Minipuls 2.2

Manual

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1. Safety

Attention!
This device works with high voltage to 12 000 V, possible in the short-circuit currents up to 100 mA. Do never touch the output or anything connected to it while in operation.

Attention: Also at Maintenance and adjustment works, do never touch the transformer cascade. The primary voltages are limited to 40 V and harmles. The bridge converter should never operate without fuse (max. 4A)

Attention: In operation grounded both boards! The cascade board at the bottom left mounting bolts and the bridge board at any bolts.

2. Principle of operation

The assembly Minipuls 2.2 is developed to generate high AC voltages up to 10 kV peak (=20kVpp or 7 kV RMS). The operation frequency range is 5-20 kHz. The device consists of a full bridge converter and a transformer cascade. Input voltages can be supplied by a standard laboratory power supply. The converter delivers a powerful low voltage square wave, and the cascade transforms this up and filters out a sine-like waveform. For monitoring, there is a high voltage divider and a current monitor. The device is protected against over voltages by a spark gap.

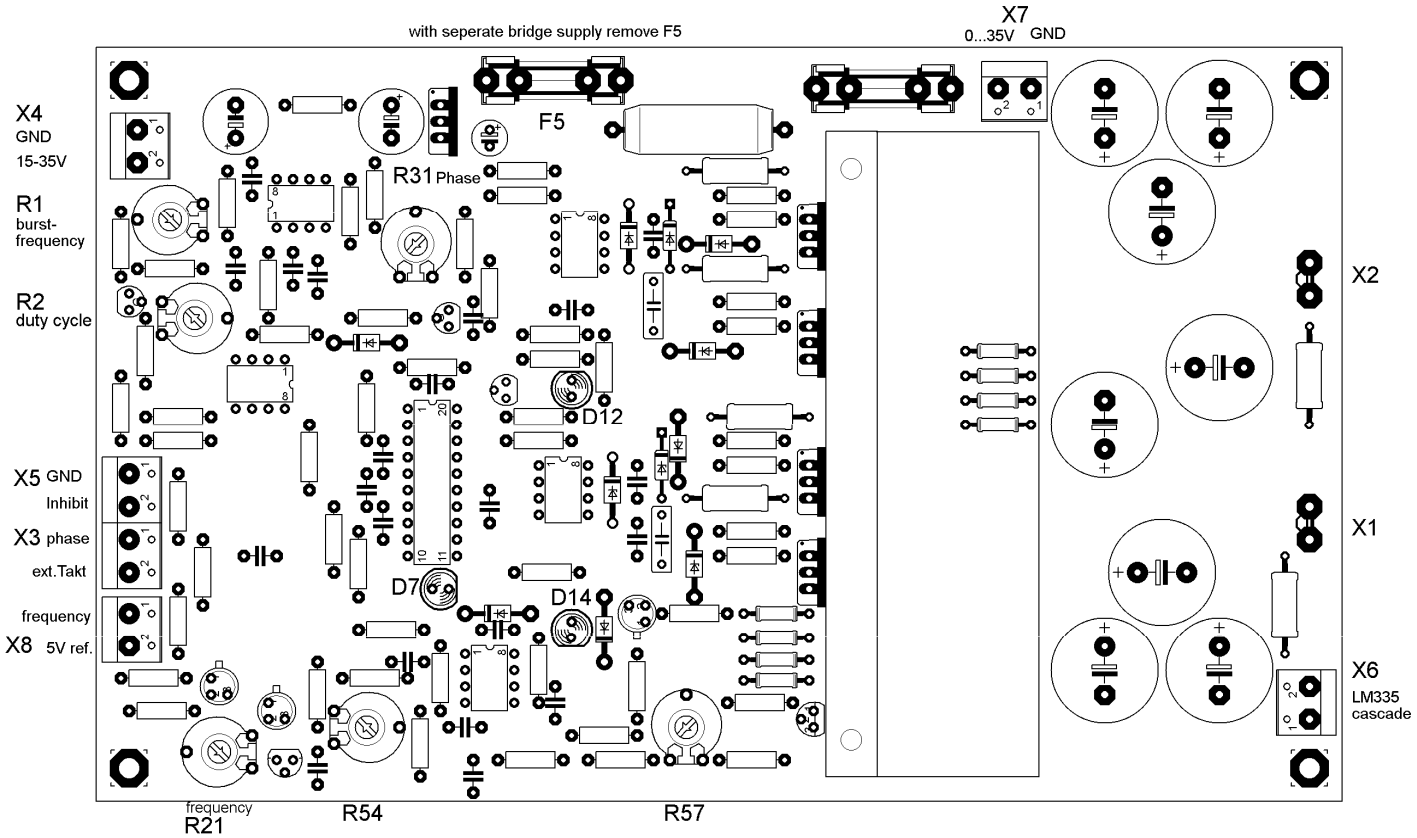
3. Operation

At first connect supply voltage 15-35 V on terminal X4-2 (GND: X4-1). Second connect the twisted red/black cable between terminal X6 bridge converter and terminal X9 of the transformer cascade. Thirdly check the inhibit-input (X5-2 chapter 3.1.1). In case of unknown load to start with low supply voltage (15V) and choose a higher frequency 20 kHz (potentiometer ï R21 right stop; duty R2 left stop).

