
DESIGN CONSIDERATIONS FOR RECHARGEABLE LITHIUM BATTERIES



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BATTERY SYSTEMS GROUP



OUTLINE

- * OBJECTIVE
- * CELL BASELINE DESIGN & TESTING
- * CELL DESIGN PARAMETERS STUDIES
- * CELL CYCLING PERFORMANCE
- * SUMMARY AND CONCLUSIONS

OBJECTIVE

DETERMINE THE INFLUENCE OF CELL DESIGN PARAMETERS ON THE PERFORMANCE OF Li-TiS₂ CELLS

Li-TiS₂ CELL BASELINE DESIGN

RATED CAPACITY	1 Ah CELL
TiS₂ CAPACITY	1.2 Ah (Theoretical) 1.0 Ah (Practical)
LITHIUM CAPACITY	6 Ah
Li:TiS₂ CAP. RATIO	6
ELECTROLYTE	1.5M LiAsF₆/ 10%EC + 90%2-MeTHF
SEPARATOR	CELGARD 2400
ELECTROLYTE QTY.	7.5 cc
CURRENT COLLECTOR	Ni EXMET
CAN & COVER MAT'LS	SS
SEAL	GLASS TO METAL

CELL DESIGN PARAMETERS STUDIED

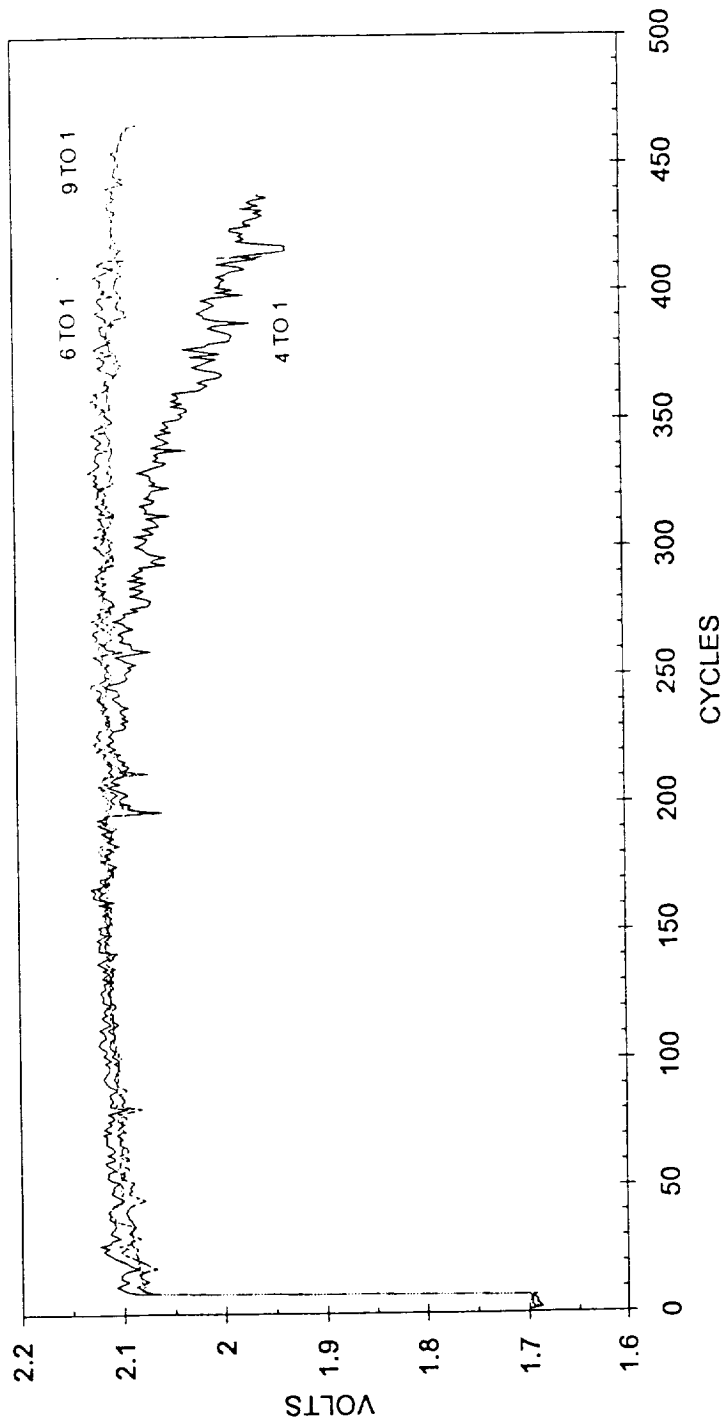
DESIGN PARAMETERS	VARIATIONS
ANODE TO CATHODE CAPACITY RATIO	4:1, 6:1, and 9:1
PACK TIGHTNESS	Tight, medium, and loose
TYPE OF ELECTROLYTE Salt: 1.5 M LiAsF ₆	2-MeTHF, 10% EC + 90% 2-MeTHF, THF + 2% 2-MeF, THF + 2-MeTHF + 2% 2-MeF, Diox + 2-MeTHF + THF + 2% 2-MeF, and EC + PC.
QUANTITY OF ELECTROLYTE	4, 7.5, and 9 c.c.
SEPARATOR	Microporous Polypropylene Microporous Polyethylene Sub-microporous Polypropylene Thermal separator
BINDER CONCENTRATION	2 and 1 weight %
CASE POLARITY	Isolated, floating, and positive.

