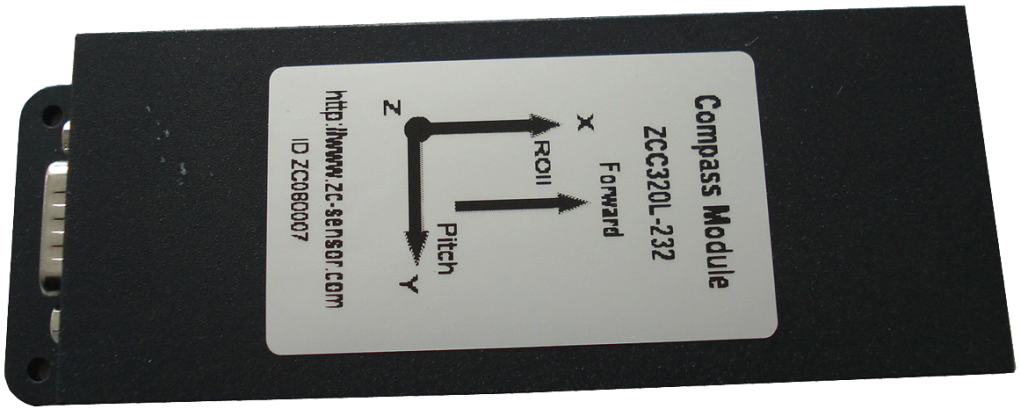
High accuracy three-axis digital compass module

ZCC320L Series



User's guide

***Please read this manual carefully before using the product.**

Table of Contents

I. INTRODUCTION

1.1 General description

ZCC320L-232 uses magnetic sensors with proven MR technology and a two-axis tilt sensor to bring you the heading information. This electronically gimbaled compass gives accurate heading even when the compass is tilted up to 50 degrees. ZCC320L-232 is reliable and rugged since it does not contain any moving components and uses all surface mountable components. It is easy to use and extremely versatile. It allows the user to configure compass output to include any combination of six NMEA standard messages and to change measurement parameters for the magnetometer to suit the application. It can provide RS232 and RS485 interface.

- Single power supply 12V （range from 7 V to 14V)
- Azimuth repeatability 0.5 degree，inclinometer repeatability 0.1 degree
- DB9 interface, case configuration waterproof, non-magnetic
- Wide operation temperature,range from -40℃～85℃.
- Hard magnetic compensation
- Integrated restore reset circuit, high anti-jamming performance, output stability and high accuracy.
- User can define baud rate, update rate, declination,deviatione etc.
- Model

ZCC320L－232	RS232 interface with encapsulation
ZCC320L－485	RS485 interface with encapsulation

1.2 ZCC320L Series Communication

ZCC320L series communications are governed by a simple, asynchronous, ASCII protocol modeled after the NMEA 0183 standard. Either an RS-232 or an RS-485 electrical interface can be used. ASCII characters are transmitted and received using 1 start bit, 8 data bits (LSB first), no parity (MSB always 0), and 1 stop bit; 10 bits total per character. Baud rate can be any one of 1200, 2400, 4800, 9600, 19200, 38400.The default value is 19200.

1.3 ZCC320L Series output

ZCC320L Series output sentence format accord with voyage communication Standard NMEA 0813. ZCC320L series has four operation mode:

Continuous Mode

Output unsolicited NMEA standard message(s) at a configurable rate

Strobe Mode

Active Strobe Mode- Measurement is continuous and message output on request

Passive Strobe Mode- Measurement and output upon request

Sleep Mode (requires an interrupt signal at the connector)

Both measurement and output are suspended with serial inputs ignored

Calibrate Mode
Enter the compass in to user Hard Iron calibration mode

There are six possible NMEA messages, three standard and three proprietary, that can be automatically sent from ZCC320 in Continuous Mode by selecting their Update Rates. Additionally, there is a seventh, non-conforming ASCII display message that can also be sent. The ASCII display message is not expected to commingle with the other six NMEA messages. It is intended for simpler systems where ZCC320 is connected to a numerical readout device instead of a host processor.

The update rate for each message can be set independently to one of the following: 0, 1, 2, 3, 6, 12, 20, 30, 60, 120, 180, 300, 413, 600, 825, or 1200 sentences per minute. If the output channel, due to its programmed baud rate, cannot accommodate the total number of sentences selected, then the channel will operate at full speed and highest priority will be given to responses to input, followed by sentences with update rates from lowest to highest. Fairness will be implemented in the priority scheme so that each sentence ready for output is transmitted at least once before higher priority sentences are repeated.

