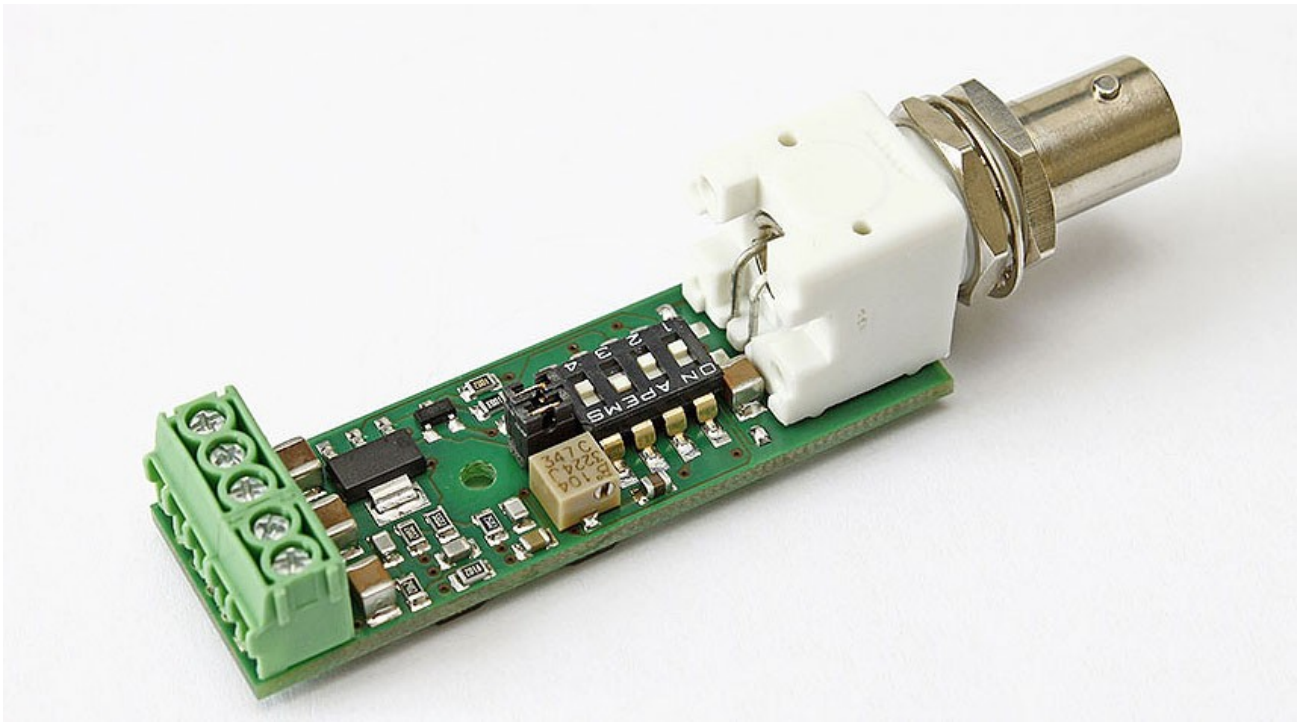
IPE-FM3 – versatile DC / AC / IEPE front end

1 Description



The module IPE-FM3 is a versatile front-end for DC / AC or IEPE signal conditioning applications.

The amplifier circuit is equipped with a switchable constant current source, which is powered from a 24 VDC power supply to meet the requirements of IEPE two-wire technique.

IPE-FM3 dispense with the on-board switching regulators (such as IPE-FM1) to obtain the best-possible signal quality. The three supply voltages +12 to 15 VDC, -12 to 15 VDC and +24 VDC are supplied externally here.

Amplifiers

To adapt to different measurement tasks, the module may be equipped with different types of amplifiers:
Type 1: Single FET amp with gain G = 1
Type 2 Real instrumentation amp (PGA207 = differential FET inputs) with switchable gain G = 1, 2, 5, 10
Type 3: Combination of FET input amplifier G = 1 and subsequently a switchable amplifier (PGA103) with the gains G = 1, 10, 100
Type 4: Combination of the instrumentation type PGA207 and PGA103 below the type. For gains of 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 can be adjusted.
Amplification factors higher than 100 may no longer useful for high-impedance AC input, but precise DC output, eg be operated for IEPE application.

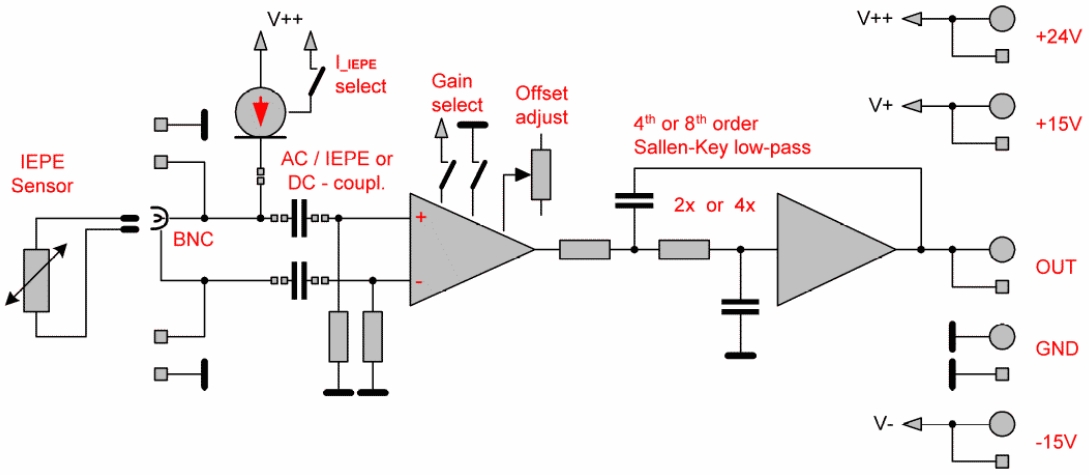
Here is the DC offset voltage due to the high impedance input resistors, no longer manageable. Already changes in the uV range resulting output change in the 1-2 digit mV range. Here already submits draft on the module to AC-coupling of eg 4.7 uF and 100 K ohm to cause a change in output of some 10 mV.
Therefore, gains higher than 100 for DC applications are provided with a low source impedance.

