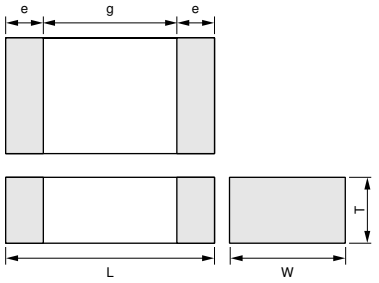
Data Sheet

Monolithic Ceramic Capacitors

GRM188R71C104KA01☐ (0603, X7R, 0.10μF, 16Vdc)

☐: packaging code



(in mm)

■ Dimensions

Length L	1.60mm±0.10mm
Width W	0.80mm±0.10mm
Thickness T	0.80mm±0.10mm
Electrode e	0.20 to 0.50mm
Electrode Gap g (min.)	0.50mm

■ Packaging

Code	Packaging	Minimum Quantity
D	180mm Paper Tape	4000
J	330mm Paper Tape	10000
C	Bulk Case	15000
B	Bulk(Bag)	1000

■ Rated Value

TC Code	**R7**
TC Code (Standard)	X7R (EIA)
Capacitance Change	±15%
Capacitance	0.10μF±10%
Rated Voltage	16Vdc

■ Specifications

Please refer to 'Specification' PDF file.

● This data sheet is applied for CHIP MONOLITHIC CERAMIC CAPACITOR used for General Electronics equipment for your design.

<Notice>

● Solderability of Tin plating termination chip might be deteriorated when low temperature soldering profile where peak solder temperature is below the Tin melting point is used. Please confirm the solderability of Tin plating termination chip before use.

⚠Note:

1. Export Control
   〈For customers outside Japan〉
   Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.
   〈For customers in Japan〉
   For products which are controlled items subject to the “Foreign Exchange and Foreign Trade Law” of Japan, the export license specified by the law is required for export.
2. Please contact our sales representatives or product engineers before using the products in this data sheet for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage to a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this data sheet.
   ① Aircraft equipment ② Aerospace equipment
   ③ Undersea equipment ④ Power plant equipment
   ⑤ Medical equipment ⑥ Transportation equipment (vehicles, trains, ships, etc.)
   ⑦ Traffic signal equipment ⑧ Disaster prevention / crime prevention equipment
   ⑨ Data-processing equipment ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above
3. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.
4. This data sheet has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering. Especially, please read rating and ⚠CAUTION (for storage, operating, rating, soldering, mounting and handling) in them to prevent smoking and/or burning, etc.
5. You are able to read a detailed specification in the website of Search Engine (http://search.murata.co.jp/) or catalog library (http://www.murata.com/catalog/) before to require our product specification or to transact the approval sheet for product specification.
6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our data sheets. In this connection, no representation shall be made to the effect that any third parties are authorized to use the right mentioned above under licenses without our consent.
7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Item</th><th colspan="2">Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td>1</td><td>Operating Temperature Range</td><td>−55 to +125℃</td><td>B1, B3, F1, R6 : −25 to +85℃
R1, R7 : −55 to +125℃
E4 : +10 to +85℃
F5 : −30 to +85℃</td><td>Reference temperature : 25℃
(2Δ, 3Δ, 4Δ, B1, B3, F1, R1, R6 : 20℃)</td></tr>
<tr><td>2</td><td>Rated Voltage</td><td colspan="2">See the previous pages</td><td>The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor.
When AC voltage is superimposed on DC voltage, V^{P-P} or V^{O-P}, whichever is larger, should be maintained within the rated voltage range.</td></tr>
<tr><td>3</td><td>Appearance</td><td colspan="2">No defects or abnormalities</td><td>Visual inspection</td></tr>
<tr><td>4</td><td>Dimensions</td><td colspan="2">Within the specified dimensions</td><td>Using calipers</td></tr>
<tr><td>5</td><td>Dielectric Strength</td><td colspan="2">No defects or abnormalities</td><td>No failure should be observed when *300% of the rated voltage (temperature compensating type) or 250% of the rated voltage (high dielectric constant type) is applied between the terminations for 1 to 5 seconds, provided the charge/discharge current is less than 50mA. *200% for 500V</td></tr>
<tr><td>6</td><td>Insulation Resistance</td><td colspan="2">C≦0.047μF : More than 10,000MΩ
C>0.047μF : 500Ω・F
C : Nominal Capacitance</td><td>The insulation resistance should be measured with a DC voltage not exceeding the rated voltage at 20/25℃ and 75%RH max. and within 2 minutes of charging, provided the charge/discharge current is less than 50mA.</td></tr>
<tr><td>7</td><td>Capacitance</td><td colspan="2">Within the specified tolerance</td><td rowspan="2">The capacitance/Q/D.F. should be measured at 20/25℃ at the frequency and voltage shown in the table.
<table><tr><th>Char.
Item</th><th>ΔC to ΔU, 1X (1000pF and below)</th><th>ΔC to ΔU, 1X (more than 1000pF)
R6, R7, F5
B1, B3, F1</th><th>E4</th></tr><tr><td>Frequency</td><td>1±0.1MHz</td><td>1±0.1kHz</td><td>1±0.1kHz</td></tr><tr><td>Voltage</td><td>0.5 to 5Vrms</td><td>1±0.2Vrms</td><td>0.5±0.05Vrms</td></tr></table></td></tr>
<tr><td>8</td><td>Q/
Dissipation Factor (D.F.)</td><td>30pF and over : Q≧1000
30pF and below :
Q≧400+20C

