

## 1. HOW TO ORDER

<b>TCS</b>	<b>C</b>	<b>106</b>	<b>M</b>	<b>035</b>	<b>R</b>
<b>Type</b>	<b>Case Size</b> See table above	<b>Capacitance Code</b> pF code: 1st two digits represent significant figures 3rd digit represents multiplier (number of zeros to follow)	<b>Tolerance</b> K=±10% M=±20%	<b>Rated DC Voltage</b> 002=2.5Vdc 004=4Vdc 006=6.3Vdc 010=10Vdc 016=16Vdc 020=20Vdc 025=25Vdc 035=35Vdc 050=50Vdc	<b>Packaging</b> R = 7" T/R (Lead Free since production date 1/1/04) S = 13" T/R (Lead Free since production date 1/1/04) A = Gold Plating 7" Reel B = Gold Plating 13" Reel

## 2. TECHNICAL SPECIFICATIONS

Technical Data:

All technical data relate to an ambient temperature of +25°C

Capacitance Range:	0.1 $\mu$ F to 2200 $\mu$ F									
Capacitance Tolerance:	±10%; ±20%									
Rated Voltage ( $V_R$ )	+85°C:	2.5	4	6.3	10	16	20	25	35	50
Category Voltage ( $V_C$ )	+125°C:	1.7	2.7	4	7	10	13	17	23	33
Surge Voltage ( $V_S$ )	+85°C:	3.3	5.2	8	13	20	26	32	46	65
Surge Voltage ( $V_S$ )	+125°C:	2.2	3.4	5	8	13	16	20	28	40
Temperature Range:	-55°C to +125°C									
Reliability:	1% per 1000 hours at 85°C, $V_R$ with 0.1 $\Omega/V_R$ series impedance, 60% confidence level									
Qualification:	CECC 30801 - 005 issue 2 EIA 535BAAC									
	Meets requirements of AEC-Q200									

### 3. CAPACITANCE AND RATED VOLTAGE, $V_R$ (VOLTAGE CODE) RANGE (LETTER DENOTES CASE SIZE)

Capacitance		Rated voltage DC ( $V_R$ ) to 85°C								
$\mu F$	Code	2.5V (e)	4V (G)	6.3V (J)	10V (A)	16V (C)	20V (D)	25V (E)	35V (V)	50V (T)
0.10	104								A	A
0.15	154								A	A/B
0.22	224								A	A/B
0.33	334								A	B
0.47	474							A	A/B	B/C
0.68	684						A	A	A/B	B/C
1.0	105					A A	A A	A	A/B	B/C
1.5	155				A	A/B	A/B	A/B	A/B/C	C/D
2.2	225			A	A		A/B	A/B	A/B/C	C/D
3.3	335			A A	A	A/B	A/B	A/B/C	B/C	C/D
4.7	475		A	A/B	A/B	A/B/C	A/B/C	B/C	B/C/D	D
6.8	685		A	A/B	A/B	A/B/C	A/B/C	B/C	C/D	D
10	106		A	A/B	A/B/C	A/B/C	B/C	C/D	C/D/E	D/E
15	156		A/B	A/B	A/B/C	A <sup>(M)</sup> /B/C	B/C/D	C/D	C/D	E
22	226		A	A/B/C	A/B/C	B/C/D	B/C/D	C/D	D/E	V
33	336		A/B	A/B/C	A/B/C/D	B/C/D	C/D	D/E	D/E/V	
47	476	A	A/B	A/B/C/D	B/C/D	C/D	C/D/E	D/E	D/E	E/V
68	686	A	B/C	B/C/D	B/C/D	C/D	D/E	E/V	E/V	V <sup>(M)</sup>
100	107	B B	B/C B/C	B/C/D	B <sup>(M)</sup> /C/D/E	D/E	D/E/V	V		
150	157	B/D	B <sup>(M)</sup> /C/D	C/D	C/D/E D/E	D/E/V	E/V			
220	227			C/D/E		D/E/V				
330	337	D	C/D/E	C/D/E	D/E/V	E/V				
470	477	C/D	D/E	D/E/V	E/V	V				
680	687	D/E	D/E	E/V						
1000	108	D <sup>(M)</sup> /E	D/E/V	V <sup>(M)</sup>						
1500	158	D/E/V	E/V <sup>(M)</sup>							
2200	228	V								

Non preferred Ratings - not recommended for new designs, higher voltage or smaller case size substitution are offered.

