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ES-185A GPS MASTER CLOCK

OPERATION AND MAINTENANCE MANUAL

The ES-185A is a GPS Master Clock/Time Code Generator. The unit receives accurate time and date information from Global Positioning System satellites and supplies this data to the user in a variety of forms. An eight-channel receiver is employed that is capable of tracking up to eight (8) satellites simultaneously, although reception of only one is required for time data to be output.

IMPORTANT NOTE:

The Antenna Module supplied with the ES-185A is designed for "direct mounting". This implies that the antenna should be mounted to a "deck plane", which may be a wall, a roof or any other "suitable" surface.

The dome of the Antenna Module is designed for mounting outside (or inside near a window with a view of the sky) and is capable of withstanding most weather conditions (including sun, wind, rain and snow, etc.). The cable, however, should be routed so as to minimize its exposure to the elements, especially moisture and direct sun.

In order to prevent moisture from seeping back into the Antenna Module, it is important that the cable "hangs down" as it exits the Antenna Module. Also, a drip loop should be made between the Antenna Module and the ES-185A. Improper cable routing may allow moisture to enter the Antenna Module or the ES-185A and permanently damage the antenna and/or the clock, voiding that portion of the warranty. A recommended Installation Procedure is provided on page 7.

INSTALLATION & OPERATION

The basic operation of the ES-185A is nearly as simple as connecting the antenna cable to the clock, applying power (typically 117 VAC) and allowing the unit to "lock" onto GPS. However, after any "bench" testing is complete, the most important concern is to mount the Antenna Module and route the cable according to the instructions provided on page 7.

All other connections between the ES-185A and other equipment should be made by a qualified technician or engineer. The technician or engineer should be familiar with each piece of equipment being interfaced with the ES-185A. Please refer to the descriptions and specifications which follow for details concerning the various Standard Features and Options. Consult the manufacturer of the equipment or the ESE factory if assistance is required.

STANDARD FEATURES

Display

The front-panel display consists of nine .56" high yellow LEDs that display Julian Day, Hours, Minutes and Seconds.

A single green LED indicates if the unit is "Locked" to GPS. Access to a TTL output of GPS "Lock" information is accessible on the DB-9 connector.

Outputs

The rear-panel of the ES-185A provides access to all outputs via various connectors (XLR, BNC, DB-9 & DB-37). Please refer to the "Rear Panel Connector Pin Designations" and "Specifications" for more details.

ESE Time Code: The most efficient and cost-effective method for time code distribution in a Master Clock/Slave Clock System employs the ESE Time Code output. ESE Time Code is capable of driving up to 100 slaves at a distance of up to 4000 feet. Connections (between the ES-185A ESE Time Code Output and any ESE Time Code Slave) can be made using twisted pair wire or coax cable such as RG-58 or RG-59. The accuracy is 17mS of UTC and the time code is accessible on two separate BNC connectors (TC89 & TC90). TC89 is an older version of ESE Time Code and should be used to drive older ESE Time Code Slaves (non-"A" versions). TC90 contains "Date" information as well as time data and should be used if "Date" is to be displayed on the Slave.

1PPS: The most accurate time information available from the ES-185A is that provided by the 1PPS Output (one pulse per second). Two (2) outputs are provided: a 20% duty signal specified as being within 45ηS of UTC, and a 50% duty signal which is within 4μS of UTC. The 20% duty signal is obtained directly from the receiver. The 50% duty signal is regenerated by the timekeeping microprocessor; this signal is isolated from dropouts due to signal loss and should be used for long-term timekeeping purposes. Both signals are positive edge true. The 1PPS can be used for synchronization purposes in a variety of applications. One such application allows the 1PPS to drive an Impulse Driver (ES-165 or ES-162A) which, in turn, can drive "Analog" Impulse Clocks (ES-168 or ES-162S).

SMPTE Time Code: A SMPTE Time Code Output is accessible via an XLR connector. Accuracy of the SMPTE is +/- 400 mS or can be synchronized to a video source via the "Video In" BNC connector. The SMPTE time code is automatically "re-synched" to GPS at 2:00:00 AM. SMPTE (Society of Motion Picture and Television Engineers) is used predominantly in the TV, Cable and Video industries. EBU/PAL (the European equivalent to SMPTE/NTSC) can be specified if desired. See "Setup Features". The SMPTE User Bits are, from high to low, as follows: 1OY-X-Y-X-10M/10D-M-D-X. When Julian Day of Year is used, the SMPTE User Bits are as follows: X-X-X-X-X-100D-10D-D.

IRIG-B Time Code: An IRIG-B Time Code is accurate to 1μS of UTC and is accessible on a BNC connector. IRIG-B (Inter Range Instrumentation Group) is needed most frequently for military applications.

RS-232C: RS-232C ASCII Time Code is used to interface with a PC or other computer system. The ASCII transmission contains date and time data and is transmitted once per second. The data is accessible on the DB-9 connector. Software is included enabling the ES-185A to continuously update a computer's clock.

SETUP FEATURES

Several features of the ES-185A are factory set according to information supplied by the end user or according to factory standards. All Setup Features are selected via internal jumpers (solderable) except "Time Zone", "Time Delay/Advance" and "Cable Delay". All Setup Features are discussed below.

Time Zone: The ES-185A receives GPS time and date information which has been encoded and set to UTC (Universal Coordinated Time/Greenwich Mean Time). The unit must be set at the factory to decode and display time for the end-user's time zone. Or, by using the software supplied with the ES-185A, the time-zone can be changed "in the field". This is accomplished by connecting the RS-232C input to a computer serial port and running the ESEGPS.EXE (Windows®) or GPSINI.EXE (DOS) program. Running GPSINI.EXE without command line switches will print the instructions on screen. Run the program again using the appropriate command line parameters. Please connect ONLY the 2 data lines & the ground line to the computer: the DB-9 connector also provides access to unrelated functions which should not be connected to the computer. (Software is also available for download at the ESE Web-Site at **http://www.ESE-WEB.com**.)

Time Delay: This program allows the ES-185A to provide an advanced or delayed time output. Refer to the "readme.txt" file on the provided CD for more details.

Cable Delay: This program allows the ES-185A to compensate for antenna cable delay, adjustable for 0 - 22,215 feet. Refer to the "readme.txt" file on the provided CD for more details.

12/24 Hr: Although the front-panel display is always in 24 hour format, the ESE “TC89” Time Code can be output in either 12 hour or 24 hour format. This enables Slave Clocks to differ from the Master. Install the "24HR" Jumper for 24 hour operation. Note: Most ESE Serial Time Code Slave Clocks can be programmed for either 12 hour or 24 hour format regardless of the “TC89” format.

DST Off: DST (Daylight Savings Time) can automatically be compensated for if the end-user desires. Installing the "DST OFF" Jumper disables the DST feature. The DST adjustment is according to the standards used in the United States and switches at 2:00 AM. Foreign DST standards are available on a "custom" basis.

Drop Frame: Unless otherwise specified, the unit is set to provide "Drop Frame" SMPTE Time Code. If non-Drop Frame SMPTE is desired, install the "NDF" Jumper.

Date: The date information encoded into the "user bits" of the SMPTE time code is typically set to include Month-Day-Year information. Installing the "Julian" Jumper reformats the data to contain Julian Day of Year (001-366) instead of Month-Day-Year.

EBU: If EBU Time Code is desired instead of SMPTE, install the "EBU" Jumper.

ANTENNA

An "active" GPS Antenna (1.575 GHz) with 16’ 5” cable is supplied with the ES-185A. ESE has conducted a series of tests with the purpose of determining a maximum cable length (with or without amplification). A summary of the tests and the alternatives are discussed on page 8. Proper installation of the Antenna Module is imperative for proper operation and continued life of the antenna and clock. See page 7.

BATTERY

The ES-185A has a built-in Battery Back-up/Charger System. The battery is capable of maintaining the satellite tracking/timekeeping portion of the unit for up to 4 hours. All outputs are suspended during a power outage. If continuous outputs during power outages are required, a UPS (Uninterruptable Power Supply) is suggested.

ENCLOSURE

The ES-185A is housed in a 1RU rack-mount enclosure which measures 1" high x 19" wide x 9" deep (plus connectors). The ruggedized enclosure is constructed of etched and clear anodized aluminum. A black anodized front-panel can optionally be specified.

OPTIONS

The rear-panel of the ES-185A provides access to all "Optional" inputs and outputs via various connectors (BNC, DB-9 & DB-25). Please refer to the "Rear Panel Connector Pin Designations" and "Specifications" for more details.

ANT: A high performance antenna for challenging EMI environments is provided with this option. Nineteen feet of cable is supplied with the antenna.

B: Option "B" provides a parallel BCD Output of the display data. The data is CMOS compatible and contains 20 Data Lines (10's Hours thru Seconds) and Ground. Data is decoded on the "ES-169A" PCB and is accessible on the DB-25 connector.