CELL TESTING CONDITIONS

* DISCHARGING	1 Ah CELLS
TYPE:	CONSTANT CURRENT
CURRENT DENSITY (mA/cm ²):	1
CUTOFF VOLTAGE (V)	1.7
DEPTH OF DISCHARGE	50%
* CHARGING	CONSTANT CURRENT
TYPE:	0.5
CURRENT DENSITY (mA/cm ²):	2.7 V
CUTOFF VOLTAGE:	
* TEMPERATURE	25° C

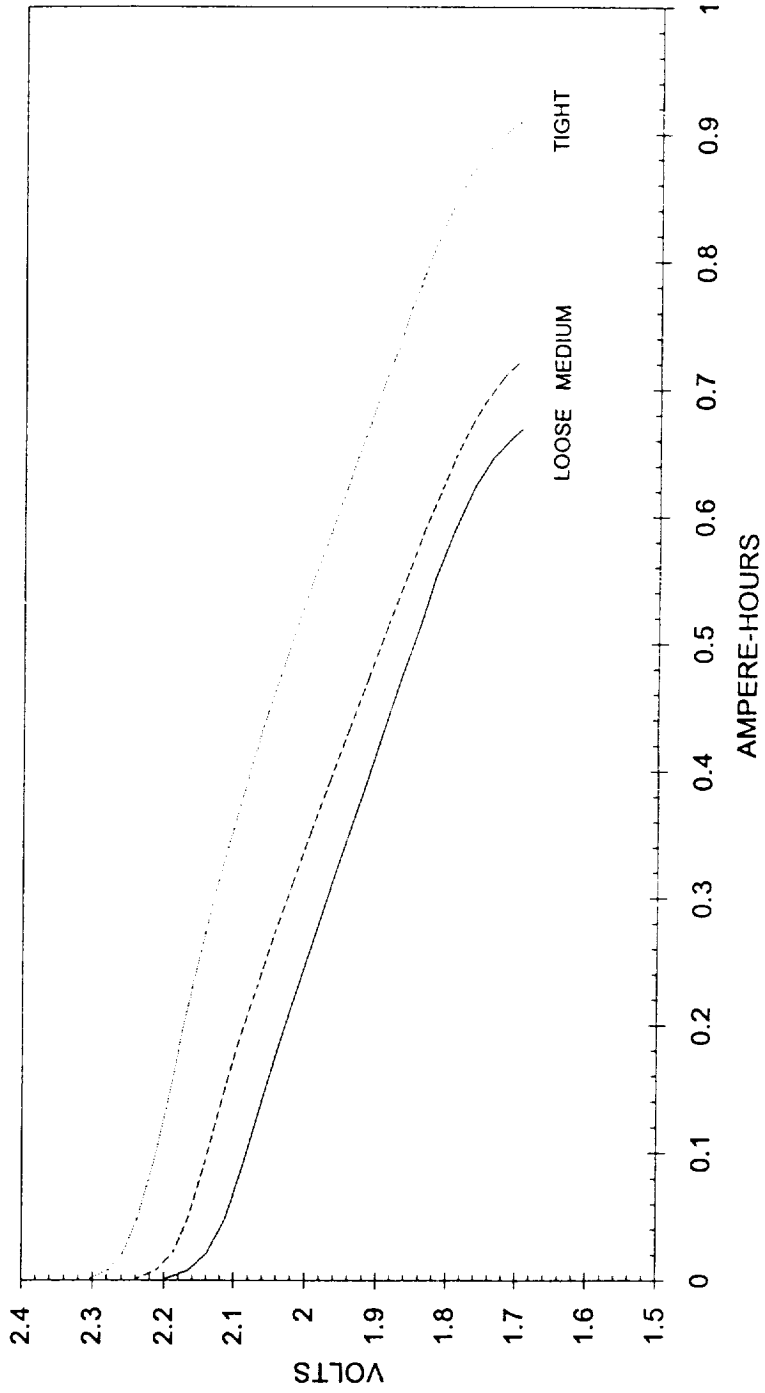
DESIGN PARAMETER STUDIES

EFFECT OF ANODE TO CATHODE CAPACITY RATIO
ON END-OF-DISCHARGE VOLTAGE



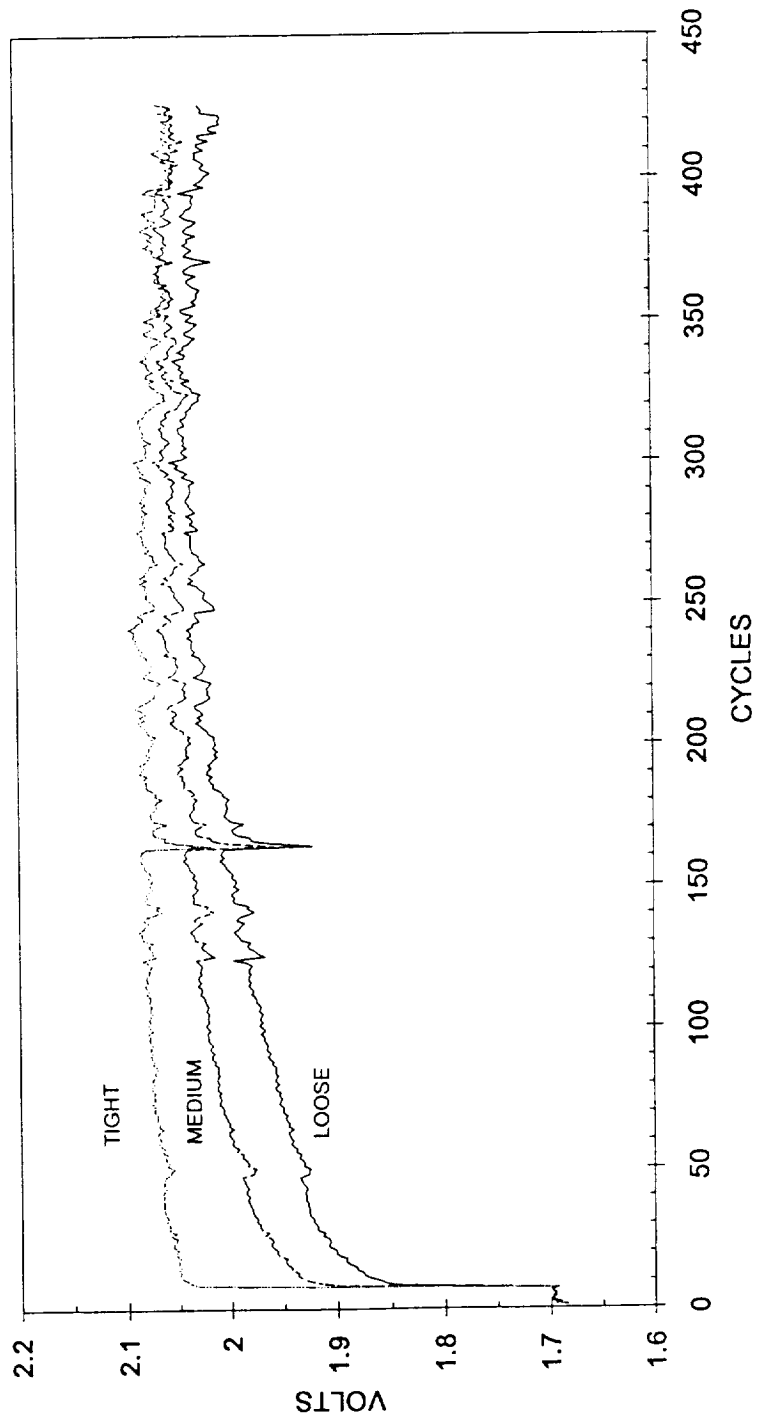
DESIGN PARAMETER STUDIES

