

# IFX21004TN V51

Dual Voltage Regulator with 5 V and 15 V Outputs

IFX21004TN V51

## Data Sheet

Rev. 1.00, 2010-11-04

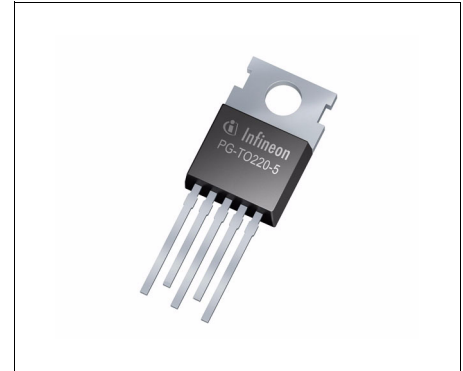
Standard Power



## 1 Overview

### Features

- Dual Output: 5 V and 15 V
- High Input Voltage Range: up to 60 V Peak
- High Output Current Capability 100 mA and 30 mA
- High Output Voltage Accuracy
- Very low Current Consumption
- Overtemperature Shutdown
- Thermal Optimized Package
- Green Product (RoHS compliant)



PG-TO220-5

For automotive applications please refer to the Infineon TLE- and TLF-series voltage regulators.

### Description

The **IFX21004TN V51** is a monolithic integrated voltage regulator providing two output voltages: Output Q1 is a 5 V output for loads up to 100 mA and output Q2 is a 15 V output providing up to 30 mA. The device is available in the **PG-TO220-5** package.

The **IFX21004TN V51** is designed to supply any system that requires 5 V and 15 V. These can be for example systems with a microcontroller (5 V) and a standard MOS-driver-IC (15 V). To fulfill also the requirements of severe operating conditions the IFX21004TN V51 is able to operate across a wide junction temperature range of  $-40\text{ °C} < T_j < 150\text{ °C}$  and is also equipped with additional protection functions.

Both outputs are protected against overload by an integrated output current limitation circuit. The built-in overtemperature shutdown circuit protects the device against overheat.

The IC operates across a wide input voltage range from 20 V up to 60 V peak and up to 40V for continuous operation. The output voltages are regulated to  $V_{Q1} = 5\text{ V}$  and  $V_{Q2} = 15\text{ V}$ . The standard **PG-TO220-5** package is especially suitable for this kind of application, as it reduces system cost and provides excellent thermal characteristics.