DC: The ES-185A can be ordered from the factory to operate exclusively from a DC source. Two versions of this option are available, 12 VDC and 28 VDC. The range for the 12 VDC is +10 VDC to +16 VDC and the range of the 28 VDC is +20 to +34 VDC. The DC voltage applied to the unit is via the Locking DC Power Plug. Note: When the DC Option is specified, the unit is NOT operable from AC. Also, at time of order, either 12 or 28 must be specified.

EBU: The ES-185A can output either SMPTE Time Code or EBU Time Code. If EBU is required, the EBU Option must be specified.

K: Option "K" provides two separate frequency outputs. The 10 MHz output and the 1 KHz output are accessible on BNC connectors. The accuracy of these outputs is specified at 10^{-7}.

HR: Option "Hr" provides a relay contact closure on the Hour and on the Half-Hour. An internal jumper/resistor (R32) can be relocated if a closure on the Hour ONLY is required (Hr & 1/2 Hr is supplied unless otherwise specified). The reed relay is rated at 10 watts maximum resistive load (500 mA switching current) and is intended for control applications only. Relay contacts are accessible on the DB-9 connector.

J: The standard ES-185A is intended to operate from 117 VAC 50/60 Hz. If 220 VAC operation is required, Option "J" must be specified.

UL: When Option "UL" is specified, the unit's power transformer is external to the unit, ie: a "wall wart" type UL/CSA approved transformer is supplied. This option allows the ES-185A to be installed in facilities requiring "UL" (or equivalent) approved equipment.

SPECIFICATIONS

GPS RECEIVER: Motorola 8-channel
1 PPS OUTPUTS: DB-9 connector, TTL outputs, positive edge true:
#1 - 20% duty output < 45nS accuracy, directly from receiver
#2 - 50% duty output < 4µS accuracy, regenerated
ESE TC OUTPUT: BNC, drives 100 slaves, 4000' cable maximum
TC89 - drives non-"A" version Slaves
TC90 - drives "Date" Slaves and/or "A" version Slaves
SMPTE TC OUTPUT: XLR, 600 ohm balanced or unbalanced
IRIG-B TC OUTPUT: BNC, 3 VPP (mark amplitude), 600Ω
RS-232C OUTPUT: DB-9 connector, ASCII Date & Time, sent once per second
RS-232C FORMAT: ASCII @ 9600 Baud, 8 Data, No Parity, 1 Stop
MM-DD-YY<SPACE><SPACE>DDD:HH:MM:SS<CR>
Transmission is once per second and ends 7 mS before Time True.
VIDEO INPUT: BNC, RS-170 composite video / blackburst, 1 VPP, 75 ohm
ACCURACY: 1PPS @ < 45ηS
IRIG-B @ 1µS
ESE TC @ 17mS
SMPTE @ 0 Frames with respect to Video Sync, or +/- 400 mS if free running (due to Drop Frame compensation)
POWER: 110-120 VAC, 60 Hz, 15 Watts maximum
(Option "DC" only) +11 to +35 VDC, 1 Amp maximum
MECHANICAL: Rackmount Enclosure 1 3/4" H x 19" W x 9½" D
10 MHz (Option K): 2.6 Vpp, sine wave
1 KHz (Option K): 5 Vpp, square wave

REAR PANEL CONNECTOR PIN DESIGNATIONS

DB-9

Pin	Function
1	N/C
2	RS232 TXD
3	RS232 RXD
4	1 PPS (20 % duty)
5	1 PPS (50 % duty)
6	Relay (Hr opt)
7	Relay (Hr opt)
8	GPS Lock
9	Ground

BC1 (optional)

Pin	Function	Pin	Function
1	A Sec	13	A 10 Min
2	B	14	B
3	C	15	C
4	D	16	Not Used
5	A 10 Sec	17	A Hours
6	B	18	B
7	C	19	C
8	Not Used	20	D
9	A Min	21	A 10 Hrs
10	B	22	B
11	C	23,25	Not Used
12	D	24	Ground

SMPTE (XLR Connector)

Pin	Function
1	Chassis Grou
2	Signal Lo
3	Signal Hi

Note: If connecting SMPTE to an existing non-ESE Master Clock System (using SMPTE time code), it is recommended to connect the balanced output of the ES-185A, using pins 2 & 3, to the existing system (unless the existing system requires an un-balanced signal).

TEMPLATE FOR ANTENNA/MOUNTING PLATE

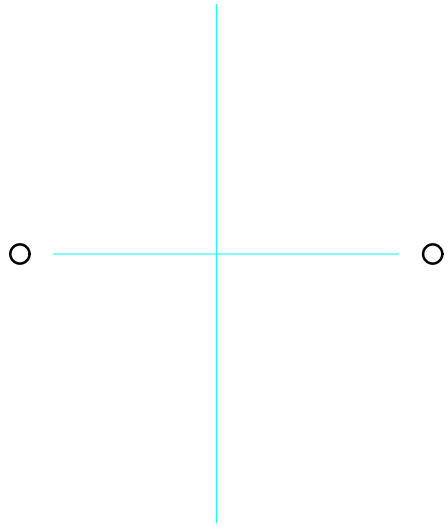


Figure 1.

Note: The Antenna Mounting Plate can also be used as a Template.

ANTENNA With LA-12F And 150' Of EXTRA CABLE (RG-58)

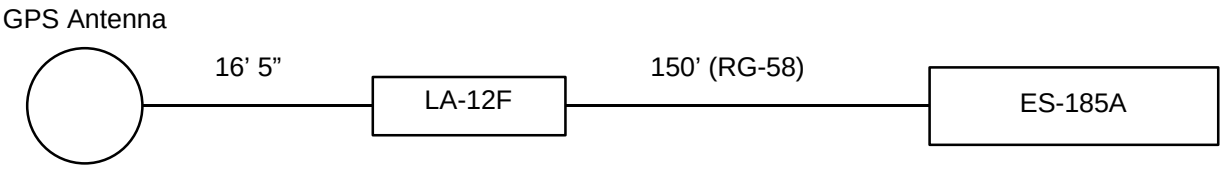


Figure 2.

ANTENNA With 5) LA-12FN And 500' Of EXTRA CABLE (RG-8) With ES-AB1A

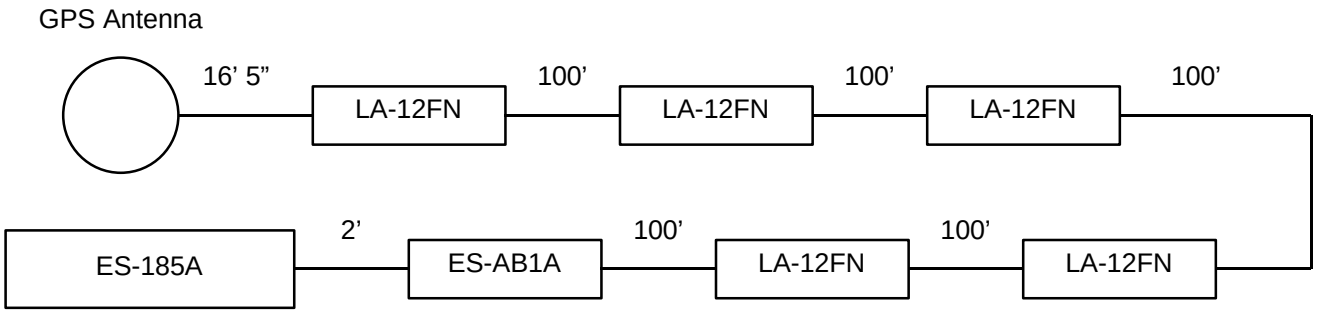


Figure 3.

ANTENNA
MOUNTING INSTRUCTIONS

Refer to Figure 1 on Page 6 and perform the following steps to install the Direct Mount Antenna.

1. Locate a spot that allows the Antenna a view of the sky and where the antenna can be mounted according to the instructions that follow. Note: It is advised to test the Antenna at the location where it is to be mounted prior to mounting (and drilling holes) to verify proper operation.
2. Two 1/8" holes on the mounting plate are used to mount the antenna. Two #4 screws can be used to secure the mounting plate. If using plastic anchors, drill two holes of the appropriate diameter and depth (using the template provided on page 6) through the deck plane where you are mounting the antenna.
3. Press into each hole a plastic anchor until the top of the anchor is flush with the deck plane.
4. Drill a 5/8" hole (for the antenna connector/cable) slightly below where the antenna is to be mounted.
5. Route the antenna connector/cable through the 5/8" hole and then fasten the Antenna to the deck plane using two (2) #4 screws.
6. Connect the antenna connector/cable to the "Antenna" connector on the rear panel of the ES-185A Master Clock.
7. Fill the hole (through which the antenna connector/cable was routed) with an all-weather caulking compound.

Note: If desired, the Antenna can be "magnet mounted" to any steel or other appropriate surface. The mounting plate should be removed from the Antenna. The magnet is mounted to the Antenna.

ANTENNA CABLE TESTS & ALTERNATIVES

The antenna supplied with the ES-185A is designed to provide excellent reception under a variety of conditions. For best results, the top of the antenna should have at least a partial view (unobstructed line of sight) of the sky. However, the view of the sky may be through a window and the antenna may be mounted indoors if the roof or upper floors do not shield the signal. Bench testing is recommended before the permanent location for the antenna is decided.

