TOSLINE-S20 Gateway Installation Guide

Revision: ***0.4***

Purpose:
User and Installation document for the TOSLINE-S20 Gateway. This is the top-level guide for the gateway consisting of TMPCGW, TLS20GW1 and ancillary equipment. The gateway provides a means of communications between TOSLINE-S20 and the more recent TC-net 100, TC-net 1G and TC-net I/O Loop proprietary protocols to facilitate the upgrading of existing installations.

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0.1	HNV	RAS	Initial Draft – based on UG-3284 rev 1.3	30-Jun-2022
0.2	RAS	HNV	Added Specifications section	5-Jul-2022
0.3	KMcD	RAS/HNV	Expanded System Design Strategy Section	6-Jul-2022
0.4	HNV	RAS	Updated Title and naming conventions	3-Nov-2022

PROPRIETARY STATEMENT

TRADEMARKS

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[2]	UM-3291	TL-S20 Gateway Tool User Manual
[3]	UG-3298	TL-S20 USB Installation Update and Recovery TLS20GW
[4]	AP-3301	AP-3301 Advantech USB Software Update Procedure
[5]		reserved
[6]	6F8C0902	Toshiba Model 3000 TOSLINE-S20 User's Manual
[7]	6F3B0360	Toshiba TOSLINE-S20 Active Star Coupler (ASC25) Instruction Manual
[8]	6E3B0691	Toshiba S-Net Chip Manual
[9]	6F8C1440	Toshiba JTGI23 TC-net 1G Manual
[10]	6F8C1450	Toshiba JTNI61 TC-net 100 Manual

TABLE OF ABBREVIATIONS AND DEFINITIONS

Abbreviation	*Definition*
TMEIC	Toshiba Mitsubishi-Electric Industrial Systems Corporation
TMTAC	TMEIC Process Technology Application Centre Pty Ltd
TL-S20	TOSLINE-S20 Data Communication Network
ASC25	Toshiba Active Star Coupler
IEC	International Electrotechnical Commission.

1 Introduction

1.1 Purpose

This document is provided as an instruction manual and a guideline to ensure proper installation of the gateway and minimize risks of safety and reliability issues due to incorrect connectivity of the interface.
The installation team is free to use their own documentation template, but this guideline should be used as main reference.
The objective of this document is to set up the basic rule for a correct installation and usage.

An inadequate installation may lead to reliability issues.
If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

This procedure is an obligation for contractors to provide installation instructions to reduce possible mistakes, errors, misinterpretations, loss of time to find the correct information, etc. ..., during the software installation phase for the integration team.

1.2 Scope

This document is intended to assist the installation team to understand the connectivity of the TL-S20 Gateway and each of its component to ensure a correct installation and to help any issues during the commissioning. It will not cover detailed aspects of the design, test acceptance or validation procedures.

For further support refer to the reference documents.

System designers, device designers, and maintenance personnel using a TOSLINE-S20 network should refer to these manuals for information about how these components can be used in a TOSLINE-S20 network.

2 System Configurations

2.1 Typical Upgrade Path

The following sections give an example of a typical upgrade path.

2.1.1 Legacy System

Starting with a legacy V-Series PLC System consisting of a CPU Rack, and I/O rack containing multiple SN322A or SN322H modules, interfacing to existing TOSLINE-S20 I/O networks.

2.1.2 Shadowing

An optional step is to install the nV Station and Gateway along-side the legacy system.

The TOSLINE-S20 Gateway is configured in pass-through mode with TLS20GW regenerating and listening to multiple TOSLINE-S20 networks. Up to four independent networks can be supported in this configuration. For the purposes of shadowing the existing system, data is then transferred from the TLS20GW via a MikroTik Ethernet Switch to the TMPCGW Gateway PC. From here data is bridged to TC-net and/or ODG.

