AD-A193 079 ELECTRICAL LOAD AND POWER SOURCE CAPACITY REPORT FOR 1/1
THE C-130 AIRCRAFT S..(U) LEAR SIEGLER INC GRAND RAPIDS
MICH J M SCHIEFFER 28 AUG 87 GRR-6216-011-REV
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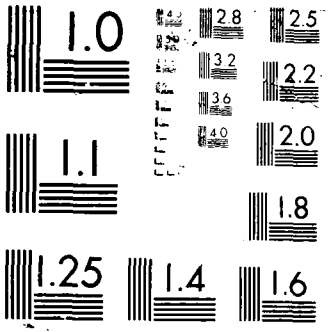
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Report No. 6216-011
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ELECTRICAL LOAD
AND POWER SOURCE CAPACITY REPORT
FOR THE C-130 AIRCRAFT
SELF CONTAINED NAVIGATION SYSTEM (SCNS)
LSI MODEL 6216A, 6216B, 6216C

28 AUGUST 1987

CONTRACT NO. F09603-85-C-1224

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1.0 SCOPE - This report presents the electrical load analysis for the installation of the Self Contained Navigation System (SCNS) Class V Modification into the C-130 aircraft. It contains the delta load requirements by incorporation of the SCNS equipment, the load requirements of the SCNS equipment and the load requirements of removed aircraft equipment.

2.0 APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

SPECIFICATIONS:

Military

MIL-E-7016F	Electric Load and Power Source Capacity, Aircraft, Analysis of

OTHER PUBLICATIONS:

Technical Orders

T.O. 1C-130B-2-7	Technical Manual Maintenance Instructions Electrical Systems USAF Series C-130B, C-130E, C-130H Serial No. AF 73-0158 through AF 73-01598 USCG Series HC-130B aircraft
T.O. 1C-130E-2-7-1	Technical Manual Maintenance Instructions Electrical Systems USAF Series C-130E aircraft (AWADS)
T.O. 1C-130E-2-7-2	Technical Manual Maintenance Instructions Electrical Systems USAF Series C-130E, C-130H aircraft (AN/APN-169A)
T.O. 1C-130H-2-7	Technical Manual Maintenance Instructions Electrical Systems USAF Series C-130H and LC-130H aircraft Serial No. AF 74-01658 and up

3.0 POWER LOADING DATA

3.1 POWER LOADING REMOVED EQUIPMENT - Electrical power loading data are given in table I and table II for the equipment removed as part of the SCNS installation.

3.2 POWER LOADING SCNS EQUIPMENT - Electrical power loading data are given in table III and table IV for the equipment installed for the SCNS Class V modification.

3.3 DELTA POWER LOADING - The delta power loading data are given in table V through table X for different aircraft types. Table V and table VII present the delta AC loads for different aircraft types. Table VIII through X present the delta DC loads for different aircraft types. The 26 VAC power is used as a reference voltage only and the current flow for this voltage source is negligible. Therefore, the tables do not reflect the 26 VAC synchro references required for SCNS since it is not considered an electrical load or power source.

3.4 BATTERY ANALYSIS - The battery analysis data is given in figures 1 and 2 for the INU battery (type BB-638/U). The battery discharge curve is based on a 301 watt load driven by a 31 AH battery. The battery charge curve is in accordance with the requirements of MIL-E-7016F. The battery charging summary data is given in table IV.

3.5 FIGURES - The figures give the performance data for the INU battery to be installed as part of the SCNS equipment.

a. Figure 1 describes the battery discharge curves at 301 watts for a temperature of 27 degrees centigrade and -50 degrees centigrade.

b. Figure 2 describes the battery charge curve for a discharged battery.