One of the main concerns when using a GPS receiver (Master Clock) is the distance between the antenna and the receiver. The ES-185A Antenna is supplied with 16' 5" of coax cable which can be connected directly to the clock. If more cable is required an in-line amplifier may be required.

When extra cable is required, several options exist. The most simple and least expensive methods are discussed below. It is, however, the ultimate responsibility of the end-user to decide which option will best satisfy the specific situation. Please feel free to contact the ESE factory for assistance.

Also... please read the section below which discusses the tests performed at ESE.

CABLING SUGGESTIONS / ALTERNATIVES

Method 1 (low loss cable)

Several types of "low loss" coax cable are available including RG-8 and RG-213. Using any of these types of cable "may" allow up to 300' of additional cable to be added to the 16' 5" supplied with the antenna. Both RG-8 and RG-213 are expensive (relative to RG-58) and are cumbersome to work with due to their larger diameter.

Method 2 (in-line amplifier)

The use of an in-line amplifier such as the LA-12F (manufactured by Raven and available from ESE) may be more convenient than low loss cable. Installing one of these amps "may" allow up to 150' of RG-58 (or 300' of RG-8/RG-213) to be added to the 16' 5" supplied. The LA-12FN has 'N' connectors which allow for convenient interconnections with RG-8 and RG-213 cable. See Figure 2 on page 6.

Method 3 (in-line amplifiers with power divider)

Due to the power limitations of the ES-185A's receiver and antenna, only one in-line amplifier can be used. However, if a power divider such as the ES-AB1A is used, up to five (5) in-line amplifiers may be added. The more amplifiers used, the shorter the cable run between amps. See Figure 3 on page 6.

ESE TEST RESULTS

The methods mentioned above are conclusions based upon actual tests performed by ESE and on information provided by various manufacturers. The performance of your unit may differ due to antenna position and obstructions to its line of sight, weather/atmospheric conditions, cable length or signal reflections.

Listed below are the "best" consistent performances. That is, they were repeatable performances on a consistent basis... not just fluke observations.

Caution is recommended: as the GPS Satellites age, their signal strength may decrease and today's cable length could cause undesirable results at a later date.

The ESE factory conducted several tests which demonstrate how the ES-185A/GPS Antenna can be expected to operate for given sets of circumstances. All tests were conducted at ESE (in El Segundo, CA) in 1998 and due to the architecture of the GPS Satellite Constellation, can be considered applicable most anywhere in the world.

Test 1
The first test shows that up to 112' of RG-58 cable can be added to the 16' 5" without any significant loss in signal. (Adding 125' impaired the clock's performance.)

Test 2
When using a single LA-12F, in-line amplifier with 150' of RG-58 cable (in addition to the 16' 5" supplied), the clock would "lock-on" in a nominal amount of time. (Adding 175' impaired the clock's performance.)

Test 3
Using an ES-AB1A (power divider) and two (2) LA-12F with 100' of RG-58 cable attached to each (216' 5" total) permitted the clock to "lock-on" in a nominal amount of time. Adding a third LA-12F with 75' of RG-58 cable did not impair the clock's performance, however, increasing the 75' to 100' did impair the clock's performance.

Test 4
Using an ES-AB1A (power divider) and four (4) LA-12F with 75' of RG-58 cable attached to each (316' 5" total) permitted the clock to "lock-on" in a nominal amount of time. Adding a fifth LA-12F with 25' of RG-58 cable also permitted the clock to "lock-on" in a nominal amount of time. Increasing the 25' to 50' impaired the clock's performance.

All of the tests mentioned above were conducted twice; first with the antenna indoors and second with the antenna outdoors. (Indoors refers to the ESE factory which is a single story building with a wood ceiling and asphalt composite roofing. And outdoors, the antenna had a very narrow look at the sky with approximately six feet of clearing between buildings.)

In all cases, the ES-185A "Locked-on" within fifteen minutes, and in less time when the antenna was outside. ("Locked-on" refers to starting the clock from a completely "powered down" mode and the nine-digit display "catching" real-time with the "GPS Lock" LED lit.)

Various tests conducted away from the factory show that the exact unit which took five minutes to lock-on at the factory, may take up to 45 minutes at a different location. Possible explanations for this phenomenon lead us to believe that atmospheric conditions or poor antenna locations may be responsible.

Please note that once the ES-185A has "Locked-on", and then removing AC power while the battery is "On", the unit will typically re-"Lock-on" within ten seconds after AC is reapplied.

APPLICATION NOTES

Application Note 1

ESE has noticed that the manufacturers' cable length specifications for the Motorola GPS Receiver and the Raven LA-12F differ from the test results of ESE. Please be aware that Motorola specs the maximum cable distance between the antenna and the receiver is 16' 5" (5 meters) without amplification. Also, please be aware that Raven specs the maximum RG-58 cable that the LA-12F can drive is 50 feet.

ESE's test results may indicate that longer lengths of cable may be used. We are not inferring that the longer cable lengths should be used. We are only reporting the results of our tests and repeat the caution mentioned earlier.

Caution is recommended:

as the GPS Satellites age, their signal strength may decrease and excessive cable length may cause undesirable results.

Application Note 2

All ESE tests were conducted using RG-58 coax cable. According to several manufacturers of low loss cable, the signal loss attributable to cable length can be reduced with the use of "low loss" cable. According to the RG-8 and RG-213 cable specifications, when compared to RG-58, cable lengths may be doubled or more with "equal to" or "better than" results.

Application Note 3

Once an ES-185A has "Locked-on", the receiver creates a semi-permanent "Library" of where it expects to "see" a satellite(s) at a specific point in time. However, if after "Locking-on", the unit is relocated (for instance, from the ESE factory in California to an end-user's site in Europe), the unit's 1 PPS (and other outputs') accuracy may appear erratic for up to three hours. When the receiver has created an updated Library, all outputs will then comply with the specifications discussed in this manual.

MASTER CLOCK SOFTWARE - Program Descriptions

The ES-185A is shipped with a CD that contains several "Setup" Programs. Some of those programs are discussed below. All programs are described in the "Readme" file. It is suggested that one refer to the "Readme" file as it may contain updates issued after this manual was published. This software is also available from our web-site at "**www.ESE-WEB.com**". The DOS programs described below do not need to be used if the Windows® programs are used.

ESEGPS.EXE

This Windows® program synchronizes the computer system time to the Master Clock time, and provides a control panel for adjusting various Master Clock functions. This program opens as a "watch" icon in the System Tray. Click on this icon to open the Control Panel applet.

MC32.EXE

This Windows® program works with the ASCII time output (Format "A", "0" or "1"). It synchronizes the computer system time to the Master Clock time. This program opens as a "watch" icon in the System Tray. Click on this icon to open the Control Panel applet.

MCDOS.EXE

This DOS program will set the System Time and Date of a PC/Compatible computer from an ES-185A GPS Master Clock when the machine is booted up. The line "MCDOS" should be added to your AUTOEXEC.BAT file. The file MCDOS.EXE should be placed either in the root directory or where the current PATH can find it.

The program by default is set to use COM1. To set it to a different COM port, add the port number to the command line:

MCDOS /2

The MCDOS.EXE program may also be invoked from the DOS prompt to set the time whenever desired. If you are using the optional serial port command described above, you can make running the program easier by creating a batch file to run the program:

COPY CON:T.BAT <enter>
MCDOS /2 <enter>
F6 (the function key) <enter>

Now, just typing T <enter> will set the time.

GPSINI.EXE

This DOS program is used to initialize the Time Zone, Time Delay and Cable Delay Compensation values. The Time Delay factor is set to zero, and the Cable Compensation is set for 19 feet. Running the program will print full instructions on screen for setting the time zone.

GPSHIFT(x).EXE

These DOS programs are used set the ES-185A to provide an advanced or delayed time output. This can be useful in TV network situations to compensate for video satellite delays. The time is adjustable from 0 to +/- 400 milliseconds, in increments of 1 millisecond. Determine which COM port you have available and use GPSHIFT1.EXE for COM1: and GPSHIFT2.EXE for COM2:. To set a 1/4 second delay using COM1:, for example, type GPSHIFT1-250 then hit the ENTER key.

GPSCBL(x).EXE

These DOS programs are used to compensate for antenna cable delay, adjustable from 0 - 22215 feet. Determine which COM port you have available and use GPSCBL1.EXE for COM1: and GPSCBL2.EXE for COM2:. To compensate the unit for 200 feet using COM1:, for example, type GPSCBL1 200 then hit the ENTER key.

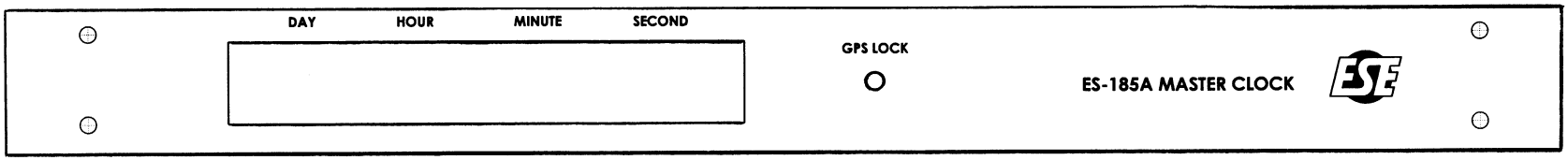
NOTE: All of these settings are remembered by the ES-185A, even if powered down with the battery off.

