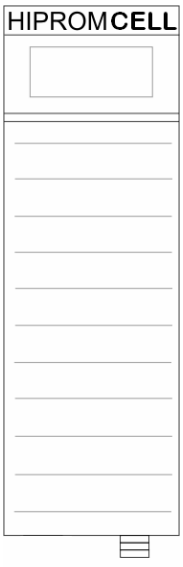
1756HP-CELL

USER MANUAL

V1.00.08



INTRODUCTION

The 1756HP-CELL module provides a method of sending text messages to either a user's mobile phone or another 1756HP-CELL module which will allow communication between multiple PLCs.

Messages are sent over a GSM network to a cellular number of another SIM card (used by a mobile phone, CELL module etc). Sufficient network reception is required for successful SMS communication. The connectivity of the modules will be limited by the GSM network reception in the deployment area.

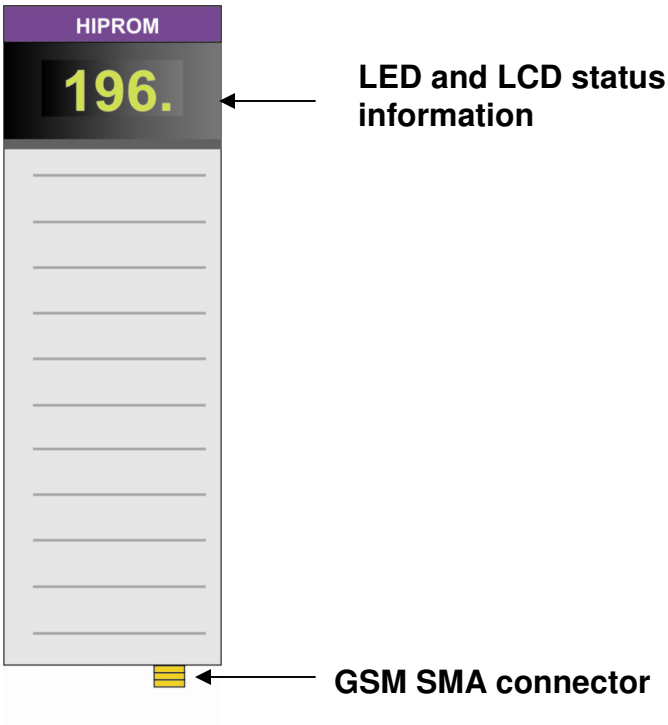
This document serves to describe the functionality, installation, configuration and operation of the module.

NOTE: The Connection parameters and configuration images are only valid for firmware version 1.01.02 onwards. Please see User Manual v1 00 07 for details.

INSTALLATION

Hardware

The 1756HP-CELL module is designed to operate within the Allen-Bradley ControlLogix platform. All power required for the module's operation is derived from the ControlLogix backplane.



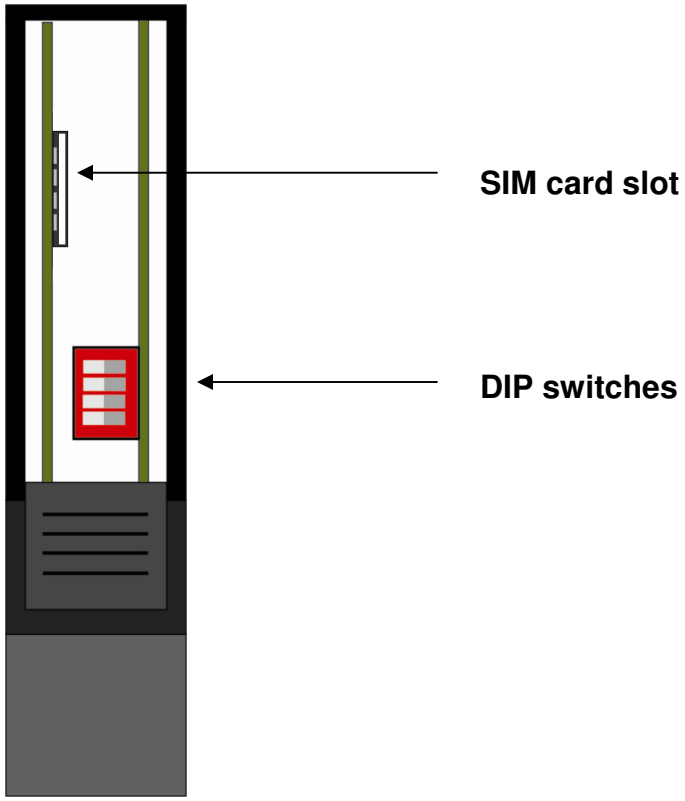
1756HP-CELL Front View

LED and LCD information

All information regarding the module status, cellular operator, signal strength, APN IP address etc. will be given via the LCD and LED indicators. Please view *Module Status* section for more information.

GSM SMA Connector

This connector is used to connect the supplied GSM antenna. The installation of this antenna will be explained later in this section.



1756HP-CELL Top View

SIM card slot
The SIM card must be inserted into the module with the metallic surface towards the PCB side, and the triangle corner cut-off towards the front and the top of the module. The PIN number (if assigned) for the SIM card must be entered into the Config Image for successful operation.