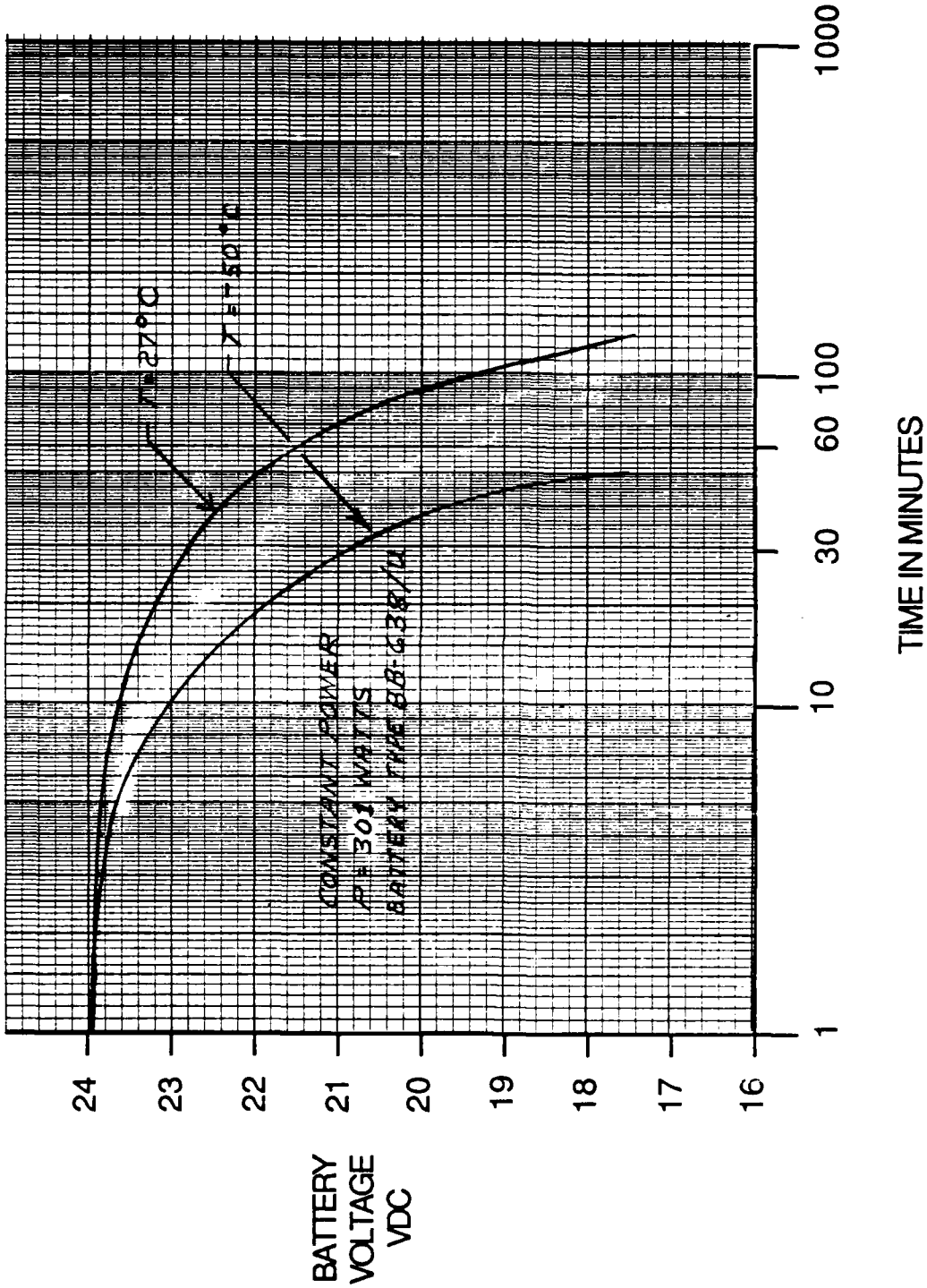

Figure 1. Battery Discharge Curves

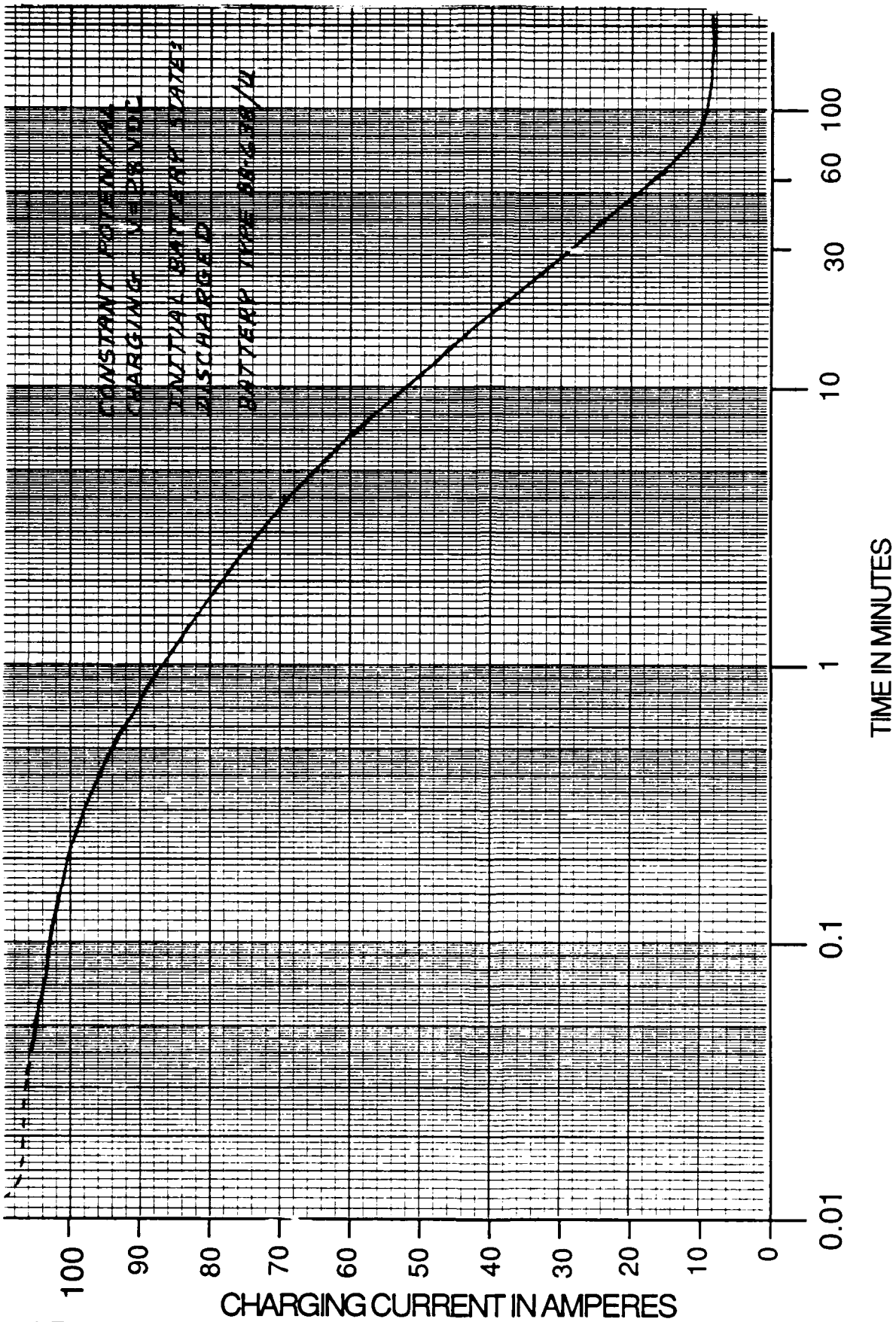

Figure 2. Battery Charge Curve

3.6 TABLES - The tables give the load requirements of the major equipment removed from the aircraft, the SCNS equipment installed in the aircraft, and the delta load change for affected aircraft types.

a. Table I describes the AC power loading data for the removed equipment.

b. Table II describes the DC power loading data for the removed equipment.

c. Table III describes the AC power loading data for the added SCNS equipment.

d. Table IV describes the DC power loading data for the added SCNS equipment.

e. Table V describes the Delta AC load change for C-130 non-AWADS aircraft.

f. Table VI describes the Delta AC load change for C-130E AWADS aircraft.

g. Table VII describes the Delta AC load change for HC-130 H, N, P aircraft.

h. Table VIII describes the Delta DC load change for C-130B, E (non-AWADS), H and WC-130E, H aircraft.

i. Table IX describes the Delta DC load change for C-130E AWADS aircraft.

j. Table X describes the Delta DC load change for HC-130E, H aircraft.