C : Nominal Capacitance (pF)</td><td>[B1, B3, R1, R6, R7, E4, C8]
W.V. : 25V min. : 0.025 max.
W.V. : 16/10V : 0.035 max.
W.V. : 6.3/4V
: 0.05 max. (C<3.3μF)
: 0.1 max. (C≧3.3μF)
[F1, F5]
W.V. : 25V min.
: 0.05 max. (C<0.1μF)
: 0.09 max. (C≧0.1μF)
W.V. : 16/10V : 0.125 max.
W.V. : 6.3V : 0.15 max.</td></tr>
</table>

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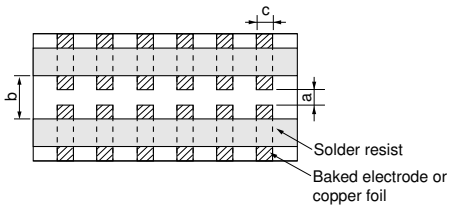
<table>
<tr><th rowspan="2">No.</th><th colspan="2" rowspan="2">Item</th><th colspan="2">Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Capacitance Temperature Characteristics</td><td>No bias</td><td>Within the specified tolerance (Table A-1)</td><td>B1, B3 : Within ±10% (−25 to +85℃)
R1, R7 : Within ±15% (−55 to +125℃)
R6 : Within ±15% (−55 to +85℃)
E4 : Within +22/−56% (+10 to +85℃)
F1 : Within +30/−80% (−25 to +85℃)
F5 : Within +22/−82% (−30 to +85℃)
C8 : Within ±22% (−55 to +105℃)</td><td rowspan="3">The capacitance change should be measured after 5 min. at each specified temp. stage.
(1)Temperature Compensating Type
The temperature coefficient is determined using the capacitance measured in step 3 as a reference.
When cycling the temperature sequentially from step 1 through 5 (5C : +25 to +125℃/ΔC : +20 to +125℃ : other temp. coeffs. : +25 to +85℃/+20 to +85℃) the capacitance should be within the specified tolerance for the temperature coefficient and capacitance change as Table A-1.
The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1, 3 and 5 by the cap. value in step 3.
<table><tr><th>Step</th><th>Temperature (℃)</th></tr><tr><td>1</td><td>Reference Temperature ±2</td></tr><tr><td>2</td><td>−55±3 (for ΔC)/−25±3 (for other TC)</td></tr><tr><td>3</td><td>Reference Temperature ±2</td></tr><tr><td>4</td><td>125±3 (for ΔC)/85±3 (for other TC)</td></tr><tr><td>5</td><td>Reference Temperature ±2</td></tr></table>
(2) High Dielectric Constant Type
The ranges of capacitance change compared with the 20℃ value over the temperature ranges shown in the table should be within the specified ranges.∗
In case of applying voltage, the capacitance change should be measured after 1 more min. with applying voltage in equilibration of each temp. stage.
<table><tr><th>Step</th><th>Temperature (℃)</th><th>Applying Voltage (V)</th></tr><tr><td>1</td><td>Reference Tempereture ±2</td><td rowspan="4">No bias</td></tr><tr><td>2</td><td>–55±3 (for R1, R7, R6)
–25±3 (for B1, B3, F1)
–30±3 (for F5)/10±3 (for E4)</td></tr><tr><td>3</td><td>Reference Tempereture ±2</td></tr><tr><td>4</td><td>125±3 (for R1, R7)/
85±3 (for B1, B3, R6
F1, F5, E4)</td></tr><tr><td>5</td><td>Reference Tempereture ±2</td><td rowspan="4">50% of the rated voltage</td></tr><tr><td>6</td><td>–55±3 (for R1)/
–25±3 (for B1, F1)</td></tr><tr><td>7</td><td>Reference Tempereture ±2</td></tr><tr><td>8</td><td>125±3 (for R1)/
85±3 (for B1, F1)</td></tr></table></td></tr>
<tr><td>50% of the Rated Voltage</td><td></td><td>B1 : Within +10/–30%
R1 : Within +15/–40%
F1 : Within +30/–95%</td></tr>
<tr><td>Capacitance Drift</td><td>Within ±0.2% or ±0.05pF (Whichever is larger.)
∗Not apply to 1X/25V</td><td>∗Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/–10℃ for one hour and then set for 48±4 hours at room temperature.
Perform the initial measurement.</td></tr>
<tr><td>10</td><td colspan="2">Adhesive Strength of Termination</td><td>No removal of the terminations or other defect should occur
 