Active Filters

The versatility of IPE-FM3 is enhanced by the combination of amplifier / IEPE current source plus anti-aliasing filters already on the module. The Sallen-Key low-pass filter circuit can be equipped with the filter characteristics of Bessel or Butterworth in the frequency range 500 Hz to 20 kHz in 4th or 8th order.
The choice of filter characteristics and cut-off frequency depends on the application and is the responsibility of the user.

IPE-FM3 – versatile DC / AC / IEPE front end

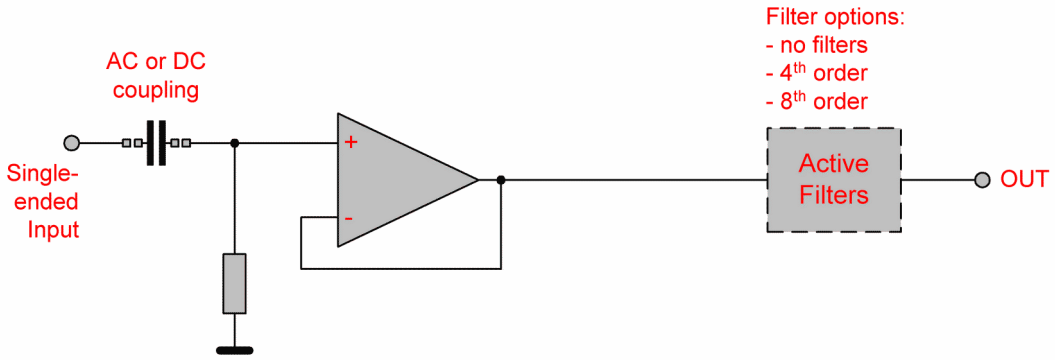
2 Schematic: Principle of the IPE_FM3 – amplifier and active filters