GPSTIME.EXE

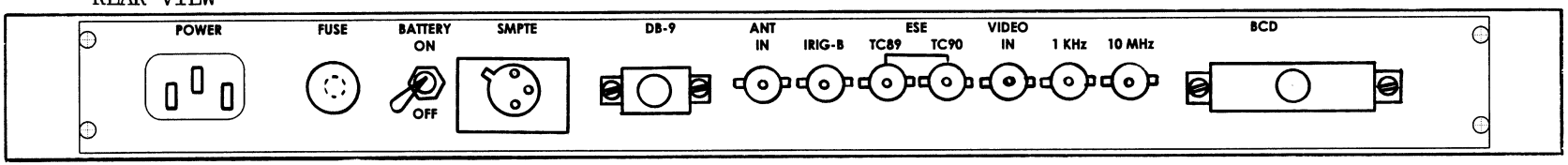
This DOS program is used to set the Time and Date of the unit in the absence of a satellite signal.

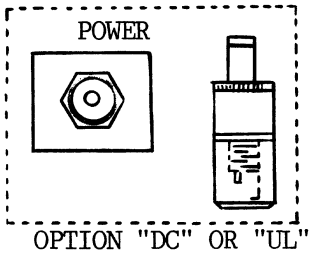
ES-185A

FRONT VIEW

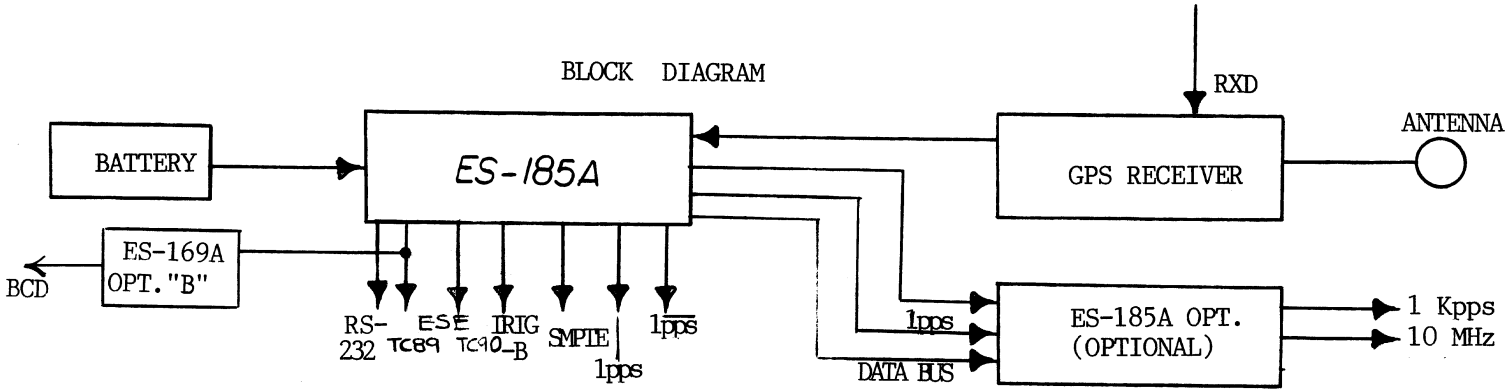


REAR VIEW





BLOCK DIAGRAM



ES-185A
PARTS LIST

PCB COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1	Z16	OSCILLATOR	32.0 MHZ OSC
1	Z5	INTEGRATED CIRCUIT	4001
1	Z6	INTEGRATED CIRCUIT	4020
1	Z18	INTEGRATED CIRCUIT	4028
1	Z7	INTEGRATED CIRCUIT	4070
2	Z11;Z12	INTEGRATED CIRCUIT	4503
1	Z4	INTEGRATED CIRCUIT	74HCT04
1	Z19	INTEGRATED CIRCUIT	74HCT244
1	Z8	INTEGRATED CIRCUIT	TL072
2	Z9;Z10	INTEGRATED CIRCUIT	1458
1	Z13	INTEGRATED CIRCUIT	LM1881N
1	Z3	INTEGRATED CIRCUIT	MAX 233CPP/ADM233LJM
1	Z1	INTEGRATED CIRCUIT	LM317T
2	Z20;Z21	INTEGRATED CIRCUIT	75492
1	Z2	INTEGRATED CIRCUIT	TL 750M05CKC
1	Z17	INTEGRATED CIRCUIT	DS87C520WCL-185A
9	Q3-Q11	TRANSISTOR	PN2222
1	Q1	TRANSISTOR	2N5484
1	D5	DIODE	1N4003
3	D1-D3	DIODE	1N5400
8	R46-R53	RESISTOR	10 OHM 1/4W
8	R5;R7;R8;R18;R25;R26;R28;R29	RESISTOR	27 OHM 1/4W
1	R59	RESISTOR	47 OHM 1/4W
1	R30	RESISTOR	75 OHM 1/2W
1	R54	RESISTOR	150 OHM 1/2W
2	R4;R58	RESISTOR	220 OHM 1/4W
1	R36	RESISTOR	1K OHM 1/4W
2	R2;R3	RESISTOR	1.8K OHM 1/4W
1	R56	RESISTOR	2.7K OHM 1/4W
2	R12;R13	RESISTOR	4.7K OHM 1/4W
3	R11;R14;R17	RESISTOR	10K OHM 1/4W
2	R55;R57	RESISTOR	10K OHM 1/4W
1	R10	RESISTOR	15K OHM 1/4W
2	R22;R27	RESISTOR	27K OHM 1/4W
8	R38-R45	RESISTOR	22K OHM 1/4W
1	R20	RESISTOR	51K OHM 1/4W
2	R23;R24	RESISTOR	100K OHM 1/4W
1	R21	RESISTOR	120K OHM 1/4W
1	R19	RESISTOR	240K OHM 1/4W
1	R31	RESISTOR	680K OHM 1/4W
1	R15	RESISTOR	1 MEG OHM 1/4W
1	R37	RESISTOR	10 MEG OHM 1/4W
1	R1	POTENTIOMETER	1K OHM MINI POT
1	R16	POTENTIOMETER	50K OHM MINI POT
1		2 x 5 HEADER	
2	C23;C25	CERAMIC CAPACITOR	25 PF 50V
1	C33	CERAMIC CAPACITOR	.001uf 50V

ES-185A
PARTS LIST

CONTINUED

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
3	C13;C14;C17	CERAMIC CAPACITOR	.002 UF 50V
1	C21	MYLAR CAPACITOR	.001 UF 100V MYLAR
3	C13;C14;C17	CERAMIC CAPACITOR	.002 UF 50V
1	C16	MYLAR CAPACITOR	.047 UF 100V MYLAR
7	C9-C12;C15;C19;C22	CERAMIC CAPACITOR	.1 UF 50V
4	C28;C29;C30;C31	CERAMIC CAPACITOR	.1 UF 50V
1	C18	ELECTROLYTIC CAPACITOR	1 UF 50V
1	C7	ELECTROLYTIC CAPACITOR	10 UF 16V
2	C25;C26	ELECTROLYTIC CAPACITOR	10 UF 25V NP
2	C8;C20	ELECTROLYTIC CAPACITOR	100 UF 25V
5	C2-C6	ELECTROLYTIC CAPACITOR	3300 UF 16V
1	C1	ELECTROLYTIC CAPACITOR	4700 UF 10V
1	C24	VARIABLE CAPACITOR	5-30 PF TRIMM H
3	N1-N3	DISPLAY	LTD 6840Y
1	D7	LED	GREEN LED (T-1 3/4)
1	X1	CRYSTAL	2.048 MHZ
4		8 PIN DIP SOCKET	
5		14 PIN DIP SOCKET	
4		16 PIN DIP SOCKET	
2		20 PIN DIP SOCKET	
1		40 PIN DIP SOCKET	
1		534-4245 FUSE HOLDER	
1		2A FUSE	
1		HEAT SINK	185A HEAT SINK
1		PC BOARD	185A DISPLAY BOARD
1		PCB	ES-185A

CHASSIS COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
3	T1-T3	TRANSFORMER	P6465
1		FUSE	1/2 AMP FUSE
1		FUSE HOLDER	HTA FUSE HOLDER
1		CONNECTOR	FEMALE TNC
1		CONNECTOR	MALE TNC
4		CONNECTOR	BNC (UG-1094)
1		CONNECTOR	XLR-3-32
1		CONNECTOR	9 PIN FEMALE
1		CONNECTOR	9 PIN MALE
1		CONNECTOR	9 PIN D-SUB HOOD
1		SWITCH	SPDT TOGGLE
1		AC SOCKET	161-3516 AC SOCKET
1		LINE CORD	3 WIRE CORD/PLUG
1		BATTERY	NP1.3-6V BATTERY
1		BATTERY BRACKET	165 BATTERY BRACKET
2			BATTERY LUG #902
1			#6 GROUND LUG
1		GPS RECEIVER	
1		GPS ANTENNA	
1		ANT. CABLE	
1		CASE & HARDWARE	ES-185A