Fig. 1a</td><td>Solder the capacitor to the test jig (glass epoxy board) shown in Fig. 1a using an eutectic solder. Then apply 10N* force in parallel with the test jig for 10±1 sec.
The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
∗1N (GRM02), 2N (GR□03), 5N (GR□15, GRM18)
(in mm)
<table><tr><th>Type</th><th>a</th><th>b</th><th>c</th></tr><tr><td>GRM02</td><td>0.2</td><td>0.56</td><td>0.23</td></tr><tr><td>GR□03</td><td>0.3</td><td>0.9</td><td>0.3</td></tr><tr><td>GR□15</td><td>0.4</td><td>1.5</td><td>0.5</td></tr><tr><td>GRM18</td><td>1.0</td><td>3.0</td><td>1.2</td></tr><tr><td>GRM21</td><td>1.2</td><td>4.0</td><td>1.65</td></tr><tr><td>GRM31</td><td>2.2</td><td>5.0</td><td>2.0</td></tr><tr><td>GRM32</td><td>2.2</td><td>5.0</td><td>2.9</td></tr><tr><td>GRM43</td><td>3.5</td><td>7.0</td><td>3.7</td></tr><tr><td>GRM55</td><td>4.5</td><td>8.0</td><td>5.6</td></tr></table></td></tr>
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No.	Item		Specifications: Temperature Compensating Type	Specifications: High Dielectric Type	Test Method
11	Vibration Resistance	Appearance	No defects or abnormalities		Solder the capacitor on the test jig (glass epoxy board) in the same manner and under the same conditions as (10). The capacitor should be subjected to a simple harmonic motion having a total amplitude of 1.5mm, the frequency being varied uniformly between the approximate limits of 10 and 55Hz. The frequency range, from 10 to 55Hz and return to 10Hz, should be traversed in approximately 1 minute. This motion should be applied for a period of 2 hours in each 3 mutually perpendicular directions (total of 6 hours).
		Capacitance	Within the specified tolerance		
		Q/D.F.	30pF and over : Q≧1000 30pF and below : Q≧400+20C C : Nominal Capacitance (pF)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.025 max. W.V. : 16/10V : 0.035 max. W.V. : 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [F1, F5] W.V. : 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V. : 16/10V : 0.125 max. W.V. : 6.3V : 0.15 max.	
12	Deflection		No crack or marked defect should occur		Solder the capacitor on the test jig (glass epoxy board) shown in Fig. 2a using an eutectic solder. Then apply a force in the direction shown in Fig. 3a for 5±1 sec. The soldering should be done either with an iron or using the reflow method and should be conducted with care so that the soldering is uniform and free of defects such as heat shock.
13	Solderability of Termination		75% of the terminations are to be soldered evenly and continuously		Immerse the capacitor in a solution of ethanol (JIS-K-8101) and rosin (JIS-K-5902) (25% rosin in weight proportion) . Preheat at 80 to 120℃ for 10 to 30 seconds. After preheating, immerse in an eutectic solder solution for 2±0.5 seconds at 230±5℃.
14	Resistance to Soldering Heat		The measured and observed characteristics should satisfy the specifications in the following table		Preheat the capacitor at 120 to 150℃ for 1 minute. Immerse the capacitor in an eutectic solder solution at 270±5℃ for 10±0.5 seconds. Set at room temperature for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type), then measure. •Initial measurement for high dielectric constant type Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 48±4 hours. Perform the initial measurement. •Preheating for GRM32/43/55
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±2.5% or ±0.25pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±7.5% F1, F5, E4 : Within ±20%	
		Q/D.F.	30pF and over : Q≧1000 30pF and below : Q≧400+20C C : Nominal Capacitance (pF)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.025 max. W.V. : 16/10V : 0.035 max. W.V. : 6.3/4V : 0.05 max. (C<3.3μF) : 0.1 max. (C≧3.3μF) [F1, F5] W.V. : 25V min. : 0.05 max. (C<0.1μF) : 0.09 max. (C≧0.1μF) W.V. : 16/10V : 0.125 max. W.V. : 6.3V : 0.15 max.	
		I.R.	More than 10,000MΩ or 500Ω・F (Whichever is smaller)		
		Dielectric Strength	No defects		

