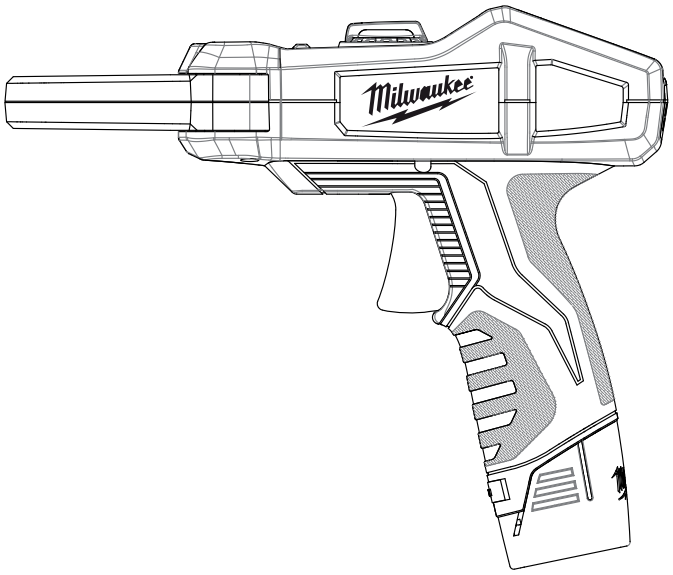
REPAIR SERVICE INSTRUCTIONS — CALIBRATION
2238-20 Clamp Meter for HVAC/R
2239-20 Clamp Meter

Environmental Condition	Perform all calibration at an ambient temperature of 23°C ± 2°C / 73.4°F ± 3.6°F and relative humidity of 80% - allow the fork meter to sit at this temperature for a minimum of 30 minutes before proceeding.

REPAIR SERVICE INSTRUCTIONS
Calibration



MILWAUKEE ELECTRIC TOOL CORPORATION
13135 WEST LISBON ROAD • BROOKFIELD, WISCONSIN 53005-2550 • USA
58-92-2238d1 04/2010

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Introduction

⚠WARNING

To avoid shock or injury, do not perform the verification tests or calibration procedures described in the manual unless you are qualified to do so.
The information provided in this document is for the use of qualified personnel only.

CAUTION

The 2238-20 and 2239-20 contain parts that can be damaged by static discharge.
Follow the standard practices for handling static sensitive devices.

Precautions and Safety Information

Use the Meter only as described in the Operator's Manual. If you do not do so, the protection provided by the Meter may be impaired. Read the "Safety Information" page before servicing this product.
In this manual, a **⚠WARNING** identifies conditions and actions that pose hazard (s) to the user; a **CAUTION** identifies conditions and actions that may damage the Meter or the test instruments.

The Symbols

The symbols used on the Meter and in this manual are explained in Table 1.

Table A. The Symbols

⚠	Risk of electric shock
⚠	See instruction card
⎓	DC measurement
⧈	Equipment protected by double or reinforced insulation
+	Battery
⏚	Earth
~	AC measurement
Ω	Resistance
μA	DC Current
⊣(	Capacitance
)))	Continuity
	Temperature
ϟ	Application around and removal from hazardous live conductors is permitted.
CE	Conforms to EU directives
c UL us	Underwriters Laboratories, Inc. United States and Canada
	Do not discard this product or throw away.

SAFETY

Review the following safety precautions to avoid injury and prevent damage to this product or products connected to it. To avoid potential hazards, use the product only as specified.

⚠**WARNING:** These statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION: These statements identify conditions or practices that could result in damage to the equipment or other property.

Specific precautions

To reduce the risk of injury, user must read and understand operator's manual.

Do not operate without covers. To avoid personal injury, do not apply any voltage or current to the product without covers in place.

Electric overload. Never apply a voltage to a connector on the product that is outside the range specified for that connector.

Avoid electric shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads from the meter while they are connected to a voltage source.

