



NSP SERIES – LOW ESR SOLID ALUMINUM ELECTROLYTIC CAPACITOR

SUB: APPLICATION GUIDELINE

GENERAL:

- WHEN DESIGNING ELECTRONIC CIRCUITS, ALWAYS PROVIDE OPEN OR SHORT FAILURE MODE PROTECTION
- DESIGN REDUNDANT OR SECONDARY PROTECTION (WHEN POSSIBLE) IN CASE OF MAIN CIRCUIT FAILURE

VOLTAGE DE-RATING:

- VOLTAGE DE-RATING IS NOT REQUIRED FOR THIS PRODUCT
- CAN SAFELY BE USED, TO RATED VOLTAGE, OVER -40°C ~ +105°C TEMPERATURE RANGE

SURGE & OVER-VOLTAGE OPERATION:

- DO NOT APPLY VOLTAGE GREATER THAN RATED VOLTAGE. INCREASED LEAKAGE CURRENT AND OR POSSIBLE DAMAGE (DUE TO INTERNAL HEATING) MAY OCCUR.
- DO NOT USE MULTIPLE SERIES CONNECTED PARTS (TO INCREASE VOLTAGE RATING)
- CONFIRM THE SUM OF THE DC OPERATION VOLTAGE (VDC) AND PEAK AC RIPPLE VOLTAGE DO NOT EXCEED THE VOLTAGE RATING OF THE COMPONENT

POLARITY:

- COMPONENT IS MARKED FOR POLARITY; ANODE (+) POLARITY BAND
- VERIFY CORRECT POLARITY BEFORE USE
- REVERSE BIAS OPERATION MAY DAMAGE THE COMPONENT
- REVIEW REVERSE BIAS CONDITIONS WITH NIC [TPMG@NICCOMP.COM]
- CONFIRM THE COMPONENT IS NOT REVERSE BIASED UNDER HIGH AC RIPPLE OPERATION AND LOW VDC OPERATION

RIPPLE CURRENT OPERATION:

- DO NOT EXCEED THE RIPPLE CURRENT RATING (**RCR**) OF THE COMPONENT
- EXCESSIVE AC RIPPLE CURRENT WILL RESULT IN INCREASED SELF-HEATING AND POSSIBLE DAMAGE TO [OR FAILURE OF] THE COMPONENT
- RIPPLE CURRENT CORRECTION FACTOR OVER FREQUENCY

FREQUENCY	10 KHZ	20KHZ	50KHZ	100KHZ	250KHZ	500KHZ	1MHZ
RCR MULTIPLIER	0.6	0.7	0.8	1.0	1.1	1.2	1.3

TIME CONSTANT APPLICATION:

- DO NOT USE THIS COMPONENT IN TIME CONSTANT CIRCUIT OR COUPLING APPLICATION

NSP SERIES – LOW ESR SOLID ALUMINUM ELECTROLYTIC CAPACITOR
 SUB: APPLICATION GUIDELINE – FAILURE RATE CALCULATION

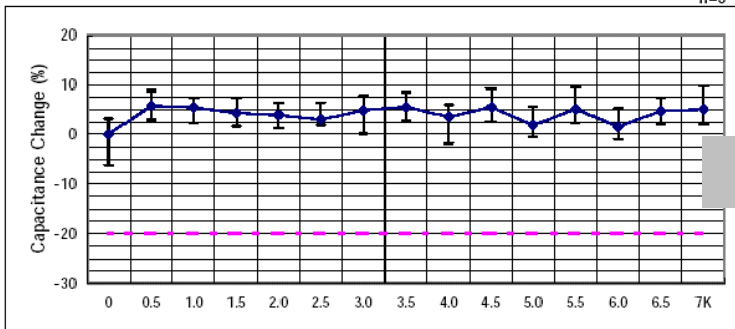
FAILURE RATE ESTIMATION:

- SOLID ELECTROLYTE (PPY) CONSTRUCTION OF NSP SERIES, RESULTS TO ELIMINATE COMMON “DRY-OUT” OF LIQUID ELECTROLYTE (ON STANDARD TYPE) ALUMINUM E-CAPS
- NO DEGRADATION OF OPERATION OVER TEMPERATURE OR TIME (SEE BELOW PERFORMANCE DATA)
- LOAD LIFE TEST DATA IS PROVIDED ON-LINE AT <http://www.low-esr.com/endurance.html-ssi>

