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PRODUCT REQUIREMENTS DOCUMENT (PRD)

For


TND 540

Revision 1.6

Written By:

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NOTICE OF REVISION

| REV | DATE | DESCRIPTION | AUTHOR |
|-----|------|--|--------|
| 1.4 | 5/10 | <ul style="list-style-type: none"> Added Charging LED | V. Rao |
| | | <ul style="list-style-type: none"> | |

Note: All revisions are subject to formal document control. Changes from previous version are identified in the native Word document format.

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1

INTRODUCTION

1.1 Purpose

This document is intended to establish the product requirements for Rand McNally's 5th generation dedicated GPS navigation products for 2017.

1.2 Scope

This will cover the product requirements for Rand McNally's 5 inches PND device.

1.3 Distribution

Distribution of this document outside of Rand McNally requires an authorized Non-Disclosure Agreement (NDA) with the recipient.

1.4 Change Control

This document is defined as an engineering specification and is therefore subject to formal change control. Once approved, an authorized Engineering Change Order (ECO) is required for any and all changes.

2

SYSTEM DESCRIPTION

2.1 Product Description

TND540 are dedicated GPS navigation devices for consumer retail use in the consumer, trucking and RV markets. They will be Android based, but will not expose the Android operating system, similar to competitive Android based units from Garmin and Magellan.

2.1.1 External Interfaces


- USB for power when in use, charging and transfer data with computer.
- SD Card for System updates (new SW), import/export data (GPS data files/.db, fuel logs...)
- BT to connect to the following equipments: ELD50 and DC200
- Wifi to connect to the internet for the following: GPS Live Data, DriverConnect Registration

2.1.2 In Box Accessories

- Car charger (2 A)
- Anti-glare Screen Protector
- Cling to protect the screen (with or without branding to be determined later)

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- USB cable to connect to computer (data transfer + charging capabilities)
- Mount (same as 530/730)
- Quick Start Guide
- Customer Service Card
- Anti-theft labels
- Prop 65 warning

2.1.3 Limitations compared to TND740

- No Mic / No Voice recognition
- No Pogo Pin / No Smart Mount -> This implies that charging will be accomplished by connecting a power source (car charger) directly to the device.
- No magnet-based alignment / attachment

2.2 Critical Parameters / Key features

- GPS - Time for GPS to report a location
- Display - should be visible in sunny environment (with default brightness)
- Touch - all part of the screen should respond to touch
- Audio quality - GPS voice announcement should sound natural and loud enough in noisy truck environment
- SW Stability (criteria TBD)
- Hard Keys should have good tactile feel (with and without the protective Guard)
 - Gold standard is OverDryve 7

2.3 System Requirements

2.3.1 Hardware System Requirements


The hardware system requirements are defined in the table below. In ODM comments, please fill in one of the three comments listed below:

- Compliance by design
- Compliance by test
- N/A

| Description | TND540 HW Specification | ODM Comments |
|-----------------------|-------------------------|--------------|
| Environmental | | |
| Operating Temperature | -10 C to +60 C | |

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|-------------------------------|--|--|
| Storage Temperature | -30 C to +70 C | |
| Operating Surface temperature | Under room temperature unit surface temperature rising shall not exceed 15 in any area that consumer can touch. Room temperature = 25C *Unit shall be tested using Rand McNally navigation app in demo mode with maximum brightness. | |
| Display | | |
| Screen Resolution | 854 x 480 200 x 200 dpi | |
| Touch screen | minimum icon design need to be: 6 mm by 6 mm; | |
| Backlight | Backlit LED | |
| Brightness | 350 lux Brightness is measured with touch panel installed. | |
| Contrast Ratio | 500:1 | |
| Polarization | LCD screen shall be circular polarized (or equivalent) that be viewed through a polarized sunglass. | |
| Processor | | |
| CPU | A64 | |
| Memory and Storage | | |
| Main Memory (RAM) | 1GB (512*2) | |
| On Board Storage (EMMC) | 16GB SanDisk iNAND or equivalent with 8-bits data interface. HW implantation shall capable upgrade to 32GB of EMMC. | |
| GPS Performance | | |
| TTFF | ≤60 sec | |
| GPS Antenna | Antenna Center Frequency:1575.42 ± 4MHz Polarization: RHCP Antenna Patch Size: 18mm x 18mm x2mm Peak Gain: 3dBi VSWR: 2:1 6dB Beamwidth: 150 degrees | |

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| GPS Receiver Sensitivity (Conducted) | Acquisition sensitivity: -142 dBm Tracking Sensitivity: -162dBm Reacquisition: -161dBm CNR: GPS receiver shall have CNR value range within 38 to 48 with signal input level of -130dBm at antenna. * GPS receiver sensitivity shall not be degraded by on board Wi-Fi and Bluetooth transmit signal. | |
| GPS Receiver Sensitivity (Radiated) | GPS sensitivity shall meet or exceed following criteria when tested in open sky. 2 Satellite SNR Values >= 45dB 2 Satellite SNR Values >= 42dB and <45dB | |
| Enhanced GPS Options | N/A | |
| Wireless Connectivity | | |
| Wi-Fi (Conducted Sensitivity) | Frequency Band <ul style="list-style-type: none"> 2.4 GHz Band Single TX and Single RX Support Wi-Fi B, G, N Minimum TX Power @ 2.4 GHz/MCS7: 14 dBm ± 1.5 dB Minimum RX Sensitivity @ 2.4 GHz, 20MHz <ul style="list-style-type: none"> 11 Mbps: -86 dBm 54 Mbps: -71 dBm 65 Mbps: -71 dBm Minimum Antenna Gain @ 2.4 GHz: 2 dBi | |
| Wi-Fi (Radiated Sensitivity) | <u>Wi-Fi Throughput</u> Channel 1: 15Mbps/ S Channel 2: 15Mbps/s Channel 11: 15Mbps/s * iperf SW tool and a Wi-Fi certified access point should be used for this test. * Test should be conducted in an open ground with minimum of distance separation of 10 meters * Test with UDP | |
| Bluetooth (Conducted Sensitivity) | <u>RX sensitivity:</u> GFSK: -70 dBm $\pi/4$ DQPSK: -70 dBm 8DPSK: -70 dBm <u>TX Power and RMS DEVm:</u> | |

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| | Minimum TX power: 0 dBm (Class 2) Maximum RMS DEVM: ≤ 0.20 ($\pi/4$ DQPSK) Maximum RMS DEVM: ≤ 0.20 (8DQPSK) * Bluetooth is used for data communication with other Bluetooth enabled devices. * Bluetooth circuit can be depopulated. * Bluetooth and Wi-Fi circuit will share the same antenna to reduce implementation cost. | |
| Bluetooth (Radiated Sensitivity) | Need to get measurements from Apical / targets from the chip vendor | |
| TMC | internal TMC receiver | |
| Audio | | |
| Microphone | N/A | |
| Audio Out | Unit shall have a 3.5mm audio jack | |
| Audio requirement | Speaker Minimum Rated Input Power: 2.0 Watts — same as speaker on 518s, scan SPL of 530 as criteria Impedance: 4 +/- 15% Ohm Audio Amplifier Output Power: 2 Watts at < 10% distortion, and <15% distortion at full volume. Speaker shall be mounted on the housing with screws, with sealed front/back isolation. Speaker Frequency Range: 200 Hz—20 kHz @ > 78 dB SPL(?) @ 0.5m (?) Yes, we should get an audio consultant to help us define the spec; | |
| Power And Reset | | |
| Power Input (Via USB port) | Input Voltage: 5V +/- 5% Maximum Input Current: 2A | |
| Low-power mode | Yes via OS control; auto-reduced backlight; | |
| Power Mode | TND540 shall support following power mode: <ul style="list-style-type: none"> • On • Low power mode (CPU running with screen off) <ul style="list-style-type: none"> ○ Unit shall enter "low power mode" from "On mode" after user press the power button; ○ Unit shall exit "low power mode" to "on mode" after user press the power button; | |