It is important to connect the ground from transformer cascade with the ground of the full bridge (yellow/green cable).

3.1 Connections

3.1.1 Bridge converter



output bridge converter X1 and X2
The transformer cascade is connected here by means of a 6.3mm plug (twisted black cable).

phase input X3-1
Can be used to adjust the high voltage amplitude (analog input: 0 to 5V allowed;
setting: 1V é 3.3V ←→ 0é 180°).

supply voltage X4-2 (+) , X4-1 (-)
Connect an external supply voltage of nominal 24 V (possible 15-35V).

inhibit-input (X5-2)
The inhibit-input disables the generator at input voltages >2V and enables it at <2V.

disables	Input open or U > 2 V
enables	U < 2 V

Current into signal inputs <0.5mA

terminal X6 ï NTC Thermistor (10k)
Connect a twisted grey cable with the terminal X9 of the transformer cascade. Monitoring the temperature at the first transformer and switches off by over temperature.

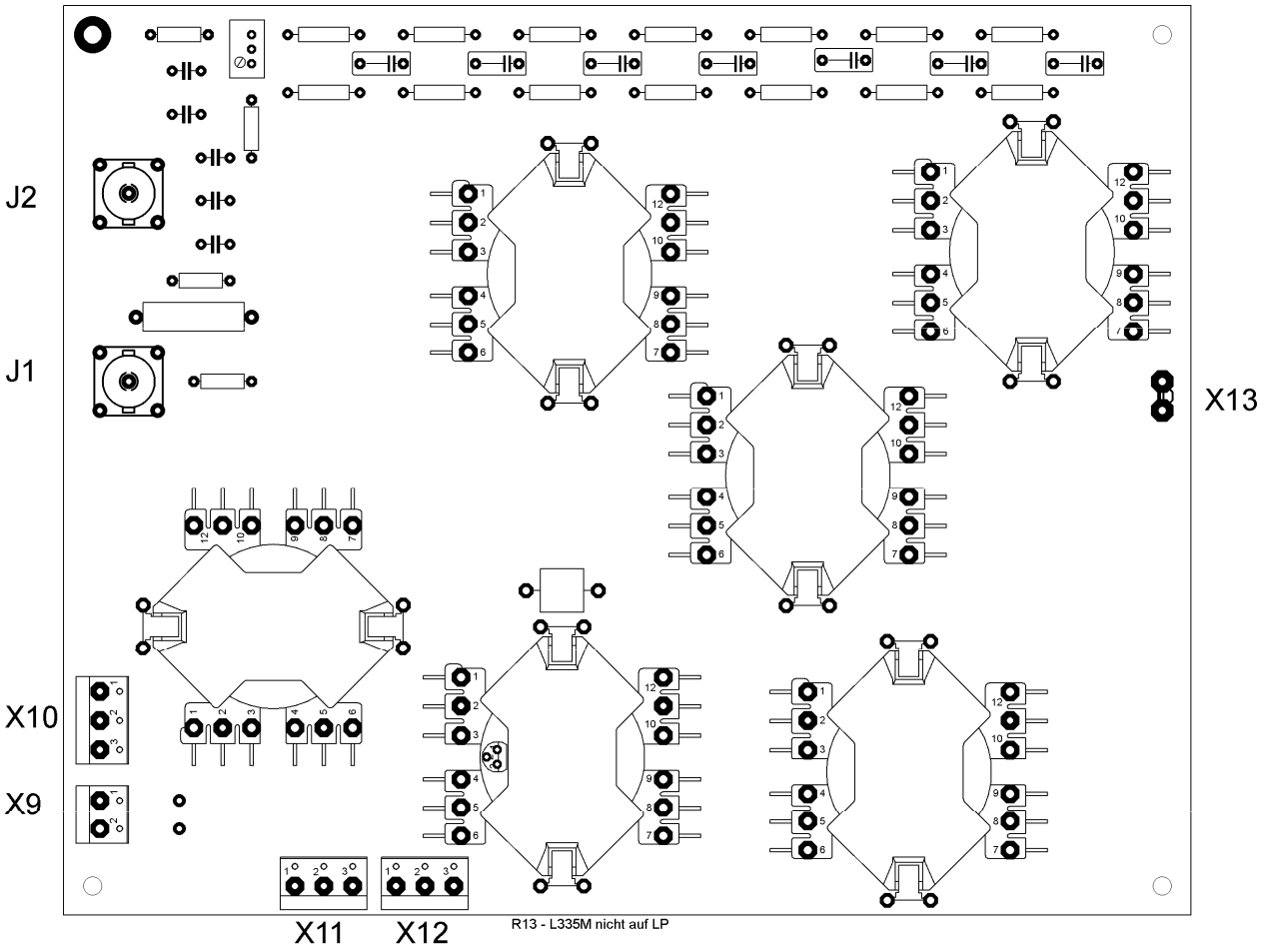
external control pulse input X3-2
Connect external control pulse generator to the signal input on terminal X3-2. The pulse generator is controlled by the signal input with a TTL signal. The output frequency is the half clock frequency. R21 (frequency potentiometer) this case should be set to minimum frequency (stop left).

