Since 1984, Altech Corporation has grown to become a leading supplier of automation and industrial control components. Headquartered in Flemington, NJ, Altech has an experienced staff of engineering, manufacturing and sales personnel to provide the highest quality products with superior service. This is the Altech Commitment!

With experienced Product Engineers and Customer Service personnel, Altech provides solutions to your most pressing application challenges. All with one thought in mind - to ensure that we solve your problem the first time!

**Quality Commitment**

Altech's control components meet diverse national and international standards such as UL, NEC, CSA, IEC, VDE and more. Altech provides superior customer service and delivery through Total Quality Management and Continuous Process Improvement. Altech is ISO 9001 approved. We perform these services with honesty and integrity and are committed to achieve these goals.
# Table of contents

**Altech Digital Panel Meters**

*Features and Selection Guide* ................................................................. 4-5

**Digital Multi Function Meters**
- MFM Series (Power, Energy, Voltage, Current, Frequency, Power Factor) ........ 6-7
- VAF Series (Voltage, Current, Frequency) ............................................. 8
- EM Series (Power, Energy) ................................................................. 9

**Digital Ampere Meters**
- MA12 Series (LED Display) ............................................................... 10
- MA Series (LCD Display) ............................................................... 11

**Digital Voltage Meters**
- MV15 Series (LED Series) ............................................................... 12
- MV Series (LCD Display) ............................................................... 13

**Digital Frequency Meter**
- MF16 Series .................................................................................... 14

**Digital Power Factor Meter**
- MP14 Series .................................................................................... 14

**Disconnect and Test Terminal Block**
- For Meter Circuits ........................................................................ 15-17
- Application Examples .................................................................... 16-17

**Glossary** ....................................................................................... 18-21

**Index** .......................................................................................... 22

**Terms and Conditions** .................................................................. 23
Digital Panel Meter Features

**RS485 MODBUS Communication** (available in MFM, VAF and EM Series)

Pulse Output (24VDC, 100mA)

UL Listed

**Faceplate; IP65 Protection Rating**

**7 Segment LED Display**

**Available Functions:** Voltage, Current, Power, Energy, Frequency and Power Factor (true RMS values)

**Standard DIN sizes (1/4 DIN, 1/8 DIN and 1/16 DIN)**

**RS485 MODBUS Communication** (available in MFM, VAF and EM Series)

Pulse Output (24VDC, 100mA)

Analog Bar Graph Indicator for Current Percentage

UL Listed

**Faceplate; IP65 Protection Rating**

**Modern LCD Display**

**Available Functions:** Voltage, Current, Power, Energy, Frequency and Power Factor (true RMS values)
### DIGITAL PANEL METERS

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>Supply Voltage</th>
<th>Phases</th>
<th>Filters</th>
<th>Voltage</th>
<th>Current</th>
<th>Power Factor</th>
<th>Power</th>
<th>Frequency</th>
<th>Energy</th>
<th>Display</th>
<th>LED</th>
<th>LCD</th>
<th>Bar Graph</th>
<th>Pulse Output</th>
<th>RS485 MODBUS Communication</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFM304-CU</td>
<td>110/240V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFM303A-CU</td>
<td>110/240V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFM374-CU</td>
<td>220V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFM374-CU</td>
<td>220V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAF36A-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAF39A-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EM368-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA12-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA12-50mV-DC-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA12-100mV-DC-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA501-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA2301-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV15-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV15-DC-20V-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV15-DC-200V-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV507-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV2307-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MF16-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP14-110V-CU</td>
<td>110V</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**FEATURES**

- Measurement Functions
  - 3 Ø Voltage (True RMS)
  - 3 Ø Current (True RMS)
  - 3 Ø Power Factor
  - 3 Ø Power (Active, Reactive, Apparent)
  - Energy (Active, Reactive, Apparent)
  - Frequency
- Programmable CT/PT Primary/Secondary
- RS485 Modbus RTU Communication
- Single Pulse Output

### MFM Series MFM384-C-CU MFM383A-CU

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>Display</th>
<th>Terminal Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Display Type</td>
<td>LCD Display with backlight</td>
</tr>
<tr>
<td></td>
<td>Digits</td>
<td>4 rows of 4 digits</td>
</tr>
<tr>
<td></td>
<td>1 row of 8 digits for energy display</td>
<td>1 row of 7.5 digits for energy display</td>
</tr>
<tr>
<td></td>
<td>Bargraph</td>
<td>Bargraph for current percentage</td>
</tr>
<tr>
<td></td>
<td>Supply Specification</td>
<td>85 – 270 VAC (50/ 60Hz)</td>
</tr>
<tr>
<td></td>
<td>Input Specification</td>
<td>3 Phase (3/4 wires), 2 Phase (3 wire), 1 Phase (2 wire)</td>
</tr>
<tr>
<td></td>
<td>Input Voltage Range</td>
<td>11 – 300 VAC (Phase to Neutral)</td>
</tr>
<tr>
<td></td>
<td>19 – 519 VAC (Phase to Phase)</td>
<td>19 – 519 VAC (Phase to Phase)</td>
</tr>
<tr>
<td></td>
<td>Input Current Range</td>
<td>10mA – 5A (External CT required for current &gt;5A)</td>
</tr>
<tr>
<td></td>
<td>Frequency</td>
<td>45 – 65Hz</td>
</tr>
<tr>
<td></td>
<td>Parameter Resolution</td>
<td>Energy 0.01k, 0.1k, 1k, 0.01M, 0.1M, 1M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power, Voltage, Current Auto resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Factor 0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accuracy Class Voltage (L-N, L-L), Current +/- 0.5% of Full-Scale Value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Factor +/-1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Frequency 0.1 Hz +/- 0.1 Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active, Reactive, Apparent Power 1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active, Reactive, Apparent Energy Class 1</td>
</tr>
<tr>
<td></td>
<td>Output Specifications</td>
<td>Pulse Output 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulse Voltage 24 VDC max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulse Current 100mA max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulse Duration 100ms +/-5ms</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>RS485 MODBUS Communication</td>
</tr>
<tr>
<td></td>
<td>Programmable Parameters</td>
<td>CT Primary 1A/ 5A – 10,000A (Programmable for any value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT Secondary 1A/ 5A (External CT must be connected for current &gt;5A)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT Primary 100V – 500 kV (any value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT Secondary 100V – 500 VAC (any value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Humidity Up to 85% RH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Protection Level IP65 for Faceplate</td>
</tr>
<tr>
<td></td>
<td>Physical Specifications</td>
<td>Size 1/4 DIN, 96 mm x 96 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight 0.70 lbs (318g)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Terminal Size Acceptability and Torque 20-14 AWG (0.5 – 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
</tr>
</tbody>
</table>