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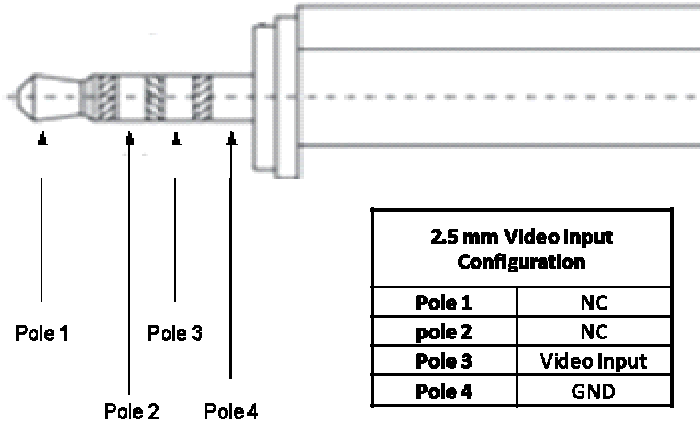
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| | <ul style="list-style-type: none"> • Suspended <ul style="list-style-type: none"> ○ Unit shall not enter "suspended mode" when there is external power; ○ Unit shall enter "Suspend mode" with following conditions after 1 min (Android default setting) <ul style="list-style-type: none"> ■ No external power to the unit ■ Truck navigation is not in active route • OFF <ul style="list-style-type: none"> ● Unit shall draw no more than 1mA of current from internal Li-ion battery when unit is in OFF state. | |
| OFF mode current consumption | | |
| Suspended mode current consumption | Unit shall draw no more than 10mA of current from internal battery when unit is in suspended mode. | |
| Auto Power ON / OFF | PND shall auto power ON when external power source is applied. PND shall sense when external power supply is removed and provide following two options to user: 1) Power OFF after 30 seconds Continue operate with battery with tap on screen within 30 second of external power removal. | |
| Reset | 2) Unit shall capable perform a hard reset that is equivalent to power on reset through external reset button or key combination. | |
| Unit External Ports | | |
| USB OTG | Unit shall have an USB 2.0 Mini-B Receptacle interface to be used for data transfer and power; Unit USB port shall support OTG function; | |
| SD | Micro SD | |
| Audio Output | 3.5mm Audio Out (Headphone output without MIC input) 3.5mm TRS Audio Pin Configuration: Tip: Left Audio Signal Ring: Right Audio Signal Sleeve: Ground | |
| Video Input External Connection (Not required for 540) | Unit shall support 2.5 mm video input plug with following pole configuration | N/A |

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| | <div></div> <div><table><tr><th colspan="2">2.5 mm Video Input Configuration</th></tr><tr><td>Pole 1</td><td>NC</td></tr><tr><td>Pole 2</td><td>NC</td></tr><tr><td>Pole 3</td><td>Video Input</td></tr><tr><td>Pole 4</td><td>GND</td></tr></table></div> | 2.5 mm Video Input Configuration | | Pole 1 | NC | Pole 2 | NC | Pole 3 | Video Input | Pole 4 | GND | |
|----------------------------------|--|----------------------------------|--|--------|----|--------|----|--------|-------------|--------|-----|--|
| 2.5 mm Video Input Configuration | | | | | | | | | | | | |
| Pole 1 | NC | | | | | | | | | | | |
| Pole 2 | NC | | | | | | | | | | | |
| Pole 3 | Video Input | | | | | | | | | | | |
| Pole 4 | GND | | | | | | | | | | | |
| Buttons & Indicators | | | | | | | | | | | | |
| Power Key | <div>Yes<ul style="list-style-type: none">HW shall support auto power-on when external power is applied.Activation force: 160 +/- 70 gfMinimum Power key life cycle 50000</div> | | | | | | | | | | | |
| Reset Button | <div>Yes<ul style="list-style-type: none">* Reset button is accessible via reset opening in the housing.</div> | | | | | | | | | | | |
| Volume Button | <div>Yes<ul style="list-style-type: none">Activation force: 160 +/- 70 gfMinimum Power key life cycle 50000</div> | | | | | | | | | | | |
| Home Button | <div>Yes<ul style="list-style-type: none">Activation force: 160 +/- 70 gfMinimum Power key life cycle 50000</div> | | | | | | | | | | | |
| Charging LED | <div>Dual color LED (Red and Green) to show different charging state.<ul style="list-style-type: none">Red (Unit is on but not powered)Orange (Unit is on with external power and battery is charging)Green (Unit is on with external power and battery is full)</div> | | | | | | | | | | | |
| Internal Battery Requirement | | | | | | | | | | | | |
| Battery Capacity | <div>Charge Cycle: 400 (85% DOD) Battery charging temperature: 0C to 45C ADD NTC ON BATT Between 45C and 60C: unit will be powered and keep running, but battery will not charge. Battery discharging temperature: -10C to 60C</div> | | | | | | | | | | | |

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| Battery Type/Size | Polymer Li-Ion | |
| Battery | ODM shall provide battery profile and compare with the battery vendor's data sheet Battery voltage V.S capacity table | |
| External Power Supply | | |
| 120V Power Supply For In Home Use (not a requirement for 540) | Input: 100 - 240 V Input frequency: 50/60 Hz Plug: U.S Output Voltage: 5 Volts +/- 5% Output Current: 2 Amps Output Plug Type: Mini-B Plug Minimum power cord length: 8" * 120V wall charger is not included in retail package for | N/A |
| 12V Power Cord With CLA | CLA shall meet following requirement: <ul style="list-style-type: none"> Output Voltage: 5 Volts +/- 5% (@ device input under load) Output Current: 2 Amps 8' length non-coil cord with Velcro-type wrap Power indicator light Right angle mini-USB interface per RM spec | |
| ESD Requirement | | |
| ESD | 4kV ESD contact discharge 8KV ESD over the air discharge | |

2.3.2 OS Requirement

| Description | OS Requirements | ODM Comments |
|-----------------------------|--|-----------------|
| OS and Platform Requirement | | |
| OS Version | Android 5.1 | |
| Device model number | TND540 | |
| OS Memory Partition | OS will have following memory partition: /boot 128MB /system 1GB /cache 512MB /data 12GB | |
| Unit serial number | Unit shall have follow serial number programed in the protected area of the flash memory; | |

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| | * Serial number shall not be erased after OTA, or flash * Flash tool for SN number modification Unit shall have SN number format described in "Serial Number & Product ID Master - 20170323.pdf" | |
| Unit MAC address | Unit shall have unique MAC address programed for Wi-Fi and BT module; | |
| OS release | ODM shall provide following OS version to RM during product development: <ul style="list-style-type: none"> User Mode Firmware User Debug Firmware Incremental OTA (User Debug) from previous development release to current Provide tools and components that allow modification to the /system partition and allow the creation of a system.img using the make_ext4fs tool. Provide tools and components to generate Full OTA after modifying the /system partition. All necessary software tools for flashing Release Notes document identifying version name & build number and all changes from previous release, listing JIRA IDs where applicable ODM shall provide following OS components to RM after first official release: <ul style="list-style-type: none"> User Mode Firmware User Debug Firmware Incremental OTA from <u>initial Production build</u> (User Mode) Provide tools and components that allow modification to the /system partition and allow the creation of a system.img using the make_ext4fs tool. Provide tools and components to generate Full OTA after modifying the /system partition. All necessary software tools for flashing Release Notes document identifying version name & build number and all changes from previous release, listing JIRA IDs where applicable | |
| Files to be supported | Should be basic in Aosp, below are the files required for the GPS: Shared libraries .so: Following audio files: wav, Following image files: png, Following other files: txt, ini, db | |
| Pre-loaded Apps | See Jira GTAB-178 Need to support web browser (see Jira for details on pre-loaded app) | |