Type	Package	Marking
IFX21004TN V51	PG-TO220-5	IFX21004

## 2 Block Diagram

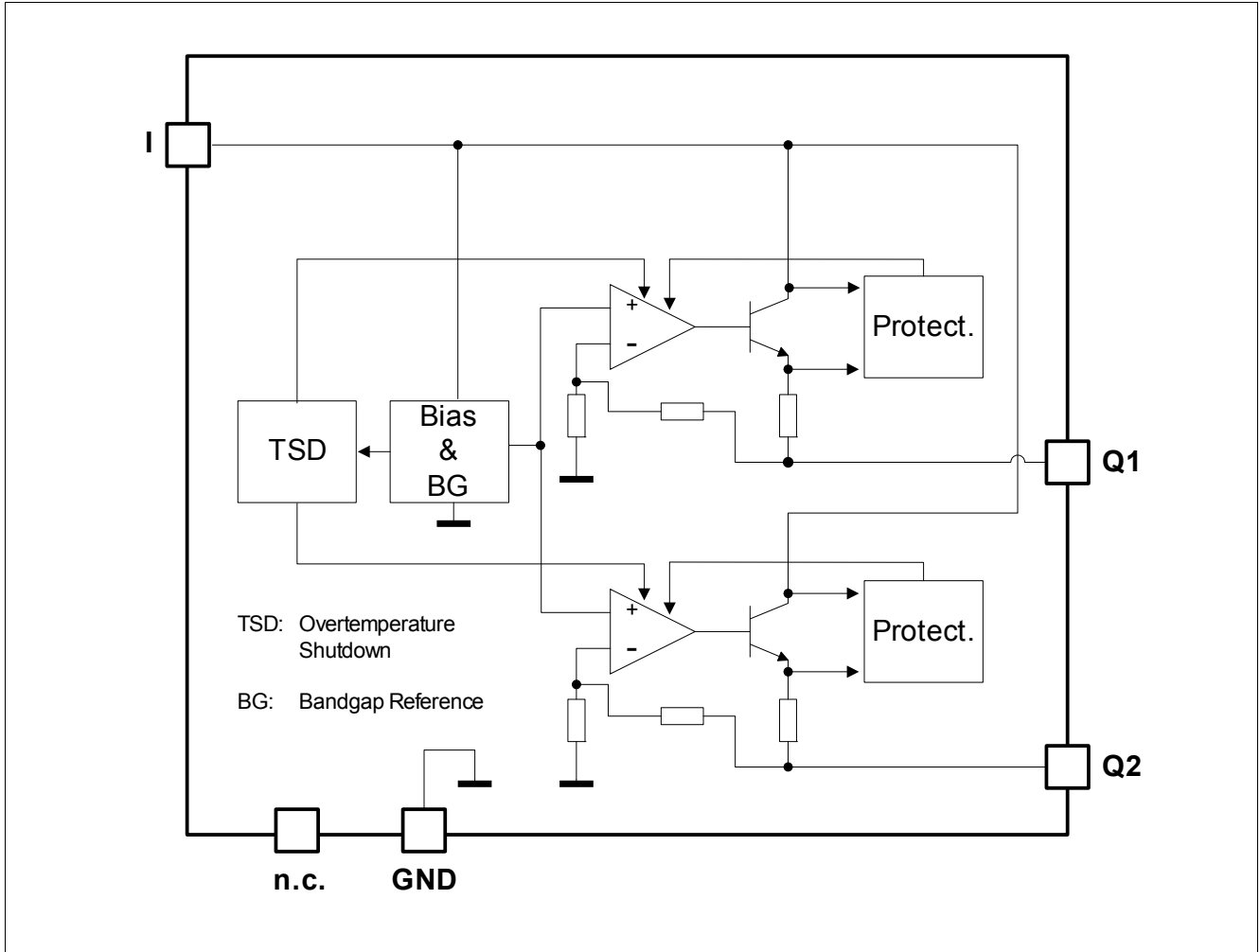


Figure 1 Block Diagram

### 3 Pin Configuration

#### 3.1 Pin Assignment

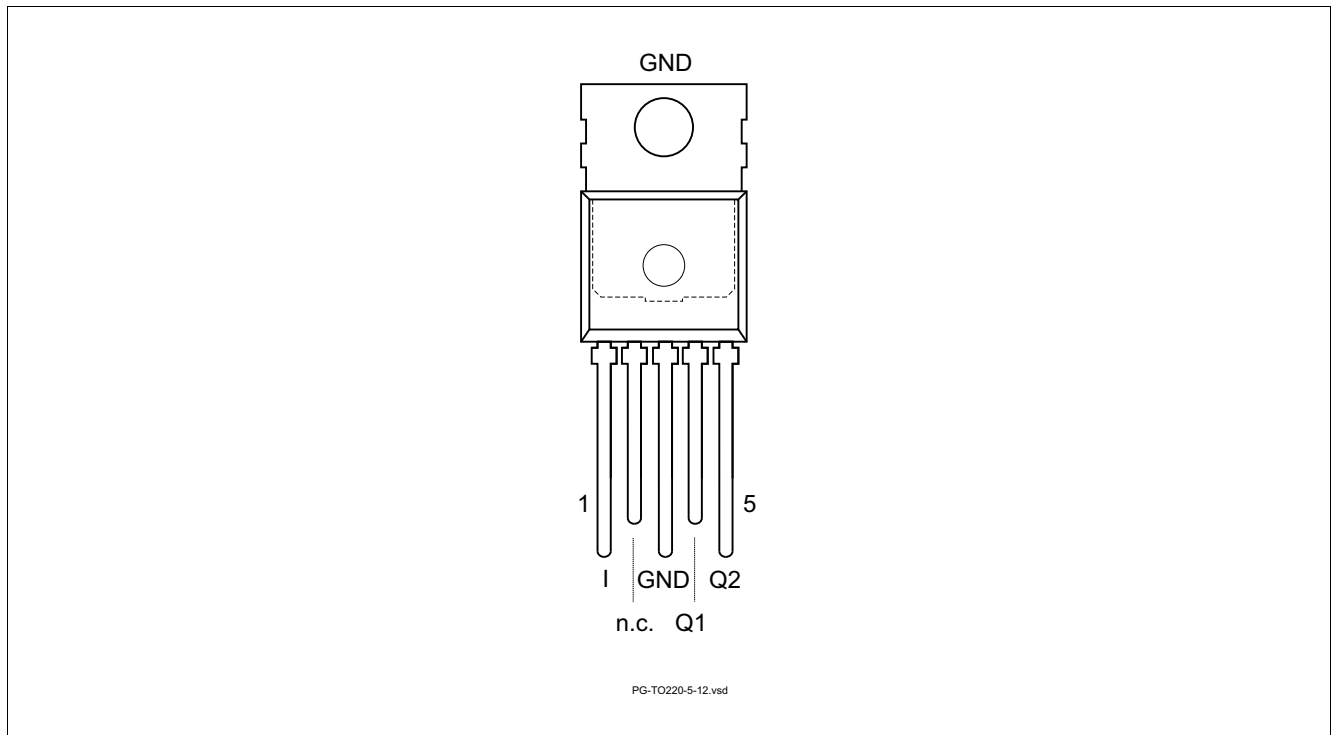


Figure 2 Pin Configuration

#### 3.2 Pin Definitions and Functions

Pin	Symbol	Function
1	I	<b>Input voltage</b> block to ground directly at the IC with a ceramic capacitor.
2	n.c.	<b>not connected</b> leave open, don't connect
3	GND	<b>Ground</b> connect to tab (heat sink)
4	Q1	<b>5V-Output voltage, e.g. for microcontroller and logic circuit</b> block to ground with a capacitor respecting the values given in <a href="#">“Output Capacitor’s Requirements for Stability” on Page 7</a>
5	Q2	<b>15V-Output voltage, e.g. for MOS driver circuit</b> block to ground with a capacitor as specified in <a href="#">“Output Capacitor’s Requirements for Stability” on Page 8</a>
Tab	–	<b>Tab</b> connect to pin3 (GND) and heatsink area

## 4 General Product Characteristics

### 4.1 Absolute Maximum Ratings

**Table 1 Absolute Maximum Ratings**

$T_j = -40\text{ °C}$  to  $+150\text{ °C}$ ; all voltages with respect to ground, positive current flowing into pin (unless otherwise specified)

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
<b>Input</b>					
Voltage	$V_I$	-0.3	60	V	during max. 400ms see also <a href="#">Chapter 6</a>
		-0.3	40	V	
<b>Outputs Q1, Q2</b>					
Voltage	$V_{Q1}$	-0.3	6.5	V	–
Voltage	$V_{Q2}$	-0.3	20	V	–
<b>Temperatures</b>					
Junction Temperature	$T_j$	-40	150	°C	–
Storage Temperature	$T_{stg}$	-50	150	°C	–
<b>ESD-Protection</b>					
All Pins	$V_{ESD}$	-2	2	kV	HBM <sup>1)</sup>
All Pins	$V_{ESD}$	-1	1	kV	CDM <sup>2)</sup>

1) ESD susceptibility, HBM according to EIA/JESD 22-A114B

