Documenting Multifunction Calibrator
and Arbitrary Function Generator

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WARNING: These products are not designed for use in, and should not be used for, human applications.
Documenting Multifunction Calibrator
and Arbitrary Function Generator

iCal

PROVA INSTRUMENTS INC.
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<tbody>
<tr>
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<td>💿</td>
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<tr>
<td>163</td>
<td>🐐</td>
</tr>
<tr>
<td>164</td>
<td>✍</td>
</tr>
<tr>
<td>165</td>
<td>🍃</td>
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<td>166</td>
<td>🙅</td>
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<td>167</td>
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<td>182</td>
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<tr>
<td>183</td>
<td>😞</td>
</tr>
</tbody>
</table>
Features:

1. **Unique mapping function** let you calibrate temperature (300°C) or voltage (220V) directly (instead of 4 to 20mA indirectly).
2. CL427 is a **multifunction calibrator** and an **arbitrary function generator**.
3. **Source**: mA (4 to 20mA), V (0 to 15V, 0 to 70mV), Hz, sine wave, square wave, triangular wave, truncated sine wave, user programmable waveform and temperature for 11 types of thermocouples.
4. **Measure**: Current (mA), Voltage (V, mV) and temperature in °C or °F.
5. **Programmable cold junction compensation** allows users to fine tune temperature output and measurement.
6. Programmable 0% and 100% value for easy **25% step function**.
7. **Output error warning** when output is shorted or open.
8. **Short circuit protection** for voltage output.
9. **Clear and easy user interface** (Numerical key pad, sliding switch and dot matrix LCM with backlight).
10. Voltage, frequency, PWM duty-cycle (square wave and triangular wave), and offset are programmable in the **Hz function**.
11. **Frequency range (0.3Hz to 20KHz)** covers application of audio band (speaker, MP3, MD etc.)
12. **DTMF** (Dual Tone Multi-Frequency) can perform professional testing for telephone line and audio product (MP3 or MD).
13. **Auto-step and auto-ramp functions** can quickly perform linear test.
14. **PC** can program calibrator through USB port.
15. CL427 can perform **data logging** with programmable sampling time (0-255 seconds) and memory of 4000 records.
16. **Rechargeable Lithium battery** (1600mAH) with built-in charging circuit.
17. **Calibration results** (source and measure) can be **saved in memory** (2000 records). Then users download them to a PC for documentation. No needs to transcribe calibration data manually.
18. To **distinguish calibration data** at different locations, data can be saved under different file names.
## VIII. GENERAL SPECIFICATIONS

| AC Adaptor:       | AC 110V, 60Hz input;  
or AC 220V, 50/60Hz input.  
DC 15V / 0.5A output, |
|-------------------|------------------------|
| Dimension:        | 214.0(L) x 98.7(W) x 56.0(H) mm  
8.4” (L) x 3.9” (W) x 2.2” (H) |
| Weight:           | 650g / 22.9oz (Batteries included) |
| Operation Environment: | 0 ℃ ~ 50 ℃, 85% RH |
| Storage Environment: | -20 ℃ ~ 60 ℃, 75% RH |
| Accessories:      | Carrying case x 1  
User manual x 1  
AC adaptor x 1  
USB cable x 1  
Software CD x 1  
Software manual x 1  
K-type thermocouple (dual plugs) x 1  
Alligator clips x 2 (black and red)  
Test leads x 2 (black and red)  
Rechargeable lithium battery  
(11.1V/ 1600mAh) x 1 |

### Applications:
1. **Calibration of 4 to 20mA** transmitters and panel meters.
2. **Temperature calibration** of panel meters or instruments for 11 types of thermocouples.
3. **Calibration of valve opening** by changing duty cycle of a PWM signal.
4. **Generation** of selected test frequency and waveform for electronic device.
5. **Pre-stored** 1/3 octave audition, white noise, and pink noise for MP3, MD, speaker and audio driver tests.
6. **Audio Frequency Synthesizer**: Programmable frequency and phase synthesis of single tone, DTMF(Double Tone, Multi-Frequency) for audio products such as MP3, MD and telephone line.
7. **Function generation** for transistor DC bias characteristics test, amplifier overload and transient characteristics.
8. **Function generation** for vibration testing.
9. **Calibration of a chart recorder** with different waveforms (sine, square, or triangular wave).
10. Simulation of **PLC**.
I. PANEL DESCRIPTION

1. LCM display.
2. ON/OFF button.
3. SELECT button for selecting waveforms (in the Hz function).
4. SETUP button.
5. Numerical key pads; or buttons for special functions (e.g. REC, 0%, 100%).
6. Output terminals (for SOURCE).
7. Input terminals (for MEASURE).
8. Sliding switch (for various functions).
10. SHIFT button for using secondary functions on the numerical key pads:
    DTMF and Frequency switching.
11. S/M button (for selecting SOURCE or MEASURE).

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 20V</td>
<td>0.001V</td>
<td>6% +/- 0.4V</td>
</tr>
</tbody>
</table>

**Voltage of Offset** (Maximum Vpp < 20V)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5V to 5V</td>
<td>0.001V</td>
<td>5% +/- 0.5V +/-5%xVpp</td>
</tr>
</tbody>
</table>

**Duty Cycle** (%), square wave, 10 Vpp, 0.3~20KHz

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Rise Time of Vpp</th>
<th>Fall Time of Vpp</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100%</td>
<td>1%</td>
<td>10µS max,</td>
<td>15µS max,</td>
</tr>
</tbody>
</table>
<pre><code>|            | 5µS typical    |                  |
</code></pre>

**DTMF (Hz)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 to 99,999</td>
<td>0.1Hz</td>
<td>0.002Hz</td>
</tr>
<tr>
<td>10.00 to 999.99</td>
<td>0.1Hz</td>
<td>0.02Hz</td>
</tr>
<tr>
<td>1000.0 to 9999.9</td>
<td>0.1Hz</td>
<td>0.2Hz</td>
</tr>
<tr>
<td>10000 to 20000</td>
<td>1Hz</td>
<td>2Hz</td>
</tr>
</tbody>
</table>

**DTMF (%)**

<table>
<thead>
<tr>
<th>Range (%)</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% ~ 100%</td>
<td>1%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**DTMF (Phase Angle)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ~ 360</td>
<td>1°</td>
<td>100µS+ 1°</td>
</tr>
</tbody>
</table>

**DTMF (Vpp, F1=F2, <1 KHz, %1=%2, Phase1=Phase2)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V ~ 20V</td>
<td>0.001V</td>
<td>10% +/- 0.6V</td>
</tr>
</tbody>
</table>

**DTMF (Offset, F1=F2, <1 KHz, %1=%2, Phase1=Phase2)**

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5V ~ 5V</td>
<td>0.001V</td>
<td>10% +/- 0.6V +/-5%xVpp</td>
</tr>
</tbody>
</table>

(Vpp, 0.3~20KHz, 50% duty cycle, square wave, 0V offset)
II. OPERATION

1. Voltage Source

1a. -3V ~ 15V

(1) Turn on the power, and move the sliding switch to V.
(2) Press S/M button to select SOURCE (output) mode.

