

TENMA®



True RMS Digital Multimeter

Model: 72-7780

User Manual

I. Overview

72-2800 is a professional handheld true RMS multimeter with wide scope of application. It is a safe, stable and reliable measurement device for AC/DC, resistance, diode, continuity, capacitance, frequency, NCV measurement etc.

II. Unpacking Inspection

Open the package box and take out the device. Please check whether the following items are deficient or damaged and contact your supplier immediately if they are.


- User manual-----1pc
- Test leads-----1pair
- K-type thermocouple-----1pc
- Optional current clamp

III. Safety information



Safety Standards








- EN 61010-1:2010
- CAT III 600V, double insulation standard, over voltage standard, and RoHS, pollution grade II

Please read and comply with the safety information carefully, or the protection provided by the device may be impaired.

1. Do not use the device if the rear cover is not covered up or it will pose a shock hazard
2. Do not use the device if the device or test leads appear damaged or if you suspect that the device is not operating properly. Pay particular attention to the insulation layers.
3. To avoid false reading, replace the battery when the battery indicator  appears.
4. Functional dial should be switched to proper position.
5. Never input voltage and current exceeding the value listed on the device.
6. Do not switch the functional dial during measuring.
7. After each measure, disconnect the test leads with the circuit. For measuring current, switch off the power supply before test leads disconnection, especially important for measuring large current.
8. Use caution to measure voltage >DC 60V or AC 30Vrms.
9. Do not use or store the device in high temperature, high humidity, flammable, explosive or strong magnetic field environments.
10. Do not change the internal circuit of the device in order to avoid the damage to the device and users.
11. Use damp cloth to clean the case; do not use detergent containing solvents or abrasives.

IV. Symbols

	Low battery
	Buzzer indicator

	Diode
	AC/DC
	Warning
	Grounding
	Current clamp
	Double insulation
	Comply with European Union Directives

V. General specifications

1) **Max voltage between input terminals and earth grounding:** See Technical Specifications

2) **Fuse Type:**

10A Jack: F 10A H 600V Fuse (Φ6x25) mm

mA/μA Jack: F 600mA H 600V Fuse (Φ6x32) mm

3) **Max Display Value:**

Capacitance measurement: 9999

Frequency measurement: 9999

Other measurement: 6000

Duty Ratio: 1~99.9%

Diode: 3.2V

Others:

1) Range: Auto/Manual

2) Polarity: Auto

3) Display updates 2~3 times for every second. Overrange Indicator: "OL"

4) Operating temperature: 0°C~40°C (32°F~104°F)

Storage temperature: -10°C~50°C (14°F~122°F)

Relative humidity: ≤75% at 0°C~30°C; ≤50% at 30°C~40°C

5) Operating altitude: 0~2000m

6) Battery type: AA R6P 1.5V×2

7) Low power indicator: 

8) Dimension: 175mm×80mm×48.5mm

9) Weight: 350g (batteries included)

10) Electromagnetic compatibility:

RF≤1V/m, overall accuracy=specified accuracy+5% of range.

RF>1V/m, no specified calculation.

VI. Structure (see figure 1)

1/ Protective case

2/Display screen

3/4/7 Functional buttons

5/Functional dial

6/ Input jacks

VII. Display

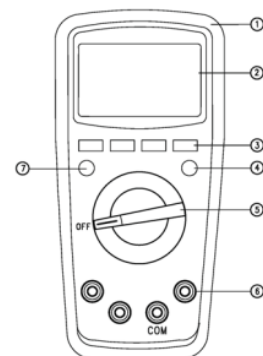


Figure 1

72-7780-LCD



Symbol	Indication
	Data hold
—	Negative value
AC/DC	AC or DC measurement
MAX/MIN	Maximum or minimum reading
	Low power
Auto Range	Auto range selection
	Diode measurement
	Continuity measurement
Δ	Relative measurement
Ω、kΩ、MΩ	Unit of resistance
Hz、kHz、MHz	Unit of frequency
%	Unit of duty ratio
mV、V	Unit of voltage
μA、mA、A	Unit of current
nF、μF、mF	Unit of capacitance
°C	Celsius degree
°F	Fahrenheit degree
NCV	Non-contact voltage
	Auto shutdown
	Current clamp