2) ESD susceptibility, Charged Device Model "CDM" EIA/JESD22-C101 or ESDA STM5.3.1

*Note: Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

*Note: Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.*

### 4.2 Operating Range

**Table 2 Operating Range**

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
Input Voltage Range for Q1	$V_{I1}$	12	60	V	only Q1 functional; during max. 400ms <sup>1)</sup>
	$V_{I1}$	12	40	V	only Q1 functional <sup>1)</sup>
Input Voltage Range for Q2	$V_{I2}$	20	60	V	Q1 and Q2 functional; during max. 400ms <sup>1)</sup>
	$V_{I2}$	20	40	V	Q1 and Q2 functional <sup>1)</sup>
Junction temperature	$T_j$	-40	150	°C	–

1) also consider the specification of the Dropout Voltage  $V_{DRQ1}$ ,  $V_{DRQ2}$  given in the [Table 4](#)

### 4.3 Thermal Resistances

**Table 3 Thermal Resistances<sup>1)</sup>**

Parameter	Symbol	Typ. Limit Value	Unit	Remarks
Junction to Case	$R_{thJC}$	4.1	K/W	underlying P = 2W power dissipation with power zener activated <sup>2)</sup>
Junction to Case	$R_{thJC}$	6.1	K/W	underlying P = 2W power dissipation with power zener deactivated <sup>3)</sup>

1) not subject to production test, specified by design

2) for the taken case with the zener diode activated the power distribution on the chip is given as follows. Power zener:  $P_{Zener} = 0.85W$ ; power stage Q1:  $P_{PowerstageQ1} = 1.03W$ ; power stage Q2:  $P_{PowerstageQ2} = 0.12W$

3) for the taken case with the zener diode deactivated the power distribution on the chip is given as follows. Power stage Q1  $P_{PowerstageQ1} = 1.72W$ ; power stage Q2  $P_{PowerstageQ2} = 0.28W$

*Note: In the operating range, the functions given in the circuit description are fulfilled.*