(Press once to store it as default mode when power is turned on.)
(3) Type in a voltage value (including decimal point); then press ENTER.
(4) Connect Test leads or Alligator clips to SOURCE terminals
   (red to red, and black to black).
(5) Then connect Test leads or Alligator clips to the object for calibration.
(6) To perform voltage scanning, refer to “Scanning for Source” chapter.
(7) To perform data logging function, refer to “Data logging” chapter.

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in a voltage value (including decimal point), press ENTER, then
   CL427 will output this voltage value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.
**Warning:** 1. Do not make an input with voltage potential or connect any charged circuitry to SOURCE (terminals) to prevent from damaging CL427.  
2. When there is a short circuit or overload at the output terminals, CL427 cannot output the correct voltage. Please remove connecting leads and check when there is a symbol of OUTPUT ERROR.  
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

1b. How to set up

1. Press 📅 to enter SETUP function.
2. V 0%: set up the “starting” voltage for scanning.  
   (refer to SCANNING chapter).
3. V 100%: set up the “ending” voltage for scanning.  
   (refer to SCANNING chapter).
4. SAMPLE: set up the “sampling time” for data logging.  
   (refer to DATA LOGGING chapter).
5. FILE NAME: data can be saved under different file names. Here users can set up a “file name”. (refer to DATA LOGGING chapter)

![Screenshot of setup options]

1c. Details for set up
VI. BATTERY RECHARGING

1. Inside iCal there is a rechargeable lithium battery.

2. After turning on the power of iCal, the display will show the remaining power percentage of the rechargeable battery.

3. When the remaining power percentage of the rechargeable battery is less than 10%, we suggest users to recharge the battery by using the AC adaptor provided along with iCal.

4. To do the battery recharging, users just need to:
   (1) put the AC adaptor into the socket;
   (2) connect the AC adaptor to DC terminal of iCal;
   (3) and turn on iCal.

(1) Press button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) FILE NAME: Type in a name by corresponding to ASCII codes (refer to Appendix 1). For example, for the letter “A” users should type in “65”.
(4) The data under the same file name will be put together.
2. Current Source

2a. -4mA ~ 24mA

(1) Turn on the power. Sliding switch turned to mA.
(2) Press S/M button to select SOURCE (output) mode.

(Press [SETUP] once to store it as default mode when power is turned on.)
(3) Type in a current value (including decimal point); then press ENTER.
(4) Connect Test leads or Alligator clips to SOURCE terminals
(red to red, and black to black).
(5) Then connect Test leads or Alligator clips to the object for calibration.
(6) Current scanning function: refer to “Scanning for Source” chapter.
(7) Data logging function: refer to “Data logging” chapter.

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in a current value (including decimal point), press ENTER, then CL427 will output this current value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.
**Warning:** 1. Do not make an input or connect any charged installment to SOURCE (terminals) to prevent from damaging CL427I.
2. When there is an output open circuit or overload, CL427 can not output the correct current. Please remove connecting leads and check when there is a symbol of OUTPUT ERROR.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

**2b. How to set up**

(1) Press **SETUP** to enter SETUP function.
(2) mA 0%: set up the “starting” current for scanning.
   (refer to SCANNING chapter).
(3) mA 100%: set up the “ending” current for scanning.
   (refer to SCANNING chapter).
(4) 4mA→: set up the mapping unit for 4mA.
(5) 20mA→: set up the mapping unit for 20mA.
(6) MAPPING: here users can decide if they want MAPPING function.

![Setup Options]

**2c. Details for set up**
(1) Press button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) When setting up the mapping unit for 4mA or 20mA, type in the unit by corresponding to ASCII codes (refer to Appendix 1). For example, for “KW” users should type in “75” and “87”.
(4) MAPPING: “YES” means the mapping function is enabled; “NO” means the mapping function is disabled.

2b. Start Data Logging

(1) Under any ranges/modes except Hz range, press and then “SHIFT” will show on the left bottom of the display. Press button to start logging single-point data under specified FILE NAME.
(2) Under all the ranges/modes, single-point data under the same FILE NAME can be logged together.
(3) To continue data logging under each range, users just have to repeat the above step 1.

3. Multi-point Data Logging

3a. Data Logging Set Up

(1) Only under V range, users can set up SAMPLE and FILE NAME. And the setups under V range will be applied to other ranges (mA, …).
(2) Press to enter SETUP function.
(3) SAMPLE: set up the “sampling time” (from 1~255 sec.).
(4) FILE NAME: for multi-point data logging, data can not be saved under different file names. Here users do not have to set up a “file name”.

| V 0%: | 4.000V |
| V 100%: | 15.000V |
| SAMPLE: | 0SEC |
| FILE NAME: | MAIN0001 |

press DIGITS
(3) To stop data logging, please repeat the above procedures.
To continue data logging, users just have to repeat it again.
(4) When users want to logged data for a different mode (SOURCE or MEASURE), they have to clear memory first (and save the data before clearing the memory if necessary, please refer to Software Manual).

1c. Save data in FILE NAME

This data logging can be performed under any ranges (V, mA, ℃ & ℉) and any modes (SOURCE and MEASURE). And the logged data can be saved in the FILES NAME(s) decided by users.

(1) SAMPLE (rate) has to be 0 if users would like to use the function of saving data in FILE NAMEs.
(2) To perform data logging, press and then “SHIFT” will show on the left bottom of the display. Press button to start data logging.
(3) Data logging for various data can be performed under any ranges or any modes. Users just have to follow the above procedures to continue data logging and saving.

2. Single-point Data Logging

2a. Data Logging Set Up
(1) Only under V range, users can set up SAMPLE and FILE NAME. And the setups under V range will be applied to other ranges (mA, …).

(2) Press to enter SETUP function.
(3) SAMPLE: set up the “sampling time” as “0”.
(4) FILE NAME: data can be saved under different file names. Here users can set up a “file name” (by referring to ASCII codes).

2d. MAPPING Function
(1) In the SETUP display when users choose YES for MAPPING, the MAPPING function is enabled.
(2) The display unit will be the same as the one set up by users. For example, for the unit “KW” users should type in “75” and “87”.
(3) (If in the SETUP display, users set up 0KW for 4mA and 100KW for 20mA) When users type in 100 and then press ENTER, the display will show: 100.0KW (the main display) and 20.000mA (which means the original output of iCal is 20.000mA).
(4) When users perform scanning function, the display show 0~100KW instead of 4mA ~ 20mA.
3. TEMPERATURE SOURCE (THERMOCOUPLES, °C & °F)

3a. TC Simulating Thermocouple Signals
(for Types K, J, E, T, R, S, N, L, U, B, C, and mV Output)

(1) Turn on the power. Sliding switch turned to °C °F mV.
(2) Select a TC TYPE in the SETUP display.
(3) Type in a temperature value (including decimal point); then press ENTER.
(4) Connect Thermocouple to TC/mV terminals.
(5) Then connect the other end of Thermocouple to the object for calibration.