VIII. Functional dial and buttons

Position	Note
V \sim 、V \equiv 、mV \cong	AC/DC voltage
Ω	Resistance
	Diode
	Continuity
μ C	Capacitance
Hz	Frequency
%	Duty ratio
°C/°F	Temperature
μA \cong mA \cong A \cong	AC/DC current
60A \cong	AC/DC current clamp

NCV	Non-contact voltage
OFF	shutdown

Buttons:

RANGE: Switch the range mode to auto/manual and then cycle through all ranges. To exit auto/manual mode, press the button for 2 seconds or switch the functional dial. (Only for $V_{\approx}, \Omega, I_{\approx}$ measurement)

MAX/MIN: Starts and stops Max/Min recording. To exit this mode, press the button for 2 seconds or switch the functional dial. (Only for $V_{\approx}, \Omega, I_{\approx}$ and $^{\circ}C / ^{\circ}F$ measurement)



REL: Save the first reading as reference value. The second reading = second measurement value - reference value. To exit this mode, press the button for 2 seconds. (Only for $V_{\approx}, \Omega, I_{\approx}$ and $^{\circ}C / ^{\circ}F$ and μC measurement); when measuring capacitance, REL button is only used for eliminating intrinsic value.

Hz/%: When measuring AC voltage/ current, press the button to cycle through frequency and duty ratio measurement.

SELECT: Select functions. Under AC modes, long press the button until UFC appears to enter VFC measurement mode and measure the variable frequency voltage. Long press gain to exit VFC measurement mode.

HOLD: Press the button once to hold the reading. Press again to unlock the reading and enter general measurement modes.

IX. Operation instructions

To avoid false reading, replace the battery if the battery low power symbol  appears. Also pay special attention to the warning sign  besides the test lead housing, indicating that the tested voltage or current must not exceed the values listed on the device.

1. AC/DC voltage measurement (see Figure 3)

- 1) Connect test leads with the load in parallel.
- 2) When input impedance about $10M\Omega$, there is measurement errors. Input impedance $\leq 10k\Omega$, measurement errors can be ignored ($\leq 0.1\%$)

⚠ Notes:

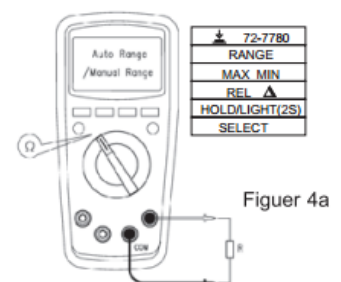
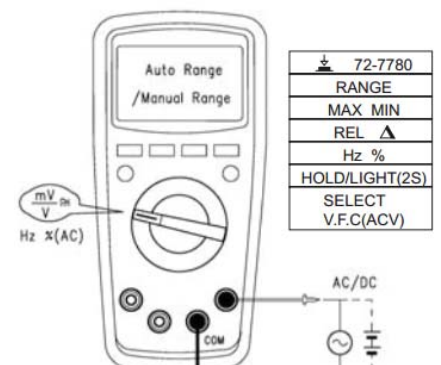
- Do not measure voltage over 600Vrms, or it may expose users to electric shock and damage the device.
- Please pay extra attention when measuring high voltage in order to avoid electric shock.

2. Resistance measurement (see figure 4a)

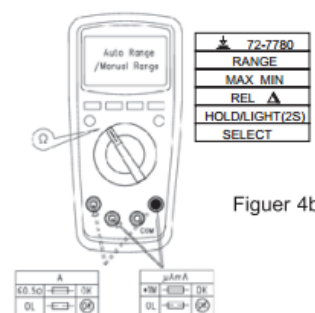
Connect test leads with the resistance in parallel.

⚠ Warnings:

- If the resistor is open or over the range, the "OL" symbol will be displayed on the screen.
- Before measuring resistance, switch off the power supply of the circuit, and fully discharge all capacitors.
- When measuring low resistance, the test leads will produce $0.1\Omega \sim 0.2\Omega$ measurement error. To obtain accurate



Figuer 4a



Figuer 4b

measurement, short the test leads and use REL function.

- If the resistance when shorted is more than 0.5Ω , please check if test leads are loosened or damaged.
- When measuring high resistance above $60M\Omega$, it is normal to take a few seconds to steady the readings.
- Resistance measurement can be used to inspect device's internal fuses. (see **figure 4b**)
- Do not input voltage over DC 60V or AC30V.