II SPECIFICATIONS:

Parameter	Description	Value	Unit
Electrical			
Supply voltage	Single supply	12	V
Operation current		50	mA
Heading			
Measuring range	@room temperature	±6	Gauss
Resolution	@room temperature	85	μGauss
		0.1	º
Accuracy	@room temperature		
	horizontal	0.5	º
	tilt<20 º	1	º
	tilt>20 º	2	º
Repeatability	@room temperature	±0.5	º
Pitch and roll			
Measuring range	@room temperature	±50	º

Resolution	@room temperature	0.1	º
Accuracy	@room temperature	0.1	º
Repeatability	@room temperature	0.1	º

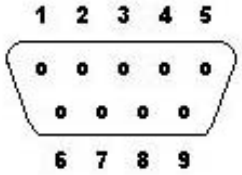
Electronic

Baud rate	User optional	Default 19200(1200~19200 optional)	BPS
Response frequency	User optional	Max 20	Hz

Physical

Operating temperture		-40~85	℃
Connection type		DB9	
Dimensions	Aluminium case	46*139*27	mm
	Circuit board	33*111*19	mm

III PIN DEFINITION:



Nine pins array like the above diagram,their definition is as follows;

Pin	Description
1	Opertion/Calibration
2	TxD/A(RS232 send)/485-A(RS485 in phase)
3	RxD/B(RS232 accept)/485-B(RS485 out of phase)
4	Ready/Reset
5	GND
6	Run/Stop
7	Cont/Reset
8	5V(regulated voltage input)
9	7-14V(unregulated voltage input)

IV: OPERATION IN DETAILS

4.1 PC software operation

Launch PC Demo Interface by double clicking the program icon in PC Demo Interface

window. Select the appropriate COM port and choose **19200** as the baud rate (factory setting). Message box, identifying the Firmware Version, should appear. This message indicates a successful installation and interface connection.

Activate *Tune Parameters* in the PC Demo Interface (from the *Parameters* menu or use the **Tune** button). The compass is in RUN (Continuous) mode with NO messages coming out. (Message rates for all the output sentences are set to 0 at the factory). Set the message rate of HPR sentence to 825 (*Tune Page* | *Serial Output*). Now the compass should output heading, pitch and roll data at 825 sentences/min rate.

Activate *Display* | *View Interface*, or *Display* | *Monitor NMEA Sentences* to see the output. *Diagnostics* | *View Log* is another option to inspect compass data. Make sure the Log all messages (logging page in Diagnostics \ Options menu) option is activated.

Note: A non-zero HPR message rate should be chosen for View \ Interface to be active.

4.2 compass calibration

All magnetic compasses have to be calibrated in order to compensate for magnetic fields other than the earth's field components to get accurate heading. These additional magnetic fields are generated by the host and therefore depend on the compass mounting location. By performing a simple procedure, the HMR3000 can compensate for steady, static magnetic fields known as hard iron fields. Field components found after a calibration are only valid for the particular orientation and location of the compass. A re-calibration is necessary after a relocation of the compass or if the platform has changed its magnetic character.

The goal of the calibration procedure is to sample the magnetic field components for many possible orientations of the host system. Rotating the host system through 360 degrees or driving in a circle (in the case of a vehicle) will enable the compass to sample its magnetic environment.
To put the ZCC320L into calibration mode (issue #F33.4=0*51<CR><lf>): Slowly rotate the host system through a full circle in a gentle motion while changing roll and pitch as much as the host will allow. Generally this procedure will take over two minutes.

3D Calibration—This method is recommended when the hard iron field is large. The PC demo interface will collect magnetic vector information and analyze to find the hard iron offsets. Launch PC Demo Interface .In PC Demo, go to Diagnostics menu and to Perform 3D Calibration menu. In Hard Iron page, activate Read Data.You should see the *Total Valid Readings* (# of data points collected) go up.If not check the following.First quit the Cal page.Go to Diagnostics \ Options \ Calibration.Select *Real Time Data from Unit* by clicking that option.Slowly rotate the platform through a full circle in a gentle motion while changing roll and pitch as much as the platform will allow. Generally this procedure will take over two minutes. At the end of this

procedure hit *Stop*.Once the computation is complete hit *Apply* to put the Hard Iron offsets into the unit.
If sufficient tilt change were not encountered during the calibration procedure, then the calculated Z offset value may not be reliable. In such case the Z offset will appear in red, and the corresponding check box empty. User has the option to accept this value by checking the box.

