



SENTINEL™

**TORO® SENTINEL™ WMS
SPECIFICATION GUIDELINES**

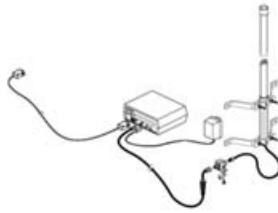
CENTRAL COMPUTER / SYSTEM OPTIONS



A



B



C



D

E

COMPONENT:	A	B	C	D	E
DESCRIPTION:	Sentinel Software	Central Computer	Central Communications Hardware	Satellite Communications Hardware	Sentinel Satellite

CENTRAL COMPUTER

MODEL	DESCRIPTION	INCLUDES		
SGIS-1-T	Sentinel Software Only. Two Years of Toro NSN® Support included.	A		
SGIS-0-1	Sentinel Software & Radio Communications hardware. Two Years of Toro NSN® Support included	A		C UHF Radio (Includes Computer Interface, Power Supply, & Base Station Antenna)
SGIS-1-C	Sentinel Software & NSN Computer. Two Years of Toro NSN® Support included (& computer warranty).	A	B	
SGIS-1-0	Sentinel Software, Computer, & Radio Communications hardware. Two Years of Toro NSN® Support included (& computer warranty).	A	B	C UHF Radio (Includes Computer Interface, Power Supply, & Base Station Antenna)

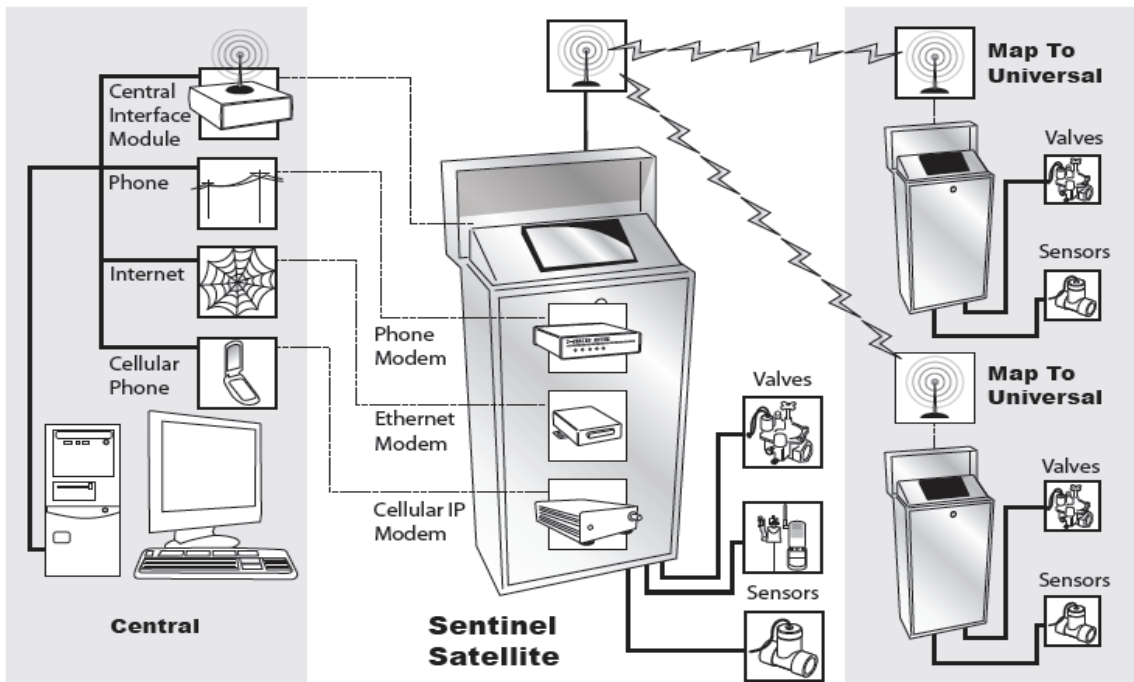
Radio Communications Hardware consists of:

- Central Interface Module with Maxon UHF 450-470 MHz Radio (P/N 102-2376)
- CPU Cable Assembly (P/N 102-2375)
- Power Supply for the Central Interface Module (PN 102-2377)
- 5db gain Antenna Assembly which includes the Grounding Assembly and 50' of Antennae Cable (P/N 102-2379 and P/N 102-2378)

TORO NSN® SUPPORT PLAN EXTENSIONS

Model	Description
SSE-T-1	1-Year NSN Support Extension for SGIS-0-1 or SGIS-1-T
SSE-T-3	3-Year NSN Support Extension for SGIS-0-1 or SGIS-1-T
SSE-C-1	1-Year NSN Support Extension for SGIS-1-C or SGIS-1-0 (includes computer warranty)
SSE-C-3	3-Year NSN Support Extension for SGIS-1-C or SGIS-1-0 (includes computer warranty)

COMPUTER TO SATELLITE COMMUNICATION OPTIONS



Type	Description
UHF Radio	Standard Sentinel Communications. Point-to-point narrowband radio 450-470 MHz. Requires FCC License in U.S. – Distributors responsible for ensuring compliance with local communication guidelines.
Telephone	Landline (POTS) Telephone. Central Phone Modem model #: ESB-CPM Satellite Phone Modem model #: ESB-EPM
Cellular-enabled Data Modem (U.S.)	Internet from computer, CDMA Modem in Satellite. Contact Toro for Specifying Details.
GSM Cellular Modem (Europe)	GSM Modem at Computer: SGIS-COM-GSM1 GSM Modem at Satellite: SSAK-COM-GSM1
Ethernet/Internet	Contact Toro for Specifying Details. Satellite Ethernet Modem model #: ESB-ENM
License-Free Spread Spectrum Radio	Contact Toro for Specifying Details.
Fiber Optics	Contact Toro for Specifying Details.
Short Haul (RAD 4-wire Short Haul hardware communication) Modems	Contact Toro for Specifying Details.
Sentinel Remote Transceiver Assembly	Sentinel Remote Transceiver Assembly (SRTA) – Allows utilization of two communications types to reach the field controller. For example, phone to SRTA and UHF Radio on site. Contact Toro for Specifying Details.
Other	For alternate communication needs, contact Toro for custom communications quote.

TORO NSN SENTINEL COMPUTER SPECIFICATIONS – SPEC VERSION 111

COMPONENTS	SPECIFICATION
Processor / Chip	Intel® Core i3 (3.06 GHz) Intel DQ57TM Micro ATX System Board LGA1156 socket 1333 MHz Bus
RAM	4 GB DDR3 – Dual Channel
Audio	Intel® High Definition – Realtek ALC662-VC, 6 channel (integrated)
Network Interface	Intel® Gigabit 10/100/1000 Mb/s Integrated
Motherboard Bus Type	(1) PCI, (2) PCI Express 2.0 x1, (1) PCI Express 2.0 x16 Connector
Hard Drive	500 GB
Optical Drive	DVD-RW Dual Format LightScribe. Supports All Formats including CD / CDR / CDRW / DVD / DVD-RW
Case Type	Mid-Tower (5-Bay)
Video/Graphics	MB-Intel® Q57 Express Chipset with Intel Flexible Display Interface 256 MB integrated/shared. CPU Integrated Graphics.
Serial (COM) Ports	6 - (1) Integrated system board COM port, (1) Single Port SIIG PCI Serial Card, (4) USB/Serial module
USB Ports	8 (2) in front, (6) integrated in back
1394 (Firewire) Ports	N/A
Other Peripheral Connections	(1) eSATA 3.0 port (in back), (1) Intel Display Port (in back)
Backup Device	320 GB Removable Hard Disk
Mouse	Microsoft® Optical USB
Keyboard	USB
Monitor	27" ViewSonic® Wide Screen Flat Panel
Speakers	Stereo – On Monitor
Battery Backup	EATON/Powerware Back-UPS 700
Printer	HP® DeskJet D2660
Operating System	Windows® 7 Ultimate with Downgrde Option
Recovery Software	Windows® 7 Ultimate
Antivirus Software	AVAST Anti-Virus (3 year) (License only)
DVD Decoder Software	Windows Media Player (DVD Player CODEC)
CD/DVD Authoring Software	Windows® 7 Ultimate
Accessories	See List **

**Accessory kit is composed of: in-line surge protection device, CD Caddy, mouse pad, blank recording CD, USB printer cable, and any other necessary cables.