NOTE: If the SIM card requires a PIN and the user failed to enter the correct PIN in the Config Image the SIM card will be locked and the user will need to unlock it using the PUK code.

DIP switches
These are used to select certain general operation options for the module. The settings will be explained in the *Module Configuration* section.

Software

The user will need the following software to configure and use the 1756HP-CELL:

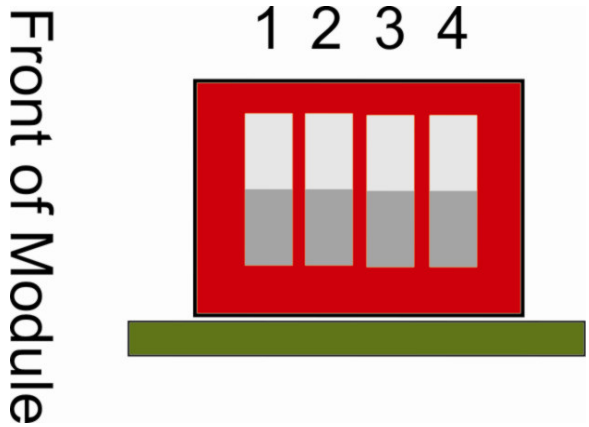
- RSLogix 5k ladder example code
- Future: Add on Profile (AOP)

Both the applications can be found on the product CD or the Hiprom Technologies website: www.hiprom.com

SETUP

Hardware

DIP switches
The switches are numbered as shown below:

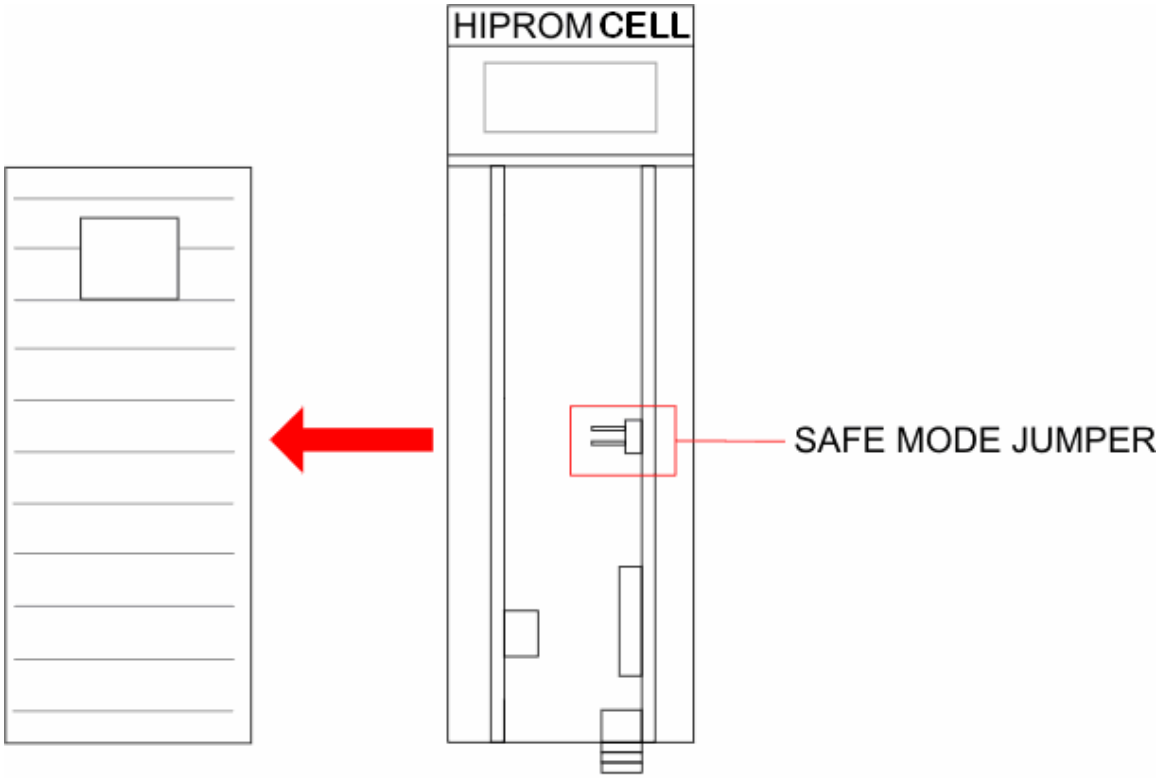


Switch	Description
1	This is used for debugging the module. The user must never set this.
2	This is reserved for future use.
3	This is reserved for future use.
4	This is reserved for future use.

