

CR21-GOES DCP
INSTRUCTION MANUAL

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SECTION 1. FUNCTIONAL DESCRIPTION

1.1 GENERAL

The CR21 GT package is a battery powered, compact and easily programmed means of collecting and transmitting data via satellite. The user is able on location to setup, interrogate and do test transmissions of the GOES TRANSMITTER (GT). The data can then be retrieved from SYNERGETECS INTERNATIONAL or the NATIONAL ENVIRONMENTAL SATELLITE SERVICE (NESS).

The CR21's minutes and seconds are updated hourly with the GT's Master Control Clock. This is done at minute 32 after the hour each hour.

The normal CR21 data array format is reduced down 40% when dumping to the GT. This is done by removing the ID and one space between data points. This increases the number of data points that can be transmitted in the NESS assigned transmission window. The user can also select which output table is to be sent via satellite.

Software for the CR21 GT package are PROMS 351 (application PROM) and 352 (system PROM). The applications programs in PROM number 351 are the same as in PROM 266AS. The ability of the CR21 to dump data to tape, or printer remains the same as outlined in the CR21 OPERATOR'S MANUAL for a Format II, 10 sec scan rate machine. The CR21 will not however dump data via a modem.

SECTION 2. INSTALLATION

2.1 GENERAL

There are five main electrical connections that must be made for basic operation of the CR21 GT package. Refer to the enclosed illustrations for proper connections.

1. The SC34 GOES INTERFACE CONNECTOR. The SC34 is connected between the CR21 serial I/O connector and the GT RS232 Programmer Port.
2. +12 volts and ground to the GT. Taken from one of the +12 volt outputs from the front of the PS34 POWER SUPPLY and connected to the J4 DC Input power connector on the back of the MASTER CONTROL MODULE. Carefully observe the polarity.
3. +12 volts and ground to the CR21. The CR21 can be powered either from its own 12 volt battery pack or it can be connected into one of the PS34's 12 volt output connectors.
4. An external battery or a charging circuit to the PS34. The PS34 CANNOT POWER THE CR21 GT PACKAGE BY ITSELF. A charging circuit of some type (solar panel) or else a 12 volt car type battery must be used. The charging circuit connects to the 16-26 VDC charge input on the front of the PS34. The external battery connects to the external battery input on the front of the PS34. The user is referred to the documentation on the PS34 POWER SUPPLY for further details. Carefully observe polarity.
5. Connect the appropriate antenna to the Type-N coaxial connector on the front of the 3421 A GOES TRANSMITTER. For information on antenna positioning, contact CAMPBELL SCIENTIFIC, INC. (801-753-2342).

SECTION 3. PROGRAMMING THE GOES TRANSMITTER

3.1 PROGRAMMING

A basic understanding of the CR21 programming protocol is necessary before proceeding to program the GT via the CR21. The user is referred to section one of the CR21 OPERATOR'S MANUAL.

The GT has two basic MODES, the setup MODE and the enter data MODE. In the setup MODE parameters may be entered that set the Master Control Module clock, schedule the times of transmissions and enter the channel and ID code for the GT transmissions. In the enter data MODE selected data from the CR21 is stored in the GT data buffer.

Upon power up, the GT is in the setup MODE. The CR21 is placed in a GT programming MODE by pressing the * key and then the B key. This is the *B MODE. The *B MODE has 24 parameters. Parameters 1 - 22 are for setting the GT's clock, ID, channel number, transmission times and pre/postamble. Parameters 23 and 24 are respectively CR21 output enabling and control. Parameter 24 has an ID of 60. The *B MODE parameters are summarized in TABLE 3-1.

