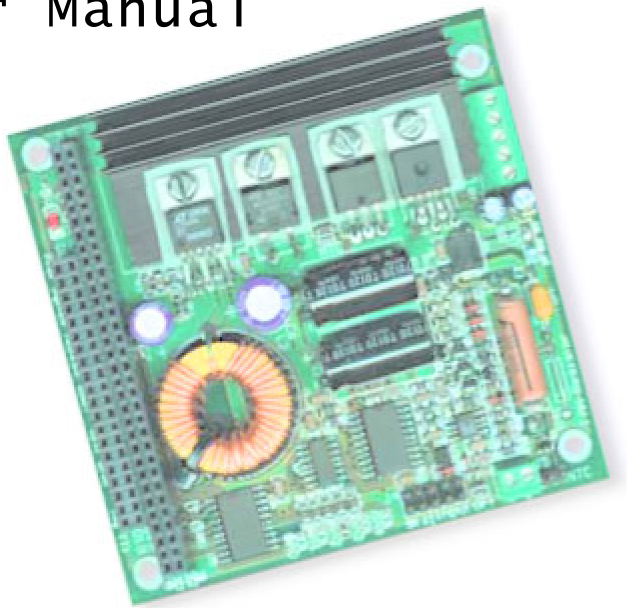
PCAN-PC/104-Power

Switching Power Supply 5V/5A with PC/104 Profile

User Manual



PEAK System

Products taken into account

Product Name	Model	Item Number
PCAN-PC/104-Power		IPEH-002070
PCAN-PC/104-Power Digi	Digital PC interface	IPEH-002071
PCAN-PC/104-Power II	Extended input voltage range	IPEH-002072
PCAN-PC/104 Power II Digi	Extended input voltage range, digital PC interface	IPEH-002073

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1 Introduction

The power supply was designed for use in PC/104 computer systems. Possible fields of use are motor vehicles or SPS systems with 24 Volts. The power supply is set up as step-down switching regulator with the component LT1074 by Linear Technology. Further options of the power supply are a temperature-dependent fan regulation, a start and stop logic, and six digital inputs. These options are offered separately.

1.1 Properties at a Glance

- PC/104 switching power supply with max. 5 A output current at 5 V output voltage
- Range of input voltage: 9 to 35 V (up to 55 V with type II)
- Integrated protective circuit at faulty output voltage
- Integrated, temperature-dependent PWM output for fan connection
- Two start modes
- Switch-off control by software possible (only Digi version)
- Temperature control and six digital inputs (only Digi version)

1.2 Scope of Supply

The scope of supply normally consists of the following parts:

- Switching power supply PCAN-PC/104-Power
- User manual

2 Technical Description

The circuit's main function is the generation of a 5 Volt output with high precission. The circuit is designed as **step-down switching regulator**. For this task the component LT1074 by Linear Technology is used (http://www.linear.com). This chip produces a typical maximum output current of 6.5 Ampere. You can find further information in the corresponding data sheet realeased by the manufacturer.

The **input voltage** of the circuit may lie in the range of 9 to 35 Volts. The lower limit is cause of the minimum input voltage of the switching regulator and the voltage drop over the electronic switch. If the power supply is used without switching option, a minimum input voltage of 8 Volts can be reached. When operating the power supply below this limit, make sure that there aren't any high amplitude load alterations, because transient responses of up to 6 Volts can occur (about 1 ms duration).

For protection against destruction of the connected hardware a **power transient protection** has been integrated that shorts the input circuit at about 6 Volts at the output and therefore burns the fuse. A slow-blow fuse (5 Ampere) with soldered connection is used.

For stable operation the switching controller requires a **minimum load** of 30 Ohm. If this load value is exceeded, the switching controller doesn't generate a proper switching pulse, however, this has no influence on the output voltage.

The switching controller has a maximum **power dissipation** of about 8 Watts. This value is reached at full load and small input voltage. This requires a sufficient cooling of the board. The temperature-dependent fan regulation may be useful for this task.

