

TCI-232

SMPTE TIME CODE

INTERFACE



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DISCLAIMER

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See important limited warranty information starting on page 14.

INTRODUCTION

The TCI-232 is a general purpose interface between SMPTE time code (TC) and external systems. It reads linear TC in the 24 - 25 & 30 fps format and provides precise timing, control & user bit information via:

RS-232 or RS-422 @ 9600 BAUD

Pulse and Relay Contact Closure

Regenerated Time Code With Selectable:

-11 to +12 hour time zone offset from incoming TC

Daylight saving time adjustment

Date information in user bits

Heathkit - 300 BAUD Format for GV Switchers

INITIAL OPERATION

Setup for initial operation consists of :

- supplying a source of time code
- connecting a power source
- selecting the desired setup parameters with switches inside the case
- installing jumpers on header pins (located inside the case) for the desired output
- connecting to an external time code reader device

SMPTE SOURCE

A source of either 24, 25 or 30 fps SMPTE time code is required. During initialization, immediately after being first powered up, the TCI-232 automatically determines if the incoming time code is 24, 25 or 30 fps and adjust itself accordingly.

Time Code Interconnect Cable

TC is an audio signal similar to that of a Modem. It can be routed over unshielded wire like a telephone or, if desired, over a RG-58/59 coaxial cable.

Input Connections

Connect the TC to the BNC connector on the rear of the TCI-232. The input is balanced, isolated from chassis ground and has an input impedance of < 1K ohm.

Time Code Input Level

The input level of the TCI-232 was set at the factory for normal operation at approximately 1.25 volt PP (or 0db/600 ohms). Should adjustment be required an input level adjustment is available inside the case. (See hardware section if level adjustment is required.)

POWER SUPPLY

Apply power by inserting the PS module into an appropriate AC power source and the XLR power connector into the male XLR socket on the rear of the unit.

Power Supply Voltage

The TCI-232 requires a nominal power supply voltage of 12 VDC. Power consumption is approximately 2.5 watts.

Battery Operation

If desired the unit can be operated from a nominal 12 VDC power source (9-15 VDC range). Observe voltage polarity - printed on the rear panel.

SETUP AND I/O OPTIONS

Various setup parameters can be configured by setting switches and pin jumpers inside the case. For access to the PC card see the section "Access to PC Board".

Figure 1 shows the location of the various switches and jumpers on the PC board.

All output signals and functions are via the DB9 I/O connector. If only the time code output is used, a DB9 to BNC male adapter is available from MC. Other custom cable configurations are available from MC on a custom basis. Contact the factory for pricing and details.

With the exception of simultaneous RS-232/422 (not possible), all I/O functions are available on J1 at all times in addition to the TC. To simultaneously use some combination of functions, special jumper wires for J1 and a custom I/O cable would be necessary. Such cables can be fabricated locally by a competent electronic technician or, on a custom basis, by C&A.

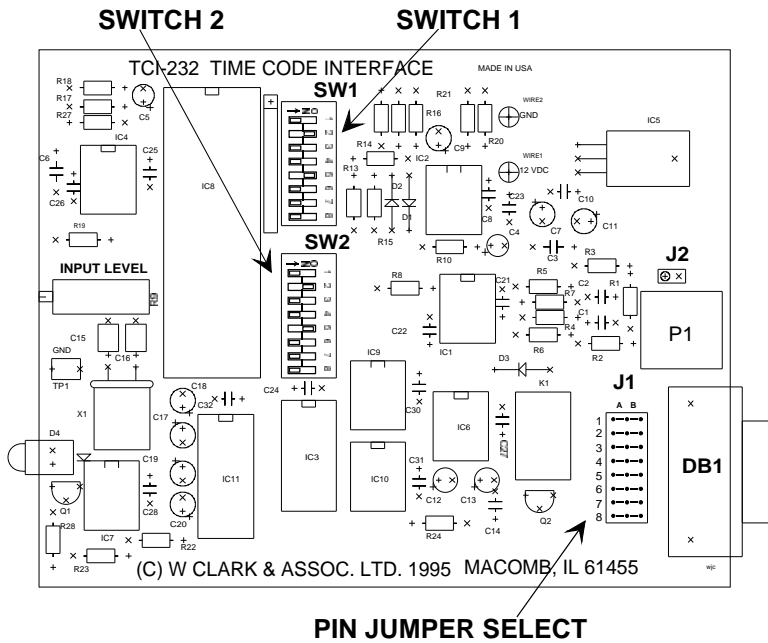
RS-232 or RS-422

As mentioned above it is not possible to use RS-232 and RS-422 simultaneously. The TCI-232 is normally configured and shipped for RS-232. If RS-422 is to be used, in addition to changing the pin jumpers, it is necessary to remove IC-11 (MAX232) and install a SN75176B and a SN75179B in IC sockets IC 9 & 10 respectively. These ICs are available from local electronic supply sources or from C&A. To change back to RS-232, IC 9 & 10 should be removed and IC 11 installed