TABLE 3-1 *B MODE PARAMETER SUMMARY

<u>ID</u>	<u>DATA</u>	<u>DESCRIPTION</u>
01 - 06	- - - - -	Clock (Yr, Mo, Dy, Hr, Min, Sec)
07 - 14	- - - - -	ID Number (0 to 15 for each hex digit)
15	-	Channel Number (1 to 266)
16 - 18	- - -	Time of First Transmission (Hr, Min, Sec)
19 - 21	- - -	Time Between Transmissions (Hr, Min, Sec)
22	-	Pre/Postamble (0, 1, 2, or 3)
23	-	Output Table Enable (0 to 7)
60	-	Control (0 TO 11)

SECTION 3. PROGRAMMING

The clock parameters must meet the following conditions:

Year 0 to 99
Month 1 to 12
Day 1 to 31
Hour 0 to 23
Min 0 to 59
Sec 0 to 59

When setting the clock parameters, keep in mind that the actual clock setting will occur upon execution of control command 1. The ID must be a valid 8 character hex code. Use 0 to 15 to represent the 15 hexadecimal digits (e.g., 10 for A, 11 for B, 12 for C, 13 for D, 14 for E, 15 for F). The channel parameter must be the NESS assigned channel number from 1 to 266. The time of first transmission and the transmission interval parameters must meet the following conditions:

Hours 0 TO 23
Min 0 TO 59
Sec 0 TO 59

The transmission interval parameters must divide into 24 hours evenly. Time of first transmission and transmission interval parameters must be selected such that a transmission never occurs during minutes 30 - 32 inclusive. This is because at minute 30 data is dumped to the GT's data buffer and at min 32 the CR21 is updating its clock with the GT's Master Control Clock. The Pre/Postamble parameter sets the preamble type: the long (5 seconds carrier, 2.4 seconds bit-synchronization pattern) or short (0.5 seconds carrier, 0.48 seconds bit-synchronization pattern). The Pre/Postamble parameter is summarized in TABLE 3-2.

TABLE 3-2 Pre/Postamble Summary

<u>KEY</u>	<u>PREAMBLE</u>	<u>VERTICAL PARITY</u>
0	long	off
1	long	on
2	short	off
3	short	on

The next parameter to key in is the output table enable. The number placed in this location tells the CR21 which output table to dump to the GT's data buffer. The output table enable is binary selectable. The output table enable is summarized in TABLE 3-3.

SECTION 3. PROGRAMMING

TABLE 3-3 OUTPUT TABLE ENABLE SUMMARY

<u>KEY</u>	<u>OUTPUT TABLE SELECTED</u>
1	1
2	2
3	1,2
4	3
5	1,3
6	2,3
7	1,2,3

After the parameters 1 - 22 are entered and the output enable parameter is selected the control parameter is keyed in. The ID for the control parameter is 60. The control parameter is for setting up, interrogating and test transmissions of the GT. After the control parameter has been keyed in and immediately following the A key the CR21 will begin execution of the selected control parameter. When control commands 1 or 3 are executed the data field will blank momentarily following which the setup data will flash on the display as it is transmitted to the GT. The data field will once again momentarily blank, following which a single error code digit will be displayed. In a normal setup situation with no errors the error code digit will be zero. The error code digit will be displayed for 2 sec, following which the CR21 will return to control parameter 60 with the control command parameter set to zero, unless 0 was the command being executed. At this point it is important to note that whenever the GT processor is active the ACTIVE LED on the MASTER CONTROL MODULE will be lit. This occurs mainly when the GT is being setup or interrogated by the CR21. It will also occur when the GT is transmitting. The control commands are summarized in TABLE 3-4.

TABLE 3-4 CONTROL COMMAND SUMMARY

<u>KEY</u>	<u>DESCRIPTION</u>
0	Return to parameter jump location for *B MODE
1	Set clock, ID, transmission time, transmission interval, postamble and leave in enter data MODE.
2	Exit enter data MODE and leave in the setup MODE
3	Set ID, transmission time, transmission interval, postamble, and leave in the enter data MODE.