In the following block diagram you can find the **solder jumper Vin** (JP1). With this switch the **input of the switching controller** is specified. The power supply is operated either by applying an input voltage or with an electronic switch. For direct operation a connection from the left to the mid pad must be prepared. The label "perm" (for permanent) is printed below these two pads. If the switching option shall be used, the solder bridge must connect the mid and the right pad (label "SW").

The **block diagram** shows the function units for a completely equipped power supply. Details about special blocks are described in the following chapters.

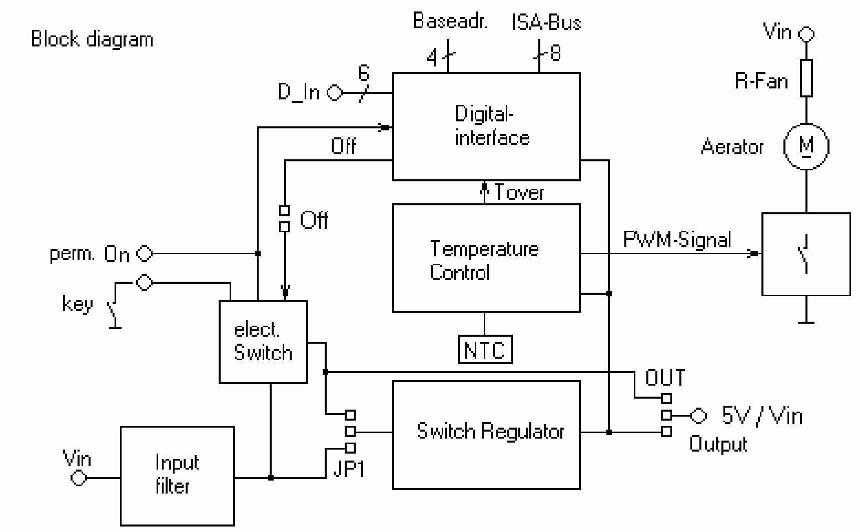

Figure 1: Block diagram of the switching power supply

In Appendix C you can find four oscilloscope patterns of the output voltage. They show the voltage increase after powering on with loads of 18 Ohm and 1 Ohm, and the behaviour at load alteration between 18 and 1 Ohm. In Appendix B you can find the standardized pin assignment of the PC/104 bus connector (A1 to D19).

Figure 2 shows the structure of the power supply. **Connector J3** has following pins:

Pin	Description
1	Input for "Permanent On" (e.g. terminal 15 in a motor vehicle)
2	Output +5 Volt or Vin, to be set with jumper OUT on the bottom side of the PCB
3	Pushbutton (switching on)
4	Negative power supply (Ground, e.g. terminal 31 in a motor vehicle)
5	Positive power supply (+Vin, e.g. terminal 30 in a motor vehicle)

The lit **LED** indicates a generated output voltage of 5 Volts.

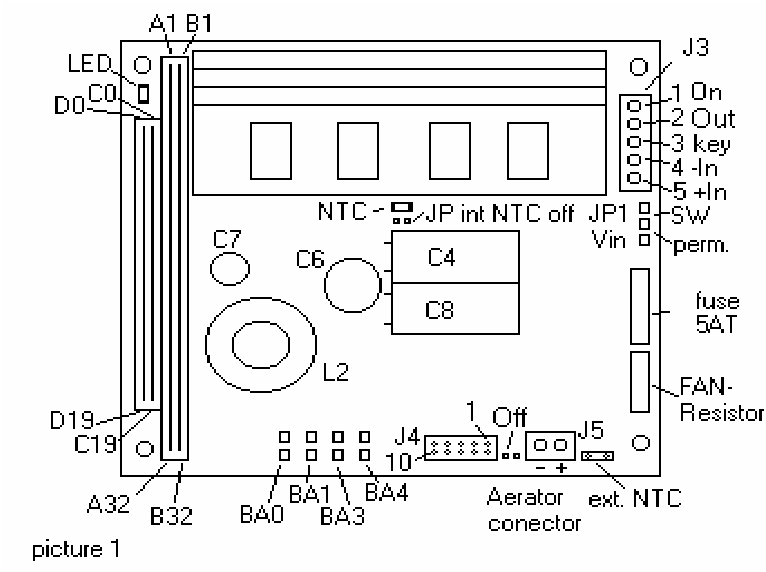

Figure 2: Structure of the power supply

2.1 Digi Version

The Digi version of the power supply has a digital interface to the PC. The connection is established via the ISA bus of the card. It permits status monitoring of the power supply and the arbitrary use of six digital inputs (pushbuttons, open-collector inputs, ...).