3 Assembly Variants

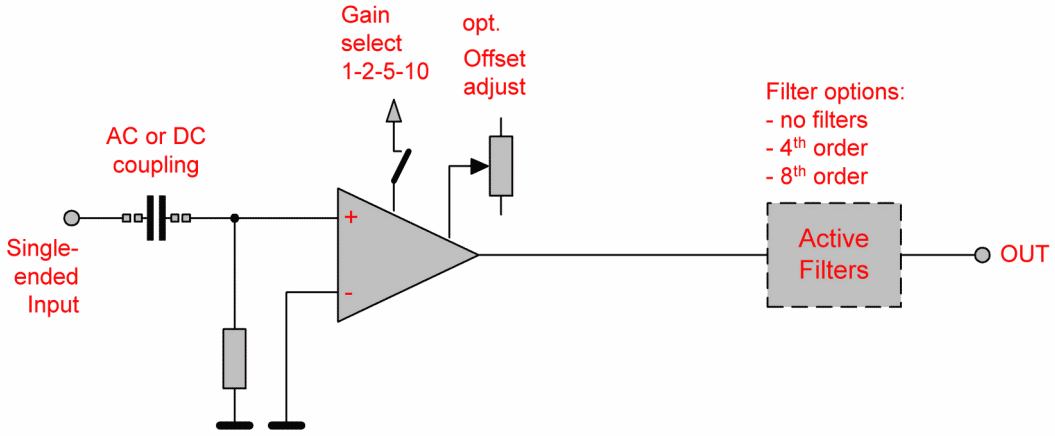
Amp Type 1: Single FET-Amp G = 1

Application:
- AC
- DC
- IEPE



Amp Type 2: Instrumentation-Amp PGA207 – single-ended input G = 1-10

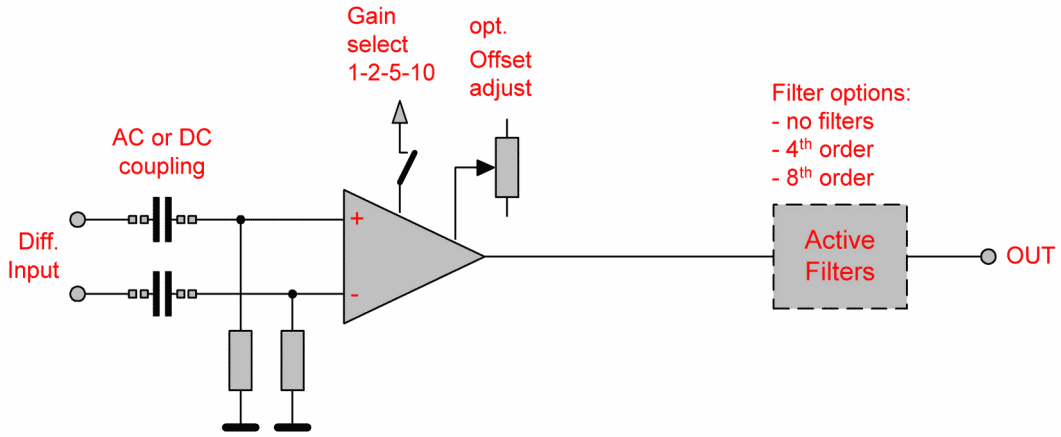
Application:
- AC
- DC
- IEPE



IPE-FM3 – versatile DC / AC / IEPE front end

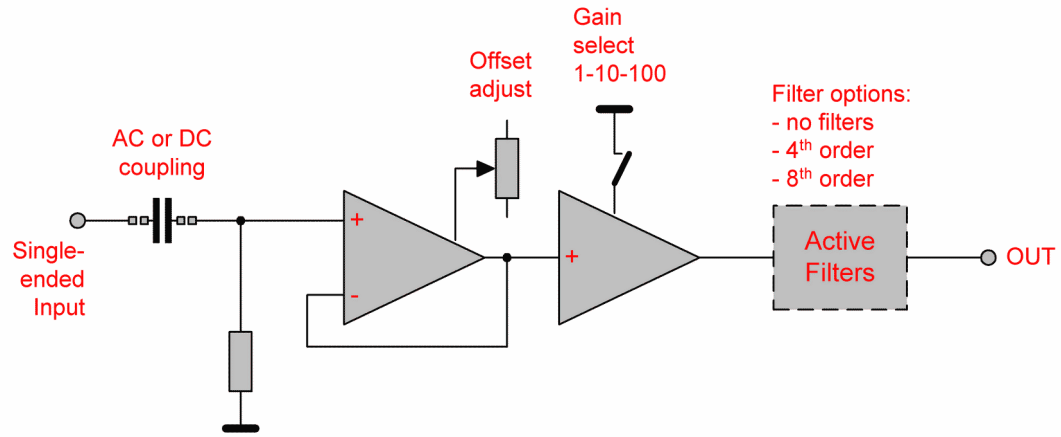
Amp Type 2: Instrumentation-Amp PGA207 – real instrumentation input G = 1-10

Application:
- AC
- DC



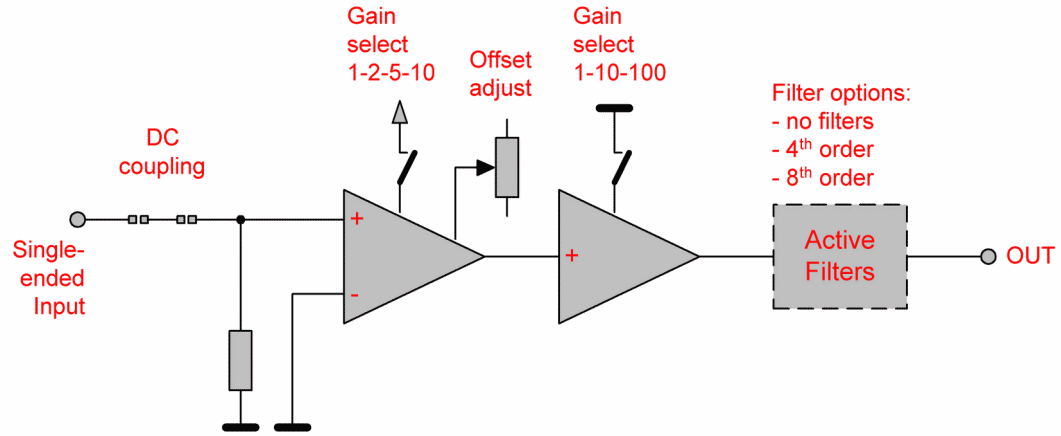
Amp Type 3: Single FET-Amp plus Programmable Gain Amp PGA103 – single-ended input G = 1-100