SAFE MODE

The module has the option to run the firmware that it was originally shipped with. This can be used in a case where the power was cycled whilst flashing the firmware. Thus if the module does not boot because of the corrupted firmware the user can set the module into safe mode and re-flash the module. The safe mode jumper is located under the front cover as shown below:

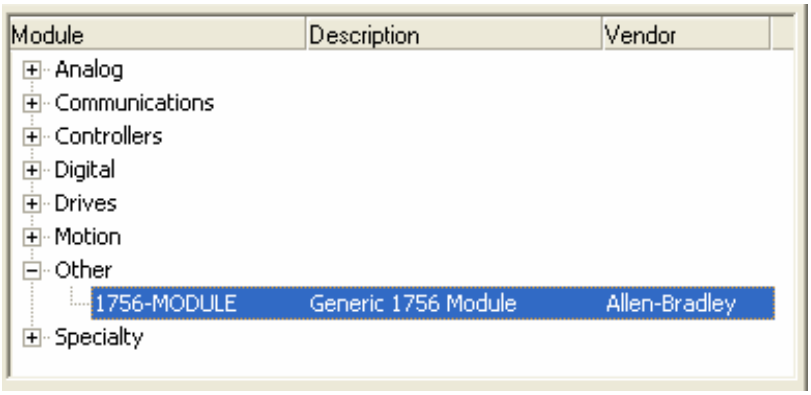
NOTE: **The module must be placed back into non-SAFE MODE to avoid running old firmware even if the module has been flashed with new firmware.**



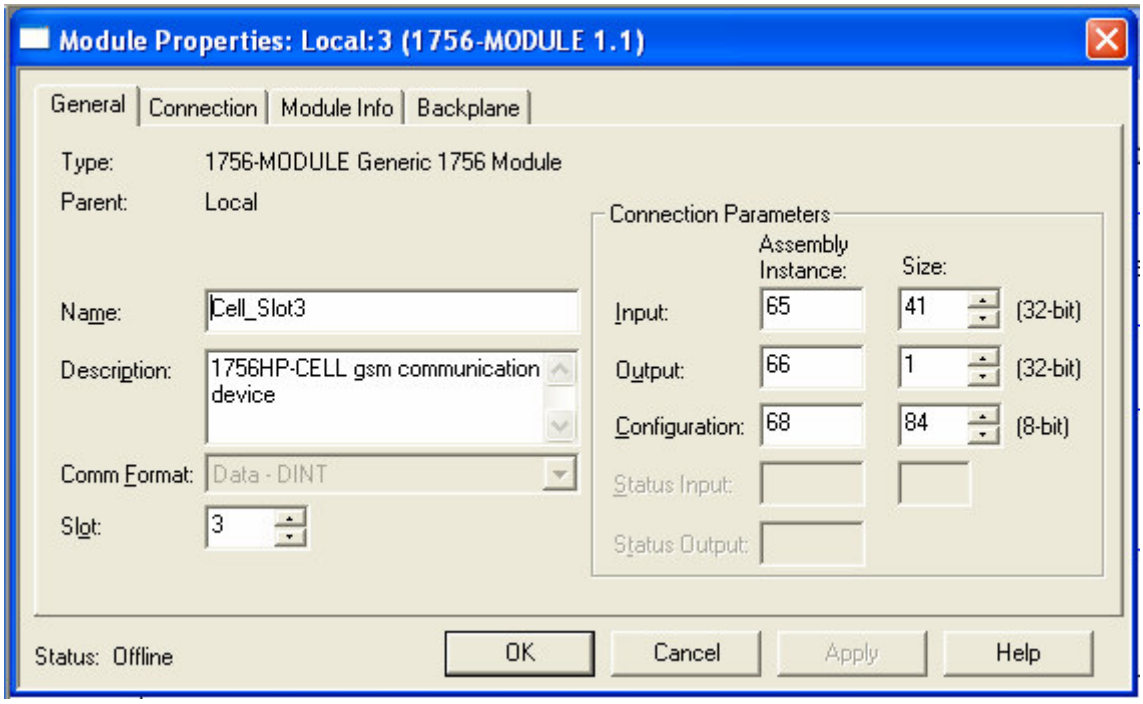
RSLogix

This section describes the procedures required to configure the 1756HP-CELL module within the Logix platform.

The user must select the Generic 1756 Module in RSLogix when adding the module to the IO tree in RSLogix 5k.



The following assembly parameters must be used for the module.



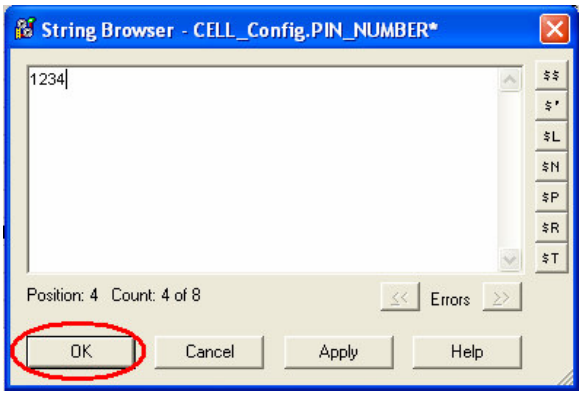
The user must copy the CELL_CONFIG UDT as given in the example code to the Config Image of the module. Please refer to the example code.

