

**DC1765 CELLULAR PHONE PACKAGE
OPERATOR'S MANUAL**

REVISION: 9/94

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1. INTRODUCTION

Telecommunication using cellular telephones is a convenient alternative to standard phone or RF telemetry. In areas with cellular coverage, it has an advantage over ordinary phone lines where the lines are not established and would be costly to install. The advantage over an independent RF telemetry system is that the company providing the cellular service takes care of the FCC licensing and maintenance of repeater stations.

To determine if a site has sufficient cellular coverage, a user can usually borrow a portable cellular phone and visit the site. If a standard cellular phone can place a call from the site with good sound clarity and good signal strength the site should have no problems using cellular telemetry. If a Yagi antenna is being used, it would be a good idea to have the cellular phone company locate their cellular tower on a map so the antenna can be pointed towards the tower.

Campbell Scientific's DC1765 Cellular Phone Package includes:

- Motorola S1765 Transceiver
- Campbell Scientific DC112 Modem
- Crydom Relay D1D07
- Mounting bracket and wiring

An appropriate power supply and antenna must be selected for each station.

The Motorola S1765 Cellular Connection Transceiver has a standard RJ11C telephone interface. A standard RJ11C cable connects the DC112 Modem directly to the transceiver. A computer equipped with the PC208 Datalogger Support Software and a Hayes compatible phone modem connected to a standard phone line is used to call the cellular equipped stations (see Figure 1-1).

The transceiver does not have a handset, but if the user wishes to place a voice call, any standard touchtone telephone can be connected. However, the DC112 and a telephone cannot be connected to the transceiver at the same time. Programmable phones will not work with the transceiver.

2. SPECIFICATIONS

S1765 TRANSCEIVER

- Dimensions: 2.0 x 3.5 x 8.5 inches
- Operating Temperature: -30 to 60 °C
- Average current drain
 - standby: 0.38 A
 - on line: 2.1 A
- Supply voltage: 10.9 - 16.3 VDC
- Antenna Termination: Mono UHF

D1D07 RELAY

- Control Voltage: 3.5-32.0 VDC
- Control Current: <1.6 mA @ 5 VDC
- Output Rating: 7 A @ 100 VDC

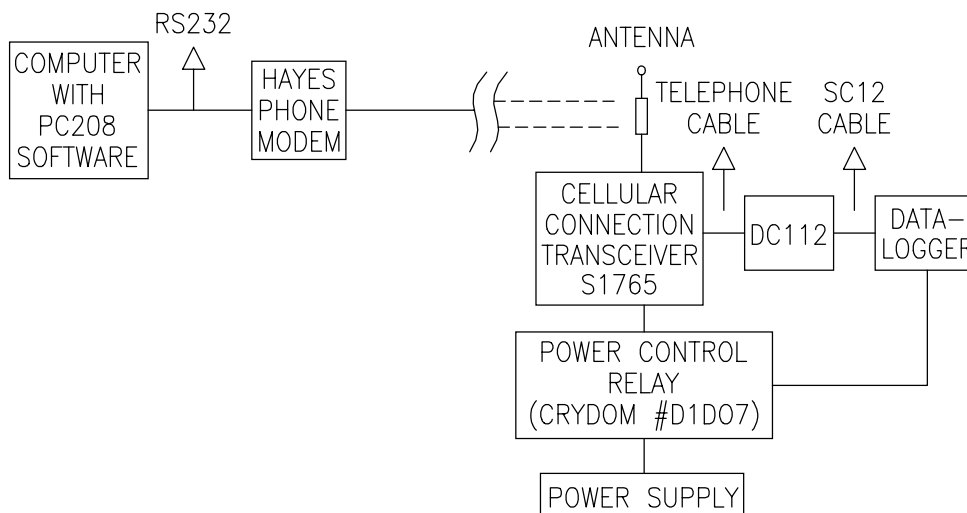


FIGURE 1-1. Cellular Telecommunications

3. ANTENNAS

Each transceiver in a cellular phone system must have an antenna. Two common types of antennas are used, omnidirectional and directional. An omnidirectional antenna transmits and receives in any direction. A directional antenna transmits and receives in a particular direction.