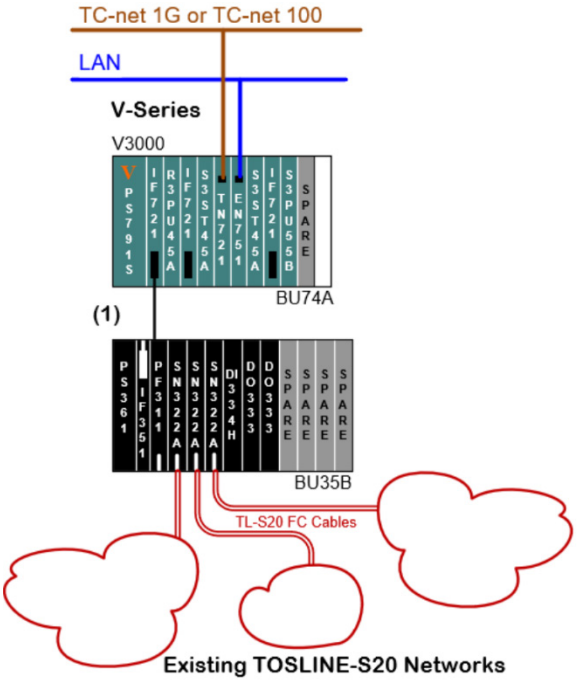


Figure 1 – Legacy System

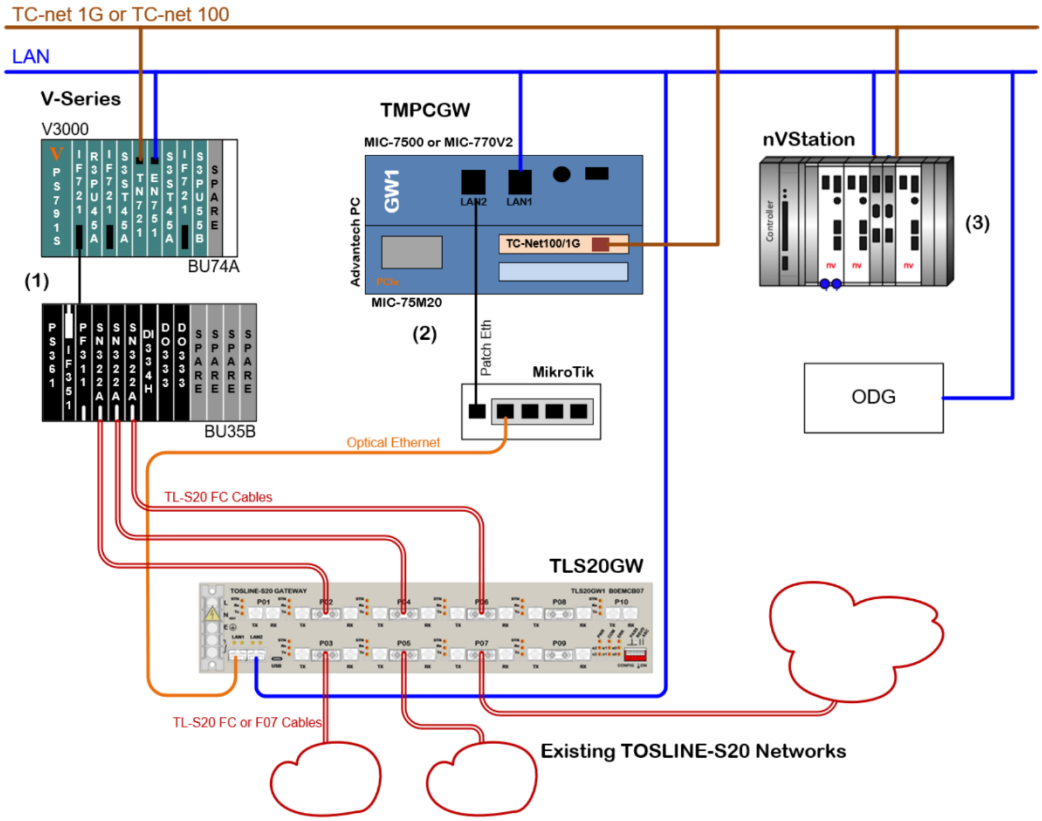


Figure 2 – Shadowing

2.1.3 Progressively Upgrade Control Functions

An nV PLC system can then communicates over TC-net with the TMPCGW. Progressively, TL-S20 networks can be migrated from Legacy Master to Gateway Master with control functions taken over by the nV PLC. As each TL-S20 network is moved across to the new PLC, the pass-through function is disabled and channels switched from Passive to Active mode.

2.1.4 Final Configuration

Once all control functions are switched over the legacy V-Series is decommissioned.

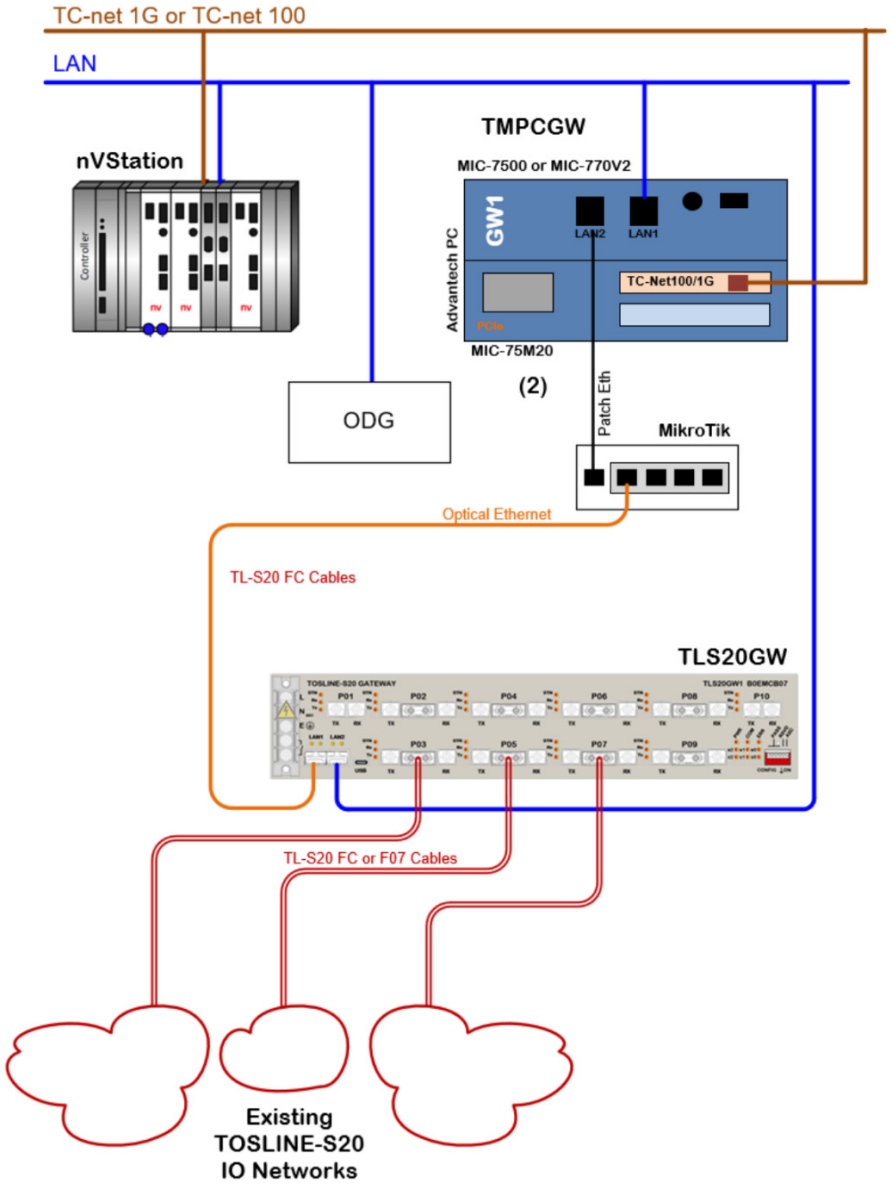


Figure 3 – Final Configuration

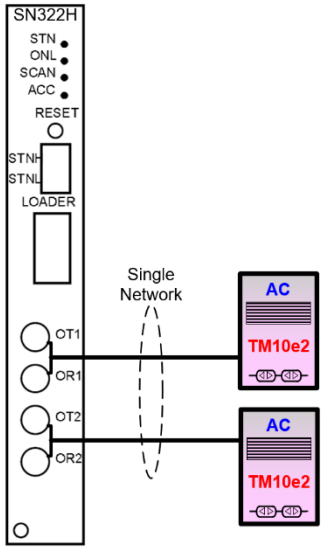
2.2 TOSLINE-S20 Network Topologies

Existing TOSLINE-S20 networks are arranged as star networks. Loop topologies are not supported.

2.2.1 Maximum Network Characteristics

Item	Specification	Note
Total number of stations	Standard Speed = 64 stations High Speed = 5 stations	
Transmission Distance	Station to Station: Max 1km ASC to ASC: Max 1km ASC to Station: Max 1km Total Distance: Max 10km	
Total Hops	The number of daisy-chain connected star couplers (ASC25 or TLS20GW units): Max 9 Or 10 hops including the stations at the end of the daisy-chain. Note inserting a TLS20GW in an exiting network like in Figure 1 does add another hop.	
Scan Time	Standard Speed: Target 3msec to 61msec High Speed: Typically 700usec for 2 stations / 10 words. The actual scan times depend on the particular configuration – stations/words.	
Words	Standard Speed: 1024 words High Speed: 128 words	
Message Length	Standard Speed: 544 bytes High Speed: 74 Bytes	[8] Figure 1.4.4
Single Wire Break	Stop transmission when no receive signal detected. This allows for graceful re-connection.	Supported
Redundancy	Connecting stations in a loop (TOSLINE-S20LP) as described in [6] section 4.3 is not supported.	Not Supported

2.2.2 Direct High-speed Connections



A common high-speed configuration includes one SN322H connected directly to one or two drives. In this case we have 3 stations on a single network where the two pairs of FC connectors on the SN322H are acting like a mini star coupler between the internal channel and the two external drives.