FIGURE 1

PC Board Layout

PIN JUMPERS AND DB-9 OUTPUT CONNECTOR DETAILS



Input/Output details for J1 pin jumpers and wiring details for the DB-9 output connector are shown on Figure 2 - Simplified I/O Schematic.

RS-232 Default Output Connections

The TCI-232 is shipped with the pin jumpers installed as follows:

--Note that 1 denotes pin jumper installed - 0 - not installed--

Row	J1			DB-9	
	A	B		Pin	
1	0	1	Pulse Output	1	
2	0	1	Time Code Out	6	
3	0	1	RS-232 Rec	2	
4	0	1	NC	7	
5	0	1	RS-232 TX	3	
6	0	1	NC	8	
7	0	1	Relay Com	4	
8	0	1	Relay N/O	9	
			Ground	5	

IBM 9 Pin Serial Port Compatible

The RS-232 pinout configuration is the same as is used on IBM compatible 9 pin serial ports, i.e. pin 2 receive, pin 3 transmit and pin 5 ground. A standard DB-9 male to DB-25 adapter can be used to connect most 25 pin serial cables.

RS-422 OUTPUT CONNECTIONS

For RS-422 output jumper J1 as follows:

--Note that 1 denotes pin jumper installed - 0 - not installed--

Row	J1			DB-9	
	A	B		Pin	
1	0	1	Pulse Output	1	
2	0	1	Time Code Out	6	
3	1	0	Rec -	2	
4	1	0	Rec +	7	

5	1	0	Send +	3
6	1	0	Send -	8
7	0	1	Relay Com	4
8	0	1	Relay N/O	9
			Ground	5

HEATHKIT WWV CLOCK - RS-232 OUTPUT EMULATION

In this mode the TCI-232 automatically outputs time and date information in the Heathkit data format (once per second as required by Grass Valley Switchers) at 300 bits per second. The jumpers on J1 should be set for RS-232 and SW1-8 should be set to on.. In this mode only the RS-232 TX line (pin 3 of DB1) and ground is used. The TCI-232 does not expect to receive and will ignore any commands on the RS-232 Rec line.

PULSE OUTPUT

The output pulse is available on pin 1 of the DB-9 connector. This pulse is approximately 5V in amplitude and 100 ms in duration.

Pulse Timing

Pulse timing is controlled by SW2. The pulse can be set to occur once per: sec - min - hr or day. (See Figure 3 for switch details.) Normally only one of the switches should be set to on. If either the min (#7) or hr (#6) position is set in addition to the day position (#5), only the day position will be read; the hour and min position will be ignored.

One Second Advance

Timing of the pulse can be advanced so as to occur at the 59 sec point of the respective period by setting SW2-8 to the on position in addition to either the min, hr or day SW. For example setting SW2, 8 & 6 on will cause the pulse to occur at the XX:59:59. Setting SW2, 8 & 5 on will cause the pulse to occur at the 23:59:59.

Pulse Accuracy

Time is valid at the leading edge of the pulse and is accurate to within < 1 ms of frame 0 of the incoming TC.

TTL Level Output

This is a high impedance TTL level signal and is not designed to drive relays and other low impedance devices directly. Connecting such devices, including shorting the output pin, and causing more than approximately 5 ma of current to flow, could damage the unit. Such damage is not covered by warranty.

RELAY CONTACT CLOSURE

The N/O relay contacts are available on pins 4 & 9 of the DB-9. (The N/C contact is available on J1) See Figure 2 - simplified schematic for details.

Relay Contact Closure Timing

The point in time when the relay closes is controlled by SW 2. The relay can be set to close once per: sec - min - hr or day. See switch details in Figure 3. Normally only one of the switches should be set to on. If either the min (#3) or hr (#2) position is set in addition to the day position (#1), only the day position will be read; the hour and min position will be ignored.