Z Reference Method—In applications which changing the tilt of the host is not possible, an approximate value of the Z offset can be found by using the Z Reference Method. This method directly compares the Z component of the earth's magnetic field in an undisturbed location to that of the host. This procedure involves two steps:
Step 1. Collect Z reference value near the calibration site, away from large metal objects that will distort the earth's field by:
Activating Diagnostics \ Capture/Clear Z Reference
Hit Read Data
Hold the compass approximately level
Hit Stop after capturing 10-20 readings and hit 'Apply' to save the new Z Reference value in the EEPROM.

Step 2. Install the compass on the host and follow the normal 3D Calibration described above. Mag Z offset will be computed from the Z Reference method as well as the normal method, and the most appropriate value is indicated by a cross mark against the value.

4.3 Query for NMEA Sentences

The three NMEA standard sentences (HDG, HDT, and XDR) and three proprietary (HPR, RCD, and CCD) messages can be queried as follows.
The three standard query messages accepted are:

$TNHCQ,HDG*27<cr><lf>
$TNHCQ,HDT*34<cr><lf>
$TNHCQ,XDR*22<cr><lf>

The three proprietary query messages accepted are:

$PTNT,HPR*78<cr><lf>
$PTNT,RCD*67<cr><lf>
$PTNT,CCD*76<cr><lf>

4.4 Format of NMEA Sentences Output

HDG Heading, Deviation, & Variation

$HCHDG,x.x,x.x,a,x.x,a*hh<cr><lf>

If either the deviation or variation parameter has not been programmed, the corresponding field will be null (per NMEA 0183 version 2.1, section 5.2.2.3). Parameters have not been programmed if their absolute values are greater than 3200 mils or 180.0 degrees. Positive deviation and variation is indicated by a = E; negative values by a = W. Heading field will be null if it cannot be calculated (see HPR proprietary sentence). NMEA requires that units for heading measurement be degrees.

Eg. In Degree Mode
$HCHDG,85.8,0.0,E,0.0,E*77
$HCHDG,271.2,0.0,E,0.0,E*44
$HCHDG,271.1,10.7,E,12.2,W*52
$HCHDG,0.0,10.7,E,12.2,W*57
Mil Mode is not allowed by NMEA standard

HDT Heading, True
$HCHDT,x.x,T*hh<cr><lf>

The heading field will be null if variation has not been programmed (see HDG and Definitions), or if heading cannot be calculated. If deviation has not been programmed, it is assumed to be zero, otherwise it is added to measured heading and variation to express true heading of compass board.

Eg. In Degree Mode
$HCHDT,86.2,T*15
$HCHDT,271.1,T*2C
$HCHDT,0.9,T*20
Mil Mode not allowed by NMEA standard

XDR Transducer Measurements
$HCXDR,A,x.x,D,PITCH,A,x.x,D,ROLL,G,x.x,,MAGX,G,x.x,,MAGY,
G,x.x,,MAGZ,G,x.x,,MAGT*hh<cr><lf>

Each of the six possible measurements - pitch; roll; and magnetic x, y, z, and total—can be individually included in or excluded from the message (see "XDR has …" parameters). See NMEA 0183 for a detailed description of the "Type-Data-Units-ID" field encoding. The "Data" field of an included measurement will be null if its contents cannot be determined due to saturated measurements. Only units of degrees are allowed by NMEA for pitch and roll measurements.

Magnetic measurements are transmitted in engineering units (milli Gauss) determined by a tunable conversion factor. MAGX aligns with the compass board north-south axis, and MAGZ is perpendicular to the plane of the compass board. MAGT is the total magnetic field strength determined by calculating the square root of the sum of the squares of MAGX, MAGY, and MAGZ.