Do not operate in wet/damp conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

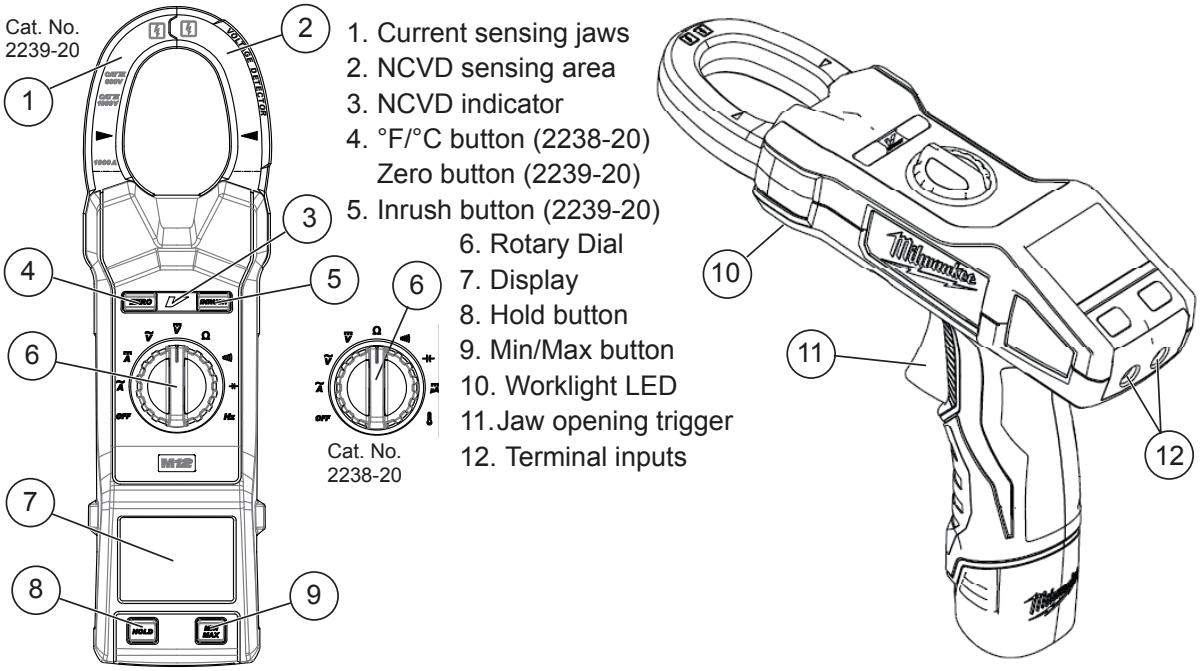
SPECIFICATIONS

All specifications are warranted unless noted typical and apply to the 2238-20 and 2239-20. Stated accuracies are at 23°C±5°C at than 80% relative humidity and without the battery indicator displayed.

General specifications

Characteristics	Description
Display count	6000 counts
Numeric update rate	3 times / sec
Polarity display	Automatic
Overrange display	Display "OL" when the reading exceeds range by 10%
Low voltage indicator	is indicated
Automatic power-off time	20 minutes
Power source	12 V Lithium-Ion Milwaukee Battery Pack 49-11-2401, 49-11-2402
Maximum input voltage	1000V CAT lll between IV and COM
Maximum floating voltage	1000V CAT lll between any terminal and earth ground
V connector	V~, V⎓, Ω, •))), ⊣
Temperature Coefficient	0.1×(Spec. Accuracy) / °C, <18°C or >28°C
Battery Run Time	Greater than 12 hours with all functions

FUNCTIONAL DESCRIPTION



1. Current sensing jaws
2. NCVD sensing area
3. NCVD indicator
4. °F/°C button (2238-20)
   Zero button (2239-20)
5. Inrush button (2239-20)
6. Rotary Dial
7. Display
8. Hold button
9. Min/Max button
10. Worklight LED
11. Jaw opening trigger
12. Terminal inputs

Measurement Specifications

Accuracy is ±(% reading + number of digits) at 23°C ± 5°C, less than 80% R.H.
Temperature coefficient: 0.1 * (Specified accuracy)/°C, <18°C, >28°C

(1) DC Voltage

Range	Resolution	Accuracy
600V	0.1V	±(2% reading + 2 digits)
1000V	1V	

(2) AC Voltage

Range	Resolution	Accuracy (Sine Wave)
600V	0.1V	±(1.2% reading + 5 digits) (50/60 Hz)
1000V	1V	±(1.8% reading + 5 digits) (45~500 Hz)

(3) DC μ A (2238-20 only)

Range	Resolution	Accuracy
600.0μA	0.1μA	±(1.5% reading + 5 digits)