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|---------------------|---|--|
| ADB SD Card logging | <p>Upon tablet boot, if there is an SD Card found and the card has a file named "DebugLogRecorder.ini" in the root folder, the OS will:</p> <ul style="list-style-type: none"> • If a folder named "logs" is not found in the root directory, a folder will be created named "logs" in the root directory. • If a folder named "logs" is present on the SD Card the OS will: <ul style="list-style-type: none"> ○ A new file will be created in the "logs" directory with the file name "<ModelNumber>_YYYY_MM_DD_HHMMSS_kmsg.txt". The "/proc/kmsg" will be written to this new file until the tablet shutdown. ○ A new file will be created in the "logs" directory with the file name "<ModelNumber>_YYYY_MM_DD_HHMMSS_logcat.txt". The "logcat -v time" will be written into this file until the tablet shutdown. ○ Each file will have the following naming rules: <ul style="list-style-type: none"> ■ ModelNumber = TND540 ■ YYYY = system clock Year. ■ MM = system clock Month. ■ HHMMSS = Hour, Minute and second from the system clock. | |
| ADB log services | <p>In Android's "Settings->Developer options" a new menu item must be added that will be called "Log services" with two sub items:</p> <ul style="list-style-type: none"> • "Enable Log Services" with a radio button that defaults to Off upon tablet boot. <ul style="list-style-type: none"> ○ Subheading "Log path: /mnt/sdcard/rmmsg" ○ When the radio button is turned on: <ul style="list-style-type: none"> ■ The OS will create a folder "/mnt/sdcard/rmmsg" if it does not exist. ■ If the "/mnt/sdcard/rmmsg" folder exists, a new file will be created in that directory with the file name "<ModelNumber>_YYYY_MM_DD_HHMMSS_kmsg.txt". The "/proc/kmsg" will be written to this new file until the radio button is turned Off or the tablet is shutdown. ■ If the "/mnt/sdcard/rmmsg" folder exists, a new file will be created in that directory with the file name | |

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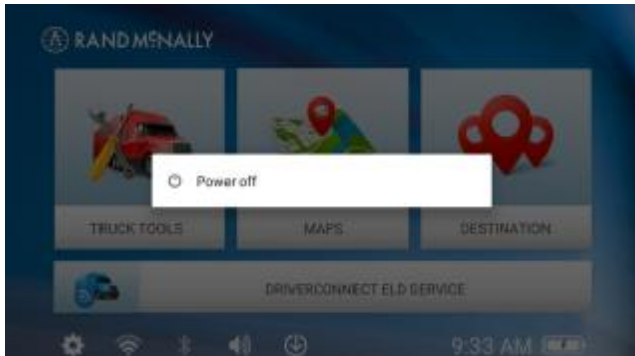
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| | <p>"<ModelNumber>_YYYY_MM_DD_HHMMS S_logcat.txt". The "logcat -v time" will be written to this new file until the radio button is turned Off or the tablet is shutdown.</p> <ul style="list-style-type: none"> ○ If the radio button is turned off: <ul style="list-style-type: none"> ■ The OS will stop logging to the "<ModelNumber>_YYYY_MM_DD_HHMMS S_kmsg.txt" and "<ModelNumber>_YYYY_MM_DD_HHMMS S_logcat.txt" files. ● "Erase all Log Services" <ul style="list-style-type: none"> ○ If the "Enable Log Services" radio button is off, the "Erase all Log Services" will display the subheading of "Click to erase all log messages." <ul style="list-style-type: none"> ■ When clicked the OS will erase all files in the "/mnt/sdcard/rmmsg" folder or do nothing if the folder does not exist. ○ If the "Enable Log Services" radio button is On, the "Erase all Log Services" will be greyed out and will display subheading "Log services recording, please disable log services first" | |
| Hard Keys | | |
| Power button | <p>Unit shall start normal power up process after user press the power button 2s in OFF mode; FROM SUSPEND TO WAKE UP TAKES 2 sec. Unit shall start normal power down process after user press the power button "2"s in ON or Suspended mode;</p> <ul style="list-style-type: none"> ● Short Press will turn off screen, device is still working in the background ● Pressing and holding the power button for 2 seconds will initiate powering up sequence (see reference image below) ● Pressing and holding the power button while the device is on, will prompt the Power off screen to appear wherever the user is within the device <ul style="list-style-type: none"> ○ Pressing within the white Power off pop up screen will power down the device ○ Pressing anywhere outside the white Power off screen will remove the Power off screen and allow the user to resume where they left off using the device | |

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| | <div></div> <ul style="list-style-type: none">● Long press on Power will shut down the unit after 1min (to be confirmed) | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|--|------------|------------|---------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|-------------------|--------|------------------|--|
| Volume Up / Down | <ul style="list-style-type: none">● Volume button - will have" –" & "+" keys: Pressing + will increase volume,● Pressing – will decrease volume● Pressing and holding down on " –" & "+" will continue to decrease or increase volume until max setting is reached● # of volume steps = 10 with follow spacing <table><tr><th>Volume Key</th><th>Max Volume</th></tr><tr><td>Step 10</td><td>95% of Max Volume</td></tr><tr><td>Step 9</td><td>90% of Max Volume</td></tr><tr><td>Step 8</td><td>85% of Max Volume</td></tr><tr><td>Step 7</td><td>80% of Max Volume</td></tr><tr><td>Step 6</td><td>75% of Max Volume</td></tr><tr><td>Step 5</td><td>60% of Max Volume</td></tr><tr><td>Step 4</td><td>45% of Max Volume</td></tr><tr><td>Step 3</td><td>30% of Max Volume</td></tr><tr><td>Step 2</td><td>15% of Max Volume</td></tr><tr><td>Step 1</td><td>0% of Max Volume</td></tr></table> | Volume Key | Max Volume | Step 10 | 95% of Max Volume | Step 9 | 90% of Max Volume | Step 8 | 85% of Max Volume | Step 7 | 80% of Max Volume | Step 6 | 75% of Max Volume | Step 5 | 60% of Max Volume | Step 4 | 45% of Max Volume | Step 3 | 30% of Max Volume | Step 2 | 15% of Max Volume | Step 1 | 0% of Max Volume | |
| Volume Key | Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 10 | 95% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 9 | 90% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 8 | 85% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 7 | 80% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 6 | 75% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 5 | 60% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 4 | 45% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 3 | 30% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 2 | 15% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Step 1 | 0% of Max Volume | | | | | | | | | | | | | | | | | | | | | | | |
| Boot-loader Factory Reset | <p>Volume + / Power will open the Bootloader menu when device is off. Menu will allow user to go into:</p> <ul style="list-style-type: none">● fastboot mode,● boot normally (by default) or● Factory Reset - boot in recovery mode. <p>After 90sec, the system will boot normally unless the user change the</p> | | | | | | | | | | | | | | | | | | | | | | | |

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| | selection. | |
| Other Combinations | Volume - & Power will take a screenshot when device is on. Screenshots are saved on the internal storage. | |
| Home button | <p>Home button – Selecting the Home button will always return the user back to the Home page (referenced below) regardless where the user is within the device</p>  | |
| OS Bootstrap | | |
| Splash screen | <p>Unit shall display Rand McNally Logo page while loading then following power up reveal the Home page (shown below)</p>  | |
| Boot up time | Unit shall display RM splash screen within 4s from the moment user press the power button. | |
| Power Management | | |