Contact Closure Accuracy

Time is accurate and valid at the end of the contact closure (when the contact opens) and is accurate to within approximately 1 ms of frame 0 of the incoming TC.

One Second Advance

Timing of the contact closure can be advanced so as to occur at the 58.9 sec point of the respective period by setting SW2-4 to the on position in addition to either the min, hr or day sw. For example setting SW2- 4 & 2 on will cause the contact closure to occur at the XX:59:58.9. Setting SW2- 4 & 1 on will cause the contact to close at the 23:59:58.9.

Contact Ratings

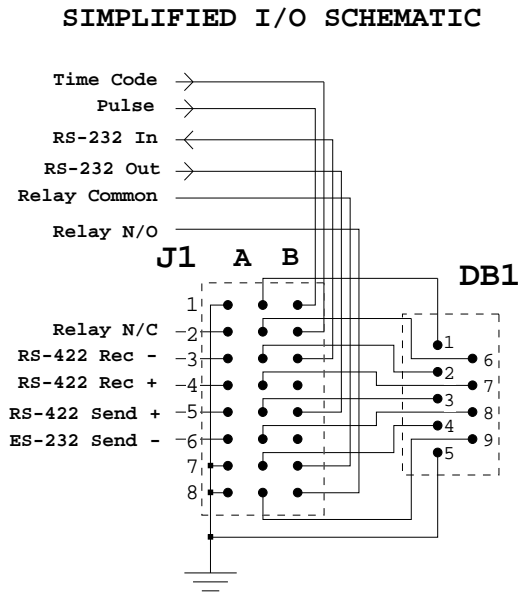
The absolute maximum contact rating is .5 Amp at 24 VDC. Nominal current should not exceed 200 ma. Connecting high current loads and exceeding the maximum rating could damage the relay and traces on the PC board . Such damage is not covered by warranty.

Once Per Second Operation Not Recommended

Even though the relay can be pulsed once per second, this is not recommended for any length of time because the number of closures (more than 600,000 per week) will rapidly exceed the specified number of lifetime operations for the relay. Damage from this type operation is not covered by warranty. (Use the pulse output with an appropriate interface system.)

FIGURE 2

Simplified I/O Schematic



TIME CODE OUTPUT

SMPTE time code is available on pin 6 of the DB-9. The output level is fixed at approximately 1.25 V pp. Output impedance is less than 50 ohms and the output is unbalanced.

TIME OFFSET FOR LOCAL TIME ZONES

SW1 switches 1 - 5 are used to set the SMPTE time code for local time zones. See Figure 3 for details. Switches 1 - 4 define the number of hours offset from 1 to 12. Switch 5 is used to define a plus or minus offset relative to UTC time. For example the East Coast (EST) of the US is 5 time zones later than UTC. SW1 setting for a -5 hr offset is as follows:

Position	5	4	3	2	1
On/Off	on	off	on	off	on

AUTOMATIC DAYLIGHT SAVING TIME

SW1-6 is used to activate automatic (US defined) daylight saving time switching. When switch 6 is in the on position, the TCI-232 will automatically advance the TC time by 1 hour at 2 AM on the first Sun of April and retard the time by 1 hour at 2 AM on the last Sun of Oct. Time is not changed when SW1-6 is in the off position. **Note in order for Automatic DST to be activated, Auto Date SW1-7 must be in the on position and date information must be encoded in the proper user bits**

AUTO DATE SET

If the user bits contain date information in the proper format (available from the C&A GPS-100 SMPTE generator) this date information can be formatted and made available to the RS-232/422 outputs by setting SW1-7 to the on position. The date information is automatically adjusted to accommodate any time zones and daylight savings offsets.

Do not set this switch on unless the user bits contain the date information in the proper format. If invalid data is present in the user bits the software could try to read the date and could produce invalid output.

9600/300 BAUD OUTPUT

SW1-8 sets the communications speed for the com port. In the off position the com port operates bi-directionally at 9600 BAUD. In the on position it operates in a 300 BPS simplex output mode. See details of the output format in the section on software.

FIGURE 3

Switch 1 & 2 Setup

SWITCH 1 & 2 SETUP OPTIONS

Switch On = 1
Switch Off = 0

SW 1 Position	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	0	0	Default
					0	0	0	1	Hr 1
					0	0	1	0	Hr 2
					0	0	1	1	Hr 3
					0	1	0	0	Hr 4
1 = Auto Output @ 300 BAUD					0	1	0	1	Hr 5
0 = 9600 BAUD Output					0	1	1	0	Hr 6
1 = Automatic Date Insert					0	1	1	1	Hr 7
1 = Automatic Daylight Set					1	0	0	0	Hr 8
1 = Minus, 0 = Plus Time Offset					1	0	0	1	Hr 9
					1	0	1	0	Hr 10
					1	0	1	1	Hr 11
					1	1	0	0	Hr 12

SW 2 Position	8	7	6	5	4	3	2	1
<u>Pulse Output</u>								
1 Pulse Per Sec	1	0	0	0				
1 Pulse Per Min	0	1	0	0				
1 Pulse Per Hour	0	0	1	0				
1 Pulse Per Day	0	0	0	1				
<u>Relay Closure</u>								
1 Per Sec					1	0	0	0
1 Per Min					0	1	0	0
1 Per Hour					0	0	1	0
1 Per Day					0	0	0	1

NORMAL OPERATION

When power is first applied (without TC present) the front panel LED will come on and stay on.

After power up (when TC is present) and after initialization, the LED will flash once each second in synchronization with frame 0 of the incoming TC.

Should TC be lost or become invalid the LED will stay on but will not blink

HARDWARE

OPERATING ENVIRONMENT

The TCI-232 is not water or moisture proof. Treat it as you would any other delicate electronic device and do not expose it to water, excessive heat or physical abuse.

ACCESS TO PC BOARD

In order to gain access to the pin jumpers and setup switches it is necessary to remove the case from the TCI-232 as follows:

First disconnect the power and other cables from the unit. Even though the highest voltage inside the TCI-232 is 12 VDC (which is generally not dangerous to touch), accidentally shorting a trace or wire inside the unit with power on could destroy or damage any one of the extremely sensitive electronic modules. **Accidentally shorting a wire or trace or subjecting the unit to a static discharge, even for a very small fraction of a second, can destroy these modules. Such damage is not covered by the warranty.**

Remove the two Phillips screws on the rear panel (this is the end with the XLR power socket - do not remove the screws from the XLR connector). Holding the case of the unit in one hand, slide the rear panel assembly outward from the rear. The entire rear panel assembly and PC board will slide out.

As was mentioned above, the PC board is sensitive to any electrical signal including static discharge. Do not touch the PC board with any external wiring and, whenever possible, handle the unit by the rear panel or on the edge of the PC board as you would a Compact Disk. When not changing the jumpers or switches, always keep the PC board installed in the case.

When reassembling the unit take care that the PC board is properly fitted into the slots in the base of the chassis. When properly inserted, the PC board and rear panel assembly will slide easily into the case, no force is necessary. The warranty does not cover damage caused to the unit while removing or reassembling the PC board.

SETTING THE INPUT LEVEL

The input level control is adjusted at the factory for a nominal input level of approximately 0dB (as measured with an audio voltmeter) or 1.6 VPP. This setting gives an operating range of approximately - 10 to + 10 dB. Should field adjustment be necessary use the following procedure.

- Supply the card with a SMPTE time code signal with an input level within the range of -15 and +20dB.
- Monitor the operation of the TCI-232 by watching the front panel LED.
 - a) First turn the level control to the left (counter clock wise) 10 complete turns.
 - b) Next turn the level control slowly to the right (CW) until the LED just starts to blink.
 - c) At that point, counting the number of turns, continue turning the control until the LED stops blinking. (The range of turns over which the LED blinks will be 4-5. turns.)
 - d) Turn the control to the left (CCW) to a point midway within the operating range of the level control. (Approximately 2 turns.)
- No further adjustments should be required unless there is a major change in input level.

SOFTWARE

This section lists the software commands that the TCI-232 will respond to and the communications protocols that are used to communicate with the unit.

A software resource diskette is available that contains a PC compatible test program that can test and display all software features of the TCI-232 via the Com port. It also contains more in-depth protocol information in a text file and examples of source code that can help in writing code to communicate with the unit. Contact the factory for availability and pricing.

TCI-232 SERIAL PROTOCOLS

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9600 BAUD

In this mode the TCI-232 can send and receive packets described in the serial messages section below. Communications in this mode will be 9600 bits per second, 8 data bits, 1 stop bit, and no parity.