EFFECT OF PACK TIGHTNESS ON C/5 CAPACITY AT CYCLE 10



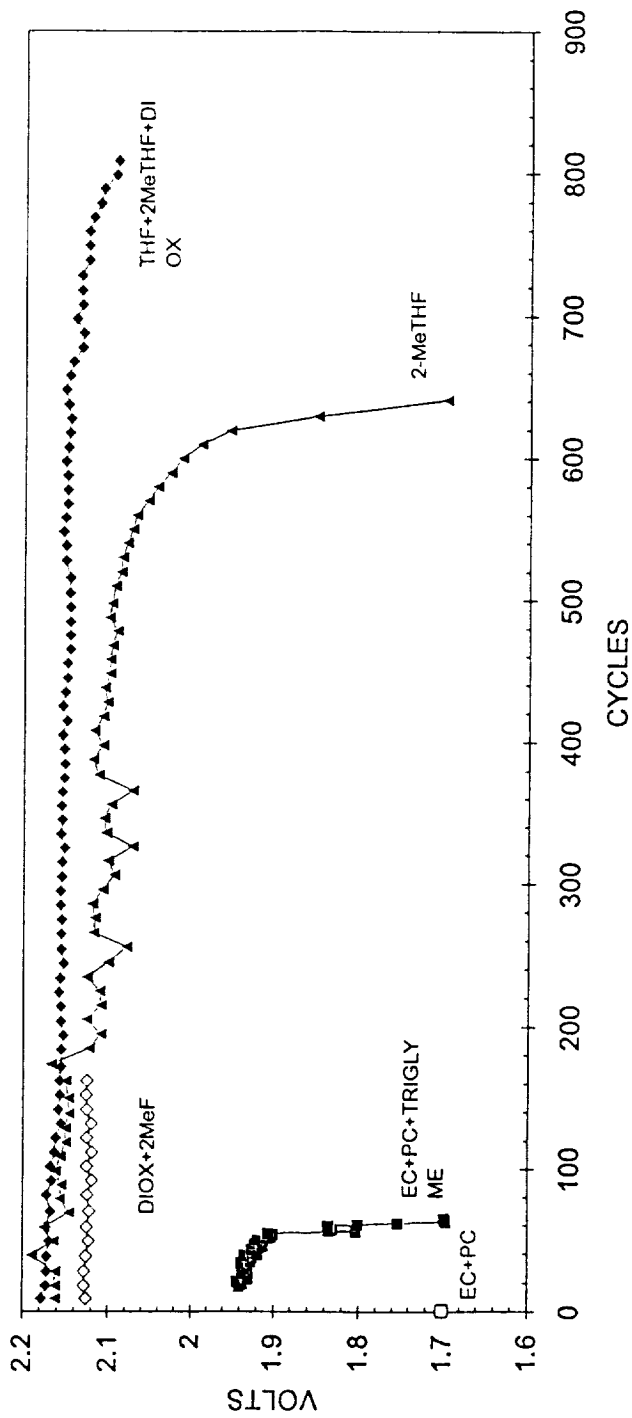
DESIGN PARAMETER STUDIES

EFFECT OF PACK TIGHTNESS ON END-OF-DISCHARGE VOLTAGE



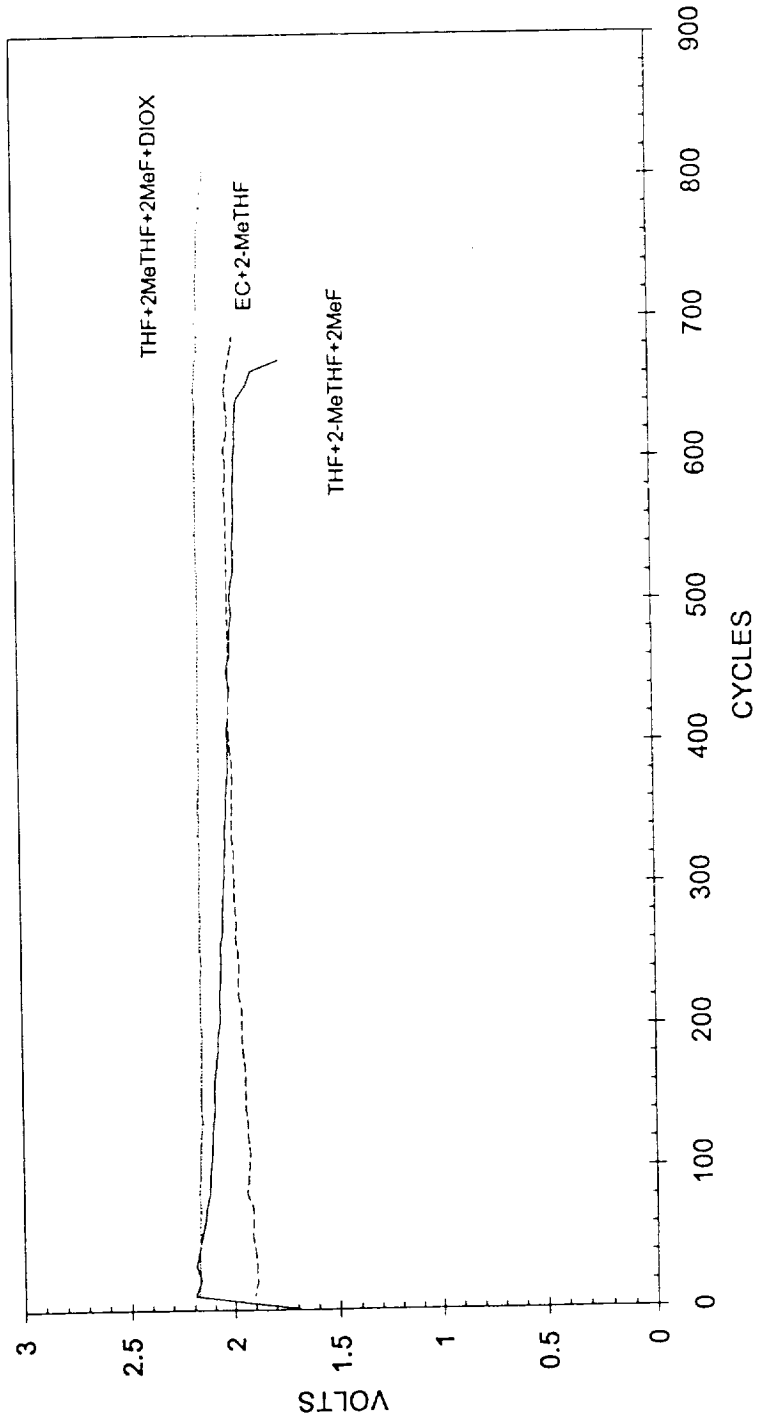
DESIGN PARAMETER STUDIES