CELL0_Config	{...}	{...}		CELL_CNFG_IMAGE
CELL0_Config.PIN_NUMBER	''	{...}		STRING8
CELL0_Config.SMS_SERV_CENTRE	''	{...}		STRING16
CELL0_Config.APN	''	{...}		STRING24
CELL0_Config.PORT	''	{...}		STRING8
CELL0_Config.MODE_SELECT	''	{...}		STRING8

CELL.Config.PIN_NUMBER This is the pin number for the SIM card inserted into the module. May be left blank if PIN is disabled on the SIM card.	Eg: 1234
CELL.Config.SMS_SERV_CENTRE The service centre that is used by the service provider to send and receive SMS messages.	Eg: Vodacom-SA: +27829129 MTN-SA: +27831000002
CELL.Config.APN If an APN has been registered with the cellular service provider to obtain a static IP address, it may be entered here. (or left blank)	Eg: www.hiprom.co.za or internet
CELL.Config.PORT The TCP/IP port used by the module when establishing a TCP server. (or left blank)	Eg: 8080
CELL.Config.MODE_SELECT The mode can be manually selected, so that the module will use '13' to select GSM,GPRS,EDGE or '14' to use 3G. Using '2' will result in Automatic selection.	'2' : Automatic '13' : GSM/GPRS/EDGE '14' : 3G (WCDMA)

NOTE: Config and SMS data and numbers are entered in ASCII format (note the STRINGx data type). To enter data see the following steps:

CELL0_Config	{...}	{...}		CELL_CNFG_IMAGE
CELL0_Config.PIN_NUMBER	''	{...}		STRING8
CELL0_Config.SMS_SERV_CENTRE	'+27829129'	{...}		STRING16
CELL0_Config.APN	''	{...}		STRING24
CELL0_Config.PORT	''	{...}		STRING8
CELL0_Config.MODE_SELECT	'13'	{...}		STRING8



CELL0_Config	{...}	{...}		CELL_CNFG_IMAGE
CELL0_Config.PIN_NUMBER	'1234'	{...}		STRING8
CELL0_Config.SMS_SERV_CENTRE	'+27829129'	{...}		STRING16
CELL0_Config.APN	''	{...}		STRING24
CELL0_Config.PORT	''	{...}		STRING8
CELL0_Config.MODE_SELECT	'13'	{...}		STRING8

OPERATION

RSLogix

Each 1756HP-CELL consumes 1 connection from the Logix Controller.

Name	Value	Force Mask	Style	Data Type
Cell_Input	{...}	{...}		CELL_INPUT
Cell_Input.CommStatus	0		Decimal	DINT
Cell_Input.ModuleOK	0		Decimal	BOOL
Cell_Input.SIMError	0		Decimal	BOOL
Cell_Input.PINRequired	0		Decimal	BOOL
Cell_Input.PUKRequired	0		Decimal	BOOL
Cell_Input.GSMError	0		Decimal	BOOL
Cell_Input.TextMSGPending	0		Decimal	BOOL
Cell_Input.ClientMode	0		Decimal	BOOL
Cell_Input.ServerMode	0		Decimal	BOOL
Cell_Input.SignalStrength	0		Decimal	SINT
Cell_Input.ServiceProvider	''	{...}		STRING24
Cell_Input.TEXT	{...}	{...}		CELL_TEXTSERVI...
Cell_Input.TEXT.MSGPendingCount	0		Decimal	SINT
Cell_Input.GSM	{...}	{...}		CELL_GSMSERVIC...
Cell_Input.GSM.noService	0		Decimal	BOOL
Cell_Input.GSM.GSM	0		Decimal	BOOL
Cell_Input.GSM.GPRS	0		Decimal	BOOL
Cell_Input.GSM.EDGE	0		Decimal	BOOL
Cell_Input.GSM.WCDMA	0		Decimal	BOOL
Cell_Input.GSM.HSDPA	0		Decimal	BOOL
Cell_Input.GSM.HSUPA	0		Decimal	BOOL
Cell_Input.GSM.HSPA	0		Decimal	BOOL
Cell_Input.GSM.APN_IPAddress	''	{...}		STRING16
Cell_Input.GSM.ErrorCode	0		Decimal	INT
Cell_Input.Reserved	0		Decimal	DINT

INPUT IMAGE

The user must copy the Input Image of the module to the CELL_INPUT UDT as given in the example code. Please refer to the example code.

CommStatus
This is reserved.

This is reserved

ModuleOK
This indicates that the module has booted and all hardware is functioning.

0	There is an error on the module
1	Module is OK, operations may continue.

SIMError
This will be active if there is an error in communicating with the inserted SIM card. This will also be active if no SIM has been inserted in the module.

0	SIM has no error.
1	SIM has error, either communicating or no SIM present.

PINRequired
A PIN number is required to operate the SIM card, contact your cellular service provider if PIN is unknown or problem

0	PIN number is OK or no pin required.
1	PIN number is required; check PIN entered into the config image.

PUKRequired
The PUK number will be required when the PIN number has been entered incorrectly three times. Please remove SIM card from the module and enter the correct PUK and new PIN from a cellular phone.

0	PUK not required.
1	PUK is required, remove SIM.

GSMError
There is an error with the GSM network or mobile equipment.

0	No error, GSM communications is OK
1	GSM error, check mobile equipment

TextMSGPending
A text message (SMS) has been received by the module and is ready to be read by the controller.

