Rapco

Equipment Handbook

RAPCO Type 1804M3
GPS/Rb Precision Frequency Source

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Designed and manufactured in the U.K.

EQUIPMENT HANDBOOK

for

RAPCO Type 1804M3
GPS/Rubidium Precision Frequency Source

Configuration list for this variant:

GPS L1 C/A Signal Compatibility

Rubidium Reference Oscillator

1 x 5MHz (Filtered TTL, quasi-sine) Drift Corrected Output

1 Hz (TTL) On-time Output

Serial RS232 I/F (Terminal & Remote modes)

Dual Programmable Alarm Output

d.c. Output for Auto-Changeover/Distribution unit

230V a.c. Power

Issue 3 Aug 2003

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Main Assembly
Sub Assemblies relevant to above

DRAWINGS

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SPECIFICATION

GPS/Rubidium Precision Frequency Source Type 1804M3

a.c. POWER SUPPLY	:	230V rms, Single Phase.
Power loading	:	40VA maxm., 25VA typical
Voltage range	:	198V to 264V
Frequency range	:	45Hz to 66Hz.
a.c. fuse rating	:	315mA anti surge (T315mA 250V), 20 x 5mm
a.c. POWER CONNECTOR	:	J1 3 pin IEC mains connector to CEE22 and BS4491
	:	Mating socket with 2-metre cable supplied with individual units.
	:	Colour coding to UK standards, brown = Live blue = Neutral green/yellow = Earth
d.c. POWER OUTPUT CONNECTOR (To 1882 ACU/Dist unit)		J2 7 pin profDIN skt See Dwg No 3398-5429

SIGNAL CONNECTORS

RS232 Port	:	J4, 9-way 'D' socket
Alarm Contact (Alarm 1)	:	J7 , BNC
Frequency Outputs -- Reference	:	J5, 5MHz, filtered TTL, quasi-sine, BNC
-- Timing	:	J6, 1pps, TTL, BNC
GPS Antenna	:	J3, L1 signal input, 50ohm, N-type socket.
	:	Note: J3 carries 5v dc supply to antenna pre-amp.

INDICATORS (front panel)

ALARM	:	(red)
GPS Status	:	(green)
CONTROL Status	:	(green)
Rb Lock	:	(green)
a.c. Power	:	(amber)

PRIMARY FREQUENCY REFERENCE : Internal Oscillator, 10 MHz Rubidium.

Stand Alone stability - typical, uncorrected.

Drift rate (ageing)	:	$< \pm 5$ in 10^{11} per month, after 30 days operation
Temperature	:	$< \pm 1$ in 10^{10} (over operating temperature range)
Short term	:	1.5 in 10^{11}, Allan variance (1 sec)

Drift corrected Accuracy with GPS on, typical SA levels, Installed rack environment
Frequency error:-- (ref: USNO)

Very long term	:	± 5 in 10^{12} typical
24hr. average	:	$< \pm 1$ in 10^{11}
1000 sec. average	:	$< \pm 5$ in 10^{11} typical

All frequency performance figures apply following a 7-day stabilisation period from initial switch-on, and assume continuous powering thereafter. Installed rack environment implies a quasi-constant temperature in the range $26^{o}C \pm 10C^{o}$.

TEMPERATURE RANGE

Rack Unit	Operating – full specification	:	$0^{o}C$ to $+50^{o}C$ RH 90% (non-condensing)
	Storage	:	$-40^{o}C$ to $+70^{o}C$ RH 30%
Antenna Unit	Operating	:	$-40^{o}C$ to $+ 70^{o}C$ RH 10%-100% (condensing)
	Storage	:	$-55^{o}C$ to $+ 85^{o}C$ RH 30%

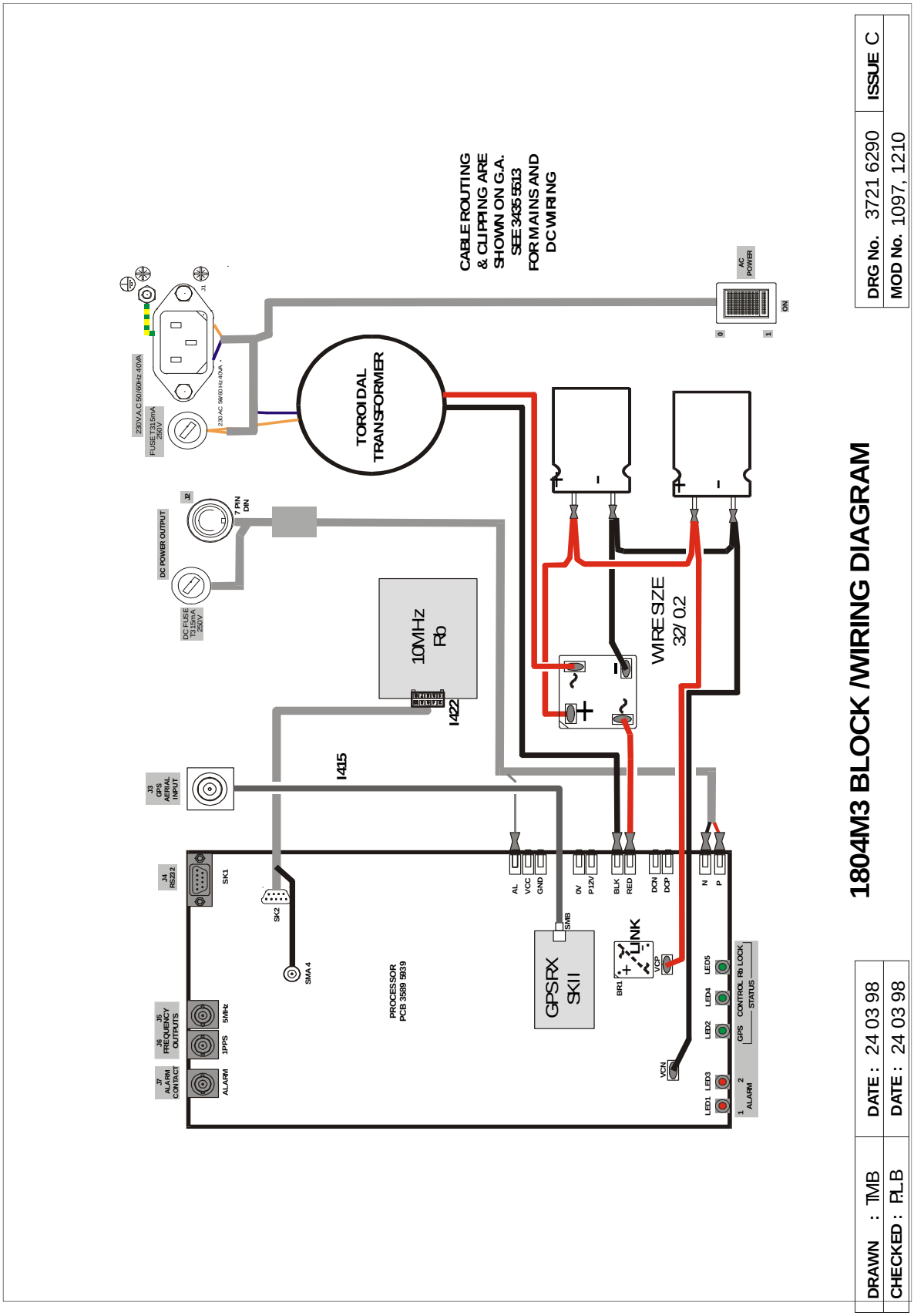
SIZE	Width	:	483mm
	Height	:	44mm
	Depth	:	350mm excluding rear panel connectors.

WEIGHT 4kg approx
/excluding external cables and connectors

FIXING POINTS : Standard rack fixing holes in front panel.
3 x tapped fixings in each side panel (M4.0 x 6mm)

FINISH : Parchment White paint on front panel surface.
: Black legends and lettering.
: Alocrom 1000 conductive finish on other surfaces.