When upgrading this system, shadowing can be achieved by inserting a TLS20GW in between the drives and the SN322. The TLS20GW can be configured as an ASC and provide the communications routing with a single link going to each station. At this same time, the gateway can monitor the network with a channel in passive mode.

Alternatively, pass-through mode can be configured on two drive connections and the SN322 continues to do the routing. Both configurations are valid and will work. It becomes a system design decision based on the desired upgrade path.

Figure 4 – SN322 - Drive

2.2.3 Star Network Configuration

In the following example a single TL-S20 network includes a mix of legacy and new hardware. The SN322A is the master of the network while the TMGWPC and TLS20GW1 provide a gateway into this network. Existing ASC units such as the ASC25 (with F07 port connections) and the ASC22 (with FC port connections) may be replaced with TLS20GW1 units acting as stand-alone ASC units.

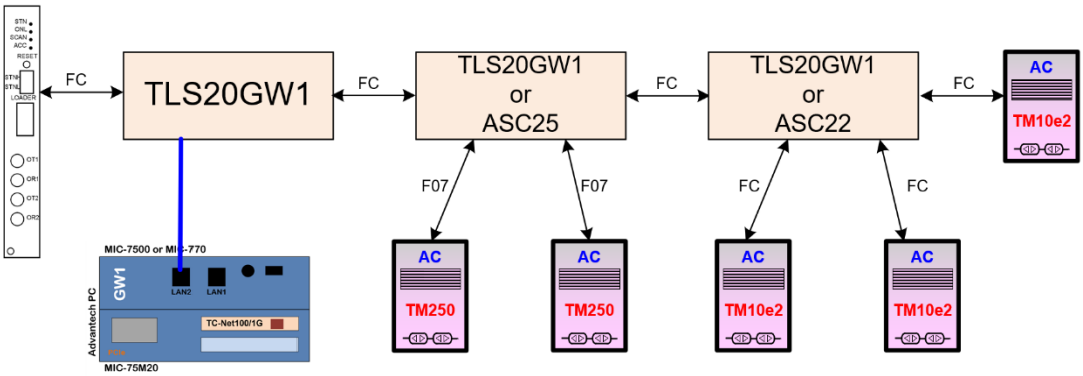


Figure 5 – Star network with ASC replacement

3 Specifications

3.1 TMPCGW – Gateway PC

The TMPCGW is an Industrial PC (iPC) where the Application and Control software of the Intelligent Gateway is executed. The iPC is based on an Advantech Industrial System, with extended temperature grade, compatible power input range, Gigabit LAN, and support for a variety of iModules.

The recommended configuration is based on a CPU module with a 2 slot iModule rack. Two CPU system have been selected to extend the life cycle support.

3.1.1 Advantech MIC-7500 CPU Module

System:	MIC-7500B-U8B1/U8A1E	
CPU:	Intel i7-6820EQ	Intel 6th Gen, 4-Core i7, QM170, 22W
Memory:	SQR-SD4I8G2K6SNBCB	DDR4 8GB, (-40-85C)
Data Sheet:	MIC-7500_DS(09.26.17).pdf	

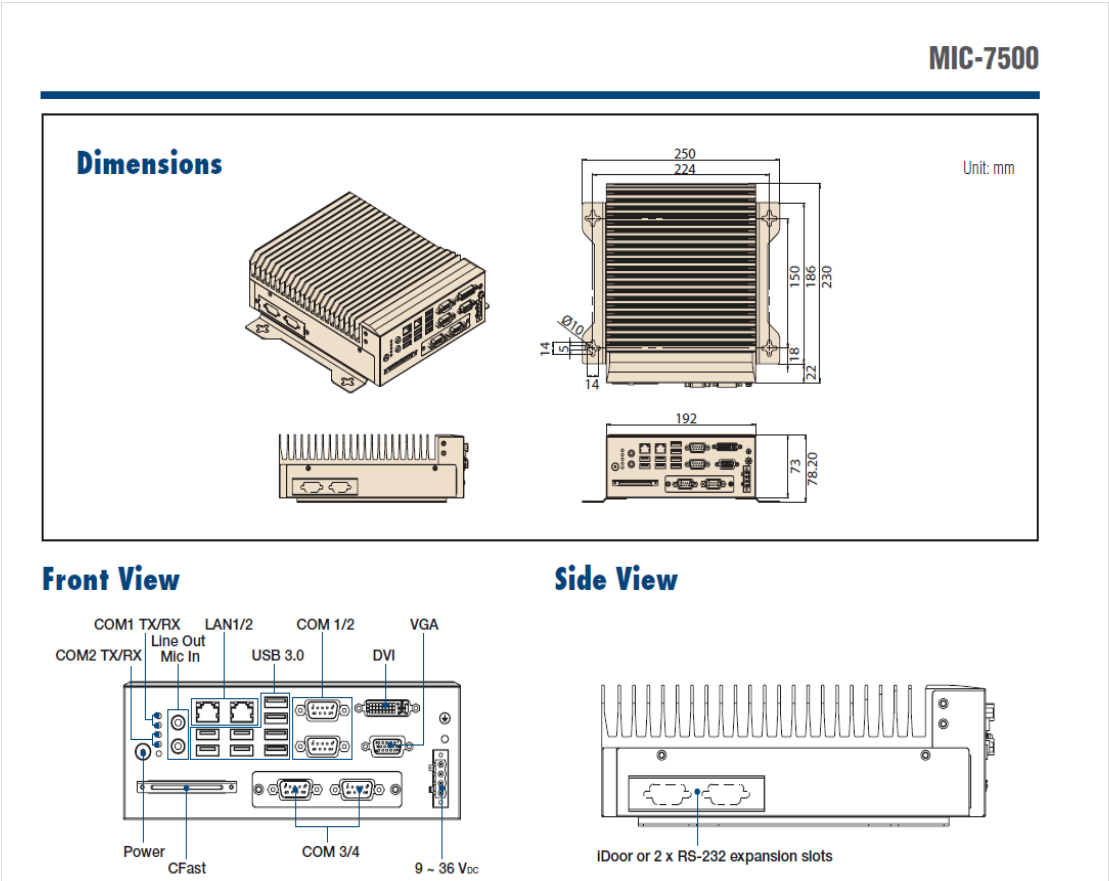


Figure 6 – MIC-7500 Front View and Mounting Dimensions

3.1.2 Advantech MIC-770V2 CPU Module

System:	MIC-770W-20A1	
CPU:	Intel Xeon W1250-TE	Intel 10th Gen 6-Core Xeon, W480E, 35W
Memory:	SQR-SD4I8G2K6SNBCB	DDR4 8GB, (-40-85C)
Data Sheet:	MIC-770-V2_DS(042522).pdf	

