APPROVAL SHEET

WF25V, WF20V, WF12V, WF08V, WF06V

±1%, ±5%

Thick Film High Voltage Chip Resistors

Size 2512,2010,1206, 0805, 0603

RoHS 2 Compliant with exemption 7C-I

Halogen free

*Contents in this sheet are subject to change without prior notice

FEATURES

1. Special material and design for high working voltage require.
2. Compatible with flow and reflow soldering
3. Suitable for lead free soldering.

APPLICATIONS

- Power supply
- Automotive industry
- Measurement instrument
- Back light inverter
- Medical or Military equipment

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a resistive paste that is applied to the top surface of the substrate. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to nominated value within tolerance which controlled by laser trimming of this resistive layer.

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For ease of soldering the outer layer of these end terminations is a Tin (lead free) alloy.

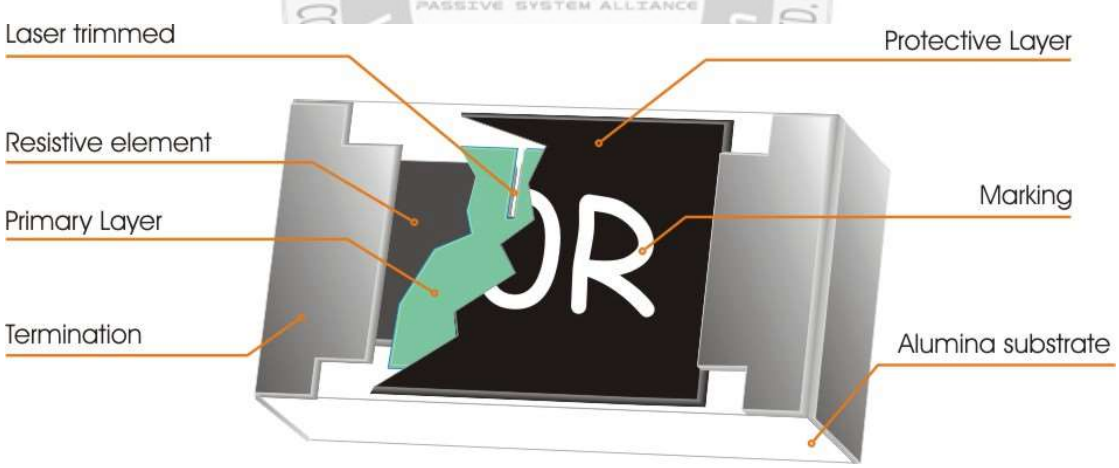


Fig 1. Consctruction of Chip-R

QUICK REFERENCE DATA

Item	General Specification				
Series No.	WF25V	WF20V	WF12V	WF08V	WF06V
Size code	2512 (6432)	2010 (5025)	1206 (3216)	0805 (2012)	0603 (1608)
Resistance Tolerance	±1% (E96/E24) , ±5% (E24)				
Resistance Range	±1%: 47Ω ~10MΩ (E96/E24) 11MΩ ~22MΩ (E24) ±5%: 47Ω ~100MΩ(E24)			±1%: 47Ω ~10MΩ (E96/E24) ±5%: 100KΩ ~22MΩ (E24)	±1%: 47Ω ~10MΩ (E96/E24) ±5%: 100KΩ ~10MΩ (E24)
TCR (ppm/°C)	±1%: 47Ω ~10MΩ ±100ppm/°C ±1%: 11MΩ ~22MΩ ±200ppm/°C ±5%: ±200ppm/°C				
Max. Dissipation at T_{amb}=70°C	1 W	1/2 W	1/4 W	1/8 W	1/10 W
Max. Operation Voltage (DC or RMS)	3000V	2000V	800V	400V	200V
Max. Overload Voltage (DC or RMS)	4000V	3000V	1600V	800V	400V
Climatic category (IEC 60068)	55/155/56				

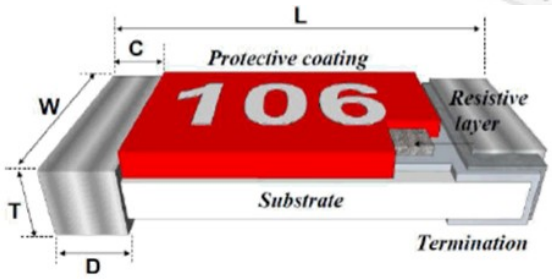
Note:

1. This is the maximum voltage that may be continuously supplied to the resistor element, see “IEC publication 60115-8”
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

$$RCWV = \sqrt{Rated\,Power \times Resistance\,Value}$$ or Max. RCWV listed above, whichever is lower.