**DIMENSIONS**

- 99mm Front bezel
- 95mm Side view
- Panel output

**TERMINAL CONNECTIONS**

- MFM Series
- MFM384-C-CU
- MFM383A-CU
MFM Series (Multi-Function Meters)

FEATURES
• Measurement Functions
  • 3 Ø Voltage (True RMS)
  • 3 Ø Current (True RMS)
  • 3 Ø Power Factor
  • 2 Home, Reactive, Apparent
  • Energy (Active, Reactive, Apparent)
  • Frequency
• Programmable CT/ PT Primary/ Secondary
• RS485 Modbus RTU Communication
• Single Pulse Output

CAT. NO. MFM374-C-CU MFM374-CU

<table>
<thead>
<tr>
<th>Display</th>
<th>7 Segment LED Display</th>
<th>7 Segment LED Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Spec.</td>
<td>85 ~ 270 VAC (50/60Hz)</td>
<td>85 ~ 270 VAC (50/60Hz)</td>
</tr>
</tbody>
</table>

Input Specification

<table>
<thead>
<tr>
<th>Electrical Wire System</th>
<th>3 Phase (3/4 wires), 2 Phase (3 wire), 1 Phase (2 wire)</th>
<th>3 Phase (3/4 wires), 2 Phase (3 wire), 1 Phase (2 wire)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage Range</td>
<td>11 ~ 300 VAC (Phase to Neutral)</td>
<td>11 ~ 300 VAC (Phase to Neutral)</td>
</tr>
<tr>
<td>Input Current Range</td>
<td>10mA ~ 5A (External CT required for current &gt;5A)</td>
<td>10mA ~ 5A (External CT required for current &gt;5A)</td>
</tr>
<tr>
<td>Frequency</td>
<td>45 ~ 65Hz</td>
<td>45 ~ 65Hz</td>
</tr>
</tbody>
</table>

Parameter Resolution

| Energy                  | 0.01k, 0.1k, 1k, 0.01M, 0.1M, 1M                     | 0.01k, 0.1k, 1k, 0.01M, 0.1M, 1M                     |
| Power, Voltage, Current | Auto resolution                                      | Auto resolution                                      |
| Power Factor            | 0.001                                                 | 0.001                                                 |

Accuracy Class

| Voltage (L-N, L-L), Current | +/- 0.5% of Full-Scale Value                          | +/- 0.5% of Full-Scale Value                          |
| Power Factor                | +/- 1%                                                | +/- 1%                                                |
| Frequency                   | 0.1 Hz                                                | 0.1 Hz                                                |
| Active, Reactive, Apparent Power | 1%                                           | 1%                                           |
| Active, Reactive, Apparent Energy | Class 1                                           | Class 1                                           |

Output Specifications

| Pulse Output | 24 VDC max.                                           | 24 VDC max.                                           |
| Pulse Current | 100mA max.                                           | 100mA max.                                           |
| Pulse Duration | 100µs +/-5µs                                         | 100µs +/-5µs                                         |

Communication

| RS485 Modbus Communication | –                                                      | –                                                      |

Programmable Parameters

| CT Primary | 1A/5A ~ 10,000A (Programmable for any value)         | 1A/5A ~ 10,000A (Programmable for any value)         |
| PT Primary | 100V ~ 500 VAC (any value)                            | 100V ~ 10 kV (any value)                              |

Environmental Specifications

| Temperature Operating: -10°C ~ 55°C, Storage: -20°C ~ 75°C | Operating: -10°C ~ 55°C, Storage: -20°C ~ 75°C |
| Humidity Up to 65% RH                                     | Up to 65% RH                                      |
| Protection Level | IP65 for Faceplate                                   | IP65 for Faceplate                                   |

Physical Specifications

| Size          | 1/4 DIN, 96 mm x 96 mm                              | 1/4 DIN, 96 mm x 96 mm                              |
| Weight        | 0.71 lbs (320g)                                     | 0.71 lbs (320g)                                     |

Terminal Size Acceptability and Torque

| 20-14 AWG (0.5 ~ 2.5mm²), 8-7 lb-in. (0.68 ~ 0.79Nm) | 20-14 AWG (0.5 ~ 2.5mm²), 8-7 lb-in. (0.68 ~ 0.79Nm) |

Please contact Altech for UL status.
VAF Series (Volt-Ampere-Frequency Meters)

FEATURES
- Measurement Functions
  - 3 Ø Voltage (True RMS)
  - 3 Ø Current (True RMS)
  - Frequency
  - RPM
  - Run Hour
- Programmable CT Primary, PT Primary/Secondary

CAT. NO. | VAF36A-110V-CU | VAF39A-110V-CU
---|---|---
Display | LCD Display with backlight | 7 Segment LED Display
Digits | 3 rows of 3 digits | 3 rows of 3 digits
Bargraph | Bargraph for current percentage | –
Supply Specification | 110 VAC +/- 20% (50/60Hz) | 110 VAC +/- 20% (50/60Hz)

Input Specification
- Electrical Wire System: 3 Phase (3/4 wires)
- Input Voltage Range: 11 ~ 300 VAC (Phase to Neutral), 19 ~ 519 VAC (Phase to Phase)
- Input Current Range: 20mA ~ 6A (External CT required for current >5A)
- Frequency: 45 ~ 65Hz

Parameter Resolution
- Current: 0.01, 0.1, 1 A/KA
- Voltage: 0.1 V/KV
- RPM: 0.1
- Run Hour: 0.1 hr (0~99999.9 hr)

Accuracy Class
- Voltage (L-N, L-L), Current +/- 0.5% of Full-Scale Value, +/- 2 digits
- Average Voltage (L-N, L-L), Current +/- 0.5% of Full-Scale Value, +/- 2 digits
- Frequency: 0.1 Hz
- RPM: +/- 0.5%
- Run Hour: +/- 1%

Output Specifications
- Pulse Output: –

Programmable Parameters
- CT Primary: 5A ~ 10,000A (Programmable for any value)
- CT Secondary: 5A fixed (External CT must be connected for current >5A)
- PT Primary: 100V ~ 500 V (any value)
- PT Secondary: 100V ~ 500 V (any value)

Environmental Specifications
- Temperature: Operating: -10°C~55°C, Storage: -20°C~75°C
- Humidity: Up to 85% RH
- Protection Level: IP65 for Faceplate

Physical Specifications
- Size: 1/4 DIN, 96 mm x 96 mm
- Weight: 0.79 lbs (357g)
- Terminal Size Acceptability and Torque: 20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)
# EM Series (Energy Meters)

**FEATURES**

- Measurement Functions
- 3 Ø Power (Active, Reactive, Apparent)
- 3 Ø Power Factor
- Energy (Active, Reactive, Apparent)
- Programmable CT Primary, PT Primary/Secondary
- RS485 Modbus RTU Communication
- Single Pulse Output