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| OS Power Management | <p>When the tablet off and not connected to external power, the OS shall turn on the unit when user press the power key when the battery level is above 5%;</p> <p>If the battery level is at or below 5%, the tablet will:</p> <ol style="list-style-type: none"> 1) If the tablet is currently ON and connected to an external power supply, do nothing. 2) If the tablet is currently ON and not connected to an external power supply, power off the tablet. 3) If the tablet is currently OFF and not connected to an external power supply, do not allow the user to power on the tablet via the power button. 4) If the tablet is currently OFF and and an external power supply is connected, automatically power on the tablet. | |
| USB Interface Requirement | | |
| USB ID | ORIGINAL PID/VID | |
| Default USB mode | If unit's battery < 15%, and connected to power via USB, then set backlight to 50%, and to be determined what other things can be turned off. | |
| USB PC Connection Procedure | Enable MTP by default | |
| USB connector | Mini USB with OTG function | |
| Flash Driver - SD Card | | |
| Flash Driver | <p>Drive name for flash will be custom name Shows both iNand and external SD if card is in slot.</p> <p>Note: Default OS behavior in Android 5.1 is supported by our software without any customization. For Android >= 6.0, external sd card should default to "Portable Mode".</p> | |
| Wi-Fi Encryption | | |
| Wi-Fi encryption supported | <p>Wi-Fi module shall supporting following encryption methods</p> <ul style="list-style-type: none"> • WEP • WPA • WPA2 | |

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| | <ul style="list-style-type: none"> o TKIP o AES • EAP <ul style="list-style-type: none"> o LEAP o PEAP | |
| BT Profiles | | |
| Bluetooth profiles supported | Bluetooth Core Specification Version 4.0 Bluetooth Power Class 2 Bluetooth Profiles: <ul style="list-style-type: none"> • RFCOMM 1.1 • AVDTP 1.2 • AVCTP 1.4 • GAVDP 1.2 • HFP 1.6 • A2DP 1.2 • AVRCP 1.5 • OPP 1.1 • SPP 1.2 | |
| OS Customization | | |
| | <ol style="list-style-type: none"> 1. The OS must not include Google Mobile Services 2. The OS shall use a common Release certificate and keystore, which will be shared between RM and ODM 3. The OS shall include multiple apps, provided by RM, to be preinstalled in the system partition. <u>The list of apps may change during development</u>; following is an initial set: <ol style="list-style-type: none"> 3.1 RMS (RM Services) 3.2 RM Launcher (should be used as the default launcher/Home in the OS) 3.3 RM Setup (onboarding & user-settings) 3.4 GPS app 4. The OS shall have the Android statusbar disabled and hidden at all times. <ol style="list-style-type: none"> 4.1 Android notifications should not be visible or accessible to the user 5. The OS shall have the Recent Apps button in the Android navbar hidden at all times. 6. To support RM's initial user-setup software ("onboarding"), the OS shall broadcast the intent "android.intent.action.BOOT_COMPLETED" in the following scenarios: <ol style="list-style-type: none"> 6.1 First boot out of the box | 9. |

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| | 6.2 First boot after firmware flash 6.3 First boot after Factory Reset 7. The OS shall support a custom storage partition for storing navigation map data (the "Navi partition"). The Navi partition should meet the following requirements: 7.1 The partition size should be 7GB; (Requirement is captured in CELT-167; 7.2 The partition must be mounted and accessible via the path "/sdcard/.Navi" (note: hidden folder) 7.3 The partition must not be erased during a Factory Reset 7.4 The partition must not be erased during an OTA update 7.5 The partition must not be erased during a firmware flash (to be discussed if not feasible) 7.6 The partition must support read & write access over MTP USB connection to desktop. 7.7 The partition must support read & write access from any app running on the device, as long as the app was signed and pre-installed to have system-level privileges or the app's manifest declares the permission to access the path "/sdcard/. Navi " 7.8 The navigation map data provided by RM should be preloaded into the Navi partition during manufacturing. 8. The "cache" partition should be large enough to hold a Full OTA package, to allow future OS updates to be downloaded and installed via RMS (using Android Recovery). | |
| System Settings | | |
| Default System Settings | 1. The following device system settings will be made enabled and made accessible 1.1 Wireless & Networks 1.1.1 WiFi 1.1.2 Bluetooth 1.2 Device 1.2.1 Display 1.2.2 Storage & USB 1.2.3 Battery 1.3 System 1.3.1 Date & Time o Default time zone GMT - 6 1.3.2 About Tablet | |

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| | <ol style="list-style-type: none"> 2. Full / All device system settings will be made available to the user through an unlock code <ol style="list-style-type: none"> 2.1 System -> About Tablet -> Model Number: Selecting Model Number seven times will enable all system settings 2.2 Selecting Model Number again seven times will disable the feature and revert back to the defaulted system settings as outlined in requirement 1 3. Developer Options will be made available to the user through an unlock code <ol style="list-style-type: none"> 3.1 System -> About Tablet -> Build number: Selecting Build Number seven times will enable the user to become a developer and allow full access to all settings and options 3.2 Selecting Build Number again seven times will disable the developer feature and revert back to no longer displaying this feature | |
| OS Update | | |
| | <ol style="list-style-type: none"> 1. The system's firmware should be updatable via microSD card, without requiring USB connection to a desktop/laptop computer. 2. The system must support the native Android functionality to apply an OTA package via Recovery Mode. | |
| Minimum Requirements if No Wifi or BT | | |
| | <p>If a lower tier product TND535 is required in the future (not planned as of March 2017),</p> <ul style="list-style-type: none"> • it will achieved by disabling "connected services", i.e. Live Traffic, Weather and Fuel prices. Disabling implies these features will not show up as options available within the product. • Hardware will still be the same as TND 540 • DriverConnect pre-load in configuration is TBD | |

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2.3.3 Mechanical Requirement

| Description | TND540 Mechanical Specification |
|---------------------------|--|
| Environmental requirement | See section 4.0 for spec |
| HALT Testing | Standard RM HALT procedure. (See RM QA test procedure) |
| Unit Logo Requirement | Rand McNally logo, with UV coating Meeting ASTM F2357 - RCA abrasion testing. |
| Sun Shield | |
| Sun Shield | N/A |
| Dash Mount | |
| Dash Mount | PND shall provide a dash mount option. |

2.3.4 Device Appearance Requirement *(Need update)*

2.3.4.1 Device ID requirement


RM shall provide ID design file. Following are the ID concept front, back and side views.

- black Bezel
- no texture on the side walls - just soft touch paint
- no dot-pattern on the back housing - just soft touch paint
- *enlarge the vent holes "bar design"*
- *Need to add "logo" in the front.*

2.3.4.1 ID Rendering

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2.3.4.2 Housing marking, CMF, and label requirement

A number of engraved markings will be required on the housing. These markings can be grouped into two categories:

a) Markings to visualize functionalities:

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| USB | Memory card | Reset | On/Off | Home Button | Volume |
|--------------------|-------------------|--------------------|----------------------|---------------------|-----------------------------|
| USB logo | micro SD logo | Reset | Power on/off logo | Home logo | Volume - and Volume + logos |
| Next to USB socket | Next to SD socket | Next to reset hole | Next to Power button | Next to Home button | Either side of the volume |

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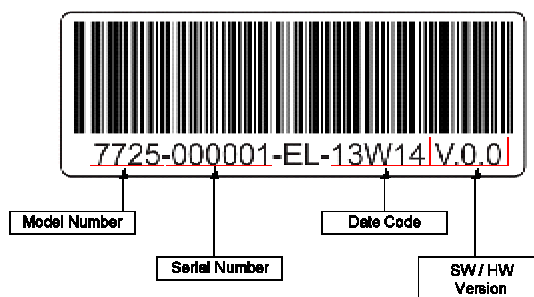
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| | | | | | rocker button as shown |
|--|--|--|--|--|---------------------------|

b) Device label

Unit shall have following labels at the bottom edge of the unit.

