Quality and reliability is our tradition

KYORITSU®

CAT.Ⅳ CLAMP METER SERIES
APPLICATION NOTE

Why are CAT.Ⅳ Clamp Meters needed?

Voltage spikes (surges) are a constant threat.

As electrical distribution systems become more complex the chances of voltage spikes are always increasing. These spikes are superimposed to normal Mains voltage waveform as shown in figure 1.

These voltage spikes are generated by:

(a) The switching of large loads such as big motors, capacitor banks in power factor correction units, variable speed drivers etc.

(b) A lightning that strikes a middle / high voltage cable, even if this is kilometers away.

A voltage spike is unpredictable and can be much higher than the maximum rated voltage of our measuring instrument.
Eg. if we are carrying out a Mains voltage measurement in a 230/400V AC distribution line, the spike could reach voltage values of 10 times higher (some 4000 V).
In this case, our safety depends on the protection circuits of our instrument. However its max voltage rating alone (for instance 300 or 600V) gives no indication of the instrument's capability to withstand high voltage spikes.

If the instrument is not purposely designed to withstand these high voltage spikes, it will blow and a potential arc blast can create a life-threatening situation for the end user.
Thus the safety of a measuring instrument has to be based on both the max voltage rating and the withstand capability against the overvoltage spikes.

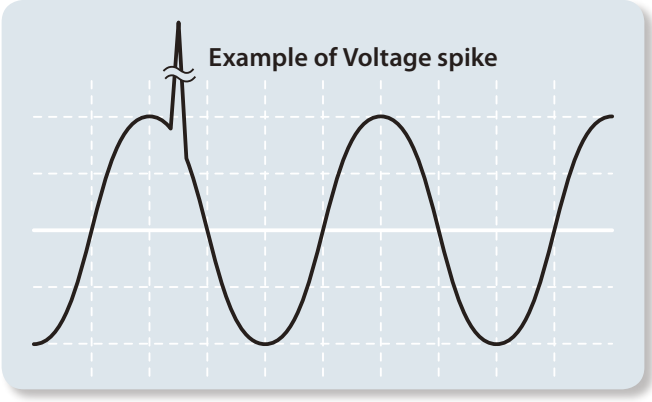
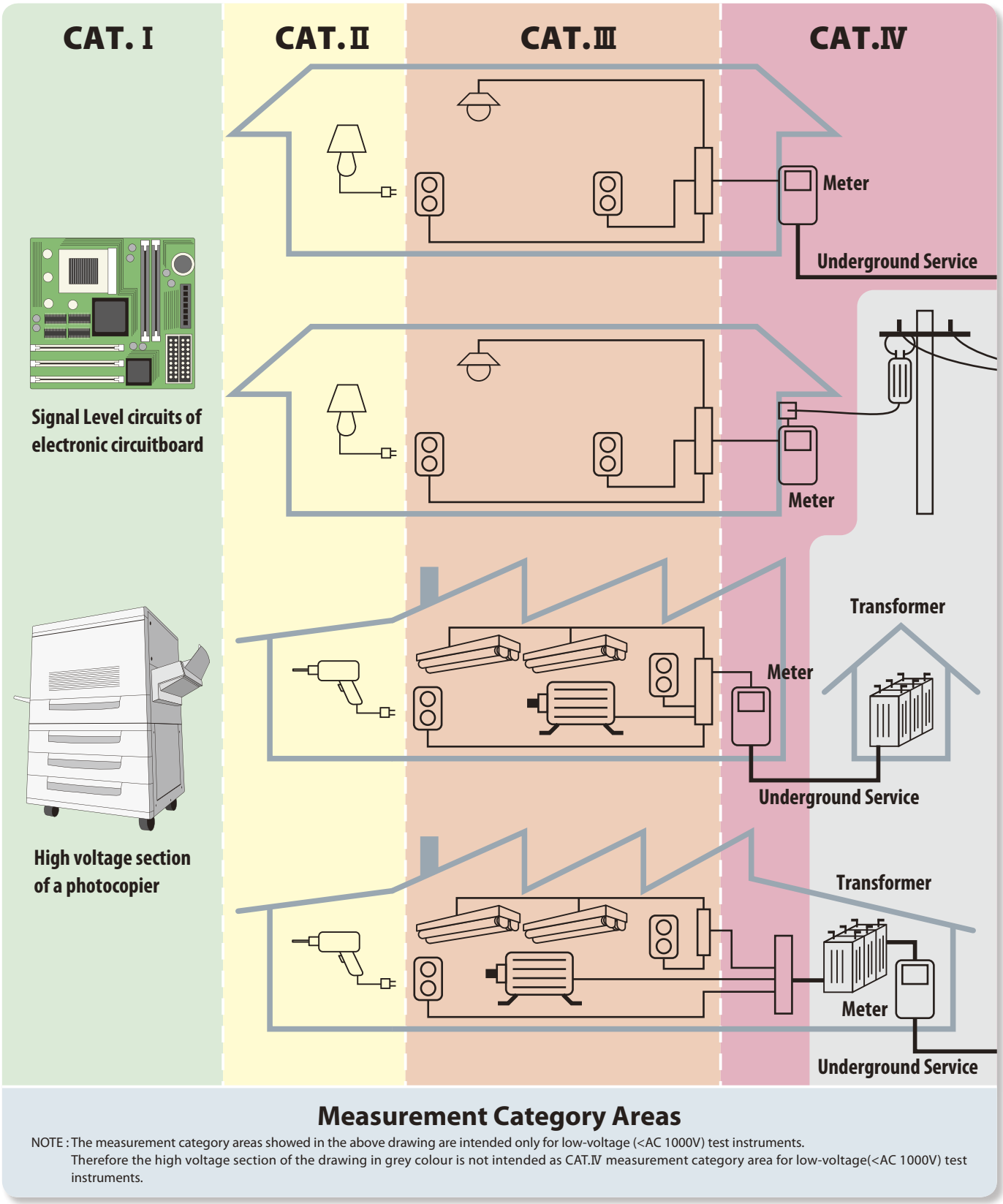