## EM Series EM368-C-CU

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>Display Type</th>
<th>Digits</th>
<th>Bargraph</th>
<th>Display Scrolling</th>
<th>Supply Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM368-C-CU</td>
<td>LCD Display with backlight</td>
<td>6 digits</td>
<td>-</td>
<td>Automatic</td>
<td>85 – 270 VAC (50/ 60Hz)</td>
</tr>
</tbody>
</table>

### Input Specification

- **Electrical Wire System**: 3 Phase (3/4 wires)
- **Input Voltage Range**:
  - Phase to Neutral: 11 – 300 VAC
  - Phase to Phase: 19 – 519 VAC
- **Input Current Range**: 10mA – 5A (External CT required for current >5A)
- **Frequency**: 45 – 65Hz

### Parameter Resolution

- **Energy**: 0.01k, 0.1k, 1k, 0.01M, 0.1M, 1M, 10M
- **Power Factor**: Auto resolution
- **Accuracy Class**:
  - Power Factor: +/-1%
  - Active, Reactive, Apparent Power: +/-1%
  - Active, Reactive, Apparent Energy: Class 1

### Output Specifications

- **Pulse Output**: 1
- **Pulse Voltage**: 24 VDC max.
- **Pulse Current**: 100mA max.
- **Pulse Duration**: 100ms +/- 5ms

### Communication

- RS485 MODBUS Communication

### Programmable Parameters

- **CT Primary**: 1A/ 5A – 10,000A (Programmable for any value)
- **CT Secondary**: 1A/ 5A (External CT must be connected for current >5A)
- **PT Primary**: 100V – 500 kV (any value)
- **PT Secondary**: 100V – 500 VAC (any value)

### Environmental Specifications

- **Temperature**:
  - Operating: -10°C– 55°C
  - Storage: -20°C– 75°C
- **Humidity**: Up to 85% RH
- **Protection Level**: IP65 for Faceplate

### Physical Specifications

- **Size**: 1/4 DIN, 96 mm x 96 mm
- **Weight**: 0.69 lbs (312g)
- **Terminal Size Acceptability and Torque**: 20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)

---

**DIMENSIONS**

EM Series

**TERMINAL CONNECTIONS**

EM368-C
**MA12 Series** (LED Ampere Meters)

**FEATURES**
- Measurement Function
- 1 Ø Current (True RMS)
- Programmable CT Primary / Shunt Setting
- AC version (CT Type)
- DC version (Shunt Type, External Shunt (50mV/100mV) is required for measurement.)
- 4 Digit LED Display

<table>
<thead>
<tr>
<th>Display No.</th>
<th>MA12-110V-CU</th>
<th>MA12-50mV-DC-110V-CU</th>
<th>MA12-100mV-DC-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>7 segment LED display</td>
<td>7 segment LED display</td>
<td>7 segment LED display</td>
</tr>
<tr>
<td>Display Type</td>
<td>4 digits</td>
<td>4 digits</td>
<td>4 digits</td>
</tr>
<tr>
<td>Display Range</td>
<td>0 - 4960A</td>
<td>0 - 4960A</td>
<td>0 - 4960A</td>
</tr>
<tr>
<td>Supply Specification</td>
<td>110 VAC +/- 20% (60Hz)</td>
<td>110 VAC +/- 20% (60Hz)</td>
<td>110 VAC +/- 20% (60Hz)</td>
</tr>
<tr>
<td>Input Specification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Type</td>
<td>AC, CT Type (External CT required for current &gt; 5A)</td>
<td>1 Phase (2 wire)</td>
<td>DC, Shunt Type (External shunt is required for current &gt; 5A)</td>
</tr>
<tr>
<td>Shunt Size</td>
<td>50mV (MA12-50mV)</td>
<td>100mV (MA12-100mV)</td>
<td></td>
</tr>
<tr>
<td>Input Current Range</td>
<td>50mA – 5A (External CT required for current &gt; 5A)</td>
<td>50mA – 5A (External shunt required for current &gt; 5A)</td>
<td></td>
</tr>
<tr>
<td>Frequency Range</td>
<td>45 – 63Hz</td>
<td>45 – 63Hz</td>
<td>45 – 63Hz</td>
</tr>
<tr>
<td>Parameter Resolution</td>
<td>0.001, 0.01, 0.1, 1A (depending on CT Primary)</td>
<td>0.001, 0.01, 0.1, 1A (depending on shunt setting)</td>
<td></td>
</tr>
<tr>
<td>Accuracy Class</td>
<td>+/- 0.5% of Full-Scale Value</td>
<td>+/- 0.5% of Full-Scale Value</td>
<td>+/- 0.5% of Full-Scale Value</td>
</tr>
<tr>
<td>Output Specifications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Programmable Parameters</td>
<td>5, 10, 20, 30, 50, 60, 75, 80, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 1600, 2000, 2500, 3000, 4000</td>
<td>5, 10, 20, 30, 50, 60, 75, 80, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 1600, 2000, 2500, 3000, 4000</td>
<td></td>
</tr>
<tr>
<td>Environmental Specifications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>Up to 85% RH</td>
<td>Up to 85% RH</td>
<td>Up to 85% RH</td>
</tr>
<tr>
<td>Protection Level</td>
<td>IP65 for Faceplate</td>
<td>IP65 for Faceplate</td>
<td></td>
</tr>
<tr>
<td>Physical Specifications</td>
<td>1/8 DIN, 48 mm x 96 mm</td>
<td>1/8 DIN, 48 mm x 96 mm</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>1/8 DIN, 48 mm x 96 mm</td>
<td>1/8 DIN, 48 mm x 96 mm</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.37 lbs (170g)</td>
<td>0.37 lbs (170g)</td>
<td></td>
</tr>
<tr>
<td>Terminal Size Acceptability and Torque</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
<td></td>
</tr>
</tbody>
</table>

230 VAC versions also available, please consult Altech.
FEATURES
• Measurement Functions
  • 1 Ø Current (True RMS)
  • 3 Ø Current (True RMS)
• Integrated selector switch for phase selection (MA2301)
• LCD Display with Backlight
• Bargraph Indicator