1. Specifications subject to change without notice. Availability and specifications of NSN products and services may vary by international region. Please contact NSN or your TORO distributor for details.
2. Items may be locally procured due to voltage or language requirements for international orders.

CONTROLLER OPTIONS

SENTINEL 24VAC OUTPUT SATELLITES – SSAK-VV-WWW-6-X-S-Y-ZZZ

Satellite	Station Count (VV)	Enclosure (WWW)	Output (6)	Communications (X)	Sensor (S)	Surge Protection Level (Y)	Power Supply (ZZZ)
SSAK – Sentinel Satellite	12 – 12 Stations	WS3 – Small Metal Cabinet, Wall Mount	6 – 24 VAC	N – Narrowband Radio	S – Sensor Ready	1 – Level 1 Surge (Nominal Protection)	Blank – 120V/50Hz
	24 – 24 Stations	WS2 – Stainless Steel Cabinet, Wall Mount		L – Less Radio		3 – Level 3 Surge (Mid-Level Protection) – WS36 Enclosures Only	50H – 220-240V/50Hz
	36 – 36 Stations	PP1 – Plastic Pedestal, Green				4 – Level 4 Surge (Maximum Protection) – WS26, PP16, PS16 Enclosures Only	
	48 – 48 Stations	PP2 - Plastic Pedestal, Sandstone*					
		PS1 – Stainless Steel Pedestal					

* PP2 – Sandstone Plastic Pedestals are special build controllers. Please contact Don Ghella for part number and ordering process through EICON.

Enclosure Examples



WS3 - Wall Mount Small Metal Cabinet



PP1 - Plastic Pedestal (Green)



PP2 (Plastic Pedestal (Sandstone)



PS1 – Stainless Steel Pedestal

Custom Station Counts, Power Supplies, or Enclosure Options

Contact Toro for specifying information on Special Build (ESB – EICON Special Build) controllers including non-standard stations counts (9, 16, 60, 96, etc), power supplies (solar), or enclosures (e.g. StrongBox® or Custom Control Small Cabinet).

SENTINEL 24VAC OUTPUT MAP-TO-ASSEMBLY SATELLITES – SSMN-VV-WWW-6-X-S-Y-ZZZ

- One or Multiple Map-to-Assemblies work in conjunction with a Single Sentinel Satellite to give a maximum of 96 stations controlled by one Satellite.
- SSK + SSMN Group can not exceed 96 stations, total.
- Total number of SSMN units assigned to a single SSK should not exceed 3 (three)

Map-To-Assembly	Station Count (VV)	Enclosure (WWW)	Output (G)	Communications (X)	Sensor (S)	Surge Protection Level (Y)	Power Supply (ZZZ)
SSMN – Sentinel Map-to-Assembly	12 – 12 Stations	WS3 – Small Metal Cabinet, Wall Mount	6 – 24 VAC	N – Narrowband Radio	S – Sensor Ready	1 – Level 1 Surge (Nominal Protection)	Blank – 120V/50Hz
	24 – 24 Stations	WS2 – Stainless Steel Cabinet, Wall Mount		L – Less Radio		3 – Level 3 Surge (Mid-Level Protection) – WS36 Enclosures Only	50H – 220-240V/50Hz**
	36 – 36 Stations	PP1 – Plastic Pedestal, Green				4 – Level 4 Surge (Maximum Protection) – WS26, PP16, PS16 Enclosures Only	
	48 – 48 Stations	PP2 - Plastic Pedestal, Sandstone*					
		PS1 – Stainless Steel Pedestal					

* PP2 – Sandstone Plastic Pedestals are special build controllers. Please contact Don Ghella for part number and ordering process through EICON.

