ITECH

YOUR POWER TESTING SOLUTION

ITECH Testing Solutions

for LEDs and LED drivers

YOUR POWER

TESTING

SOLUTION

ITECH Testing Solutions for LEDs and LED drivers

The Light Emitting Diode (LED) industry has seen remarkable growth and transformation over the past few decades. As of 2024, the industry continues to expand rapidly due to technological advancements, increasing demand for energy-efficient lighting solutions, and the versatility of LED applications across various sectors.

The global LED lighting market has been growing at a significant rate, with a compound annual growth rate (CAGR) of around 12-15%. According to recent market reports, the LED lighting market size is expected to exceed USD 100 billion by 2026. The widespread adoption of LED technology in residential, commercial, industrial, and outdoor lighting has driven this growth.

Recent Developments in LED Technology

Smart Lighting Systems

Integration of LED technology with IoT (Internet of Things) has led to the development of smart lighting systems.

Human-Centric Lighting (HCL)

Advances in LED technology have enabled the creation of lighting solutions that mimic natural daylight, supporting human circadian rhythms and improving well-being and productivity in various environments.

MicroLED and OLED

Emerging technologies such as MicroLED and Organic LED (OLED) are paving the way for new applications. MicroLED offers higher brightness and energy efficiency for displays, while OLED is known for its superior color quality and flexibility in displays and lighting.

Improved Efficacy

Continuous improvements in LED efficacy have resulted in higher lumens per watt, making LEDs even more energy-efficient and cost-ef fective.

UV-C LED Technology

being used for sterilization and disinfection purposes.

Enhanced Color Rendering



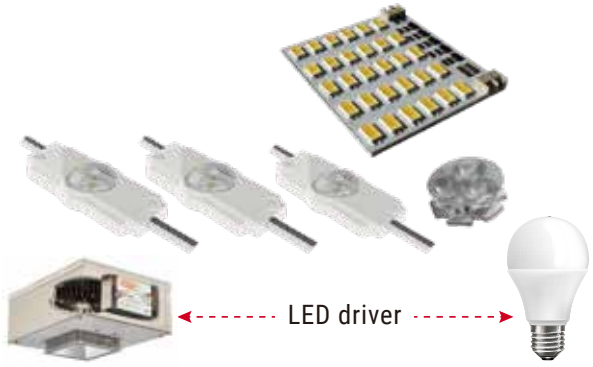



LED System Components

LED components

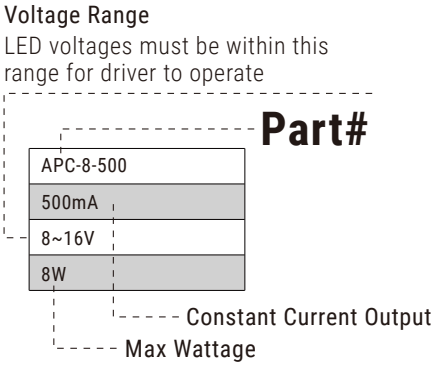
For general illumination, LED modules (or “LED engines”) are available from many companies including Xicato, Philips, GE, Osram and many others.

These modules are then used within a lamp or a fixture, both of which are powered by a driver.



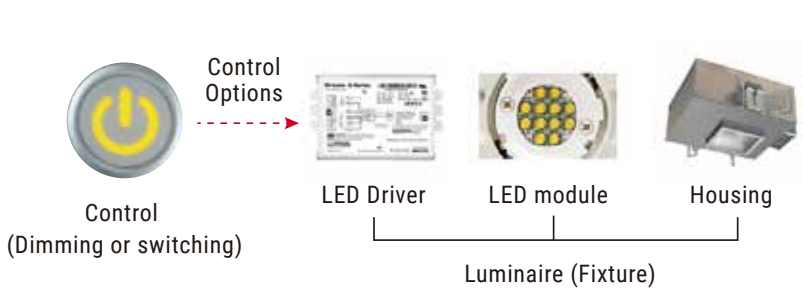
LED Drivers

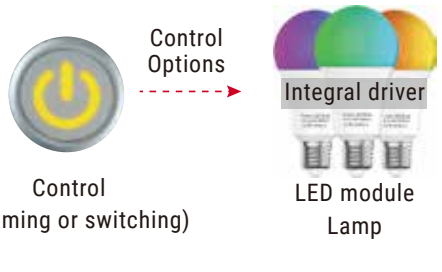
- The appropriate driver is determined by the electrical specification of the LED module and the design of the luminaire
- Two types of LED drivers exist
  - Constant Current
  - Constant Voltage
- Different types of LED drivers are NOT interchangeable



