

# Pulse Compressor Updates

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## RF source specification from the “Specs Document”

*“The RF power specification is based on the power required to drive a 300 mm travelling wave structure to 15 MV, which is 22 MW with a 9 ns flat-top time. ”*

*“The total pulse length after the pulse compressor includes a 15 ns rise and fall time hence the pulse length after the pulse compressor should be 24 ns. The RF source can provide any power and pulse length before the pulse compressor as long as it achieves a 24 ns 22 MW pulse after the pulse compressor.”*

Key information:

1. 0.3 m travelling-wave lineariser structure
2. 15 MV linearising voltage
3. 24 ns 22.0 MW compressed pulse from the pulse compressor

# Average power gain for 24 ns compressed pulse

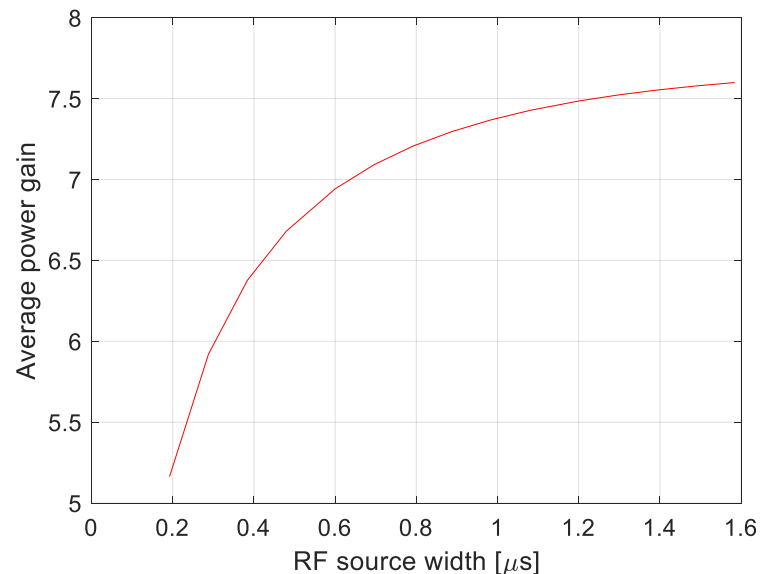
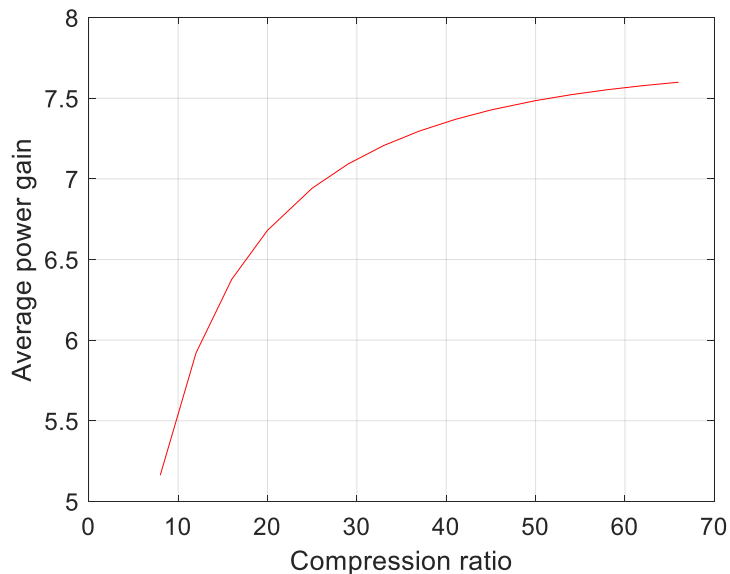
Compressed pulse = 24 ns (9 ns+ 15 ns)

TE01&TE02 dual-moded SLEDII pulse compressor

Radius of the delay line = 25 mm

Length of the delay line = 1.71 m

TE01 circular waveguide input and output



RF source width [ns]	Compression ratio	Power gain (average)
192	8	5.16
288	12	5.92
384	16	6.38
480	20	6.68
600	25	6.94
696	29	7.09
792	33	7.21
888	37	7.30
984	41	7.37
1080	45	7.43
1200	50	7.49
1296	54	7.52
1392	58	7.55
1488	62	7.58
1584	66	7.60