Application:
- AC
- DC
- IEPE



Amp Type 4: PGA207 and PGA103 – single-ended input G = 1-1000

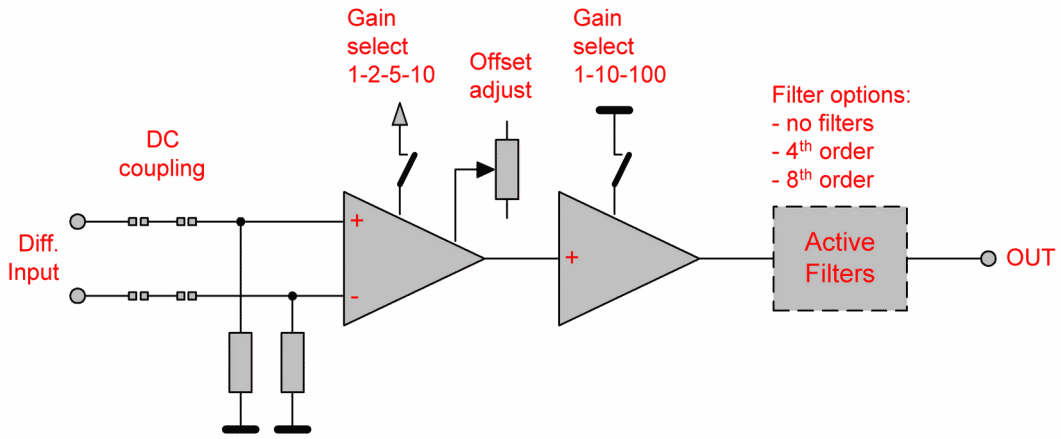
Application:
- low-imped. DC



IPE-FM3 – versatile DC / AC / IEPE front end

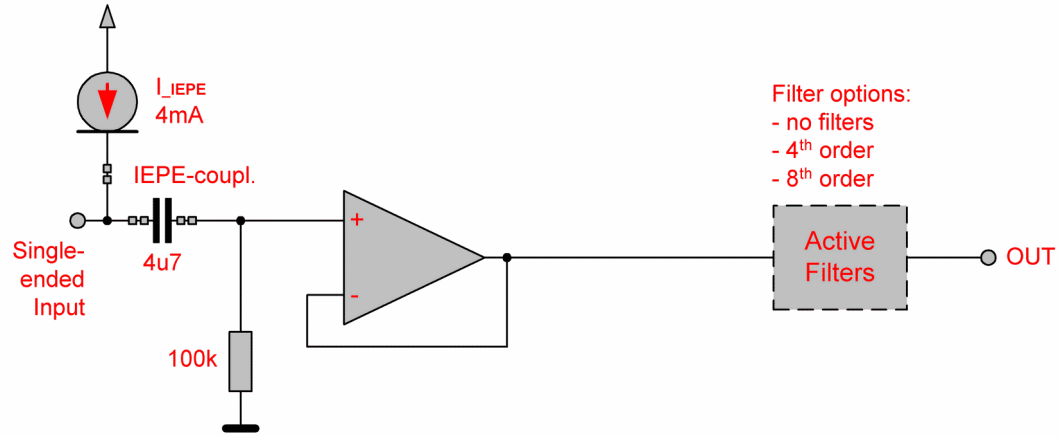
Amp Type 4: PGA207 and PGA103 – real instrumentation input G 1-1000

Application:
- low-imped. DC



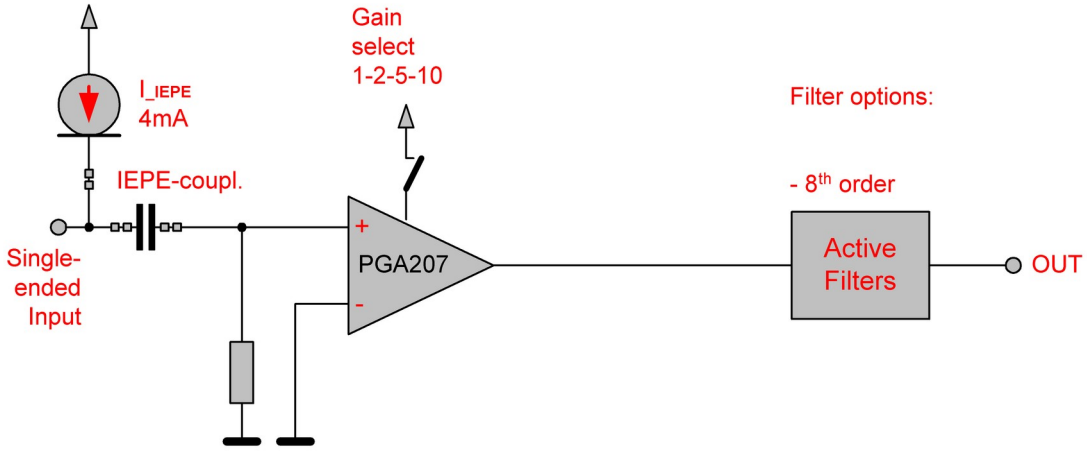
Most simple IEPE configuration: Single-ended Input G = 1

I_{IEPE}: fixed to 4 mA



Usually used IEPE configuration: Single-ended Input G = 1-10

I_{IEPE}: fixed to 4 mA



IPE-FM3 – versatile DC / AC / IEPE front end

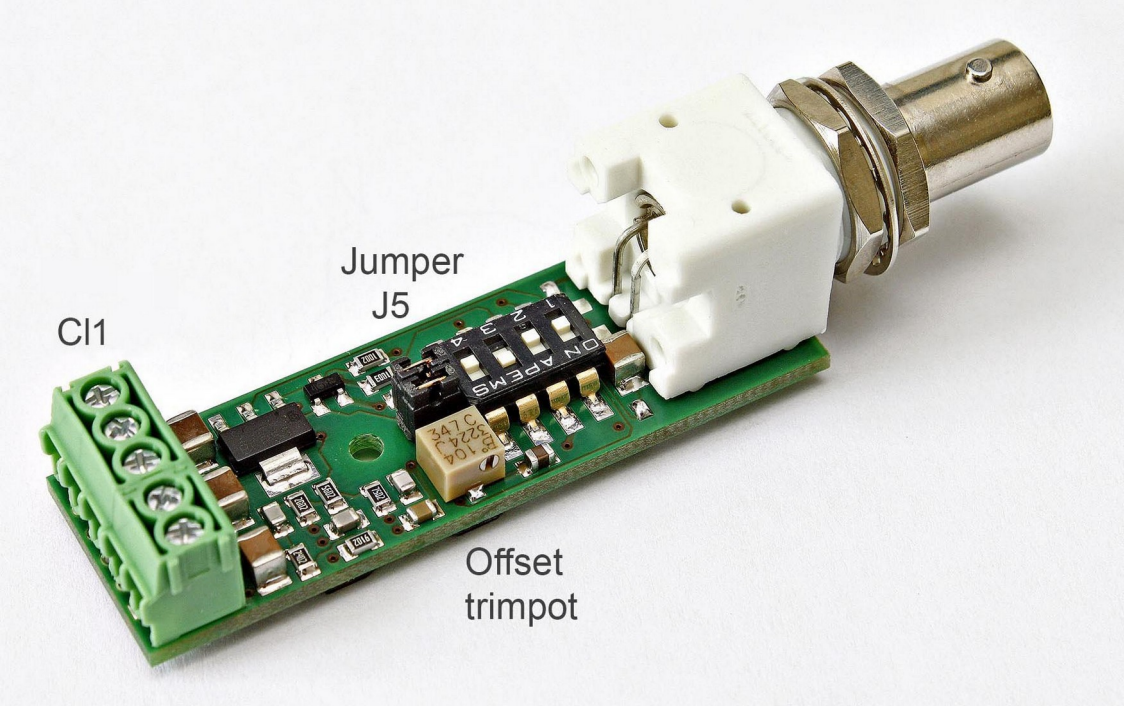
4 Module Versions – different applications – different connectors

