Power Electronics Testings

LED Driver Test Solution

www.chromaate.com

Chroma
Turn-key Solutions Provider

A Light Emitting Diode (LED), with its low power consumption, compact size, long life duration and versatility make it ideal for lighting and illumination applications. LEDs have found its applications in LCD monitor/TV backlights, street lighting, automobile lighting, interior lighting, outdoors large screen displays, consumer electronics and various other applications.

LED drivers are used to provide the power to the LEDs, and are usually designed as a constant current source due to the light emitting characteristics of the LEDs. Although LED drivers' functions and characteristics differ from the general switch mode power supply (SMPS), the components used, the design topology and the testing requirements are very similar. Chroma is able to provide LED testing solution based on its twenty-five years of experience in providing power electronics testing solutions. These solutions include : programmable AC and DC Sources, high precision Power Meters, and Electronic Loads specifically designed for LED drivers. Chroma is also able to provide Automated Test Systems suitable for R&D, QA qualifications and mass production.

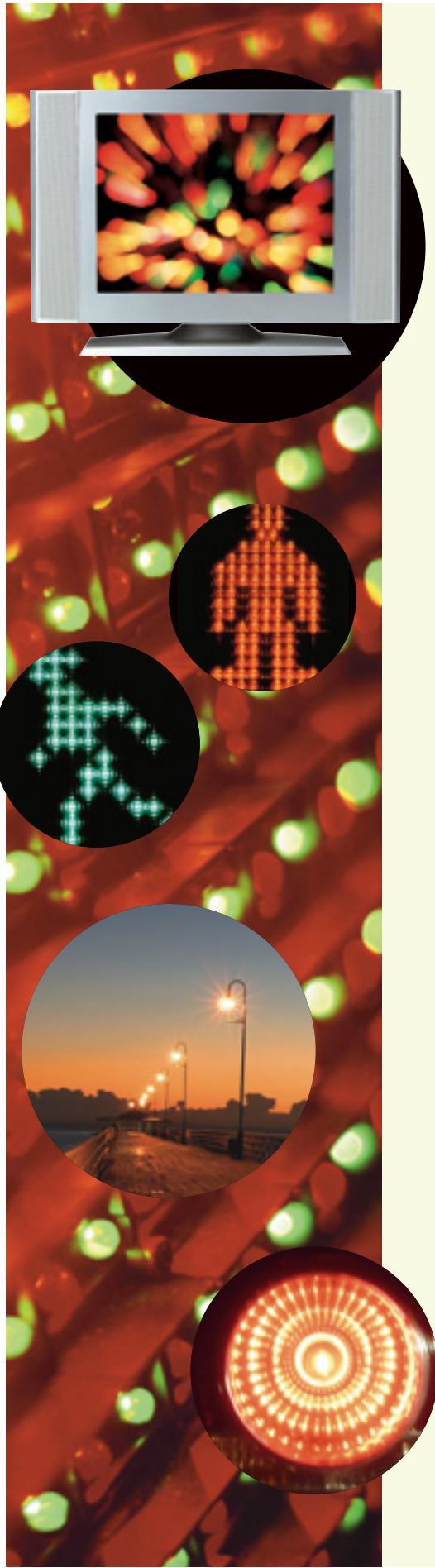**AC Power Source**

Digital Power Meter

Input

LED Driver
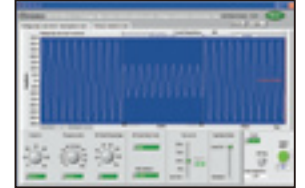
Output

DC Electronic Load

Advance Programmable AC Power Sources

Model 61500 Series

Key Features

☑ Output : 500VA~4KVA/0~300VAC/424VDC
☑ AC, DC, AC+DC output mode
☑ Turn-on, turn-off phase angle control
☑ Programmable voltage and frequency slew rate
☑ Power line disturbance simulation : LIST, PULSE, STEP modes
☑ Distortion waveform editor : SYNTH and INTERHAR modes
☑ Measurement for RMS voltage, current, power, PF, VA, VAR, crest factor, peak and inrush current
☑ Standard AC source for IEC61000-3-2 testing
☑ IEC 61000-4-11, -4-13, -4-14, -4-28 regulation testing
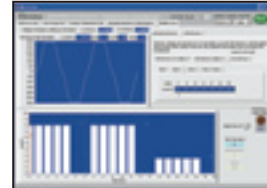
Voltage Harmonic & Interharmonics Test   Voltage DIP,Short,Variation Regulation Test