Drg. No. 3721-6290 Block/Wiring Diagram Type 1804M3



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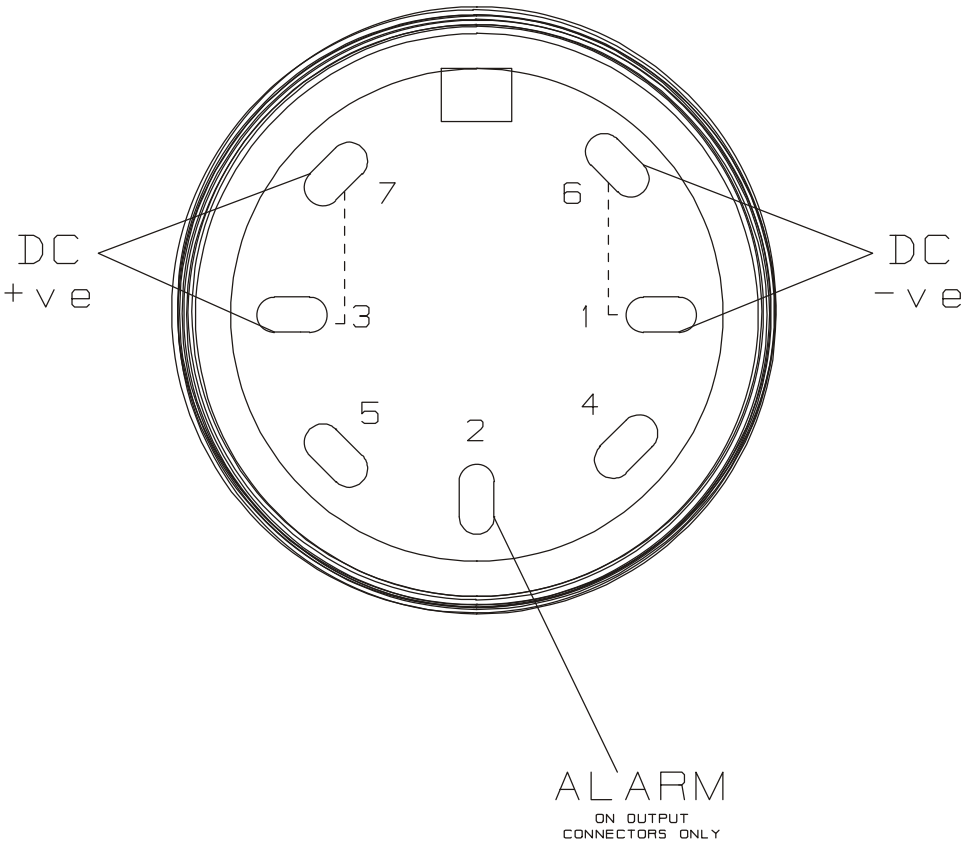
Drg. No. 3398-5429 d.c. Output connector

W/O NO.	DRG.NO.
3398	5429

USED ON
1804X,188X,1811X, DC I/P / O/P CONNECTORS

7 WAY DIN PROFESSIONAL
SOCKET, FACE VIEW,



RAPCO CAD

ISSUE	DATE	MOD NO.
359 A	27 11 95	X

W/O NO.	3398	RAPCO ELECTRONICS LTD.	
FIRST ISSUE	DATE	TITLE	DC INPUT / OUTPUT CONNECTORS
DRAWN PLB	27 11 95		
CHECKED TMB	27 11 95	ORIG SIZE A4	DWG NO 5429
		SCALE X	SHEET 1 OF 1

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OPERATING INSTRUCTIONS

The 1804M3 unit is intended for continuous powering from 230V nominal 50Hz supplies so there is no on/off switch. A power cable for a.c. is supplied with the unit.

Safety note: **Before connecting the unit to an a.c. power source, ensure that the voltage of that source is correct for the unit, and that the correct fuse is fitted. See Specification pages for voltage range and fuse details**.

The GPS antenna must be installed in a suitable outdoor location (clear view of sky) see RAPCO Drg. No.2929-7113. The antenna downlead should then be connected to J3 at the rear of the unit.

When the a.c. supply is first established, the 1804 will initially show A.C POWER on, the GPS and CONTROL status leds will be off, and the ALARM led will be on.
The power-on condition is as follows:

Timing mode (UTC/GPS)	-	Dependent on state at previous power fail
RS232 Port	-	Active in TERMINAL mode * see Note below
Time/date Output	-	Counts up from 00:00:00 01/01/97 GPS lock is required before time is corrected.
Frequency System Status	-	CONTROL status 'off'. --- (oscillator control locked at previously used value until warm-up is complete)

After a short period (2 to 3 min. typ., 15min. max) the GPS STATUS light will come on, indicating that the GPS receiver has locked onto the satellites. The Rubidium Lock status light will come on after a delay (5 min. typ. 10 min. max.) which indicates that the frequency is within ±5 parts in 10E8. Subsequently the CONTROL STATUS light will switch on; this indicates that the frequency control system has started drift correction. At this point, the date/time output (RS232 and/or Timecode) will be corrected to satellite time and the 1Hz timing output will be aligned with UTC.

The CONTROL STATUS indicator may switch off again during normal operation if the frequency reference should be disturbed by (say) a power break, GPS failure, severe temperature shock etc. Under such conditions, the oscillator control voltage is locked at the previous value (held in non-volatile memory) until the drift-correction process has re-started.
The serial RS232 port will be active from power-up and will, as factory-set, be in the TERMINAL (continual transmission) mode. *

* Note: - The power-up mode for the RS232 port, and the data content of its output when in Terminal mode, can be reconfigured using the Set-Config. Command -- see Appendix. B.

THE SERIAL (RS232) INTERFACE

The Serial interface is connected via a 9-way 'D' type socket (DE9S), J4 on the units rear panel.

