DYNACORD

Application Note

Dynacord C series amplifiers
for direct drive

Version 1.1

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Motivation

Dynacord's C series amplifiers are not only capable of driving low impedance loudspeakers but can also drive on constant voltage or so called 70/100 V lines in direct drive (without an output transformer).
70 V or 100 V lines are used to drive a large number of distributed loudspeakers. The higher voltage results in a lower electric current allowing long cable runs. Direct drives saves cost and weight of output transformers, the amplifiers drive the 70 V/100 V lines directly.

Background on 70 V/100 V operation

Loudspeaker for 70 V/100 V lines differ from conventional low-impedance loud speakers with typical 8 Ω or 4 Ω nominal impedance.

With: U=R * I and P=U * I => Power = Voltage² / Resistance: $P = \frac{U^2}{R}$ or $U = \sqrt{P*R}$

An 8 Ω loud speaker with 100 W power rating, reaches its power maximum with 28 V, while a 200 W rated loudspeaker will need 40 V. So *maximum power* for the loudspeaker depends on the *output voltage* of the amplifier.
70 V/100 V high-impedance loudspeakers on the other side are *designed for a maximum voltage* of 70 V respectively 100 V using an internal transformer *reducing the operating power* for the loudspeaker. So the max power handling is not determined by the amplifiers output power, but on the transformation ratio of the internal transformer.
What might sound a bit confusing offers some serious advantages in fixed installations:

- loudspeakers with different power handlings can be operated in parallel on one line (= cable)
- adjusting the transformer allows for individual power (= level) adjustments
- thanks to the higher voltage/lower current, long cable runs with lower diameters can be used

Important take away:

- using a 70 V/100 V line does not mean each loudspeaker is driven with 70 V /100 V. It means that the maximum power handling of the loudspeaker is reached when 70 V/ 100 V are provided to the loud speaker. In applications these 70 V/100 V are signal peaks. A 100 V line operated at -10 dB below maximum runs a little less than 32 V.
- many high impedance loudspeakers feature a power tab, to adjust the actual max power that speaker can draw. The power tab on a loudspeaker for 70 V is identical to 100 V operation with double the power. So using 70 V vs. 100 V is a way of reading.

Power Tab	1	2	3	4	5
70 V	1.8 W	3.75 W	7.5 W	15 W	30 W
100 V	3.75 W	7.5 W	15 W	30 W	n.a.

Requirements for direct drive amplifiers in fixed installation

The use of audio amplifiers in direct drive operation has some special requirements to the amplifier design:

- the amplifiers needs to be designed for a permanent operation, as fixed installations use the equipment in many cases all around the clock.
- to keep the operating cost low, the amplifier shall have a low idle mode power consumption, combined with a high efficiency when driven
- user interface and connectivity need to suit the application, e.g. power switch on the rear to avoid someone turns the amplifier accidentally off, the use of Euro-style connectors for easy installation and remote control/supervision via a network and/or control ports (GPIOs)
- the nominal voltage of 70 V / 100 V may not be exceeded, or only very minimal, as the transformers are designed for these voltages. Exceeding the voltage especially with low frequencies can easily lead to saturation of the transformer causing audible distortion, worst case damage the loud speaker.
- the frequency range needs to be filtered to exclude very low frequencies (e.g. 50 Hz, 70 Hz, or 100 Hz) as transformer designs are usually not suited for these due to size and cost reasons.
- the amplifier outputs must not produce any DC. Already a few millivolts on the amplifier output can cause the transformers to saturate
- the amplifiers needs to be stable over the entire load range. A very low signal is almost like a no load situation, while maximum output power requires the amplifier to drive high and low impedances continuously (see table below).
- very long cable runs in fixed installations represent a complex load and not a pure resistive load. This is a most demanding requirement to prevent dangerous oscillations under all load and phase conditions.

Dynacord C-Series with integrated FIR-Drive signal processing are just perfect for these applications.
Factory presets for 70 V / 100 V that include 3rd order hi-pass filters are available on dedicated amplifier models. Using the SONICUE sound system software (requires the free upgrade to firmware 2.x) even more options for e.g. the entire EVID series in 70/100 V are available.

Selection of the right C series amplifier model

Dynacord's C series has four different models with different output power. Depending on the selected operation mode (70 V or 100 V) and the total power handling of all loud speakers on one line you can select the right model.

