Single CANopen Slave for a Pre Configured Master

Prior to configuration:

1. Slave should be updated with the latest CANopen firmware.
2. Horner EDS File is required (usually found at **\Program Files\Cscape\EDS**).
3. If 3rd party Master needs to receive or transmit data, then COB-ID's would be required in the Slave configuration. **Refer to Chapter 4 Section 4.2.5 (Process Data Objects) in CANopen User Guide**.

Steps to configure a pre configured Horner Slave (Single Slave):

1. From the Project Navigator, click on Networking -> Network Configuration of the program. This will open CANopen Configurator with a default CANopen Master Node.
2. Check the *'**Configure Single Slave**'* checkbox. The dialog will change to Single slave configuration.
3. Configure '***Slave Node Id*'** and **'*Network Baud Rate***'.
4. Check "***Do Not Enter My Self Operational Automatically***" if master needs to put the slave in operational state, else the slave will enter into operational state on its own.
5. Configure '***Network Status Register***'.
6. Configure '***Error Control Object***'. Any of the error control protocol, Node guard or heart beat can be selected depending on the network / master requirements.
   a. In case of Node Guard protocol, configure Node guard time and Life time factor. The same should be configured in 3rd party master.
   b. In case of Heart Beat protocol, the producer time has to be configured. This time should be lesser than the consumer time of the master. If the slave wants to check the status of the master, the consumer time can also be configured.
   Note: To disable error control Protocol, select Node Guard protocol with Node guard time of 0 ms and Life time factor of 0.
7. Configuration of '***Process Data Object (PDO)***' (TPDOs and RPDOs) can either be done manually or the same can be loaded from EDS file.
   a. To load from the EDS file, right click on the '***Can Open Single Slave***' and select Load from EDS. Select Horner under vendor, select the type of EDS (full / limited) and profile type.
   b. To configure '***Receive PDO Communication Parameters***' *or* '**Transmit *PDO Communication Parameters***', click on '***Add Entry***', select on the entry and click '***Set to Default***'.
   c. The Mapped registers for particular COB-IDs can be seen by clicking on '***Receive PDO Mapping Parameters***' *or* '**Transmit *PDO Mapping Parameters***', select the Object index and the Sub Index to see the configured register.

NOTE: For detailed configuration refer to ***"CANopen User Guide"*** or ***"CANopen Online Help".***

The following table gives the details of Master & Slave Status Register, diagnostics and troubleshooting methods.

CANopen Master status registers is 64 bit long.

Bits	Error	Reason	Indication	Remedy	EMCY Object	Applicable	
						Master	Slave
1	Object Dictiona-ry Error.	Invalid or corrupt CANopen configuration can cause this error. Configuration of any COB-ID with value '0' (with or without disable option selection) can also cause this error to happen.	No CANopen communication at all, status register will be updated only if firmware finds configured status register address is valid.	Download new configuration with any COB-ID value apart from zero.	N/A.	✓	✓

2	Node ID Error (Invalid Node ID).	This error will be flagged if firmware finds invalid Node-id value, i.e. zero or greater than 127. The corrupt configuration can also cause this error to happen.	Firmware will ignore downloaded configuration and will refer default internal slave configuration.	Download new configuration.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
3	Error Control Protocol is Not configure -ed.	If any of (i.e. Node Guard or Heartbeat) error control protocol is not configured and node configured is single slave.	CANopen communication will work as normal but Master node will not be able to detect some of the slave failures.	User can configure any of Error control protocol.	This error will not trigger EMCY Object.	x	✓
4	TX Error.	Baud rate mismatch, CAN network without proper terminating resistor, improper CAN network cabling can cause this error.	CANopen communication might not work properly.	Verify configured baud rate, check for proper terminating resistor and cabling.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
5	RPDO Object Mapping error.	This error is disabled and indicated by other bits (collectively indicated by Bits 6, 7, 8 & 9).	N/A.	N/A.	N/A.	N/A.	
6	RPDO Set Data error.	Firmware is not able to set the configured internal register value.	RPDO data will not get updated in the register. The RPDO index value which is having error will be updated in status register.	Verify configured index value, index value should be within supported range and with read/write access.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
7	RPDO Invalid Object Index.	Configured RPDO object index value is out of range or not supported by the firmware.	RPDO data will not get updated in the register. The RPDO index value which is having error will be updated in status register.	Verify configured index value, index value should be within supported range.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓

8	RPDO DLC Error.	Configured RPDO object count (or data length) does not match with received RPDO message. The received RPDO might have less number of objects (or different data length object) compared to configured one.	RPDO data will not get updated in the register. The RPDO index value which is having error will be updated in status register.	Verify RPDO object count and data length of each object with that of actual RPDO message on bus.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
9	RPDO Mapped Object Count Error.	RPDO is configured without any objects.	RPDO data will not get updated in the register. The RPDO index value which is having error will be updated in status register.	Verify RPDO object mapping and configure as per the requirement.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
10	TPDO Object Mapping error.	This error is disabled and indicated by other bits (Collectively indicated by Bits 11, 12, 13 & 14).	N/A	N/A	N/A	N/A	
11	TPDO Get Data error.	Firmware is not able to get the configured internal register value.	Configured TPDO will not be sent. The TPDO index value which is having error will be updated in status register.	Verify configured index value, index value should be within supported range and with read access.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
12	TPDO Compo-se Error.	Firmware is not able compose the configured TPDO.	Configured TPDO will not be sent. The TPDO index value which is having error will be updated in status register.	Verify configured index value, index value should be within supported range and with read access. Also corrupt TPDO configuration can cause this error, in such case reload the CANopen configuration.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓

13	TPDO Invalid Object Index.	Configured TPDO object index value is out of range or not supported by the firmware.	Configured TPDO will not be sent. The TPDO index value which is having error will be updated in status register.	Verify configured index value, index value should be within supported range.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
14	TPDO Mapped Object Count Error.	TPDO is configured without any objects.	Configured TPDO will not be sent. The TPDO index value which is having error will be updated in status register.	Verify TPDO object mapping and configure as per the requirement.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
15	SDO DLC Error.	Received SDO message is with invalid byte count, i.e. count is not equal to 8.	SDO request or response will not be processed.	Verify SDO message generated by the node, if byte count is not equal to 8 then the node is not valid CANopen device.	This error will not trigger EMCY Object.	✓	✓
16	NMT DLC Error.	Received NMT message is with invalid byte count, i.e. count is not equal to 2.	NMT request will not be processed.	Verify NMT message generated by the node, if byte count is not equal to 2 then the node is not valid CANopen device.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	**X**	✓
17	Invalid Status Register Address.	Status register address is not configured or address is invalid.	CANopen node status will not be available.	Configure valid status register address.	This error will not trigger EMCY Object.	✓	✓
18	Time Out for Node Guard message from Master.	Node guard message request from Master is not received within configured time. It is also called as 'Node Life Time Error'.	Slave will set error, but continues with normal operation.	Verify node guard time configured in Master Configuration .	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	**X**	✓

19	Consu-mer heartbeat time expired.	Node is configured for Heartbeat message consumption and heartbeat message from producer is not received within configured consume time.	Node will set error, but continue with normal operation. But in case of Master node action to be taken can be configured.	Verify Heartbeat consume time configured in the node, it should be greater than the producer time. Check whether producer node is configured for Heartbeat message production as required interval.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓
20	Slave Error.	One of configured non mandatory slave is failed.	Master will set error, but continue with normal operation. If all slaves in the network are failed then master node doesn't allow NMT state transition. Master node can be configured to reinitialize boot up process of slave node on error.	Check CAN cabling, Error control protocol configuration in slave and master node and power status of slave node etc.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	x
21	Mandato-ry slave Error.	One of configured mandatory slave is failed.	Master will set error and try to reconfigure entire network or stop entire network based upon user configuration.	Check CAN cabling, Error control protocol configuration in slave and master node and power status of slave node etc.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	x
22	CAN Bus Overrun.	Number of CAN messages received per second is more than the limit of CAN hardware and firmware.	CANopen communication is not guaranteed.	Check the CAN bus load, it should be around 80%. Also check CAN cable wiring and terminating resistor.	This error will trigger valid EMCY Object with status register value in 'Manufacturer Specific Error Field' of message.	✓	✓