** 220-240/50Hz Models are special build controllers. Please contact Don Ghella for part number and ordering process through EICON.

Sentinel field Satellites and MapTo Assemblies in U.S. come standard with UHF radio transceiver and antenna. The radio module is manufactured by Maxon and is model number SD-125E. The antenna and radio module are UHF two-way, with frequency ranges of 450-470 MHz, nominal impedance of 50 Ω, gain of 3dB, and a max power input of 125 watts. Radiation pattern of the antenna is omni-directional, the polarization vertical.

- Built in handheld capability with Model Number SHHR and Sentinel Central Computer
- Built standard with AC junction box, toggle switch for on / off power, and provides power for alternative communication devices such as Ethernet interface, telephone modem, and cellular modem.
- Requires one Intermatic AG2401 or Hubbel 5252S OR Tripp Lite Isobar Isotel 6 for 117 VAC surge protection.
- Requires that splices be sealed with the following:
 - 3M Scotchlok UAL butt connector
 - One Preformed Line Products Super Serviseal closure kits
- Requires proper grounding (See grounding)

NOTE: All EICON Special Build Models (Designated by Order Number starting with "ESB-") must be ordered from Toro's EICON Division in Denver, CO, USA. All ESB Products will be invoiced in U.S. Dollars separate from your standard Toro Orders. For information or quotes, contact your Area Sales Manager. EICON Division • The Toro Company • 7304 S. Alton Way, Suite M • Centennial, Colorado 80112 • PHONE: +1 (303) 290-1881


SENTINEL TWO-WIRE DECODER SATELLITES – ESBTW204/WWW-XXX/TDC-YYY-ZZZ

Sentinel Two-Wire Satellites are “Special Build” by Toro’s EICON Division. They are standard 204 station-capable. Decoders sold separately.

- Sentinel Two-Wire Satellites come standard with one output (daughterboard), capable of 8 communications wire paths.
- A second daughterboard can be ordered and installed for additional wire paths. Model Number:


Special Build Controller	Two Wire	Power Supply (/WWW)	Communications (XXX)	Output (TDC)	Enclosure (YYY)	Antenna (ZZZ)
ESB – EICON Special Build	TW204 – Sentinel Two Wire, 204 Stations	Blank – 120V/60Hz	U2 – (U.S.) 450-470 MHz Narrowband Radio	TDC – Two Wire Output Boards (one Motherboard, one Daughterboard)	WS5 – [TDC] Small Metal Cabinet, Wall Mount	Blank – No Antenna
		/2250 – 220-240V/50Hz	GSM – Less Radio, GSM Modem Ready		WS2 – Stainless Steel Cabinet, Wall Mount	ATX – Stub Antenna (standard)
					PP1 – Plastic Pedestal, Green	VRA – Pancake Antenna
					PP2 – Plastic Pedestal, Sandstone	
					PS1 – Stainless Steel Pedestal	

Two-Wire Decoders*

Decoder	Station Count	
CDEC – Commercial Two-Wire Decoder (U.S. Only)	1 – One Station Output	
DEC – Two-Wire Decoder (Int'l)	2 – Two Station Outputs	
	4 – Four Station Outputs	

* Operate DC-Latching Solenoids (Toro Part Number DCLS-P)

Two-Wire Communications Surge Protection

<p>DEC-SG-LINE – Decoder Line (Communications Cable) Surge Protection</p> <p>Install grounding per controller specifications and connect a surge unit to ground rod or plate and communication line every 300 meters, or 1000 feet & no more than 150 meters (500 feet) from every decoder.</p>	
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Two-Wire Communications Cable



**TORO JACKETED
DECODER CABLES
DIRECT BURIAL**

SIZES: 14 & 12 AWG, SOLID COPPER, 2-CONDUCTOR



SENTINEL RETRO-LINK ASSEMBLIES – ESB-RLS-XX-YY

Sentinel Retro-Link Assemblies allow upgrade of Irritrol MC-E Controllers or Rain Bird ESP-MC/SAT/SITE to Sentinel Satellites.