PULSE   LIST   STEP   SYNTH   INTERHAR
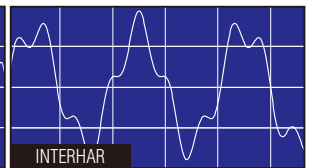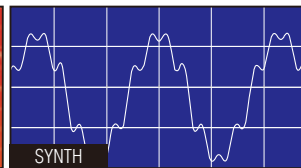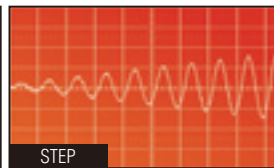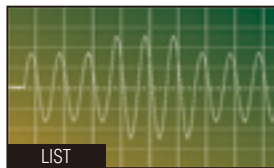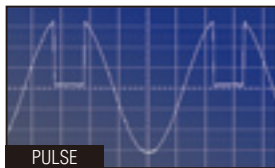
Model	61501	61502	61503	61504
Power	500VA	1000VA	1500VA	2000VA
Voltage	150V/300V/Auto	150V/300V/Auto	150V/300V/Auto	150V/300V/Auto
Max. Current	4A/2A (150V/300V)	8A/4A (150V/300V)	12A/6A (150V/300V)	16A/8A (150V/300V)
Frequency	DC, 15 ~ 1KHz	DC, 15 ~ 1KHz	DC, 15 ~ 1KHz	DC, 15 ~ 1KHz

Ideal for Energy-star & High Precision Power Measurement

Digital Power Meters

Model 66200 Series

Key Features

☑ Voltage : Vrms, Vpeak+, Vpeak-   Current : Irms, Ipeak+, Ipeak-
   Power : Watts, Power Factor, VA, VAR
☑ 10 mA minimum current range & 1mW power resolution
☑ Meets ENERGY STAR/IEC 62301 measurement requirements
☑ Accumulated energy methods for unstable power measurement
☑ User-defined criteria provides automatic PASS/FAIL indications
☑ THD, Inrush current and energy measurements (Model 66202)
☑ Interface options : USB or USB+GPIB

66200 Softpanel   66200 Softpanel   IEC 61000-3-2 Current Harmonic Test   Power Efficiency Test Softpanel

Model	66201	66202
Parameters	V, Vpk, I, Ipk, W, VA, VAR, PF, CF_I, F	V, Vpk, I, Ipk, Is, W, VA, VAR, PF, CF_I, F, THD_V, THD_I, Energy
AC Voltage	150/300/500Vrms (CF = 1.6)	150/300/500Vrms (CF = 1.6)
AC Current	0.01/0.1/0.4/2 Arms (CF=4)	SHUNT H : 0.2/2/8/20Arms (CF=2@0.2/2/8A, CF = 4@ 20A) SHUNT L : 0.01/0.1/0.4/2Arms (CF=4)
Power	47Hz ~ 63Hz : 0.1% of rdg + 0.1% of rng 15Hz ~ 1KHz : (0.1+ 0.2/PF*KHz)% of rdg + 0.18% of rng 300V x 0.01A Range : 0.2% of rdg + 7mW	47Hz ~ 63Hz : 0.1% of rdg + 0.1% of rng 15Hz ~ 1KHz : (0.1+ 0.2/PF*KHz)% of rdg + 0.18% of rng 300V x 0.01A Range : 0.2% of rdg + 7mW

Cost Effective Modular Electronic Loads

Model 63110A

Key Features

- ☑ Unique LED mode for LED driver test
- ☑ Programmable LED operating resistance (Rd)
- ☑ Programmable internal resistance (Rr) for simulating LED ripple current
- ☑ Fast response for PWM dimming test
- ☑ Up to eight channels in one mainframe
- ☑ 16-bit precision voltage and current measurement with dual-range
- ☑ Full Protection: OV, OC, OP and OT protection

As a constant current source, the LED driver has an output voltage range with a constant output current. LED drivers are usually tested in one of the following ways;
1. With LEDs
2. Using resistors for loading
3. Using Electronic Loads in Constant Resistance (CR) mode, or Constant Voltage (CV) mode
However all these testing methods each have their own disadvantages.

