ADDENDUM
to the
HP Model 66309B, 66309D User's Guide

Output Control Enhancements (Option 521)

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HP Option 521 Description

Option 521 consists of several enhancements to the output capabilities of the following dc source models:
HP 66309B Mobile Communications DC Source
HP 66309D Mobile Communications DC Source

HP 66309D DVM Enhancement

- To facilitate the measurement of floating voltages with the DVM, the minus input terminal of the DVM has been referenced to the minus terminal of output 1 with a 680K ohm resistor.

General Output Enhancements (Output 1 and Output 2)

- **Independent ON/OFF control of output 1 and output 2.**
  The outputs are set to independent ON/OFF control when shipped from the factory. For backwards compatibility, output on/off control can be coupled (see INSTrument:COUPle:OUTput:STATe).
- **Solid-state relays to connect and disconnect the output of the dc source.**
  The relays are available on the output and sense terminals of outputs 1 and 2. When the solid state relays are open, the output impedance is effectively raised to about 500k ohms for output 1, and about 200k ohms for output 2. Note that the relays disconnect the output only in response to an Output OFF command.
- **The ability to either hot switch or dry switch the solid state relays.**
  With Hot switching, the relays control the on/off characteristics of the voltage at the output terminals. With dry switching, the power mesh controls the on/off characteristics of the voltage at the output terminals. In general, Hot switching activates the relays when current is flowing through them. Dry switching activates the relays when no current is flowing through them. You can specify different relay options for the Output ON and Output OFF commands. The following table describes the actions that occur based on the relay mode selection in response to the ON or OFF commands.

Relay Mode	Output ON	Output OFF
Dry (D)	1. Closes the output relay 2. Closes the sense relay 3. Programs the output	1. Downprograms the output 2. Opens the sense relay 3. Opens the output relay
Hot (H)	1. Programs the power mesh 2. Closes the output relay 3. Closes the sense relay	1. Opens the sense relay 2. Opens the output relay 3. Downprograms the power mesh

The relay modes are stored in non-volatile memory and the last selected mode will be restored when the unit is turned on. When shipped from the factory, the relay mode for both output 1 and output 2 is set to Output ON Hot, Output OFF Hot (HH). The *RST command has no effect on the relay mode.

NOTES:

Even with open sense lead detection enabled, the dc source does not check for open sense leads when output 1 is enabled if the Output ON relay mode is set to Hot.

On output 1 and output 2, with the Output OFF relay mode set to Hot, any external output capacitors will not be downprogrammed or discharged. This is because the output relay opens prior to the downprogramming of the power mesh.

With either output 1 or output 2 disabled, the output voltage readback will not be correct. This is because the sense relay is open, effectively breaking the readback path. The voltage readback will be a small negative number.

- **An additional output compensation mode (H2) for Output 1 that guarantees that the unit stays in High compensation mode at all times.**
  Option 521 units are shipped with the output compensation set to High mode. Units set to High mode, will automatically switch to *Low* compensation mode if the unit senses that there is no load on the output (see OUTPut:TYPE[:CAP]). H2 compensation mode may be optimal in cases where a large capacitor is connected across the phone input and output 1 is sinking current. Call the Hewlett-Packard factory for application details.

Output 2 Enhancements

- **A downprogramming circuit that causes the output voltage to fall from its programmed setting to less than 2 volts in approximately 200 microseconds.**
  This occurs when output 2 is turned off (Output OFF) with the Output OFF relay mode set to Dry.
- **The 10%-to-90% up-programming speed has been decreased to less than 200 microseconds for applications that require a more rapid rise of output voltage.**
  This occurs automatically when output 2 is turned on (Output ON) with the Output ON relay mode set to Dry. It also occurs whenever any VOLT commands are given.
- **Circuitry to lower the transient undershoot voltage on output 2 when the output load or output current is suddenly removed.**
  This capability is critical in applications where the load lines have several ohms of resistance, as may be the case if relays are connected in series with the load leads.

Factory Shipped Settings

Output Coupling	None (outputs not coupled)
Output Sense Protection	Off
Output Compensation	High
Output 1 Relay Mode	HH
Output 2 Relay Mode	HH

Option 521 Characteristics

The following tables document the Option 521 characteristics.

Output 1 Supplemental Characteristics

Output Impedance	Output = OFF	500k ohms
Solid State Relay Current rise time (from 10% to 90% of the total output change)	Relay mode =Hot	100 microseconds
Solid State Relay Current fall time (from 10% to 90% of the total output change)	Relay mode =Hot	50 microseconds

Output 2 Performance Specifications (changes)

Ripple and Noise (in the range of 20Hz to 20 MHz)	Voltage (rms/p-p)	1.5 mV/10 mV

Output 2 Supplemental Characteristics

Output Down-programming speed (from 90% to 10% of the total output change)	Output = OFF Relay mode =Dry	200 microseconds
Output Up-programming speed (from 10% to 90% of the total output change)	Output = ON Relay mode =Dry	200 microseconds
Output Impedance	Output = OFF	200k ohms
Solid State Relay Current rise time (from 10% to 90% of the total output change)	Relay mode =Hot	100 microseconds
Solid State Relay Current fall time (from 10% to 90% of the total output change)	Relay mode =Hot	50 microseconds

Front Panel Menus - Additions

The following menu commands have been added for Option 521. All other front panel commands function as documented in the User's Guide. In most cases you will need to press the ▼ key multiple times to access the menu item.

