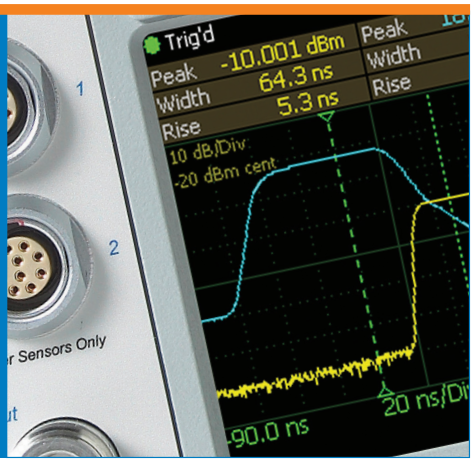
Boonton

Data Sheet

4540 Series
RF Power Meter



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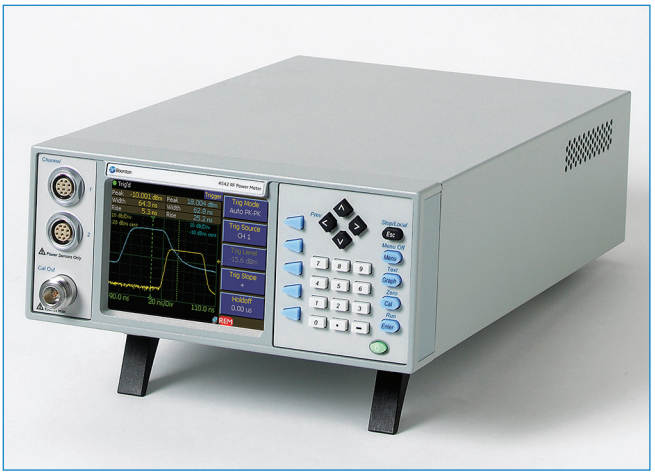
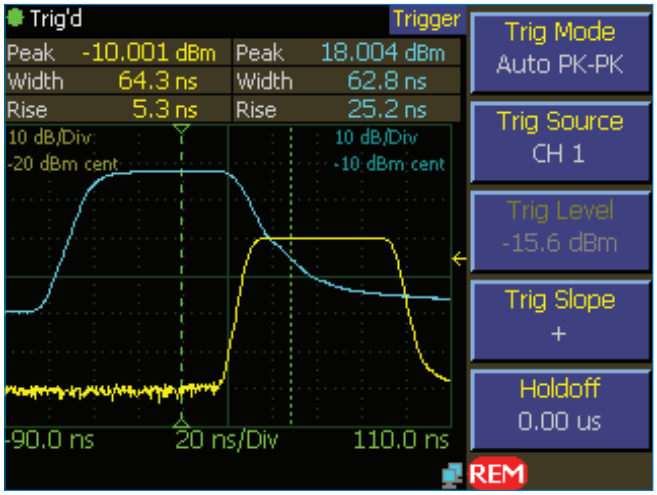
Taking performance to a new peak

4540 Series RF Power Meter

The Boonton 4540 Series RF Power Meter is the instrument of choice for capturing, displaying and analyzing RF signals. Applications include pulsed RF signals like RADAR or GSM based technologies, as well as pseudorandom, noise-like signals such as CDMA, EVDO, WLAN, WiMAX, UMTS, HSPA, LTE, OFDM or HDTV. The 4540 Series offers Pulse, Modulated/CW, and Statistical operating modes, making it well suited for all requirements of R&D, manufacturing and control operations. Single channel versions (4541) and dual channel versions (4542) are available.