Version A

Input:
BNC

Output and power supply:

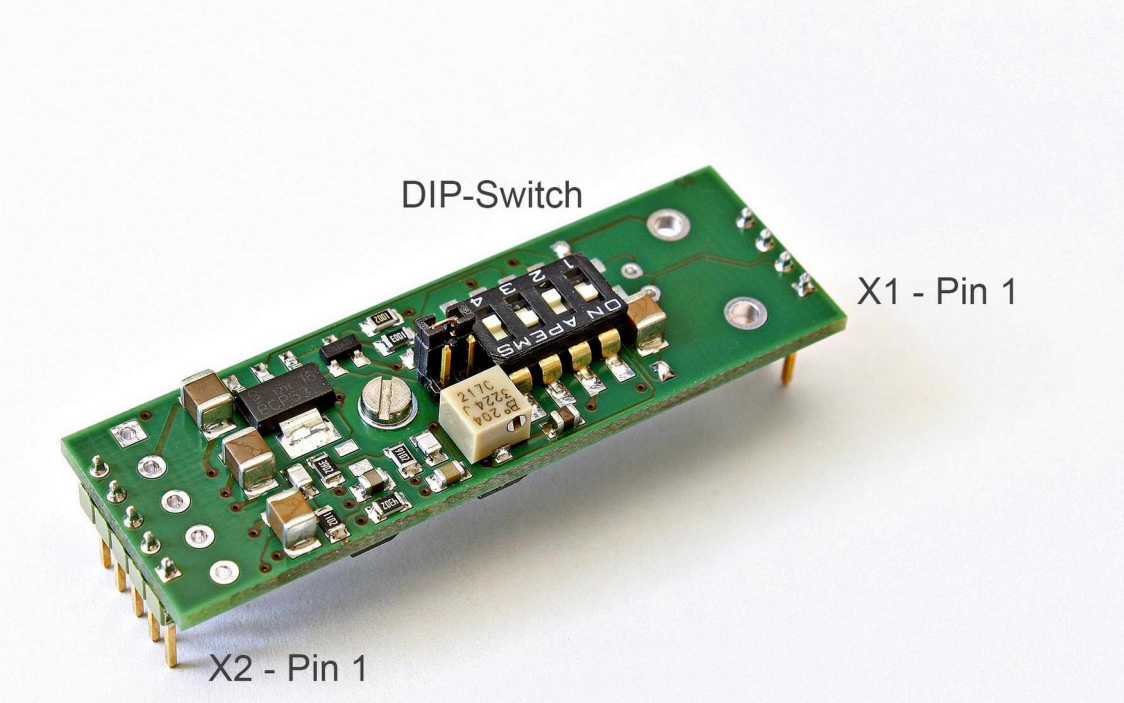
Scew terminals 5-pin



Version B

Input:
Pin header
X1 4-pin

Output and power supply:
Pin header
X2 5-pin



Standard profile: Pin header AMP Modu II plus socket connector AMP HV-100
Screw M2x6, Standoff 10.5 mm = 10 mm + 1 lining disk
Option: low-profile pin headers and female socket connectors available

