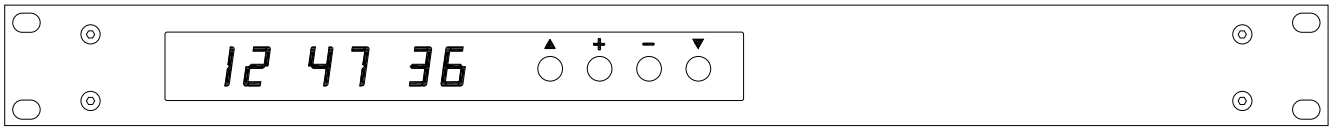
5200 Series Master Clock



Operating and Installation Instructions

Issue 1.6

In the interests of improving design, operational function, and/or reliability, Wharton Electronics Ltd reserves the right to make changes to the products described in this document without notice.

Trademarks

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Customer Support

For assistance with installation, configuration or operation of your 5200 series master clock system, please contact your vendor's representative.

For further technical information and support for your 5200 series master clock, or any other Wharton product, please visit the Wharton Electronics's World Wide Web site:

`http://www.wharton.co.uk`

Statutory Notices

Warning - To prevent fire or shock hazard, do not expose the unit to rain or moisture.

Battery Backup

This equipment has a built-in Lithium battery which in normal operation should have a service life greater than 10 years.

CAUTION

Danger of explosion if battery is incorrectly replaced.

Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

You can return your unwanted Lithium batteries to the manufacturer or their agent.

Note: In some areas disposal of Lithium batteries in household or business waste may be prohibited.

Caution: Do not handle damaged or leaking Lithium batteries.

To remove battery at end of product's life, unscrew case lid from case body to remove, locate Lithium 'coin cell' battery in holder on main driver board and unclip from holder. Battery should be disposed of as per local legislations.

End of Life

At the end of product's life, do not dispose of your device in the regular household waste. Return your device to your supplier who will dispose of it correctly.

For Customers in Europe

Electromagnetic Compatibility & Safety

The 5200 series master clock, when used in accordance with our recommendations, complies with the European Community Electromagnetic Compatibility Directive 2004/108/EC and the European Community Low Voltage Directive 2006/95/EC and conforms to the following standards:

- **EN 50121-4: 2006**
- **EN 61000-6-2: 2005**
- **EN 61000-6-4: 2007+A1: 2011**
- **EN 55022: 2010**
- **EN 55024: 2010**
- **EN 60950-1: 2006**

For Customers in the USA

The equipment has been tested and certified to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorientate or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

Warranty

The 5200 series master clock is fully guaranteed, on a return to works basis, against failure due to faulty parts or workmanship for one year from date of purchase. In the event of failure, either within or outside the warranty period, please pack the unit with care and return to the manufacturer, or their agent, for examination and repair.

In no event shall the manufacturer, or their agent, be liable for any direct, incidental or consequential damages of any nature, or losses or expenses resulting from any defective product or the use of any product, irrespective of whether the manufacturer, or their agent, has advance notice of the possibility of such damages.

Product Development

In the interests of improving design, operational function, and/or reliability, Wharton Electronics Ltd reserves the right to make changes to the products described in this document without notice.

This manual version 1.6 applies to units operating with software version 01.F5 or later, unless otherwise stated.

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1 - Introduction

The 5200 series master clocks provides the time synchronisation solution for complete systems of equipment, including computer networks, CCTV security, voice recording, industrial process control and CCC applications. Available as standard with GPS, NTP, MSF and DCF input synchronisation options, optionally the 5200 series master clock can be supplied to synchronise from a range of other time signal inputs. This flexibility allows the 5200 series master clock to be used as a universal solution for providing time synchronisation to many different devices.

Features

- **Operational**

  High visibility 6 digit display.

  Display and timecode output messages can be referenced to UTC or 'Local' time.
  'Set Once' local time zone setup, automatically calculating future time zone changes for local time zone.
  256 Year Calendar, 4 digit year setting.
  Easy to install, 'setup and forget' operation.

- **Timing accuracy**

  Integrated TCXO module as standard.

  Unsynchronised: 0.1sec/day @ 0-45ºC
  Locked to GPS: within 10uS of UTC
  Locked to NTP: within 1-10mS of NTP source (dependant on network delay & jitter)
  Locked to MSF or DCF: within 30mS of UTC

- **Network Timing Accuracy (5200 & 5201 only)**

  Clients typically synchronised within 1-10 milliseconds of 5200 or 5201 master clock timebase depending on network delay and jitter. (NTP)

- **zCode digital and analogue clock interface**

  User configurable between w482® time code output or 24V alternate polarity impulse output. 5200 and 5202 models fitted with dual zCode outputs, 5201 and 5203 models fitted with single zCode output.

  w482® time code output supports up to 50 off 400A and 47xA series digital clocks and time zone displays.

  'Set Once' time zone setup, automatically calculating future seasonal time changes for 15 time zones.

  Impulse *output* supports one second, half minute or one minute alternate polarity impulses, rated at 500mA per output.

  Fully protected output drive circuitry detects power failure and short circuit line conditions which are automatically corrected for on fault removal.

- **RS232 and RS485/422 interface**

  One RS232 and RS485 serial output. 85 preset data formats for specific CCTV and embedded equipment. Output interval programmable for every second, every minute, 5 minutes, every hour, every day or on request.

  User selection of 1200, 2400, 4800, 9600 or 19200 baud, 7 or 8 data bits and odd, even or no parity on nonspecific message formats

The 5200 & 5201 Master Clocks are supplied fitted with a 10/100Base-T Ethernet interface to allow it to act as a time server on a TCP/IP network. The 5200 & 5201 interface supports the following protocols:

- **NTP and SNTP**

  Network Time Protocol (NTP) v2, v3 and v4 clients are supported. (RFC1305 & RFC1119)

  Simple Network Time Protocol (SNTP) v3 and v4 clients are supported. (RFC2030 & RFC1769)

- **TIME Protocol**

  TIME protocol (RFC868) is supported in UDP mode.

Additional outputs available on 5200 series Master Clocks (when appropriate option modules are fitted).

- **IRIG-B Output (requires AFOUT module)**

  1KHz amplitude modulated 3v p-p, 600Ω transformer coupled output.

  Output formats: IRIG-B (B123)

- **EBU (LTC) Output (requires AFOUT module)**

  EBU longitudinal timecode (LTC) output, 2000 bps with 25 complete messages every second.

  Balanced 600Ω output.

Additional inputs available on 5200 series Master Clocks (when appropriate option modules are fitted).

- **IRIG-B Synchronisation (requires IRIGIN module)**

  Synchronisation from 1KHz amplitude modulated IRIG-B (B123) signal.

Environment

Power supply:	110-240V AC 50/60Hz
Power consumption:	< 0.4A @ 230V AC
Battery Backup:	1 Year. (The battery backup maintains the internal time count during periods of mains failure)
Enclosure:	1u high 19" rack mount - 483mm wide x 185mm deep x 44mm high (19" x 7.3" x 1.75") Weight: 2.8Kg
Operating temperature:	0-50ºC
Relative Humidity:	0% to 90% (non-condensing.)
Altitude:	0 to 3,000m
MTBF:	> 50,000 hours

2 - Installation

Warning - dangerous voltages - the 5200 series master clock must be disconnected from the mains supply prior to removing the top cover.

Power Supply Connection

The 5200 series master clocks are fitted with universal power supplies suitable for 110V - 240V AC operation. Please specify appropriate end user location at time of order to enable correct power adapter or connector type to be supplied.

PSU order codes:

.AU - Australian style, 240v 50Hz ac.

.EU - European style, 230v 50Hz ac.

.UK - UK style, 230v 50Hz ac.

.US - US style, 110v 60Hz ac.

The 5200 series master clocks are supplied with an IEC style mains lead.

The master clock must be connected to the appropriate supply after first verifying the correct voltage by reference to the supply voltage label fixed to the side of the clock.

A connection to the earth line must be made to ensure safe operation and ensure compliance with EMC regulations.

To ensure conformance with EN60950:

(A) For installations where the 5200 series master clock is to be permanently connected into the mains power circuit, a readily accessible disconnect device should be incorporated in the fixed wiring.

(B) For installations where the 5200 series master clock is to be plugged into the mains power circuit, a socketed outlet should be installed near the equipment and should be easily accessible.

All installation work should be performed in accordance with the Seventeenth Edition of the IEE Wiring Regulations.

Battery backup.

The 5200 series master clock is fitted with a Lithium battery which will maintain the internal time count for a period normally in excess of 1 year if the mains supply is interrupted.

Fuses and Output protection.

The 5200 series master clocks make use of advanced automatically resettable fuse technology so that it is protected under fault conditions.

The universal power supply within the 5200 series master clock uses a 20mm fuse rated at 2 Amps 250V. Please note that this fuse is not a user serviceable part.

External Connections

The external connections located on the rear of the 5200 series master clocks provide the following inputs and outputs:

Standard Connections	**Section**
GPS / Synchronisation Connection	6
10/100BaseT Ethernet Connection	7
zCode Digital and Analogue Clock Connection	8
RS232 and RS422/485 Connection	9

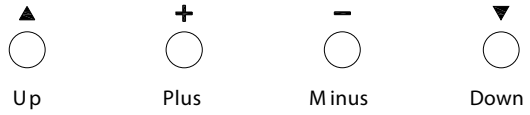
Model Specific Connections	**Section**
IRIG and EBU Connection	10

Please see the relevant sections of this manual for further information.

3 - 5200 Progamming

The 5200 series master clocks have a user friendly interface based on the use of four buttons.

The buttons are located on the front panel of the unit, to the right hand side of the display and are labelled as follows.

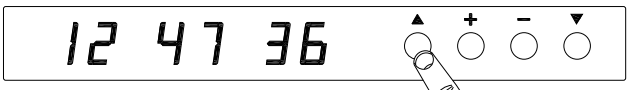


To select any of the modes whilst they are displayed in the function mode press the Up button. This allows the user to enter a specific mode and make any necessary changes to the related settings.

To progress through the options use the Up button and to alter the values for these options using the Plus and Minus buttons. On completion of any changes the Up and Down buttons can be used to save the settings and to step forward or backward through any other options before returning to the normal time display.

When menu option or value is selected, that option or value will flash.

5200 Function Menu Structure



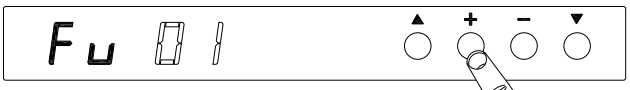
Normal time display: Press Up button to enter 'Function Menu'.

Function Menu 'Time Setting' option is selected (see Section 4): Press Up button to access this option, Plus to step on or Down to exit.

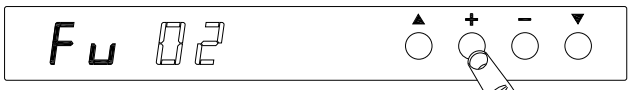
Function Menu 'Location Setting' option is selected (see Section 5): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'Synchronisation Setting' option is selected (see Section 6): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'Network Setting' option is selected* (see Section 7): Press Up button to access this option, Plus to step on or Down to exit.



Function Menu 'zCode Output 1 Setting' option is selected (see Section 8): Press Up button to access this option, Plus to step on or Down to exit.



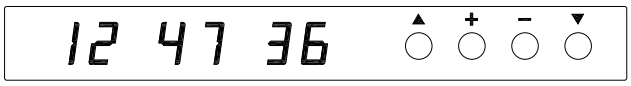
Function Menu 'zCode Output 2 Setting' option is selected* (see Section 8): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'Serial Setting' option is selected (see Section 9): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'Audio Time Code Output 1 Setting' option is selected* (see Section 10): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'Audio Time Code Output 2 Setting' option is selected* (see Section 10): Press Up button to access this option, Plus to step on or Down to exit.

Function Menu 'System Setting Menu' optoin is selected (see Section 10): Press Up button to access this option, Plus to step on or Down to exit.



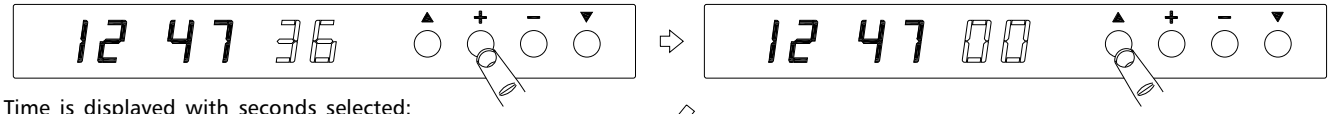
Normal time display.

* Menu option only visible when relevant option is installed in master clock.

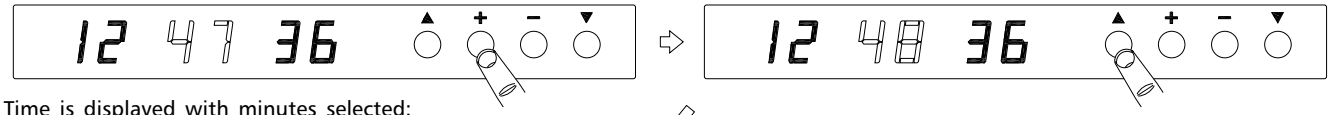
4 - Time Setting Procedure

Normal time display: Press *Up* button to enter 'Function Menu'.

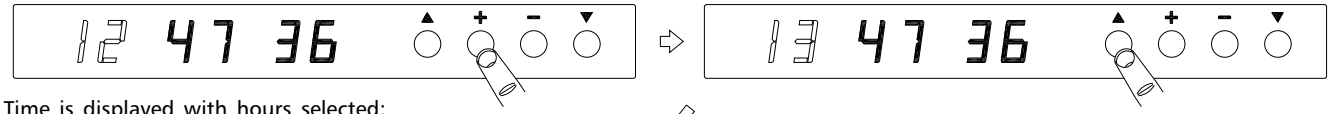
Function Menu 'Time Setting' option is selected: Press *Up* button to access this option.