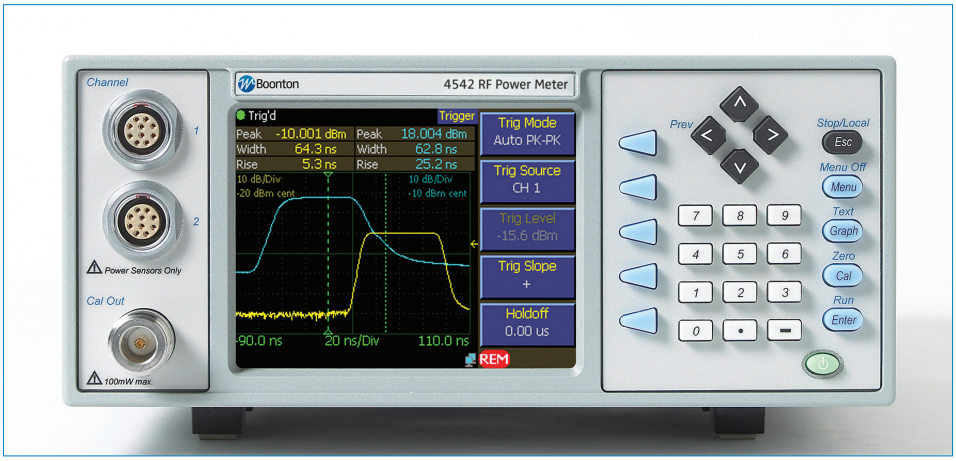


Both 4541 and 4542 power meters command powerful pulse recognition and analysis systems. Parameters like pulse-width, rise time, fall time, power distribution and many others are automatically detected, measured and presented.

Features

- 200 ps time resolution
- 7 ns rise time
- Video bandwidth up to 70 MHz
- 17 default presets plus storage for 25 user defined presets
- Fast statistical analysis including CCDF
- Text view of up to 14 out of 28 parameters per channel simultaneously (power / voltage, time, statistics, channel math)
- Bright, clear 4'' color LCD display
- GPIB, LAN, USB device (B-type connector) interfaces
- High bandwidth, wide dynamic range sensors available

Modulated, Pulsed and Statistical Measurements



Modulated Mode

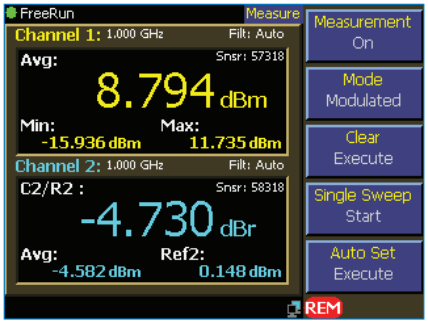
Modulated Mode measurements are possible with cost effective CW sensors, or with fast Peak Power sensors. Using Peak Power sensors, the 4540 Series can measure true average power of modulated waveforms, while providing important information about the instantaneous peak power value. Large digits allow clear, legible measurement reading.

Pulsed Mode

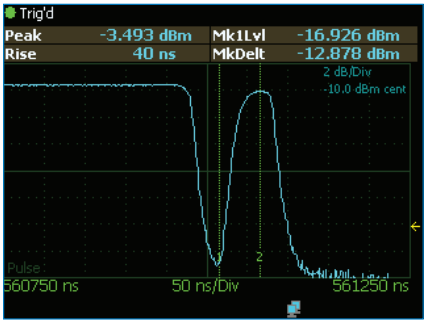
Analysis of fast single pulses or pulses with high pulse repetition interval (PRI) requires an instrument with sophisticated trigger and data acquisition capability. This provides accuracy and high definition trace detail of the measured signal. A variety of trigger settings, including pre and post trigger in combination with a high sampling rate allow the 4540 Series to capture any pulse. High level of signal detail is essential when short pulses, signal edges, signal overshoots, filters, high gain amplifiers, delay lines and such have to be analyzed.

Statistical Mode

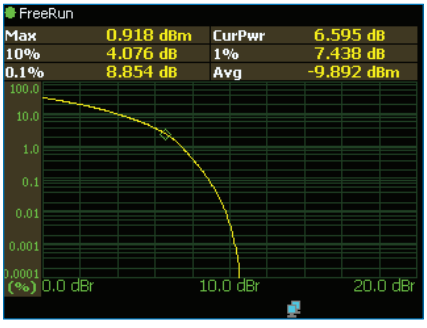
Non-periodic signals, such as HDTV, EVDO, UMTS or LTE are noise-like and consist of varying magnitude peaks randomly distributed over the channel. These random events do not serve as a trigger for consistent measurements. Amplifier designs require fast peak measurement capability from a power meter to detect signal clipping and compression due to overload. The Complementary Cumulative Distribution Function, or CCDF, displayed by the 4540 plots the probability that the power will be at or below a specified level. By examining the areas close to 100% probability, it is possible to see how often the highest peaks occur. It is easy to see amplifier compression under actual operating conditions, and to predict the effect on error rate that this may have. Up to 4 GSamples of data can be collected, compiled and analyzed by the 4540 Series.