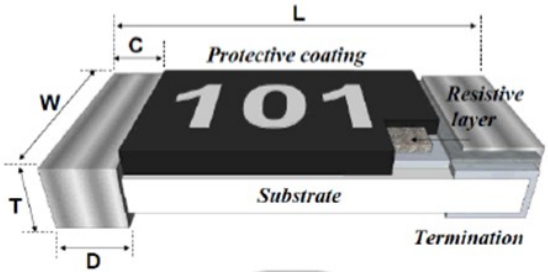
MECHANICAL DATA

R value ≥ 100KΩ



Series No.	WF25V	WF20V	WF12V	WF08V	WF06V
L	6.40 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10
W	3.20 ± 0.20	2.50 ± 0.20	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10
C	0.65 ± 0.25	0.65 ± 0.25	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.20
D	0.90 ± 0.25	0.60 ± 0.25	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.20
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10

R value < 100KΩ



Series No.	WF25V	WF20V	WF12V	WF08V	WF06V
L	6.40 ± 0.20	5.00 ± 0.20	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10
W	3.10 ± 0.20	2.50 ± 0.20	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10
C	0.60 ± 0.25	0.65 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
D	1.80 ± 0.25	0.60 ± 0.25	0.50 ± 0.25	0.40 ± 0.20	0.30 ± 0.20
T	0.60 ± 0.15	0.60 ± 0.10	0.55 ± 0.10	0.50 ± 0.10	0.45 ± 0.10

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

WF25	V	1004	F	T	L
Size code WF25 : 2512 WF20 : 2010 WF12 : 1206 WF08 : 0805 WF06 : 0603	**Type code** V :High Voltage	**Resistance code** ±5% E24: 2 significant digits followed by no. of zeros and a blank 47Ω = 470_ 680Ω = 681_ 750KΩ = 754_ 1MΩ = 105_ 100MΩ = 107_ ("_" means a blank) ±1%, E24+E96: 3 significant digits followed by no. of zeros 47Ω = 47R0 680Ω = 6800 750KΩ = 7503 1MΩ = 1004 22MΩ = 2205	**Tolerance** J : ±5% F : ±1%	**Packaging code** T : 7" Reel taping Q :10" Reel taping G: 13" Reel taping	**Termination code** L = Sn base (lead free)

Tape packaging:
1206, 0805: 0603: 8mm width paper taping 5Kpcs per 7" reel, 10Kpcs per 10" reel, 20Kpcs per 13" reel
2512,2010: 12mm width plastic taping 4Kpcs per 7" reel, 8Kpcs per 10" reel, 16Kpcs per 13" reel

MARKING

R value ≥ 100KΩ, Overcoat Color is “Red”

R value < 100KΩ, Overcoat Color is “Black”

E24 series ±5%:

Each resistor is marked with a three–digit code on the protective coating to designate the nominal resistance value.

0603/0805/1206/2010/2512:

104 → $10x10^{4}$=100 KΩ

E24/E96 series ±1%:

Each resistor is marked with a four–digit code on the protective coating to designate the nominal resistance value.

0805/1206/2010/2512:

1001 → $100x10^{1}$=1 KΩ

E24 series ±1%:

Each resistor is marked with a three–digit code on the protective coating to designate the nominal resistance value.

0603:

915 → $91x10^{5}$=9.1 MΩ

E96 series ±1%:

Each resistor is marked with a three–digit code on the protective coating to designate the nominal resistance value.

0603:

01B → Refer 0603 1% E96 CODE table = 1 KΩ

The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value. The markings for the overlap values between E24 and E96 series are based on the E96 CODE table.

Code	Z	Y	X	A	B	C	D	E	F	G
Multiplier	10^{-3}	10^{-2}	10^{-1}	10^{0}	10^{1}	10^{2}	10^{3}	10^{4}	10^{5}	10^{6}

Example

RESISTANCE	1.78Ω	17.8Ω	178Ω	1K78	17K8	178K	1M78	10M0
3 digits marking	25Y	25X	25A	25B	25C	25D	25E	01F

