Keysight Technologies Increase Automotive ECU Test Throughput

Application Note

Description

The automobile electrical system is poorly regulated and subject to frequent dips and overshoots. Voltage can range from 11 to 15 volts under normal conditions and from 8 to 24 volts under transient starting and running conditions. As a result, voltage margin testing is a necessary part of testing Engine Control Units (ECUs) to verify proper operation and tolerance for extreme bias voltage conditions.

KEYSIGHT TECHNOLOGIES

Problem

Every second of test time counts in the competitive automotive electronics marketplace. Testing at multiple bias voltage levels is a necessary, but time consuming part of ECU testing. Most system DC sources available require significant time to change and settle to a new output setting, adding several seconds to the overall test time.

Solution

The Keysight Technologies, Inc. N6700 Modular Power System and N6752A power supply module incorporate features that reduce ECU test time and enhance testing, including:

- The N6752A 50 V, 10 A, 100 W autoranging power supply module features active down programming for fast output downward transitions regardless of load.
- Less than 1 millisecond command processing time reduces test time.
- Less than 4 milliseconds output response time reduces test time.
- Identical modules can be paralleled and operated as a virtual single output for greater output current and power, for testing higher power ECUs.
- Up to four modules fit in the 1-U high mainframe, saving test system space.

ECU Input and Output Characteristics

An ECU takes a myriad of signals monitoring the vehicle and its environment. In turn it manages and controls the engine and ancillary equipment for optimum operation. Figure 1 summarizes the many input and output signals of a typical ECU.

In ECU functional test, appropriate test system resources emulate the various input signals in a controlled manner and load and check the outputs for correct response. It is readily apparent based on the number of inputs and outputs that test system resources for ECU test is quite extensive.

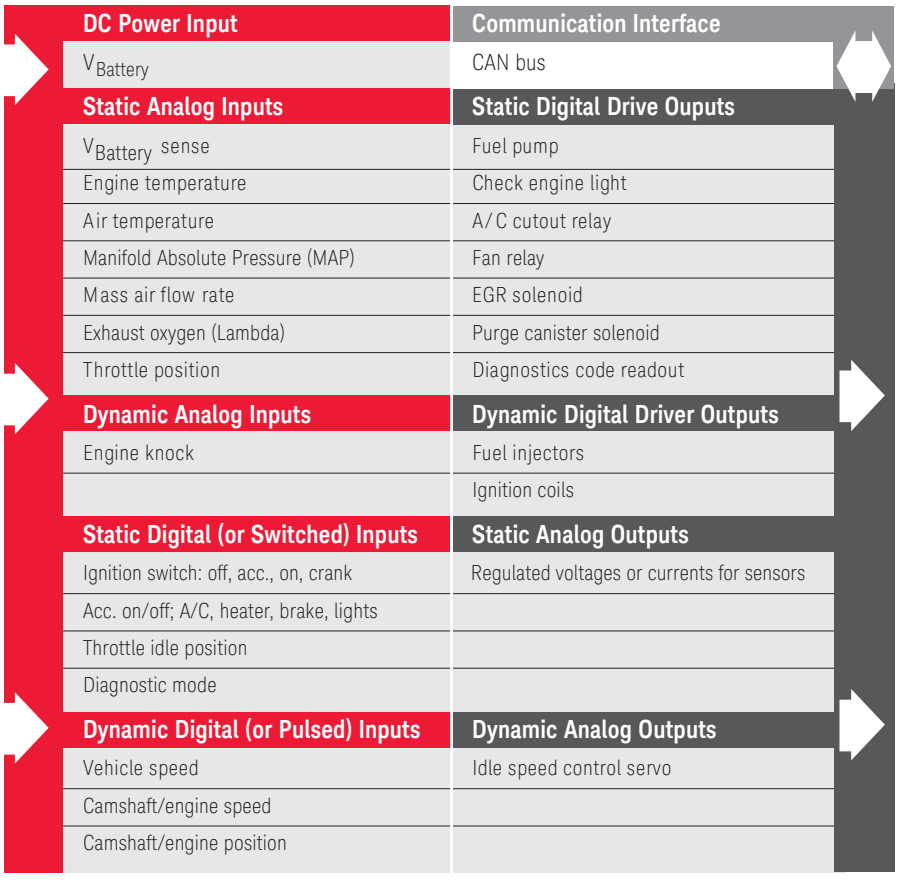


Figure 1. ECU Inputs and Outputs

Key Bias Voltage Levels in Automotive Electrical Systems

Depending on the operating state of the vehicle, certain voltage levels are commonly encountered in an automotive electrical system. These levels become key voltages for ECU test, as illustrated in Figure 2. Some relevant tests at key voltages include:

- Continuity between multiple ground, power and high current driver pins is checked with the power supply set to zero or disabled.
- Shorts or other unexpected faults can be checked by applying a very low voltage and measuring the resultant current.
- Various functional tests are run from a low level of around 8 volts, representing starting, up to high level of around 15 volts, representing full charging conditions.
- The ECU voltage monitor circuit, if included, is calibrated or verified, typically by applying two end-point operating voltages at minimum.
- The ECU low voltage reset level is verified by checking its minimum “must not trip” and maximum “must trip” thresholds.

In all, an ECU may be subjected to up to 20 bias voltage level changes during test.

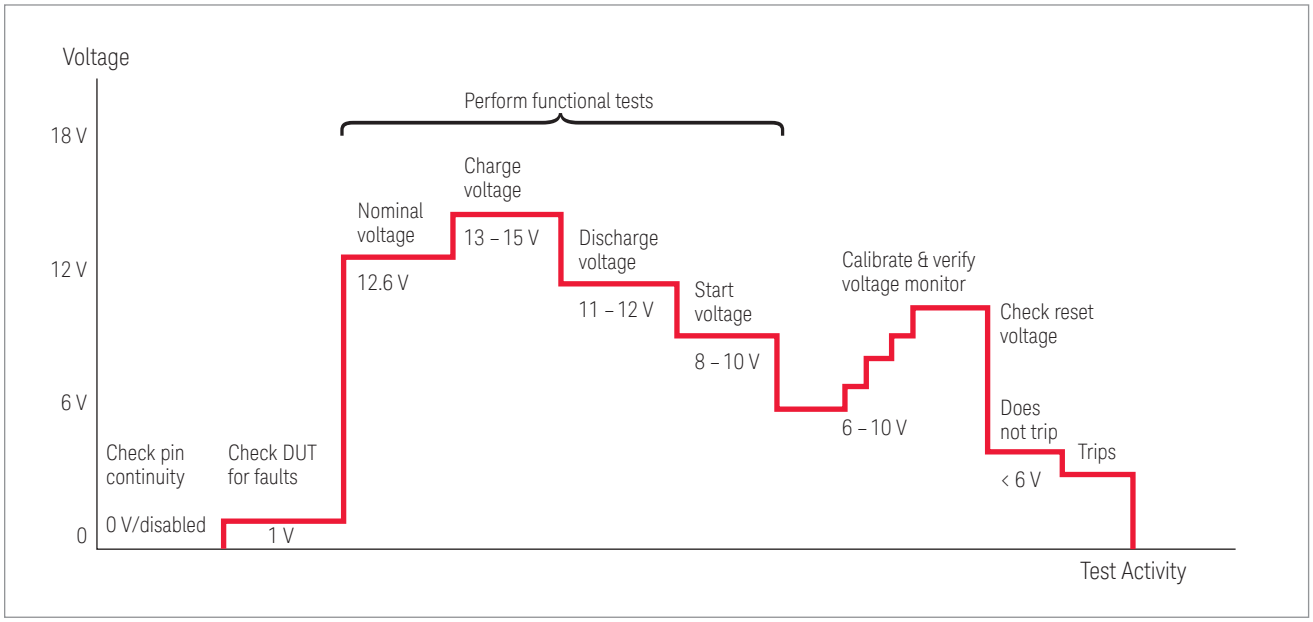


Figure 2. Key Bias Voltage Levels

Power Supply Output Response Time

A few steps occur when changing a power supply output voltage setting to a new value, as depicted in Figure 3. These steps all take a finite amount of time.