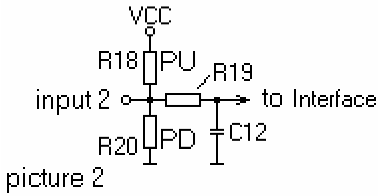

Figure 3: Circuit of a digital input (here: In2)

In Figure 3 you can see the pull-up and pull-down resistors which may either be equipped. They are implemented with SMD technology having the footprint 1206 (bottom side).

The following table shows the labels, values, and the pins for the six inputs. The values may be varied. The six digital inputs are routed to J4.

Pin at J4	1	2	3	4	5	6
Input	In 2	In 3	In 4	In 5	In 6	In 7
Pull-up resistor (47 kOhm)	R18	R24	R27	R30	R33	R36
Series resistor (10 kOhm)	R19	R25	R28	R31	R34	R37
Pull-down resistor (47 kOhm)	R20	R26	R29	R32	R35	R38
Capacitor (100 nF)	C12	C14	C15	C16	C17	C18

Pins 7 and 8 are connected to Ground, pins 9 and 10 are connected to 5 Volt. The 5 Volt output at J4 may be loaded with up to 500 mA and is <u>not</u> fused.

The status monitor implements two parameters: the occurrence of "Permanent On" and an overtemperature signal (see also chapter 4 *Temperature-dependent Fan Control*). The information is read out by an 8-bit value related to the set-up base address. The terminal "Permanent On" permits switching on the power supply with an external voltage (e.g. terminal 15 in a motor vehicle). Bit 0 follows the corresponding level. Overtemperature (Tover) is low-active, e.g. this bit is set to 1 in normal state. This results in the following bit pattern:

In 7	In 6	In 5	In 4	In 3	In 4	Tover	Perm. On
MSB							LSB

When using pull-up resistors, and neither the signals for overtemperature nor an external switch-on voltage, then the return value is 0xFE when reading from the address.

The input current consumption of the digital interface is about 10 mA at 5 Volt.

The base address is set-up with solder jumpers BA0 to BA4. The address lies in the range of 0x100 to 0x3E0. It is set by the address lines A5 to A9. Appendix A shows the corresponding jumper scheme.

Note: The solder jumpers must be set before using the power supply.

3 Switching Options at Operation with Switch

When using the electronic switch (JP1 set to SW), there are two possibilities for activating the power supply. Those are "Permanent On" (J3, pin 1) or a pushbutton. The option "Permanent On" is intended for use in a motor vehicle (control with terminal 15, ignition). The voltage for activating the power supply lies in the range of 8 to 30 Volt. The status of the pin "Permanent On" is reflected in bit 0 of the 8-bit value. When the voltage "Permanent On" is switched off, the power supply is not deactivated immediately. The running application must poll the status and generate an active switch-off. The advantage of this procedure is the defined shut-down of the application.

The second possibility for activation is a pushbutton against ground. This pushbutton is connected to pin 3 of J3. Actuating the pushbutton activates the power supply with latching. The switching level lies at R_Taster < 6 kOhm against ground.

A switch-off is done by writing an arbitrary value to the defined base address.

Note: When developing the application, make sure that writing to the base address only occurs for switch-off.

In Figure 2 you can see a solder jumper left to the fan connector labeled "Off". By opening the jumper the switch-off of the power supply can be omitted. For example, this is needed during an installation of Windows, since during hardware detection the power supply would switch off.

Caused by the switch option is a non-operate current of the power supply of about 0.1 mA (dependent on the input voltage).

