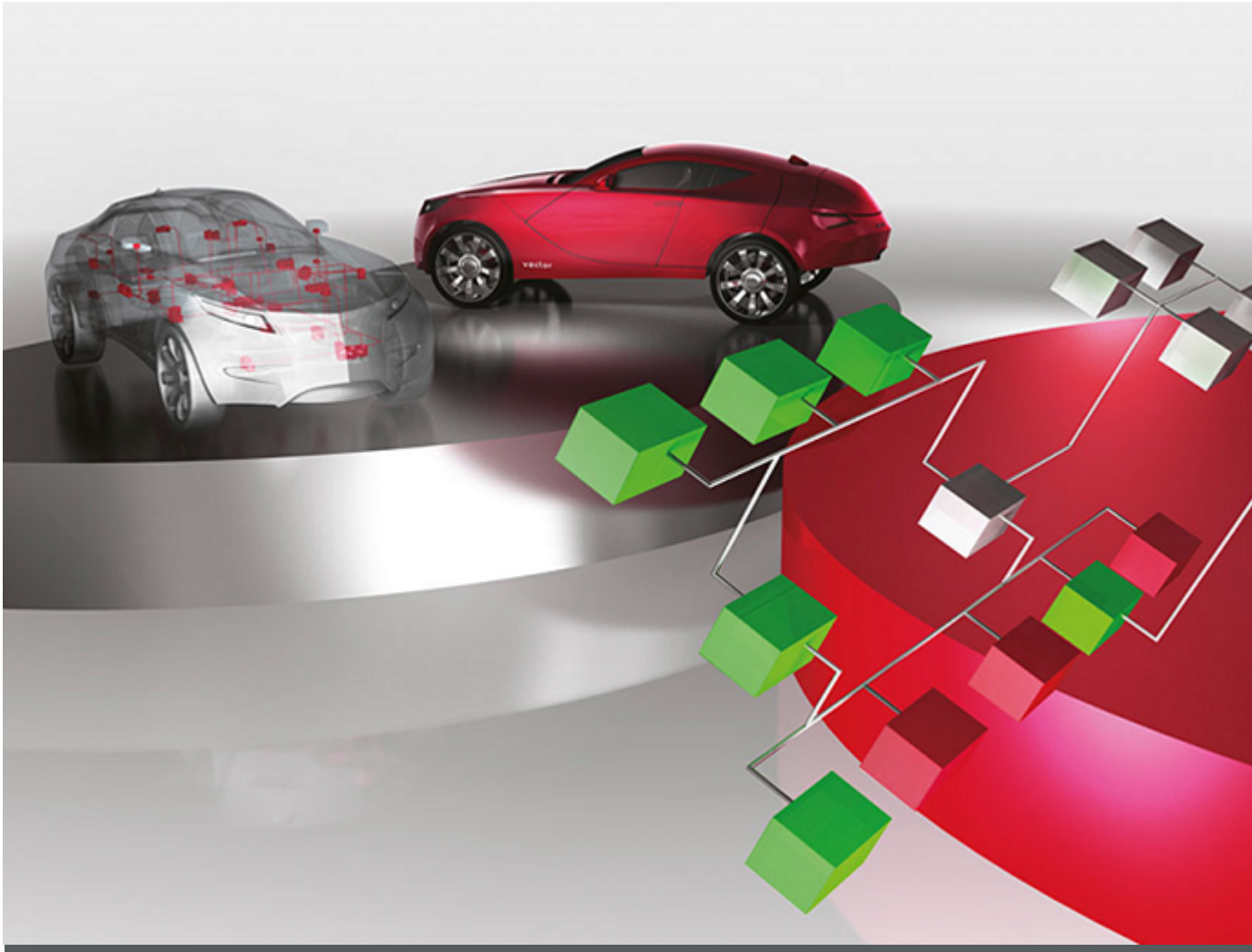
VECTOR



User Manual VT7820
VT System

Version 1.1
English

Imprint

Vector Informatik GmbH
Ingersheimer Straße 24
D-70499 Stuttgart

Table of Contents

1 Introduction

This chapter contains the following information:

1.1 About this User Manual

1.1.1 Access Helps and Conventions

To find information quickly

The user manual provides you the following access helps:

> At the beginning of each chapter you will find a summary of its contents,
> in the header you see the current chapter and section,
> in the footer you see to which program version the user manual replies.