## 5 Electrical Characteristics

**Table 4 Electrical Characteristics**

$V_I = 24\text{ V}$ ;  $-40\text{ °C} < T_j < 150\text{ °C}$ ; all voltages with respect to ground; positive current defined flowing out of pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
<b>Current Consumption</b>						
Quiescent Current $I_q = I_I - (I_{Q1} + I_{Q2})$	$I_q$	–	700	1000	$\mu\text{A}$	$I_{Q1} = 1\text{ mA}$ ; $I_{Q2} = 1\text{ mA}$
Current Consumption $I_q = I_I - (I_{Q1} + I_{Q2})$	$I_q$	–	1	3.5	$\text{mA}$	$I_{Q1} = 100\text{ mA}$ ; $I_{Q2} = 30\text{ mA}$
<b>Output Q1 (5 V)</b>						
Output Voltage	$V_{Q1}$	4.85	5.00	5.15	$\text{V}$	$I_{Q1} = 80\text{ mA}$ ; $T_j = 25\text{ °C}$
Output Voltage	$V_{Q1}$	4.75	–	5.25	$\text{V}$	$1\text{ mA} < I_{Q1} < 100\text{ mA}$
Output Current Limitation	$I_{Q1}$	101	180	600	$\text{mA}$	$V_{Q1, \text{nom}} - 100\text{mV}$ ; $V_I = 24\text{V}$
Dropout Voltage $V_{\text{DRQ1}} = V_I - V_{Q1}$	$V_{\text{DRQ1}}$	–	5	10	$\text{V}$	$I_{Q1} = 100\text{ mA}$ ; $I_{Q2} = 30\text{ mA}^{1)}$
Load Regulation (steady state)	$\Delta V_{Q1}$	–	20	50	$\text{mV}$	$1\text{ mA} < I_{Q1} < 100\text{ mA}$ ; $V_I = 24\text{ V}$
Line Regulation (steady state)	$\Delta V_{Q1}$	–	15	50	$\text{mV}$	$I_{Q1} = 1\text{ mA}$ ; $24\text{ V} < V_I < 40\text{ V}$
Power Supply Ripple Rejection <sup>2)</sup>	$PSRR_{Q1}$	–	55	–	$\text{dB}$	$f_r = 100\text{ Hz}$ ; $V_r = 1\text{Vpp}$
Output Capacitor's Requirements for Stability	$C_{Q1}$	1.0	–	–	$\mu\text{F}$	– <sup>2)3)</sup>
	$ESR(C_{Q1})$	–	–	5.0	$\Omega$	– <sup>2)</sup>

**Electrical Characteristics**
**Table 4 Electrical Characteristics (cont'd)**

$V_1 = 24\text{ V}$ ;  $-40\text{ °C} < T_j < 150\text{ °C}$ ; all voltages with respect to ground; positive current defined flowing out of pin; unless otherwise specified.

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
<b>Output Q2 (15 V)</b>						
Output Voltage	$V_{Q2}$	14.4	15.0	15.6	V	$I_{Q2} = 15\text{ mA}$ ; $T_j = 25\text{ °C}$
Output Voltage	$V_{Q2}$	14.25	–	15.75	V	$1\text{ mA} < I_{Q2} < 30\text{ mA}$
Output Current Limitation	$I_{Q2}$	31	100	220	mA	$V_{Q2, \text{nom}} - 100\text{mV}$ ; $V_1 = 24\text{V}$
Dropout Voltage $V_{\text{DRQ2}} = V_1 - V_{Q2}$	$V_{\text{DRQ2}}$	–	3	6	V	$I_{Q2} = 30\text{ mA}$ ; $I_{Q1} = 100\text{ mA}^{1)}$
Load Regulation	$\Delta V_{Q2}$	–	50	150	mV	$1\text{ mA} < I_{Q2} < 30\text{ mA}$ ; $V_1 = 24\text{ V}$
Line Regulation	$\Delta V_{Q2}$	–	30	150	mV	$I_{Q2} = 1\text{ mA}$ ; $24\text{ V} < V_1 < 40\text{ V}$
Power Supply Ripple Rejection <sup>2)</sup>	$PSRR_{Q2}$	–	50	–	dB	$f_r = 100\text{ Hz}$ ; $V_r = 1\text{Vpp}$
Output Capacitor's Requirements for Stability	$C_{Q2}$	1.0	–	–	$\mu\text{F}$	– <sup>2)3)</sup>
	$ESR(C_{Q2})$	–	–	5.0	$\Omega$	– <sup>2)</sup>

1) Drop voltage =  $V_1 - V_Q$  (measured when the output voltage has dropped 100 mV from the nominal value).

2) not subject to production test, specified by design.

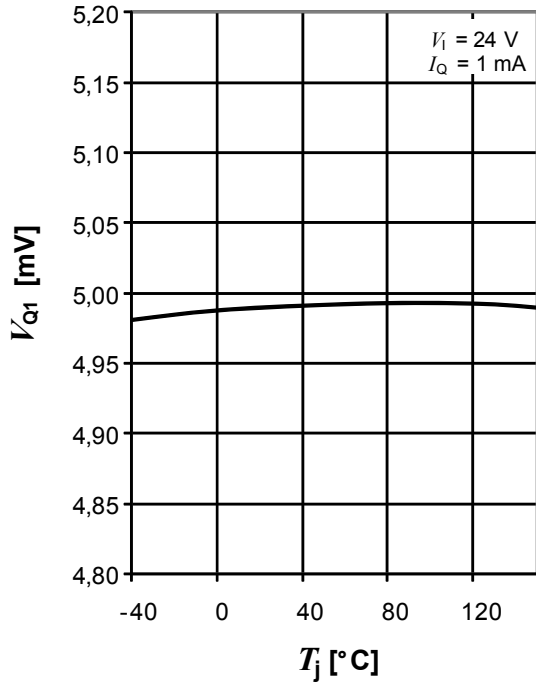
3) for further details please refer to [Chapter 6](#).

*Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specified mean values expected over the production spread. If not otherwise specified, typical characteristics apply at  $T_A = 25\text{ °C}$  and the given supply voltage.*

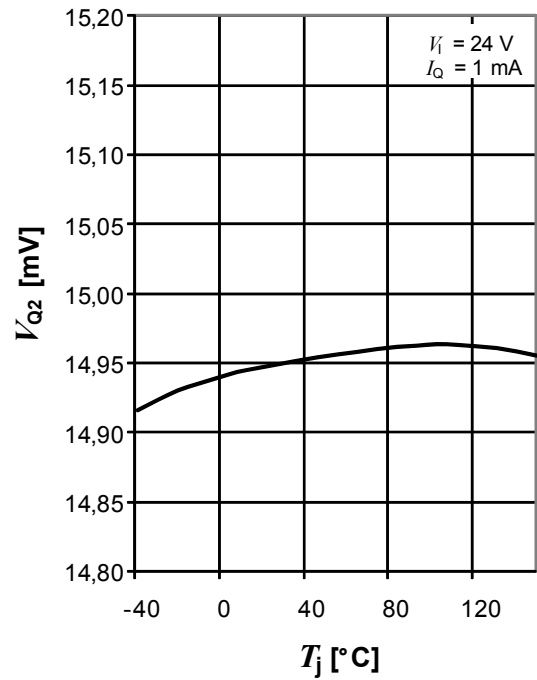


### 5.1 Typical Performance Characteristics

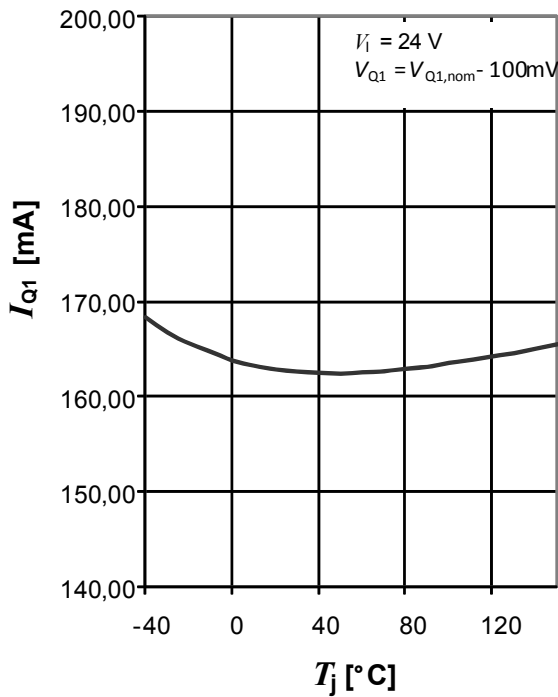
Output Voltage  $V_{Q1}$  versus Junction Temperature  $T_j$



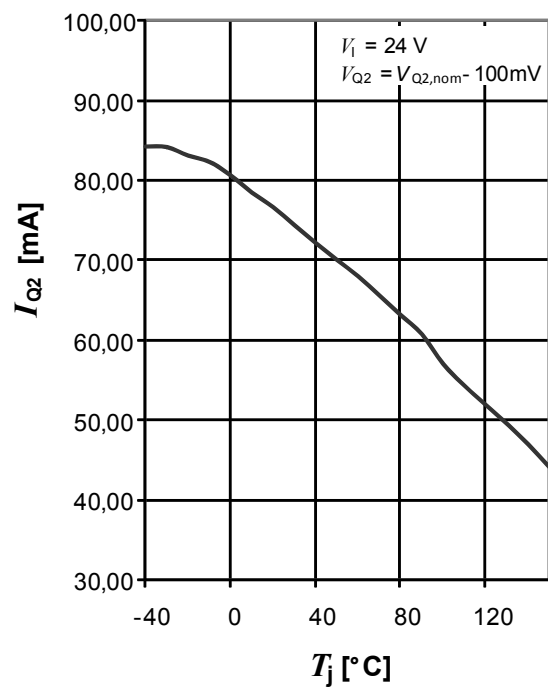
Output Voltage  $V_{Q2}$  versus Junction Temperature  $T_j$