4 Temperature-dependent Fan Control

The power supply has an option for temperature-dependent fan control. Controlling is done with PWM of the switch in the fan circuit (see Figure 1: Block diagram of the switching power supply). You can use DC fans with a maximum current consumption of 200 mA. The operating voltage of the fan depends on the input voltage of the power supply. A so-called fan resistor compensates occuring voltage offsets. The value is calculated as follows:

$R\_fan = (Vin – V\_fan) / I\_fan$

The power rating of the resistor is:

$P\_v = I\_fan^2 \times R\_fan$

At delivery the power supply is equipped with a wire jumper (R_fan = 0 Ohm). The temperature acquisition is done with an NTC thermistor. Two points are dedicated for acquisition, however, they cannot be used simultaneously. The first point lies directly on heat sink of the power supply, labeled with NTC. The second possibility is an external NTC thermistor that can be attached to the connector NTC next to the fan connector (J5, FAN). If an external NTC thermistor shall be used you must open the solder jumper beneath the on-board NTC. The equipped NTC thermistor has a nominal resistance of 47 kOhm. With this value the fan starts to turn at about 33 °C (91 °F), a PWM keying of 100 % is reached at about 60 °C (140 °F). If the value of the NTC thermistor is 33 kOhm, the starting temperature lies at about 27 °C (81 °F), 100 % PWM keying is reached at about 45 °C (113 °F). Adaption to specific temperature values may be achieved by varying the NTC thermistor's value.
A reached 100-percent keying ratio is indicated by the status change of bit 1 (Tover) of the readable byte value to Low (low-active).

5 Software

To use the optional functions (six digital inputs, switching logic, temperature control) you need a software for reading and writing of port addresses. By reading the dedicated port adresses you can access the states of the digital inputs, the level of the switch voltage, and the temperature control.

5.1 Example of a C routine for ANSI C

Please refer to the compiler's manual to get information about the commands for port I/O.

Note: For port outputs under DOS you usually use the address as first parameter and the output value as second parameter. C compilers for linux handle this vice versa.

```
#define PC104_POWER_BASE  0x360

unsigned int Get_PC104_DIG_1( )
{
 unsigned int ret;
  /* Read base address and test for BIT 0 */
  ret = (unsigned int) (_inpb(PC104_POWER_BASE)&0x01)
  return ret;
}
```

Under windows you can use the function library `PC104Pow.DLL`. You can retrieve it from our homepage (http://www.peak-system.com).

```
//     Set Base Adress (must be the first call to the
//     DLL to init the Interface)
void __stdcall Set_PowBase(unsigned short port);

//     Get Base Adress (must be set first with
//     SetBase Adress)
unsigned short __stdcall Get_PowBase();

//       Get_PP()
//  Status of Digital Port Permanent Power
bool __stdcall Get_PP();

//      Get_Tover()
//  Status of Digital Port Temprature Control
bool __stdcall Get_Tover();

//     Power_ShutDown - be carefull to use this
//     function !! System will not be shut
//     down Windows Operating System !!
void __stdcall Power_ShutDown();

//     Get_DI_1()
//  Status of Digital Port 1
bool __stdcall Get_DI_1();

//     Get_DI_2()
//  Status of Digital Port 2
bool __stdcall Get_DI_2();

//     Get_DI_3()
//  Status of Digital Port 3
bool __stdcall Get_DI_3();

//     Get_DI_4()
//  Status of Digital Port 4
bool __stdcall Get_DI_4();

//     Get_DI_5()
//  Status of Digital Port 5
bool __stdcall Get_DI_5();

//     Get_DI_6()
//  Status of Digital Port 6
bool __stdcall Get_DI_6();
```

Note: Operating systems based on Windows NT technology do not allow a direct port access. A needed device driver is available on demand.