CAT. NO. | MA501-110V-CU | MA2301-110V-CU
---|---|---
Display | LCD display with backlight | LCD display with backlight
Display Type | 4 digits | 4 digits
Digits | Analog bargraph indicator | Analog bargraph indicator
Bargraph | 0 – 6200A | 0 – 6200A
Display Range | manual phase selector switch | manual phase selector switch
Display Scrolling | 45 – 65Hz | 45 – 65Hz
Frequency Range | 0.001, 0.01, 0.1, 1A (depending on CT Primary) | 0.001, 0.01, 0.1, 1A (depending on CT Primary)
Parameter Resolution | 3 samples / sec. | 3 samples / sec.
Sampling Rate | +/- 0.5% of Full-Scale Value | +/- 0.5% of Full-Scale Value
Accuracy Class | Current | Output Specifications
Input Specifications | Programmable Parameters
Electrical Wire System | Measurement Type | 1 Phase (2 wire) | AC, CT Type (External CT required for current > 5A)
 | 3 Phase/4 wire | AC, CT Type (External CT required for current > 5A)
 | Measurement Type | 1 Phase (2 wire) | AC, CT Type (External CT required for current > 5A)
 | 3 Phase/4 wire | AC, CT Type (External CT required for current > 5A)
Input Current Range | 50mA – 5A (External CT required for current > 5A) | 50mA – 5A (External CT required for current > 5A)
 | Frequency Range | 45 – 65Hz | 45 – 65Hz
 | Parameter Resolution | 0.001, 0.01, 0.1, 1A (depending on CT Primary) | 0.001, 0.01, 0.1, 1A (depending on CT Primary)
 | Sampling Rate | 3 samples / sec. | 3 samples / sec.
 | Accuracy Class | +/- 0.5% of Full-Scale Value | +/- 0.5% of Full-Scale Value
 | Output Specifications | Programmable Parameters
CT Primary | 5, 10, 20, 30, 40, 50, 60, 75, 80, 100, 125, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 1600, 2000, 2250, 2500, 5000 | 5, 10, 20, 30, 40, 50, 60, 75, 80, 100, 125, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 1600, 2000, 2250, 2500, 5000
 | CT Secondary | 5A fixed (External CT must be connected for current > 5A) | 5A fixed (External CT must be connected for current > 5A)
 | Humidity | Up to 85% RH | Up to 85% RH
 | Protection Level | IP65 for Faceplate | IP65 for Faceplate
 | Physical Specifications | Size | 1/16 DIN, 48 mm x 48mm | 72 mm x 72 mm
 | Weight | 0.25 lbs (113g) | 0.40 lbs (163g)
 | Terminal Size Acceptability and Torque | 20-14 AWG (0.5 – 2.5mm²), 6-7 lb-in. (0.68 – 0.79Nm) | 20-14 AWG (0.5 – 2.5mm²), 6-7 lb-in. (0.68 – 0.79Nm)

MA501-110V-CU | MA2301-110V-CU
---|---

DIMENSIONS

TERMINAL CONNECTIONS

230 VAC versions also available, please consult Altech.
## MV15 Series (LED Voltage Meters)

### FEATURES
- Measurement Function
- 1 Ø Voltage (True RMS)
- 3 Digit LED Display

![MV15 Series Meters](image)

### MV15-110V-CU
- **Display Type**: 7 segment LED Display
- **Digits**: 3 digits
- **Display Range**: 0 - 516V
- **Supply Specification**: 110 VAC +/-20% (60Hz)

### MV15-DC-20V-110V-CU
- **Display Type**: 7 segment LED Display
- **Digits**: 3 digits
- **Display Range**: 0 - 516V
- **Supply Specification**: 110 VAC +/-20% (60Hz)

### Table: Display Specifications

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>Display Type</th>
<th>Digits</th>
<th>Display Range</th>
<th>Supply Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV15-110V-CU</td>
<td>7 segment LED Display</td>
<td>3 digits</td>
<td>0 - 516V</td>
<td>110 VAC +/-20% (60Hz)</td>
</tr>
<tr>
<td>MV15-DC-20V-110V-CU</td>
<td>7 segment LED Display</td>
<td>3 digits</td>
<td>0 - 516V</td>
<td>110 VAC +/-20% (60Hz)</td>
</tr>
</tbody>
</table>

### Table: Input Specification

| CAT. NO.                  | Electrical Wire System | Input Voltage Range | Input Impedance | Parameter Resolution | Accuracy Class
|---------------------------|------------------------|--------------------|-------------------|---------------------|-----------------
| MV15-110V-CU             | 1 Phase (2 wire)       | 50 – 516 VAC       | 1 MΩ (+/-5%)     | Voltage 1V          | +/- 0.5% of Full-Scale Value |
| MV15-DC-20V-110V-CU      | 1 Phase (2 wire)       | 0 – 20 VDC (MV15-20V) | 1 MΩ (+/-5%)     | Voltage 1V          | +/- 0.5% of Full-Scale Value |

### Table: Output Specifications

| CAT. NO.                  | Resolution | Accuracy Class
|---------------------------|------------|-----------------
| MV15-110V-CU             | Voltage 1V | +/- 0.5% of Full-Scale Value |
| MV15-DC-20V-110V-CU      | Voltage 1V | +/- 0.5% of Full-Scale Value |

### Table: Environmental Specifications

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>Temperature Operating: -10°C–55°C, Storage: -20°C–75°C</th>
<th>Humidity Up to 85% RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV15-110V-CU</td>
<td>Operating: -10°C–55°C, Storage: -20°C–75°C</td>
<td>Up to 85% RH</td>
</tr>
<tr>
<td>MV15-DC-20V-110V-CU</td>
<td>Operating: -10°C–55°C, Storage: -20°C–75°C</td>
<td>Up to 85% RH</td>
</tr>
</tbody>
</table>

### Table: Physical Specifications

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>Size 1/8 DIN, 40 mm x 96 mm</th>
<th>Weight 0.38 lbs (170g)</th>
<th>Terminal Size Acceptability and Torque 20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV15-110V-CU</td>
<td>1/8 DIN, 40 mm x 96 mm</td>
<td>0.38 lbs (170g)</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
</tr>
<tr>
<td>MV15-DC-20V-110V-CU</td>
<td>1/8 DIN, 40 mm x 96 mm</td>
<td>0.38 lbs (170g)</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
</tr>
</tbody>
</table>

### Dimensions

![Dimensions Diagram](image)

### Terminal Connections

**MV15-110V-CU (AC Type)**

<table>
<thead>
<tr>
<th>Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>L</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

**MV15-DC-20V-110V-CU (DC Type)**

<table>
<thead>
<tr>
<th>Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>L</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

230 VAC versions also available, please consult Altech.

---

Altech Corp.® • 35 Royal Road • Flemington, NJ 08822-6000 • Phone (908)806-9400 • FAX (908)806-9490 • www.altechcorp.com
## FEATURES

- Measurement Functions
  - 1 Ø Voltage (True RMS)
  - 3 Ø Voltage (True RMS)
- Integrated selection switch for Phase Selection (MV2307)
- LCD Display with Backlight
- Bargraph Indicator