CYCLE LIFE PERFORMANCE OF 1 AHR LITHIUM-TITANIUM DISULFIDE CELLS WITH VARIOUS ELECTROLYTES



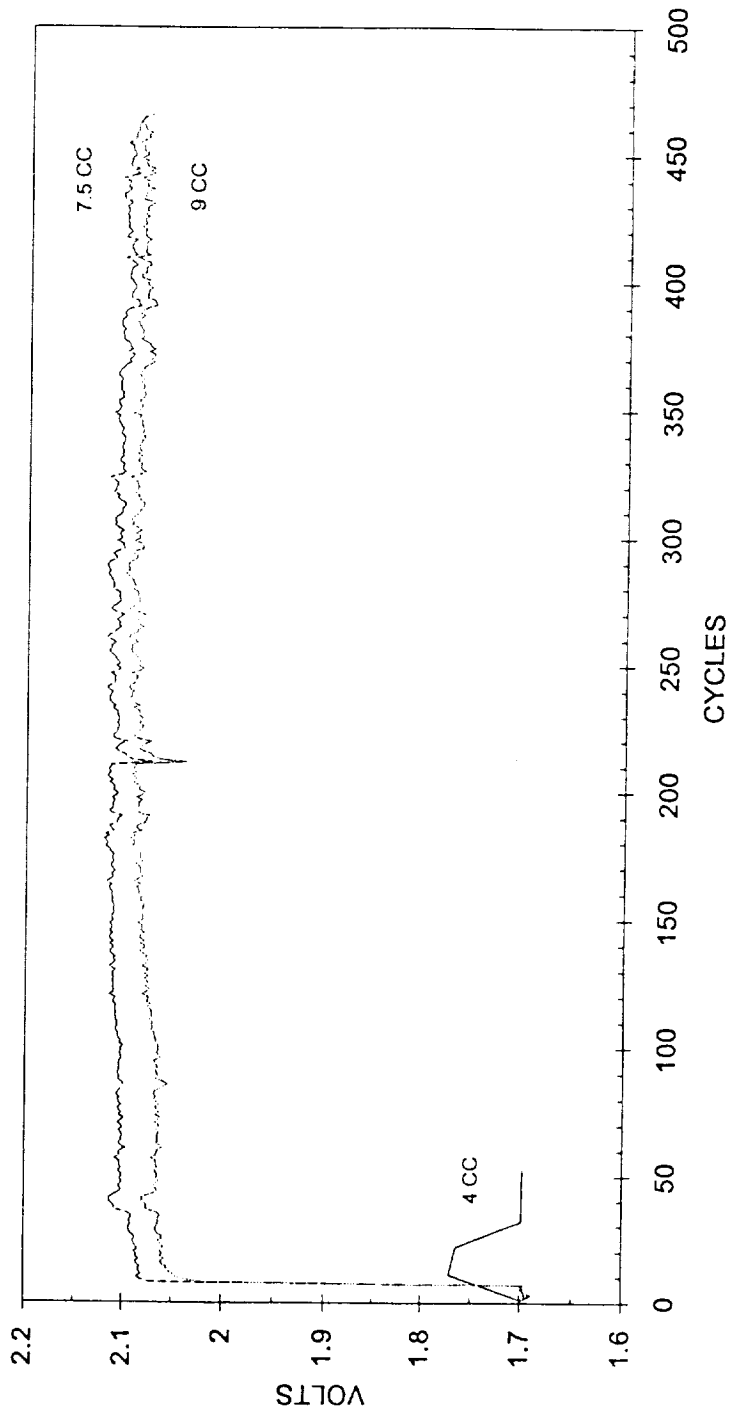
DESIGN PARAMETER STUDIES

END-OF-DISCHARGE VOLTAGE OF CELLS WITH SELECTED ELECTROLYTES