0	No text messages
1	Text message available to be read by the controller.

ClientMode
When an APN is set, the CELL module will try to connect to a network. The module has also connected to another TCP/IP server and is acting as a client.

0	Module will is not set as Client
1	Module will be set as Client

ServerMode
The module has connected to an accessible APN and has started in server mode. (default)

0	Module is not set as the Server
1	Module is set as the Server

SignalStrength
The received signal strength on the GSM network, given as a max of 99, minimum of 0.

Signal strength given as a SINT

ServiceProvider
On startup the service provider's name is requested and presented here in Ascii format and scrolled on the module's screen.

Service provider displayed in Ascii.

TextMSGPendingCount
The amount of text messages that are stored on the CELL module that must be read.

Amount of unread SMSs that are stored on the CELL module.

GSM.
The current service level and modulation scheme that the CELL module's mobile equipment is using. A Boolean bit will be active on the current service level, there is a bit for each service. The module will choose the best available service. Note: this is network dependant.

GSM.GSM
Basic cellular connection.

0	Is not selected
1	GSM service is selected and in-use.

GSM.GPRS
General Packet Radio Services, the minimum connection required for packet transmissions.

0	Is not selected
1	GPRS service is selected and in-use.

GSM.EDGE
Faster than GPRS. (2.5G).

0	Is not selected
1	EDGE service is selected and in-use.

GSM.WCDMA Basic 3G connection speed, also known as UMTS.	0 – Is not selected 1 – WCDMA service is selected and in-use.
GSM.HSDPA High Speed, faster download than WCDMA.	0 – Is not selected 1 – HSDPA service is selected and in-use.
GSM.HSUPA High speed, faster upload than WCDMA.	0 – Is not selected 1 – HSUPA service is selected and in-use.
GSM.HSPA High speed upload and download of data.	0 – Is not selected 1 – HSPA service is selected and in-use.
GSM.APN_IPAddress This is the IP address obtained after connection to the APN has been established. Note: this is an Ascii string.	**Example:** IP Address = 192.135.145.007 – “192.135.145.007”
GSM.ErrorCode When an error is experienced, the error code will be displayed in an INT.	0 – No error has occurred xxx – Please see *Appendix C* for relevant error codes
Reserved reserved.	reserved

OUTPUT IMAGE

The output image is not used in the CELL module.

Sending a Text message (SMS)

In order to communicate with another CELL module or to send a notification, an SMS must be sent. See the *Appendix B: Message Blocks* on how to set the custom message to be able to send an SMS.

Name	Value	Force Mask	Style	Data Type
CELL_SMS	{...}	{...}		CELL_SMS
CELL_SMS.Received	{...}	{...}		SMS
CELL_SMS.Received.NUMBER	''	{...}		STRING16
CELL_SMS.Received.DATA	''	{...}		STRING160
CELL_SMS.Sending	{...}	{...}		SMS
CELL_SMS.Sending.NUMBER	''	{...}		STRING16
CELL_SMS.Sending.DATA	''	{...}		STRING160

The user must copy the Input Image of the module to the CELL_INPUT UDT as given in the example code.

In **Cell_SMS.Sending.NUMBER,** the number entered is in ASCII format, and must be preceded by the '**+**' character along with the international country code, eg for South Africa +27XX XXX XXXX or for United Kingdom +44XX XXX XXXX etc.

For the text message **Cell_SMS.Sending.DATA** is populated with the desired data (in Ascii format) The current maximum length of the text message sent to and from the CELL module is 160 characters long.

To see ladder logic for sending an SMS, please refer to the example code.

Receiving a Text message (SMS)

Name	Value	Force Mask	Style	Data Type
CELL_SMS	{...}	{...}		CELL_SMS
CELL_SMS.Received	{...}	{...}		SMS
CELL_SMS.Received.NUMBER	''	{...}		STRING16
CELL_SMS.Received.DATA	''	{...}		STRING160
CELL_SMS.Sending	{...}	{...}		SMS
CELL_SMS.Sending.NUMBER	''	{...}		STRING16
CELL_SMS.Sending.DATA	''	{...}		STRING160

In order to communicate with another CELL module or to receive an SMS, the CELL module must be requested for the pending SMS. See the *Appendix B: Message Blocks* on how to set the custom message to be able to receive an SMS. An SMS can only be read if there is an SMS pending, notified by **TextMSGPending** in the Input Image.

This is the sender of the SMS is **Cell_SMS.Received.NUMBER,** the number populated is in Ascii format, and is preceeded by the '**+**' character along with the international country code, eg for South Africa +27XX XXX XXXX or for United Kingdom +44XX XXX XXXX etc.

For the received text message **Cell_SMS.Sending.DATA** is populated with the desired data (in Ascii format) The current maximum length of the text message sent to and from the CELL module is 160 characters long.

To see ladder logic for receiving an SMS, please refer to the example code.

NOTE: IN future revisions of the CELL module, GPRS/3G will be used with client/server modes, based on TCP/IP. This will be advantageous as it is a cheaper and faster alternative to SMS messaging.

GSM or CDMA-EVDO

NOTE: The CELL module uses mobile equipment that operates on the GSM network. The CELL module will not operate on a CDMA network.