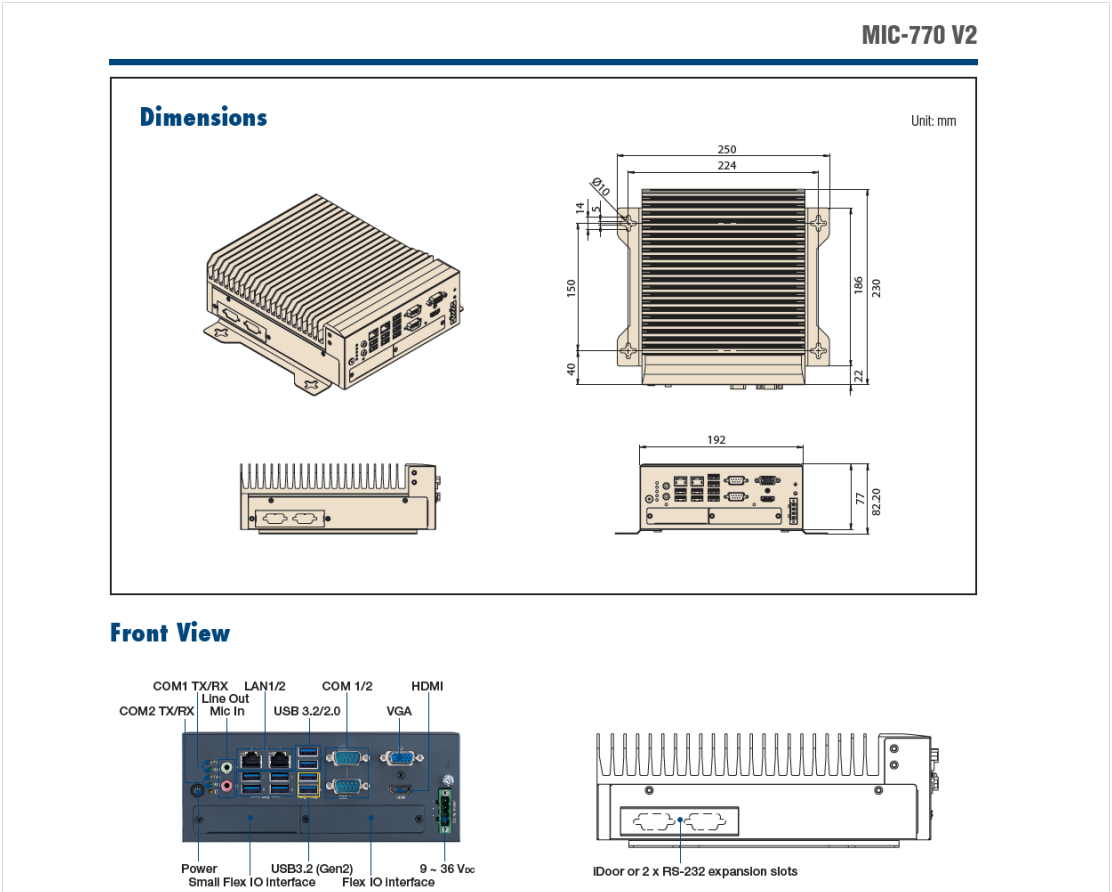


Figure 7 – MIC-770 V2 Front View

3.1.3 Advantech MIC-75M20 iModule

iModule:	MIC-75M20-01A1E	MIC-75M20 i-module, 2 PCIEx8
Data Sheet:	i-Module Series_DS201906.pdf	

3.1.4 TC-net Network Cards

The TMPCGW supports TC-net100 and TC-net1G. Only one TC-net Card can be installed at one given time.

3.1.4.1 TC-net 100

Module:	JTNI61	TC-net 100 PCIe
Data Sheet:	6F8C1450.pdf	

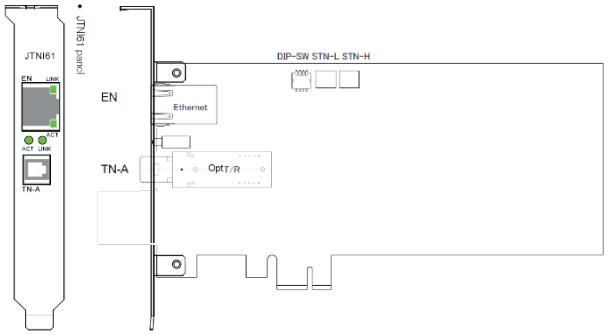


Figure 8 – JTNI61 – TC-net 100

3.1.4.2 TC-net 1G

Module: JTGI23 TC-net 1G PCIe
Data Sheet: 6F8C1440.pdf

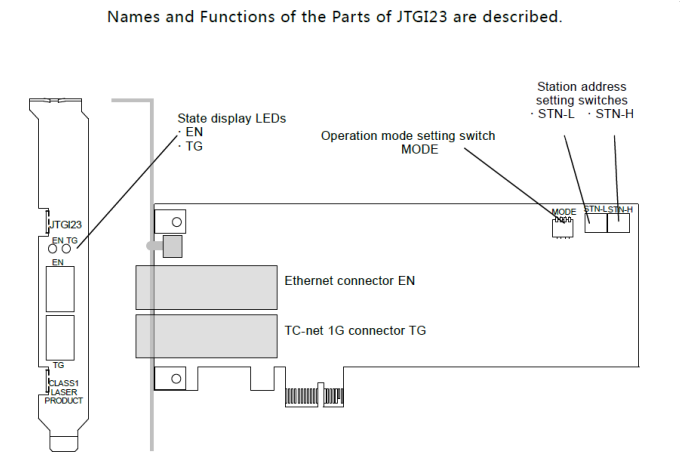


Figure 9 – JTGI23 – TC-net1G

3.2 TLS20GW

Module p/n: TLS20GW1-B0EMCB07 TOSLINE-S20 Gateway
Data Sheet: DT-3289 TLS20GW Data Sheet.pdf

3.3 MikroTik Switch

p/n: CRS305-1G-4S+IN
ds: https://mikrotik.com/product/crs305_1g_4s_in

p/n: CRS309-1G-8S+IN
ds: https://mikrotik.com/product/crs309_1g_8s_in

3.4 Accessories

3.4.1 F07 Cable specs – TOSLINE-S20

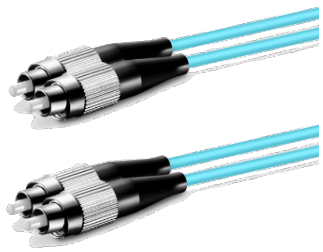
Cable p/n:	1mt	S3200-CN101-2020
	5mt	S3200-CN501-2020
	10mt	S3200-CN102-2020
	…	S3200-CNxxy-2020

Optical Fibre:	H-PCF 200/230 Cable
Wavelength:	850nm

Connector:	TOCP200	Toshiba
	CF-2071	Sumitomo

From Factor: JIS-F07 Standard

3.4.2 FC Cable specs – TOSLINE-S20



Cable p/n:	Customized Duplex OM4 Multimode FC/UPC-FC/UPC Fibre Optic Patch
Connector:	FC/UPC – Single x2
Wavelength	850nm
Fibre:	50/125um
Jacket	PVC
Diameter	2.0/3.0mm

