MASTERCLOCK ® NETWORK CONTROL PROTOCOL for REMOTE CONTROL of NTDSXX Digital Clock Displays

COMMUNICATION PARAMETERS:

• Multicast, default IP=239.252.0.0, port=6168 and configurable using TELNET commands or WinDiscovery
administrative functions (Figure 1)
• UDP datagram packets

PACKET BUFFER FORMAT:

<HDR1><HDR2><RSRV1><DEVICE><FAMILY><RSRV2><ZEROS><RSRV3><CTRLCODE><H><M><S>*

Where:

<HDR1>	4 bytes	=	($2381D765_{16}$)
<HDR2>	4 bytes	=	($10B32FE1_{16}$)
<RSRV1>	2 bytes	=	Zero-filled
<DEVICE>	2 bytes	=	Least-significant two bytes of the Remote Control Device MAC address -or- Auxiliary Control Source ID
<FAMILY>	4 bytes	=	(00000080_{16})
<RSRV2>	3 bytes	=	Zero-filled
<ZEROS>	1 byte	=	(00_{16}): Leading zeros ON (01_{16}): Leading zeros OFF
<RSRV3>	24 bytes	=	Zero-filled
<CTRLCODE>	1 byte	=	(00_{16}): Release remote control, clock set to normal display ($01(02_{16})$: Clock displays **<H><M><S>** values $_{16}$): Clock displays blanks (02_{16}): Clock displays **<H><M><S>** values (03_{16}): Clock displays dashes
<H>	1 byte	=	Hours display (in hexadecimal)
<M>	1 byte	=	Minutes display (in hexadecimal)
<S>	1 byte	=	Seconds display (in hexadecimal)
<DAYS>	2 bytes	=	Days (1 – 366) (in hexadecimal) (note: display feature not supported by all clocks)
<CHANNEL>	1 byte	=	Source channel (A, B, or C) (in ASCII) (note: set to 0 (in hexadecimal) if not needed)

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***NOTE:** This UDP packet buffer is encrypted prior to transmission, the C-code for this algorithm is provided in Appendix A.

****NOTE:** Masterclock® Remote Control Devices include models: RC1000, RC600, and RC500.

OPERATION NOTES:

• While under remote control (i.e. the NTDSxx did not receive a **<CTRLCODE>** = 0 end-of-control command), the clock expects to see data at a minimum rate of one transmission per second, even when the display is paused or stopped (in these cases the data is simply retransmitted continuously.) If these transmissions are interrupted for more than three seconds, the colons will flash indicating loss of communication, and the display will freeze with the last updated value. The clock is configurable to revert to normal mode after a preset timeout period using TELNET commands or WinDiscovery administrative functions (Figure 1).

• During a control session, the NTDSxx provides no internal timing functions and no error checking on the values it displays. It also will not synchronize the display updates to top-of-second, although the internal time synchronization is maintained and will resume after remote control is released.

• It is possible to send data at a rate faster than once per second, and the NTDSxx should respond at that faster rate, although the limit of this rate has not been tested.

• There is no provision for controlling the NTDSxx colons or decimals; colons remain on and decimals off during uninterrupted remote control communication.

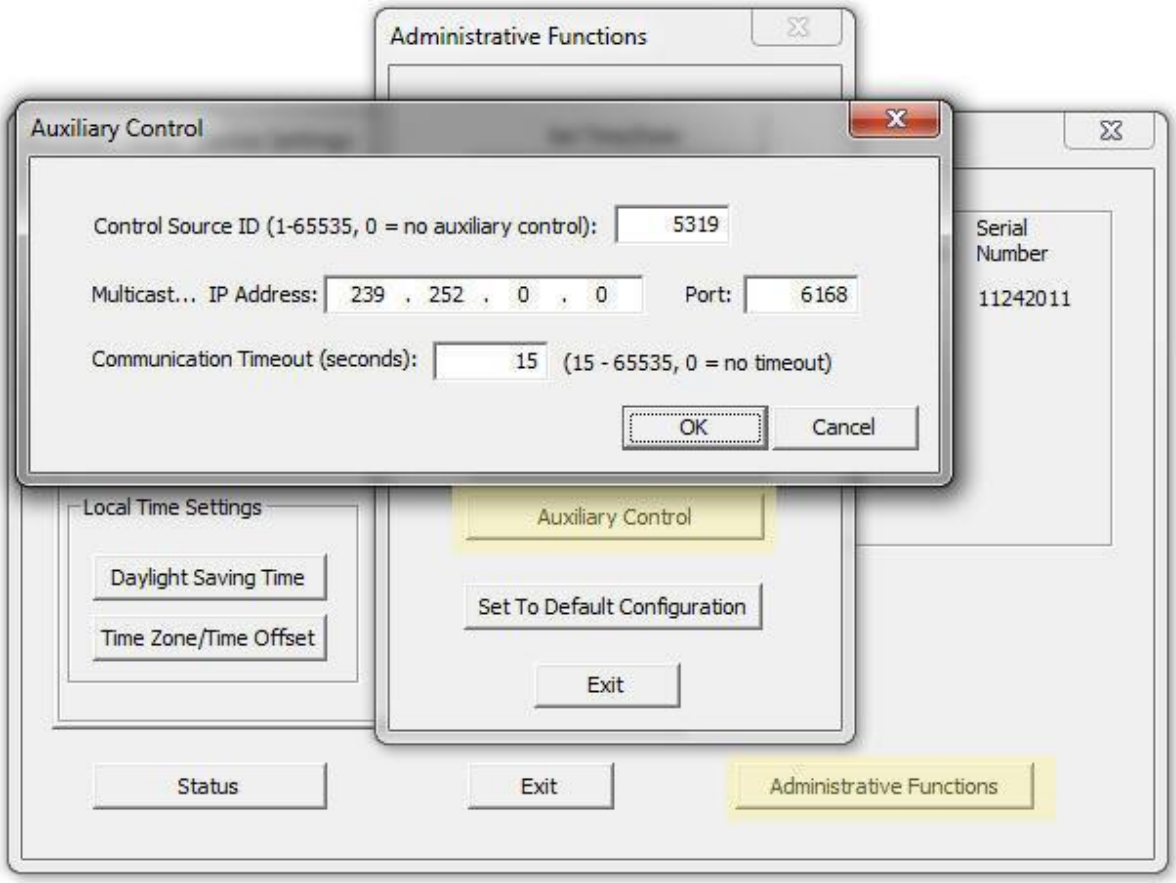
• The data payload **<H><M><S>** of a **<CTRLCODE>** = 0 packet is arbitrary (i.e. not displayed on the clock) and typically set to zeros.