3. Continuity measurement (see figure 5)

If the resistance being measured is over 150Ω , circuit is in open status, buzzer does not go off. If the resistance less than 10Ω , circuit is in good conduction status, buzzer will continuously go off.

⚠ Note:

- To avoid damage to the device, before measuring continuity, switch off all power supplies and fully discharge all capacitors.
- Do not input voltage over DC 60V or AC30V.

4. Diode measurement (see figure 6)

"OL" symbol appears when the diode is open or polarity is reversed.

For silicon PN junction, normal value: $500 \sim 800mV$ ($0.5 \sim 0.8V$).

⚠ Notes:

- Switch off the power supply to the circuit, and fully discharge all capacitors
- Voltage for testing diode is about 3.1 V.
- Do not input voltage over DC 60V or AC30V.

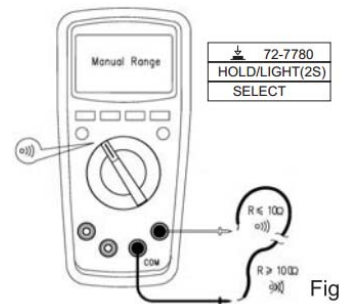


Figure 5

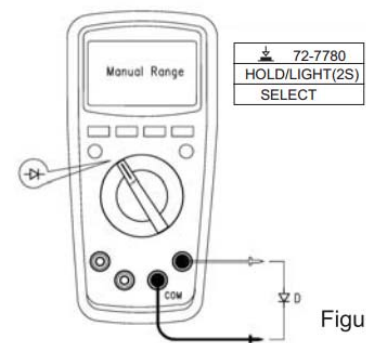


Figure 6

5. Capacitance measurement (see figure 7)

When there is no input, the device displays a fixed value (intrinsic capacitance). For small capacitance measurement, to ensure measurement accuracy, the measured value must be subtracted from intrinsic capacitance. Or users can measure small capacity capacitors with relative measurement function (REL) (the device will automatically subtract the intrinsic

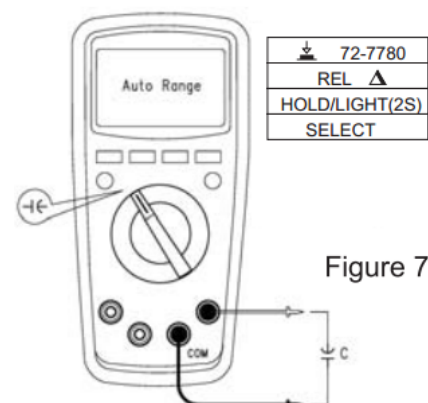


Figure 7

capacitance)

⚠ Notes:

- If the tested capacitor is shorted or its capacity is over the specified range “OL” symbol will be displayed on the screen.
- When measuring large capacitors, it may take a few seconds to obtain steady readings.
- Before measuring capacitors (especially for high voltage capacitors), please fully discharge them.

6. Frequency/Duty ratio measurement (see figure 8)

At the frequency position, press the Hz/% to select frequency/duty ratio measurement mode.

⚠ Notes:

- Do not input voltage over DC 60V or AC30V.

7. Temperature measurement (see figure 9)

Turn on the device, after “OL” symbol appears, insert K-thermocouple into the device.

⚠ Note:

Only K-type thermocouple is applicable. The measured temperature should be less than 230°C/ 446°F ($^{\circ}\text{F} = ^{\circ}\text{C} * 1.8 + 32$)

8. AC/DC current measurement (see figure 10)

Connect test leads with the tested circuit in series. Readings under this AC measurement is true RMS.

⚠ Notes:

- Before measuring, switch off the power supply of the circuit.
- If the range of the measured current is unknown, select the maximum range and then accordingly reduce.
- There are fuses inside 10A jack and mA/μA jack. Do not connect the test leads with any circuits in parallel.
- If the tested current is over 5A, each measurement time should be less than 10 seconds and the next test should be after 15 minutes.
- When measuring AC current, press Hz/% button to display AC frequency or duty ratio.
- 60A AC and DC current clamp measurement (see figure 11)

Connect as shown with the attached current clamp.