SECTION 3. PROGRAMMING

- 4 - Read GT battery voltage
- 5 - Read GT temperature (absolute value in deg C)
- 6 - Read GT forward RF power in dBm as of last transmission.
- 7 - Read GT reflected RF power in dBm as of last transmission.
- 8 - Read GT transmission error code, reset to 00 after execution of control commands 4 through 8
- 9 - Read GT hour and min
- 10 - Read GT min. and sec.
- 11 - Test transmission of GT data buffer (antenna must be connected or damage to GT may result)

Control Inputs 1, 3, 4 - 11 must be executed in the setup MODE. When executing control commands 4 - 10 the requested information will be displayed for 2 seconds following which the CR21 will return to control parameter 60 with the control command set to zero. When in the setup MODE and resetting the GT clock the A key should be pressed 4 seconds prior to the actual time desired. When setting the clock for the first time allow 5 seconds.

Control Command 4 displays the GT's battery voltage as a three digit number. The following display format would indicate a GT battery voltage of 12.5 volts:

ID Data
60:0125

Control Commands 5 through 8 display the requested GT information as two digit numbers. If Control Command 5 is executed the following display format would indicate a GT temperature of + or - 16 deg. centigrade:

ID Data
60:0016

Control Commands 9 and 10 are displayed as 4 digit numbers. Executing Control Command 10 would display 10 minutes and 34 seconds as follows:

ID Data
60:1034

SECTION 3. PROGRAMMING

Upon execution of Control Command 11 (test transmission of the GT data buffer), the CR21 data field will blank during the transmission period, following which the error code digit 0 will be display. Even though the 0 error code digit is displayed, the user should still execute Control Command 8 to display any errors that may have occur during transmission of the GT data buffer. GT transmission error code numbers are summarized in TABLE 3-5. When the GT is transmitting the ACTIVE LED on the 3421A GOES TRANSMITTER will light, indicating RF power is present at the Type-N receptacle.

TABLE 3-5 TRANSMISSION ERROR CODE SUMMARY

<u>DIGITS</u>	<u>DESCRIPTION</u>
00 -	No errors detected
01 -	Incorrect transmission time
18 -	GOES channel read-back error
19 -	Circular buffer fill error
20 -	Incorrect transmitter status
21 -	Transmission attempted within 70 seconds of previous transmission
22 -	No "synthesizer on" acknowledgment
23 -	No "power amplifier on" acknowledgment
24 -	Phase-lock not achieved within 1 second
29 -	Low battery voltage (<10.5 V) during transmission

When invalid or out of sequence, control commands are sent. An error digit is displayed for two seconds following which the CR21 will return to control parameter 60 with the control command set to zero. If control commands 1 or 3 are executed an error code of 0 is displayed if the command was executed without errors. If comunication between the CR21 and the GT is interrupted an error digit will also be displayed. Error code digits are summarized in TABLE 3-6.

SECTION 3. PROGRAMMING

TABLE 3-6 ERROR CODE SUMMARY

<u>DIGIT</u>	<u>DESCRIPTION</u>
0	- The control command was taken and executed
1	- Parameter out of range
2	- Transmission attempt aborted (control command 8 will display transmission error code)
3	- In enter data MODE
4	- The GT does not respond
5	- In setup MODE
6	- Previous command interrupted, try again
7	- Invalid command

PROGRAMMING EXAMPLES

EXAMPLE 1a: Setting up the GT with the following parameters:

```
Clock ----- 23 Jan. 83 13:30:00
ID ----- ABCD1234
Channel----- 151
First Transmission ---- 16:00:00
Transmission Interval -- 03:00:00
Pre/Postamble ----- long, vertical parity off
Output Table Enable --- 1 and 2
```

<u>Key In</u>	<u>ID Data</u>	<u>Description</u>
*B	11:	*B MODE -- GT programming and interrogation MODE
A	01:0000	First parameter (year)
83	01:83.	year 83
A	02:0000	Entry completed -- pointer advanced to 2nd paramter (month)
1	02:1.	Month 1 (January)
A	03:0000	Entry completed -- pointer advanced to 3rd parameter (day)