As shown on the V-I curve in figure 1, the LED has a forward voltage V_F and a operating resistance (Rd). When using a resistor as loading, the V-I curve of the resistor is not able to simulate the V-I curve of the LED as shown in blue on figure 1. This may cause the LED driver to not start up due to the difference in V-I characteristic between the resistors and the LEDs. When using Electronic Loads, the CR and CV mode settings are set for when the LED is under stable operation and therefore, is unable to simulate turn on or PWM brightness control characteristics. This may cause the LED driver to function improperly or trigger it's protection circuits. These testing requirements can be achieved when using a LEDs as a load; however, issues regarding the LED aging as well as different LED drivers may require different types of LEDs or a number of LEDs. This makes it inconvenient for mass production testing.
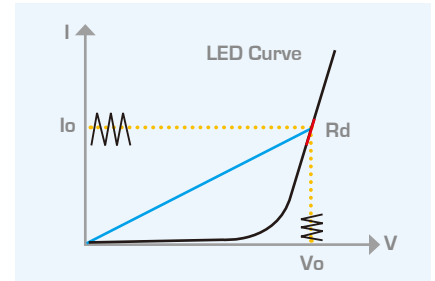
Figure 1 LED V-I Characteristics

Mainframe Model	6312A (2 slots)	6314A (4 slots)
Dimensions (H×W×D)	194×275×550 mm / 7.6×10.8×21.7 inch	194×439×550 mm / 7.6×17.3×21.7 inch
Weight	15 kg / 33.1 lbs	21.5 kg / 47.4 lbs

Chroma has created the industries first LED operating mode for simulating LED loading with our 63110A load model from our 6310A series Electronic Loads. By setting the LED driver's output voltage, and current, the Electronic Load can simulate the LED's loading characteristics. The LED's forward voltage and operating resistance can also be set to further adjust the loading current and ripple current to better simulate LED characteristics. The 63110A design also has increased bandwidth to allow for PWM dimming testing.

Figure 2 shows the current waveform from a LED load. Figure 3 shows the current waveform from 63110A's LED mode load function. From figures 2 and 3, the start up voltage and current of the LED driver is very similar. Figure 4 shows the dimming current waveform of the LED. Figure 5 shows the dimming current waveform when using 63110A as a load.
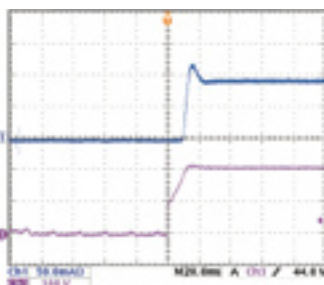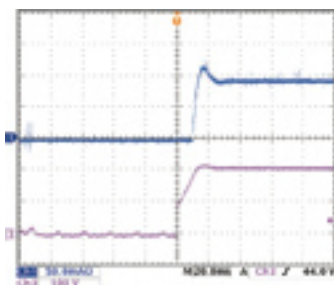
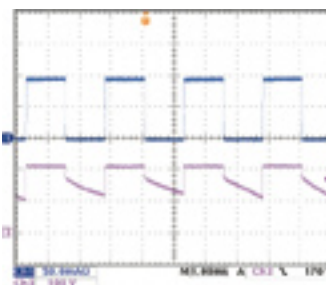Figure 2 - LED loading

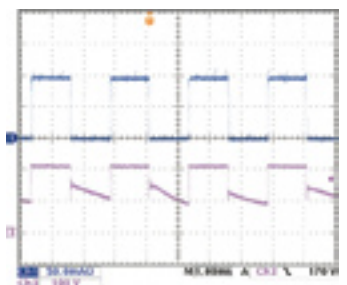Figure 3 - 63110A LED mode loading

Figure 4 - LED dimming test

Figure 5 - 63110A dimming test

The internal resistance (Rr) can be adjusted to simulate the LED driver output ripple current. The traditional E-load can not simulate the ripple current of LED shown as Figure 6. Figure 7 shows the ripple current waveform from a LED load. Figure 8 shows the ripple current waveform from the 63110A LED mode load function.
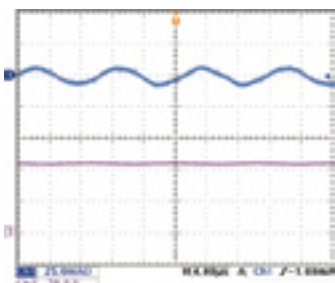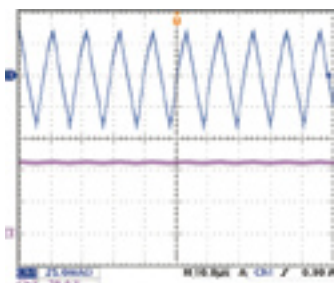

Figure 6 - Traditional E-load loading
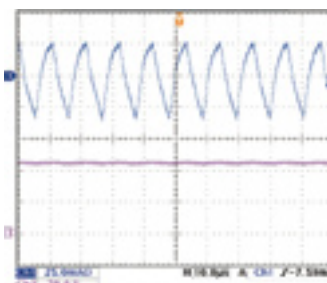

Figure 7 - LED loading

Figure 8 - 63110A loading

Figure 9 shows the current waveform from a resistive load. Figure 10 shows the current waveform from a CR mode of an Electronic Load loading. Figure 9 and 10 current waveform differs significantly from that of LED loading, especially the voltage and current overshoot, which may cause the LED driver to go into protection. Using resistive load or CR mode to test LED drivers may cause the LED drivers to fail to turn on as shown in Figure 11.
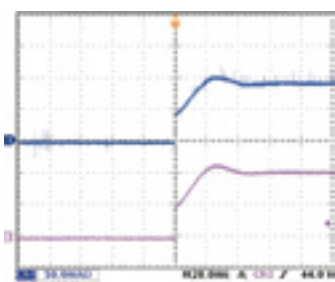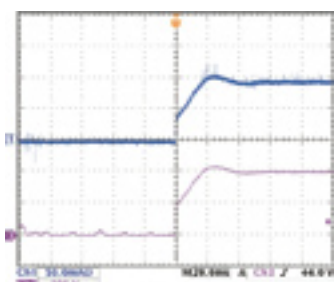
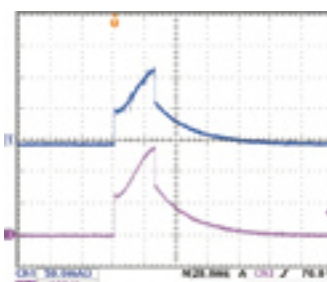
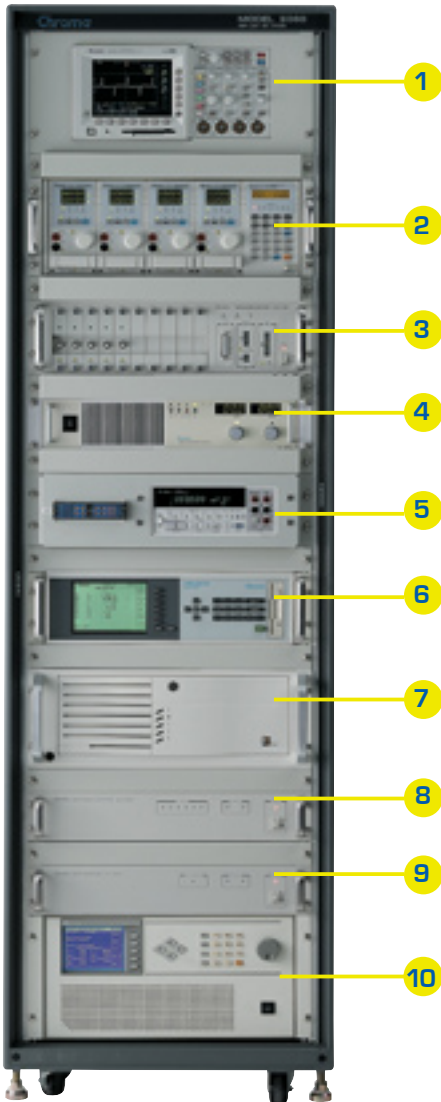Figure 9 - Resistive loading

