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Contract N° 4000129501/20/NL/HK

32GHz 150W TWT (THL 32150 C)

THALES AVS FRANCE

25/01/2023

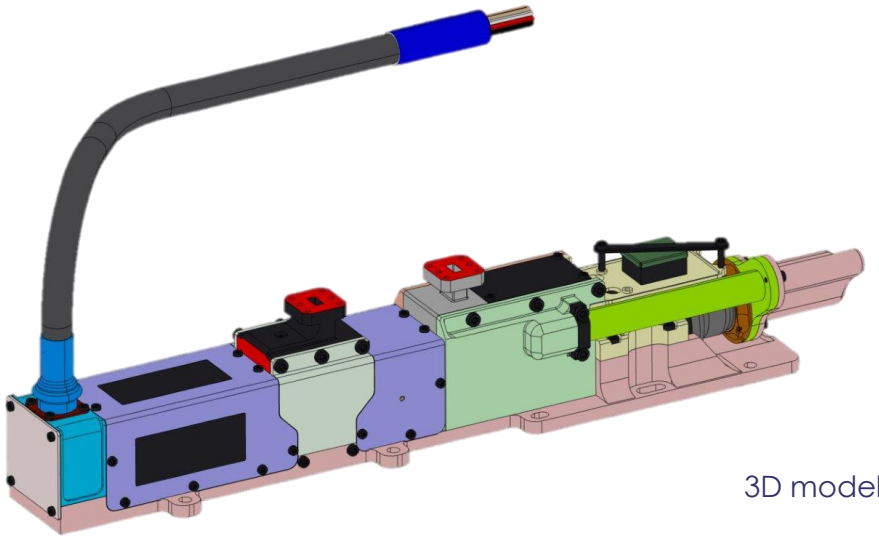
Summary

- TWT Development plan
- TWT EBB Results
- Ways of TWT improvements
- TWT Tunability

TWT Development plan

3 main phases

- **1st = preliminary design & EBB testing → Final Review → PDR milestones**
- 2nd = improvement of design & critical margin tests → CDR milestones
- 3rd = qualification & acceptance tests → TQR milestones



3D model of the THL32150C

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Baseline technology & design

Summary

Sub assembly	TWT configuration	250W Ka-band configuration	TV 1 (HW1)	EBB1	EBB3
Gun	Technology	10 KV class Metallic envelop gun			
	Design	250W Ka-band			
	M cathode Ø	Diam. 1		Diam. 2	
Delay line	Barrel	250W Ka-band			
	PPM stack	250W Ka-band PPM stack	Optimized 250W Ka-band PPM stack	150W 32 GHz PPM stack	Optimized 150W 32 GHz PPM stack (magnets at the end of the line)
	Helix thickness	Same dimensions			
	Helix length	Same dimension			
	Helix conicity	Low	increased		
	Helix taper/ diameter	THL20250C - THL20250R	Profil 1		
	Input rods	Same geometry as 250W Ka-band			
	Output rods				
	RF input	Coaxial connector	Wave-Guide on coax connector		New Wave-Guide on coax connector
	RF output	doorknob	Wave-Guide on coax connector	Doorknob	
Collector		250W Ka Shrunk 4 stage collector	80W Q 4 stage collector		
Housing		250W Ka housing	-		THL32150C housing

Tests results

Operating point

Parameter	EBB1	EBB3	Proposed operating point
VH (V)	9100	9050	**9000**
IK (mA)	112	111	**112**
Vc1 (V)	4150	4400	**4250**
Vc2 (V)	3600	3750	**3650**
Vc3 (V)	3000	3050	**3050**
Vc4 (V)	800	800	**800**

Compatible with 15 years lifetime

Good focussing

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Tests results over 31.8-32.3 GHz

Output power at saturation (T° = 25°C)

Output power above **150W** within temperature operating range

Max phase-shift at Fmax < **50°**

Typical **global efficiency** > 50%

Gain at small-signal & saturation

Typical **gain at sat** = **54 dB** → **Pin max = -2.5 dBm at Fmax**

Typical **gain at ss** = **62 dB**

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TWT Flexibility

Power flexibility

- RF performances from 100W to 150W
- Frequency band [31.8 – 32.3] GHz (VH = constant = 9050 V)

Output power min (W)	**Global efficiency** mean (%)	**Pin max** at sat, at Fmax (dBm)	**IH** mean (mA)	**IK** (mA)
150 W	52	-2	1	112
140 W	50	-0.5	0.9	109
130 W	48.6	0.7	0.8	105
121 W	47.6	1.1	0.8	102
110 W	46.3	1.6	0.7	99
100 W	44.7	2.4	0.7	95

Good output power fexibility

Tests results over 31.8 – 32.3 GHz

Gain variations at 25°C

Specifications are challenging

Can be improved by changing slightly the delay-line taper

VSWR Input & Output

Input : VSWR **can be improved** (minor modification)

Output : **Good** max VSWR

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Ways of TWT improvement

Global Efficiency

- Relaxation of phase-shift specification → redesign of helix taper
- Improvement of electron optic collector
- Improvement of magnetic stack at the entrance of collector

Stability of the gain

- Slight modification of the helix taper to better balance Gain

Mass

- Redesign of housing

Conclusion

Feasibility of a TWT delivering 150W output power in a [31.8 – 32.3] GHz bandwidth has been demonstrated

Overall performances are good

- Good RF performances + No oscillations
- Good focusing + Compatible of 10KV EPC class

Improvement margins

- Efficiency / Gain / Mass

TWT flexibility

- Good behavior vs. different output power and frequency range

All relevant parameters have been fulfilled paving the way to launch CDR phase