- 1) Each unit shall have a serial number label that indicates RM product model number, unique serial number
 - a. All pre-production units shall use alphabet to indicate HW and SW versions. For example: V.A.A



(Example unit serial number label) - This will NOT be used in production units

- 2) Each unit shall have a device label with following information:


- Rand McNally name and logo
- Rand McNally product model name and number
- ~~Canada 310 compliance logo~~
- FCC compliance logo
- ~~RoHS compliance logo~~
- Country of origin



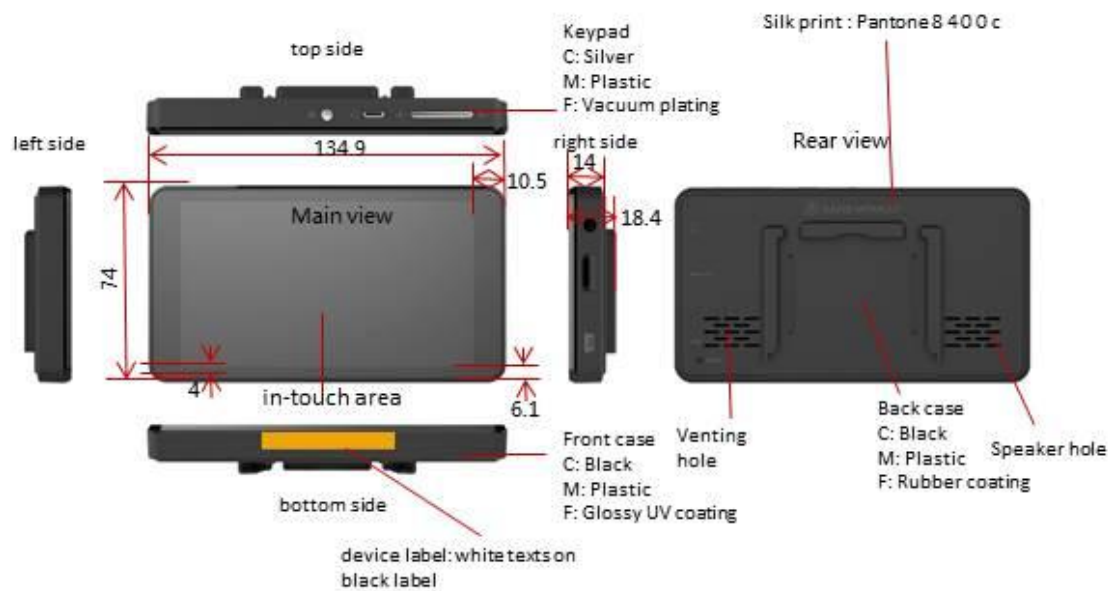
(Example Device Label)

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b) Device CMF



3 CONFORMANCE REQUIREMENTS

3.1 Design and Construction

3.1.1 Flammability & Safety Requirements


All materials, components, and interconnect wire and cable used in the construction of products shall meet the flammability and electrical safety requirements defined in UL 60950. PCBs shall have a flammability rating of V94. AC supply conductors shall be color-coded black and white for line and neutral conductors, respectively. DC supply conductors shall be color-coded red and black for plus and minus polarity, respectively.

3.1.2 Fasteners and Hardware

All screws and fasteners for attachment hardware shall be of corrosion resistant steel. All attachments shall conform to Unified American Standard (UNF) thread forms. No special tooling shall be required for the assembly or service of the system.

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3.1.3 *Seals and Gaskets*

Not applicable.

3.1.4 *Corrosion Protection*

Not applicable.

3.1.5 *Reliability*

TBD

3.2 *General Test Requirements*

Unless specified otherwise, the following requirements shall apply to all tests.

3.2.1 *Ambient Conditions*

Ambient conditions including room temperature and humidity are defined as from 18 to 28 °C @ 50% relative humidity.

3.2.2 *Accuracy and Calibration*

The accuracy of test conditions shall be $\pm 1\%$ for voltage, frequency, time, torque, and distance. Accuracy of temperature shall be $\pm 2^\circ \text{C}$ and the accuracy of humidity and pressure shall be $\pm 5\%$. Calibration of lab instruments is usually performed on an 'as need' basis. The calibration of test equipment and the resultant accuracy thereof is the responsibility of the test laboratory or test engineer.

3.2.3 *Samples*


Sample size for a given product may vary depending on product maturity and availability. Recommended minimum sample sizes for singular environmental tests is 5 and for combined, endurance or stress tests is a minimum of 7. It is required that ALL samples be inspected before and after test. Where deviations in sample size are required, there shall be mutual agreement between the design engineer and test engineer prior to test. Test samples shall be randomly selected and allocated for tests. Each sample shall be permanently identified with a unique unit under test (UUT) sample number. Acceptable methods of marking shall be permanent markers, etching, labels, or tags.

3.2.4 *Sample Inspection*

Without exception, all test samples shall be inspected for conformance to engineering documentation including drawings/schematics, compliance with workmanship and material standards or specifications.

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3.2.5 Acceptance Test Criteria

The following criteria in accordance with IEC 1000-4-x and EN 50082-1 shall be used for determination of product acceptance to the requirements defined herein.

- A Normal performance within specified limits
- B Temporary degradation in performance or loss of function which is self-recoverable
- C Temporary degradation in performance or loss of function that requires operator intervention or system reset.
- D Degradation or loss of function that is not recoverable due to damage of equipment (components) or software, or loss of data. No unsafe condition permitted.

3.2.6 Test Reports

Subsequent to the completion of the test, a detailed test report summarizing the results obtained shall be generated. The test report shall include executive summary including a list or reference to test requirements, list of deviations or exceptions to these requirements, sample description and identification, test setup, and any limitations of the test.

- ODM shall provide HW test report per RM requirement for all development phase;
 - P1 5 units
 - P2 5 units
- ODM shall provide OS regression test report per RM requirement for all official OS release;
- ODM shall provide all environmental test report conducted on the final HW version;

4 Environmental Conditions

4.1 Thermal Requirements

The thermal requirements for TND540 specified herein are adapted from the Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests (MIL-STD-810F).

4.1.1 Operating Temperature


The product shall operate in accordance with this specification before, during and after exposure to temperatures ranging from -10°C to $+60^{\circ}\text{C}$. **A total of 5 units shall be used for this test.**

4.1.2 Survival Temperature

Not applicable

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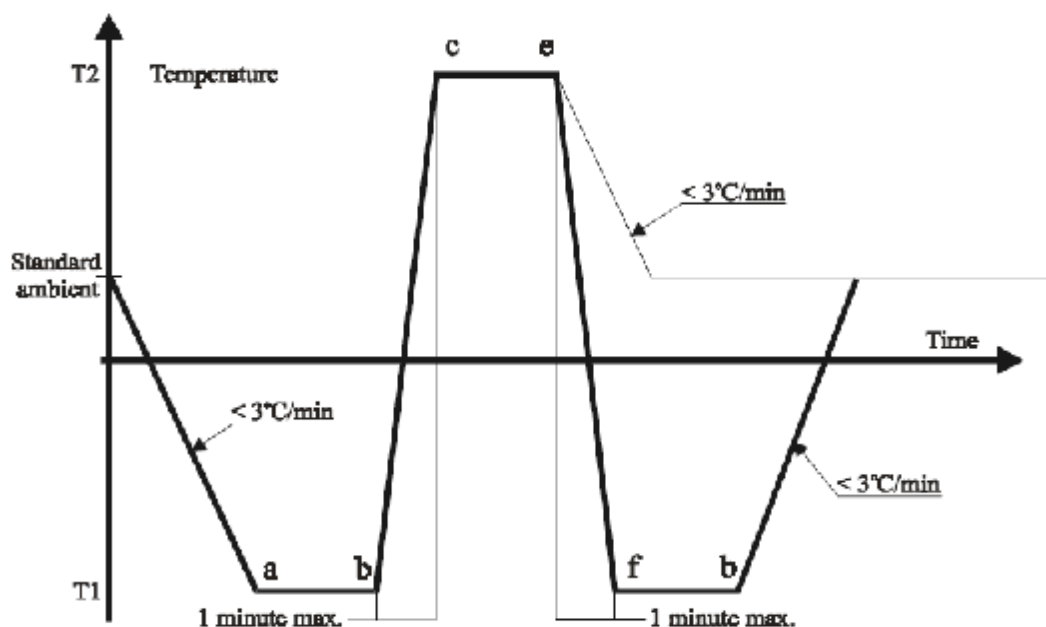
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4.1.3 Storage Temperature

The product shall not be damaged and perform in accordance with this specification after exposure to storage temperatures ranging from -30°C to $+80^{\circ}\text{C}$ for 48 hours. A total of 5 units shall be used for this test.