0603 1% E96 CODE table:															
CODE	**R value**	**CODE**	**R-value**	**CODE**	**R-Value**	**CODE**	**R-value**	**CODE**	**R-value**	**CODE**	**R-value**	**CODE**	**R-value**	**CODE**	**R-value**
01	**100**	13	**133**	25	**178**	37	**237**	49	**316**	61	**422**	73	**562**	85	**750**
02	**102**	14	**137**	26	**182**	38	**243**	50	**324**	62	**432**	74	**576**	86	**768**
03	**105**	15	**140**	27	**187**	39	**249**	51	**332**	63	**442**	75	**590**	87	**787**
04	**107**	16	**143**	28	**191**	40	**255**	52	**340**	64	**453**	76	**604**	88	**806**
05	**110**	17	**147**	29	**196**	41	**261**	53	**348**	65	**464**	77	**619**	89	**825**
06	**113**	18	**150**	30	**200**	42	**267**	54	**357**	66	**475**	78	**634**	90	**845**
07	**115**	19	**154**	31	**205**	43	**274**	55	**365**	67	**487**	79	**649**	91	**866**
08	**118**	20	**158**	32	**210**	44	**280**	56	**374**	68	**499**	80	**665**	92	**887**
09	**121**	21	**162**	33	**215**	45	**287**	57	**383**	69	**511**	81	**681**	93	**909**
10	**124**	22	**165**	34	**221**	46	**294**	58	**392**	70	**523**	82	**698**	94	**931**
11	**127**	23	**169**	35	**226**	47	**301**	59	**402**	71	**536**	83	**715**	95	**953**
12	**130**	24	**174**	36	**232**	48	**309**	60	**412**	72	**549**	84	**732**	96	**976**

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of ±1%, ±5%. The values of the E24/E96 series are in accordance with “IEC publication 60063”.

Derating curve

The power that the resistor can dissipate depends on the operating temperature; see Fig.2

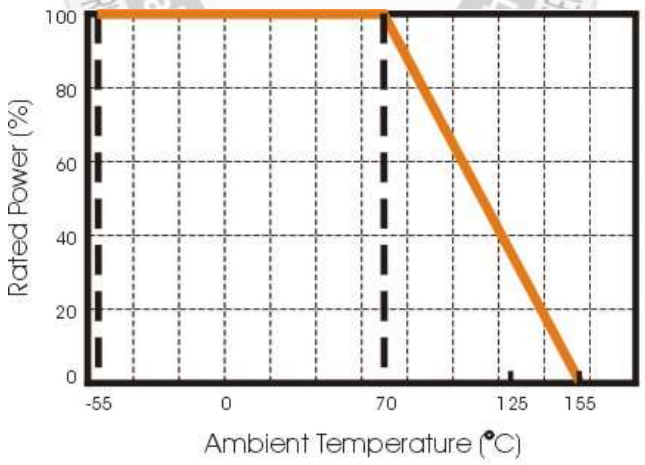


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

MOUNTING

Chip placement can be on ceramic substrates and printed-circuit boards (PCBs).

Electrical connection to the circuit is by individual soldering condition.

The end terminations guarantee a reliable contact.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
2. To store products with following condition:

   Temperature :5 to 40°C

   Humidity :20 to 70% relative humidity
3. Caution:

   a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.

   It may cause oxdization of electrode, which easily be resulted in poor soldering.

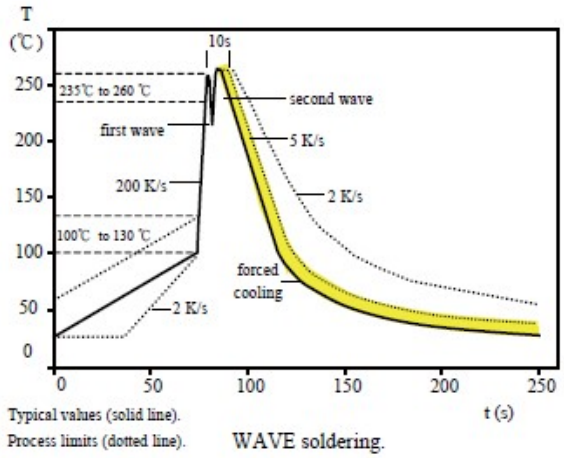
   b. To store products on the shelf and avoid exposure to moisture.