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in a temperature value (including decimal point), press ENTER, then iCal will output this temperature value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.

Warning: 1. Do not make an input or connect any charged installment to TC terminals to prevent from damaging CL427.
2. When there is an output short circuit or overload, CL427 can not output the correct temperature. Please remove connecting leads and check when there is a symbol of OUTPUT ERROR.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE , MEASURE , or TC alone.
3b. How to set up

1. Press \texttt{SETUP} to enter SETUP function.
2. TC 0%: set up the "starting" temperature for scanning.
   (refer to SCANNING chapter).
3. TC 100%: set up the "ending" temperature for scanning.
   (refer to SCANNING chapter).
4. C. J. COMP.: set up the Cold Junction Compensation.
5. TC TYPE: set up the thermocouple type.
6. UNIT: here users can choose \(^\circ C\) or \(^\circ F\).

3c. Details for set up

1. Press \texttt{button} to select the item you’d like to setup.
2. When the selected item is in reverse video, type in a value.
3. C. J. COMP.: Users can type in the temperature for Cold Junction Compensation. (The default is 0.0 \(^\circ C\), users can make compensation from -5 \(^\circ C\) to +5 \(^\circ C\) in accordance with the ideal output values.)
4. When "TC TYPE" is in reverse video, users can press \texttt{button} to choose the thermocouple type they want.
5. When "UNIT" is in reverse video, users can press \texttt{button} to choose \(^\circ C\) or \(^\circ F\).
4. Frequency (Hz) Output

4a. 0.1Vpp ~ 20Vpp, 0.3Hz ~ 20KHz, offset: -5V ~ +5V

1. Turn on the power. Sliding switch turned to Hz.
   (Press ✂️ once to store it as default mode when power is turned on.)

2. Press SELECT button to select the type of waveform (Sine wave, Square wave, Triangular wave, Truncated sine wave, and User programmable waveform).

3. Press ▲▼ button to switch among “Voltage Peak to Peak (Vpp)”, “OFFSET”, “DUTY” and “Hz”.

4. Then type in a value (including decimal point) and press ENTER.

5. Connect Test leads or Alligator clips to SOURCE terminals (red to red, and black to black).

6. Connect Test leads or Alligator clips to the object for calibration.

3c. Example of Connecting Leads (for Ramp and Multi-step Scanning)

Connecting Leads for Fast ramp
| Remark: 1. Users are allowed to type in max. 5 digits. |
| 2. Type in each parameter (including decimal point), press ENTER, then CL427 will output the parameter values. |
| 3. When the output value is <0, please type in a negative sign first. |
| 4. When the output value is <1 and >0, please type in “0.” first. |

| Warning: 1. Do not make an input or connect any charged installment to SOURCE (terminals) to prevent from damaging CL427. |
| 2. When there is an output short circuit or overload, can not output the CL427 correct frequency. |
| 3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone. |

4b. How to set up

(1) Press  to enter SETUP function.

(2) Waveform Index: give a number for a “user programmable waveform”.

(3) Press  again to enter the main display of Hz range.

(4) Press  button to select the “user programmable waveform”. Then, CL427 will output this selected “user programmable waveform” (e.g. number 7 waveform – named SINONE60 Sinusoidal Wave 60Hz).
4c. Details for fine-tuning items

(1) Hz: set up the output frequency.
(2) OUTPUT: set up the output voltage (Peak to Peak).
(3) OFFSET: set up the output DC bias accurate position. Fine tune this item can output TTL or modulate PWM signal.
(4) DUTY: for a square wave, users can decide the band width of the positive wave. For a triangular wave, users can set up the saw-toothed shape.

(5) Set up the waveform: users can select among sine wave, square wave, triangular wave, truncated sine wave, and user programmable waveform.
(6) User programmable waveform: first users have to compile a waveform in PC and then send it to CL427 (the details please refer to Software Manual).
5. DTMF (Dual Tone Multi-Frequency)

5a. 5Vpp~20Vpp, 0.3Hz~20KHz, offset: -5V~+5V, %: 0~100%, phase: 0~360°

(1) Turn on the power. Sliding switch turned to Hz.

(Press \[\text{SETUP}\] once to store it as default mode when power is turned on.)

(2) Press \[\text{DTMF}\] button to enter DTMF mode.

(3) Press \[\text{arrow button}\] to set up all the parameters of F1 and F2.

(4) Then type in a value (including decimal point) and press ENTER.

(5) Connect Test leads or Alligator clips to SOURCE terminals (red to red, and black to black).

(6) Connect Test leads or Alligator clips to the object for calibration.

Connecting Leads for Multi-step Scanning
### Remark:

1. Users are allowed to type in max. 5 digits.
2. Type in each parameter (including decimal point), press ENTER, then CL427 will output the parameter values.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.

### Warning:

1. Do not make an input or connect any charged installment to SOURCE (terminals) to prevent from damaging CL427.
2. When there is an output short circuit or overload, CL427 can not output the correct frequency/waveform.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

### 5b. How to set up

1. Hz: set up the output frequency of F1 and F2.
2. %: set up the output % of F1 and F2.
3. Phase: set up the outset phase angle of F1 and F2.
4. Vpp: set up the output Peak to Peak voltage.
5. Offset: set up the output DC bias accurate position.

<table>
<thead>
<tr>
<th>DTMF</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HZ:</td>
<td>50.0Hz</td>
<td>2000.0Hz</td>
</tr>
<tr>
<td>%:</td>
<td>67%</td>
<td>33%</td>
</tr>
<tr>
<td>Phase:</td>
<td>60°</td>
<td>120°</td>
</tr>
<tr>
<td>Vpp:</td>
<td>20.000V</td>
<td></td>
</tr>
<tr>
<td>Offset:</td>
<td>0.000V</td>
<td></td>
</tr>
</tbody>
</table>
6. Voltage Input (Measure)

6a. -3V ~ 24V
(1) Turn on the power. Sliding switch turned to V.
(2) Press button to select MEASURE (input) mode.
(3) Connect Test leads or Alligator clips to MEASURE terminals (red to red, and black to black).
(4) Then connect the other ends of Test leads or Alligator clips to the object for measurement.
(5) The display of CL427 will show the measurement result.
(6) Data logging function: refer to “Data logging” chapter.

Remark:
1. The measurement result is 5-digit (including decimal point and negative sign).

Warning: 1. Do not measure over 30V for MEASURE (terminals) to prevent from damaging CL427.
2. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.
7. Current Input (Measure)
7a. -4mA ~ 24mA

(1) Turn on the power. Sliding switch turned to mA.

(2) Press button to select MEASURE (input) mode.
(3) Connect Test leads or Alligator clips to MEASURE terminals (red to red, and black to black).
(4) Then connect the other ends of Test leads or Alligator clips to the object for measurement.
(5) The display of CL427 will show the measurement result.
(6) Data logging function: refer to “Data logging” chapter.

Remark: 1. The measurement result is 5-digit (including decimal point and negative sign).