The loudspeakers models get selected according their acoustic parameters for a certain application- then you add up the power handling of all loudspeakers on one line (line). The output power of the amplifiers needs to be higher than the total power handling summation.

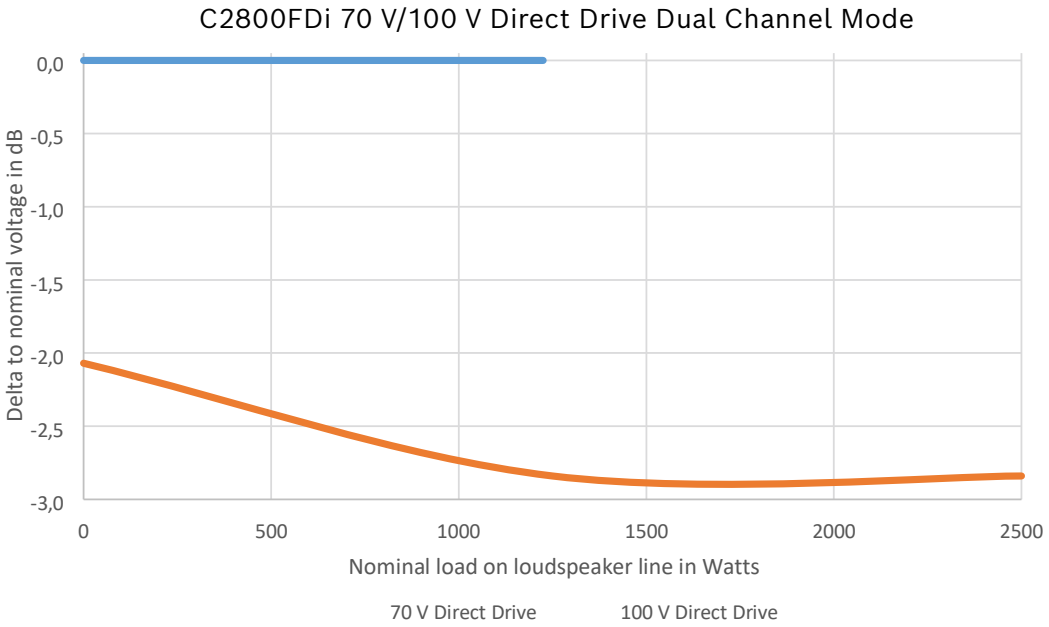
We have: $R(line) = \frac{U^2}{P(total)}$; $R(line) = \frac{(70\ V)^2}{P(total)}$ respect. $\frac{(100\ V)^2}{P(total)}$

The following table is showing the relation between a 70 V and a 100 V line and the total power handling of the loudspeakers:

P(total) (W)	1	5	10	15	30	60	100	200	300	600	1250	2500
R(line) @ 70 V (Ω)	4900	980	490	327	163	82	49	25	16	8	4	2
R(line) @ 100 V (Ω)	10000	2000	1000	667	333	167	100	50	33	17	8	4

The table illustrates why 70/100 V loudspeakers with typical power tabs @ 5 – 30 Watts, are also referred to as “high impedance” loudspeakers.

To understand better which C series model works best let’s take a closer look at the C2800FDi in direct drive mode for 70 V and 100 V.



The diagram is showing for 70 V in blue and 100 V in orange the total wattage (Ptotal) that can be driven per amplifier channel and the level deviation to nominal voltage.

In example: 40 loudspeakers with a 30 W power handling in 70 V represent a total maximum power handling of 1200 W, so the amplifiers would need a direct drive load capability of 1200 W or more. Looking at the C2800FDi at 70 V: one amplifier channel can drive from 0 W up to 1225 W with 0 dB deviation- 70 V can be achieved over the entire load spectrum with maximum load capability of 1225 W, equal to 40 loudspeakers @ 30 W, or 80 loudspeakers @ 15 W.

For a 100 V line the C2800FDi can drive up to 2500 W per channel, with a deviation of -2.0 dB to -3.0 dB. That means: all loudspeakers will be driven, but their maximum output will be 2 dB to 3 dB below their maximum output level (which is usually a safety margin kept in many applications). If the maximum SPL of each is required to achieve the desired acoustic result, you can use either the C2800FDi in bridge mode, or consider running a 70 V line instead.