figure 1

Standard for Overvoltage - Measurement Categories.

To protect us against overvoltage spikes, we must use instruments that meet the requirements for high protection standards.
The IEC (International Electrotechnical Commission) has prepared an International and European safety standard named IEC 61010-1 with the aim of defining the safety requirements for measuring instruments.

In particular IEC 61010-1 standard defines also the safety Measurement areas called Categories, shortly indicated with the abbreviation “CAT”.
These Categories start from CAT.Ⅰ to CAT.Ⅳ and the most dangerous one is the CAT.Ⅳ. The figure below shows some area examples of Measurement Categories.



Measurement Category Areas

NOTE : The measurement category areas showed in the above drawing are intended only for low-voltage (<AC 1000V) test instruments.
Therefore the high voltage section of the drawing in grey colour is not intended as CAT.Ⅳ measurement category area for low-voltage(<AC 1000V) test instruments.

High voltage spikes are more dangerous at the origin of the installation since a spike is attenuated during its transit through the installation as a result of cable impedance. The categories are thus classified accordingly.
So, the closer we are to the power source origin (eg. the secondary side of a power transformer or the incoming service cable) the higher is the category number and the potential danger from voltage spikes.

Therefore an instrument designed for CAT.Ⅳ, can resist high voltage spikes for CAT.Ⅳ and for all the lower categories as CAT.Ⅲ, CAT.Ⅱ and CAT.Ⅰ.

Some Measurement Category scenarios.

CAT.Ⅳ

Generally the Measurement Category CAT.Ⅳ is for measurements to an area at the origin or near the origin of installation.
This area includes:

- An incoming service cable whether it is an underground cable or an, overhead line to a detached building.
- The outside and service entrance.
- The service drop from a pole to a building.
- The tails from the power electricity meter to the main protective device (breaker or fuse) or main distribution board.
- The secondary side of Middle Voltage Power Transformer and its main distribution board closed to it.

N.B. instruments designed for CAT.Ⅳ may also be used in all lower Categories Ⅲ, Ⅱ, Ⅰ and when an even higher degree of reliability and availability is desired.

Note:
An overhead line that supplies a house might be only 230 or 400V, but it is still technically CAT.Ⅳ because any outdoor conductor can be subject to very high energy lightning-related overvoltage spikes.
Also incoming underground cables are considered as CAT.Ⅳ, because although they may not be struck directly by lightning, a nearby lightning strike can generate high electromagnetic fields that induce overvoltage spikes on the underground cables.

CAT.Ⅲ

Generally the Measurement Category CAT.Ⅲ is for measurements performed to an area inside the building installation.
This area includes:

- Equipment in fixed installations such as main switchgear and distribution boards.
- Stationary Motors with permanent connection, Bus-bar, junction boxes and sub main cables in industrial plants.
- Short branch circuits, fuse or circuit-breaker panels and some mains installation control equipment.
- Fix Lighting systems and wirings including cables.
- Three-phase and Single-phase appliance sockets.