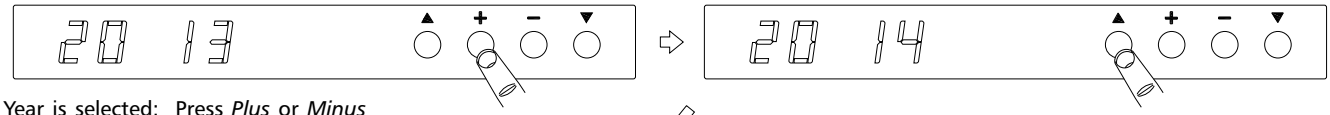
Time is displayed with seconds selected: Press *Plus* button to zero seconds or *Up* button to step on to minutes setting.



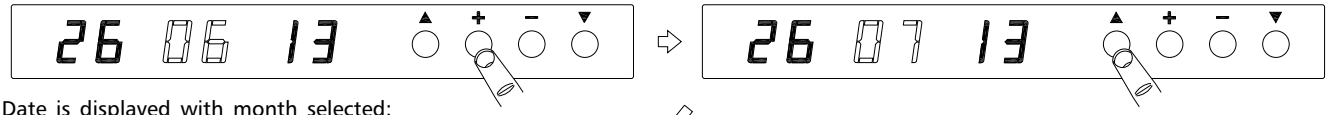
Time is displayed with minutes selected: Press *Plus* or *Minus* buttons to increment or decrement value *or Up* button to step on to hours setting.



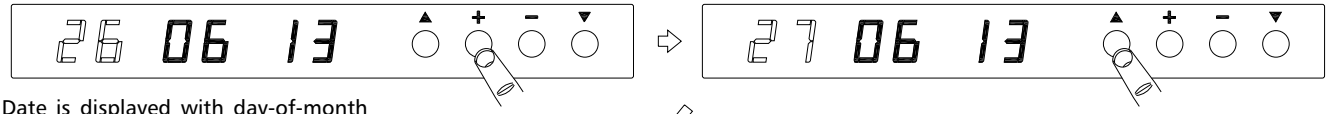
Time is displayed with hours selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to year setting.



Year is selected: Press *Plus* or *Minus* buttons to increment or decrement *value or Up* button to step on to month setting.



Date is displayed with month selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to day-of-month setting.



Date is displayed with day-of-month selected: Press *Plus* or *Minus* butons to increment or decrement value or *Up* button to exit.

Normal time display.

5 - Location Setup

The 5200 series master clocks provides advanced time zone functionality. Regardless of time synchronisation source, the 5200 series units can be used to provide time and date information referenced to UTC, user 'local' time or other custom time zone. Incorporating 'Set Once' technology, the 5200 series units will automatically calculate future seasonal time changes for all 83 of the preset time location code settings (where daylight savings changes are implemented).

Setting the location

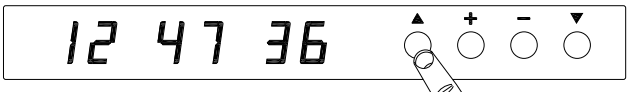
For installations where the output of the 5200 series master clock is to be referenced to UTC / GMT, the location code should be set to 00. For installations where the output of the 5200 series unit is to be referenced to the 'local' time zone, select the appropriate location code from the table opposite. (e.g. For a unit installed in Birmingham, England, where 'local' time output is required, location code 01 should be used.)

User Programmable Time Zone

For time-offsets and daylight saving time change dates not covered by the location codes on page 9, a user programmable time zone is provided. Information regarding the time offset from UTC and any daylight saving change rules may be input via a 12 digit code.

Please contact our technical department for further information regarding this function.

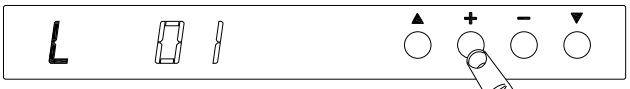
Location Code Setting Procedure



Normal time display: Press *Up* button to enter 'Function Menu'.

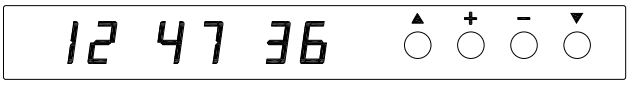
Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Location Setting' option is selected.

Function Menu 'Location Setting' option is selected: Press *Up* button to access this option.



Current Location Code is selected: Press *Plus* or *Minus* buttons to increment or decrement value.

New Location Code is selected: Press *Up* button to exit.



Normal time display.

Time Zone Locations

Code	Time Zone / City / Location	UTC Offset	Seasonal Time Changes?
00	UTC+0 (ZULU), UTC, GMT	0	No
01	WET/WEST, GMT/BST, London, Lisbon	0	Yes
02	UTC+1 (ALPHA), WAT, Luanda, Angola	+1	No
03	CET/CEST, MEZ/MESZ, Brussels, Frankfurt	+1	Yes
04	UTC+2 (BRAVO), SAST, Johannesburg, Pretoria, South Africa	+2	No
05	EET/EEST, Greece - Athens, Ukraine - Kiev	+2	Yes
06	IST/IDT, Israel - Tel Aviv	+2	Yes
07	MSK-1, Russia - Kaliningrad	+3	No
08	UTC+3 (CHARLIE), AST, Iraq - Baghdad, S Arabia - Riyadh	+3	No
09	MSK, Russia - Moscow	+4	No
10	IRST/IRDT, Iran - Tehran	+3½	Yes
11	UTC+4 (DELTA), GST, UAE - Dubai, Abu Dhabi	+4	No
12	AZT/AZST, Azerbaijan - Baku	+4	Yes
13	AFT, Afghanistan - Kabul	+4½	No
14	UTC+5 (ECHO), TMT, Turkmenistan - Ashgabat	+5	No
15	PKT, Pakistan - Islamabad	+5	No
16	YEKT, MSK+2, Russia - Yekaterinburg	+6	No
17	IST, India - New Delhi, Mumbai	+5½	No
18	UTC+6 (FOXTROT), BST, Bangladesh - Dhaka	+6	No
19	OMST, MSK+3, Russia - Omsk	+7	No
20	MMT, Myanmar - Naypyidaw	+6½	No
21	UTC+7 (GOLF), WIB, Indonesia - Jakarta	+7	No
22	KRAT, MSK+4, Russia - Krasnoyarsk	+8	No
23	UTC+7½	+7½	No
24	UTC+8 (HOTEL), CST - Beijing, WITA, Central Indonesia, WST, Australia - Perth	+8	No
25	IRKT, MSK+5, Russia - Irkutsk	+9	No
26	UTC+9 (INDIA), JST, Japan - Tokyo, WIT, Eastern Indonesia	+9	No
27	YAKT, MSK+6, Russia - Yakutsk	+10	No
28	CST, Australia - Darwin	+9½	No
29	CST/CDT, Australia - Adelaide	+9½	Yes
30	UTC+10 (KILO), EST, Australia - Brisbane, ChST, Guam	+10	No
31	EST/EDT, Australia - Sydney, Tasmania - Hobart	+10	Yes
32	VLAT, MSK+7, Russia - Vladivostok	+11	No
33	UTC+10½	+10½	No
34	UTC+11 (LIMA), SBT, Solomon Islands - Honiara	+11	No
35	MAGT, MSK+8, Russia - Magadan	+12	No
36	UTC+12 (MIKE), MHT, Marshall Islands - Majuro, Kwajalein	+12	No
37	NZST/NZDT, New Zealand - Wellington, Auckland	+12	Yes
38	TKT, Tokelau - Fakaofo	+13	No
39	LINT, Line Islands - Kiritimati	+14	No
40	UTC-13	-13	No
41	UTC-12 (YANKEE)	-12	No
42	UTC-11 (X-RAY), Midway Islands	-11	No
43	UTC-10 (WHISKEY), HAST, Hawaii - Honolulu	-10	No
44	UTC-9 (VICTOR)	-9	No
45	AKST/AKDT, US - Alaska, Anchorage	-9	Yes
46	UTC-8 (UNIFORM), PST, US - Pitcairn Islands, Adamstown	-8	No
47	PST/PDT, US - Pacific, L.A.	-8	Yes
48	UTC-7 (TANGO), US - Arizona, Phoenix	-7	No
49	MST/MDT, US - Mountain, Denver	-7	Yes
50	UTC-6 (SIERRA), Costa Rica - San Jose	-6	No

Time Zone Locations - cont.

Code	Time Zone / City / Location	UTC Offset	Seasonal Time Changes?
51	EST/CST, Mexico - Mexico City	-6	Yes
52	CDT/CST, US - Central, Chicago	-6	Yes
53	UTC-5 (ROMEO), PET, Peru - Lima	-5	No
54	EST/EDT, US - Eastern, New York	-5	Yes
55	VET, Venezuela - Caracas	-4½	No
56	UTC-4 (QUEBEC), BOT, Bolivia - La Paz	-4	No
57	CLT/CLST, Chile - Santiago	-4	Yes
58	ADT/AST, US - Atlantic	-4	Yes
59	PYT/PYST, Paraguay - Asuncion	-4	Yes
60	UTC-3½	-3½	No
61	NST/NDT, US - Newfoundland	-3½	Yes
62	UTC-3 (PAPA), ART, Argentina - Buenos Aires	-3	No
63	BRT/BRST, Brazil, - Brasilia, Sao Paulo	-3	Yes
64	WGT/WGST, Greenland (West) - Nuuk	-3	Yes
65	PMST/PMDT, US - Pierre & Miquelon	-3	Yes
66	UYT/UYST, Uruguay - Montevideo	-3	Yes
67	UTC-2½	-2½	No
68	UTC-2 (OSCAR)	-2	No
69	UTC-1 (NOVEMBER), CVT, Cape Verdi - Praia	-1	No
70	AZOT/AZOST, Portugal - Azores	-1	Yes
71	EGT/EGST, Greenland (East) - Ittoqqortoormiit	-1	Yes
72	Morocco - Rabat, Casablanca	0	Yes
73	WT/WST, Western Sahara - El Aaiún	0	Yes
74	Namibia - Windhoek	+1	Yes
75	Egypt - Cairo	+2	No
76	Gaza - Gaza	+2	Yes
77	Jordan - Amman	+2	Yes
78	Lebanon - Beirut	+2	Yes
79	Syria - Damascus	+2	Yes
80	West Bank - Bethlehem	+2	Yes
81	NPT Nepal - Kathmandu	+5¾	No
82	FJT/FJST, Fiji - Suva	+12	Yes
83	SST, Samoa - Apia	+13	Yes
98	Custom Location	n/a	n/a
99	Blank Display	n/a	n/a

6 - Synchronisation Method Setup

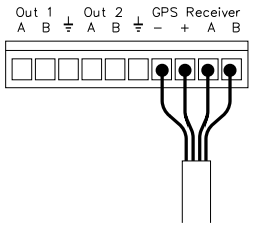
To provide an increased level of accuracy, the 5200 series master clocks can be configured to synchronise to one of the following sources.

A number of the synchronisation methods require additional user input (e.g. NTP synchronisation requires IP address of time server to be specified), in order to fully configure the master clock. Please refer to appropriate sub-section for further details regarding specific synchronisation methods.

Synchronisation Methods

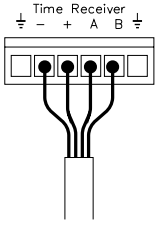
Code	Synchronisation Source	Notes
None	Standalone operation using internal TCXO	No external time reference, accuracy better than 0.1 sec./day at 0-45°C.
NTP	Network Time Protocol - Synchronisation from NTP time server	5200 and 5201 models only. See sub-section 5.1.
GPS	488HS3 GPS Receiver - Synchronisation from GPS satellites	Very accuate time source, can be used anywhere in the world. See sub-section 5.2.
DCF	484.03 DCF Recevier - Synchronisation from DCF radio time signal	Accurate time source, can be used in central Europe. See sub-section 5.3
MSF	484.02 MSF Recevier - Synchronisation from MSF radio time signal	Accurate time source, can be used in UK. See sub-section 5.3
IRIG	IRIG-B Signal - Synchronisation from 1KHz Amplitude Modulated IRIG-B signal	Requires IRIGIN module to be fitted. See sub-section 5.4

488HS3 to 52xx Cable Connections



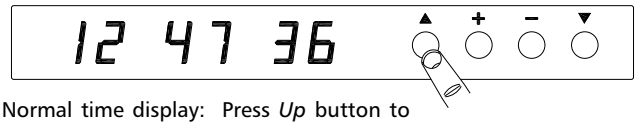
Red ..... GPS +
Blue ..... GPS -
Yellow..... GPS A
Green ..... GPS B

488HS3 to /SYNC2 Module Cable Connections

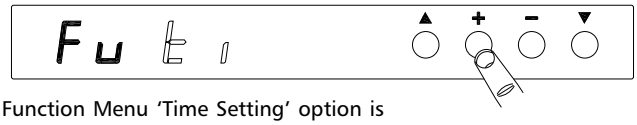


Red ..... GPS +
Blue ..... GPS -
Yellow..... GPS A
Green ..... GPS B

Synchronisation Method Setting Procedure

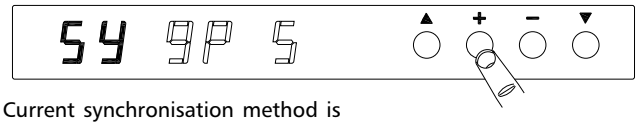


Normal time display: Press *Up* button to enter 'Function Menu'.

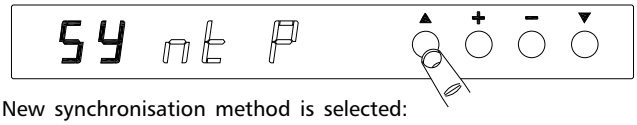


Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Synchronisation Setting' option is selected.

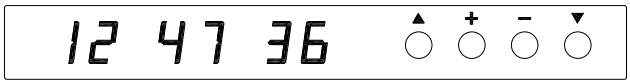
Function Menu 'Synchronisation Setting' option is selected: Press *Up* button to access this option.



Current synchronisation method is selected: Press *Plus* or *Minus* buttons to change between synchronisation options.



New synchronisation method is selected: Press *Up* to exit.



Normal time display.

6.1 - NTP Synchronisation Setup

The 5200 and 5201 master clocks can be configured to synchronise to an NTP time source on a TCP/IP Computer network.