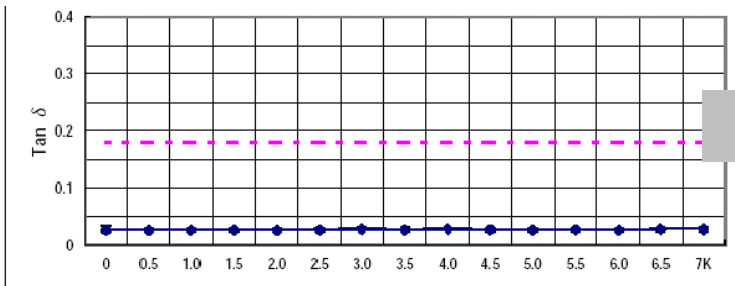
LIFE TEST RESULTS
 ALUMINUM ELECTROLYTIC CAPACITOR
 Nippon Industries Co., Ltd.

NIC-QC-9-10C
 Date : 2001/09/11

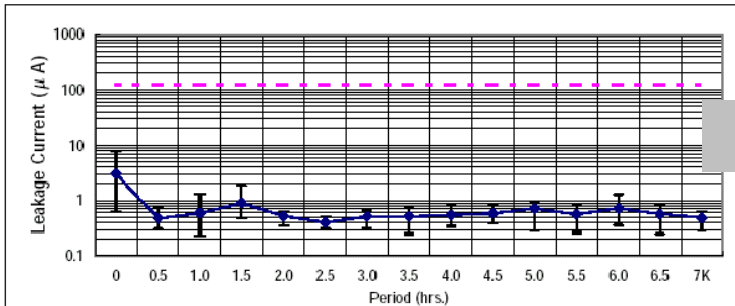
NIC PN: NSPZ101M6.3V6.3x6.3 Customer PN : _____
 NIC Model: NSPZ Rating : 100 μF 6.3 Vdc Case Size: 6.3X6.3 mm
 Test Conditions : 105 °C 6.3 Vdc 7,000 Hours Date Code : 00.6.29NK
 n=5



Stable Capacitance Value Over Life



Stable DF [ESR] Over Life



Stable Leakage Current Over Life

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 SUB: APPLICATION GUIDELINE

FAILURE RATE (FR):

- CALCULATED FR BASED UPON MIL-HDBK-217F (USA)
- FR INFLUENCED BY:
 - TEMPERATURE OF OPERATION
 - APPLIED VOLTAGE TO VOLTAGE RATING (VOLTAGE RATIO FACTOR)
 - CAPACITANCE VALUE FACTOR

$$FR = (BFR) \times (\text{TEMPERATURE FACTOR}) \times (\text{VOLTAGE FACTOR}) \times (\text{CAPACITANCE VALUE FACTOR})$$

BFR = Basic Failure Rate for Aluminum Electrolytic Capacitors (per MIL-HDBK-217F)

Temperature (degC)	Temp. Factor	Voltage Ratio	Voltage Factor	Capacitance Value (uF)	Capacitance Factor
+20	0.91	0.1	1	0.1	0.59
+30	1.1	0.2	1	0.5	0.85
+40	1.3	0.3	1	1	1
+50	1.6	0.4	1.1	3	1.3
+60	1.8	0.5	1.4	8	1.6
+70	2.2	0.6	2	18	1.9
+80	2.5	0.7	3.2	40	2.3
+90	2.8	0.8	5.2	200	3.4
+100	3.2	0.9	8.6	1000	4.9
+110	3.7	1	14		
+120	4.1				
+130	4.6				
+140	5.1				
+150	5.6				

EXAMPLE: (BASED UPON ACTUAL USAGE CONDITIONS)

P/N: NSP101M6.3TRD3TR [100uF / 6.3VDC]

Conditions: 6.3VDC & +25degC

$$\text{Calculated FR} = (0.00012) \times (1.0) \times (14) \times (3.4) = 0.005712 / 1\text{KKhrs} = 5.7 \text{ FIT}$$

- Actual Acceleration Test Results @ Rated Voltage & Rated Temperature:
 - Total Test Time = 19,796,000 hours
 - Failures = 0
 - FR = (60% confidence; 0.917/T) = **46 FIT**
- Field Failure Reporting:
 - Total Test Time = 6,856,894,000 hours
 - Failures = 0
 - FR = (60% confidence; 0.917/T) = **0.13 FIT**