3.4.3 SFPs and requirements.

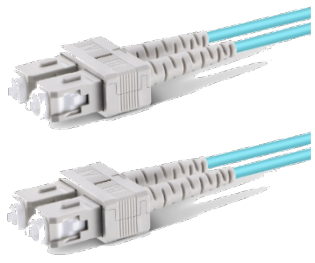
3.4.3.1 Ethernet – RJ45 Copper cables

SFP p/n:	10/100/1000Base-T SGMII (Mkt)
Brand:	10GTek
Compatibility:	Mikrotik

3.4.3.2 Ethernet Optical

SFP p/n:	ASF85-24-X2-D (Mkt)
Wavelength	850nm
Brand:	10GTek
Compatibility:	Mikrotik

3.4.4 LC-LC Optical Patch Cable Specs



Cable p/n:	Customized Duplex OM4 Multimode LC/UPC-LC/UPC Fibre Optic Patch
Connector:	LC/UPC Duplex
Wavelength	850nm
Fibre:	50/125um
Jacket	PVC
Diameter	2.0/3.0mm

SFP Transceivers are tested compliant with Class 1 Laser.

Do not look directly at the light emitting device.

4 Installation Instructions

4.1 Environmental Requirements

The TMPCGW, TLS20GW and all associated equipment must be installed in an IP5X rated cabinet in a dry environment. Dust protection covers must be fitted on all unused ports.