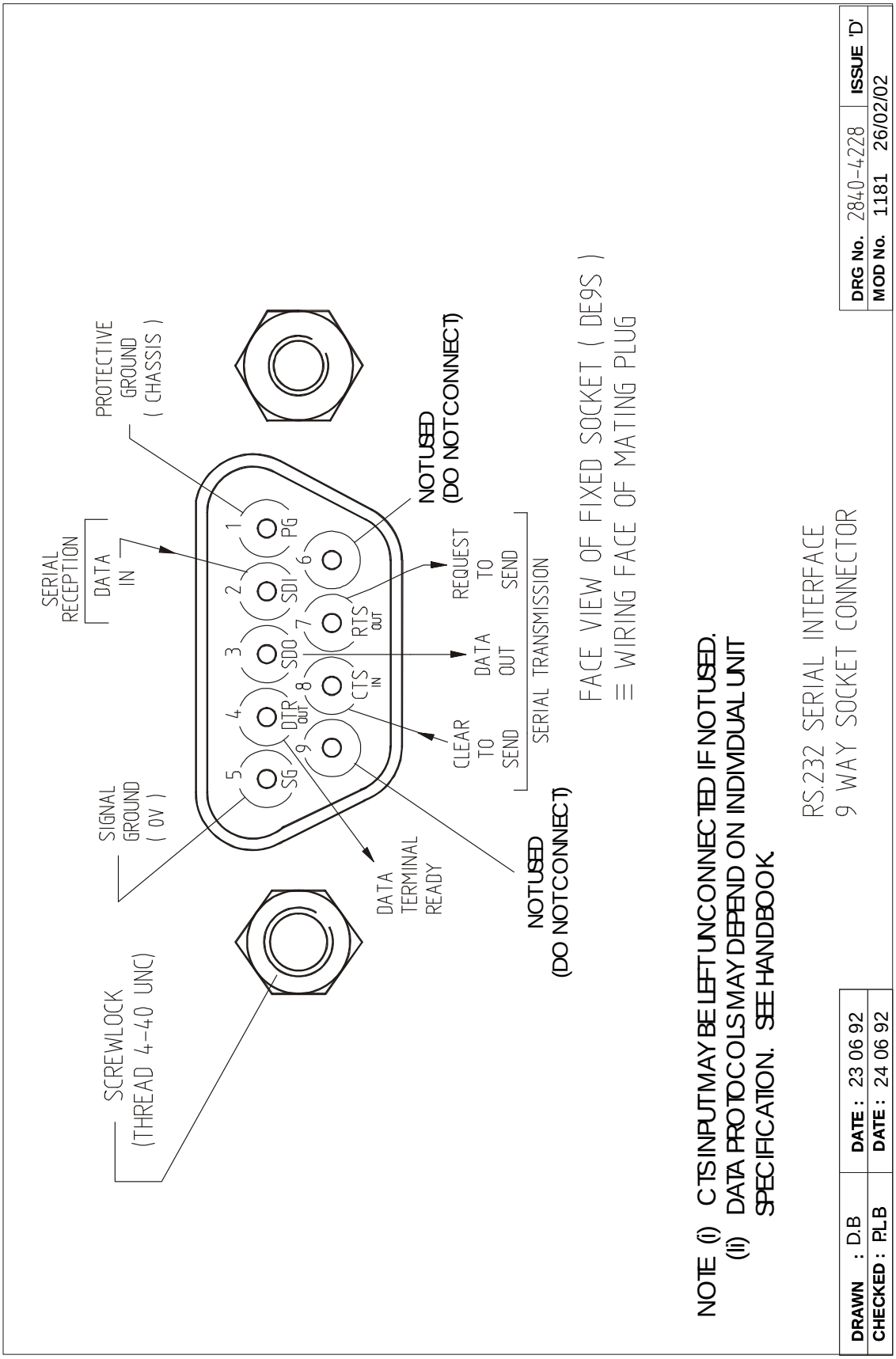
Pin designations are shown below and in Drg. No. 2840-4228.
Output signal levels and input signal specifications are in accordance with EIA-RS232C.

Pin No		Function
1	-	Chassis (Protective Ground)
2	-	SDI ----- Serial Data - INPUT
3	-	SDO --- Serial Data - OUTPUT
4	-	DTR --- Data Terminal Ready - OUTPUT
5	-	Signal Ground
7	-	RTS --- Ready to Send - OUTPUT
8	-	CTS --- Clear to Send - INPUT

Serial Communication parameters are not user adjustable; they are pre-set as follows:

Character format	-	8 bits
Baud Rate	-	4800
Stop-Bit Length	-	1 bit
Parity	-	None

Drg. No. 2840-4228 -- Serial (RS232) Connector



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Operating modes

The RS232 port can operate in two distinct modes:

(i) ***TERMINAL*** - where the port will output a continual fixed format sequence of data from the 1804 which can be displayed on a 'dumb' terminal, this is useful for evaluation and confidence-checking of the units operation.

In this mode only 3 commands are accepted, which are

<Control>S - stop display scroll

<Control>Q - start display scroll

? - Change serial mode (to REMOTE)

Any other command will be ignored; no delimiters are necessary. The unit is factory set to power-up (or reset) to the Terminal mode, but can be user set to adopt the Remote mode at power-up by use of the Set Config command; see Appendix B.

(ii) ***REMOTE*** - In this mode the port accepts a number of remote control commands allowing full remote control and interrogation of the unit.
The '?' command remains available to allow a return to the TERMINAL mode if required. Errors will invoke a defined error message. See below for command structure details; note that <CR> delimiters are required on all commands except '?' and that <CR><LF> will be sent with all responses.

Fixed Format Output (*TERMINAL* mode)

The data transmitted in the TERMINAL mode allows the display of date/time and position messages on a 'dumb' RS232 terminal, or a PC using a Terminal Emulator programme
See below for example of format.

ASCII character strings (at 4800Bd, 8 data, No Parity, 1 Stop) are transmitted as follows:

At every second, a time-date message,
Every ten seconds, a position and satellite-data message

Example:

		See notes:
UTC Time	: 10:33:41 26/06/97	(i)
UTC Time	: 10:33:42 26/06/97	
UTC Time	: etc., etc.	
UTC Time	: 10:33:49 26/06/97	
UTC Time	: 10:33:50 26/06/97	
Position	: 51 16.425 N 001 06.040 W 0107M	(ii)
PDOP	: 03	(iii)
Sat PRN	: 03,12,20,24,25,30	(iv)
Sat level	: 09,11,24,12,15,22	(v)
Fix, Mode	: 3D , Control	(vi)
UTC Time	: 10:33:51 26/06/97	
UTC Time	: 10:33:52 26/06/97	
UTC Time	: 10:33:53 26/06/97	
UTC Time	: 10:33:54 26/06/97	
UTC Time	: etc.	

In addition to the above data, when the unit is operating in the 'frequency control' state, the frequency control voltage value may occasionally be inserted (when it has changed) as a four-digit ASCII-hex number.
Thus: DAC Output: 7D52

In addition, on power-up or reset, the GPS Receiver software number is transmitted,
E.g. GPS S.W :01.00 08/20/92 01.00 08/20/92.

Notes:--

(i) If the unit is operating in the GPS timing mode, the prefix **UTC** will be replaced by the prefix **GPS**. See CONTROL COMMAND section for definition of UTC and GPS time.

(ii) '**Position**' is shown as <Latitude><Longitude><Height>
Latitude being xx yy.abcN
Longitude being xxx yy.abcW
Height xyzM
Where xxx = degrees, and yy abc= minutes of arc.(three decimal places)
N = North, S = South, E = East, W = West.
Height is in Metres above WGS-84 m.s.l.

(iii) **PDOP'** is the current 'Position Dilution of Precision statistic. In normal operation this should be 06 or less; note that lower is better, 01 is best available. If receiver is not doing fixes then 00 will be shown.

(iv) **'Sat PRN'** These are the identity codes of currently visible satellites according to the GPS almanac

(v) **'Sat level'** These are the signal level indications from the receiver for the satellites identified above in the PRN list, they will vary with time and site conditions (in the range 00 to over 30). The signal levels shown are on an arbitrary scale, not a dB scale and are valid only when the receiver is showing a 1D, 2D, or 3D fix, see (vi) below**.**

(vi) **'Fix'** indicates the status of the GPS receiver where 1D shows it working in the single-satellite (time only) operation whilst 2D or 3D show, respectively, 3 or 4 satellite (time and position) working.
'Mode' indicates the status of the units' frequency reference drift-correction system, this may be in the 'Inactive' or in the 'Control' state.

THE CONTROL COMMAND SET (REMOTE mode)

Command Format

The command format used on the serial RS232 control port is of the form:

[ASCII letter character/s] [byte string (parameter)] [delimiter]
Note:
Command identity letter/s may be in upper case or lower case.
The parameter string is required only on certain commands.
The standard delimiter character is Carriage Return (ASCII 0DH).
Line Feed (ASCII 0AH) characters are ignored; i.e. CR LF is OK.
Spaces and punctuation characters are illegal.

Command List

The following standard commands are recognised in the REMOTE mode.

(i) Interrogation Commands
These Commands are used to read information from the unit on a routine basis; they do not affect the normal operation of the unit.

Format		Command Name
RA	<CR>	Read 1804 status
RB	<CR>	Read GPS receiver status
RC	<CR>	Read GPS receiver version
RK	<CR>	Read Satellite PRN
RL	<CR>	Read Satellite signal level
RP	<CR>	Read Position
RT	<CR>	Read Local date & time
RNT	<CR>	Read Next Local date & time
RU	<CR>	Read UTC/GPS date & time
RNU	<CR>	Read Next UTC/GPS date & time

(ii) Control & Configuration Commands

These are commands used to set-up the operating mode of the unit according to requirements. Care should be exercised when using any 'Set' commands, particularly where the unit is operational in a performance-critical situation.