In cellular service there are two main competing network technologies: Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA). Cellular carriers including Sprint PCS, Cingular Wireless, Verizon and T-Mobile use one or the other. Understanding the difference between GSM and CDMA will allow you to choose a carrier that uses the preferable network technology for your needs.

The GSM Association is an international organization founded in 1987, dedicated to providing, developing, and overseeing the worldwide wireless standard of GSM. CDMA, a proprietary standard designed by Qualcomm in the United States, has been the dominant network standard for North America and parts of Asia. However, GSM networks continue to make inroads in the United States, as CDMA networks make progress in other parts of the world. There are camps on both sides that firmly believe either GSM or CDMA architecture is superior to the other. That said, to the non-invested consumer who simply wants bottom line information to make a choice, the following considerations may be helpful.

Coverage: The most important factor is getting service in the areas you will be using your phone. Upon viewing competitors' coverage maps you may discover that only GSM or CDMA carriers offer cellular service in your area. If so, there is no decision to be made, but most people will find that they do have a choice.

Data Transfer Speed: With the advent of cellular phones doing double and triple duty as streaming video devices, podcast receivers and email devices, speed is important to those who use the phone for more than making calls. CDMA has been traditionally faster than GSM, though both technologies continue to rapidly leapfrog along this path. Both boast "3G" standards, or 3rd generation technologies.

EVDO, also known as CDMA2000, is CDMA's answer to the need for speed with a downstream rate of about 2 megabits per second, though some reports suggest real world speeds are closer to 300-700 kilobits per second (kbps). This is comparable to basic DSL. As of fall 2005, EVDO is in the process of being deployed. It is not available everywhere and requires a phone that is CDMA2000 ready.

GSM's answer is EDGE (Enhanced Data Rates for GSM Evolution), which boasts data rates of up to 384 kbps with real world speeds reported closer to 70-140 kbps. With added technologies still in the works that include UMTS (Universal Mobile Telephone Standard) and HSDPA (High Speed Downlink Packet Access), speeds reportedly increase to about 275—380 kbps. This technology is also known as W-CDMA, but is incompatible with CDMA networks. An EDGE-ready phone is required.

In the case of EVDO, theoretical high traffic can degrade speed and performance, while the EDGE network is more susceptible to interference. Both require being within close range of a cell to get the best speeds, while performance decreases with distance.

Subscriber Identity Module (SIM) cards: In the United States only GSM phones use SIM cards. The removable SIM card allows phones to be instantly activated, interchanged, swapped out and upgraded, all without carrier intervention. The SIM itself is tied to the network, rather than the actual phone. Phones that are card-enabled can be used with any GSM carrier.

The CDMA equivalent, an R-UIM card, is only available in parts of Asia but remains on the horizon for the U.S. market. CDMA carriers in the U.S. require proprietary handsets that are linked to one carrier only and are not card-enabled. To upgrade a CDMA phone, the carrier must deactivate the old phone then activate the new one. The old phone becomes useless.

Roaming: For the most part, both networks have fairly concentrated coverage in major cities and along major highways. GSM carriers, however, have roaming contracts with other GSM carriers, allowing wider coverage of more rural areas, generally speaking, often without roaming charges to the customer. CDMA networks may not cover rural areas as well as GSM carriers, and though they may contract with GSM cells for roaming in more rural areas, the charge to the customer will generally be significantly higher.

International Roaming: If you need to make calls to other countries, a GSM carrier can offer international roaming, as GSM networks dominate the world market. If you travel to other countries you can even use your GSM cell phone abroad, providing it is a quad-band phone (850/900/1800/1900 MHz). By purchasing a SIM card with minutes and a local number in the country you are visiting, you can make calls against the card to save yourself international roaming charges from your carrier back home. CDMA phones that are not card-enabled do not have this capability, however there are several countries that use CDMA networks. Check with your CDMA provider for your specific requirements.

SPECIFICATION

Electrical

specification	value
Power Requirements Power Consumption	All power is derived from the 1756 backplane.
Operating Temperature	0 to 50 ºC
Storage Temperature	0 to 50 ºC
Relative Humidity	5 to 95 % non-condensing
Operating Shock	
Storage Shock	
Vibration	
Emissions	
ESD Immunity	
Radiated RF Immunity	
EFT/B Immunity	
Conducted RF Immunity	
Enclosure Type Rating	IP20

Cable

specification	value
Type	RG-175 or equivalent
Impedance	50 Ohm
Capacitance	16.5 pF / foot (54.1 pF / meter)
Shield	Foil or copper braid (100% coverage)
Connectors	SMA (module side)