### MV Series (LCD Voltage Meters)

#### CAT. NO.

<table>
<thead>
<tr>
<th></th>
<th>MV507-110V-CU</th>
<th>MV2307-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>LCD display with backlight</td>
<td>LCD display with backlight</td>
</tr>
<tr>
<td>Display Type</td>
<td>LCD display with backlight</td>
<td>LCD display with backlight</td>
</tr>
<tr>
<td>Digits</td>
<td>3 digits</td>
<td>3 digits</td>
</tr>
<tr>
<td>Bargraph</td>
<td>Analog style bargraph indicator</td>
<td>Analog style bargraph indicator</td>
</tr>
<tr>
<td>Display Range</td>
<td>0 - 516V</td>
<td>0 - 516V</td>
</tr>
<tr>
<td>Display Scrolling</td>
<td>manual phase selector switch</td>
<td>manual phase selector switch</td>
</tr>
</tbody>
</table>

### Supply Specification

- 110 VAC +/-20% (60Hz)
- 110 VAC +/-20% (60Hz)

### Input Specification

<table>
<thead>
<tr>
<th></th>
<th>MV507-110V-CU</th>
<th>MV2307-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Wire System</td>
<td>1 Phase (2 wire)</td>
<td>3 Phase/4 wire</td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>50 – 516 VAC</td>
<td>50 – 516 VAC</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>1 MΩ (+/-5%)</td>
<td>1 MΩ (+/-5%)</td>
</tr>
</tbody>
</table>

### Parameter Resolution

<table>
<thead>
<tr>
<th></th>
<th>MV507-110V-CU</th>
<th>MV2307-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>1V</td>
<td>1V</td>
</tr>
<tr>
<td>Sample Rate</td>
<td>3 samples / sec.</td>
<td>3 samples / sec.</td>
</tr>
<tr>
<td>Run Hour</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Accuracy Class

- Voltage +/- 0.5% of Full-Scale Value
- Voltage +/- 0.5% of Full-Scale Value

### Output Specifications

- -
- -

### Programmable Parameters

- -
- -

### Environmental Specifications

<table>
<thead>
<tr>
<th></th>
<th>MV507-110V-CU</th>
<th>MV2307-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td>Up to 85% RH</td>
<td>Up to 85% RH</td>
</tr>
<tr>
<td>Protection Level</td>
<td>IP55 for Faceplate</td>
<td>IP65 for Faceplate</td>
</tr>
</tbody>
</table>

### Physical Specifications

<table>
<thead>
<tr>
<th></th>
<th>MV507-110V-CU</th>
<th>MV2307-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>1/16 DIN, 48 mm x 48mm</td>
<td>72 mm x 72 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>0.36 lbs (165g)</td>
<td>0.43 lbs (194g), 0.45 lbs (206g)</td>
</tr>
<tr>
<td>Terminal Size Acceptability and Torque</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
<td>20-14 AWG (0.5 - 2.5mm²), 6-7 lb-in. (0.68 - 0.79Nm)</td>
</tr>
</tbody>
</table>

230 VAC versions also available, please consult Altech.
# MF16 Series (Frequency Meter) - MP14 Series (Power Factor Meter)

## FEATURES
- Measurement Function
  - Frequency (MF16)
  - Power Factor (MP16)
- 4 Digit LED Display

## TERMINAL CONNECTIONS

### CAT. NO.

<table>
<thead>
<tr>
<th>Display</th>
<th>MF16-110V-CU</th>
<th>MP14-110V-CU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Type</td>
<td>7 segment LED Display</td>
<td>7 segment LED Display</td>
</tr>
<tr>
<td>Digits</td>
<td>4 digits</td>
<td>4 digits</td>
</tr>
<tr>
<td>Bargraph</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Display Range</td>
<td>45.00 ~ 65.00 Hz</td>
<td>-1.000 ~ +1.000</td>
</tr>
<tr>
<td>Supply Specification</td>
<td>110 VAC +/- 20% (60Hz)</td>
<td>110 VAC +/- 20% (60Hz)</td>
</tr>
</tbody>
</table>

### Input Specification

| Electrical Wire System | 1 Phase (2 wire) | 1 Phase (2 wire) |
| Input Current Range    | –               | 0.25 – 6A       |
| Frequency Range        | 45 – 65 Hz      | 50/60Hz         |

### Parameter Resolution

<table>
<thead>
<tr>
<th>Frequency Resolution</th>
<th>0.01 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Factor Resolution</td>
<td>– 0.001</td>
</tr>
</tbody>
</table>

### Accuracy Class

<table>
<thead>
<tr>
<th>Frequency Accuracy</th>
<th>+/- 0.05Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Factor Accuracy</td>
<td>+/- 0.05% +/- 2 digits</td>
</tr>
</tbody>
</table>

### Output Specifications

| Pulse Output | – |
| Communication | – |

### Programmable Parameters

| – | – |

### Environmental Specifications

| Temperature | Operating: -10°C ~ 55°C, Storage: -20°C ~ 75°C |
| Humidity    | Up to 85% RH |
| Protection Level | IP65 for Faceplate |

### Physical Specifications

| Size          | 1/8 DIN, 48 mmx 96 mm |
| Weight        | 0.37 lbs (170g) |
| Terminal Size Acceptability and Torque | 20-14 AWG (0.5 ~ 2.5mm²), 6-7 lb-in. (0.68 ~ 0.79Nm) |

## DIMENSIONS

![Dimensions Diagram]

## TERMINAL CONNECTIONS

![Terminal Connections Diagram]

### MF / MP Series

230 VAC versions also available, please consult Altech.
Disconnect and Test Terminal Blocks
For Meter Circuits

Disconnect and Test Terminals Blocks are an ideal choice for measuring control and regulatory circuits. The terminals provide a clear functional advantage for devices having utility instruments and associated transformers when it is mandatory to keep the secondary side shorted at any point while taking current measurements. Specially designed socket head screws act as test/monitoring points.

In the CDS6U, separate testing points facilitate insertion of test probes. Disconnection is achieved by means of a slide link operated with a Screw Driver.

In the CDS6U/TS, the insulated test point screw system (TPSLS) is integrated.

The SLS2 and SLS4 slide shorting link can be used in combination with either the supplied screw or the TPSLS Test point screw system.

Lock out cap LCCDS can be used to lock the center shorting screw, to prevent accidental opening of circuits.

Specially designed socket head screws act as test/monitoring points in CDTTU and CDTTU-SH.
Usage of Altech Disconnect & Test Terminal Block
In Ampere Meter / Current Transformer Circuits

Operating status

Comparison measurement for L1

Meter test for L1 through external power supply

Meter Exchange for L1

<table>
<thead>
<tr>
<th>No.</th>
<th>Cat. No.</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CDS6U</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>SLS2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>EPC035U</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>LC005</td>
<td>1</td>
</tr>
</tbody>
</table>

Sequence for test:
1) Close short circuit slide SLS2 of terminals 1 and 2.
2) Open disconnect slide link of terminal 2.
3) Connect external power supply to test sockets of terminals 1 and 2.