Special Build Controller	Retro-Link	Communications (XX)	Controller Compatibility (YY)
ESB – EICON Special Build	RLS – Retro-Link Assembly	U2 – (U.S.) 450-470 MHz Narrowband Radio	IR – Irritrol MC-E
		NR – No Radio. Radio or communications sourced locally.	RB – Rain Bird ESP-MC/SAT/SITE

SENTINEL ACCESSORIES

SENTINEL HANDHELD REMOTE

- Satellites are Handheld Ready

Model	Description
SHHR	Sentinel Handheld UHF Radio with voice communications capabilities. Requires FCC License. Satellites are Remote Ready. FCC & IC-approved radio. CE & C-TICK customers contact Toro for handheld remote options.

WEATHER SOURCES

Weather Stations

Manufacturer	Model Number
Davis Instruments	Vantage Pro2 Plus
Campbell Scientific	ET107
Campbell Scientific	TurfWeather
Irrisoft	Weather Reach WR-7

Web-based Weather Sources (North America Only)

Type	Description
Toro Precision-ET™	Web-based Weather Source provided by Toro with resolution to 1 sq. km. Based on Latitude and Longitude.
CIMIS	California Irrigation Management Information System (CIMIS) Web-based weather source and stations for the State of California, only.

ON-SITE WEATHER STATION RECOMMENDATIONS

- 1) Davis Vantage Pro2 Plus- (Davis p/n 6162C) - Direct connect to central computer
 - a) Integrated Sensor Suite (ISS) includes Sensor Interface Module, Rain Collector, Anemometer, UV sensor, Solar Radiation Sensor and Passive Radiation Shield.
 - b) Console provides the user interface, data display, A/D conversion, and calculations. The console and ISS are powered by an AC adapter connected to the console. Batteries can be installed in the console to provide a backup power supply.
 - c) Weatherlink 5.5.1 (Davis p/n 6150SER) The SER model connects the console to computer via a serial connection or a remote modem connection.
 - d) Requires that splices be sealed with the following:
 - i) 3M Scotchlok UAL butt connector
 - ii) One Preformed Line Products Super Serviseal closure kits
 - e) Requires proper grounding (See grounding)

FLOW SENSORS

- Satellites are Flow Sensor Ready
- Single Flow Sensor Requires No Additional Components

Model Number (Toro TFS Series)	Size	Description	Suggested Operating Range
TFS-050	1/2"	Flow Sensor, 1/2", Plastic Tee	1.2 – 12 GPM
TFS-075	3/4"	Flow Sensor, 3/4", Plastic Tee	2.7 – 28 GPM
TFS-100	1"	Flow Sensor, 1", Plastic Tee	5 – 50 GPM
TFS-150	1.5"	Flow Sensor, 1.5", Plastic Tee	5 – 100 GPM
TFS-200	2"	Flow Sensor, 2", Plastic Tee	10 – 200 GPM
TFS-300	3"	Flow Sensor, 3", Plastic Tee	20 – 300 GPM
TFS-400	4"	Flow Sensor, 4", Plastic Tee	40 – 500 GPM

FLOW SENSOR ADAPTER BOARDS - MULTIPLE SENSORS OR NON-TORO FLOW SENSORS – ESB-MSI-X

ESB	MSI	Sensor Inputs (X)
ESB – EICON Special Build	MSI – Multiple Sensor Input	1 – One Sensor Input
		2 – Two Sensor Inputs
		3 – Three Sensor Inputs
		4 – Four Sensor Inputs

NOTE: Flow Sensor & System Information required when ordering:

MAX GALLON/LITERS PER MINUTE: _____
 EXPECTED FLOW RANGE: _____
 PIPE SIZE: _____
 FLOW SENSOR K FACTOR (Liters per Pulse, etc): _____

CABLE FOR FLOW SENSORS

1. TFS series sensors may be located up to 2000' from the controller.
2. All data communications wire connecting flow sensors to the electronics that are buried below grade, with or without conduit, shall be constructed to direct burial specifications similar to Telecommunications Exchange Cable (REA PE-89).
3. The cable shall be constructed of 20 AWG, or larger, copper conductors twisted into pairs of varying lengths to prevent cross talk. Conductors shall be insulated with polyethylene or propylene with a suggested working voltage of 350 volts.
4. The cable shall feature an aluminum-polyester shield and be finished with a black high-density polyethylene jacket. Cable should be equivalent to AT&T PE-39 or PE-89.