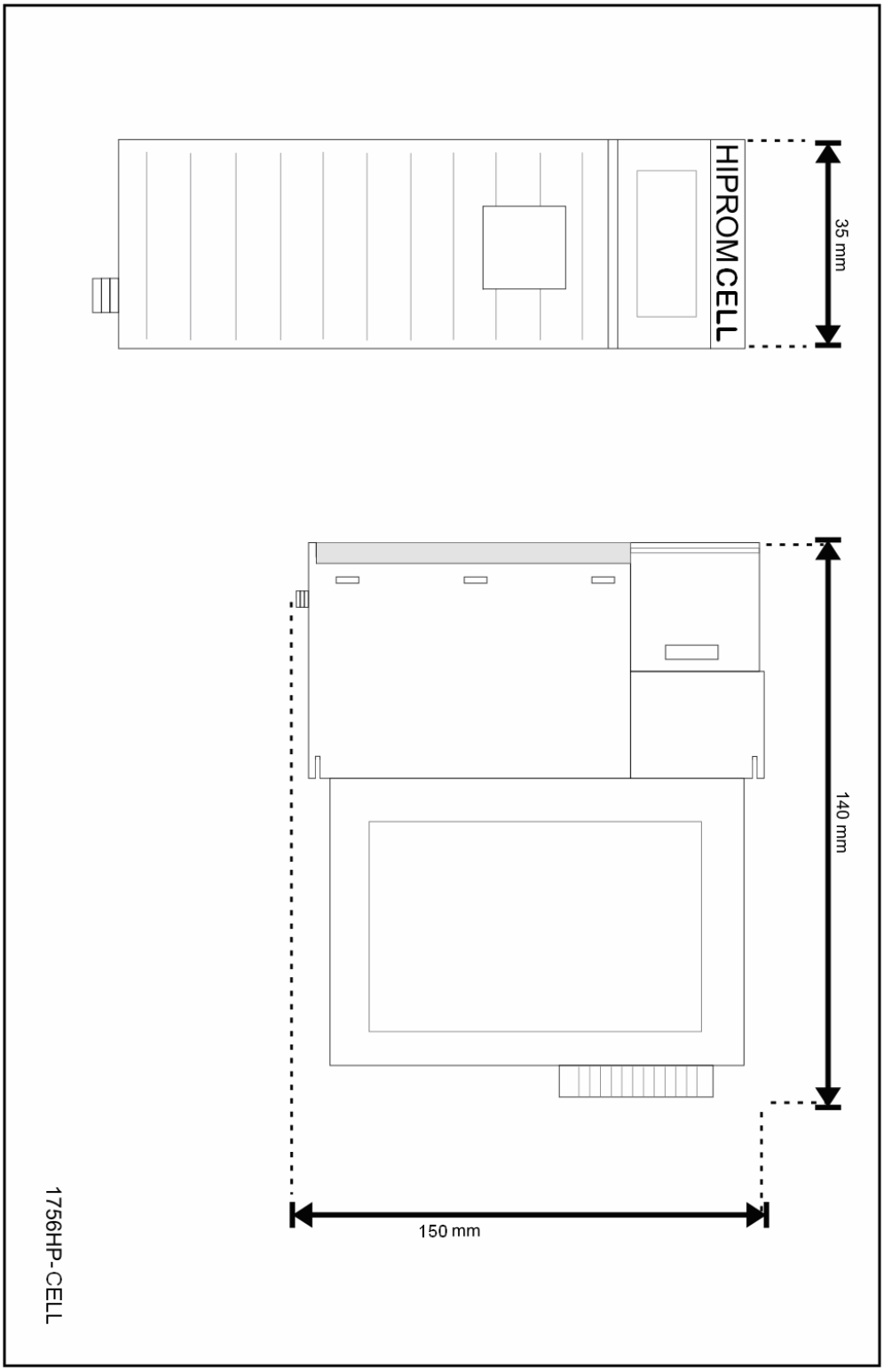
Signal attenuation	< 10 dB / 100 feet for cable and connectors

Antenna

specification	**value**
Dimensions	3.05” D x 2.61” H (77.5mm x 66.2 mm)
Weight	6.0 oz (170 grams)
Connector	SMA (module side)
Mounting	Magnetic

“Shark-fin” antenna

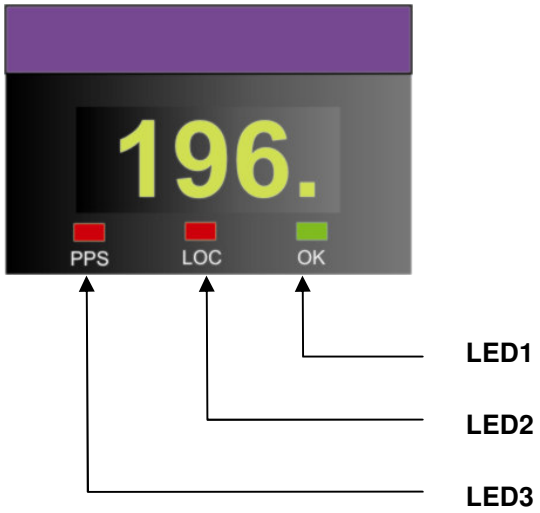
Mechanical



APPENDIX A

Display Status

The display of the 1756HP-CELL module will provide certain diagnostics to the user as given below:



LED 1

This will show green if the module has booted successfully. If the LED is red the module has a hardware fault.

LED 2

This will show green if the module has been setup successfully with the configuration image. If the LED is red the module has a setup fault.