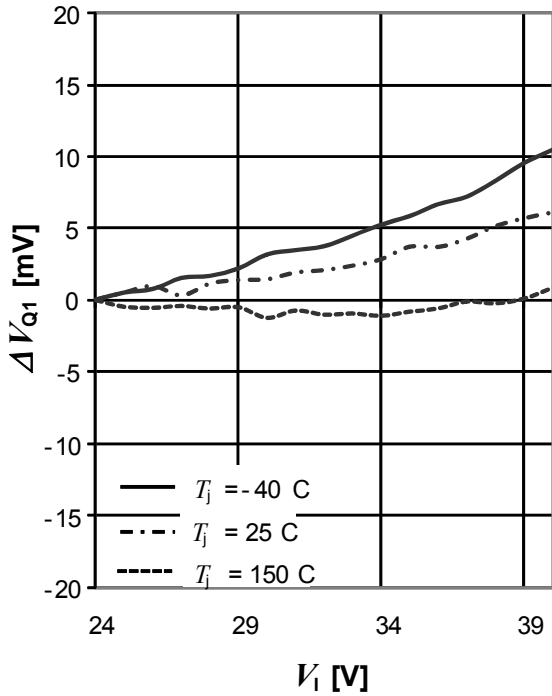
Output Current Limitation  $I_{Q1}$  versus Junction Temperature  $T_j$  (@  $V_{Q1, nom} - 100mV$ )



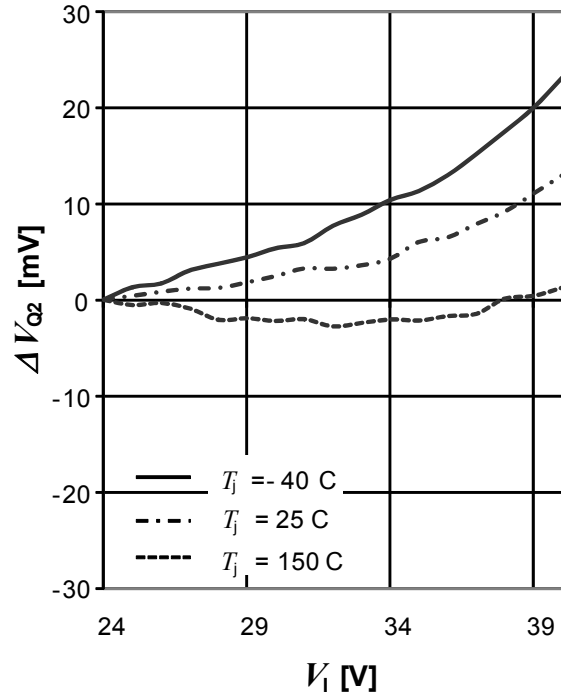
Output Current Limitation  $I_{Q2}$  versus Junction Temperature  $T_j$  (@  $V_{Q2, nom} - 100mV$ )



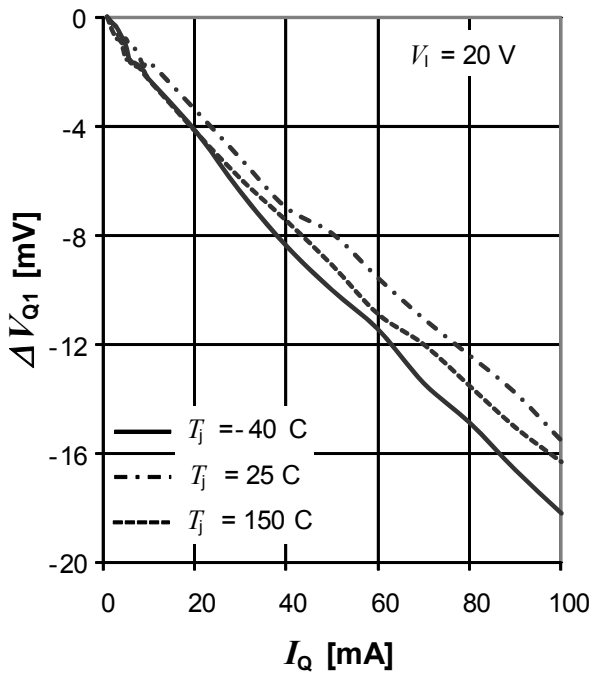
**Line Regulation  $\Delta V_{Q1,line}$  versus Input Voltage Change  $V_I$**



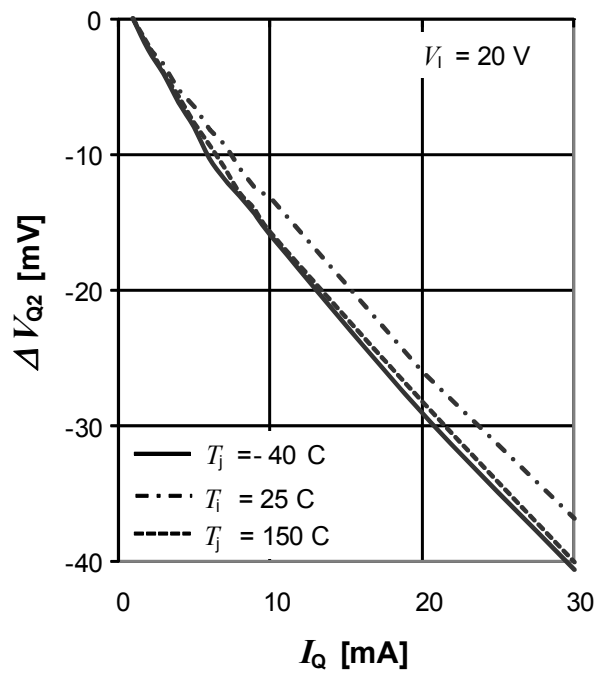
**Line Regulation  $\Delta V_{Q2,line}$  versus Input Voltage Change  $V_I$**