ES-185K
PARTS LIST

PCB COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1	Z12	INTEGRATED CIRCUIT	4053
2	Z13;Z14	INTEGRATED CIRCUIT	74HC74
1	Z11	INTEGRATED CIRCUIT	74HC14
1	Z4	INTEGRATED CIRCUIT	74HCT160
6	Z5-Z10	INTEGRATED CIRCUIT	74HC161
3	C10;C15;C16	CERAMIC CAPACITOR	25 PF 50V
1	Q2	TRANSISTOR	PN2222
1	Q3	TRANSISTOR	2N4124 OR PN4124
1	Q1	TRANSISTOR	2N5484
4	D1-D4	DIODE	1N4148
1	D5	DIODE	MV209
2	R6;R7	RESISTOR	2.7 OHM 1/4W
1	R20	RESISTOR	10 OHM 1/4W
1	R17	RESISTOR	27 OHM 1/4W
1	R13	RESISTOR	47 OHM 1/4W
1	R12	RESISTOR	100 OHM 1/4W
1	R19	RESISTOR	1K OHM 1/4W
2	R8;R11	RESISTOR	2.2K OHM 1/4W
1	R15	RESISTOR	2.7K OHM 1/4W
3	R1;R2;R10	RESISTOR	10K OHM 1/4W
2	R9;R14	RESISTOR	15K OHM 1/4W
2	R4;R16	RESISTOR	100K OHM 1/4W
1	R18	RESISTOR	180K OHM 1/4W
1	R3	RESISTOR	1 MEG OHM 1/4W
1	R5	RESISTOR	10 MEG 1/4W
3	C10;C15;C16	CERAMIC CAPACITOR	25 PF 50V
1	C7	CERAMIC CAPACITOR	47 PF 50V
1	C18	CERAMIC CAPACITOR	100 PF 50V
1	C14	CERAMIC CAPACITOR	200 PF 50V
2	C12;C13	CERAMIC CAPACITOR	.01 UF 50V
5	C2-C6	CERAMIC CAPACITOR	.1 UF 50V
2	C1;C8	ELECTROLYTIC CAPACITOR	10 UF 16V
1	C9	ELECTROLYTIC CAPACITOR	100 UF 25V
1	C17	VARIABLE CAPACITOR	5-30PF TRIMM H
1	C11	VARIABLE CAPACITOR	9-50PF TRIMM 5mm H
1	L1	INDUCTOR	3.3 uh
1	X1	CRYSTAL	10 MHZ CRYSTAL
3		14 PIN DIP SOCKET	14 PIN DIP SOCKET
9		16 PIN DIP SOCKET	16 PIN DIP SOCKET
1		PCB	185K

IF COMPONENT REMOVAL IS REQUIRED, WE RECOMMEND REMOVING ALL SOLDER USING A 35W OR SMALLER SOLDERING IRON AND 'SOLDER WICK' TO PREVENT DAMAGE TO THE PRINTED CIRCUIT BOARD.

ALL INFORMATION CONTAINED IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE.