Format		Command Name
RD	<CR>	Read 1Hz timing
SDyy	<CR>	Set 1Hz timing (advance/retard)
RO	<CR>	Read Local time offset
SOshhmm	<CR>	Set Local time offset
TU	<CR>	Set timing mode to UTC
TG	<CR>	Set timing mode to GPS
Dx	<CR>	Read Alarm time delay
Dxnnnn	<CR>	Set Alarm time delay
@C	<CR>	Read Configuration data)-- see Appendix B
@Cwxyz	<CR>	Set Configuration data)
VL	<CR>	Lock Reference control voltage
VU	<CR>	Unlock Reference control voltage
RV	<CR>	Read Reference control voltage
@Vhhhh	<CR>	Set Reference control voltage
Wabcxyz	<CR>	Wrap (test)
Z	<CR>	Instrument reset (software)
?	(no delimiter)	Change serial mode (to TERMINAL)

Command and response detail

RA<CR> Read 1804 status

Respons e RAxyzw<CR><LF>

where x is ASCII coded hex representing
'8' bit & '4' bit, -- n/u
'2' bit -- GPS status 1 = OK (led on)
'1' bit -- Drift Correction status 1 = not correcting (inverse of bit y4)

similarly y '8' bit -- n/u
'4' bit -- Drift correction mode, 1 = correcting (inverse of bit x1)
'2' bit -- Drift correction remote lock, 0 = unlocked 1 = locked (VL command)
'1' bit -- UTC/GPS time mode 0 = UTC 1 = GPS (TU/TG commands)

similarly z '8' bit & '1' bit -- n/u
'4' bit -- dc power, 1 = OK
'2' bit -- ac power, 1 = OK

similarly w '8' bit & '2' bit & '1' bit -- n/u
'4' bit -- Rb Lock, 1 = locked

RB<CR> Read GPS rcvr. status

Respons e RBabcdefghjk<CR><LF>

where a = n/u - state undefined

b = 0 - Doing position fixes
= 1 - No GPS time available
= 3 - PDOP is too high
= 8 - No usable satellites
= 9 - Only 1 usable satellite
= A - Only 2 usable satellites
= B - Only 3 usable satellites
= C - The chosen satellite is unusable

c is ASCII coded hex representing
'8' bit, '4' bit, '2' bit -- n/u
'1' bit -- Antenna feed-line fault (open or short circuit)

d is ASCII coded hex representing
'8' bit, '4' bit, '2' bit -- n/u
'1' bit -- No battery back-up at start-up

ef is the GPS rcvr. id. code. e.g. '14' dependent on issue.

g = n/u

h is ASCII coded hex representing
'4' bit, '2' bit, '1' bit -- n/u
'8' bit -- Almanac is not complete and current

jk = n/u

RC<CR> Read GPS rcvr. s/w version

Response RCaabbccddeeffgghhjjkk<CR><LF>

where aa,bb...kk are ASCII coded decimal numbers representing

aa	=	Nav proc	-	Major version No.
bb	=	Nav proc	-	Minor version No.
cc	=	Nav proc	-	Month
dd	=	Nav proc	-	Day
ee	=	Nav proc	-	Year No.
ff	=	Sig proc	-	Major version No.
gg	=	Sig proc	-	Minor version No.
hh	=	Sig proc	-	Month
jj	=	Sig proc	-	Day
kk	=	Sig proc	-	Year No.

RK<CR> Read satellite PRN

Response RKaa,bb,....ff,gg<CR><LF>

Where aa, bb etc. are ASCII coded decimal representing the PRN for each satellite which the GPS rcvr. is tracking or attempting to track.

RL<CR> Read satellite level

Response RLaa,bb,....ff,gg<CR><LF>

where aa, bb etc. are ASCII coded decimal representing the signal level for each satellite corresponding to the PRN in the RK response.

RP<CR> Read Position

Response RPddmm.mmmadddmm.mmmbhhhh Pxx<CR><LF>

where ddmm.mmm are the degrees & minutes of position in ASCII coded decimal
a is 'N' for North or 'S' for South (Latitude)
b is 'E' for East or 'W' for West (Longitude)
hhhh is the Height in metres in ASCII coded decimal
Pxx is the current PDOP statistic.

RT<CR> Read Local date & time (UTC or GPS, plus offset)

Response RTyymmddhhmmss<CR><LF>

Where yy is ASCII coded decimal year '00'-'99'
mm is ASCII coded decimal month '01'-'12'
dd is ASCII coded decimal day '01'-'31'
hh is ASCII coded decimal hours '00'-'23'
mm is ASCII coded decimal minutes '00'-'59'
ss is ASCII coded decimal seconds '00'-'59'

RNT<CR> Read Next Local date & time

This command causes the 1804 to wait until the next 'on-time', second roll over point, and then transmits the new time. Delay from end of command delimiter to start of response will vary, and may be slightly longer than one second (1.1 second maxm.)

The delay from the true 'on-time' point to the start bit of the first character in the response will be nominally 0.5 millisecond. Software timing tolerances may cause the delay to vary in the range 0.2msec. to 0.8msec.

Response RNTyymmddhhmmss<CR><LF>

Where yy etc. are as in RT command above

Note Sending any other command to the unit before the new time response has been sent will cancel the RNT command and no new time will be sent.

RU<CR> Read UTC/GPS date and time

Response RUyymmddhhmmss<CR><LF>

Where yy is ASCII coded decimal year '00'-'99'
mm is ASCII coded decimal month '01'-'12'
dd is ASCII coded decimal day '01'-'31'
hh is ASCII coded decimal hours '00'-'23'
mm is ASCII coded decimal minutes '00'-'59'
ss is ASCII coded decimal seconds '00'-'59'

RNU<CR> Read Next UTC/GPS date & time

This command causes the 1804 to wait until the next 'on-time', second roll over point, and then transmits the new time. Delay from end of command delimiter to start of response will vary, and may be slightly longer than one second (1.1 seconds maxm.)

The delay from the true 'on-time' point to the start bit of the first character in the response will be nominally 0.5 millisecond. Software timing tolerances may cause the delay to vary in the range 0.2msec. to 0.8msec.

Response RNUyymmddhhmmss<CR><LF>

Where yy etc. are as in RU command above

Note: Sending any other command to the unit before the new time response has been sent will cancel the RNU command and no new time will be sent.

RD<CR> Read 1Hz timing

Response: RDyy<CR><LF>

Where yy is the current advance or retard setting. Hex values, see SD command below.

SDyy<CR> Set 1Hz timing (advance/retard)

This command allows the 1Hz (positive edge) timing marker pulse to be offset by up to ± 3.2 μS from it's normal position. This facility may be used in timing-critical network applications to make sub-microsecond adjustments which will partially compensate for timing errors caused by differing antenna cable lengths or antenna types which may be installed at points in the network. The value of such adjustment is highly dependent upon the users ability to accurately estimate the value of offset required and the type of reference oscillator which may be fitted in the unit. Offset values entered using this command are stored in non-volatile memory so that they are retained following a power loss/recovery cycle.
The offset parameter yy is entered as a two-digit (Hex) number in the range 00 to FF. The normal centred position corresponds to the middle of the numeric range, i.e. 80 (Hex) which is the default setting.
At a setting of 00 (Hex) the timing will be retarded by 3.2 μsec causing the 1Hz edge to occur 3.2 μsec later with respect to the GPS 1pps UTC marker. Setting 80 (Hex) will apply no correction.
Setting FF (Hex) will advance the timing by 3.2 μsec. Resolution (one digit) is 25 nanoseconds.
Factory (default) setting is B2(Hex) to provide a nominal correction for a Rapco Type 4b antenna and E44 low-loss downlead cable.

