U·M·D

Technical Reference Manual

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INTRODUCTION

This manual provides detailed information about the operation of Under Monitor Displays (UMDs). UMDs are compact, single-line LED display systems. They are available in different lengths and can be configured to function in several different ways. UMDs are intended for use as computer-driven annunciators for a variety of real-time control systems. In addition to operating under computer control via serial port, they can also respond to switch signals connected to inputs on the unit provided for this purpose.

The information presented here is intended for use by hardware, firmware, and software engineers who have experience with serial data communications. Included in this document are details on aspects of the serial interface, the UMD signal inputs, and the message and command formats.

THE PHYSICAL DATA LINK

Each UMD has a single serial data input and output. This port uses standard async RS-232c protocol. The serial port electrical interface is RS-422/RS-485. This allows many UMDs to share the same daisy-chain network trunk. Each UMD has two RJ11 jacks connected to its serial data port. Daisy-chain trunk cable is easily "looped through" each UMD because both RJ11 connectors have identical pinouts. See appendix B on page 14 for pinout details.

Your data source must provide RS-232 data using RS-422/RS-485 differential drivers. If you do not have an async RS-485 port, a protocol converter that changes RS-232 signals to RS-485 signals is available from TDC.

CABLING CONSIDERATIONS

You must use a daisy-chain cabling pattern. In a daisy-chain, there can be only two ends to the network trunk cable: one at the data source, and the other at the last display in the daisy-chain. If your wiring plan creates a network trunk with more than two ends, it is not a daisy-chain pattern. You can either

loop the trunk cable directly through each UMD, or you can install a drop cable from the trunk to a UMD less than ten feet away.

For many installations, you can use standard 4-wire flat telephone extension cord with RJ11 plugs crimped onto each end for the network cables. These must be straight-through cables. Be aware that this is the opposite of standard telephone extension cords, which have connector ends that reverse the wiring. When cabling your UMD network, be sure to purchase or fabricate straight-through cables. If you use drop cables, each one must connect to only one UMD and must be less than 10 feet in length. With drop cables, special precautions must be taken to ensure that the wiring remains straight-through with respect to the target UMD connector.

For network cable runs over 250 feet in length, you should use an unshielded, low-capacitance, dual twisted-pair cable. Both twisted pairs will require 50 to 100 ohm resistive termination at each end of the run to ensure clear signal propagation throughout the cable. Very long runs or networks with more than twenty UMDs attached may require active signal boosters. If you have any questions about the best way to cable your UMD network, contact Tally Display Corporation for assistance.

Do not use shielded cable for your network trunk. Digital differential driver circuits are not like analog audio and video circuits. They obtain noise immunity from the twisted wire pair, *not* from shielding. Standard shielded cable actually degrades differential digital signals because of its inherent high capacitance.

WARNING: Improperly installed network trunk cabling will prevent the UMDs from working properly. Correcting this problem is very expensive and time-consuming. Be sure to consult TDC *before* you make your cable runs if you have any questions.

SWITCH SIGNAL INPUTS

Besides having a serial data interface, UMDs also contain an RJ45 connector that allows you to input switch signals to the unit. When a given switch signal is activated, it can change the color of the message showing on the display, or it can select one of several different pre-loaded messages to be shown on the display. The function of the switch inputs depends on whether a UMD is set to operate in COLOR mode or MESSAGE mode. These two modes of operation are explained in the next section.

In COLOR mode, there are three inputs available, marked *G*, *Y*, and *R*, and a common *GROUND* connector for all three inputs. In MESSAGE mode, there are five inputs available, marked *16*, *8*, *4*, *2*, and *1*, and a common *GROUND* connector for all five inputs. See appendix B on page 15 for pinout details. An input that is floating (not connected to anything) is deactivated, while an input that is grounded (connected to the *GROUND* pin) is activated.

COLOR MODE & MESSAGE MODE

UMDs can operate in COLOR mode or in MESSAGE mode. This option is switch-selectable on each UMD unit.

