Programmable D.C. Electronic Load

PEL-2000A Series

CE RS-232 GPIB USB LabVIEW Driver

The PEL-2004A and PEL-2002A are multiple channel, programmable DC electronic loads with a modularized structure. The PEL-2000A Series is designed to meet the continuing shift toward high speed operation in today's semiconductor market. As the power supply units, DC-DC converters, and batteries that drive semiconductor circuits need to follow this shift, power supply design, quality inspection and characteristic certification using high-speed performance loads have become necessary. The PEL-2000A Series includes two types of mainframes and 4 types of load modules to accommodate users' requirements in a flexible manner. Any load module combination can be used with a mainframe to tailor a test system based on the number of channels, and the maximum load power, voltage and current of each channel. Multiple loads can be connected in parallel to provide a higher-power load to test higher power supply outputs. This flexibility significantly reduces the investment needed for future projects that have differed power requirements.

PEL-2004A is a 4-slot mainframe with a master control unit to hold 4 load modules, while PEL-2002A is a 2-slot mainframe with master control unit to hold 2 load modules. When PEL-2004A is configured with 4 load modules rated at 350W each, the PEL-2000A series is able to sink up to 1.4kVA of power.

For higher load capacities, mainframes can be linked together in parallel with standard MIL 20-pin connectors. A maximum of 5 mainframes, including one master and 4 slaves can be chained together to create a total load capacity of 7kW for high current and high power applications. Using 4 dual channel load modules, PEL-2004A is able to test 8 power supply outputs simultaneously.

The Sequence function allows each channel to change its load sink according to a predefined sequence at a rate of up to $100\mu s$ per step. Each sequence is able to run concurrently, under the control of one clock. This is one of the most powerful features of the PEL-2000A Series as it is able to realistically simulate a multi-output power supply load. Under Dynamic mode, the load current or load resistance pulses between two preset levels at a pre-defined speed up to $25\mu s$ per step. This is often used as the standard test procedure to verify the response of a power supply to quick load changes. Most remarkably, multiple load channels can be connected in parallel to run Dynamic tests synchronously under a single clock. This Parallel Dynamic functionality gives the flexibility to perform dynamic tests for a high-power power supply without the need of another high-power load.

The PEL-2000A Series includes a number of protection modes: Over Current Protection (OCP), Over Voltage Protection (OVP), Over Power Protection (OPP), Reverse Voltage Protection (RVP), and Under Voltage Protection(UVP). The protection modes are useful to protect both the load modules and the DUT(s). A buzzer can be set for when a protection setting has been tripped. When a protection mode has been tripped, the load unit will display an alarm and stop sinking current/voltage. When a load unit is operating in CR or CV mode, the unit may need Over Current Protection to prevent excessive current being sunk. Over Current Protection stops the load from sinking more current than its recommended limit and prevents the load from burn-out damage. Over Voltage Protection is used to limit the amount of voltage sunk. If the OVP trips, the PEL-Series load will stop sinking voltage. Over Power Protection is used when the input power exceeds the specifications of the load. When OPP is tripped, the power will cease to be sunk. Reverse Voltage Protection prevents reverse voltage damage to the PEL-2000A Series up to the specified rating. When Reverse Voltage Protection has been tripped, an alarm tone will sound until the reverse voltage is removed. Under Voltage Protection will turn off the load when the voltage drops below a set limit.

The Go/NoGo function is available to monitor test results all the time. When a test result goes beyond a preset limit range, a "No Go" indication will be shown on the display and a "No Go" signal can be sent out through the D-SUB interface for external device control. This Go/NoGo function is available for CC mode, CV mode and CR mode. Under "Program" mode, 12 programs each containing 10 panel-setup memories, can be edited to create work routines for repetitive tests. After a program has been executed, the results of all test steps, along with the Go/NoGo judgments, will be shown on the screen. For external control and system configuration, the PEL series has USB and RS232 interfaces as standard and GPIB as an option. The LabView driver and Data Logging PC software are both supported for all the available interfaces. Each channel has an analog control/monitoring connector on the rear panel to externally turn a load on/off and to externally monitor load input current and voltage.