Table I. Removed Equipment Chart - AC Load, Equipment, and Identification

EQUIPMENT	SOURCE OF POWER					NO. OF UNITS	VOLT-AMP PER UNIT 200 V		PWR FACTOR	LOADING AND ANCHOR	TAKEOFF AND CLIMB	CRUISE	CRUISE COMBAT	LANDING	ATM EMERG	ATM START HOTDAY
	LH AC BUS	ESS AC BUS	MAIN AC BUS	RH AC BUS	SEC AC BUS		3Ø	1Ø								
DOPPLER RADAR AN/APN-147	√					1		330	0.9	301	301	301		301		
DOPPLER COMPUTER AN/ASN-35	√					1		95	0.9	85	85	85		85		
OMEGA AN/ARN-131	√					2		105	0.9	100	100	100		100		
ASN 24 COMPUTER		1/				1	1010		0.9	909	909	909		909		
ASN 24 COMPUTER SERVO		1/				1		130	1.0	130	130	130		130		
ASN 24 COMPUTER LOSS XFMR SERVO		1/				1		40	.53	21	21	21		21		
ASN 24 BLOWER		1/				1	173		.76	130	130	130		130		
ASN 24 SIGNAL DATA CONVERTER		1/				1	250		.92	230	230	230		230		
TOTAL LOADS REMOVED NON AWADS		√				N/A		530	0.9	477	477	477		477		
TOTAL LOADS REMOVED C-130E AWADS		√				N/A	1433	700	0.86 0.9	1269 628	1269 628	1269 628		1290 630		

NOTES:

1/ Effectivity limited to C-130 AWADS aircraft only.

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Table II. Removed Equipment Chart - DC Load, Equipment, and Identification

EQUIPMENT	SOURCE OF POWER: ESS DC BUS	SOURCE OF POWER: ISO AND BAT BUS	SOURCE OF POWER: MAIN DC BUS	NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER
DOPPLER RADAR AN/APN-147	√			1	5.0	5.0	5.0	5.0	5.0		5.0		
DOPPLER COMPUTER AN/APN-35	4/			1	5.0	5.0	5.0	5.0	5.0		5.0		5.0
COMPUTER AN/ASN-24	1/			1	5.2	5.2	5.2	5.2	5.2		5.2		
COMPUTER RELAY PANEL	1/			2/					0.5				
COMPUTER BLOWER RELAY	1/			1	0.4	0.4	0.4	0.4	0.4		0.4		
SIGNAL DATA CONVERTER	1/			1	0.1	0.1	0.1	0.1	0.1		0.1		
FREE AIR TEMP IND			√	1	0.08	0.08	0.08	0.08	0.08		0.08		
TOTAL LOADS REMOVED NON AWADS	√			N/A	10.0	10.0	10.0	10.0	10.0		10.0		5.0
			√	N/A	0.08	0.08	0.08	0.08	0.08		0.08		
TOTAL LOADS REMOVED C-130E AWADS	√			N/A	15.7	15.7	15.7	15.7	16.1		15.7		5.0
			√	N/A	0.08	0.08	0.08	0.08	0.08		0.08		

NOTES:

1/ Effectivity: C-130E AWADS.

2/ Worse case relay operation.

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Table III. Added SCNS Equipment Chart - AC Load, Equipment and Identification

EQUIPMENT	SOURCE OF POWER: LH AC BUS	ESS AC BUS	MAIN AC BUS	RH AC BUS	SEC AC BUS	NO. OF UNITS	VOLT-AMP PER UNIT 200 V: 3Ø	1Ø	PWR FACTOR	LOADING AND ANCHOR	TAKEOFF AND CLIMB	CRUISE	CRUISE COMBAT	LANDING	ATM EMERG	ATM START HOTDAY
BICU		√				1	60		0.9	54	54	54		54		
INU		√				1		140	0.9	126	126	126		126		
INU FAN		√				1	150		0.8	120	120	120		120		
DVS		√				1		150	0.9	135	135	135		135		
SCNS ICDU LTG		√				2		24	1.0	48	48	48		48		
			√			1		24	1.0	24	24	24		24		
			1/			1		24	1.0	24	24	24		24		
MASTER LTG VOL CONT PNL		√				1		3.0	1.0	3.0	3.0	3.0		3.0		
FDMS PNL LTG		√				2		2.4	1.0	4.8	4.8	4.8		4.8		
AD/TJ PNL		√				1		1.8	1.0	1.8	1.8	1.8		1.8		
SCNS CONT PNL LTG			√			1		3.0	1.0	3.0	3.0	3.0		3.0		
0-5 VAC LTG CONT			2/			1		1.8	1.0	1.8	1.8	1.8		1.8		
TOTAL ADDED LOADS		√					210		0.85	174	174	174		174		
		√						345.2	0.92	316.2	316.2	316.2		316.2		
			1/					52.8	1.0	52.8	52.8	52.8		52.8		
			3/					27.0	1.0	27.0	27.0	27.0		27.0		
			4/					28.8	1.0	28.8	28.8	28.8		28.8		