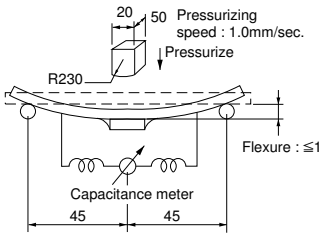

Fig. 3a

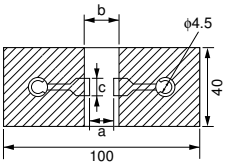

Fig. 2a

t : 1.6mm (GR□02/03/15 : t : 0.8mm)

Type	a	b	c
GRM02	0.2	0.56	0.23
GR□03	0.3	0.9	0.3
GR□15	0.4	1.5	0.5
GRM18	1.0	3.0	1.2
GRM21	1.2	4.0	1.65
GRM31	2.2	5.0	2.0
GRM32	2.2	5.0	2.9
GRM43	3.5	7.0	3.7
GRM55	4.5	8.0	5.6

(in mm)

Step	Temperature	Time
1	100 to 120℃	1 min.
2	170 to 200℃	1 min.

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<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Item</th><th colspan="2">Specifications</th><th rowspan="2">Test Method</th></tr>
<tr><th>Temperature Compensating Type</th><th>High Dielectric Type</th></tr>
<tr><td rowspan="6">15</td><td rowspan="6">Temperature Cycle</td><td colspan="3">The measured and observed characteristics should satisfy the specifications in the following table</td><td rowspan="6">Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10).
Perform the five cycles according to the four heat treatments shown in the following table.
Set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.
<table><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>Temp. (℃)</td><td>Min. Operating Temp. +0/−3</td><td>Room Temp.</td><td>Max. Operating Temp. +3/−0</td><td>Room Temp.</td></tr><tr><td>Time (min.)</td><td>30±3</td><td>2 to 3</td><td>30±3</td><td>2 to 3</td></tr></table>•Initial measurement for high dielectric constant type
Perform a heat treatment at 150+0/−10℃ for one hour and then set at room temperature for 48±4 hours.
Perform the initial measurement.</td></tr>
<tr><td>Appearance</td><td colspan="2">No defects or abnormalities</td></tr>
<tr><td>Capacitance Change</td><td>Within ±2.5% or ±0.25pF (Whichever is larger)</td><td>B1, B3, R1, R6, R7, C8 : Within ±7.5%
F1, F5, E4 : Within ±20%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧1000
30pF and below :
Q≧400+20C

C : Nominal Capacitance (pF)</td><td>[B1, B3, R1, R6, R7, E4, C8]
W.V. : 25V min. : 0.025 max.
W.V. : 16/10V : 0.035 max.
W.V. : 6.3/4V
: 0.05 max. (C<3.3μF)
: 0.1 max. (C≧3.3μF)
[F1, F5]
W.V. : 25V min.
: 0.05 max. (C<0.1μF)
: 0.09 max. (C≧0.1μF)
W.V. : 16/10V : 0.125 max.
W.V. : 6.3V : 0.15 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 10,000MΩ or 500Ω・F (Whichever is smaller)</td></tr>
<tr><td>Dielectric Strength</td><td colspan="2">No defects</td></tr>
<tr><td rowspan="6">16</td><td rowspan="6">Humidity (Steady State)</td><td colspan="3">The measured and observed characteristics should satisfy the specifications in the following table</td><td rowspan="6">Set the capacitor at 40±2℃ and in 90 to 95% humidity for 500±12 hours.
Remove and set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure.</td></tr>
<tr><td>Appearance</td><td colspan="2">No defects or abnormalities</td></tr>
<tr><td>Capacitance Change</td><td>Within ±5% or ±0.5pF (Whichever is larger)</td><td>B1, B3, R1, R6, R7, C8 : Within ±12.5%
F1, F5 : Within ±30%</td></tr>
<tr><td>Q/D.F.</td><td>30pF and over : Q≧350
10pF and over
30pF and below :
Q≧275+2.5C
10pF and below :
Q≧200+10C