SPLICES FOR FLOW SENSOR

1. All wire connections shall be watertight with no leakage to ground or shorting from one conductor to another.
2. All splices shall be made in accordance with National Electrical Code® Articles 300.5 (Underground Installations) and 110.14 (Electrical Connections) using 3M DBY-6 or DBR-6 connectors, which are UL listed under "UL 486D-Direct Burial", for wet or damp locations, 600 volts.

GROUNDING

A good ground source is a mandatory component of overall surge protection for Toro Irrigation Control Systems. Grounding electrode(s) should be placed at each automatic controller or controller group locations.

It is the responsibility of the installer to connect all electronic irrigation equipment for which he is responsible to earth ground in accordance with regional requirements, in U.S. - Article 250 of the National Electrical Code (NEC.) Use grounding electrodes that are UL listed or manufactured to meet the minimum requirements of Article 250-52 of the 1999 NEC or applicable regional requirements.

NOTE: Toro Product Warranty requires a ground reading of 10 Ohms or less. Even with optimum grounding, neither Toro nor Toro Warranty Company are liable for product failures due to acts of God (i.e., lightning, flooding, etc.) and these failures are not covered by warranty.

Recommended Grounding

The resistance to the grounding electrode must not exceed 10 Ohms when measured with a Megger Earth Resistance Testing instrument or equivalent.

Single Rod Grounding

- 1) Install an 8' copper-clad ground rod into well-moistened soil to about 12" below grade. The grounding rod should be installed into a well-irrigated area to maintain soil moisture around the rod.
- 2) Connect a 12 gauge (2.0mm²) solid copper wire in the shortest and most direct path from the copper clad ground rod to the Equipment Ground. Avoid bends smaller than a 12" radius.
- 3) Clamp the bare wire securely to the pipe or ground rod. Make sure the wire contact area is free of dirt and corrosion. To minimize resistance, the copper wire should be pre-welded to the grounding rod or welded on site using an exothermic welding process (e.g. Paige Electric Cadweld).

Note: Use of a small round valve box is recommended to cover ground rod.

Supplementary Grounding

In the event that a resistance reading of 10 ohms or less can not be achieved using single rod grounding, the installer can decrease resistance by surrounding the grounding rod with ground enhancement material such as POWERSET from Paige Electric Corporation or GEM (Ground Enhancing Material) from ERICO.

If ground resistance still measures higher than 10 Ohms, the installer can use additional rods or plates as follows:

- **"Y" Grid** – A "Y" design grid consists of three, 8 foot-long copper-clad ground rods installed in a radial 120 degree ("Y") configuration from the controller. Each rod must be installed in a true vertical position, at least 16 feet from the controller.
- **Grounding Plates** – If soils conditions (i.e. ledge rock) prevent copper clad rod installation, one or more copper plates measuring 1/8" x 12" x 18" can be buried under well compacted soil.
- **Grounding Plate & Rod** – The "Plate & Rod" design consists of one vertical 8-foot copper-clad ground rod at least eight feet from the controller, and a copper grounding plate. Install the grounding plate horizontally, three feet deep and 15 feet from the grounding rod.

Additional Information

For additional information on grounding, refer to the following:

- American Society of Irrigation Consultants Grounding Guidelines:
http://www.asic.org/files/asic_grounding_guidelines.pdf
- Ground Resistance Testing Equipment and Technical/Application info:
<http://www.aemc.com/>
<http://www.megger.com>
- Grounding Products:
<http://www.paigewire.com/grounding.htm>
<http://www.erico.com>

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