Response: Sdyy<CR><LF>

RO<CR> Read Local time offset

Response: ROshhmm<CR><LF>

Where s is the sign of the offset '+' or '-'
hh is ASCII coded decimal hours offset '00' to '59'
mm is ASCII coded decimal minutes offset '00' to '59'

SOshhmm<CR> Set Local time offset

Response: SOshhmm<CR>

Where s is the sign of the offset '+' or '-'
hh is ASCII coded decimal hours offset '00' to '23'
mm is ASCII coded decimal minutes offset '00' to '59'

TU<CR> Set timing mode (display and output) to UTC *See Note below

Response: TU<CR><LF>

TG<CR> Set timing mode (display and output) to GPS *See Note below

Response: TG<CR><LF>

*NOTE: The GPS and UTC timescales increment at an essentially identical rate; in other words the one second on-time points are synchronous to within the limits of accuracy defined for the GPS system. The UTC timescale differs in that it has 'Leap seconds' inserted at certain intervals to maintain its relationship with astronomical timescales. For this reason, GPS time differs from UTC by a whole number of seconds. At August 2003, the difference was such that UTC appears to be 13 seconds behind GPS, due to the thirteen positive Leap second events that have occurred since the start of the GPS timescale in January 1980. Leap second

insertions are scheduled in advance by the International Earth Rotation Service (IERS) and will occur (only when scheduled) at midnight on either December 31st. or June 30th. Since the turn of the century, they have been less frequent than in the previous decade, during the 1990's they have usually been eighteen months apart.

Dx<CR> Read Alarm Time delay

Response Dxnnnn<CR><LF>

Where x = A,B,C or D (Delay identifier)
nnnn = 4 digit ASCII Hex number representing the alarm delay in seconds.

Example nnnn = 012C = 300 secs. = 5 mins.
See section on Alarm Output System.

Dxnnnn<CR> Set Alarm Time delay

Response Dxnnnn<CR><LF>

Where x, nnnn are as above.

@C<CR> Read Configuration Data

Response @Cwxyz<CR><LF>

See Appendix B for interpretation of this command

@Cwxyz<CR> Set Configuration Data

Response @Cwxyz<CR><LF>

See Appendix B before using this Command

VL<CR> Lock Reference Control voltage

Note: Locking the oscillator control will cause the CONTROL status indicator to switch off; it will remain in this state until the control voltage is unlocked and the frequency correction system has resumed control.

Response VL<CR><LF>

VU<CR> Unlock Reference Control voltage

Response VU<CR><LF>

RV<CR> Read Reference Control voltage

Response RVaaaa<CR><LF>

Where aaaa is ASCII coded hex of the control voltage '00'-'FFFF'

@Vhhhh Set Reference Control Voltage

Response	@Vhhhh<CR><LF>
Where	hhhh is ASCII coded hex of the control voltage '0000'-'FFFF'

Wabcxyz<CR> Interface test (Wrap)

Respons e abcxyz<CR><LF>

Where abcxyz are ASCII alphanumeric characters

Z<CR> Instrument reset (forces software reset)

Respons e NONE - N.B. No commands should be sent to the unit for 1 second following this command.

? <No Delimiter required> RS232 Port -- Mode Toggle Command

Switches operation of the port between the TERMINAL and REMOTE Modes.
Can be used from either mode.

Respons e NONE -

Errors

Any command error will respond with ERx<CR><LF> in place of the usual command response, when the unit is in the REMOTE mode.

Where x = 1 Command format error
x = 2 Command parameter error.
x = 3 Command ignored (E.g. @Vxxxx command when drift correcting.)

FREQUENCY OUTPUTS

The 1804M3 is fitted with sockets on its rear panel which provide drift-corrected frequency outputs. These are configured as follows:

REFERENCE FREQUENCY OUTPUT

J5, 5MHz (filtered HCMOS, quasi-sine)

Connector Type -- 50ohm BNC
This output provides a drift-corrected 5MHz-reference frequency that is buffered from the internal oscillator. The output waveform is derived from a HCMOS gate array driving a 2-pole LC filter giving a near-sinusoidal waveform of nominally 2.5v p-p into the 1882M series Auto-Changeover/Distribution unit.

TIMING OUTPUT

J6, 1pps (TTL)

Connector Type -- 50ohm BNC
This output is driven by a 5V HCMOS buffer, which will drive two standard TTL loads and is normally interconnected to the 1pps (Master or Standby) inputs of an 1882M series ACDU. The output waveform is a squarewave at a frequency of 1Hz. In normal operation, the positive-going transition of this signal is phase controlled to align with the mean GPS 'on-time' point and is used to trigger an output pulse (20microsec) generator in the 1882M.

GPS RECEIVER AND ANTENNA

The GPS receiver used in the 1804M3 Series is a L1 carrier, 8 channel, C/A code, SPS (Standard Positioning Service) unit, which is compatible with the satellite navigation signals as described in the GPS specifications SS-GPS-300B and ICD-GPS-200.

It is used with a fixed-pattern antenna which has RF damage protection for signals which are 100MHz or more from the L1 frequency (1575.42MHz) and which have a received power level up to one watt.
The receiver/antenna combination is resistant to jamming at J/S (jamming/signal) ratios of +20dB measured at the antenna/preamplifier interface, when the L1 received signal level is -160dBW.

The receiver provides a navigation solution, which is specified at 25 metres (SEP), in the absence of Selective Availability. When SA is implemented, the position accuracy is degraded to 100 metres (2xdrms).
The receiver provides a 1 per second timing pulse which is within ±1 microsecond of the GPS 'on-time' point whenever the received satellite signals allow a 1D, 2D or 3D navigation solution.

Acquisition

The receiver is completely self-initialising from a cold start, but will exhibit a differing 'Time-to- first-Fix' according to the prevailing circumstances.
The fastest recovery from, say, temporary disconnection of the antenna or a short power failure, will normally be less than two minutes. After a longer period without power such as overnight switch-off, the acquisition process may take three minutes.
If the unit has been moved a very long way (>1000km) since last operating, then it may take over 5 minutes to re-acquire sufficient information to commence navigation. In extreme circumstances, the 'Time-to-first-fix' could be as long as 17 minutes, but this is extremely unlikely.
In normal circumstances, on slow moving platforms or in a stationary application, the receiver will be operational within 4 minutes of switch-on. The antenna must be correctly connected and must have a clear view of the sky, without significant obstructions above the default mask angle of 10^{o}.

Antenna Installation

The GPS antenna supplied with the 1804 has a built-in preamplifier, powered via the co-axial RF signal cable from a low voltage d.c. source (< 5 volts).
The antennas signal connector, although sealed at its mounting face, is not a weatherproof connector. To provide protection for the interface between this antenna and the antenna cable, a waterproof housing with an entry conduit is provided. RAPCO antenna cables, both the standard 20 metre version and the heavier 50 metre (E44) type, are ready fitted with a screw-on cable gland which allows the assembly to be weatherproofed at the point of cable exit.
In very severe environments, the user should provide further protection for the co-axial cable itself from its point of exit on the antenna assembly. Information regarding antenna installation is given in Drg. No. 2929-7113, which depicts the standard antenna assembly (Type 4b).