LED Dimming Control Options

LED System Architecture





LED Drivers

LED drivers can be configured to dim the LEDs in two ways

- Pulse-width modulation (PWM)
- Constant current reduction (CCR)

The most commonly used methods for dimmer-to-driver signal initiation

Phase control

- 2-Wire (Forward Phase/ Leading Edge or Reverse Phase/ Trailing Edge)
- 3-Wire (forward phase, like Lutron) (Typically USA only)

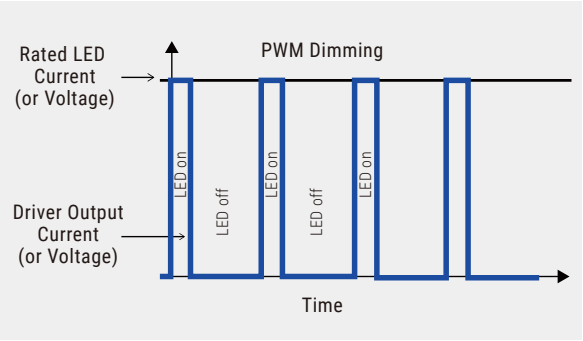
Low voltage control

- Analog: 4-wire (0-10V)
- Digital: DALI or DMX

LED Drivers

Pulse Width Modulation (PWM) Output Dimming Method

- Available for both Constant Current and Constant Voltage drivers
- PWM dimming cycles the LED on and off (120-1000+ Hz), reducing the average light output
- Claimed Benefits
  - Provides more precise control for shared parallel loads
  - Prevents color shift
- Disadvantage
  - high frequency switching can generate electromagnetic interference (EMI) and audible noise

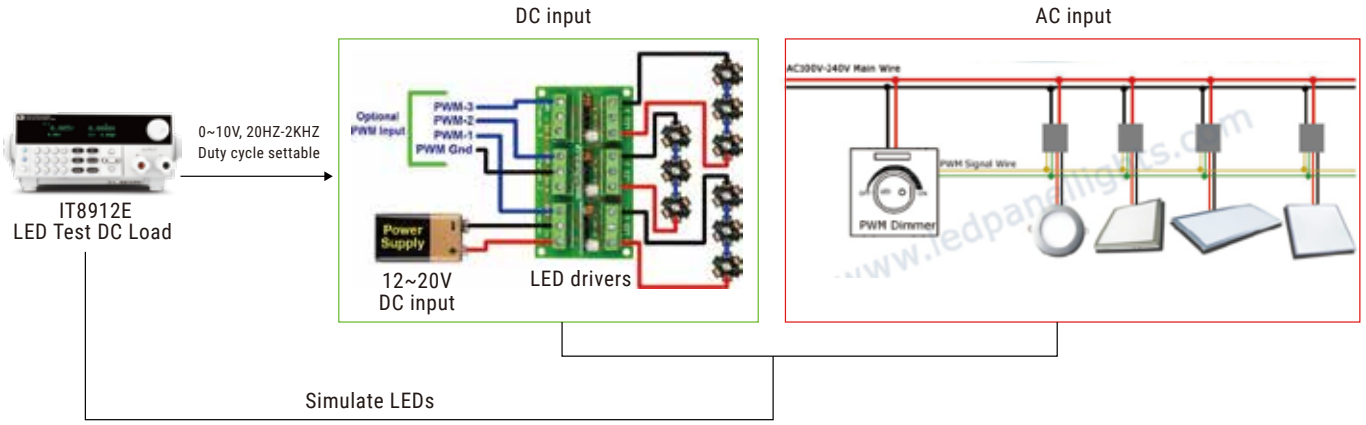


PWM Dimming Function

IT8912E can generate a PWM(20Hz-2KHz) signal to the LED driver and replace a signal generator