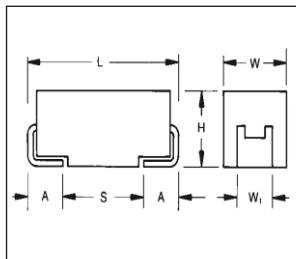
Developmental Ratings - subject to change.

Released codes <sup>(M tolerance only)</sup>

Note: Voltage ratings are minimum values.

higher ratings in the same case size, to the same reliability standards.

### 4. CASE DIMENSIONS: millimeters (inches)



For part marking see page 157

Code	EIA Code	$L \pm 0.20$ (0.008)	$W + 0.20$ (0.008) $- 0.10$ (0.004)	$H + 0.20$ (0.008) $- 0.10$ (0.004)	$W_1 \pm 0.20$ (0.008)	$A + 0.30$ (0.012) $- 0.20$ (0.008)	S Min.
A	3216-18	3.20(0.126)	1.60(0.063)	1.60(0.063)	1.20(0.047)	0.80(0.031)	1.80(0.071)
B	3528-21	3.50(0.138)	2.80(0.110)	1.90(0.075)	2.20(0.087)	0.80(0.031)	1.40(0.055)
C	6032-28	6.00(0.236)	3.20(0.126)	2.60(0.102)	2.20(0.087)	1.30(0.051)	2.90(0.114)
D	7343-31	7.30(0.287)	4.30(0.169)	2.90(0.114)	2.40(0.094)	1.30(0.051)	4.40(0.173)
E	7343-43	7.30(0.287)	4.30(0.169)	4.10(0.162)	2.40(0.094)	1.30(0.051)	4.40(0.173)
V	7361-38	7.30(0.287)	6.10(0.240)	$3.45 \pm 0.30$ (0.136 $\pm$ 0.012)	3.10(0.120)	1.40(0.055)	4.40(0.173)

W<sub>1</sub> dimension applies to the termination width for A dimensional area only.

## 5. RATINGS & PART NUMBER REFERENCE

HKT Part No.	Case Size	Capacitance (µF)	Rated Voltage (V)	DCL (µA) Max.	DF % Max.	ESR Max. (Ω) @100kHz
TCSA476*002	A	47	2.5	0.9	6	3
TCSA686*002	A	68	2.5	1.4	8	1.5
TCSB107*002	B	100	2.5	2.5	8	1.4
TCSB157*002	B	150	2.5	3	10	1.6
TCSB227*002	B	220	2.5	4.4	16	1.6
TCSD227*002	D	220	2.5	5.5	8	0.3
TCSD337*002	D	330	2.5	8.2	8	0.3
TCSC477*002	C	470	2.5	9.4	12	0.2
TCSD477*002	D	470	2.5	11.6	8	0.2
TCSD687*002	D	680	2.5	17	16	0.2
TCSE687*002	E	680	2.5	17	10	0.2
TCSD108*002	D	1000	2.5	25	20	0.2
TCSE108*002	E	1000	2.5	20	14	0.4
TCSD158*002	D	1500	2.5	37.5	60	0.2
TCSE158*002	E	1500	2.5	37	20	0.2
TCSV158*002	V	1500	2.5	30	20	0.2
TCV228*002	V	2200	2.5	55	50	0.2
TCSA336*004	A	33	4	1.3	6	3
TCSA476*004	A	47	4	1.9	8	2.6
TCSB686*004	B	68	4	2.7	6	1.8
TCSB107*004	B	100	4	4	8	0.9
TCSB157*004	B	150	4	6	8	1.5
TCSC157*004	C	150	4	6	6	0.3
TCSB227*004	B	220	4	8.8	12	1.1
TCSC227*004	C	220	4	8.8	8	1.2
TCSD227*004	D	220	4	8.8	8	0.9
TCSC337*004	C	330	4	13.2	8	0.9
TCSD337*004	D	330	4	13.2	8	0.9
TCSD477*004	D	470	4	18.8	12	0.9
TCSE477*004	E	470	4	18.8	10	0.5
TCSD687*004	D	680	4	27.2	14	0.5
TCSE687*004	E	680	4	27.2	14	0.9
TCSD108*004	D	1000	4	40	60	0.2
TCSE108*004	E	1000	4	40	14	0.4
TCV108*004	V	1000	4	40	16	0.4
TCSE158*004	E	1500	4	60	30	0.2
TCV158*004	V	1500	4	60	30	0.2
TCSA106*006	A	10	6.3	0.6	6	4
TCSA156*006	A	15	6.3	0.9	6	3.5
TCSA226*006	A	22	6.3	1.4	6	3
TCSA336*006	A	33	6.3	2.1	8	2.5
TCSA476*006	A	47	6.3	2.8	10	1.6
TCSB476*006	B	47	6.3	3	6	2
TCSC476*006	C	47	6.3	3	6	1.6
TCSB686*006	B	68	6.3	4	8	0.9
TCSC686*006	C	68	6.3	4.3	6	1.5
TCSB107*006	B	100	6.3	6.3	10	1.7
TCSC107*006	C	100	6.3	6.3	6	0.9
TCSC157*006	C	150	6.3	9.5	6	1.3
TCSD157*006	D	150	6.3	9.5	6	0.9
TCSC227*006	C	220	6.3	13.9	8	1.2
TCSD227*006	D	220	6.3	13.9	8	0.9
TCSE227*006	E	220	6.3	13.9	8	0.9
TCSD337*006	D	330	6.3	20.8	8	0.4
TCSE337*006	E	330	6.3	20.8	8	0.4
TCSD477*006	D	470	6.3	28	12	0.4
TCSE477*006	E	470	6.3	28	10	0.4