**Load Regulation  $\Delta V_{Q1,load}$  versus Output Current Change  $I_Q$**



**Load Regulation  $\Delta V_{Q2,load}$  versus Output Current Change  $I_Q$**



## 6 Application Information

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.

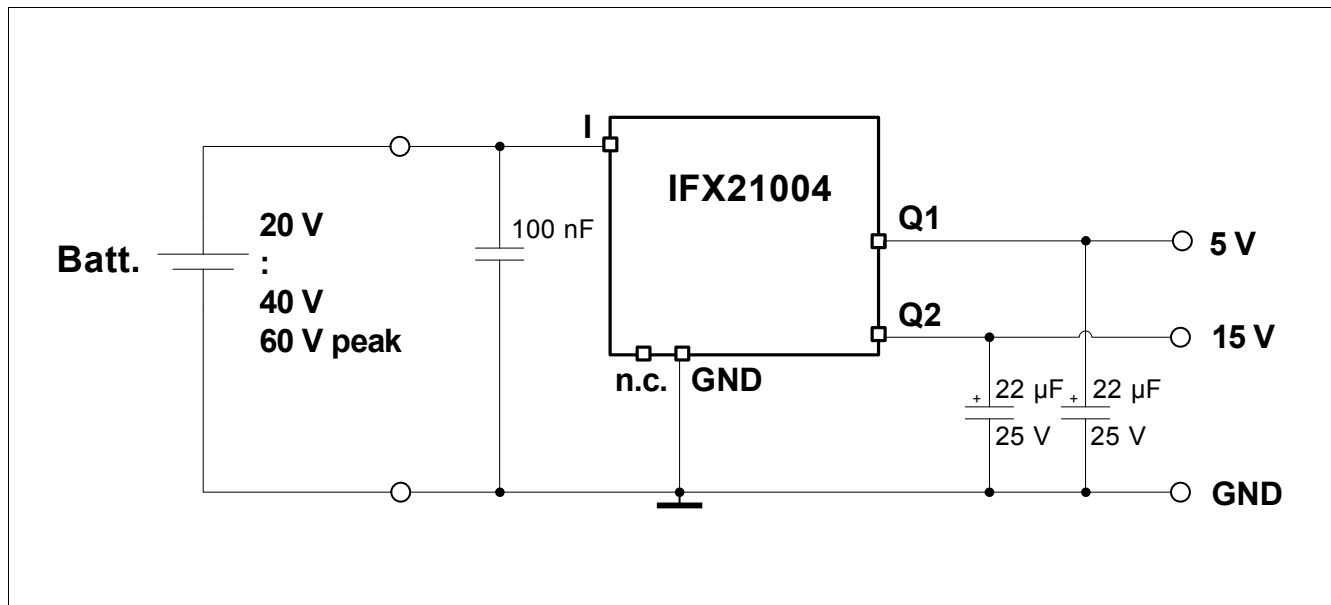


Figure 3 Application Circuit

Note: This is a very simplified example of an application circuit. The function must be verified in the real application.

The IFX21004TN V51 is operating from  $20\text{ V} < V_1 < 40\text{ V}$  (60 V Peak) and can be directly connected to e.g. a battery line. The maximum output current of this regulator is controlled and limited internally; its output short circuit protection to ground is ensured up to  $V_1$ -values of up to 24V.

When any high frequency disturbance is existing and should be filtered, an input capacitor in the range of 100 nF is helpful.