Rear Panel

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PEL--2000A Series

SPECIFICATIONS

	PEL-2020A		PEL-2030A		
CHANNEL	L/R	L/R	Left	Right	Right
RANGE	Low	High	N/A	Low	High
POWER	100W	100W	30W	250W	250W
CURRENT	0~2A	0~20A	0~5A	0~4A	0~40A
VOLTAGE	0~80V	0~80V	1~80V	1~80V	1~80V
MIN.OPERATING VOLTAGE(DC)	0.4V at 2A	0.8V at 20A	0.8V at 5A	0.4V at 4A	0.8V at 40A
(Typ.)	0.2V at 1A	0.4V at 10A	0.4V at 2.5A	0.2V at 2A	0.4V at 20A

STATIC MODE

CONSTANT CURRENT MODE					
Operating Range	0~2A	0~20A	0~5A	0~4A	0~40A
Setting Range	0~2.04A	0~20.4A	0~5.1A	0~4.08A	0~40.8A
Resolution	0.1mA	1mA	0.125mA	0.1mA	1mA
Accuracy	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.2%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.1%F.S.)	±(0.1%set + 0.2%F.S.)

CONSTANT RESISTANCE MODE				
Operating Range	0.075Ω~300Ω(100W/16V) 3.75Ω~15K(100W/80V)	0.3Ω~1.2KΩ(30W/16V) 15Ω~60K(30W/80V)	0.0375Ω~150Ω(250W/16V) 1.875Ω~7.5K(250W/80V)
Setting Range	0.075Ω~300Ω(100W/16V) 3.75Ω~15K(100W/80V)	0.3Ω~1.2KΩ(30W/16V) 15Ω~60K(30W/80V)	0.0375Ω~150Ω(250W/16V) 1.875Ω~7.5K(250W/80V)
Resolution	0.333mS(100W/16V) 6.667μS(100W/80V)	83.333(30W/16V) 1.666μS(30W/80V)	0.666mS(250W/16V) 13.333μS(250W/80V)
Accuracy (with ≥ 2.5V at input)	300Ω: ±(0.2%set+0.1S) 15KΩ: ±(0.1%set+0.01S)	1.2KΩ:±(0.2%set+0.1S) 60KΩ:±(0.1%set+0.01S)	150Ω:±(0.2%set+0.1S) 7.5KΩ:±(0.1%set+0.01S)

CONSTANT VOLTAGE+CONSTANT CURRENT MODE			
Operating Range	1~80V		
Setting Range	0~81.6V		
Resolution	2mV		
Accuracy	±(0.05%set + 0.1%F.S.)		
Current Setting Range	0~20A	0~5A	0~40A
Resolution	1mA	0.125mA	1mA
Accuracy	±(0.1%set + 0.2%F.S)		

CONSTANT POWER MODE					
Operating Range*	1~10W	1~100W	1~30W	1~25W	1~250W
Setting Range	0~10.2W	0~102W	0~30.6W	0~25.5W	0~255W
Resolution	1mW	10mW	1mW	1mW	10mW
Accuracy	±(0.5%set + 0.5%F.S)	±(0.5%set + 0.5%F.S)	±(0.5%set + 0.5%F.S)	±(0.5%set + 0.5%F.S)	±(0.5%set + 0.5%F.S)

DYNAMIC MODE

T1&T2				
	0.025mS~10mS/Res:1μS 10mS~30S/Res:1mS	0.025mS~10mS/Res:1μS 10mS~30S/Res:1mS		
Accuracy	1μS/1mS ± 100ppm	1μS/1mS ± 100ppm		

CONSTANT CURRENT MODE					
Slew Rate (±10%set+15μS)	0.32~80mA/μS	3.2~800mA/μS	0.8~200mA/μS	0.64~160mA/μS	6.4~1600mA/μS
Slew Rate Resolution	0.32mA/μS	3.2mA/μS	0.8mA/μS	0.64mA/μS	6.4mA/μS
Slew Rate Accuracy of Setting	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)
Current Settong Range	0~2A	0~20A	0~5A	0~4A	0~40A
Current Resolution	0.1mA	1mA	0.125mA	0.1mA	1mA
Current Accuracy	±0.4% F.S.	±0.4% F.S.	±0.4%F.S.	±0.4%F.S.	±0.4%F.S.