(4) AC Current

Range	Resolution	Accuracy
2238-20: 60/600A **2239-20:** 60/600/1000A	0.01/0.1A 0.01/0.1/1A	±1.9% rdg ± 5dgt (50/60Hz) ±3.0% rdg ± 5dgt (45-500Hz) * Add 2% at CF>2

(5) Resistance

Range	Resolution	Accuracy
600 Ω/6k Ω/60 kΩ/600 kΩ	0.1 Ω/1 Ω/10 Ω/0.1 kΩ	±1.0% rdg ± 2dgt

(6) Continuity

Range	Resolution	Accuracy
Continuity Buzzer 600.0Ω	0.1Ω	Buzzer sounds at 30Ω or less

(7) Capacitance

Range	Resolution	Accuracy
400μF / 4000μF	0.1μF/1μF	±2.5% ±20dgt up to 60μF

(8) Temperature (2238-20)

Range	Resolution	Accuracy
-40ºC ~ 538ºC -40ºF ~ 1000ºF	0.1°C 0.1ºF	±1% ±10dgt ±1% ±18dgt

(9) Hertz (2239-20)

Range	Resolution	Accuracy
ACA: 600 Hz, 6 kHz ACV: 600 Hz, 6 kHz, 60 kHz	0.1 Hz, 1 Hz, 10 Hz	±1%rdg ±1dgt Sensitivity: Amps 5A RMS; Volts - 30V RMS Minimum Hz measurement is 10Hz

(10) Volt Sense

Volt Sense Light should be on at 90V @ 1 inch (2.54 cm).

(11) Thermocouple

K Type Class II Thermocouple with standard dual banana jack.
Measurement Range: -40.0°C ~ 260.0°C (-40.0°F ~ 500.0°F)
Accuracy: ±2.5°C

(12) Over-range Indication

Display “OL” when the reading exceeds the measuring range.

(13) Rotary Switch

In order to prevent a “0” reading, the contacts about the input signal must be made properly before the contact of the function selection.

(14) Auto Power Off

Meter automatically turns power off after powering up and no operation for 20 ±5 minutes. Press any key or rotate the rotary to power up.

(15) Battery: Milwaukee 12 V Lithium-Ion Battery Pack: 49-11-2401, 49-11-2402

(16) Battery life:

Approx. 12 hours with all functions

(17) Overvoltage Category

IEC/EN 61010-1 2nd edition for measurement CAT lll, 1000V; CAT lV, 600V

(18) Operating Temperature

-10°C to 50ºC (14ºF to 122ºF)

(19) Storage Temperature

-40°C to 60ºC (-40º to 140ºF) (No batteries)

Physical and Environmental Characteristics

Environmental characteristics	Description
Temperature operating	-10 to +50°C
Non-Operating	-40 to +60°C
Humidity (operating)	<80% R.H.
Altitude Operating	2,000M (6560 ft.)
Vibration & shock Operating	MIL-PRF-28800F for Class 2 Instrument
Indoor Use	

Certifications and compliances

Safety	Designed to IEC61010-1, UL61010-1 and CSA specifications
Input rating	Category Ill 1000V.
Over voltage category	CAT IV : The source of the Low-Voltage installation.
	CAT III : Distribution level mains, fixed installation.
	CAT II : Local level mains, appliances, portable equipment
	CAT I : Signal level, special equipment or parts of equipment, telecommunication, electronics.
Pollution Degree 2	Do not operate in environments where conductive Pollutants may be present.

Basic Maintenance

⚠WARNING

To avoid shock, disconnect test leads from any voltage source than remove from meter before opening the case or replacing the battery.

Inserting/Removing the Battery

To remove the battery, use a flat screwdriver to pry open the lock latch. Push in the release buttons and pull the battery pack away from the tool.

To **insert** the battery, slide the pack into the body of the tool. Make sure it latches securely into place. Press in the lock latch to lock the battery in place.

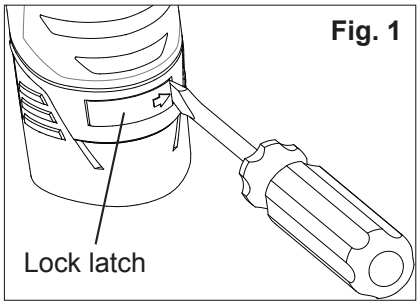


Fig. 1

⚠WARNING

To reduce the risk of personal injury and damage, never immerse your tool, battery pack or charger in liquid or allow a liquid to flow inside them.

