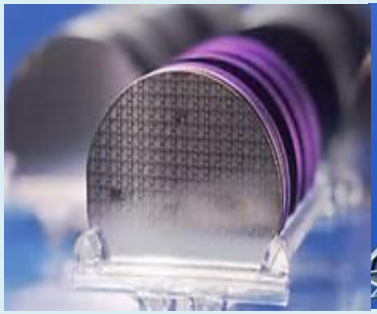
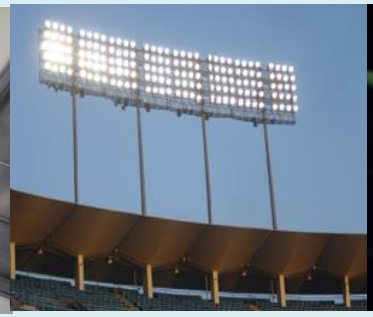
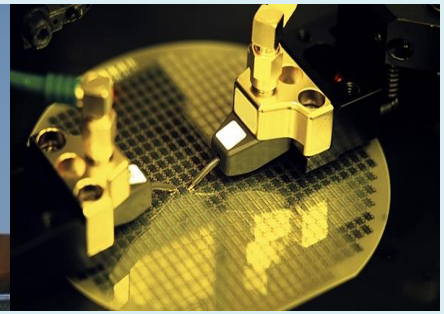
Wireless Japan 2018



RF Power Innovative Integration
www.innogration.net

One Stop RF Power Semiconductor Solution

RF POWER IN EVERYDAY LIFE

By Innogration Technologies





GaN on SiC	1MHz to 6GHz	Power Transistor	Wireless Infrastructure
LDMOS	0.1W to 1200W	MCM	Multi Market
GaAs	12V to 100V	MMIC	Radio Energy Source
VDMOS	Ceramic to plastic	iModule ™	

Company Profile

RF Power design and manufacturing house for semiconductor, device, module and sub-system

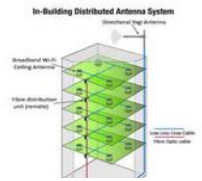
- GaN/LDMOS /GaAs/VDMOS technologies
  One stop RF Power house
- Focused on back end assembly quality management, with proven industrial experience and high yield volume record
- Broad product offerings:
  die, IPD, device, MMIC, MCM, iModule, custom design products
- Best in class time to market
  Timely application support

Core Market

Wireless Access

- Macro cell Base station and RRU
  4.5G/5G Massive MIMO MCM
  iModule, IC, Discrete
- WIFI
  2.4GHz /5.8GHz
- Non-Cellular band mobile network
  230MHz/350MHz/1.4GHz/1.8GHz





RF Energy

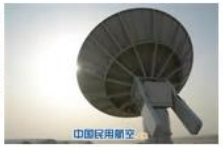
- Magnetron replacement
  (Solid state heating , cooking , Defrost
  Plasma lighting)
- Industrial (plasma generator, Plasma etcher)
- Medical (MRI/Ablation/Skin Treatment/Diathermy)
- Laser (Machining/Drilling/ Marking/ Cutting)
- New energy Automobile
- Synchrotron accelerator




Multi Market

- Broadband communication
- TV Broadcast
- Radio Station
- Commercial Pulsed Radar
- Navigation
- Avionics





ST + Innogration LDMOS partnership

http://www.st.com/content/st_com/en/about/media-center/press-item.html/t4023.html

STMicroelectronics Signs License and Cooperation Agreement on LDMOS Technology from Innogration

- *Arrangement expands serviceable RF power market for ST*
- *Mature and proven technology is very well suited for applications such as wireless infrastructure; industrial, scientific, and medical; avionics and radar; and non-cellular radio*

Geneva / 14 Feb 2018

STMicroelectronics (NYSE: STM), a global semiconductor leader serving customers across the spectrum of electronics applications, today announced it has signed an agreement on LDMOS[1] RF power technology from Innogration Technologies, a fabless semiconductor company headquartered in Suzhou, China, specializing in the design and manufacturing of RF power semiconductor devices, modules, and sub-system assemblies. Combining a short conduction-channel length with a high breakdown voltage, LDMOS devices are well suited for RF power amplifiers where they can be used in base stations for wireless communications systems, as well as in the power amplifiers for commercial and industrial systems. The agreement with Innogration expands the range of applications that ST can address with LDMOS technology.

Terms of the agreements were not disclosed.

Manufacturing Facility

Assembly Area

- 1000 M^2
- Class 10000

Installed key hardware

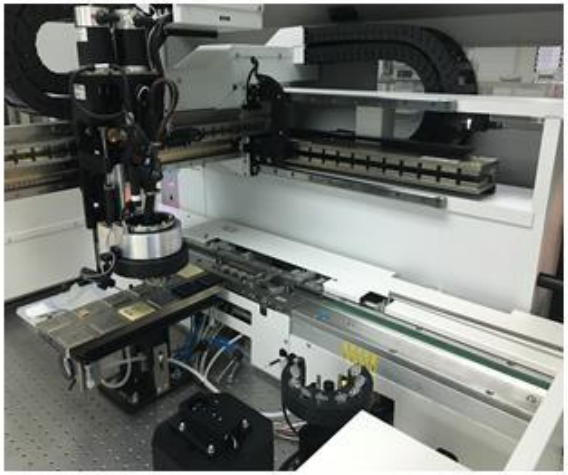
- Die Attached
- Wire bonding
- DC Test station
- RF Test station
- Lid sealing

ISO9000/ISO14000 certificated

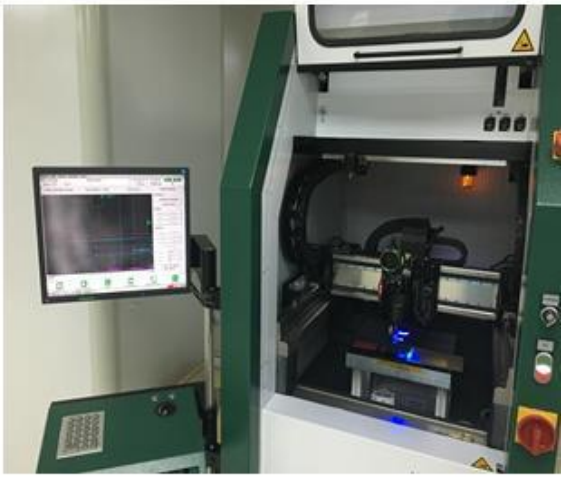
Assembly Hardware

Wafer storage

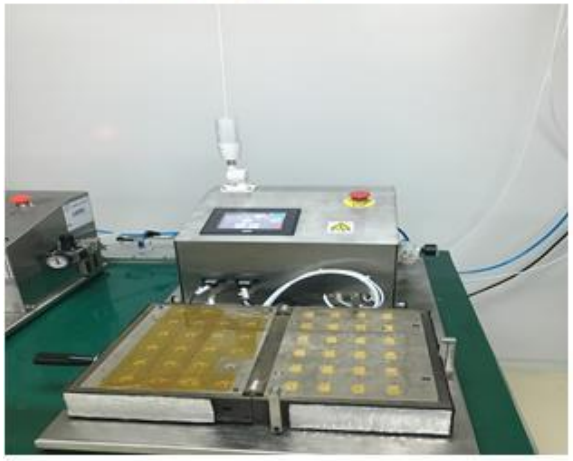
Automatic Die Attach



Automatic Wire bonding

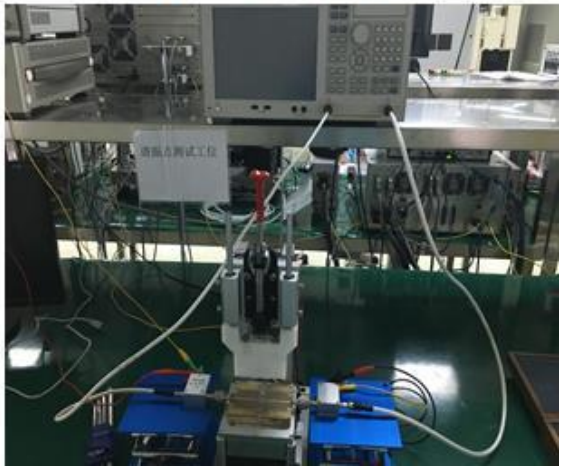


Lid sealing



Die shear & Bond pull test

RF/DC Test bench



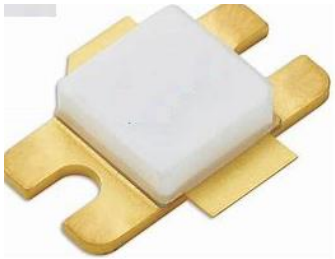
5G NR

Innogration Technologies

Product selection guide for Sub-6GHz 5G NR

Category	Availability	Band (GHz)	Part type	Status	Package or Size	Power Supply (V)	Psat (dBm)	Pavg (W)	Efficiency @Pavg (%)	Power Gain(dB)
Packaged MCM	Now	3.4-3.8	GMAH3438-35	Limited sampling	10*6mm	28	>45.5	5	43	30
	Now	4.4-5.0	GMAH4450-35	Limited sampling	10*6mm	28	>45.5	5	38	28
	Q4-2018	3.6-4.2	GMAH3642-35	Development	10*6mm	28	>45.5	5	39	29
Discrete Device	Now	0.7-3.8	GTAH35015M2	Released	MM	28	42	¥	¥	¥
	Now	3.3-3.8	GTAH35060GX	Released	GX	28	48	¥	¥	¥
	Now	3.4-3.8	GTAH35101A2	Released	A2	28	50	¥	¥	¥
	Now	4.4-5.0	GTAH58015GX	Released	GX	28	42	¥	¥	¥
	Now	4.4-5.0	GTAH58030GX	Released	GX	28	45	¥	¥	¥
	Now	4.4-5.0	GTAH58045GX	Released	GX	28	47	¥	¥	¥
	Now	3.4-3.8	GTAV30030E2	Sampling	E2	50	45	¥	¥	¥
	Q3-2018	3.4-3.8	GTAV38150A2	Development	A2	50	>50	¥	¥	¥

* RF performance typically specified @25℃ case temperature

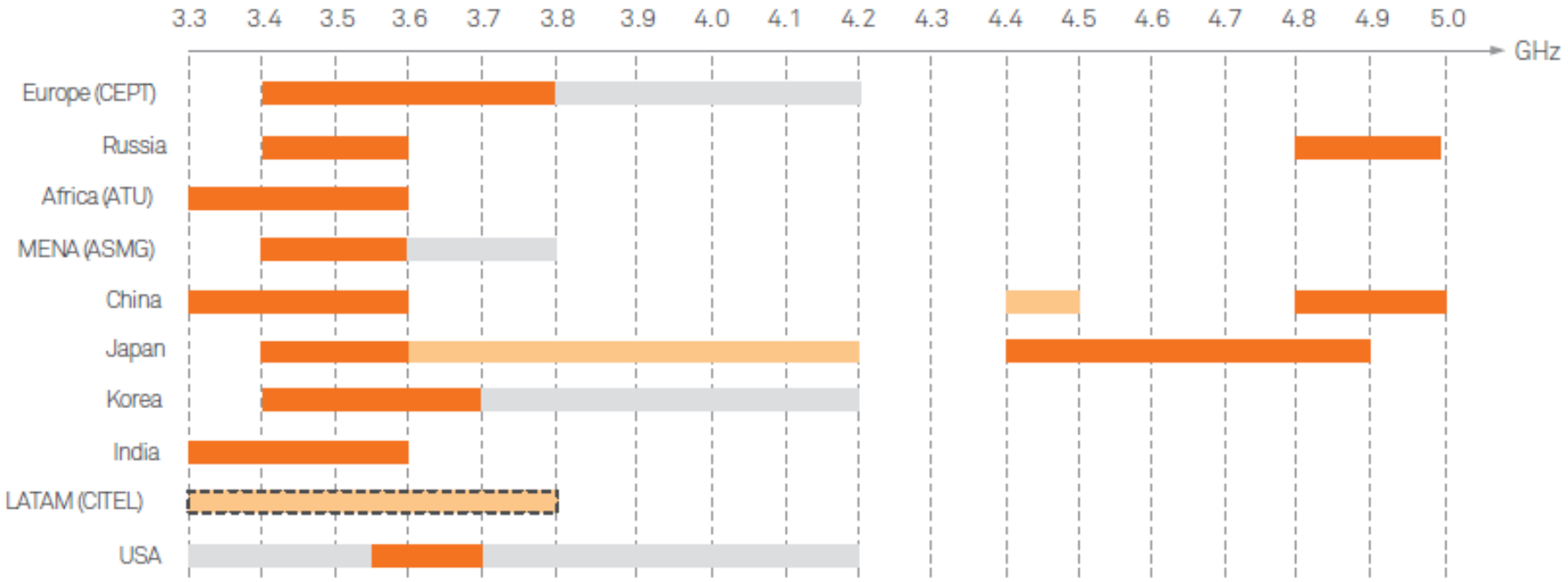


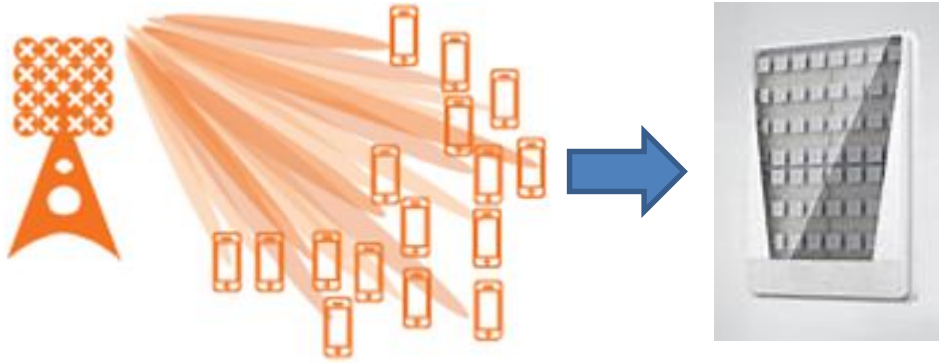
Discrete Device

Packaged MCM

5G NR MIMO Active Antenna demanding innovative MCM PA solutions

World wide sub 6GHz spectrum allocation plan





Core bands

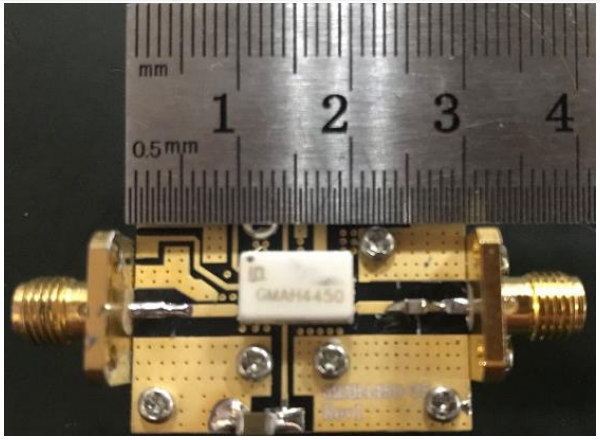
- **3.4 to 3.8GHz**
- **3.6 to 4.2GHz (Japan)**
- **4.4 to 5.0GHz**

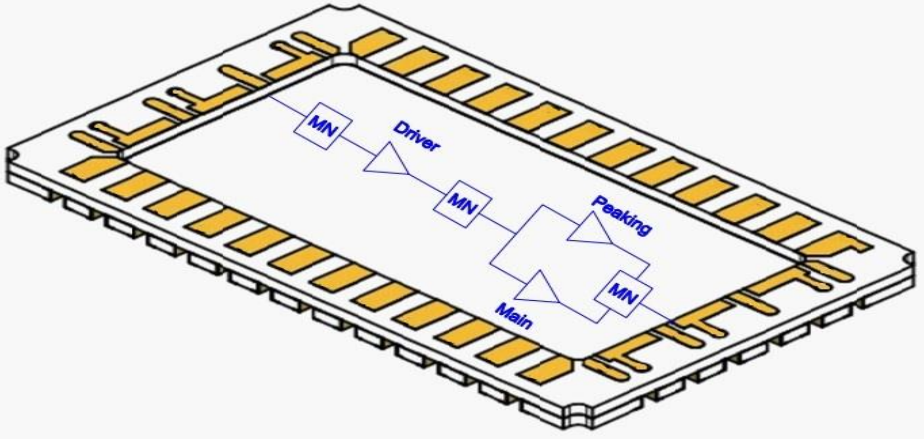
Mainstream configuration

- **64TX**
- **Pavg=5W**

*All base station or RRU pictures are gotten from public info. For demonstration only

Innogration Sub-6GHz Massive MIMO MCM PA





- 6*10mm package
- Drop in replacement cover full bands
- Thermally enhanced package design
- 3 variations (GMAH3642-35 under development)

BEST IN CLASS

- Most Powerful !
- Full band !

Highest Efficiency!
Same size across types!

GMAH4450-35

Product Feature

4.4 - 5.0 GHz

- Operating Drain Voltage: +28V (Up to 32V)
- 50 Ω Input / Output
- Patented Integrated Doherty Final Stage
- Gain at 5W avg.: 28 dB
- **Efficiency >38% @ 5 W Pavg**
- Linearity before and after DPD -30dBc/-50dBc (100MHz 5C LTE signal)
- **4.8-5GHz, Asymmetric DPA, Efficiency >43% @ 5 W**

GMAH3438-35

Product Feature

3.4-3.8GHz

- Operating Drain Voltage: +28V (Up to 32V)
- 50 Ω Input / Output
- Patented Integrated Doherty Final Stage
- Gain at 5W avg.: 30 dB
- **Efficiency > 43% @ 5 W Pavg**
- Linearity before/after DPD -30dBc/-50dBc (100MHz 5C LTE signal)
- **3.4-3.6GHz, Asymmetric DPA, Efficiency >48% @ 5 W**

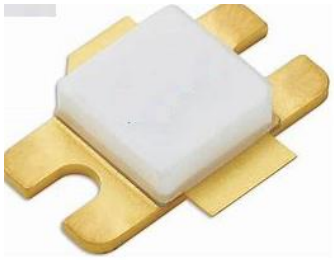
2.45GHz
RF Energy and
ISM application



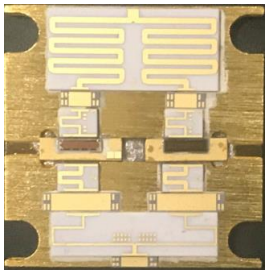

Product selection guide for 2.45GHz

Category	Availability	Match to 50ohm	Part type	Status	Package or Size	Power Supply(V)	Number of stages	CW Power (W)	Efficiency @Psat(%)	Power Gain(dB)	Shielding	Isolator
Connected Amplifier	Now	Yes	IMPA2425-270	Sampling	75*135mm	50	2	270	60	30	Yes	Yes
	Apr-18	Yes	IMPA2425-30	Development	40*55mm	50	2	30	58	30	Yes	Yes
iModule (Chip on carrier)	Now	Yes	IMIA2425-270	Limited sampling	<40*50mm	50	1	270	65	16	No	No
	May-18	Yes	IMIA2425-500	Development	60*60mm	50	1	500	62	15	No	No
Discrete Device (GaN or LDMOS)	Now	No	GTAV25180A2	Sampling	A2	50	1	150	68	16	N/A	N/A
	Now	No	GTAV25100E2	Sampling	E2	50	1	85	70	16	N/A	N/A
	Now	No	GTAV30030E2	Sampling	E2	50	1	30	70	18	N/A	N/A
	Now	No	ITCH25350D4	Released	D4	32	1	400	55	12.5	N/A	N/A
	Now	No	ITCH25280D4	Released	D4	32	1	300	56	13	N/A	N/A
	Now	No	ITCH25180B2	Released	B2	32	1	200	59	13.5	N/A	N/A
	Now	No	ITCH27015E2	Released	E2	32	1	15	65	17	N/A	N/A

* RF performance typically specified at 2450MHz and 25℃ case temperature



Discrete Device

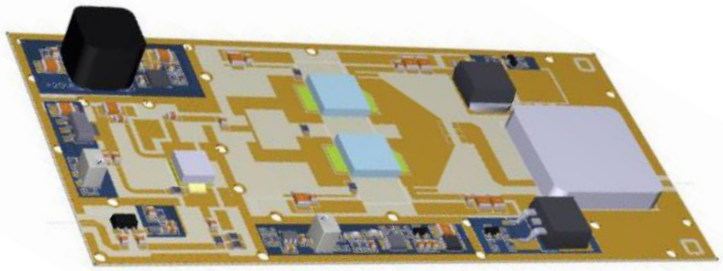


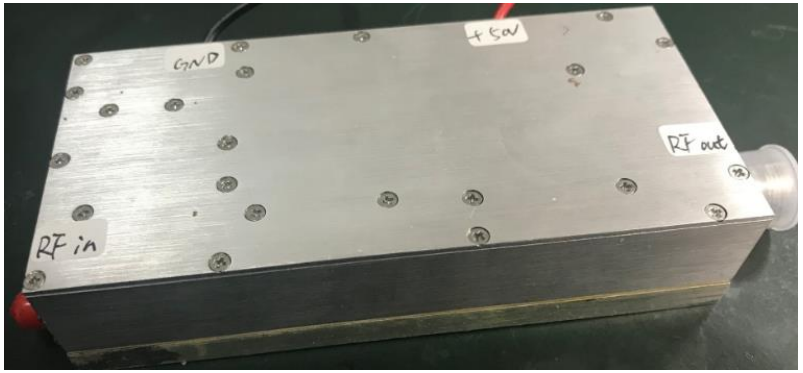
iModule

Connected Amplifier

IMPA2425-270 in details

- **All inhouse technologies including GaN/LDMOS/GaAs**
- **Cost Effective**
- **Secure supply chain**





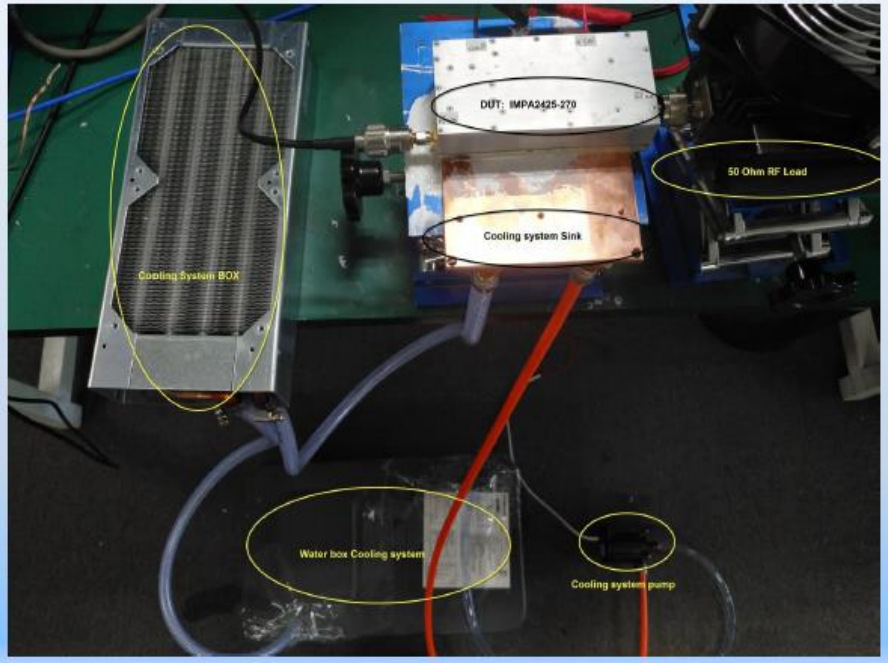
RF Performance summary for 3 DUT
Condition:

- Test @ 10 seconds after power/RF on
- CW Test
- Water cooling

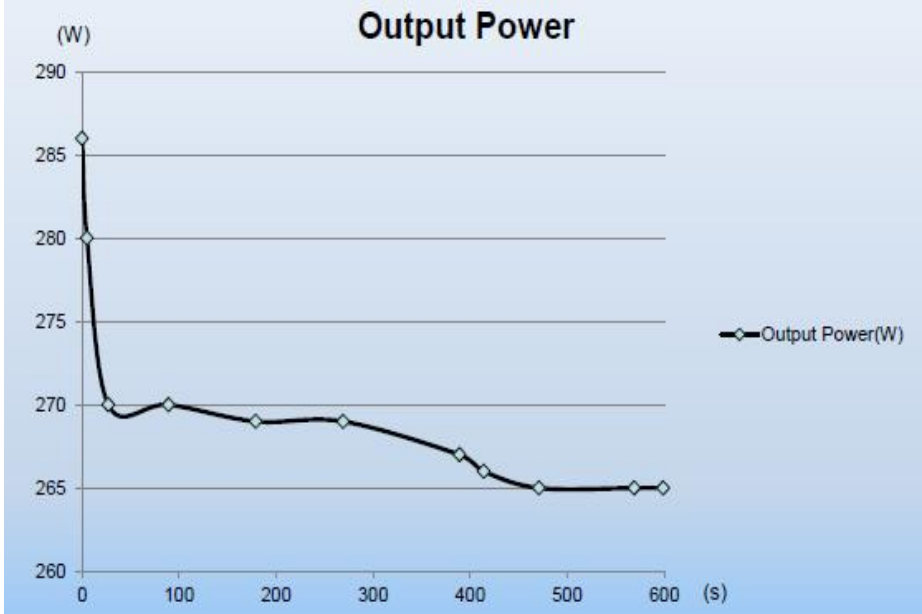
No.	Pin(dBm)	Pout(dBm)	Pout(W)	IDS(A)	GP(dB)	EFF(%)
1	19.7	54.58	287	9.2	34.88	62.4%
2	20.3	54.84	305	9.8	34.54	62.2%
3	20.3	54.59	288	9.3	34.29	61.9%

IMPA2425-270 operation under water cooling and mismatch test

Module and Cooling System



10 minutes CW test with the same input power

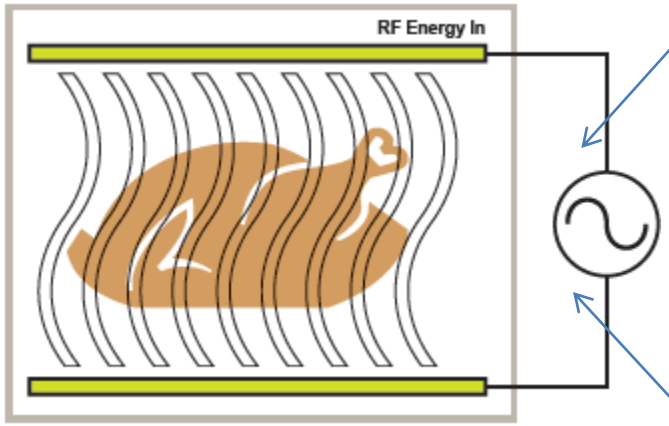


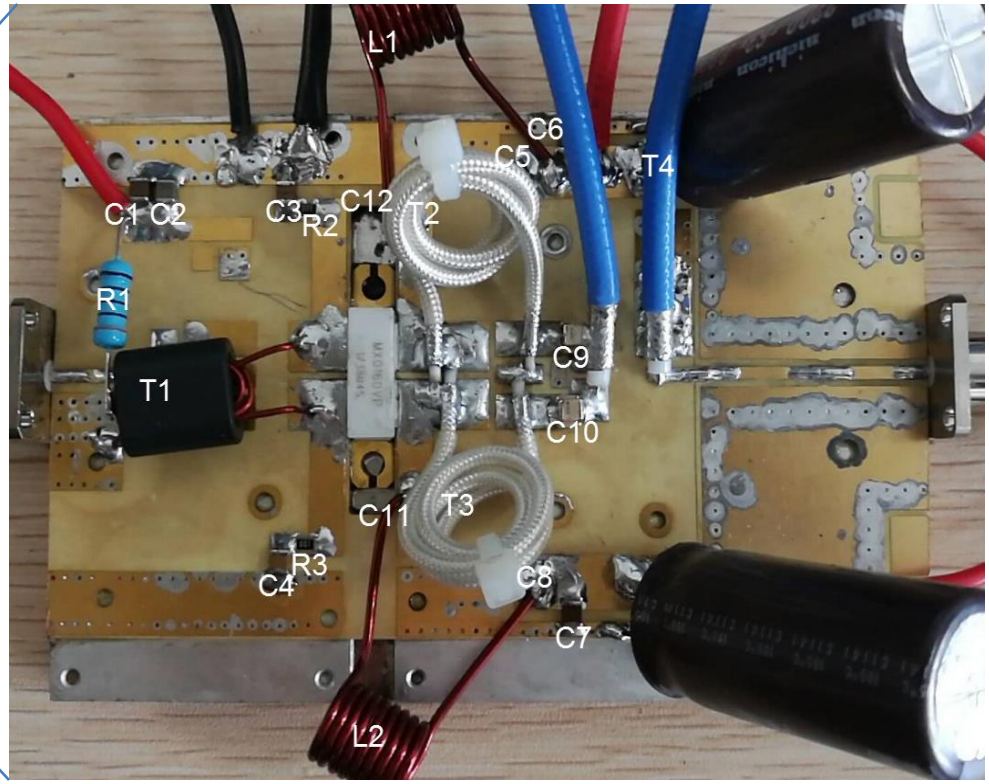
Load open for 1 Minute: Survived!

433MHz/40.68MHz RF Energy Defrost Application

40.68MHz by MX0560VPX

Freq(MHz)	Pin(dBm)	Psat(dBm)	Psat(W)	IDS(A)	Gain(dB)	Eff(%)
40.68(36V)	36.85	55.1	324	10.71	18.25	84
40.68(42V)	37.85	56.34	431	12.32	18.49	83
40.68(50V)	39.9	57.87	612	14.8	17.97	83





433MHz by ITBH09200B2

Pin(dBm)	Pout (W)	IDS (A)	VGS (V)	VDS (V)	IDQ (mA)	Pout (dBm)	Gain (dB)	Eff(%)
34.3	200	9.0	2.72	28	100	53.0	18.7	80%

Broadcast & ISM

Product selection guide for Sub-1GHz 50V LDMOS

Part Number	Package	Frequency Band	Application	Pout(W)	Voltage(V)	Efficiency (%)@ Pout	Power Gain(dB)	Condition
MU1503V	GX	HF-1.5GHz	General	30	50	/	/	CW
MX1506VP	LBB	HF-1.5GHz	General	60	50	/	/	CW
MX1512VP	LBB	HF-1.5GHz	General	120	50	/	/	CW
MU1014V	GXB	HF-1GHz	General	140	50	/	/	CW
MX0160VPX	LBB	HF-0.2GHz	General	550	50	/	/	CW
MQ011K1VPX	D4E	HF-0.2GHz	General	1100	50	/	/	CW
MX0560VPX	LBB	HF-0.6GHz	General	550	50	/	/	CW
MQ051K1VPX	D4E	HF-0.5GHz	General	1100	50	/	/	CW
MQ081K0VP	D4E	0.4-0.8GHz	General	1000	50	/	/	Pulse
MK1040VP	B4E	0.5-1GHz	General	400	50	/	/	CW
MQ1080VP	D4E	0.5-1GHz	General	800	50	/	/	CW

Application

- VHF/UHF TV
- FM Broadcasting
- UHF/VHF Commercial Radar
- ISM