Clear and legible numeric display allows quick measurement readings.



The falling signal edge shows an unwanted anomaly. The signal bounces back, after an initial decline, and then it settles to the actual off level.



Noise-like signals are analyzed statistically. The average power in this CCDF representation serves as a reference, while the graph shows the distribution of lower power levels.

Effective Random Sampling

The 4540 Series RF Power Meter offers an impressingly detailed representation of measured signals. As a result, signals can be analyzed thoroughly and anomalies can be detected immediately. High signal definition is achieved with two powerful features: a time resolution of 200ps, unprecedented in a power meter of this class, and a technique called Repetitive Random Sampling. For repetitive signals, the 4540 Series offers an effective sampling rate of up to 5 GSamples / second.

Autoset/Preset

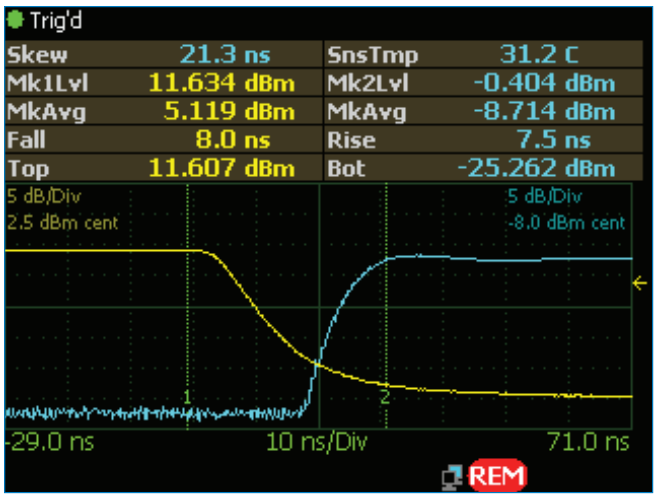
For accurate, repeatable measurements, power meters require diligently chosen trigger and timing settings. Finding the correct trigger settings is often more difficult than performing the actual measurement – not so with the 4540 Series. Our instruments are equipped with an "AutoSet" feature. This feature analyzes incoming signals and presets the instrument's timing and trigger settings in a way that allows for immediate measurements. Presets are available for many common wireless formats.

RF-Voltage Measurements

In some cases it is necessary to measure RF voltage without terminating or significantly loading the source. The 4540 Series supports voltage measurements with different Boonton voltage probes (also known as voltage sensors). Boonton's high impedance voltage probes are available for frequencies from 10 Hz to 1.2 GHz. Voltage probes are designed to measure CW voltage to 10 V, but they can also be used to measure the root mean square (RMS) value of a fluctuating or modulated signal up to 20 mV (2 V with 1:100 divider). Linearity correction factors are stored in the sensor adapter, so voltage measurements can be taken immediately.

Firmware Updates

Boonton strives to provide the best products to our customers, hence the 4540 Series can be easily field-updated with new firmware. New firmware versions are released periodically and available at the Boonton website. The download package comes with a loader that handles the proper update of the 4540 Series via a PC. Advantages of firmware updates are obvious: features added – for free.



The Graphic Header feature of the 4541 / 4542 RF power meters allows displaying up to 10 user selectable parameters. Colors refer to the specific channel: yellow – ch1, blue ch-2.

Virtual Front Panel Software

The 4540 Virtual Front Panel software (VFP) can be downloaded from the Boonton web site. It provides three powerful features:

- 4540 Series Remote Key Simulation
- Screenshots
- Full Screen Display

Remote Key Simulation allows simulating all the keys of the 4540 Series that is connected to the PC via LAN. If more than one 4540 Series is present at the subnet, VFP software will detect all instruments and show their IP addresses and serial numbers. The operator can now select which instrument he wants to control. VFP does not switch the power meters into remote state; while controlled by VFP they still allow operation via the actual front panel keys.

Screenshots of traces are often required as records or when signals need to be analyzed at a later point in time. The 4540 VFP software takes a screenshot with one push of a button and stores the images as bitmap files.

The 4540 Series has a 4" display providing high resolution and great detail of the signal trace. Menu buttons can be hidden to increase the usable screen area. If an even larger screen display is required, the Viewer function of the VFP transfers the 4540 Series screen live to a PC to utilize the full screen size.