Serial communication with the TCI-232 is accomplished by the exchange of messages. A command message is sent to the TCI-232 from the user application. A response message is returned to the user application from the TCI-232. A response message will consist of a single response for query-type commands or multiple responses on some specified interval for mode-type commands. Mode-type commands are enabled and disabled.

A message will be defined as a group of bytes including a header, ID, data size, and data. The message header is used by both the TCI-232 and the user application to identify the message and message type. A message header consists of the hexadecimal byte sequence 0xFF 0xAB (255 171). A message ID will be one byte from the list of commands which the TCI-232 recognizes.

Command messages - to the TCI-232

****from the user application:*

The format for transmitting command messages to the TCI-232 is as follows:

<message header><message id>[<data bytes.....>]

The data portion of a command message will vary depending on the type of message being sent. Some messages do not require any data to be transmitted so none should be sent. The TCI-232 knows the required amount of data bytes for each command message. If a command message is transmitted without the appropriate number of data bytes it will be ignored.

Response messages - from the TCI-232

****to the user application:*

The format for the response messages from the TCI-232 is as follows:

<message header><message id><data size><data bytes...>

The message ID indicates to which command number the response is directed. The data size specifies the number of response data bytes forthcoming. All response messages contain at least one data byte.

Message types:

ID: 0
Type: Mode

Description: Enable or disable automatic transmission of time information once per second at the valid start of the first frame of the second.

Note: Automatic transmission of this message begins on the first second after the second during which the enable message was received.

Command format:

#	Byte	Description
1	0xFF	message header
2	0xAB	" "
3	0x00	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable

Response format:

#	Byte	Description
1	0xFF	message header
2	0xAB	" "
3	0x00	response ID
4	0x03	response data size
5	0x??	hour (0-23)
6	0x??	minute (0-59)
7	0x??	second (0-59)

ID: 1

Type: Mode

Description: Enable or disable automatic transmission of time/date information once per second at the valid start of the first frame of the second.

Note: Automatic transmission of this message begins on the first second after the second during which the enable message was received. This mode can not be enabled unless the "Auto Date Set" (SW1-7) switch is in the ON position.

Command format:

#	Byte	Description
1	0xFF	message header
2	0xAB	" "
3	0x01	command ID
4	0x??	0x01 to enable this mode, 0x00 to disable

Response format:

#	Byte	Description
1	0xFF	message header
2	0xAB	" "
3	0x01	response ID
4	0x07	response data size
5	0x??	hour (0-23)
6	0x??	minute (0-59)
7	0x??	second (0-59)
8	0x??	month (1-12)
9	0x??	day (1-31)
10	0x??	year (0-99)
11	0x??	day of week (0-6)

ID: 2

Type: Mode

Description: Enable or disable automatic transmission of frame once per frame at the valid start of the frame.

Note: Automatic transmission of this message begins on the first frame after the frame during which the enable message was received.

ID: 3
Type: Mode

Description: Enable or disable automatic frame transmission of specified frame once per second at the valid end of the specified frame (before the sync word).

Note: Automatic transmission of this message begins on the first occurrence of the specified transmit frame. If an invalid frame value is specified for the type of time code being processed this mode will not be enabled.

ID: 15
Type: Query

Description: Request time information

ID: 16
Type: Query

Description: Request date information

Note: This query will be ignored unless the "Auto Date Set" (SW1-7) switch is in the ON position.

ID: 17
Type: Query

Description: Request time/date information

Note: This query will be ignored unless the "Auto Date Set" (SW1-7) switch is in the ON position.

ID: 18
Type: Query

Description: Request hour BCD

Note: The two MSB's of the high nibble will also contain the status of unassigned bit addresses 59 and 58, respectively.

ID: 19
Type: Query

Description: Request minute BCD

Note: The MSB of the high nibble will also contain the status of unassigned bit address 43.

ID: 20
Type: Query

Description: Request second BCD

Note: The MSB of the high nibble will also contain the status of unassigned bit address 27.

ID: 21
Type: Query

Description: Request frame BCD

Note: The two MSB's of the high nibble will also contain the color frame flag (bit address 11) and drop frame flag (bit address 10), respectively.

ID: 22
Type: Query

Description: Request user groups 1 & 2 BCD

Note: User group 1 is packed in the high nibble of the response, user group 2 in the low.

ID: 23
Type: Query

Description: Request user groups 3 & 4 BCD

Note: User group 3 is packed in the high nibble of the response, user group 4 in the low.