HKT Part No.	Case Size	Capacitance (µF)	Rated Voltage (V)	DCL (µA) Max.	DF % Max.	ESR Max. (Ω) @100kHz
TCV477*006	V	470	6.3	28	10	0.4
TCSE687*006	E	680	6.3	42.8	10	0.5
TCV687*006	V	680	6.3	42.8	10	0.5
TCV108*006	V	1000	6.3	63	16	0.4
TCSA475*010	A	4.7	10	0.5	6	5
TCSA685*010	A	6.8	10	0.7	6	4
TCSA106*010	A	10	10	1	6	3
TCSA156*010	A	15	10	1.5	6	3.2
TCSB156*010	B	15	10	1.5	6	2.8
TCSA226*010	A	22	10	2.2	8	3
TCSB226*010	B	22	10	2.2	6	2.4
TCSA336*010	A	33	10	3.3	8	1.7
TCSB336*010	B	33	10	3.3	6	1.8
TCSC336*010	C	33	10	3.3	6	1.6
TCSB476*010	B	47	10	4.7	8	1
TCSC476*010	C	47	10	4.7	6	1.2
TCSB686*010	B	68	10	6.8	6	1.4
TCSC686*010	C	68	10	6.8	6	1.3
TCSB107*010	B	100	10	10	8	1.4
TCSC107*010	C	100	10	10	8	1.2
TCSD107*010	D	100	10	10	6	0.9
TCSC157*010	C	150	10	15	8	0.9
TCSD157*010	D	150	10	15	6	0.9
TCSE157*010	E	150	10	15	8	0.9
TCSD227*010	D	220	10	22	8	0.5
TCSE227*010	E	220	10	22	8	0.5
TCSD337*010	D	330	10	33	8	0.9
TCSE337*010	E	330	10	33	8	0.9
TCV337*010	V	330	10	33	10	0.9
TCSE477*010	E	470	10	47	10	0.5
TCV477*010	V	470	10	47	10	0.5
TCSA225*016	A	2.2	16	0.5	6	6.5
TCSA335*016	A	3.3	16	0.5	6	5
TCSB335*016	B	3.3	16	0.5	6	4.5
TCSA475*016	A	4.7	16	0.8	6	4
TCSB475*016	B	4.7	16	0.8	6	3.5
TCSA685*016	A	6.8	16	1.1	6	3.5
TCSB685*016	B	6.8	16	1.1	6	2.5
TCSA106*016	A	10	16	1.6	8	3
TCSB106*016	B	10	16	1.6	6	2.8
TCSC106*016	C	10	16	1.6	6	2
TCSA156*016	A	15	16	2.4	6	2
TCSB156*016	B	15	16	2.4	6	2.5
TCSC156*016	C	15	16	2.4	6	1.8
TCSB226*016	B	22	16	3.5	6	2.3
TCSC226*016	C	22	16	3.5	6	1.6
TCSD226*016	D	22	16	3.5	6	1.1
TCSB336*016	B	33	16	5.3	8	2.1
TCSC336*016	C	33	16	5.3	6	1.5
TCSD336*016	D	33	16	5.3	6	0.9
TCSC476*016	C	47	16	7.5	6	1.4
TCSD476*016	D	47	16	7.5	6	0.9
TCSC686*016	C	68	16	10.9	6	1.3
TCSD686*016	D	68	16	10.9	6	0.9
TCSD107*016	D	100	16	16	6	0.9
TCSE107*016	E	100	16	16	6	0.9
TCSD157*016	D	150	16	24	6	0.9