Conventions

In the two following tables you will find the conventions used in the user manual regarding utilized spellings and icons.

Style	Utilization
bold	Fields, interface elements, window and dialog names in the software. Accentuation of warnings and notes. **[OK]** Buttons are denoted by square brackets **File** | **Save** Notation for menus and menu commands
CANoe	Legally protected proper names and side notes.
`Source code`	File name and source code.
Hyperlink	Hyperlinks and references.
<Ctrl>+<S>	Notation for shortcuts.

Symbol	Utilization
	This icon indicates notes and tips that facilitate your work.
	This icon warns of dangers that could lead to damage.
	This icon indicates more detailed information.
	This icon indicates examples.
	This icon indicates step-by-step instructions.
	This icon indicates text areas where changes of the currently described file are allowed or necessary.
	This icon indicates files you must not change.
	This icon indicates multimedia files like e.g. video clips.
	This icon indicates an introduction into a specific topic.
	This icon indicates text areas containing basic knowledge.

Symbol	Utilization
	This icon indicates text areas containing expert knowledge.
	This icon indicates that something has changed.

1.1.2 Latest Information

Additional technical information

You may find additional technical information about your VT System:

- in the CANoe online help,
- on the Vector website www.vector.com (e.g. application notes), and
- in your CANoe installation.

Reference: You may find the **latest version of VT System user manual** in your CANoe installation as well as a **technical user manual** which explains more technical background details, limitations, application tips or connection possibilities of the VT System (start menu ⇨ CANoe ⇨ Help).

1.1.3 Certification

Certified Quality Management System

Vector Informatik GmbH has ISO 9001:2008 certification.
The ISO standard is a globally recognized quality standard.

CE Compliance

All VT System products comply with CE regulations.

1.1.4 Warranty

Restriction of warranty

We reserve the right to modify the contents of the documentation or the software without notice. Vector disclaims all liabilities for the completeness or correctness of the contents and for damages which may result from the use of this documentation.

1.1.5 Support

Need support?

You can get through to our hotline by calling +49 (711) 80670-200
or you can send a problem report to CANoe Support.

1.1.6 Trademarks

Protected trademarks

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- MATLAB® and Simulink® are registered trademarks of The MathWorks, Inc.
- Altera® and Quartus® are registered trademarks of Altera Corporation.
- EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

2 General Information

This chapter contains the following information:

2.1 Purpose

VT7820

The VT7820 is a module for simulating digital rotational sensors. It is an application board which is mounted on the VT7900A FPGA extension module. The module can simulate voltage and current based sensors and has the following features:

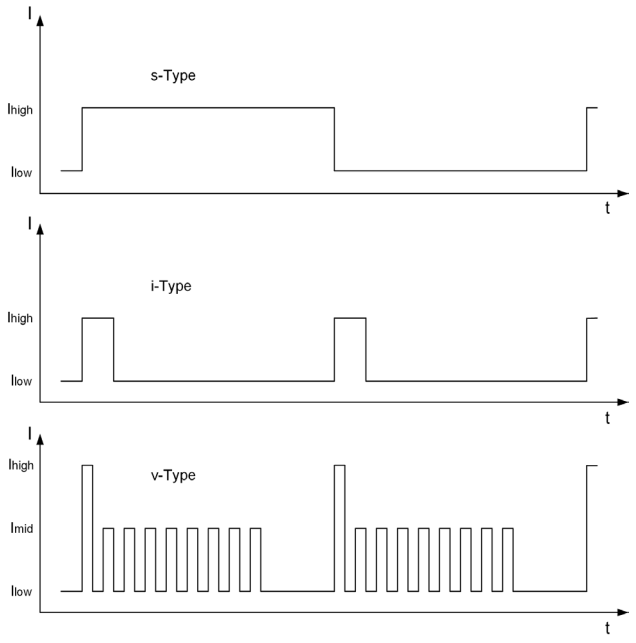
- Electrically isolated from the remaining VT System
- Output Currents from 0 A to 100 mA
- Output Voltage from -12 V to +12 V
- Output Sampling Rate up to 2.16 MSamples/s
- Break and Shortcircuit Relays

Sensor types

Several wheel speed sensor types are directly supported by the firmware.