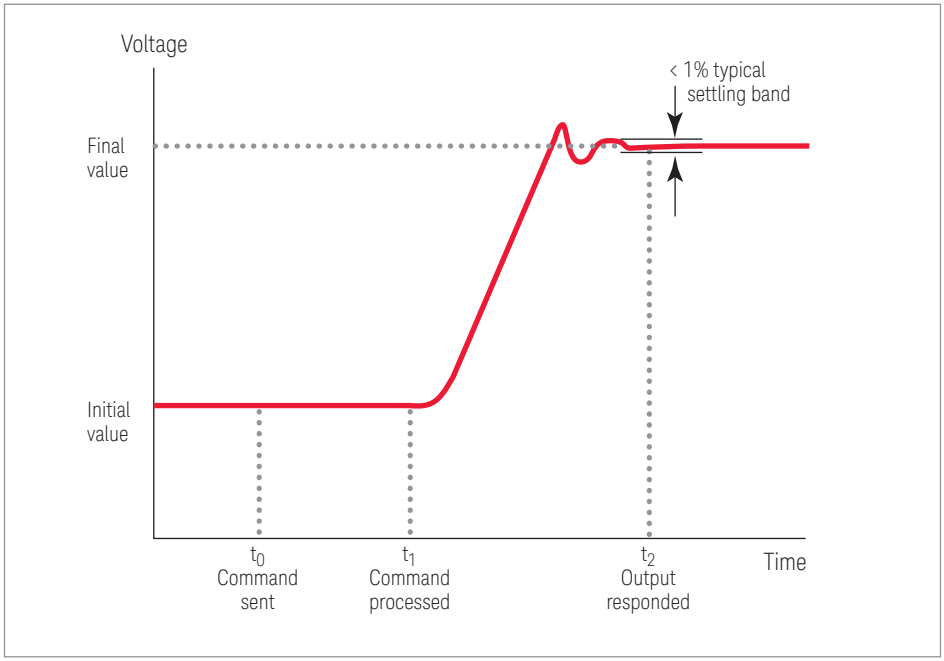


Figure 3. Power Supply Command Processing and Output Response

Once a command is received by the power supply-it must process it; this is its command processing time. The power supply's output then responds and changes to the new setting. The time it takes to reach its final value, within a certain settling band, is its output response time. A 1% settling band is suitable for ECU test.

Table 1: Command Processing and Output Response Times

Parameter	Keysight N6700A/N6752A	Typical System DC Sources
Command Processing Time	< 1 millisecond	20 to 50 milliseconds
Output Response Time	≤ 4 milliseconds to 50 mV	50 to 500 milliseconds to <1%

Table 1 compares the command processing and output response times of many typical programmable power supplies to the N6700 and N6752A. The exceptional speed characteristics are a result of being designed for high throughput test applications.

It is especially important to take note of down programming output response time. Many power supplies depend upon the actual loading of the DUT to bring the voltage down. Under light loading conditions it can take a second or more for some power supplies without down programmers to reach their final value. The N6752A power supply module incorporates an internal down programmer for fast down programming, independent of the load. Both fast up and down programming speed is important in ECU testing.

Throughput Improvement Using Keysight Technologies N6700 Modular Power System and N6752A Power Supply Module

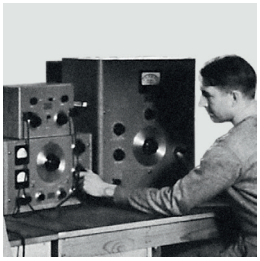
The test time reduction achieved by switching to the N6700 and N6752A from a slower power supply is a product of the command processing and output response time improvement and the number of output voltage transitions. A 200-millisecond time improvement and 15 output transitions yields a 3 second test time reduction. For an ECU having a 20 second test time, this translates to a 15% improvement in throughput. Such an improvement is highly valued by ECU manufacturers, greatly reducing their cost of test and providing immediate benefit.

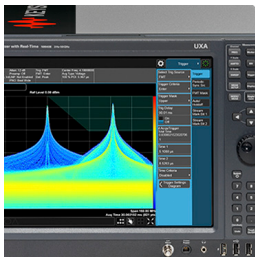
Related Applications

- Automotive Electronic Control Modules (ECMs)
- Automotive Body Electronics
- Automotive Telematics

Evolving Since 1939

Our unique combination of hardware, software, services, and people can help you reach your next breakthrough. We are unlocking the future of technology.
From Hewlett-Packard to Agilent to Keysight.





myKeysight

myKeysight
www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

http://www.keysight.com/find/emt_product_registration
Register your products to get up-to-date product information and find warranty information.

KEYSIGHT SERVICES
Accelerate Technology Adoption.
Lower costs.

Keysight Services
www.keysight.com/find/service
Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—one-stop calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.

CALIBRATION UP TO 10 YEARS WARRANTY
ASSURANCE PLANS

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

This document was formerly known as application note number 1505

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 11 2626
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-9-7-17)

DEKRA Certified
ISO9001 Quality Management System

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015
Quality Management System

KEYSIGHT TECHNOLOGIES

Published in USA, December 1, 2017
5989-1682EN
www.keysight.com