The master clock should be connected to TCP/IP network via RJ45 10/100Base-T Ethernet adaptor on rear of unit.

The network settings of the master clock should be configured as per Section 7, prior to configuring the NTP synchronisation settings.

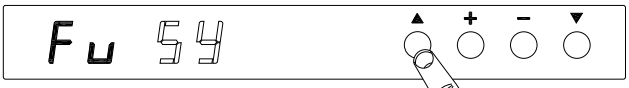
The IP address of the NTP time server is specified by individually entering the four octets of the address.

Note: If Full DHCP support is selected during the network settings configuration, the master clock will automatically acquire the NTP time server IP address from the DHCP server. In this configuration, the master clock shall display DHCP in place of the below NTP time server IP address setting screens.

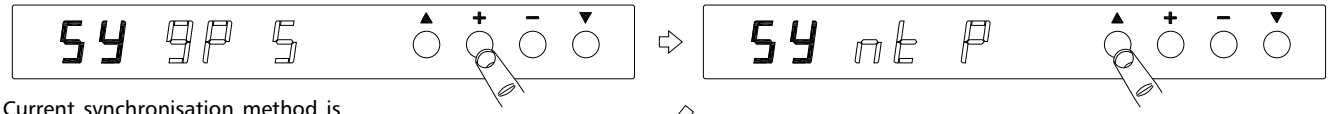
NTP Synchronisation Setting Procedure

Normal time display: Press *Up* button to enter 'Function Menu'.

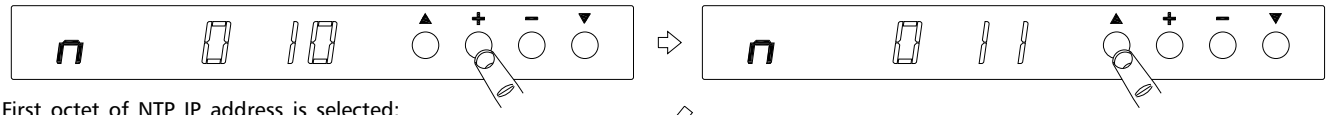
Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Synchronisation Setting' option is selected.



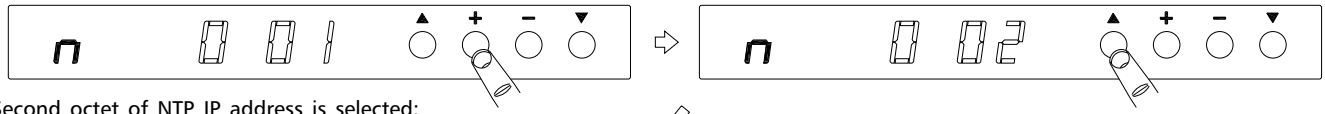
Function Menu 'Synchronisation Setting' option is selected: Press *Up* button to access this option.



Current synchronisation method is selected: Press *Plus* or *Minus* buttons until NTP is displayed then press *Up* button to access NTP settings.



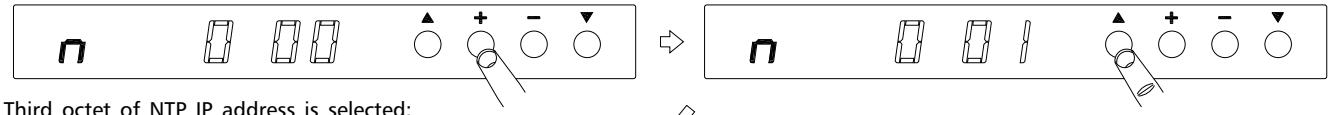
First octet of NTP IP address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to second octet of NTP IP address.



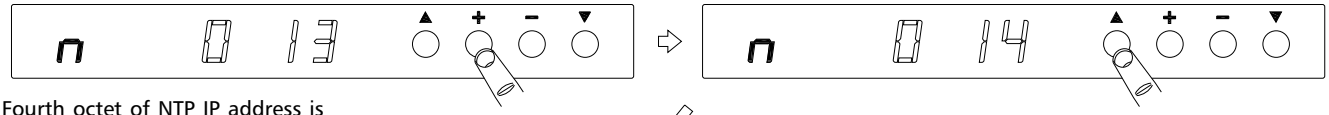
Second octet of NTP IP address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to third octet of NTP IP address.

Continued overleaf.

NTP Synchronisation Setting Procedure Continued



Third octet of NTP IP address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to fourth octet of NTP IP address.



Fourth octet of NTP IP address is selected: Press *Plus* or *Minus* buttons to increment or decrement value *or Up* button to exit.

Normal time display.

6.2 - GPS Synchronisation Setup

The 5200 series master clocks can be configured to synchronise to GPS time code via 488HS3 GPS receiver to provide a highly accurate time source.

The 488HS3 GPS receiver system is designed to be automatically synchronised to time signals transmitted from the Global Positioning System (GPS) navigation network. The GPS constellation consists of 28 operational satellites, operating in 12 hour orbits at an altitude of 20,200km.

The 488HS3 GPS receiver has been designed for simple installation and operation by the end-user, requiring only a 4 wire interconnection to the 5200 series master clock. When synchronised to a 488HS3 GPS receiver system, the 5200 series master clock output signals are maintained within 10uS of UTC.

The reception gain pattern of both GPS systems is designed for full, upper hemispherical coverage with the gain diminishing at low elevations. This cross-section is consistent through 360 degrees and so the 3 dimensional gain pattern is a symmetrical spheroid surface.

Advantages of GPS time synchronisation:

- Very accurate synchronisation
- Can be used anywhere in the world
- Better resistance to EM interference

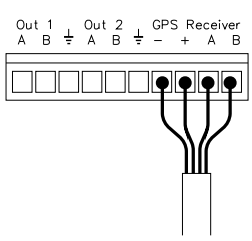
Disadvantages of GPS time synchronisation:

- Antenna needs to be mounted externally with a clear view of 75% of the sky.

488HS3 System Installation

To ensure ease of operation and to remove the possibility of operator error, the 488HS3 GPS system is designed to self initialise.

Ensure that the 5200 series master clock is disconnected from the mains power supply when making connections to the 488HS3 GPS receiver system.



488HS3 Connections

Red	GPS +
Blue	GPS -
Yellow	GPS A
Green	GPS B

1 Install the 488HS3 unit horizontally using the post mounting kit provided. Ensure that the unit has a clear view of at least 75% of the sky. If the sky view is reduced the interval between 'switch-on' and system time synchronisation will be considerably increased.

2 A connection between the 488HS3 and the 5200 series master clock should be made using the 25 metre four core cable supplied. If a longer cable distance is required Appendix A should be consulted for suitable cable specifications. The maximum distance between the GPS system and the 5200 series master clock is 200m.
The cable screen should be connected to the EMC ground connection on the 10 way terminal block, located on the rear of the 5200 series master clock. The screen is supplied pre-connected on 488HS3 units with captive cable connections.

3 The four GPS cable cores should be connected to the input connections located on the 10 way terminal block on the rear of the 5200 series master clock, as shown in the diagram above.

4 Connect the power supply to the 5200 series master clock.

5 Once the power has been applied the receiver will automatically begin to search the sky for all available satellites, during this process the yellow LED will flash. After three satellites have been acquired the yelloiw LED will stop flashing and become constantly

illuminated and the green LED will flash, indicating that a precise date and time has been calculated from the satellite data transmissions. From a 'cold' start this process will typically take less than 10 minutes.

6 Ensure that the 5200 series master clock is configured to synchronise from the GPS signal as per instruction at start of section.

Once the green LED has illuminated the synchronising time signals are transmitted from the GPS system to the 5200 series master clock. The master clock should lock in and display the correct time within 5 minutes.

6.3 - MSF and DCF Synchronisation Setup

The 5200 series master clocks can be configured to synchronise to either MSF or DCF radio time code via either 484.02 or 484.03 radio receivers provide an accurate time source.

MSF and DCF are the two most widely used radio time code signals. The DCF signal is derived from the atomic clocks at the Physics Institute of Brunswick and transmitted at a frequency of 77.5KHz from Manflingen, near Frankfurt in Germany. The MSF signal is referenced to the Caesium Beam Oscillators at the National Physical Laboratory and transmitted on a frequency of 60KHz from Anthorn in the United Kingdom.

Under normal circumstances the DCF signal provides reliable operation at distances of up to 1500km, MSF signals are normally usable up to 1000km from the transmitter. Greater operating ranges are possible at night.

When synchronised to MSF or DCF using a 484 radio receiver the 5200 series master clock output signals are maintained within 30mS of UTC.

Advantages of MSF and DCF time synchronisation:

- Lower purchase cost than GPS
- Can sometimes be installed internally.

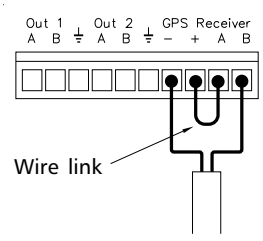
Disadvantages of MSF and DCF time synchronisation:

- Can be difficult to find good location for signal reception.
- Suffers greatly from EM interference - Avoid locating near computers, electronic equipment, fluorescent lighting, lift equipment, metal girders, reinforced concrete walls and all other sources of electrical noise.
- MSF is off-air for maintenance on the second Thursday of every March, June, September and December. MSF status can be checked at:

  `http://www.npl.co.uk/time`

Installation

Ensure that the 5200 series master clock is disconnected from the mains power supply when making connections to the 484 radio receiver.



484.02 & .03 Connections

Red ..... GPS B

Black ..... GPS -

Link GPS + and GPS A

1 Install the 484 radio receiver as per the following guidelines.

- At least 2.5 metres from the 5200 series master clock.
- At greatest practical distance from:
  Other electronic equipment including computers, fluorescent lights and signs, metal girders, reinforced concrete walls and any other sources of electrical noise.
- On the side of the building nearest Anthorn (MSF) or Frankfurt (DCF).
- Preferably on the outside of the building (484.02 and 484.03 only) as high as possible. The case is weatherproof to IP65, however it is preferable to provide some protection from direct rain.
- With the cable entry on the lower face of the case. (484.02 and 484.03 only)

2 A connection between the 484 and the 5200 series master clock should be made using the 5 metre two core cable supplied. If a longer cable distance is required Appendix A should be consulted for suitable cable specifications. The maximum distance between the radio receiver and the 5200 series master clock is 200m.
A Screened cable should be used to connect the 484 radio receiver to the 5200 series master clock in areas of high electrical noise. The screen should be connected to the EMC grounding point on 5200 series master clock only.

3 The two radio receiver cable cores should be connected to the input connections located on the 10 way terminal block on the rear of the 5200 series master clock, as shown in the diagram above.

4 Connect the power supply to the 5200 series master clock.

5 Ensure that the 5200 series master clock is configured to synchronise from the MSF or DCF signal as per instruction at start of section.

Alignment

The 484.02 (MSF) and 484.03 (DCF) radio receivers have dual ferrite antennas, which normally permit location regardless of orientation to the transmitter. The receiver is mounted by means of four fixing holes in the rear surface which are accessed after removing the front cover. The four mounting holes are located outside of the central sealed compartment.

The front cover of the 484.02 and 484.03 receivers may be removed to enable the indicator LED to be viewed.

The alignment of the receiver is correct when the LED flashes once per second.

Signal reception

In good conditions the 5200 series master clock will take three minutes to synchronise with the transmitted time code from either DCF or MSF. When the 5200 series master clock is 'locked' to the transmitted signal, the Lock LED, is illuminated continuously. During periods of signal failure or signal corruption the clock will maintain timekeeping using its internal crystal oscillator.

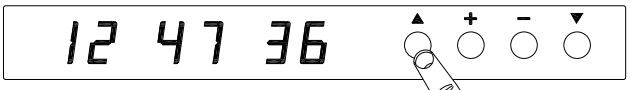
6.4 - IRIG-B Synchronisation Setup

When fitted with the IRIGIN option module, the 5200 series master clocks can be configured to synchronise to a 1KHz amplitude modulated IRIG-B signal.

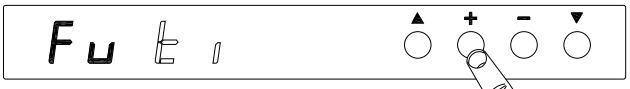
The master clock should be connected to IRIG-B signal via BNC connector on rear of unit.

To allow the use of non-UTC based IRIG-B signals (i.e. time information provided is offset from UTC), the master clock should be programmed with the number of minutes offset between UTC and the synchronising time signal. Offset range is between –720 minutes (-12 hours) and +720 minutes (+12 hours) of UTC, selectable in 30 minute increments.

IRIG-B Synchronisation Setting Procedure

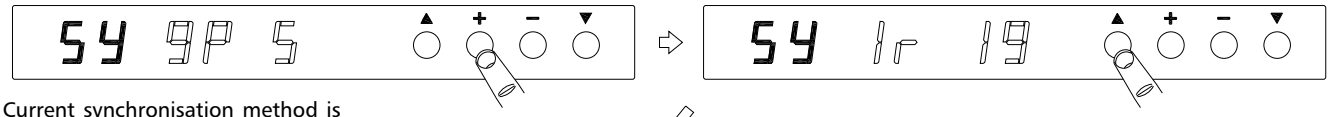


Normal time display: Press *Up* button to enter 'Function Menu'.

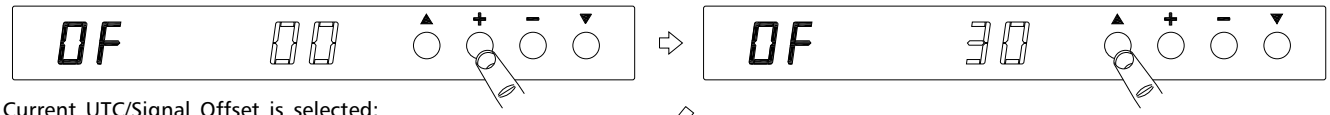


Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Synchronisation Setting' option is selected.

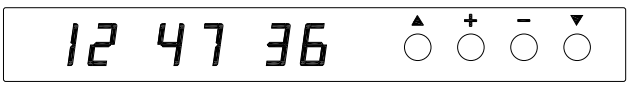
Function Menu 'Synchronisation Setting' option is selected: Press *Up* button to access this option.