High power LED Lighting Applications

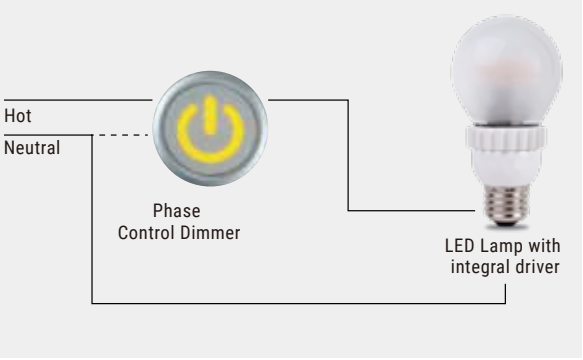
- Home and automotive needs
- IR Illumination along with LED Grow Lights



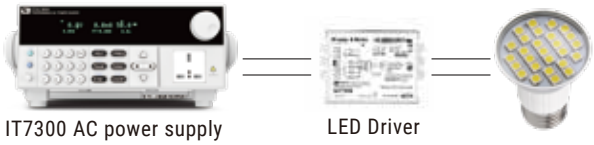
LED Dimming Control Options

Phase Control

- Typically used to control an LEDi lamp
- Most installed incandescent (forward phase control) dimmers are not UL listed for LED loads, but forward phase control dimmers listed for LED loads are now available
- Reverse phase control dimmers can have better performance, but they require a neutral wire connection
- Dimmers can be wall-mounted or panel based, but compatibility between dimmer and LED load MUST be confirmed

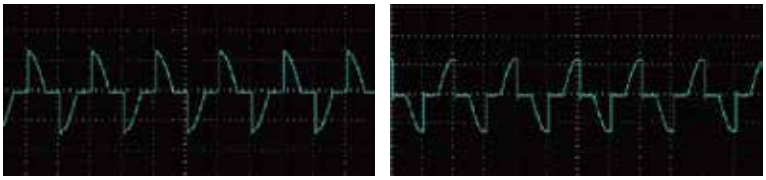


Phase Control Dimming Functions



IT7300 AC power supply
Replace Dimmer

LED Driver



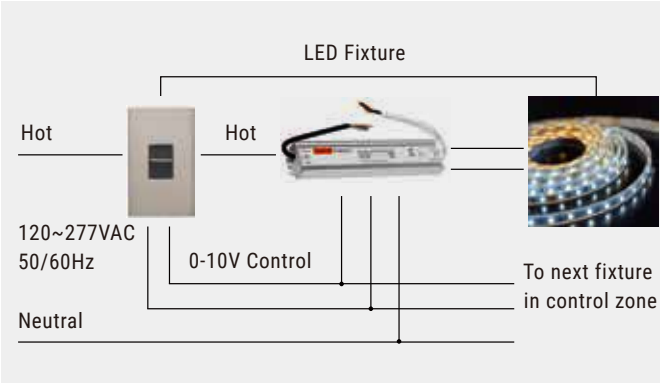
Leading edge phase dimming

Trailing edge phase dimming

LED Dimming Control: 0-10V

0-10 Volt Control (analog)

- Most 0-10V controls follow standard IEC 60929
  - States that fixture (driver) sources current, and control sinks it
  - Alternate ANSI 0-10V standard is not compatible, and uncommon
- Typically, line-voltage switching is also included with the control to switch the fixture off
- 0-10V control signals can be made by wallbox dimmers, panel dimmers, or interfaces



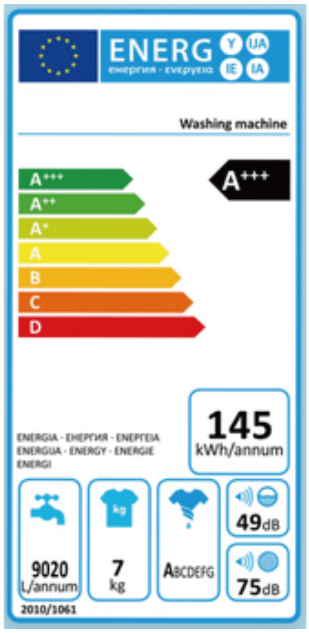
LED Lighting Safety Standards in the European Union

Performance parameters are becoming an increasingly important aspect for Lighting Products as they are needed to demonstrate compliance to performance regulations and also to provide more product information in a competitive marketplace and a potential route to insurance for product warranties.