Appendix A Jumper

The table shows the jumper scheme. Jumpers marked with X must be closed to gain the desired base address. Besides the base addresses listed here any other in the range of 0x100 to 0x3E0 with a step width of 0x20 is possible. BA0 determines the value for address line A5, BA4 for A9. Address line A7 is permanently low. With an open jumper the corresponding address line is retrieved for High, with a closed jumper for Low. Address lines A2 to A4 are always referenced to Low. A0 and A1 are without significance for reading the byte value, however, for switching off the power supply the addresses A0 and A1 must be Low.

ADR	BA0 Address A5	BA1 Address A6	BA3 Address A8	BA4 Address A9
0x100	X	X	-	X
0x120	-	X	-	X
0x140	X	-	-	X
0x160	-	-	-	X
0x200	X	X	X	-
0x220	-	X	X	-
0x240	X	-	X	-
0x260	-	-	X	-
0x300	X	X	-	-
0x320	-	X	-	-
0x340	X	-	-	-
0x360	-	-	-	-

Appendix B Pin Assignment of the PC/104 Connector

The used assignment corresponds to the standard for PC/104 ISA connectors. See also http://www.pc104.org.

Pin	Row A	Row B	Row C	Row D
0	-	-	GND	GND
1	IOCHCK	GND	SBHE	MEMCS16
2	D7	RSTDRV	LA23	IOCS16
3	D&	+5V	LA22	IRQ10
4	D5	IRQ9	LS21	IRQ11
5	D4	-5V	LS20	IRQ12
6	D3	DRQ2	LS19	IRQ15
7	D2	-12V	LA18	IRQ14
8	D1	ENDXFR	LA17	DACK0
9	D0	+12V	MEMR	DRQ0
10	IOCHRDY	GND/KEY	MEMW	DACK5
11	AEN	SMEMW	SD8	DRQ5
12	A19	SMEMR	SD9	DACK6
13	A18	IOW	SD10	DRQ6
14	A17	IOR	SD11	DACK7
15	A16	DACK3	SD12	DRQ7
16	A15	DRQ3	SD13	+5V
17	A14	DACK1	SD14	MASTER
18	A13	DRQ1	SD15	GND
19	A12	REFRESH	GND/KEY	GND
20	A11	SYSCLK		
21	A10	IRQ7		
22	A9	IRQ6		
23	A8	IRQ5		
24	A7	IRQ4		

Pin	Row A	Row B	Row C	Row D
25	A6	IRQ3		
26	A5	DACK2		
27	A4	TC		
28	A3	BALE		
29	A2	+5V		
30	A1	OSC		
31	A0	GND		
32	GND	GND		

Appendix C Various Voltage Curves

The following curves show the behavior during switch-on and load alterations. The behavior at switch-on has been documented for two load conditions: a start with a load of 1 Ohm and 18 Ohm. The two other curves show the load alteration from 18 Ohm to 1 Ohm and from 1 Ohm to 18 Ohm. The used loads had pure omic resistance.