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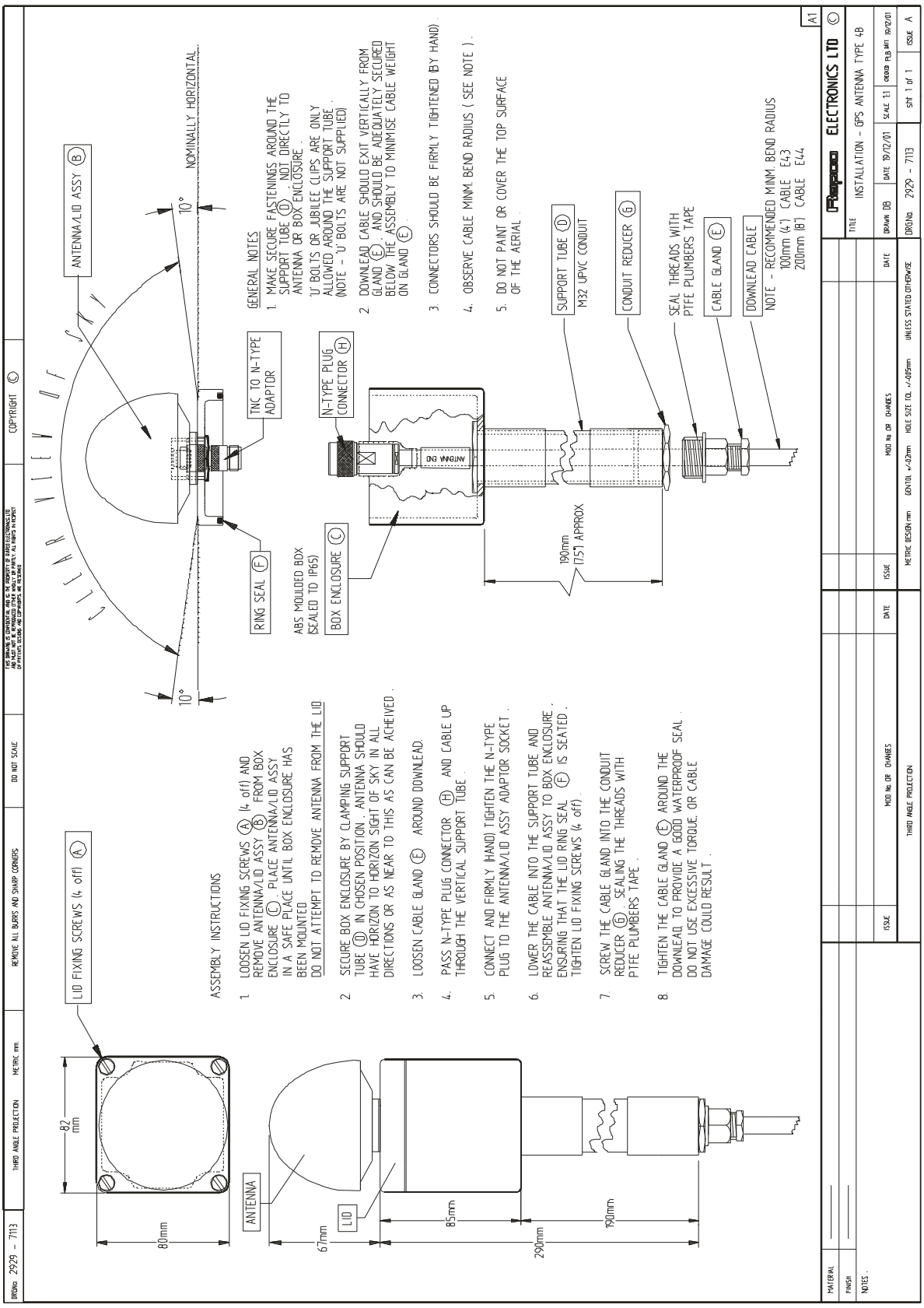
Drawing No. 2929-7113 -- Type 4b Antenna Installation.



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THE ALARM OUTPUT SYSTEM

An alarm contact output is presented at connector (J7); this is identified as Alarm-1 and is intended for connection to the users' alarm management system
The voltage-free alarm relay contacts are factory configured to present as

contacts closed	=	no fault
contacts open	=	fault.

This configuration can be reversed using an internal jumper link, but this is not recommended. Note that the shell of the alarm contact connector is connected to chassis (ground). The relay contacts are wired between the inner contact and shell of the BNC. The contact ratings are 30V max open circuit, and 0.5A d.c. max . closed-circuit.

The contacts are high quality gold-plated crossbar type, which are suitable for switching low current logic input circuits (recommended current level, 10mA; minimum 1mA).

The contacts will adopt the open-circuit (fault) state if the unit enters an alarm state and will return to the closed (no fault) state when the fault conditions are removed.

Another, separate alarm signal is identified as Alarm-2; this is a TTL compatible logic signal which is connected via the dc output connector (J2) to provide an alarm signal to the 1882M ACU/Distribution unit. This signal is configured as high for fault.
Separate Alarm (red) status indicators are fitted on the front panel; showing the current state of Alarm-1 and Alarm-2

indicator on	=	alarm state
indicator off	=	no alarm

Programmable time delays may be applied to the onset of an alarm state, see below for details.

An alarm state will be initiated by the software under any of the conditions listed below:

(i) GPS Receiver is not providing a 2D or 3D fix.
(ii) Oscillator control voltage is outside normal range (even if oscillator is on-frequency)
(iii) Oscillator significantly off-frequency, even if control voltage is normal.

Condition (i) will extinguish the GPS status led and the CONTROL status led
(ii) or (iii) will extinguish the CONTROL status indicator alone.

Any change in status, into or out of a fault condition, will be indicated at the appropriate STATUS light within one second of the units software having detected the change. Any delays programmed into the alarm system will not affect these STATUS indicators.
The system provides for user-selectable time delays between the detection of a failure and the initiation of the output alarm signal and the associated ALARM indicator light.
Separate delays may be applied to GPS status alarms and CONTROL status alarms.
In addition, different delay settings may be used for the Alarm-1 (contact alarm output signal at J7) and Alarm-2 (TTL alarm output signal to 18xx series ACDU at J2).
Therefore, four setting commands are available.

These alarm delay setting commands are:

DAnnnn - sets ALARM 1 (GPS) delay

DBnnnn - sets ALARM 1 (CONTROL) delay

DCnnnn - sets ALARM 2 (GPS) delay

DDnnnn - sets ALARM 2 (CONTROL) delay

Values of nnnn describe the hold-off time delay in seconds (hex. digit ranges)
For example:

0002	=	2	Second (minimum. delay)		
000A	=	10	Seconds		
012C	=	300	Seconds	=	5 minutes
0258	=	600	Seconds	=	10 minutes
0E10	=	3600	Seconds	=	1 hour
FFFF	=	65535	Seconds	=	18 hr, 12 min,15 sec.

The settings nnnn = 0000 and 0001 are reserved as special cases and are used for system testing, allowing an ALARM state to be simulated regardless of whether a fault condition exists. Therefore, the minimum usable delay setting is 2 second i.e. DA0002<CR>; this is the factory (reset/default) setting for all the delay values.

As noted above, any GPS status failure condition will almost immediately cause a CONTROL status failure, since the oscillator-control software can only operate in the presence of a valid GPS reference pulse (1pps). Without it, the oscillator control-voltage is locked to maintain best frequency accuracy.

The alarm logic is configured to distinguish between the situation where a CONTROL status failure occurs due to a GPS failure and the situation where a CONTROL failure occurs in isolation. This feature allows the alarm system to operate due to a GPS failure (the consequent CONTROL failure being ignored) or due to a CONTROL only fault. This is important as regards the setting of the separate alarm-delays, since it allows a more meaningful use to be made of the CONTROL delay setting.

The programmable alarm delay settings are stored in non-volatile memory. They may be programmed as required to suit unusual conditions prevailing at certain sites. Settings should be chosen to reduce the probability of a spurious alarm triggering the users warning system unnecessarily, with the attendant high cost of response.
For example, if a GPS antenna obscuration should occur, or if severe temporary interference should block reception, then a one-hour 'hold-off' may be appropriate. Even a CONTROL failure alarm can be delayed significantly in some applications.