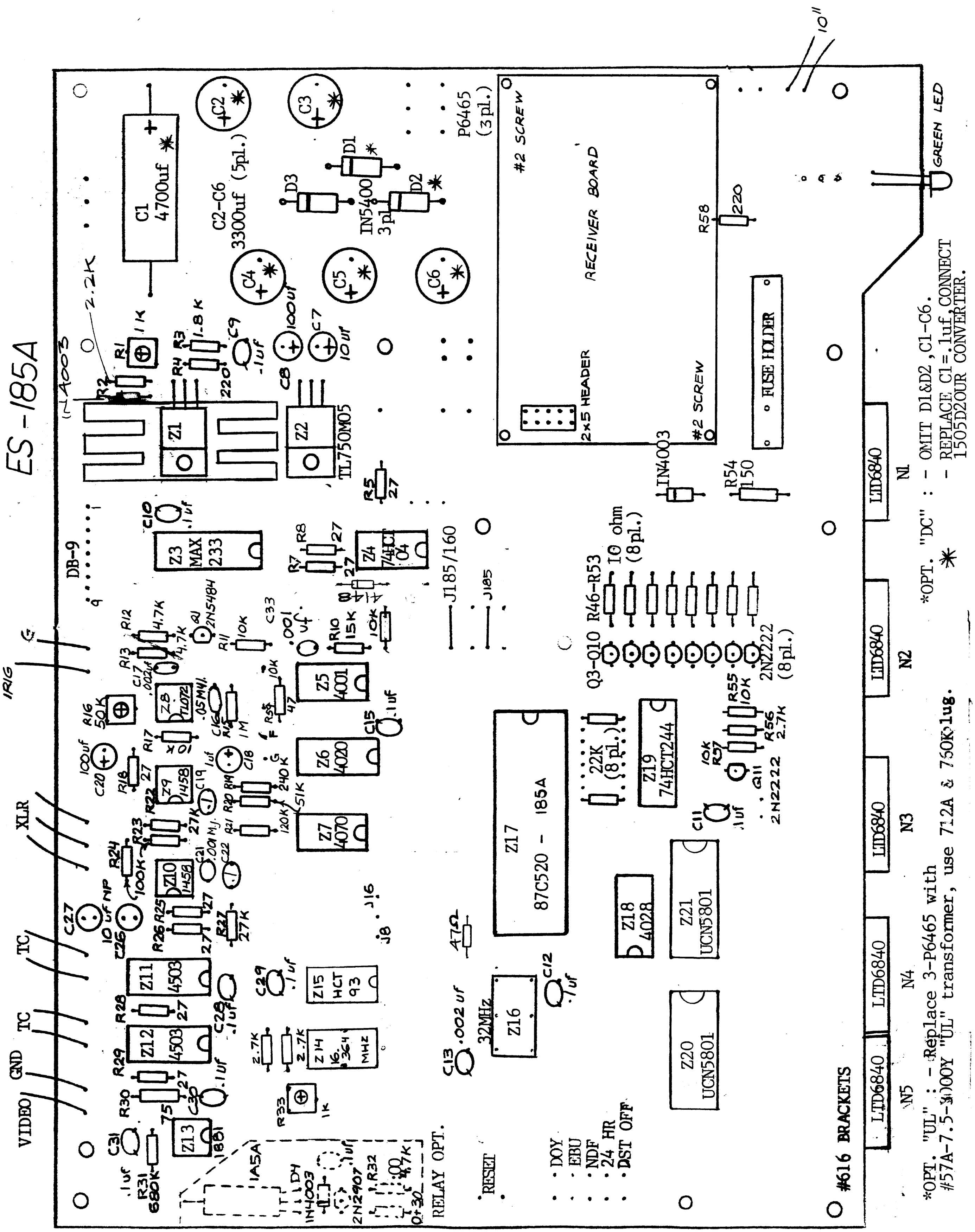
ES-185A
PARTS LIST

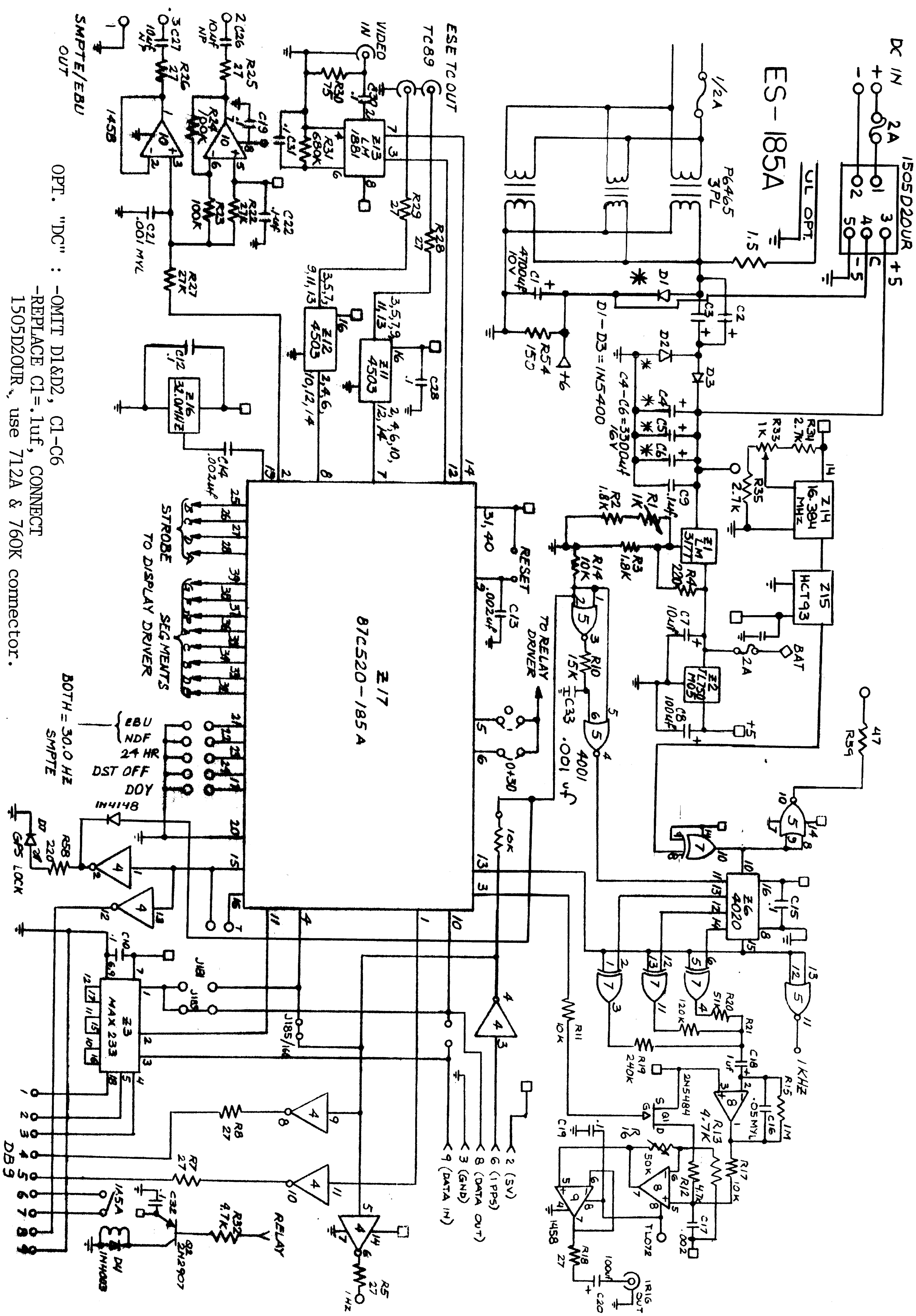
OPTIONAL COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1	Q2 (RELAY OPT)	TRANSISTOR	2N2907
1	D4 (RELAY OPT)	DIODE	1N4003
1	K1 (RELAY OPT)	RELAY	1A5A RELAY
1	R32 (RELAY OPT)	RESISTOR	4.7K OHM 1/4W
1	C32 (RELAY OPT)	CERAMIC CAPACITOR	.1 UF 50V
3	T1-T3 (OPT. B)	TRANSFORMER	P6465
2	T1;T2 (OPT. J)	TRANSFORMER	P8705
1	(OPT."CE")	PWR RESISTOR	1.5 OHM 10W
1	(OPT."CE")	TRANSFORMER	16VAC 1.5A BRICK
1	(OPT."CE")	FEMALE CONNECTOR	FEMALE DIN
1	(OPT."CE")	GROUND LUG	GND. LUG
1	(OPT."CE")	DIN PLATE	
1	(OPT."CE")	ESD SHIELD	ESD SHIELD

IF COMPONENT REMOVAL IS REQUIRED, WE RECOMMEND REMOVING ALL SOLDER USING A 35W OR SMALLER SOLDERING IRON AND 'SOLDER WICK' TO PREVENT DAMAGE TO THE PRINTED CIRCUIT BOARD.

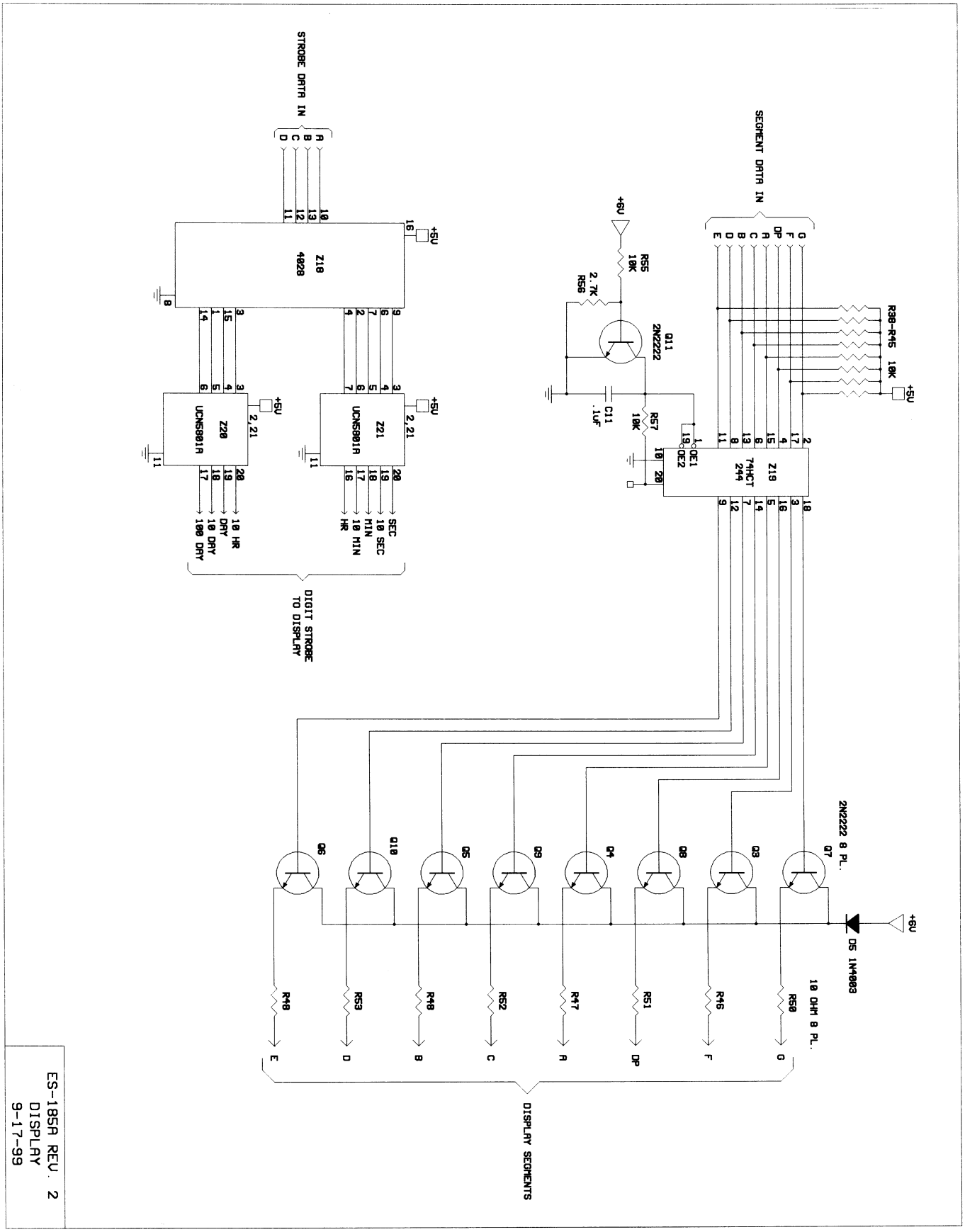
ALL INFORMATION CONTAINED IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE.


ES-185A
RECEIVER BOARD
#2 SCREW
2x5 HEADER
FUSE HOLDER
GREEN LED
C1 4700uf
C2-C6 3300uf (5pl.)
IN5400 3pl
TL750M05
P6465 (3pl.)
DB-9
Z3 MAX 233
Z17 87C520 - 185A
Z19 74HCT244
Z20 UCN5801
Z21 UCN5801
Z18 4028
Z16 32MHz
Z5 4001
Z6 4020
Z7 4070
Z11 4503
Z12 4503
Z9 1458
Z10 1458
Q3-Q10 2N2222 (8pl.)
R46-R53 10 ohm (8pl.)
22K (8pl.)
J185/160
LTD6840
N1
N2
N3
N4
N5
#616 BRACKETS
IRIG
XLR
TC
GND
VIDEO
RELAY OPT.
RESET
DOY
EBU
NDF
24 HR
DST OFF
*OPT. "DC" : - OMIT D1&D2,C1-C6.
- REPLACE C1=.1uf CONNECT 1505D2OUR CONVERTER.
*OPT. "UL" : - Replace 3-P6465 with #57A-7.5-1000Y "UL" transformer, use 712A & 750K lug.