4.2 General Recommendations

4.2.1 Remotely Located

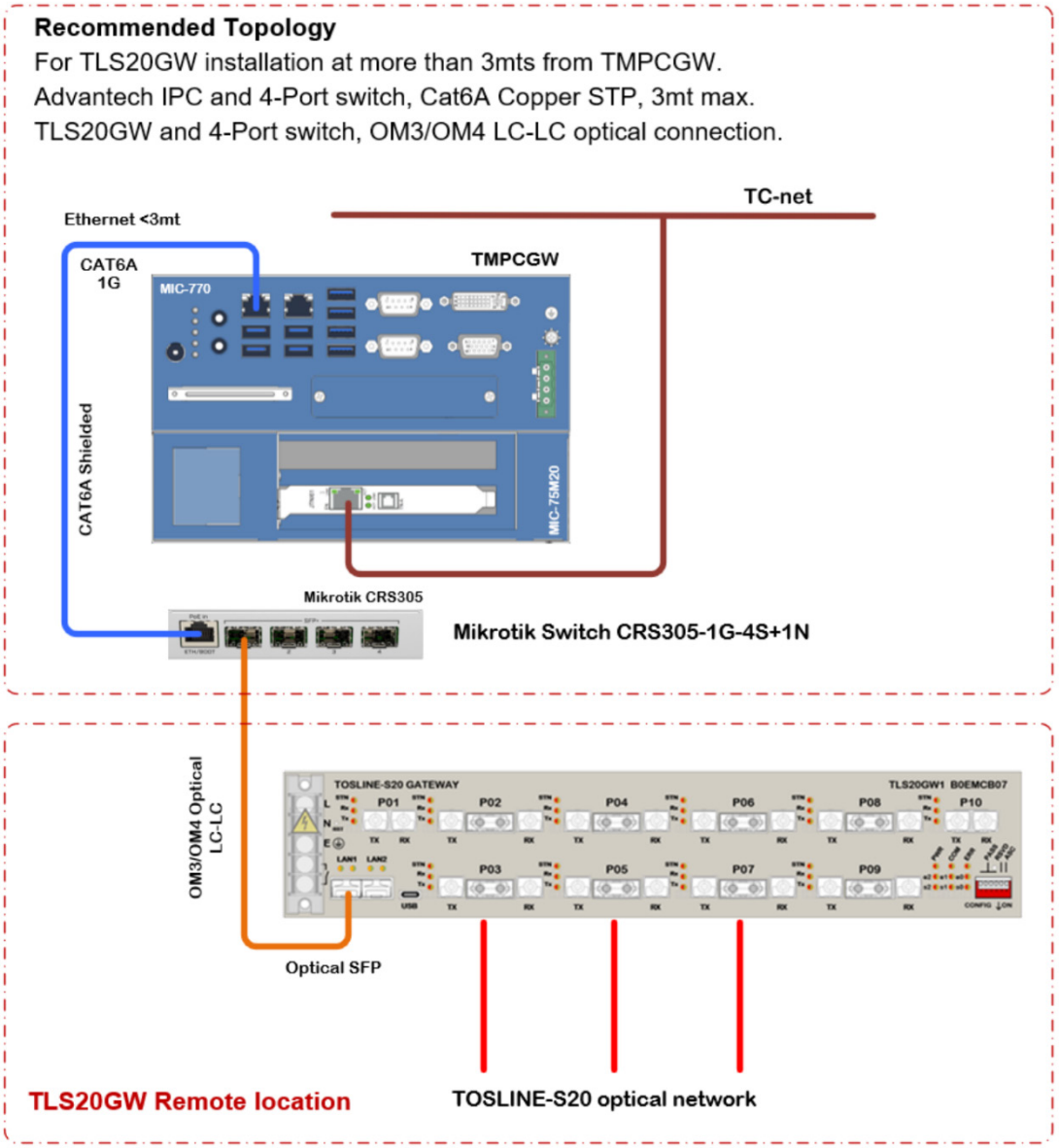


Figure 10 – Remotely Located TL-S20

4.2.2 Same Location

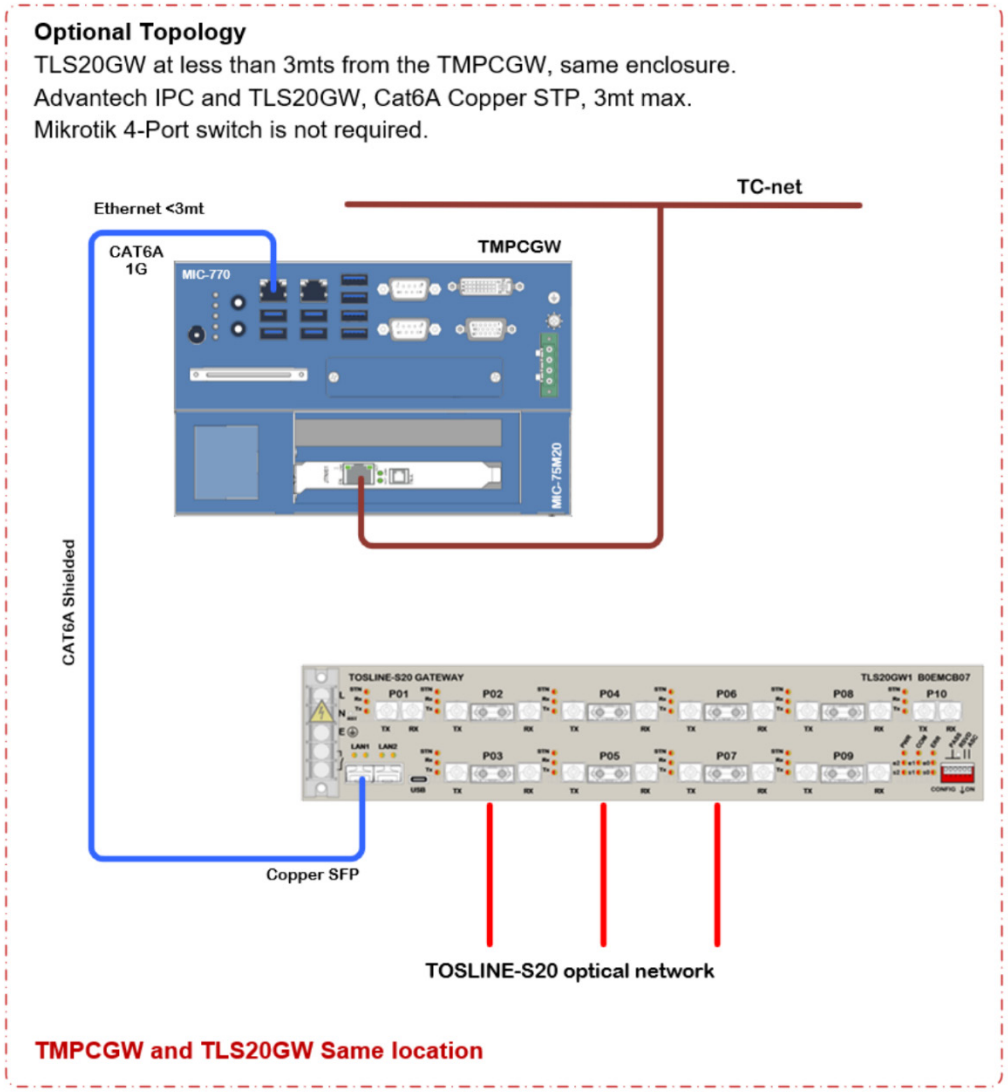


Figure 11 – Same Location

4.2.3 Cable Recommendations

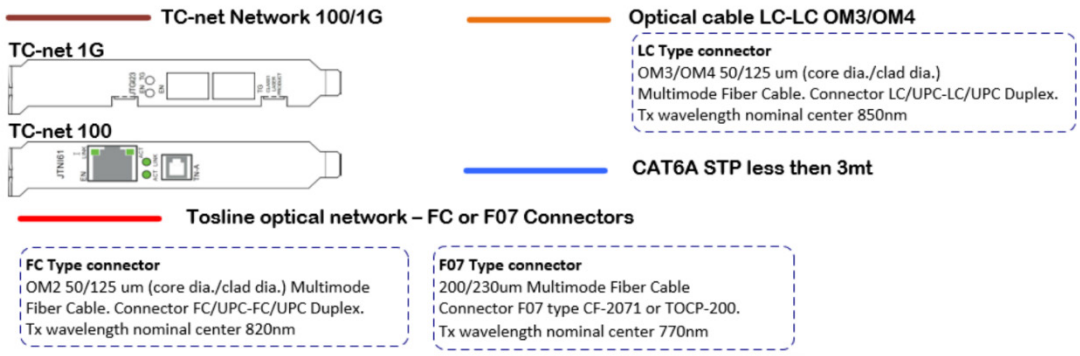


Figure 12 – Cables Recommendations

4.3 TMPCGW – Advantech

4.3.1 Configuring Hardware

To upgrade the PC software please refer to [4] for details on USB Update and Recovery procedure.

Configuration, minor software updates, and general management of the TMPCGW is done using the Gateware Windows Tool [2].

4.3.2 Assembly & Disassembly

Disassembly is required to install a TC-net Card and to access/replace the filter.

	ESD Sensitive Apparatus. To be serviced by qualified personnel with electrostatic protective gear.

To disassemble the TMPCGW, 8 screws need to be removed to access the card cage:

Figure 13 – Removing the Enclosure Cover

Now the card cage is exposed, the TC-net card may be inserted in one of the spare PCIE slots:

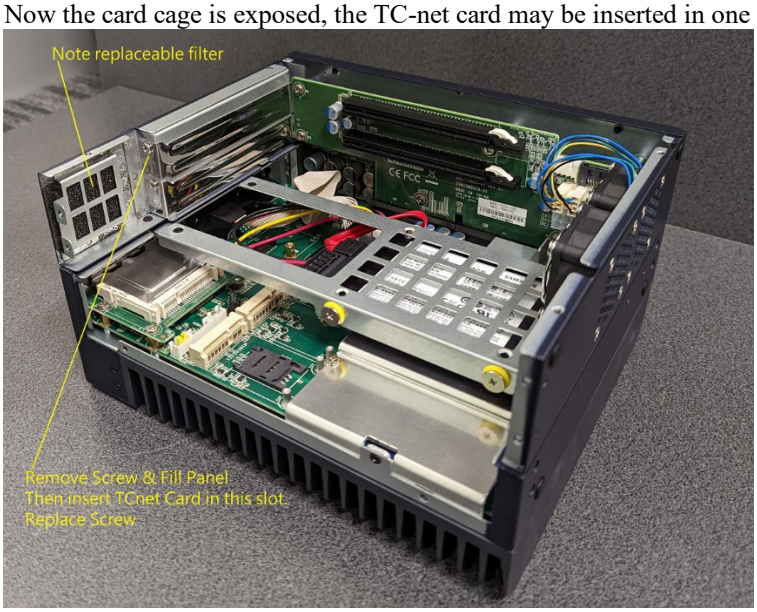


Figure 14 – TMPCGW Internal View

Once completed, re-assemble in the reverse order.

4.3.2.1 TC-net 100 Card Installation

Confirm DIP switch settings and provide reference to Toshiba manual [10].

4.3.2.2 TC-net 1G Card Installation

Confirm DIP switch settings and provide reference to Toshiba manual [9].

4.3.3 Installation

Power supply requirements.

Provide link to Advantech installation manual.

Recommended mounting on shelf.

4.4 TLS20GW

Installation instructions for the TLS20GW1 are contained in [1].

Important Safety Instructions

Read these instructions carefully. Become familiar with the instructions before trying to install, operate, service or maintain this equipment.

The following safety messages and symbols may appear throughout the instruction manuals or on the equipment to warn of potential hazards. Read the information that clarifies or simplifies the installation and operation procedure.