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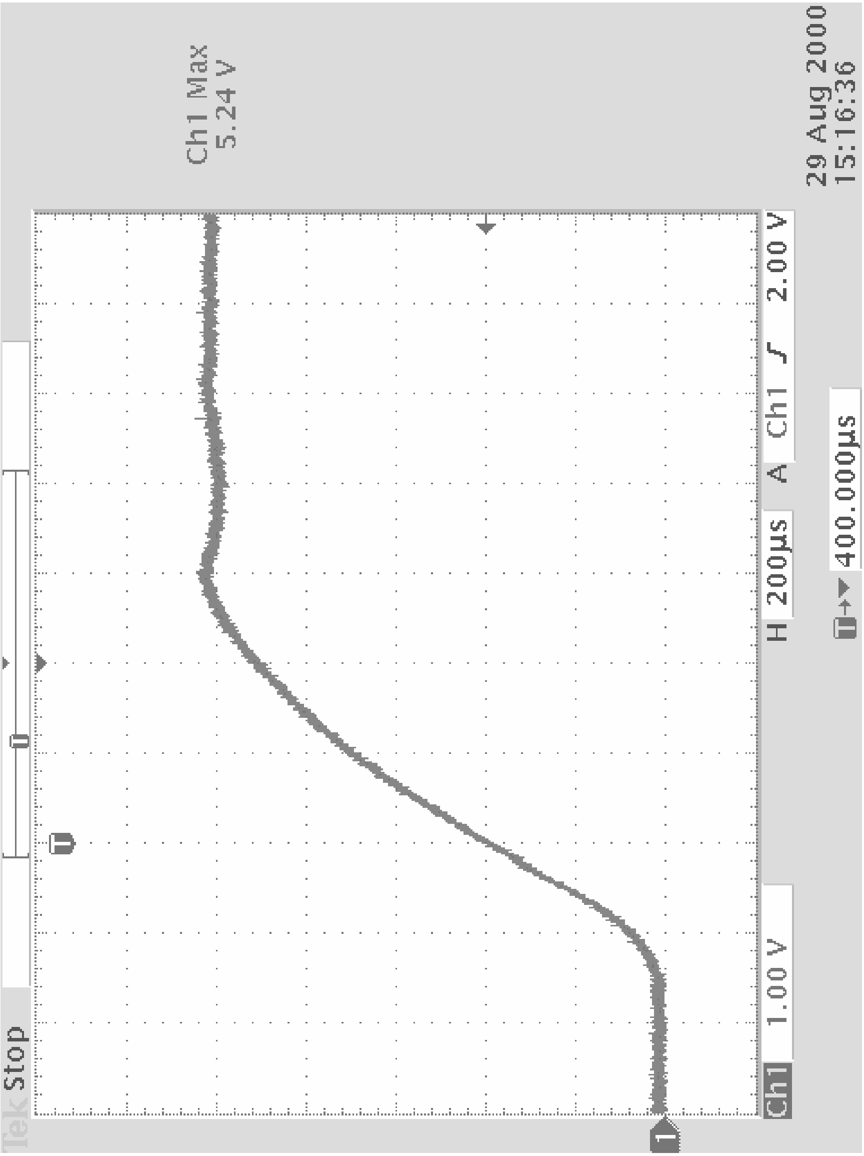