IPE-FM3 – versatile DC / AC / IEPE front end

Built-In Example

Version A

Power Supply for 4 Channel

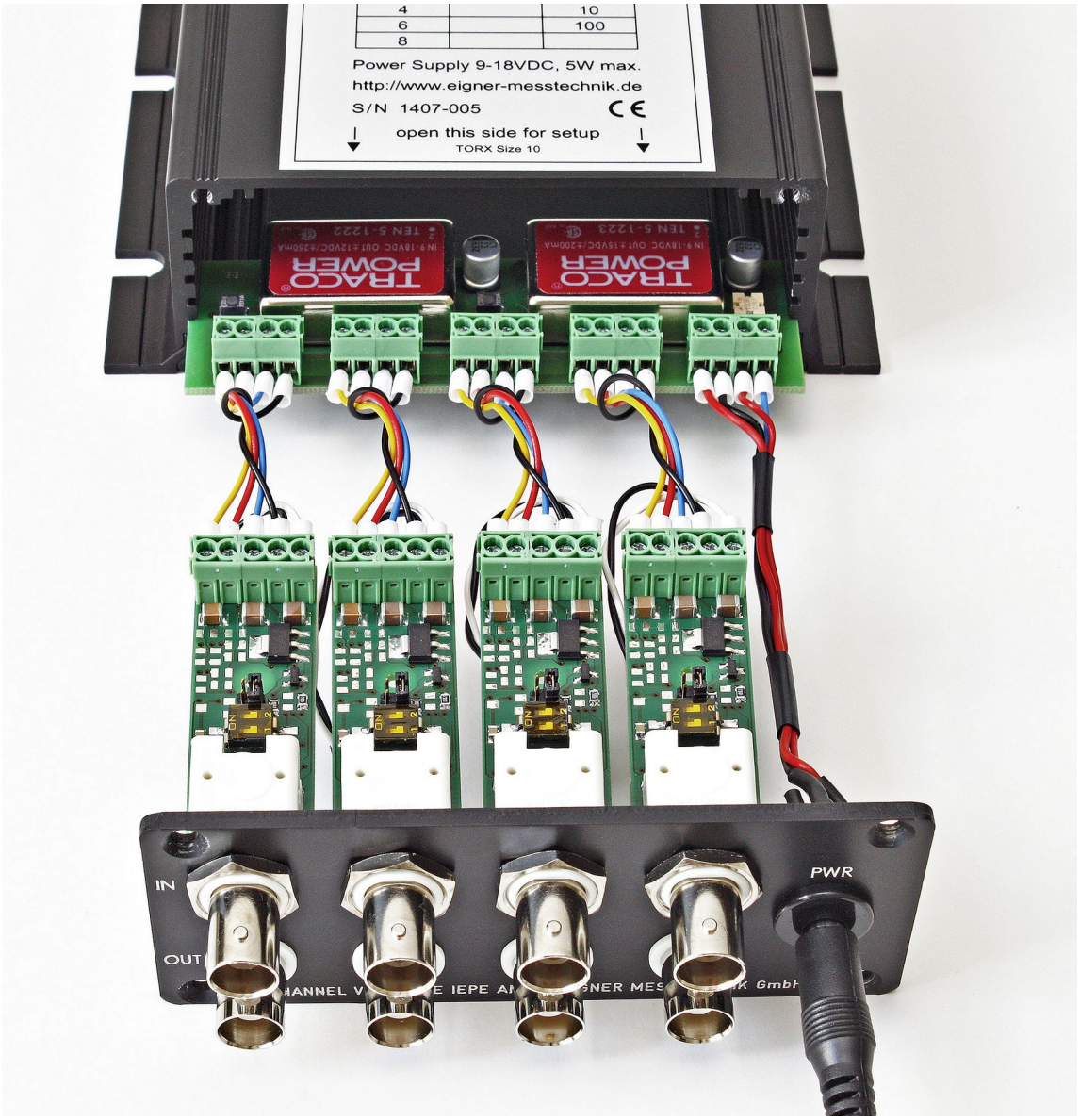
IPE-FM3 – versatile DC / AC / IEPE front end

4 Modules

built-in

plus

Power Supply



IPE-FM3 – versatile DC / AC / IEPE front end

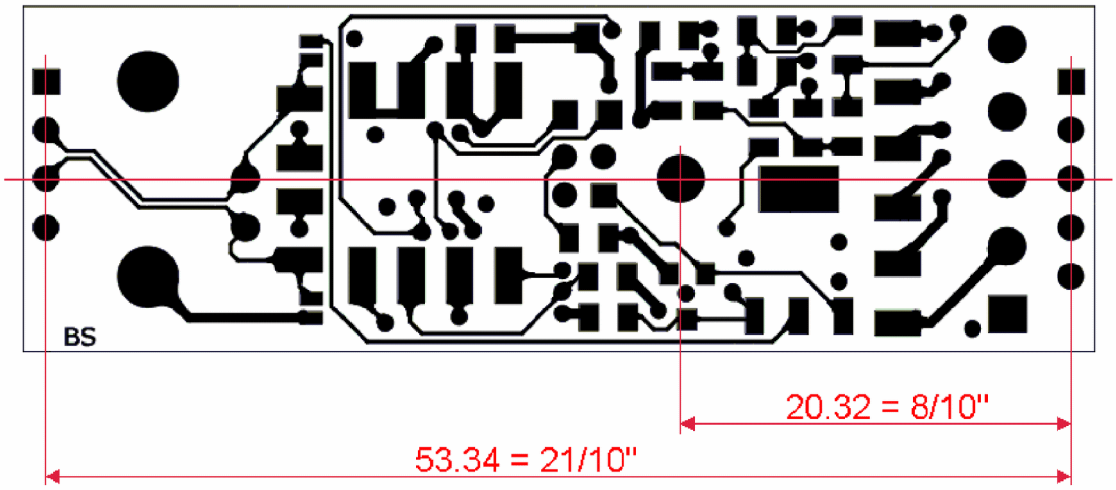
5 Modules – Physical dimensions

Over all size (without BNC):

55.74 x 18 [mm]

With BNC:

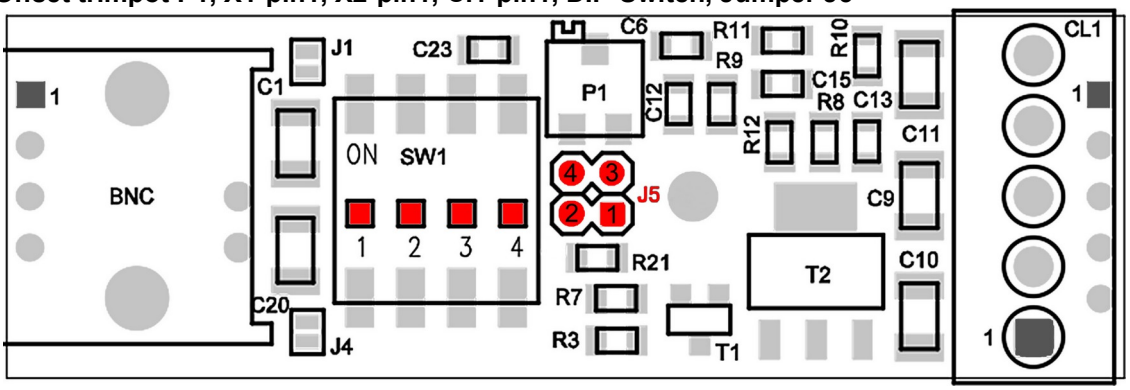
77.7 x 18 [mm]



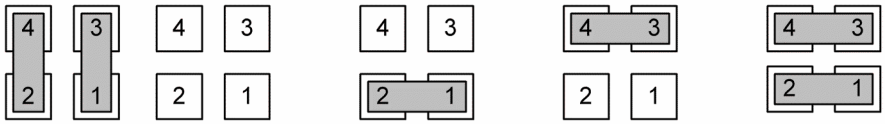
Pin header to pin header and pin header to mounting hole:
Suitable to main boards with 1/10” grid

6 Switches and Jumpers

Position: **Offset trimpot P1, X1-pin1, X2-pin1, CI1-pin1, DIP-Switch, Jumper J5**



Position: **I_{IEPE} setup: Jumper J5**



Option: I_{IEPE} 1 - 2 - 3 - 4 [mA]

IPE-FM3 – versatile DC / AC / IEPE front end

7 Module pin assignment

Pin headers or screw terminals

X1		X2		CI	
1	GND	1	+24 VDC	1	Output
2	+ Input	2	+ 15 VDC	2	GND
3	- Input	3	-15 VDC	3	-15 VDC
4	GND	4	GND	4	+15 VDC
		5	Output	5	+24 VDC

8 Gain setup

Amp Type 2: Programmable Instrumentation Amp PGA207

DIP-Switch on module

PGA207						
1	2	- - -	- - -	GAIN		
OFF	OFF			1	recommended for	DC / AC / IEPE
ON	OFF			2	recommended for	DC / AC / IEPE
OFF	ON			5	recommended for	DC / AC / IEPE
ON	ON			10	recommended for	DC / AC / IEPE

Amp Type 3: Programmable Gain Amp PGA103

DIP-Switch on module

		PGA103				
- - -	- - -	1	2	GAIN		
		ON	ON	1	recommended for	DC / AC / IEPE
		OFF	ON	10	recommended for	DC / AC / IEPE
		ON	OFF	100	recommended for	DC / AC / IEPE
		OFF	OFF	not valid	not valid	generally

Amp Type 4: Combination PGA207 and PGA103

DIP-Switch on module

PGA207		PGA103				
1	2	3	4	GAIN		
OFF	OFF	ON	ON	1	recommended for	DC / AC / IEPE
ON	OFF	ON	ON	2	recommended for	DC / AC / IEPE
OFF	ON	ON	ON	5	recommended for	DC / AC / IEPE
ON	ON	ON	ON	10	recommended for	DC / AC / IEPE
OFF	OFF	OFF	ON	10	not recommended	
ON	OFF	OFF	ON	20	recommended for	DC / AC / IEPE
OFF	ON	OFF	ON	50	recommended for	DC / AC / IEPE
ON	ON	OFF	ON	100	recommended for	DC / AC / IEPE
OFF	OFF	ON	OFF	100	not recommended	
ON	OFF	ON	OFF	200	recommended only for	low-imped. DC
OFF	ON	ON	OFF	500	recommended only for	low-imped. DC
ON	ON	ON	OFF	1000	recommended only for	low-imped. DC
X	X	OFF	OFF	not valid	Invalid setting	

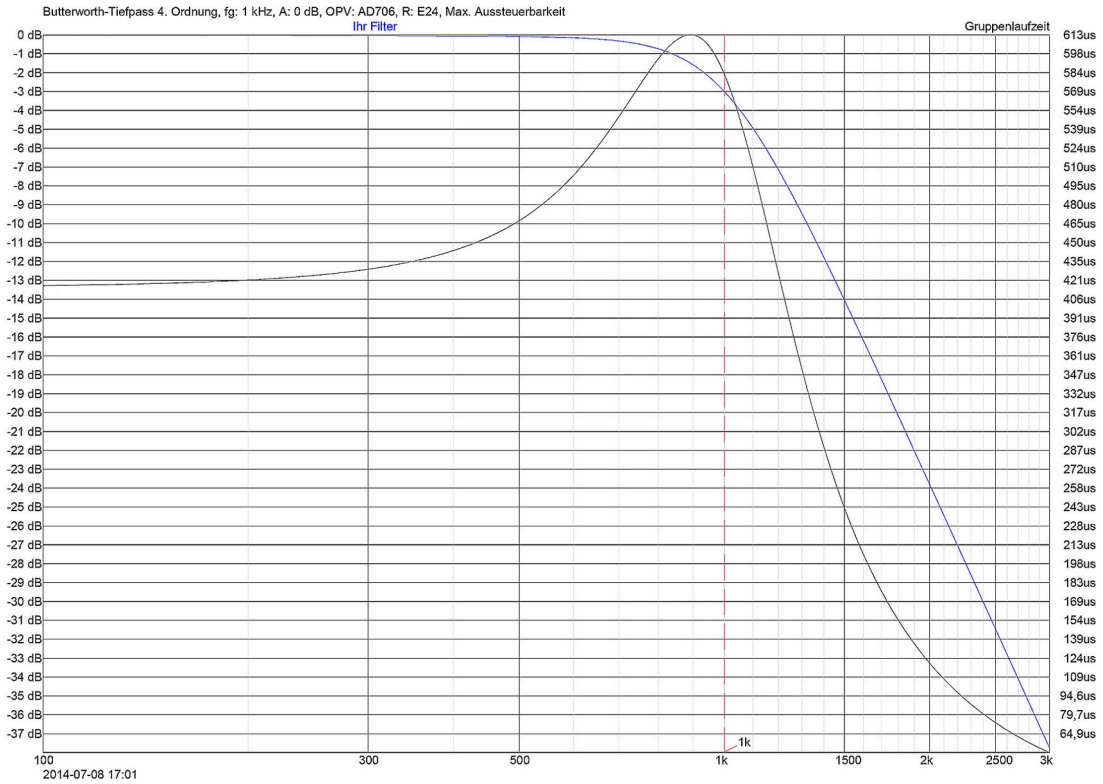
IPE-FM3 – versatile DC / AC / IEPE front end