In appendix 1 you find the all diagrams for the 4 C series models in dual channel mode as well as bridged mode.

Direct Drive Load Capability of C Series

Choose the matching C series amplifier model depending on your project needs

Load capability	Dual channel mode		Bridged mode	
	70 V	100 V	70 V	100 V
C3600FDi	not rec.	2 x 2500 W (-1.5 dB)	not rec.	not rec.
C2800FDi	2 x 1250 W (0.0 dB)	2 x 2500 W (-3.0 dB)	not rec.	1 x 1250 W (0.0 dB)
C1800FDi	2 x 1250 W (-1.5 dB)	n.a.	not rec.	1 x 1250 W (-1.5 dB)
C1300FDi	n.a.	n.a.	1 x 625 W (0.0 dB)	n.a.

Or in a different format

Load capability	70 V operation		100 V operation	
	Dual channel	Bridged	Dual Channel	Bridged
C3600FDi	not rec.	not rec.	2 x 2500 W (-1.5 dB)	not rec.
C2800FDi	2 x 1250 W (0.0 dB)	not rec.	2 x 2500 W (-3.0 dB)	1 x 1250 W (0.0 dB)
C1800FDi	2 x 1250 W (-1.5 dB)	not rec.	n.a.	1 x 1250 W (-1.5 dB)
C1300FDi	n.a.	1 x 625 W (0.0 dB)	n.a.	n.a.

n.a.: direct drive is not available for this configuration
not rec.: this operation is not recommended due to efficiency reasons. Please choose next smaller amplifier model for this mode.

Using the factory presets in C series for 70/100 V direct drive

We recommend to use the factory presets on C series for direct drive only if you can't use a PC to configure the amplifiers with SONICUE. The factory presets support the direct drive options with limiter settings for 70/100 V, bridge mode setting if required, as well as dedicated 3rd order hi-pass filter @ 50 Hz to prevent transformers in loudspeakers from saturation.

Factory preset	70 V operation		100 V operation	
	Dual channel	Bridged	Dual Channel	Bridged
C3600FDi	not rec.	not rec.	F10	not rec.
C2800FDi	F08	not rec.	F10	n.a.
C1800FDi	F08	not rec.	n.a.	F10
C1300FDi	n.a.	F08	n.a.	n.a.

Room EQ and level settings could be made from the front panel – however we strongly recommend to use SONICUE sound system software with dedicated 70/100 V settings via the Generic Speaker device, as it will not only have so many more options to better suit the application, SONICUE also allows a much better tuning result of the system.

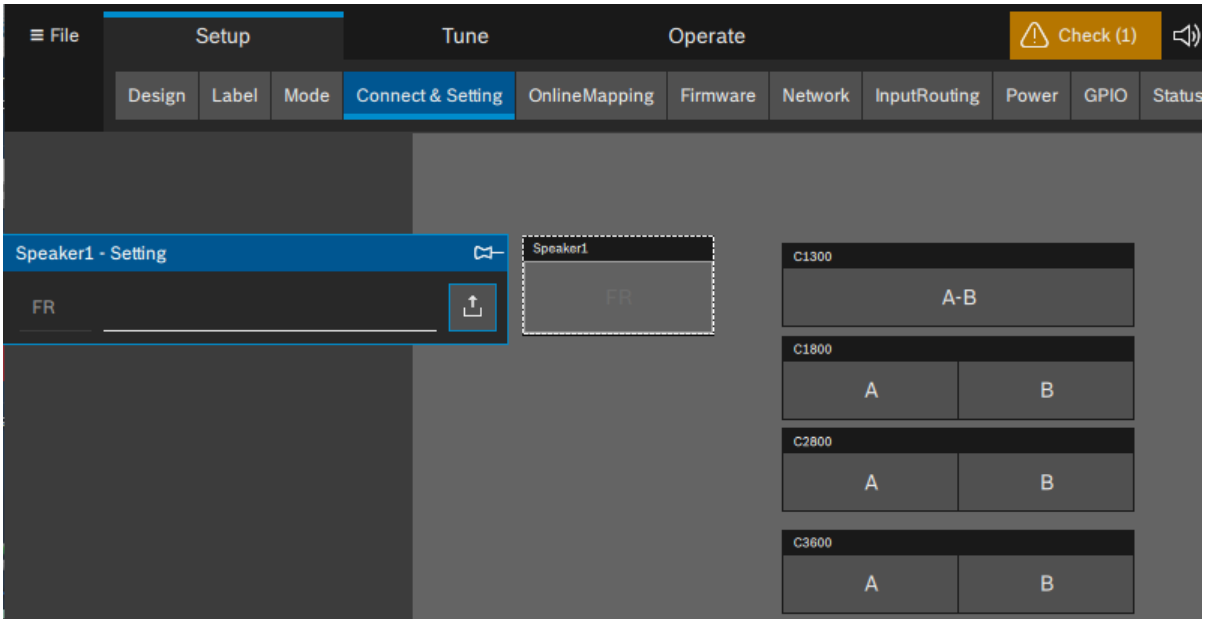
Using SONICUE to configure C series in direct drive