Sequence for test:
1) Remove SLS2 screw from terminal 1.
2) Connect ammeter to test sockets of terminal 1 and 2.
3) Open disconnect slide link of terminal 1.

Sequence for test:
1) Remove SLS4 screw from terminal 1.
2) Connect ammeter to test sockets of terminal 1 and 5.
3) Connect external power supply to test sockets of terminals 1 and 5.

Usage of Altech Disconnect & Test Terminal Block
In Ampere Meter / Current Transformer Circuits
Operating status  
(with internal distribution of the k-point)

Meter test for L1 through external power supply

Sequence for test:
1) Close short circuit slide SLS2 of terminals 1 and 2.
2) Open disconnect slide link of terminal 2 and 7.
3) Connect external power supply to test sockets of terminals 1, 2 and 7.

Comparison measurement for L1

Sequence for test:
1) Remove SLS2 screw from terminal 2.
2) Connect ammeter to test sockets of terminal 2.
3) Open disconnect slide link of terminal 2.
4) Connect voltmeter to test sockets of terminals 7 and 10.

Meter exchange for L1

Sequence for test:
1) Close short circuit slide SLS2 of terminals 1 and 2.
2) Open disconnect slide link of terminal 2 and 7.
3) Disconnect meter for L1 at terminals 1, 2 and 7.

<table>
<thead>
<tr>
<th>No.</th>
<th>Cat. No.</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CDS6U</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>SLS2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>LCCDS</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>CA723/5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>EPCDS6U</td>
<td>1</td>
</tr>
</tbody>
</table>

SLS2 in open condition

Closing of SLS2
Glossary

**Accuracy**
The maximum deviation to be expected between a true meter reading and the actual value being measured under specified operating conditions. Usually indicated as percentage of full scale value for analog instruments or percentage of reading for digital instruments. (see figure 1)

**Active energy**
Active Energy is the product of Active Power and Time. The unit is Wh.

Active Energy = P * t [Wh]

P = active power [W]
t = time in hour [h]

**Active (Real or True) Power**
It is measured in watts [W] and is the Power drawn by an electrical system.

Active Power

Active Power P = V*I*cosθ [W]

V = Voltage [V]
I = Current [A]
θ = Power factor

**Ampere**
Unit of electrical current. Amount of electrical current which flows through a 1 ohm resistor with 1 volt applied at a specific time.

**Apparent energy**
Apparent Energy is the product of Apparent Power and Time. It’s unit is VAh.

Apparent energy = S * t [VAh]

S = apparent power [VA]
t = time in hour [h]

**Apparent Power**
It is measured in volt-amperes (VA) and is the voltage on an AC system multiplied by all the current that flows in it. It is the vector sum of the active and the reactive power.

Apparent Power S = V*I [VA]

V = Voltage [V]
I = Current [A]

**Average**
Average value is normally taken to mean the average value of only half a cycle of the wave. (see figure 2)

**Burden**
The electrical load taken from an electrical circuit by measuring instruments expressed in Volt-Ampere (VA) or watts. In current transformers burden in VA is the maximum the transformer can support while operating within its rated accuracy.

**Crest Factor**
The ratio of peak voltage to the RMS voltage of a waveform (with the DC component removed).

**CT (Current Transformer)**
A current transformer (CT) is used to step down the large value of current. When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments.

**CT Ratio (Current Transformer Ratio)**
CT ratio is the ratio of primary (input) current to secondary (output) current. A CT with a listed ratio of 4000:1 would provide 1A of output current, when the primary current was 4000A.

**DC Shunt**
A low-value resistor typically embedded in Ampere Meters. This low-value resistor “shunts” high currents around the Ampere Meters sensitive input circuit.

**Export of energy**
When energy accumulation is negative, it is defined as “Export of Energy”.

**Energy**
It is Defined as the ability to do work & work is the transfer of Energy from one form to another.
**Glossary**

**End Scale Value**
The end scale value of an instrument is the value of the actuating electrical quantity that corresponds to end scale indication. When zero is not at the end or at the electrical center of the scale, the higher value is taken.

**Error**
The difference between measured value, set value, or rated value, and the measured or supplied true value.

**Frequency**
Number of times an electrical signal replicates in one second; its unit is Hertz [Hz].

**Frequency Output**
An output in the form of frequency, which varies as a function of the applied input.

**Frequency Response**
A measure of how effectively a circuit or device transmits the different frequencies applied to it.

**Full-Scale Input**
The maximum value of an input voltage or current that can be safely applied to a digital panel meter.

**Full-Scale Value**
The arithmetic difference of the two end-scale values. When zero is not on the scale, the full-scale value is the higher end-scale value.

**Impedance**
The combination of resistance and reactance affecting the flow of an alternating current generally expressed in ohms.

**Import of energy**
When energy accumulation is positive it is defined as “import of Energy”.

**Input Impedance**
The resistance and reactance of a panel meter. In the case of a voltmeter, this impedance has to be taken into account when the source impedance is high.

**Kwh**
kWh stands for Kilowatt-Hour, it is the energy consumed by 1000 Watts in 1Hour.

**KVAh**
KVAh stands for kilo-Volt-Ampere-hour known as Apparent Energy. It is the technical name for ‘total’ electrical energy, that includes both its ‘useful’ and the ‘lossy’ components. The unit of Apparent Energy is kVAh.

**Lagging Power Factors**
When load is capacitive the current waveform leads the voltage waveform. Capacitive reactances produce lagging power factor. Capacitive loads are capacitor banks or buried cables.

**Leading Power Factors**
When load is inductive the current waveform is lagging behind the voltage waveforms. Inductive reactances produce a leading power factor. Inductive loads are transformers, motors and wound coils.

**LSD (Least Significant Digit)**
The right-most active digit of a digital display.

**Load**
The amount of electrical power required by the connected electrical equipment.

**Max Demand**
It is the highest of demand values recorded. It is the highest value of power recorded within a particular interval. The Meter stores the reading only if it exceeds the previous maximum Demand value recorded.

**MSD (Most Significant Digit)**
The left-most digit on a digital display.

**Nominal**
The normal operating value.

**Nominal Voltage**
A nominal voltage value assigned to a circuit or system for the purpose of conveniently designating its voltage class.

**Ohm**
Unit of electrical resistance; one Volt can force one Ampere of current through a resistance of one Ohm.
**Glossary**

**Output Load**
The total effective resistance of the circuits and apparatus connected externally to the output terminals.

**Over Voltage**
A voltage greater than that at which a device or circuit is designed to operate.

**Rated Overload**
The maximum load over full scale value that an instrument can withstand without damage or failure. Displayed as a percentage of a full scale value.

**Over Range**
In digital meters, a reading that exceeds full scale (but is less than an overload) that does not require switching to a higher range.