separate bridge supply X7-2 (X7-1 GND)
If this input use, the 4A-fuse must be removed at F5 and insert to F1. Itôs a input voltage between 0-35V allowed.

frequency control input X8-1
The frequency increases proportionally to the applied voltage. The setting of R21 sets the minimum frequency.

reference output +5V X8-2
Can be used to supply a external potentiometer (10kOhm) for connection with input phase or frequency control.

3.1.2 Transformer cascade



terminal X9 ï NTC Thermistor (10k)
see above 3.1.1 bridge converter ï connect the NTC thermistor.

transformer cascade input X10-1 and X10-3
The bridge converter (X1, X2) is connected here by means of a terminal.

terminals X11 and X12

connections	inductance	connections	transformation ratio output transformer
X11-1	81 µH	X12-1	1:146
X11-2	121 µH	X12-2	1:121
X11-3	169 µH	X12-3	1:103

monitor output J1 (I) , J2 (U)
Output current and -voltage can be measured on the monitor output. J1 has a relation of 10V/A. The voltage monitor signal has a divisor relation from nominally 1:1000. If a cable connected to the exit, the capacity has influence on the divisor relation. The divisor relation should be postcalibrated.

high voltage output X13
The load is connected directly at the end of the transformer cascade. A sufficient isolation (to least >5cm) is important, because the pulse generator delivers voltages up to 12 kV. So it hazardous to touch the output while the unit is in operation.

3.2 Settings

burst frequency R1
adjust the burst frequency in the range 10 to 400Hz.

duty cycle R2
adjust the duty cycle in the range 0 to 100%.

frequency R21
adjust output frequency in the range 5 to 20 kHz.

phase R31
adjust the phase in the range of 0 to 180°.

R54 ï temperature transformer cascade

Set with potentiometer R54 the calibration of the minimum triggering level from NTC Thermistor. Adjusts the maximum temperature of the transformer cascade (R54) in a range from 45é 95°C (conforms: ~2.4...~1.05V). Standard settings are about 85°C and should not be changed. Too high temperature destroy the transformer cascade! Red LED D7 on indicates overtemperature.

R57 ï temperature bridge converter

Set with potentiometer R57 the calibration of the minimum triggering level from temperature sensor. Adjusts the maximum temperature of the bridge converter (R57) in a range from 25é 110°C (conforms: ~2.8...~3.6V). The temperature sensors have a typical error of less than 5°C. Standard settings are about 80°C. If the temperature exceeds 70°C at the heatsink, the generator switches off. Red LED D14 on indicates overtemperature.

3.3 monitoring and limiting

To the destructive influence of unfavorable load or control input has the generator some security circuits:

primary current monitoring: If the primary current exceeds 4 A the pulse is switched off immediately (<0.5 µs).

overvoltage limiting: The device is protected against over voltages by a spark gap. If the voltage in the first transformer exceeds 2.5 kV (approx. 12 kV output voltage) the spark gap will fire. Then the voltage, phase or frequency should be reduced.

fuse: If the current is greater 4 A, the fuse will blow.

temperature monitoring bridge converter: If the temperature exceeds 70°C at the transistors, the generator switches off. Red LED D14 on indicates overtemperature.

temperature monitoring transformer cascade: If the temperature exceeds 85°C at the first transformer, the generator switches off. Red LED D7 on indicates over temperature.