Figure 10 - CR mode loading

Figure 11 - Resistive loading (Fail)

| Model	63110A (100Wx2)	
Power	100W	
Current	0~0.5A	0~2A
Voltage	0~Í 00V	
CONSTANT RESISTANCE MODE		
Range	CRL: 1Ω~1kΩ (50V) CRH: 10Ω~10kΩ (300V)	
Resolution	14 bits	
Accuracy	1kΩ : 0.001mho+0.2% 10kΩ : 0.0001mho+0.1%	
CONSTANT VOLTAGE MODE		
Range	0~300V	
Resolution	CVL: 3.66mV CVH: 20mV	
Accuracy	0.05%±0.1%F.S.	
LED MODE		
Range	CV: 0~300V RdL: 1Ω~1kΩ (50V) RdH: 10Ω~10kΩ (300V)	
Resolution	CVL: 3.66mV CVH: 20mV CR: 14 bits	
Accuracy	V: 0.05%±0.1%F.S. RdL: 1kΩ : 0.001mho+0.2% RdH: 10kΩ : 0.0001mho+0.1%	
MEASUREMENT SECTION		
VOLTAGE READ BACK		
Range	0~50V	0~300V
Resolution	1mV	5mV
Accuracy	0.025%+0.025% F.S.	
CURRENT READ BACK		
Range	0~0.5A	0~2A
Resolution	10uA	40uA
Accuracy	0.05%+0.05% F.S.	

High Performance Hardware Devices and Software Architecture
LED Driver Automatic Test Systems

Model 8000/8020

1. **Digital Storage Oscillate Scope:** TEK TDS Series
2. **DC Electronic Load :** Chroma 6310A/6330A Series
3. **Time/Noise Analyzer :** Chroma 6011/80611 + 80611N + Current Transducer
4. **DC source:** Chroma 62000P Series
5. **Digital Multi-Meter:** Agilent 34401A
6. **Digital Power Meter/Analyzer :** Chroma 6630/66200 Series
7. **Sytem Controller :** Industrial PC
8. **OVP/Short circuit tester :** Chroma 6012/80612
9. **ON/OFF Controller :** Chroma 6013/80613
10. **AC Source :** Chroma 6500/61500/61600 Series

Model Type for RD, QA Verification
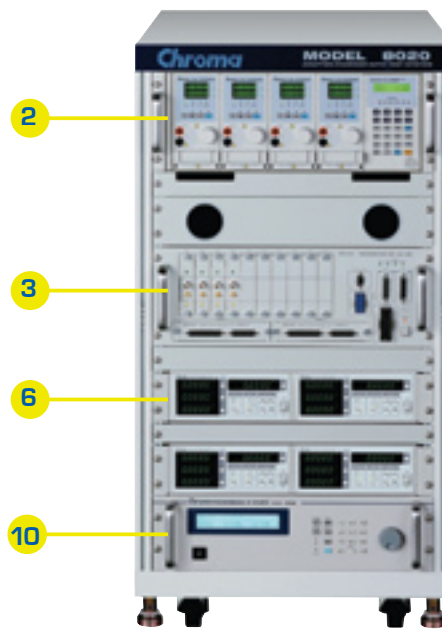
Model Type for Production Line

Optimized Test Items

The Chroma 8000/8020 ATS is equipped with optimized standard test items for LED driver testing. The user is only required to define the test conditions and specifications for the standard test items to perform the test.

The optimized test items cover 6 types of power supply test requirements. OUTPUT PERFORMANCES verifie the output characteristics of the UUT. INPUT CHARACTERISTICS check the UUT input parameters. REGULATIONS test the stability of UUT under varying line-in and loading changes. TIMING & TRANSIENT test the timing and transient states during protection. PROTECTION TESTS trigger and test the protection circuit, the SPECIAL TESTS provide means to test the most sophisticated UUT's when unique test routines are needed.