- RoHS
- Low Voltage Directive (LVD)
- EMC Directive(UL or FCC in US)
- Radio Equipment Directive (RED)
- Ecodesign Directive
- CE Marking
- CE Documentation
- WEEE Symbol
- REACH
- Directive 94/62/EC: Packaging Regulations

Products

- LED light bulbs
- LED light strips
- LED luminaires
- LED lamps
- Smart home products
- IoT products



Energy Labeling

EMC Performance

- **EN 55015**

  EMC Emissions (Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment)

- **EN 61000-3-2**

  Harmonics (Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

- **EN 61547**

  EMC Immunity (Equipment for general lighting purposes – EMC immunity requirements)

- **EN 61000-3-3**

  Voltage fluctuations and flicker (Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <16 A per phase and not subject to conditional connection)

Recommended

IT-M7700/IT7600/IT7800 series AC Power Supply

Advantages

Comply with IEC/EN 55015, IEC/EN 61547, IEC/EN 61000-3-2 and IEC/EN 61000-3-3

Reliability and Life Test

Recommended

DC Power Supply

IT6860A (Dual range)/ IT6900/ IT6100B

AC Power Supply

IT7600/IT-M7700/IT7300/IT7200/IT7800

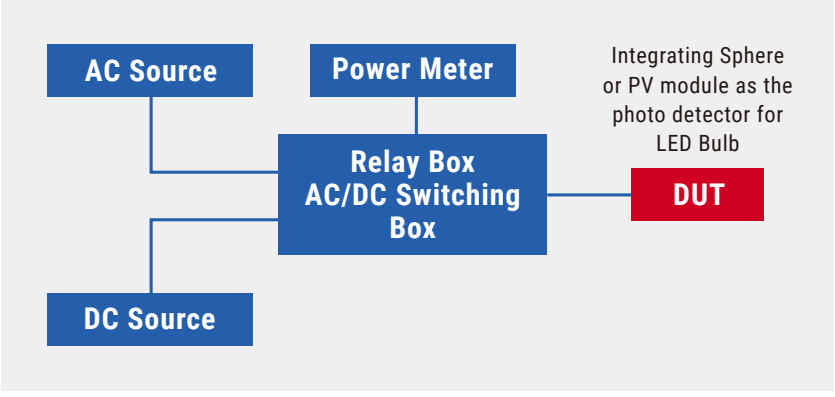
Advantages

IT6860A/ IT6900 series

Dual range, small current overshoot

IT7800 series

Comply with IEC/EN 61547, IEC/EN 61000-4-15, IEC/EN 61000-3-3 and IEEE 1453

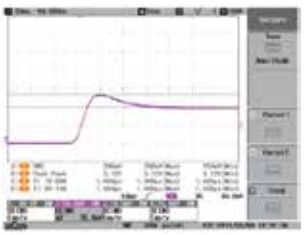


Test Architecture for LED Bulb

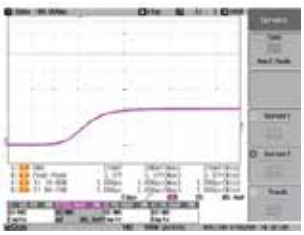
Case Analysis: LED Luminous Flux Test by Integrating Sphere

- Aging test is important for testing LED's luminous decay, color temperature and leakage current.
- When power on general power supply, it will generate inrush current. Which may damage LED. Whereas IT6874A can effectively limit inrush current, protect LED.
- When output micro-current, general power supply may easily enter limiting current mode which will lead to slow voltage rise, whereas IT6874A can fast light LED, which improves test efficiency.