4540 Series Specifications

Acquisition and Measurement System

Measurement Technique	
Random repetitive sampling system providing pre and post-trigger data and statistical histogram accumulation	
Sampling Rate	50 MSa / second on each channel simultaneously
Effective Sampling Rate	5 GSa /second on each channel simultaneously
Memory depth	262,144 samples at max sampling rate
Vertical Resolution	0.008%, 14-bit A/D Converter
DSP	32 bit floating point
Time resolution	200 ps

Sensor Inputs

RF Channels	1 or 2 (4541 / 4542)
RF Frequency Range	10 kHz to 40 GHz*
Pulse Meas. Range	-50 to +20 dBm*
Modulated Meas. Range	-55 to +20 dBm*
CW Pwr Range	-70 to +44 dBm*
Relative Offset Range	±200.00 dB
Video BW	70 MHz*
Risetime	< 7 ns*
Single Shot Bandwidth	5 MHz (based on 10 samples/pulse)

* Sensor Dependent, Calibrator Dependent

Vertical Scale

Logarithmic	
0.1 to 50 dBm/div	in 1-2-5 sequence
0.1 to 50 dBV/div	in 1-2-5 sequence
0.1 to 50 dBmV/div	in 1-2-5 sequence
0.1 to 50 dBuV/div	in 1-2-5 sequence
Linear	
1 nW/div to 50 MW/div	in 1-2-5 sequence
1 nV/div to 50 MV/div	in 1-2-5 sequence

Trigger

Mode	Normal, Auto, Auto Pk-to-Pk, Free Run
Source	Channel 1 (internal) Channel 2 (internal) External

Trigger (continued)

Internal Level Range	-40 to +20 dBm (sensor dependent)
External Level Range	±5 volts (±50 volts with 10:1 divider probe)
External Input Impedance	1 MOhm (13 pF DC Coupled)
Slope	+ or –
Hold-off	0.0 - 1.0 sec (10 ns resolution)
Min Trigger Pulse Width	15 ns
Max Trigger Rate	30 MHz

Time Base

Time Base Resolution	200 ps
Time Base Range	10 ns/div to 1 hr/div
Time Base Accuracy	0.01%
Time Base Display	Sweeping or Roll Mode
Trigger Delay Range	
Timebases 10 ns to 500 ns:	-4 ms to +100 ms
Timebases 1 us to 10 ms:	±4000 divisions
Timebases 20 ms to 3600 s:	-40 s to +100 s
Trigger Delay Resolution	0.02 divisions

Pulse Mode Operation

Automatic Measurements	
Pulse width	Pulse rise-time
Pulse fall-time	Pulse period
Pulse repetition frequency	Pulse duty cycle
Pulse off-time	Peak power
Pulse ''on'' power	Pulse overshoot (dB or %)
Waveform Average power	Top level power (IEEE spec)
Bottom level power (IEEE spec)	Edge delay
Edge skew (2 channel instruments only)	
Marker Measurements	
Markers (vertical cursors)	Settable in time relative to the trigger position
Markers independently	Average, minimum, peak power at a single time offset
Pair of Markers	Average, minimum, peak power over the interval between markers, power ratio between markers
Acquisition Mode	Discontinuous triggered sample acquisition
Trace Display	Power versus time swept trace (rolled trace for slow time bases)
Trace Averaging	1 to 16384 samples per sweep data point, exponential

Modulated Mode Operation

Automatic Measurements		
Average power	Peak power	Minimum power
Peak to Average ratio	Dynamic range	
Signal Filtering	"Sliding window" filter; 0.002 to 16.0 seconds (fixed) or auto-filter	
Acquisition Mode	Continuous (un-triggered) sample acquisition	
Trace Display	Power versus time rolled trace	
Channel Math		
Ratio, sum (power sensors) or difference (voltage sensors) between channels or between a channel and a reference measurement		