Output Performances	Input Characteristics	Regulation Tests	Protection Tests

Output Performances
1. Output voltage
2. Output current
3. Ripple Current (RMS & p-p)
4. Efficiency
5. In-test adjustment

Input Characteristics
6. Input Inrush Current
7. Input RMS Current
8. Input Peak Current
9. Input Power
10. Current Harmonics
11. Input Power Factor
12. Input Voltage Ramp
13. Input Freq.Ramp
14. AC Cycle Drop Out
15. PLD Simulation

Regulation Tests
16. Current Regulation
17. Voltage Regulation
18. Total Regulation

Timing & Transient
19. Turn ON Time
20. Hold Up Time

Protection Tests
21. Short Circuit
22. OV Protection
23. OL Protection
24. OP Protection

Special Tests
25. GPIB Read/Write
26. RS232 Read/Write

Software Platform of ATS

The Model 8000 Test Systems include the industries most sophisticated power supply testing software platform, PowerPro III. PowerPro III provides users with an open software architecture suited for a wide range of applications and devices.
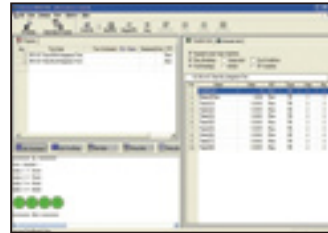
Power Pro III is a Windows 98/NT/2000/XP environment, which provides necessary computer peripherals.
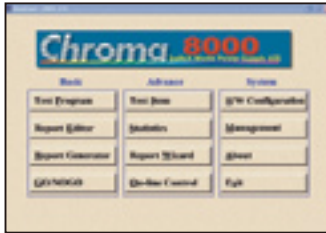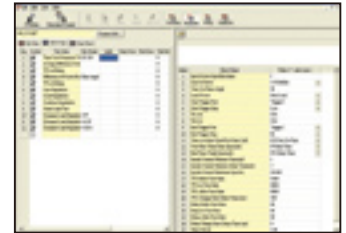

Software Main Screen
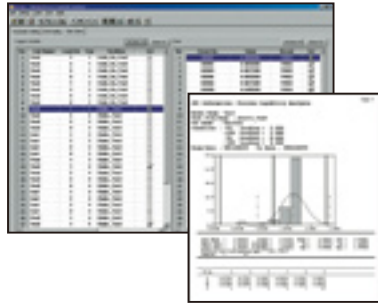
Statistical Report

Running GO/NOGO

Test Program Editing

Ordering Information

Programmable AC sources

61501 : Programmable AC Source 0~300V, 15~1kHz / 500VA, 1φ
61502 : Programmable AC Source 0~300V, 15~1kHz / 1KVA, 1φ
61503 : Programmable AC Source 0~300V, 15~1kHz / 1.5KVA, 1φ
61504 : Programmable AC Source 0~300V, 15~1kHz / 2KVA, 1φ
61505 : Programmable AC Source 0~300V, 15~1kHz / 4KVA, 1φ
A615001 : Remote Interface Board for Model 61501~61505 Series (External V Input, RS-232 Interface, GPIB Interface)
A610004 : Universal Socket Center for Model 61501/61502/ 61503/61504/61505 Series
A615007 : Softpanel for Model 61501~61505 Series
A615008 : DC Noise Filter (Max. 16A)

Digital Power Meters

66201 : Digital Power Meter
66202 : Digital Power Meter
A662001 : USB Remote Interface Board
A662002 : GPIB+USB Remote Interface Board
A662003 : Measurement Test Fixture (250V/15A)
A662005 : USB Cable (180cm)
A662008 : Power Efficiency Test Softpanel
A662009 : Softpanel for Model 66200 Series

Programmable DC Electronic Loads

6312A : Mainframe for 2 Load Modules
6314A : Mainframe for 4 Load Modules
63110A : Load Module 2A/300V/100Wx2 channels
A630002 : GPIB Interface for Model 6314A/6312A Mainframe
A631003 : USB Interface for Model 6314A/6312A Mainframe
A631001 : Remote Controller
A631002 : Test Fixture
A631005 : Softpanel for Model 6310A series

LED Driver Automatic Test Systems

8000: LED Driver ATS
8020: LED Driver ATS

Chroma