In COLOR mode, the UMD can hold one message, which is downloaded to the unit via the serial interface. This message is constantly shown on the screen of the UMD. The message includes a color command which sets the text color. When a switch input is activated, it overrides this default color setting, and forces the message to be shown in the color selected by the switch. Each switch input selects a different color. The 'G' input selects GREEN, the 'Y' input selects YELLOW, and the 'R' input selects RED. Note that the message text will remain in the selected color only as long as an input is activated. When the input is deactivated, the message returns to its default color. The RED input has priority over the other two inputs, and the YELLOW input has priority over the GREEN input. If more than one input is activated at the same time, the text is set to the highest priority color.

In MESSAGE mode, the UMD can hold up to 32 different messages. These are downloaded to the unit via the serial interface. Each message is tagged with a different page number, from 0 to 31. The UMD normally shows the message in page 0. When one or more switch inputs are activated, they are considered to be a binary value by the UMD. This value is the sum of each activated input number, and represents a specific page. The message in the selected page is shown on the LED screen. Note that the UMD will show the selected message only while its binary value is present at the switch inputs. When the inputs change to a different page number, the UMD immediately shows the message in the new page number. When all inputs are deactivated, the UMD again shows the default message in page 0.

COLOR MODE OUTPUT SWITCH

The RJ45 has two additional connections available when the unit is in COLOR mode. These are marked *COMMON* and *NO*. They are attached to a set of relay contacts in the UMD. Whenever the message on the UMD is any color besides red, the relay is off, and the *COMMON* and *NO* pins are not connected. Whenever the UMD message is red, the relay is energized, and the *COMMON* and *NO* pins are connected. Note that this output switch is available only when the UMD is in COLOR mode. The relay contacts are not available when the UMD is in MESSAGE mode.

DATA TRANSMISSION PROTOCOL

UMDs expect a 10-bit async serial data byte, with 1 start bit, 8 data bits, no parity, and 1 stop bit. The baud rate is switch-selectable from 300 baud to 9600 baud. For maximum performance, we recommend 9600 baud. (Note: UMD configuration switch settings are shown in appendix C on page 16.)

UMDs do not use character-level hardware or software flow control. You do not need to insert any idle time between commands to the displays. Also, you are not required to send data bytes at any minimum or maximum rate, or make any other special timing considerations in your data transmissions.

COMMAND STRUCTURE OVERVIEW

UMDs are designed for use in direct, hard-wired environments. Commands have minimal structure, with no checksums or CRCs. This allows for extremely fast operation and also reduces the programming burden for the developer. While these are desirable goals, it also means that UMD operation will only be as reliable as the physical communication layer. Therefore, we do not recommend operating UMDs over modems or other data links that are susceptible to errors.

All commands and messages are constructed from the standard ASCII character set. In general, commands and messages are made up of three parts, consisting of UMD instructions, ASCII text, and a terminator:

- UMD instructions are enclosed in the angle bracket characters '<' and '>'.
- The ASCII text defines the message to be shown on the UMD screen.
- The command terminator tells the UMD that the command is complete, and consists of the control character pair CR - LF (`0x0D 0x0A`).

ONE-WAY & TWO-WAY OPERATION

UMDs can operate either as one-way or two-way systems. This option is switch-selectable at each UMD unit. In a one-way system, you send an addressed command to a target unit, which receives and carries out the command. No answerback or other acknowledgment ever occurs from the target UMD regardless of the result of the transmission or the nature of the command. In a two-way system, you send an addressed command to a target unit. When the target unit receives and carries out the command, it sends an acknowledgment back to you. This allows you to verify that the target unit has received the message intact.

The nature of your application will determine whether you should use one-way or two-way UMD operation. One-way operation is easier to do and is adequate for many situations. However, if your data source must be 100% sure that a target UMD receives commands sent to it, use two-way operation.