Current synchronisation method is selected: Press *Plus* or *Minus* buttons until IRIG is displayed then press *Up* button to access IRIG-B settings.



Current UTC/Signal Offset is selected: Press *Plus* or *Minus* buttons until required offset in minutes is selected, then press *Up* button to exit.



Normal time display.

7 - Network Setup

The 5200 and 5201 master clocks can be configured to operate as an NTP time server on a TCP/IP Computer network.

The master clock should be connected to TCP/IP network via RJ45 10/100Base-T Ethernet adaptor on rear of unit.

The network settings of the master clock should be configured as detailed below. The IP address, subnet mask and gateway address of the master clock is specified by individually entering the four octets of the address.

Note: If the DHCP setting is set to either Full or Yes, the master clock will automatically acquire the IP address, subnet mask and gateway address from the DHCP server. In this configuration, the master clock shall not display the IP address, subnet mask and gateway address setting screens.

Supported Protocols

Time Protocol (RFC868)

RFC868 defines the original TIME protocol, which provides site-independent, machine-readable date and time in response to a request from a client PC.

When a request is received the 5200 or 5201 master clock responds with a 32-bit time value corresponding to the number of seconds since midnight of January 1st 1900. This representation of time will serve until the year 2036.

Time Protocol is supported in the UDP mode of operation. (RFC868)

NTP (RFC1305 & RFC1119)

The Network Time Protocol (NTP) is the most widely used computer time synchronisation protocol in use today. It provides a mechanism to both organise a synchronisation subnet and distribute precise time synchronisation information to the local clocks of all participating computers. In most parts of the Internet today it is possible to use NTP to provide accuracy's of tens of milliseconds, depending on the characteristics of the synchronisation source, stratum of operation, the local network paths and the client software used.

The NTP standard has been designed so that it can provide reliable operation with clients and servers of vastly different specifications and across network paths with diverse delay and jitter characteristics. Most users of Internet NTP synchronisation make use of the standard NTP distribution available from http://www.ntp.org. This software package includes the full suite of NTP options and algorithms and has been ported to a wide variety of hardware platforms ranging from Personal Computers (PC's) to supercomputers.

We would recommend that, in large hierarchical time distribution projects, the standard NTP distribution be used on the Stratum 2 and 3 servers for maximum redundancy and client availability.

Network Time Protocol (NTP) v2, v3 and v4 clients are supported in unicast mode of operation. (RFC1305 & RFC1119)

SNTP (RFC2030 & RFC1769)

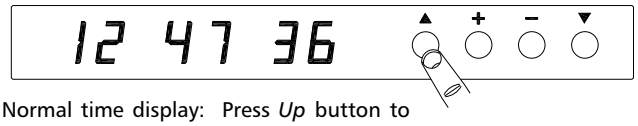
Simple Network Time Protocol (SNTP) is an adaptation of NTP, which can be used for applications where the ultimate performance and associated overhead of the full NTP implementation is not required.

Most PC client software is based on the SNTP specification and certainly for most intranet applications will provide a higher degree of accuracy than is required.

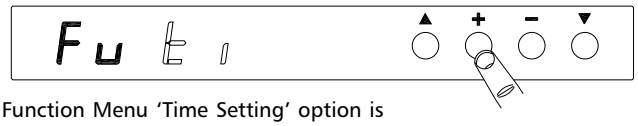
Simple Network Time Protocol (SNTP) v3 and v4 clients are supported in unicast mode of operation. (RFC2030 & RFC1769)

Please see Appendix B for further details regarding TCP/IP network concepts.

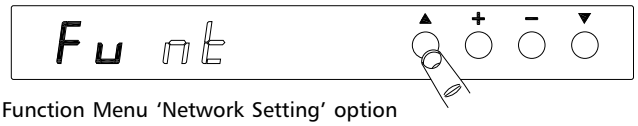
Network Configuration Procedure



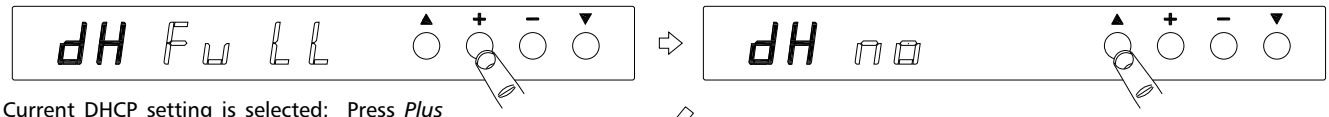
Normal time display: Press *Up* button to enter 'Function Menu'.



Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Network Setting' option is selected.



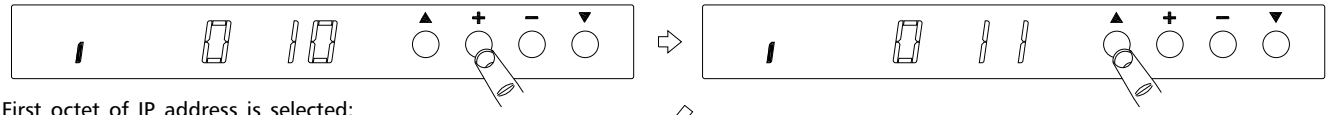
Function Menu 'Network Setting' option is selected: Press *Up* button to access this option.



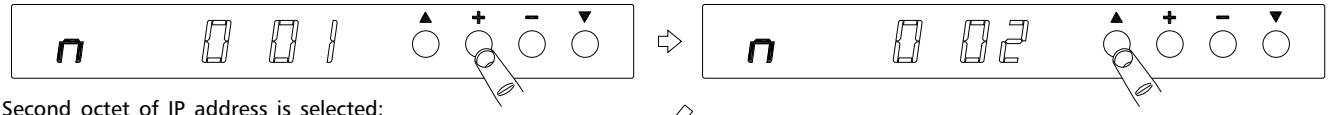
Current DHCP setting is selected: Press *Plus* button to select between FULL, Yes or No, then press *Up* button to step on to first octet of IP address (or exit if DCHP Full or Yes is selected).

Continued overleaf.

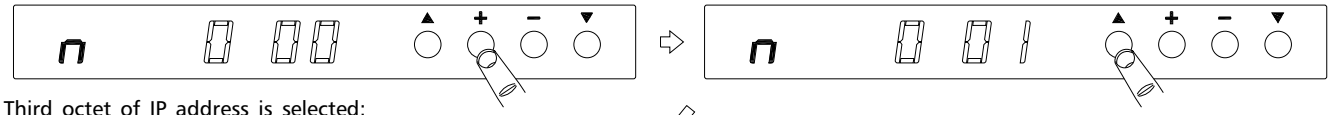
Network Configuration Procedure Continued



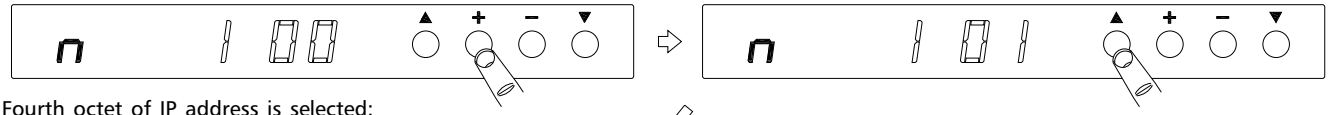
First octet of IP address is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to second octet of IP address.



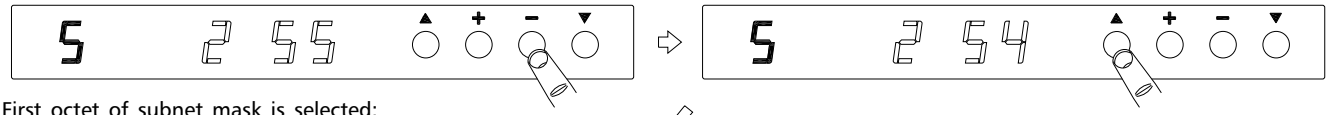
Second octet of IP address is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to third octet of IP address.



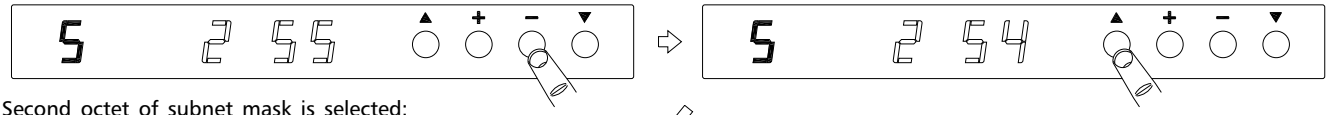
Third octet of IP address is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to fourth octet of IP address.



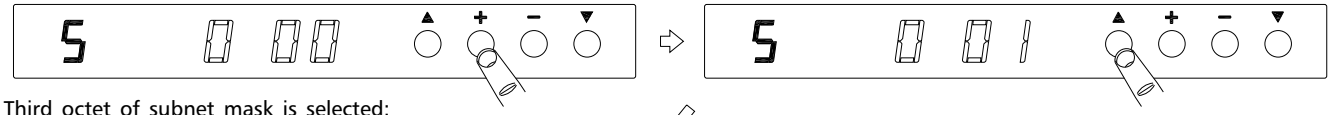
Fourth octet of IP address is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to first octet of subnet mask.



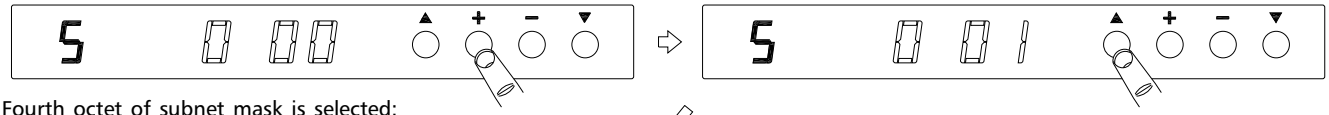
First octet of subnet mask is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to second octet of subnet mask.



Second octet of subnet mask is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to third octet of subnet mask.



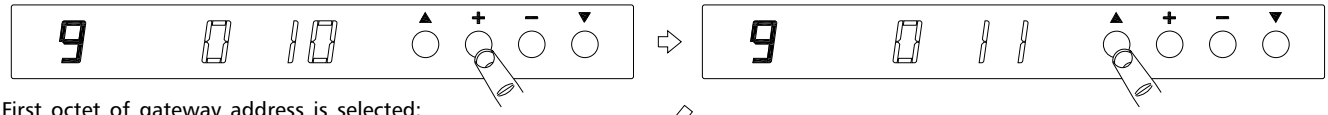
Third octet of subnet mask is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to fourth octet of subnet mask.



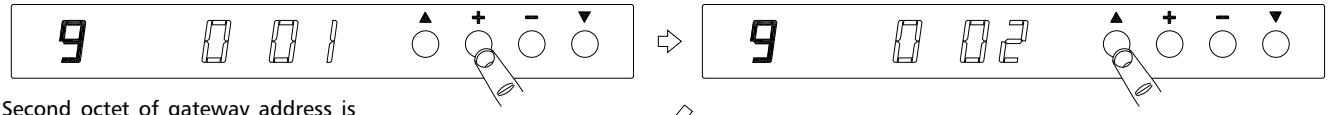
Fourth octet of subnet mask is selected:
Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to first octet of gateway address.

Continued overleaf.

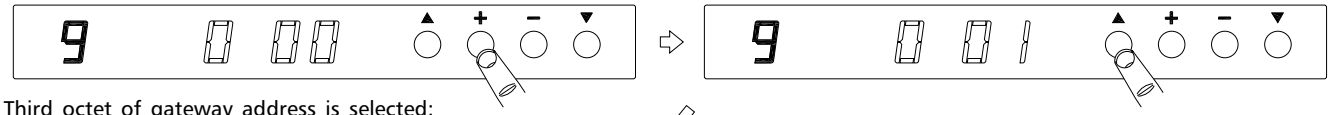
Network Configuration Procedure Continued



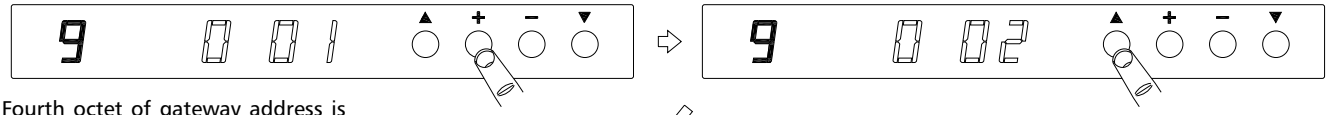
First octet of gateway address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to second octet of gateway address.



Second octet of gateway address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to third octet of gateway address.



Third octet of gateway address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to fourth octet of gateway address.



Fourth octet of gateway address is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to exit.

Normal time display.

8 - zCode Output Setup

The 520x series master clocks are fitted with either one off zCode output (5201) or two off zCode outputs (5200) for the synchronisation of digital and/or analogue clocks.

Each zCode output can be configured to provide either w482® time code for the synchronisation of 4000E or 400A series digital clocks and 47xA series time zone displays or 24V alternate polarity impulses.

When both zCode outputs are being implemented (5200 units only), the setup procedure should be repeated for zCode output 2.

zCode Status Indicators

Please see Section 11 for details regarding the zCode front panel indicator LEDs.

zCode Output Configuration

Each zCode output needs to be configured to provide the required output (e.g. w482® time code, 24V alternate polarity impulses). The output types are configured via the System Settings Menu. Following the instructions in Section 10, ensure that each output is configured correctly.

zCode Output Types

Code	Output Type	Notes
OFF	Output disabled	
u482	w482/48x0 time code	Used for synchronisation of 4000E, 47xxN, 400A and 47xA series digital clocks.
InP	24V Alternate Polarity Impulses	Used for synchronisation of analogue clocks with 24V alternate polarity impulse movements.
DCF	DCF time code signal	

When the zCode output is configured for 24V alternate polarity impulse, the appropriate impulse type needs to be selected.