CONSTANT RESISTANCE MODE					
Slew Rate	0.32~80mA/μS	3.2~800mA/μS	0.8~200mA/μS	0.64~160mA/μS	6.4~1600mA/μS
Slew Rate Resolution	0.32mA/μS	3.2mA/μS	0.8mA/μS	0.64mA/μS	6.4mA/μS
Slew Rate Accuracy of setting	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)
Resistance Setting Range	0.075Ω~300KΩ(100W/16V) 3.75Ω~15K(100W/80V)		0.3Ω~1.2KΩ(30W/16V) 15Ω~60K(30W/80V)	0.0375Ω~150KΩ(250W/16V) 1.875Ω~7.5K(250W/80V)	
Resistance Resolution	0.333mS(100W/16V) 6.667μS(100W/80V)		83.333mS(30W/16V) 1.666μS(30W/80V)	0.666mS(250W/16V) 13.333μS(250W/80V)	
Resistance Resolution Resistance Accuracy	300Ω:±(0.5%set+0.1S) 15KΩ:±(0.5%set+0.01S)		1.2KΩ:±(0.5%set+0.1S) 60KΩ:±(0.5%set+0.01S)	150Ω:±(0.5%set+0.1S) 7.5KΩ:±(0.5%set+0.01S)	

MEASUREMENT

VOLTAGE READBACK					
Range	0~16V	0~80V	0~16V,0~80V	0~16V	0~80V
Resolution	0.32mV	1.6mV	0.32mV,1.6mV	0.32mV	1.6mV
Accuracy	±(0.025%set + 0.025%F.S.)				

CURRENT READBACK					
Range	0~2A	0~20A	0~5A	0~4A	0~40A
Resolution	0.04mA	0.4mA	0.1mA	0.08mA	0.8mA
Accuracy	±(0.05%set + 0.05%F.S.)				

POWER READBACK				
Range	0~10W	0~100W	0~30W	0~25W	0~250W
Accuracy	±(0.1%set + 0.1%F.S.*1)			*1 : Power F.S.=Vrange F.S. x Irange F.S.	

PROTECTION

OVER POWER PROTECTION			
Range	1~102W	1~30.6W	1~255W
Resolution	0.5W	0.15W	1.25W
Accuracy	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)
OVER CURRENT PROTECTION			
Range	0~20.4A	0~5.1A	0~40.8A
Resolution	0.05A	0.0125A	0.1A
Accuracy	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)
OVER VOLTAGE PROTECTION			
Range	1~81.6V	1~81.6V	1~81.6V
Resolution	0.2V	0.2V	0.2V
Accuracy	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)	±(2%set+0.25%F.S.)
Over Temperature Protection	≒85℃	≒85℃	≒85℃
RATED POWER PROTECTION			
Value	110W	33W	275W
Accuracy	±(2%set)	±(2%set)	±(2%set)

GENERAL

SHORT CIRCUIT					
Current(CC)	≒2.2/2A	≒22/20A	≒5.5/5A	≒4.4/4A	≒44/40A
Voltage(CV)	0V	0V	0V	0V	0V
Resistance(CR)	≒3.75Ω	≒0.075Ω	≒15Ω ,≒0.3Ω	≒1.875Ω	≒0.0375Ω

INPUT RESISTANCE(LOAD OFF)	
	500KΩ(Typical)

POWER SOURCE	AC100V ~ 230V ± 10% ; 50Hz / 60Hz ±2Hz
WEIGHT	Approx. 3.8 kg
DIMENSIONS & WEIGHT(PEL-2002A)	272(W) x 200(H) x 581(D) mm ; Approx. 16.1kg(full modules)
DIMENSIONS & WEIGHT(PEL-2004A)	435(W) x 200(H) x 581(D) mm ; Approx. 24.8kg(full modules)

SPECIFICATIONS

	PEL-2040A		PEL-2041A	
CHANNEL	One channel	One channel	One channel	One channel
RANGE	Low	High	Low	High
POWER	350W	350W	350W	350W
CURRENT	0~7A	0~70A	0~1A	0~10A
VOLTAGE	0~80V	0~80V	0~500V	0~500V
MIN.OPERATING VOLTAGE(DC)	0.4V at 7A	0.8V at 70A	0.4V at 1A	0.8V at 10A
(Typ.)	0.2V at 3.5A	0.4V at 35A	0.2V at 0.5A	0.4V at 5A