Maintaining Tool

Keep your tool, battery pack and charger in good repair by adopting a regular maintenance program. After six months to one year, depending on use, return the tool, battery pack and charger to a MILWAUKEE service facility for service. If the tool does not start or operate at full power with a fully charged battery pack, clean the contacts on the battery pack. If the tool still does not work properly, return the tool, charger and battery pack, to a MILWAUKEE service facility for repairs.

Cleaning

Clean dust and debris from charger and tool vents. Keep tool handles clean, dry and free of oil or grease. Use only mild soap and a damp cloth to clean the tool, battery pack and charger since certain cleaning agents and solvents are harmful to plastics and other insulated parts. Some of these include gasoline, turpentine, lacquer thinner, paint thinner, chlorinated cleaning solvents, ammonia and household detergents containing ammonia. Never use flammable or combustible solvents around tools.

Performance Tests

The following performance tests verify the complete operability of the Meter and check the accuracy of each Meter function against the Meter's specifications.

Accuracy specifications are valid for a period of one year after calibration, when measured at an operating temperature of 18°C to 28°C and a maximum of 80% relative humidity.

To perform the following tests, it is not necessary to open the case, no adjustments are necessary, merely make the required connections, apply the designated inputs, determine if the reading on the Meter display falls within the acceptable range indicated.

If the Meter fails any of these tests, it needs calibration adjustment or repair.

Testing the Display

Press "HOLD" key while turning the Meter on from the "OFF" position to hold the display in the Display Test Mode. Compare the display with the example in Figure 2. Turn off the meter to escape the test mode.

LCD Graphics 2238-20

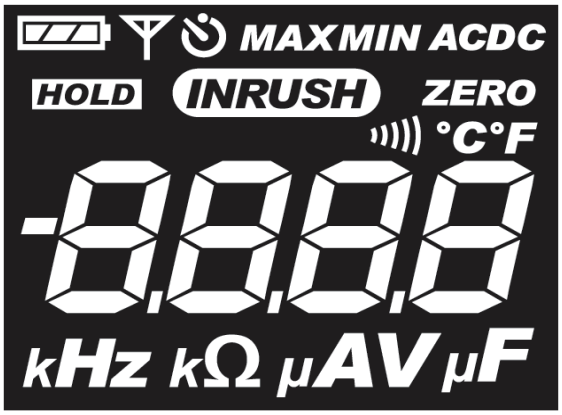


Figure 2 Display Test

Calibration Procedures: 2238-20

Mode：M2238 True RMS Clamp Meter for HVAC/R

Environmental：Temperature 18°C ~ 28°C Humidity：<70%RH

Calibration equipment：1. FLUKE 5520A 2.FLUKE 5500A/COIL(50TURNS) 3.M2238 Fixture

4.Temperature Connector 5.Screw adjustment probe

Step	Function	Switch Position	Input Signal	Adjustment	Adjust Range	Note
1.	DCV Adjustment	V⎓	300VDC	VR1	299.9~300.1V	
2.	ACV Zero Adjustment	V~	Open Circuit	VR2	0.0~0.1V	(1)
3.	ACV Adjustment	V~	300V/60Hz (sine wave)	VR3	299.9~300.1V	
4.	DCuA Adjustment	μA⎓	300uADC	VR4	299.9~300.1uA	
5.	ACA 600A Adjustment	A~	300A/60Hz	VR5	299.9~300.1A	
6.	ACA 60A Adjustment	A~	30A/60Hz	VR6	29.99~30.01A	
7.	Capacitor Adjustment	⊣⊢	220uF	Soft Key	218.0~222.0	(2)
8.	Capacitor Adjustment	⊣⊢	2200uF	Soft Key	2180~2220	(3)
9.	Temp. Adjustment		0mVDC	Soft Key	---	(4)
10.	Temp. Adjustment		16.395mVDC	Soft Key	---	(5)
11.	Temp. Adjustment		0°C	Soft Key	-0.1~0.1°C	(6)
12.						
13.						

NOTE:

(1) Turn the unit off. Press and hold "***HOLD*** + ***MIN MAX*** " keys and turn the function dial to range " ***Ṽ*** " then push "***°F/°C*** " button within 2 sec. The LCD will blink "ZERO"

symbol to indicate the software forced zero is disabled and the actual reading is now displayed so the operator can adjust the real AD zero. Wait around 1 minute the reading will stop falling and the operator can adjust VR2 to null the number. Check the adjusting result stay at zero and turn the unit off to finish the adjusting.