Impulse Output Types

Code	Impulse Type	Notes
1SA	1 second - standard	0.4 sec. long impulse, 120 pulses per minute catch up speed.
1SB	1 second - slow correction	0.4 sec. long impulse, 85 pulses per minute catch up speed.
1SC	1 second - seconds only	0.4 sec. long impulse, used for the seconds movement on analogue clocks with separate seconds and minutes mechanisms.
30S	½ minute	0.5 sec. long impulse, 30 pulses per minute catch up speed.
1nA	1 minute - standard	0.5 sec. long impulse, 30 pulses per minute catch up speed.
1nB	1 minute - slow correction	3.0 sec. long impulse, 6 pulses per minute catch up speed.
1nC	1 minute - fast correction	0.5 sec. long impulse, 120 pulses per minute catch up speed.

w482® and 48x0 Time Code

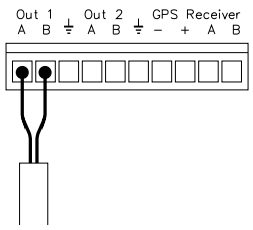
The w482® signal was developed for controlling electronic clocks, using a single cable pair data interconnection, in electrically noisy environments. A principal advantage of w482® is the ability to provide time information in any one of fifteen different synchronised time zones. All fifteen time zones can be individually configured from the front panel of the 5200 series master clock, using 'Set Once' technology to allow automatic seasonal time change correction. The 48x0 signal is transmitted at the same time as the w482 signal but is UTC based to allow synchronising devices to calculate world times / UTC offsets locally.

The w482® signal is transmitted at 4-24v amplitude and at a 50 bits per second data rate. The signal is virtually immune to electro-magnetic interference.

One 5200 series master clocks can control up to fifty off 4000E or 400A series digital clocks and 47xA series time zone displays located up to 1km from the master clock unit using a simple, non-critical cable pair.

w482® Time Code Wiring

The w482® signal is transmitted using a simple two-core cable. Each digital clock should be connected to the zCode time code output of the master clock in parallel, in either a 'daisy-chain' or a 'starwire' configuration. Please see Appendix A for further details regarding w482® time code interconnecting cable specifications.



w482 Connections

Polarity not critical.

w482® Commissioning

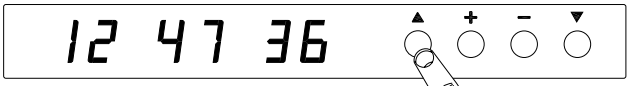
Ensure that the 5200 series master clock is disconnected from the mains power supply when making connections to the digital clocks.

1 Connect the 4000E, 400A or 47xA series digital clocks to the 5200 series master clock's zCode output terminals as shown in the diagram above (and relevant digital clock user manual).
If a screened cable is being used, the screen should be connected to the EMC ground connection on the 10 way terminal block, located on the rear of the 5200 series master clock.
Ensure that the 4000E, 400A or 47xA series digital clocks are programmed for w482® time code synchronisation. If the 4000E, 400A or 47xA series digital clock is to be synchronised by a w482® time zone which is not Zone 1 (i.e. master clock local time), program the 4000E, 400A or 47xA series digital clock accordingly.
Refer to the 4000E, 400A or 47xA series digital clock operating and installation manual for more details.

2 Connect the power supply to the 5200 series master clock.

3 Decide what time you want to display on your digital clocks. If you just want to display Local Time, as previously programmed during 'Location Setting' (Section 5), system is ready for use.
If you have more than one time zone to display or want to display a different time zone from that set in the Location Setting, determine the zone location codes required as per the Location Code table (page 9) and program w482® Zones '2' - 'F' accordingly.

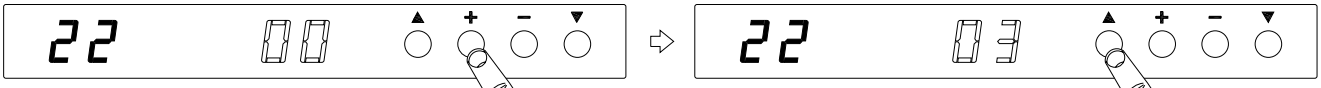
w482 Time Code Output Configuration



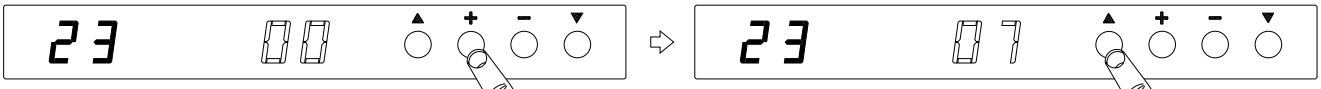
Normal time display: Press ▲ *Up* button to enter 'Function Menu'.

Function Menu 'Time Setting' option is selected: Press + *Plus* button until 'zCode Output 1' option is selected.

Function Menu 'zCode Output 1' option is selected: Press + *Up* button to access this option.

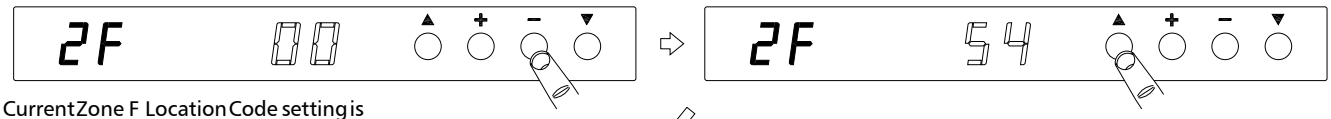


Current Zone 2 Location Code setting is selected: Press + *Plus* or – *Minus* buttons to increment or decrement value or ▲ *Up* button to step on to Zone 3 Location Code setting.

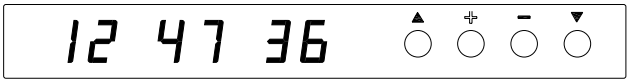


Current Zone 3 Location Code setting is selected: Press + *Plus* or – *Minus* buttons to increment or decrement value or ▲ *Up* button to step on to Zone 4 Location Code setting.

Repeat above procedure for Zones 4 to 9, then A to F as required. Any unused Zones can be left at existing settings (e.g. Location Code 00).



Current Zone F Location Code setting is selected: Press + *Plus* or – *Minus* buttons to increment or decrement value or ▲ *Up* button to exit.



Normal time display.

24V Alternate Polarity Impulses

Each zCode output may be programmed by the user for one of a number of different combinations of pulse length and repetition rate to drive impulse clocks requiring one second, half minute or one minute alternate polarity impulses.

The fully protected output drive circuits detect power failure and short circuit line fault conditions which are automatically corrected for on fault removal.

Automatic Correction

Automatic time correction following power failures, the removal of fault conditions and after seasonal time changes is carried out by increasing the pulse repetition rate or by stopping the impulses depending on which action will result in a shorter correction time.

In the *1 second - standard* mode the system will take one hour to correct for each hour that the slave clocks are behind the master.

In the *1 second - slow correction* mode the system will take approximately one and a half hours to correct for each hour that the slave clocks are behind the master.

The *1 second - seconds only* mode is intended for use with 4 wire slave clocks requiring both minute and second impulses.

24V Alternate Polarity Impulse Wiring

The 24V alternate polarity impulses are transmitted using a simple two-core cable. Each impulse clock should be connected to the zCode time code output of the master clock in parallel, in either a 'daisy-chain' or a 'starwire' configuration.

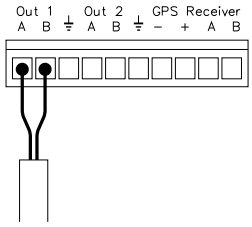
Please see Appendix A for further details regarding 24V alternate polarity impulse interconnecting cable specifications.

Visual Indication of Operation

When operating, the zCode output LEDs on the front panel of the unit will in time with impulses being transmitted.

24V Alternate Polarity Commissioning

Ensure that the 5200 series master clock is disconnected from the mains power supply when making connections to the digital clocks.



Impulse Connections

1 Ensure that time shown on all impulse clocks is the same.

2 Connect the impulse clocks to the 5200 series master clock's zCode output terminals as shown in the diagram above (and relevant impulse clock user manual).
If a screened cable is being used, the screen should be connected to the EMC ground connection on the 10 way terminal block, located on the rear of the 5200 series master clock.

3 Connect the power supply to the 5200 series master clock.

4 Access zCode output settings in System menu (see Section 10 for further details) and ensure that correct impulse type is selected as per table on page 18.

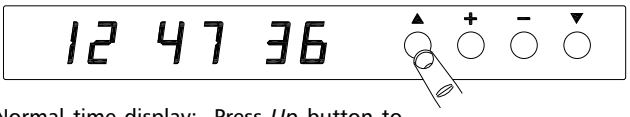
5 Use Pulse function to send a single impulse to all connected impulse clocks.

6 Examine all connected impulse clocks. Reverse cable connections on units which appear to have 'missed' impulse and manually advance these units by two impulses. All impulse clocks connected to output should now be operating at same polarity.

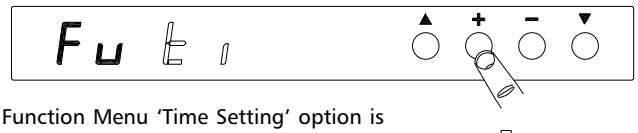
6 Access zCode Output Menu and enter *Impulse Time* (i.e. time shown on analogue clocks).

7 Use Run function to start impulses. 5200 series master clock will automatically calculate if it is quicker to send *catch up* impulses or temporarily halt impulses until *Impulse Time* and actual time match. When *Impulse TIme* and actual time match, impulses will be sent at usual rate.

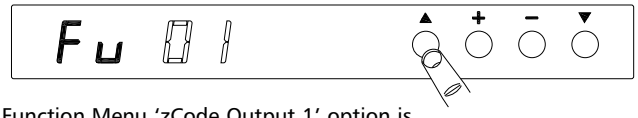
24V Alternate Polarity Output Configuration



Normal time display: Press *Up* button to enter 'Function Menu'. ⇩

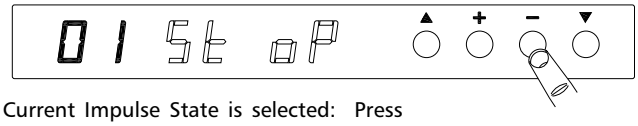


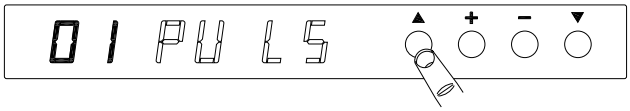
Function Menu 'Time Setting' option is selected: Press *Plus* button until 'zCode Output 1' option is selected. ⇩



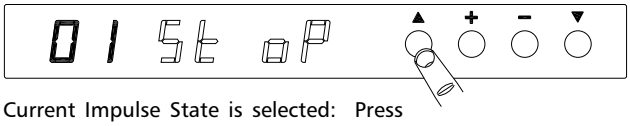
Function Menu 'zCode Output 1' option is selected: Press *Up* button to access this option. ⇩

24V Alternate Polarity Output Configuration Continued



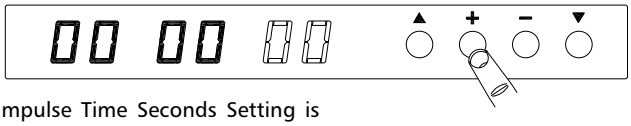


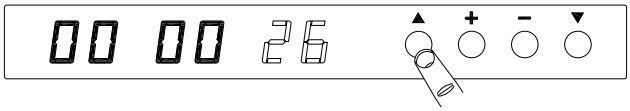
Current Impulse State is selected: Press *Minus* button to enter Pulse mode or *Up* button to enter *Impulse Time*.



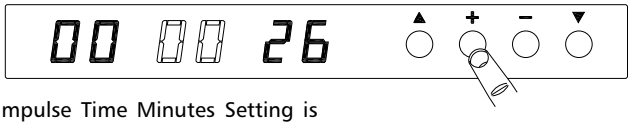
Pulse mode is selected: Press *Plus* button to return to Impulse State mode or *Up* button to transmit single impulse.

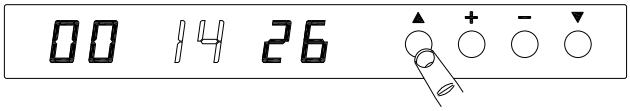
Current Impulse State is selected: Press *Minus* button to enter Pulse mode or *Up* button to enter *Impulse Time*.



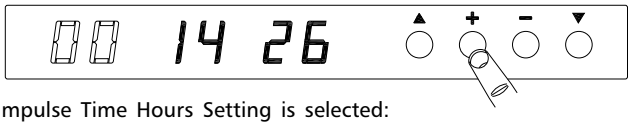


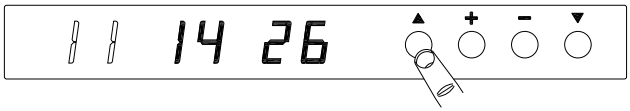
Impulse Time Seconds Setting is selected: Press *Plus* or *Minus* buttons to increment or decrement Seconds value or *Up* button to step on to Minutes setting.



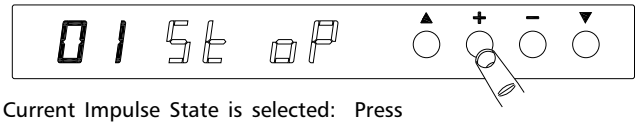


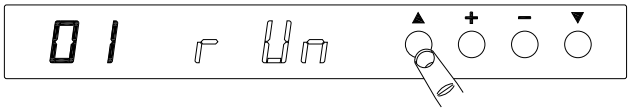
Impulse Time Minutes Setting is selected: Press *Plus* or *Minus* buttons to increment or decrement Minutes value or *Up* button to step on to Hours setting.



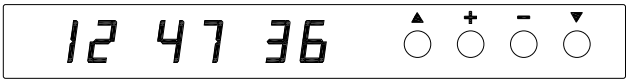


Impulse Time Hours Setting is selected: Press *Plus* or *Minus* buttons to increment or decrement Hours value or *Up* button to step on to return to Impulse State setting.





Current Impulse State is selected: Press *Plus* button to start impulses or *Up* button to enter *Impulse Time* or return to normal time display if impulses are running.



Normal Time Display.

9 - Serial Output Setup

The 5200 series master clocks are fitted as standard with one off RS232 and RS485/RS422 serial data output. The signals are accessed via the female DB9 connector labelled RS232/RS485 S1 mounted on the rear of the unit.