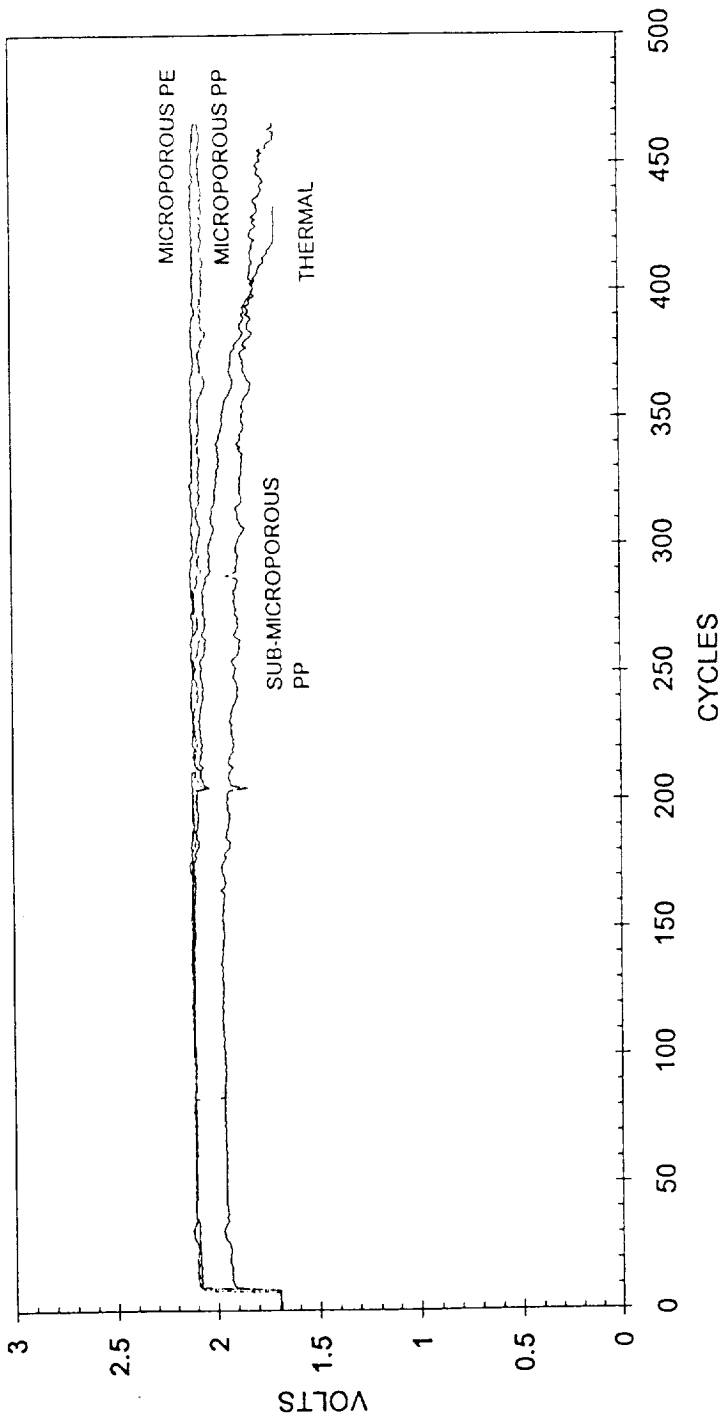
DESIGN PARAMETER STUDIES

**EFFECT OF ELECTROLYTE VOLUME
ON END-OF-DISCHARGE VOLTAGE**



DESIGN PARAMETER STUDIES

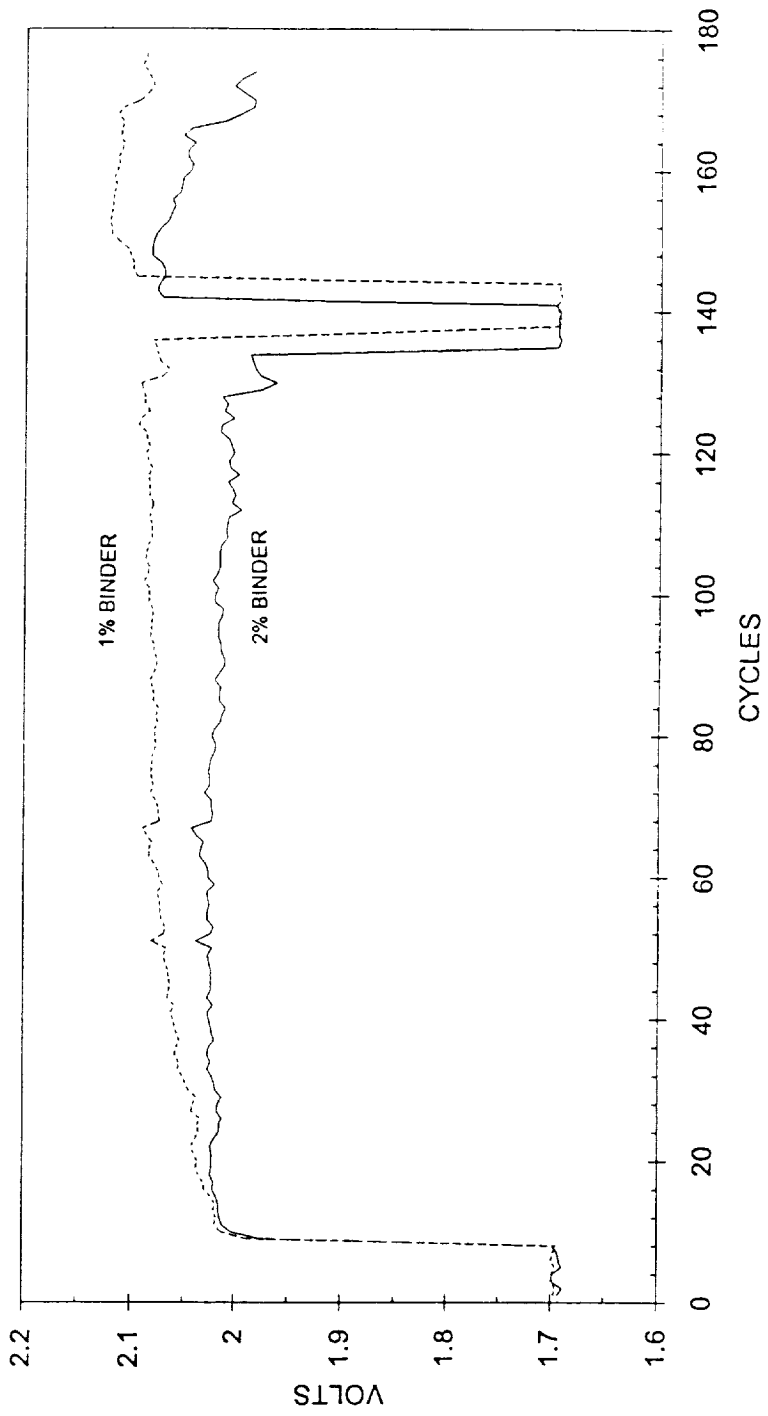
EFFECT OF SEPARATOR ON END-OF-DISCHARGE VOLTAGE