## RATINGS & PART NUMBER REFERENCE

HKT PartNo.	Case Size	Capacitance (μF)	Rated Voltage (V)	DCL (μA) Max.	DF % Max.	ESR Max. (Ω) @100kHz
TCSE157*016	E	150	16	24	8	0.3
TCSV157*016	V	150	16	24	8	0.5
TCSE227*016	E	220	16	35.2	10	0.5
TCSV227*016	V	220	16	35.2	8	0.9
TCSA105*020	A	1	20	0.5	4	9
TCSA155*020	A	1.5	20	0.5	6	6.5
TCSA225*020	A	2.2	20	0.5	6	5.3
TCSB225*020	B	2.2	20	0.5	6	3.5
TCSA335*020	A	3.3	20	0.7	6	4.5
TCSB335*020	B	3.3	20	0.7	6	3
TCSA475*020	A	4.7	20	0.9	6	4
TCSB475*020	B	4.7	20	0.9	6	3
TCSA685*020	A	6.8	20	1.4	6	2.5
TCSB685*020	B	6.8	20	1.4	6	2.5
TCSC685*020	C	6.8	20	1.4	6	2
TCSB106*020	B	10	20	2	6	2.1
TCSC106*020	C	10	20	2	6	1.9
TCSB156*020	B	15	20	3	6	2
TCSC156*020	C	15	20	3	6	1.7
TCSB226*020	B	22	20	4.4	6	1.8
TCSC226*020	C	22	20	4.4	6	1.6
TCSD226*020	D	22	20	4.4	6	0.9
TCSC336*020	C	33	20	6.6	6	1.5
TCSD336*020	D	33	20	6.6	6	0.9
TCSC476*020	C	47	20	9.4	6	0.9
TCSD476*020	D	47	20	9.4	6	0.9
TCSE476*020	E	47	20	9.4	6	0.9
TCSD686*020	D	68	20	13.6	6	0.9
TCSE686*020	E	68	20	13.6	6	0.9
TCSD107*020	D	100	20	20	6	0.9
TCSE107*020	E	100	20	20	6	0.9
TCSV107*020	V	100	20	20	8	0.9
TCSE157*020	E	150	20	30	8	0.3
TCSV157*020	V	150	20	30	8	0.5
TCSA474*025	A	0.47	25	0.5	4	14
TCSA684*025	A	0.68	25	0.5	4	10
TCSA105*025	A	1	25	0.5	4	8
TCSA155*025	A	1.5	25	0.5	6	7.5
TCSB155*025	B	1.5	25	0.5	6	5
TCSA225*025	A	2.2	25	0.6	6	7
TCSB225*025	B	2.2	25	0.6	6	4.5
TCSA335*025	A	3.3	25	0.8	6	3.7
TCSB335*025	B	3.3	25	0.8	6	3.5
TCSB475*025	B	4.7	25	1.2	6	2.8
TCSB685*025	B	6.8	25	1.7	6	2.8
TCSC685*025	C	6.8	25	1.7	6	2
TCSC106*025	C	10	25	2.5	6	1.8
TCSD106*025	D	10	25	2.5	6	1.2
TCSC156*025	C	15	25	3.8	6	1.6
TCSD156*025	D	15	25	3.8	6	1
TCSC226*025	C	22	25	5.5	6	1.4
TCSD226*025	D	22	25	5.5	6	0.9
TCSD336*025	D	33	25	8.3	6	0.9
TCSE336*025	E	33	25	8.3	6	0.9
TCSD476*025	D	47	25	11.8	6	0.9
TCSE476*025	E	47	25	11.8	6	0.9
TCSE686*025	E	68	25	17	6	0.9
TCSV686*025	V	68	25	17	6	0.9
TCSV107*025	V	100	25	25	8	0.4
TCSA104*035	A	0.1	35	0.5	4	24