To operate C series amplifiers you need to upgrade the amplifier firmware on 2.0 (or higher).

In SONICUE sound system software you have two options to load speaker settings for direct drive operation to your C series amplifiers:

- connect the amplifier to speaker in 70/100 V operation mode from the device catalog
- connect the amplifier to a generic (passive) speaker and load a sps (speaker setting file) from the SONICUE library (C:\Program Files\SONICUE\1.2.0\speakerfiles)

The first option is of course the most convenient, as all parameters are matching the speaker: all EVID settings in the EV database 1.1 have 70/100 V settings utilizing the potential of C series FIR-Drive DSP. For any other speaker we recommend option two. In any case you should check and set the amplifiers operation mode (dual channel or bridged) before you connect any speaker (= loading the speaker setting).

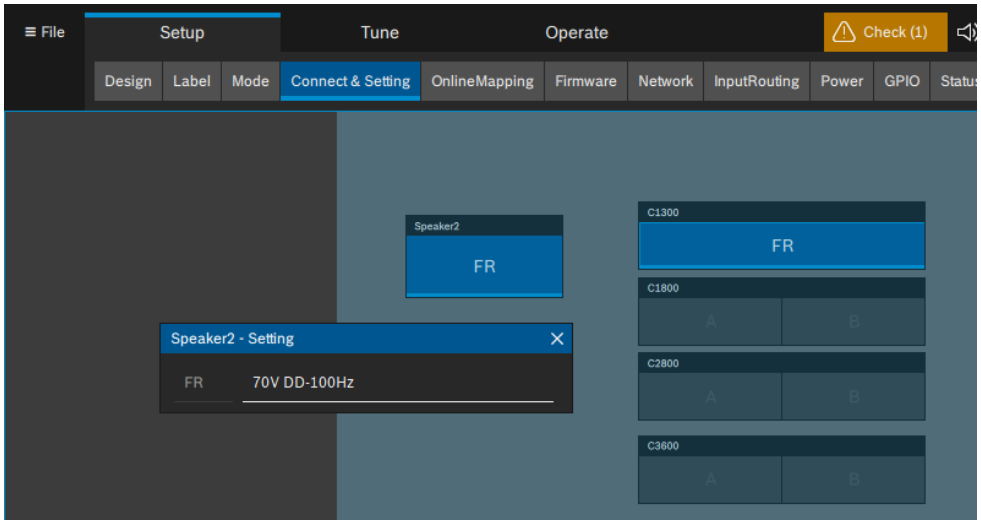


After the amplifiers are set to the right operation mode (dual channel or bridged), select the generic speaker “passive” from the catalog (Setup > Design) and drag on the workspace