Warning: 1. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.
7b. How to set up

1. Press [SETUP] to enter SETUP function.
2. 4mA : set up the mapping unit for 4mA.
3. 20mA : set up the mapping unit for 20mA.
4. MAPPING: here users can decide if they want MAPPING function.

<table>
<thead>
<tr>
<th>mA 0%:</th>
<th>4.000mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>mA 100%:</td>
<td>20.000mA</td>
</tr>
<tr>
<td>4mA</td>
<td>0.0000KW</td>
</tr>
<tr>
<td>20mA</td>
<td>100.00KW</td>
</tr>
<tr>
<td>MAPPING</td>
<td>YES</td>
</tr>
<tr>
<td>press DIGITS</td>
<td></td>
</tr>
</tbody>
</table>

7c. Details for set up

1. Press [S/M] button to select the item you’d like to setup.
2. When the selected item is in reverse video, type in a value.
3. When setting up the mapping unit for 4mA or 20mA, type in the unit by corresponding to ASCII codes (refer to Appendix 1). For example, for “KW” users should type in “75” and “87”.
4. MAPPING: “YES” means the mapping function is enabled; “NO” means the mapping function is disabled.
7d. MAPPING Function

(1) In the SETUP display when users choose YES for MAPPING, the MAPPING function is enabled.
(2) The display unit will be the same as the one set up by users. For example, for the unit “KW” users should type in “75” and “87”.
(3) (If in the SETUP display, users set up 0KW for 4mA and 100KW for 20mA) When users type in 100 and then press ENTER, the display will show: 100.0KW (the main display) and 20.000mA (which means the original output of iCal is 20.000mA).

1c. Example of Connecting Leads (for Rapid and Multi-step Scanning)
8. Temperature Input (Measure)

8a. TC Simulating Thermocouple Signals
(for Types K, J, E, T, R, S, N, L, U, B, C, and mV Input)

(1) Turn on the power. Sliding switch turned to °C °F mV.

(2) Press button to select MEASURE (input) mode.
(3) Select a TC TYPE in the SETUP display.
(4) Connect Thermocouple to TC/mV terminals.
(5) Then connect the other end of Thermocouple to the object for measurement.
(6) The display of CL427 will show the temperature of the tested object.

Remark: 1. The measurement result is 5-digit (including decimal point and negative sign).

Warning: 1. The Input TC terminals is for measuring mV, do not measure over 30V for MEASURE (terminals) to prevent from damaging CL427.
2. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.
8b. How to set up

(1) Press \( \boxed{\text{SETUP}} \) to enter SETUP function.
(2) C. J. COMP.: set up the Cold Junction Compensation.
(3) TC TYPE: set up the thermocouple type.
(4) UNIT: here users can choose \( ^\circ \text{C} \) or \( ^\circ \text{F} \).

<table>
<thead>
<tr>
<th>TC 0%:</th>
<th>100.0 ( ^\circ \text{C} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 100%:</td>
<td>1000.0 ( ^\circ \text{C} )</td>
</tr>
<tr>
<td>C.J.COMP.:</td>
<td>0.0 ( ^\circ \text{C} )</td>
</tr>
<tr>
<td>TC TYPE:</td>
<td>K</td>
</tr>
<tr>
<td>UNIT:</td>
<td>( ^\circ \text{C} )</td>
</tr>
</tbody>
</table>

press DIGITS

8c. Details for set up

(1) Press \( \boxed{\text{S/M}} \) button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) C. J. COMP.: Users can type in the temperature for Cold Junction Compensation. (The default is 0.0 \( ^\circ \text{C} \), users can make compensation from -5 \( ^\circ \text{C} \) to +5 \( ^\circ \text{C} \) in accordance with the ideal output values.)
(4) When “TC TYPE” is in reverse video, users can press \( \boxed{\text{SELECT}} \) button to choose the thermocouple type they want.
(5) When “UNIT” is in reverse video, users can press \( \boxed{\text{SELECT}} \) button to choose \( ^\circ \text{C} \) or \( ^\circ \text{F} \).

III. SCANNING FOR SOURCE

1. Voltage Scanning for SOURCE

1a. How to setup:

(1) Press \( \boxed{\text{SETUP}} \) button to enter SETUP function.
(2) V 0%: set up the “starting” voltage for scanning.
(3) V 100%: set up the “ending” voltage for scanning.

| V 0%:        | 4.000V |
| V 100%:      | 15.000V |
| SAMPLE:      | 1 SEC  |
| FILE NAME:   | MAIN0001 |

press DIGITS

Remark:
1. Users are allowed to type in max. 5 digits.
2. Type in a voltage value (including decimal point), press ENTER, then iCal will output this voltage value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.
III. SCANNING FOR SOURCE

1. Voltage Scanning for SOURCE

1a. How to setup:

(1) Press \( \text{SETUP} \) button to enter SETUP function.
(2) \( V \ 0\% \): set up the “starting” voltage for scanning.
(3) \( V \ 100\% \): set up the “ending” voltage for scanning.

Remark:
1. Users are allowed to type in max. 5 digits.
2. Type in a voltage value (including decimal point), press ENTER, then CL427 will output this voltage value.
3. When the output value is \(<0\), please type in a negative sign first.
4. When the output value is \(<1\ and \ >0\), please type in “0.” first.
1b. Functions of Voltage Scanning for SOURCE

Press \( \text{SHIFT} + \), then the lower left of LCM will display various functions (see the descriptions on below).

<table>
<thead>
<tr>
<th>SHIFT +</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ramp scanning 1% 2%... 100% 99%...2% 1%</td>
</tr>
<tr>
<td>2</td>
<td>Manual Multi-step scanning (increase progressively) Press this button once +25% till it reaches 100%</td>
</tr>
<tr>
<td>3</td>
<td>Fast ramp scanning 4% 8%...100% 96%...8% 4%</td>
</tr>
<tr>
<td>4</td>
<td>Return to the “starting” point of scanning 0%</td>
</tr>
<tr>
<td>5</td>
<td>Press it during scanning period to HOLD the scanning</td>
</tr>
<tr>
<td>6</td>
<td>Return to the “ending” point of scanning 100%</td>
</tr>
<tr>
<td>7</td>
<td>Auto Multi-step scanning (increase and decrease progressively) 0% 25% 50% 75% 100%...</td>
</tr>
<tr>
<td>8</td>
<td>Manual Multi-step scanning (decrease progressively) Press this button once -25% till it reaches 0%.</td>
</tr>
</tbody>
</table>

8. Temperature Input (Measure)

8a. TC Simulating Thermocouple Signals
(for Types K, J, E, T, R, S, N, L, U, B, C, and mV Input)

(1) Turn on the power. Sliding switch turned to \( ^\circ C \) \( ^\circ F \) mV.

(2) Press \( \uparrow \downarrow \) button to select MEASURE (input) mode.
(3) Select a TC TYPE in the SETUP display.
(4) Connect Thermocouple to TC/mV terminals.
(5) Then connect the other end of Thermocouple to the object for measurement.
(6) The display of iCal will show the temperature of the tested object.

Remark: 1. The measurement result is 5-digit (including decimal point and negative sign).