SECTION 3. PROGRAMMING

23	03:23.	Day 23
A	04:0000	Entry completed -- pointer advanced to 4th parameter (hour)
13	04:13.	Hour 13
A	05:0000	Entry completed -- pointer advanced to 5th parameter (minutes)
30	05:30.	Minute 30
A	06:0000	Entry completed -- pointer advanced to 6th parameter (seconds)
A	07:0000	Entry completed -- pointer advanced to 7th parameter (ID, 1st digit)
10	07:10.	Hex digit A
A	08:0000	Entry completed -- pointer advanced to 8th parameter (ID, 2nd digit)
11	08:11.	Hex digit B
A	09:0000	Entry completed -- pointer advanced to 9th parameter (ID, 3rd digit)
12	09:12.	Hex digit C
A	10:0000	Entry completed -- pointer advanced to 10th parameter (ID, 4th digit)
13	10:13.	Hex digit D
A	11:0000	Entry completed -- pointer advanced to 11th parameter (ID, 5th digit)
1	11:1.	Hex digit 1
A	12:0000	Entry completed -- pointer advanced to 12th parameter (ID, 6th digit)
2	12:2.	Hex digit 2
A	13:0000	Entry completed -- pointer advanced to 13th parameter (ID, 7th digit)
3	13:3.	Hex digit 3
A	14:0000	Entry completed -- pointer advanced to 14th parameter (ID, 8th digit)
4	14:4.	Hex digit 4
A	15:0000	Entry completed -- pointer advanced to 15th parameter (channel number)
151	15:151.	channel number 151
A	16:0000	Entry completed -- pointer advanced to 16th parameter (1st transmission, hour)
16	16:16.	hour 16
A	17:0000	Entry completed -- pointer advanced to 17th parameter (1st transmission, min.)
A	18:0000	Entry completed -- pointer advanced to 18th parameter (1st transmission, sec.)
A	19:0000	Entry completed -- pointer advanced to 19th parameter (transmission interval, hour)
3	19:3.	3 Hours

SECTION 3. PROGRAMMING

A	20:0000	Entry completed -- pointer advanced to 20th parameter (transmission interval, minutes)
A	21:0000	Entry completed -- pointer advanced to 21st parameter (transmission interval, seconds)
A	22:0000	Entry completed -- pointer advanced to 22nd parameter (Pre/Postamble)
2	22:2.	2 for short preamble, and vertical parity off
A	23:0000	Entry completed -- pointer advanced to 23rd parameter (output table enable)
3	23:3.	3 for selecting output tables 1, and 2
A	60:0000	Entry completed -- pointer advanced to control parameter (note that the ID is 60 and not 24).
1	60:1.	Control command 1 (setup GT's clock, ID, channel number, time of first transmission, time between transmissions, pre/postamble, and output table enable). This will leave the GT in the ENTER DATA MODE.
A	60:	The data field will blank momentarily, following which the setup data will flash on the display as it is transmitted to the GT.
	60: 0	The error code 0 indicates that setup of the GT is completed with no errors.
	60:0000	The error code digit will be displayed for 2 sec, following which the CR21 will return to control parameter 60 with the control command parameter set to zero.

EXAMPLE 1b

Reset the time of transmission to 15:30:00 from where EXAMPLE 1a left off.

<u>Key In</u>	<u>ID Data</u>	<u>Description</u>
	60:0000	The CR21 is in the same location that EXAMPLE 1a left us in.
A	11:	Beginning of the *B MODE -- (parameter jump location)
16	11:16.	16th parameter (time of first transmission)

SECTION 3. PROGRAMMING

A	16:0016	Parameter jump completed -- pointer advanced to 16th parameter (1st transmission, hour)
15	16:15.	Hour 15
A	17:0000	Entry completed -- pointer advanced to 17th parameter (1st transmission, minutes)
30	17:30.	Minute 30
A	18:0000	Entry completed -- pointer advanced to 18th parameter (1st transmission, seconds). At this point the desired parameters have been changed. The next step is to execute control command 3.
*B	11:	Beginning of the *B MODE -- (parameter jump location)
60	11:60.	Location for the control command parameter
A	60:0000	Control commands may now be executed
3	60:3.	Control command 3 (Set ID, transmission time, transmission interval, postamble and leave in the enter data MODE)
	60:	The data field will blank momentarily, following which the setup parameters will flash on the display as they are transmitted to the GT.
	60: 0	The error code 0 indicates that control command 3 was executed without errors.
	60:0000	The error code digit will be displayed for 2 sec., following which the CR21 will return to control parameter 60 with the control command parameter set to zero.