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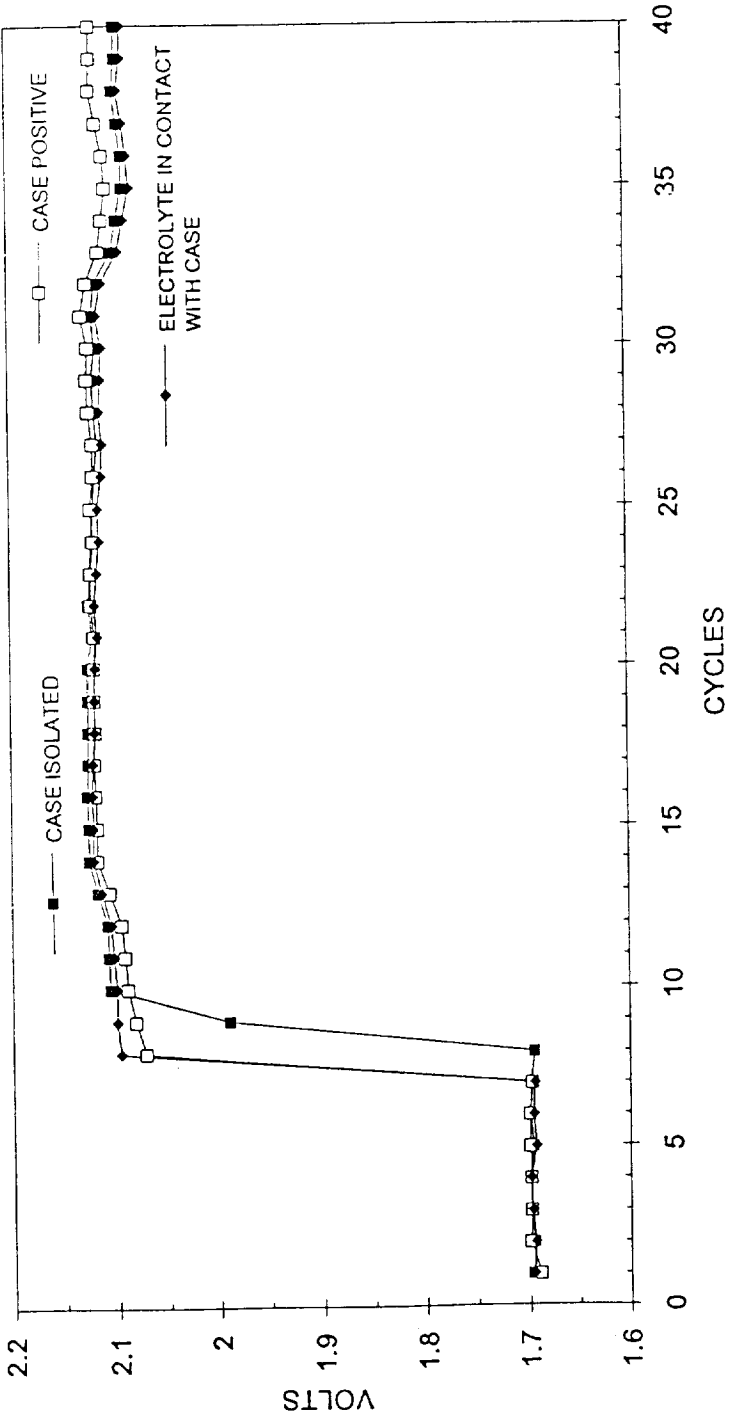
DESIGN PARAMETER STUDIES

EFFECT OF CATHODE BINDER CONCENTRATION ON END-OF-DISCHARGE VOLTAGE



DESIGN PARAMETER STUDIES

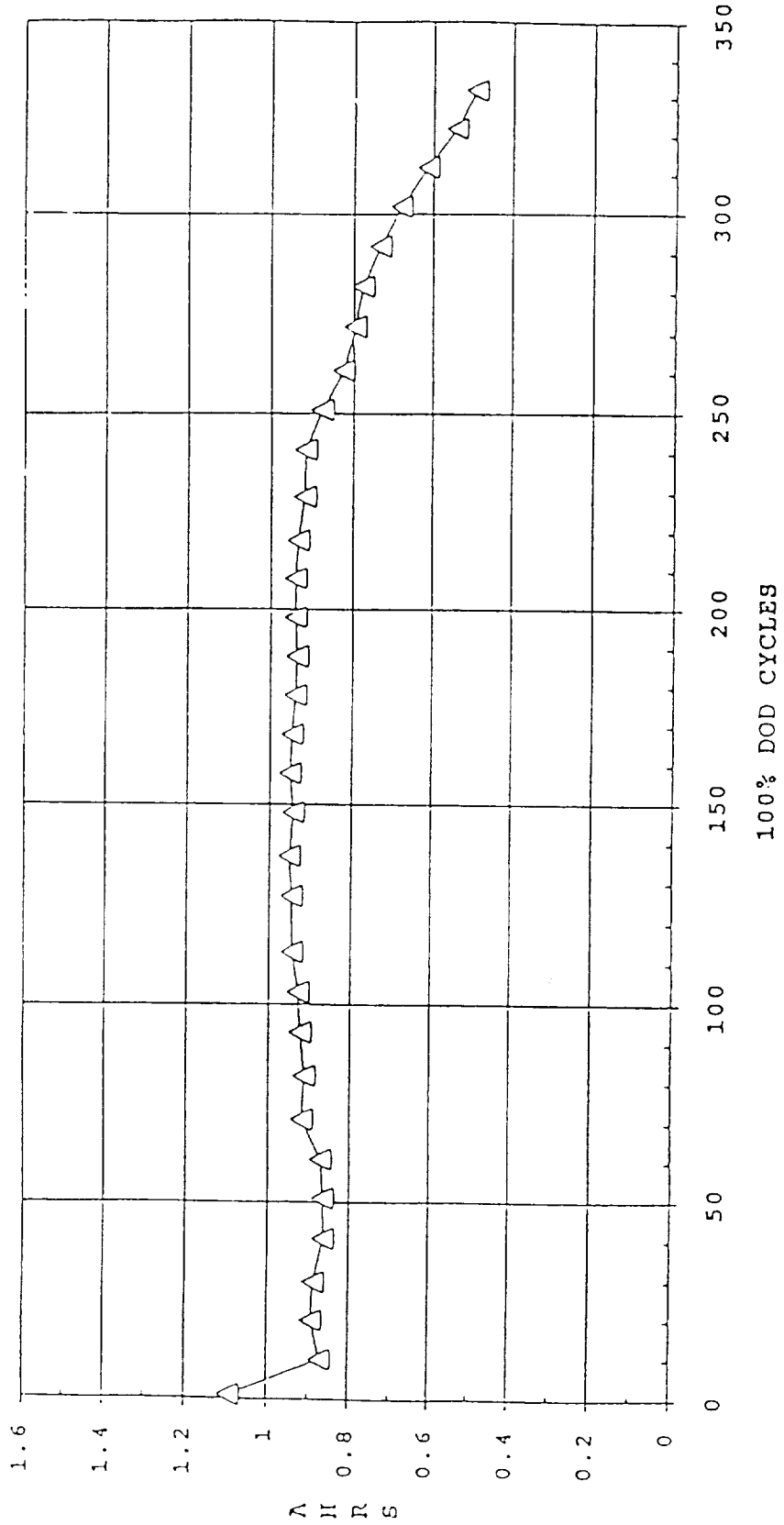
EFFECT OF CASE POLARITY ON END-OF-DISCHARGE VOLTAGE