COMMAND REFERENCE - BOTH MESSAGE & COLOR MODE

This section summarizes the commands that are available when the UMD is in either COLOR or MESSAGE mode. In the command descriptions below, literal ASCII characters are shown in regular text, ASCII parameters that you supply are shown in italics, and the carriage return / line-feed terminator (0x0D 0x0A) characters are shown as "cr lf" in bold text.

1. GENERAL QUERY & ANSWERBACK FORMAT:

This command causes the target UMD to return an answerback if it is set for two-way operation. This allows the data source to poll the network to find out which display IDs are in use and operational. The format of this command is:

<ID*nn*> **cr lf**

where *nn* is the ID number of the target UMD. The ID number you supply must be exactly two ASCII digits in hexadecimal format, so for ID numbers under "10", use a leading "0." Each UMD has DIP switches allowing you to set its ID number. Valid ID numbers range from 1 ("01") to 511 ("1FF"). ID number 0 is not valid and you should not attempt to use it.

Note that the answerback of a UMD is identical to the query command shown above. A UMD set for two-way operation will return the above answerback each time it receives any addressed command, including the query command.

2. RESET COMMAND:

This command is used to reset a UMD. The memory will be erased and the UMD will revert to the mode set by the DIP switches.

<ID*nn*><ZC>

3.GLOBAL ADDRESSING

To address all UMDs on a network use:

<ID**>

4. REMOTE MODE CHANGE:

This command allows you to set the target UMD to either COLOR mode or MESSAGE mode without setting the DIP switch on the back of the unit. The format of this command is:

`<ID`*nn*`><MC>` **`cr lf`** (Sets target UMD to COLOR mode)

`<ID`*nn*`><MM>` **`cr lf`** (Sets target UMD to MESSAGE mode)

where *nn* is the ID number of the target UMD. The remote mode setting remains in effect until you change it with another remote mode command or the UMD is powered up again. On power-up, UMD mode is always determined by the DIP switch. IMPORTANT: Each time you change the mode of the UMD using the remote mode command, the entire memory of the UMD is cleared and any messages in the unit are erased.

5. CLOCK SET:

This command sets the real-time clock value maintained in the UMD. It contains no addressing, and is received by all of the displays on the network, regardless of whether they are in COLOR mode or MESSAGE mode. Displays that are set for two-way operation do not send an answerback when they receive this command. The format of this command is:

`<T`*hhmmss*`>` **`cr lf`**

Where *hh* is the hour setting from "00" to "23", *mm* is the minutes setting from "00" to "59", and *ss* is the seconds setting from "00" to "59".

All parameters are in ASCII. You must use exactly two digits for each parameter, so use a leading "0" for values under "10." Note that the hours setting is in 24-hour format. In this format, 12 is added to the afternoon hours, so that 1 PM is "13", 7 PM is "19", and 11 PM is "23". The midnight hour is "00".

NOTE: The real-time clock value is valid only while the UMD has power. Each time a UMD is powered up, its internal clock value is reset to 00:00 and must be set to the actual time of day by the data source. Therefore, we recommend that your data source send a CLOCK SET message at least once a minute to keep all UMD clocks accurate.

6. 12/24 HOUR FORMAT ADJUST:

This command sets the format of the time-of-day display on the target UMD. When time-of-day appears on the UMD, the hours can be shown either as 12-hour or 24-hour based digits. The format of this command is:

`<ID`*nn*`><M1>` **`cr lf`** (Sets target UMD to use 12-hour format)

`<ID`*nn*`><M2>` **`cr lf`** (Sets target UMD to use 24-hour format)

where *nn* is the ID number of the target UMD. This setting remains in effect until you change it with another format adjust command or the UMD is powered up again. On power-up, the UMD is always set to 24-hour format.

COMMAND REFERENCE - COLOR MODE

This section summarizes the commands that are available when the UMD is in COLOR mode. In the command descriptions below, literal ASCII characters are shown in regular text, ASCII parameters that you supply are shown in italics, and the carriage return / line-feed terminator (0x0D 0x0A) characters are shown as "cr lf" in bold text.