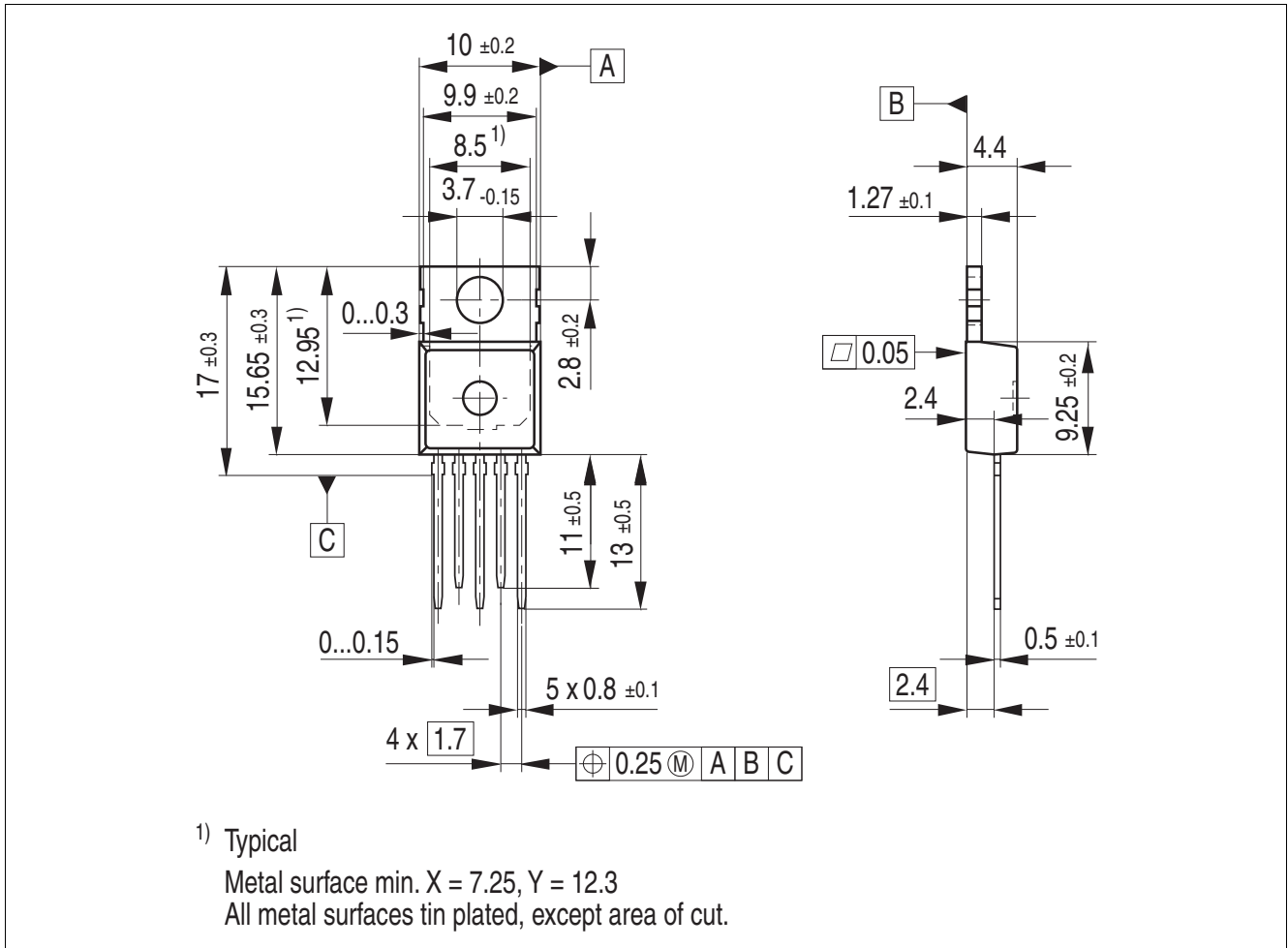
At both outputs Q1 and Q2 capacitors  $C_{Q1}$  and  $C_{Q2}$  are required in any case to maintain regulating stability. Therefore as minimum values the specification in [Table 4 “Electrical Characteristics” on Page 7](#) needs to be respected. In addition, to keep a good line transient regulation<sup>1)</sup> and load transient regulation<sup>2)</sup>, capacitor values of  $C_{Q1} = C_{Q2} > 22\text{ }\mu\text{F}$  are recommended.

The IFX21004TN V51 is capable to withstand input voltages exceeding its nominal operating range up to values of 60 V during short time periods of up to 400ms. Such short input voltage pulses exceeding 40 V are absorbed by activating an internal zener diode structure. Please note in this context that, due to hysteresis, in some cases the zener diode may remain activated also after the pulse when the input voltage is afterwards around values of 40V. If in such cases the input voltage is lowered afterwards the power zener will be switched off again. During the switching of the zener diode the effects of potential switching noise needs to be considered as they may cause transients on the outputs Q1 and Q2. The occurrence of such transient output voltages is dependent on the application's load as well as the used output capacitors. Such potential output transients can be minimized by using larger values for  $C_{Q1}$  and  $C_{Q2}$  that will damp such output transients.

1) fast voltage transients at the regulator's input

2) fast current transients at the regulator's output

## 7 Package Outlines



**Figure 4 PG-TO220-5 (Plastic Small Outline Transistor)**

### Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e. Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

## 8 Revision History

Revision	Date	Changes
1.00	2010-11-04	Data Sheet Initial Release

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