Figure 4: Diagram for voltage increase at 1 Ohm load

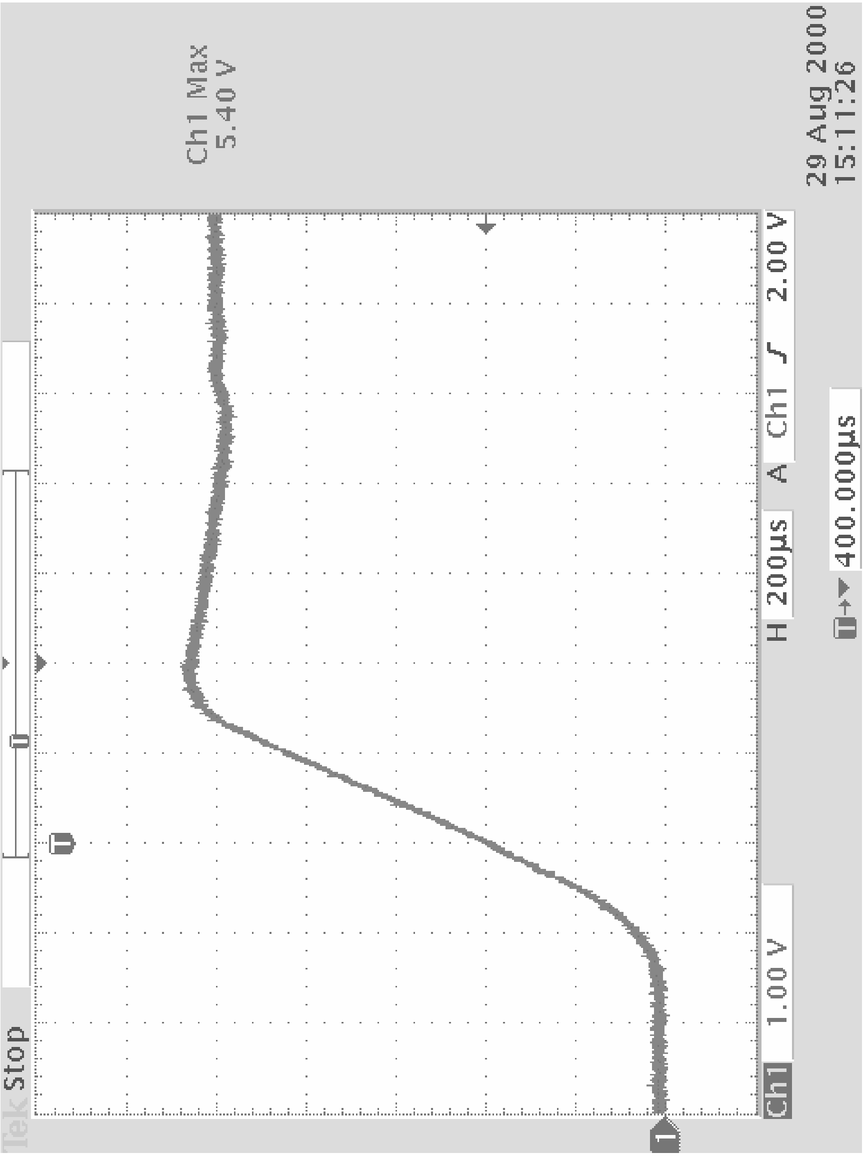

Figure 5: Diagram for voltage increase at 8 Ohm load

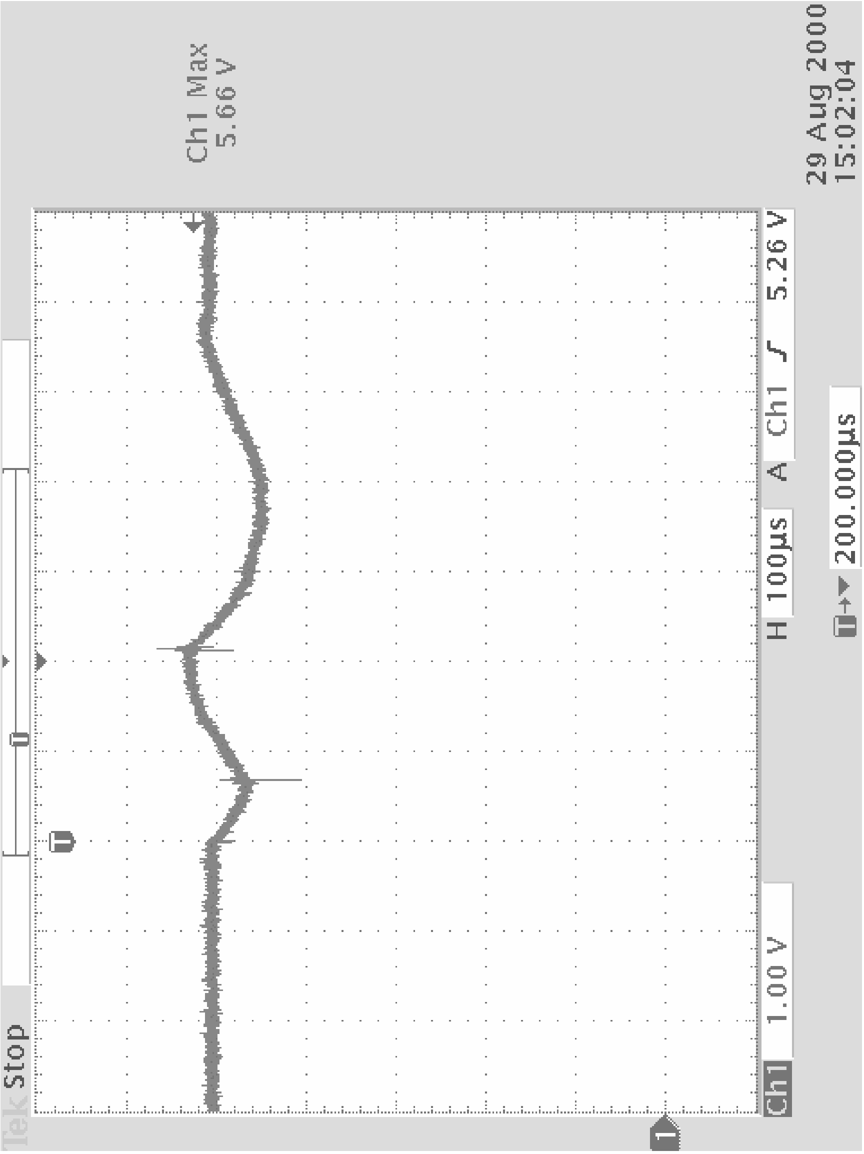