The following sensor types are supported:

- **s-Type**: output is a simple PWM which has a fixed duty cycle and directly correlates to the wheel speed. No additional information is provided.
- **i-Type**: output is a signal with two logical levels. The sensor generates a high pulse after each detected magnetic signal edge, therefore the signal frequency of the “i” mode is two times the signal frequency of the “s” mode. The high time of the signal is kept constant and gives additional information, e.g.the direction of the rotation or information about the assembly position.
- **v-Type**: gives a three level data signal. The signal consists of a sync pulse followed by nine bits of data. The data consists of the direction of the rotation, several bits to detect assembly errors and a parity bit. The amplitude of the sync pulse is typically twice the amplitude of the data bits. The sensor generates a sync pulse and an output datagram at each magnetic signal edge, therefore the signal frequency of the “v” mode is two times the signal frequency of the “s” mode.
- **Crank and Camshaft**: output is identical to S-Type sensor but all channels use the wheel speed of channel 1 and are synchronized. With this configuration, mechanically correlated sensors like camshaft and crankshaft sensors can be simulated. If a fixed factor between the frequency of two channels is needed this can be done by adjusting the number of teeth for each channel.



2.2 Installation

Installation

Please follow the general installation instructions in the installation section of the VT System user manual.

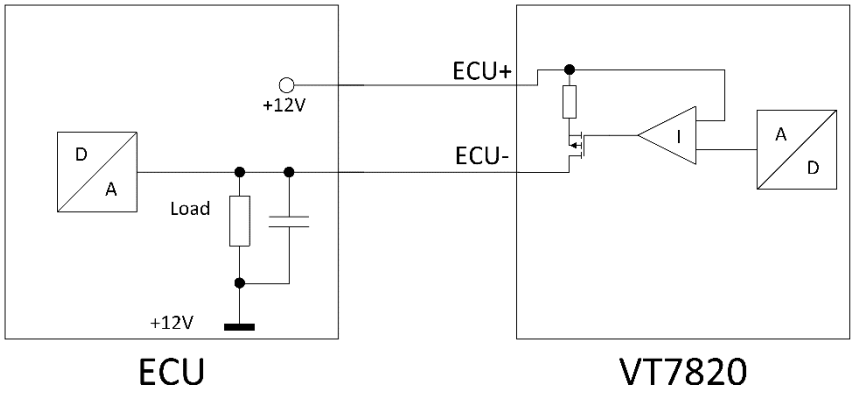
2.3 Usage

2.3.1 Basic Connection Scheme

For simulating rotational sensors the following signals can be connected.

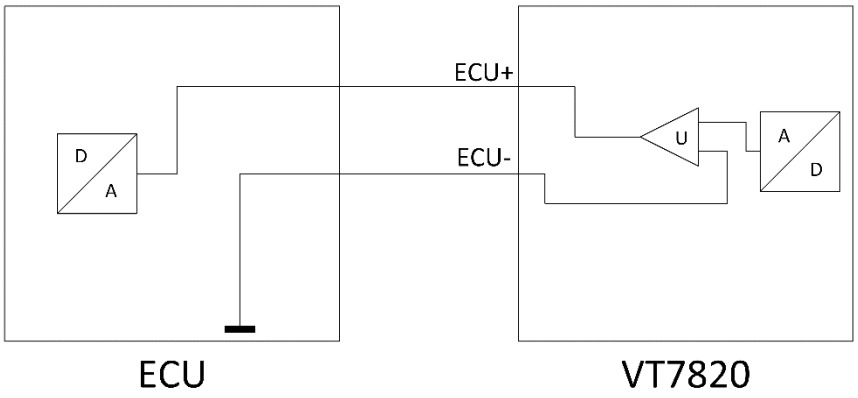
Simulating current modulated sensors

> **Connecting of current signal**
To connect the VT7820 to an ECU simply connect the output pins ECU+ and ECU-. In current mode ECU+ typically is connected to the supply voltage of the ECU and ECU- is connected to the sensor input of the ECU. The ECU sensor input typically has a load resistor which enables the ECU to convert the current coming from the sensor back to a measurable voltage.