Eg. In Degree Mode
$HCXDR,A,-
0.8,D,PITCH,A,0.8,D,ROLL,G,122,,MAGX,G,1838,,MAGY,G,-
667,,MAGZ,G,1959,,MAGT*11
In Mil Mode
$HCXDR,A,-
3,D,PITCH,A,14,D,ROLL,G,1090,,MAGX,G,5823,,MAGY,G,-
20,,MAGZ,G,5924,,MAGT*2B

The following describe the proprietary sentences in detail:

HPR *Heading, Pitch, & Roll*

$PTNTHPR,x.x,a,x.x,a,x.x,a*hh<cr><lf>

This sentence combines HMR3000's three significant measurements with useful status information. Data fields represent, in order: heading, magnetic field status, pitch, pitch status, roll, and roll status. Heading, pitch, and roll measurements are presented in degrees or mils depending on the setting in EEPROM. The heading measurement is corrected for deviation and variation when these factors are programmed in the EEPROM.

Eg. In Degree Mode

$PTNTHPR,85.9,N,-0.9,N,0.8,N*2C

$PTNTHPR,7.4,N,4.2,N,2.0,N*33

$PTNTHPR,354.9,N,5.2,N,0.2,N*3A

In Mil Mode

$PTNTHPR,90,N,29,N,15,N*1C

Status fields can contain one of six letter indicators:

L = low alarm,

M = low warning,

N = normal,

O = high warning, or

P = high alarm.

C = Tuning analog circuit

If any of the three status fields indicates alarm, then the heading field will be null as well as the corresponding measurement field. Thresholds for alarm and warning levels can be changed in the EEPROM.

RCD Raw Compass Data

$PTNTRCD,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<cr><lf>

This sentence provides raw tilt and magnetic measurements for diagnostic use. Contents of each field represent A/D readings for, in order: TiltAp, TiltAm, TiltBp, TiltBm, MagA, MagB, MagC, MagAsr, MagBsr, MagCsr. All values represent the actual A/D readings from the most recent conversions, except that tilt readings are adjusted if low gain was used for the conversion. Mag_sr values represent the sum of the most recent calibration.Set and Reset pulse measurements for each sensor. There are never any null fields in this sentence.

Eg. In Degree Mode

$PTNTRCD,1509,1551,1548,1553,15199,16146,17772,17055,16176,17059*42

In Mil Mode

$PTNTRCD,1435,1512,1497,1453,16776,14066,9477,17403,16073,17225*7F

CCD *Conditioned Compass Data*

$PTNTCCD,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<cr><lf>

This sentence provides conditioned tilt and magnetic measurements for diagnostic use. The fields are, in order:

Tilt X 32768 times tangent of angle between compass board north-south axis and level plane. This value is the difference between the raw tilt measurements normalized, linearized, and filtered according to parameter settings. The pitch measurement is determined by taking the arctan of TiltX/32768.

TiltY same as TiltX but for the compass board east-west axis (roll).

MagX normalized and filtered magnetic field strength along the north-south axis of the compass board. This value has been adjusted for any hard-iron offset determined during calibration (or tuned manually).

MagY same as MagX but along the compass board east-west axis.

MagZ same as MagX and MagY, but along the axis perpendicular to the plane of the board. This value has been adjusted both for gain variation with the X-Y sensor pair and for hard-iron.

MagT Total magnetic field strength.

Heading calculated heading based on the magnetometer and inclinometer data in this sentence. Presented in degrees or mils depending on the setting in EEPROM. This field will be null if the heading cannot be calculated.

Eg. In Degree Mode

$PTNTCCD,522,-472,109,1841,677,1964,86.3*44

In Mil Mode

$PTNTCCD,-25187,351,-3909,1899,-4394,6180,1838*58

ASCII Message

The special ASCII display message normally consists of a string of 4 digits that represent the heading in degrees and tenths, followed by a terminating carriage return character. Heading is corrected for deviation and variation. when these factors are programmed in the EEPROM. When the heading cannot be transmitted due to a magnetometer or tilt signal out of range, then 4 minus signs are transmitted instead.

Eg. In Degree Mode

86.1

4.5 Warning and Alarm Settings

Tilt and magnetometer limits can be programmed in to the EERROM to generate Warning and Alarm conditions in the status fields of the HPR sentence output.

Tilt Settings

When the tilt measured is below the warning level, the status fields will indicate ‘N’.

$PTNTHPR,59.6,N,-0.2,N,-3.0,N*0F

Tilt high warning and high alarm can be user programmed.

When the pitch or roll measured is between the warning and alarm levels, the HPR message will indicate this with letter ‘O’ in the corresponding pitch or roll status field.