23	CAN Bus Off Error.	One of CAN controller error state entered when it detects more than 256 CAN errors.	No CANopen communication	Check for proper terminating resistor and CAN wiring. Requires power reset to start new CANopen communica-tion.	N/A	✓	✓
24	CAN Bus Passive Error.	One of CAN controller error state entered when it detects more than 127 CAN errors, but less than 256. Unplugging CAN network cable can cause this error.	No CANopen communication	Check for proper terminating resistor, CAN wiring and firm connection CAN connector to device	N/A	✓	✓
25 - 32	NMT Sate	The 8 bit displays CANopen NMT state of device. It can have following different values. 127(Decimal) – 0x7F (Hex) - Preoperational State 005(Decimal) – 0x05 (Hex) - Operational State 004(Decimal) – 0x04 (Hex) - Stop State	N/A	N/A	N/A	N/A	
33-48	Failed TPDO array Index	Failed TPDO array Index (Updated only in case of any TPDO errors and array index will start with value 0).	N/A	N/A	N/A	N/A	
49-64	Failed RPDO array Index	Failed RPDO array Index (Updated only in case of any RPDO errors and array index will start with value 0).	N/A	N/A	N/A	N/A	

Master Node will have additional status of each Slave Node following 64bit long Status register. One 16 bit register indicates status of every slave node configured on the network. The 16 bit information contains the following:

- Bit 1 to 8: Error Code
- Bit 9 to 16: Node-ID

Error codes for the slave:

Error Code Values	Error Description
0	No error.
1	The slave no longer exists in the Network list
2	No response on access to Actual Device Type (object 1000h) received
3	Actual Device Type (object 1000h) of the slave node did not match with the expected Device Type Identification in object 1F84h
4	Actual Vendor ID (object 1018h) of the slave node did not match with the expected Vendor ID
5	Slave node did not respond with its state during Check node state -process. Slave is a heartbeat producer
6	Slave node did not respond with its state during Check node state -process. Slave is a Node Guard slave (NMT slave)
7	It was requested to verify the application software version, but the expected version date and time values were not configured
8	Actual application software version Date or Time did not match with the expected date and time values. Automatic software update was not allowed
9	Actual application software version Date or Time did not match with the expected date and time values and automatic software update failed
10	Automatic configuration download failed
11	The slave node did not send its heartbeat message during Start Error Control Service although it was reported to be a heartbeat producer
12	Slave was initially operational. (CANopen manager may resume operation with other nodes)
13	Actual Product Code (object 1018h) of the slave node did not match with the expected Product Code
14	Actual Revision Number (object 1018h) of the slave node did not match with the expected Revision Number
15	Actual Serial Number (object 1018h) of the slave node did not match with the expected Serial Number in object
244	Error Configuring Error Control Protocol (Either Node Guard or Heart Beat) parameters
245	Error Configuring SYNC Protocol parameters
246	Error Configuring Time-Stamp Protocol parameters
247	Error Configuring Emergency (EMCY) protocol parameters
248	Error Configuring RPDO communication parameters
249	Error Configuring RPDO mapping parameters
250	Error Configuring TPDO communication parameters
251	Error Configuring TPDO Mapping parameters
252	Error Configuring SDO protocol parameters
253	Invalid NMT state (Mismatch between Master NMT state and that slave NMT state)
254	Received Emergency Object
255	Unknown Error/ Master Reconfiguration is Active

Glossary:

CAN: Controller Area Network is a standardized serial bus system.

COB (Communication Object): A unit of transportation in a CAN network. Data must be sent across a CAN Network inside a COB. There are 2048 different COB's in a CAN network. A COB can contain at most 8 bytes of data.

COB-ID: Each COB is uniquely identified in a CAN network by a number called the COB Identifier (COB-ID). The COB-ID determines the priority of that COB for the MAC sub-layer.

MAC (Medium Access Control): One of the sub-layers of the Data Link Layer in the CAN Reference Model that controls who gets access to the medium to send a message.

Node ID: The Node-ID of the NMT Slave has to be assigned uniquely.

PDO (Process Data Object): Process Data Object protocol is used to process real time data among various nodes. It can transfer up to 8 bytes (64bits) data in one PDO either from or to the device

TPDO (Transmit PDO): TPDO is used for reading data from a device.

RPDO (Receive PDO): RPDO is used for sending data to a device.

SDO (Service Data Object): The SDO protocol is used to set and read values from the object directory of a remote device. The device whose object directory is accessed is the SDO server and the device accessing the remote device is the SDO client

SYNC (Synchronization Object): The Sync Object is broadcast periodically by the Sync Producer. The Sync-Producer provides the synchronization-signal for the Sync-Consumer. When the Sync-Consumer receives the signal they start carrying out their synchronous tasks.