9. NCV measurement (see figure 12)

- 1) Switch the dial to NCV position

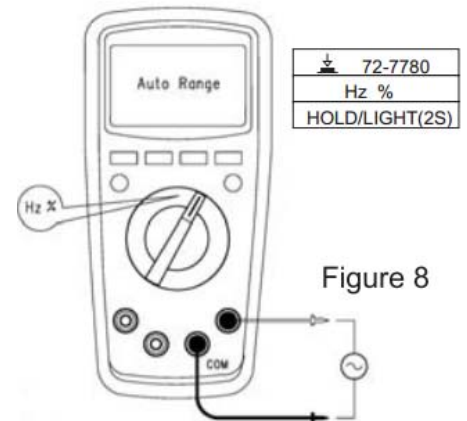


Figure 8

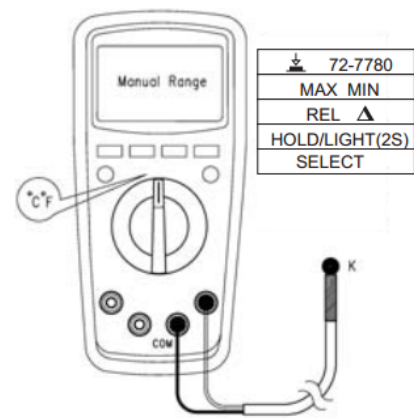


Figure 9

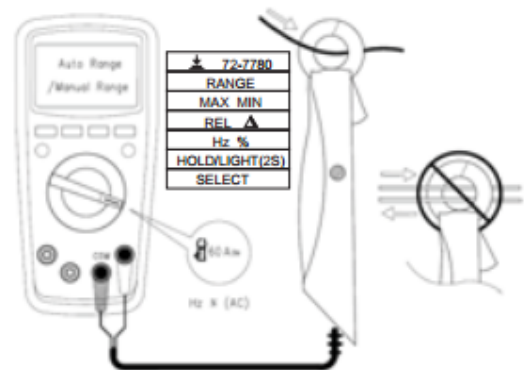
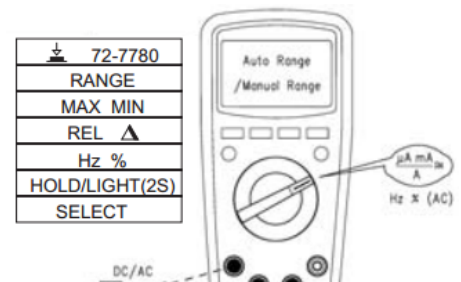


Figure 11

- 2) Place the device near the measured object.
 “-“ symbol indicates the intensity of the electric field. More “-“ and the higher the buzzer frequency, the higher the electric field intensity.
- 3) Intensity of electric field
 - * "EF": 0 ~ 50mV
 - * "-": 50 ~ 100mV
 - * "--": 100 ~ 150mV
 - * "---": 150 ~ 200mV
 - * "----": > 200mV

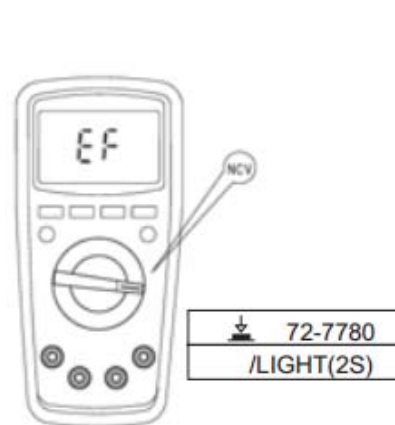


Figure 12

Notes:

Test leads are not required for NCV measurement.

10. Others

- The device enters measurement status in 2 seconds after startup. Restart the device, "ErrE" appears.
- The device automatically shuts down if there is no operation for 15 minutes. You can wake up the device by pressing any key. To disable auto shutdown, switch the dial to OFF position, long press SELETE button and turn on the device. ☺ symbol will disappear with one long beep. Recover the auto-off function by restarting the device.
- **Buzzer notification**
 - 1) Input voltage ≥ 600V (AC /DC), buzzer will continuously beep indicating measure range is at limit
 - 2) Input current > 10A (AC/DC), buzzer will continuously beep indicating measure range is at limit
- Low power warnings: Voltage of the battery < 2.4V, 🔋 symbol appears, the device can still be used. If voltage is lower than 2.2V, the device cannot work and the symbol disappears after startup.
- The screen backlight cannot work if battery voltage less than 2.6V.