C : Nominal Capacitance (pF)</td><td>[B1, B3, R1, R6, R7, E4, C8]
W.V. : 25V min. : 0.05 max.
W.V. : 16/10V : 0.05 max.
W.V. : 6.3/4V
: 0.075 max. (C<3.3μF)
: 0.125 max. (C≧3.3μF)
[F1, F5]
W.V. : 25V min.
: 0.075 max. (C<0.1μF)
: 0.125 max. (C≧0.1μF)
W.V. : 16/10V : 0.15 max.
W.V. : 6.3V : 0.2 max.</td></tr>
<tr><td>I.R.</td><td colspan="2">More than 1,000MΩ or 50Ω・F (Whichever is smaller)</td></tr>
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No.	Item		Specifications		Test Method
			Temperature Compensating Type	High Dielectric Type	
17	Humidity Load		The measured and observed characteristics should satisfy the specifications in the following table		Apply the rated voltage at 40±2℃ and 90 to 95% humidity for 500±12 hours. Remove and set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA. •Initial measurement for F1, F5/10V max. Apply the rated DC voltage for 1 hour at 40±2℃. Remove and set for 48±4 hours at room temperature. Perform initial measurement.
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±7.5% or ±0.75pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±12.5% F1, F5, E4 : Within ±30% [W.V. : 10V max.] F1, F5 : Within +30/−40%	
		Q/D.F.	30pF and over : Q≧200 30pF and below : Q≧100+10C/3 C : Nominal Capacitance (pF)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.05 max. W.V. : 16/10V : 0.05 max. W.V. : 6.3V : 0.075 max. (C<3.3μF) : 0.125 max. (C≧3.3μF) [F1, F5] W.V. : 25V min. : 0.075 max. (C<0.1μF) : 0.125 max. (C≧0.1μF) W.V. : 16/10V : 0.15 max. W.V. : 6.3V : 0.2 max.	
		I.R.	More than 500MΩ or 25Ω・F (Whichever is smaller)		
18	High Temperature Load		The measured and observed characteristics should satisfy the specifications in the following table		Apply *200% of the rated voltage at the maximum operating temperature ±3℃ for 1000±12 hours. Set for 24±2 hours (temperature compensating type) or 48±4 hours (high dielectric constant type) at room temperature, then measure. The charge/discharge current is less than 50mA. •Initial measurement for high dielectric constant type. Apply 200% of the rated DC voltage at the maximum operating temperature ±3℃ for one hour. Remove and set for 48±4 hours at room temperature. Perform initial measurement. *150% for 500V
		Appearance	No defects or abnormalities		
		Capacitance Change	Within ±3% or ±0.3pF (Whichever is larger)	B1, B3, R1, R6, R7, C8 : Within ±12.5% F1, F5, E4 : Within ±30% [Except 10V max. and C≧1.0μF] F1, F5 : Within +30/−40% [10V max. and C≧1.0μF]	
		Q/D.F.	30pF and over : Q≧350 10pF and over 30pF and below : Q≧275+2.5C 10pF and below : Q≧200+10C C : Nominal Capacitance (pF)	[B1, B3, R1, R6, R7, E4, C8] W.V. : 25V min. : 0.04 max. W.V. : 16/10V : 0.05 max. W.V. : 6.3V : 0.075 max.(C<3.3μF) : 0.125 max.(C≧3.3μF) [F1, F5] W.V. : 25V min. : 0.075 max.(C<0.1μF) : 0.125 max.(C≧0.1μF) W.V. : 16/10V : 0.15 max. W.V. : 6.3V : 0.2 max.	
		I.R.	More than 1,000MΩ or 50Ω・F (Whichever is smaller)		