HKT PartNo.	Case Size	Capacitance (μF)	Rated Voltage (V)	DCL (μA) Max.	DF % Max.	ESR Max. (Ω) @100kHz
TCSA154*035	A	0.15	35	0.5	4	21
TCSA224*035	A	0.22	35	0.5	4	18
TCSA334*035	A	0.33	35	0.5	4	15
TCSA474*035	A	0.47	35	0.5	4	12
TCSB474*035	B	0.47	35	0.5	4	10
TCSA684*035	A	0.68	35	0.5	4	8
TCSB684*035	B	0.68	35	0.5	4	8
TCSA105*035	A	1	35	0.5	4	7.5
TCSB105*035	B	1	35	0.5	4	6.5
TCSA155*035	A	1.5	35	0.5	6	7.5
TCSB155*035	B	1.5	35	0.5	6	5.2
TCSC155*035	C	1.5	35	0.5	6	4.5
TCSA225*035	A	2.2	35	0.8	6	4.5
TCSB225*035	B	2.2	35	0.8	6	4.2
TCSC225*035	C	2.2	35	0.8	6	3.5
TCSB335*035	B	3.3	35	1.2	6	3.5
TCSC335*035	C	3.3	35	1.2	6	2.5
TCSB475*035	B	4.7	35	1.2	6	3.1
TCSC475*035	C	4.7	35	1.6	6	2.2
TCSD475*035	D	4.7	35	1.6	6	1.5
TCSC685*035	C	6.8	35	2.4	6	1.8
TCSD685*035	D	6.8	35	2.4	6	1.3
TCSC106*035	C	10	35	3.5	6	1.6
TCSD106*035	D	10	35	3.5	6	1
TCSE106*035	E	10	35	3.5	6	0.9
TCSC156*035	C	15	35	5.3	6	1.4
TCSD156*035	D	15	35	5.3	6	0.9
TCSE226*035	E	22	35	7.7	6	0.9
TCSD226*035	D	22	35	7.7	6	0.9
TCSD336*035	D	33	35	11.6	6	0.9
TCSE336*035	E	33	35	11.6	6	0.9
TCSV336*035	V	33	35	11.6	6	500
TCSE476*035	E	47	35	16.5	6	0.9
TCSV476*035	V	47	35	16.5	6	0.4
TCSV686*035	V	68	35	23.8	6	0.5
TCSA104*050	A	0.1	50	0.5	4	22
TCSA154*050	A	0.15	50	0.5	4	15
TCSB154*050	B	0.15	50	0.5	4	17
TCSA224*050	A	0.22	50	0.5	4	18
TCSB224*050	B	0.22	50	0.5	4	14
TCSC334*050	B	0.33	50	0.5	4	12
TCSB474*050	B	0.47	50	0.7	4	9.5
TCSC474*050	C	0.47	50	0.5	4	8
TCSB684*050	B	0.68	50	0.5	4	8
TCSC684*050	C	0.68	50	0.5	4	7
TCSB105*050	B	1	50	0.5	4	7
TCSC105*050	C	1	50	0.5	4	5.5
TCSC155*050	C	1.5	50	0.8	6	4.5
TCSD155*050	D	1.5	50	0.8	6	4
TCSC225*050	C	2.2	50	1.1	6	3
TCSD225*050	D	2.2	50	1.1	6	2.5
TCSC335*050	C	3.3	50	1.7	6	2.5
TCSD335*050	D	3.3	50	1.7	6	2
TCSD475*050	D	4.7	50	2.4	6	1.4
TCSD685*050	D	6.8	50	3.4	6	1
TCSD106*050	D	10	50	5	6	0.8
TCSE106*050	E	10	50	5	6	1
TCSE156*050	E	15	50	7.5	6	0.6
TCSV226*050	V	22	50	11	8	0.6