

**TMD**

*...the power in microwaves!*

INSTRUMENTATION  
AMPLIFIERS



product summary

# INSTRUMENTATION AMPLIFIERS

[www.tmd.co.uk](http://www.tmd.co.uk)  
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# INSTRUMENTATION AMPLIFIERS

FOR LABORATORY APPLICATIONS (INCLUDING EMC TESTING, PIM TESTING,  
SCIENTIFIC AND MEDICAL)

**TMD's latest innovation is a new modular amplifier design, available for certain units designated PTCM... These units feature major improvements to user interface and maintainability. Please contact TMD for more information.**

- Advanced self-diagnostics
- Ethernet interface
- Remote management and diagnostics
- VSWR reflected power protection
- Plug and play field replaceable power supplies
- And more...

Our instrumentation amplifiers are closely related to our rugged amplifiers.

They are based on the same switched mode power supply technology as the rugged amplifiers - with all the advantages of performance and reliability, but have been neatly re-packaged for less demanding physical environments into compact, lightweight and affordable rack-mountable units.

A set of standard amplifiers covers the range between 1-40 GHz in both pulsed and CW modes. In addition, **special products can be designed to customers' specific requirements.**

Over the past 20 years TMD has proved itself to be a world leader in TWTA design innovation, offering particularly unusual products for a variety of markets and applications, many of which have proven to be unobtainable elsewhere. We have particular strength in the area of high power pulsed TWTA's (up to 40 kW) for EMC HIRF testing.

Recently we have developed a new range of Ultra High Power HIRF amplifiers achieving over 10 kW. TMD also now offers a full range of solid state amplifiers. Designated the PTCS Series, these amplifiers have been developed for use at frequencies below 18 GHz.



Right hand page:HIRF testing facility at TRW Conekt (photo (c) TRW Limited)  
Cover image: C band 4 kW CW amplifier for ultra high power testing (courtesy Honeywell Aerospace)

**EMC test laboratories using TMD's range of Ultra High Power amplifiers have generated 14,000 V/m, easily complying with the latest most demanding test requirement - RTCA/DO-160G and L. Other standards covered include: MIL Standard, EUROCAE and AIRBUS ABD 100.**

For many years TMD has been providing amplifiers for scientific establishments such as CERN. Projects we have been involved with have included: Driver Amplifiers for Anti-matter Experimentation (CERN in collaboration with Riken Laboratory, Japan), Amplifiers for the CERN CLIC Test Facility CTF3 and Kicker Amplifiers for Oxford University.

**Special products can be designed to customers' specific requirements.**

The following table shows a selection of generic products in this range – but don't worry if you can't see exactly what you are looking for – bespoke solutions are available and our Business Development Team is always eager to discuss the ways in which TMD can contribute to new technology areas.

**For more details of TMD's products and capabilities, please go to [www.tmd.co.uk](http://www.tmd.co.uk) or [www.tmdus.com](http://www.tmdus.com) if you are in the USA.**

### **After sales support**

At TMD relationships with our customers do not end when an order is placed. We pride ourselves in our after sales support, through delivery, set up and user testing. We also offer a comprehensive repairs service for our own or other companies' microwave products; contact us at [wecare@tmd.co.uk](mailto:wecare@tmd.co.uk) for an evaluation.

TMD is approved to the rigorous Quality Standard BS EN ISO 9001:2015. Quality is at the heart of everything we do.

### **DID YOU KNOW?**

TMD's Instrumentation Amplifiers have helped investigate the mysteries of the universe. A few years ago we provided a Driver Amplifier to CERN for an antimatter experiment carried out in collaboration with Riken Laboratory, Japan. We are also in close collaboration with several other leading organisations involved in fundamental particle physics.



# NEW PTCM SERIES

## MODULAR INSTRUMENTATION AMPLIFIERS

FOR EMC TESTING, RADAR, EW, RF COMPONENT TESTING, COMMUNICATIONS, SCIENTIFIC AND MEDICAL APPLICATIONS

Introducing a new range of high power amplifiers for EMC testing, radar, EW, RF component testing, communications, scientific and medical applications.

Continuing with TMD's heritage in ultra-reliable amplifiers, we have now improved the capability of our amplifiers through built in self-test, advanced fault diagnostics, modular, plug and play field replaceable PCBs and Ethernet remote control and monitoring.

In the unlikely event that a problem occurs within the amplifier, the amplifier will identify where the problem lies and a field engineer can get it back up and running in no time.

A standard but customisable 6U chassis and "soft" re-configurable control system enables many options to be easily and quickly configured.

Single TWT amplifiers have part numbers beginning PTCM1xxx. High Power Dual TWT Amplifiers at 12U high are easily configured using TMD's modular system and these part numbers start at PTCM2xxx.

The Digital Control PCB that contains the SOC chip is both the heart and brains of the amplifier and represents the most advanced control system that TMD has developed to date.



Photo Courtesy of NATO JEWCS



A suite of 2-18 GHz Dual tube combined HIRF Amplifiers for DO160 Category L testing

### Standard Features

- Rugged, ultra-reliable design
- High Power Dual TWT in 12U chassis
- Advanced Self-Diagnostics
- Ethernet interface
- Remote Management and diagnostics via an embedded web server
- Graphical User Interface to run on any PC or laptop with a standard browser with operational parameters updated in real time
- VSWR Reflected Power Protection
- RF forward and reverse sample ports
- Plug and Play field replaceable power supplies
- Front panel RF input and output
- 100 – 240 VAC single phase

The intelligence behind the PTCM range is provided by a state-of-the-art advanced “System-on-Chip” (SOC) microcircuit which not only controls and synchronises all of the power conversion circuitry in real time but also provides the intelligence for all of the monitoring, control, data logging and user interface functionality.

The Digital Control PCB that contains the SOC chip is both the heart and brains of the amplifier and represents the most advanced control system that TMD has developed to date.

### Options

Please take the part number and add (in the order shown in the table) the following options as required. Leave options out that are not required

Options	Part Number Addition
5" LCD Screen	-S
Rear Panel RF	-R
RF Inhibit BNC	-IN
IEEE GPIB*	-GP*
RS-232*	-R2*
RS-444/485*	-R4*
Fibre-Optic	-FO*
Rack Slides	-RS
3-Phase 110V	-3P
Extended Pulse Width**	-PW
Reverse Power Monitor	-RP

\* The unit comes with an Ethernet port as standard and one of the green options if requested

\*\* up to 100 µs on selected models only

For Example: PTCM1001-S-IN-RS has a screen, RF inhibit and rack slides

The screenshot shows the TMD user interface. At the top, there are three power status buttons: 'Power' (grey), 'Standby' (orange), and 'Operate' (green). Below these are status indicators for 'Time to heater warning' and 'Water'. The main content area displays 'Trip Code' and 'Trip Reason' information. A table lists various parameters with their current values and units.

Parameter	Value	Unit
R.F. Power Fwd	19	dBm
R.F. Power Rev	-20	dBm
V.S.W.R.	1	
Pulse Width	0.0	Us
P.R.F.	0.0	kHz
Duty Cycle	0.0	%
T.W.T. Temp	93	Deg. C
Power Supply Temp	-11	Deg. C
Beam Current Peak	0	mA
Body Current Average	0	mA
Heater Voltage	0.00	Volts
Grid OFF Voltage	0	Negative Volts
Grid ON Voltage	0	Volts
Cathode Voltage	0.0	Negative kV
Fan Speed	499	r.p.m.
Standby Accumulated	1412	Hours
Operate Accumulated	161	Hours

### User Interface, monitoring and control

The main interface type is Ethernet (although almost all interface types are available) which enables the amplifier to be connected to a standard PC or Laptop web browser, either point to point, on a LAN or from the other side of the world!

### Black Box Logging

The amplifier will log operational hours and any tripped states with a date stamp throughout its life. This greatly aids diagnostics, for instance, TMD can assess (when allowed) whether a TWT is near end of life and arrange a replacement TWT so the amplifier is available when you need it.

### Reliability and Thermal Management

The amplifier architecture is based on TMD's ultra reliable military power supplies – proven over years in the field.

TMD employs a state-of-the-art cooling system, incorporating heat pipe

technology. This has the effect of spreading the heat dissipated by the TWT over a large area, reducing peak temperatures and significantly improving MTBF.

### Environmental

Military Standard 810G-Transport  
0°C to +40°C operational temperature  
-10°C to +50°C storage temperature

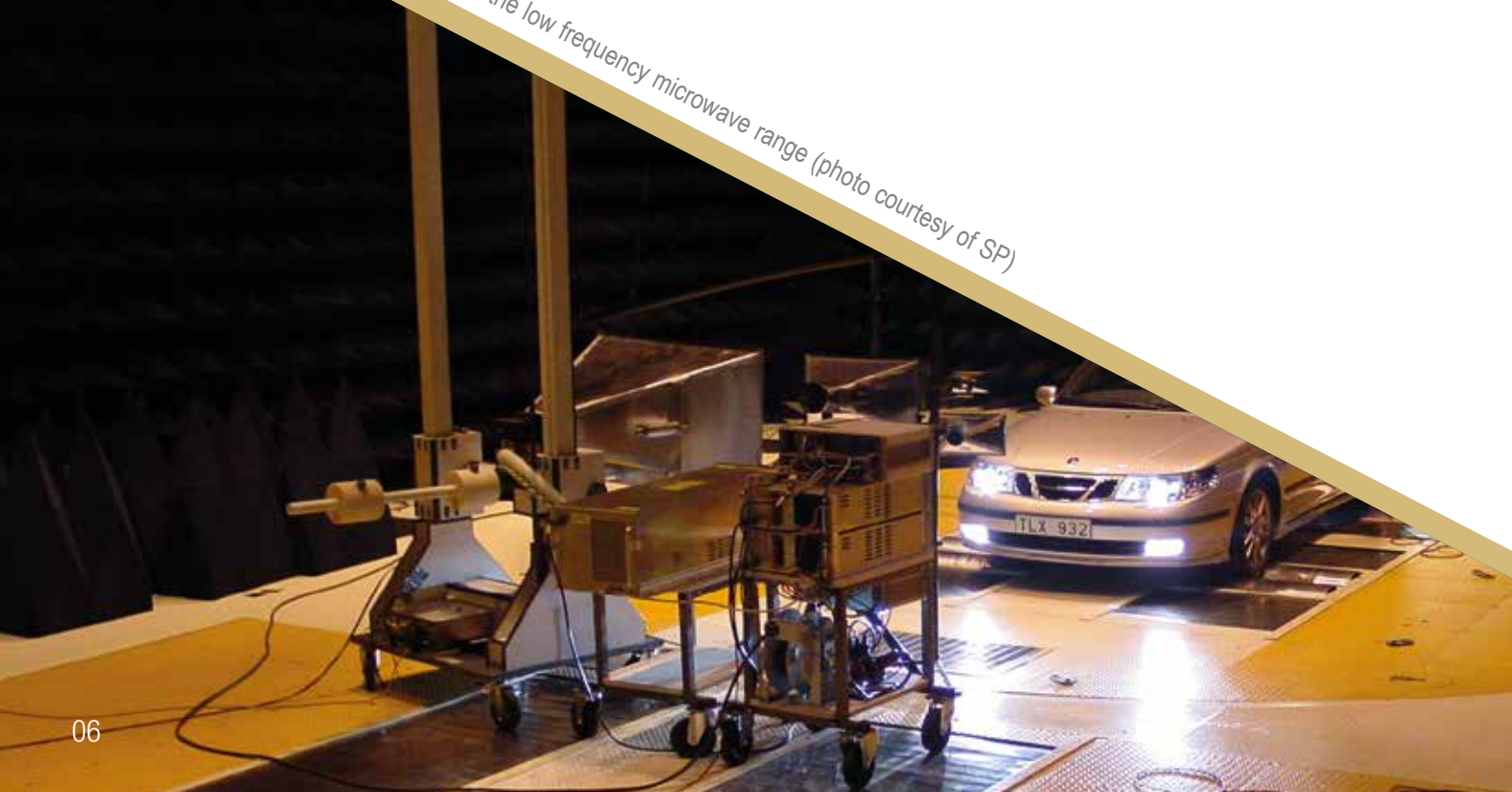
### Mechanical

19" Front Panel, 6U height,  
800 mm long  
Weight - 47 kg  
Fan Noise - TBD

### Safety & EMC

CE marked and certified to comply with EN 61010-1:2010 and EN 61000 UL certified.

EMC testing of vehicles at SP in Sweden - in the low frequency microwave range (photo courtesy of SP)



# STANDARD BROADBAND AMPLIFIERS

CW 1 – 40.0 GHz (also CW/pulsed options available)

Type Number	Frequency Range GHz	Output Power (W Min)	Output Power (W Typ)	Height	Length (mm)	Typical Weight (kg)
<b>Low Power</b>						
PTCM1011	1.0 - 18.0	50	60	6U	800	45
PTCM1003	2.0 - 4.0	250	300	6U	800	45
PTCM1004	2.0 - 6.0	200	250	6U	800	45
PTCM1005	2.5 - 8.0	250	300	6U	800	45
PTCM1006	4.0 - 8.0	250	300	6U	800	45
PTCM1007	6.5 - 18.0	200	220	6U	800	45
PTCM1008	6.0 - 18.0	300	320	6U	800	45
PTCM1009	7.5 - 18.0	200	250	6U	800	45
PTCM1010	7.5 - 18.0	250	300	6U	800	45
<b>Medium Power</b>						
PTCM1012	0.8 - 2.5	500	560	6U	800	45
PTCM1013	2.5 - 7.5	500	560	6U	800	45
PTC6522	6.0 - 18.0	550	570	8U	700	48
PTC6442	7.5 - 18.0	500	560	8U	700	48
PTCM1014	10.5 - 13.0	400	450	6U	800	45
<b>High Power</b>						
PTC7440	1.0 - 2.5	1000	1000	12U	700	110
PTC7441	2.5 - 7.5	1000	1000	12U	700	110
PTC7442	7.5 - 18.0	1000	1000	19U	700	130
<b>Millimetric</b>						
PTCM10031	17.3 - 22.0	1700	1900	24U	800	200
PTCM1015	17.5 - 21.5	210	280	6U	800	45
PTCM1016	18.0 - 28.0	45	70	6U	800	45
PTCM1017	18.0 - 23.0	210	311	6U	800	45
PTC6437	18.0 - 23.0	250	270	4U	700	30
PTCM1018	18.0 - 40.0	40	80	6U	800	45
PTCM1019	23.0 - 27.0	400	420	6U	800	45
PTC10010	25.0 - 33.0	100	120	6U	800	45
PTCM1022	26.0 - 31.0	200	220	6U	800	45
PTCM1023	26.5 - 40.0	40	70	6U	800	45
PTCM1024	27.0 - 31.0	112	125	6U	800	45
PTC9995	30.0 - 40.0	125	170	4U	800	45
PTCM1025	31.6 - 32.5	230	260	6U	800	45
PTCM1027	34.5 - 35.5	100	35	6U	800	47
PTCM1026	35.65 - 35.85	300	320	6U	800	45
PTCM20066	38.0 - 42.0	180	200	12U	800	100

EMC test laboratories using TMD's range of Ultra High Power amplifiers have generated 14,000 V/m, easily complying with the latest most demanding test requirement - RTCA/DO-160G and L.

Naval EW application (courtesy Brazilian navy)



“TMD units, delivered a decade ago are still the most reliable we’ve ever used.”

Major US EMC Facility

TMD is approved to the rigorous Quality Standard BS EN ISO9001:2015. Quality is at the heart of everything we do.

## STANDARD BROADBAND AMPLIFIERS

### Pulsed 1 – 18.0 GHz

Type Number	Frequency Range GHz	Output Power (W Min)	Output Power (W Typ)	Duty Cycle (Max %)	Pulse Length (µs)	Height	Length (mm)	Typical Weight (kg)
<b>Low Power</b>								
PTCM1201P	2.0 - 4.0	1700	2000	6	0.2-100	6U	800	47
PTCM1202P	2.5 - 8.0	1700	2100	6	0.2-100	6U	800	47
PTCM1203P	4.0 - 8.0	1700	2100	6	0.2-100	6U	800	47
PTCM1204P	5.0 - 11.0	1600	2200	5	0.2-100	6U	800	47
PTCM1205P	7.5 - 18.0	1500	2000	6	0.2-100	6U	800	47
<b>Medium Power</b>								
PTCM1207P	2.0 - 8.0	1900	2100	6	0.2-100	6U	800	47
PTC7383	2.0 – 8.0	3500	4000	6	0.2-100	8U	700	70
PTC9643	6.5 - 18.0	2000	2400	6	0.2-50	8U	800	70
PTCM1208P	8.0 - 12.4	1700	2500	6	0.2-20	6U	800	47
PTCM1209P	8.0 - 18.0	2000	2200	4	0.2-20	6U	800	47
<b>High Power (for HIRF testing)</b>								
PTC6704	1.0 - 1.5	10000	11000	1	0.2-50	4U	900	40
PTC7030	1.1 - 1.5	30000	40000	1	0.2-20	8U	1200	100
PTC6706	1.5 - 2.0	7000	8000	1	0.2-20	4U	880	30
PTCM1211P	2.0 - 4.0	5000	5500	6	0.2-20	6U	800	47
PTCM1212P	2.9 - 4.0	9000	11000	4	0.2-50	6U	800	47
PTCM1219P	4.0 - 8.0	4000	5000	6	0.2-20	6U	780	35
PTCM1213P	8.0 - 12.4	4000	5000	6	0.2-20	6U	800	47
PTCM1214P	8.0 - 11.0	5900	7500	5	0.2-20	6U	800	47
PTCM1220P	8.5 - 10.5	6800	8000	5	0.2-100	IFA	S	30
PTCM1215P	8.7 - 10.0	5000	6500	7	0.2-50	6U	800	47
PTCM1216P	8.0 - 12.0	4200	5000	6	0.2-50	6U	800	47
PTCM1217P	10.5 - 12.5	9000	10000	2	0.1-20	6U	800	47
PTCM1218P	12.4 -18.0	3500	4000	6	0.2-20	6U	800	47
<b>Ultra High Power (for HIRF Testing)</b>								
PTC9740	1.0 – 1.5	8000	9000	4	0.2-20	8U	880	40
PTC6708	1.0 – 1.5	10000	11000	2	0.2-20	8U	880	40
PTC9741	1.5 – 2.0	6000	9000	4	0.2-20	8U	880	40
PTC6709	1.5 – 2.0	8000	10000	2	0.2-20	8U	880	40
PTCM2211P	2.0 - 4.0	9000	11000	6	0.2-50	12U	880	100
PTCM2219P	4.0 – 8.0	7000	10000	6	0.2-50	12U	880	100
PTCM2213P	8.0 – 12.4	8000	9000	5	0.2-50	12U	800	100
PTCM2214P	8.0 – 11.0	12000	12600	5	0.2-20	12U	880	110
PTCM2218P	12.4 – 18.0	6000	8000	6	0.2-50	12U	880	100

All units are Integral Forced Air cooled except PTC7030 which is IFA plus internal liquid cooled.





# SOLID STATE AMPLIFIERS

Type Number	Frequency Range	Output Power (W Min)	Output Power (W Typ)	Duty Cycle (Max %)	Pulse Length ( $\mu$ s)
PTCS9648	9 kHz – 100 MHz	500	550	100	-
PTCS9649	9 kHz – 100 MHz	600	700	100	-
PTCS9669	9 kHz – 220 MHz	3000	3300	100	-
PTCS9670	9 kHz – 220 MHz	5000	5500	100	-
PTCS9732	9 kHz – 250 MHz	500	550	100	-
PTCS9711	9 kHz – 250 MHz	800	900	100	-
PTCS9717	9 kHz – 400 MHz	400	450	100	-
PTCS9667	20 MHz – 100 MHz	500	550	100	-
PTCS9668	20 MHz – 100 MHz	1000	1100	100	-
PTCS9719	80 MHz – 1 GHz	250	300	100	-
PTCS9729	80 MHz – 1 GHz	400	450	100	-
PTCS9684	80 MHz – 1 GHz	1000	1100	100	-
PTCS6909	80 MHz – 3 GHz	500	550	100	-
PTCS6922	200 MHz – 1 GHz	1000	1100	100	-
PTCS6924	400 MHz – 1 GHz	1200	1300	100	-
PTCS9762	400 MHz – 1 GHz	1500	1600	100	-
PTCS9761	400 MHz – 1 GHz	2000	2100	100	-
PTCS6913	400 MHz – 1 GHz	4000	4200	100	-
PTCS10065	0.4 GHz – 1.0 GHz	4000	4400	10	100 $\mu$ s
PTCS6932	0.5 GHz – 2.5 GHz	200	220	100	-
PTCS6907	0.5 GHz – 2.5 GHz	250	270	100	-
PTCS10063	0.5 GHz – 2.5 GHz	500	550	100	-
PTCS9731	0.5 GHz – 2 GHz	500	550	100	-
PTCS10064	0.5 GHz – 2 GHz	2000	2200	10	100 $\mu$ s
PTCS10062	0.7 GHz – 18 GHz	30	35	100	-
PTCS6918	0.8 GHz – 3 GHz	200	220	100	-
PTS9611	0.8 GHz – 2.5 GHz	250	280	100	-
PTCS9655	0.8 GHz – 3 GHz	250	280	100	-
PTCS9651	0.8 GHz – 4.2 GHz	700	770	100	-
PTCS7364	1 GHz – 2 GHz	200	220	100	-
PTCS10052	1 GHz – 2 GHz	4000	4400	10	100 $\mu$ s
PTCS6941	1 GHz – 2 GHz	8000	9000	10	100 $\mu$ s
PTCS6942	1 GHz – 2 GHz	11000	12000	10	100 $\mu$ s
PTCS6923	1 GHz – 2.5 GHz	500	550	100	-
PTS9612	1 GHz – 6 GHz	50	55	100	-
PTCS9672	1 GHz – 2.5 GHz	1000	1100	100	-
PTCS9650	1 GHz – 3 GHz	100	110	100	-
PTCS9720	1 GHz – 4 GHz	120	130	100	-
PTCS6929	1 GHz – 2.5 GHz	1000	1100	6	0.2 – 50 $\mu$ s
PTCS6937	1 GHz – 18 GHz	10	12	100	-
PTCS9756	1 GHz – 18 GHz	50	60	100	-
PTCS9759	2 GHz – 6 GHz	100	110	100	-
PTCS9758	2 GHz – 6 GHz	200	220	100	-
PTCS9757	2 GHz – 6 GHz	500	550	100	-



Photo: Category G testing at Element Materials Technology Warwick Ltd

Over the past 20 years TMD has proved itself to be a world leader in TWTA design innovation, offering particularly unusual products for a variety of markets and applications.

Photo Courtesy of EWST



# AMPLIFIER AND ANTENNA SOLUTIONS

## FOR DO160 CAT-G TESTING

INCREASED POWER CAN ALSO BE PROVIDED TO MEET CATEGORY L. PLEASE CONTACT TMD FOR MORE INFORMATION.

TMD has close working partnerships with antenna specialists, and is therefore able to provide test laboratories with amplifier/antenna turnkey solutions - delivering some of the highest field strengths available for EMC HIRF testing.

The examples given below are proven solutions used both in the UK and throughout the world, achieving DO160 category G in various chamber setups. Antenna photos are provided courtesy of Steatite Q-par.