1. SET MESSAGE:

This command sets the message to be shown. When this command is received, the target UMD immediately begins showing the message on its LED screen.

The format of this command is:

`<ID`*nn*`><`*cc*`>`*message-text* **cr lf**

where *nn* is the ID number of the target UMD, *cc* is a color setting command, and *message-text* is the ASCII text string you want to appear on the target display. *Message-text* can be any ASCII text string you choose. The *nn* parameter is described in the GENERAL QUERY command above. The *cc* parameter must be one of the following two-character ASCII color codes:

LG	Low Brightness Green
MG	Medium Brightness Green
HG	High Brightness Green
LY	Low Brightness Yellow
MY	Medium Brightness Yellow
HY	High Brightness Yellow
LR	Low Brightness Red
MR	Medium Brightness Red
HR	High Brightness Red

2. SHOW TIME-OF-DAY:

This command causes the UMD to show the time-of-day on its LED screen. The time-of-day shown is obtained from the real-time value maintained in the UMD, which you can set using the CLOCK SET command explained in the next section. The format of the show time-of-day command is:

`<ID`*nn*`><`*cc*`><FU>` **cr lf**

where *nn* is the ID number of the target UMD, and *cc* is one of the ASCII color codes as shown in the table for SET MESSAGE.

3. REMOTE COLOR CHANGE:

This command causes the target UMD to switch to the color specified. The format of this command is:

<ID*nn*><L*x*> **cr lf**

where *nn* is the ID number of the target UMD, and *x* is one of the ASCII color codes as follows:

x = 0 Hardware Select (switch inputs determine the color setting)
x = 1 Set to RED
x = 2 Set to GREEN
x = 3 Set to YELLOW

This command overrides the color-setting switch inputs on the back of the unit. To make the UMD follow the switch inputs again, send this command using the "hardware select" setting. This command adjusts the color setting only. The brightness setting of the target UMD is not affected.

COMMAND REFERENCE - MESSAGE MODE

This section summarizes the commands that are available when the UMD is in MESSAGE mode. (NOTE: The GENERAL QUERY and SET CLOCK commands are the same for both COLOR mode and MESSAGE mode.) In the command descriptions below, literal ASCII characters are shown in regular text, ASCII parameters that you supply are shown in italics, and the carriage return / line-feed terminator (0x0D 0x0A) characters are shown as "cr lf" in bold text.

1. SET MESSAGE:

This command loads a message into the memory of the UMD. When this command is received, the target UMD stores the message in the specified page number.

The format of this command is:

`<ID`*nn*`><P`*ww*`><Cx><Sy><Fz>`*message-text* **cr lf**

where *nn* is the ID number of the target UMD; *ww* is the target page number; *x*, *y*, and *z* are message control codes (described below); and *message-text* is the ASCII text string you want to appear on the target display. The *nn* parameter is described in the GENERAL QUERY command for COLOR mode. The *ww* parameter specifies the page number where this message will be stored. It must be exactly two ASCII digits in hexadecimal format, so for page numbers under "10", use a leading "0." Valid page numbers range from 0 ("00") to 31 ("1F"). *Message-text* can be any ASCII text string you choose.

There are three message control codes that you must supply. The first is the *color* code. This code determines what color is used for the message text. The second code is the *size* code. This code determines what size the text will be when it is shown on the LED screen. The third is the *function* code. This code determines how the image will be presented on the LED screen. The tables below show what ASCII letter character you use in place of the *x*, *y*, and *z* parameters to select the desired message effects.