Fixed sites are equipped with a directional antenna because it provides the strongest signal and can be aimed at a cellular repeater site. There are various shapes of directional antennas, the most common being Yagi antennas, such as the ASP962.

Mobile applications use omnidirectional antennas. Generally, an omnidirectional antenna is a spiraled, cylindrical rod, mounted vertically. The omni antennas listed below differ mainly in mounting hardware.

OMNI ANTENNAS

ASPD1874 Magnetic Mount Antenna

Gain: 3 dB
Frequency: 826-896 MHz
Impedance: 50 ohms
Height: 15"

ASPD910M Trunk Mount Antenna

Gain: 3 dB
Frequency: 806-869 MHz or 824-876 MHz
Bandwidth: 60 MHz @ 1.5:1
75 MHz @ 1.9:1
Impedance: 150 ohms
Height: 24"

ASPD913 Mirror or Side Body Mount Antenna

Gain: 3 dB
Frequency: 824-896 MHz
VSWR Max: 1.9:1
Impedance: 50 Ohms
Cable/connector: 17 ft/Mini UHF

ASP955 Vertical Base Station Antenna

Gain: 3 dB
Power: 500 W
Freq: 806-896 MHz
VSWR Max: 1.5:1
Termination: N female

YAGI ANTENNA

ASP962 Broadband Yagi

Gain: 8 dB
Frequency: 806-896 MHz
Bandwidth: 90 MHz
Input Impedance: 50 Ohms
VSWR Max: 1.5:1

Front to Back Ratio: 15 dB
VSWR Max: 1.5:1
Dimensions: 28.5" x 8.25" x 2.5"
Termination: N female

4. POWER CONSIDERATIONS

The relay included with the cellular phone package allows the datalogger to switch power to the cellular transceiver. Even so, the relatively high current required by the cellular transceiver makes it necessary to use a solar panel, vehicle power system, or AC power to maintain a charge on the system battery. It is unfeasible to power the datalogger and transceiver from batteries alone unless the battery capacity is very large, the batteries are changed frequently, or the transceiver is switched on infrequently.

For fixed site applications without AC power, the MSX18R Solar Panel is recommended with a user-supplied deep cycle marine or RV battery. If the transceiver is seldom on and the site receives adequate sunlight, a smaller battery and solar panel may work (see power calculations).

When AC power is available, The Campbell Scientific PS12LA power supply may be used to power the cellular transceiver. The standard transformer supplied with the PS12LA will only supply 300 milliamps current. The transceiver standby power requirement is 380 mA; power to the transceiver must be switched to avoid draining the battery. A power budget can be calculated using the following equation:

$$(\text{off hook current}) \times (\text{time off hook}) + (\text{on hook current}) \times (\text{time on hook}) = \text{charge expended}$$

Suppose the transceiver is switched on from midnight to 1:00 a.m. daily. For one half hour the transceiver is on hook and for one half hour the transceiver is off hook. Each day, the transceiver will drain the battery by:

$$(2.1 \text{ A})(0.5 \text{ h}) + (0.38 \text{ A})(0.5 \text{ h}) = 1.24 \text{ Amp-hours}$$

A seven Amp-hour battery would be depleted after 5.65 hours of powering the transceiver, or 5 hours and 38 minutes.

NOTE: When initiating a call from the datalogger (Instruction 97), the transceiver must be switched on at least 6 seconds before the call is placed.