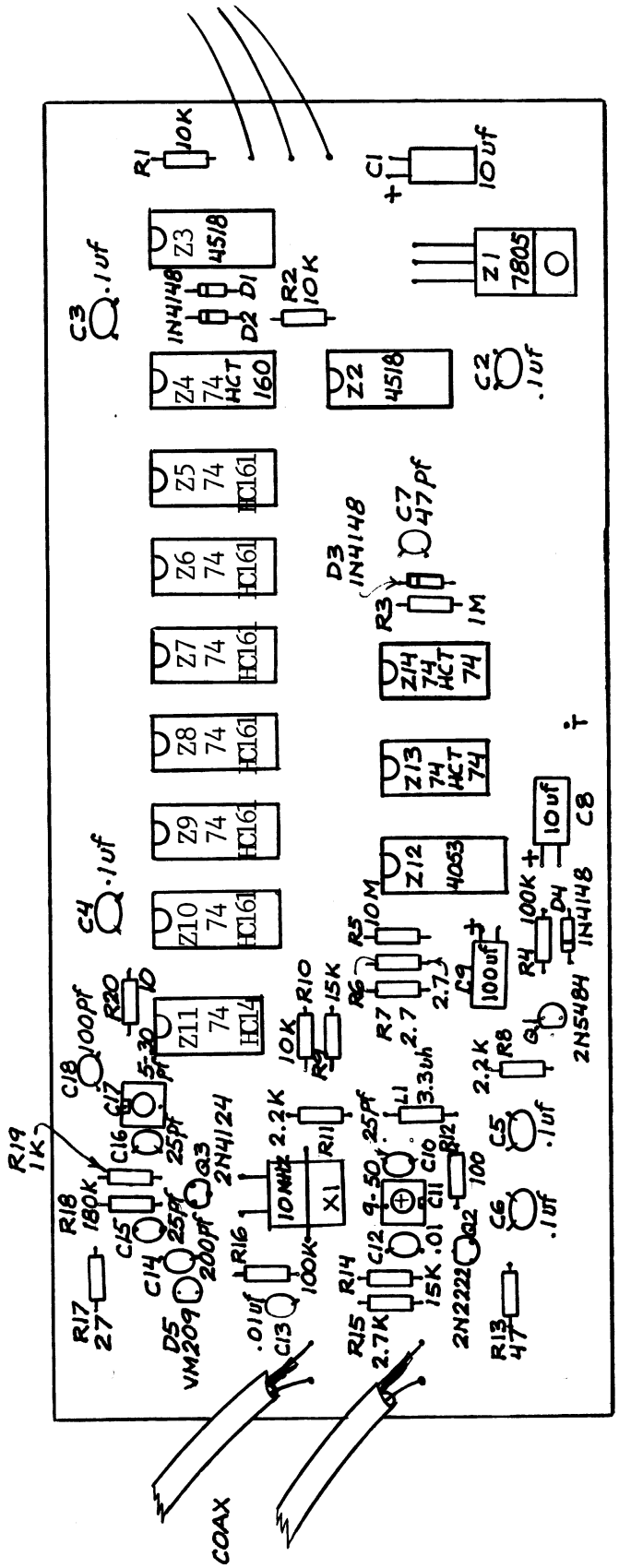


OPT. "DC" : -OMIT D1&D2, C1-C6
-REPLACE C1=.1uf, CONNECT
1505D20UR, use 712A & 760K connector.

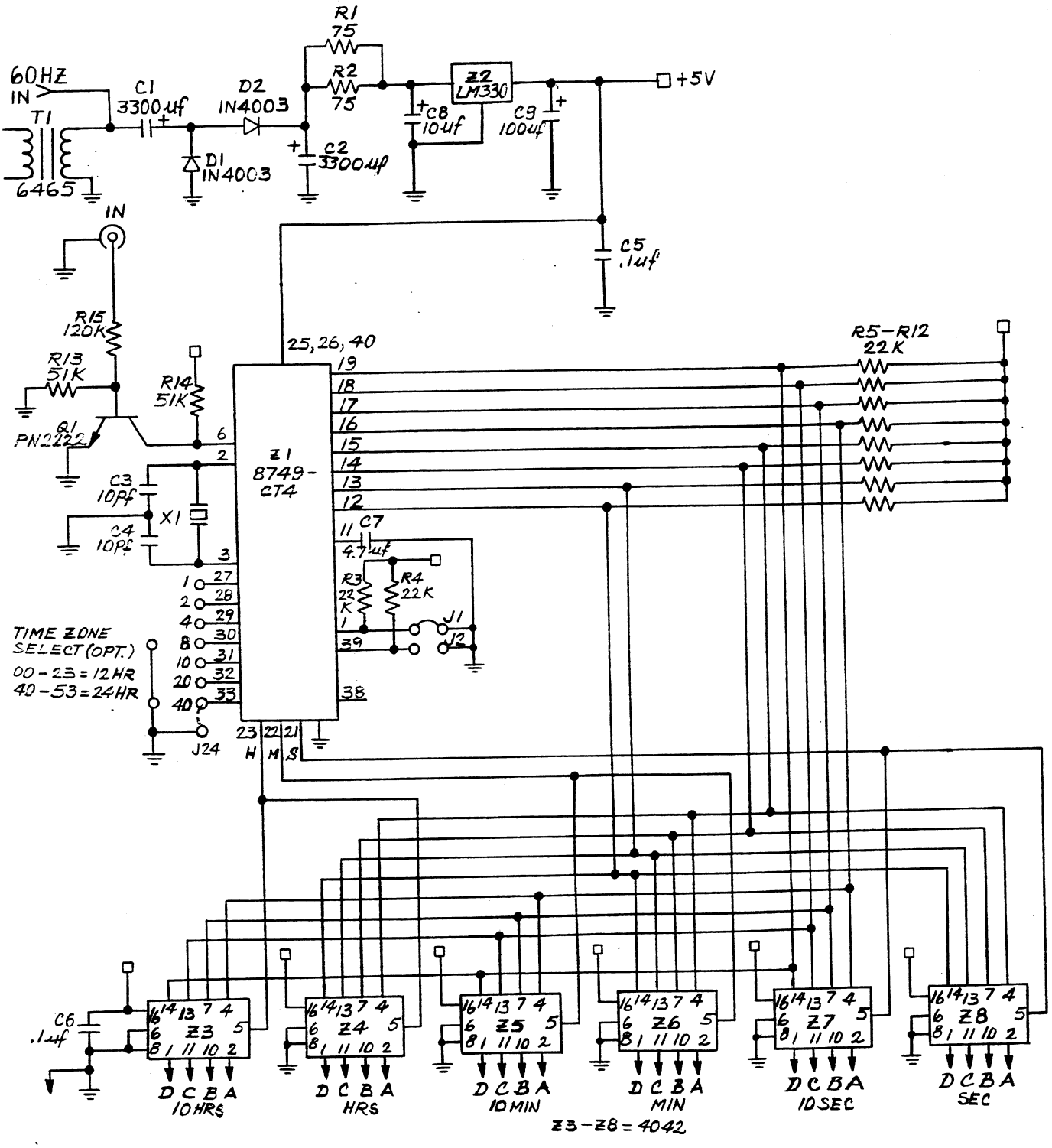
OPT. "UL" : - Replace 3-P6465 with #57A-7.5-3000Y
UL transformer, use "UL" Power plug.


STROBE DATA IN
SEGMENT DATA IN
Z18
4028
Z19
74HCT
244
Z20
UCN5801A
Z21
UCN5801A
Q11
2N2222
2N2222 8 PL.
D5 1N4003
R36-R45 10K
R55
10K
2.7K
R56
R57
10K
C11
.1uF
10 OHM 8 PL.
R46
R47
R48
R49
R50
R51
R52
R53
10 HR
DAY
10 DAY
100 DAY
SEC
10 SEC
MIN
10 MIN
HR
DIGIT STROBE
TO DISPLAY
DISPLAY SEGMENTS
ES-185A REV. 2
DISPLAY
9-17-99

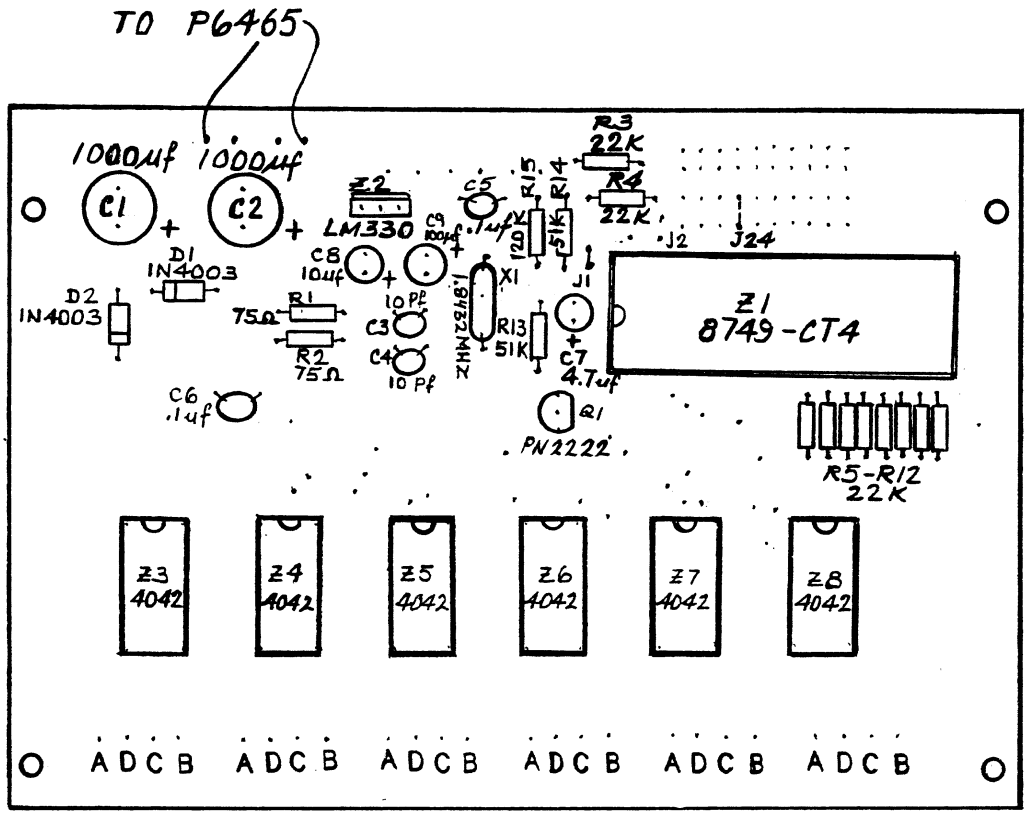
ES-185A "K" OPT.