EXAMPLE 2

READ GT BATTERY VOLTAGE

<u>Key In</u>	<u>ID Data</u>	<u>Description</u>
	99:1331	Assume the CR21 is in the enter data MODE and the GT is also in the enter data MODE. The first step is to get into the *B MODE.
*B	11:	Beginning of the *B MODE -- (parameter jump location)
60	11:60.	Location for the control command parameter.

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A	60:0000	Control commands may now be executed.
4	60:4.	Control command 4 (read GT battery voltage)
A	60: .3	Error code 3 is displayed. This is because Control command 4 must be executed only when the GT is in the Setup MODE. After 2 sec. the CR21 returns to control parameter 60.
	60:0000	Control commands may now be executed.
2	60:2.	Control command 2 (exit Enter Data MODE and leave in the Setup MODE)
A	60:	The CR21 data field blanks momentarily, following which an error code will be displayed.
	60: 0	Error code 0 indicates that Control command 2 was executed without errors. After 2 sec. the CR21 returns to Control parameter 60.
	60:0000	Control commands may now be executed.
4	60:4.	Control command 4 (read GT battery voltage)
A	60:	The CR21 data field blanks momentarily, following which the GT's battery voltage is displayed.
	60:0127	The GT's battery voltage is 12.7 volts. The battery voltage will be displayed for 2 sec., following which the CR21 will return to Control parameter 60.
*0	60:0000 99:1331	*0 MODE -- Log data -- display shows current time (13:31). After setting up and interrogating the GT always place the CR21 back into the *0 MODE.

SECTION 4: DATA RETRIEVAL AND TRANSFER RATES

4.1 GENERAL

As mentioned in the FUNCTIONAL DESCRIPTION the ability of the CR21 to dump data to tape or printer remains the same as outlined in the CR21 OPERATOR'S MANUAL.

When collecting data via satellite there are several factors involved when considering data transfer rates. The following are the most important:

1. The NESS assigned transmit time and interval between transmissions. Depending on the need of the user, NESS will assign a transmission time and interval.
2. How many data points are dumped to the GT's data buffer. Each data point from the CR21 takes up six bytes of the GT's data buffer. It must also be remembered that at the end of each line of data, and data array there is a carriage return - line feed, which takes up two more bytes of the GT's buffer.
3. How many data points the GT data buffer can hold. The current GT data buffer is 1024 bytes long.
4. How many data points can be transmitted in the allotted NESS assigned transmit time. Each character that is transmitted takes 10 bits. After the preamble is finished the GT begins transmitting data at a rate of 100 bits per seconds. Since there are six characters per data point, it takes the GT 600 ms to transmit one data point.

Using the above information an equations can be written to determine data transfer rate limits.

VARIABLES:

A = Maximum number of bytes dumped to the GT's data buffer in any given transmission interval.

B = Time of Preamble used in seconds.

C = Transmission window in seconds.

SECTION 4. DATA RETRIEVAL & TRANSFER RATES

EQUATIONS:

1. $A < 1025$
2. $.1(A) + B + 10 \leq C$

Note: The 10 seconds in equation 2 is used as a margin to overcome timing errors between the GT & the satellite. It is a good idea to start transmitting 5 seconds after the specified transmit time and end 5 seconds before the termination of the NESS assigned transmission window.