5. INSTALLATION

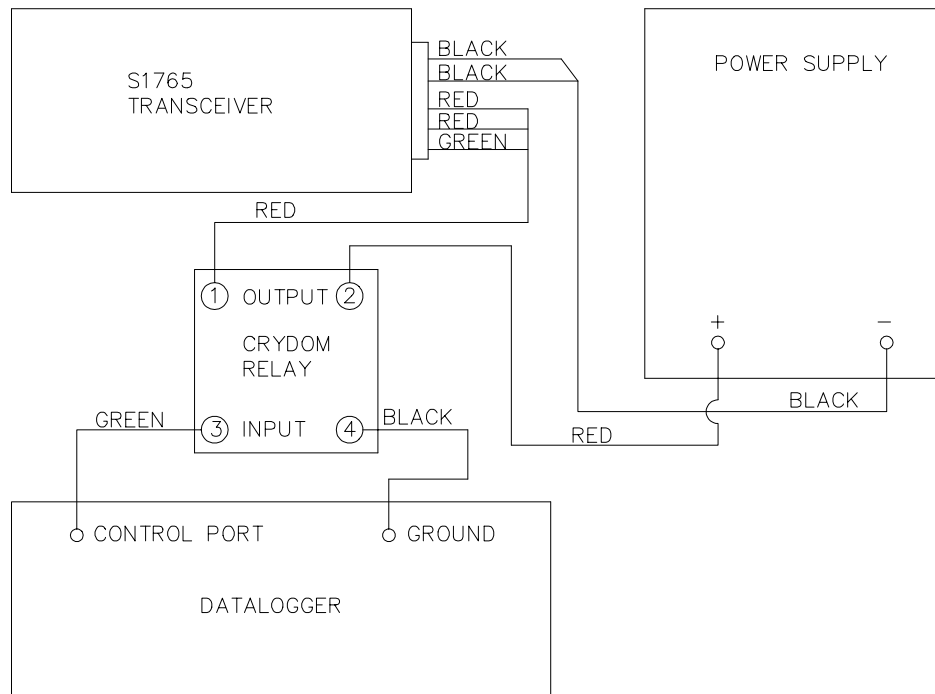


FIGURE 5-1. DC1765 Wiring

6. COMMUNICATION USING PC208

Once consistent cellular coverage has been established on a stationary phone, interference should not be a problem. Interference on mobile phones is more easily encountered. The local cellular company can verify cellular coverage of a specific area.

When a transceiver moves, the call may be transferred from one cell to another. Transceivers generally stay on-line during these transfers, and data are transmitted properly. However, if all the cells are busy or if too much interference occurs, the call will be dropped. This causes the transceiver and the DC112 to hang up.

Possible sources of interference that should be avoided include heavy construction sights, tunnels, transmitting from the fringes of an area, and power transmission lines.

6.1 TELCOM

TELCOM checks the signature of each block of data as it is received from the datalogger. A poor connection will result in the retransmission of incorrectly received blocks. If a link is consistently noisy, use of smaller block size may improve throughput. If the connection is completely broken TELCOM will record a

"COMMUNICATION BROKEN WITH DATALOGGER" error message along with the time and date of the failure in the error (.ERR) file. TELCOM keeps track of what data was successfully collected and will attempt to call the datalogger to collect the remaining data based on the retry schedule in the station file was created.

NOTE: If using a relay to switch power to the transceiver, make sure retries occur at times the transceiver is on.

6.2 TERM OR GRAPHTERM

If TERM or GraphTerm is being used in the Monitor or Graph Mode to view datalogger status, a poor connection will result in "SEQUENTIAL INTERRUPT" errors. If several successive SEQUENTIAL INTERRUPTS occur TERM aborts monitoring and returns to the Option Menu. This indicates that the connection is either completely broken or very poor. If the connection is broken, it is necessary to call the datalogger again before monitoring can resume. If communication is poor or interrupted while downloading a program, the user should verify that the program was received correctly and that the datalogger is correctly logging data.