Startup of general power supply VS startup of IT6874A

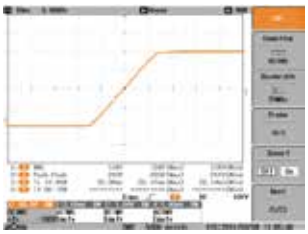


With obvious inrush current

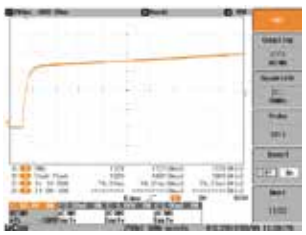


No inrush current

Startup of general power supply VS startup of IT6874A



Voltage rise slowly



Voltage rise rapidly

Reliability and Life Test of LED Bulb

Advantages

IT6860A/ IT6900 series

- CC and CV mode, programmable
- Prevent current overshoot and protect LED

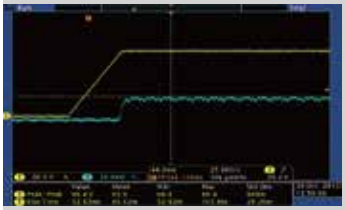
IT6100B series

- High precision of current and voltage
- CC loop priority selectable which can restrain current overshoot

IT6900A Wide-range Programmable DC Power Supply

IT6100B Programmable DC Power Supply

IT6874A

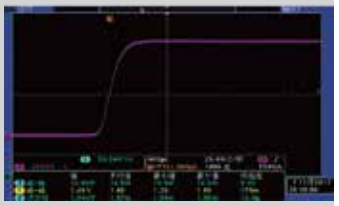


LED (80V/20mA) rising about 80ms

LED (80V/400mA) rising about 50ms

IT6162B/IT616

LED light up at 2.5A under CC priority



LED light up at 250mA under CC priority

Case Analysis: LED Car Light Test

Advantages

IT6860A/ IT6900 series

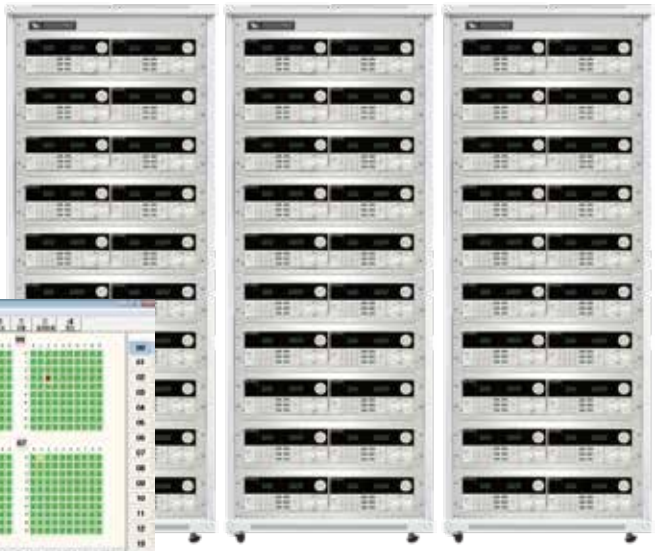
- CC and CV programmable
- Limit current overshoot
- IT6860A/IT6900/IT-M3200/IT6100B series have free IT9000 software for List programming and remote control

Minor loop (Different Voltage)	0.6s ON	0.6s OFF	0.6s ON	0.6s OFF	0.6s ON	0.6s OFF	.....	OFF
Major loop	5 min ON (the minor loop includes 500 steps)							5min OFF (one step)
Whole loop	Major loop include 501 steps, T=10min repeated 36 times (last 6 hours)							

Aging Test System for LED Beads

Strengths of ITS9100 Aging Test System

- Long-time stable running
- Monitor hundreds of channels at one interface
- Automatic record data and alarm system
- Module design, extensible, easy maintenance



IT6860A/ IT6900 series

What is a Mini-LED Display?

Traditional liquid crystal displays (LCDs) use LED backlighting to light-up pixels either from behind or from the screen edges. The LEDs used in conventional displays are about 1000 microns in size in average.