(2) Turn the unit off. Press and hold "***HOLD*** + ***MIN MAX*** " keys and turn the function dial to range "⊣⊢" then push "***°F/°C***" button within 2 sec. The LCD will blink "INRUSH" symbol. Input 220uF signal to the terminal then press "***MIN MAX***" button to write the calibration data into the unit.

(3) Continue from note (2). Press "***HOLD***" button to switch unit to 4000uF range. Input 2200uF signal to the terminal then press "***MIN MAX***" button to write the calibration data into the unit. Check 220uF and 2200uF again. If reading is correct, turn off the unit to complete the calibration procedure.

(4) Turn the unit off. Press and hold "***HOLD*** + ***MIN MAX***" buttons and turn the function dial to range "  " then press "***°F/°C***" button within 2 sec. The LCD will blink "**ZERO**" symbol. Input 0mV to the input terminals then press "***MIN MAX***" button to write in the calibration data.

(5) Continue process in note (4). Input 16.395mV to the input terminals then press "***MIN MAX***" to write in the calibration data.

(6) Continue process in note (5). Press "***HOLD***" button and the LCD will blink "Ω" symbol. Input 0°***C*** signal to the input terminals and press "***MIN MAX***" button the write in the calibration data. Check the reading. If the reading is correct, turn the unit off to complete the process.

Calibration Procedures: 2239-20

Mode：M2239 True RMS AC/ DC clamp meter

Environmental：Temperature 18℃~ 28℃ Humidity：<70%RH

Calibration equipment：1. FLUKE 5520A 2.FLUKE 5500A/COIL(50TURNS)

3.M2238 Fixture 4.Screw adjustment probe

Step	Function	Switch Position	Input Signal	Adjustment	Adjust Range	Note
1.	DCV Adjustment	V⎓	300VDC	VR2	299.9~300.1V	
2.	ACV Zero Adjustment	V~	Open Circuit	VR4	0.0~0.1V	(1)
3.	ACV Adjustment	V~	300V/60Hz (sine wave)	VR3	299.9~300.1V	
4.	ACA BalanceAdjustment	A~	20A/60Hz (sine wave)	VR5	X ± 0.03A	(2)
5.	DCA ZeroAdjustment	A⎓	Open Circuit	VR6	-0.03~0.03A	
6.	ACA 60A Adjustment	A~	30A /60Hz	VR8	29.99~30.01A	
7.	ACA 600AAdjustment	A~	300A /60Hz	VR7	299.9~300.1A	
8.	ACA INRUSH Adjustment	A~ + INRUSH	300A/60Hz	VR1	299.0 ~ 301.0A	(3)
9.	Capacitor Adjustment	⊣⊢	220uF	Soft Key	218.0~222.0	(4)
10.	Capacitor Adjustment	⊣⊢	2200uF	Soft Key	2180~2220	(5)
11.						
12.						
13.						
14.						
15.						

Note:

(1) Turn the unit off. Press and hold "**HOLD** + **MIN MAX**" keys and turn the function dial to range "$\widetilde{V}$" then push "INRUSH" button within 2 sec. The LCD will blink "**ZERO**" symbol to indicate the software forced zero is disabled and the actual reading is now displayed so the operator can adjust the real AD zero. Wait

around 1 minute the reading will stop falling and the operator can adjust VR4 to null the number. Check the adjusting result stay at zero and turn the unit off to finish the adjusting.

(2) **X** represents the reading when the wire is at the center of the jaw.

(3) Repeat the procedure of getting “INRUSH” reading then adjust VR1 to make the reading within the acceptable range.

(4) Turn the unit off. Press and hold “***HOLD*** + ***MIN MAX***” keys and turn the function dial to range “ ⊣⊱ ” then push “INRUSH” button within 2 sec. The LCD will blink “INRUSH” symbol. Input 220uF signal to the terminal then press “ ***MIN MAX*** ” button to write the calibration data into the unit.

(5) Continue from note (4). Press “***HOLD***” button to switch unit to 4000uF range. Input 2200uF signal to the terminal then press “***MIN MAX***” button to write the calibration data into the unit. Check 220uF and 2200uF again. If the reading is correct, turn off the unit to complete the calibration procedure.