R1 10K
C1 10uf
C3 .1uf
Z3 4518
1N4148 D1
D2
R2 10K
Z1 7805
Z4 74 HCT 160
Z2 4518
C2 .1uf
Z5 74 HC161
Z6 74 HC161
Z7 74 HC161
Z8 74 HC161
Z9 74 HC161
Z10 74 HC161
C4 .1uf
D3 1N4148
C7 47pf
R3 1M
Z14 74 HCT 74
Z13 74 HCT 74
Z12 4053
R5 10M
C8
C9 100uf
R4 100K
D4 1N4148
2N5484
Z11 74 HC14
R20 10
C18 100pf
C17 5-30 pf
C16 25pf
C15 25pf
C14 200pf
Q3 2N4124
R19 1K
R18 180K
R17 27
D5 VM209
R16 100K
C13 .01uf
X1 10 MHz
R11 2.2K
C12 9-50 pf
C11 .01
C10
R12 100
Q2 2N2222
R15 2.7K
R14 15K
C6 .1uf
R13 47
R10 15K
R9 10K
R7 2.7
R6 2.7
L1 3.3uh
C5 .1uf
R8 2.2K
Q1
MIN COAX

ES-169A

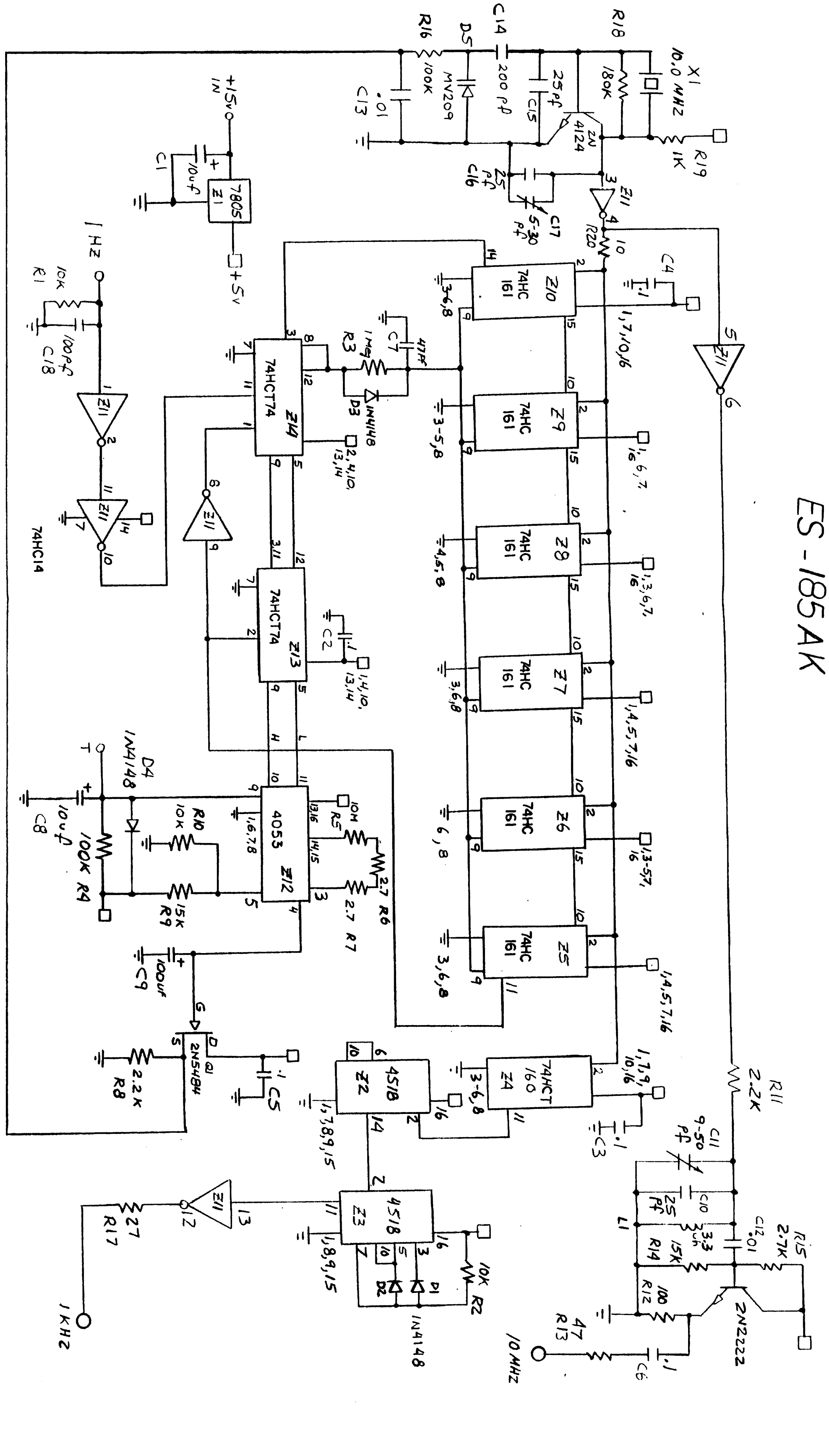

60HZ IN
T1
6465
C1 3300uf
D2 IN4003
D1 IN4003
R1 75
R2 75
C2 3300uf
Z2 LM330
C8 10uf
C9 100uf
+5V
IN
C5 .1uf
R15 120K
R13 51K
R14 51K
Q1 PN2222
C3 10pf
C4 10pf
X1
Z1 8749-CT4
25,26,40
R5-R12 22K
C7 4.7uf
R3 22K
R4 22K
J1
J2
TIME ZONE SELECT (OPT.)
00-23 = 12HR
40-53 = 24HR
J24
C6 .1uf
Z3
Z4
Z5
Z6
Z7
Z8
D C B A
10HRS
HRS
10MIN
MIN
10SEC
SEC
Z3-Z8 = 4042

ES-169A



PCB COMPONENTS

QTY	DESIGNATION	DESCRIPTION	PART NUMBER
1	Z1	INTEGRATED CIRCUIT	8749-CT4
1	Z2	INTEGRATED CIRCUIT	LM330T-5.0
6	Z3-Z8	INTEGRATED CIRCUIT	4042
1	Q1	TRANSISTOR	PN2222
2	D1;D2	DIODE	1N4003
2	C3;C4	CERAMIC CAPACITOR	10 PF 50V
2	C5;C6	CERAMIC CAPACITOR	.1 UF 50V
1	C7	ELECTROLYTIC CAPACITOR	4.7 UF 10V
1	C8	ELECTROLYTIC CAPACITOR	10 UF 16V
1	C9	ELECTROLYTIC CAPACITOR	100 UF 25V
2	C1;C2	ELECTROLYTIC CAPACITOR	1000 UF 16V
2	R1;R2	RESISTOR	75 OHM 1/2W
10	R3-R12	RESISTOR	22K OHM 1/4W
2	R13;R14	RESISTOR	51K OHM 1/4W
1	R15	RESISTOR	120K OHM 1/4W
1	X1	CRYSTAL	1.8432 MHZ
1	T1	TRANSFORMER	P6465
6		16 PIN DIP SOCKET	
1		40 PIN DIP SOCKET	
2		WIRE CAPS	
1		LINE CORD	2 WIRE LINE CORD
1		PC BOARD	ES-169A


ES-185AK
X1
10.0 MHZ
R18
180K
C14
200 pf
D5
MV209
R16
100K
C13
.01
C15
25pf
2N
4124
R19
1K
C16
C17
5-30
pf
+15v
IN
7805
Z1
+5v
C1
10uf
1 HZ
R1
10K
C18
100pf
74HC14
74HCT74
Z14
Z13
R3
1 Meg
C7
47pf
D3
1N4148
C2
.1
Z10
Z9
Z8
Z7
Z6
Z5
74HC
161
C4
.1
Z12
4053
D4
1N4148
C8
10uf
100K R4
R10
10K
R9
15K
R5
10M
R6
2.7
R7
2.7
C9
100uf
2N5484
Q1
R8
2.2K
C5
.1
74HCT
160
Z4
C3
.1
4518
Z2
Z3
R17
27
1 KHZ
D1
D2
1N4148
R2
10K
R11
2.2K
C11
9-50
pf
C10
25
pf
L1
3.3
uh
C12
.01
R14
15K
R15
2.7K
R12
100
2N2222
R13
47
C6
.1
10 MHZ