The *x* parameter selects one of the following text color schemes (in ver. 2.0)

A	High Bright Red	I	Nul
B	High Bright Green	J	Nul
C	High Bright Yellow	K	Nul
D	Nul	L	Orange
E	Medium Bright Red	M	Pale Green
F	Medium Bright Green	N	Nul
G	Medium Bright Yellow	O	Rainbow 1
H	Nul	P	Rainbow 2

The *y* parameter selects one of the following text sizes (in ver. 2.0):

A	Normal (4 x 7 or 5 x 7 char.)	G	No background
B	Bold (2X character)	H	Nul
C	4 x 7 character	I	Nul
D	5 x 7 character	J	Nul
E	7 x 7 character	K	Nul
F	Background	L	Nul

The *z* parameter selects one of the following function codes (in ver. 2.0):

A	Spring	N	Spark Off
B	Full Wipe On	O	Travel
C	Pitch On	P	Pull On
D	Scroll Down On	Q	Stretch On
E	Half Wipe On	R	Spark On
F	Flash	S	Open from Center
G	Hold 30 Seconds	T	Scroll Up On
H	Hold 5 Seconds	U	Show Time-of-Day
I	Interlace On	V	Scroll Up Off
J	Full Wipe Off	W	Weave On
K	Scroll Down Off	X	Speed 1 (fast)
L	Instant Appear	Y	Speed 2 (middle)
M	Interlace Off	Z	Speed 3 (slow)
0 (zero)	Stop (await command)	1	Close Toward Center

2. OPTIONAL MESSAGE PARAMETERS:

There are two optional parameters you can use to control the content of your messages. The first allows you to insert empty dot columns at any point in the ASCII message string. The format of this parameter is:

`<J`*n*`>`

where *n* is an ASCII number from "1" to "9". The number you specify will determine how many empty dot columns are inserted in the message.

The other parameter allows you to insert a pre-defined graphic block at any point in the ASCII message string. There are 26 graphic blocks available. (The content of the graphic block is determined by the SET GRAPHIC BLOCK command explained in the next section.) The format of the insert graphic block parameter is:

`<B`*n*`>`

where *n* is an ASCII character from "A" to "Z". The letter you specify will determine which of the 26 pre-defined graphic blocks is inserted into the message.

3. SET GRAPHIC BLOCK:

This command allows you to set the content of up to 26 different graphic blocks. These blocks can be inserted at any point in a message using the insert graphic block parameter as explained above. Each graphic block is exactly 18 dot columns wide and 7 dot rows high, for a total of 126 dots per block. The format of this command is:

`<ID`*nn*`><I`*x*`>`*graphic-block-data* **cr lf**

where *nn* is the UMD ID number, *x* is the graphic block identifier, and *graphic-block-data* is a 126-character string containing the dot settings for the entire graphic block. The *nn* parameter is described in the GENERAL QUERY command for COLOR mode. The *x* parameter specifies which of the 26 available graphic blocks you are setting. It must be exactly one ASCII character from "A" to "Z". The *graphic-block-data* string can contain the

characters "B", "R", "G", and "Y". Each of these characters sets a specific dot in the block to black, red, green, or yellow, respectively. The first 18 characters in the data string represent the 18 dots in the top row of the block, from left to right. The next 18 characters in the data string represent the 18 dots in the second row of the block, etc. Note that a *graphic-block-data* string must always define all 7 rows of the graphic block, so it must be exactly 126 characters long. If it is any other length, the UMD will ignore this command.

4. REMOTE PAGE SELECT:

This command causes the target UMD to show the contents of the specified page number. The format of this command is:

<ID*nn*><R*xx*> **cr lf**

where *nn* is the ID number of the target UMD, and *xx* is an ASCII page number in hexadecimal. Valid page numbers range from "01" (page 1) to "1F" (page 31). In addition, the two characters "**" are used to return the UMD to page selection via the switch inputs. Some examples of the *xx* parameter are:

xx = ** Hardware Select (switch inputs determine the page number)

xx = 00 Set to page 0

xx = 08 Set to page 8

xx = 10 Set to page 16

xx = 1E Set to page 30

This command overrides the page-selection switch inputs on the back of the unit. To make the UMD follow the switch inputs again, send this command using the "hardware select" setting.