After setting, the current delays may be checked using DA, DB, DC and DD commands.
(See Control Command section)

APPENDIX A -- Frequency & Timing Control

Frequency. (Drift correction)

The frequency control system utilises the unit's processor and software to maintain the accuracy of the internal reference oscillator. During warm-up from cold, the oscillator control voltage is locked at the last known value that has been stored in non-volatile memory. Time is allowed (approx 2000 seconds) for the frequency reference oscillator to approach its designed operating temperature, and during this stage the unit will indicate 'Inactive' status at the control interface; the CONTROL status indicator will be 'off'.
The software operates intelligently following a power-up and estimates the required oven warm-up time by examining the time since power failure. As a result, very short power breaks will result in a shorter hold-off time, because the oscillator requires less time to re-stabilise.

After the GPS receiver has locked on to satellites, phase correction routines adjust the reference-derived 1Hz into phase alignment with the 'raw' 1 pps from the GPS receiver.
At this stage, no corrections are made to the oscillator frequency since its oven temperature may still be slewing. When the oven temperature time-out period expires, another, more precise, adjustment is made to the 1Hz UTC alignment. The CONTROL status indicator will be lit when this 1Hz alignment has been achieved.
A frequency control regime is then started during which control-voltage changes are made to drive the reference towards zero error, and no more phase steps are applied to the 1Hz output.
Following initial rack installation in a new system, it is recommended that at least 24 hours should elapse for complete stabilisation of the frequency control system, particularly if the unit has been in storage, or inoperative for a long period.

A remote control command, VL<CR> is available for testing purposes, to lock the control voltage at its current value. Locking the control voltage will disable the drift-correction loop and will cause the CONTROL status indicator to switch off and a CONTROL Alarm to be set.
Normal operation must be subsequently restored by the VU<CR> command. After such intervention, the CONTROL indicator will remain off, and the Alarm will persist, until the control loop has measured for a complete averaging cycle that will last for over 2¼ hours.
A similar alarm indication will occur if the oscillator approaches either end of its' control range due to extreme age or a fault in its internal circuits. In such circumstances, onset of the Alarm state actually occurs with 10% of the control range left, giving 'early-warning' of failure.

Time (Data and 1Hz on-time mark)

Timing data output at power-up increments from 00:00:00 01/01/1997. When the GPS receiver has acquired lock, the unit will indicate 1D, 2D or 3D in the status bits. The front panel GPS status indicator will then be 'on' and the time output data will be derived from the satellite data to show correct UTC(GPS).
When the unit has had sufficient time for the frequency control system to stabilise, the 1Hz output at the rear panel provides a precise source of 'on-time' indication; it is not subject to the short-term temporal variations associated with the GPS receiver 1pps solution.
With satellites in view, and the reference oscillator in a stable state, the mean timing error will be within ±300 nanoseconds, ref: UTC(GPS), when using the rear panel 1 Hz signal as the on-time marker. Timing calibration may be used (SDyy<CR> Command) to compensate for site-specific delays in the antenna and downlead to reduce if suitable facilities are available.
The stability of the 1Hz timing mark is typically ±300 nanoseconds (95% probability)

APPENDIX B -- The Set Configuration Command.

@Cwxyz

This command is provided to enable the user to configure the RS232 port behaviour, the timecode generator operation --if fitted-- and other parameters as required.

The command allows certain condition-flag register bits in the units' microprocessor to be directly set from the RS232 port whilst in the Remote mode
Like all such control features, care is required in its use in order to avoid anomalous behaviour, particularly as regards any system status bits which may be factory set. See RAPCO Drg. No. 3627-6075 (overleaf) that defines in detail the structure of this register.

The 'w' bit-group is of significance only on units fitted with the optional timecode generation feature. If the timecode option is not fitted, the state of these bits is ignored. They may normally be set to zero. Bit w8 is currently unused

The w4 bit defines the timing epoch to be used in the encoded data for the timecode. This may be UTC(GPS) or LOCAL Time.

The w2 bit defines the required timecode type as IRIG or XR3.

The w1 bit defines high or low carrier frequency.

In the case of IRIG timecode,	high = 10kHz	low = 1 kHz
In the case of XR3 timecode,	high = 1kHz.	low = 250 Hz

The 'x' bit-group is currently unused

The 'y' and 'z' groups are applicable to all units having the Set Configuration command.

The y8 bit defines the power-up default state for the RS232 port as either TERMINAL (continuous transmission) or as REMOTE (control).

The y4 bit defines whether the TERMINAL mode data format is to include satellite/status data packets (All data), or just date / time lines (Date/Time only)

The y2 bit defines whether the date/time data transmitted in terminal mode shows UTC(GPS) or the alternative LOCAL timescale.

The y1 bit is similar in effect to the y8 bit - see above - but defines the power-up default state for the **second** serial port which may be fitted as an option on some units. If the second port is not fitted, or is configured to a special user-defined function, the state of this bit is irrelevant

The z8 bit is a hardware related system set-up bit and should not be overwritten.

The z4 bit allows the user to choose between a long or short re-sync timer setting for the 1Hz timing output. This timer measures the length of any period of GPS signal loss, but is of significance only on units having both time and frequency output signals i.e. the 1804 series. It is not necessary on 1814B units that are configured for 'timing-only' applications.
If a GPS signal loss occurs, then on return of the GPS signal, the 1Hz time-marker output is immediately realigned with UTC by phase stepping the 1Hz signal. In the case of 1814B series units this always occurs regardless of the duration of the GPS loss -- i.e. bit z4 is ignored.
On 1804 units the timer is used to modify their behaviour so that if the GPS loss is shorter than the timer setting, no direct phase adjustments are made. In this case, realignment of the 1Hz signal is achieved by 'steering' the oscillator frequency to achieve the same result. This occurs over a longer period, but without loss of coherence between the 1Hz output and the 10MHz or other reference outputs; this can be important in some applications.
The frequency excursions which occur as a result of the steering process may be greater than those occurring in normal operation, particularly if the period of GPS signal loss has been several hours. The magnitude of these excursions will be dependent not only on the duration of the signal loss, but also on the type of reference oscillator fitted, and on its environment. These factors will all influence the amount by which the timing pulse will have deviated from UTC alignment during the signal loss. For most applications the 10minute re-sync delay (where z4 = 0) is recommended; this is the default setting.

The z2 bit is currently unused.

The z1 bit defines the timing mode for the unit as being GPS or UTC. Its use is an alternative to that of the TU and TG commands. See Command details for explanation of the GPS/UTC time relationship.

NOTE:
The factory-default setting for the Set-Config. Register is to the all-zero state, using command @C0000.