Output On/Off		Toggles the output of the selected output between the ON and OFF states. When coupled, turns both output channels ON or OFF
Output ▼	*COUPLING NONE*	Couples or decouples Output 1 and Output 2 (NONE or ALL)
▼	*[1]REL:MODE DD*	Specifies the output relay mode (DD, HD, DH, or HH). See OUTP:REL:MODE. The relay mode of output 1 and output 2 must be set separately. Note that the output must be turned off before this command can take effect.
▼	*TYPE:CAP H2*	Specifies High 2 output compensation. This mode guarantees that the unit stays in High compensation mode at all times. Call the Hewlett-Packard factory for further details.

SCPI Programming Commands - Additions

The following SCPI commands have been added or modified for Option 521. Provided that the output coupling is set to NONE, all other SCPI commands function as documented in the User's Guide.

OUTPut [1|2]

[:STATe] <bool>	Turns the selected output channel ON or OFF. Applies to channel 1 if no channel is selected. Applies to both channels if output coupling = ALL[1].
RELay:	
MODE <mode>	Specifies the output relay mode (DD, HD, DH, or HH). The Output ON mode is specified first, followed by the Output Off mode.
TYPE[:CAP] <mode>	Specifies the output compensation (HIGH, LOW, or H2). H2 guarantees that the unit stays in High compensation mode at all times.

INSTrument

:COUPling	
:OUTPut	
:STATe <state>	Couples or decouples output channels 1 and 2. (ALL or NONE) [1]

[1]When output coupling is set to ALL, any of the above OUTPut commands turn both output channels ON or OFF.

Front Panel Programming

Independently Controlling Output 1 and Output 2

	Action	Display
1.	Press **Meter** to return the display to Meter mode.	
2.	Press **Shift Channel** to toggle between output 1 and output 2. The left-most digit of the front panel display identifies the output channel that is presently being controlled by the front panel. It will indicate a "1" for output 1, or a "2" for output 2.	[1]3.6V 2.04A [2]7.5V 1.04A
3.	Press **Output ON/OFF** to turn the output of the selected output channel on or off.	

Coupling Output 1 and Output 2

	Action	Display
1.	On the Function keypad, press **OUTPUT**. Then scroll to the **COUPLING** command. To couple the outputs, use the 🡻 numeric key to select **ALL**, then press **Enter**.	COUPLING ALL

Setting the Relay Mode

	Action	Display
1.	Press **Meter** to return the display to Meter mode.	
2.	Press **Shift Channel** to select either output channel 1 or output channel 2.	[1]3.6V 2.04A [2]7.5V 1.04A
3.	On the Function keypad, press **OUTPUT**. Then scroll to the **REL:MODE** command. Use the 🡻 numeric key to select one of the relay modes (DD, DH, HD, or HH) then press **Enter**. Relay settings cannot be coupled; they must be set separately for each output.	[2]REL:MODE HH
4.	Press **Output ON/OFF** to turn the output of the selected output channel off. The output must be turned off before any relay settings take effect.	

Additional SCPI Commands

OUTPut[1 | 2]

This command enables or disables either output 1 or output 2. If no output channel is specified, the command applies to output channel 1. The state of a disabled output is a condition of zero output volts with the output relays open. If outputs 1 and 2 are coupled, all OUTPut commands will turn both outputs ON or OFF together.. Refer to INSTrument:COUPle:OUTput:STATe.

Command Syntax	OUTPut[1|2][:STATe] <bool>
Parameters	0 | OFF | 1 | ON
***RST Value**	0
Examples	`OUTP1 ON  OUTP2 OFF`
Query Syntax	OUTPut[1|2][:STATe]?
Returned Parameters	<NR1>0 or 1

INSTrument:COUPle:OUTPut:STATe

Couples Output 1 and Output 2. When outputs 1 and 2 are coupled, **ALL** OUTPut commands will turn both outputs ON or OFF together. When not coupled, use the OUTPut1 or OUTPut2 commands to turn the specified output ON or OFF individually.

Command Syntax INSTrument:COUPle:OUTPut:STATe <state>
Parameters ALL | NONE
***RST Value** NONE
Examples `INST:COUP:OUTP:STAT ALL`
Query Syntax INSTrument:COUPle:OUTPut:STATe?
Returned Parameters <CRD>

To have the unit turn on with the outputs coupled, set the output coupling to ALL, save this state in location 0, and set the power-on state to RCL 0. However, when an output state is recalled, the outputs are set to the state in which they were in when the state was saved, regardless of the output coupling setting.

OUTPut[1 | 2]:RELay:MODE

Specifies one of the relay modes (DD, DH, HD, or HH). The output must be turned off before any programmed mode settings take effect. Relay settings cannot be coupled; they must be set separately for each output. Relay modes are stored in non-volatile memory and will be restored when the unit is turned on. When shipped from the factory, the relay mode for both output 1 and output 2 is set to HH.

	Output ON	Output OFF
DD	Dry	Dry
DH	Dry	Hot
HD	Hot	Dry
HH	Hot	Hot

Command Syntax OUTPut[1|2]:RELay:MODE <mode>
Parameters DD | DH | HD | HH
Examples `OUTP:REL:MODE DH` (sets output 1 relay mode DH)
`OUTP2:REL:MODE HH` (sets output 2 relay mode HH)
Query Syntax OUTPut[1|2]:REL:MODE?
Returned Parameters <CRD>

NOTE: When the Output ON relay mode is set to Hot, the dc source does not check for open sense leads when the output is turned on or enabled. This is because with Hot output switching, the output is programmed before the sense relays are closed.