Although OLED panels have been around for quite some time, their adoption is yet to gain considerable ground outside of smartphone displays, owing to limitations in producing large OLED panels, gradual loss of luminance over time, and lower power efficiency at higher brightness to name a few. Mini-LEDs aim to overcome some of these limitations and offer a good compromise between conventional LEDs and OLEDs.

Mini-LED displays are similar to conventional LED ones in that they still use a backlight as a source of brightness. However, a mini-LED display uses miniature LEDs that are about 100 to 200 microns in size. This allows panel makers to cram thousands of them into the display as opposed to just hundreds in conventional LED backlit panels. The primary advantage of this approach is that the backlight zones are now much smaller, which enables better control over contrast, brightness, and color with blacks approaching near-OLED levels. The increased number of backlight zones also means better local dimming, which is a requirement for true HDR output.

Case Study: Mini LED, OLED Test

For Mini LED, OLED, IC, IoT devices, communication electronics, (new energy) automotive electronics, smart driving sensor, etc.

IT-M3200 High Precision Programmable DC Power Supply

Advantages

- 100/200/360W（expandable）
- 1/2 U
- Three current range with 10nA current resolution
- Multi-channel control with Link function
- OVP/OCP/OPP/UVP/UCP/Foldback

Model	Voltage	Current	Power
IT-M3223	60V	10A	100W
IT-M3233	60V	10A	200W
IT-M3243	60V	10A	360W
new IT-M3253	20V	20A	100W
new IT-M3263	20V	20A	200W
new IT-M3273	20V	20A	360W

Circuit Architecture of LED Driver Test System

- IT-M7700 or IT7600 or IT7300(Phase Dimming) for AC input.
- IT9121 power meter maybe needed when using IT7300 for harmonic test
- IT8912E is used to simulate LED. (IT8500G+, IT8700 can SW simulating LED)

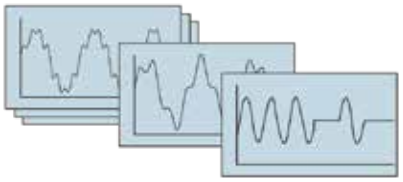
IT7700 AC Power Supply

AC input

LED driver

DC output

IT8912E LED Test E-Load

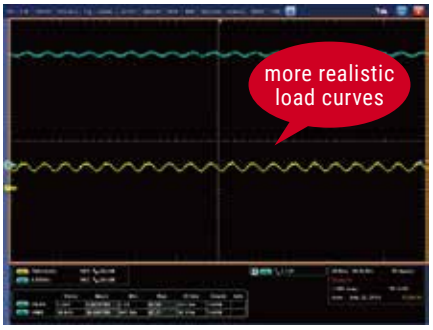


IEC61000-4-11
IEC61000-4-13

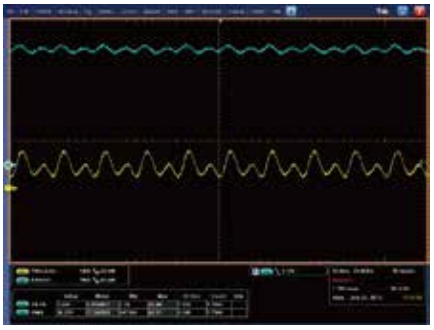
LED Driver Test: CR-LED mode of IT8500G+/IT8700/ IT8800/ IT8912E

CV+CR(CR-LED) mode of IT8700/ IT8800/ IT8912E

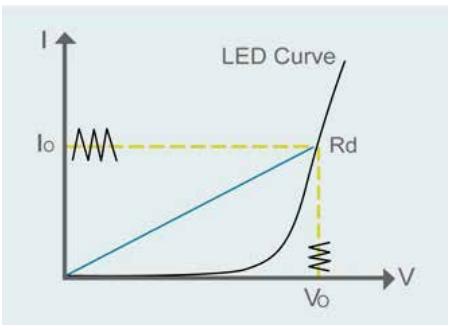
- The end user could edit two parameters to simulate LED characteristics (see attached User's Manual).
- IT8912E adopts hardware simulation which could be faster and wider bandwidth.



