POWER CELL

The Power Cell is designed to sense 3 phase power and works on both fixed frequency and variable frequency power.

It is used as a stand alone transducer with an analog output (0–5 Volts, 0–10 Volts, 4–20 Milliamp, 0–1 Milliamp).

The Power Cell has 3 balanced Hall Effect devices, each with a flux concentrator. Each of the 3 phases passes through a flux concentrator. A voltage sample is also taken from each of the phases. No external current and voltage transformers are needed for the power sensing. This improves accuracy by eliminating the large phase shift errors from the CT’s and PT’s at low power factors.

HALL EFFECT DEVICES

To measure power with odd shapes and frequencies 3 balanced Hall Effect sensors are used. A Hall Effect sensor has these two characteristics:

- It senses a magnetic field which is proportional to the current flowing in the conductor.
- The Hall Effect semiconductor can multiply two signals. Each sensor is excited with a signal that comes from the voltage sample for that phase. The Hall device multiplies the voltage and current signals.

This is a vector multiplication which also calculates the lag or lead of the current (Power Factor). The resulting output is then proportional to power (Volts × Amps × Power Factor).

The signals for each of the 3 phases is summed and the analog output signal is proportional to the 3 phase power. (Horsepower or Kilowatts)
MOUNTING

The Power Cell is direction sensitive. Locate the Power Cell so that the three motor electrical supply lines can be passed through the cell. The TERMINAL side of the Cell faces the LOAD. Mount the external transformer in a convenient location.

INPUT CONNECTIONS

Pass each of the phases through the L1, L2, L3 holes in the Cell. Be certain that **DIRECTION** is correct. The TERMINAL side of the Cell faces the LOAD.

Provide a voltage sample for each phase with 20 gauge or larger wire. When a variable frequency drive is being used, locate the Power Cell on the output side of the drive. Take the voltage samples on the output side also.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Voltage</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Volts</td>
<td>Terminal 7</td>
</tr>
<tr>
<td>L2</td>
<td>Volts</td>
<td>Terminal 8</td>
</tr>
<tr>
<td>L3</td>
<td>Volts</td>
<td>Terminal 9</td>
</tr>
</tbody>
</table>

**MAKE CERTAIN THAT THE VOLTAGE SAMPLES DON’T GET SWITCHED.**

EXTERNAL TRANSFORMER CONNECTIONS

An external AC transformer is supplied with each Power Cell. Connect 120 Volts to transformer bottom 2 Connectors.

Hook the transformer Secondary to Terminals 2, 3, and 4.

- Outside Connections: Terminals 3 and 4
- Center Tap: Terminal 2
- Twist the Wires — 20 gauge or larger

**MAKE CERTAIN THAT THE CENTER TAP ON THE TRANSFORMER IS CONNECTED TO TERMINAL 2.**

CHASSIS GROUND

Ground the Power Cell Chassis Terminal 1

ANALOG OUTPUT

Analog Output Positive Terminal 5
Analog Output Ground Terminal 6 (Ground at device)

**TERMINAL 6 NEEDS TO BE GROUNDED** — Preferably at the device (computer, meter, recorder, controller, etc.) For devices with differential inputs, TERMINAL 6 can be connected to TERMINAL 1. Use shielded cable 20 gauge or larger for the analog output. Shield is ungrounded at Power Cell. Grounded at device. The Analog Output is powered by the Power Cell.
Terminals MUST face load.
Terminal 6 MUST be grounded.
The Voltage sample from the wire that goes through the L1 hole must go to terminal 7, L2 hole to terminal 8 and L3 hole to terminal 9.

FOR ANALOG SIGNAL
USE SHIELDED CABLE
20GA. OR LARGER.
GROUND SHIELD
AT DEVICE

GROUND ANALOG—
AT DEVICE

EXTERNAL TRANSFORMER
(PROVIDED WITH EACH POWER CELL)
MODEL 241-4-28 OR 241-4-2371
PRIMARY 120 VOLTS AC
SECONDARY 14VAC-20VAC
REFERENCED TO TERMINAL 2
CHANGING CAPACITY OF THE POWER CELL
The capacity for each of the Hall Sensors is set with 8 pin resistor networks. These
are easily changed in the field. This lets you match the Power Cell to the load. Cost:
$10 each.

In the 3 phase Power Cell there are:
- 3 Current Networks
- 1 Voltage Network
- 1 Function Network for the 0-5 Volt and 0-10 Volt Outputs
An additional circuit board for the 4-20 milliamp and 0-1 milliamp Outputs

1 = Location of Pin 1
V = Voltage Network
A = Current Network
F = Function Network
(0-10V or 0-5V output)

Function network in photo is shown plugged in for PH-3A
Analog Output Transducer. To convert to PH-3 for use with
Load Control, reverse the Function network.

For 4-20MA output, no function
network is used.

WHEN CHANGING THE NETWORKS, PLUG THE NETWORKS BACK IN THE
CORRECT DIRECTION!
FULL SCALE POWER

The Voltage and Current Networks provide a Full Scale Calibration Point.
The Power Cell senses the Actual Voltage and Current. The Networks operate
accurately from 0 to 130% of marked value.