4.1.4 Thermal Shock

The product shall perform in accordance with this specification before and after exposure to accelerated thermal shock. The unit shall be subjected to 24-hour 3 thermal shock cycles in accordance with figure 503.4-1 of MIL-STD_810F and figure below. A total of 2 units shall be used for this test.




Notes:

1. $T_1 = -10^{\circ}\text{C}$
2. $T_2 = +60^{\circ}\text{C}$
3. Time duration from a to b: 2 hours
4. Time duration form c to 2: 2 hours
5. Time duration from f to b: 2 hours

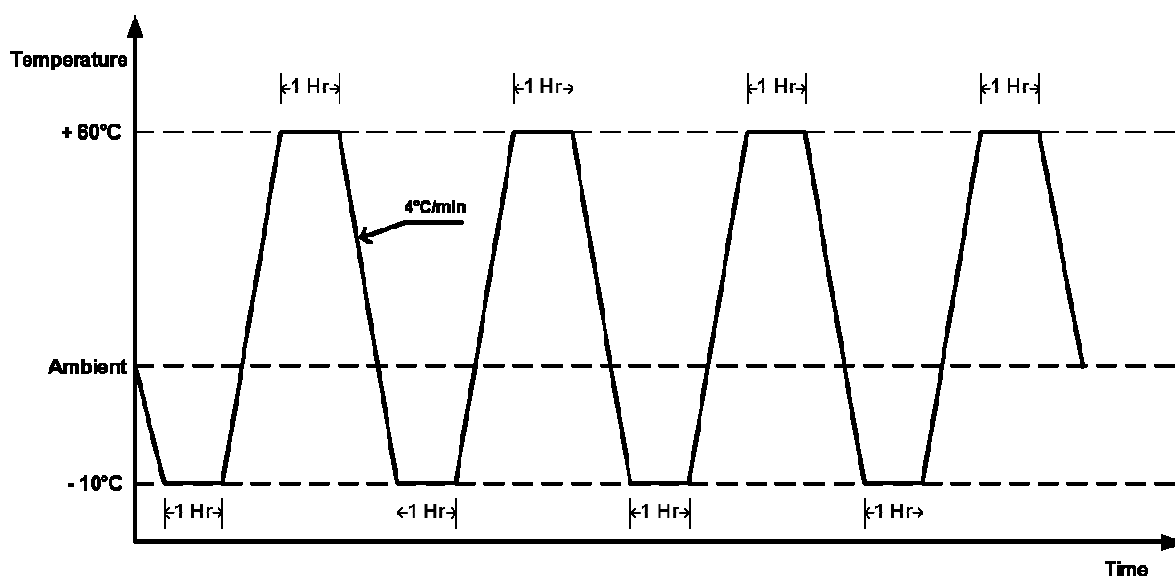
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4.1.5 Thermal Cycle

The product shall perform in accordance with this specification before, during and after thermal cycle according to following requirement. A total of 5 units shall be used for this test.




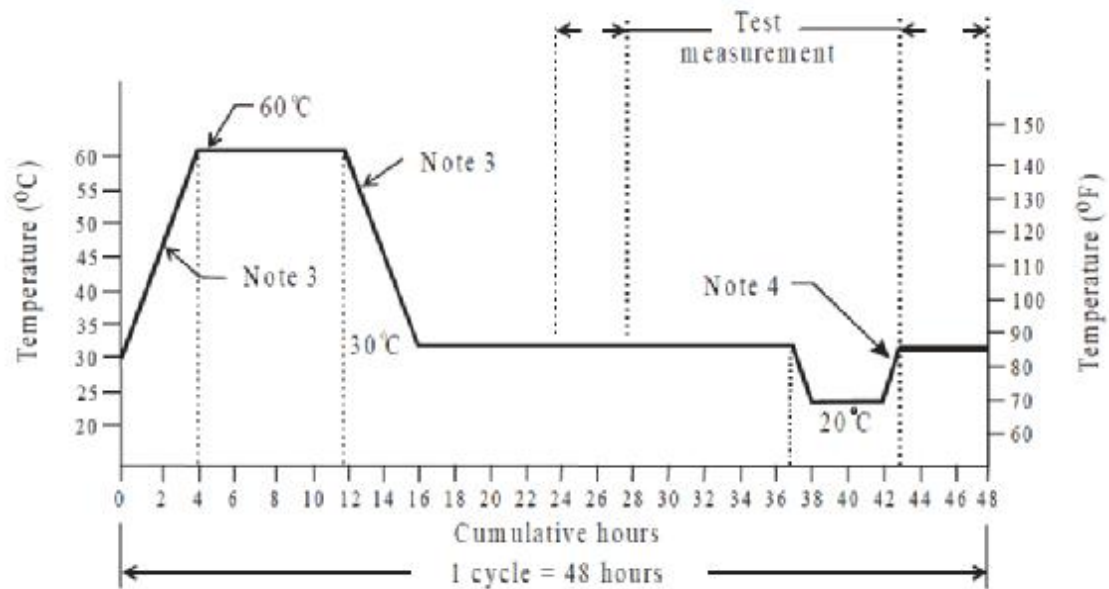
4.1.6 Relative Humidity

The product shall perform in accordance with this specification before, during and after exposure to $95 \pm 4\%$ relative humidity (non-condensing). The unit shall be subjected to the 48-hour humidity cycle in accordance with figure 507.4-1 of MIL-STD-810F and figure below. The unit shall be operated throughout the humidity cycle. A total of 5 units shall be used for this test.

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- NOTES:
1. During temperature change, use a tolerance of not greater than 3°C.
 2. Maintain the relative humidity at 95 r4% at all times except that during the descending temperature periods the relative humidity may drop to as low as 85%.
 3. Use a rate of temperature change between 30 and 60°C of not less than 8°C per hour.
 4. Do not use a temperature increase in this portion of the curve that is less than 10°C per hour.

4.2 Moisture and Contaminates

Not applicable.

4.2.1 Rod Entry

Not applicable.

4.2.2 Drip


Not applicable.