NOTES:

1/ Effectivity: HC-130H, N, P
2/ Effectivity: C-130B, E, H HC-130H, N, P WC-130E
3/ Effectivity: C-130E AWADS
4/ Effectivity: C-130B, E, H WC-130E

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Table IV. Added SCNS Equipment Chart - DC Load, Equipment, and Identification

SOURCE OF POWER				NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER	INU BATTERY POWER
EQUIPMENT	ESS DC BUS	ISO AND BAT BUS	MAIN DC BUS											
BICU	√			1	2.0	2.0	2.0	2.0	2.0		2.0			
ICDU	1/			3	4.1	12.3	12.3	12.3	12.3		12.3			4/ 6.4
ICDU	2/			4	4.1	16.4	16.4	16.4	16.4		16.4			4/ 6.4
SCNS CONTROL PANEL			3/	1	0.1	0.1	0.1	0.1	0.8		0.8			
SCNS LHAND RH RELAY CONTROL PANELS	3/			2	0.2	0.2	0.2	0.2	1.2		1.2			
IDCU POWER RELAYS	1/		3	3	0.12	0.36	0.36	0.36	0.36		0.36			4/ 0.12
ICDU POWER RELAYS	2/		4	4	0.12	0.48	0.48	0.48	0.48		0.48			4/ 0.12
INU POWER RELAYS	√		2	2	0.12	0.24	0.24	0.24	0.24		0.24			4/ 0.24
BICU POWER RELAYS	√		2	2	0.12	0.24	0.24	0.24	0.24		0.24			
PILOTS FDMS			3/	1		0.1	0.1	0.1	0.64		0.64			
COPILOTS FDMS			3/	1		0.1	0.1	0.1	0.64		0.64			
INU BATTERY CHARGE	√			1		86.5	86.5	64.8	43.2	43.2	21.6			
INU				1										8.8

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Table IV. Added SCNS Equipment Chart - DC Load, Equipment, and Identification (Continued)

EQUIPMENT	SOURCE OF POWER: ESS DC BUS	SOURCE OF POWER: ISO AND BAT BUS	SOURCE OF POWER: MAIN DC BUS	NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER	INU BATTERY POWER
VOR/ILS PWR RELAYS	√			2	0.12	0.24					0.24			
TROOP JUMP RELAYS		√		3	0.11	0.33			0.33					
UHF NO. 1 CONT		√		2	0.081	0.162	0.162	0.162	0.162		0.162			
INU BATTERY RELAYS	√			1	1.1	1.1	1.1	1.1	1.1		1.1			1.1
TOTAL ADDED LOADS 1/	√			N/A	N/A	102.6	102.3	80.6	60.0	43.2	38.7			15.5
		√		N/A	N/A	0.495	0.162	0.162	0.495		0.162			
			√	N/A	N/A	0.3	0.3	0.3	2.1		2.1			
TOTAL ADDED LOADS 2/	√			N/A	N/A	106.7	106.4	85.7	64.1	43.2	42.8			15.5
		√		N/A	N/A	0.495	0.162	0.162	0.495		0.162			
			√	N/A	N/A	0.3	0.3	0.3	2.1		2.1			

NOTES

1/ Effectivity: C-130B, E, and H, WC-130E, H.

2/ Effectivity: HC-130H, N, P.

3/ Worse case operation implies SCNS mode failure.

4/ Only navigators ICDU utilizes INU battery.