CYCLE LIFE CHARACTERISTICS OF 1 Ah Li-TiS₂ CELL

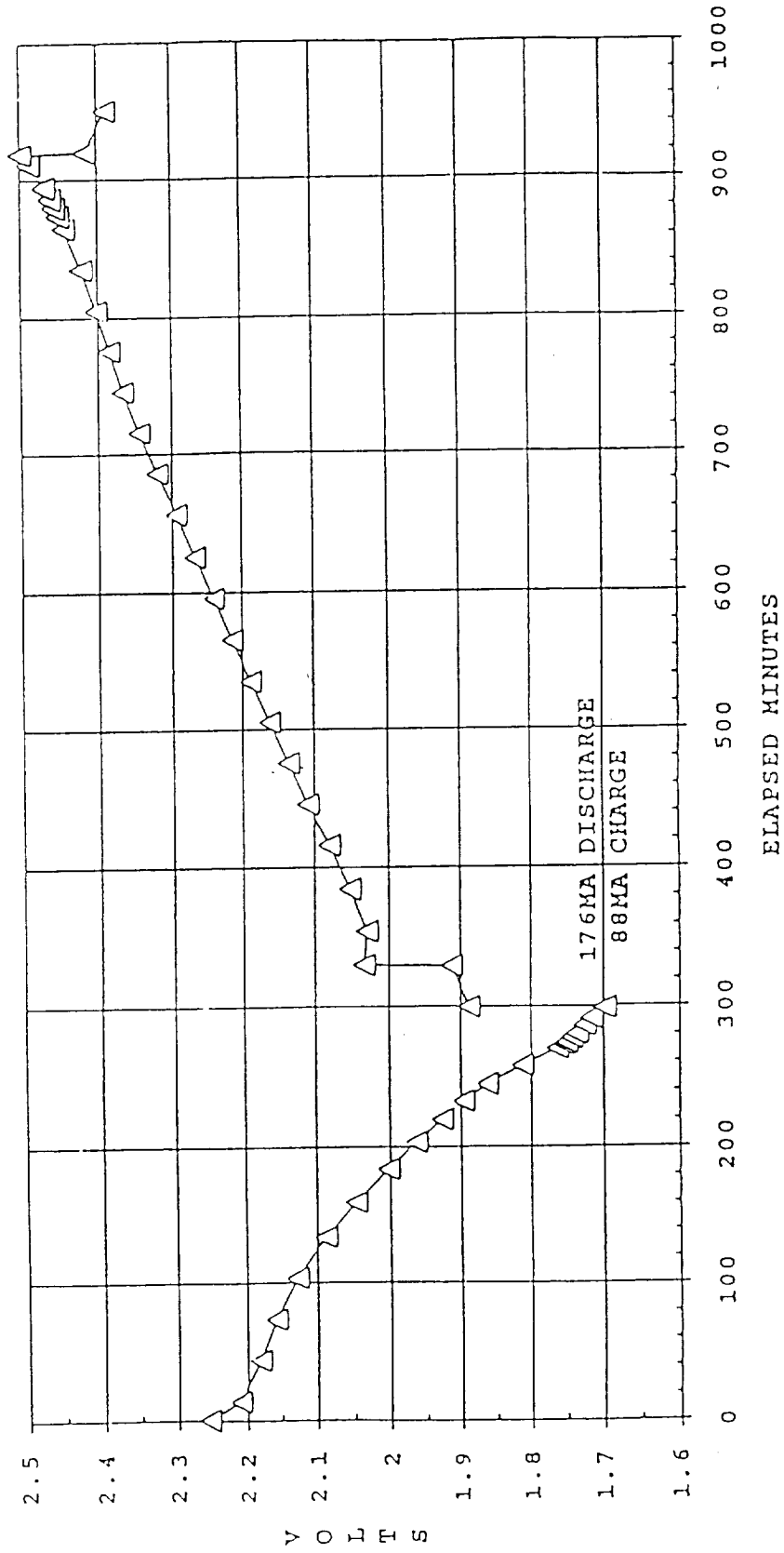
(C/5 DISCHARGE, C/10 CHARGE - AT 100% DOD)

CELL #9005





TYPICAL CHARGE/DISCHARGE CURVE FOR 1 Ah Li-TiS₂ CELL



SUMMARY
SUGGESTED CELL DESIGN PARAMETERS

DESIGN PARAMETERS	VARIATIONS
ANODE TO CATHODE CAPACITY RATIO	6:1
PACK TIGHTNESS	Tight
TYPE OF ELECTROLYTE Salt: 1.5 M LiAsF ₆	10% EC + 88% 2-MeTHF + 2% 2-MeF THF + 2-MeTHF + 2% 2-MeF, DIOX + 2-MeTHF + THF + 2% 2-MeF
QUANTITY OF ELECTROLYTE	7.5 c.c.
SEPARATOR	Microporous Polypropylene Microporous Polyethylene Sub-microporous Polypropylene
BINDER CONCENTRATION	1 % by weight
CASE POLARITY	floating or positive.

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