4.2.3 Rust Resistance

Not applicable

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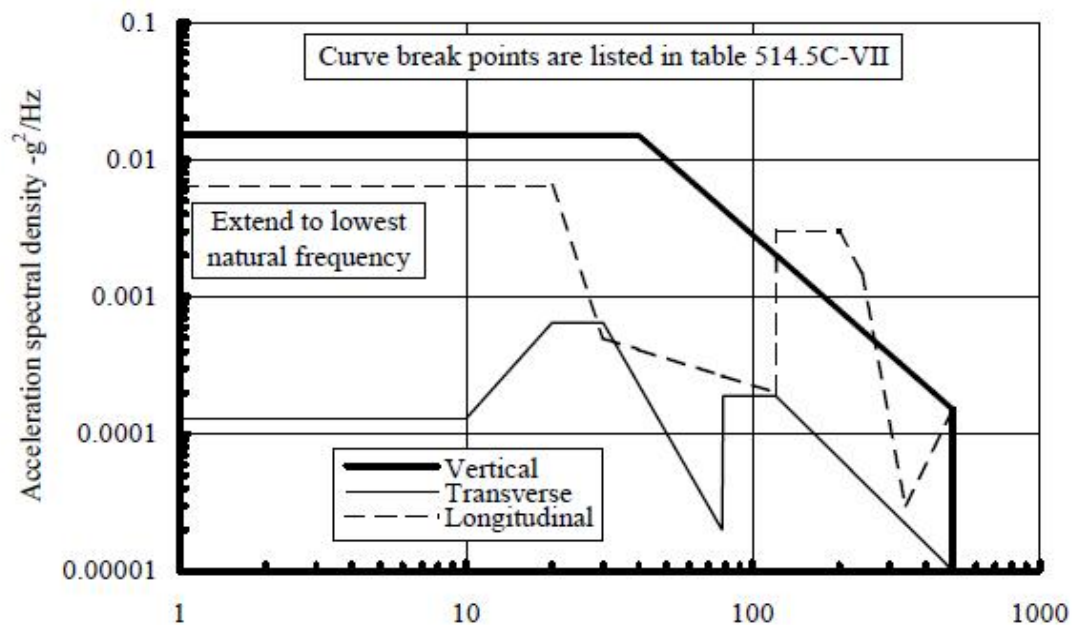
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4.3 Mechanical Environment

The random vibration requirement for the TND540 are derived from MIL-STD-810F. The operating and operational shock requirements for TND540 are derived from MIL-STD-202F and ASTM D 5276, respectively.


4.3.1 Random Vibration

The product shall operate in accordance with this specification before, during and after exposure PSD profile defined by MIL-STD-810F. A total of 2 units shall be used for this test.



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| U. S. highway truck vibration exposures figure 514.5C-1 | | | | | |
|--|----------|-------------|----------|--------------|----------|
| vertical | | transverse | | longitudinal | |
| Hz | g^2/Hz | Hz | g^2/Hz | Hz | g^2/Hz |
| 10 | 0.01500 | 10 | 0.00013 | 10 | 0.00650 |
| 40 | 0.01500 | 20 | 0.00065 | 20 | 0.00650 |
| 500 | 0.00015 | 30 | 0.00065 | 120 | 0.00020 |
| 1.04 g rms | | 78 | 0.00002 | 121 | 0.00300 |
| | | 79 | 0.00019 | 200 | 0.00300 |
| | | 120 | 0.00019 | 240 | 0.00150 |
| | | 500 | 0.00001 | 340 | 0.00003 |
| | | 0.204 g rms | | 500 | 0.00015 |
| | | | | 0.740 g rms | |


4.3.2 Operational Shock

The product shall operate in accordance with this specification before and after exposure to the shock test defined in MIL-STD-202G Method 213B (test condition A). This test shall be performed using a half-sine pulse of 50 g's (peak) for duration of 11 ms. Three shocks in each direction shall be applied along each of the three mutually perpendicular axes of the unit for a total of 18 shocks. The unit shall be verified to be operating properly before and after the test. The unit shall also be inspected for damage and mechanical fatigue at the conclusion of the test. A total of 2 units shall be used for this test.

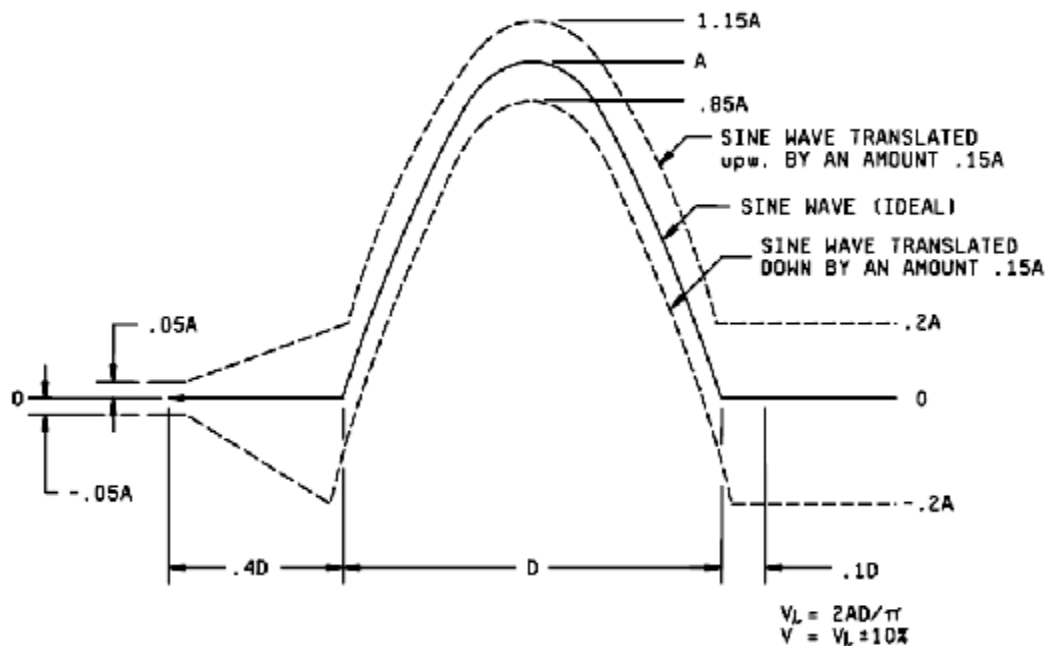
| Test condition | Peak value (g's) | Normal duration (D) (ms) | Waveform | Velocity change (V _i) ft/sec |
|----------------|------------------|--------------------------|------------------------------------|--|
| A | 50 | 11 | Half-sine | 11.3 |
| B | 75 | 6 | Half-sine | 9.2 |
| C | 100 | 6 | Half-sine | 12.3 |
| D | 500 | 1 | Half-sine $\frac{1}{2}/\frac{3}{}$ | 10.2 |
| E | 1,000 | 0.5 | Half-sine $\frac{1}{2}/\frac{3}{}$ | 10.2 |
| F | 1,500 | 0.5 | Half-sine $\frac{1}{2}/\frac{3}{}$ | 15.4 |
| G | 50 | 11 | Sawtooth $\frac{2}{}$ | 8.8 |
| H | 75 | 6 | Sawtooth $\frac{2}{}$ | 7.2 |
| I | 100 | 6 | Sawtooth $\frac{2}{}$ | 9.7 |
| J | 30 | 11 | Half-sine | 6.8 |
| K | 30 | 11 | Sawtooth | 5.3 |

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The half-sine pulse shall meet following profile specified in MIL-STD-202G.



4.3.3 Transport Shock

The product shall perform in accordance with this specification after exposure to the *Standard Test Method for Drop Test of Loaded Containers by Free Fall* (ASTM D 5276, A2.2.4). The test shall be performed with the unit packaged for shipment. A total of 2 packages shall be used for this test.


Note: A2.2.4 Twenty-six drop cycle – Drop the test package on each flat face, edge and corner.

4.3.4 Drop Requirement

The product shall perform in accordance with this specification and no visible damage after 1 meter drop on to a level concrete surface one time each of the three mutually perpendicular planes (three drops total). A total of 2 units shall be used for this test.

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4.4 Electromagnetic Compatibility

Not applicable.

4.4.1 Power Transients

Not applicable.

4.4.2 Coupled Transients

Not applicable.

4.4.3 Conducted Immunity

Not applicable.

4.4.4 Bulk Current Injection

Not applicable.

4.4.5 Radiated Immunity

Not applicable.

4.4.6 Magnetic Field Immunity

Not applicable.

4.4.7 Conducted Emissions

Not applicable.

4.4.8 Radiated Emissions


See section 4.5 for regulatory requirement.