STATIC MODE

	PEL-2040A		PEL-2041A	
CONSTANT CURRENT MODE				
Operating Range	0~7A	0~70A	0~1A	0~10A
Setting Range	0~7.14A	0~71.4A	0~1.02A	0~10.2A
Resolution	0.2mA	2mA	0.05mA	0.5mA
Accuracy	±(0.1%set +0.1%F.S.)	±(0.1%set +0.2%F.S.)	±(0.1%set+0.1%F.S.)	±(0.1%set+0.2%F.S.)
CONSTANT RESISTANCE MODE				
Operating Range	0.025Ω~100Ω(350W/16V) 1.25Ω~5K(350W/80V)		1.25Ω~5KΩ(350W/125V) 50Ω~200K(350W/500V)	
Setting Range	0.025Ω~100Ω(350W/16V) 1.25Ω~5K(350W/80V)		1.25Ω~5Ω(350W/125V) 50Ω~200K(350W/500V)	
Resolution	1mS(350W/16V) 20μS(350W/80V)		20μS(350W/125V) 0.5μS(350W/500V)	
Accuracy (with ≥ 2.5V at input)	100Ω: ±(0.2%set+0.1S) 5KΩ: ±(0.1%set+0.01S)		5KΩ:±(0.2%set+0.02S) 200KΩ:±(0.1%set+0.005S)	
CONSTANT VOLTAGE+CONSTANT CURRENT MODE				
Operating Range	1~80V		2.5~500V	
Setting Range	0~81.6V		0~510V	
Resolution	2mV		10mV	
Accuracy	±(0.05%set + 0.1%F.S.)		±(0.05%set + 0.1%F.S.)	
Current Setting Range	0~70A		0~10A	
Resolution	2mA		0.5mA	
Accuracy	±(0.1%set + 0.2%F.S)			
CONSTANT POWER MODE				
Operating Range*	1~35W	1~350W	1~35W	1~350W
Setting Range	0~35.7W	0~357W	0~35.7W	0~357W
Resolution	1mW	10mW	1mW	10mW
Accuracy	±(0.5%set+0.5%F.S)	±(0.5%set+0.5%F.S)	±(0.5%set+0.2%F.S.)	±(0.5%set+0.5%F.S.)

DYNAMIC MODE

	PEL-2040A		PEL-2041A	
T1&T2	0.025mS~10mS/Res:1μS 10mS~30S/Res:1mS		0.025mS~10mS/Res:1μS 10mS~30S/Res:1mS	
Accuracy	1μS/1mS±100ppm		1μS/1mS±100ppm	
CONSTANT CURRENT MODE				
Slew Rate (±10%set+15μS)	0.001~0.28A/μS	0.01~2.8A/μS	0.16~40mA/μS	1.6~400mA/μS
Slew Rate Resolution	0.001A/μS	0.01A/μS	0.16mA/μS	1.6mA/μS
Slew Rate Accuracy of Setting	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)
Current Settong Range	0~7A	0~70A	0~1A	0~10A
Current Resolution	0.2mA	2mA	0.05mA	0.5mA
Current Accuracy	±0.4% F.S.	±0.4% F.S.	±0.4%F.S.	±0.4%F.S.
CONSTANT RESISTANCE MODE				
Slew Rate	0.001~0.28A/μS	0.01~2.8A/μS	0.16~40mA/μS	1.6~400mA/μS
Slew Rate Resolution	0.001A/μS	0.01A/μS	0.16mA/μS	1.6mA/μS
Slew Rate Accuracy of setting	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)	±(10%+15μs)
Resistance Setting Range	0.025Ω~100Ω(350W/16V) 1.25Ω~5K(350W/80V)		1.25Ω~5KΩ(350W/125V) 50Ω~200K(350W/500V)	
Resistance Resolution	1mS(350W/16V) 20μS(350W/80V)		20μS(350W/125V) 0.5μS(350W/500V)	
Resistance Resolution Resistance Accuracy	100Ω:±(0.5%set + 0.1S) 5KΩ:±(0.5%set + 0.01S)		5KΩ:±(0.5%set + 0.02S) 200KΩ:±(0.5%set + 0.005S)	

MEASUREMENT

	PEL-2040A		PEL-2041A	
VOLTAGE READBACK				
Range	0~16V	0~80V	0~125V	0~500V
Resolution	0.32mV	1.6mV	2.5mV	10mV
Accuracy	±(0.025%set + 0.025%F.S.)			
CURRENT READBACK				
Range	0~7A	0~70A	0~1A	0~10A
Resolution	0.14mA	1.4mA	0.02mA	0.2mA
Accuracy	±(0.05%set + 0.05%F.S.)			
POWER READBACK				
Range	0~35W	0~350W	0~35W	0~350W
Accuracy	±(0.1%set + 0.1%F.S.*1)		*1 : Power F.S.=Vrange F.S. x Irange F.S.	