EXAMPLE: Determine the maximum number of data points that can be sent via satellite under the following conditions:

1. Transmission window of 1 min every three hours.
2. Transmitting using the long preamble.

Using equation 2 above we can calculate the total number of bytes that can be transmitted in the allotted transmission window.

$$C = 60 \text{ sec}$$
$$B = 7.4 \text{ sec (long preamble)}$$

$$.1(A) + 7.4 + 10 = 60$$

$$A = 426 \text{ bytes}$$

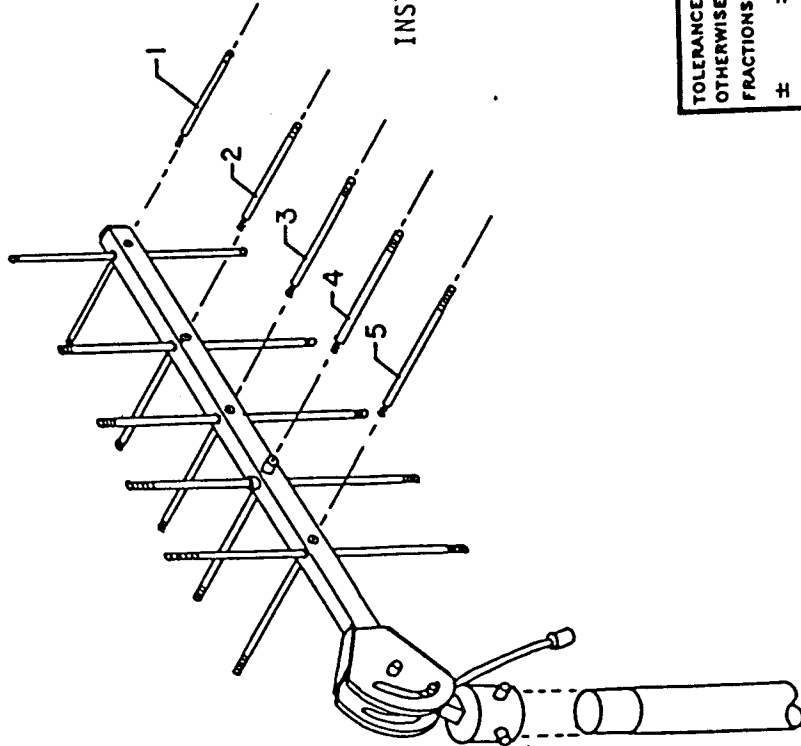
If we now divide by 6 we get the total number of data points that can be transmitted.

$$426/6 = 71 \text{ data points}$$

Remember that this number does not include the carriage return-line feeds that will also be transmitted. These too must be figured in to be completely accurate.

-- CAUTION --

DO NOT ASSEMBLE ELEMENTS TO BOOM USING ANY TOOLS (i.e. PLIERS, VISE-GRIPS, etc...) OR DAMAGE TO THE ANTENNA MAY RESULT. "FINGER-TIGHTEN ONLY"



ITEM	DESCRIPTION	QUANTITY
1	1-BAND DIRECTOR ELEMENT	4
2	2-BAND DIRECTOR ELEMENT	4
3	3-BAND DIRECTOR ELEMENT	4
4	4-BAND DRIVEN ELEMENT	4
5	5-BAND REFLECTOR ELEMENT	4

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	AS ISSUED	6 Feb 80	

ASSEMBLY:

- The antenna element lengths are coded by the number of bands on the non-threaded end.
- There are four (4) elements of each length.
- Assemble, as shown, all twenty elements. Use approximately 1 drop of #242 loctite (supplied) and apply to thread surfaces of both element and boom. Tighten all elements "finger-tight". (NO TOOLS)
- The antenna boom is stamped with the corresponding element code for additional reference.


INSTALLATION:

- Mount antenna and adjust azimuth and elevation. in a position clear of metal objects.
- Connect to transmitter.
- Wrap or otherwise protect coax junctions.
- Check SWR. Should be < 1.5:1 (-14 dB)

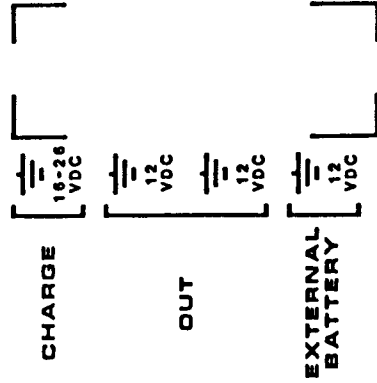
SYNERGETICS INTERNATIONAL, INC.
P.O. BOX E, BOULDER, CO. 80306