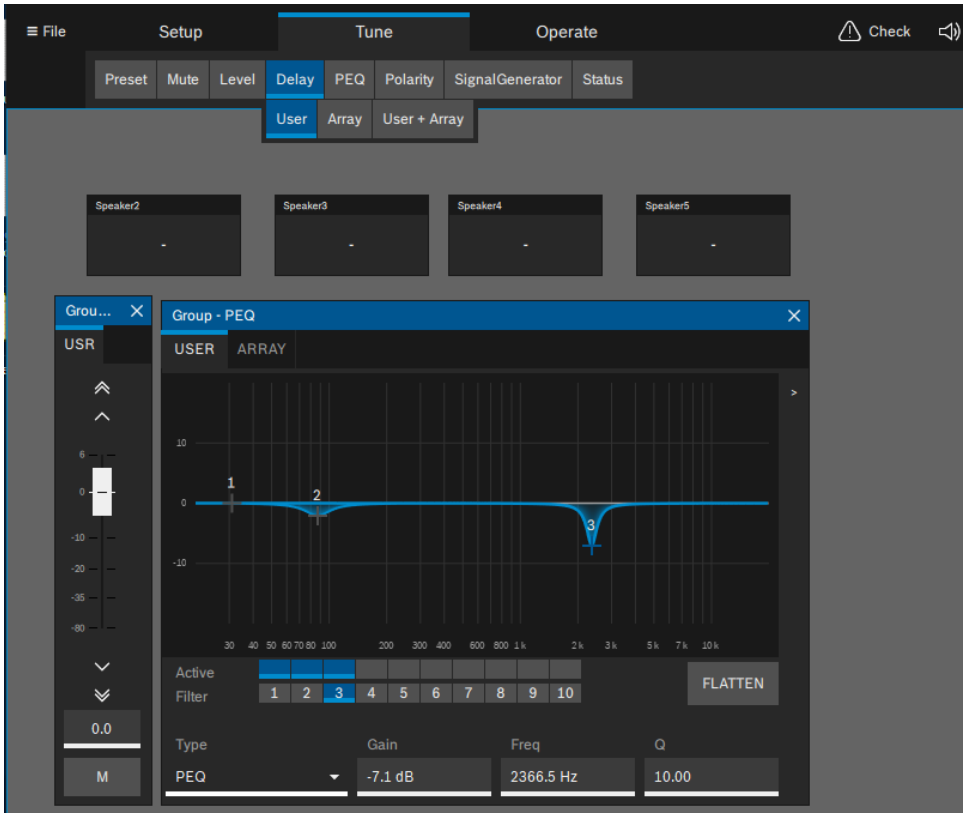
Go to Connect & Setting and click on the generic speaker: the speaker settings flyout will open.

Click on the upload icon- by default you will be directed to the library in Program Files\SONICUE\1.2.0\speakerfiles. Here you can select: 70 V or 100 V with hi-pass frequencies (24 dB Butterworth) of 50, 80, 100, 150 or 300 Hz.
The speaker files include peak and RMS limiters matching their application mode and an additional lo-pass filter at 17 kHz (to avoid annoying HF, e.g. from pilot tones).

The loaded speaker file will be shown as a label in the flyout. Click on the speaker and the amplifier (channel) to make the connection. You can use the Label function to provide a name for your generic speaker.