9 Active Filters: cut-off frequencies – group delays

Blue: Amplitude vs. frequency
Black: Group delay vs. frequency
Red: Cut-off frequency (-3dB)

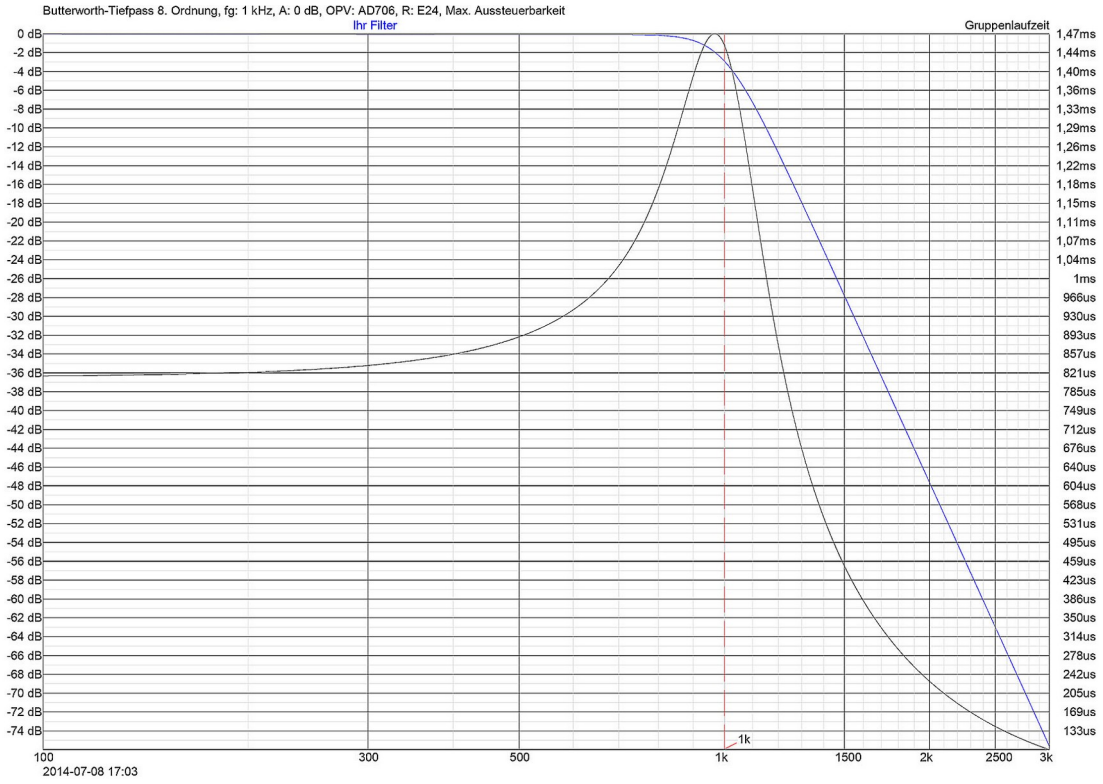
Butterworth 4th order

Example 1 kHz



Butterworth 8th order

Example 1 kHz



IPE-FM3 – versatile DC / AC / IEPE front end

10 Electrical Data

Power supply	Amplifier, Filters: ±12 to ±15 VDC **and** additionally for IEPE application IEPE current source: +24 to +30 VDC Current cons. @ +15 VDC max. 16mA, -15 VDC max: 18mA (depending on the built-in amps) Current cons. @ +24 VDC max. selected $I_{_IEPE}$ plus approx. 1 mA
Signal range	@V_{Supply} ±12 VDC: V_{Signal} = 0 to ±8 V (min) @V_{Supply} ±15 VDC: V_{Signal} = 0 to ±10 V (min
Frequency range	DC: 0 to 20 kHz (min.) AC / IEPE: 0.5 (-3 dB) to 20 kHz (min.)
Gain accuracy	PGA207: max. ± 0.1 % PGA103: max. ± 0.2 %
DC-Offset	Gain = 1: < ±3 mV Gain > 1: adjustable