ID: 24
Type: Query

Description: Request user groups 5 & 6 BCD

Note: User group 5 is packed in the high nibble of the response, user group 6 in the low.

ID: 25
Type: Query

Description: Request user groups 7 & 8 BCD

Note: User group 7 is packed in the high nibble of the response, user group 8 in the low.

ID: 26
Type: Query

Description: Request time code type

Note: The time code type response 255 (undetermined) indicates that time code has not yet been applied to the TCI-232.

Heathkit WWV Clock Emulation for Grass Valley Switchers

Grass Valley switchers can accept a time code input from Heathkit WWV Clocks via RS-232 at 300 bits per second, 8 data bits, 1 stop bit, no parity. The expected format is:

HH:MM:SS.T MM/DD/YY<CR>

HH=hour, MM=minute, SS=second, T=tenths of second followed by five spaces followed by MM=month, DD=day, YY=year (0-99) followed by a carriage return.

With SW1-8 switch in the ON position (Auto Output @ 300 baud) the Heathkit format message will be sent once per second at the valid start of the first frame of that second. The tenths of second field will always contain '0' (ASCII value 48). Note that if SW1-7 switch (Auto Date Set) is in the OFF position the MM/DD/YY fields will be padded with the character '0' (ASCII value 48). The Grass Valley switcher may not accept the serial message without the date included.

PROBLEMS - TROUBLE SHOOTING

All TCI-232 units are checked for proper operation before shipment and unless physical damage is found, the unit is probably functional.

If you have problems in getting the unit to work:

- double check all input and output connections
- make sure that power is applied and the front panel LED is showing the startup sequence when first activated
- verify that a valid SMPTE TC is connected
- verify that the TC input level is correct
- verify that the TC output level is correct for the device being fed

If the unit does not work even after the above precautions have been noted, please contact the factory.

SPECIFICATIONS

INPUT

Format: SMPTE - 24 - 25 or 30 fps
Level: approx. - 1.25 Vpp (0 db/600 Ω)
Impedance: approx. 1K ohm
Connector: BNC male

OUTPUT

Format: SMPTE - 24 - 25 or 30 fps
Level: Approx. - 1.25 Vpp (0 db/600 Ω)
Impedance: < 50 ohm
Connector: DB-9

TC OUTPUT ACCURACY

Latency from incoming TC < 100 μ sec

RELAY CONTACT RATINGS

500 ma, 24 VDC

POWER SUPPLY REQUIREMENTS

Input voltage 12 VDC
Input power connector 4 pin XLR male
Pin 4 +12 VDC
Pin 1 Ground
Power consumption - @ 12V @ 200 ma (2.4 W)

PHYSICAL

Size: 1.5 x 4.1 x 5.5 in. (3.8 x 10.4 x 14 cm)
Weight 17 oz. (480 gr.)

OPERATING TEMPERATURE

Temperature 0 to +70 °

LIMITED WARRANTY & SERVICE

This Masterclock, Inc. (hereinafter MC) product warranty extends to the original purchaser.

MC warrants the TCI-232 against defects in materials and workmanship for a period of five years from date of sale. If MC receives notice of such defects during the warranty period, MC will, at its option, either repair or replace products which prove to be defective.

Should MC be unable to repair or replace the product within a reasonable amount of time, the customer's alternate remedy shall be a refund of the purchase price upon return of the product to MC. This warranty gives the customer specific legal rights. Other rights, which vary from state to state or province to province, may be available.

EXCLUSIONS

The above warranty shall not apply to defects resulting from improper or inadequate maintenance by the customer, customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product or improper site preparation and maintenance (if applicable).

WARRANTY LIMITATIONS

MC MAKES NO OTHER WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS PRODUCT. MC SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

In any state or province which does not allow the foregoing disclaimer, any implied warranty of merchantability or fitness for a particular purpose imposed by law in those states or provinces is limited to the one-year duration of the written warranty.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MC BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

In any state or province which does not allow the foregoing exclusion or limitation of incidental or consequential damages, the customer may have other remedies.

HARDWARE SERVICE

You may return your TCI-232 to MC for repair service. Please contact the factory for return authorization before returning the unit. When you return your TCI-232 for service, you must prepay all shipping charges, duty, and taxes. Except for products returned by the customer from another country, MC will pay for return shipment of products to the customer.