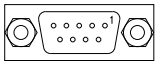
Additional serial outputs

When the 5200 series master clock is fitted with SER23 option module, two off additional serial outputs are available. Each serial output can be independently configured.

When multiple serial outputs are available, the setup procedure should be repeated for Serial Output 2 and 3.

Please note that RS232 level 1PPS is only available on S1 output.

RS232 and RS485/RS232 Serial Connections



DB9-F Connector

RS232
1 ..... 1PPS
2 ..... Transmitted Data (TXD)
3 ..... Received Data (RXD)
5 ..... Signal Ground (GND)

RS485/RS422
8 ..... 'A' - non-inverting
9 ..... 'B' - inverting

Note:
The 1PPS signal is at RS232 levels and goes from an R232 'zero' to an RS232 'one' for 100ms on the second edge.

Setting the Message Format

The 5200 series master clock has 85 different preprogrammed serial output messages as detailed on pages 23 to 25.

Setting the Output Message Time Offset

The 5200 series master clock serial output message may be referenced to the current Location Setting (see Section 5) or UTC/GMT.

Data Formats

Many of the serial message formats are user programmable. This allows the user to program information concerning the baud rate, data bits, parity, stop bits and serial repetition to ensure that the format chosen meets their requirements.

Some of the other serial data messages have factory preset transmission formats to ensure that system interconnection is trouble free.

Message Format

Wharton Format 1 (Code 1)

STX Su St Mu Mt Hu Ht Du Dt Mtu Mtt Yu Yt St ETX

Wharton Format 2 (Code 4)

T Yt Yu : Mtt Mtu : Dt Du : 0 W : Ht Hu : Mt Mu : St Su CR LF

Byte	Description	ASCII value
S	seconds	30h-39h
M	minutes	30h-39h
H	hours	30h-39h
W	day-of-week	31h-37h
D	day-of-month	30h-39h
Mt	month	30h-39h
Y	year	30h-39h
STX	start transmission	02h
ETX	end transmission	03h
CR	carriage return	0dh
LF	line feed	0ah
0	ASCII zero	30h
:	ASCII colon	3ah
St	status - see table	30h-3fh

where: t = tens
u = units

Status byte - ASCII value 30h-3fh

Bit 0 undefined.
Bit 1 0 = Winter time, 1 = Summer Time
Bit 2 0 = not synchronised, 1 = synchronised
Bit 3 0 = no early warning bit, 1 = early warning bit

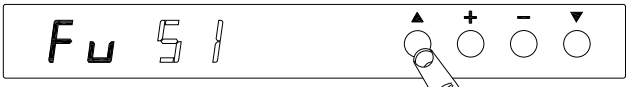
User programmable serial settings

Display	Setting	Range	Notes
bAud	Baud Rate	19 - 19200 baud, 96 - 9600 baud, 48 - 4800 baud, 24 - 2400 baud, 12 - 1200 baud.	Data transmission rate.
bitS	Data bits	7 - 7 data bits, 8 - 8 data bits.	Number of data bits in each ASCII character.
PAr	Parity	odd - Odd parity, EvE - Even parity, no - No parity.	Even and Odd Parity allow error checking of incoming signal.
StoP	Stop bits	1 - 1 stop bit, 2 - 2 stop bits.	Number of stop bits per character.
Rep	Serial Repetition	1SE - 1 serial message every sec, 1nn - 1 serial message every min, 5nn - 1 serial message every 5 min, 1 Hr - 1 serial message every hour, 24 Hr - 1 serial message every 24 hrs at Midnight, 4An - 1 serial message every 24 hrs at 4 AM, rSE - On demand, next second edge. P15 - 1 serial message at 15 mins past every hour.	The 'on demand' repetition setting allows the user to send one of the following ASCII characters to the 4860 and have it respond with the currently selected message. Valid 'on demand' characters: 's' (0x73), 'S' (0x53), 't' (0x74), 'T' (0x54) and '?' (0x3f)

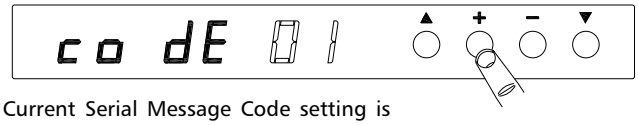
Serial Output Configuration

Normal time display: Press *Up* button to enter 'Function Menu'.

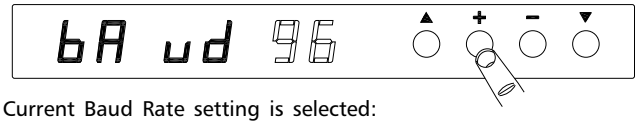
Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Serial Output 1 Setting' option is selected.

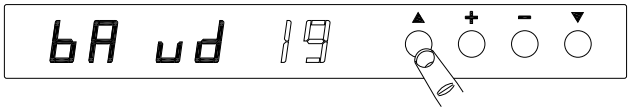


Function Menu 'Serial Output 1' option is selected: Press *Up* button to access this option.

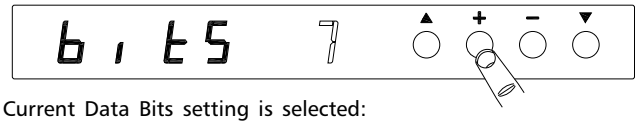


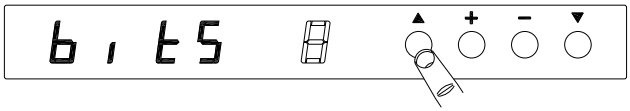
Current Serial Message Code setting is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to Baud Rate setting.



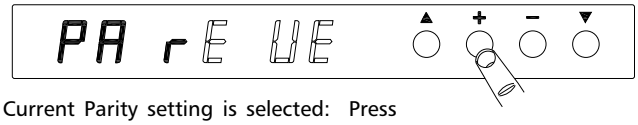


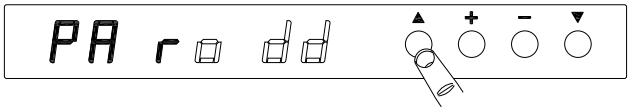
Current Baud Rate setting is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to Data Bits setting.



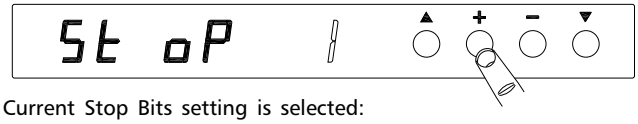


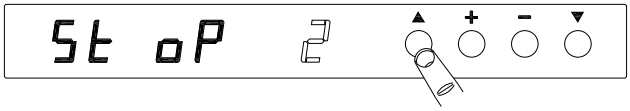
Current Data Bits setting is selected: Press *Plus* button to select between 7 or 8 data bits or *Up* button to step on to Parity setting.





Current Parity setting is selected: Press *Plus* button to select between Even, Odd or No parity or *Up* button to step on to Stops Bits setting.

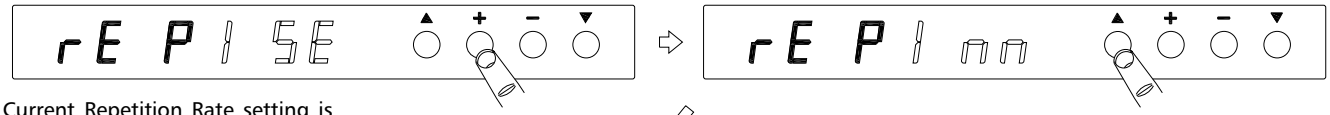




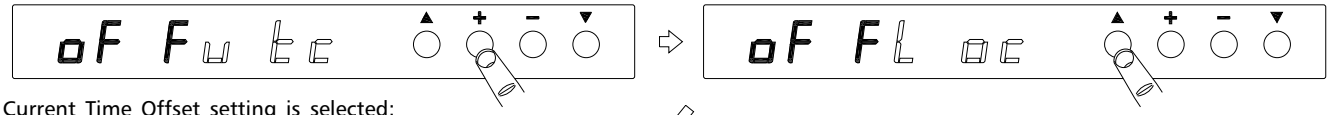
Current Stop Bits setting is selected: Press *Plus* button to select between 1 or 2 stop bits or *Up* button to step on to Repetition Rate setting.

Continued overleaf.

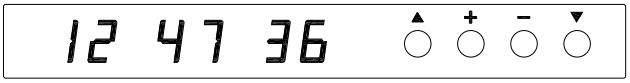
Serial Output Configuration Continued



Current Repetition Rate setting is selected: Press *Plus* or *Minus* buttons to increment or decrement value or *Up* button to step on to Time Offset setting.



Current Time Offset setting is selected: Press *Plus* button select between UTC and Local Time or *Up* button to exit.



Normal Time Display

Serial Messages

Code	Message Format	Repetition	Transmission Format	**Notes** (Please refer to specified application note on CD-ROM)
01	Wharton Format 1	User Programmable	User Programmable	
02	Wharton Format 1 without status	User Programmable	User Programmable	
03	Wharton Format 2	User Programmable	User Programmable	
04	Wharton Format 2 with day of week	User Programmable	User Programmable	
05	Racal ICR64	User Programmable	User Programmable	
06	Schauer	User Programmable	User Programmable	
07	NetClock/2 - format 0	User Programmable	User Programmable	AN128 - NTP synchronisation
08	GPZDA NMEA Message	User Programmable	User Programmable	
09	EES Format 5	User Programmable	User Programmable	
10	Scientific Atlanta / CSI	On Demand	Preset - 9600,8,e,2	AN111
11	Mitsubishi BRS5600 VCR	5 Min	Preset -1200,8,n,1	AN112
12	Panasonic	5 Min	Preset - 9600,7,o,1	AN113
13	Grundig / Plettac Vaz	5 Min	Preset - 9600,8,n,1	
14	Vision Factory Montage / Montage+	5 Min	Preset - 9600,8,n,1	AN115 & AN116 Montage+ has to be connected by RS232 if remote keyboard is used.
15	Tecton Drax	1 Hr	Preset - 9600,8,n,1	AN101
16	Vicon VPS	5 Min	Preset - 9600,8,o,1	AN100
17	EBCDIC Racal ICR64 format	1 Hr	Preset - 4800,8,n,1	
18	Philips Projects Special Format	5 Min	Preset - 9600,8,n,1	
19	Cartner	1 Sec	Preset - 1200,7,e,1	
20	Dedicated Micros	User Programmable	User Programmable	AN127
21	Tecton Kramplex / Molynx Visilynx 2	5 Min	Preset - 9600,8,n,1	AN125 Visilynx 2 requires PCBV309 card fitted with software SW191
22	Vision Factory Cameo	5 Min	Preset - 19200,8,n,1	AN117 Can also be used with Montage+
23	ASC Telecom DL2 and Marathon	1 Sec	Preset - 9600,8,n,1	AN129 / AN136
24	Maxpro	User Programmable	User Programmable	
25	LUL Standard Format	1 Sec	Preset - 1200,8,e,2	
26	Wharton wSync & sync32 software	1 Sec	Preset - 9600,7,e,1	
27	Philips LTC3990/50 VCR	5 Min	Preset - 1200,8,n,1	
28	LUL Northern Line Fomat 1	User Programmable	User Programmable	
29	LUL Northern Line Fomat 2	User Programmable	User Programmable	
30	AudioSoft	User Programmable	User Programmable	Audiosoft format without sync alarm notifier
31	Philips LTC2600 MultiplexerUK	5 Min	Preset - 9600,8,n,1	UK Format Date (LTC2600)

Serial Messages *(cont.)*

Code	Message Format	Repetition	Transmission Format	**Notes** (Please refer to specified application note on CD-ROM)
32	Philips LTC2600 Multiplexer US Burle TC8286 & TC8288 Multiplexers. Allegiant LTC8300 Series, LTC8511C, LTC8610/00, TC8719A, LTC 8810/00, LTC8910/00 with CPU rev 7.2	5 Min	Preset - 9600,8,n,1	US Format Date (LTC2600)
33	Philips LTC2600 Multiplexer ISO	5 Min	Preset - 9600,8,n,1	ISO Format Date (LTC2600)
34	Moser-Baer IF482	1 Sec	Preset - 9600,7,e,1	
35	Sony HSR-1/1P/2/2P	5 Min	Preset - 9600,8,n,1	AN135
36	GPZDA NMEA Message (Tardis)	1 Sec	Preset - 9600,8,n,1	Ensure that the latest version of Tardis is used
37	Geutebrück MultiScope	User Programmable	User Programmable	
38	Geutebrück TDT-10 / VicroSoft / AMC	User Programmable	User Programmable	
39	GPRMC NMEA Message (Syac DigiEye)	User Programmable	User Programmable	
40	Racal Wordsafe	User Programmable	User Programmable	GT message Standard Setting is 9600,8,n,1
41	Racal Wordnet Series 2	User Programmable	User Programmable	TG message Standard Setting is 9600,8,n,1
42	Tecton Darlex	15 Mins past every Hr	Preset - 9600,8,n,1	AN137
43	Macq Electronique SA	User Programmable	User Programmable	
44	Racal CD20	User Programmable	User Programmable	
45	Mitsubishi BRS, Multiple VCRs	5 Min	Preset - 1200, 8, n, 1	
46	Vision Factory Cameo D1	Once per day @ 4 AM	User Programmable	AN138
47	Norbain Vista Columbus	User Programmable	User Programmable	
48	Philips Divar	5 Min	Preset - 9600, 8, n, 1	AN140
49	Baxall DTL 960	5 Min	Preset - 9600, 8, n, 1	AN141
50	BAXNET / Vista - No advance	5 Min	Preset - 9600, 8, n, 1	Special Order Only - AN139
51	BAXNET / Vista - 1 Sec advance	5 Min	Preset - 9600, 8, n, 1	Special Order Only - AN139
52	BAXNET / Vista - 2 Sec advance	5 Min	Preset - 9600, 8, n, 1	Special Order Only - AN139
53	TBA	-	-	
54	TBA	-	-	
55	Vicon AurorAcorD / AurorA2000			
56	Dedicated Micros UNIPLEX Series I / II	User Programmable	User Programmable	Will not work with UNIPLEX software version 22
57	Panasonic WJSX850	User Programmable	User Programmable	
58	Panasonic WJHD500	User Programmable	User Programmable	
59	Tower Access Control	User Programmable	User Programmable	
60	Philips DVR1	5 Min	Preset - 9600, 8, n, 1	
61	Vortex Timelord	User Programmable	User Programmable	
62	Audiosoft v2	User Programmable	User Programmable	Audiosoft format with sync alarm notifier