$PTNTHPR,72.9,N,-1.6,N,-29.6,O*33

When the pitch or roll measured is beyond the alarm level, the HPR message will indicate this with letter 'P' in the corresponding pitch or roll status field, and the heading field will be null.
$PTNTHPR,,N,-1.5,N,,P*03

Magnetometer Settings
Four levels can be set for the magnetometer alarm and warning levels. High Warn and Alarm levels, and Low Alarm and
Warning levels. Five settings are generated depending on the measured total magnetic field value (Mag T) and the levels
programmed in the EEPROM.

LEVEL	Mag Status Field	Heading Field
Low Warn < Mag T < High Warn	N	Normal
High Warn < Mag T <High Alarm	O	Normal
High Alarm < Mag T	P	Null
Low Alarm < Mag T < Low Warn	M	Normal
Mag T < Low Alarm	L	Null

Magnetometer high alarm condition example $PTNTHPR,,P,0.3,N,0.1,N*06

4.6 Operational

Using the serial protocol described in the previous section, an external host can direct operation of ZCC320 with the following commands:

Command	Description	Command Syntax	Action
RUN	1=RUN	#FA0.3=1*26<CR><lf>	Start Compass measurements
STOP	0=STOP	#FA0.3=0*27<CR><lf>	Stop Compass measurements
Query	query for Run/Stop status	#FA0.3?*15<CR><lf>	Respond with status
Response	RUN	#1*31<CR><lf>	
	STOP	#0*30<CR><lf>	
Force Reset	Perform power up reset sequence	#F33.6=1*52<CR><lf>	
Initialize Filters	Reset IIR filter (set after changing TC1)	# F33.2=1*56	

4.7 Configuration Parameters

Parameter Name	Description	Command Syntax

Deviation angle	Sets the Deviation angle to value nnn.n (in degree mode)	**#IE2=nnn.n*hh<CR><lf>**
	'hh' is the checksum value	
Query	Deviation angle	**#IE2?*01<CR><lf>**
response		**#nnn.n*hh<CR><lf>**
Variation angle	Sets the Variation angle to value nnn.n (in degree mode)	**#IE4=nnn.n*hh<CR><lf>**
	'hh' is the checksum value	
Query	Variation angle	**#IE4?*07<CR><lf>**
response		**#nnn.n*hh<CR><lf>**

4.8 Measurement Parameters

Parameter Name	**Description**	**Command Syntax**
MagX offset (nnnn)	Hard-iron offset along north-south axis in magnetometer counts. Allows the user to input a value.	**#IC4=nnnn*hh<CR><lf>**
Query		**#IC4?*01<CR><lf>**
Response	N=Hard Iron offset (in counts)	**#N*hh<CR><lf>**
MagY offset (nnnn)	Hard-iron offset along east-west axis in magnetometer counts. Allows the user to input a value.	**#IC6=nnnn*hh<CR><lf>**
Query		**#IC6?*03<CR><lf>**
Response	N=Hard Iron offset	**#N*hh<CR><lf>**
MagZ offset (nnnn)	Hard-iron offset along vertical axis in magnetometer counts. Allows the user to input a value.	**#IC8=nnnn*hh<CR><lf>**
Query		**#IC8?*0D<CR><lf>**
Response	N=Hard Iron offset	**#N*hh<CR><lf>**
Mag High Alarm	Sets the magnetometer Over Range Alarm level in magnetometer counts.Issues an Alarm condition (P) in the magnetic field status of the HPR output sentence when the total mag field value (Mag T) exceeds the parameter setting	**#WB6=nnnn*hh<CR><lf>**
Query		**#WB6?*12<CR><lf>**
Response		**#nnnnn*hh<CR><lf>**

Mag high warn *Query* *Response*	Sets the magnetometer Over Range Warning level in magnetometer counts. Issues a Warning condition (O) in the magnetic field status of the HPR output sentence when the total mag field value (Mag T) exceeds the parameter setting	**#WB8=nnnn*hh<CR><lf>** **#WB8?*12<CR><lf>** **#nnnnn*hh<CR><lf>**
Mag low warn *Query* *Response*	Sets the magnetometer Under range warning level in magnetometer counts. Issues a Warning condition (M) in the magnetic field status of the HPR output sentence when the total mag field value(Mag T) falls below the parameter setting	**#WBA=nnnn*hh<CR><lf>** **#WBA?*6B<CR><lf>** **#nnnnn*hh<CR><lf>**
Mag Low Alarm *Query* *Response*	Sets the magnetometer Under range alarm level in magnetometer counts. Issues an Alarm condition (L) in the magnetic field status of the HPR output sentence when the total mag field value (Mag T) falls below the parameter setting.	**#WBC=nnnn*hh<CR><lf>** **#WBC?*69<CR><lf>** **#nnnnn*hh<CR><lf>**
Pitch/roll alarm (nn.n) *Query* *Response*	Sets the Over range alarm level for pitch and roll.Issues an Alarm condition (P) in the Pitch or Roll status fields of the HPR output sentence when either pitch or roll output exceeds the parameter setting.In degrees Pitch/ Roll alarm level	**#WB6=nn.n*hh<CR><lf>** **#WB6?*1B<CR><lf>** **#nn.n*hh<CR><lf>**