LED 3

This LED indicates the signal of the module. Red and blinking means severely insufficient signal (0-19%) Red means insufficient signal strength (<40%). Green and blinking means sufficient signal (<60%), and solid green means very good signal (>=61%).

NOTE: If all three LEDs are red, this is a fault that will inhibit the module from continuing, please check the LCD for the reason and remedy as necessary.

LCD

Below is the list of messages that can be displayed by the LCD of the module:

- **CNFG**

If CNFG is displayed the Cell module has to be configured in RSLogix5000. The module must be configured before it can be successfully used. *See also: No Operator*

- **Booting CELL**

The above is an example of the message that will scroll across the LCD while the module is booting its mobile equipment.

- **1756HP-CELL/A Rev 1.01.02**

This will show the revision of the firmware on the module. Will be display once when powered on.

- **VodaCom-SA**

The above is an example of an Operator ID that will scroll across the LCD.

- **No Service Provider Name**

The above is an example if no cellular operator name has been acquired. This will also be displayed in conjunction with CNFG, if the module has not yet been configured.

- **Signal is 77%**

The above is an example of the received network signal strength.

- **3G selected**

The above is an example of the network modulation scheme in operation that will scroll across the LCD.

- **APN IP 192.168.1.100**

The above is an example of an IP address that will scroll across the LCD. *Note: this is only relevant to the APN that the module is connected to internally in the GSM network.*

- **RST**

This will be displayed if the module has received a reset CIP command. The module is in reset.

- **SIM**

There is no SIM card in the module. Remedy by inserting a valid SIM card in the module.

- **PIN**

The PIN for the SIM card is invalid. Please check and re-enter PIN in the config parameters in RSLogix5000 project.

- **PUK**

The PIN has been entered incorrectly more than three times. Please remove the SIM card and enter a valid PUK number from within a cellular/mobile telephone.

- **Debug Mode**

When the correct DIP switch has been set the module will be in debug mode. The user must never put the module in debug mode.

- **Safe Mode**

When the safe mode jumper has been set the module will be in safe mode. This means that the module has booted from the code that it was shipped with.

APPENDIX B

MESSAGE BLOCKS

Send a text message (SMS)

Below is the structure of the message block:

Message settings	
Message Type	CIP Generic
Service Type	Custom
Service Code	32h
Class	72h
Instance	01h
Attribute	01h
Date elements	
Source Element	Cell_SMS.Sending.NUMBER.LEN*
Source Length	108
Destination	(blank)

* Refer to the example code

Read a text message (SMS)

Below is the structure of the message block:

Message settings	
Message Type	CIP Generic
Service Type	Custom
Service Code	32h
Class	72h
Instance	02h
Attribute	01h
Date elements	
Source Element	(blank)
Source Length	0
Destination	Cell_SMS.Received.NUMBER.LEN*

* Refer to the example code

NOTE: A message must only be read when the *TextMSGPending* bit is set from the Input image. Please refer to sample project.

APPENDIX C

Error Codes

Error	DESCRIPTION
0	phone failure
1	no connection to phone
2	phone-adaptor link reserved
3	operation not allowed
4	operation not supported
5	PH-SIM PIN required
6	PH-FSIM PIN required
7	PH-FSIM PUK required
10	SIM not inserted
11	SIM PIN required
12	SIM PUK required
13	SIM failure
14	SIM busy
15	SIM wrong
16	incorrect password
17	SIM PIN2 required
18	SIM PUK2 required
20	memory full
21	invalid index
22	not found
23	memory failure
24	text string too long
25	invalid characters in text string
26	dial string too long
27	invalid characters in dial string
30	no network service
31	network timeout
32	network not allowed - emergency calls only
40	network personalization PIN required
41	network personalization PUK required
42	network subset personalization PIN required
43	network subset personalization PUK required
44	service provider personalization PIN required
45	service provider personalization PUK required
46	corporate personalization PIN required
47	corporate personalization PUK required
100	unknown
103	Illegal MS (#3)
106	Illegal ME (#6)
107	GPRS services not allowed (#7)
111	PLMN not allowed (#11)
112	location area not allowed (#12)
113	roaming not allowed in this location area (#13)

132 service option not supported (#32)
133 requested service option not subscribed (#33)
134 service option temporarily out of order (#34)
149 PDP authentication failure
150 invalid mobile class
148 unspecified GPRS error
151 VBS/VGCS not supported by the network
152 no service subscription on SIM
153 no subscription for group ID
154 group Id not activated on SIM
155 no matching notification
156 VBS/VGCS call already present
157 congestion
158 network failure
159 uplink busy
160 no access rights for SIM file
161 no subscription for priority
162 operation not applicable or not possible

300 ME failure
301 SMS service of ME reserved
302 operation not allowed
303 operation not supported
304 invalid PDU mode parameter
305 invalid text mode parameter
310 SIM not inserted
311 SIM PIN required
312 PH-SIM PIN required
313 SIM failure
314 SIM busy
315 SIM wrong
316 SIM PUK required
317 SIM PIN2 required
318 SIM PUK2 required
320 memory failure
321 invalid memory index
322 memory full
330 SMSC address unknown
331 no network service
332 network timeout
340 no +CNMA ack expected
500 unknown error

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