Statistical Mode Operation

Acquisition Mode	Continuous sample acquisition
Sampling Rate	Configuration dependent
Number of Histogram Bins	16,384
Bin Power Resolution	<0.02 dB (statistical measurements)
Limit Count	Adjustable, 2 – 4096 MSamples
Terminal Action	Stop, flush and or decimate
Graph Presentation	Normalized CCDF trace (relative to maximum power)
Horizontal Scale	0.1 to 5 dB/div
Horizontal Offset	±50.00 dBr
Vertical Axis	0.0001 to 100% (Log, 6 decades)
Text Measurements	
Average, Peak and Minimum absolute power, Peak-to-Average and Dynamic Range ratios	
CCDF table (Peak/Average ratios at decade-spaced % CCDF intervals)	
Cursor Measurements	
Peak-to-Average ratio at specified % CCDF	
% CCDF at specified Peak-to-Average ratio	
Status Display	Total acquisition time (MM:SS)
	Total acquired Samples

Field Parameter

Measurements, settings, parameters & channel math that can be displayed (User selectable)

Chan Frequency	Vertical Scale	Vertical Center	dB Offset
Sensor Temp	Avg CW Power	Max Power	Min Power
Peak / Avg	Dynamic Range	Marker Avg	Marker Max
Marker Pk/Avg	Marker1 Level	Marker2 Level	Marker Delta
Marker Max Avg	Marker Min Avg	Marker1 Min	Marker1 Max
Marker2 Min	Marker2 Max	Marker Ratio	Mark Rev
Ratio	Mark Rev Delta	CH1-CH2	CH2-CH1
CH1+CH2	CH1/CH2	CH2/CH1	Reference 1
Reference 2	CH1/Ref1	CH1-Ref1	CH2+Ref1
CH2/Ref2	CH2-Ref2	CH2+Ref2	

Calibration Source

Internal Calibrator	
Operating Modes	Off, On CW
Frequency	50.025 MHz ± 0.1%
Level Range	-60 to +20 dBm
Resolution	0.1 dB
RF Connector	Type N
Source VSWR	1.05 (reflection coefficient = 0.024)
Accuracy, 0C to 20C, NIST traceable	
0 dBm	±0.055 dB (1.27%)
+20 to -39 dBm	±0.075 dB (1.74%)
-40 to -60 dBm	±0.105 dB (2.45%)
Auto-calibration	Automatically generated linearity calibration data for peak power sensors

Measurement Setup / Storage

25 complete user defined settings (save & recall)

Presets

Default	GSM	EDGE	NADC
Bluetooth	cdmaOne	W-CDMA	CDMA2000
iDEN	RADAR	MCPA	WiFi 802.11a
802.11b/g	1xEV-DO	1xEV-DV	TD-SCDMA
DVB	HiperLAN2		

External Interfaces

Remote Control	
GPIB	
Complies with IEEE-488.1 and SCPI version 1993. Implements AH1, SH1, T6, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1.	
LAN	TCP/IP Ethernet Programmable interfaces
USB	"USB Device", Type-B connector
Multi I/O BNC connector	
User selectable	Status, trigger, alarm or voltage output
Range	0 to 10 V (Analog unipolar) -10 V to +10 V (Analog bipolar) 0 or 5 V (Logic)
Accuracy	±200 mV (±100 mV typical)
Linearity	0.1% typical

VGA Out / Ext Cal

HDB-15 connector, video output (320x240) for VGA compatible analog RGB video monitor or external calibrator control interface for Model 2530 calibrator

Physical And Environmental Characteristics

Case Dimensions	8.4 W x 3.5 H x 13.5 D inches (21.3 x 8.9 x 34.3 cm), Half-rack width, 2U height
Weight	7.7 lbs (3.5 kg)
Power Requirements	90 to 260 VAC, 47 to 60 Hz 90 to 135 VAC, 47 to 400 Hz 50 W (70 VA)
Operating Temperature	0 to 50 deg C (32 F to 122 F)
Storage Temperature	-40 to +75 deg C (-40 F to 167 F)
Ventilation	Thermostatically controlled fan
Humidity	95% maximum, non-condensing
Altitude	Operation up to 15,000 feet (4575 m)
Shock	Withstands ±5 G, 11 ms impulse in X, Y, and Z axes, as per EN 60068-2-27
Vibration	Withstands 2 G sine, 1.25 G random, as per EN 60068-2-6 and EN 60068-2-64

Other Characteristics

Display	4.0" Diagonal TFT color LCD, 320 x 240 pixels, CCFL backlight
Keyboard	27 Key conductive rubber
Main Computer	32-bit Floating Point embedded processor
DSP	32-bit Floating Point DSP
Battery	User-replaceable BR2325 lithium coin cell (alkaline cells optional), typical life: >10 years (lithium)