Pitch/Roll Warn (nn.n) *Query* *Response*	Sets the Over range warn level for pitch and roll.Issues an warn condition (O) in the Pitch or Roll status fields of the HPR output sentence when either pitch or roll output exceeds the parameter setting. In degrees	**#WB8=nn.n*hh<CR><lf>** **#WB8?*15<CR><lf>** **#nn.n*hh<CR><lf>**
TC1 time constant (T) *Query* *Response*	Sets the filter constant. Normalized time constant for IIR filter 1 T=0 (disable), T=1 (= 72 msec), T=255 (= 18.4 sec) Normalized time constant, T,	**#BA2=T*hh<CR><lf>** **#BA2?*0E<CR><lf>** **#T*hh<CR><lf>**
S smoothing factor (S) *Query* *Response*	Sets the parameter (S) for the non-linear Heading filter. Smoothing amount (see algorithm in text) 0 = disable, Max = 0.999985 m=S*65535 m=S*65535	**#WB2=m*hh<CR><lf>** **#WB2?*18<CR><lf>** **#m*hh<CR><lf>**
L smoothing factor (L) *Query* *Response*	Sets the parameter (L) for the non-linear Heading filter. Difference knee in mils (see algorithm in text) 0 = disable, 1 = 1 mil, max = 255 mils Smoothing factor (L)	**#BB1=L*hh<CR><lf>** **#BB1?*0E<CR><lf>** **#L*hh<CR><lf>**

4.9 Serial I/O

Name	Description	Command Syntax
Baud Rate	Sets the Serial I/O Baud rate: Index Value (I) 1200 : (2) 2400 : (4) 4800 : (8) 9600 : (16) 19200 : (32) Should be followed by a Force Reset command for new rate to be active immediately or a power up is required	#BA4H=2T*24<CR><lf> #BA4H=4T*22<CR><lf> #BA4H=8T*2E<CR><lf> #BA4H=16T*11<CR><lf> #BA4H=32T*17<CR><lf>
Query		#BA4H?*40<CR><lf>
Response	Returns the Index value for the baud rate	#I*hh<CR><lf>
HDG Update Rate (R) Query	Sets the HDG message update rate (R) in sentences per minute Allowed R values are indexed with an integer (I) - see table below	#BAA=I*hh<CR><lf> #BAA?*7D<CR><lf>
Response	Returns Index value, I, for HDG update rate	#I*hh<CR><lf>
HDT Update Rate (R) Query	Same as above, for HDT sentence	#BAB=I*hh<CR><lf> #BAB?*7E<CR><lf>
Response	Returns the Index value, I, for HDT rate	#I*hh<CR><lf>
XDR Update Rate Query	Same as previous for XDR sentence I= Index value	#BAC=I*hh<CR><lf> #BAC?*7F<CR><lf>
Response	Returns the Index value, I, for XDR rate	#I*hh<CR><lf>
HPR Update Rate Query	Same as previous for HPR sentence I= Index value	#BAD=I*hh<CR><lf> #BAD?*78<CR><lf>

Response	Returns the Index value, I, for HPR rate	#I*hh<CR><lf>
RCD Update Rate Query Response	Same as previous for RCD sentence I= Index value Returns the Index value, I, for RCD rate	#BAE=I*hh<CR><lf> #BAE?*79<CR><lf> #I*hh<CR><lf>
CCD Update Rate Query Response	Same as previous for CCD sentence I= Index value Returns the Index value, I, for CCD rate	#BAF=I*hh<CR><lf> #BAF?*7A<CR><lf> #I*hh<CR><lf>
ASCII Update Rate Query Response	Same as previous for ASCII display sentence I= Index value Returns the Index value, I, for ASCII rate	#BB0=I*hh<CR><lf> #BB0?*0F<CR><lf> #I*hh<CR><lf>

In the current configuration software, when the baud rate is changed, the new rate will not take effect until a “Force Reset” command is issued or until the unit is powered off then on. When any output sentence rate is changed, the current interval will expire before the new rate takes effect.