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Table V. Delta Load C-130E (Non-AWADS), C-130H, and WC-130E, H Chart - AC Load, Equipment, and Identification

EQUIPMENT	SOURCE OF POWER: LH AC BUS	ESS AC BUS	MAIN AC BUS	RH AC BUS	SEC AC BUS	NO. OF UNITS	VOLT-AMP PER UNIT 200 V: 3Ø	1Ø	PWR FACTOR	LOADING AND ANCHOR	TAKEOFF AND CLIMB	CRUISE	CRUISE COMBAT	LANDING	ATM EMERG	ATM START HOTDAY
ADDED		√				N/A	210	345.2	0.85 0.92	174 316.2	174 316.2	174 316.2		174 316.2		
			√			N/A		28.8	1.0	28.8	28.8	28.8		28.8		
REMOVED																
DELTA		√				N/A	+210	-184.8	0.85 0.9	+174 -160.8	+174 -160.8	+174 -160.8		+174 -160.8		
			√			N/A		+28.8	1.0	+28.8	+28.8	+28.8		+28.8		

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Table VI. Delta Load C-130E AWADS Chart - AC Load, Equipment, and Identification

SOURCE OF POWER						NO. OF UNITS	VOLT-AMP PER UNIT 200 V		PWR FACTOR	LOADING AND ANCHOR	TAKEOFF AND CLIMB	CRUISE	CRUISE COMBAT	LANDING	ATM EMERG	ATM START HOTDAY
EQUIPMENT	LH AC BUS	ESS AC BUS	MAIN AC BUS	RH AC BUS	SEC AC BUS		3Ø	1Ø								
ADDED		√				N/A	210		0.85	174	174	174		174		
								345.2	0.92	316.2	316.2	316.2		316.2		
			√			N/A		27.0	1.0	27.0	27.0	27.0		27.0		
REMOVED		√				N/A	1433		0.86	1269	1269	1269		1269		
								700	0.9	628	628	628		628		
DELTA		√				N/A	-1223		0.86	-1095	-1095	-1095		-1095		
								-354.8	0.9	-311.8	-311.8	-311.8		-311.8		
			√			N/A		27.0	1.0	27.0	27.0	27.0		27.0		

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Table VII. Delta Load HC-130H, N, P Chart - AC Load, Equipment, and Identification

EQUIPMENT	SOURCE OF POWER: LH AC BUS	ESS AC BUS	MAIN AC BUS	RH AC BUS	SEC AC BUS	NO. OF UNITS	VOLT-AMP PER UNIT 200 V: 3Ø	1Ø	PWR FACTOR	LOADING AND ANCHOR	TAKEOFF AND CLIMB	CRUISE	CRUISE COMBAT	LANDING	ATM EMERG	ATM START HOTDAY
ADDED		√				N/A	210		0.85	174	174	174		174		
								345.2	0.92	316.2	316.2	316.2		316.2		
			√			N/A		52.8	1.0	52.8	52.8	52.8		52.8		
REMOVED		√				N/A		530	0.9	477	477	477		477		
DELTA		√				N/A	+210		0.85	+174	+174	+174		+174		
								-184.8	0.9	-160.8	-160.8	-160.8		-160.8		
			√			N/A		+52.8	1.0	+52.8	+52.8	+52.8		+52.8		

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Table VIII. Delta C-130E (Non-AWADS), H, WC-130E, H Chart - DC Load, Equipment and Identification

EQUIPMENT	SOURCE OF POWER: ESS DC BUS	SOURCE OF POWER: ISO AND BAT BUS	SOURCE OF POWER: MAIN DC BUS	NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER	INU BATTERY POWER
TOTAL LOADS ADDED	√			N/A	N/A	102.6	102.3	80.6	60.0	43.2	38.7			15.5
			√	N/A	N/A	0.3	0.3	0.3	2.1		2.1			
		√		N/A	N/A	0.495	0.162	0.162	0.495		0.162			
TOTAL REMOVED LOADS	√			N/A	N/A	10.0	10.0	10.0	10.0		10.0		5.0	
			√	N/A	N/A	0.08	0.08	0.08	0.08		0.08			
DELTA LOAD CHANGE	√			N/A	N/A	+92.6	+92.6	+70.6	+50.0	+43.2	+28.7		-5.0	15.5
			√	N/A	N/A	+0.22	+0.22	+0.22	+2.01		+2.01			
		√		N/A	N/A	+0.495	+0.162	+0.162	+0.495		+0.162			

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Table IX. Delta Load C-130E AWADS Chart - DC Load, Equipment and Identification