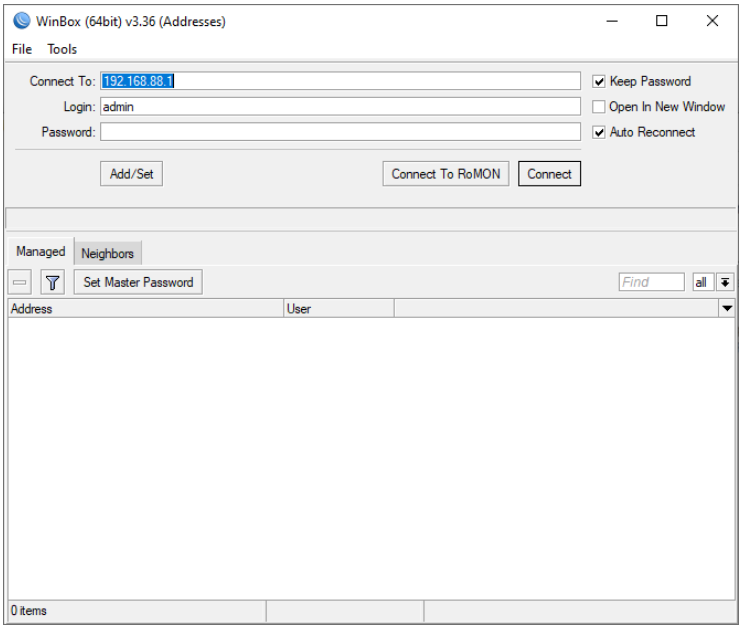
	High Voltage Present. This symbol indicated “Danger” or “Warning”. This safety message indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed. Do not open this equipment. To be serviced by qualified electrician only.
	General Warning. The addition of this symbol to a “Caution” safety message indicates potential safety hazard which will result in personal injury if the instructions are not followed.
	ESD Sensitive Apparatus. Do not open this equipment. To be serviced by qualified personnel with electrostatic protective gear.

4.5 Mikrotik Switch

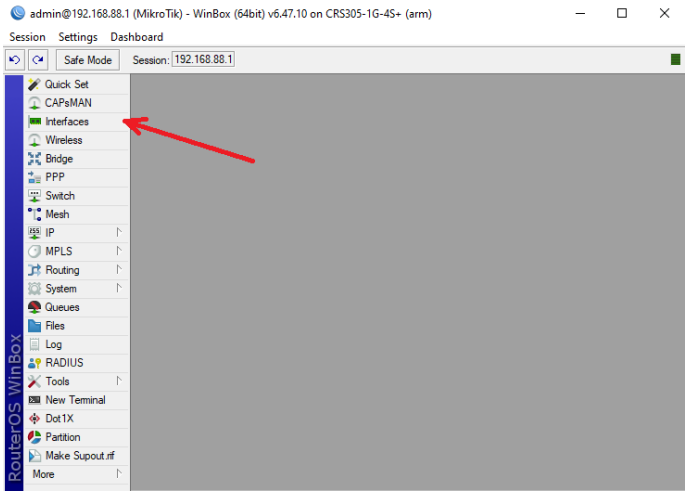
4.5.1 Configuration

To configure the Mikrotik switch, download WinBox from MikroTik Routers and Wireless - Software

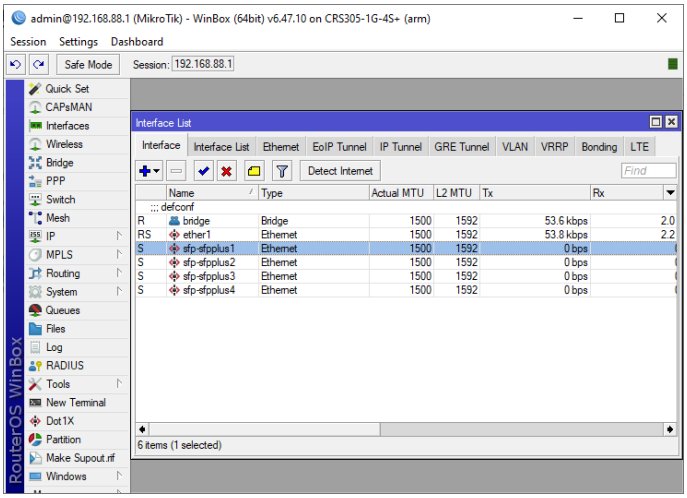
Connect to the switch using the Ethernet port. Default IP address is 192.168.88.1, admin and no password



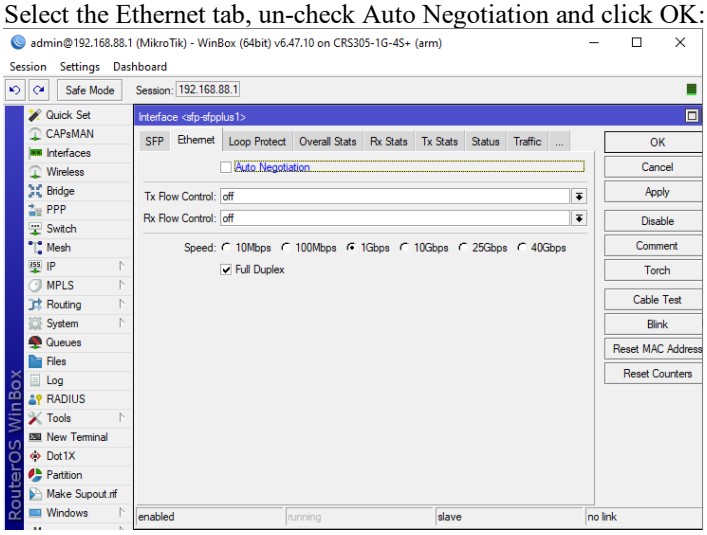
Select Interfaces:



Double-click on the first SFP interface:



Select the Ethernet tab, un-check Auto Negotiation and click OK:



Repeat for all the SFP Interfaces

4.5.2 Installation

The Specifications and User Manual for the 4-1 optical switch can be found at: [MikroTik Routers and Wireless - Products: CRS305-1G-4S+IN]

In summary the switch required 12-57VDC, 18W max. There are redundant DC inputs or use the plug pack provided. In the installation kit we also provide a 24V screw terminal plug adaptor if you wish to power the switch from a 24V supply available in the PLC cabinet.

Mounting options are detailed in the User Manual which includes the following dimensions in mm:

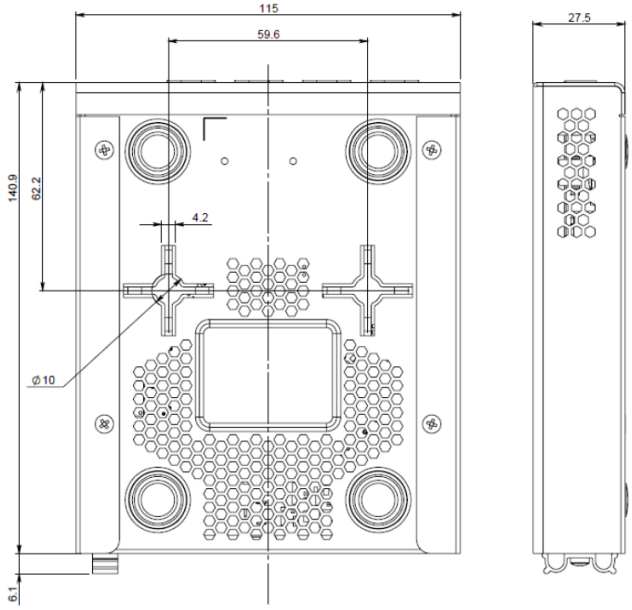


Figure 15 – Mikrotik Switch Dimensions

5 System Design Strategy

This section is designed to be a brief guide as to best practice for designing a TOSLINE-S20 upgrade supporting legacy hardware and modern PLCs.