PROTECTION

	PEL-2040A		PEL-2041A	
OVER POWER PROTECTION				
Range	1~357W		1~357W	
Resolution	1.75W		1.75W	
Accuracy	±(2%set+0.25%F.S.)		±(2%set+0.25%F.S.)	
OVER CURRENT PROTECTION				
Range	0~71.4A		0~10.2A	
Resolution	0.175A		0.025A	
Accuracy	±(2%set+0.25%F.S.)		±(2%set+0.25%F.S.)	
OVER VOLTAGE PROTECTION				
Range	1~81.6V		1~510V	
Resolution	0.2V		1.25V	
Accuracy	±(2%set+0.25%F.S.)		±(2%set+0.25%F.S.)	
Over Temperature Protection	≒85℃		≒85℃	
RATED POWER PROTECTION				
Value	385W		385W	
Accuracy	±(2%set)		±(2%set)	

GENERAL

	PEL-2040A		PEL-2041A	
SHORT CIRCUIT				
Current(CC)	≒7.7/7A	≒77/70A	≒1.1/1A	≒11/10A
Voltage(CV)	0V	0V	0V	0V
Resistance(CR)	≒1.25Ω	≒0.025Ω	≒15Ω , ≒50Ω	≒1.25Ω
INPUT RESISTANCE(LOAD OFF)				
	500KΩ(Typical)			
POWER SOURCE	AC100V ~ 230V ± 10% ; 50Hz / 60Hz ± 2Hz			
WEIGHT	Approx. 3.8 kg			
DIMENSIONS & WEIGHT(PEL-2040A)	272(W) x 200(H) x 581(D) mm ; Approx. 16kg(full modules)			
DIMENSIONS & WEIGHT(PEL-2041A)	435(W) x 200(H) x 581(D) mm ; Approx. 28.4kg(full modules)			

Specifications subject to change without notice.   EL-2000AGD1DH

## MODULARIZED STRUCTURE/PROGRAM & INTERFACE

Modularized Structure

PEL-2004A is a 4-slot mainframe with a master control unit made to hold 4 load modules, and PEL-2002A is a 2-slot mainframe with a master control unit made to hold 2 load modules. The modularized structure of the PEL-2000A Series allows any combination of mainframe and load module (PEL-2020A, PEL-2030A, PEL-2040A, PEL-2041A) to be integrated into a custom-tailored system.

Multiple loads within the same mainframe can be connected in parallel to perform both static and dynamic tests. This flexibility makes the PEL-2000A Series a very cost-effective instrument for testing a broad range of power supply outputs.

Program & Interface

The PEL-2000A Series supports a total of 12 different programs and 10 sequences to each program. With a total of up to 120 different configurations. For external control and system configuration, the PEL-Series has USB and RS-232 interfaces as standard and GPIB as an option. The LabView driver and Data Logging PC software are supported for all the interfaces available. Each channel has an analog control/monitoring connector to externally turn a load on/off and to externally monitor load input current and voltage.

AUTOMATICALLY SEQUENCE FUNCTION
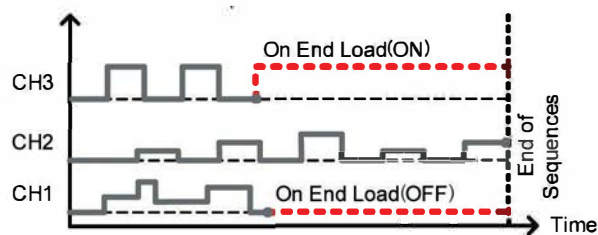
Sequence - On End Load
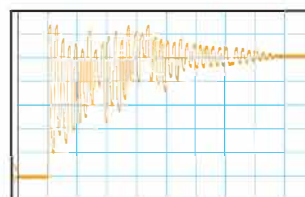
The figure above shows the current waveform of a simulation using the sequence function.

The Sequence function allows each channel to change its load sink according to a predefined sequence at a rate of up to 100μs per step. Each sequence is able to run concurrently, under the control of one clock. This is one of the most powerful features of the PEL-2000A Series as it is able to realistically simulate a multi-output power supply load. Under Dynamic mode, the load current or load resistance pulses between two preset levels at a pre-defined speed up to 25μs per step. This is often used as the standard test procedure to verify the response of a power supply to quick load changes.

The picture above is an example of a sequence used as a load profile for a single output switching power supply. A load profile is programmed to simulate the current drawn of a power supply load.
By using a current probe to acquire a current waveform, PEL-2000A is able to evaluate the performance of a power supply based on the load sequence that is programmed. An oscilloscope is then used to display the result.

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