• For NTDSxx clocks controlled by a device other than a Masterclock Remote Control Device, the **<DEVICE>** value can be arbitrarily assigned, however, the clock must be configured via TELNET commands or WinDiscovery administrative functions (Figure1) to accept control from this **<DEVICE>** address.

• UDP datagram control packets are to be transmitted in network byte order (in C-code this is accomplished using the *htonl()* and *htons()* functions on UINT32 and UINT16 datatypes, respectively.)

• The nature of multicasting requires that devices “join” and “leave” groups based on an assigned IP address/port combination. It is important to note that on some routers multicasting is not enabled by default and must be configured to allow this communication.

FIGURE 1:


Administrative Functions
Auxiliary Control
Control Source ID (1-65535, 0 = no auxiliary control):
5319
Multicast... IP Address:
239 . 252 . 0 . 0
Port:
6168
Communication Timeout (seconds):
15
(15 - 65535, 0 = no timeout)
OK
Cancel
Serial Number
11242011
Local Time Settings
Daylight Saving Time
Time Zone/Time Offset
Auxiliary Control
Set To Default Configuration
Exit
Status
Exit
Administrative Functions

EXAMPLE:

For a clock listening to device ($14C7_{16}$) on multicast IP 239.252.0.0:6168 to display “12:34:56”, the following procedure would be used:

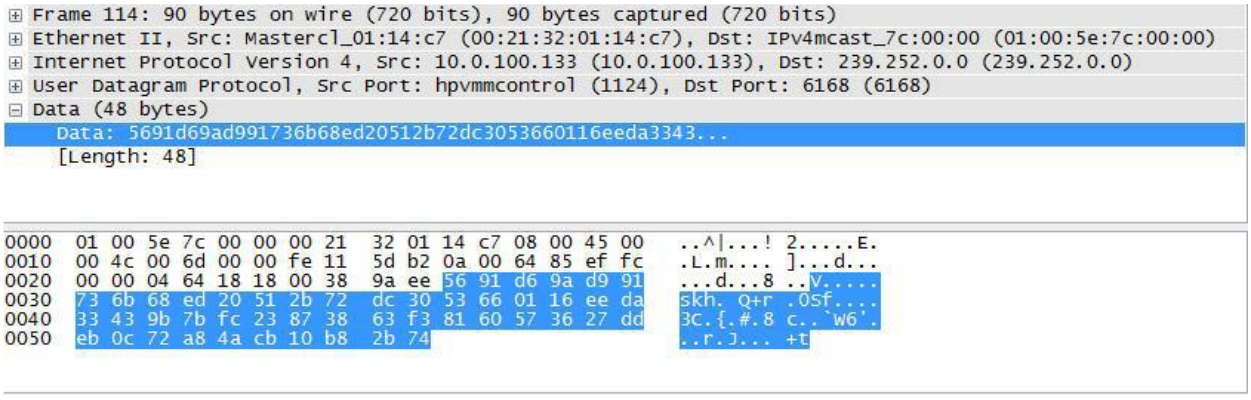
• Fill a 48-element array with the hexadecimal values (note **<H><M><S>** are also hexadecimal.)

23 81 D7 65 10 B3 2F E1 00 00 14 C7 00 00 00 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 02 0C 22 38

• Execute the *crypt()* function on this array as outlined in Appendix A to yield

56 91 D6 9A D9 91 73 6B 68 ED 20 51 2B 72 DC 30 53 66 01 16 EE DA 33 43 9B 7B FC 23 87 38 63 F3 81 60 57 36 27 DD EB 0C 72 A8 4A CB 10 B8 2B 74

• Multicast this packet on 239.252.0.0:6168. A WireShark screen capture shows the full UDP datagram for this control packet, with the data portion highlighted…



APPENDIX A:

```
#define KEY_SIZE          17

const UINT8 _key[KEY_SIZE] =
        { 0x74, 0x12, 0x02, 0xfb, 0xcc, 0x24, 0x5b, 0x82,
        0x61, 0xe7, 0x3f, 0x9a, 0x26, 0x7c, 0xd3, 0xa0, 0x42 };

void crypt(UINT8 *buf, UINT32 bsize);

void crypt(UINT8 *buf, UINT32 bsize)

{

        UINT8    padcnt, keycnt, *p;

        UINT32                   t;

padcnt = 1;
keycnt = 0;
t = 0;
p = buf;

while(t < bsize)

{

        *p = *p ^ padcnt ^ _key[keycnt];

        if (++keycnt == KEY_SIZE) keycnt = 0;
        if (++padcnt == 254) padcnt = 1;

        p++;

        t++;

        }

}
```