X. Technical specification

Accuracy: ± (% of reading + numerical value in least significant digit slot), 1 Year Warranty

Ambient temperature: 23°C±5°C (73.4°F±9°F)

Ambient humidity: ≤75% RH

1. DC voltage

Range	Resolution	Accuracy
60.00mV*	0.01mV	±(0.5%+2)
600.0mV**	0.1mV	
6.000V	0.001V	±(0.7%+3)
60.00V	0.01V	
600.0V	0.1V	
600V	1V	

⚠ Input impedance: about 10MΩ.

Results might be unstable at mV range when no load is connected. The value becomes stable once the load is connected. Least significant digit $\leq \pm 3$

Max input voltage: $\pm 600V$, when the voltage $\geq 600V$, "OL" symbol appears and the buzzer goes off."

2. AC voltage

Range	Resolution	Accuracy
60.00mV	0.01mV	$\pm(1.0\%+3)$
600.0mV	0.1mV	
6.000V	0.001V	$\pm(0.8\%+3)$
60.00V	0.01V	
600.0V	0.1V	
600V	1V	$\pm(1.0\%+3)$
VFC 200.0V~600V	0.1/1V	$\pm(4.0\%+3)$

⚠ Input impedance: about 10MΩ

Display true RMS. Frequency response: 45Hz ~1KHz (LPF 45~400Hz)

Accuracy guarantee range: 5 -100% of the range, shorted circuit allows least significant digit ≤ 10

Crest factor at Max range=3.0 (excluding 600V range, crest factor=1.5)

Max input voltage: 600Vrms

3. Resistance measurement.

Range	Resolution	Accuracy
600.0Ω	0.1Ω	$\pm(1.0\%+2)$
6.000kΩ	0.001kΩ	$\pm(0.8\%+2)$
60.00kΩ	0.01kΩ	
600.0kΩ	0.1kΩ	
6.000MΩ	0.001MΩ	$\pm(1.2\%+3)$
60.00MΩ	0.01MΩ	$\pm(1.5\%+5)$

⚠ Measurement result = reading of resistor – reading of shorted test leads

Open circuit voltage=1V (Current=0.4mA)

Overload protection: 600V-PTC

4. Continuity, Diode

Position	Resolution	Remark
•)	0.1Ω	Set Value: Open circuit: resistance $\geq 150\Omega$, no beep. Well-connected circuit: resistance $\leq 10\Omega$, continuous beeps.
✚	0.001V	Open circuit voltage :3.2V Silicon PN junction voltage: 0.5 ~ 0.8V.

⚠ Overload protection: 600V-PTC

5. Capacitance

Range	Resolution	Accuracy
9.999nF	0.001nF	REL mode: $\pm(4\%+10)$
99.99nF~999.9 μ F	0.01nF~0.1 μ F	$\pm(4\%+5)$
9.999mF~99.99mF	0.001mF~0.01mF	$\pm 10\%$

⚠ Overload protection: 600V-PTC

Test capacitance \leq 100nF, adapt REL mode.

6. Frequency/Duty ratio

Range	Resolution	Accuracy
9.999Hz~9.999MHz	0.001Hz~0.001MHz	$\pm(0.1\%+4)$
0.1%~99.9%	0.1%	Only for reference

⚠ Overload protection: 600V-PTC

Input range: (DC level=0)

\leq 100kHz: 100mVrms \leq a \leq 20Vrms

> 100 kHz~1MHz: 200mVrms \leq a \leq 20Vrms

>1MHz: 500mVrms \leq a \leq 20Vrms

>5MHz~10MHz: 1Vrms \leq a \leq 20Vrms

Duty ratio%: Only for frequency measurement \leq 100kHz

Notes: When measuring AC voltage or current, following conditions should be satisfied:

Frequency response \leq 1kHz

AC voltage: mV position \geq 100mV; V position \geq Range \times 6%

AC current: input range: 4000/6000 μ A, 400/600mA, 10A: A \geq range \times 6%

400/600 μ A, 40/60mA, 4/6A:A \geq range \times 60%

7. Temperature

Range		Resolution	Accuracy
°C	-40~1000°C	-40~0°C	± 3
		>0~100°C	$\pm(1.0\%+3)$
		>100~1000°C	$\pm(2.0\%+3)$
°F	-40~1832°F	-40~32°F	± 5
		>32~212°F	$\pm(1.5\%+5)$
		>212~1832°F	$\pm(2.5\%+5)$

⚠ Overload protection: 600V-PTC

- K-type thermocouple is only applicable for temperature less than 250°C/482°F.