5. COUNTDOWN:

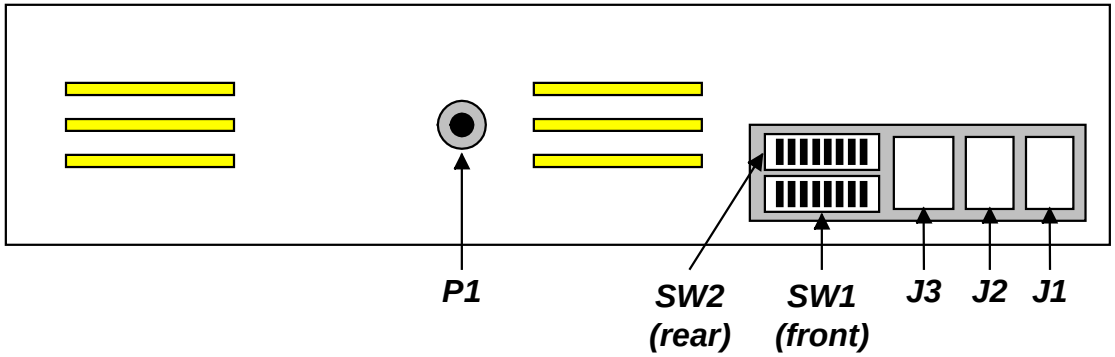
<IDnnn><Dxx> cr lf	xx = 10	Set 10 sec. countdown
	xx = 20	Set 20 sec. countdown
	xx = 45	Set 45 sec. countdown
	nn = **	Global transmit

6. UPDATE STYLE-CHANGE

This command sets the update style for the UMD and applies to firmware versions 2.*x* or later. This command allows you to choose between two styles of update. The first style is a “blink” mode. When data is sent to the UMD, the UMD will momentarily blink off, and then on again, with the new data. The second mode is an instantaneous update where the updated data will instantly replace the original data without blinking.

<IDnnn><Bx> cr lf	where x is 1 for the blink mode update, or x is 0 (zero) for an instantaneous update

UMD - REAR VIEW - COMPONENT LOCATION



J1: RJ11 Connector. Serial data I/O loop-through. See page 16.

J2: RJ11 Connector. Serial data I/O loop-through. See page 16.

J3: RJ45 Connector. Switch Inputs. See page 17.

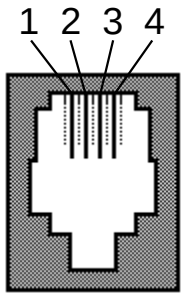
SW1: DIP Switch 1. ID number selection. See page 18.

SW2: DIP Switch 2 (if black). Baud rate & mode selection. See page 19.

DIP Switch 2 (if blue or red). ID increase by 256 & mode selection. See page 19.

P1: Power Connector. 9 VAC input @ 3.4 amps.

APPENDIX B - CONNECTOR PINOUTS - J1 & J2



RJ11 JACK

For J1 and J2 the pinouts are identical:

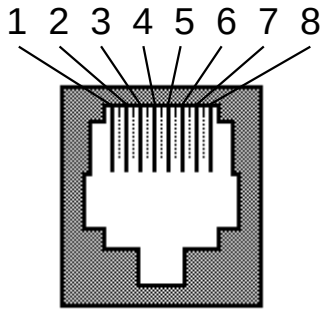
1: TX (+)

2: TX (-)

3: RX (+)

4: RX (-)

APPENDIX B (contd.) - CONNECTOR PINOUTS - J3



RJ45 JACK

J3 pinouts when UMD is in COLOR mode:

1:	Ground	***5:***	No Connection
2:	Red	***6:***	No Connection
3:	Yellow	***7:***	Relay N. O. (normally open)
4:	Green	***8:***	Relay COMMON

J3 pinouts when UMD is in MESSAGE mode:

1:	Ground	***5:***	2
2:	16	***6:***	1
3:	8	***7:***	No Connection
4:	4	***8:***	No Connection

J3 pinouts for UMD model LMS-1034 triple display
(default color must be green):

1:	Ground	***5:***	Left Section Yellow
2:	Left Section Red	***6:***	Middle Section Yellow
3:	Middle Section Red	***7:***	Relay N. O. (normally open)
4:	Right Section Red	***8:***	Relay COMMON