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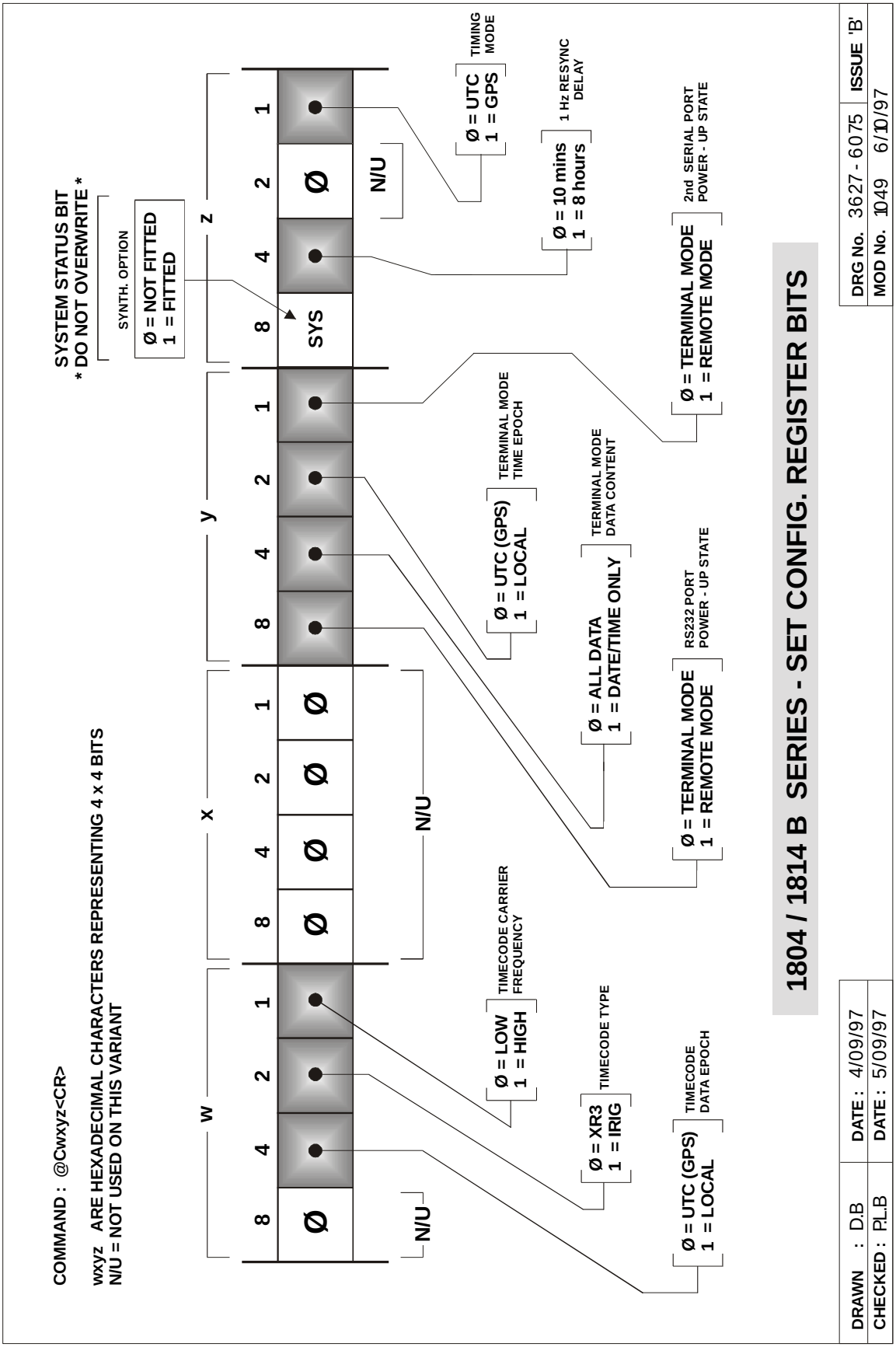
Drawing No.3627-6075 -- 1804/1814B Series Set Config. Register



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Statement of Compliance (LVD) for 1804M3

CE

Rapco
ELECTRONICS LIMITED

DECLARATION OF CONFORMITY

We declare that the product(s) listed below meet the safety requirements of the European Commission Directive 73/23/EEC as amended by 93/68/EEC, referred to below as 'The Directive'.

Product(s)	1804 GPS Precision Frequency Source, all versions.

The products identified above meet or exceed the protection requirements of :

EN 61010 -1 Safety requirements for electrical equipment for measurement, control and laboratory use.

The products are defined as Class 1 (earthed) equipment when installed and used in accordance with the instructions in the operators manual.

This equipment is not suitable for use in explosive atmospheres or as a component in a life support system.

..... Date : **27 th JAN'97**

P.L.Baker
Technical Director

for and on behalf of

Rapco Electronics Ltd.

11 Joule Road, Basingstoke, Hants U.K. RG21 6XF

Note : The attention of the specifier, purchaser, installer, or user is drawn to special measures and limitations to use which may apply when the product is taken into service, to maintain compliance with the Directive. The equipment must be installed and used in accordance with all relevant information contained in the product handbook.

NQA ISO 9001 REGISTERED COMPANY
NATIONAL ACCREDITATION OF CERTIFICATION BODIES
BS EN ISO 9001 - Certificate No. 0329

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Statement of Compliance (EMC) for 1804M3

CE

Rapco
ELECTRONICS LIMITED

DECLARATION OF CONFORMITY

We declare that the product(s) listed below meet the electromagnetic compatibility requirements of the European Commission Directive 89/336/EEC as amended by 93/31/EEC and 93/68/EEC, referred to below as 'The Directive'.

Product(s)	**1804 M3 GPS/Rb FREQUENCY SOURCE**

The products identified above comply with the requirements of the Directive by meeting the following standards :

EN 50081 - 1 E.M.C. Generic Emission Standard Part 1 Residential, Commercial and Light Industry.

EN 50082 - 1 E.M.C. Generic Immunity Standard Part 1 Residential, Commercial and Light Industry.

The technical documentation required to demonstrate that the product meets the requirements of the Directive has been compiled by the signatory below and is available for inspection by the relevant enforcement authorities.

The C E mark was first applied in : **1998**

Date : **31st Mar ' 98**

P.L.Baker

Technical Director

for and on behalf of

Rapco Electronics Ltd.

11 Joule Road, Basingstoke, Hants U.K. RG21 6XF

Note : The attention of the specifier, purchaser, installer, or user is drawn to special measures and limitations to use which may apply when the product is taken into service, to maintain compliance with the Directive. Details of any such special measures and limitations to use, are, if applicable, contained in the product handbook.

NQA ISO 9001 REGISTERED COMPANY — NATIONAL ACCREDITATION OF CERTIFICATION BODIES

BS EN ISO 9001 - Certificate No. 0329

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ELECTROMAGNETIC COMPATIBILITY NOTES

The following special measures and limitations to use, should be observed when the equipment is taken into service, in order to maintain compliance with the EMC Directive 89/336/EEC.

Power Cables

(i) a.c. Power

The a.c. power cables supplied with the unit(s) are the only approved type.

Always ensure that the green/yellow conductor is connected to a safety earth at the supply source.

Always ensure that the retainer clip is used to prevent accidental or partial disconnection of the power cable.

If the separate earth stud on the rear panel of the unit is connected to a local earth bus (eg in an equipment rack), ensure that this is a clean earth which is free from electrical noise.

(ii) d.c. Power

The d.c. power input and output ports on RAPCO equipment are intended only for direct connection to other RAPCO units, normally mounted in adjacent, or near adjacent, positions. The only approved cables for these purposes are those supplied by RAPCO.

Signal, Data, or Antenna Cables

Where interconnecting cables are required between RAPCO units, these are normally supplied with the equipment. Such cables should not be modified or extended; EMI absorbers (ferrites) or in-line filters supplied with cables should not be removed. Cables that interconnect with the users equipment and not supplied by RAPCO, should be of correct specification and of adequate quality. EMC considerations involving such cables are the users responsibility. Consult RAPCO if informal advice is required regarding choice of cables.

Unused input or output connectors

If any connector is unused in a particular installation, or if it is used only occasionally (eg. maintenance or test) then suitable protection should be used to ensure that the EMC profile of the unit is maintained as regards both immunity and emissions.

(i) Co-axial connectors should be fitted with screening (metallic) protective caps, or fitted with termination loads as required. Note that outputs designated TTL should not be terminated with 50 ohm loads.

(ii) Data connectors. To provide ESD protection and screening for unused multi-pin data connectors, it is recommended that an unwired mating part, complete with metallic hood and fixing screws or clips is fitted at the unused port. Suitable connector parts may be ordered from RAPCO.

(iii) Antenna connectors. In normal applications these will be permanently connected to RAPCO supplied antenna assemblies via RAPCO cables. In the unlikely event that a unit is to be installed without the antenna downlead cable connected, protection in the form discussed above for data cables, is recommended. Note that where equipment is configured for use with an active antenna, the connector may have a d.c. voltage across its pins, and should not be fitted with a 50 ohm terminator as this could overload the power source; use a screened blanking cap or 'dummy' unwired connector instead.