N.B. instruments designed for CAT.Ⅲ may also be used in all lower Categories .Ⅱ and Ⅰ.

CAT.Ⅱ

Generally the Measurement Category CAT.Ⅱ is for measurements performed on circuits directly connected to the low voltage installation.
Examples are :

- Portable (eg driller, hair dryer, table lamp, etc) or fixed (eg. fridge, water heater, etc) equipment powered via a socket outlet.
- Household appliances, portable tools and similar equipments.

N.B. Instruments designed for CAT.Ⅱ may also be used in Category Ⅰ area.

CAT.Ⅰ

Generally the Measurement Category CAT.Ⅰ is for measurements performed to the following examples.
Examples are:

- Equipment intended to be connected to a Mains supply in which means have been taken to substantially and reliably reduce overvoltage spikes to a level where they cannot be a hazard.
- Any high-voltage (but with low-energy source) derived from a highwinding resistance transformer, such as the high-voltage section of a photocopier.
- Signal level circuits for telecommunications and electronic equipment.

Note:
Inside a photocopier (or other appliances like TVs, Monitors, PCs, etc that fall within typical CAT.Ⅰ area) we could actually find some DC voltages much higher than the Mains voltage of 230V / 400V AC measured on a large motor typically classified as a CAT.Ⅲ area.
However the spikes in a CAT.Ⅰ electronic circuitry, whatever the voltage, are clearly of a lesser threat than ones we can find on a CAT.Ⅲ area, as the energy available to form an arc is limited. This does not mean that there is no electrical hazard present in CAT.Ⅰ equipment.

Sometimes there are more Categories in one object.

In some case it is difficult to classify the correct category as the same equipment could contain more than one category.
Examples:

- In electronic equipment like a photocopier, TV, monitor etc, there is often more than one category. For instance, in a photocopier, from the 230 V side of the power supply back to the socket outlet is CAT.Ⅱ. But its electronic circuitry is CAT.Ⅰ.
- In building control systems, such as lighting control panels, or industrial control equipment such as PLCs, programmable controllers, it is possible to find electronic circuits (CAT.Ⅰ) together with power circuits (CAT.Ⅲ).

What should be done in similar situations? It is not reasonable to study and define the right category before each and every measurements. So it is always recommended to select an instrument with a rated category and voltage sufficient to cater for the worst case scenario.

Safety first is the right choice!

Before purchasing a new Clamp Meter, we strongly recommend to consider the worst case scenario you might come across in your job and then determine which category is needed.

So first choose a Clamp Meter designed for the highest category you could be working in. Then, look for a Clamp Meter with a voltage rating and the category matching your needs.

The modern clamp meters designed to meet the IEC 61010-1 must clearly mark all the Category information and the max voltage rating. See the below example:

KEW 2056R

Look for Category and Voltage rating of your Clamp Meter!

KYORITSU Products for CAT.Ⅳ

Kyoritsu Electrical Instruments presents a range of very complete Clamp Meters capable of carrying out Measurement up to CAT .Ⅳ 600V.

These Clamp Meters are KEW 2040, KEW 2046R, KEW 2055, KEW 2056R, KEW 2003A and they are shown in the table below.