Simulating voltage modulated sensors

> **Connecting of voltage signal**
To connect the VT7820 to an ECU simply connect the output pins ECU+ and ECU-. In voltage mode ECU- typically is connected to the ECU ground or a similar reference potential. ECU+ is then connected to the sensor input of the ECU.

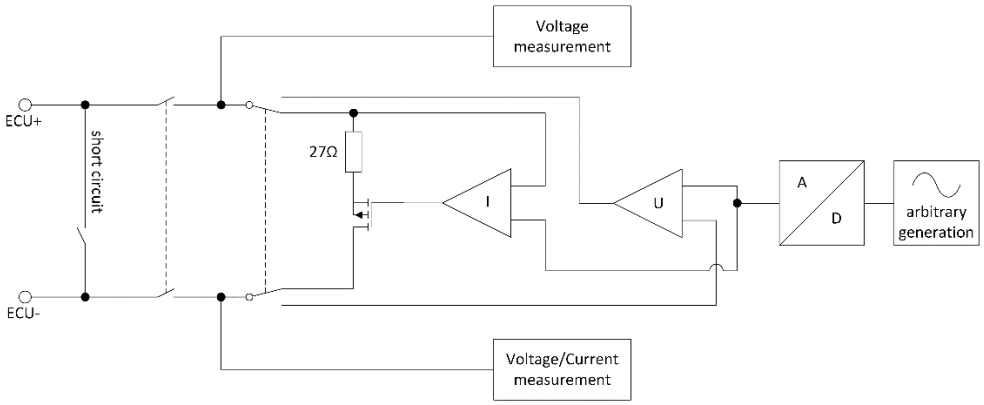


Caution: This application board (signals, supply voltages and ground) is electrically isolated from the remaining VT System. So care has to be taken when connecting external measurement devices (e.g. oscilloscope) that no ground connection to the VT System is established via the power network. It is recommended to use an isolation transformer.

2.3.2 Signal Path Switching

Signal paths and switching options

The figure below shows the signal paths and switching options.



The VT7820 has circuits to simulate either a voltage or a current based sensor. To vary between these two possibilities the signal path will be set by switching the relevant relays.

2.3.3 System Variables

The stimulation parameters for the sensor communication (rotation frequency, tooth configuration, voltage and current levels) can be controlled via system variables in CANoe. The relays are accessible via system variables, too.

System variables reference

The namespace is the name of the module specified in the VT System configuration:

Caution: The variables **OutputType** and **RelaySwitch** must always have the same value. If you want to change the values of these variables please deactivate the output and open all output relays for the corresponding channel. Otherwise this could damage the VT7820 and other hardware that is connected to it.

Value/Setting	System Variable	R/W	Value Semantic
Relay function according to schematic in chapter 2.3.2	RelayBreak, RelayShort, RelaySwitch	W	Integer (0 = open, 1 = closed)
Activate output	ActivateOutput	W	Integer (0 = deactivated, 1 = activated
Angle of an edge for a manually created output signal	DownloadAngle	W	Float, in degree (0 to 359.999)
Edge data for the specified angle	DownloadEdge	W	Integer (0 = falling edge, 1 = rising edge)
Triggers the download of manually created output value	DownloadTrigger	W	Integer Change from 0 to 1 to activate the creation
Needed for a handshake procedure for the manual download	DownloadUpdate	W	Integer, 32 Bits
This variable returns the value of **DownloadUpdate** when a value is written into the RAM of the FPGA	DownloadUpdate Ack	R	Integer, 32 Bits
High value for the current output	HighCurrent	W	Float, in A (0.0 to 0.1)
High value for the voltage output	HighVoltage	W	Float, in V (-12.0 to +12.0)
Low value for the current output	LowCurrent	W	Float, in A (0.0 to 0.1)
Low value for the voltage output	LowVoltage	W	Float, in V (-12.0 to +12.0)
Middle value for the current output (e.g. value for the data signal of a v-sensor)	MiddleCurrent	W	Float, in A (0.0 to 0.1)
Middle value for the voltage output (e.g. value for the data signal of a v-sensor)	MiddleVoltage	W	Float, in V (-12.0 to +12.0)
Specifies how many teeth should be created automatically by the FPGA (evenly distributed)	NumberOfTeeth	W	Integer, 1 up to 3600
Specifies if the module outputs a current or a voltage signal	OutputType	W	Integer (0 = current, 1 = voltage)