**Peak Voltage**
The maximum value present in a varying or altering voltage. This value may be either positive or negative. This is known as the peak or crest value of an AC waveform. *(see figure 3)*

**Peak to Peak Voltage**
The total height between opposite peaks is known as peak to peak value of an AC waveform. *(see figure 4)*

**Phase Angle**
The difference in degrees by which the voltage wave lags or leads the current wave in an AC circuit.

**Power**
Power is the rate at which energy is transferred, used, or transformed or Measure of the amount of work an electrical signal can do. The instantaneous electrical power \( P(t) \) delivered to a component is given by

\[
P(t) = I(t) \times V(t)\]

**Power Consumption**
The power necessary to operate the meter.

**Power Factor**
It is the ratio between the KW and the KVA drawn by an electrical load. Where, the KW is the actual load power and the KVA is the apparent load power. It is a measure of how effectively electrical power is being used. Power Factor is usually expressed as a number between 0 and 1.

**Power Supply**
Separate unit or part of a circuit that supplies power to the rest of the circuit or to a system.

**Pulse Output**
In meters a pulse o/p corresponds to a pulse generated after a certain unit of energy is recorded by the meter which (Energy) intern is dependent on the product of CT & PT Ratio.

**Range (Full Scale)**
The difference between minimum and maximum values that an input or output can reach.

**Ratio**
The ratio of a current transformer indicates the multiple between the current in the secondary lines and the current in the primary lines. For example: a 50:5 transformer will transmit 5 Amperes through the secondary line when the primary line is carrying 50 Amperes.

**Reactive Energy**
Reactive energy is the product of power and time. Its unit is VArh.

\[
\text{Reactive energy} = Q \times t \quad \text{[VArh]}
\]

\( Q \) = reactive power [VAr]

\( t \) = time in hour [h]

**Reactive Power**
It is measured in volt-amperes (VAR). Reactive Power is stored in and discharged by inductive motors, transformers and solenoids.

\[
\text{Reactive power: } Q = V \times I \times \sin \theta \quad \text{[VArh]}
\]

\( V \) = Voltage [V]

\( I \) = Current [A]

\( \theta \) = Power factor

**Repeatability**
The ability of an instrument to repeat its indications when the pointer is deflected upscale, compared to the indications taken when the pointer is deflected down-scale, expressed as a percentage of the fiducial value.

**RMS**
The RMS (Root Mean Square) value of a set of values (or a continuous time waveform) is the square root of arithmetic mean(Average) of the squares of the original values (or the function that defines the continuous waveform).
**Glossary**

**Sampling Rate**
The sampling rate, sample rate, or sampling frequency (Fs) defines the number of samples per unit of time (usually seconds) taken from a continuous signal to make a discrete signal.

**Scaling**
For direct read out in engineering units, the capability of the meter to associate any desired value to the electrical input range.

**Shunt**
A calibrated low resistance connected in parallel with the input terminals of a voltmeter in order to enable measurements of large currents. It can be internal or external. The voltmeter measures the voltage drop typically in the milli volt range across the shunt resistor and displays a number corresponding to the current flowing through the shunt.

**True RMS**
‘rms’ stands for “root-mean-square”. True RMS reading meters can accurately measure the value of non-sinusoidal waveforms (step, triangle, square, etc.). For significantly non-sinusoidal signals, a True RMS is required.

**Volt**
Unit of measurement of electrical potential. One volt applied across a one ohm resistor will produce a current of one ampere.

**Voltage Burden**
Burden voltage is the voltage drop caused by current (amps) flowing through a current measuring device. A large burden voltage can affect the circuit being measured, corrupting the measurement. For this reason, it is necessary for burden voltage to be kept as low as possible.

**Volt Ampere**
An AC unit of measure. Volt Amperes [VA] is the product a circuit’s RMS voltage and its RMS current. The volt-ampere is also referred to as ‘apparent power’.

**Voltmeter**
An instrument designed to measure and display, in either digital or analog format, AC or DC volts.

**Watt**
Unit of measurement of electrical power; one Watt is the amount of work that one Ampere at one Volt can do.

**Wye**
A three phase, four-wire electrical configuration where each of the individual phases is connected to a common point, the “center” of the Y. This common point normally is connected to an electrical ground.
<table>
<thead>
<tr>
<th>Part No.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFM384-C-CU</td>
<td>6</td>
</tr>
<tr>
<td>MFM383A-CU</td>
<td>6</td>
</tr>
<tr>
<td>MFM374-CU</td>
<td>7</td>
</tr>
<tr>
<td>MFM374-C-CU</td>
<td>7</td>
</tr>
<tr>
<td>VAF36A-110V-CU</td>
<td>8</td>
</tr>
<tr>
<td>VAF39A-110V-CU</td>
<td>8</td>
</tr>
<tr>
<td>EM368-C-CU</td>
<td>9</td>
</tr>
<tr>
<td>MA12-110V-CU</td>
<td>10</td>
</tr>
<tr>
<td>MA12-50mV-DC-110V-CU</td>
<td>10</td>
</tr>
<tr>
<td>MA12-100mV-DC-110V-CU</td>
<td>10</td>
</tr>
<tr>
<td>MA501-110V-CU</td>
<td>11</td>
</tr>
<tr>
<td>MA2301-110V-CU</td>
<td>11</td>
</tr>
<tr>
<td>MV15-110V-CU</td>
<td>12</td>
</tr>
<tr>
<td>MV15-DC-20V-110V-CU</td>
<td>12</td>
</tr>
<tr>
<td>MV15-DC-200V-110V-CU</td>
<td>12</td>
</tr>
<tr>
<td>MV507-110V-CU</td>
<td>13</td>
</tr>
<tr>
<td>MV2307-110V-CU</td>
<td>13</td>
</tr>
<tr>
<td>MF16-110V-CU</td>
<td>14</td>
</tr>
<tr>
<td>MP14-110V-CU</td>
<td>14</td>
</tr>
</tbody>
</table>
Terms & Conditions

TITLE - Title to the products of ALTECH shall remain with ALTECH until payment is made in full by Customer. Such reservation of title is for the purpose of insuring the purchase price and shall not relieve Customer of the duty to inspect the products upon receipt, to notify ALTECH of any alleged deficiencies or defects, and to exercise due care in the use, installation, operation, and maintenance of the products when on the premise of the Customer or under the control of the Customer. Notwithstanding any reservation of title by ALTECH, risk of loss shall pass to customer at any time of shipment.