4.0 Maintenance, troubleshooting

Danger!
The pulse generator delivers up to 12 kV with serious output power. So it hazardous to touch the output or anything inside while the unit is in operation. All circuits of the pulse generator are fully documented, but because of the dangers maintenance should be restricted to qualified staff.

nothing happens when switch on / control input:

- check the voltage
- fuse okay?
- inhibit activ?
- logic adjusted correct?
- check output transistor, control circuit
- bug in the control input
- short-circuit

loud flashover, crackle noise:

- mistake in the high voltage assembly, voltage to high or ignited the spark cap

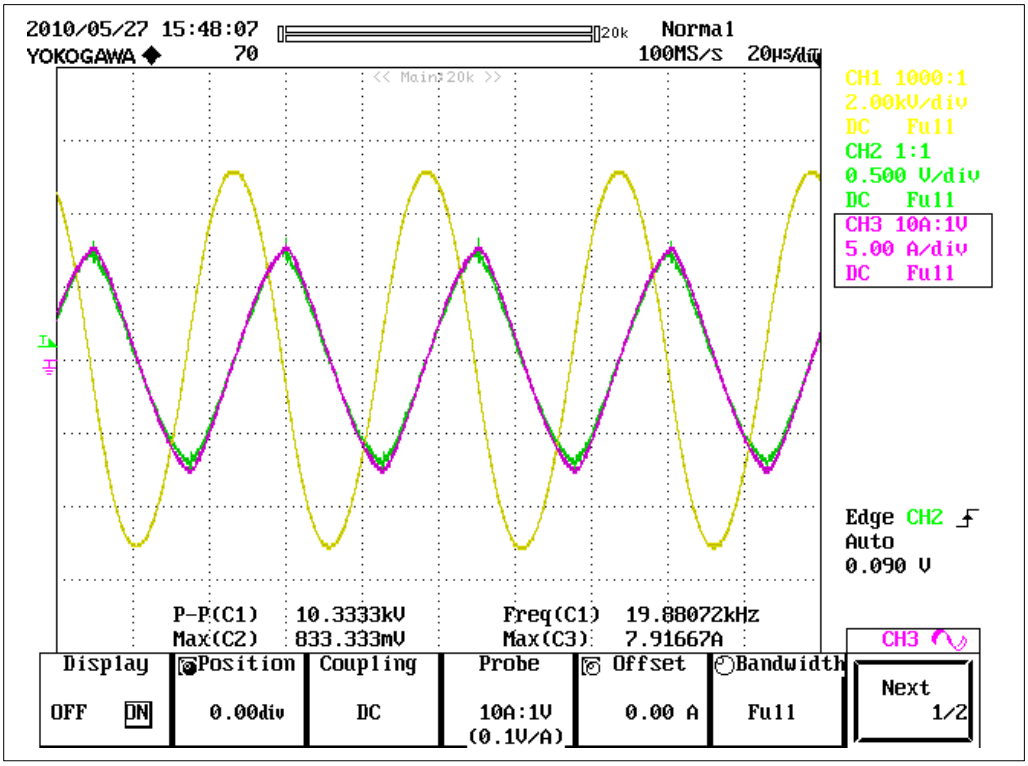
no pulses can be measured, but high primary current:

- switch off device and check switching transistor

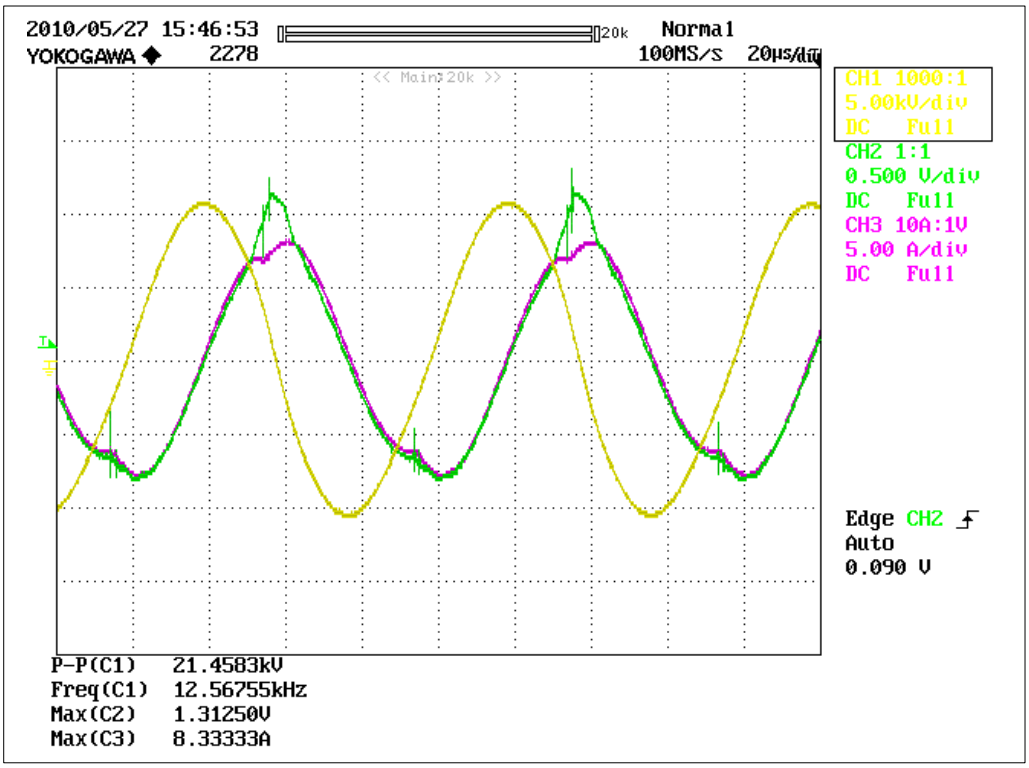
unusual elctric smell

- something may be overheated. Switch of device. Check components (capacitor, transformer, transistor, semiconductor for overheating)

5. Measuring example



load: 90pF CH1: output voltage CH2: current monitor 10V/A
CH3: primary current cascade



load: 90pF CH1: output voltage CH2: current monitor 10V/A
CH3: primary current cascade

6. Test results Minipuls 2.2

by:	date:	serial number

Voltage divider 1:1000

test voltage 20Vpp	
5 kHz sinus	[1:1000 +/- 10%]
10 kHz sinus	[1:1000 +/- 10%]
20 kHz sinus	[1:1000 +/- 10%]

Control board

delay time full bridge	**IC3**	**IC4**
rising edge input ⇔ falling LO	µs	µs
rising edge input ⇔ rising bridge	µs	µs
rising edge input ⇔ rising HO	µs	µs
falling edge input ⇔ rising LO	µs	µs
falling edge input ⇔ falling bridge	µs	µs
falling edge input ⇔ falling HO	µs	µs

operating parameters

	minimal	maximal
pulse frequency	kHz	kHz
burst frequency	Hz	Hz
phase	°	°
duty cycle	%	%

inhibit-input:
external control (TTL):
temperature monitoring ï calibration:

calibration temperature monitoring

	adjusted voltage-value	temperature
control board		
transformer cascade		

output

resonance frequency idle ï [inductance 1 ï transformer 3]	kHz
resonance frequency idle ï [inductance 3 ï transformer 1]	kHz
maximum voltage by overvoltage protection (idle)	kV
Ue=30V, output shorted, maximum output current by overcurrent detection (measure on 55mΩ shunt)	A

Transformer cascade
operation with different conditions (capacitive)

bridge voltage [V]	supply current [A]	duty cycle [%]	burst frequency [Hz]	load [pF]	inductance	pulse frequency [kHz]	output voltage [kVpp]	current monitor [mA]	pulse current [A]
15 V		50	50	90	1/3				
15 V		50	400	90	1/3				
30 V		50	50	90	1/3				
30 V		50	400	90	1/3				
15 V		100	-	90	1/3				
30 V		100	-	90	1/3				
15 V		100	-	125	1/3				
30 V		100	-	125	1/3				
15 V		100	-	90	3/1				
30 V		100	-	90	3/1				
15 V		100	-	125	3/1				
30 V		100	-	125	3/1				
15 V		100	-	90	1/1				
30 V		100	-	90	1/1				
15 V		100	-	125	1/1				
30 V		100	-	125	1/1				
15 V		100	-	90	3/3				
30 V		100	-	90	3/3				
15 V		100	-	125	3/3				
30 V		100	-	125	3/3				

thermal

supply voltage	supply current	time	What components get warm?
30 V	**2 A**	**5 min**	

OK: