WATTMETERS CT 418 AND CT 419

6625-99-101-9916 AND 6625-99-943-5568

(MARCONI INSTRUMENTS TF 1152A AND TF 1152A/1)

GENERAL AND TECHNICAL INFORMATION AND SCALE OF SERVICING SPARES

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LEADING PARTICULARS

Ref. No. ... ... CT418 : 6625-99-101-9916.
CT419 : 6625-99-943-5568.

Purpose — Portable direct-indication absorption type meter with linear power scales indicating true mean power irrespective of waveform. Neither external power supplies nor internal batteries required.

Power ranges — 0.5 to 10 W and 5 to 25 W.

Frequency ranges — DC to 500 MHz.

Frequency accuracy — DC to 250 MHz within ±5% of f.s.d.
250 to 500 MHz within ±10% of f.s.d.

VSWR — Better than 1.2 from d.c. to 500 MHz.

Input impedance — CT418 : 75 Ω. CT419 : 50 Ω.

Dimensions and weight

	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
CT418	292	154	292	2.3
CT419	292	154	292	2.3

Accessories required — Coaxial plug, Type N for r.f. input socket. 50 Ω for CT419 and 75 Ω for CT418.

Commercial equivalent — Marconi Instruments TF 1152A (CT418) and TF 1152A/1 (CT419).

GENERAL INFORMATION

Introduction

1. Wattmeters Types CT418 and CT419 are direct-reading absorption instruments for use at any frequency up to 500 MHz. Each model has two measurement ranges of 10 and 25 watts full-scale; from d.c. to 250 MHz, the accuracy of measurement is 5% of full-scale and from 250 to 500 MHz the accuracy is 10% of full-scale. The CT418 has an input impedance of 75 Ω and the CT419 has an input impedance of 50 Ω. For both models the v.s.w.r. is less than 1.2 from d.c. to 500 MHz.

Fig. 1. Wattmeter CT419

Design details

2. The dissipative element in the CT418 and CT419 consists of a heavy-duty high stability resistor R1. This resistor has a tubular ceramic former with a conducting outer coating of cracked carbon and it is mounted so that it forms the central conductor of a slab, or parallel-plate, line of relatively large dimensions.

3. Connection of the power source is made to a type N coaxial socket SKT1 on the front panel, the input being fed to the "live" end of the load resistor by an outward-taper constant-impedance section. From the "earthy" end of the resistor, connection is made back to the input socket

through broad metal sheets which serve as the outer conductor to complete the slab line.

4. Indication of power level is achieved by means of a vacuum thermocouple X1, and a moving-coil meter M1; the thermocouple heater is fed from a tap near the "earthy" end of the main load resistor. The meter sensitivity is adjusted by two preset series resistors RV1 and RV2, one for each power range; the appropriate preset resistor is brought into circuit by operation of a toggle switch SW1 mounted on the front panel.

5. Instruments with serial numbers prefixed 52555 and above have a thermistor, TH1, with a shunt resistor, R3, added in series with RV1 (Fig.5) to improve the temperature characteristic on the 25 W range.

Operation

6. There is a constant ratio between power in the main load and power in the heater of the thermocouple feeding the panel meter. Because of this and the fact that the output from the thermocouple is dependent on the level of power dissipated in its heater, the meter indicates true mean power irrespective of waveform. Thus, power contained in the harmonics of the input is summed with the fundamental; furthermore, since the meter will indicate the correct increase in power when a previously unmodulated input has amplitude modulation applied, modulation depth can be calculated.

Connections

7. External connection to the wattmeter is effected by type N coaxial socket mounted on the front panel. A suitable type N free plug is supplied with each instrument. Recommended coaxial cables for use with these plugs are as follows :-

CAUTION . . .

Mechanical damage may be done if a 50 Ω type plug is inserted in a 75 Ω socket.
Measurement errors may be incurred if a 75 Ω type plug is inserted in a 50 Ω socket.
For typical caution label see Fig. 2.

(1) CT418 (75 Ω)
Great Britain : Joint-Service types UR57 or UR60.
United States : Military Nos. RG-11/U, RG-12/U or RG-13/U.

(2) CT419 (50 Ω)
Great Britain : Joint-Service UR67.
United States : Military Nos. RG-8/U, RG-9/U or RG-10/U.

Making a measurement

8. Before connecting the instrument to the equipment under test, set the RANGE switch to the position appropriate to the expected power level. If the order of the power level is not known, set the RANGE switch initially to 25 watts. To make a power measurement, connect the source under test to the socket on the front panel of the r. f. power meter; the mean power input to the instrument is then read directly on the meter.

9. When making a measurement, the following points should be borne in mind :-

(1) Ideally, the impedance presented by the power meter to a transmitter under test should be purely resistive. In practice, the power meter impedence will, inevitably, include a small reactive component which will be reflected back into the transmitter tuned-output circuit. This will have the effect of partially detuning the transmitter output stage. To obtain a true measure of the power output capabilities of a transmitter, its output stage should always be tuned to produce maximum indication on the power meter. This also applies when substituting one power meter for another.

(2) Due to the time lag in thermocouple heating and also to the low-resistance meter

Circuit, a slight delay of the order of two or three seconds, should be allowed before reading the actual power value.

CAUTION

TO AVOID
MEASUREMENT
ERRORS
50 OHM TYPE
N PLUGS
ONLY TO
BE USED

Fig. 2 Caution label (for CT419)

(3) If the instrument is run at a fairly high power for some time and then a lower power is applied, a suitable period should be allowed for the instrument to attain thermal stability. The time interval will depend on the change in power levels, the degree of accuracy required, and the duration of the high-power measurement; in general, sufficient time should be allowed for the residual reading to fall to zero after each measurement.

(4) The peak voltage that can be applied to the wattmeter is limited by the input socket insulation; this is rated to withstand a maximum of 500 volts. The peak power that can be applied to the 75 Ω CT418 is accordingly of the order of the 3 kW and, for the 50 Ω CT419, 5 kW.

Temperature correction (Fig. 3)

10. Wattmeters CT418 and CT419 are calibrated in such a manner that optimum accuracy is obtained when the ambient temperature is 20°C. The typical temperature/accuracy curve, Fig. 3, may be used to obtain greater accuracy at other ambient temperatures. Protracted power measurements will cause air-temperature increase within the instrument, leading to long-term drift. All measurements should, therefore, be made as rapidly as possible. For greater accuracy, time should be allowed between measurements for the power meter to revert to ambient temperature as described in para. 9.

Determination of modulation depth

11. The depth of amplitude modulation of an r.f. signal with a sinusoidal envelope can be determined as follows :-

(1) Measure the output power of the source under test with the signal unmodulated. Let this reading be P_C watts.

(2) Modulate the signal and again measure the output power. Let this reading be P_M watts.

(3) Calculate the modulation depth. This can be evalued since P_C , P_M and the modulation factor m, are related by

$$P_M = P_C \left(1 + \frac{m^2}{2}\right) \quad \ldots \quad (1)$$

Transposing and simplifying, equation provides

$$\text{Modulation depth} = \sqrt{2\left(\frac{P_M - P_C}{P_C}\right)} \times 100\% \quad \ldots \quad (2)$$

Example : From measurements, it is found that P_C = 11 watts and

P_M = 15 watts.

Hence, from equation (2),

$$\text{Modulation depth} = \sqrt{2\left(\frac{15 - 11}{11}\right)} \times 100\%$$

$$= 85.3\%$$

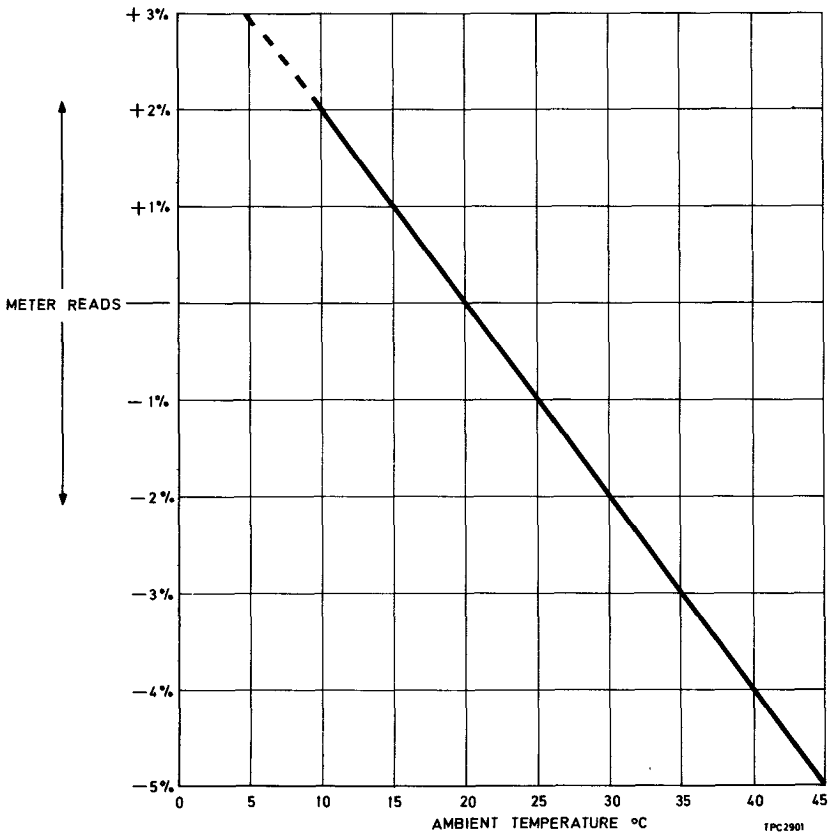

Fig. 3 Temperature correction chart

12. CAUTION . . .

Component parts of this power meter must not be dismantled nor rearranged except by authorized personnel.

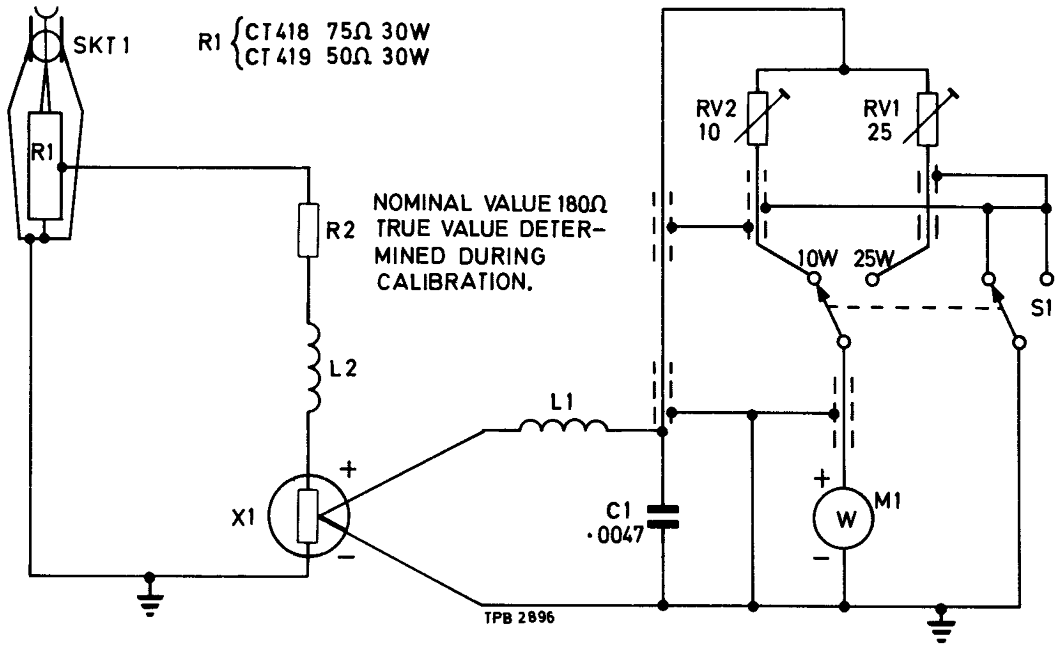

Fig. 4 Wattmeters CT418 and CT419 - old circuit

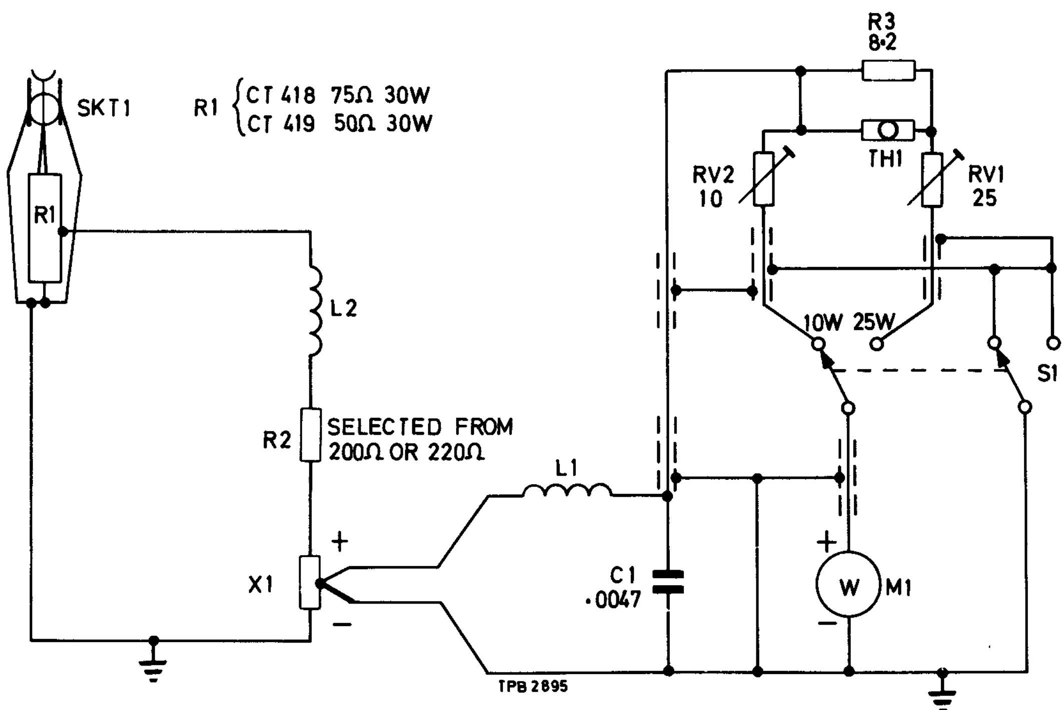

Fig. 5 Wattmeters CT418 and CT419 : modified circuit

TOPIC 3D

SCALE OF SERVICING SPARES

FOR

6625-99-101-9916 WATTMETER, CT418

AND

6625-99-943-5568 WATTMETER, CT419

This Scale of Servicing Spares is based on the most up-to-date information available at the time of printing. Any aspect of the scale thought to be unsatisfactory is to be reported in accordance with AP 3158 Vol. 2 (2nd Edition) Leaflet D6 (as amended) to Ministry of Defence (ADSM 25) RAF Via Command Headquarters.

COLUMN HEADINGS AND SPECIAL NOTES

Col.1 - Section and reference number.

Col.2 - Nomenclature.

Col.3 - Qty off per equipment.

Col.4 - Items marked with an asterisk denotes second line servicing.

Col.5 - Items marked with an asterisk denotes components 'selected on test'.

Col.6 - Blank.

Col.7 - Blank.

Col.8 - Items marked ∅ affect calibration of the equipment.

Col.9 - Circuit reference, part number or other reference.

Note (1) The replacement of certain components may affect the calibration of this test equipment. It is recommended that the calibration be checked after replacement of these electronic components. Where ∅ appears in Col. 8 and more than one circuit reference is listed in Col. 9, components affecting calibration will be underlined.

Note (2) Items not scaled for 2nd line, are available for use on 'as required' basis, providing it does not affect calibration.

1	2	3	4	5	6	7	8	9
10AC 5310-99- 101-8212	WASHER FLAT rd; aluminium alloy; 0.390 in id, 0.750 in od; 0.064 in thk.	2						TB6775/469
5355-99- 945-0427	SHAFT LOCK, ELECTRONIC COMPONENT aluminium alloy; 1/4 in dia shaft; 3/8 in -32 size designation mtg nut	2						Firth Cleve AD/1570/37 (25878-203)
10AE 6685-99- 972-1286	THERMOCOUPLE, HEATING ELEMENT 25mA; glass cylindrical; o/a dim 3-5/32 in dia. 5/8 in w.	1						TB27102 (44312-001)
10AK 5340-99- 949-3474	HANDLE, LUGGAGE grey; PVC; canvas, cloth backed retaining plates; 8 in lg. 3/4 in w 5/16 in thk.	1						TC18996/5 (22315-520)
10AL 6625-99- 631-3709	FELT PAD felt; 1/2 in dia, 1/16 in thk.	1						TB42913 (37111-103)
5325-99- 942-3414	GROMMET, RUBBER 0.188 in dia hole; 0.438 in od by 0.257 in h o/a.	1						BS1767 (23187-132)
10AR 5365-99- 631-3088	SHIM brass; 1 in lg., 1 in w, 20 swg thk.	1						TB27179 34215-102
5340-99- 932-5186	CLAMP LOOP 3/16 in loop id.	3						Insuloid NXI SSM(L)Y-4/2 TB22686/- (23243-622)
10C 5950-99- 631-3710	INDUCTOR, RADIO FREQUENCY 22 turns	2						TB33334 (44221-802)
5950-99- 911-8390	INDUCTOR, RADIO FREQUENCY 15 turns, unscreened; 5/32 in dia; fixed	1						TB22722/6 (35127-105)
10F 5930-99- 194-4697	SWITCH, TOGGLE 2 pole; 1 on/1 off; 3 A max. 250 V.	1						NSF 8373B232
10H 5935-99- 900-6093	PLUG, ELECTRICAL fixed; aluminium; coaxial; KV; female shell; locking. FITTED TO CT 418 ONLY	1						SDA183565
10S 6625-99- 119-2088	WATTMETER dc; rect. flange mtd; 3-15/16 in barrel dia; 0 to 10 W, 0 to 25 W.	1						TC18200/64 (44561-403)

1	2	3	4	5	6	7	8	9
10W								
5905-99-223-6406	RESISTOR, THERMAL 14 ohms at 20 deg C, 1.4 V max.	1						S.T & CKS2Y (25683-424)
5905-99-631-3089	RESISTOR, FIXED, FILM insulated; 8.2 ohms ±5%; 1/2W	1						M24500-019 PT24552-018G
5905-99-631-3094	RESISTOR, VARIABLE wirewound, 25 ohms ±10%; 3 W; linear	1						M25815-203 PT25815-233D
5905-99-631-3095	RESISTOR, VARIABLE wirewound, 10 ohms ±10% 3 W; linear	1						M25815-203 PT25815-203F
6625-99-631-3708	DUMMY LOAD, ELECTRICAL 75 ohms. FITTED TO CT 418 only	1						TC47839 (44368-009) (TM 9556/2)
6625-99-633-8278	DUMMY LOAD, ELECTRICAL 50 ohms FITTED TO CT 419 ONLY	1						TC47833 (44368-007)
110H								
5935-00-149-4236	PLUG, ELECTRICAL free; 1 pole (coaxial, 50 ohms) thd coupling nut locking style	1						UG21BU (23443-703)