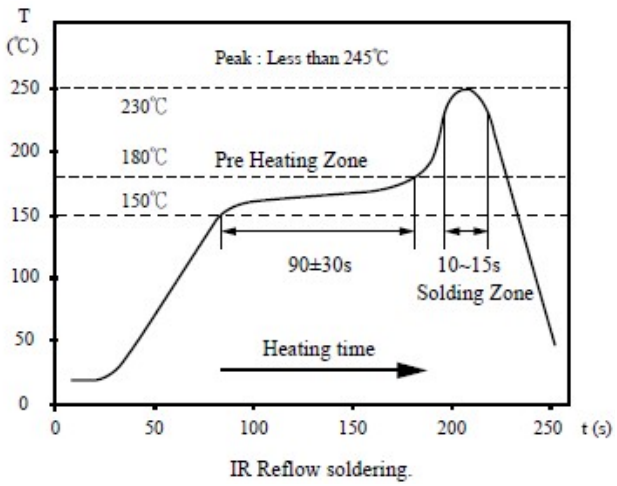
c. Don't expose products to excessive shock, vibration, direct sunlight and so on

SOLDERING CONDITION

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount Surface Mount Resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs).

Surface Mount Resistors are tested for solderability at 235°C during 2 seconds. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3.





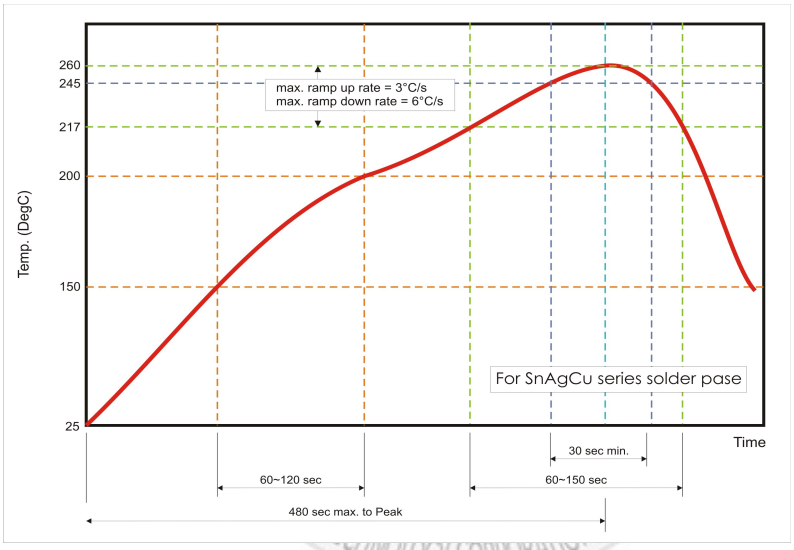
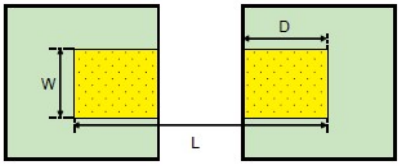


Fig 3. Infrared soldering profile

Recommend Solder Pad Dimensions

Type	W	D	L
WF06V	0.90	1.00	3.00
WF08V	1.30	1.15	3.50
WF12V	1.80	1.30	4.70
WF20V	3.00	1.50	6.80
WF25V	3.70	1.60	7.60
WF25V <100KΩ	3.70	1.60	7.60



Unit:mm

TESTS AND REQUIREMENTS (JIS C 5201-1 : 1998)

Essentially all tests are carried out according to the schedule of IEC publication 115-8, category **LCT**/**UCT**/56(rated temperature range : **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; damp heat, long term, 56 days). The testing also meets the requirements specified by EIA, EIAJ and JIS.

The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to IEC 60068-1, subclause 5.3. Unless otherwise specified, the following value supplied :

Temperature: 15°C to 35°C.

Relative humidity: 45% to 75%.

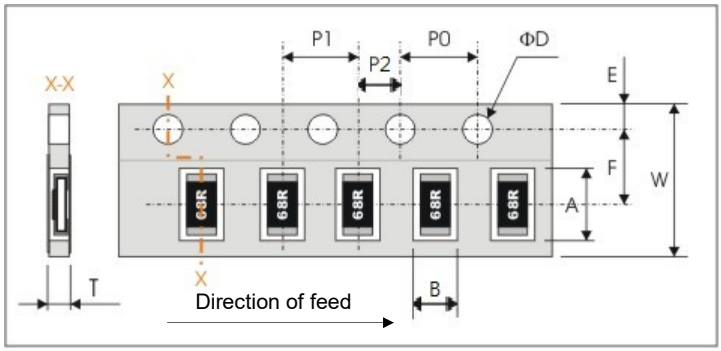
Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

All soldering tests are performed with midly activated flux.