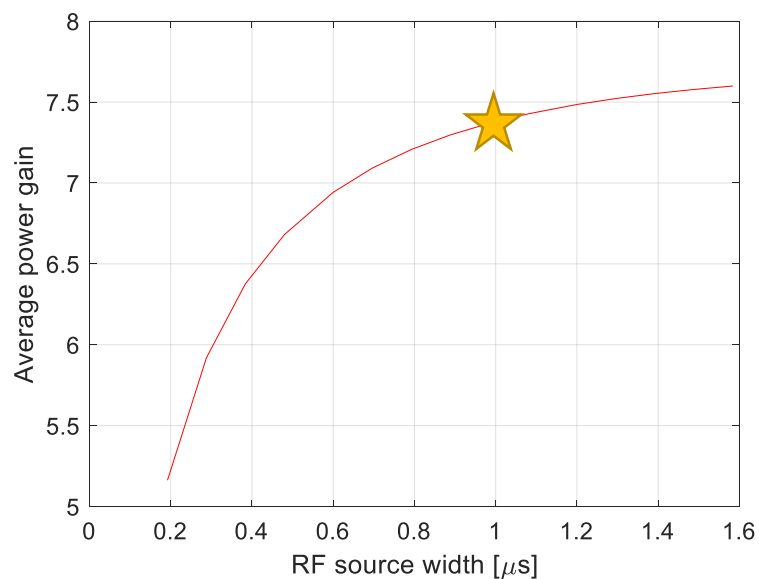
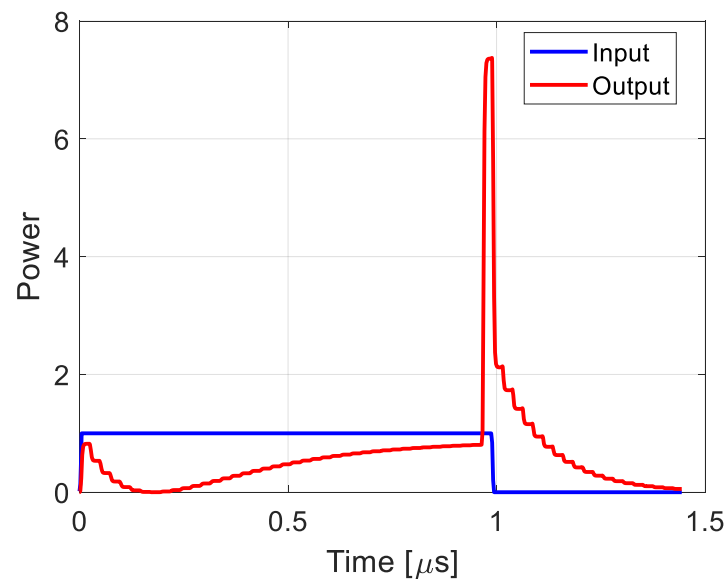
# Average power gain for 24 ns compressed pulse

*“The peak power available to drive all structures summed together should be considered 2.85 MW from the RF source (3 MW including 5% loss) with a 1000 ns pulse”*

984 ns gyrokystron pulse width ( $\sim 1 \mu\text{s}$ )  $\rightarrow$  24 ns compressed pulse  
2.85 MW gyrokystron  $\rightarrow$  21.0 MW compressed pulse

Longer input pulse width gain little for the compressed power

Not meet the requirement of 24 ns 22.0 MW compressed pulse



RF source width [ns]	Compression ratio	Power gain (average)	Compressed Power
192	8	5.16	14.71
288	12	5.92	16.87
384	16	6.38	18.18
480	20	6.68	19.04
600	25	6.94	19.79
696	29	7.09	20.21
792	33	7.21	20.54
888	37	7.30	20.80
984	41	7.37	21.00
1080	45	7.43	21.17
1200	50	7.49	21.33
1296	54	7.52	21.44
1392	58	7.55	21.52
1488	62	7.58	21.60
1584	66	7.60	21.66

# Methods to solve the problem

## 1. Increase the source power

increase the gyrokystron's output from 3.0 MW to 3.14 MW

check with Strathclyde → the max output is 3.2 MW 😊

## 2. Increase the input pulse width to the pulse compressor

compress 5  $\mu$ s gyrokystron pulse gives a power gain of 7.7

$2.85 \text{ MW} * 7.7 = 21.95 \text{ MW}$

we gain little from increasing the input pulse width

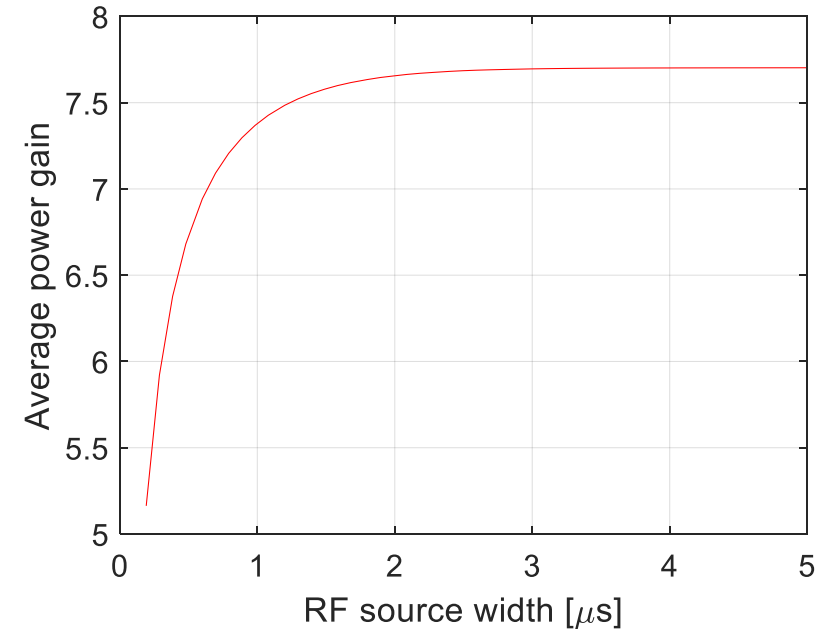
## 3. Reduce the required compressed width

use 20 ns compressed pulse as the lineariser input

1000 ns gyrokystron pulse → 20 ns 21.5 MW compressed pulse

## 4. Reduce the required compressed power

use 21.0 MW as the input power to the lineariser and optimize the lineariser structure



# Summary

1. TE01 & TE02 dual-moded SLEDII pulse compressor  
25 mm radius and 1.71 m length
2. Gyroklystron pulse of 984 ns 3.0 MW → 24 ns 21.0 MW compressed pulse (within 5% loss) 😞
3. Gyroklystron pulse of 984 ns 3.2 MW → 24 ns 22.4 MW compressed pulse (within 5% loss) 😊
4. Solutions to avoid power insufficiency  
increase the input pulse width from 1  $\mu$ s to several  $\mu$ s  
reduce the required the compressed pulse width (24 ns) or the compressed power (22 MW)