Warning: 1. The Input TC terminals is for measuring mV, do not measure over 30V for MEASURE (terminals) to prevent from damaging iCal.
2. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.
7d. MAPPING Function

1. In the SETUP display when users choose YES for MAPPING, the MAPPING function is enabled.
2. The display unit will be the same as the one set up by users. For example, for the unit “KW” users should type in “75” and “87”.
3. (If in the SETUP display, users set up 0KW for 4mA and 100KW for 20mA) When users type in 100 and then press ENTER, the display will show: 100.0KW (the main display) and 20.000mA (which means the original output of iCal is 20.000mA).

1c. Example of Connecting Leads (for Rapid and Multi-step Scanning)
7b. How to set up

(1) Press SETUP to enter SETUP function.
(2) 4mA → set up the mapping unit for 4mA.
(3) 20mA → set up the mapping unit for 20mA.
(4) MAPPING: here users can decide if they want MAPPING function.

| mA 0%: | 4.000mA |
| mA 100%: | 20.000mA |
| 4mA → | 0.0000KW |
| 20mA → | 100.00KW |
| MAPPING | YES |
| press DIGITS |

7c. Details for set up

(1) Press S/M button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) When setting up the mapping unit for 4mA or 20mA, type in the unit by corresponding to ASCII codes (refer to Appendix 1). For example, for “KW” users should type in “75” and “87”.
(4) MAPPING: “YES” means the mapping function is enabled; “NO” means the mapping function is disabled.
2. Current Scanning for SOURCE

2a. How to setup:

(1) Press button to enter SETUP function.
(2) mA 0%: set up the “starting” current for scanning.
(3) mA 100%: set up the “ending” current for scanning.

![Image of CL427 setup screen]

Remark:
1. Users are allowed to type in max. 5 digits.
2. Type in a voltage value (including decimal point), press ENTER, then CL427 will output this current value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.
2b. Functions of Current Scanning for SOURCE

Press \( \text{SHIFT} \), then the lower left of LCM will display various functions (see the descriptions on below).

<table>
<thead>
<tr>
<th>SHIFT +</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ramp 1% 2%... 100% 99%...2% 1%</td>
</tr>
<tr>
<td>2</td>
<td>Manual Multi-step scanning (increase progressively) Press this button once +25% till it reaches 100%</td>
</tr>
<tr>
<td>3</td>
<td>Fast ramp 4% 8%...100% 96%...8% 4%</td>
</tr>
<tr>
<td>4</td>
<td>Return to the “starting” point of scanning 0%</td>
</tr>
<tr>
<td>5</td>
<td>Press it during scanning period to HOLD the scanning</td>
</tr>
<tr>
<td>6</td>
<td>Return to the “ending” point of scanning 100%</td>
</tr>
<tr>
<td>7</td>
<td>Auto Multi-step scanning (increase and decrease progressively) 0% 25% 50% 75% 100%...</td>
</tr>
<tr>
<td>8</td>
<td>Manual Multi-step scanning (decrease progressively) Press this button once -25% till it reaches 0%.</td>
</tr>
</tbody>
</table>

6. Voltage Input (Measure)

6a. -3V ~ 24V

(1) Turn on the power. Sliding switch turned to V.

(2) Press \( \text{button} \) to select MEASURE (input) mode.

(3) Connect Test leads or Alligator clips to MEASURE terminals (red to red, and black to black).

(4) Then connect the other ends of Test leads or Alligator clips to the object for measurement.

(5) The display of iCal will show the measurement result.

(6) Data logging function: refer to “Data logging” chapter.

Remark:
1. The measurement result is 5-digit (including decimal point and negative sign).

Warning: 1. Do not measure over 30V for MEASURE (terminals) to prevent from damaging iCal.
2. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.


**Remark:**

1. Users are allowed to type in max. 5 digits.
2. Type in each parameter (including decimal point), press ENTER, then iCal will output the parameter values.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.

**Warning:**

1. Do not make an input or connect any charged installment to SOURCE (terminals) to prevent from damaging iCal.
2. When there is an output short circuit or overload, iCal can not output the correct frequency/waveform.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

---

**5b. How to set up**

1. Hz: set up the output frequency of F1 and F2.
2. %: set up the output % of F1 and F2.
3. Phase: set up the outset phase angle of F1 and F2.
4. Vpp: set up the output Peak to Peak voltage.
5. Offset: set up the output DC bias accurate position.

---

**2c. Example of Connecting Leads (for Rapid and Multi-step Scanning)**

Connecting Leads for Fast ramp
5. DTMF (Dual Tone Multi-Frequency)

5a. 5Vpp~20Vpp, 0.3Hz~20KHz, offset: -5V~+5V, %: 0~100%, phase: 0~360°

(1) Turn on the power. Sliding switch turned to Hz.
   (Press once to store it as default mode when power is turned on.)

(2) Press button to enter DTMF mode.

(3) Press button to set up all the parameters of F1 and F2.
(4) Then type in a value (including decimal point) and press ENTER.
(5) Connect Test leads or Alligator clips to SOURCE terminals (red to red, and black to black).
(6) Connect Test leads or Alligator clips to the object for calibration.
3. Temperature Scanning for SOURCE

3a. How to setup:

(1) Press \[\text{SETUP}\] button to enter SETUP function.
(2) TC 0%: set up the “starting” temperature for scanning.
(3) TC 100%: set up the “ending” temperature for scanning.

Remark:
1. Users are allowed to type in max. 5 digits.
2. Type in a temperature value (including decimal point), press ENTER, then CL427 will output this temperature value.
3. When the output value is \(<0\), please type in a negative sign first.
4. When the output value is \(<1\ and \ >0\), please type in “0.” first.
3b. Functions of Temperature Scanning for SOURCE

Press , then the lower left of LCM will display various functions (see the descriptions on below).

<table>
<thead>
<tr>
<th>SHIFT +</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ramp</td>
<td>1% 2%.... 100% 99%....2% 1%</td>
</tr>
<tr>
<td>2 Manual Multi-step scanning (increase progressively)</td>
<td>Press this button once +25% till it reaches 100%</td>
</tr>
<tr>
<td>3 Fast ramp</td>
<td>4% 8%....100% 96%....8% 4%</td>
</tr>
<tr>
<td>4 Return to the “starting” point of scanning 0%</td>
<td></td>
</tr>
<tr>
<td>5 Press it during scanning period to HOLD the scanning</td>
<td></td>
</tr>
<tr>
<td>6 Return to the “ending” point of scanning 100%</td>
<td></td>
</tr>
<tr>
<td>7 Auto Multi-step scanning (increase and decrease progressively)</td>
<td>0% 25% 50% 75% 100%....</td>
</tr>
<tr>
<td>8 Manual Multi-step scanning (decrease progressively)</td>
<td>Press this button once -25% till it reaches 0%.</td>
</tr>
</tbody>
</table>

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in each parameter (including decimal point), press ENTER, then iCal will output the parameter values.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.