TEST	PROCEDURE (IEC 60115)	REQUIREMENT
DC Resistance	IEC 60115-1 / JIS C 5201-1 , Clause 4.5 Measure the resistance Value.	F:±1%, J:±5%
Temperature Coefficient of Resistance(T.C.R) Clause 4.8	Natural resistance change per change in degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ (ppm/°C) R_1 : Resistance at reference temperature R_2 : Resistance at test temperature t_1: 25°C t_2: -55~+155°C	Refer to "QUICK REFERENCE DATA"
Short time overload (S.T.O.L) Clause 4.13	5×Rated power or Max. Overload voltage for 5 sec. Measure the resistance after 30 minutes	J: ΔR/R max.±(2%+0.1Ω) F: ΔR/R max.±(1%+0.1Ω)
Resistance to soldering heat(R.S.H) Clause 4.18	Un-mounted chips completely immersed for 10±1second in a SAC solder bath at 260°C ±5°C	ΔR/R max. ±(1%+0.1Ω) no visible damage
Solderability Clause 4.17	Un-mounted chips completely immersed for 2±0.5second in a SAC solder bath at 245°C±2°C	good tinning (>95% covered) no visible damage
Temperature cycling Clause 4.19	30 minutes at -55°C±3°C, 2~3 minutes at 20°C+5°C-1°C, 30 minutes at +155°C±3°C, 2~3 minutes at 20°C+5°C-1°C, total 5 continuous cycles	ΔR/R max. ±(1%+0.1Ω) no visible damage
Load life (endurance) Clause 4.25	1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off	J: ΔR/R max.±(3%+0.1Ω) F: ΔR/R max.±(1%+0.1Ω)
Load life in Humidity Clause 4.24	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off	J: ΔR/R max.±(3%+0.1Ω) F: ΔR/R max.±(1%+0.1Ω)
Insulation Resistance Clause 4.6	Test voltage：100±15V	Between termination and coating must over 1000MΩ
Bending strength Clause 4.33	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending 2mm: 2512,2010,1206, 3mm: 0805,0603 once for 10 seconds	ΔR/R max. ±(0.5%+0.05Ω)
Voltage Coefficient of Resistance (VCR)	IEC 60115-1, Clause 4.11 Max. test voltage : 500V V_L: 10% RCWV or Max. RCWV V_H: 100% RCWV or Max. RCWV	100KΩ~≤1MΩ : ±100ppm >1MΩ : ±200ppm ≥10MΩ : ±300ppm

PACKAGING

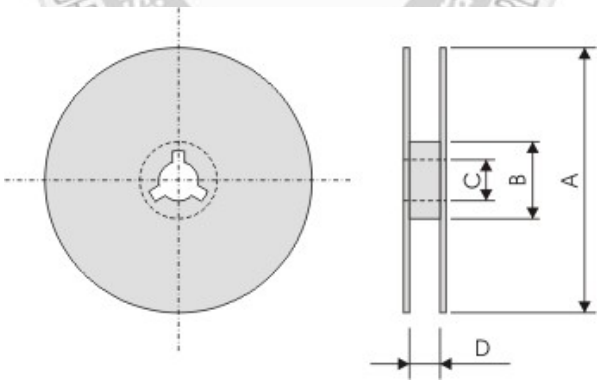
Tape specifications (unit :mm)



Series No.	A	B	W	F	E
WF25V	6.90±0.20	3.60±0.20	12.00±0.30	5.50±0.10	1.75±0.10
WF20V	5.50±0.20	2.80±0.20			
WF12V	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF08V	2.40±0.20	1.65±0.20	8.00±0.30	3.50±0.20	1.75±0.10
WF06V	1.90±0.20	1.10±0.20	8.00±0.30	3.50±0.20	1.75±0.10

Series No.	P1	P0	P2	ΦD	T
WF25V	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.2
WF20V					
WF12V					Max. 1.0
WF08V					
WF06V					

Reel dimensions



(unit : mm)

Size	Reel	Packaging Q'ty	A	B	C	D
0603 0805 1206	7" Reel for 8mm tape	5Kpcs/reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	10.00±1.5
	10"reel for 8mm tape	10Kpcs/reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	10.00±1.5
	13"reel for 8mm tape	20Kpcs/reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	10.00±1.5
2010 2512	7" Reel for 12mm tape	4Kpcs/reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	13.8±1.5
	10" Reel for 12mm tape	8Kpcs/reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	13.8±1.5
	13" Reel for 12mm tape	16Kpcs/reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	13.8±1.5