SOURCE OF POWER				NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER	INU BATTERY POWER
EQUIPMENT	ESS DC BUS	ISO AND BAT BUS	MAIN DC BUS											
TOTAL LOADS ADDED	√			N/A	N/A	102.6	102.3	80.6	60.0		38.7			15.5
			√	N/A	N/A	0.3	0.3	0.3	2.1		2.1			
		√		N/A	N/A	0.495	0.162	0.162	0.495		0.162			
TOTAL LOADS REMOVED	√			N/A	N/A	15.7	15.7	15.7	16.1		15.7		5.0	
			√	N/A	N/A	0.08	0.08	0.08	0.08		0.08			
DELTA LOAD CHANGE	√			N/A	N/A	+86.6	+86.9	+64.9	+43.9		+23.0		-5.0	+15.5
			√	N/A	N/A	+0.22	+0.22	+0.22	+2.01		+2.01			
		√		N/A	N/A	+0.495	+0.162	+0.162	+0.495		+0.162			

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Table X. Delta Load HC-130E, H Chart - DC Load, Equipment, and Identification

SOURCE OF POWER				NO. OF UNITS	AMPS	LOADING AND ANCHOR	TAXI	TAKEOFF AND CLIMB	CRUISE	EMERGENCY	LANDING	START BATTERY	ATM START POWER	INU BATTERY POWER
EQUIPMENT	ESS DC BUS	ISO AND BAT BUS	MAIN DC BUS											
TOTAL LOADS ADDED	√			N/A	N/A	106.7	106.4	85.7	64.1	43.2	42.8			15.5
			√	N/A	N/A	0.3	0.3	0.3	2.1		2.1			
		√		N/A	N/A	0.495	0.162	0.162	0.495		0.162			
TOTAL LOADS REMOVED	√			N/A	N/A	10.0	10.0	10.0	10.0		10.0		5.0	
			√	N/A	N/A	0.08	0.08	0.08	0.08		0.08			
DELTA LOAD	√			N/A	N/A	+96.7	+96.4	+75.7	+64.1	+43.2	+32.8		-5.0	15.5
			√	N/A	N/A	+0.22	+0.22	+0.22	+2.01		+2.01			
		√		N/A	N/A	+0.495	+0.162	+0.162	+0.495		+0.162			

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INSTRUMENT DIVISION
4141 EASTERN AVENUE S.E. GRAND RAPIDS MI 49508
LSI 41.5-188 1/86

4.0 SUMMARY AND CONCLUSIONS

4.1 SUMMARY

4.1.1 AC ELECTRICAL LOAD - The SCNS equipment will obtain AC electrical power from the Essential AC Bus. Panel lighting is 0-5 VAC supplied by the ESS AC Bus at the Pilot, Copilot, and Pedestal and the Main AC Bus at other locations.

4.1.2 DC ELECTRICAL LOAD - The SCNS major equipment will obtain DC electrical power from the Essential DC Bus. The INU Battery is installed in the battery box which is the same type as the current aircraft battery. SCNS annunciator light will obtain power from the Main DC Bus.

4.1.3 BATTERY ANALYSIS - Under adverse operating conditions (temperature equals -50 degrees centigrate) the battery will operate for 49 minutes before the battery voltage drops to 18 VDC. Under normal operating conditions (temperature equals 27 degrees centigrade) the battery will operate for 111 minutes before the battery voltage drops to 18 volts. These times are based on constant power requirements of 301 watts.

4.2 CONCLUSIONS

a. AC Delta load. For non-AWADS C-130 aircraft installation of the SCNS will increase the 3-phase Essential Bus load by 210 VA and decrease the single-phase A Essential Bus load by 184.8 VA. For C-130E AWADS aircraft, installation of the SCNS will decrease the 3-phase Essential Bus load by 1223 VA, decrease the single-phase A Essential Bus load by 354 VA, and increase the single-phase Main AC Bus load by 27 VA.

b. DC Delta load. The worse case increase for Essential DC Bus power is for HC-130 aircraft which will require up to 96.7 amps at 28 VDC. The worse case load increase for the Main DC Bus will be 2.01 amps at 28 VDC. The INU battery load will be 15.5 amps. The Essential Bus load is increased by 23 percent and will be operating at 66 percent of capacity.

c. Battery analysis. The INU battery (type BB-638/U) is of sufficient capacity to operate the INU and Navigators ICDU for 49 minutes under the most adverse conditions. The majority of the Delta DC Electrical Load is due to the battery. This load will only be drawn if a discharged battery is in the aircraft.

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