CR-LED mode



CV mode



- I-V curve under CR mode of E-load
- LED I-V curve

Case Study: LED Driver Test——Vegetable Grow Light

LED grow lights offer energy efficiency, customizable light spectrums, long lifespan, low heat emission, versatility, improved yield and quality, and environmental benefits, making them a superior choice for growing weed plants.

- Power consumption: 100W~1000W

LED driver test instrument: IT8900A/E series

Advantages

- 2kW~6kW, 600A in 4U
- CC/CV/CR/CP/CC+CV/CV+CR/CR+CC/CP+CC
- Built-in LAN/USB/RS232/GPIB/CAN/Analog control

Recommended

IT8500G+ Electronic Load

Advantages

- 7 operating modes: : CC/CV/CR/CW/CR+CC/CV+CC/CR-LED
- Voltage and Current Ripple Test with 300kHz Bandwidth
- Readback resolution up to 0.1mV / 0.1mA
- Dynamic Response up to 20kHz
- OCP/OPP Test
- Short circuit test
- USB (TMC+VCP), LAN Communication Port
- Built-in 8 fast charging communication protocol, including QC2.0, QC3.0, PE+, PE2.0+, USB PD2.0, USB,PD3.0, FCP, SCP(suitable for IT8511G+ and IT8511AG+)

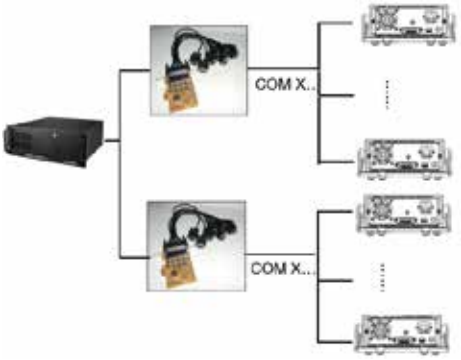
IT8500G+ E-load+ Ripple Tester +DVM

Model	Spec	Interface
IT8511G+	150V/ 30A/ 150W	USB
IT8511AG+	150V/ 30A/ 150W	USB
IT8512G+	150V/ 30A/ 300W	USB, LAN
IT8512BG+	600V/15A/300W	USB, LAN

IT8500G+ USB-VCP

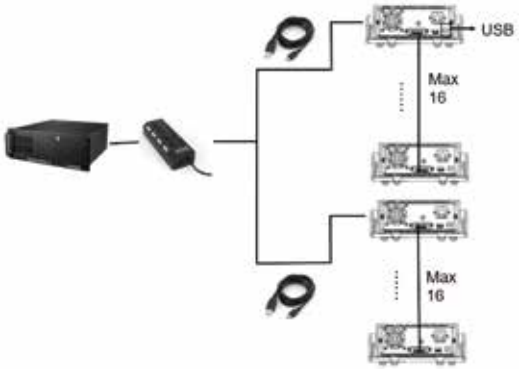
ITECH multi-channel function， Save more than $300 per 32 channels

Tradition RS232 Networking Scheme



Cost: One 1-to-8 port serial card costs about $83, to achieve 32 channel aging test, costs about $332 for communication cards.

ITECH multi-channel USB Networking



Cost: to achieve 32 channel aging test, costs about $7.8 for 8-port USB communication card using IT85G+

HV AC LED

There is more and more market potential to adopt high input voltage planning in the design of large-scale LED lamps around the world (for example, North America and some countries and regions with poor input voltage stability, or applications using generators as input voltage power supply)

Recommended

IT-M7700 AC power supply

Advantages

- Serial connection of two units can output 600V
- Power meter built-in
- Complete communication interfaces for remote control

Outdoor Fishing Lighting

180 ~ 528 VAC input
65W~ 1000W from Mean Well

Micro LED

Micro LED, sometimes called μLED is made up of tiny LED, measure less than 100μm. Another way of looking at this is that MicroLEDs are simply traditional LEDs shrunk down and placed into an array.