TOLERANCES UNLESS OTHERWISE SPECIFIED		YAGI MODEL 18B	
FRACTIONS	DEC	—FIELD INSTALLATION DETAIL —	
±	±	SCALE	SIZE
±	±	18 Feb 80	A
APPROVALS	DATE	DRAWING NO. 00018-92101-1	
DRAWN <i>ESS</i>	6 Feb 80		
CHECKED <i>ALC</i>		DO NOT SCALE DRAWING	
		SHEET	



AC POWER 

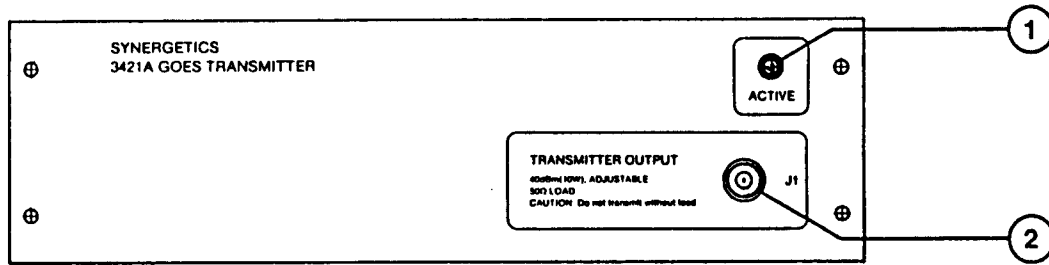
**PS34
POWER SUPPLY**



MADE IN USA

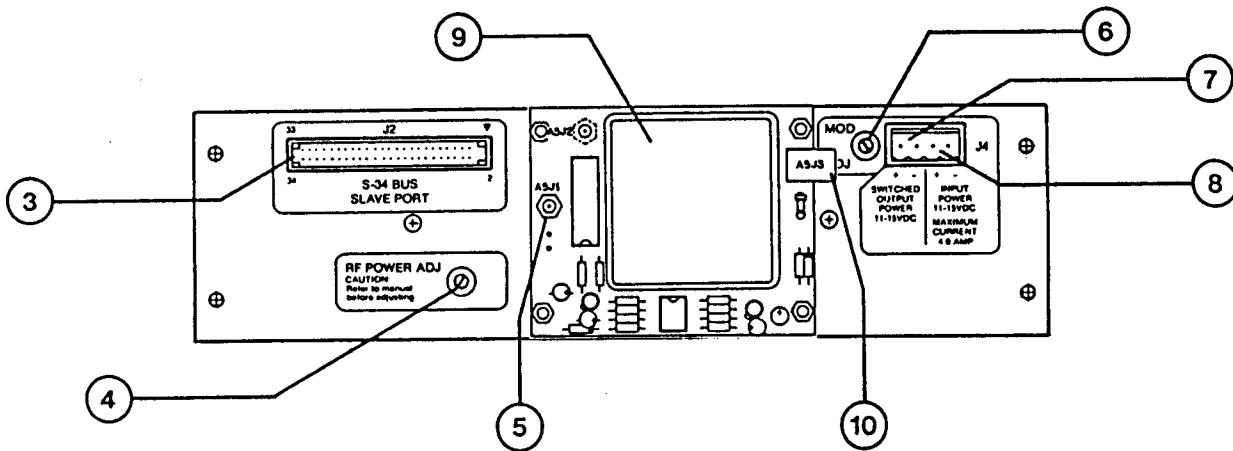
PS34 POWER SUPPLY FRONT PANEL

3421A GOES TRANSMITTER



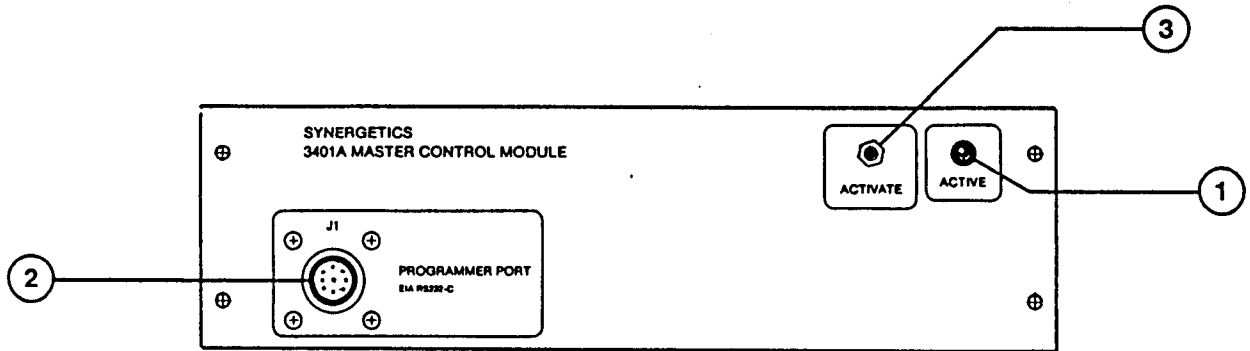
1. Light-emitting diode indicator: ON when power amplifier is enabled. RF power is present at the Type-N receptacle when the LED is on.
2. N-Receptacle: RF output at 400 MHz, 2 to 13 W (internal adjustment) when the Power Amplifier has been turned on.

Front Panel



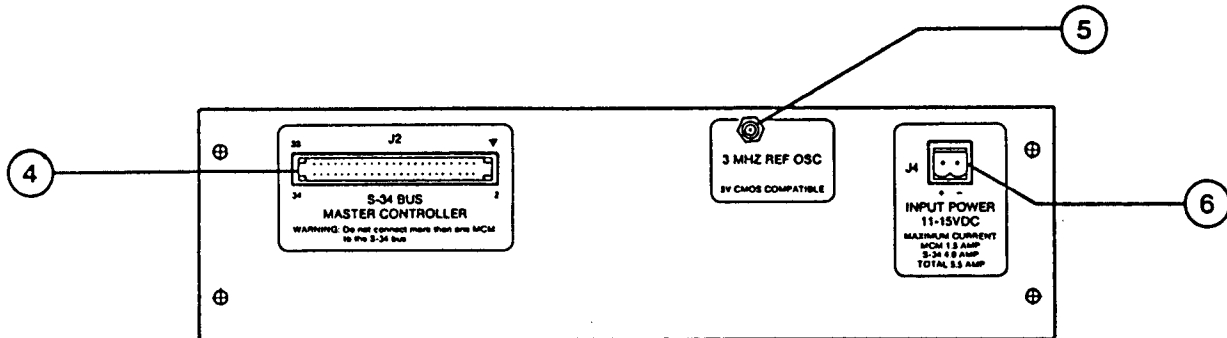
3. S-34 Bus Receptacle: Connect other 3400 Series modules to this receptacle.
4. RF Power: Adjust RF Power from 2 to 13 W. Turn clockwise to increase output power.
5. Reference Oscillator Output: 3.0 MHz Oscillator Output, 74C series compatible.
6. Modulation Index: Adjust Modulation Index. Turn clockwise to increase modulation.
7. Switched DC Output: Fused battery output, 4 amps nominal. Intended for external RF power amplifier.
8. DC Input: 10.5 to 15 V DC input.
9. TCXO Frequency: Oscillator Frequency Adjustment (25° C only).
10. TCXO DC Input: DC Power Input for TCXO, 10.5 to 15 V DC.

3401A MASTER CONTROL MODULE



- | | |
|--------------------|---|
| 1. Active LED | lit when module is AWAKE and all circuits are powered |
| 2. RS-232 Port | terminal connected here |
| 3. ACTIVATE Button | pushed when in the SLEEP state to ACTIVATE module |

Front Panel



- | | |
|-------------------|---|
| 4. S-34 Connector | other 3400 Series modules connected to 3401A here |
| 5. 3 MHz Input | 3 MHz TCXO connected to this SMC coax connector |
| 6. DC Input | 10.5 to 15 V DC @ 400 mA maximum connected here to power module |

Rear Panel