Figure 6: Diagram for load alteration from 18 Ohm to 1 Ohm

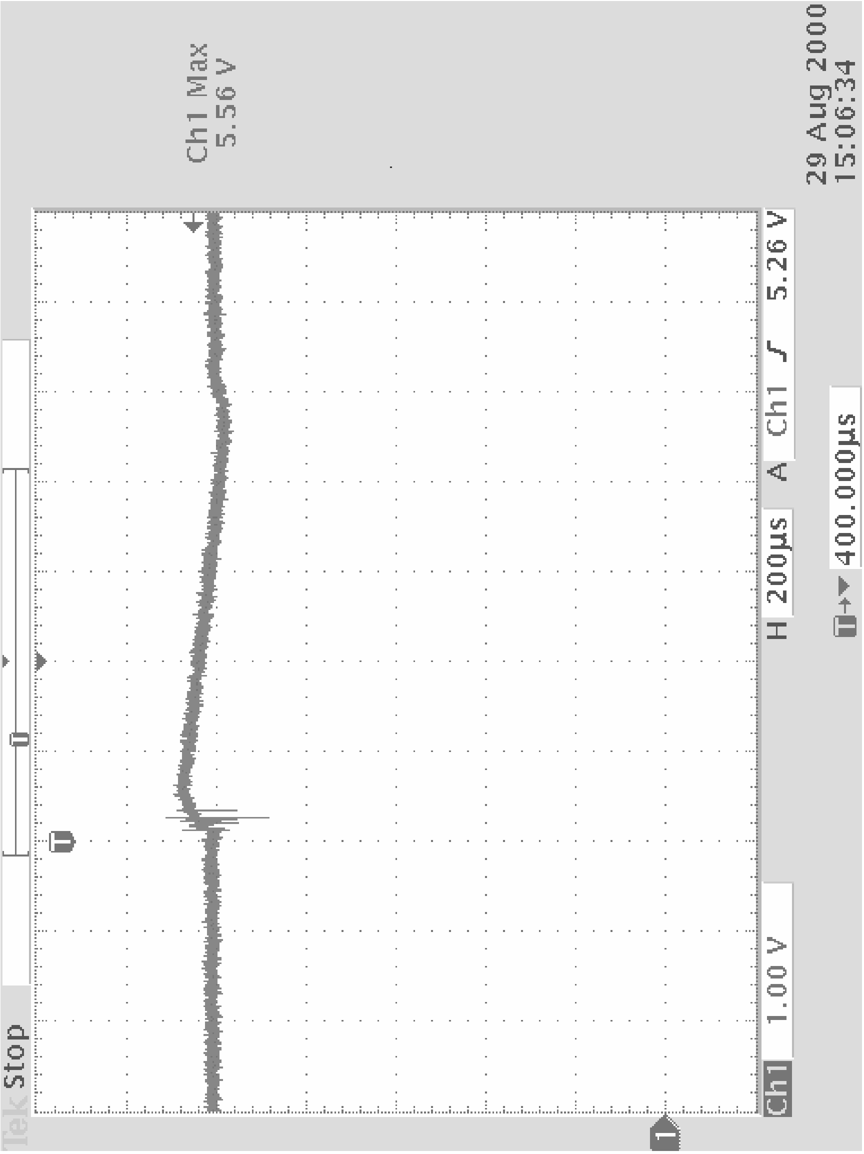

Figure 7: Diagram for load alteration from 1 Ohm to 18 Ohm