## HIRF AMPLIFIER AND ANTENNA SOLUTIONS



0.4 – 1 GHz

700 V/m at 1 metre with an input power of 1.1 kW



**PTCS6924**  
400 MHz – 1 GHz 1.2 kW



1 – 1.6 GHz

3,000 V/m at 1 metre with an input power of 3.8 kW



**PTCS10052**  
1.0 – 2.0 GHz 4 kW

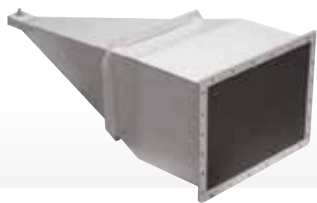


1.5 – 2.6 GHz

3,000 V/m at 1 metre with an input power of 2.8 kW



**PTCS10052**  
1.0 – 2.0 GHz 4 kW



2.6 – 4 GHz

3000 V/m at 1 metre with an input power of 2.85 kW



**PTCM1211P**  
2.0 – 4.0 GHz 5 kW

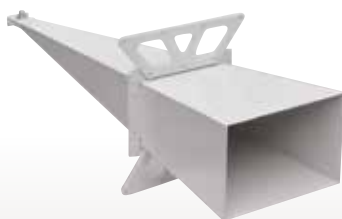


4 – 6 GHz

3000 V/m at 1 metre with an input power of 2.3 kW



**PTCM1219P**  
4.0 – 8.0 GHz 4 kW

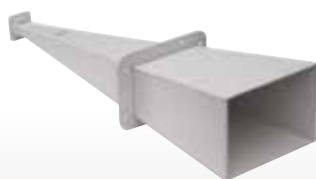


6 – 8 GHz

3000 V/m at 1 metre with an input power of 2.0 kW



**PTCM1219P**  
4.0 – 8.0 GHz 4 kW

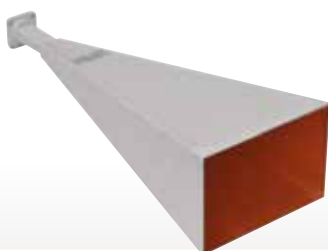


8 – 12 GHz

3000 V/m at 1 metre with an input power of 2.5 kW



**PTCM1213P**  
8.0 – 12.4 GHz 4 kW



12 – 18 GHz

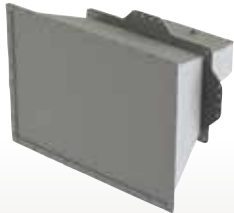
3000 V/m at 1 metre with an input power of 2.1 kW



**PTCM1218P**  
12.4 – 18 GHz 3.5 kW

# MILITARY STANDARD AMPLIFIER & ANTENNA SOLUTIONS

Working with antenna specialists TMD is able to provide turnkey amplifier/antenna solutions for MIL Spec applications - meeting 200 V/m from 0.4 - 40 GHz.



0.4 – 1.8 GHz

High Gain Horn Antenna  
for 200 V/m testing



**PTCS9783**  
0.4 – 1 GHz 500 W CW



1 – 4.2 GHz

High Gain Horn Antenna  
for 200 V/m testing

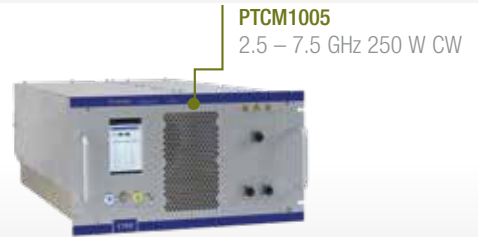


**PTS9611**  
0.8 – 2.5 GHz 250 W CW

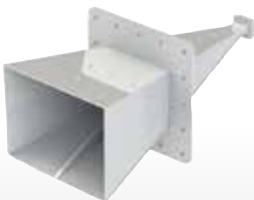


2.5 – 7.5 GHz

High Gain Horn Antenna  
for 200 V/m testing



**PTCM1005**  
2.5 – 7.5 GHz 250 W CW



7.5 – 18 GHz

High Gain Horn Antenna  
for 200 V/m testing

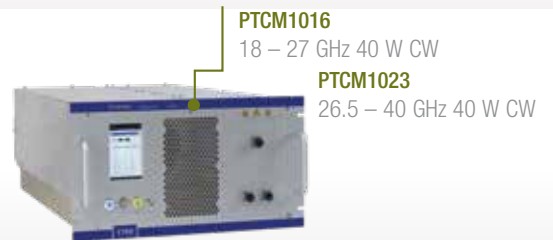


**PTCM1010**  
7.5 – 18 GHz 250 W CW



18 – 40 GHz

High Gain Horn Antenna  
for 200 V/m testing



**PTCM1016**  
18 – 27 GHz 40 W CW  
**PTCM1023**  
26.5 – 40 GHz 40 W CW

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