Serial Messages *(cont.)*

Code	Message Format	Repetition	Transmission Format	**Notes** (Please refer to specified application note on CD-ROM)
63	AIT Comfile	1 Sec	Preset - 9600,8,n,1	
64	Team Simoco DX3000	1 Min	Preset - 9600,8,n,1	
65	NATS Link Protocol	User Programmable	User Programmable	
66	NATS Link Protocol 2	User Programmable	User Programmable	NATS Link Protocol with Line Feed.
67	Pelco CM6800	User Programmable	User Programmable	
68	Remguard NetVu / DVIP	User Programmable	User Programmable	MUST NOT be set to 1 second repetition. Output should be referenced to UTC.
69	Norbain Vista VVRL27	User Programmable	User Programmable	
70	Panasonic WJ-HD316	User Programmable	User Programmable	
71	NetClock/2 - format 1	User Programmable	User Programmable	
72	GE DRC format	User Programmable	User Programmable	
73	NATS VCS Protocol	User Programmable	User Programmable	
74	LUL Northern Line Fletchers format	User Programmable	User Programmable	
75	Kentec Syncro	User Programmable	User Programmable	
76	2008 Dedicated Micros serial message for CC01A Adaptor	User Programmable	User Programmable	
77	BlackBoxCamera GPSBOX GPS Video Overlay Unit	User Programmable	User Programmable	
78	Westinghouse Westlock Technician Workstation	User Programmable	User Programmable	
79	Visilynx VIS31-328	User Programmable	User Programmable	
80	AB PLC5/80	User Programmable	User Programmable	Output should be referenced to UTC.
81	NMEA GPZDA (BS EN61162-1:2008)	User Programmable	User Programmable	
82	Chrono-Log K-Series	User Programmable	User Programmable	
83	European Electronics Systems M100	User Programmable	User Programmable	
84	V-AR	User Programmable	User Programmable	
85	Varitext 2625 MCS-01	User Programmable	User Programmable	

10 - Audio Output Setup

When fitted with the AFOUT option module, the 5200 series master clocks have two off audio time code outputs which can be independently configured to output either 1KHz amplitude modulated IRIG-B or 25 frames per second EBU (LTC) time code.

Connection to the AFOUT option module on master clock is made via two off BNC connectors on rear of unit.

Each output can be independently configured and the setup procedure should be repeated for Audio Time Code output 2 as required.

IRIG-B output

IRIG is a series of time codes originally developed in the 1940s by the International Range Instrumentation Group (IRIG) for recording time information on magnetic tape and wire for rocket test range instrumentation purposes. IRIG-B code is normally transmitted at a 100Hz bit rate, amplitude modulated on a 1KHz carrier, where the amplitude of a '1' bit is three times that of a '0' bit.

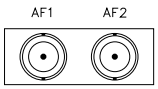
Standard IRIG-B code contains day-of-year and hours, minutes and seconds information.

EBU (LTC) output

EBU timecode is used in broadcast applications for 'stamping' time information on recordings and for the control of clocks and other intelligent systems. EBU time code is used in PAL and SECAM applications at 25 frames per second.

The signal data rate for EBU is 2000 bits per second, with each frame of data comprising 80 bits. The EBU standard defines the format for hours, minutes, and seconds information.

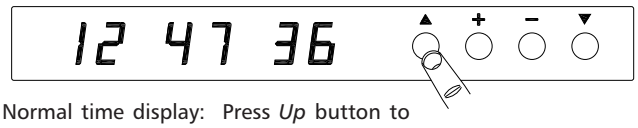
Audio Time Code Connections



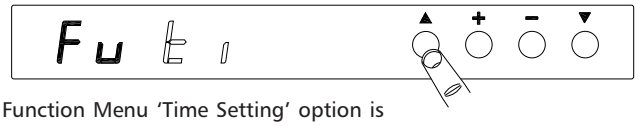
BNC Connectors

Balanced 600Ω signal

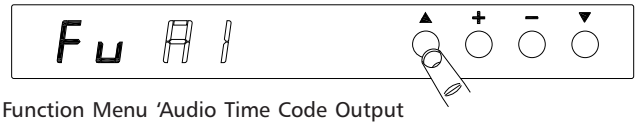
Audio Time Code Output Configuration



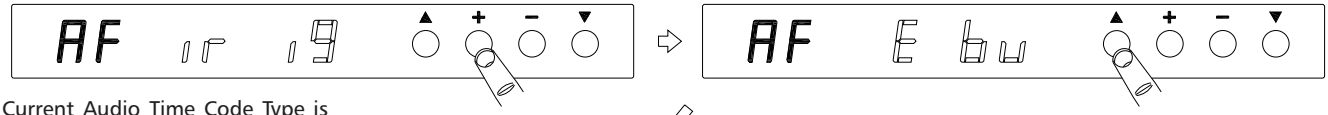
Normal time display: Press *Up* button to enter 'Function Menu'.



Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Audio Time Code Output' option is selected.



Function Menu 'Audio Time Code Output 1' option is selected: Press *Up* button to access this option.



Current Audio Time Code Type is selected: Press *Plus* button to select between IRIG-B or EBU or *Up* button to exit.

Normal time display.

11 - Relay Setup

When fitted with the RELAY or LVRELAY option modules, the 5200 series master clocks have two off voltage free programmable relays.

Connection to the RELAY and LVRELAY option modules on master clock are made via screw terminal connectors on rear of unit.

Each Relay Rircuit can be independently configured and the setup procedure should be repeated for Relay Cicuit 2 as required.

RELAY module

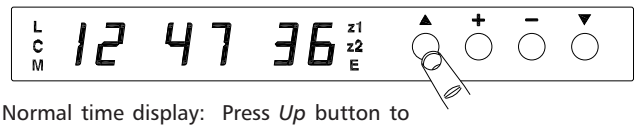
Dual 230V mains AC relays for periodic, signalling of error conditions and control of third party equipment.

The relay is configured so that contacts 1A—1C are normally open and contacts 1B—1C are normally closed. Circuit 2 contacts follow the same configuration.

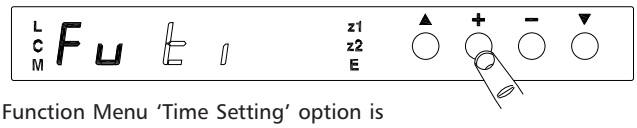
LVRELAY Module

Dual low Voltage relay outputs rated for low current operation at 110V DC. Contacts 1A—1B are normally open. Circuit 2 follows the same configuration.

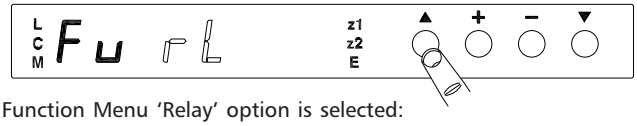
RELAY and LVRELAY Configuration



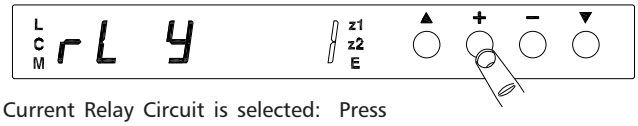
Normal time display: Press *Up* button to enter 'Function Menu'.

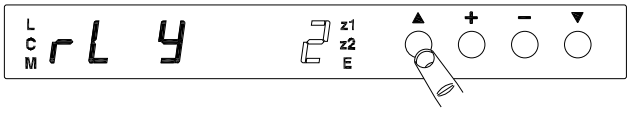


Function Menu 'Time Setting' option is selected: Press *Plus* button until 'Relay' option is selected.

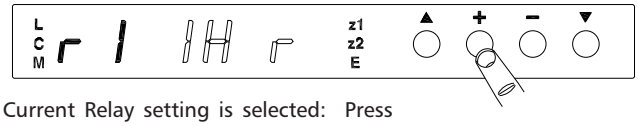


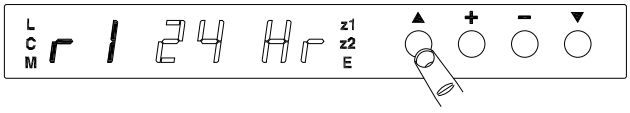
Function Menu 'Relay' option is selected: Press *Up* button to access this option.





Current Relay Circuit is selected: Press *Plus* button to select second Relay Circuit then *Up* button configure Relay Circuit.

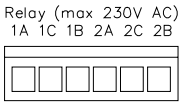




Current Relay setting is selected: Press *Plus* or *minus* button to adjust or *Up* button to exit.

Normal time display.

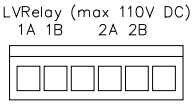
RELAY Connections



1A Circuit 1 normally open
1B Circuit 1 normally closed contact
1C Circuit 1 common contact

2A Circuit 2 normally open
2B Circuit 2 normally closed contact
2C Circuit 2 common contact

LVRELAY Connections



1A Circuit 1 contact A
1B Circuit 1 contact B

2A Circuit 2 contact A
2B Circuit 2 contact B

Relay Modes

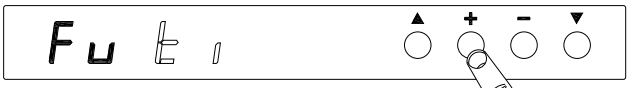
Code	Relay Mode	Notes
5SEC	1 contact closure every 5 seconds	
1nn	1 contact closure every minute	
30nn	1 contact closure every 30 minutes	
1Hr	1 contact closure every hour	
24Hr	1 contact closure every 24 hours	Contact closure at midnight (00:00:00).
PPS	Pulse per Second	Pulse per Second only available on LVRELAY option module when PPS jumper is fitted
Pr	Power	Contact closure when unit is powered.
Loc	Lock	Contact closure when unit is synchronised to external source.

12 - System Settings and Status

The System Settings menu and System Statuc displays provide access to general setting information for the 5200 series master clock.

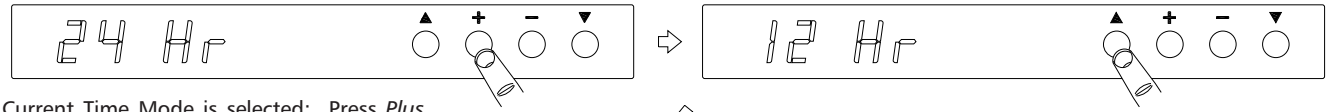
System Setting Menu

Normal time display: Press *Up* button to enter 'Function Menu'.

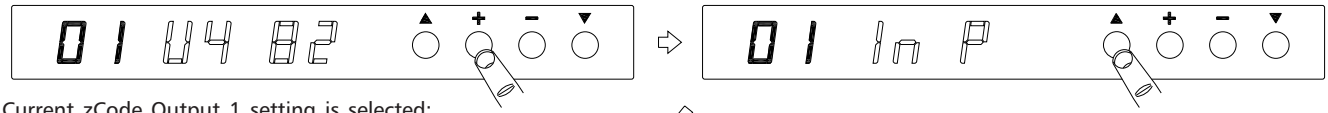


Function Menu 'Time Setting' option is selected: Press *Plus* button until 'System Setting' option is selected.

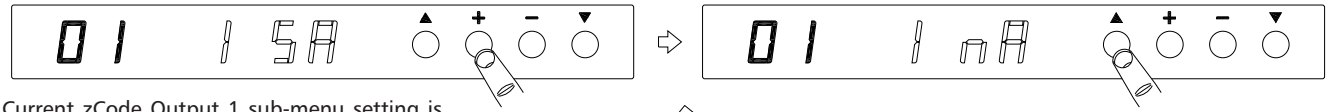
Function Menu 'System Setting' option is selected: Press *Up* button to access this option.



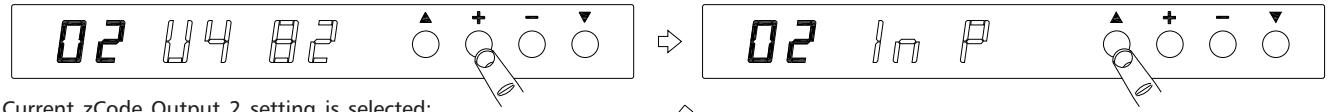
Current Time Mode is selected: Press *Plus* or *Minus* buttons to change between 24 Hour and 12 Hour Display or *Up* button to access 'zCode Output 1' settings.



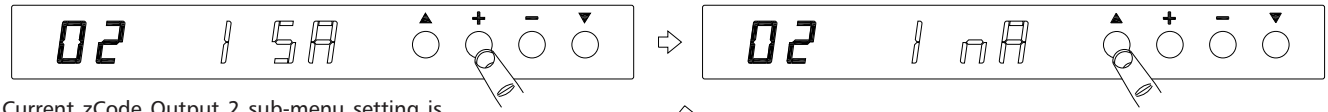
Current zCode Output 1 setting is selected: Press *Plus* or *Minus* buttons to change between modes or *Up* button to access sub-menu (when available) or 'zCode Output 2' settings.



Current zCode Output 1 sub-menu setting is selected: Press *Plus* or *Minus* buttons to change between modes or *Up* button to access 'zCode Output 2' settings.

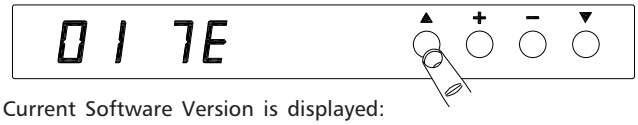


Current zCode Output 2 setting is selected: Press *Plus* or *Minus* buttons to change between modes or *Up* button to access sub-menu (when available) or to view Software Version.

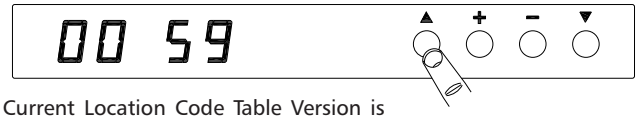


Current zCode Output 2 sub-menu setting is selected: Press *Plus* or *Minus* buttons to change between modes or *Up* button to view Software Version.