4.10 DESCRIPTION OF HARDWARE INTERRUPT PINS

Detail description of the functionality of the Cont./Reset, Operate/Calibrate, Ready/Sleep, Run/Stop switches.
The order of precedence for operation of the switch inputs is as follows (highest first):

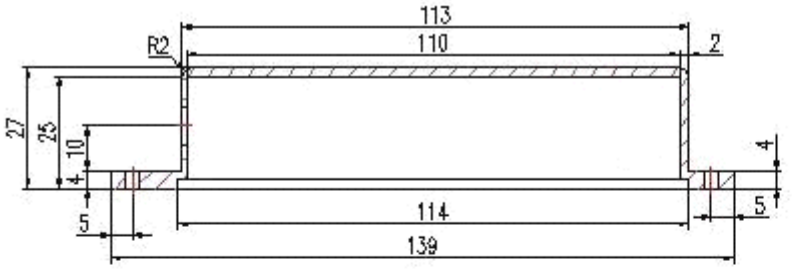
1. Setting "Cont. / Reset" low unconditionally holds the processor in its reset state. No other functions can be performed until the switch is returned to the "Continue" Position.

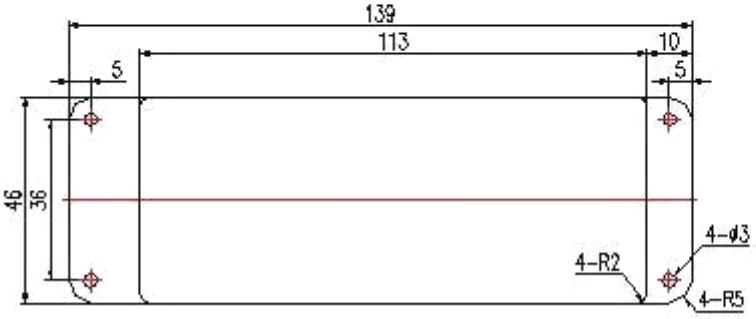
2. Setting "Operate / Calibrate" low (Calibrate) forces the processor into Calibrate mode. The "Run / Stop" and "Ready / Sleep" switches are ignored in this mode. When the switch is set to the Operate position, the unit can be in either mode depending on the "Select Mode" command bit that can be changed via the serial interface.The "Select Mode" command bit is initialized to the Operate state on power up.

3. Setting "Ready / Sleep" low while the unit is not in Calibrate mode forces the unit into a low power state with measurements and outputs suspended, and with serial inputs ignored. This switch must be returned to the "Ready" position before a host can send a serial command. When momentarily placed in the "Ready" position,the processor will run a complete measurement and output cycle (if in Run mode) before suspending operation.Mechanical switch bounce on this input can be tolerated in the firmware.

4. Setting "Run / Stop" low stops any output in progress within one character time and prevents further output.When the switch is in the Run position, the state of the internal Run/Stop command bit controls the unsolicited output.The internal Run/Stop command bit is initialized to the settings saved in the EEPROM.

V. PHYSICAL DIMENSIONS





VI: ATTENTIONS

1. Before using the product, please read this manual carefully and operation accord with request.
2. When using this product, first please make sure correct power supply. If wrong connection and input voltage will cause damage to the product.
3. Please do not disassemble the compass, avoid to cause damage or influence on measurement result.

4. Install the product as far as possible from any source generating a magnetic field and far from ferrous metal objects,Calibration and compensation routines in the compass can effectively compensate for static magnetic fields superimposed on the earth's field components, which are used for heading calculations. However, compass can not compensate for the effects of varying fields produced by dc and ac currents.
5. If outdoor use,please prepare waterproof arrangement.

VII: GUARANTEE

1. The guarantee of the whole product is one year. Zhichuan Electronic Tech Co.,Ltd warrants that for a period of one year from time of purchase it will repair ZCC320L,if it fails to function properly due to a defect in workmanship or materials in the instrument. Damage caused to the product by improper use or disassemble privately is expressly excluded from this warranty.
2. Before using the product please make sure you have read the manual carefully and operate accord with its request, avoid to cause unnecessary damage.