Value/Setting	System Variable	R/W	Value Semantic
Specifies the pulse duration for i- and v-sensors	PulseDuration	W	Float, in µs (0.0 to 53.0*10^6)
Specifies which tooth should be removed (the first tooth is number 0)	RemoveToothAt Index	W	Integer
Specifies the rotation frequency	RotationFreq	W	Float, in rps (rotations per second) (-300.0 to +300.0)
Data for a v-sensor	SensorData	W	Integer, 9 Bit
Selects which sensor type should be output	SensorSelect	W	Integer, (0 = no sensor, 1 = s-sensor, 2 = i-sensor, 3 = v-sensor, 4 = combined crank and cam shaft)
Specifies the slew rate of the current signal	SlewRateCurrent	W	Float, in A/µs (1.0*10^{-6} to 1.0)
Specifies the slew rate of the voltage signal	SlewRateVoltage	W	Float, in V/µs (1.0*10^{-3} to 1000.0)
Specifies at which angle a signal should start	StartAngle	W	Float, in degree (0 to 359.999)
No functionality at the moment	Status	R	Integer

2.3.3.1 Automatic Creation of an Output Signal

An output signal (e.g. cogwheel) can be automatically created by the FPGA using the variable **NumberOfTeeth**. With **NumberOfTeeth** it is specified how many teeth should be created for the signal. The creation is automatically activated when a new value for **NumberOfTeeth** is send to the FPGA. Up to 3600 teeth can be created this way. The teeth are distributed as evenly as possible. The creation takes up to 1 second to complete.

To remove a specific tooth the variable **RemoveToothAtIndex** is used. **RemoveToothAtIndex** specifies which tooth should be removed. Valid index values range between 0 and (NumberOfTeeth – 1). This process uses the original signal, even considering already removed teeth. The removal is automatically activated when a new value for **RemoveToothAtIndex** is sent to the FPGA. Only one tooth can be removed at a time. The removal takes up to 1 ms.

2.3.3.2 Manual Creation of a Signal

An output signal can be created manually be telling the FPGA if you want a rising or falling edge at a specific angle. This option uses the variables **DownloadAngle**, **DownloadEdge**, **DownloadTrigger**, **DownloadUpdate** and **DownloadUpdateAck**. To manually download an output signal the following steps have to be executed:

2. **DownloadAngle** has to be set to the angle (in degree) for the edge.
3. **DownloadEdge** specifies if it is a rising or falling edge. 0 for a falling edge and 1 for a rising edge.
4. **DownloadUpdate** is used for a handshake. As soon as the FPGA wrote the edge into its RAM, the value will be returned to CANoe via the variable **DownloadUpdateAck**. It is recommended that two consecutive dates use separate **DownloadUpdate** cycles.
5. DownloadTrigger activates the creation of the edge using DownloadAngle, DownloadEdge and DowndloadUpdate.
6. **DownloadUpdateAck** is returned from the FPGA to CANoe to signalize that a downloaded value was written into the RAM. This variable returns the value of **DownloadUpdate**.

2.3.4 Error Simulation

The module features basic error simulation and parameter variation possibilities:

- Simulation of broken wire
- Simulation of short circuit between ECU+ and ECU-
- Variation of signal high and low levels
- Variation of rise and fall times

The variation range of the parameters and values can be found in the section technical data, chapter 2.5.

The simulation of short and broken wires will be done by relays. The necessary relay settings can be found in the figure in the section 2.3.2.