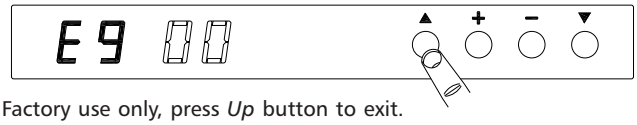
System Setting Menu Continued



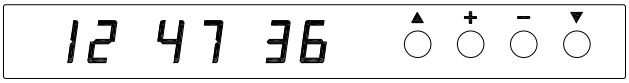
Current Software Version is displayed: Press *Up* button to view Location Code Table Version.



Current Location Code Table Version is displayed: Press *Up* button to step on.

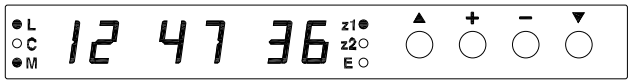


Factory use only, press *Up* button to exit.



Normal time display.

Front Panel LED Status Indicators



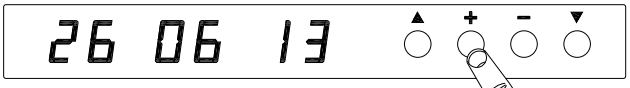
The front panel of the 5000 series network time servers include the following front panel status indicators.

Status Indicators

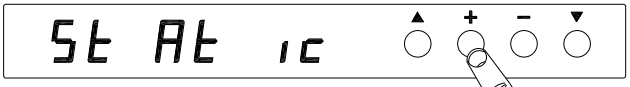
Code	Indicator	Notes
L	Locked/Synchronised	Illuminates when unit is synchronised to selected source.
C	Code	Illuminates when synchronisation code is received (e.g. GPS PPS).
M	Mains Power	Illuminates when unit is powered from main power supply.
z1	zCode Output 1	Illuminates when zCode Output 1 is active.
z2	zCode Output 1	Illuminates when zCode Output 2 is active.
E	Error	Illuminates when unit is in Error state.

System Status Display

Normal time display: Press *Plus* button to view system date.

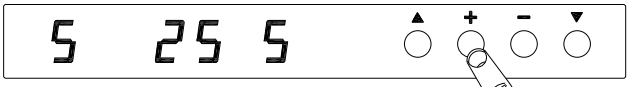


System date: Press *Plus* button to view IP assignment configuration.



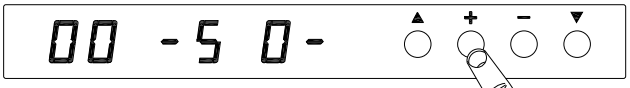
IP assignment configuration (Static, DHCP or Full DHCP): Press *Plus* button to view IP address.

IP address (scrolling display): Press *Plus* button to view subnet mask.



Subnet mask (scrolling display): Press *Plus* button to view gateway address.

Gateway address (scrolling display): Press *Plus* button to view MAC address.



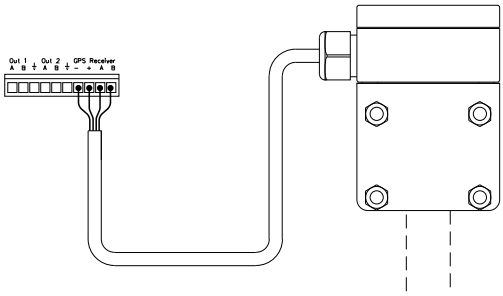
MAC address (scrolling display): Press *Plus* button to view normal time display.

Normal time display.

Appendix A - Cable Specifications

5200 series -> 488HS3 GPS interconnection

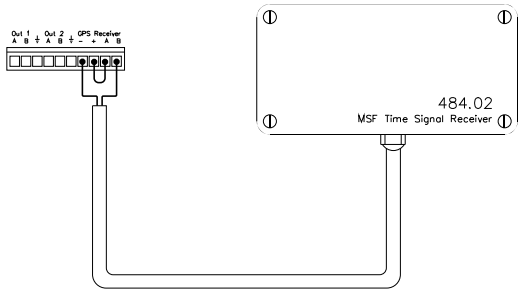
The 488HS3 GPS Receiver systems are supplied with 25 metres of four core 7/0.2 (0.22mm²) screened cable. The cable screen should be grounded at the 5200 series master clock end by means of the EMC rear grounding terminal.



For distances of up to 100 metres the length can be extended by adding an additional length of 7/0.2 cable. For greater distances, up to a maximum of 200m, 16/0.2 (0.5mm²) cable should be used.

5200 series -> 484 MSF and DCF radio receiver interconnection

The 484 series radio receiver is supplied with a 5m long unscreened cable as standard.



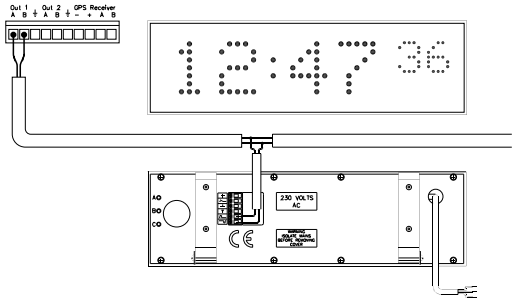
The cable length may be extended to 10m using unscreened cable, RS 528-2235 - 22 awg or equivalent. In areas of high electrical noise a screened twisted pair should be used. The cable screen should be grounded at the 5200 series master clock end only.

Cable length may be extended to 200m using a screened twisted pair cable, RS 528-1917 - 22 awg or equivalent. (UL style 2092, Alpha 2401)

For screened LSOH (Low Smoke Zero Halogen) applications RS 528-2308 (two pairs 7/0.25 - 22 awg) may be used. Equivalent to UL style 2493.

5200 series -> w482 / 48x0 time code interconnection

The w482/48x0 time code system is designed to have considerable immunity to external electrical interference and screened cable is only required in areas of high electrical noise.



Normal installations may use standard mains cable. (e.g. twin 1.5mm²) The size of the cable depends on the overall cable length, the number of clocks and their spacing on the cable.

The use of twin 1.5mm² cable will be adequate for installations of up to 50 clocks, calendar clocks or time-zone displays using up to 1km of cable. For LSOH applications low smoke cable to IEC332 and BS4066 may be used. RS 468-1956 (1.5mm² Pirelli PSX™).

Unscreened data cables should not be run in proximity to power cables supplying fluorescent lighting or other sources of electrical noise.

In areas of high electrical noise a screened twisted pair should be used. The cable screen should be grounded at the 5200 series master clock end only by means of the rear grounding terminal.

A suitable screened cable is RS 528-2241, (twin 16/0.254 - 18 awg) equivalent to Alpha 2421, BICC H8093, UL style 2092 which is adequate for a spur controlling 25 clocks over a 1km cable run or a greater number of clocks over a shorter distance.

For screened LSOH applications RS 528-2308 (two pairs 7/0.25 - 22 awg) may be used. Two conductors may be connected in parallel to provide a similar performance to 18 awg. Equivalent to UL style 2493.

For a Cat 5 installation, (24 awg) a single pair can be used to connect up to 10 400A series clocks or time-zone displays at a distance of up to 250m. For further distances or greater numbers of clocks, additional cores should be paired together, lowering the cable resistance.

5200 -> 4000E, 47xxN w482 /48x0code Interconnection

Cable Type	Max. Number of Clocks	Maximum Cable Distance
CAT5 (24 AWG)	10	250m
0.22mm² / 24AWG / 7/0.2	10	250m
0.5mm² / 20AWG / 16/0.2	50	300m
0.5mm² / 20AWG / 16/0.2	16	1000m
1.0mm² / 17AWG / 32/0.2	50	600m
1.0mm² / 17AWG / 32/0.2	30	1000m
1.5mm² / 15AWG	50	1000m

Note: The above data assumes that all cable interconnections are of negligible resistance when compared to that of the cable used.

If in doubt one should always consider the use of the next heavier gauge cable as this invariably increases system integrity at minimal additional system cost and allows for future system expansion.

All installation work should be performed in accordance with current Building Regulations and the Seventeenth Edition of the IEE Wiring Regulations, or equivalent local regulations.

5200 -> Analogue Impulse Clock interconnection

Cabling for analogue clock systems is highly dependent on the number of clocks, power consumption of the clock movements and distance of cable involved.

Based on the use of 10mA clock movements, each zCode output of the 5200 master clock could drive 50 clocks. Alternatively, each each zCode output of the 5200 master clock could drive 62 8mA clock movements.

5200 -> Analoogue Impulse Clock Interconnection

Cable Type	Max. Number of Clocks	Maximum Cable Distance
0.5mm^2 / 20AWG / 16/0.2	50	300m
1.0mm^2 / 17AWG / 32/0.2	50	650m
1.5mm^2 / 15AWG	50	1000m

Note: The above data assumes that all cable interconnections are of negligible resistance when compared to that of the cable used and the impulse clock movements draw 10mA each.

Appendix B - TCP/IP Concepts

IP Address

TCP/IP is todays most prevalent networking technology. It can be used for small Local Area Networks (LAN) of two or three users, right through to the other end of the spectrum where it is used as the protocol connecting every machine on the Internet.

Each connected computer must have a unique address to ensure that data transmitted from one location reaches the correct destination.

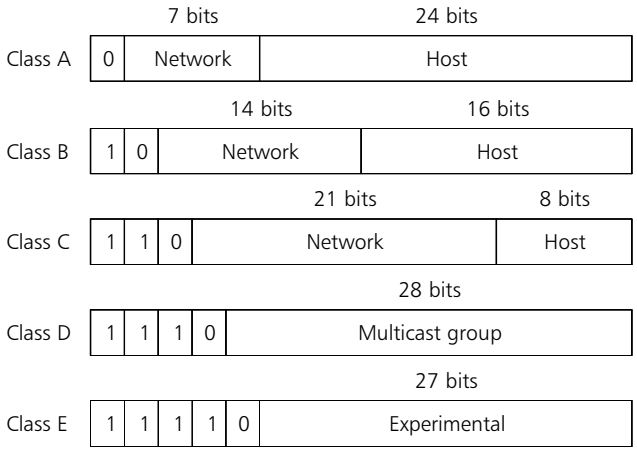
Blocks of addresses are assigned to organizations by the Internet Assigned Numbers Authority (IANA). Users and small organisations usually obtain their addresses from their Internet Service Provider while larger organisations liaise directly with the IANA.

The Internet Protocol (IP) uses 32 bit addresses, which when displayed to humans are usually written in dotted-decimal notation. Dotted-decimal notation is where the address is written as four decimal numbers, one for each byte of the address.

For example the dotted-decimal IP address 195.112.5.193 can be represented in the following formats:

Decimal representation:	3278898625
Hexadecimal representation:	0xC37005C1
Binary representation:	11000011 01110000 00000101 11000001

The IP address of a computer is constructed of two parts. The first part of the address identifies the network to which the computer or host is connected, the second part specifies the actual host itself. The TCP/IP software on each host can automatically determine the class of an IP address by examining the first byte of that address.



There are five different classes of address:

Class A - 1.x.x.x - 126.x.x.x

These addresses have a 8 bit network number and a 24 bit host number addresses. Each class A network can have 16,777,214 hosts.

Class B - 128.1.x.x - 191.254.x.x

These addresses have a 16 bit network number and a 16 bit host addresses. This means that each class B network can have 65,354 hosts.

Class C - 192.0.1.x - 223.255.254.x

These addresses have a 24 bit network number and an 8 bit host addresses. This means that each class C network can have 254 hosts.

Class D - 224.0.0.0 - 239.255.255.255

Class D network addresses are used for multicasting, which is where information sent from one address can be sent to many different hosts simultaneously.

Class E - 240.0.0.0 - 254.255.255.255

Class E network addresses are used for experimental purposes.

For each unique network number, the base address of the range (i.e. host number zero) is known as the network address and is not assigned to a host. The top address of the range is (i.e. host number set to all ones) the broadcast address which is used as the address for sending to all hosts on the same network number simultaneously.

Subnet Addressing

Subnet addressing allows us to split one IP network address into several smaller physical networks known as subnets. This is especially useful with Class A and Class B addresses where there are very large numbers of network hosts with the same network address.

A subnet is created by splitting the host address part of the IP address into two, the first being subnet address and the second host ID.

Subnet Mask

The subnet mask is a 32 bit number which specifies how many bits of the IP address are for the network / subnet address and how many are for the host address.

FThe following table details a few typical subnet masks and the network classes / subnets they describe.

Network & Subnet bit length	Subnet Mask	Typical Usage
8	255.0.0.0	Class A address with no subnets
16	255.255.0.0	Class B address with no subnets or Class A with 254 subnets, etc
24	255.255.255.0	Class C address with no subnets or Class B with 254 subnets.

Private IP addresses

With the massive growth of the Internet there was a real danger that the IANA would run out of IP addresses. To avoid this situation three blocks of IP addresses have been reserved for use in private networks. It is recommended that on an organisation's TCP/IP networks use these private network numbers for their networks and make use of a technology like NAT (Network Address Translation) to allow their users access to the Internet.

10.0.0.0 - 10.255.255.255

172.16.0.0 - 172.31.255.255

192.168.0.0 - 192.168.255.255

ARP & MAC

When one device (A) wants to send data to another device (B) on the same Ethernet LAN it must convert the IP address of the destination device to the Ethernet Media Access Control (MAC) address of that device. Each Ethernet device has a globally unique 48 bit MAC address which is assigned at time of manufacture.

If device A does not have B's MAC address an Address Resolution Protocol (ARP) request is broadcast onto the local Network. The ARP request contains the IP address of device B, so device B is the only device to respond. Device B sends its MAC address to device A and it is stored in device A's ARP table.
Device A can now send data directly to device B.

Gateway Address

The gateway address is used when a device on a network sends data to another device that is connected to a different network segment. The gateway device is typically a router connecting two different networks together.

When one device sends data to another device the TCP/IP software checks to see if the destination network address is the same as its own network address. If the network address is the same the data is transmitted normally, using ARP to resolve the destination MAC address if required.

If the network address is different the data is forwarded to the IP address specified in the 'Gateway' setting for routing onwards to the specified network. This routing process may occur several times as the data travels across different networks enroute to its destination.

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