SHIPMENT AND DELIVERY - All orders for destination in the mainland United States (less Hawaii, Alaska and non-continental United States possessions) will be shipped F.O.B. Flemington, N.J. All destination, shipping and other charges shall be paid by the Customer in accordance with ALTECH’s then current shipping and billing practices. Delivery dates given in the acceptance of any order are approximate. ALTECH shall not be liable for delays in delivery or in performance due to causes beyond its reasonable control including acts of God, acts of Customer, acts of civil or military authority, fires, strikes or other labor disturbances, war, riot or delays in transportation. In the event of such delay, the date of delivery or performance shall be extended for a period equal to the time lost by reason of the delay.

PRICE - PRICES in any ALTECH publication are subject to change without notice. All prices are subject to change at any time after date of quotation. Customer shall pay all sales, use, excise or similar taxes whenever required by law.

PAYMENT - Customer agrees to make payment within thirty (30) days of date of invoice from ALTECH. Customer agrees to pay a late payment charge of one and one-half percent (1.5%) per month, or the maximum late payment charge permitted by applicable law, whichever is less, on any unpaid amount for each calendar month (or fraction thereof) that such payment is in default. Orders amounting to less than $100.00 will be billed at $100.00 plus freight. Credit terms are subject to approval. In the event of referral to an attorney for collection, reasonable attorney's fees for collection of the overdue amount shall be paid by Customer. In the event payment is not received within 30 days from the date of invoice, any discount shall be cancelled and the full list price will be due.

LIMITED WARRANTY - ALTECH warrants to Customer that the equipment purchases shall be free from defects in material and workmanship under normal use and service for a period of one year from shipment. Written notice as an explanation of the circumstances of any claim that the equipment has proved defective in material or workmanship shall be given promptly by the Customer to ALTECH.

ALTECH will not be liable for any misuse, improper operations, improper installation, improper maintenance, alteration, modification, accident or unusual degradation of the equipment or parts due to an unsuitable installation environment. No representation of other affirmation of facts, including but not limited to statements regarding capacity, suitability for use or performance of the equipment, shall be or be deemed to be a warranty or representation by ALTECH for any purpose, nor give rise to any liability or obligation of ALTECH whatsoever.

Customer's sole and exclusive remedy in the event of breach of warranty, as set forth herein, is expressly limited to (1) the correction of the defect by adjustment, repair, modification, or replacement, or (2) issuance of a credit or refund of the purchase price for the defective equipment at ALTECH's election and sole expense. EXCEPT AS SPECIFICALLY PROVIDED IN THIS AGREEMENT, THERE ARE NO OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY EXTENDS ONLY TO THE CUSTOMER FROM ALTECH OR ITS AUTHORIZED DISTRIBUTOR.

LIMITATION OF LIABILITY - IN NO EVENT, SHALL ALTECH BE LIABLE FOR LOSS OF PROFITS, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER SIMILAR DAMAGES ARISING OUT OF ANY BREACH OF THIS AGREEMENT OR OBLIGATIONS UNDER THE AGREEMENT.

ALTECH SHALL NOT BE LIABLE FOR ANY DAMAGES CAUSED BY DELAY IN SHIPMENT, INSTALLATION OR FURNISHING OF EQUIPMENT OR SERVICES UNDER THIS AGREEMENT. No action arising out of any claimed breach of this Agreement may be brought by either party more than two (2) years after the cause of action has accrued.

PATENT INDEMNITY - ALTECH shall defend or settle any suit or proceeding brought against Customer based on a claim that any equipment made to ALTECH's design and furnished hereunder constitutes an infringement of any existing United States patent, provided ALTECH is notified promptly in writing and is given complete authorization and information required for the defense, and ALTECH shall pay all damages and costs awarded against Customer, but shall not be responsible for any costs, expense or compromise incurred or made by Customer without ALTECH's prior written consent. If any equipment is in ALTECH's opinion likely to or does become the subject of a claim for patent infringement, ALTECH may at its option and expense procure for the Customer the right to continue using the device, modify it to become non-infringing, but in the event ALTECH is not reasonably able to modify, substitute, or otherwise procure for Customer the right to continue using it, ALTECH will remove such equipment and refund to the Customer the amount paid in excess of a reasonable rental for past use.

The foregoing states the entire liability of ALTECH to Customer arising from patent infringement.

SELLER'S REMEDIES - Should Customer fail to make any payment within ten (10) days of its due date, or fail to perform any other of the Customer's obligations hereunder upon thirty (30) days written notice, or should Customer be or become insolvent or be a party to any bankruptcy receivership proceeding prior to full payment of all amounts payable hereunder, ALTECH may: (a) with or without demand or notice to customer declare the entire amount unpaid immediately due and payable; (b) enter upon the premises where the equipment is located to take possession of the equipment and make it available to ALTECH at a place reasonably convenient to both parties and shall permit and assist ALTECH in effecting the retaking and removal of the equipment; and (c) sell any or all the equipment as permitted under applicable law, applying the proceeds of the sale to payment of the expenses of retaking, repairing and selling the equipment, reasonable attorney's fees and to the satisfaction of all indebtedness then due and unpaid under this Agreement. Any surplus shall be paid to Customer and any deficiency shall be paid to ALTECH by Customer.

The remedies provided herein shall be cumulative and in addition to all other remedies provided by law or equity or under the Uniform Commercial Code.

GOVERNING LAW - This agreement will be governed by the Laws of the State of New Jersey.

GENERAL - This Agreement shall only become effective and binding when either (a) it has been accepted and executed by an authorized representative of ALTECH, or (b) the equipment has been shipped to Customer, with or without acceptance in writing hereon. Notice of acceptance is hereby waived by Customer. Customer hereby acknowledges receipt of a true and complete copy hereof.

No addition to or modification of any of the Terms and Conditions of Sale as they appear herein shall be binding upon ALTECH unless signed in writing by a duly authorized representative of ALTECH in Flemington, N.J.

Any typographical and clerical errors in quotations, orders and acknowledgments are subject to correction.

This Agreement is not assignable without the prior written consent of ALTECH. Any attempt to assign any of the rights, duties or obligations of this Agreement without such consent is void.

If any provision or provisions of this Agreement shall be held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

ALTECH is not responsible for failure to fulfill its obligation under this Agreement due to causes beyond its control, or except as agreed herein.

THE CUSTOMER ACKNOWLEDGES THAT HE HAS READ THE AGREEMENT, UNDERSTANDS IT, AND AGREES TO BE BOUND BY ITS TERMS AND CONDITIONS. FURTHERMORE, THE CUSTOMER AGREES THAT IT IS THE COMPLETE AND EXCLUSIVE STATEMENT OF THE AGREEMENT BETWEEN THE PARTIES, WHICH SUPERSEDES ALL PROPOSALS OR PRIOR AGREEMENTS, ORAL OR WRITTEN, EXPRESSED OR IMPLIED, AND ALL OTHER COMMUNICATIONS BETWEEN THE PARTIES RELATING TO THE SUBJECT MATTER OF THIS AGREEMENT.