Warning: 1. Do not make an input or connect any charged installment to SOURCE (terminals) to prevent from damaging iCal.
2. When there is an output short circuit or overload, iCal cannot output the correct frequency.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

4b. How to set up

(1) Press to enter SETUP function.
(2) Waveform Index: give a number for a “user programmable waveform”.
(3) Press again to enter the main display of Hz range.
(4) Press button to select the “user programmable waveform”. Then, iCal will output this selected “user programmable waveform” (e.g. number 7 waveform – named SINONE60 Sinusoidal Wave 60Hz).

Waveform Index: 7
SINONE60 Sinusoidal Wave 60Hz

press DIGITS
4. Frequency (Hz) Output

4a. 0.1Vpp ~ 20Vpp, 0.3Hz ~ 20KHz, offset: -5V ~ +5V

(1) Turn on the power, Sliding switch turned to Hz.
   (Press once to store it as default mode when power is turned on.)

(2) Press button to select the type of waveform (Sine wave, Square wave, Triangular wave, Truncated sine wave, and User programmable waveform).

(3) Press button to switch among “Voltage Peak to Peak (Vpp)”, “OFFSET”, “DUTY” and “Hz”.
(4) Then type in a value (including decimal point) and press ENTER.
(5) Connect Test leads or Alligator clips to SOURCE terminals (red to red, and black to black).
(6) Connect Test leads or Alligator clips to the object for calibration.

3c. Example of Connecting Leads (for Ramp and Multi-step Scanning)
Connecting Leads for Multi-step Scanning

3b. How to set up

(1) Press  to enter SETUP function.
(2) TC 0%: set up the “starting” temperature for scanning. (refer to SCANNING chapter).
(3) TC 100%: set up the “ending” temperature for scanning. (refer to SCANNING chapter).
(4) C. J. COMP.: set up the Cold Junction Compensation.
(5) TC TYPE: set up the thermocouple type.
(6) UNIT: here users can choose ℃ or ℉.

3c. Details for set up

(1) Press button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) C. J. COMP.: Users can type in the temperature for Cold Junction Compensation. (The default is 0.0 ℃, users can make compensation from -5 ℃ to +5 ℃ in accordance with the ideal output values.)
(4) When “TC TYPE” is in reverse video, users can press button to choose the thermocouple type they want.
(5) When “UNIT” is in reverse video, users can press button to choose ℃ or ℉.
3. TEMPERATURE SOURCE (THERMOCOUPLES, ℃ & ℉)

3a. TC Simulating Thermocouple Signals
(for Types K, J, T, R, S, N, L, U, B, C, and mV Output)

(1) Turn on the power. Sliding switch turned to ℃, ℉, or mV.
(2) Select a TC TYPE in the SETUP display.
(3) Type in a temperature value (including decimal point); then press ENTER.
(4) Connect Thermocouple to TC/mV terminals.
(5) Then connect the other end of Thermocouple to the object for calibration.

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in a temperature value (including decimal point), press ENTER, then iCal will output this temperature value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.

Warning: 1. Do not make an input or connect any charged installment to TC terminals to prevent from damaging iCal.
2. When there is an output short circuit or overload, iCal can not output the correct temperature. Please remove connecting leads and check when there is a symbol of OUTPUT ERROR.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

IV. DATA LOGGING

1. The way of logging
   The data logging function is available for all the ranges except Hz.

1a. How to set up
   (1) Only under V range, users can set up SAMPLE and FILE NAME.
   And the setups under V range will be applied to other ranges (mA, ...).
   (2) Press SETUP to enter SETUP function.
   (3) SAMPLE: set up the “sampling time” for data logging.
   (4) FILE NAME: data can be saved under different file names. Here users can set up a “file name”. (However, this function is available only when the SAMPLE is set up as “0”.)

   | V 0%:  | 4.000V |
   | V 100%: | 15.000V |
   | SAMPLE: | 1 SEC |
   | FILE NAME: | MAIN0001 |

   press DIGITS

1b. Data logging for V, mA, Temperature (℃ & ℉)
   (1) The data logging can be preformed under both modes (SOURCE and MEASURE). But the data can not be logged under different ranges or under different modes. (When the SAMPLE is set up as “0”, many single logged data under the same file name can be put together).

   (2) To perform data logging, press DTMF and then “SHIFT” will show on the left bottom of the display. Press button to start data logging.
(3) To stop data logging, please repeat the above procedures.
To continue data logging, users just have to repeat it again.
(4) When users want to logged data for a different mode (SOURCE or MEASURE), they have to clear memory first (and save the data before clearing the memory if necessary, please refer to Software Manual).

1c. Save data in FILE NAME

This data logging can be performed under any ranges (V, mA, ℃ & ℉) and any modes (SOURCE and MEASURE). And the logged data can be saved in the FILES NAME(s) decided by users.

(1) SAMPLE (rate) has to be 0 if users would like to use the function of saving data in FILE NAME(s).

(2) To perform data logging, press and then “SHIFT” will show on the left bottom of the display. Press button to start data logging.

(3) Data logging for various data can be performed under any ranges or any modes. Users just have to follow the above procedures to continue data logging and saving.

2. Single-point Data Logging

2a. Data Logging Set Up

(1) Only under V range, users can set up SAMPLE and FILE NAME. And the setups under V range will be applied to other ranges (mA, ...).

(2) Press to enter SETUP function.

(3) SAMPLE: set up the “sampling time” as “0”.

(4) FILE NAME: data can be saved under different file names. Here users can set up a “file name” (by referring to ASCII codes).

2d. MAPPING Function

(1) In the SETUP display when users choose YES for MAPPING, the MAPPING function is enabled
(2) The display unit will be the same as the one set up by users. For example, for the unit “KW” users should type in “75” and “87”.
(3) (If in the SETUP display, users set up 0KW for 4mA and 100KW for 20mA) When users type in 100 and then press ENTER, the display will show: 100.0KW (the main display) and 20.000mA (which means the original output of iCal is 20.000mA).
(4) When users perform scanning function, the display show 0~100KW instead of 4mA ~ 20mA.
(1) Press \( \text{[S/M]} \) button to select the item you’d like to setup.
(2) When the selected item is in reverse video, type in a value.
(3) When setting up the mapping unit for 4mA or 20mA, type in the unit by corresponding to ASCII codes (refer to Appendix 1). For example, for “KW” users should type in “75” and “87”.
(4) MAPPING: “YES” means the mapping function is enabled; “NO” means the mapping function is disabled.

2b. Start Data Logging

(1) Under any ranges/modes except Hz range, press \( \text{[SHIFT]} \) and then “SHIFT” will show on the left bottom of the display. Press \( \text{[REC]} \) button to start logging single-point data under specified FILE NAME.
(2) Under all the ranges/modes, single-point data under the same FILE NAME can be logged together.
(3) To continue data logging under each range, users just have to repeat the above step 1.

3. Multi-point Data Logging

3a. Data Logging Set Up

(1) Only under V range, users can set up SAMPLE and FILE NAME. And the setups under V range will be applied to other ranges (mA, …).

