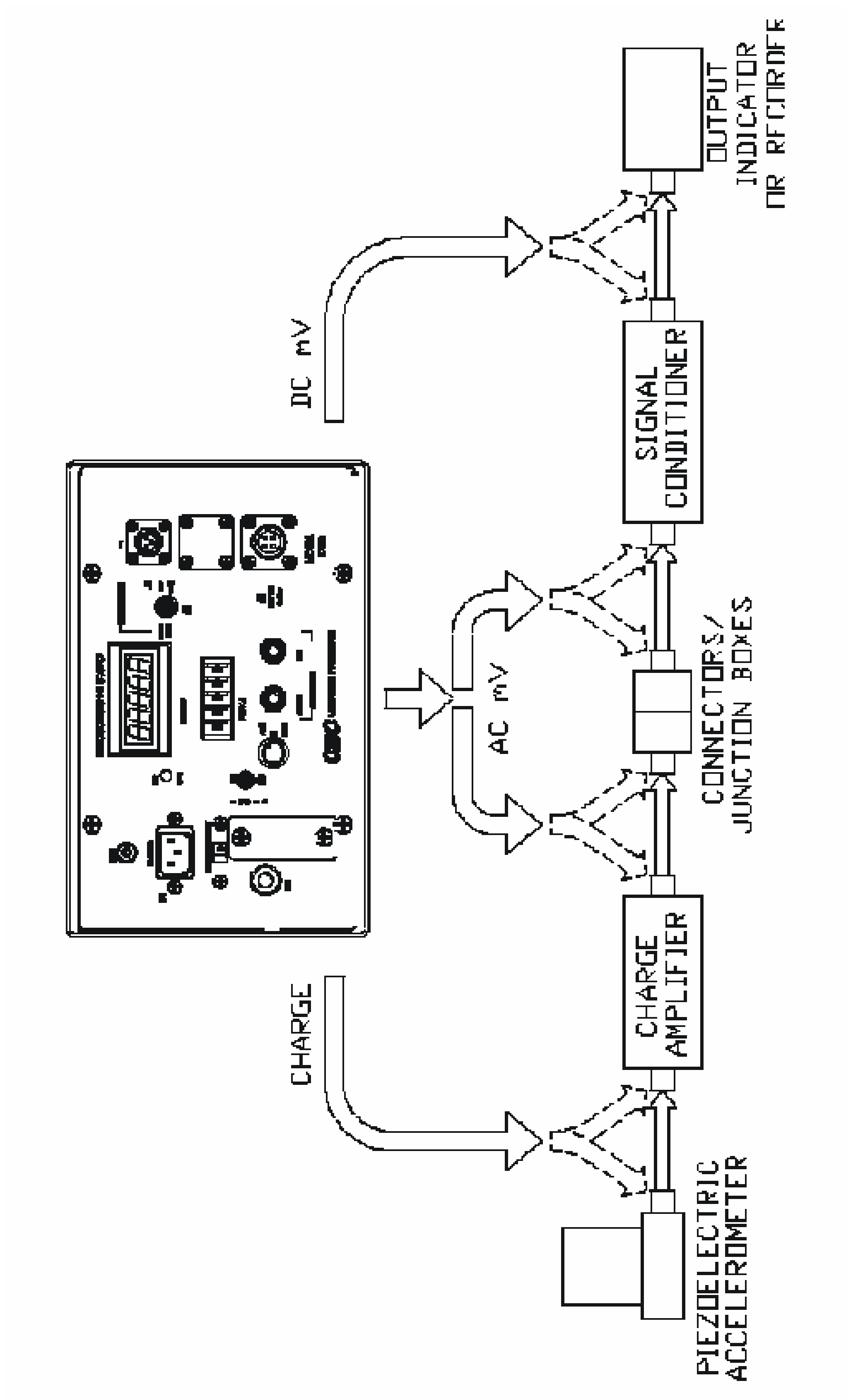

Figure 3-1. 2700-0105

SECTION IV - MAINTENANCE

4.1 GENERAL

The CEC 2700 Signal Source is a precision electronic instrument. Under normal conditions, it will give trouble-free service. But, if repair is required, CEC can provide factory service. CEC warrants the instrument for one year from the date of purchase.

4.2 CHARGING THE BATTERIES

Batteries are discharged at the time of purchase. Therefore, you should charge the batteries before using the CEC 2700. Charge between 32°F and 104°F (0°C and 40°C) as follows:

1. Plug in the AC power cord to receptacle P1 located on the face of the CEC 2700 and to a 115/200 VAC, 50/400 Hz power source.

2. Leave the POWER switch OFF for a fast charge.

   NOTE: *If BAT CHG light does not come on when AC power is applied, make sure POWER switch is OFF. Then, unplug unit and plug it back in again.*

3. The BAT CHG indicator will illuminate when the battery pack is being charged in the fast mode and the batteries are not fully charged. When the BAT CHG indicator goes off, the batteries are fully charged.

   NOTE: *A fully charged battery will normally give approximately 8 hours of operation. Make sure LOW BAT display is not visible when operating from the internal power source. If charge light on the unit does not turn on when AC is applied, leave AC attached for at least 10 minutes, BAT CHG light should turn on indicating the battery is charging. If the BAT CHG light does not illuminate and you can not turn the unit on, the battery should be considered bad and replaced.*

When using the CEC 2700, the LOW BAT display will be visible when only a few minutes of battery charge is left. If this occurs, continue operating the instrument on AC power. Then, when convenient, recharge the batteries. As NiCad batteries age, they hold less charge. If the LOW BAT indicator is illuminated shortly after you recharge the battery, the battery pack needs to be replaced.
See Paragraph 4-3.

4.3 REPLACING THE BATTERIES

If batteries need replacement, proceed as follows:

1. Disconnect AC power cord.

2. Remove four screws holding front panel to case and carefully lift up the front panel.

3. Locate battery pack in case and cut tie-wrap holding battery pack in place.

4. Disconnect cable between battery pack and instrument.

5. Install new battery pack, Part. No. 700154-00-0000 in reverse order of disassembly

4-4. CALIBRATION OF INSTRUMENT

CEC maintains a NIST-certified calibration facility for the CEC 2700 Precision Signal Source. We recommend that you return your instrument to CEC for calibration.

4-5. REPLACING THE FUSE

If the system will not operate from AC power, first check the fuse located on the front panel. If fuse is burned out, replace with a new 1/2 amp, slow blow fuse (see Table 5-1). If after replacement the fuse continues to blow out, there may be a serious electrical condition that warrants the return of the instrument to CEC for evaluation and repair.

4-6. TECHNICAL SUPPORT

For technical support or factory service, contact:

CEC Vibration Products Inc.
746 Arrow Grand Circle
Covina, California 91722

Phone: (626) 938-0200
Toll Free: (800) 468-1345 (USA Only)
Fax: (626) 938-0202

Internet: www.cecvp.com
E-mail: info@cecvp.com

SECTION V – PARTS LIST

5.1 GENERAL

Except for the battery pack and fuse, there are no customer replaceable parts for the following Models:

2700-0104
2700-0105
2700-0200.

Table 5-1
Precision Signal Source Spare Parts

DESCRIPTION	CEC PART NUMBER
Fuse F1	016656-0110
Battery Pack	0700154-00000
Electrical Power Cable	0550518

NOTES:

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