APPENDIX C - DIP SWITCH SETTINGS - SW1 & SW2

NOTE: SW1 is closest to the opening in the rear panel of the UMD. On both DIP packages, switches are numbered 1 through 8, with switch 1 on the left and switch 8 on the right. On black DIPs, switches are OFF when they are set toward you, and ON when they are set away from you (closer to the front screen of the UMD). On blue or red DIPs, switches are OFF when they are up (↑) and ON when they are down (↓). In the following tables, "1" represents ON and "0" represents OFF.

On UMDs with two black DIPs, the highest ID number is 255. On UMDs with one black and one blue or red DIP, the highest ID number is 511.

SW1 sets the ID number of the UMD. Each switch represents a binary number value. When a switch is ON, its value is added to the total to produce the UMD ID number. The value of each switch (from 1 to 8, respectively) is 1, 2, 4, 8, 16, 32, 64, 128. On UMDs with a blue or red SW2, switch 1 down (↓) (on blue or red SW2) adds 256 to the ID set by SW1. The table below shows some sample ID settings.

SW1 - ID Setting:

	Section Number 1 2 3 4 5 6 7 8	(if UMD has blue or red SW2)
ID 1:	1 0 0 0 0 0 0 0	with (blue or red) ***SW2*** section 1 up ↑
ID 2:	0 1 0 0 0 0 0 0	with (blue or red) ***SW2*** section 1 up ↑
ID 3:	1 1 0 0 0 0 0 0	with (blue or red) ***SW2*** section 1 up ↑
ID 17:	1 0 0 0 1 0 0 0	with (blue or red) ***SW2*** section 1 up ↑
ID 18:	0 1 0 0 1 0 0 0	with (blue or red) ***SW2*** section 1 up ↑
ID 253:	1 0 1 1 1 1 1 1	with (blue or red) ***SW2*** section 1 up ↑
ID 509:	1 0 1 1 1 1 1 1	with (blue or red) ***SW2*** section 1 down ↓
ID 510:	0 1 1 1 1 1 1 1	with (blue or red) ***SW2*** section 1 down ↓

APPENDIX C (contd.) - DIP SWITCH SETTINGS

Note: Please follow the settings listed below depending on whether SW2 is *black, blue or red* (*blue or red* DIP package: 0 = switch up ↑, 1 = switch down ↓)

(black)

SW2 - Baud Rate:

	Section Number 1 2 3 4 5 6 7 8
300:	1 0 0 - - - - -
600:	0 1 0 - - - - -
1200:	1 1 0 - - - - -
2400:	0 0 1 - - - - -
4800:	1 0 1 - - - - -
9600:	0 1 1 - - - - -

SW2 - Flash On Red:

	1 2 3 4 5 6 7 8
FLASH OFF:	- - - 0 - - - -
FLASH ON:	- - - 1 - - - -

SW2 - Answerback:

	1 2 3 4 5 6 7 8
ONE-WAY:	- - - - 0 - - -
TWO-WAY:	- - - - 1 - - -

SW2 - Operation Mode:

	1 2 3 4 5 6 7 8
COLOR:	- - - - - 0 0 1
MESSAGE:	- - - - - 1 1 0

(blue or red)

SW2 - Baud Rate:

Fixed at 9600 baud

SW2 - ID:

Section 1 (↓) adds 256 to the ID number set by SW1

SW2 - Flash On Red:

	1 2 3 4 5 6 7 8
FLASH OFF:	- - - ↑ - - - -
FLASH ON:	- - - ↓ - - - -

SW2 - Answerback:

	1 2 3 4 5 6 7 8
ONE-WAY:	- - - - ↑ - - -
TWO-WAY:	- - - - ↓ - - -

SW2 - Operation Mode:

	1 2 3 4 5 6 7 8
COLOR:	- - - - - ↑ ↑ ↓
MESSAGE:	- - - - - ↓ ↓ ↑