(2) Press \( \text{[SETUP]} \) to enter SETUP function.
(3) SAMPLE: set up the “sampling time” (from 1~255 sec.).
(4) FILE NAME: for multi-point data logging, data can not be saved under different file names. Here users do not have to set up a “file name”.
3b. Start Data Logging

(1) Under any ranges/modes except Hz range, press and then “SHIFT” will show on the left bottom of the display. Press button to start logging multi-point data per the sampling time set us by users.

(2) To stop data logging, please repeat the above procedure.

(3) All the data can not logged under different ranges or different modes. If users have to log data for a different mode or range, they have to download data or clear memory first.

4. Delete Data & Download Data

(1) Delete Data: Turn off the power first. Press and buttons at the same time, there will be 2 beep sounds. Then the memory is cleared.

(2) Download Data: First install the software (provided along with CL427) to PC, then users can download data (refer to software manual).
V. REMOTE PC (CONTROLLING CL427)

1. The baud rate between PC and CL427 is 460800 Bps.
2. Please refer to below list for corresponding iCal buttons to the (remote) PC buttons.

<table>
<thead>
<tr>
<th>iCal buttons</th>
<th>PC buttons</th>
<th>ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0x30</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0x31</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>0x32</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0x33</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0x34</td>
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<tr>
<td>5</td>
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<td>0x35</td>
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<td>6</td>
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<td>7</td>
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<td>0x37</td>
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<td>8</td>
<td>8</td>
<td>0x38</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>0x39</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>0x2E</td>
</tr>
<tr>
<td>ENTER</td>
<td>ENTER</td>
<td>0x0D</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>0x46</td>
</tr>
<tr>
<td>U</td>
<td>U</td>
<td>0x55</td>
</tr>
<tr>
<td>S</td>
<td>S</td>
<td>0x53</td>
</tr>
<tr>
<td>I</td>
<td>I</td>
<td>0x49</td>
</tr>
</tbody>
</table>
VI. BATTERY RECHARGING

1. Inside CL427 there is a rechargeable lithium battery.

2. After turning on the power of CL427, the display will show the remaining power percentage of the rechargeable battery.

3. When the remaining power percentage of the rechargeable battery is less than 10%, we suggest users to recharge the battery by using the AC adaptor provided along with CL427.

4. To do the battery recharging, users just need to:
   (1) put the AC adaptor into the socket;
   (2) connect the AC adaptor to DC terminal of CL427;
   (3) and turn on CL427.
Warning: 1. Do not make an input with voltage potential or connect any charged circuitry to SOURCE (terminals) to prevent from damaging iCal.
2. When there is a short circuit or overload at the output terminals, iCal cannot output the correct voltage. Please remove connecting leads and check when there is a symbol of OUTPUT ERROR.
3. Perform one function at a time and make connection to the specific terminals only. Remove all other connections to the unused terminals. Always connect to only one of SOURCE, MEASURE, or TC alone.

1b. How to set up

(1) Press SETUP to enter SETUP function.
(2) V 0%: set up the “starting” voltage for scanning.
   (refer to SCANNING chapter).
(3) V 100%: set up the “ending” voltage for scanning.
   (refer to SCANNING chapter).
(4) SAMPLE: set up the “sampling” time for data logging.
   (refer to DATA LOGGING chapter).
(5) FILE NAME: data can be saved under different file names. Here users can set up a “file name”. (refer to DATA LOGGING chapter)

V 0%: 4.000V
V 100%: 15.000V
SAMPLE: 1 SEC
FILE NAME: MAIN0001 press DIGITS

1c. Details for set up

VII. ELECTRICAL SPECIFICATIONS

(23 +/- 5 °C, 10 minutes after turning on the power)

mA (source) (Vopen > 15V)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4mA to -0.005mA</td>
<td>1uA</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>0.005mA to 4mA</td>
<td>1uA</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>4mA to 20mA</td>
<td>1uA</td>
<td>+/-0.03% +/-3dgts</td>
</tr>
<tr>
<td>20mA to 24mA</td>
<td>1uA</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
</tbody>
</table>

V (source) (maximum load 1mA, short circuit protection < 100mA)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3V to -0.005V</td>
<td>0.001V</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>0.005V to 10V</td>
<td>0.001V</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
<tr>
<td>10V to 15V</td>
<td>0.001V</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
</tbody>
</table>

mA (measure)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4mA to -0.005mA</td>
<td>1uA</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>0.005mA to 4mA</td>
<td>1uA</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>4mA to 20mA</td>
<td>1uA</td>
<td>+/-0.03% +/-3dgts</td>
</tr>
<tr>
<td>20mA to 24mA</td>
<td>1uA</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
</tbody>
</table>

If reading of mA (measure) is less than 5 digits, it is displayed as 0.

V (measure)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3V to -0.005V</td>
<td>0.001V</td>
<td>+/-0.03% +/- 5dgts</td>
</tr>
<tr>
<td>0.005V to 10V</td>
<td>0.001V</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
<tr>
<td>10V to 24V</td>
<td>0.001V</td>
<td>+/-0.03% +/-5dgts</td>
</tr>
</tbody>
</table>

If reading of V (measure) is less than 5 digits, it is displayed as 0.

Frequency (source, 10 Vpp, 0V offset, square wave, duty cycle = 50%)

<table>
<thead>
<tr>
<th>Range (Hz)</th>
<th>Input Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 to 99.999</td>
<td>0.1Hz</td>
<td>0.002Hz</td>
</tr>
<tr>
<td>10.00 to 999.99</td>
<td>0.1Hz</td>
<td>0.02Hz</td>
</tr>
<tr>
<td>1000.0 to 9999.9</td>
<td>0.1Hz</td>
<td>0.2Hz</td>
</tr>
<tr>
<td>10000 to 20000</td>
<td>1Hz</td>
<td>2Hz</td>
</tr>
</tbody>
</table>

Temperature, Thermocouples (source and measure, 0.1°C & 0.1°F Resolution, Internal Cold Junction Compensation, thermocouple accuracy not included, 3 minutes after plugging in thermocouples.)
II. OPERATION

1. Voltage Source

1a. -3V ~ 15V

(1) Turn on the power, and move the sliding switch to V.
(2) Press S/M button to select SOURCE (output) mode.
(3) Type in a voltage value (including decimal point); then press ENTER.
(4) Connect Test leads or Alligator clips to SOURCE terminals (red to red, and black to black).
(5) Then connect Test leads or Alligator clips to the object for calibration.
(6) To perform voltage scanning, refer to “Scanning for Source” chapter.
(7) To perform data logging function, refer to “Data logging” chapter.