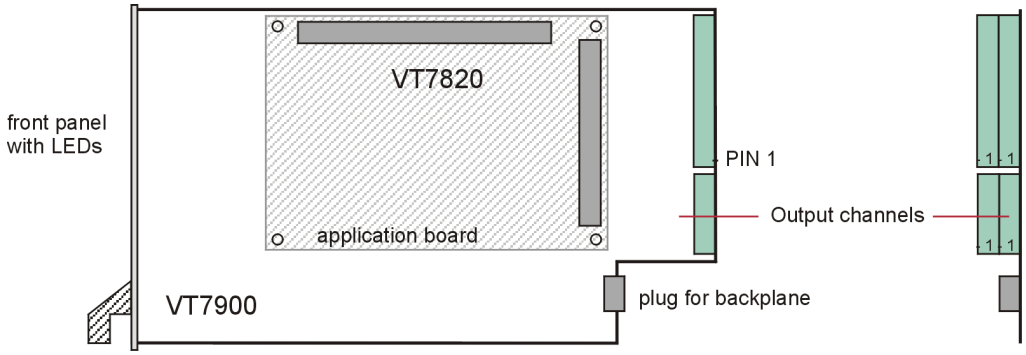
2.3.5 Displays

Front panel LEDs

The LEDs on the front panel of the main module VT7900A FPGA are not used for this application.

2.4 Connectors

Connectors



2.4.1 Output Connector

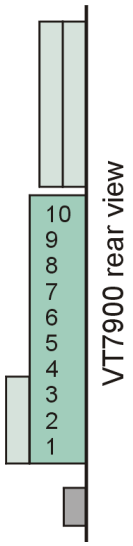
Plug type

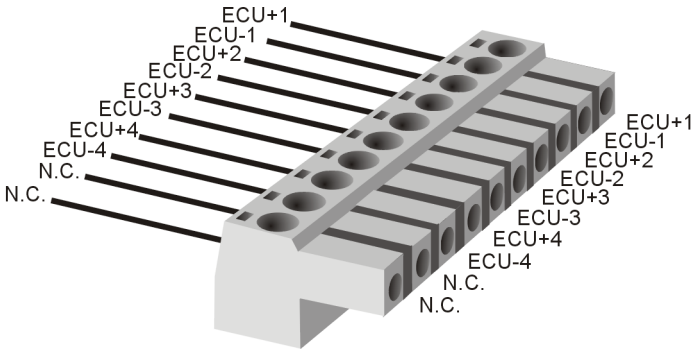
Plug type: Phoenix Contact MC 1,5/10-ST-3,81

Plug allocation

Plug allocation (from top to bottom, viewed from the rear after installation):

Pin	Description
10	N.C.
9	N.C.
8	ECU-4
7	ECU+4
6	ECU-3
5	ECU+3
4	ECU-2
3	ECU+2
2	ECU-1
1	ECU+1





2.5 Technical Data

2.5.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage (via the backplane)	10.8	12	13.2	V
Power consumption at 12.0 V > all relays off > all relays on		 6.1 8.6		 W W
Temperature range	0		+55	ºC
Dimensions (length × width × depth)	300 × 173 × 36			mm
Total weight incl. VT7900A FPGA	approx. 110 approx. 450			g g

2.5.2 Current Stimulation

Parameter	Min.	Typ.	Max.	Unit
Input voltage range > allowed > range ≤ 20mA > range > 20mA	 0 2 5		 24	 V V V
Output current range > at voltage ≤ 12V > at voltage > 12V, load < 100Ω > at voltage > 12V, load ≥ 100Ω	 0 0 0		 100 50 100	 mA mA mA
Accuracy at 23±3°C, ±(% of value + offset) > full range	 -(2.0+1 mA)		 +(2.0+1 mA)	
D/A converter > Resolution > Sample rate		 14 6		 Bits MSamples/s
Bandwidth			300	kHZ
Slew Rate (resistive load)		250		mA/µs

2.5.3 Voltage Stimulation

Parameter	Min.	Typ.	Max.	Unit
Output voltage range	-12		12	V
Output current			50	mA
Accuracy at 23±3°C, ±(% of value + offset) > full range	 -(2.0+0.5 V)		 -(2.0+0.5 V)	
D/A converter > Resolution > Sample rate		 14 6		 Bits MSamples/s
Bandwidth			1	MHz
Slew Rate (resistive load)		190		V/µs

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