### Full Scale Capacity - 460 Volt Network

<table>
<thead>
<tr>
<th>Model</th>
<th>Current Network</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH-3A-HG</td>
<td>4.2 AMP</td>
<td>4.5 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>10(9.54) AMP</td>
<td>10 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>15(13.34) AMP</td>
<td>14 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>20 AMP</td>
<td>21 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>30 AMP</td>
<td>32 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>40 AMP</td>
<td>43 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>50 AMP</td>
<td>53 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>60 AMP</td>
<td>64 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>70 AMP</td>
<td>75 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>80 AMP</td>
<td>85 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>90 AMP</td>
<td>96 HP</td>
</tr>
<tr>
<td>PH-3A</td>
<td>100 AMP</td>
<td>107 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>140 AMP</td>
<td>149 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>175 AMP</td>
<td>187 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>210 AMP</td>
<td>224 HP</td>
</tr>
</tbody>
</table>

Above 210 Amps check conductor size, maximum opening is ¾”

<table>
<thead>
<tr>
<th>Model</th>
<th>Current Network</th>
<th>Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH-3A-350</td>
<td>245 AMP</td>
<td>261 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>280 AMP</td>
<td>299 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>315 AMP</td>
<td>336 HP</td>
</tr>
<tr>
<td>PH-3A-350</td>
<td>350 AMP</td>
<td>373 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>100 (95.4) AMP</td>
<td>102 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>200 AMP</td>
<td>213 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>300 AMP</td>
<td>320 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>400 AMP</td>
<td>427 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>500 AMP</td>
<td>533 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>600 AMP</td>
<td>640 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>700 AMP</td>
<td>747 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>800 AMP</td>
<td>853 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>900 AMP</td>
<td>960 HP</td>
</tr>
<tr>
<td>PH-1000</td>
<td>1000 AMP</td>
<td>1067 HP</td>
</tr>
</tbody>
</table>

**KW=(HP)(.746)**

**Additional Turns**
The capacity can be reduced by taking additional “turns” through each hole for
each phase.

Example: A 10 HP unit is reduced to 5 HP by taking 2 turns through each
hole. It is reduced to 3.33 HP with 3 turns, etc.

**To Calculate Full Scale Capacity For Other Voltage Networks**

Full Scale Watts = (Voltage Network) (Current Network) (1.73)

Horsepower = Watts/746

**OVERLOAD DAMAGE**
The Power Cell is designed so that it is **NOT DAMAGED** by overloads. At about 20% above full capacity, the internal circuitry latches up. This prevents damage to attached meters, etc. It also means that the Power Cell can be sized to match the running load without worrying about inrush current.
PH-1000 POWER CELL

For loads over 210 Amps or conductor size greater than .75", the PH-1000 is used.

HOOK UP IS LIKE PH-3A.

CHANGING CAPACITY PH-1000

<table>
<thead>
<tr>
<th>Terminal Designations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>L3 Volts</td>
</tr>
<tr>
<td>8</td>
<td>L2 Volts</td>
</tr>
<tr>
<td>7</td>
<td>L1 Volts</td>
</tr>
</tbody>
</table>

1 = Location of Pin 1

V = Voltage Network
A = Current Network
F = Function Network

Function network in photo is shown plugged in for PH-1000 Analog Output Transducer. To convert to PH-1000 for use with Load Control, reverse the Function network.

For 4-20MA output, no Function network is used.

1. Chassis Gnd
2. Center Tap
3. 14-20 VAC
4. 14-20 VAC
5. Analog Pos
6. Analog Gnd
4-20 MILLIAMPS
OUTPUT BOARD
FOR PH-3A AND PH-1000

A plug-in circuit board is used for 4-20 Milliamp output.

For field change to 4-20MA output, remove the Function network before plugging in the board.

OPTIONAL RESPONSE ADJUSTMENT

In some cases, an average power signal may be more useful than instantaneous power. The Optional Response Adjustment slows the response of the Power Cell.

CHECK LIST

Power Cell Terminals Must Face Load.

Voltage samples must match phases.

Analog Output Ground must be grounded.

External Transformer — 14-20 Volt AC Terminals 3 and 4. Referenced to Terminal 2.

Fuses — 1/2 Amp — 3AG Fast Acting

Voltage and Current Networks — Must be firmly inserted in CORRECT DIRECTION.

Open Delta Wiring Systems — Some older transformer hook-ups were Open Delta. An isolation transformer is available from Load Controls, Inc. for a nominal cost for these systems.

Remember — The Power Cell is sensing power rather than just current. Power is low for lightly loaded motors (because the power factor is low). The output signal increases linearly as the load increases.
SPECIFICATIONS

FREQUENCY
3Hz to 1KHz
Derate above 1KHz

RESPONSE
15 Milliseconds (.015 seconds)
.060 Seconds to 1 Second with
optional response adjustment

ACCURACY/REPEATABILITY
2.5% of Full Scale
.25%

COMPLIANCE/IMPEDANCE
Compliance: 6 Volts
10 Volt Output: 2K ohm min-
umum connected impedance
4-20MA Output: 300 ohm maxi-
umum connected inedance
High Compliance units available
— Special order

TEMPERATURE
55 degrees C maximum

CURRENT NETWORKS
AVAILABLE FOR PH-3A
and PH-1000
SEE PAGE 5

VOLTAGE NETWORKS
AVAILABLE FOR PH-3A
and PH-1000
115 Volt 185 Volt 230 Volt 255 Volt
350 Volt 380 Volt 460 Volt 580 Volt

SPECIFY CURRENT
NETWORK VOLTAGE
NETWORK AND OUTPUT
WHEN ORDERING
POWER CELL

DIMENSIONS

PH-3A POWER CELL

4¼" 1¾"
9½"

Maximum conductor ¾"
with grommets removed
Mounting: (2) #10 screws
8½" on center

PH-1000 POWER CELL

5¼" 2"
13¾"

Maximum Conductor: 1¾"
Mounting: (4) ¼" screws
12¾" x 1¼" on centers
Weight: 12 pounds

EXTERNAL TRANSFORMER
Provided with each
Power Cell

Mounting: (2) #10
screws
2" on center

53 TECHNOLOGY PARK ROAD
STURBRIDGE, MA 01566
PHONE 508-347-2606
FAX 508-347-2064