### Voltage Peak to Peak for Sine Wave

(Vpp, 0.3~20KHz, 50% duty cycle, sine wave, 0V offset)

<table>
<thead>
<tr>
<th>Range(V)</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 20V</td>
<td>0.001V</td>
<td>5% +/- 0.3V</td>
</tr>
</tbody>
</table>

### Voltage Peak to Peak for Non-Sine Wave

(Vpp, 0.3~20KHz, 0V offset)

<table>
<thead>
<tr>
<th>Range(V)</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 20V</td>
<td>0.001V</td>
<td>6% +/- 0.4V</td>
</tr>
</tbody>
</table>

### Voltage Peak to Peak

Remark: 1. Users are allowed to type in max. 5 digits.
2. Type in a voltage value (including decimal point), press ENTER, then iCal will output this voltage value.
3. When the output value is <0, please type in a negative sign first.
4. When the output value is <1 and >0, please type in “0.” first.
I. PANEL DESCRIPTION

1. LCM display.
2. ON/OFF button.
3. SELECT button for selecting waveforms (in the Hz function).
4. SETUP button.
5. Numerical key pads; or buttons for special functions (e.g. REC, 0%, 100%).
6. Output terminals (for SOURCE).
7. Input terminals (for MEASURE).
8. Sliding switch (for various functions).
10. SHIFT button for using secondary functions on the numerical key pads:
    - DTMF and Frequency switching.
11. S/M button (for selecting SOURCE or MEASURE).

### Voltage of Offset (Maximum Vpp < 20V)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5V to 5V</td>
<td>0.001V</td>
<td>5% +/-0.5V +/-5%xVpp</td>
</tr>
</tbody>
</table>

### Duty Cycle (%), square wave, 10 Vpp, 0.3~20KHz

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Rise Time of Vpp</th>
<th>Fall Time of Vpp</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100%</td>
<td>1%</td>
<td>10µS max, 5µS typical</td>
<td>15µS max, 7.5µS typical</td>
</tr>
</tbody>
</table>

### DTMF (Hz)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 to 99.999</td>
<td>0.1Hz</td>
<td>0.002Hz</td>
</tr>
<tr>
<td>10.00 to 999.99</td>
<td>0.1Hz</td>
<td>0.02Hz</td>
</tr>
<tr>
<td>1000.0 to 9999.9</td>
<td>0.1Hz</td>
<td>0.2Hz</td>
</tr>
<tr>
<td>10000 to 20000</td>
<td>1Hz</td>
<td>2Hz</td>
</tr>
</tbody>
</table>

### DTMF (%)

<table>
<thead>
<tr>
<th>Range (%)</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% ~ 100%</td>
<td>1%</td>
<td>5%</td>
</tr>
</tbody>
</table>

### DTMF (Phase Angle)

<table>
<thead>
<tr>
<th>Range (°)</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ~ 360</td>
<td>1°</td>
<td>100µS°</td>
</tr>
</tbody>
</table>

### DTMF (Vpp, F1=F2, <1 KHz, %1=%2, Phase1=Phase2)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V ~ 20V</td>
<td>0.001V</td>
<td>10% +/-0.6V</td>
</tr>
</tbody>
</table>

### DTMF (Offset, F1=F2, <1 KHz, %1=%2, Phase1=Phase2)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy of Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5V ~ 5V</td>
<td>0.001V</td>
<td>10% +/-0.6V +/-5%xVpp</td>
</tr>
</tbody>
</table>
### VIII. GENERAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>AC Adaptor:</th>
<th>AC 110V, 60Hz input; or AC 220V, 50/60Hz input. DC 15V / 0.5A output,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension:</td>
<td>214.0(L) x 98.7(W) x 56.0(H) mm 8.4” (L) x 3.9” (W) x 2.2” (H)</td>
</tr>
<tr>
<td>Weight:</td>
<td>650g / 22.9oz (Batteries included)</td>
</tr>
<tr>
<td>Operation Environment:</td>
<td>0 ℃ ~ 50 ℃, 85% RH</td>
</tr>
<tr>
<td>Storage Environment:</td>
<td>-20 ℃ ~ 60 ℃, 75% RH</td>
</tr>
<tr>
<td>Accessories:</td>
<td>Carrying case x 1 User manual x 1 AC adaptor x 1 USB cable x 1 Software CD x 1 Software manual x 1 K-type thermocouple (dual plugs) x 1 Alligator clips x 2 (black and red) Test leads x 2 (black and red) Rechargeable lithium battery (11.1V/1600mAh) x 1</td>
</tr>
</tbody>
</table>

### Applications:
1. **Calibration of 4 to 20mA transmitters and panel meters.**
2. **Temperature calibration** of panel meters or instruments for 11 types of thermocouples.
3. **Calibration of valve opening** by changing duty cycle of a PWM signal.
4. **Generation** of selected test **frequency and waveform** for electronic device.
5. **Pre-stored** 1/3 octave audition, white noise, and pink noise for MP3, MD, speaker and audio driver tests.
6. **Audio Frequency Synthesizer**: Programmable frequency and phase synthesis of single tone, DTMF(Double Tone, Multi-Frequency) for audio products such as MP3, MD and telephone line.
7. **Function generation** for transistor DC bias characteristics test, amplifier overload and transient characteristics.
8. **Function generation** for vibration testing.
9. **Calibration of a chart recorder** with different waveforms (sine, square, or triangular wave).
10. Simulation of **PLC**.
Features:
1. **Unique mapping function** let you calibrate temperature (300 °C) or voltage (220V) directly (instead of 4 to 20mA indirectly).
2. iCal is a **multifunction calibrator** and an **arbitrary function generator**.
3. **Source**: mA (4 to 20mA), V (0 to 15V, 0 to 70mV), Hz, sine wave, square wave, triangular wave, truncated sine wave, user programmable waveform and temperature for 11 types of thermocouples.
4. **Measure**: Current (mA), Voltage (V, mV) and temperature in ℃ or ℉.
5. **Programmable cold junction compensation** allows users to fine tune temperature output and measurement.
6. Programmable 0% and 100% value for easy **25% step function**.
7. **Output error warning** when output is shorted or open.
8. **Short circuit protection** for voltage output.
9. **Clear and easy user interface** (Numerical key pad, sliding switch and dot matrix LCM with backlight).
10. Voltage, frequency, PWM duty-cycle (square wave and triangular wave), and offset are programmable in the Hz **function**.
11. **Frequency range (0.3Hz to 20KHz)** covers application of audio band (speaker, MP3, MD etc.)
12. **DTMF** (Dual Tone Multi-Frequency) can perform professional testing for telephone line and audio product (MP3 or MD).
13. **Auto-step and auto-ramp functions** can quickly perform linear test.
14. **PC** can program calibrator through USB port.
15. iCal can perform **data logging** with programmable sampling time (0-255 seconds) and memory of 4000 records.
16. **Rechargeable Lithium battery** (1600mAH) with built-in charging circuit.
17. **Calibration results** (source and measure) can be **saved in memory** (2000 records). Then users download them to a PC for documentation. No needs to transcribe calibration data manually.
18. To **distinguish calibration data** at different locations, data can be saved under different file names.

---

( Appendix 1 ) ASCII code list

<table>
<thead>
<tr>
<th>Decimal System</th>
<th>ASCII</th>
<th>Decimal System</th>
<th>ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>!</td>
<td>62</td>
<td>&gt;</td>
</tr>
<tr>
<td>33</td>
<td>?</td>
<td>63</td>
<td>@</td>
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<tr>
<td>34</td>
<td></td>
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