Regulatory Categories

Full CE compliance with the following European Union directives and standards

Low Voltage Directive 2006/95/EC EN 60950-1:2002 for safety

Electromagnetic Compatibility Directive (EMC) 2004/108/EC
EN 61326:1997 + A1:1998 + A2:2001 + A3:2003

RoHS Directive 2002/95/EC for material safety

Manufactured to the intent of MIL-T28800E, Type III, Class 5, Style E

Sensors / Voltage Probes

Peak Power

Model	Frequency Range	Dynamic Range	Rise Time (Bandwidth)
57006	0.05 to 6.0 GHz	-50 to +20 dBm	<7 ns (70 MHz)
59318	0.05 to 18.0 GHz	-24 to +20 dBm	<10 ns (50 MHz)
57518	0.05 to 18.0 GHz	-40 to +20 dBm	<100 ns (6 MHz)
59340	0.05 to 40.0 GHz	-24 to +20 dBm	<10 ns (50 MHz)
57540	0.05 to 40.0 GHz	-40 to +20 dBm	<100 ns (6 MHz)

CW Power

Wide Dynamic Range

Model	Frequency Range	Dynamic Range
51071A	10 MHz to 26.5 GHz	-70 to +20 dBm
51072A	30 MHz to 40 GHz	-70 to +20 dBm
51075A	500 kHz to 18 GHz	-70 to +20 dBm
51077A	500 kHz to 18 GHz	-60 to +30 dBm
51079A	500 kHz to 18 GHz	-50 to +40 dBm

Thermocouple

Model	Frequency Range	Dynamic Range
51100 (9E)	10 MHz to 18 GHz	-20 to +20 dBm
51200	10 MHz to 18 GHz	0 to +37 dBm

Special Purpose

Model	Frequency Range	Dynamic Range
51011 (EMC)	10 kHz to 8GHz	-60 to +20 dBm (DC coupled)
51011 (4B)	100 kHz to 12.4 GHz	-60 to +20 dBm
51013 (4E)	100 kHz to 18 GHz	-60 to +20 dBm
51015 (5E)	100 kHz to 18 GHz	-50 to +30 dBm
51033 (6E)	100 kHz to 18 GHz	-40 to +33 dBm
51078	100 kHz to 18 GHz	-20 to +37 dBm

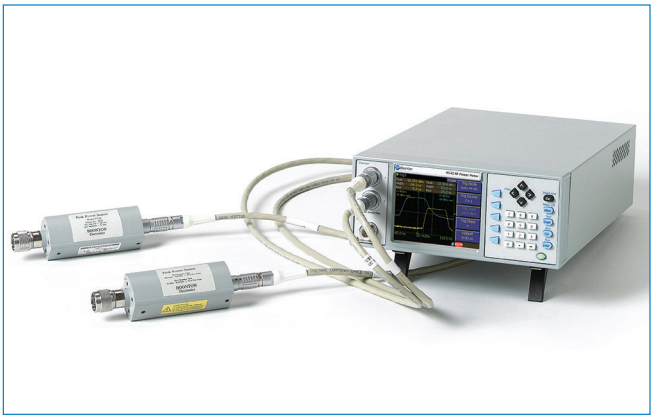
Diode Average

Model	Frequency Range	Dynamic Range
51085	500 kHz to 18GHz	-30 to +20 dBm

For 51085 Peak Power - 1kW peak, 5µs pulse width, 0.25% duty cycle
For 51085 CW Power - 5W (+37dBm) average to 25°C ambient temperature, derated linearly to 2W (+33dBm) at 85°C

Voltage Probes

95206302A	RF-Voltage Probe Kit 10 kHz - 1.2 GHz
95206402A	Low Frequency Voltage Probe Kit 10 Hz - 100 MHz



Ordering Information

4541	RF Power Meter, single channel, front panel input
4542	RF Power Meter, dual channel, front panel inputs
-02	Rear sensor inputs
-03	Calibrator, rear panel output
-30	Warranty extended to 3 years

Accessories

95403001A	19'' Rack Mount Kit
95006201A	Transit case, holds the 4540 Series and up to 4 sensors