8. DC current

Range		Resolution	Accuracy
μ A	600.0 μ A	0.1 μ A	$\pm(0.7\%+2)$
	6000 μ A	1 μ A	
mA	60.00mA	0.01mA	
	600.0mA	0.1mA	
A	6.000A	0.001A	$\pm(1.0\%+3)$
	10.00A	0.01A	

- ⚠ Overload protection:

μA mA range: F1Fuse (φ6×32)mm FF 600mA H 600V

10 A range:F2Fuse (φ6×25)mm FF 10A H 600V

9. AC current

Range		Resolution	Accuracy
μA	600.0μA	0.1μA	±(1.0+3)
	6000μA	1μA	
mA	60.00mA	10μA	
	600.0mA	0.1mA	
A	6.000A	1mA	±(1.2%+3)
	10.00A	10mA	

Frequency response: 45~1kHz

Display: true RMS

Accuracy guarantee range: 5 -100% of the range, shorted circuit allows least significant digit≤2

Crest factor at Max range=3.0

⚠ Overload protection: (similar to **DC current**)

10. Current clamp measurement (60A)

Range	Resolution	Accuracy
60A DC	0.01A	±(1.0+3)
60A AC		±(1.2+3)

⚠ Overload protection: (similar to **DC current**)

XI. Maintenance

⚠ Warning: Before opening the rear cover, switch off the power supply (remove test leads from the input terminal and the circuit).

1. General maintenance

- 1) Clean the case with a damp cloth and detergent. Do not use abrasants or solvents
- 2) If there is any malfunction, stop using the device and send it to maintenance.
- 3) The maintenance and service must be implemented by qualified professionals or designated departments.

2. Replacements (see Figure13)

Battery replacement:

To avoid false reading, replace the battery when the battery indicator appears.

Battery Specification: AA 1.5Vx2

- 1) Switch the dial to "OFF "position and remove the test leads from the input terminal.
- 2) Take off the protective case. Loosen the screw on battery cover; remove the cover to replace the battery. Please identify the positive and negative pole.

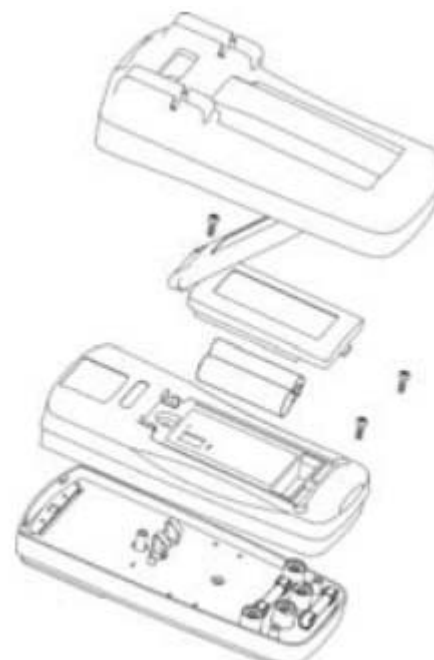


Figure 13

Fuse replacement:

- 1) Switch the dial to "OFF" position and remove the test leads from the input terminal
- 2) Loosen the both screws on the rear cover, and then remove the rear cover to replace the fuse

Fuse specification

F1 Fuse $\phi 6 \times 32$ mm FF 600mA H 600V

F2 Fuse $\phi 6 \times 25$ mm FF 10A H 600V



INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT.

This symbol indicates that separate collection of Waste Electrical and Electronic Equipment (WEEE) or waste batteries is required. Do not dispose of these items with general household waste. Separate for the treatment, recovery and recycling of the materials used. Waste batteries can be returned to any waste battery recycling point which are provided by most battery retailers. Contact your local authority for details of the battery and WEEE recycling schemes available in your area.



Tenma Test Equipment
405 S. Pioneer Blvd.
Springboro, Oh