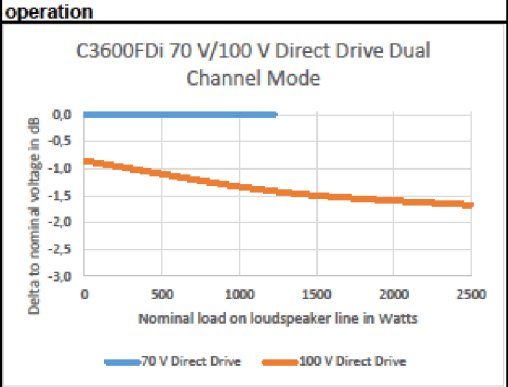
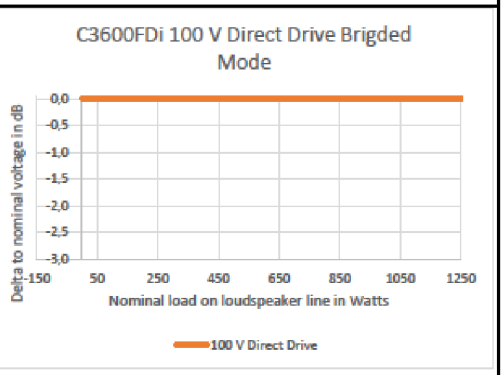
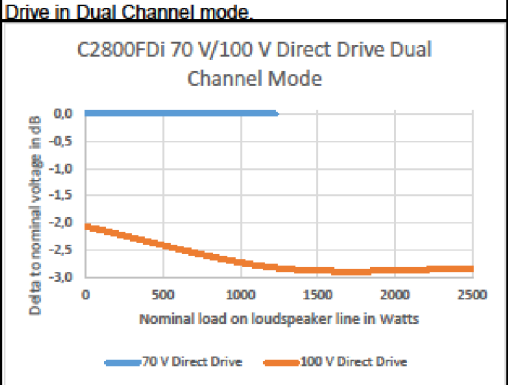
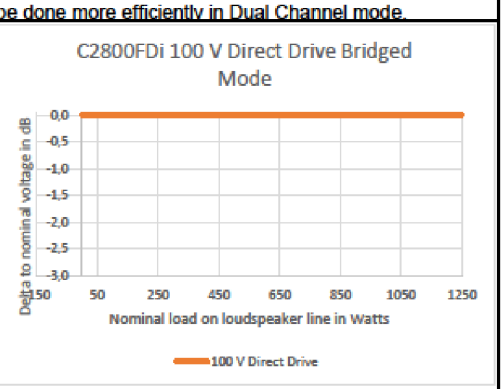
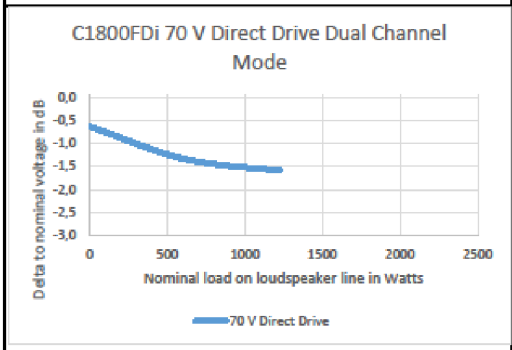
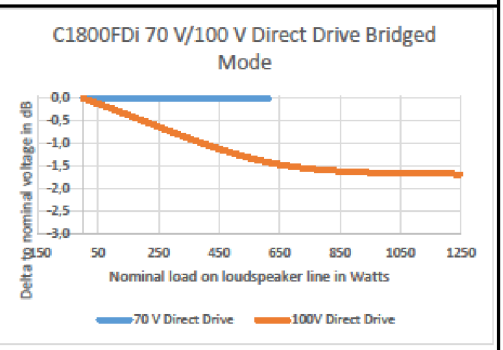
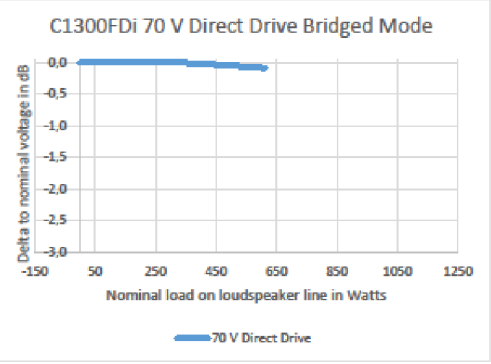
Note: speaker settings are being stored in the generic device and are included in copy/paste – while the label is not.
So if your design is using multiple speaker lines that utilize the same setting, you just have to upload the speaker file once, then use duplicate (or copy/paste) to create more speakers with the required setting.



Once the setting is loaded you can utilize all advantages of SONICUE for tuning your system.

Appendix 1

Recommendation for 70 V/ 100 V Direct Drive Operation of Dynacord C Series amplifier

Model of C Series	Direct Drive capability in Dual Channel Mode operation	Direct Drive capability in Bridged Mode operation
C3600FDi		
	C3600FDi is the recommended amplifier for 100 V Direct Drive in Dual Channel mode.	C3600FDi can drive a single 100 V line, altough this can be done more efficiently in Dual Channel mode.
C2800FDi		
	C2800FDi is the recommended amplifier for 70 V Direct Drive in Dual Channel mode.	C2800FDi can drive a single 100 V line with a maximum wattage of 1250 W.
C1800FDi		
		
	C1800FDi can drive efficiently two 70 V lines with some delta to the maximum SPL.	C1800FDi is a cost efficient solution for driving a single 100 V line with a maximum wattage of 1250 W.
C1300FDi	n.a.	
	C1300FDi is not recommended for Direct Drive Operation in Dual Channel Mode	C1300FDi is a cost efficient solution for driving a single 70 V line with a maximum wattage of 612 W.

DYNACORD

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