NOTE: When a program is downloaded to a station that switches power to the transceiver, communication will be broken when the program is compiled and all ports are set low. If the downloaded program does not include the instructions to switch on the transceiver, it will be necessary to visit the site and reprogram the datalogger before resuming cellular communication.

7. PROGRAMMING TO SWITCH TRANSCEIVER POWER

Switching power to the transceiver allows the datalogger to maintain a lower power budget by limiting communication to predetermined times. The transceiver must be switched on before it can answer or call.

This section provides examples of datalogger programming to switch power. If the power supply is sufficient to power the cellular transceiver continuously without switching, no special programming is necessary.

7.1 POWERING ON FIXED INTERVALS

The simplest program switches power on at specific times and off a fixed time later. This can be accomplished with two Instructions. Instruction 92 sets the port controlling the relay high to turn the power on and a second Instruction 92 sets the port low. In these examples, control port 1 controls the relay.

The following program switches the transceiver on at midnight for 15 minutes:

*	1	Table 1 Programs
01:	10	Sec. Execution Interval
01:	P92	If time is
01:	0	minutes into a
02:	1440	minute interval
03:	41	Set high Port 1
02:	P92	If time is
01:	15	minutes into a
02:	1440	minute interval
03:	51	Set low Port 1

With the transceiver on for 15 minutes following midnight, TELCOM would be set to call automatically once a day at 2 minutes after midnight. In some areas there are discounts for calls during off hours.

To allow contacting the station throughout the day, the transceiver can be turned on for the first 10 minutes of each hour:

01:	P92	If time is
01:	0	minutes into a
02:	60	minute interval
03:	41	Set high Port 1
02:	P	92 If time is
01:	10	minutes into a
02:	60	minute interval
03:	51	Set low Port 1

Or one might want to power the transceiver for one hour at 10 a.m. and at 10 p.m.

01:	P	92 If time is
01:	600	minutes into a
02:	720	minute interval
03:	41	Set high Port 1
02:	P	92 If time is
01:	660	minutes into a
02:	720	minute interval
03:	51	Set low Port 1

Whatever the time that the program powers the transceiver, the station must be called while the transceiver is on; it cannot answer a call at other times.

7.2 PROGRAM TO ALLOW EXTENDING ON TIME

In the previous examples, communication time is limited by the program. When the datalogger switches off the power, communication is broken and cannot be resumed until the next time the transceiver is powered. When monitoring current measurements is important, the caller must be able to extend the time the link is active.

The following datalogger program powers the cellular transceiver for the first 5 minutes of every half hour. Twenty-five minutes is the longest one must wait before calling the station. A 5 minute timer is used to determine when the transceiver is switched off. Once GT or TERM has established communication with the station, the caller can set flag one high (press F1 in the monitor or graph mode) to restart the timer and extend the time the link will remain active. The transceiver is switched off 5 minutes after the last time flag one is set high.

*	1	Table 1 Programs
01:	10	Sec. Execution Interval
01:	P92	If time is
01:	0	minutes into a
02:	30	minute interval
03:	30	Then Do
02:	P86	Do
01:	41	Set high Port 1
03:	P18	Time
01:	1	Minutes into current day
02:	0	Mod/by
03:	21	Loc [:START MIN]
04:	P95	End
05:	P18	Time
01:	1	Minutes into current day
02:	0	Mod/by
03:	22	Loc [:MINinDAY]
06:	P35	Z=X-Y
01:	22	X Loc MINinDAY
02:	21	Y Loc START MIN
03:	23	Z Loc [:5minTIMER]
07:	P89	If X<=>F
01:	23	X Loc 5minTIMER
02:	3	>=
03:	5	F
04:	51	Set low Port 1
08:	P91	If Flag/Port
01:	11	Do if flag 1 is high
02:	30	Then Do
09:	P18	Time
01:	1	Minutes into current day
02:	0	Mod/by
03:	21	Loc [:START MIN]
10:	P86	Do
01:	21	Set low Flag 1
11:	P95	End