MODEL	2040	2046R	2055	2056R	2003A
Specifications	 CAT.Ⅳ 600V, ϕ33, MAX AC 600A	 CAT.Ⅳ 600V, ϕ33, MAX AC/DC 600A, TRUE RMS, ℃	 CAT.Ⅳ 600V, ϕ40, MAX AC/DC 1000A	 CAT.Ⅳ 600V, ϕ40, MAX AC/DC 1000A, TRUE RMS, ℃	 CAT.Ⅳ 600V, ϕ55, MAX AC/DC 2000A
AC A	0~600.0A 1.5%rdg±5dgt(50/60Hz) 3.5%rdg±8dgt(40~400Hz)	0~600.0A 2.0%rdg±5dgt(50/60Hz) 3.5%rdg±5dgt(40~500Hz)	0~600.0/1000A 1.5%rdg±5dgt(50/60Hz) 3.0%rdg±5dgt(40~400Hz)	0~600.0/1000A 2.0%rdg±5dgt(50/60Hz) 3.5%rdg±5dgt(40~500Hz)	400A/2000A [0~1000A] ±1.5%rdg±2dgt(50/60Hz) ±3%rdg±4dgt (40~500Hz) ±5%rdg±4dgt (500Hz~1kHz) [1001~2000A] ±3%rdg±2dgt (50/60Hz)
AC V	6/60/600V Auto Ranging 1.3%rdg±4dgt(50/60Hz) 3.0%rdg±5dgt(40~400Hz)	6/60/600V Auto Ranging 1.5%rdg±4dgt(50/60Hz) 3.5%rdg±5dgt(40~400Hz)	6/60/600V Auto Ranging 1.3%rdg±4dgt(50/60Hz) 3.0%rdg±5dgt(40~400Hz)	6/60/600V Auto Ranging 1.5%rdg±4dgt(50/60Hz) 3.5%rdg±5dgt(40~400Hz)	400/750V ±1.5%rdg±2dgt [50/60Hz] ±1.5%rdg±4dgt[40Hz~1kHz]
DC A	—	0~600.0A 1.5%rdg±5dgt	0~600.0A/1000A 1.5%rdg±5dgt	0~600.0A/1000A 1.5%rdg±5dgt	400/2000A ±1.5%rdg±2dgt
DC V	600m/6/60/600V Auto Ranging 1.0%rdg±3dgt	600m/6/60/600V Auto Ranging 1.0%rdg±3dgt	600m/6/60/600V Auto Ranging 1.0%rdg±3dgt	600m/6/60/600V Auto Ranging 1.0%rdg±3dgt	400/1000V ±1%rdg±2dgt
Frequency / DUTY	10/100/1k/10kHz (Auto Ranging) / 0.1~99.9%				—
Ω	600/6k/60k/600k/6M/60MΩ (Auto Ranging) 1%rdg±5dgt(600~6M) / 5%rdg±8dgt(60M)				400/4000Ω ±1.5%rdg±2dgt
Continuity buzzer	Buzzer Sounds at 100Ω				Buzzer sounds at 50±35Ω
Diode Check	●	●	●	●	—
Capacitance	—	400n/4μ/40μF (Auto Ranging)	—	400n/4μ/40μF (Auto Ranging)	—
Temperature	—	●	—	●	—
Data Hold	●	●	●	●	●
Peak Hold	—	●	—	●	—
MAX / MIN	●	●	●	●	●(MAX Hold)
Bar Graph	●	●	●	●	—
NCV*	●	●	●	●	—
Backlight Display	—	●	●	●	—
Withstand Voltage	6880V AC for 5 seconds				
Applicable Standard	IEC61010-1 CAT.Ⅳ 600V, IEC61010-031, IEC61010-2-032, IEC61326				IEC 61010-1 CAT.Ⅳ 600V,CAT.Ⅲ 1000V IEC61010-031, IEC61010-2-032
Power Source	R03(1.5V)(AAA) × 2				R6P(AA)(1.5V) × 2
Dimensions	243(L) × 77(W) × 36(D) mm		254(L) × 82(W) × 36(D) mm		250(L) × 105(W) × 49(D)mm
Weight	300g		310g		530g approx.
Accessories	7066(Test Lead) 9094(Carrying Case) Instruction Manual R03 × 2	7066(Test Lead) 9094(Carrying Case) Instruction Manual R03 × 2	7066(Test Lead) 9094(Carrying Case) Instruction Manual R03 × 2	7066(Test Lead) 9094(Carrying Case) Instruction Manual R03 × 2	7107(Test Lead) 8201(Output Plug) 9094(Carrying Case) R6P(AA) × 2, Instruction Manual
Option	8008(Multi-Tran)	8008(Multi-Tran) (AC only) 8216(Temperature Probe)	8008(Multi-Tran) (AC only)	8008(Multi-Tran) (AC only) 8216(Temperature Probe)	8008(Multi-Tran) (AC only) 7014 (Output Cord)

*Non-Contact Voltage

For further information and updates on instrument features please refer to latest Kyoritsu catalogue or visit Kyoritsu web site: http://www.kew-ltd.co.jp

Safety Warnings :

Please read the "Safety Warnings" in the instruction manual supplied with the instrument thoroughly and completely for correct use. Failure to follow the safety rules can cause fire, trouble, electrical shock, etc. Therefore, make sure to operate the instrument on a correct power supply and voltage rating marked on each instrument.

For inquires or orders :

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