Pros

Comparing with TFT LCD and OLED, Micro LED has very fast response time, high brightness, wide viewing angle and long lifespan.

Replacing organic material with inorganic GaN material eliminates the need of polarizing and encapsulation layer, found in OLED. Micro LED is smaller and thinner, consumes less power.

Cons

Expensive: Micro LED is a new technology, expensive to make.

Difficult to produce: As all new technologies, manufacturing Micro LED is facing many difficulties at the moment.

Technology	TFT LCD	OLED	Micro LED
Light Source	LCD backlight	Self emmit	Self emmit
Cost	Low	Medium	High
Power Consumption	High	60%-80% of LCD	30%- 40% of LCD
Brightness	Low	High	High
Efficiency	Low	Medium	High
Lifespan	Long	Medium	Long
Contrast	Low	High	High
Response Time	ms	μS	ns

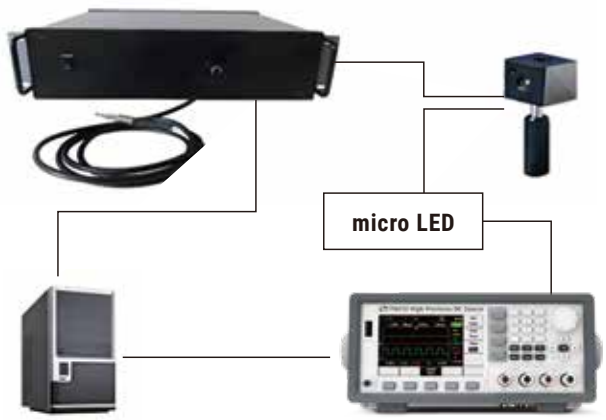
The Luminance Test of Micro LED Array

Recommended

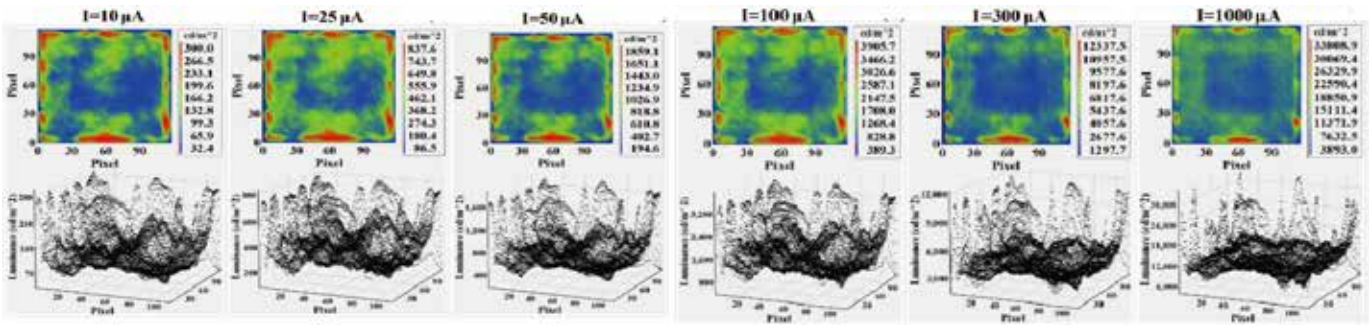
IT6400 Bipolar DC Power Supply / Battery Simulator

Advantages

- Dynamic response time < 20 us
- Current display resolution up to 1 nA
- Current ripple < 2 uArms
- No current overshoot in LED test
- Standard LAN / USB / GPIB interface



IT6400 Bipolar DC Power Supply / Battery Simulator



The pseudo-color map and 3D distribution of the brightness of Micro-LED chips

YOUR POWER TESTING SOLUTION

This information is subject to change without notice. For more information, please contact ITECH.

ITECH ELECTRONIC CO.,LTD.

Taipei

Add: No.918, Zhongzheng Rd., Zhonghe Dist., New Taipei City 235, Taiwan
Web: www.itechate.com
TEL: +886-3-6684333
E-mail: info@itechate.com

ITECH Web

ITECH Facebook

ITECH LinkedIn