5.1 Existing System Analysis

5.1.1 Hardware Topology

5.1.1.1 Arrangement

Generally the new hardware topology will consist of one or more Advantech industrial PCs as the top level gateway bridging to & from TC-net 100, TC-net 1G and optionally ODG.

Each Advantech PC supports a single TL-S20 gateway unit.

Each TL-S20 gateway unit can support multiple TOSLINE-S20 networks according to the rules described below.

5.1.1.2 Ports

A TLS20GW unit provides 10 optical interface ports. Eight of these ports are dual FC & F07, whilst two are FC only. The FC only ports are designed generally for upstream and downstream daisy chaining of a TOSLINE-S20 network. By use of the gateway "Tool" these ports may be connected together in groups and attached to channels.

5.1.1.3 Channels

A channel is a logical interface within the TLS20GW unit and provides the ability to terminate the TL-S20 protocol. Various modes are possible, OFFLINE, ACTIVE or PASIVE. Channels may be assigned to single ports or a grouping of ports as needed. The TLS20GW units provides twelve channels. These channels can each terminate a TL-S20 network, but due to performance considerations generally the number of networks should be limited to four in production. Some exceptions are permissible, subject to rigorous system design checks. For lab based system testing as a simulator, more channels can be used up to the maximum of twelve.

5.1.1.4 Legacy Networks

Typical legacy TL-S20 networks consist of interface cards within the PLC IO system. Each interface card provides the ability to connect to a single network. Typical cards are the SN322A (normal speed) or SN322H (high speed).

Legacy TL-S20 PLC cards may be connected as direct I/O as an I/O card connected directly to a PLC CPU via a G3 interface, or via a PLC remote TC-net I/O module connected via an R3 module. An R3 module uses TC-net 100 for communications, so a new gateway system can be designed to use the same TC-net layout as the original system. For direct I/O connections the PLC system design needs to be modified to change from direct I/O to TC-net I/O. This change requires planning.

5.1.1.5 Passive Operation (Shadowing)

To ease the commissioning aspects and check out new software prior to a PLC changeover, the TLS20GW unit can be used in a passive or shadowing configuration. In this configuration pairs of ports are used to pass the data through the unit in an active pass-through mode. The TLS20GW unit is interposed between the legacy PLC TL-S20 interface cards and the downstream devices. It should be emphasized that the unit must be powered on and configured for passive mode operation as the network signal is regenerated as it passes through the unit. This incidentally adds an extra hop to a legacy network, so the constraints on maximum number of hops should be checked and precautions taken not to violate this constraint. To ensure that there is no chance of misconfiguring the passive mode, it is

also possible to use the hardware pass through DIP switches on the TLS20GW unit to enforce the pass-through mode by hardware. When pass through mode is configured by DIP switch it is not possible to configure any channels connected to passthrough ports to be ACTIVE.

5.1.1.6 Active Operation

A network is defined by a group of one or more ports on the TLS20GW unit. To participate actively on a network at least one channel must be configured in an active mode on a port group. For most PLC upgrades a single channel associated with a port group can be considered a replacement for a TL-S20 PLC interface such as a single SN322A or SN322H module.

5.1.1.7 ASC25 Unit Replacement

The TLS20GW can be used as a standalone ASC25 unit replacement. The ASC25 replacement mode is selected by DIP switch. When in ASC25 mode no active channels can be configured on the TLS20GW unit, although it is still possible to isolate pairs of ports in passthrough mode by using the associated pass-through mode DIP switches. Typical legacy systems operating on normal speed networks with SN322A PLC interfaces may interface with many drives and a number of daisy chained and star connected ASC25 units. A TLS20GW unit is a one for one replacement for an ASC25 unit.

5.1.1.8 TL-S20 Network

TL-S20 networks can be identified by examination of the legacy PLC program. For our analysis here we assume the use of the vTool programming software. The network can be examined in the vTool and exported as a text file for further examination. The TL-S20 gateway tool also has the capability to import the TOSLINE-S20 networks for temporary use in configuration. Generally, we recommend that each TL-S20 network be replaced by a port group and single allocated channel to terminate the protocol. The rule allows up to four TL-S20 networks per TL-S20 gateway system.

5.1.1.9 TC-net Networks

Legacy systems are generally TC-net 100 networks or direct I/O. the replacement PLC system may be TC-net 100 or TC-net 1G according to the system design requirements.

If direct I/O is used in the legacy system, the upgrade to the new system must include the necessary changes to convert the TL-S20 I/O signals to TC-net talkers and listeners. The actual process here is specific to the individual systems and is not covered in this document.

5.1.2 IO Configuration

As part of the system design the structure and I/O allocations of the TL-S20 networks and signals should be verified. Much of the data is defined within the vTool program, but it is important to verify the configurations of attached devices such as drives.

Tools such as the SLS loader may be connected via serial port to SN322A or SN322H cards and the device parameters captured and verified. For convenience there is a Windows 10 version of the original SLS loader tool available.

The TMEIC Drive Navigator may also be used to determine parameters of attached drives.

5.2 Define Upgrade Path

Work out a broad plan. Number of shutdowns required and schedule.

Identify risk minimization strategies.

The upgrade strategy needs to be planned and executed step by step. Where possible, particularly for complex legacy installation, perform upgrades section by section.

Use shadowing where possible for validation of the converted program. Tags, Talkers/listeners, ODG for verifications. The shadowing phase can verify that signals passing to and from drives are valid, but not all aspects of program conversion can be tested in a shadowing mode.

5.3 Failure Mode Analysis and Corrective Actions

Failure modes and corrective actions on partial system failures must be considered in the legacy system replacement design.

In general, most TOSLINE-S20 devices have application software to implement a round trip heartbeat function. This tests the integrity of the communications link from PLC through the gateway system to individual drives and back to the PLC. A failure at any point in the system will cause a loss of heartbeat to be detected in both drive and PLC.

Some earlier projects do not have round trip heartbeat monitoring so the Advantech and TLS20GW1 units provide a means to monitor crucial ports of communications links and take failure modes actions on link failure and recover actions on link restoration. To ensure that there is no unintended movement of drive equipment it is also possible to sequence a recovery at the top level only by either rebooting the Advantech gateway or by halting and running the associated PLC CPU.

Depending on whether legacy drive devices are connected by direct I/O or by remote TC-net I/O further considerations are required. The selection of whether to HOLD or ZERO references and/or switch the controlling channel to standby mode must also be considered.

Further information will be provided in this section soon.