4.4.9 Electrostatic Discharge

See section 2.2 for ESD requirement.

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4.5 Regulatory Compliance

4.5.1 FCC Certification

TND540 shall comply with Part 15 of the FCC Code of Federal Regulations – Telecommunication (CFR 47) for a class B digital device and Intentional radiator.

TND540 shall comply with Canada Radio Radio Standard Specification RSS-210, Licence-Exempt Radio Apparatus: Category II Equipment.

4.5.2 RoHS

TND540 shall comply with *Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment*.

4.5.3 Energy Star

External wall power supply shall meet Energy Star program efficiency level IV requirement. External wall power supply will not be included in retail package, and can be purchased as an aftermarket accessory.

4.5.4 Prop 65

Not required. We will add a warning in the Quick Start Guide.

4.5.5 UL Requirement

Polymer Li-Ion battery used for TND540 shall have UL certification (UL1642 and UL2054) and pass mandatory UN Transportation Tests for lithium-ion batteries (UN 38.3).

[Polymer Li-ion battery used for TND540 shall have all necessary documents that support WERCS CERT.](#)

4.5.6 Bluetooth Certification

Bluetooth module used for TND 540 shall pass all qualification tests that are mandated by Bluetooth SIG. Vendor shall provide QDID to Rand McNally.

5


REFERENCES

The following listed documents of the latest issue form a part of this document. If no date is given, the most current date is applicable. In the event of conflict between the documents referenced herein and the contents of this document, the contents of this document are considered a superseding requirement.

1. Code of Federal Regulations - Telecommunication; FCC CFR 47; 1995.

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2. RSS-Gen — General Requirements for Compliance of Radio Apparatus; Issue 4; November 13, 2014
 - <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08449.html#s8.4>
3. Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests (MIL-STD-810F).
4. Test Method Standard Electronics and Electrical Component Parts (MIL-STD-202G).
5. Acceptability of Electronic Assemblies; IPC-A-610B; ANSI; Jan 96.
6. Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems; EIA-485; April 1983.
7. Sampling Procedures and Tables for Inspection by Attributes; ANSI/ASQC Z1.4-1993.
8. Methods of Measurement of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz; ANSI C63.4; 1992.
9. Military Handbook – Reliability Prediction of Electronic Equipment; MIL-HDBK-217F; 2 Dec 91.

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ACRONYMS

| | |
|------|---------------------------------------|
| A | Ampere |
| ANSI | American National Standards Institute |
| AQL | Acceptable Quality Level |
| AR | Acrylic |
| ATP | Acceptance Test Procedure |
| AVL | Approved Vendors List |
| BOM | Bill of Materials |
| CPU | Central Processing Unit |
| DC | Direct Current |
| ECO | Engineering Change Order |
| EIA | Electronic Industries Alliance |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| ESS | Environmental Stress Screening |
| FCC | Federal Communications Commission |
| FVT | Functional Verification Test |
| ESD | Electro-Static Discharge |
| FFK | Fixed Function Key |
| FPC | Flex Printed Circuit |
| GB | Giga Byte |
| GPS | Global Positioning System |
| I/O | Input-Output |
| ICD | Interface Control Document |
| ICT | In-Circuit Test |
| ISO | Industries Standards Organization |
| LAN | Local Area Network |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| mA | Milli-Amp |
| MB | Mega-Byte |
| MTBF | Mean Time Between Failure |
| NA | Not Applicable |
| NDA | Non-Disclosure Agreement |
| OEM | Original Equipment Manufacturer |
| PCB | Printed Circuit Board |
| PCBA | Printed Circuit Board Assembly |
| PFS | Product Functional Specification |
| PFK | Programmable Function Key |

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| | |
|------|---|
| PN | Part Number |
| POST | Power On Self Test |
| PRD | Prototype Requirements Document |
| QA | Quality Assurance |
| QTP | Qualification Test Plan |
| QTR | Qualification Test Report |
| RAM | Random Access Memory |
| RF | Radio Frequency |
| RoHS | Restriction of Hazardous Substances |
| SAE | Society of Automotive Engineers |
| SN | Serial Number |
| SOP | Standard Operating Procedure |
| SRU | Shop Replaceable Unit |
| SSD | Solid State Drive |
| TBD | To Be Determined |
| UL | Underwriters Laboratory |
| USB | Universal Serial Bus |
| UUT | Unit Under Test |
| VDC | Volts, Direct Current |
| VESA | Vehicle Electronics Standards Association |
| VGA | Video Graphics Adapter |
| WLAN | Wireless Local Area Network |

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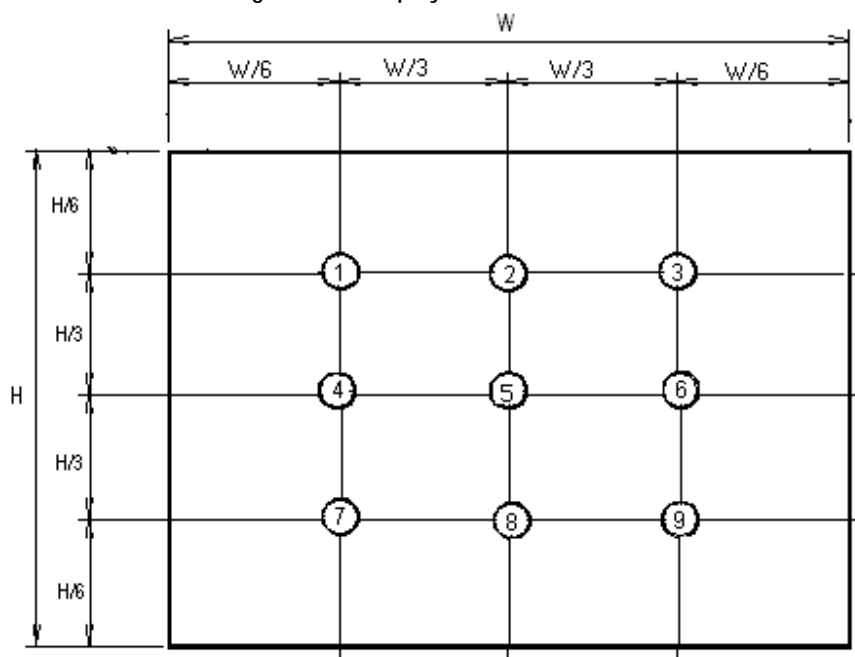
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Notes

7.1 Display Brightness and Uniformity

The methods of testing backlight brightness (luminance) and uniformity are defined below. Measurements shall be performed with a full white pattern on the display using a (TBD) Luminance Meter (Model xxxxx or equivalent). The display should be operating for at least 10 minutes prior to test to ensure stability of the backlight and stray light on the display or into the luminance meter should be avoided.

Figure 7.1 – Display Measurement Points




7.1.1 Brightness

Brightness or luminance is determined using the 5-spot method. This consists of measuring the luminance perpendicular to the screen at 5 specific points (P1, P3, P5, P7, P9). The average of three measurements at each point will be combined and divided by the number of points to obtain the average brightness. This value should be equal to or greater than 343 nits as specified herein.

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7.1.2 Uniformity

Uniformity is determined using the 5-spot method. This consists of measuring the luminance perpendicular to the screen at 5 specific points (P1, P3, P5, P7, P9) and dividing the highest measurement by the lowest measurement. This value should be equal to or less than 1.2 as specified herein.

FCC Statement:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The highest SAR value reported under this standard during product certification for use at the when properly worn the the body is 0.219W/kg, This device was tested for typical body-worn operations. To comply with RF exposure requirements, a minimum separation distance of 0 cm. must be maintained between the user's body and the interphone, including the antenna. Third-party belt-clips, holsters and similar accessories used by this device should not contain any metallic components. Body-worn accessories that do not meet these requirements may not comply with RF exposure requirements and should be avoided.

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